



August 10, 2017

## PRELIMINARY FOUNDATION INVESTIGATION REPORT

**DUNLOP STREET UNDERPASS, SITE NO. 30-175  
HIGHWAY 400 WIDENING  
FROM 1 KM SOUTH OF HIGHWAY 89 TO JUNCTION OF HIGHWAY 11  
MINISTRY OF TRANSPORTATION, ONTARIO  
G.W.P. 06-20016**

**Submitted to:**

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REPORT

**GEOCRES NO: 31D-679**

**Report Number:** 14-1111-0002-10

**Distribution:**

- 2 Copies – Ministry of Transportation, Ontario – Foundations Section
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## Table of Contents

### **PART A – PRELIMINARY FOUNDATION INVESTIGATION REPORT**

<b>1.0 INTRODUCTION.....</b>	<b>1</b>
<b>2.0 SITE DESCRIPTION.....</b>	<b>1</b>
<b>3.0 INVESTIGATION PROCEDURES.....</b>	<b>1</b>
3.1 Previous Borehole Investigation .....	1
3.2 Current Borehole Investigation .....	2
<b>4.0 SITE GEOLOGY AND SUBSURFACE CONDITIONS .....</b>	<b>3</b>
4.1 Regional Geology .....	3
4.2 Subsurface Conditions.....	3
4.2.1 West Abutment, Pier 1 and Pier 2.....	4
4.2.1.1 Topsoil.....	4
4.2.1.2 Silty Clay Fill.....	4
4.2.1.3 Clayey Silt.....	4
4.2.1.4 Sandy Silt .....	5
4.2.1.5 Silty Clay.....	5
4.2.1.6 Silty Sand .....	5
4.2.2 Pier #3 and East Abutment .....	5
4.2.2.1 Topsoil.....	6
4.2.2.2 Sand Fill.....	6
4.2.2.3 Sand .....	6
4.2.2.4 Silt (Upper) .....	6
4.2.2.5 Clayey Silt.....	7
4.2.2.6 Silt (Lower) .....	7
4.2.2.7 Silt and Sand to Silty Sand .....	7
4.3 Groundwater Conditions .....	8
<b>5.0 CLOSURE .....</b>	<b>8</b>
<b>REFERENCES</b>	



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## PRELIMINARY FOUNDATION AND DESIGN REPORT - HIGHWAY 400 DUNLOP STREET UNDERPASS

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### DRAWINGS

Drawing 1	Borehole Locations
Drawing 2	Soil Strata (Profile)
Drawing 3	Soil Strata (Cross-Sections)

### APPENDIX A Record of Borehole and Laboratory Test Results – Previous Investigation

List of Symbols and Abbreviations

Record of Borehole	B11-1
Figure 1	Grain Size Distribution – Clayey Silt to Silty Clay
Figure 2	Grain Size Distribution – Sandy Silt with Clayey Silt Interlayers

### APPENDIX B Record of Borehole and Laboratory Test Results – Current Investigation

Lists of Symbols and Abbreviations

Record of Borehole	DL1-1
Figure B1	Grain Size Distribution – Sand
Figure B2	Grain Size Distribution – Silt (Upper)
Figure B3	Plasticity – Silt (Upper)
Figure B4	Plasticity – Clayey Silt
Figure B5	Grain Size Distribution – Silt (Lower)
Figure B6	Plasticity – Silt (Lower)
Figure B7	Grain Size Distribution – Silt and Sand



# **PART A**

**PRELIMINARY FOUNDATION INVESTIGATION REPORT  
DUNLOP STREET UNDERPASS – SITE NO. 30-175  
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G.W.P. 06-20016**



### 1.0 INTRODUCTION

Golder Associates Ltd. (Golder) has been retained by URS Canada Inc. (now AECOM) on behalf of the Ministry of Transportation, Ontario (MTO) to provide preliminary foundation engineering services for the replacement of the Dunlop Street Underpass (Site No. 30-175) in the City of Barrie. The proposed work is part of the preliminary and design-build ready design associated with the Highway 400 widening from 1 km south of Highway 89 to the junction of Highway 11 in Simcoe County, Ontario.

This report addresses the proposed replacement of the Dunlop Street Underpass (MTO Structure Site No. 30-175) and the associated approach embankments only.

The terms of reference and scope of work for the foundation investigation are outlined in MTO's Request for Proposal, dated July 2013. Golder's scope of work for foundation engineering services associated with the Dunlop Street Underpass replacement is contained in Section 5.8 of AECOM's Technical Proposal for this assignment. The work has been carried out in accordance with Golder's Supplementary Specialty Plan for foundation engineering services for this project, dated January 20, 2014.

### 2.0 SITE DESCRIPTION

The Dunlop Street Underpass, which is part of the Highway 400-Dunlop Street (Simcoe Road 90, formerly Highway 90) Interchange, is located approximately 2.3 km north of Essa Road and south of Bayfield Street, in Barrie, Ontario, as shown in the Key Plan on Drawing 1. Dunlop Street cross Highway 400 on an approximately 38 degree skew oriented southwesterly-northeasterly relative to Highway 400. The overall surface topography in the vicinity of the site is relatively flat and land use consists of commercial businesses to the east and west of Highway 400.

At Dunlop Street, the Highway 400 grade is near original ground surface at about Elevation 231 m and the Dunlop Street approach embankments are about 6.5 m high with the roadway surface at about Elevation 237.5 m. The existing bridge is a two-span structure supported on spread footings. The existing bridge deck is approximately 79.5 m long, with span lengths of about 27 m and a deck width of about 14 m, as measured parallel to Highway 400.

### 3.0 INVESTIGATION PROCEDURES

#### 3.1 Previous Borehole Investigation

One borehole was advanced at this site as part of a previous investigation carried out by Golder Associates in 2001 (MTO, 2002) for the replacement of the existing Dunlop Street Underpass structure, associated with the widening of Highway 400. Borehole B11-1 was advanced on the west side of Highway 400, north of Dunlop Street from the Highway 400 grade, to a depth of 39.8 m below ground surface. The borehole location is shown on Drawing 1 and the Record of Borehole sheet and associated laboratory testing results are provided in Appendix A.

The borehole was advanced using NW and BW size casing. Samples of the overburden were obtained at intervals of depth of about 0.75 m and 1.5 m using a 50 mm outer diameter split-spoon sampler driven by a manual hammer in accordance with the Standard Penetration Test (SPT) procedure.



## PRELIMINARY FOUNDATION AND DESIGN REPORT - HIGHWAY 400 DUNLOP STREET UNDERPASS

The water level in the open borehole was observed during and following the drilling operations and a piezometer was installed in the borehole to allow monitoring of the groundwater level at the site.

The borehole location in MTM NAD83 (Zone 10) northing and easting coordinates, ground surface elevations reference to Geodetic datum and drilled depth are summarized below.

Borehole Number	Location (MTM NAD83)		Ground Surface Elevation (m)	Borehole Depth (m)
	Northing (m)	Easting (m)		
BH11-1	4,915,592.6	287,961.2	231.2	39.8

### 3.2 Current Borehole Investigation

The field work at the site of the Dunlop Street Underpass was carried out between November 27 and 30, 2016 during which time one borehole (designated Borehole DL1-1) was advanced to supplement the existing subsurface information from the 2001 investigation. In addition, a Dynamic Cone Penetration Test (DCPT) was advanced from the bottom of Borehole DL1-1. The Record of Borehole DL1-1 is presented in Appendix B. The location of this borehole is shown in plan on Drawing 1 and in profile and cross-section on Drawings 2 and 3.

The borehole investigation was carried out using a Diedrich D-90 truck-mounted drill rig supplied and operated by Walker Drilling Ltd. of Utopia, Ontario. The borehole was advanced through the overburden using 108 mm inside diameter hollow stem augers and NW size casing with wash boring techniques. Soil samples were generally obtained at intervals of depth about 0.75 m and 1.5 m, using a 50 mm outside diameter split-spoon sampler driven by an automatic hammer in accordance with the Standard Penetration Test (SPT) procedure (ASTM D1586). The groundwater conditions and water level in the open boreholes were observed during and immediately following the completion of drilling operations and a piezometer was installed in a borehole adjacent to Borehole DL1-1 to allow monitoring of the groundwater level at the site. During the extraction of the NQ casing (71 mm O.D.) in Borehole DL1-1 a casing connection sheared resulting in about 24.4 m of NQ casing remaining in the borehole, between depths of about 21.8 m and 46.2 m below ground surface, corresponding to between Elevations 209.8 m and 185.4 m. Attempts to retrieve the casing were unsuccessful and as a result Borehole DL1-1 and the 24.4 m length of NQ casing were backfilled with bentonite pellets.

The field work was observed by a member of Golder's engineering staff who located the borehole, arranged for the clearance of underground services, observed the drilling, sampling and in situ testing operations, logged the borehole and examined and cared for the soil samples. The samples were identified in the field, placed in appropriate containers, labelled and transported to Golder's Mississauga geotechnical laboratory where the samples underwent further visual examination and laboratory testing. All of the laboratory tests were carried out to MTO and/or ASTM Standards, as appropriate. Classification testing (water content, grain size distribution and Atterberg limits) was carried out on selected soil samples. The results of the laboratory testing are presented on the Record of Borehole sheet and are shown on the laboratory test sheets included in Appendix B.

The as-drilled borehole location was measured relative to the existing on-site features shown on the Digital Terrain Model (DTM) for the site, and the ground surface elevation was interpolated from the topographic data provided by AECOM. The borehole location provided on the Record of Borehole and presented on Drawings 1 to 3 are given using MTM NAD83 (Zone 10) northing and easting coordinates, and the ground surface elevation is referenced to Geodetic datum. The borehole location, ground surface elevation and drilled depth are summarized below.



## PRELIMINARY FOUNDATION AND DESIGN REPORT - HIGHWAY 400 DUNLOP STREET UNDERPASS

Borehole Number	Location (MTM NAD83)		Ground Surface Elevation (m)	Borehole / DCPT Depth (m)
	Northing (m) / Latitude (°)	Easting (m) / Longitude (°)		
DL1-1	4,915,644.7 / 44.380615	288,037.8 / -79.710359	231.6	46.2 / 47.4

## 4.0 SITE GEOLOGY AND SUBSURFACE CONDITIONS

### 4.1 Regional Geology

As delineated in *The Physiography of Southern Ontario*<sup>1</sup>, the section of Highway 400 extending from 6 km south of Highway 89 to the junction of Highway 11 traverses, generally in a south–north direction, the following physiographic regions: the Peterborough Drumlin Field; the Simcoe Lowlands; and the Simcoe Uplands. Along Highway 400, the Peterborough Drumlin Field is present from the southern limit of the project site to south of Line 13 of the Township of Bradford West Gwillimbury, as well as between about 1 km north of Highway 89 to about Essa Road. The Simcoe Lowlands covers the area from south of Line 13 to approximately 1 km north of Highway 89 and from about Essa Road to just north of Anne Street. The Simcoe Uplands extends from just north of Anne Street to beyond the northern limit of the project site.

The surficial soils in the Peterborough Drumlin Field consist primarily of gravelly sand till or sand and gravel deposits. Deposits of silt, clay or peat may also be found in the low-lying areas between drumlins and eskers.

Along Highway 400, the Simcoe Lowlands include: the Holland River valley; the lowlands of the Lake Simcoe basin to the east; and the lowlands of the Nottawasaga basin to the west, which includes Innisfil Creek and the Nottawasaga River to the south and west of the project limits, respectively. The Lake Simcoe and Nottawasaga basins are connected by a flat floored valley through Barrie which extends from the shores of Kempenfelt Bay west generally along Highway 90. The Simcoe Lowlands are generally characterized by deep deposits of deltaic or lacustrine silts, sands and clays associated with glacial Lake Algonquin.

The Simcoe Uplands consist of till plains and ancient shorelines. The till deposits range from clayey to silty and generally become sandier and containing more boulders in the north section. The low-lying areas of this region may also contain shallow deposits of sand and gravel associated with former glacial lake shorelines.

### 4.2 Subsurface Conditions

The Record of Borehole sheets and laboratory testing results from the 2001 and 2016 investigations are presented in Appendices A and B, respectively. The interpreted stratigraphic profile and cross-sections are shown on Drawings 2 and 3.

The results of the in situ field tests (i.e. SPT 'N'-values) carried out during the 2001 and 2016 investigations as presented on the Record of Borehole sheets and in Section 4.2 are uncorrected. According to the Canadian Foundation Engineering Manual (*CFEM*, 2006), the energy delivered to the drill rod varies with the hammer release system, hammer type, anvil and operator characteristics, and as different hammer release systems were

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



## PRELIMINARY FOUNDATION AND DESIGN REPORT - HIGHWAY 400 DUNLOP STREET UNDERPASS

used during the 2001 and 2016 investigations (i.e. manual vs automatic, respectively) the SPT 'N'-values measured during the 2001 investigation may be higher than the 'N'-values measured during the 2016 investigation within the same deposit. In addition, some soil descriptions from the previous investigation differ slightly from the descriptions associated with the laboratory testing results. For the purposes of this report the soils are described consistent with the test results (i.e. for Atterberg limits).

The stratigraphic boundaries shown on the Record of Borehole sheets and on the interpreted stratigraphic profile and cross-sections are inferred from observations of drilling progress and 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.

### 4.2.1 West Abutment, Pier 1 and Pier 2

Borehole B11-1 was advanced between the proposed south pier and central pier (Pier 1 and Pier 2). In general, the subsurface conditions at the western section of the structure consist of a layer of topsoil and silty clay fill underlain by alternating deposit of clayey silt, sandy silt and silty sand. A detailed description of the subsurface conditions encountered at this area of the site are provided in the following sections.

#### 4.2.1.1 Topsoil

A 200 mm thick layer of topsoil was encountered at surface in Borehole B11-1.

#### 4.2.1.2 Silty Clay Fill

A 0.6 m thick deposit of silty clay fill was encountered below the topsoil in Borehole B11-1 at Elevation 231.0 m.

#### 4.2.1.3 Clayey Silt

A 9.9 m thick deposit of clayey silt was encountered below the fill in Borehole B11-1 at Elevation 230.4 m and pockets of silty sand up to 0.4 m thick. An interlayer of silty sand about 1.7 m thick were encountered within the clayey silt deposit at depths of 4.1 m and 6.6 m, corresponding to Elevations 227.1 m and 224.6 m, respectively.

The SPT 'N'-values measured within the clayey silt deposit range from 4 blows to 19 blows per 0.3 m of penetration, suggesting a firm to very stiff consistency. The SPT 'N'-value measured at the boundary of the clayey silt deposit and the underlying silty sand interlayer is 26 blows per 0.3 m of penetration, suggesting a very stiff consistency transitioning to a compact relative density. An SPT 'N'-value measured within the silty sand interlayer is 37 blows per 0.3 m of penetration, indicating a dense relative density.

The natural water content measured on four samples of the clayey silt deposit are between about 15 per cent and 20 per cent. The natural water content measured on a sample of the silty sand interlayer is about 16 per cent.

The result of a grain size distribution test completed on one sample of the clayey silt deposit is provided on Figure 1 in Appendix A.





## PRELIMINARY FOUNDATION AND DESIGN REPORT - HIGHWAY 400 DUNLOP STREET UNDERPASS

Atterberg limits test carried out on three samples of the cohesive deposit measured liquid limits between about 22 per cent and 27 per cent, plastic limits between about 13 per cent and 16 per cent and plasticity indices between about 7 per cent and 12 per cent. The results of the Atterberg limits tests indicate that the material is classified as a clayey silt of low plasticity.

### **4.2.1.4 Sandy Silt**

A 7.3 m thick deposit of sandy silt with silty clay interlayers was encountered below the clayey silt deposit in Borehole B11-1 at Elevation 220.5 m.

The SPT 'N'-values measured within the sandy silt deposit range from 31 blows to 48 blows per 0.3 m of penetration, indicating a dense relative density.

The natural water content measured on three samples of the sandy silt deposit range between about 14 per cent and 17 per cent.

The result of the grain size distribution test completed on a sample of the sandy silt deposit is provided on Figure 2 in Appendix A.

### **4.2.1.5 Silty Clay**

A 20.7 m thick deposit of silty clay was encountered below the sandy silt deposit in Borehole B11-1 at Elevation 213.2 m. A 0.3 m thick silty sand and a sandy silt pocket was encountered within the silty clay deposit at depths of 19.8 m and 29.3 m, corresponding to Elevations 211.4 m and 201.9 m, respectively.

The SPT 'N'-values measured within the silty clay deposit range from 15 blows to 54 blows per 0.3 m of penetration, suggesting a very stiff to hard consistency.

The natural water content measured on three samples of the silty clay deposit are between about 16 per cent and 24 per cent.

### **4.2.1.6 Silty Sand**

A silty sand deposit was encountered below the silty clay deposit in Borehole 11-1 at Elevation 192.5 m and penetrated into for 1.1 m before borehole termination.

The SPT 'N'-value measured within silty sand deposit is 175 blows per 0.15 m of penetration, indicating a very dense relative density.

The natural water content measured on a sample of the silty sand deposit is about 22 per cent.

## **4.2.2 Pier #3 and East Abutment**

Borehole DL1-1 was advanced near the proposed north pier (Pier 3) and East Abutment. In general, the subsurface conditions in this area of the site consists of a layer of topsoil and sand fill underlain by alternating



## PRELIMINARY FOUNDATION AND DESIGN REPORT - HIGHWAY 400 DUNLOP STREET UNDERPASS

deposit of clayey silt, silt, silty sand, silt and sand to sand. A detailed description of the subsurface conditions encountered at this area of the site are provided in the following sections.

### **4.2.2.1     Topsoil**

A 200 mm thick layer of topsoil was encountered at ground surface in Borehole DL1-1

### **4.2.2.2     Sand Fill**

A 2.0 m thick deposit of sand fill was encountered below the topsoil in Borehole DL1-1 at Elevation 231.4 m.

The SPT 'N'-values measured within the sand fill range from 13 blows to 48 blows per 0.3 m of penetration, indicating a compact to dense relative density.

The natural water content measured on a sample of the sand fill is about 12 per cent.

### **4.2.2.3     Sand**

A 6.5 m thick deposit of sand was encountered below the fill in Borehole DL1-1 at Elevation 229.4 m.

The SPT 'N'-values measured within the sand deposit range from 5 blows to 46 blows per 0.3 m of penetration, indicating a loose to dense relative density.

The natural water content measured on two samples of the sand deposit are about 22 per cent and 25 per cent.

The result of a grain size distribution test completed on one sample of the sand deposit is provided on Figure B1 in Appendix B.

### **4.2.2.4     Silt (Upper)**

An upper silt deposit 18.9 m thick was encountered below the sand deposit in Borehole DL1-1 at Elevation 222.9 m. Sand pockets and interlayers about 0.6 m and 1.4 m thick were encountered within the upper silt deposit at Elevations 218.9 m and 205.4 m, respectively.

The SPT 'N'-values measured within the upper silt deposit range from 16 blows to 37 blows per 0.3 m of penetration, indicating a compact to dense relative density.

The natural water content measured on six samples of the upper silt deposit range between about 15 per cent and 21 per cent.

The results of the grain size distribution tests completed on three sample of the upper silt deposit from are provided on Figure B2 in Appendix B.

Atterberg limits test carried out on two samples of the upper silt deposit measured liquid limits of about 18 per cent, plastic limits of about 15 per cent and corresponding plasticity indices of about 3 per cent. The results of the Atterberg limits tests, which are shown on Figure B3 in Appendix B, indicate that the material is



classified as a silt of slight plasticity. The result of one Atterberg limits test carried out on a sample of the upper silt deposit indicate that the material is non-plastic.

#### **4.2.2.5     *Clayey Silt***

A 3.2 m thick deposit of clayey silt was encountered below the sand interlayer within the silt deposit in Borehole DL1-1 at Elevation 204.0 m.

The SPT 'N'-values measured within the clayey silt deposit are 31 blows per 0.3 m of penetration, indicating a hard consistency.

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

An Atterberg limits test carried out on a sample of the clayey silt deposit measured a liquid limit of about 20 per cent, a plastic limit of about 12 per cent and a corresponding plasticity index of about 8 per cent. The result of the Atterberg limits test, which is shown on Figure B4 in Appendix B, indicates that the material is classified as a clayey silt of low plasticity.

#### **4.2.2.6     *Silt (Lower)***

A lower silt deposit 10.7 m thick deposit containing silty clay lenses was encountered below the clayey silt in Borehole DL1-1 at Elevation 200.8 m.

The SPT 'N'-values measured within the lower silt deposit range from 22 blows to 64 blows per 0.3 m of penetration, indicating a compact to very dense relative density.

The natural water content measured on three samples of the silt deposit are between about 19 per cent and 23 per cent.

The result of the grain size distribution test completed on one sample of the lower silt deposit from Borehole DL1-1 is shown on Figure B5 in Appendix B.

An Atterberg limits test carried out on a sample of the silt deposit measured a liquid limit of about 19 per cent, a plastic limit of about 16 per cent and corresponding plastic index of about 3 per cent. The result of the Atterberg limits test, which is shown on Figure B6 in Appendix B, indicates that the material is classified as a silt of slight plasticity, and an Atterberg limits test carried out on another sample of the lower silt deposit indicates that the material is non-plastic.

#### **4.2.2.7     *Silt and Sand to Silty Sand***

A silt and sand to silty sand deposit, comprised of an upper layer of silty sand and an underlying layer of silt and sand, was encountered below the lower silt deposit in Borehole DL1-1 at Elevation 190.1 m and was penetrated into for a depth of 4.7 m before borehole termination. The deposit thickness may potentially be greater than 5.9 m as inferred from a DCPT advanced from the bottom of Borehole DL1-1.

The SPT 'N'-values measured within the silt and sand to silty sand deposit are 95 blows and 157 blows per 0.3 m of penetration, indicating a very dense relative density.



## PRELIMINARY FOUNDATION AND DESIGN REPORT - HIGHWAY 400 DUNLOP STREET UNDERPASS

The natural water content measured on a sample of the silt and sand portion of the deposit is about 18 per cent.

The result of the grain size distribution test completed on one sample of the silt and sand portion of the deposit is shown on Figure B7 in Appendix B.

### 4.3 Groundwater Conditions

The water level encountered during drilling and observed in Borehole B11-1 upon completion of drilling in 2001 was between approximately Elevation 225.0 m and 222.4 m.

Standpipe piezometers were installed in Borehole B11-1 and DL1-1 as part of the 2001 and 2016 investigations, respectively. The observed groundwater level in the standpipe piezometers is shown on the Record of Borehole sheets and summarized below:

Borehole	Depth to Water Level (m)	Groundwater Elevation (m)	Date of Measurement
B11-1	1.3	229.9	March 15, 2001
DL1-1	1.9	229.7	March 15, 2017

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 during periods of precipitation.

## 5.0 CLOSURE

This report was prepared by Ms. Amelia Jewison, B.A.Sc., EIT, a member of the geotechnical engineering group, and was reviewed by Mr. Christopher Ng, P.Eng., a senior geotechnical engineer and Associate of Golder. Mr. Jorge M. A. Costa, P.Eng., a Senior Consultant with Golder and Designated MTO Foundations Contact, conducted an independent quality control review of this report.



## PRELIMINARY FOUNDATION AND DESIGN REPORT - HIGHWAY 400 DUNLOP STREET UNDERPASS

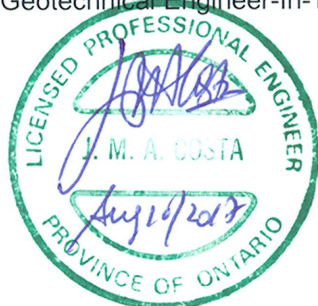
### Report Signature Page

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AJ/MCK/CN/JMAC/mck

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# DRAWINGS

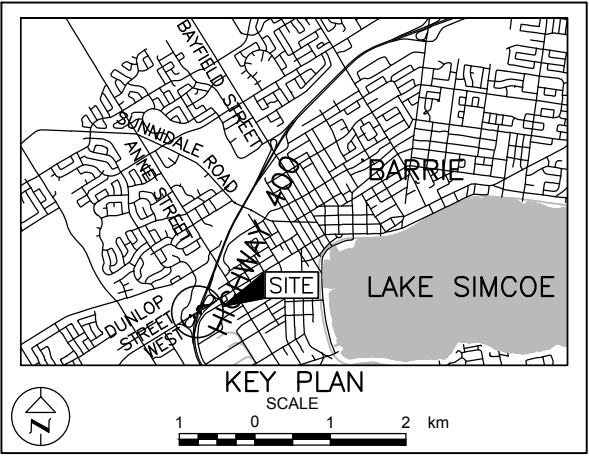


**METRIC**  
DIMENSIONS ARE IN METRES AND/OR  
MILLIMETRES UNLESS OTHERWISE SHOWN.  
STATIONS IN KILOMETRES + METRES.

CONT No.  
GWP No. 06-20016

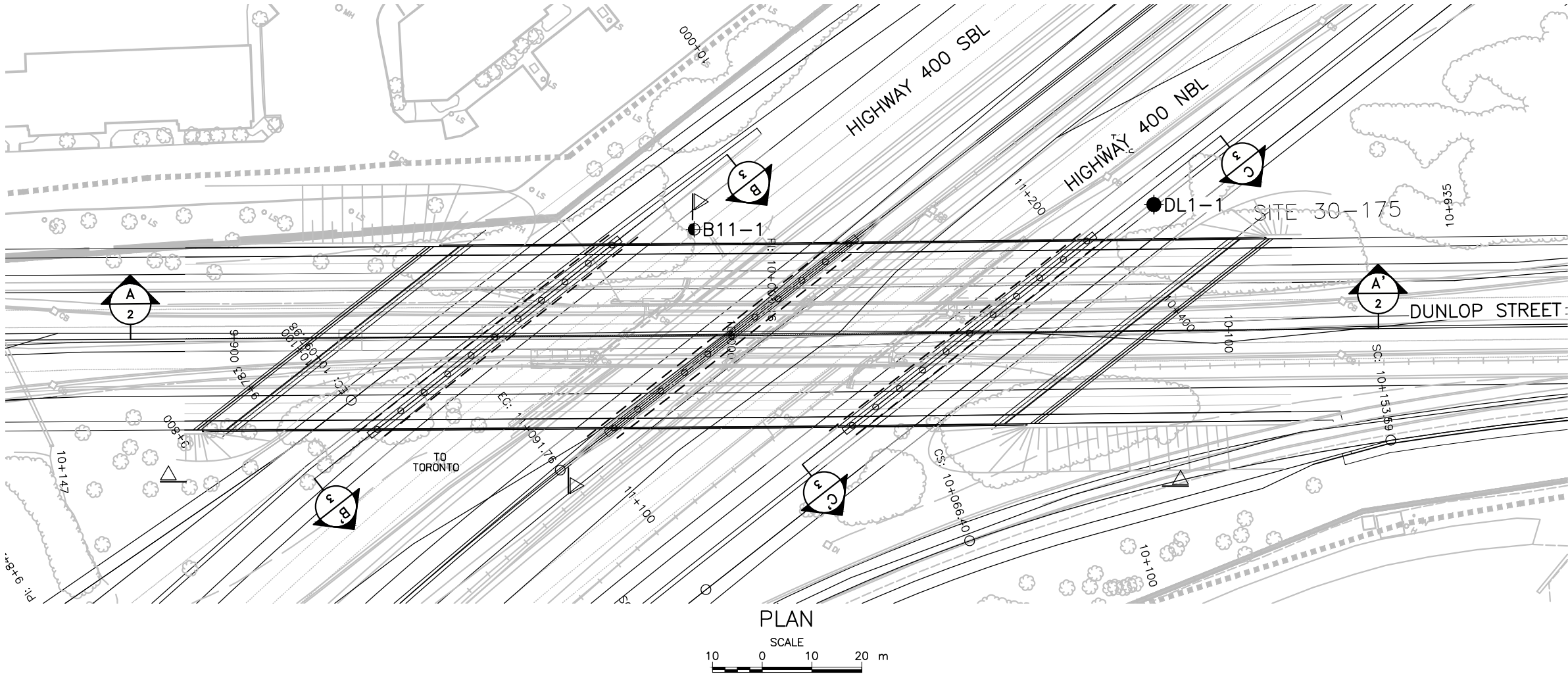
DUNLOP STREET UNDERPASS  
HIGHWAY 400 WIDENING  
BOREHOLE LOCATIONS

  
SHEET



LEGEND	
	Borehole - Current Investigation
	Borehole - Previous Investigation

BOREHOLE CO-ORDINATES			
No.	ELEVATION	NORTHING	EASTING
B11-1	231.2	4915592.6	287961.2
DL1-1	231.6	4915644.7	288037.8



**NOTES**

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

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

**REFERENCE**

General arrangement, designs, base plans, profile and surface data provided in digital format by AECOM, drawing file nos. "01\_Dunlop Street Underpass\_GA(2).dwg", received June 23, 2016, "X-Base\_All.dwg", received January 27, 2016, "X-design\_4th Line\_Interim.dwg", received June 22, 2015, and "X-Surfaces.dwg", received April 14, 2015.

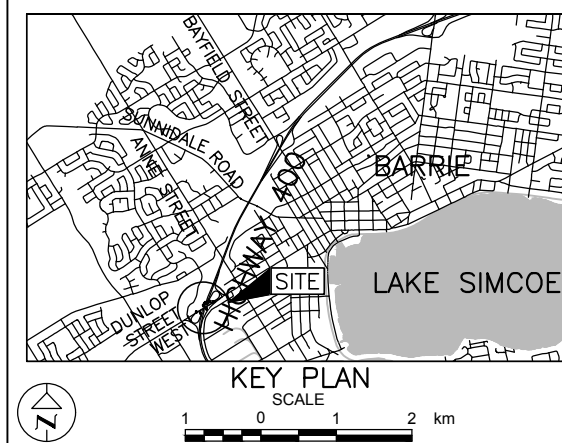


NO.	DATE	BY	REVISION
Geocres No. 31D-679			
HWY. 400	PROJECT NO. 14-1111-0002		DIST. .
SUBM'D. AJ	CHKD. MCK	DATE: 7/11/2017	SITE: 30-175
DRAWN: TB	CHKD. CN	APPD. JMAC	DWG. 1








CONT No.  
GWP No. 06-20016

**DUNLOP STREET UNDERPASS**  
HIGHWAY 400 WIDENING  
**SOIL STRATA**

**SHEET**



## LEGEND

-  Borehole – Current Investigation  
 Borehole – Previous Investigation  
 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 MAR 15, 2001 and MAR 15, 2017

BOREHOLE CO--ORDINATES			
No.	ELEVATION	NORTHING	EASTING
B11-1	231.2	4915592.6	287961.2
DL1-1	231.6	4915644.7	288037.8

## NOTES

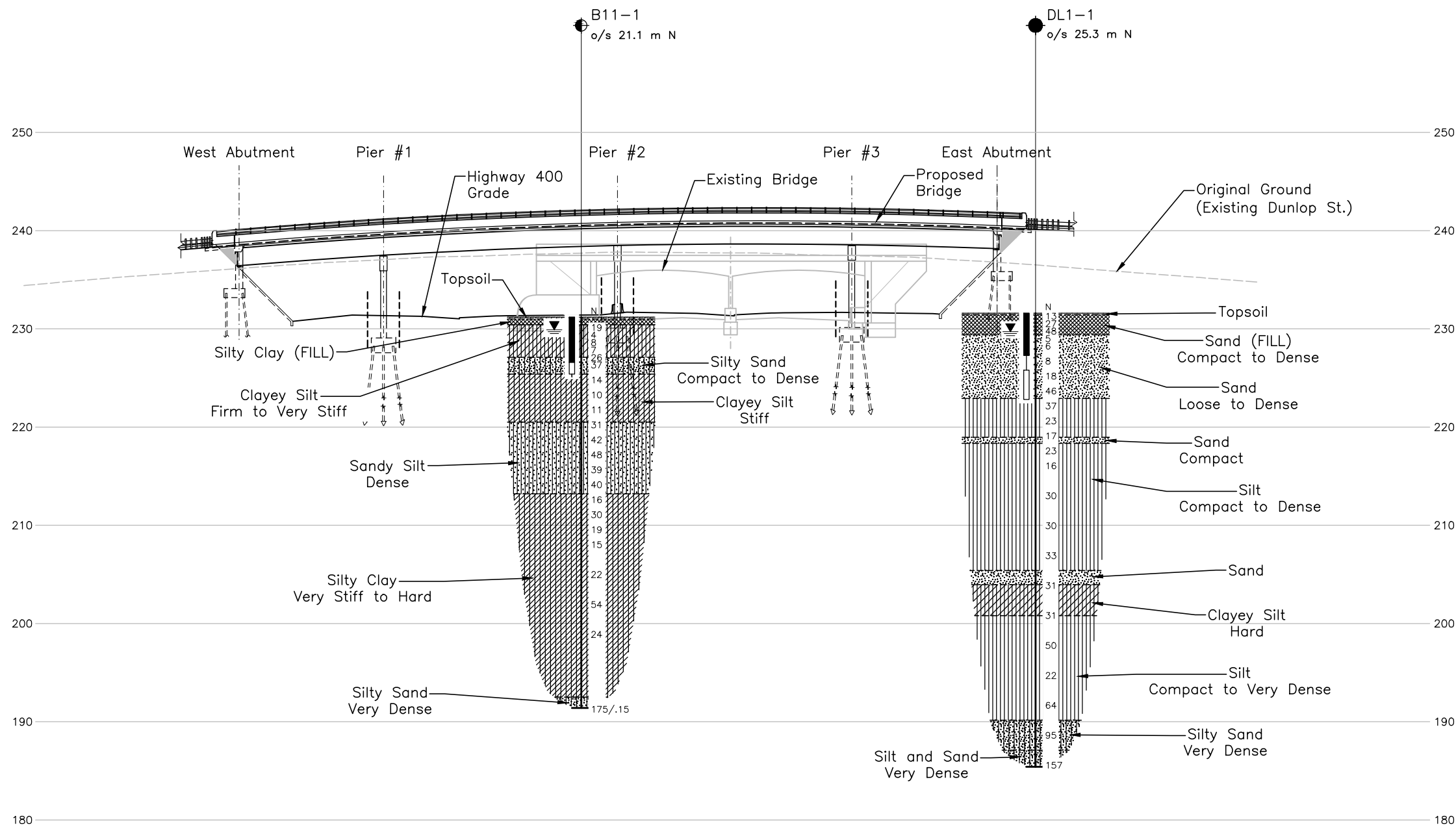
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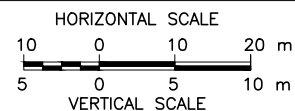
## REFERENCE

General arrangement, designs, base plans, profile and surface data provided in digital format by AECOM, drawing file nos. "01\_Dunlop Street Underpass\_GA(2).dwg", received June 23, 2016, "X-Base\_All.dwg", received January 27, 2016, "X-design\_4th Line\_Interim.dwg", received June 22, 2015, and "X-Surfaces.dwg", received April 14, 2015.

NO.	DATE	BY	REVISION		
Geocres No. 31D-679					
HWY. 400			PROJECT NO. 14-1111-0002		DIST. .
SUBM'D. AJ		CHKD. MCK	DATE: 7/11/2017		SITE: 30-175
DRAWN: TB		CHKD. CN	APPD. JMAC		DWG. 2



# HIGHWAY 400 CENTERLINE PROFILE





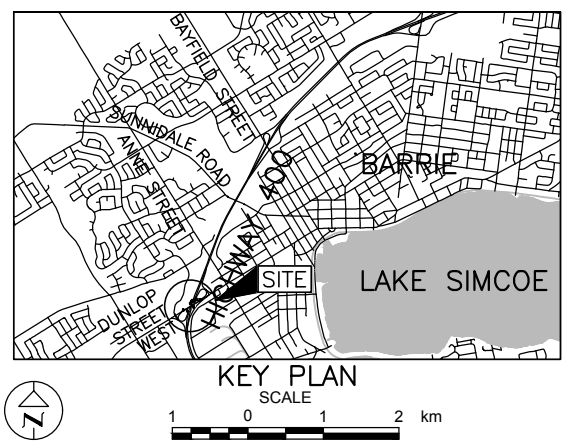
CONT No.  
GWP No. 06-20016

# DUNLOP STREET UNDERPASS







## HIGHWAY 400 WIDENING

### SOIL STRATA

**SHEET**



### LEGEND

-  Borehole – Current Investigation  
 Borehole – Previous Investigation  
 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 MAR 15, 2001, and  
MAR 15, 2017

BOREHOLE CO-ORDINATES			
No.	ELEVATION	NORTHING	EASTING
B11-1	231.2	4915592.6	287961.2
DL1-1	231.6	4915644.7	288037.8

## NOTES

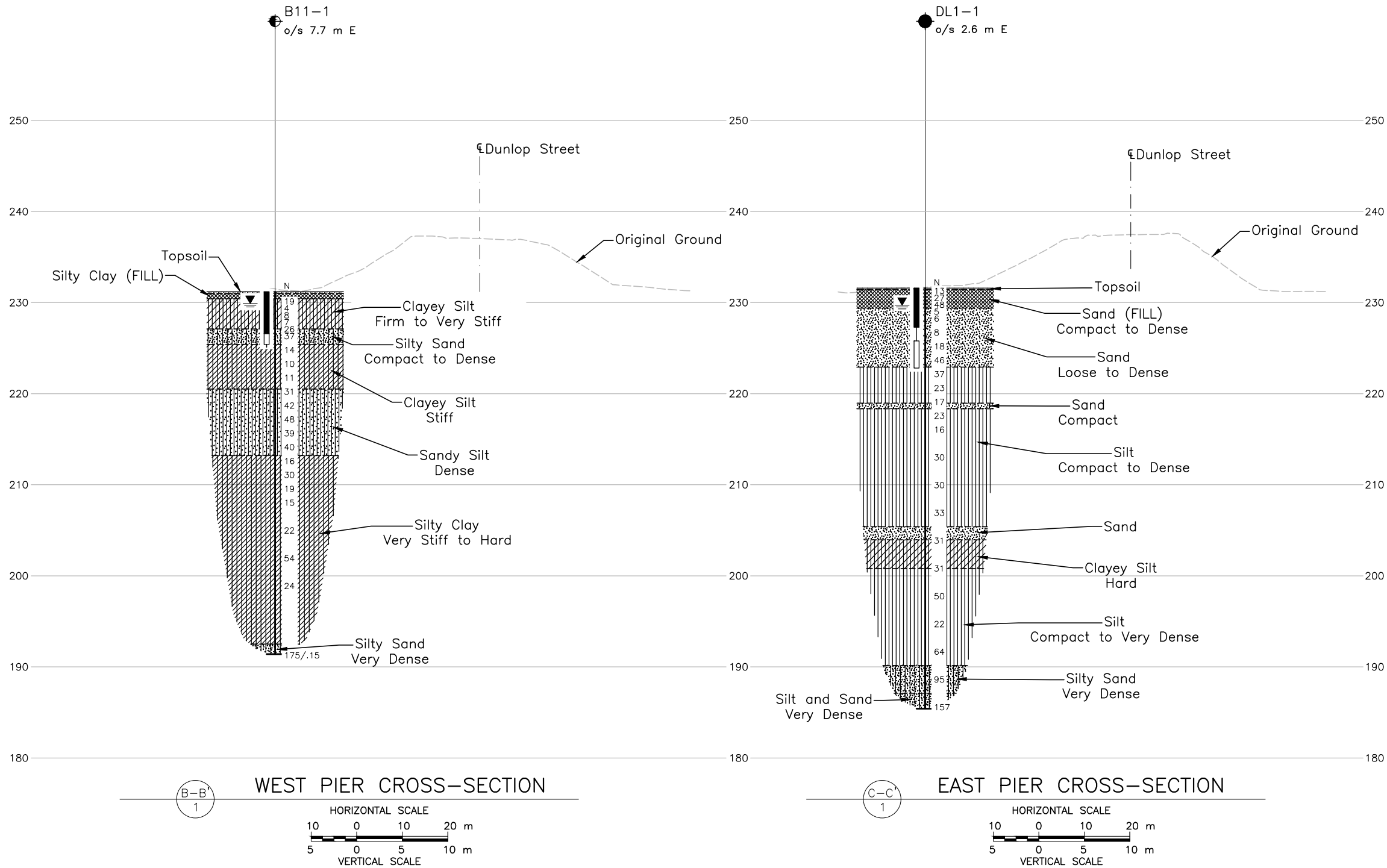
This drawing is for subsurface information only. The proposed structure details/works are shown for illustration purposes only and may not be consistent with the final design configuration as shown elsewhere in the Contracts Documents.

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

## REFERENCE

General arrangement, designs, base plans, profile and surface data provided in digital format by AECOM, drawing file nos. "01\_Dunlop Street Underpass\_GA(2).dwg", received June 23, 2016, "X-Base\_All.dwg", received January 27, 2016, "X-design\_4th Line\_Interim.dwg", received June 22, 2015, and "X-Surfaces.dwg", received April 14, 2015.

-	-	-	-
NO.	DATE	BY	REVISION
<b>Geocres No. 31D-679</b>			
HWY. 400		PROJECT NO. 14-1111-0002	DIST. .
SUBM'D. AJ	CHKD. MCK	DATE: 7/11/2017	SITE: 30-175
DRAWN: TB	CHKD. CNK	APPD. JMAC	DWG. 3





# **APPENDIX A**

## **Record of Borehole and Laboratory Test Results – Previous Investigation**

## 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
SS	Split-spoon
DS	Denison type sample
FS	Foil sample
RC	Rock core
SC	Soil core
ST	Slotted tube
TO	Thin-walled, open
TP	Thin-walled, piston
WS	Wash sample

### III. SOIL DESCRIPTION

#### (a) Cohesionless Soils

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

### 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.)

#### (b) Cohesive Soils

##### Consistency

	$c_u, s_u$	$c_u, s_u$
	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

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

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

**PH:** Sampler advanced by hydraulic pressure

**PM:** Sampler advanced by manual pressure

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

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

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

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

### IV. SOIL TESTS

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

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

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## LIST OF SYMBOLS

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

### I. GENERAL

$\pi$	= 3.1416
$\ln x$ ,	natural logarithm of x
$\log_{10} x$ or $\log x$ ,	logarithm of x to base 10
$g$	acceleration due to gravity
$t$	time
$F$	factor of safety
$V$	volume
$W$	weight

### II. STRESS AND STRAIN

$\gamma$	shear strain
$\Delta$	change in, e.g. in stress: $\Delta \sigma$
$\varepsilon$	linear strain
$\varepsilon_v$	volumetric strain
$\eta$	coefficient of viscosity
$\nu$	Poisson's ratio
$\sigma$	total stress
$\sigma'$	effective stress ( $\sigma' = \sigma - u$ )
$\sigma'_{vo}$	initial effective overburden stress
$\sigma_1, \sigma_2, \sigma_3$	principal stresses (major, intermediate, minor)
$\sigma_{oct}$	mean stress or octahedral stress = $(\sigma_1 + \sigma_2 + \sigma_3)/3$
$\tau$	shear stress
$u$	porewater pressure
$E$	modulus of deformation
$G$	shear modulus of deformation
$K$	bulk modulus of compressibility

### III. SOIL PROPERTIES

#### (a) Index Properties

$\rho(\gamma)$	bulk density (bulk unit weight*)
$\rho_d(\gamma_d)$	dry density (dry unit weight)
$\rho_w(\gamma_w)$	density (unit weight) of water
$\rho_s(\gamma_s)$	density (unit weight) of solid particles
$\gamma'$	unit weight of submerged soil ( $\gamma' = \gamma - \gamma_w$ )
$D_R$	relative density (specific gravity) of solid particles ( $D_R = \rho_s / \rho_w$ ) (formerly $G_s$ )
$e$	void ratio
$n$	porosity
$S$	degree of saturation
*	Density symbol is $\rho$ . Unit weight symbol is $\gamma$ where $\gamma = \rho g$ (i.e. mass density x acceleration due to gravity)

#### (a) Index Properties (con't.)

$w$	water content
$w_L$	liquid limit
$w_p$	plastic limit
$I_p$	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)

#### (c) 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

#### (d) Consolidation (one-dimensional)

$C_c$	compression index (normally consolidated range)
$C_r$	recompression index (overconsolidated range)
$C_s$	swelling index
$C_\alpha$	coefficient of secondary consolidation
$m_v$	coefficient of volume change
$c_v$	coefficient of consolidation
$T_v$	time factor (vertical direction)
$U$	degree of consolidation
$\sigma'_p$	pre-consolidation pressure
OCR	Overconsolidation ratio = $\sigma'_p / \sigma'_{vo}$

#### (e) Shear Strength

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

Notes: 1.  $\tau = c' + \sigma' \tan \phi'$   
2. Shear strength = (Compressive strength)/2

PROJECT 001-1143F				RECORD OF BOREHOLE No B11-1				1 OF 3		METRIC		
W.P. 30-95-00				LOCATION N 4915592.6; E 287961.2				ORIGINATED BY SB/PKS				
DIST SW HWY 400				BOREHOLE TYPE SEE NOTE 1				COMPILED BY LCC				
DATUM Geodetic				DATE Jan.17-26/2001				CHECKED BY ASP				
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC NATURAL LIQUID LIMIT MOISTURE LIMIT CONTENT		UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES		SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x REMOULDED		WATER CONTENT (%)			
231.2	GROUND SURFACE						20 40 60 80 100					
0.0	Topsoil											
0.2	Silty Clay, trace sand (Fill) Brown											
230.4												
0.8	Clayey Silt to Silty Clay, trace sand Firm to very stiff Moist Grey		1	SS	19							
			2	SS	4							
			3	SS	8							
			4	SS	7							
227.1												
4.1	Silty Sand, trace clay and gravel Compact to dense Moist Grey		5	SS	26							
			6	SS	37							
225.4												
5.8	Silty Clay, trace sand Stiff Moist Grey  Contains a layer of silty sand from 6.6m to 7m depth (Elev.224.6m to 224.2m)		7	SS	14							
			8	SS	10							
			9	SS	11							
220.5												
10.7	Sandy Silt containing silty clay interlayers Dense Wet Grey		10	SS	31							
			11	SS	42							
			12	SS	48							

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Continued Next Page

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

PROJECT 001-1143F				RECORD OF BOREHOLE No B11-1				2 OF 3		METRIC				
W.P. 30-95-00				LOCATION N 4915592.6; E 287961.2				ORIGINATED BY SB/PKS						
DIST SW HWY 400				BOREHOLE TYPE SEE NOTE 1				COMPILED BY LCC						
DATUM Geodetic				DATE Jan. 17-26/2001				CHECKED BY ASP						
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES		SHEAR STRENGTH kPa							
--- CONTINUED FROM PREVIOUS PAGE ---														
213.2 18.0	Sandy Silt containing silty clay interlayers Dense Wet Grey		13	SS	39	216								
						215								
			14	SS	40	214								
	Silty Clay, trace sand Very stiff Moist Grey		15	SS	16	213								
						212								
			16	SS	30	211								
						210								
			17	SS	19	209								
Silty sand layer encountered between 19.8m and 20.1m depth (Elev. 211.4m to 211.1m)		18	SS	15	208									
					207									
					206									
		19	SS	22	205									
					204									
Sandy Silt layer encountered between 29.3m and 29.6m depth (Elev. 201.9m to 201.6m)					203									
					202									
		20	SS	54										

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+ 3, X 3: Numbers refer to Sensitivity      O 3% STRAIN AT FAILURE

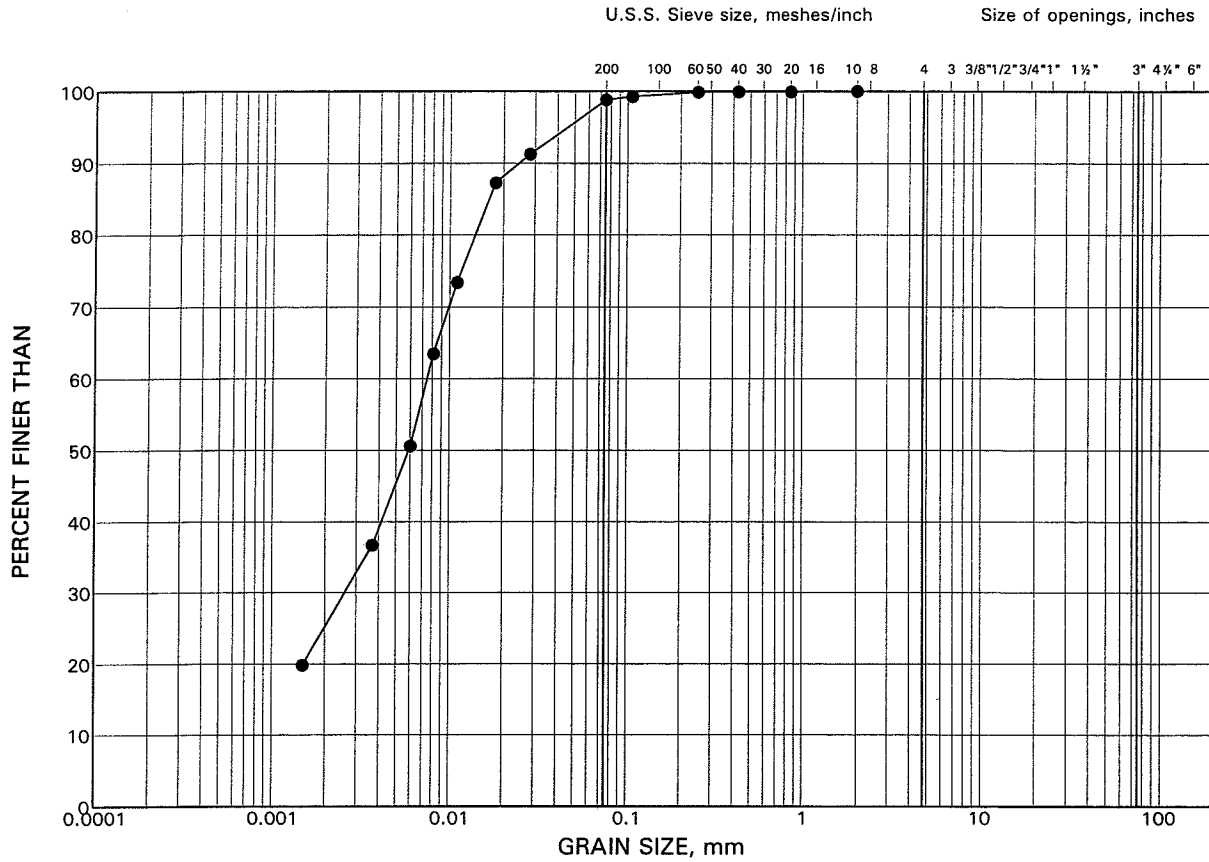
PROJECT 001-1143F			RECORD OF BOREHOLE No B11-1			3 OF 3			METRIC								
W.P. 30-95-00			LOCATION N 4915592.6; E 287961.2			ORIGINATED BY SB/PKS											
DIST SW HWY 400			BOREHOLE TYPE SEE NOTE 1			COMPILED BY LCC											
DATUM Geodetic			DATE Jan.17-26/2001			CHECKED BY ASP											
SOIL PROFILE			SAMPLES			DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC NATURAL LIQUID LIMIT MOISTURE CONTENT			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 (%)			UNIT WEIGHT	REMARKS & GRAIN SIZE DISTRIBUTION		
	--- CONTINUED FROM PREVIOUS PAGE ---							20 40 60 80 100 ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL X REMOULDED			W <sub>p</sub> W W <sub>L</sub> 10 20 30			γ	GR SA SI CL		
192.5	Silty Clay, trace sand Very stiff Moist Grey		21	SS	24		201										
38.7	Silty Sand Very dense Brown Wet						200										
191.4							199										
39.8	END OF BOREHOLE		22	SS	175/15		198										
	Notes: 1. Hollow stem augers used to advance to 10.7m depth. After sampling, bentonite seal was placed between 11.3m and 8.8m depth, and augers were withdrawn. "N" casing was installed to 10.7m depth, then "B" casing was used for the remainder of the borehole. 2. During drilling operations, water level in open borehole was typically between 6.2m and 8.8m depth (Elev.225.0m to 222.4m). 3. Piezometer installed in second borehole drilled 4m west. Water level in piezometer measured at 1.3m depth (Elev.229.9m) on March 15, 2001.						197										
							196										
							195										
							194										
							193										
							192										

ON MOT 0011143F.GPJ ON MOT.GDT 14/1/02

# GRAIN SIZE DISTRIBUTION

Clayey Silt to Silty Clay

FIGURE 1



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

## LEGEND

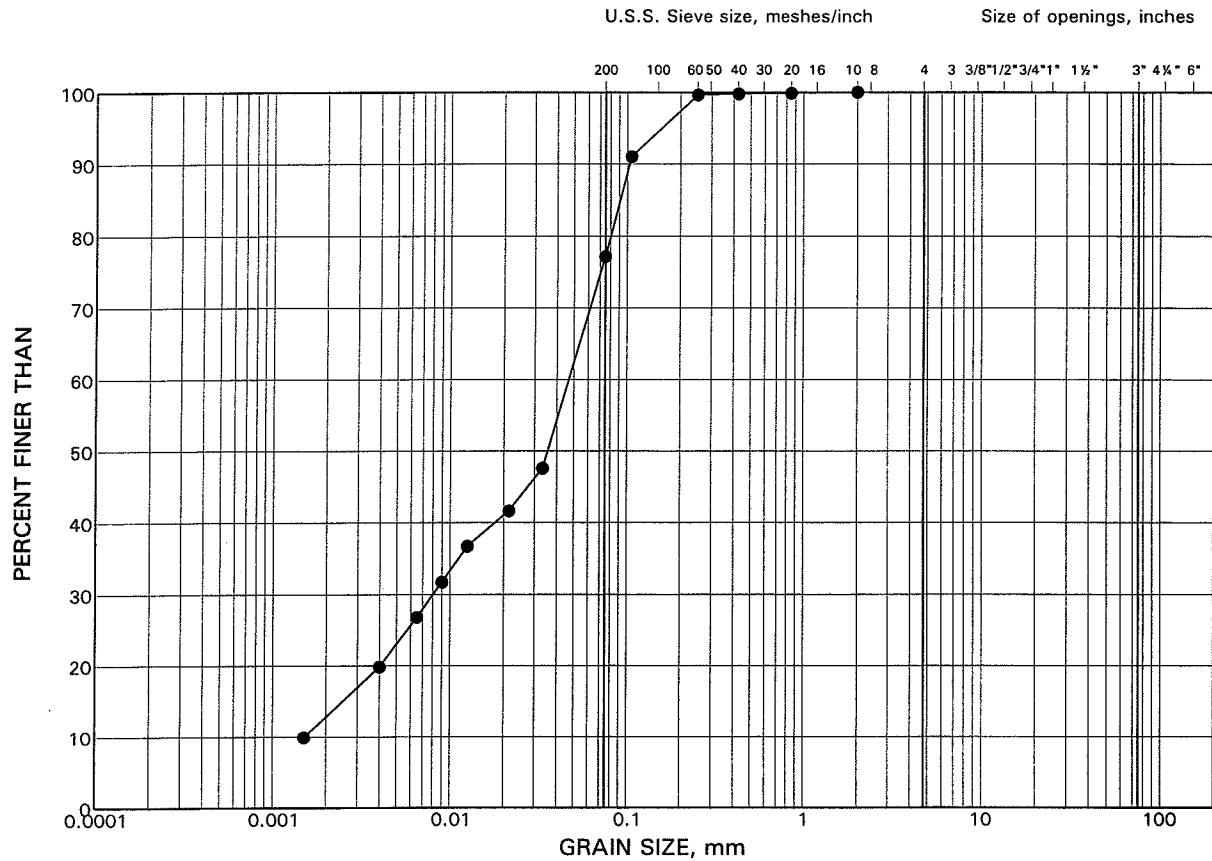
SYMBOL	BOREHOLE	SAMPLE	ELEVATION (m)
•	B11-1	4	227.8



# GRAIN SIZE DISTRIBUTION

Sandy Silt with Clayey Silt Interlayers

FIGURE 2



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

## LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION (m)
•	B11-1	12	217.2



# **APPENDIX B**

## **Record of Borehole and Laboratory Test Results – Current Investigation**



## LIST OF SYMBOLS

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

### I. GENERAL

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

### II. STRESS AND STRAIN

$\gamma$	shear strain
$\Delta$	change in, e.g. in stress: $\Delta \sigma$
$\varepsilon$	linear strain
$\varepsilon_v$	volumetric strain
$\eta$	coefficient of viscosity
$\nu$	Poisson's ratio
$\sigma$	total stress
$\sigma'$	effective stress ( $\sigma' = \sigma - u$ )
$\sigma'_{vo}$	initial effective overburden stress
$\sigma_1, \sigma_2, \sigma_3$	principal stress (major, intermediate, minor)
$\sigma_{oct}$	mean stress or octahedral stress $= (\sigma_1 + \sigma_2 + \sigma_3)/3$
$\tau$	shear stress
u	porewater pressure
E	modulus of deformation
G	shear modulus of deformation
K	bulk modulus of compressibility

### III. SOIL PROPERTIES

#### (a) Index Properties

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

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

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

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

#### (b) Hydraulic Properties

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

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

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

#### (d) Shear Strength

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

Notes: 1  
2

$\tau = c' + \sigma' \tan \phi'$   
shear strength = (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

### III. SOIL DESCRIPTION

#### (a) Non-Cohesive 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

### 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.)

#### (b) Cohesive Soils

Consistency	Cu, Su	psf
Very soft	0 to 12 kPa	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

#### Dynamic Cone Penetration Resistance; Nd:

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

**PH:** Sampler advanced by hydraulic pressure

**PM:** Sampler advanced by manual pressure

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

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

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

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

### IV. SOIL TESTS

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



GTA-MTO 001 S:\CLIENTS\MTOWHY 400 BARRIE02 DATA\GINT\1411110002 LAT LONG.GPJ GAL-GTA.GDT 2/8/17

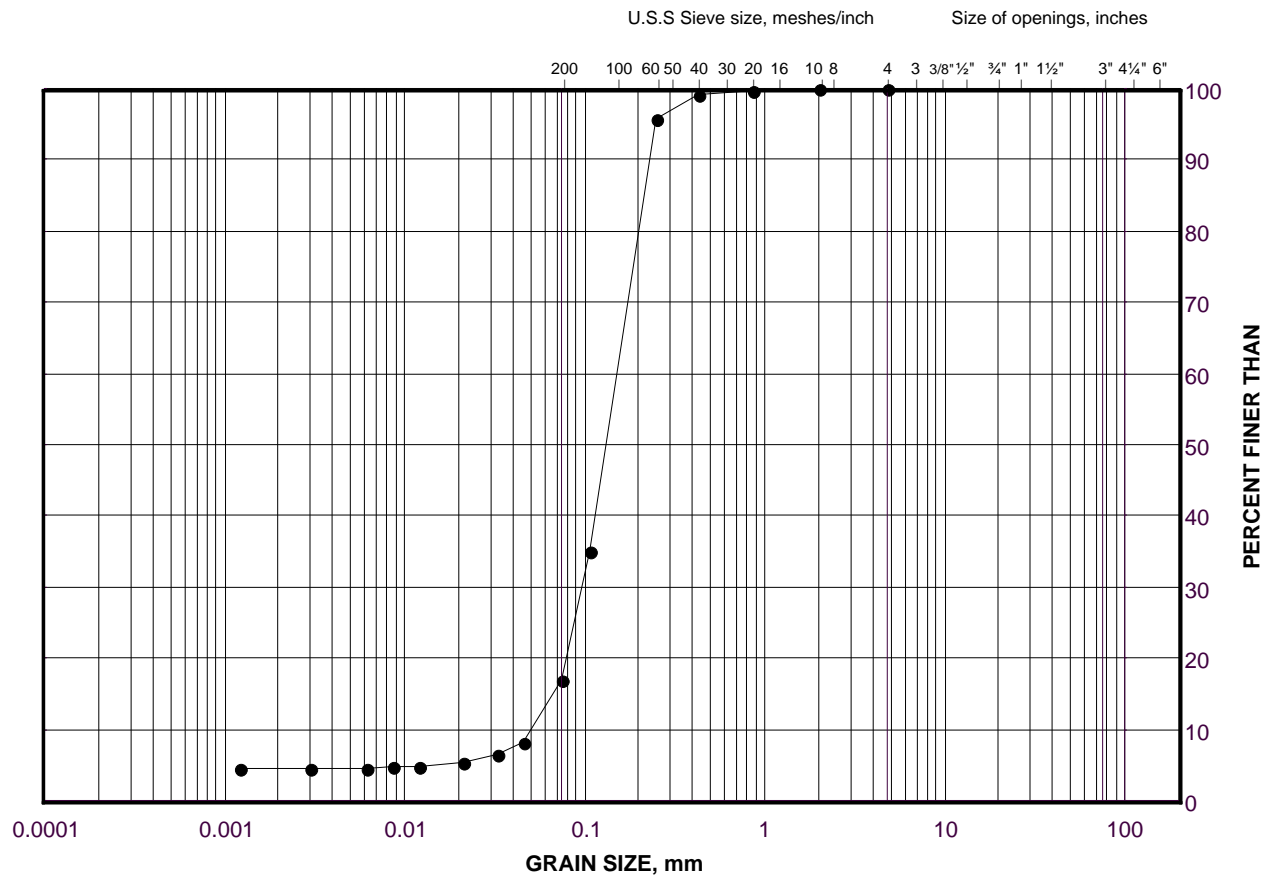
+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to Sensitivity      ○<sup>3%</sup> STRAIN AT FAILURE

PROJECT		14-1111-0002		RECORD OF BOREHOLE No DL1-1		SHEET 4 OF 4		METRIC													
G.W.P.		06-20016		LOCATION		N 4915644.7; E 288037.8 MTM ZONE 10 (LAT. 44.380615; LONG. -79.710359)		ORIGINATED BY ML													
DIST		Central HWY 400		BOREHOLE TYPE		Diedrich D-90, 108 mm I.D. Hollow Stem Augers, Tricone, NW Casing (Auto Hammer)		COMPILED BY SMD													
DATUM		Geodetic		DATE		November 27 to 30, 2016		CHECKED BY MCK													
SOIL PROFILE			SAMPLES			DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT			REMARKS & GRAIN SIZE DISTRIBUTION (%)						
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	SHEAR STRENGTH kPa					WATER CONTENT (%)			γ			GR SA SI CL		
	--- CONTINUED FROM PREVIOUS PAGE ---							20 40 60 80 100 ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × REMOULDED					W <sub>p</sub> W W <sub>L</sub> 10 20 30			kN/m <sup>3</sup>					
185.4	SILT and SAND, trace clay Very dense Grey Wet		23	SS	157		186						○						0 55 44 1		
46.2	END OF BOREHOLE																				
184.2	END OF DCPT																				
47.4	NOTE:  1. Water levels measured in piezometer  Date    Depth (m)    Elev (m) 15/03/17    1.9    229.7  2. Approximately 24.4 m of NQ casing sheared in the borehole between depths 21.8 m (Elev. 209.8 m) and 46.2 m (Elev. 185.4 m). Borehole and casing backfilled with bentonite pieces. An additional borehole was advanced about 1.7 m north to install the monitoring well.																				

# GRAIN SIZE DISTRIBUTION

Sand

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)
•	DL 1-1	6	226.7

Project Number: 14-1111-0002

Checked By: ARJ

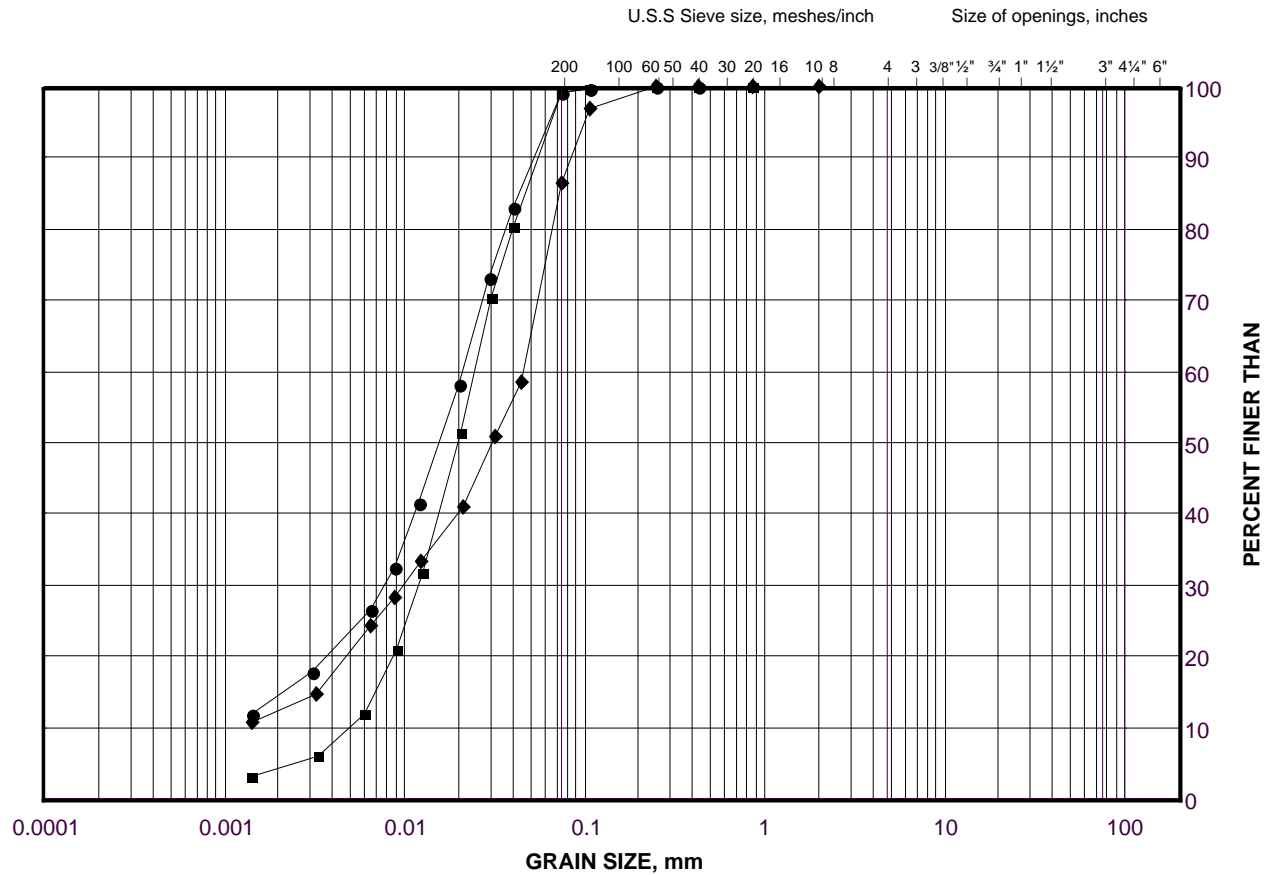
**Golder Associates**

Date: 24-Mar-17

# GRAIN SIZE DISTRIBUTION

Silt (Upper)

FIGURE B2



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

## LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
●	DL 1-1	14	213.0
■	DL 1-1	15	210.0
◆	DL 1-1	9	222.1

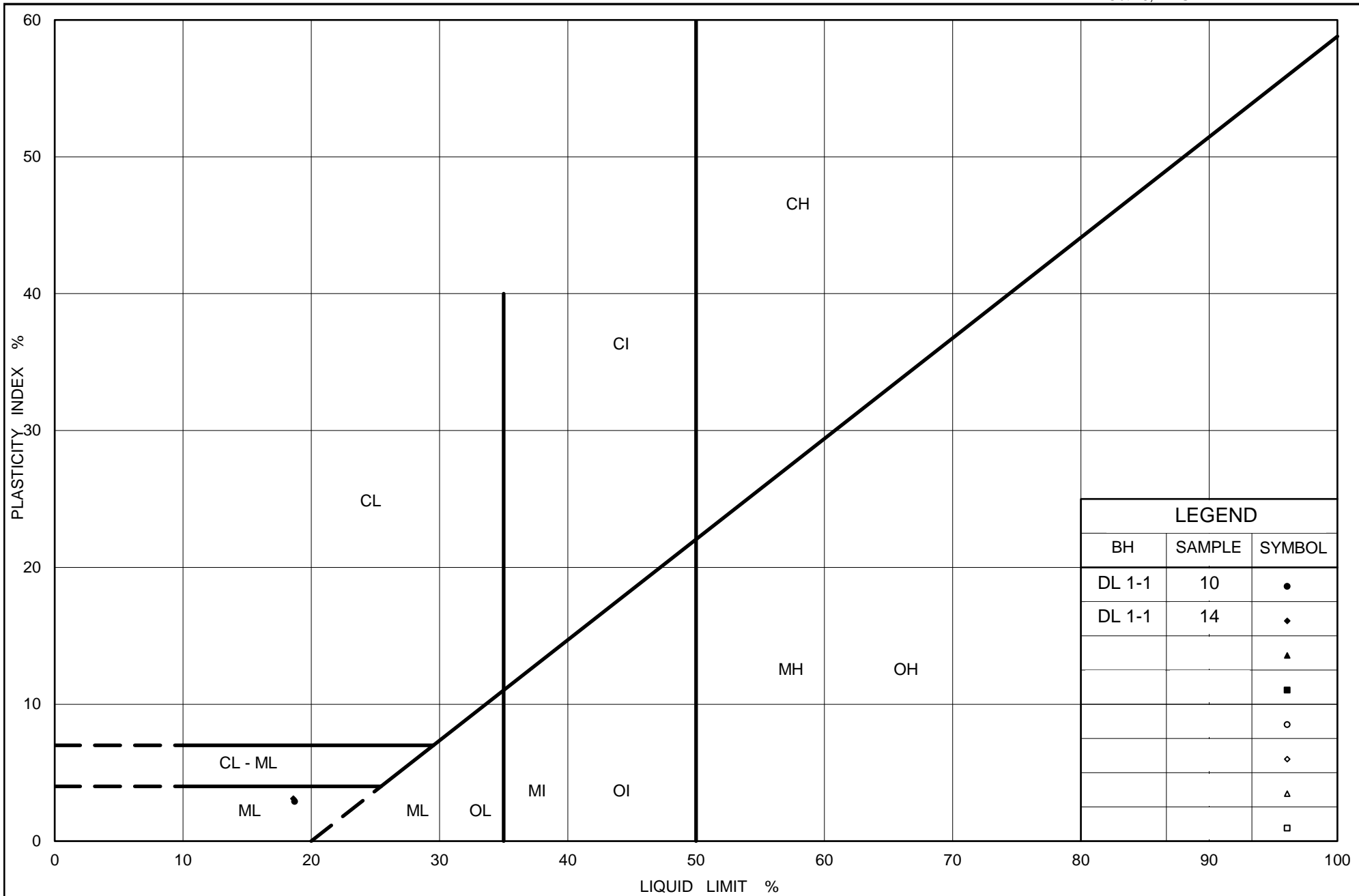
Project Number: 14-1111-0002

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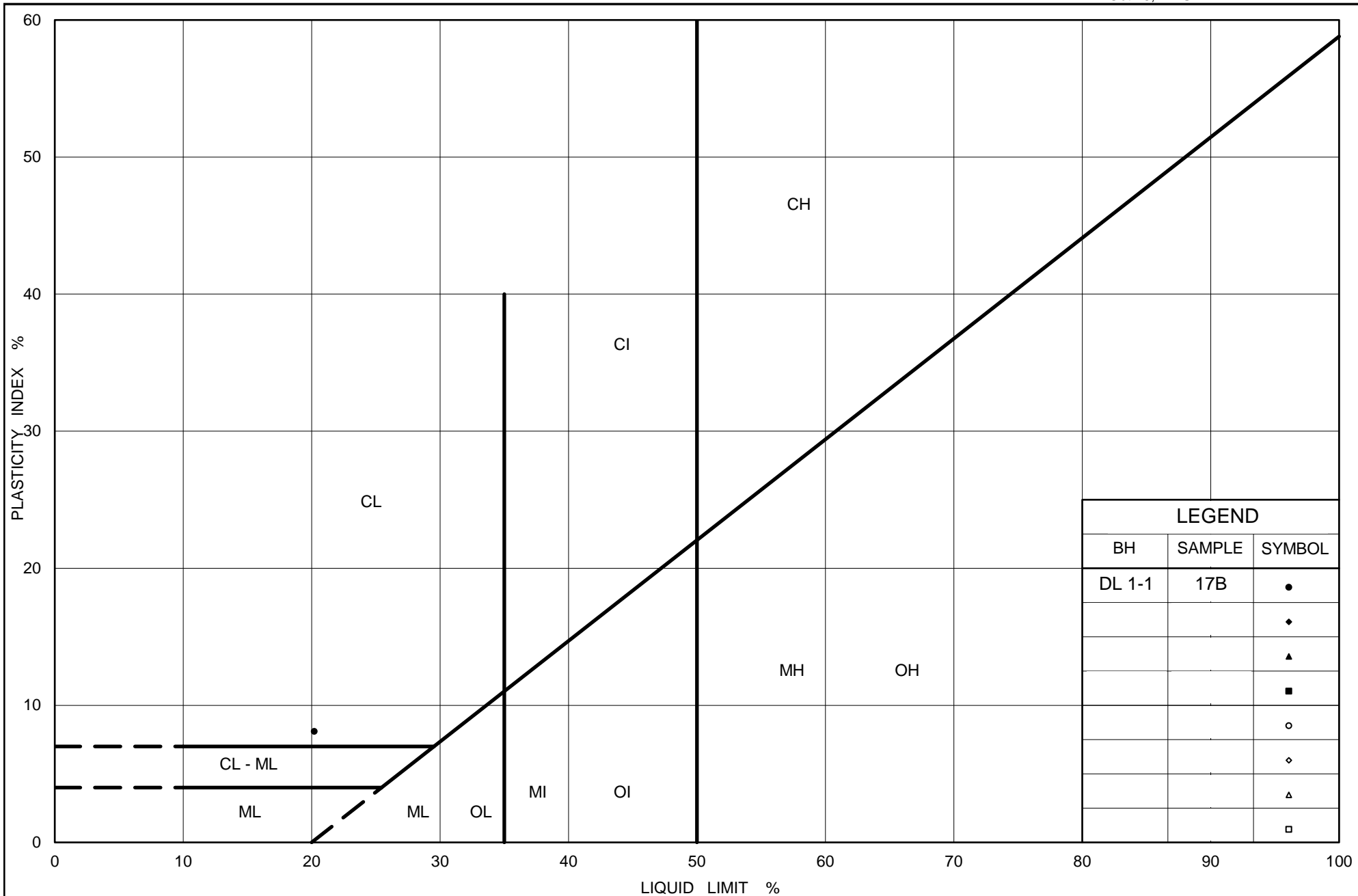
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## PLASTICITY CHART Silt (Upper)

Figure No. B3

Project No. 14-1111-0002

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## PLASTICITY CHART

### Clayey Silt

Figure No. B4

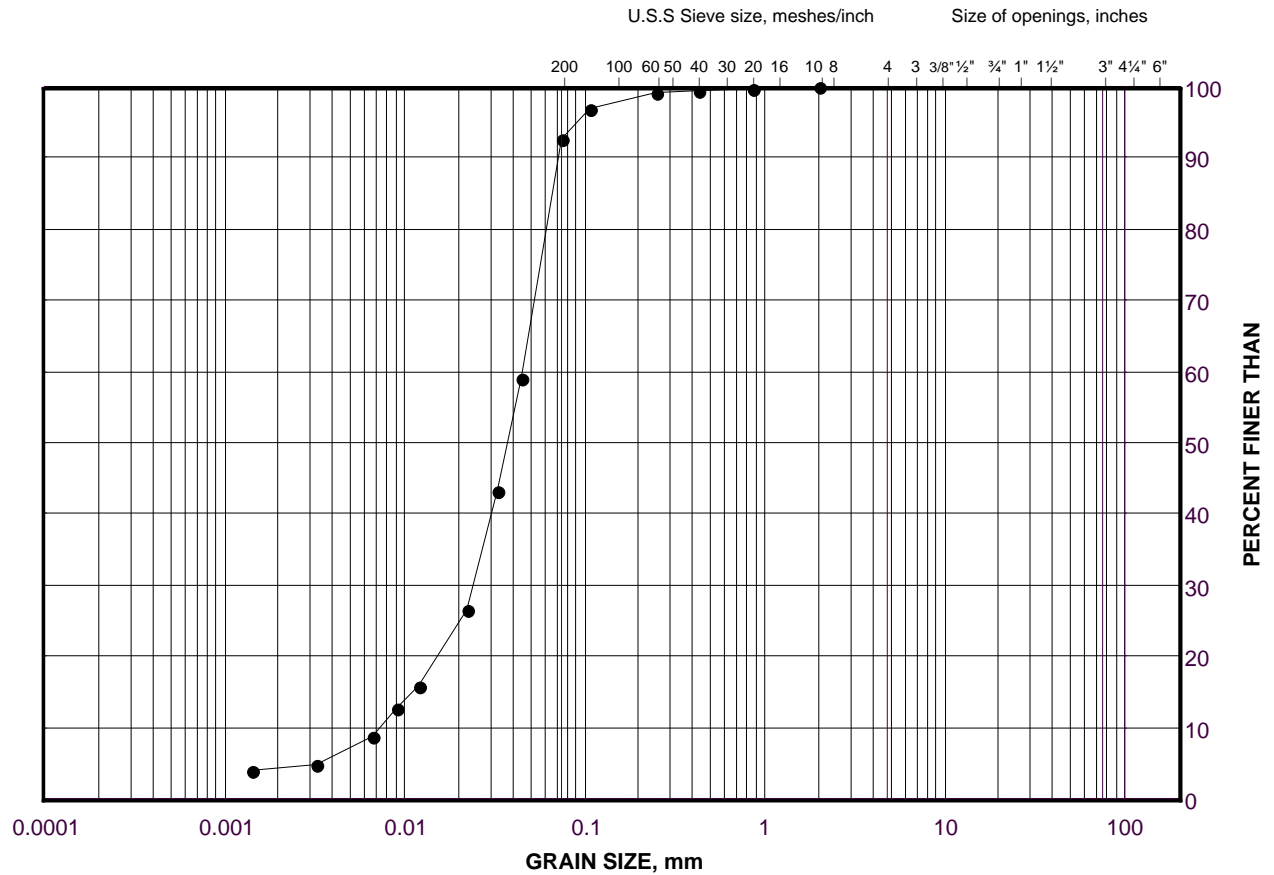
Project No. 14-1111-0002

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# GRAIN SIZE DISTRIBUTION

Silt (Lower)

FIGURE B5



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

## LEGEND

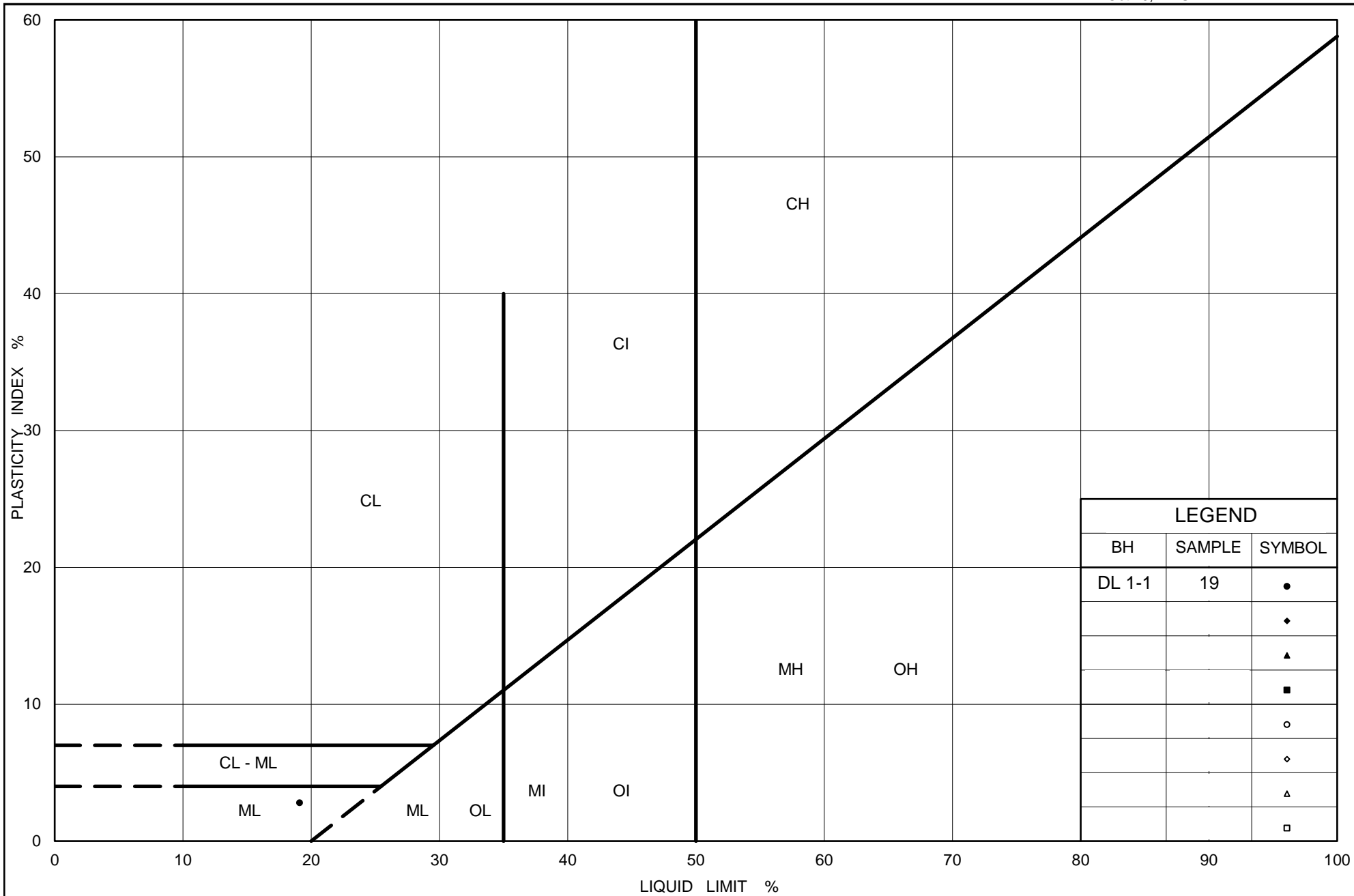
SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
•	DL 1-1	21	191.6

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## PLASTICITY CHART Silt (Lower)

Figure No.B6

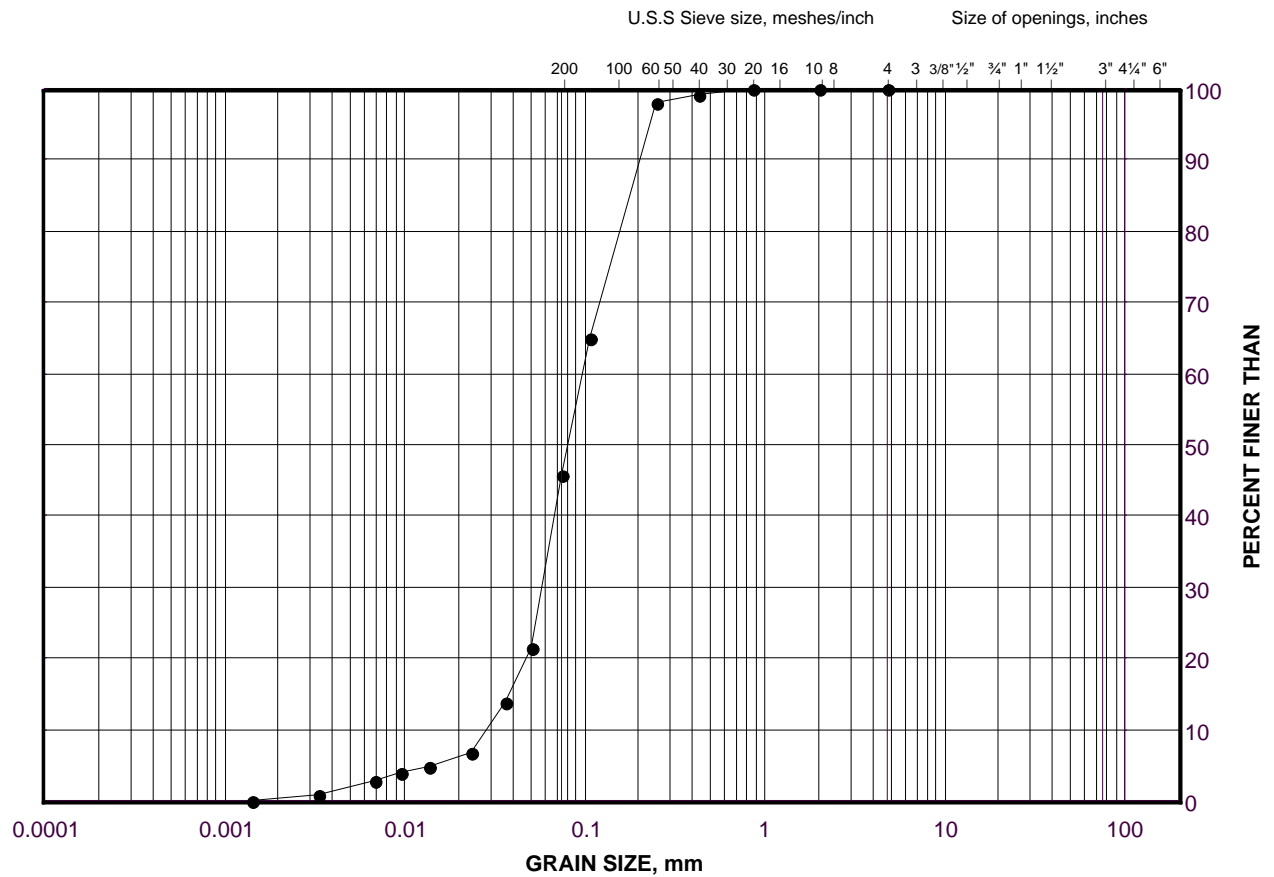
Project No. 14-1111-0002

Checked By:ARJ

# GRAIN SIZE DISTRIBUTION

Silt and Sand

FIGURE B7



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

## LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION(m)
•	DL 1-1	23	185.6

Project Number: 14-1111-0002

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Date: 24-Mar-17

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