



November 1, 2017

FOUNDATION INVESTIGATION AND DESIGN REPORT

QEW - OVERHEAD SIGN SUPPORTS AND HIGH MAST LIGHT POLE QEW WIDENING FROM EAST OF CAWTHRA ROAD TO THE EAST MALL, CITIES OF MISSISSAUGA AND ETOBICOKE MINISTRY OF TRANSPORTATION, ONTARIO GWP 2102-13-00 & 2432-13-00

Submitted to:
AECOM
30 Leek Crescent
Richmond Hill, ON
L4B 4N4



REPORT

GEOCRES No.: 30M11-270
Report Number: 1530382
Distribution:

1 PDF and 1 Copy	Ministry of Transportation, Ontario (Central Region)
1 PDF and 1 Copy	Ministry of Transportation, Ontario (Foundations Section)
1 PDF	AECOM
1 PDF	Golder Associates Ltd.



Table of Contents

PART A – FOUNDATION INVESTIGATION REPORT

1.0 INTRODUCTION.....	1
2.0 SITE DESCRIPTION.....	1
3.0 INVESTIGATION PROCEDURES	1
4.0 SITE GEOLOGY AND SUBSURFACE CONDITIONS	3
4.1 Regional Geology	3
4.2 Subsurface Conditions.....	4
4.2.1 Asphalt / Concrete	4
4.2.2 Fill	4
4.2.3 Silt to Sandy Silt to Silty Sand to Sand and Gravel.....	5
4.2.4 Clayey Silt.....	5
4.2.5 Clayey Silt Till	6
4.2.6 Residual Soil.....	6
4.2.7 Bedrock.....	6
4.3 Groundwater Conditions	8
4.4 Analytical Testing of Soil Sample	8
5.0 CLOSURE	10

PART B – FOUNDATION DESIGN REPORT

6.0 DISCUSSION AND ENGINEERING RECOMMENDATIONS.....	11
6.1 General.....	11
6.2 Design of Sign Support Foundations	11
6.2.1 Site-Specific Caisson Foundation Design in Soil	12
6.2.2 Caisson Foundations Embedded or Socketted into Bedrock	12
6.3 Design of High Mast Light Pole Foundations.....	12
6.4 Corrosion Assessment and Protection.....	13
6.4.1 Potential for Sulphate Attack.....	13
6.4.2 Potential for Corrosion	13
6.5 Construction Considerations.....	14
6.5.1 Control of Soil and Groundwater.....	14



6.5.2	Foundations in Bedrock	14
-------	------------------------------	----

7.0 CLOSURE	15
--------------------------	-----------

REFERENCES

TABLES

Table 1	Geotechnical Design Parameters for Overhead Sign Foundations, G.W.P. 2102-13-00 & 2432-13-00
Table 2	Geotechnical Design Parameters for High Mast Light Pole Foundation, G.W.P. 2102-13-00 & 2432-13-00

DRAWINGS

Drawing 1	Borehole Locations
-----------	--------------------

APPENDICES

Appendix A Record of Boreholes and Record of Drillhole Sheets

Lists of Symbols and Abbreviations	
Lithological and Geotechnical Rock Description Terminology	
Record of Boreholes	OHS-1 to OHS-6, RW2-5, RW3-3, NW6-8, NW9-1, and HML-1
Record of Drillholes	OHS-2, OHS-4, OHS-5B, OHS-6, RW3-3 and HML-1

Appendix B Laboratory Test Results, Bedrock Core Photographs

Figure B1	Grain Size Distribution – Silt and Sand to Gravelly Silty Sand to Sand (Fill)
Figure B2	Plasticity Chart – Clayey Silt (Fill)
Figure B3	Grain Size Distribution – Sand to Sand and Gravel
Figure B4	Grain Size Distribution– Silt
Figure B5	Plasticity Chart – Silt
Figure B6	Grain Size Distribution – Clayey Silt to Clayey Silt with Sand
Figure B7	Plasticity Chart – Clayey Silt
Figure B8	Grain Size Distribution – Clayey Silt with Sand (Till)
Figure B9	Plasticity Chart – Clayey Silt (Till)
Figure B10	Grain Size Distribution– Clayey Silt (Residual Soil)
Figure B11	Plasticity Chart – Clayey Silt (Residual Soil)
Figure B12	Bedrock Core Photographs – OHS-2
Figure B13	Bedrock Core Photographs – OHS-4
Figure B14	Bedrock Core Photographs – OHS-5B
Figure B15	Bedrock Core Photographs – OHS-6
Figure B16	Bedrock Core Photographs – RW3-3
Figure B17	Bedrock Core Photographs – HML-1
Bedrock Laboratory Testing Results - Geomechanica	

Appendix C Analytical Test Results

Appendix D Non-Standard Special Provisions



PART A

FOUNDATION INVESTIGATION REPORT
QEW - OVERHEAD SIGN SUPPORTS AND HIGH MAST LIGHT POLE
QEW WIDENING FROM EAST OF CAWTHRA ROAD TO THE EAST MALL
CITIES OF MISSISSAUGA AND ETOBICOKE
MINISTRY OF TRANSPORTATION, ONTARIO
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 Queen Elizabeth Way (QEW) improvement from east of Cawthra to the East Mall, in the Cities of Mississauga and Etobicoke, Ontario, including rehabilitation of three bridge sites, replacement of three bridges, replacement of two culverts, stormwater management (SWM) ponds, retaining walls, noise barrier walls, high mast light pole foundations, and sign support foundations. This report addresses the results of the foundation investigation carried out for the overhead sign (OHS) supports and high mast light (HML) pole.

The purpose of this investigation is to establish the subsurface soil and bedrock conditions at the proposed OHS support and HML pole locations, by borehole drilling, rock coring and laboratory testing on selected soil and rock core samples.

The Terms of Reference (TOR) and the scope of work for the foundation investigation are outlined in MTO's Request for Proposal, dated January 2016, which forms part of the Consultant's Assignment Number 2015-E-0001 for this project. The work has been carried out in accordance with Golder's Project Specific Supplementary Specialty Plan for foundation engineering services for this project, dated June 6, 2016.

2.0 SITE DESCRIPTION

The west limit of the OHS support and high mast light (HML) pole investigation in the QEW corridor is approximately at the Ogden Avenue Pedestrian Bridge (Station 11+850), and the east limit is approximately at The East Mall interchange (Station 15+000), in the Cities of Mississauga and Etobicoke, respectively. The natural ground surface in this area of the QEW corridor slopes gradually downward from about Elevation 106 m at the west limit to about Elevation 102 m near Etobicoke Creek, then it slopes down into the Etobicoke Creek valley to about Elevation 92 m. East of the Etobicoke Creek valley the natural ground surface rises to about Elevation 112 m near the east limit of the project site. The QEW has generally been constructed on embankment fill, with the embankment height varying from less than 1 m to about 3 m above the adjacent ground surface.

3.0 INVESTIGATION PROCEDURES

The field work for the foundation investigations along the QEW corridor was carried out between September 9 and 22, 2016 during which time a total of ten boreholes were advanced in the general area of the nine proposed OHS structures and one borehole was advanced at the approximate location of the proposed HML pole. The boreholes, designated as Boreholes OHS-1 to OHS-6, RW2-5, RW3-3, NW6-8, NW9-1 and HML-1, were advanced at the locations shown on Drawing 1 and the Record of Borehole/Drillhole sheets are presented in Appendix A.

The field borehole investigation was carried out using truck-mounted CME 55 and CME 75 drill rigs, supplied and operated by Davis Drilling of Milton, Ontario. The boreholes were advanced through the overburden using 108 mm outside diameter (O.D.) solid stem augers and NW casing. Soil samples were obtained at 0.75 m and 1.5 m intervals of depth, using a 50 mm outer diameter (O.D.) split-spoon sampler driven by an automatic hammer in



accordance with Standard Penetration Test (SPT) procedures (ASTM D1586-08)¹. Samples of the bedrock were obtained using an 'NQ' size rock core barrel and coring techniques.

The boreholes were typically advanced to a minimum depth of 6 m below ground surface or to auger and/or sampler refusal (i.e. inferred bedrock) and bedrock was confirmed by coring. The boreholes were advanced to depths ranging from about 6.2 m to 10.9 m below existing ground surface, including coring of bedrock for core lengths between about 3.0 m and 5.7 m in Boreholes OHS-2, OHS-4 to OHS-6, RW3-3 and HML-1. Photographs of the recovered rock samples are provided in Appendix B. Due to restrictions in lane closure times, coring of the bedrock in Borehole OHS-5 was not carried out on the date that Borehole OHS-5 was drilled through the overburden. A second borehole drilled for bedrock coring purposes, Borehole OHS-5B, was advanced adjacent to Borehole OHS-5 through the overburden.

The groundwater conditions and water levels in the open boreholes were observed during the drilling operations. All boreholes were backfilled with bentonite upon completion in accordance with Ontario Regulation 903, "Wells" (as amended).

The field work was observed by members of Golder's engineering and technical staff, who located the boreholes, arranged for the clearance of underground services, observed the drilling, coring, sampling and in situ testing operations, logged the boreholes, and examined and cared for the soil and rock samples. The samples were identified in the field, placed in appropriate containers, labelled and transported to our Mississauga geotechnical laboratory where the samples underwent further visual examination and laboratory testing. All of the laboratory tests were carried out to MTO and/or ASTM Standards, as appropriate. Classification testing (water content, Atterberg limits and grain size distribution) was carried out on selected samples. Point Load Index testing was carried out on selected bedrock core samples and a sample of the bedrock core from Borehole HML-1 was submitted to Geomechanica Inc. for unconfined compression (uniaxial) strength (UCS) testing. The results of the laboratory testing are included in Appendix B.

One soil sample obtained during the field investigation from each of Borehole OHS-4 and OHS-5, using appropriate sampling protocols, were submitted to a specialist analytical laboratory under chain of custody procedures for chemical analysis of conductivity / resistivity, pH and sulphate, and chloride content to assess the potential for the soil to cause deterioration to buried concrete and corrosion to steel. The results of the analytical testing are discussed in Section 4.4 and are provided in Appendix C.

The borehole locations and the ground surface elevations of the as-drilled locations were obtained using a GPS (Trimble XH 3.5G), having an accuracy of 0.1 m in the vertical and 0.1 m in the horizontal. The locations given in the Record of Borehole/Drillhole sheets and shown on Drawing 1 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.

¹ ASTM D1586-08a – Standard Test Method for Standard Penetration Tests and Split Barrel Sampling of the soil.



FOUNDATION REPORT
QEW - OHS AND HML, GWP 2102-13-00 & 2432-13-00

Borehole No.	Approximate Station	Location (MTM NAD 83)		Ground Surface Elevation (m)	Borehole Depth (m)
		Northing (Latitude)	Easting (Longitude)		
OHS-1	11+835	4,827,742.0 (43.589586)	298,624.3 (-79.576480)	103.5	6.2
OHS-2	11+900	4,827,799.9 (43.590107)	298,661.6 (-79.576019)	104.0	10.9*
OHS-3	12+365	4,828,159.5 (43.593347)	298,952.8 (-79.572416)	105.5	8.2
OHS-4	12+750	4,828,464.7 (43.596096)	299,192.8 (-79.569448)	105.6	10.8*
OHS-5/5B	13+245	4,828,855.1 (43.599612)	299,494.6 (-79.565714)	107.0	9.1*
OHS-6	13+705	4,829,219.3 (43.602892)	299,776.2 (-79.562228)	105.0	9.3*
RW2-5	13+815	4,829,306.2 (43.603674)	299,845.3 (-79.561374)	102.1	7.7
RW3-3	13+830	4,829,295.7 (43.603581)	299,881.0 (-79.560932)	102.0	7.6*
NW6-8	13+370	4,828,943.1 (43.600405)	299,587.1 (-79.564569)	107.0	6.7
NW9-1	14+120	4,829,518.2 (43.605585)	300,060.1 (-79.558715)	101.0	7.7
HML-1	14+930	4,830,170.8 (43.611462)	300,564.8 (-79.552469)	109.7	9.3*

* includes bedrock core of between 3.0 m and 6.1 m lengths

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 sands, silts and gravels, with a shallow cover of till remaining over the bedrock.

The bedrock underlying the Greater Toronto Area consists of three shale dominated units: from oldest to youngest, they are the Blue Mountain, Georgian Bay and Queenston Formations. These bedrock formations are essentially

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.)



horizontally bedded, although on a regional scale, they dip gently to the south. The Georgian Bay Formation 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

The detailed subsurface soil, bedrock and groundwater conditions as encountered in the boreholes advanced during this investigation and the results of the laboratory tests carried out on selected soil and bedrock core samples are presented on the Record of Borehole and Drillhole sheets provided in Appendix A and on the individual laboratory test reports included in Appendix B and Appendix C. The results of the in-situ field tests (i.e. SPT 'N'-values) as presented on the Record of Borehole Sheets and in Section 4 are uncorrected.

The stratigraphic boundaries shown on the Record of Borehole sheets are inferred from non-continuous sampling, observations of drilling progress and the results of 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 record of Borehole and Drillhole sheets governs any interpretation of the site conditions.

In general, the subsurface conditions in the area of the proposed OHS supports and HML pole consist of a layer of asphalt over a deposit of fill associated with the construction of the existing Highway embankment. The fill is underlain by granular deposits of silt to sand in some locations, and silty clay to clayey silt with sand, silty clay till or residual soil. The overburden deposits are underlain by shale bedrock. Additional boreholes advanced within the project limits for the design of noise walls (NW series boreholes) and retaining walls (RW series boreholes), are included in the associated reports (under separate cover), and confirm that in general the stratigraphy is consistent along a majority of the alignment and that subsurface conditions and bedrock surface elevations do not vary significantly over short distances. As such, the boreholes advanced at the locations nearest to the overhead sign supports (i.e. within about 30 m) are considered to be applicable to adequately determine the subsurface conditions of the overhead sign support foundations.

A detailed description of the subsurface conditions encountered in the boreholes advanced in the area of the overhead signs and high mast light pole are provided in the following sections.

4.2.1 Asphalt / Concrete

All of the boreholes were advanced through the QEW roadway surface and encountered a layer of asphalt varying in thickness from about 65 mm to 300 mm. A 380 mm thick layer of concrete was encountered underlying the asphalt in Borehole OHS-5, and a 180 mm thick layer of concrete was encountered underlying the asphalt in Borehole RW2-5.

4.2.2 Fill

Fill material associated with the road base/subbase and highway embankment ranging in thickness between 0.1 m and 3.7 m was encountered in Boreholes OHS-1 to OHS-4, OHS-6, RW2-5, RW3-3, NW6-8, NW9-1 and HML-1 underlying the asphalt and concrete (where present). The fill materials encountered in the boreholes are variable in composition, ranging from sand and gravel road base materials, which are generally present immediately below the asphalt, and from sandy silt to silty sand to gravelly silty sand to sand comprising the roadway embankment. In Borehole NW9-1 a 1.4 m thick layer of cohesive fill consisting of clayey silt was encountered interlayered within the non-cohesive embankment fill. The fill ranges in thickness between about 0.1 m and 3.6 m at the borehole locations.



The measured Standard Penetration Test (SPT) “N”-values in the fill material range from 4 blows to 55 blows per 0.3 m of penetration, and generally greater than 11 blows per 0.3 m of penetration, indicating a loose to very dense, and generally compact, relative density. The measured Standard Penetration Test (SPT) “N”-values in the cohesive fill layer in Borehole NW9-1 are 5 blows and 10 blows per 0.3 m of penetration, suggesting a firm to stiff consistency. The natural moisture content measured on samples of the fill materials ranges between 17 per cent and 25 per cent.

Grain size distribution tests were carried out on three samples of the non-cohesive fill deposits and the results are presented on Figure B1, in Appendix B. An Atterberg limits test was carried out on a sample of the cohesive fill deposit encountered in Borehole NW9-1 and measured a liquid limit of 26 per cent, a plastic limit of 16 per cent and a plasticity index of 10 per cent. This result, which is plotted on a plasticity chart on Figure B2 in Appendix B, indicates that the fill can be classified as clayey silt of low plasticity.

4.2.3 Silt to Sandy Silt to Silty Sand to Sand and Gravel

A 1.0 m to 4.1 m thick deposit of non-cohesive soils, ranging in composition from silt to sandy silt to gravelly sandy silt to silty sand to sand to sand and gravel was encountered underlying the fill in Borehole OHS-2, OHS-3 and NW6-8, underlying the concrete in Borehole OHS-5, underlying the clayey silt in Borehole NW9-1 (as discussed in Section 4.2.4), and interlayered with the clayey silt deposit (as discussed in Section 4.2.4) in Borehole OHS-2. The surface of the granular deposit was encountered between about Elevations 94.9 m and 106.5 m and extends to depths of between about 3.8 m and 7.6 m below ground surface (between Elevations 103.2 m and 93.4 m).

The SPT “N”-values measured within the non-cohesive deposit range from 6 blows to 67 blows per 0.3 m of penetration, indicating that the non-cohesive deposit has a loose to very dense relative density.

Grain size distribution tests were carried out on four samples of the non-cohesive deposit and the results are presented on Figure B3 (sand to sand and gravel portion of the deposit) and Figure B4 (silt portion of the deposit), in Appendix B. An Atterberg limits test was carried out on a samples of the silt deposit encountered in Borehole OHS-3 and measured a liquid limit of 18 per cent, a plastic limit of 14 per cent and a plasticity index of 4 per cent. This result, which is plotted on a plasticity chart on Figure B5 in Appendix B, indicates that the deposit is a silt of slight plasticity.

The water content measured on eight samples of the granular deposit ranges between 6 per cent and 25 per cent.

4.2.4 Clayey Silt

A 0.7 m to 6.3 m thick deposit of clayey silt trace sand to with sand, trace gravel to gravelly, was encountered underlying the fill in Boreholes OHS-1, RW2-5, NW9-1 and HML-1, underlying the non-cohesive native deposit in Borehole NW6-8 and interlayered within the non-cohesive deposit in Borehole OHS-2. The surface of the clayey silt deposit was encountered at between about Elevations 97.3 m and 109.4 m and extends to depths of between about 2.3 m and 7.7 m below ground surface (between Elevations 107.4 m and 94.4 m).

The SPT “N”-values measured within the clayey silt deposit range from 4 blows to 39 blows per 0.3 m of penetration and 50 blows for 0.1 m of penetration, suggesting a firm to hard consistency.

Grain size distribution tests were carried out on six samples of the clayey silt deposit and the results are presented on Figure B6, in Appendix B. Atterberg limits tests were carried out on seven samples of the clayey silt deposit and measured liquid limits between 21 per cent and 33 per cent, plastic limits between 14 per cent and 21 per cent and plasticity indices between 8 per cent and 14 per cent. These results, which are plotted on a plasticity chart on Figure B7 in Appendix B, indicate that the deposit is a clayey silt of low plasticity.



The water content measured on samples of the clayey silt deposit ranges between 10 per cent and 24 per cent.

4.2.5 Clayey Silt Till

A 0.3 m to 3.7 m thick till deposit consisting of clayey silt with sand to some sand, trace gravel to gravelly was encountered underlying the granular deposit in Borehole OHS-3, underlying the fill deposit in Borehole OHS-6 and underlying the clayey silt with sand deposit in Borehole NW6-8. The surface of the clayey silt till deposit was encountered between about Elevation 98.5 m and 104.2 m and the deposit extends to a depth of about 4.5 m below ground surface (Elevation 100.5 m) in Borehole OHS-6 and to depths of 6.7 m and 8.2 m below ground surface in Boreholes NW6-8 and OHS-3 (Elevation 100.3 m and 97.3 m), respectively, wherein the boreholes were terminated without fully penetrating the deposit. The presence of cobbles and boulders within the till deposit in Borehole OHS-6 was inferred based on grinding of the augers as noted on the Record of Borehole sheet in Appendix A.

The SPT "N"-values measured within the clayey silt till deposit range from 21 blows to 59 blows per 0.3 m of penetration, suggesting a very stiff to hard consistency.

A grain size distribution test was carried out on one sample of the clayey silt till deposit and the result is presented on Figure B8, in Appendix B. Atterberg limits tests were carried out on two samples of the clayey silt till deposit and measured liquid limits of 26 per cent and 27 per cent, plastic limits of 17 per cent and plasticity indices of 9 per cent and 10 per cent. These results, which are plotted on a plasticity chart on Figure B9 in Appendix B, indicate that the deposit is a clayey silt of low plasticity.

The water content measured on two samples of the clayey silt till deposit is 8 per cent.

4.2.6 Residual Soil

Underlying the cohesive deposit in Boreholes OHS-1 and HML-1, the fill in Borehole OHS-4, the granular deposits in Borehole OHS-5 and the till deposit in Borehole OHS-6, a 1.5 m to 4.0 m thick deposit of residual soil was encountered. The surface of the residual soil deposit was encountered at between about Elevations 100.5 m and 107.4 m and the deposit extends to depths between about 4.4 m and 6.3 m below ground surface (Elevations 103.5 m and 98.9 m).

The SPT "N"-values measured within the residual soil deposit range from 21 blows to 59 blows per 0.3 m of penetration, suggesting a very stiff to hard consistency.

The deposit consists of clayey silt some sand to with sand, trace to with gravel and contains varying amounts of shale fragments, and is derived from weathering of the underlying shale bedrock. Grain size distribution tests were carried out on two samples of the residual soil deposit and the results are presented on Figure B10, in Appendix B. Atterberg limits tests were carried out on four samples of the residual soil deposit and measured liquid limits between 23 per cent and 30 per cent, plastic limits between 14 per cent and 19 per cent and plasticity indices between 9 per cent and 12 per cent. These results, which are plotted on a plasticity chart on Figure B11 in Appendix B, indicate that the residual soil deposit may be classified as a clayey silt of low plasticity.

The water content measured on samples of the residual soil deposit range between 6 per cent and 15 per cent.

4.2.7 Bedrock

Bedrock was encountered and core samples were recovered in Boreholes OHS-2, OHS-4 to OHS-6, RW3-3 and HML-1. The bedrock surface was encountered in Boreholes OHS-1 and NW9-1 and penetrated for depths of 1.8 m



FOUNDATION REPORT
QEW - OHS AND HML, GWP 2102-13-00 & 2432-13-00

and 0.1 m, respectively, by auger drilling and/or split spoon sampling. The depths to bedrock below ground surface and the corresponding bedrock surface elevation are summarized below.

Borehole	Depth to Bedrock Surface / Refusal (m)	Bedrock Surface / Refusal Elevation (m)	Comments
OHS-1	4.4	99.1	Bedrock penetrated by augering to a depth of 6.2 m.
OHS-2	6.1	97.9	Bedrock cored between depths of 7.6 m and 10.9 m.
OHS-4	4.7	100.9	Bedrock cored between depths of 4.7 m and 10.8 m.
OHS-5 / OHS-5B	6.2 / 6.1	100.8 / 100.9	Bedrock cored between depths of 6.1 m and 9.1 m in Borehole OHS-5B.
OHS-6	6.1	98.9	Bedrock cored between depths of 6.2 m and 9.3 m.
RW3-3	2.3	99.7	Bedrock cored between depths of 3.8 m and 7.6 m.
NW9-1	7.6	93.4	Split-spoon sample recovered
HML-1	6.2	103.5	Bedrock cored between depths of 6.3 m and 9.3 m.

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 (with some completely weathered or slightly weathered zones), thinly laminated, very fine grained, non-porous, weak, grey, with medium strong to strong limestone interbeds at varying intervals, as presented in the Record of Drillhole sheets in Appendix A, and shown on the photographs of the recovered core samples on Figures B12 to B17 in Appendix B. The degree of weathering of the bedrock samples (i.e. fresh to slightly weathered – W1 to W2), and the strength classification of the intact rock mass based on field identification (i.e. strong to very strong – R4 to R5) are described in accordance with the International Society for Rock Mechanics (ISRM³) standard classification system.

The Rock Quality Designation (RQD) measured on the core samples ranges from 0 per cent to 100 per cent, and is generally greater than 53 per cent, indicating a rock mass of very poor to excellent quality, and generally of fair or better quality, as per Table 3.10 of CFEM (2006)⁴. The Total Core Recovery (TCR) and Solid Core Recovery (SCR) of samples recovered are between 0 per cent and 100 per cent.

One unconfined compression strength (UCS) test (ASTM D7012)⁵ was carried out on a core sample of the shale bedrock obtained in Borehole HML-1 which measured a compressive strength of about 17.8 MPa, as summarized in the report from Geomechanica included in Appendix B.

Based on the laboratory UCS test, in accordance with Table 3.5 in CFEM (2006), the shale bedrock is classified as weak (R2, 5 MPa < UCS < 25 MPa).

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 Publisher Ltd., British Columbia.

⁵ ASTM D7012 – Standard Test Method for Compressive Strength and Elastic Moduli of Intact Rock Core Specimens



Point Load tests were carried out on thirteen samples of the bedrock core, and the results are summarized below:

Borehole No.	Sample Depth (m)	Approximate Sample Elevation (m)	Axial (A) or Diametral (D) Test	Rock Type	I _s (50 mm) (MPa)
OHS-2	8.55	95.5	D	Limestone	4.60
OHS-2	8.55	95.5	D	Limestone	3.32
OHS-2	8.55	95.5	D	Limestone	4.60
OHS-2	8.57	95.4	A	Limestone	10.70
OHS-2	8.60	95.4	A	Limestone	4.97
OHS-2	9.66	94.3	A	Shale	0.95
OHS-4	7.90	97.7	A	Limestone	2.78
OHS-5	6.52	100.5	D	Shale	0.06
OHS-5	6.52	100.5	A	Shale	0.85
OHS-5	6.89	100.1	A	Shale	0.44
OHS-5	6.32	100.7	D	Shale	0.38
OHS-5	6.33	100.7	A	Shale	0.62
OHS-6	7.65	97.4	A	Shale	0.31

Based on the point load test results, in accordance with Table 3.5 from CFEM (2006), the shale bedrock within the depth of exploration is classified as weak (R2, PLI < 1 MPa), containing strong to extremely strong (R4 to R6, 2 MPa < PLI < 10 MPa) limestone interlayers.

4.3 Groundwater Conditions

The overburden samples obtained from the boreholes were generally moist to wet. The water level observed in Boreholes OHS-1 to OHS-4, NW9-1 and NW6-8 upon completion of drilling (and prior to rock coring as applicable) varied between depths of about 1.1 m and 6.5 m (between Elevations 102.4 m and 94.5 m), and Boreholes OHS-5, OHS-6, RW3-3 and RW2-5 were observed to be dry upon completion of drilling operations.

It should be noted that the groundwater level in the area is subject to seasonal fluctuations and precipitation events, and should be expected to be higher during wet periods of the year.

4.4 Analytical Testing of Soil Sample

Analytical testing was carried out on a soil sample from each of Boreholes OHS-4 and OHS-5, from depths of about 2.4 m and 4.1 m below ground surface, respectively. The testing was carried out to assess the corrosivity and concrete degradation potential of the soils against the proposed new OHS footings. The analytical test results from the specialist analytical laboratory are presented in Appendix C and are summarized below.



FOUNDATION REPORT
QEW - OHS AND HML, GWP 2102-13-00 & 2432-13-00

Parameter	OHS-4	OHS-5
Soil Resistivity	850 ohm-cm	1400 ohm-cm
Soil Conductivity	1180 $\mu\text{mho/cm}$	720 $\mu\text{mho/cm}$
Sulphate Concentration	270 $\mu\text{g/g}$	560 $\mu\text{g/g}$
Chloride Concentration	500 $\mu\text{g/g}$	40 $\mu\text{g/g}$
Soil pH	7.9	7.9



5.0 CLOSURE

This report was prepared by Mr. Matthew Kelly, P.Eng., a geotechnical engineer with Golder. Mr. Jorge Costa, P.Eng., Golder's Designated MTO Foundation Contact for this project and Senior Consultant with Golder, conducted an independent quality control review of the report.

GOLDER ASSOCIATES LTD.



Matthew Kelly, P. Eng.
Geotechnical Engineer

MWK/JMAC/smsm



Jorge M.A. Costa, P.Eng.
Designated MTO Foundations Contact, Senior Consultant

c:\users\mwkelly\desktop\final\1530382 17oct4 fdr - ohs and hml.docx



PART B

FOUNDATION DESIGN REPORT
QEW - OVERHEAD SIGN SUPPORTS AND HIGH MAST LIGHT POLE
QEW WIDENING FROM EAST OF CAWTHRA ROAD TO THE EAST MALL
CITIES OF MISSISSAUGA AND ETOBICOKE
MINISTRY OF TRANSPORTATION, ONTARIO
GWP 2102-13-00 & 2432-13-00



6.0 DISCUSSION AND ENGINEERING RECOMMENDATIONS

6.1 General

This section of the report provides foundation recommendations for the design of the overhead sign (OHS) supports and High Mast Light (HML) pole foundation. These recommendations are based on interpretation of the factual data obtained from the boreholes advanced during the subsurface investigation along the QEW corridor. The interpretation and recommendations presented in this report are intended to provide the designers with sufficient information to assess the feasible foundation alternatives and carry out detail design of the OHS support and HML pole foundations.

The foundation investigation report, interpretation of data 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. Contractors 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 aspects of construction should make their own interpretation of the factual information provided as such interpretation may affect equipment selection, proposed construction methods, scheduling and the like.

6.2 Design of Sign Support Foundations

Caisson foundations for sign supports should be designed in accordance with the requirements in MTO's *Sign Support Manual* (MTO, 2015). The *Sign Support Manual* includes standard caisson foundation designs for each sign type as follows:

- **Cantilever Signs:** Cantilever Static Sign Supports, Section 3 and Standard Drawings SS118-3, SS118-4 and SS118-5.
- **Trichord Overhead Signs:** Tri-Chord Static Sign Supports, Section 4 and Standard Drawings SS118-3, SS118-4 and SS118-5.

In the standard caisson foundation design, the caisson is extended 5 m to 6.5 m below the design frost depth (i.e. 1.2 m as per OPSD 3090.101 Foundation Frost Penetration Depths for Southern Ontario) resulting in a total length of 6.2 to 7.7 m below final grade depending on the sign class and corresponding caisson diameter. The standard sign foundation designs presented in the MTO's *Sign Support Manual* have been developed based on the minimum soil conditions given below.

- **Case 1 (Non-Cohesive Soils):** Sand with a friction angle of 28 degrees surrounding the upper two-thirds of the portion of the caisson foundation below the frost depth, and sand with a friction angle of 30 degrees surrounding the lower third of the portion of the caisson below the design frost depth.
- **Case 2 (Cohesive Soils):** Soft clay with an undrained shear strength of 25 kPa surrounding the upper two-thirds of the portion of the caisson foundation below the frost depth, and "soft" clay with an undrained shear strength of 50 kPa surrounding the lower third of the portion of the caisson below the design frost depth.

The standard foundation design provided in MTO's *Sign Support Manual* does not apply to sites where extensive poor fill materials or materials looser or softer than those of Case 1 or Case 2 are present. The standard foundation design is also not applicable where bedrock is encountered within the standard foundation depth. For such subsurface conditions, a site-specific design is required.



Based on the review of the borehole information, the subsurface conditions at the proposed sign locations have been compared to the standard design requirements to assess whether a standard or site-specific design is required. The requirement for either a standard or site-specific design is summarized in Table 1, following the text of this report, along with geotechnical parameters for design.

In the area of the Etobicoke Creek flood plain (OHS No. 4) Borehole RW3-3 (drilled from the table land on the south shoulder of the QEW) encountered bedrock immediately underlying the roadway embankment fill; whereas Borehole RW2-5 (drilled from the flood plain on the north shoulder of the QEW) encountered an approximately 6.3 m thick deposit of clayey silt underlying the 1.4 m thick layer of roadway fill (and concrete/asphalt pavement). It is anticipated that the overhead sign will span across the transition from table land to flood plain between the south shoulder and the center median. Separate recommendations are provided in Table 1 for the foundation at the south shoulder and the foundation at the centre median (if required).

6.2.1 Site-Specific Caisson Foundation Design in Soil

A site-specific caisson foundation design may be carried out by the structural engineer to optimize the standard foundation design using the geotechnical design parameters given in Table 1 following the text of this report. In the design of the sign foundations, the passive resistance within the upper 1.2 m below ground surface should be neglected to account for frost action. The unfactored lateral resistance should be calculated assuming an equivalent width equal to three times the caisson diameter. A resistance factor of 0.5 should be applied to this unfactored lateral resistance to obtain the factored lateral geotechnical resistance at Ultimate Limit Status (ULS).

The current General Arrangement drawings indicate that the OHS foundations will be constructed in areas of relatively flat ground, however, in the event that the OHS foundations are located on the highway embankment slope or within about 2 diameters of the crest of the slope in the direction of loading, there would be unbalanced earth pressures around the foundation due to it being located within sloping ground (assumed 2H:1V embankment). For this case, the passive earth pressure coefficient ($K_{p2:1}$), to be used in the foundation design is also included in Table 1.

6.2.2 Caisson Foundations Embedded or Socketted into Bedrock

In accordance with MTO's *Sign Support Manual*, where bedrock is encountered at a depth, z (in metres), of less than 5 m below the bottom of the frost layer, the required depth of the foundation below the frost layer may be taken as follows:

$$z + [(5 - z) / 2]$$

Where bedrock is present within the "standard" foundation depth, the required depth of rock socket can be determined using the equation above based on the depths/elevations given in Table 1. Alternatively, site-specific design could be carried out for these locations (using the parameters given in Table 1) to determine whether the overburden soils can provide the required lateral resistance. From a geotechnical perspective, the rock sockets could have a diameter less than the "standard" caisson diameter of 1200 mm; in this case, the actual rock socket diameter should be determined based on site-specific design by the structural engineers, using the passive lateral resistance (f_{horiz} , in kPa) for the rock mass as provided in Table 1.

6.3 Design of High Mast Light Pole Foundations

Caisson foundations for HML poles should be designed in accordance with the requirements in MTO's *Guidelines for the Design of High Mast Pole Foundations* (MTO, 2004), based on the stratigraphy and geotechnical design parameters given in Table 2 following the text of this report. As noted above, where both undrained shear strength



and effective stress parameters are provided, the structural assessment should be completed for both cohesive and non-cohesive soil cases, and the more conservative approach adopted. In the design of the foundations, the passive resistance within the upper 1.2 m below ground surface should be neglected to account for frost action.

The current General Arrangement drawings indicate that the HML pole will be constructed in an area of relatively flat ground, however, in the event that the HML Pole are located on the highway embankment slope or within about 2 diameters of the crest of the slope, there would be unbalanced earth pressures around the HML Pole foundation due to its foundation being located within sloping ground (assumed 2H:1V embankment). For this case, the passive earth pressure coefficient ($K_{p2.1}$), to be used in the foundation design is also included in Table 2.

Where sufficient resistance is not provided by the overburden soils, the caisson foundations will have to be embedded into the shale bedrock. The depth to “sound” bedrock is provided in Table 2, along with recommended values for the factored horizontal bearing capacity of sound rock at Ultimate Limit States (f_{horiz} , as defined in *Guidelines for the Design of High Mast Pole Foundations*).

6.4 Corrosion Assessment and Protection

Soil corrosivity may affect the concrete foundations and reinforced steel and other concrete elements buried in the soil. The long-term performance and durability of the foundations are directly related to their respective corrosion resistance. Generally, the corrosivity of a structure depends on the soil resistivity, hydrogen ion concentration, salts (chloride and sulphate) concentrations and redox potential. The analytical results for the samples submitted for testing are presented in Section 4.4 and included in Appendix C.

6.4.1 Potential for Sulphate Attack

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 concentrations measured in the samples are less than 0.056 per cent, which is below the exposure class of moderate. Therefore, based on the test results of the single soil samples from the boreholes at two of the OHS locations the effects of sulphates from within the existing native deposits around the foundations may not need to be considered.

6.4.2 Potential for Corrosion

The soil has a pH of about 7.9 and a resistivity of between about 850 ohm-cm and 1,300 ohm-cm. According to the Gravity Pipe Design Guidelines (MTO, 2014), the pH is not considered detrimental to concrete durability. However, the resistivity is in less than 2,000 ohm-cm, which indicates that the soil corrosiveness is severe ($R < 2,000$ ohm-cm), as per Table 3.2 of the Gravity Pipe Design Guidelines (MTO, 2014). Based on these results some level of protection may be required depending on the foundation design and materials specified. Further, given that the OHS and HML pole foundations are located adjacent to the roadway shoulder and will be exposed to de-icing salt, consideration should be given to selection of a “C” type exposure class as defined by 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 Construction Considerations

6.5.1 Control of Soil and Groundwater

The water-bearing cohesionless soils at this site should be expected to run or flow into the caisson hole during or after drilling of the caisson foundations for the overhead signs or HML pole. Therefore, appropriate equipment and procedures will be required to minimize ground loss during drilling and concrete placement. This could include the use of temporary or permanent caisson liners, and/or the use of drilling mud. Foundations for the overhead sign supports and for the high mast light pole should be constructed consistent with OPSS 915 (Sign Support Structures) and OPSS 903 (Deep Foundations), respectively. It is recommended that a Non-Standard Special Provision (NSSP) be included in the Contract Documents to warn the Contractor of this condition; such an NSSP is provided in Appendix D.

6.5.2 Foundations in Bedrock

Caisson foundations for some of the overhead sign supports and for the high mast light pole foundation will extend into the shale bedrock, which is weak, and which contains medium strong to extremely strong interlayers of limestone. Appropriate construction procedures and equipment (such as coring or churn drilling equipment) will be required to penetrate the bedrock. It is recommended that an NSSP be included in the Contract Documents to warn the Contractor of this condition; such an NSSP is provided in Appendix D.



7.0 CLOSURE

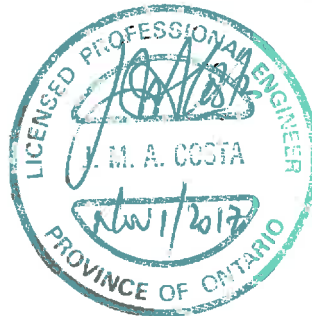
This report was prepared by Mr. Matthew Kelly, P.Eng. a geotechnical engineer with Golder. Mr. Jorge M. A. Costa, P.Eng., a Senior Consultant with Golder and Designated MTO Foundations Contact conducted an independent quality control review of this report.

GOLDER ASSOCIATES LTD.



Matthew Kelly, P. Eng.
Geotechnical Engineer

MWK/JMAC/sm



Jorge M.A. Costa, P.Eng.
Designated MTO Foundations Contact, Senior Consultant

c:\users\mwkelly\desktop\final\1530382 17oct4 fidr - ohs and hml.docx



REFERENCES

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

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.

CSA Group. 2014. A23.1-14/A23.2-14 - Concrete materials and methods of concrete construction / Test methods and standard practices for concrete.

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.

ASTM International:

- | | |
|------------|--|
| ASTM D1586 | Standard Test Method for Standard Penetration Test (SPT) and Split-Barrel Sampling of Soils |
| ASTM D7012 | Standard Test Method for Compressive Strength and Elastic Moduli of Intact Rock Core Specimens under Varying States of Stress and Temperatures |

Ontario Provisional Standard Drawing:

- | | |
|---------------|---|
| OPSD 3090.101 | Foundation, Frost Penetration Depths for Southern Ontario |
|---------------|---|

Ontario Provincial Standard Specification:

- | | |
|----------|--|
| OPSS 903 | Construction Specification for Deep Foundations |
| OPSS 915 | Construction Specification for Sign Support Structures |

Ontario Water Resources Act:

- | | |
|------------------------|--------------------|
| Ontario Regulation 903 | Wells (as amended) |
|------------------------|--------------------|

Ministry of Transportation, Ontario

Ministry of Transportation Ontario. Guidelines for the Design of High Mast Pole Foundations, Fourth Edition. Bridge Office, Engineering Standards Branch, Ontario Ministry of Transportation. May 2004.

Ministry of Transportation Ontario. Sign Support Manual. Provincial Highways Management Division, Highway Standards Branch, Bridge Office. April 2015.

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



TABLES

TABLE 1
GEOTECHNICAL DESIGN PARAMETERS FOR OVERHEAD SIGN FOUNDATIONS

Overhead Sign ID (Location)	Reference Borehole (Station)	Ground Surface Elevation at Reference Borehole (m)	Estimated Ground Surface Elevation at OHS Location (m)	Standard or Site-Specific Foundation Design	Stratum	Depth Relative to Proposed Ground Surface (m) ¹	Elevation (m)	Groundwater Elevation (m)	Design Parameters ^{2,3}						
									S _u (kPa)	Φ'	γ (kN/m ³)	γ' (kN/m ³)	K _p	K _{p2:1}	f _{horiz} (kPa)
OHS No. 1 (EBL, Sta. 11+840)	OHS-1 (11+835)	103.5	103.5	Standard / Site Specific ⁴	Very loose to compact silty sand - Fill	0 - 1.4	103.5 - 102.1	102.4	--	28	19	9	2.8	1.1	--
					Soft to stiff clayey silt	1.4 - 2.9	102.1 - 100.6		15	26	20	10	2.6	0.9	--
					Hard clayey silt (Residual Soil)	2.9 - 4.4	100.6 - 99.1		200	34	21	11	3.5	1.4	--
					Weathered Shale Bedrock	4.4 - 6.2	99.1 - 97.3		--	34	23	13	3.5	1.4	--
OHS No. 2 (EBL, Sta. 12+370)	OHS-3 (12+365)	105.5	105.5	Site-Specific	Loose to dense sandy silt - Fill	0 - 2.9	105.5 - 102.6	101	--	28	19	9	2.8	1.1	--
					Dense sand	2.9 - 4.4	102.6 - 101.1		--	32	20	10	3.3	1.3	--
					Loose to compact silty sand - Fill	4.4 - 7.0	101.1 - 98.5		--	28	19	9	2.8	1.1	--
					Hard clayey silt till	7.0 - 8.2	98.5 - 97.3		200	34	21	11	3.5	1.4	--
					Compact sandy silt - Fill	0 - 2.1	105.5 - 103.4		--	28	19	9	2.8	1.1	--
OHS No. 3 (EBL, Sta. 12+750)	OHS-4 (12+750)	105.6	105.5	Site-Specific	Hard clayey silt (Residual Soil)	2.1 - 4.6	103.4 - 100.9	102.2	200	34	21	11	3.5	1.4	--
					Completely weathered shale bedrock	4.6 - 6.3	100.9 - 99.2		--	34	21	11	3.5	1.4	--
					Moderately weathered shale bedrock	6.3 - 7.7	99.2 - 97.8		--	34	23	13	3.5	1.4	--
					Shale bedrock	Below 7.7	Below 97.8		--	--	23	13	--	--	600
					Loose to very dense silty sand - Fill	0 - 3.4	107.0 - 103.7		--	28	19	9	2.8	1.1	--
OHS No. 4 (EBL, Sta. 13+370)	NW6-8 (13+370)	107.0	107.0	Standard	Loose to compact sandy silt to gravelly sandy silt	3.4 - 4.4	103.7 - 102.6	103.5	--	30	20	10	3.0	1.2	--
					Firm to hard clayey silt with sand and gravel	4.4 - 6.4	102.6 - 100.6		50	30	20	10	3.0	1.2	--
					Hard clayey silt till	6.4 - 6.7	100.6 - 100.3		100	32	21	11	3.3	1.3	--
					Loose to compact gravelly silty sand	0 - 2.3	102.0 - 99.7		--	28	19	9	2.8	1.1	--
OHS No. 5 (south shoulder) (EBL, Sta. 13+830)	RW3-3 (13+830)	102.0	102.0	Site-Specific	Weathered Shale Bedrock	2.3 - 4.7	99.7 - 97.3	100.0	--	34	23	13	3.5	1.4	--
					Shale bedrock	Below 4.7	Below 97.3		--	--	23	13	--	--	600
					Compact silty sand - Fill	0 - 1.3	102.0 - 100.7		--	28	19	9	2.8	1.1	--
OHS No. 5 (Center Median)	RW2-5 (13+815)	102.1	102.0	Standard	Stiff to hard clayey silt	1.3 - 7.7	100.7 - 94.4	100.0	100	32	21	11	3.3	1.3	--
					Loose to compact silty sand - Fill	0 - 2.0	101.5 - 99.5		--	28	19	9	2.8	1.1	--
OHS No. 6 (EBL, Sta. 14+160)	NW9-1 (14+120)	101.0	101.5	Standard	Firm to very stiff clayey silt - Fill	2.0 - 3.4	99.5 - 98.1	95.0	50	28	20	10	2.8	1.1	--
					Compact silt and sand - Fill	3.4 - 4.2	98.1 - 97.3		--	28	20	10	2.8	1.1	--
					Stiff clayey silt with sand	4.2 - 6.6	97.3 - 94.9		75	30	20	10	3.0	1.2	--
					Loose silty sand	6.6 - 8.2	94.9 - 93.3		--	30	20	10	3.0	1.2	--
					Compact silty sand - Fill	0 - 2.1	104.0 - 101.9		--	28	19	9	2.8	1.1	--
OHS No. 7 (WBL, Sta. 11+900)	OHS-2 (11+900)	104.0	104.0	Standard / Site Specific ⁴	Loose to compact sandy silt to silt	2.1 - 3.7	101.9 - 100.3	100.6	--	28	19	9	2.8	1.1	--
					Very stiff clayey silt	3.7 - 4.4	100.3 - 99.6		100	32	21	11	3.3	1.3	--
					Very dense silty sand	4.4 - 6.1	99.6 - 97.9		--	34	21	11	3.5	1.4	--
					Weathered Shale Bedrock	6.1 - 7.6	97.3 - 96.4		--	34	23	13	3.5	1.4	--
					Shale bedrock	Below 7.6	Below 96.4		--	--	23	13	--	--	600
					Compact to dense silty sand to silty sand and gravel	0 - 2.6	107.0 - 104.4		--	30	20	10	3.0	1.2	--
OHS No. 8 (WBL, Sta. 13+250)	OHS-5/5B (13+245)	107.0	107.0	Standard / Site Specific ⁴	Compact to Dense sand and gravel	2.6 - 3.8	104.4 - 103.2	100.8	--	30	20	10	3.0	1.2	--
					Very stiff to hard sandy clayey silt (Residual soil)	3.8 - 6.1	103.2 - 100.9		100	32	21	11	3.3	1.3	--
					Shale bedrock	Below 6.1	Below 100.9		--	--	23	13	--	--	600
					Compact silty sand - Fill	0 - 0.8	105.0 - 104.2		--	28	19	9	2.8	1.1	--
OHS No. 9 (WBL, Sta. 13+710)	OHS-6 (13+705)	105.0	105.0	Site-Specific	Very stiff to hard clayey silt with sand Till	0.8 - 4.5	104.2 - 100.5	98.9	100	32	21	11	3.3	1.3	--
					Hard clayey silt / Weathered shale bedrock	4.5 - 6.1	100.5 - 98.9		200	34	21	11	3.5	1.4	--
					Shale bedrock	Below 6.1	Below 98.9		--	--	23	13	--	--	600

NOTES:

1. Depths are given at the existing or proposed sign support locations relative to the estimated proposed ground surface following construction, including any median grade raises or regrading. Although Su, φ' and Kp parameters are given for the full depth of the soil, the passive resistance in the upper 1.2 m should be neglected to account for frost action.
2. Design parameters:
 - S_u = undrained shear strength (kPa);
 - φ' = effective friction angle (degrees);
 - γ = bulk unit weight (kN/m3);
 - γ' = effective unit weight below the groundwater level (kN/m3);
 - K_p = passive earth pressure coefficient; and
 - K_{p2:1} = passive earth pressure coefficient for 2H:1V sloping ground surface.
 - f_{horiz} = factored lateral geotechnical resistance of sound rock at Ultimate Limit States (kPa).
3. Where both undrained shear strength and effective friction angle parameters have been provided for fill materials, the structural assessment should be completed for both cohesive soil and cohesionless soil cases, and the selected design should be based on the more conservative approach.
4. Site specific foundation design for signs requiring a caisson total length greater than 6.2 m

TABLE 2

GEOTECHNICAL DESIGN PARAMETERS FOR HIGH MAST LIGHT POLE FOUNDATION

Reference Borehole	Station	Ground Surface Elevation at Reference Borehole (m)	Estimated Ground Surface Elevation at HML (m)	Stratum	Depth Below Ground Surface at Proposed HML Pole Location (m) ¹	Elevation (m)	Groundwater Elevation ² (m)	Design Parameters ^{3,4}						
								S _u (kPa)	Φ'	γ (kN/m ³)	γ' (kN/m ³)	K _p	K _{p2:1}	f _{horiz} (kPa)
HML-1	15+005	109.7	109.7	Sand and Gravel Fill	0 - 0.4	109.7 - 109.3	109.0	--	28	19	9	2.8	1.1	-
				Very stiff to hard clayey silt	0.4 - 2.3	109.3 - 107.4		100	32	21	11	3.3	1.3	-
				Hard clayey silt (Residual Soil)	2.3 - 6.3	107.4 - 103.5		200	34	21	11	3.5	1.4	
				Shale bedrock	Below 6.3	Below 103.5		--	--	23	13	-	--	600

- NOTES:
1. Depths are given at the proposed HML pole location. Although Su, φ' and Kp parameters are given for the full depth of the soil, the passive resistance in the upper 1.2 m should be neglected to account for frost action.

2. Groundwater level inferred based on additional boreholes in vicinity of HML Pole location

3. Design paramet

S_u

= undrained shear strength (kPa);

φ'

= effective friction angle (degrees);

γ

= bulk unit weight (kN/m3);

γ'

= effective unit weight below the groundwater level (kN/m3);

K_p

= passive earth pressure coefficient;

K_{p2:1}

= passive earth pressure coefficient for 2H:1V sloping ground surface.

f_{horiz}

= factored lateral geotechnical resistance of sound rock at Ultimate Limit States (kPa).

4. Where both undrained shear strength and effective friction angle parametersare provided, the structural assessment should be completed for both cohesive soil and cohesionless soil cases, and the selected design should be based on the more conservative approach.



DRAWINGS

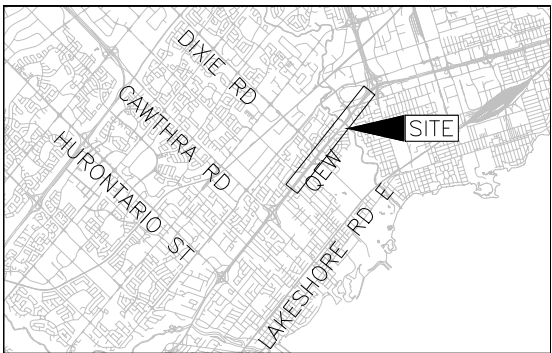
METRIC
DIMENSIONS ARE IN METRES AND/OR
MILLIMETRES UNLESS OTHERWISE SHOWN.
STATIONS IN KILOMETRES + METRES.

CONT No. _____
GWP No. 2102-13-00 / 2432-13-00



QEW
OVERHEAD SIGN SUPPORTS AND
HIGH MAST LIGHT POLES
BOREHOLE LOCATIONS

SHEET



KEY PLAN
SCALE
2 0 2 4 km

LEGEND

● Borehole - Current Investigation

BOREHOLE CO-ORDINATES

No.	ELEVATION	NORTHING	EASTING
OHS-1	103.5	4827742.0	298624.3
OHS-2	104.0	4827799.9	298661.6
OHS-3	105.5	4828159.5	298952.8
OHS-4	105.6	4828464.7	299192.8
OHS-5/5B	107.0	4828855.1	299494.6
OHS-6	105.0	4829219.3	299776.2
HML-1	109.7	4830170.8	300564.8
NW6-8	107.0	4828943.1	299587.1
NW9-1	101.0	4829518.2	300060.1
RW2-5	102.1	4829306.2	299845.3
RW3-3	102.0	4829295.7	299881.0

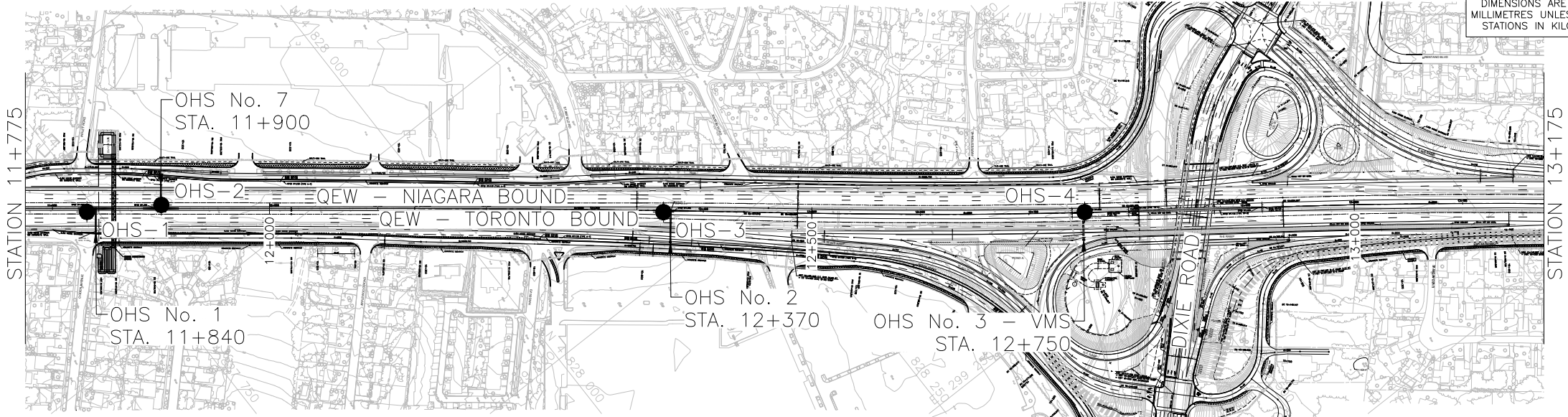
NOTES

This drawing is for subsurface investigation information only. The proposed highway 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.

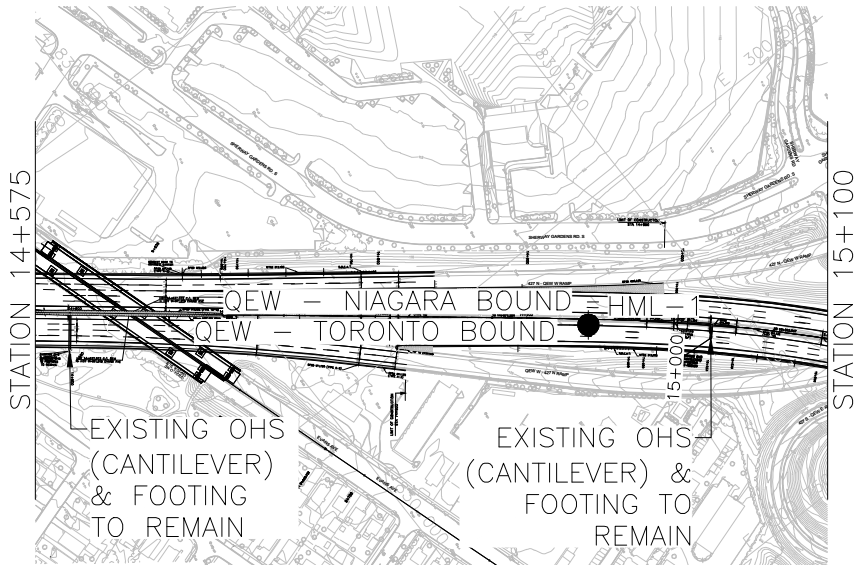
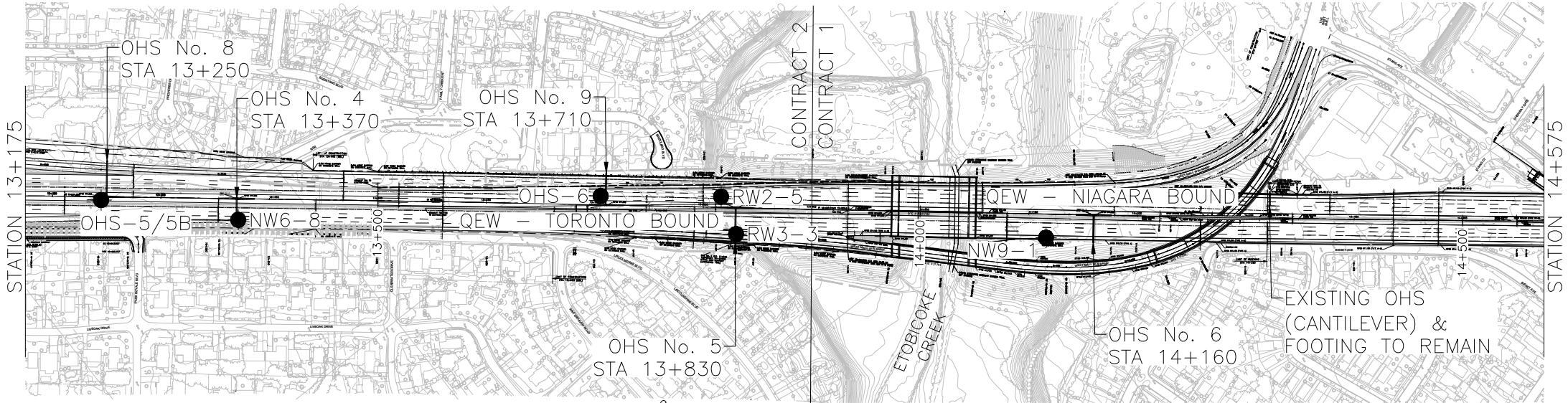
REFERENCE

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.
Key plan base data - MNRF LIO, obtained 2015.

NO.	DATE	BY	REVISION
Geocres No. 30M11-270			
HWY. QEW	PROJECT NO. 1530382		DIST. CENTRAL
SUBM'D. MWK	CHKD. MWK	DATE: 8/28/2017	SITE: .
DRAWN: MR	CHKD. SMM	APPD. JMAC	DWG. 1



PLAN



SCALE
50 0 50 100 m





APPENDIX A

Lists of Abbreviations and Symbols

Lithological and Geotechnical Rock Description Terminology

Record of Boreholes and Record of Drillholes



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

$$\tau = c' + \sigma' \tan \phi'$$

$$\text{shear strength} = (\text{compressive strength})/2$$



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

Density Index	N
Relative Density	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



LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY

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

Description	Bedding Plane Spacing
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

Description	Spacing
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

Term	Size*
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	

PROJECT		2102-13-00; 2432-13-00		LOCATION		N 4827742.0; E 298624.3 MTM NAD 83 ZONE 10 (LAT. 43.589586; LONG. -79.576480)		ORIGINATED BY		MK											
DIST		Central HWY QE		BOREHOLE TYPE		108 mm O.D. Continuous Flight Solid Stem Augers		COMPILED BY		PKS											
DATUM		Geodetic		DATE		September 13 and 14, 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	20			40	60	80	100	20						40	60	80
103.5	GROUND SURFACE																				
0.0	ASPHALT (80 mm)																				
0.1	Silty sand, trace gravel (FILL) Very loose to compact Dark brown/brown Dry to wet		1	SS	16																
			2	SS	4																
102.1	CLAYEY SILT, trace to some sand Soft to stiff Grey Moist		3	SS	10																
1.4			4	SS	4																
100.6	CLAYEY SILT, some sand, trace gravel, trace shale fragments (RESIDUAL SOIL) Very stiff Brown/Grey Moist to wet		5	SS	20																
2.9			6	SS	31																
99.1	SHALE (BEDROCK)		7	SS	50/0.08																
4.4			8	SS	50/0.10																
97.3	END OF BOREHOLE																				
6.2	NOTE: 1. Water in open borehole at a depth of 1.1 m below ground surface (Elev.102.4 m) upon completion of drilling.																				


GTA-MTO 001 S:\CLIENTS\MTQEQW-DIXIE\02_DATA\GTA\GTD 11/01/17 GPK

PROJECT 1530382		RECORD OF BOREHOLE No OHS-2		SHEET 1 OF 2		METRIC											
G.W.P. 2102-13-00; 2432-13-00		LOCATION N 4827799.9; E 298661.6 MTM NAD 83 ZONE 10 (LAT. 43.590107; LONG. -79.576019)		ORIGINATED BY KG													
DIST Central HWY QEW		BOREHOLE TYPE 108 mm O.D. Continuous Flight Solid Stem Augers		COMPILED BY PKS													
DATUM Geodetic		DATE September 14, 2016		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 kN/m³	GR SA SI CL
								20 40 60 80 100	20 40 60 80 100	20 40 60 80 100	W _p	W	W _L				
104.0	GROUND SURFACE																
0.0	ASPHALT (80 mm)																
0.1	Silty sand, trace gravel (FILL) Compact Brown/grey Moist		1	SS	11												
			2	SS	23												
			3	SS	26												
101.9	SILT to Sandy SILT, trace gravel, some silty clay seams Loose to compact Grey Moist		4	SS	11												
2.1			5	SS	6												
100.3	CLAYEY SILT, some sand, trace gravel Very stiff Grey Moist		6	SS	20												
3.7			7	SS	67												
99.6	Silty SAND, some gravel, some shale fragments Very dense Brown/grey Moist		8	SS	60/0.15												
4.4																	
97.9	SHALE (BEDROCK)																
6.1	Bedrock cored from depths of 7.6 m to 10.9 m. Bedrock not cored from 6.1 m to 7.6 m depth due to difficulty seating casing. For bedrock coring details refer to Record of Drillhole OHS-2.		1	RC	REC 76%												RQD = 68%
			2	RC	REC 90%												RQD = 85%

Continued Next Page

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

GTA-MTO 001 S:\CLIENTS\MTQEW-DIXIE02_DATA\GINTQEW-DIXIE.GPJ GAL-GTA.GDT 11/01/17 GPK

PROJECT 1530382		RECORD OF BOREHOLE No OHS-2				SHEET 2 OF 2		METRIC								
G.W.P. 2102-13-00; 2432-13-00		LOCATION N 4827799.9; E 298661.6 MTM NAD 83 ZONE 10 (LAT. 43.590107; LONG. -79.576019)				ORIGINATED BY KG										
DIST Central HWY QEW		BOREHOLE TYPE 108 mm O.D. Continuous Flight Solid Stem Augers				COMPILED BY PKS										
DATUM Geodetic		DATE September 14, 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 kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa								
	--- CONTINUED FROM PREVIOUS PAGE ---						20 40 60 80 100 ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × REMOULDED					WATER CONTENT (%)				
	SHALE (BEDROCK)		2	RC	REC 90%											
93.1	END OF BOREHOLE															
10.9	NOTE: 1. Water level in open borehole measured at a depth of 3.4 m below ground surface (Elev. 100.6 m) upon completion of drilling and prior to rock coring.															

GTA-MTO 001 S:\CLIENTS\MTQEQW-DIXIE02_DATA\GINTQEW-DIXIE.GPJ GAL-GTA.GDT 11/01/17 GPK

SHEET 1 OF 1

DATUM: Geodetic

DRILL RIG: CME 75 (Truck Mounted)

DEPTH SCALE

1 : 50

 **Golder Associates**

LOGGED: KG

CHECKED: KG/AB

STA-MTO 001 S:\CLIENTS\MTO\QEW-DIXIE\02 DATA\GIN\QEW-DIXIE.GPJ GAL-GTA.GDT 11/01/17 GPK

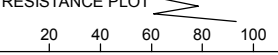

+ 3, × 3: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

PROJECT 1530382		RECORD OF BOREHOLE No OHS-4		SHEET 1 OF 2		METRIC														
G.W.P. 2102-13-00; 2432-13-00		LOCATION N 4828464.7; E 299192.8 MTM NAD 83 ZONE 10 (LAT. 43.596096; LONG. -79.569448)		ORIGINATED BY KG																
DIST Central HWY QEW		BOREHOLE TYPE 108 mm O.D. Continuous Flight Solid Stem Augers		COMPILED BY ACK																
DATUM Geodetic		DATE September 12, 2016		CHECKED BY SMM																
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS			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		ELEVATION SCALE	SHEAR STRENGTH kPa			W _p W W _L			γ	GR SA SI CL					
105.6	GROUND SURFACE							○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × REMOULDED			20 40 60 80 100 10 20 30									
0.0	ASPHALT (90 mm)																			
0.1	Sandy silt to silty sand, trace gravel (FILL) Compact Brown/grey Dry to moist		1	SS	18		105													
			2	SS	14															
							104													
			3	SS	13															
103.4	CLAYEY SILT, some sand (RESIDUAL SOIL) Hard Brown Moist		4	SS	61/0.28		103								0 13 55 32					
2.2			5	SS	50/0.10															
							102													
			6	SS	50/0.08															
100.9	SHALE (BEDROCK)						101													
4.7	Bedrock cored from depths of 4.7 m to 10.8 m. For bedrock coring details refer to Record of Drillhole OHS-4.		1	RC	REC 10%		100								RQD = 0%					
							99								RQD = 11%					
			2	RC	REC 18%		98													
			3	RC	REC 100%		97								RQD = 98%					
			4	RC	REC 100%		96								RQD = 100%					

Continued Next Page

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

GTA-MTO 001 S:\CLIENTS\MTQEQW-DIXIE02_DATA\GINTQEQW-DIXIE.GPJ GAL-GTA.GDT 11/01/17 GPK

PROJECT 1530382		RECORD OF BOREHOLE No OHS-4				SHEET 2 OF 2		METRIC											
G.W.P. 2102-13-00; 2432-13-00		LOCATION N 4828464.7; E 299192.8 MTM NAD 83 ZONE 10 (LAT. 43.596096; LONG. -79.569448)				ORIGINATED BY KG													
DIST Central HWY QEW		BOREHOLE TYPE 108 mm O.D. Continuous Flight Solid Stem Augers				COMPILED BY ACK													
DATUM Geodetic		DATE September 12, 2016				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 ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × REMOULDED					W _p	W	W _L	γ	GR SA SI CL		
94.8	SHALE (BEDROCK)		4	RC	REC 100%		95												RQD = 100%
10.8	END OF BOREHOLE																		
NOTE:																			
1. Water level in open borehole at a depth of 3.4 m below ground surface (Elev. 102.2 m) upon completion of drilling / prior to rock coring.																			

GTA-MTO 001 S:\CLIENTS\MTQEQW-DIXIE02_DATA\GINTQEQW-DIXIE.GPJ GAL-GTA.GDT 11/01/17 GPK

SHEET 1 OF 1

DATUM: Geodetic

DRILLING CONTRACTOR: Davis Drilling Ltd.

[illegible]

BROKEN CORE



CLAY SEAM



LIMESTONE



LOST CORE

DEPTH SCALE

1 : 50


**Golder
Associates**

LOGGED: KG

CHECKED: KG/AB

STA-RCK 054 S:\CLIENTS\IMTO\QEW-DIXIE\02_DATA\GIN\QEW-DIXIE.GPJ GAL-MISS.GDT 11/01/17 GPK

PROJECT 1530382		RECORD OF BOREHOLE No OHS-5				SHEET 1 OF 1		METRIC						
G.W.P. 2102-13-00; 2432-13-00		LOCATION N 4828855.1; E 299494.6 MTM NAD 83 ZONE 10 (LAT. 43.599612; LONG. -79.565714)				ORIGINATED BY PKS								
DIST Central HWY QEW		BOREHOLE TYPE CME 75, 108 mm O.D. Solid Stem Augers				COMPILED BY AJ								
DATUM Geodetic		DATE September 22, 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 kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
107.0	GROUND SURFACE													
0.0	ASPHALT (80 mm)													
0.1	CONCRETE (380 mm)													
106.5	Silty SAND, trace clay Compact to dense Brown Moist		1	SS	11		106							
			2	SS	44		105							
104.7	SAND and GRAVEL, trace to some silt, trace clay Dense to compact		3	SS	36		104			○				44 41 11 4
2.3			4	SS	25									
	- SILT observed in tip of spoon													
103.2	Sandy CLAYEY SILT, trace gravel (RESIDUAL SOIL) Very stiff to hard Grey Moist		5	SS	20		103			○	1			4 28 45 23
3.8			6	SS	66		102			○				
							101							
100.9	SHALE (BEDROCK)		7	SS	100/0.15									
6.1	Borehole OHS-5B advanced 2 m East of Borehole OHS-5 to obtain bedrock core samples; Bedrock cored from depths of 6.1 m to 9.1 m. For bedrock coring details refer to Record of Drillhole OHS-5B.		1	RC	REC 100%		100							RQD = 90%
			2	RC	REC 80%		99							RQD = 66%
97.9	END OF BOREHOLE						98							
9.1	NOTE: 1. Open borehole OHS-5 dry upon completion of drilling.													

GTA-MTO 001 S:\CLIENTS\MTQEQW-DIXIE\02_DATA\GINTQEQW-DIXIE.GPJ GAL-GTA.GDT 11/01/17 GPK

SHEET 1 OF 1

DATUM: Geodetic

DRILLING CONTRACTOR: Davis Drilling Ltd.

LOGGED: AB
CHECKED: ACK/AB

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

PROJECT: 1530382

RECORD OF DRILLHOLE: OHS-6

SHEET 1 OF 1

LOCATION: N 4829219.3 ;E 299776.2

DRILLING DATE: September 14 and 15, 2016

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: —

DRILL RIG: CME 75 (Truck Mounted)

DRILLING CONTRACTOR: Davis Drilling Ltd.

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			FRACT. INDEX PER Meter	DISCONTINUITY DATA						ROCK STRENGTH INDEX		WEATH- ERING INDEX																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																						
						TOTAL CORE %	SOLID CORE %			R.Q.D. %	B Angle	DIP w.r.t CORE AXIS	TYPE AND SURFACE DESCRIPTION	Jr	Ja	R4	R3	R2	R1	W1	W2				W3	W4	W5	W6																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																												
		Continued from Record of Borehole OHS-6		98.80																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																				

FEATURES LEGEND



BROKEN CORE



CLAY SEAM



LIMESTONE



LOST CORE

DEPTH SCALE

1 : 50



LOGGED: KG

CHECKED: KG/AB

GTA-RCK 054 S:\CLIENTS\MTOW\QEW-DIXIE\02 DATA\INT\QEW-DIXIE.GPJ GAL-MISS.GDT 11/01/17 GPK

PROJECT 1530382		RECORD OF BOREHOLE No RW2-5		SHEET 1 OF 1		METRIC															
G.W.P. 2102-13-00; 2432-13-00		LOCATION N 4829306.2; E 299845.3 MTM NAD 83 ZONE 10 (LAT. 43.603674; LONG. -79.561374)		ORIGINATED BY MK																	
DIST Central HWY QEW		BOREHOLE TYPE 108 mm O.D. Continuous Flight Solid Stem Augers		COMPILED BY ACK																	
DATUM Geodetic		DATE September 9, 2016		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		
102.1	GROUND SURFACE							20 40 60 80 100 ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × REMOULDED					W _p W W _L 10 20 30			kN/m ³					
0.0	ASPHALT (100 mm)						102														
101.8	CONCRETE (180 mm)																				
0.3	Silty sand, some gravel to silty sand and gravel, containing clayey silt pockets (FILL) Compact Brown Moist		1	AS	-																
			2	SS	14		101														
100.7	CLAYEY SILT, some gravel (TILL) Stiff to hard Grey Moist		3	SS	15																
1.4			4	SS	14		100														
99.1	CLAYEY SILT, trace to some sand, trace to some gravel Very stiff to hard Grey Moist		5	SS	45		99														
3.0	- Shale fragments at a depth of 3.8 m below ground surface		6	SS	50/0.10																
							98														
			7	SS	23		97														
			8	SS	41		96														
							95														
94.5	- Shale fragments at a depth of 7.6 m below ground surface		9	SS	50/0.08																
7.7	SHALE (BEDROCK) END OF BOREHOLE AUGER REFUSAL ON PROBABLE BEDROCK																				
	NOTE: 1. Open borehole dry upon completion of drilling.																				

GTA-MTO 001 S:\CLIENTS\MTQEQW-DIXIE\GPJ GAL-GTA.GDT 11/01/17 GPK

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

[illegible]

FEATURES LEGEND



BROKEN CORE



CLAY SEAM



LIMESTONE



LOST CORE

DEPTH SCALE

1 : 50


**Golder
Associates**

LOGGED: PKS

CHECKED: CEC/AB

PROJECT 1530382		RECORD OF BOREHOLE No NW6-8				SHEET 1 OF 1		METRIC									
G.W.P. 2102-13-00; 2432-13-00		LOCATION N 4828943.1; E 299587.1 MTM NAD 83 ZONE 10 (LAT. 43.600405; LONG. -79.564569)				ORIGINATED BY PKS											
DIST Central HWY QEW		BOREHOLE TYPE 108 mm O.D. Continuous Flight Solid Stem Augers				COMPILED BY ACK											
DATUM Geodetic		DATE September 13, 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 kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
107.0	GROUND SURFACE						20	40	60	80	100						
0.0	ASPHALT (100 mm)																
0.1	Silty sand, trace to some gravel (FILL) Loose to very dense Brown to grey Dry to moist		1	SS	9												
			2	SS	42												
			3	SS	55												
104.9	SAND, some gravel, some silt (FILL) Dense Brown to grey Moist		4	SS	33												
2.1			5A	SS	15												
103.7	Sandy SILT, trace gravel Compact Grey Moist		5B	SS	15												
3.4																	
103.3	Gravelly Sandy SILT, containing shale fragments Loose Grey Wet		6	SS	7												
3.7																	
102.6	Gravelly CLAYEY SILT with SAND Firm to hard Grey Wet		7	SS	6												
4.4																	
100.6	CLAYEY SILT, some sand, trace to some gravel (TILL) Hard Grey Moist		8	SS	34												
6.4																	
100.3	END OF BOREHOLE																
6.7																	
	NOTE: 1. Water level in open borehole at a depth of 3.5 m below ground surface (Elev. 103.5 m) upon completion of drilling.																

PROJECT 1530382		RECORD OF BOREHOLE No NW9-1				SHEET 1 OF 1		METRIC						
G.W.P. 2102-13-00; 2432-13-00		LOCATION N 4829518.2; E 300060.1 MTM NAD 83 ZONE 10 (LAT. 43.605585; LONG. -79.558715)				ORIGINATED BY MK								
DIST Central HWY QEW		BOREHOLE TYPE 108 mm O.D. Continuous Flight Solid Stem Augers				COMPILED BY PKS								
DATUM Geodetic		DATE September 15, 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						
101.0	GROUND SURFACE													
0.0	ASPHALT (100 mm)													
0.1	Silty sand, trace gravel, containing asphalt fragments (FILL) Loose to compact Dark brown/black Moist		1	SS	19									
	- Inferred boulder/cobble at a depth of 0.4 m below ground surface		2	SS	7									
99.5														
1.5	Clayey silt, some sand, trace gravel, containing rootlets (FILL) Firm to stiff Grey Moist		3	SS	5									
			4	SS	10									
98.1														
2.9	Silt and sand, trace to some clay, trace gravel, containing wood pieces and rootlets (FILL) Compact Grey Moist		5	SS	11									5 45 40 10
97.3														
3.7	CLAYEY SILT with SAND, trace to some gravel (TILL) Stiff Grey Moist		6	SS	9									
			7	SS	11									8 35 42 15
94.9														
6.1	Silty SAND, trace gravel, trace clay Loose Grey Moist to wet		8	SS	6									
93.4														
7.7	SHALE (BEDROCK) END OF BOREHOLE		9	SS	50/0.08									
NOTE: 1. Water level in open borehole at a depth of 6.5 m below ground surface (Elev. 94.5 m) upon completion of drilling.														

GTA-MTO 001 S:\CLIENTS\MTQEQW-DIXIE.GPJ GAL-GTA.GDT 11/01/17 GPK

PROJECT 1530382		RECORD OF BOREHOLE No HML-1		SHEET 1 OF 1		METRIC											
G.W.P. 2102-13-00; 2432-13-00		LOCATION N 4830170.8; E 300564.8 MTM NAD 83 ZONE 10 (LAT. 43.611462; LONG. -79.552469)		ORIGINATED BY PKS													
DIST Central HWY QEW		BOREHOLE TYPE CME 55, 108 mm O.D. Solid Stem Augers		COMPILED BY ACK													
DATUM Geodetic		DATE September 21, 2016		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	20 40 60 80 100	20 40 60 80 100	W _p	W	W _L	γ	GR	SA	SI	CL
109.7 0.0	GROUND SURFACE ASPHALT																
109.4 0.4	Sand and gravel (FILL) Brown Moist CLAYEY SILT with SAND, trace to some gravel Very stiff to hard Grey Moist		1	SS	19		109										
			2	SS	39		108							8	31	48	13
107.4 2.3	CLAYEY SILT with GRAVEL (RESIDUAL SOIL) Hard Grey Moist		3	SS	100/0.15		107										
			4	SS	80		106										
			5	SS	100/0.10		105										
			6	SS	74		104										
103.5 6.2	SHALE (BEDROCK) Bedrock cored from depths of 6.3 m to 9.3 m. For bedrock coring details refer to record of drillhole HML-1.		7	SS	100/0.05		103										
			1	RC	REC 70%		102										
			2	RC	REC 93%		101										
100.4 9.3	END OF BOREHOLE NOTE: 1. Groundwater level not measured prior to rock coring.																

SHEET 1 OF 1

DATUM: Geodetic

DRILLING CONTRACTOR: Davis Drilling Ltd.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV.	RUN No.	CORRECTION										DISCONTINUITY DATA										FEATURES	R0/RT ZONES	NOTES PIEZOMETER OR STANDPIPE INSTALLATION																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																	
				DEPTH (m)		RECOVERY		R.Q.D. %	FRACT. INDEX PER Meter	B Angle	DIP w/L 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																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																					
						80 60 40 20	80 60 40 20						80 60 40 20	80 60 40 20	80 60 40 20	80 60 40 20	80 60 40 20	80 60 40 20	80 60 40 20	80 60 40 20	80 60 40 20	80 60 40 20	80 60 40 20	80 60 40 20	80 60 40 20																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																				
		Continued from Record of Borehole HML-1		103.49																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																									



BROKEN CORE



CLAY SEAM



LIMESTONE



LOST CORE

DEPTH SCALE

1 : 50


**Golder
Associates**

LOGGED: AB

CHECKED: KG/AB

STA-RCK 054 S:\CLIENTS\MTQ\QEW-DIXIE\02 DATA\INTQEW-DIXIE.GPJ GAL-MISS.GDT 11/01/17 GPK



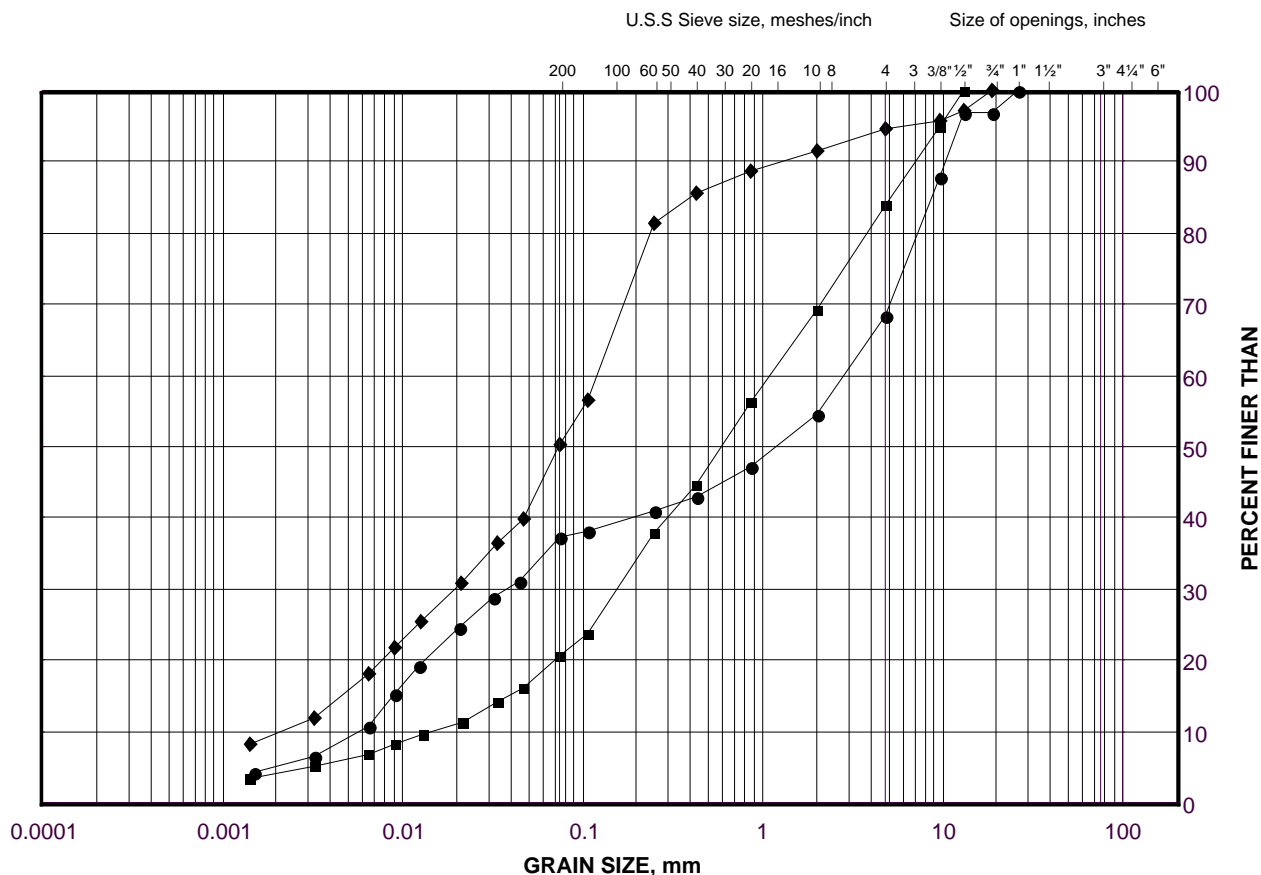
APPENDIX B

Laboratory Test Results, Bedrock Core Photographs

GRAIN SIZE DISTRIBUTION

Silt and Sand to Gravelly Silty Sand to Sand (Fill)

FIGURE B1



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

LEGEND

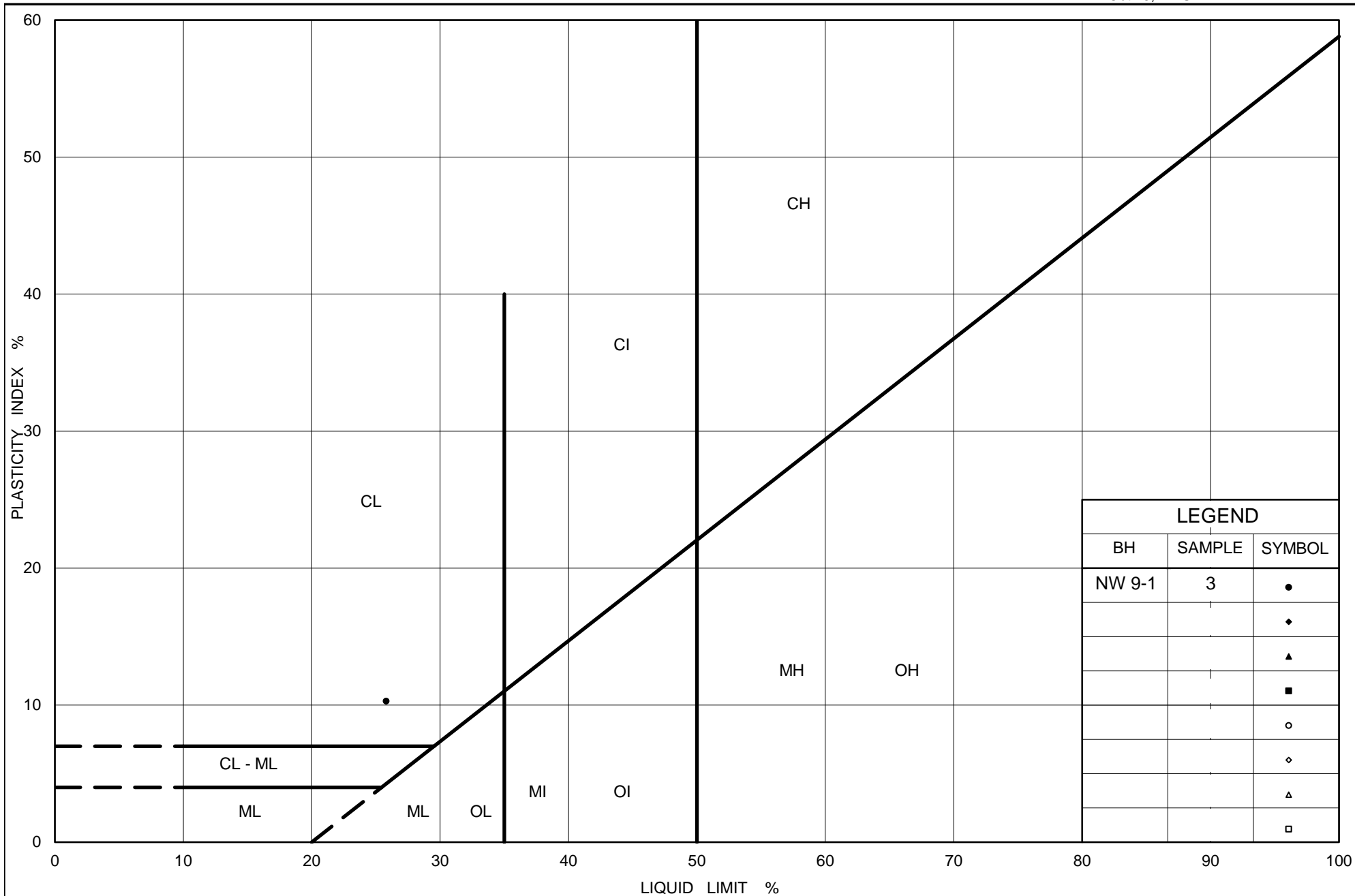
SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
●	RW 3-3	2	100.1
■	NW 6-8	4	104.3
◆	NW 9-1	5	97.6

Project Number: 1530382

Checked By: MWK

Golder Associates

Date: 02-Oct-17



Ministry of Transportation

Ontario

PLASTICITY CHART Clayey Silt (Fill)

Figure No. B2

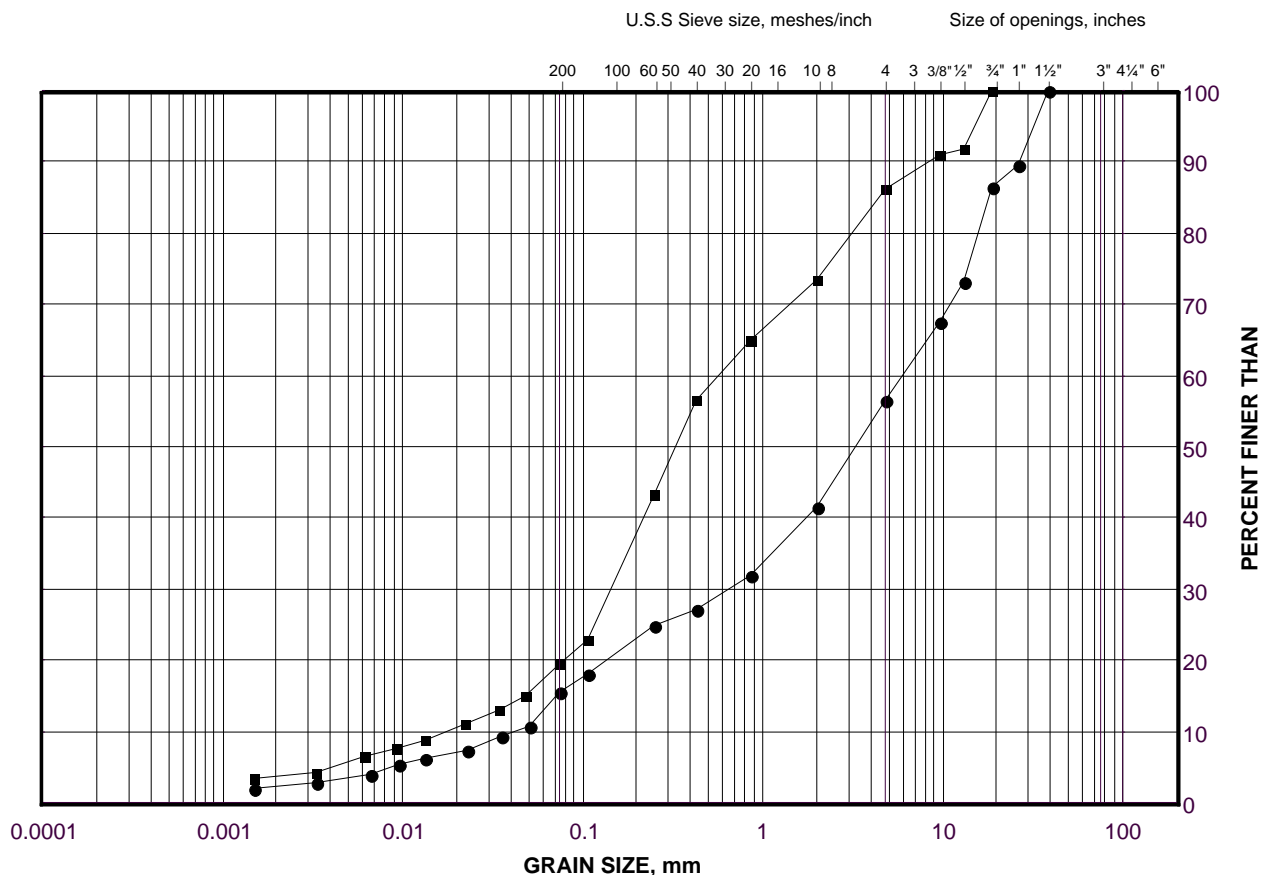
Project No. 1530382

Checked By: MWK

GRAIN SIZE DISTRIBUTION

Silt and Sand and Gravel to Sand to Sand to Gravel

FIGURE B3



LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
●	OHS-5	3	104.4
■	OHS -3	5	102.1

Project Number: 1530382

Checked By: MWK

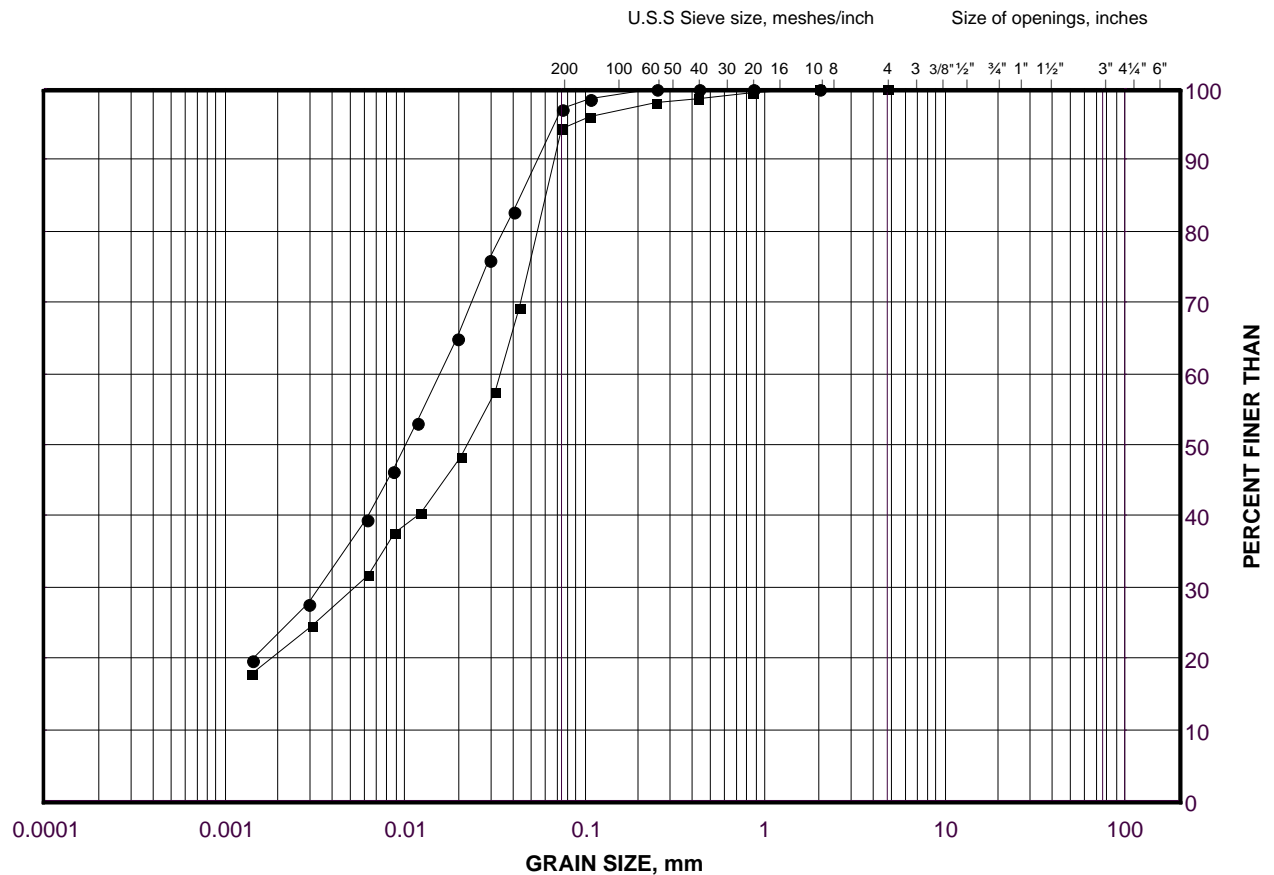
Golder Associates

Date: 03-Oct-17

GRAIN SIZE DISTRIBUTION

Silt

FIGURE B4



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

LEGEND

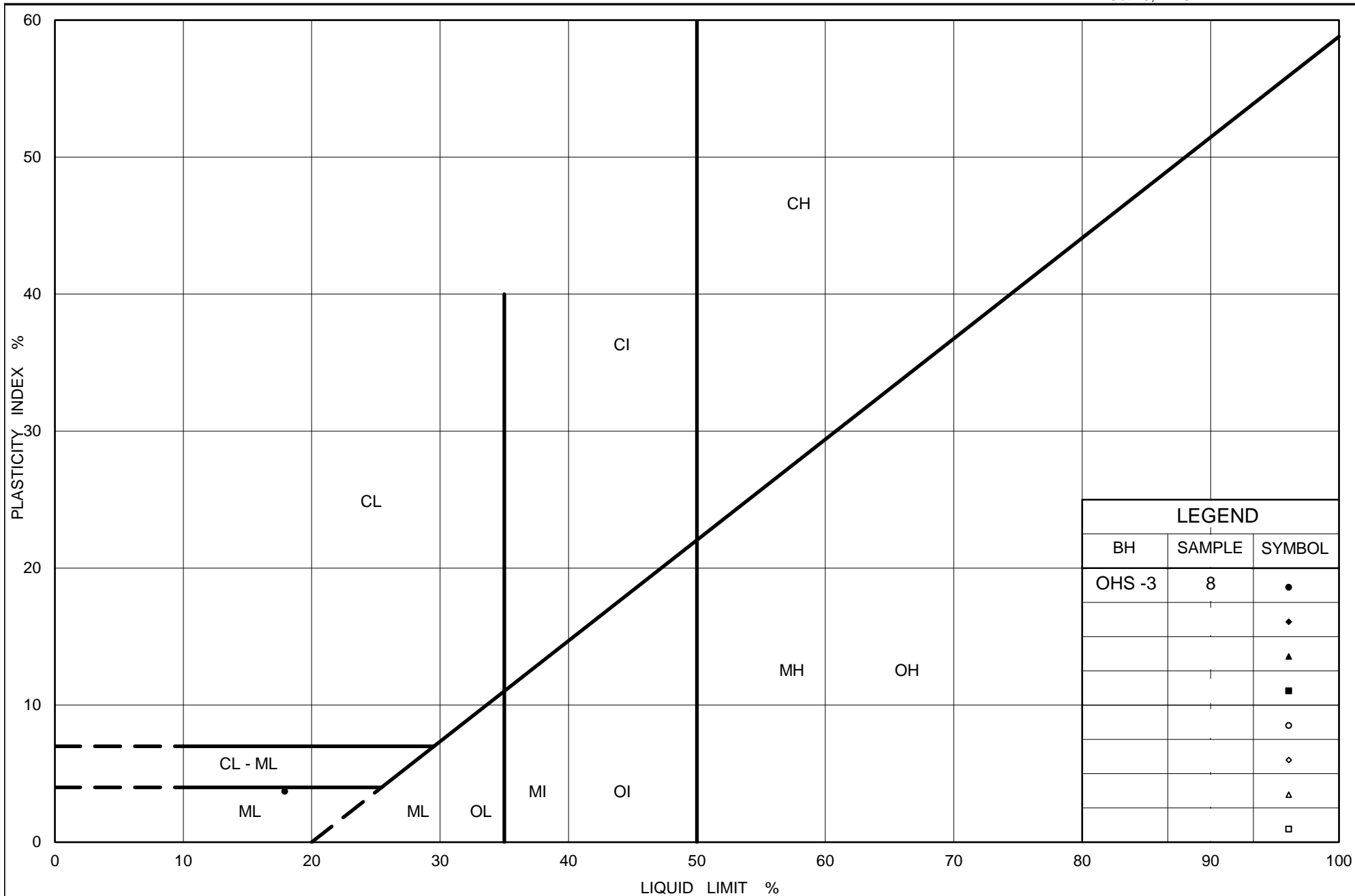
SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
●	OHS-2	4	101.4
■	OHS-3	8	99.1

Project Number: 1530382

Checked By: MWK

Golder Associates

Date: 02-Oct-17



Ministry of Transportation

Ontario

PLASTICITY CHART

Silt

Figure No. B5

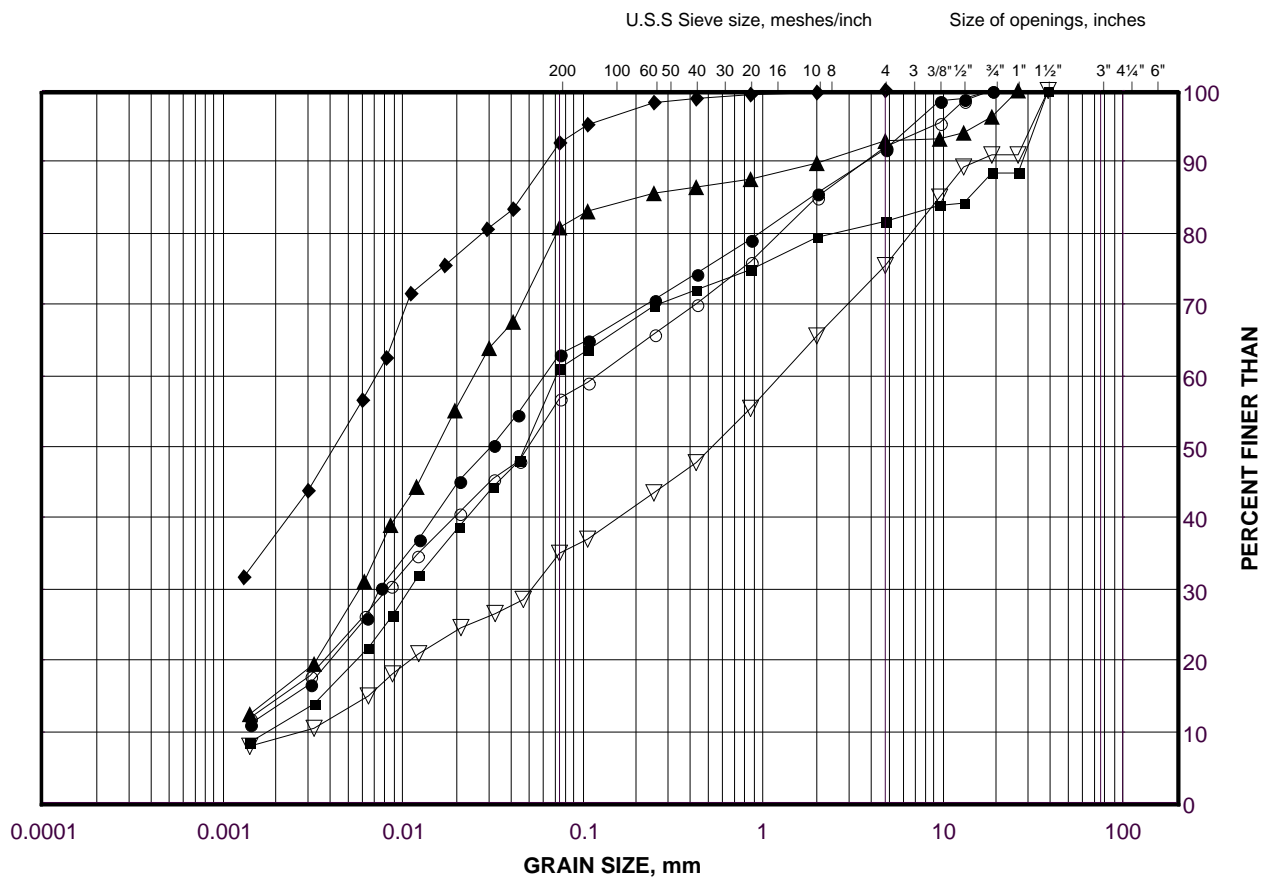
Project No. 1530382

Checked By: MWK

GRAIN SIZE DISTRIBUTION

Clayey Silt to Clayey Silt with Sand

FIGURE B6



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

LEGEND

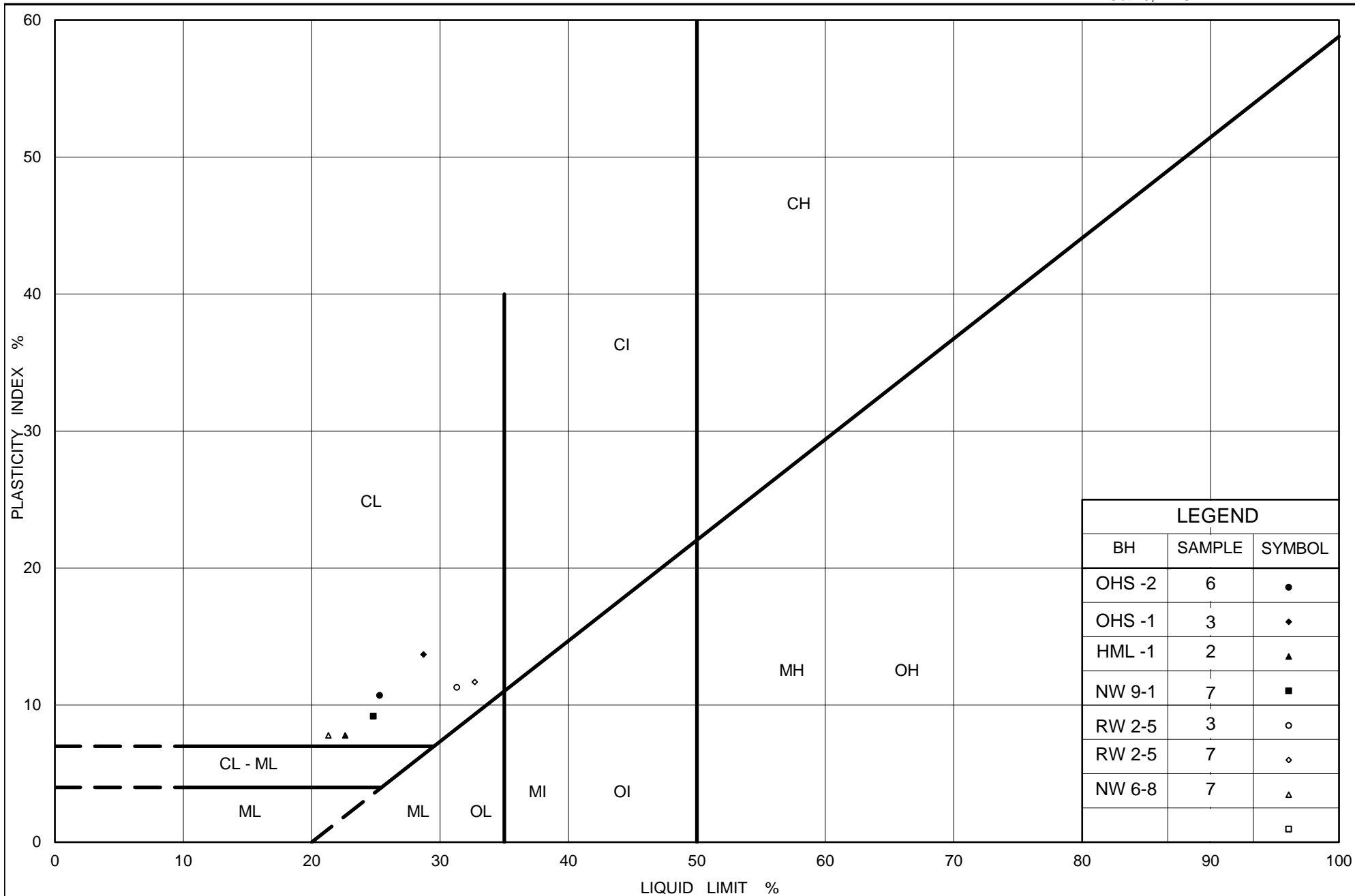
SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
●	HML -1	2	107.9
■	RW 2-5	3	100.3
◆	OHS -1	3	101.7
▲	RW 2-5	7	97.2
▽	NW 6-8	7	102.1
○	NW 9-1	7	96.1

Project Number: 1530382

Checked By: MWK

Golder Associates

Date: 03-Oct-17



Ministry of Transportation

Ontario

PLASTICITY CHART

Clayey Silt

Figure No. B7

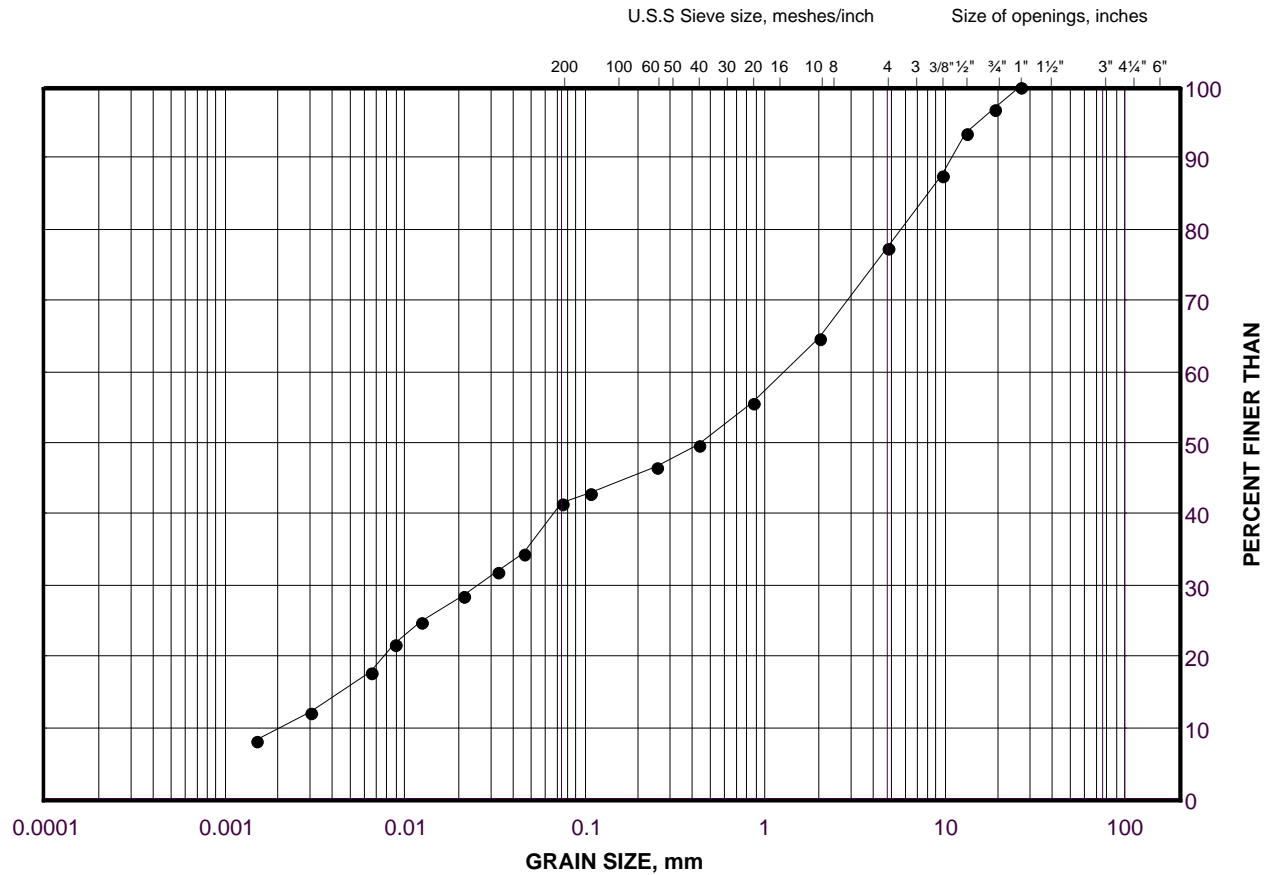
Project No. 1530382

Checked By: MWK

GRAIN SIZE DISTRIBUTION

Clayey Silt with Sand (Till)

FIGURE B8



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

LEGEND

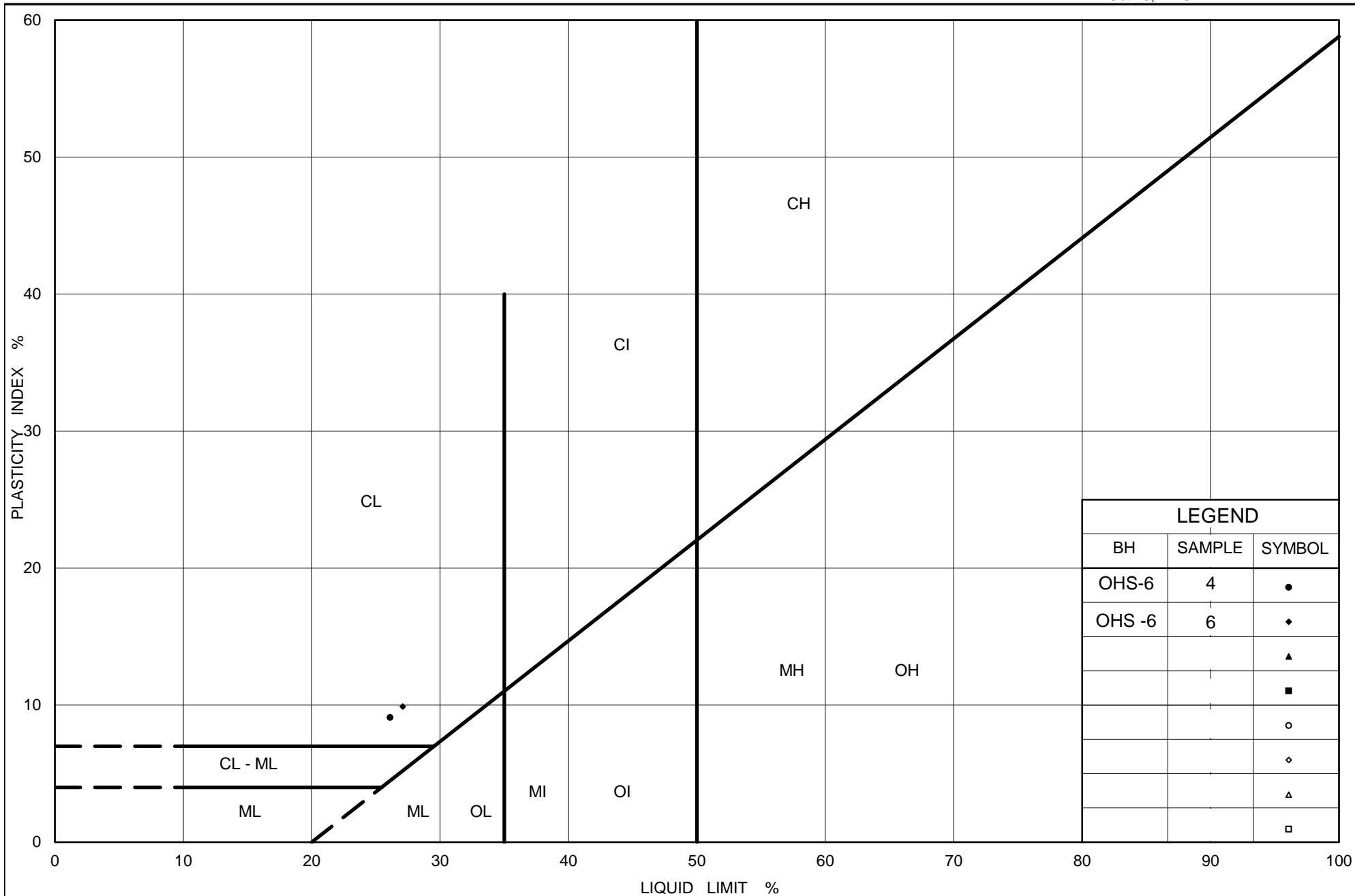
SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
•	OHS-6	4	102.4

Project Number: 1530382

Checked By: MWK

Golder Associates

Date: 02-Oct-17



Ministry of Transportation

Ontario

PLASTICITY CHART

Clayey Silt (Till)

Figure No. B9

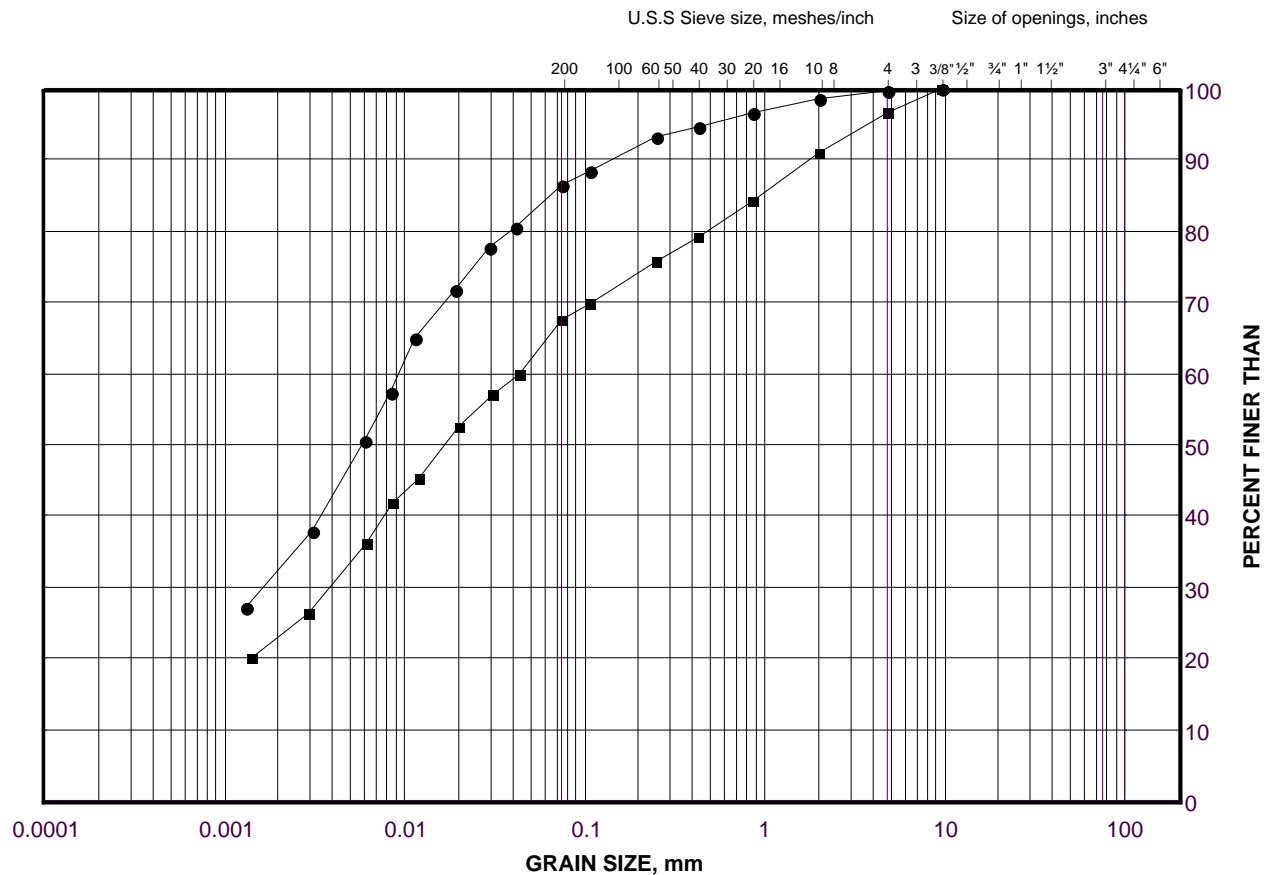
Project No. 1530382

Checked By: MWK

GRAIN SIZE DISTRIBUTION

Clayey Silt (Residual Soil)

FIGURE B10



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

LEGEND

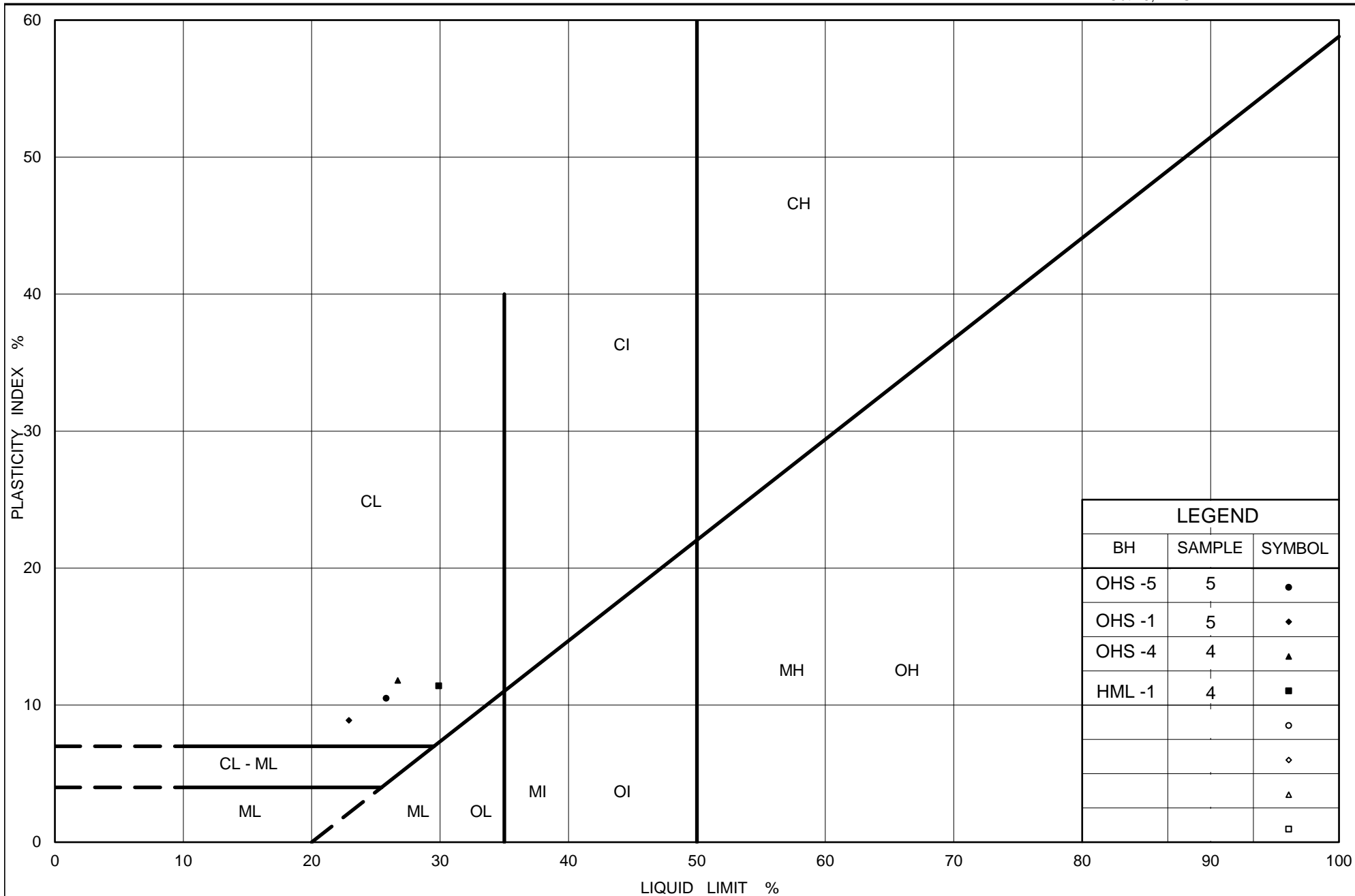
SYMBOL	BOREHOLE	SAMPLE	ELEVATION(ft)
●	OHS -4	4	103.0
■	OHS-5	5	102.9

Project Number: 1530382

Checked By: MWK

Golder Associates

Date: 02-Oct-17



Ministry of Transportation

Ontario

PLASTICITY CHART Clayey Silt (Residual Soil)

Figure No. B11


Project No. 1530382

Checked By: MWK

7.62 m



10.87 m

PROJECT FOUNDATION REPORT – QEW - OHS AND HML, GWP 2102-13-00 & 2432-13-00				
TITLE BEDROCK CORE PHOTOGRAPHS – OHS-2				
	PROJECT No. 1530382		FILE No. ----	
	DESIGN	MWK	SCALE	NTS
	CADD	--	FIGURE B12	
	CHECK			
	REVIEW	JMAC		

4.70 m

6.30 m



9.0 m


9.25 m

10.0 m

10.10 m



10.79 m


PROJECT					FOUNDATION REPORT – QEW - OHS AND HML, GWP 2102-13-00 & 2432-13-00		
TITLE					BEDROCK CORE PHOTOGRAPHS – OHS-4		
		PROJECT No. 1530382		FILE No. ----		FIGURE B13	
		DESIGN	MWK		SCALE NTS		
		CADD	--				
		CHECK					
		REVIEW	JMAC				

6.10 m



9.14 m

REVISION DATE: BY: FILE:


PROJECT		FOUNDATION REPORT – QEW - OHS AND HML, GWP 2102-13-00 & 2432-13-00		
TITLE		BEDROCK CORE PHOTOGRAPHS – OHS-5B		
		PROJECT No. 1530382		FILE No. ----
		DESIGN	MWK	SCALE NTS
		CADD	--	REV.
		CHECK		FIGURE B14
		REVIEW	JMAC	

6.17 m



9.30 m

REVISION DATE: BY: FILE:

PROJECT					FOUNDATION REPORT – QEW - OHS AND HML, GWP 2102-13-00 & 2432-13-00		
TITLE					BEDROCK CORE PHOTOGRAPHS – OHS-6		
					PROJECT No. 1530382		FILE No. ----
					DESIGN	MWK	SCALE NTS
					CADD	--	REV.
					CHECK		FIGURE B15
					REVIEW	JMAC	


3.86m



6.10 m



7.62 m

PROJECT					FOUNDATION REPORT – QEW - OHS AND HML, GWP 2102-13-00 & 2432-13-00		
TITLE					BEDROCK CORE PHOTOGRAPHS – RW3-3		
					PROJECT No. 1530382		FILE No. ----
					DESIGN	MWK	SCALE NTS
					CADD	--	REV.
					CHECK		FIGURE B16
					REVIEW	JMAC	

6.25 m




7.77 m

7.77 m



9.30 m

PROJECT		FOUNDATION REPORT – QEW - OHS AND HML, GWP 2102-13-00 & 2432-13-00					
TITLE							
BEDROCK CORE PHOTOGRAPHS – HML-1							
		PROJECT No. 1530382		FILE No. ----			
		DESIGN	MWK		SCALE	NTS	REV.
		CADD	--		FIGURE B17		
		CHECK					
		REVIEW	JMAC				

December 16, 2016

Ms. Sandra McGaghran
Golder Associates Ltd.
6925 Century Avenue, Suite #100
Mississauga, Ontario
Canada L5N 7K2

Re: UCS Testing of shale samples - Golder Associates Project No. 1530382

Dear Ms. McGaghran:

On December 2, 2016 three (3) NQ-sized core samples were received by Geomechanica Inc. via drop-off. These samples were identified as shale from a drilling investigation near the QEW and Dixie Road in Mississauga, Ontario. Three (3) uniaxial compressive strength (UCS) test specimens were prepared and tested (one from each sample). The tangent elastic modulus was measured during one (1) of these three tests.

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

Sincerely,



Giovanni Grasselli Ph.D., P. Eng.

Geomechanica Inc.
Tel: (647) 478-9767
Email: giovanni.grasselli@geomechanica.com

Rock Laboratory Testing Results

A report submitted to:

Ms. Sandra McGaghran
Golder Associates Ltd.
6925 Century Avenue, Suite #100
Mississauga, Ontario
Canada L5N 7K2

Prepared by:

Bryan Tatone, PhD
Omid Mahabadi, PhD
Giovanni Grasselli, PhD, PEng
Geomechanica Inc
#900-390 Bay St
Toronto ON
M5H 3V9 Canada
Tel: +1-647-478-9767
info@geomechanica.com

December 16, 2016

Project number: 1530382

Abstract

This document summarizes the results of Uniaxial Compressive Strength (UCS) testing of 3 NQ-sized rock core samples for Golder Associates Ltd. (Golder Project No. 1530382). The samples were identified as shale from a drilling investigation near the QEW and Dixie Road in Mississauga Ontario. The results, including the tabulated values of the UCS, bulk density, and elastic modulus along with photos of the test specimens before and after testing, are presented herein.

In this document:

1	Uniaxial Compressive Strength Tests	1
---	-------------------------------------	---

1 Uniaxial Compressive Strength Tests

1.1 Introduction

This section summarizes the results of rock laboratory testing of NQ-sized shale samples under unconfined uniaxial compression. The tests were performed in Geomechanica's rock testing laboratory in Vaughan, Ontario using a 150 ton (1.3 MN) Forney hydraulic loading frame equipped with pressure-compensated control valve to maintain a nearly constant axial displacement rate of 0.1 mm/min (Figure 1). The specimen preparation and testing procedure included the following:

1. Unwrapping of the core samples, inspecting them for damage, and re-wrapping them in electrical tape to maintain the moisture content and avoid breakage during handling and preparation.
2. Diamond sawing the core samples to length such that cylindrical specimens with nearly parallel end faces were obtained. When possible, specimens were cut such that they had a length:diameter ratio of at least 2:1. For this project, 1 out of the 3 core samples provided was too short to obtain the desired length to diameter ratio.
3. Surface grinding of specimens to obtain flat and parallel end faces within ± 0.025 mm.
4. Loading the specimens into a stiff hydraulic loading frame and applying a small axial load of 0.5-1.0 kN, removing of the electrical tape, and subsequently loading the specimen to rupture while continuously recording axial force and axial deformation (for select specimens) to determine the peak strength (UCS) and (tangent) Young's modulus (E) (for select specimens).



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

1.2 Results

The results of UCS testing are summarized in Table 1. The stress-strain curve for CV 02/03-1 is shown in Figure 2. The Young's modulus value presented in Table 1 represents 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.

Table 1: Summary of UCS test results.

Sample	Rock type	Depth from (m)	Depth to (m)	Bulk density (g/cm ³)	UCS (MPa)	Young's modulus, E_{50} (GPa)	Notes
SWM-A-2	Shale	5.10	5.30	2.59	17.7	-	
CV 02/03-1	Shale	7.47	7.70	2.60	17.6	1.2	¹
HML-1	Shale	7.41	7.50	2.59	17.8	-	²
Min				2.59	17.6	1.2	
Max				2.60	17.8	1.2	
Mean				2.59	17.7	1.2	
Standard Deviation				0.01	0.1	-	

¹ Top 25 mm of specimen is limestone
² Specimen length:diameter < 2:1

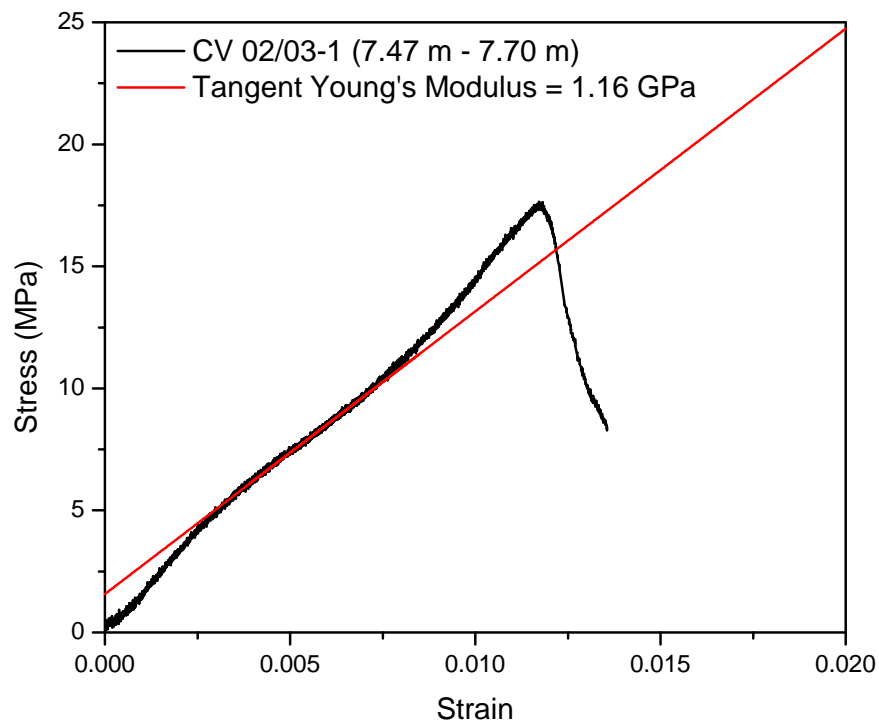


Figure 2: Measured stress-strain curves for samples from different boreholes.

1.3 Specimen photographs

Photographs of the specimens before and after testing are shown in Figure 3.



Figure 3: Photographs of test specimens before testing (top) and after testing (bottom).



APPENDIX C

Analytical Test Results

Your Project #: 1530382
Site Location: QEW-CAWTHRA
Your C.O.C. #: 70344

Attention: Alysha Kobylinski

Golder Associates Ltd
Mississauga - Standing Offer
6925 Century Ave
Suite 100
Mississauga, ON
CANADA L5N 7K2

Report Date: 2016/11/19
Report #: R4252452
Version: 1 - Final

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B605411

Received: 2016/11/10, 17:14

Sample Matrix: SOLID
Samples Received: 5

Analyses	Date		Date Analyzed	Laboratory Method	Reference
	Quantity	Extracted			
Chloride (20:1 extract)	5	N/A	2016/11/16	CAM SOP-00463	EPA 325.2 m
Conductivity	5	N/A	2016/11/16	CAM SOP-00414	OMOE E3530 v1 m
pH CaCl2 EXTRACT	5	2016/11/16	2016/11/16	CAM SOP-00413	EPA 9045 D m
Resistivity of Soil	5	2016/11/10	2016/11/17	CAM SOP-00414	SM 22 2510 m
Sulphate (20:1 Extract)	5	N/A	2016/11/16	CAM SOP-00464	EPA 375.4 m

Remarks:

Maxxam Analytics' laboratories are accredited to ISO/IEC 17025:2005 for specific parameters on scopes of accreditation. Unless otherwise noted, procedures used by Maxxam are based upon recognized Provincial, Federal or US method compendia such as CCME, MDDELCC, EPA, APHA.

All work recorded herein has been done in accordance with procedures and practices ordinarily exercised by professionals in Maxxam's profession using accepted testing methodologies, quality assurance and quality control procedures (except where otherwise agreed by the client and Maxxam in writing). All data is in statistical control and has met quality control and method performance criteria unless otherwise noted. All method blanks are reported: unless indicated otherwise, associated sample data are not blank corrected.

Maxxam Analytics' liability is limited to the actual cost of the requested analyses, unless otherwise agreed in writing. There is no other warranty expressed or implied. Maxxam has been retained to provide analysis of samples provided by the Client using the testing methodology referenced in this report. Interpretation and use of test results are the sole responsibility of the Client and are not within the scope of services provided by Maxxam, unless otherwise agreed in writing.

Solid sample results, except biota, are based on dry weight unless otherwise indicated. Organic analyses are not recovery corrected except for isotope dilution methods. Results relate to samples tested.

This Certificate shall not be reproduced except in full, without the written approval of the laboratory.

Reference Method suffix "m" indicates test methods incorporate validated modifications from specific reference methods to improve performance.

* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.

Your Project #: 1530382
Site Location: QEW-CAWTHRA
Your C.O.C. #: 70344

Attention: Alysha Kobylinski

Golder Associates Ltd
Mississauga - Standing Offer
6925 Century Ave
Suite 100
Mississauga, ON
CANADA L5N 7K2

Report Date: 2016/11/19
Report #: R4252452
Version: 1 - Final

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B6O5411
Received: 2016/11/10, 17:14

Encryption Key

Please direct all questions regarding this Certificate of Analysis to your Project Manager.

Ema Gitej, Senior Project Manager

Email: EGitej@maxxam.ca

Phone# (905)817-5829

=====

Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

RESULTS OF ANALYSES OF SOLID

Maxxam ID		DKV715	DKV715		DKV716		
Sampling Date		2016/11/03	2016/11/03		2016/11/10		
COC Number		70344	70344		70344		
	UNITS	RW3-3-4.33M-4.43M	RW3-3-4.33M-4.43M Lab-Dup	QC Batch	OHS-4-SA4-2.29M-2.59M	RDL	QC Batch

Calculated Parameters							
Resistivity	ohm-cm	2000		4745989	850		4745989
Inorganics							
Soluble (20:1) Chloride (Cl)	ug/g	<20		4748291	500	20	4748291
Conductivity	umho/cm	499		4749169	1180	2	4749169
Available (CaCl ₂) pH	pH	8.18		4750330	7.92		4750333
Soluble (20:1) Sulphate (SO ₄)	ug/g	250	230	4748348	270	20	4748348
RDL = Reportable Detection Limit QC Batch = Quality Control Batch Lab-Dup = Laboratory Initiated Duplicate							

Maxxam ID		DKV716		DKV717	DKV718		
Sampling Date		2016/11/10		2016/11/10	2016/11/03		
COC Number		70344		70344	70344		
	UNITS	OHS-4-SA4-2.29M-2.59M Lab-Dup	QC Batch	OHS-5-SA5-3.81M-4.42M	CV01-01-8.74M-8.80M	RDL	QC Batch

Calculated Parameters							
Resistivity	ohm-cm		4745989	1400	1000		4745989
Inorganics							
Soluble (20:1) Chloride (Cl)	ug/g		4748291	40	260	20	4748291
Conductivity	umho/cm		4749169	720	965	2	4749169
Available (CaCl ₂) pH	pH	7.90	4750333	7.86	8.14		4750330
Soluble (20:1) Sulphate (SO ₄)	ug/g		4748348	560	320	20	4748348
RDL = Reportable Detection Limit QC Batch = Quality Control Batch Lab-Dup = Laboratory Initiated Duplicate							

Maxxam Job #: B605411
Report Date: 2016/11/19

Golder Associates Ltd
Client Project #: 1530382
Site Location: QEW-CAWTHRA
Sampler Initials: AJ

RESULTS OF ANALYSES OF SOLID

Maxxam ID		DKV719		
Sampling Date		2016/11/03		
COC Number		70344		
	UNITS	CV02/3-1-5.27M-5.32M	RDL	QC Batch
Calculated Parameters				
Resistivity	ohm-cm	1500		4745989
Inorganics				
Soluble (20:1) Chloride (Cl)	ug/g	100	20	4748291
Conductivity	umho/cm	682	2	4749169
Available (CaCl2) pH	pH	8.01		4750330
Soluble (20:1) Sulphate (SO4)	ug/g	250	20	4748348
RDL = Reportable Detection Limit				
QC Batch = Quality Control Batch				

TEST SUMMARY

Maxxam ID: DKV715
Sample ID: RW3-3-4.33M-4.43M
Matrix: SOLID

Collected: 2016/11/03
Shipped:
Received: 2016/11/10

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride (20:1 extract)	KONE/EC	4748291	N/A	2016/11/16	Alina Dobreanu
Conductivity	AT	4749169	N/A	2016/11/16	Tahir Anwar
pH CaCl2 EXTRACT	AT	4750330	2016/11/16	2016/11/16	Neil Dassanayake
Resistivity of Soil		4745989	2016/11/17	2016/11/17	Automated Statchk
Sulphate (20:1 Extract)	KONE/EC	4748348	N/A	2016/11/16	Deonarine Ramnarine

Maxxam ID: DKV715 Dup
Sample ID: RW3-3-4.33M-4.43M
Matrix: SOLID

Collected: 2016/11/03
Shipped:
Received: 2016/11/10

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Sulphate (20:1 Extract)	KONE/EC	4748348	N/A	2016/11/16	Deonarine Ramnarine

Maxxam ID: DKV716
Sample ID: OHS-4-SA4-2.29M-2.59M
Matrix: SOLID

Collected: 2016/11/10
Shipped:
Received: 2016/11/10

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride (20:1 extract)	KONE/EC	4748291	N/A	2016/11/16	Alina Dobreanu
Conductivity	AT	4749169	N/A	2016/11/16	Tahir Anwar
pH CaCl2 EXTRACT	AT	4750333	2016/11/16	2016/11/16	Neil Dassanayake
Resistivity of Soil		4745989	2016/11/17	2016/11/17	Automated Statchk
Sulphate (20:1 Extract)	KONE/EC	4748348	N/A	2016/11/16	Deonarine Ramnarine

Maxxam ID: DKV716 Dup
Sample ID: OHS-4-SA4-2.29M-2.59M
Matrix: SOLID

Collected: 2016/11/10
Shipped:
Received: 2016/11/10

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
pH CaCl2 EXTRACT	AT	4750333	2016/11/16	2016/11/16	Neil Dassanayake

Maxxam ID: DKV717
Sample ID: OHS-5-SA5-3.81M-4.42M
Matrix: SOLID

Collected: 2016/11/10
Shipped:
Received: 2016/11/10

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride (20:1 extract)	KONE/EC	4748291	N/A	2016/11/16	Alina Dobreanu
Conductivity	AT	4749169	N/A	2016/11/16	Tahir Anwar
pH CaCl2 EXTRACT	AT	4750330	2016/11/16	2016/11/16	Neil Dassanayake
Resistivity of Soil		4745989	2016/11/17	2016/11/17	Automated Statchk
Sulphate (20:1 Extract)	KONE/EC	4748348	N/A	2016/11/16	Deonarine Ramnarine

Maxxam Job #: B605411
Report Date: 2016/11/19

Golder Associates Ltd
Client Project #: 1530382
Site Location: QEW-CAWTHRA
Sampler Initials: AJ

TEST SUMMARY

Maxxam ID: DKV718
Sample ID: CV01-01-8.74M-8.80M
Matrix: SOLID

Collected: 2016/11/03
Shipped:
Received: 2016/11/10

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride (20:1 extract)	KONE/EC	4748291	N/A	2016/11/16	Alina Dobreanu
Conductivity	AT	4749169	N/A	2016/11/16	Tahir Anwar
pH CaCl2 EXTRACT	AT	4750330	2016/11/16	2016/11/16	Neil Dassanayake
Resistivity of Soil		4745989	2016/11/17	2016/11/17	Automated Statchk
Sulphate (20:1 Extract)	KONE/EC	4748348	N/A	2016/11/16	Deonarine Ramnarine

Maxxam ID: DKV719
Sample ID: CV02/3-1-5.27M-5.32M
Matrix: SOLID

Collected: 2016/11/03
Shipped:
Received: 2016/11/10

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride (20:1 extract)	KONE/EC	4748291	N/A	2016/11/16	Alina Dobreanu
Conductivity	AT	4749169	N/A	2016/11/16	Tahir Anwar
pH CaCl2 EXTRACT	AT	4750330	2016/11/16	2016/11/16	Neil Dassanayake
Resistivity of Soil		4745989	2016/11/17	2016/11/17	Automated Statchk
Sulphate (20:1 Extract)	KONE/EC	4748348	N/A	2016/11/16	Deonarine Ramnarine

GENERAL COMMENTS

Each temperature is the average of up to three cooler temperatures taken at receipt

Package 1	14.0°C
-----------	--------

Results relate only to the items tested.

QUALITY ASSURANCE REPORT

Golder Associates Ltd
Client Project #: 1530382
Site Location: QEW-CAWTHRA
Sampler Initials: AJ

QC Batch	Parameter	Date	Matrix Spike		SPIKED BLANK		Method Blank		RPD	
			% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits
4748291	Soluble (20:1) Chloride (Cl)	2016/11/16	NC	70 - 130	108	70 - 130	<20	ug/g	0.49	35
4748348	Soluble (20:1) Sulphate (SO4)	2016/11/16	NC	70 - 130	107	70 - 130	<20	ug/g	9.4	35
4749169	Conductivity	2016/11/16			99	90 - 110	<2	umho/cm	0.93	10
4750330	Available (CaCl2) pH	2016/11/16			99	97 - 103			0.28	N/A
4750333	Available (CaCl2) pH	2016/11/16			99	97 - 103			0.26	N/A

N/A = Not Applicable

Duplicate: Paired analysis of a separate portion of the same sample. Used to evaluate the variance in the measurement.

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

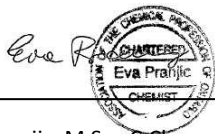
Spiked Blank: A blank matrix sample to which a known amount of the analyte, usually from a second source, has been added. Used to evaluate method accuracy.

Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.

NC (Matrix Spike): The recovery in the matrix spike was not calculated. The relative difference between the concentration in the parent sample and the spiked amount was too small to permit a reliable recovery calculation (matrix spike concentration was less than 2x that of the native sample concentration).

VALIDATION SIGNATURE PAGE

The analytical data and all QC contained in this report were reviewed and validated by the following individual(s).



Ewa Pranjić, M.Sc., C.Chem, Scientific Specialist

Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

INVOICE INFORMATION				REPORT INFORMATION (if differs from invoice)				PROJECT INFORMATION				MAXXAM JOB NUMBER																																																																																																															
Company Name: <u>Golder Associates</u>				Company Name:				Quotation #:				00																																																																																																															
Contact Name: <u>Alysha Kobylinski</u>				Contact Name:				P.O. #:																																																																																																																			
Address: <u>6925 CENTURY AVE, SUITE 100</u>				Address:				Project #:																																																																																																																			
<u>Mississauga, ON</u>								Site Location: <u>QEW - CAWTHRA</u>																																																																																																																			
Phone: <u>647-618-1364</u> Fax: <u>905-567-6561</u>				Phone: Fax:				Site #:																																																																																																																			
Email: <u>Alysha.Kobylinski@golder.com</u>				Email:				Sampled By:																																																																																																																			
<p>***Note: For MOE Regulated Drinking Water samples, please use the Drinking Water CoC.***</p> <table border="1"> <thead> <tr> <th colspan="4">Regulation 153 (2011)</th> <th colspan="4">Other Regulations</th> </tr> </thead> <tbody> <tr> <td>Table 1</td> <td>Res/Park</td> <td>Med/Fine</td> <td>CCME</td> <td>Sanitary Sewer Bylaw</td> </tr> <tr> <td>Table 2</td> <td>Ind/Comm</td> <td>Coarse</td> <td>Reg. 558</td> <td>Storm Sewer Bylaw</td> </tr> <tr> <td>Table 3</td> <td>Agri/Other</td> <td>For RSC</td> <td>MISA</td> <td>Municipality:</td> </tr> <tr> <td>Table</td> <td></td> <td>Yes</td> <td>PWQO</td> <td></td> </tr> <tr> <td></td> <td></td> <td><input checked="" type="checkbox"/> No</td> <td>Other (specify):</td> <td></td> </tr> </tbody> </table> <p>Include Criteria on Certificate of Analysis (Y/N)?</p> <p>SAMPLES MUST BE KEPT COOL (<10°C) FROM TIME OF SAMPLING UNTIL DELIVERY TO MAXXAM.</p> <table border="1"> <thead> <tr> <th>Sample Identification</th> <th>Date Sampled</th> <th>Time Sampled</th> <th>Matrix (GW, SW, Soil, etc.)</th> <th>MOE Regulated Drinking Water? (Y/N)</th> <th>Metals Field Filtered? (Y/N)</th> <th>CORROSION PACKAGE</th> </tr> </thead> <tbody> <tr> <td>1 RW 3-3-4.33m-4.43m</td> <td>NOV 3, 2016</td> <td>AM</td> <td>ROCK</td> <td>N</td> <td>N</td> <td>X</td> </tr> <tr> <td>2 OHS-4-SA4-2.29m-2.59m</td> <td>NOV 10, 2016</td> <td>AM</td> <td>SOIL</td> <td>N</td> <td>N</td> <td>X</td> </tr> <tr> <td>3 OHS-6-SA5-3.81m-4.42m</td> <td>NOV 10, 2016</td> <td>AM</td> <td>SOIL</td> <td>N</td> <td>N</td> <td>X</td> </tr> <tr> <td>4 CV01-01-8.14m-8.80m</td> <td>NOV 3, 2016</td> <td>AM</td> <td>ROCK</td> <td>N</td> <td>N</td> <td>X</td> </tr> <tr> <td>5 CV02/3-1-5.27m-5.32m</td> <td>NOV 3, 2016</td> <td>AM</td> <td>ROCK</td> <td>N</td> <td>N</td> <td>X</td> </tr> <tr><td>6</td><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td>7</td><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td>8</td><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td>9</td><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td>10</td><td></td><td></td><td></td><td></td><td></td><td></td></tr> </tbody> </table>												Regulation 153 (2011)				Other Regulations				Table 1	Res/Park	Med/Fine	CCME	Sanitary Sewer Bylaw	Table 2	Ind/Comm	Coarse	Reg. 558	Storm Sewer Bylaw	Table 3	Agri/Other	For RSC	MISA	Municipality:	Table		Yes	PWQO				<input checked="" type="checkbox"/> No	Other (specify):		Sample Identification	Date Sampled	Time Sampled	Matrix (GW, SW, Soil, etc.)	MOE Regulated Drinking Water? (Y/N)	Metals Field Filtered? (Y/N)	CORROSION PACKAGE	1 RW 3-3-4.33m-4.43m	NOV 3, 2016	AM	ROCK	N	N	X	2 OHS-4-SA4-2.29m-2.59m	NOV 10, 2016	AM	SOIL	N	N	X	3 OHS-6-SA5-3.81m-4.42m	NOV 10, 2016	AM	SOIL	N	N	X	4 CV01-01-8.14m-8.80m	NOV 3, 2016	AM	ROCK	N	N	X	5 CV02/3-1-5.27m-5.32m	NOV 3, 2016	AM	ROCK	N	N	X	6							7							8							9							10							<p>TURNAROUND TIME (TAT) REQUIRED</p> <p>PLEASE PROVIDE ADVANCE NOTICE FOR RUSH PROJECTS.</p> <p>Regular (Standard) TAT: <input checked="" type="checkbox"/> (5-7 working days for most tests)</p> <p>Rush TAT: <input type="checkbox"/> (Samples must be received by 3pm to guarantee your TAT)</p> <p>Rush Confirmation #: PN</p> <p><input type="checkbox"/> 1 day <input type="checkbox"/> 2 days <input type="checkbox"/> 3 days</p> <p>Date Req'd:</p> <p>TATs for certain tests are > 5 days. Please contact your Project Manager for details.</p> <p># of Cont. COMMENTS / TAT COMMENTS</p>	
Regulation 153 (2011)				Other Regulations																																																																																																																							
Table 1	Res/Park	Med/Fine	CCME	Sanitary Sewer Bylaw																																																																																																																							
Table 2	Ind/Comm	Coarse	Reg. 558	Storm Sewer Bylaw																																																																																																																							
Table 3	Agri/Other	For RSC	MISA	Municipality:																																																																																																																							
Table		Yes	PWQO																																																																																																																								
		<input checked="" type="checkbox"/> No	Other (specify):																																																																																																																								
Sample Identification	Date Sampled	Time Sampled	Matrix (GW, SW, Soil, etc.)	MOE Regulated Drinking Water? (Y/N)	Metals Field Filtered? (Y/N)	CORROSION PACKAGE																																																																																																																					
1 RW 3-3-4.33m-4.43m	NOV 3, 2016	AM	ROCK	N	N	X																																																																																																																					
2 OHS-4-SA4-2.29m-2.59m	NOV 10, 2016	AM	SOIL	N	N	X																																																																																																																					
3 OHS-6-SA5-3.81m-4.42m	NOV 10, 2016	AM	SOIL	N	N	X																																																																																																																					
4 CV01-01-8.14m-8.80m	NOV 3, 2016	AM	ROCK	N	N	X																																																																																																																					
5 CV02/3-1-5.27m-5.32m	NOV 3, 2016	AM	ROCK	N	N	X																																																																																																																					
6																																																																																																																											
7																																																																																																																											
8																																																																																																																											
9																																																																																																																											
10																																																																																																																											
<p>10-Nov-16 17:14</p> <p>Ema Gitej</p> <p>B605411</p> <p>KP7 ENV-803</p>																																																																																																																											
<p>*RELINQUISHED BY (Signature/Print)</p> <p><u>Amelia Jewison</u></p>				<p>Date (YYYY/MM/DD)</p> <p><u>2016/11/10</u></p>				<p>Time</p> <p><u>17:10</u></p>				<p>RECEIVED BY (Signature/Print)</p> <p><u>[Signature]</u></p>																																																																																																															
								<p>Date (YYYY/MM/DD)</p> <p><u>2016/11/10</u></p>				<p>Time</p> <p><u>17:14</u></p>																																																																																																															
								<p>#JARS USED AND NOT SUBMITTED</p>				<p>Laboratory Use Only</p> <table border="1"> <tr> <td>Custody Seal</td> <td>Yes</td> <td>No</td> </tr> <tr> <td>Present</td> <td><input checked="" type="checkbox"/></td> <td><input type="checkbox"/></td> </tr> <tr> <td>Intact</td> <td><input checked="" type="checkbox"/></td> <td><input type="checkbox"/></td> </tr> </table> <p>Temperature (°C) on Receipt</p> <p><u>16.12/14°C</u></p>		Custody Seal	Yes	No	Present	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Intact	<input checked="" type="checkbox"/>	<input type="checkbox"/>																																																																																																					
Custody Seal	Yes	No																																																																																																																									
Present	<input checked="" type="checkbox"/>	<input type="checkbox"/>																																																																																																																									
Intact	<input checked="" type="checkbox"/>	<input type="checkbox"/>																																																																																																																									

*MANDATORY SECTIONS IN GREY MUST BE FILLED OUT. AN INCOMPLETE CHAIN OF CUSTODY MAY RESULT IN ANALYTICAL TAT DELAYS.

COC-1004 (10/11) - ENV. ENG.

Maxxam Analytics International Corporation o/a Maxxam Analytics

White: Maxxam

Yellow: M... Pink: Client



APPENDIX D

Non-Standard Special Provisions



DEEP FOUNDATIONS - Item No.

Non-Standard Special Provision

Where OPSS 903 is called up by OPSS 915, OPSS 903 is amended by the following. Where conflict occurs, this NSSP shall take precedence.

The Contractor shall construct sign support foundations and high mast light pole foundations in conformance with the design and at the locations indicated in the Contract Documents.

The Contractor shall construct the sign support foundations and high mast light pole foundations against undisturbed bases and sides of excavations. The bases of caisson excavations shall be cleaned of loosened and/or softened materials prior to pouring concrete for the foundation. The construction methods and techniques shall be the responsibility of the Contractor, but consideration could be given to using temporary liners or tremie concreting techniques where conditions warrant.

The Contractor is advised that variable subsurface conditions may be encountered at caisson locations for (including conventional overhead and tri-chord types and high mast light pole) foundation locations where included in the contract. For bidding purposes, the Contractor shall assume that the overburden has zones of non-cohesive soil and contains cobbles and boulders, and that the groundwater levels are near the surface. The Contractor is advised that non-cohesive soil is susceptible to disturbance under conditions of unbalanced hydrostatic head. As a lower priority than the above-noted instruction, the Contractor shall assume that the subsurface conditions at sign (including conventional overhead and tri-chord types) and high mast light pole foundation locations are generally similar to the closest of the boreholes, as illustrated in the Foundation Investigation Report.

Pre-augering/pre-coring for caissons for the sign support and high mast light pole foundations may extend into the shale bedrock, which is weak and which contains medium strong to extremely strong interlayers of limestone. Appropriate construction procedures and equipment will be required to penetrate the bedrock.

Basis of Payment

Payment at the lump sum contract price for this tender item shall be full compensation for all labour, equipment and materials for completion of the work.

END OF SECTION

At Golder Associates we strive to be the most respected global company providing consulting, design, and construction services in earth, environment, and related areas of energy. Employee owned since our formation in 1960, our focus, unique culture and operating environment offer opportunities and the freedom to excel, which attracts the leading specialists in our fields. Golder professionals take the time to build an understanding of client needs and of the specific environments in which they operate. We continue to expand our technical capabilities and have experienced steady growth with employees who operate from offices located throughout Africa, Asia, Australasia, Europe, North America, and South America.

Africa	+ 27 11 254 4800
Asia	+ 86 21 6258 5522
Australasia	+ 61 3 8862 3500
Europe	+ 356 21 42 30 20
North America	+ 1 800 275 3281
South America	+ 55 21 3095 9500

solutions@golder.com
www.golder.com

Golder Associates Ltd.
6925 Century Avenue, Suite #100
Mississauga, Ontario, L5N 7K2
Canada
T: +1 (905) 567 4444

