



Foundation Investigation and Design Report

*Storm Sewer Replacements, East of Etobicoke Creek, QEW Improvements from East of Cawthra Road to The East Mall, City of Etobicoke, Ontario
Ministry of Transportation, Ontario, GWP 2102-13-00 & 2432-13-00*

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PART A

**FOUNDATION INVESTIGATION REPORT
STORM SEWERS EAST OF ETOBICOKE CREEK
QEW IMPROVMENTS FROM EAST OF CAWTHRA ROAD TO THE EAST
MALL, CITIES OF MISSISSAUGA AND ETOBICOKE, ONTARIO
MTO, GWP 2102-13-00 & 2432-13-00**

1.0 INTRODUCTION

Golder Associates Ltd. (Golder) has been retained by AECOM on behalf of the Ministry of Transportation, Ontario (MTO) to provide foundation engineering services for the proposed storm sewer replacements along the Queen Elizabeth Way (QEW) between Etobicoke Creek and The East Mall, included as part of the QEW Improvements from East of Cawthra to The East Mall, in the City of Etobicoke, Ontario. The purpose of this investigation is to establish the subsurface soil and groundwater conditions along the proposed storm sewer alignments by borehole drilling and laboratory testing.

The Terms of Reference and the scope of work for the foundation investigation are outlined in MTO's Request for Proposal, dated June 2011, which forms part of the Consultant Agreement for Assignment No. 2015-E-0001 for this project. The scope of work is outlined in Golder's Revised Change Request, dated February 16, 2018. The work has been carried out in accordance with Golder's Supplementary Specialty Plan for this project, dated June 6, 2016.

2.0 SITE DESCRIPTION

The proposed storm sewers extend along the QEW from near Etobicoke Creek to near The East Mall overpass in the City of Etobicoke in the area shown on the Key Plan presented on Drawing 1. The proposed alignment is generally located within the left shoulder (median) of the Fort Erie-bound (westbound) lanes of the QEW, with additional sections along the QEW on-ramp/off-ramp to The West Mall and along the right shoulder of the Toronto-bound (eastbound) lanes of the QEW. The proposed sewer alignments are shown on Drawings 1 and 2.

The QEW in this area is a six-lane highway, with paved shoulders and median; with on/off ramps from/to The East Mall and Highway 427. The existing road grade along the proposed storm sewer alignments generally ranges from about Elevations 101 m to 113 m, rising easterly from the Etobicoke Creek bridge. Land use surrounding this section of the highway consists of parkland and residential developments to the north and south of the QEW nearer the Etobicoke Creek and commercial developments to the north and south of the QEW approaching The East Mall.

3.0 INVESTIGATION PROCEDURES

3.1 Previous Investigations

In 1966, a foundation investigation for the QEW bridge structure over Etobicoke Creek, was carried out by Dominion Soil Investigation Limited (Dominion) during which time one borehole (designated as Borehole 158) was advanced at the west end of the proposed storm sewer alignments. The borehole was advanced to a depth of 7.0 m below ground surface and included 3.0 m of rock coring. The results of the Dominion investigation were provided to the Department of Highways Ontario who analysed the data and prepared a foundation engineering report for the structure, titled "Supplementary Foundation Investigation for QEW and Highway 27 Interchange, Twp. of Etobicoke, County of York, District #6 (Toronto), W.P. 275-64-1 and W.P. 275-64-4, W.J. 65-F-104", dated October 11, 1966 (GEOCRE 30M11-20).

In August 2014, a preliminary foundation investigation for the QEW bridge structure over Etobicoke Creek, was carried out by Thurber Engineering Ltd. (Thurber) during which time one borehole (designated as Borehole EC 14-01) was advanced at the west end of the proposed storm sewer alignments. The borehole was advanced to a depth of 7.9 m below ground surface and included 5.2 m of bedrock coring. Laboratory point load testing (PLT) was carried out on various samples of the rock cores. A standpipe piezometer, screened within the bedrock, was installed in Borehole EC14-01. The results of the Thurber investigation are contained in their report titled

“Preliminary Foundation Investigation Report, Etobicoke Creek Bridge Replacement, Queen Elizabeth Way, Etobicoke, Ontario”, Report No. 19-1351-219, dated July 14, 2015 (GEOCRE 30M11-252).

The locations of the boreholes advanced by Dominion and Thurber are shown on Drawing 1. The borehole locations are positioned relative to MTM NAD 83 (Zone 10) northing and easting coordinates and the ground surface elevations are referenced to geodetic datum. The borehole locations, ground surface elevations and drilled depths are summarized below.

Borehole No.	Location (MTM NAD 83 Zone 10)		Ground Surface Elevation (m)	Total Borehole/ Drillhole Depth (m)	Bedrock Core Length (m)
	Northing	Easting			
158	4,829,497.1	299,977.6	96.6	7.0	3.0
EC14-01	4,829,449.4	300,013.7	93.8	7.9	5.2

3.2 Current Investigation

In July 2017, a foundation investigation for the replacement of the QEW bridge structure over Etobicoke Creek, was carried out by Golder during which time four boreholes (designated as Boreholes ECB-3 to ECB-6) were advanced at the west end of the proposed storm sewer alignments. The boreholes were advanced to depths of 7.7 m and 12.2 m below ground surface, and Boreholes ECB-4 and ECB-5 REV 1 were cored 3.6 m and 4.7 m, respectively. The results of the 2017 investigation are contained in the report by Golder Associates Ltd. titled:

- “Foundation Investigation and Design Report, QEW - Etobicoke Creek Bridge Replacement Structure Site No. 37-237/1&2, QEW Widening from East of Cawthra Road to The East Mall, Cities of Mississauga and Etobicoke, Ministry of Transportation, Ontario, Report No. 1530382-1, dated December 15, 2017 (GEOCRE 30M11-271).

As part of the current 2018 field investigation for the storm sewer replacements, twenty-nine boreholes (designated as Boreholes SS-1 to SS-29) were drilled along the proposed storm sewer alignments between April 22 and July 19, 2018. The boreholes were advanced to depths ranging from 5.1 m to 9.2 m below ground surface and bedrock was cored 1.0 m to 4.3 m in twelve boreholes (Boreholes SS-6, SS-9, SS-11, SS-13, SS-15, SS-17, SS-18, SS-20, SS-23, SS-25, and SS-28).

Boreholes SS-1 to SS-29 were advanced through the overburden using solid stem augers by truck-mounted CME-55 and CME-75 drill rigs supplied and operated by TriPhase Group of Etobicoke, Ontario. Soil samples were obtained in the boreholes at 0.75 m intervals of depth using a 50 mm outer diameter (O.D.) split-spoon sampler, driven by an automatic hammer in accordance with the Standard Penetration Test (SPT) procedures (ASTM D1586)¹. Bedrock samples were obtained in selected boreholes using an ‘HQ’ size rock core barrel and coring techniques.

The groundwater conditions were observed in the open boreholes during and immediately following drilling operations. A standpipe piezometer was installed in four boreholes (Boreholes SS-2, SS-13, SS-18, and SS-28) to allow monitoring of the water level at these borehole locations. The installed piezometers consist of a 50 mm diameter PVC pipe, with a 1.5 m long slotted screen. The annulus surrounding the piezometer screens and the borehole to 0.3 m above the screen was backfilled with a filter sand pack. The section of borehole below the

¹ ASTM D1586 Standard Test Method for Standard Penetration Test

standpipe piezometers was backfilled with bentonite to the underside of the sand pack level, and the remainder of the borehole above the sand pack was backfilled with bentonite to near the ground surface and topped with cold patch asphalt or sand and gravel to match the adjacent ground surface material. The installed piezometers were not decommissioned as it is understood that they are to be decommissioned as part of the construction activities at the site. All remaining boreholes were backfilled with bentonite upon completion in accordance with Ontario Regulation 903 Wells (as amended).

The field work was supervised on a full-time basis by members of Golder's engineering staff who located the boreholes in the field, cleared all locations of underground utilities, directed the drilling, sampling and in-situ testing operations, and logged the subsurface conditions and examined and cared for the soil and rock samples. The samples were identified in the field, placed in labelled containers and transported to Golder's laboratories in Whitby and Mississauga for further visual examination and laboratory testing.

Selected soil samples were submitted to Golder's laboratories for geotechnical index and classification testing, consisting of moisture content, Atterberg limits, and grain size distribution. Selected bedrock core samples were submitted to Geomechanics of Toronto, Ontario for geotechnical unconfined compression (UC) testing, assessment of Young's modulus and bulk density. Selected bedrock core samples were submitted to Queen's University in Kingston, Ontario for unconfined compression (UC) testing. Selected soil samples were submitted to AGAT Laboratories (AGAT) in Mississauga, Ontario for analytical testing of petroleum hydrocarbon fractions F1 to F4 (PHC F1 to F4), volatile organic compounds (VOC) and corrosion potential parameters (pH, sulphate, chloride, resistivity, and electrical conductivity). Additional bedrock core samples were also analyzed by AGAT for a suite of parameters indicative of the potential for corrosivity including pH, resistivity, conductivity, chloride concentration and sulphate concentration.

The locations of the boreholes were obtained using an ArcGIS Collector and a Trimble R1 GPS, having an accuracy of +/- 1 m in the horizontal direction. The ground surface elevations at the borehole locations were interpolated from the ground surface contours on the digital terrain model. The locations are positioned relative to MTM NAD 83 (Zone 10) northing and easting coordinates and the ground surface elevations are referenced to geodetic datum. The borehole locations, ground surface elevations and drilled depths are summarized below.

Borehole No.	Location (MTM NAD 83 Zone 10)				Ground Surface Elevation (m)	Total Borehole/ Drillhole Depth (m)	Bedrock Core Length (m)
	Northing	Easting	Latitude	Longitude			
ECB-3	4829482.0	300008.0	43.605304	-79.559361	99.8	7.8 ¹	-
ECB-4	4829490.2	299980.3	43.605332	-79.559702	99.5	10.9	3.6
ECB-5 REV1	4829476.0	299998.7	43.605224	-79.559475	99.7	7.7 ¹	-
ECB-6	7829462.5	300015.7	43.605083	-79.559264	99.7	12.2	4.3
SS-1	4829578.4	300049.1	43.606135	-79.558856	101.4	7.4	-
SS-2	4829636.4	300084.5	43.606657	-79.558417	103.4	6.2 ^{1,2}	-
SS-3	4829709.3	300104.5	43.607314	-79.558170	107.1	6.7 ¹	-
SS-4	4829490.5	300067.8	43.605344	-79.558622	102.6	7.5	-

Borehole No.	Location (MTM NAD 83 Zone 10)				Ground Surface Elevation (m)	Total Borehole/ Drillhole Depth (m)	Bedrock Core Length (m)
	Northing	Easting	Latitude	Longitude			
SS-5	4829535.3	300112.4	43.605748	-79.558070	105.9	6.7	-
SS-6	4829605.9	300126.8	43.606383	-79.557893	102.8	6.2	1.0
SS-7	4829542.4	300050.5	43.605811	-79.558838	101.0	6.9	-
SS-8	4829596.5	300092.6	43.606299	-79.558316	102.2	6.2 ¹	-
SS-9	4829651.4	300139.4	43.606793	-79.557738	103.5	7.0	3.0
SS-10	4829720.5	300192.8	43.607415	-79.557076	105.0	6.9 ¹	-
SS-11	4829780.5	300240.9	43.607955	-79.556481	106.4	7.3	4.0
SS-12	4829844.5	300292.6	43.608532	-79.555841	107.5	6.9 ¹	-
SS-13	4829899.4	300334.9	43.609026	-79.555317	107.8	5.6 ²	2.4
SS-14	4829964.9	300386.6	43.609616	-79.554677	108.5	6.2 ¹	-
SS-15	4830012.4	300426.8	43.610044	-79.554180	108.5	7.2 ¹	3.8
SS-16	4830073.9	300476.4	43.610598	-79.553566	109.0	6.9 ¹	-
SS-17	4830133.7	300523.4	43.611137	-79.552984	109.5	7.5	3.9
SS-18	4830154.7	300567.7	43.611326	-79.552435	109.5	6.2 ²	3.0
SS-19	4830219.0	300596.4	43.611904	-79.552080	110.0	6.2 ¹	-
SS-20	4830234.7	300637.5	43.612046	-79.551571	109.9	6.6	4.1
SS-21	4830289.7	300662.9	43.612542	-79.551258	110.7	6.2 ¹	-
SS-22	4830338.5	300721.8	43.612981	-79.550528	111.1	6.9 ¹	-
SS-23	4830351.4	300774.8	43.613098	-79.549871	110.9	6.2	4.3
SS-24	4830390.5	300795.3	43.613450	-79.549618	111.8	6.2 ¹	-
SS-25	4830423.2	300903.9	43.613744	-79.548272	111.7	7.4	3.5
SS-26	4830445.2	300898.2	43.613942	-79.548343	112.5	5.1 ¹	-
SS-27	4830471.3	300967.7	43.614177	-79.547482	112.8	6.2 ¹	-
SS-28	4830501.6	301079.6	43.614451	-79.546096	113.4	7.2 ²	1.5
SS-29	4829469.4	300018.7	43.605153	-79.559233	100.0	9.2 ¹	-

Notes:

1. Includes penetration into shale bedrock by auguring and/or split spoon sampling for depths/lengths ranging from 0.5 m to 4.5 m.
2. Standpipe piezometer installed in borehole.

4.0 SITE GEOLOGY AND SUBSURFACE CONDITIONS

4.1 Regional Geology

The project area is located within the Iroquois Plain physiographic region, as delineated in The Physiography of Southern Ontario (Chapman and Putman, 1984)². The glacial Iroquois Plain stretches along the northern shoreline of Lake Ontario, extending from the Niagara Escarpment in the west to the Scarborough Bluffs in the east. The Iroquois Plain soils consist of glaciolacustrine sediments deposited in Lake Iroquois, primarily sand, silt and gravel, with a shallow cover of till remaining over the bedrock.

The Georgian Bay Formation bedrock, which underlies the study area, consists mainly of blue-grey shale, containing siltstone, sandstone and limestone interbeds. Outcrops of this formation are commonly found along water courses on the west side of Toronto and in Mississauga, notably in the Humber River, Mimico Creek, Etobicoke Creek and Credit River valleys.

4.2 Subsurface Conditions

Subsurface soil, bedrock and groundwater conditions as encountered in the boreholes, details of the piezometer installations and water level readings, and the results of the geotechnical laboratory tests carried out on selected soil and bedrock samples for the current investigation are presented on the Records of Borehole and Drillhole sheets provided in Appendix B. Photographs of the recovered bedrock core samples are presented on Figures B-1 to B-13, in Appendix B. The results of the in-situ field tests (i.e., SPT “N”-values) as presented on the Record of Borehole sheets and in sub-sections of Section 4.2 are uncorrected. Lists on abbreviations and symbols and lithological, geotechnical rock description terminology, field estimation of rock hardness and rock weathering classification are also included in Appendix B to assist in the interpretation of the borehole and drillhole records. The results of the geotechnical laboratory testing on the soil and bedrock samples are also presented in Appendix C. The analytical laboratory test report is included in Appendix D and the test results are summarized in Section 4.2.9.

Stratigraphic boundaries shown on the Record of Borehole sheets and on the stratigraphic profile on Drawings 1 to 4 are inferred from non-continuous sampling, observations of drilling progress and the results of the Standard Penetration Tests. These boundaries, therefore, represent transitions between soil types rather than exact planes of geological change. Furthermore, subsurface conditions will vary between and beyond the borehole locations; however, the factual data presented in the borehole and drillhole records governs any interpretation of the site conditions. It should be noted that the interpreted stratigraphy shown on Drawings 1 to 4 are a simplification of the subsurface conditions. In general, the subsurface conditions encountered consist of a pavement structure underlain by a non-cohesive and cohesive fill, in turn underlain by a deposit of clayey silt to silty clay and a cohesive till deposit over shale bedrock. Detailed descriptions of the encountered subsurface conditions are provided in the following sections. Where relatively significant thicknesses of overburden were encountered, the various soil types are described in detail for each main deposit.

4.2.1 Topsoil

An approximately 175 mm thick layer of topsoil was encountered at ground surface in Borehole EC14-01.

² Chapman, L.J. and Putman, 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.)

4.2.2 Pavement Structure

4.2.2.1 Asphalt

An approximately 100 mm to 178 mm thick layer of asphalt pavement was encountered at ground/roadway surface in all boreholes, excluding Boreholes 158 and EC14-01.

4.2.2.2 Concrete

An approximately 100 mm to 175 mm thick layer of concrete was encountered directly below the asphalt in Boreholes SS-1 to SS-5. A 30 mm and 400 mm thick slab of concrete was also encountered in Boreholes ECB-4 and ECB-6, underlying the fill deposit at depths of 7.3 m and 7.5 m below ground surface (Elevation 92.2 m), respectively.

4.2.3 Fill

4.2.3.1 Sand to Sand and Gravel (FILL)

A 0.2 m to 2.8 m thick layer of granular fill was encountered at ground surface in Borehole 158, and underlying the asphalt / concrete in all other boreholes, excluding Boreholes EC 14-01, SS-12, SS-17 and SS-21. In Borehole ECB-4 the granular fill extends to a depth of 6.4 m below ground surface (Elevation 93.1 m). In Borehole ECB-6 a 0.8 m thick fill layer consisting of sand was encountered underlying the silty sand fill at a depth of about 3.7 m below ground surface (Elevation 96.0 m). In Borehole SS-7 a 1.5 m thick granular fill layer was encountered underlying the cohesive fill at a depth of about 4.5 m below ground surface (Elevation 96.5 m).

The fill consists of sand to gravelly sand to silty sand and gravel to sand and gravel and contains asphalt fragments at Borehole SS-22 and rock fragments at Borehole ECB-5 REV1.

The SPT “N”-values measured within the granular fill range from 6 blows to 49 blows per 0.3 m of penetration, with one SPT “N”-values of 111 blows for 0.28 m of penetration, indicating a loose to dense, but generally compact, compactness condition.

Grain size distribution testing was carried out on twelve samples of the sand to sand and gravel fill and the results are shown on Figures C-1A and C-1B in Appendix C. The water content measured on samples of the sand to sand and gravel fill range from about 3 per cent to 16 per cent.

4.2.3.2 Silt to Silty Sand (FILL)

A 0.7 m to 2.8 m thick upper layer of fill consisting of silt to silty sand was encountered underlying the asphalt, granular fill or cohesive fill layers (described below) in Boreholes ECB-3, ECB-5 REV1, ECB-6, SS-4, SS-12, SS-13, SS-21, and SS-25, SS-27, SS-28 and SS-29. The surface of this upper silt to silty sand fill layer was encountered at depths ranging from 0.1 m to 3.1 m below ground surface (Elevation 112.4 m to 97.3 m). A 1.5 m to 3.8 m thick lower layer of silty sand fill was encountered underlying the cohesive fill layers (described in Section 4.2.3.3) in Boreholes ECB-5 REV 1, SS-4 and SS-29. The surface of this lower silty sand fill layer was encountered at depths of about 3.7 m to 5.3 m below ground surface (Elevations 97.3 m and 94.7 m).

The silt to silty sand fill contains trace to some gravel, and trace to some clay. The silty sand fill contains some shale fragments in Boreholes ECB-5 REV 1, SS-4 and SS-28, and some clayey silt inclusions, organics and wood fragments in Borehole SS-29. Additionally, hydrocarbon odours were noted within the silty sand fill in Borehole SS-13.

The SPT “N”-values measured within the silt to silty sand fill range from 3 blows to 45 blows per 0.3 m of penetration, indicating a very loose to dense, but generally compact, compactness condition.

Grain size distribution testing was carried out on nine samples of the silt to silty sand fill and the results are shown on Figures C-2A and C-2B in Appendix C. Atterberg limits testing was carried out on two samples of the silt to silty sand fill (from Boreholes SS-4 and SS-29) and indicate the material is non-plastic. The water content measured on samples of the silt to silty sand fill ranges from about 3 per cent to 18 per cent.

4.2.3.3 *Sandy/Gravelly Clayey Silt to Sandy Clayey Silt (FILL)*

Cohesive fill layers varying in thickness from about 0.2 m to 4.8 m were encountered underlying the asphalt, granular fill and interlayered within the granular fill in Boreholes EC 14-01, ECB-3 to ECB-6, SS-1, SS-4, SS-7 to SS-9, SS-11, SS-14, SS-17, SS-20, SS-21, SS-23 to SS-25, SS-28 and SS-29. The depth and elevation of the surface and base of the cohesive fill and the corresponding thickness is summarized below.

Borehole No.	Top of Layer		Bottom of Layer		Thickness (m)
	Depth (m)	Elevation (m)	Depth (m)	Elevation (m)	
ECB-3	0.7	99.1	2.5	97.3	1.8
ECB-4	6.4	93.1	7.5	92.2	1.1
ECB-5 REV 1	3.0	96.7	3.7	96.0	0.7
ECB-6	4.5	95.2	7.5	92.2	3.0
SS-1	0.5	100.9	5.3	96.1	4.8
SS-4	0.8	101.8	1.7	100.0	0.9
	2.6	100.0	5.3	97.3	2.7
	6.8	95.8	7.5	Below 95.1	Greater than 0.7
SS-7	3.0	98.0	4.5	96.5	1.5
	6.0	95.0	6.9	Below 94.1	Greater than 0.9
SS-8	0.6	101.6	0.8	101.4	0.2
SS-9	0.8	102.7	1.0	102.5	0.2
SS-11	0.3	106.1	0.8	105.6	0.5
SS-14	1.1	107.4	1.5	107.0	0.4
SS-17	0.1	109.4	1.5	108.0	1.4
SS-20	0.4	109.5	0.8	109.1	0.4
SS-21	0.3	110.4	0.8	109.9	0.5
SS-23	0.8	110.1	1.4	109.5	0.6
SS-24	0.4	111.4	1.5	110.3	1.1
SS-25	1.7	110.0	2.3	109.4	0.6

Borehole No.	Top of Layer		Bottom of Layer		Thickness (m)
	Depth (m)	Elevation (m)	Depth (m)	Elevation (m)	
SS-28	1.0	112.4	1.5	111.9	0.5
SS-29	4.5	95.5	5.3	94.6	0.8

A 30 mm and 0.4 m thick layer (slab) of concrete was encountered in Boreholes ECB-4 and ECB-6. (at Elevation 92.2 m) between the clayey silt with sand fill and the underlying shale bedrock. The cohesive fill consists of gravelly clayey silt, some sand to clayey silt with sand to clayey silt, trace to some gravel. The cohesive fill contains rootlets and organic inclusions in Boreholes SS-1, SS-4, and SS-7 and rock fragments at Boreholes EC14-01, SS-8, SS-17, and SS-28. Additionally, hydrocarbon odours were noted within the cohesive fill at Boreholes SS-1, SS-4, and SS-7.

The SPT “N”-values measured within the cohesive fill layers range from 3 blows to 33 blows per 0.3 m of penetration, with one SPT “N”-value of 106 blows for 0.1 m of penetration, suggesting a very soft to hard, but generally firm to very stiff, consistency.

Grain size distribution tests were carried out on seven samples of the cohesive fill layers and the results are shown on Figure C-3 in Appendix C. Atterberg limits tests were carried out on twelve samples of the cohesive fill and the results are shown on Figure C-4 in Appendix C. The Atterberg limits tests measured liquid limits ranging from 19 per cent to 28 per cent, plastic limits ranging from 13 per cent to 17 per cent, and plasticity indices ranging from 6 per cent to 12 per cent and indicate the cohesive fill is comprised of a clayey silt of low plasticity. The water content measured on samples of the cohesive fill ranges from about 9 per cent to 23 per cent. One organic content test completed on a sample of the cohesive fill measured about 1.6 per cent.

4.2.4 Clayey Silt to Silty Clay

A 0.7 m to 1.9 m thick deposit of clayey silt to silty clay was encountered underlying the cohesive fill, cohesive till (described in Section 4.2.5), and granular fill in Boreholes SS-1, SS-10, and SS-22 at depths of 5.3 m, 3.4 m and 0.3 m below ground surface (Elevations 96.1 m, 101.6 m and 110.8 m), respectively. The clayey silt to silty clay deposit contains trace to some gravel and trace sand.

The SPT “N”-values measured within the clayey silt to silty clay deposit range from 9 blows to 44 blows per 0.3 m of penetration, suggesting a stiff to hard consistency.

Grain size distribution and Atterberg limits testing was carried out on three samples of the clayey silt to silty clay deposit and the results are shown on Figure C-5 in Appendix C. The Atterberg limits tests measured liquid limits ranging from 30 per cent to 40 per cent, plastic limits ranging from 20 per cent to 23 per cent, and plasticity indices ranging from 10 per cent to 17 per cent and indicate the deposit is comprised of clayey silt of low plasticity to silty clay of intermediate plasticity. The water content measured on samples of the clayey silt to silty clay deposit ranged from about 8 per cent to 18 per cent.

4.2.5 Gravelly Sandy Clayey Silt to Sandy Clayey Silt (TILL)

A 0.5 m to 3.6 m thick cohesive till deposit was encountered underlying the fill in Boreholes SS-2, SS-3, SS-5, SS-6, SS-8, SS-10, SS-12, SS-14, SS-16, SS-19, SS-20, SS-24, SS-26 to SS-28 at depths ranging from 0.5 m to 3.2 m below ground surface (Elevations 111.0 m to 101.4 m).

The cohesive till deposit consists of gravelly sandy clayey silt to sandy clayey silt trace gravel and contains some rock/shale fragments in Boreholes SS-3, SS-8, SS-10, SS-24, and SS-26 to SS-28. Cobbles and boulders are inferred to be present within this deposit as evidenced by auger grinding during drilling within this deposit in some boreholes and experience in the region indicates that the glacial deposits contain cobbles and boulders that are not identified by conventional drilling/sampling methods.

The SPT “N”-values measured within the cohesive till deposit range from 11 blows to 97 blows per 0.3 m of penetration, suggesting a stiff to hard, but generally very stiff to hard, consistency.

Grain size distribution and Atterberg limits testing was carried out on thirteen samples of the cohesive till deposit and the results are shown on Figures C-7A/C-7B and C-8, respectively, in Appendix C. The Atterberg limits tests measured liquid limits ranging from 18 per cent to 26 per cent, plastic limits ranging from 13 per cent to 16 per cent, and plasticity indices ranging from 5 per cent to 10 per cent and indicate the cohesive till deposit is comprised of a clayey silt of low plasticity. The water content measured on samples of the cohesive till deposit ranged from 8 per cent to 12 per cent.

4.2.6 Silt and Sand (TILL)

A 0.7 m to 3.0 m thick non-cohesive till deposit was encountered underlying the cohesive fill or till deposit in Boreholes SS-6, SS-8, and SS-11. The surface of the non-cohesive till deposit was encountered at depths ranging from 0.8 m to 2.2 m below ground surface (Elevations 105.6 m to 100.0 m).

The non-cohesive till deposit consists of silt and sand trace to some gravel, trace to some clay, and contains trace rock/shale fragments in Borehole SS-8. Cobbles and boulders are inferred to be present within this deposit as evidenced by auger grinding during drilling within this deposit, and experience in the region indicates that the glacial deposits contain cobbles and boulders that are not identified by conventional drilling/sampling methods.

The SPT “N”-values measured within the non-cohesive till deposit range from 50 blows to 102 blows per 0.3 m of penetration, with SPT “N”-values up to 100 blows for 0.10 m of penetration, indicating a dense to very dense compactness condition.

Grain size distribution testing was carried out on three samples of the non-cohesive till deposit and the results are shown on Figure C-9 in Appendix C. Atterberg limits testing was carried out on two samples of the non-cohesive till deposit (from Boreholes SS-8 and SS-11) and indicate the material is non-plastic. The water content measured on samples of the silt and sand till deposit ranges from 4 per cent to 8 per cent.

4.2.7 Shale Bedrock

The upper portion of the bedrock was sampled by split-spoon and the bedrock was confirmed by rock coring in Boreholes ECB-4, ECB-6, SS-6, SS-9, SS-11, SS-13, SS-15, SS-17, SS-18, SS-23, SS-25 and SS-28. The length of bedrock sampled by split-spoon and by coring, the depths to and corresponding elevation of the completely to moderately weathered shale bedrock, and the depths to and corresponding elevations of the slightly weathered to fresh shale bedrock are summarized below.

Borehole No.	Completely to Moderately Weathered Bedrock		Length of Bedrock sampled by Split-Spoon (m)	Moderately to Slightly Weathered to Fresh Bedrock		Length of Bedrock Cored (m)
	Depth (m)	Elevation (m)		Depth (m)	Elevation (m)	
158	2.9 – 4.0	93.7 – 92.6	--	4.0 – 7.0	92.6 – 89.6	3.0
EC14-01	1.7 – 2.7	92.1 – 91.1	1.0	2.7 – 7.9	91.1 – 85.9	7.7
ECB-3	7.2 – 7.7	92.6 – 92.1	0.5	--	--	--
ECB-4 ¹	--	--	--	7.34 – 10.92	92.16 – 88.58	3.58
ECB-5 REV 1	7.5 – 7.7	92.2 – 92.0	0.2	--	--	--
ECB-6 ¹	--	--	--	7.93 – 12.19	91.77 – 87.51	4.26
SS-1	6.0 – 7.4	95.4 – 94.0	1.4	--	--	--
SS-2	2.3 – 6.2	101.1 – 97.2	3.9	--	--	--
SS-3	3.7 – 6.7	103.4 – 100.4	3.0	--	--	--
SS-5	4.5 – 6.7	101.4 – 99.2	2.2	--	--	--
SS-6	4.5 – 5.2	98.3 – 97.6	0.7	5.18 – 6.19	97.57 – 96.56	1.01
SS-7	6.9	94.1	Split-spoon and auger refusal			
SS-8	--	--	3.2	3.0 – 6.2	99.2 – 96.0	--
SS-9	1.0 – 4.0	102.5 – 99.5	3.0	4.04 – 6.99	99.46 – 96.51	2.95
SS-10	4.5 – 6.9	100.5 – 98.1	2.4	--	--	--
SS-11	--	--	1.8	1.5 – 7.26	104.9 – 99.14	4.00
SS-12	--	--	4.5	2.4 – 6.9	105.1 – 100.6	--
SS-13	--	--	0.2	3.1 – 5.62	104.8 – 102.17	2.45
SS-14	2.2 – 3.0	106.3 – 105.5	0.8	3.0 – 6.2	105.5 – 102.3	--
SS-15	1.5 – 3.4	107.0 – 105.2	1.9	3.35 – 7.21	105.15 – 101.29	3.86
SS-16	2.2 – 3.6	106.8 – 105.4	1.4	3.6 – 6.9	105.4 – 102.1	--
SS-17	1.5 – 3.6	108.0 – 105.9	2.1	3.58 – 7.47	105.92 – 102.03	3.89
SS-18	0.9 – 3.2	108.6 – 106.3	2.3	3.17 – 6.17	106.33 – 103.33	3.00
SS-19	1.5 – 3.4	108.5 – 106.6	4.7	3.4 – 6.2	106.6 – 103.8	--
SS-20	1.5 – 2.5	108.4 – 107.4	1.0	2.51 – 6.61	107.39 – 103.29	4.10

Borehole No.	Completely to Moderately Weathered Bedrock		Length of Bedrock sampled by Split-Spoon (m)	Moderately to Slightly Weathered to Fresh Bedrock		Length of Bedrock Cored (m)
	Depth (m)	Elevation (m)		Depth (m)	Elevation (m)	
SS-21	0.8 – 2.3	109.9 – 108.4	5.4	2.3 – 6.2	108.4 – 104.5	--
SS-22	--	--	4.7	2.2 – 6.9	108.9 – 104.2	--
SS-23	--	--	0.5	1.4 – 6.24	109.5 – 104.66	4.34
SS-24	--	--	4.0	2.2 – 6.2	109.6 – 105.6	--
SS-25	2.3 – 3.9	109.4 – 107.8	1.6	3.94 – 7.41	107.76 – 104.29	3.47
SS-26	3.0 – 5.1	109.5 – 107.4	2.1	--	--	--
SS-27	--	--	2.2	4.0 – 6.2	108.8 – 106.6	--
SS-28	--	--	2.0	3.7 – 7.21	109.7 – 106.19	1.50
SS-29	6.8 – 7.6	93.2 – 92.4	2.4	7.6 – 9.2	92.4 – 90.8	--

Note: 1. Boreholes ECB-4 and ECB-6 penetrated a 30 mm and 400 mm thick slab of concrete overlying bedrock, respectively.

Completely to Moderately Weathered Shale

Completely to moderately weathered shale bedrock is inferred present at depths ranging from 0.8 m to 7.5 m below ground surface (Elevations 109.9 m to 92.1 m) based on drilling behaviour, observations of drilling cuttings and split-spoon sampling. The thickness of the completely to moderately weathered bedrock is inferred to range from about 0.2 m to 3.9 m.

The SPT “N”-values measured within the completely to moderately weathered shale bedrock range from 22 blows to 136 blows per 0.3 m of penetration with multiple “N”-values ranging from 100 blows for 0.15 m of penetration to 169 blows for 0.18 m of penetration, suggesting a very stiff to hard consistency; and blockages of sampling equipment by fragments of rock.

Grain size distribution testing was carried out on fifteen samples of the inferred completely to moderately weathered shale bedrock obtained by split-spoon sampling and the results are shown on Figures C-10A, C-10B and C-10C in Appendix C. The split-spoon samples obtained from within the inferred completely to moderately weathered bedrock do not contain larger fragments of rock due to the sampler size and sampling method. Larger fragments of unweathered shale bedrock may be present in-situ. In addition, the percentage of gravel-size particles may include shale fragments that either remained intact after or were broken during sampling and sample preparation. Therefore, the results of the grain size distribution testing may not be representative of the bulk grain size distribution or behaviour of the in-situ or excavated completely to moderately weathered shale bedrock.

Atterberg limits testing was carried out on the finer fractions of fifteen samples of the inferred completely to moderately weathered shale bedrock and measured liquid limits ranging from about 20 per cent to 28 per cent, plastic limits ranging from about 17 per cent to 18 per cent, and plasticity indices ranging from about 6 per cent to 10 per cent. These results are plotted on a plasticity chart on Figure C-11 in Appendix C and indicate that the finer

fraction of the inferred completely to moderately weathered shale bedrock, when broken down to the Atterberg limits testing size (soil-like) consists of clayey silt of low plasticity.

The water content measured on samples of the inferred completely to moderately weathered shale bedrock range between approximately 5 per cent and 11 per cent.

Moderately Weathered to Fresh Shale

Based on a review of the bedrock core samples, the bedrock consists of shale of the Georgian Bay Formation. In general, the bedrock core samples are described as moderately weathered to fresh, thin to thickly bedded, dark grey, fine grained, non-porous, weak shale. Details of the bedrock cores are presented on the drillhole records in Appendix B and on the bedrock core photographs (Figures B-1 to B-13) in Appendix B. The degree of weathering of the bedrock samples (i.e., fresh to moderately weathered – W1 to W3), and the strength classification of the intact rock mass based on field identification (i.e., very weak to weak – R1 to R2) are described in accordance with the International Society for Rock Mechanics (ISRM³) standard classification system. However, in Boreholes 158 and EC14-01, the upper 1 m of the bedrock at these locations is noted to be completely to highly weathered. A 50 mm sand seam was encountered within the cohesive till deposit at Borehole SS-5

The Rock Quality Designation (RQD) measured on the core samples ranges from about 12 per cent to 100 per cent, indicating a rock mass of very poor to excellent quality as per Table 3.10 of CFEM (2006)⁴. The Total Core Recovery (TCR) ranges from about 49 per cent to 100 per cent and the Solid Core Recovery (SCR) ranges from about 0 per cent to 100 per cent.

Point Load Testing (PLT) was carried out on various bedrock core samples from Borehole EC 14-01, as part of the previous investigation by Thurber. Unconfined Compressive (UC) testing was carried on ten bedrock core samples, as part of the current investigation. Based on the UC tests, the uniaxial compressive strength (UCS) of the shale bedrock ranges from about 5 MPa to 19 MPa, as summarized below, and indicates the bedrock samples are classified as weak (R2, 5 MPa < UCS < 25 MPa) according to Table 3.5 of CFEM (2006)⁴. The laboratory PLT and UC tests results are detailed on the rock testing reports provided in Appendix C.

Borehole	Core Run	Sample Depth (m)	Bulk Density (g/cm ³)	UCS (MPa)	Young's Modulus (GPa)
ECB-4	2	8.8 – 9.1	2.6	7.1	0.54
	3	10.2 – 10.4	2.6	4.5	0.40
SS-6	1	6.0 – 6.1	2.61	14.9	0.70
SS-9	1	4.9 – 5.1	2.62	10.6	0.43
SS-13	1	3.5 – 3.7	2.59	19.3	0.96
SS-17	2	4.1 – 4.3	2.04	9.7	0.21
SS-18	1	3.5 – 3.7	2.59	11.7	0.56

³ International Society for Rock Mechanics Commission on Test Methods, 1985. Int. J. Rock Mech. Min. Sci. & Geomech. Abstr. Vol 22, No. 2, pp. 51-60.

⁴ Canadian Geotechnical Society, 2006. Canadian Foundation Engineering Manual (CFEM), 4th Edition. The Canadian Geotechnical Society, BiTech Published Ltd., British Columbia.

Borehole	Core Run	Sample Depth (m)	Bulk Density (g/cm ³)	UCS (MPa)	Young's Modulus (GPa)
SS-23	3	5.5 – 5.7	2.59	13.6	0.56
SS-25	2	5.5 – 5.7	2.56	10.6	0.42
SS-28	1	6.2 – 6.3	2.59	11.9	0.67

4.2.8 Groundwater Conditions

Details of the water levels observed in the open boreholes at the time of drilling are summarized on the borehole records in Appendix B. The depth to the water level was measured in the open boreholes and ranges from 3.5 m to 7.8 m below ground surface, Elevations 109.2 m to 92.8 m, and was generally located near the bottom of the open boreholes, and eighteen boreholes were found to be dry upon completion of drilling (water was not measured in the borehole).

A standpipe piezometer was installed in five of the boreholes to monitor the groundwater level at the site, as shown on the borehole records and presented below. The water level in the standpipe piezometers was measured at depths ranging from 1.1 m to 2.3 m below ground surface, ranging from Elevations 101.2 m to 107.2 m on June 19 and July 14, 2018.

Borehole No.	Screened Strata	Depth to Groundwater (m)	Groundwater Elevation (m)	Date
EC 14-01	Shale Bedrock	2.1	91.7	September 9, 2014
		2.0	91.8	January 15, 2015
SS-2	Shale Bedrock	2.2	101.2	June 19, 2018
		2.2	101.2	July 14, 2018
SS-13	Silty Sand Fill	1.1	106.7	June 19, 2018
		1.6	106.2	July 14, 2018
SS-18	Shale Bedrock	2.3	107.2	June 20, 2018
		2.3	107.2	July 14, 2018
SS-28	Silty Sand Fill / Sandy Clayey Silt Till	2.2	111.2	June 19, 2018
		2.3	111.1	July 14, 2018

It should be noted that the groundwater level is subject to seasonal fluctuations and precipitation events and should be expected to be higher during wet periods of the year. Additionally, as evident by the groundwater level measured in the silty sand fill at Borehole SS-13, perched groundwater conditions may be present within the non-cohesive fill at this site.

4.2.9 Analytical Testing Results

4.2.9.1 Environmental Quality

Nine soil samples were submitted to AGAT Laboratories for chemical analysis of Petroleum Hydrocarbon Fractions F1 to F4 (PHC F1-F4) and Volatile Organic Compounds (VOCs). The soil samples submitted for environmental quality testing were obtained from the anticipated sewer invert depth (Sample 4, at about 2.5 m depth) from Boreholes SS-1, SS-3, SS-6, SS-13, SS-17, SS-22, SS-26, SS-27, and SS-28.

No evidence of odour or environmental staining was noted during drilling in any of the samples, with the following exceptions, where potential hydrocarbon odours were detected:

- Borehole SS-1, Sample 2 (Sandy Clayey Silt Fill)
- Borehole SS-4, Sample 10 (Sandy Clayey Silt Fill)
- Borehole SS-7, Sample 9 (Sandy Clayey Silt Fill)
- Borehole SS-13, Samples 3 and 4 (Silty Sand Fill)

4.2.9.2 Corrosion Potential and Sulphate Attack

Eight soil and six bedrock samples were submitted under chain of custody procedure to AGAT Laboratories for analysis of parameters used to assess the potential corrosivity of the site soil to steel and deterioration of concrete. The soil and bedrock samples were obtained from the anticipated sewer invert depth (Sample 4 at about 2.5 m depth). The AGAT report is provided in Appendix D and the analytical test results are summarized below.

Borehole	Parameter						
	Sulphide (%)	Chloride (µg/g)	Sulphate (µg/g)	pH	Conductivity (mS/cm)	Resistivity (ohm-cm)	Redox Potential (mV)
SS-1	0.26	836	97	8.31	1.37	730	172
SS-3	0.34	185	281	8.04	0.62	1,600	159
SS-6	0.35	163	132	8.60	0.50	1,990	196
SS-9	0.32	156	250	8.45	0.68	1,470	146
SS-10	0.38	103	167	8.31	0.49	2,030	181
SS-11	0.70	143	599	7.97	1.05	952	160
SS-13	0.10	447	39	9.22	0.87	1,150	163
SS-15	0.37	184	154	8.37	0.63	1,580	178
SS-17	0.29	587	182	9.18	1.26	794	154
SS-19	0.28	834	202	8.67	1.54	649	148
SS-22	0.13	330	136	8.29	0.78	1,280	174

Borehole	Parameter						
	Sulphide (%)	Chloride (µg/g)	Sulphate (µg/g)	pH	Conductivity (mS/cm)	Resistivity (ohm-cm)	Redox Potential (mV)
SS-26	0.18	679	123	9.06	1.44	694	121
SS-27	0.31	543	139	8.48	1.04	962	163
SS-28	0.11	2,140	108	8.36	3.16	316	169

5.0 CLOSURE

This report was prepared by Ms. Anastasia Poliacik, P.Eng, a geotechnical engineer with Golder and reviewed by Ms Sandra McGaghran, M.Eng., P.Eng an Associate and senior geotechnical engineer with Golder. Mr. Jorge M.A. Costa, P.Eng., a MTO Foundations Designated Contact and Senior Consultant with Golder, conducted a technical and quality control review of the report.

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PART B

**FOUNDATION DESIGN REPORT
STORM SEWERS EAST OF ETOBICOKE CREEK
QEW IMPROVMENTS FROM EAST OF CAWTHRA ROAD TO THE EAST
MALL, CITIES OF MISSISSAUGA AND ETOBICOKE, ONTARIO
MTO, GWP 2102-13-00 & 2432-13-00**

6.0 DISCUSSION AND ENGINEERING RECOMMENDATIONS

This section of the report provides geotechnical recommendations for the installation of proposed storm sewer replacements along the Queen Elizabeth Way (QEW) between Etobicoke Creek and The East Mall, included as part of the QEW Improvements from East of Cawthra Road to The East Mall, in the cities of Mississauga and Etobicoke, Ontario (see Key Plan on Drawing 1). The recommendations are based on interpretation of the factual data obtained from the boreholes advanced by others and boreholes advanced during the current investigation in the vicinity of the proposed open-cut storm sewer alignment. The discussions and recommendations presented are intended to provide the designer with sufficient information to carry out the design of the storm sewers structural elements and pipe support/encapsulation materials. The following sections of the report discuss the general design and construction considerations for the installation of the storm sewers using cut-and-cover construction methods, based on an invert depth ranging from 3 m to 4 m below existing grade.

The foundation investigation report, discussion and recommendations are intended for the use of the Ministry of Transportation, Ontario (MTO) and shall not be used or relied upon for any other purpose or by any other parties, including the construction or design-build contractor. The contractor must make their own interpretation based on the factual data in Part A (Foundation Investigation) of the report. Where comments are made on construction, they are provided to highlight those aspects that could affect the design of the project and for which special provisions may be required in the Contract Documents. Those requiring information on the aspects of construction must make their own interpretation of the factual information provided as such interpretation may affect equipment selection, proposed construction methods, scheduling, and the like.

6.1 General

It is understood that the proposed storm sewer replacements will be installed by cut-and-cover construction methods, with use of temporary protection systems. It is noted that two additional sections of the storm sewer (located just west and east of the Etobicoke Creek Bridge) will be constructed using trenchless methods and are excluded from this report.

Based on the proposed sewer profile provided by AECOM on June 14, 2019 (Sheet No. 134A to 140A, dated May 30, 2018), the proposed 300 mm to 750 mm pipe diameter sewers are to be constructed at invert depths ranging from 1.6 m and 5.1 m below existing grade (Elevation 111.2 m to 96.3 m), except at the outlet to Etobicoke Creek (Station 0+012 to 0+036) where the invert depths range from 0 m to 6.9 m below existing grade (Elevation 92.4 m to 92.9 m). The pipe diameters, invert depths, and invert elevations are summarized below.

Location	Approximate Station	Pipe Diameter (mm)	Approximate Invert Depth below existing grade (m)	Approximate Invert Elevation (m)
On-ramp from The West Mall to Westbound QEW	9+875 to 10+110	525	3.0 – 4.6	102.7 – 97.0
Eastbound QEW, off-ramp to The West Mall	10+130 to 10+152	525	4.7 – 5.1	96.3 – 96.8
	10+152 to 10+284	300	1.9 – 4.1	97.8 – 105.6

Location	Approximate Station	Pipe Diameter (mm)	Approximate Invert Depth below existing grade (m)	Approximate Invert Elevation (m)
QEW, right shoulder of eastbound lanes	0+012 to 0+036	750	0 - 6.9	92.4 – 92.9
	0+036 to 0+250	450	2.4 – 3.4	96.3 – 101.2
	14+915 to 15+050	300	1.6 – 2.4	108.0 – 106.9
	15+180 to 15+265	300/375	1.6 – 1.9	109.2 – 108.4
QEW, crossing eastbound lanes	15+370	450	2.6 – 3.8	109.8 – 108.9
QEW, centreline	14+054 to 14+137	700	2.9 – 3.1	97.2 – 98.5
	14+137 to 14+376	600	2.4 – 3.2	99.5 – 103.1
	14+376 to 14+514	525	2.6 – 3.1	103.2 – 104.6
	14+514 to 14+610	450	2.6 – 2.9	104.7 – 105.5
	14+663 to 14+724	750	3.2 – 3.4	104.8 – 105.3
	14+724 to 14+816	675	3.0 – 3.2	105.4 – 106.0
	14+816 to 15+052	375	1.7 – 2.8	106.5 – 108.4
	15+052 to 15+105	300	1.5 – 1.6	108.5 – 108.8
	15+150 to 15+235	375	2.2 – 2.5	108.5 – 109.2
	15+235 to 15+280	300	2.2	109.3 – 109.6
	15+372 to 15+450	450	2.4 – 2.8	109.5 – 110.3
	15+450 to 15+501	375	2.2 – 2.4	110.4 – 110.8
	15+547 to 15+593	300	2.2 – 2.5	110.7 – 111.2

6.2 Excavations

The anticipated founding conditions along the proposed storm sewer alignments noted above consist of non-cohesive/cohesive fill, clayey silt to silty clay, non-cohesive/cohesive till, and/or bedrock, as shown on the stratigraphic profiles on Drawings 1 to 4.

The fill strata are considered generally suitable for supporting the pipes; however, there are some soft areas in the vicinity of Borehole SS-28. The native deposits comprised of clayey silt to silty clay, and till are considered suitable for supporting the pipes, provided the integrity of the base of the excavation can be maintained during construction. The bedrock is also considered suitable for supporting the pipes. Depending on the final storm sewer pipe invert elevation, the pipes may be founded on bedrock in the vicinity of Boreholes EC14-01, SS-2, SS-3, SS-8, SS-9, and SS-11, SS-12, SS-14 to SS-26.

The subgrade should be inspected by geotechnical personnel to ensure that all existing topsoil and unsuitable fill/softened soils or other unsuitable materials have been removed. Proof-rolling of the subgrade (using a plate tamper in combination with visual inspection) will be required to identify any softened zones. Where any softened zones are present, sub-excavation is required to remove unsuitable materials, and the sub-excavated area should be backfilled with granular material meeting OPSS.PROV 1010 (*Aggregates*) Granular 'A' or Granular 'B' Type II that is placed and compacted in accordance with OPSS.PROV 501 (*Compacting*) as amended by SP 105S12. Further, care will be required to avoid disturbing the base of the excavation during construction which could lead to loss of support of the storm sewer pipes. Any materials that are disturbed by construction at the base of the excavation should be removed and replaced with engineered fill or additional bedding materials.

Till deposits randomly contain cobbles and boulders and the shale bedrock may contain limestone layers. Contract Documents must identify these conditions to the Contractor. A suggested Non-Standard Special Provision (NSSP) to be included in the Contract Documents is provided in Appendix E.

All excavations should be carried out in accordance with the guidelines outlined in the Occupational Health and Safety Act and Regulations (OHSA), with local regulations, and as outlined in Ontario Provincial Standard Specification (OPSS) OPSS.PROV 401 (*Trenching, Backfilling and Compacting*). According to OHSA, the soil/rock classification and corresponding excavation side slopes of the soils anticipated to be excavated are provided below. However, depending upon the construction procedures adopted by the contractor, actual groundwater seepage conditions, the success of the contractor's groundwater control methods and weather conditions at the time of construction, some flattening and/or blanketing of the slopes may be required.

Soil Description	Above/Below Groundwater	OHSA Soil Type	Maximum Foundation Excavation Side Slopes
Non-Cohesive Fill (very loose to very dense)	Above	Type 3	1 Horizontal :1 Vertical
	Below	Type 4	3 Horizontal :1 Vertical
Cohesive Fill (very soft to hard)	Above	Type 3	1 Horizontal :1 Vertical
	Below	Type 4	3 Horizontal :1 Vertical
Clayey Silt to Silty Clay (Stiff to Hard)	Above	Type 2	1 Horizontal :1 Vertical to within 1.2 m of the bottom of the excavation
	Below	Type 3	1 Horizontal :1 Vertical
Clayey silt with sand to Clayey silt (Till) (Firm to Very Stiff)	Above	Type 2	1 Horizontal :1 Vertical to within 1.2 m of the bottom of the excavation
	Below	Type 3	1 Horizontal :1 Vertical
Completely to highly weathered Shale (Stiff to Hard)	Above	Type 2	1 Horizontal :1 Vertical to within 1.2 m of the bottom of the excavation
	Below	Type 3	1 Horizontal :1 Vertical
Slightly weathered to Fresh Shale	Above/Below	NA	1 Horizontal :10 Vertical ¹

Note: 1. Near vertical side slopes are recommended to minimize potential undercutting of shale layers, providing excavation and backfilling are completed with a short period of time (i.e. one or two days).

The completely to highly weathered shale should be considered analogous to a soil and behaviour that would fall under the general characteristics of Soil Type 2; however, given the variable nature of this material, the soil behaviour type and its relation to excavation support must be examined and judged for each exposure during construction. Temporary excavations in the slightly weathered to fresh shale bedrock can be made near vertical;

however, the moderately weathered shale bedrock represents a transition between highly weathered and slightly weathered and, depending on the extent of weathering and the duration that the excavation remains open, temporary protections system may be required to extend through this material. Excavated material must be stockpiled at a distance away from the excavation equal to or greater than the depth of the open cut excavation through the overburden. Where sufficient space is not available to stockpile the excavated material at the site, off-site disposal of the excavated material intended for reuse would need to be arranged. Care must also be taken during excavation to ensure that adequate support is provided for any existing structures, roadways and underground services located adjacent to the excavations. Care should be taken to direct surface water runoff away from the open excavations.

Standard excavating equipment, such as backhoes, should be adequate for excavation of the storm sewer trench in the overburden soils. A hydraulic hammer (i.e. hoe-ram) could be used for excavation of bedrock materials. Pneumatic breakers or chisels will be required to break and remove the harder limestone layers that may be encountered within the shale bedrock; blasting and vibration/hammering is not permitted adjacent to structures. Excavations should be made in accordance with OPSS.PROV 401 (*Trenching, Backfilling and Compacting*) and OPSS.PROV 403 (*Rock Excavation in Open Cut*).

6.2.1 Temporary Protection Systems

Where the side slopes of cut-and-cover excavations are required to be steepened to limit the extent of the excavation, some form of trench support will be required. The excavations could be carried out using a vertically unsupported excavation (using a properly engineered prefabricated support system for personnel protection, certified by an experienced engineer) in open areas which can tolerate lateral movement of the soil deposits; or by a supported excavation (discussed below) if in close proximity to adjacent structures or underground services where restriction of lateral movements is required. It must be emphasized that a prefabricate support system (trench liner box) provides protection for construction personnel but does not provide any lateral support for adjacent excavation walls, underground services or existing structures. It is imperative that underground services and existing structures adjacent to the trench excavations be accurately located prior to construction and adequate support provided where required. Steepened excavations should be left open for as short a duration as possible and completely backfilled at the end of each working day. Given the potential presence of buried utilities along or traversing the excavations, the constant traffic flow along both sides of and in close proximity to the excavations, and given the subsurface conditions along the alignment, and the likely excavation geometry, it is anticipated that a soldier pile and lagging system with internal bracing (struts), anchors or rakers would be required, which is considered suitable to provide lateral support of the excavation. A driven interlocking sheetpile system fitted with internal bracing, anchors or rakers, could also be utilized, but consideration should be given to the potential for encountering cobbles and/or boulders in the surficial soils. An interlocking sheetpile system has an advantage with respect to controlling groundwater seepage where zones of perched groundwater are present. Groundwater seepage and the potential loss of fine soil particles can be mitigated if a soldier pile and lagging system is adopted, by backing the lagging with filter cloth in areas where the temporary shoring intercepts zones of perched groundwater or seepage and directing the seepage to a positive discharge point.

The temporary excavation support system should be designed and constructed in accordance with OPSS.PROV 539 (*Construction Specification for Temporary Protection Systems*), as amended by SP 105S09. The lateral movement of the temporary shoring system should meet Performance Level 2 as specified in OPSS.PROV 539 (*Construction Specification for Temporary Protection Systems*), as amended by SP 105S09. The design of temporary support systems is the responsibility of the contractor. For consideration, the system design should be based on trapezoid-shaped apparent earth pressure distributions using the design parameters

given below. The internal bracing or raker supports must be designed to accommodate the loads applied from earth pressures, water pressures and surcharge pressures from area, line or point loads, as well as the effects of sloping ground behind the system. Passive toe restraint to the soldier piles may be determined using conventional passive earth pressure distribution acting over an equivalent width equal to three times the soldier pile socket diameter provided that the soldier piles are separated by more than three times the socket diameter. In the event that circular shaft support systems are planned, the lateral earth pressure coefficients provided below will require modification.

Soil Type	Coefficient of Lateral Earth Pressure			Angle of Internal Friction (Degrees)	Unit Weight (kN/m ³)
	Active, K_a	At Rest, K_o	Passive, K_p		
Sand to Gravelly Sand to Sand and Gravel (Fill) (Loose to Very Dense)	0.33	0.5	3.03	30	18
Silt to Silty Sand to Sand (Fill) (Very Loose to Dense)	0.36	0.53	2.8	28	18
Cohesive (Fill) (Firm to Hard)	0.36	0.53	2.8	28	19
Silty Clay (Stiff to Hard)	0.36	0.53	2.8	28	19
Clayey Silt to Clayey Silt with Sand (Till) (Stiff to Hard)	0.28	0.44	3.55	34	20
Non-Cohesive (Till) (Very Dense)	0.28	0.44	3.55	34	20
Completely to highly weathered shale bedrock	0.22	0.36	4.56	40	22

Notes:

- 1) The lateral earth pressure coefficients presented above are based on a horizontal surface adjacent to the excavation. If sloped surfaces are expected, the coefficients showed need to be corrected accordingly.
- 2) The total passive resistance below the base of the excavation (i.e., within the shored excavation and / or adjacent to the temporary protection system, may be calculated based on the value of K_p indicated above but reduced by an appropriate factor that considers the allowable wall movement in accordance with Figure C6:16 of the CHBDC (2014) to account for the fact that a large strain would be required for mobilization of the full passive resistance.

The measured groundwater levels along the proposed sewer alignment range from Elevation 91.7 m at the west end of the alignment to Elevation 111.2 m at the east end of the alignment, as presented in Section 4.2.8. The design groundwater elevation is expected to range between these elevations, dependant on the location along the proposed alignment, and the designer should use the information in Section 4.2.8 to infer the design groundwater level for the section of temporary protection system wall being designed.

Temporary excavations in the slightly weathered to fresh shale bedrock may be developed with vertical sidewalls, provided that all loosened rock fragments are removed from the excavated rock faces.

It is recommended that the temporary protection system be fully removed upon completion of construction or each stage of construction (as required) to mitigate potential impediments to future rehabilitation/reconstruction work on the highway. An NSSP is included in Appendix E which addresses the full removal of the protection systems for inclusion into the Contract Documents.

Vibration monitoring should be considered during installation/removal of temporary protection systems to ensure that the vibration levels at nearby structures and utilities are maintained below tolerable levels. Details for vibration monitoring are provided in Section 6.5.

6.2.2 Groundwater Control

The depth to the groundwater level and groundwater elevations measured in five piezometers installed in selected boreholes along the proposed storm sewer alignment is between about 1.1 m to 2.3 m below existing grade, between about Elevations 111.2 m and 91.7 m, although most boreholes were found to be dry upon completion of drilling operations. Groundwater inflow during construction can likely be controlled by pumping from sumps at the base of the excavations. It is also noted that perched groundwater conditions may be present within the upper fill layers and, depending on the time of construction, greater dewatering efforts may be required; however, it is anticipated that the groundwater can still be controlled by pumping from sumps at the base of the excavation. Although not anticipated, if dewatering is required it should be carried out in accordance with OPSS.PROV 517 (Construction Specification for Dewatering), as modified by the Special Provision (SP) 517F01 (Dewatering System, Temporary Flow Passage System).

If a soldier pile and lagging system is employed and groundwater is present, it would be necessary to control seepage or include measures to mitigate loss of soil particles through the lagging boards. For all excavations with groundwater seepage, the formation of ice on the shaft walls should be expected during the winter months. The accumulation of ice on the walls should be closely monitored and periodic removal will be required to prevent ice from falling into the excavation and endangering workers in the excavation.

6.3 Pipe Bedding, Cover, and Trench Backfill

The bedding, cover, and backfill for the concrete storm sewer pipe should be compatible with the type and class of pipe, the surrounding subsoil/bedrock conditions and anticipated loading conditions and should be designed in accordance with OPSD 802 (*Rigid Pipe Bedding, Cover, and Backfill*), as presented in OPSD 802.030, 802.031, and 802.033, for construction in Type 2 soil, Type 3 soil, and bedrock, respectively, adopting Class B bedding.

6.3.1 Bedding and Cover

The bedding and cover material should consist of the material as specified in OPSS.PROV 401 (*Trenching, Backfilling, and Compacting*). Clear stone should not be used as bedding or cover material. Bedding shall consist of OPSS.PROV1010 (*Aggregates*) Granular 'A' or OPSS 1359, unshrinkable fill. All bedding and cover material should be placed in loose lifts and uniformly compacted to at least 98 per cent of the material's Standard Proctor Maximum Dry Density (SPMDD), in accordance with OPSS.PROV 501 (*Compacting*), as amended by SP 105S22.

6.3.2 Backfill

Native site soils or excavated cohesive and non-cohesive fills may be used for trench backfill, provided they are free of topsoil, organic material or other deleterious materials. If water contents of the site soils at the time of construction are too high, or if there is a shortage of suitable in-situ material, then an approved imported material which meets the requirements for OPSS.PROV 1010 (*Aggregates*) Select Subgrade Material (SSM) or

Granular 'B' Type I could be used. It should be placed and compacted as indicated above for granular materials and to 95 per cent of the materials SPMDD for native soils/excavated fills. Backfilling operations during cold weather should avoid inclusions of frozen lumps of material, snow and ice, and backfilling with fine grained (i.e., silts and/or clays) materials should not be undertaken.

Settlement of the compacted trench backfill should be anticipated, and the majority of such settlement should take place within about 6 months following the completion of trench backfilling operations. This settlement will be reflected at the ground surface and may be compensated for, where necessary, by placing additional granular material as required. Alternatively, if the asphalt binder course is placed shortly following the completion of trench backfilling operations in these areas, any settlement that may be reflected by subsidence of the surface of the binder asphalt should be compensated for by placing an additional thickness of binder asphalt or by padding.

The design frost depth in the area is estimated to be 1.2 m below ground surface, as interpreted from OPSD 3090.101 (*Frost Penetration Depths for Southern Ontario*). To avoid undue differential movements or settlement of ground surface adjacent to and over the trench, the general backfill materials should match, as practically as possible, to the native or fill material exposed in the trench walls, or granular materials should be used as backfill as it will undergo most of the settlement during construction. Backfill within the zone of frost penetration below the bedrock surface should consist of non-frost susceptible material such as OPSS.PROV 1010 (*Aggregates*) Granular 'A' or Granular 'B' Type 1.

6.4 Corrosion Assessment and Protection

Soil corrosivity may affect concrete pipes, steel pipes and reinforced steel and other concrete elements buried in soil. The long-term performance and durability of the storm sewer pipes is directly related to their respective corrosion resistance. Generally, the corrosivity of a structure, including concrete storm sewer pipes, depends on the soil resistivity, hydrogen ion concentration, salts (chloride and sulphate) concentrations and redox potential. Analytical testing was carried out on fourteen soil samples obtained in the boreholes from a depth of about 2.5 m below ground surface. The results, as presented in Section 4.4.2, were used to assess the potential sulphate attack on concrete and corrosion potential along the proposed concrete storm sewer alignment.

The analytical test results were compared to CSA Standard, CAN/CSA-A23.1-14 Table 3 (*"Additional requirements for concrete subjected to sulphate attack"*) for potential sulphate attack on concrete. The sulphate concentration measured in the samples range from less than 0.01 per cent to about 0.06 per cent, which correlate to exposure classes of S-3 (Moderate) or is "Negligible", according to Table 7.2 of the MTO Gravity Pipe Design Guidelines (2014). Therefore, based on the test results, when the designer is selecting the exposure class for the storm sewer pipes, the effects of sulphates from within the site soils may not need to be considered.

The soil samples measured a pH between 8.0 and 9.2, with seven samples indicating a pH about equal to or greater than 8.5, suggesting a strongly alkaline condition (MTO, 2014). The resistivity of the tested samples is less than 2,000 ohm-cm, except for one results which was slightly greater than 2,000 ohm-cm, which indicates that the soil corrosiveness is Severe, as per Table 3.2 of the MTO Gravity Pipe Design Guidelines (2014). Based on these results, some level of pipe protection will be required depending on the pipe material used (concrete in this case). Based on the results of the sampled tested and given that the storm sewer is located under a highway and will be exposed to de-icing salt, consideration should be given by the designer to designing for a "C" type exposure class as defined in CSA A23.1 Table 1.

It is ultimately up to the designer to determine the appropriate exposure class and to ensure that all aspects of CSA A23.1 Section 4.1.1 "Durability Requirements" are followed.

6.5 Vibration Monitoring During Construction

A maximum peak particle velocity (PPV) of 100 mm/s is generally considered applicable for bridge structures in good condition. Based on vibration monitoring experience, it is considered unlikely that vibrations induced by conventional construction activities such as installation/removal of temporary protection systems or hoe-ramming in bedrock will reach this threshold level and, therefore, vibration monitoring for the existing bridge is not expected to be required during construction at this site.

Residential homes are located within about 100 m of the proposed storm sewer replacement alignments. A lower PPV threshold of 25 mm/s is generally considered applicable for vibration impacts on buildings, and the zone of influence could extend to about 250 m. Therefore, vibration monitoring should be carried out at the existing structures during bedrock excavation operations. Various commercial/industrial buildings, private structures, and utilities are located within 250 m of the proposed works; therefore, MTO may consider that pre- and post-construction condition surveys and vibration monitoring be carried out. An NSSP describing the requirements for vibration monitoring is presented in Appendix E.

7.0 CLOSURE

This report was prepared by Ms. Anastasia Poliacik, P.Eng, a geotechnical engineer with Golder and reviewed by Ms. Sandra McGaghran, M.Eng., P.Eng., an Associate and senior geotechnical engineer at Golder. Mr. Jorge Costa, P.Eng., a MTO Foundations Designated Contact for Golder and Senior Consultant, conducted a technical and quality control review of the report.

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[https://golderassociates.sharepoint.com/sites/19542g/1 foundations/9 - reports/9 - median storm sewer/3 - final/1530382 final fidr 2019july16 median storm sewer.docx](https://golderassociates.sharepoint.com/sites/19542g/1%20foundations/9%20-%20reports/9%20-%20median%20storm%20sewer/3%20-%20final/1530382%20final%20fidr%202019july16%20median%20storm%20sewer.docx)

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Canadian Standards Association (CSA) CAN/CSA – A23.1-14

Chapman, L.J. and Putnam, D.F. 1984. The Physiography of Southern Ontario, Ontario Geological Survey, Special Volume 2, Third Edition. Accompanied by Map P.2715, Scale 1:600,000.

Ministry of the Environment, Conservation and Parks, Environmental Protection Act. April 15, 2014.

Ministry of Transportation Ontario. 2014. *Gravity Pipe Design Guideline*. Drainage and Hydrology Design and Contract Standards Office.

Ontario Provincial Standard Drawings:

OPSD 802.030	Rigid Pipe Bedding, Cover and Backfill, Type 1 or 2 Soil – Earth Excavation
OPSD 802.031	Rigid Pipe Bedding, Cover and Backfill, Type 3 Soil – Earth Excavation
OPSD 802.033	Rigid Pipe Bedding, Cover and Backfill, Rock Excavation
OPSD 3090.101	Foundation Frost Penetration Depth for Southern Ontario

Ontario Provincial Standard Specifications:

OPSS.PROV 401	Construction Specification for Trenching, Backfilling, and Compacting
OPSS.PROV 403	Construction Specification for Rock Excavation for Pipelines, Utilities and Associated Structures in Open Cut
OPSS.PROV 501	Construction Specification for Compacting
OPSS.PROV 539	Construction Specification for Temporary Protection Systems
OPSS.PROV 1010	Material Specification for Aggregates – Base, Subbase, Select Subgrade and Backfill Material
OPSS PROV 1539	Material Specification for Aggregates – Base, Subbase, Select Subgrade and Backfill Material Unshrinkable Fill
SP 105S22	Special Provision – Amendment to OPSS 501, June 2016
SP 105S09	Special Provision – Amendment to OPSS 539, November 2014

ASTM International:

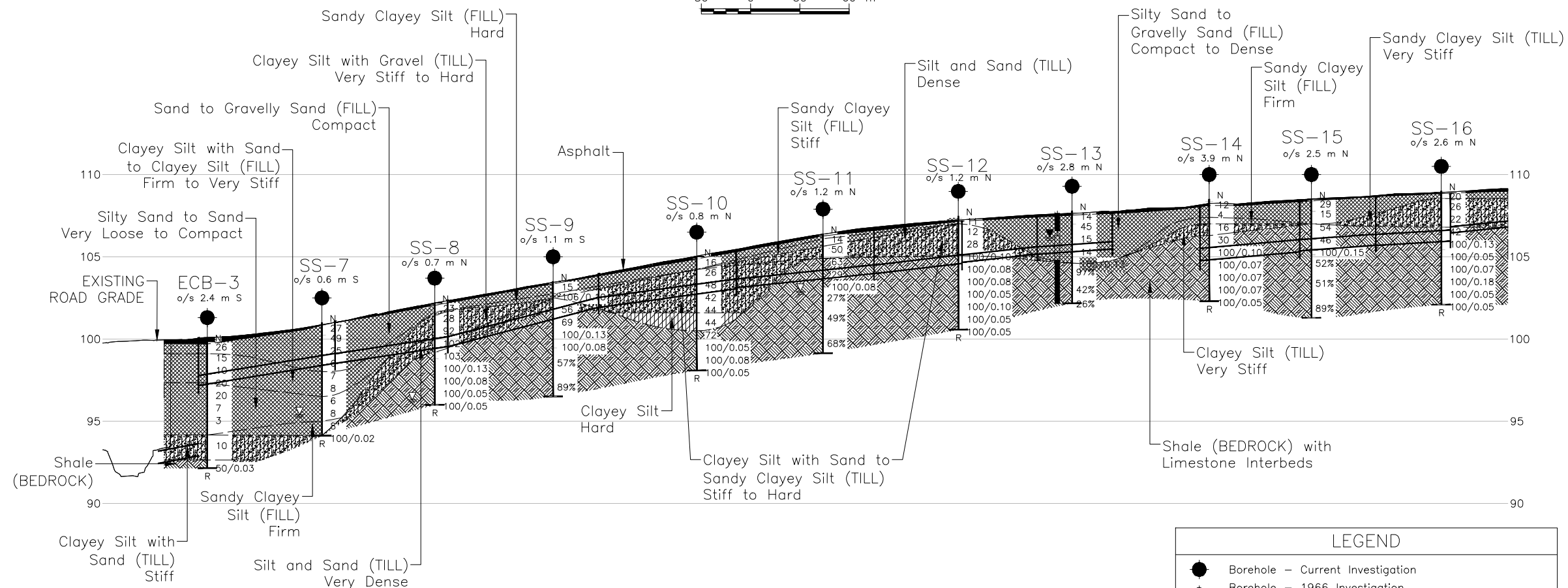
ASTM D1586	Standard Test Method for Standard Penetration Test (SPT) and Split-Barrel Sampling of Soils
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Ontario Water Resources Act:

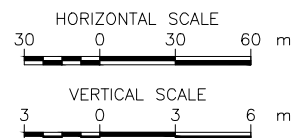
Ontario Regulation 903	Wells (as amended)
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Ontario Occupational Health and Safety Act:

Ontario Regulation 213	Construction Projects (as amended)
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QEW CENTRELINE PROFILE



REFERENCE

Storm Sewer plan provided in digital format by AECOM, drawing file no. qew_dixieic_plan.dwg, Retaining walls plan provided in digital format by AECOM, drawing file nos. 04_RetainingWall_New_24--887W.dwg and 07_RetainingWall_NewPortion_24--888W.dwg, received January 18, 2018.

Base plans provided in digital format by AECOM, drawing file nos. QEW_DixielC_base.dwg and QEW_DixielC_plan.dwg, dated July 20, 2016, received Dec. 06, 2016.










Design plans provided in digital format by AECOM, drawing file nos. QEW_DixieCont1_plan.dwg and QEW_DixieCont2_plan.dwg, received July 21, 2017.

Existing ground contours provided in digital format by AECOM, drawing file no. QEW_DixielC_Contours3D.dwg, received Nov. 08, 2016, contour interval 0.5 m.

Storm sewer profile provided in digital format by AECOM, drawing file no. QEW_DixielCCont1_profile.dwg, received June 12, 2019.

Key plan base data – MNRF LIO, obtained 2015.

LEGEND

	Borehole – Current Investigation
	Borehole – 1966 Investigation (Geocres No. 30M11–20)
	Borehole – 2014 Investigation (Geocres No. 30M11–252)
	Approximate Storm Sewer Alignment
	Seal
	Piezometer
16	Blows/0.3m unless otherwise stated (Std. Pen. Test, 475 j/blow)
100%	Rock Quality Designation (RQD)
	Split–Spoon Refusal
	WL in piezometer, measured on JUL 14, 2018
	WL upon completion of drilling

SHEET

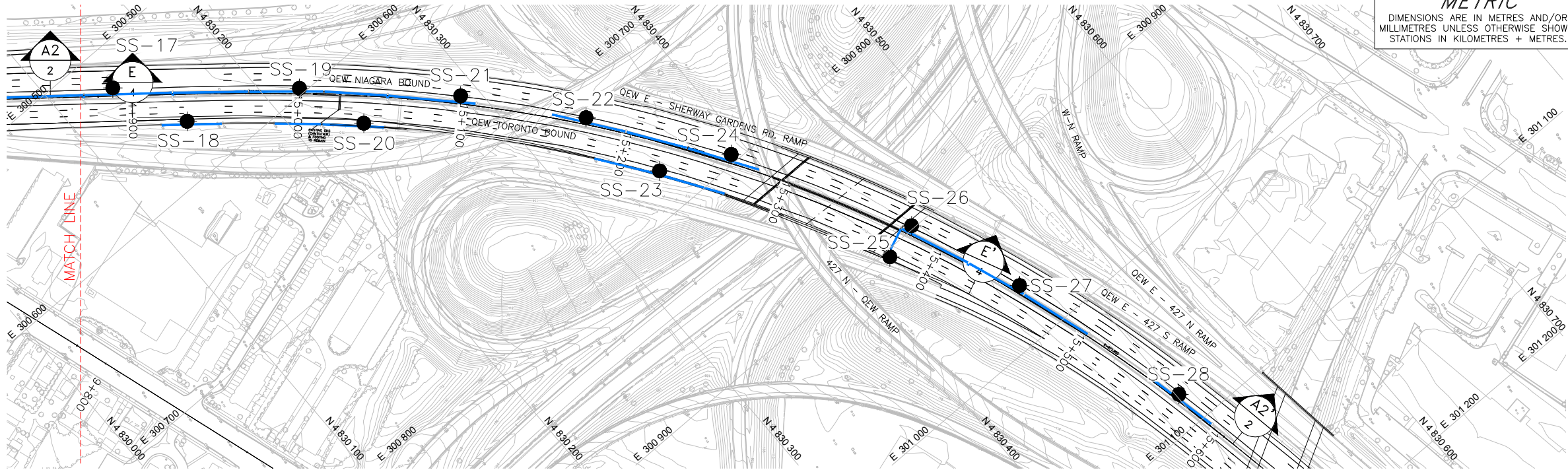


BOREHOLE CO-ORDINATES (MTM NAD 83 ZONE 10)			
No.	ELEVATION	NORTHING	EASTING
SS-5	105.9	4829535.3	300112.4
SS-4	102.6	4829490.5	300067.8
SS-3	107.1	4829709.3	300104.5
SS-2	103.4	4829636.4	300084.5
SS-16	109.0	4830073.9	300476.4
SS-14	108.5	4829964.9	300386.6
SS-12	107.5	4829844.5	300292.6
SS-10	105.0	4829720.5	300192.8
SS-8	102.2	4829596.5	300092.6
SS-9	103.5	4829651.4	300139.4
SS-11	106.4	4829780.5	300240.9
SS-13	107.8	4829899.4	300334.9
SS-15	108.5	4830012.4	300426.8
SS-6	102.8	4829605.9	300126.8
SS-1	101.4	4829578.4	300049.1
SS-7	101.0	4829542.4	300050.5
SS-29	100.0	4829469.4	300018.1
ECB-6	99.7	4829462.5	300015.7
ECB-5	99.7	4829476.0	299998.7
ECB-4	99.5	4829490.2	299980.3
ECB-3	99.8	4829487.0	300008.0
EC14-01	93.8	4829449.4	300013.7
158	96.6	4829497.1	299977.6

This drawing is for subsurface information only. The proposed structure details/works are shown for illustration purposes only and may not be consistent with the final design configuration as shown elsewhere in the Contracts Documents.

The boundaries between soil strata have been established only at borehole locations. Between boreholes the boundaries are assumed from geological evidence.

NO.	DATE	BY	REVISION		
Geocres No. 30M11-294					
HWY. QEW		PROJECT NO. 1530382		DIST. CENTRA	
SUBM'D. AP	CHKD. AP	DATE: 07/16/2019		SITE:	
DRAWN: DD	CHKD. SMM	APPD. JMAC		DWG. 1	



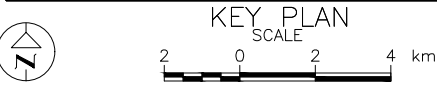
METRIC
DIMENSIONS ARE IN METRES AND/OR
MILLIMETRES UNLESS OTHERWISE SHOWN.
STATIONS IN KILOMETRES + METRES.

CONT No. 2018-2001
GWP No. 2102-13-00 & 2432-13-00



QEW - CAWTHRA RD TO EAST MALL WIDENING
STORM SEWER
BOREHOLE LOCATIONS AND SOIL
STRATA

SHEET

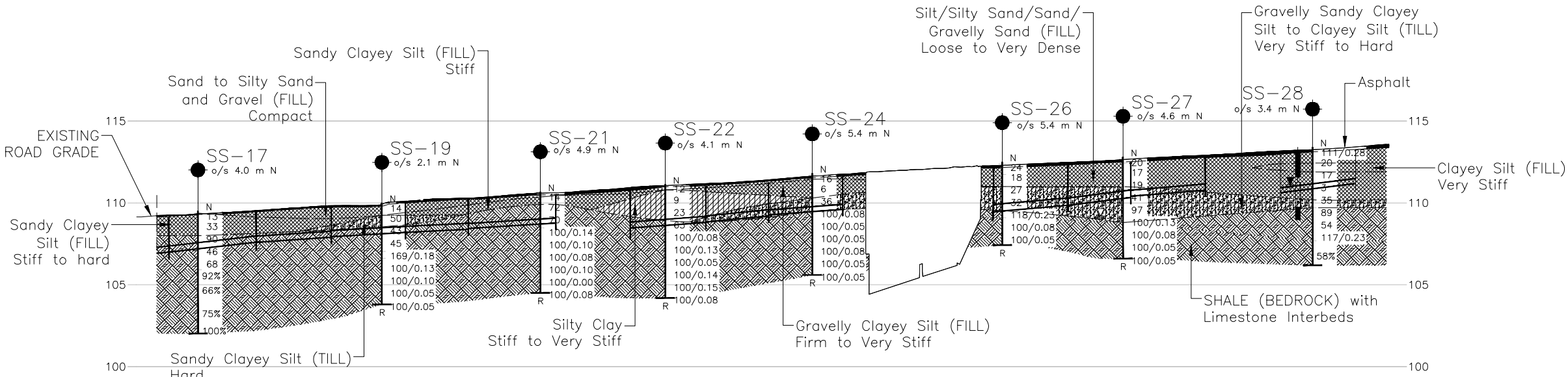


LEGEND

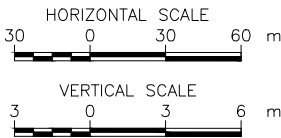
- Borehole
- Approximate Storm Sewer Alignment
- ⊥ Seal
- ⊥ Piezometer
- 16 Blows/0.3m unless otherwise stated (Std. Pen. Test, 475 j/blow)
- 100% Rock Quality Designation (RQD)
- R Split-Spoon Refusal
- WL in piezometer, measured on JUL 14, 2018
- WL upon completion of drilling

BOREHOLE CO-ORDINATES (MTM NAD 83 ZONE 10)

No.	ELEVATION	NORTHING	EASTING
SS-17	109.5	4830133.7	300523.4
SS-18	109.5	4830154.7	300567.7
SS-19	110.0	4830219.0	300596.4
SS-20	109.9	4830234.7	300637.5
SS-21	110.7	4830289.7	300662.9
SS-22	111.1	4830338.5	300721.8
SS-23	110.9	4830351.4	300774.8
SS-24	111.8	4830390.5	300795.3
SS-25	111.7	4830423.2	300903.9
SS-26	112.5	4830445.2	300898.2
SS-27	112.8	4830471.3	300967.7
SS-28	113.4	4830501.6	301079.6



A-A QEW CENTRELINE PROFILE



REFERENCE

Storm Sewer plan provided in digital format by AECOM, drawing file no. qew_dixieic_plan.dwg.
Retaining walls plans provided in digital format by AECOM, drawing file nos. 04_Retaining Wall_New_24-887W.dwg and 07_Retaining Wall_NewPortion_24-888W.dwg, received January 18, 2018.
Base plans provided in digital format by AECOM, drawing file nos. QEW_DixieIC_base.dwg and QEW_DixieIC_plan.dwg, dated July 20, 2016, received Dec. 06, 2016.
Design plans provided in digital format by AECOM, drawing file nos. QEW_Dixie_Cont1_plan.dwg and QEW_Dixie_Cont2_plan.dwg, received July 21, 2017.
Existing ground contours provided in digital format by AECOM, drawing file no. QEW_DixieIC_Contours3D.dwg, received Nov. 08, 2016, contour interval 0.5 m.
Storm sewer profile provided in digital format by AECOM, drawing file no. QEW_DixieIC_Cont1_profile.dwg, received June 12, 2019.
Key plan base data - MNR LIO, obtained 2015.

NOTES

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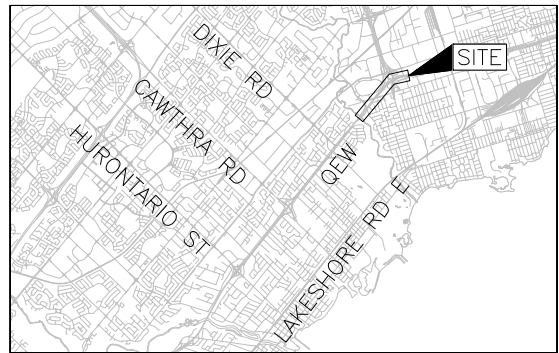
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METRIC
DIMENSIONS ARE IN METRES AND/OR
MILLIMETRES UNLESS OTHERWISE SHOWN.
STATIONS IN KILOMETRES + METRES.

CONT No. 2018-2001
GWP No. 2102-13-00 & 2432-13-00

QEW - CAWTHRA RD TO EAST MALL WIDENING
STORM SEWER

SHEET



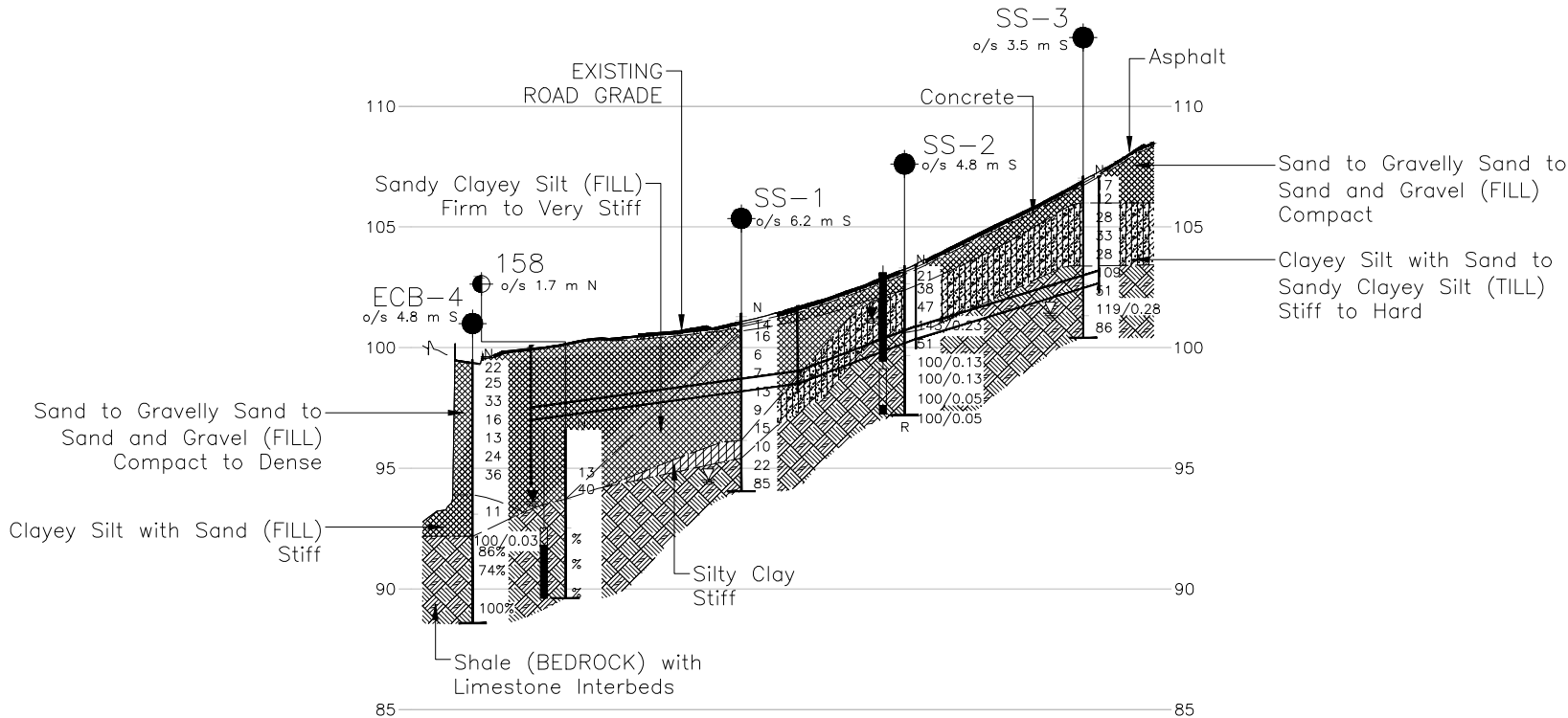
KEY PLAN
SCALE
2 0 2 4 km

LEGEND

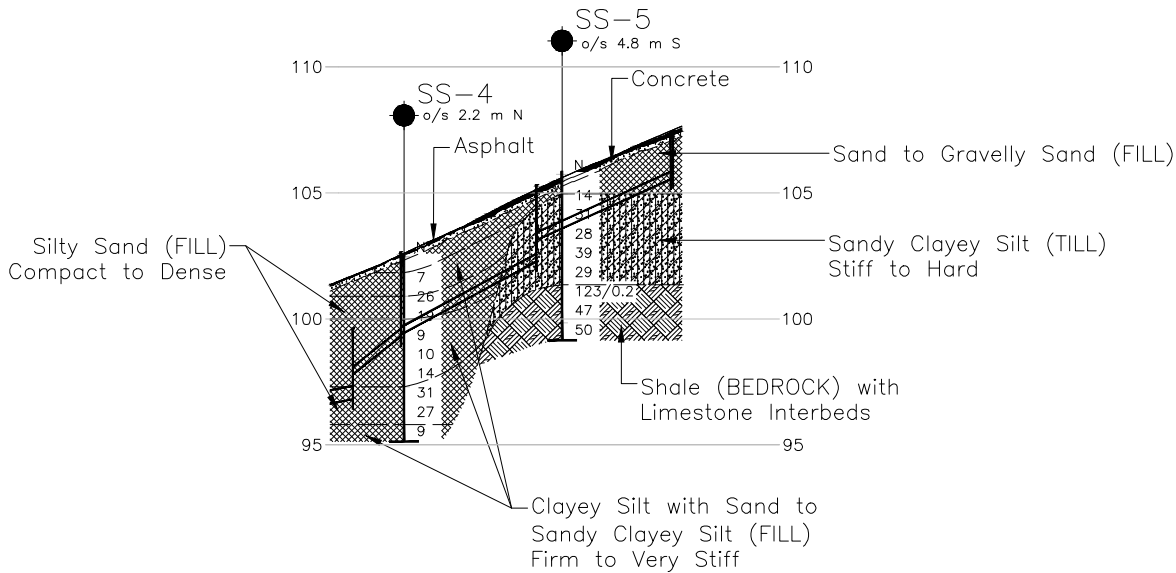
- Borehole - Current Investigation
- Borehole - 1966 Investigation (Geocres No. 30M11-20)
- Approximate Storm Sewer Alignment
- Seal
- Piezometer
- 16 Blows/0.3m unless otherwise stated (Std. Pen. Test, 475 j/blow)
- 100% Rock Quality Designation (RQD)
- R Split-Spoon Refusal
- WL in piezometer, measured on JUL 14, 2018
- WL upon completion of drilling

BOREHOLE CO-ORDINATES (MTM NAD 83 ZONE 10)

No.	ELEVATION	NORTHING	EASTING
SS-5	105.9	4829535.3	300112.4
SS-4	102.6	4829490.5	300067.8
SS-3	107.1	4829709.3	300104.5
SS-2	103.4	4829636.4	300084.5
SS-1	101.4	4829578.4	300049.1
ECB-4	99.5	4829490.2	299980.3
158	96.6	4829497.1	299977.6



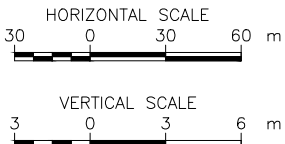
THE WEST MALL N-W RAMP PROFILE
1



THE WEST MALL W-N RAMP PROFILE
1

REFERENCE

Storm Sewer plan provided in digital format by AECOM, drawing file no. qew_dixieic_plan.dwg.
Retaining walls plans provided in digital format by AECOM, drawing file nos. 04_Retaining Wall_ New_24-887W.dwg and 07_Retaining Wall_NewPortion_24-888W.dwg, received January 18, 2018.
Base plans provided in digital format by AECOM, drawing file nos. QEW_DixielC_base.dwg and QEW_DixielC_plan.dwg, dated July 20, 2016, received Dec. 06, 2016.
Design plans provided in digital format by AECOM, drawing file nos. QEW_Dixie_Cont1_plan.dwg and QEW_Dixie_Cont2_plan.dwg, received July 21, 2017.
Existing ground contours provided in digital format by AECOM, drawing file no. QEW_DixielC_Contours3D.dwg, received Nov. 08, 2016, contour interval 0.5 m.
Storm sewer profile provided in digital format by AECOM, drawing file no. QEW_DixielC_Cont1_profile.dwg, received June 12, 2019.
Key plan base data - MNRF LIO, obtained 2015.



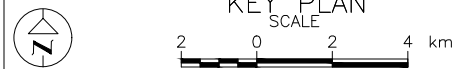
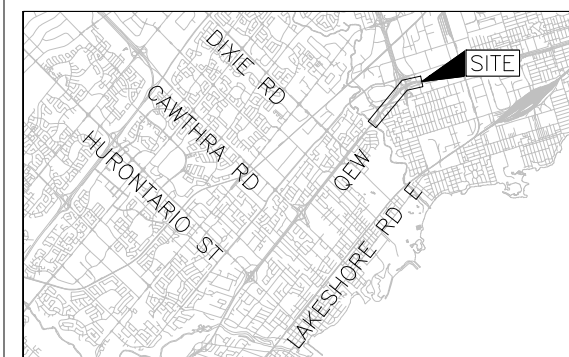
NOTES

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NO.	DATE	BY	REVISION
Geocres No. 30M11-294			
HWY. QEW	PROJECT NO. 1530382		DIST. CENTRAL
SUBM'D. AP	CHKD. AP	DATE: 07/16/2019	SITE: .
DRAWN: DD	CHKD. SMM	APPD. JMAC	DWG. 3

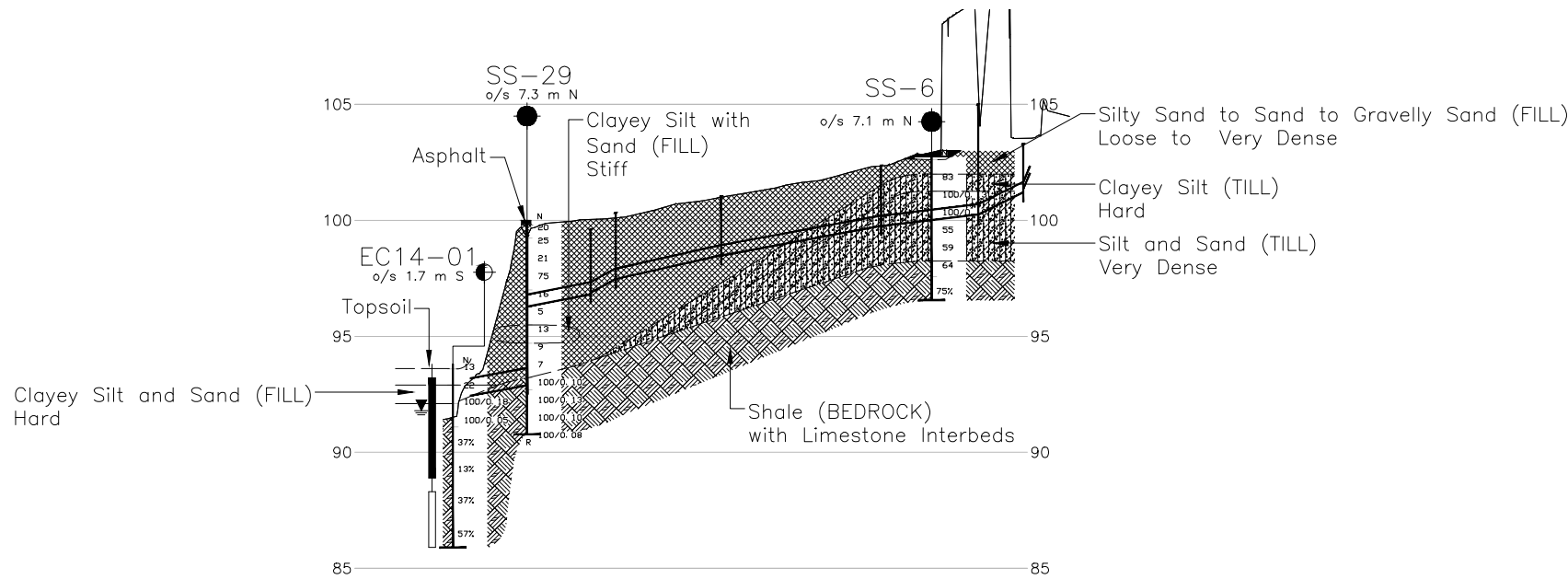


LEGEND

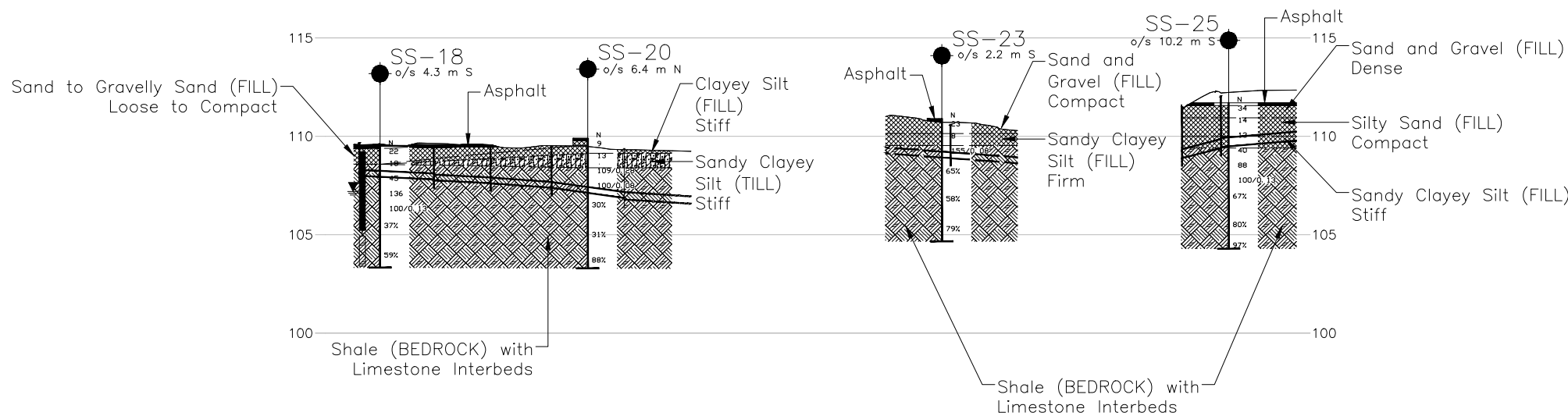
- Borehole - Current Investigation
- Borehole - 2014 Investigation (Geocres No. 30M11-252)
- Approximate Storm Sewer Alignment
- Seal
- Piezometer
- 16 Blows/0.3m unless otherwise stated (Std. Pen. Test, 475 j/blow)
- 100% Rock Quality Designation (RQD)
- R Split-Spoon Refusal
- WL in piezometer, measured on JUL 14, 2018

BOREHOLE CO-ORDINATES (MTM NAD 83 ZONE 10)

No.	ELEVATION	NORTHING	EASTING
SS-29	100.0	4829469.4	300018.1
SS-25	111.7	4830423.2	300903.9
SS-23	110.9	4830351.4	300774.8
SS-20	109.9	4830234.7	300637.5
SS-18	109.5	4830154.7	300567.7
SS-6	102.8	4829605.9	300126.8
EC14-01	93.8	4829449.4	300013.7



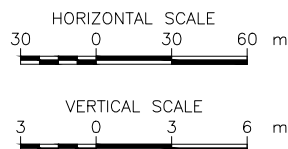
D-D QEW TORONTO BOUND SHOULDER PROFILE



E-E QEW TORONTO BOUND SHOULDER PROFILE

REFERENCE

Storm Sewer plan provided in digital format by AECOM, drawing file no. qew_dixielc_plan.dwg.
Retaining walls plans provided in digital format by AECOM, drawing file nos. 04_Retaining Wall_New_24-887W.dwg and 07_Retaining Wall_NewPortion_24-888W.dwg, received January 18, 2018.
Base plans provided in digital format by AECOM, drawing file nos. QEW_DixielC_base.dwg and QEW_DixielC_plan.dwg, dated July 20, 2016, received Dec. 06, 2016.
Design plans provided in digital format by AECOM, drawing file nos. QEW_Dixie_Cont1_plan.dwg and QEW_Dixie_Cont2_plan.dwg, received July 21, 2017.
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Key plan base data - MNR LIO, obtained 2015.



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NO.	DATE	BY	REVISION
1	07/16/2019	JMAC	Initial Design
2	07/16/2019	JMAC	Revised Design
3	07/16/2019	JMAC	Final Design
4	07/16/2019	JMAC	As Shown

Geocres No. 30M11-294

HWY. QEW	PROJECT NO. 1530382	DIST. CENTRAL
SUBM'D. AP	CHKD. AP	DATE: 07/16/2019
DRAWN: DD	CHKD. SMM	APPD. JMAC
		DWG. 4

APPENDIX A

Record of Borehole Sheets

GEOTECHNICAL DATA SHEET FOR BOREHOLE 158.

OUR REFERENCE NO. 6-7-15

W.P. 174-65-1

CLIENT: D. H. O.

PROJECT: Q. E. W. & HWY. No. 27 INTERCHANGE, BRIDGE No 21

LOCATION: 85' RT. of STA. 256 + 71

DATUM ELEVATION: G. S. C.

METHOD OF BORING: WASHBORING

DIAMETER OF BOREHOLE 3"

DATE: AUG. 10. 1966.

ENCLOSURE NO

ELEVATION ft	DEPTH ft	STRATIFICATION DESCRIPTION	STRATIFICATION SYMBOL	SAMPLES			PENETRATION RESISTANCE blows per foot		CONSISTENCY water content %		REMARKS
				NUMBER	TYPE	N Advancement of Sampler	20	40	60	80	
317.0	0	GROUND SURFACE									
315.0		Generally Compact to Dense Brown SANDY SILT with some gravel and a trace of clay.									
310.0	5	(FILL)		1	SS	13					
307.5	9.5			2	SS	40					
305.0	10	Grey Extremely Weathered SHALE									
303.7	13.3										
300.0	15	Grey SHALE with layers of LIMESTONE BEDROCK		3	RC 56 %						
				4	RC 87 %						
295.0	20			5	RC 79 %						
	23	END OF BOREHOLE									

W.L. 307.0 ft.
AUG. 25, 1966

SYMBOLS, ABBREVIATIONS AND TERMS USED ON RECORDS OF BOREHOLES

1. TEXTURAL CLASSIFICATION OF SOILS

CLASSIFICATION	PARTICLE SIZE	VISUAL IDENTIFICATION
Boulders	Greater than 200mm	same
Cobbles	75 to 200mm	same
Gravel	4.75 to 75mm	5 to 75mm
Sand	0.075 to 4.75mm	Not visible particles to 5mm
Silt	0.002 to 0.075mm	Non-plastic particles, not visible to the naked eye
Clay	Less than 0.002mm	Plastic particles, not visible to the naked eye

2. COARSE GRAIN SOIL DESCRIPTION (50% greater than 0.075mm)

TERMINOLOGY	PROPORTION
Trace or Occasional	Less than 10%
Some	10 to 20%
Adjective (e.g. silty or sandy)	20 to 35%
And (e.g. sand and gravel)	35 to 50%

3. TERMS DESCRIBING CONSISTENCY (COHESIVE SOILS ONLY)

DESCRIPTIVE TERM	UNDRAINED SHEAR STRENGTH (kPa)	APPROXIMATE SPT ⁽¹⁾ 'N' VALUE
Very Soft	12 or less	Less than 2
Soft	12 to 25	2 to 4
Firm	25 to 50	4 to 8
Stiff	50 to 100	8 to 15
Very Stiff	100 to 200	15 to 30
Hard	Greater than 200	Greater than 30

NOTE: Hierarchy of Soil Strength Prediction

- 1) Laboratory Triaxial Testing
- 2) Field Insitu Vane Testing
- 3) Laboratory Vane Testing
- 4) SPT value
- 5) Pocket Penetrometer

4. TERMS DESCRIBING DENSITY (COHESIONLESS SOILS ONLY)

DESCRIPTIVE TERM	SPT "N" VALUE
Very Loose	Less than 4
Loose	4 to 10
Compact	10 to 30
Dense	30 to 50
Very Dense	Greater than 50

5. LEGEND FOR RECORDS OF BOREHOLES

SYMBOLS AND ABBREVIATIONS FOR SAMPLE TYPE	SS Split Spoon Sample	WS Wash Sample	AS Auger (Grab) Sample
	TW Thin Wall Shelby Tube Sample	TP Thin Wall Piston Sample	
	PH Sampler Advanced by Hydraulic Pressure	PM Sampler Advanced by Manual Pressure	
	WH Sampler Advanced by Self Static Weight	RC Rock Core	SC Soil Core

$$\text{Sensitivity} = \frac{\text{Undisturbed Shear Strength}}{\text{Remoulded Shear Strength}}$$

 Water Level
 Shear Strength Determination by Pocket Penetrometer

- (1) SPT 'N' Value Standard Penetration Test 'N' Value – refers to the number of blows from a 63.5kg hammer free falling a height of 0.76m to advance a standard 50 mm outside diameter split spoon sampler for 0.3 m depth into undisturbed ground.
- (2) DCPT Dynamic Cone Penetration Test – Continuous penetration of a 50 mm outside diameter, 60° conical steel point attached to "A" size rods driven by a 63.5 kg hammer free falling a height of 0.76 m. The resistance to cone penetration is the number of hammer blows required for each 0.3 m advance of the conical point into undisturbed ground.

EXPLANATION OF ROCK LOGGING TERMS


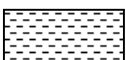

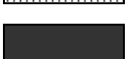

ROCK WEATHERING CLASSIFICATION

Fresh (FR)	No visible signs of weathering.
Fresh Jointed (FJ)	Weathering limited to the surface of major discontinuities.
Slightly Weathered (SW)	Penetrative weathering developed on open discontinuity surfaces, but only slight weathering of rock material.
Moderately Weathered (MW)	Weathering extends throughout the rock mass, but the rock material is not friable.
Highly Weathered (HW)	Weathering extends throughout the rock mass and the rock is partly friable.
Completely Weathered (CW)	Rock is wholly decomposed and in a friable condition, but the rock texture and structure are preserved.

DISCONTINUITY SPACING

Bedding	Bedding Plane Spacing
Very thickly bedded	Greater than 2m
Thickly bedded	0.6 to 2m
Medium bedded	0.2 to 0.6m
Thinly bedded	60mm to 0.2m
Very thinly bedded	20 to 60mm
Laminated	6 to 20mm
Thinly Laminated	Less than 6mm

SYMBOLS

	CLAYSTONE
	SILTSTONE
	SANDSTONE
	COAL
	BEDROCK

STRENGTH CLASSIFICATION

Rock Strength	Approximate Uniaxial Compressive Strength		Field Estimation of Hardness*
	(MPa)	(psi)	
Extremely Strong	Greater than 250	Greater than 36,000	Specimen can only be chipped with a geological hammer
Very Strong	100-250	15,000 to 36,000	Requires many blows of geological hammer to break
Strong	50-100	7,500 to 15,000	Requires more than one blow of geological hammer to break
Medium Strong	25.0 to 50.0	3,500 to 7,500	Breaks under single blow of geological hammer.
Weak	5.0 to 25.0	750 to 3,500	Can be peeled by a pocket knife with difficulty
Very Weak	1.0 to 5.0	150 to 750	Can be peeled by a pocket knife, crumbles under firm blows of geological pick.
Extremely Weak (Rock)	0.25 to 1.0	35 to 150	Indented by thumbnail

TERMS

Total Core Recovery: (TCR)	Core recovered as a percentage of total core run length
Solid Core Recovery:(SCR)	Percent Ratio of solid core of full cylindrical shape recovered. Expressed with respect to the total length of core run
Rock Quality Designation:(RQD)	Total length of sound core recovered in pieces 0.1m in length or larger as a % of total core run length.
Uniaxial Compressive Strength (UCS)	Axial stress required to break the specimen
Fracture Index:(FI)	Frequency of natural fractures per 0.3m of core run.

UNIFIED SOILS CLASSIFICATION

MAJOR DIVISIONS		GROUP SYMBOL	TYPICAL DESCRIPTION
COARSE GRAINED SOILS	GRAVEL AND GRAVELLY SOILS	GW	Well-graded gravels or gravel-sand mixtures, little or no fines.
		GP	Poorly-graded gravels or gravel-sand mixtures, little or no fines.
		GM	Silty gravels, gravel-sand-silt mixtures.
		GC	Clayey gravels, gravel-sand-clay mixtures.
	SAND AND SANDY SOILS	SW	Well-graded sands or gravelly sands, little or no fines.
		SP	Poorly-graded sands or gravelly sands, little or no fines.
		SM	Silty sands, sand-silt mixtures.
		SC	Clayey sands, sand-clay mixtures.
FINE GRAINED SOILS	SILTS AND CLAYS W _L < 50%	ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity.
		CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays. (W _L < 30%).
		CI	Inorganic clays of medium plasticity, silty clays. (30% < W _L < 50%).
		OL	Organic silts and organic silty-clays of low plasticity.
	SILTS AND CLAYS W _L > 50%	MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts.
		CH	Inorganic clays of high plasticity, fat clays.
		OH	Organic clays of medium to high plasticity, organic silts.
HIGHLY ORGANIC SOILS		Pt	Peat and other highly organic soils.
CLAY SHALE			
SANDSTONE			
SILTSTONE			
CLAYSTONE			
COAL			

RECORD OF BOREHOLE No EC 14-01

1 OF 1

METRIC

W.P. 09-20003 LOCATION Etobicoke Creek Bridge N 4 829 007.0 E 616 272.0 ORIGINATED BY SLL
 HWY QEW BOREHOLE TYPE Hollow Stem Augers/NQ Coring COMPILED BY AN
 DATUM Geodetic DATE 2014.08.07 - 2014.08.07 CHECKED BY AMP

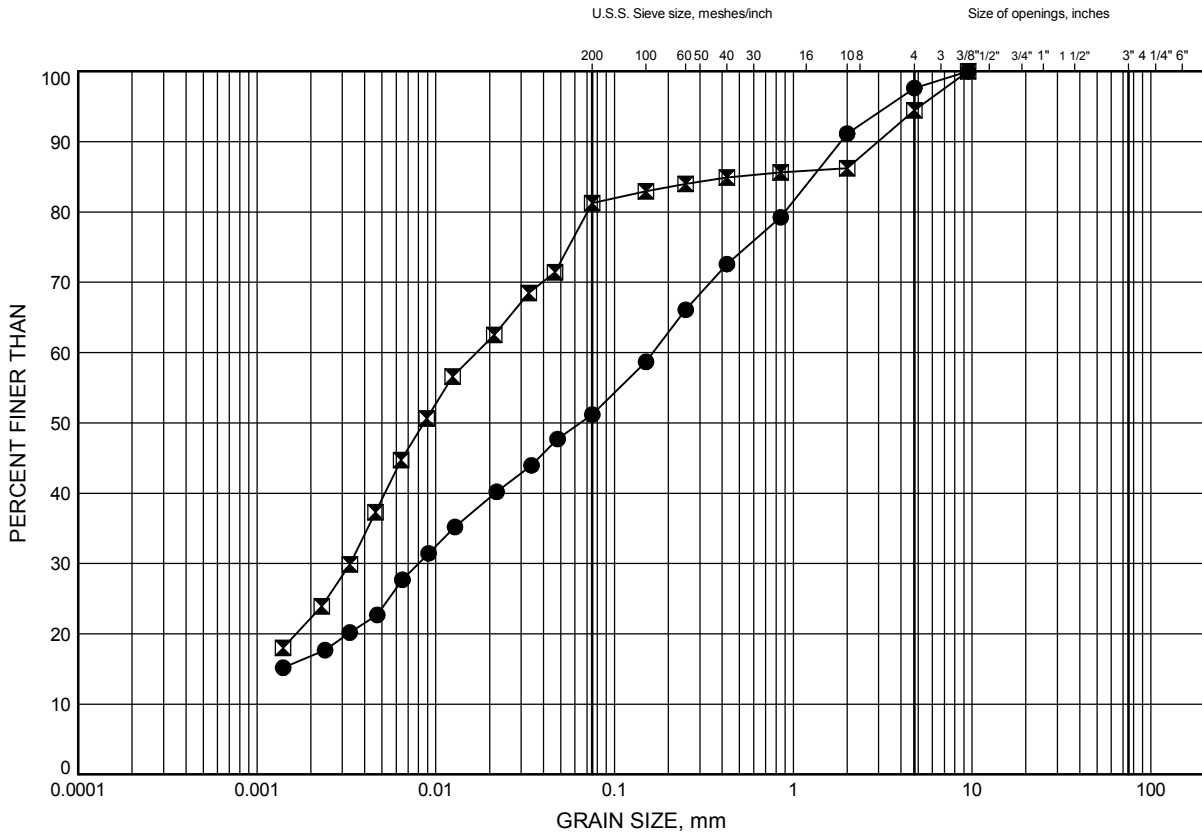
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa										
93.8	GROUND SURFACE							20	40	60	80	100						
0.0	TOPSOIL, frequent roots and rootlets: (175mm)		1	SS	13													
0.2	SAND, some silt, trace clay, trace topsoil Compact Dark Brown Moist (FILL)																	
92.9			2	SS	22													
0.9	Clayey SILT and SAND, trace gravel, occasional limestone fragments Hard Brown Moist (FILL)																	
92.1			3	SS	100/													
1.7					0.175													
	SHALE BEDROCK, highly weathered, occasional limestone interbeds Hard Grey Moist (Georgian Bay Formation)		4	SS	100/													
91.1					0.050													
2.7			1	RUN														
	SHALE BEDROCK, moderately to slightly weathered, thinly bedded, weak to strong, occasional strong limestone interbeds, grey (Georgian Bay Formation)		2	RUN														
	Highly weathered zones 50mm to 75mm thick to 3.4m depth.		3	RUN														
			4	RUN														
85.9																		
7.9	END OF BOREHOLE AT 7.9m. Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen. WATER LEVEL READINGS: DATE DEPTH (m) ELEV. (m) 2014.09.29 2.1 91.7 2015.01.15 2.0 91.8																	

ONTMT4S 1219.GPJ 2012TEMPLATE(MTO).GDT 1/22/15

QEW Cawthra Road
GRAIN SIZE DISTRIBUTION

FIGURE B1

CLAYEY SILT TO CLAYEY SILT WITH SAND FILL



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	EC 14-01	1.07	92.74
⊠	EC 14-04	6.40	93.64

Date January 2015
W.P. 09-20003



Prep'd MFA
Chkd. AMP



THURBER ENGINEERING LTD.

POINT LOAD TEST SHEET

Job No : 19-1351-219

Client : MMM

Project Name : QEW CAWTHRA ROAD
ETOBICOKE CREEK BRIDGE

Date Drilled : 7 Aug, 2014

Core Size : NQ BH No : EC14-01

Date Tested : 8 Aug, 2014

Tester : GAZ

Test No.	Run No.	Depth (m)	Axial or Diametral	Gauge (MPa)	Diameter (mm)	Length (mm)	UCS (MPa)	Rock Type	Notes
1	1	3.3	A	1.9	47.0	65.1	12.3	Shale	Weak
2	2	4.2	A	2.2	46.8	59.8	15.2	Shale	Weak
3	2	4.6	D	1.4	45.1	95.0	15.4	Shale	Weak
4	2	4.9	A	1.9	47.3	58.8	13.2	Shale	Weak
5	3	5.4	A	2.4	47.3	50.7	18.5	Shale	Weak
6	3	6.4	D	1.9	47.2	53.9	18.5	Shale	Weak
7	4	7.5	A	11.8	47.4	51.8	90.7	Shale/Limestone	Strong
8	4	7.9	D	6.4	47.1	100.1	64.0	Shale	Strong
9									
10									
11									
12									
13									
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* It is ideal to perform axial test on core specimens with D/L ratio of 1.1 ± 0.1

Long pieces of core can be tested diametrically to produce suitable lengths for axial testing

* Diametral Test should have $0.7 \times D$ on either side of test point.

Last Modified: August 15, 2013



Photograph 1 – Rock cores from Borehole EC14-01



Photograph 2 – Rock cores from Borehole EC14-02

APPENDIX B

**Geotechnical Laboratory Test
Results and Bedrock Core
Photographs**

LIST OF SYMBOLS

Unless otherwise stated, the symbols employed in the report are as follows:

I. GENERAL

π	3.1416
$\ln x$,	natural logarithm of x
\log_{10}	x or log x, logarithm of x to base 10
g	acceleration due to gravity
t	time
FoS	factor of safety

II. STRESS AND STRAIN

γ	shear strain
Δ	change in, e.g. in stress: $\Delta \sigma$
ε	linear strain
ε_v	volumetric strain
η	coefficient of viscosity
ν	Poisson's ratio
σ	total stress
σ'	effective stress ($\sigma' = \sigma - u$)
σ'_{vo}	initial effective overburden stress
$\sigma_1, \sigma_2, \sigma_3$	principal stress (major, intermediate, minor)
σ_{oct}	mean stress or octahedral stress $= (\sigma_1 + \sigma_2 + \sigma_3)/3$
τ	shear stress
u	porewater pressure
E	modulus of deformation
G	shear modulus of deformation
K	bulk modulus of compressibility

III. SOIL PROPERTIES

(a) Index Properties

$\rho(\gamma)$	bulk density (bulk unit weight)*
$\rho_d(\gamma_d)$	dry density (dry unit weight)
$\rho_w(\gamma_w)$	density (unit weight) of water
$\rho_s(\gamma_s)$	density (unit weight) of solid particles
γ'	unit weight of submerged soil ($\gamma' = \gamma - \gamma_w$)
D_R	relative density (specific gravity) of solid particles ($D_R = \rho_s / \rho_w$) (formerly G_s)
e	void ratio
n	porosity
S	degree of saturation

(a) Index Properties (continued)

w	water content
w_l or LL	liquid limit
w_p or PL	plastic limit
I_p or PI	plasticity index = $(w_l - w_p)$
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
I_D	density index = $(e_{max} - e) / (e_{max} - e_{min})$ (formerly relative density)

(b) Hydraulic Properties

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

(c) Consolidation (one-dimensional)

C_c	compression index (normally consolidated range)
C_r	recompression index (over-consolidated range)
C_s	swelling index
C_{α}	secondary compression index
m_v	coefficient of volume change
C_v	coefficient of consolidation (vertical direction)
C_h	coefficient of consolidation (horizontal direction)
T_v	time factor (vertical direction)
U	degree of consolidation
σ'_p	pre-consolidation stress
OCR	over-consolidation ratio = σ'_p / σ'_{vo}

(d) Shear Strength

τ_p, τ_r	peak and residual shear strength
ϕ'	effective angle of internal friction
δ	angle of interface friction
μ	coefficient of friction = $\tan \delta$
c'	effective cohesion
c_u, s_u	undrained shear strength ($\phi = 0$ analysis)
p	mean total stress $(\sigma_1 + \sigma_3)/2$
p'	mean effective stress $(\sigma'_1 + \sigma'_3)/2$
q	$(\sigma_1 - \sigma_3)/2$ or $(\sigma'_1 - \sigma'_3)/2$
q_u	compressive strength $(\sigma_1 - \sigma_3)$
S_t	sensitivity

* Density symbol is ρ . Unit weight symbol is γ where $\gamma = \rho g$ (i.e. mass density multiplied by acceleration due to gravity)

Notes: 1
2

$\tau = c' + \sigma' \tan \phi'$
shear strength = (compressive strength)/2

LIST OF ABBREVIATIONS

The abbreviations commonly employed on Records of Boreholes, on figures and in the text of the report are as follows:

I. SAMPLE TYPE

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

II. 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.).

PH: Sampler advanced by hydraulic pressure

PM: Sampler advanced by manual pressure

WH: Sampler advanced by static weight of hammer

WR: Sampler advanced by weight of sampler and rod

Piezo-Cone Penetration Test (CPT)

A electronic cone penetrometer with a 60° conical tip and a project end area of 10 cm² pushed through ground at a penetration rate of 2 cm/s. Measurements of tip resistance (Q_t), porewater pressure (PWP) and friction along a sleeve are recorded electronically at 25 mm penetration intervals.

III. SOIL DESCRIPTION

(a) Non-Cohesive (Cohesionless) Soils

Compactness	N
Condition	Blows/300 mm or Blows/ft
Very loose	0 to 4
Loose	4 to 10
Compact	10 to 30
Dense	30 to 50
Very dense	over 50

(b) Cohesive Soils Consistency

	C_u, S_u	
	kPa	psf
Very soft	0 to 12	0 to 250
Soft	12 to 25	250 to 500
Firm	25 to 50	500 to 1,000
Stiff	50 to 100	1,000 to 2,000
Very stiff	100 to 200	2,000 to 4,000
Hard	over 200	over 4,000

IV. SOIL TESTS

w	water content
w_p	plastic limit
w_l	liquid limit
C	consolidation (oedometer) test
CHEM	chemical analysis (refer to text)
CID	consolidated isotropically drained triaxial test ¹
CIU	consolidated isotropically undrained triaxial test with porewater pressure measurement ¹
D_R	relative density (specific gravity, G_s)
DS	direct shear test
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
SO_4	concentration of water-soluble sulphates
UC	unconfined compression test
UU	unconsolidated undrained triaxial test
V	field vane (LV-laboratory vane test)
γ	unit weight

Note: 1 Tests which are anisotropically consolidated prior to shear are shown as CAD, CAU.

V. MINOR SOIL CONSTITUENTS

Per cent by Weight	Modifier	Example
0 to 5	Trace	Trace sand
5 to 12	Trace to Some (or Little)	Trace to some sand
12 to 20	Some	Some sand
20 to 30	(ey) or (y)	Sandy
over 30	And (non-cohesive (cohesionless)) or With (cohesive)	Sand and Gravel Silty Clay with sand / Clayey Silt with sand

WEATHERINGS STATE

Fresh: no visible sign of weathering

Faintly weathered: weathering limited to the surface of major discontinuities.

Slightly weathered: penetrative weathering developed on open discontinuity surfaces but only slight weathering of rock material.

Moderately weathered: weathering extends throughout the rock mass but the rock material is not friable.

Highly weathered: weathering extends throughout rock mass and the rock material is partly friable.

Completely weathered: rock is wholly decomposed and in a friable condition but the rock and structure are preserved.

BEDDING THICKNESS

<u>Description</u>	<u>Bedding Plane Spacing</u>
Very thickly bedded	Greater than 2 m
Thickly bedded	0.6 m to 2 m
Medium bedded	0.2 m to 0.6 m
Thinly bedded	60 mm to 0.2 m
Very thinly bedded	20 mm to 60 mm
Laminated	6 mm to 20 mm
Thinly laminated	Less than 6 mm

JOINT OR FOLIATION SPACING

<u>Description</u>	<u>Spacing</u>
Very wide	Greater than 3 m
Wide	1 m to 3 m
Moderately close	0.3 m to 1 m
Close	50 mm to 300 mm
Very close	Less than 50 mm

GRAIN SIZE

<u>Term</u>	<u>Size*</u>
Very Coarse Grained	Greater than 60 mm
Coarse Grained	2 mm to 60 mm
Medium Grained	60 microns to 2 mm
Fine Grained	2 microns to 60 microns
Very Fine Grained	Less than 2 microns

Note: * Grains greater than 60 microns diameter are visible to the naked eye.

CORE CONDITION

Total Core Recovery (TCR)

The percentage of solid drill core recovered regardless of quality or length, measured relative to the length of the total core run.

Solid Core Recovery (SCR)

The percentage of solid drill core, regardless of length, recovered at full diameter, measured relative to the length of the total core run.

Rock Quality Designation (RQD)

The percentage of solid drill core, greater than 100 mm length, recovered at full diameter, measured relative to the length of the total core run. RQD varied from 0% for completely broken core to 100% for core in solid sticks.

DISCONTINUITY DATA

Fracture Index

A count of the number of discontinuities (physical separations) in the rock core, including both naturally occurring fractures and mechanically induced breaks caused by drilling.

Dip with Respect to Core Axis

The angle of the discontinuity relative to the axis (length) of the core. In a vertical borehole a discontinuity with a 90° angle is horizontal.

Description and Notes

An abbreviation description of the discontinuities, whether naturally occurring separations such as fractures, bedding planes and foliation planes or mechanically induced features caused by drilling such as ground or shattered core and mechanically separated bedding or foliation surfaces. Additional information concerning the nature of fracture surfaces and infillings are also noted.

Abbreviations

JN Joint	PL Planar
FLT Fault	CU Curved
SH Shear	UN Undulating
VN Vein	IR Irregular
FR Fracture	K Slickensided
SY Stylolite	PO Polished
BD Bedding	SM Smooth
FO Foliation	SR Slightly Rough
CO Contact	RO Rough
AXJ Axial Joint	VR Very Rough
KV Karstic Void	
MB Mechanical Break	

FIELD ESTIMATION OF ROCK HARDNESS

Grade	Description	Field Identification	Approx. Range of UCS (MPa)
R0	Extremely Weak Rock	Indented by thumbnail	0.25 - 1
R1	Very Weak Rock	Material can be peeled or shaped with a knife. Crumbles under firm blows from geological hammer.	1 - 5
R2	Weak Rock	Knife cuts material but too hard to shape into triaxial specimens or material can be peeled with a knife with difficulty. Shallow (<5mm) indentations made by firm blows from pick of a geological hammer.	5 - 25
R3	Moderately Strong Rock	Cannot be peeled or scraped with a knife. Hand held specimens can be fractured with single firm blow of geological hammer.	25 - 50
R4	Strong Rock	Hand held specimen requires more than one blow of geological hammer to fracture.	50 - 100
R5	Very Strong Rock	Hand held specimen requires many blows of geological hammer to fracture.	100 - 250
R6	Extremely Strong Rock	Specimen can only be chipped under repeated hammer blows, rings when hit.	> 250

Notes:

1. Hand held specimens should have height approximately 2 times the diameter.
2. Materials having a uniaxial compressive strength of less than approximately 0.5 MPa and cohesionless materials should be classified using soil classification systems.
3. Rocks with a uniaxial compressive strength below 25 MPa (i.e. below R2) are likely to yield highly ambiguous results under point load testing.

Reference:

Brown, 1981. "Suggested Methods for Rock Characterization Testing and Monitoring", International Society for Rock Mechanics.

Hoek, E., Kaiser, P.K., Bawden, W.F., 1995. "Support of Underground Excavations in Hard Rock", Balkema, Rotterdam.

ROCK WEATHERING CLASSIFICATION

Term	Symbol	Description	Discoloration Extent	Fracture Condition	Surface Characteristics
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.	Throughout	N/A	Resembles soil
Completely weathered	W5	100% of rock material is decomposed and/or disintegrated to soil. The original mass structure is still largely intact.	Throughout	Filled with alteration minerals	Resembles soil
Highly weathered	W4	More than 50% of the rock material is decomposed and/or disintegrated to a soil. Fresh or discoloured rock is present either as a discontinuous framework or as corestones.	Throughout	Filled with alteration minerals	Friable and possibly pitted
Moderately weathered	W3	Less than 50% of the rock material is decomposed and/or disintegrated to a soil. Fresh or discoloured rock is present either as a discontinuous framework or as corestones. Visible texture of the host rock still preserved. Surface planes are weathered (oxidized or carbonate filling) even when breaking the "intact rock".	>20% of fracture spacing on both sides of fracture	Discoloured, may contain thick filling	Partial to complete discoloration, not friable except poorly cemented rocks
Slightly weathered	W2	Discoloration indicates weathering of rock material on discontinuity surfaces (usually oxidized). Less than 5% of rock mass altered.	<20% of fracture spacing on both sides of fracture	Discoloured, may contain thin filling	Partial discoloration
Fresh	W1	No visible sign of rock material weathering.	None	Closed or discoloured	Unchanged

Reference:

Brown, 1981. "Suggested Methods for Rock Characterization Testing and Monitoring", International Society for Rock Mechanics.

PROJECT		1530382		RECORD OF BOREHOLE No ECB-3		SHEET 1 OF 1		METRIC								
G.W.P.		2432-13-00		LOCATION		N 4829487.0; E 300008.0 MTM NAD 83 ZONE 10 (LAT. 43.605304; LONG. -79.559361)		ORIGINATED BY								
DIST		Central HWY QEW		BOREHOLE TYPE		CME 75, 150 mm O.D. Solid Stem Augers		COMPILED BY								
DATUM		Geodetic		DATE		July 4, 2016		CHECKED BY								
SMM																
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa								
99.8	GROUND SURFACE															
0.0	ASPHALT (102 mm)															
0.1	Sand, some gravel (FILL) Compact Brown Moist		1	SS	26											
99.1																
0.7	Clayey silt, some sand to sandy, some gravel (FILL) Stiff to very stiff Grey Moist		2	SS	15											
			3	SS	10											
97.3																
2.5	Silty sand (FILL) Very loose to compact Brown Moist to wet		4A	SS	20											
			4B	SS												
			5	SS	20											
			6	SS	7											
			7	SS	3											
94.2																
5.6	CLAYEY SILT with SAND, trace gravel Stiff Grey Wet		8	SS	10											
92.6																
7.2	Inferred moderately weathered, grey, extremely weak to weak SHALE (Georgian Bay Formation)															
92.1			9	SS	50/0.03											
7.7	END OF BOREHOLE															
	NOTE: 1. Water level in open borehole at a depth of 6.2 m below ground surface (Elev. 93.6 m) upon completion of overburden drilling.															


PROJECT 1530382		RECORD OF BOREHOLE No ECB-4		SHEET 1 OF 2		METRIC	
G.W.P. 2432-13-00		LOCATION N 4829490.2; E 299980.3 MTM NAD 83 ZONE 10 (LAT. 43.605332; LONG. -79.559702)		ORIGINATED BY NN			
DIST Central HWY QEW		BOREHOLE TYPE CME 75, 150 mm O.D. Solid Stem Augers, HQ Coring		COMPILED BY ACK			
DATUM Geodetic		DATE July 7, 2016		CHECKED BY SMM			

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					WATER CONTENT (%)				GR	SA	SI	CL
								○ UNCONFINED ● QUICK TRIAXIAL	+ FIELD VANE × REMOULDED					W _p	W		W _L			
99.5	GROUND SURFACE																			
0.0	ASPHALT (127 mm)																			
0.1	Sand, some gravel to gravelly sand, some silt (FILL) Compact to dense Brown Moist		1	SS	22							○								
			2	SS	25							○					21	63	14	2
			3	SS	33							○								
			4	SS	16															
			5	SS	13							○								
			6	SS	24							○					18	71	9	2
			7	SS	36							○								

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+³, ×³: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

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PROJECT 1530382		RECORD OF BOREHOLE No ECB-4				SHEET 2 OF 2		METRIC									
G.W.P. 2432-13-00		LOCATION N 4829490.2; E 299980.3 MTM NAD 83 ZONE 10 (LAT. 43.605332; LONG. -79.559702)				ORIGINATED BY NN											
DIST Central HWY QEW		BOREHOLE TYPE CME 75, 150 mm O.D. Solid Stem Augers, HQ Coring				COMPILED BY ACK											
DATUM Geodetic		DATE July 7, 2016				CHECKED BY SMM											
SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV. DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa									WATER CONTENT (%)
	--- CONTINUED FROM PREVIOUS PAGE ---						20	40	60	80	100						
88.6	SHALE (BEDROCK) Bedrock cored from depths of 7.3 m to 10.9 m. For bedrock coring details refer to Record of Drillhole ECB-4.		3	HQRC	REC 100%	89										Density = 2.57 g/cm ³	RQD = 100%
10.9	END OF BOREHOLE NOTES: 1. Open borehole dry upon completion of drilling, July 7, 2016. 2. Water level in NW casing not recorded upon completion of bedrock coring.																

SHEET 1 OF 1

DATUM: Geodetic

DRILLING CONTRACTOR: Davis Drilling Ltd.

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BROKEN CORE



CLAY SEAM



LIMESTONE



LOST CORE

DEPTH SCALE

1 : 50



GOLDER

LOGGED: NN

CHECKED: MJT

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+³, ×³: Numbers refer to Sensitivity ○^{3%} STRAIN AT FAILURE


PROJECT 1530382		RECORD OF BOREHOLE No ECB-6		SHEET 1 OF 2		METRIC	
G.W.P. 2432-13-00		LOCATION N 4829462.5; E 300015.7 MTM NAD 83 ZONE 10 (LAT. 43.605083; LONG. -79.559264)		ORIGINATED BY NN			
DIST Central HWY QEW		BOREHOLE TYPE CME 75, 150 mm O.D. Solid Stem Augers, NQ Coring		COMPILED BY ACK			
DATUM Geodetic		DATE July 6, 2016		CHECKED BY SMM			

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL LIMIT MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%)						
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					WATER CONTENT (%)				GR	SA	SI	CL			
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × REMOULDED	20	40	60	80	100	w _p	w		w _L						
99.7	GROUND SURFACE																						
99.9	ASPHALT (178 mm)																						
99.5																							
0.2	Silty sand, some gravel to gravelly sand, some silt (FILL) Compact Brown to grey Moist		1	SS	-							○											
			2	SS	24							○						22	61	14	3		
			3	SS	25							○											
			4	SS	26							○								23	62	12	3
			5	SS	27							○											
96.0																							
3.7	Sand, some silt, some gravel (FILL) Compact Grey Moist		6	SS	13							○								16	60	17	7
95.2																							
4.5	Clayey silt with sand, trace to some gravel (FILL) Very soft to soft Grey Moist to wet		7	SS	3							○											
			8	SS	4																		
92.2			9	SS	100/100																		
7.5	CONCRETE		1	NQRC	REC 100%																		
91.8																							
7.9	SHALE (BEDROCK)																						
	Concrete/Bedrock cored from depths of 7.5 m to 12.2 m. For bedrock coring details refer to Record of Drillhole ECB-6.		2	NQRC	REC 81%																		RQD = 81%
			3	NQRC	REC 49%																		RQD = 49%
																			</				

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+³, ×³: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

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PROJECT 1530382		RECORD OF BOREHOLE No ECB-6				SHEET 2 OF 2		METRIC									
G.W.P. 2432-13-00		LOCATION N 4829462.5; E 300015.7 MTM NAD 83 ZONE 10 (LAT. 43.605083; LONG. -79.559264)				ORIGINATED BY NN											
DIST Central HWY QEW		BOREHOLE TYPE CME 75, 150 mm O.D. Solid Stem Augers, NQ Coring				COMPILED BY ACK											
DATUM Geodetic		DATE July 6, 2016				CHECKED BY SMM											
SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa									WATER CONTENT (%)
	--- CONTINUED FROM PREVIOUS PAGE ---						20	40	60	80	100						
	SHALE (BEDROCK)		3	NQRC	REC 49%												RQD = 49%
	Concrete/Bedrock cored from depths of 7.5 m to 12.2 m. For bedrock coring details refer to Record of Drillhole ECB-6.		4	NQRC	REC 72%												RQD = 51%
87.5																	
12.2	END OF BOREHOLE																
	NOTES: 1. Water level in open borehole at a depth of 6.2 m below ground surface (Elev. 93.5 m) upon completion of overburden drilling. 2. Water level in NW casing not recorded upon completion of bedrock coring.																

SHEET 1 OF 1

DATUM: Geodetic

DRILLING CONTRACTOR: Davis Drilling Ltd.

[illegible]

FEATURES LEGEND



BROKEN CORE



CLAY SEAM



LIMESTONE



LOST CORE

DEPTH SCALE

1 : 50



GOLDER

LOGGED: NN

CHECKED: MJT

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PROJECT		1530382		RECORD OF BOREHOLE No SS-1				SHEET 1 OF 1		METRIC						
G.W.P.		2102-13-00 and 2432-13-00		LOCATION		N 4829578.4; E 300049.1 MTM NAD 83 ZONE 10 (LAT. 43.606135; LONG. -79.558856)		ORIGINATED BY		SK						
DIST		Central HWY QEW		BOREHOLE TYPE		Power Auger, 150 mm O.D. Solid Stem Augers		COMPILED BY		AMP						
DATUM		Geodetic		DATE		April 23, 2018		CHECKED BY		SMM						
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa								
101.4	GROUND SURFACE															
0.0	ASPHALT (125 mm)															
	CONCRETE (150 mm)															
100.9	Sand and gravel, some silt (FILL) Compact Brown Moist		1A	SS	14											
0.5	Sandy clayey silt, trace to some gravel (FILL) Firm to very stiff Grey Moist - Hydrocarbon odours in sample 2		1B	SS	14											
			2	SS	16											
			3	SS	6											
			4	SS	7											
			5	SS	13											
			6	SS	9											
	- Rootlets, organic inclusions in sample 6															
			7	SS	15											
96.1	SILTY CLAY, trace sand, trace gravel Stiff Grey Moist															
5.3			8	SS	10											
95.4	Inferred completely to highly weathered, grey, extremely weak to weak SHALE (BEDROCK) (Georgian Bay Formation)															
6.0			9	SS	22											
			10	SS	85											
94.0	END OF BOREHOLE															
7.4	NOTES: 1. Borehole caved to a depth of 7.0 m below ground surface upon completion of drilling. 2. Water measured in caved borehole at a depth of 6.9 m below ground surface (Elev. 94.5 m) upon completion of drilling.															

PROJECT		1530382		RECORD OF BOREHOLE No SS-2		SHEET 1 OF 1		METRIC																
G.W.P.		2102-13-00 and 2432-13-00		LOCATION		N 4829636.4; E 300084.5 MTM NAD 83 ZONE 10 (LAT. 43.606657; LONG. -79.558417)		ORIGINATED BY SK																
DIST		Central HWY QEWS		BOREHOLE TYPE		Power Auger, 150 mm O.D. Solid Stem Augers		COMPILED BY AMP																
DATUM		Geodetic		DATE		April 24, 2018		CHECKED BY SMM																
SOIL PROFILE		SAMPLES		GROUND WATER CONDITIONS		ELEVATION SCALE		DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT		UNIT WEIGHT		REMARKS & GRAIN SIZE DISTRIBUTION (%)										
ELEV	DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES																		
103.4		GROUND SURFACE																						
0.0		ASPHALT (100 mm)																						
		CONCRETE (125 mm)																						
0.2		Sand, some gravel, some silt (FILL)		1	SS	21																		
102.6		Compact Brown Moist																						
0.8		CLAYEY SILT with SAND, some gravel (TILL)		2	SS	38																		
		Hard Grey Moist																						
				3	SS	47																		
101.1																								
2.3		Inferred highly to moderately weathered, grey, extremely weak to weak SHALE (BEDROCK) (Georgian Bay Formation) - Rock fragments in sample 4		4	SS	143/0.23																		
				5	SS	51																		
				6	SS	100/0.13																		
				7	SS	100/0.13																		
				8	SS	100/0.05																		
97.2		- No recovery from sample 9		9	SS	100/0.05																		
6.2		END OF BOREHOLE SPLIT-SPOON REFUSAL																						
NOTES: 1. Borehole caved to a depth of 5.9 m below ground surface upon completion of drilling. 2. Borehole dry upon completion of drilling. 3. Water measured in standpipe piezometer as follows: <table border="1" style="margin-left: 40px; margin-top: 10px;"> <thead> <tr> <th>Date</th> <th>Depth (m)</th> <th>Elev. (m)</th> </tr> </thead> <tbody> <tr> <td>June 19/18</td> <td>2.2</td> <td>101.2</td> </tr> <tr> <td>July 14/18</td> <td>2.2</td> <td>101.2</td> </tr> </tbody> </table>																Date	Depth (m)	Elev. (m)	June 19/18	2.2	101.2	July 14/18	2.2	101.2
Date	Depth (m)	Elev. (m)																						
June 19/18	2.2	101.2																						
July 14/18	2.2	101.2																						

PROJECT		1530382		RECORD OF BOREHOLE No SS-3				SHEET 1 OF 1		METRIC			
G.W.P.		2102-13-00 and 2432-13-00		LOCATION		N 4829709.3; E 300104.5 MTM NAD 83 ZONE 10 (LAT. 43.607314; LONG. -79.558170)		ORIGINATED BY		SK			
DIST		Central HWY QEW		BOREHOLE TYPE		Power Auger, 150 mm O.D. Solid Stem Augers		COMPILED BY		AMP			
DATUM		Geodetic		DATE		April 22, 2018		CHECKED BY		SMM			
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT		UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	20 40 60 80 100	W _p W W _L	WATER CONTENT (%)		
107.1	GROUND SURFACE												
0.0	ASPHALT (100 mm)												
0.2	CONCRETE (100 mm)												
	Sand to gravelly sand, some silt (FILL) Compact Brown Moist		1	SS	17								
106.0			2A	SS	12								
1.1	Sandy CLAYEY SILT, trace gravel (TILL) Stiff to hard Grey Moist		2B										
			3	SS	28								
	- Rock fragments in sample 4		4	SS	33								
			5	SS	28								
103.4													
3.7	Inferred highly to moderately weathered, grey, extremely weak to weak SHALE (BEDROCK) (Georgian Bay Formation)		6	SS	109								
			7	SS	51								
			8	SS	119/0.28								
			9	SS	86								
100.4													
6.7	END OF BOREHOLE												
NOTES:													
1. Borehole caved to a depth of 5.8 m below ground surface upon completion of drilling.													
2. Water measured in caved borehole at a depth of 5.7 m below ground surface (Elev. 101.4 m) upon completion of drilling.													

GTA-MTO 001 S:\CLIENTS\MTQ\QEW-DIXIE02_DATA\GINT\QEW-DIXIE.GPJ GAL-GTA.GDT 19-5-24

PROJECT		1530382		RECORD OF BOREHOLE No SS-4				SHEET 1 OF 1		METRIC							
G.W.P.		2102-13-00 and 2432-13-00		LOCATION		N 4829490.5; E 300067.8 MTM NAD 83 ZONE 10 (LAT. 43.605344; LONG. -79.558622)		ORIGINATED BY		SK							
DIST		Central HWY QEW		BOREHOLE TYPE		Power Auger, 150 mm O.D. Solid Stem Augers		COMPILED BY		AMP							
DATUM		Geodetic		DATE		May 9, 2018		CHECKED BY		SMM							
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
102.6	GROUND SURFACE																
0.0	ASPHALT (125 mm)																
	CONCRETE (175 mm)																
0.3	Gravelly sand, some silt, trace clay (FILL) Brown Moist		1	AS	-												21 59 17 3
101.8	Sandy clayey silt, trace wood fragments (FILL) Firm Grey Moist		2	SS	7												
100.9	Silty sand, trace to some gravel, trace to some clay (FILL) Compact Brown Moist		3A	SS	26												
1.7			3B														
100.0			4A	SS	19												
2.6	Clayey silt with sand, trace to some gravel (FILL) Stiff to very stiff Grey Moist		4B														
			5	SS	9												
			6	SS	10												
	- 125 mm sand layer at 4.6 m depth		7	SS	14												
97.3	Silty sand, trace to some gravel, trace to some clay (FILL) Compact to dense Brown to black Moist - Auger grinding at 5.8 m depth - Rock fragments in sample 9		8	SS	31												6 31 44 19
5.3			9	SS	27												
	- Auger grinding at 6.4 m depth																
95.8	Sandy clayey silt, some gravel (FILL) Stiff Black-grey Moist - Hydrocarbon odour in sample 10		10	SS	9												
6.8																	
95.1	END OF BOREHOLE																
7.5	NOTES: 1. Borehole open and dry upon completion of drilling.																

PROJECT		RECORD OF BOREHOLE				No SS-5		SHEET 1 OF 1		METRIC							
G.W.P. 2102-13-00 and 2432-13-00		LOCATION		N 4829535.3; E 300112.4 MTM NAD 83 ZONE 10 (LAT. 43.605748; LONG. -79.558070)				ORIGINATED BY SK									
DIST Central HWY QEW		BOREHOLE TYPE		Power Auger, 150 mm O.D. Solid Stem Augers				COMPILED BY AMP									
DATUM Geodetic		DATE		April 30, 2018				CHECKED BY SMM									
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
105.9	GROUND SURFACE																
0.0	ASPHALT (125 mm)																
	CONCRETE (175 mm)																
0.3	Sand, some gravel, some silt (FILL) Black Moist																
105.0							105										
0.9	Sandy CLAYEY SILT, trace to some gravel (TILL) Stiff to hard Brown to grey Moist		1	SS	14												
			2	SS	31		104										
			3	SS	28												
							103										
			4	SS	39												
			5	SS	29		102										
101.4																	
4.5	Inferred completely to highly weathered, grey, extremely weak to weak SHALE (BEDROCK) (Georgian Bay Formation)		6	SS	123/0.2		101										
	- 50 mm sand seam at 5.6 m depth		7	SS	47		100										
			8	SS	50												
99.2																	
6.7	END OF BOREHOLE																
	NOTES: 1. Borehole open and dry upon completion of drilling.																

PROJECT		1530382		RECORD OF BOREHOLE No SS-6		SHEET 1 OF 1		METRIC								
G.W.P.		2102-13-00 and 2432-13-00		LOCATION		N 4829605.9; E 300126.8 MTM NAD 83 ZONE 10 (LAT. 43.606383; LONG. -79.557893)		ORIGINATED BY SK								
DIST		Central HWY QEW		BOREHOLE TYPE		Power Auger, 108 mm I.D. and 209 mm O.D. Hollow Stem		COMPILED BY AMP								
DATUM		Geodetic		DATE		June 5, 2018		CHECKED BY SMM								
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa								
102.8	GROUND SURFACE															
0.0	ASPHALT (125 mm)															
0.1	Gravelly sand, some silt, trace clay (FILL) Brown Moist		1	AS	-											27 54 14 5
102.0																
0.8	CLAYEY SILT, some sand, some gravel (TILL) Hard Grey Moist		2	SS	83											
101.3																
1.5	SILT and SAND, trace to some gravel, trace clay (TILL) Very dense Grey Moist		3	SS	100/0.13											10 54 30 6
			4	SS	100/0.10											
			5	SS	55											
			6	SS	59											
98.3																
4.5	Inferred moderately weathered, grey, extremely weak to weak SHALE (BEDROCK) (Georgian Bay Formation)		7	SS	64											
97.6																
5.2	Slightly weathered															
	Bedrock cored between depths of 5.2 and 6.2 m. For bedrock coring details refer to Record of Drillhole No. SS-6.		1	RC	REC 84%											RQD = 75%
96.6																
6.2	END OF BOREHOLE															
	NOTES: 1. Borehole open and dry upon completion of soil drilling.															

GTA-MTO 001 S:\CLIENTS\MTQ\QEW-DIXIE02_DATA\GINT\QEW-DIXIE.GPJ GAL-GTA.GDT 19-5-24

PROJECT: 1530382

RECORD OF DRILLHOLE: SS-6

SHEET 1 OF 1

LOCATION: N 4829605.9 ;E 300126.8

DRILLING DATE: June 5, 2018

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: CME 55 (Truck Mounted)

DRILLING CONTRACTOR: Tri-Phase Drilling

DEPTH SCALE METRES	DRILLING RECORD		DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	JN - Joint FLT - Fault SHR- Shear VN - Vein CJ - Conjugate BD - Bedding FO - Foliation CO - Contact OR - Orthogonal CL - Cleavage PL - Planar CU - Curved UN - Undulating ST - Stepped IR - Irregular PO - Polished K - Slickensided SM - Smooth Ro - Rough MB - Mechanical Break BR - Broken Rock NOTE: For additional abbreviations refer to list of abbreviations & symbols.																FEATURES	R0/R1 ZONES	NOTES PIEZOMETER OR STANDPIPE INSTALLATION																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																													
							RECOVERY		R.Q.D. %	FRACT. INDEX PER 0.25 m	B Angle 0 90 180 270 360	DIP w.r.t CORE AXIS 0 30 60 90 120 150 180 210 240 270 300 330 360	DISCONTINUITY DATA TYPE AND SURFACE DESCRIPTION	Jr	Ja	ROCK STRENGTH INDEX			WEATH- ERING INDEX																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																			
							TOTAL CORE % 00 20 40 60 80 100	SOLID CORE % 00 20 40 60 80 100								R4	R3	R2	R1	W1	W2	W3				W4	W5	W6																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																										

FEATURES LEGEND



BROKEN CORE



CLAY SEAM



LIMESTONE



LOST CORE

DEPTH SCALE

1 : 50



GOLDER

LOGGED: SK

CHECKED: KF

GTA-RCK 054 S:\CLIENTS\MTQ\QEW-DIXIE\02 DATA\GINT\QEW-DIXIE.GPJ GAL-MISS.GDT 19-5-27

PROJECT		1530382				RECORD OF BOREHOLE No SS-7				SHEET 1 OF 1				METRIC			
G.W.P.		2102-13-00 and 2432-13-00		LOCATION		N 4829542.4; E 300050.5 MTM NAD 83 ZONE 10 (LAT. 43.605811; LONG. -79.558838)				ORIGINATED BY				SK			
DIST		Central		HWY		QEW		BOREHOLE TYPE		Power Auger, 150 mm O.D. Solid Stem Augers				COMPILED BY		AMP	
DATUM		Geodetic		DATE		April 27, 2018				CHECKED BY		SMM					
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					WATER CONTENT (%)				
101.0	GROUND SURFACE																
0.0	ASPHALT (150 mm)																
0.2	Gravelly sand, some silt (FILL) Compact Brown Moist		1	SS	27												
100.2																	
0.8	Sand, some silt, trace gravel, trace clay (FILL) Loose to dense Brown Moist		2	SS	49												
			3	SS	25												
			4	SS	6												
98.0																	
3.0	Clayey silt with sand, trace to some gravel, trace rootlets, organic staining (FILL) Firm Grey-brown Moist		5	SS	7											9 51 25 15	
			6	SS	8												
96.5																	
4.5	Sand, trace to some silt, trace clay (FILL) Loose Brown-grey Moist		7	SS	6												
			8	SS	8											0 83 12 5	
95.0																	
6.0	Sandy clayey silt (FILL) Firm Grey Moist - Hydrocarbon odours in sample 9		9	SS	8											0 25 54 21	
			10	SS	100/0.02												
94.1																	
6.9	END OF BOREHOLE SPLIT-SPOON AND AUGER REFUSAL																
	NOTES: 1. Borehole caved to a depth of 6.4 m below ground surface upon completion of drilling. 2. Water measured in caved borehole at a depth of 5.6 m below ground surface (Elev. 95.4 m) upon completion of drilling.																

PROJECT		1530382		RECORD OF BOREHOLE No SS-8		SHEET 1 OF 1		METRIC									
G.W.P.		2102-13-00 and 2432-13-00		LOCATION		N 4829596.5; E 300092.6 MTM NAD 83 ZONE 10 (LAT. 43.606299; LONG. -79.558316)		ORIGINATED BY SK									
DIST		Central HWY QEW		BOREHOLE TYPE		Power Auger, 150 mm O.D. Solid Stem Augers		COMPILED BY AMP									
DATUM		Geodetic		DATE		May 8, 2018		CHECKED BY SMM									
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS		ELEVATION SCALE		DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT		UNIT WEIGHT		REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV	DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES											
102.2		GROUND SURFACE															
0.0		ASPHALT (150 mm)															
0.1		Gravelly sand, some silt (FILL) Compact Brown Moist		1A	SS	23											
101.6		Sandy clayey silt, some gravel, trace rock fragments (FILL) Very stiff Grey Moist		1B	SS	28											
101.4		CLAYEY SILT with GRAVEL, some sand, trace rock fragments, (TILL) Very stiff to hard Grey Moist		2	SS	28											
0.8				3	SS	92											
100.0		SILT and SAND, some gravel, trace to some clay, trace shale fragments, (TILL) Very dense Grey Moist		4	SS	102											
2.2																	
99.2		- Augers grinding at 2.4 m depth		5A	SS	103											
3.0		Inferred moderately to slightly weathered, grey, extremely weak to weak SHALE (BEDROCK) (Georgian Bay Formation)		5B													
				6	SS	100/0.13											
				7	SS	100/0.08											
				8	SS	100/0.05											
				9	SS	100/0.05											
96.0		END OF BOREHOLE SPLIT-SPOON REFUSAL															
6.2		NOTES: 1. Water measured in open borehole at a depth of 5.9 m below ground surface (Elev. 96.3 m) upon completion of drilling.															

PROJECT		1530382		RECORD OF BOREHOLE No SS-9		SHEET 1 OF 1		METRIC									
G.W.P.		2102-13-00 and 2432-13-00		LOCATION		N 4829651.4; E 300139.4 MTM NAD 83 ZONE 10 (LAT. 43.606793; LONG. -79.557738)		ORIGINATED BY SK									
DIST		Central HWY QEW		BOREHOLE TYPE		Power Auger, 108 mm I.D. and 203 mm O.D. Hollow Stem		COMPILED BY AMP									
DATUM		Geodetic		DATE		May 10, 2018		CHECKED BY SMM									
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
103.5	GROUND SURFACE																
0.0	ASPHALT (125 mm)																
0.1	Sand, some silt, some gravel, trace to some clay (FILL)		1	SS	15												16 59 19 6
102.7	Compact Brown Moist																
102.5	Sandy clayey silt, trace gravel (FILL)		2	SS	106/0.10												
1.0	Hard Grey Moist																
	Inferred completely to highly weathered, grey, extremely weak to weak SHALE (BEDROCK) (Georgian Bay Formation)		3	SS	56												
			4	SS	69												6 12 62 20
	- Auger grinding at 3.2 m depth		5	SS	100/0.13												
			6	SS	100/0.08												
99.5	Moderately to slightly weathered																
4.0	Bedrock cored between depths of 4.0 and 7.0 m.		1	RC	REC 100%												RQD = 57%
	For bedrock coring details refer to Record of Drillhole No. SS-9.		2	RC	REC 100%												RQD = 89%
96.5	END OF BOREHOLE																
7.0	NOTES: 1. Borehole open and dry upon completion of soil drilling. 2. Drillhole No. SS-9 advance 0.8 m west of Borehole No. SS-9.																

SHEET 1 OF 1

DATUM: Geodetic

DRILLING CONTRACTOR: Tri-Phase Drilling

[illegible]

BROKEN CORE



CLAY SEAM



LIMESTONE



LOST CORE

DEPTH SCALE

1 : 50



GOLDER

LOGGED: SK

CHECKED: EJ

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PROJECT		1530382		RECORD OF BOREHOLE		No SS-10		SHEET 1 OF 1		METRIC							
G.W.P.		2102-13-00 and 2432-13-00		LOCATION		N 4829720.5; E 300192.8 MTM NAD 83 ZONE 10 (LAT. 43.607415; LONG. -79.557076)		ORIGINATED BY		SK							
DIST		Central HWY QEW		BOREHOLE TYPE		Power Auger, 150 mm O.D. Solid Stem Augers		COMPILED BY		AMP							
DATUM		Geodetic		DATE		May 10, 2018		CHECKED BY		SMM							
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
105.0	GROUND SURFACE																
0.0	ASPHALT (125 mm)																
0.1	Sand, some gravel, some silt (FILL) Compact Brown Moist		1	SS	16												
104.2	Sandy CLAYEY SILT to CLAYEY SILT with SAND, trace to some gravel, trace shale fragments (TILL) Very stiff to hard Grey Moist		2	SS	26												
0.8																	
			3	SS	48												6 40 41 13
			4	SS	42												8 26 48 18
101.6	CLAYEY SILT, trace sand, trace gravel Hard Grey Moist		5	SS	44												
3.4																	
			6	SS	44												1 4 70 25
100.5	Inferred moderately to slightly weathered, grey, extremely weak to weak SHALE (BEDROCK) (Georgian Bay Formation)		7	SS	72												
4.5																	
			8	SS	100/0.05												
			9	SS	100/0.05												
98.1	END OF BOREHOLE SPLIT-SPOON REFUSAL		10	SS	100/0.05												
6.9	NOTES: 1. Borehole open and dry upon completion of drilling.																

PROJECT		1530382		RECORD OF BOREHOLE No SS-11				SHEET 1 OF 1				METRIC			
G.W.P.		2102-13-00 and 2432-13-00		LOCATION		N 4829780.5; E 300240.9 MTM NAD 83 ZONE 10 (LAT. 43.607955; LONG. -79.556481)				ORIGINATED BY SK					
DIST		Central HWY QEW		BOREHOLE TYPE		Power Auger, 150 mm O.D. Solid Stem Augers				COMPILED BY AMP					
DATUM		Geodetic		DATE		May 11, 2018				CHECKED BY SMM					
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa							
106.4	GROUND SURFACE														
0.0	ASPHALT (125 mm)														
0.3	Sand, some gravel, some silt (FILL) Brown to black Moist		1A				106								
105.6	Sandy clayey silt, some sand to sandy, some gravel (FILL) Stiff Grey Moist		1B	SS	14										
0.8			2	SS	50										
104.9	SILT and SAND, some gravel, trace to some clay (TILL) Dense Grey Moist						105								
1.5	Inferred moderately to slightly weathered, grey, extremely weak to weak SHALE (BEDROCK) (Georgian Bay Formation) - Auger grinding at 1.7 m depth		3	SS	63										
			4	SS	29		104								
	- Auger grinding at 2.7 m depth		5	SS	100/0.08										
103.1	Moderately to slightly weathered						103								
3.3	Bedrock cored between depths of 3.3 and 7.3 m. For bedrock coring details refer to Record of Drillhole No. SS-11.		1	RC	REC 100%										RQD = 27%
			2	RC	REC 83%		102								RQD = 49%
			3	RC	REC 88%		101								
							100								RQD = 68%
99.1	END OF BOREHOLE														
7.3	NOTES: 1. Water measured in open borehole at a depth of 3.5 m below ground surface (Elev. 102.9 m) upon completion of soil drilling. 2. Bedrock coring carried out in separate borehole, adjacent borehole SS-11 on May 24, 2018.														

PROJECT: 1530382

RECORD OF DRILLHOLE: SS-11

SHEET 1 OF 1

LOCATION: N 4829780.5 ; E 300240.9

DRILLING DATE: May 24, 2018

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: CME 75 (Truck Mounted)

DRILLING CONTRACTOR: Tri-Phase Drilling

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV.	RUN No.	DISCONTINUITY DATA																			FEATURES	R0/R1 ZONES	NOTES PIEZOMETER OR STANDPIPE INSTALLATION																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																			
				DEPTH (m)		RECOVERY		R.O.D. %	FRACT. INDEX PER 0.25 m	B Angle °	DIP w.r.t. CORE AXIS °	TYPE AND SURFACE DESCRIPTION	ROCK STRENGTH INDEX		WEATH- ERING INDEX																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																															
						TOTAL CORE %	SOLID CORE %						Jr	Ja	R4	R3	R2	R1	W1	W2	W3	W4	W5	W6																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																						
JN - Joint FLT - Fault SHR- Shear VN - Vein CJ - Conjugate BD- Bedding FO- Foliation CO- Contact OR- Orthogonal CL - Cleavage PL - Planar CU- Curved UN- Undulating ST - Stepped IR - Irregular PO- Polished K - Slickensided SM- Smooth Ro - Rough MB- Mechanical Break BR - Broken Rock NOTE: For additional abbreviations refer to list of abbreviations & symbols.																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																														
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FEATURES LEGEND



BROKEN CORE



CLAY SEAM



LIMESTONE



LOST CORE

DEPTH SCALE

1 : 50



GOLDER

LOGGED: SK

CHECKED: KF

GTA-RCK 054 S:\CLIENTS\MTQ\QEW-DIXIE\02_DATA\GINT\QEW-DIXIE.GPJ GAL-MISS.GDT 19-5-27

PROJECT		1530382		RECORD OF BOREHOLE No SS-12		SHEET 1 OF 1		METRIC					
G.W.P.		2102-13-00 and 2432-13-00		LOCATION		N 4829844.5; E 300292.6 MTM NAD 83 ZONE 10 (LAT. 43.608532; LONG. -79.555841)		ORIGINATED BY SK					
DIST		Central HWY QEW		BOREHOLE TYPE		Power Auger, 150 mm O.D. Solid Stem Augers		COMPILED BY AMP					
DATUM		Geodetic		DATE		May 8, 2018		CHECKED BY SMM					
SOIL PROFILE			SAMPLES			DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC NATURAL LIQUID UNIT REMARKS				
ELEV	DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	20 40 60 80 100	W _p W W _L	WATER CONTENT (%)	γ	GR SA SI CL
107.5	0.0	GROUND SURFACE											
	0.1	ASPHALT (125 mm)											
	0.1	Silty sand, some gravel (FILL)		1A	SS	11		107					
	0.5	Compact Brown Moist		1B									
		Sandy CLAYEY SILT, some gravel to gravelly (TILL)		2	SS	12							
		Stiff to very stiff											
		Grey Moist		3	SS	28		106					20 30 38 12
				4	SS	100/0.10		105					
	2.4	Inferred moderately to slightly weathered, grey, extremely weak to weak SHALE (BEDROCK) (Georgian Bay Formation)		5	SS	100/0.08							
				6	SS	100/0.08		104					
				7	SS	100/0.05							
				8	SS	100/0.10		103					
				9	SS	100/0.05							
				10	SS	100/0.05		102					
								101					
	100.6	END OF BOREHOLE SPLIT-SPOON REFUSAL											
	6.9	NOTES: 1. Borehole open and dry upon completion of drilling.											

PROJECT		1530382		RECORD OF BOREHOLE No SS-13		SHEET 1 OF 1		METRIC											
G.W.P.		2102-13-00 and 2432-13-00		LOCATION		N 4829899.4; E 300334.9 MTM NAD 83 ZONE 10 (LAT. 43.609026; LONG. -79.555317)		ORIGINATED BY											
DIST		Central HWY QEW		BOREHOLE TYPE		Power Auger, 150 mm O.D. Solid Stem Augers		COMPILED BY											
DATUM		Geodetic		DATE		May 30, 2018		CHECKED BY											
								SMM											
SOIL PROFILE			SAMPLES			DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT			REMARKS & GRAIN SIZE DISTRIBUTION (%)				
ELEV	DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	SHEAR STRENGTH kPa					WATER CONTENT (%)			γ	GR SA SI CL	
								20 40 60 80 100	○ UNCONFINED + FIELD VANE	● QUICK TRIAXIAL × REMOULDED	W _p	W	W _L	10 20 30					
107.8	0.0	GROUND SURFACE																	
	0.1	ASPHALT (125 mm)																	
	0.1	Sand, some gravel, some silt (FILL) Compact Brown Moist		1	SS	14		107											
	0.8	Silty sand, trace to some gravel, trace clay (FILL) Compact to dense Brown to black Moist		2	SS	45		107											
		- Hydrocarbon odours in sample 3		3	SS	15		106										6 66 24 4	
		- Hydrocarbon odours and wood fragments in sample 4		4	SS	14		105											
	104.8	SHALE (BEDROCK) Grey Fresh		5	SS	100/0.13		104										RQD = 97%	
	3.1	Bedrock cored between depths of 3.2 and 5.6 m. For bedrock coring details refer to Record of Drillhole No. SS-13.		1	RC	REC 100%		104											
				2	RC	REC 78%		103										RQD = 42%	
				3	RC	REC 94%												RQD = 26%	
	102.2	END OF BOREHOLE																	
	5.6	NOTES: 1. Water level measured in caved borehole at a depth of 3.1 m below ground surface upon completion of drilling. 2. Water level measured in standpipe piezometer as follows: Date Depth (m) Elev. (m) June 19/18 1.1 106.7 July 14/18 1.6 106.2																	

[illegible]

FEATURES LEGEND



BROKEN CORE



CLAY SEAM



LIMESTONE



LOST CORE

DEPTH SCALE

1 : 50



GOLDER

LOGGED: SK

CHECKED: KF

PROJECT		1530382		RECORD OF BOREHOLE No SS-14		SHEET 1 OF 1		METRIC						
G.W.P.		2102-13-00 and 2432-13-00		LOCATION		N 4829964.9; E 300386.6 MTM NAD 83 ZONE 10 (LAT. 43.609616; LONG. -79.554677)		ORIGINATED BY SK						
DIST		Central HWY QEW		BOREHOLE TYPE		Power Auger, 150 mm O.D. Solid Stem Augers		COMPILED BY AMP						
DATUM		Geodetic		DATE		May 2, 2018		CHECKED BY SMM						
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
108.5	GROUND SURFACE													
0.0	ASPHALT (125 mm)													
0.1	Gravelly sand, some silt (FILL) Compact Brown Moist		1	SS	12									
107.4			2	SS	4									
1.1	Sandy clayey silt, some gravel (FILL) Firm Grey Moist													
107.0														
1.5	CLAYEY SILT, some gravel, some sand, (TILL) Very stiff Grey Moist		3	SS	16									
106.3														
2.2	Inferred highly to moderately weathered, grey, extremely weak to weak SHALE (BEDROCK) (Georgian Bay Formation)		4	SS	30									
105.5														
3.0	Slightly weathered		5	SS	100/0.10									
			6	SS	100/0.07									
			7	SS	100/0.07									
			8	SS	100/0.07									
			9	SS	100/0.05									
102.3	END OF BOREHOLE SPLIT-SPOON REFUSAL													
6.2	NOTES: 1. Borehole caved to a depth of 5.5 m below ground surface upon completion of drilling. 2. Borehole dry upon completion of drilling.													

PROJECT		1530382		RECORD OF BOREHOLE No SS-15		SHEET 1 OF 1		METRIC								
G.W.P.		2102-13-00 and 2432-13-00		LOCATION		N 4830012.4; E 300426.8 MTM NAD 83 ZONE 10 (LAT. 43.610044; LONG. -79.554180)		ORIGINATED BY								
DIST		Central HWY QEW		BOREHOLE TYPE		Power Auger, 108 mm I.D. and 209 mm O.D. Hollow Stem		COMPILED BY								
DATUM		Geodetic		DATE		May 27, 2018		CHECKED BY								
SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa					WATER CONTENT (%)			
108.5	GROUND SURFACE															
0.0	ASPHALT (100 mm)															
0.1	Gravelly sand, some silt, trace clay (FILL) Compact Brown Moist		1	SS	29											
107.8																
0.7	Sand, trace silt, trace gravel (FILL) Compact Brown Moist		2	SS	15											
107.0																
1.5	Inferred highly to moderately weathered, grey, extremely weak to weak SHALE (BEDROCK) (Georgian Bay Formation)		3	SS	54											
			4	SS	46											
			5	SS	100/0.15											
105.2																
3.4	Slightly weathered															
	Bedrock cored between depths of 3.4 and 7.2 m. For bedrock coring details refer to Record of Drillhole No. SS-15.		1	RC	REC 70%											RQD = 52%
			2	RC	REC 96%											RQD = 51%
			3	RC	REC 100%											RQD = 89%
101.3																
7.2	END OF BOREHOLE															
	NOTES: 1. Borehole open and dry upon completion of soil drilling.															

PROJECT: 1530382

RECORD OF DRILLHOLE: SS-15

SHEET 1 OF 1

LOCATION: N 4830012.4 ;E 300426.8

DRILLING DATE: May 27, 2018

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: CME 55 (Truck Mounted)

DRILLING CONTRACTOR: Tri-Phase Drilling

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	JN - Joint FLT - Fault SHR - Shear VN - Vein CJ - Conjugate BD - Bedding FO - Foliation CO - Contact OR - Orthogonal CL - Cleavage PL - Planar CU - Curved UN - Undulating ST - Stepped IR - Irregular PO - Polished K - Slickensided SM - Smooth Ro - Rough MB - Mechanical Break BR - Broken Rock NOTE: For additional abbreviations refer to list of abbreviations & symbols.																		FEATURES	R0/R1 ZONES	NOTES PIEZOMETER OR STANDPIPE INSTALLATION																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																										
						RECOVERY		R.Q.D. %	FRACT. INDEX PER 0.25 m	DISCONTINUITY DATA						ROCK STRENGTH INDEX		WEATH- ERING INDEX																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																		
						TOTAL CORE %	SOLID CORE %			TYPE AND SURFACE DESCRIPTION	Jr	Ja	R4	R3	R2	R1	W1	W2	W3	W4	W5	W6																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																														
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FEATURES LEGEND



BROKEN CORE



CLAY SEAM



LIMESTONE



LOST CORE

DEPTH SCALE

1 : 50



GOLDER

LOGGED: CC

CHECKED: KF

GTA-RCK 054 S:\CLIENTS\MTQ\QEW-DIXIE\02 DATA\GINTQEW-DIXIE.GPJ GAL-MISS.GDT 19-5-27



+³, ×³: Numbers refer to Sensitivity ○^{3%} STRAIN AT FAILURE

PROJECT		1530382		RECORD OF BOREHOLE No SS-17				SHEET 1 OF 1		METRIC						
G.W.P.		2102-13-00 and 2432-13-00		LOCATION		N 4830133.7; E 300523.4 MTM NAD 83 ZONE 10 (LAT. 43.611137; LONG. -79.552984)		ORIGINATED BY		SK						
DIST		Central HWY QEWS		BOREHOLE TYPE		Power Auger, 150 mm O.D. Solid Stem Augers		COMPILED BY		AMP						
DATUM		Geodetic		DATE		May 28, 2018		CHECKED BY		SMM						
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa								
109.5	GROUND SURFACE															
0.0	ASPHALT (125 mm)															
0.1	Sandy clayey silt, trace to some gravel (FILL) Stiff to hard Grey Moist		1	SS	13											11 21 51 17
	- Auger grinding at 0.9 m depth - Rock fragments in sample 2		2	SS	33											
108.0																
1.5	Inferred highly to moderately weathered, grey, extremely weak to weak SHALE (BEDROCK) (Georgian Bay Formation)		3	SS	90											
			4	SS	46											
			5A	SS	68											42 12 37 9
105.9			5B													
3.6	Slightly weathered		1	RC	REC 100%											RQD = 92%
	Bedrock cored between depths of 3.6 and 7.5 m.		2	RC	REC 100%											RQD = 66%
	For bedrock coring details refer to Record of Drillhole No. SS-17.		3	RC	REC 100%											RQD = 75%
			4	RC	REC 100%											RQD = 100%
102.0	END OF BOREHOLE															
7.5	NOTES: 1. Borehole open and dry upon completion of soil drilling.															

SHEET 1 OF 1

DATUM: Geodetic

DRILLING CONTRACTOR: Tri-Phase Drilling

FEATURES LEGEND

LOST CORE

CHECKED: KF

1 : 50

PROJECT		1530382		RECORD OF BOREHOLE No SS-18		SHEET 1 OF 1		METRIC								
G.W.P.		2102-13-00; 2432-13-00		LOCATION		N 4830154.7; E 300567.7 MTM NAD 83 ZONE 10 (LAT. 43.611326; LONG. -79.552435)		ORIGINATED BY SK								
DIST		Central HWY QEW		BOREHOLE TYPE		Power Auger, 108 mm I.D. and 209 mm O.D. Hollow Stem		COMPILED BY AMP								
DATUM		Geodetic		DATE		June 18, 2018		CHECKED BY SMM								
SOIL PROFILE		SAMPLES		GROUND WATER CONDITIONS		ELEVATION SCALE		DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT		UNIT WEIGHT		REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV	DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES										
109.5		GROUND SURFACE														
0.0		ASPHALT (125 mm)														
0.1		Sand, some gravel, some silt (FILL) Compact Brown Moist		1	SS	22										
108.6				2A												
0.9		Inferred highly to moderately weathered, grey, extremely weak to weak SHALE (BEDROCK) (Georgian Bay Formation) - Augers grinding at 1.1 m depth		2B	SS	18										
				3	SS	45										
				4	SS	136										
106.3				5	SS	100/0.13										
3.2		Slightly weathered														
		Bedrock cored between depths of 3.2 and 6.2 m. For bedrock coring details refer to Record of Drillhole No. SS-18.		1	RC	REC 95%										
				2	RC	REC 100%										
103.3																
6.2		END OF BOREHOLE SPLIT-SPOON REFUSAL														
		NOTES: 1. Borehole open and dry upon completion of drilling. 2. Water level measured in standpipe piezometer as follows: Date Depth (m) Elev. (m) June 20/18 2.3 107.2 July 14/18 2.3 107.2														

SHEET 1 OF 1

DATUM: Geodetic

DRILLING CONTRACTOR: Tri-Phase Drilling

LOGGED: SK
CHECKED:

PROJECT		1530382		RECORD OF BOREHOLE No SS-19		SHEET 1 OF 1		METRIC						
G.W.P.		2102-13-00 and 2432-13-00		LOCATION		N 4830219.0; E 300596.4 MTM NAD 83 ZONE 10 (LAT. 43.611904; LONG. -79.552080)		ORIGINATED BY SK						
DIST		Central HWY QEW		BOREHOLE TYPE		Power Auger, 150 mm O.D. Solid Stem Augers		COMPILED BY AMP						
DATUM		Geodetic		DATE		May 2, 2018		CHECKED BY SMM						
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
110.0	GROUND SURFACE							20 40 60 80 100	20 40 60 80 100	10 20 30				
0.0	ASPHALT (100 mm)													
0.1	Sand, some gravel, some silt (FILL) Compact Grey Moist		1	SS	14									
109.2														
0.8	Sandy CLAYEY SILT, trace to some gravel (TILL) Hard Grey Moist		2	SS	50		109							
108.5														
1.5	Inferred completely to highly weathered, grey, extremely weak to weak SHALE (BEDROCK) (Georgian Bay Formation)		3	SS	43		108							
			4	SS	45									
			5	SS	169/0.18		107							
106.6			6	SS	100/0.13		106							
3.4	Inferred moderately to slightly weathered		7	SS	100/0.10		105							
			8	SS	100/0.05									
103.8			9	SS	100/0.05		104							
6.2	END OF BOREHOLE SPLIT-SPOON REFUSAL													
NOTES: 1. Borehole caved to a depth of 5.6 m below ground surface upon completion of drilling. 2. Borehole dry upon completion of drilling.														

PROJECT		1530382		RECORD OF BOREHOLE No SS-20		SHEET 1 OF 1		METRIC													
G.W.P.		2102-13-00 and 2432-13-00		LOCATION		N 4830234.7; E 300637.5 MTM NAD 83 ZONE 10 (LAT. 43.612046; LONG. -79.551571)		ORIGINATED BY SK													
DIST		Central HWY QEW		BOREHOLE TYPE		Power Auger, 150 mm O.D. Solid Stem Augers		COMPILED BY AMP													
DATUM		Geodetic		DATE		June 8, 2018		CHECKED BY SMM													
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS		ELEVATION SCALE		DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT		SHEAR STRENGTH kPa		WATER CONTENT (%)		UNIT WEIGHT		REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV	DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES															
109.9	0.0	GROUND SURFACE																			
		ASPHALT (125 mm)																			
109.5	0.4	Gravelly sand, some silt (FILL)		1A																	
		Loose Brown Moist		1B	SS	9															
109.1	0.8	Clayey silt, trace gravel, some sand (FILL)		2	SS	13															
		Stiff Grey Moist																			
108.4	1.5	Sandy CLAYEY SILT, some gravel, (TILL)		3	SS	109/0.28															
		Stiff Grey Moist																			
		Inferred completely to moderately weathered, grey, extremely weak to weak SHALE (BEDROCK) (Georgian Bay Formation)		4	SS	100/0.08															
107.4	2.5	Slightly weathered																			
		Bedrock cored between depths of 2.5 and 6.6 m.		1	RC	REC 95%															
		For bedrock coring details refer to Record of Drillhole No. SS-20.																			
				2	RC	REC 92%															
				3	RC	REC 100%															
103.3	6.6	END OF BOREHOLE																			
		NOTES:																			
		1. Borehole open and dry upon completion of soil drilling.																			

SHEET 1 OF 1

DATUM: Geodetic

DRILLING CONTRACTOR: Tri-Phase Drilling

[illegible]

PROJECT		1530382		RECORD OF BOREHOLE No SS-21		SHEET 1 OF 1		METRIC							
G.W.P.		2102-13-00 and 2432-13-00		LOCATION		N 4830289.7; E 300662.9 MTM NAD 83 ZONE 10 (LAT. 43.612542; LONG. -79.551258)		ORIGINATED BY							
DIST		Central HWY QEW		BOREHOLE TYPE		Power Auger, 150 mm O.D. Solid Stem Augers		COMPILED BY							
DATUM		Geodetic		DATE		May 29, 2018		CHECKED BY							
SOIL PROFILE		SAMPLES		GROUND WATER CONDITIONS		ELEVATION SCALE		DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT		UNIT WEIGHT		REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV	DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES									
110.7	0.0	GROUND SURFACE													
		ASPHALT (125 mm)													
	0.3	Silty sand and gravel, trace to some clay (FILL)		1A											
		Compact Grey Moist		1B	SS	14									
	109.9	Sandy clayey silt, trace gravel (FILL)		2	SS	72									
	0.8	Stiff Grey Moist													
		Inferred moderately to slightly weathered, grey, extremely weak to weak SHALE (BEDROCK) (Georgian Bay Formation)		3	SS	70									
	108.4	Slightly weathered		4	SS	100/0.14									
	2.3			5	SS	100/0.10									
				6	SS	100/0.08									
				7	SS	100/0.10									
				8	SS	100/0.00									
				9	SS	100/0.08									
	104.5	END OF BOREHOLE SPLIT-SPOON REFUSAL													
	6.2	NOTES: 1. Borehole open and dry upon completion of drilling.													

PROJECT		1530382		RECORD OF BOREHOLE No SS-22		SHEET 1 OF 1		METRIC	
G.W.P.		2102-13-00 and 2432-13-00		LOCATION		N 4830338.5; E 300721.8 MTM NAD 83 ZONE 10 (LAT. 43.612981; LONG. -79.550528)		ORIGINATED BY	
DIST		Central HWY QEW		BOREHOLE TYPE		Power Auger, 150 mm O.D. Solid Stem Augers		COMPILED BY	
DATUM		Geodetic		DATE		May 28, 2018		CHECKED BY	
SOIL PROFILE		SAMPLES		GROUND WATER CONDITIONS		ELEVATION SCALE		DYNAMIC CONE PENETRATION RESISTANCE PLOT	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100 SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × REMOULDED 20 40 60 80 100	
								PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT W _p W W _L WATER CONTENT (%)	
								UNIT WEIGHT γ kN/m ³	
								REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
111.1	GROUND SURFACE								
0.0	ASPHALT (125 mm)								
110.8	Sand and gravel, trace to some silt, trace asphalt fragments (FILL)		1A	SS	12				
0.3	Compact Grey Moist		1B						
	SILTY CLAY, trace to some sand, trace gravel		2	SS	9				
	Stiff to very stiff								
	Mottled brown and grey		3	SS	23				
	Moist								
108.9	Inferred slightly weathered, grey, extremely weak to weak SHALE (BEDROCK) (Georgian Bay Formation)		4	SS	63				
2.2			5	SS	100/0.08				
			6	SS	100/0.13				
			7	SS	100/0.05				
			8	SS	100/0.14				
			9	SS	100/0.15				
104.2	END OF BOREHOLE SPLIT-SPOON REFUSAL		10	SS	100/0.08				
6.9	NOTES: 1. Borehole caved to a depth of 6.6 m below ground surface upon completion of drilling. 2. Borehole dry upon completion of drilling.								

PROJECT		1530382		RECORD OF BOREHOLE No SS-23				SHEET 1 OF 1		METRIC							
G.W.P.		2102-13-00; 2432-13-00		LOCATION		N 4830351.4; E 300774.8 MTM NAD 83 ZONE 10 (LAT. 43.613098; LONG. -79.549871)		ORIGINATED BY		SK							
DIST		Central HWY QEWS		BOREHOLE TYPE		Power Auger, 108 mm I.D. and 209 mm O.D. Hollow Stem		COMPILED BY		AMP							
DATUM		Geodetic		DATE		June 19, 2018		CHECKED BY		SMM							
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
110.9	GROUND SURFACE																
0.0	ASPHALT (125 mm)																
0.1	Sand and gravel, some silt (FILL) Compact Brown Moist		1	SS	23												
110.1																	
0.8	Sandy clayey silt, some gravel (FILL) Firm Brown to grey Dry		2	SS	8												
109.5																	
1.4	Inferred slightly weathered to fresh, grey, extremely weak to weak SHALE (BEDROCK) (Georgian Bay Formation)		3A	SS	55/0.08												
109.0			3B														
1.9	Slightly weathered																
	Bedrock cored between depths of 1.9 and 6.2 m.																
	For bedrock coring details refer to Record of Drillhole No. SS-23.																
			1	RC	REC 100%												RQD = 65%
			2	RC	REC 100%												RQD = 58%
			3	RC	REC 100%												RQD = 79%
104.7																	
6.2	END OF BOREHOLE																
	NOTES: 1. Borehole open and dry upon completion of soil drilling.																

PROJECT: 1530382

RECORD OF DRILLHOLE: SS-23

SHEET 1 OF 1

LOCATION: N 4830351.4 ; E 300774.8

DRILLING DATE: June 19, 2018

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: CME 55 (Truck Mounted)

DRILLING CONTRACTOR: Tri-Phase Drilling

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	JN - Joint FLT - Fault SHR- Shear VN - Vein CJ - Conjugate BD - Bedding FO - Foliation CO - Contact OR - Orthogonal CL - Cleavage PL - Planar CU - Curved UN - Undulating ST - Stepped IR - Irregular PO - Polished K - Slickensided SM - Smooth Ro - Rough MB - Mechanical Break BR - Broken Rock NOTE: For additional abbreviations refer to list of abbreviations & symbols.																FEATURES	R0/R1 ZONES	NOTES PIEZOMETER OR STANDPIPE INSTALLATION																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																								
						RECOVERY		R.Q.D. %	FRACT. INDEX PER 0.25 m	DISCONTINUITY DATA					ROCK STRENGTH INDEX			WEATH- ERING INDEX																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																														
						TOTAL CORE %	SOLID CORE %			TYPE AND SURFACE DESCRIPTION		Jr	Ja	R4 R3 R2 R1	W1 W2 W3 W4 W5 W6																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																	
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2	HQ Coring	Continued from Record of Borehole SS-23		109.00																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																												

USC = 13.6 MPa

FEATURES LEGEND



BROKEN CORE



CLAY SEAM



LIMESTONE



LOST CORE

DEPTH SCALE

1 : 50

**GOLDER**

LOGGED: SK

CHECKED: JS

GTA-RCK 054 S:\CLIENTS\MTQ\QEW-DIXIE\02 DATA\GINTQEW-DIXIE.GPJ GAL-MISS GDT 19-5-27

PROJECT		1530382		RECORD OF BOREHOLE No SS-24				SHEET 1 OF 1		METRIC						
G.W.P.		2102-13-00 and 2432-13-00		LOCATION		N 4830390.5; E 300795.3 MTM NAD 83 ZONE 10 (LAT. 43.613450; LONG. -79.549618)		ORIGINATED BY		SK						
DIST		Central HWY QEW		BOREHOLE TYPE		Power Auger, 150 mm O.D. Solid Stem Augers		COMPILED BY		AMP						
DATUM		Geodetic		DATE		May 29, 2018		CHECKED BY		SMM						
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa								
111.8	GROUND SURFACE															
0.0	ASPHALT (125 mm)															
111.4	Sand and gravel, some silt (FILL)		1A													
0.4	Compact Brown Moist		1B	SS	16											
	Gravelly clayey silt, some sand (FILL)															
	Firm to very stiff Brown Moist		2	SS	6											29 16 39 16
110.3																
1.5	Sandy CLAYEY SILT, trace to some gravel, trace rock fragments, (TILL)		3	SS	36											7 22 54 17
	Hard Grey Moist															
109.6																
2.2	Inferred slightly weathered, grey, extremely weak to weak SHALE (BEDROCK) (Georgian Bay Formation)		4	SS	100/0.08											
			5	SS	100/0.05											
			6	SS	100/0.05											
			7	SS	100/0.08											
			8	SS	100/0.05											
			9	SS	100/0.05											
105.6																
6.2	END OF BOREHOLE SPLIT-SPOON REFUSAL															
NOTES:																
1. Borehole open and dry upon completion of drilling.																

PROJECT		1530382		RECORD OF BOREHOLE No SS-25				SHEET 1 OF 1		METRIC							
G.W.P.		2102-13-00; 2432-13-00		LOCATION		N 4830423.2; E 300903.9 MTM NAD 83 ZONE 10 (LAT. 43.613744; LONG. -79.548272)		ORIGINATED BY		SK							
DIST		Central HWY QEW		BOREHOLE TYPE		Power Auger, 108 mm I.D. and 209 mm O.D. Hollow Stem		COMPILED BY		AMP							
DATUM		Geodetic		DATE		June 20, 2018		CHECKED BY		SMM							
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
111.7	GROUND SURFACE																
0.0	ASPHALT (125 mm)																
0.1	Sand and gravel, some silt (FILL) Dense Brown Dry		1	SS	34												32 53 (15)
110.9																	
0.8	Silty sand, trace to some gravel (FILL) Compact Brown Moist		2	SS	14												
110.0																	
1.7	Sandy clayey silt, some gravel (FILL) Stiff Grey Moist		3A														
109.4			3B	SS	13												11 66 (23)
2.3	- Auger grinding at 2.1 m depth Inferred completely to moderately weathered, grey, extremely weak to weak SHALE (BEDROCK) (Georgian Bay Formation)																
109.4			4	SS	40												17 18 47 18
2.3																	
			5	SS	88												
107.8																	
3.9	Slightly weathered		6	SS	100/0.13												
	Bedrock cored between depths of 3.9 and 7.4 m. For bedrock coring details refer to Record of Drillhole No. SS-25.		1	RC	REC 100%												RQD = 67%
			2	RC	REC 100%												RQD = 80%
			3	RC	REC 100%												RQD = 97%
104.3																	
7.4	END OF BOREHOLE																
	NOTES: 1. Borehole open and dry upon completion of soil drilling.																

PROJECT: 1530382

RECORD OF DRILLHOLE: SS-25

SHEET 1 OF 1

LOCATION: N 4830423.2 ; E 300903.9

DRILLING DATE: June 20, 2018

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: CME 55 (Truck Mounted)

DRILLING CONTRACTOR: Tri-Phase Drilling

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	JN - Joint FLT - Fault SHR- Shear VN - Vein CJ - Conjugate BD- Bedding FO- Foliation CO- Contact OR- Orthogonal CL - Cleavage PL - Planar CU- Curved UN- Undulating ST - Stepped IR - Irregular PO- Polished K - Slickensided SM- Smooth Ro - Rough MB- Mechanical Break BR - Broken Rock NOTE: For additional abbreviations refer to list of abbreviations & symbols.																FEATURES	R0/R1 ZONES	NOTES PIEZOMETER OR STANDPIPE INSTALLATION																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																														
						RECOVERY		R.Q.D. %	FRACT. INDEX PER 0.25 m	DISCONTINUITY DATA					ROCK STRENGTH INDEX			WEATH- ERING INDEX																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																				
						TOTAL CORE %	SOLID CORE %			B Angle DIP w.r.t. CORE AXIS	TYPE AND SURFACE DESCRIPTION	Jr	Ja	R4 R3 R2 R1	W1 W2 W3 W4 W5 W6																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																							
4	HQ Coring	Continued from Record of Borehole SS-25		107.76 3.94																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																		

FEATURES LEGEND



BROKEN CORE



CLAY SEAM



LIMESTONE



LOST CORE

DEPTH SCALE

1 : 50



GOLDER

LOGGED: SK

CHECKED: JS

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PROJECT		1530382		RECORD OF BOREHOLE No SS-26				SHEET 1 OF 1		METRIC							
G.W.P.		2102-13-00 and 2432-13-00		LOCATION		N 4830445.2; E 300898.2 MTM NAD 83 ZONE 10 (LAT. 43.613942; LONG. -79.548343)		ORIGINATED BY		SK							
DIST		Central HWY QEW		BOREHOLE TYPE		Power Auger, 150 mm O.D. Solid Stem Augers		COMPILED BY		AMP							
DATUM		Geodetic		DATE		May 29, 2018		CHECKED BY		SMM							
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
112.5	GROUND SURFACE																
0.0	ASPHALT (125 mm)																
0.1	Sand, some gravel, some silt (FILL) Compact Brown Moist		1	SS	24												
111.7																	
0.8	Sand, some silt, trace clay (FILL) Compact Brown Moist		2	SS	18												
111.0																	
1.5	CLAYEY SILT, some sand, trace to some gravel, trace shale fragments, (TILL) Very stiff to hard Grey Moist		3	SS	27												
			4	SS	32												
109.5																	
3.0	Inferred completely to moderately weathered, grey, extremely weak to weak SHALE (BEDROCK) (Georgian Bay Formation)		5	SS	118/0.23												
			6	SS	100/0.08												
			7	SS	100/0.05												
107.4																	
5.1	END OF BOREHOLE AUGER REFUSAL																
	NOTES: 1. Borehole open and dry upon completion of drilling.																

PROJECT		1530382		RECORD OF BOREHOLE No SS-27				SHEET 1 OF 1		METRIC							
G.W.P.		2102-13-00 and 2432-13-00		LOCATION		N 4830471.3; E 300967.7 MTM NAD 83 ZONE 10 (LAT. 43.614177; LONG. -79.547482)		ORIGINATED BY		SK							
DIST		Central HWY QEW		BOREHOLE TYPE		Power Auger, 150 mm O.D. Solid Stem Augers		COMPILED BY		AMP							
DATUM		Geodetic		DATE		May 29, 2018		CHECKED BY		SMM							
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
112.8	GROUND SURFACE																
0.0	ASPHALT (125 mm)																
112.4	Sand, some silt, some gravel (FILL)		1A														
0.4	Compact Brown Moist		1B	SS	20												
	Silt, trace to some clay, trace to some sand, trace gravel (FILL)		2	SS	17												
	Compact Brown Moist to wet																
111.0			3A														
1.8	Gravelly sandy CLAYEY SILT, trace shale fragments, (TILL)		3B	SS	19												
	Very stiff to hard Brown to grey Moist to wet																
			4	SS	41												
			5	SS	97												
108.8			6A														
4.0	Inferred moderately to slightly weathered, grey, extremely weak to weak SHALE (BEDROCK) (Georgian Bay Formation)		6B	SS	100/0.13												
			7	SS	100/0.08												
			8	SS	100/0.05												
			9	SS	100/0.05												
106.6	END OF BOREHOLE SPLIT-SPOON REFUSAL																
6.2	NOTES: 1. Borehole caved to a depth of 3.7 m below ground surface upon completion of drilling. 2. Water measured in caved borehole at a depth of 3.6 m below ground surface (Elev. 109.2 m) upon completion of drilling.																

PROJECT		RECORD OF BOREHOLE No SS-28				SHEET 1 OF 1		METRIC									
G.W.P. 2102-13-00 and 2432-13-00		LOCATION N 4830501.6; E 301079.6 MTM NAD 83 ZONE 10 (LAT. 43.614451; LONG. -79.546096)				ORIGINATED BY SK											
DIST Central HWY QEW		BOREHOLE TYPE Power Auger, 108 mm I.D. and 209 mm O.D. Hollow Stem				COMPILED BY AMP											
DATUM Geodetic		DATE June 13, 2018				CHECKED BY SMM											
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS		ELEVATION SCALE		DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT		UNIT WEIGHT		REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV	DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES											
113.4	0.0	GROUND SURFACE															
	0.1	ASPHALT (125 mm)															
	1.0	Gravelly sand, some silt (FILL) Compact to very dense Brown Moist		1	SS	111/0.28											
	112.4			2A													
	1.0	Clayey silt, some gravel, trace shale fragments (FILL) Very stiff Grey Moist		2B	SS	20											
	111.9																
	1.5	Silty sand, some gravel, trace organics, trace shale fragments (FILL) Loose to compact Brown Moist to wet		3	SS	17											
				4	SS	3											
	110.2			5A													
	3.2	Sandy CLAYEY SILT, some gravel, trace shale fragments, (TILL) Hard Grey Moist		5B	SS	35											15 25 47 13
	109.7																
	3.7	Inferred moderately weathered, grey, extremely weak to weak SHALE (BEDROCK) (Georgian Bay Formation)		6	SS	89											
				7	SS	54											25 19 44 12
				8	SS	117/0.23											
	107.7	Slightly weathered															
	5.7	Bedrock cored between depths of 5.7 and 7.2 m. For bedrock coring details refer to Record of Drillhole No. SS-28.		1	RC	REC 100%											RQD = 58%
	106.2	END OF BOREHOLE															
	7.2	NOTES: 1. Water level measured in open borehole at a depth of 2.7 m below ground surface upon completion of drilling. 2. Water level measured in standpipe piezometer as follows: Date Depth (m) Elev. (m) June 19/18 2.2 111.2 July 14/18 2.3 111.1															

GTA-MTO 001 S:\CLIENTS\MTQEW-DIXIE02_DATAGINT\QEW-DIXIE.GPJ GAL-GTA GDT 19-5-24

PROJECT: 1530382

RECORD OF DRILLHOLE: SS-28

SHEET 1 OF 1

LOCATION: N 4830501.6 ; E 301079.6

DRILLING DATE: June 13, 2018

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: ---

DRILL RIG: CME 55 (Truck Mounted)

DRILLING CONTRACTOR: Tri-Phase Drilling

DEPTH SCALE METRES	DRILLING RECORD		DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	JN - Joint FLT - Fault SHR - Shear VN - Vein CJ - Conjugate BD - Bedding FO - Foliation CO - Contact OR - Orthogonal CL - Cleavage PL - Planar CU - Curved UN - Undulating ST - Stepped IR - Irregular PO - Polished K - Slickensided SM - Smooth Ro - Rough MB - Mechanical Break BR - Broken Rock <div>NOTE: For additional abbreviations refer to list of abbreviations & symbols.</div>																FEATURES	R0/R1 ZONES	NOTES PIEZOMETER OR STANDPIPE INSTALLATION																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																				
							RECOVERY		R.Q.D. %	FRACT. INDEX PER 0.25 m	DISCONTINUITY DATA				ROCK STRENGTH INDEX			WEATH- ERING INDEX																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																											
							TOTAL CORE %	SOLID CORE %			TYPE AND SURFACE DESCRIPTION	Jr	Ja	R4	R3	R2	R1	W1	W2	W3	W4	W5				W6																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																			
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			Continued from Record of Borehole SS-28		107.69																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																								

FEATURES LEGEND



BROKEN CORE



CLAY SEAM



LIMESTONE



LOST CORE

DEPTH SCALE

1 : 50



GOLDER

LOGGED: SK

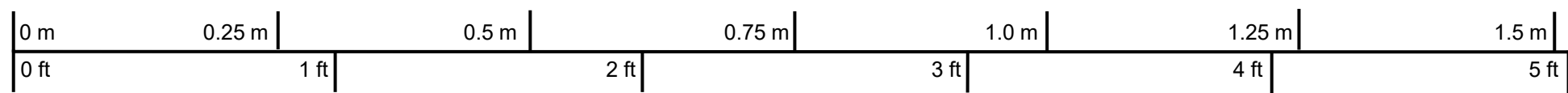
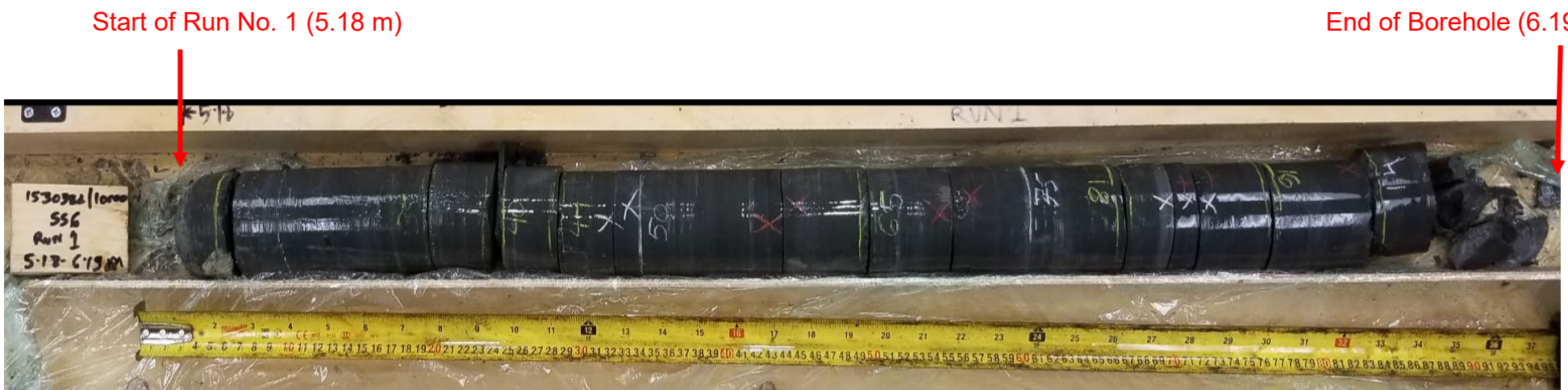
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GTA-RCK 054 S:\CLIENTS\MTQ\QEW-DIXIE\02 DATA\GINT\QEW-DIXIE.GPJ GAL-MISS GDT 19-5-27

PROJECT		1530382		RECORD OF BOREHOLE No SS-29		SHEET 1 OF 1		METRIC								
G.W.P.		2102-13-00 and 2432-13-00		LOCATION		N 4829469.4; E 300018.1 MTM NAD 83 ZONE 10 (LAT. 43.605153; LONG. -79.559239)		ORIGINATED BY SK								
DIST		Central HWY QEW		BOREHOLE TYPE		Power Auger, 150 mm O.D. Solid Stem Augers		COMPILED BY AMP								
DATUM		Geodetic		DATE		June 4, 2018		CHECKED BY SMM								
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa								
100.0	GROUND SURFACE															
99.8	ASPHALT (190 mm)															
0.2	Gravelly sand, trace silt (FILL) Compact Brown to grey Moist		1	SS	20											
99.2																
0.8	Sand, some gravel, some silt, trace clay (FILL) Compact to very dense Reddish-brown to brown Moist		2	SS	25											
			3	SS	21											17 64 15 4
			4	SS	75											
97.0	- Augers grinding at a depth of 3.0 m															
3.0	Silty sand, trace to some clay, trace to some gravel, some clayey silt inclusions (FILL) Loose to compact Black to brown to reddish-brown Moist		5	SS	16											5 66 21 8
			6	SS	5											
95.5																
4.5	Clayey silt with sand, trace to some gravel (FILL) Stiff Brown Moist		7	SS	13											12 36 37 15
94.7																
5.3	Silty sand, some clay, trace organics and wood fragments (FILL) Loose Brown to black Moist to wet		8	SS	9											
			9	SS	7											
93.2																
6.8	Inferred highly weathered, grey, extremely weak to weak SHALE (BEDROCK) (Georgian Bay Formation) - Augers grinding between depths of 7.0 m and 7.6 m		10	SS	100/0.10											
92.4																
7.6	Inferred slightly weathered		11	SS	100/0.13											
			12	SS	100/0.10											
90.8																
9.2	END OF BOREHOLE SPLIT-SPOON REFUSAL		13	SS	100/0.08											
	NOTE: 1. Water level not measured.															

GTA-MTO 001 S:\CLIENTS\MTQEW-DIXIE\02 DATAGINT\QEW-DIXIE.GPJ GAL-GTA.GDT 19-5-24

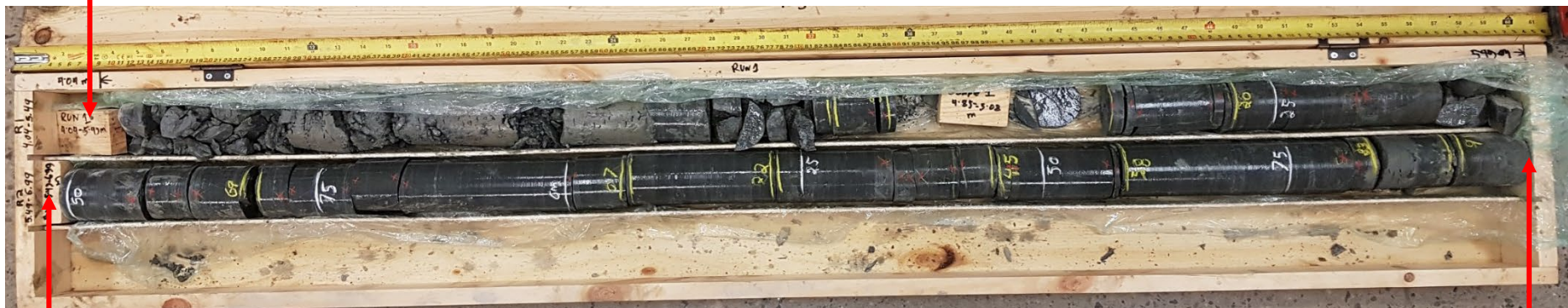
REVISION DATE: January 23, 2018 BY: DCB Project: 1530382



Scale

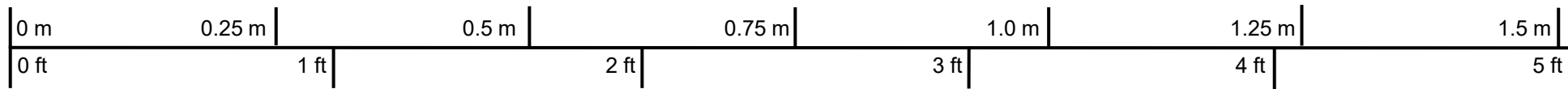
PROJECT		STORM SEWER EAST OF ETOBICOKE CREEK QEW IMPROVEMENTS FROM EAST OF CAWTHRA ROAD TO EAST MALL, CITY OF ETOBICOKE, ONTARIO				
TITLE		Bedrock Core Photographs Borehole SS6 (5.18 m to 6.19 m)				
		PROJECT No. 1530382			FILE No. ----	
		DRAFT	SK	Feb 2019	SCALE	NTS
		CADD	--		FIGURE B-1	
		CHECK	AMP	Feb 2019		
		REVIEW				

Start of Run No. 1 (4.04 m)




Start of Run No. 2 (5.49 m)

End of Borehole (6.99 m)



Scale

PROJECT						
STORM SEWER EAST OF ETOBICOKE CREEK QEW IMPROVEMENTS FROM EAST OF CAWTHRA ROAD TO EAST MALL, CITY OF ETOBICOKE, ONTARIO						
TITLE						
Bedrock Core Photographs Borehole SS9 (4.04 m to 6.99 m)						
 GOLDER	PROJECT No. 1530382			FILE No. ----		
	DRAFT	SK	Feb 2019	SCALE	NTS	VER. 1.
	CADD	--		FIGURE B-2		
	CHECK	AMP	Feb 2019			
	REVIEW					

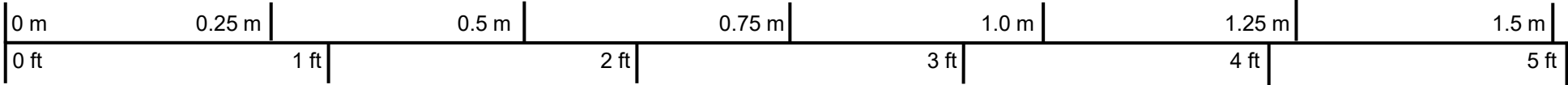
Start of Run No. 1 (3.26 m)

Start of Run No. 2 (4.16 m)




Start of Run No. 3 (5.71 m)

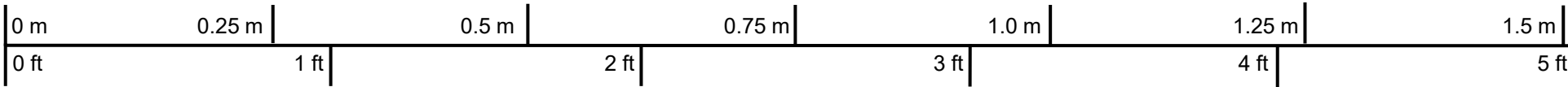
End of Borehole (7.26)




Scale

PROJECT					
STORM SEWER EAST OF ETOBICOKE CREEK QEW IMPROVEMENTS FROM EAST OF CAWTHRA ROAD TO EAST MALL, CITY OF ETOBICOKE, ONTARIO					
TITLE					
Bedrock Core Photographs Borehole SS11 (3.26 m to 7.26 m)					
 GOLDER	PROJECT No. 1530382			FILE No. ----	
	DRAFT	SK	Feb 2019	SCALE	NTS
	CADD	--		FIGURE B-3	
	CHECK	AMP	Feb 2019		
	REVIEW				
				VER.	1.

REVISION DATE: January 23, 2018 BY: DCB Project: 1530382

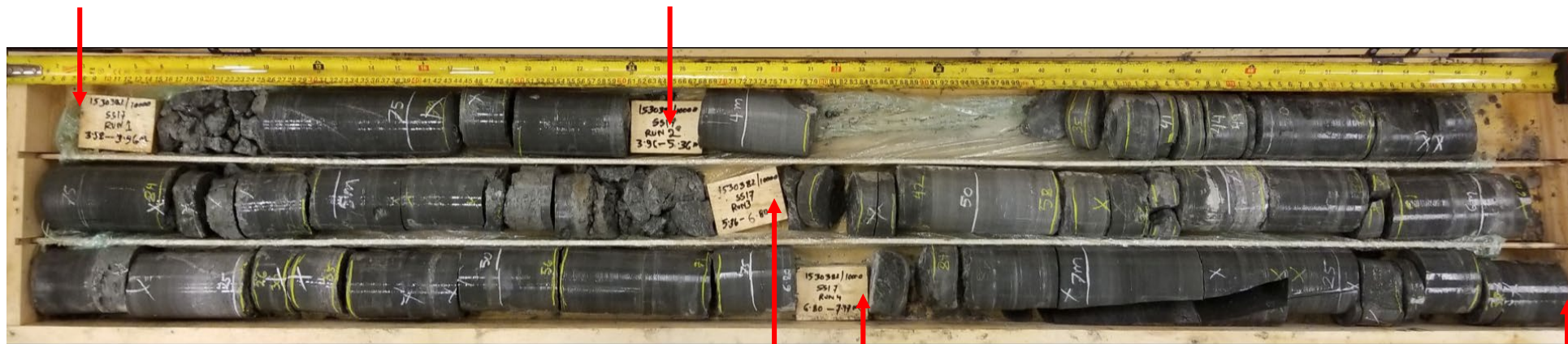


Scale

PROJECT STORM SEWER EAST OF ETOBICOKE CREEK QEW IMPROVEMENTS FROM EAST OF CAWTHRA ROAD TO EAST MALL, CITY OF ETOBICOKE, ONTARIO					
TITLE Bedrock Core Photographs Borehole SS13 (3.17 m to 5.62 m)					
 GOLDER	PROJECT No. 1530382			FILE No. ----	
	DRAFT	SK	Feb 2019	SCALE	NTS
	CADD	--		FIGURE B-4	
	CHECK	AMP	Feb 2019		
	REVIEW				
			VER. 1.		

Start of Run No. 1 (3.58 m)

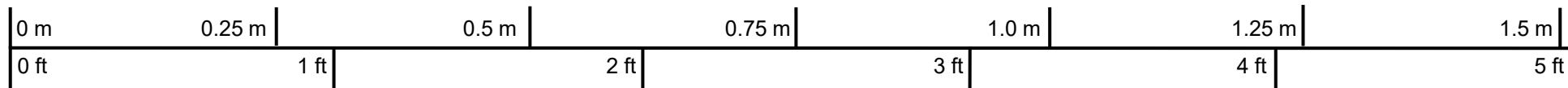
Start of Run No. 2 (3.96 m)




Start of Run No. 3 (5.36 m)

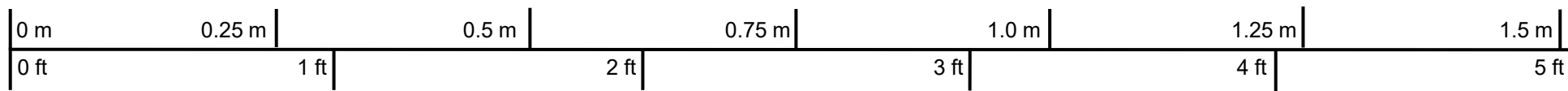
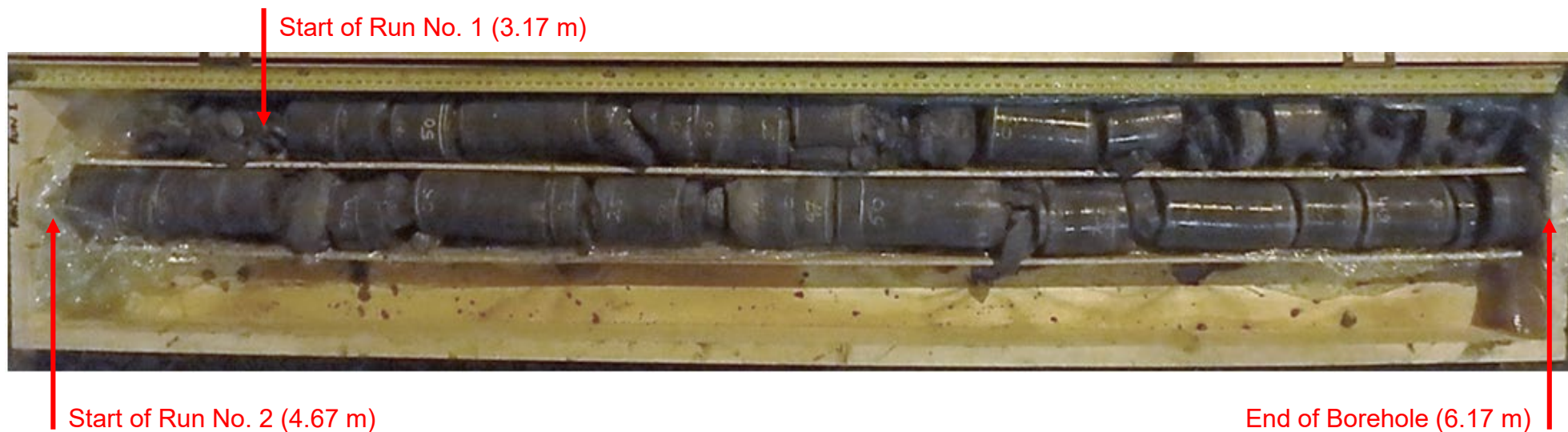
Start of Run No. 4 (6.80 m)

End of Borehole (7.47 m)




Scale

PROJECT		STORM SEWER EAST OF ETOBICOKE CREEK QEW IMPROVEMENTS FROM EAST OF CAWTHRA ROAD TO EAST MALL, CITY OF ETOBICOKE, ONTARIO			
TITLE		Bedrock Core Photographs Borehole SS17 (3.58 m to 7.47 m)			
 GOLDER	PROJECT No. 1530382			FILE No. ----	
	DRAFT	SK	Feb 2019	SCALE	NTS
	CADD	--		FIGURE B-6	
	CHECK	AMP	Feb 2019		
	REVIEW				
			VER. 1.		

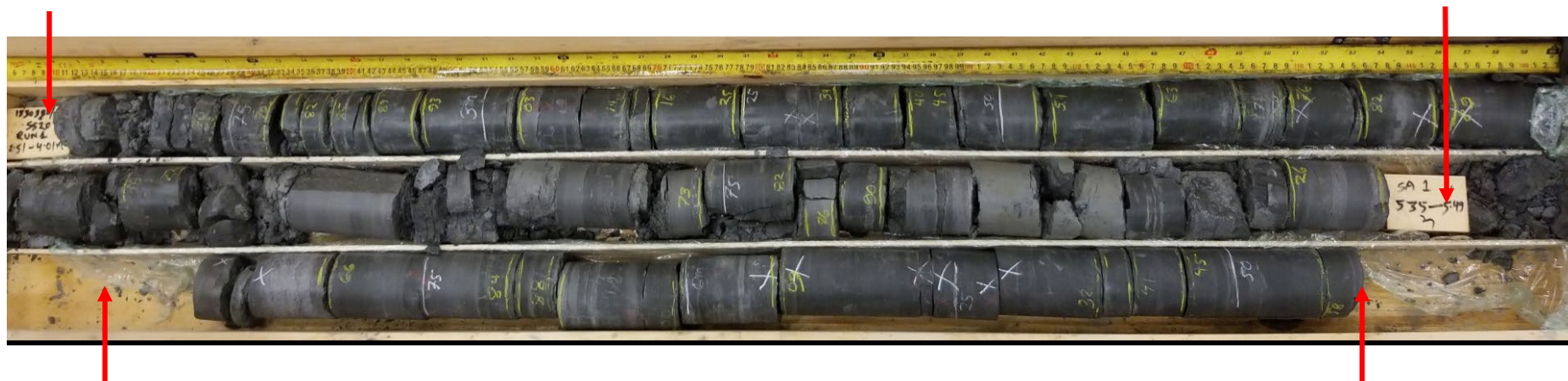


Scale

PROJECT		STORM SEWER EAST OF ETOBICOKE CREEK QEW IMPROVEMENTS FROM EAST OF CAWTHRA ROAD TO EAST MALL, CITY OF ETOBICOKE, ONTARIO				
TITLE		Bedrock Core Photographs Borehole SS18 (3.17 m to 6.17 m)				
 GOLDER		PROJECT No. 1530382			FILE No. ----	
		DRAFT	SK	Feb 2019	SCALE	NTS
		CADD	--		FIGURE B-7	
		CHECK	AMP	Feb 2019		
		REVIEW				
					VER. 1.	

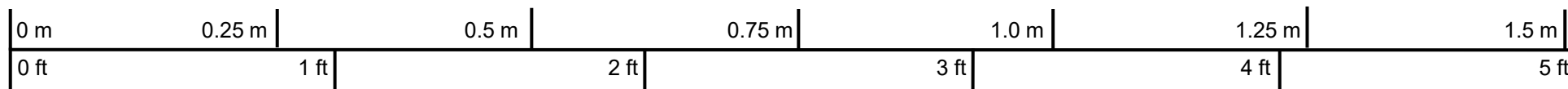
Start of Run No. 1 (2.51 m)

Start of Run No. 2 (4.01 m)




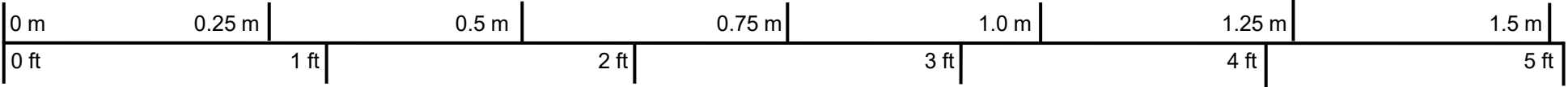
Start of Run No. 3 (5.53 m)

End of Borehole (6.61 m)



Scale

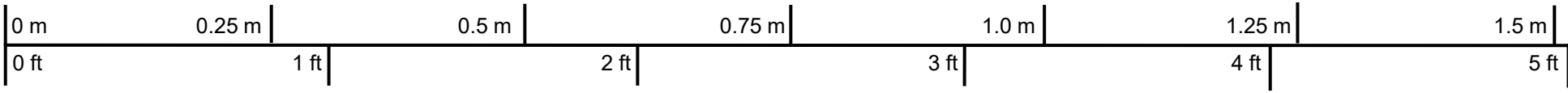
PROJECT					
STORM SEWER EAST OF ETOBICOKE CREEK QEW IMPROVEMENTS FROM EAST OF CAWTHRA ROAD TO EAST MALL, CITY OF ETOBICOKE, ONTARIO					
TITLE					
Bedrock Core Photographs Borehole SS20 (2.51 m to 6.61 m)					
 GOLDER			PROJECT No. 1530382		FILE No. ----
			DRAFT	SK	Feb 2019
			CADD	--	
			CHECK	AMP	Feb 2019
			REVIEW		
			SCALE	NTS	VER. 1.
FIGURE B-8					




Scale

PROJECT		STORM SEWER EAST OF ETOBICOKE CREEK QEW IMPROVEMENTS FROM EAST OF CAWTHRA ROAD TO EAST MALL, CITY OF ETOBICOKE, ONTARIO				
TITLE		Bedrock Core Photographs Borehole SS23 (1.90 m to 6.24 m)				
	PROJECT No. 1530382			FILE No. ----		
	DRAFT	SK	Feb 2019	SCALE	NTS	VER. 1.
	CADD	--		FIGURE B-9		
	CHECK	AMP	Feb 2019			
	REVIEW					

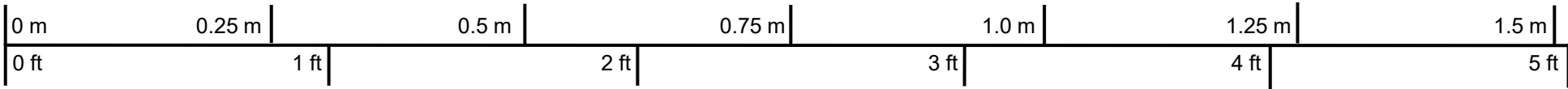
REVISION DATE: January 23, 2018 BY: DCB Project: 1530382




Scale

PROJECT							STORM SEWER EAST OF ETOBICOKE CREEK QEW IMPROVEMENTS FROM EAST OF CAWTHRA ROAD TO EAST MALL, CITY OF ETOBICOKE, ONTARIO									
TITLE							Bedrock Core Photographs Borehole SS25 (3.94 m to 7.41 m)									
							PROJECT No. 1530382			FILE No. ----						
							DRAFT		SK	Feb 2019		SCALE		NTS	VER. 1.	
							CADD		--			FIGURE B-10				
							CHECK		AMP	Feb 2019						
							REVIEW									

REVISION DATE: January 23, 2018 BY: DCB Project: 1530382



Scale

PROJECT						
STORM SEWER EAST OF ETOBICOKE CREEK QEW IMPROVEMENTS FROM EAST OF CAWTHRA ROAD TO EAST MALL, CITY OF ETOBICOKE, ONTARIO						
TITLE						
Bedrock Core Photographs Borehole SS28 (5.71 m to 7.21 m)						
 GOLDER			PROJECT No. 1530382		FILE No. ----	
			DRAFT	SK	Feb 2019	SCALE NTS
			CADD	--		VER. 1.
			CHECK	AMP	Feb 2019	FIGURE B-11
			REVIEW			

REVISION DATE: January 23, 2018 BY: DCB Project: 1530382

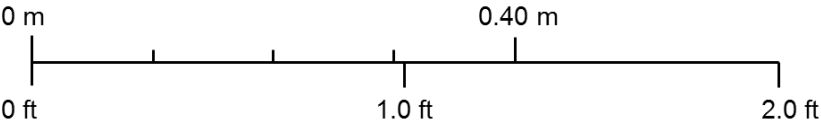
Start of Run No. 1 (7.34 m)

Start of Run No. 2 (7.77 m)


End of Borehole (10.92 m)



Start of Run No. 3 (9.30 m)



Scale

PROJECT STORM SEWER EAST OF ETOBICOKE CREEK QEW IMPROVEMENTS FROM EAST OF CAWTHRA ROAD TO EAST MALL, CITY OF ETOBICOKE, ONTARIO						
TITLE Bedrock Core Photographs Borehole ECB-4 (7.34 m to 10.92 m)						
 GOLDER			PROJECT No. 1530382		FILE No. ----	
			DRAFT	SK	Feb 2019	SCALE NTS
			CADD	--		VER. 1.
			CHECK	AMP	Feb 2019	FIGURE B-12
			REVIEW			

Start of Run No. 1 (7.49 m)

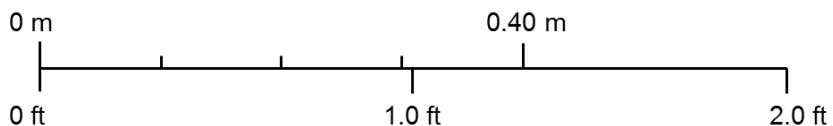
Start of Run No. 2 (7.73 m)

End of Borehole (12.19 m)




Start of Run No. 3 (9.13 m)

Start of Run No. 4 (10.62 m)



Scale

PROJECT		STORM SEWER EAST OF ETOBICOKE CREEK QEW IMPROVEMENTS FROM EAST OF CAWTHRA ROAD TO EAST MALL, CITY OF ETOBICOKE, ONTARIO			
TITLE		Bedrock Core Photographs Borehole ECB-6 (7.49 m to 12.19 m)			
 GOLDER	PROJECT No. 1530382			FILE No. ----	
	DRAFT	SK	Feb 2019	SCALE	NTS
	CADD	--		FIGURE B-13	
	CHECK	AMP	Feb 2019		
	REVIEW				

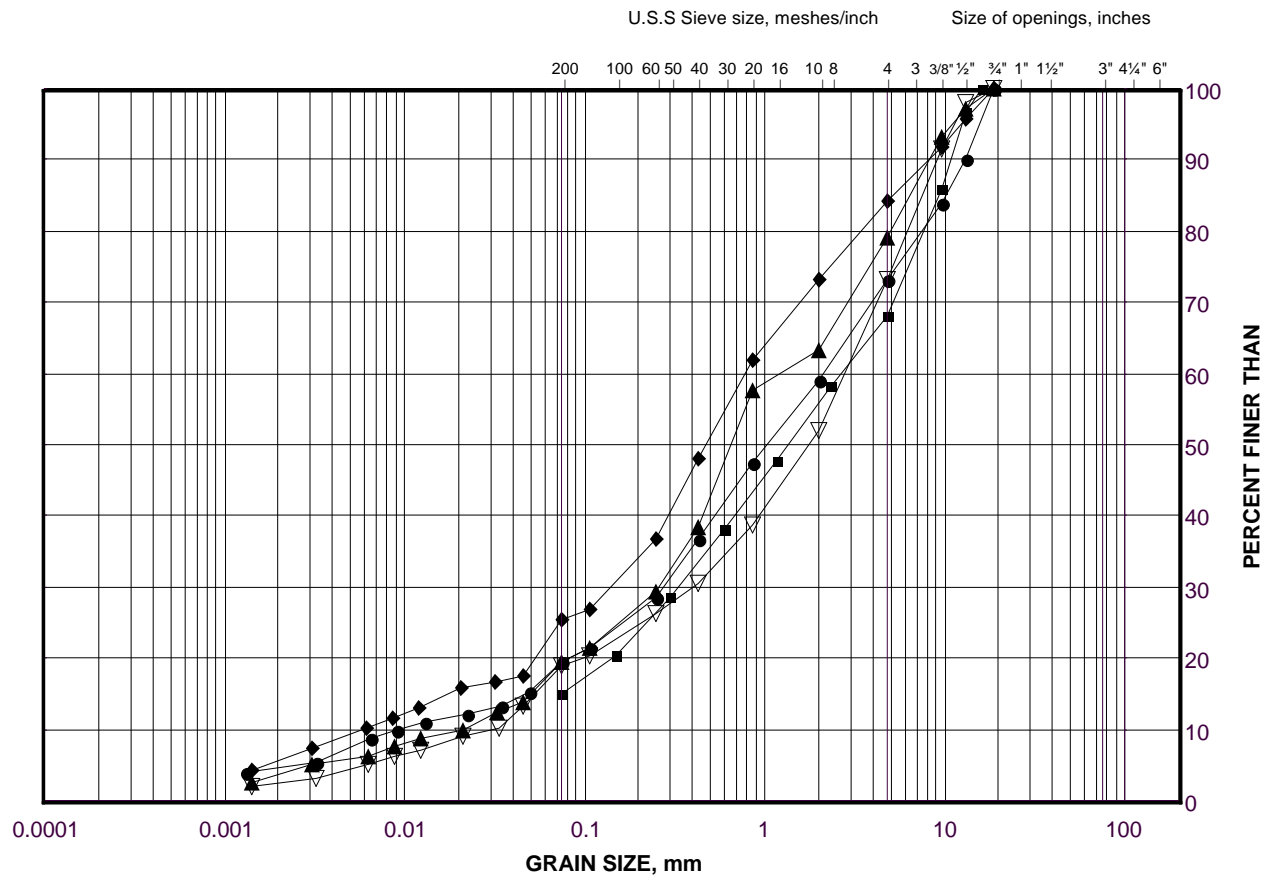
APPENDIX C

**Geotechnical Laboratory Test
Results – Soil and Bedrock**

GRAIN SIZE DISTRIBUTION

Sand to Gravelly Sand to Sand and Gravel (FILL)

FIGURE C-1A



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

LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
●	SS-6	1	102.3
■	SS-25	1	111.2
◆	SS-9	1	103.1
▲	SS-4	1	102.1
▽	SS-16	1A	108.7

Project Number: 1530382

Checked By: AMP

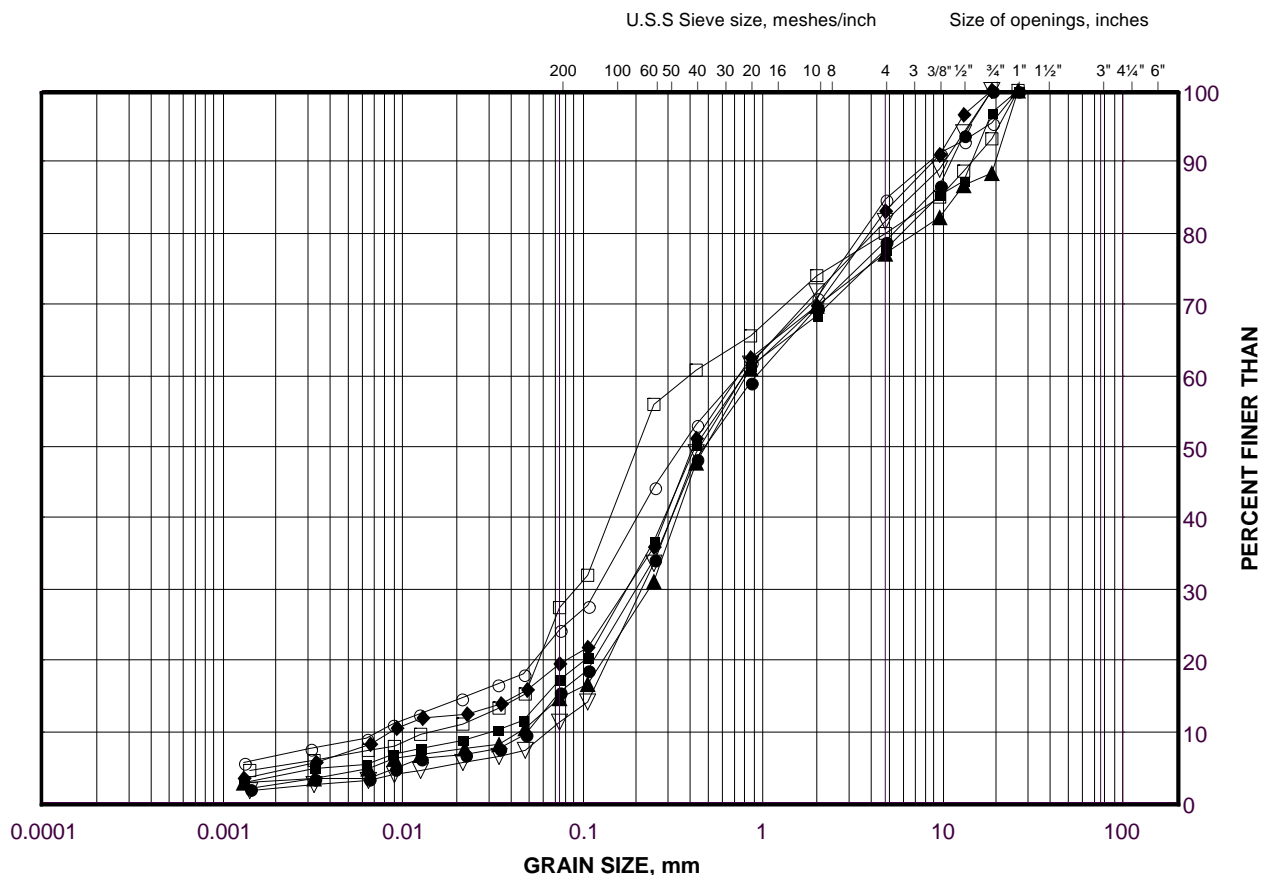
Golder Associates

Date: 09-Feb-19

GRAIN SIZE DISTRIBUTION

Silty Sand to Sand to Gravelly Sand to Sand and Gravel (FILL)

FIGURE C-1B



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

LEGEND

SYMBOL	BOREHOLE	SAMPLE	DEPTH(m)
●	EBC-4	2	98.4
■	ECB-6	2	98.7
◆	SS-29	3	98.2
▲	ECB-6	4	97.1
▽	ECB-4	6	95.4
○	ECB-6	6	95.5
□	ECB-5	8	93.3

Project Number: 1530382

Checked By: _AMP_____

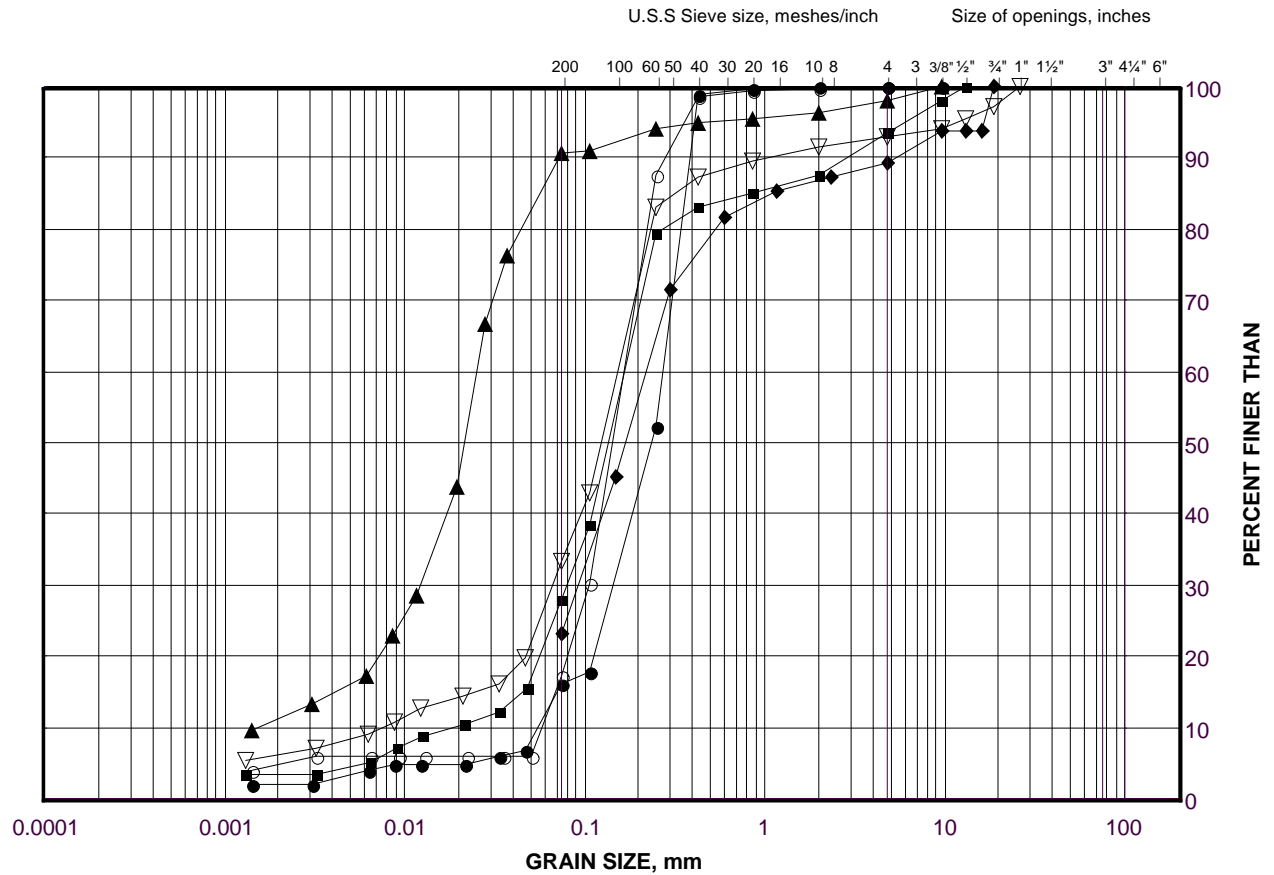
Golder Associates

Date: 13-Feb-19

GRAIN SIZE DISTRIBUTION

Silt to Silty Sand to Sand (FILL)

FIGURE C-2A



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

LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
●	SS-26	2	111.4
■	SS-13	3	106.0
◆	SS-25	3A	110.1
▲	SS-27	3A	111.2
▽	SS-4	8	97.0
○	SS-7	8	95.4

Project Number: 1530382 (10 005)

Checked By: _AMP_____

Golder Associates

Date: 09-Feb-19

Silty Sand to Sand (FILL)

U.S.S Sieve size, meshes/inch

Size of openings, inches

PERCENT FINER THAN

GRAIN SIZE, mm

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

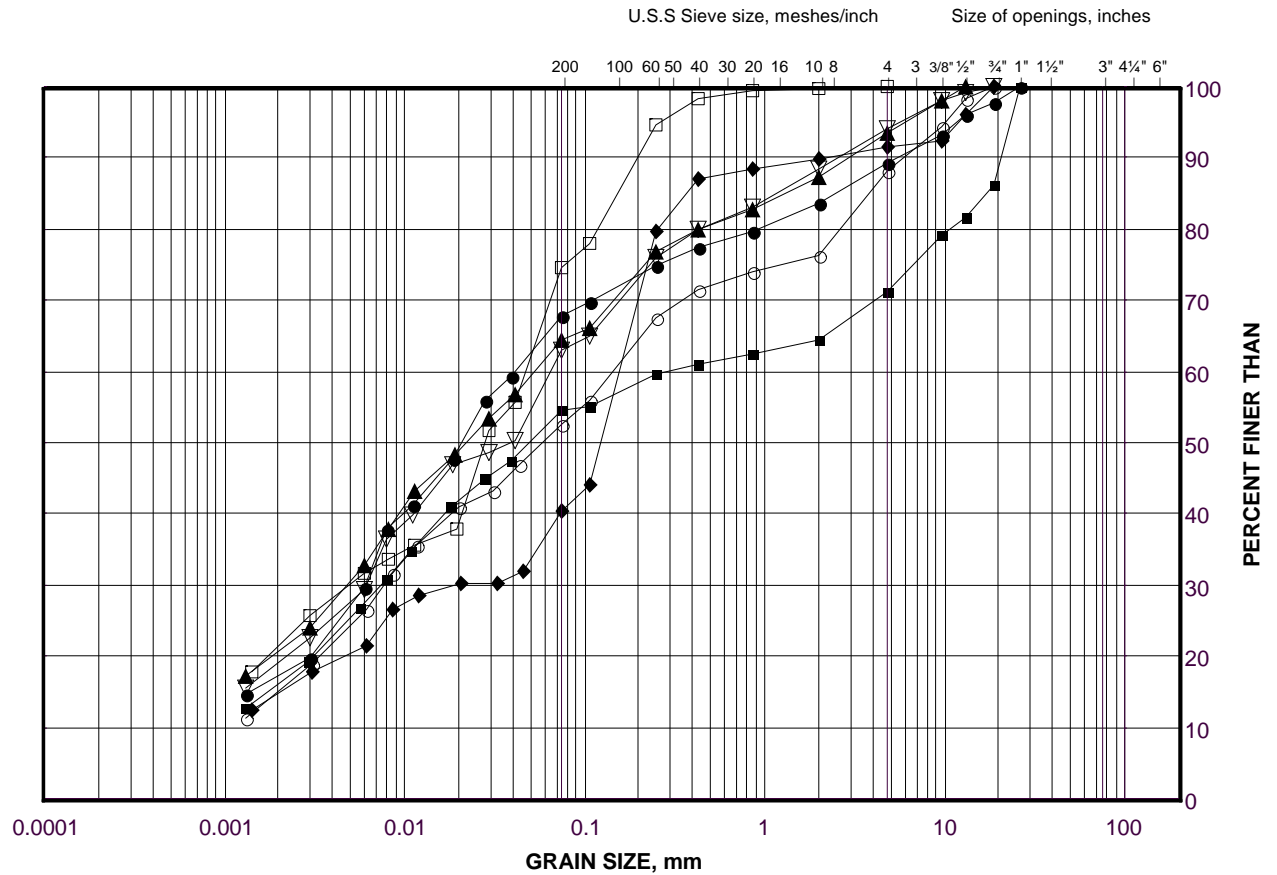
SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
●	ECB-5	2	98.7
■	SS-29	5	96.6
◆	ECB-3	5	96.5

Date: 13-Feb-19

GRAIN SIZE DISTRIBUTION

Gravelly Clayey Silt to Sandy Clayey Silt (FILL)

FIGURE C-3



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

LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
●	SS-17	1	109.1
■	SS-24	2	110.7
◆	SS 7	5	97.6
▲	SS-1	5	98.1
▽	SS-4	6	98.5
○	SS-29	7	95.1
□	SS- 7	9	94.6

Project Number: 1530382

Checked By: _AMP_____

Golder Associates

Date: 13-Feb-19

PLASTICITY CHART

Gravelly Clayey Silt to Clayey Silt with Sand to Clayey Silt (FILL)

Figure No. C-4

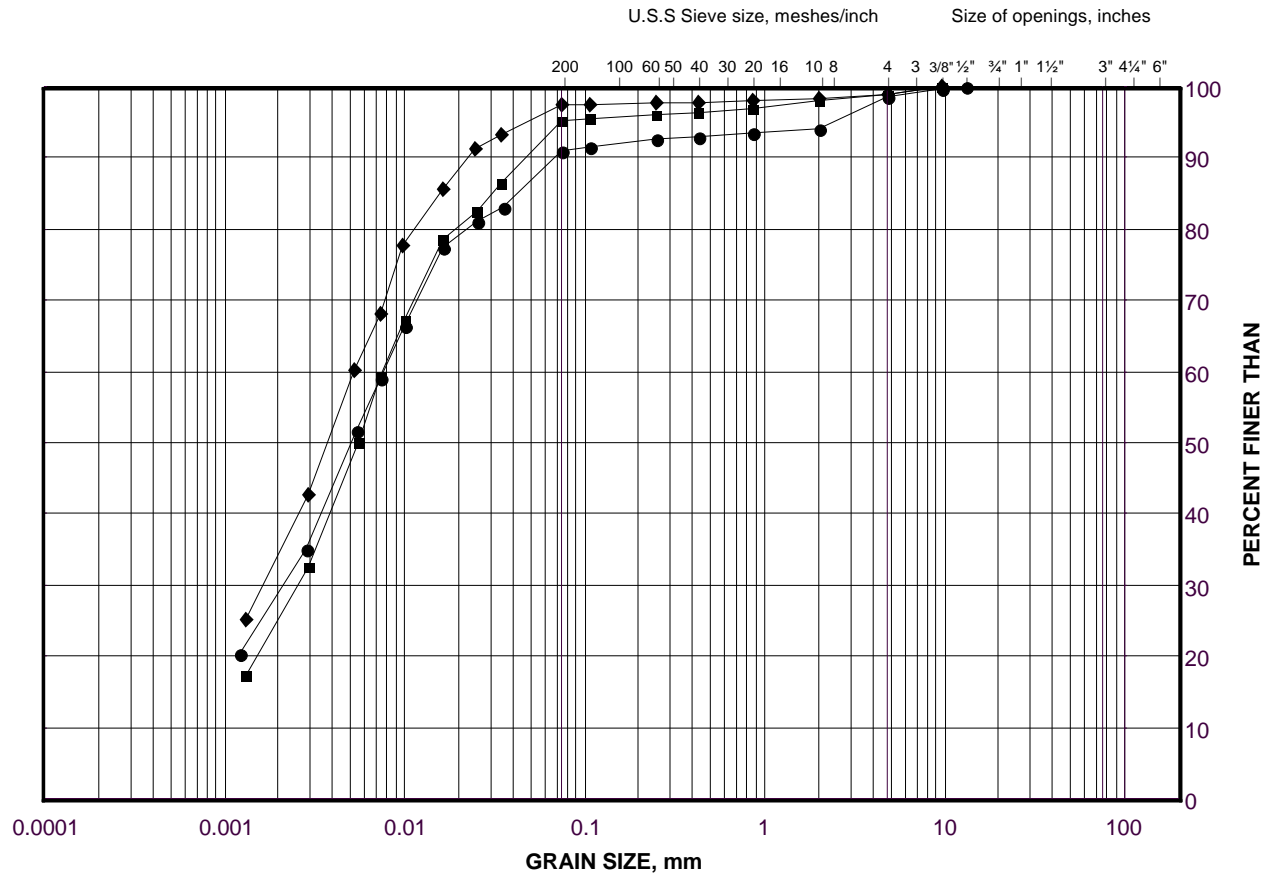
Project No. 1530382

Checked By: AMP

GRAIN SIZE DISTRIBUTION

Clayey Silt to Silty Clay

FIGURE C-5



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

LEGEND

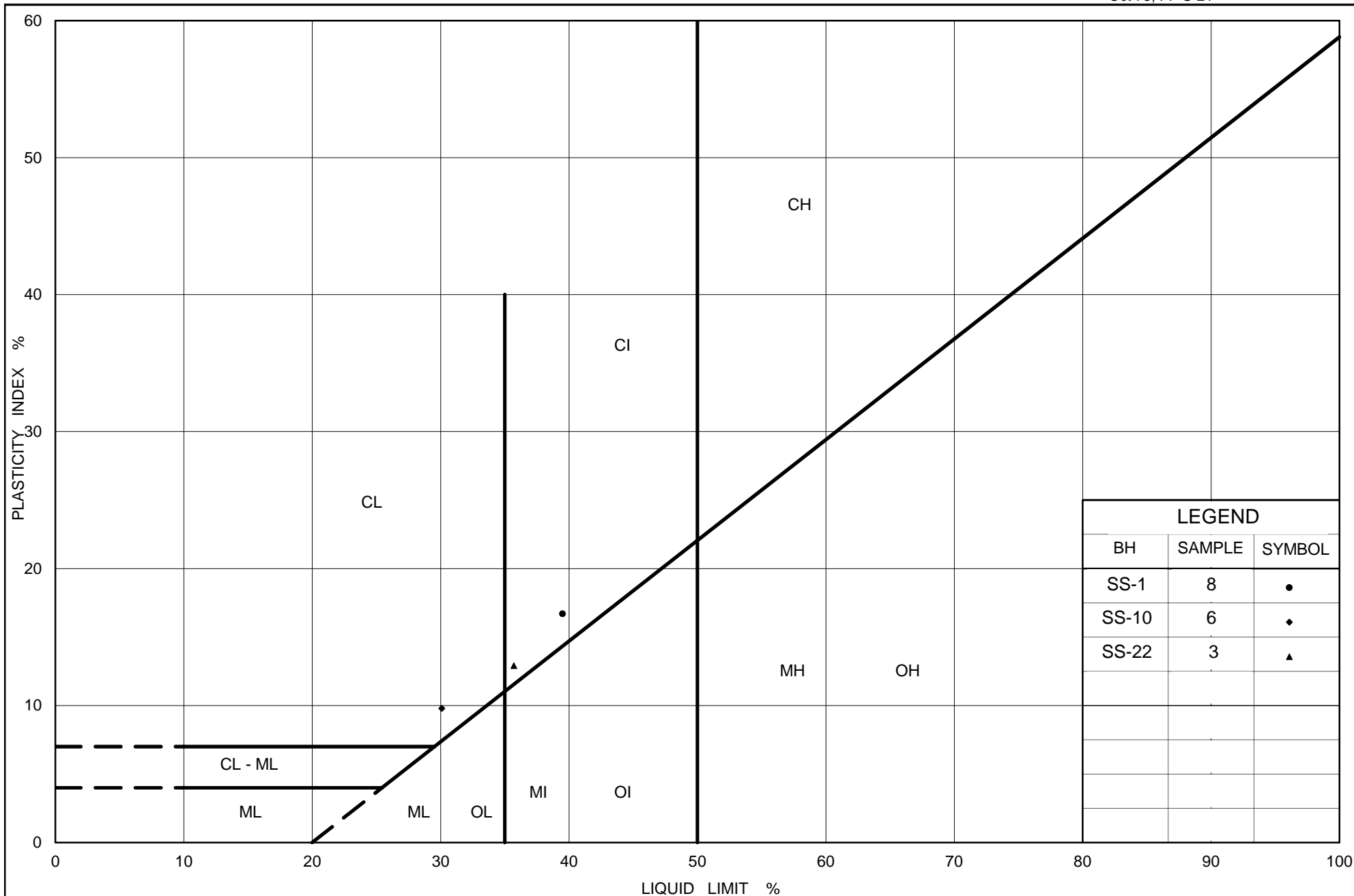
SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
●	SS-22	3	109.3
■	SS-10	6	100.9
◆	SS-1	8	95.8

Project Number: 1530382

Checked By: AMP

Golder Associates

Date: 09-Feb-19



Ministry of Transportation

Ontario

PLASTICITY CHART

Clayey Silt to Silty Clay

Figure No. C-6

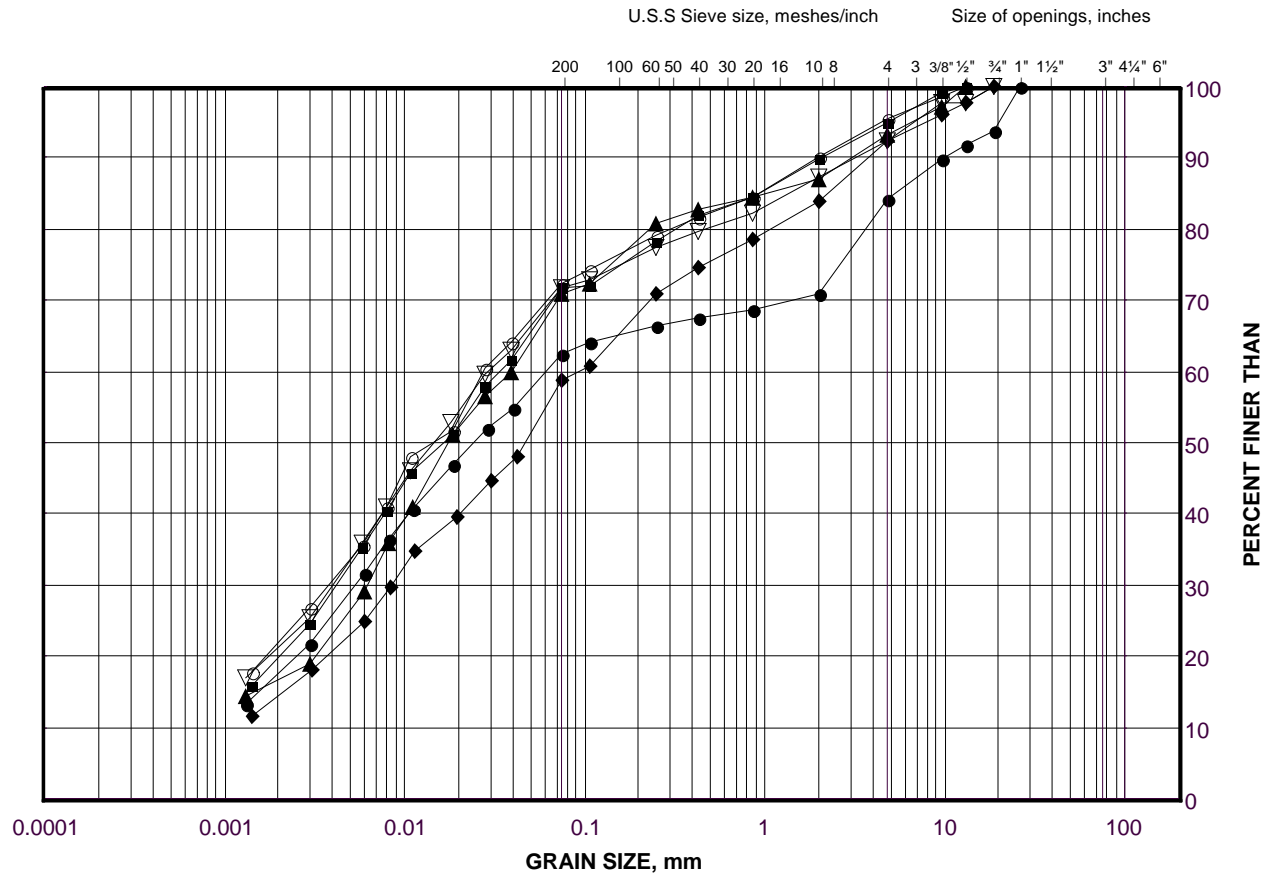
Project No. 1530382

Checked By: AMP

GRAIN SIZE DISTRIBUTION

Clayey Silt with Sand/Gravel to Sandy Clayey Silt (TILL)

FIGURE C-7A



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

LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
●	SS-20	2	108.8
■	SS-16	2	107.9
◆	SS-2	2	102.3
▲	SS24	3	110
▽	SS-5	3	103.3
○	SS-3	3	105.3

Project Number: 1530382 (10 005)

Checked By: AMP

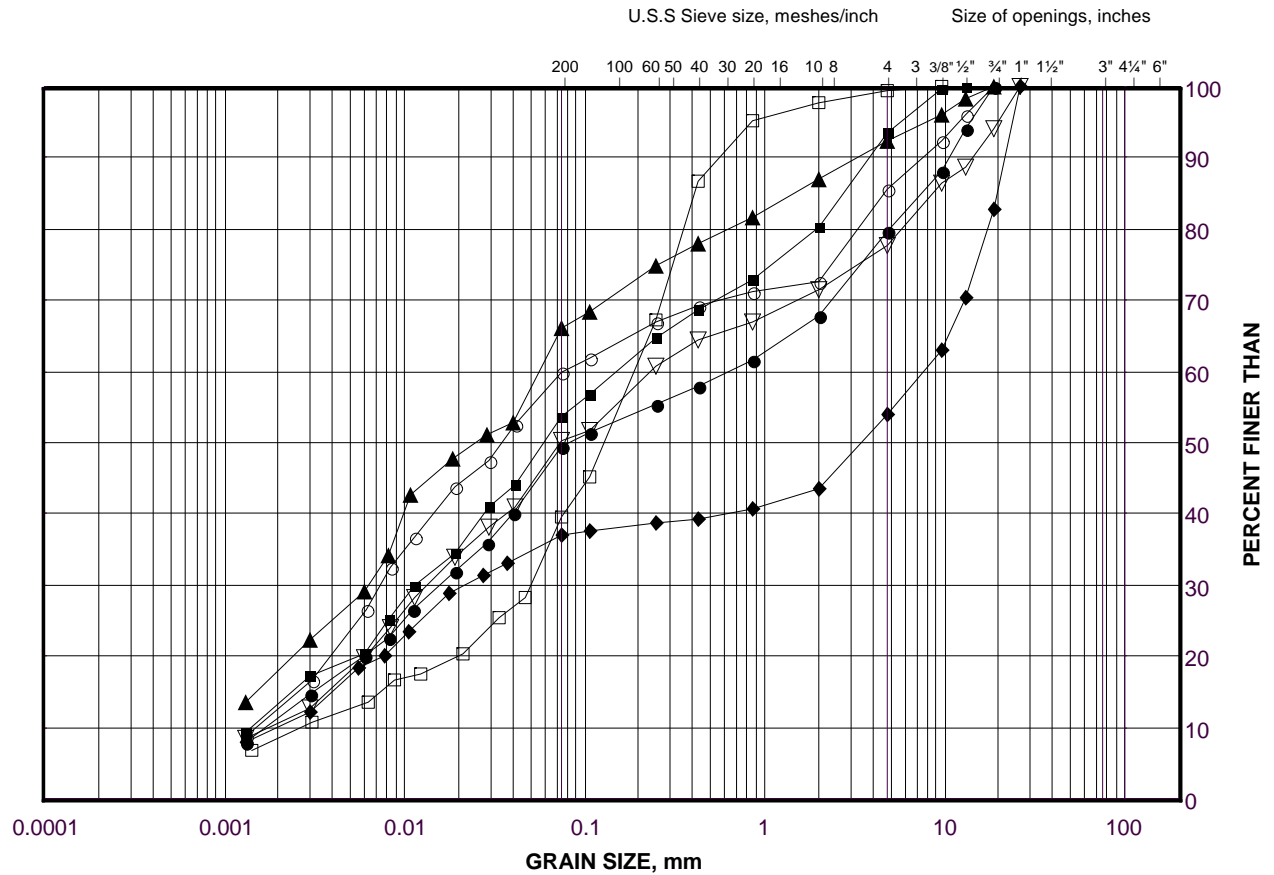
Golder Associates

Date: 22-May-19

GRAIN SIZE DISTRIBUTION

Clayey Silt with Sand/Gravel to Sandy Clayey Silt (TILL)

FIGURE C-7B



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

LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
●	SS-12	3	105.7
■	SS-10	3	103.2
◆	SS-8	3	100.4
▲	SS-10	4	102.4
▽	SS-27	5	109.5
○	SS-28	5B	110.1
□	ECB-3	8	93.4

Project Number: 1530382

Checked By: AMP

Golder Associates

Date: 09-Feb-19



PLASTICITY CHART

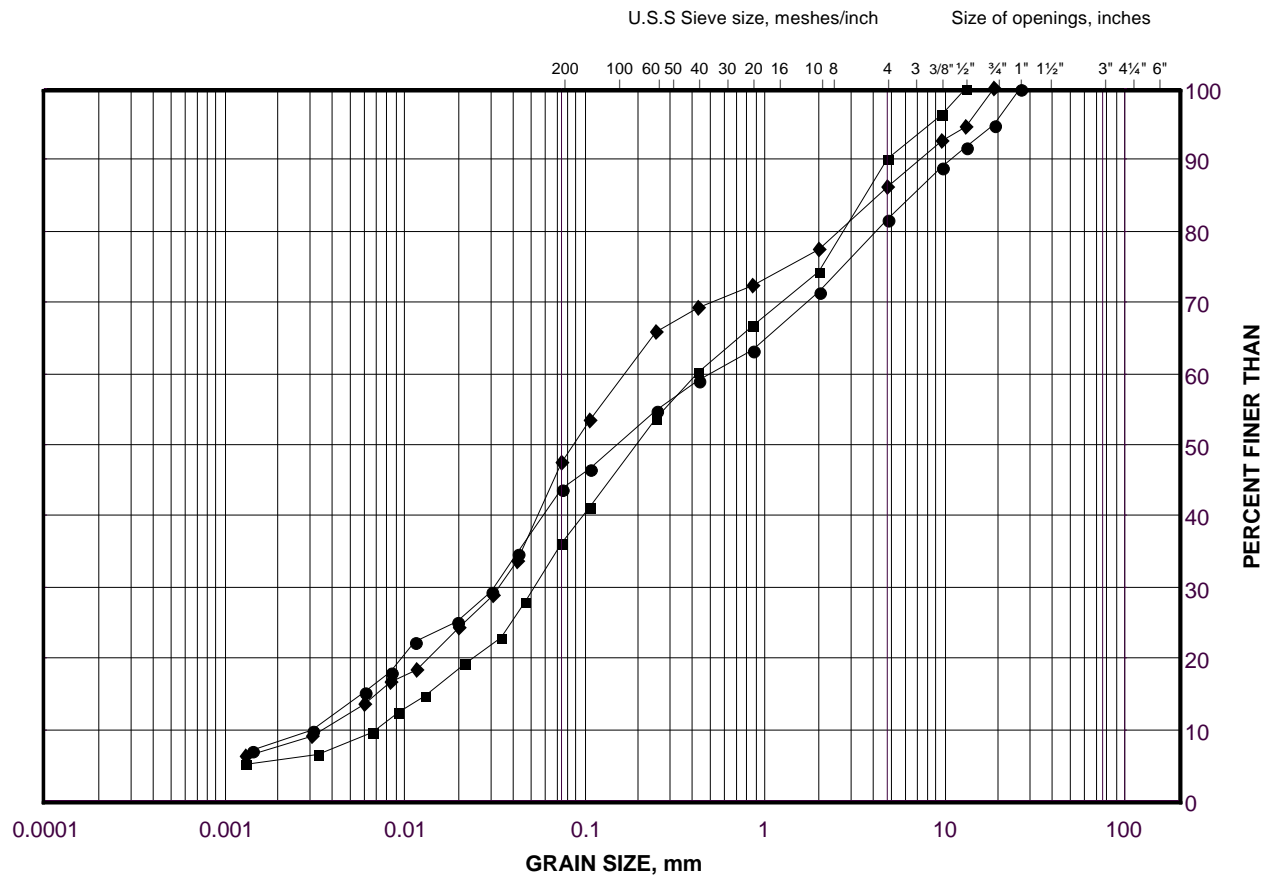
Gravelly Sandy Clayey Silt to Clayey Silt (TILL)

Checked By: AMP

GRAIN SIZE DISTRIBUTION

Silt and Sand (TILL)

FIGURE C-9



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

LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
●	SS-11	2	105.9
■	SS-6	3	101.2
◆	SS-8	4	99.6

Project Number: 1530382 (10 005B)

Checked By: AMP

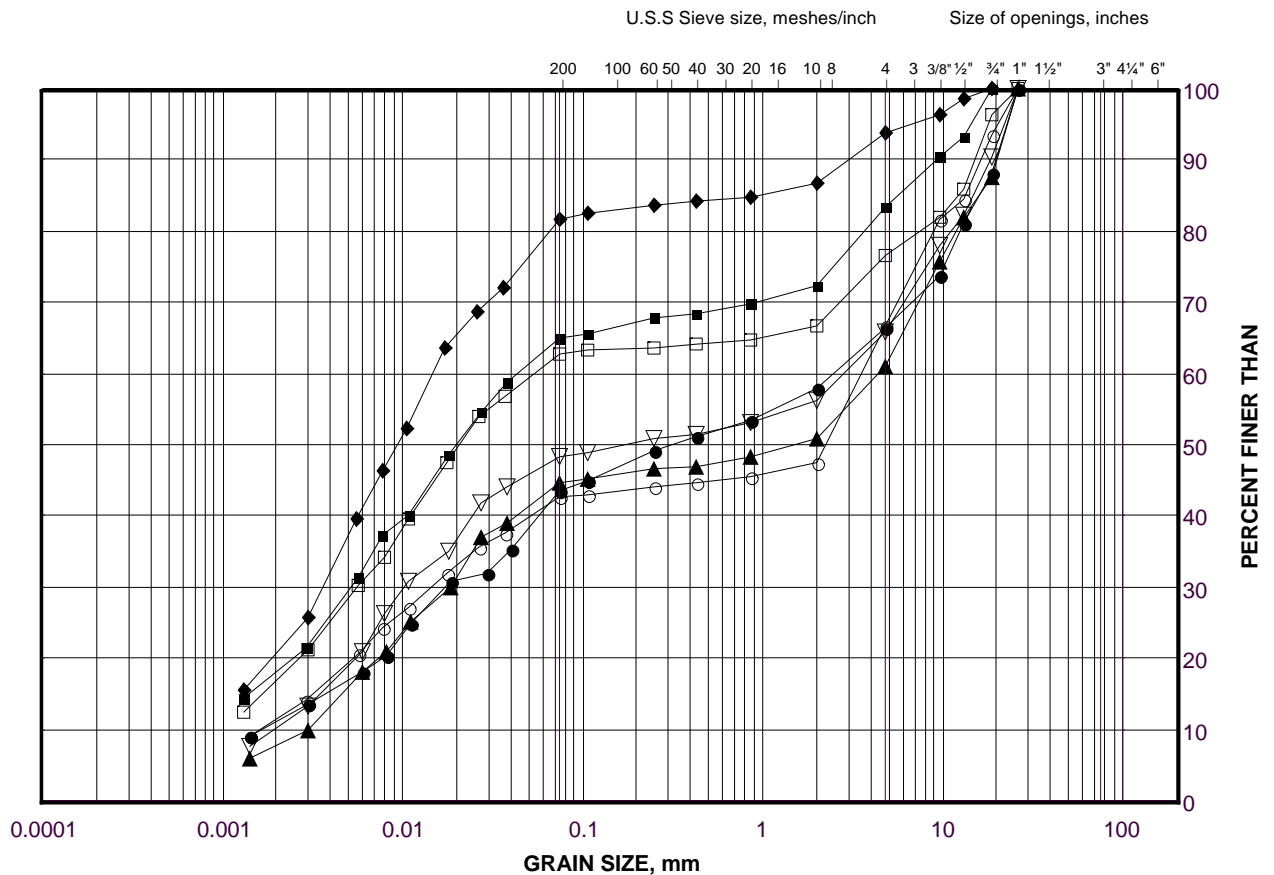
Golder Associates

Date: 16-Jul-18

GRAIN SIZE DISTRIBUTION

Inferred Completely to Moderately Weathered Shale (Bedrock)

FIGURE C-10A



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

LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
●	SS-11	3	104.6
■	SS-25	4	109.1
◆	SS-9	4	100.9
▲	SS-16	4	106.4
▽	SS-14	4	105.9
○	SS-19	5	106.8
□	SS-2	5	100.1

NOTES:

- The samples of inferred completely to moderately weathered bedrock were obtained by split-spoon sampling, and as such, the particle size(s) are effected by the sampling method and are limited to the size of the sampler. Larger fragments of shale bedrock may be present in-situ.
- The percentage of gravel size particles may include shale fragments that either remained intact after or were broken during sampling and sample preparation. Therefore, the results of the grain size distribution testing may not be representative of the bulk grain size distribution or behavior of the in-situ or excavated completely to moderately weathered shale bedrock.

Project Number: 1530382

Checked By: AMP

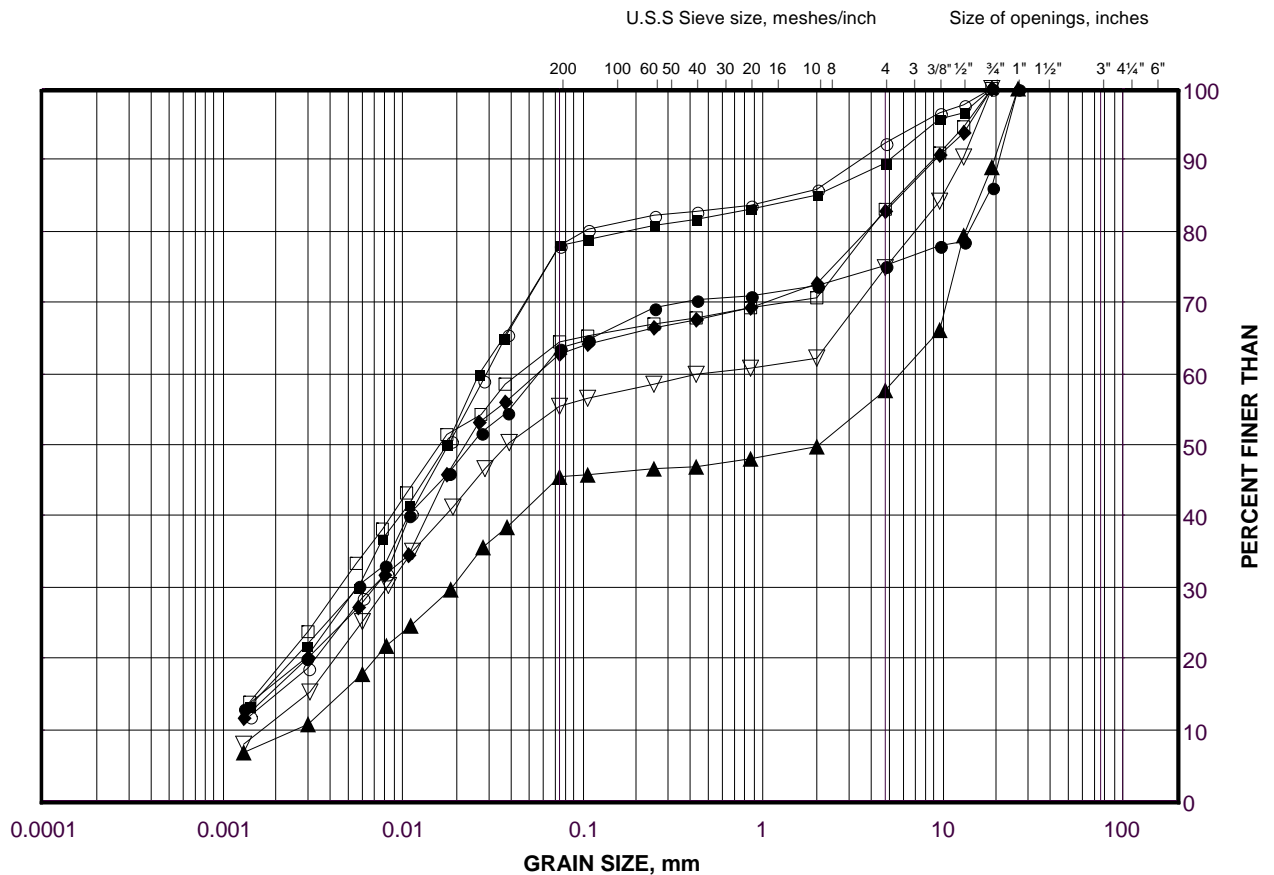
Golder Associates

Date: 09-Feb-19

GRAIN SIZE DISTRIBUTION

Inferred Completely to Moderately Weathered Shale (Bedrock)

FIGURE C-10B



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

LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
●	SS-21	2	109.6
■	SS-26	5	109.3
◆	SS-8	5A	98.8
▲	SS-17	5A	106.3
▽	SS-28	7	108.6
○	SS-5	8	99.5
□	SS-3	8	101.6

NOTES:

- The samples of inferred completely to moderately weathered bedrock were obtained by split-spoon sampling, and as such, the particle size(s) are effected by the sampling method and are limited to the size of the sampler. Larger fragments of shale bedrock may be present in-situ.
- The percentage of gravel size particles may include shale fragments that either remained intact after or were broken during sampling and sample preparation. Therefore, the results of the grain size distribution testing may not be representative of the bulk grain size distribution or behavior of the in-situ or excavated completely to moderately weathered shale bedrock.

Project Number: 1530382

(Checked By: AMP)

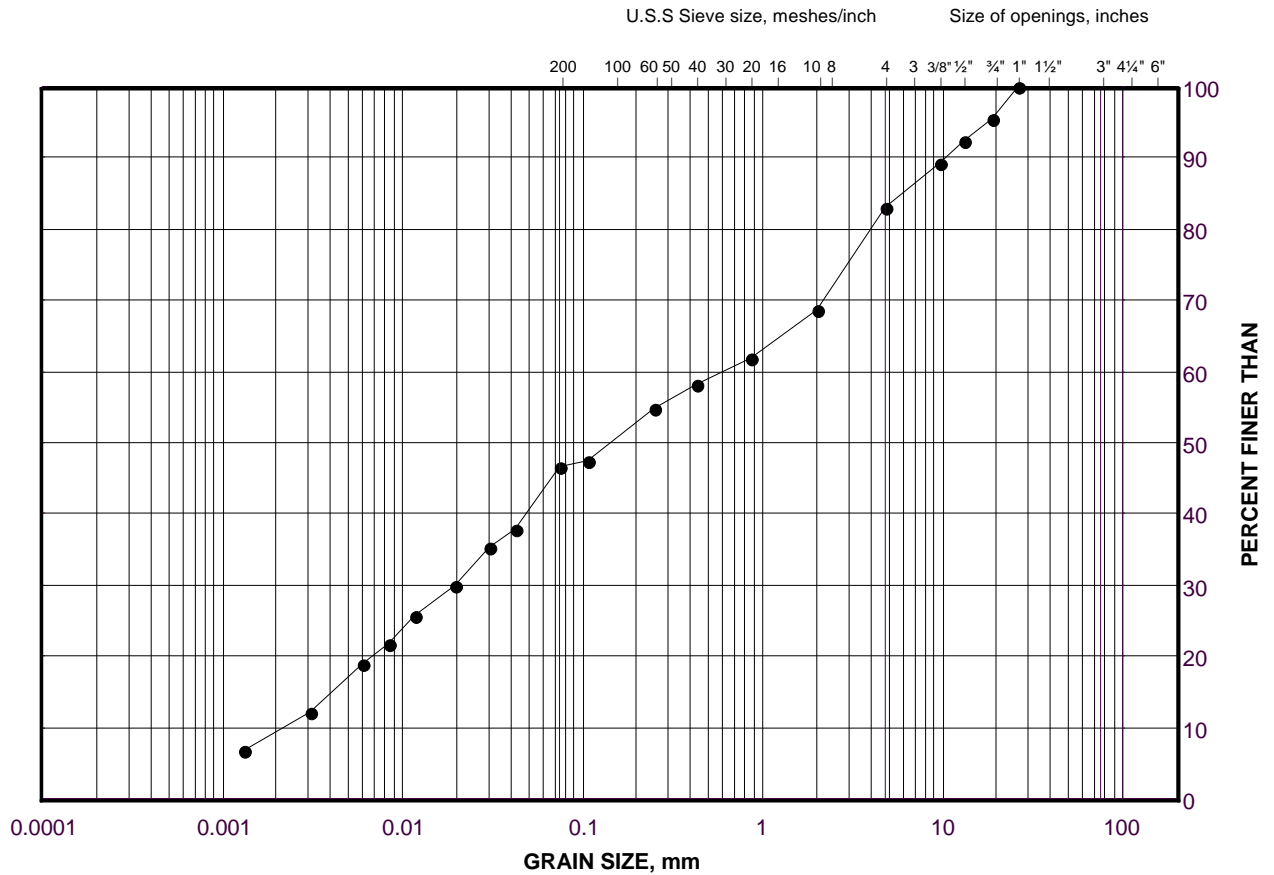
Golder Associates

Date: 09-Feb-19

GRAIN SIZE DISTRIBUTION

Inferred Completely to Moderately Weathered Shale (Bedrock)

FIGURE C-10C



LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
•	SS-18	3	107.7

NOTES:

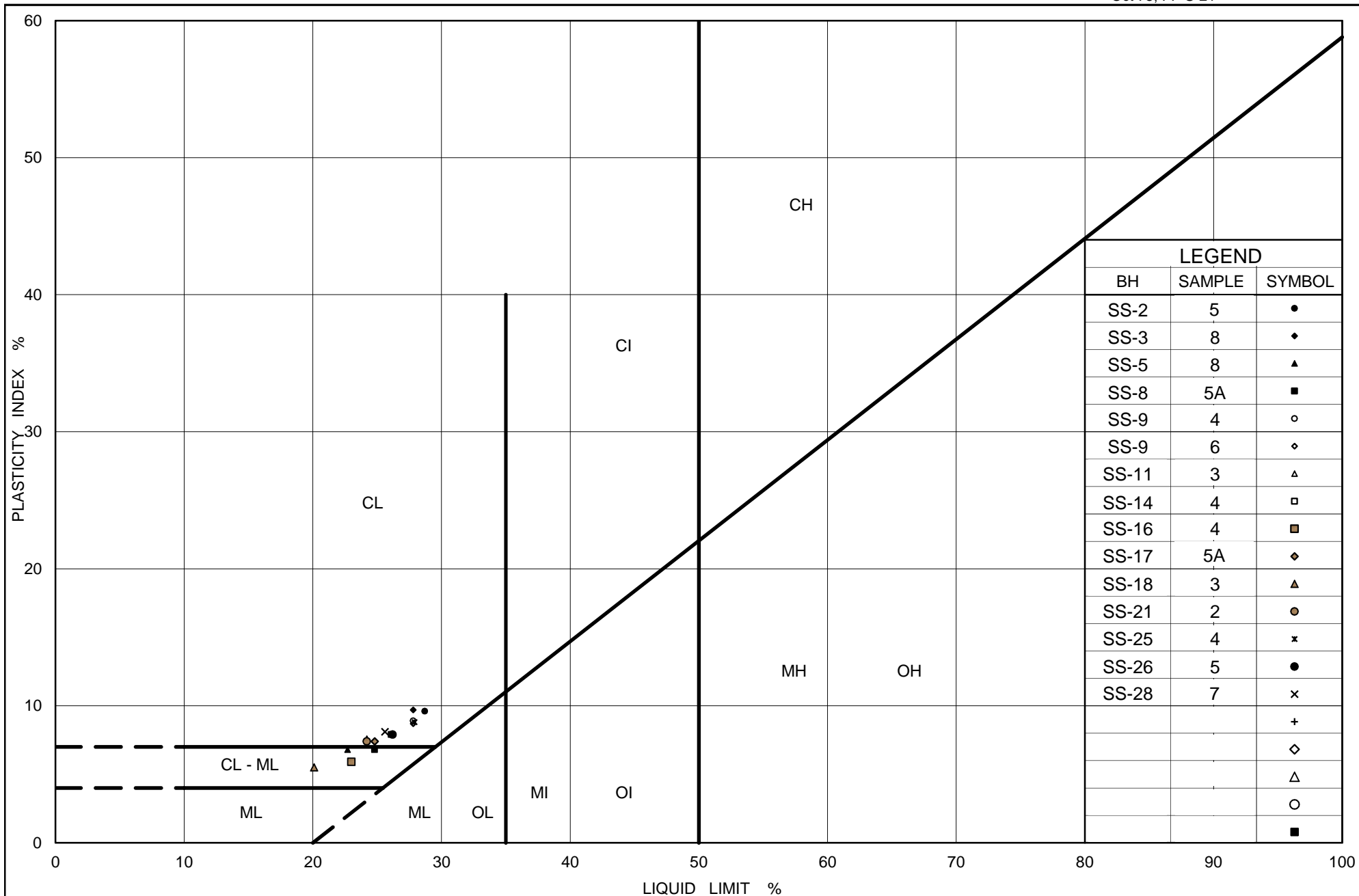
1. The sample of inferred completely to moderately weathered bedrock was obtained by split-spoon sampling, and as such, the particle size(s) are effected by the sampling method and are limited to the size of the sampler. Larger fragments of shale bedrock may be present in-situ.
2. The percentage of gravel size particles may include shale fragments that either remained intact after or were broken during sampling and sample preparation. Therefore, the results of the grain size distribution testing may not be representative of the bulk grain size distribution or behavior of the in-situ or excavated completely to moderately weathered shale bedrock.

Project Number: 1530382 (10 005)

Checked By: _AMP_____

Golder Associates

Date: 22-May-19



Ministry of
Transportation

Ontario

PLASTICITY CHART

Inferred Completely to Moderately Weathered Shale (Bedrock)

Figure No. C-11

Project No. 1530382

Checked By: AMP

Bedrock Core Sample Test Results
Boreholes ECB-2, Run #2 and ECB-4 Run #2
Summary of Batch #5 (2016) Failure Test Results – Project # 1530382
July, 2016

Borehole/Sample (depth, m)	Density (g/cm ³)	Young's Modulus (MPa)	Poisson's ratio	UCS (MPa)
ECB-2-1 (9.80-10.00)	2.45	47.0	0.16	1.0
ECB-4-1 (8.83-9.15)	2.56	542.1	0.29	7.1

Reference

-
- Testing carried out by Queens University and the results were reported in a letter dated July 13, 2016.

Pre-Test Specimen Photos



Post-Test Specimen Photos



Bedrock Core Sample Test Results
(Borehole ECB-4 Run #3)
Summary of Batch #5 (2016) Failure Test Results – Project # 1530382
Batch #2 - July, 2016

Borehole/Sample (depth, m)	Density (g/cm ³)	Young's Modulus (MPa)	Poisson's ratio	UCS (MPa)
ECB-4-2 (10.20-10.35)	2.57	402.3	0.28	4.5

Pre-Test Specimen Photos



Post-Test Specimen Photos



July 6, 2018

Mr. Shantanu Kar
Golder Associates Ltd.
6925 Century Avenue, Suite #100
Mississauga, Ontario
Canada L5N 7K2

Re: UCS+E testing
(Golder Project No. 1530382 Phase 10005)

Dear Mr. Kar:

On June 7, 2018 and June 25, 2018, a series of four (4) HQ-sized core samples and seven (7) HQ-sized core samples were received by Geomechanica Inc. via drop-off, respectively. These samples were identified as being from Golder project 1530382 Phase 10005. From these samples, eight (8) UCS tests were completed.

Details regarding the steps of specimen preparation and testing along with the test results and photographs of the test specimens before and after testing are presented in the accompanying laboratory report and spreadsheets.

Sincerely,



Bryan Tatone Ph.D., P. Eng.

Geomechanica Inc.
Tel: (647) 478-9767
Email: bryan.tatone@geomechanica.com

Rock Laboratory Testing Results

A report submitted to:

Shantanu Kar
Golder Associates Ltd.
6925 Century Avenue, Suite #100
Mississauga, Ontario
Canada L5N 7K2

Prepared by:

Bryan Tatone, PhD, PEng
Omid Mahabadi, PhD, PEng
Geomechanica Inc
#900-390 Bay St
Toronto ON
M5H 2Y2 Canada
Tel: +1-647-478-9767
info@geomechanica.com

July 6, 2018

Project number: 1530382-10005

Abstract

This document summarizes the results of Uniaxial Compressive Strength (UCS) laboratory testing of HQ-sized core samples obtained during the drilling investigation for Golder Project no. 1530382 Phase 10005.

In this document:

1	Uniaxial Compressive Strength Tests	1
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1 Uniaxial Compressive Strength Tests

1.1 Overview

This section summarizes the results of uniaxial compressive strength testing of HQ-sized specimens. The testing was performed in Geomechanica's rock testing laboratory using a 150 ton (1.3 MN) Forney loading frame equipped with a pressure-compensated control valve to maintain an axial displacement rate of approximately 0.175 mm/min (Figure 1). The specimen preparation and testing procedure included the following:

1. Unwrapping of the core sample, inspecting it for damage, and re-wrapping it in electrical tape to minimize exposure to moisture during subsequent specimen preparation.
2. Diamond cutting of core sample to obtain cylindrical specimens with an appropriate length (length:diameter = 2:1) and nearly parallel end faces.
3. Diamond grinding of specimen to obtain flat (within ± 0.025 mm) and parallel end faces (within 0.25°).
4. Placement of the specimen into the loading frame, applying a 1 kN axial load, and removing the electrical tape.
5. Axially loading the specimens to rupture while continuously recording axial force and axial deformation to determine the peak strength (UCS) and tangent Young's modulus (E).



Figure 1: Forney loading frame setup for uniaxial compression testing.

Using a precision V-block mounted on the magnetic chuck of the surface grinder, test specimens met the end flatness, end parallelism, and perpendicularity criteria set out in ASTM D4543-08. The side straightness criteria, as checked with a feeler gauge, was met for all samples. The minimum length:diameter criteria was met for four samples, but could not be met for four samples due to the short sample lengths provided for testing combined with difficulties in prepping the samples without them experiencing delamination along fissility planes. Testing of the specimens followed ASTM D7012-14 with the following exceptions:

- Rather than a spherical seat diameter equal to 1 to 2 times the specimen diameter, the setup used here employed a 25.4 mm diameter high precision ball bearing and seat. Despite the smaller diameter, this seat could move freely to accommodate small angular rotations in any direction, as needed, and therefore did not appreciably influence the results.
- The performed tests included measurement of the UCS and elastic modulus, but not the Poisson's ratio. This represents a hybrid between Methods C and D of ASTM D7012-14.

1.2 Results

The results of UCS testing are summarized in Table 1. Additional details and measurements for each test specimen are included in the summary spreadsheet that accompanies this report. The corresponding stress-strain curves are presented in Figures 2 and 3. The Young's modulus values presented in Table 1 represent the tangent modulus, calculated as the slope of the best fit line through ± 300 data points on either side of the point representing 50% of the UCS, unless noted otherwise.

Table 1: Summary of UCS test results.

Sample ID	Lithology description	Depth (m)	Bulk density, ρ (g/cm ³)	UCS (MPa)	Young's modulus, E_{50} (GPa)	Failure notes
SS6, SA-1	Georgian Bay Formation - shale with 3 limestone layers 5-10 mm thick	5.97 - 6.14	2.61	14.9	0.70	axial splitting ¹
SS9, SA-1	Georgian Bay Formation - shale	4.85 - 5.08	2.62	10.6	0.43	inclined shear fracture ¹
SS13, SA-1	Georgian Bay Formation - shale	3.47 - 3.68	2.59	19.3	0.96	inclined shear band ¹
SS17, SA-1	Georgian Bay Formation - shale with several partial limestone lenses	4.07 - 4.32	2.04	9.7	0.21	inclined shear band ¹
SS18, SA-1	Georgian Bay Formation - shale	3.51 - 3.65	2.59	11.7	0.56	axial splitting ^{1,2}
SS23, SA-1	Georgian Bay Formation - shale & siltstone	5.52 - 5.66	2.59	13.6	0.56	localized crushing near platens ^{1,2}
SS25, SA-1	Georgian Bay Formation - shale	5.51 - 5.68	2.56	10.6	0.42	Hourglass failure ^{1,2}
SS28, SA-1	Georgian Bay Formation - siltstone	6.18 - 6.30	2.59	11.9	0.67	localized crushing near platens ^{1,2}

¹ Specimen emitted pore water upon loading

² Length:diameter ratio < 2

1.3 Specimen photographs

Photographs of the specimens after testing are presented in Figures 4 and 5.

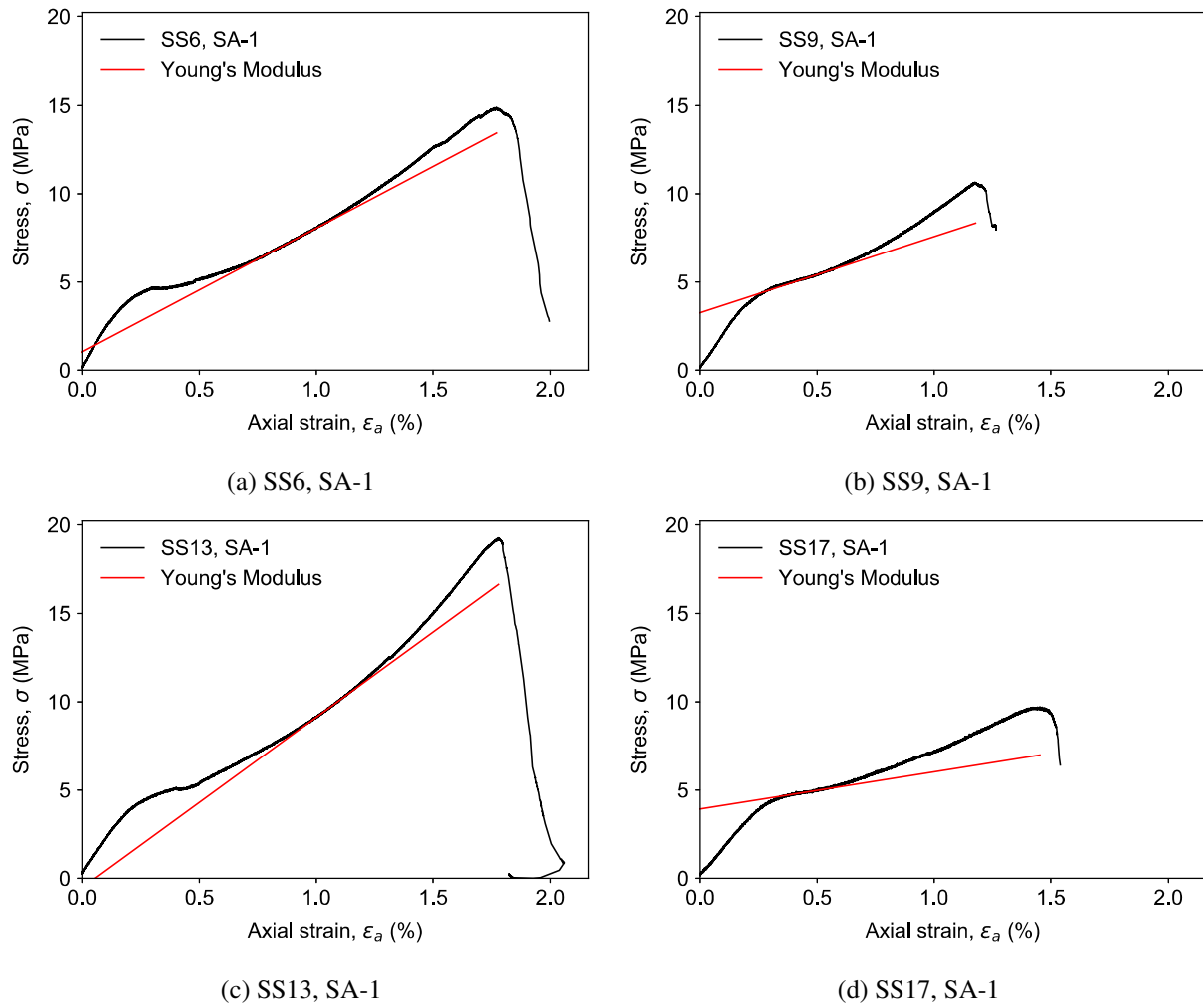
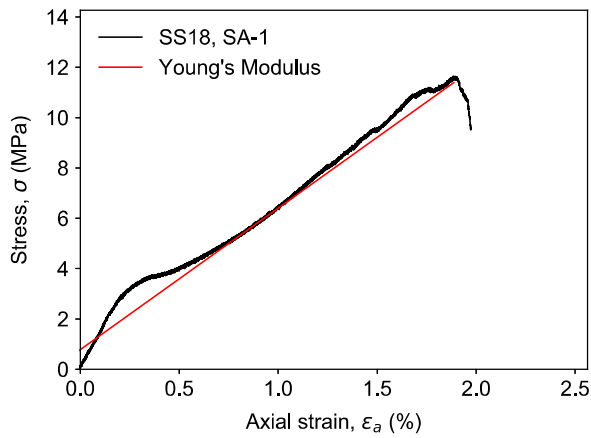
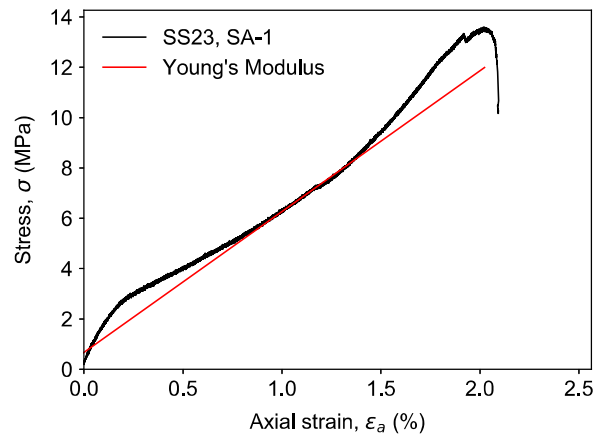


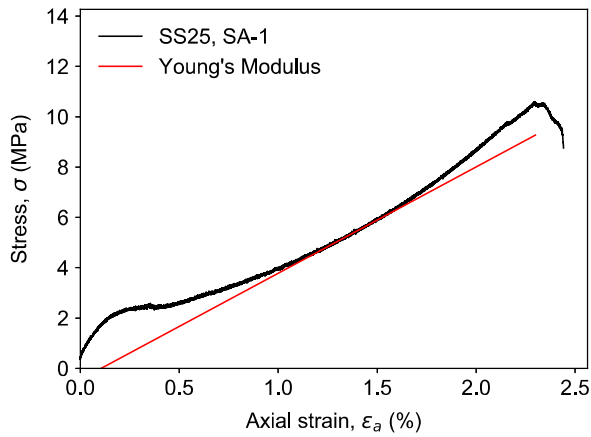
Figure 2: Measured stress-strain curves.



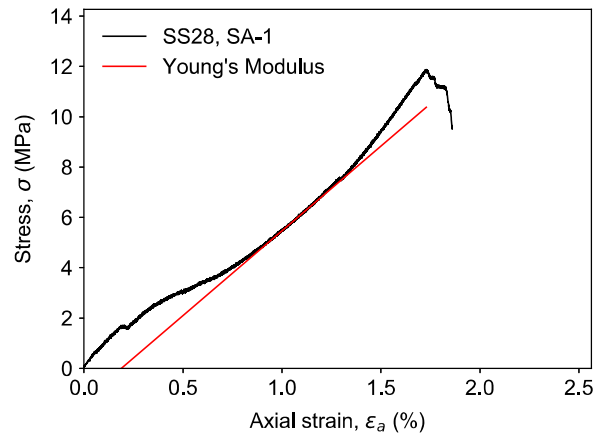
(a) SS18, SA-1



(b) SS23, SA-1



(c) SS25, SA-1



(d) SS28, SA-1

Figure 3: Measured stress-strain curves (continued).



Figure 4: Photographs of UCS specimens before testing (top) and after testing (bottom).

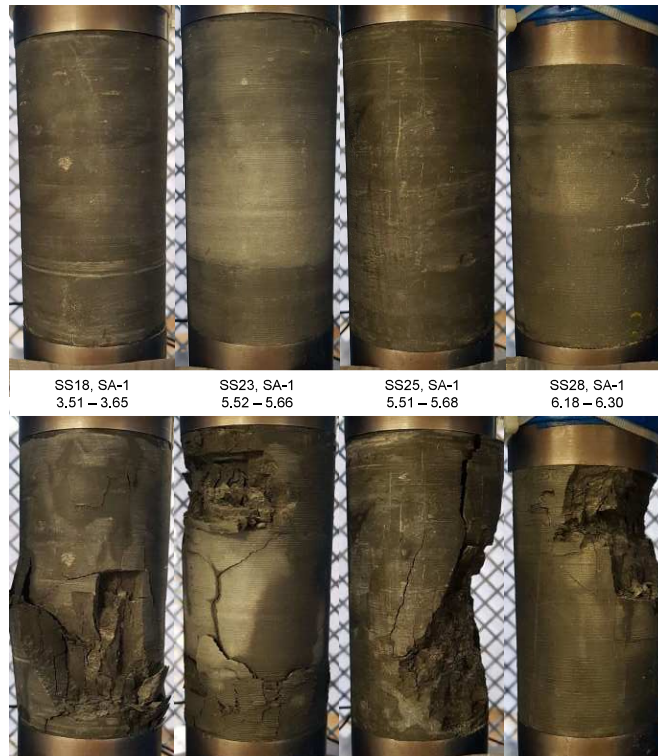


Figure 5: Photographs of UCS specimens before testing (top) and after testing (bottom) (continued).

APPENDIX D

Analytical Laboratory Test Results

CLIENT NAME: GOLDER ASSOCIATES LTD.
100 SCOTIA COURT
WHITBY, ON L1N8Y6
(905) 723-2727

ATTENTION TO: Anastasia Poliacik

PROJECT: 1530382 Phase 10005

AGAT WORK ORDER: 18T337267

SOIL ANALYSIS REVIEWED BY: Amanjot Bhela, Inorganic Coordinator

TRACE ORGANICS REVIEWED BY: Oksana Gushyla, Trace Organics Lab Supervisor

DATE REPORTED: May 17, 2018

PAGES (INCLUDING COVER): 12

VERSION*: 1

Should you require any information regarding this analysis please contact your client services representative at (905) 712-5100

*NOTES

All samples will be disposed of within 30 days following analysis. Please contact the lab if you require additional sample storage time.



Certificate of Analysis

AGAT WORK ORDER: 18T337267

PROJECT: 1530382 Phase 10005

5835 COOPERS AVENUE
MISSISSAUGA, ONTARIO
CANADA L4Z 1Y2
TEL (905)712-5100
FAX (905)712-5122
<http://www.agatlabs.com>

CLIENT NAME: GOLDER ASSOCIATES LTD.

SAMPLING SITE:

ATTENTION TO: Anastasia Poliacik

SAMPLED BY:

Corrosivity Package

DATE RECEIVED: 2018-05-09

DATE REPORTED: 2018-05-17

		SAMPLE DESCRIPTION: SS1 Sample 4				SS3 Sample 4		SS31 Sample 4	
		SAMPLE TYPE: Soil				Soil		Soil	
		DATE SAMPLED: 2018-04-22				2018-04-22		2018-04-30	
Parameter	Unit	G / S	RDL	9233128	RDL	9233137	RDL	9233153	
Sulfide (S2-)	%		0.05	0.26	0.05	0.34	0.05	0.30	
Chloride (2:1)	µg/g		4	836	2	185	4	709	
Sulphate (2:1)	µg/g		4	97	2	281	4	249	
pH (2:1)	pH Units		NA	8.31	NA	8.04	NA	8.10	
Electrical Conductivity (2:1)	mS/cm		0.005	1.37	0.005	0.624	0.005	1.30	
Resistivity (2:1)	ohm.cm		1	730	1	1600	1	769	
Redox Potential (2:1)	mV		5	172	5	159	5	162	

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard

9233128 EC/Resistivity, pH, Chloride, Sulphate and Redox Potential were determined on the extract obtained from the 2:1 leaching procedure (2 parts DI water: 1 part soil).
*Sulphide analyzed at AGAT 5623 McAdam

9233137 Elevated RDL indicates the degree of sample dilution prior to the analysis in order to keep analytes within the calibration range of the instrument and to reduce matrix interference.
EC/Resistivity, pH, Chloride, Sulphate and Redox Potential were determined on the extract obtained from the 2:1 leaching procedure (2 parts DI water: 1 part soil).
*Sulphide analyzed at AGAT 5623 McAdam

9233153 EC/Resistivity, pH, Chloride, Sulphate and Redox Potential were determined on the extract obtained from the 2:1 leaching procedure (2 parts DI water: 1 part soil).
*Sulphide analyzed at AGAT 5623 McAdam

Elevated RDL indicates the degree of sample dilution prior to the analysis in order to keep analytes within the calibration range of the instrument and to reduce matrix interference.

Certified By:

Amanjot Bhela



Certificate of Analysis

AGAT WORK ORDER: 18T337267

PROJECT: 1530382 Phase 10005

5835 COOPERS AVENUE
MISSISSAUGA, ONTARIO
CANADA L4Z 1Y2
TEL (905)712-5100
FAX (905)712-5122
<http://www.agatlabs.com>

CLIENT NAME: GOLDER ASSOCIATES LTD.

SAMPLING SITE:

ATTENTION TO: Anastasia Poliacik

SAMPLED BY:

O. Reg. 153(511) - PHCs F1 - F4 (-BTEX) (Soil)

DATE RECEIVED: 2018-05-09

DATE REPORTED: 2018-05-17

		SAMPLE DESCRIPTION:		SS1 Sample 4	SS3 Sample 4	SS31 Sample 4
		SAMPLE TYPE:		Soil	Soil	Soil
		DATE SAMPLED:		2018-04-22	2018-04-22	2018-04-30
Parameter	Unit	G / S	RDL	9233128	9233137	9233153
F1 (C6 to C10)	µg/g	25	5	<5	<5	<5
F1 (C6 to C10) minus BTEX	µg/g	25	5	<5	<5	<5
F2 (C10 to C16)	µg/g	10	10	<10	<10	<10
F3 (C16 to C34)	µg/g	240	50	<50	<50	61
F4 (C34 to C50)	µg/g	120	50	<50	<50	66
Gravimetric Heavy Hydrocarbons	µg/g	120	50	NA	NA	NA
Moisture Content	%		0.1	11.7	9.1	8.4
Surrogate	Unit	Acceptable Limits				
Terphenyl	%	60-140		87	67	83

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard: Refers to Table 1: Full Depth Background Site Condition Standards - Soil - Residential/Parkland/Institutional/Industrial/Commercial/Community Property Use
Guideline values are for general reference only. The guidelines provided may or may not be relevant for the intended use. Refer directly to the applicable standard for regulatory interpretation.

9233128-9233153 Results are based on sample dry weight.
The C6-C10 fraction is calculated using toluene response factor.
The C10 - C16, C16 - C34, and C34 - C50 fractions are calculated using the average response factor for n-C10, n-C16, and n-C34.
Gravimetric Heavy Hydrocarbons are not included in the Total C16-C50 and are only determined if the chromatogram of the C34 - C50 hydrocarbons indicates that hydrocarbons >C50 are present.
The chromatogram has returned to baseline by the retention time of nC50.
Total C6 - C50 results are corrected for BTEX contributions.
This method complies with the Reference Method for the CWS PHC and is validated for use in the laboratory.
nC6 and nC10 response factors are within 30% of Toluene response factor.
nC10, nC16 and nC34 response factors are within 10% of their average.
C50 response factor is within 70% of nC10 + nC16 + nC34 average.
Linearity is within 15%.
Extraction and holding times were met for this sample.
Fractions 1-4 are quantified without the contribution of PAHs. Under Ontario Regulation 153, results are considered valid without determining the PAH contribution if not requested by the client.

Certified By:



Certificate of Analysis

AGAT WORK ORDER: 18T337267

PROJECT: 1530382 Phase 10005

5835 COOPERS AVENUE
MISSISSAUGA, ONTARIO
CANADA L4Z 1Y2
TEL (905)712-5100
FAX (905)712-5122
<http://www.agatlabs.com>

CLIENT NAME: GOLDER ASSOCIATES LTD.

ATTENTION TO: Anastasia Poliacik

SAMPLING SITE:

SAMPLED BY:

O. Reg. 153(511) - VOCs (Soil)

DATE RECEIVED: 2018-05-09

DATE REPORTED: 2018-05-17

		SAMPLE DESCRIPTION:		SS1 Sample 4	SS3 Sample 4	SS31 Sample 4
		SAMPLE TYPE:		Soil	Soil	Soil
		DATE SAMPLED:		2018-04-22	2018-04-22	2018-04-30
Parameter	Unit	G / S	RDL	9233128	9233137	9233153
Dichlorodifluoromethane	µg/g	0.05	0.05	<0.05	<0.05	<0.05
Vinyl Chloride	ug/g	0.02	0.02	<0.02	<0.02	<0.02
Bromomethane	ug/g	0.05	0.05	<0.05	<0.05	<0.05
Trichlorofluoromethane	ug/g	0.25	0.05	<0.05	<0.05	<0.05
Acetone	ug/g	0.5	0.50	<0.50	<0.50	<0.50
1,1-Dichloroethylene	ug/g	0.05	0.05	<0.05	<0.05	<0.05
Methylene Chloride	ug/g	0.05	0.05	<0.05	<0.05	<0.05
Trans- 1,2-Dichloroethylene	ug/g	0.05	0.05	<0.05	<0.05	<0.05
Methyl tert-butyl Ether	ug/g	0.05	0.05	<0.05	<0.05	<0.05
1,1-Dichloroethane	ug/g	0.05	0.02	<0.02	<0.02	<0.02
Methyl Ethyl Ketone	ug/g	0.5	0.50	<0.50	<0.50	<0.50
Cis- 1,2-Dichloroethylene	ug/g	0.05	0.02	<0.02	<0.02	<0.02
Chloroform	ug/g	0.05	0.04	<0.04	<0.04	<0.04
1,2-Dichloroethane	ug/g	0.05	0.03	<0.03	<0.03	<0.03
1,1,1-Trichloroethane	ug/g	0.05	0.05	<0.05	<0.05	<0.05
Carbon Tetrachloride	ug/g	0.05	0.05	<0.05	<0.05	<0.05
Benzene	ug/g	0.02	0.02	<0.02	<0.02	<0.02
1,2-Dichloropropane	ug/g	0.05	0.03	<0.03	<0.03	<0.03
Trichloroethylene	ug/g	0.05	0.03	<0.03	<0.03	<0.03
Bromodichloromethane	ug/g	0.05	0.05	<0.05	<0.05	<0.05
Methyl Isobutyl Ketone	ug/g	0.5	0.50	<0.50	<0.50	<0.50
1,1,2-Trichloroethane	ug/g	0.05	0.04	<0.04	<0.04	<0.04
Toluene	ug/g	0.2	0.02	<0.02	<0.02	<0.02
Dibromochloromethane	ug/g	0.05	0.05	<0.05	<0.05	<0.05
Ethylene Dibromide	ug/g	0.05	0.04	<0.04	<0.04	<0.04
Tetrachloroethylene	ug/g	0.05	0.05	<0.05	<0.05	<0.05
1,1,1,2-Tetrachloroethane	ug/g	0.05	0.04	<0.04	<0.04	<0.04
Chlorobenzene	ug/g	0.05	0.05	<0.05	<0.05	<0.05
Ethylbenzene	ug/g	0.05	0.05	<0.05	<0.05	<0.05
m & p-Xylene	ug/g		0.05	<0.05	<0.05	<0.05

Certified By:



Certificate of Analysis

AGAT WORK ORDER: 18T337267

PROJECT: 1530382 Phase 10005

5835 COOPERS AVENUE
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<http://www.agatlabs.com>

CLIENT NAME: GOLDER ASSOCIATES LTD.

SAMPLING SITE:

ATTENTION TO: Anastasia Poliacik

SAMPLED BY:

O. Reg. 153(511) - VOCs (Soil)						
DATE RECEIVED: 2018-05-09				DATE REPORTED: 2018-05-17		
		SAMPLE DESCRIPTION:		SS1 Sample 4	SS3 Sample 4	SS31 Sample 4
		SAMPLE TYPE:		Soil	Soil	Soil
		DATE SAMPLED:		2018-04-22	2018-04-22	2018-04-30
Parameter	Unit	G / S	RDL	9233128	9233137	9233153
Bromoform	ug/g	0.05	0.05	<0.05	<0.05	<0.05
Styrene	ug/g	0.05	0.05	<0.05	<0.05	<0.05
1,1,2,2-Tetrachloroethane	ug/g	0.05	0.05	<0.05	<0.05	<0.05
o-Xylene	ug/g		0.05	<0.05	<0.05	<0.05
1,3-Dichlorobenzene	ug/g	0.05	0.05	<0.05	<0.05	<0.05
1,4-Dichlorobenzene	ug/g	0.05	0.05	<0.05	<0.05	<0.05
1,2-Dichlorobenzene	ug/g	0.05	0.05	<0.05	<0.05	<0.05
Xylene Mixture	ug/g	0.05	0.05	<0.05	<0.05	<0.05
1,3-Dichloropropene	µg/g	0.05	0.04	<0.04	<0.04	<0.04
n-Hexane	µg/g	0.05	0.05	<0.05	<0.05	<0.05
Surrogate	Unit	Acceptable Limits				
Toluene-d8	% Recovery	50-140		95	95	95
4-Bromofluorobenzene	% Recovery	50-140		103	100	101

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard: Refers to Table 1: Full Depth Background Site Condition Standards - Soil - Residential/Parkland/Institutional/Industrial/Commercial/Community Property Use

Guideline values are for general reference only. The guidelines provided may or may not be relevant for the intended use. Refer directly to the applicable standard for regulatory interpretation.

9233128-9233153 The sample was analysed using the high level technique. The sample was extracted using methanol, a small amount of the methanol extract was diluted in water and the purge & trap GC/MS analysis was performed. Results are based on the dry weight of the soil.

Certified By:



Quality Assurance

CLIENT NAME: GOLDER ASSOCIATES LTD.

PROJECT: 1530382 Phase 10005

SAMPLING SITE:

AGAT WORK ORDER: 18T337267

ATTENTION TO: Anastasia Poliacik

SAMPLED BY:

Soil Analysis

RPT Date: May 17, 2018

RPT Date: May 17, 2018			DUPLICATE			Method Blank	REFERENCE MATERIAL		METHOD BLANK SPIKE			MATRIX SPIKE			
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD		Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper

Corrosivity Package

Sulfide (S2-)	9233128	9233128	0.26	0.26	0.0%	< 0.05	95%	80%	120%						
Chloride (2:1)	9229991		124	118	5.0%	< 2	107%	80%	120%	105%	80%	120%	104%	70%	130%
Sulphate (2:1)	9229991		16	15	6.5%	< 2	102%	80%	120%	107%	80%	120%	102%	70%	130%
pH (2:1)	9233341		7.79	7.81	0.3%	NA	100%	90%	110%	NA			NA		
Electrical Conductivity (2:1)	9232757		2.23	2.17	2.7%	< 0.005	97%	90%	110%	NA			NA		
Redox Potential (2:1)	9229304		178	174	2.3%	< 5	103%	70%	130%	NA			NA		

Comments: NA signifies Not Applicable.

Certified By:

Amanjot Bhela

Quality Assurance

CLIENT NAME: GOLDER ASSOCIATES LTD.

PROJECT: 1530382 Phase 10005

SAMPLING SITE:

AGAT WORK ORDER: 18T337267

ATTENTION TO: Anastasia Poliacik

SAMPLED BY:

Trace Organics Analysis

RPT Date: May 17, 2018			DUPLICATE			Method Blank	REFERENCE MATERIAL		METHOD BLANK SPIKE		MATRIX SPIKE				
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD		Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper

O. Reg. 153(511) - PHCs F1 - F4 (-BTEX) (Soil)

F1 (C6 to C10)	9229869		< 5	< 5	NA	< 5	93%	60%	130%	111%	85%	115%	114%	70%	130%
F2 (C10 to C16)	9233153	9233153	< 10	< 10	NA	< 10	102%	60%	130%	95%	80%	120%	84%	70%	130%
F3 (C16 to C34)	9233153	9233153	61	70	NA	< 50	104%	60%	130%	96%	80%	120%	85%	70%	130%
F4 (C34 to C50)	9233153	9233153	66	73	NA	< 50	100%	60%	130%	96%	80%	120%	92%	70%	130%

O. Reg. 153(511) - VOCs (Soil)

Dichlorodifluoromethane	9229103		< 0.05	< 0.05	NA	< 0.05	79%	50%	140%	80%	50%	140%	81%	50%	140%
Vinyl Chloride	9229103		< 0.02	< 0.02	NA	< 0.02	86%	50%	140%	82%	50%	140%	83%	50%	140%
Bromomethane	9229103		< 0.05	< 0.05	NA	< 0.05	76%	50%	140%	72%	50%	140%	72%	50%	140%
Trichlorofluoromethane	9229103		< 0.05	< 0.05	NA	< 0.05	78%	50%	140%	70%	50%	140%	78%	50%	140%
Acetone	9229103		< 0.50	< 0.50	NA	< 0.50	92%	50%	140%	79%	50%	140%	113%	50%	140%

1,1-Dichloroethylene	9229103		< 0.05	< 0.05	NA	< 0.05	104%	50%	140%	82%	60%	130%	75%	50%	140%
Methylene Chloride	9229103		< 0.05	< 0.05	NA	< 0.05	74%	50%	140%	70%	60%	130%	83%	50%	140%
Trans- 1,2-Dichloroethylene	9229103		< 0.05	< 0.05	NA	< 0.05	84%	50%	140%	104%	60%	130%	89%	50%	140%
Methyl tert-butyl Ether	9229103		< 0.05	< 0.05	NA	< 0.05	92%	50%	140%	116%	60%	130%	68%	50%	140%
1,1-Dichloroethane	9229103		< 0.02	< 0.02	NA	< 0.02	73%	50%	140%	108%	60%	130%	73%	50%	140%

Methyl Ethyl Ketone	9229103		< 0.50	< 0.50	NA	< 0.50	78%	50%	140%	74%	50%	140%	90%	50%	140%
Cis- 1,2-Dichloroethylene	9229103		< 0.02	< 0.02	NA	< 0.02	79%	50%	140%	115%	60%	130%	108%	50%	140%
Chloroform	9229103		< 0.04	< 0.04	NA	< 0.04	77%	50%	140%	102%	60%	130%	93%	50%	140%
1,2-Dichloroethane	9229103		< 0.03	< 0.03	NA	< 0.03	87%	50%	140%	78%	60%	130%	103%	50%	140%
1,1,1-Trichloroethane	9229103		< 0.05	< 0.05	NA	< 0.05	68%	50%	140%	109%	60%	130%	76%	50%	140%

Carbon Tetrachloride	9229103		< 0.05	< 0.05	NA	< 0.05	64%	50%	140%	72%	60%	130%	77%	50%	140%
Benzene	9229103		< 0.02	< 0.02	NA	< 0.02	99%	50%	140%	85%	60%	130%	109%	50%	140%
1,2-Dichloropropane	9229103		< 0.03	< 0.03	NA	< 0.03	92%	50%	140%	82%	60%	130%	103%	50%	140%
Trichloroethylene	9229103		< 0.03	< 0.03	NA	< 0.03	93%	50%	140%	88%	60%	130%	112%	50%	140%
Bromodichloromethane	9229103		< 0.05	< 0.05	NA	< 0.05	80%	50%	140%	76%	60%	130%	77%	50%	140%

Methyl Isobutyl Ketone	9229103		< 0.50	< 0.50	NA	< 0.50	84%	50%	140%	100%	50%	140%	90%	50%	140%
1,1,2-Trichloroethane	9229103		< 0.04	< 0.04	NA	< 0.04	85%	50%	140%	104%	60%	130%	84%	50%	140%
Toluene	9229103		< 0.02	< 0.02	NA	< 0.02	86%	50%	140%	103%	60%	130%	79%	50%	140%
Dibromochloromethane	9229103		< 0.05	< 0.05	NA	< 0.05	87%	50%	140%	118%	60%	130%	115%	50%	140%
Ethylene Dibromide	9229103		< 0.04	< 0.04	NA	< 0.04	83%	50%	140%	108%	60%	130%	88%	50%	140%

Tetrachloroethylene	9229103		< 0.05	< 0.05	NA	< 0.05	89%	50%	140%	106%	60%	130%	85%	50%	140%
1,1,1,2-Tetrachloroethane	9229103		< 0.04	< 0.04	NA	< 0.04	114%	50%	140%	102%	60%	130%	86%	50%	140%
Chlorobenzene	9229103		< 0.05	< 0.05	NA	< 0.05	86%	50%	140%	105%	60%	130%	82%	50%	140%
Ethylbenzene	9229103		< 0.05	< 0.05	NA	< 0.05	110%	50%	140%	97%	60%	130%	82%	50%	140%
m & p-Xylene	9229103		< 0.05	< 0.05	NA	< 0.05	87%	50%	140%	75%	60%	130%	80%	50%	140%

Bromoform	9229103		< 0.05	< 0.05	NA	< 0.05	111%	50%	140%	119%	60%	130%	94%	50%	140%
Styrene	9229103		< 0.05	< 0.05	NA	< 0.05	84%	50%	140%	103%	60%	130%	82%	50%	140%
1,1,2,2-Tetrachloroethane	9229103		< 0.05	< 0.05	NA	< 0.05	86%	50%	140%	106%	60%	130%	89%	50%	140%
o-Xylene	9229103		< 0.05	< 0.05	NA	< 0.05	87%	50%	140%	104%	60%	130%	80%	50%	140%

AGAT QUALITY ASSURANCE REPORT (V1)

Page 7 of 12

AGAT Laboratories is accredited to ISO/IEC 17025 by the Canadian Association for Laboratory Accreditation Inc. (CALA) and/or Standards Council of Canada (SCC) for specific tests listed on the scope of accreditation. AGAT Laboratories (Mississauga) is also accredited by the Canadian Association for Laboratory Accreditation Inc. (CALA) for specific drinking water tests. Accreditations are location and parameter specific. A complete listing of parameters for each location is available from www.cala.ca and/or www.scc.ca. The tests in this report may not necessarily be included in the scope of accreditation.

Results relate only to the items tested and to all the items tested



Quality Assurance

CLIENT NAME: GOLDER ASSOCIATES LTD.

PROJECT: 1530382 Phase 10005

SAMPLING SITE:

AGAT WORK ORDER: 18T337267

ATTENTION TO: Anastasia Poliacik

SAMPLED BY:

Trace Organics Analysis (Continued)

RPT Date: May 17, 2018

RPT Date: May 17, 2018			DUPLICATE			Method Blank	REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD		Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper
1,3-Dichlorobenzene	9229103		< 0.05	< 0.05	NA	< 0.05	90%	50%	140%	107%	60%	130%	85%	50%	140%
1,4-Dichlorobenzene	9229103		< 0.05	< 0.05	NA	< 0.05	87%	50%	140%	107%	60%	130%	85%	50%	140%
1,2-Dichlorobenzene	9229103		< 0.05	< 0.05	NA	< 0.05	92%	50%	140%	108%	60%	130%	89%	50%	140%
Xylene Mixture	9229103		< 0.05	< 0.05	NA	< 0.05	87%	50%	140%	87%	60%	130%	80%	50%	140%
1,3-Dichloropropene	9229103		< 0.04	< 0.04	NA	< 0.04	88%	50%	140%	104%	60%	130%	89%	50%	140%
n-Hexane	9229103		< 0.05	< 0.05	NA	< 0.05	104%	50%	140%	108%	60%	130%	114%	50%	140%

Comments: When the average of the sample and duplicate results is less than 5x the RDL, the Relative Percent Difference (RPD) will be indicated as Not Applicable (NA).

Certified By:

Method Summary

CLIENT NAME: GOLDER ASSOCIATES LTD.

AGAT WORK ORDER: 18T337267

PROJECT: 1530382 Phase 10005

ATTENTION TO: Anastasia Poliacik

SAMPLING SITE:

SAMPLED BY:

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Soil Analysis			
Sulfide (S ²⁻)	MIN-200-12025	ASTM E1915-09	GRAVIMETRIC
Chloride (2:1)	INOR-93-6004	McKeague 4.12 & SM 4110 B	ION CHROMATOGRAPH
Sulphate (2:1)	INOR-93-6004	McKeague 4.12 & SM 4110 B	ION CHROMATOGRAPH
pH (2:1)	INOR 93-6031	MSA part 3 & SM 4500-H+ B	PH METER
Electrical Conductivity (2:1)	INOR-93-6036	McKeague 4.12, SM 2510 B	EC METER
Resistivity (2:1)	INOR-93-6036	McKeague 4.12, SM 2510 B, SSA #5 Part 3	CALCULATION
Redox Potential (2:1)		McKeague 4.12 & SM 2510 B	REDOX POTENTIAL ELECTRODE



Method Summary

CLIENT NAME: GOLDER ASSOCIATES LTD.

PROJECT: 1530382 Phase 10005

SAMPLING SITE:

AGAT WORK ORDER: 18T337267

ATTENTION TO: Anastasia Poliacik

SAMPLED BY:

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Trace Organics Analysis			
F1 (C6 to C10)	VOL-91-5009	CCME Tier 1 Method, SW846 5035	P & T GC / FID
F1 (C6 to C10) minus BTEX	VOL-91-5009	CCME Tier 1 Method, SW846 5035	P & T GC / FID
F2 (C10 to C16)	VOL-91-5009	CCME Tier 1 Method	GC / FID
F3 (C16 to C34)	VOL-91-5009	CCME Tier 1 Method	GC / FID
F4 (C34 to C50)	VOL-91-5009	CCME Tier 1 Method	GC / FID
Gravimetric Heavy Hydrocarbons	VOL-91-5009	CCME Tier 1 Method	Balance
Moisture Content	VOL-91-5009	CCME Tier 1 Method, SW846 5035,8015	BALANCE
Terphenyl	VOL-91-5009	CCME Tier 1 Method	GC/FID
Dichlorodifluoromethane	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Vinyl Chloride	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Bromomethane	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Trichlorofluoromethane	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Acetone	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
1,1-Dichloroethylene	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Methylene Chloride	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Trans- 1,2-Dichloroethylene	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Methyl tert-butyl Ether	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
1,1-Dichloroethane	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Methyl Ethyl Ketone	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Cis- 1,2-Dichloroethylene	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Chloroform	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
1,2-Dichloroethane	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
1,1,1-Trichloroethane	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Carbon Tetrachloride	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Benzene	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
1,2-Dichloropropane	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Trichloroethylene	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Bromodichloromethane	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Methyl Isobutyl Ketone	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
1,1,2-Trichloroethane	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Toluene	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Dibromochloromethane	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Ethylene Dibromide	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Tetrachloroethylene	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
1,1,1,2-Tetrachloroethane	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Chlorobenzene	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Ethylbenzene	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
m & p-Xylene	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Bromoform	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Styrene	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
1,1,2,2-Tetrachloroethane	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
o-Xylene	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
1,3-Dichlorobenzene	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
1,4-Dichlorobenzene	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
1,2-Dichlorobenzene	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Xylene Mixture	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
1,3-Dichloropropene	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
n-Hexane	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS

Method Summary

CLIENT NAME: GOLDER ASSOCIATES LTD.

AGAT WORK ORDER: 18T337267

PROJECT: 1530382 Phase 10005

ATTENTION TO: Anastasia Poliacik

SAMPLING SITE:

SAMPLED BY:

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Toluene-d8	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
4-Bromofluorobenzene	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS

CLIENT NAME: GOLDER ASSOCIATES LTD.
100 SCOTIA COURT
WHITBY, ON L1N8Y6
(905) 723-2727

ATTENTION TO: Aria Poliacik

PROJECT: 15303821

AGAT WORK ORDER: 18T346903

SOIL ANALYSIS REVIEWED BY: Amanjot Bhela, Inorganic Coordinator

TRACE ORGANICS REVIEWED BY: Inga Kuzmina, Trace Organics Lab Manager

DATE REPORTED: Jun 12, 2018

PAGES (INCLUDING COVER): 13

VERSION*: 1

Should you require any information regarding this analysis please contact your client services representative at (905) 712-5100

*NOTES

All samples will be disposed of within 30 days following analysis. Please contact the lab if you require additional sample storage time.



AGAT Laboratories

Certificate of Analysis

AGAT WORK ORDER: 18T346903

PROJECT: 15303821

5835 COOPERS AVENUE
MISSISSAUGA, ONTARIO
CANADA L4Z 1Y2
TEL (905)712-5100
FAX (905)712-5122
<http://www.agatlabs.com>

CLIENT NAME: GOLDER ASSOCIATES LTD.

SAMPLING SITE:

ATTENTION TO: Aria Poliacik

SAMPLED BY:

Corrosivity Package

DATE RECEIVED: 2018-06-05

DATE REPORTED: 2018-06-12

		SAMPLE DESCRIPTION:		SS10 Sample 4	SS15 Sample 4	SS13 Sample 4		SS17 Sample 4	SS26 Sample 4
		SAMPLE TYPE:		Soil	Soil	Soil		Soil	Soil
		DATE SAMPLED:		2018-05-08	2018-05-27	2018-05-30		2018-05-28	2018-05-29
Parameter	Unit	G / S	RDL	9300395	9300406	9300407	RDL	9300408	9300410
Sulfide (S2-)	%		0.05	0.38	0.37	0.10	0.05	0.29	0.18
Chloride (2:1)	µg/g	NA	2	103	184	447	4	587	679
Sulphate (2:1)	µg/g		2	167	154	39	4	182	123
pH (2:1)	pH Units		NA	8.31	8.37	9.22	NA	9.18	9.06
Electrical Conductivity (2:1)	mS/cm	0.57	0.005	0.492	0.632	0.872	0.005	1.26	1.44
Resistivity (2:1)	ohm.cm		1	2030	1580	1150	1	794	694
Redox Potential (2:1)	mV		5	181	178	163	5	154	121

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard: Refers to Table 1: Full Depth Background Site Condition Standards - Soil - Residential/Parkland/Institutional/Industrial/Commercial/Community Property Use

Guideline values are for general reference only. The guidelines provided may or may not be relevant for the intended use. Refer directly to the applicable standard for regulatory interpretation.

9300395-9300407 EC/Resistivity, pH, Chloride, Sulphate and Redox Potential were determined on the extract obtained from the 2:1 leaching procedure (2 parts DI water: 1 part soil).

*Sulphide analyzed at AGAT 5623 McAdam

9300408-9300410 EC/Resistivity, pH, Chloride, Sulphate and Redox Potential were determined on the extract obtained from the 2:1 leaching procedure (2 parts DI water: 1 part soil).

*Sulphide analyzed at AGAT 5623 McAdam

Elevated RDL indicates the degree of sample dilution prior to the analysis in order to keep analytes within the calibration range of the instrument and to reduce matrix interference.

Certified By:

Amanjot Bhela



AGAT Laboratories

Certificate of Analysis

AGAT WORK ORDER: 18T346903

PROJECT: 15303821

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CLIENT NAME: GOLDER ASSOCIATES LTD.

SAMPLING SITE:

ATTENTION TO: Aria Poliacik

SAMPLED BY:

O. Reg. 153(511) - PHCs F1 - F4 (-BTEX) (Soil)

DATE RECEIVED: 2018-06-05

DATE REPORTED: 2018-06-12

		SAMPLE DESCRIPTION: SS13 Sample 4		SS17 Sample 4		SS26 Sample 4	
		SAMPLE TYPE: Soil		Soil		Soil	
		DATE SAMPLED: 2018-05-30		2018-05-28		2018-05-29	
Parameter	Unit	G / S	RDL	9300407	9300408	9300410	
F1 (C6 to C10)	µg/g	25	5	<5	<5	<5	
F1 (C6 to C10) minus BTEX	µg/g	25	5	<5	<5	<5	
F2 (C10 to C16)	µg/g	10	10	<10	<10	<10	
F3 (C16 to C34)	µg/g	240	50	<50	<50	<50	
F4 (C34 to C50)	µg/g	120	50	<50	<50	<50	
Gravimetric Heavy Hydrocarbons	µg/g	120	50	NA	NA	NA	
Moisture Content	%		0.1	9.6	9.1	9.9	
Surrogate	Unit	Acceptable Limits					
Terphenyl	%	60-140		106	119	86	

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard: Refers to Table 1: Full Depth Background Site Condition Standards - Soil - Residential/Parkland/Institutional/Industrial/Commercial/Community Property Use
Guideline values are for general reference only. The guidelines provided may or may not be relevant for the intended use. Refer directly to the applicable standard for regulatory interpretation.

9300407-9300410 Results are based on sample dry weight.
The C6-C10 fraction is calculated using toluene response factor.
The C10 - C16, C16 - C34, and C34 - C50 fractions are calculated using the average response factor for n-C10, n-C16, and n-C34.
Gravimetric Heavy Hydrocarbons are not included in the Total C16-C50 and are only determined if the chromatogram of the C34 - C50 hydrocarbons indicates that hydrocarbons >C50 are present.
The chromatogram has returned to baseline by the retention time of nC50.
Total C6 - C50 results are corrected for BTEX contributions.
This method complies with the Reference Method for the CWS PHC and is validated for use in the laboratory.
nC6 and nC10 response factors are within 30% of Toluene response factor.
nC10, nC16 and nC34 response factors are within 10% of their average.
C50 response factor is within 70% of nC10 + nC16 + nC34 average.
Linearity is within 15%.
Extraction and holding times were met for this sample.
Fractions 1-4 are quantified without the contribution of PAHs. Under Ontario Regulation 153, results are considered valid without determining the PAH contribution if not requested by the client.

Certified By:



Certificate of Analysis

AGAT WORK ORDER: 18T346903

PROJECT: 15303821

5835 COOPERS AVENUE
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CLIENT NAME: GOLDER ASSOCIATES LTD.

ATTENTION TO: Aria Poliacik

SAMPLING SITE:

SAMPLED BY:

O. Reg. 153(511) - VOCs (Soil)

DATE RECEIVED: 2018-06-05

DATE REPORTED: 2018-06-12

		SAMPLE DESCRIPTION:		SS13 Sample 4	SS17 Sample 4	SS26 Sample 4
		SAMPLE TYPE:		Soil	Soil	Soil
		DATE SAMPLED:		2018-05-30	2018-05-28	2018-05-29
Parameter	Unit	G / S	RDL	9300407	9300408	9300410
Dichlorodifluoromethane	µg/g	0.05	0.05	<0.05	<0.05	<0.05
Vinyl Chloride	ug/g	0.02	0.02	<0.02	<0.02	<0.02
Bromomethane	ug/g	0.05	0.05	<0.05	<0.05	<0.05
Trichlorofluoromethane	ug/g	0.25	0.05	<0.05	<0.05	<0.05
Acetone	ug/g	0.5	0.50	<0.50	<0.50	<0.50
1,1-Dichloroethylene	ug/g	0.05	0.05	<0.05	<0.05	<0.05
Methylene Chloride	ug/g	0.05	0.05	<0.05	<0.05	<0.05
Trans- 1,2-Dichloroethylene	ug/g	0.05	0.05	<0.05	<0.05	<0.05
Methyl tert-butyl Ether	ug/g	0.05	0.05	<0.05	<0.05	<0.05
1,1-Dichloroethane	ug/g	0.05	0.02	<0.02	<0.02	<0.02
Methyl Ethyl Ketone	ug/g	0.5	0.50	<0.50	<0.50	<0.50
Cis- 1,2-Dichloroethylene	ug/g	0.05	0.02	<0.02	<0.02	<0.02
Chloroform	ug/g	0.05	0.04	<0.04	<0.04	<0.04
1,2-Dichloroethane	ug/g	0.05	0.03	<0.03	<0.03	<0.03
1,1,1-Trichloroethane	ug/g	0.05	0.05	<0.05	<0.05	<0.05
Carbon Tetrachloride	ug/g	0.05	0.05	<0.05	<0.05	<0.05
Benzene	ug/g	0.02	0.02	<0.02	<0.02	<0.02
1,2-Dichloropropane	ug/g	0.05	0.03	<0.03	<0.03	<0.03
Trichloroethylene	ug/g	0.05	0.03	<0.03	<0.03	<0.03
Bromodichloromethane	ug/g	0.05	0.05	<0.05	<0.05	<0.05
Methyl Isobutyl Ketone	ug/g	0.5	0.50	<0.50	<0.50	<0.50
1,1,2-Trichloroethane	ug/g	0.05	0.04	<0.04	<0.04	<0.04
Toluene	ug/g	0.2	0.05	<0.05	<0.05	<0.05
Dibromochloromethane	ug/g	0.05	0.05	<0.05	<0.05	<0.05
Ethylene Dibromide	ug/g	0.05	0.04	<0.04	<0.04	<0.04
Tetrachloroethylene	ug/g	0.05	0.05	<0.05	<0.05	<0.05
1,1,1,2-Tetrachloroethane	ug/g	0.05	0.04	<0.04	<0.04	<0.04
Chlorobenzene	ug/g	0.05	0.05	<0.05	<0.05	<0.05
Ethylbenzene	ug/g	0.05	0.05	<0.05	<0.05	<0.05
m & p-Xylene	ug/g		0.05	<0.05	<0.05	<0.05

Certified By:



Certificate of Analysis

AGAT WORK ORDER: 18T346903

PROJECT: 15303821

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CLIENT NAME: GOLDER ASSOCIATES LTD.

SAMPLING SITE:

ATTENTION TO: Aria Poliacik

SAMPLED BY:

O. Reg. 153(511) - VOCs (Soil)						
DATE RECEIVED: 2018-06-05				DATE REPORTED: 2018-06-12		
SAMPLE DESCRIPTION: SS13 Sample 4 SS17 Sample 4 SS26 Sample 4						
		SAMPLE TYPE:		Soil	Soil	Soil
		DATE SAMPLED:		2018-05-30	2018-05-28	2018-05-29
Parameter	Unit	G / S	RDL	9300407	9300408	9300410
Bromoform	ug/g	0.05	0.05	<0.05	<0.05	<0.05
Styrene	ug/g	0.05	0.05	<0.05	<0.05	<0.05
1,1,2,2-Tetrachloroethane	ug/g	0.05	0.05	<0.05	<0.05	<0.05
o-Xylene	ug/g		0.05	<0.05	<0.05	<0.05
1,3-Dichlorobenzene	ug/g	0.05	0.05	<0.05	<0.05	<0.05
1,4-Dichlorobenzene	ug/g	0.05	0.05	<0.05	<0.05	<0.05
1,2-Dichlorobenzene	ug/g	0.05	0.05	<0.05	<0.05	<0.05
Xylene Mixture	ug/g	0.05	0.05	<0.05	<0.05	<0.05
1,3-Dichloropropene	µg/g	0.05	0.04	<0.04	<0.04	<0.04
n-Hexane	µg/g	0.05	0.05	<0.05	<0.05	<0.05
Moisture Content	%		0.1	9.6	9.1	9.9
Surrogate	Unit	Acceptable Limits				
Toluene-d8	% Recovery	50-140		87	99	94
4-Bromofluorobenzene	% Recovery	50-140		101	83	83

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard: Refers to Table 1: Full Depth Background Site Condition Standards - Soil - Residential/Parkland/Institutional/Industrial/Commercial/Community Property Use

Guideline values are for general reference only. The guidelines provided may or may not be relevant for the intended use. Refer directly to the applicable standard for regulatory interpretation.

9300407-9300410 The sample was analysed using the high level technique. The sample was extracted using methanol, a small amount of the methanol extract was diluted in water and the purge & trap GC/MS analysis was performed. Results are based on the dry weight of the soil.

Certified By:



Guideline Violation

AGAT WORK ORDER: 18T346903

PROJECT: 15303821

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CLIENT NAME: GOLDER ASSOCIATES LTD.

ATTENTION TO: Aria Poliacik

SAMPLEID	SAMPLE TITLE	GUIDELINE	ANALYSIS PACKAGE	PARAMETER	UNIT	GUIDEVALUE	RESULT
9300406	SS15 Sample 4	ON T1 S RPI/ICC	Corrosivity Package	Electrical Conductivity (2:1)	mS/cm	0.57	0.632
9300407	SS13 Sample 4	ON T1 S RPI/ICC	Corrosivity Package	Electrical Conductivity (2:1)	mS/cm	0.57	0.872
9300408	SS17 Sample 4	ON T1 S RPI/ICC	Corrosivity Package	Electrical Conductivity (2:1)	mS/cm	0.57	1.26
9300410	SS26 Sample 4	ON T1 S RPI/ICC	Corrosivity Package	Electrical Conductivity (2:1)	mS/cm	0.57	1.44



Quality Assurance

CLIENT NAME: GOLDER ASSOCIATES LTD.

PROJECT: 15303821

SAMPLING SITE:

AGAT WORK ORDER: 18T346903

ATTENTION TO: Aria Poliacik

SAMPLED BY:

Soil Analysis

RPT Date: Jun 12, 2018			DUPLICATE			Method Blank	REFERENCE MATERIAL		METHOD BLANK SPIKE		MATRIX SPIKE	
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD		Measured Value	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper

Corrosivity Package

Sulfide (S2-)	9300395	9300395	0.38	0.37	2.7%	< 0.05	99%	80%	120%						
Chloride (2:1)	9300395	9300395	103	103	0.0%	< 2	103%	80%	120%	105%	80%	120%	106%	70%	130%
Sulphate (2:1)	9300395	9300395	167	166	0.6%	< 2	96%	80%	120%	104%	80%	120%	105%	70%	130%
pH (2:1)	9300395	9300395	8.31	8.38	0.8%	NA	100%	90%	110%	NA			NA		
Electrical Conductivity (2:1)	9300395	9300395	0.492	0.496	0.8%	< 0.005	95%	90%	110%	NA			NA		
Redox Potential (2:1)	9300395	9300395	181	183	1.1%	< 5	104%	70%	130%	NA			NA		

Comments: NA signifies Not Applicable.

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

Certified By:

Amanjot Bhela

Quality Assurance

CLIENT NAME: GOLDER ASSOCIATES LTD.

PROJECT: 15303821

SAMPLING SITE:

AGAT WORK ORDER: 18T346903

ATTENTION TO: Aria Poliacik

SAMPLED BY:

Trace Organics Analysis

RPT Date: Jun 12, 2018			DUPLICATE			Method Blank	REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD		Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper

O. Reg. 153(511) - VOCs (Soil)

Dichlorodifluoromethane	9300407	9300407	< 0.05	< 0.05	NA	< 0.05	79%	50%	140%	112%	50%	140%	75%	50%	140%
Vinyl Chloride	9300407	9300407	< 0.02	< 0.02	NA	< 0.02	81%	50%	140%	97%	50%	140%	99%	50%	140%
Bromomethane	9300407	9300407	< 0.05	< 0.05	NA	< 0.05	85%	50%	140%	91%	50%	140%	80%	50%	140%
Trichlorofluoromethane	9300407	9300407	< 0.05	< 0.05	NA	< 0.05	103%	50%	140%	86%	50%	140%	74%	50%	140%
Acetone	9300407	9300407	< 0.50	< 0.50	NA	< 0.50	95%	50%	140%	92%	50%	140%	99%	50%	140%
1,1-Dichloroethylene	9300407	9300407	< 0.05	< 0.05	NA	< 0.05	73%	50%	140%	72%	60%	130%	73%	50%	140%
Methylene Chloride	9300407	9300407	< 0.05	< 0.05	NA	< 0.05	90%	50%	140%	100%	60%	130%	96%	50%	140%
Trans- 1,2-Dichloroethylene	9300407	9300407	< 0.05	< 0.05	NA	< 0.05	70%	50%	140%	74%	60%	130%	82%	50%	140%
Methyl tert-butyl Ether	9300407	9300407	< 0.05	< 0.05	NA	< 0.05	108%	50%	140%	101%	60%	130%	105%	50%	140%
1,1-Dichloroethane	9300407	9300407	< 0.02	< 0.02	NA	< 0.02	87%	50%	140%	78%	60%	130%	75%	50%	140%
Methyl Ethyl Ketone	9300407	9300407	< 0.50	< 0.50	NA	< 0.50	116%	50%	140%	81%	50%	140%	86%	50%	140%
Cis- 1,2-Dichloroethylene	9300407	9300407	< 0.02	< 0.02	NA	< 0.02	88%	50%	140%	79%	60%	130%	86%	50%	140%
Chloroform	9300407	9300407	< 0.04	< 0.04	NA	< 0.04	81%	50%	140%	80%	60%	130%	82%	50%	140%
1,2-Dichloroethane	9300407	9300407	< 0.03	< 0.03	NA	< 0.03	75%	50%	140%	80%	60%	130%	105%	50%	140%
1,1,1-Trichloroethane	9300407	9300407	< 0.05	< 0.05	NA	< 0.05	82%	50%	140%	74%	60%	130%	75%	50%	140%
Carbon Tetrachloride	9300407	9300407	< 0.05	< 0.05	NA	< 0.05	79%	50%	140%	80%	60%	130%	79%	50%	140%
Benzene	9300407	9300407	< 0.02	< 0.02	NA	< 0.02	77%	50%	140%	79%	60%	130%	101%	50%	140%
1,2-Dichloropropane	9300407	9300407	< 0.03	< 0.03	NA	< 0.03	79%	50%	140%	90%	60%	130%	82%	50%	140%
Trichloroethylene	9300407	9300407	< 0.03	< 0.03	NA	< 0.03	80%	50%	140%	98%	60%	130%	79%	50%	140%
Bromodichloromethane	9300407	9300407	< 0.05	< 0.05	NA	< 0.05	87%	50%	140%	88%	60%	130%	75%	50%	140%
Methyl Isobutyl Ketone	9300407	9300407	< 0.50	< 0.50	NA	< 0.50	78%	50%	140%	86%	50%	140%	85%	50%	140%
1,1,2-Trichloroethane	9300407	9300407	< 0.04	< 0.04	NA	< 0.04	88%	50%	140%	91%	60%	130%	97%	50%	140%
Toluene	9300407	9300407	< 0.02	< 0.02	NA	< 0.05	72%	50%	140%	91%	60%	130%	103%	50%	140%
Dibromochloromethane	9300407	9300407	< 0.05	< 0.05	NA	< 0.05	81%	50%	140%	85%	60%	130%	81%	50%	140%
Ethylene Dibromide	9300407	9300407	< 0.04	< 0.04	NA	< 0.04	94%	50%	140%	84%	60%	130%	92%	50%	140%
Tetrachloroethylene	9300407	9300407	< 0.05	< 0.05	NA	< 0.05	84%	50%	140%	79%	60%	130%	95%	50%	140%
1,1,1,2-Tetrachloroethane	9300407	9300407	< 0.04	< 0.04	NA	< 0.04	105%	50%	140%	75%	60%	130%	80%	50%	140%
Chlorobenzene	9300407	9300407	< 0.05	< 0.05	NA	< 0.05	77%	50%	140%	94%	60%	130%	104%	50%	140%
Ethylbenzene	9300407	9300407	< 0.05	< 0.05	NA	< 0.05	87%	50%	140%	86%	60%	130%	99%	50%	140%
m & p-Xylene	9300407	9300407	< 0.05	< 0.05	NA	< 0.05	82%	50%	140%	91%	60%	130%	106%	50%	140%
Bromoform	9300407	9300407	< 0.05	< 0.05	NA	< 0.05	74%	50%	140%	83%	60%	130%	81%	50%	140%
Styrene	9300407	9300407	< 0.05	< 0.05	NA	< 0.05	83%	50%	140%	87%	60%	130%	93%	50%	140%
1,1,2,2-Tetrachloroethane	9300407	9300407	< 0.05	< 0.05	NA	< 0.05	84%	50%	140%	81%	60%	130%	90%	50%	140%
o-Xylene	9300407	9300407	< 0.05	< 0.05	NA	< 0.05	78%	50%	140%	96%	60%	130%	108%	50%	140%
1,3-Dichlorobenzene	9300407	9300407	< 0.05	< 0.05	NA	< 0.05	76%	50%	140%	92%	60%	130%	103%	50%	140%
1,4-Dichlorobenzene	9300407	9300407	< 0.05	< 0.05	NA	< 0.05	80%	50%	140%	93%	60%	130%	106%	50%	140%
1,2-Dichlorobenzene	9300407	9300407	< 0.05	< 0.05	NA	< 0.05	82%	50%	140%	95%	60%	130%	108%	50%	140%
1,3-Dichloropropene	9300407	9300407	< 0.04	< 0.04	NA	< 0.04	83%	50%	140%	77%	60%	130%	83%	50%	140%
n-Hexane	9300407	9300407	< 0.05	< 0.05	NA	< 0.05	90%	50%	140%	81%	60%	130%	93%	50%	140%

Quality Assurance

CLIENT NAME: GOLDER ASSOCIATES LTD.

AGAT WORK ORDER: 18T346903

PROJECT: 15303821

ATTENTION TO: Aria Poliacik

SAMPLING SITE:

SAMPLED BY:

Trace Organics Analysis (Continued)

RPT Date: Jun 12, 2018			DUPLICATE			Method Blank	REFERENCE MATERIAL		METHOD BLANK SPIKE			MATRIX SPIKE			
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD		Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper

O. Reg. 153(511) - PHCs F1 - F4 (-BTEX) (Soil)

F1 (C6 to C10)	9300446	< 5	< 5	NA	< 5	85%	60%	130%	85%	85%	115%	77%	70%	130%
F2 (C10 to C16)	9297659	31	31	NA	< 10	92%	60%	130%	98%	80%	120%	98%	70%	130%
F3 (C16 to C34)	9297659	< 50	< 50	NA	< 50	97%	60%	130%	100%	80%	120%	103%	70%	130%
F4 (C34 to C50)	9297659	< 50	< 50	NA	< 50	98%	60%	130%	104%	80%	120%	106%	70%	130%

Comments: When the average of the sample and duplicate results is less than 5x the RDL, the Relative Percent Difference (RPD) will be indicated as Not Applicable (NA).

Certified By:



Method Summary

CLIENT NAME: GOLDER ASSOCIATES LTD.

AGAT WORK ORDER: 18T346903

PROJECT: 15303821

ATTENTION TO: Aria Poliacik

SAMPLING SITE:

SAMPLED BY:

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Soil Analysis			
Sulfide (S ²⁻)	MIN-200-12025	ASTM E1915-09	GRAVIMETRIC
Chloride (2:1)	INOR-93-6004	McKeague 4.12 & SM 4110 B	ION CHROMATOGRAPH
Sulphate (2:1)	INOR-93-6004	McKeague 4.12 & SM 4110 B	ION CHROMATOGRAPH
pH (2:1)	INOR 93-6031	MSA part 3 & SM 4500-H+ B	PH METER
Electrical Conductivity (2:1)	INOR-93-6036	McKeague 4.12, SM 2510 B	EC METER
Resistivity (2:1)	INOR-93-6036	McKeague 4.12, SM 2510 B, SSA #5 Part 3	CALCULATION
Redox Potential (2:1)		McKeague 4.12 & SM 2510 B	REDOX POTENTIAL ELECTRODE

Method Summary

CLIENT NAME: GOLDER ASSOCIATES LTD.

AGAT WORK ORDER: 18T346903

PROJECT: 15303821

ATTENTION TO: Aria Poliacik

SAMPLING SITE:

SAMPLED BY:

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Trace Organics Analysis			
F1 (C6 to C10)	VOL-91-5009	CCME Tier 1 Method, SW846 5035	P & T GC / FID
F1 (C6 to C10) minus BTEX	VOL-91-5009	CCME Tier 1 Method, SW846 5035	P & T GC / FID
F2 (C10 to C16)	VOL-91-5009	CCME Tier 1 Method	GC / FID
F3 (C16 to C34)	VOL-91-5009	CCME Tier 1 Method	GC / FID
F4 (C34 to C50)	VOL-91-5009	CCME Tier 1 Method	GC / FID
Gravimetric Heavy Hydrocarbons	VOL-91-5009	CCME Tier 1 Method	Balance
Moisture Content	VOL-91-5009	CCME Tier 1 Method, SW846 5035,8015	BALANCE
Terphenyl	VOL-91-5009	CCME Tier 1 Method	GC/FID
Dichlorodifluoromethane	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Vinyl Chloride	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Bromomethane	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Trichlorofluoromethane	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Acetone	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
1,1-Dichloroethylene	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Methylene Chloride	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Trans- 1,2-Dichloroethylene	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Methyl tert-butyl Ether	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
1,1-Dichloroethane	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Methyl Ethyl Ketone	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Cis- 1,2-Dichloroethylene	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Chloroform	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
1,2-Dichloroethane	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
1,1,1-Trichloroethane	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Carbon Tetrachloride	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Benzene	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
1,2-Dichloropropane	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Trichloroethylene	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Bromodichloromethane	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Methyl Isobutyl Ketone	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
1,1,2-Trichloroethane	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Toluene	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Dibromochloromethane	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Ethylene Dibromide	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Tetrachloroethylene	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
1,1,1,2-Tetrachloroethane	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Chlorobenzene	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Ethylbenzene	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
m & p-Xylene	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Bromoform	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Styrene	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
1,1,2,2-Tetrachloroethane	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
o-Xylene	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
1,3-Dichlorobenzene	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
1,4-Dichlorobenzene	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
1,2-Dichlorobenzene	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Xylene Mixture	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
1,3-Dichloropropene	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
n-Hexane	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS

Method Summary

CLIENT NAME: GOLDER ASSOCIATES LTD.

AGAT WORK ORDER: 18T346903

PROJECT: 15303821

ATTENTION TO: Aria Poliacik

SAMPLING SITE:

SAMPLED BY:

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Toluene-d8	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
4-Bromofluorobenzene	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Moisture Content	VOL-91-5002	MOE E3139	BALANCE



Chain of Custody Record

If this is a Drinking Water sample, please use Drinking Water Chain of Custody Form (potable water consumed by humans)

Report Information:

Company: GOLDER
Contact: Ana Poliacik
Address: 100 Scotia Crt.
Whitby
289-4041915 Fax: _____
Phone: _____
Reports to be sent to: _____
1. Email: apoliacik@golder.com
2. Email: _____

Project Information:

Project: 1530382/
Site Location: QEW
Sampled By: SR
AGAT Quote #: GOLDER PO: _____
Please note: If quotation number is not provided, client will be billed full price for analysis.

Invoice Information:

Bill To Same: Yes ☒ No ☐
Company: _____
Contact: _____
Address: _____
Email: _____

Regulatory Requirements:

(Please check all applicable boxes)

☒ Regulation 153/04 ☐ No Regulatory Requirement
☐ Sewer Use ☐ Regulation 558
☐ Sanitary ☐ CCME
☐ Storm ☐ Prov. Water Quality Objectives (PWQO)
☐ Other
Soil Texture (Check One) Region _____
☐ Coarse ☐ MISA ☐ Fine ☐ Indicate One

Is this submission for a Record of Site Condition?

☐ Yes ☒ No

Report Guideline on Certificate of Analysis

☐ Yes ☐ No

Sample Matrix Legend

B Biota
GW Ground Water
O Oil
P Paint
S Soil
SD Sediment
SW Surface Water

Field Filtered - Metals, Hg, CrVI

O. Reg 153

Metals and Inorganics
☐ All Metals ☐ 153 Metals (excl. Hydrides)
☐ Hydride Metals ☐ 153 Metals (incl. Hydrides)

ORPs: ☐ B-HWS ☐ Cl ☐ CN
☐ Cr⁶⁺ ☐ EC ☐ FOC ☐ Hg
☐ pH ☐ SAR

Full Metals Scan

Regulation/Custom Metals

Nutrients: ☐ TP ☐ NH₄ ☐ TKN
☐ NO₃ ☐ NO₂ ☐ NO₃+NO₂

Volatiles: ☒ VOC ☐ BTEX ☐ THM

PHCs F1 - F4

ABNs

PAHs

PCBs: ☐ Total ☐ Aroclors

Organochlorine Pesticides

TCLP: ☐ M&I ☐ VOCs ☐ ABNs ☐ B/a/P ☐ PCBs

Sewer Use

Corrosivity Package

Sample Identification	Date Sampled	Time Sampled	# of Containers	Sample Matrix	Comments/ Special Instructions	Y / N	Metals and Inorganics	ORPs	Nutrients	Volatiles	PHCs F1 - F4	ABNs	PAHs	PCBs	Organochlorine Pesticides	TCLP	Sewer Use	Corrosivity Package
SS10 Sample 4	May 8/18	---	1	SW														
SS10 Sample 4	May 8/18	---	1	SW														
SS8 Sample 4	May 5/18	---	1	SW														
SS15 Sample 4	May 27/18	---	1	SW														
SS13 Sample 4	May 30/18	---	1	SW														
SS17 Sample 4	May 28/18	---	1	SW														
SS21 Sample 4	May 29/18	---	1	SW														
SS26 Sample 4	May 29/18	---	2	SW														

Samples Relinquished By (Print Name and Sign): <u>Anastasia Poliacik</u>	Date: <u>May 28/18</u>	Time: <u>2:51</u>	Samples Received By (Print Name and Sign): <u>R. P. [Signature]</u>	Date: <u>2018/6/5</u>	Time: <u>9:30</u>
Samples Relinquished By (Print Name and Sign): <u>[Signature]</u>	Date: <u>May 17/18</u>	Time: <u>2:51</u>	Samples Received By (Print Name and Sign): <u>[Signature]</u>	Date: <u>2018/6/5</u>	Time: <u>9:30</u>
Samples Relinquished By (Print Name and Sign): <u>[Signature]</u>	Date: _____	Time: _____	Samples Received By (Print Name and Sign): <u>[Signature]</u>	Date: _____	Time: _____

Page 1 of 1
No: **T 058159**

CLIENT NAME: GOLDER ASSOCIATES LTD.
100 SCOTIA COURT
WHITBY, ON L1N8Y6
(905) 723-2727

ATTENTION TO: Anastasia Poliacik

PROJECT: 1530382 Phase 10005

AGAT WORK ORDER: 18T351427

SOIL ANALYSIS REVIEWED BY: Amanjot Bhela, Inorganic Coordinator

TRACE ORGANICS REVIEWED BY: Oksana Gushyla, Trace Organics Lab Supervisor

DATE REPORTED: Jun 25, 2018

PAGES (INCLUDING COVER): 14

VERSION*: 1

Should you require any information regarding this analysis please contact your client services representative at (905) 712-5100

*NOTES

All samples will be disposed of within 30 days following analysis. Please contact the lab if you require additional sample storage time.



Certificate of Analysis

AGAT WORK ORDER: 18T351427

PROJECT: 1530382 Phase 10005

5835 COOPERS AVENUE
MISSISSAUGA, ONTARIO
CANADA L4Z 1Y2
TEL (905)712-5100
FAX (905)712-5122
<http://www.agatlabs.com>

CLIENT NAME: GOLDER ASSOCIATES LTD.

SAMPLING SITE:

ATTENTION TO: Anastasia Poliacik

SAMPLED BY:

Corrosivity Package

DATE RECEIVED: 2018-06-15

DATE REPORTED: 2018-06-25

SAMPLE DESCRIPTION: SS6 SA4 7'6" -9'						SS28 SA4 7'6" -9'		SS22 Sample 4 Soil 2018-05-29		SS27 Sample 4 Soil 2018-05-29		SS19 Sample 4 Soil 2018-05-02	
SAMPLE TYPE: Soil						Soil		Soil		Soil		Soil	
DATE SAMPLED: 2018-06-05						2018-06-11		2018-05-29		2018-05-29		2018-05-02	
Parameter	Unit	G / S	RDL	9335188	RDL	9335202	RDL	9335203	RDL	9335204	RDL	9335205	RDL
Sulfide (S2-)	%		0.05	0.35	0.05	0.11	0.05	0.13	0.05	0.31		0.28	
Chloride (2:1)	µg/g	NA	2	163	8	2140	2	330	4	543		834	
Sulphate (2:1)	µg/g		2	132	8	108	2	136	4	139		202	
pH (2:1)	pH Units		NA	8.60	NA	8.36	NA	8.29	NA	8.48		8.67	
Electrical Conductivity (2:1)	mS/cm	0.57	0.005	0.503	0.005	3.16	0.005	0.779	0.005	1.04		1.54	
Resistivity (2:1)	ohm.cm		1	1990	1	316	1	1280	1	962		649	
Redox Potential (2:1)	mV		5	196	5	169	5	174	5	163		148	
SAMPLE DESCRIPTION: SS11 Sample 4						SS9 Sample 4 Soil 2018-05-10							
SAMPLE TYPE: Soil						Soil							
DATE SAMPLED: 2018-05-11						2018-05-10							
Parameter	Unit	G / S	RDL	9335206	RDL	9335207							
Sulfide (S2-)	%		0.05	0.70	0.05	0.32							
Chloride (2:1)	µg/g	NA	4	143	2	156							
Sulphate (2:1)	µg/g		4	599	2	250							
pH (2:1)	pH Units		NA	7.97	NA	8.45							
Electrical Conductivity (2:1)	mS/cm	0.57	0.005	1.05	0.005	0.678							
Resistivity (2:1)	ohm.cm		1	952	1	1470							
Redox Potential (2:1)	mV		5	160	5	146							

Certified By:

Amanjot Bhela



AGAT Laboratories

Certificate of Analysis

AGAT WORK ORDER: 18T351427

PROJECT: 1530382 Phase 10005

5835 COOPERS AVENUE
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<http://www.agatlabs.com>

CLIENT NAME: GOLDER ASSOCIATES LTD.

SAMPLING SITE:

ATTENTION TO: Anastasia Poliacik

SAMPLED BY:

Corrosivity Package

DATE RECEIVED: 2018-06-15

DATE REPORTED: 2018-06-25

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard: Refers to Table 1: Full Depth Background Site Condition Standards - Soil - Residential/Parkland/Institutional/Industrial/Commercial/Community Property Use
Guideline values are for general reference only. The guidelines provided may or may not be relevant for the intended use. Refer directly to the applicable standard for regulatory interpretation.

9335188 EC/Resistivity, pH, Chloride, Sulphate and Redox Potential were determined on the extract obtained from the 2:1 leaching procedure (2 parts DI water: 1 part soil).
*Sulphide analyzed at AGAT 5623 McAdam

9335202 EC/Resistivity, pH, Chloride, Sulphate and Redox Potential were determined on the extract obtained from the 2:1 leaching procedure (2 parts DI water: 1 part soil).
*Sulphide analyzed at AGAT 5623 McAdam
Elevated RDL indicates the degree of sample dilution prior to the analysis in order to keep analytes within the calibration range of the instrument and to reduce matrix interference.

9335203 EC/Resistivity, pH, Chloride, Sulphate and Redox Potential were determined on the extract obtained from the 2:1 leaching procedure (2 parts DI water: 1 part soil).
*Sulphide analyzed at AGAT 5623 McAdam

9335204 EC/Resistivity, pH, Chloride, Sulphate and Redox Potential were determined on the extract obtained from the 2:1 leaching procedure (2 parts DI water: 1 part soil).
*Sulphide analyzed at AGAT 5623 McAdam
Elevated RDL indicates the degree of sample dilution prior to the analysis in order to keep analytes within the calibration range of the instrument and to reduce matrix interference.

9335205-9335207 EC/Resistivity, pH, Chloride, Sulphate and Redox Potential were determined on the extract obtained from the 2:1 leaching procedure (2 parts DI water: 1 part soil).
*Sulphide analyzed at AGAT 5623 McAdam

Elevated RDL indicates the degree of sample dilution prior to the analysis in order to keep analytes within the calibration range of the instrument and to reduce matrix interference.
Samples were received and analyzed beyond recommended hold times.

Certified By:

Amanjot Bhela



AGAT Laboratories

Certificate of Analysis

AGAT WORK ORDER: 18T351427

PROJECT: 1530382 Phase 10005

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<http://www.agatlabs.com>

CLIENT NAME: GOLDER ASSOCIATES LTD.

ATTENTION TO: Anastasia Poliacik

SAMPLING SITE:

SAMPLED BY:

O. Reg. 153(511) - PHCs F1 - F4 (-BTEX) (Soil)

DATE RECEIVED: 2018-06-15

DATE REPORTED: 2018-06-25

Parameter	Unit	SAMPLE DESCRIPTION: SS6 SA4 7'6"-9'					
		SS28 SA4		7'6"-9'		SS22 Sample 4	
		SAMPLE TYPE: Soil		Soil		Soil	
		DATE SAMPLED: 2018-06-05		2018-06-11		2018-05-29	
		G / S	RDL	9335188	9335202	9335203	9335204
F1 (C6 to C10)	µg/g	25	5	<5	<5	<5	<5
F1 (C6 to C10) minus BTEX	µg/g	25	5	<5	<5	<5	<5
F2 (C10 to C16)	µg/g	10	10	<10	<10	<10	<10
F3 (C16 to C34)	µg/g	240	50	<50	<50	<50	<50
F4 (C34 to C50)	µg/g	120	50	<50	<50	<50	<50
Gravimetric Heavy Hydrocarbons	µg/g	120	50	NA	NA	NA	NA
Moisture Content	%		0.1	7.4	18.9	8.7	8.3
Surrogate	Unit	Acceptable Limits					
Terphenyl	%	60-140	110	120	77	113	

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard: Refers to Table 1: Full Depth Background Site Condition Standards - Soil - Residential/Parkland/Institutional/Industrial/Commercial/Community Property Use
Guideline values are for general reference only. The guidelines provided may or may not be relevant for the intended use. Refer directly to the applicable standard for regulatory interpretation.

9335188-9335204 Results are based on sample dry weight.
The C6-C10 fraction is calculated using toluene response factor.
The C10 - C16, C16 - C34, and C34 - C50 fractions are calculated using the average response factor for n-C10, n-C16, and n-C34.
Gravimetric Heavy Hydrocarbons are not included in the Total C16-C50 and are only determined if the chromatogram of the C34 - C50 hydrocarbons indicates that hydrocarbons >C50 are present.
The chromatogram has returned to baseline by the retention time of nC50.
Total C6 - C50 results are corrected for BTEX contributions.
This method complies with the Reference Method for the CWS PHC and is validated for use in the laboratory.
nC6 and nC10 response factors are within 30% of Toluene response factor.
nC10, nC16 and nC34 response factors are within 10% of their average.
C50 response factor is within 70% of nC10 + nC16 + nC34 average.
Linearity is within 15%.
Extraction and holding times were met for this sample.
Fractions 1-4 are quantified without the contribution of PAHs. Under Ontario Regulation 153, results are considered valid without determining the PAH contribution if not requested by the client.

Certified By:



Certificate of Analysis

AGAT WORK ORDER: 18T351427

PROJECT: 1530382 Phase 10005

5835 COOPERS AVENUE
MISSISSAUGA, ONTARIO
CANADA L4Z 1Y2
TEL (905)712-5100
FAX (905)712-5122
<http://www.agatlabs.com>

CLIENT NAME: GOLDER ASSOCIATES LTD.

SAMPLING SITE:

ATTENTION TO: Anastasia Poliacik

SAMPLED BY:

O. Reg. 153(511) - VOCs (Soil)

DATE RECEIVED: 2018-06-15

DATE REPORTED: 2018-06-25

Parameter	Unit	SAMPLE DESCRIPTION: SS6 SA4 7'6"-9'					
		SAMPLE TYPE:		SS28 SA4		SS22 Sample 4	
		Soil		7'6"-9'		Soil	
		DATE SAMPLED:		Soil		Soil	
		G / S	RDL	2018-06-05	2018-06-11	2018-05-29	2018-05-29
				9335188	9335202	9335203	9335204
Dichlorodifluoromethane	µg/g	0.05	0.05	<0.05	<0.05	<0.05	<0.05
Vinyl Chloride	ug/g	0.02	0.02	<0.02	<0.02	<0.02	<0.02
Bromomethane	ug/g	0.05	0.05	<0.05	<0.05	<0.05	<0.05
Trichlorofluoromethane	ug/g	0.25	0.05	<0.05	<0.05	<0.05	<0.05
Acetone	ug/g	0.5	0.50	<0.50	<0.50	<0.50	<0.50
1,1-Dichloroethylene	ug/g	0.05	0.05	<0.05	<0.05	<0.05	<0.05
Methylene Chloride	ug/g	0.05	0.05	<0.05	<0.05	<0.05	<0.05
Trans- 1,2-Dichloroethylene	ug/g	0.05	0.05	<0.05	<0.05	<0.05	<0.05
Methyl tert-butyl Ether	ug/g	0.05	0.05	<0.05	<0.05	<0.05	<0.05
1,1-Dichloroethane	ug/g	0.05	0.02	<0.02	<0.02	<0.02	<0.02
Methyl Ethyl Ketone	ug/g	0.5	0.50	<0.50	<0.50	<0.50	<0.50
Cis- 1,2-Dichloroethylene	ug/g	0.05	0.02	<0.02	<0.02	<0.02	<0.02
Chloroform	ug/g	0.05	0.04	<0.04	<0.04	<0.04	<0.04
1,2-Dichloroethane	ug/g	0.05	0.03	<0.03	<0.03	<0.03	<0.03
1,1,1-Trichloroethane	ug/g	0.05	0.05	<0.05	<0.05	<0.05	<0.05
Carbon Tetrachloride	ug/g	0.05	0.05	<0.05	<0.05	<0.05	<0.05
Benzene	ug/g	0.02	0.02	<0.02	<0.02	<0.02	<0.02
1,2-Dichloropropane	ug/g	0.05	0.03	<0.03	<0.03	<0.03	<0.03
Trichloroethylene	ug/g	0.05	0.03	<0.03	<0.03	<0.03	<0.03
Bromodichloromethane	ug/g	0.05	0.05	<0.05	<0.05	<0.05	<0.05
Methyl Isobutyl Ketone	ug/g	0.5	0.50	<0.50	<0.50	<0.50	<0.50
1,1,2-Trichloroethane	ug/g	0.05	0.04	<0.04	<0.04	<0.04	<0.04
Toluene	ug/g	0.2	0.05	<0.05	<0.05	<0.05	<0.05
Dibromochloromethane	ug/g	0.05	0.05	<0.05	<0.05	<0.05	<0.05
Ethylene Dibromide	ug/g	0.05	0.04	<0.04	<0.04	<0.04	<0.04
Tetrachloroethylene	ug/g	0.05	0.05	<0.05	<0.05	<0.05	<0.05
1,1,1,2-Tetrachloroethane	ug/g	0.05	0.04	<0.04	<0.04	<0.04	<0.04
Chlorobenzene	ug/g	0.05	0.05	<0.05	<0.05	<0.05	<0.05
Ethylbenzene	ug/g	0.05	0.05	<0.05	<0.05	<0.05	<0.05

Certified By:



Certificate of Analysis

AGAT WORK ORDER: 18T351427

PROJECT: 1530382 Phase 10005

5835 COOPERS AVENUE
MISSISSAUGA, ONTARIO
CANADA L4Z 1Y2
TEL (905)712-5100
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<http://www.agatlabs.com>

CLIENT NAME: GOLDER ASSOCIATES LTD.

SAMPLING SITE:

ATTENTION TO: Anastasia Poliacik

SAMPLED BY:

O. Reg. 153(511) - VOCs (Soil)							
DATE RECEIVED: 2018-06-15				DATE REPORTED: 2018-06-25			
		SAMPLE DESCRIPTION: SS6 SA4 7'6"-9'		SS28 SA4 7'6"-9'	SS22 Sample 4	SS27 Sample 4	
		SAMPLE TYPE: Soil		Soil	Soil	Soil	
		DATE SAMPLED: 2018-06-05		2018-06-11	2018-05-29	2018-05-29	
Parameter	Unit	G / S	RDL	9335188	9335202	9335203	9335204
m & p-Xylene	ug/g		0.05	<0.05	<0.05	<0.05	<0.05
Bromoform	ug/g	0.05	0.05	<0.05	<0.05	<0.05	<0.05
Styrene	ug/g	0.05	0.05	<0.05	<0.05	<0.05	<0.05
1,1,2,2-Tetrachloroethane	ug/g	0.05	0.05	<0.05	<0.05	<0.05	<0.05
o-Xylene	ug/g		0.05	<0.05	<0.05	<0.05	<0.05
1,3-Dichlorobenzene	ug/g	0.05	0.05	<0.05	<0.05	<0.05	<0.05
1,4-Dichlorobenzene	ug/g	0.05	0.05	<0.05	<0.05	<0.05	<0.05
1,2-Dichlorobenzene	ug/g	0.05	0.05	<0.05	<0.05	<0.05	<0.05
Xylene Mixture	ug/g	0.05	0.05	<0.05	<0.05	<0.05	<0.05
1,3-Dichloropropene	µg/g	0.05	0.04	<0.04	<0.04	<0.04	<0.04
n-Hexane	µg/g	0.05	0.05	<0.05	<0.05	<0.05	<0.05
Surrogate	Unit	Acceptable Limits					
Toluene-d8	% Recovery	50-140		102	113	90	94
4-Bromofluorobenzene	% Recovery	50-140		86	92	86	88

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard: Refers to Table 1: Full Depth Background Site Condition Standards - Soil - Residential/Parkland/Institutional/Industrial/Commercial/Community Property Use

Guideline values are for general reference only. The guidelines provided may or may not be relevant for the intended use. Refer directly to the applicable standard for regulatory interpretation.

9335188-9335204 The sample was analysed using the high level technique. The sample was extracted using methanol, a small amount of the methanol extract was diluted in water and the purge & trap GC/MS analysis was performed. Results are based on the dry weight of the soil.

Certified By:



Guideline Violation

AGAT WORK ORDER: 18T351427

PROJECT: 1530382 Phase 10005

5835 COOPERS AVENUE
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CANADA L4Z 1Y2
TEL (905)712-5100
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<http://www.agatlabs.com>

CLIENT NAME: GOLDER ASSOCIATES LTD.

ATTENTION TO: Anastasia Poliacik

SAMPLEID	SAMPLE TITLE	GUIDELINE	ANALYSIS PACKAGE	PARAMETER	UNIT	GUIDEVALUE	RESULT
9335202	SS28 SA4 7'6"-9'	ON T1 S RPI/ICC	Corrosivity Package	Electrical Conductivity (2:1)	mS/cm	0.57	3.16
9335203	SS22 Sample 4	ON T1 S RPI/ICC	Corrosivity Package	Electrical Conductivity (2:1)	mS/cm	0.57	0.779
9335204	SS27 Sample 4	ON T1 S RPI/ICC	Corrosivity Package	Electrical Conductivity (2:1)	mS/cm	0.57	1.04
9335205	SS19 Sample 4	ON T1 S RPI/ICC	Corrosivity Package	Electrical Conductivity (2:1)	mS/cm	0.57	1.54
9335206	SS11 Sample 4	ON T1 S RPI/ICC	Corrosivity Package	Electrical Conductivity (2:1)	mS/cm	0.57	1.05
9335207	SS9 Sample 4	ON T1 S RPI/ICC	Corrosivity Package	Electrical Conductivity (2:1)	mS/cm	0.57	0.678

Quality Assurance

CLIENT NAME: GOLDER ASSOCIATES LTD.

PROJECT: 1530382 Phase 10005

SAMPLING SITE:

AGAT WORK ORDER: 18T351427

ATTENTION TO: Anastasia Poliacik

SAMPLED BY:

Soil Analysis

RPT Date: Jun 25, 2018			DUPLICATE				REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD	Method Blank	Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper

Corrosivity Package

Sulfide (S2-)	9335188	9335188	0.35	0.35	0.0%	< 0.05	92%	80%	120%						
Chloride (2:1)	9333736		14	14	0.0%	< 2	99%	80%	120%	108%	80%	120%	100%	70%	130%
Sulphate (2:1)	9333736		15	15	0.0%	< 2	99%	80%	120%	106%	80%	120%	100%	70%	130%
pH (2:1)	9335400		8.43	8.45	0.2%	NA	102%	90%	110%	NA			NA		
Electrical Conductivity (2:1)	9341069		0.521	0.519	0.4%	< 0.005	94%	90%	110%	NA			NA		
Redox Potential (2:1)	9333736		188	190	1.1%	< 5	104%	70%	130%	NA			NA		

Comments: NA signifies Not Applicable.

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

Certified By:





Quality Assurance

CLIENT NAME: GOLDER ASSOCIATES LTD.

PROJECT: 1530382 Phase 10005

SAMPLING SITE:

AGAT WORK ORDER: 18T351427

ATTENTION TO: Anastasia Poliacik

SAMPLED BY:

Trace Organics Analysis

RPT Date: Jun 25, 2018			DUPLICATE			Method Blank	REFERENCE MATERIAL		METHOD BLANK SPIKE		MATRIX SPIKE				
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD		Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper

O. Reg. 153(511) - VOCs (Soil)

Dichlorodifluoromethane	9341603		< 0.05	< 0.05	NA	< 0.05	83%	50%	140%	80%	50%	140%	75%	50%	140%
Vinyl Chloride	9341603		< 0.02	< 0.02	NA	< 0.02	80%	50%	140%	106%	50%	140%	82%	50%	140%
Bromomethane	9341603		< 0.05	< 0.05	NA	< 0.05	88%	50%	140%	89%	50%	140%	80%	50%	140%
Trichlorofluoromethane	9341603		< 0.05	< 0.05	NA	< 0.05	98%	50%	140%	85%	50%	140%	94%	50%	140%
Acetone	9341603		< 0.50	< 0.50	NA	< 0.50	92%	50%	140%	88%	50%	140%	82%	50%	140%
1,1-Dichloroethylene	9341603		< 0.05	< 0.05	NA	< 0.05	83%	50%	140%	84%	60%	130%	80%	50%	140%
Methylene Chloride	9341603		< 0.05	< 0.05	NA	< 0.05	104%	50%	140%	113%	60%	130%	111%	50%	140%
Trans- 1,2-Dichloroethylene	9341603		< 0.05	< 0.05	NA	< 0.05	83%	50%	140%	84%	60%	130%	93%	50%	140%
Methyl tert-butyl Ether	9341603		< 0.05	< 0.05	NA	< 0.05	87%	50%	140%	114%	60%	130%	113%	50%	140%
1,1-Dichloroethane	9341603		< 0.02	< 0.02	NA	< 0.02	82%	50%	140%	80%	60%	130%	80%	50%	140%
Methyl Ethyl Ketone	9341603		< 0.50	< 0.50	NA	< 0.50	104%	50%	140%	79%	50%	140%	79%	50%	140%
Cis- 1,2-Dichloroethylene	9341603		< 0.02	< 0.02	NA	< 0.02	83%	50%	140%	87%	60%	130%	90%	50%	140%
Chloroform	9341603		< 0.04	< 0.04	NA	< 0.04	89%	50%	140%	83%	60%	130%	83%	50%	140%
1,2-Dichloroethane	9341603		< 0.03	< 0.03	NA	< 0.03	76%	50%	140%	77%	60%	130%	79%	50%	140%
1,1,1-Trichloroethane	9341603		< 0.05	< 0.05	NA	< 0.05	81%	50%	140%	80%	60%	130%	83%	50%	140%
Carbon Tetrachloride	9341603		< 0.05	< 0.05	NA	< 0.05	100%	50%	140%	85%	60%	130%	88%	50%	140%
Benzene	9341603		< 0.02	< 0.02	NA	< 0.02	79%	50%	140%	79%	60%	130%	79%	50%	140%
1,2-Dichloropropane	9341603		< 0.03	< 0.03	NA	< 0.03	74%	50%	140%	83%	60%	130%	80%	50%	140%
Trichloroethylene	9341603		< 0.03	< 0.03	NA	< 0.03	72%	50%	140%	78%	60%	130%	86%	50%	140%
Bromodichloromethane	9341603		< 0.05	< 0.05	NA	< 0.05	80%	50%	140%	84%	60%	130%	90%	50%	140%
Methyl Isobutyl Ketone	9341603		< 0.50	< 0.50	NA	< 0.50	98%	50%	140%	89%	50%	140%	91%	50%	140%
1,1,2-Trichloroethane	9341603		< 0.04	< 0.04	NA	< 0.04	78%	50%	140%	89%	60%	130%	85%	50%	140%
Toluene	9341603		< 0.05	< 0.05	NA	< 0.05	81%	50%	140%	112%	60%	130%	79%	50%	140%
Dibromochloromethane	9341603		< 0.05	< 0.05	NA	< 0.05	90%	50%	140%	84%	60%	130%	79%	50%	140%
Ethylene Dibromide	9341603		< 0.04	< 0.04	NA	< 0.04	73%	50%	140%	84%	60%	130%	82%	50%	140%
Tetrachloroethylene	9341603		< 0.05	< 0.05	NA	< 0.05	79%	50%	140%	85%	60%	130%	90%	50%	140%
1,1,1,2-Tetrachloroethane	9341603		< 0.04	< 0.04	NA	< 0.04	89%	50%	140%	81%	60%	130%	77%	50%	140%
Chlorobenzene	9341603		< 0.05	< 0.05	NA	< 0.05	82%	50%	140%	73%	60%	130%	103%	50%	140%
Ethylbenzene	9341603		< 0.05	< 0.05	NA	< 0.05	72%	50%	140%	82%	60%	130%	103%	50%	140%
m & p-Xylene	9341603		< 0.05	< 0.05	NA	< 0.05	90%	50%	140%	90%	60%	130%	86%	50%	140%
Bromoform	9341603		< 0.05	< 0.05	NA	< 0.05	80%	50%	140%	91%	60%	130%	81%	50%	140%
Styrene	9341603		< 0.05	< 0.05	NA	< 0.05	98%	50%	140%	80%	60%	130%	87%	50%	140%
1,1,2,2-Tetrachloroethane	9341603		< 0.05	< 0.05	NA	< 0.05	87%	50%	140%	83%	60%	130%	78%	50%	140%
o-Xylene	9341603		< 0.05	< 0.05	NA	< 0.05	80%	50%	140%	84%	60%	130%	83%	50%	140%
1,3-Dichlorobenzene	9341603		< 0.05	< 0.05	NA	< 0.05	85%	50%	140%	77%	60%	130%	79%	50%	140%
1,4-Dichlorobenzene	9341603		< 0.05	< 0.05	NA	< 0.05	81%	50%	140%	74%	60%	130%	83%	50%	140%
1,2-Dichlorobenzene	9341603		< 0.05	< 0.05	NA	< 0.05	81%	50%	140%	73%	60%	130%	90%	50%	140%
1,3-Dichloropropene	9341603		< 0.04	< 0.04	NA	< 0.04	95%	50%	140%	86%	60%	130%	86%	50%	140%
n-Hexane	9341603		< 0.05	< 0.05	NA	< 0.05	102%	50%	140%	83%	60%	130%	101%	50%	140%



Quality Assurance

CLIENT NAME: GOLDER ASSOCIATES LTD.

AGAT WORK ORDER: 18T351427

PROJECT: 1530382 Phase 10005

ATTENTION TO: Anastasia Poliacik

SAMPLING SITE:

SAMPLED BY:

Trace Organics Analysis (Continued)

RPT Date: Jun 25, 2018			DUPLICATE			Method Blank	REFERENCE MATERIAL		METHOD BLANK SPIKE			MATRIX SPIKE			
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD		Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper

O. Reg. 153(511) - PHCs F1 - F4 (-BTEX) (Soil)

F1 (C6 to C10)	9334940		< 5	< 5	NA	< 5	89%	60%	130%	97%	85%	115%	108%	70%	130%
F2 (C10 to C16)	9335204	9335204	< 10	< 10	NA	< 10	98%	60%	130%	99%	80%	120%	102%	70%	130%
F3 (C16 to C34)	9335204	9335204	< 50	< 50	NA	< 50	98%	60%	130%	89%	80%	120%	95%	70%	130%
F4 (C34 to C50)	9335204	9335204	< 50	< 50	NA	< 50	90%	60%	130%	103%	80%	120%	110%	70%	130%

Comments: When the average of the sample and duplicate results is less than 5x the RDL, the Relative Percent Difference (RPD) will be indicated as Not Applicable (NA).

Certified By:

Method Summary

CLIENT NAME: GOLDER ASSOCIATES LTD.

AGAT WORK ORDER: 18T351427

PROJECT: 1530382 Phase 10005

ATTENTION TO: Anastasia Poliacik

SAMPLING SITE:

SAMPLED BY:

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Soil Analysis			
Sulfide (S ²⁻)	MIN-200-12025	ASTM E1915-09	GRAVIMETRIC
Chloride (2:1)	INOR-93-6004	McKeague 4.12 & SM 4110 B	ION CHROMATOGRAPH
Sulphate (2:1)	INOR-93-6004	McKeague 4.12 & SM 4110 B	ION CHROMATOGRAPH
pH (2:1)	INOR 93-6031	MSA part 3 & SM 4500-H+ B	PH METER
Electrical Conductivity (2:1)	INOR-93-6036	McKeague 4.12, SM 2510 B	EC METER
Resistivity (2:1)	INOR-93-6036	McKeague 4.12, SM 2510 B, SSA #5 Part 3	CALCULATION
Redox Potential (2:1)		McKeague 4.12 & SM 2510 B	REDOX POTENTIAL ELECTRODE

Method Summary

CLIENT NAME: GOLDER ASSOCIATES LTD.

AGAT WORK ORDER: 18T351427

PROJECT: 1530382 Phase 10005

ATTENTION TO: Anastasia Poliacik

SAMPLING SITE:

SAMPLED BY:

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Trace Organics Analysis			
F1 (C6 to C10)	VOL-91-5009	CCME Tier 1 Method, SW846 5035	P & T GC / FID
F1 (C6 to C10) minus BTEX	VOL-91-5009	CCME Tier 1 Method, SW846 5035	P & T GC / FID
F2 (C10 to C16)	VOL-91-5009	CCME Tier 1 Method	GC / FID
F3 (C16 to C34)	VOL-91-5009	CCME Tier 1 Method	GC / FID
F4 (C34 to C50)	VOL-91-5009	CCME Tier 1 Method	GC / FID
Gravimetric Heavy Hydrocarbons	VOL-91-5009	CCME Tier 1 Method	Balance
Moisture Content	VOL-91-5009	CCME Tier 1 Method, SW846 5035,8015	BALANCE
Terphenyl	VOL-91-5009	CCME Tier 1 Method	GC/FID
Dichlorodifluoromethane	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Vinyl Chloride	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Bromomethane	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Trichlorofluoromethane	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Acetone	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
1,1-Dichloroethylene	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Methylene Chloride	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Trans- 1,2-Dichloroethylene	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Methyl tert-butyl Ether	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
1,1-Dichloroethane	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Methyl Ethyl Ketone	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Cis- 1,2-Dichloroethylene	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Chloroform	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
1,2-Dichloroethane	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
1,1,1-Trichloroethane	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Carbon Tetrachloride	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Benzene	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
1,2-Dichloropropane	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Trichloroethylene	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Bromodichloromethane	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Methyl Isobutyl Ketone	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
1,1,2-Trichloroethane	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Toluene	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Dibromochloromethane	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Ethylene Dibromide	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Tetrachloroethylene	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
1,1,1,2-Tetrachloroethane	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Chlorobenzene	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Ethylbenzene	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
m & p-Xylene	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Bromoform	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Styrene	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
1,1,2,2-Tetrachloroethane	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
o-Xylene	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
1,3-Dichlorobenzene	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
1,4-Dichlorobenzene	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
1,2-Dichlorobenzene	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
Xylene Mixture	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
1,3-Dichloropropene	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
n-Hexane	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS

Method Summary

CLIENT NAME: GOLDER ASSOCIATES LTD.

AGAT WORK ORDER: 18T351427

PROJECT: 1530382 Phase 10005

ATTENTION TO: Anastasia Poliacik

SAMPLING SITE:

SAMPLED BY:

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Toluene-d8	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS
4-Bromofluorobenzene	VOL-91-5002	EPA SW-846 5035 & 8260	(P&T)GC/MS



AGAT

Laboratories

5835 Coopers Avenue
Mississauga, Ontario L4Z 1Y2
Ph: 905.712.5100 Fax: 905.712.5122
web@earth.agatlabs.com

Chain of Custody Record

If this is a Drinking Water sample, please use Drinking Water Chain of Custody Form (potable water intended for human consumption)

Report Information:

Company: Golder
Contact: Anastasia Poliacik
Address: 100 Scotia Ct
Whitby
Phone: 289-404-1915 Fax: _____
Reports to be sent to:
1. Email: apoliacik@golder.com
2. Email: _____

Project Information:

Project: 1530382 Phase 10005
Site Location: QEW
Sampled By: Shantana
AGAT Quote #: Golder PO: _____
Please note: If quotation number is not provided, client will be billed full price for analysis.

Invoice Information:

Company: _____
Contact: _____
Address: _____
Email: _____
Bill To Same: Yes ☒ No ☐

Regulatory Requirements:

(Please check all applicable boxes)

☒ Regulation 153/04

Table 1
Indicate One

☐ Ind/Com

☐ Res/Park

☐ Agriculture

Soil Texture (Check One)

☐ Coarse

☐ Fine

☐ Sewer Use

☐ Sanitary

☐ Storm

Region _____

Indicate One

☐ Regulation 558

☐ CCME

☐ Prov. Water Quality
Objectives (PWQO)

☐ Other

Indicate One

Is this submission for a
Record of Site Condition?

☐ Yes

☒ No

Report Guideline on
Certificate of Analysis

☒ Yes

☒ No

Sample Matrix Legend

B Biota
GW Ground Water
O Oil
P Paint
S Soil
SD Sediment
SW Surface Water

Sample Identification	Date Sampled	Time Sampled	# of Containers	Sample Matrix	Comments/ Special Instructions	Metals	Metal	Hydride	Client	ORPs: <input type="checkbox"/> Cr ⁶⁺ <input type="checkbox"/> Total	Nutrient <input type="checkbox"/> NO ₃	Volatiles	CCME	ABNs	PAHs	Chloro	PCBs	Organic	TCLP M	Sewer	Com
SS 6 SA4 7'6"-8'4"	June 5/18	—	2	S								X	X								X
SS 28 SA4 7'6"-9'	June 11/18	—	2	S								X	X								X
SS 22 Sample 4	May 29/18	—	2	S								X	X								X
SS 27 Sample 4	May 29/18	—	2	S								X	X								X
SS 19 Sample 4	May 2/18	—	1	S								X	X								X
SS 11 Sample 4	May 11/18	—	1	S								X	X								X
SS 9 Sample 4	May 10/18	—	1	S								X	X								X
					</																

Samples Relinquished By (Print Name and Sign):

Juliana Fischer
[Signature]

Samples Relinquished By (Print Name and Sign):

[Signature]

Date

June 15/18

Time

2:30pm

Samples Received By (Print Name and Sign):

Roy
[Signature]

Samples Received By (Print Name and Sign):

[Signature]

Date

2018/6/15

Time

2:35

Page 1 of 1

Nº: **T017604**

Pink Copy - Client | Yellow Copy - AGAT | White Copy - AGAT

Date Issued: Jan 8, 2015

Page 14 of 14

APPENDIX E

**Non-Standard Special Provisions
and Notice to Contractor**

PROTECTION SYSTEM – Item No.

Special Provision

Amendment to OPSS 539, November 2014

593.07.02 Removal of Protection Systems

Subsection 539.07.02 of OPSS 539 is deleted in its entirety and replaced with the following:

Protection systems shall be removed from the right-of-way.

The method and sequence of removal shall be such that there shall be no damage to the new work, existing work and facility being protected.

All disturbed areas shall be restored to an equivalent or better condition than existing prior to the commencement of construction.

VIBRATION MONITORING – Item No.

Special Provision

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- 1.0 SCOPE**
- 2.0 REFERENCES**
- 3.0 DEFINITIONS**
- 4.0 DESIGN AND SUBMISSION REQUIREMENTS**
- 5.0 MATERIALS - Not Used**
- 6.0 EQUIPMENT**
- 7.0 CONSTRUCTION**
- 8.0 QUALITY ASSURANCE - Not Used**
- 9.0 MEASUREMENT FOR PAYMENT - Not Used**
- 10.0 BASIS OF PAYMENT**

1.0 SCOPE

This special provision describes requirements for vibration monitoring during excavations and installation of spread/strip footings, deep foundations, cofferdams and temporary protection systems for the construction of the QEW Credit River bridge, Mississauga Road overpass, East-West Active Transport bridge, North-South Active Transport bridge, stormwater management ponds, east access road, culverts, overhead sign supports, high mast light pole foundations and caissons for noise barrier walls.

2.0 REFERENCES

The subsurface conditions at the site are described in the following Foundation Investigation Report entitled:

FOUNDATION INVESTIGATION REPORT

Queen Elizabeth Way (QEW) - Etobicoke Bridge Replacement (Site No. 37-237/1&2), City Of Mississauga, Etobicoke (a suburb of Toronto), Ministry of Transportation, Ontario, GWP 2102-13-00 and 2432-13-00

FOUNDATION INVESTIGATION REPORT

Queen Elizabeth Way (QEW) – Storm Sewer Replacements, East of Etobicoke Creek, QEW Improvements from East of Cawthra Road to The East Mall, City Of Mississauga, Etobicoke (a suburb of Toronto), Ministry of Transportation, Ontario, GWP 2102-13-00 and 2432-13-00

3.0 DEFINITIONS

For the purpose of this specification, the following definitions apply:

Contractor's Engineer means an Engineer with a minimum of five (5) years' experience in the field of installation of piling and vibration monitoring or, alternatively, with expertise demonstrated by providing satisfactory quality verification services for a minimum of two (2) projects of similar scope to the Contract. The Contractor's Engineer shall be retained by the Contractor to ensure general conformance with the Contract Documents and issue certificates of conformance.

Peak Particle Velocity (PPV) means the maximum component velocity in millimetres per second that ground particles move as a result of energy released from vibratory construction operations.

Pre-Construction Condition Survey means a detailed record, accompanied by film or video, as necessary, of the condition of private or public property, prior to the commencement of vibratory construction operations.

Post-Construction Condition Survey means a detailed record, accompanied by film or video, as necessary, of the condition of private or public property, after completion of vibratory construction operations.

4.0 DESIGN AND SUBMISSION REQUIREMENTS

4.1 Submission Requirements

The Contractor/Contractor's Engineer shall submit details of the vibration monitoring plan to the Contract Administrator for information purposes at least 2 weeks prior to any work related to installation of storm sewers and temporary protection systems. The submittals shall satisfy the specifications and at a minimum contain the following specific information:

- a) Equipment and methods used by the Contractor to perform the work that may cause undue vibration.
- b) Qualifications of vibration monitoring specialist.
- c) Details regarding proposed instrumentation.
- d) Proposed location of instruments adjacent to the on the residences, structures, utilities, wells, or other potentially vibration-sensitive structures within a 250 m radius from the excavation and installation of storm sewers and temporary protection systems, as applicable.
- e) Proposed frequency of readings.
- f) Action plan to be taken to adjust excavation, deep foundation and protection system installation methods if readings show vibrations exceeding tolerable levels.

6.0 EQUIPMENT

6.1 Vibration Monitoring Equipment

All vibration monitoring equipment shall be capable of measuring and recording ground vibration PPV up to 200 mm/s in the vertical, transverse, and radial directions. The equipment shall have been calibrated within the last 12 months either by the manufacturer or other qualified agent. Proof of calibration shall be submitted to the Contract Administrator prior to commencement of any monitoring operations.

7.0 CONSTRUCTION

7.1 Pre- and Post-Construction Condition Surveys

A Pre-Construction Condition Survey and Post-Construction Condition Survey shall be prepared for all buildings, utilities, structures, water wells, and facilities within 250 m of excavation and installation of spread/strip footings, cofferdams, deep foundations and temporary protection systems.

7.1.1 Pre-Construction Condition Surveys

The standard inspection procedure shall include the provision of an explanatory letter to the owner or occupant and owner with a formal request for permission to carry out an inspection.

The Pre-Construction Condition Survey, at each structure/well within a 250 m radius of excavation and installation of spread/strip footings, cofferdams, deep foundations and temporary protection systems, shall be completed a minimum of two (2) weeks prior to commencement of excavation and installation of storm sewers and temporary protection systems. Only one Pre-Construction Condition Survey per structure or facility is required to be carried out in advance of excavation and installation of storm sewers and temporary protection systems, unless more than six (6) months will elapse between these operations, in which case an interim inspection will be required.

The Pre-Construction Condition Survey shall include, as a minimum, the following information:

- a) Type of structure, including type of construction and if possible, the date when built.
- b) Identification and description of existing differential settlements, including visible cracks in walls, floors, and ceilings, including a diagram, if applicable, room-by-room. All other apparent structural and cosmetic damage or defects shall also be noted. Defects shall be described, including dimensions, wherever possible.
- c) Digital photographs or digital video or both, as necessary, to record areas of significant concern.

Photographs and videos shall be clear and shall accurately represent the condition of the property. Each photograph or video shall be clearly labelled with the location and date taken.

A copy of the Pre-Construction Condition Survey limited to a single residence or property, including copies of any photographs or videos that may form part of the report, shall be provided to the owner of that residence or property, upon request.

7.1.2 Post-Construction Condition Surveys

The standard inspection procedure shall include the provision of an explanatory letter to the owner or occupant and owner with a formal request for permission to carry out an inspection.

A Post-Construction Condition Survey at each structure within a 250 m radius of the storm sewer and temporary protection system, is required within two (2) months of completion of the excavation and installation of storm sewers and temporary protection systems.

The Post-Construction Condition Survey shall include, as a minimum, the following information:

- a) Identification and description of existing differential settlements, including visible cracks in walls, floors, and ceilings, including a diagram, if applicable, room-by-room. All other apparent structural and cosmetic damage or defects shall also be noted. Defects shall be described, including dimensions, wherever possible.
- b) Digital photographs or digital video or both, as necessary, to record areas of significant concern.

- c) Comparison between pre-condition survey documented concerns and post-condition concerns.

Photographs and videos shall be clear and shall accurately represent the condition of the property. Each photograph or video shall be clearly labelled with the location and date taken.

A copy of the Post-Construction Condition Survey limited to a single residence or property, including copies of any photographs or videos that may form part of the report, shall be provided to the owner of that residence or property, upon request. The report shall confirm that there have been no changes to the property between the Pre-Construction Condition Survey and the Post-Construction Condition Survey as a result of the excavation and installation of storm sewers and temporary protection systems.

7.2 Monitoring

The vibration monitoring equipment shall be placed on the ground surface in the vicinity of each foundation element or protection system, and on the ground surface at radial distances of 25 m, 50 m, and 100 m from the foundation element or protection system locations within the project. The Contractor shall take readings continuously during excavation and installation of storm sewers and temporary protection systems, and shall immediately notify the Contract Administrator if the vibrations exceed the limits specified herein.

The vibrations measured on private structures, wells, etc. shall not exceed 25 mm/s. Those measured on utilities, if applicable, shall not exceed 10 mm/s.

If the readings are not within the limits stated above, the Contractor must alter the installation procedures until the vibrations at the various locations are within acceptable levels.

7.3 Records

The Contractor/Contractor's Engineer shall submit details of the vibration monitoring to the Contract Administrator as follows:

- a) The time/duration of each reading.
- b) Construction operations (i.e. installation of sheet piling) and timing of such relative to the readings.
- c) Details of exceedances and modifications to operations.
- d) Final report containing all relevant data including vibration monitoring and Pre- and Post-Construction Condition Surveys.

10.0 BASIS OF PAYMENT

Payment at the Contract price for the above tender item shall be full compensation for all labour, Equipment and Material required to do the work.

NOTICE TO CONTRACTOR – Subsurface Obstructions

Special Provision

The Contractor shall be alerted to the potential presence of cobbles, boulders and limestone and shale fragments in the fill and native soils, and glacially derived soils, as encountered in various boreholes advanced for the storm sewer replacements associated with the QEW widening from East of Cawthra to The East Mall.

In addition, where the excavations for storm sewer replacements and associated temporary protection systems extend to or into the shale bedrock, which is extremely weak to weak and which contains medium strong to very strong limestone layers at varying depths/elevations, appropriate equipment and construction procedures will be required to penetrate into the bedrock.

The presence of the above-noted near surface conditions shall be considered by the Contractor in the selection of appropriate equipment and procedures for various activities, including but not limited to excavation, grading, installation of the storm sewer replacements and temporary protection systems.



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