



July 29, 2016

FOUNDATION INVESTIGATION AND DESIGN REPORT

HIGH MAST LIGHT POLES HIGHWAY 401 WIDENING FROM HIGHWAY 403/410 INTERCHANGE TO THE CREDIT RIVER CITY OF MISSISSAUGA, REGION OF PEEL G.W.P. 2150-01-00

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REPORT



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PART A

**FOUNDATION INVESTIGATION REPORT
HIGH MAST LIGHT POLES
HIGHWAY 401 WIDENING FROM HIGHWAY 403/410 INTERCHANGE
TO THE CREDIT RIVER
CITY OF MISSISSAUGA, REGION OF PEEL
G.W.P. 2150-01-00**



1.0 INTRODUCTION

Golder Associates Ltd. (Golder) has been retained by AECOM Canada Inc. (AECOM) on behalf of the Ministry of Transportation, Ontario (MTO) to provide foundation engineering services for High Mast Lights (HMLs) associated with the widening of Highway 401 from the Highway 403/410 Interchange to the Credit River in the City of Mississauga, Region of Peel, Ontario.

This report addresses the results of the foundation investigation carried out for the proposed twenty (20) High Mast Light (HML) poles along the Highway 401 corridor.

The terms of reference and scope of work for the foundation investigation are outlined in MTO's Request for Proposal (RFP) dated October 5, 2010 and subsequent clarifications and as presented in Golder Associates Ltd. (Golder's) revised scope change letter (Scope Change No. 6) dated July 9, 2014.

This Foundation Investigation report for the HML pole design is based on a field investigation conducted by Golder involving the advancement of 16 new boreholes along Highway 401 and associated ramps near the Mavis Road Interchange, supplemented with current boreholes advanced for other foundation components of this overall project under G.W.P. 2150-01-00.

2.0 SITE DESCRIPTION

The proposed HMLs are to be located predominantly along the Highway 401 median from about 300 m east of the Credit River to approximately 50 m east of McLaughlin Rd. Several new HMLs are proposed north and south of Highway 401 within ramp easements at the Mavis Road Interchange.

The road surface along this section of the Highway 401 corridor is at a low point (about Elevation 164 m) near the west limit of the project site (i.e. Credit River) and rises gradually towards the east to about Elevation 191 m at the east limit (i.e. near McLaughlin Road).

Based on the information provided by AECOM, the proposed HML pole designations, locations, and proposed ground surface elevations at the pole locations are summarized below and shown on Drawings 1 and 2.

HML Pole Designation	Coordinates (MTM NAD83)		Station	Offset	Location Description	Proposed Ground Surface Elevation (Geodetic)
	Northing	Easting				
P1	4830439.7	286599.1	15+346.8	-	Hwy 401 Centre Median	164.6
P2	4830510.7	286731.0	15+496.5	-	Hwy 401 Centre Median	164.7
P3	4830581.8	286863.3	15+646.7	-	Hwy 401 Centre Median	164.3
P4	4830648.5	286987.2	15+787.4	-	Hwy 401 Centre Median	165.3
P5	4830719.5	287119.3	15+937.3	-	Hwy 401 Centre Median	166.6
P6	4830790.5	287251.3	16+087.3	-	Hwy 401 Centre Median	167.8
P7	4830861.6	287383.5	16+237.4	-	Hwy 401 Centre Median	169.0
P8	4830931.7	287513.8	16+385.4	-	Hwy 401 Centre Median	172.9
P9	4831004.1	287648.4	16+538.1	-	Hwy 401 Centre Median	176.7



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HML Pole Designation	Coordinates (MTM NAD83)		Station	Offset	Location Description	Proposed Ground Surface Elevation (Geodetic)
	Northing	Easting				
P10	4831080.2	287789.8	16+698.8	-	Hwy 401 Centre Median	180.7
P11	4831161.1	287940.3	16+869.6	-	Hwy 401 Centre Median	184.9
P12	4831089.7	288028.6	16+820.6	45.7 RT	Ramp N-E	187.1
P13	4831337.1	287993.4	17+128.4	21.2 LT	Ramp S-W	188.1
P14	4831241.6	288089.9	17+039.5	-	Hwy 401 Centre Median	188.3
P15	4831360.0	288082.0	17+091.3	30.1 RT	Ramp E-NS	189.5
P16	4831315.0	288226.4	17+194.5	-	Hwy 401 Centre Median	189.6
P17	4831379.7	288346.6	17+330.9	-	Hwy 401 Centre Median	189.5
P18	4831447.5	288474.1	17+475.4	-	Hwy 401 Centre Median	189.1
P19	4831522.7	288615.4	17+635.4	-	Hwy 401 Centre Median	189.5
P20	4831600.7	288760.4	17+800.1	-	Hwy 401 Centre Median	190.1

3.0 INVESTIGATION PROCEDURES

As part of the current foundation investigation for the proposed Highway 401 widening project (G.W.P. 2150-01-00), about 90 boreholes have been drilled by Golder between May 2012 and January 2015 and the locations of boreholes within the limits of the proposed HMLs are shown on Drawings 1 and 2.

A total of 20 boreholes (designated BH-2014-1, 2014-2, 2014-3A, 2014-3B, 2014-4 to 2014-7, 2014-8A, 2014-9A, 2014-11 to 2014-16, FC-6, FC-5, MR-2, and MR-4) from the current project are considered relevant for the proposed new HMLs and are shown on Drawing 1 and 2 together with tabular borehole co-ordinate information. It is noted that the remaining boreholes drilled as part of the current project for the other foundation components of this project are also shown on Drawings 1 and 2 for information purposes only and are not discussed further in this report.

Of the 20 boreholes, 4 boreholes (FC-6, FC-5, MR-2 and MR-4) related to the Fletcher's Creek bridges and Mavis Road bridge extension components of this overall project have been reported and the complete investigation reports are available from the MTO Pavement and Foundations Section's GEOCREs database as follows:

- **MTO GEOCREs No. 30M12-355:** "Foundation Investigation Report, Mavis Road Underpass, Highway 401 Widening from Highway 403-410 interchange to the Credit River, City of Mississauga, Region of Peel G.W.P. 2150-01-00", by Golder Associates Ltd., dated October 23, 2013.
- **MTO GEOCREs No. 30M12-356:** "Foundation Investigation Report, Fletcher's Creek Bridges, Highway 401 Widening from Highway 403-410 Interchange to the Credit River, City of Mississauga, Region of Peel G.W.P. 2150-01-00", by Golder Associates Ltd., dated October 23, 2013.



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The remaining relevant 16 boreholes for the HMLs were drilled between November and December 2014 as part of a combined investigation for the HMLs and Overhead Sign (OHS) supports components of the project. The foundation investigation report for the OHS supports is provided under separate cover.

The current boreholes were drilled using truck and track-mounted drill rigs supplied and operated by Davis Drilling Inc. of Milton, Ontario. The boreholes were drilled through the overburden using 150 mm outside diameter solid stem augers or 108 mm diameter hollow stem augers, with soil samples obtained at 0.75 m and 1.5 m intervals of depth using a 50 mm outside diameter split-spoon sampler driven by an automatic hammer in accordance with the Standard Penetration Test (SPT) procedure (*ASTM D1586-08a, Standard Test Method for Standard Penetration Test and Split-Barrel Sampling of Soils*).

The groundwater conditions were observed in the open boreholes during and immediately following the drilling operations. All boreholes were backfilled with bentonite / holeplug upon completion, in accordance with Ontario Regulation 903 (as amended).

The field work was supervised on a full-time basis by members of Golder's engineering and technical staff who located the boreholes in the field, directed the drilling, sampling, and in situ testing operations, and logged the boreholes. The soil samples were identified in the field, placed in labelled containers and transported to Golder's laboratory in Mississauga for further examination and laboratory testing. Index and classification tests consisting of water content determinations, Atterberg limits, and grain size distribution were carried out on selected soil samples. The results of the testing program are shown on the Record of Borehole sheets in Appendix A and the laboratory test figures contained in Appendix B.

The borehole locations were collected in the field by Golder personnel using a GPS enabled Tablet connected to a Garmin GPS Booster device, with an accuracy of approximately 1 m to 3 m. The borehole locations were further refined using local site features and cross-referencing with the digital terrain models provided by AECOM. The ground surface elevation at each borehole location was estimated from the digital terrain model provided by AECOM.

The relevant borehole locations (referenced to the MTM NAD83 co-ordinate system), ground surface elevations (referenced to geodetic datum) and borehole depths at each borehole location are provided on the Record of Boreholes and shown on Drawing 1 and 2, as summarized below.

Borehole No.	MTM NAD83 Northing (m)	MTM NAD83 Easting (m)	Ground Surface Elevation (m)	Borehole Depth (m)
BH-2014-1	4830439.1	286600.6	164.5	10.9
BH-2014-2	4830539.7	286789.0	164.5	6.7
BH-2014-3A	4830578.8	286866.1	164.5	2.1
BH-2014-3B	4830578.8	286864.9	164.5	11.3
BH-2014-4	4830717.3	287120.6	166.5	11.3
FC-6	4830817.2	287306.2	168.3	14.2
FC-5	4830834.4	287327.5	168.6	13.9



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Borehole No.	MTM NAD83 Northing (m)	MTM NAD83 Easting (m)	Ground Surface Elevation (m)	Borehole Depth (m)
BH-2014-5	4830930.0	287516.6	173.0	11.0
BH-2014-6	4831006.6	287698.5	177.7	6.7
BH-2014-7	4831075.0	287793.5	180.8	11.3
BH-2014-8A	4831083.8	287904.3	182.2	12.8
MR-2	4831239.6	287971.8	195.1	37.2
MR-4	4831158.4	288051.0	195.4	31.1
BH-2014-9A	4831109.3	288020.6	185.6	8.2
BH-2014-11	4831349.9	288014.6	186.5	11.1
BH-2014-12	4831238.4	288089.1	188.2	11.3
BH-2014-13	4831359.4	288079.9	190.0	14.3
BH-2014-14	4831392.6	288269.8	189.5	6.7
BH-2014-15	4831378.5	288349.1	189.5	11.3
BH-2014-16	4831518.7	288613.5	190.0	11.3

4.0 SITE GEOLOGY AND SUBSURFACE CONDITIONS

4.1 Regional Geology

This section of Highway 401 is located within the Peel Plain, physiographic region, as delineated in *The Physiography of Southern Ontario* (Chapman and Putnam, 1984)¹.

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

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



4.2 Subsurface Conditions

As part of the current subsurface investigations, 20 boreholes were advanced in the Highway 401 and 403 corridors which are relevant to the HML component of the project: 4 boreholes from the Fletcher's Creek and Mavis Road structures; 9 boreholes from the Overhead Sign Structures; supplemented with 7 boreholes drilled specifically at or near HML locations. The locations of the relevant boreholes are shown on Drawings 1 and 2.

The detailed subsurface soil and groundwater conditions encountered in the boreholes advanced as part of the current and previous investigations and the results of in situ and laboratory testing are given on the borehole records contained in Appendix A; the borehole records are presented generally in order from west to east along the Highway 401 corridor in this appendix. The results of geotechnical laboratory testing from boreholes advanced during the current investigation either associated with the Overhead signs or HML are also presented on Figures B1 to B6 contained in Appendix B.

The stratigraphic boundaries shown on the borehole records are inferred from observations of drilling progress and from non-continuous sampling and, therefore, represent transitions between soil types rather than exact planes of geological change. The subsoil conditions will vary between and beyond the borehole locations.

In general, the subsurface conditions at the site consist of: layers of non-cohesive fill and cohesive fill; underlain by native materials comprised of silt to sand and gravel, clayey silt to silty clay to sandy silty clay; and till. The till deposit is predominantly comprised of sandy clayey silt, although it grades to silty clay and silty sand to silty sand and gravel in places.

A more detailed description of the subsurface conditions encountered in the boreholes is provided in the following sections. The subsurface conditions (i.e. presence, elevation and thickness of soil layers) for each specific HML pole location can be inferred from the closest borehole.

4.2.1 Fill

Fill material was encountered in many of the boreholes. The fill materials encountered vary in composition from non-cohesive to cohesive material, ranging from non-cohesive silt and sand, silty sand, and sand to cohesive clayey silt to silty clay to silty clay with sand. The fill materials in places contain cobbles and trace to some asphalt fragments.

The natural water content of the non-cohesive fill materials measured in 4 samples ranges from 3 per cent to 9 per cent. The natural water content of the cohesive fill material determined in 8 samples ranges from 10 per cent to 18 per cent.

The result of one grain size distribution test completed on a sample of the non-cohesive sand fill from the current investigation is shown on Figure B1 in Appendix B.

The measured Standard Penetration Test (SPT) "N"-values in the fill material are variable, ranging from approximately 3 blows to 60 blows per 0.3 m of penetration. These SPT "N"-values suggest that the cohesive portions of the fill have a variable, firm to hard consistency, while the cohesionless portions of the fill have a variable, very loose to very dense relative density.



4.2.2 Silt to Sand and Gravel

Non-cohesive native deposits and interlayers ranging in gradation from silt to sandy silt to silt and sand to silty sand to sand and gravel, trace clay, was encountered in some of the boreholes.

The Standard Penetration Test (SPT) "N"-values measured in the non-cohesive native material are variable, typically ranging from 10 blows to 89 blows per 0.3 m of penetration and up to 69 blows per 0.18 m of penetration. These SPT "N"-values indicate that the non-cohesive deposits are of loose / compact to very dense relative density.

The natural water content of the non-cohesive native materials determined on 9 samples ranges from 5 per cent to 17 per cent.

The results of grain size distribution tests completed on 3 samples of the non-cohesive native deposits from the current investigation are shown on Figures B2-1 and B2-2 in Appendix B.

4.2.3 Clayey Silt to Sandy Clayey Silt

Deposits and interlayers of clayey silt with sand to sandy clayey silt to clayey silt to silty clay were encountered in most of the boreholes. The clayey silt deposit also contains trace to some gravel and in places the deposit is gravelly. In Borehole BH-2014-12 cobbles were inferred by grinding of the augers during drilling.

The measured Standard Penetration Test (SPT) "N" values in the cohesive native deposits/interlayers are variable, ranging generally from 8 blows to 50 blows per 0.3 m of penetration, suggesting that the deposits/interlayers are of firm to hard consistency.

The natural water content of the cohesive native materials determined on 11 samples range from 8 per cent to 19 per cent.

The results of grain size distribution tests completed on 4 samples of the sandy clayey silt to clayey silt with sand portion of the deposits, including that of a clayey gravel seam, from the current investigation are shown on Figure B3 in Appendix B.

Atterberg limits tests were completed on 5 samples of the cohesive deposit from the current investigation and the results are shown on Figure B4 in Appendix B. The measured liquid limits range from 19 per cent to 39 per cent, the plastic limits range from 13 per cent to 18 per cent and the plasticity indices range from 6 per cent to 21 per cent and indicate that portions of the deposits may be classified as clayey silt/clayey silt with sand of low plasticity to silty clay of intermediate plasticity.

4.2.4 Clayey Silt to Sandy Silty Clay Till and Silty Sand and Gravel Till

The predominant soil deposit throughout the Highway 401 corridor is a cohesive till comprised of clayey silt to gravelly sandy clayey silt to sandy silty clay. The till deposit is generally comprised of clayey silt, trace to some gravel, however, the till does vary in composition to silty sand and gravel.

The measured SPT "N" values in the till deposit vary from approximately 7 blows to 65 blows per 0.3 m of penetration, as well as 95 blows per 0.2 m of penetration, suggesting that the deposit has a firm to hard consistency.



The natural water content of the till deposits was determined in 54 samples and range from 8 per cent to 28 per cent.

Grain size distribution tests were completed on 18 samples of the clayey silt to clayey silt with sand till from the current investigation and the results are presented on Figures B5-1 to B5-3 in Appendix B. Although cobbles and/or boulders were not encountered or inferred to be present within the till deposits of the current borehole investigation, the till deposits in southern Ontario typically contain such materials and they should be expected within such glacial deposits.

Atterberg limits tests were completed on 21 samples of the till deposit from the current investigation and the results are shown on the plasticity charts on Figures B6-1 to B6-3 in Appendix B. The measured liquid limits range from 20 per cent to 30 per cent, the plastic limits range from 11 per cent to 16 per cent and the plasticity indices range from 6 per cent to 14 per cent. These test results indicate that the cohesive till deposit is comprised predominantly of clayey silt of low plasticity (with a gradation range from sandy to with sand).

4.3 Groundwater Conditions

The groundwater levels as observed in the open boreholes during drilling and immediately following completion of drilling are recorded on the borehole records contained in Appendix A. It should be noted that these water levels do not represent the long-term “stabilized” groundwater level at the borehole locations, and the groundwater levels in the area are subject to seasonal fluctuations and variations due to precipitation events.

A piezometer was installed in each of Borehole MR-4 and BH-2014-9A to allow for longer term monitoring of the groundwater level, as shown on the Record of Borehole sheets. Additionally, artesian conditions were encountered in a number of boreholes advanced at the Fletcher’s Creek site (as noted for example in Borehole FC-12 included in the report under GEOCRETS 30M12-356) and observed at ground surface in the immediate vicinity of the Creek during the subsurface investigation. The groundwater conditions, depths to the water level and elevations are summarized below:

Borehole No.	Ground Surface Elevation (m)	Depth (m) to Water Level	Water Level Elevation (m)
BH-2014-1	164.5	10.2	154.3*
BH-2014-2	164.5	Dry to 6.7	Below 157.8*
BH-2014-3A	164.5	Dry to 2.1	Below 162.4*
BH-2014-3B	164.5	4.7	159.9*
BH-2014-4	166.5	8.1	158.4*
FC-6	168.3	NR**	NR**
FC-5	168.6	1.8	166.8*
BH-2014-5	173.0	8.0	165.0*
BH-2014-6	177.7	Dry to 6.7	Below 171.0*



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Borehole No.	Ground Surface Elevation (m)	Depth (m) to Water Level	Water Level Elevation (m)
BH-2014-7	180.8	6.5	174.3*
BH-2014-8A	183.6	Dry to 12.8	Below 169.4*
MR-2	195.1	19.8	175.3***
MR-4	195.4	18.3	177.1**** (Nov. 5, 2012)
BH-2014-9A	185.6	0.8	184.8****(June 30, 2015)
BH-2014-11	186.5	10.2	176.3*
BH-2014-12	188.2	Dry to 11.3	Below 176.9*
BH-2014-13	190.0	12.3	177.7*
BH-2014-14	189.5	Dry to 6.7	Below 182.8*
BH-2014-15	189.5	11.0	178.5*
BH-2014-16	190.0	Dry to 11.3	Below 178.7*

* Water level was obtained upon completion of drilling.

** Water level was not recorded as wash boring techniques were used - Refer to Record of Borehole.

*** Water level was obtained from augers at the start of the second day of drilling. Refer to Record of Borehole for details.

**** Water level was obtained from piezometer reading. Refer to Record of Borehole for details.

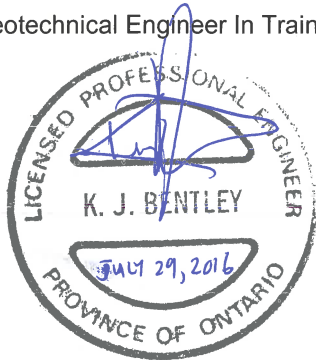


5.0 CLOSURE

This Foundation Investigation Report was prepared by Alex Szot, BASc and reviewed by Mr. Kevin Bentley, P.Eng., a geotechnical engineer and Associate with Golder. Mr. Jorge M. A. Costa, P.Eng., a Designated MTO Foundations Contact and Senior Consultant with Golder, conducted an independent review and quality control audit of this report.

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PART B

**FOUNDATION DESIGN REPORT
HIGH MAST LIGHT POLES
HIGHWAY 401 WIDENING FROM HIGHWAY 403/410 INTERCHANGE
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CITY OF MISSISSAUGA, REGION OF PEEL
G.W.P. 2150-01-00**



6.0 DISCUSSION AND ENGINEERING RECOMMENDATIONS

6.1 General

This section of the report provides foundation recommendations for the design of the high mast light (HML) poles. The recommendations are based on interpretation of the factual data obtained from the boreholes advanced during the current and previous subsurface investigations along the Highway 401 corridor. The interpretation and recommendations contained in this report are intended to provide the designers with sufficient information to carry out detail design of the HML pole foundations.

Where comments are made on construction, they are provided to highlight those aspects that could affect the design of the project, and for which special provisions may be required in the Contract Documents. Those requiring information on aspects of construction should make their own interpretation of the factual information provided as such interpretation may affect equipment selection, proposed construction methods, scheduling and the like.

The following points are noted regarding determining the locations of pertinent boreholes for potential use with respect to the foundation design for the proposed HML pole locations:

- In general, an existing borehole or a borehole drilled for the purpose of this HML pole investigation is located no further than approximately 100 m of the proposed HML pole location.
- Where multiple boreholes are located near a proposed HML pole location, the more conservative (i.e. lower strength soil) data was assumed from the nearest borehole in selecting the recommended parameter values for use in the HML pole foundation design.

6.2 Design of High Mast Light Pole Foundations

Twenty new HML poles are required for this project to be supported on a single caisson foundation at each HML pole location.

Caisson foundations for HML poles should be designed in accordance with the requirements in MTO's *Guidelines for the Design of High Mast Pole Foundations* (MTO, 2004), based on the interpreted stratigraphy and groundwater conditions and the recommended geotechnical design parameters given in Table 1 following the text of this report.

Where both undrained shear strength, S_u , and effective stress, ϕ' , parameters values are provided in Table 1, for the cohesive deposits, the structural assessment should be completed for both the undrained and drained soil cases, and the more conservative approach (design) should be adopted.

In the design of the foundations, the passive resistance of the soil within the upper 1.2 m below ground surface should be neglected to account for frost action.



6.3 Construction Considerations

It is recommended that a Non-Standard Special Provision (NSSP), such as the one provided in Appendix C, be included in the Contract Documents to warn the Contractor of the special conditions such as control of soil and groundwater during caisson construction and the presence of obstructions (such as cobbles and boulders) during caisson advancement.

6.3.1 Control of Soil and Groundwater

Water-bearing non-cohesive soil lenses or interlayers within the cohesive fill and native deposits will likely be present at the HML Pole locations. Depending on the period of the year, “perched” groundwater may also be encountered within the fill soils overlying the cohesive soil deposits. Wet non-cohesive soil lenses or interlayers (if encountered) should be expected to run or flow into the drilled hole during or after augering for the sign support foundations. Therefore, temporary or permanent caisson liners are recommended to minimize ground loss during drilling cleaning of the caisson and to allow for concrete placement fully to the bottom of the caisson. Artesian conditions are present and should be expected to be encountered while drilling the HML pole foundations near Fletcher’s Creek.

6.3.2 Cobbles and Boulders

Cobbles are inferred present in the boreholes drilled at the HML Pole support locations, in the Fill and Till layers, based on grinding of the augers and split spoon sampling as noted on the borehole records and discussed in Part A of this report. Further, boulders should be anticipated to be present within the glacially derived soils, and possibly the fill materials, although boulders were not encountered in any of the boreholes drilled at this site. Appropriate equipment and procedures will be required to penetrate the cobbles and boulders during the augering of the hole for the HML pole caisson foundations.



7.0 CLOSURE

This Foundation Design Report was prepared by Alex Szot, BASc and reviewed by Mr. Kevin Bentley, P.Eng., a geotechnical engineer and Associate with Golder. Mr. Jorge M. A. Costa, P.Eng., a Designated MTO Foundations Contact and Senior Consultant with Golder, conducted an independent review and quality control audit of this report.

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AJS/KJB/JMAC/sm

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Ontario Provincial Standard Drawings (OPSD)

OPSD 3090.101 Foundation Frost Penetration Depths for Southern Ontario

Ontario Water Resources Act

Regulation 903 Wells (as amended)

TABLE 1
GEOTECHNICAL DESIGN PARAMETERS FOR HIGH MAST LIGHT POLE FOUNDATIONS
HIGHWAY 401 WIDENING, G.W.P. 2150-01-00

Pole No.	Station	Reference Borehole (s)	Ground Surface Elevation at Reference Borehole(s) (m)	Proposed Top of Footing Elevation (m)	Proposed Ground Surface Elevation (m)	Stratum	Depth Below Proposed Ground Surface at HML Pole Location ² (m)	Elevation (m)	Groundwater Elevation (m)	Design Parameters ^{1,3}				
										S _u (kPa)	Φ'	γ (kN/m ³)	γ' (kN/m ³)	K _p
P1	15+346.8	BH-2014-1	164.5	164.6	164.6	Compact Sand to Sand and Gravel Fill	0-1.1	Above 163.4	154.3	-	28	20	10	2.8
						Firm to stiff Silty Clay Fill	1.1-3.0	163.4-161.5		25	28	19	9	2.8
						Firm to stiff Clayey Silt	3.0-3.7	161.5-160.8		25	28	19	9	2.8
						Compact to very dense Sand and Gravel	3.7-4.8	160.8-159.7		-	34	21	11	3.5
						Very Stiff Clayey Silt Till	4.8-6.7	159.7-157.8		100	32	20	10	3.3
						Dense to very dense Silty Sand	6.7-10.2	157.8-154.3		-	34	21	11	3.5
						Hard gravelly sandy Clayey Silt Till	10.2-10.9	154.3-153.6		100	32	20	10	3.3
P2	15+496.5	BH-2014-2 BH-2014-3A BH-2014-3B	164.5 164.5 164.5	165.7	164.7	Compact Sand and Gravel Fill	0-0.8	Above 163.7	159.9	-	28	20	10	2.8
						Firm to hard Silty Clay Fill	0.8-3.7	163.7-160.8		30	28	19	9	2.8
						Dense / Stiff Sandy Silt / Clayey Silt	3.7-4.1	160.8-160.4		-	30	20	10	3.0
						Compact to dense Sand and Gravel	4.1-5.6	160.4-158.9		-	32	21	11	3.3
						Very stiff to hard Sandy Clayey Silt Till	5.6-7.2	158.9-157.3		100	32	20	10	3.3
						Very dense Silty Sand	7.2-8.6	157.3-155.9		-	34	21	11	3.5
						Very stiff Sandy Clayey Silt/Silty Clay Till	8.6-10.2	155.9-154.3		100	32	20	10	3.3
						Hard Silty Clay	10.2-11.3	154.3-153.2		100	32	20	10	3.3
P3	15+646.7	BH-2014-3A BH-2014-3B	164.5 164.5	165.4	164.3	Compact Sand and Gravel Fill	0-0.6	Above 163.7	159.9	-	28	20	10	2.8
						Stiff to hard Silty Clay Fill	0.6-3.5	163.7-160.8		30	28	20	10	2.8
						Dense Sandy Silt	3.5-3.9	160.8-160.4		-	32	21	10	3.3
						Compact Sand and Gravel	3.9-5.4	160.4-158.9		-	32	21	11	3.3
						Very stiff Sandy Clayey Silt Till	5.4-7.0	158.9-157.3		100	32	20	11	3.3
						Very dense Silty Sand	7.0-8.4	157.3-155.9		-	34	21	11	3.5
						Very stiff Sandy Clayey Silt Till	8.4-10.0	155.9-154.3		100	32	20	11	3.3
						Hard Silty Clay	10.0-11.1	154.3-153.2		100	32	20	11	3.3
P4	15+787.4	BH-2014-3A BH-2014-3B	164.5 164.5	166.4	165.3	Compact Sand and Gravel Fill	0-1.6	Above 163.7	159.9	-	28	20	10	2.8
						Firm to hard Silty Clay Fill	1.6-4.5	163.7-160.8		30	28	20	10	2.8
						Dense Sandy Silt	4.5-4.9	160.8-160.4		-	32	21	11	3.3
						Compact Sand and Gravel	4.9-6.4	160.4-158.9		-	32	21	11	3.3
						Very stiff Sandy Clayey Silt Till	6.4-8.0	158.9-157.3		100	32	20	10	3.3
						Very dense Silty Sand	8.0-9.4	157.3-155.9		-	34	21	11	3.5
						Very stiff Sandy Clayey Silt Till	9.4-11.0	155.9-154.3		100	32	20	10	3.3
						Hard Silty Clay	11.0-12.1	154.3-153.2		100	32	20	10	3.3
		BH-2014-4	166.5			Compact Sand and Gravel Fill	0.0-0.0	Above 165.7		-	28	20	10	2.8
						Compact Silt Fill	0.0-0.2	165.7-165.1		-	28	20	10	2.8
						Very stiff Clayey Silt with sand	0.2-1.8	165.1-163.5		100	32	20	10	3.3
						Very stiff Sandy Clayey Silt Till	1.8-6.0	163.5-159.3		100	32	20	10	3.3
						Very dense Sand and Silt	6.0-7.5	159.3-157.8		-	34	21	11	3.5
						Very dense Silty Sand	7.5-10.1	157.8-155.2		-	34	21	11	3.5
P5	15+937.3	BH-2014-4	166.5	167.6	166.6	Compact Sand and Gravel Fill	0-0.9	Above 165.7	158.4	-	28	20	10	2.8
						Compact Silt Fill	0.9-1.5	165.7-165.1		-	28	20	10	2.8
						Very stiff Clayey Silt with sand	1.5-3.1	165.1-163.5		100	32	20	10	3.3
						Very stiff Sandy Clayey Silt Till	3.1-7.3	163.5-159.3		100	32	20	10	3.3
						Very dense Sand and Silt	7.3-8.8	159.3-157.8		-	34	21	11	3.5
						Very dense Silty Sand	8.8-11.4	157.8-155.2		-	34	21	11	3.5
P6	16+087.3	FC-6	168.3	168.8	167.8	Compact Sand and Gravel Fill	0-0.3	Above 167.5	168.0	-	28	20	10	2.8
						Firm to very stiff Clayey Silt Fill	0.3-6.7	167.5-161.1		30	28	19	9	2.8
						Firm to stiff Clayey Silt	6.7-9.7	161.1-158.1		50	30	19	9	3.0
						Dense Silty Sand Till	9.7-11.2	158.1-156.6		-	34	21	11	3.5
						Very dense Sand and Gravel Till	11.2-13.7	156.6-154.1		-	34	21	11	3.5

TABLE 1
GEOTECHNICAL DESIGN PARAMETERS FOR HIGH MAST LIGHT POLE FOUNDATIONS
HIGHWAY 401 WIDENING, G.W.P. 2150-01-00

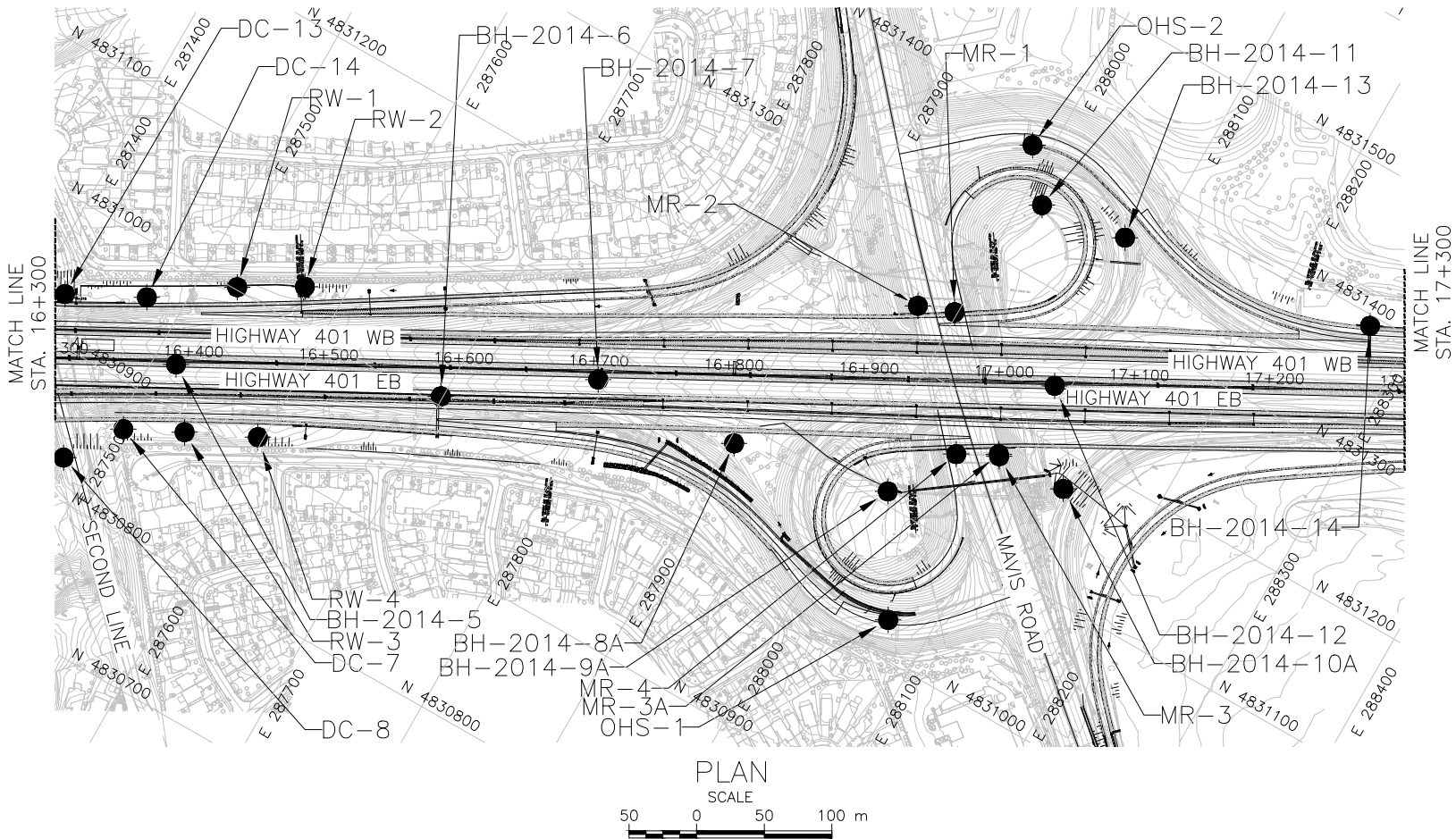
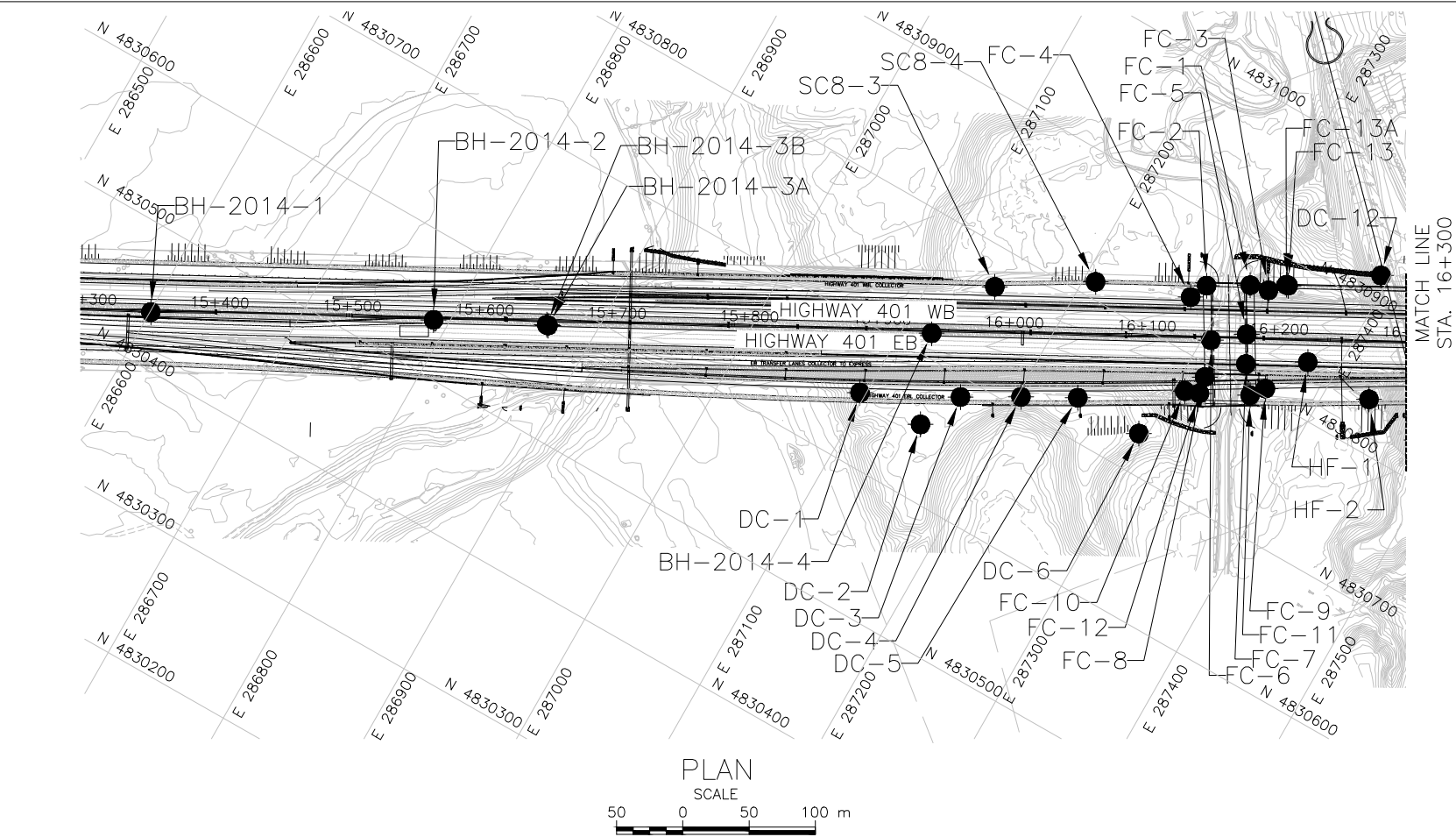
Pole No.	Station	Reference Borehole (s)	Ground Surface Elevation at Reference Borehole(s) (m)	Proposed Top of Footing Elevation (m)	Proposed Ground Surface Elevation (m)	Stratum	Depth Below Proposed Ground Surface at HML Pole Location ² (m)	Elevation (m)	Groundwater Elevation (m)	Design Parameters ^{1, 3}				
										S _u (kPa)	Φ'	γ (kN/m ³)	γ' (kN/m ³)	K _p
P7	16+237.4	FC-5	168.6	170.1	169.0	Sand and Gravel Fill	0-1.2	Above 167.8	169.0	-	28	20	10	2.8
						Firm to very stiff Clayey Silt Fill	1.2-6.2	167.8-162.8		30	28	19	9	2.8
						Very loose to loose Sand and Silt	6.2-7.7	162.8-161.3		-	28	19	9	2.8
						Firm to very stiff Clayey Silt	7.7-10	161.3-159.0		50	32	19	9	3.3
						Very dense Silty Sand and Gravel Till	10.0-14.3	159.0-154.7		-	34	20	10	3.5
P8	16+385.4	BH-2014-5	173.0	173.9	172.9	Compact Silty Sand and Gravel Fill	0-0.8	Above 172.1	165.1	-	28	20	10	2.8
						Very stiff Clayey Silt Fill	0.8-2.9	172.1-170.0		50	28	19	9	2.8
						Stiff to hard Sandy Clayey Silt Till	2.9-10.1	170.0-162.8		100	32	20	10	3.3
						Very dense Silty Sand	10.1-10.8	162.8-162.1		-	34	21	11	3.5
P9	16+538.1	BH-2014-5 BH-2014-6	173.0 177.7	177.8	176.7	Compact Silty Sand and Gravel Fill	0-4.5	Above 172.2	168.0	-	28	20	10	2.8
						Firm to very stiff Clayey Silt Fill	4.5-6.7	172.2-170.0		30	28	19	9	2.8
						Firm to Hard Clayey Silt Till	6.7-13.9	170.0-162.8		50	30	20	10	3.0
						Very dense Silty Sand	13.9-14.6	162.8-162.1		-	34	21	11	3.5
P10	16+698.8	BH-2014-7	180.8	181.8	180.7	Compact Sand and Gravel Fill	0-0.8	Above 179.9	174.3	-	28	20	10	2.8
						Stiff to very stiff Silty Clay Fill	0.8-2.9	179.9-177.8		50	28	19	9	2.8
						Very stiff Silty Clay	2.9-4.4	177.8-176.3		100	32	21	11	3.3
						Very stiff to hard Clayey Silt Till	4.4-11.2	176.3-169.5		100	32	20	10	3.3
P11	16+869.6	BH-2014-8A	182.2	186.0	184.9	Compact Silty Sand and Gravel Fill	0-2.7	Above 182.2	174.3	-	28	20	10	2.8
						Firm to stiff Silty Clay Fill	2.7-3.4	182.2-181.5		25	28	19	9	2.8
						Firm to stiff Silty Clay	3.4-4.9	181.5-180.0		25	28	19	9	2.8
						Stiff to very stiff Clayey Silt with Sand Till	4.6-15.5	180.0-169.4		100	32	20	10	3.3
P12	16+820.6	MR-2 MR-4 BH-2014-9A	195.1 194.6 185.6	187.1	187.1	Firm to hard Clayey Silt Fill	0-1.9	Above 183.5	177.1	25	28	19	9	2.8
						Stiff to hard Clayey Silt with Sand Till	1.9-26.3	183.5-159.1		100	32	20	10	3.3
						Compact Sand and Gravel	26.3-27.6	159.1-157.9		-	30	21	11	3.0
P13	17+128.4	BH-2014-9A	185.6	188.1	188.1	Firm Clayey Silt Fill	0-1.7	Above 184.8	185.0	25	28	19	9	2.8
						Stiff to very stiff Clayey Silt with Sand Till	1.7-9.1	184.8-177.4		100	32	20	10	3.3
P14	17+039.5	BH-2014-11	186.5	189.3	188.3	Suitable Fill	0 - 1.9	Above 186.5	176.3	-	28	19	9	2.8
						Stiff Silty Clay Fill	1.9-2.5	186.5-185.9		30	28	19	9	2.8
						Very stiff to Hard Clayey Silt Till	2.5-12.9	185.9-175.4		100	32	20	10	3.3
P15	17+091.3	BH-2014-12	188.2	189.5	189.5	Dense Sand and Gravel Fill	0-1.5	Above 187.3	178	-	28	20	10	2.8
						Stiff to very stiff Clayey Silt to Silty Clay Fill	1.5-2.8	187.3-186.0		30	28	19	10	2.8
						Very stiff Clayey Silt	2.8-5.1	186.0-183.7		100	32	20	10	3.3
						Firm to stiff Clayey Silt with Sand Till	5.1-11.9	183.7-176.9		50	30	20	10	3.0
P16	17+194.5	BH-2014-13	190.0	190.7	189.6	Compact Silty Sand and Gravel Fill	0-0.3	Above 189.3	177.7	-	28	20	10	2.8
						Very stiff Silty Clay with Gravel Fill	0.3-2.0	189.3-187.6		50	28	19	10	2.8
						Stiff to very stiff Clayey Silt	2.0-5.2	187.6-184.4		100	32	20	10	2.8
						Stiff to hard Clayey Silt with Sand Till	5.2-13.9	184.4-175.7		100	32	20	10	3.3
P17	17+330.9	BH-2014-14 BH-2014-15	189.5 189.5	190.6	189.5	Compact to dense Sand and Gravel Fill	0-0.8	Above 188.7	178.5	-	28	20	10	2.8
						Very stiff Clayey Silt Fill	0.8-1.4	188.7-188.1		50	28	19	9	2.8
						Very stiff Silty Clay	1.4-3.0	188.1-186.5		100	32	20	10	3.3
						Stiff to very stiff Clayey Silt Till	3.0-10.2	186.5-179.3		100	32	20	10	3.3
						Stiff Silty Clay	10.2-11.3	179.3-178.2		50	30	20	10	3.0
P18	17+475.4	BH-2014-15	189.5	190.2	189.1	Compact to dense Sand and Gravel Fill	0-0.4	Above 188.7	178.5	-	28	20	10	2.8
						Very stiff Clayey Silt Fill	0.4-1.0	188.7-188.1		50	28	19	9	2.8
						Very stiff Silty Clay	1.0-2.6	188.1-186.5		100	32	20	10	3.3
						Stiff to very stiff Clayey Silt Till	2.6-9.8	186.5-179.3		100	32	20	10	3.3
						Stiff Silty Clay	9.8-10.9	179.3-178.2		50	30	20	10	3.0

TABLE 1
GEOTECHNICAL DESIGN PARAMETERS FOR HIGH MAST LIGHT POLE FOUNDATIONS
HIGHWAY 401 WIDENING, G.W.P. 2150-01-00

Pole No.	Station	Reference Borehole (s)	Ground Surface Elevation at Reference Borehole(s) (m)	Proposed Top of Footing Elevation (m)	Proposed Ground Surface Elevation (m)	Stratum	Depth Below Proposed Ground Surface at HML Pole Location ² (m)	Elevation (m)	Groundwater Elevation (m)	Design Parameters ^{1, 3}				
										S _u (kPa)	Φ'	γ (kN/m ³)	γ' (kN/m ³)	K _p
P19	17+635.4	BH-2014-15 BH-2014-16	189.5 190.0	189.5	189.5	Compact to dense Sand and Gravel Fill	0-1.3	Above 188.7	178.5	-	28	20	10	2.8
						Stiff to very stiff Clayey Silt Fill	1.3-2.2	188.7-187.8		30	28	19	9	2.8
						Very stiff Silty Clay	2.2-3.5	187.8-186.5		100	32	20	10	3.3
						Stiff to very stiff Clayey Silt with Sand Till	3.5-10.7	186.5-179.3		100	32	20	10	3.3
						Stiff Silty Clay	10.7-11.8	179.3-178.2		50	30	20	10	3.0
P20	17+800.1	BH-2014-16	190.0	190.1	190.1	Dense Sand and Gravel Fill	0-1.3	Above 189.2	179.5	-	28	20	10	2.8
						Stiff to very stiff Silty Clay Fill	1.3-2.7	189.2-187.8		30	28	19	10	2.8
						Stiff to hard Silty Clay with Sand Till	2.7-11.8	187.8-178.7		100	32	20	10	3.3

NOTES:

1. Design parameters:
S_u = undrained shear strength (kPa);
Φ' = effective friction angle (degrees);
γ = bulk unit weight (kN/m³);
γ' = effective unit weight below the groundwater level (kN/m³);
K_p = passive earth pressure coefficient
2. Depths given at the proposed HML pole locations are relative to the estimated proposed ground surface following construction, including any median grade raises or regrading. Although Su, φ' and Kp parameters are given for the full depth of the borehole, the passive resistance in the upper 1.2 m should be ignored to account for frost action.
3. Where both undrained shear strength and effective friction angle parameters are provided for fill materials, the structural assessment should be completed for both cohesive soil and cohesionless soil cases, and the selected design should be based on the more conservative result.

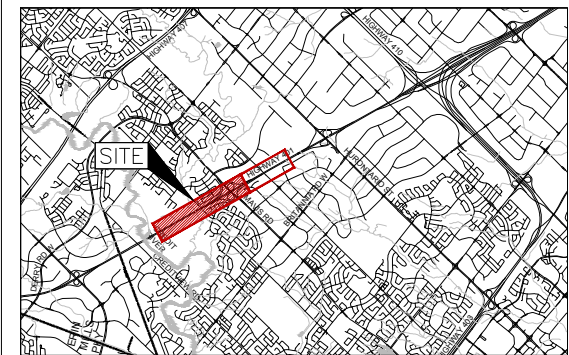


METRIC
DIMENSIONS ARE IN METRES AND/OR
MILLIMETRES UNLESS OTHERWISE SHOWN.
STATIONS IN KILOMETRES + METRES.

CONT No.
GWP No. 2150-01-00



HIGHWAY 401 WIDENING
HIGH MAST LIGHTS STA. 15+300 TO STA. 17+300
BOREHOLE LOCATIONS



KEY PLAN
SCALE
1.5 0 1.5 3 km

LEGEND

● Borehole - Current Investigation

RELEVANT BOREHOLE CO-ORDINATES

No.	ELEVATION	NORTHING	EASTING
BH-2014-1	164.5	4830439.1	286600.6
BH-2014-2	164.5	4830539.7	286789.0
BH-2014-3A	164.5	4830578.8	286866.1
BH-2014-3B	164.5	4830578.8	286864.9
BH-2014-4	166.5	4830717.3	287120.6
BH-2014-5	173.0	4830930.0	287516.6
BH-2014-6	177.7	4831006.6	287698.5
BH-2014-7	180.8	4831075.0	287793.5
BH-2014-8A	182.2	4831083.8	287904.3
BH-2014-9A	185.6	4831109.3	288020.6
BH-2014-10A	189.4	4831175.3	288132.5
BH-2014-11	186.5	4831349.9	288014.6
BH-2014-12	188.2	4831238.4	288089.1
BH-2014-13	190.0	4831359.4	288079.9
BH-2014-14	189.5	4831392.6	288269.8
FC-5	168.6	4830834.4	287327.5
FC-6	168.3	4830817.2	287306.2
MR-2	195.1	4831239.6	287971.8
MR-4	194.6	4831158.4	288051.0

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 complete Foundation Investigation and Design Report for this project and other related documents may be examined at the Materials Engineering and Research Office, Downsview. Information contained in this report and related documents is specifically excluded in accordance with Section GC 2.01 of OPS General Conditions.

REFERENCE

Base plans provided in digital format by AECOM, drawing file nos. XDesign_Elec-30-Oct-2014.dwg, received February 18, 2015, X-60213979-C-DE-HWY401_MAVIS.dwg, received October 3, 2014 and X-60213979-C-BA-HWY401_MAVIS.dwg, received September 24, 2014.



NO.	DATE	BY	REVISION
Geocres No. 30M12-397			
HWY. 401	PROJECT NO. 10-1111-0211		
SUBM'D. KJB	CHKD. AJS	DATE: 7/28/2016	SITE:
DRAWN: JFC/DD	CHKD. KJB	APPD. JMAC	DWG. 1

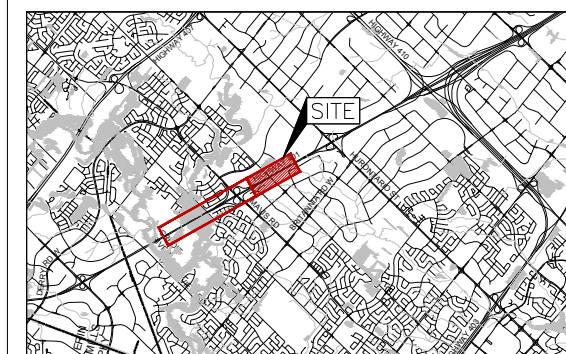
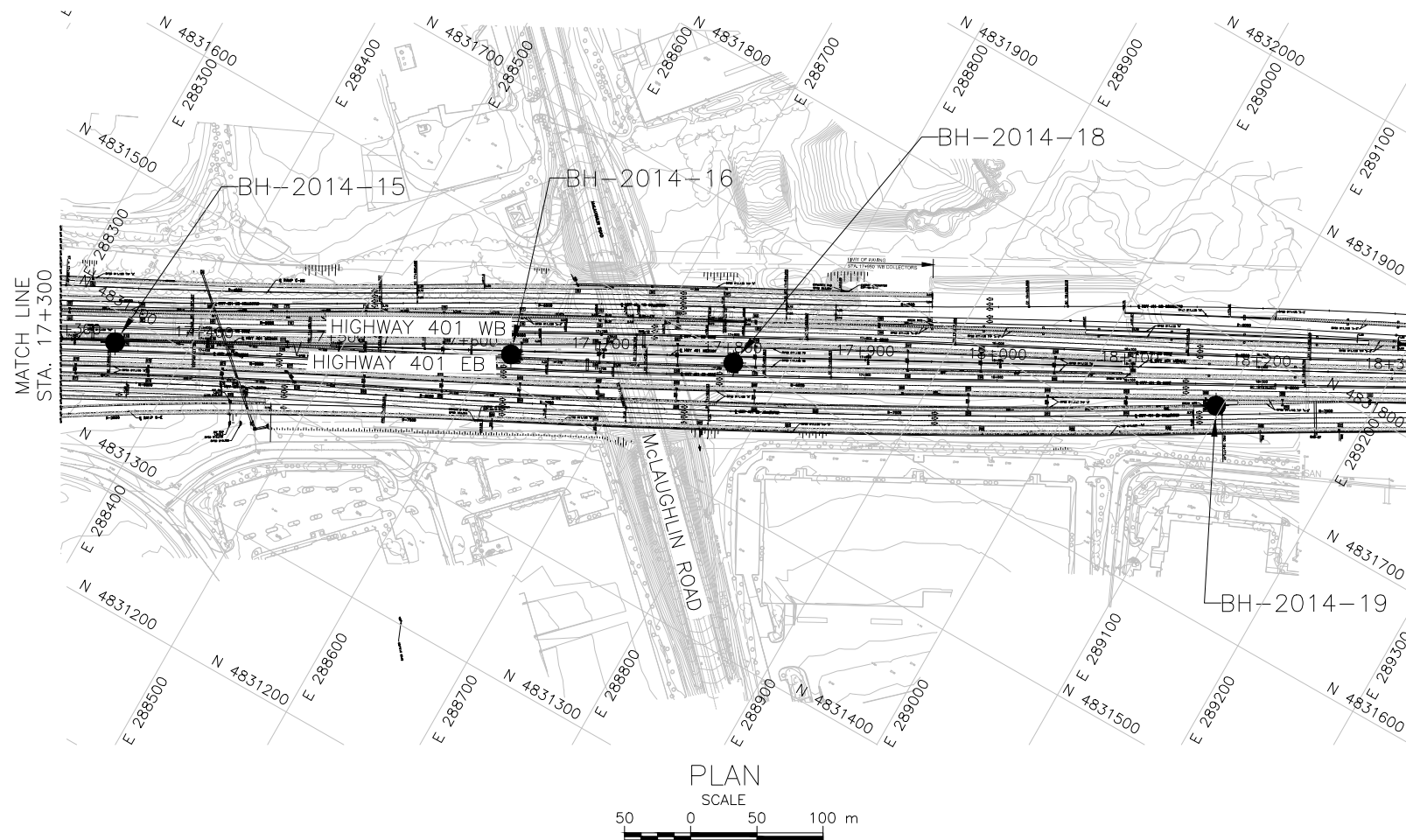
CONT No.
GWP No. 2150-01-00



HIGHWAY 401 WIDENING

HIGH MAST LIGHTS STA. 17+300 TO STA. 18+300

BOREHOLE LOCATIONS



KEY PLAN
SCALE
1.5 0 1.5 3 km

LEGEND

● Borehole – Current Investigation

RELEVANT BOREHOLE CO-ORDINATES			
No.	ELEVATION	NORTHING	EASTING
BH-2014-15	189.5	4831378.5	288349.1
BH-2014-16	190.0	4831518.7	288613.5

NOTES

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APPENDIX A

Borehole Records



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



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		10-1111-0211		RECORD OF BOREHOLE No BH-2014-1		SHEET 1 OF 1		METRIC									
G.W.P.		2150-01-00		LOCATION		N 4830439.1 ; E 286600.6		ORIGINATED BY									
DIST		Central HWY 401		BOREHOLE TYPE		150 mm O.D. Solid Stem Augers		COMPILED BY									
DATUM		GEODETIC		DATE		Nov. 12 & 13, 2014		CHECKED BY									
								KJB									
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									
164.5	GROUND SURFACE																
0.0	ASPHALT																
0.2	Sand and gravel (FILL)		1	SS	20												
163.7	Compact Brown Moist																
163.4	Sand, some silt, some gravel, trace to some clay (FILL)		2A	SS	14												
1.1	Compact Reddish brown Moist		2B														
	Silty clay, some sand, some gravel (FILL)		3	SS	8												
	Firm to stiff Brown Moist		4	SS	6												
161.5	CLAYEY SILT, some sand, some gravel, containing rootlets		5	SS	8												
3.0	Firm to stiff Brown Moist																
160.8	SAND AND GRAVEL, trace clay		6	SS	52												
3.7	Compact to very dense Brown Moist																
159.7	CLAYEY SILT, some sand to CLAYEY SILT with SAND, trace to some gravel (TILL)		7	SS	18												
4.8	Very stiff Brown becoming grey at about 4.9 m depth Moist																
157.8	SILT SAND, some gravel		8	SS	24												
6.7	Dense to very dense Grey Moist																
			9	SS	32												
			10	SS	59												
154.3	Gravelly, sandy CLAYEY SILT (TILL)																
10.2	Hard Grey Moist		11	SS	95/0.2												
153.6	END OF BOREHOLE																
10.9																	
NOTE: 1. Water level measured in open borehole at a depth of 10.2 m below ground surface (Elev. 154.3 m) upon completion of drilling.																	

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PROJECT		RECORD OF BOREHOLE				No BH-2014-2		SHEET 1 OF 1		METRIC								
G.W.P.		LOCATION		ORIGINATED BY														
DIST		BOREHOLE TYPE		COMPILED BY														
DATUM		DATE		CHECKED BY														
10-1111-0211		N 4830539.7 ; E 286789.0		AJS														
2150-01-00		150 mm O.D. Solid Stem Augers		MCK														
Central HWY 401		Nov. 13 & 14, 2014		KJB														
GEODETIC																		
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 (%)
164.5	GROUND SURFACE							20	40	60	80	100						
0.0	ASPHALT																	
0.2	Sand and gravel, some silt, some asphalt fragments (FILL)		1	SS	21													
163.7	Compact Brown Moist		2	SS	15													
0.8	Silty clay, trace sand to sandy, some gravel, trace organics, trace rootlets (FILL)		3A	SS	10													
	Firm to very stiff Grey and brown Moist		3B															
			4	SS	8													
161.2	Wood fragments encountered at 3.1 m depth.		5A															
3.3	CLAYEY SILT, trace sand, trace gravel to gravelly		5B	SS	10													
160.4	Stiff to very stiff Brown Moist		6	SS	25													
4.1	SAND AND GRAVEL, trace to some silt, trace clay		7	SS	15													
	Compact Brown Moist to wet at 4.6 m depth																	
158.9																		
5.6	CLAYEY SILT, some sand, some gravel (TILL)		8	SS	65													
157.8	Hard Grey Moist																	
6.7	END OF BOREHOLE																	
NOTE:																		
1. Open borehole dry upon completion of drilling.																		

PROJECT 10-1111-0211		RECORD OF BOREHOLE No BH-2014-3A					SHEET 1 OF 1		METRIC								
G.W.P. 2150-01-00		LOCATION N 4830578.8 ; E 286866.1					ORIGINATED BY AJS										
DIST Central HWY 401		BOREHOLE TYPE 150 mm O.D. Solid Stem Augers					COMPILED BY MCK										
DATUM Geodetic		DATE Nov. 12 & 13, 2014					CHECKED BY KJB										
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									
164.5	GROUND SURFACE																
0.0	ASPHALT																
0.2	Sand and gravel, trace silt (FILL)		1	SS	29												
163.7	Compact Reddish-brown Moist		2	SS	62/0.23												
0.8	Sandy silty clay, some gravel, inferred cobbles from 1.2 m to 1.5 m depth (FILL)																
	Stiff to hard Brown Dry		3	SS	11												
162.4	END OF BOREHOLE																
2.1	NOTES: 1. Open borehole dry upon completion of drilling. 2. Augers misaligned while drilling through inferred cobble at 1.2 m depth. Borehole backfilled and new borehole (BH-2014-3B) advanced 1.0 m west of original location.																

PROJECT 10-1111-0211				RECORD OF BOREHOLE No BH-2014-3B SHEET 1 OF 1				METRIC													
G.W.P. 2150-01-00		LOCATION N 4830578.8 ; E 286864.9		ORIGINATED BY AJS																	
DIST Central HWY 401		BOREHOLE TYPE 150 mm O.D. Solid Stem Augers		COMPILED BY MCK																	
DATUM Geodetic		DATE Nov. 12 & 13, 2014		CHECKED BY KJB																	
SOIL PROFILE			SAMPLES			DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC NATURAL LIQUID			UNIT WEIGHT			REMARKS & GRAIN SIZE DISTRIBUTION (%)						
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	SHEAR STRENGTH kPa					WATER CONTENT (%)			γ			GR SA SI CL		
164.5	GROUND SURFACE							20 40 60 80 100	20 40 60 80 100	W _p	W	W _L	10 20 30	kN/m ³							
0.0	Refer to description on RECORD OF BOREHOLE No. BH-2014-3A.						164														
162.4							163														
2.1	Silty clay, trace sand, trace gravel (FILL) Stiff Brown becoming grey at about 3.6 m depth Moist		1	SS	9		162														
			2	SS	15		161														
160.8							160														
160.4	Sandy SILT, trace gravel, trace clay Dense Brown Moist		3A	SS	48		159														
4.1	SAND and GRAVEL, trace to some silt, trace clay, pockets of silty clay to clayey silt Dense Brown Moist to wet		3B				158														
			4	SS	31		157														
158.9							156														
5.6	Sandy CLAYEY SILT, some gravel, some seams of silt and silty clay (TILL) Very stiff Grey Moist		5	SS	21		155														
157.3							154														
7.2	SILTY SAND, some gravel Very dense Grey Moist		6	SS	89																
155.9																					
8.6	Sandy SILTY CLAY, some gravel (TILL) Very stiff Grey Moist		7	SS	24																
	Silt seam encountered at a depth of 9.3 m.																				
154.3																					
10.2	SILTY CLAY, trace sand, trace gravel Hard Grey Moist		8	SS	50																
153.2																					
11.3	END OF BOREHOLE																				
	NOTE: 1. Water level measured in open borehole at a depth of 4.7 m below ground surface (Elev. 159.8 m) upon completion of drilling.																				

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PROJECT		10-1111-0211		RECORD OF BOREHOLE No BH-2014-4		SHEET 1 OF 1		METRIC							
G.W.P.		2150-01-00		LOCATION		N 4830717.3 ; E 287120.6		ORIGINATED BY							
DIST		Central HWY 401		BOREHOLE TYPE		150 mm O.D. Solid Stem Augers		COMPILED BY							
DATUM		GEODETIC		DATE		Nov. 17 & 18, 2014		CHECKED BY							
SOIL PROFILE		SAMPLES		GROUND WATER CONDITIONS		ELEVATION SCALE		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									
166.5	0.0	GROUND SURFACE													
165.7	0.2	ASPHALT													
165.7	0.8	Sand and gravel, trace silt (FILL) Compact Brown Dry		1	SS	23									
165.1	1.4	Silt, some sand, some gravel (FILL) Compact Brown becoming grey at about 1.2 m depth Dry		2	SS	23									
163.5	3.0	CLAYEY SILT with SAND, trace to some gravel Very stiff Brown becoming grey at about 1.8 m depth Moist		3	SS	19									
		CLAYEY SILT, trace to some sand, trace to some gravel (TILL) Very stiff to hard Grey Moist		4	SS	19									
		Containing silt pockets at a depth of 4.6 m.		5	SS	19									
				6	SS	18									
				7	SS	19									
				8	SS	33									
159.3	7.2	SILT and SAND, some gravel, trace clay, some shale fragments Very dense Grey Moist		9	SS	76/0.23									
157.8	8.7	SILTY SAND, trace clay, some gravel, some shale fragments Very dense Grey Moist to Wet		10	SS	69/0.18									
155.2	11.3	END OF BOREHOLE		11	SS	63									
		NOTE: 1. Water level measured in open borehole at a depth of 8.1 m below ground surface (Elev. 158.4 m) upon completion of drilling.													

PROJECT <u>10-1111-0211</u>		RECORD OF BOREHOLE No FC-6		SHEET 1 OF 2		METRIC	
G.W.P. <u>2150-01-00</u>		LOCATION <u>N 4830817.2 ; E 287306.2</u>		ORIGINATED BY <u>SB</u>			
DIST <u> </u> HWY <u>401</u>		BOREHOLE TYPE <u>108 mm I.D. Hollow Stem Augers, NW Casing with Tricone, Wash Boring</u>		COMPILED BY <u>CC/TVA</u>			
DATUM <u>Geodetic</u>		DATE <u>May 13 and 14, 2012</u>		CHECKED BY <u>KJB</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 kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa										WATER CONTENT (%)		
								○ UNCONFINED + FIELD VANE												
								● QUICK TRIAXIAL × REMOULDED												
168.3	GROUND SURFACE						20	40	60	80	100	10	20	30						
0.0	ASPHALT																			
0.2	Sand and gravel (FILL)																			
167.5	Brown Moist																			
0.8	Clayey silt, trace to some gravel, trace sand (FILL) Firm to very stiff Brown Moist		1	SS	18							○								
			2	SS	20															
			3	SS	17							○	—							
			4	SS	22															
			5	SS	10															
			6	SS	18							○	—							
			7	SS	5										○					
161.1																				
7.2	CLAYEY SILT, some sand, trace to some gravel, containing sandy silt interlayers Stiff Grey Moist		8	SS	9							○	—			7 25 55 13				
			9	SS	8															
158.1																				
10.2	Silty SAND, trace to some gravel, trace to some clay (TILL) Dense Grey Wet		10	SS	40							○				10 59 22 9				
156.6																				
11.7	SAND and GRAVEL, trace to some silt, trace clay, containing cobble (TILL) Very dense Grey Wet		11	SS	88							○				46 39 13 2				
			12	SS	184															
154.1																				
14.2	END OF BOREHOLE																			

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

GTA-MTO 001 1011110211.GPJ GAL-GTA.GDT 2/8/13



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

GTA-MTO 001 1011110211.GPJ GAL-GTA.GDT 2/8/13



PROJECT	10-1111-0211	RECORD OF BOREHOLE		No FC-5	SHEET 1 OF 2	METRIC
G.W.P.	2150-01-00	LOCATION	N 4830834.4 ;E 287327.5		ORIGINATED BY	SB
DIST	HWY 401	BOREHOLE TYPE	108 mm I.D. Hollow Stem Augers, NW Casing with Tricone, Wash Boring		COMPILED BY	CC/TVA
DATUM	Geodetic	DATE	May 14 and 15, 2012		CHECKED BY	KJB

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

○ 3% STRAIN AT FAILURE

GTA-MTO 001 1011110211.GPJ GAL-GTA.GDT 2/8/13




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

GTA-MTO 001 1011110211.GPJ GAL-GTA.GDT 2/8/13

PROJECT		RECORD OF BOREHOLE				No BH-2014-5		SHEET 1 OF 1		METRIC			
G.W.P. 2150-01-00		LOCATION				N 4830930.0 ; E 287516.6		ORIGINATED BY		AJS			
DIST Central HWY 401		BOREHOLE TYPE				150 mm O.D. Solid Stem Augers		COMPILED BY		MCK			
DATUM GEODETIC		DATE				Nov. 17 & 18, 2014		CHECKED BY		KJB			
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT		UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa		W _p W W _L			
173.0	GROUND SURFACE												
0.0	ASPHALT												
0.2	Silty sand and gravel (FILL)		1	SS	30								
172.2	Compact to dense Brown Moist		2	SS	20								
0.8	Clayey silt, some sand, trace to some gravel (FILL)		3	SS	24								
	Very stiff Brown Moist		4	SS	23								
170.0													
3.0	CLAYEY SILT, some sand, some gravel (TILL)		5	SS	8								
	Stiff to hard Grey Moist		6	SS	12								
	0.25 m thick silty clay pocket at a depth of 3.81 m.		7	SS	9								
	Silt pocket at a depth of 4.6 m.												
			8	SS	24								
			9	SS	20								
			10	SS	40								
162.8													
10.2	SILTY SAND, some gravel, trace clay		11	SS	69/0.28								
162.1	Very dense Grey Moist												
11.0	END OF BOREHOLE												
NOTE: 1. Water level measured in open borehole at a depth of 8.0 m below ground surface (Elev. 165.0 m) upon completion of drilling.													

PROJECT		RECORD OF BOREHOLE				No BH-2014-6		SHEET 1 OF 1		METRIC							
G.W.P. 10-1111-0211		LOCATION		N 4831006.6 ; E 287698.5		ORIGINATED BY		AJS									
DIST Central HWY 401		BOREHOLE TYPE		150 mm O.D. Solid Stem Augers		COMPILED BY		MP									
DATUM GEODETIC		DATE		Dec. 2 & 3, 2014		CHECKED BY		KJB									
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									
177.7	GROUND SURFACE																
0.0	ASPHALT																
0.2	Sand and gravel, some silt (FILL) Compact Brown Moist		1	SS	22												
176.9																	
176.5	Clayey silt, some sand, trace to some gravel, trace organics (FILL) Firm Brown Moist		2A 2B 2C	SS	7												
1.2																	
	SILTY CLAY, trace to some sand, trace to some gravel, trace organics Firm Black Moist		3	SS	16												
	CLAYEY SILT to CLAYEY SILT with SAND, trace to some gravel, containing oxidation staining (TILL) Stiff to hard Brown becoming grey at about 5.6 m depth Moist		4	SS	21												
			5	SS	51												
			6	SS	25												
			7	SS	14												
			8	AS	-												
			9	SS	11												
171.0	END OF BOREHOLE																
6.7	NOTE: 1. Open borehole dry upon completion of drilling.																

PROJECT		RECORD OF BOREHOLE				No BH-2014-7		SHEET 1 OF 1		METRIC							
G.W.P.		LOCATION		ORIGINATED BY													
DIST		BOREHOLE TYPE		COMPILED BY													
DATUM		DATE		CHECKED BY													
10-1111-0211		N 4831075.0 ; E 287793.5		AJS													
2150-01-00		150 mm O.D. Solid Stem Augers		MCK													
Central HWY 401		Nov. 18 & 19, 2014		KJB													
GEODETTIC																	
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 kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									WATER CONTENT (%)
180.8	GROUND SURFACE																
180.0	ASPHALT																
0.3	Sand and gravel, some silt (FILL) Compact Brown Moist		1	SS	27												
179.9																	
0.9	Silty clay, some sand, trace to some gravel, trace organics (FILL) Stiff to very stiff Brown Moist		2	SS	12												
			3	SS	12												
			4	SS	17												
177.8																	
3.0	Sandy SILTY CLAY, some gravel Very stiff Brown Moist		5	SS	23												
			6	SS	28												
176.3																	
4.5	CLAYEY SILT with SAND, trace to some gravel, containing sandy silt seams throughout (TILL), Very stiff to hard Grey Moist		7	SS	24												
			8	SS	18												
			9	SS	17												
			10	SS	33												
			11	SS	24												
169.5																	
11.3	END OF BOREHOLE																
NOTE: 1. Water level measured in open borehole at a depth of 6.5 m below ground surface (Elev. 174.3 m) upon completion of drilling.																	

PROJECT 10-1111-0211				RECORD OF BOREHOLE No BH-2014-8A SHEET 1 OF 1				METRIC									
G.W.P. 2150-01-00		LOCATION N 4831083.8 ; E 287904.3				ORIGINATED BY AJS											
DIST Central HWY 401		BOREHOLE TYPE 150 mm O.D. Solid Stem Augers				COMPILED BY MP											
DATUM GEODETIC		DATE Dec. 15, 2014				CHECKED BY KJB											
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									
182.2	GROUND SURFACE							20	40	60	80	100					
0.0	Silty sand and gravel, some asphalt fragments (FILL)		1	SS	11												
181.5	Compact Brown Moist		2	SS	7												
0.7	SILTY CLAY, trace to some sand, trace to some gravel Firm to stiff Brown Moist		3	SS	10												
180.0	CLAYEY SILT, some sand to CLAYEY SILT with SAND, trace to some gravel, pocket of sandy silt from 3.7 m to 5.2 m depth (TILL) Stiff to very stiff Brown becoming mottled brown and grey at about 3.7 m depth Moist		4	SS	10												
2.2			5	SS	11												
			6	SS	29												3 35 44 18
			7	SS	24												9 43 32 16
			8	SS	12												
			9	SS	16												
			10	SS	17												
			11	SS	28												
			12	SS	27												
169.4	END OF BOREHOLE																
12.8	NOTE: 1. Open borehole dry upon completion of drilling.																

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RECORD OF BOREHOLE No BH-2014-9A SHEET 1 OF 1
METRIC

PROJECT 10-1111-0211
 G.W.P. 2150-01-00 LOCATION N 4831109.3 ; E 288020.6 ORIGINATED BY QC
 DIST Central HWY 401 BOREHOLE TYPE 150 mm O.D. Solid Stem Augers COMPILED BY MP
 DATUM Geodetic DATE Dec. 16, 2014 CHECKED BY KJB

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 kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa								
								○ UNCONFINED	+ FIELD VANE	×						
185.6	GROUND SURFACE						20	40	60	80	100					
0.9	TOPSOIL		1	SS	7											
184.8	Clayey silt, trace to some sand, trace to some gravel, trace rootlets and organics (FILL)		2	SS	19											
0.8	Firm Brown Moist															
	Sandy CLAYEY SILT to CLAYEY SILT with SAND, trace to some gravel (TILL)		3	SS	25											
	Stiff to very stiff Brown becoming grey below 3.7 m Moist															
			4	SS	22											
	Oxidation staining between 2.3 m and 3.7 m depth															
			5	SS	29											
			6	SS	14											
			7	SS	18											
			8	SS	16											
			9	SS	20											
177.4	END OF BOREHOLE															
8.2	NOTES: 1. Water level in open borehole measured at a depth of 7.2 m below ground surface (Elev. 178.4 m) upon completion of drilling. 2. Water level measured in piezometer: Date Depth (m) Elev. (m) 06/30/15 0.8 184.8 12/16/15 1.4 184.2															

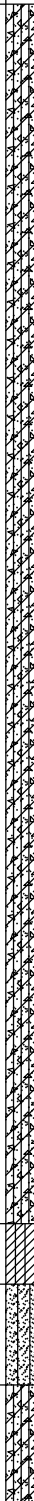
³, ³: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

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GTA-MTO 001 101110211.GPJ GAL-GTA.GDT 2/7/13

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

PROJECT <u>10-1111-0211</u>		RECORD OF BOREHOLE No MR-2		SHEET 2 OF 3		METRIC	
G.W.P. <u>2150-01-00</u>		LOCATION <u>N 4831239.6 ; E 287971.8</u>		ORIGINATED BY <u>SB</u>			
DIST <u> </u> HWY <u>401</u>		BOREHOLE TYPE <u>108 mm I.D. Hollow Stem Augers</u>		COMPILED BY <u>CC/TVA</u>			
DATUM <u>Geodetic</u>		DATE <u>May 22 to 23, 2012</u>		CHECKED BY <u>KJB</u>			


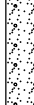
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%)						
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						WATER CONTENT (%)			GR	SA	SI	CL
								○ UNCONFINED ● QUICK TRIAXIAL	+ FIELD VANE × REMOULDED	20	40	60		80	100	w _p	w	w _L		
--- CONTINUED FROM PREVIOUS PAGE ---																				
	CLAYEY SILT with SAND, trace to some gravel (TILL) Stiff to hard Brown Moist		13	SS	21															
				14	SS	18														
				15	SS	12														
				16	SS	19														
				17	SS	15														
			18	SS	83															
			19	SS	116															
			20	SS	84															
168.0																				
27.1	SILTY CLAY, trace sand, trace gravel Hard Grey Wet		21A	SS	39															
167.4			21B																	
27.7	Silty SAND and GRAVEL, trace clay Dense Grey Wet																			
166.4																				
28.7	SAND and SILT, trace to some gravel, trace to some clay (TILL) Compact to very dense Grey Wet		22	SS	64															

Continued Next Page

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

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PROJECT <u>10-1111-0211</u>	RECORD OF BOREHOLE No MR-2	SHEET 3 OF 3	METRIC
G.W.P. <u>2150-01-00</u>	LOCATION <u>N 4831239.6 ; E 287971.8</u>	ORIGINATED BY <u>SB</u>	
DIST <u> </u> HWY <u>401</u>	BOREHOLE TYPE <u>108 mm I.D. Hollow Stem Augers</u>	COMPILED BY <u>CC/TVA</u>	
DATUM <u>Geodetic</u>	DATE <u>May 22 to 23, 2012</u>	CHECKED BY <u>KJB</u>	

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%)						
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						W _p	W	W _L	GR	SA	SI	CL
								○ UNCONFINED	+ FIELD VANE	● QUICK TRIAXIAL	× REMOULDED	WATER CONTENT (%)								
	--- CONTINUED FROM PREVIOUS PAGE ---																			
	SAND and SILT, trace to some gravel, trace to some clay (TILL) Compact to very dense Grey Wet Frequent shale fragment inclusions below a depth of 30.5 m		23	SS	61															
159.1			24	SS	29															
36.0	SAND and GRAVEL, some silt, trace clay Compact Grey Wet		25	SS	11															
157.9																				
37.2	END OF BOREHOLE Dynamic Cone Penetration Test (DCPT)																			
156.1																				
39.0	END OF DCPT Refusal to Further Penetration (200 Blows / 0.15 m) NOTE: 1. Water level inside augers at a depth of 19.8 m below ground surface (Elev. 175.3 m), measured at the start of work day on May 22, 2012.																			

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

PROJECT 10-1111-0211		RECORD OF BOREHOLE No MR-4		SHEET 1 OF 3		METRIC	
G.W.P. 2150-01-00		LOCATION N 4831158.4 ; E 288051.0		ORIGINATED BY SB/CC			
DIST _____ HWY 401		BOREHOLE TYPE 108 mm I.D. Hollow Stem Augers		COMPILED BY CC/TVA			
DATUM Geodetic		DATE May 24 to 28, 2012		CHECKED BY KJB			

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m³	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 _p	W	W _L					
195.4	GROUND SURFACE																			
0.0	ASPHALT																			
0.2	Sand and gravel, (FILL) Brown Moist						195													
194.6																				
0.8	Clayey silt, trace to some sand, trace gravel, containing wood fragments, (FILL) Stiff to hard Brown Moist		1	SS	11		194													
			2	SS	10															
			3	SS	10		193													
			4	SS	14		192													
			5	SS	14		191													
			6	SS	17		190													
	----- inferred cobbles		7	SS	80		189													

	----- with sand		8	SS	9		188													
							187													
			9	SS	28		186													
							185													
			10	SS	36		184													
183.8							183													
11.6	CLAYEY SILT with SAND, trace to some gravel, (TILL) Very stiff to hard Brown to grey Moist		11	SS	30		182													
			12	SS	22		181													

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

GTA-MTO 001 1011110211.GPJ GAL-GTA.GDT 2/7/13

PROJECT		10-1111-0211		RECORD OF BOREHOLE No MR-4		SHEET 3 OF 3		METRIC							
G.W.P.		2150-01-00		LOCATION		N 4831158.4 ; E 288051.0		ORIGINATED BY							
DIST		HWY 401		BOREHOLE TYPE		108 mm I.D. Hollow Stem Augers		COMPILED BY							
DATUM		Geodetic		DATE		May 24 to 28, 2012		CHECKED BY							
KJB															
SOIL PROFILE		SAMPLES		GROUND WATER CONDITIONS		ELEVATION SCALE		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										
	--- CONTINUED FROM PREVIOUS PAGE ---														
164.3	CLAYEY SILT with SAND, trace to some gravel, (TILL) Very stiff to hard Brown to grey Moist		20	SS	63		165								
31.1	containing shale fragments														
	END OF BOREHOLE														
	NOTES:														
	1. Difficulties advancing auger was observed between depths of 15.2 m and 16.8 m (Elev. 180.2 m and 178.6 m) below ground surface.														
	2. Water level inside augers at a depth of 0.9 m below ground surface (Elev. 194.5 m), measured at start of work day on May 25, 2012.														
	3. Water level inside augers at a depth of 21.3 m below ground surface (Elev. 174.1 m) upon completion of sampling on May 28, 2012.														
	4. Piezometer installation consists of 50 mm diameter PVC pipe with a 3.0 m slotted screen.														
	Water Level Readings														
	Date Depth (m) Elev. (m)														
	05/28/12 18.3 177.1														
	05/30/12 18.6 176.8														
	08/10/12 18.4 177.0														
	10/09/12 18.4 177.0														
	11/05/12 18.3 177.1														

PROJECT		RECORD OF BOREHOLE				No BH-2014-11		SHEET 1 OF 1		METRIC							
G.W.P. 2150-01-00		LOCATION		N 4831349.9 ; E 288014.6				ORIGINATED BY QC									
DIST Central HWY 401		BOREHOLE TYPE		150 mm O.D. Solid Stem Augers				COMPILED BY MP									
DATUM Geodetic		DATE		Dec. 17, 2014				CHECKED BY KJB									
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 kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
186.5	GROUND SURFACE							20	40	60	80	100					
0.9	TOPSOIL		1	SS	9												
185.8	SILTY CLAY, trace to some sand, trace to some gravel, trace rootlets Stiff Brown Moist		2	SS	27												
0.7	CLAYEY SILT to CLAYEY SILT with SAND, trace to some gravel, pocket of sandy silt at a depth of 2.3 m (TILL) Stiff to hard Brown Moist		3	SS	31												
			4	SS	17												
			5	SS	25												
			6	SS	19												
			7	SS	15												
	Wet silt and sand seams and oxidation staining below a depth of 4.5 m																
			8	SS	14												
			9	SS	15												
			10	SS	21												
			11	SS	41												
175.4	END OF BOREHOLE																
11.1	NOTE: 1. Water level measured in open borehole at a depth of 10.2 m below ground surface (Elev. 176.3 m) upon completion of drilling.																

PROJECT		RECORD OF BOREHOLE				No BH-2014-12		SHEET 1 OF 1		METRIC							
G.W.P. 2150-01-00		LOCATION				N 4831238.4 ; E 288089.1		ORIGINATED BY		AJS							
DIST Central HWY 401		BOREHOLE TYPE				150 mm O.D. Solid Stem Augers		COMPILED BY		MCK							
DATUM GEODETIC		DATE				Nov. 18 & 19, 2014		CHECKED BY		KJB							
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									
188.2	GROUND SURFACE																
187.9	ASPHALT																
0.3	Sand and gravel, some silt (FILL) Dense Brown Moist		1	SS	35												
187.3																	
0.9	Clayey silt to silty clay, some sand, trace to some gravel, trace organics (FILL) Stiff to very stiff Brown Moist		2	SS	13												
			3	SS	17												
186.0																	
2.2	Sandy CLAYEY SILT, trace to some gravel, some cobbles Very stiff Brown Moist		4	SS	20												
			5	SS	20												
			6	SS	28												
183.7																	
4.5	CLAYEY SILT with SAND, some gravel (TILL) Firm to stiff Brown to grey Moist		7	SS	7												
			8	SS	11												
			9	SS	11												
			10	SS	12												
			11	SS	14												
176.9																	
11.3	END OF BOREHOLE																
NOTE: 1. Open borehole dry upon completion of drilling.																	



METRIC

CHECKED BY KJE

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



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

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PROJECT 10-1111-0211			RECORD OF BOREHOLE No BH-2014-14 SHEET 1 OF 1				METRIC							
G.W.P. 2150-01-00		LOCATION N 4831392.6 ; E 288269.8		ORIGINATED BY QC										
DIST Central HWY 401		BOREHOLE TYPE 150 mm O.D. Solid Stem Augers		COMPILED BY MP										
DATUM GEODETIC		DATE Dec. 18, 2014		CHECKED BY KJB										
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						
189.5	GROUND SURFACE													
0.9	TOPSOIL													
188.8	SILTY CLAY, trace to some sand, some gravel, trace rootlets and organics		1	SS	6									
0.7	Firm Brown Moist		2	SS	25									
187.3	Sandy CLAYEY SILT, trace to some gravel, some pockets of sandy silt, Very stiff Brown Moist		3	SS	27									
2.2	Oxidation staining from depth of 1.5 m to 2.2 m.		4	SS	23									
	CLAYEY SILT with SAND, trace to some gravel (TILL) Stiff to hard Brown becoming grey at about 3.8 m depth Moist		5	SS	32									
	Oxidation staining from a depth of 1.5 m to 3.7 m.		6	SS	19									
			7	SS	16									
			8	SS	15									
182.8	END OF BOREHOLE													
6.7	NOTE: 1. Open borehole dry upon completion of drilling.													

GTA-MTO 001 T:\PROJECTS\2010\10-1111-0211 (AECOM, MISSISSAUGA)\LOG\1011110211.GPJ GAL-GTA.GDT 7/30/15 PR

PROJECT		RECORD OF BOREHOLE				No BH-2014-15		SHEET 1 OF 1		METRIC							
G.W.P. 10-1111-0211		LOCATION		N 4831378.5 ; E 288349.1		ORIGINATED BY		AJS									
DIST Central HWY 401		BOREHOLE TYPE		150 mm O.D. Solid Stem Augers		COMPILED BY		MCK									
DATUM GEODETIC		DATE		Nov. 20 & 21, 2014		CHECKED BY		KJB									
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 kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
189.5	GROUND SURFACE																
0.0	ASPHALT																
0.2	Sand and gravel (FILL) Compact to dense Brown Moist		1	SS	30												
188.7	Clayey silt, some sand, some gravel (FILL) Very stiff Brown Moist		2	SS	18												
188.1	SILTY CLAY, some sand, some gravel Very stiff Brown Moist		3	SS	21												
186.5	CLAYEY SILT with SAND, some gravel (TILL) Stiff to very stiff Brown becoming grey at about 4.5 m depth Moist		4	SS	24												
3.0			5	SS	28												
			6	SS	23												
			7	SS	13												
			8	SS	18												
			9	SS	18												
			10	SS	15												
179.3	SILTY CLAY, trace sand, some gravel Stiff Grey Moist		11	SS	13												
178.2	END OF BOREHOLE																
11.3	NOTE: 1. Water level measured in open borehole at a depth of 11.0 m below ground surface (Elev. 178.5 m) upon completion of drilling.																

PROJECT 10-1111-0211			RECORD OF BOREHOLE No BH-2014-16 SHEET 1 OF 1				METRIC							
G.W.P. 2150-01-00		LOCATION N 4831518.7 ; E 288613.5		ORIGINATED BY AJS										
DIST Central HWY 401		BOREHOLE TYPE 150 mm O.D. Solid Stem Augers		COMPILED BY MCK										
DATUM Geodetic		DATE Nov. 20 & 21, 2014		CHECKED BY KJB										
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
190.0	GROUND SURFACE							20 40 60 80 100	20 40 60 80 100	10 20 30				
0.0	ASPHALT													
0.2	Sand and gravel, trace silt (FILL) Dense Brown Moist		1	SS	32									
189.2														
0.8	Silty clay, some sand, some gravel (FILL) Stiff to very stiff Brown Moist		2	SS	9									
			3	SS	17									
187.8														
2.2	CLAYEY SILT with SAND, trace to some gravel (TILL) Stiff to hard Brown becoming grey at about 4.0 m depth Moist		4	SS	22									
			5	SS	31									
			6	SS	26									
			7	SS	15									
			8	SS	13									
			9	SS	20									
			10	SS	14									
			11	SS	17									
178.7														
11.3	END OF BOREHOLE													
	NOTE: 1. Open borehole dry upon completion of drilling.													



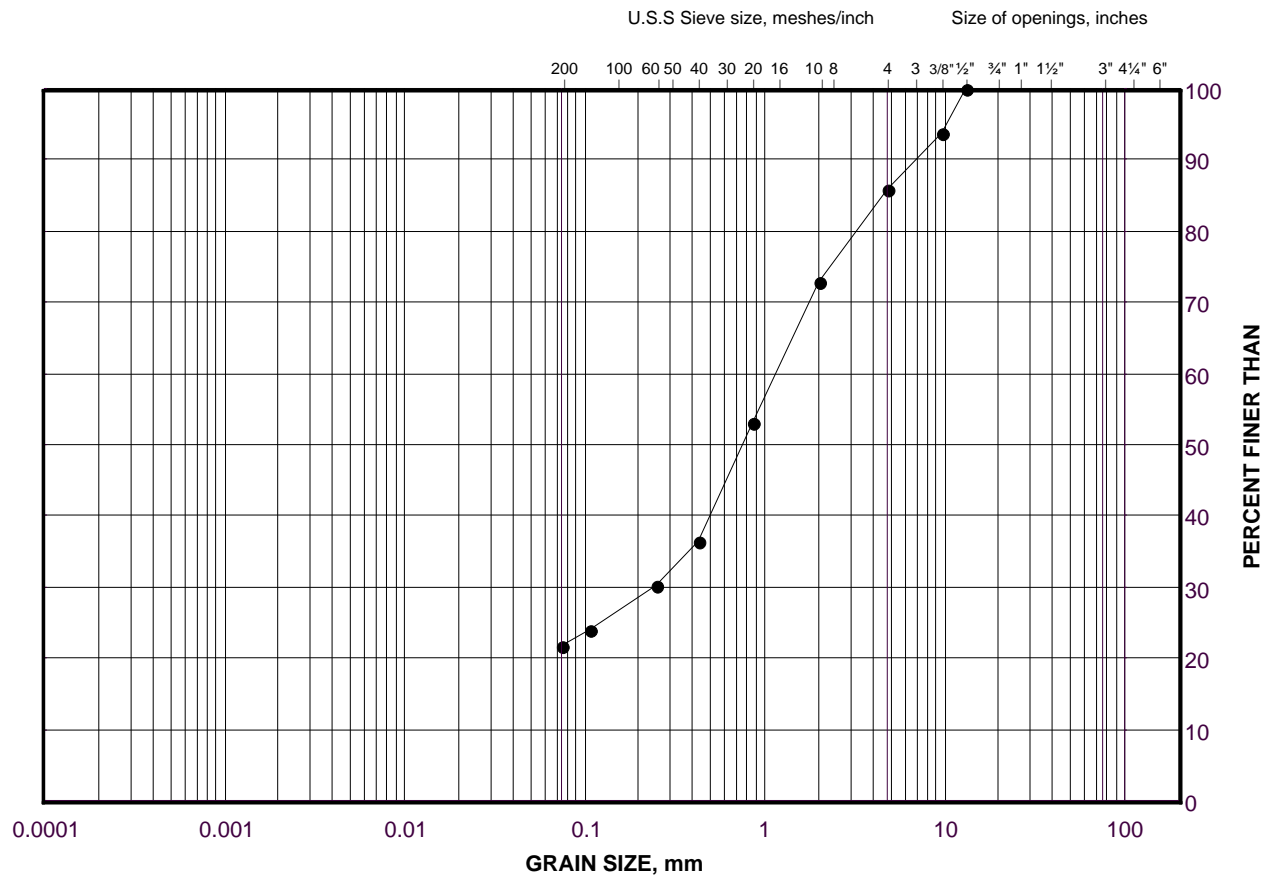
APPENDIX B

Laboratory Test Results

GRAIN SIZE DISTRIBUTION

Sand (Fill)

FIGURE B1



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

LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
•	BH-2014-1	2A	163.6

Project Number: 10-1111-0211

Checked By: AJS

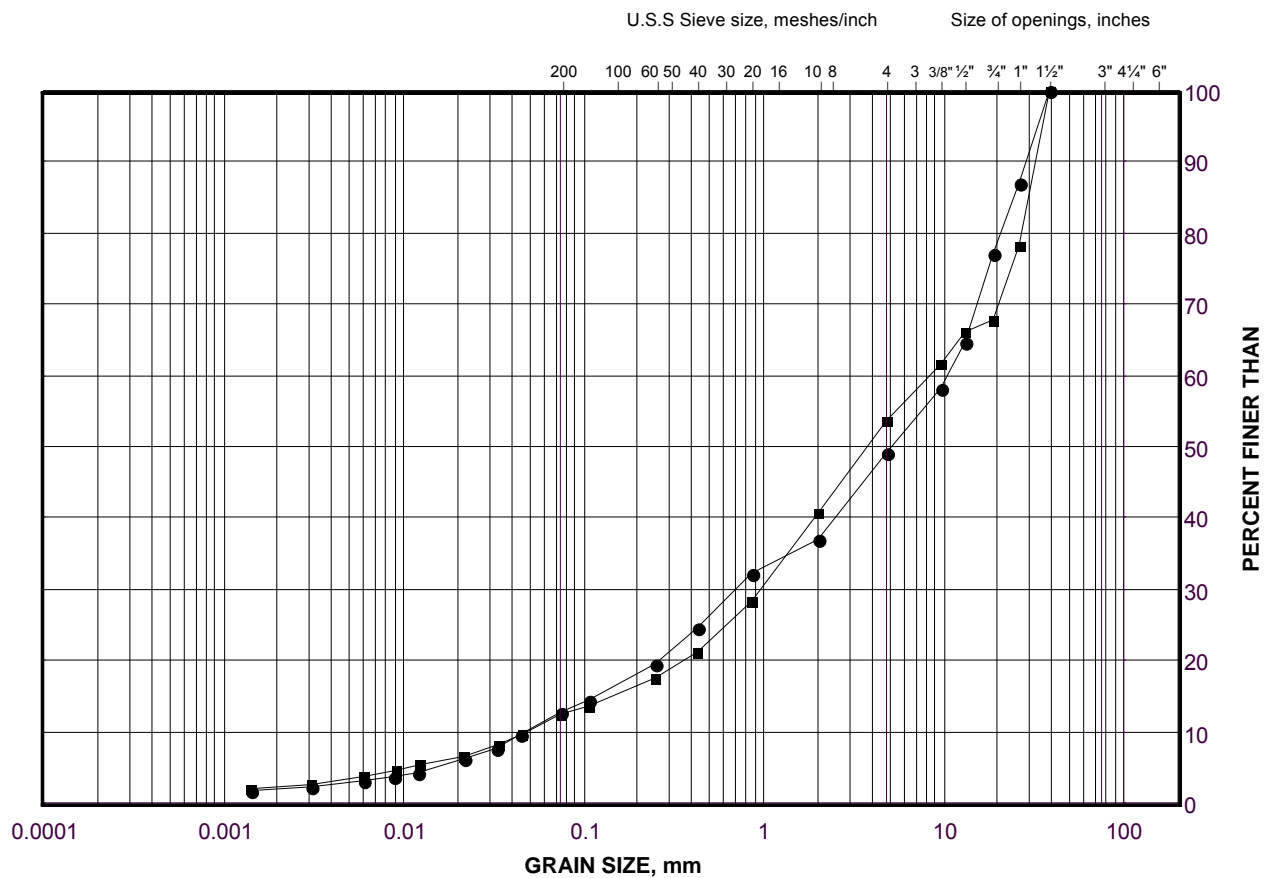
Golder Associates

Date: 01-May-15

GRAIN SIZE DISTRIBUTION

Silty Sand

FIGURE B2-1



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

LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
●	2014-03B	3B	160.2
■	2014-02	7	159.6

Project Number: 10-1111-0211

Checked By: AJS

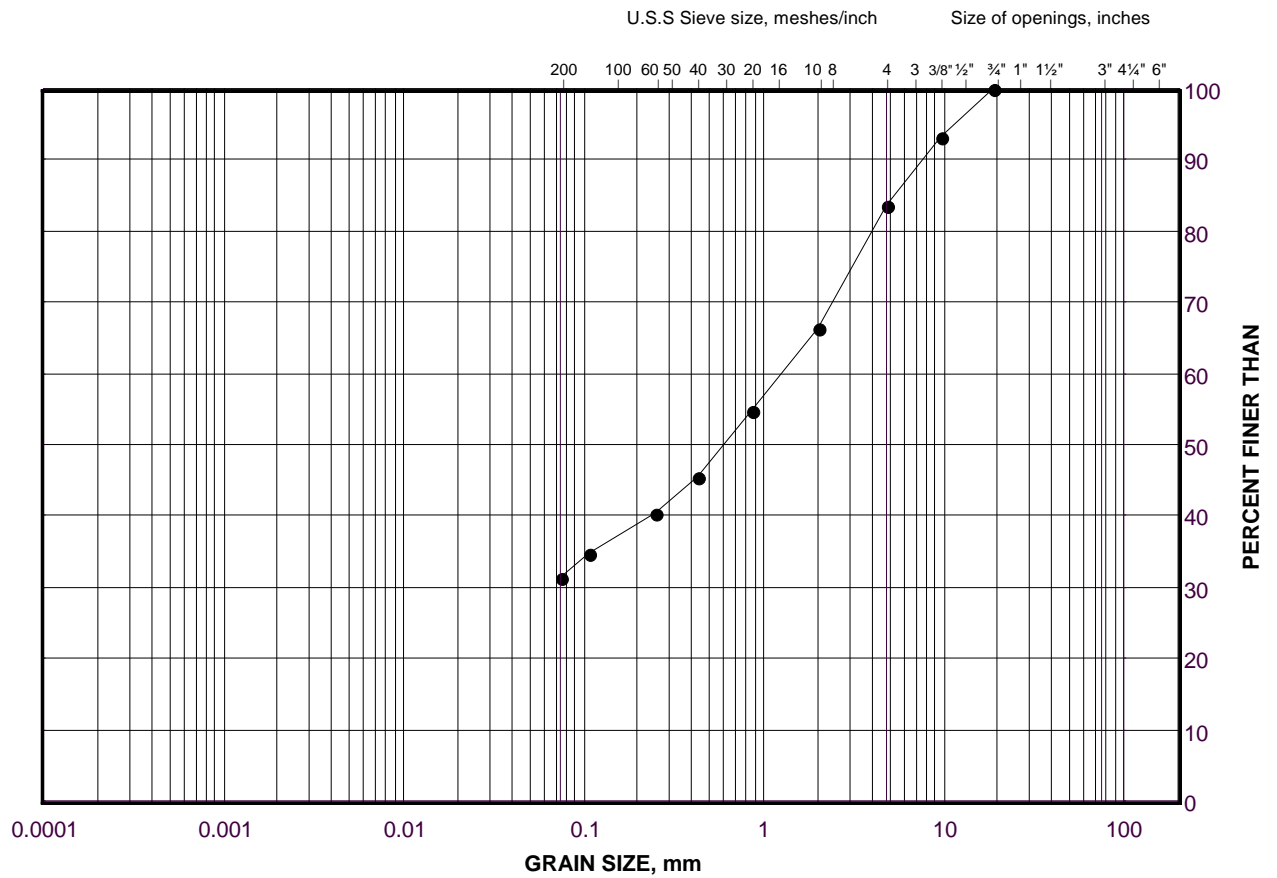
Golder Associates

Date: 14-Jul-15

GRAIN SIZE DISTRIBUTION

Sand and Gravel

FIGURE B2-2



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

LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
•	2014-05	11	162.2

Project Number: 10-1111-0211

Checked By: AJS

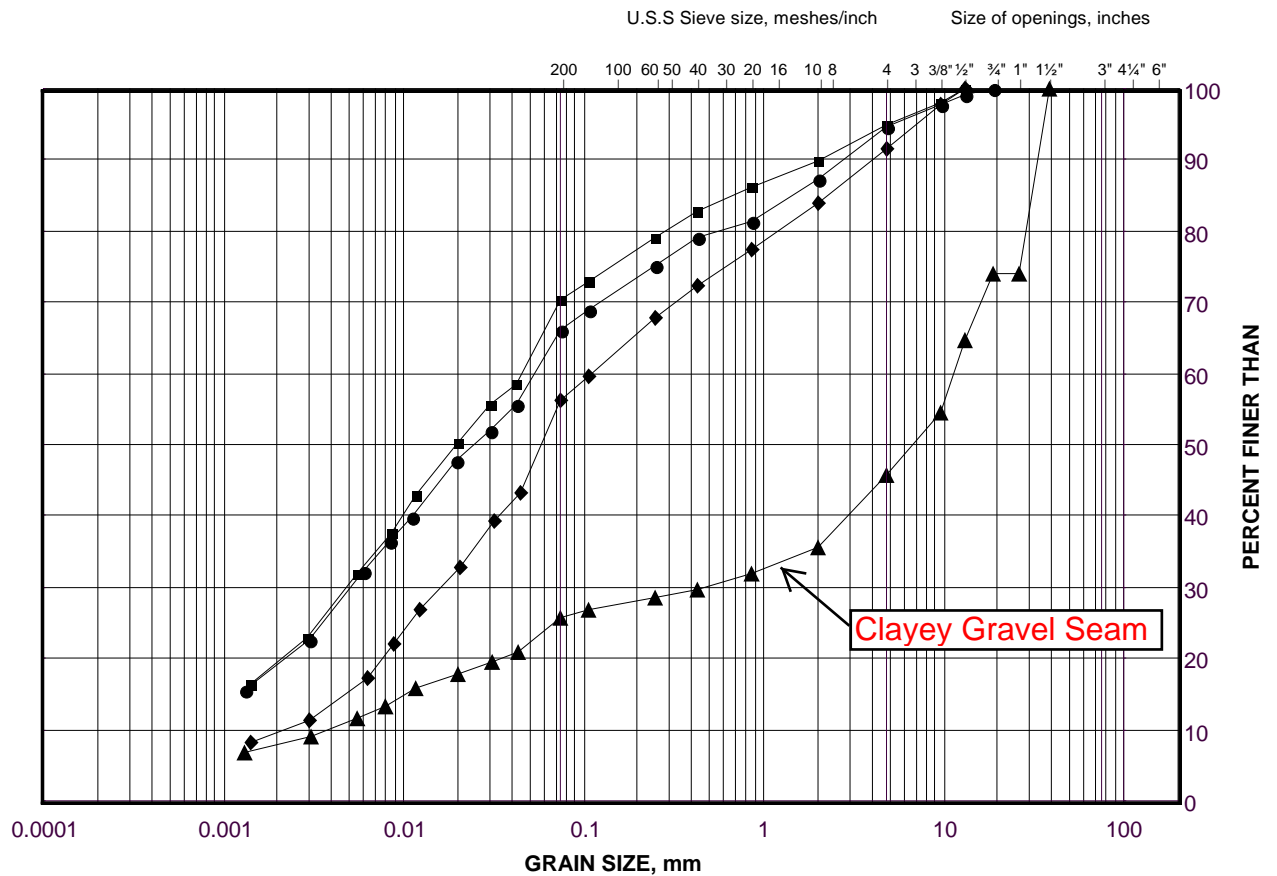
Golder Associates

Date: 14-Jul-15

GRAIN SIZE DISTRIBUTION

Sandy Clayey Silt to Clayey Silt with Sand

FIGURE B3



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

LEGEND

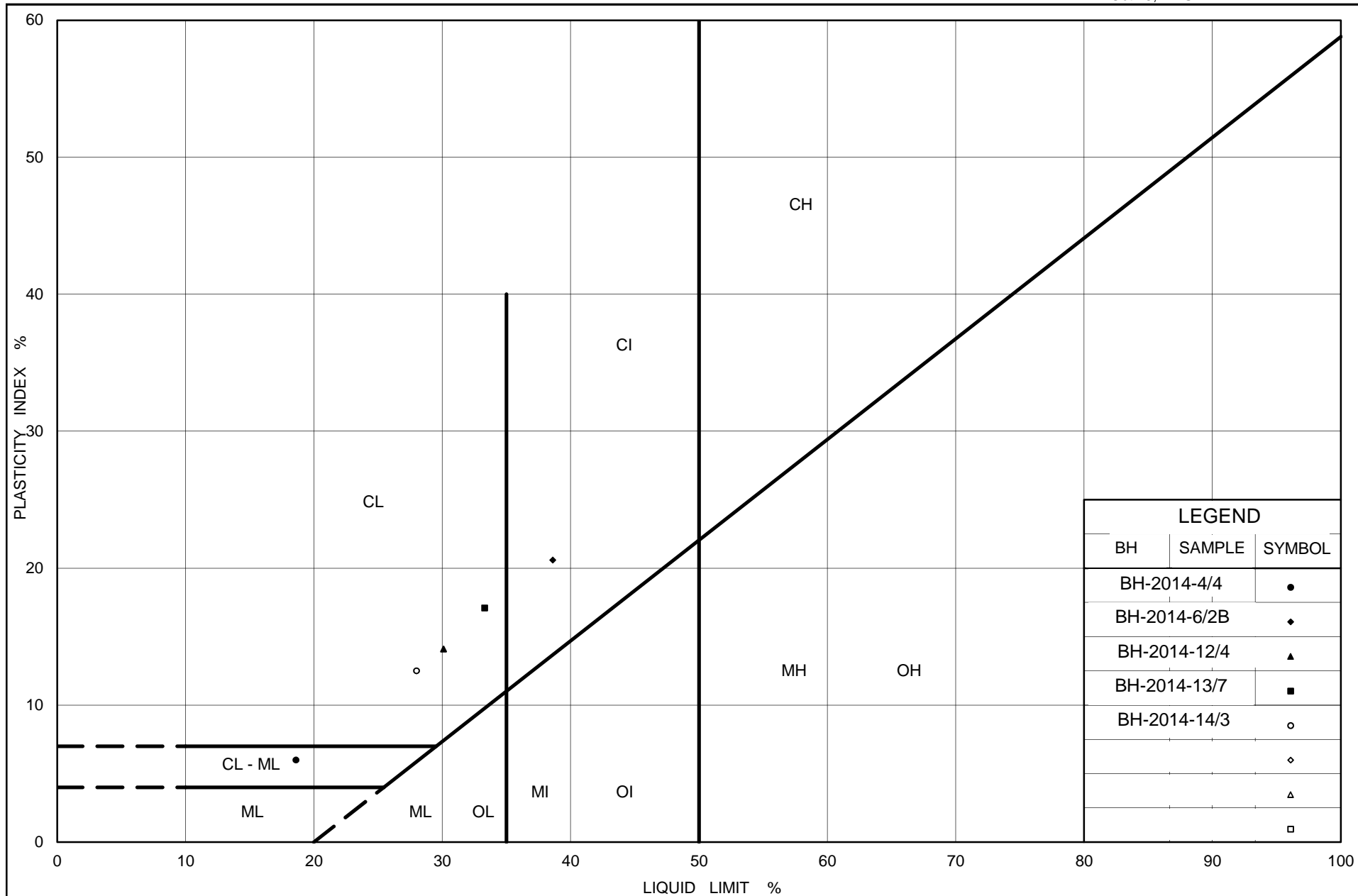
SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
●	2014-14	3	187.7
■	2014-12	4	185.6
◆	2014-04	4	163.9
▲	2014-13	5	186.7

Project Number: 10-1111-0211

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Date: 14-Jul-15



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PLASTICITY CHART Clayey Silt with Sand to Silty Clay

Figure No. B4

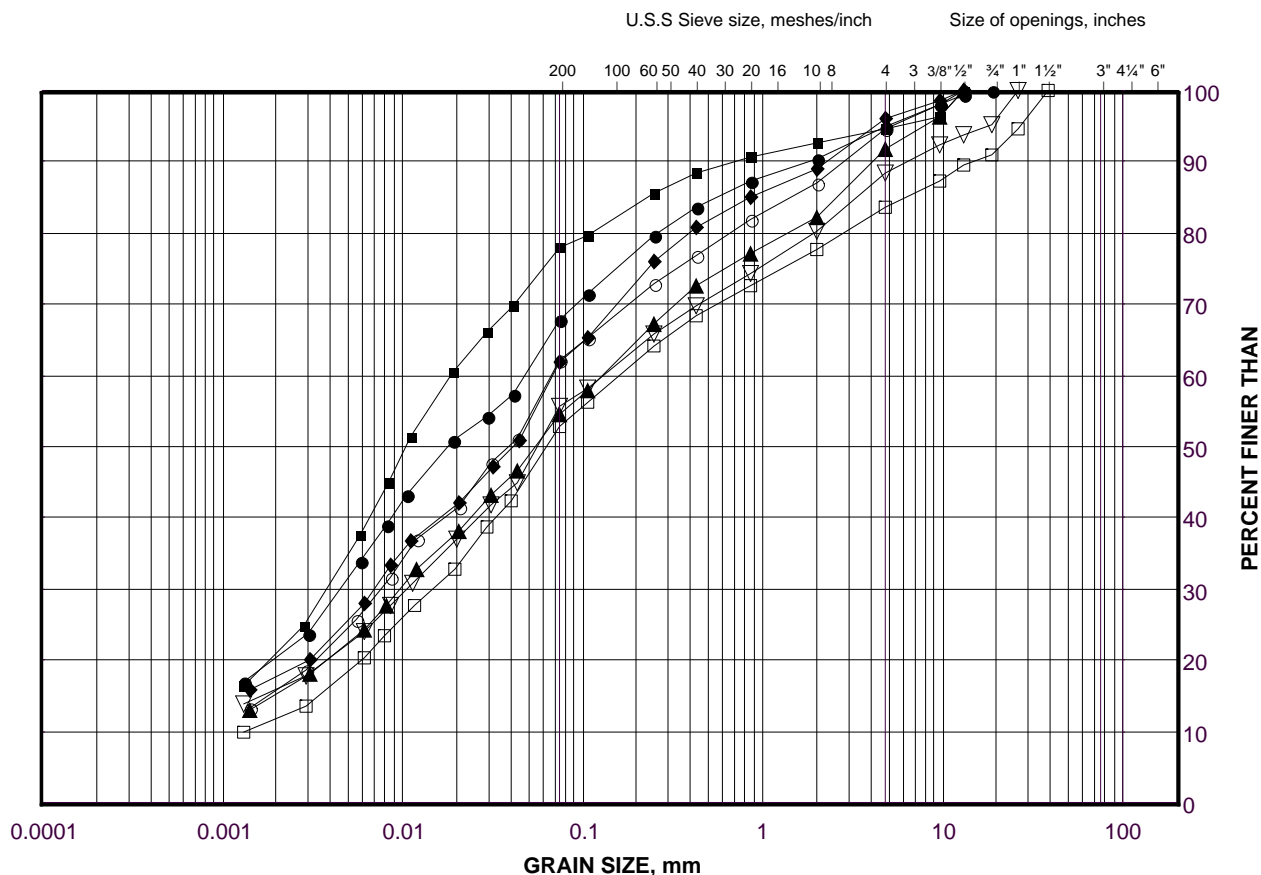
Project No. 10-1111-0211

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GRAIN SIZE DISTRIBUTION

Clayey Silt to Clayey Silt with Sand (Till)

FIGURE B5-1



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

LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
●	BH-2014-9A	2	184.5
■	BH-2014-6	3	175.9
◆	BH-2014-8A	6	178.1
▲	BH-2014-8A	7	177.3
▽	BH-2014-6	7	172.8
○	BH-2014-1	8	158.1
□	BH-2014-7	9	172.9

Project Number: 10-1111-0211

Checked By: AJS

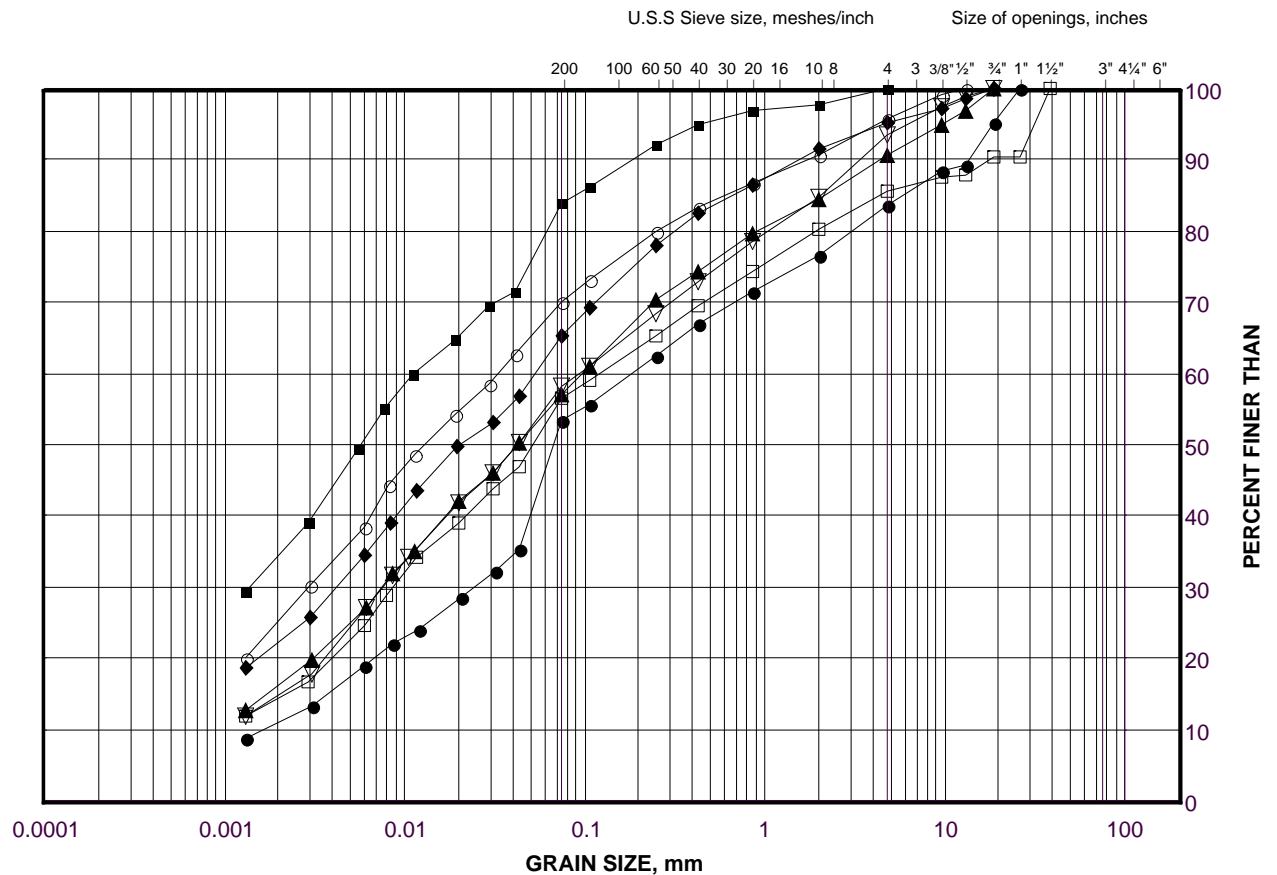
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Date: 04-May-15

GRAIN SIZE DISTRIBUTION

Clayey Silt to Clayey Silt with Sand (Till)

FIGURE B5-2



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

LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
●	BH-2014-13	10	180.7
■	BH-2014-11	4	183.9
◆	BH-2014-10A	4	186.8
▲	BH-2014-9A	5	182.3
▽	BH-2014-11	7	181.6
○	BH-2014-10A	7	184.6
□	BH-2014-11	9	178.6

Project Number: 10-1111-0211

Checked By: AJS

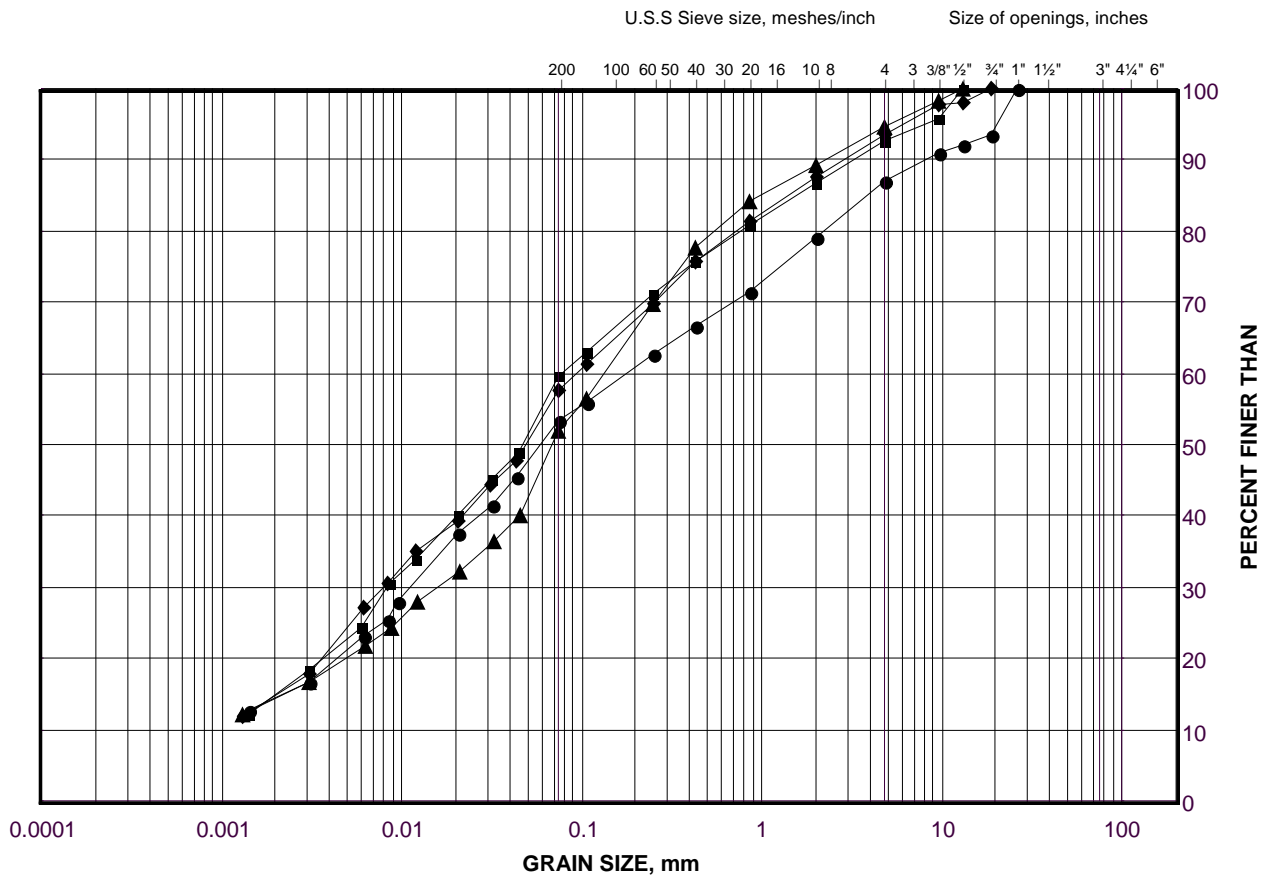
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Date: 04-May-15

GRAIN SIZE DISTRIBUTION

Clayey Silt to Clayey Silt with Sand (Till)

FIGURE B5-3



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

LEGEND

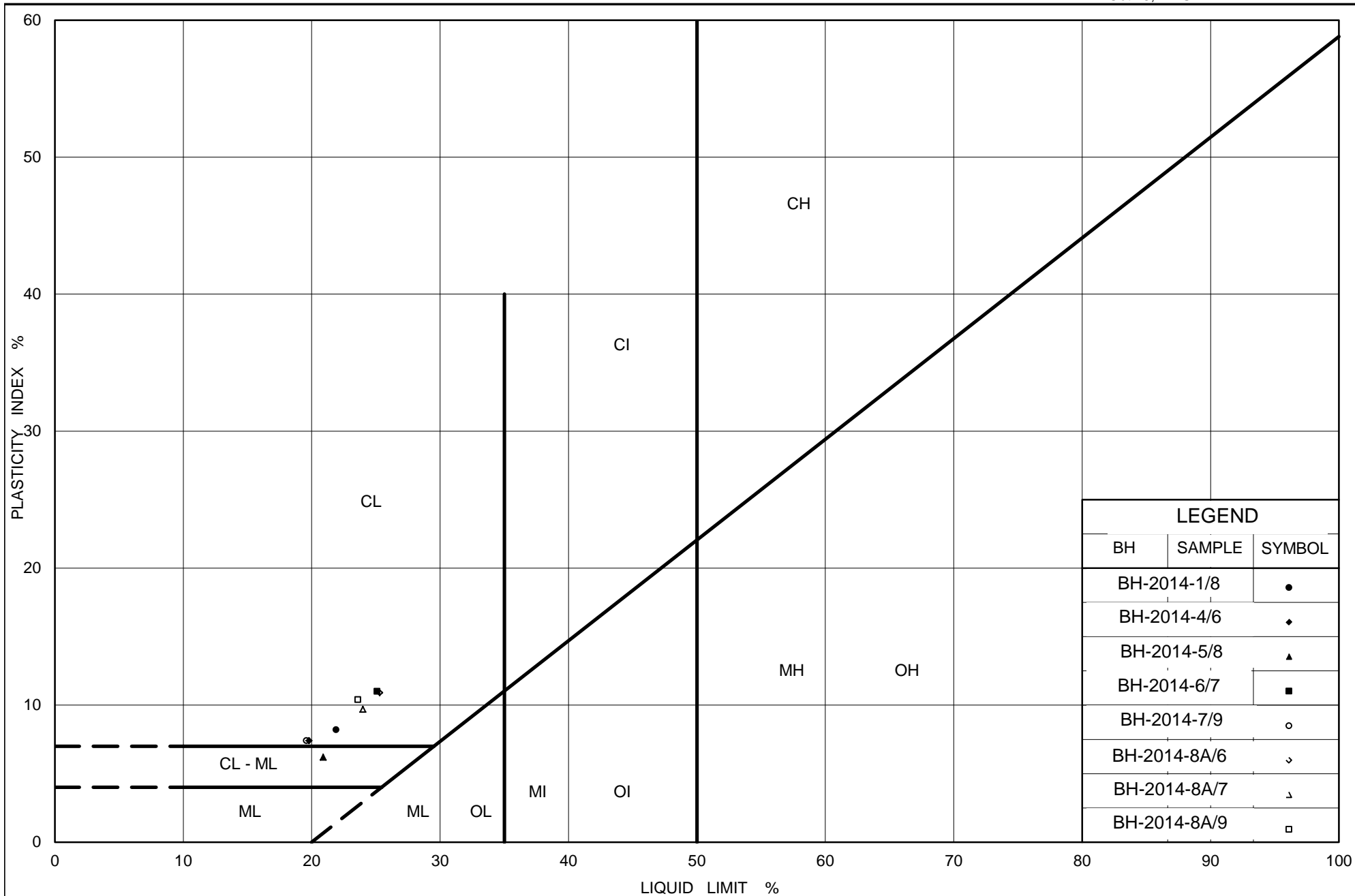
SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
●	2014-13	12	177.40
■	2014-15	5	186.20
◆	2014-14	8	183.20
▲	2014-16	9	182.10

Project Number: 10-1111-0211

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Date: 14-Jul-15



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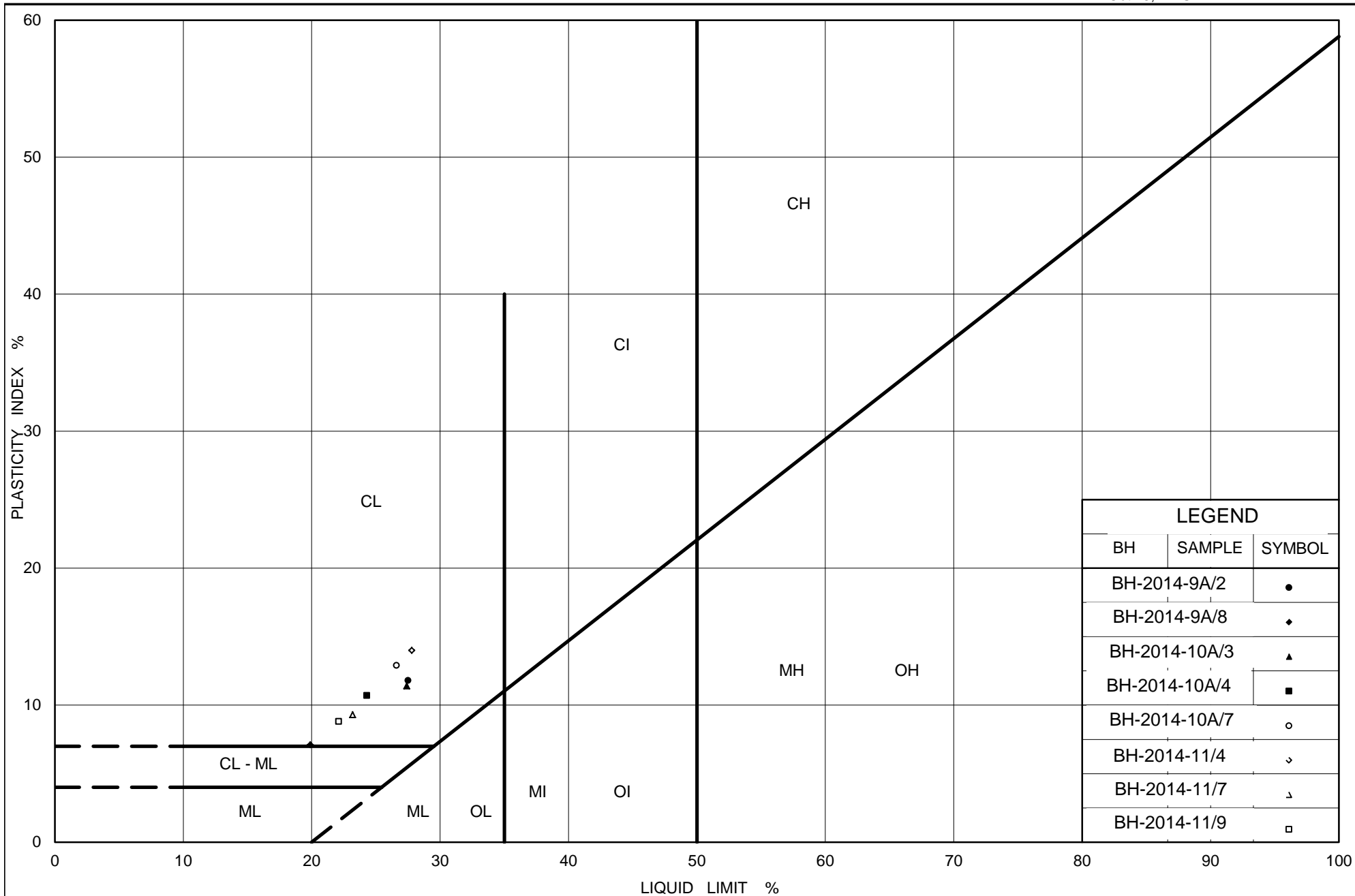
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PLASTICITY CHART Clayey Silt to Clayey Silt with Sand (Till)

Figure No. B6-1

Project No. 10-1111-0211

Checked By: **AJS**



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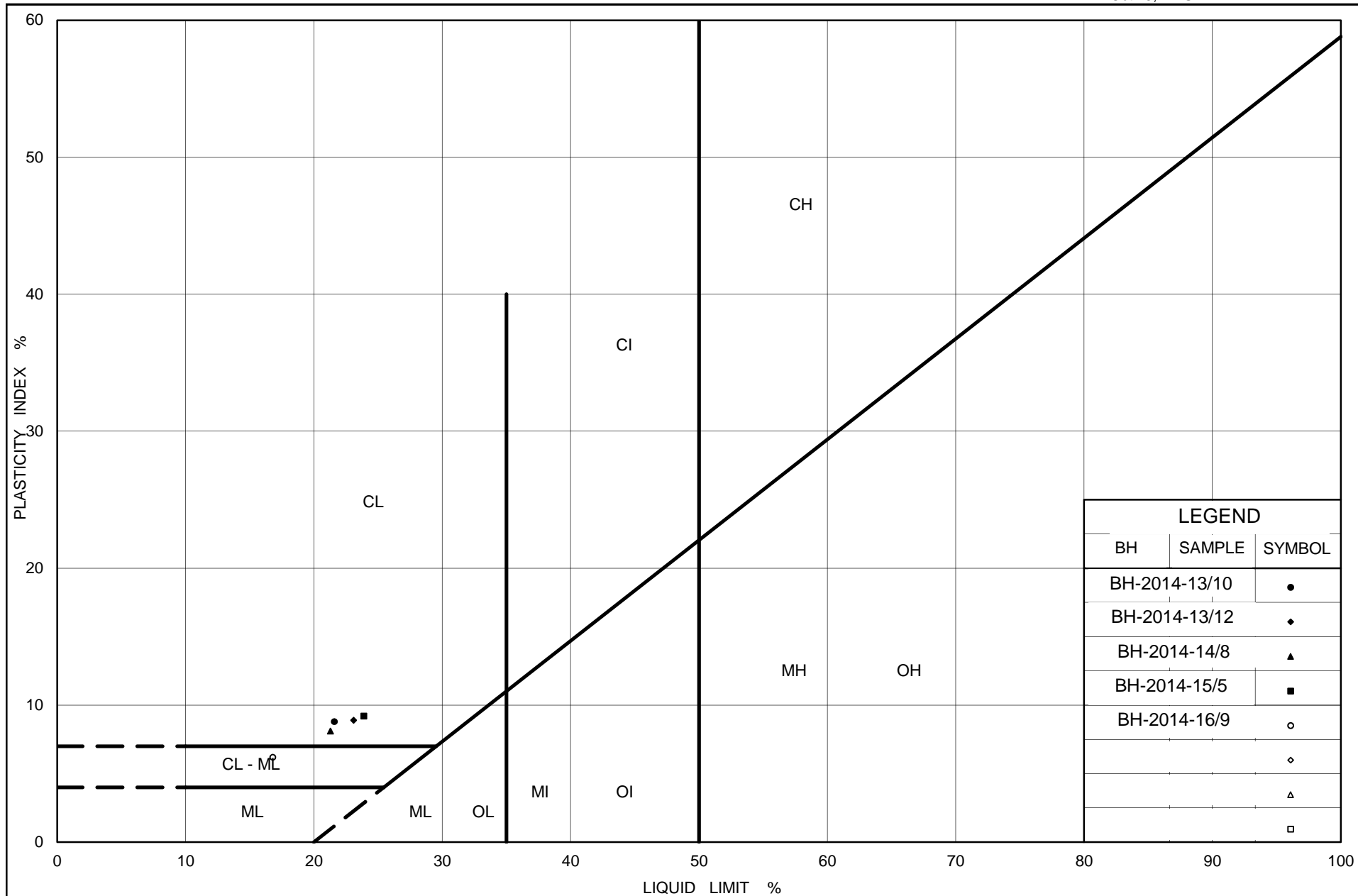
Ontario

PLASTICITY CHART Clayey Silt to Clayey Silt with Sand (Till)

Figure No. B6-2

Project No. 10-1111-0211

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PLASTICITY CHART Clayey Silt to Clayey Silt with Sand (Till)

Figure No. B6-3

Project No. 10-1111-0211

Checked By: AJS



APPENDIX C

Non-Standard Special Provisions



CAISSON FOR HML FOUNDATIONS - Item No.

Special Provision

The Contractor shall construct the HML pole foundations in conformance with the design and at the locations indicated in the Contract Documents. Caissons should be installed in accordance with OPSS 903 (Deep Foundations).

The Contractor shall construct the HML pole foundations against undisturbed base and sides of excavations. The base of caisson excavations shall be cleaned of loosened and/or softened materials prior to pouring concrete for the foundation. The construction methods and techniques shall be the responsibility of the Contractor, but consideration could be given to using temporary liners or tremie concreting techniques where conditions warrant.

The Contractor is advised that variable subsurface conditions may be encountered at the HML locations. The Contractor should note that the overburden consists of non-cohesive and cohesive (sand to sand and gravel/clayey silt) fill underlain by a cohesive deposit of clayey silt till and/or granular deposit of sand and gravel. Water-bearing non-cohesive soil lenses / interlayers within the cohesive glacial till deposits are known to be present and, depending on the period of the year, “perched” groundwater near the ground surface may also be encountered within the fill soils. Wet non-cohesive soil lenses or layers should be expected to run or flow into the drilled hole during or after augering for the sign support foundations. Artesian groundwater conditions are also known to be present near Fletcher’s Creek. The Contractor is advised that granular soil is susceptible to disturbance under conditions of unbalanced hydrostatic head.

Cobbles are inferred present in the boreholes drilled at the HML Pole locations, in the Fill and Till layers, based on the results of the geotechnical investigation. Further, boulders should be anticipated to be present within the glacially derived soils, and possibly the fill materials, although boulders were not encountered in the boreholes drilled at this site.

The Contractor may assume that the subsurface and groundwater conditions at the HML Pole caisson locations are generally similar to the closest of the boreholes, as illustrated in the Foundation Investigation Report.

Basis of Payment

Payment at the lump sum contract price for this tender item shall be full compensation for all labour, equipment and materials for completion of the work.

END OF SECTION

At Golder Associates we strive to be the most respected global company providing consulting, design, and construction services in earth, environment, and related areas of energy. Employee owned since our formation in 1960, our focus, unique culture and operating environment offer opportunities and the freedom to excel, which attracts the leading specialists in our fields. Golder professionals take the time to build an understanding of client needs and of the specific environments in which they operate. We continue to expand our technical capabilities and have experienced steady growth with employees who operate from offices located throughout Africa, Asia, Australasia, Europe, North America, and South America.

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