



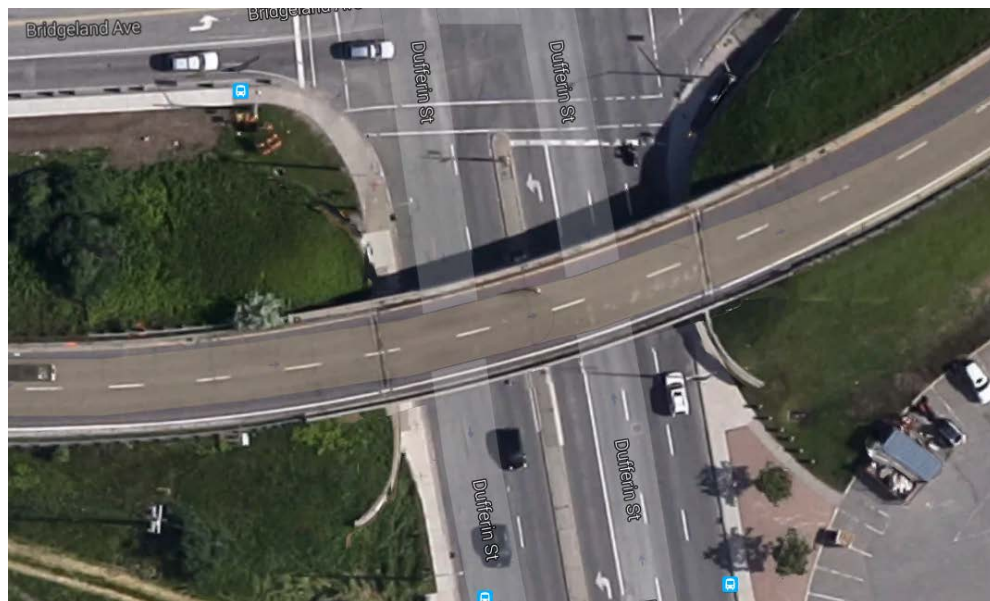
April 28, 2016

FOUNDATION INVESTIGATION REPORT

**HIGHWAY 401 W - YORKDALE ROAD RAMP OVER
DUFFERIN STREET (SITE NO. 37-284)
HIGHWAY 401 EASTBOUND COLLECTOR
REHABILITATION FROM JANE STREET
TO AVENUE ROAD
GWP 2131-01-00, AGREEMENT NO. 2009-E-0011**

Submitted to:

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Reference: ©2016 Google –Image Digital Globe,

GEOCRES No.: 30M11-262

Project Number: 09-1111-6007

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REPORT





FOUNDATION REPORT HIGHWAY 401 W - YORKDALE ROAD RAMP (SITE NO. 37-284) OVER DUFFERIN STREET

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1.0 INTRODUCTION

Golder Associates Ltd. (Golder) has been retained by AECOM on behalf of the Ministry of Transportation, Ontario (MTO) to provide foundation engineering services in support of the rehabilitation of the Highway 401 eastbound collector lanes (EBC) between Jane Street and Avenue Road in Toronto, Ontario. Foundation engineering services are required under two phases:

- Phase 1: Foundation Engineering Assessment, in the form of a desktop study, of existing foundations of various structures including the Highway 401 W - Yorkdale Road ramp over Dufferin Street.
- Phase 2: Detail Foundation Investigation at various bridge structures, including the Highway 401 W - Yorkdale Road ramp over Dufferin Street.

This report addresses the Phase 2 Detail Foundation Investigation for the proposed replacement of Highway 401 W - Yorkdale Road Ramp over Dufferin Street (Site No. 37-284).

The terms of reference and scope of work for the foundation investigation are outlined in MTO's Request for Proposal (RFP) for Agreement No. 2009-E-0011, issued on December 16, 2009, and MTO's revised Terms of Reference in Addenda dated May 2013. The scope of work for the foundation engineering services is presented in Golder's scope change letter, dated July 30, 2014.

Subsurface information from previous investigations associated with the Highway 401 W - Yorkdale Road ramp over Dufferin Street structure was obtained from the MTO Geocres library and AECOM as follows:

- MTO GEOCREs No. 30M11-081: Report titled "Hwy #401, Spadina Expressway Bridge #2, Twp. Of North York, Cty. Of York. District No. 6, W.J. 63-F-24 A - W.P. 233-61-2-2," prepared by the Department of Highways – Ontario, Materials and Research Section, dated May 24, 1963.
- Design Drawings by the Department of Highways Ontario – Bridge Division, titled "Spadina Bridge # 2 – Hwy No. 401", T.W.P. 72-284-1-A, dated March 1963; provided by AECOM.
- General Arrangement Drawings for Dufferin #37-284, titled "Ramp 401W – Yorkdale E/W over Dufferin Bridge R" received November 3rd, 2015, provided by AECOM.

2.0 SITE DESCRIPTION

The existing Highway 401 W – Yorkdale Road ramp over Dufferin Street is a two-span structure supported on spread/strip footings founded at shallow depth. The bridge structure is approximately 32 m long and 10.5 m wide. Based on the 1963 drawings, the natural ground surface at this site is approximately Elevation 188 m with Dufferin Street constructed at a grade of approximately Elevation 189 m. The Highway 401 W – Yorkdale Road ramp slopes down from west to east from approximately Elevations 195 m to 194 m.

3.0 INVESTIGATION PROCEDURES

The field work for the current foundation investigation was carried out between September 28 and November 2, 2015, at which time a total of six boreholes (Boreholes DS15-1 to DS15-6 and DS15-6A) were advanced using a CME 75 truck-mounted drill rig, supplied and operated by Geo-Environmental Drilling Inc. of



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Halton Hills, Ontario and Davis Drilling Inc. of Milton, Ontario. Borehole DS15-6 was terminated at a depth of 2.9 m below the Dufferin street roadway surface due to proximity to an existing storm sewer as inferred by the presence of sand fill in the SPT samples. Borehole DS15-6A was advanced on the east side of the pier to the desired drill depth. Two boreholes (designated 3A and 3B in GEOCREs 30M11-081) advanced as part of a previous investigation at the Highway 401 W – Yorkdale Road ramp site are also used in this report to supplement the current investigation, and have been renumbered to show the MTO GEOCREs reference number followed by the original borehole designation (i.e., 81-3A and 81-3B). Boreholes DS15-1 to DS15-6, DS15-6A, 81-3A and 81-3B pertaining to the existing bridge structure and proposed new bridge structure, were advanced at the locations shown on Drawing 1.

Boreholes DS15-1 to DS15-4 and DS15-6 were advanced using 215 mm outside diameter hollow stem augers, while Boreholes BS15-5 and BS15-6A were advanced using 215 mm outside diameter hollow stem augers and, 125 mm outside NW casing using Tricone and wash boring techniques. Soil samples were obtained in the boreholes at 0.75 m and 1.5 m intervals of depth using a 50 mm outer diameter split-spoon sampler in accordance with the Standard Penetration Test (SPT) procedure (ASTM D1586) driven by an automatic hammer. The in situ test results presented in the borehole records are uncorrected.

The groundwater conditions in the open boreholes were observed during and immediately following the drilling operations. A standpipe piezometer was installed in each of the Boreholes DS15-1 and DS15-2 to permit monitoring of the groundwater level at the site. The piezometers consists of a 50 mm diameter, 3.0 m long PVC slotted screen installed within a filter sand pack, above which the borehole annulus was backfilled to the ground surface with bentonite pellets and/or cement grout. The details of the piezometer installation are shown on the Records of Boreholes DS15-1 and DS15-2. The remaining boreholes were backfilled to immediately below ground surface with bentonite upon completion, in accordance with Ontario Regulation 903 (as amended). The boreholes advanced through the road surface were sealed at the surface with cold patch asphalt, approximately 0.2 m thick.

The field work was observed on a full-time basis by a member of Golder's technical staff who located the boreholes in the field, arranged for the clearance of underground utilities, 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 (water contents, Atterberg limits and grain size distributions) were carried out on selected soil samples. All geotechnical laboratory testing was completed to ASTM and MTO LS standards, as applicable.

The borehole locations were measured on-site relative to the existing bridge and site features and the ground surface elevations were obtained from the Digital Terrain Model for the site, provided by AECOM. The borehole locations, including MTM NAD83 northing and easting coordinates, the ground surface elevations referenced to Geodetic datum and the drilled depths are summarized below and are shown on Drawing 1. Also presented below and shown on Drawing 1 is the location of the boreholes advanced as part of the previous investigation at the site (GEOCREs No. 30M11-081).

Borehole No.	MTM NAD83 Northing (m)	MTM NAD83 Easting (m)	Ground Surface Elevation (m)	Borehole Depth (m)
DS15-1	4,842,970.0	308,197.3	195.1	11.3
DS15-2	4,842,984.8	308,242.3	194.5	14.3
DS15-3	4,842,975.9	308,205.3	189.5	17.1
DS15-4	4,842,977.3	308,212.1	189.5	18.8



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Borehole No.	MTM NAD83 Northing (m)	MTM NAD83 Easting (m)	Ground Surface Elevation (m)	Borehole Depth (m)
DS15-5	4,843,006.0	308,237.8	189.0	17.2
DS15-6	4,842,965.0	308,214.2	189.2	2.9
DS15-6A	4,842,967.4	308,219.9	189.3	15.7
81-3A*	4,842,961.1	308,202.8	189.0	9.6
81-3B*	4,842,969.8	308,237.0	189.0	6.6

* Approximate borehole locations obtained from the Digital Terrain Model as plotted relative to centerline of Highway 401 and the existing Highway 401 W – Yorkdale Road ramp structure.

4.0 SITE GEOLOGY AND SUBSURFACE CONDITIONS

4.1 Regional Geology

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

A surficial till sheet, which generally follows the surface topography, is generally present throughout much of this area. The till is typically comprised of clayey silt to silty clay, with occasional sand to silt zones and is mapped in this area as the Halton Till. 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 melt water ponds scattered throughout the Peel Plain and concentrated near river valleys, such as the West Don River valley. 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.

4.2 Subsurface Conditions

As part of the current subsurface investigation, six boreholes (Boreholes DS15-1 to DS15-6 and DS15-6A) were advanced at the existing Highway 401 W – Yorkdale Road ramp structure site. The borehole locations, ground surface elevations and interpreted stratigraphic conditions are shown on Drawings 1 and 2.

The detailed subsurface soil and groundwater conditions encountered in the boreholes advanced as part of the current investigation and the results of the laboratory testing are provided on the borehole records contained in Appendix A; the results of the geotechnical laboratory testing are presented on Figures B1 to B6 contained in Appendix B. The borehole information from the previous (MTO) investigation is presented in Appendix C.

The stratigraphic boundaries shown on the borehole records and on the interpreted stratigraphic profile and cross-sections on Drawings 1 and 2 are inferred 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.

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



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In general, the subsurface conditions at the site consist of surficial layers of asphalt and fill of varying thickness (an upper thin layer of granular material and a lower layer of clayey silt), underlain by a stiff to hard clayey silt to silty clay glacial till deposit.

A more detailed description of the subsurface conditions encountered in the current boreholes is provided in the following sections.

4.2.1 Asphalt, Concrete and Topsoil

An approximately 150 mm thick layer of asphalt was encountered immediately below the ground surface in all the boreholes drilled during the current investigation. An approximately 250 mm to 300 mm thick layer of concrete was encountered below the asphalt in all the boreholes drilled on the Dufferin Street road surface (DS15-3, DS15-4, DS15-6 and DS15-6A). Approximately 200 mm of topsoil was encountered immediately below the ground surface in Boreholes 81-3A and 81-3B drilled as part of the previous investigation.

4.2.2 Fill

Fill materials were encountered underlying the asphalt or concrete in all the boreholes drilled as part of the current investigation (Boreholes DS15-1 to DS15-6 and DS15-6A). The extent and composition of the fill varies depending on the location of the boreholes, with thicker cohesive layers encountered at the approach embankments (Boreholes DS15-1 and DS15-2) and thinner cohesive layers encountered in Boreholes DS15-3, DS15-5 and DS15-6A. Borehole DS15-6 encountered a 2.1 m thick layer of sand fill inferred to be backfill to the local sewer pipe. The surface of the fill layer was encountered between Elevations 194.9 m and 188.8 m. The thickness of the fill layer varies between about 1.5 m and 3.0 m in the boreholes drilled along the Dufferin Street road surface (Boreholes DS15-3, DS15-4, DS15-5, DS15-6 and DS15-6A), and is 7.0 m and 6.8 m thick in Boreholes DS15-2 and DS15-1, respectively, drilled along the approach embankments. The base of the fill encountered in all boreholes is between Elevations 188.0 m and 186.3 m. Borehole DS15-6 terminated within the fill layer, penetrating it for a thickness of 2.5 m.

The fill material is variable in composition and comprised of an upper layer of sand and gravel to gravelly sand to sand below the asphalt and/or concrete, and a lower layer of cohesive material consisting of clayey silt to sandy clayey silt. Trace organics were encountered in Boreholes DS15-2 and DS15-4 within the fill layer, extending to about Elevation 190 m at the east abutment (Borehole DS15-2) and to about Elevation 188 m at the pier location (Borehole DS15-4).

The Standard Penetration Test (SPT) "N"-values measured within the non-cohesive fill generally range from 11 blows to 37 blows per 0.3 m of penetration, indicating a compact to dense relative density. The SPT "N"-value measured within the cohesive fill range from 2 blows to 20 blows per 0.3 m of penetration, suggesting that the clayey silt to sandy silty clay fill has a very soft to very stiff consistency.

Grain size distribution tests were carried out on four (4) samples of the clayey silt to sandy clayey silt fill and the results are provided on Figure B1 in Appendix B.

Atterberg limits testing was carried out on four (4) samples of the cohesive fill and measured plastic limits ranging between 13 per cent and 15 per cent, liquid limits ranging between 26 per cent and 33 per cent, and corresponding plasticity indices ranging between 13 per cent and 18 per cent. These test results, which are plotted on Figure B2 in Appendix B, indicate that the cohesive fill material consists of clayey silt of low plasticity.



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The laboratory water content measured on selected samples of the non-cohesive fill ranges from 7 per cent to 20 per cent, and the laboratory water content measured on selected samples of the cohesive fill ranges from 12 per cent to 28 per cent.

4.2.3 Clayey Silt

An approximately 1.5 m thick stratum of clayey silt, trace sand to sandy, was encountered underlying the cohesive fill in borehole DS15-1. The surface of this deposit was encountered at a depth of 7.2 m below ground surface, corresponding to Elevation 187.9.

The SPT "N"-value measured within the clayey silt deposit is 20 blows per 0.3 m of penetration, suggesting a very stiff consistency

4.2.4 Sandy Clayey Silt to Clayey Silt with Sand Till

A till deposit comprised of sandy clayey silt to clayey silt with sand was encountered underlying the fill Boreholes DS15-1 to DS15-5 and DS15-6A from the current investigation and underlying the topsoil in the boreholes from the previous investigation (Boreholes 81-3A and 81-3B). All boreholes from the current and previous investigation, with the exception of Borehole DS15-5 and DS15-6, were terminated within this deposit. The elevations of the surface and base of the till deposit and the thickness of this stratum as encountered in the boreholes are summarized below.

Borehole No.	Depth to Surface of Deposit (m)	Surface Elevation of Deposit (m)	Thickness of Deposit (m)	Base Elevation of Deposit (m)	Deposit Description
DS15-1	8.7	186.4	>2.6	Below 183.8	Sandy Clayey Silt (Till)
DS15-2	7.2	187.3	>7.1	Below 180.2	Sandy Clayey Silt to Clayey Silt with Sand (Till)
DS15-3	1.5	188.0	>15.6	Below 172.4	Sandy Clayey Silt (Till)
DS15-4	1.5	188.0	>17.3	Below 170.7	Sandy Clayey Silt to Clayey Silt with Sand (Till)
DS15-5	2.2	186.8	11.1	175.7	Sandy Clayey Silt (Till)
DS15-6A	3.0	186.3	>12.7	Below 173.6	Sandy Clayey Silt to Clayey Silt with Sand (Till)
81-3A	0.2	188.8	>9.4	Below 179.4	Silty Clay and Clayey Silt (Till)
81-3B	0.2	188.8	>6.4	Below 182.4	Clayey Silt and Silty Clay (Till)



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The cohesive till deposit generally consists of sandy clayey silt to clayey silt with sand, trace to some gravel; sand and silt seams. Cobbles and boulder are inferred present within the till deposit as noted by augur grinding and very small sample recovery coupled with greater than 100 blows SPT "N"-values, such as encountered in boreholes DS15-3 between depths of about 12.8 m and 16.8 m (corresponding to about Elevation 176.7 m and 172.7 m). A silt pocket was encountered within the till deposit at about Elevation 183 m.

The SPT "N"-values measured within cohesive till generally range from 10 blows per 0.3 m to greater than 100 blows per 0.01 m of penetration, suggesting a stiff to hard consistency.

Grain size distribution tests were carried out on twelve (12) selected samples of the sandy clayey silt to clayey silt with sand till deposit and the results are shown on Figures B3A and B3B in Appendix B.

Atterberg limits tests were carried out on thirteen (13) selected samples of the cohesive till deposit and measured liquid limits ranging between 18 per cent and 28 per cent, plastic limits ranging between 11 per cent and 14 per cent, and corresponding plasticity indices ranging between 7 per cent and 13 per cent. These results, which are plotted on a plasticity chart on Figures B4A and B4B in Appendix B, indicate that the till deposit generally consists of clayey silt of low plasticity. The result of an Atterberg Limits test of a sample of the silt pocket (from borehole DS15-6A) indicates a liquid limit of about 18 per cent, a plastic limit of about 16 per cent and a plasticity index of about 2 percent, as shown on Figure B4B, indicating that the material is a silt of slight plasticity.

The natural water content measured on selected samples of the sandy clayey silt to clayey silt with sand till ranges from 7 per cent to 14 per cent.

4.2.5 Silt

An approximately 1.6 m thick silt deposit was encountered underlying the sandy clayey silt till in Borehole DS15-5. The surface of the deposit was encountered at a depth of 13.3 m below ground surface, corresponding to Elevation 175.7 m.

The SPT "N"-value measured within the silt deposit is 100 blows per 0.18 m of penetration, indicating a very dense relative density.

The natural water content measured on one sample of the silt deposit is 18 per cent.

4.2.6 Silt and Sand Till

A till deposit comprised of silt and sand was encountered below the silt deposit in Borehole DS15-5, at a depth of 14.9 m below ground surface, corresponding to Elevation 174.1 m. Borehole DS15-5 was terminated within this deposit, penetrating it for a thickness of 2.3m.

The SPT "N"-values measured within the silt and sand till deposit are 128 blows per 0.25 m of penetration and 127 blows per 0.2 m of penetration, indicating that the silt and sand till deposit has a very dense relative density.

A grain size distribution test was carried out on one selected sample of the silt and sand till deposit and the result is provided on Figure B5 in Appendix B.

An Atterberg limits test carried out on one (1) sample of the silt and sand till deposit measured a liquid limit of 15 per cent, a plastic limit of 11 per cent and a corresponding plasticity index of 4 per cent. The result of the Atterberg limits test is shown on a plasticity chart on Figure B6 in Appendix B and indicates that the deposit consists of silt of slight plasticity.



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The natural water content measured on two (2) selected samples of the silt and sand till deposit are 9 per cent and 10 per cent.

4.2.7 Groundwater Conditions

The observed/recorded water levels in the open boreholes following completion of drilling and in the piezometer (P) in Boreholes DS15-1 and DS15-2 are shown on the Record of Borehole sheets and are summarized below.

Borehole Number	Ground Surface Elevation	Depth to Water Level below Ground Surface	Groundwater Elevation (P: Piezometer)	Date
DS15-1	195.1 m	dry	dry	Sept. 28, 2015
		7.1 m	188.0 m (P)	Nov. 19, 2015
		7.2 m	187.9 m (P)	Dec. 14, 2015
DS15-2	194.5 m	dry	dry	Sept. 29, 2015
		6.6 m	187.9 m (P)	Nov. 19, 2015
		6.7 m	187.8 m (P)	Dec. 14, 2015
DS15-3	189.5 m	dry	-	Oct. 12, 2015
DS15-4	189.5 m	dry	-	Oct. 13, 2015
DS15-5	189.0 m	*	-	Nov. 1, 2015
DS15-6	189.2 m	dry	-	Oct. 4, 2015
DS15-6A	189.3 m	*	-	Nov. 2, 2015
81-3A	189.0 m	6.1 m	182.9 m	Mar. 15, 1963
81-3B	189.0 m	4.5 m	184.5 m	Mar. 21, 1963

* Water level not recorded as water was introduced into the borehole as part of the drilling operations.

Based on the groundwater levels recorded during this current investigation, the water level at this site is at approximately Elevation of 187.9 m.

The water levels presented above and on the Record of Borehole sheets may not represent stabilized groundwater conditions at the time of the investigation. The water level at the site is expected to fluctuate seasonally in response to changes in precipitation and snow melt, and is expected to be higher during the Spring and periods of precipitation.



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5.0 CLOSURE

This Foundation Investigation Report was prepared by Qasim Cheema, P.Eng., a geotechnical engineer, and reviewed by Ms. Nikol Kochmanová, P.Eng., a geotechnical engineer with Golder. Mr. Jorge Costa, P.Eng., a Designated MTO Contact and Principal of Golder, conducted an independent review and quality control audit of this report.

GOLDER ASSOCIATES LTD.



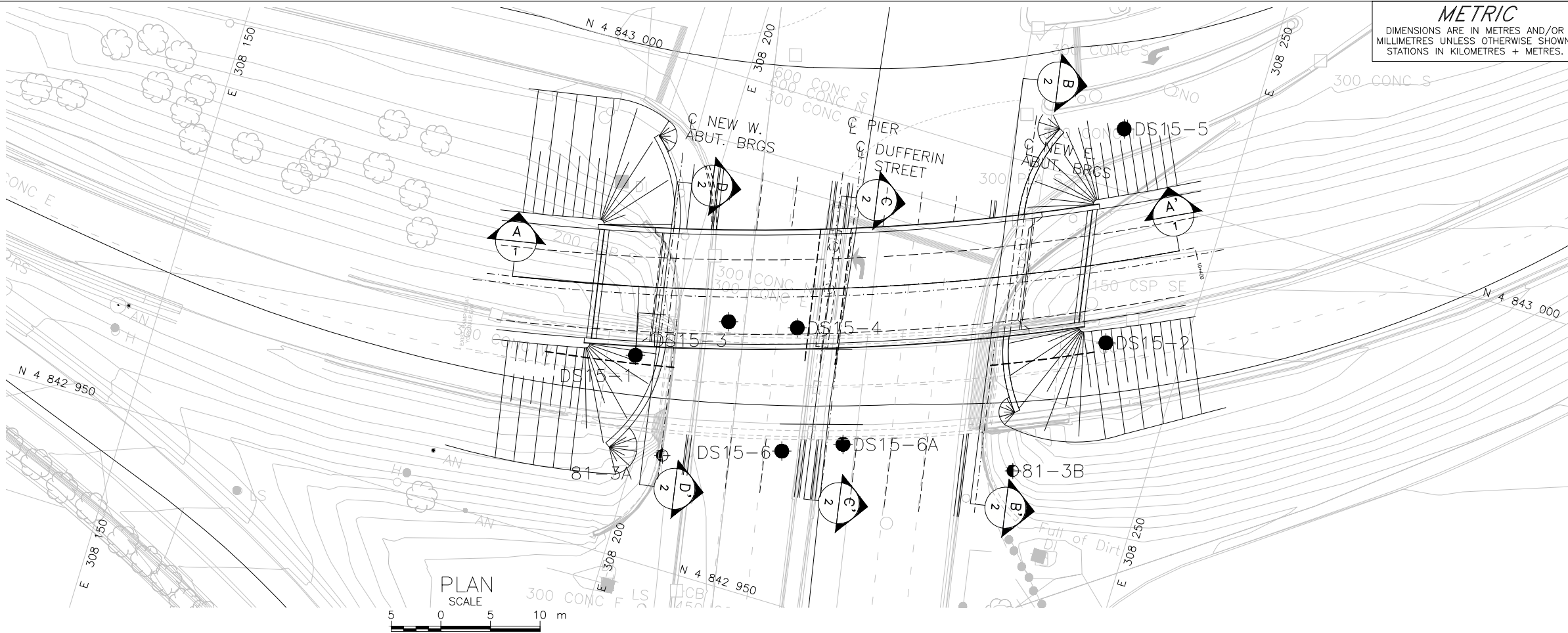
Nikol Kochmanová, Ph.D., P.Eng., PMP
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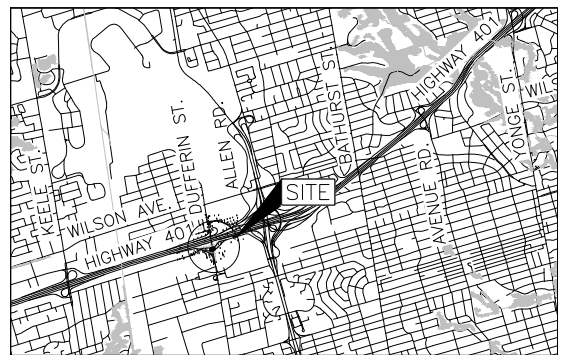
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CONT No. _____
GWP No. 2131-01-00



HIGHWAY 401
HIGHWAY 401 W - YORKDALE RAMP OVER
DUFFERIN STREET SITE NO. 37-284
**BOREHOLE LOCATIONS AND
SOIL STRATA**

SHEET



KEY PLAN
SCALE
1 0 1 2 km

LEGEND

- Borehole - Current Investigation
- Borehole - Previous Investigation 1 (Geocres No. 30M11-081)
- ⊥ Seal
- ⊥ Piezometer
- N Standard Penetration Test Value
- 16 Blows/0.3m unless otherwise stated (Std. Pen. Test, 475 j/blow)
- ≡ WL in piezometer, measured on DEC 14, 2015
- ≡ WL upon completion of drilling

BOREHOLE CO-ORDINATES

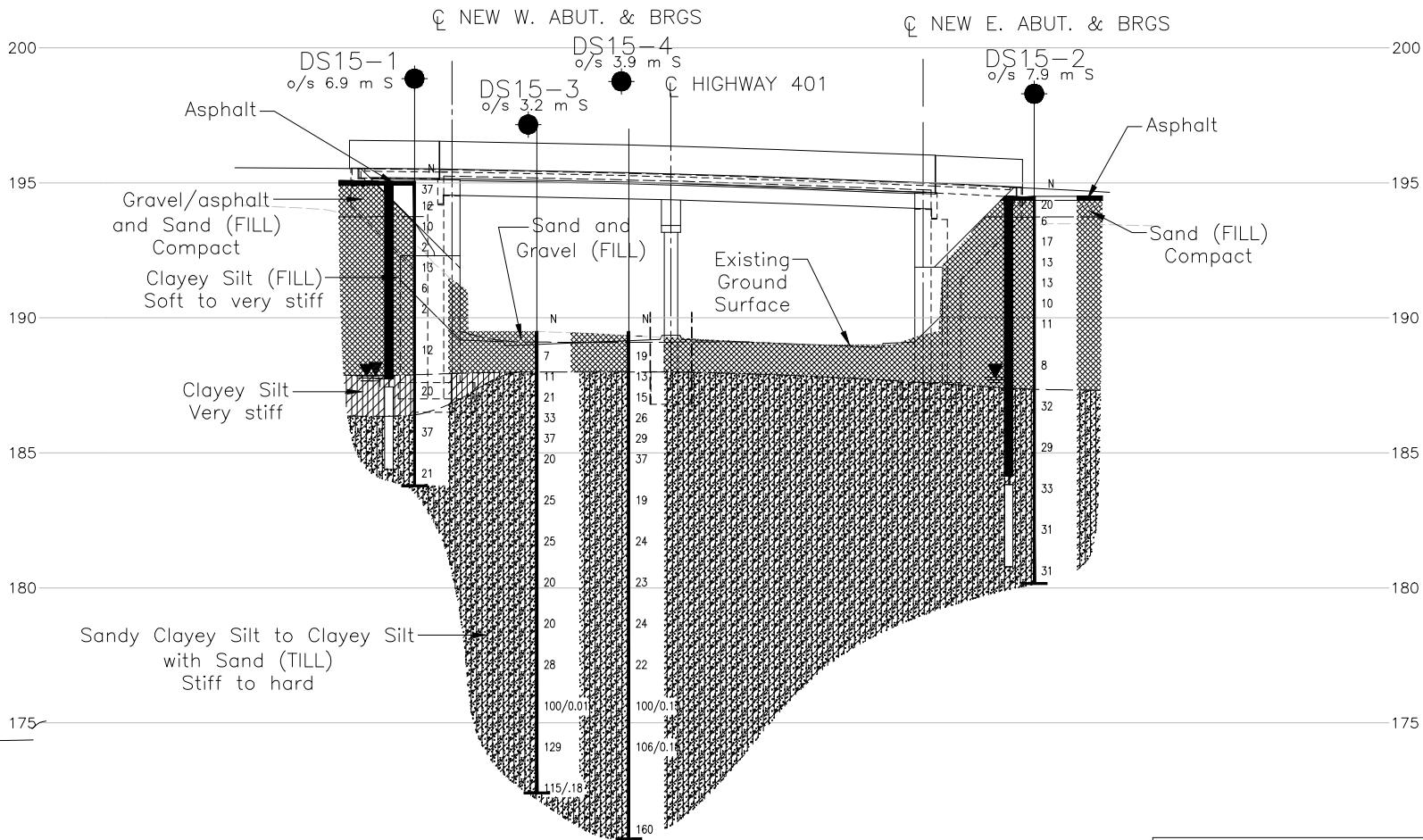
No.	ELEVATION	NORTHING	EASTING
81-3A	189.0	4842961.1	308202.8
81-3B	189.0	4842969.8	308237.0
DS15-1	195.1	4842970.0	308197.3
DS15-2	194.5	4842984.8	308242.3
DS15-3	189.5	4842975.9	308205.3
DS15-4	189.5	4842977.3	308212.1
DS15-5	189.0	4843006.0	308237.8
DS15-6	189.2	4842965.0	308214.2
DS15-6A	189.3	4842967.4	308219.9

NOTES

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

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

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.



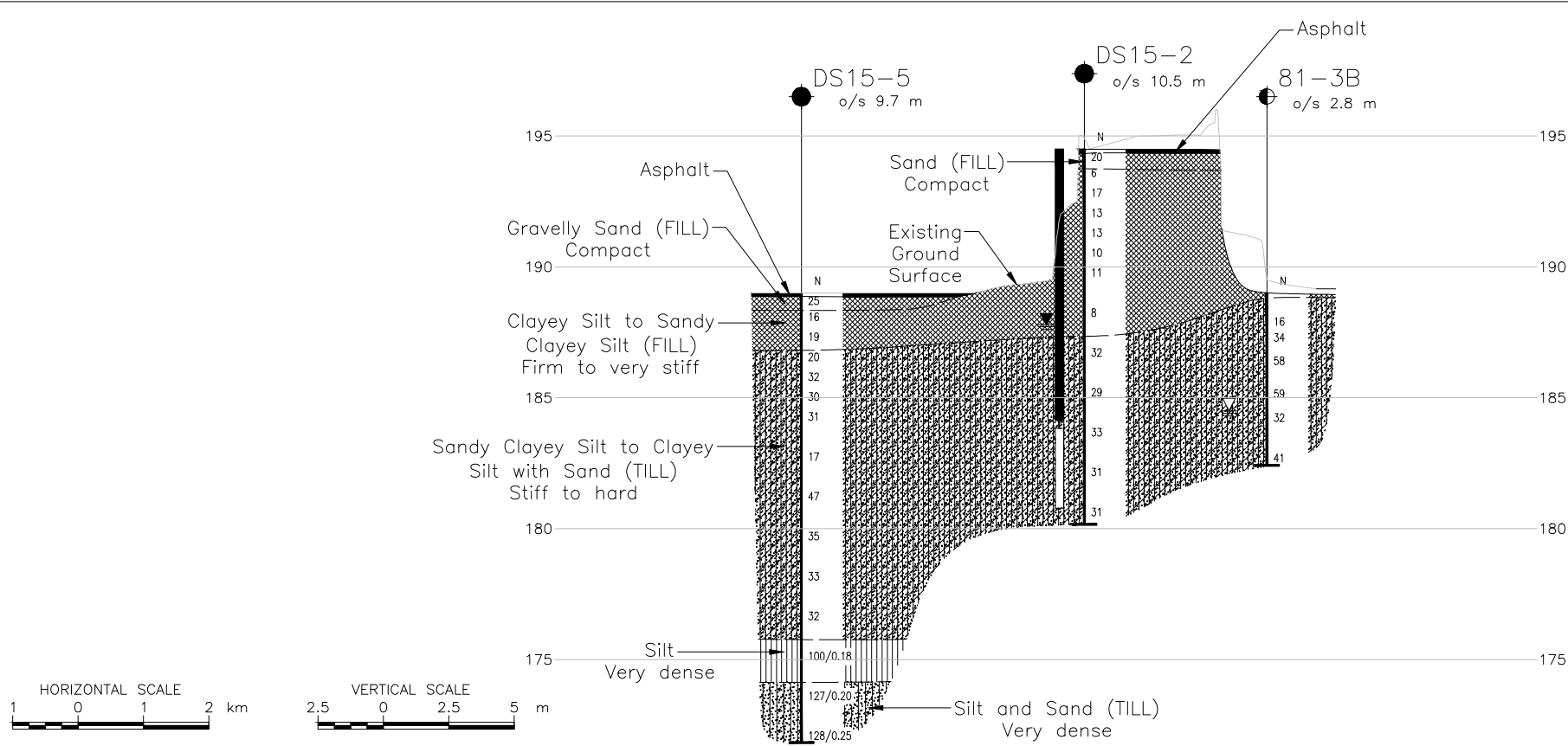
REFERENCE

Base plans and Ramp general arrangement provided in digital format by AECOM, drawing file nos. Hwy401_bgd-Dufferin.dwg, Hwy401_contours-Dufferin.dwg and Dufferin #37-284_GA.dwg, received November 3, 2015, and 01_Dufferin_Ramp_GA.dwg, received March 21 2016.

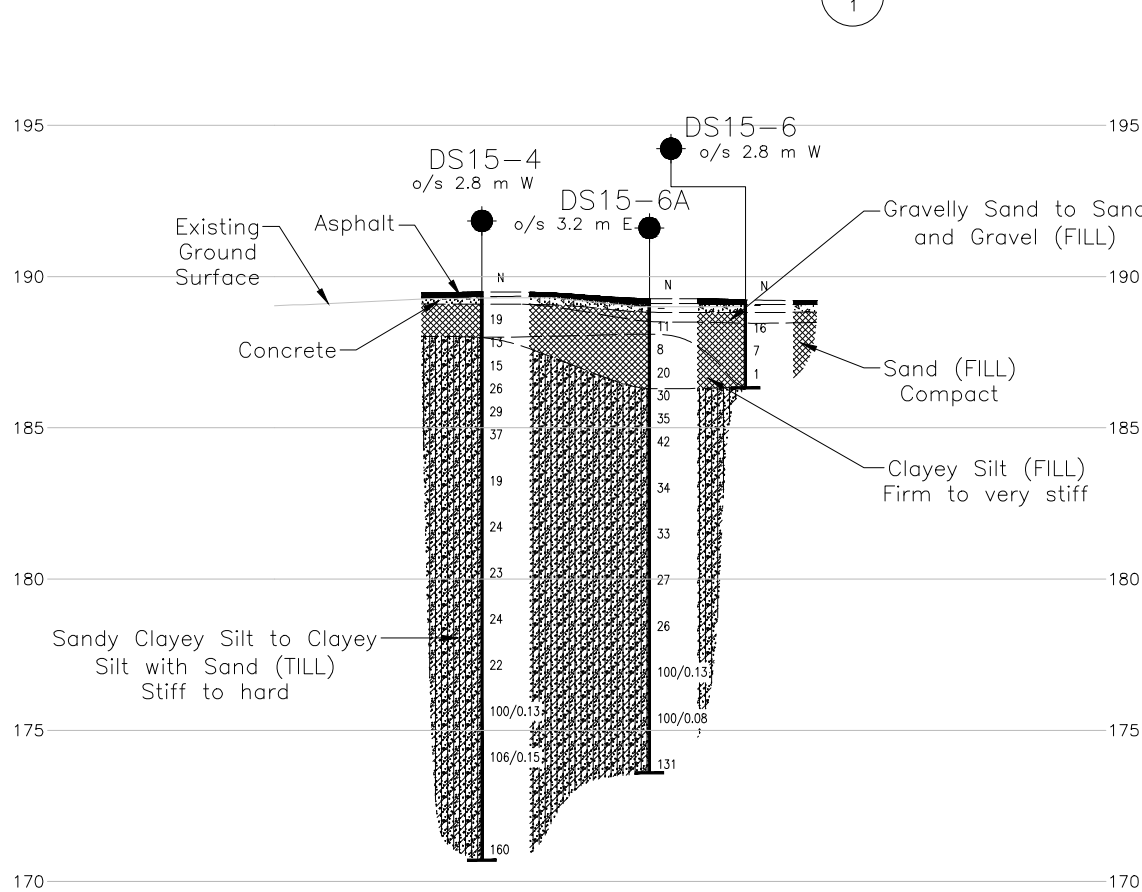
NO.	DATE	BY	REVISION
Geocres No. 30M11-262			
HWY. 401	PROJECT NO. 09-1111-6007		DIST. CENTRAL
SUBM'D. AJS	CHKD. QC	DATE: Nov. 2015	SITE: .
DRAWN: JFC/MR	CHKD. NK	APPD. JMAC	DWG. 1



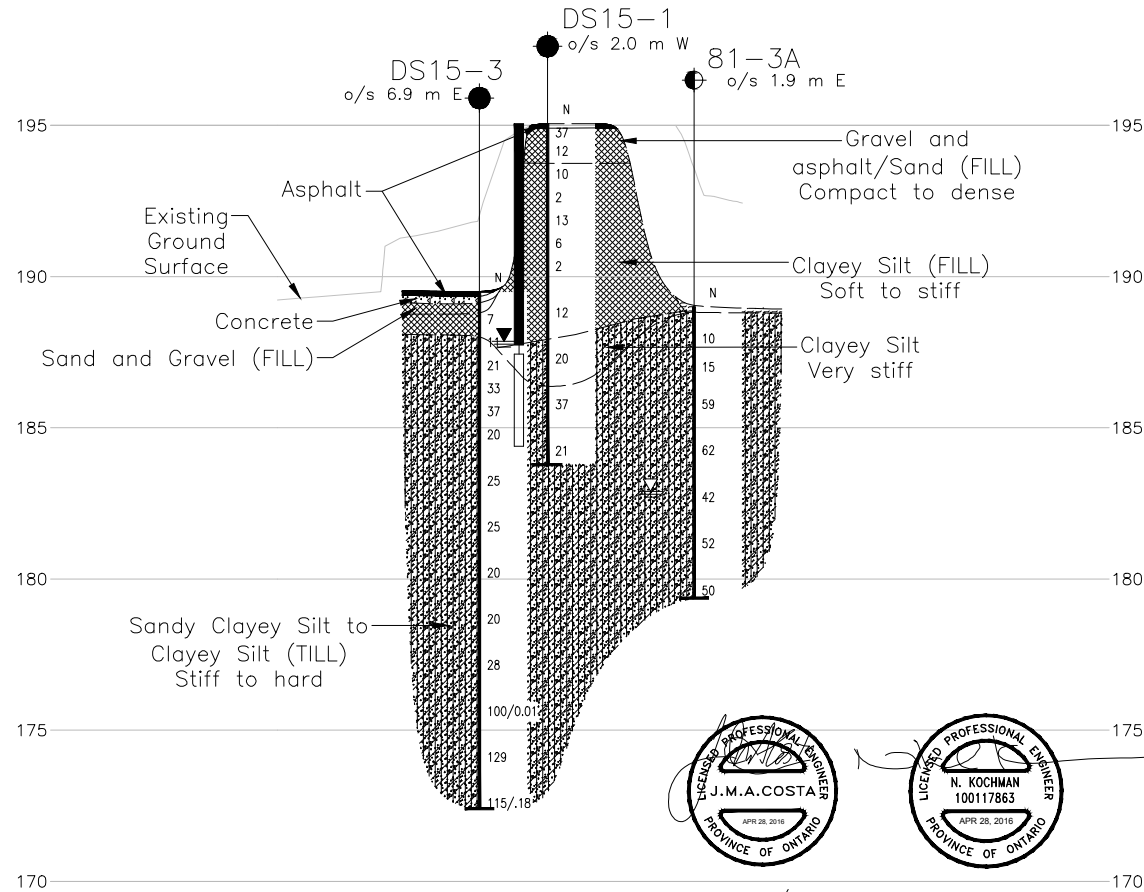
A-A CENTRELINE PROFILE OF HWY 401W-YORKDALE RAMP



B-B' EAST ABUTMENT OF HWY401 W - YORKDALE RAMP



C-C' DUFFERIN STREET OVERPASS PIER



D-D' WEST ABUTMENT OF HWY 401 W/YORKDALE RAMP

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

CONT No. GWP No. 2131-01-00
HIGHWAY 401
HIGHWAY 401 W - YORKDALE RAMP OVER DUFFERIN STREET SITE NO. 37-284
SOIL STRATA



KEY PLAN
SCALE 1 0 1 2 km

- LEGEND**
- Borehole - Current Investigation
 - Borehole - Previous Investigation 1 (Geocres No. 30M11-081)
 - Seal
 - ⊥ Piezometer
 - N Standard Penetration Test Value
 - 16 Blows/0.3m unless otherwise stated (Std. Pen. Test, 475 j/blow)
 - ≡ WL in piezometer, measured on DEC 14, 2015
 - ≡ WL upon completion of drilling

BOREHOLE CO-ORDINATES			
No.	ELEVATION	NORTHING	EASTING
81-3A	189.0	4842961.1	308202.8
81-3B	189.0	4842969.8	308237.0
DS15-1	195.1	4842970.0	308197.3
DS15-2	194.5	4842984.8	308242.3
DS15-3	189.5	4842975.9	308205.3
DS15-4	189.5	4842977.3	308212.1
DS15-5	189.0	4843006.0	308237.8
DS15-6	189.2	4842965.0	308214.2
DS15-6A	189.3	4842967.4	308219.9

NOTES

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

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

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. Hwy401_bgd-Dufferin.dwg, Hwy401_contours-Dufferin.dwg and Dufferin #37-284_GA.dwg, received November 3, 2015.

NO.	DATE	BY	REVISION
Geocres No. 30M11-262			
HWY. 401	PROJECT NO. 09-1111-6007		DIST. CENTRAL
SUBM'D. QC	CHKD. QC	DATE: Nov. 2015	SITE:
DRAWN: MR	CHKD. NK	APPD. JMAC	DWG. 2



**FOUNDATION REPORT
HIGHWAY 401 W - YORKDALE ROAD RAMP (SITE NO. 37-284)
OVER DUFFERIN STREET**

APPENDIX A

Record of Borehole Sheets



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 09-1111-6007		RECORD OF BOREHOLE No DS15-1		SHEET 1 OF 1		METRIC	
G.W.P. 2131-01-00		LOCATION N 4842970.0 ;E 308197.3		ORIGINATED BY		QC	
DIST Central HWY 401		BOREHOLE TYPE CME 75 Truck-mount, 215 mm O.D. Hollow Stem Augers		COMPILED BY		AJS	
DATUM Geodetic		DATE September 28, 2015		CHECKED BY		NK	

[illegible]

PROJECT 09-1111-6007		RECORD OF BOREHOLE No DS15-2		SHEET 1 OF 2		METRIC	
G.W.P. 2131-01-00		LOCATION N 4842984.8 ; E 308242.3		ORIGINATED BY QC			
DIST Central HWY 401		BOREHOLE TYPE CME 75 Truck-mount, 215 mm O.D. Hollow Stem Augers		COMPILED BY AJS			
DATUM Geodetic		DATE September 29, 2015		CHECKED BY NK			

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 (%)		
								○ UNCONFINED + FIELD VANE	● QUICK TRIAXIAL × REMOULDED	20 40 60 80 100	20 40 60 80 100	w _p w w _L					
194.5	GROUND SURFACE																
0.0	ASPHALT (150 mm)																
0.2	Sand, some silt, trace gravel (FILL)		1	SS	20						○						
193.7	Compact Brown Moist		2	SS	6												
0.8	Clayey silt, some sand to sandy clayey silt, trace gravel, trace organics (FILL)		3	SS	17												
	Firm to very stiff		4	SS	13						□	□					
	Brown to grey Moist		5	SS	13												
			6	SS	10						○			6 24 48 22			
			7	SS	11												
			8	SS	8						○						
187.3	Sandy CLAYEY SILT, to CLAYEY SILT with SAND, trace gravel, oxidation staining to a depth of 8.7 m (TILL)		9	SS	32						□	□		1 25 54 20			
7.2	Very stiff to hard		10	SS	29												
	Brown, becoming grey below a depth of 9.3 m		11	SS	33						○						
	Dry to moist		12	SS	31												
			13	SS	31						○	□		3 32 49 16			
180.2	END OF BOREHOLE																
14.3																	

Continued Next Page


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

GTA-MTO 001 T:\PROJECTS\2009\09-1111-6007 (URS, TORONTO)\LOG\09-1111-6007.GPJ GAL-GTA.GDT 24/02/16 CD



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

GTA-MTO 001 T:\PROJECTS\2009\09-1111-6007 (URS, TORONTO)\LOG\09-1111-6007.GPJ GAL-GTA.GDT 24/02/16 CD

PROJECT		RECORD OF BOREHOLE No DS15-3				SHEET 2 OF 2		METRIC												
G.W.P. 09-1111-6007		LOCATION N 4842975.9 ; E 308205.3				ORIGINATED BY QC														
DIST Central HWY 401		BOREHOLE TYPE CME 75 Truck-mount, 215 mm O.D. Hollow Stem Augers				COMPILED BY AJS														
DATUM Geodetic		DATE October 12, 2015				CHECKED BY NK														
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												
	--- CONTINUED FROM PREVIOUS PAGE ---						20 40 60 80 100 ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × REMOULDED 20 40 60 80 100					WATER CONTENT (%) 10 20 30								
172.4	Sandy CLAYEY SILT, trace gravel, some silt and sand pockets, oxidation staining to a depth of 4.4 m (TILL) Stiff to hard Mottled brown, becoming grey below a depth of 3.8 m Dry to moist		13	SS	129	174											4	24	50	22
173																				
17.1	END OF BOREHOLE		14	SS	115/18															
	NOTE: 1. Borehole dry upon completion of drilling.																			

PROJECT 09-1111-6007		RECORD OF BOREHOLE No DS15-4		SHEET 1 OF 2		METRIC	
G.W.P. 2131-01-00		LOCATION N 4842977.3 ;E 308212.1		ORIGINATED BY QC			
DIST Central HWY 401		BOREHOLE TYPE CME 75 Truck-mount, 215 mm O.D. Hollow Stem Augers		COMPILED BY AJS			
DATUM Geodetic		DATE October 13, 2015		CHECKED BY NK			

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

GTA-MTO 001 T:\PROJECTS\2009\09-1111-6007 (URS, TORONTO)\LOG\09-1111-6007.GPJ GAL-GTA.GDT 24/02/16 CD

PROJECT 09-1111-6007			RECORD OF BOREHOLE No DS15-4			SHEET 2 OF 2			METRIC															
G.W.P. 2131-01-00			LOCATION N 4842977.3 ; E 308212.1			ORIGINATED BY QC																		
DIST Central HWY 401			BOREHOLE TYPE CME 75 Truck-mount, 215 mm O.D. Hollow Stem Augers			COMPILED BY AJS																		
DATUM Geodetic			DATE October 13, 2015			CHECKED BY NK																		
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 ---																								
	Sandy CLAYEY SILT to CLAYEY SILT with SAND, trace gravel, oxidation staining at a depth of 5.6 m (TILL) Stiff to hard Mottled brown, becoming grey below a depth of 4.6 m Moist		14	SS	106/0.15																			
170.7				15	SS	160																		
18.8	END OF BOREHOLE NOTE: 1. Borehole dry upon completion of drilling.																							

PROJECT 09-1111-6007		RECORD OF BOREHOLE No DS15-5		SHEET 1 OF 2		METRIC	
G.W.P. 2131-01-00		LOCATION N 4843006.0 ; E 308237.8		ORIGINATED BY QC			
DIST Central HWY 401		BOREHOLE TYPE CME 75, 215 mm O.D. Hollow Stem Augers/Tricone with 125 mm O.D. Casing		COMPILED BY AJS			
DATUM Geodetic		DATE November 1, 2015		CHECKED BY NK			


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 (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa			WATER CONTENT (%)				
								○ UNCONFINED ● QUICK TRIAXIAL	+ FIELD VANE × REMOULDED		w _p	w	w _L		
189.0	GROUND SURFACE														
0.0	ASPHALT (150 mm)														
0.2	Gravelly sand, trace silt (FILL)														
188.3	Compact Brown		1	SS	25										
0.7	Dry to moist														
	Sandy clayey silt, trace gravel, some silt pockets (FILL)		2	SS	16										
	Very stiff														
	Mottled brown and grey		3	SS	19										
	Moist														
186.8															
2.2	Sandy CLAYEY SILT, trace to some gravel, oxidation staining to a depth of 4.6 m (TILL)		4	SS	20										
	Very stiff to hard														
	Brown, becoming grey below a depth of 4.6 m		5	SS	32										
	Moist														
			6	SS	30										
			7	SS	31										
			8	SS	17										
			9	SS	47										
			10	SS	35										
			11	SS	33										
			12	SS	32										
175.7															
13.3	SILT, some sand to sandy		13	SS	100/0.18										
	Very dense														
	Grey														
	Wet														
174.1															

Continued Next Page



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

GTA-MTO 001 T:\PROJECTS\2009\09-1111-6007 (URS, TORONTO)\LOG\09-1111-6007.GPJ GAL-GTA.GDT 24/02/16 CD

PROJECT <u>09-1111-6007</u>		RECORD OF BOREHOLE No DS15-5		SHEET 2 OF 2		METRIC	
G.W.P. <u>2131-01-00</u>		LOCATION <u>N 4843006.0 ; E 308237.8</u>		ORIGINATED BY <u>QC</u>			
DIST <u>Central</u> HWY <u>401</u>		BOREHOLE TYPE <u>CME 75, 215 mm O.D. Hollow Stem Augers/Tricone with 125 mm O.D. Casing</u>		COMPILED BY <u>AJS</u>			
DATUM <u>Geodetic</u>		DATE <u>November 1, 2015</u>		CHECKED BY <u>NK</u>			

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					WATER CONTENT (%)				GR	SA	SI	CL	
								<div><div>20406080100</div><div>○ UNCONFINED + FIELD VANE</div><div>● QUICK TRIAXIAL × REMOULDED</div></div>						<div><div>102030</div><div>W_p W W_L</div></div>							
14.9	SILT and SAND, some clay, trace gravel (TILL) Very dense Grey Moist		14	SS	127/0.20																
171.8				15	SS	128/0.25															
17.2	END OF BOREHOLE																				
	NOTES: 1. Water level not recorded in open borehole upon completion of drilling as water was introduced into the borehole due to method of advancement.																				

PROJECT		RECORD OF BOREHOLE		No DS15-6		SHEET 1 OF 1		METRIC									
G.W.P. 09-1111-6007		LOCATION		N 4842965.0 ; E 308214.2		ORIGINATED BY		QC									
DIST Central HWY 401		BOREHOLE TYPE		CME 75 Truck-mount 215 mm O.D. Hollow Stem Augers		COMPILED BY		AJS									
DATUM Geodetic		DATE		October 14, 2015		CHECKED BY		NK									
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									
189.2 0.0	GROUND SURFACE ASPHALT (150 mm) CONCRETE (250 mm)		1	AS	-												
188.4 0.8	Sand and gravel (FILL) Brown Moist Sand, trace silt, trace to some gravel (FILL) Very loose to compact Brown Moist to wet		2	SS	16												
			3	SS	7												
			4	SS	1												
186.3 2.9	END OF BOREHOLE NOTE: 1. Water level not recorded upon completion of drilling. 2. Drilling stopped due to proximity to storm sewer as inferred by presence of sand fill.																

PROJECT 09-1111-6007		RECORD OF BOREHOLE No DS15-6A				SHEET 2 OF 2		METRIC									
G.W.P. 2131-01-00		LOCATION N 4842967.4 ; E 308219.9				ORIGINATED BY QC											
DIST Central HWY 401		BOREHOLE TYPE CME 75, 215 mm O.D. Hollow Stem Augers/Tricone with 125 mm O.D. Casing				COMPILED BY AJS											
DATUM Geodetic		DATE November 2, 2015				CHECKED BY NK											
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									
	--- CONTINUED FROM PREVIOUS PAGE ---						20 40 60 80 100 ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × REMOULDED					WATER CONTENT (%)					
							20	40	60	80	100	10	20	30			
173.6			14	SS	131		174										0 24 53 23
15.7	END OF BOREHOLE NOTES: 1. Water level not recorded in open borehole upon completion of drilling as water was introduced into the borehole due to method of advancement.																



**FOUNDATION REPORT
HIGHWAY 401 W - YORKDALE ROAD RAMP (SITE NO. 37-284)
OVER DUFFERIN STREET**

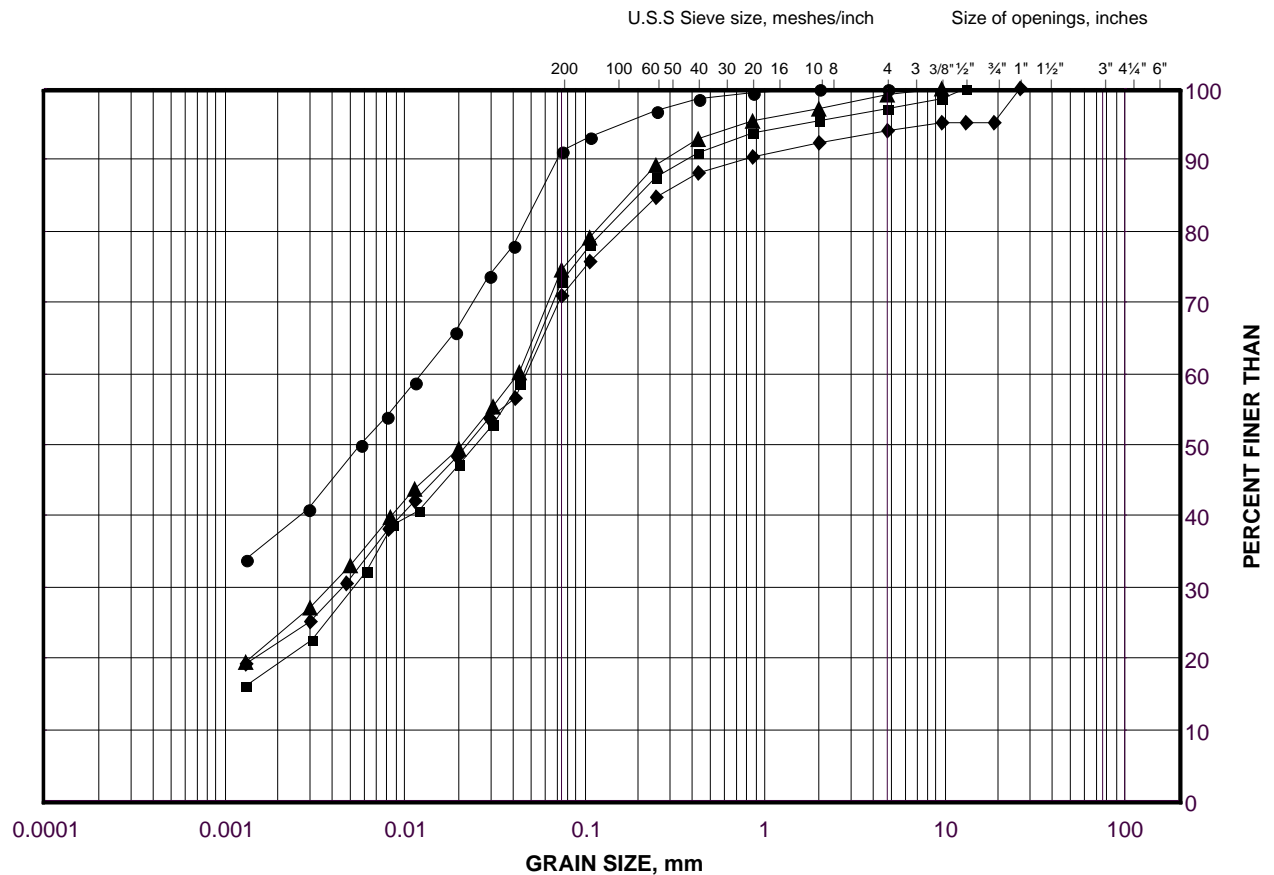
APPENDIX B

Laboratory Test Results

GRAIN SIZE DISTRIBUTION

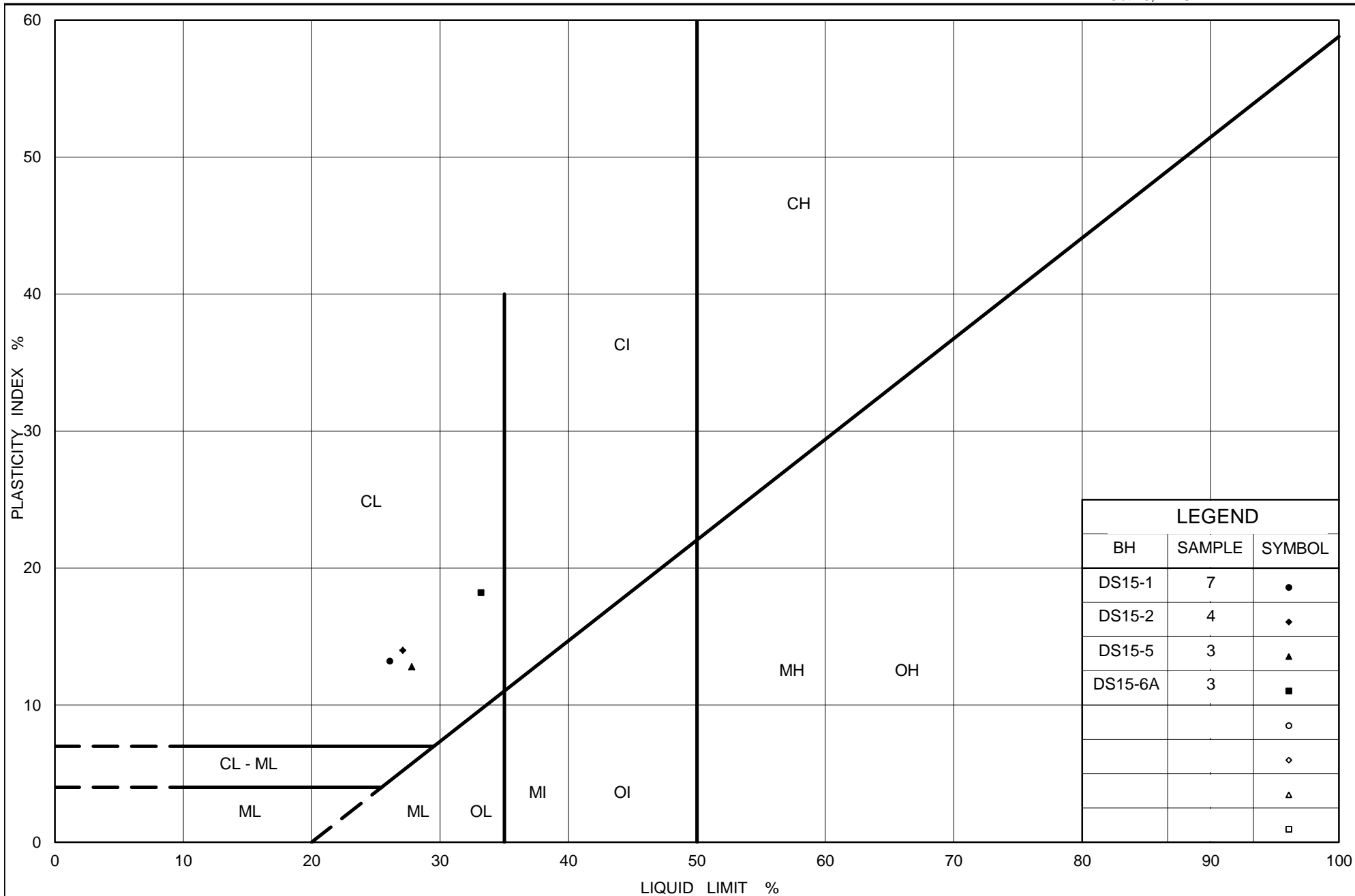
Clayey Silt to Sandy Clayey Silt (Fill)

FIGURE B1



LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
●	DS15-3	1	188.4
■	DS15-5	2	187.9
◆	DS15-2	6	190.4
▲	DS15-1	7	190.2



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PLASTICITY CHART Clayey Silt to Sandy Clayey Silt (Fill)

Figure No. B2

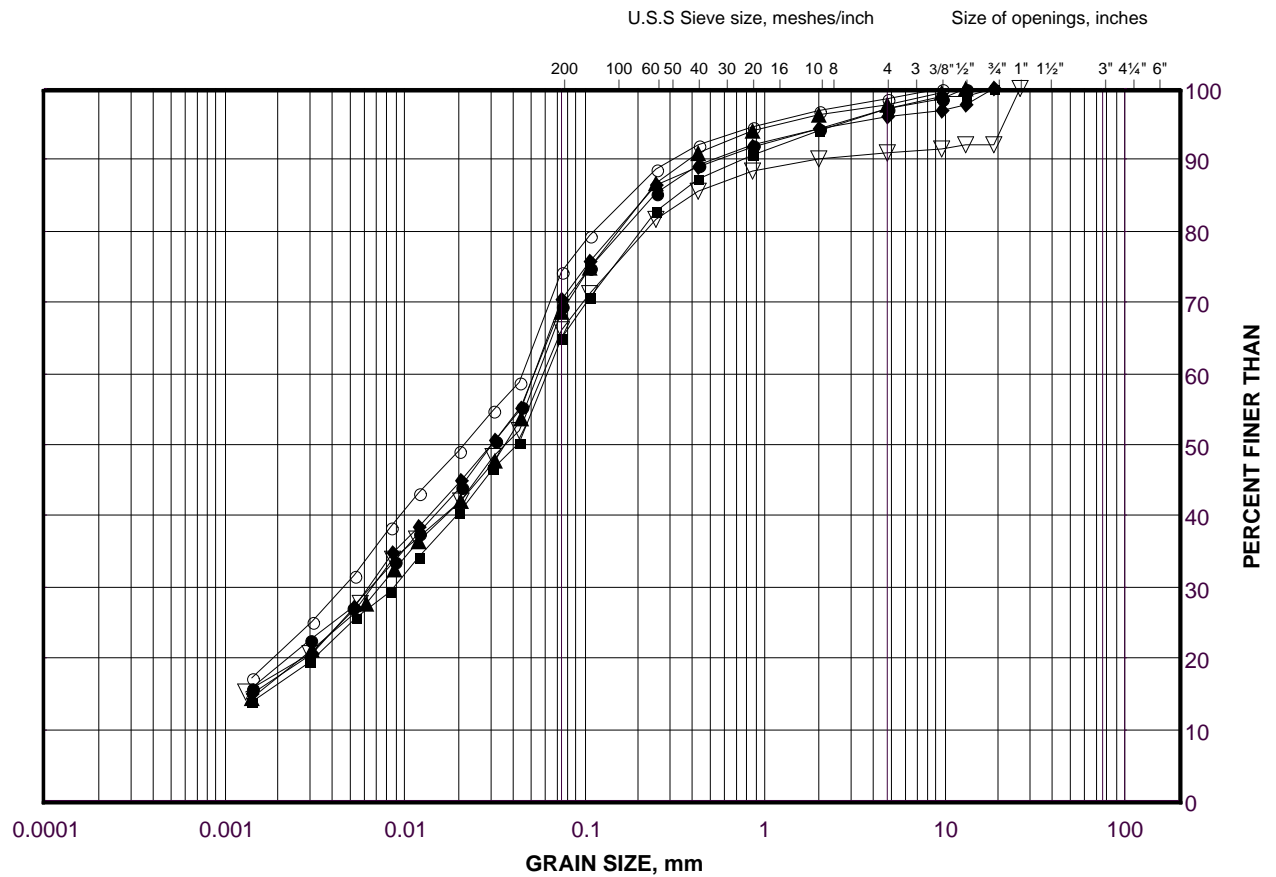
Project No. 09-1111-6007

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GRAIN SIZE DISTRIBUTION

Sandy Clayey Silt to Clayey Silt with Sand (Till)

FIGURE B3A



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

LEGEND

SYMBOL	STATION	SAMPLE	ELEVATION(m)
●	DS15-1	10	185.6
■	DS15-2	13	180.5
◆	DS15-4	5	186.1
▲	DS15-3	5	185.3
▽	DS15-6A	6	185.2
○	DS15-2	9	186.5

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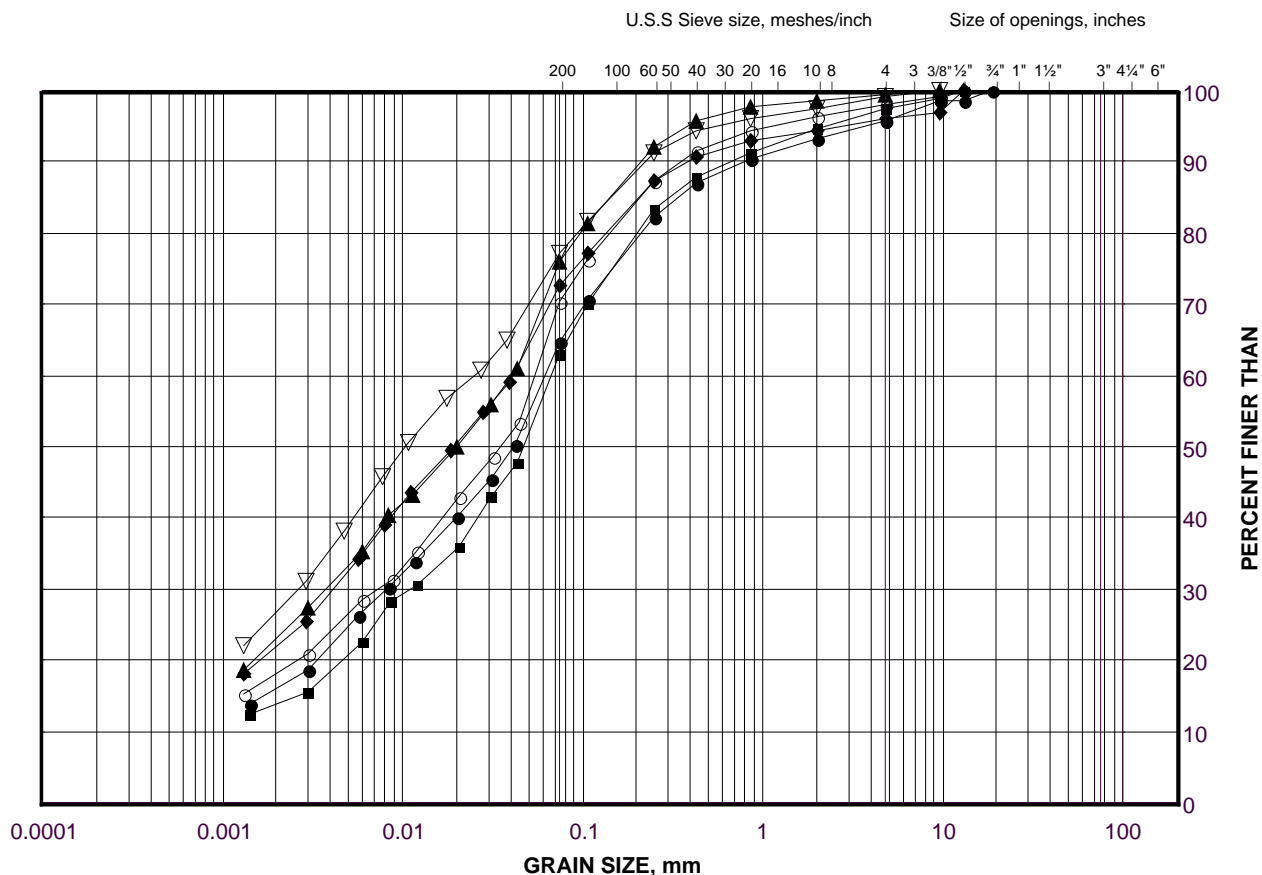
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Date: 11-Feb-16

GRAIN SIZE DISTRIBUTION

Sandy Clayey Silt to Clayey Silt with Sand (Till)

FIGURE B3B



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

LEGEND

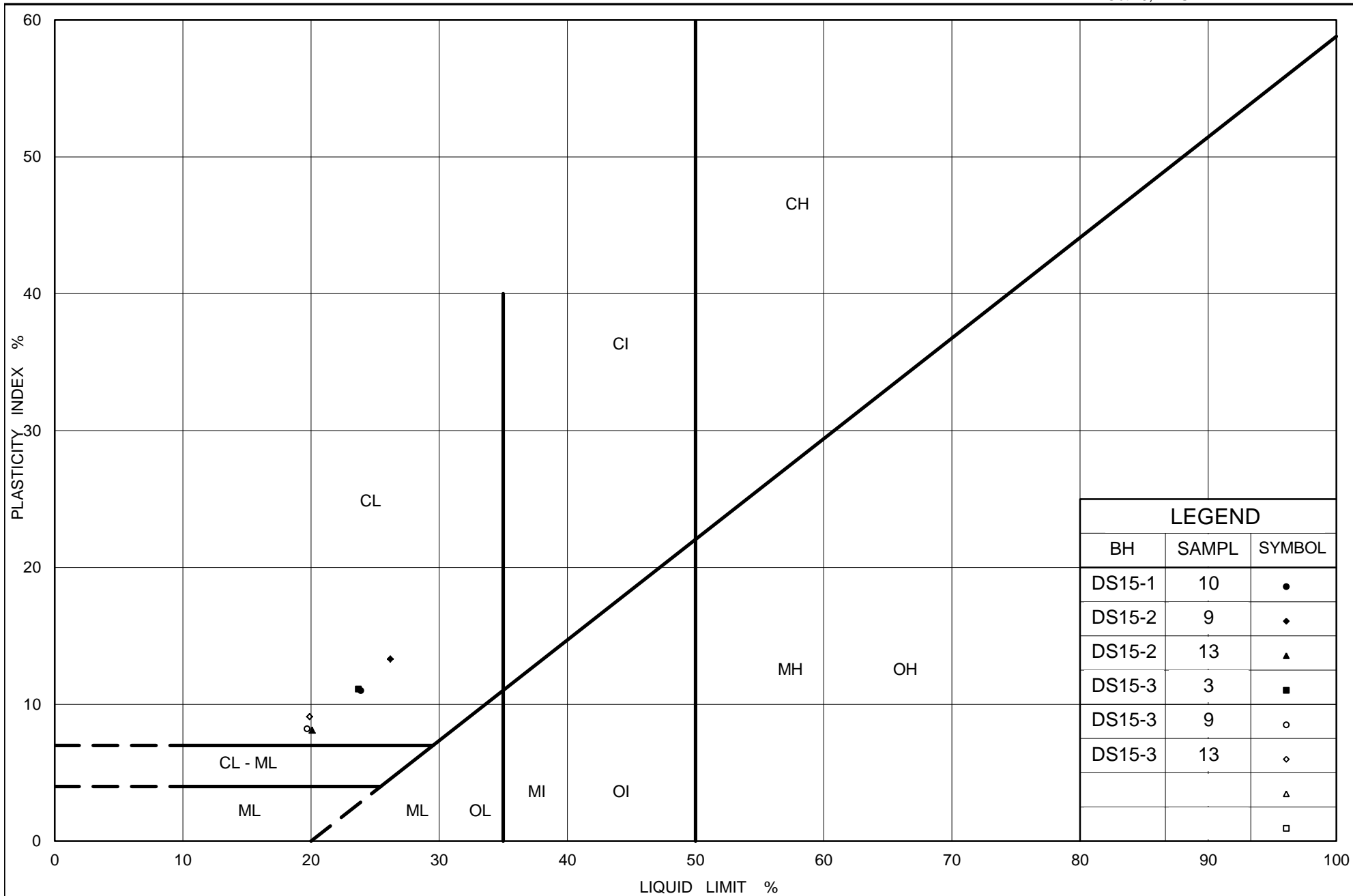
SYMBOL	BOREHOLE	SAMPLE	DEPTH(m)
●	DS15-6A	10	179.8
■	DS15-4	11	178.5
◆	DS15-3	13	174.0
▲	DS-6A	14	173.8
▽	DS15-4	15	171.0
○	DS15-5	7	184.1

Project Number: 09-1111-6007

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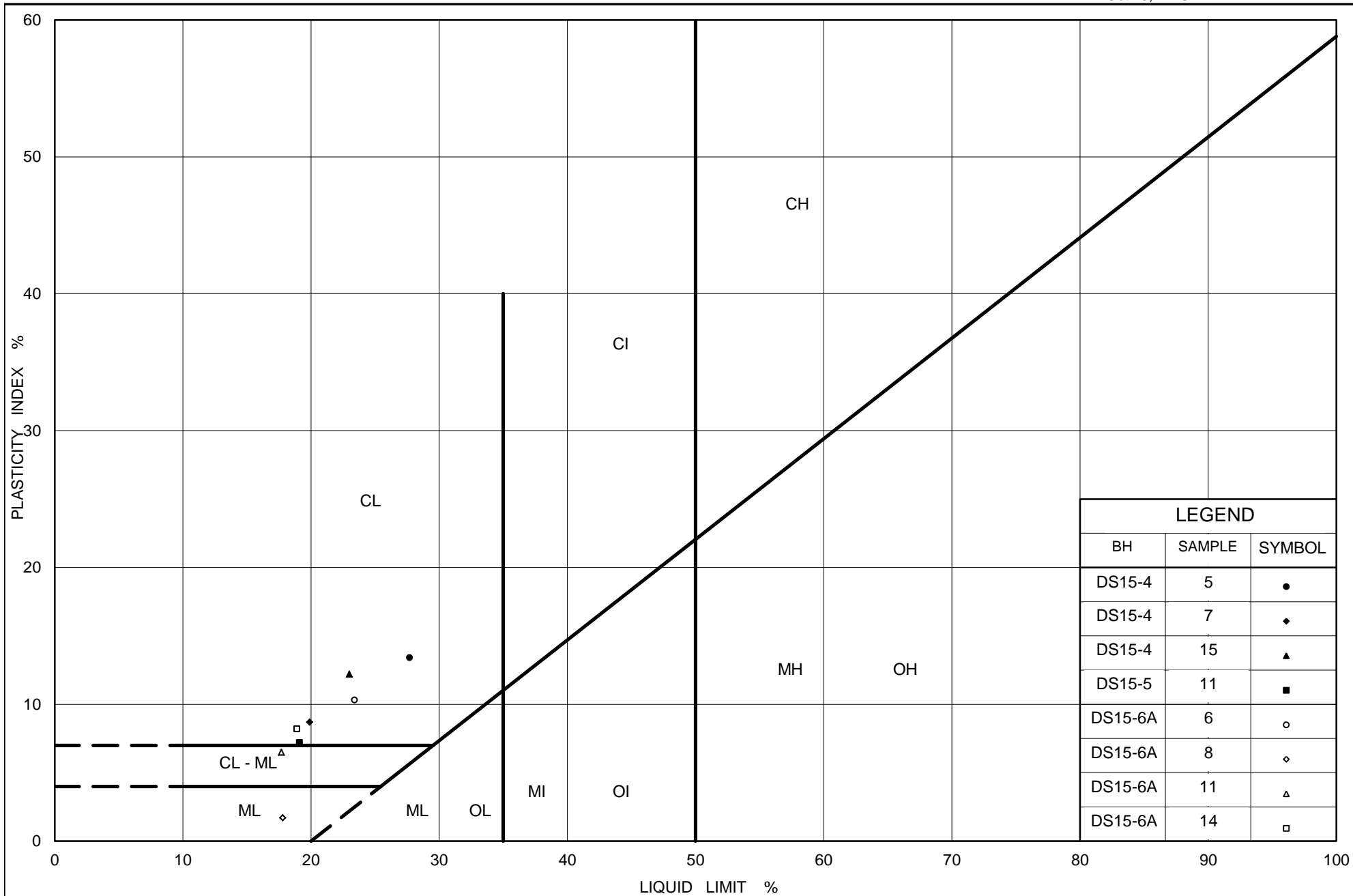
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PLASTICITY CHART Sandy Clayey Silt to Clayey Silt with Sand (Till)

Figure No. B4A

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PLASTICITY CHART Sandy Clayey Silt to Clayey Silt with Sand (Till), and Silt (Pocket)

Figure No. B4B

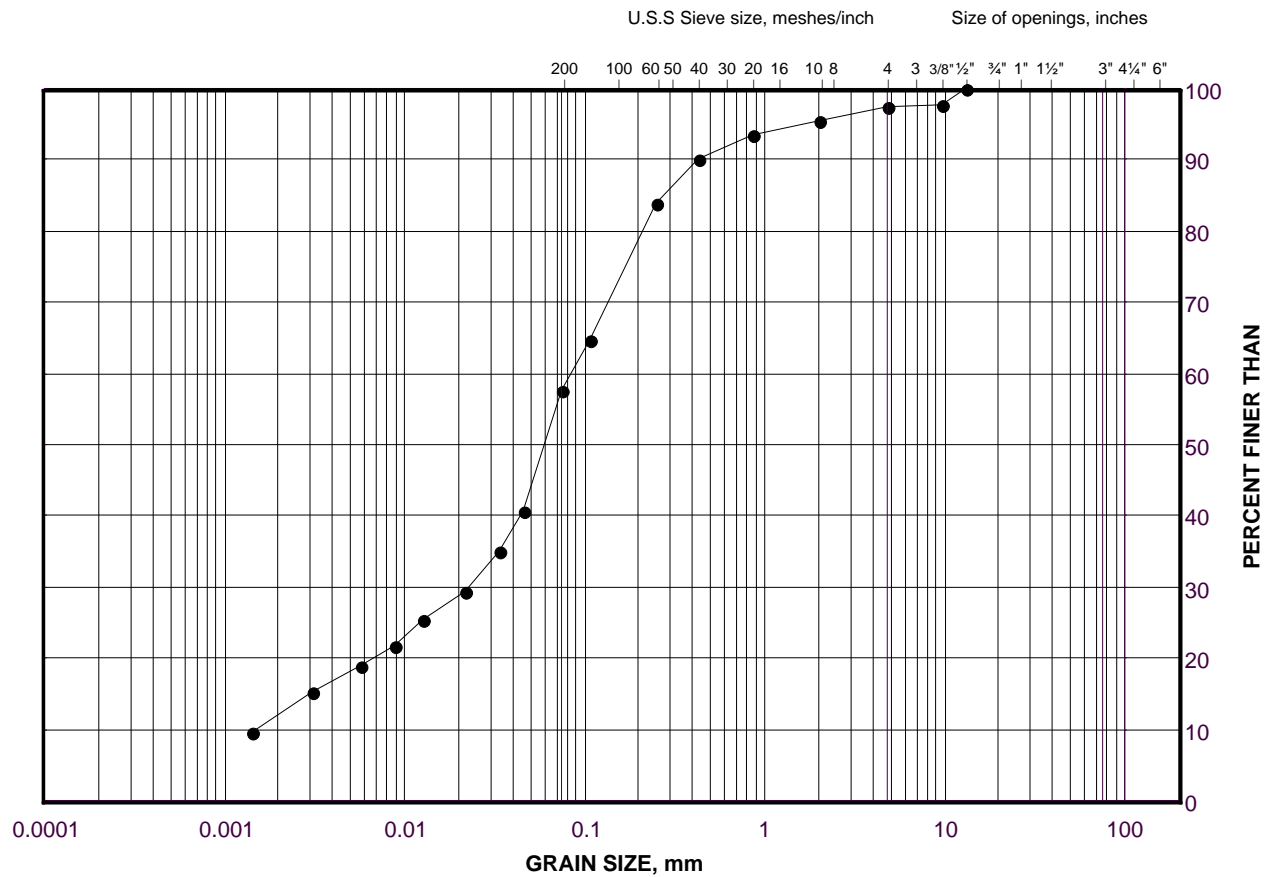
Project No. 09-1111-6007

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GRAIN SIZE DISTRIBUTION

Sand and Silt (Till)

FIGURE B5



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

LEGEND

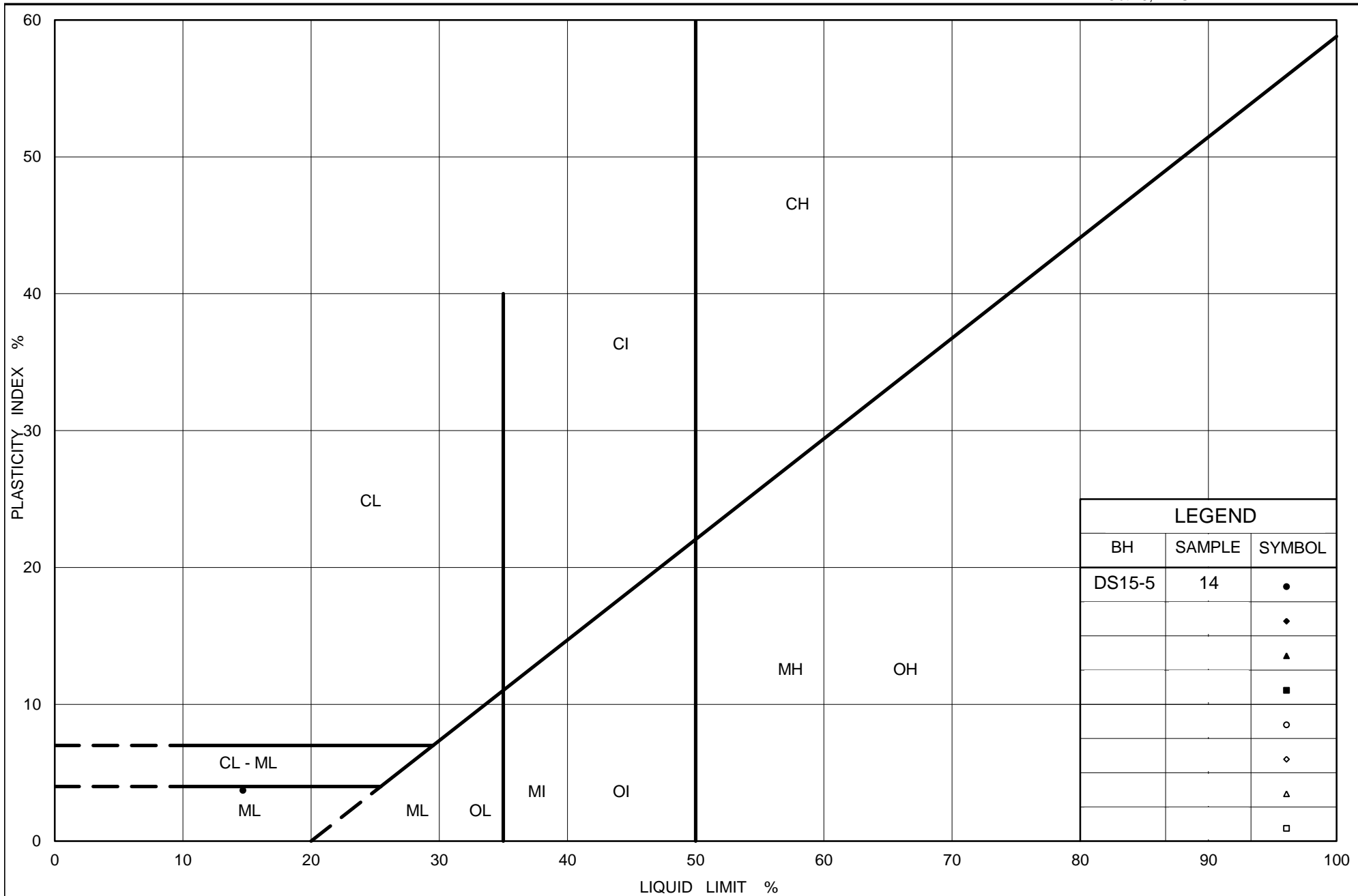
SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
•	DS15-5	15	172.0

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PLASTICITY CHART

Silt and Sand (Till)

Figure No. B6

Project No. 09-1111-6007

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**FOUNDATION REPORT
HIGHWAY 401 W - YORKDALE ROAD RAMP (SITE NO. 37-284)
OVER DUFFERIN STREET**

APPENDIX C

Records of Boreholes from Previous Investigation


Borehole No. 81-3A

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & RESEARCH DIVISION

RECORD OF BOREHOLE NO. 3A

FOUNDATION SECTION

JOB	63-F-24	LOCATION	217735 470' Rt.	ORIGINATED BY	B.M.G.
W.P.	233-61-2-2	BORING DATE	March 15, 1963.	COMPILED BY	B.M.G.
DATUM	Geodetic	BOREHOLE TYPE	Pennsylvania Auger - 4 1/2" Ø	CHECKED BY	K.G.S.

SOIL PROFILE			SAMPLES		DYNAMIC PENETRATION RESISTANCE		LIQUID LIMIT		BULK DENSITY P.C.F.	REMARKS		
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT	ELEV. SCALE	BLOWS / FOOT				WATER CONTENT %	
							20	40			60	80
620	Topsoil											
0.6	Silty clay and clayey silt with trace of fine gravel. (Glacial Till) Trace of organic to El. 617 Stiff to hard. Brown changing to grey at El. 605'		1	SS	10	615						
			2	TW	15							
			3	SS	59	610						
			4	SS	62	605						
			5	SS	42	600						
			6	SS	52	595						
588.5		7	SS	50	590							
31.6	End of borehole.					585						

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