

FINAL REPORT

Foundation Investigation Report
Christina Street Underpass,
Site 14-37 Highway 402
City of Sarnia, Ontario
District - London
G.W.P. 3038-03-00

STANTEC CONSULTING LTD.

PROJECT NO. 1012607
GEOCRES NO. 40J16-78

PROJECT NO. 1012607

REPORT TO	Stantec Consulting Inc. 1400 Rymal Road East Hamilton, ON L8W 3N9
FOR	Final Foundation Investigation Report
ON	Christina Street Underpass, Site 14-37 Highway 402 City of Sarnia, Ontario G.W.P. 3038-03-00 District – London GEOCRES NO. 40J16-78

September 26, 2008

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Record of Borehole Sheets
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FOUNDATION INVESTIGATION REPORT

**Christina Street Underpass,
Site 14-37 Highway 402
City of Sarnia, Ontario
G.W.P. 3038-03-00
District – London**

1.0 INTRODUCTION

Jacques Whitford Limited (Jacques Whitford) was retained by Stantec Consulting Ltd., to complete a Foundation Investigation and Design Report for the proposed Highway 402 Underpass at Christina Street, in the City of Sarnia, Ontario, (GWP No. 3038-03-00).

The work was carried out under Agreement No. 3005-E-0029 and in general accordance with the Subconsultant Agreement dated May 24, 2006. Authorization to proceed with the investigation was provided by Mr. David Emery, P.Eng., of Stantec Consulting Ltd., the prime consultant on this detailed design assignment.

The scope of work for the foundation investigation is incorporated within Stantec's project, which forms part of the above noted subconsultant agreement.

This foundation investigation report has been prepared specifically and solely for the project described herein. It contains the factual results of foundation investigation and laboratory testing.

2.0 SITE DESCRIPTION

The site location is on Highway 402 at the Christina Street Interchange (IC-2) in the City of Sarnia, Ontario.

Highway 402 at Christina Street is a semi-urban freeway with wide gravel shoulders and a wide grass covered centre median. The highway is slightly lower than the grade of the surrounding lands. Highway 402 is generally oriented in an east-west direction with two east bound and two west bound lanes passing below Christina Street.

Drainage is provided by ditches located along the sides and in the central median of the Highway. The ditches are sloped towards catch basins located along the existing highway. Regional drainage is towards the St. Clair River located approximately 1.4 km west of the project site.

The existing Christina Street underpass is a rigid frame structure, consisting of 2 - 15 m spans (approximate) with a wide central pier. The bridge is constructed of reinforced concrete. Based on the as-built drawings dated August 1950, revised October 1950, it is understood that the existing bridge structure is supported on shallow footings placed on the native sand at an elevation of approximately 179.8 m. The existing bridge deck is at an elevation of approximately 188.9 m and the profile of Highway 402 is at an elevation of approximately 181.7 m.



Christina Street is 4 lanes wide, locally widened in areas to accommodate left and right turning lanes. At the bridge approaches, the street is constructed on embankments that are approximately 6 m high at the abutment locations. Drainage is provided by concrete gutters and a series of catch basins.

A representative site photograph of the underpass structure is provided in **Appendix E**.

3.0 PHYSIOGRAPHY

Based on the physiography of Southern Ontario by Chapman and Putnam (1984), this section of Highway 402 is situated in the physiographic region known as the Huron Fringe, a narrow geological strip between Lake Huron and the adjacent St. Clair Clay Plains. The Huron Fringe is composed mainly of surficial sands, silts and gravels, underlain by lacustrine clayey silt and silty clay.

The bedrock in the area of the site consists of laminated, thinly bedded shale that is black to grey in colour and is of the Kettle Point Formation.

4.0 BACKGROUND

Previous Investigations

A previous assessment of the site was carried out by Golder Associates Ltd. The results of the assessment were provided in a written report titled:

Preliminary Foundation Investigation and Design Report, Proposed Christina Street Underpass Replacement, Highway 402, GWP 3038-03-00, Agreement Number 3005-A-000394, Dated October 14, 2005.

The reported subsurface conditions included the following strata types:

Strata	Layer Thickness (m)	Depth to underside of Strata (m)
Fill	0.8 to 1.0	0.8 to 1.0
Sand	3.7 to 4.6	4.9 to 5.9
Peat	0.15 (G-BH1 Only)	6.3
Clayey silt	11.2 to 17.7	17.4 to 22.6
Silty clay	26.2 to 31.9	48.8 to 49.4
Silt	0.9 (G-BH1 Only)	50.4
Sand and Gravel	0.9 (G-BH2 Only)	50.3
Till	3.2 and 4.8	Termination depth of the boreholes

The sand layer was generally reported to be compact with exception of the lower portion at one of the boreholes, which was very loose.

The clayey silt layer was stated to be firm to very stiff, with actual reported measurements indicating stiff to very stiff conditions. Laboratory tests were reported as follows:

- Moisture contents ranging from 12% to 26%, average of about 19%;
- Average plastic limit of approximately 15; and,
- Average liquid limit of approximately 31.
- Pre-consolidation pressure of 150 kPa from the consolidation test on a sample from Elevation 169.5 m. This indicates that the sample was slightly overconsolidated by 10 kPa.

The silty clay layers were stated to be firm to very stiff based on the SPT N-values. Laboratory tests were reported as follows:

- Moisture contents ranging from 27% to 33%, average of about 30%;
- Average plastic limit of approximately 21; and,
- Average liquid limit of approximately 43.

The till was very dense with SPT N-values exceeding 100. Laboratory tests were reported as follows:

- Moisture contents ranging from 7% to 26%, average of about 12%; and,
- Shale fragments were also reported in the till.

These boreholes have been referenced in this report as Boreholes G-BH1 and G-BH2.

5.0 INVESTIGATION PROCEDURES

5.1 Field Program

The fieldwork for the present investigation was carried out between October 31, 2006, and November 10, 2006, and December 6 to 12, 2006. A total of 13 boreholes were advanced to depths ranging from approximately 6.7 m to 57 m using a track and truck mounted drill rigs equipped with 250 mm (outside diameter), hollow-stem augers and mud-rotary drilling, supplied and operated by Aardvark Drilling Inc.

The following outlines the general purpose of the boreholes:

Location	Boreholes
South Abutment and approach fills	CS-1 and G-BH2
Central pier	CS-2
North Abutment and Approach fills	CS-3, CS-4 and G-BH1
Retaining Walls	R-1 to R-5
Embankment and approach fills	CS-1, CS-3, CS-4 and CS-6 to CS-8

Borehole CS-5 was advanced at the site for a proposed storm water management pond. The results of the storm water management pond foundation investigation and geotechnical recommendations for design are provided under separate cover.

Prior to commencing the field investigation, the borehole locations were established in the field by Jacques Whitford personnel. The borehole locations were cleared of underground utilities by the various utility companies.

Soil samples were recovered from the boreholes at regular intervals using a 50 mm Outside Diameter split-tube sampler by conducting Standard Penetration Tests (SPTs) in general accordance with the procedures outlined in the ASTM specification D1586-99. Relatively undisturbed samples were obtained by pushing thin walled sample tubes in general accordance with ASTM D1587.

Where cohesive soils were encountered, in situ shear vane testing was carried out using a vane meeting the MTO N-vane design requirements and following the procedures outlined in ASTM D2573-94.

Jacques Whitford field personnel recorded the conditions encountered in all boreholes at the time of the investigation. Soils were described in accordance with the MTO Soils Classification System for foundation reports.

The groundwater levels, where encountered, were measured in the boreholes at the completion of drilling. All boreholes were backfilled in accordance with Ontario Regulation 903, using cement/bentonite slurry.

All soil samples recovered from the boreholes were placed in moisture-proof bags and returned to our laboratory for detailed classification and testing as required.

5.2 Survey

The borehole locations were established by Jacques Whitford personnel and referenced to the stations on Christina Street, the respective ramps, or Highway 402. Offsets were referenced looking up chainage. The borehole locations are also referenced to Northing and Easting co-ordinates, which are provided on the Record of Borehole sheets and on Drawing Nos. 1 to 4.

The ground surface elevation at the borehole locations were surveyed by Jacques Whitford personnel. The boreholes were surveyed to one of the following benchmarks, as identified on a Survey Drawing by J. D. Barnes, titled "Pre-Engineering Sta. 11+000 to Sta. 11+700", with a survey date of August, 2004.

- BM 812, a bronze plate set in the concrete sidewalk on the west side of Christina Street, south of the existing south bridge abutment, with a reported Geodetic elevation of 186.87 m.
- BM 332, a monument set at Sta. 11+430, off-set 20 m left, with a reported Geodetic elevation of 183.55 m.

The benchmark locations are shown on Drawing No. 1 in **Appendix A**.

5.3 Laboratory Testing

All samples returned to the laboratory were subjected to detailed visual examination and classification. Representative samples of the native soils were tested for grain size, Atterberg Limits and unit weight testing. In addition, a series of samples were submitted for moisture content determination. Consolidation testing of one soil sample obtained by Jacques Whitford was carried out by Golder Associates on our behalf. The results of the grain size analyses, Atterberg Limits, consolidation and unit weight tests are shown on Figure Nos. 1 through 7 in **Appendix C**. The laboratory testing carried



out by Golder Associates for the preliminary foundation investigation has been incorporated into this report and is included in **Appendix D**.

Unless requested in advance, all samples will be stored in our laboratory for a period of 12 months after issuance of this report.

6.0 RESULTS OF THE INVESTIGATION

6.1 Subsurface Conditions

The subsurface conditions encountered in the boreholes are summarized on the Record of Borehole Sheets provided in **Appendix B**. An explanation of the terms used on the Record of Borehole Sheets is also provided in **Appendix B**.

The boreholes from the preliminary geotechnical investigation, completed by Golder Associates, have been incorporated herein, and are also provided in **Appendix B**. In addition, the laboratory test data from the preliminary report have been incorporated into this report and are provided in **Appendix D**.

Borehole Location plans and strata plots of the soils encountered in the boreholes are provided on Drawing Nos. 1 to 4 in **Appendix A**.

A summary of the soil and groundwater conditions encountered in the boreholes is provided below.

6.2 Soil

6.2.1 Asphalt

Asphalt was encountered at the ground surface in several boreholes. The following table outlines the borehole location, borehole number and asphalt thickness measured at each borehole, where encountered:

Location	Borehole Number	Asphalt Thickness (mm)
Christina Street	CS-1	150
Christina Street	CS-3	200
Christina Street	R-1	150
Christina Street	R-2	150
S-E Ramp	R-4	180
S-E Ramp	R-5	200

6.2.2 Topsoil

Topsoil was encountered at the ground surface in Boreholes G-BH1 and G-BH2.

6.2.3 Sand Fill

Sand fill was encountered at the ground surface in Boreholes CS-2, CS-6 to CS-8 and R-1, and below the asphalt or topsoil in all other boreholes. The granular material ranged in thickness from approximately 0.7 m to 5.1 m. Thicker sand fill, in the range of approximately 4.6 m to 5.3 m, was encountered in Boreholes CS-1 and CS-3, which were drilled through the approach embankments for the existing bridge structure.

The sand fill generally consisted of sand and gravel directly below the asphalt, grading to sand, trace gravel with increasing depth. The sand fill contained trace silt and was generally moist to damp.

Based on the N-Values obtained from the Standard Penetration Tests (SPTs), the compactness of the sand fill was variable ranging from very dense to very loose, but was typically compact.

Laboratory testing performed on selected samples consisted of moisture content tests and grain size distribution tests. The test results are as follows:

- Moisture Content:
 - 5% to 8%
- Gradation:
 - 9% to 37% gravel;
 - 51% to 86% sand; and,
 - 4% to 12% fines (silt and clay).

The results of the moisture content tests and grain size distribution tests are provided on the Record of Borehole sheets in **Appendix B**.

The results of the grain size distribution tests are provided on Figure 1 in **Appendix C**.

6.2.4 Native Sand

Native sand was encountered below the fill in all boreholes. The sand was encountered at depths ranging from approximately 0.9 m to 5.3 m below existing grade, or at elevations of approximately 183.1 to 176.7 m. The thickness of the sand ranged from approximately 2.8 m to 7.6 m.

The sand was generally moist to wet. Based on the N-Values obtained from the SPTs, the compactness of the sand ranged from very dense to compact.

Laboratory testing performed on selected samples consisted of moisture content tests and grain size distribution tests. The test results are as follows:

- Moisture Content:
 - 10% to 30%
- Gradation:
 - 0% to 10% gravel;
 - 83% to 96% sand; and,
 - 2% to 17% fines (silt and clay).

The results of the moisture content tests and grain size distribution tests are provided on the Record of Borehole sheets in **Appendix B**.



The results of the grain size distribution tests are provided on Figures 2 and 3 in **Appendix C** and on Figure A-1 in **Appendix D**.

A second layer of sand was encountered below the silty clay in Borehole G-BH2, at a depth of approximately 49.7 m or elevation of about 131.9 m. This layer of sand was approximately 0.6 m thick and contained gravel and trace silt.

6.2.5 Peat

A peat seam was encountered in Borehole G-BH1 below a thin seam of clay silt (noted below) at a depth of approximately 6.1 m below grade, or elevation 175.9 m. The peat was described by Golder as follows:

- 150 mm thick;
- Moisture content: 110%;
- Saturated;
- Fibrous; and,
- SPT N-value of 4.

6.2.6 Clayey Silt / Silty Clay

Clayey silt / silty clay was encountered below the sand in all boreholes. The clayey silt / silty clay was encountered at depths in the range of approximately 4.7 m to 12.2 m below existing grade, or elevations of approximately 174.7 m to 177.6 m. All boreholes, with the exception of Boreholes CS-2, G-BH1 and G BH2, were terminated in the clayey silt / silty clay at depths in the range of approximately 6.7 m to 15.8 m or elevations of approximately 170.5 m to 177.9 m. The clayey silt / silty clay was approximately 43 m, 44 m and 45 m thick in Boreholes CS-2, G-BH1, and G-BH2, respectively.

The clayey silt / silty clay was generally moist to damp.

The upper 2 m of the silty clay generally could be classified as very stiff to hard, indicating this layer is likely a desiccated layer. Below this depth, the consistency of the clayey silt / silty clay is generally stiff.

In situ shear vane testing was carried out in the clayey silt / silty clay. The results of the testing indicated that the shear strength of the clayey silt / silty clay was variable ranging from approximately 55 kPa to >140kPa, but was more typically in the range of approximately 70 kPa to 85 kPa.

Laboratory testing performed on selected samples consisted of moisture content tests, grain size distribution tests, Atterberg Limits tests, Consolidation Tests and Unit Weight tests. The test results are as follows:

- Moisture Content:
 - 13% to 34%.
- Gradation:
 - 0% to 7% gravel;
 - 5% to 32% sand;
 - 40% to 75% silt; and,
 - 17% to 42% clay.

- Atterberg Limits:
 - Liquid Limits: 24 to 47; and,
 - Plastic Limits: 10 to 24.
- Unit Weight: 20.9 to 21.5 kN/m³.

The results of the moisture content tests, grain size distribution tests, Atterberg Limits tests and unit weight tests are provided on the Record of Borehole sheets in **Appendix B**.

The results of the grain size distribution tests are provided on Figure 4 in **Appendix C** and Figure A-2 and A-5 in **Appendix D**. The results of the Atterberg Limits tests are provided on Figure 5 in **Appendix C**, and Figure A-3 and A-6 in **Appendix D**.

The results of the consolidation tests carried out by Golder on behalf of Jacques Whitford in January 2007 for the present investigation are provided on Figure 6 in **Appendix C**.

The results of the consolidation tests carried out by Golder as part of the October 2005 Preliminary Foundation Investigation are provided on Figure A-4 in **Appendix D**.

The results of the unit weight tests are provided on Figure 7 in **Appendix C**.

6.2.7 Silt

Silt was encountered below the clayey silt /silty clay in Borehole G-BH1 at a depth of approximately 49.4 m or an elevation of about 131.9 m. The silt was described by Golder as follows:

- Approximately 1 m thick;
- Contained trace clay and layers of silty clay;
- Generally wet;
- Compact; and,
- Moisture content of 26%.

6.2.8 Sandy Silt Till

Sandy silt till was encountered below the silt, sand or clayey silt / silty clay in Boreholes CS-2, G-BH1 and G-BH2 at depths in the range of approximately 47.2 m to 50.4 m below existing grade or elevations of approximately 130.9 to 133.8 m. Boreholes CS-2, G-BH1 and G-BH2 were terminated in the sandy silt till stratum at depths of approximately 53.5 to 57.0 m below existing grade, elevations of approximately 124.4 m to 128.1 m.

The sandy silt till was generally moist. Based on the N-Values obtained from the SPTs, the compactness of the sandy silt till was very dense.

Laboratory testing performed on selected samples consisted of moisture content tests and grain size distribution test. The test results are as follows:

- Moisture Content:
 - 8% to 11%.
- Gradation:



- 11% gravel;
- 43% sand;
- 33% silt; and,
- 13% clay.

The results of the moisture content tests and grain size distribution test are provided on the Record of Borehole sheets in **Appendix B**.

The results of the grain size distribution test are provided on Figure A-7 in **Appendix D**.

6.3 Groundwater

Ground water was encountered in the boreholes during drilling. It was not practical to measure the ground water on completion of drilling in all of the boreholes, given the use of drillers mud during drilling. The following table provides a summary of the groundwater conditions encountered:

Borehole	Drill Date	Ground Water First Encountered		Ground Water measured on Completion of Drilling		Depth to Cave of Borehole (m)	
		Depth (m)	Elevation (m)	Depth (m)	Elevation (m)	Depth (m)	Elevation (m)
CS-1	06-11-08	-	-	7.6	179.3	6.5	180.4
CS-2	06-12-06	-	-	-	-	-	-
CS-3	06-11-08	-	-	7.6	179.2	6.7	180.1
CS-6	06-11-10	3.0	180.1	*	*	2.9	180.2
CS-7	06-11-10	3.0	180.1	*	*	2.6	180.6
CS-8	06-11-10	4.0	179.5	*	*	2.9	180.6
R-1	06-11-09	4	179.4	*	*	3.3	180.1
R-2	06-11-09	6.1	178.7	*	*	4.4	180.4
R-3	06-11-10	4.6	179.1	*	*	3.5	180.2
R-4	06-11-10	4	180.0	*	*	3.7	180.3
R-5	06-11-10	-	-	*	*	3	180.0
G-BH1	04-07-12	1.8	179.5	*	*	-	-
G-BH2	04-07-19	1.7	179.9	*	*	-	-

* - Could not be measured due to the drilling techniques used.

Fluctuation in the groundwater level due to seasonal variations or in response to a particular precipitation event should be anticipated.

7.0 CLOSURE

A soil investigation is a limited sampling of a site. The information is gathered at specific borehole locations and can only be extrapolated to an undefined limited area around the borehole locations. The extent of the limited area depends on the variability of the soil and ground water conditions as influenced by geological processes, as well as the history of the site reflecting natural conditions, construction activities and site use. Should any conditions at the site be encountered that differ from those at the borehole locations, we request that we be notified immediately in order to assess the additional information.

We trust the above information meets with your present requirements. Should you have any questions or require further information, please do not hesitate to contact us at your convenience.

Yours very truly,

JACQUES WHITFORD LIMITED

Original Signed By:

Geoffrey Creer, P.Eng.
Geotechnical Engineer

Original Signed By:

Raymond Haché, P.Eng.
Principal, Geotechnical Service Director, and
Designated Principal
MTO Foundations Contact

GC/RH/dd

Enclosures

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APPENDIX A

Drawings

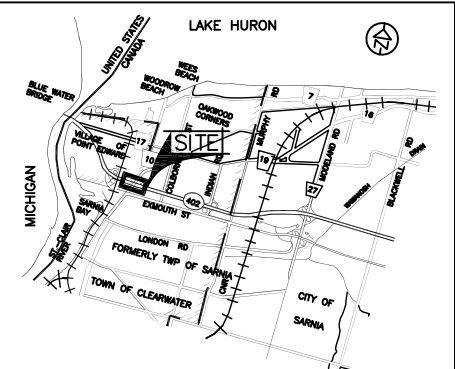
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HWY 402
STATION —
11+200 TO 11+600



HIGHWAY 402
CHRISTINA STREET
UNDERPASS
BOREHOLE LOCATION PLAN

SHEET



N.T.S

LEGEND

- Borehole (Jacques Whitford, 2006)
- Borehole (By Golder, 2004)
- Benchmark

BH No.	ELEVATION (m)	NORTHING	EASTING
CS-1	186.9	476 0877.2	313 072.4
CS-2	181.6	476 0908.3	313 107.7
CS-3	186.8	476 0940.7	313 102.6
CS-4	182.4	476 0974.3	313 133.6
CS-5	182.4	476 0953.8	313 243.0
CS-6	183.1	476 1014.9	313 255.9
CS-7	183.1	476 0961.6	313 279.1
CS-8	183.5	476 0931.3	313 327.9
R-1	183.4	476 0780.2	313 025.7
R-2	184.8	476 0821.0	313 045.6
R-3	183.7	476 0777.0	313 043.1
R-4	184.0	476 0858.0	313 093.2
R-5	183.0	476 0880.2	313 140.8
G-BH1	181.3	476 0934.8	313 086.3
G-BH2	181.6	476 0884.5	313 100.0

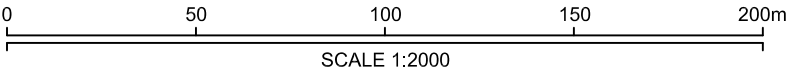
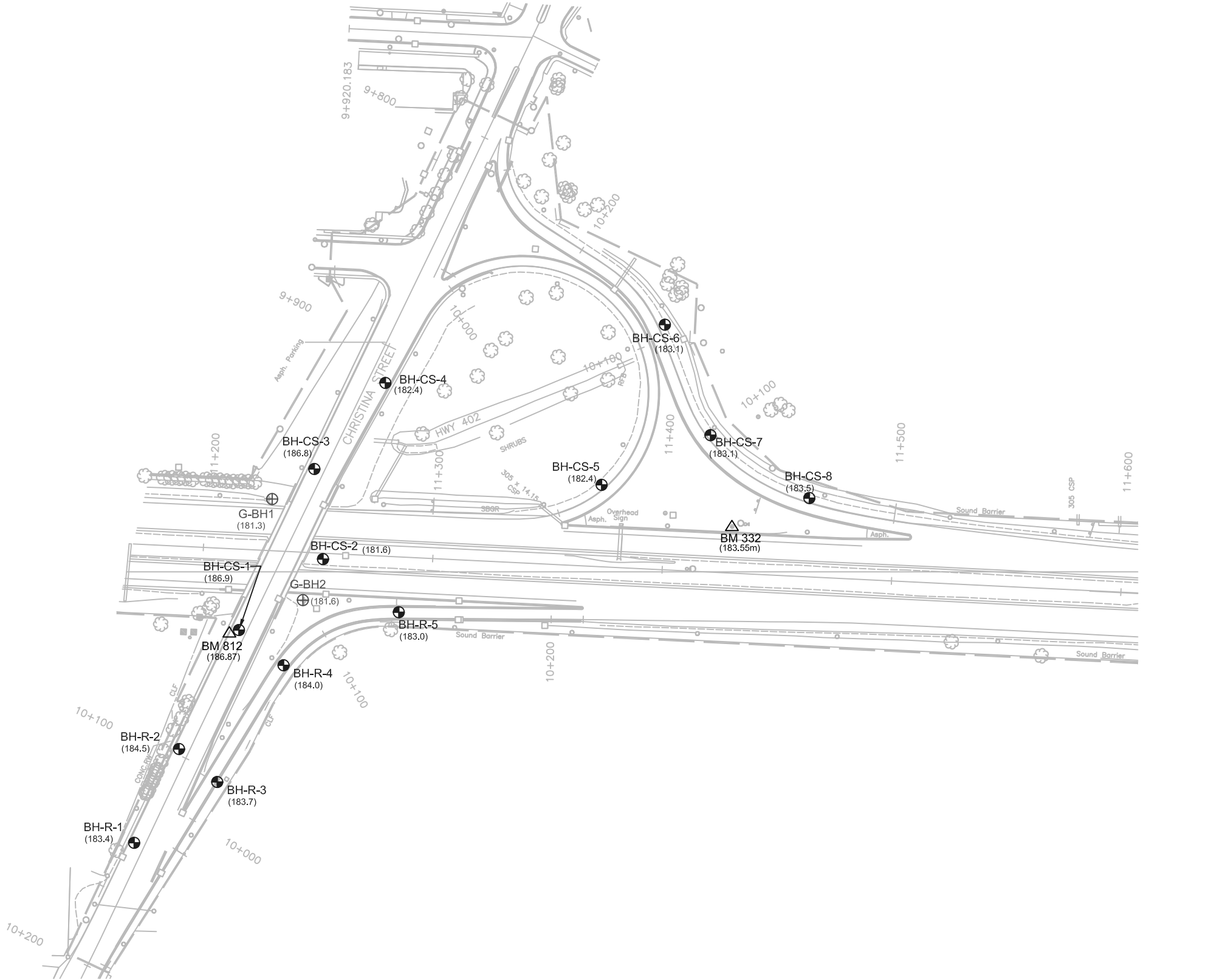
NOTE

- * Base Plan provided by Stantec Consulting.
- * Borehole locations and site features shown are approximate and may vary from that shown.

NOTE: The complete foundation investigation and design report for this project and other related documents may be examined at the Engineering Materials Office, Downsview. Information contained in this report and related documents is specifically excluded in accordance with the conditions of Section 102-2 of Form 100.

REVISIONS	DATE	BY	DESCRIPTION
1	2008-09-24	GC	Initial Design
2	2008-09-24	HZ	Final Design

HWY No 402	SUBM'D GC	CHECKED	DATE 2008-09-24	DIST LONDON
DRAWN PC/HZ	CHECKED	APPROVED	SITE 14-37	
GEORES No 40J16-78			DWG 1012607-GE0-CS-01	



P:\100xx\CHRIS TINA SH1012607-GE0-CS-01 borehole locations\20080924.dwg (Model)

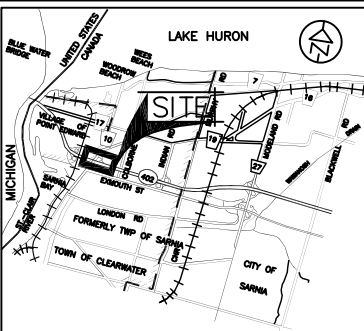
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HWY 402
CONT No -
WP No 3038-03-00



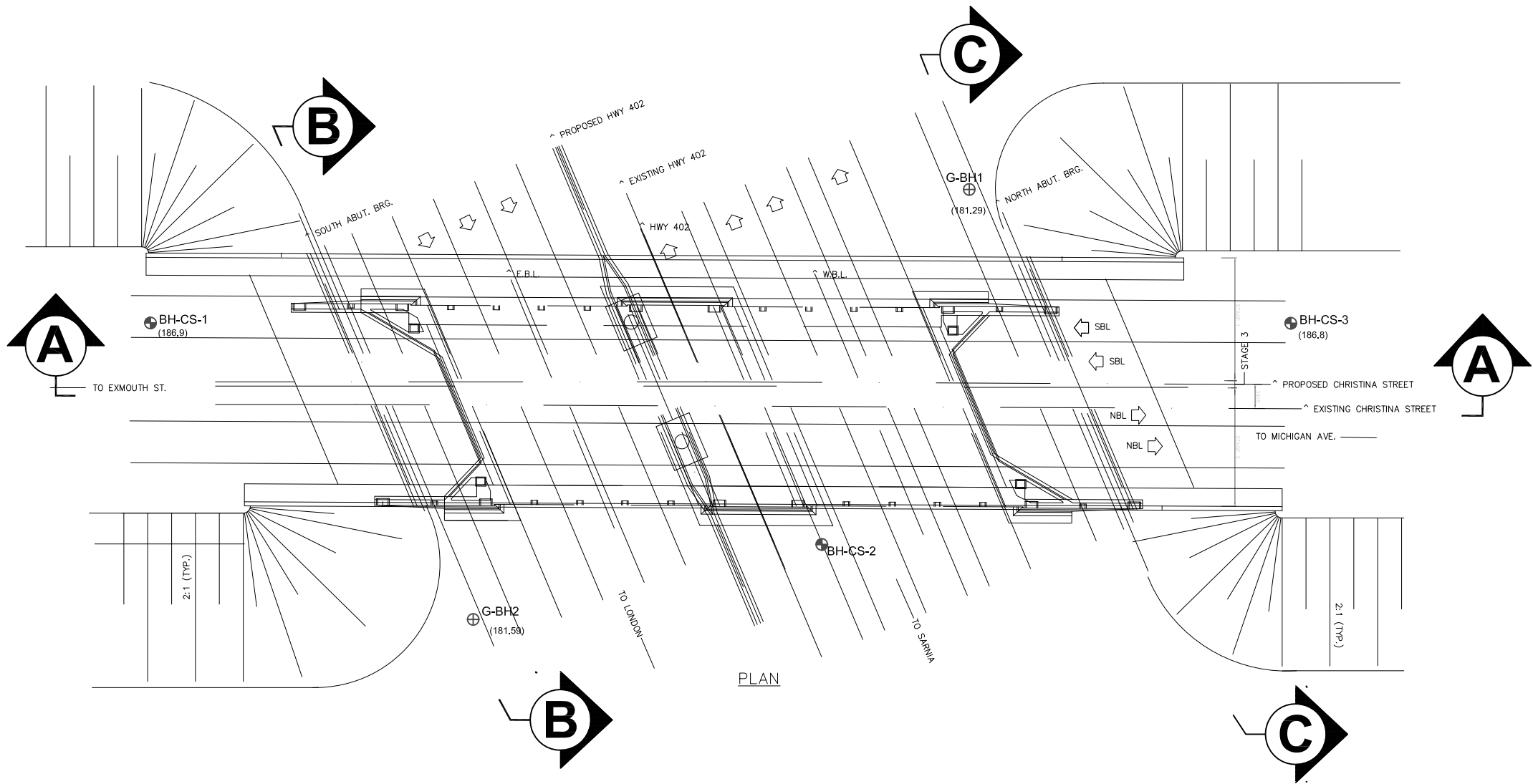
CHRISTINA STREET
UNDERPASS
BOREHOLE LOCATION PLAN

SHEET



KEY PLAN

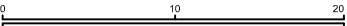
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LEGEND

- Borehole (Jacques Whitford, 2006)
- Borehole (By Golder, 2004)

BH No.	ELEVATION (m)	NORTHING	EASTING
CS-1	186.9	4 760 877.2	313 072.4
CS-2	181.6	4 760 908.3	313 107.7
CS-3	186.8	4 760 940.7	313 102.6
G-BH1	181.3	4 760 934.8	313 086.3
G-BH2	181.6	4 760 884.5	313 100.0



NOTES

The boundaries between soil strata have been established only at Bore Hole locations. Between Bore holes the boundaries are assumed from geological evidence.

NOTES: 1) The complete foundation investigation and design report for this project and other related documents may be examined at the Engineering Materials Office, Downsview. Information contained in this report and related documents is specifically excluded in accordance with the conditions.

2) Base plan provided by Stantec Consulting Ltd.

3) This drawing is for subsurface information only. Surface details and features are for conceptual illustration.

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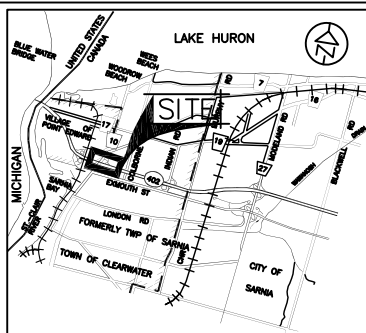
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HWY 402
CONT No —
WP No 3038-03-00



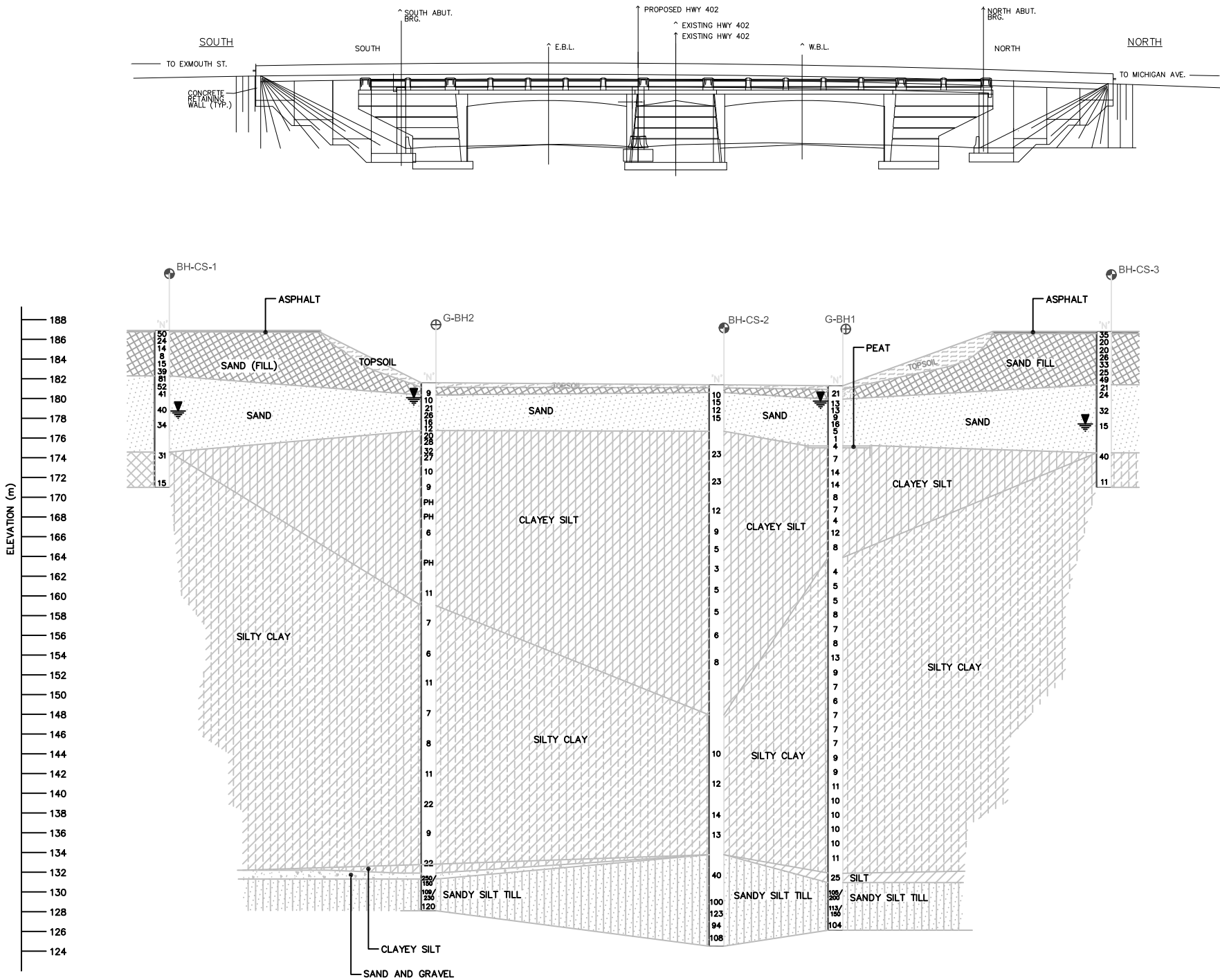
CHRISTINA STREET
UNDERPASS
SOIL STRATA SECTION A

SHEET



KEY PLAN

N.T.S

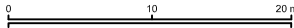


A-A SOIL PROFILE

LEGEND

- Borehole (Jacques Whitford, 2006)
- ⊕ Borehole (By Golder, 2004)
- ▽ WL at time of investigation 04 03

BH No.	ELEVATION (m)	NORTHING	EASTING
CS-1	186.9	4 760 877.2	313 072.4
CS-2	181.6	4 760 908.3	313 107.7
CS-3	186.8	4 760 940.7	313 102.6
G-BH1	181.3	4 760 934.8	313 086.3
G-BH2	181.6	4 760 884.5	313 100.0



NOTES

The boundaries between soil strata have been established only at Bore Hole locations. Between Bore holes the boundaries are assumed from geological evidence.

NOTES: 1) The complete foundation investigation and design report for this project and other related documents may be examined at the Engineering Materials Office, Downsview. Information contained in this report and related documents is specifically excluded in accordance with the conditions.

2) Base plan provided by Stantec Consulting Ltd.

3) This drawing is for subsurface information only. Surface details and features are for conceptual illustration.

REVISIONS				
NO.	DATE	BY	DESCRIPTION	
1				
GEOCRES No 40J16-78				
HWY No 402				DIST LONDON
SUBM'D GC	CHECKED	DATE 2008-09-24		SITE 14-37
DRAWN PC/HZ	CHECKED	APPROVED		DWG 3

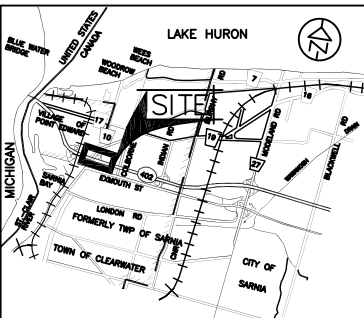
METRIC
DIMENSIONS ARE IN METRES
AND/OR MILLIMETRES
UNLESS OTHERWISE SHOWN

HWY 402
CONT No —
WP No 3038-03-00



CHRISTINA STREET
UNDERPASS
SOIL STRATA SECTION B AND C

SHEET



KEY PLAN

N.T.S.

LEGEND

- ⊕ Borehole (Jacques Whitford, 2006)
- ⊕ Borehole (By Golder, 2004)
- ↓ WL at time of investigation 04 03

BH No.	ELEVATION (m)	NORTHING	EASTING
CS-1	186.9	4 760 877.2	313 072.4
CS-3	186.8	4 760 940.7	313 102.6
G-BH1	181.3	4 760 934.8	313 086.3
G-BH2	181.6	4 760 884.5	313 100.0

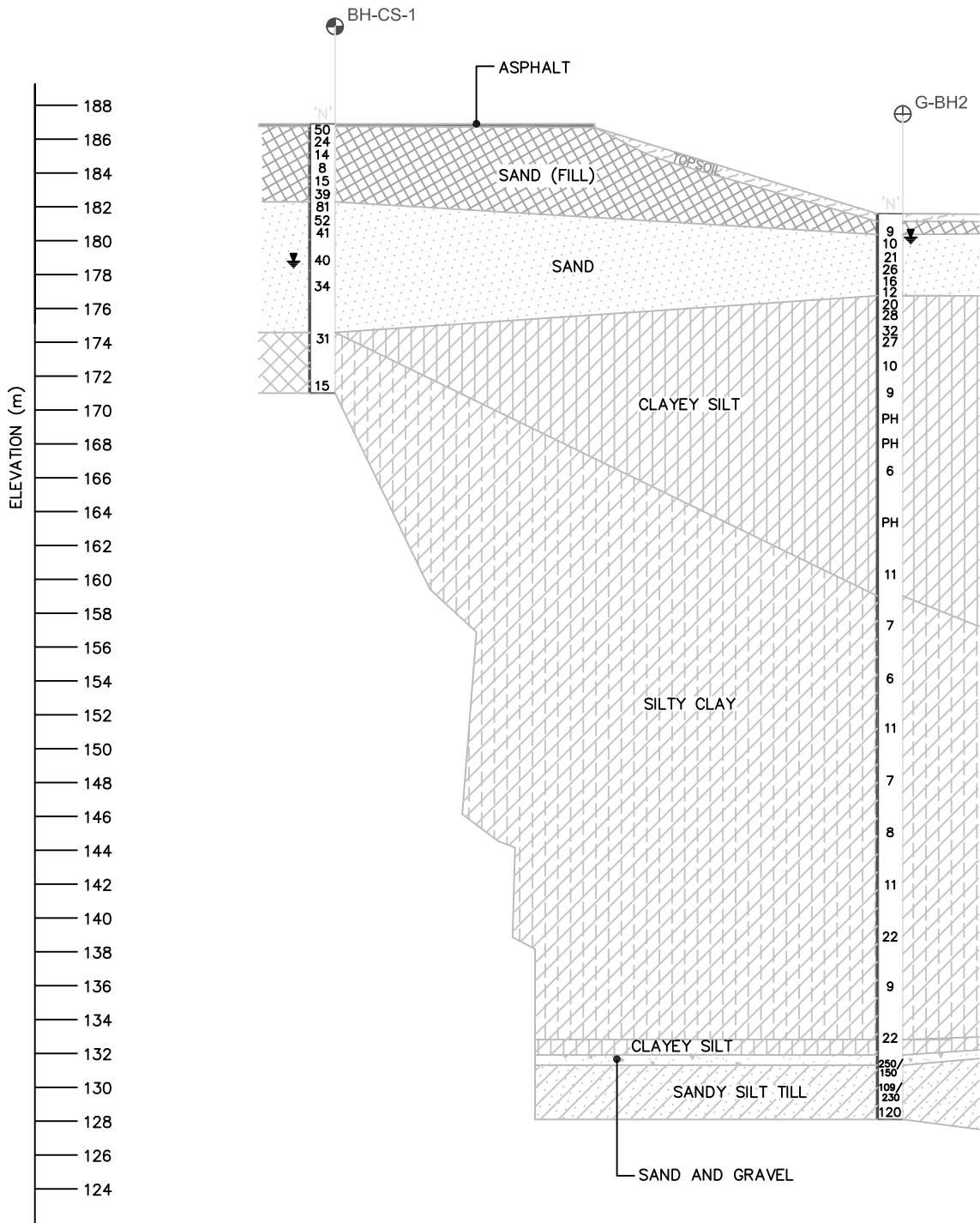
0 5 10 m

NOTES

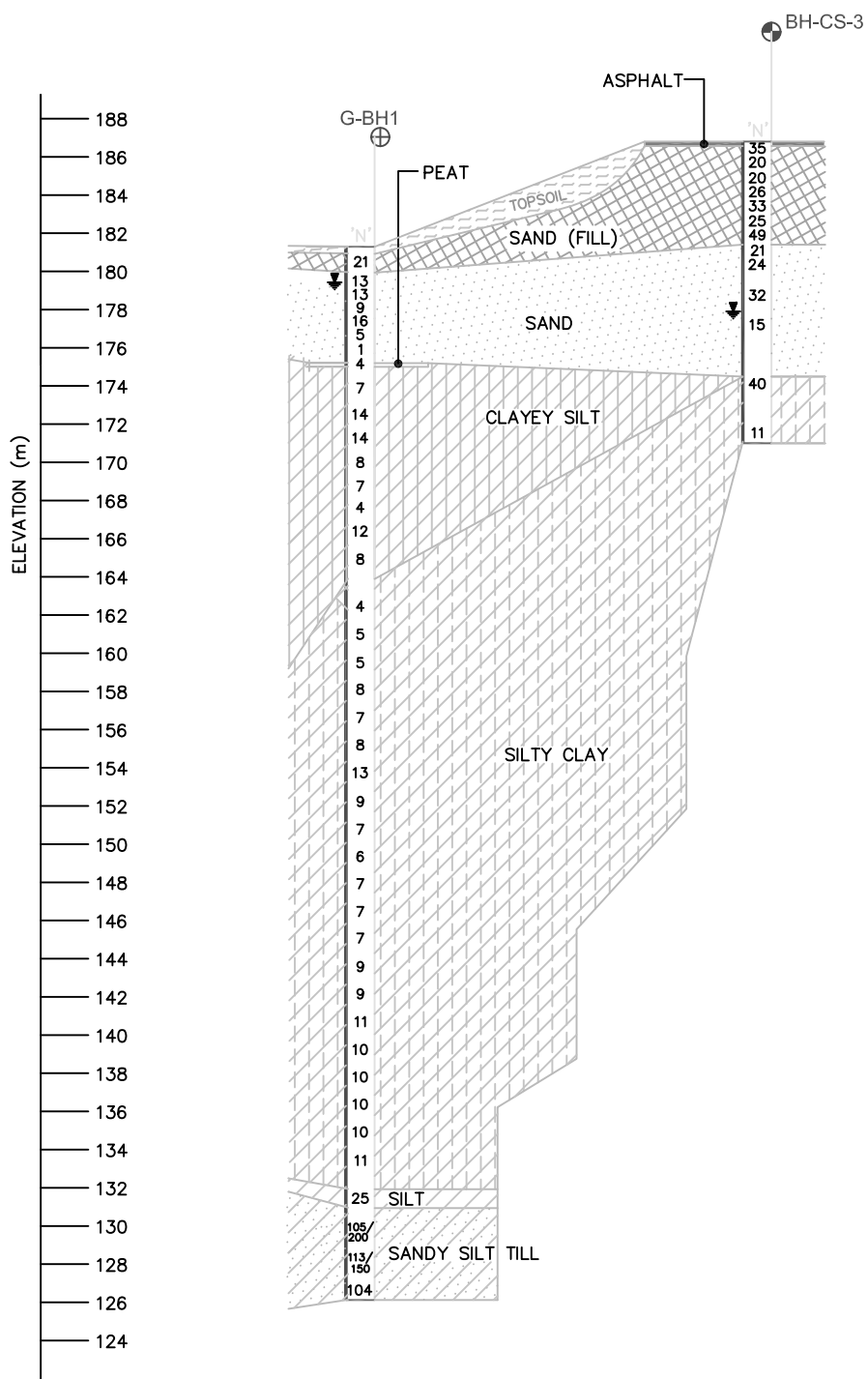
The boundaries between soil strata have been established only at Bore Hole locations. Between Bore holes the boundaries are assumed from geological evidence.

- NOTES: 1) The complete foundation investigation and design report for this project and other related documents may be examined at the Engineering Materials Office, Downsview. Information contained in this report and related documents is specifically excluded in accordance with the conditions.
- 2) Base plan provided by Stantec Consulting Ltd.
- 3) This drawing is for subsurface information only. Surface details and features are for conceptual illustration.

REVISIONS	DATE	BY	DESCRIPTION
1			
GEOID No 40J16-78			
HWY No 402			DIST LONDON
SUBM'D GC	CHECKED	DATE 2008-09-24	SITE 14-37
DRAIN PC/HZ	CHECKED	APPROVED	DWG 4



B-B SOIL PROFILE



C-C SOIL PROFILE

APPENDIX B

Terms and Symbols Used on the Record of Borehole Sheets
Record of Borehole Sheets

EXPLANATION OF TERMS USED IN REPORT

N VALUE: THE STANDARD PENETRATION TEST (SPT) N VALUE IS THE NUMBER OF BLOWS REQUIRED TO CAUSE A STANDARD 51mm O.D. SPLIT BARREL SAMPLER TO PENETRATE 0.3m INTO UNDISTURBED GROUND IN A BOREHOLE WHEN DRIVEN BY A HAMMER WITH A MASS OF 63.5kg, FALLING FREELY A DISTANCE OF 0.76m. FOR PENETRATIONS OF LESS THAN 0.3m N VALUES ARE INDICATED AS THE NUMBER OF BLOWS FOR THE PENETRATION ACHIEVED. AVERAGE N VALUE IS DENOTED THUS \bar{N} .

DYNAMIC CONE PENETRATION TEST: CONTINUOUS PENETRATION OF A CONICAL STEEL POINT (51mm O.D. 60° CONE ANGLE) DRIVEN BY 475 J IMPACT ENERGY ON 'A' SIZE DRILL RODS. THE RESISTANCE TO CONE PENETRATION IS MEASURED AS THE NUMBER OF BLOWS FOR EACH 0.3m ADVANCE OF THE CONICAL POINT INTO THE UNDISTURBED GROUND.

SOILS ARE DESCRIBED BY THEIR COMPOSITION AND CONSISTENCY OR DENSENESS.

CONSISTENCY: COHESIVE SOILS ARE DESCRIBED ON THE BASIS OF THEIR UNDRAINED SHEAR STRENGTH (c_u) AS FOLLOWS:

c_u (kPa)	0 - 12	12 - 25	25 - 50	50 - 100	100 - 200	> 200
	VERY SOFT	SOFT	FIRM	STIFF	VERY STIFF	HARD

DENSENESS: COHESIONLESS SOILS ARE DESCRIBED ON THE BASIS OF DENSENESS AS INDICATED BY SPT N VALUES AS FOLLOWS:

N (BLOWS/0.3m)	0 - 5	5 - 10	10 - 30	30 - 50	> 50
	VERY LOOSE	LOOSE	COMPACT	DENSE	VERY DENSE

ROCKS ARE DESCRIBED BY THEIR COMPOSITION AND STRUCTURAL FEATURES AND / OR STRENGTH.

RECOVERY: SUM OF ALL RECOVERED ROCK CORE PIECES FROM A CORING RUN EXPRESSED AS A PERCENT OF THE TOTAL LENGTH OF THE CORING RUN.

MODIFIED RECOVERY: SUM OF THOSE INTACT CORE PIECES, 100mm+ IN LENGTH EXPRESSED AS A PERCENT OF THE LENGTH OF THE CORING RUN. THE ROCK QUALITY DESIGNATION (RQD), FOR MODIFIED RECOVERY, IS:

RQD (%)	0 - 25	25 - 50	50 - 75	75 - 90	90 - 100
	VERY POOR	POOR	FAIR	GOOD	EXCELLENT

JOINTING AND BEDDING:

SPACING	50mm	50 - 300mm	0.3m - 1m	1m - 3m	> 3m
JOINTING	VERY CLOSE	CLOSE	MOD. CLOSE	WIDE	VERY WIDE
BEDDING	VERY THIN	THIN	MEDIUM	THICK	VERY THICK

ABBREVIATIONS AND SYMBOLS

FIELD SAMPLING

S S	SPLIT SPOON	T P	THINWALL PISTON
W S	WASH SAMPLE	O S	OSTERBERG SAMPLE
S T	SLOTTED TUBE SAMPLE	R C	ROCK CORE
B S	BLOCK SAMPLE	P H	T W ADVANCED HYDRAULICALLY
C S	CHUNK SAMPLE	P M	T W ADVANCED MANUALLY
T W	THINWALL OPEN	F S	FOIL SAMPLE

STRESS AND STRAIN

u_w	kPa	PORE WATER PRESSURE
r_u	1	PORE PRESSURE RATIO
σ	kPa	TOTAL NORMAL STRESS
σ'	kPa	EFFECTIVE NORMAL STRESS
τ	kPa	SHEAR STRESS
$\sigma_1, \sigma_2, \sigma_3$	kPa	PRINCIPAL STRESSES
ϵ	%	LINEAR STRAIN
$\epsilon_1, \epsilon_2, \epsilon_3$	%	PRINCIPAL STRAINS
E	kPa	MODULUS OF LINEAR DEFORMATION
G	kPa	MODULUS OF SHEAR DEFORMATION
μ	1	COEFFICIENT OF FRICTION

MECHANICAL PROPERTIES OF SOIL

m_v	kPa ⁻¹	COEFFICIENT OF VOLUME CHANGE
C_c	1	COMPRESSION INDEX
C_s	1	SWELLING INDEX
C_α	1	RATE OF SECONDARY CONSOLIDATION
C_v	m ² /s	COEFFICIENT OF CONSOLIDATION
H	m	DRAINAGE PATH
T_v	1	TIME FACTOR
U	%	DEGREE OF CONSOLIDATION
σ'_{vo}	kPa	EFFECTIVE OVERBURDEN PRESSURE
σ'_p	kPa	PRECONSOLIDATION PRESSURE
τ_f	kPa	SHEAR STRENGTH
c'	kPa	EFFECTIVE COHESION INTERCEPT
ϕ'	-°	EFFECTIVE ANGLE OF INTERNAL FRICTION
c_u	kPa	APPARENT COHESION INTERCEPT
ϕ_u	-°	APPARENT ANGLE OF INTERNAL FRICTION
τ_R	kPa	RESIDUAL SHEAR STRENGTH
τ_r	kPa	REMOULDED SHEAR STRENGTH
S_t	1	SENSITIVITY = $\frac{c_u}{\tau_r}$

PHYSICAL PROPERTIES OF SOIL

ρ_s	kg/m ³	DENSITY OF SOLID PARTICLES	e	1, %	VOID RATIO	e_{min}	1, %	VOID RATIO IN DENSEST STATE
γ_s	kn/m ³	UNIT WEIGHT OF SOLID PARTICLES	n	1, %	POROSITY	I_D	1	DENSITY INDEX = $\frac{e_{max} - e}{e_{max} - e_{min}}$
ρ_w	kg/m ³	DENSITY OF WATER	w	1, %	WATER CONTENT	D	mm	GRAIN DIAMETER
γ_w	kn/m ³	UNIT WEIGHT OF WATER	S_r	%	DEGREE OF SATURATION	D_n	mm	n PERCENT - DIAMETER
P	kg/m ³	DENSITY OF SOIL	w_L	%	LIQUID LIMIT	C_u	1	UNIFORMITY COEFFICIENT
γ	kn/m ³	UNIT WEIGHT OF SOIL	w_p	%	PLASTIC LIMIT	h	m	HYDRAULIC HEAD OR POTENTIAL
ρ_d	kg/m ³	DENSITY OF DRY SOIL	w_s	%	SHRINKAGE LIMIT	q	m ³ /s	RATE OF DISCHARGE
γ_d	kn/m ³	UNIT WEIGHT OF DRY SOIL	I_p	%	PLASTICITY INDEX = $w_L - w_p$	v	m/s	DISCHARGE VELOCITY
ρ_{sat}	kg/m ³	DENSITY OF SATURATED SOIL	I_L	1	LIQUIDITY INDEX = $\frac{w - w_p}{I_p}$	i	1	HYDRAULIC GRADIENT
γ_{sat}	kn/m ³	UNIT WEIGHT OF SATURATED SOIL	I_C	1	CONSISTENCY INDEX = $\frac{w_L - w}{I_p}$	k	m/s	HYDRAULIC CONDUCTIVITY
ρ'	kg/m ³	DENSITY OF SUBMERGED SOIL	e_{max}	1, %	VOID RATIO IN LOOSEST STATE	j	kn/m ²	SEEPAGE FORCE
γ'	kn/m ³	UNIT WEIGHT OF SUBMERGED SOIL						

RECORD OF BOREHOLE No CS-1

1 OF 2

METRIC

W.P. 3038-03-00 LOCATION Christina St. Str.: 10+035 o/s: 5.5 m Rt; N4760877.2, E313072.4 ORIGINATED BY KH
 DIST London HWY 402 BOREHOLE TYPE Hollow Stem Auger, Split Spoon COMPILED BY MW
 DATUM Geodetic DATE 11.8.06 CHECKED BY GC

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W _P	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									WATER CONTENT (%)		
								○ UNCONFINED	✕ FIELD VANE	● QUICK TRIAXIAL	✕ LAB VANE								
186.9	Christina St S.B. D.L.						20	40	60	80	100								
186.0	150 mm ASPHALT		1A	SS	50														
0.2	SAND (FILL), trace gravel, trace silt and clay, damp, compact to dense, brown (SW) - trace gravel		1B																
			2	SS	24														
			3	SS	14														
	- dark brown loose		4	SS	8											9	86 (4)		
	- brown compact		5A	SS	15														
	- some gravel		5B																
			6A	SS	39														
182.3			6B																
4.6	SAND, with gravel, trace silt and clay, damp, very dense to dense, brown (SP)		7	SS	81														
	- trace gravel, moist		8	SS	52														
			9	SS	41											0	94 (6)		
			10	SS	40														
	- wet		11	SS	34														
	- saturated																		
174.6	- some silt		12A	SS	31														
12.2	Silty CLAY, with sand, trace gravel, damp, hard to stiff, brown (CL)		12B													3	32 40 25		
172.4	- grey, trace sand, wet																		
14.5																			

Continued Next Page

\times^3, \times^3 : Numbers refer to Sensitivity \circ 3% STRAIN AT FAILURE

METRIC

\times^3, \times^3 : Numbers refer to Sensitivity

 $\bigcirc^{3\%}$ STRAIN AT FAILURE

RECORD OF BOREHOLE No CS-2

1 OF 4

METRIC

W.P. 3038-03-00 LOCATION Highway 402, Stn.: 11+250 o/s: C.L.; N4760908.3, E313107.7 ORIGINATED BY KH
 DIST London HWY 402 BOREHOLE TYPE Hollow Stem Auger, Tricone, Split Spoon COMPILED BY MW
 DATUM Geodetic DATE 12.6.06 - 12.12.06 CHECKED BY GC

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT NATURAL MOISTURE LIQUID CONTENT LIMIT			UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%)					
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					WATER CONTENT (%)			GR	SA	SI	CL	
								○ UNCONFINED × FIELD VANE					w _p w w _L							
								● QUICK TRIAXIAL × LAB VANE												
181.6	Hwy 402 Median Ditch						20	40	60	80	100	10	20	30						
0.0	SAND (FILL), trace silt, trace gravel, trace organic matter, moist, brown (SW)																			
180.8																				
0.8	SAND, some silt, trace gravel, wet, compact, brown (SP)		1	SS	10															
			2	SS	15															
179.3																				
2.3	Silty SAND, trace organic matter, wet, compact, grey (SM)		3	SS	12															
			4	SS	15															
176.9			5a																	
4.7	Clayey SILT, trace gravel, trace sand, wet, very stiff, grey (CL)		5b	SS	23															
			6	SS	23															
	- stiff		7	SS	12															
			8	SS	9															
	- firm		9	SS	5															
			10	TW																
	- soft		11	SS	3															

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\times^3, \times^3 : Numbers refer to Sensitivity \bigcirc 3% STRAIN AT FAILURE

METRIC

\times^3, \times^3 : Numbers refer to Sensitivity


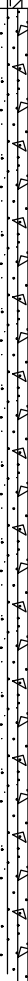
 $\bigcirc^{3\%}$ STRAIN AT FAILURE

METRICContinued Next Page

\times^3, \times^3 : Numbers refer to Sensitivity
 $\bigcirc^{3\%}$ STRAIN AT FAILURE

METRIC

W.P.	3038-03-00	LOCATION	Highway 402, Strn.: 11+250 o/s: C.L.; N4760908.3, E313107.7	ORIGINATED BY	KH
DIST	London	HWY	402	BOREHOLE TYPE	Hollow Stem Auger, Tricone, Split Spoon
				COMPILED BY	MW
DATUM	Geodetic	DATE	12.6.06 - 12.12.06	CHECKED BY	GC

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 ● QUICK TRIAXIAL	✕ FIELD VANE ✕ LAB VANE	20	40				60	80	100
								20	40	60	80	100	10	20	30		
134.3 47.2	Silty CLAY, trace gravel, trace sand, wet, hard, grey (CL) <i>(continued)</i>						136										
			24	SS	13		135										
							134										
							133										
			25	SS	40		132										
							131										
							130										
		- some gravel		26	SS		100	129									
				27	SS		123	128									
				28	SS		94	127									
124.6 57.0						126											
	END OF BOREHOLE at approximately 57.0 m		29	SS	108	125											

RECORD OF BOREHOLE No CS-3

1 OF 2

METRIC

W.P. 3038-03-00 LOCATION Christina St. Str.: 9+965 o/s: 5.5 m Rt; N4760940.7, E313102.6 ORIGINATED BY KH
 DIST London HWY 402 BOREHOLE TYPE Hollow Stem Auger, Split Spoon COMPILED BY MW
 DATUM Geodetic DATE 11.8.06 CHECKED BY GC

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
								○ UNCONFINED		✕ FIELD VANE							
								● QUICK TRIAXIAL		✕ LAB VANE							
							WATER CONTENT (%)										
186.8	Christina St S.B. D.L.						20	40	60	80	100					GR SA SI CL	
186.0	200 mm ASPHALT																
0.2	SAND (FILL), trace gravel, trace silt and clay, moist, compact to dense, brown (SW)		1A	SS	35												
	- trace gravel		1B	SS													
			2	SS	20		186										
	- some gravel		3	SS	20		185					○			18 76 (6)		
			4	SS	26		184										
	- trace organic matter		5	SS	33		183										
	- some organic matter		6	SS	25		182										
	- 50 mm black sand seam		7	SS	49												
181.5																	
5.3	SAND, Brown, trace gravel, trace silt and clay, moist, compact to dense, brown (SP)		8	SS	21		181										
			9	SS	24		180										
	- trace silt, wet		10	SS	32		179										
178.1																	
8.7	- grey						178										
	- some silt and clay		11	SS	15		177					○			0 89 (12)		
	- compact																
							176										
174.6							175										
12.2	Silty CLAY, with sand, trace gravel, damp, hard to stiff, brown (CL)		12	SS	40		174										
							173										
172.4																	
14.5	- grey, wet						172										
	Stiff																

Continued Next Page

\times^3, \times^3 : Numbers refer to Sensitivity \circ^3 STRAIN AT FAILURE

RECORD OF BOREHOLE No CS-3

2 OF 2

METRIC

W.P. 3038-03-00 LOCATION Christina St. Stn.: 9+965 o/s: 5.5 m Rt; N4760940.7, E313102.6 ORIGINATED BY KH
 DIST London HWY 402 BOREHOLE TYPE Hollow Stem Auger, Split Spoon COMPILED BY MW
 DATUM Geodetic DATE 11.8.06 CHECKED BY GC





SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE LIQUID CONTENT			UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%)				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa		WATER CONTENT (%)				GR	SA	SI	CL	
								20 40 60 80 100		W _p W W _L								
								○ UNCONFINED × FIELD VANE ● QUICK TRIAXIAL × LAB VANE										
								20 40 60 80 100		10 20 30								

RECORD OF BOREHOLE No CS-4

1 OF 1

METRIC

W.P. 3038-03-00 LOCATION Christina St. Stn.: 9+925 o/s: 8.0 m Lt; N4760974.3, E313133.6 ORIGINATED BY JP
 DIST London HWY 402 BOREHOLE TYPE Hollow Stem Auger, Split Spoon COMPILED BY MW
 DATUM Geodetic DATE 10.31.06 CHECKED BY GC

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 (%)				
								20 40 60 80 100					W _p W W _L				
182.4	Christina St N.B. D.L.																
180.0	180 mm ASPHALT																
0.2	SAND (FILL), with gravel, some silt and clay, damp, dense to very dense, brown (SW)		1	SS	36		182								37 51 (12)		
	- trace gravel, moist		2	SS	19		181										
	- trace silt and clay, trace organic matter		3	SS	17		180									10 83 (7)	
			4	SS	15												
	- loose		5	SS	6		179										
	- some gravel		6	SS	6		178										
	- very loose - some organic matter		7	SS	4												
177.0	SAND, some silt and clay, moist, compact to dense, brown (SP)		8	SS	22		177									0 86 (13)	
5.3	- wet		9	SS	26		176										
175.5	- grey		10	SS	33		175										
6.9			11	SS	18			174									
								173									
172.9	Silty CLAY, some sand, trace gravel, moist, stiff to very stiff, grey (CL)		12	SS	17			172								3 17 42 38	
9.4			13	SS	30			171									
							170										
			14	SS	11												
169.6																	
12.8	END OF BOREHOLE at approximately 12.8 m																
	Groundwater measured at a depth of approximately 6.1 m (Elev. 176.3 m) on completion of drilling.																

\times^3, \times^3 : Numbers refer to Sensitivity \circ^3 STRAIN AT FAILURE

ONTARIO MOT 1012607.GPJ ONTARIO MOT.GDT 11/19/08

METRIC

\times^3, \times^3 : Numbers refer to Sensitivity

 $\bigcirc^{3\%}$ STRAIN AT FAILURE






ONTARIO MOT 1012607.GPJ ONTARIO MOT.GDT 11/19/08

RECORD OF BOREHOLE No CS-7

1 OF 1

METRIC

W.P. 3038-03-00 LOCATION Christina St. E-N Ramp Stn.: 10+100 o/s: 4.0 m Rt; N4760961.6, E313279.1 ORIGINATED BY KH
 DIST London HWY 402 BOREHOLE TYPE Hollow Stem Auger, Split Spoon COMPILED BY MW
 DATUM Geodetic DATE 11.10.06 CHECKED BY GC

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)							
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa				W _p W W _L				GR	SA	SI	CL				
								20	40	60	80	100	20	40						60	80	100	10
183.1	Christina St E-N Ramp, Rt. Shoulder		1	SS	24		182									28	67	(5)					
0.0	SAND (FILL), with gravel, trace silt and clay, trace asphalt fragment, moist, compact, brown (SW)		2	SS	12																		
181.5																							
1.5	SAND, trace gravel, trace silt and clay, moist, compact to dense, brown (SP)		3	SS	11			181													0	90	(10)
			4	SS	30																		
	- no gravel, wet		5	SS	32																		
			6	SS	36																		
178.5	- grey		7	SS	34			178															
4.6																							
177.4	Silty CLAY, some sand, trace gravel, moist, hard, grey (CL)		8	SS	36	177																	
5.6																							
	- trace gravel and sand		9	SS	42		176																
174.8	END OF BOREHOLE at approximately 8.2 m Water first encountered on spoon at a depth of approximately 3.0 m (180.1 m) below grade Borehole caved to a depth of approximately 2.6 m (Elev. 180.5 m) on completion of drilling				175																		
8.2																							

RECORD OF BOREHOLE No CS-8

1 OF 1

METRIC

W.P. 3038-03-00 LOCATION Christina St. E-N Ramp Str.: 10+040 o/s: 3.5 m Rt; N4760931.3, E313327.9 ORIGINATED BY KH
 DIST London HWY 402 BOREHOLE TYPE Hollow Stem Auger, Split Spoon COMPILED BY MW
 DATUM Geodetic DATE 11.10.06 CHECKED BY GC

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					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												
								20 40 60 80 100												
								○ UNCONFINED × FIELD VANE ● QUICK TRIAXIAL × LAB VANE												
WATER CONTENT (%)					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT w _p w w _L															
183.5	Christina St E-N Ramp, Rt. Shoulder		1	SS	23		183													
0.0	SAND (FILL), with gravel, trace silt, damp, compact to dense, brown (SW)		2	SS	38		182													
	- trace silt																			
181.9			3	SS	16		181													
1.5	SAND, trace gravel, trace silt and clay, moist, compact to dense, brown (SP)		4	SS	26		180													
	- wet		5	SS	26		179													
			6	SS	36		178													
178.9			7	SS	33		177													
4.6	- grey, some silt and clay, no gravel						176													
177.8			8	SS	24															
5.6	Silty CLAY, some sand, trace gravel, wet, very stiff, grey (CL)																			
	- trace sand		9	SS	29															
175.2																				
8.2	END OF BOREHOLE at approximately 8.2 m																			
	Water first encountered on spoon at a depth of approximately 4.0 m (179.5 m) below grade																			
	Borehole caved to a depth of approximately 2.9 m (Elev. 180.6 m) on completion of drilling																			

RECORD OF BOREHOLE No R-1

1 OF 1

METRIC

W.P. 3038-03-00 LOCATION Christina St. Str.: 10+145 o/s: 5.5 m Rt; N4760780.2, E313025.7 ORIGINATED BY KH
 DIST London HWY 402 BOREHOLE TYPE Hollow Stem Auger, Split Spoon COMPILED BY MW
 DATUM Geodetic DATE 11.9.06 - 11.9.06 CHECKED BY GC

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
								20 40 60 80 100						
								○ UNCONFINED ✕ FIELD VANE ● QUICK TRIAXIAL ✕ LAB VANE						
							WATER CONTENT (%)							
							w _p w w _L							
							PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT							
183.4	Christina St S.B. D.L.													
180.0	150 mm ASPHALT													
0.2	SAND (FILL), some gravel, trace silt, trace organic matter, damp, very dense to compact, brown (SW)		1	SS	88		183							
	- augers grinding on possible cobble or boulder		2	SS	19									
			3A	SS			182							
	- trace gravel		3B	SS	10									
181.1														
2.3	SAND, trace gravel, trace silt and clay, moist, dense, brown (SP)		4	SS	31		181							
	- saturated		5	SS	37		180							
			6	SS	34		179							
			7	SS	33									
177.8							178							
5.6	- grey		8	SS	39		177							
							176							
175.8	Clayey SILT, some sand, wet, very soft to firm, grey (CL)		9	SS	2		175							
	- trace sand		10	SS	5		174							
173.7														
9.8	END OF BOREHOLE at approximately 9.8 m Water first encountered on spoon at a depth of approximately 4.0 m (179.4 m) below grade Borehole caved to a depth of approximately 3.3 m (Elev. 180.1 m) on completion of drilling													

Numbers refer to
Sensitivity

STRAIN AT FAILURE

RECORD OF BOREHOLE No R-2

1 OF 2

METRIC

W.P. 3038-03-00 LOCATION Christina St. Str.: 10+100 o/s: 5.5 m Rt; N4760821.0, E313045.6 ORIGINATED BY KH
 DIST London HWY 402 BOREHOLE TYPE Hollow Stem Auger, Split Spoon COMPILED BY MW
 DATUM Geodetic DATE 11.9.06 - 11.9.06 CHECKED BY GC

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa								WATER CONTENT (%)		
								○ UNCONFINED	✕ FIELD VANE									
								● QUICK TRIAXIAL	✕ LAB VANE									
184.8	Christina St S.B. D.L.						20	40	60	80	100							
184.0	150 mm ASPHALT																	
0.2	SAND (FILL), some gravel, trace silt and clay, moist, dense, brown (SW)		1	SS	44													
184.0																		
183.8	150 mm Silty CLAY (FILL), some sand, trace gravel, damp, grey (CL)		2A	SS														
0.9	SAND (FILL), trace gravel, trace silt and clay, moist, compact, brown (SW)		2B	SS	29													
183.3																		
183.2			3A	SS														
1.6	100 mm Silty CLAY (FILL), some sand, trace gravel, damp, grey (CL)		3B	SS	17													
182.5	SAND (FILL), trace gravel, trace silt and clay, moist, compact, brown (SW)		4A	SS														
2.3	SAND, some gravel, trace silt and clay, moist, dense to compact, brown (SP)		4B	SS	52													
			5	SS	25													
			6	SS	26													
			7	SS	30													
179.2	- grey																	
5.6			8	SS	31													
			9	SS	12													
175.6	Silty CLAY, trace gravel, trace sand, damp, hard to very stiff, grey (CL)		10A	SS														
9.2			10B	SS	40													
											</							

Continued Next Page


Numbers refer to Sensitivity \times^3, \times^3 \circ 3% STRAIN AT FAILURE

RECORD OF BOREHOLE No R-2

2 OF 2

METRIC

W.P. 3038-03-00 LOCATION Christina St. Str.: 10+100 o/s: 5.5 m Rt; N4760821.0, E313045.6 ORIGINATED BY KH
 DIST London HWY 402 BOREHOLE TYPE Hollow Stem Auger, Split Spoon COMPILED BY MW
 DATUM Geodetic DATE 11.9.06 - 11.9.06 CHECKED BY GC





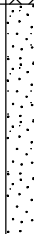









SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa					WATER CONTENT (%)			
						20	40	60	80	100	W _p	W	W _L	kN/m ³	GR SA SI CL	
168.9	Silty CLAY, trace gravel, trace sand, damp, hard to very stiff, grey (CL) (continued)		12	SS	8										2 16 45 38	
15.8	END OF BOREHOLE at approximately 15.8 m Water first encountered on spoon at a depth of approximately 6.1 m (178.7 m) below grade Borehole caved to a depth of approximately 4.4 m (Elev. 180.4 m) on completion of drilling															

RECORD OF BOREHOLE No R-3

1 OF 1

METRIC

W.P. 3038-03-00 LOCATION Christina St. S-E Ramp Stn.: 9+985 o/s: 3.0 m Rt; N4760777.0, E313043.1 ORIGINATED BY KH
 DIST London HWY 402 BOREHOLE TYPE Hollow Stem Auger, Split Spoon COMPILED BY MW
 DATUM Geodetic DATE 11.10.06 - 11.10.06 CHECKED BY GC

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 (%)					
183.7 0.0	Christina St S-E Ramp, Rt. Shoulder SAND (FILL), with gravel, some silt, some organic matter, moist, compact, brown (SW)		1	SS	17		20	40	60	80	100				GR SA SI CL	
			2	SS	15											
182.0 1.7	SAND, trace gravel, trace silt and clay, moist, compact, brown (SP)		3	SS	14											3 95 (2)
			4	SS	24											
			5	SS	24											
179.6 4.1	- grey, wet		6	SS	21											
			7	SS	14											
	- some silt and clay															
175.8 7.9	Silty CLAY, trace gravel, trace sand, moist, hard, grey (CL)		8	SS	39											
173.9 9.8	END OF BOREHOLE at approximately 9.8 m Water first encountered on spoon at a depth of approximately 4.6 m (179.1 m) below grade Borehole caved to a depth of approximately 3.5 m (Elev. 180.2 m) on completion of drilling															

\times^3, \times^3 : Numbers refer to Sensitivity \circ 3% STRAIN AT FAILURE

RECORD OF BOREHOLE No R-4

1 OF 1

METRIC

W.P. 3038-03-00 LOCATION Christina St. S-E Ramp Stn.: 10+077 o/s: 2.0 m Rt; N4760858.0, E313093.2 ORIGINATED BY KH
 DIST London HWY 402 BOREHOLE TYPE Hollow Stem Auger, Split Spoon COMPILED BY MW
 DATUM Geodetic DATE 11.10.06 - 11.10.06 CHECKED BY GC

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa										WATER CONTENT (%)		
								○ UNCONFINED × FIELD VANE												
								● QUICK TRIAXIAL × LAB VANE												
184.0	Christina St S-E Ramp, D.L.						20	40	60	80	100									
180.0	180 mm ASPHALT																			
0.2	SAND (FILL), some silt, some organic matter, trace gravel, trace clay, moist, compact, brown (SW)		1	SS	30															
183.1	SAND, trace gravel, trace silt and clay, moist, compact to dense, brown (SP)		2	SS	23															
0.9			3	SS	37															
			4	SS	14															
			5	SS	23															
179.9	- grey																			
4.1	- wet		6	SS	33															
	- some silt		7	SS	27															
176.1	Silty CLAY, trace gravel, trace sand, moist, hard, grey (CL)																			
7.9																				
			8	SS	43															
174.2	END OF BOREHOLE at approximately 9.8 m																			
9.8	Water first encountered on spoon at a depth of approximately 4.0 m (180.0 m) below grade																			
	Borehole caved to a depth of approximately 3.7 m (Elev. 180.3 m) on completion of drilling																			

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

RECORD OF BOREHOLE No R-5

1 OF 1

METRIC

W.P. 3038-03-00 LOCATION Christina St. S-E Ramp Stn.: 10+133 o/s: 2.0 m Rt; N4760880.2, E313140.8 ORIGINATED BY KH
 DIST London HWY 402 BOREHOLE TYPE Hollow Stem Auger, Split Spoon COMPILED BY MW
 DATUM Geodetic DATE 11.10.06 - 11.10.06 CHECKED BY GC

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%)				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa			W _p W W _L								
								○ UNCONFINED × FIELD VANE ● QUICK TRIAXIAL × LAB VANE	WATER CONTENT (%)										
183.0	Christina St S-E Ramp, D.L.							20	40	60	80	100				GR	SA	SI	CL
182.0	200 mm ASPHALT																		
0.2	SAND (FILL), some gravel, trace silt and clay, moist, very dense, brown (SW)		1	SS	60														
182.1	SAND, some gravel, trace silt and clay, moist, very dense to compact, brown (SP)		2	SS	52		182										16	80	(4)
0.9																			
			3	SS	37														
			4	SS	29														
	- wet		5	SS	30		180												
178.9	- grey						179												
4.1			6	SS	26		178												
177.4	Silty CLAY, trace gravel, trace sand, wet, stiff to very stiff, grey (CL)		7	SS	14		177												
5.6							176												
							175												
	- with sand, moist		8	SS	22		174							W _n = 14%		7	28	40	24
173.3	END OF BOREHOLE at approximately 9.8 m																		
9.8	Water first encountered on spoon at a depth of approximately 3.5 m (179.5 m) below grade																		
	Borehole caved to a depth of approximately 3.0 m (Elev. 180.0 m) on completion of drilling																		

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

PROJECT <u>041-130099-2</u>	RECORD OF BOREHOLE No BH1		1 OF 4	METRIC
G.W.P. <u>3038-03-00</u>	LOCATION <u>N 4760934.8 E 313088.3</u>	ORIGINATED BY <u>MA</u>		
DIST <u>1</u> HWY <u>402</u>	BOREHOLE TYPE <u>POWER AUGER/HOLLOW STEM & MUD ROTARY</u>	COMPILED BY <u>BG</u>		
DATUM <u>GEODETIC</u>	DATE <u>July 12, 2004 - July 15, 2004</u>	CHECKED BY <u><i>[Signature]</i></u>		

[illegible]

Continued Next Page

+³, X³: Numbers refer to Sensitivity ○^{3%} STRAIN AT FAILURE

PROJECT 041-130099-2

RECORD OF BOREHOLE No BH1

2 OF 4

METRIC

G.W.P. 3038-03-00

LOCATION N 4760934.8 E 313088.3

ORIGINATED BY MA

DIST 1 HWY 402

BOREHOLE TYPE POWER AUGER/HOLLOW STEM & MUD ROTARY

COMPILED BY BG

DATUM GEODETIC

DATE July 12, 2004 - July 15, 2004

CHECKED BY *RJB*

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT Y kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100		
	CLAYEY SILT, trace to some sand, trace to some gravel Firm to very stiff Grey		15	SS	12		166							
			16	SS	8		165							
163.92							164							
17.37	SILTY CLAY, trace sand, trace gravel, Firm to stiff, Grey		17	SS	4		163							
			18	SS	5		162							
			19	SS	5		161							
			20	SS	8		160							
			21	SS	7		159							
			22	SS	8		158							
			23	SS	13		157							
			24	SS	9		156							
							155							
							154							
							153							
							152							

ON MTO 041-130099-2.GPJ ON MOT.GDT 10/12/05

Continued Next Page

+3, x3: Numbers refer to Sensitivity
○ 3% STRAIN AT FAILURE

PROJECT <u>041-130099-2</u>		RECORD OF BOREHOLE No BH1		4 OF 4	METRIC
G.W.P. <u>3038-03-00</u>	LOCATION <u>N 4780934.8 E 313085.3</u>	ORIGINATED BY <u>MA</u>			
DIST <u>1</u> HWY <u>402</u>	BOREHOLE TYPE <u>POWER AUGER/HOLLOW STEM & MUD ROTARY</u>	COMPILED BY <u>BG</u>			
DATUM <u>GEODETIC</u>	DATE <u>July 12, 2004 - July 15, 2004</u>	CHECKED BY <u>[Signature]</u>			

[illegible]

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

RECORD OF BOREHOLE No BH2

1 OF 4

METRIC

PROJECT 041-130099-2

G.W.P. 3038-03-00

LOCATION N 4761884.5 E 313100.0

ORIGINATED BY MA

DIST 1 HWY 402

BOREHOLE TYPE POWER AUGER/HOLLOW STEM & MUD ROTARY/TRI-CONE

COMPILED BY BG

DATUM GEODETIC

DATE July 19, 2004 - July 20, 2004

CHECKED BY *[Signature]*

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									
								20	40	60						80	100
181.59	GROUND SURFACE																
0.00	TOPSOIL, sandy, some gravel, Brown																
181.16																	
0.43	FILL, fine to medium sand, some gravel, trace silt, Loose, Brown		1	SS	9												
180.37																	
1.22	SAND, fine, trace to some silt layered Compact, Brown becoming grey at about elev. 178.0m		2	SS	10												
			3	SS	21												
			4	SS	26												
			5	SS	16												
			6	SS	12												
175.71																	
4.88	CLAYEY SILT, trace to some sand, trace gravel, Firm to very stiff, Brown becoming grey at about elev. 173.4m		7	SS	20												
			8	SS	28												
			9	SS	32												
			10	SS	27												
			11	SS	10												
			12	SS	9												
			13	TO	PH												
			14	TO	PH												

Continued Next Page

+ ³/₃ X ³/₃ Numbers refer to Sensitivity

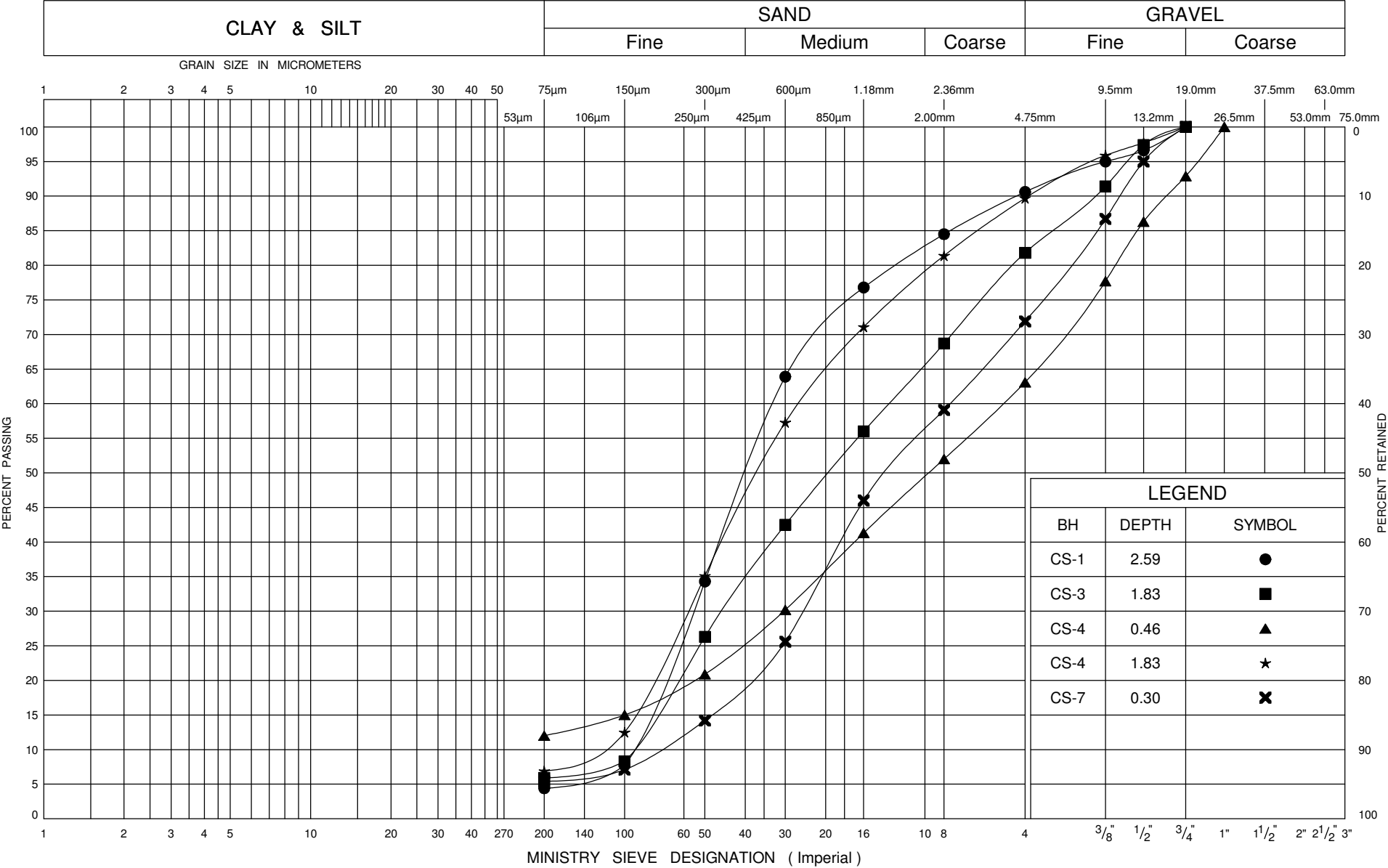
○ 3% STRAIN AT FAILURE

+³, X³: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

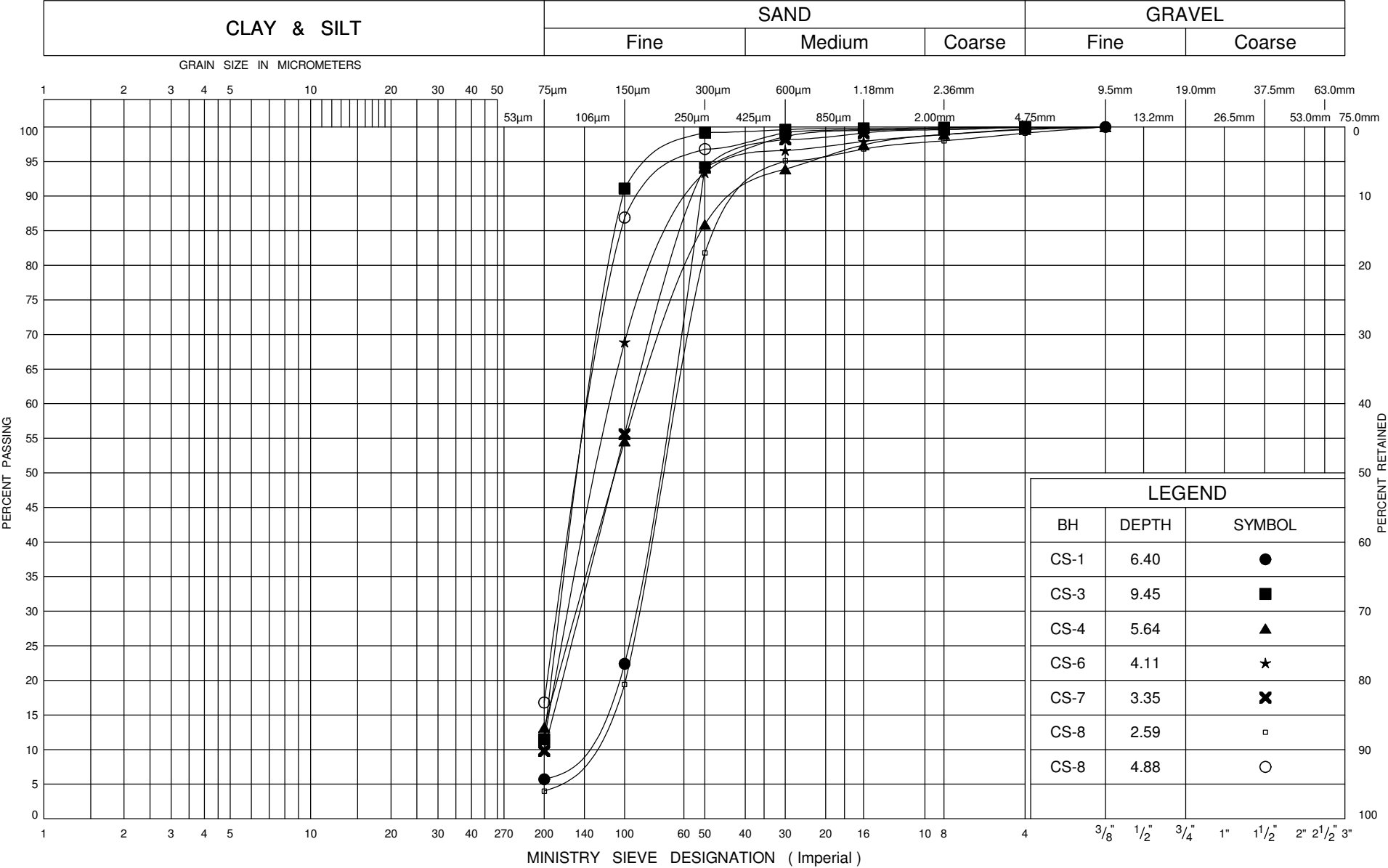
APPENDIX C

Geotechnical Laboratory Test Results

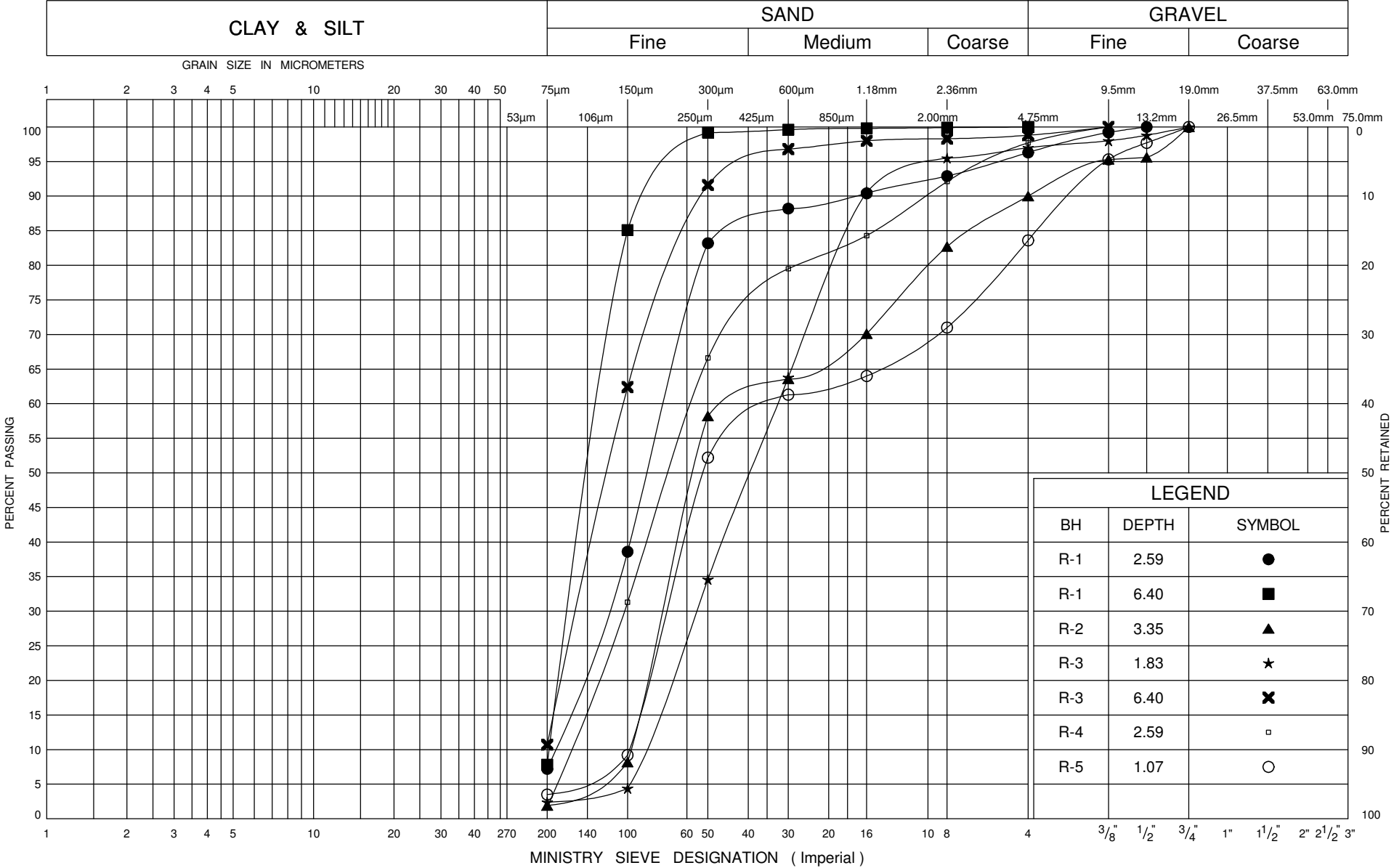
UNIFIED SOIL CLASSIFICATION SYSTEM



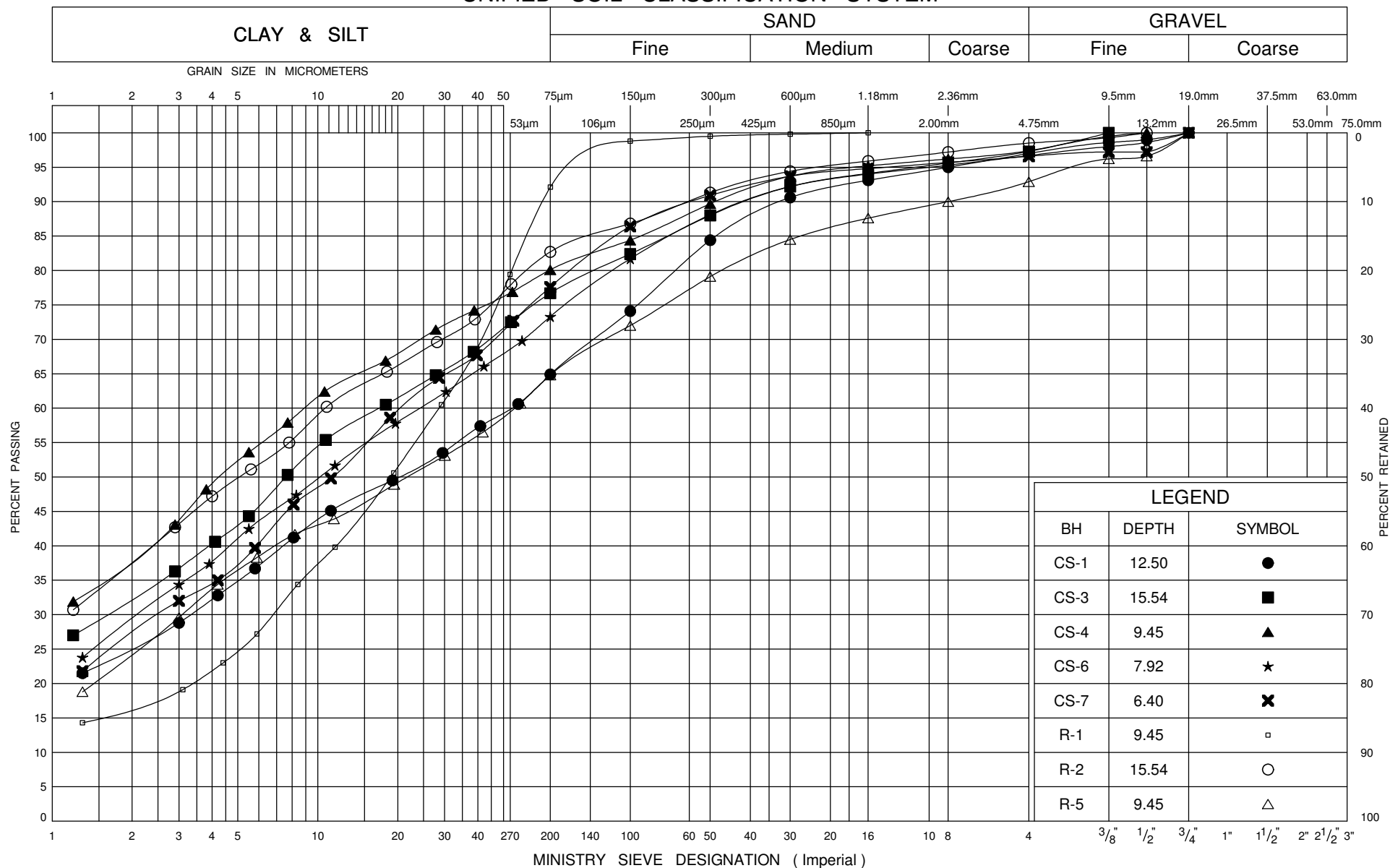
UNIFIED SOIL CLASSIFICATION SYSTEM



UNIFIED SOIL CLASSIFICATION SYSTEM



UNIFIED SOIL CLASSIFICATION SYSTEM



GRAIN SIZE DISTRIBUTION

Clayey SILT/ Silty CLAY

FIG No 4

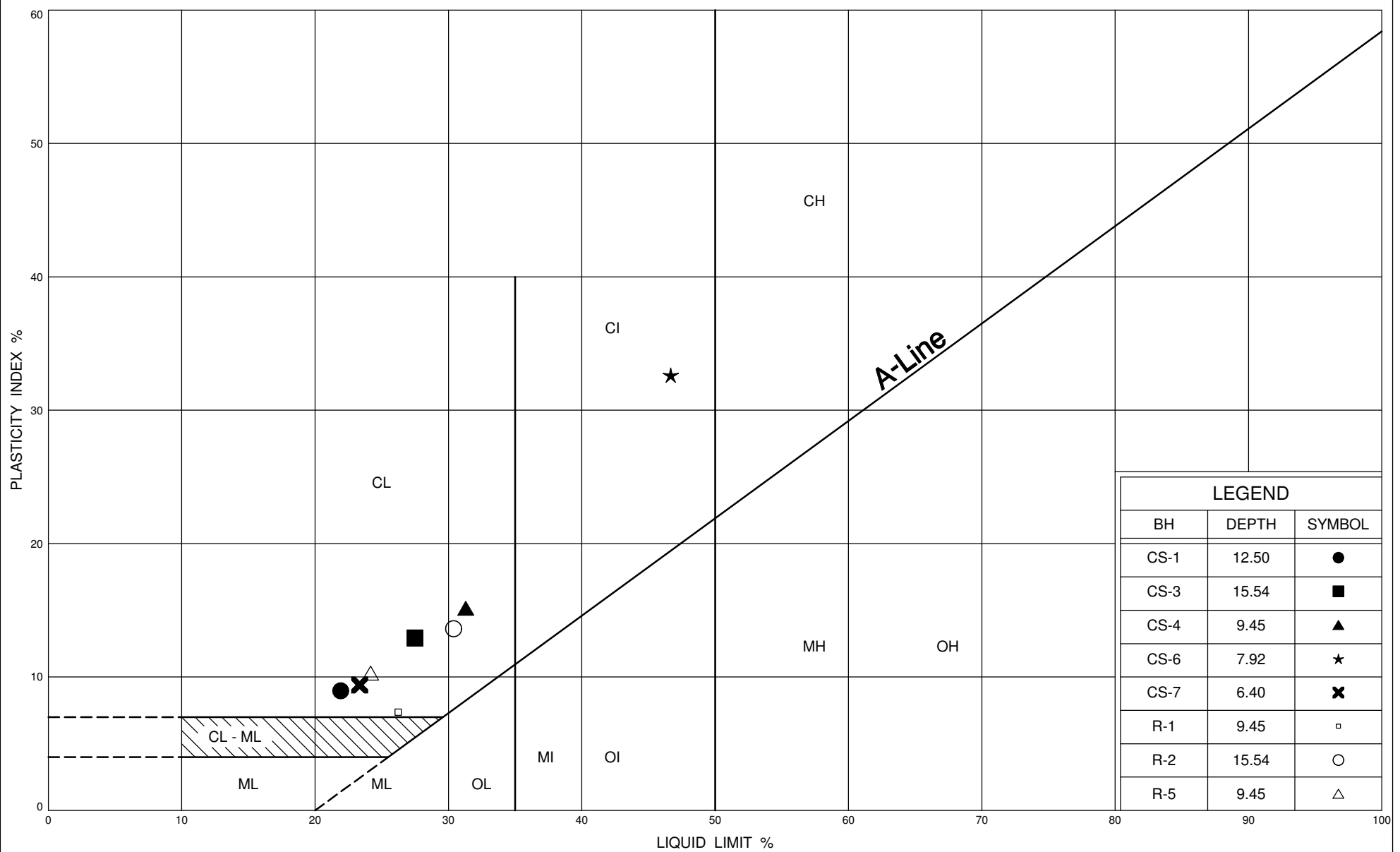
W P 3038-03-00

Hwy 402, Township of Sarnia



Ministry of
Transportation

Ontario



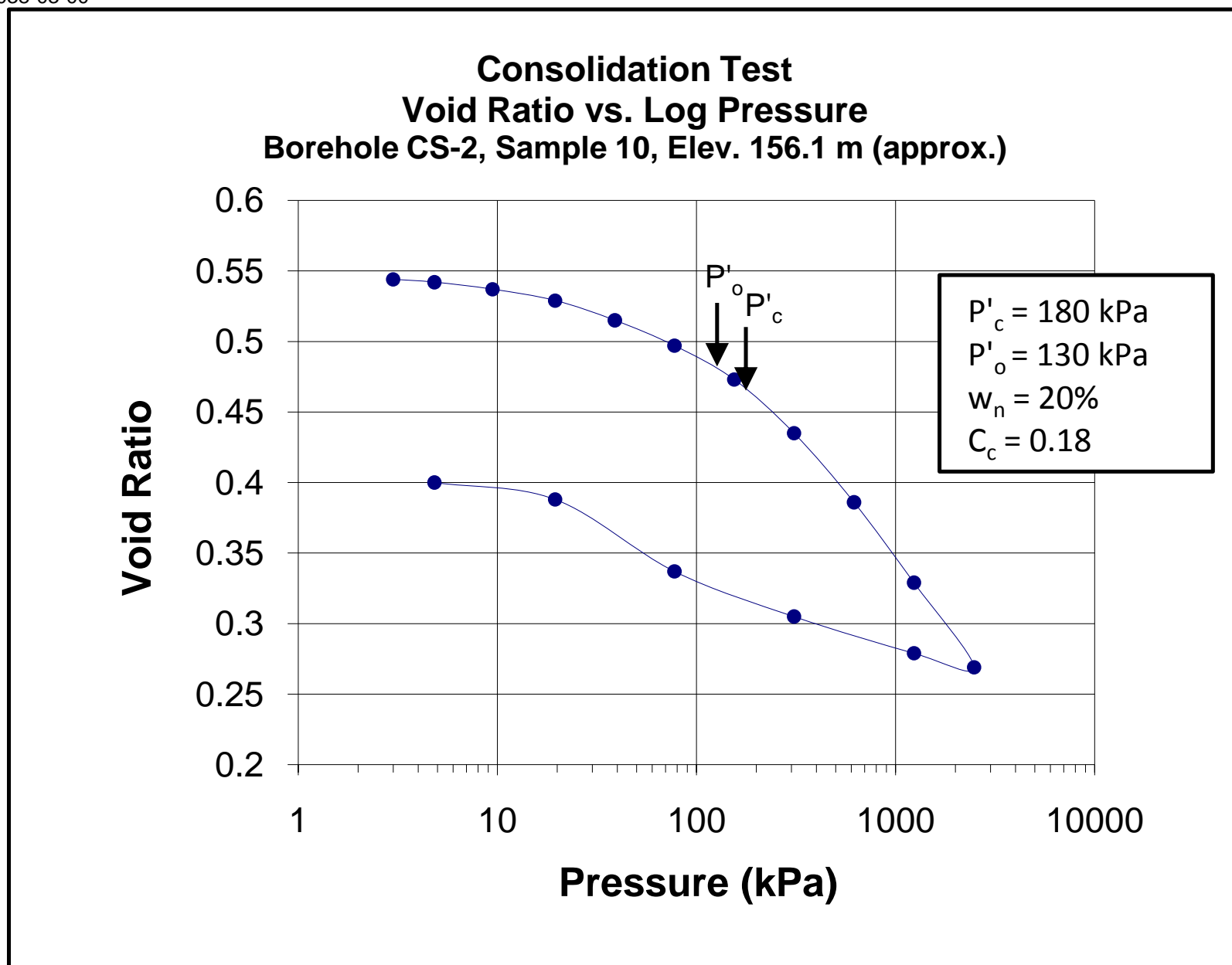


Figure 6



**Jacques Whitford
Limited**

7271 Warden Ave,
Markham, Ontario
L3R 5X5
Tel: (905) 474 -7700
Fax: (905) 479-9326

**Density/Bulk Unit Weight
Of Soil Specimen**

Figure 7

Clint: Stantec/MTO

Project No.: 1012607

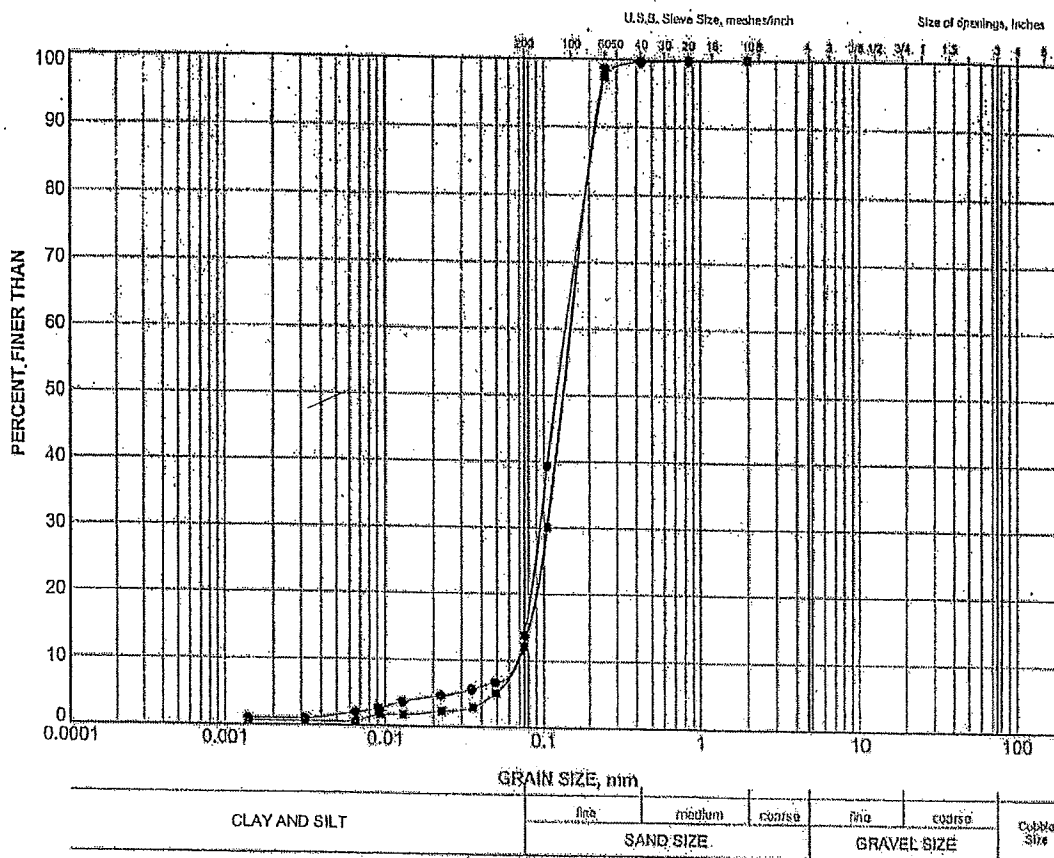
**Location: Highway 402 Underpass at Christina Street
Sarnia, Ontario**

	<i>Unit</i>		1	2	3
Borehole No.			BH R4-8	BH CS4-13	BH R2-10B
Mass of soil specimen in air	<i>gms</i>	A	138.6	96.3	97.1
Mass of soil specimen in liquid (oil)	<i>gms</i>	B	83.3	58.4	58.1
Mass of Liquid displaced	<i>cc</i>	C=(A-B)	55.3	37.9	39.0
Specific Gravity of Liquid (oil)		γ_L	0.8714	0.8714	0.8714
Density of soil sample	<i>Kg/m³</i>	$D = \frac{1000A * \gamma_L}{(A-B)}$	2184	2214	2170
Unit Weight of soil sample	<i>KN/m³</i>	$U = \frac{U}{D * 0.009807}$	21.4	21.7	21.28

APPENDIX D

Laboratory Test Results - Preliminary Foundation Investigation Report

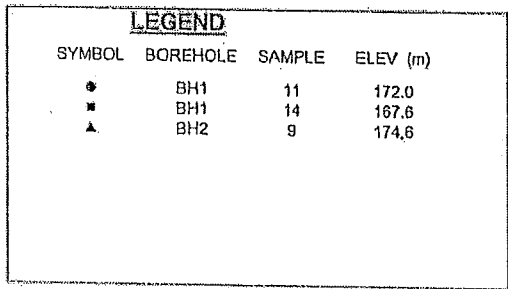





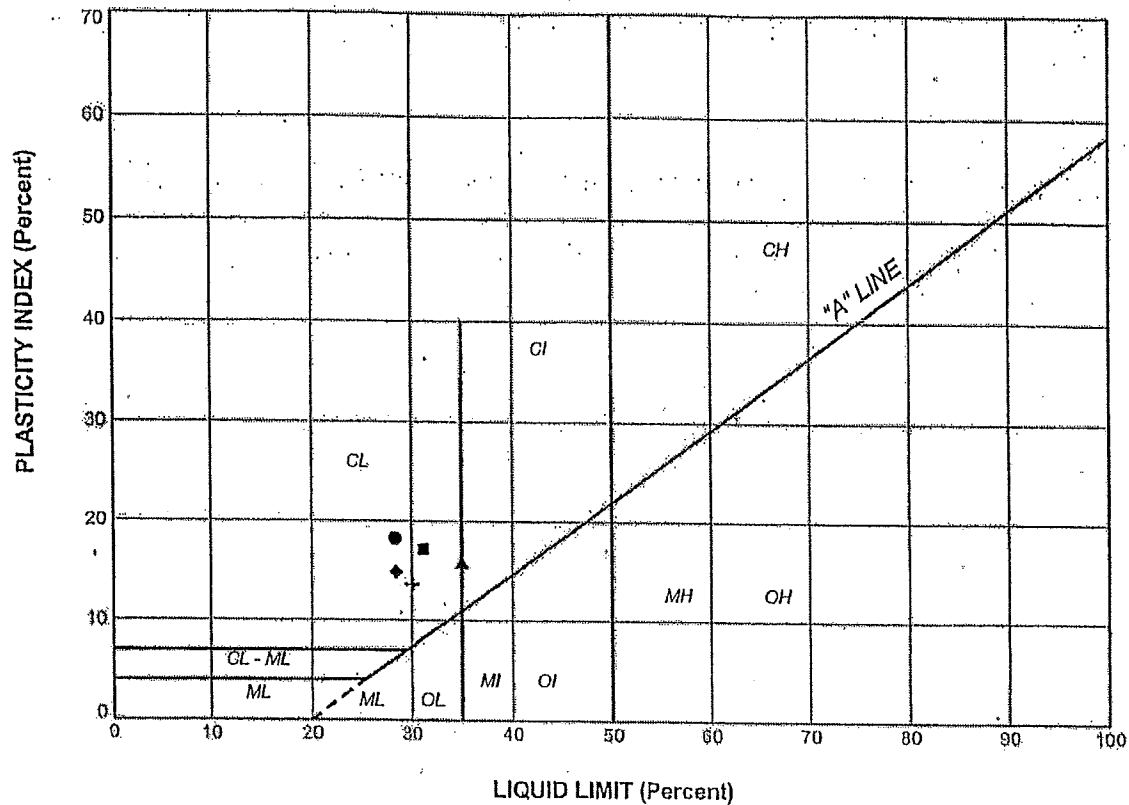
LEGEND			
SYMBOL	BOREHOLE	SAMPLE	ELEV (m)
•	BH1	4	178.0
■	BH2	2	179.8

PROJECT			
CHRISTINA STREET UNDERPASS REPLACEMENT			
GWP 3038-03-00			
HWY 402			
TITLE			
GRAIN SIZE DISTRIBUTION			
FINE SAND			
 Golder Associates LONDON, ONTARIO	PROJECT No.	011-120029	
	FILE No.	011-120029-GP1	
	SCALE	N/A	
DRAWN	WDF	SEP 14/04	
CHECK	BY	Oct 14/04	
			FIGURE A-1

LEN 370 NEW GDR 12/4/02



PROJECT CHRISTINA STREET UNDERPASS REPLACEMENT GWP 3038-03-00 HWY 402			
TITLE GRAIN SIZE DISTRIBUTION CLAYEY SILT			
 Golder Associates LONDON, ONTARIO	PROJECT No. D44-300898		FILE No. D44-300898-2.GPJ
	DESIGN WOF	SEP 14/04	SCALE N/A
	CHECK <i>47</i>	<i>012.13165</i>	FIGURE A-2



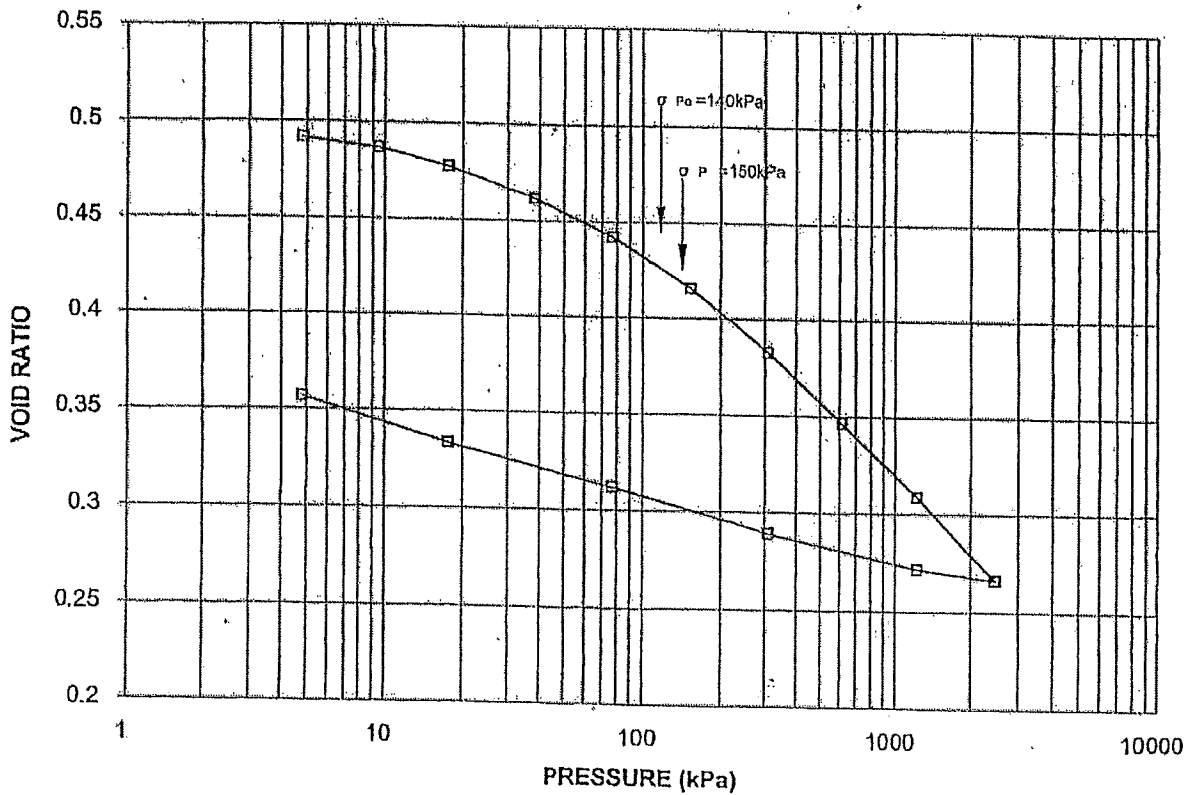
SOIL TYPE
 C = Clay
 M = Silt
 O = Organic

PLASTICITY
 L = Low
 I = Intermediate
 H = High

LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEV (m)	LL(%)	PL(%)	PI
●	BH1	10	173.8	28.4	10.2	18.2
■	BH1	15	166.4	31.2	14.1	17.1
▲	BH2	8	175.8	35.0	19.2	15.8
+	BH2	12	171.2	30.1	16.5	13.6
+	BH2	13	169.7	28.5	13.7	14.8


PROJECT CHRISTINA STREET UNDERPASS REPLACEMENT GWP 3038-03-00 HWY 402			
TITLE PLASTICITY CHART (Clayey Silt)			
PROJECT No. 011-100000-2		FILE No. 011-100000-2 (UP)	
DRAWN BY	DATE	SCALE	REV.
CHECK	DATE		
Golder Associates LONDON, ONTARIO		FIGURE A-3	

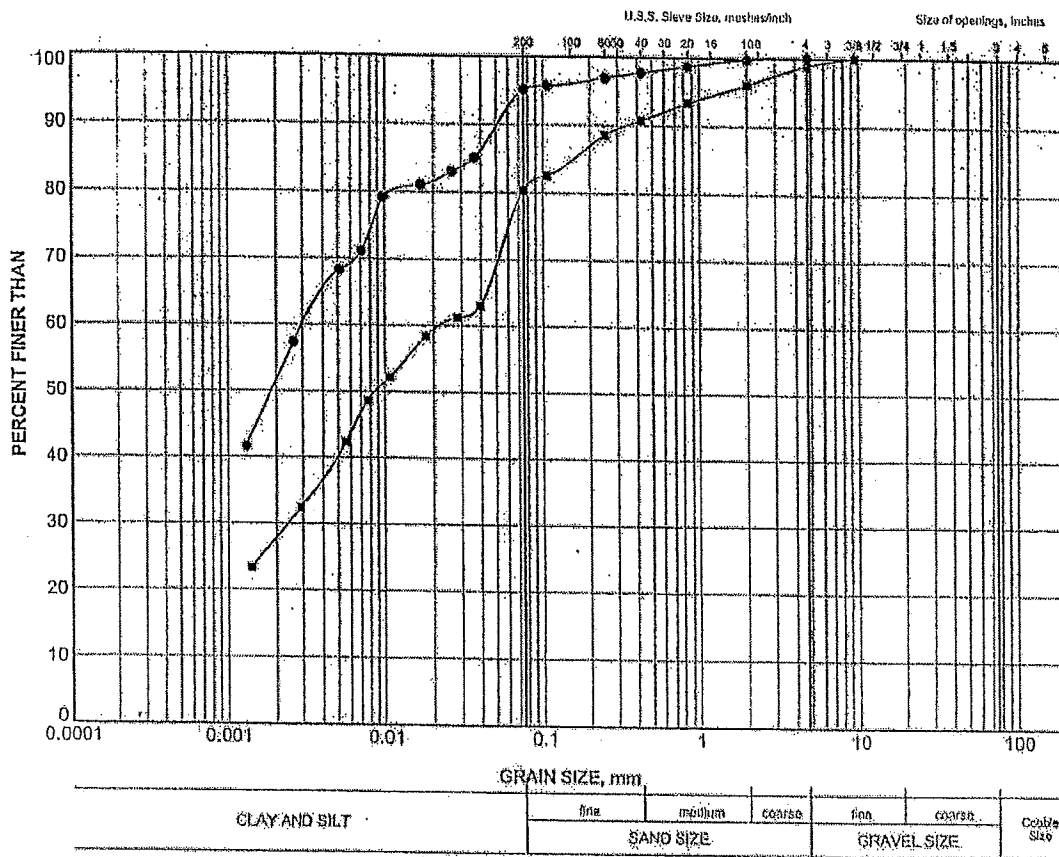


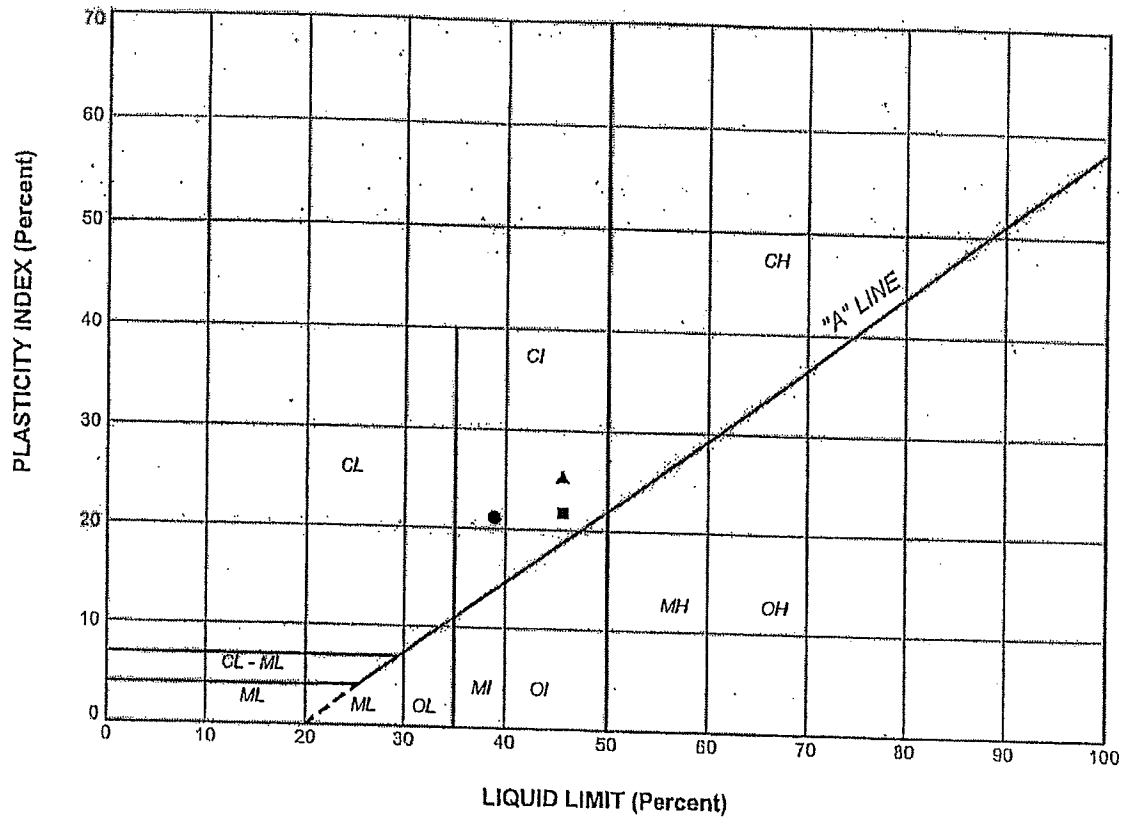
BOREHOLE 2, SAMPLE 13, ELEV. 169.5m

NOTE

- 1) THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ACCOMPANYING TEXT.

PROJECT									
CHRISTINA STREET UNDERPASS REPLACEMENT GWP 3038-03-00 HWY 402									
TITLE									
CONSOLIDATION TEST VOID RATIO VS. LOG PRESSURE									
PROJECT No. 041-130000-2		FILE No. 041130000-2004							
SCALE AS SHOWN		REV. 0							
 Golder Associates LONDON, ONTARIO		<table border="1"> <tr> <td>DATE</td> <td>WCF</td> <td>04/11/04</td> </tr> <tr> <td>CHECK</td> <td>07/07/04</td> <td>07/07/04</td> </tr> </table>		DATE	WCF	04/11/04	CHECK	07/07/04	07/07/04
DATE	WCF	04/11/04							
CHECK	07/07/04	07/07/04							
FIGURE A-4									

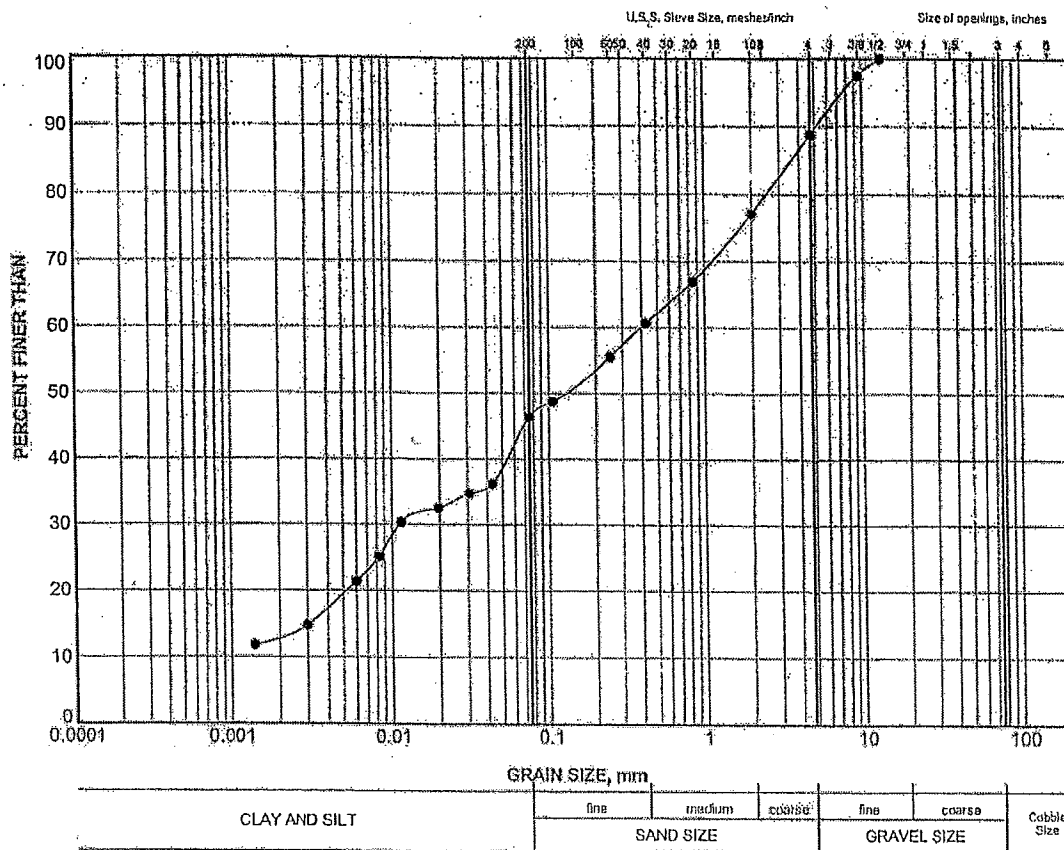




LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEV (m)	LL(%)	PL(%)	PI
●	BH1	18	161.8	38.9	17.8	21.1
■	BH1	28	146.5	45.8	23.9	21.7
▲	BH2	22	145.3	45.6	20.3	25.3

PROJECT					
CHRISTINA STREET UNDERPASS REPLACEMENT					
GWP 3038-03-00					
HWY 402					
REQ					
PLASTICITY CHART (Silty Clay)					
PROJECT No.		041-130009-2		FILE No.	
DRAWN		BO.		SEP 16/04	
CHECK		JW		DEC 13/05	
SHEET		10A		REV.	
Golder Associates		FIGURE A-6			
LONDON, ONTARIO					



LEGEND			
SYMBOL	BOREHOLE	SAMPLE	ELEV (m)
•	BH1	39	129.9

PROJECT				CHRISTINA STREET UNDERPASS REPLACEMENT			
				GWP 3038-03-00			
				HWY 402			
TITLE							
GRAIN SIZE DISTRIBUTION							
SANDY SILT TILL							
PROJECT NO.		041-130002		FILE NO.		041-130002.GPJ	
DRAWN		WDR		SCALE		N/A	
CHECK		SEP 14/04		REV		REV	
		BY		DATE		FIGURE A-7	



Appendix E

Representative Site Photographs



Photo 1: Christina Street Underpass looking west from Highway 402.



Photo 2: Christina Street Underpass looking south along Christina to Highway 402.