



July 21, 2017

## FOUNDATION INVESTIGATION REPORT

# Agreement No. 2016-E-0031 Retainer Assignment #4 Gormley Patrol Yard Brine Storage Facility 1700 Major Mackenzie Drive Richmond Hill, Ontario

**Submitted to:**

Ontario Ministry of Transportation  
Geotechnical Engineering Section  
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159 Sir William Hearst Avenue  
Downsview, ON  
M3M 0B7

REPORT

**GEOCRES No.:** 30M14-465

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**Distribution:**

1 e-Copy - Ministry of Transportation Ontario  
1 e-Copy - Golder Associates Ltd.





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## FOUNDATION INVESTIGATION REPORT GORMLEY PATROL YARD BRINE STORAGE FACILITY

### 1.0 INTRODUCTION

Golder Associates Ltd. (Golder) has been retained by the Ministry of Transportation, Ontario (MTO) to provide foundation engineering services for the construction of a new concrete floor slab inside an old storage shed at the Gormley Patrol Yard located at 1700 Major Mackenzie Drive north of Highway 404 in Richmond Hill, Ontario (refer to the Key Plan on Drawing 1).

The terms of reference and scope of work for the foundation engineering services are outlined in MTO's Assignment Order Form for Order #4 for Agreement No. 2016-E-0031, issued on June 5, 2017.

### 2.0 SITE AND PROJECT DESCRIPTION

The site is located on the north side of Major Mackenzie Drive East in the Gormley Patrol Yard, approximately 350 m west of Hwy 404 in Richmond Hill in MTO's Central Region. There is currently an existing approximately 11 m (36 ft) long by 8.2 m (27 ft) wide storage shed at the site in which a new concrete floor slab will be constructed. The terrain at the site is generally flat, with the ground surface at about Elevation 217.6 m.

### 3.0 INVESTIGATION PROCEDURES

The field work for this investigation was carried out on June 21, 2017, at which time two boreholes (17-6 and 17-7) were advanced to a depth of 5 m, near the southwest and northeast corners of the shed, respectively, at the locations shown on the Drawing 1.

The borehole investigation was carried out using a 7822DT Geoprobe drill rig supplied and operated by Tri-Phase Group of Mississauga, Ontario using 150 mm diameter solid stem augers. Soil samples were obtained at intervals of depth of about 0.75 m and 1.5 m, using a 50 mm outside diameter split-spoon sampler driven by an automatic hammer in accordance with Standard Penetration Test (SPT) procedures (ASTM D1586 – Standard Test Method for Standard Penetration Test and Split-Barrel Sampling of Soils).

The groundwater conditions and water levels were observed in the open boreholes during and upon completion of drilling. A 19 mm diameter standpipe piezometer was installed in Borehole 17-6 and sealed within the clayey silt till deposit to monitor the groundwater level. The piezometer installation details and water level readings are indicated on the respective Record of Borehole sheet. The remaining borehole was backfilled to the ground surface upon completion of the drilling operations using bentonite pellets, in accordance with Ontario Regulation 903, as amended.

The field work for this investigation was observed by members of our engineering staff who arranged underground service locates, observed the drilling and sampling operations, and logged the boreholes. The soil samples were identified in the field, placed in appropriate containers, labelled and transported to Golder's Whitby geotechnical laboratory for further examination, natural water content testing and selected classification testing (i.e. sieve and hydrometer and Atterberg limits).

The borehole locations were located in the field by Golder referenced to existing site features and based on the layout drawing titled "Brine Storage Building Layout", provided by MTO. The borehole locations in MTM NAD83 (Zone 10) northing and easting coordinates and geographic coordinates, the ground surface elevation (referenced to Geodetic datum) and the drilled depths are presented below and shown on the Record of Borehole sheets. The locations and elevations of the as drilled boreholes were surveyed by Callon Dietz.



## FOUNDATION INVESTIGATION REPORT GORMLEY PATROL YARD BRINE STORAGE FACILITY

Borehole Number	Location (MTM NAD 83)		Ground Surface Elevation (m)	Borehole Depth (m)
	Northing (m) (Latitude°)	Easting (m) (Longitude°)		
17-6	4 860 407.2 (43.883579)	314 117.4 (-79.384047)	217.6	5.0
17-7	4 860 401.8 (43.883530)	314 126.1 (-79.383938)	217.6	5.0

## 4.0 GENERAL SITE GEOLOGY AND STRATIGRAPHY

### 4.1 Regional Geology

The study area of this assignment lies within the Stratford Till Plain physiographic region of Southern Ontario (Chapman and Putnam, 1984<sup>1</sup>). Subsoils in this physiographic region generally consist of silty clay till, where the silt and clay contents vary within certain limits (Chapman and Putnam, 1984<sup>2</sup>).

### 4.2 Site Stratigraphy

The detailed subsurface soil and groundwater conditions encountered in the boreholes, together with the results of geotechnical laboratory tests carried out on selected soil samples, are presented on the Record of Borehole sheets in Appendix A and on Figures B1 to B3 in Appendix B. The results of the in-situ field tests (i.e. SPT 'N' - values) as presented on the borehole records are uncorrected. The stratigraphic boundaries shown on the borehole records are inferred from non-continuous sampling, observations of drilling progress and the results of geotechnical in-situ and laboratory tests. These boundaries, therefore, represent transitions between soil types rather than exact planes of geological change. Subsoil conditions will vary between and beyond the borehole locations.

In summary, the boreholes advanced at the site encountered sand to sand and gravel fill at ground surface underlain by a till deposit comprised of clayey silt with sand, interlayered by sand and gravel. Groundwater was encountered within a depth of about 1 m below the ground surface. A more detailed description of the subsurface conditions encountered in the boreholes is provided in the following sections.

#### 4.2.1 Sand and Gravel (Fill)

An approximately 0.9 m and 1.1 m thick layer of sand and gravel fill was encountered from ground surface in both Boreholes 17-6 and 17-7, respectively. The base surface of the layer is at Elevation 4 to 6 m in both boreholes. The sand and gravel fill contains trace to some silt and trace clay pockets.

The measured SPT 'N'-values within the sand and gravel fill range from 1 blow to 8 blows per 0.3 m of penetration, indicating a very loose to loose relative density.

<sup>1</sup> Chapman, L.J., and Putnam, D/F/, 1984. *The Physiography of Southern Ontario*, 3<sup>rd</sup> Edition. Ontario Geological Survey, Special Volume 2. Ontario Ministry of Natural Resources.

<sup>2</sup> Chapman, L.J., and Putnam, D/F/, 1984. *The Physiography of Southern Ontario*, 3<sup>rd</sup> Edition. Ontario Geological Survey, Special Volume 2. Ontario Ministry of Natural Resources.



### 4.2.2 Clayey Silt with Sand (Till)

A 4.1 m and 3.9 m thick deposit of brown to grey, moist to wet, till was encountered below the sand and gravel fill in both Boreholes 17-6 and 17-7. The till deposit is comprised of an upper 1.2 m and 1.0 m thick layer and a lower 2.1 m thick layer of clayey silt with sand, trace gravel, intersected by a 0.8 m thick interlayer of sand and gravel (see section 4.2.3). The clayey silt with sand till deposit was encountered at depths of 0.9 m and 1.1 m below ground surface (Elevation 216.7 m and 216.5) and extended to the borehole termination depth of 5 m.

The SPT 'N'-values measured within the clayey silt with sand till deposit range from 3 blows to 72 blows per 0.3 m of penetration, suggesting a soft to hard consistency but generally a very stiff to hard consistency. The upper portion of the deposit and interface with the underlying fill measured SPT 'N'-values of 3 blows and 8 blows per 0.3 m of penetration inferred to be due to the influence of the fill deposit above.

Atterberg limits tests were carried out on three samples of the cohesive till and measured liquid limits ranging from about 17 per cent to 19 per cent, plastic limits ranging from about 10 per cent to 11 per cent and plasticity indices of about 8 per cent. The test results, which are plotted on a plasticity chart on Figure B1 in Appendix B, indicate that the material is a clayey silt of low plasticity.

The results of grain size distribution testing completed on three samples of the clayey silt with sand till are shown on Figure B2 in Appendix B.

The water contents measured on four samples of the clayey silt with sand till range from about 8 per cent to 12 per cent.

### 4.2.3 Sand and Gravel Interlayer

A 0.8 m thick interlayer of brown, wet, silty sand and gravel or sand and gravel, trace to some silt was encountered within the clayey silt with sand till in both boreholes at a depth of 2.1 m below ground surface (Elevation 215.5 m).

The SPT 'N'-values measured within the sand and gravel deposit are 31 blows and 41 blows per 0.3 m of penetration, indicating a dense relative density.

The result of grain size distribution testing completed on one sample of the sand and gravel is shown on Figure B3 in Appendix B.

The water contents measured on two samples of the interlayer are about 7 per cent and 9 per cent.

## 4.3 Groundwater Conditions

Details of the groundwater conditions encountered in the boreholes are shown on the Record of Borehole sheets. A standpipe piezometer was installed in Borehole 17-6 to allow monitoring of the groundwater level at the site. Details of the piezometer installation is shown on the Record of Borehole sheet in Appendix A. The groundwater level measured in the open boreholes is 0.8 m and 0.9 m below ground surface on completion of drilling operations in Boreholes 17-6 and 17-7, respectively, corresponding to between Elevations 216.8 m and 216.7 m.

The groundwater level was measured in the standpipe piezometer in Borehole 17-6 at a depth of 1.0 m below ground surface, corresponding to Elevation 216.6 m on July 10, 2017.

The groundwater levels in the area are subject to fluctuations seasonally and following precipitation events, and should be expected to be higher during wet periods of the year.



## **5.0 CLOSURE**

The field drilling program was supervised by and this report prepared by Ms. Lindsay Palmer. The technical aspects were reviewed by Sarah E. M. Poot, P.Eng., a senior geotechnical engineer and an Associate of Golder. Mr. Jorge M. A. Costa, P.Eng., a Senior Consultant of Golder and Designated MTO Foundations Contact conducted an independent quality control review of this report.



## FOUNDATION INVESTIGATION REPORT GORMLEY PATROL YARD BRINE STORAGE FACILITY

### Report Signature Page

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LP/SEMP/JMAC/nh

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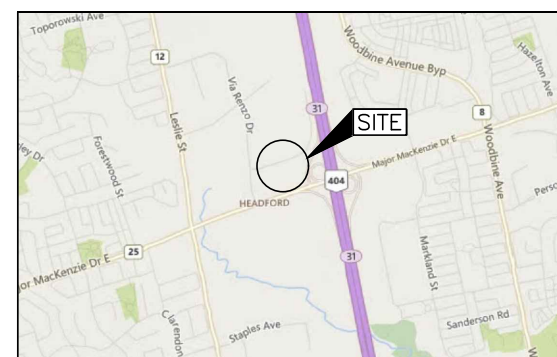
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WP No.,



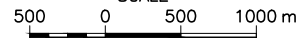
**HIGHWAY 404**  
GORMLEY PATROL YARD

**BOREHOLE LOCATIONS**

**SHEET**



KEY PLAN  
SCALE



## LEGEND



Borehole

BOREHOLE CO-ORDINATES			
No.	ELEVATION	NORTHING	EASTING
17-6	217.6	4860407.2	314117.4
17-7	217.6	4860401.8	314126.1

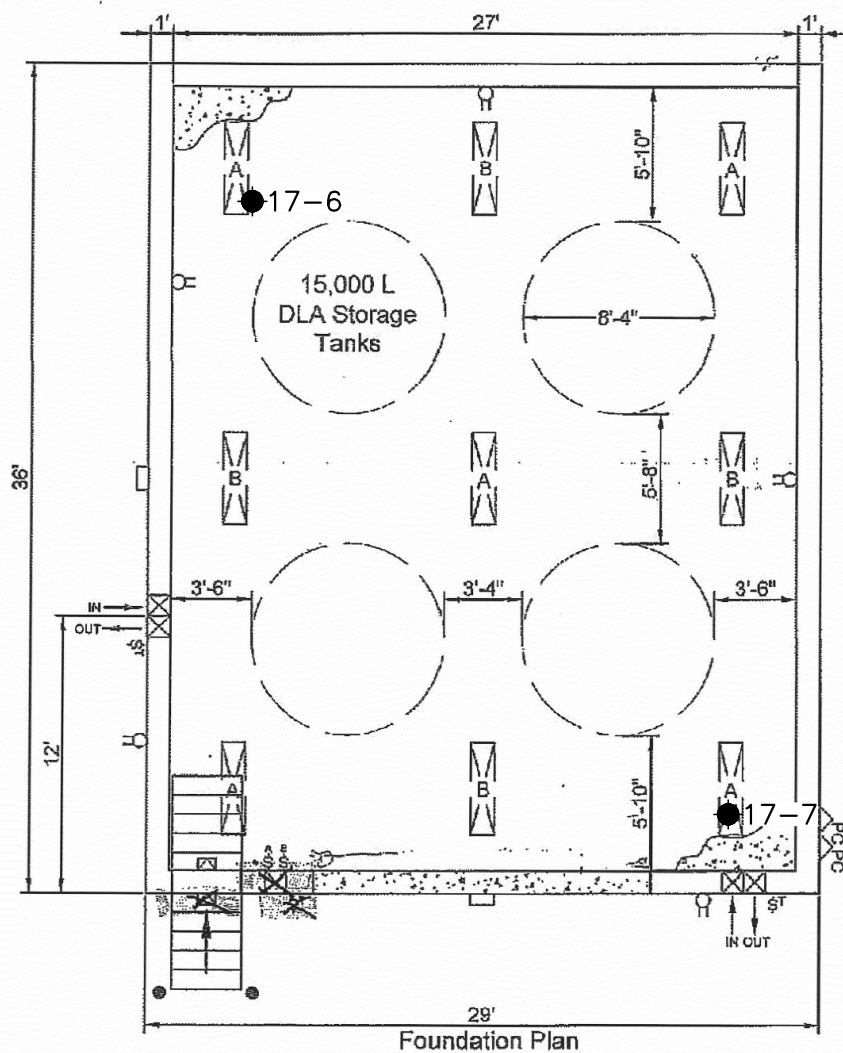
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NOTES

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

## REFERENCE

Base data – Ministry of Transportation – Central Region, Brine Storage Building, Drawing 1, obtained 2017  
Base imagery – 2017 here and 2017 Microsoft Corporation.  
Produce by Golder Associates Ltd under license from Ontario Ministry of Natural Resources, Queens Printer 2017.



PLAN  
SCALE



A horizontal scale bar with tick marks at 1, 0, 1, and 2 meters. The bar is divided into segments by these tick marks.



-	-	-	-	-	-
NO.	DATE	BY	REVISION		
Geocres No. 30M14-465					
HWY. 404		PROJECT NO. 1664350		DIST. .	
SUBM'D..		CHKD.. DATE: 7/20/2017		SITE:	
DRAWN: TB		CHKD. SEMP		APPD. JMJC DWG. 1	





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**FOUNDATION INVESTIGATION REPORT  
GORMLEY PATROL YARD BRINE STORAGE FACILITY**

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# **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

<b>(a)</b>	<b>Index Properties</b>
$\rho(\gamma)$	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

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

#### (b) Cohesive Soils Consistency

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

### IV. SOIL TESTS

w	water content
$w_p$	plastic limit
$w_l$	liquid limit
C	consolidation (oedometer) test
CHEM	chemical analysis (refer to text)
CID	consolidated isotropically drained triaxial test <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



## LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY

### WEATHERINGS STATE

**Fresh:** no visible sign of weathering

**Faintly weathered:** weathering limited to the surface of major discontinuities.

**Slightly weathered:** penetrative weathering developed on open discontinuity surfaces but only slight weathering of rock material.

**Moderately weathered:** weathering extends throughout the rock mass but the rock material is not friable.

**Highly weathered:** weathering extends throughout rock mass and the rock material is partly friable.

**Completely weathered:** rock is wholly decomposed and in a friable condition but the rock and structure are preserved.

### BEDDING THICKNESS

Description	Bedding Plane Spacing
Very thickly bedded	Greater than 2 m
Thickly bedded	0.6 m to 2 m
Medium bedded	0.2 m to 0.6 m
Thinly bedded	60 mm to 0.2 m
Very thinly bedded	20 mm to 60 mm
Laminated	6 mm to 20 mm
Thinly laminated	Less than 6 mm

### JOINT OR FOLIATION SPACING

Description	Spacing
Very wide	Greater than 3 m
Wide	1 m to 3 m
Moderately close	0.3 m to 1 m
Close	50 mm to 300 mm
Very close	Less than 50 mm

### GRAIN SIZE

Term	Size*
Very Coarse Grained	Greater than 60 mm
Coarse Grained	2 mm to 60 mm
Medium Grained	60 microns to 2 mm
Fine Grained	2 microns to 60 microns
Very Fine Grained	Less than 2 microns

Note: \* Grains greater than 60 microns diameter are visible to the naked eye.

### CORE CONDITION

#### Total Core Recovery (TCR)

The percentage of solid drill core recovered regardless of quality or length, measured relative to the length of the total core run.

#### Solid Core Recovery (SCR)

The percentage of solid drill core, regardless of length, recovered at full diameter, measured relative to the length of the total core run.

#### Rock Quality Designation (RQD)

The percentage of solid drill core, greater than 100 mm length, recovered at full diameter, measured relative to the length of the total core run. RQD varied from 0% for completely broken core to 100% for core in solid sticks.

### DISCONTINUITY DATA

#### Fracture Index

A count of the number of discontinuities (physical separations) in the rock core, including both naturally occurring fractures and mechanically induced breaks caused by drilling.

#### Dip with Respect to Core Axis





The angle of the discontinuity relative to the axis (length) of the core. In a vertical borehole a discontinuity with a 90° angle is horizontal.





#### Description and Notes

An abbreviation description of the discontinuities, whether naturally occurring separations such as fractures, bedding planes and foliation planes or mechanically induced features caused by drilling such as ground or shattered core and mechanically separated bedding or foliation surfaces. Additional information concerning the nature of fracture surfaces and infillings are also noted.

#### Abbreviations

JN Joint	PL Planar
FLT Fault	CU Curved
SH Shear	UN Undulating
VN Vein	IR Irregular
FR Fracture	K Slickensided
SY Stylolite	PO Polished
BD Bedding	SM Smooth
FO Foliation	SR Slightly Rough
CO Contact	RO Rough
AXJ Axial Joint	VR Very Rough
KV Karstic Void	
MB Mechanical Break	

PROJECT 1664350-4		<b>RECORD OF BOREHOLE No 17-6</b>				1 OF 1 <b>METRIC</b>							
		LOCATION N 4860407.2; E 314117.4 MTM ZONE 10 (LAT. 43.883579; LONG. -79.384047)				ORIGINATED BY LP							
DIST _____ HWY 404		BOREHOLE TYPE 150 mm Diam. Solid Stem Augers				COMPILED BY TB							
DATUM GEODETIC		DATE June 21, 2017				CHECKED BY SEMP							
SOIL PROFILE			SAMPLES			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	GROUND WATER CONDITIONS	ELEVATION SCALE	SHEAR STRENGTH kPa		WATER CONTENT (%)			
217.6	GROUND SURFACE							20 40 60 80 100	20 40 60				
0.0	Sand, trace gravel, trace clay pockets (FILL) Very loose Brown Moist		1	SS	1		217						
216.7													
0.9	CLAYEY SILT with SAND, some gravel (TILL) Soft to very stiff Brown Wet		2	SS	3		216						13 35 38 14
215.5			3	SS	28								
2.1	SAND and GRAVEL, trace to some silt Dense Brown Wet		4	SS	31		215						52 39 7 2
214.7													
2.9	CLAYEY SILT with SAND, trace gravel (TILL) Hard Brown-grey Moist		5	SS	31		214						
212.6							213						
5.0	END OF BOREHOLE		6	SS	58								1 35 47 17
Note: 1. Water level at a depth of 0.8 m below ground surface (Elev. 216.8 m) upon completion of drilling. 2. Water level in piezometer at a depth of 1.0 m (Elev. 217.6 m) on July 10, 2017.													

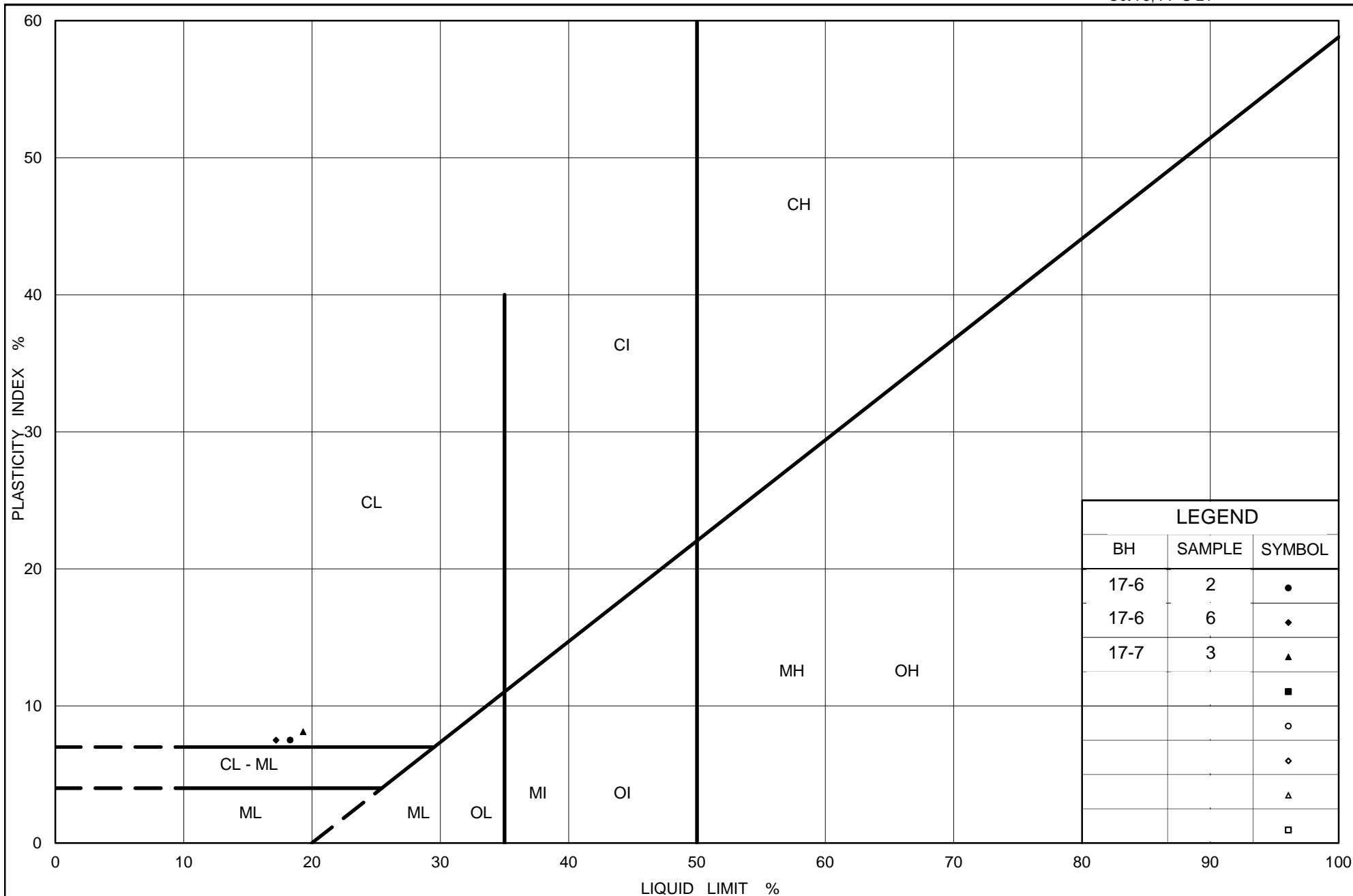
PROJECT <u>1664350-4</u>		<b>RECORD OF BOREHOLE No 17-7</b>				1 OF 1 <b>METRIC</b>											
		LOCATION <u>N 4860401.8; E 314126.1 MTM ZONE 10 (LAT. 43.883530; LONG. -79.383938)</u>				ORIGINATED BY <u>LP</u>											
DIST <u>          </u> HWY <u>404</u>		BOREHOLE TYPE <u>150 mm Diam. Solid Stem Augers</u>				COMPILED BY <u>TB</u>											
DATUM <u>GEODETIC</u>		DATE <u>June 21, 2017</u>				CHECKED BY <u>SEMP</u>											
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  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									
217.6	GROUND SURFACE							20	40	60	80	100					
0.0	Sand and gravel to sand, trace gravel, trace silt (FILL) Very loose to loose Brown Moist to wet		1	SS	3	▽	217										
216.5			2	SS	8		216										
1.1	CLAYEY SILT with SAND, trace gravel, oxidation staining (TILL) Hard Brown Wet		3	SS	34		215										
215.5			4	SS	41		214										
2.1	Silty SAND and GRAVEL Dense Brown Wet		5	SS	23		213										
214.7			6	SS	72												
2.9	Cobble/coarse gravel in tip of split-spoon in Sample 4. CLAYEY SILT with SAND, trace gravel (TILL) Very stiff to hard Brown to grey Wet																
212.6	END OF BOREHOLE																
5.0	Note:  1. 1. Water level at a depth of 0.9 m below ground surface (Elev. 216.7 m) upon completion of drilling.																





# **APPENDIX B**

## **Geotechnical Laboratory Test Results**



Ministry of Transportation

Ontario

# **PLASTICITY CHART** CLAYEY SILT with SAND (TILL)

Figure No. B1

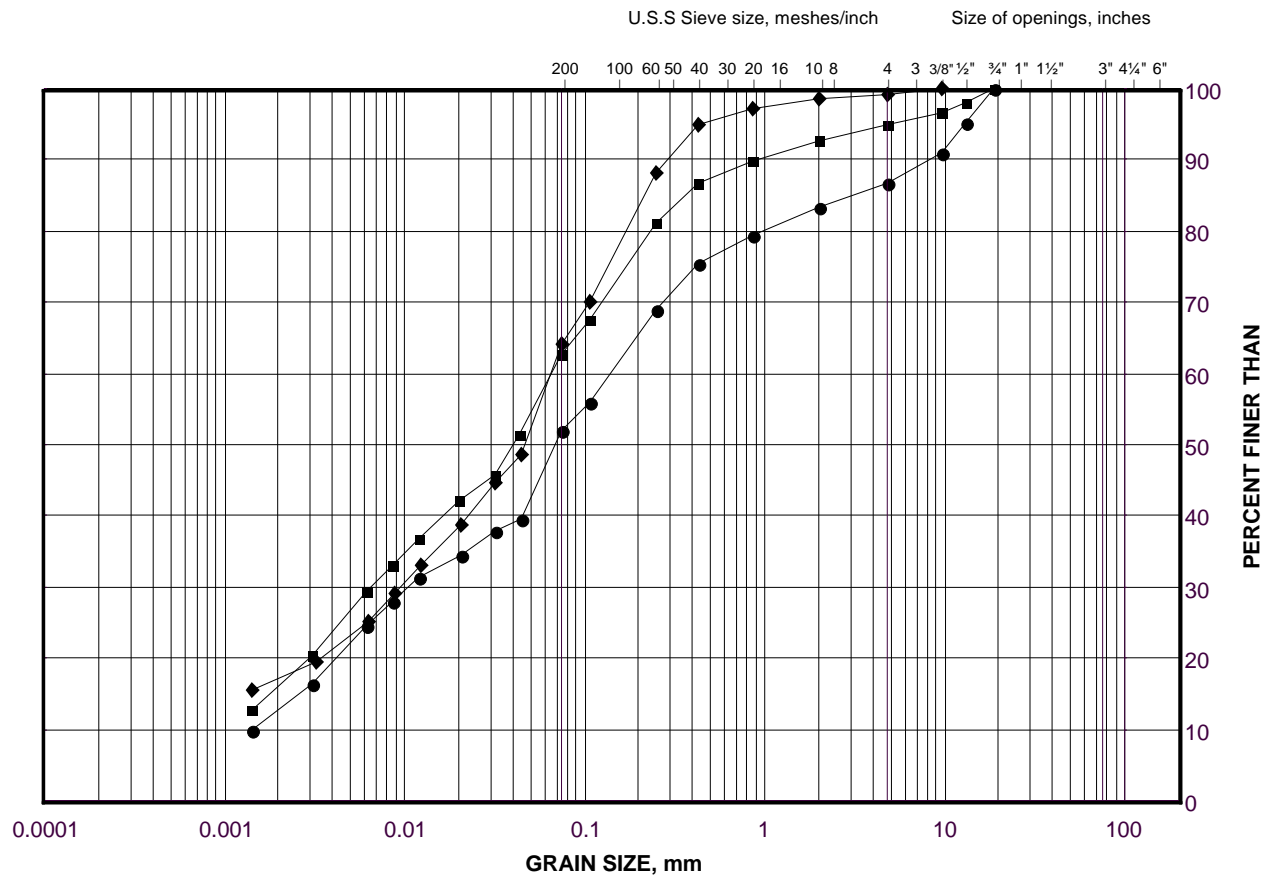
Project No. 1664350 (4) - 2

Checked By: SEMP

# GRAIN SIZE DISTRIBUTION

CLAYEY SILT with sand (TILL)

FIGURE B2



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

## LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
●	17-6	2	216.6
■	17-7	3	215.8
◆	17-6	6	212.7

Project Number: 1664350 (4) - 2

Checked By: \_SEMP\_\_\_\_\_

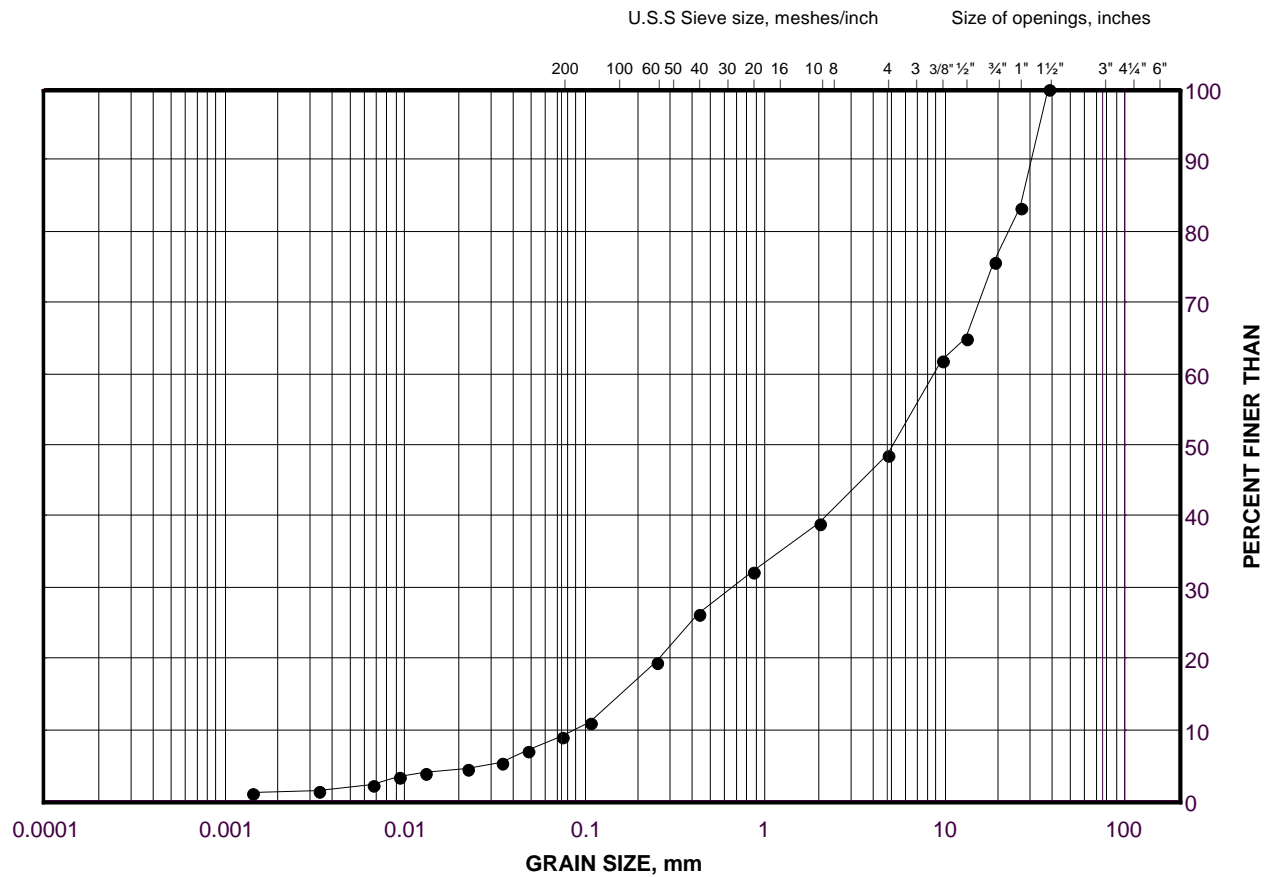
**Golder Associates**

Date: 12-Jul-17

# GRAIN SIZE DISTRIBUTION

SAND and GRAVEL

FIGURE B3



## LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
•	17-6	4	215.1

Project Number: 1664350 (4) - 2

Checked By: \_SEMP\_\_\_\_\_

**Golder Associates**

Date: 12-Jul-17

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