

REPORT

Foundation Investigation Report

Two Overhead Sign Support Structures

Highway 400, Steeles Avenue West to Langstaff Road

City of Toronto and City of Vaughan, Ontario

GWP 2324-16-00

Submitted to:

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GEOCRES No.: 30M13-328

OS-1: Lat. 43.769674° Long. -79.533934°

OS-2: Lat. 43.774545° Long. -79.535243°

19115306

January 4, 2022

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Report R6912263

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1.0 INTRODUCTION

Golder Associates Ltd. (Golder) has been retained by Morrison Hershfield Limited (MH) on behalf of the Ministry of Transportation, Ontario (MTO) to provide foundation engineering services for the detail design of two overhead signs spanning across Highway 400 northbound lanes and associated off-ramp lanes.

The purpose of this investigation is to assess the subsurface conditions near the locations of the new sign supports by methods of borehole drilling, in-situ testing, and laboratory testing on selected soil samples.

This report summarizes the factual results of field and laboratory work (including field investigation procedures, borehole stratigraphy, and geotechnical and analytical laboratory test results) and provides a description of the interpreted soil and groundwater conditions near each overhead sign support.

2.0 PROJECT AND SITE DESCRIPTION

The orientation (i.e., north, south, east, west) stated in the text of the report is referenced to project north and therefore may differ from magnetic north shown on Drawing 1. For the purpose of this report, Highway 400, which extends between Toronto and Barrie, is considered to be oriented in a south-north direction with the proposed overhead signs perpendicular to the highway in a generally east-west direction.

2.1 Project Description

As part of the rehabilitation of the pavement on Highway 400 core and collector lanes between Steeles Avenue West and Langstaff Road, two existing overhead signs spanning across the Highway 400 northbound lanes and associated off-ramp lanes are proposed to be demolished and replaced with two new simply supported tri-chord overhead signs. The new overhead signs, designated as OS-1 and OS-2, are proposed to be located about 235 m north and about 370 m south of Steeles Avenue West, respectively. The western legs are proposed to be median mounted (i.e., mounted to the top of the median concrete jersey barriers), while the eastern legs are proposed to be ground mounted (i.e., mounted directly to the founding caissons).

2.2 Site Description

The site of the proposed overhead sign OS-1 is located about 370 m south of Steeles Avenue West in the northern limit of City of Toronto, Ontario. Highway 400 at the location of the proposed overhead sign consists of an approximately 4 m high earth fill embankment carrying six southbound lanes, four northbound lanes, and three off-ramp lanes associated with the Highway 400 to Highway 407 S-E/W Ramp. The travelled portion of the highway, including the shoulders, consists of an asphalt surface which is at approximately Elevation 190.5 m in the vicinity of the proposed overhead sign. The embankment side slopes are vegetated with grasses. The highway corridor is surrounded by commercial/industrial units.

The site of the proposed overhead sign OS-2 is located about 235 m north of Steeles Avenue West in the southern limit of City of Vaughan, Ontario. Highway 400 at the location of the proposed overhead sign consists of an approximately 7 m to 8 m high earth fill embankment carrying four southbound lanes, one on-ramp lane associated with the Steeles Avenue West E/W-S Ramp, four northbound lanes, and one off-ramp lane associated with the Highway 400 to Steeles Avenue West S-E/W Ramp. The travelled portion of the highway, including the shoulders, consists of an asphalt surface which is at approximately Elevation 194 m in the vicinity of the proposed overhead sign. While the existing ground surface outside of the Highway 400 corridor varies between approximately Elevation 187 m and Elevation 186 m. The embankment side slopes are vegetated with grasses. The highway

corridor is surrounded by open fields inside the loop ramps and commercial/industrial units. A railway corridor extends below the Highway 400 corridor approximately 200 m north of the proposed overhead sign OS-2.

3.0 INVESTIGATION PROCEDURES

The field work at the site was carried out on October 31 and November 1, 2021 during which time a total of two boreholes (designated as Boreholes OHS-1 and OHS-2) were advanced near the proposed overhead sign support structures.

The subsurface conditions encountered in the boreholes are shown in detail on the borehole records in Appendix A. List of abbreviations, terms, and symbols are also provided in Appendix A to assist in the interpretation of the borehole records. The locations of the as-drilled boreholes are shown in plan on Drawing 1.

The boreholes were advanced using a CME-75 truck-mounted drilling rig, supplied and operated by Geo-Environmental Drilling Inc. of Halton Hills, Ontario. The boreholes were advanced using 150 mm outer diameter hollow stem augers. Soil samples were generally obtained at 0.75 m and 1.5 m intervals of depth, using a 50 mm outer diameter split-spoon sampler driven by an automatic hammer in accordance with Standard Penetration Test (SPT) procedures (ASTM D1586, *Standard Test Method for Standard Penetration Test (SPT) and Split-Barrel Sampling of Soils*). The split-spoon sampler 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. A field vane shear test was carried out in the cohesive fill encountered in Borehole OHS-2 to assess the undrained shear strength (ASTM D2573, *Standard Test Method for Field Vane Shear Strength Test in Cohesive Soil*) using the MTO Standard 'N'-size vane.

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 of drilling in accordance with Ontario Regulation 903 (*Wells*), as amended. At the surface, the boreholes were backfilled with cold patch to reinstate the pavement.

Prior to commencement of the field work, Golder arranged for the clearance of underground utilities and services. The field work was observed on a full-time basis by a member of Golder's engineering staff, who monitored the borehole drilling, in-situ testing, and soil sampling operations, and logged the borehole in the field. The soil samples were transported to Golder's Mississauga geotechnical laboratory where the samples underwent further visual and tactile examination and geotechnical laboratory testing.

Geotechnical index testing (i.e., 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 B. All the soil laboratory tests were carried out to MTO Laboratory and/or ASTM Standards, as appropriate.

One soil sample from each borehole was also collected for corrosivity testing. The selected soil samples were submitted, under chain-of-custody procedures, to Bureau Veritas of Mississauga, Ontario (A Standards Council of Canada accredited laboratory) for analysis of corrosivity parameters including, pH, sulphate, sulphide, chloride, and resistivity/conductivity.

The as-drilled borehole locations (in plan) and corresponding ground surface elevations were established on-site by Golder personnel using a Trimble Geo7 GPS unit with a horizontal accuracy of +/- 1 cm to 2 cm and a vertical accuracy of +/- 2 cm to 4 cm. The borehole survey information including, northing/easting coordinates (presented

in the MTM NAD83 Zone 10 datum), latitude/longitude coordinates, corresponding ground surface elevations, and borehole depths, are provided on the borehole records in Appendix A and summarized below.

Borehole No.	Coordinates (MTM NAD83 Zone 10)		Ground Surface Elevation	Depth of Borehole
	Northing (Latitude)	Easting (Longitude)		
OHS-1	4,847,717.6 m (43.769421°)	302,077.7 m (-79.533817°)	190.4 m	8.1 m
OHS-2	4,848,311.9 m (43.774771°)	301,971.5 m (-79.535139°)	193.7 m	9.8 m

4.0 SITE GEOLOGY AND SUBSURFACE CONDITIONS

4.1 Regional Geology

The area surrounding the Highway 400 and Steeles Avenue West interchange is within the physiographic region known as the Peel Plain, as delineated in *The Physiography of Southern Ontario* (Chapman and Putnam, 1984).

The Peel Plain physiographic region covers the central portions of the Regional Municipalities of York, Peel and Halton. The general topography of this region consists of level to gently rolling terrain, sloping gradually southward toward Lake Ontario. A surficial till sheet, which generally follows the surface topography, is present throughout much of this area. The till typically consists of clayey silt to silty clay, with occasional sand to silt zones. Shallow, localized deposits of loose sand and silt and/or soft clay can overlie this uppermost till sheet, and these represent relatively recent deposits, formed in small glacial meltwater ponds scattered throughout the Peel Plain and concentrated near river valleys. The recent sand, silt and clay and uppermost till deposits in this area overlie and are interbedded with stratified deposits of sand, silt and clay.

4.2 Subsurface Conditions

The subsurface soil and groundwater conditions encountered in the boreholes advanced at the sites, together with the results of the in-situ and geotechnical/analytical laboratory testing, are presented on the borehole records in Appendix A and the laboratory figures/reports are presented in Appendices B and C.

The stratigraphic boundaries shown on the borehole records have been inferred from observations of drilling progress, generally non-continuous sampling and in-situ testing, and therefore represent transitions between soil types rather than exact planes of geologic change. Further, subsurface conditions will vary between and beyond the borehole locations.

In general, the subsurface soils encountered at both overhead sign sites consist of asphalt, underlain by granular fill which in turn is underlain by cohesive fill comprised of clayey silt-silt to clayey silt to silty clay with varying proportions of sand and gravel. The fill is then underlain by a cohesive glacial till deposit comprised of clayey silt-silt to clayey silt with varying proportions of sand and gravel. At one site, the cohesive glacial till deposit is underlain by (or transitions with depth into) a deposit of sandy silt till.

The subsurface soils encountered along the Highway 400 corridor between about 300 m north of Sheppard Avenue West and about 450 m north of Steeles Avenue West (at the CNR and Highway 400 site) are generally consistent with those encountered at the aforementioned overhead sign sites. Based on existing MTO GEOCRES information (GEOCRES Nos. 30M13-008, 30M13-010, 30M13-012, 30M13-058, 30M13-060, 30M13-079, 30M13-079, 30M13-080, 30M13-082, 30M13-087, and 30M14-479), the subsurface soils generally consist of cohesive fill (and/or granular fill in places) underlain by a cohesive glacial till deposit. In places, the cohesive glacial till deposit is underlain by or interlayered with a granular deposit typically comprised of sand, some silt.

A more detailed description of the subsurface conditions encountered in the boreholes advanced during the current field investigation is provided in the following sections.

4.2.1 Asphalt

An approximately 305 mm and 254 mm thick layer of asphalt was encountered at the ground surface in Boreholes OHS-1 and OHS-2, respectively, which were advanced on the shoulders of the off-ramps. The top of the asphalt layer was encountered at Elevation 190.4 m and Elevation 193.7 m at the respective borehole locations.

4.2.2 Gravelly SAND (SP) (FILL)

An approximately 1.2 m and 0.6 m thick layer of granular fill comprised of gravelly sand, trace fines was encountered below the asphalt in Boreholes OHS-1 and OHS-2, respectively. The top of the granular fill was encountered at a depth of about 0.3 m below ground surface corresponding to Elevation 190.1 m and Elevation 193.4 m in the respective boreholes. The granular fill extends to depths of about 1.5 m (Elevation 189.0 m) and 0.9 m (Elevation 192.8 m) below ground surface in Boreholes OHS-1 and OHS-2, respectively. Although there was no indication of abandoned underground infrastructure, construction debris, refuse, cobbles/boulders, or other obstructions within the fill, such obstructions may be expected in fills utilized to construct the Highway 400 corridor.

The SPT 'N'-values measured within the granular fill were 46 blows and 47 blows per 0.3 m of penetration, indicating a dense state of compactness.

The water contents measured on four samples recovered from the gravelly sand fill range between about 3% and 7%.

4.2.3 CLAYEY SILT-SILT (CL-ML) to CLAYEY SILT (CL) to SILTY CLAY (CI) (FILL)

An approximately 2.2 m to 6.3 m thick layer of cohesive fill was encountered below the gravelly sand fill in Boreholes OHS-1 and OHS-2, respectively. The cohesive fill consists of clayey silt-silt to clayey silt to silty clay to clayey silt, with varying proportions of sand and gravel. The cohesive fill was encountered at depths of about 1.5 m (Elevation 189.0 m) and 0.9 m (Elevation 192.8 m) below ground surface, and extends to depths of about 3.7 m (Elevation 186.7 m) and 7.2 m (Elevation 186.5 m) below ground surface in Boreholes OHS-1 and OHS-2, respectively. Although there was no indication of abandoned underground infrastructure, construction debris, refuse, cobbles/boulders, or other obstructions within the fill, such obstructions may be expected in fills utilized to construct the Highway 400 corridor.

The SPT 'N'-values measured within the cohesive fill range from 5 blows to 17 blows per 0.3 m of penetration, suggesting a firm to very stiff consistency. An in-situ vane test was carried out within the cohesive fill in Borehole OHS-2 (between samples with SPT 'N'-values of 5 and 7 blows per 0.3 m of penetration) measured an undrained shear strength greater than 96 kPa.

Grain size distribution testing was carried out on three samples of the cohesive fill, and the results are presented on Figure B1 in Appendix B. Atterberg limit testing was carried out on three samples of the cohesive fill. The tests measured liquid limits between about 27% and 30%, plastic limits between about 15% and 16%, and plasticity indices between about 12% and 14%. The results of these Atterberg limit tests are presented on Figure B2 in Appendix B, and indicate that the cohesive fill is classified as a clayey silt-silt to clayey silt of low plasticity to silty clay of intermediate plasticity. The water contents measured on samples of the cohesive fill generally range from about 8% to 21%. The water content measured on a sample of the silty clay fill recovered from Borehole OHS-2 is about 60%.

4.2.4 CLAYEY SILT-SILT (CL-ML) to CLAYEY SILT (CL) (TILL)

A cohesive glacial till deposit comprised of clayey silt-silt to clayey silt, some sand to sandy, trace gravel was encountered below the cohesive fill in Boreholes OHS-1 and OHS-2 at depths of about 3.7 m (Elevation 186.7 m) and 7.2 m (Elevation 186.5 m) below ground surface, respectively. In Borehole OHS-1, the cohesive till deposit is approximately 3.5 m thick and extends to a depth of about 7.2 m below ground surface corresponding to Elevation 183.2 m. Borehole OHS-2 was terminated within the cohesive till deposit at a depth of about 9.8 m below ground surface corresponding to Elevation 184.0 m. Although there was no indication of cobbles and/or boulders within the cohesive till deposit during drilling, glacial till deposits in southern Ontario typically contain such obstructions, which should be expected within such glacial deposits.

The SPT 'N'-values measured within the upper portion of the cohesive till deposit range from 8 blows to 18 blows per 0.3 m of penetration, indicating a stiff to very stiff consistency. A SPT 'N'-value measured at the bottom of the cohesive till deposit in Borehole OHS-1 was 93 blows per 0.3 m of penetration, suggesting a hard consistency.

Grain size distribution testing was carried out on two samples of the clayey silt-silt to clayey silt till deposit, and the results are presented on Figure B3 in Appendix B. Atterberg limit testing was also carried out on two samples of the cohesive till deposit. The tests measured liquid limits of about 17% and 21%, plastic limits of about 11% and 13%, and corresponding plasticity indices of about 5% and 8%. The Atterberg limit test results are presented on Figure B4 in Appendix B and indicate that the materials are clayey silt to clayey silt-silt to clayey silt of low plasticity. The water content measured on samples of the cohesive till deposit range between about 9% and 24%.

4.2.5 Sandy SILT (ML) (TILL)

A granular till deposit comprised of sandy silt of slight plasticity, trace gravel, was encountered below the cohesive till deposit in Borehole OHS-1. The deposit was encountered at a depth of about 7.2 m below ground surface corresponding to Elevation 183.2 m. The borehole was terminated within the sandy silt till deposit at a depth of about 8.1 m below ground surface corresponding to Elevation 182.3 m. Although there was no indication of cobbles and/or boulders within the sandy silt till deposit during drilling, glacial till deposits in southern Ontario typically contain such obstructions, which should be expected within such glacial deposits.

An SPT 'N'-value measured within the sandy silt till deposit was 101 blows per 0.3 m of penetration, indicating a very dense state of compactness.

Grain size distribution testing was carried out on a sample of the sandy silt till deposit, and the results are presented on Figure B5 in Appendix B. Atterberg limit testing was carried out on a sample of the fine-grained portion of the till deposit and the results are presented on Figure B6 in Appendix B. The Atterberg limit testing measured a liquid limit of about 15%, a plastic limit of about 13%, and a corresponding plasticity index of about 2%. The results indicate that the material is classified as a silt of slight plasticity. The water content measured on a sample of the sandy silt till deposit is about 15%.

4.3 Groundwater Conditions

In general, the soil samples recovered the boreholes were moist. The groundwater levels were measured in open boreholes upon completion of drilling operations. At the location of Borehole OHS-1, the borehole caved to a depth of about 6.7 m below ground surface (Elevation 183.7 m) upon completion of drilling and the groundwater level was observed at a depth of about 6.1 m below ground surface, corresponding to Elevation 184.3 m. At the location of Borehole OHS-2, the borehole caved to a depth of about 8.7 m below ground surface (Elevation 185.0 m) upon completion of drilling and the open borehole was dry above the caved depth. These water level measurements do not necessarily represent the stabilized groundwater conditions at the site. Based on the colour transition from brown to grey, it is anticipated that the groundwater level in the vicinity of Borehole OHS-1 is at approximately Elevation 186 m, while that in the vicinity of borehole OHS-2 is at approximately Elevation 184.5 m to 185 m.

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

4.4 Analytical Testing

Two soils samples, one from each borehole, were collected and submitted to Bureau Veritas in Mississauga, Ontario 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.	Average Approximate Sample Depth (Elevation) (m)	Soil Type	Parameters				
				Chloride (µg/g)	Sulphate (µg/g)	pH	Conductivity (µohm/cm)	Resistivity (ohm-cm)
OHS-1	6	4.1 (186.3)	Clayey Silt (Till)	1,100	87	7.68	1,980	510
OHS-2	5	3.4 (190.4)	Clayey Silt (Fill)	300	<20	7.77	671	1,500

Note:

1. The sulphate concentration measured on the soil sample recovered from Borehole OHS-2 is below the reportable detection limit of 20 µg/g.

The sulphide concentration measured on the soil samples recovered from Boreholes OHS-1 and OHS-2 was also analyzed and is 3.7 mg/kg.

5.0 CLOSURE

This Foundation Investigation Report was prepared by Mr. Bryan Lui, E.I.T., and reviewed by Mr. Tomasz Zalucki, P.Eng., a senior geotechnical engineer with Golder who is RAQS certified in the Foundations Engineering Category – Geotechnical (Structures and Embankments) – Low Complexity. Ms. Lisa Coyne, P.Eng., a Principal and MTO Foundations Designated Contact with Golder conducted an independent technical and quality review of this report.

Signature Page

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BL/TZ/LCC/bl/ml

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<https://golderassociates.sharepoint.com/sites/102477/deliverables/foundations/final fidr/19115306-rpt-rev0-hwy 400-overhead signs-fidr-20220104.docx>

REFERENCES

Canadian Standards Association (CSA). 2019. *Canadian Highway Bridge Design Code and Commentary on CAN/CSA S6-19*. CSA Special Publication, S6.1-19.

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.

ASTM International:

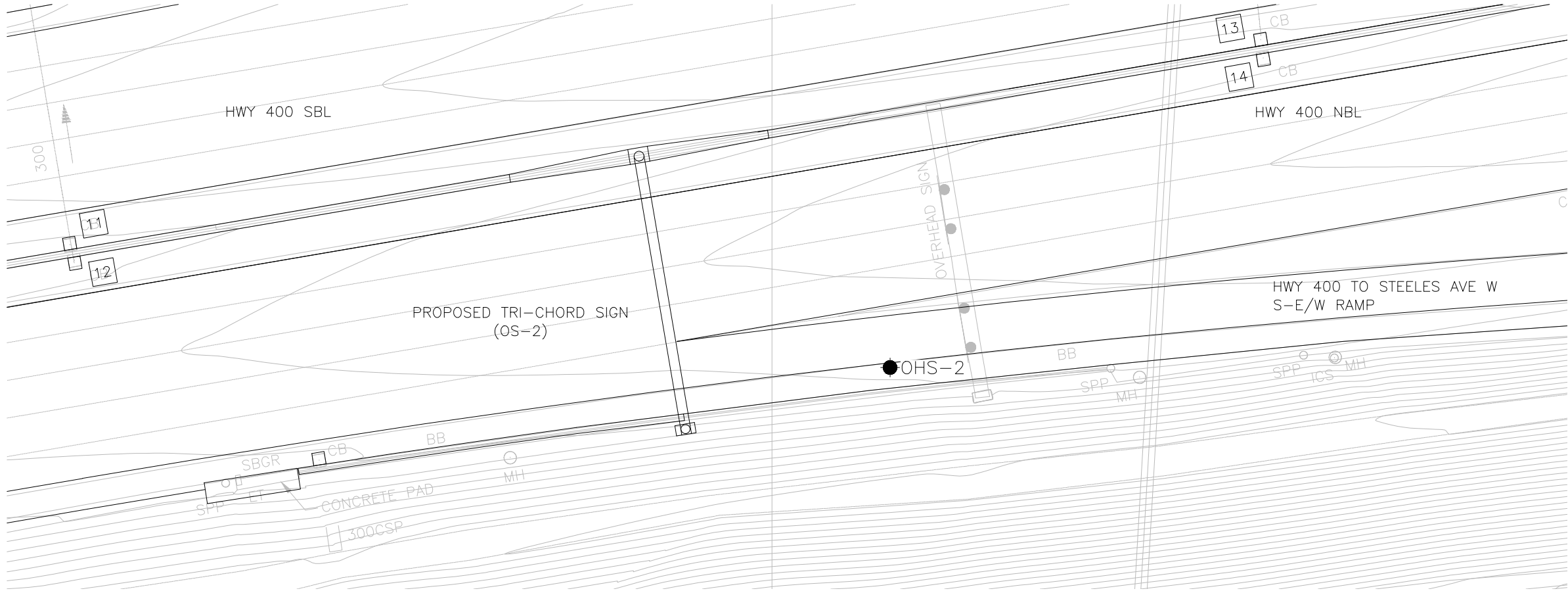
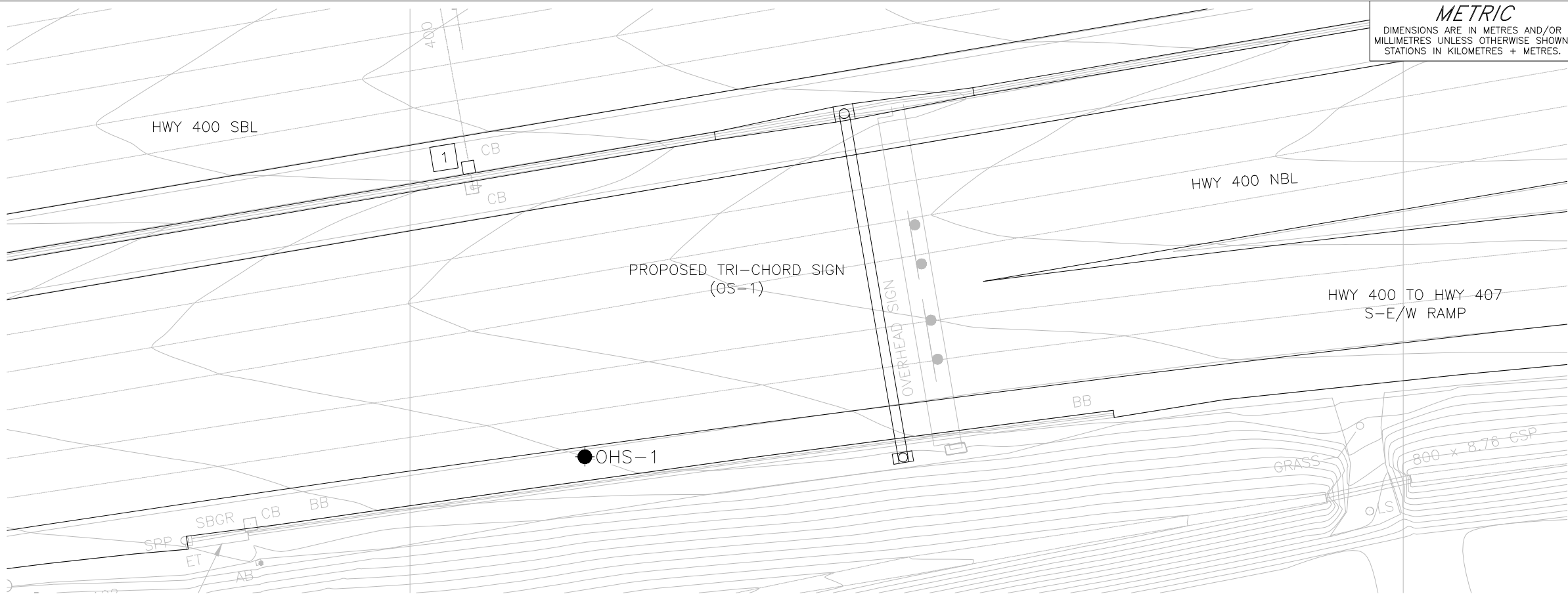
ATSM D1586 Standard Test Method for Standard Penetration Test (SPT) and Split-Barrel Sampling of Soils

ASTM D2573 Standard Test Method for Field Vane Shear Strength Test in Cohesive Soil

Ontario Occupational Health and Safety Act:

Ontario Regulation 903 Wells (as amended)

DRAWINGS



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

CONT No.
GWP No. 2324-16-00

HIGHWAY 400
OVERHEAD SIGN SUPPORT STRUCTURES
BOREHOLE LOCATION PLAN

SHEET



KEY PLAN
SCALE
1.5 0 1.5 3 km

LEGEND

Borehole - Current Investigation

BOREHOLE CO-ORDINATES (MTM NAD83 ZONE10)			
No.	ELEVATION	NORTHING	EASTING
OHS-1	190.4	4847717.6	302077.7
OHS-2	193.7	4848311.9	301971.5

OS-1 SITE COORDINATES: Lon. -79.533934, Lat. 43.769674
OS-2 SITE COORDINATES: Lon. -79.535243, Lat. 43.774545



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.

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

REFERENCE

Base plans provided in digital format by MH, drawing file nos. x190131000_Baseplan.dwg , dated September 10, 2021, Contours provided in digital format by MH, drawing file nos.x190131000_ExContours.dwg, dated September 10, 2021, Utilities provided in digital format by MH, drawing file nos. x190131000_ExUtilities.dwg , dated September 10, 2021 and Design provided in digital format by MH, drawing file nos. X1901310_NC.dwg , dated September 10, 2021.

NO.	DATE	BY	REVISION
Geocres No. 30M13-328			
HWY. 400	CHKD. BL	PROJECT NO. 19115306	DIST. .
SUBM'D. BL	CHKD. TZ	DATE: 1/4/2022	SITE: .
DRAWN: SA	CHKD. TZ	APPD. LCC	DWG. 1

APPENDIX A

Records of Borehole Sheets

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>i.e.</i> , SAND and gravel)
> 20 to 35	Primary soil name prefixed with "gravelly, sandy" as applicable
> 10 to 20	some (<i>i.e.</i> , some sand)
≤ 10	trace (<i>i.e.</i> , 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 cm² 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, G _s)
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)
Y	unit weight

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

COARSE-GRAINED SOILS

Compactness¹

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

- 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 grain size. 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.
- 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

- SPT 'N' in accordance with ASTM D1586, uncorrected for overburden pressure effects; approximate only.
- 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.

LIST OF SYMBOLS

MINISTRY OF TRANSPORTATION, ONTARIO

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 $= (w_L - w_P)$
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
$C_{a(e)}$	secondary compression index
C_a	rate of secondary compression
$C_{a(e)}$	modified 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 $= \sigma'_p / \sigma'_{vo}$

(d) Shear Strength

τ_p, τ_r	peak and residual shear strength
c'	effective cohesion
ϕ'	effective angle of internal friction
δ	angle of interface friction
μ	coefficient of friction $= \tan \delta$
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 or 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 $\gamma = \rho \cdot g$ (i.e., mass density multiplied by
acceleration due to gravity)

Notes: 1
2

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

PROJECT 19115306		RECORD OF BOREHOLE No OHS-1				SHEET 1 OF 1		METRIC								
G.W.P. 2324-16-00		LOCATION N 4847717.6; E 302077.7 MTM NAD 83 ZONE 10 (LAT. 43.769421; LONG. -79.533817)				ORIGINATED BY AM										
DIST Central HWY 400		BOREHOLE TYPE 150 mm O.D. Continuous Flight Hollow Stem Augers				COMPILED BY BL										
DATUM Geodetic		DATE October 31, 2021				CHECKED BY TZ										
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								
190.4	GROUND SURFACE															
0.0	ASPHALT (305 mm)															
190.1			1	GS	-											
0.3	Gravelly SAND (SP), trace fines (FILL) Dense Brown Moist		2	SS	46											
189.0																
1.5	CLAYEY SILT-SILT (CL-ML), some sand to sandy, trace gravel to CLAYEY SILT (CL), some sand to sandy, trace gravel (FILL) Stiff to very stiff Brown Moist		3	SS	17											
			4	SS	13											
			5	SS	15											
186.7																
3.7	CLAYEY SILT-SILT (CL-ML), some sand to sandy, trace gravel to CLAYEY SILT (CL), some sand to sandy, trace gravel (TILL) Very stiff to hard Brown to grey Moist - Grey below a depth of about 4.6 m (Elev. 185.8 m)		6	SS	16											
			7	SS	18											
			8	SS	93											
183.2																
7.2	Sandy SILT of slight plasticity (ML), trace gravel (TILL) Very dense Brown Moist															
182.3			9	SS	101											
8.1	END OF BOREHOLE															
NOTES:																
1. Borehole caved to a depth of about 6.7 m (Elev. 183.7 m) upon completion of drilling.																
2. Groundwater measured in open borehole at a depth of about 6.1 m (Elev. 184.3 m) upon completion of drilling.																

PROJECT 19115306		RECORD OF BOREHOLE No OHS-2				SHEET 1 OF 1		METRIC						
G.W.P. 2324-16-00		LOCATION N 4848311.9; E 301971.5 MTM NAD 83 ZONE 10 (LAT. 43.774771; LONG. -79.535139)				ORIGINATED BY AM								
DIST Central HWY 400		BOREHOLE TYPE 150 mm O.D. Continuous Flight Hollow Stem Augers				COMPILED BY BL								
DATUM Geodetic		DATE November 1, 2021				CHECKED BY TZ								
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						
193.7	GROUND SURFACE													
0.0	ASPHALT (254 mm)													
0.3	Gravelly SAND (SP), trace fines (FILL)		1	SS	47									
192.8	Dense Brown Moist		2A	SS	9									
0.9	CLAYEY SILT (CL), some sand to sandy, trace gravel to SILTY CLAY (CI), some sand, trace gravel (FILL)		3	SS	11									
	Firm to stiff Brown Moist		4	SS	9									
			5	SS	5									
			6	SS	7									
			7	SS	13									
186.5	CLAYEY SILT-SILT (CL-ML), some sand to sandy, trace gravel to CLAYEY SILT (CL), some sand to sandy, trace gravel (TILL)		8	SS	8									
7.2	Stiff Brown to grey Moist													
			9	SS	12									
184.0	- Grey below a depth of about 9.2 m (Elev. 184.5 m)													
9.8	END OF BOREHOLE													
NOTES: 1. Borehole caved to a depth of about 8.7 m (Elev. 185.0 m) upon completion of drilling. 2. Borehole dry above the caved depth upon completion of drilling.														

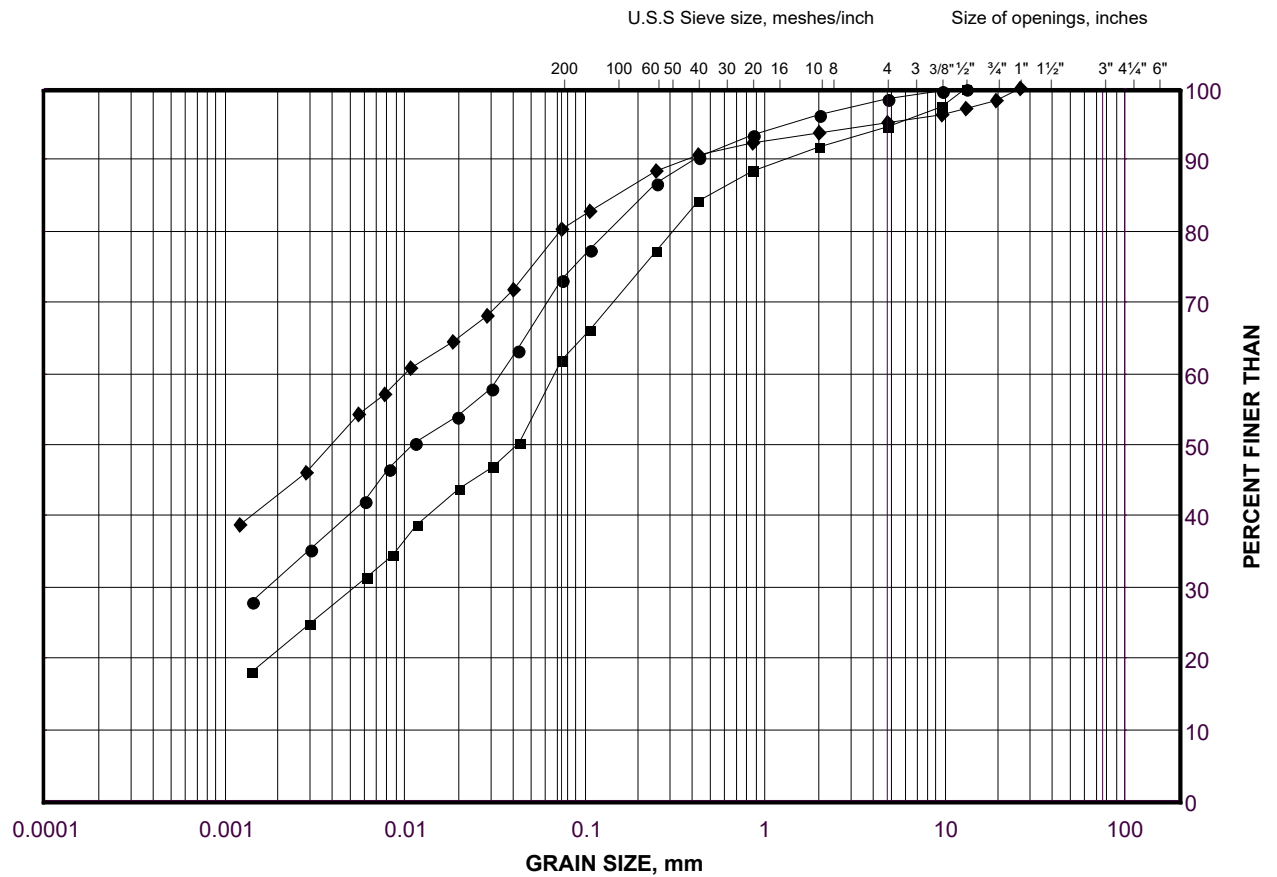
APPENDIX B

Geotechnical Laboratory Test Results

GRAIN SIZE DISTRIBUTION

Sandy CLAYEY SILT (CL) to SILTY CLAY (CI) (FILL)

FIGURE B1



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

LEGEND

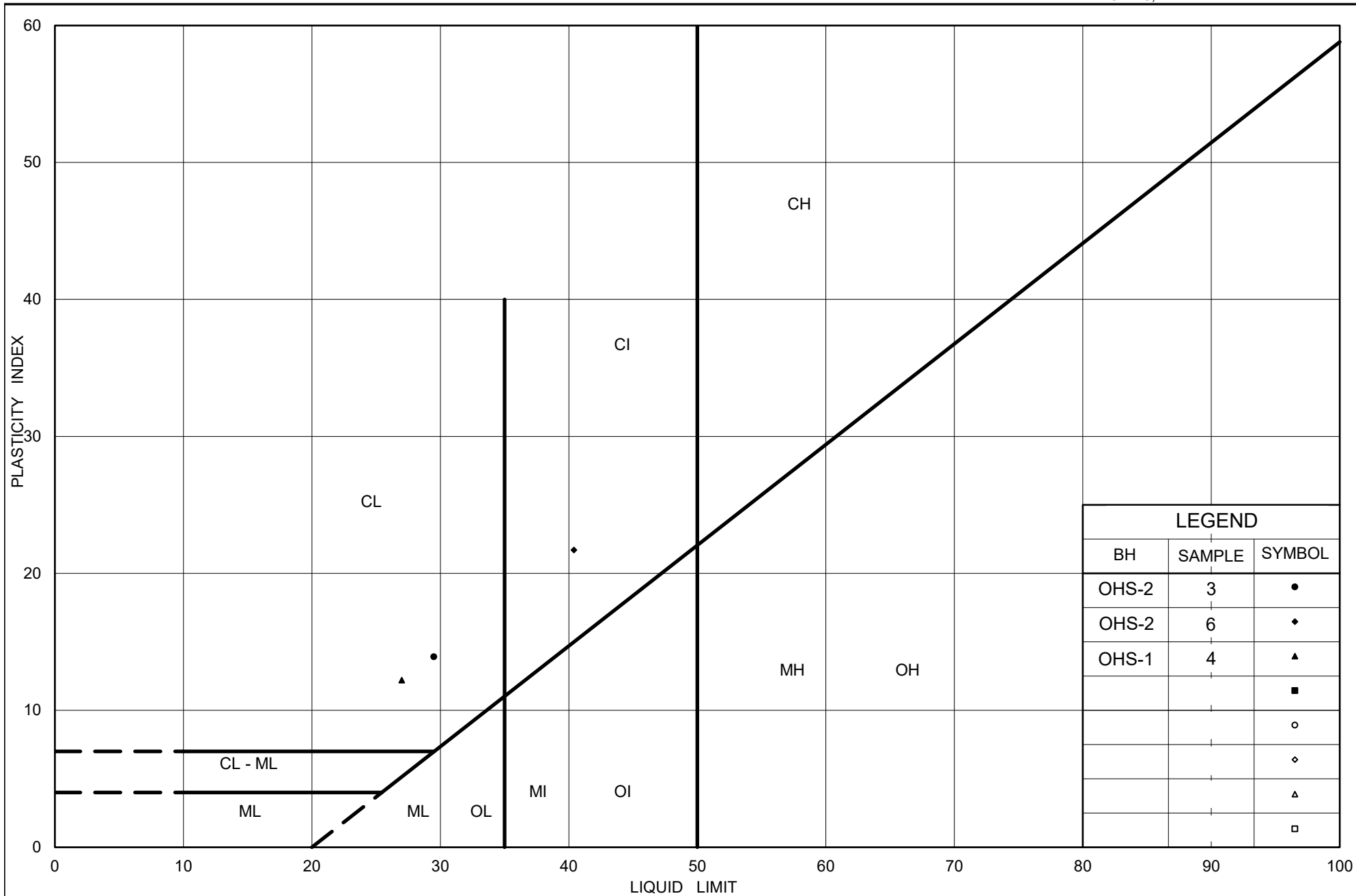
SYMBOL	Borehole	SAMPLE	ELEVATION(m)
●	OHS-2	3	191.9
■	OHS-1	4	187.8
◆	OSH-2	6	188.8

Project Number: 19115306

Checked By: TZ

Golder Associates

Date: 17-Dec-21



Ministry of Transportation

Ontario

PLASTICITY CHART
Sandy CLAYEY SILT (CL) to SILTY CLAY (CI)
(FILL)

Figure No. B2

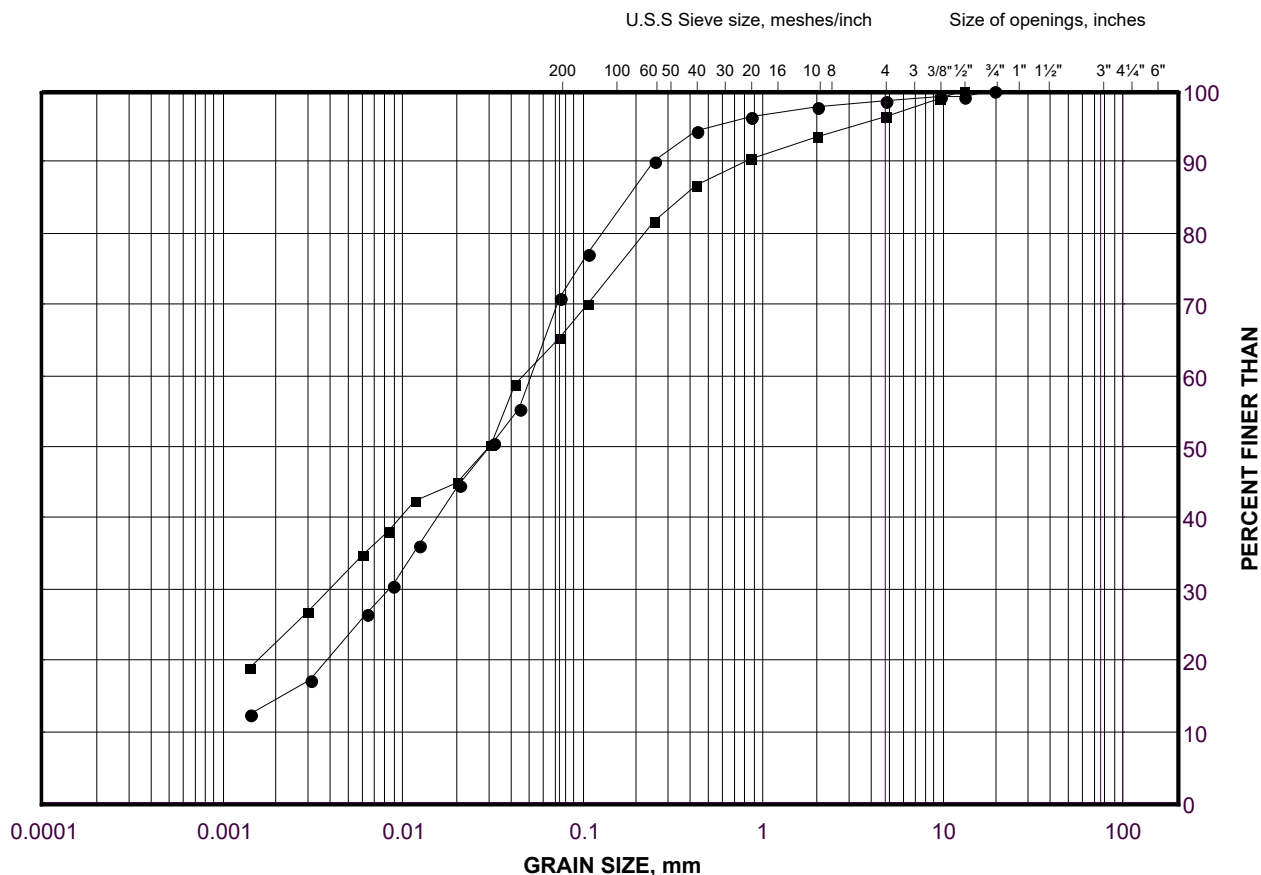
Project No. 19115306

Checked By: TZ

GRAIN SIZE DISTRIBUTION

Sandy CLAYEY SILT-SILT (CL-ML) to Sandy CLAYEY SILT (CL) (TILL)

FIGURE B3



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

LEGEND

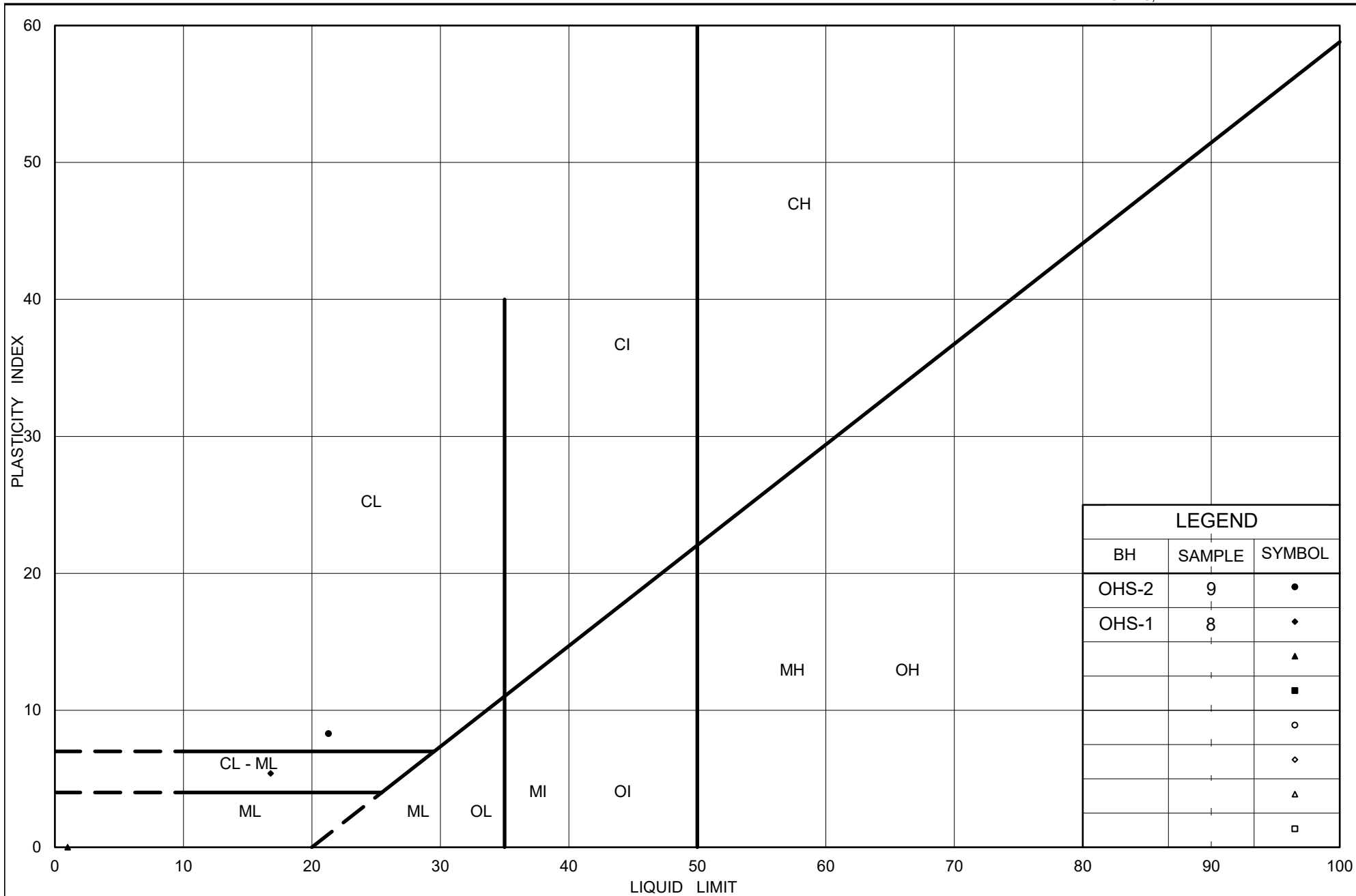
SYMBOL	Borehole	SAMPLE	ELEVATION(m)
●	OHS-1	8	184.0
■	OHS-2	9	184.2

Project Number: 19115306

Checked By: TZ

Golder Associates

Date: 17-Dec-21



Ministry of Transportation

Ontario

PLASTICITY CHART
 Sandy CLAYEY SILT-SILT (CL-ML) to
 Sandy CLAYEY SILT (CL) (TILL)

Figure No. B4

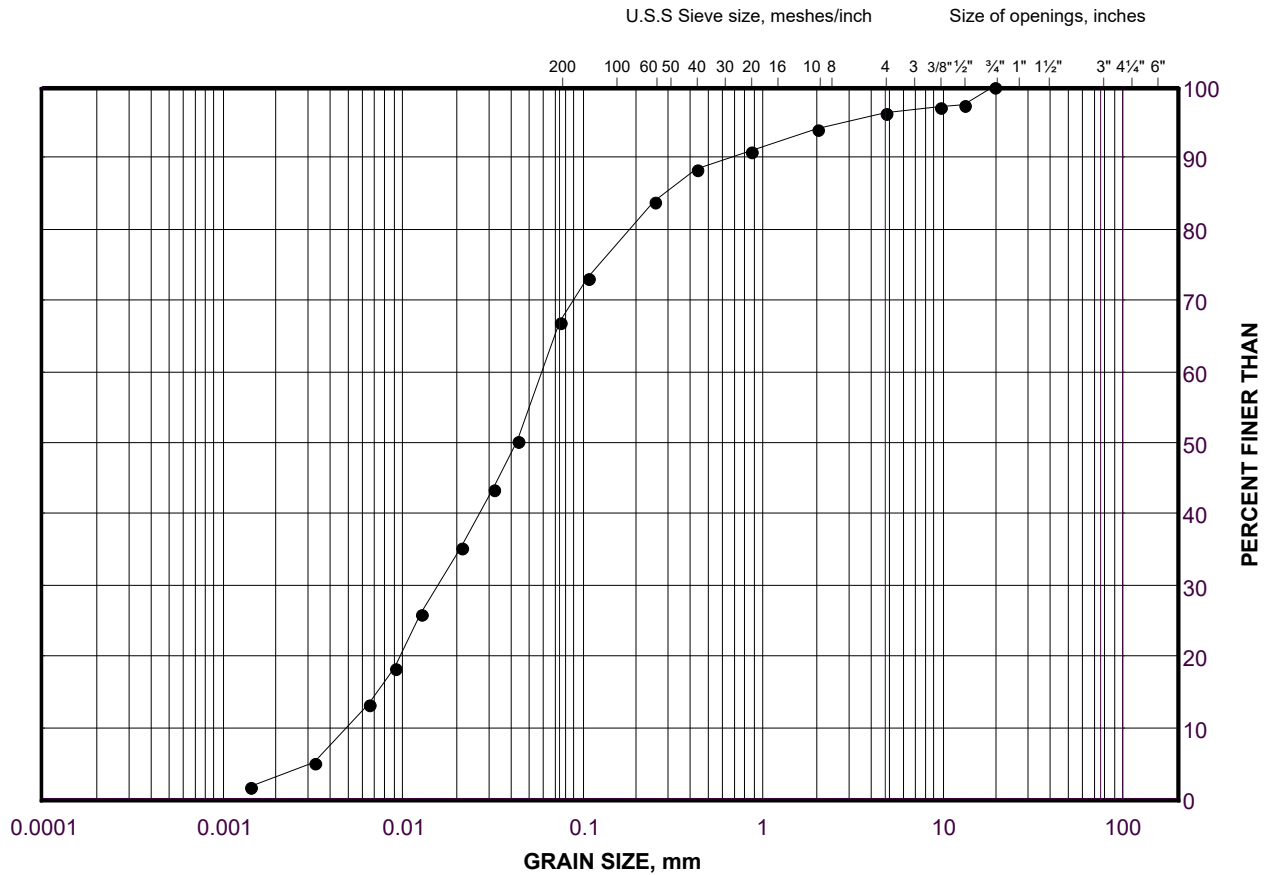
Project No. 19115306

Checked By: TZ

GRAIN SIZE DISTRIBUTION

Sandy SILT (ML) of slight plasticity

FIGURE B5



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

LEGEND

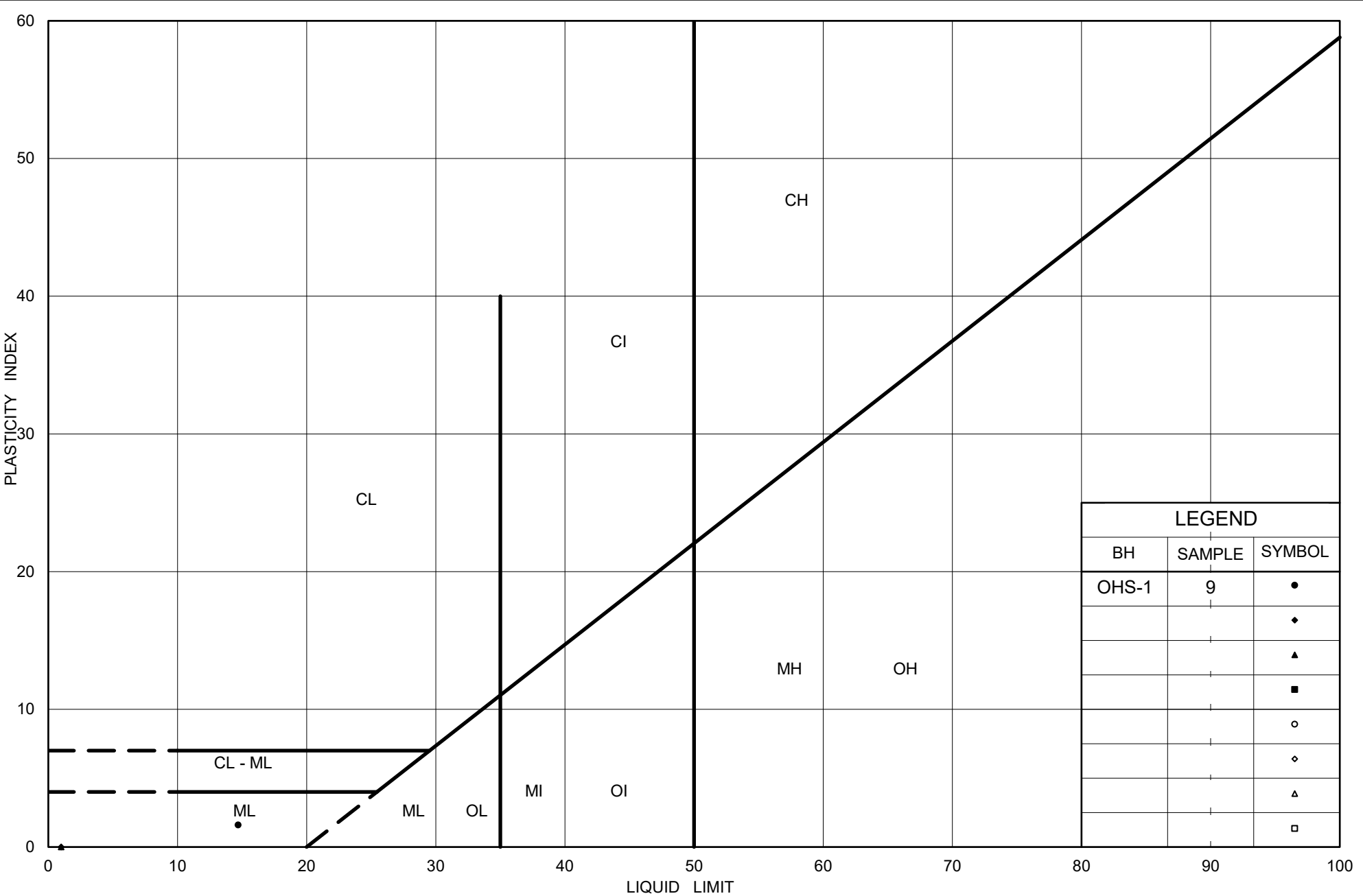
SYMBOL	Borehole	SAMPLE	ELEVATION(m)
•	OHS-1	9	182.6

Project Number: 19115306

Checked By: TZ

Golder Associates

Date: 17-Dec-21



APPENDIX C

Analytical Laboratory Test Results



Your Project #: 19115306
Site Location: HWY 400 VAUGHAN
Your C.O.C. #: N/A

Attention: Bryan Lui

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

Report Date: 2021/12/08
Report #: R6912263
Version: 2 - Revision

CERTIFICATE OF ANALYSIS – REVISED REPORT

BV LABS JOB #: C1W6270

Received: 2021/11/05, 15:59

Sample Matrix: Soil
Samples Received: 2

Analyses	Quantity	Date	Date	Laboratory Method	Analytical Method
		Extracted	Analyzed		
Chloride (20:1 extract)	2	2021/11/11	2021/11/11	CAM SOP-00463	SM 23 4500-Cl E m
Conductivity	2	2021/11/11	2021/11/11	CAM SOP-00414	OMOE E3530 v1 m
Moisture (Subcontracted) (1, 2)	2	N/A	2021/11/13	AB SOP-00002	CCME PHC-CWS m
Sulphide in Soil (1)	2	N/A	2021/11/10	AB SOP-00080	EPA9030B/SM4500S2-DF
pH CaCl2 EXTRACT	2	2021/11/10	2021/11/10	CAM SOP-00413	EPA 9045 D m
Resistivity of Soil	2	2021/11/08	2021/11/11	CAM SOP-00414	SM 23 2510 m
Sulphate (20:1 Extract)	2	2021/11/11	2021/11/11	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.

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.

(1) This test was performed by Bureau Veritas Calgary (19th), 4000 19th Street NE, Calgary, AB, T2E 6P8

(2) Offsite analysis requires that subcontracted moisture be reported.



Your Project #: 19115306
Site Location: HWY 400 VAUGHAN
Your C.O.C. #: N/A

Attention: Bryan Lui

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

Report Date: 2021/12/08
Report #: R6912263
Version: 2 - Revision

CERTIFICATE OF ANALYSIS – REVISED REPORT

BV LABS JOB #: C1W6270

Received: 2021/11/05, 15:59

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

=====

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.



BUREAU
VERITAS

Bureau Veritas Job #: C1W6270

Report Date: 2021/12/08

Golder Associates Ltd

Client Project #: 19115306

Site Location: HWY 400 VAUGHAN

Sampler Initials: AM

SOIL CORROSIVITY PACKAGE (SOIL)

Bureau Veritas ID		RDS088		RDS089		
Sampling Date		2021/11/01		2021/10/31		
COC Number		N/A		N/A		
	UNITS	OHS-2 SS6 12'6"-14'6"	RDL	OHS-1 SS5 10'-12'	RDL	QC Batch
Calculated Parameters						
Resistivity	ohm-cm	1500		510		7686386
Inorganics						
Soluble (20:1) Chloride (Cl-)	ug/g	300	20	1100	40	7694175
Conductivity	umho/cm	671	2	1980	2	7694504
Available (CaCl2) pH	pH	7.77		7.68		7692003
Soluble (20:1) Sulphate (SO4)	ug/g	<20	20	87	20	7694179
Sulphide	mg/kg	3.7 (1)	0.5	3.7 (1)	0.5	7699458
Physical Testing						
Moisture-Subcontracted	%	12	0.30	13	0.30	7699668
RDL = Reportable Detection Limit						
QC Batch = Quality Control Batch						
(1) Sample extracted past method-specified hold time. Analyzed past method specified hold time						



BUREAU
VERITAS

Bureau Veritas Job #: C1W6270
Report Date: 2021/12/08

Golder Associates Ltd
Client Project #: 19115306
Site Location: HWY 400 VAUGHAN
Sampler Initials: AM

TEST SUMMARY

Bureau Veritas ID: RDS088
Sample ID: OHS-2 SS6 12'6"-14'6"
Matrix: Soil

Collected: 2021/11/01
Shipped:
Received: 2021/11/05

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride (20:1 extract)	KONE/EC	7694175	2021/11/11	2021/11/11	Alina Dobreanu
Conductivity	AT	7694504	2021/11/11	2021/11/11	Kien Tran
Moisture (Subcontracted)	BAL	7699668	N/A	2021/11/13	Yong Mei (May) Liang
Sulphide in Soil	SPEC	7699458	N/A	2021/11/10	Bailey Morrison
pH CaCl2 EXTRACT	AT	7692003	2021/11/10	2021/11/10	Taslima Aktar
Resistivity of Soil		7686386	2021/11/11	2021/11/11	Automated Statchk
Sulphate (20:1 Extract)	KONE/EC	7694179	2021/11/11	2021/11/11	Avneet Kour Sudan

Bureau Veritas ID: RDS089
Sample ID: OHS-1 SS5 10'-12'
Matrix: Soil

Collected: 2021/10/31
Shipped:
Received: 2021/11/05

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Chloride (20:1 extract)	KONE/EC	7694175	2021/11/11	2021/11/11	Alina Dobreanu
Conductivity	AT	7694504	2021/11/11	2021/11/11	Kien Tran
Moisture (Subcontracted)	BAL	7699668	N/A	2021/11/13	Yong Mei (May) Liang
Sulphide in Soil	SPEC	7699458	N/A	2021/11/10	Bailey Morrison
pH CaCl2 EXTRACT	AT	7692003	2021/11/10	2021/11/10	Taslima Aktar
Resistivity of Soil		7686386	2021/11/11	2021/11/11	Automated Statchk
Sulphate (20:1 Extract)	KONE/EC	7694179	2021/11/11	2021/11/11	Avneet Kour Sudan



BUREAU
VERITAS

Bureau Veritas Job #: C1W6270

Report Date: 2021/12/08

Golder Associates Ltd

Client Project #: 19115306

Site Location: HWY 400 VAUGHAN

Sampler Initials: AM

GENERAL COMMENTS

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

Package 1	20.7°C
-----------	--------

Revised report (2021/12/08): Sample IDs updated as requested.

Results relate only to the items tested.



BUREAU
VERITAS

Bureau Veritas Job #: C1W6270

Report Date: 2021/12/08

QUALITY ASSURANCE REPORT

Golder Associates Ltd

Client Project #: 19115306

Site Location: HWY 400 VAUGHAN

Sampler Initials: AM

QC Batch	Parameter	Date	Matrix Spike		SPIKED BLANK		Method Blank		RPD	
			% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits
7692003	Available (CaCl ₂) pH	2021/11/10			101	97 - 103			0.14	N/A
7694175	Soluble (20:1) Chloride (Cl ⁻)	2021/11/11	109	70 - 130	108	70 - 130	<20	ug/g	NC	35
7694179	Soluble (20:1) Sulphate (SO ₄)	2021/11/11	NC	70 - 130	104	70 - 130	<20	ug/g	2.1	35
7694504	Conductivity	2021/11/11			99	90 - 110	<2	umho/cm	0.31	10
7699458	Sulphide	2021/11/10	32 (1)	75 - 125	97	75 - 125	<0.5	mg/kg	NC	30
7699668	Moisture-Subcontracted	2021/11/13					<0.30	%		

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)

NC (Duplicate RPD): The duplicate RPD was not calculated. The concentration in the sample and/or duplicate was too low to permit a reliable RPD calculation (absolute difference <= 2x RDL).

(1) Recovery or RPD for this parameter is outside control limits. The overall quality control for this analysis meets acceptability criteria.



BUREAU
VERITAS

Bureau Veritas Job #: C1W6270
Report Date: 2021/12/08

Golder Associates Ltd
Client Project #: 19115306
Site Location: HWY 400 VAUGHAN
Sampler Initials: AM

VALIDATION SIGNATURE PAGE

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

Brad Newman, B.Sc., C.Chem., Scientific Service Specialist

Ghayasuddin Khan, M.Sc., P.Chem., QP, Scientific Specialist, Inorganics

Veronica Falk, B.Sc., P.Chem., QP, Scientific Specialist, Organics

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.

(work order) MSA between Golder and BU Lab.

bryan-lui@
golder.com

Dated May 18, 2021.

6740 Campbell Road, Mississauga, Ontario L5N 2L8
Phone: 905-817-5700 Fax: 905-817-5779 Toll Free: 800-563-6266

CHAIN OF CUSTODY RECORD

ENV COC - 00014v2

Page 1 of 1

Invoice Information				Report Information (if differs from invoice)				Project Information				LAB USE ONLY - PLACE STICKER HERE			
Company: Golder Associates Ltd.				Company: Golder Associates Ltd.				Quotation #: NA				LAB USE ONLY - PLACE STICKER HERE			
Contact Name: Bryan Lui				Contact Name: SAME				P.O. # / AFER:							
Street Address: 6725 Century Ave Suite #100				Street Address: SAME				Project #: 19115306				Rush Confirmation #:			
City: Mississauga Prov: ON Postal Code: L5N 2L8				City: Prov: Postal Code:				Site #: Hwy 400 Vaughan							
Phone: 905-466-1745				Phone: SAME				Site Location: Hwy 400 Vaughan				Rush Confirmation #:			
Email: bryan-lui@golder.com				Email: bryan-lui@golder.com				Site Province: ON							
Copies:				Copies:				Sampled By: AM-AM				Regular Turnaround Time (TAT) 5 to 7 Day <input checked="" type="checkbox"/> 10 Day <input type="checkbox"/> Rush Turnaround Time (TAT) Surcharge apply <input type="checkbox"/> Same Day <input type="checkbox"/> 1 Day <input type="checkbox"/> 2 Day <input type="checkbox"/> 3 Day <input type="checkbox"/> 4 Day			
Regulatory Criteria				Regulatory Criteria				Regulatory Criteria							
Table 1 <input type="checkbox"/> Res/Park <input type="checkbox"/> Med/Fine <input type="checkbox"/> CMR <input type="checkbox"/> Reg 406, Table: <input type="checkbox"/> Table 2 <input type="checkbox"/> Ind/Comm <input type="checkbox"/> Ag 558* <input type="checkbox"/> Reg 558* <input type="checkbox"/> Sanitary Sewer Bylaw <input type="checkbox"/> Table 3 <input type="checkbox"/> Agri/Other <input type="checkbox"/> For RSC <input type="checkbox"/> *min 3 day TAT <input type="checkbox"/> Storm Sewer Bylaw <input type="checkbox"/> Table <input type="checkbox"/> MISA <input type="checkbox"/> Municipality <input type="checkbox"/> Table <input type="checkbox"/> PWQO <input type="checkbox"/> Other: <input type="checkbox"/>				Include Criteria on Certificate of Analysis (check if yes): <input type="checkbox"/>				Include Criteria on Certificate of Analysis (check if yes): <input type="checkbox"/>				Include Criteria on Certificate of Analysis (check if yes): <input type="checkbox"/>			
SAMPLES MUST BE KEPT COOL (<10°C) FROM TIME OF SAMPLING UNTIL DELIVERY TO BUREAU VERITAS				SAMPLES MUST BE KEPT COOL (<10°C) FROM TIME OF SAMPLING UNTIL DELIVERY TO BUREAU VERITAS				SAMPLES MUST BE KEPT COOL (<10°C) FROM TIME OF SAMPLING UNTIL DELIVERY TO BUREAU VERITAS				SAMPLES MUST BE KEPT COOL (<10°C) FROM TIME OF SAMPLING UNTIL DELIVERY TO BUREAU VERITAS			
Sample Identification				Date Sampled				Time (24hr)				Matrix			
1 OHS-1 SCS 10'-12'				21 11 01 PM				COLL				COLL			
2 OHS-2 SCS 12'-14'				21 10 31 PM				COLL				COLL			
3															
4															
5															
6															
7															
8															
9															
10															
11															
12															
05-Nov-21 15:59				05-Nov-21 15:59				05-Nov-21 15:59				05-Nov-21 15:59			
Ema Gitej				Ema Gitej				Ema Gitej				Ema Gitej			
C1W6270				C1W6270				C1W6270				C1W6270			
VTH ENV-1508				VTH ENV-1508				VTH ENV-1508				VTH ENV-1508			
*UNLESS OTHERWISE AGREED TO IN WRITING, WORK SUBMITTED ON THIS CHAIN OF CUSTODY IS SUBJECT TO BUREAU VERITAS STANDARD TERMS AND CONDITIONS. SIGNING OF THIS CHAIN OF CUSTODY DOCUMENT IS ACKNOWLEDGMENT AND ACCEPTANCE OF OUR TERMS AND CONDITIONS WHICH ARE AVAILABLE FOR VIEWING AT WWW.BVNA.COM/TERMS-AND-CONDITIONS OR BY CALLING THE LABORATORY LISTED ABOVE TO OBTAIN A COPY				*UNLESS OTHERWISE AGREED TO IN WRITING, WORK SUBMITTED ON THIS CHAIN OF CUSTODY IS SUBJECT TO BUREAU VERITAS STANDARD TERMS AND CONDITIONS. SIGNING OF THIS CHAIN OF CUSTODY DOCUMENT IS ACKNOWLEDGMENT AND ACCEPTANCE OF OUR TERMS AND CONDITIONS WHICH ARE AVAILABLE FOR VIEWING AT WWW.BVNA.COM/TERMS-AND-CONDITIONS OR BY CALLING THE LABORATORY LISTED ABOVE TO OBTAIN A COPY				*UNLESS OTHERWISE AGREED TO IN WRITING, WORK SUBMITTED ON THIS CHAIN OF CUSTODY IS SUBJECT TO BUREAU VERITAS STANDARD TERMS AND CONDITIONS. SIGNING OF THIS CHAIN OF CUSTODY DOCUMENT IS ACKNOWLEDGMENT AND ACCEPTANCE OF OUR TERMS AND CONDITIONS WHICH ARE AVAILABLE FOR VIEWING AT WWW.BVNA.COM/TERMS-AND-CONDITIONS OR BY CALLING THE LABORATORY LISTED ABOVE TO OBTAIN A COPY				*UNLESS OTHERWISE AGREED TO IN WRITING, WORK SUBMITTED ON THIS CHAIN OF CUSTODY IS SUBJECT TO BUREAU VERITAS STANDARD TERMS AND CONDITIONS. SIGNING OF THIS CHAIN OF CUSTODY DOCUMENT IS ACKNOWLEDGMENT AND ACCEPTANCE OF OUR TERMS AND CONDITIONS WHICH ARE AVAILABLE FOR VIEWING AT WWW.BVNA.COM/TERMS-AND-CONDITIONS OR BY CALLING THE LABORATORY LISTED ABOVE TO OBTAIN A COPY			
LAB USE ONLY				LAB USE ONLY				LAB USE ONLY				LAB USE ONLY			
Seal present: <input checked="" type="checkbox"/>				Seal present: <input checked="" type="checkbox"/>				Seal present: <input checked="" type="checkbox"/>				Seal present: <input checked="" type="checkbox"/>			
Seal intact: <input checked="" type="checkbox"/>				Seal intact: <input checked="" type="checkbox"/>				Seal intact: <input checked="" type="checkbox"/>				Seal intact: <input checked="" type="checkbox"/>			
Cooling media present: <input checked="" type="checkbox"/>				Cooling media present: <input checked="" type="checkbox"/>				Cooling media present: <input checked="" type="checkbox"/>				Cooling media present: <input checked="" type="checkbox"/>			
Relinquished by: (Signature/Print)				Relinquished by: (Signature/Print)				Relinquished by: (Signature/Print)				Relinquished by: (Signature/Print)			
Bryan Lui				Bryan Lui				Bryan Lui				Bryan Lui			
21 11 05 15 58				21 11 05 15 58				21 11 05 15 58				21 11 05 15 58			
Received by: (Signature/Print)				Received by: (Signature/Print)				Received by: (Signature/Print)				Received by: (Signature/Print)			
W4 11 05 15 59				W4 11 05 15 59				W4 11 05 15 59				W4 11 05 15 59			
Special Instructions				Special Instructions				Special Instructions				Special Instructions			



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