



## FOUNDATION INVESTIGATION REPORT

# Highway 65, Station 11+775, Township of Kerns Culvert Replacement Ministry of Transportation, Ontario GWP 5204-14-00

Submitted to:

**AECOM Canada Ltd**

189 Wyld Street, Suite 103  
North Bay, ON P1B 1Z2

Submitted by:

**Golder Associates Ltd.**

33 Mackenzie Street, Suite 100  
Sudbury, Ontario, P3C 4Y1, Canada  
+1 705 524 6861

1896349-R08

October 17, 2019

GEOCRES NO: 31M-128

LAT: 47.639094  
LONG: -79.864841



## Distribution List

3 Copies + 1 PDF Copy: Ministry of Transportation, Ontario (NE Region)

1 Copy + 1 PDF Copy: Ministry of Transportation, Ontario (Foundations)

1 Copy + 1 PDF Copy: AECOM Canada Ltd.

1 PDF Copy: Golder Associates Ltd.

# Table of Contents

## PART A - FOUNDATION INVESTIGATION REPORT

<b>1.0 INTRODUCTION .....</b>	<b>1</b>
<b>2.0 SITE DESCRIPTION .....</b>	<b>1</b>
<b>3.0 INVESTIGATION PROCEDURES .....</b>	<b>1</b>
<b>4.0 SITE GEOLOGY AND SUBSURFACE CONDITIONS.....</b>	<b>3</b>
4.1 Regional Geology.....	3
4.2 Subsurface Conditions .....	3
4.2.1 Asphalt/Fill.....	4
4.2.2 Silty Clay .....	4
4.2.3 Upper Silt .....	5
4.2.4 Clayey Silt to Silty Clay .....	5
4.2.5 Lower Silt .....	5
4.3 Groundwater Conditions .....	6
4.4 Analytical Laboratory Testing Results.....	6
<b>5.0 CLOSURE .....</b>	<b>6</b>

## DRAWINGS

Drawing 1: Borehole Locations and Soil Strata

## PHOTOGRAPHS

Photographs 1 to 4

## APPENDICES

### APPENDIX A Record of Boreholes

Lists of Abbreviations and Symbols

Record of Boreholes C78-1 to C78-5

### APPENDIX B Laboratory Test Results

Figure B-1 Plasticity Chart – Silty Clay to Organic Silty Clay (FILL)

Figure B-2 Grain Size Distribution – Silty Clay (FILL)

Figure B-3 Plasticity Chart – Clayey Silt to Silty Clay

Figure B-4 Grain Size Distribution – Clayey Silt to Silty Clay

Maxxam Analytical Laboratory Test Report

**PART A**

FOUNDATION INVESTIGATION REPORT  
HIGHWAY 65, STA 11+775, TOWNSHIP OF KERNS  
CULVERT REPLACEMENT  
MINISTRY OF TRANSPORTATION, ONTARIO  
GWP 5204-14-00

## 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 65 at Station 11+775, in the Township of Kerns, Ontario, approximately 1.3 km west of the intersection with McCool Road. The Key Plan of the general location of this section of Highway 65 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 the Drawing 1. For the purpose of this report, Highway 65 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 south-north direction.

The existing culvert consists of a 1.2 m diameter, 35 m long Corrugated Steel Pipe (CSP). At the inlet of the culvert, a wooden catch basin is connected to the outlet of a separate pipe that extends parallel to the highway on the south side towards the east. The culvert inlet (south end) and outlet (north end) inverts are approximately Elevations 228.4 m and 227.1 m, respectively. In general, the topography within the vicinity of the culvert consists of sloping ground on the side of a hill that eventually leads into a valley where the highway crosses the Wabi River. The site is surrounded by relatively flat farm land and light forest cover with the Wabi River located about 200 m west of the site. At the culvert location, the highway grade is at approximately Elevation 233.5 m and the embankment is up to approximately 6.4 m high relative to the culvert invert at the outlet. The ground surface conditions at select locations near the culvert, are shown on Photographs 1 to 4. In general, the existing embankment sloped at about 2H:1V at the culvert location, did not show signs of instability at the time of our site visit in November 2018.

## 3.0 INVESTIGATION PROCEDURES

Field work for this subsurface investigation was carried out between November 19 to 23, 2018, and February 22 and 23, 2019, during which time, five boreholes (Boreholes C78-1 to C78-5) were advanced at approximately the locations shown on Drawing 1. Boreholes C78-1 to C78-3 were advanced through the roadway embankment using a track mounted CME-55LC drilling rig supplied and operated by George Downing Estate Drilling (Downing) of Grenville-Sur-La-Rouge, Quebec. Borehole C78-4 was advanced near the toe of the highway embankment adjacent to the culvert outlet, using a portable tripod rig supplied and operated by Landcore

Drilling (Landcore) of Chelmsford, Ontario. Borehole C78-5 was advanced near the toe of the highway embankment slope adjacent to the culvert inlet using a portable tripod rig supplied and operated by Downing for the upper 2.1 m portion of the borehole and the lower portion of the borehole, from 2.1 m to the bottom of the borehole, was advanced by Landcore's portable tripod rig. Traffic control, where required, was performed in accordance with MTO's Ontario Traffic Control Manual Book 7 – Temporary Conditions.

Boreholes C78-1 to C78-3 were advanced through the roadway using 108 mm I.D. Hollow Stem Augers and Boreholes C78-4 and C78-5 were advanced at the toes of the embankment slopes using NW casing with wash boring techniques. 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 a full weight automatic or cathead hammer (except the upper 2.1 m portion of Borehole C78-5), in accordance with the Standard Penetration Test (SPT) procedure (ASTM D1586). The split-spoon sampler utilized by Downing's portable equipment in the upper 2.1 m portion of Borehole C78-5 to obtain Samples 1 to 3 was driven by a half-weight hammer, and the SPT "N"-values shown on the borehole record have been adjusted to the inferred values that would have been obtained using a standard weight (63.6 kg) hammer. Field vane shear tests were conducted in cohesive soils for determination of undrained shear strengths (ASTM D2573) using an MTO Standard "N" size vane. The groundwater level inside the augers/casing was observed and recorded during the drilling operations. The boreholes were backfilled in accordance with Ontario Regulation 903 (as amended). The roadway surface at the boreholes drilled through Highway 65 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. Analytical laboratory testing of a suite of parameters for assessment of corrosion potential was carried out on select soil samples by Maxxam Analytics of Mississauga, Ontario.

The as-drilled borehole locations were measured relative to the highway chainage/station and centreline 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 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)
C78-1	5278400.7 (47.639146)	390080.9 (-79.864988)	232.8	15.9
C78-2	5278391.4 (47.639059)	390104.4 (-79.864677)	233.9	16.5
C78-3	5278399.4 (47.639132)	390093.9 (-79.864816)	233.5	20.4
C78-4	5278415.9 (47.639282)	390083.9 (-79.864945)	227.3	9.8
C78-5	5278379.7 (47.638955)	390098.1 (-79.864764)	231.1	9.8

## 4.0 SITE GEOLOGY AND SUBSURFACE CONDITIONS

### 4.1 Regional Geology

Based on Northern Ontario Engineering Geology Terrain Study (NOEGTS)<sup>1</sup> mapping, the culvert site is located within a glaciolacustrine plain, and the subsoils in the area primarily consist of clay and sand.

Based on geological mapping of bedrock in Ontario (MNDM)<sup>2</sup>, the site is underlain by mafic and related intrusive rocks and mafic dikes.

### 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 detailed results of geotechnical laboratory testing are contained in Appendix B. The results of the in-situ field tests (i.e., SPT 'N' values), as presented on the Record of Borehole sheets and discussed in Section 4.2, are uncorrected. The stratigraphic boundaries shown on the Record of Borehole sheets and on the interpreted stratigraphic profile 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 Maxxam) 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 major soil deposits and groundwater conditions encountered in the boreholes is provided below.

<sup>1</sup> Ontario Ministry of Natural Resources and Forestry. Northern Ontario Engineering Geology Terrain Study. Ontario Geological Society Electronic Mapping. Map 31MNW

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



It should be noted that the interpreted stratigraphy, shown on Drawing 1, is a simplification of the subsurface conditions.

#### 4.2.1 Asphalt/Fill

Asphalt was encountered in Boreholes C78-1 to C78-3 at ground surface between Elevation 233.9 m and 232.8 m. The asphalt ranges in thickness from about 200 mm to 240 mm. In Borehole C78-2, the asphalt was underlain by 100 mm of sand and gravel fill, which was underlain by an additional 80 mm of asphalt. An approximately 1 m to 1.6 m thick layer of sand and gravel to sand (fill) was encountered below the asphalt, underlain by an approximately 0.8 m to 1.6 m thick layer of silty clay fill with the surface between Elevation 232.5 m and 231.4 m, in turn underlain by a 0.8 m to 1.4 m thick layer of sand to silty sand (fill) with the surface between Elevation 230.9 m and 230.5 m. In Borehole C78-3, a 2.1 m thick layer of organic silty clay was encountered at Elevation 229.0 m. Trace wood pieces were encountered in the silty clay fill in Borehole C78-2 from 2.3 m to 2.9 m depth and in the organic silty clay in Borehole C78-3 from 5.0 m to 5.2 m depth. Trace to some asphalt fragments were encountered in the samples of the sand to silty sand (fill) in Boreholes C78-1 to C78-3. The sand to silty sand fill was noted to contain pieces of asphalt with a hydrocarbon odour in Sample 4 from Borehole C78-2 and Samples 4 and 5 in Borehole C78-3.

Borehole C78-4 encountered 0.6 m of silty sandy topsoil (fill) from ground surface at Elevation 227.3 m and Borehole C78-5 encountered 0.6 m of silty clay fill from ground surface at Elevation 231.1 m. In Borehole C78-5, the silty clay fill was underlain by 0.9 m of sand fill.

The SPT “N”-values measured within the sand to silty sand fill range between 5 and 50 blows per 0.3 m of penetration, indicating a loose to dense compactness condition. The SPT “N”-values measured within the silty clay, organic silty clay and topsoil (fill) range between 2 and 14 blows per 0.3 m of penetration, suggesting a soft to stiff consistency.

The water content measured on two samples of the silty clay fill in Boreholes C78-2 and C78-3 is 26% and 28% and on two samples of the organic silty clay fill in Borehole C78-3 is about 17% and 41%. An organic content test was carried out on Sample 7A from Borehole C78-3 and returned an organic content of 5.7%.

Atterberg limits testing was carried out on three selected samples of the silty clay to organic silty clay (fill), which measured liquid limits ranging from about 35 to 44%, plastic limits ranging from about 17 to 24% and plasticity indices ranging from about 17 to 20%. The Atterberg limit test results are shown on the plasticity chart on Figure B1 in Appendix B and indicate a cohesive deposit of low to intermediate plasticity. The results of grain size distribution tests completed on two samples of the silty clay fill are shown on Figure B2 in Appendix B.

#### 4.2.2 Silty Clay

In Boreholes C78-1 and C78-2, a 1.5 m and 1.4 m thick deposit of black to grey to brown silty clay, with trace to some organics (including wood pieces) was encountered underlying the fill at Elevations 229.8 m and 230.1 m, respectively.

The SPT “N”-values measured within the deposit are between 6 blows and 14 blows per 0.3 m of penetration, suggesting that the deposit has a firm to stiff consistency.



The water content measured on two samples of the silty clay deposit are 29% and 31%.

Atterberg limits testing was carried out on two samples of the clayey deposit, which measured liquid limits of about 35 and 40%, plastic limits of about 19 and 21% and plasticity indices of about 16 and 19%. Two Atterberg limit test results are shown on the plasticity chart on Figure B3 in Appendix B and indicate a cohesive deposit of intermediate plasticity. The results of grain size distribution tests completed on two samples of the deposit are shown on Figure B4 in Appendix B.

#### 4.2.3 Upper Silt

A 0.8 m thick deposit of grey silt with silty clay layers was encountered underlying the silty clay deposit in Borehole C78-1 at Elevation 228.3 m.

An SPT “N”-value measured within the silt deposit was 8 blows per 0.3 m of penetration, indicating a loose compactness condition.

#### 4.2.4 Clayey Silt to Silty Clay

A deposit of grey clayey silt to silty clay was encountered below the silt in Borehole C78-1, below the silty clay with trace to some organics in Borehole C78-2, and below the fill in Boreholes C78-3 to C78-5. The deposit was encountered from Elevations 229.6 m to 226.7 m and was 11.7 m thick in Borehole C78-3. Boreholes C78-1, C78-2, C78-4, and C78-5 were terminated after exploring the deposit to depths ranging from about 8.3 m to 11.3 m.

The SPT “N”-values in the clayey silt to silt clay deposit range from 0 blows (i.e., weight of hammer) to 7 blows per 0.3 m of penetration. In-situ shear vane testing carried out at frequent intervals within the deposit, measured shear strengths ranging from about 48 kPa to greater than 100 kPa, indicating a firm to very stiff consistency.

The water content measured on 13 samples of the clayey silt to silty clay deposit ranges from 30 to 41%.

Atterberg limits testing was carried out on eight selected samples of the cohesive deposit, which measured liquid limits ranging from about 26 to 39%, plastic limits ranging from about 16 to 21% and plasticity indices ranging from about 8 to 18%. The Atterberg limit test results are shown on the plasticity chart on Figure B3 in Appendix B and indicate a cohesive deposit of low to intermediate plasticity. The results of grain size distribution tests completed on four samples of the clayey silt to silty clay deposit are shown on Figure B4 in Appendix B.

#### 4.2.5 Lower Silt

In Borehole C78-3, a deposit of grey silt was encountered below the clayey silt to silty clay deposit at Elevation 215.2 m. Borehole C78-3 was terminated after exploring the silt deposit to a depth of 2.1 m.

Two SPT “N”-values measured within the silt deposit were 4 blows and 8 blows per 0.3 m of penetration, indicating a very loose to loose compactness condition.

### 4.3 Groundwater Conditions

The unstabilized groundwater levels relative to ground surface measured inside the casing or augers upon completion of drilling are summarized below. The watercourse was observed to be generally dry or frozen at the time of the investigation. Groundwater and watercourse levels in the area are subject to seasonal fluctuations and variations due to precipitation events. It is anticipated that water levels will be higher in the Spring and during periods of heavy precipitation, and perched groundwater conditions can be expected within the fill soils above the cohesive deposits.

Borehole No.	Depth Below Ground Surface to Unstabilized Groundwater Level (m)	Approximate Groundwater Elevation (m)
C78-1	Dry	n/a
C78-2	Dry	n/a
C78-3	Dry/4.8 <sup>1</sup>	228.7
C78-4	0 <sup>2</sup>	227.3
C78-5	0 <sup>2</sup>	231.1

Notes: n/a = not applicable

1. Borehole dry upon completion of drilling; however, when augers were drilled to 6.1 m depth, the water level inside hollow stem augers was at 4.8 m depth below ground surface.
2. Boreholes C78-4 and C78-5 were advanced using NW casing and wash boring techniques. As such, the measured groundwater levels were taken after introduction of water during wash boring and may not be representative of the in-situ groundwater conditions.

### 4.4 Analytical Laboratory Testing Results

Analytical testing was carried out on a soil sample recovered from Borehole C78-3. The soil sample was submitted to Maxxam Analytics of Sudbury, 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.	Sample No.	Depth (m)	Parameters					
			Resistivity (ohm-cm)	Electrical Conductivity (µmho/cm)	Soluble Sulphate (SO <sub>4</sub> ) Content (µg/g)	Sulphide (µg/g)	Soluble Chloride (Cl) Content (µg/g)	pH
C78-3	7B	6.6-6.7	2,400	416	<20 <sup>1</sup>	0.62	140	7.70

Note:

1. The sulphate concentration is below the reportable detection limit of 20 µg/g.

### 5.0 CLOSURE

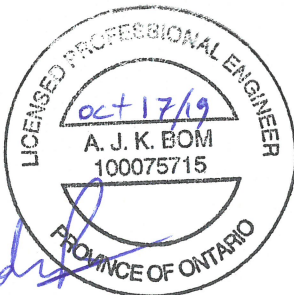
The field drilling program was carried out under the supervision of Mr. Mathew Riopelle, under the overall direction of Mr. André Bom, P.Eng. This Foundation Investigation Report was prepared by Ms. Kirsten Janssen, EIT and Mr. André Bom, P.Eng. provided a technical review of the report. Mr. Kevin Bentley, P.Eng., an MTO Foundations Designated Contact and Associate with Golder, conducted an independent quality control review of this report.

## Signature Page

Golder Associates Ltd.



Kirsten Janssen, EIT  
*Geotechnical Engineering Intern*



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



Kevin Bentley, P.Eng.  
*MTO Foundations Designated Contact, Associate*

GM/KJ/AB/sb/sm

Golder and the G logo are trademarks of Golder Associates Corporation

[https://golderassociates.sharepoint.com/sites/1809001/deliverables/foundations/2\\_reporting/r08-ker178/3\\_final/1896349-r08-rev0-aecom culvert 78 \(ker 178\) hwy 65 fidr 17oct\\_2019.docx](https://golderassociates.sharepoint.com/sites/1809001/deliverables/foundations/2_reporting/r08-ker178/3_final/1896349-r08-rev0-aecom%20culvert%2078%20(ker%20178)%20hwy%2065%20fidr_17oct_2019.docx)

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

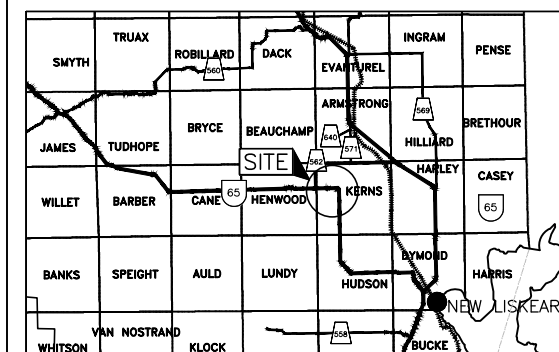
CONT No.  
GWP No. 5204-14-00





# HIGHWAY 65

STATION 11+775 TOWNSHIP OF KERNS CULVERT

## BOREHOLE LOCATIONS AND SOIL STRATA



## LEGEND

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

BOREHOLE CO-ORDINATES (NAD83 MTM ZONE 12)

No.	ELEVATION	NORTHING	EASTING
C78-1	232.8	5278400.7	390080.9
C78-2	233.9	5278391.4	390104.4
C78-3	233.5	5278399.4	390093.9
C78-4	227.3	5278415.9	390083.9
C78-5	231.1	5278379.7	390098.1



## NOTES

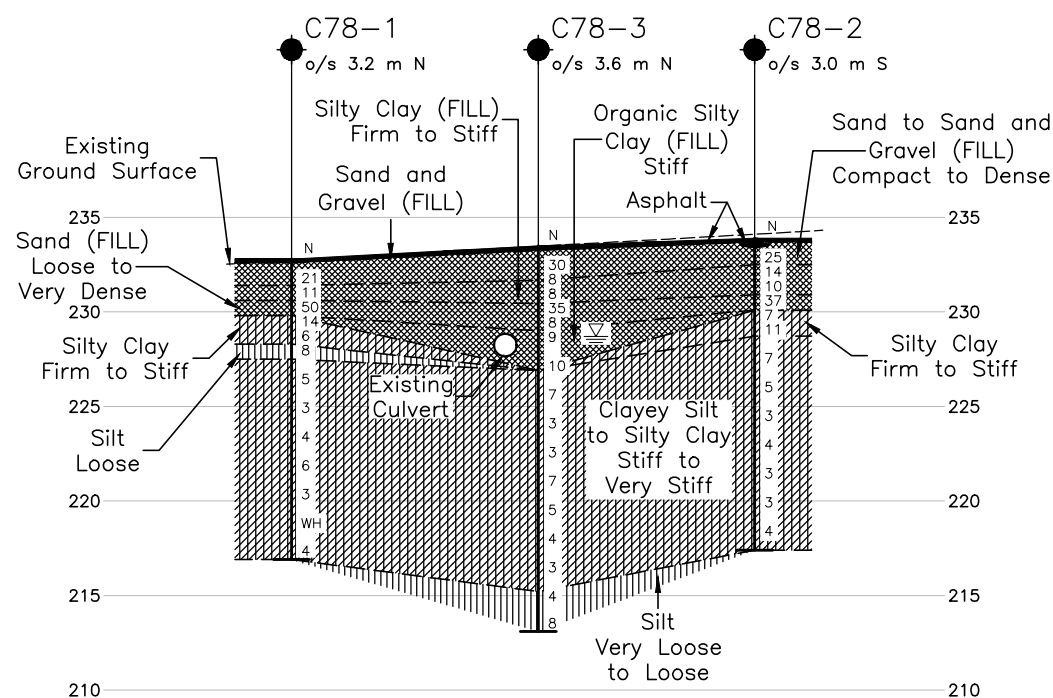
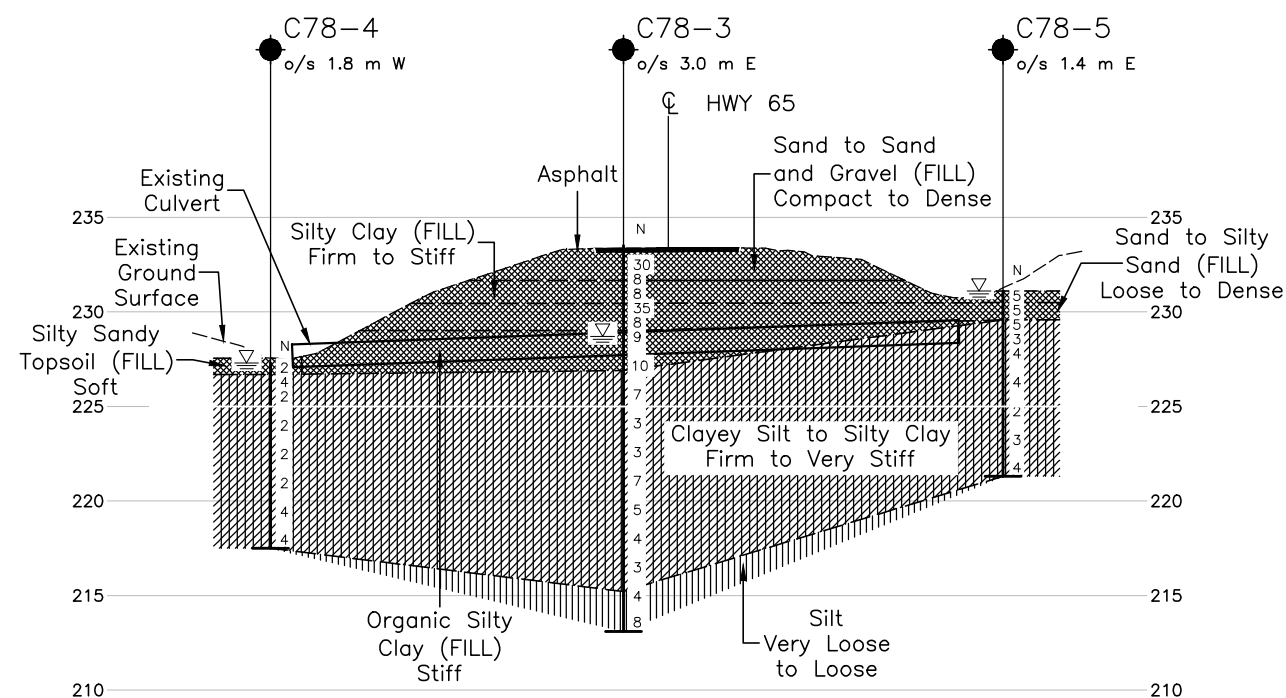
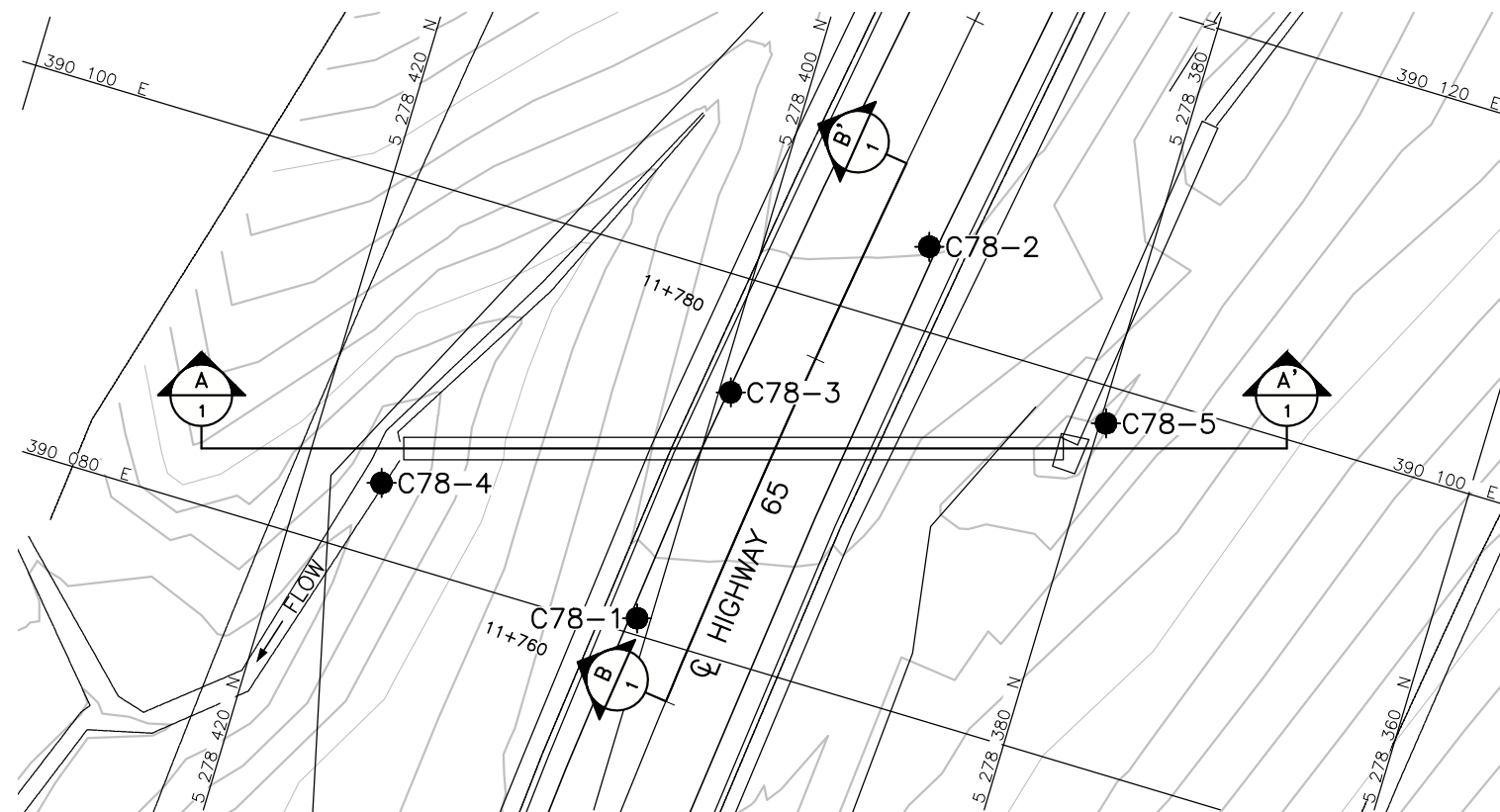
This drawing is for subsurface information only. The proposed structure details/works are shown for illustration purposes only and may not be consistent with the final design configuration as shown elsewhere in the Contracts Documents.

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 AECOM LTD. drawing file no. B065KER SITE 178.dwg, received JUNE 13, 2019.

NO.		DATE		BY	
REVISION					
Geocres No. 31M-128					
HWY. 65		PROJECT NO. 1896349			DIST. .
SUBM'D. KJ		CHKD. TB		DATE: 10/16/2019	
DRAWN: TR		CHKD. AB		APPD. KJB	
				DWG. 1	







**Photograph 1: Road Surface at Culvert, Facing West (November 2018)**



**Photograph 2: Road Surface at Culvert, Facing East (November 2018)**





**Photograph 3: Culvert Embankment and Outlet (North Side) from Roadway Surface (November 2018)**



**Photograph 4: Culvert Embankment and Inlet (South Side) from Roadway Surface (November 2018)**

**APPENDIX A**

# Record of Boreholes



## LIST OF SYMBOLS

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

### I. GENERAL

$\pi$	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

$\gamma$	shear strain
$\Delta$	change in, e.g. in stress: $\Delta \sigma$
$\varepsilon$	linear strain
$\varepsilon_v$	volumetric strain
$\eta$	coefficient of viscosity
$\nu$	Poisson's ratio
$\sigma$	total stress
$\sigma'$	effective stress ( $\sigma' = \sigma - u$ )
$\sigma'_{vo}$	initial effective overburden stress
$\sigma_1, \sigma_2, \sigma_3$	principal stress (major, intermediate, minor)
$\sigma_{oct}$	mean stress or octahedral stress $= (\sigma_1 + \sigma_2 + \sigma_3)/3$
$\tau$	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
$\gamma'$	unit weight of submerged soil ( $\gamma' = \gamma - \gamma_w$ )
$D_R$	relative density (specific gravity) of solid particles ( $D_R = \rho_s / \rho_w$ ) (formerly $G_s$ )
e	void ratio
n	porosity
S	degree of saturation

#### (a) Index Properties (continued)

w	water content
$w_l$ or LL	liquid limit
$w_p$ or PL	plastic limit
$I_p$ or PI	plasticity index = $(w_l - w_p)$
$w_s$	shrinkage limit
$I_L$	liquidity index = $(w - w_p) / I_p$
$I_c$	consistency index = $(w_l - w) / I_p$
$e_{max}$	void ratio in loosest state
$e_{min}$	void ratio in densest state
$I_D$	density index = $(e_{max} - e) / (e_{max} - e_{min})$ (formerly relative density)

#### (b) Hydraulic Properties

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

#### (c) Consolidation (one-dimensional)

$C_c$	compression index (normally consolidated range)
$C_r$	recompression index (over-consolidated range)
$C_s$	swelling index
$C_{\alpha}$	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
$\sigma'_p$	pre-consolidation stress
OCR	over-consolidation ratio = $\sigma'_p / \sigma'_{vo}$

#### (d) Shear Strength

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

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

Notes: 1  
2

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

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

## LIST OF ABBREVIATIONS

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

### I. SAMPLE TYPE

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

### II. PENETRATION RESISTANCE

#### Standard Penetration Resistance (SPT), N:

The number of blows by a 63.5 kg. (140 lb.) hammer dropped 760 mm (30 in.) required to drive a 50 mm (2 in.) drive open sampler for a distance of 300 mm (12 in.)

#### Dynamic Cone Penetration Resistance; $N_d$ :

The number of blows by a 63.5 kg (140 lb.) hammer dropped 760 mm (30 in.) to drive uncased a 50 mm (2 in.) diameter, 60° cone attached to "A" size drill rods for a distance of 300 mm (12 in.).

**PH:** Sampler advanced by hydraulic pressure

**PM:** Sampler advanced by manual pressure

**WH:** Sampler advanced by static weight of hammer

**WR:** Sampler advanced by weight of sampler and rod

#### Piezo-Cone Penetration Test (CPT)

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

### III. SOIL DESCRIPTION

#### (a) Non-Cohesive (Cohesionless) Soils

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

#### (b) Cohesive Soils Consistency

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

### IV. SOIL TESTS

w	water content
$w_p$	plastic limit
$w_l$	liquid limit
C	consolidation (oedometer) test
CHEM	chemical analysis (refer to text)
CID	consolidated isotropically drained triaxial test <sup>1</sup>
CIU	consolidated isotropically undrained triaxial test with porewater pressure measurement <sup>1</sup>
$D_R$	relative density (specific gravity, $G_s$ )
DS	direct shear test
M	sieve analysis for particle size
MH	combined sieve and hydrometer (H) analysis
MPC	Modified Proctor compaction test
SPC	Standard Proctor compaction test
OC	organic content test
SO <sub>4</sub>	concentration of water-soluble sulphates
UC	unconfined compression test
UU	unconsolidated undrained triaxial test
V	field vane (LV-laboratory vane test)
$\gamma$	unit weight

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

### V. MINOR SOIL CONSTITUENTS

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

SUD-MTO 001 S:\CLIENTS\MTO\HWY65&66\02 DATA\GINT\1896349.GPJ GAL-MISS.GDT 7-29-19 TR

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

PROJECT <u>1896349</u>		<b>RECORD OF BOREHOLE No C78-1</b>				2 OF 2 <b>METRIC</b>	
G.W.P. <u>5204-14-00</u>		LOCATION <u>N 5278400.7; E 390080.9 NAD83 MTM ZONE 12 (LAT. 47.639146; LONG. -79.864988)</u>				ORIGINATED BY <u>MR</u>	
DIST <u>          </u> HWY <u>65</u>		BOREHOLE TYPE <u>108 mm I.D. Hollow Stem Augers</u>				COMPILED BY <u>GM</u>	
DATUM <u>GEODETIC</u>		DATE <u>November 19, 2018</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 $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					WATER CONTENT (%)				
								20	40	60	80	100	W <sub>p</sub>	W	W <sub>L</sub>		
	--- CONTINUED FROM PREVIOUS PAGE ---																
	CLAYEY SILT to SILTY CLAY Stiff to very stiff Grey w>PL		11	SS	3											0 1 70 29	
						220											
			12	SS	WH	219											
						218											
216.9			13	SS	4												
15.9	END OF BOREHOLE					217											
	NOTES:  1. Borehole dry upon completion of drilling.																

PROJECT 1896349		RECORD OF BOREHOLE No C78-2				1 OF 2 METRIC									
G.W.P. 5204-14-00		LOCATION N 5278391.4; E 390104.4 NAD83 MTM ZONE 12 (LAT. 47.639059; LONG. -79.864677)				ORIGINATED BY MR									
DIST _____ HWY 65		BOREHOLE TYPE 108 mm I.D. Hollow Stem Augers				COMPILED BY GM									
DATUM GEODETIC		DATE November 22, 2018				CHECKED BY AB									
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa							
233.9	GROUND SURFACE														
0.0	ASPHALT (200 mm)														
	Sand and gravel (FILL)														
	ASPHALT (80 mm)														
0.5	Sand and gravel (FILL)														
	Sand, some gravel (FILL)														
	Compact Brown Frozen to moist		1	SS	25		233								
232.5	Silty clay (FILL)														
1.4	Stiff Grey w>PL		2	SS	14		232								
	- Trace wood pieces from 2.3 m to 2.9 m														
			3	SS	10										
230.9	Sand, some gravel, trace asphalt pieces, trace non-plastic fines, hydrocarbon odour (FILL)						231								
3.0	Dense Grey to black Wet		4	SS	37										
230.1	SILTY CLAY, trace to some organics, trace wood pieces						230								
3.8	Firm to stiff Black to grey w>PL		5	SS	7										
			6	SS	11		229								
228.7	CLAYEY SILT to SILTY CLAY														
5.2	Stiff to very stiff Grey w>PL						228								
			7	SS	7										
							227								
			8	SS	5		226								
			9	SS	3		225								
			10	SS	4		224								
							223								
							222								

Continued Next Page

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

SUD-MTO 001 S:\CLIENTS\MTOT\HWY65&amp;66\02\_DATA\GINT\1896349.GPJ GAL-MISS.GDT 7-29-19 TR

PROJECT <u>1896349</u>		<b>RECORD OF BOREHOLE No C78-2</b>				2 OF 2 <b>METRIC</b>	
G.W.P. <u>5204-14-00</u>		LOCATION <u>N 5278391.4; E 390104.4 NAD83 MTM ZONE 12 (LAT. 47.639059; LONG. -79.864677)</u>				ORIGINATED BY <u>MR</u>	
DIST <u>          </u> HWY <u>65</u>		BOREHOLE TYPE <u>108 mm I.D. Hollow Stem Augers</u>				COMPILED BY <u>GM</u>	
DATUM <u>GEODETIC</u>		DATE <u>November 22, 2018</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 $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					W <sub>p</sub>	W	W <sub>L</sub>		
								20	40	60	80	100					
	--- CONTINUED FROM PREVIOUS PAGE ---																
	CLAYEY SILT to SILTY CLAY Stiff to very stiff Grey w>PL		11	SS	3												
						221											
			12	SS	3	220											
						219											
			13	SS	4	218											
217.4																	
16.5	END OF BOREHOLE																
	NOTES:  1. Borehole dry upon completion of drilling.																

SUD-MTO 001 S:\CLIENTS\MTO\HWY65&66\02 DATA\GINT\1896349.GPJ GAL-MISS GDT 7-29-19 TR

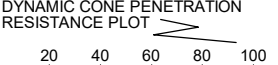


Continued Next Page

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




PROJECT 1896349		RECORD OF BOREHOLE No C78-3				2 OF 2 METRIC							
G.W.P. 5204-14-00		LOCATION N 5278399.4; E 390093.9 NAD83 MTM ZONE 12 (LAT. 47.639132; LONG. -79.864816)				ORIGINATED BY MR							
DIST _____ HWY 65		BOREHOLE TYPE 108 mm I.D. Hollow Stem Augers				COMPILED BY GM							
DATUM GEODETIC		DATE November 20, 2018				CHECKED BY AB							
SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa					
	--- CONTINUED FROM PREVIOUS PAGE ---						20 40 60 80 100						
	CLAYEY SILT to SILTY CLAY Stiff to very stiff Grey w>PL		11	SS	7								
			12	SS	5								
			13	SS	4								
			14	SS	3								
215.2													
18.3	SILT Very loose to loose Grey Wet		15	SS	4								
			16	SS	8								
213.1													
20.4	END OF BOREHOLE												
	NOTES:  1. When augers were drilled to 6.1 m depth, water level inside hollow stem augers was 4.8 m below ground surface.  2. Borehole dry upon completion of drilling.												

SUD-MTO 001 S:\CLIENTS\MTOT\HWY65&amp;66\02\_DATA\GINT\1896349.GPJ GAL-MISS.GDT 7-29-19 TR

PROJECT 1896349			RECORD OF BOREHOLE No C78-4			1 OF 1 METRIC					
G.W.P. 5204-14-00			LOCATION N 5278415.9; E 390083.9 NAD83 MTM ZONE 12 (LAT. 47.639282; LONG. -79.864945)			ORIGINATED BY MR					
DIST _____ HWY 65			BOREHOLE TYPE Portable Equipment, NW Casing, Wash Boring			COMPILED BY GM					
DATUM GEODETIC			DATE February 22, 2019			CHECKED BY AB					
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT  SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × REMOULDED	PLASTIC LIMIT W <sub>p</sub> NATURAL MOISTURE CONTENT W   LIQUID LIMIT W <sub>L</sub> WATER CONTENT (%)	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES						
227.3	GROUND SURFACE										
0.0	Silty sandy topsoil (FILL) Soft Brown to black Frozen		1	SS	2		227				
226.7											
0.6	CLAYEY SILT to SILTY CLAY Firm to stiff Grey w>PL		2	SS	4		226				
			3	SS	2		225				
							224				
			4	SS	2		223				
							222				
			5	SS	2		221				
							220				
			6	SS	2		219				
							218				
			7	SS	4						
			8	SS	4						
217.5	END OF BOREHOLE										
9.8	NOTES:  1. Water level at ground surface (Elev. 227.3 m) inside casing upon completion of drilling and wash boring activities.										

SUD-MTO 001 S:\CLIENTS\MTOT\HWY65&amp;66\02\_DATA\GINT\1896349.GPJ GAL-MISS.GDT 7-29-19 TR

PROJECT 1896349			RECORD OF BOREHOLE No C78-5			1 OF 2 METRIC											
G.W.P. 5204-14-00			LOCATION N 5278379.7; E 390098.1 NAD83 MTM ZONE 12 (LAT. 47.638955; LONG. -79.864764)			ORIGINATED BY MR											
DIST _____ HWY 65			BOREHOLE TYPE Portable Equipment, NW Casing, Wash Boring			COMPILED BY GM											
DATUM GEODETIC			DATE November 23, 2018 and February 23, 2019			CHECKED BY AB											
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES		ELEVATION SCALE	SHEAR STRENGTH kPa									WATER CONTENT (%)
231.1	GROUND SURFACE							20	40	60	80	100					
0.0	Silty clay, trace organics (FILL) Firm Dark brown w>PL		1	SS	5	231											
230.5	Sand, trace gravel (FILL) Loose Orange brown Moist		2	SS	5	230											
229.6	CLAYEY SILT to SILTY CLAY Stiff Grey w>PL		3	SS	5	229											
			4	SS	3	228											
			5	SS	4	227											
			6	SS	4	226											
			7	SS	2	225											
			8	SS	3	224											
			9	SS	4	223											
221.3	END OF BOREHOLE					222											
9.8																	

Continued Next Page

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

SUD-MTO 001 S:\CLIENTS\MTOT\HWY65&amp;66\02\_DATA\GINT\1896349.GPJ GAL-MISS.GDT 7-29-19 TR

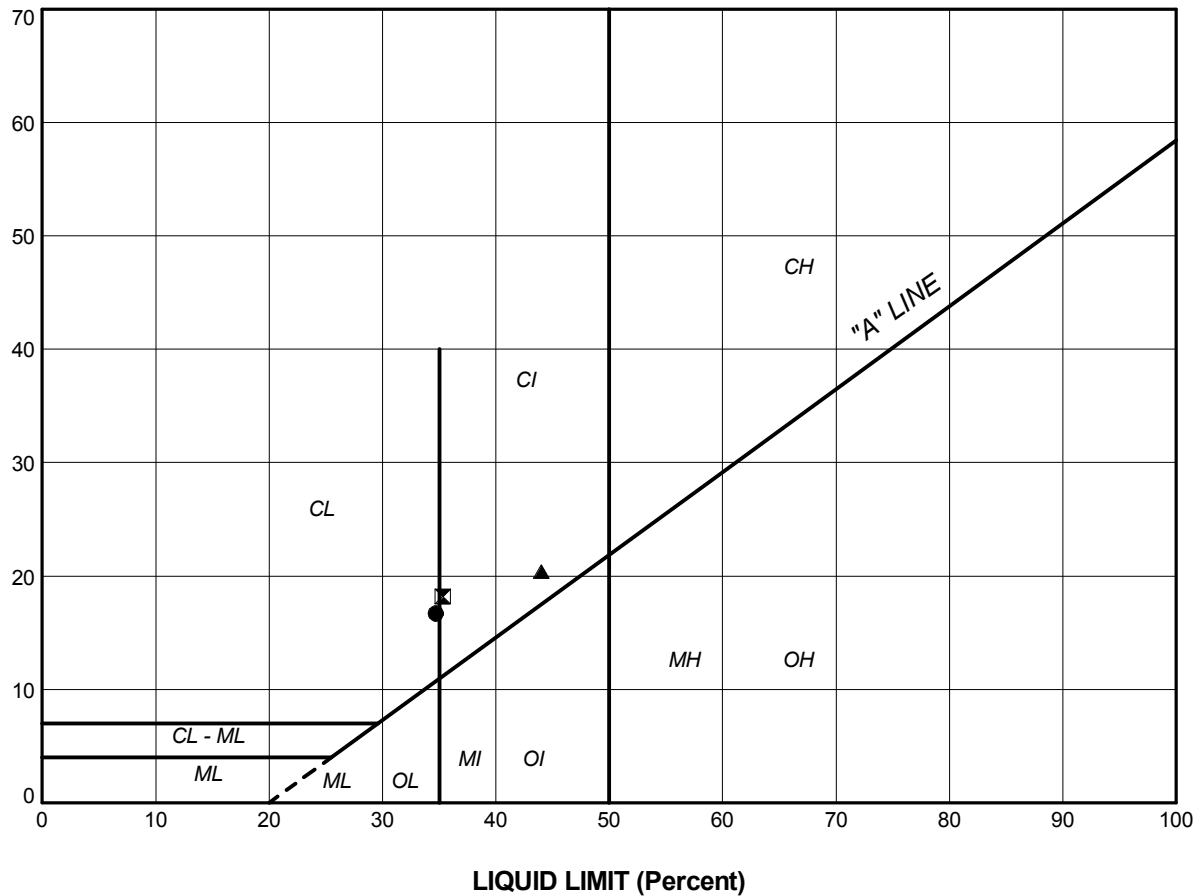
PROJECT <u>1896349</u>		<b>RECORD OF BOREHOLE No C78-5</b>				2 OF 2 <b>METRIC</b>																			
G.W.P. <u>5204-14-00</u>		LOCATION <u>N 5278379.7; E 390098.1 NAD83 MTM ZONE 12 (LAT. 47.638955; LONG. -79.864764)</u>				ORIGINATED BY <u>MR</u>																			
DIST <u>          </u> HWY <u>65</u>		BOREHOLE TYPE <u>Portable Equipment, NW Casing, Wash Boring</u>				COMPILED BY <u>GM</u>																			
DATUM <u>GEODETIC</u>		DATE <u>November 23, 2018 and February 23, 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 $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)									
ELEV. DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa					W <sub>p</sub>	W			W <sub>L</sub>								
--- CONTINUED FROM PREVIOUS PAGE ---							<div style="display: flex; justify-content: space-between;"> <span>20 40 60 80 100</span> <span>20 40 60 80 100</span> </div> <div style="display: flex; justify-content: space-between;"> <span>○ UNCONFINED   + FIELD VANE</span> <span>● QUICK TRIAXIAL   × REMOULDED</span> </div>					WATER CONTENT (%)													
	NOTES:  1. Borehole drilled to 2.1 m depth on Nov. 23, 2018 and from 2.1 m to 9.8 m on Feb. 23, 2019.  2. Water level at ground surface (Elev. 231.1 m) inside casing upon completion of drilling and wash boring activities.  3. Split spoon samples 1 to 3 obtained by driving with a half weight hammer. SPT 'N' values have been adjusted to the inferred values that would be measured using a standard weight hammer. Split spoon samples 4 to 9 obtained by driving a full weight hammer.																								

SUD-MTO 001 S:\CLIENTS\MTOT\HWY65&amp;66\02\_DATA\GINT\1896349.GPJ GAL-MISS.GDT 7-29-19 TR

**APPENDIX B**

# Laboratory Test Results

PLASTICITY INDEX (Percent)




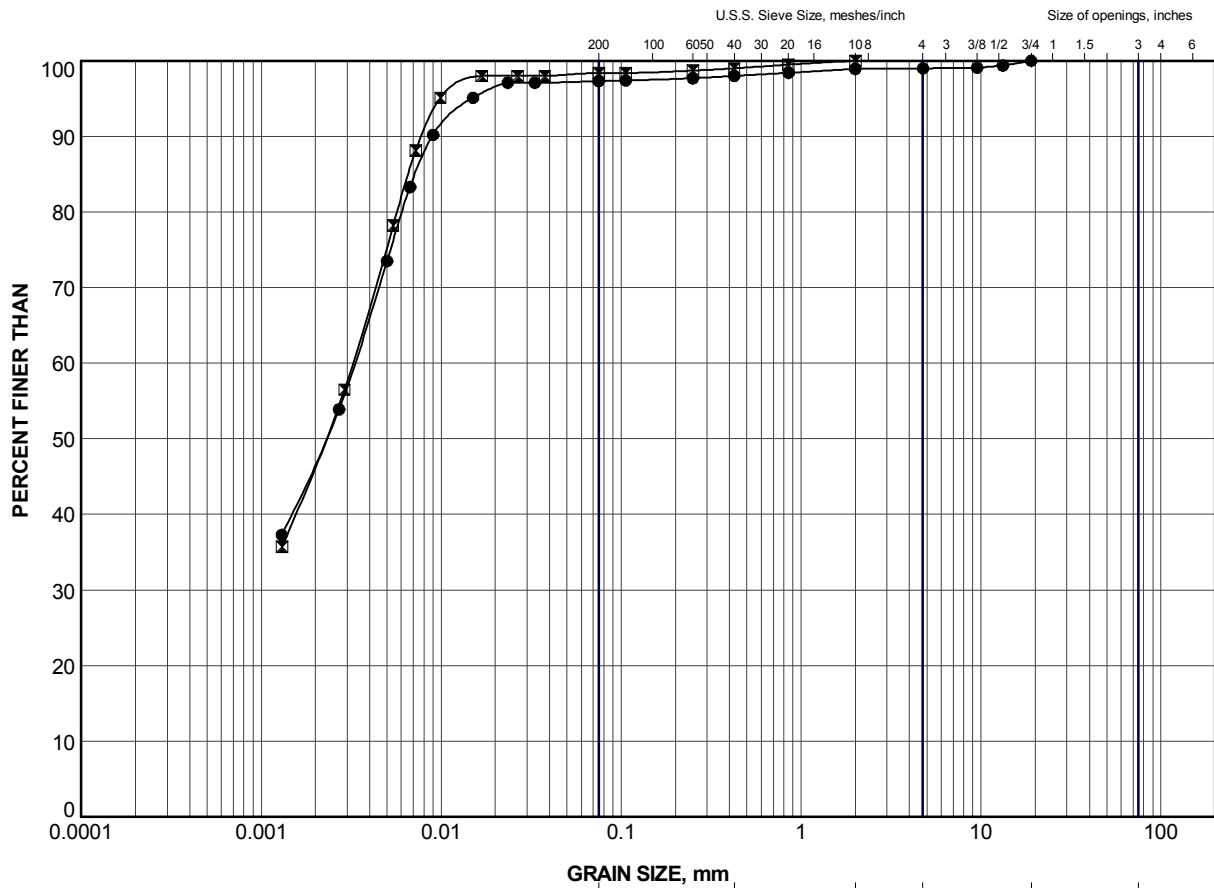
**SOIL TYPE**  
 C = Clay  
 M = Silt  
 O = Organic

**PLASTICITY**  
 L = Low  
 I = Intermediate  
 H = High

### LEGEND

SYMBOL	BOREHOLE	SAMPLE	LL(%)	PL(%)	PI
●	C78-2	3	34.7	18.0	16.7
⊠	C78-3	6	35.3	17.1	18.2
▲	C78-3	7A	44.0	23.6	20.4

PROJECT		HIGHWAY 65 STATION 11+775 TOWNSHIP OF KERNS CULVERT			
TITLE		<b>PLASTICITY CHART</b> Silty Clay to Organic Silty Clay (FILL)			
PROJECT No.		1896349		FILE No.	
DRAWN		TR	Oct 2019	SCALE	N/A
CHECK		AB	Oct 2019	REV.	
APPR		KJB	Oct 2019	FIGURE B-1	
 <b>GOLDER</b> SUDBURY, ONTARIO					



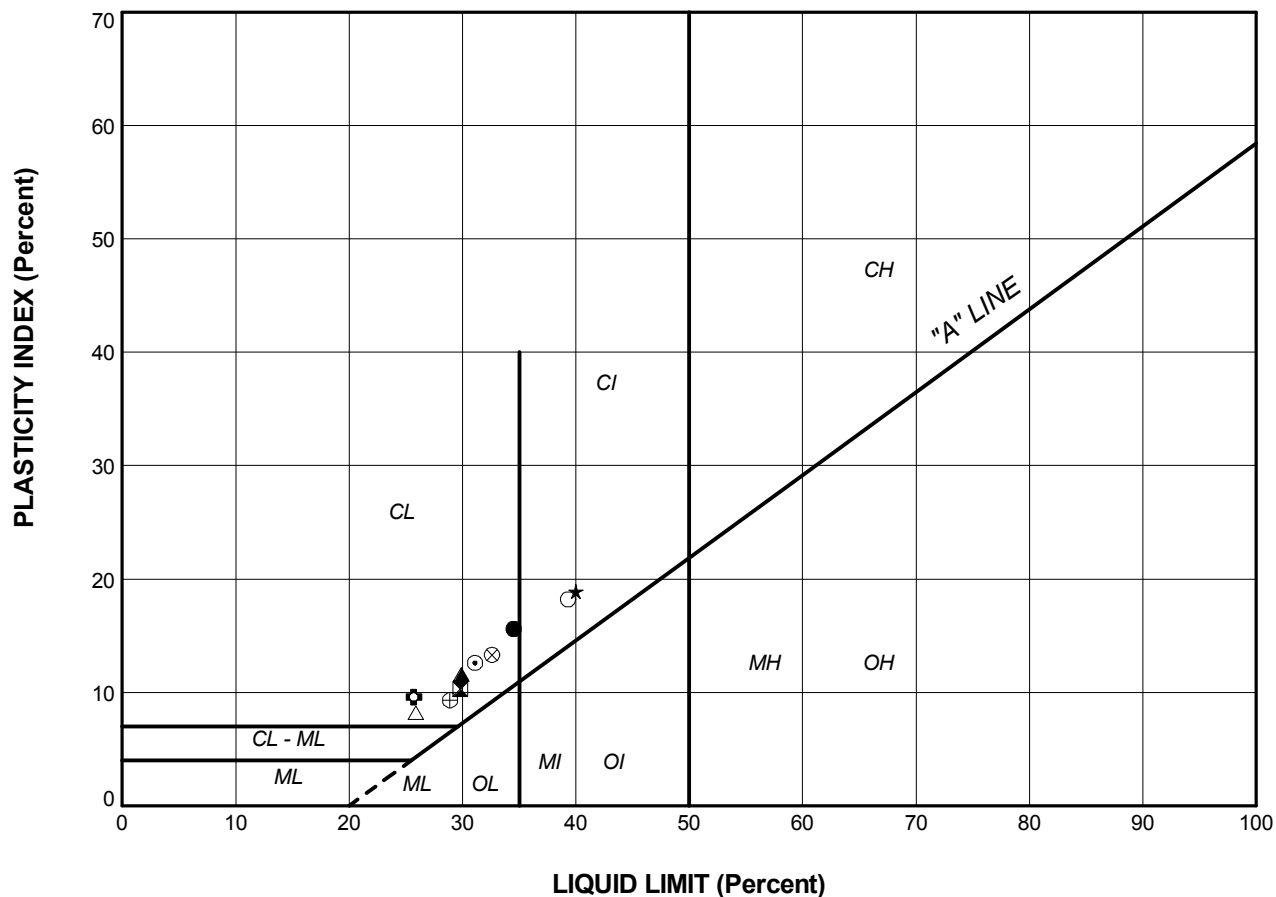
GRAVEL SIZE, mm							Cobble Size
CLAY AND SILT	fine	medium	coarse	fine	coarse		
	SAND SIZE			GRAVEL SIZE			

### LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEV (m)
●	C78-2	3	231.3
×	C78-3	3	230.9


PROJECT		HIGHWAY 65 STATION 11+775 TOWNSHIP OF KERNS CULVERT			
TITLE		<b>GRAIN SIZE DISTRIBUTION</b> Silty Clay (FILL)			
PROJECT No.		1896349		FILE No. 1896349.GPJ	
DRAWN	TR	Oct 2019	SCALE	N/A	REV.
CHECK	AB	Oct 2019	<b>FIGURE B-2</b>		
APPR	KJB	Oct 2019			
GOLDER		SUDBURY, ONTARIO			

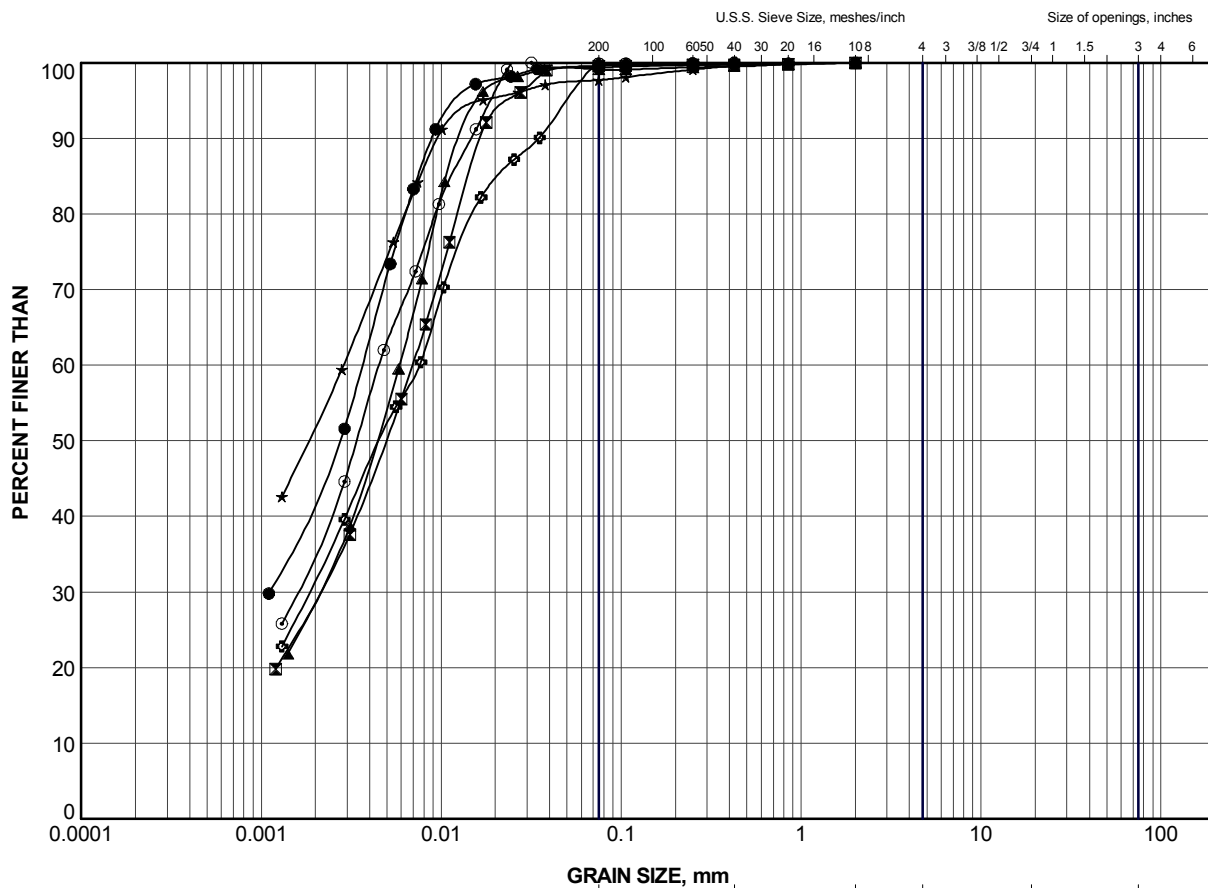




### LEGEND

SYMBOL	BOREHOLE	SAMPLE	LL(%)	PL(%)	PI
●	C78-1	5	34.5	18.9	15.6
⊠	C78-1	8	29.8	19.5	10.3
▲	C78-1	11	29.9	18.3	11.6
★	C78-2	6	40.0	21.1	18.9
⊙	C78-2	9	31.1	18.5	12.6
⊕	C78-3	10	25.7	16.1	9.6
○	C78-4	3	39.3	21.1	18.2
△	C78-4	6	25.9	17.7	8.2
⊗	C78-5	3	32.6	19.3	13.3
⊕	C78-5	7	28.9	19.6	9.3


PROJECT		HIGHWAY 65 STATION 11+775 TOWNSHIP OF KERNS CULVERT			
TITLE		<b>PLASTICITY CHART</b> Clayey Silt to Silty Clay			
PROJECT No.		1896349		FILE No.	
DRAWN		TR	Oct 2019	SCALE	N/A
CHECK		AB	Oct 2019	REV.	
APPR		KJB	Oct 2019	<b>FIGURE B-3</b>	
 <b>GOLDER</b> SUDBURY, ONTARIO					



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

### LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEV (m)
●	C78-1	5	228.7
⊠	C78-1	8	224.9
▲	C78-1	11	220.3
★	C78-2	6	229.0
⊙	C78-2	9	224.5
⊛	C78-3	10	222.5

PROJECT		HIGHWAY 65 STATION 11+775 TOWNSHIP OF KERNS CULVERT			
TITLE		<b>GRAIN SIZE DISTRIBUTION</b> Clayey Silt to Silty Clay			
PROJECT No.		1896349		FILE No. 1896349.GPJ	
DRAWN	TR	Oct 2019	SCALE	N/A	REV.
CHECK	AB	Oct 2019	<b>FIGURE B-4</b>		
APPR	KJB	Oct 2019			
 <b>GOLDER</b> SUDBURY, ONTARIO					

### RESULTS OF ANALYSES OF SOIL

<b>Maxxam ID</b>		IKA229		
<b>Sampling Date</b>		2018/11/20 12:12		
<b>COC Number</b>		62170		
	<b>UNITS</b>	<b>C78-3 SA 1</b>	<b>RDL</b>	<b>QC Batch</b>
<b>CONVENTIONALS</b>				
Sulphide	ug/g	0.62	0.50	5872398
<b>Calculated Parameters</b>				
Resistivity	ohm-cm	2400		5859836
<b>CONVENTIONALS</b>				
Redox Potential	mV	140	N/A	5865933
<b>Inorganics</b>				
Soluble (20:1) Chloride (Cl-)	ug/g	140	20	5862969
Conductivity	umho/cm	416	2	5863312
Available (CaCl2) pH	pH	7.70		5864763
Soluble (20:1) Sulphate (SO4)	ug/g	<20	20	5862489
<b>Physical Testing</b>				
Moisture-Subcontracted	%	24	0.30	5872397
RDL = Reportable Detection Limit QC Batch = Quality Control Batch N/A = Not Applicable				



**[golder.com](http://golder.com)**