



FOUNDATION INVESTIGATION REPORT

Highway 66, Station 16+083, Township of Gauthier Culvert Replacement Ministry of Transportation, Ontario GWP 5210-14-00

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PART A

FOUNDATION INVESTIGATION REPORT
HIGHWAY 66, STA 16+083, TOWNSHIP OF GAUTHIER
CULVERT REPLACEMENT
MINISTRY OF TRANSPORTATION, ONTARIO
GWP 5210-14-00

1.0 INTRODUCTION

Golder Associates Ltd. (Golder) has been retained by AECOM Canada Ltd. (AECOM) on behalf of the Ministry of Transportation, Ontario (MTO) to provide foundation engineering services related to the replacement of the culvert on Highway 66 at Station 16+083, in the Township of Gauthier, approximately 1.0 km west of Yost Road, Ontario. The Key Plan of the general location of this section of Highway 66 and the location of the investigated area are shown on Drawing 1.

The purpose of this investigation is to establish the subsurface conditions at the culvert replacement site by borehole drilling with laboratory testing carried out on selected soil samples.

The Terms of Reference (TOR) and the scope of work for the foundation investigation are outlined in MTO's Request for Proposal, dated February 2018, and the subsequent clarifications/addenda, which forms part of the Consultant's Assignment Number 5017-E-0039 for this project. The work has been carried out in accordance with Golder's Supplementary Specialty Plan for foundation engineering services for this project dated November 2018.

2.0 SITE DESCRIPTION

It should be noted that the orientation (i.e., north, south, east, west) stated in the text of the report is typically referenced to project north and therefore may differ from magnetic north shown on Drawing 1. For the purpose of this report, Highway 66 is oriented in a west-east direction with the culvert positioned perpendicular to the highway generally in a north-south orientation. At the culvert location, the creek flows in a north to south direction.

The existing structure consists of a 1.2 m high by 1.3 m wide span 24.6 m long Creosote Timber Culvert (CTC). The culvert inlet (north end) and outlet (south end) inverts are at approximately Elevations 282.7 m and 282.5 m, respectively. The highway grade at the culvert location is at approximately Elevation 285.4 m and the highway embankment is about 2.7 m to 2.9 m high relative to the culvert inlet and outlet invert, respectively. In general, the topography within the vicinity of the culvert consists of relatively flat, forested terrain.

At the time of the subsurface exploration field work, the embankment side slopes appeared to be grass covered and stable, with no signs of slope instability or roadway settlement although a longitudinal and a transverse crack of the pavement surface is evident in the culvert area. The ground surface conditions at select locations of the culvert area are shown on Photographs 1 to 4.

3.0 INVESTIGATION PROCEDURES

Field work for this subsurface exploration was carried out on May 13 and 14, 2019, during which time five boreholes (Boreholes C256-1 to C256-5) were advanced at the approximate locations shown on Drawing 1. Boreholes C256-1 to C256-3 were advanced from the roadway surfaces/shoulders through the roadway embankment and Boreholes C256-4 and C256-5 were advanced near the south and north toes of the highway embankment adjacent to the culvert outlet and inlet, respectively. The boreholes were advanced using a track mounted CME-55LC drilling rig supplied and operated by George Downing Estate Drilling (Downing) of Grenville-Sur-La-Rouge, Quebec. Traffic control, where required, was performed in accordance with MTO's Ontario Traffic Control Manual Book 7 – Temporary Conditions.

The boreholes were advanced using 108 mm I.D. Hollow Stem Augers. Soil samples were obtained in the boreholes at 0.75 m and 1.5 m intervals of depth using 50 mm outer diameter split-spoon samplers driven by an automatic or cathead hammer in accordance with the Standard Penetration Test (SPT) procedure (ASTM D1586). In situ vane shear tests were carried out in cohesive soils for determination of the undrained shear strength, in accordance with Standard Test Method for Field Vane Shear Test in Saturated Fine Grained Soils (ASTM 2573) using an MTO standard "N"-size vane. The groundwater level inside the augers was observed open completion of the drilling operations. The boreholes were backfilled upon completion in accordance with Ontario Regulation 903 (wells) as amended. The boreholes drilled through the paved section of Highway 66 were capped at ground surface using cold patch asphalt.

Field work was supervised on a full-time basis by a member of Golder's technical staff who: located the boreholes in the field; arranged for the clearance of underground services; supervised the drilling and sampling operations; logged the boreholes; and examined the soil samples. The soil samples were identified in the field, placed in labelled containers and transported to Golder's geotechnical laboratory in Sudbury for further examination and laboratory testing. Index and classification testing consisting of water content determinations, grain size distributions, and Atterberg limits was carried out on selected soil samples. The geotechnical laboratory testing was completed according to ASTM and MTO LS standards, as applicable. One soil sample was submitted to Bureau Veritas Laboratories (formerly Maxxam) of Mississauga, an accredited analytical laboratory, for testing a suite of corrosivity indicator parameters.

The as-drilled borehole locations were measured relative to highway chainages/station marked on the pavement by a member of our technical staff and converted into northing/easting coordinates on the plan drawing. The ground surface elevations at the borehole locations were surveyed by Golder relative to the highway and culvert centreline, with the elevation of the centrelines provided by AECOM. The MTM NAD 83-CSRS CBN v6-2010.0 (Zone 12) northing and easting coordinates, geographical coordinates, ground surface elevations referenced to Geodetic datum, and borehole depths at each borehole location are presented on the borehole records in Appendix A and summarized below.

Borehole Number	MTM NAD 83 Northing (m) (Latitude)	MTM NAD 83 Easting (m) (Longitude)	Ground Surface Elevation (m)	Borehole Depth (m)
C256-1	5331091.7 (48.112667)	392465.2 (-79.822574)	285.6	21.0
C256-2	5331081.1 (48.112571)	392477.3 (-79.822414)	285.6	16.5
C256-3	5331102.7 (48.112765)	392465.3 (-79.822571)	285.3	16.5
C256-4	5331080.4 (48.112565)	392465.5 (-79.822572)	284.5	10.4
C256-5	5331104.7 (48.112781)	392482.9 (-79.822334)	284.1	10.4

4.0 SITE GEOLOGY AND SUBSURFACE CONDITIONS

4.1 Regional Geology

Based on Northern Ontario Engineering Geology Terrain Study (NOEGTS) ¹ mapping, the culvert site is located within a glaciolacustrine plain, with the subsoils consisting primarily of clay.

Based on geological mapping (MNDM) ², the site is underlain by mafic to intermediate metavolcanics rocks.

4.2 Subsurface Conditions

The detailed subsurface soil and groundwater conditions encountered in the boreholes and the summary results of in situ and laboratory testing are given on the Record of Borehole sheets contained in Appendix A. The plotted results of geotechnical laboratory testing are contained in Appendix B. The results of the in-situ field tests (i.e., SPT 'N'-values and in situ vane shear strengths) as presented on the Record of Borehole sheets and discussed in Section 4.2 are uncorrected. The stratigraphic boundaries shown on the Record of Borehole sheets and on the interpreted stratigraphic profiles shown on Drawing 1 are inferred from non-continuous sampling and, therefore, represent transitions between soil types rather than exact planes of geological change. The results of the analytical laboratory testing (by Bureau Veritas Laboratories) are summarized in Section 4.4 and the detailed laboratory testing report is included in Appendix B.

The subsurface conditions will vary between and beyond the borehole locations, however, the factual data presented on the Record of Borehole Sheets governs any interpretation of the site conditions. A summary description of the soil deposits and groundwater conditions encountered in the boreholes is provided below. It should be noted that the interpreted stratigraphy shown on Drawing 1 is a simplification of the subsurface conditions.

4.2.1 Asphalt/Fill

An approximately 120 mm thick layer of asphalt pavement was encountered in Boreholes C256-2 and C256-3 at Elevations 285.6 m and 285.3 m, respectively. A 0.4 m to 3.0 m thick layer of embankment fill, consisting of an upper 0.2 m to 0.4 m thick layer of sand and gravel in Boreholes C256-1 to C256-3, and C256-5, underlain by a 1.9 m to 2.9 m thick layer of sand in Boreholes C256-2 and C256-3, was encountered below the asphalt in Boreholes C256-2 and C256-3 and at ground surface in Boreholes C256-1 and C256-5.

The SPT "N"-values measured within the non-cohesive sand fill layer range from 3 blows to 78 blows per 0.3 m of penetration, indicating a very loose to very dense compactness condition. However, the upper portion of the fill was frozen at the time of the investigation and therefore the SPT "N"-values measured within the upper portion of the sand fill layer may not be representative of the in-situ compactness condition of the fill.

¹ Ontario Ministry of Natural Resources and Forestry. Northern Ontario Engineering Geology Terrain Study. Ontario Geological Society Electronic Mapping. Map 41PNE.

² Ontario Ministry of Northern Development and Mines. Bedrock Geology of Ontario, East-Central Sheet. Map 2543.

4.2.2 Organic Silt/Peat

A 0.8 m thick deposit of organic silt was encountered at ground surface in Borehole C256-4 at Elevation 284.5 m. A 1.4 m and 1.1 m thick deposit of amorphous peat was encountered beneath the organic silt and fill in Boreholes C256-4 and C256-5, respectively, at Elevation 283.7 m.

The SPT “N”-values measured within the amorphous peat deposit are 2 blows per 0.3 m of penetration, indicating a very soft consistency.

4.2.3 Sand

A 1.5 m to 3.4 m thick deposit of non-cohesive sand was encountered underlying the fill in Boreholes C256-1 to C256-3, and underlying the peat deposit in Boreholes C256-4 and C256-5, between Elevations 283.4 m and 282.3 m.

The SPT “N”-values measured within the sand deposit range from 1 blow to 8 blows per 0.3 m of penetration, indicating a very loose to loose compactness condition.

Grain size distribution analysis was carried out on four samples of the sand deposit and the results are presented on Figure B-1 in Appendix B. The natural moisture content measured on samples of the sand deposit ranges from about 23 per cent to 27 per cent.

4.2.4 Silt

A 0.8 m thick deposit of non-cohesive silt was encountered underlying the sand deposit in Boreholes C256-4 and C256-5, at Elevations 280.8 m and 280.4 m, respectively.

The SPT “N”-values measured within the silt deposit are 2 blows and 5 blows per 0.3 m of penetration, indicating a very loose to loose compactness condition.

Grain size distribution analysis was carried out on one sample of the silt deposit and the result is presented on Figure B-2 in Appendix B. The natural moisture content measured on one sample of the silt deposit is about 27 per cent.

4.2.5 Sandy Silt to Silt and Sand

A 4.2 m to 5.7 m thick deposit of non-cohesive sandy silt to silt and sand was encountered underlying the sand deposit in Boreholes C256-1 to C256-3 and underlying the silt deposit in Boreholes C256-4 and C256-5, between Elevations 280.8 m and 279.5 m.

The SPT “N”-values measured within the sandy silt to silt and sand deposit range from 0 blows (weight of hammer – WH) to 11 blows per 0.3 m of penetration indicating that the deposit has a very loose to compact compactness condition.

Grain size distribution analysis was carried out on four samples of the silt and sand portion of the deposit and the results are presented on Figure B-3 in Appendix B. The natural moisture content measured on samples of the sandy silt to silt and sand deposit ranges from about 25 per cent to 29 per cent.

4.2.6 Silt to Clayey Silt

A 1.7 m to 4.9 m thick deposit of silt to clayey silt was encountered underlying the sandy silt to silt and sand deposit in Boreholes C256-1 to C256-5, between Elevations 275.8 m and 275.1 m. Boreholes C256-4 and C256-5 were terminated within the silt to clayey silt deposit at a depth of 10.4 m below ground surface.

The SPT “N”-values measured within the silt to clayey silt deposit range from 0 blows (weight of hammer – WH) to 6 blows per 0.3 m of penetration. In-situ field vane tests carried out within the deposit measured undrained shear strengths ranging from about 77 kPa to about 85 kPa, with one value greater than 100 kPa, and a sensitivity of about 2. The SPT “N”-values, together with the field vane test results, suggest that the deposit has a stiff to very stiff consistency / very loose to loose compactness condition.

Grain size distribution analysis was carried out on three samples of the silt to clayey silt deposit and the results are presented on Figure B-4 in Appendix B. Atterberg limit testing was carried out on five samples from this deposit: one sample tested non-plastic; and four samples measured liquid limits ranging from about 20 per cent to 24 per cent, plastic limits ranging from about 15 per cent to 17 per cent, and plasticity indices ranging from about 3 per cent to 7 per cent. The Atterberg limit test results are shown on Figure B-5 in Appendix B and indicate that the deposit ranges from a non-plastic silt, to silt of slight plasticity to clayey silt of low plasticity. The natural moisture content measured on samples of the silt to clayey silt deposit ranges from about 23 per cent to 30 per cent.

4.2.7 Varved Clay and Clayey Silt

A 1.4 m to 6.4 m thick cohesive deposit of varved clay and clayey silt, trace sand, was encountered below the silt to clayey silt deposit in Boreholes C256-1 to C256-3, between Elevations 271.7 m and 270.5 m. Boreholes C256-1 to C256-3 were terminated within this deposit between Elevations 269.1 m and 264.6 m.

The SPT “N”-values measured within the varved clay and clayey silt deposit range from 0 blows (weight of hammer – WH) to 4 blows per 0.3 m of penetration. In-situ field vane tests carried out within the deposit measured undrained shear strengths ranging from about 43 kPa to 91 kPa and a sensitivity of about 2.0. The SPT “N”-values, together with the field vane test results, suggest that the varved deposit has a firm to stiff consistency.

Grain size distribution testing was carried out on two samples of the combined varved clay and clayey silt and the results are presented on Figure B-6. Atterberg limit testing was carried out on three samples from the varved deposit and measured liquid limits ranging from about 24 per cent to 56 per cent, plastic limits ranging from about 15 per cent to 23 per cent, and plasticity indices ranging from about 9 per cent to 34 per cent. The Atterberg limit test results are shown on Figure B-7 in Appendix B and indicate that the deposit (combined clay and clayey silt varves) ranges from clayey silt of low plasticity to clay of high plasticity (with clayey silt and clay varves). The natural moisture content measured on samples of the combined varved clay and clayey silt deposit ranges from about 28 per cent to 55 per cent.

4.3 Groundwater Conditions

The unstabilized groundwater levels measured inside the augers upon completion of drilling are summarized below. Groundwater and creek water levels in the area are subject to seasonal fluctuations and variations due to precipitation events.

Borehole No.	Depth to Unstabilized Groundwater Level (m)	Approximate Groundwater Elevation (m)
C256-1	1.5	284.1
C256-2	1.3	284.3
C256-3	1.4	283.9
C256-4	0.7	283.8
C256-5	0.5	283.6

4.4 Analytical Laboratory Testing Results

Analytical testing was carried out on a sample of the sand deposit recovered from Borehole C256-1 (Sample 4). The soil sample was submitted to Bureau Veritas Laboratories of Mississauga, Ontario for corrosivity testing. The analytical laboratory test results are summarized below, and the detailed analytical laboratory test report is included in Appendix B.

Borehole No.	Borehole Sample No.	Depth (m)	Parameters					
			Resistivity (ohm-cm)	Electrical Conductivity (µmho/cm)	Soluble Sulphate (SO ₄) Content (µg/g)	Chloride (Cl) Content (µg/g)	Sulphide (µg/g)	pH
C256-1	4	3.0 – 3.6	22,000	46	<20 ¹	<20 ¹	<0.30 ¹	6.30

Notes:

1. The sulphate, chloride, and sulphide concentrations are below the reportable detection limits of 20 µg/g, 20 µg/g and 0.30 µg/g, respectively.

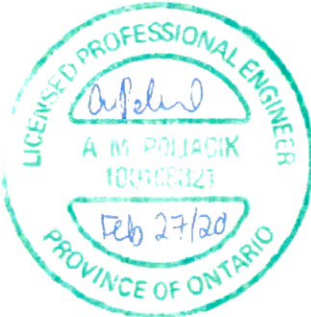
Redox potential testing was carried out on the sample noted above and yielded a value of -95.6 mV. The redox potential laboratory test report, provided by Eurofins Environmental Testing, is presented in Appendix B.

5.0 CLOSURE

The field drilling program was carried out under the supervision of Mr. Mathew Riopelle, under the overall direction of Mr. André Bom, P.Eng., an Associate of Golder. This Foundation Investigation Report was prepared by Ms. Anastasia Poliacik, P.Eng., a geotechnical engineer with Golder. Mr. André Bom, P.Eng., reviewed the report. Mr. Jorge Costa, P.Eng., an MTO Foundations Designated Contact and Senior Consultant with Golder, conducted an independent quality control review of this report.

Signature Page

Golder Associates Ltd.



Anastasia Poliacik, P.Eng.
Geotechnical Engineer



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

A handwritten signature in blue ink, appearing to read "André Bom".

André Bom, P.Eng.
Senior Geotechnical Engineer, Associate

AB/JMAC/ca

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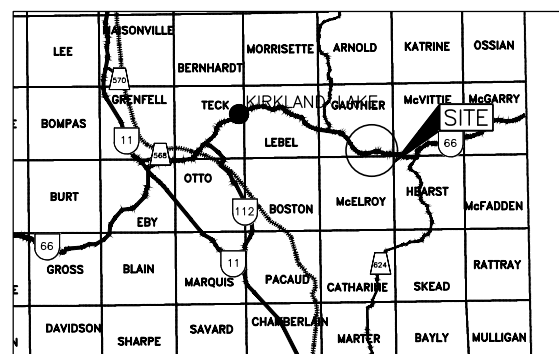
https://golderassociates.sharepoint.com/sites/1809001/deliverables/foundations/2_reporting/r16-gau256/3_final/1896349_r-rev0_aecom_culvert_gau256_hwy66_fir_27feb_2020.docx

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



CONT No.
GWP No. 5210-14-00

HIGHWAY 66
STATION 16+083
TOWNSHIP OF GAUTHIER CULVERT

BOREHOLE LOCATIONS AND SOIL STRATA



LEGEND

- | | |
|---|--|
|  | Borehole – Current Investigation |
| N | Standard Penetration Test Value |
| 16 | Blows/0.3m unless otherwise stated
(Std. Pen. Test, 475 j/blow) |
|  | WL upon completion of drilling |

BOREHOLE CO-ORDINATES (NAD 83 MTM ZONE 12)

No.	ELEVATION	NORTHING	EASTING
C256-1	285.6	5331091.7	392465.2
C256-2	285.6	5331081.1	392477.3
C256-3	285.3	5331102.7	392465.3
C256-4	284.5	5331080.4	392465.5
C256-5	284.1	5331104.7	392482.9



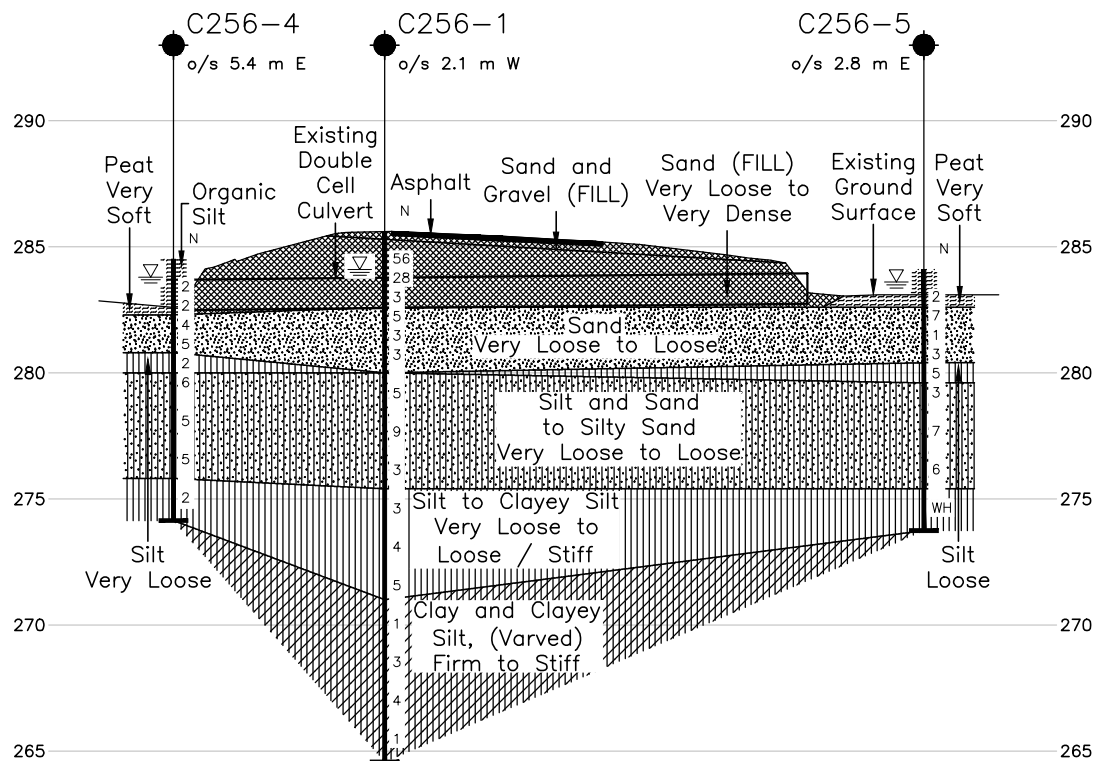
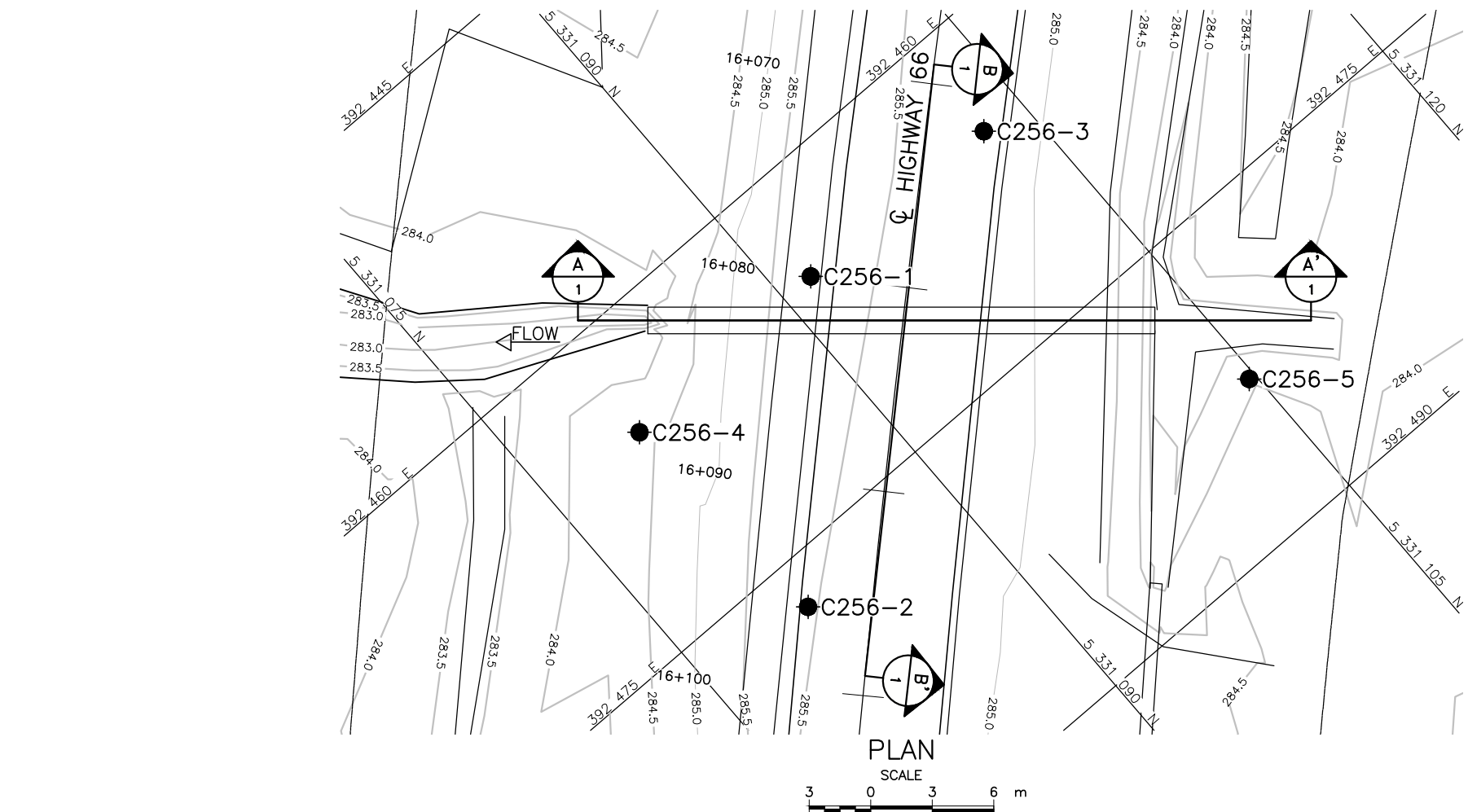
NOTES

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.

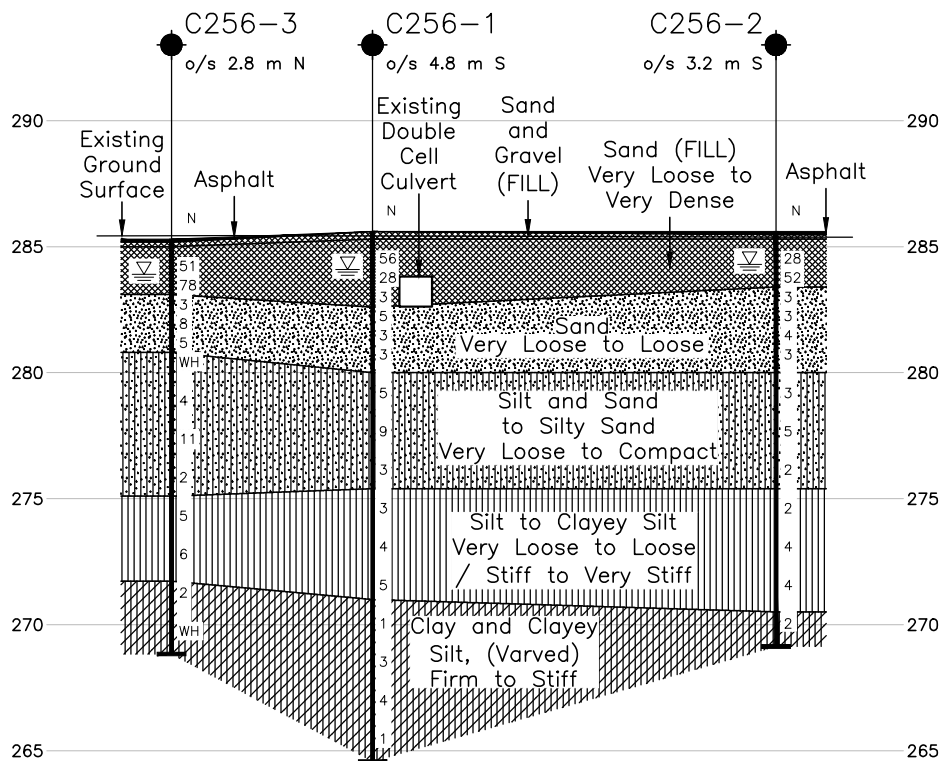
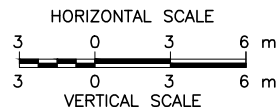
The boundaries between soil strata have been established only at borehole locations. Between boreholes the boundaries are assumed from geological evidence.

REFERENCE

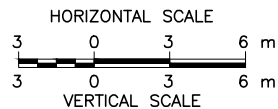
Base plans provided in digital format by CALLON DIETZ LTD. drawing file no. gwp52101400b.dwg, received AUGUST 14, 2019.



CULVERT CENTERLINE PROFILE



HIGHWAY CENTERLINE PROFILE





Photograph 1: Drilling rig set up at Borehole C256-1, looking south east (May 2019)



Photograph 2: North End (Inlet) of Culvert (May 2019)



Photograph 3: Drilling rig setup at Borehole C256-5, near Culvert Inlet (May 2019)



Photograph 4: South end (Outlet) of Culvert (May 2018)

APPENDIX A

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	>300	>12
COBBLES	Not Applicable	75 to 300	3 to 12
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

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 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.

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.

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

* 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 $= \sigma'_p / \sigma'_{vo}$

(d) Shear Strength

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

Notes: 1
2

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



SUD-MTO 001 S:\CLIENTS\IMTO\HWY65&66\02 DATA\GINT\1896349.GPJ GAL-MISS.GDT 11-25-19 TR

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

PROJECT 1896349		RECORD OF BOREHOLE No C256-1				2 OF 2 METRIC									
G.W.P. 5210-14-00		LOCATION N 5331091.7; E 392465.2 NAD83 MTM ZONE 12 (LAT. 48.112667; LONG. -79.822574)				ORIGINATED BY MR									
DIST _____ HWY 66		BOREHOLE TYPE 108 mm I.D. Hollow Stem Augers				COMPILED BY TR									
DATUM GEODETIC		DATE May 14, 2019				CHECKED BY AB									
SOIL PROFILE			SAMPLES			DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT		UNIT WEIGHT		REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	SHEAR STRENGTH kPa		WATER CONTENT (%)		γ		GR SA SI CL	
<div style="display: flex; justify-content: space-between;"> <div> <p>20 40 60 80 100</p> <p>20 40 60 80 100</p> </div> <div> <p>20 40 60</p> <p>20 40 60</p> </div> </div>															
<div style="display: flex; justify-content: space-between;"> <div> <p>○ UNCONFINED + FIELD VANE</p> <p>● QUICK TRIAXIAL × REMOULDED</p> </div> <div> <p>W_p — W — W_L</p> </div> </div>															
<div style="display: flex; justify-content: space-between;"> <div> <p>271.0</p> <p>14.6</p> </div> <div> <p>--- CONTINUED FROM PREVIOUS PAGE ---</p> <p>SILT to CLAYEY SILT, trace to some sand Very loose to loose / stiff Grey Wet</p> <p>CLAY and CLAYEY SILT, varved, trace sand Firm to stiff Grey Wet</p> </div> <div> <p>11</p> <p>SS</p> <p>4</p> </div> <div> <p>12</p> <p>SS</p> <p>5</p> </div> <div> <p>13</p> <p>SS</p> <p>1</p> </div> <div> <p>14</p> <p>SS</p> <p>3</p> </div> <div> <p>15</p> <p>SS</p> <p>4</p> </div> <div> <p>16</p> <p>SS</p> <p>1</p> </div> </div>															
<div style="display: flex; justify-content: space-between;"> <div> <p>273</p> <p>272</p> <p>271</p> <p>270</p> <p>269</p> <p>268</p> <p>267</p> <p>266</p> <p>265</p> </div> <div> <p>2</p> <p>2</p> <p>2</p> <p>2</p> <p>2</p> <p>2</p> <p>2</p> <p>2</p> </div> </div>															
<div style="display: flex; justify-content: space-between;"> <div> <p>NP</p> </div> <div> <p>0 10 83 7</p> <p>0 1 43 56</p> </div> </div>															
<p>END OF BOREHOLE</p> <p>NOTES:</p> <p>1. Water level measured at a depth of 1.5 m below ground surface (Elev. 284.1 m) inside augers upon completion of drilling.</p> <p>2. Borehole caved to a depth of 18.3 m below ground surface (Elev. 267.3 m) upon completion of drilling.</p>															

SUD-MTO 001 S:\CLIENTS\IMTO\HWY65&66\02 DATA\GINT\1896349.GPJ GAL-MISS.GDT 11-25-19 TR

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

PROJECT <u>1896349</u>		RECORD OF BOREHOLE No C256-2				2 OF 2 METRIC								
G.W.P. <u>5210-14-00</u>		LOCATION <u>N 5331081.1; E 392477.3 NAD83 MTM ZONE 12 (LAT. 48.112571; LONG. -79.822414)</u>				ORIGINATED BY <u>MR</u>								
DIST <u> </u> HWY <u>66</u>		BOREHOLE TYPE <u>108 mm I.D. Hollow Stem Augers</u>				COMPILED BY <u>TR</u>								
DATUM <u>GEODETIC</u>		DATE <u>May 13, 2019</u>				CHECKED BY <u>AB</u>								
SOIL PROFILE			SAMPLES			DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT		REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × REMOULDED		W _p	W	W _L	γ	GR SA SI CL
	--- CONTINUED FROM PREVIOUS PAGE ---							20 40 60 80 100						
270.5	SILT to CLAYEY SILT, trace sand Very loose to loose / stiff to very stiff Grey Wet		11	SS	4		273							
							272							
			12	SS	4									
							271							
15.1	CLAY and CLAYEY SILT, varved, trace sand Firm Grey Wet		13	SS	2		270							
269.1														
16.5	END OF BOREHOLE NOTES: 1. Water level measured at a depth of 1.3 m below ground surface (Elev. 284.3 m) inside augers upon completion of drilling. 2. Borehole caved to a depth of 3.3 m below ground surface (Elev. 282.3 m) upon completion of drilling.													

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PROJECT <u>1896349</u>		RECORD OF BOREHOLE No C256-3		1 OF 2 METRIC	
G.W.P. <u>5210-14-00</u>		LOCATION <u>N 5331102.7; E 392465.3 NAD83 MTM ZONE 12 (LAT. 48.112765; LONG. -79.822571)</u>		ORIGINATED BY <u>MR</u>	
DIST <u> </u> HWY <u>66</u>		BOREHOLE TYPE <u>108 mm I.D. Hollow Stem Augers</u>		COMPILED BY <u>TR</u>	
DATUM <u>GEODETIC</u>		DATE <u>May 14, 2019</u>		CHECKED BY <u>AB</u>	

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					WATER CONTENT (%)				GR	SA	SI	CL	
								<div><div><div></div><div></div><div></div><div></div><div></div></div></div>					<div><div><div></div><div></div><div></div></div></div>	<div><div><div></div><div></div><div></div></div></div>	<div><div><div></div><div></div><div></div></div></div>						
285.3	GROUND SURFACE					<div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div>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Continued Next Page

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

SUD-MTO 001 S:\CLIENTS\MTOWHY\65866\02_DATAGINT\1896349.GPJ GAL-MISS.GDT 11-25-19 TR

PROJECT 1896349		RECORD OF BOREHOLE No C256-3				2 OF 2 METRIC															
G.W.P. 5210-14-00		LOCATION N 5331102.7; E 392465.3 NAD83 MTM ZONE 12 (LAT. 48.112765; LONG. -79.822571)				ORIGINATED BY MR															
DIST _____ HWY 66		BOREHOLE TYPE 108 mm I.D. Hollow Stem Augers				COMPILED BY TR															
DATUM GEODETIC		DATE May 14, 2019				CHECKED BY AB															
SOIL PROFILE			SAMPLES			DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT			REMARKS & GRAIN SIZE DISTRIBUTION (%)						
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	SHEAR STRENGTH kPa					WATER CONTENT (%)			γ			GR SA SI CL		
	--- CONTINUED FROM PREVIOUS PAGE ---							20 40 60 80 100 ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × REMOULDED					W _p — W — W _L 20 40 60			kN/m ³					
271.7	SILT to CLAYEY SILT, trace sand Loose / Stiff Grey Wet		11	SS	6		273														
13.6	CLAY and CLAYEY SILT, varved, trace sand Stiff Grey Wet		12	SS	2		272														
							271														
							270														
268.8	END OF BOREHOLE		13	SS	WH		269														
16.5	NOTES: 1. Water level measured at a depth of 1.4 m below ground surface (Elev. 283.9 m) inside augers upon completion of drilling. 2. Borehole caved to a depth of 5.5 m below ground surface (Elev. 279.8 m) upon completion of drilling.																				

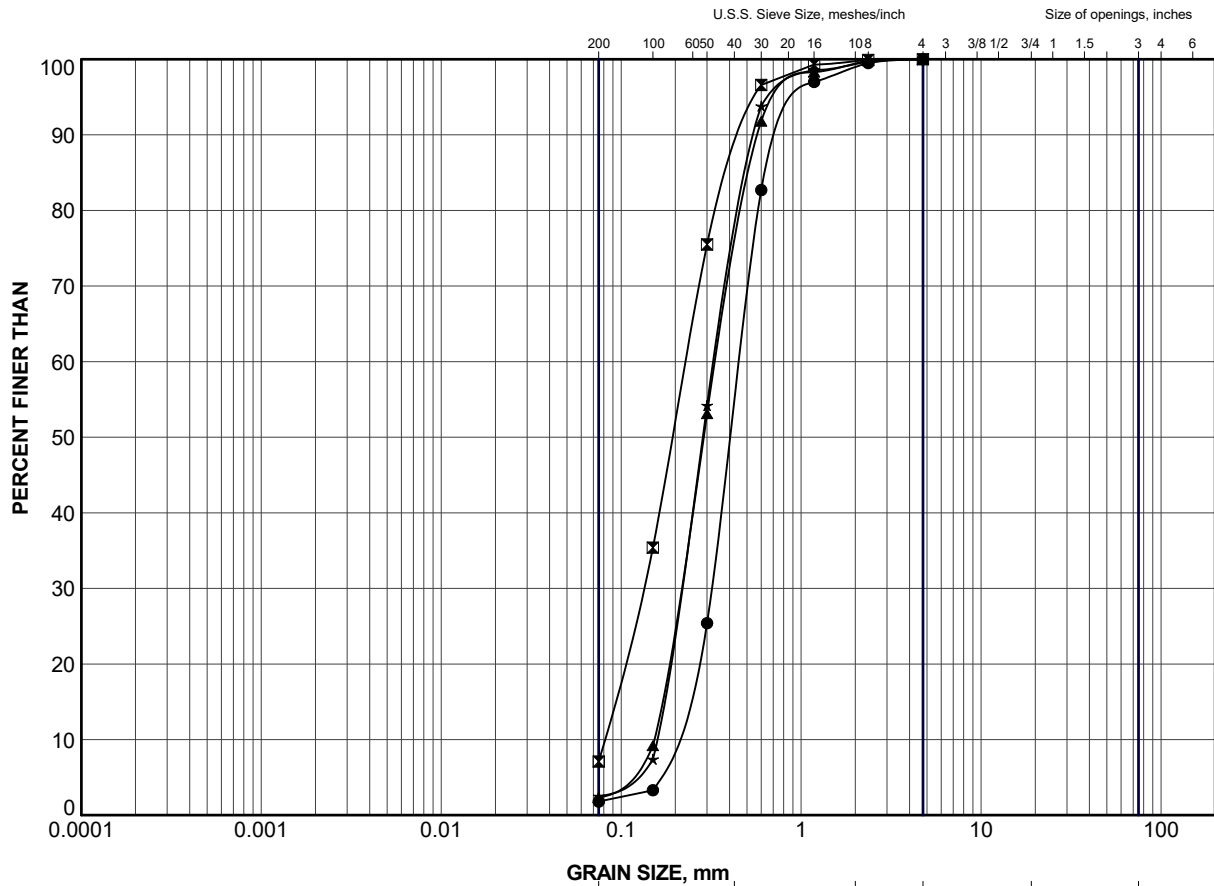
PROJECT 1896349		RECORD OF BOREHOLE No C256-4				1 OF 1 METRIC											
G.W.P. 5210-14-00		LOCATION N 5331080.4; E 392465.5 NAD83 MTM ZONE 12 (LAT. 48.112565; LONG. -79.822572)				ORIGINATED BY MR											
DIST _____ HWY 66		BOREHOLE TYPE 108 mm I.D. Hollow Stem Augers				COMPILED BY TR											
DATUM GEODETIC		DATE May 13, 2019				CHECKED BY AB											
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									
284.5	GROUND SURFACE							20	40	60	80	100					
0.0	ORGANIC SILT Black Wet						284										
283.7	Amorphous PEAT Very soft Dark brown Wet		1	SS	2		283										
			2	SS	2												
282.3	SAND, trace silt Very loose to loose Grey Wet		3	SS	4		282										
			4	SS	5		281										
280.8	SILT, some clay, trace sand Very loose Grey Wet		5	SS	2												
280.0	Sandy SILT to SILT and SAND, trace clay Loose Grey Wet		6	SS	6		280										
							279										
			7	SS	5		278										
							277										
			8	SS	5		276										
275.8	SILT Very loose Grey Wet		9	SS	2		275										
274.1	END OF BOREHOLE																
10.4	NOTES: 1. Water level measured at a depth of 0.7 m below ground surface (Elev. 283.8 m) inside augers upon completion of drilling. 2. Borehole caved to a depth of 2.5 m below ground surface (Elev. 282.0 m) upon completion of drilling.																

PROJECT 1896349		RECORD OF BOREHOLE No C256-5				1 OF 1 METRIC											
G.W.P. 5210-14-00		LOCATION N 5331104.7; E 392482.9 NAD83 MTM ZONE 12 (LAT. 48.112781; LONG. -79.822334)				ORIGINATED BY MR											
DIST _____ HWY 66		BOREHOLE TYPE 108 mm I.D. Hollow Stem Augers				COMPILED BY TR											
DATUM GEODETIC		DATE May 14, 2019				CHECKED BY AB											
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									
284.1	GROUND SURFACE							20	40	60	80	100					
0.0	Sand and gravel (FILL) Brown Moist																
283.7	Amorphous PEAT Very soft Dark brown Wet																
0.4			1	SS	2												
282.6																	
1.5	SAND, trace silt Very loose to loose Brown to grey Wet																
			2	SS	7												
			3	SS	1												0 97 (3)
			4	SS	3												
280.4																	
3.7	SILT Loose Grey Wet																
			5	SS	5												
279.6																	
4.5	Sandy SILT to SILT and SAND, trace to some clay Very loose to loose Grey Wet																
			6	SS	3												0 36 54 10
			7	SS	7												
			8	SS	6												
275.4																	
8.7	SILT to CLAYEY SILT Stiff Grey Wet																
			9	SS	WH												
273.7																	
10.4	END OF BOREHOLE																
	NOTE: 1. Water level measured at a depth of 0.5 m below ground surface (Elev. 283.6 m) inside augers upon completion of drilling. 2. Borehole caved to a depth of 2.4 m below ground surface (Elev. 281.7 m) upon completion of drilling.																

SUD-MTO 001 S:\CLIENTS\MTOWHY\6586602_DATAGINT\1896349.GPJ GAL-MISS.GDT 11-25-19 TR

APPENDIX B

Laboratory Test Results

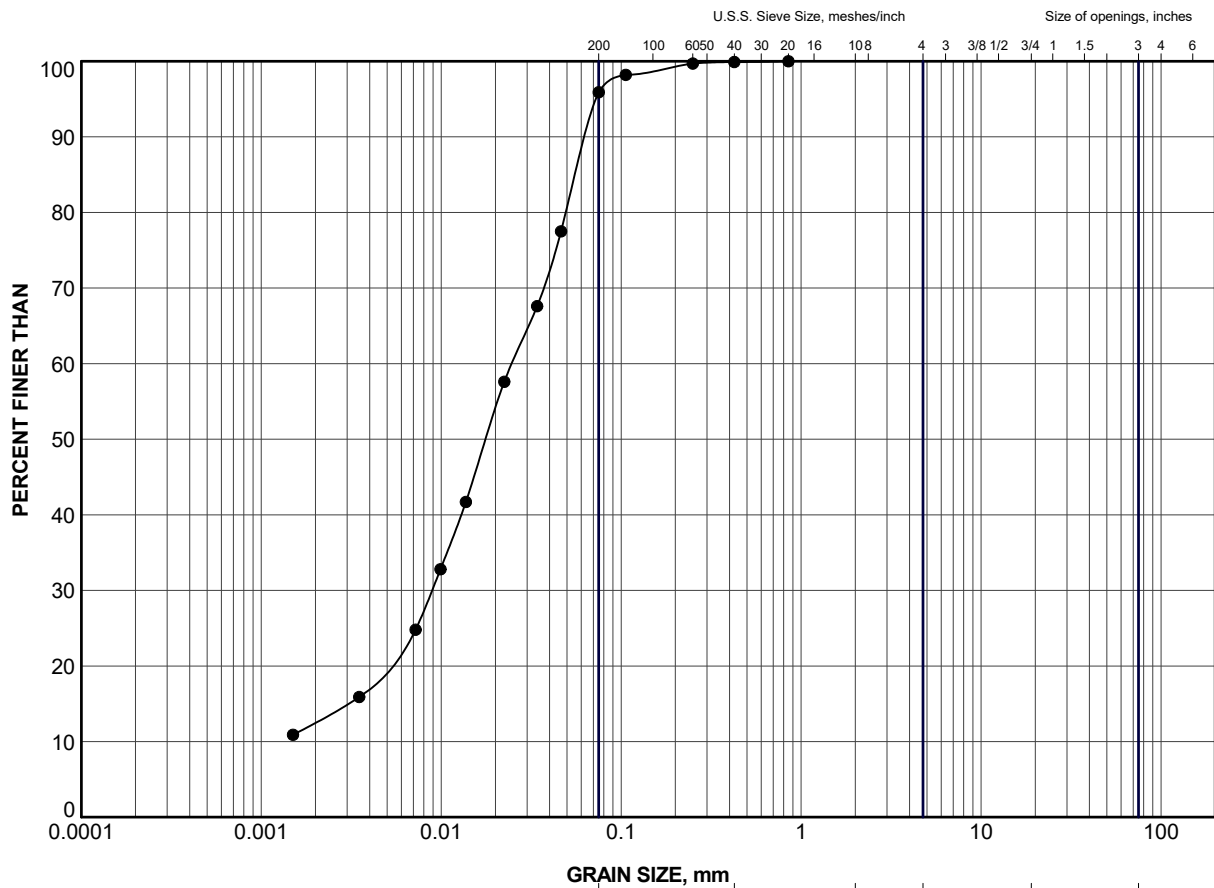


GRAVEL SIZE, mm						
CLAY AND SILT	fine	medium	coarse	fine	coarse	Cobble Size
	SAND SIZE			GRAVEL SIZE		

LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEV (m)
●	C256-1	5	281.5
⊠	C256-2	3	283.0
▲	C256-3	4	282.0
★	C256-5	3	281.5


PROJECT						HIGHWAY 66 STATION 16+083 TOWNSHIP OF GAUTHIER CULVERT					
TITLE						GRAIN SIZE DISTRIBUTION SAND					
PROJECT No.			1896349			FILE No.			1896349.GPJ		
DRAWN	TR	Nov 2019	SCALE	N/A	REV.	FIGURE B-1					
CHECK	AMP	Nov 2019									
APPR	JMAC	Nov 2019									
GOLDER						SUDBURY, ONTARIO					

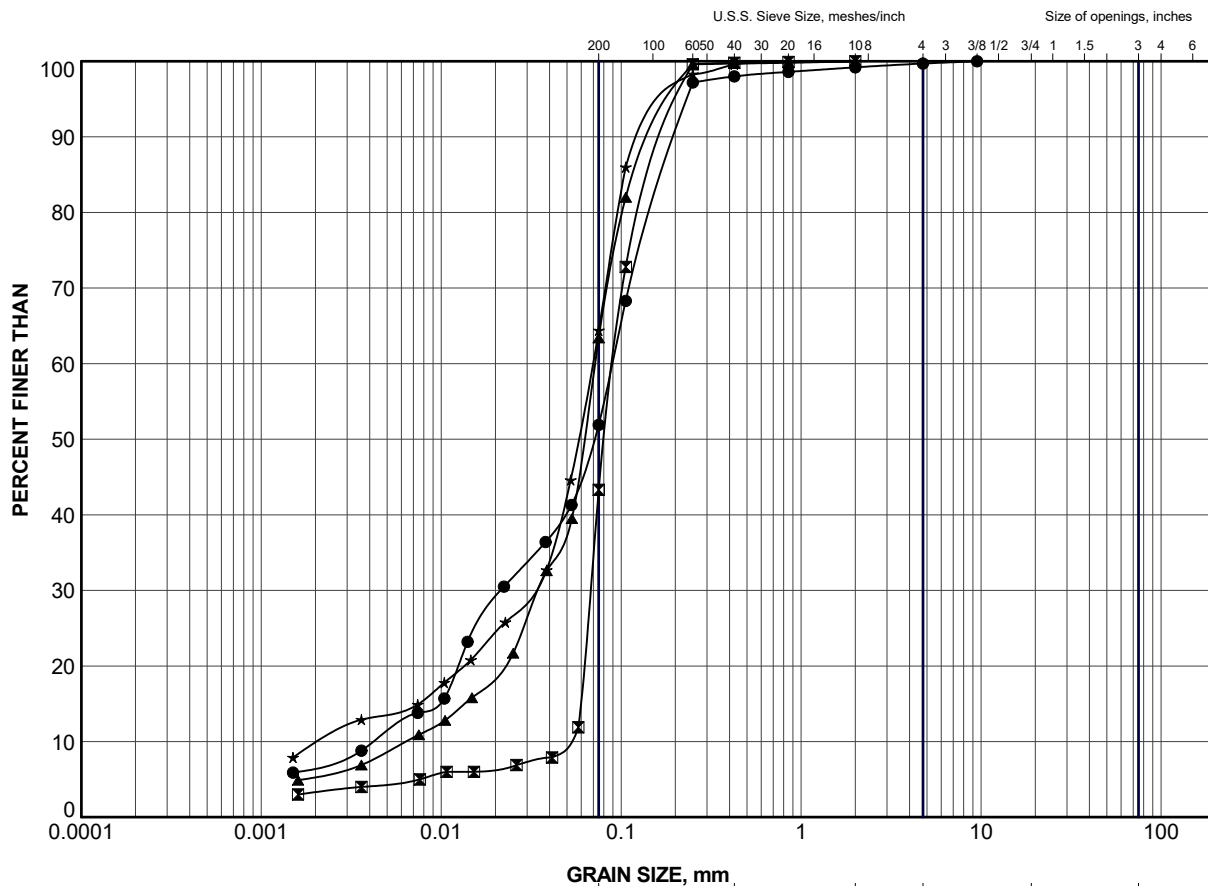


CLAY AND SILT	GRAIN SIZE, mm			Cobble Size	
	fine	medium	coarse	fine	coarse
SAND SIZE				GRAVEL SIZE	

LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEV (m)
●	C256-4	5	280.4


PROJECT						HIGHWAY 66 STATION 16+083 TOWNSHIP OF GAUTHIER CULVERT					
TITLE						GRAIN SIZE DISTRIBUTION SILT					
PROJECT No.			1896349			FILE No.			1896349.GPJ		
DRAWN	TR	Nov 2019	SCALE	N/A	REV.	FIGURE B-2					
CHECK	AMP	Nov 2019									
APPR	JMAC	Nov 2019									
 GOLDER SUDBURY, ONTARIO											

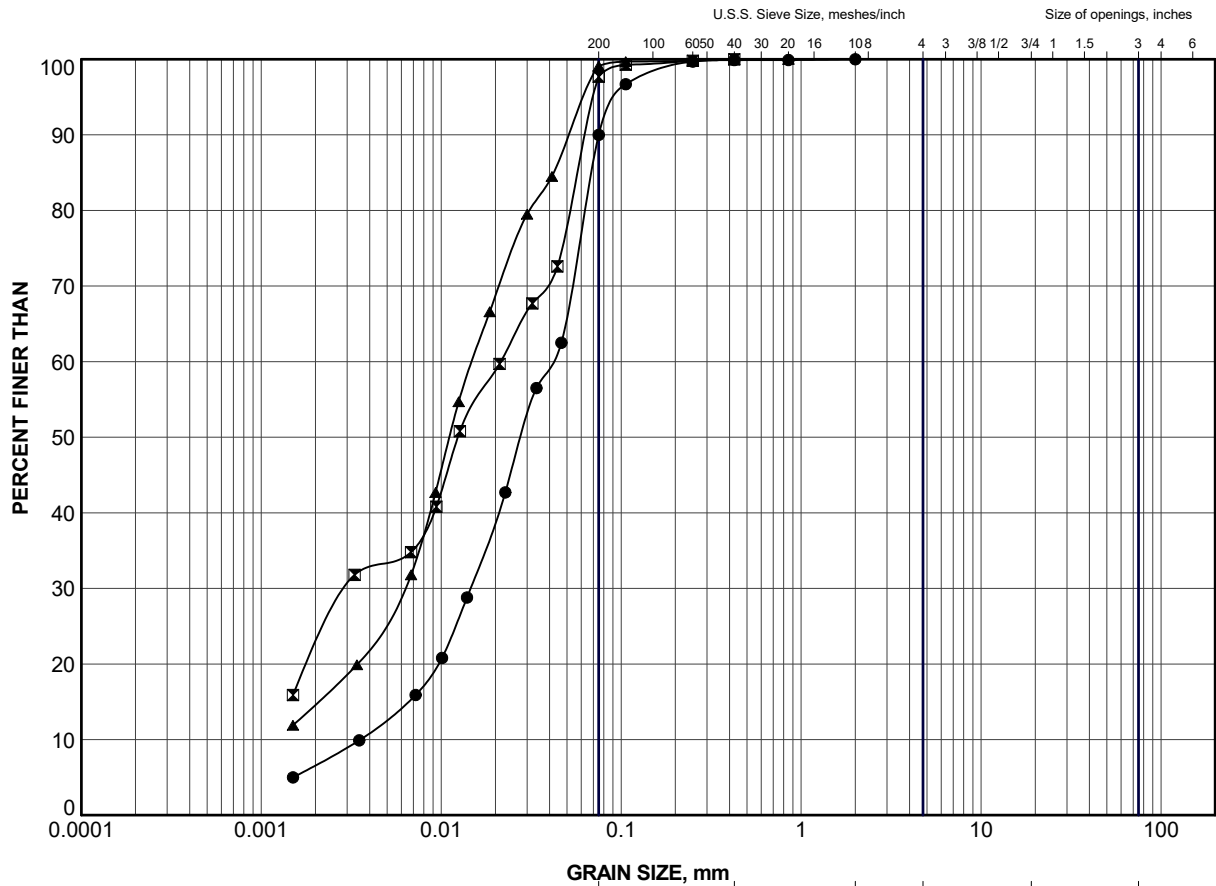


CLAY AND SILT	GRAVEL SIZE, mm					Cobble Size
	fine	medium	coarse	fine	coarse	
	SAND SIZE			GRAVEL SIZE		

LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEV (m)
●	C256-1	8	277.7
⊠	C256-2	7	279.2
▲	C256-3	9	275.9
★	C256-5	6	279.2

PROJECT						HIGHWAY 66 STATION 16+083 TOWNSHIP OF GAUTHIER CULVERT					
TITLE						GRAIN SIZE DISTRIBUTION SILT and SAND					
PROJECT No.			1896349			FILE No.			1896349.GPJ		
DRAWN	TR	Nov 2019	SCALE	N/A	REV.						
CHECK	AMP	Nov 2019									
APPR	JMAC	Nov 2019									
 GOLDER SUDBURY, ONTARIO						FIGURE B-3					

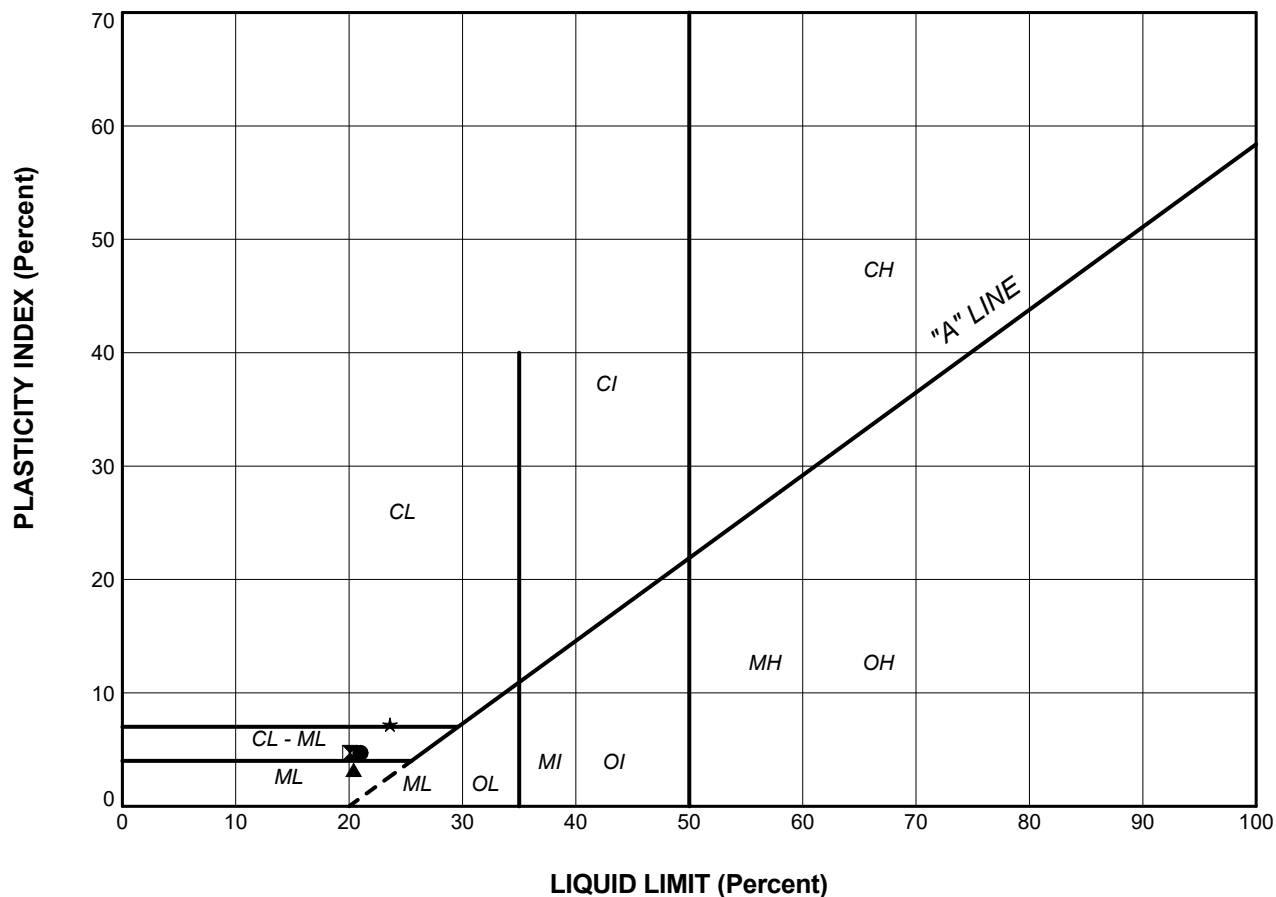


CLAY AND SILT	GRAVEL SIZE, mm						Cobble Size
	fine	medium	coarse	fine	coarse		
	SAND SIZE			GRAVEL SIZE			

LEGEND


SYMBOL	BOREHOLE	SAMPLE	ELEV (m)
●	C256-1	11	273.1
⊠	C256-2	10	274.6
▲	C256-4	9	275.1

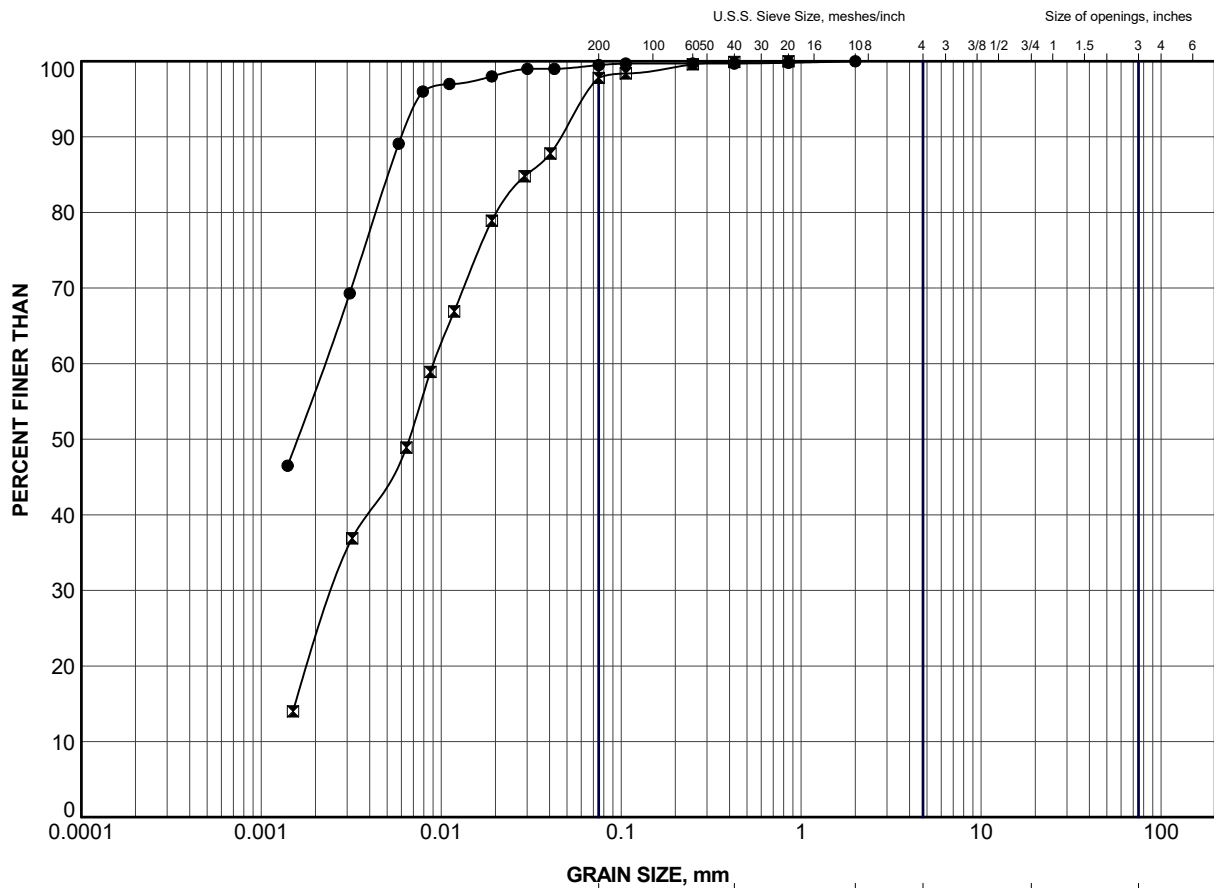
PROJECT		HIGHWAY 66 STATION 16+083 TOWNSHIP OF GAUTHIER CULVERT			
TITLE		GRAIN SIZE DISTRIBUTION SILT to CLAYEY SILT			
PROJECT No.		1896349		FILE No. 1896349.GPJ	
DRAWN	TR	Nov 2019	SCALE	N/A	REV.
CHECK	AMP	Nov 2019	FIGURE B-4		
APPR	JMAC	Nov 2019			
GOLDER		SUDBURY, ONTARIO			



LEGEND

SYMBOL	BOREHOLE	SAMPLE	LL(%)	PL(%)	PI
●	C256-2	10	21.0	16.3	4.7
⊠	C256-3	10	20.1	15.4	4.7
▲	C256-4	9	20.4	17.2	3.2
★	C256-5	9	23.6	16.4	7.2


PROJECT		HIGHWAY 66 STATION 16+083 TOWNSHIP OF GAUTHIER CULVERT			
TITLE		PLASTICITY CHART SILT to CLAYEY SILT			
PROJECT No.		1896349		FILE No. 1896349.GPJ	
DRAWN	TR	Nov 2019		SCALE	N/A
CHECK	AMP	Nov 2019		REV.	
APPR	JMAC	Nov 2019		FIGURE B-5	
 GOLDER SUDBURY, ONTARIO					

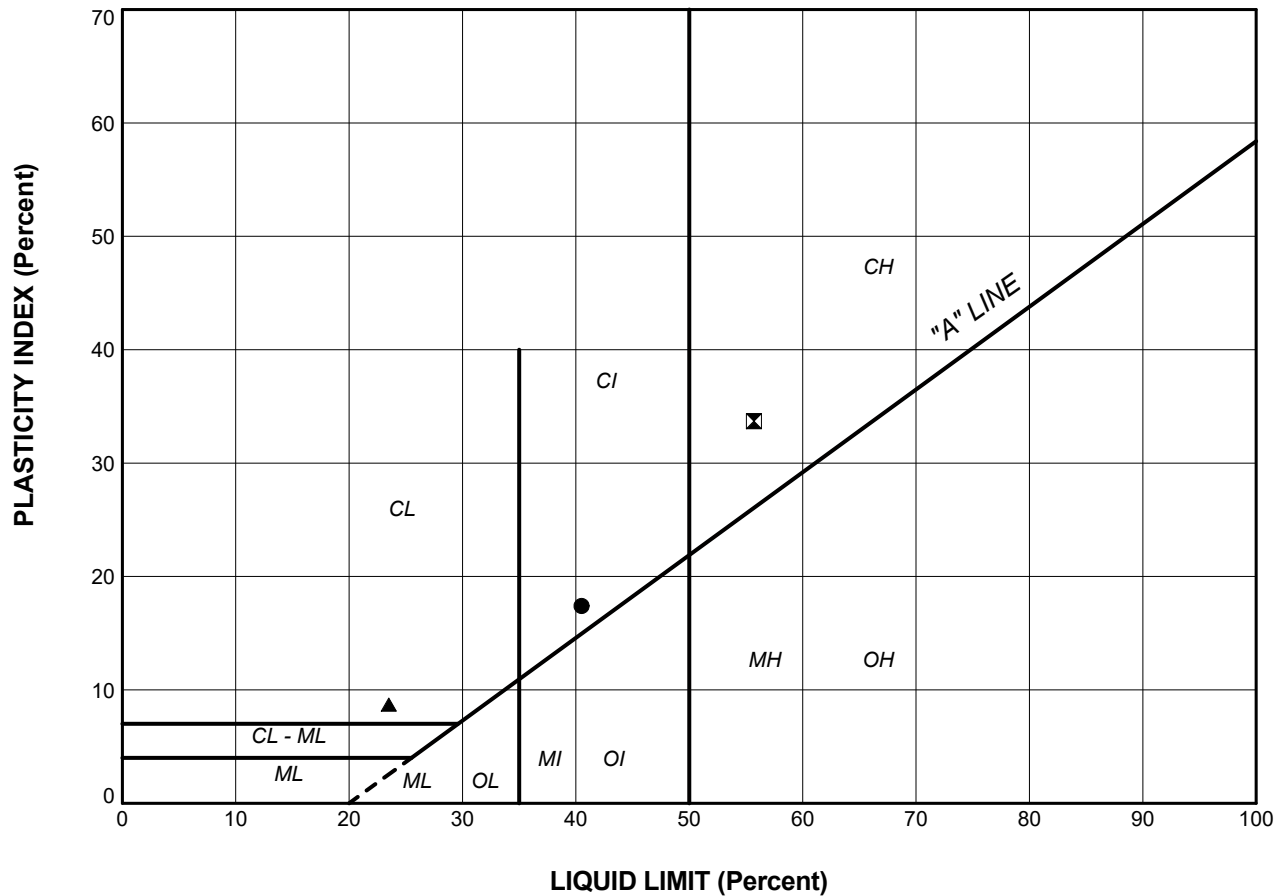


GRAIN SIZE, mm						
CLAY AND SILT	fine	medium	coarse	fine	coarse	Cobble Size
	SAND SIZE			GRAVEL SIZE		

LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEV (m)
●	C256-1	15	267.0
×	C256-3	12	271.3

PROJECT		HIGHWAY 66 STATION 16+083 TOWNSHIP OF GAUTHIER CULVERT			
TITLE		GRAIN SIZE DISTRIBUTION CLAY and CLAYEY SILT, varved (combined components)			
PROJECT No.		1896349		FILE No. 1896349.GPJ	
DRAWN	TR	Nov 2019	SCALE	N/A	REV.
CHECK	AMP	Nov 2019			
APPR	JMAC	Nov 2019			
 GOLDER SUDBURY, ONTARIO		FIGURE B-6			



SOIL TYPE
 C = Clay
 M = Silt
 O = Organic

PLASTICITY
 L = Low
 I = Intermediate
 H = High

LEGEND

SYMBOL	BOREHOLE	SAMPLE	LL(%)	PL(%)	PI
●	C256-1	14	40.5	23.1	17.4
⊠	C256-1	15	55.7	22.0	33.7
▲	C256-3	12	23.5	14.8	8.7

PROJECT						HIGHWAY 66 STATION 16+083 TOWNSHIP OF GAUTHIER CULVERT					
TITLE						PLASTICITY CHART CLAY and CLAYEY SILT, varved (combined components)					
PROJECT No.			1896349			FILE No.			1896349.GPJ		
DRAWN	TR	Nov 2019	CHECK	AMP	Nov 2019	SCALE	N/A	REV.			
APPR	JMAC	Nov 2019				FIGURE B-7					



GOLDER

SUDBURY, ONTARIO



BUREAU
VERITAS

BV Labs Job #: B9D3975
Report Date: 2019/06/03

Golder Associates Ltd
Client Project #: 1896349(2100)
Site Location: HWY 66
Sampler Initials: MR

RESULTS OF ANALYSES OF SOIL

BV Labs ID		JTI432			JTI433	JTI434	JTI435	JTI436		
Sampling Date		2019/05/03 10:45			2019/05/04 14:47	2019/05/08 12:39	2019/05/11 16:36	2019/05/14 08:49		
COC Number		127611			127611	127611	127611	127611		
	UNITS	C236-1 Lab-Dup	RDL	QC Batch	C267-1	C228-1	C227-1	C256-1	RDL	QC Batch

CONVENTIONALS										
Sulphide	ug/g				<0.30	<0.30	<0.30	<0.30	0.30	6150574
Calculated Parameters										
Resistivity	ohm-cm				23000	12000	2500	22000		6129977
Inorganics										
Soluble (20:1) Chloride (Cl ⁻)	ug/g				<20	29	250	<20	20	6133046
Conductivity	umho/cm				43	84	405	46	2	6135430
Available (CaCl ₂) pH	pH				7.74	6.56	7.00	6.30		6133358
Soluble (20:1) Sulphate (SO ₄)	ug/g				<20	<20	<20	<20	20	6133048
Physical Testing										
Moisture-Subcontracted	%	15	0.30	6150575	21	20	20	20	0.30	6150575
RDL = Reportable Detection Limit QC Batch = Quality Control Batch Lab-Dup = Laboratory Initiated Duplicate										



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