



**THURBER** ENGINEERING LTD.

**FOUNDATION INVESTIGATION REPORT  
HIGHWAY 7 EBL AND WBL BRIDGES OVER RIVERBEND DRIVE TO  
SHIRLEY STREET CONNECTOR  
HIGHWAY 7-NEW, KITCHENER TO GUELPH  
G.W.P. 408-88-00**

**GEOCRES No. 40P8-284**

**Latitude 43.468162° , Longitude -80.464760 °**

**Report**

**to**

**WSP**

Date: July 24, 2020  
File: 11375



## TABLE OF CONTENTS

### PART 1: FACTUAL INFORMATION

1.	INTRODUCTION .....	1
2.	SITE DESCRIPTION .....	2
3.	INVESTIGATION PROCEDURES .....	2
4.	LABORATORY TESTING .....	5
5.	DESCRIPTION OF SUBSURFACE CONDITIONS .....	5
5.1	Topsoil.....	6
5.2	Fill.....	6
5.3	Sand.....	6
5.4	Silty Clay and Silty Clay Till .....	7
5.5	Sandy Silt and Sand and Silt Till .....	9
5.6	Groundwater Conditions .....	11
6.	CORROSIVITY AND SULPHATE TEST RESULTS .....	13
7.	MISCELLANEOUS .....	13

### APPENDICES

Appendix A	Record of Borehole Sheets, Laboratory Test Results and Analytical Laboratory Test Results for Present Site Investigation
Appendix B	Record of Borehole Sheets and Laboratory Test Results for Previous Site Investigation
Appendix C	Borehole Locations and Soil Strata Drawing



**FOUNDATION INVESTIGATION REPORT  
HIGHWAY 7 BRIDGES OVER RIVERBEND DRIVE CONNECTOR  
HIGHWAY 7-NEW, KITCHENER TO GUELPH  
G.W.P. 408-88-00**

**GEOCRES No. 40P8-284**

**PART 1: FACTUAL INFORMATION**

**1. INTRODUCTION**

This report presents the factual findings obtained from a detailed foundation investigation conducted at the site of two new bridge structures to carry the eastbound lanes (EBL) and westbound lanes (WBL) of Highway 7-New over Riverbend Drive to Shirley Street Connector in the Regional Municipality of Waterloo, Ontario.

The purpose of this investigation was to explore the subsurface conditions at the site and, based on the data obtained, to provide a borehole location plan, records of boreholes, stratigraphic profiles, cross sections, laboratory test results and a written description of the subsurface conditions. A model of the subsurface conditions under the potential foundation footprints was developed from the data obtained in the course of the investigation.

Thurber was retained by WSP to carry out the site investigation under the Ministry of Transportation Ontario (MTO) Agreement Order Number 3014-E-0013.

Reference has been made to information on subsurface conditions contained in a previous foundation report prepared for this site during the preliminary design phase. The title of the report is:

- Preliminary, Foundation Investigation and Design Report, Proposed Highway 7 Bridge over Riverbend Drive Connector, Highway 7-New, Kitchener to Guelph, G.W.P. 408-88-00, Geocres No. 40P8-178, Report to Ministry of Transportation Ontario Southwestern Region, File: 15-64-17, dated December 17, 2009. (Reference 1).

Client: WSP  
File No.: 11375

Date: July 24, 2020  
Page: 1 of 15

E file: \\tor-fs01.thurber.local\Share01\Projects\10000+\11375 Hwy 7 New PD and DD Foundations\Reports & Memos\Riverbend\Final\11375- Riverbend Final FIR.docx



## **2. SITE DESCRIPTION**

At the site, the Highway 7-New alignment runs approximately parallel to the existing Shirley Avenue. The site lies 700 m to the east of the existing Kitchener-Waterloo Expressway and 250 m to the east of existing Riverbend Drive. Lands to the north of the site are also vacant or undeveloped. The south side is occupied by commercial and industrial lands.

Based on the Ontario Geological Survey Special Volume 2, The Physiography of Southern Ontario, Third Edition by Chapman and Putnam, the site lies within the physiographic region known as the Waterloo Hills, characterized by ridges of sandy till kames or kame moraines, with outwash sands occupying the intervening hollows.

## **3. INVESTIGATION PROCEDURES**

A preliminary geotechnical investigation was carried out at this site between June 11 and June 20, 2008. Four boreholes, numbered 08-033 to 08-036, were drilled for the WBL and EBL bridges. One borehole was drilled at each bridge abutment of possible one-span structure arrangements. The depths of three boreholes ranged from 20.0 m to 21.5 m (Elevation 293.2 to 292.1). Borehole 08-035 drilled at the EBL West abutment was terminated at 9.6 m depth (Elevation 305.7). The Record of Borehole sheets for the boreholes from the initial investigation are included in Appendix B.

A detailed geotechnical investigation was conducted between May 14 and July 3, 2018. Six boreholes (numbered RS16-01 to RS16-06) were drilled during the detailed investigation. Boreholes RS16-01 and RS16-02 were drilled at the west approach embankments and Boreholes RS16-05 and RS16-06 were drilled at the east approach embankments. Boreholes RS16-03, and RS16-04 were drilled between the west and east abutments of the WBL and EBL bridges, respectively. The boreholes ranged in depth from 15.8 m to 22.9 m (Elevations 299.7 to 289.9). The Record of Borehole sheets for the most recent boreholes are included in Appendix A.

The approximate locations of the boreholes from the previous and current investigations, are shown on the attached Borehole Locations and Soil Strata Drawing in Appendix C. The coordinates and elevations of the current and previous boreholes are given on the drawings and on the individual Record of Borehole Sheets in Appendices A and B, respectively.

The ground surface elevations and coordinates of the recent as-drilled boreholes were provided by WSP.

Client: WSP  
File No.: 11375

Date: July 24, 2020  
Page: 2 of 15

E file: \\tor-fs01.thurber.local\Share01\Projects\10000+11375 Hwy 7 New PD and DD Foundations\Reports & Memos\Riverbend\Final\11375- Riverbend Final FIR.docx



Prior to commencing the site investigation, utility clearances were obtained for all borehole locations. Road occupancy permit was also obtained to complete site investigation.

During the current investigation, a track -mounted B-57 drill rig was used in conjunction with hollow-stem augers, mud rotary and casing advancer drilling methods to advance the boreholes. Samples were obtained at selected intervals using a split spoon sampler in conjunction with Standard Penetration Testing (SPT) in the overburden soils.

The drilling, sampling and in-situ testing operations were supervised on a full-time basis by a member of Thurber's technical staff. The supervisor logged the boreholes and processed the recovered soil samples for transport to Thurber's laboratory for further examination and testing. Results of field drilling and sampling of the investigation are presented on the Record of Borehole sheets in Appendix A.

Groundwater conditions in the open boreholes were observed throughout the drilling operations. In Boreholes 08-034, 08-035, and RS16-04 a standpipe piezometer consisting of 25 mm diameter PVC pipe with a slotted screen was installed and enclosed in filter sand to permit longer-term groundwater level monitoring. Boreholes without piezometer installations were backfilled in general accordance with O. Reg. 903. The borehole completion details are also shown in Table 3.1.

The completion of the boreholes and the standpipe piezometers were carried out in accordance with the requirements of O. Reg. 903 (as amended by O. Reg. 372/07).

**Table 3.1 – Borehole Completion Details**

Foundation Unit		Borehole	Ground Surface Elevation (m)	Borehole Depth / Base Elevation (m)	Piezometer Tip Elevation (m)	Completion Details
WBL	West Approach	RS16-01	314.3	15.8/298.5	None Installed	Borehole backfilled with bentonite holeplug and auger cuttings to surface.
	West Abutment	08-033	313.2	21.1/292.1	None Installed	Borehole backfilled with bentonite to 0.6 m, then holeplug to surface.



Foundation Unit		Borehole	Ground Surface Elevation (m)	Borehole Depth / Base Elevation (m)	Piezometer Tip Elevation (m)	Completion Details
		RS16-03	314.5	20.1/294.4	None Installed	Borehole backfilled with bentonite holeplug and auger cuttings to surface.
	East Abutment	08-034	312.2	20.0/292.2	18.8/293.4	Piezometer with 1.5 m slotted screen installed with sand filter to 16.8 m, holeplug from 16.8 m to 16.2 m, bentonite seal from 16.2 m to 1.8 m, holeplug from 1.8 m to 0.6 m, then auger cuttings to ground surface.
		RS16-04	312.9	22.9/289.9	22.8/290.0	Piezometer with 3.0 m slotted screen installed with sand filter to 18.8 m, holeplug from 18.8 m to 15.8 m, then grout from 15.8 m to ground surface.
	East Approach	RS16-05	313.6	15.8/297.8	None Installed	Borehole backfilled with bentonite holeplug and auger cuttings to surface.
EBL	West Approach	RS16-02	315.5	15.8/299.7	None Installed	Borehole backfilled with bentonite holeplug and auger cuttings to surface.
	West Abutment	08-035	315.3	9.6/305.7	9.0/306.3	Piezometer with 1.5 m slotted screen installed with sand filter to 7.0 m, holeplug from 7.0 m to 6.6 m, bentonite seal from 6.6 m to 0.3 m, then holeplug to ground surface.
		RS16-03	314.5	20.1/294.4	None Installed	Borehole backfilled with bentonite holeplug and auger cuttings to surface.
	East Abutment	08-036	314.6	21.5/293.2	None Installed	Borehole backfilled with bentonite to 0.9 m, then holeplug to surface.
		RS16-04	312.9	22.9/289.9	22.8/290.0	Piezometer with 3.0 m slotted screen installed with sand filter to 18.8 m, holeplug from 18.8 m to 15.8 m, then grout from 15.8 m to ground surface.



Foundation Unit		Borehole	Ground Surface Elevation (m)	Borehole Depth / Base Elevation (m)	Piezometer Tip Elevation (m)	Completion Details
	East Approach	RS16-06	314.7	15.8/298.8	None Installed	Borehole backfilled with bentonite holeplug and auger cuttings to surface.

#### 4. LABORATORY TESTING

The recovered soil samples were subjected to Visual Identification (VI) and to natural moisture content determination. Selected samples were also subjected to grain size analysis and Atterberg Limits testing. All the laboratory tests were carried out in accordance with MTO and/or ASTM Standards, as appropriate. The results of the laboratory testing of current and previous investigations are summarized on the Record of Borehole sheets in Appendices A and B, and also presented on the figures included in Appendices A and B.

In order to assess the potential for sulphate attack on concrete foundations, as well as the potential for corrosion associated with the structure, a sample of the existing native silty clay soil was collected. The sample was submitted to SGS Canada Inc., a CALA accredited analytical laboratory in Lakefield, Ontario, for analytical testing of corrosivity parameters and sulphate content. The results of the analytical testing are summarized in Section 6 and are presented in Appendix A.

#### 5. DESCRIPTION OF SUBSURFACE CONDITIONS

Details of the encountered soil stratigraphy are presented on the Record of Borehole sheets included in Appendices A and B. A general description of the stratigraphy, based on the conditions encountered in the boreholes, is given in the following paragraphs. However, the factual data presented on the Record of Borehole sheets takes precedence over this general description and must be used for interpretation of the site conditions. It should be recognized and expected that soil conditions may vary between and beyond borehole locations.

In general, the site is underlain by topsoil overlying layers of native stiff to hard silty clay and silty clay till, and compact to very dense silty sand till/sand and silt till. Layers of compact to very

Client: WSP  
File No.: 11375

Date: July 24, 2020  
Page: 5 of 15

E file: \\tor-fs01.thurber.local\Share01\Projects\10000+\11375 Hwy 7 New PD and DD Foundations\Reports & Memos\Riverbend\Final\11375- Riverbend Final FIR.docx



dense sand and gravelly sand were encountered within the till deposits. Descriptions of the individual strata are presented below.

## **5.1 Topsoil**

Topsoil was identified at the ground surface in all of the boreholes except for RS16-02. The topsoil thickness ranged from 100 mm to 600 mm. The topsoil thickness may vary between and beyond the borehole locations and the data is not intended for the purpose of estimating quantities.

## **5.2 Fill**

A layer of silty clay fill with organics, trace sand, and trace gravel was encountered at the ground surface in Borehole RS16-02. The fill layer was 0.9 m thick and extended to Elevation 314.6.

The SPT 'N' value of the fill was 1 blow per 0.3 m of penetration, indicating a very soft consistency. The moisture content of the fill was 39 percent.

## **5.3 Sand to Silt**

Layers of native brown sand containing trace gravel to gravelly and some silt were encountered below the topsoil in Boreholes 08-033 and 08-034. A 500-mm thick layer of silt was contacted within the sand in Borehole 08-033. The thickness of these upper sand layers range from 1.2 m to 1.3 m with the base of the layers at Elevation 310.7 to 311.7.

A layer of sandy silty with trace clay was encountered in Borehole 08-036 below the topsoil. The thickness of the layer was 1.9 m with the base of the layer at Elevation 312.6.

Layers of grey sand were also contacted within the glacial till deposits at lower depths, from 6.6 m to 16.2 m (Elevations 306.6 to 296.0) in Boreholes 08-033 and 08-034, respectively. The thickness of these layers ranged from 2.4 m to 3.8 m with the base of the layers at Elevations 293.6 to 302.8.

A 1.3 m thick layer of grey gravelly sand containing trace silt and trace clay was contacted at 16.5 m depth (Elevation 296.4) in Borehole RS16-04.

The upper layers of sand and silt have a compact relative density with SPT 'N' values of 13 to 17 blows per 0.3 m of penetration. SPT 'N' values measured in the lower layers of sand and gravelly





sand within the till deposit ranged from 93 blows per 0.3 m of penetration to higher than 100 blows per 0.15 m of penetration, indicating a very dense relative density. The moisture content ranged from 10 percent to 20 percent.

Grain size distribution curves for samples of the sand layers are presented on the Record of Borehole sheets and on Figure A6 of Appendix A and Figure B1 of Appendix B. The results of grain size distribution tests carried out on sand samples were as follows:

Soil Particle	Sand Percentage (%)	Gravelly Sand Percentage (%)
Gravel	2 to 13	27
Sand	76 to 91	62
Silt and Clay	7 to 11	11

#### 5.4 Silty Clay and Silty Clay Till

Native brown to grey silty clay and silty clay till containing trace sand to sandy and trace gravel were observed in all the boreholes at depths and elevations indicated in Table 5.1.

**Table 5.1 – Depths and Elevations of Native Silty Clay and Silty Clay Till**

Foundation Unit		Borehole	Depth below existing ground surface (m)	Elevation (m)	Thickness (m)
WBL	West Approach	RS16-01	0.6 to 7.3	313.7 to 307.0	6.7
			7.3 to 10.5*	307.0 to 303.8	3.2
			10.5 to 15.8 (Borehole termination depth)	303.8 to 298.5	> 5.3
	West Abutment	08-033	1.5 to 4.1 12.2 to 17.4	311.7 to 309.1 301.0 to 295.8	2.6 5.2
		RS16-03	0.3 to 6.0 12.0 to 16.5	314.1 to 308.4 302.5 to 298.0	5.7 4.5
	East Abutment	08-034	1.4 to 6.1 10.0 to 16.2	310.7 to 306.1 302.2 to 296.0	4.7 6.2
		RS16-04	0.1 to 16.5	312.8 to 296.4	16.4



Foundation Unit		Borehole	Depth below existing ground surface (m)	Elevation (m)	Thickness (m)
	East Approach	RS16-05	0.2 to 15.8 (Borehole termination depth)	313.4 to 297.8	> 15.6
EBL	West Approach	RS16-02	0.9 to 4.9 7.5 to 10.0* 10.0 to 15.8 (Borehole termination depth)	314.6 to 310.7 308.0 to 305.5 305.5 to 299.7	4.0 2.5 > 5.8
	West Abutment	08-035	0.2 to 4.4 8.8 to 9.6* (Borehole termination depth)	315.1 to 310.9 306.5 to 305.7	4.2 > 0.8
		RS16-03	0.3 to 6.0 12.0 to 16.5	314.1 to 308.4 302.5 to 298.0	5.7 4.5
	East Abutment	08-036	2.1 to 13.3* 13.3 to 18.1	312.6 to 301.4 301.4 to 296.6	11.2 4.8
		RS16-04	0.1 to 16.5	312.8 to 296.4	16.4
	East Approach	RS16-06	0.3 to 15.8 (Borehole termination depth)	314.4 to 298.8	> 15.5

\* Silty clay till

SPT 'N' values within the silty clay to silty clay till ranging from 8 to 100 blows per 0.3 m of penetration indicating a stiff to hard consistency. Lower blow counts ranging from 1 to 8 blows per 0.3 m of penetration were recorded at approximate depths between 2.5 and 10 m below ground surface (Elevations 312.5 and 305.0) in RS16-01, RS-02, RS16-03, RS16-04 and RS16-06. This weaker layer has a thickness ranging from approximately 2 to 5 m. Undrained shear strength values measured by in-situ vane shear tests in this weaker silty clay layer ranged from 95 kPa to greater than 150 kPa. These results suggest that the weaker silty clay deposit has a stiff to very stiff consistency. Vane shear test carried out in RS16-01 indicated that the sensitivity ratio of this silty clay was 6, indicating that the silty clay deposit has medium sensitivity. Below 8.0 to 10 m depth, SPT 'N' values were higher, generally ranging from 15 to 100, indicating a very stiff to hard consistency. SPT 'N' values higher than 100 blows per 0.1 m of penetration were



also measured at and below approximate elevation 306 in Boreholes 08-035 and 08-036, both boreholes were drilled at the proposed Highway 7 EBL.

The natural moisture contents generally lay in the range of 12 percent to 39 percent.

Grain size distribution curves for the silty clay and silty clay till samples are presented on the Record of Borehole sheets and on Figures A1 to A3 of Appendix A and B2 and B3 of Appendix B. Atterberg Limits test results are presented on Figures A7 and A8 of Appendix A and Figures B7 and B8 of Appendix B. The results of grain size distribution tests are summarized as follows:

Soil Particles	Silty clay (%)	Silty clay till (%)
Gravel	0 to 1	0 to 2
Sand	0 to 4	4 to 29
Silt	18 to 53	37 to 46
Clay	47 to 81	32 to 57

Liquid Limit	38 to 59
Plastic Limit	17 to 23

The above results show that the silty clay and silty clay till is of medium to high plasticity with a group symbol of CI-CH.

It should be noted that glacial tills are known to contain cobbles and boulders.

### 5.5 Sandy Silt Till to Silty Sand Till

Native deposits of brown to grey sandy silt till to silty sand till containing trace of gravel, trace to some clay and occasional cobbles were observed in Boreholes 08-033, 08-034, 08-035, 08-036, RS16-02, RS16-03, and RS16-04 at depths and elevations indicated in Table 5.2.

**Table 5.2 – Depths and Elevations of Native Sandy Silt Till to Silty Sand Till**

Foundation Unit		Borehole	Depth below existing ground surface (m)	Elevation (m)	Thickness (m)
WBL	West Abutment	08-033	4.1 to 6.6 10.4 to 12.2 17.4 to 21.1** (Borehole termination depth)	309.1 to 306.6 302.8 to 301.0 295.8 to 292.1	2.5 1.8 > 3.7
			6.0 to 12.0 16.5 to 20.1** (Borehole termination depth)	308.4 to 302.5 298.0 to 294.4	6.0 >3.6
	East Abutment	08-034	6.1 to 10.0 18.6 to 20.0** (Borehole termination depth)	306.1 to 302.2 293.6 to 292.2	3.9 > 1.4
		RS16-04	17.8 to 22.9** (Borehole termination depth)	295.0 to 289.9	> 5.1
EBL	West Approach	RS16-02	4.9 to 7.5	310.7 to 308.0	2.6
	West Abutment	08-035	4.4 to 8.8	310.9 to 306.5	4.4
		RS16-03	6.0 to 12.0 16.5 to 20.1** (Borehole termination depth)	308.4 to 302.5 298.0 to 294.4	6.0 3.6
	East Abutment	08-036	18.1 to 21.5** (Borehole termination depth)	296.6 to 293.2	3.4
		RS16-04	17.8 to 22.9** (Borehole termination depth)	295.0 to 289.9	5.1

\*\* Lower sandy silt till layer



SPT values measured in the sandy silt and sandy silt till ranged from 16 to 73 blows per 0.3 m of penetration, indicating a compact to dense relative density. SPT 'N' values of 90 blows per 0.3 m of penetration to higher than 100 blows per 0.1 m of penetration were measured below 6.0 m depth in Boreholes 08-033 and 08-035 (west abutments) and below 18.0 m depth in Boreholes 08-034, 08-036, RS16-03, and RS16-04. The high SPT 'N' values were generally measured in the lower silty sand till to sandy silt till layers.

The natural moisture contents generally lay in the range of 7 percent to 25 percent.

Grain size distribution curves for the sandy silt and sandy silt till samples tested are presented on the Record of Borehole sheets and on Figures A4 and A5 of Appendix A and Figures B4 to B6 of Appendix B. Atterberg Limits test results are presented on Figure B9 of Appendix B. The results of grain size distribution tests were as follows:

Soil Particles	(%)
Gravel	0 to 9
Sand	6 to 55
Silt	20 to 82
Clay	8 to 27

Liquid Limit (%)	16
Plastic Limit (%)	10

The above results show that the sandy silt and sandy silt till is of low plasticity with a group symbol of CL-ML.

Although not specifically identified in the boreholes, this layer may contain cobbles and boulders which may account for some high SPT 'N' values and resistance to augering.

## 5.6 Groundwater Conditions

Groundwater conditions were observed during drilling operations, and groundwater levels were measured in the open boreholes upon completion of drilling. Standpipe piezometers were installed in Boreholes 08-034, 08-035, and RS16-04 to monitor the groundwater level at the site.



The groundwater levels measured in the open boreholes and in the standpipe piezometers are summarized below.

**Table 5.3 – Water Level Measurements**

Foundation Unit		Borehole	Date	Water Level (m)		Remark
				Depth	Elevation	
WBL	West Approach	RS16-01	May 16, 2018	Water level not taken due to use of mud		Open Borehole
	West Abutment	08-033	June 19, 2008	Dry	-	Open Borehole
		RS16-03	May 18, 2018	-1.8*	316.3	Open Borehole
	East Abutment	08-034	August 20, 2008 August 27, 2008	12.5 12.4	299.7 299.8	Piezometer
		RS16-04	August 31, 2018	8.2	304.7	Piezometer
	East Approach	RS16-05	May 22, 2018	1.8	311.8	Open Borehole
EBL	West Approach	RS16-02	May 14, 2018	Water level not taken due to use of mud		Open Borehole
	West Abutment	08-035	February 7, 2008	-0.5*	315.8	Piezometer
			June 13, 2008	-0.5*	315.8	
			July 2, 2008	-0.6*	315.9	
			August 20, 2008	-0.7*	316.0	
			August 27, 2008	-0.7*	316.0	
		RS16-03	May 18, 2018	-1.8*	316.3	Open Borehole
	East Abutment	08-036	June 12, 2008	Dry	-	Open Borehole
		RS16-04	August 31, 2018	8.2	304.7	Piezometer
	East Approach	RS16-06	May 22, 2018	2.2	312.5	Open Borehole

\*Above ground surface (artesian conditions)



The groundwater levels above are short-term readings, and seasonal fluctuations of the groundwater levels are to be expected. The groundwater levels may be at a higher elevation after periods of significant or prolonged precipitation.

Piezometric readings indicate the presence of artesian conditions on the site, where groundwater levels were measured 0.5 m to 1.8 m above ground surface (Elevations 315.8 to 316.3). The piezometers are planned to be decommissioned in the summer of 2020.

## 6. CORROSIVITY AND SULPHATE TEST RESULTS

A sample of the silty clay from Borehole RS16-03 was submitted for analytical testing of corrosivity parameters and sulphate. The results of the analytical tests are shown in Table 6.1. The laboratory certificates of analysis are presented in Appendix A.

**Table 6.1 – Analytical Test Results**

Parameter	Units (Soil)	Test Results
		RS16-03 SS 4 Depth 2.7 m
		Silty Clay
Sulphide	%	<0.02
Chloride	µg/g	240
Sulphate	µg/g	70
pH	No unit	8.87
Electrical Conductivity	µS/cm	301
Resistivity	Ohms.cm	3320
Redox Potential	mV	246

## 7. MISCELLANEOUS

Landshark Drilling of Brantford, Ontario supplied a rubber track-mounted B-57 drill rig and conducted the drilling, sampling and in-situ testing operations for the present investigation.

The coordinates for the boreholes were obtained with GPS equipment by Thurber, and the elevations were provided by WSP.



The drilling and sampling operations in the field for the current investigation were supervised on a full-time basis by Thurber field technicians.

Geotechnical laboratory testing was carried out at Thurber's geotechnical laboratory. Analytical laboratory testing was carried out by SGS Canada Inc.

Overall supervision of the field program for the present investigation was conducted by Dr. Nancy Berg, P.Eng. Interpretation of the data and preparation of the current report was carried out by Ms. R. Palomeque Reyna, P.Eng. and Dr. Nancy Berg, P.Eng.

Mr. Jason Lee, P.Eng. and Dr. P.K. Chatterji, P.Eng., a Designated Principal Contact for MTO Foundations projects, reviewed the report.





Thurber Engineering Ltd.



Nancy Berg, P.Eng.  
Geotechnical Engineer



Jason Lee, P.Eng.  
Principal/Senior Geotechnical Engineer



P.K. Chatterji, P.Eng.  
Review Principal, Designated MTO



## **Appendix A**

### **Record of Borehole Sheets, Laboratory Test Results, and Analytical Laboratory Test Results (Current Investigation)**

## SYMBOLS, ABBREVIATIONS AND TERMS USED ON RECORDS OF BOREHOLES

### 1. TEXTURAL CLASSIFICATION OF SOILS

CLASSIFICATION	PARTICLE SIZE	VISUAL IDENTIFICATION
Boulders	Greater than 200mm	same
Cobbles	75 to 200mm	same
Gravel	4.75 to 75mm	5 to 75mm
Sand	0.075 to 4.75mm	Not visible particles to 5mm
Silt	0.002 to 0.075mm	Non-plastic particles, not visible to the naked eye
Clay	Less than 0.002mm	Plastic particles, not visible to the naked eye

### 2. COARSE GRAIN SOIL DESCRIPTION (50% greater than 0.075mm)

TERMINOLOGY	PROPORTION
Trace or Occasional	Less than 10%
Some	10 to 20%
Adjective (e.g. silty or sandy)	20 to 35%
And (e.g. sand and gravel)	35 to 50%

### 3. TERMS DESCRIBING CONSISTENCY (COHESIVE SOILS ONLY)

DESCRIPTIVE TERM	UNDRAINED SHEAR STRENGTH (kPa)	APPROXIMATE SPT <sup>(1)</sup> 'N' VALUE
Very Soft	12 or less	Less than 2
Soft	12 to 25	2 to 4
Firm	25 to 50	4 to 8
Stiff	50 to 100	8 to 15
Very Stiff	100 to 200	15 to 30
Hard	Greater than 200	Greater than 30

NOTE: Hierarchy of Soil Strength Prediction

- 1) Laboratory Triaxial Testing
- 2) Field Insitu Vane Testing
- 3) Laboratory Vane Testing
- 4) SPT value
- 5) Pocket Penetrometer


### 4. TERMS DESCRIBING DENSITY (COHESIONLESS SOILS ONLY)

DESCRIPTIVE TERM	SPT "N" VALUE
Very Loose	Less than 4
Loose	4 to 10
Compact	10 to 30
Dense	30 to 50
Very Dense	Greater than 50

### 5. LEGEND FOR RECORDS OF BOREHOLES

SYMBOLS AND ABBREVIATIONS FOR SAMPLE TYPE	SS Split Spoon Sample	WS Wash Sample	AS Auger (Grab) Sample
	TW Thin Wall Shelby Tube Sample	TP Thin Wall Piston Sample	
	PH Sampler Advanced by Hydraulic Pressure	PM Sampler Advanced by Manual Pressure	
	WH Sampler Advanced by Self Static Weight	RC Rock Core	SC Soil Core

$$\text{Sensitivity} = \frac{\text{Undisturbed Shear Strength}}{\text{Remoulded Shear Strength}}$$


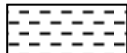



 Water Level  
 Shear Strength Determination by Pocket Penetrometer

- (1) SPT 'N' Value      Standard Penetration Test 'N' Value – refers to the number of blows from a 63.5kg hammer free falling a height of 0.76m to advance a standard 50 mm outside diameter split spoon sampler for 0.3 m depth into undisturbed ground.
- (2) DCPT      Dynamic Cone Penetration Test – Continuous penetration of a 50 mm outside diameter, 60° conical steel point attached to "A" size rods driven by a 63.5 kg hammer free falling a height of 0.76 m. The resistance to cone penetration is the number of hammer blows required for each 0.3 m advance of the conical point into undisturbed ground.

# UNIFIED SOILS CLASSIFICATION

MAJOR DIVISIONS		GROUP SYMBOL	TYPICAL DESCRIPTION
COARSE GRAINED SOILS	GRAVEL AND GRAVELLY SOILS	GW	Well-graded gravels or gravel-sand mixtures, little or no fines.
		GP	Poorly-graded gravels or gravel-sand mixtures, little or no fines.
		GM	Silty gravels, gravel-sand-silt mixtures.
		GC	Clayey gravels, gravel-sand-clay mixtures.
	SAND AND SANDY SOILS	SW	Well-graded sands or gravelly sands, little or no fines.
		SP	Poorly-graded sands or gravelly sands, little or no fines.
		SM	Silty sands, sand-silt mixtures.
		SC	Clayey sands, sand-clay mixtures.
FINE GRAINED SOILS	SILTS AND CLAYS W <sub>L</sub> < 50%	ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity.
		CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays. (W <sub>L</sub> < 30%).
		CI	Inorganic clays of medium plasticity, silty clays. (30% < W <sub>L</sub> < 50%).
		OL	Organic silts and organic silty-clays of low plasticity.
	SILTS AND CLAYS W <sub>L</sub> > 50%	MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts.
		CH	Inorganic clays of high plasticity, fat clays.
		OH	Organic clays of medium to high plasticity, organic silts.
HIGHLY ORGANIC SOILS		Pt	Peat and other highly organic soils.
CLAY SHALE			
SANDSTONE			
SILTSTONE			
CLAYSTONE			
COAL			

## EXPLANATION OF ROCK LOGGING TERMS

<u>ROCK WEATHERING CLASSIFICATION</u>		<u>SYMBOLS</u>	
<b>Fresh (FR)</b>	No visible signs of weathering.		
<b>Fresh Jointed (FJ)</b>	Weathering limited to the surface of major discontinuities.		CLAYSTONE
<b>Slightly Weathered (SW)</b>	Penetrative weathering developed on open discontinuity surfaces, but only slight weathering of rock material.		SILTSTONE
<b>Moderately Weathered (MW)</b>	Weathering extends throughout the rock mass, but the rock material is not friable.		SANDSTONE
<b>Highly Weathered (HW)</b>	Weathering extends throughout the rock mass and the rock is partly friable.		COAL
<b>Completely Weathered (CW)</b>	Rock is wholly decomposed and in a friable condition, but the rock texture and structure are preserved.		Bedrock (general)

<u>DISCONTINUITY SPACING</u>		<u>STRENGTH CLASSIFICATION</u>			
Bedding	Bedding Plane Spacing	Rock Strength	Approximate Uniaxial Compressive Strength		Field Estimation of Hardness*
			(MPa)	(psi)	
Very thickly bedded	Greater than 2m	Extremely Strong	Greater than 250	Greater than 36,000	Specimen can only be chipped with a geological hammer
Thickly bedded	0.6 to 2m				
Medium bedded	0.2 to 0.6m	Very Strong	100-250	15,000 to 36,000	Requires many blows of geological hammer to break
Thinly bedded	60mm to 0.2m	Strong	50-100	7,500 to 15,000	Requires more than one blow of geological hammer to break
Very thinly bedded	20 to 60mm				
Laminated	6 to 20mm	Medium Strong	25.0 to 50.0	3,500 to 7,500	Breaks under single blow of geological hammer.
Thinly Laminated	Less than 6mm				

<u>TERMS</u>					
Total Core Recovery: (TCR)	Core recovered as a percentage of total core run length.	Weak	5.0 to 25.0	750 to 3,500	Can be peeled by a pocket knife with difficulty
Solid Core Recovery: (SCR)	Percent Ratio of solid core of full cylindrical shape recovered. Expressed with respect to the total length of core run.	Very Weak	1.0 to 5.0	150 to 750	Can be peeled by a pocket knife, crumbles under firm blows of geological pick.
Rock Quality Designation: (RQD)	Total length of sound core recovered in pieces 0.1m in length or larger as a percentage of total core run length.	Extremely Weak (Rock)	0.25 to 1.0	35 to 150	Indented by thumbnail
Uniaxial Compressive Strength (UCS)	Axial stress required to break the specimen				
Fracture Index: (FI)	Frequency of natural fractures per 0.3m of core run.				

# RECORD OF BOREHOLE No RS16-01

1 OF 2

METRIC

GWP# 408-88-00 LOCATION Riverbend-Shirley Connection, MTM NAD 83 Zone 10: N 4 814 693.0 E 226 704.2 ORIGINATED BY JP  
 DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MP  
 DATUM Geodetic DATE 2018.05.15 - 2018.05.16 LATITUDE 43.468108 LONGITUDE -80.465223 CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	
314.3 0.0	GROUND SURFACE TOPSOIL		1	SS	2		314					
313.7 0.6	Silty CLAY, trace sand, trace gravel Stiff to Soft Brown Moist		2	SS	12		313					
			3	SS	13		312					
	Grey		4	SS	8		311					
			5	SS	5		310					
			6	SS	3		309					
			7	SS	1		308					
307.0 7.3	Silty CLAY, sandy, trace gravel Soft to Very Stiff Grey Wet (TILL)		8	SS	4		307					
			9	SS	21		306					
							305					

Continued Next Page

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to  
Sensitivity

20  
15  
10


(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No RS16-01

2 OF 2

METRIC

GWP# 408-88-00 LOCATION Riverbend-Shirley Connection, MTM NAD 83 Zone 10: N 4 814 693.0 E 226 704.2 ORIGINATED BY JP  
DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MP  
DATUM Geodetic DATE 2018.05.15 - 2018.05.16 LATITUDE 43.468108 LONGITUDE -80.465223 CHECKED BY RPR

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 <sup>3</sup>	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 <sub>P</sub> W      W <sub>L</sub>											
Continued From Previous Page								○ UNCONFINED      + FIELD VANE												
								● QUICK TRIAXIAL      × LAB VANE												
303.8	Silty CLAY, sandy, trace gravel (TILL)						304													
10.5	Silty CLAY, trace sand, trace gravel Very Stiff to Hard Grey Moist		10	SS	29															
							303													
							302													
							301													
							300													
							299													
298.5			13	SS	27												0   0   31   69			
15.8	END OF BOREHOLE AT 15.8m. BOREHOLE OPEN UPON COMPLETION. MUD WAS ADDED DURING DRILLING; THEREFORE, IT WAS NOT POSSIBLE TO MEASURE THE WATER LEVEL UPON COMPLETION OF DRILLING. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND AUGER CUTTINGS TO SURFACE.																			

ONTMT4S2 MTO-11375(GINTDATA).GPJ 2017TEMPLATE(MTO).GDT 5/28/20

# RECORD OF BOREHOLE No RS16-02

1 OF 2

METRIC

GWP# 408-88-00 LOCATION Riverbend-Shirley Connection, MTM NAD 83 Zone 10: N 4 814 671.8 E 226 713.0 ORIGINATED BY JP  
 DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MP  
 DATUM Geodetic DATE 2018.05.14 - 2018.05.14 LATITUDE 43.467905 LONGITUDE -80.465086 CHECKED BY RPR

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 <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)  GR   SA   SI   CL						
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					WATER CONTENT (%)								
								○ UNCONFINED      + FIELD VANE					w <sub>p</sub> w      w <sub>L</sub>								
								● QUICK TRIAXIAL      × LAB VANE													
315.5	GROUND SURFACE						20	40	60	80	100	20	40	60							
0.0	Silty CLAY, with organics, trace sand, trace gravel Very Soft Brown Moist (FILL)		1	SS	1								○								
314.6																					
0.9	Silty CLAY, trace sand Very Stiff to Firm Brown Moist		2	SS	14								○								
			3	SS	19								○	—	—			0   0   40   60			
			4	SS	14								○								
			5	SS	6								○								
310.7			6	SS	7								○								
4.9	SAND and SILT, trace clay Dense Grey Moist (TILL)												○								

Continued Next Page

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to  
Sensitivity

20  
15  
10

(%) STRAIN AT FAILURE

ONTMT4S2 MTO-11375(GINTDATA)GPJ 2017TEMPLATE(MTO).GDT 6/9/20



# RECORD OF BOREHOLE No RS16-02

2 OF 2

METRIC

GWP# 408-88-00 LOCATION Riverbend-Shirley Connection, MTM NAD 83 Zone 10: N 4 814 671.8 E 226 713.0 ORIGINATED BY JP  
 DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MP  
 DATUM Geodetic DATE 2018.05.14 - 2018.05.14 LATITUDE 43.467905 LONGITUDE -80.465086 CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	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								
								20 40 60 80 100								
Continued From Previous Page							○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT w P w w L WATER CONTENT (%)				
10.0	Silty <b>CLAY</b> , trace sand Very Stiff to Hard Grey Moist						305									
			10	SS	15											
							304									
			11	SS	48		303								0 4 39 57	
			12	SS	77		302									
							301									
			13	SS	100		300									
299.7																
15.8	END OF BOREHOLE AT 15.8m. BOREHOLE OPEN UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND AUGER CUTTINGS TO SURFACE.															

ONTMT452 MTO-11375.GPJ 2017TEMPLATE(MTO).GDT 2/5/19

# RECORD OF BOREHOLE No RS16-03

1 OF 3

METRIC

GWP# 408-88-00 LOCATION Riverbend-Shirley Connection, MTM NAD 83 Zone 10: N 4 814 692.7 E 226 723.0 ORIGINATED BY JP  
DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers/Casing Advance/Tricone COMPILED BY MP  
DATUM Geodetic DATE 2018.05.18 - 2018.05.18 LATITUDE 43.468088 LONGITUDE -80.464972 CHECKED BY RPR

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 (%)				
								○ UNCONFINED	+ FIELD VANE	● QUICK TRIAXIAL	× LAB VANE	W <sub>P</sub>	W	W <sub>L</sub>		
314.5	GROUND SURFACE															
0.0	TOPSOIL															
314.1			1	SS	3											
0.3	Silty <b>CLAY</b> Soft to Stiff Brown Moist		2	SS	8										0 0 45 55	
			3	SS	13											
			4	SS	10											
			5	SS	8											
			6	SS	5											
308.4																
6.0	Silty <b>SAND</b> , some clay, trace to some gravel Compact to Very Dense Grey Wet (TILL)		7	SS	22											
			8	SS	34										9 55 21 15	
			9	SS	57											

Continued Next Page

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to  
Sensitivity

20  
15  
10  
(%) STRAIN AT FAILURE

## METRIC

[illegible]

(%) STRAIN AT FAILURE

ONTMT4S2 MTO-11375.GPJ 2017TEMPLATE(MTO).GDT 2/5/19

RECORD OF BOREHOLE No RS16-03

3 OF 3

METRIC

GWP# 408-88-00 LOCATION Riverbend-Shirley Connection, MTM NAD 83 Zone 10: N 4 814 692.7 E 226 723.0 ORIGINATED BY JP  
DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers/Casing Advance/Tricone COMPILED BY MP  
DATUM Geodetic DATE 2018.05.18 - 2018.05.18 LATITUDE 43.468088 LONGITUDE -80.464972 CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	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						
294.4	Continued From Previous Page				0.275									
20.1	END OF BOREHOLE AT 20.1m UPON AUGER REFUSAL. A TEMPORARY PIPE WAS INSTALLED IN THE BOREHOLE TO MEASURE GROUND WATER LEVEL. WATER LEVEL WAS MEASURED AT 1.8m ABOVE THE GROUND SURFACE IN THE TEMPORARY PIPE (ARTESIAN CONDITION). BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND AUGER CUTTINGS TO SURFACE.													

# RECORD OF BOREHOLE No RS16-04

1 OF 3

METRIC

GWP# 408-88-00 LOCATION Riverbend-Shirley Connection, MTM NAD 83 Zone 10: N 4 814 713.9 E 226 763.3 ORIGINATED BY SB  
 DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers/Mud Rotary COMPILED BY MP  
 DATUM Geodetic DATE 2018.07.03 - 2018.07.03 LATITUDE 43.468200 LONGITUDE -80.464593 CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ 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 × LAB VANE	WATER CONTENT (%)					
312.9	GROUND SURFACE													
0.0	TOPSOIL: (100mm)													
0.1	Silty CLAY, trace sand, trace gravel Soft to Stiff Grey Moist		1	SS	2									
			2	SS	8									
			3	SS	11									0 1 41 58
			4	SS	15									
			5	SS	13									
			6	SS	14									
			7	SS	15									
			8	SS	11									
			9	SS	8									0 1 29 70
			10	SS	26									
	Very Stiff													

Continued Next Page

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to  
Sensitivity 20  
15 5  
10 (%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No RS16-04

2 OF 3

METRIC

GWP# 408-88-00 LOCATION Riverbend-Shirley Connection, MTM NAD 83 Zone 10: N 4 814 713.9 E 226 763.3 ORIGINATED BY SB  
 DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers/Mud Rotary COMPILED BY MP  
 DATUM Geodetic DATE 2018.07.03 - 2018.07.03 LATITUDE 43.468200 LONGITUDE -80.464593 CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ 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 × LAB VANE								
	Continued From Previous Page															
	Silty CLAY, trace sand Very Stiff to Hard Grey Moist		11	SS	20		302									
							301									
			12	SS	42		300									
							299									
			13	SS	30		298									
							297									
			14	SS	38		296									
							295									
296.4	Gravelly SAND, trace silt, trace clay Very Dense Grey Wet		15	SS	93		294									
16.5	Auger grinding at 17.4m						293									
295.0	SAND and SILT, trace gravel, trace clay Very Dense Grey Wet (TILL)		16	SS	100/ 0.300											
17.8																

Continued Next Page

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to  
Sensitivity 20  
15 10 5 (%) STRAIN AT FAILURE

ONTMT4S2 MTO-11375(GINTDATA).GPJ 2017TEMPLATE(MTO).GDT 5/28/20

RECORD OF BOREHOLE No RS16-04

3 OF 3

METRIC

GWP# 408-88-00 LOCATION Riverbend-Shirley Connection, MTM NAD 83 Zone 10: N 4 814 713.9 E 226 763.3 ORIGINATED BY SB  
DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers/Mud Rotary COMPILED BY MP  
DATUM Geodetic DATE 2018.07.03 - 2018.07.03 LATITUDE 43.468200 LONGITUDE -80.464593 CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ 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 × LAB VANE									
	Continued From Previous Page		17	SS	100/												
	SAND and SILT, some clay, trace gravel Very Dense Grey Wet (TILL)				0.225												
	clayey zone at 21.5m		18	SS	100/												2 38 33 27
					0.050												
289.9			19	SS	100/												
22.9	END OF BOREHOLE AT 22.9m. Piezometer installation consists of 25mm diameter Schedule 40 PVC pipe with a 3.0m slotted screen.  WATER LEVEL READINGS DATE DEPTH(m) ELEV.(m) 2018.08.31 8.2 304.7				0.075												

# RECORD OF BOREHOLE No RS16-05

1 OF 2

METRIC

GWP# 408-88-00 LOCATION Riverbend-Shirley Connection, MTM NAD 83 Zone 10: N 4 814 726.8 E 226 765.6 ORIGINATED BY AF  
 DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers/Casing Advance COMPILED BY MP  
 DATUM Geodetic DATE 2018.05.22 - 2018.05.22 LATITUDE 43.468419 LONGITUDE -80.464456 CHECKED BY RPR

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			20    40    60    80    100	W <sub>P</sub> W      W <sub>L</sub>	WATER CONTENT (%)			GR		SA	SI	CL								
SHEAR STRENGTH kPa								○ UNCONFINED      + FIELD VANE																	
313.6	GROUND SURFACE							● QUICK TRIAXIAL      × LAB VANE <td colspan="3"></td> <td colspan="3"></td> <td></td> <td colspan="4"></td>																	
0.0	TOPSOIL							20    40    60    80    100	20    40    60																
0.2	Silty <b>CLAY</b> , trace sand Soft to Stiff Grey Moist		1	SS	3	▽	313							138											
			2	SS	5																				
			3	SS	12																				
			4	SS	9																				
			5	SS	12																				
			6	SS	11																				
			7	SS	14																				
			8	SS	10																				
			9	SS	94																				
	Hard																								

Continued Next Page

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to  
Sensitivity

20  
15  
10  
(%) STRAIN AT FAILURE



# RECORD OF BOREHOLE No RS16-05

2 OF 2

METRIC

GWP# 408-88-00 LOCATION Riverbend-Shirley Connection, MTM NAD 83 Zone 10: N 4 814 726.8 E 226 765.6 ORIGINATED BY AF  
 DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers/Casing Advance COMPILED BY MP  
 DATUM Geodetic DATE 2018.05.22 - 2018.05.22 LATITUDE 43.468419 LONGITUDE -80.464456 CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	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						
								20 40 60 80 100						
	Continued From Previous Page							○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE						
	Silty <b>CLAY</b> , trace sand Hard Grey Moist							20 40 60 80 100						
			10	SS	61		303							
							302							
			11	SS	37		301							
							300							
			12	SS	44		299							
							298							
297.8			13	SS	50									0 0 36 64
15.8	END OF BOREHOLE AT 15.8m. WATER LEVEL AT 1.8m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND AUGER CUTTINGS TO SURFACE.													

ONTMT452 MTO-11375.GPJ 2017TEMPLATE(MTO).GDT 2/5/19

# RECORD OF BOREHOLE No RS16-06

1 OF 2

METRIC

GWP# 408-88-00 LOCATION Riverbend-Shirley Connection, MTM NAD 83 Zone 10: N 4 814 701.3 E 226 779.2 ORIGINATED BY AF  
 DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers/Casing Advance COMPILED BY MP  
 DATUM Geodetic DATE 2018.05.22 - 2018.05.22 LATITUDE 43.468175 LONGITUDE -80.464298 CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	20 40 60 80 100	20 40 60 80 100		
314.7	GROUND SURFACE											
0.0	TOPSOIL											
0.3	Silty CLAY, trace sand, trace gravel Soft to Firm Grey Moist		1	SS	2		314					
			2	SS	9		313					
			3	SS	19		312					
	Very Stiff to Firm		4	SS	16		311					
			5	SS	11		310					
			6	SS	8		309					
			7	SS	12		308					
			8	SS	7		307					
			9	SS	6		306					
							305					

Continued Next Page

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to Sensitivity 20 15 10 5 0 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No RS16-06

2 OF 2

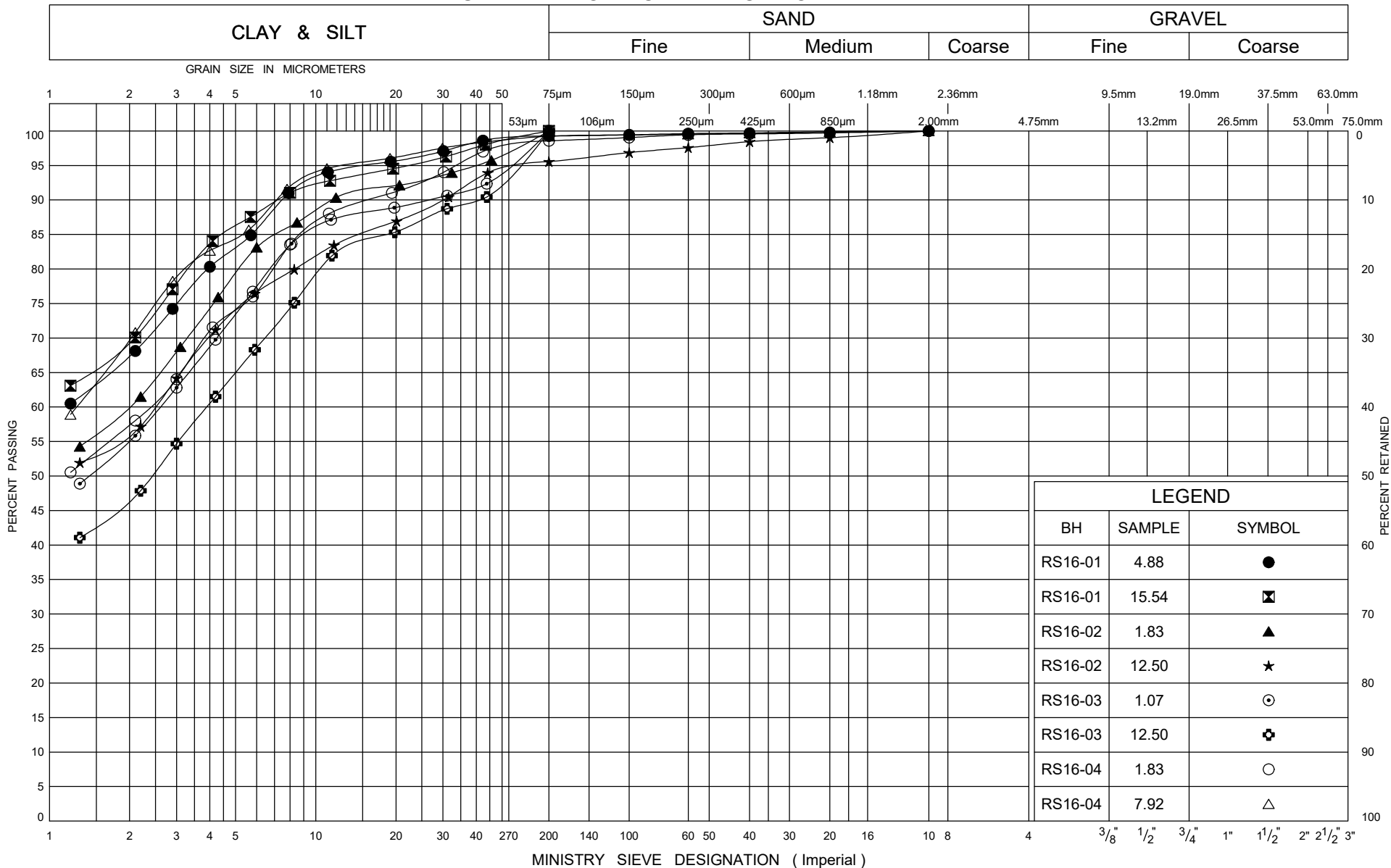
METRIC

GWP# 408-88-00 LOCATION Riverbend-Shirley Connection, MTM NAD 83 Zone 10: N 4 814 701.3 E 226 779.2 ORIGINATED BY AF  
DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers/Casing Advance COMPILED BY MP  
DATUM Geodetic DATE 2018.05.22 - 2018.05.22 LATITUDE 43.468175 LONGITUDE -80.464298 CHECKED BY RPR

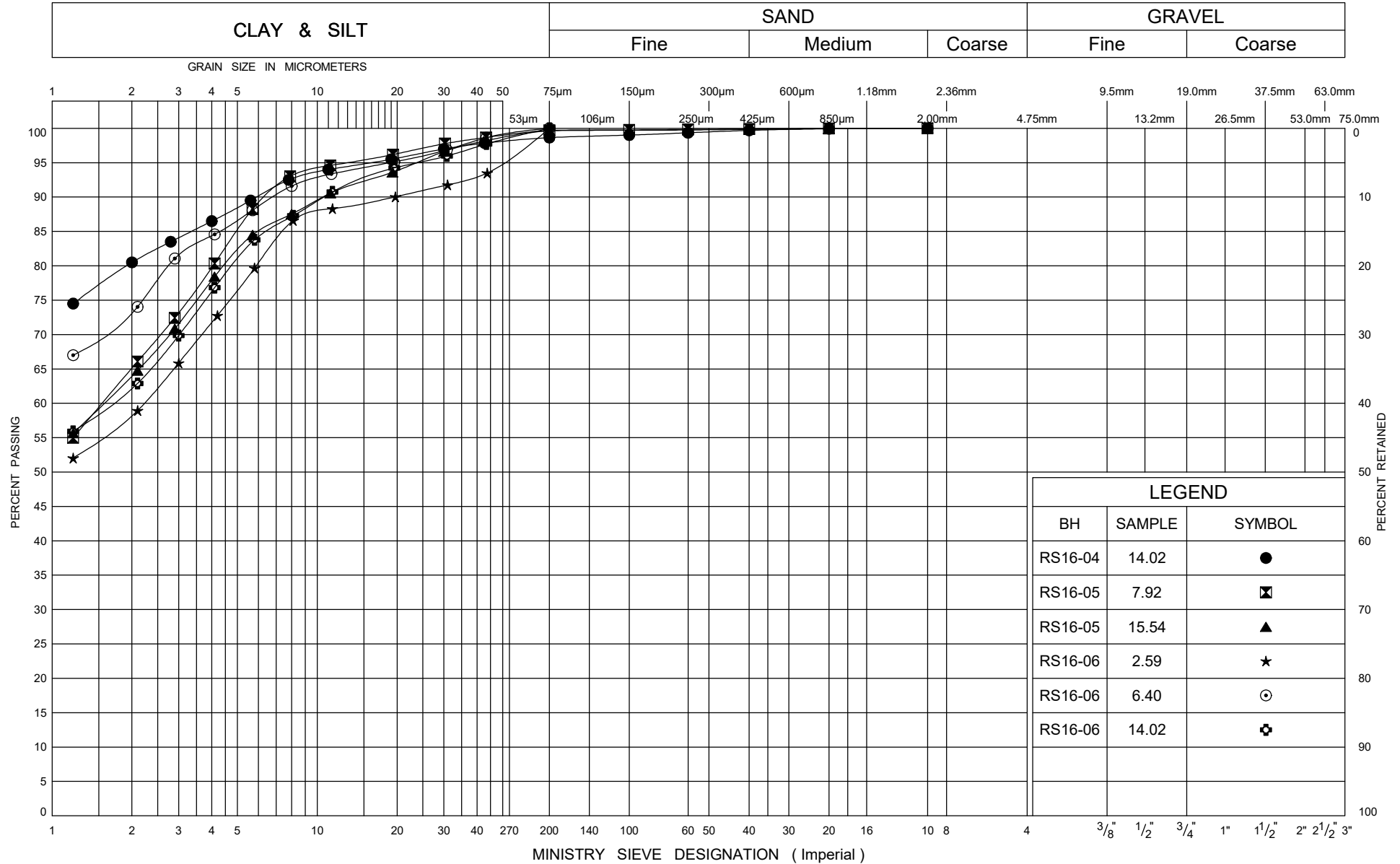
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE								
	Continued From Previous Page															
	Silty CLAY, trace sand, trace gravel Very Stiff to Hard Grey Moist															
			10	SS	24		304									
							303									
			11	SS	52		302									
							301									
			12	SS	49											
							300									
			13	SS	55		299									
298.8																
15.8	END OF BOREHOLE AT 15.8m. WATER LEVEL AT 2.2m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND AUGER CUTTINGS TO SURFACE.															

ONTMT4S2 MTO-11375(GINTDATA).GPJ 2017TEMPLATE(MTO).GDT 5/28/20

# UNIFIED SOIL CLASSIFICATION SYSTEM



## UNIFIED SOIL CLASSIFICATION SYSTEM



Ministry of  
Transportation

## GRAIN SIZE DISTRIBUTION

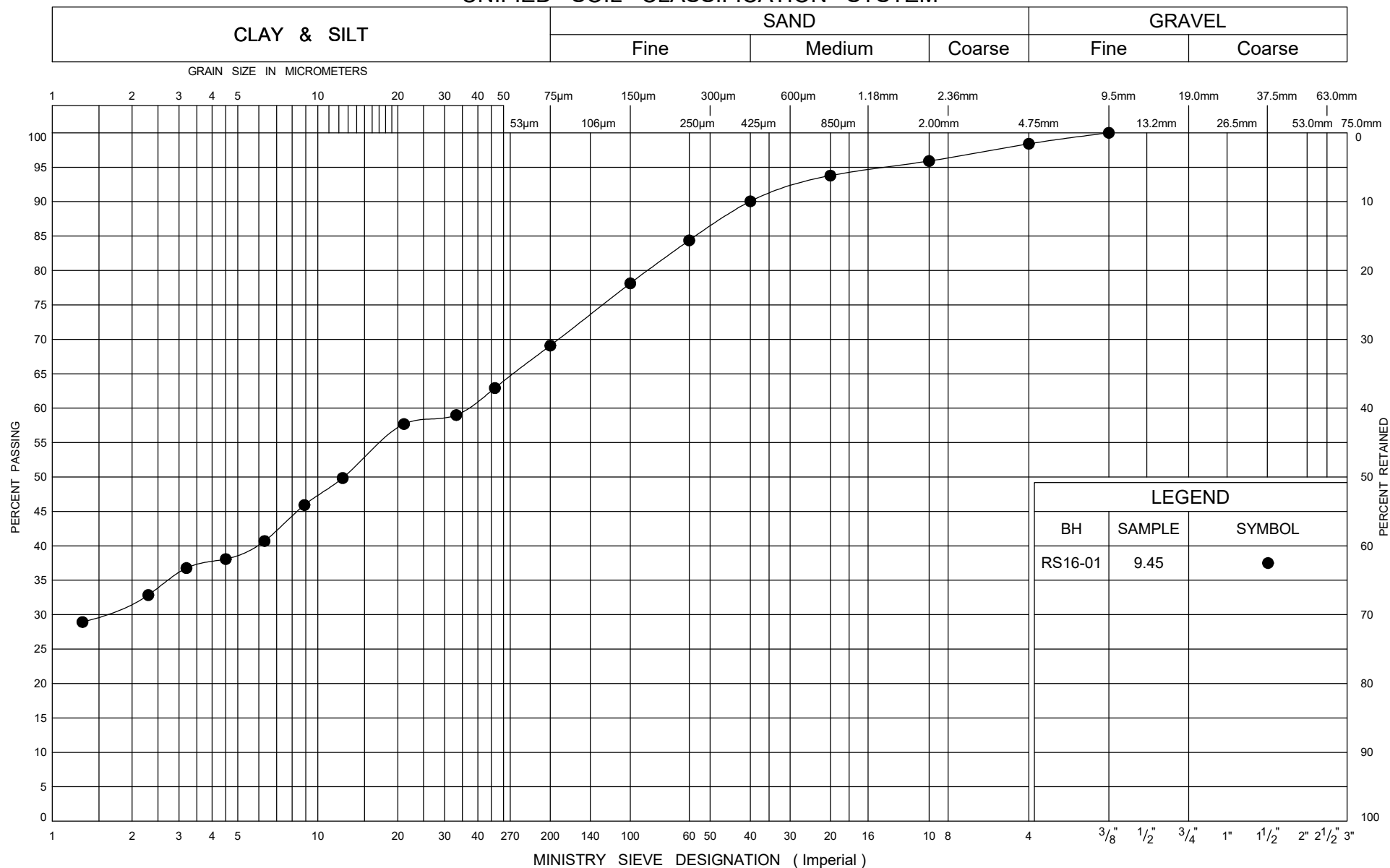
Silty Clay

FIG No B2

W P 408-88-00

Riverbend-Shirley Connection

## UNIFIED SOIL CLASSIFICATION SYSTEM



Ministry of  
Transportation

## GRAIN SIZE DISTRIBUTION

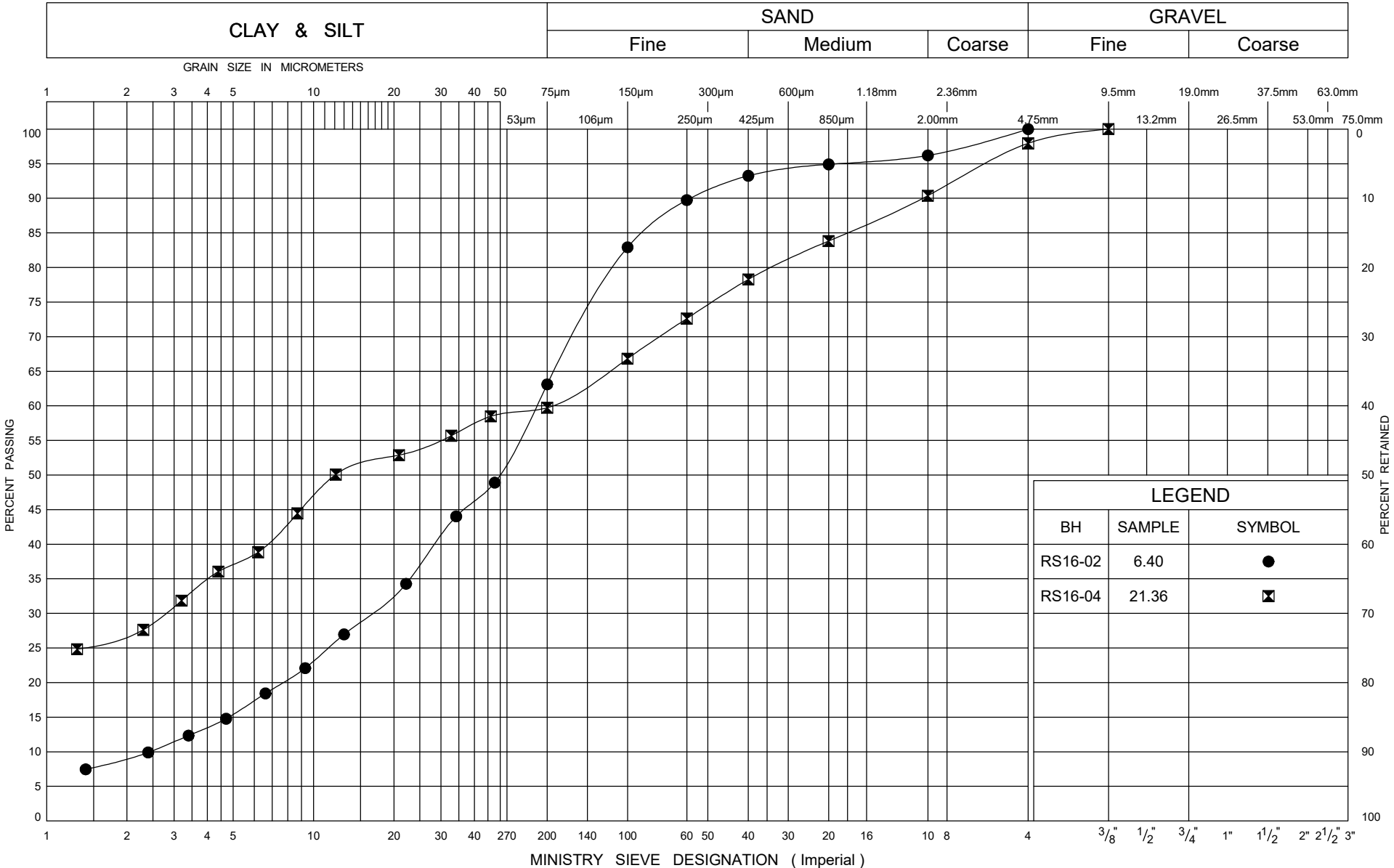
Silty Clay Till

FIG No B3

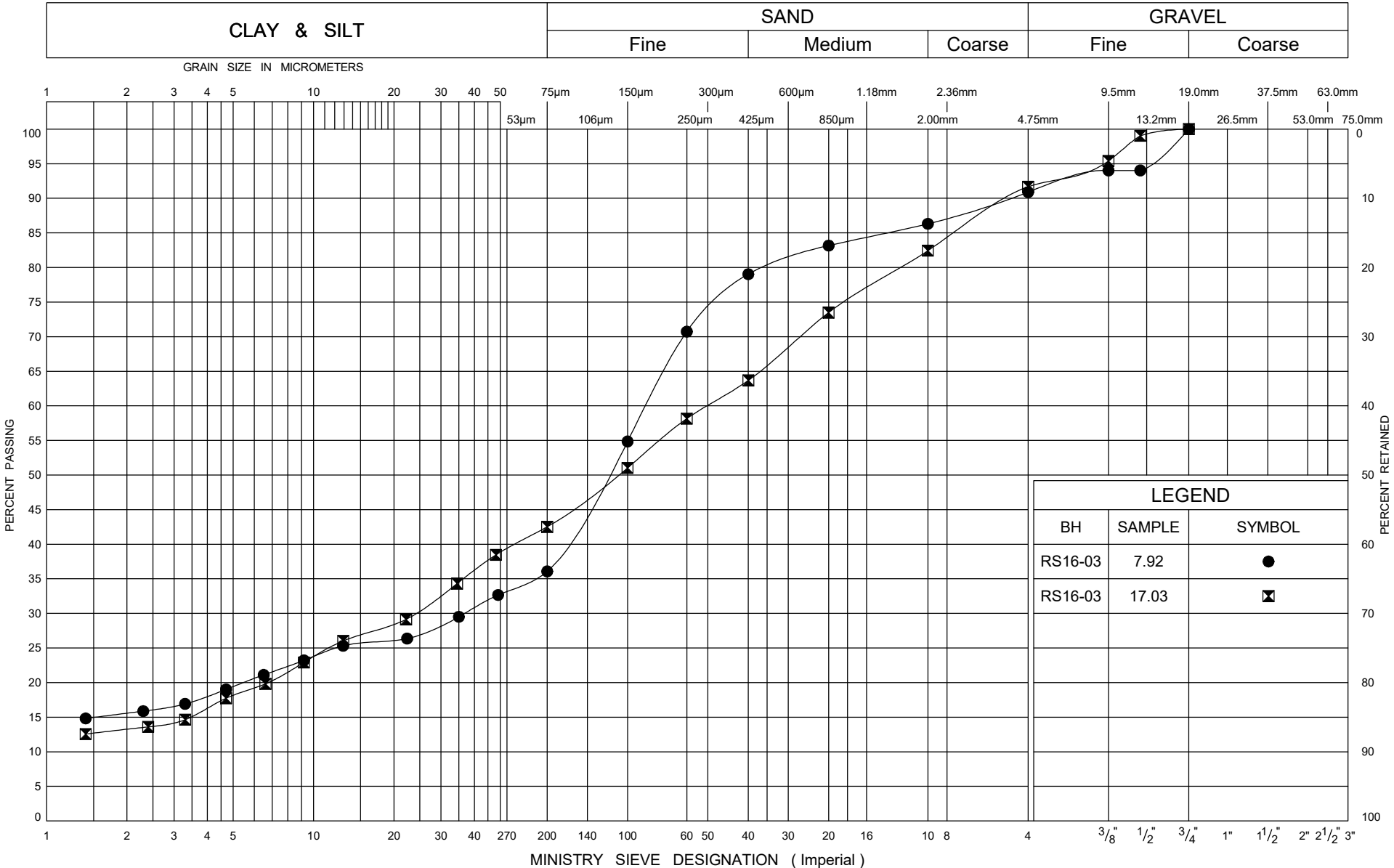
W P 408-88-00

Riverbend-Shirley Connection

UNIFIED SOIL CLASSIFICATION SYSTEM

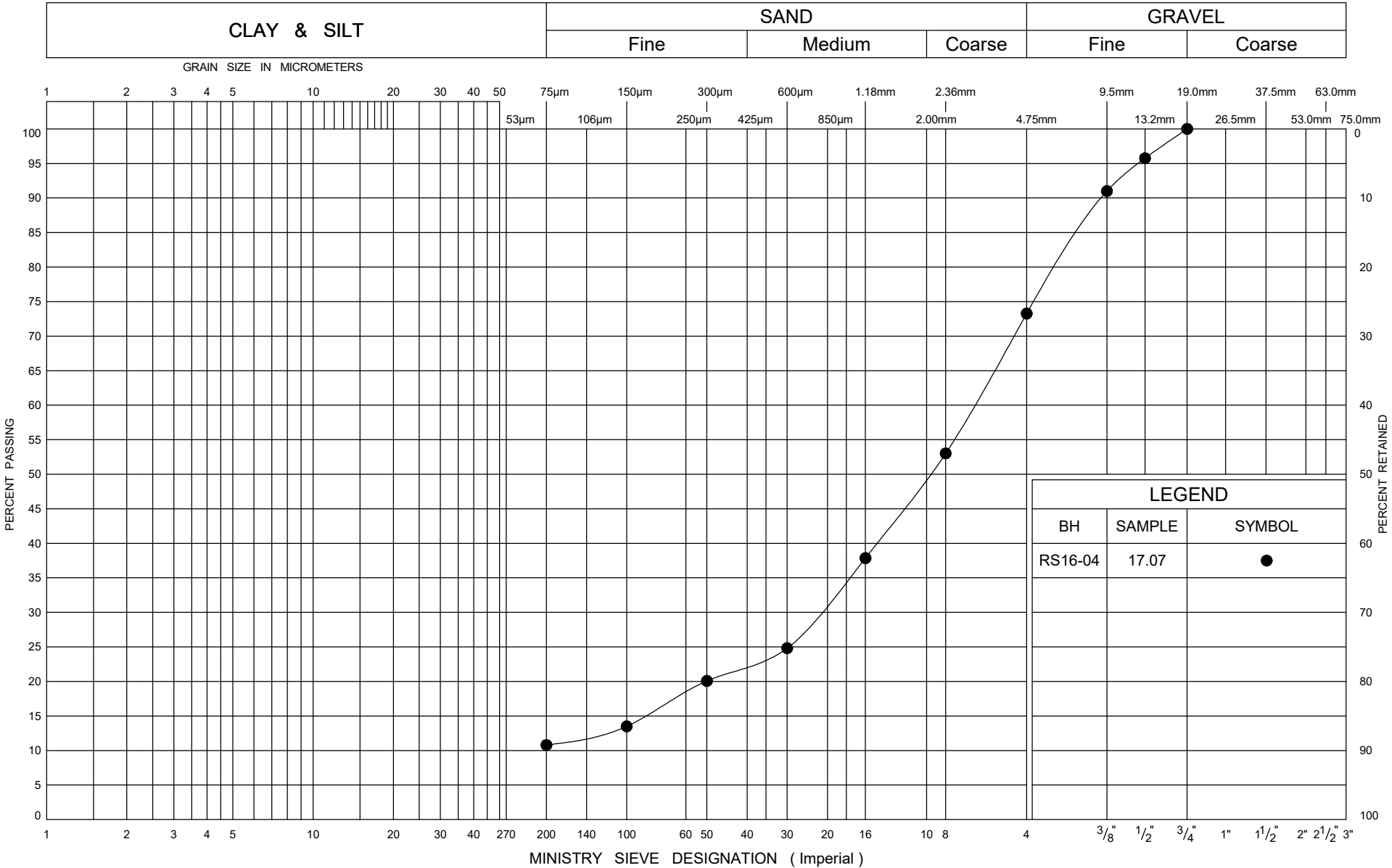


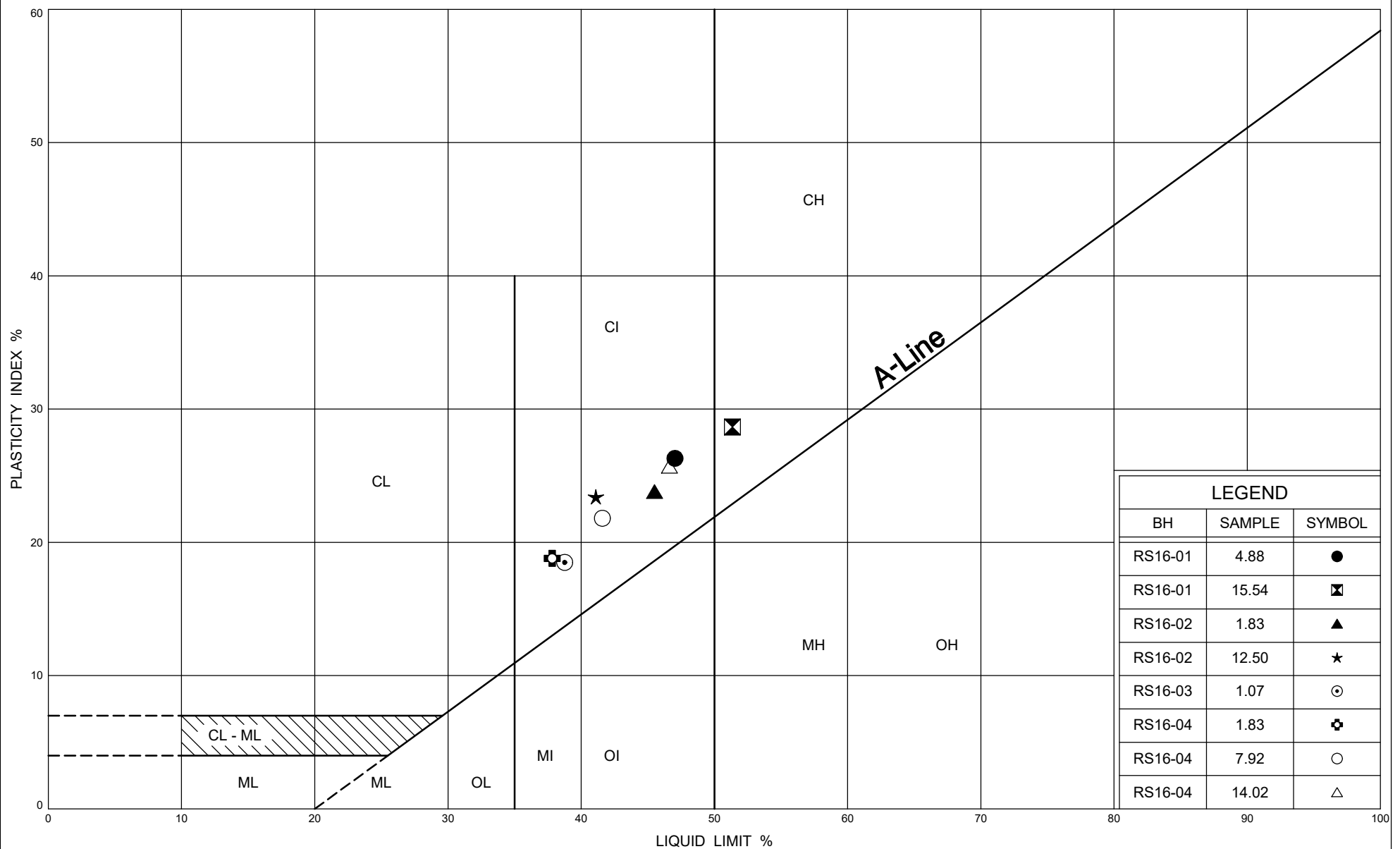
UNIFIED SOIL CLASSIFICATION SYSTEM





UNIFIED SOIL CLASSIFICATION SYSTEM





Ministry of  
Transportation

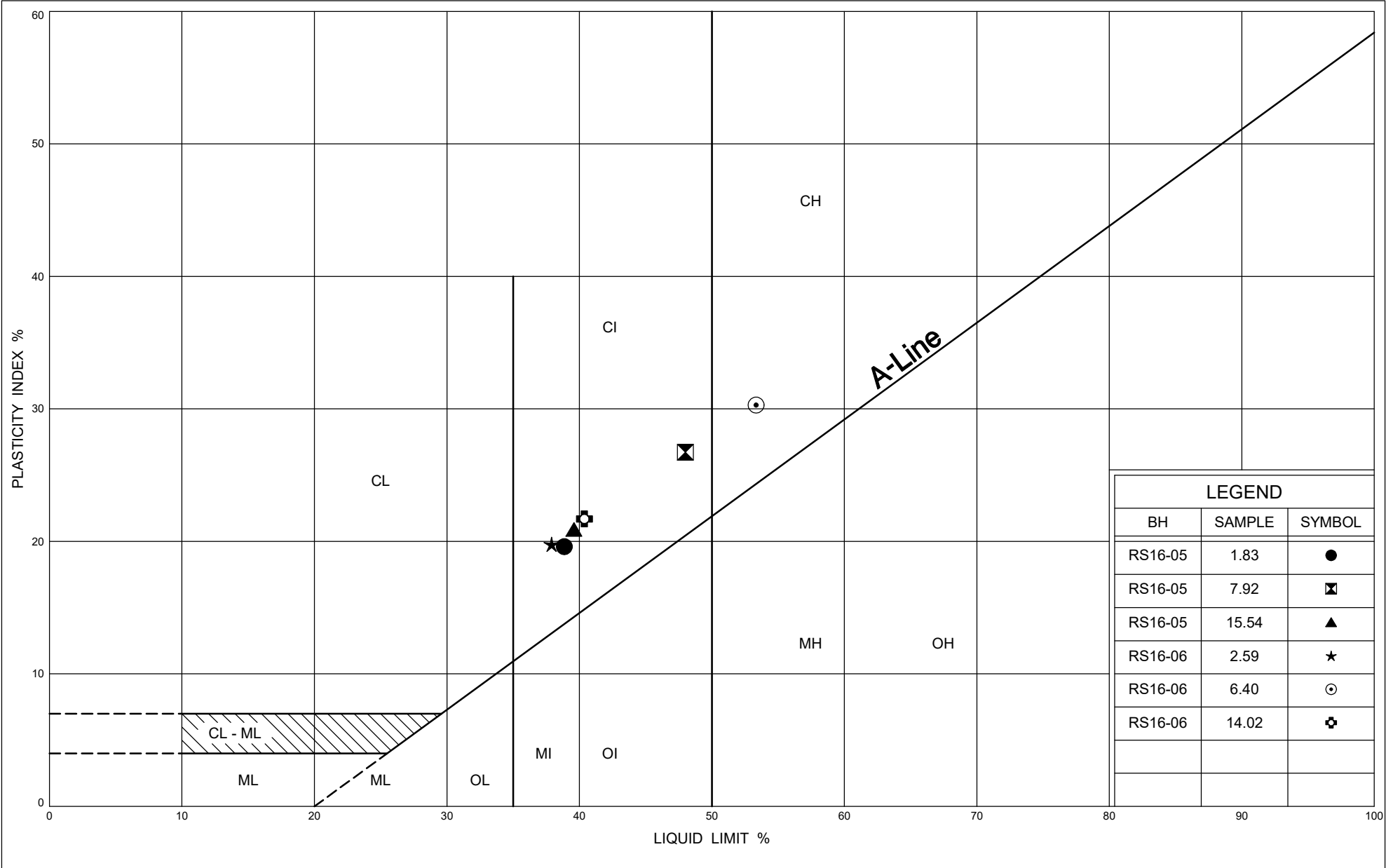
## PLASTICITY CHART

Silty Clay

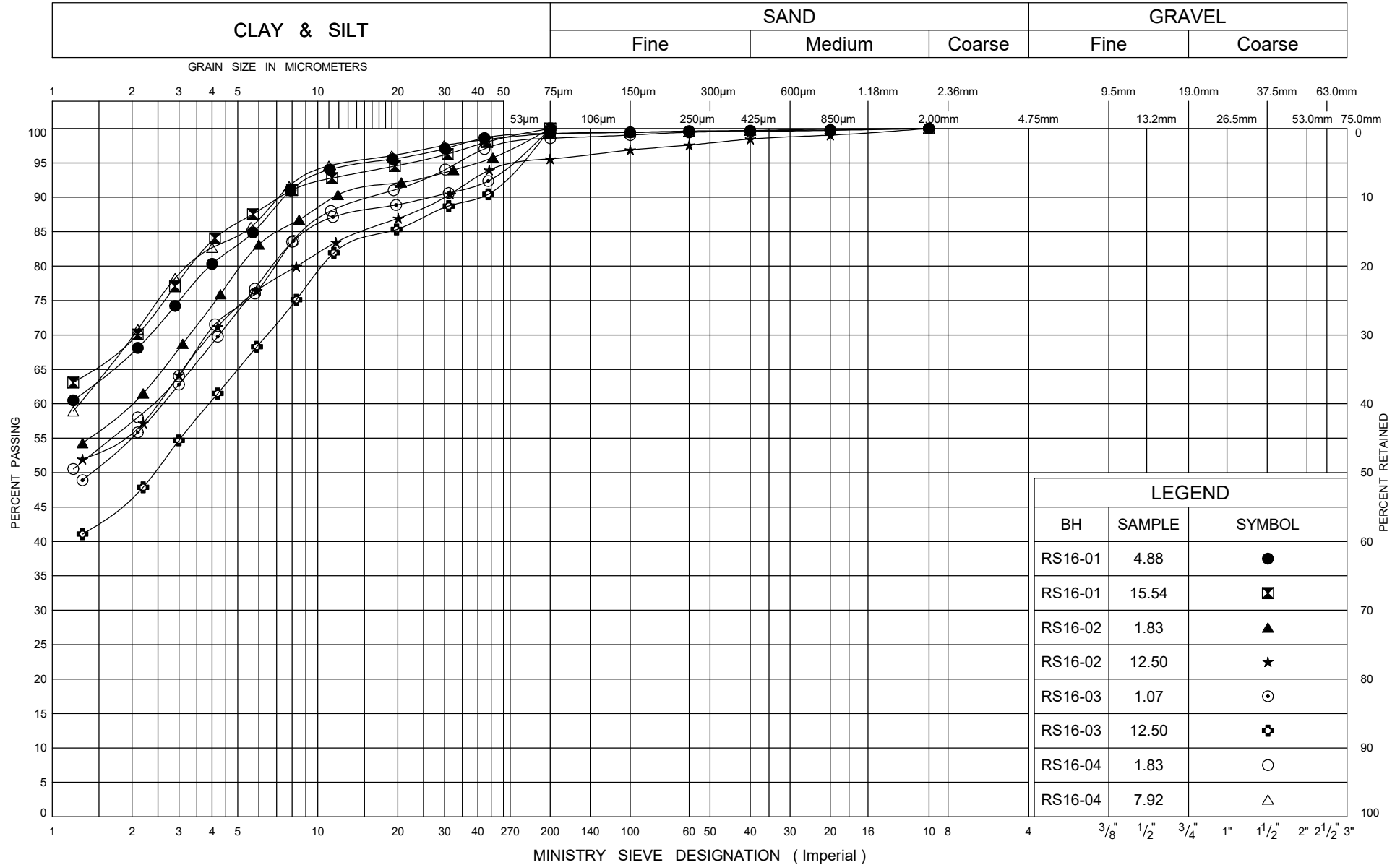
FIG No B7

W P 408-88-00

Riverbend-Shirley Connection



## UNIFIED SOIL CLASSIFICATION SYSTEM



Ministry of  
Transportation

# GRAIN SIZE DISTRIBUTION

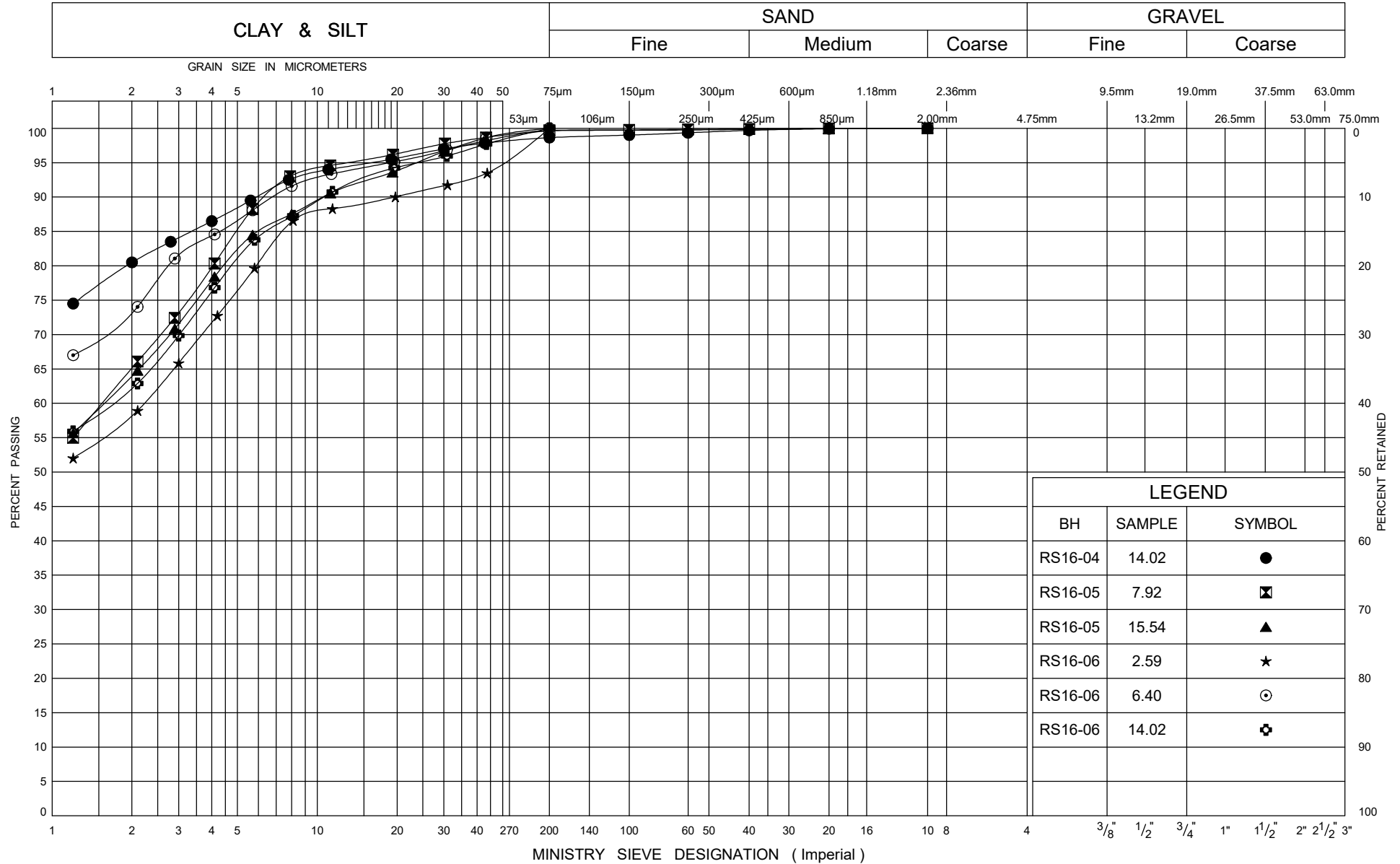
Silty Clay

FIG No B1

W P 408-88-00

Riverbend-Shirley Connection

## UNIFIED SOIL CLASSIFICATION SYSTEM



Ministry of  
Transportation

## GRAIN SIZE DISTRIBUTION

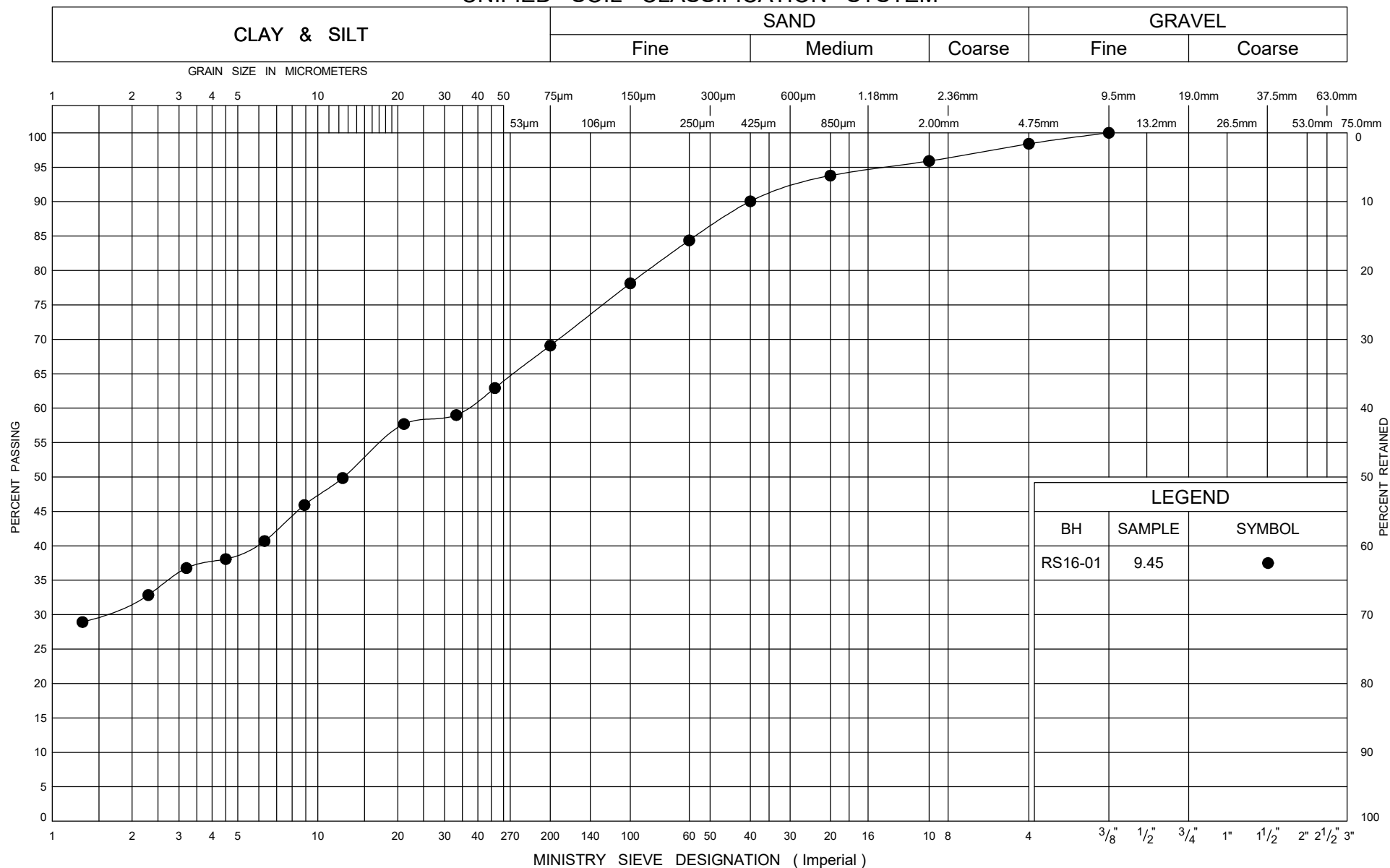
Silty Clay

FIG No B2

W P 408-88-00

Riverbend-Shirley Connection

## UNIFIED SOIL CLASSIFICATION SYSTEM



Ministry of  
Transportation

## GRAIN SIZE DISTRIBUTION

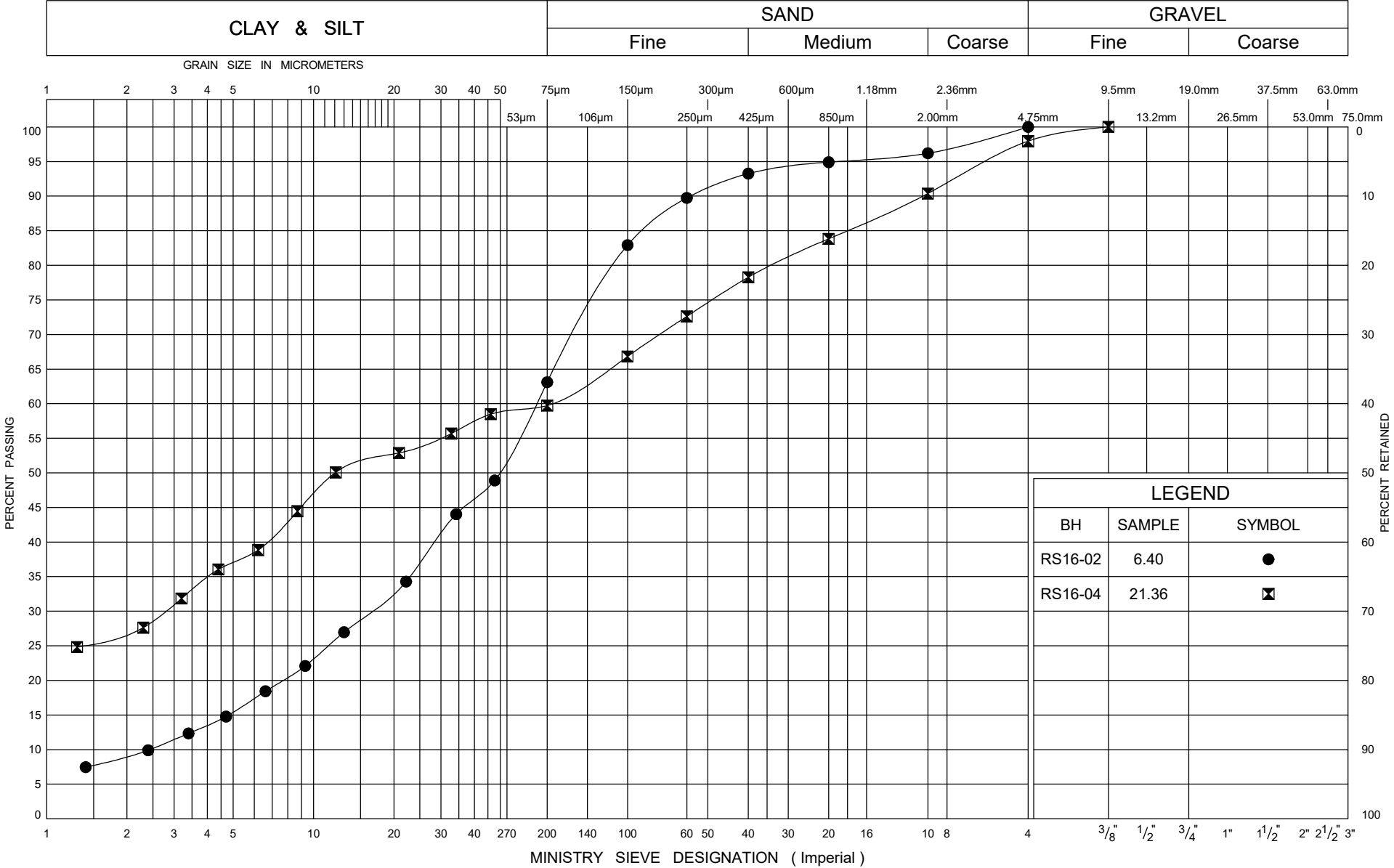
Silty Clay Till

FIG No B3

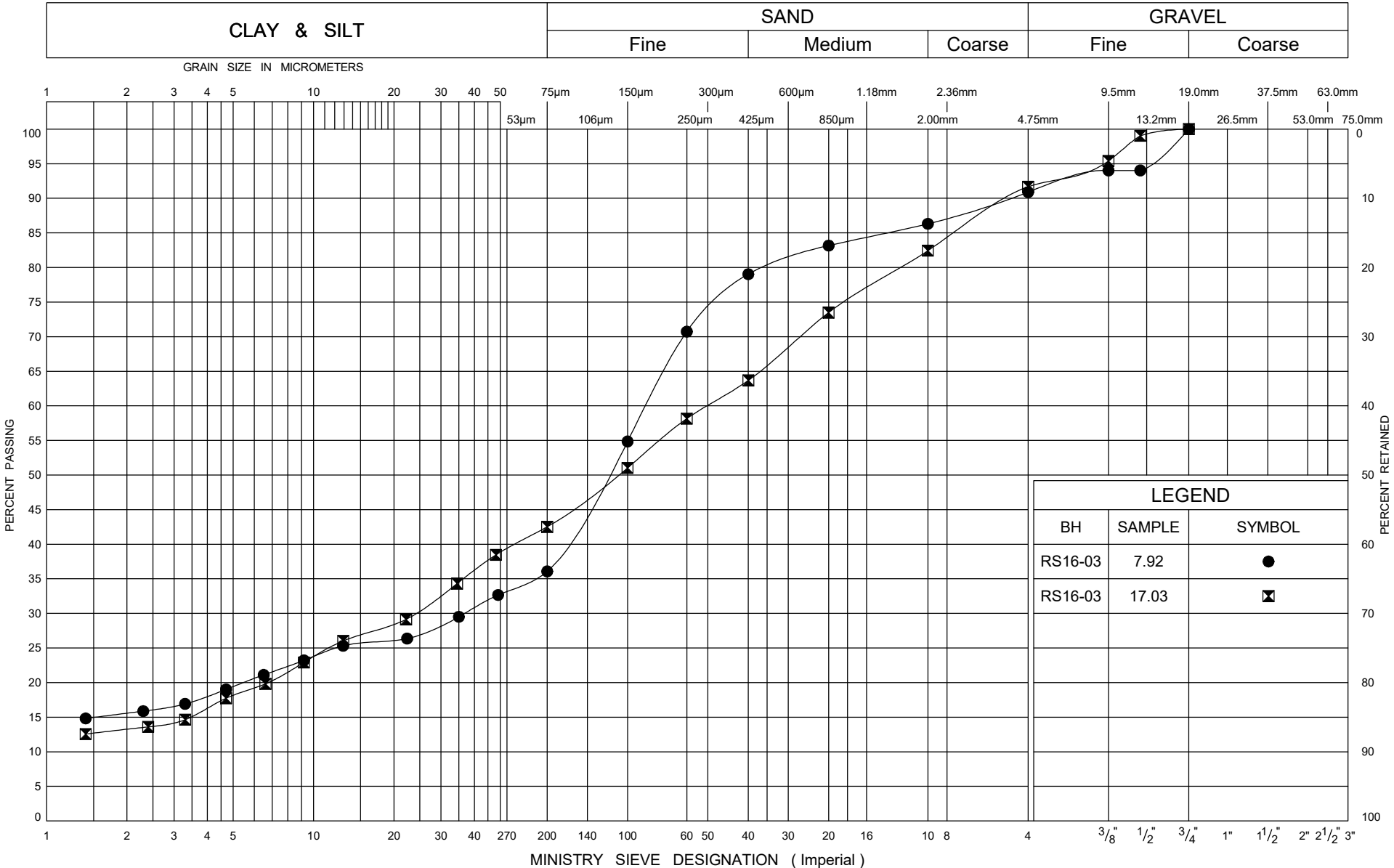
W P 408-88-00

Riverbend-Shirley Connection

UNIFIED SOIL CLASSIFICATION SYSTEM

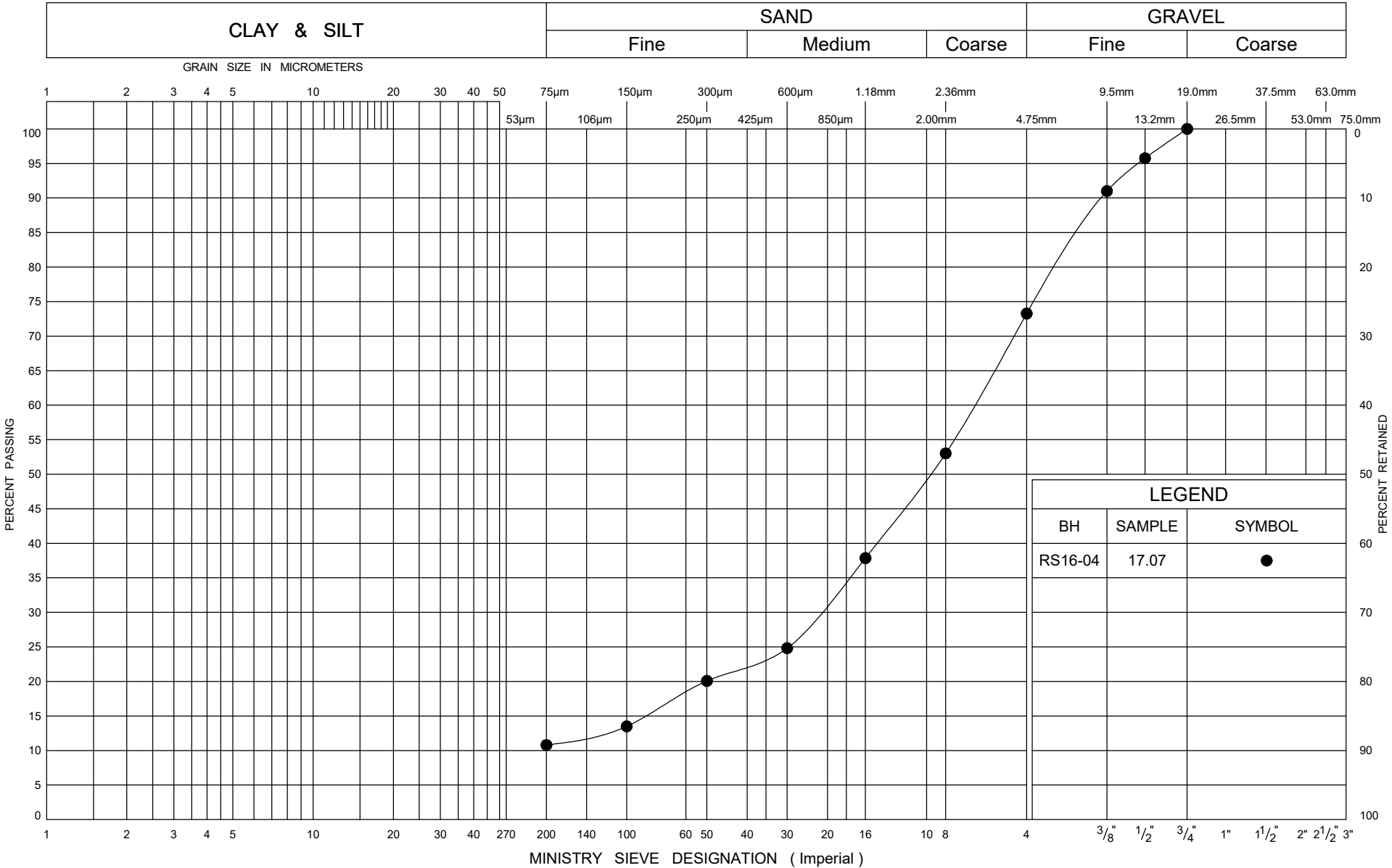


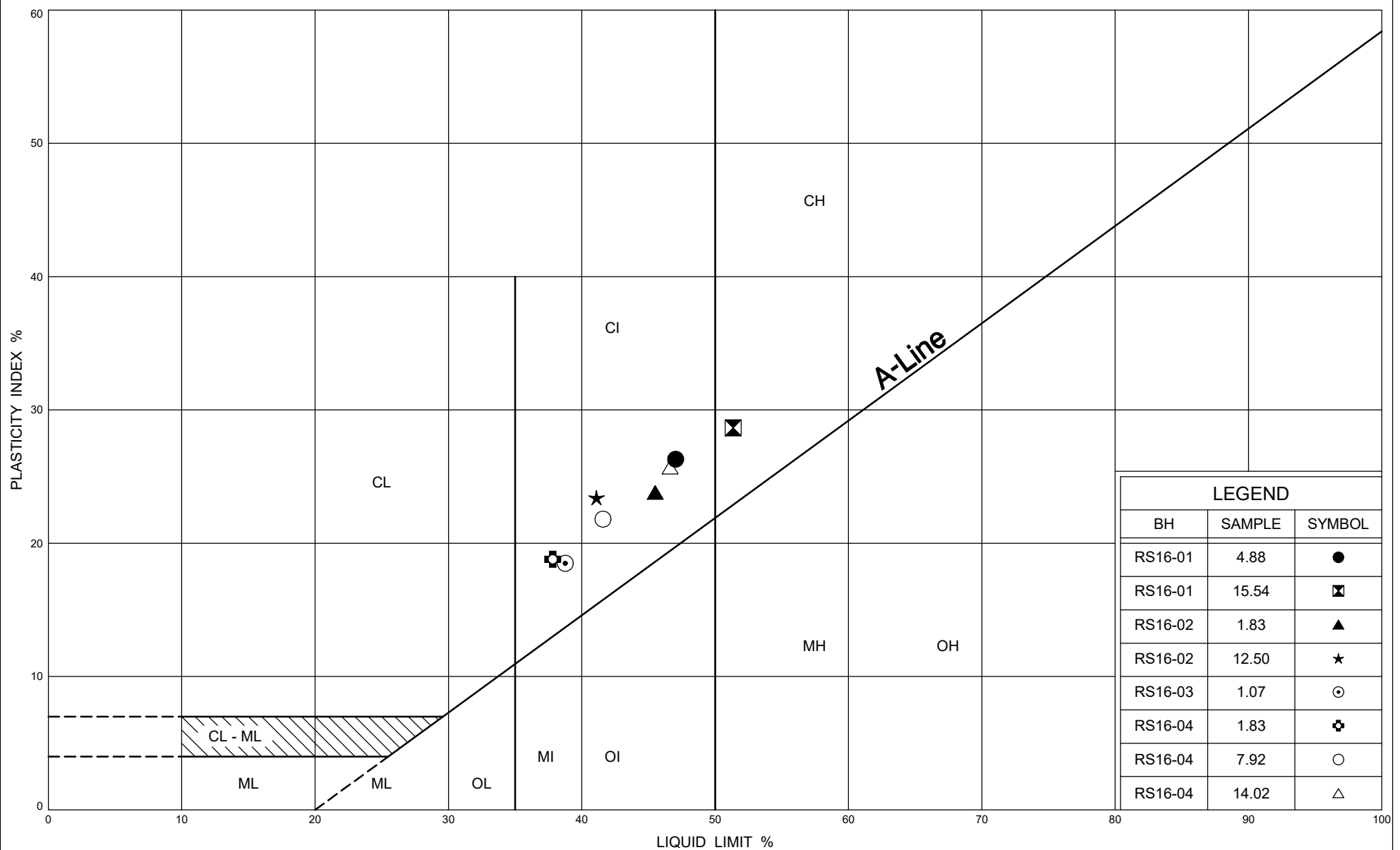
UNIFIED SOIL CLASSIFICATION SYSTEM





UNIFIED SOIL CLASSIFICATION SYSTEM





Ministry of  
Transportation

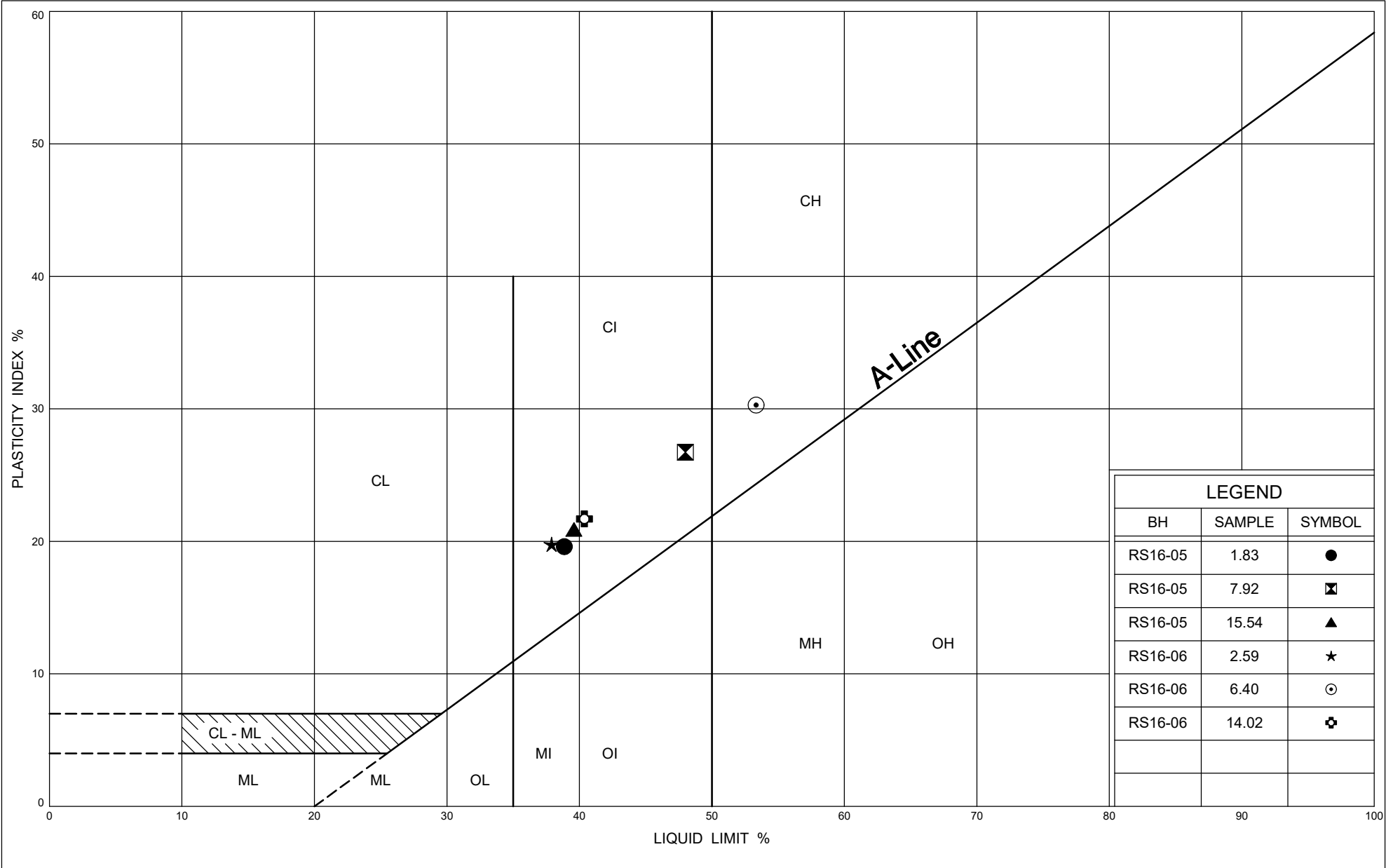
## PLASTICITY CHART

Silty Clay

FIG No B7

W P 408-88-00

Riverbend-Shirley Connection





## FINAL REPORT

CA14445-AUG18 R1

11375

Prepared for

**Thurber Engineering Ltd.**

## First Page

### CLIENT DETAILS

Client Thurber Engineering Ltd.

Address 103, 2010 Winston Park Drive  
Oakville, ON  
L6H 5R7, Canada

Contact Rocio Palomeque

Telephone 905-829-8666 x 263

Facsimile

Email rreyna@thurber.ca

Project 11375

Order Number

Samples Soil (5)

### LABORATORY DETAILS

Project Specialist Deanna Edwards, B.Sc, C.Chem

Laboratory SGS Canada Inc.

Address 185 Concession St., Lakefield ON, K0L 2H0

Telephone 705-652-2000

Facsimile 705-652-6365

Email deanna.edwards@sgs.com

SGS Reference CA14445-AUG18

Received 08/16/2018

Approved 08/23/2018

Report Number CA14445-AUG18 R1

Date Reported 08/23/2018

### COMMENTS

Temperature of Sample upon Receipt: 6 degrees C

Cooling Agent Present.

Custody Seal Present&intact.

Corrosivity Index is based on the American Water Works Corrosivity Scale according to AWWA C-105. An index greater than 10 indicates the soil matrix may be corrosive to cast iron alloys.

### SIGNATORIES

Deanna Edwards, B.Sc, C.Chem





TABLE OF CONTENTS

---

First Page..... 1

Index..... 2

Results..... 3-4

QC Summary..... 5-6

Legend..... 7

Annexes..... 8-9



# FINAL REPORT

CA14445-AUG18 R1

Client: Thurber Engineering Ltd.

Project: 11375

Project Manager: Rocío Palomeque

Samplers: N/A

## PACKAGE: - Corrosivity Index (SOIL)

Sample Number	5	6	7	8	9
Sample Name	RS16-03-SS4	RW7-01-SS3	RW1-04-SS2	NE16-10 SS4	EC16-08 SS3
Sample Matrix	Soil	Soil	Soil	Soil	Soil
Sample Date	18/05/2018	05/06/2018	06/06/2018	27/04/2018	27/04/2018

Parameter	Units	RL	Result	Result	Result	Result	Result
-----------	-------	----	--------	--------	--------	--------	--------

### Corrosivity Index

Corrosivity Index	none	1	4.0	4.0	6.5	4.0	4.5
Soil Redox Potential	mV	-	246	362	187	205	169
Sulphide	%	0.02	< 0.02	< 0.02	0.04	< 0.02	0.86
pH	no unit	0.05	8.87	9.36	10.7	9.02	8.15
Resistivity (calculated)	ohms.cm	-9999	3320	10500	4120	4070	4410

## PACKAGE: - General Chemistry (SOIL)

Sample Number	5	6	7	8	9
Sample Name	RS16-03-SS4	RW7-01-SS3	RW1-04-SS2	NE16-10 SS4	EC16-08 SS3
Sample Matrix	Soil	Soil	Soil	Soil	Soil
Sample Date	18/05/2018	05/06/2018	06/06/2018	27/04/2018	27/04/2018

Parameter	Units	RL	Result	Result	Result	Result	Result
-----------	-------	----	--------	--------	--------	--------	--------

### General Chemistry

Conductivity	uS/cm	2	301	95	243	246	227
--------------	-------	---	-----	----	-----	-----	-----

## PACKAGE: - Metals and Inorganics (SOIL)

Sample Number	5	6	7	8	9
Sample Name	RS16-03-SS4	RW7-01-SS3	RW1-04-SS2	NE16-10 SS4	EC16-08 SS3
Sample Matrix	Soil	Soil	Soil	Soil	Soil
Sample Date	18/05/2018	05/06/2018	06/06/2018	27/04/2018	27/04/2018

Parameter	Units	RL	Result	Result	Result	Result	Result
-----------	-------	----	--------	--------	--------	--------	--------

### Metals and Inorganics

Moisture Content	%	0.1	19.4	3.0	7.6	11.0	13.9
Sulphate	µg/g	0.4	70	6.6	270	9.1	710



FINAL REPORT

CA14445-AUG18 R1

Client: Thurber Engineering Ltd.

Project: 11375

Project Manager: Rocío Palomeque

Samplers: N/A

PACKAGE: - Other (ORP) (SOIL)

Sample Number

5

6

7

8

9

Sample Name

RS16-03-SS4

RW7-01-SS3

RW1-04-SS2

NE16-10 SS4

EC16-08 SS3

Sample Matrix

Soil

Soil

Soil

Soil

Soil

Sample Date

18/05/2018

05/06/2018

06/06/2018

27/04/2018

27/04/2018

Parameter

Units

RL

Result

Result

Result

Result

Result

Other (ORP)

Chloride

µg/g

0.4

240

13

60

130

4.4





FINAL REPORT

CA14445-AUG18 R1

QC SUMMARY

Anions by IC  
Method: EPA300/MA300-Ions1.3 | Internal ref.: ME-CA-IENVIIC-LAK-AN-001

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Chloride	DIO0280-AUG18	µg/g	0.4	<0.4	2	20	96	80	120	97	75	125
Sulphate	DIO0280-AUG18	µg/g	0.4	<0.4	5	20	97	80	120	81	75	125

Carbon/Sulphur  
Method: ASTM E1915-07A | Internal ref.: ME-CA-IENVIARD-LAK-AN-020

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Sulphide	ECS0022-AUG18	%	0.02	<0.02	99	20	99	80	120			

Conductivity  
Method: SM 2510 | Internal ref.: ME-CA-IENVIEWL-LAK-AN-006

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Conductivity	EWL0253-AUG18	uS/cm	2	< 0.002	0	10	99	90	110	NA		



FINAL REPORT

CA14445-AUG18 R1

QC SUMMARY

pH  
Method: SM 4500 | Internal ref.: ME-CA-1ENVIEWL-LAK-AN-001

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
pH	EWL0253-AUG18	no unit	0.05	NA	0		101			NA		

Method Blank: a blank matrix that is carried through the entire analytical procedure. Used to assess laboratory contamination.

Duplicate: Paired analysis of a separate portion of the same sample that is carried through the entire analytical procedure. Used to evaluate measurement precision.

LCS/Spike Blank: Laboratory control sample or spike blank refer to a blank matrix to which a known amount of analyte has been added. Used to evaluate analyte recovery and laboratory accuracy without sample matrix effects.

Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate laboratory accuracy with sample matrix effects.

Reference Material: a material or substance matrix matched to the samples that contains a known amount of the analyte of interest. A reference material may be used in place of a matrix spike.

RL: Reporting limit

RPD: Relative percent difference

AC: Acceptance criteria

**Multielement Scan Qualifier:** as the number of analytes in a scan increases, so does the chance of a limit exceedance by random chance as opposed to a real method problem. Thus, in multielement scans, for the LCS and matrix spike, up to 10% of the analytes may exceed the quoted limits by up to 10% absolute and the spike is considered acceptable.

**Duplicate Qualifier:** for duplicates as the measured result approaches the RL, the uncertainty associated with the value increases dramatically, thus duplicate acceptance limits apply only where the average of the two duplicates is greater than five times the RL.

**Matrix Spike Qualifier:** for matrix spikes, as the concentration of the native analyte increases, the uncertainty of the matrix spike recovery increases. Thus, the matrix spike acceptance limits apply only when the concentration of the matrix spike is greater than or equal to the concentration of the native analyte.

## LEGEND

## FOOTNOTES

**NSS** Insufficient sample for analysis.

**RL** Reporting Limit.

↑ Reporting limit raised.

↓ Reporting limit lowered.

**NA** The sample was not analysed for this analyte

**ND** Non Detect

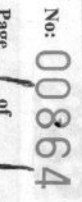
Samples analysed as received. Solid samples expressed on a dry weight basis. "Temperature Upon Receipt" is representative of the whole shipment and may not reflect the temperature of individual samples.

Analysis conducted on samples submitted pursuant to or as part of Reg. 153/04, are in accordance to the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act" published by the Ministry and dated March 9, 2004 as amended.

SGS provides criteria information (such as regulatory or guideline limits and summary of limit exceedances) as a service. Every attempt is made to ensure the criteria information in this report is accurate and current, however, it is not guaranteed. Comparison to the most current criteria is the responsibility of the client and SGS assumes no responsibility for the accuracy of the criteria levels indicated. This document is issued, on the Client's behalf, by the Company under its General Conditions of Service available on request and accessible at [http://www.sgs.com/terms\\_and\\_conditions.htm](http://www.sgs.com/terms_and_conditions.htm). The Client's attention is drawn to the limitation of liability, indemnification and jurisdiction issues defined therein. Any other holder of this document is advised that information contained hereon reflects the Company's findings at the time of its intervention only and within the limits of Client's instructions, if any. The Company's sole responsibility is to its Client and this document does not exonerate parties to a transaction from exercising all their rights and obligations under the transaction documents.

This report must not be reproduced, except in full. This report supersedes all previous versions.

-- End of Analytical Report --



No: 00864  
Page 1 of 1

CA 14445 -  
LAB LIMS #: AUC18  
603

## PROJECT INFORMATION

Quotation #: \_\_\_\_\_ P.O. #: \_\_\_\_\_  
Project #: 11375 Site Location/ID: \_\_\_\_\_

**TURNAROUND TIME (TAT) REQUIRED**

☒ Regular TAT (5-7days) TATs are quoted in business days (exclude statutory holidays & weekends).  
Samples received after 3pm or on weekends : TAT begins the next business day

RUSH TAT (Additional Charges May Apply) ☐ 1 Day ☐ 2 Days ☐ 3-4 Days

**PLEASE CONFIRM RUSH FEASIBILITY WITH SGS REPRESENTATIVE PRIOR TO SUBMISSION**

Specify Due Date: \_\_\_\_\_ Rush Confirmation ID: \_\_\_\_\_

**Sewer By-Law:**

☐ Sanitary  
☐ Storm

DATE SAMPLED	TIME SAMPLED	# OF BOTTLES	MATRIX
-----------------	-----------------	-----------------	--------

[illegible]

Sampled By (NAME):	Signature: 	Date: <u>08/15/2012</u> (mm/dd/yy)	Pink Copy - Client
--------------------	--	------------------------------------	--------------------

Reinquished by (NAME):	Signature:	Date: ____ / ____ / ____	(mm/dd/yy)	Yellow & White Copy - SGS
This document is leased by the Commanu under its General Conditions of Service accessible at <a href="http://www.sgs.com/terms_and_conditions.htm">http://www.sgs.com/terms_and_conditions.htm</a> .				



## SAMPLE INTEGRITY REPORT

Project Number: 11375

ONTARIO REGULATION 153/04

SGS Sample ID CAK4445-Aug18

Date / Time Sampled see CoC

Client Sample ID

ALL

### Sample Submission General Sample Integrity Violations

- Temperature >10 C upon receipt if not sampled same day ☐
- No evidence of cooling trend initiated if sampled same day ☐
- Chain of Custody not submitted ☐
- Chain of Custody incomplete ☐
- Chain of Custody not signed / dated ☒
- Chain of Custody not a current version ☐
- Bottles / Samples listed on CoC but not received ☐
- Bottles / Samples received but not listed on the CoC ☐
- Sample container received empty ☐

### Sample Specific Sample Integrity Violations

- |   |                          |                          |                          |                          |                          |                          |                          |
|---|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| Sample received past hold time                                    | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Incorrect preservation (including no preservation where required) | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Headspace present in VOC vial (aqueous)                           | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Sample(s) received frozen   | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Bottle(s) broken or damaged in transport                          | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Discrepancy between sample label and chain of custody             | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Analysis requirements absent / unclear                            | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Missing or incorrect sample label(s)                              | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Inappropriate sample container used                               | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Insufficient number of bottles received                           | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Limited sample volume   | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Insufficient sample volume  | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Sample contains multiple phases                                   | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

### Sediment Log

- |  |                          |                          |                          |                          |                          |                          |                          |
|--|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| Groundwater samples contain visible sediment / particulate                       | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Groundwater contains greater than 1cm of sediment / particulate matter in bottle | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

### Additional Comments/Remarks:

No issues upon receipt



Initials:

KH



## **Appendix B**

### **Record of Borehole Sheets and Laboratory Test Results (Previous Investigation)**

# RECORD OF BOREHOLE No 08-033

1 OF 3

METRIC

G.W.P. 408-88-00 LOCATION N 4 814 712.66 E 226 708.59 ORIGINATED BY SLL  
 HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY ES  
 DATUM Geodetic DATE 2008.06.19 - 2008.06.20 CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			UNIT WEIGHT  γ  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
								20 40 60 80 100						
								20 40 60 80 100						
							WATER CONTENT (%)							
							PLASTIC LIMIT   NATURAL MOISTURE CONTENT   LIQUID LIMIT							
							W <sub>P</sub> W   W <sub>L</sub>							
							○ UNCONFINED   + FIELD VANE							
							● QUICK TRIAXIAL   × LAB VANE							
							20 40 60 80 100							
							20 40 60							
313.2														
0.0	TOPSOIL, occasional roots and rootlets: (150mm)						313							
0.2	SAND, some silt Compact Brown Moist  Layer of silt, some clay (500mm)		1	SS	14									
311.7							312							
1.5	Silty CLAY, trace sand Stiff to Very Stiff Brown to Grey		2	SS	22									
			3	SS	26									
			4	SS	14									
309.1							310							
4.1	Sandy SILT, trace gravel, trace to some clay Compact to Very Dense Grey Moist (TILL)		5	SS	18							0 2 48 50		
			6	SS	90									
306.6							309							
6.6	SAND, trace silt, trace gravel, trace clay Very Dense Grey Wet		7	SS	93							1 55 20 24		
			8	SS	100/ 250									
							308							
							307					5 45 40 10		
							306							
							305					2 91 7 (SI+CL)		
							304							

Continued Next Page

+ 3, x 3 : Numbers refer to Sensitivity 20 15 10 5 0 (%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No 08-033

2 OF 3

METRIC

G.W.P. 408-88-00 LOCATION N 4 814 712.66 E 226 708.59 ORIGINATED BY SLL  
 HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY ES  
 DATUM Geodetic DATE 2008.06.19 - 2008.06.20 CHECKED BY RPR

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 <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)  GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa			WATER CONTENT (%)				
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE							
								20 40 60 80 100			20 40 60				
	Continued From Previous Page														
302.8	SAND, trace silt, trace gravel, trace clay Very Dense Grey Wet  Sandy SILT, trace clay Very Dense Grey Moist to Wet (TILL)						303								
10.4			9	SS	100/ .150										0 48 49 3
							302								
301.0	Silty CLAY, trace sand, trace gravel Hard Grey		10	SS	35		301								
12.2															
								300							
					11	SS	79								
							299								
							298							1 4 40 55	
			12	SS	85										
							297								
			13	SS	53										
295.8							296								
17.4	Sandy SILT, trace to some clay, trace gravel Very Dense Grey Moist (TILL) Slow augering at 17.4m.		14	SS	100/ .175		295							2 27 47 24	
					15	SS	100/ .075		294						2 44 42 12

Continued Next Page

+ <sup>3</sup> . × <sup>3</sup> : Numbers refer to  
Sensitivity

20  
15  
10

(%) STRAIN AT FAILURE



# RECORD OF BOREHOLE No 08-033

3 OF 3

METRIC

G.W.P. 408-88-00 LOCATION N 4 814 712.66 E 226 708.59 ORIGINATED BY SLL  
 HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY ES  
 DATUM Geodetic DATE 2008.06.19 - 2008.06.20 CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w <sub>P</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT  γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
	Continued From Previous Page							20	40	60	80	100					
	Sandy SILT, trace to some clay, trace gravel Very Dense Grey Moist (TILL)						293										
292.1			16	SS	100/												
21.1	END OF BOREHOLE AT 21.1m. BOREHOLE DRY UPON COMPLETION OF DRILLING. BOREHOLE BACKFILLED WITH BENTONITE TO 0.61m THEN HOLEPLUG TO SURFACE.				.075												

# RECORD OF BOREHOLE No 08-034

1 OF 3

METRIC

G.W.P. 408-88-00 LOCATION N 4 814 735.77 E 226 754.73 ORIGINATED BY SLL  
 HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY ES  
 DATUM Geodetic DATE 2008.06.17 - 2008.06.18 CHECKED BY RPR

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 (%)				
312.2							○ UNCONFINED      + FIELD VANE	20 40 60 80 100	20 40 60					
0.0	TOPSOIL, peaty, occasional roots and rootlets: (200mm) Black Moist						● QUICK TRIAXIAL      × LAB VANE	20 40 60 80 100	20 40 60				kN/m <sup>3</sup>	GR SA SI CL
0.2	SAND, some silt Compact Brown Wet		1	SS	13									
310.7	Silty CLAY, trace gravel Stiff to Very Stiff Brown to Grey		2	SS	12									
1.4			3	SS	18									0 0 47 53
			4	SS	14									
			5	SS	10									
306.1														
6.1	Sandy SILT, trace gravel, some clay Compact to Dense Grey Moist (TILL)		6	SS	16									1 30 55 14
			7	SS	37									3 40 41 16
	occasional silt pockets		8	SS	39									
302.2														

Continued Next Page

+ 3 x 3: Numbers refer to  
Sensitivity

20  
15 5  
10 (%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No 08-034

2 OF 3

METRIC

G.W.P. 408-88-00 LOCATION N 4 814 735.77 E 226 754.73 ORIGINATED BY SLL  
 HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY ES  
 DATUM Geodetic DATE 2008.06.17 - 2008.06.18 CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ 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	WATER CONTENT (%)					
10.0	Continued From Previous Page Silty CLAY, trace gravel, occasional silt pockets Very Stiff to Hard Grey													
			9	SS	29									0 1 22 77
			10	SS	34									
			11	SS	45									
			12	SS	38									
296.0														
16.2	SAND, some gravel, trace silt, trace clay, occasional cobbles Very Dense Grey Wet		13	SS	100/ 150									13 76 11 (SI+CL)
			14	SS	100/ 175									
293.6														
18.6	Sandy SILT, some clay, trace gravel Very Dense Grey (TILL)													
			15	SS	100/									2 32 47 19
292.2														

Continued Next Page

+ 3 × 3 : Numbers refer to  
Sensitivity 20  
15 5  
10 (%) STRAIN AT FAILURE

ONTMT4S 6417R.GPJ 9/2/08

RECORD OF BOREHOLE No 08-034

3 OF 3

METRIC

G.W.P. 408-88-00 LOCATION N 4 814 735.77 E 226 754.73 ORIGINATED BY SLL  
 HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY ES  
 DATUM Geodetic DATE 2008.06.17 - 2008.06.18 CHECKED BY RPR

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 (%)					
20.0	Continued From Previous Page  END OF BOREHOLE AT 20.0m. Piezometer installation consists of 25mm diameter schedule 40 PVC pipe with a 1.52m slotted screen. WATER LEVEL READINGS: DATE DEPTH (m) ELEV. (m) 2008.08.20 12.5m 299.7 2008.08.27 12.4m 299.8				150									

ONTMT4S 6417R.GPJ 9/2/08

# RECORD OF BOREHOLE No 08-035

1 OF 2

METRIC

G.W.P. 408-88-00 LOCATION N 4 814 668.41 E 226 725.11 ORIGINATED BY SLL  
 HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY WM  
 DATUM Geodetic DATE 2008.06.11 - 2008.06.11 CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC NATURAL LIQUID LIMIT MOISTURE CONTENT			UNIT WEIGHT  γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	20 40 60	w <sub>p</sub> w w <sub>L</sub>	WATER CONTENT (%)	GR SA SI CL		
315.3														
0.0	TOPSOIL, trace sand and gravel, occasional roots and rootlets: (150mm)													
0.2	Silty CLAY, trace sand Very Stiff Brown		1	SS	16									
			2	SS	25									
			3	SS	30									0 4 45 51
			4	SS	25									
310.9														
4.4	Sandy SILT, trace clay, trace gravel Compact Brown Moist to Wet (TILL)		5	SS	22									1 45 46 8
	Very Dense Grey		6	SS	100/ .250									2 49 39 10
	trace sand, some clay		7	SS	100/ .200									0 6 82 12
306.5														
8.8	Silty CLAY, trace sand Hard Grey (TILL)		8	SS	64/ 100									0 4 39 57
305.7														
9.6	END OF BOREHOLE AT 9.6m. Piezometer installation consists of 25mm diameter schedule 40 PVC pipe													

Continued Next Page

+<sup>3</sup> × 3 : Numbers refer to  
Sensitivity 20  
15 10 5 0 (%) STRAIN AT FAILURE

ONTMT4S 6417R.GPJ 8/6/08

RECORD OF BOREHOLE No 08-035

2 OF 2

METRIC

G.W.P. 408-88-00 LOCATION N 4 814 668.41 E 226 725.11 ORIGINATED BY SLL  
 HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY WM  
 DATUM Geodetic DATE 2008.06.11 - 2008.06.11 CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			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 LAB VANE					WATER CONTENT (%) W P W W L																				
	Continued From Previous Page with a 1.52m slotted screen.																																
	WATER LEVEL READINGS: <table border="1"> <thead> <tr> <th>DATE</th> <th>DEPTH (m)</th> <th>ELEV. (m)</th> </tr> </thead> <tbody> <tr> <td>2008.02.07</td> <td>0.5*</td> <td>315.8</td> </tr> <tr> <td>2008.06.13</td> <td>0.5*</td> <td>315.8</td> </tr> <tr> <td>2008.07.02</td> <td>0.6*</td> <td>315.9</td> </tr> <tr> <td>2008.08.20</td> <td>0.7*</td> <td>316.0</td> </tr> <tr> <td>2008.08.27</td> <td>0.7*</td> <td>316.0</td> </tr> </tbody> </table> *Above ground level	DATE	DEPTH (m)	ELEV. (m)	2008.02.07	0.5*	315.8	2008.06.13	0.5*	315.8	2008.07.02	0.6*	315.9	2008.08.20	0.7*	316.0	2008.08.27	0.7*	316.0														
DATE	DEPTH (m)	ELEV. (m)																															
2008.02.07	0.5*	315.8																															
2008.06.13	0.5*	315.8																															
2008.07.02	0.6*	315.9																															
2008.08.20	0.7*	316.0																															
2008.08.27	0.7*	316.0																															

# RECORD OF BOREHOLE No 08-036

1 OF 3

METRIC

G.W.P. 408-88-00 LOCATION N 4 814 685.09 E 226 764.24 ORIGINATED BY SLL  
 HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY WM  
 DATUM Geodetic DATE 2008.06.12 - 2008.06.12 CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	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					WATER CONTENT (%)		
								20 40 60 80 100					20 40 60		
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE					w <sub>p</sub> w w <sub>L</sub>		
314.6															
0.0	TOPSOIL, with roots and rootlets: (175mm)														
0.2	Sandy SILT, trace clay Compact Brown Wet		1	SS	15										
			2	SS	17										
312.6												0 23 73 4			
2.1	Silty CLAY, trace sand Very Stiff Grey (TILL)		3	SS	19										
			4	SS	19										
			5	SS	8										
			6	SS	45										
	Hard Grey														
			7	SS	17										
			8	SS	100/ 275										

Continued Next Page

+ <sup>3</sup> . <sup>3</sup> : Numbers refer to  
Sensitivity

20  
15 5  
10 (%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No 08-036

2 OF 3

METRIC

G.W.P. 408-88-00 LOCATION N 4 814 685.09 E 226 764.24 ORIGINATED BY SLL  
 HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY WM  
 DATUM Geodetic DATE 2008.06.12 - 2008.06.12 CHECKED BY RPR

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 <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa		W <sub>P</sub> W                      W <sub>L</sub>				
								○ UNCONFINED      + FIELD VANE ● QUICK TRIAXIAL    × LAB VANE	WATER CONTENT (%)					
						20   40   60   80   100								
10.0	Continued From Previous Page													
	Silty CLAY, trace sand Hard Grey (TILL)		9	SS	80/ .275		304							
							303							
			10	SS	73		302						0   6   42   52	
301.4														
13.3	Silty CLAY, occasional silt pockets Hard Grey		11	SS	60		301						0   4   30   66	
							300							
			12	SS	72		299							
							298							
			13	SS	63		297						0   4   31   65	
296.6														
18.1	Sandy SILT, some clay, trace, gravel Very Dense Grey Moist (TILL)		14	SS	100/ .150		296							
							295						3   26   46   25	
			15	SS	100/									

Continued Next Page

+<sup>3</sup> . ×<sup>3</sup> : Numbers refer to Sensitivity 20 15 10 5 0 (%) STRAIN AT FAILURE



RECORD OF BOREHOLE No 08-036

3 OF 3

METRIC

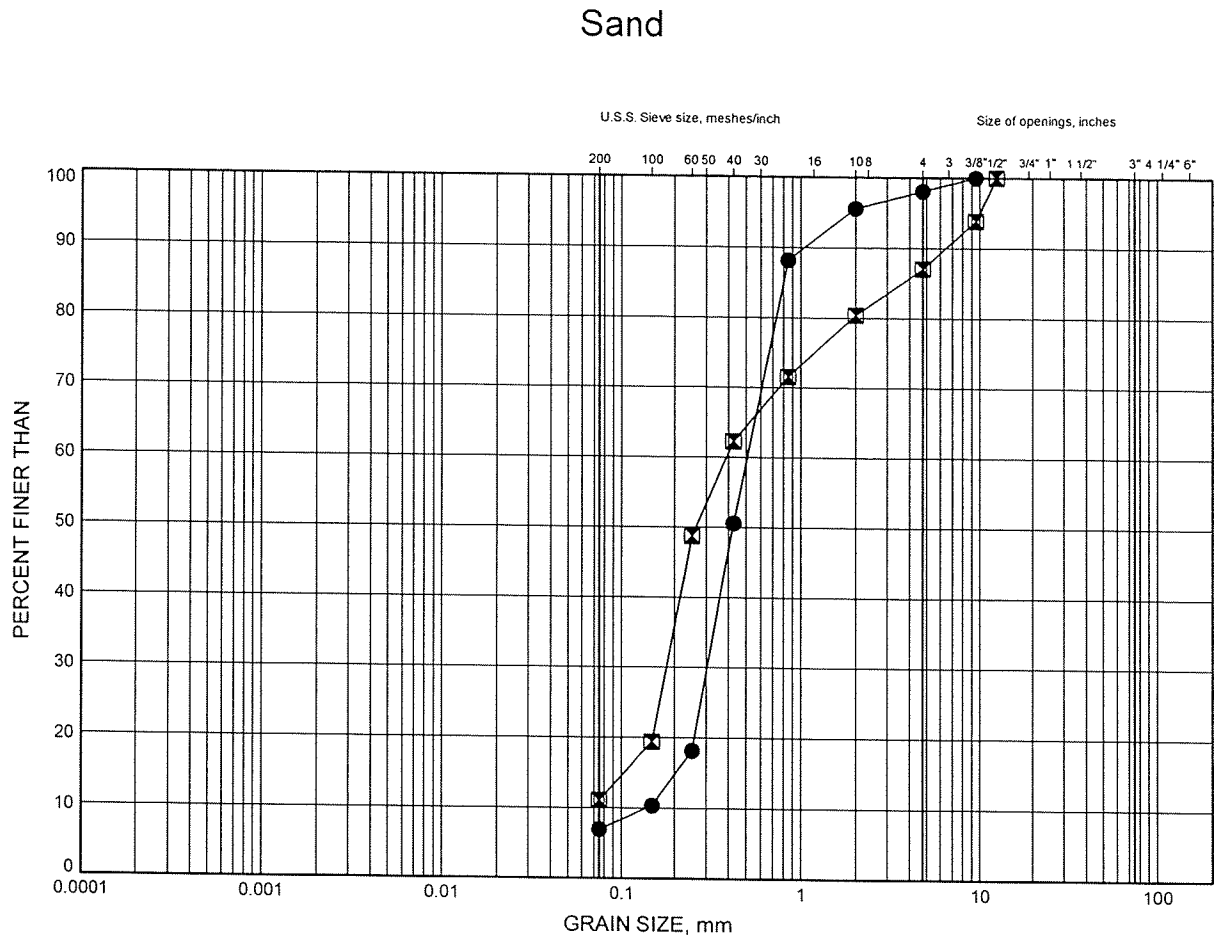
G.W.P. 408-88-00 LOCATION N 4 814 685.09 E 226 764.24 ORIGINATED BY SLL  
HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY WM  
DATUM Geodetic DATE 2008.06.12 - 2008.06.12 CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	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			20	40	60	80	100		
	Continued From Previous Page							SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE						
								WATER CONTENT (%) w <sub>p</sub> — w — w <sub>L</sub>						
293.2	Sandy SILT, some clay, trace, gravel Very Dense Grey Moist (TILL)		16	SS	100/		294							1 15 71 13
21.5	END OF BOREHOLE AT 21.5m. BOREHOLE DRY UPON COMPLETION OF DRILLING. BOREHOLE BACKFILLED WITH BENTONITE TO 0.90m THEN HOLEPLUG TO SURFACE.				.125									

ONTMT4S 6417R.GPJ 8/5/08

# Highway 7 - New GRAIN SIZE DISTRIBUTION

FIGURE B1



SILT and CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
FINE GRAINED	SAND			GRAVEL		

## LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	08-033	7.85	305.36
◻	08-034	16.92	295.28

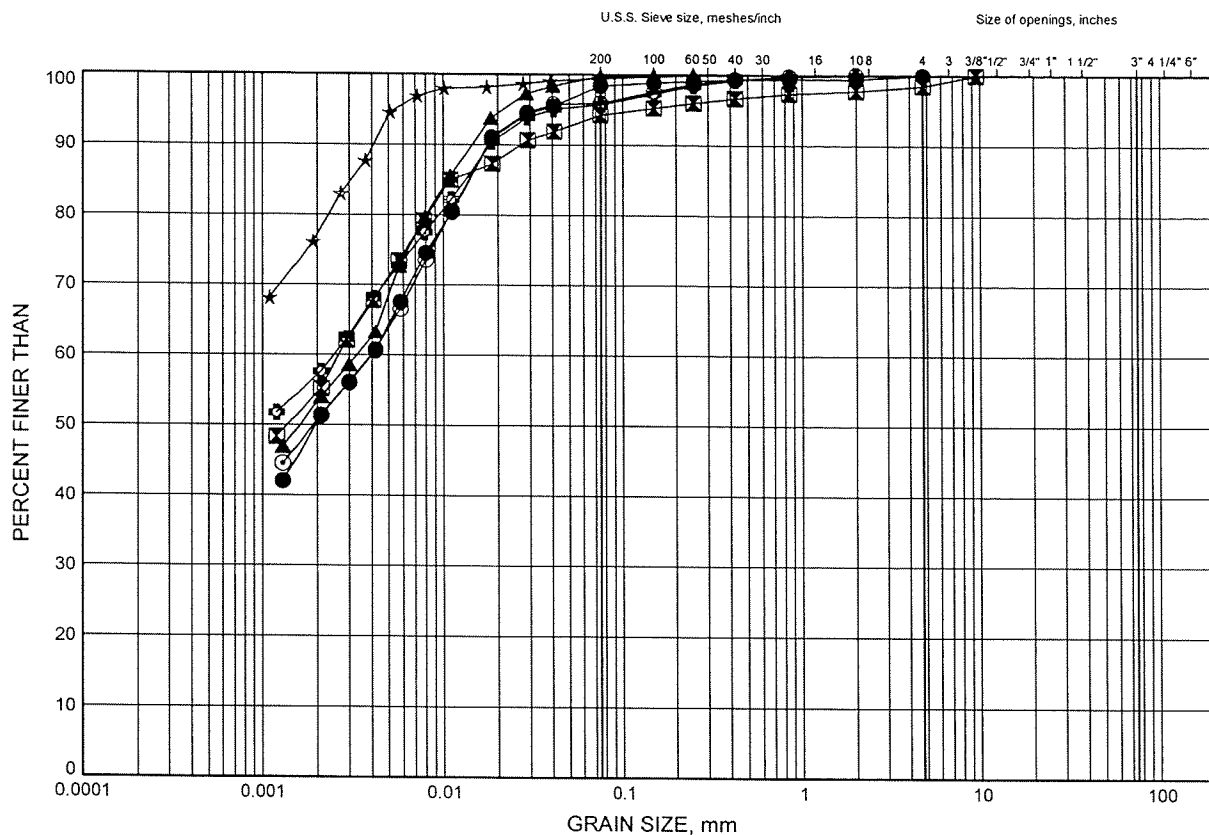


W.P.# 408-88-00  
Prepared By SA  
Checked By RPR

# Highway 7 - New GRAIN SIZE DISTRIBUTION

FIGURE B2

## Silty Clay and Silty Clay Till



SILT and CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
FINE GRAINED	SAND			GRAVEL		

### LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	08-033	2.59	310.61
⊠	08-033	15.24	297.96
▲	08-034	2.59	309.60
☆	08-034	10.97	301.22
⊙	08-035	2.59	312.70
⊗	08-035	9.36	305.93

GRAIN SIZE DISTRIBUTION - THURBER 6417R.GPJ 7/29/08

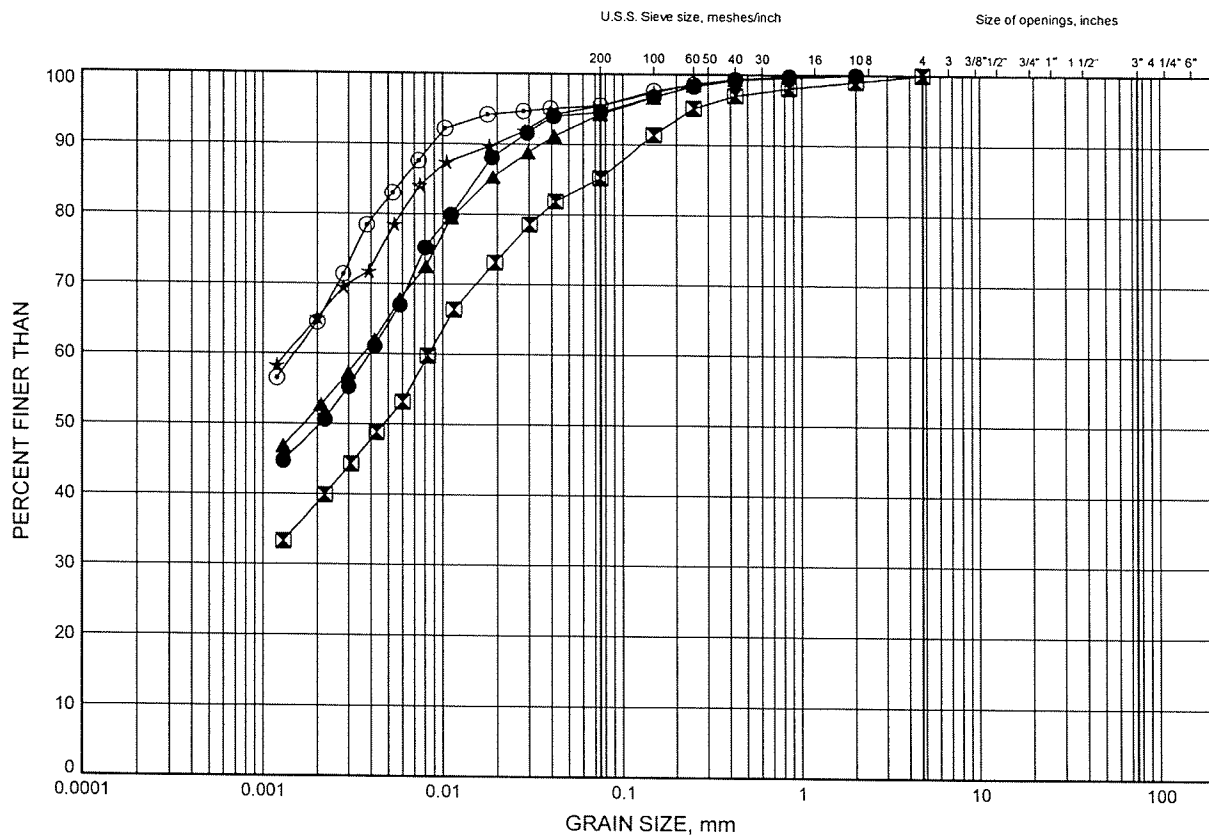
W.P.# 408-88-00  
Prepared By SA  
Checked By RPR



# Highway 7 - New GRAIN SIZE DISTRIBUTION

FIGURE B3

## Silty Clay and Silty Clay Till



SILT and CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
FINE GRAINED	SAND			GRAVEL		

### LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	08-036	3.35	311.28
⊠	08-036	7.92	306.71
▲	08-036	12.48	302.15
☆	08-036	14.02	300.61
⊙	08-036	17.07	297.56

GRAIN SIZE DISTRIBUTION - THURBER 6417R.GPJ 7/29/08

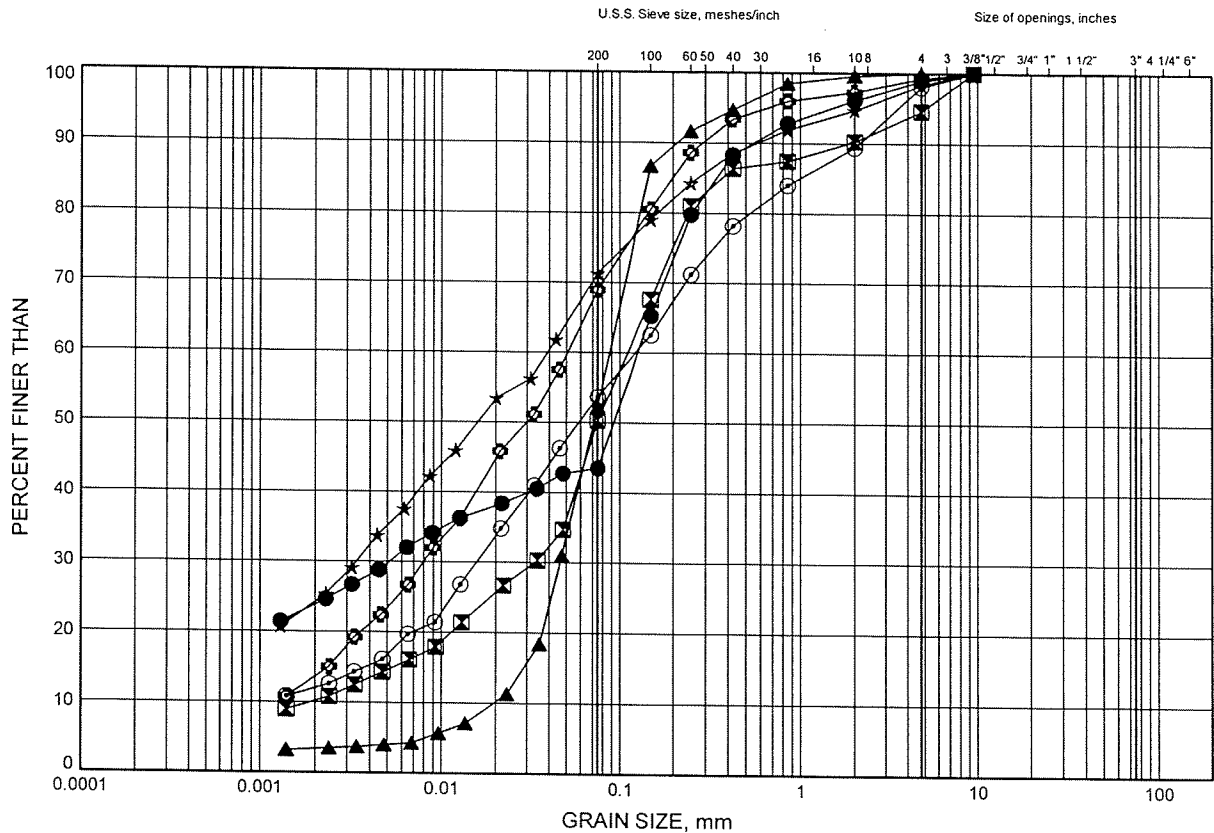
W.P.# 408-88-00  
Prepared By SA  
Checked By RPR



# Highway 7 - New GRAIN SIZE DISTRIBUTION

FIGURE B4

## Sandy Silt and Sandy Silt Till



SILT and CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
FINE GRAINED	SAND			GRAVEL		

### LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	08-033	4.88	308.33
⊠	08-033	6.38	306.83
▲	08-033	10.82	302.38
☆	08-033	18.07	295.13
⊙	08-033	19.54	293.66
⊗	08-034	6.40	305.79

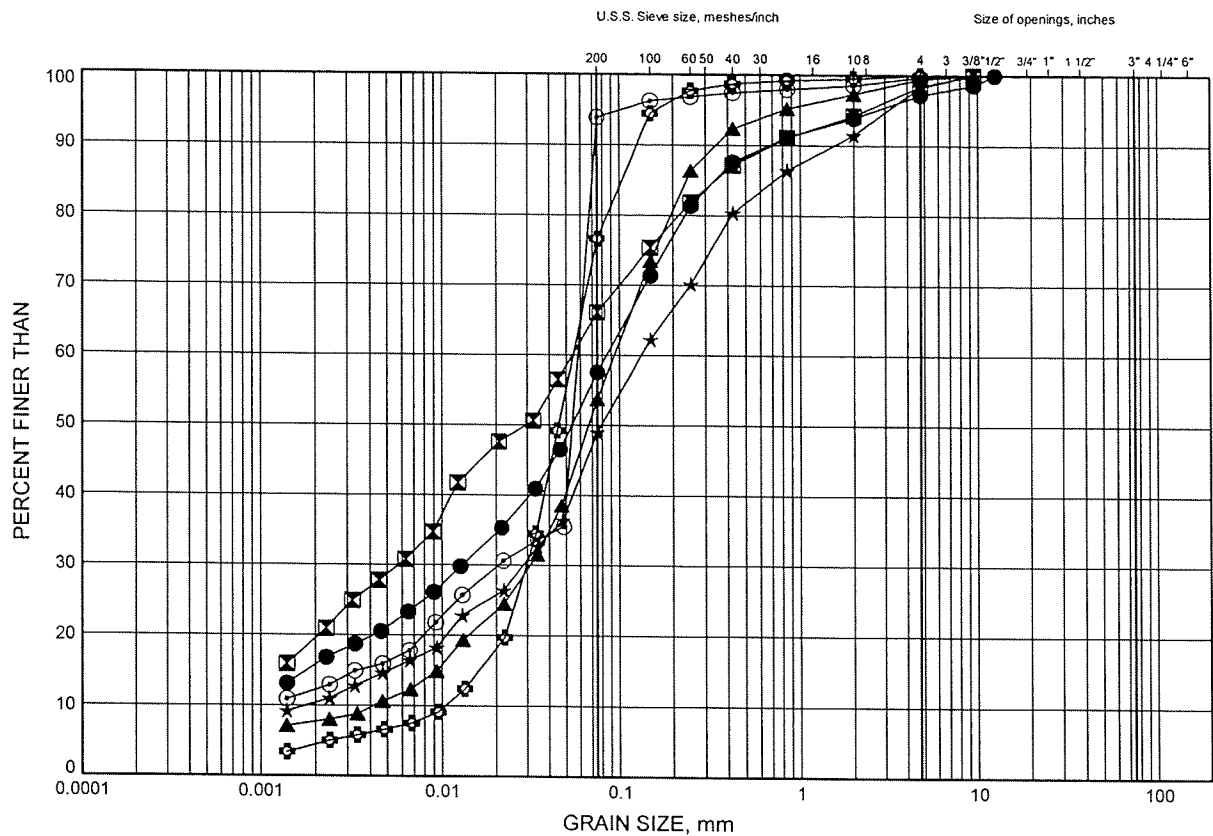


W.P.# 408-88-00.....  
Prepared By SA.....  
Checked By RPR.....

# Highway 7 - New GRAIN SIZE DISTRIBUTION

FIGURE B5

## Sandy Silt and Sandy Silt Till



SILT and CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
FINE GRAINED	SAND			GRAVEL		

### LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	08-034	7.89	304.31
⊠	08-034	19.89	292.30
▲	08-035	4.88	310.41
☆	08-035	6.22	309.07
⊙	08-035	7.72	307.57
⊛	08-036	1.83	312.80

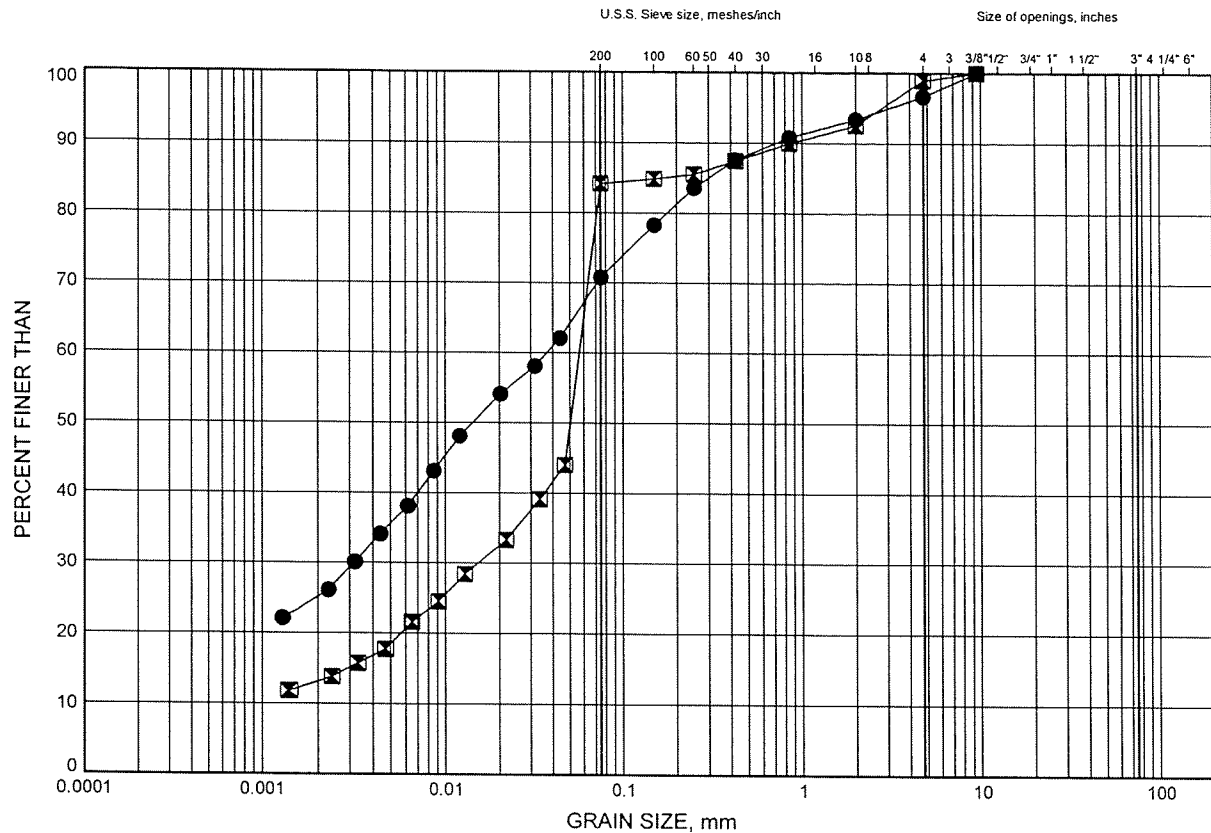


W.P.# 408-88-00.....  
Prepared By SA.....  
Checked By RPR.....

# Highway 7 - New GRAIN SIZE DISTRIBUTION

FIGURE B6

## Sandy Silt and Sandy Silt Till



SILT and CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
FINE GRAINED	SAND			GRAVEL		

### LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	08-036	19.87	294.76
⊠	08-036	21.40	293.23

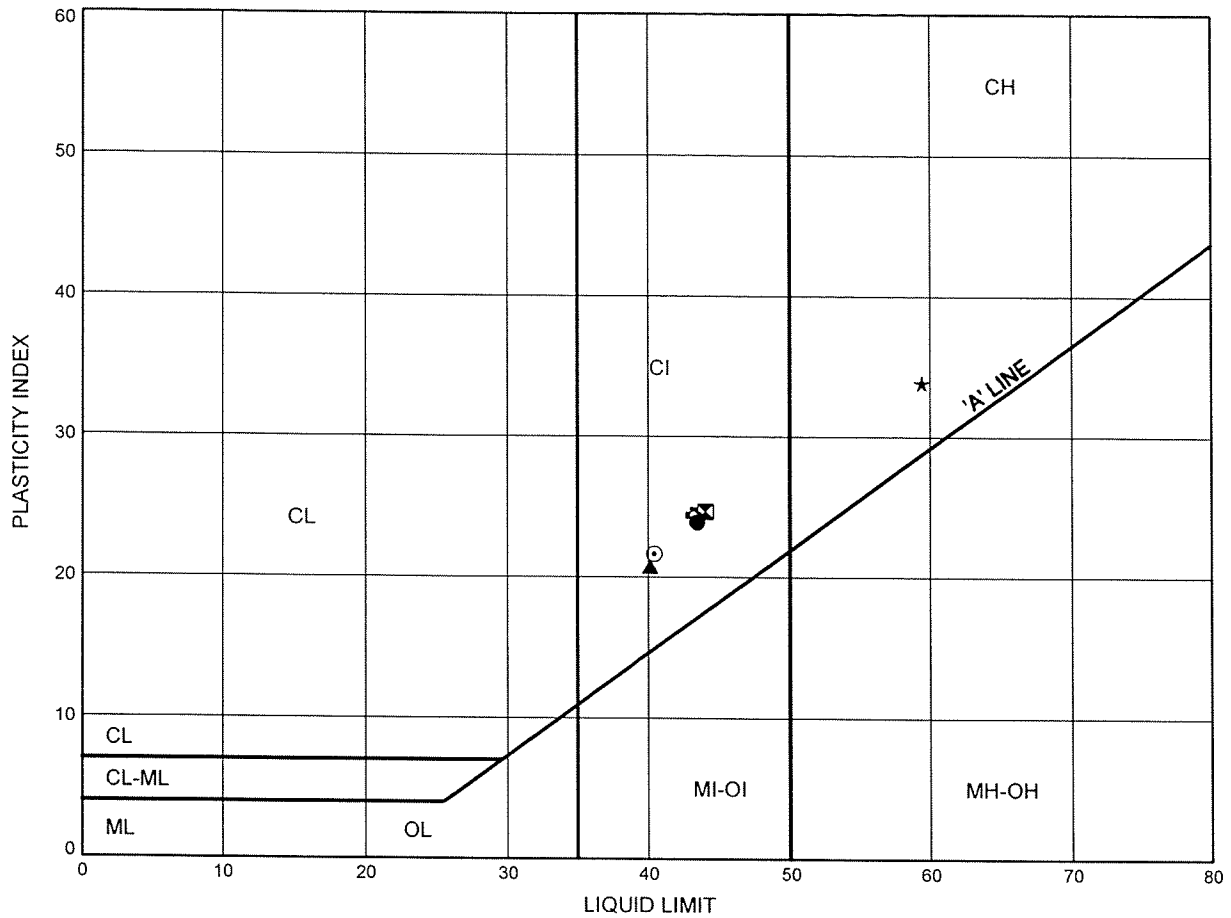


W.P.# 408-88-00  
Prepared By SA  
Checked By RPR

# Highway 7 - New ATTERBERG LIMITS TEST RESULTS

FIGURE B7

### Silty Clay and Silty Clay Till



SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	08-033	2.59	310.61
⊠	08-033	15.24	297.96
▲	08-034	2.59	309.60
★	08-034	10.97	301.22
⊙	08-035	2.59	312.70
⊕	08-035	9.36	305.93

Date July 2008  
Project 408-88-00



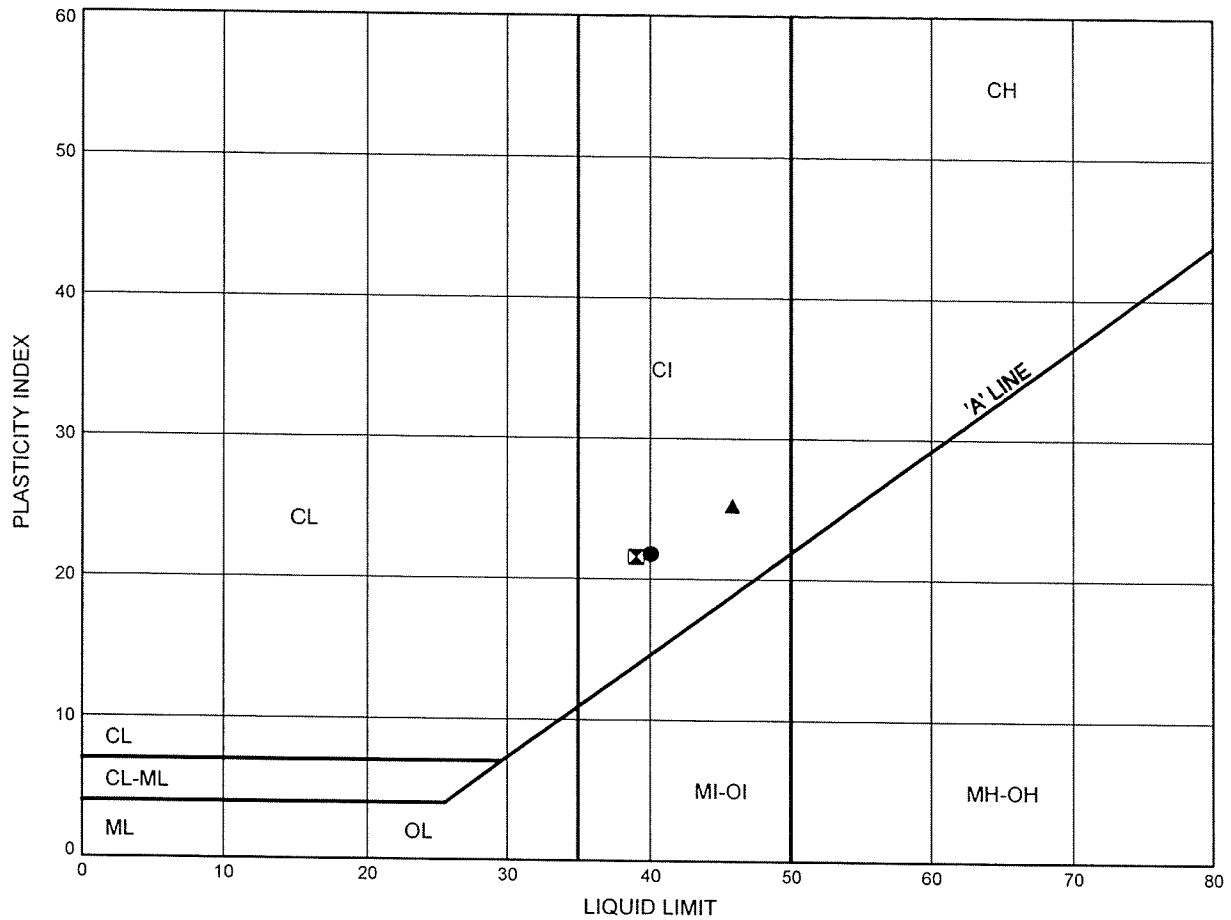
Prep'd SA  
Chkd. RPR



# Highway 7 - New ATTERBERG LIMITS TEST RESULTS

FIGURE B8

### Silty Clay and Silty Clay Till



SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	08-036	3.35	311.28
⊠	08-036	12.48	302.15
▲	08-036	17.07	297.56

Date July 2008  
Project 408-88-00

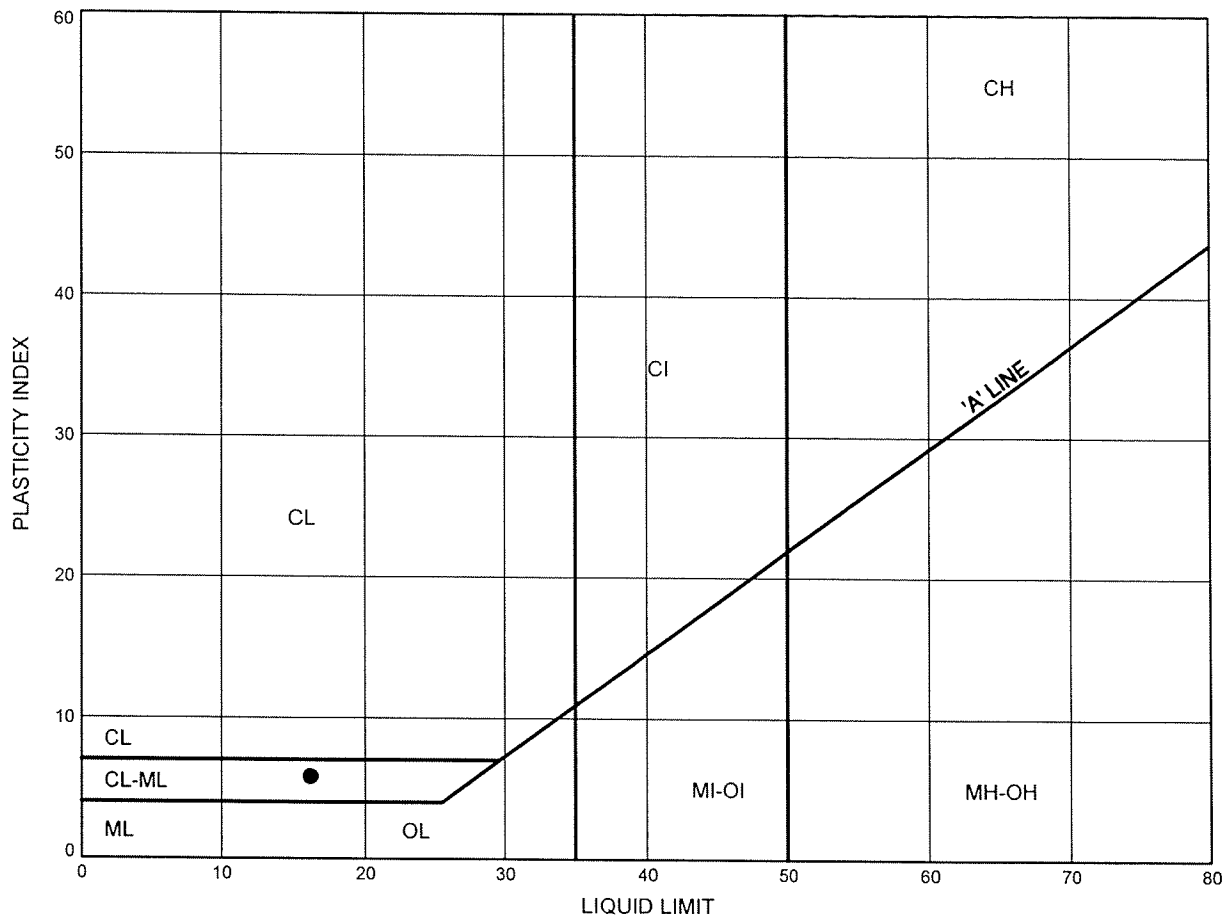


Prep'd SA  
Chkd RPR

# Highway 7 - New ATTERBERG LIMITS TEST RESULTS

FIGURE B9

Sandy Silt and Sandy Silt Till



SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	08-034	6.40	305.79

Date July 2008  
Project 408-88-00

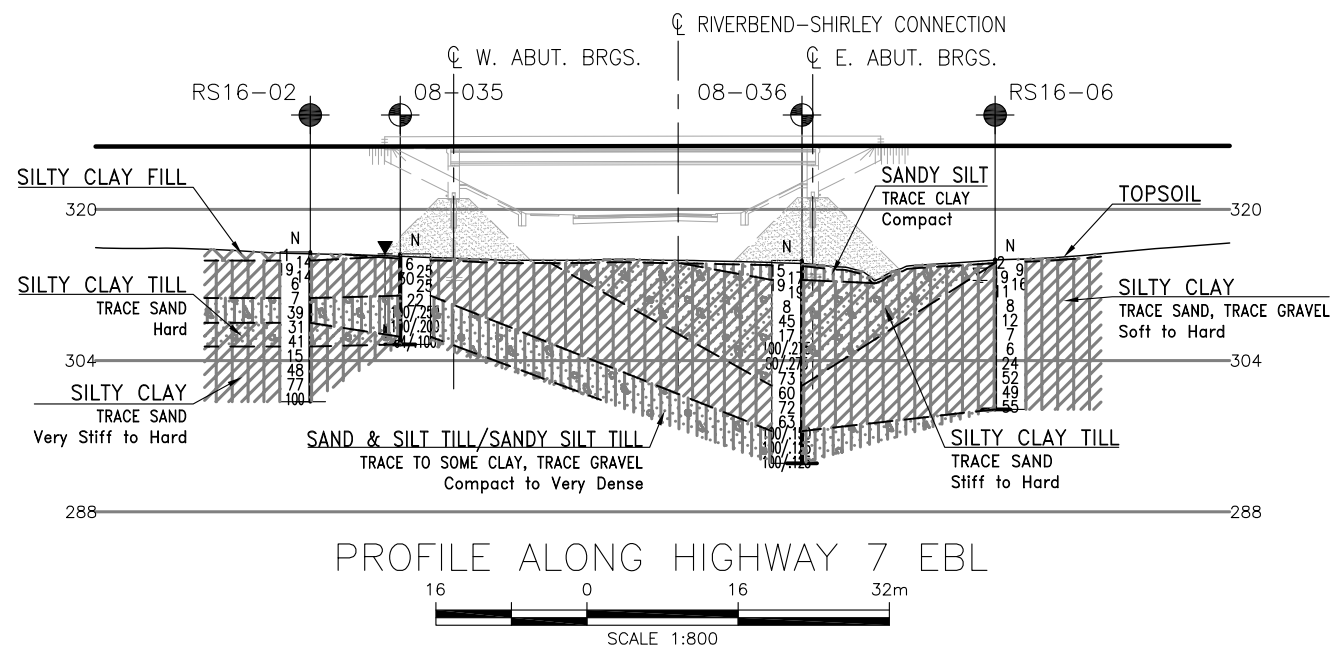
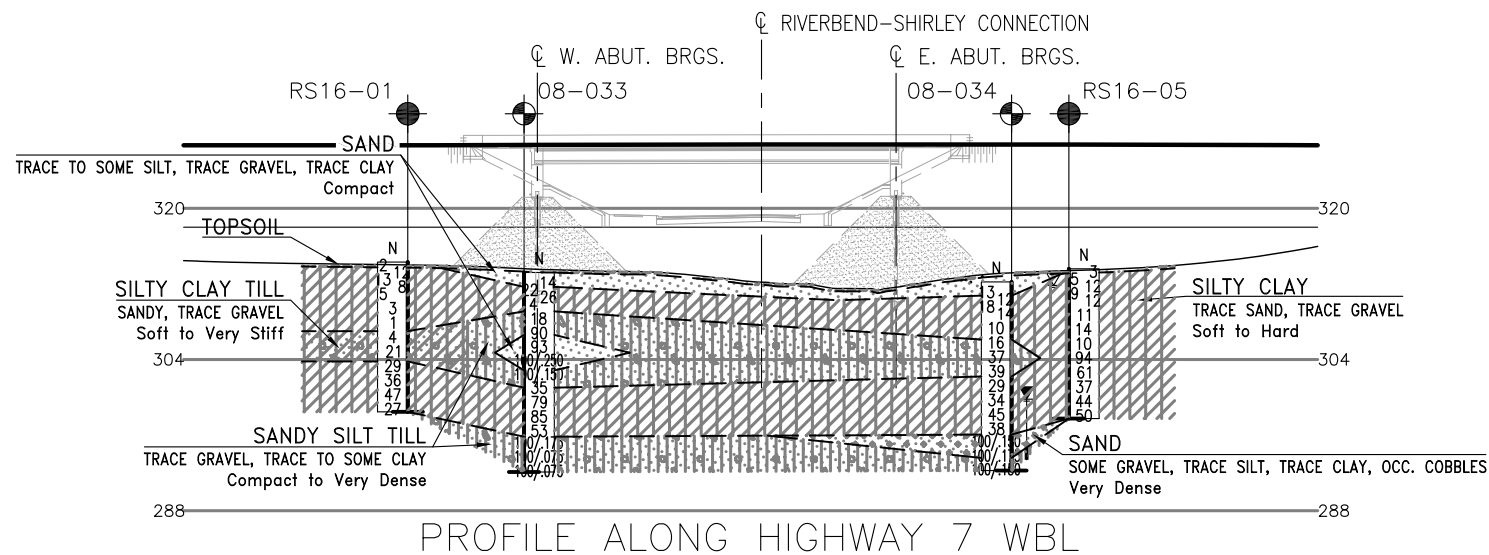
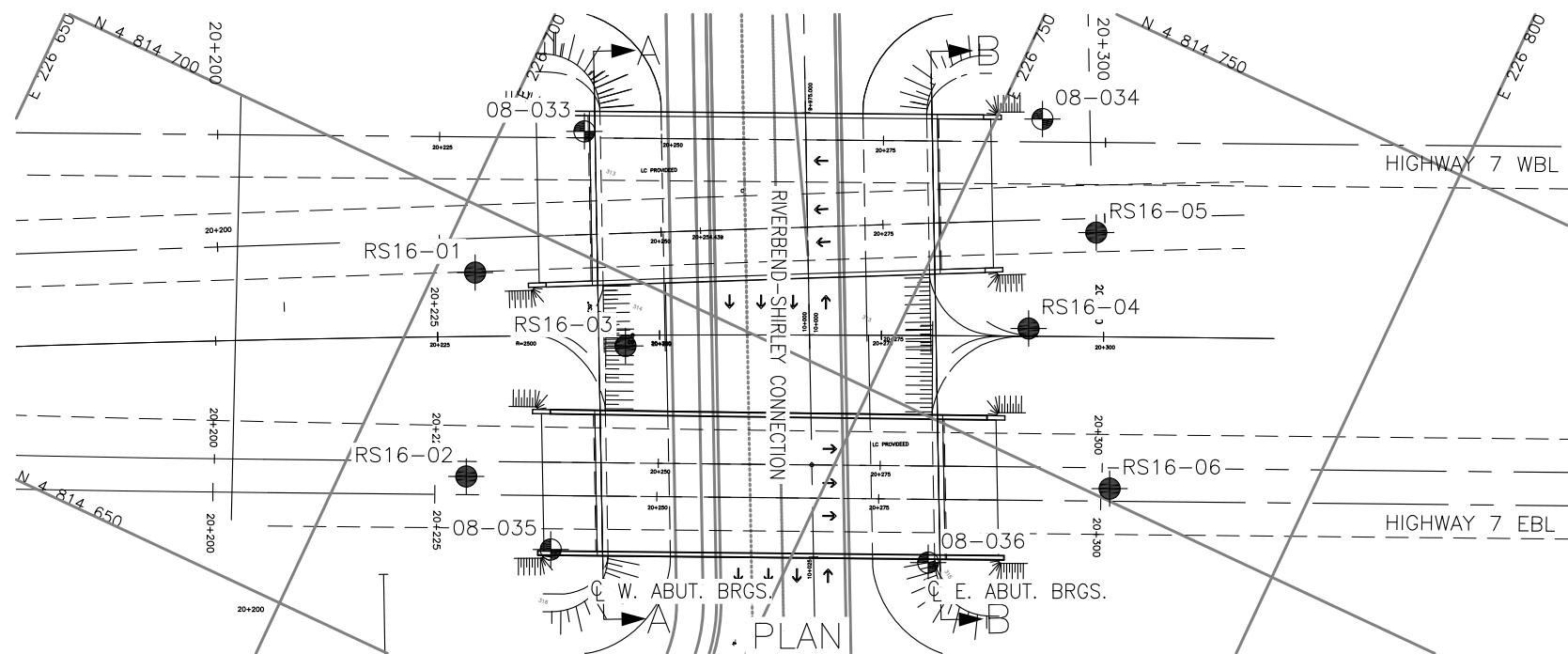


Prep'd SA  
Chkd RPR



## **Appendix C**

### **Borehole Locations and Soil Strata Drawing**

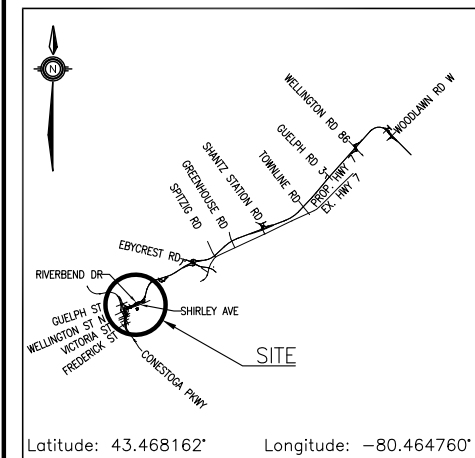


METRIC  
DIMENSIONS ARE IN METRES  
AND/OR MILLIMETRES  
UNLESS OTHERWISE SHOWN



CONT No  
GWP No 408-88-00

HIGHWAY 7  
RIVERBEND-SHIRLEY CONNECTION  
PROPOSED BRIDGES  
BOREHOLE LOCATIONS AND SOIL STRATA



Latitude: 43.468162°

Longitude: -80.464760°

## KEYPLAN

## LEGEND

●	Borehole (Current Investigation)
○	Borehole (2008 Investigation)
N	Blows /0.3m (Std Pen Test, 475J/blow)
CONE	Blows /0.3m (60° Cone, 475J/blow)
PH	Pressure, Hydraulic
▽	Water Level
⊥	Head Artesian Water
⊥	Piezometer
90%	Rock Quality Designation (RQD)
A/R	Auger Refusal

NO	ELEVATION	NORTHING	EASTING
RS16-01	314.3	4 814 693.0	226 704.2
RS16-02	315.5	4 814 671.8	226 713.0
RS16-03	314.5	4 814 692.7	226 723.0
RS16-04	312.9	4 814 713.8	226 763.3
RS16-05	313.6	4 814 726.8	226 765.6
RS16-06	314.7	4 814 701.3	226 779.2
08-033	313.2	4 814 712.7	226 708.6
08-034	212.2	4 814 735.8	226 754.7
08-035	315.3	4 814 668.4	226 725.1
08-036	314.6	4 814 685.1	226 764.2

## -NOTES-

- The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.
- This drawing is for subsurface information only. Surface details and features are for conceptual illustration.
- Coordinate system is MTM NAD 83 Zone 10.

GEOCRES No. 40P8-284

REVISIONS																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																								
-----------	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

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

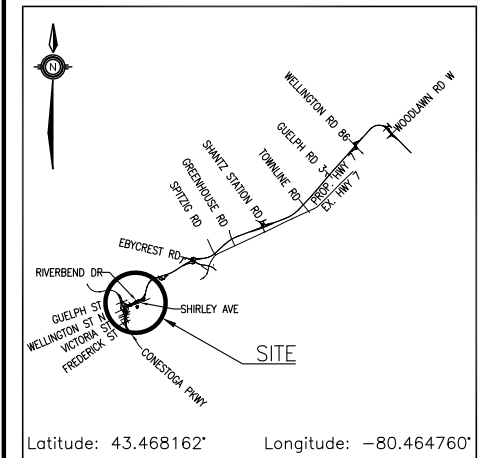
CONT No  
GWP No 408-88-00

HIGHWAY 7  
RIVERBEND-SHIRLEY CONNECTION  
PROPOSED BRIDGES  
BOREHOLE LOCATIONS AND SOIL STRATA

SHEET



THURBER ENGINEERING LTD.



### KEYPLAN

### LEGEND

	Borehole (Current Investigation)
	Borehole (2008 Investigation)
N	Blows /0.3m (Std Pen Test, 475J/blow)
CONE	Blows /0.3m (60° Cone, 475J/blow)
PH	Pressure, Hydraulic
	Water Level
	Head Artesian Water
	Piezometer
90%	Rock Quality Designation (RQD)
A/R	Auger Refusal

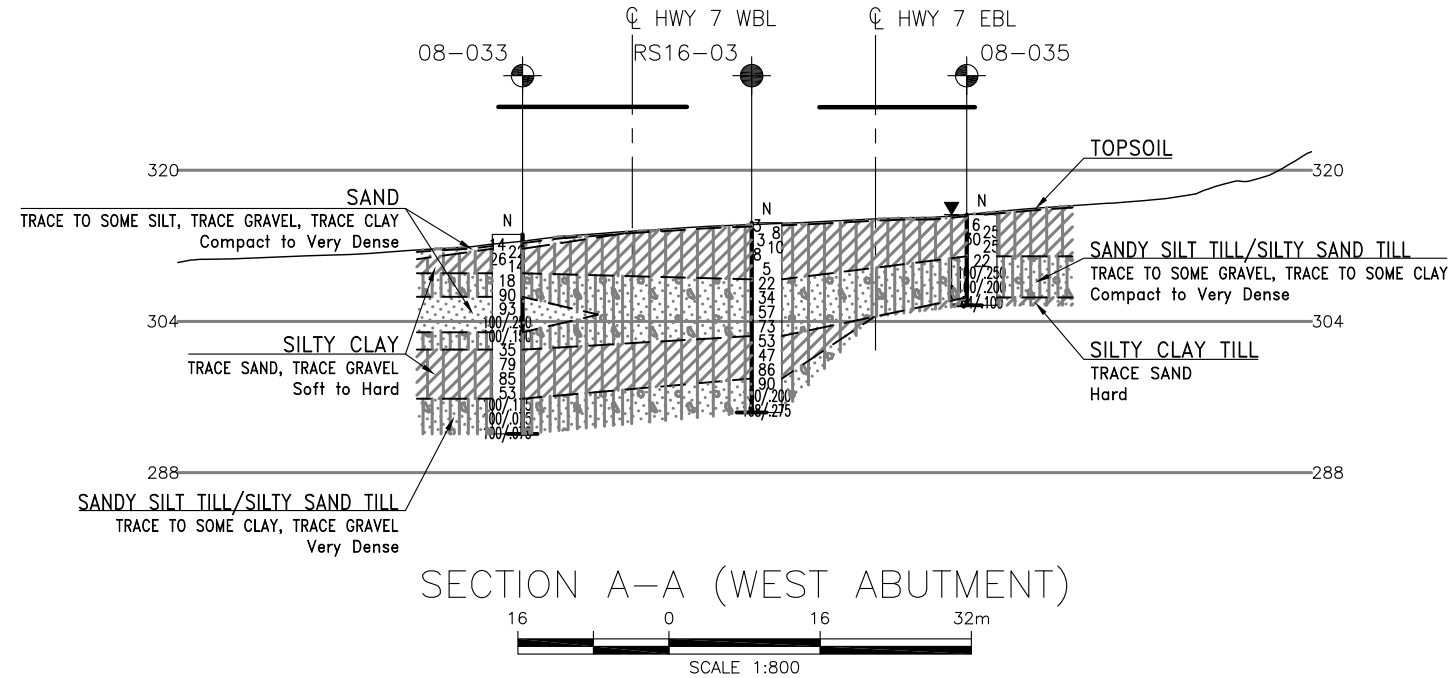
NO	ELEVATION	NORTHING	EASTING
RS16-01	314.3	4 814 693.0	226 704.2
RS16-02	315.5	4 814 671.8	226 713.0
RS16-03	314.5	4 814 692.7	226 723.0
RS16-04	312.9	4 814 713.8	226 763.3
RS16-05	313.6	4 814 726.8	226 765.6
RS16-06	314.7	4 814 701.3	226 779.2
08-033	313.2	4 814 712.7	226 708.6
08-034	212.2	4 814 735.8	226 754.7
08-035	315.3	4 814 668.4	226 725.1
08-036	314.6	4 814 685.1	226 764.2

### -NOTES-

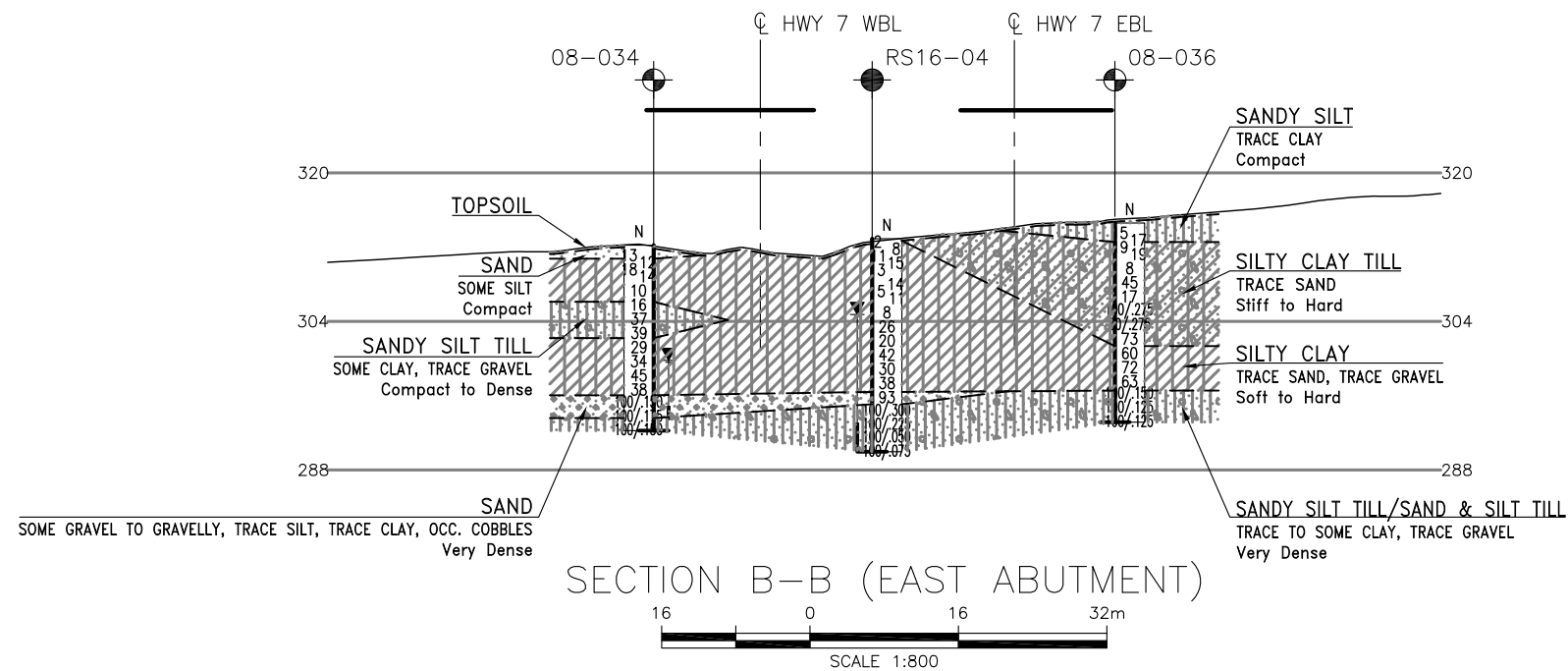
- The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.
- This drawing is for subsurface information only. Surface details and features are for conceptual illustration.
- Coordinate system is MTM NAD 83 Zone 10.

**GEOCRES No. 40P8-284**

REVISIONS																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																										
-----------	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--



### SECTION A-A (WEST ABUTMENT)



### SECTION B-B (EAST ABUTMENT)