



March 9, 2018

FOUNDATION INVESTIGATION REPORT

BACKFILLING OF HIGHWAY 400/6th LINE OVERPASS (SITE NO. 30-211/1&2) TOWN OF INNISFIL, SIMCOE COUNTY MTO G.W.P. 2289-13-00

Submitted to:

Morrison Hershfield Limited
Suite 300, 125 Commerce Valley Drive West
Markham, Ontario
L3T 7W4



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REPORT



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1.0 INTRODUCTION

Golder Associates Ltd. (Golder) has been retained by Morrison Hershfield Limited (MH) on behalf of the Ministry of Transportation, Ontario (MTO) to provide foundation engineering services for construction of a new Highway 400/6th Line underpass and decommissioning of the existing Highway 400/6th Line overpass, in the Town of Innisfil, Simcoe County, Ontario.

This report addresses the investigation for the proposed backfilling below the existing Highway 400/6th Line overpass, based on the results of both current and previous (2000) borehole investigations and associated geotechnical laboratory testing.

The Terms of Reference (TOR) and the scope of work for the foundation investigation are outlined in MTO's Request for Proposal, dated November 30, 2016, which forms part of the Consultant's Agreement for Assignment No. 2016-E-0057. The work has been carried out in accordance with Golder's Supplementary Specialty Plan for foundation engineering services for this project, dated May 19, 2017.

2.0 SITE DESCRIPTION

The existing Highway 400 / 6th Line overpass is located about 7 km north of the Highway 400/ Highway 89 underpass. Highway 400 is oriented in a north-south direction, and 6th Line is oriented in an east-west direction. Highway 400 consists of three lane in each of the northbound and southbound directions, while 6th Line consists of one lane in each direction.

At the location of the existing overpass, the existing Highway 400 grade is at about Elevation 296.4 m; 6th Line was constructed in a cut, with its grade below the overpass varying from about Elevation 291.2 m to 290.9 m. The underside of the bridge deck is at about Elevation 295.3 m, resulting in a vertical clearance of approximately 4.1 m to 4.4 m between the 6th Line pavement surface and the underside of the bridge deck.

The existing overpass is a single-span structure about 30 m wide (as measured along 6th Line), supported on spread footings. The inside dimension between the abutment walls is about 7 m. Beyond the abutment wingwalls, the Highway 400 embankment fill and the cut for 6th Line are sloped downward at an orientation of about 2H:1V, to existing concrete toe walls north and south of 6th Line. The existing structure appears to have performed well with no visual evidence or historic records of settlement. The Highway 400 embankment side slopes and 6th Line cut slopes do not show any visual signs of distress and there was no evidence of global instability at the time of Golder's 2017 investigation.

3.0 INVESTIGATION PROCEDURES

3.1 2000 Investigation

In 2000, a preliminary foundation investigation for the Highway 400/6th Line replacement structure was carried out by Golder. Two boreholes, designated Boreholes B3-1 and B3-2, were advanced just east and west of the existing Highway 400 overpass, respectively, from the 6th Line grade. Boreholes B3-1 and B3-2 were advanced to depths of 8.2 m and 11.3 m, respectively and laboratory testing was carried out on select soil samples. The results of the 2000 investigation are contained in the report titled "Preliminary Foundation Investigation and Design Report,



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Innisfil Sixth Line Overpass Structure, Site 30-211, Highway 400 Widening from 1 km South of Highway 89 to Highway 11, G.W.P. 30-95-00", prepared by Golder Associates Ltd., dated January 2002 (GEOCREs No. 31D00-467).

The locations of the boreholes advanced by Golder in 2000 are shown on Drawing 1, and the borehole records including a summary of the laboratory testing results from this investigation are presented in Appendix A. Soil samples were obtained at 0.75 m and 1.5 m intervals of depth, using a 50 mm outer diameter split-spoon sampler driven by a manual rope hammer in accordance with the Standard Penetration Test (SPT) procedures. The coordinates relative to MTM NAD 83 Zone 10 northing and easting coordinates, and the ground surface elevations referenced to Geodetic datum, are presented below and on the borehole records in Appendix A.

Borehole No.	Location (MTM NAD 83)		Ground Surface Elevation (m)	Borehole Depth (m)
	Northing (m) (Latitude, °)	Easting (m) (Longitude, °)		
B3-1	4,902,360.3 (44.261114)	290,986.9 (-79.672998)	291.2	8.2
B3-2*	4,902,336.7 (44.260901)	290,949.2 (-79.673469)	290.9	11.3

* The northing and easting coordinates as presented on the borehole record for Borehole B3-2 were incorrect in the original report; however, the correct locations have been presented on the borehole record in Appendix A, and in the above table.

3.2 Current Investigation

The field work for the current foundation investigation was carried out between October 9 and 13, 2017 during which time a total of six boreholes were advanced. Boreholes TPS-01 to TPS-04 were advanced from Highway 400 grade north and south of the existing overpass, and Boreholes HF-11 and HF-12 were advanced from 6th Line grade east and west of the overpass. It is noted that, while the "HF" borehole designation is intended to denote high fill embankments (i.e., embankments of greater than 4.5 m in height), the height/depth of the backfilling on 6th Line below and adjacent to the existing overpass is generally less than 4.5 m. The locations of the boreholes are shown on Drawing 1 and the borehole records are provided in Appendix B. Lists of abbreviations and symbols are also provided in Appendix B to assist in the interpretation of the borehole and records.

The field work was carried out using a D-90 truck-mounted drill rig supplied and operated by Walker Drilling Ltd. of Utopia, Ontario. The boreholes were advanced through the overburden using 108 mm outer diameter solid stem augers. Soil samples were obtained at 0.75 m and 1.5 m intervals of depth, using a 50 mm outer diameter split-spoon sampler driven by automatic hammer in accordance with the Standard Penetration Test (SPT) procedures outlined in ASTM D1586-08¹. The groundwater conditions and water levels in the open boreholes were observed during and immediately following drilling operations, and these observations are recorded on the borehole records.

The field work was observed by a member of Golder's engineering and technical staff, who located the boreholes, arranged for the clearance of underground services, observed the drilling, sampling and in situ testing operations, logged the boreholes, and examined the soil samples. The samples were identified in the field, placed in

¹ ASTM D1586-08a – Standard Test Method for Standard Penetration Tests and Split Barrel Sampling of the soil.



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appropriate containers, labelled and transported to our Mississauga geotechnical laboratory where the samples underwent further visual examination and geotechnical laboratory testing. All of the geotechnical laboratory tests were carried out in accordance with MTO and/or ASTM Standards, as appropriate. Classification testing (water content, Atterberg limits and grain size distribution) was carried out on selected soil samples. The results of the geotechnical laboratory testing for the current investigation are included in Appendix C.

The borehole locations and ground surface elevations were measured using a GPS unit (Trimble XH 3.5G), having an accuracy of 0.1 m in the vertical and horizontal directions. The locations provided on the borehole records and shown on Drawing 1 are positioned relative to MTM NAD 83 (Zone 10) coordinates system and the ground surface elevations are referenced to Geodetic datum. The borehole locations and ground surface elevations and drilled depths are summarized below.

Borehole No.	Location (MTM NAD 83, Zone 10)		Ground Surface Elevation (m)	Borehole Depth (m)
	Northing (m) (Latitude, °)	Easting (m) (Longitude, °)		
TPS-01	4,902,357.9 (44.261092)	290,952.8 (-79.673425)	296.4	11.3
TPS -02	4,902,328.4 (44.260827)	290,958.5 (-79.673352)	296.3	6.7
TPS -03	4,902,365.8 (44.261164)	290,979.3 (-79.673093)	296.4	6.7
TPS -04	4,902,336.7 (44.260902)	290,984.7 (-79.673025)	296.3	11.3
HF-11	4,902,368.8 (44.261191)	290,030.7 (-79.672449)	292.7	6.7
HF-12	4,902,330.6 (44.260845)	290,905.6 (-79.674015)	291.2	6.7

4.0 SITE GEOLOGY AND SUBSURFACE CONDITIONS

4.1 Regional Geology

This project area is located within the Peterborough Drumlin Field physiographic region, as delineated in *The Physiography of Southern Ontario* (Chapman and Putman, 1894)². The surficial soils in the Peterborough Drumlin Field frequently consist of gravelly sand till or sand and gravel deposits, although clayey silt to silt/sand till deposits are also common in the vicinity of the Highway 400 corridor. Drumlins (glacially-shaped hills comprised of till) are more frequent in the southern portion of the section of the Peterborough Drumlin Field that is traversed by Highway 400. Deposits of silt, clay or peat may be found in the low-lying areas between drumlins. The Peterborough Drumlin Field is underlain at depth by bedrock of the Lindsay and Verulam Formations, which consists mainly of fossiliferous limestone.

² Chapman, L.J. and Putman, D.F., 1894, *The Physiography of Southern Ontario*, Ontario Geological Society, Special Volume 2, Third Edition. Accompanied by Map p. 2715, Scale 1:600,000.)



4.2 Subsurface Conditions

The detailed subsurface soil and groundwater conditions as encountered in the boreholes advanced during the 2000 and current investigations, together with the results of the geotechnical laboratory tests carried out on selected soil samples, are presented on the borehole records provided in Appendices A and B, respectively. The results of the in-situ field tests (i.e. SPT “N” values) as presented on the borehole records and in sub-sections of Section 4.2 are uncorrected and it is noted that those from the 2000 investigation were completed using a manual hammer, while those from the current investigation are based on an automatic hammer. The geotechnical laboratory testing plots from the current investigation are contained in Appendix C.

The stratigraphic boundaries shown on the borehole records and on the stratigraphic profile shown on Drawings 1 and 2 are inferred from non-continuous sampling, observations of drilling progress and the results of Standard Penetration Tests. These boundaries, therefore, represent transitions between soil types rather than exact planes of geological change. Furthermore, subsurface conditions will vary between and beyond the borehole locations. It should be noted that the interpreted stratigraphy shown on Drawings 1 and 2 is a simplification of the subsurface conditions.

In general, the subsurface conditions in the boreholes advanced from the Highway 400 grade consist of pavement structure underlain by fill that varies in composition from gravelly sand to silty sand to clayey silt. The Highway 400 fill and the local road pavement structure within the 6th Line cut are underlain by a glacial till deposit, which varies in composition from clayey silt with sand to silty sand. A more detailed description of the subsurface conditions encountered in the boreholes is provided in the following sections.

4.2.1 Asphalt Pavement

Boreholes TPS-01 and TPS-02 were advanced through the west shoulder of Highway 400 southbound lanes and Boreholes TPS-03 and TPS-04 were advanced through the east shoulder of Highway 400 northbound lanes. The encountered asphalt is approximately 200 mm thick.

Boreholes HF-11 and HF-12 were advanced through the existing 6th Line and the asphalt encountered at these locations is approximately 450 mm thick. Boreholes B3-1 and B3-2 were advanced through 6th Line closer to the overpass, and the asphalt was approximately 100 mm thick at these locations at the time of the 2000 investigation.

4.2.2 Fill

In Boreholes TPS-01 to TPS-04 advanced on Highway 400, granular fill consisting of gravelly sand to sand was encountered underlying the asphalt, extending to depths of 2.2 m to 3.7 m (Elevation 294.2 m and 292.6 m) below the pavement surface. Below the granular fill in Borehole TPS-01 at a depth of 2.2 m, a layer of clayey silt with sand fill was encountered. This cohesive fill extends to a depth of 3.0 m (Elevation 293.4 m) below the pavement surface.

In Boreholes B3-1, B3-2, HF-11 and HF-12 advanced on the existing 6th Line, granular fill consisting of gravelly sand to silty sand was encountered underlying the pavement structure, extending to depths of 0.3 m to 2.1 m (between Elevation 292.0 m and 288.8 m) below pavement surface.

The SPT “N” values within the granular fill range from 3 blows to 38 blows per 0.3 m of penetration, indicating that the granular fill has a very loose to dense compactness condition. One SPT “N” value measured within the cohesive fill was 8 blows per 0.3 m of penetration, indicating that the cohesive fill has a stiff consistency.



The results of grain size distribution tests completed on four samples of the granular fill are presented on Figure C1 in Appendix C. The gravelly sand fill contains some fines and the sand contains some silt and gravel and trace clay. In Borehole B3-2, a cobble was encountered within the fill. The water content measured in the granular fill material ranges from about 1 to 8 per cent.

The result of a grain size distribution test completed on one sample of the cohesive fill is presented on Figure C2 in Appendix C. An Atterberg limits test was carried out on the fines portion of one sample of the cohesive fill, and measured a liquid limit of about 22 per cent, a plastic limit of about 11 per cent, and a plasticity index of about 11 per cent; as shown on the plasticity chart on Figure C3 in Appendix C, this result indicates that the fines portion of the cohesive fill can be classified as a clayey silt of low plasticity. The water content measured on a sample of the cohesive fill was 18 per cent.

4.2.3 Clayey Silt with Sand Till to Silty Sand Till

A glacial till deposit was encountered underlying the fill in all boreholes advanced at the site. The till is variable in composition, grading between low plasticity clayey silt with sand, and silty sand. In the boreholes advanced from Highway 400, the surface of the till deposit was encountered at depths ranging between about 2.3 m and 3.7 m (Elevation 294.0 m and 292.6 m) below the highway pavement surface. In the four boreholes advanced from the 6th Line cut grade, the surface of the till deposit was encountered at depths ranging between about 0.3 m and 2.1 m (between Elevation 292.0 m and 288.8 m) below the pavement surface. All boreholes from the 2000 and current investigations terminated within this till deposit at depths ranging from about 6.7 m to 11.3 m (Elevation 289.8 m and 279.6 m) below the Highway 400 or 6th Line pavement surface.

The SPT “N” values recorded within the till deposit are variable. They generally range from about 30 to 86 blows per 0.3 m of penetration in the current investigation, although lower SPT “N” values of 15 to 27 blows per 0.3 m of penetration were measured in the upper 1 m of the deposit in some boreholes, and occasional higher values (greater than 100 blows per 0.3 m of penetration) were measured at varying depths within the deposit. In the 2000 investigation, in which sampling was completed using a manual hammer, the SPT “N” values range from 67 to greater than 100 blows per 0.3 m of penetration. These results suggest a generally hard consistency within the cohesive till deposit, with upper zones that are very stiff, and a generally dense to very dense compactness condition within the granular till deposit, although the upper portion may be compact.

The results of grain size distribution tests completed on eight samples of the till deposit are shown on Figures C4A and 4B in Appendix C. The clayey silt with sand contains trace to some gravel. Cobbles are noted on the borehole records for Boreholes B3-1 and B3-2. Although difficult drilling suggesting the presence of cobbles and/or boulders was not experienced within the till deposit during the current investigation, the till deposits in southern Ontario typically contain such materials and they should be expected within such till deposits.

Atterberg limits tests were carried out on the fines portion of eleven samples of the till deposit from the current investigation. The Atterberg limits tests measured liquid limits ranging from about 13 to 15 per cent, plastic limits ranging from about 9 to 10 per cent, and plasticity indices ranging from about 3 to 6 per cent. The results of the Atterberg Limits tests are shown on the plasticity charts on Figures C5A and C5B in Appendix C, demonstrating the variability in the plasticity and behaviour of the deposit: some portions of the deposit are classified as a clayey silt of low plasticity, and the fines portion of the deposit grades to a silt of slight plasticity. The natural water content measured on 20 samples of this till deposit ranges from about 5 to 9 per cent.



4.2.4 Groundwater Conditions

The soil samples obtained from the boreholes were generally moist; however, below a depth of 7.2 m in Borehole TPS-01 and below a depth of 8.7 m in Borehole TPS-04, the samples were wet; this corresponds to approximately Elevation 289.2 m and 287.6 m, respectively. The groundwater levels in the open boreholes were measured upon completion of drilling operations and all boreholes advanced for the current investigation were dry upon completion of the drilling operations, although it is noted that this does not represent the stabilized groundwater level at this site. Based on observations in other boreholes (including monitoring wells) at the site, it is anticipated that the stabilized groundwater level within the vicinity of the existing overpass is near the 6th Line cut grade.

During the preliminary investigation a standpipe piezometer was installed in Borehole B3-1 to permit monitoring of groundwater levels at this site; however, it was destroyed shortly after installation before the stabilized groundwater level could be measured.

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

5.0 CLOSURE

This Foundation Investigation Report was prepared by Ms. Sandra McGaghran, M.Eng., P.Eng., a geotechnical engineer and Associate with Golder. Ms. Lisa Coyne, P.Eng., a Principal and Designated MTO Foundations Contact for Golder, conducted an independent quality control review of the report.

GOLDER ASSOCIATES LTD.



Sandra McGaghran, M.Eng., P.Eng.
Geotechnical Engineer, Associate



Lisa Coyne, P.Eng.
Principal, Designated MTO Foundations Contact

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[https://golderassociates.sharepoint.com/sites/13019g/6-deliverables/fnds/backfilling of overpass/final/1670268 fir 2018mar9 hwy 400 6th line tps.docx](https://golderassociates.sharepoint.com/sites/13019g/6-deliverables/fnds/backfilling%20of%20overpass/final/1670268%20fir%202018mar9%20hwy%20400%206th%20line%20tps.docx)



REFERENCES

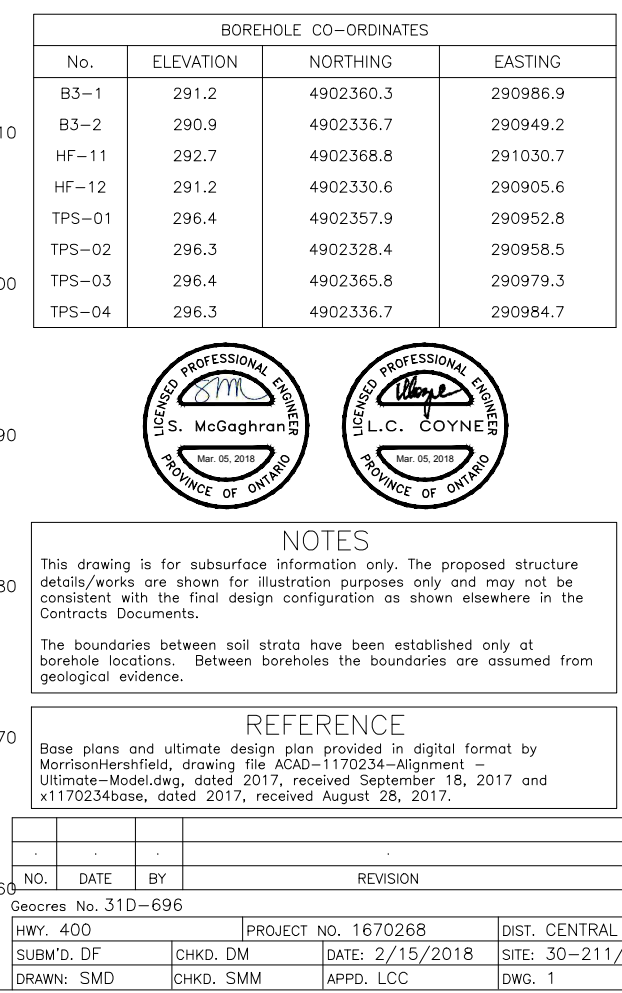
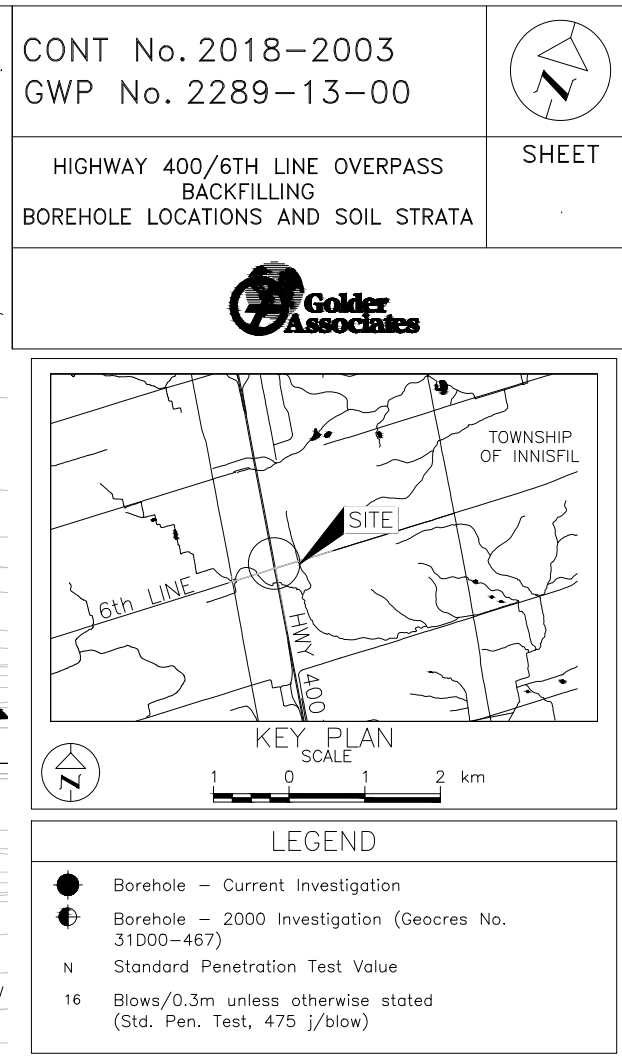
Chapman, L.J. and Putnam, D.F. 1984. The Physiography of Southern Ontario, Ontario Geological Survey, Special Volume 2, Third Edition. Accompanied by Map P.2715, Scale 1:600,000.

ASTM International:

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

Ontario Water Resources Act:

Ontario Regulation 903 Wells (as amended)

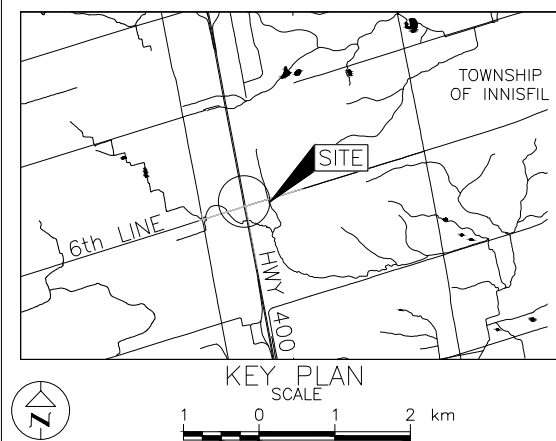


CONT No. 2018-2003
GWP No. 2289-13-00





HIGHWAY 400/6TH LINE OVERPASS
BACKFILLING
SOIL STRATA

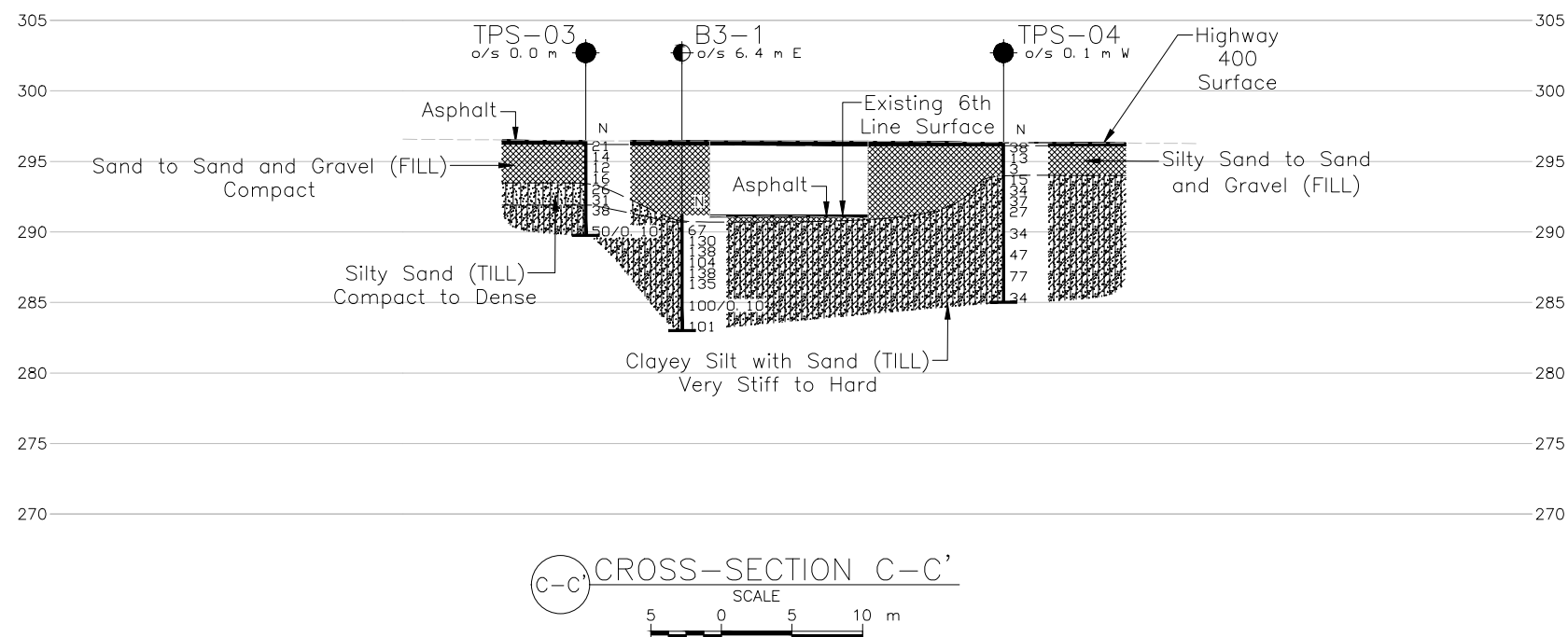
SHEET



LEGEND

- | | |
|---|--|
|  | Borehole – Current Investigation |
|  | Borehole – 2000 Investigation (Geocres No. 31D00-467) |
| N | Standard Penetration Test Value |
| 16 | Blows/0.3m unless otherwise stated
(Std. Pen. Test, 475 j/blow) |

BOREHOLE CO-ORDINATES			
No.	ELEVATION	NORTHING	EASTING
B3-1	291.2	4902360.3	290986.9
B3-2	290.9	4902336.7	290949.2
TPS-01	296.4	4902357.9	290952.8
TPS-02	296.3	4902328.4	290958.5
TPS-03	296.4	4902365.8	290979.3
TPS-04	296.3	4902336.7	290984.7



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 and ultimate design plan provided in digital format by MorrisonHershfield, drawing file ACAD-1170234-Alignment - Ultimate-Model.dwg, dated 2017, received September 18, 2017 and x1170234base, dated 2017, received August 28, 2017.

NO.	DATE	BY	REVISION		
Geocres No. 31D-696					
HWY. 400		PROJECT NO. 1670268		DIST. CENTRAL	
SUBM'D. DF	CHKD. DM	DATE: 2/16/2018		SITE: 30-211/1	
DRAWN: SMD	CHKD. SMM	APPD. LCC		DWG. 2	

Geocres No. 31D-696

HWY. 400		PROJECT NO. 1670268	DIST. CENTRAL
SUBM'D. DF	CHKD. DM	DATE: 2/16/2018	SITE: 30-211/1
DRAWN: SMD	CHKD. SMM	APPD. LCC	DWG. 2



APPENDIX A

Borehole Records – 2000 Investigation (GEOCRES No. 31D00-467)



LIST OF SYMBOLS

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

I. GENERAL

π	3.1416
$\ln x$,	natural logarithm of x
\log_{10}	x or log x, logarithm of x to base 10
g	acceleration due to gravity
t	time
FoS	factor of safety

II. STRESS AND STRAIN

γ	shear strain
Δ	change in, e.g. in stress: $\Delta \sigma$
ε	linear strain
ε_v	volumetric strain
η	coefficient of viscosity
ν	Poisson's ratio
σ	total stress
σ'	effective stress ($\sigma' = \sigma - u$)
σ'_{vo}	initial effective overburden stress
$\sigma_1, \sigma_2, \sigma_3$	principal stress (major, intermediate, minor)
σ_{oct}	mean stress or octahedral stress $= (\sigma_1 + \sigma_2 + \sigma_3)/3$
τ	shear stress
u	porewater pressure
E	modulus of deformation
G	shear modulus of deformation
K	bulk modulus of compressibility

III. SOIL PROPERTIES

(a)	Index Properties
$\rho(\gamma)$	bulk density (bulk unit weight)*
$\rho_d(\gamma_d)$	dry density (dry unit weight)
$\rho_w(\gamma_w)$	density (unit weight) of water
$\rho_s(\gamma_s)$	density (unit weight) of solid particles
γ'	unit weight of submerged soil ($\gamma' = \gamma - \gamma_w$)
D_R	relative density (specific gravity) of solid particles ($D_R = \rho_s / \rho_w$) (formerly G_s)
e	void ratio
n	porosity
S	degree of saturation

(a) Index Properties (continued)

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

(b) Hydraulic Properties

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

(c) Consolidation (one-dimensional)

C_c	compression index (normally consolidated range)
C_r	recompression index (over-consolidated range)
C_s	swelling index
C_α	secondary compression index
m_v	coefficient of volume change
C_v	coefficient of consolidation (vertical direction)
C_h	coefficient of consolidation (horizontal direction)
T_v	time factor (vertical direction)
U	degree of consolidation
σ'_p	pre-consolidation stress
OCR	over-consolidation ratio = σ'_p / σ'_{vo}

(d) Shear Strength

τ_p, τ_r	peak and residual shear strength
ϕ'	effective angle of internal friction
δ	angle of interface friction
μ	coefficient of friction = $\tan \delta$
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 ρ . Unit weight symbol is γ 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 cm² 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

Condition	N 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 ¹
CIU	consolidated isotropically undrained triaxial test with porewater pressure measurement ¹
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 ₄	concentration of water-soluble sulphates
UC	unconfined compression test
UU	unconsolidated undrained triaxial test
V	field vane (LV-laboratory vane test)
γ	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

PROJECT 001-1143F				RECORD OF BOREHOLE No B3-1				1 OF 1		METRIC				
W.P. 30-95-00				LOCATION N 4902360.3; E 290986.9				ORIGINATED BY AZ						
DIST SW HWY 400				BOREHOLE TYPE 108mm DIAMETER SOLID STEM AUGERS				COMPILED BY LCC						
DATUM Geodetic				DATE Oct.25/2000				CHECKED BY ASP						
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						
291.2	GROUND SURFACE													
0.9	Asphalt													
290.7	Sand and Gravel (Fill)													
0.5	Clayey Silt with sand, trace to some gravel (Till) Hard Brown becoming grey at 1.4m depth Moist		1	SS	67									
			2	SS	130									
			3	SS	138									
			4	SS	104									
			5	SS	138									
			6	SS	135									
			7	SS	100/10									
	Cobble at 6.4m depth													
283.0			8	SS	101									
8.2	END OF BOREHOLE													
	Notes: 1. Water level in open borehole at 7.4m depth (Elev.283.8m) immediately after completion of drilling. Water level rose to 6.9m depth (Elev.284.3m) about 10 minutes after completion of drilling. 2. Piezometer could not be found on January 19 or March 15, 2001; piezometer presumed destroyed.													

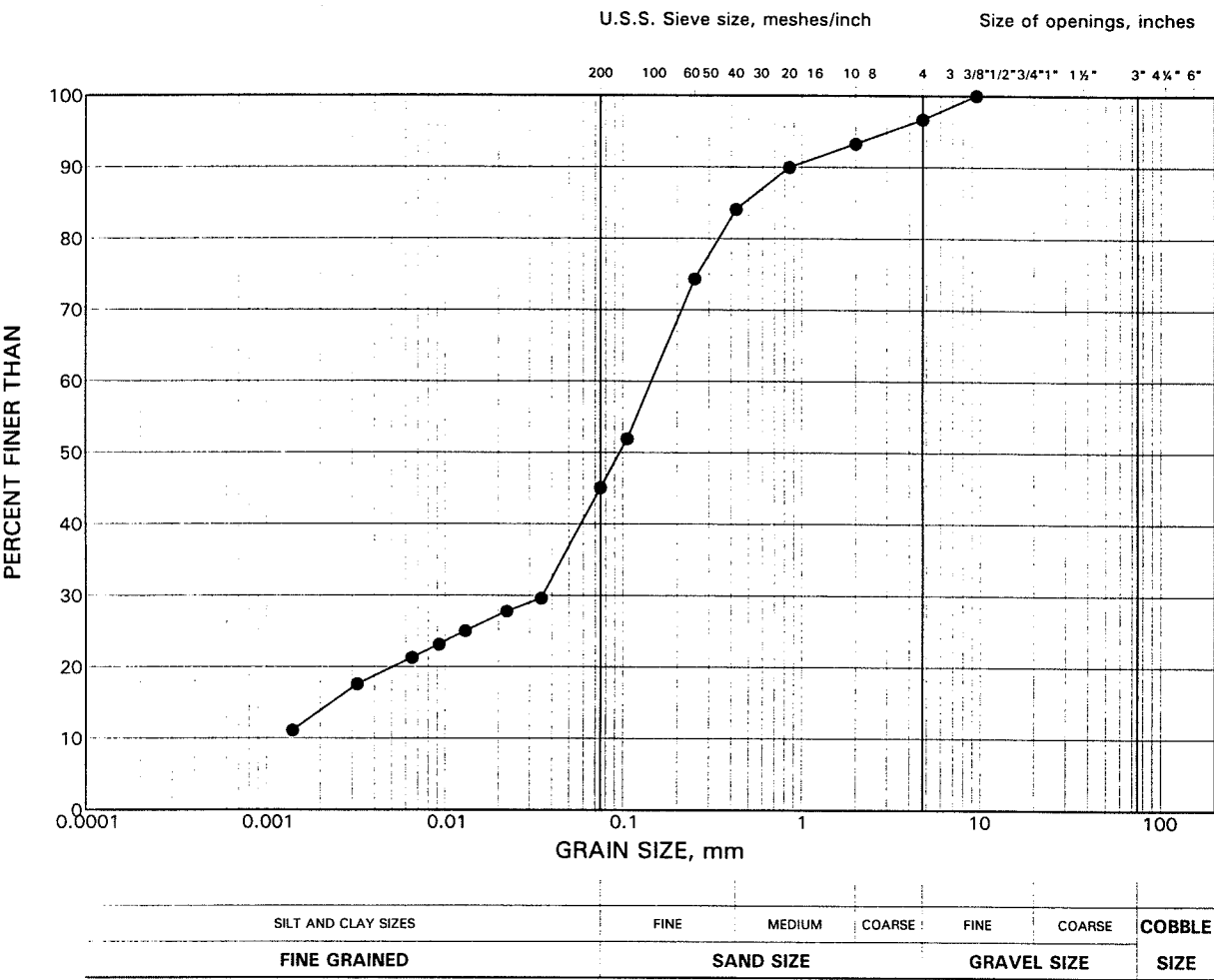
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+³, ×³: Numbers refer to Sensitivity ○^{3%} STRAIN AT FAILURE

GRAIN SIZE DISTRIBUTION TEST RESULT

Clayey Silt Till

FIGURE 1



LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION (m)
●	B3-1	3	288.7



APPENDIX B

Borehole Records – Current Investigation



LIST OF SYMBOLS

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

I. GENERAL

π	3.1416
$\ln x$,	natural logarithm of x
\log_{10}	x or log x, logarithm of x to base 10
g	acceleration due to gravity
t	time
FoS	factor of safety

II. STRESS AND STRAIN

γ	shear strain
Δ	change in, e.g. in stress: $\Delta \sigma$
ε	linear strain
ε_v	volumetric strain
η	coefficient of viscosity
ν	Poisson's ratio
σ	total stress
σ'	effective stress ($\sigma' = \sigma - u$)
σ'_{vo}	initial effective overburden stress
$\sigma_1, \sigma_2, \sigma_3$	principal stress (major, intermediate, minor)
σ_{oct}	mean stress or octahedral stress $= (\sigma_1 + \sigma_2 + \sigma_3)/3$
τ	shear stress
u	porewater pressure
E	modulus of deformation
G	shear modulus of deformation
K	bulk modulus of compressibility

III. SOIL PROPERTIES

(a)	Index Properties
$\rho(\gamma)$	bulk density (bulk unit weight)*
$\rho_d(\gamma_d)$	dry density (dry unit weight)
$\rho_w(\gamma_w)$	density (unit weight) of water
$\rho_s(\gamma_s)$	density (unit weight) of solid particles
γ'	unit weight of submerged soil ($\gamma' = \gamma - \gamma_w$)
D_R	relative density (specific gravity) of solid particles ($D_R = \rho_s / \rho_w$) (formerly G_s)
e	void ratio
n	porosity
S	degree of saturation

(a) Index Properties (continued)

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

(b) Hydraulic Properties

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

(c) Consolidation (one-dimensional)

C_c	compression index (normally consolidated range)
C_r	recompression index (over-consolidated range)
C_s	swelling index
C_α	secondary compression index
m_v	coefficient of volume change
C_v	coefficient of consolidation (vertical direction)
C_h	coefficient of consolidation (horizontal direction)
T_v	time factor (vertical direction)
U	degree of consolidation
σ'_p	pre-consolidation stress
OCR	over-consolidation ratio = σ'_p / σ'_{vo}

(d) Shear Strength

τ_p, τ_r	peak and residual shear strength
ϕ'	effective angle of internal friction
δ	angle of interface friction
μ	coefficient of friction = $\tan \delta$
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 ρ . Unit weight symbol is γ 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 cm² 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 ¹
CIU	consolidated isotropically undrained triaxial test with porewater pressure measurement ¹
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 ₄	concentration of water-soluble sulphates
UC	unconfined compression test
UU	unconsolidated undrained triaxial test
V	field vane (LV-laboratory vane test)
γ	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



PROJECT 1670268		RECORD OF BOREHOLE No HF-11				SHEET 1 OF 1		METRIC									
G.W.P. 2289-13-00		LOCATION N 4902368.8; E 291030.7 MTM NAD 83 ZONE 10 (LAT. 44.261192; LONG. -79.672449)				ORIGINATED BY DMF											
DIST Central HWY 400		BOREHOLE TYPE Power Auger - 203 mm O.D. Hollow Stem Augers				COMPILED BY JL											
DATUM Geodetic		DATE October 13, 2017				CHECKED BY SMM											
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									
292.7	GROUND SURFACE							20	40	60	80	100					
0.0	ASPHALT		1A	SS	26												
292.2			1B														
0.7	Gravelly sand, trace to some silt, contains clayey silt pockets (FILL) Compact Brown Moist CLAYEY SILT with SAND, trace to some gravel, contains sand pockets (TILL) Very stiff to hard Brown, becoming grey at 3.7 m Moist		2	SS	16												
			3	SS	48												
			4	SS	47												
			5	SS	63												
			6	SS	46												
			7	SS	53												
			8	SS	60												
286.0	END OF BOREHOLE																
6.7	NOTES: 1. Borehole dry upon completion of drilling.																

PROJECT		2289-13-00		LOCATION		N 4902330.6; E 290905.6 MTM NAD 83 ZONE 10 (LAT. 44.260845; LONG. -79.674015)		ORIGINATED BY		DMF								
DIST		Central HWY 400		BOREHOLE TYPE		Power Auger - 203 mm O.D. Hollow Stem Augers		COMPILED BY		JL								
DATUM		Geodetic		DATE		October 13, 2017		CHECKED BY		SMM								
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					WATER CONTENT (%)							
291.2	GROUND SURFACE																	
0.0	ASPHALT (120 mm)		1A	SS	24													
0.1	Gravelly sand, some silt (FILL)		1B															
290.5	Compact Brown Moist																	
0.7	Silty SAND, trace to some clay, trace gravel (TILL)		2	SS	20													
	Compact to dense Brown Moist		3	SS	45													
289.0																		
2.2	CLAYEY SILT with SAND, trace gravel, contains some sand pockets (TILL)		4	SS	46													
	Hard Brown, becoming grey at 2.2 m Moist		5	SS	94													
			6	SS	51													
			7	SS	56													
			8	SS	73													
284.5																		
6.7	END OF BOREHOLE																	
NOTES:																		
1. Borehole dry upon completion of drilling.																		

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PROJECT 1670268		RECORD OF BOREHOLE No TPS-01		SHEET 1 OF 1		METRIC											
G.W.P. 2289-13-00		LOCATION N 4902357.9; E 290952.8 MTM NAD 83 ZONE 10 (LAT. 44.261092; LONG. -79.673425)		ORIGINATED BY DMF													
DIST Central HWY 400		BOREHOLE TYPE Power Auger - 108 mm I.D. and 200 mm O.D. Hollow Stem Augers		COMPILED BY JL													
DATUM Geodetic		DATE October 10, 2017		CHECKED BY SMM													
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 kN/m³	GR SA SI CL
								20 40 60 80 100	20 40 60 80 100	20 40 60 80 100	W _p	W	W _L				
296.4	GROUND SURFACE																
0.0	ASPHALT																
0.2	Gravelly sand, some fines, contains asphalt fragments (FILL) Loose to dense Brown Moist		1A 1B	SS	32		296										
			2	SS	7												
							295										
			3	SS	15												
294.2	Clayey silt with sand, trace gravel (FILL) Stiff Mottled brown/grey Moist		4	SS	8		294										
293.4	CLAYEY SILT with SAND, trace gravel, oxidation staining at 5.6 m (TILL) Hard Brown, becoming grey at 7.2 m Moist, becoming wet at 7.2 m		5	SS	39		293										
			6	SS	86												
			7	SS	130		292										
							291										
			8	SS	132		290										
							289										
			9	SS	64												
							288										
			10	SS	35		287										
							286										
285.1	END OF BOREHOLE		11	SS	66												
11.3	NOTE: 1. Borehole dry upon completion of drilling.																

PROJECT <u>1670268</u>		RECORD OF BOREHOLE No TPS-02		SHEET 1 OF 1		METRIC	
G.W.P. <u>2289-13-00</u>		LOCATION <u>N 4902328.4; E 290958.5 MTM NAD 83 ZONE 10 (LAT. 44.260827; LONG. -79.673352)</u>		ORIGINATED BY <u>DMF</u>			
DIST <u>Central</u> HWY <u>400</u>		BOREHOLE TYPE <u>Power Auger - 108 mm I.D. and 200 mm O.D. Hollow Stem Augers</u>		COMPILED BY <u>JL</u>			
DATUM <u>Geodetic</u>		DATE <u>October 10, 2017</u>		CHECKED BY <u>SMM</u>			

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									
						○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × REMOULDED					WATER CONTENT (%)						
						20	40	60	80	100	10	20	30				
296.3	GROUND SURFACE																
0.0	ASPHALT																
0.2	Gravelly sand, trace to some gravel, trace to some fines, contains asphalt fragments (FILL) Compact to dense Brown Moist		1A	SS	34												
			1B														
			2	SS	20												
			3	SS	11												
			4	SS	14												
293.3	Silty sand, trace gravel and clay (FILL) Dense Mottled brown/grey Moist		5	SS	31												
292.6	CLAYEY SILT with SAND, trace gravel, contains sand pockets (TILL) Very stiff to hard Brown Moist		6	SS	26												
3.7			7	SS	27												
			8	SS	46												
289.6	END OF BOREHOLE																
6.7	NOTES: 1. Borehole dry upon completion of drilling.																

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PROJECT		1670268		RECORD OF BOREHOLE No TPS-03				SHEET 1 OF 1		METRIC							
G.W.P.		2289-13-00		LOCATION		N 4902365.8; E 290979.3 MTM NAD 83 ZONE 10 (LAT. 44.261164; LONG. -79.673093)		ORIGINATED BY		DMF							
DIST		Central HWY 400		BOREHOLE TYPE		Power Auger - 108 mm I.D. and 200 mm O.D. Hollow Stem Augers		COMPILED BY		JL							
DATUM		Geodetic		DATE		October 10, 2017		CHECKED BY		SMM							
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									
296.4	GROUND SURFACE																
0.0	ASPHALT																
0.2	Sand, some gravel, some silt, contains clayey silt pockets, oxidation staining (FILL) Compact Brown Moist		1A 1B	SS	21		296										
			2	SS	14												
			3	SS	12		295										
			4	SS	16		294										
293.4	Silty SAND, some clay, trace gravel (TILL) Compact to dense Brown Moist		5	SS	26		293										
3.0			6	SS	31												
291.9	CLAYEY SILT with SAND, trace gravel, contains sand pockets (TILL) Very stiff to hard Brown, becoming grey at 5.6 m Moist		7	SS	38		292										
4.5			8	SS	50/0.10		291										
289.8	END OF BOREHOLE						290										
6.7	NOTES: 1. Borehole dry upon completion of drilling.																

PROJECT		1670268		RECORD OF BOREHOLE No TPS-04				SHEET 1 OF 1		METRIC							
G.W.P.		2289-13-00		LOCATION		N 4902336.7; E 290984.7 MTM NAD 83 ZONE 10 (LAT. 44.260902; LONG. -79.673025)		ORIGINATED BY		DMF							
DIST		Central HWY 400		BOREHOLE TYPE		Power Auger - 108 mm I.D. and 200 mm O.D. Hollow Stem Augers		COMPILED BY		JL							
DATUM		Geodetic		DATE		October 9, 2017		CHECKED BY		SMM							
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									
296.3	GROUND SURFACE							20	40	60	80	100					
0.0	ASPHALT																
0.2	Gravelly sand, some fines (FILL)		1A	SS	38												
295.6	Dense Brown Moist		1B														
0.7	Silty sand, trace to some gravel, contains clayey silt pockets, oxidation staining (FILL)		2	SS	13												
	Very loose to compact		3	SS	3												
	Brown Moist																
294.0	CLAYEY SILT with SAND, trace to some gravel, contains sand pockets (TILL)		4	SS	15												
2.3	Very stiff to hard		5	SS	34												
	Brown, becoming grey at 10.2 m		6	SS	37												
	Moist becoming wet at 8.7 m		7	SS	27												
			8	SS	34												
			9	SS	47												
			10	SS	77												
			11	SS	34												
285.0	END OF BOREHOLE																
11.3	NOTES:																
	1. Borehole dry upon completion of drilling.																

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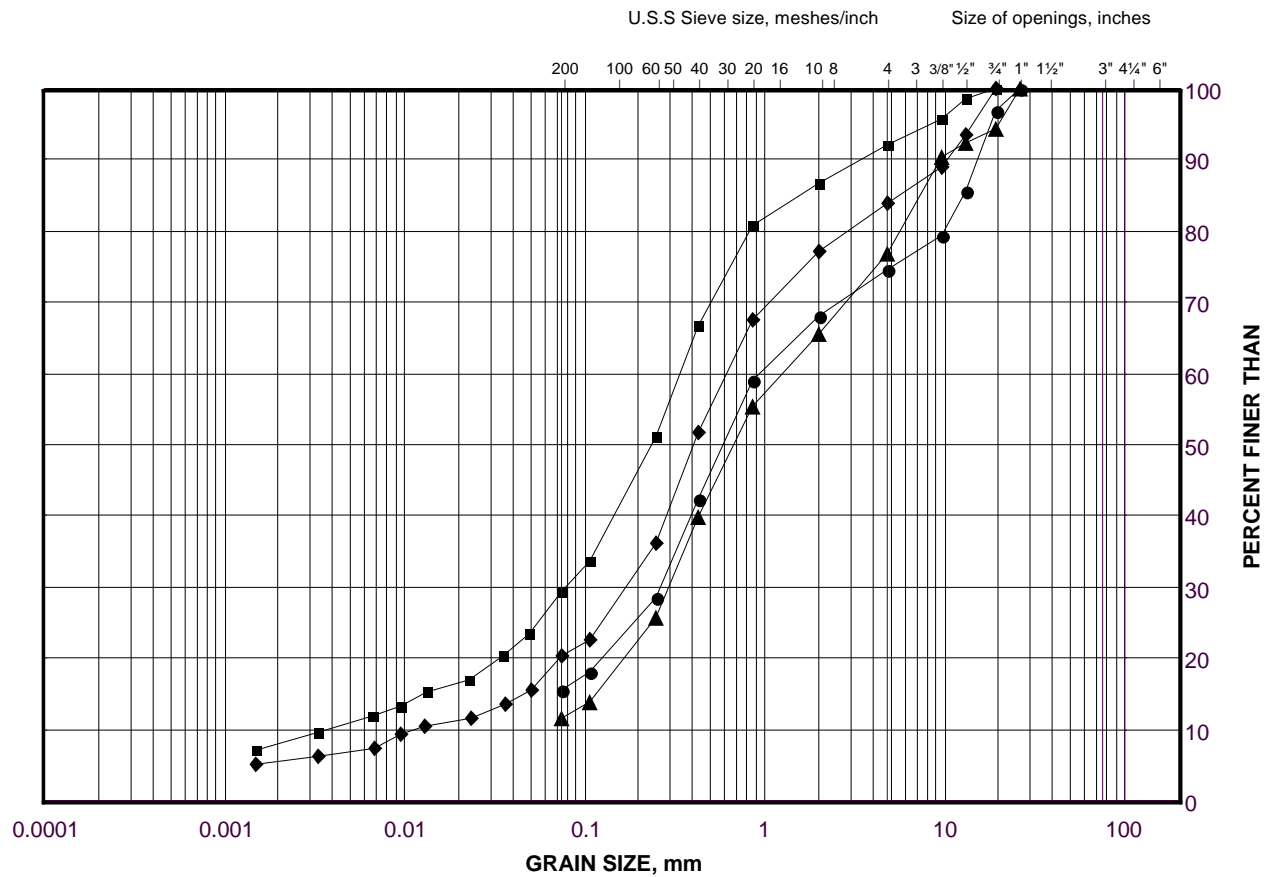
APPENDIX C

Geotechnical Laboratory Test Results

GRAIN SIZE DISTRIBUTION

Gravelly Sand to Silty Sand (Fill)

FIGURE C1



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

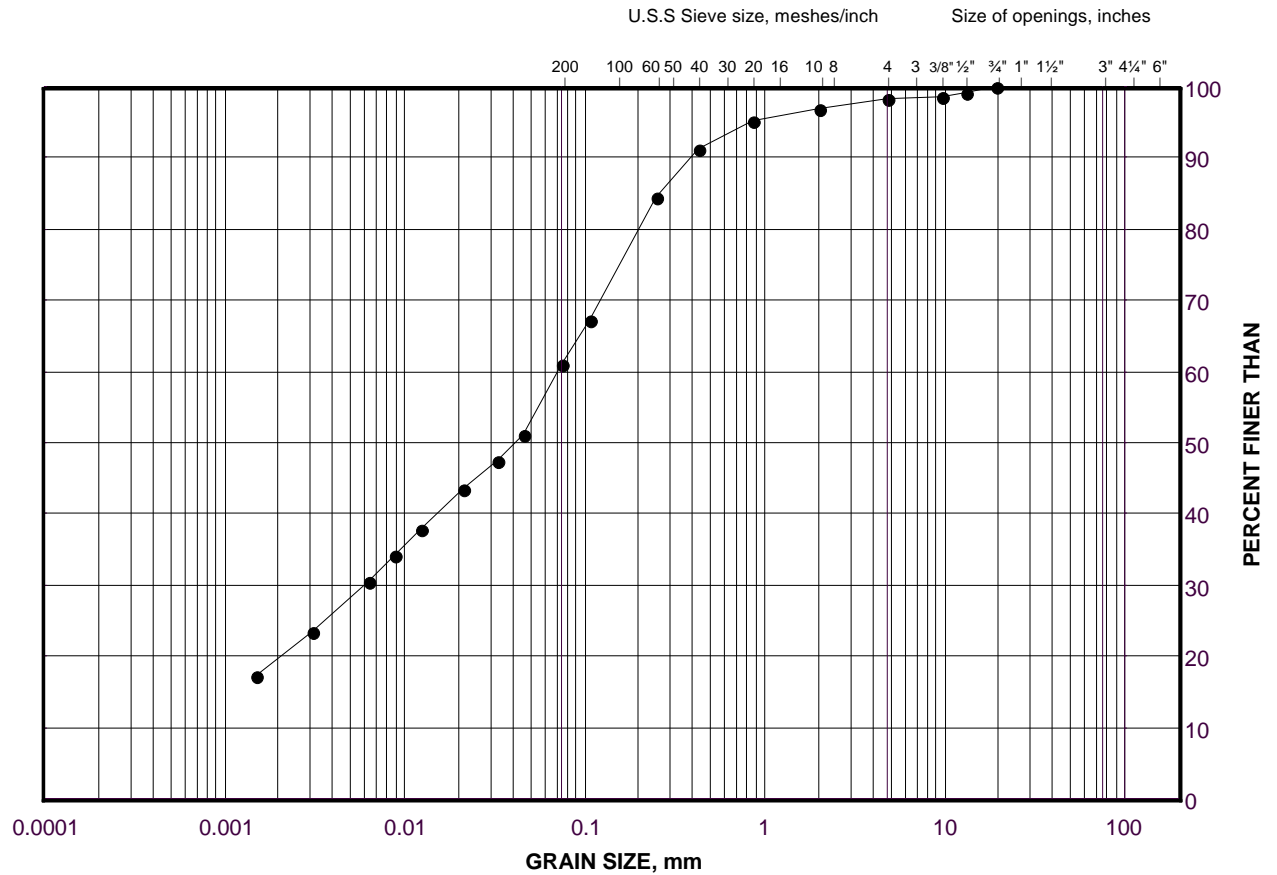
LEGEND

SYMBOL	Borehole	SAMPLE	ELEVATION(m)
●	TPS-01	2	295.3
■	TPS-04	3	294.5
◆	TPS-03	3	294.6
▲	TPS-02	3	294.5

GRAIN SIZE DISTRIBUTION

Clayey Silt with Sand (Fill)

FIGURE C2



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

LEGEND

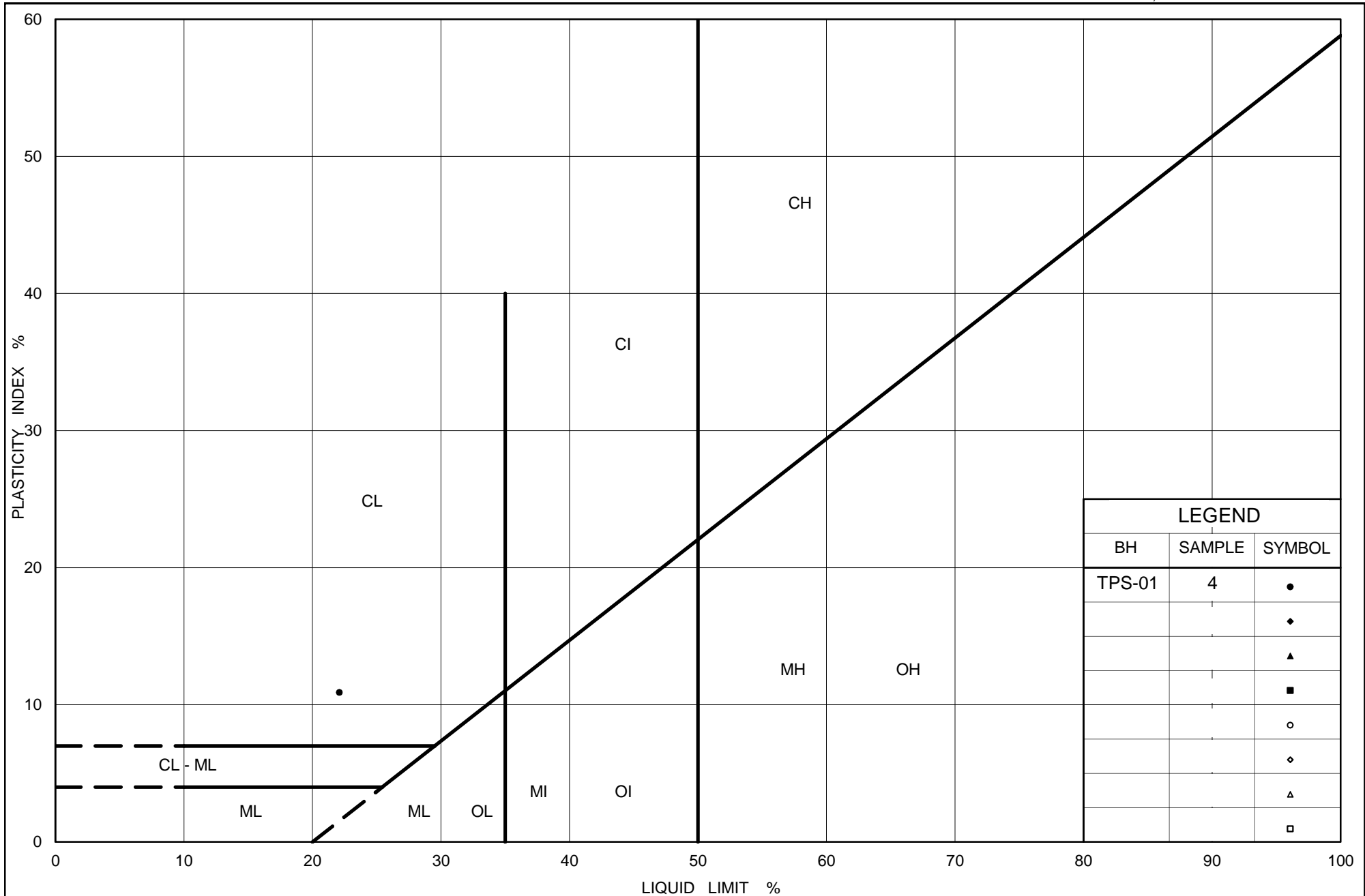
SYMBOL	Borehole	SAMPLE	ELEVATION(m)
•	TPS-01	4	293.8

Project Number: 1670268

Checked By: SMM

Golder Associates

Date: 08-Feb-18



Ministry of Transportation

Ontario

PLASTICITY CHART Clayey Silt with Sand (Fill)

Figure No. C3

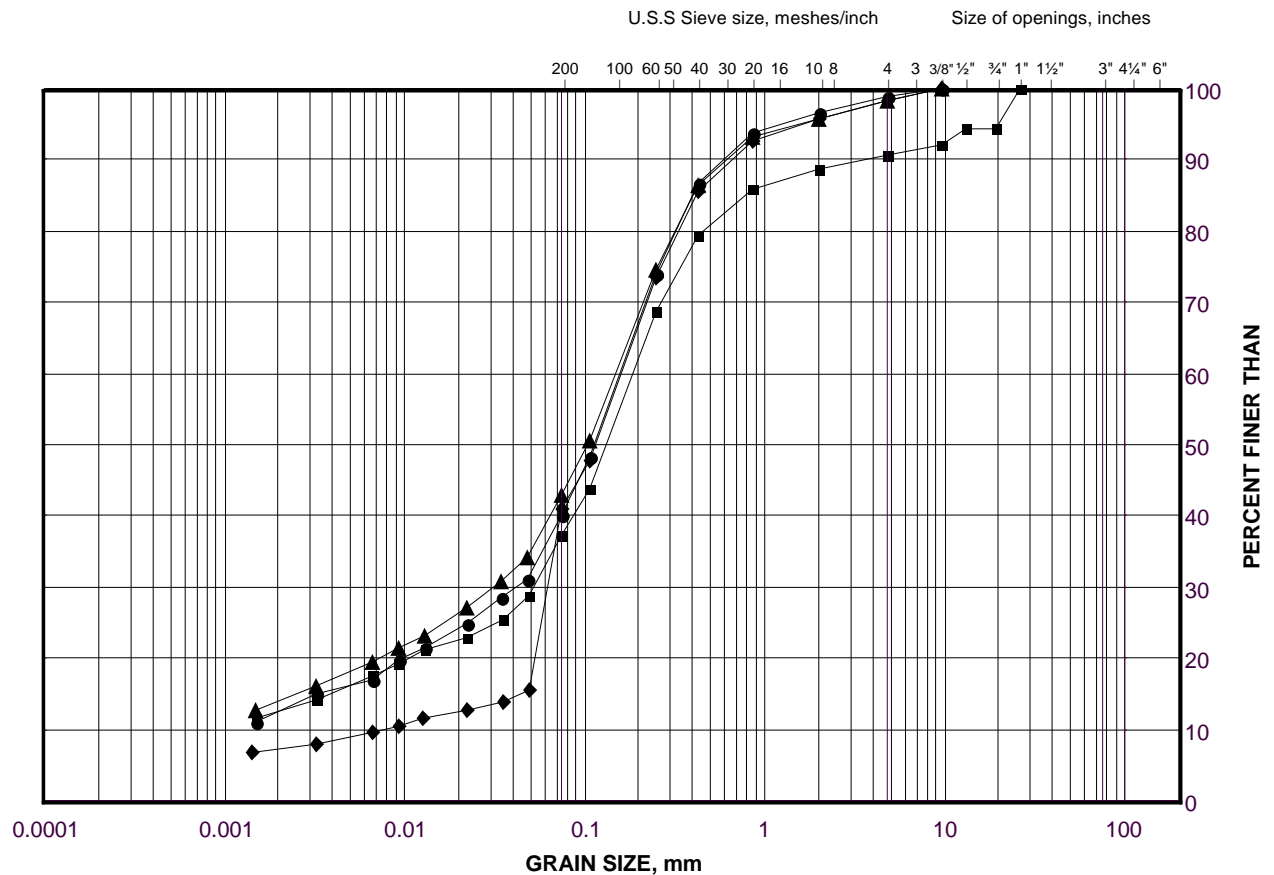
Project No. 1670268

Checked By: SMM

GRAIN SIZE DISTRIBUTION

Sandy Clayey Silt to Silty Sand (Till)

FIGURE C4A



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

LEGEND

SYMBOL	Borehole	SAMPLE	ELEVATION(m)
●	TPS-03	6	292.2
■	TPS-04	7	291.5
◆	TPS-02	7	291.4
▲	TPS-01	7	291.6

Project Number: 1670268

Checked By: SMM

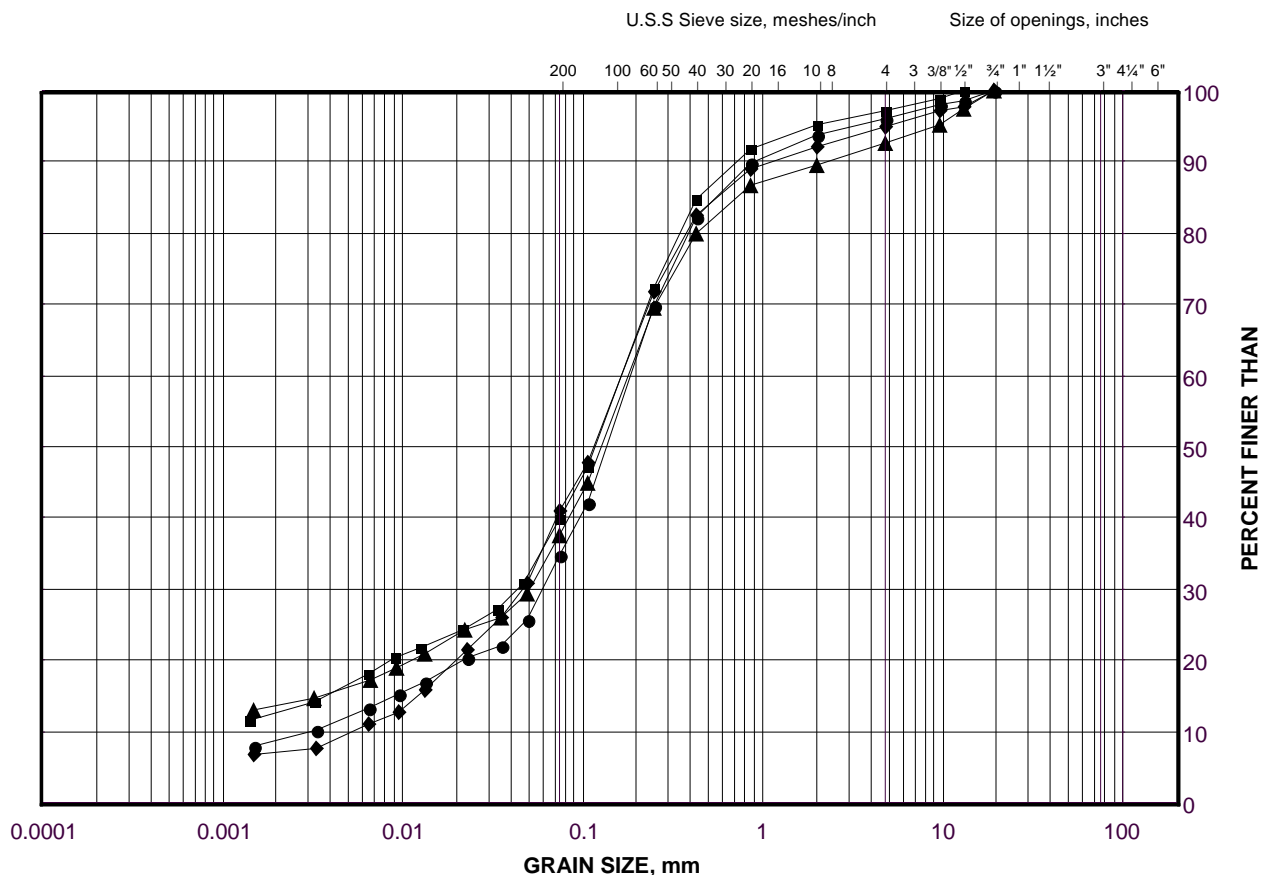
Golder Associates

Date: 13-Feb-18

GRAIN SIZE DISTRIBUTION

Sandy Clayey Silt to Silty Sand (Till)

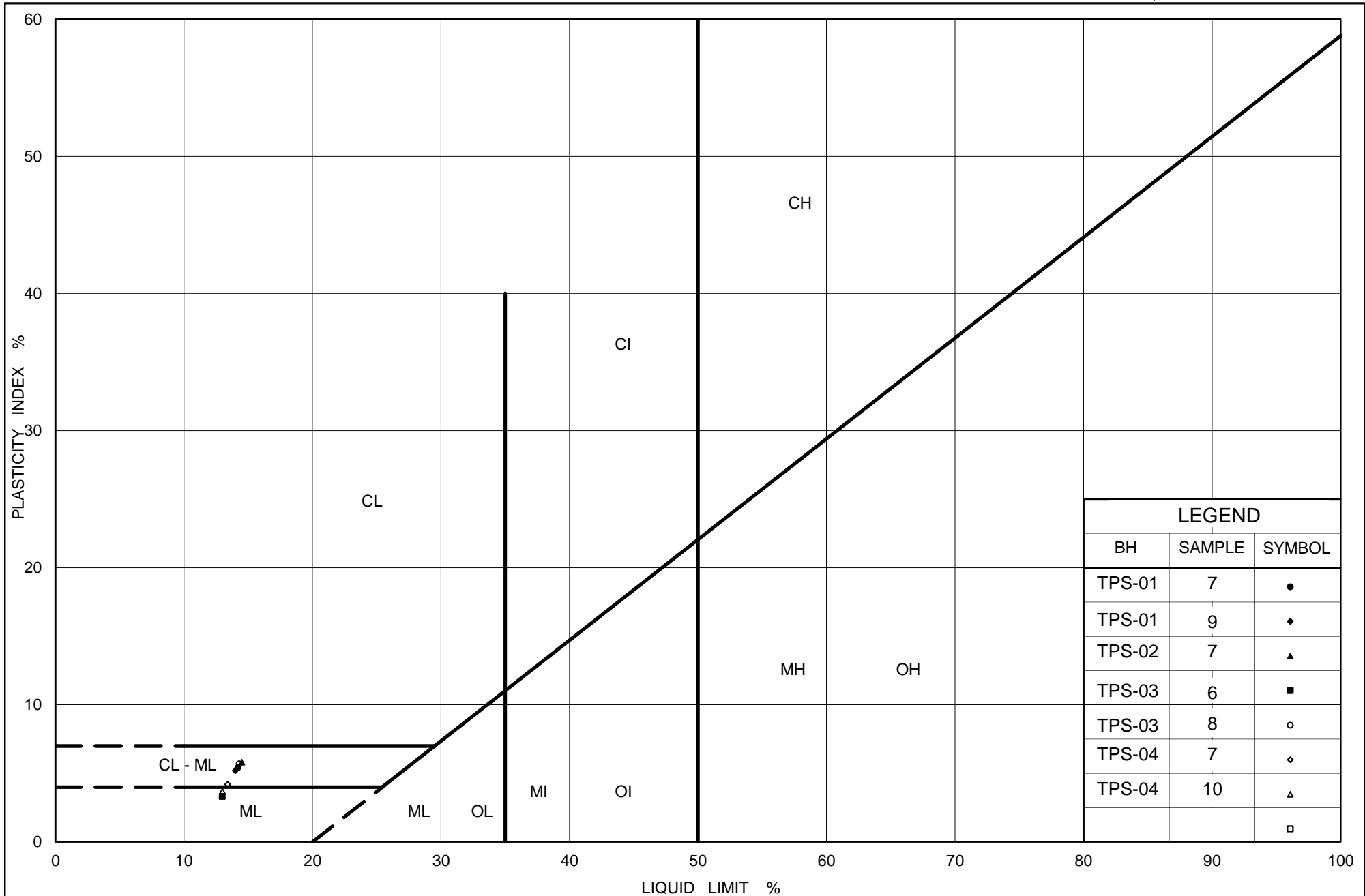
FIGURE C4B



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

LEGEND

SYMBOL	Borehole	SAMPLE	ELEVATION(m)
●	HF-12	3	289.3
■	HF-11	3	290.8
◆	HF-12	6	287.0
▲	HF-11	7	287.8



Ministry of Transportation

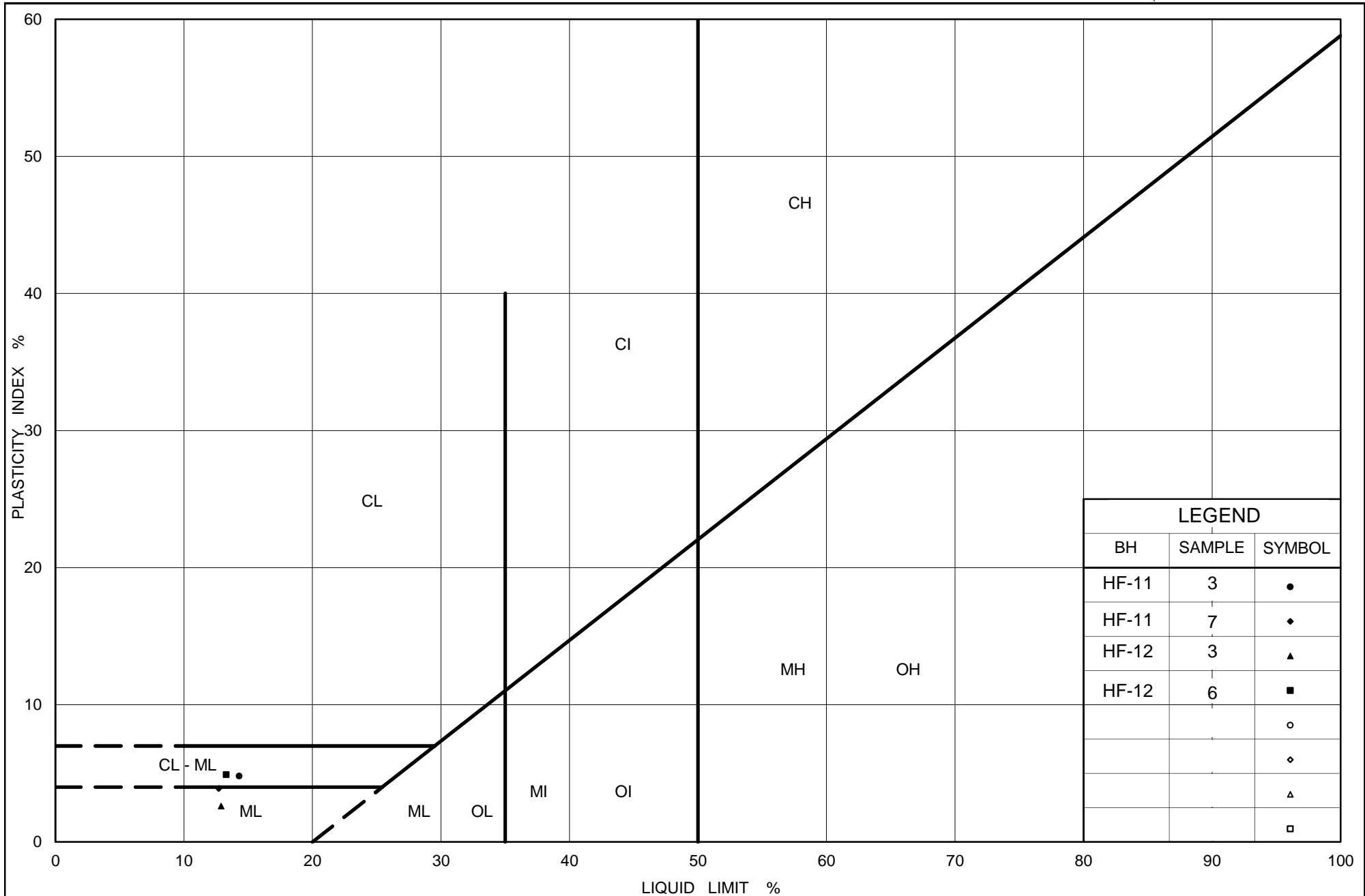
Ontario

PLASTICITY CHART Sandy Clayey Silt to Silty Sand (Till)

Figure No. C5A

Project No. 1670268

Checked By: SMM



Ministry of Transportation

Ontario

PLASTICITY CHART Sandy Clayey Silt to Silty Sand (Till)

Figure No. C5B

Project No. 1670268

Checked By: SMM

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For more information, visit golder.com

Africa	+ 27 11 254 4800
Asia	+ 86 21 6258 5522
Australasia	+ 61 3 8862 3500
Europe	+ 44 1628 851851
North America	+ 1 800 275 3281
South America	+ 56 2 2616 2000

solutions@golder.com
www.golder.com

Golder Associates Ltd.
6925 Century Avenue, Suite #100
Mississauga, Ontario, L5N 7K2
Canada
T: +1 (905) 567 4444

