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REPORT

Foundation Investigation and Design Report

Six Overhead Sign Support Structures
Highway 401 Eastbound Collector Lanes, Avenue Road to Warden Avenue, Toronto, Ontario
MTO G.W.P. 2130-01-00

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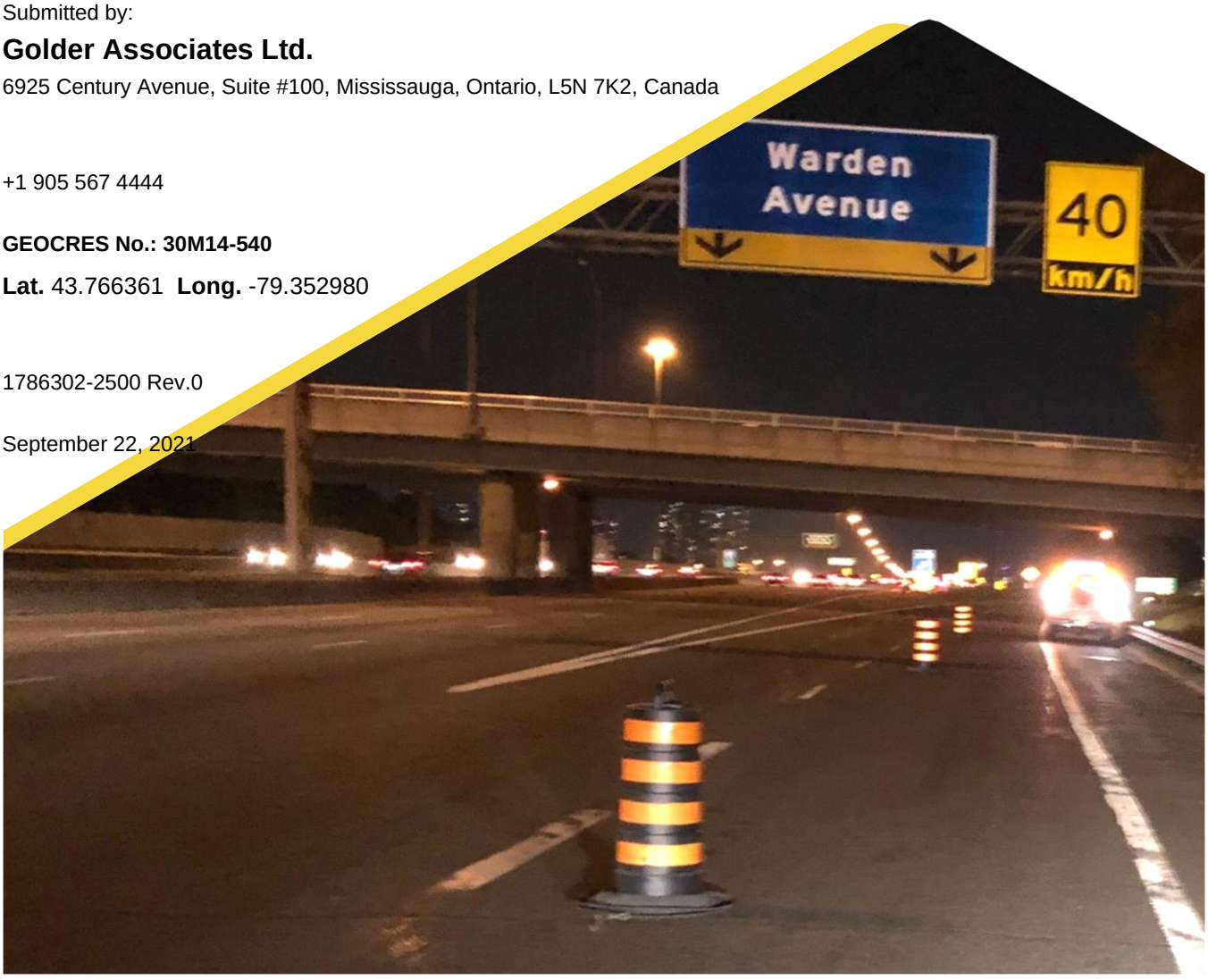

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PART A

FOUNDATION INVESTIGATION REPORT
SIX OVERHEAD SIGN SUPPORT STRUCTURES
HIGHWAY 401 EASTBOUND COLLECTOR LANES FROM AVENUE ROAD TO WARDEN AVENUE, TORONTO, ONTARIO
MTO GWP 2130-01-00

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 rehabilitation of the Highway 401 Eastbound Collector lanes between Avenue Road and Warden Avenue (approximately 10 km) in Toronto, Ontario (Assignment No. 2016-E-0089).

This report presents the subsurface conditions at the site of six new overhead sign (OHS) support structures located along the proposed Highway 401 Eastbound Collector (EBC) widening, from west of Bayview Avenue to east of Warden Avenue. The results of foundation investigations for other works associated with this assignment are presented in separate reports.

2.0 SITE DESCRIPTION

The highway grade of Highway 401 EBC between the six sign support structures ranges from about Elevation 168 m at Bayview Avenue to Elevation 139 m at Leslie Street to Elevation 180 m east of Warden Avenue. The proposed sign support foundation elements are located at the median concrete barrier between the proposed Eastbound Core and Collector lanes, the outside shoulder of the proposed Eastbound Collector lanes, or the grass-covered area at the embankment slope beyond the outside shoulders or the highway entrance ramps. Vegetation at the toe of embankment slope consists of grass, small shrubs, and sparsely spaced trees.

3.0 INVESTIGATION PROCEDURES

3.1 Previous Investigations

3.1.1 February 1987 Investigation by Others (GEOCRES No. 30M14-184)

From February 2 to 11, 1987, a foundation investigation was completed by the Ministry of Transportation and Communications during which time a total of 16 boreholes were advanced, and one of which, designated as Borehole 9 is in the immediate vicinity of proposed Overhead Sign (OHS) No. 1. The results of the investigation are contained in their report titled, “Foundation Investigation Report for High Mass Lighting from East of Young Street to East of Bayview Avenue, W.P. 202-87-00, Site NA, Hwy. 401, District 6, Toronto”, dated March 24, 1987 (GEOCRES No. 30M14-184). It should be noted that the report references outdated station numbering along Highway 401, and Golder has assumed the geographic coordinates. The location of Borehole 9 is presented below, along with the assumed geographic coordinates, ground surface elevation (in Geodetic Datum), and the depth of the borehole prior to termination. The assumed location of this borehole is shown on plan on Drawing 1 and the borehole record and the summary of the relevant laboratory testing results from the investigation are presented in Appendix A.

Borehole No.	Location (MTM NAD 83 Zone 10)[1]		Ground Surface Elevation (m)[1]	Depth of Borehole (m)
	Northing (Latitude, °)	Easting (Longitude, °)		
9	4,846,913.0 (43.762133)	313,486.7 (-79.392118)	168.1	15.4

Note: 1. The Northing and Easting coordinates have been estimated.

3.1.2 June 1987 Investigation by Others (GEOCRES No. 30M14-186)

From June 22 to July 7, 1987, a foundation investigation was completed by the Ministry of Transportation and Communications during which time a total of 4 boreholes were advanced, and one of which, designated as Borehole 102 is in the immediate vicinity of proposed Overhead Sign (OHS) No. 1. The results of the investigation are contained in their report titled, "Foundation Investigation Report for F.T.M.S. – Signs Eastbound from West of Bayview Avenue to West of Leslie Street, W.P. 67-85-01, and from East of Leslie Street to East of Warden Avenue, W.P. 259-86-01, Hwy. 401, District 6 – Toronto", dated 1987 (GEOCRES No. 30M14-186). It was noted that the station numbering used in the report does not match those of the current assignment, and that the datum is referenced to the Highway 401 curb, rather than a Geodetic datum. As a result, the location and ground surface elevation of Borehole 102 presented below has been approximated based on a comparison between the borehole location plan in report and the base plan/alignment drawings provided by AECOM. The approximate location of this borehole is shown on plan on Drawing 1 and the borehole record from the investigation is presented in Appendix A.

Borehole No.	Location (MTM NAD 83 Zone 10)[1]		Ground Surface Elevation (m)[1]	Depth of Borehole (m)
	Northing (Latitude, °)	Easting (Longitude, °)		
102	4,846,871.6 (43.761761)	313,503.7 (-79.391908)	169.2[1]	9.6

Note: 1. The Northing and Easting coordinates, as well as the ground surface elevation has been estimated.

3.2 Current Investigation

The field work for the proposed OHS support structures was carried out June 18, 2019 and between May 16 and 21, 2021, at which time a total of five boreholes designated as OHS-4, OHS-6, OHS-7, OHS-9 and N/E RE-1 were advanced. Boreholes OHS-4, OHS-6, OHS-7 and OHS-9 were advanced specifically for overhead sign support structures, while Borehole N/E RE-1 was advanced for the proposed ramp realignment, which is also in the general vicinity of a proposed overhead sign. The Record of Borehole sheets and the results of the laboratory testing for the boreholes are presented in Appendices B and C, respectively.

Due to the existing reinforced concrete composite pavement structure along Highway 401, the coring of the pavement structure was completed by 254 mm outside diameter (O.D.) core bit, at all borehole locations advanced through the highway, supplied, and operated by Canadian Cutting and Coring of Brampton, Ontario. Upon completion of the coring of the pavement structure, boreholes were advanced using a CME-75 and 55 truck-mounted drill rig, supplied and operated by Geo-Environmental Drilling Inc. of Halton Hills, Ontario. The boreholes were advanced using 150 mm and 213 mm O.D. hollow stem augers. Soil samples were generally obtained at 0.75 m and 1.5 m intervals of depth, using a 50 mm O.D. split-spoon sampler driven by automatic hammer in accordance with Standard Penetration Test (SPT) procedures. The split-spoon samplers used in the investigation limit the maximum particle size that can be sampled and tested to about 35 mm. Therefore, particles or objects that may exist within the soils that are larger than this dimension would not be sampled or represented in the grain size distributions. Field vane shear tests were carried out in cohesive soils for assessment of undrained shear strengths using MTO Standard 'N' size vanes.

Groundwater conditions and water levels in the open boreholes were observed during and immediately following the drilling operations. The boreholes were backfilled with bentonite upon completion in accordance with Ontario Regulation 903 Wells (as amended), and the ground surface was restored to near original condition as practical.

The field work was observed by members of Golder's engineering and technical staff, who arranged for the clearance of underground services, observed the drilling, sampling and in-situ testing operations, logged the borehole, and examined and cared for the soil samples. The soil samples were identified in the field, placed in appropriate containers, labelled, and transported to Golder's Mississauga geotechnical laboratory where the samples underwent further visual examination and laboratory testing. All the soil 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 soil samples. The results of the laboratory testing are included in Appendix C.

Selected soil samples were submitted to Bureau Veritas Laboratories, a Standards Council of Canada (SCC) accredited laboratory of Mississauga, Ontario for chemical analysis. The selected samples were analyzed for a suite of corrosivity parameters, including conductivity, resistivity, soluble chloride, soluble sulphate, and pH. The results of the chemical analysis are presented in Appendix C.

The as-drilled borehole locations and the ground surface elevations were obtained using a GPS Trimble GEO 7X, having an accuracy of approximately 0.1 m in the vertical and horizontal directions. The locations given on the borehole logs, shown on Drawing 1, are positioned related to MTM NAD 83 (Zone 10) CSRS CGVD28 northing and easting coordinates and the ground surface elevations are referenced to Geodetic datum. The borehole locations, geographic coordinates, ground surface elevations and drilled depths are summarized below.

Borehole No.	Structure ID	Location (MTM NAD 83 Zone 10)		Ground Surface Elevation (m)	Depth of Borehole (m)
		Northing (Latitude, °)	Easting (Longitude, °)		
OHS-4	OHS No. 4	4,847,387.6 (43.766361)	316,637.2 (-79.352980)	138.1	11.3
OHS-6	OHS No. 6	4,847,660.2 (43.768752)	320,127.5 (-79.309621)	176.7	9.8
OHS-7	OHS No. 7	4,847,779.1 (43.769813)	320,511.1 (-79.304853)	179.8	9.8
N/E RE-1	OHS No. 8	4,847,230.8 (43.764962)	315,852.2 (-79.362732)	139.7	11.7
OHS-9	OHS No. 9	4,847,189.8 (43.764592)	315,942.4 (-79.361614)	139.2	12.8

4.0 SITE GEOLOGY AND SUBSURFACE CONDITIONS

4.1 Regional Geology

The area surrounding along Highway 401 between Bayview Avenue and Warden Avenue is within the physiographic regions known as the South Slope and the Peel Plain, as delineated in *The Physiography of Southern Ontario* (Chapman and Putnam, 1984) [1].

The South Slope physiographic region is characterized by a smooth to drumlinized till plain that was formed as a result of glacial action and deposition of till material south of the Oak Ridges Moraine. The South Slope contains a variety of soil deposits that have developed over till and the overburden soils can typically be more than 50 m thick.

The Peel Plain physiographic region covers portions of the Regional Municipalities of York, Peel and Halton. A surficial till sheet, which is mapped as the Halton Till, is present throughout much of the Peel Plain and generally follows the surface topography. The Halton Till typically consists of cohesive clayey silt to silty clay, with non-cohesive sand to silt zones. Shallow, local deposits of sand and silt and/or clay can overlie this uppermost till sheet, and these represent relatively recent deposits, formed in small glacial melt water ponds scattered throughout the Peel Plain and concentrated near river valleys. The recent sand, silt, and clay in the uppermost till deposits in this area overlie and are interbedded with stratified deposits of sand, silt, and clay.

The underlying bedrock consists of grey shale of the Georgian Bay Formation interbedded with limestone, siltstone, and sandstone. Within and adjacent to the East Don River, interglacial and post-glacial flooding in the valley has produced deposits of glaciolacustrine sands, silts, and silty clay.

4.2 General Overview of Subsurface Conditions

The soil and groundwater conditions as encountered in the boreholes advanced during the foundation investigation is presented on the Record of Borehole sheets in Appendix B and the geotechnical laboratory test results are presented in Appendix C.

The results of in-situ tests (i.e., SPTs and shear vane tests) as presented in the borehole records and in Section 4.2 are uncorrected. The boundaries between the soil deposits on the borehole records have been 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. Variation in the stratigraphic boundaries between and beyond boreholes will exist and is to be expected.

In general, the subsurface soils encountered at the proposed overhead sign locations consist of pavement structure or surficial layers of topsoil, underlain by cohesive and non-cohesive fill. The fill is then underlain by a deposit of sandy clayey silt which in turn is underlain by a deposit of silt to sand. Below the silt to sand is a deposit of silty clay to sandy clayey silt-silt. A more detailed description of the subsurface conditions encountered in the boreholes is provided in the following sections.

4.2.1 Topsoil

An approximately 130 mm thick layer of topsoil was encountered at ground surface in Borehole N/E RE-1.

[1] 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.

These materials were classified solely based on visual and textural evidence. Testing for organic content or other nutrients was not carried out. Therefore, the use of materials classified as topsoil cannot be relied upon for support and growth of landscaping vegetation.

4.2.2 Asphalt and Concrete Pavement Structure

An approximately 75 mm to 300 mm thick layer of asphalt was encountered at the ground surface in Boreholes OHS-4, OHS-6 and OHS-7, which were advanced at Highway 401 grade.

An approximately 225 mm and 240 mm thick layer of concrete was encountered underlying the asphalt in Boreholes OHS-4 and OHS-7, respectively. Photographic record of the asphalt and/or concrete core recovered from Boreholes OHS-6 and OHS-7 are presented on Figures B1 and B2 in Appendix B.

4.2.3 SILTY SAND (SM) to SAND (SP) (FILL)

A 0.5 m to 2.9 m thick layer of non-cohesive fill consisting of silty sand to sand to sand with gravel, was encountered at ground surface in Borehole OHS-9, underlying the topsoil in Borehole N/E RE-1, and underlying the pavement structure in Boreholes 9, OHS-4, OHS-6, and OHS-7. The non-cohesive fill was encountered at depths ranging from 0 m (i.e. ground surface) to 0.3 m below ground surface (between Elevations 179.5 m and 137.8 m) and extended to depths of 0.8 m to 2.2 m below ground surface (between Elevations 179.0 m and 136.7 m).

The measured Standard Penetration Test (SPT) “N”-values in the non-cohesive fill material ranges from 4 to 35 blows per 0.3 m of penetration, indicating a loose to very dense, relative density. The water content measured on three samples of the non-cohesive fill material range from about 5% to 10%.

4.2.4 Sandy CLAYEY SILT (CL) to CLAYEY SILT-SILT (CL-ML) and Sand to SILT (ML) (FILL)

A 1.1 m and 7.6 m thick layer of cohesive fill consisting of sandy clayey silt to clayey silt and sand to sandy silt was encountered underlying the non-cohesive fill in Boreholes OHS-7 and OHS-4, respectively. The cohesive fill was encountered at a depth of 0.8 m below ground surface (between Elevations 179.0 m and 137.3 m) and extended to depths of 1.9 m to 8.4 m below ground surface (between Elevations 177.9 m and 8.4 m).

The measured SPT “N”-values in the cohesive fill material ranges from 2 to 53 blows per 0.3 m of penetration, suggesting a soft to hard consistency.

Grain size distribution testing was carried out on four samples of the cohesive fill and the results are presented on C1, in Appendix C. Atterberg limit testing was carried out on four samples of the cohesive fill material and measured liquid limits ranging from about 14% to 22%, plastic limits ranging from about 10% to 13%, and plastic indices ranging from about 3% to 9%. The Atterberg limit test results are presented on Figure C2 in Appendix C and indicates that the deposit ranges from a sandy clayey silt to a sandy silt of low plasticity. The water content measured on five samples of the fill material range from about 7% to 12%.

4.2.5 Sandy CLAYEY SILT (CL)

A 1.4 m to 1.8 m thick layer of sandy clayey silt was encountered underlying fill in Boreholes OHS-6 and OHS-4, respectively. The sandy clayey silt deposit was encountered at depths of 0.8 m and 8.4 m below ground surface (at Elevations 175.9 m and 129.7 m) and extended to depths of 2.2 m and 10.2 m below ground surface (at Elevations 174.5 m and 127.9 m).

The SPT “N”-values measured within the cohesive deposit range from 8 to 29 blows per 0.3 m of penetration, suggested a stiff to very stiff consistency.

The water content measured on samples of the deposit range from about 9% to 15%.

4.2.6 SILT (ML) to SILT (ML/SM) and Sand to SILTY SAND (SM) to SAND (SP-SM)

A 1.1 m to 14.1 m thick deposit of silt to silt and sand to silty sand to sand, trace to some gravel, was encountered at ground surface in Borehole 102, underlying fill in Boreholes 9, OHS-7, OHS-9, and N/E RE-1, and underlying the sandy clayey silt in Boreholes OHS-4 and OHS-6. The silt to sand deposit was encountered at depths of 0 m to 10.2 m below ground surface (between Elevations 177.9 m and 127.9 m) and extends to depths ranging from 5.0 m to 15.4 m below ground surface (between Elevations 171.8 m and 126.8 m). Boreholes 9, 102, OHS-4, and OHS-7 were terminated within this deposit.

The SPT "N"-values measured within the silt to sand deposit range from 2 blows per 0.3 m of penetration to 177 blows per 0.13 m of penetration, indicating a very loose to very dense state of compactness.

Grain size distribution testing was carried out on fourteen samples of the silt to sand deposit. The results of five tests from Borehole 9 are shown on Figure No. 19 in Appendix A, and the results of seven grain size distribution tests associated with the boreholes from the current investigation are presented on Figure C3 in Appendix C. The laboratory test results of two test from Borehole 102 were not presented in the GEOCRES Report 30M-184; however, the components of the test are shown on the record of borehole in Appendix A.

Atterberg limit testing was carried out on a sample of the deposit and measured a liquid limit of about 14%, a plastic limit of about 11%, corresponding to a plastic index of about 3%. The Atterberg limit test results are presented on Figure C4 in Appendix C and indicates that the material is a silt of low plasticity. The water content measured on samples of the cohesive deposit range from about 3% and 29%.

4.2.7 SILTY CLAY (CI) to CLAYEY SILT (CL) to Sandy CLAYEY SILT-SILT (CL-ML)

A 3.0 m to 4.8 m thick deposit of silty clay to clayey silt to sandy clayey silt-silt, trace to some sand, trace to some gravel, was encountered underlying the silt to sand deposit in Boreholes OHS-6, OHS-9 and N/E RE-1. The deposit was encountered at depths ranging 5.0 m to 8.7 m below ground surface (between Elevations 171.8 m and 130.5 m) and extends to depths ranging from 9.8 m to 12.8 m (between Elevations 167.0 m and 126.4 m). All three boreholes were terminated within this deposit.

The SPT "N"-values measured within the cohesive deposit range from 0 blows (weight of hammer) to 85 blows per 0.3 m of penetration. In-situ field vane tests carried out within the deposit measured undrained shear strengths ranging from about 29 kPa to 38 kPa. The SPT "N"-values and field vane test results indicate that the silty clay to sandy clayey silt-silt has a very soft to hard consistency.

Grain size distribution testing was carried out on four samples of the cohesive deposit, and the results are presented on Figure C5 in Appendix C.

Atterberg limit testing was carried out on five samples of the deposit and measured liquid limits ranging from about 15% to 39%, plastic limits ranging from about 11% to 17%, and plastic indices ranging from about 4% to 22%. The Atterberg limit test results are presented on Figure C6 in Appendix C and indicates the deposit ranges from a sandy clayey silt-silt of low plasticity to a silty clay of medium plasticity. The water content measured on samples of the deposit range from about 8% to 37%.

4.3 Groundwater Conditions

In general, the soil samples taken in the boreholes were moist. Boreholes OHS-4, OHS-6, OHS-7, and OHS-9 were noted to be dry upon completion of drilling. Groundwater observed in Boreholes N/E RE-1, 9 and 102 are presented in the table below. However, these conditions and groundwater levels do not represent the stabilized groundwater level at the site.

Borehole No.	Water Level		Date
	Depth (m)	Elevation (m)	
N/E RE-1	4.5	135.2	June 18, 2019
9	4	164.1	February 12, 1987
102	7.2	162.0	June 24, 1987

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

4.4 Analytical Testing

Four samples were collected and submitted to Bureau Veritas Laboratories for analysis of parameters used to assess corrosion potential and sulphate attack. A summary of the results is presented in the following table. The Certificate of Analysis is provided in Appendix C.

Borehole No.	Sample No.	Sample Depth (Elevation) (m)	Soil Type	Parameters				
				Chloride (µg/g)	Sulphate (µg/g)	pH	Conductivity (µmho/cm)	Resistivity (ohm-cm)
OHS-4	2	0.8 – 1.4 (137.3 – 136.7)	Sandy Clayey Silt Fill	760	53	7.91	1,410	710
OHS-6	2	0.8 – 1.4 (175.9 – 175.3)	Sandy Clayey Silt	380	<20	7.92	897	1,100
OHS-7	4	2.3 – 2.9 (177.5 – 176.9)	Silty Sand	400	50	8.08	861	1,200
OHS-9	3	1.5 – 2.1 (137.7 – 237.1)	Sand	44	140	7.87	339	3,000

5.0 CLOSURE

The Foundation Investigation Report was prepared by Ms. Katelyn Nero, P.Eng., a geotechnical engineer with Golder. Mr. Christopher Ng, P.Eng., an Associate and MTO Foundations Designated Contact with Golder conducted an independent technical and quality review of this report.

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PART B

FOUNDATION DESIGN REPORT
SIX OVERHEAD SIGN SUPPORT STRUCTURES
HIGHWAY 401 EASTBOUND COLLECTOR LANES FROM AVENUE ROAD TO WARDEN AVENUE, TORONTO, ONTARIO
MTO GWP 2130-01-00

6.0 DISCUSSION AND ENGINEERING RECOMMENDATIONS

6.1 General

This section of the report provides geotechnical engineering parameters and foundation design recommendations for the design of foundations of six overhead sign (OHS) support structures. The recommendations are based on interpretation of the factual data obtained from the boreholes advanced during the current subsurface investigation within the project limits. The design report with the interpretation and recommendations is intended for the use of the Ministry of Transportation to provide the designers with information to carry out detail design of the overhead sign support structure foundations and shall not be used or relied upon for any other purpose or by any other parties, including the constructor or design-build contractor. The contractor must make their own interpretation based on the factual data in the Foundation Investigation Report (i.e. Part A of the report).

Where comments are made on construction, they are provided to highlight those aspects that could affect the design on the project, and for which special provisions or operation constraints may be required in the Contract Documents. Contractors must make their own interpretation of the factual information provided as such interpretation may affect equipment selection, proposed construction methods, scheduling and the like.

6.2 Design of Sign Support Foundations

It is understood that different types of sign supports are required for the six proposed overhead signs to be constructed as part of the widening of Highway 401 Eastbound Collector lanes (EBC). The locations of the proposed overhead signs and sign-support structure type at each overhead sign location is summarized below.

Sign Support Designation	Approximate Sign Location	Proposed Sign Support Structure Type
OHS No. 1	Station 23+325 EBC	Tri-Chord Static Sign
OHS No. 4	Station 26+510 EBC Right (South)	Cantilever Tri-Chord Static Sign
OHS No. 6	Station 30+020 EBC Right (South)	Cantilever Tri-Chord Static Sign
OHS No. 7	Station 30+422 EBC	Tri-Chord Static Sign
OHS No. 8	Station 10+115 Leslie St. N-E Entrance Ramp to Highway 401	Single Cantilever Static Sign
OHS No. 9	Station 10+209 Leslie St. S-E Entrance Ramp to Highway 401	Single Cantilever Static Sign

Caissons foundations for sign supports should be designed in accordance with the requirements provided in MTO's *Sign Support Manual (*MTO 2019). The *Sign Support Manual* includes standard caisson foundation designs for each sign type as follows:

- **Cantilever Overhead Signs**: Single Cantilever Static Sign Supports, Section 3 and Standard Drawings SS118-3, SS118-4 and SS118-5.
- **Tri-Chord Overhead Signs**: Tri-Chord Static Sign Supports and Cantilever 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 at least 5 m below the design frost depth, which for this site is 1.2 m as interpreted from OPSD 3090.101 (*Foundation, Frost Penetration Depth*), resulting in a total caisson length of at least 6.2 m below the final grade. The standard sign foundation designs presented in 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 portion of the caisson below the frost depth.
- **Case 2 (Cohesive Soils):** Soft clay with an undrained sheet 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. For such subsurface conditions, a site-specific design is required. Based on the review of the subsurface conditions at the proposed sign locations, the footings for the overhead signs does not require special design considerations and can be carried out using the standard foundation design as outlined in MTO's *Sign Support Manual*.

If the sign area is larger than that permitted under the standard design outlined in MTO's *Sign Support Manual*, a site-specific caisson foundation design can be carried out by the structural designer using the equations provided below to calculate the unfactored passive lateral earth pressure P_p (kPa), distributed along the length of the caisson, based on the idealized stratigraphy and geotechnical parameters given in Table 1 following the text of this report. The geotechnical parameters presented in Table 1 are based on field and laboratory test data as well as accepted correlations (NAVFAC, 1986, Bowles, 1984 and Kulhawy and Mayne, 1990) and the analysis was tempered by engineering judgement based on experience in similar soils.

$P_p = K_p \cdot \gamma \cdot d$ above the groundwater table, and,

$P_p = K_p \cdot \gamma \cdot d_w + K_p \cdot \gamma' \cdot (d - d_w)$ below the groundwater table.

Where

$K_p =$ passive earth pressure coefficient

$\gamma =$ bulk unit weight (kN/m^3)

$\gamma' =$ effective unit weight below the groundwater level (kN/m^3)

$d =$ depth below the ground surface (m); and

$d_w =$ depth of groundwater level (m)

Referring to the design parameters in Table 1, at the six overhead locations where the proposed ground surface is higher than the ground surface at the time of investigation, it is assumed that suitable engineered fill will be placed and compacted in accordance with OPSS.PROV 501, and the soil parameters provided for the existing fill can be assumed to extend to the existing grade.

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 ultimate diameter. A resistance factor of 0.5 (consistent with a "typical" consequence level and degree of site understanding, per the 2019 *Canadian Highway Bridge Design Code CSA S6:19* (CHBDC, 2019)) should be applied to this unfactored lateral resistance to obtain the factored ultimate lateral geotechnical resistance.

6.3 Construction Considerations

Construction of the footing foundations for the sign support structures should be in accordance with OPSS.PROV 915 (Sign Support Structures).

6.3.1 Control of Soil and Groundwater

Water-bearing non-cohesive soils at this site should be expected to run or flow into the drilled shaft (caisson) hole during or after drilling of the footings/caissons for the overhead. Therefore, appropriate equipment and procedures will be required to minimize ground loss during drilling and concrete placement. This could include the use of temporary caisson liners, and/or the use of bentonite and/or polymer slurry.

It is recommended that the Non-Standard Special Provisions (NSSP) presented in Appendix D be included in the Contract Documents to warn the Contractor of the potential presence of wet non-cohesive soils which may affect the installation of the caisson foundations at this site.

6.4 Analytical Testing of Construction Materials

The results of analytical testing carried out on four soil samples and are presented in Section 4.4 and on the Certificate of Analysis in Appendix C. The analytical test results were compared to CSA A23.1 Table 3 (*Additional requirements for concrete subjected to sulphate attack*) to assess the potential severity of sulphate attack on concrete during its service life. The sulphate concentrations measured on the soil samples range from less than 0.002% to 0.014%, which indicates a less than Moderate degree of exposure (i.e., below the class S3 exposure limits) and may be considered negligible according to Table 7.2 of MTO's Gravity Pipe Design Guidelines (2004). Therefore, based on the soil samples tested, when the designer is selecting the exposure class for the concrete structure, the effects of sulphates from within the site soils in contact with the overhead sign support structures and any portion of the proposed structure constructed below the ground surface may not need to be considered. However, given that the proposed structure will be exposed to de-icing salt/chemicals, consideration should also be given by the designer to designing the concrete structure for a "C" type exposure class as defined by CSA A23.1 Table 1.

The pH measured on the soil samples range from about 7.9 to about 8.1, which is not considered to be detrimental to durability as it is less than a pH of 8.5 according to the MTO Gravity Pipe Design Guidelines (2014). The resistivity measured in the four soil samples range from 710 ohm-cm to 3,000 ohm-cm which indicates that the soil corrosiveness is moderate (4,500 > R > 2,000) to severe (2,000 > R) as per Table 3.2 of the MTO Gravity Pipe Design Guideline (2014).

These recommendations are provided as guidance only; the structural designer should take the results of the laboratory testing, the potential for corrosion and the corrosion susceptibility of materials to be used in construction of the structure foundations in Table 7.1 of the MTO Gravity Pipe Design Guideline (2014) into consideration of the ultimate selection of materials. Ultimately, it is the designer's decision to determine the appropriate exposure class and to ensure that all aspects of CSA A23.1 Section 4.1.1 (Durability Requirements) are satisfied.

7.0 CLOSURE

Foundation Design Report was prepared by Ms. Katelyn Nero, P.Eng., a geotechnical engineer with Golder. Mr. Christopher Ng, P.Eng., as Associate and MTO Foundations Designated Contact with Golder conducted an independent technical and quality review of this report.

Signature Page

Golder Associates Ltd.

Katelyn Nero, P.Eng.
Geotechnical Engineer

Christopher Ng, P.Eng.
Associate, MTO Foundations Designated Contact

KNN/CN/ml

https://golderassociates.sharepoint.com/sites/20393g/deliverables/foundations/11 - ohs (cr6 and 8)/3. final/1786302-fidr-highway 401 six ohs sign support structures_2021september22.docx

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Ontario Occupational Health and Safety Act:

Ontario Regulation 903 Wells (as amended)

Ontario Provincial Standard Specifications (OPSS)

OPSS.PROV 501 Construction Specification for Compacting

OPSS.PROV 915 Construction Specification for Sign Support Structures

Ontario Provincial Standard Drawings (OPSD)

OPSD 3090.101 Foundation, Frost Penetration Depths for Southern Ontario

Table 1: Geotechnical Design Parameters for Sign Support Foundations

Borehole No.	Sign Location	Sign Structure	Soil Stratum	Depth[1] (m)	Elevation[1] (m)	Design Groundwater Elevation[2] (m)	Design Parameters[3]				
							S_u (kPa)	φ' (°)	γ (kN/m^3)	γ' (kN/m^3)	K_p[4]
No. 9 No. 102	Highway 401 EBC Station 23+325	OHS No. 1	Compact Sand with Gravel (Fill)	0.0 – 1.3	168.1 – 166.8	164.0	--	36	21	11	3.9
			Compact to Very Dense SILT to Sandy SILT to SILT and Sand to SILTY SAND to SAND	1.3 – 15.4	166.8 – 152.7		--	36	20	10	3.9
OHS-4	Highway 401 EBC Right (South) Footing Station 26+510	OHS No.4	SILTY SAND (Fill)	0.3 – 0.8	137.8 – 137.3	126.5	--	34	21	11	3.5
			Soft to Hard Sandy CLAYEY SILT to CLAYEY SILT-SILT and sand to Sandy SILT (Fill)	0.8 – 8.4	137.3 - 129.7		65	30	21	11	3.0
			Firm Sandy CLAYEY SILT	8.4 – 10.2	129.7 – 127.9		50	29	21	11	2.9
			Loose Sandy SILT	10.2 – 11.3	127.9 – 126.8		--	30	20	10	3.0
OHS-6	Highway 401 EBC Right (South) Footing Station 30+020	OHS No.6	SILTY SAND (Fill)	0.1 – 0.8	176.6 - 175.9	172.5	--	34	21	11	3.5
			Stiff to Very Stiff Sandy CLAYEY SILT	0.8 – 2.2	175.9 - 174.5		70	35	21	11	3.7
			Dense to Very Dense SILT and Sand	2.2 – 5.0	174.5 - 171.8		--	36	20	10	3.9
			Stiff to Hard Sandy CLAYEY SILT-SILT	5.0 – 9.8	171.8 – 167.0		90	35	21	11	3.7
OHS-7	Highway 401 EBC Station 30+422	OHS No.7	SILTY SAND (Fill)	0.3 – 0.8	179.5 - 179.0	172.5	--	34	21	11	3.5
			Stiff to Hard CLAYEY SILT-SILT and Sand (Fill)	0.8 – 1.9	179.0 – 177.9		85	34	21	11	3.5

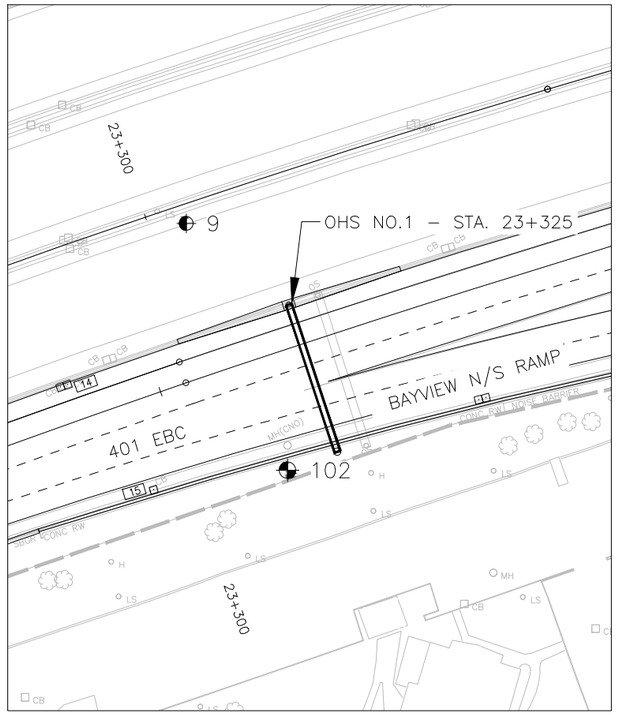
Borehole No.	Sign Location	Sign Structure	Soil Stratum	Depth[1] (m)	Elevation[1] (m)	Design Groundwater Elevation[2] (m)	Design Parameters[3]				
							S_u (kPa)	φ' (°)	γ (kN/m^3)	γ' (kN/m^3)	K_p[4]
			Dense to Very Dense SILT and Sand to SILTY SAND	1.9 – 9.8	177.9 – 170.1		--	36	21	10	3.9
N/E RE-1	Leslie St. N-E Entrance Ramp to HWY 401 Station 10+115	OHS No.8	Loose to Compact SAND (FILL)	0.1 – 3.0	139.6 – 136.7	135.2	--	34	21	11	3.5
			Very Loose to Compact SILT to SAND	3.0 – 8.7	136.7 – 131.0		--	34	20	10	3.5
			Firm SILTY CLAY to CLAYEY SILT	8.7 – 11.7	131.0 – 128.0		30	27	21	11	2.7
OHS-9	Leslie St. S-E Entrance Ramp to HWY 401 Station 10+209	OHS No.9	Compact to Dense SILTY SAND (FILL)	0.0 – 2.2	139.2 – 137.0	135.2	--	36	21	11	3.5
			Very Loose to Compact SILT to SILT and Sand	2.2 – 8.7	137.0 – 130.5		--	32	20	10	3.3
			Very Soft CLAYEY SILT	8.7 – 12.8	130.5 – 126.4		35	31	21	11	2.7

NOTES:

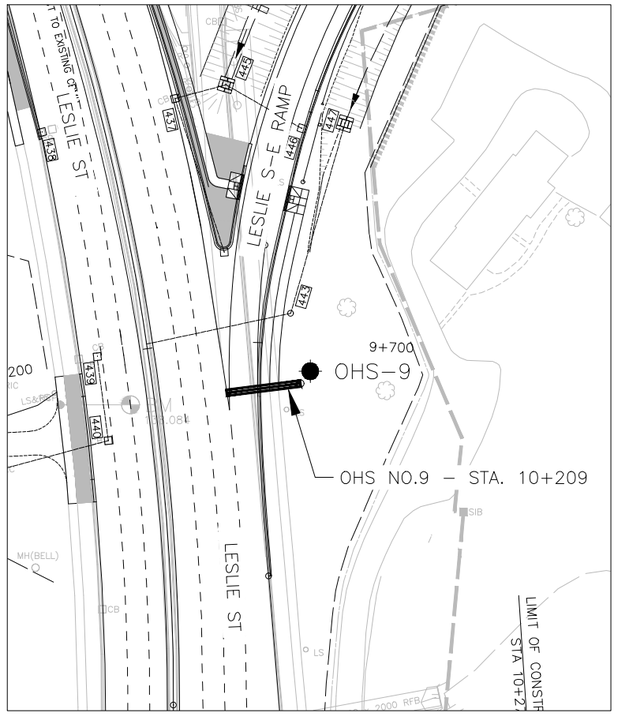
1. Depths are given related to the borehole ground surface elevation; the ground surface elevation at the borehole location(s) should be compared to the ground surface elevation at the actual OHS location, and the depths to various soil stratum adjusted accordingly
2. Groundwater level inferred based on additional boreholes in the vicinity of the OHS locations
3. Design Parameters:
   S_u = undrained shear strength (kPa)
   φ' = effective friction angle (degrees)
   γ = bulk unit weight (kN/m^3)
   γ' = effective unit weight below the groundwater level (kN/m^3)
   K_p = passive earth pressure coefficient
4. The total passive resistance may be calculated based on the K_p indicated above but reduced by an appropriate factor that considers the allowable wall movement in accordance with Figure C6.27 of the *Canadian Highway Bridge Design Code* (CHBDC, 2019) to account for large strain would be required to mobilize of the full passive resistance.

Drawings

MINISTRY OF TRANSPORTATION, ONTARIO



OHS NO.1 – STA. 23+325



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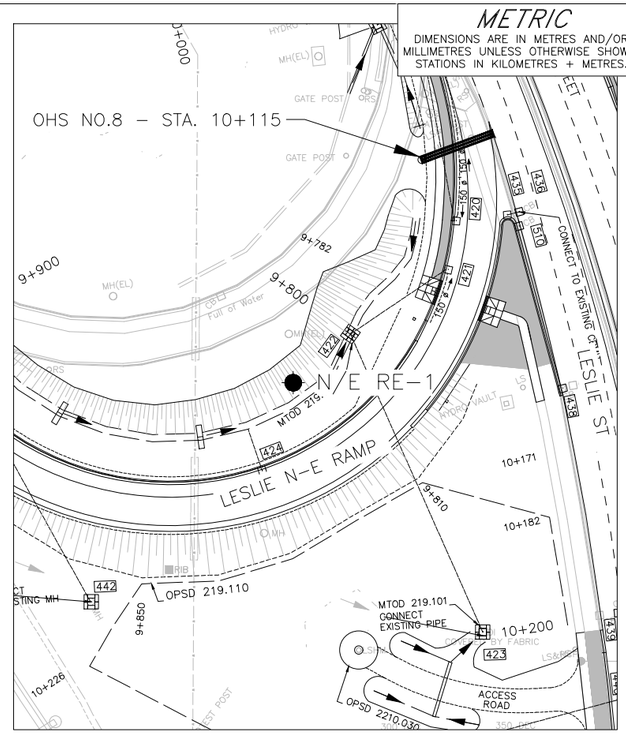
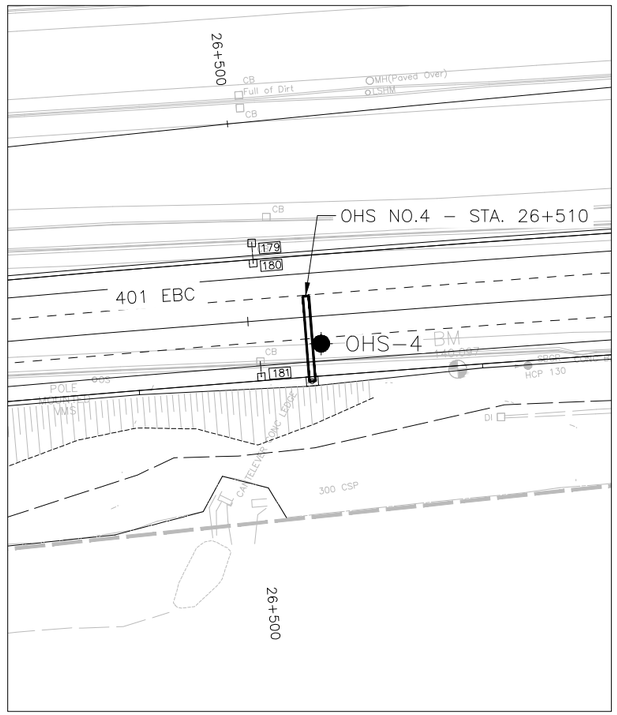
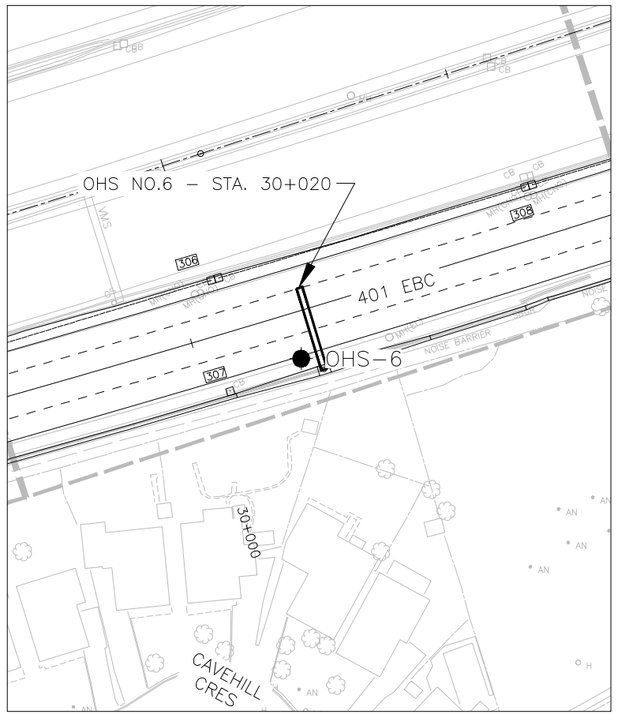


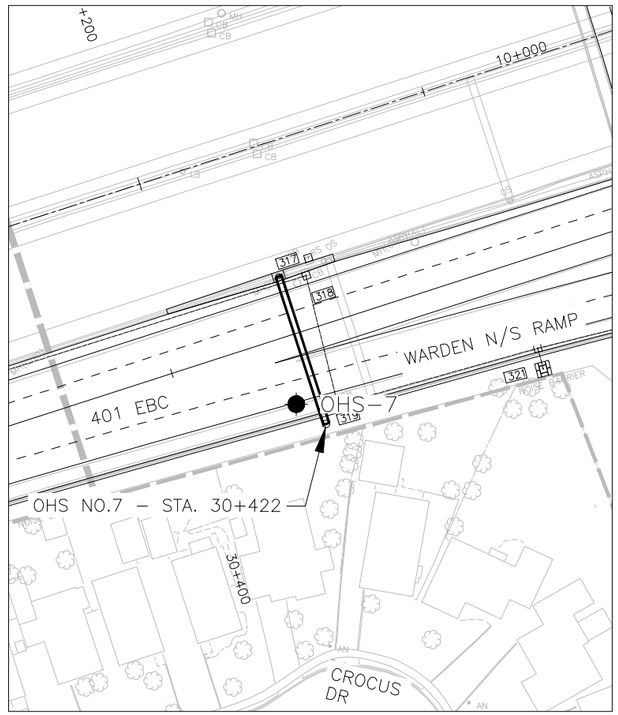
OHS NO.8 – STA. 10+115



OHS NO.4 – STA. 26+510



OHS NO.6 – STA. 30+020



OHS NO.7 – STA. 30+422

SCALE
10 0 10 20 m

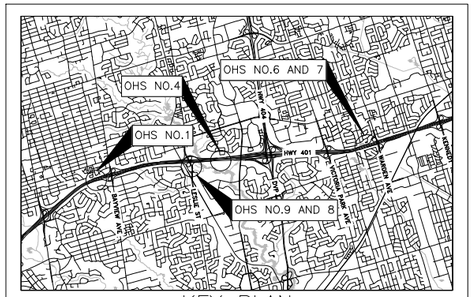
METRIC
DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN. STATIONS IN KILOMETRES + METRES.

CONT No.
GWP No. 2130-01-00

HIGHWAY 401
SIX OVERHEAD SIGN SUPPORT STRUCTURES
BOREHOLE LOCATIONS

SHEET

GOLDER
MEMBER OF WSP



KEY PLAN
SCALE
1.5 0 1.5 3 km

LEGEND

- Borehole – Current Investigation
- Borehole – Previous Investigation (MTO GEOCRES No. 30M14-184)
- Borehole – Previous Investigation (MTO GEOCRES No. 30M14-186)

BOREHOLE CO-ORDINATES (NAD 83 MTM ZONE 10)

No.	ELEVATION	NORTHING	EASTING
N/E RE-1	139.7	4847230.8	315852.2
OHS-7	179.8	4847779.1	320511.1
OHS-6	176.7	4847660.2	320127.5
OHS-4	138.1	4847387.6	316637.2
OHS-9	139.2	4847189.8	315942.4
9	168.1	4846913.0	313486.7
102	169.2	4846871.6	313503.7

LICENSED PROFESSIONAL ENGINEER
K. NERO
100538674
Sep. 17, 2021
PROVINCE OF ONTARIO

LICENSED PROFESSIONAL ENGINEER
C.C. NG
100086170
Sep. 17, 2021
PROVINCE OF ONTARIO

NOTES

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

REFERENCE

Base and design plans provided in digital format by AECOM, drawing file no. 401_EBC_Avenue-Warden_base.dwg, received February 7, 2019 and 401_EBC_Avenue-Warden_plan.dwg, received March 29, 2021.

NO.	DATE	BY	REVISION
.	.	.	.

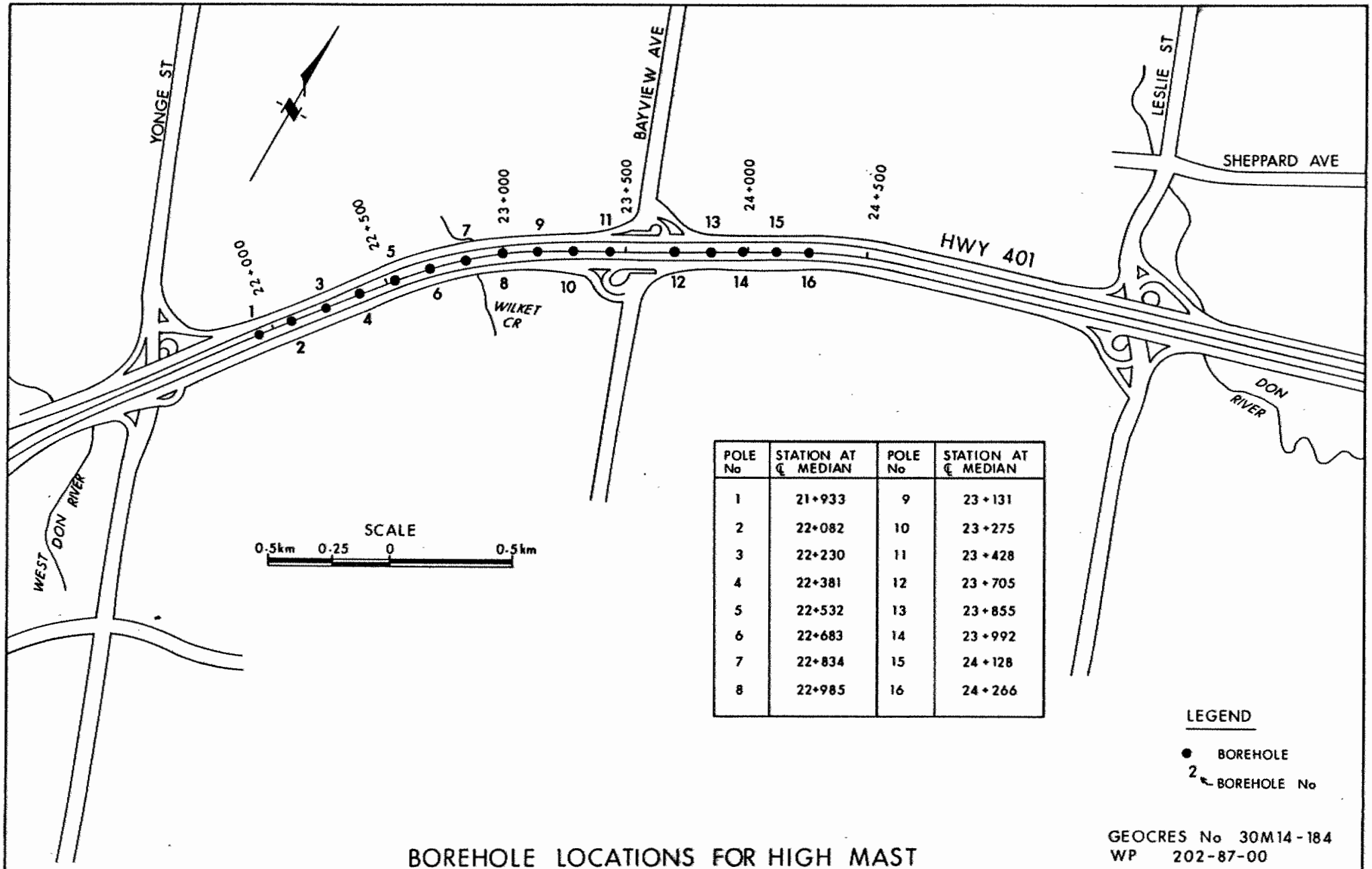
Geocres No. 30M14-540

HWY. 401		PROJECT NO. 1786302	DIST. CENTRAL
SUBM'D. KN	CHKD. KN	DATE: Sep. 17, 2021	SITE: .
DRAWN: DD/SA	CHKD. CN	APPD. CN	DWG. 1

PLOT DATE: September 21, 2021
FILENAME: S:\Clients\MTO\Hwy_401_Leslie_Street\06_PRO\1786302\60_PROD\0005_Str_Overhead_Sign_Support\1786302-0005-BD-0001.dwg

APPENDIX A

Previous Investigation – MTO GEOCRES No. 30M14-184



POLE No	STATION AT ℄ MEDIAN	POLE No	STATION AT ℄ MEDIAN
1	21+933	9	23+131
2	22+082	10	23+275
3	22+230	11	23+428
4	22+381	12	23+705
5	22+532	13	23+855
6	22+683	14	23+992
7	22+834	15	24+128
8	22+985	16	24+266

LEGEND

● BOREHOLE

2 BOREHOLE No

BOREHOLE LOCATIONS FOR HIGH MAST LIGHTING POLE FOUNDATIONS

GEOCRES No 30M14-184
WP 202-87-00
HWY 401
DIST 6
TORONTO
DWG No 2028700-A

EXPLANATION OF TERMS USED IN REPORT

N VALUE: THE STANDARD PENETRATION TEST (SPT) N VALUE IS THE NUMBER OF BLOWS REQUIRED TO CAUSE A STANDARD 51mm O.D. SPLIT BARREL SAMPLER TO PENETRATE 0.3m INTO UNDISTURBED GROUND IN A BOREHOLE WHEN DRIVEN BY A HAMMER WITH A MASS OF 63.5kg, FALLING FREELY A DISTANCE OF 0.76m. FOR PENETRATIONS OF LESS THAN 0.3m N VALUES ARE INDICATED AS THE NUMBER OF BLOWS FOR THE PENETRATION ACHIEVED. AVERAGE N VALUE IS DENOTED THUS $\bar{N}$.

DYNAMIC CONE PENETRATION TEST: CONTINUOUS PENETRATION OF A CONICAL STEEL POINT (51mm O.D. 60° CONE ANGLE) DRIVEN BY 475 J IMPACT ENERGY ON 'A' SIZE DRILL RODS. THE RESISTANCE TO CONE PENETRATION IS MEASURED AS THE NUMBER OF BLOWS FOR EACH 0.3m ADVANCE OF THE CONICAL POINT INTO THE UNDISTURBED GROUND.

SOILS ARE DESCRIBED BY THEIR COMPOSITION AND CONSISTENCY OR DENSENESS.

CONSISTENCY: COHESIVE SOILS ARE DESCRIBED ON THE BASIS OF THEIR UNDRAINED SHEAR STRENGTH (c_u) AS FOLLOWS:

c_u (kPa)	0 - 12	12 - 25	25 - 50	50 - 100	100 - 200	>200
	VERY SOFT	*SOFT*	*FIRM*	*STIFF*	*VERY STIFF*	*HARD*

DENSENESS: COHESIONLESS SOILS ARE DESCRIBED ON THE BASIS OF DENSENESS AS INDICATED BY SPT N VALUES AS FOLLOWS:

N (BLOWS/0.3m)	0 - 5	5 - 10	10 - 30	30 - 50	>50
	VERY LOOSE	*LOOSE*	*COMPACT*	*DENSE*	*VERY DENSE*

ROCKS ARE DESCRIBED BY THEIR COMPOSITION AND STRUCTURAL FEATURES AND / OR STRENGTH.

RECOVERY: SUM OF ALL RECOVERED ROCK CORE PIECES FROM A CORING RUN EXPRESSED AS A PERCENT OF THE TOTAL LENGTH OF THE CORING RUN.

MODIFIED RECOVERY: SUM OF THOSE INTACT CORE PIECES, 100mm+ IN LENGTH EXPRESSED AS A PERCENT OF THE LENGTH OF THE CORING RUN. THE ROCK QUALITY DESIGNATION (R Q D), FOR MODIFIED RECOVERY, IS:

R Q D (%)	0 - 25	25 - 50	50 - 75	75 - 90	90 - 100
	VERY POOR	*POOR*	*FAIR*	*GOOD*	*EXCELLENT*

JOINTING AND BEDDING:

SPACING	50mm	50 - 300mm	0.3m - 1m	1m - 3m	>3m
JOINTING	*VERY CLOSE*	*CLOSE*	*MOD. CLOSE*	*WIDE*	*VERY WIDE*
BEDDING	*VERY THIN*	*THIN*	*MEDIUM*	*THICK*	*VERY THICK*

ABBREVIATIONS AND SYMBOLS

FIELD SAMPLING

S S	SPLIT SPOON	T P	THINWALL PISTON
W S	WASH SAMPLE	O S	OSTERBERG SAMPLE
S T	SLOTTED TUBE SAMPLE	R C	ROCK CORE
B S	BLOCK SAMPLE	P H	T W ADVANCED HYDRAULICALLY
C S	CHUNK SAMPLE	P M	T W ADVANCED MANUALLY
T W	THINWALL OPEN	F S	FOIL SAMPLE

STRESS AND STRAIN

u_w	kPa	PORE WATER PRESSURE
r_u	1	PORE PRESSURE RATIO
σ	kPa	TOTAL NORMAL STRESS
σ'	kPa	EFFECTIVE NORMAL STRESS
τ	kPa	SHEAR STRESS
$\sigma_1, \sigma_2, \sigma_3$	kPa	PRINCIPAL STRESSES
ϵ	%	LINEAR STRAIN
$\epsilon_1, \epsilon_2, \epsilon_3$	%	PRINCIPAL STRAINS
E	kPa	MODULUS OF LINEAR DEFORMATION
G	kPa	MODULUS OF SHEAR DEFORMATION
μ	1	COEFFICIENT OF FRICTION

MECHANICAL PROPERTIES OF SOIL

m_v	kPa^{-1}	COEFFICIENT OF VOLUME CHANGE
C_c	1	COMPRESSION INDEX
C_s	1	SWELLING INDEX
C_α	1	RATE OF SECONDARY CONSOLIDATION
c_v	m^2/s	COEFFICIENT OF CONSOLIDATION
H	m	DRAINAGE PATH
T_v	1	TIME FACTOR
U	%	DEGREE OF CONSOLIDATION
σ'_{vo}	kPa	EFFECTIVE OVERBURDEN PRESSURE
σ'_p	kPa	PRECONSOLIDATION PRESSURE
τ_f	kPa	SHEAR STRENGTH
c'	kPa	EFFECTIVE COHESION INTERCEPT
ϕ'	-°	EFFECTIVE ANGLE OF INTERNAL FRICTION
c_u	kPa	APPARENT COHESION INTERCEPT
ϕ_u	-°	APPARENT ANGLE OF INTERNAL FRICTION
τ_R	kPa	RESIDUAL SHEAR STRENGTH
τ_r	kPa	REMOULDED SHEAR STRENGTH
S_t	1	SENSITIVITY = $\frac{c_u}{\tau_r}$

PHYSICAL PROPERTIES OF SOIL

ρ_s	kg/m^3	DENSITY OF SOLID PARTICLES	e	1,%	VOID RATIO	e_{min}	1,%	VOID RATIO IN DENSEST STATE
γ_s	kN/m^3	UNIT WEIGHT OF SOLID PARTICLES	n	1,%	POROSITY	I_D	1	DENSITY INDEX = $\frac{e_{max} - e}{e_{max} - e_{min}}$
ρ_w	kg/m^3	DENSITY OF WATER	w	1,%	WATER CONTENT	D	mm	GRAIN DIAMETER
γ_w	kN/m^3	UNIT WEIGHT OF WATER	S_r	%	DEGREE OF SATURATION	D_n	mm	n PERCENT - DIAMETER
ρ	kg/m^3	DENSITY OF SOIL	w_L	%	LIQUID LIMIT	C_U	1	UNIFORMITY COEFFICIENT
γ	kN/m^3	UNIT WEIGHT OF SOIL	w_p	%	PLASTIC LIMIT	h	m	HYDRAULIC HEAD OR POTENTIAL
ρ_d	kg/m^3	DENSITY OF DRY SOIL	w_S	%	SHRINKAGE LIMIT	q	m^3/s	RATE OF DISCHARGE
γ_d	kN/m^3	UNIT WEIGHT OF DRY SOIL	I_p	%	PLASTICITY INDEX = $w_L - w_p$	v	m/s	DISCHARGE VELOCITY
ρ_{sat}	kg/m^3	DENSITY OF SATURATED SOIL	I_L	1	LIQUIDITY INDEX = $\frac{w - w_p}{I_p}$	i	1	HYDRAULIC GRADIENT
γ_{sat}	kN/m^3	UNIT WEIGHT OF SATURATED SOIL				k	m/s	HYDRAULIC CONDUCTIVITY
ρ'	kg/m^3	DENSITY OF SUBMERGED SOIL	I_C	1	CONSISTENCY INDEX = $\frac{w_L - w}{I_p}$	j	kN/m^3	SEEPAGE FORCE
γ'	kN/m^3	UNIT WEIGHT OF SUBMERGED SOIL	e_{max}	1,%	VOID RATIO IN LOOSEST STATE			

RECORD OF BOREHOLE No 9 METRIC

W P 202-87-00 LOCATION Sta. 23 + 131 O/S 2.1 m Lt. ORIGINATED BY MJ
DIST 6 HWY 401 BOREHOLE TYPE Solid Stem Augers COMPILED BY LP
DATUM Geodetic DATE 87 02 12 CHECKED BY DT

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	TYPE	'N' VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
168.1	Shoulder Surface						168	
0.0	Asphalt							
166.8	Sand with Gravel (Fill)		1	SS	23			
1.3	Silt, some sand trace gravel clay Occ. plastic zones		2	SS	56		166	
			3	SS	80			1 10 80 9
			4	SS	57			
163.5	Very Dense		5	SS	39	*	164	
4.6			6	SS	60			25 65 (10)
	Sand, trace/some gravel, trace silt clay		7	SS	60			
			8	SS	52		162	9 78 (13)
161.1	Very Dense							
7.0			9	SS	108			
	Silt with sand trace gravel clay						160	
			10	SS	100			
							158	
	Sand with silt Very Dense		11	SS	180			
			12	SS	146		156	3 33 59 5
	Very Dense							
			13	SS	112/13 cm	**	154	
152.7			14	SS	63			6 35 (59)
15.4	End of Borehole							

DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100

SHEAR STRENGTH
○ UNCONFINED + FIELD VANE
● QUICK TRIAXIAL × LAB VANE

PLASTIC LIMIT Wp — NATURAL MOISTURE CONTENT W — LIQUID LIMIT Wl
WATER CONTENT (%) 10 20 30

UNIT WEIGHT γ

* Groundwater level measured at completion of B.H. Level may not be stabilized.

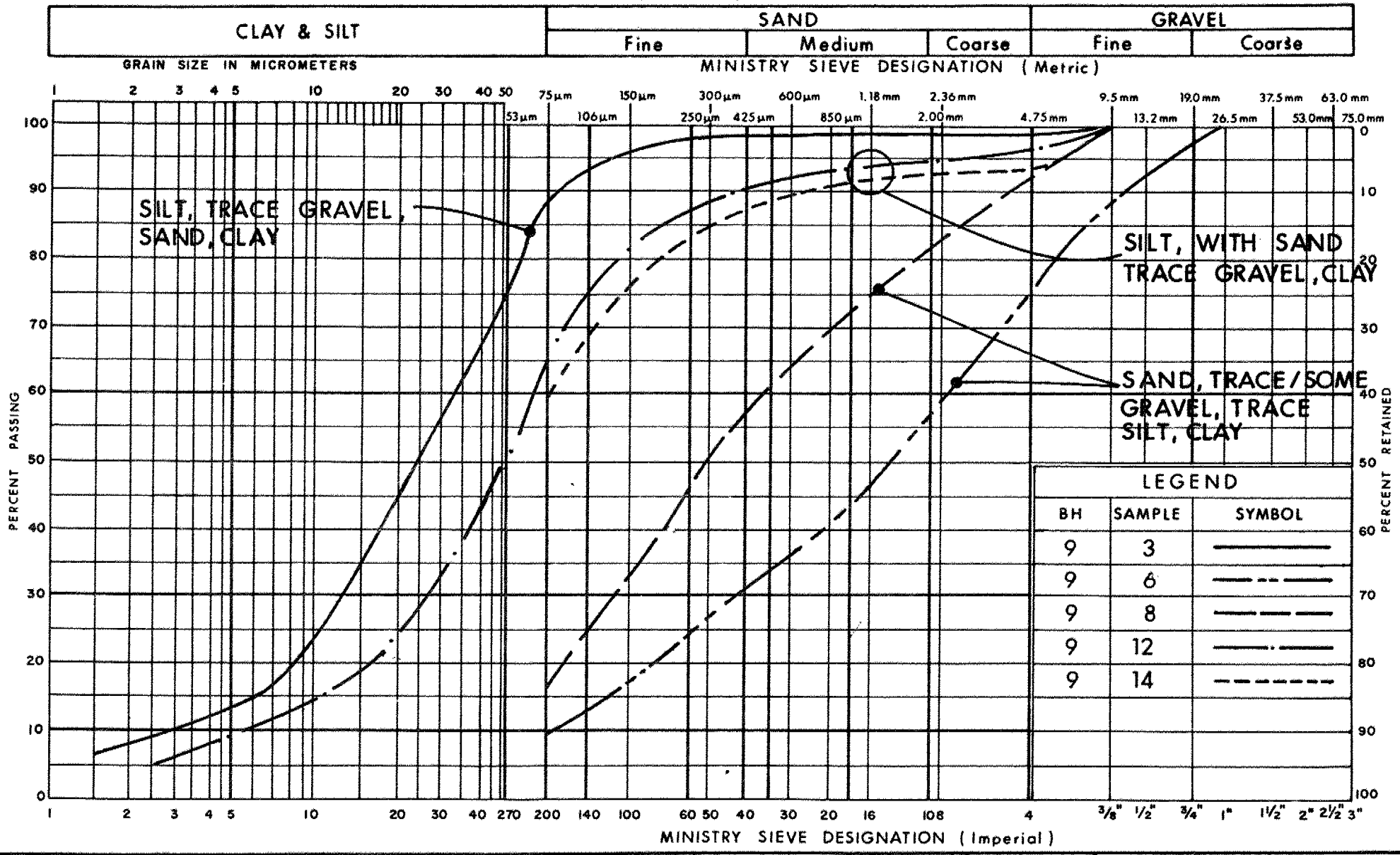
** N value for SS#13 may not be representative since sand came up to Elev.155 before driving spoon

$+^3$, $\times^5$: Numbers refer to Sensitivity

20
15 ◇ 5 (%) STRAIN AT FAILURE
10

OFFICE REPORT ON SOIL EXPLORATION

UNIFIED SOIL CLASSIFICATION SYSTEM



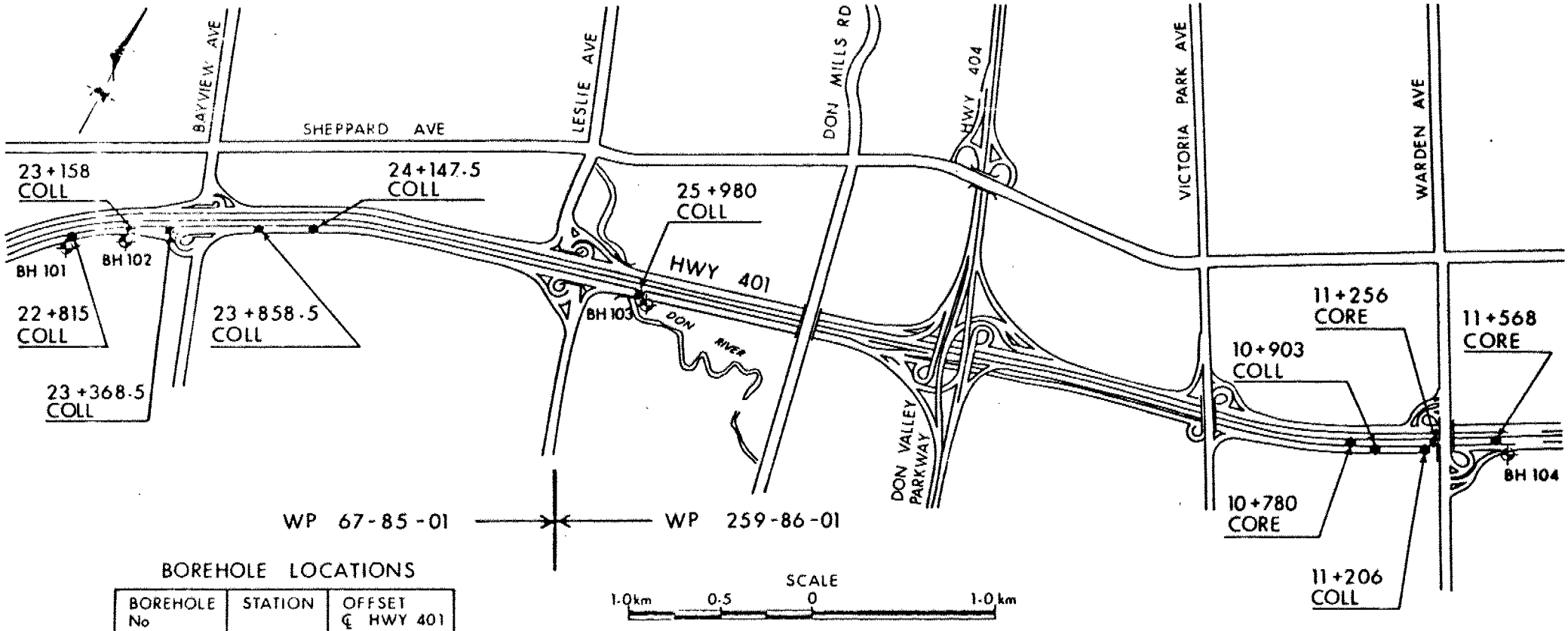
Ministry of Transportation and Communications
Ontario

GRAIN SIZE DISTRIBUTION

FIG No 19
W P 202-87-00
BH - 9

APPENDIX A

Previous Investigation – MTO GEOCRES No. 30M14-186



BOREHOLE LOCATIONS

BOREHOLE No	STATION	OFFSET ℄ HWY 401	
101	22+801	43.0m Rt	WP 67-85-01
102	23+131	47.0m Rt	WP 67-85-01
103	25+988	43.0m Rt	WP 259-86-01
104	11+622	54.0m Rt	WP 259-86-01

LEGEND

- BOREHOLE & CONE TEST
- FTMS - CMS

FTMS - CMS LOCATIONS & BOREHOLE LOCATIONS

GEOCRES No 30M14-186
WP 67-85-01 & 259-86-01
HWY 401
DIST 6
TORONTO
FIGURE 1

EXPLANATION OF TERMS USED IN REPORT

N VALUE: THE STANDARD PENETRATION TEST (SPT) N VALUE IS THE NUMBER OF BLOWS REQUIRED TO CAUSE A STANDARD 51mm O.D. SPLIT BARREL SAMPLER TO PENETRATE 0.3m INTO UNDISTURBED GROUND IN A BOREHOLE WHEN DRIVEN BY A HAMMER WITH A MASS OF 63.5kg, FALLING FREELY A DISTANCE OF 0.76m. FOR PENETRATIONS OF LESS THAN 0.3m N VALUES ARE INDICATED AS THE NUMBER OF BLOWS FOR THE PENETRATION ACHIEVED. AVERAGE N VALUE IS DENOTED THUS $\bar{N}$.

DYNAMIC CONE PENETRATION TEST: CONTINUOUS PENETRATION OF A CONICAL STEEL POINT (51mm O.D. 60° CONE ANGLE) DRIVEN BY 475 J IMPACT ENERGY ON 'A' SIZE DRILL RODS. THE RESISTANCE TO CONE PENETRATION IS MEASURED AS THE NUMBER OF BLOWS FOR EACH 0.3m ADVANCE OF THE CONICAL POINT INTO THE UNDISTURBED GROUND.

SOILS ARE DESCRIBED BY THEIR COMPOSITION AND CONSISTENCY OR DENSENESS.

CONSISTENCY: COHESIVE SOILS ARE DESCRIBED ON THE BASIS OF THEIR UNDRAINED SHEAR STRENGTH (c_u) AS FOLLOWS:

c_u (kPa)	0 - 12	12 - 25	25 - 50	50 - 100	100 - 200	>200
	VERY SOFT	*SOFT*	*FIRM*	*STIFF*	*VERY STIFF*	*HARD*

DENSENESS: COHESIONLESS SOILS ARE DESCRIBED ON THE BASIS OF DENSENESS AS INDICATED BY SPT N VALUES AS FOLLOWS:

N (BLOWS/0.3m)	0 - 5	5 - 10	10 - 30	30 - 50	>50
	VERY LOOSE	*LOOSE*	*COMPACT*	*DENSE*	*VERY DENSE*

ROCKS ARE DESCRIBED BY THEIR COMPOSITION AND STRUCTURAL FEATURES AND / OR STRENGTH.

RECOVERY: SUM OF ALL RECOVERED ROCK CORE PIECES FROM A CORING RUN EXPRESSED AS A PERCENT OF THE TOTAL LENGTH OF THE CORING RUN.

MODIFIED RECOVERY: SUM OF THOSE INTACT CORE PIECES, 100mm+ IN LENGTH EXPRESSED AS A PERCENT OF THE LENGTH OF THE CORING RUN. THE ROCK QUALITY DESIGNATION (RQD), FOR MODIFIED RECOVERY, IS:

RQD (%)	0 - 25	25 - 50	50 - 75	75 - 90	90 - 100
	VERY POOR	*POOR*	*FAIR*	*GOOD*	*EXCELLENT*

JOINTING AND BEDDING:

SPACING	50mm	50 - 300mm	0.3m - 1m	1m - 3m	>3m
JOINTING	*VERY CLOSE*	*CLOSE*	*MOD. CLOSE*	*WIDE*	*VERY WIDE*
BEDDING	*VERY THIN*	*THIN*	*MEDIUM*	*THICK*	*VERY THICK*

ABBREVIATIONS AND SYMBOLS

FIELD SAMPLING

S S	SPLIT SPOON	T P	THINWALL PISTON
W S	WASH SAMPLE	O S	OSTERBERG SAMPLE
S T	SLOTTED TUBE SAMPLE	R C	ROCK CORE
B S	BLOCK SAMPLE	P H	T W ADVANCED HYDRAULICALLY
C S	CHUNK SAMPLE	P M	T W ADVANCED MANUALLY
T W	THINWALL OPEN	F S	FOIL SAMPLE

STRESS AND STRAIN

u_w	kPa	PORE WATER PRESSURE
r_u	1	PORE PRESSURE RATIO
σ	kPa	TOTAL NORMAL STRESS
σ'	kPa	EFFECTIVE NORMAL STRESS
τ	kPa	SHEAR STRESS
$\sigma_1, \sigma_2, \sigma_3$	kPa	PRINCIPAL STRESSES
ϵ	%	LINEAR STRAIN
$\epsilon_1, \epsilon_2, \epsilon_3$	%	PRINCIPAL STRAINS
E	kPa	MODULUS OF LINEAR DEFORMATION
G	kPa	MODULUS OF SHEAR DEFORMATION
μ	1	COEFFICIENT OF FRICTION

MECHANICAL PROPERTIES OF SOIL

m_v	kPa^{-1}	COEFFICIENT OF VOLUME CHANGE
C_c	1	COMPRESSION INDEX
C_s	1	SWELLING INDEX
C_α	1	RATE OF SECONDARY CONSOLIDATION
c_v	m^2/s	COEFFICIENT OF CONSOLIDATION
H	m	DRAINAGE PATH
T_v	1	TIME FACTOR
U	%	DEGREE OF CONSOLIDATION
σ'_{vo}	kPa	EFFECTIVE OVERBURDEN PRESSURE
σ'_p	kPa	PRECONSOLIDATION PRESSURE
τ_f	kPa	SHEAR STRENGTH
c'	kPa	EFFECTIVE COHESION INTERCEPT
ϕ'	-°	EFFECTIVE ANGLE OF INTERNAL FRICTION
c_u	kPa	APPARENT COHESION INTERCEPT
ϕ_u	-°	APPARENT ANGLE OF INTERNAL FRICTION
τ_R	kPa	RESIDUAL SHEAR STRENGTH
τ_r	kPa	REMOULDED SHEAR STRENGTH
S_t	1	SENSITIVITY = $\frac{c_u}{\tau_r}$

PHYSICAL PROPERTIES OF SOIL

ρ_s	kg/m^3	DENSITY OF SOLID PARTICLES
γ_s	kN/m^3	UNIT WEIGHT OF SOLID PARTICLES
ρ_w	kg/m^3	DENSITY OF WATER
γ_w	kN/m^3	UNIT WEIGHT OF WATER
ρ	kg/m^3	DENSITY OF SOIL
γ	kN/m^3	UNIT WEIGHT OF SOIL
ρ_d	kg/m^3	DENSITY OF DRY SOIL
γ_d	kN/m^3	UNIT WEIGHT OF DRY SOIL
ρ_{sat}	kg/m^3	DENSITY OF SATURATED SOIL
γ_{sat}	kN/m^3	UNIT WEIGHT OF SATURATED SOIL
ρ'	kg/m^3	DENSITY OF SUBMERGED SOIL
γ'	kN/m^3	UNIT WEIGHT OF SUBMERGED SOIL

e	1,%	VOID RATIO
n	1,%	POROSITY
w	1,%	WATER CONTENT
S_r	%	DEGREE OF SATURATION
w_L	%	LIQUID LIMIT
w_P	%	PLASTIC LIMIT
w_S	%	SHRINKAGE LIMIT
I_P	%	PLASTICITY INDEX = $w_L - w_P$
I_L	1	LIQUIDITY INDEX = $\frac{w - w_P}{I_P}$
I_C	1	CONSISTENCY INDEX = $\frac{w_L - w}{I_P}$
e_{max}	1,%	VOID RATIO IN LOOSEST STATE

e_{min}	1,%	VOID RATIO IN DENSEST STATE
I_D	1	DENSITY INDEX = $\frac{e_{max} - e}{e_{max} - e_{min}}$
D	mm	GRAIN DIAMETER
D_n	mm	n PERCENT - DIAMETER
C_U	1	UNIFORMITY COEFFICIENT
h	m	HYDRAULIC HEAD OR POTENTIAL
q	m^3/s	RATE OF DISCHARGE
v	m/s	DISCHARGE VELOCITY
i	1	HYDRAULIC GRADIENT
k	m/s	HYDRAULIC CONDUCTIVITY
j	kN/m^3	SEEPAGE FORCE

Ministry of Transportation and Communications
Ontario

RECORD OF BOREHOLE No 102 METRIC

W P 67-85-01 LOCATION Sta. 23 + 131; O/S 47.0 m Rt. ℄ Hwy. 401 ORIGINATED BY DP
DIST 6 HWY 401 BOREHOLE TYPE Cone Test, Hollow Stem Auger COMPILED BY DP
DATUM Assumed-curb 100 m DATE 87 06 24 CHECKED BY DD

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE)	PLASTIC LIMIT Wp / NATURAL MOISTURE CONTENT W / LIQUID LIMIT WL — WATER CONTENT (%) (10 20 30)	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES						
101.1	Ground Surface										
0.0	Sandy Silt to Silty Sand Compact						101				
99.9			1	SS	12		100				
1.2	Silty Sand to Sandy Silt Trace Clay Trace Gravel Compact to Very Dense		2	SS	36		99				3 49 45 3
			3	SS	102/	25 cm					
			4	SS	55		98		o		
			5	SS	52		97				
	Frequent Silt Zones		6	SS	29		96				
			7	SS	101/	23 cm					
			8	SS	48		95				
			9	SS	41	*	94				
			10	SS	86		93				
	Some Gravel		11	SS	73/	10 cm					13 50 33 4
91.5			12	SS	100/	13 cm	92				
9.6	End of Borehole										

* Groundwater Level measured at completion of B.H. Level may not be stabilized

+3, x5 : Numbers refer to Sensitivity

20 / 15 ◇ 5 / 10 (%) STRAIN AT FAILURE

OFFICE REPORT ON SOIL EXPLORATION

APPENDIX B

Current Investigation – Record of Boreholes

ABBREVIATIONS AND TERMS USED ON RECORDS OF BOREHOLES AND TEST PITS
MINISTRY OF TRANSPORTATION, ONTARIO

PARTICLE SIZES OF CONSTITUENTS

Soil Constituent	Particle Size Description	Millimetres	Inches (US Std. Sieve Size)
BOULDERS	Not Applicable	>200	>8
COBBLES	Not Applicable	75 to 200	3 to 8
GRAVEL	Coarse Fine	19 to 75 4.75 to 19	0.75 to 3 (4) to 0.75
SAND	Coarse Medium Fine	2.00 to 4.75 0.425 to 2.00 0.075 to 0.425	(10) to (4) (40) to (10) (200) to (40)
FINES	Classified by plasticity	<0.075	< (200)

MODIFIERS FOR SECONDARY COMPONENTS[1,2]

Percentage by Mass	Modifier
> 35	Use 'and' to combine primary and secondary component (*i.e.,* SAND and gravel)
> 20 to 35	Primary soil name prefixed with "gravelly, sandy" as applicable
> 10 to 20	some (*i.e.,* some sand)
≤ 10	trace (*i.e.,* trace fines)

1. Only applicable to components not described by Primary Group Name.
2. Classification of Primary Group Name based on Unified Soil Classification System (ASTM D2487) for coarse-grained soils; fine-grained soils described per current MTO Soil Classification System.

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.) split-spoon sampler for a distance of 300 mm (12 in.). Values reported are as recorded in the field and are uncorrected.

Cone Penetration Test (CPT)

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

Dynamic Cone Penetration Resistance (DCPT); 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

SAMPLES

AS	Auger sample
BS	Block sample
CS	Chunk sample
DD	Diamond Drilling
DO or DP	Seamless open ended, driven or pushed tube sampler – note size
DS	Denison type sample
GS	Grab Sample
MC	Modified California Samples
MS	Modified Shelby (for frozen soil)
RC / SC	Rock core / Soil core
SS	Split spoon sampler – note size
ST	Slotted tube
TO	Thin-walled, open – note size (Shelby tube)
TP	Thin-walled, piston – note size (Shelby tube)
WS	Wash sample
OD / ID	Outer Diameter / Inner Diameter
HSA / SSA	Hollow-Stem Augers / Solid-Stem Augers

SOIL TESTS

w	water content
PL , w_p	plastic limit
LL , 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, Gs)
DS	direct shear test
GS	specific gravity
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 (FV)	field vane (LV-laboratory vane test)
γ	unit weight

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

COARSE-GRAINED SOILS

Compactness[1]

Term	SPT 'N' (blows/0.3m)[2]
Very Loose	0 to 4
Loose	4 to 10
Compact	10 to 30
Dense	30 to 50
Very Dense	> 50

3. Definition of compactness terms are based on SPT 'N' ranges as provided in Terzaghi, Peck and Mesri (1996). Many factors affect the recorded SPT 'N' value, including hammer efficiency (which may be greater than 60% in automatic trip hammers), overburden pressure, groundwater conditions, and grainsize. As such, the recorded SPT 'N' value(s) should be considered only an approximate guide to the soil compactness. These factors need to be considered when evaluating the results, and the stated compactness terms should not be relied upon for design or construction.
4. SPT 'N' in accordance with ASTM D1586, uncorrected for the effects of overburden pressure.

FINE-GRAINED SOILS

Consistency

Term	Undrained Shear Strength (kPa)	SPT 'N'[1,2] (blows/0.3m)
Very Soft	< 12	0 to 2
Soft	12 to 25	2 to 4
Firm	25 to 50	4 to 8
Stiff	50 to 100	8 to 15
Very Stiff	100 to 200	15 to 30
Hard	> 200	> 30

1. SPT 'N' in accordance with ASTM D1586, uncorrected for overburden pressure effects; approximate only.
2. SPT 'N' values should be considered ONLY an approximate guide to consistency; for sensitive clays (e.g., Champlain Sea clays), the N-value approximation for consistency terms does NOT apply. Rely on direct measurement of undrained shear strength or other manual observations.

Field Moisture Condition

Term	Description
Dry	Soil flows freely through fingers.
Moist	Soils are darker than in the dry condition and may feel cool.
Wet	As moist, but with free water forming on hands when handled.

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
υ	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

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

(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 = $(w_l - w_p)$
NP	non-plastic
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 δ
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

Notes: 1 $\tau = c' + \sigma' \tan \phi'$
2 shear strength = (compressive strength)/2

GOLDER
MEMBER OF WSP

RECORD OF BOREHOLE No OHS-4

SHEET 1 OF 1

METRIC

PROJECT 1786302
G.W.P. 2130-01-00
DIST Central HWY 401
DATUM Geodetic

LOCATION N 4847387.6; E 316637.2 MTM NAD 83 ZONE 10 (LAT. 43.766361; LONG. -79.352980)
BOREHOLE TYPE CME 75, 213 mm O.D. Hollow Stem Augers (Auto Hammer)
DATE May 19, 2021

ORIGINATED BY AM
COMPILED BY SK
CHECKED BY CN

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa: ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × REMOULDED (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (10 20 30)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
138.1	GROUND SURFACE						138				
0.0	ASPHALT (75 mm)										
	CONCRETE (225 mm)										
0.3	SILTY SAND (SM), some gravel (FILL)		1	AS	-						
137.3											
0.8	Brown Moist		2	SS	26		137				
	Sandy CLAYEY SILT (CL) to CLAYEY SILT-SILT (CL-ML) and sand to Sandy SILT (ML), trace gravel (FILL) Soft to hard Brown Moist		3	SS	18				○ ⊢⊣		2 36 46 16
			4	SS	14		136				
			5	SS	33		135		○ ⊢		7 35 47 11
			6	SS	10		134				
			7	SS	17		133		○		
			8	SS	18		132		○⊢⊣		2 35 40 23
	- 0.1 m silty sand seam at a depth of 7.9 m (Elev. 130.2 m) - contains organics below a depth of 8.0 m (Elev. 130.1 m)		9A 9B 9C	SS	2		131				
129.7							130				
8.4	Sandy CLAYEY SILT (CL) Firm Brown to grey Moist		10	SS	8		129		○		
127.9							128				
10.2	Sandy SILT (ML) Loose Grey Moist		11	SS	5		127		○		
126.8											
11.3	END OF BOREHOLE										

NOTES:

1. Borehole dry upon completion of drilling.

2. Borehole caved to a depth of 9.9 m (Elev. 128.2 m) upon completion of drilling.

$+^3$, $\times^3$: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

GTA-MTO 001 S:\CLIENTS\MTO\HWY_401_LESLIE_STREET\02_DATA\GINT\HWY_401_LESLIE_STREET.GPJ GAL-GTA.GDT 9/21/21

RECORD OF BOREHOLE No OHS-6

SHEET 1 OF 1

METRIC

PROJECT 1786302

G.W.P. 2130-01-00 LOCATION N 4847660.2; E 320127.5 MTM NAD 83 ZONE 10 (LAT. 43.768752; LONG. -79.309621) ORIGINATED BY AM

DIST Central HWY 401 BOREHOLE TYPE CME 75, 213 mm O.D. Hollow Stem Augers (Auto Hammer) COMPILED BY SK

DATUM Geodetic DATE May 16, 2021 CHECKED BY CN

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (20 40 60 80 100): ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × REMOULDED	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (10 20 30)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
176.7	GROUND SURFACE										
0.0	ASPHALT (140 mm)										
0.1	SILTY SAND (SM), some gravel (FILL) Brown Moist		1	AS	-						
175.9							176				
0.8	Sandy CLAYEY SILT (CL) Stiff to very stiff Brown Moist		2	SS	11						
			3	SS	29		175				
174.5											
2.2	SILT (ML) and sand, trace gravel Dense to very dense Brown Moist		4	SS	38		174				4 38 45 13
			5	SS	50/0.10						
			6	SS	100/0.08		173				
			7	SS	100/0.08		172				
171.8											
5.0	Sandy CLAYEY SILT-SILT (CL-ML), trace to some gravel Stiff to hard Brown Moist		8	SS	85		171				13 31 43 13
			9	SS	38		170				
			10	SS	14		169				5 33 45 17
			11	SS	22		168				
167.0							167				
9.8	END OF BOREHOLE										

NOTES:

1. Borehole dry upon completion of drilling.

2. Borehole caved to a depth of 7.9 m (Elev. 168.8 m) upon completion of drilling.

$+^3, \times^3$: Numbers refer to Sensitivity

$\circ^{3\%}$ STRAIN AT FAILURE

RECORD OF BOREHOLE No OHS-7

SHEET 1 OF 1

METRIC

PROJECT 1786302

G.W.P. 2130-01-00

LOCATION N 4847779.1; E 320511.1 MTM NAD 83 ZONE 10 (LAT. 43.769813; LONG. -79.304853)

ORIGINATED BY AM

DIST Central HWY 401

BOREHOLE TYPE CME 75, 213 mm O.D. Hollow Stem Augers (Auto Hammer)

COMPILED BY SK

DATUM Geodetic

DATE May 20 and 21, 2021

CHECKED BY CN

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa: ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × REMOULDED (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (10 20 30)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
179.8	GROUND SURFACE										
0.0	ASPHALT (75 mm)										
	CONCRETE (240 mm)										
0.3	SILTY SAND (SM), some gravel (FILL)		1	AS	-						
179.0											
0.8	Brown Moist		2	SS	13		179				
	CLAYEY SILT-SILT (CL-ML/ML) and Sand, trace gravel (FILL) Stiff to hard										
177.9	Brown		3A	SS	53		178		o—⊣		2 40 45 13
1.9	Moist		3B								
	SILT (ML/SM) and sand to SILTY SAND (SM), trace gravel Dense to very dense Brown Moist		4	SS	63				o		
			5	SS	52		177				
			6	SS	62		176		o		1 78 18 3
			7	SS	47		175				
							174				
			8	SS	62						
							173				
			9	SS	177/0.13		172		o		5 45 42 8
							171				
			10	SS	100/0.08						
170.1											
9.8	END OF BOREHOLE										

NOTES:

1. Borehole dry upon completion of drilling.

2. Borehole caved to a depth of 8.1 m (Elev. 171.7 m) upon completion of drilling.

$+^3, \times^3$: Numbers refer to Sensitivity

$\circ^{3\%}$ STRAIN AT FAILURE

GTA-MTO 001 S:\CLIENTS\MTO\HWY_401_LESLIE_STREET\02_DATA\GINT\HWY_401_LESLIE_STREET.GPJ GAL-GTA.GDT 9/21/21

GOLDER
MEMBER OF WSP

RECORD OF BOREHOLE No OHS-9

SHEET 1 OF 1

METRIC

PROJECT 1786302

G.W.P. 2130-01-00

LOCATION N 4847189.8; E 315942.4 MTM NAD 83 ZONE 10 (LAT. 43.764592; LONG. -79.361614)

ORIGINATED BY AM

DIST Central HWY 401

BOREHOLE TYPE CME 75, 213 mm O.D. Hollow Stem Augers (Auto Hammer)

COMPILED BY SK

DATUM Geodetic

DATE May 18 and 19, 2021

CHECKED BY CN

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa: ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × REMOULDED 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) 10 20 30	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
139.2	GROUND SURFACE										
0.0	SILTY SAND (SM), trace to some gravel (FILL) Compact to dense Brown Moist		1	AS	-		139				
			2	SS	35		138		○		
			3	SS	17				○		
137.0							137				
2.2	SILT (ML) to SILT (ML/SM) and sand, trace sand Very loose to compact Brown Moist to wet		4	SS	13						
			5	SS	18		136		○		0 48 50 2
			6	SS	24		135				
			7	SS	24						
							134				
			8	SS	17		133		○		0 3 79 18
							132				
			9	SS	2						
130.5							131				
8.7	CLAYEY SILT (CL), some sand, trace gravel Very soft Grey Wet		10	SS	1		130				
							129	+ 2.6			
			11	SS	1		128		⊢⊣		2 17 47 33
							127				
126.4			12	SS	WH						
12.8	END OF BOREHOLE										

NOTES:

1. Borehole dry upon completion of drilling.

2. Borehole caved to a depth of 4.7 m (Elev. 134.5 m) upon completion of drilling.

+ 3, × 3: Numbers refer to Sensitivity

○ 3% STRAIN AT FAILURE

GTA-MTO 001 S:\CLIENTS\MTO\HWY_401_LESLIE_STREET\02_DATA\GINT\HWY_401_LESLIE_STREET.GPJ GAL-GTA.GDT 9/21/21

GOLDER
MEMBER OF WSP

RECORD OF BOREHOLE No N/E RE-1

SHEET 1 OF 1

METRIC

PROJECT 1786302

G.W.P. 2130-01-00

LOCATION N 4847230.8; E 315852.2 MTM NAD 83 ZONE 10 (LAT. 43.764962; LONG. -79.362732)

ORIGINATED BY DH

DIST Central HWY 401

BOREHOLE TYPE Power Auger; 70 mm I.D., 150 mm O.D. Hollow Stem Augers

COMPILED BY RM

DATUM Geodetic

DATE June 18, 2019

CHECKED BY DH

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa: ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × REMOULDED (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (10 20 30)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
139.7	GROUND SURFACE										
0.0	TOPSOIL (130 mm)										
0.1	SAND (SP), trace to some fines, trace gravel, containing rootlets (FILL) Loose to compact Brown Moist		1	SS	19		139				
			2	SS	8						
			3	SS	4		138				
			4	SS	10		137				
136.7											
3.0	SILT (ML) to SAND (SP-SM), trace sand Very loose to compact Brown Wet		5	SS	9	▽	136				0 92 8 0
			6	SS	6		135				
	- grey below a depth of 5.6 m (Elev. 134.1 m)						134				
			7	SS	10		133				0 5 90 5
			8	SS	3		132				
131.0											
8.7	SILTY CLAY (CI) to CLAYEY SILT (CL), trace sand, trace gravel Firm Grey Wet		9	SS	3		131				3 10 34 53
							130	+ 2.0			
			10	SS	WH		129				
128.0							128	+ 3.0			
11.7	END OF BOREHOLE										

NOTES:

1. Groundwater level measured inside augers at a depth of 4.5 m below ground surface (Elev. 135.2 m) upon completion of drilling.

2. Borehole caved to a depth of 3.4 m below ground surface (Elev. 136.3 m) upon removal of augers.

$+^{3}, \times^{3}$: Numbers refer to Sensitivity

$\circ^{3\%}$ STRAIN AT FAILURE

GTA-MTO 001 S:\CLIENTS\MTO\HWY_401_LESLIE_STREET\02_DATA\GINT\HWY_401_LESLIE_STREET.GPJ GAL-GTA.GDT 9/21/21

PROJECT

Highway 401 Eastbound Collector Lanes, Avenue Road to Warden Avenue, Toronto, Ontario

TITLE

PAVEMENT CORE PHOTOGRAPH
BOREHOLE OHS-6
0 mm to 140 mm

GOLDER
MEMBER OF WSP

PROJECT No. 1786302			FILE No.	----	
DESIGN	AT	20210802	SCALE	NTS	VER. 1.
CADD	--	--			
CHECK	KN	20210809	**FIGURE B1**		
REVIEW	CN	20210809			

REVISION DATE: 20210802 BY: AT Project: 1786302

PROJECT

Highway 401 Eastbound Collector Lanes, Avenue Road to Warden Avenue, Toronto, Ontario

TITLE

PAVEMENT CORE PHOTOGRAPH
BOREHOLE OHS-7
0 mm to 315 mm

GOLDER
MEMBER OF WSP

PROJECT No. 1786302			FILE No. ----		
DESIGN	AT	20210802	SCALE	NTS	VER. 1.
CADD	--	--			
CHECK	KN	20210809	**FIGURE B2**		
REVIEW	CN	20210809			

REVISION DATE: 20210802 BY: AT Project: 1786302

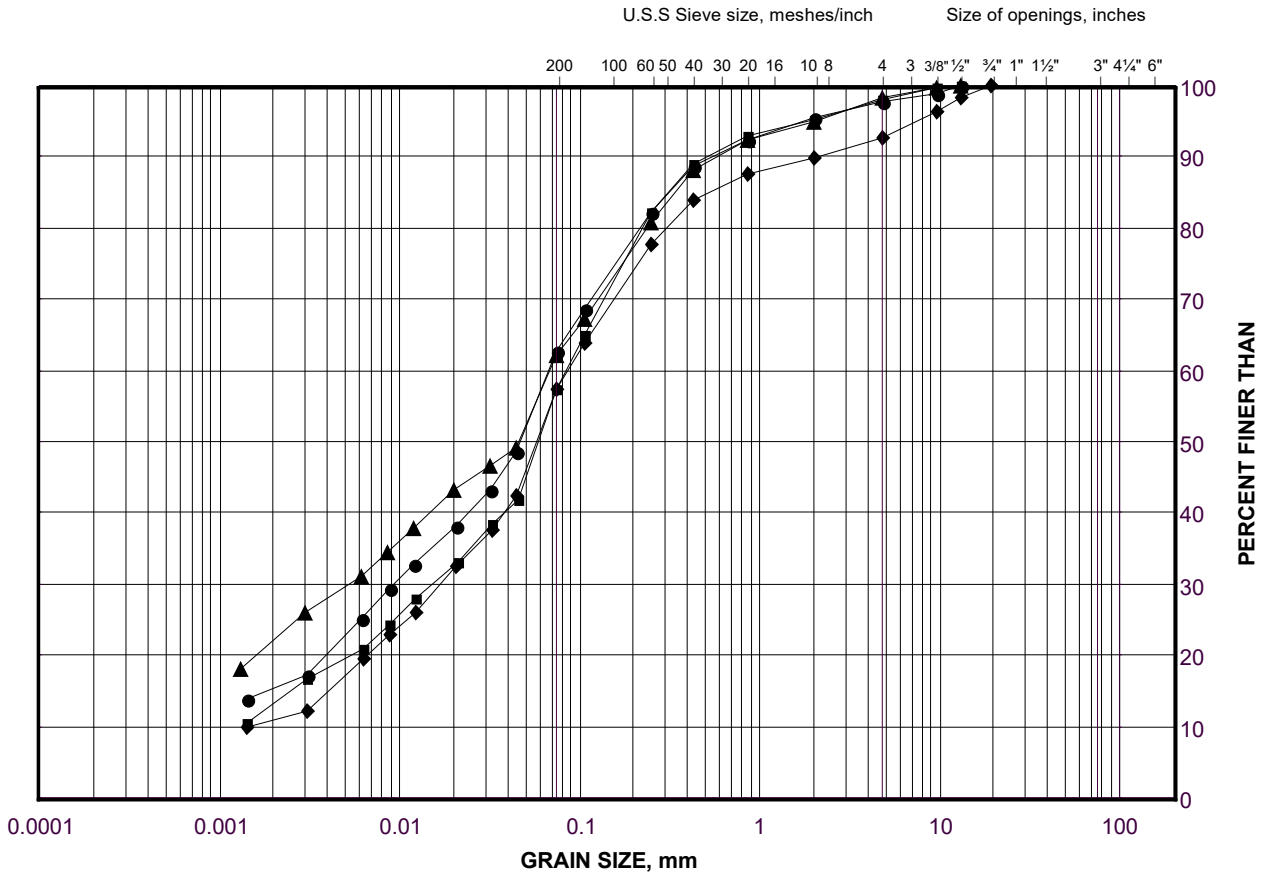
APPENDIX C

Laboratory Test Results

GRAIN SIZE DISTRIBUTION

Sandy CLAYEY SILT (CL) to CLAYEY SILT-SILT (CL-ML/ML) and Sand to Sandy SILT (ML) (FILL)

FIGURE C1



LEGEND

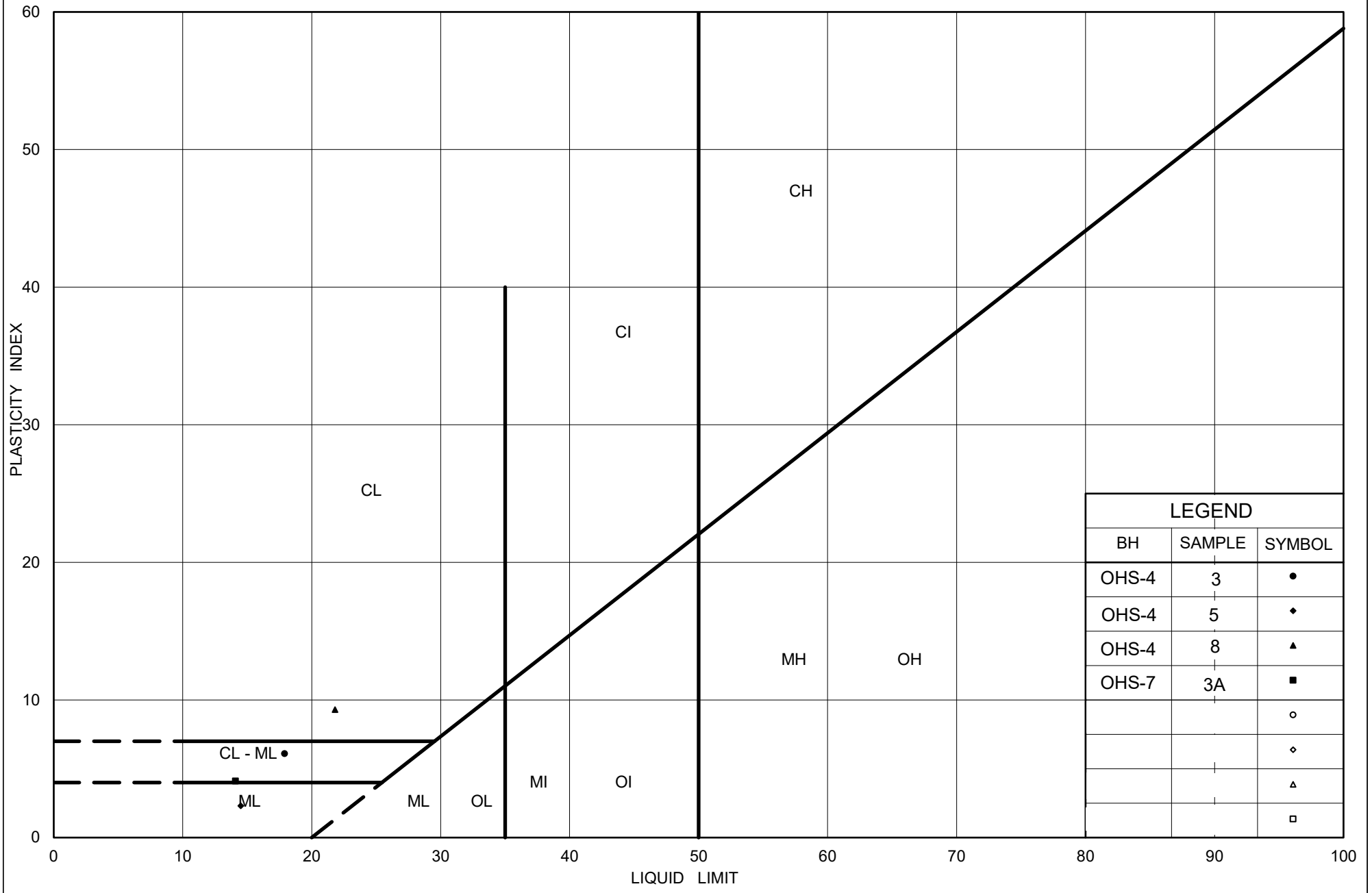
SYMBOL	Borehole	SAMPLE	ELEVATION(m)
●	OHS-4	3	136.3
■	OHS-7	3A	178.1
◆	OHS-4	5	134.8
▲	OHS-4	8	131.7

Project Number: 1786302

Checked By: CN

Golder Associates

Date: 05-Aug-21



Ministry of Transportation

Ontario

PLASTICITY CHART

Sandy CLAYEY SILT (CL) to CLAYEY SILT-SILT (CL-ML/ML) and Sand to Sandy SILT (ML) (FILL)

Figure No. C2

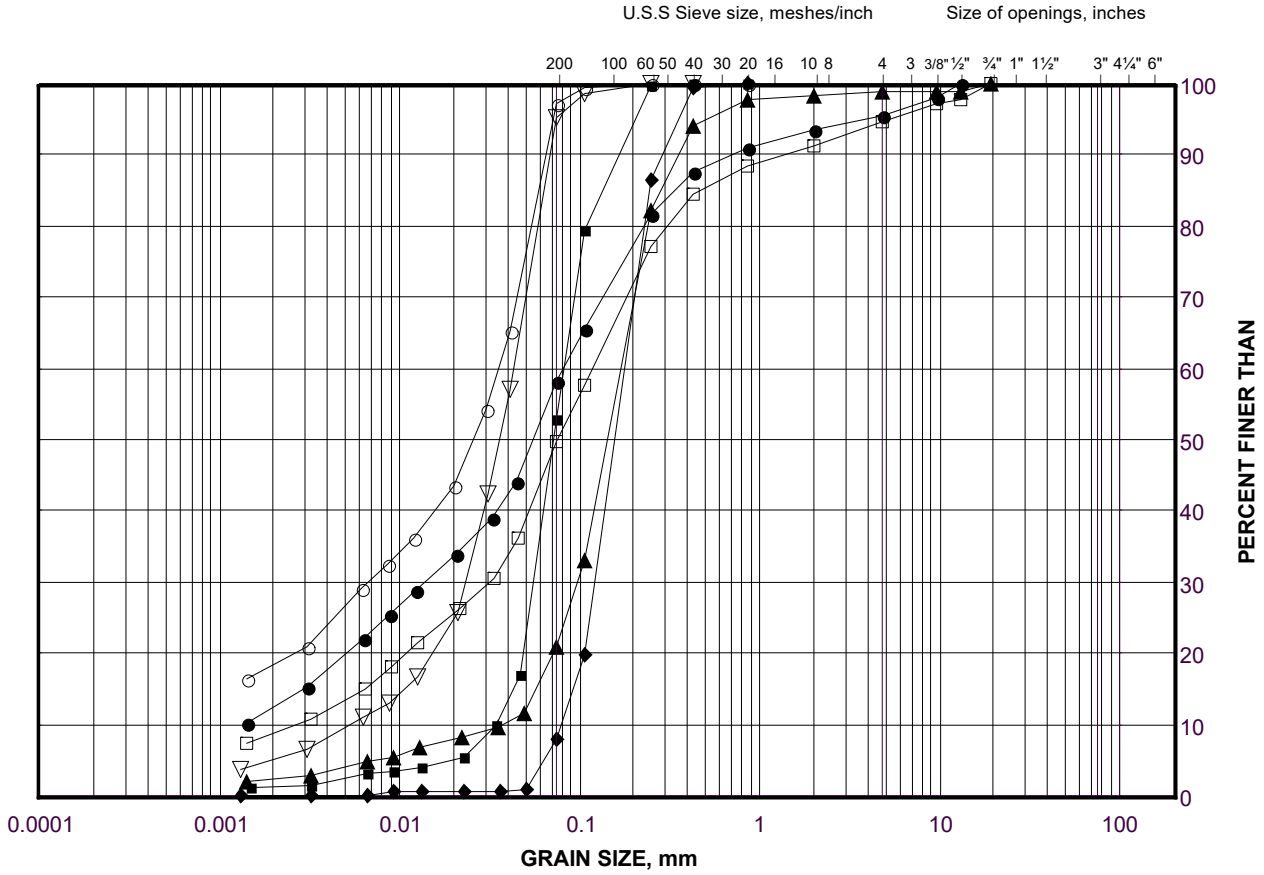
Project No. 1786302 (2500)

Checked By: CN

GRAIN SIZE DISTRIBUTION

SILT (ML) to SILT (ML/SM) and Sand to SILTY SAND (SM) to SAND (SP-SM)

FIGURE C3



LEGEND

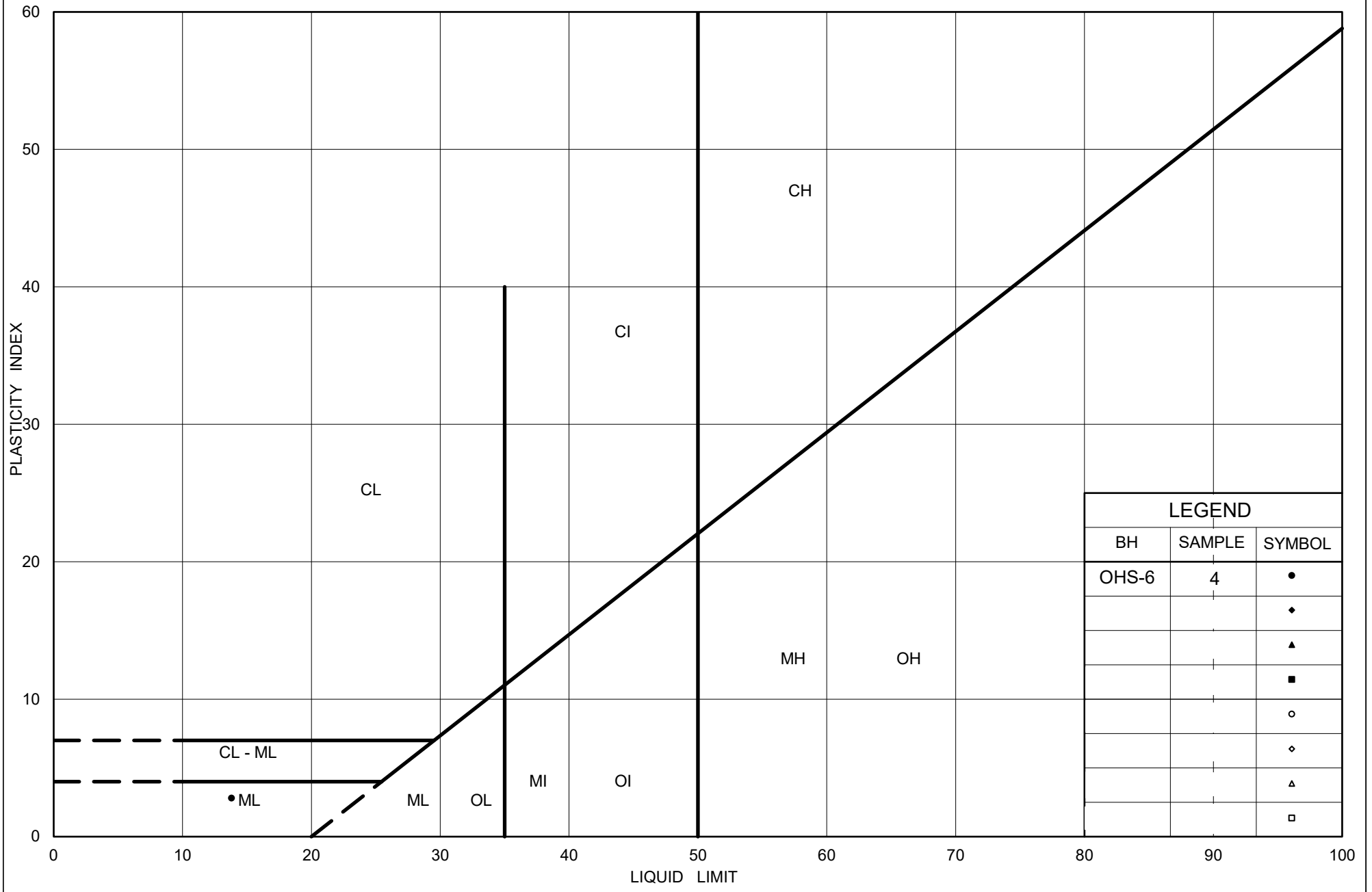
SYMBOL	Borehole	SAMPLE	ELEVATION(m)
●	OHS-6	4	174.1
■	OHS-9	5	135.9
◆	N/E RE-1	5	136.3
▲	OHS-7	6	175.7
▽	N/E RE-1	7	133.3
❍	OHS-9	8	132.8
□	OHS-7	9	171.9

Project Number: 1786302

Checked By: CN

Golder Associates

Date: 05-Aug-21



Ministry of Transportation

Ontario

PLASTICITY CHART

SILT (ML) and Sand

Figure No. C4

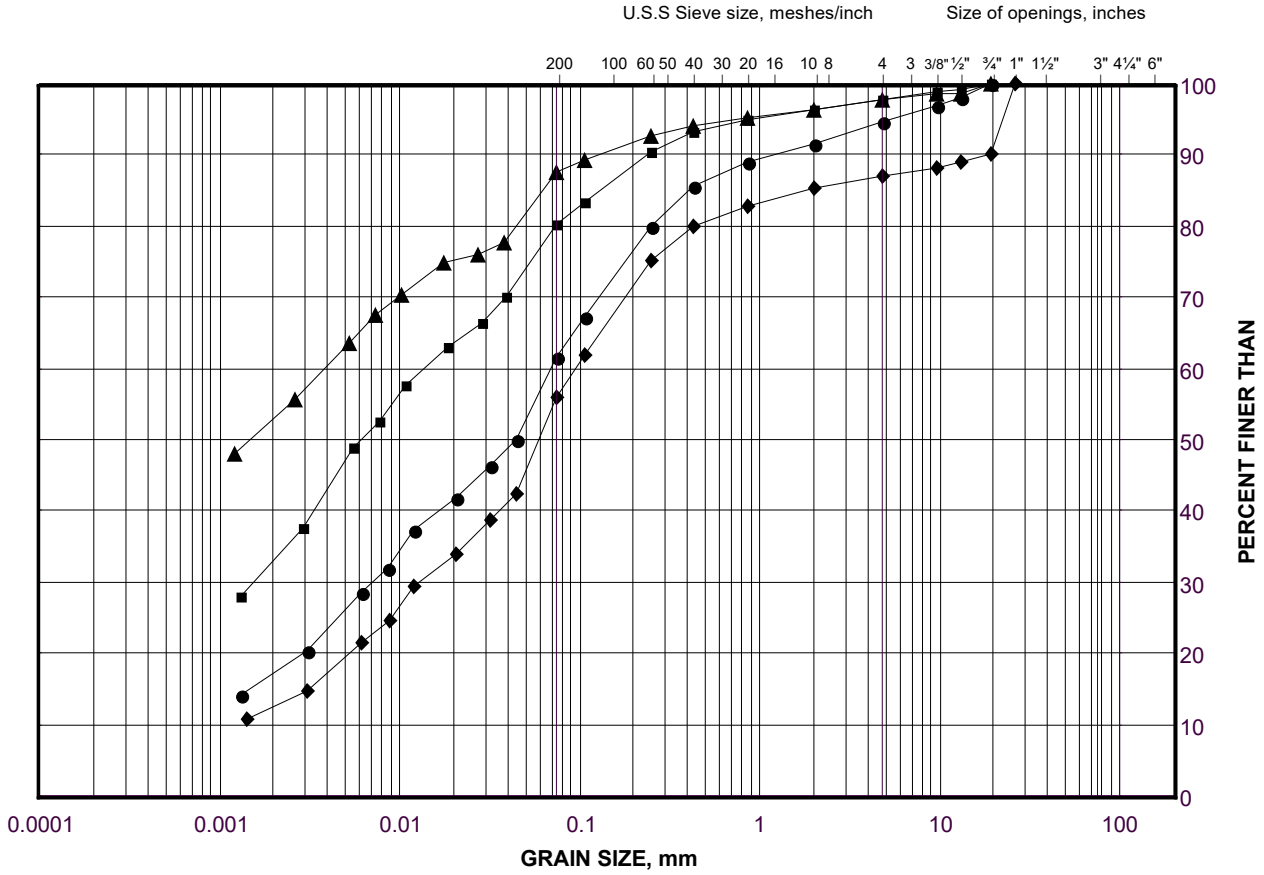
Project No. 1786302 (2500)

Checked By: CN

GRAIN SIZE DISTRIBUTION

SILTY CLAY (CI) to CLAYEY SILT (CL) to Sandy CLAYEY SILT-SILT (CL-ML)

FIGURE C5



LEGEND

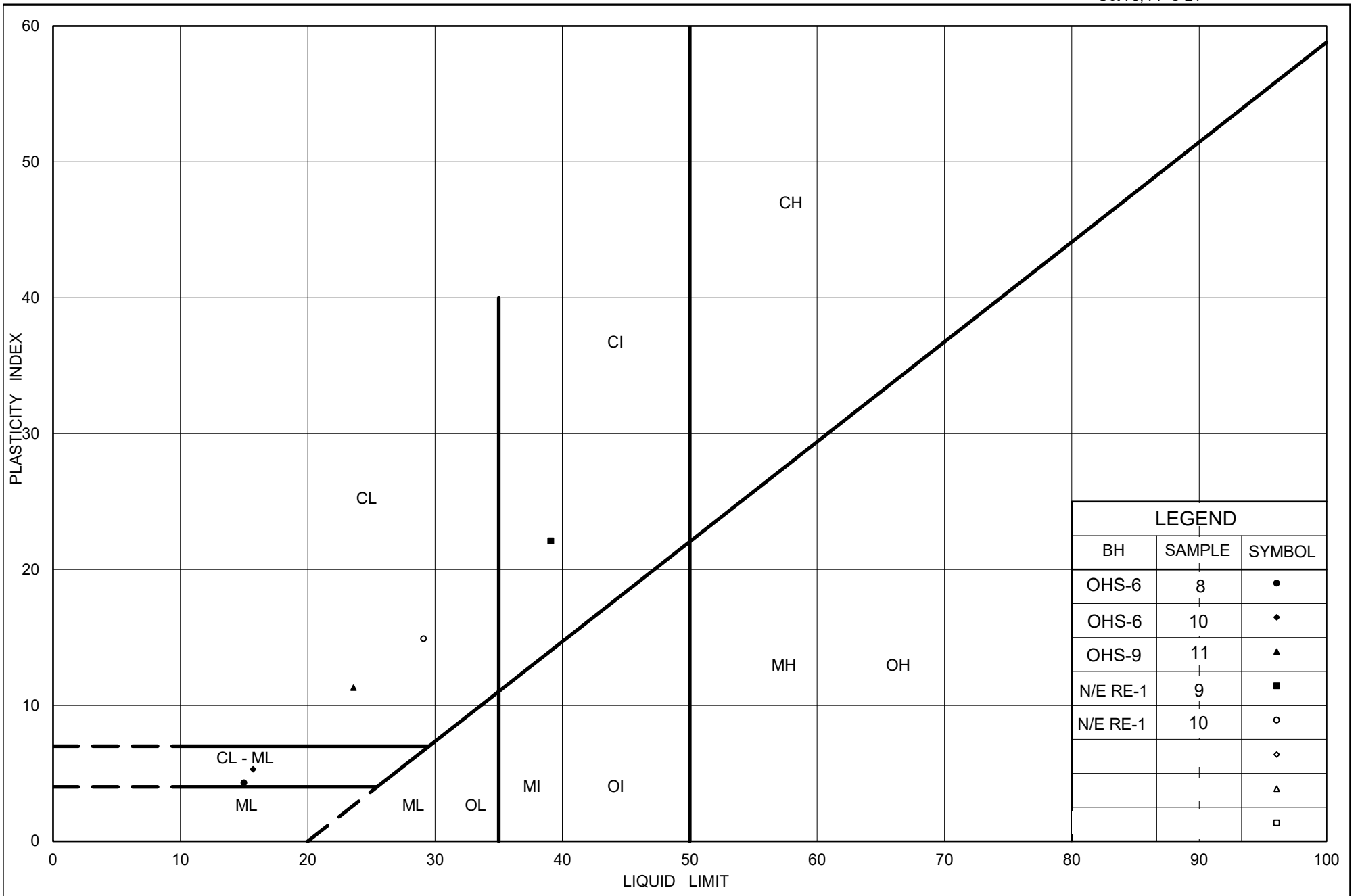
SYMBOL	Borehole	SAMPLE	ELEVATION(m)
●	OHS-6	10	170.3
■	OHS-9	11	128.2
◆	OHS-6	8	171.1
▲	N/E RE-1	9	130.2

Project Number: 1786302

Checked By: CN

Golder Associates

Date: 05-Aug-21



Ministry of Transportation

Ontario

PLASTICITY CHART

SILTY CLAY (CI) to CLAYEY SILT (CL) to Sandy CLAYEY SILT-SILT (CL-ML)

Figure No. C6

Project No. 1786302 (2500)

Checked By: CN

Your Project #: 1786302/2500/CR6
Site#: HWY 401/BAYVIEW
Site Location: HWY 401/BAYVIEW
Your C.O.C. #: na

Attention: Katelyn Nero

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

Report Date: 2021/06/09
Report #: R6668730
Version: 1 - Final

CERTIFICATE OF ANALYSIS

BV LABS JOB #: C1F1823
Received: 2021/06/03, 14:03

Sample Matrix: Soil
Samples Received: 4

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Analytical Method
Chloride (20:1 extract)	4	2021/06/08	2021/06/09	CAM SOP-00463	SM 23 4500-Cl E m
Conductivity	4	2021/06/08	2021/06/08	CAM SOP-00414	OMOE E3530 v1 m
pH CaCl2 EXTRACT	4	2021/06/08	2021/06/08	CAM SOP-00413	EPA 9045 D m
Resistivity of Soil	4	2021/06/03	2021/06/09	CAM SOP-00414	SM 23 2510 m
Sulphate (20:1 Extract)	4	2021/06/08	2021/06/09	CAM SOP-00464	EPA 375.4 m

Remarks:

Bureau Veritas is accredited to ISO/IEC 17025 for specific parameters on scopes of accreditation. Unless otherwise noted, procedures used by Bureau Veritas are based upon recognized Provincial, Federal or US method compendia such as CCME, MELCC, EPA, APHA.

All work recorded herein has been done in accordance with procedures and practices ordinarily exercised by professionals in Bureau Veritas' profession using accepted testing methodologies, quality assurance and quality control procedures (except where otherwise agreed by the client and Bureau Veritas 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. Where applicable, unless otherwise noted, Measurement Uncertainty has not been accounted for when stating conformity to the referenced standard.

Bureau Veritas liability is limited to the actual cost of the requested analyses, unless otherwise agreed in writing. There is no other warranty expressed or implied. Bureau Veritas 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 Bureau Veritas, unless otherwise agreed in writing. Bureau Veritas is not responsible for the accuracy or any data impacts, that result from the information provided by the customer or their agent.

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. When sampling is not conducted by Bureau Veritas, results relate to the supplied samples tested.

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 #: 1786302/2500/CR6
Site#: HWY 401/BAYVIEW
Site Location: HWY 401/BAYVIEW
Your C.O.C. #: na

Attention: Katelyn Nero

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

Report Date: 2021/06/09
Report #: R6668730
Version: 1 - Final

CERTIFICATE OF ANALYSIS

BV LABS JOB #: C1F1823
Received: 2021/06/03, 14:03

Encryption Key

Please direct all questions regarding this Certificate of Analysis to your Project Manager.
Ema Gitej, Senior Project Manager
Email: emese.gitej@bureauveritas.com
Phone# (905)817-5829
==========
This report has been generated and distributed using a secure automated process.
BV Labs has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per ISO/IEC 17025, signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

BV Labs Job #: C1F1823
Report Date: 2021/06/09

Golder Associates Ltd
Client Project #: 1786302/2500/CR6
Site Location: HWY 401/BAYVIEW
Sampler Initials: SK

SOIL CORROSIVITY PACKAGE (SOIL)

BV Labs ID		PSY950	PSY951			PSY951		
Sampling Date		2021/06/02	2021/06/02			2021/06/02		
COC Number		na	na			na		
	UNITS	OHS 4 SS2 2'6'-4'6'	OHS 6 SS2 2'6'-4'6'	RDL	QC Batch	OHS 6 SS2 2'6'-4'6' Lab-Dup	RDL	QC Batch
Calculated Parameters								
Resistivity	ohm-cm	710	1100		7388747			
Inorganics								
Soluble (20:1) Chloride (Cl-)	ug/g	760	380	20	7395160			
Conductivity	umho/cm	1410	897	2	7395714	907	2	7395714
Available (CaCl2) pH	pH	7.91	7.92		7394841			
Soluble (20:1) Sulphate (SO4)	ug/g	53	<20	20	7395222			

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Lab-Dup = Laboratory Initiated Duplicate

BV Labs ID		PSY952			PSY952			PSY953		
Sampling Date		2021/06/02			2021/06/02			2021/06/02		
COC Number		na			na			na		
	UNITS	OHS 7 SS4 7'6'-9'6'	RDL	QC Batch	OHS 7 SS4 7'6'-9'6' Lab-Dup	RDL	QC Batch	OHS9 SS3 5'-7'	RDL	QC Batch
Calculated Parameters										
Resistivity	ohm-cm	1200		7388747				3000		7388747
Inorganics										
Soluble (20:1) Chloride (Cl-)	ug/g	400	20	7395160	410	20	7395160	44	20	7395160
Conductivity	umho/cm	861	2	7395714				339	2	7395714
Available (CaCl2) pH	pH	8.08		7394841	8.09		7394841	7.87		7394841
Soluble (20:1) Sulphate (SO4)	ug/g	50	20	7395222				140	20	7395222

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Lab-Dup = Laboratory Initiated Duplicate

Bureau Veritas Laboratories 6740 Campobello Road, Mississauga, Ontario, L5N 2L8 Tel: (905) 817-5700 Toll-Free: 800-563-6266 Fax: (905) 817-5777 www.bvlabs.com

BV Labs Job #: C1F1823
Report Date: 2021/06/09

Golder Associates Ltd
Client Project #: 1786302/2500/CR6
Site Location: HWY 401/BAYVIEW
Sampler Initials: SK

TEST SUMMARY

BV Labs ID: PSY950
Sample ID: OHS 4 SS2 2'6'-4'6'
Matrix: Soil

Collected: 2021/06/02
Shipped:
Received: 2021/06/03

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride (20:1 extract)	KONE/EC	7395160	2021/06/08	2021/06/09	Alina Dobreanu
Conductivity	AT	7395714	2021/06/08	2021/06/08	Khushbu Vijay kumar Patel
pH CaCl2 EXTRACT	AT	7394841	2021/06/08	2021/06/08	Surinder Rai
Resistivity of Soil		7388747	2021/06/09	2021/06/09	Automated Statchk
Sulphate (20:1 Extract)	KONE/EC	7395222	2021/06/08	2021/06/09	Alina Dobreanu

BV Labs ID: PSY951
Sample ID: OHS 6 SS2 2'6'-4'6'
Matrix: Soil

Collected: 2021/06/02
Shipped:
Received: 2021/06/03

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride (20:1 extract)	KONE/EC	7395160	2021/06/08	2021/06/09	Alina Dobreanu
Conductivity	AT	7395714	2021/06/08	2021/06/08	Khushbu Vijay kumar Patel
pH CaCl2 EXTRACT	AT	7394841	2021/06/08	2021/06/08	Surinder Rai
Resistivity of Soil		7388747	2021/06/09	2021/06/09	Automated Statchk
Sulphate (20:1 Extract)	KONE/EC	7395222	2021/06/08	2021/06/09	Alina Dobreanu

BV Labs ID: PSY951 Dup
Sample ID: OHS 6 SS2 2'6'-4'6'
Matrix: Soil

Collected: 2021/06/02
Shipped:
Received: 2021/06/03

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Conductivity	AT	7395714	2021/06/08	2021/06/08	Khushbu Vijay kumar Patel

BV Labs ID: PSY952
Sample ID: OHS 7 SS4 7'6'-9'6'
Matrix: Soil

Collected: 2021/06/02
Shipped:
Received: 2021/06/03

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride (20:1 extract)	KONE/EC	7395160	2021/06/08	2021/06/09	Alina Dobreanu
Conductivity	AT	7395714	2021/06/08	2021/06/08	Khushbu Vijay kumar Patel
pH CaCl2 EXTRACT	AT	7394841	2021/06/08	2021/06/08	Surinder Rai
Resistivity of Soil		7388747	2021/06/09	2021/06/09	Automated Statchk
Sulphate (20:1 Extract)	KONE/EC	7395222	2021/06/08	2021/06/09	Alina Dobreanu

BV Labs ID: PSY952 Dup
Sample ID: OHS 7 SS4 7'6'-9'6'
Matrix: Soil

Collected: 2021/06/02
Shipped:
Received: 2021/06/03

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride (20:1 extract)	KONE/EC	7395160	2021/06/08	2021/06/09	Alina Dobreanu
pH CaCl2 EXTRACT	AT	7394841	2021/06/08	2021/06/08	Surinder Rai

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BV Labs Job #: C1F1823
Report Date: 2021/06/09

Golder Associates Ltd
Client Project #: 1786302/2500/CR6
Site Location: HWY 401/BAYVIEW
Sampler Initials: SK

TEST SUMMARY

BV Labs ID: PSY953
Sample ID: OHS9 SS3 5'-7'
Matrix: Soil

Collected: 2021/06/02
Shipped:
Received: 2021/06/03

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride (20:1 extract)	KONE/EC	7395160	2021/06/08	2021/06/09	Alina Dobreanu
Conductivity	AT	7395714	2021/06/08	2021/06/08	Khushbu Vijay kumar Patel
pH CaCl2 EXTRACT	AT	7394841	2021/06/08	2021/06/08	Surinder Rai
Resistivity of Soil		7388747	2021/06/09	2021/06/09	Automated Statchk
Sulphate (20:1 Extract)	KONE/EC	7395222	2021/06/08	2021/06/09	Alina Dobreanu

Bureau Veritas Laboratories 6740 Campobello Road, Mississauga, Ontario, L5N 2L8 Tel: (905) 817-5700 Toll-Free: 800-563-6266 Fax: (905) 817-5777 www.bvlabs.com

BV Labs Job #: C1F1823
Report Date: 2021/06/09

Golder Associates Ltd
Client Project #: 1786302/2500/CR6
Site Location: HWY 401/BAYVIEW
Sampler Initials: SK

GENERAL COMMENTS

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

Package 1	4.7°C

Results relate only to the items tested.

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BV Labs Job #: C1F1823
Report Date: 2021/06/09

QUALITY ASSURANCE REPORT

Golder Associates Ltd
Client Project #: 1786302/2500/CR6
Site Location: HWY 401/BAYVIEW
Sampler Initials: SK

			Matrix Spike		SPIKED BLANK		Method Blank		RPD	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits
7394841	Available (CaCl2) pH	2021/06/08			99	97 - 103			0.14	N/A
7395160	Soluble (20:1) Chloride (Cl-)	2021/06/09	NC	70 - 130	103	70 - 130	<20	ug/g	1.5	35
7395222	Soluble (20:1) Sulphate (SO4)	2021/06/09	NC	70 - 130	108	70 - 130	<20	ug/g	1.7	35
7395714	Conductivity	2021/06/08			99	90 - 110	<2	umho/cm	1.1	10

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 spike amount was too small to permit a reliable recovery calculation (matrix spike concentration was less than the native sample concentration)

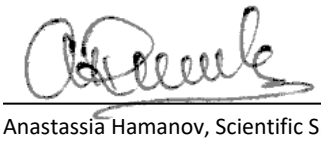
Bureau Veritas Laboratories 6740 Campobello Road, Mississauga, Ontario, L5N 2L8 Tel: (905) 817-5700 Toll-Free: 800-563-6266 Fax: (905) 817-5777 www.bvlabs.com

BV Labs Job #: C1F1823
Report Date: 2021/06/09

Golder Associates Ltd
Client Project #: 1786302/2500/CR6
Site Location: HWY 401/BAYVIEW
Sampler Initials: SK

VALIDATION SIGNATURE PAGE

The analytical data and all QC contained in this report were reviewed and validated by:



Anastassia Hamanov, Scientific Specialist

BV Labs has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per ISO/IEC 17025, signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

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BUREAU VERITAS

6740 Campobello Road, Mississauga, Ontario L5N 2L8
Phone: 905-817-5700 Fax: 905-817-5779 Toll Free: 800-563-6266
CAM FCD-01191/6

WORK ORDER

CHAIN OF CUSTODY RECORD

Invoice Information	Report Information (if differs from invoice)	Project Information (where applicable)	Turnaround Time (TAT) Required
Company Name: Golder Associates Ltd	Company Name: Golder Associates	Quotation #: B80683	[X] Regular TAT (5-7 days) Most analyses
Contact Name: Accounts Payble	Contact Name: Shantanu Kar / Katelyn Nero	P.O. #/ AFE#:	PLEASE PROVIDE ADVANCE NOTICE FOR RUSH PROJECTS
Address: 6925 Century Ave, Suite 100 Mississauga, ON, L5N 7K2	Address:	Project #: 1786302/2500/CR6	Rush TAT (Surcharges will be applied) [ ] 1 Day [ ] 2 Days [ ] 3-4 Days
Phone: 905 567 4444 Fax:	Phone: Fax:	Site Location:	
Email: AP_CustomerService@golder.com	Email: shantanu_kar@golder.com / knero@golder.com	Site #: HWY 401/Bayview	Date Required:
MOE REGULATED DRINKING WATER OR WATER INTENDED FOR HUMAN CONSUMPTION MUST BE SUBMITTED ON THE BUREAU VERITAS LABORATORIES' DRINKING WATER CHAIN OF CUSTODY		Site Location Province:	Rush Confirmation #:
		Sampled By: SK	

Regulation 153	Other Regulations
[ ] Table 1 [ ] Res/Park [ ] Med/ Fine	[ ] CCME [ ] Sanitary Sewer Bylaw
[ ] Table 2 [ ] Ind/Comm [ ] Coarse	[ ] MISA [ ] Storm Sewer Bylaw
[ ] Table 3 [ ] Agri/ Other	[ ] PWQO Region
[ ] Table ____	[ ] Other (Specify)
FOR RSC (PLEASE CIRCLE) Y / N	[ ] REG 558 (MIN. 3 DAY TAT REQUIRED)
	[ ] REG 406 Table

Include Criteria on Certificate of Analysis: Y / N

SAMPLES MUST BE KEPT COOL (< 10 °C) FROM TIME OF SAMPLING UNTIL DELIVERY TO BUREAU VERITAS

	SAMPLE IDENTIFICATION	DATE SAMPLED (YYYY/MM/DD)	TIME SAMPLED (HH:MM)	MATRIX	# OF CONTAINERS SUBMITTED	FIELD FILTERED (CIRCLE) Metals / Hg / CrVI	BTEX/ PHC F1	PHCs F2 - F4	VOCs	REG 153 METALS & INORGANICS	REG 153 ICPMS METALS	Corrosivity Pkg (Cl, SO4, EC, resistivity, pH)	HOLD- DO NOT ANALYZE
1	OHS 4 SS2 2'6" - 4'6"	2021-06-02	PM	SOIL	1							X	
2	OHS 6 SS2 2'6" - 4'6"	2021-06-02	PM	SOIL	1							X	
3	OHS 7 SS4 7'6" - 9'6"	2021-06-02	PM	SOIL	1							X	
4	OHS9 SS3 5' - 7'	2021-06-02	PM	SOIL	1							X	
5													
6													
7													
8													
9													
10													

LABORATORY USE ONLY

CUSTODY SEAL Y / N		COOLER TEMPERATURES
Present	Intact	
		3/6/5

COOLING MEDIA PRESENT: Y / N

COMMENTS

03-Jun-21 14:03
Ema Gitej
C1F1823
DSG ENV-1432

RELINQUISHED BY: (Signature/Print)	DATE: (YYYY/MM/DD)	TIME: (HH:MM)	RECEIVED BY: (Signature/Print)	DATE: (YYYY/MM/DD)	TIME: (HH:MM)	BV JOB #
ANKAREN MAHWSWARAN	2021-06-03			2021/06/03	14:03	

APPENDIX D

Non-Standard Special Provisions

FOOTINGS FOR OVERHEAD SIGNS – Item No.

Special Provision

SCOPE

Where OPSS.PROV 903 is called upon by OPSS.PROV 915, OPSS.PROV 903 is amended by the following:

The Contractor shall construct the Sign Support Footings against undisturbed base and sides of excavations. The base of footing excavations shall be cleaned of loosened and/or softened materials prior to pouring concrete for the foundation. The construction methodology 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 the Sign Support Structure foundation locations. The Contractor shall assume that overburden has zones of non-cohesive soil below groundwater level. The Contractor is advised that non-cohesive soil is susceptible to disturbance under conditions of unbalanced hydrostatic head. The subsurface conditions at the foundation locations are provided elsewhere in the Contract Documents.

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.

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