



THURBER ENGINEERING LTD.

**FOUNDATION INVESTIGATION REPORT
CULVERT AND STORM SEWER INSTALLATIONS
NORTH SHORE BOULEVARD INTERCHANGE
QUEEN ELIZABETH WAY (QEW)
BURLINGTON, ONTARIO
CENTRAL REGION ASSIGNMENT NUMBER: 2017-E-0056-001**

LATITUDE: 43.315100, LONGITUDE: -79.807891

Geocres Number: 30M5-330

Report to

MTO CENTRAL REGION

June 25, 2019
File: 25497



TABLE OF CONTENTS

PART 1: FACTUAL INFORMATION

1.0	INTRODUCTION	1
2.0	SITE DESCRIPTION	1
3.0	INVESTIGATION PROCEDURES	2
4.0	LABORATORY TESTING	5
5.0	DESCRIPTION OF SUBSURFACE CONDITIONS	5
5.1	Culvert 3 (Boreholes C3-01 to C3-04).....	6
5.2	Culvert 6 (Boreholes C6-01 to C6-03).....	9
5.3	Culvert 8 (Boreholes C8-01 to C8-04).....	11
5.4	Trenchless Sewer (Boreholes TRSR1-01 to TRSR1-04)	15
5.5	Corrosivity And Sulphate Test Results.....	17
6.0	MISCELLANEOUS	18

Appendices

Appendix A	Site Photographs
Appendix B	Record of Borehole Sheets
Appendix C	Laboratory Test Results
Appendix D	Corrosivity Testing – Certificates of Analysis
Appendix E	Borehole Location and Soil Strata Drawings



**FOUNDATION INVESTIGATION REPORT
CULVERTS AND STORM SEWER INSTALLATIONS
NORTH SHORE BOULEVARD INTERCHANGE
QUEEN ELIZABETH WAY (QEW)
BURLINGTON, ONTARIO
CENTRAL REGION ASSIGNMENT NUMBER: 2017-E-0056-001**

Geocres Number:

PART 1: FACTUAL INFORMATION

1.0 INTRODUCTION

This report presents the factual findings obtained from a foundation investigation conducted by Thurber Engineering Ltd. (Thurber) for the proposed design of culverts and storm sewer replacements in the vicinity of QEW and North Shore Boulevard interchange in Burlington (Central Region), Ontario. At the time of the work plan proposal, plans called for the replacement of two culverts (Culvert 4 and 5) and one storm sewer alignment by trenchless installation and the replacement of three culverts (Culverts 3, 6 and 8) by open-cut methodology, including an outfall to Lake Ontario. Due to a utility locate conflict with the Halton Region sanitary sewer, the replacement of Culverts 4 and 5 was cancelled by MTO Central Region during the course of this investigation.

The purpose of the investigation was to explore the subsurface conditions at the proposed culvert and storm sewer locations and, based on the data obtained, to provide borehole location plans, records of boreholes, laboratory test results, and a written description of the subsurface conditions.

Thurber completed this report under the Ministry of Transportation Ontario (MTO) Central Region Assignment Number 2017-E-0056-001.

2.0 SITE DESCRIPTION

The section of the QEW within the study limits presently conveys six lanes of traffic, with three lanes in each direction, separated by a concrete median. Fully paved shoulders are present on both sides of the travel lanes in both directions. Two-lane Toronto and Niagara bound collectors generally run parallel to the mainline and are separated from the mainline with a grass median.



The site is located at the south end of Burlington near the boundary with Hamilton to the south, and along QEW between the James N. Allan Skyway and Fairview street interchange, approximately 300 m north to 500 m south of North Shore Boulevard. The adjacent lands generally comprise industrial and commercial uses to the southeast and residential to the west and northeast. Indian Creek runs parallel to the highway along the west side and outlets in Hamilton Harbour (Lake Ontario) approximately 250 m south of North Shore Boulevard. Photographs of the sites are presented in Appendix A.

Based on a review of the existing site conditions at the time of the investigation, no evidence of embankment slope instability or settlement of the roadway was observed at the existing culverts and embankments.

Based on the information in *The Physiography of Southern Ontario*¹ by Chapman and Putnam (1984), the study area is located within the Iroquois Plain physiographic region. The Iroquois Plain was formed in the late Pleistocene times by a body of water known as Lake Iroquois, which emptied eastward at Rome, New York (Chapman and Putnam, 1984). Lake Iroquois was characterized by higher water levels than the present-day Lake Ontario, caused by an ice sheet blocking the present-day St. Lawrence River valley. When the St. Lawrence valley became free of ice, the water level dropped to a level much lower than the present Lake Ontario levels (*Pleistocene Geology of the Hamilton Map-Area*²).

Based on *Quaternary Geology Map M2509*³ and *Pleistocene Geology Map M2033*⁴, the surficial deposits on the site are lacustrine and outwash sand underlain by Halton clay or silt till. According to *Paleozoic Geology Map M2336*⁵, the bedrock geology consists of red shale of the Queenston Formation.

3.0 INVESTIGATION PROCEDURES

The site investigation was carried out during the period of March 25 to April 17, 2019 and comprised a total of 17 boreholes drilled near the proposed culvert and sewer locations. It is noted that due to a utility locate conflict with the Halton Region sanitary sewer, the replacement

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

² Karrow, P. F., 1959; *Pleistocene Geology of the Hamilton Map-Area*. Ontario; Toronto, Ontario. Ontario Department of Mines

³ Karrow, P.F., 1986: *Quaternary Geology of the Hamilton Area*, Southern Ontario; Ontario Geological Survey, Map 2509, Quaternary Geology Series, scale 1:50,000.

⁴ Karrow, P.F., 1963: *Pleistocene Geology of the Hamilton Area*, Southern Ontario; Ontario Geological Survey, Map M2033, Scale: 1:63,360.

⁵ B.A. Liberty, I.J. Bond and P. G. Telford, 1972 & 1973; *Paleozoic Geology, Hamilton, Southern Ontario*; Ontario Geological Survey, Map M2336, Scale: 1:50 000.



of Culverts 4 (C4) and 5 (C5) were cancelled by MTO Central Region. It is noted that Thurber had initiated the drilling program and completed two boreholes at C5 (C5-01 and C5-04) when the scope was revised; these borehole logs are provided within this report for reference, however, they are not discussed further. The boreholes were advanced to depths of 2.4 m to 12.8 m. Borehole details are provided in Table 3.1 below and in the Record of Borehole sheets included in Appendix B.

Table 3.1 – Borehole Details

Structure	Approximate Location	Borehole No.	Ground Elevation (m)	Borehole Termination Depth (m)	Approx. Borehole Termination Elevation (m)
Open Cut					
Culvert 3 (C3)	QEW South to North Shore East/West Ramp, approximately 100 m north of North Shore Blvd	C3-01	78.0	3.7	74.3
		C3-02	81.1	6.7	74.4
		C3-03	81.1	5.2	75.9
		C3-04	78.8	5.2	73.6
Culvert 6 (C6)	QEW North to North Shore East/West Ramp, approximately 350 m south of North Shore Blvd	C6-01	76.7	5.2	71.5
		C6-02	76.9	5.2	71.8
		C6-03	77.1	5.2	71.9
Culvert 8 (C8)	QEW Niagara Bound Collector, approximately 450 m south of North Shore Blvd	C8-01	76.3	12.8	63.5
		C8-02	76.6	5.2	71.4
		C8-03	77.0	5.2	71.8
		C8-04	76.7	5.2	71.5
Trenchless					
Culvert 5 (C5)	QEW Toronto Bound Collector, approximately 275 m south of North Shore Blvd	C5-01	77.4	2.4	75.0
		C5-04	77.2	6.7	70.5
Trenchless Sewer (TRSR)	QEW Mainline and Niagara Bound Collector, approximately 150 m north of North Shore Blvd	TRSR1-01	84.1	5.0	79.2
		TRSR1-02	84.4	5.2	79.2
		TRSR1-03	84.7	5.2	79.5
		TRSR1-04	84.3	6.7	77.6



The approximate locations of the boreholes are shown on the Borehole Locations and Soil Strata Drawings provided in Appendix E.

Thurber positioned the boreholes in the field relative to existing site features and using a handheld GPS receiver, with consideration of site features and access limitations. The ground elevations at the borehole locations were determined using Trimble R10 GNSS surveying equipment with vertical accuracy within 0.1 m and horizontal accuracy within 0.5 m.

All borehole locations were cleared of utilities prior to commencement of drilling. The boreholes were repositioned as necessary in consideration of surface features, underground utilities, and restricted site access.

The boreholes were advanced using continuous flight solid and hollow stem augers powered by track-mounted D50 and truck-mounted CME-75 drilling equipment and NW wash boring using portable tripod equipment. The portable tripod equipment was used in areas that could not be accessed by a drill rig (Boreholes C3-01, C5-01, C5-04 and C6-01).

Soil samples were obtained at selected intervals using a 50 mm outside diameter split-spoon sampler driven in conjunction with the Standard Penetration Test (SPT) completed in accordance with ASTM D1586. Dynamic cone penetration tests (DCPT) were performed adjacent to Boreholes C3-04, C6-03, C8-01, C8-02 and C8-03 where very loose or loose, non-cohesive soils were encountered.

The field investigation was supervised on a full-time basis by a member of Thurber's technical staff who marked/staked the boreholes in the field, arranged for the clearance of subsurface utilities, directed the drilling, sampling and in-situ testing operations, logged the boreholes and processed the recovered soil samples for transport to Thurber's laboratory for further examination and testing.

Groundwater conditions in the open boreholes were observed throughout the drilling operations. Standpipe piezometers (19 and 50 mm diameter) were installed and enclosed in filter sand in selected boreholes to permit groundwater level monitoring.

The details of the piezometers and monitoring wells are shown in Table 3.2.

Table 3.2 – Piezometer and Monitoring Well Details

Borehole	Piezometer/Monitoring Well Tip		Slotted Screen Length (m)
	Depth (m)	Elevation (m)	
C3-01	2.9	75.1	1.5
C3-04	4.6	74.2	3.1
C5-04	6.1	71.1	3.1
C8-01	12.2	64.1	3.1
C8-04	4.6	72.1	3.1
TRSR1-01	4.6	79.5	3.1
TRSR1-04	6.1	78.2	3.1

The boreholes in which no piezometers or monitoring wells were installed were backfilled with bentonite and cuttings to the ground surface in general accordance with MOE Regulation 903 as amended. The asphalt pavement was reinstated at the ground surface of boreholes completed on the paved roadway (Boreholes C3-02, C3-03, C6-02, C6-03, C8-03 and TRSR1-01 to TRSR1-04.)

4.0 LABORATORY TESTING

Routine laboratory testing was carried out at Thurber's laboratory. The recovered soil samples were subjected to Visual Identification (VI) and to natural moisture content determination. Selected samples were also subjected to grain size distribution analysis and Atterberg Limits testing. Results of the laboratory testing are summarized on the Record of Borehole sheets in Appendix B and presented on the figures included in Appendix C.

Selected soil samples were also submitted for analytical testing to assess the potential for soil corrosion and evaluate the potential for sulphate action on concrete. The analyses were carried out by SGS Canada Inc., an independent Canadian Association for Laboratory Accreditation (CALA) accredited laboratory. The results of the analytical testing are presented in Appendix D.

5.0 DESCRIPTION OF SUBSURFACE CONDITIONS

Reference should be made to the Record of Borehole sheets in Appendix B and the Borehole Locations and Soil Strata Drawings in Appendix E. An overall description of the stratigraphy is given in the following paragraphs. However, the factual data presented in the Record of Borehole Sheets governs any interpretation of the site conditions. It must be recognized and anticipated that soil conditions may vary between and beyond the borehole locations.

5.1 Culvert 3 (Boreholes C3-01 to C3-04)

In general terms, the subsurface stratigraphy encountered in Boreholes C3-01 to C3-04 consists of a surficial pavement structure or topsoil fill over fill, underlain by native deposits of silty sand overlying clay till. More detailed descriptions of the individual strata are presented below.

5.1.1 Pavement Structure

A flexible pavement structure consisting of 250 and 225 mm of asphalt overlying approximately 750 and 1175 mm of crushed sand and gravel fill was encountered at the ground surface of Boreholes C3-02 and C3-03, respectively.

5.1.2 Topsoil Fill

In Boreholes C3-01 and C3-04, a 125 to 150 mm thick layer of topsoil fill was encountered at the ground surface. Topsoil thickness may vary in other areas of the site and this limited data should not be used to estimate topsoil quantity.

5.1.3 Fill

Silty clay fill was encountered below the topsoil fill and pavement structure at depths of 0.1 to 1.4 m (Elev. 77.8 to 80.1) and extended to depths of 1.2 to 4.1 m (Elev. 76.8 to 77.5) in the boreholes. SPT 'N' values recorded in the fill varied from 7 to 25 blows per 0.3 m, indicating a firm to very stiff condition. Measured moisture contents ranged from 17 to 22%.

The results of grain size distribution tests carried out on the fill are shown on Figure C1 in Appendix C and summarized below:

Soil Particle	Percentage (%)
Gravel	0 to 1
Sand	14 to 23
Silt	36 to 39
Clay	38 to 47

Atterberg limits testing was carried out on two samples of fill. The results indicate that the fill samples tested consist of silty clay of low plasticity (CL).



The results are plotted on Figure C9 in Appendix C and summarized below.

Liquid Limit	31 to 33
Plastic Limit	15 to 16
Plasticity Index	16 to 17

Cobbles, boulders or other obstructions and/or debris may be present within the fill and should be anticipated when excavating during construction.

5.1.4 Silty Sand

A silty sand deposit was encountered below the fill at depths of 1.2 to 4.1 m (Elev. 76.8 to 77.5). Boreholes C3-01 to C3-03 were terminated in the sand at 3.7 to 6.7 m depth (Elev. 74.3 to 75.9). The silty sand layer was 3.0 m thick in Borehole C3-04, with a lower boundary at a depth of 4.3 m (Elev. 74.5). A 0.3 to 0.5 m thick layer of silty clay layer was encountered within the silty sand layer at depths of 2.2 to 5.1 m (Elev. 75.4 to 76.0) in Boreholes C3-01, C3-02 and C3-04. It is noted that occasional partings of silty clay and layers of black organics were observed within the sand deposit. SPT 'N' values recorded in the silty sand ranged from 3 to 13 blows per 0.3 m, indicating a very loose to compact relative density. Measured moisture contents generally ranged from 18 to 23%.

The results of grain size distribution tests carried out on the sand are shown on Figure C2 in Appendix C and summarized below:

Soil Particle	Percentage (%)
Gravel	0
Sand	56 to 69
Silt	20 to 26
Clay	9 to 18

The results of a grain size distribution analyses of the clay layer are provided on Figure C5 Appendix C. The results indicated 0% gravel, 25% sand, 39% silt, and 36% clay. Atterberg limits testing determined the liquid limit, plastic limit and plasticity index to be 32, 17 and 16, respectively. These results, which are plotted on Figure C10 in Appendix C, indicate that the sample tested consists of low plastic clay (CL).



5.1.5 Clay Till

A deposit of silty clay till was encountered underlying the silty sand in Borehole C3-04 at 4.3 m depth (Elev. 74.5) and the layer continued to the termination depth of 5.2 m (Elev. 73.6). An SPT 'N' value of 10 blows per 0.3 m was recorded within the till deposit indicating a stiff consistency. Measured moisture contents within the till was about 25%.

The results of a grain size distribution analyses of the clay till are provided on Figure C6 Appendix C. The results indicated 1% gravel, 22% sand, 50% silt, and 27% clay. Atterberg limits testing was carried out on one sample of the till. The measured liquid limit, plastic limit and plasticity index were 37, 21 and 16, respectively. These results, which are plotted on Figure C11 in Appendix C, indicate that the sample tested consists of intermediate plastic clay (CI).

Till soils frequently contain cobbles and boulders, and these should be anticipated when excavating during construction.

5.1.6 Groundwater Levels

Groundwater conditions were observed in the boreholes during and upon completion of drilling. Upon completion of augering, free water was observed in the open borehole at a depth of 2.1 m (Elev. 76.7) in Borehole C3-04; Boreholes C3-02 and C3-03 were open and dry. The wash boring borehole advancement methodology used for Borehole C3-01 introduces water into the borehole. In this regard, the water level observed at the termination of this borehole may not accurately represent the long-term stabilized ground water level and is not reported here.

The groundwater conditions recorded in the piezometers installed in selected boreholes are summarized in the table below:

Borehole	Date	Water Level (m)	
		Depth	Elev.
C3-01	April 25, 2019	0.9	77.1
	May 2, 2019	0.7	77.3
C3-04	April 25, 2019	1.0	77.8
	May 2, 2019	0.4	78.4

In general, the water level in the vicinity of these boreholes is expected to be governed by the prevailing water level in Indian Creek located approximately 30 m to the west.



The water level measurements are short-term observations and seasonal fluctuations of the groundwater level are to be expected. Water levels may be higher after snowmelt or heavy precipitation events. In general, perched groundwater and wet conditions should be anticipated in the sand deposits above underlying less permeable till materials.

5.2 Culvert 6 (Boreholes C6-01 to C6-03)

In general terms, the subsurface stratigraphy encountered in Boreholes C6-01 to C6-03 consists of a surficial pavement structure or topsoil fill over fill, underlain by native silty sand. More detailed descriptions of the individual strata are presented below.

5.2.1 Pavement Structure

A flexible pavement structure consisting of 275 and 100 mm of asphalt was encountered at the ground surface of Boreholes C6-02 and C6-03, respectively.

5.2.2 Topsoil Fill

In Borehole C6-01, a 125 mm thick layer of topsoil fill was encountered at the ground surface. Topsoil thickness may vary in other areas of the site and this limited data should not be used to estimate topsoil quantity.

5.2.3 Fill

Silty clay fill was encountered below the topsoil fill and extended to a depth of 0.7 m (Elev. 76.0) in Borehole C6-01. An SPT 'N' value of 14 blows per 0.3 m was recorded in the clay fill, indicating a stiff condition. Measured moisture was determined to be about 19%.

Sand and gravel embankment fill was encountered below the asphalt and clay fill and extended to depths of 1.4 to 1.8 m (Elev. 74.9 to 75.7) in the boreholes. SPT 'N' values recorded in the sand and gravel fill varied from 14 to 47 blows per 0.3 m, indicating a compact to dense relative density. Measured moisture contents ranged from 3 to 12%.

Cobbles, boulders or other obstructions and/or debris may be present within the fill and should be anticipated when excavating during construction.

5.2.4 Silty Sand

A silty sand deposit was encountered below the fill at depths of 1.4 to 1.8 m (Elev. 74.9 to 75.7) and the layer extended to the borehole termination depths of 5.2 m depth (Elev. 71.5 to 71.9). A

0.8 m thick layer of sand, with occasional shell fragments, was encountered within the silty sand layer at depths of 2.2 to 3.7 m (Elev. 73.0 to 74.9). It is noted that occasional layers of silt and black organics were observed within the sand deposit. SPT 'N' values recorded in the silty sand ranged from 2 to 39 blows per 0.3 m, indicating a very loose to dense relative density. Measured moisture contents generally ranged from 19 to 32%, locally 41% in Borehole C6-02.

The results of grain size distribution tests carried out on the silty sand are shown on Figures C2 and C3 in Appendix C and summarized below:

Soil Particle	Percentage (%)
Gravel	0 to 20
Sand	50 to 70
Silt	20 to 42
Clay	5 to 7

The results of grain size distribution tests carried out on the sand layer are also shown on Figures C2 and C3 in Appendix C and summarized below:

Soil Particle	Percentage (%)
Gravel	8 to 14
Sand	70 to 84
Silt + Clay	8 to 16

5.2.5 Groundwater Levels

Groundwater conditions were observed in the boreholes during and upon completion of drilling. Upon completion of augering free water and cave was measured at 2.7 m (Elev. 74.2 in Borehole C6-02; free water was observed in the open borehole a depth of 2.2 m (Elev. 74.9) in Borehole C6-03. The wash boring borehole advancement methodology used for Borehole C6-01 introduces water into the borehole. In this regard, the water level observed at the termination of this borehole may not accurately represent the long-term stabilized ground water level and is not reported here.

The water level measurements are short-term observations and seasonal fluctuations of the groundwater level are to be expected. Water levels may be higher after snowmelt or heavy precipitation events. In general, perched groundwater and wet conditions should be anticipated in the sand deposits.



5.3 Culvert 8 (Boreholes C8-01 to C8-04)

In general terms, the subsurface stratigraphy encountered in Boreholes C8-01 to C8-04 consists of a surficial pavement structure or topsoil fill over variable types of fill, underlain by native deposits of silty sand overlying layered silts and sand underlain by organic silt over sand and gravel. More detailed descriptions of the individual strata are presented below.

5.3.1 Pavement Structure

A flexible pavement structure consisting of 125 mm of asphalt overlying approximately 575 mm of crushed sand and gravel fill was encountered at the ground surface of Borehole C8-03.

5.3.2 Topsoil Fill

In Boreholes C8-01, C8-02 and C8-04, a 100 to 225 mm thick layer of topsoil fill was encountered at the ground surface. Topsoil thickness may vary in other areas of the site and this limited data should not be used to estimate topsoil quantity.

5.3.3 Fill

A layer of fill was encountered below the pavement structure and topsoil fill at depths of 0.1 to 0.7 m (Elev. 76.1 to 76.6) and this layer extended to depths of 1.4 to 2.2 m (Elev. 74.5 to 75.1). The fill layer was variable in composition and comprised sand, clayey silt and silty clay. SPT 'N' values recorded in the fill varied from 4 to 29 blows per 0.3 m, indicating a soft to very stiff/compact condition. Measured moisture contents typically ranged from 4 to 20%, locally up to 43%.

The results of grain size distribution tests carried out on the clayey silt and silty clay fill are shown on Figure C1 in Appendix C and summarized below:

Soil Particle	Percentage (%)
Gravel	0 to 1
Sand	27 to 32
Silt	44 to 50
Clay	23



Atterberg limits testing was carried out on two samples of fill. The results are plotted on Figure C9 in Appendix C and summarized below. The results indicate that the fill samples tested consist of clayey silt (CL-ML) and silty clay of low plasticity (CL).

Liquid Limit	21 to 25
Plastic Limit	15
Plasticity Index	6 to 9

Cobbles, boulders or other obstructions and/or debris may be present within the fill and should be anticipated when excavating during construction.

5.3.4 Silty Sand

A 1.9 to 2.3 m thick deposit of silty sand was encountered below the fill at depths of 1.4 to 2.2 m (Elev. 74.5 to 75.1) and this layer extended to depths of 3.7 to 4.2 m (Elev. 72.6 to 72.8). It is noted that occasional partings of silty clay and layers of silt and black organics were observed within the sand deposit. Locally, in Borehole C8-04, occasional cobbles and wood and shell fragments were noted. SPT 'N' values recorded in the silty sand ranged from 3 to 21 blows per 0.3 m, indicating a very loose to compact relative density. Measured moisture contents generally ranged from 20 to 51%.

The results of grain size distribution tests carried out on the sand are shown on Figure C3 in Appendix C and summarized below:

Soil Particle	Percentage (%)
Gravel	0
Sand	43 to 65
Silt	28 to 51
Clay	6 to 7

5.3.5 Layered Silty Sand and Sandy Silt

A deposit consisting of layered silty sand and sandy silt was encountered below the sand at depths of 3.7 to 4.2 m (Elev. 72.6 to 72.8). Boreholes C8-02 to C8-04 were terminated within this stratum at 5.2 m depth (Elev. 71.4 to 71.8). This layer is 2.4 m thick in Borehole C8-01. It is noted that occasional to numerous organic layers were observed within the deposit with thin layers of peat noted in Borehole C8-03. SPT 'N' values recorded in the deposit ranged from 2 to



6 blows per 0.3 m, indicating a very loose to loose relative density. Measured moisture contents generally ranged from 33 to 65%.

The results of grain size distribution tests carried out on the stratum are shown on Figure C3 in Appendix C and summarized below:

Soil Particle	Percentage (%)
Gravel	0 to 1
Sand	14 to 68
Silt	26 to 72
Clay	5 to 13

5.3.6 Organic Silt

A 3.3 m thick layer of organic silt was encountered below the layered sand and silt at a depth of 6.1 m (Elev. 70.2) and this layer extended to a depth of 9.4 m (Elev. 66.8) in Borehole C8-01. It is noted that occasional thin layers of peat, partings of silty clay, thin sand seams and shell fragments were observed within this deposit. SPT 'N' values recorded in the organic silt were 5 blows per 0.3 m, indicating a loose relative density. Measured moisture contents generally ranged from 34 to 89%.

The results of a grain size distribution analysis of the organic silt layer are provided on Figure C7 Appendix C. The results indicated 0% gravel, 21% sand, 63% silt, and 16% clay.

5.3.7 Sand and Gravel

A deposit of sand and gravel was encountered underlying the organic silt in Borehole C8-01 at a depth of 9.4 m (Elev. 66.8) and this layer extended to the borehole termination depth of 12.8 m (Elev. 63.5). SPT 'N' values ranging from 21 to 58 blows per 0.3 m was recorded within the deposit indicating a compact to very dense relative density. Measured moisture contents within the sand and gravel ranged from 8 to 12%.

The results of a grain size distribution analyses of the sand and gravel are provided on Figure C8 Appendix C. The results indicated 35% gravel, 56% sand and 9% silt and clay.



5.3.8 Groundwater Levels

Groundwater conditions were observed in the boreholes during and upon completion of drilling. Upon completion of augering, free water was observed in the open boreholes at depths of 2.5 and 2.2 m (Elev. 74.1 and 74.8) in Boreholes C8-02 and C8-03, respectively.

The groundwater conditions recorded in the piezometers installed in selected boreholes are summarized in the table below:

Borehole	Date	Water Level (m)	
		Depth	Elev.
C8-01	April 25, 2019	1.7	74.5
	May 2, 2019	1.0	75.3
C8-04	April 25, 2019	1.5	75.2
	May 2, 2019	1.2	75.5

The water level measurements are short-term observations and seasonal fluctuations of the groundwater level are to be expected. Water levels may be higher after snowmelt or heavy precipitation events. Perched groundwater and wet conditions should be anticipated in the sand deposits.

In general, the water level in the vicinity of these boreholes is expected to be governed by the prevailing Lake Ontario water level located immediately to the west.

The water level in Lake Ontario ranged from elevation 75.0 to 75.5, averaging about 75.2 during the month of April 2019. The lake water elevation was obtained from *Fisheries and Oceans Canada Canadian Hydrographic Service*⁶ water level gauging station located in Burlington, Ontario. The elevation is referenced to the International Great Lakes Datum 1985. It is noted that according to the *Canadian Hydrographic Service*⁷, the Lake Ontario water level elevation average ranges from 74.4 to 75.1, with maximums ranging from 75.0 to 75.8.

⁶ Fisheries and Oceans Canada – The Canadian Hydrographic Service; Burlington (#13150) Tidal Observations; <http://www.waterlevels.gc.ca/eng/station/Month?sid=13150&tz=EST&pres=2&type=1> retrieved on April 29, 2019.

⁷ Fisheries and Oceans Canada – The Canadian Hydrographic Service; Historical Monthly Mean Water Levels from the Coordinated network for each of the Great Lakes: Lake Ontario monthly mean water levels in metres referred to IGLD 1985; http://www.tides.gc.ca/C&A/network_means-eng.html; modified dated April 16, 2019; retrieved April 29, 2019.



5.4 Trenchless Sewer (Boreholes TRSR1-01 to TRSR1-04)

In general terms, the subsurface stratigraphy encountered in Boreholes TRSR1-01 to TRSR1-04 consists of a surficial pavement structure over fill, underlain by native deposits of silty sand over clay overlying clay till. More detailed descriptions of the individual strata are presented below.

5.4.1 Pavement Structure

A flexible pavement structure consisting of 100 to 250 mm of asphalt overlying approximately 475 to 1950 mm of crushed sand and gravel fill was encountered at the ground surface of the boreholes.

5.4.2 Fill

Silty clay fill was encountered below the pavement structure at depths of 0.7 to 1.4 m (Elev. 83.0 to 84.0) and extended to depths of 1.3 to 2.7 m (Elev. 81.7 to 83.0) in Boreholes TRSR1-02 to TRSR1-04. SPT 'N' values recorded in the fill varied from 12 to 30 blows per 0.3 m, indicating a stiff to hard condition. Measured moisture contents ranged from 10 to 18%.

The results of a grain size distribution analysis of the clay fill are provided on Figure C1 Appendix C. The results indicated 5% gravel, 25% sand, 37% silt, and 33% clay. Atterberg limits testing was carried out on one sample of the fill. The measured liquid limit, plastic limit and plasticity index were 25, 13 and 12, respectively. These results, which are plotted on Figure C9 in Appendix C, indicate that the sample tested consists of silty clay of low plasticity (CL).

Cobbles, boulders or other obstructions and/or debris may be present within the fill and should be anticipated when excavating during construction.

5.4.3 Silty Sand

A silty sand deposit was encountered below the fill and pavement structure at depths of 1.3 to 2.7 m (Elev. 81.7 to 83.0) and this layer extended to depths of 2.7 to 3.4 m (Elev. 81.0 to 82.0). It is noted that occasional partings of silty clay and were observed within the sand deposit. SPT 'N' values recorded in the silty sand ranged from 6 to 28 blows per 0.3 m, indicating a loose to compact relative density. Measured moisture contents generally ranged from 8 to 20%.



The results of grain size distribution tests carried out on the sand are shown on Figures C3 and C4 in Appendix C and summarized below:

Soil Particle	Percentage (%)
Gravel	0 to 1
Sand	55 to 72
Silt	18 to 36
Clay	8 to 14

5.4.4 Silty Clay

A deposit of silty clay was encountered underlying the silty sand at 2.7 to 3.4 m (Elev. 81.0 to 82.0). The clay layer extended to depths of 4.7 and 6.1 m (Elev. 79.4 and 78.2) in Boreholes TRSR1-01 and TRSR1-04 and extended to the termination depths of 5.2 m (Elev. 79.2 and 79.5) in Boreholes TRSR1-02 and TRSR1-03. SPT 'N' values of 2 to 18 blows per 0.3 m were recorded within the silty clay deposit indicating a soft to very stiff consistency. Measured moisture contents within the clay ranged from 20 to 29%.

The results of grain size distribution tests carried out on the silty clay are shown on Figure C5 in Appendix C and summarized below:

Soil Particle	Percentage (%)
Gravel	0 to 1
Sand	5 to 10
Silt	41 to 46
Clay	43 to 53

Atterberg limits testing was carried out on four samples of clay. The results are plotted on Figure C10 in Appendix C and summarized below. The results indicate that the clay samples tested consist of silty clay of low plasticity (CL).

Liquid Limit	31 to 34
Plastic Limit	15 to 17
Plasticity Index	15 to 18

5.4.5 Clay Till

A deposit of silty clay till was encountered underlying the silty clay in Boreholes TRSR1-01 and TRSR1-04 at 4.7 and 6.1 m depths (Elev. 79.4 and 78.2) and this layer extended to the borehole termination depths of 5.0 and 6.7 m (Elev. 79.2 and 77.6). SPT 'N' values of 29 blows



per 0.3 m and 100 blows for 0.25 m were recorded within the till deposit indicating a very stiff to hard consistency. Measured moisture contents within the till ranged from 9 to 12%.

Till soils frequently contain cobbles and boulders, and these should be anticipated when excavating during construction.

5.4.6 Groundwater Levels

Groundwater conditions were observed in the boreholes during and upon completion of drilling. Upon completion of augering, the boreholes were open and dry. The groundwater conditions recorded in the piezometers installed in selected boreholes are summarized in the table below:

Borehole	Date	Water Level (m)	
		Depth	Elev.
TRSR1-01	April 25, 2019	1.3	82.8
	May 2, 2019	1.2	82.9
TRSR1-04	April 25, 2019	2.2	82.2
	May 2, 2019	3.0	81.3

The water level measurements are short-term observations and seasonal fluctuations of the groundwater level are to be expected. Water levels may be higher after snowmelt or heavy precipitation events. In general, perched groundwater and wet conditions should be anticipated in the sand deposits above underlying less permeable clayey materials.

5.5 Corrosivity And Sulphate Test Results

Samples of the fill and native soils were submitted for analytical testing of corrosivity parameters and sulphate. The results of the analytical tests are shown in Table 5.1. The laboratory certificates of analysis are presented in Appendix D.

Table 5.1 – Analytical Test Results

Sample ID	Depth (m)	Description	Sulphide (%)	Chloride (µg/g)	Sulphate (µg/g)	pH	Resistivity (ohm.cm)	Redox Potential (mV)
BH C3-03 SS5	3.0-3.6	Clay Fill	<0.02	120	20	8.79	5890	126
BH C6-03 SS3	1.5-2.1	Sand	<0.02	730	67	8.03	495	220
BH C8-03 SS3	1.5-2.1	Sand Fill	<0.02	3100	60	7.45	309	312
BH TRSR1-04 SS5	3.0-3.6	Clay	0.03	360	62	8.85	2460	227



6.0 MISCELLANEOUS

Thurber positioned the boreholes in the field relative to existing site features and using a handheld GPS receiver, with consideration of site features and access limitations. The ground elevations at the borehole locations were determined using Trimble R10 GNSS surveying equipment. Walker Drilling of Utopia, Ontario and Elite Drilling Services of St. Catharines, Ontario supplied and operated the drilling and sampling equipment for the field program.

Full time supervision of the field activities was carried out by Mr. Kevin Kweon of Thurber Engineering. Overall supervision of the field program was performed by Mr. Karel Furbacher, P.Eng. of Thurber. Interpretation of the field data and preparation of the report was performed by Mr. Karel Furbacher, P.Eng. The report was reviewed by Dr. P.K. Chatterji, P.Eng., a Designated Principal Contact for MTO Foundations Projects.

Thurber Engineering Ltd.



Karel Furbacher, P.Eng.
Geotechnical Engineer



P.K. Chatterji, P.Eng., Ph.D.
Review Principal



Appendix A
Site Photographs

**CULVERTS AND STORM SEWER INSTALLATIONS
NORTH SHORE BOULEVARD INTERCHANGE
Site Photographs**



Photograph 1 – View of west outlet of Culvert 3



**Photograph 2 – Borehole C3-02 on the ramp from the QEW to North Shore Boulevard
along alignment of Culvert 3 facing southwest**

**CULVERTS AND STORM SEWER INSTALLATIONS
NORTH SHORE BOULEVARD INTERCHANGE
Site Photographs**



Photograph 3 – View of portable tripod equipment drilling at Borehole C6-01, west of inlet of Culvert 6



Photograph 4 – East end of Culvert 6 looking north towards Borehole C5-04

**CULVERTS AND STORM SEWER INSTALLATIONS
NORTH SHORE BOULEVARD INTERCHANGE
Site Photographs**



Photograph 5 – View looking east towards QEW Niagara collector lanes along the Culvert 8 alignment



Photograph 6 – West outlet of Culvert 8 into Hamilton Harbour (Lake Ontario) near Borehole C8-01



**CULVERTS AND STORM SEWER INSTALLATIONS
NORTH SHORE BOULEVARD INTERCHANGE
Site Photographs**



Photograph 7 – View looking northeast towards west outlet of TRSR



Photograph 8 – View looking east along alignment of TRSR from west outlet of TRSR



**CULVERTS AND STORM SEWER INSTALLATIONS
NORTH SHORE BOULEVARD INTERCHANGE
Site Photographs**



Photograph 9 – View looking west along alignment of TRSR from east end of TRSR



Appendix B
Record of Borehole Sheets

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 ⁽¹⁾ '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.

RECORD OF BOREHOLE No C3-01

1 OF 1

METRIC

GWP# 2117-15-00 LOCATION MTM NAD83 Zone 10: N 4 797 327.1 E 279 664.6 ORIGINATED BY KK
 DIST Central HWY QEW BOREHOLE TYPE NW Wash Boring COMPILED BY MP
 DATUM Geodetic DATE 2019.03.26 - 2019.03.26 LATITUDE 43.315407 LONGITUDE -79.809875 CHECKED BY KF

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT							UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
78.0	GROUND SURFACE							20	40	60	80	100					
0.0	TOPSOIL FILL (150mm)																
0.2	Silty CLAY , trace sand and gravel, occasional organics, contains rootlets Very Stiff Brown Moist (FILL)		1	SS	19												
76.8			2	SS	25												
1.2	Silty SAND , with occasional to numerous partings and layers of silty clay Compact Grey Wet		3	SS	13												
75.8																	
2.2	layer of silty CLAY																
75.4			4	SS	8												
2.6																	
74.3			5	SS	7												
3.7	END OF BOREHOLE AT 3.7m. Monitoring well installation consists of 19mm diameter Schedule 40 PVC pipe with a 1.5m slotted screen. WATER LEVEL READINGS DATE DEPTH(m) ELEV.(m) 2019.04.25 0.9 77.1 2019.05.02 0.7 77.3																

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

RECORD OF BOREHOLE No C3-02

1 OF 1

METRIC

GWP# 2117-15-00 LOCATION MTM NAD83 Zone 10: N 4 797 328.3 E 279 676.6 ORIGINATED BY KK
 DIST Central HWY QEW BOREHOLE TYPE Solid Stem Augers COMPILED BY MP
 DATUM Geodetic DATE 2019.04.17 - 2019.04.17 LATITUDE 43.315418 LONGITUDE -79.809727 CHECKED BY KF

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100	W _P	W			W _L		
								SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE				WATER CONTENT (%)							
81.1	GROUND SURFACE						20	40	60	80	100	20	40	60		GR	SA	SI	CL
0.0 80.8	ASPHALT: (250mm)						81												
0.3	SAND and GRAVEL Compact Brown Moist (FILL)		1	SS	14														
80.1																			
1.0	Silty CLAY, some sand, trace gravel Stiff Brown Moist (FILL)		2	SS	14		80												
			3	SS	9		79												
			4	SS	9		78												
			5	SS	10														
77.0							77												
4.1	Silty SAND, with occasional to numerous partings and layers of silty clay Loose to Compact Grey/Brown Moist		6	SS	9		76												
76.0																			
5.1	layer of silty CLAY																		
75.5																			
5.6							75												
			7	SS	12														
74.4																			
6.7	END OF BOREHOLE AT 6.7m. BOREHOLE OPEN AND DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE TO 0.2m, THEN CONCRETE AND COLD PATCH ASPHALT TO SURFACE.																		

ONTMT452 MTO-25497.GPJ 2017TEMPLATE(MTO).GDT 5/22/19

RECORD OF BOREHOLE No C3-03

1 OF 1

METRIC

GWP# 2117-15-00 LOCATION MTM NAD83 Zone 10: N 4 797 324.8 E 279 685.4 ORIGINATED BY KK
 DIST Central HWY QEW BOREHOLE TYPE Solid Stem Augers COMPILED BY MP
 DATUM Geodetic DATE 2019.04.17 - 2019.04.17 LATITUDE 43.315387 LONGITUDE -79.809619 CHECKED BY KF

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					
81.1	GROUND SURFACE							<div>20406080100</div> <div>○ UNCONFINED + FIELD VANE</div> <div>● QUICK TRIAXIAL × LAB VANE</div>					
0.0	ASPHALT: (225mm)						81						
0.2	SAND and GRAVEL Loose to Compact Brown Moist (FILL)		1	SS	8								
			2	SS	17								
79.6							80						
1.4	Silty, sandy CLAY, trace gravel Stiff to Firm Brown Moist (FILL)		3	SS	13								
			4	SS	10								
			5	SS	12								
77.0							78						
4.1	Silty SAND; with occasional to numerous partings and layers of silty clay Compact Brown Moist		6	SS	5								
75.9			7	SS	6								
5.2	END OF BOREHOLE AT 5.2m. BOREHOLE OPEN AND DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE TO 0.2m, THEN CONCRETE COLD PATCH ASPHALT TO SURFACE.						76						

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

RECORD OF BOREHOLE No C3-04

1 OF 1

METRIC

GWP# 2117-15-00 LOCATION MTM NAD83 Zone 10: N 4 797 331.6 E 279 694.9 ORIGINATED BY KK
 DIST Central HWY QEW BOREHOLE TYPE Hollow Stem Augers COMPILED BY MP
 DATUM Geodetic DATE 2019.04.04 - 2019.04.04 LATITUDE 43.315448 LONGITUDE -79.809502 CHECKED BY KF

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 (%)									
78.8	GROUND SURFACE							20	40	60	80	100	W _P	W	W _L	kN/m ³	GR	SA	SI	CL	
0.0	TOPSOIL FILL: (125mm)																				
0.1	Silty CLAY , some sand, trace gravel Firm Brown Moist (FILL)		1	SS	7																
			2	SS	7																
77.5																					
1.3	Silty SAND ; with occasional to numerous partings and layers of silty clay, occasional black organic layers Loose to Very Loose Brown Moist		3	SS	10																
			4	SS	3																
75.4			5	SS	5																
3.4	layer of silty CLAY																				
75.1																					
3.7																					
74.5																					
4.3	Silty CLAY , some sand to sandy, trace gravel Stiff Reddish Brown Moist (TILL)		6	SS	10																
73.6																					
5.2	END OF BOREHOLE AT 5.2m. BOREHOLE OPEN AND WATER LEVEL AT 2.1m UPON COMPLETION. Monitoring well installation consists of 25mm diameter Schedule 40 PVC pipe with a 3.0m slotted screen. WATER LEVEL READINGS DATE DEPTH(m) ELEV.(m) 2019.04.25 1.0 77.8 2019.05.02 0.4 78.4																				

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

RECORD OF BOREHOLE No C5-01

1 OF 1

METRIC

GWP# 2117-15-00 LOCATION MTM NAD83 Zone 10: N 4 797 137.1 E 280 106.8 ORIGINATED BY KK
 DIST Central HWY QEW BOREHOLE TYPE NW Wash Boring COMPILED BY MP
 DATUM Geodetic DATE 2019.03.25 - 2019.03.25 LATITUDE 43.313711 LONGITUDE -79.804415 CHECKED BY KF

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa							
77.4	GROUND SURFACE							20 40 60 80 100							
0.0	TOPSOIL FILL: (150mm)							20 40 60 80 100							
0.2	Silty CLAY , some sand to sandy, trace gravel Firm to Stiff Reddish Brown Moist (FILL)		1	SS	8		77								
			2	SS	52		76								2 40 34 24
			3	SS	36										
75.2															
78.4	Silty SAND , trace gravel		4	SS	100/										
2.4	Very Dense Brown Moist END OF BOREHOLE AT 2.4m UPON PRACTICAL REFUSAL TO ADVANCE. BOREHOLE OPEN AND DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO SURFACE.				0.075										

+³, ×³: Numbers refer to
Sensitivity

20
15
10

(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No C5-04

1 OF 1

METRIC

GWP# 2117-15-00 LOCATION MTM NAD83 Zone 10: N 4 797 088.6 E 280 096.4 ORIGINATED BY KK
 DIST Central HWY QEW BOREHOLE TYPE NW Wash Boring COMPILED BY MP
 DATUM Geodetic DATE 2019.03.25 - 2019.03.26 LATITUDE 43.313274 LONGITUDE -79.804541 CHECKED BY KF

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					
77.2	GROUND SURFACE							<div><div>20406080100</div><div>○ UNCONFINED + FIELD VANE</div><div>● QUICK TRIAXIAL × LAB VANE</div></div>					
0.0	TOPSOIL FILL (200mm)							<div><div>204060</div><div>W P W W L</div><div>PLASTIC NATURAL LIQUID</div><div>LIMIT MOISTURE LIMIT</div><div>CONTENT</div></div>					
0.2	Silty CLAY , some sand to sandy, trace gravel Very Stiff Brown Moist (FILL)		1	SS	20		77						
76.5													
0.7			2	SS	39		76						
	Silty SAND , trace gravel Dense Brown Moist (FILL)												
75.4			3	SS	31		75						
1.8	Silty SAND , trace gravel; with occasional to numerous partings and layers of silty clay Dense to Compact Mottled Reddish brown, brown, grey Moist												
			4	SS	34		74						0 68 27 5
			5	SS	33		73						
	with numerous layers of silt		6	SS	12		72						1 38 53 8
71.6													
5.6	Silty CLAY , trace sand; with occasional organic layers, shell fragments Stiff Grey Moist		7	SS	10		71						0 2 45 53
70.5													
6.7	END OF BOREHOLE AT 6.7m. Monitoring well installation consists of 19mm diameter Schedule 40 PVC pipe with a 3.0m slotted screen.												
	WATER LEVEL READINGS DATE DEPTH(m) ELEV.(m) 2019.04.25 1.8 75.4 2019.05.02 1.5 75.7												

ONTMT4S2 MTO-25497.GPJ 2017TEMPLATE(MTO).GDT 5/22/19

RECORD OF BOREHOLE No C6-01

1 OF 1

METRIC

GWP# 2117-15-00 LOCATION MTM NAD83 Zone 10: N 4 797 064.8 E 280 068.7 ORIGINATED BY KK
 DIST Central HWY QEW BOREHOLE TYPE NW Wash Boring COMPILED BY MP
 DATUM Geodetic DATE 2019.03.28 - 2019.03.28 LATITUDE 43.313059 LONGITUDE -79.804882 CHECKED BY KF

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)						
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa												
76.7	GROUND SURFACE							20	40	60	80	100								
0.0	TOPSOIL FILL (125mm)																			
0.1	Silty CLAY , some sand, trace gravel Stiff Brown		1	SS	14		76													
76.0	Moist (FILL)																			
0.7	SAND and GRAVEL , trace to some silt and clay Compact Brown		2	SS	18		75													
	Moist (FILL)																			
74.9			3	SS	47		74													
1.8	Silty SAND , trace gravel; with occasional layers of silt, black organic layers Compact to Dense Brown to Grey Moist to Wet																			
			4	SS	39		73													
			5	SS	24		72													
73.0																				
3.7	layer of SAND , trace to some silt and gravel; occasional shell fragments		6	SS	22															
72.2																				
4.5	Loose																			
			7	SS	8															
71.5																				
5.2	END OF BOREHOLE AT 5.2m. BOREHOLE BACKFILLED WITH BENTONITE TO SURFACE.																			

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

RECORD OF BOREHOLE No C6-02

1 OF 1

METRIC

GWP# 2117-15-00 LOCATION MTM NAD83 Zone 10: N 4 797 068.6 E 280 077.6 ORIGINATED BY KK
 DIST Central HWY QEW BOREHOLE TYPE Solid Stem Augers COMPILED BY MP
 DATUM Geodetic DATE 2019.04.16 - 2019.04.16 LATITUDE 43.313093 LONGITUDE -79.804772 CHECKED BY KF

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					
76.9	GROUND SURFACE					<div><div></div><div>20 40 60 80 100</div></div> <div><div>○ UNCONFINED</div><div>● QUICK TRIAXIAL</div></div> <div><div>+ FIELD VANE</div><div>× LAB VANE</div></div>	<div><div></div><div>20 40 60 80 100</div></div> <div><div>PLASTIC LIMIT</div><div>NATURAL MOISTURE CONTENT</div><div>LIQUID LIMIT</div></div> <div><div>W P</div><div>W</div><div>W L</div></div> <div>WATER CONTENT (%)</div>						
0.0	ASPHALT: (275mm)												
76.7													
0.3	SAND and GRAVEL, some silt Dense to Compact Brown Moist (FILL)		1	SS	41								
			2	SS	14								
75.3													
1.6	Silty SAND, trace gravel; with occasional black organic layers Loose to Very Loose Grey Moist		3	MB/CDSS	18								
			4	SS	4								
			5	SS	5								
73.2													
3.7	layer of SAND, trace to some silt and gravel; with occasional shell fragments		6	SS	3								
72.4													
4.5	with occasional layers of silt		7	SS	2								
71.8													
5.2	END OF BOREHOLE AT 5.2m. BOREHOLE CAVED AND WATER LEVEL TO 2.7m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE TO 0.2m, THEN CONCRETE AND COLD PATCH ASPHALT TO SURFACE.												

+³, ×³: Numbers refer to
Sensitivity


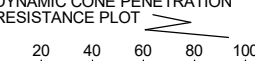


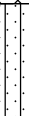
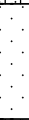
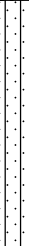
20
15
10
(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No C6-03

1 OF 1

METRIC

GWP# 2117-15-00 LOCATION MTM NAD83 Zone 10: N 4 797 072.6 E 280 087.1 ORIGINATED BY KK
 DIST Central HWY QEW BOREHOLE TYPE Solid Stem Augers COMPILED BY MP
 DATUM Geodetic DATE 2019.04.15 - 2019.04.15 LATITUDE 43.313130 LONGITUDE -79.804655 CHECKED BY KF

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa			WATER CONTENT (%)				
77.1	GROUND SURFACE												GR SA SI CL		
0.0	ASPHALT: (100mm)														
0.1	SAND and GRAVEL Dense to Compact Brown Moist (FILL)		1	SS	31										
			2	SS	17										
75.7															
1.4	Silty SAND, trace to some gravel; with occasional black organic layers Compact to Very Loose Brownish Grey Moist		3	SS	12									20 54 20 6	
74.9	layer of SAND, trace to some silt and gravel; occasional shell fragments		4	SS	7							14 70 12 4			
74.1															
3.0			5	SS	4										
			6	SS	3										
71.9															
5.2	END OF BOREHOLE AT 5.2m. BOREHOLE OPEN AND WATER LEVEL AT 2.2m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO 0.2m, THEN CONCRETE COLD PATCH ASPHALT TO SURFACE.														

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

RECORD OF BOREHOLE No C8-01

1 OF 2

METRIC

GWP# 2117-15-00 LOCATION MTM NAD83 Zone 10: N 4 796 882.7 E 280 037.1 ORIGINATED BY KK
 DIST Central HWY QEW BOREHOLE TYPE Hollow Stem Augers COMPILED BY MP
 DATUM Geodetic DATE 2019.04.01 - 2019.04.01 LATITUDE 43.311419 LONGITUDE -79.805263 CHECKED BY KF

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	
76.3	GROUND SURFACE											
0.0	TOPSOIL FILL: (225mm)											
0.2	Silty CLAY , some sand, trace gravel Soft to Firm Dark Brown to Reddish Brown Moist (FILL)		1	SS	5		76					
			2	SS	4		75					0 27 50 23
74.8												
1.4	Silty SAND , with occasional layers of silt, black organic layers Very Loose Grey Moist		3	SS	8		74					0 65 28 7
			4	SS	4							
73.3												
3.0	with occasional partings of silty clay		5	SS	3		73					
72.6												
3.7	Layered silty SAND and sandy SILT ; with occasional to numerous organic layers Very Loose to Loose Black, Brown and Grey Wet		6	SS	4		72					0 55 40 5
			7	SS	4		71					
70.2												
6.1	ORGANIC SILT , some sand to sandy inclusions, occasional thin layers of peat, partings of silty clay, thin sand seams, and shell fragments Loose Grey Moist		8	SS	5		70					
							69					
			9	SS	5		68					0 21 63 16
							67					
66.8												
9.4	Sand and GRAVEL , trace to some silt Compact to Very Dense Grey		10	SS	21							

Continued Next Page

+³, ×³: Numbers refer to
Sensitivity

20
15
10
(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No C8-01

2 OF 2

METRIC

GWP# 2117-15-00 LOCATION MTM NAD83 Zone 10: N 4 796 882.7 E 280 037.1 ORIGINATED BY KK
 DIST Central HWY QEW BOREHOLE TYPE Hollow Stem Augers COMPILED BY MP
 DATUM Geodetic DATE 2019.04.01 - 2019.04.01 LATITUDE 43.311419 LONGITUDE -79.805263 CHECKED BY KF


SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa	WATER CONTENT (%)					
	Continued From Previous Page													
	Wet		11	SS	58									
			12	SS	54									35 56 9 (SI+CL)
63.5														
12.8	END OF BOREHOLE AT 12.8m. Monitoring well installation consists of 25mm diameter Schedule 40 PVC pipe with a 3.0m slotted screen. WATER LEVEL READINGS DATE DEPTH(m) ELEV.(m) 2019.04.25 1.7 74.5 2019.05.02 1.0 75.3													

RECORD OF BOREHOLE No C8-02

1 OF 1

METRIC

GWP# 2117-15-00 LOCATION MTM NAD83 Zone 10: N 4 796 888.4 E 280 050.4 ORIGINATED BY KK
 DIST Central HWY QEW BOREHOLE TYPE Hollow Stem Augers COMPILED BY MP
 DATUM Geodetic DATE 2019.04.03 - 2019.04.03 LATITUDE 43.311470 LONGITUDE -79.805099 CHECKED BY KF

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT NATURAL MOISTURE LIMIT LIQUID CONTENT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa			W P	W	W L			WATER CONTENT (%)
76.6	GROUND SURFACE					▽		20	40	60	80	100	20	40	60	GR SA SI CL
0.0	TOPSOIL FILL: (125mm)							○ UNCONFINED + FIELD VANE								
0.1	Silty CLAY , some sand to sandy, trace gravel Firm Dark Brown to Reddish Brown Moist (FILL)		1	SS	6			● QUICK TRIAXIAL × LAB VANE								
			2	SS	6										1 32 44 23	
75.1																
1.4	Silty SAND , trace gravel; with occasional black organic layers Loose to Compact Brown Moist		3	SS	10											
74.4																
2.2	Very Loose Grey Wet		4	SS	3											
			5	SS	4											
72.8																
3.7	Layered silty SAND and sandy SILT ; with occasional to numerous organic layers Loose Grey Moist		6	SS	4											
			7	SS	2								0 68 26 6			
71.4																
5.2	END OF BOREHOLE AT 5.2m. BOREHOLE OPEN AND WATER LEVEL AT 2.5m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE TO SURFACE.															

+³, ×³: Numbers refer to
Sensitivity

20
15
10

(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No C8-03

1 OF 1

METRIC

GWP# 2117-15-00 LOCATION MTM NAD83 Zone 10: N 4 796 900.0 E 280 064.3 ORIGINATED BY KK
 DIST Central HWY QEW BOREHOLE TYPE Solid Stem Augers COMPILED BY MP
 DATUM Geodetic DATE 2019.04.11 - 2019.04.11 LATITUDE 43.311575 LONGITUDE -79.804929 CHECKED BY KF

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE			WATER CONTENT (%) w _P w w _L								
77.0	GROUND SURFACE					▽													
0.0	ASPHALT: (125mm)																		
0.1	SAND and GRAVEL Compact Brown Moist (FILL)		1	SS	17														
76.3																			
0.7	Clayey SILT, some sand to sandy, trace gravel Stiff Brown Moist (FILL)		2	SS	11														
75.5																			
1.4	Brown Moist (FILL)		3	SS	8														
74.8	SAND, some gravel, trace silt Loose Brown Moist (FILL)		4	SS	9														
2.2	Silty SAND, trace gravel; with occasional layers of silt, black organic layers Loose Grey Wet		5	SS	6														
72.8																			
4.2	Layered silty SAND and sandy SILT; with occasional to numerous organic layers and thin layers of peat Loose Grey Moist		6	SS	3														
71.8																			
5.2	END OF BOREHOLE AT 5.2m. BOREHOLE OPEN AND WATER LEVEL AT 2.2m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE AND CUTTINGS TO 0.2m, THEN CONCRETE AND ASPHALT TO SURFACE.																		

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

RECORD OF BOREHOLE No C8-04

1 OF 1

METRIC

GWP# 2117-15-00 LOCATION MTM NAD83 Zone 10: N 4 796 910.9 E 280 082.3 ORIGINATED BY KK
 DIST Central HWY QEW BOREHOLE TYPE Hollow Stem Augers COMPILED BY MP
 DATUM Geodetic DATE 2019.04.04 - 2019.04.04 LATITUDE 43.311674 LONGITUDE -79.804707 CHECKED BY KF

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
76.7	GROUND SURFACE													
0.0	TOPSOIL FILL: (100mm)													
0.1	SAND, trace to some gravel, some silt Compact Brown Moist (FILL)		1	SS	10									
			2	SS	29									
	gravelly, trace silt		3	SS	27									
74.5														
2.2	Silty SAND, some gravel, occasional cobbles, wood and shell fragments Compact to Loose Brown Moist		4	SS	18									
			5	SS	21									
72.6														
4.1	Layered silty SAND and sandy SILT; with occasional to numerous organic layers Loose Grey Moist		6	SS	6									
71.5														
5.2	END OF BOREHOLE AT 5.2m. Monitoring well installation consists of 25mm diameter Schedule 40 PVC pipe with a 3.0m slotted screen. 													

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

RECORD OF BOREHOLE No TRSR1-01

1 OF 1

METRIC

GWP# 2117-15-00 LOCATION MTM NAD83 Zone 10: N 4 797 423.6 E 279 754.2 ORIGINATED BY KK
DIST Central HWY QEW BOREHOLE TYPE Solid Stem Augers COMPILED BY MP
DATUM Geodetic DATE 2019.04.15 - 2019.04.15 LATITUDE 43.316278 LONGITUDE -79.808775 CHECKED BY KF

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa				WATER CONTENT (%)					
84.1	GROUND SURFACE							20	40	60	80	100					
0.0 83.9	ASPHALT: (250mm)																
0.3	SAND and GRAVEL Dense to Very Dense Brown Moist (FILL)		1	SS	31												
			2	SS	100/ 0.125												
			3	SS	56												
81.9																	
2.2	Silty SAND Compact Brown Moist		4	SS	15												
81.4																	
2.7	Silty CLAY, trace sand Stiff Brown Moist		5	SS	14												
79.4																	
4.7 79.2	Silty CLAY, trace sand; with numerous shale fragments		6	SS	100/ 0.250												
5.0	Hard Reddish Brown Moist (TILL) END OF BOREHOLE AT 5.0m. Monitoring well installation consists of 50mm diameter Schedule 40 PVC pipe with a 3.0m slotted screen.																
WATER LEVEL READINGS																	
DATE		DEPTH(m)		ELEV.(m)													
2019.04.25		1.3		82.8													
2019.05.02		1.2		82.9													

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

RECORD OF BOREHOLE No TRSR1-02

1 OF 1

METRIC

GWP# 2117-15-00 LOCATION MTM NAD83 Zone 10: N 4 797 398.8 E 279 735.0 ORIGINATED BY KK
DIST Central HWY QEW BOREHOLE TYPE Solid Stem Augers COMPILED BY MP
DATUM Geodetic DATE 2019.04.16 - 2019.04.16 LATITUDE 43.316054 LONGITUDE -79.809011 CHECKED BY KF

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					
84.4	GROUND SURFACE												
0.0	ASPHALT: (100mm)												
0.1	SAND and GRAVEL Dense Brown Moist (FILL)		1	SS	34		84						
			2	SS	14								
83.0							83						
1.4	Silty CLAY, some sand, trace gravel Very Stiff Brown Moist (FILL)		3	SS	18								
			4	SS	15		82						
81.7													
2.7	Silty SANDto SILT and SAND, trace gravel Compact Brown Moist		5	SS	15		81						0 55 36 9
81.0													0 5 43 52
3.4	Silty CLAY, trace sand Stiff to Very Stiff Grey Moist						80						
			6	SS	8								
79.2													
5.2	END OF BOREHOLE AT 5.2m. BOREHOLE OPEN AND DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO 0.2m, THEN CONCRETE AND COLD PATCH ASPHALT TO SURFACE.												

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

RECORD OF BOREHOLE No TRSR1-03

1 OF 1

METRIC

GWP# 2117-15-00 LOCATION MTM NAD83 Zone 10: N 4 797 377.3 E 279 726.9 ORIGINATED BY KK
 DIST Central HWY QEW BOREHOLE TYPE Solid Stem Augers COMPILED BY MP
 DATUM Geodetic DATE 2019.04.16 - 2019.04.16 LATITUDE 43.315861 LONGITUDE -79.809110 CHECKED BY KF

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE							WATER CONTENT (%) w _p w w _L	
84.7	GROUND SURFACE							20	40	60	80	100				
0.0	ASPHALT: (225mm)							20	40	60	80	100				
0.2	SAND and GRAVEL Compact Brown Moist (FILL) Silty CLAY, some sand, trace gravel Very Stiff Brown Moist (FILL)		1	SS	26		84									
84.0																
0.7																
			2	SS	17											
82.8			3	SS	30		83									
1.9	Silty SAND Compact to Dense Brown Moist															
82.0			4	SS	13		82									
2.7	Silty CLAY, trace sand, oxidized Stiff to Very Stiff Brown to Grey Moist															
			5	SS	18		81									
			6	SS	16		80									
79.5																
5.2	END OF BOREHOLE AT 5.2m. BOREHOLE OPEN AND DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO 0.2m, THEN CONCRETE AND COLD PATCH ASPHALT TO SURFACE.															

+³, ×³: Numbers refer to
Sensitivity

20
15
10

(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No TRSR1-04

1 OF 1

METRIC

GWP# 2117-15-00 LOCATION MTM NAD83 Zone 10: N 4 797 374.2 E 279 714.2 ORIGINATED BY KK
 DIST Central HWY QEW BOREHOLE TYPE Solid Stem Augers COMPILED BY MP
 DATUM Geodetic DATE 2019.04.11 - 2019.04.11 LATITUDE 43.315831 LONGITUDE -79.809266 CHECKED BY KF

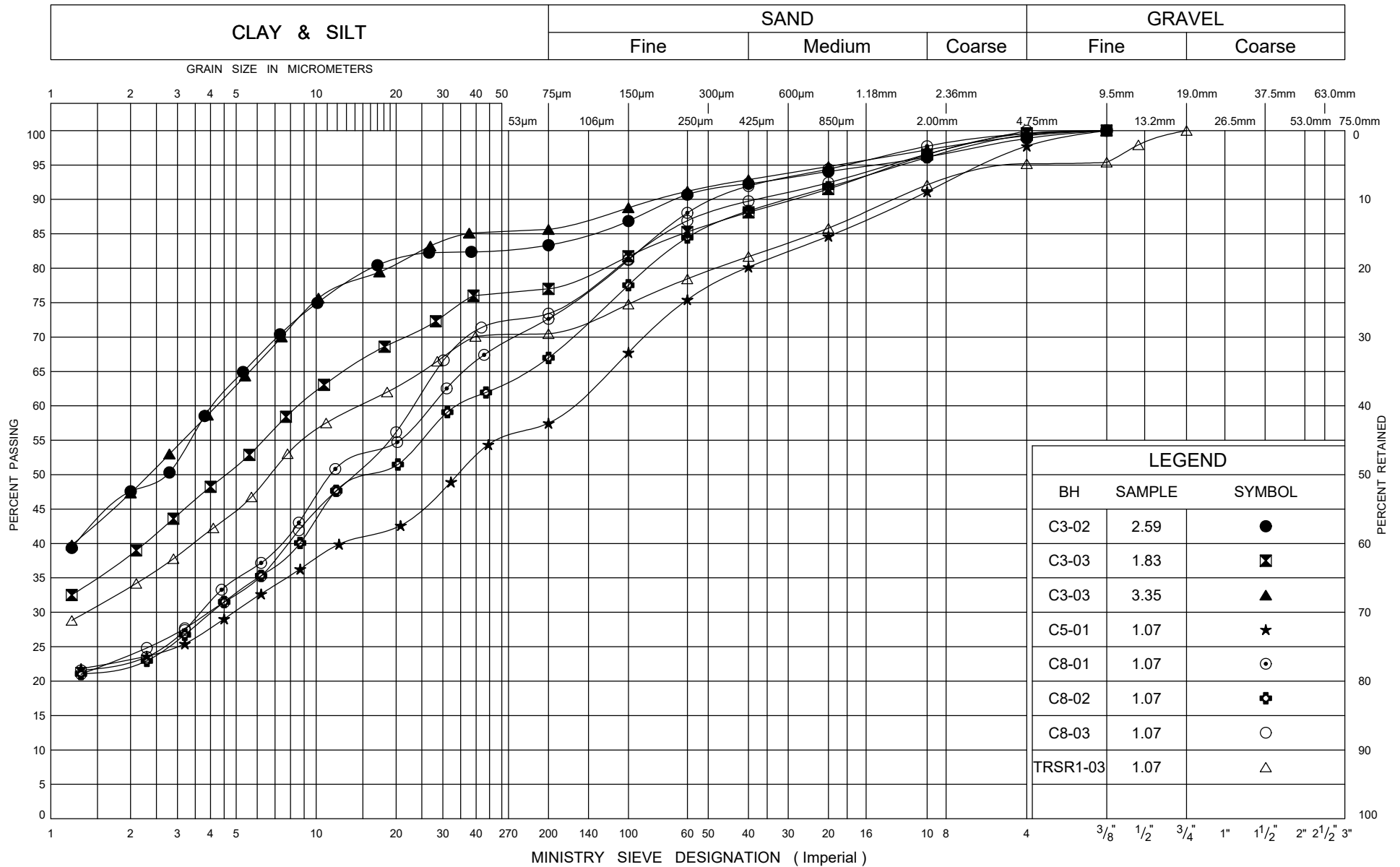
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					
84.3	GROUND SURFACE							20 40 60 80 100					
0.0	ASPHALT: (150mm)							20 40 60 80 100					
0.2	SAND and GRAVEL Compact Brown Moist (FILL)		1	SS	18		84						
83.7													
0.7	Silty CLAY, some sand, trace gravel Stiff to Very Stiff Brown Moist (FILL)		2	SS	12		83						
83.0													
1.3	Silty SAND Loose Reddish Brown Moist		3	SS	28		82						
			4	SS	6		81						1 72 19 8
81.4													
3.0	Silty CLAY, trace sand Stiff to Soft Brown to Grey Moist		5	SS	9		80						0 6 42 52
			6	SS	2		79						
							78.2						
6.1	Silty CLAY, trace sand and gravel, occasional shale fragments Very Stiff Reddish Brown Moist (TILL)		7	SS	29		78						
77.6													
6.7	END OF BOREHOLE AT 6.7m. Monitoring well installation consists of 50mm diameter Schedule 40 PVC pipe with a 3.0m slotted screen.												
WATER LEVEL READINGS													
DATE		DEPTH(m)		ELEV.(m)									
2019.04.25		2.2		82.2									
2019.05.02		3.0		81.3									

ONTMT4S2 MTO-25497.GPJ 2017TEMPLATE(MTO).GDT 5/22/19

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



Appendix C
Laboratory Test Results



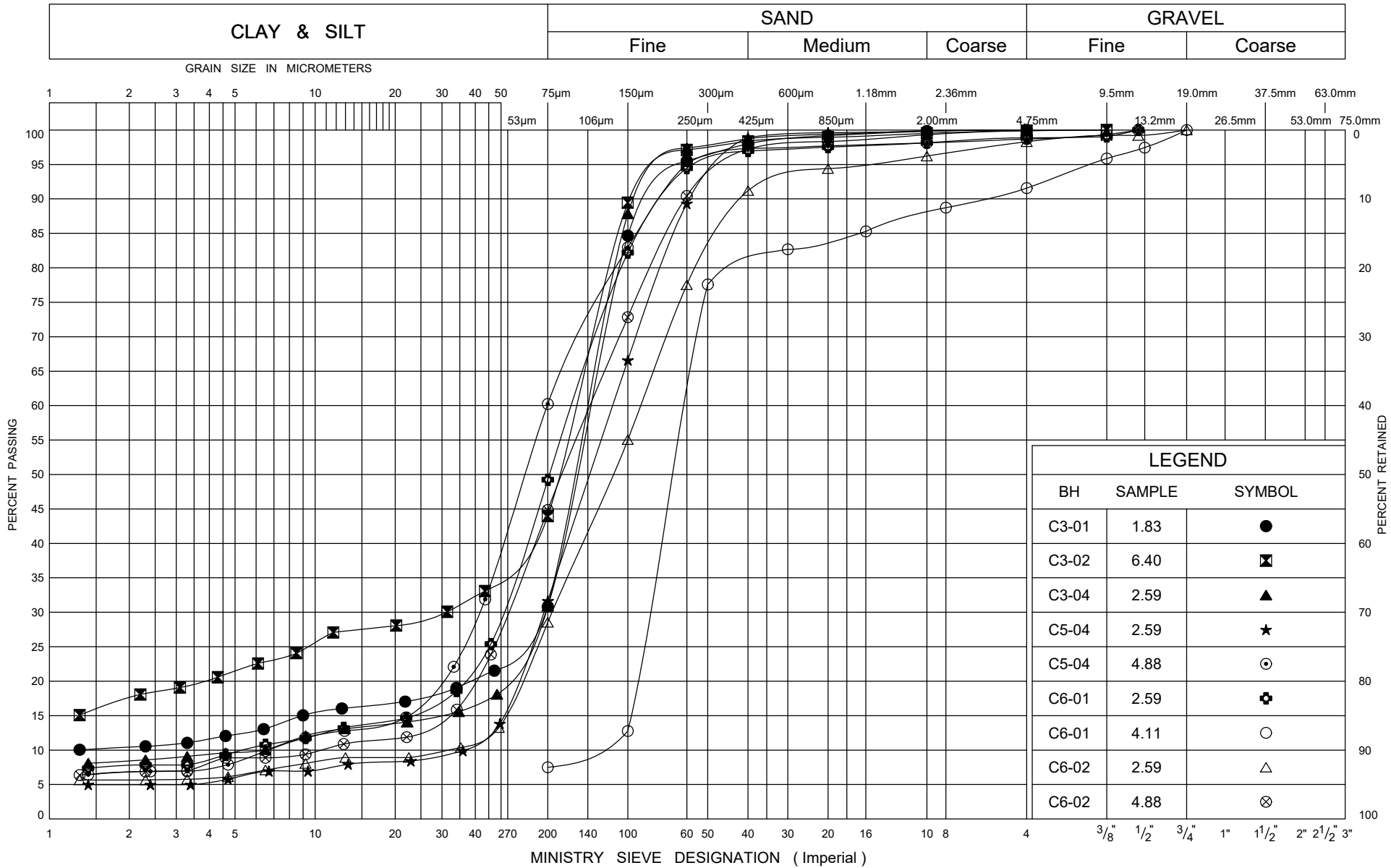
Ministry of
Transportation

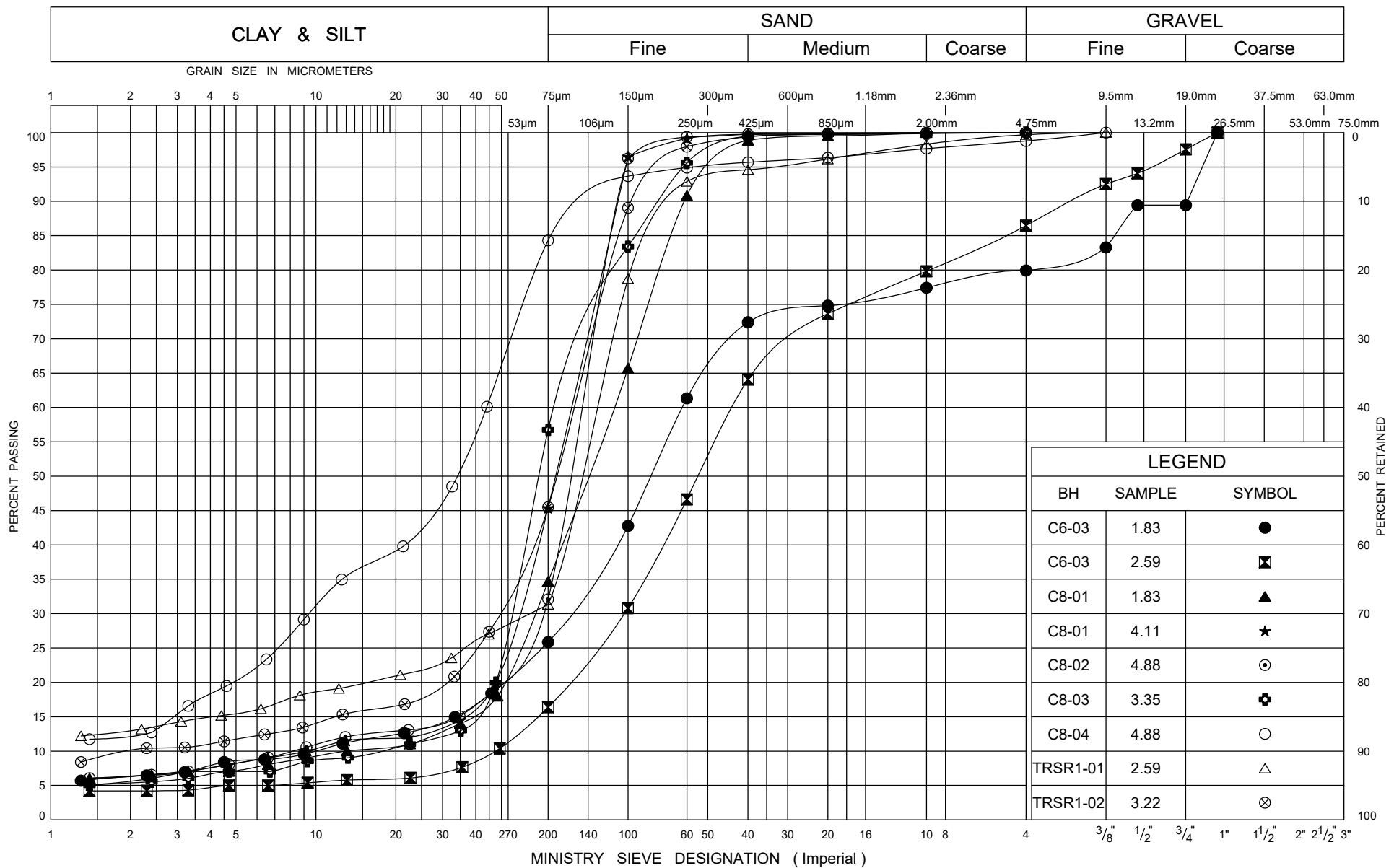
GRAIN SIZE DISTRIBUTION

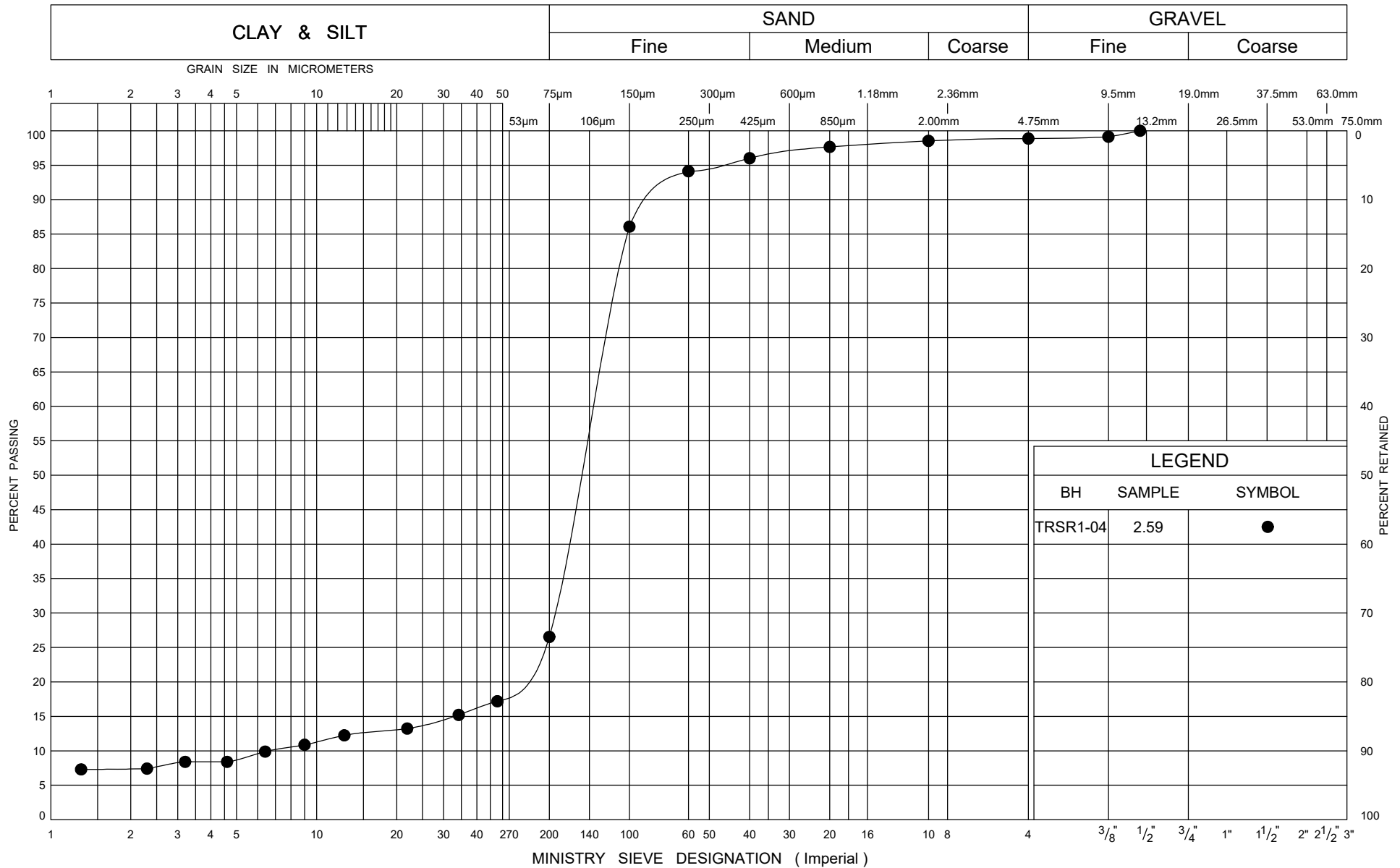
Silty CLAY and Clayey SILT FILL

FIG No C1

W P 2117-15-00







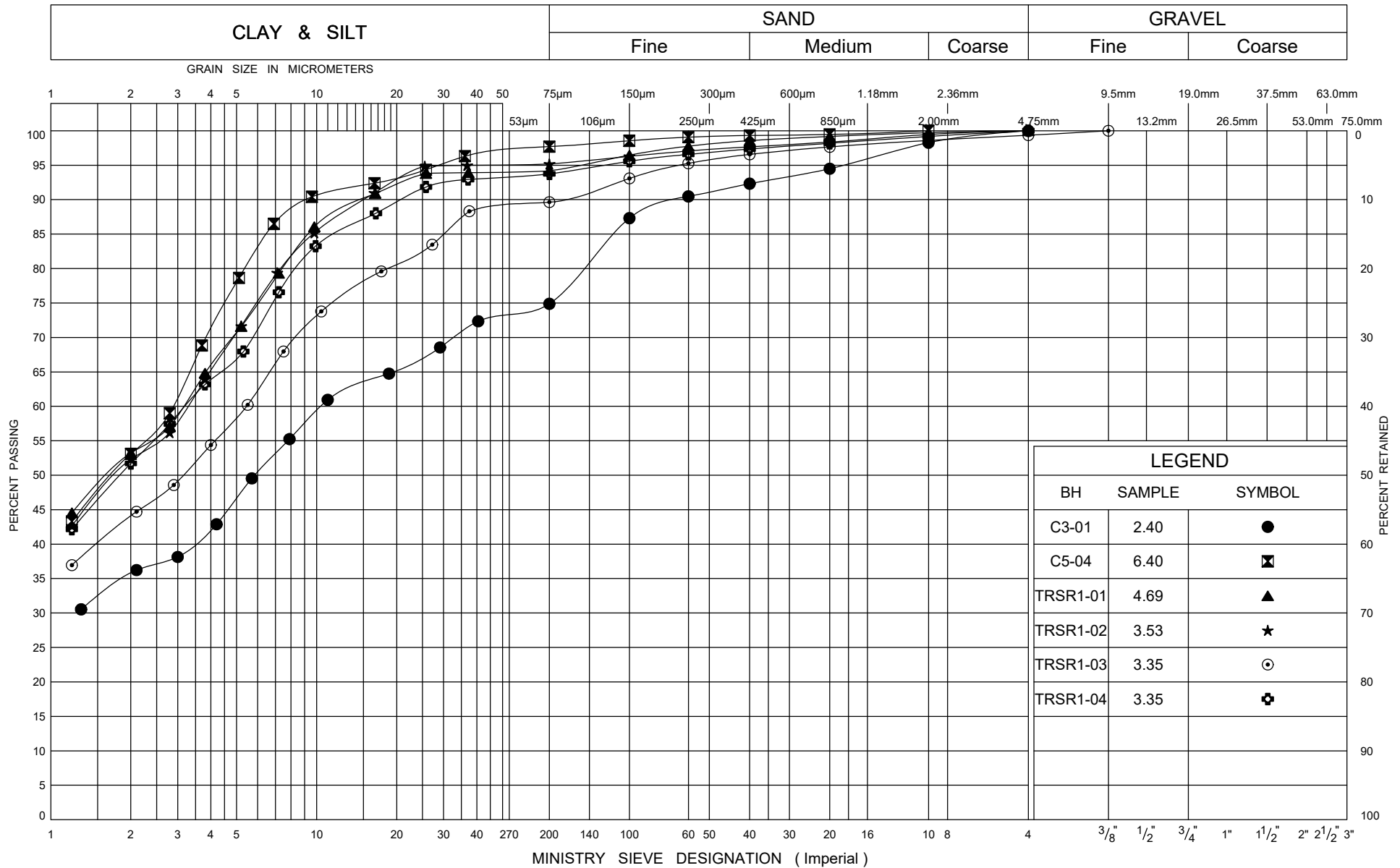
Ministry of
Transportation

GRAIN SIZE DISTRIBUTION

Silty SAND

FIG No C4

W P 2117-15-00



Ministry of
Transportation

GRAIN SIZE DISTRIBUTION

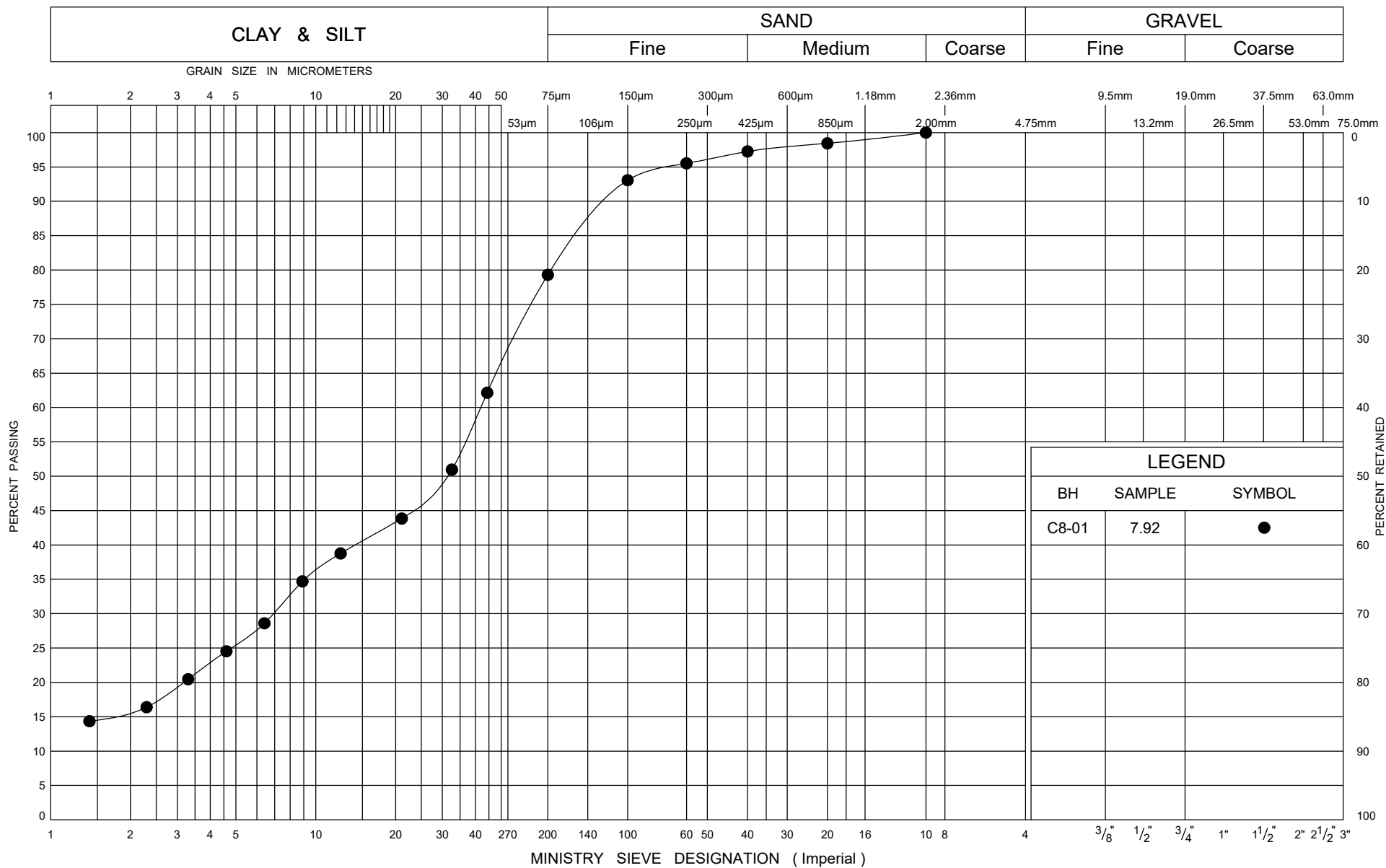
Silty CLAY

FIG No C5

W P 2117-15-00



FIG No C6
W P 2117-15-00

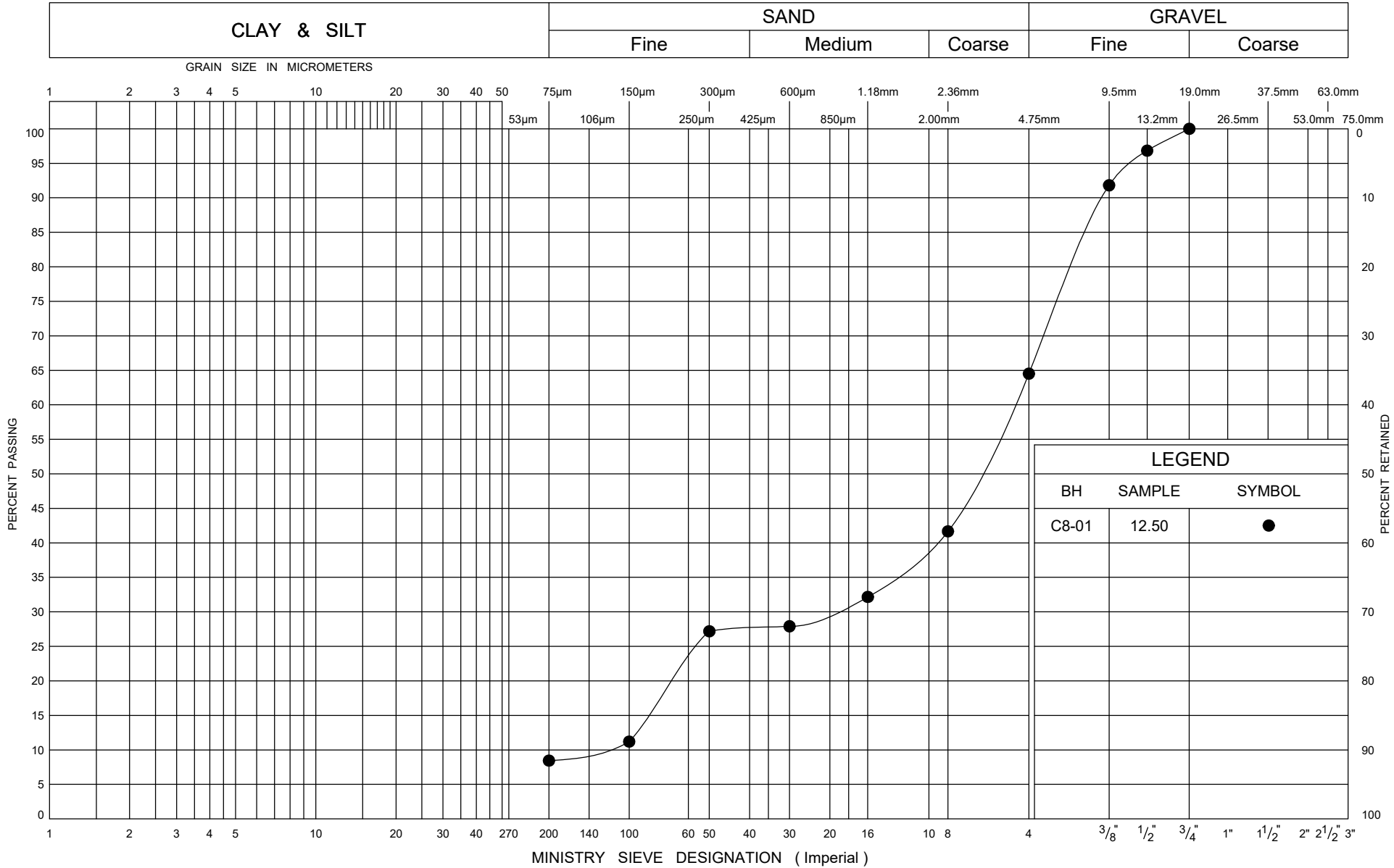


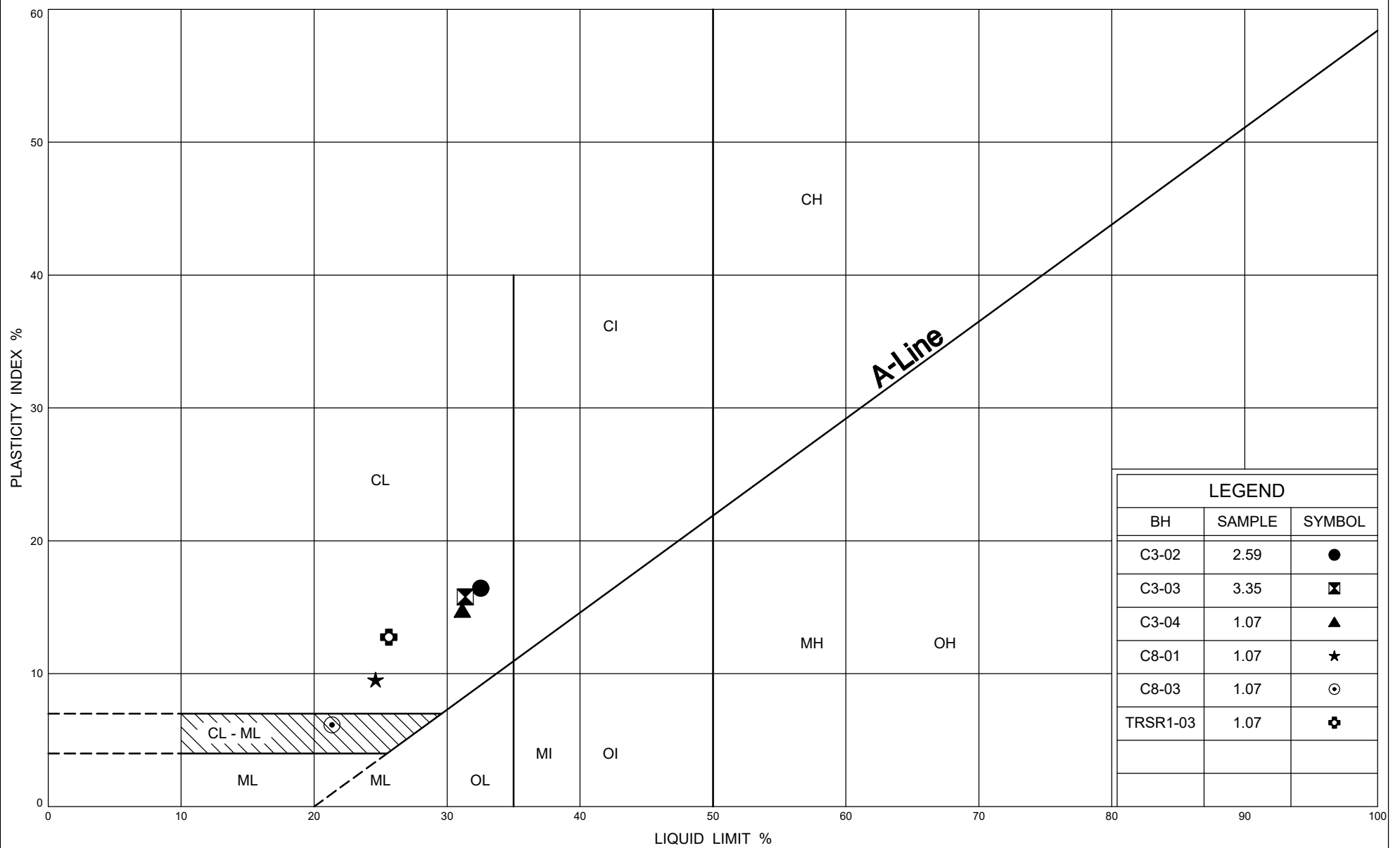
Ministry of
Transportation

GRAIN SIZE DISTRIBUTION ORGANIC SILT

FIG No C7

W P 2117-15-00





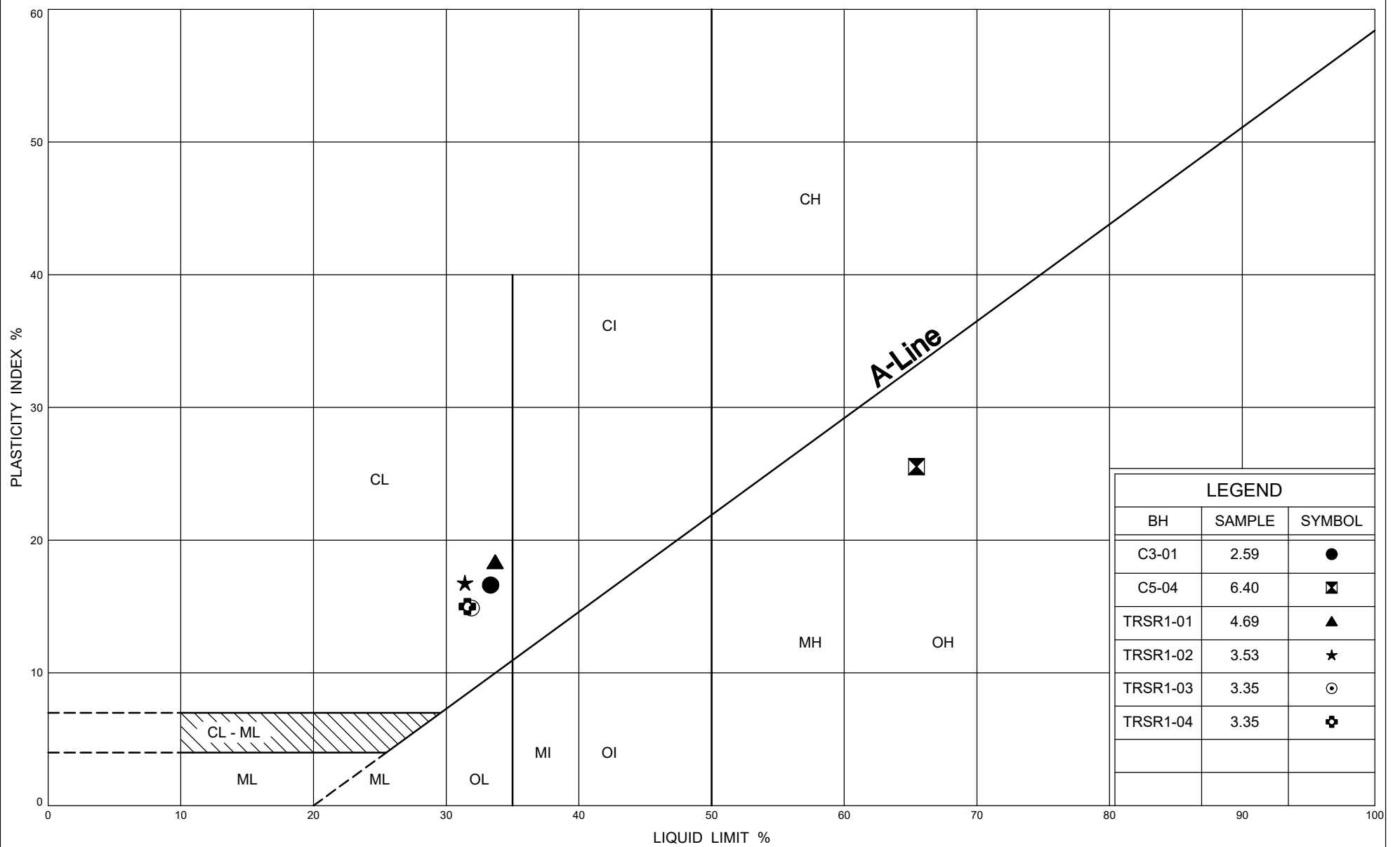
Ministry of
Transportation

PLASTICITY CHART

Silty CLAY and Clayey SILT FILL

FIG No C9

W P 2117-15-00



PLASTICITY CHART

Silty CLAY

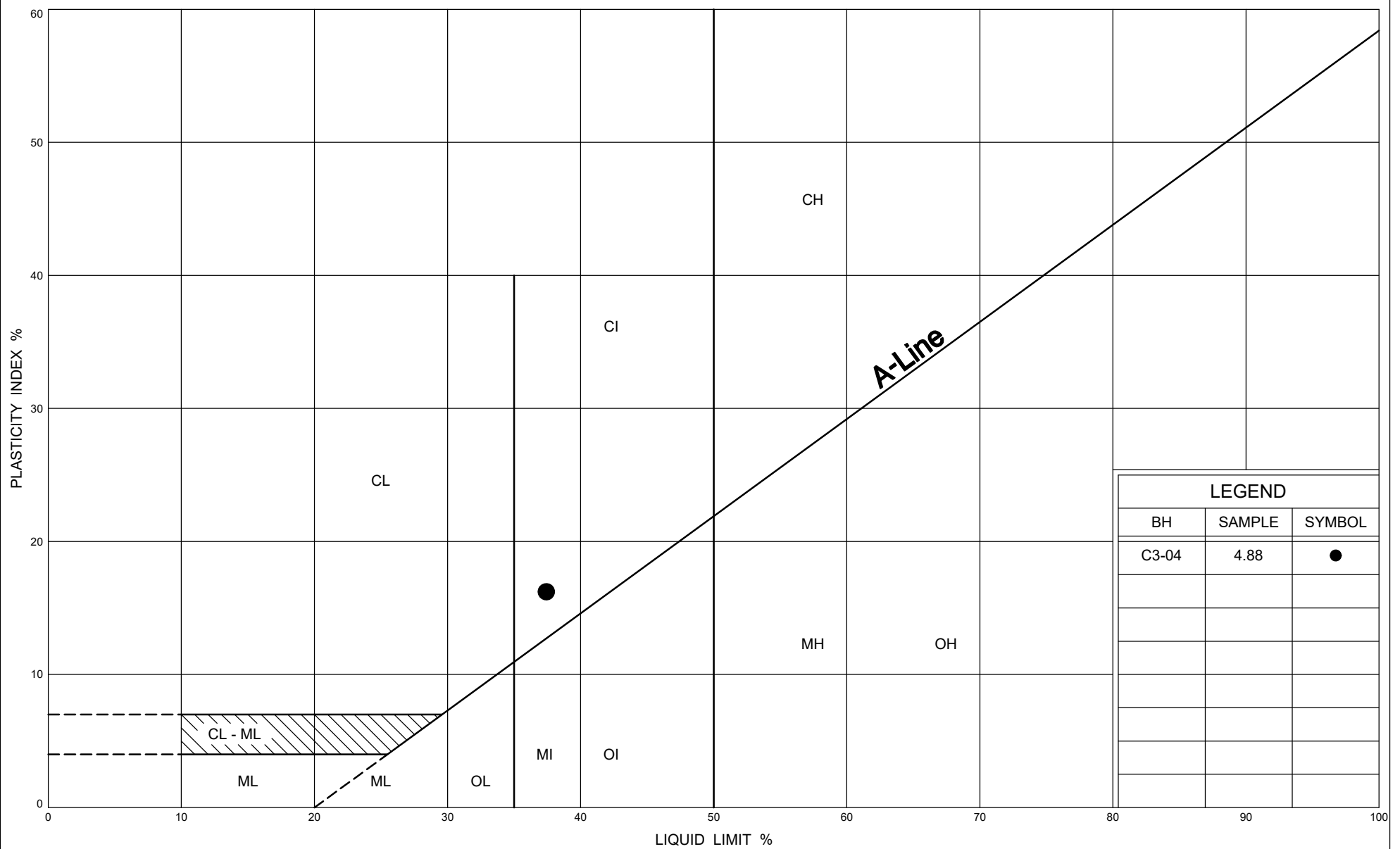
FIG No C10

W P 2117-15-00



Ministry of
Transportation

Ontario



LEGEND		
BH	SAMPLE	SYMBOL
C3-04	4.88	●



Ministry of
Transportation

PLASTICITY CHART CLAY TILL

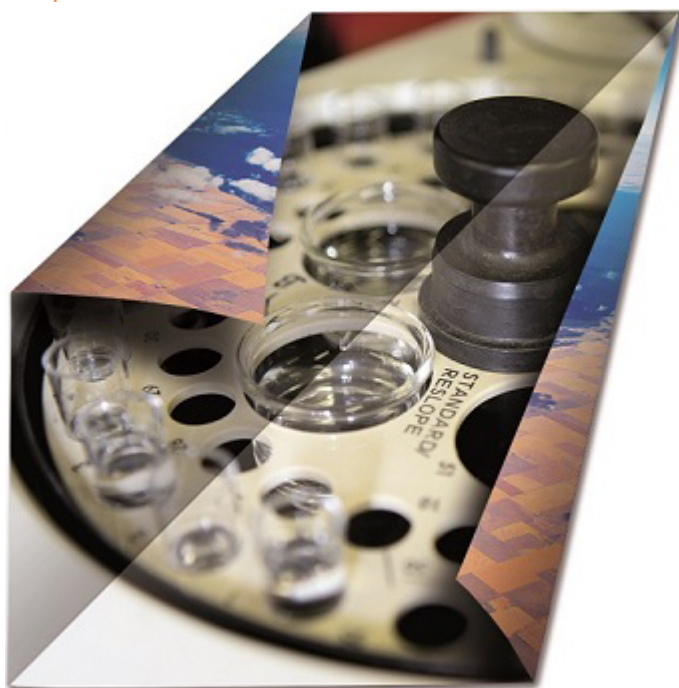
FIG No C11

W P 2117-15-00



Appendix D

Corrosivity Testing – Certificate of Analysis



FINAL REPORT

CA14706-APR19 R2

25497 QEW North Shore

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 Karel Furbacher

Telephone 289-455-7296

Facsimile

Email kfurtbacher@thurber.ca

Project 25497 QEW North Shore

Order Number

Samples Soil (2)

LABORATORY DETAILS

Project Specialist Brad Moore Hon. B.Sc

Laboratory SGS Canada Inc.

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

Telephone 705-652-2000

Facsimile 705-652-6365

Email

SGS Reference CA14706-APR19

Received 04/18/2019

Approved 05/06/2019

Report Number CA14706-APR19 R2

Date Reported 05/06/2019

COMMENTS

Temperature of Sample upon Receipt: 3 degrees C

Cooling Agent Present: yes

Custody Seal Present: no

Chain of Custody Number: N/A

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

Brad Moore Hon. B.Sc

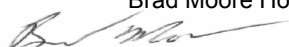




TABLE OF CONTENTS

First Page..... 1

Index..... 2

Results..... 3-4

QC Summary..... 5-7

Legend..... 8

Annexes..... 9



FINAL REPORT

CA14706-APR19 R2

Client: Thurber Engineering Ltd.

Project: 25497 QEW North Shore

Project Manager: Karel Furbacher

Samplers: Kevin Kweon

PACKAGE: - Corrosivity Index (SOIL)

Sample Number	5	6
Sample Name	BH C3-03-SS5	BH C6-03 SS3
Sample Matrix	Soil	Soil
Sample Date	17/04/2019	15/04/2019

Parameter	Units	RL		Result	Result
Corrosivity Index					
Corrosivity Index	none	1		4	11
Soil Redox Potential	mV	-		126	220
Sulphide	%	0.02		< 0.02	< 0.02
pH	pH Units	0.05		8.79	8.03
Resistivity (calculated)	ohms.cm	-9999		5890	495

PACKAGE: - General Chemistry (SOIL)

Sample Number	5	6
Sample Name	BH C3-03-SS5	BH C6-03 SS3
Sample Matrix	Soil	Soil
Sample Date	17/04/2019	15/04/2019

Parameter	Units	RL		Result	Result
General Chemistry					
Conductivity	uS/cm	2		170	2020

PACKAGE: - Metals and Inorganics (SOIL)

Sample Number	5	6
Sample Name	BH C3-03-SS5	BH C6-03 SS3
Sample Matrix	Soil	Soil
Sample Date	17/04/2019	15/04/2019

Parameter	Units	RL		Result	Result
Metals and Inorganics					
Moisture Content	%	0.1		16.2	20.5
Sulphate	µg/g	0.4		20	67



FINAL REPORT

CA14706-APR19 R2

Client: Thurber Engineering Ltd.

Project: 25497 QEW North Shore

Project Manager: Karel Furbacher

Samplers: Kevin Kweon

PACKAGE: - Other (ORP) (SOIL)

Sample Number	5	6
Sample Name	BH C3-03-SS5	BH C6-03 SS3
Sample Matrix	Soil	Soil
Sample Date	17/04/2019	15/04/2019

Parameter	Units	RL		Result	Result
Other (ORP)					
Chloride	µg/g	0.4		120	730



FINAL REPORT

CA14706-APR19 R2

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	DIO0349-APR19	µg/g	0.4	<0.4	1	20	94	80	120	NV	75	125
Sulphate	DIO0349-APR19	µg/g	0.4	<0.4	1	20	96	80	120	93	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	ECS0034-APR19	%	0.02	<0.02	ND	20	106	80	120			



FINAL REPORT

CA14706-APR19 R2

QC SUMMARY

Conductivity

Method: SM 2510 | Internal ref.: ME-CA-1ENVIEWL-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	EWL0394-APR19	uS/cm	2	< 0.002	0	10	99	90	110	NA		
Conductivity	EWL0414-APR19	uS/cm	2	< 0.002	0	10	99	90	110	NA		

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	EWL0394-APR19	pH Units	0.05	NA	0		101			NA		
pH	EWL0414-APR19	pH Units	0.05	NA	0		101			NA		

QC SUMMARY

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. 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 --

Request for Laboratory Services and CHAIN OF CUSTODY

- Lakefield: 185 Concession St., Lakefield, ON K0L 2H0 Phone: 705-652-2000 Fax: 705-652-6365 Web: www.sgs.com/environment
 - London: 657 Consortium Court, London, ON, N6E 2S8 Phone: 519-672-4500 Toll Free: 877-848-8060 Fax: 519-672-0361

No:

Page 1 of 1

Received By: Oleg Mozhiw
 Received Date (mm/dd/yy): 04/18/2019
 Received Time: 14:00

Received By (signature): [Signature]
 Custody Seal Present: ☒
 Custody Seal Intact: ☒

Cooling Agent Present: ☒
 Temperature Upon Receipt (°C): 40.0

Laboratory Information Section - Lab use only

ice applied by daniel

LAB LIMS #: CN47066

REPORT INFORMATION
 Company: Thurber Engineering Ltd.
 Contact: Karel Furbacher
 Address: 103-2010 Winston Park Drive
Oakville, Ontario
 Phone: 289-455-7296
 Email: kfurbacher@thurber.ca
 Email: manderson@thurber.ca

INVOICE INFORMATION
☒ (same as Report Information)
 Company: _____
 Contact: _____
 Address: _____
 Phone: _____
 Email: _____

PROJECT INFORMATION

Quotation #: _____ P.O. #: _____
 Project #: 25497 Site Location/ID: QEW/North Shore

TURNAROUND TIME (TAT) REQUIRED

☒ Regular TAT (5-7days) TAT's are quoted in business days (exclude statutory holidays & weekends).
 Samples received after 6pm or on weekends: TAT begins next business day

RUSH TAT (Additional Charges May Apply): ☐ 1 Day ☐ 2 Days ☐ 3 Days ☐ 4 Days
 PLEASE CONFIRM RUSH FEASIBILITY WITH SGS REPRESENTATIVE PRIOR TO SUBMISSION

Specify Due Date: _____ Rush Confirmation ID: _____

REGULATIONS

Regulation 153/04:

Table 1 ☐ R/P/I
 Table 2 ☐ I/C/C
 Table 3 ☐ A/O
 Table ☐ _____

Soil Texture: ☐ Coarse ☐ Medium ☐ Fine
 Other Regulations: ☐ Reg 347/558 (3 Day min TAT)
☐ PWQO ☐ MMER ☐ Other: _____
☐ CCME ☐ MISA

Sewer By-Law: ☐ Sanitary ☐ Storm
 Municipality: _____

RECORD OF SITE CONDITION (RSC) YES ☐ NO ☐

SAMPLE IDENTIFICATION

1 BH C3-03 SS5
 2 BH C6-03 SS3
 3
 4
 5
 6
 7
 8
 9
 10
 11
 12

DATE SAMPLED: 4/17/19
 TIME SAMPLED: 1:00 am.
 # OF BOTTLES: 1
 MATRIX: SOIL

NOTE: DRINKING (POTABLE) WATER SAMPLES FOR HUMAN CONSUMPTION MUST BE SUBMITTED WITH SGS DRINKING WATER CHAIN OF CUSTODY

ANALYSIS REQUESTED

Field Filtered (Y/N) ☐
 Metals & Inorganics ☐
 PAH ☐ ABN ☐ SVOC(alt) ☐
 PCB Total ☐ Aroclor ☐
 PHC F1-F4 ☐ VOC ☐
 BTX ☐ BTX/F1 ☐ F2-F4 ☐
 VOC ☐ BTX ☐ THM ☐
 Pesticides OC ☐ OP ☐
 TCLP M&I ☐ VOC ☐ PCB ☐
 B(a)P ☐ ABN ☐ Ignit. ☐
 Water Pkg Gen. ☐ Ext. ☐
 Use: ☐ Sewer ☐
 Corrosivity/Resistivity ☐

COMMENTS:

Observations/Comments/Special Instructions

Sampled By (NAME): Kevin Kweon Signature: [Signature] Date: 04/18/19 (mm/dd/yy) Pink Copy - Client
 Relinquished by (NAME): Karel Furbacher Signature: [Signature] Date: 04/18/19 (mm/dd/yy) Yellow & White Copy - SGS

Revision # 1.1

Date of Issue: 04 April, 2018



FINAL REPORT

CA14543-APR19 R1

25497 QEW/North Shore

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 Karel Furbacher

Telephone 289-455-7296

Facsimile

Email kfurtbacher@thurber.ca

Project 25497 QEW/North Shore

Order Number

Samples Soil (2)

LABORATORY DETAILS

Project Specialist Brad Moore Hon. B.Sc

Laboratory SGS Canada Inc.

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

Telephone 705-652-2000

Facsimile 705-652-6365

Email

SGS Reference CA14543-APR19

Received 04/15/2019

Approved 04/22/2019

Report Number CA14543-APR19 R1

Date Reported 04/22/2019

COMMENTS

Temperature of Sample upon Receipt: 7 degrees C

Cooling Agent Present: Yes

Custody Seal Present: No

Chain of Custody Number: NA

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

Brad Moore Hon. B.Sc

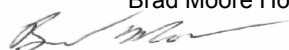




TABLE OF CONTENTS

First Page..... 1

Index..... 2

Results..... 3-4

QC Summary..... 5-6

Legend..... 7

Annexes..... 8



FINAL REPORT

CA14543-APR19 R1

Client: Thurber Engineering Ltd.

Project: 25497 QEW/North Shore

Project Manager: Karel Furbacher

Samplers: Kevin Kweon

PACKAGE: REG153 - Corrosivity Index (SOIL)

Sample Number	5	6
Sample Name	BH C8-03 SS3	BH TRSR1-04 SS5
Sample Matrix	Soil	Soil
Sample Date	11/04/2019	11/04/2019

Parameter	Units	RL		Result	Result
Corrosivity Index					
Corrosivity Index	none	1		11	9.5
Soil Redox Potential	mV	-		312	227
Sulphide	%	0.02		< 0.02	0.03
pH	pH Units	0.05		7.45	8.85
Resistivity (calculated)	ohms.cm	-9999		309	2460

PACKAGE: REG153 - General Chemistry (SOIL)

Sample Number	5	6
Sample Name	BH C8-03 SS3	BH TRSR1-04 SS5
Sample Matrix	Soil	Soil
Sample Date	11/04/2019	11/04/2019

Parameter	Units	RL		Result	Result
General Chemistry					
Conductivity	uS/cm	2		3240	407

PACKAGE: REG153 - Metals and Inorganics (SOIL)

Sample Number	5	6
Sample Name	BH C8-03 SS3	BH TRSR1-04 SS5
Sample Matrix	Soil	Soil
Sample Date	11/04/2019	11/04/2019

Parameter	Units	RL		Result	Result
Metals and Inorganics					
Moisture Content	%	0.1		18.6	18.1



FINAL REPORT

CA14543-APR19 R1

Client: Thurber Engineering Ltd.
Project: 25497 QEW/North Shore
Project Manager: Karel Furbacher
Samplers: Kevin Kweon

PACKAGE: REG153 - Metals and Inorganics (SOIL)

Sample Number	5	6
Sample Name	BH C8-03 SS3	BH TRSR1-04 SS5
Sample Matrix	Soil	Soil
Sample Date	11/04/2019	11/04/2019

Parameter	Units	RL		Result	Result
Metals and Inorganics (continued)					
Sulphate	µg/g	0.4		60	62

PACKAGE: REG153 - Other (ORP) (SOIL)

Sample Number	5	6
Sample Name	BH C8-03 SS3	BH TRSR1-04 SS5
Sample Matrix	Soil	Soil
Sample Date	11/04/2019	11/04/2019

Parameter	Units	RL		Result	Result
Other (ORP)					
Chloride	µg/g	0.4		3100	360



FINAL REPORT

CA14543-APR19 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	DIO0281-APR19	µg/g	0.4	<0.4	5	20	93	80	120	102	75	125
Sulphate	DIO0281-APR19	µg/g	0.4	<0.4	2	20	95	80	120	101	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	ECS0028-APR19	%	0.02	<0.02	11	20	118	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	EWL0283-APR19	uS/cm	2	< 2	0	10	101	90	110	NA		



QC SUMMARY

pH
Method: SM 4500 | Internal ref.: ME-CA-IENVIEWL-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	EWL0283-APR19	pH Units	0.05	NA	0		100			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. 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 --

Laboratory Information Section - Lab use only

Received By: Olaf Mozhib
Received Date (mm/dd/yy): 04/15/2019
Received Time: 11:45Received By (signature): [Signature]Cooling Agent Present: ☒ No ☐ YesCustody Seal Present: ☒ No ☐ YesCustody Seal Intact: ☒ No ☐ YesTemperature Upon Receipt (°C): 8.8°LAB LIMS #: CA14543-APR19

REPORT INFORMATION

Company: Thurber Engineering Ltd.Contact: Karel FurbacherAddress: 103-2010 Winsion Park Drive
Oakville, OntarioPhone: 289-455-7296Email: kfurbacher@thurber.caEmail: manderson@thurber.ca

INVOICE INFORMATION

☒ (same as Report Information)

Company: _____

Contact: _____

Address: _____

Phone: _____

Email: _____

PROJECT INFORMATION

Quotation #: _____

Project #: 25497

P.O. #: _____

Site Location/ID: QEW/North Shore

TURNAROUND TIME (TAT) REQUIRED

TAT's are quoted in business days (exclude statutory holidays & weekends).
Samples received after 6pm or on weekends: TAT begins next business dayRegular TAT (5-7 days) ☒ Regular TAT (Additional Charges May Apply): ☐ 1 Day ☐ 2 Days ☐ 3 Days ☐ 4 DaysRUSH TAT (Additional Charges May Apply): ☐ 1 Day ☐ 2 Days ☐ 3 Days ☐ 4 Days

Specify Due Date: _____

Rush Confirmation ID: _____

NOTE: DRINKING (POTABLE) WATER SAMPLES FOR HUMAN CONSUMPTION MUST BE
SUBMITTED WITH SGS DRINKING WATER CHAIN OF CUSTODY

REGULATIONS

Regulation 153/04:

Soil Texture: ☒ R/P/I ☒ J/C/C ☐ A/O
Table 1 ☒ Coarse
Table 2 ☒ Medium
Table 3 ☒ Fine
Table ☐

Other Regulations:

Reg 347/558 (3 Day min TAT)
☐ PWQO ☐ MMER ☐ Other:
☐ CCME ☐ MISA

Sewer By-Law:

☐ Sanitary
☐ Storm
Municipality: _____RECORD OF SITE CONDITION (RSC) ☐ YES ☐ NO

SAMPLE IDENTIFICATION

DATE SAMPLED: 4/11/19 TIME SAMPLED: 12:00 am. # OF BOTTLES: 1 MATRIX: SOILDATE SAMPLED: 4/11/19 TIME SAMPLED: 11:00 p.m. # OF BOTTLES: 1 MATRIX: SOIL

DATE SAMPLED: _____ TIME SAMPLED: _____ # OF BOTTLES: _____ MATRIX: _____

DATE SAMPLED: _____ TIME SAMPLED: _____ # OF BOTTLES: _____ MATRIX: _____

DATE SAMPLED: _____ TIME SAMPLED: _____ # OF BOTTLES: _____ MATRIX: _____

DATE SAMPLED: _____ TIME SAMPLED: _____ # OF BOTTLES: _____ MATRIX: _____

DATE SAMPLED: _____ TIME SAMPLED: _____ # OF BOTTLES: _____ MATRIX: _____

DATE SAMPLED: _____ TIME SAMPLED: _____ # OF BOTTLES: _____ MATRIX: _____

DATE SAMPLED: _____ TIME SAMPLED: _____ # OF BOTTLES: _____ MATRIX: _____

DATE SAMPLED: _____ TIME SAMPLED: _____ # OF BOTTLES: _____ MATRIX: _____

DATE SAMPLED: _____ TIME SAMPLED: _____ # OF BOTTLES: _____ MATRIX: _____

DATE SAMPLED: _____ TIME SAMPLED: _____ # OF BOTTLES: _____ MATRIX: _____

DATE SAMPLED: _____ TIME SAMPLED: _____ # OF BOTTLES: _____ MATRIX: _____

DATE SAMPLED: _____ TIME SAMPLED: _____ # OF BOTTLES: _____ MATRIX: _____

DATE SAMPLED: _____ TIME SAMPLED: _____ # OF BOTTLES: _____ MATRIX: _____

DATE SAMPLED: _____ TIME SAMPLED: _____ # OF BOTTLES: _____ MATRIX: _____

DATE SAMPLED: _____ TIME SAMPLED: _____ # OF BOTTLES: _____ MATRIX: _____

DATE SAMPLED: _____ TIME SAMPLED: _____ # OF BOTTLES: _____ MATRIX: _____

DATE SAMPLED: _____ TIME SAMPLED: _____ # OF BOTTLES: _____ MATRIX: _____

DATE SAMPLED: _____ TIME SAMPLED: _____ # OF BOTTLES: _____ MATRIX: _____

DATE SAMPLED: _____ TIME SAMPLED: _____ # OF BOTTLES: _____ MATRIX: _____

DATE SAMPLED: _____ TIME SAMPLED: _____ # OF BOTTLES: _____ MATRIX: _____

DATE SAMPLED: _____ TIME SAMPLED: _____ # OF BOTTLES: _____ MATRIX: _____

DATE SAMPLED: _____ TIME SAMPLED: _____ # OF BOTTLES: _____ MATRIX: _____

DATE SAMPLED: _____ TIME SAMPLED: _____ # OF BOTTLES: _____ MATRIX: _____

DATE SAMPLED: _____ TIME SAMPLED: _____ # OF BOTTLES: _____ MATRIX: _____

COMMENTS:

Observations/Comments/Special Instructions

Sampled By (NAME): Kevin KweonRelinquished by (NAME): Karel FurbacherSignature: [Signature]Signature: [Signature]Date: 04/12/19Date: 04/12/19

(mm/dd/yy)

(mm/dd/yy)

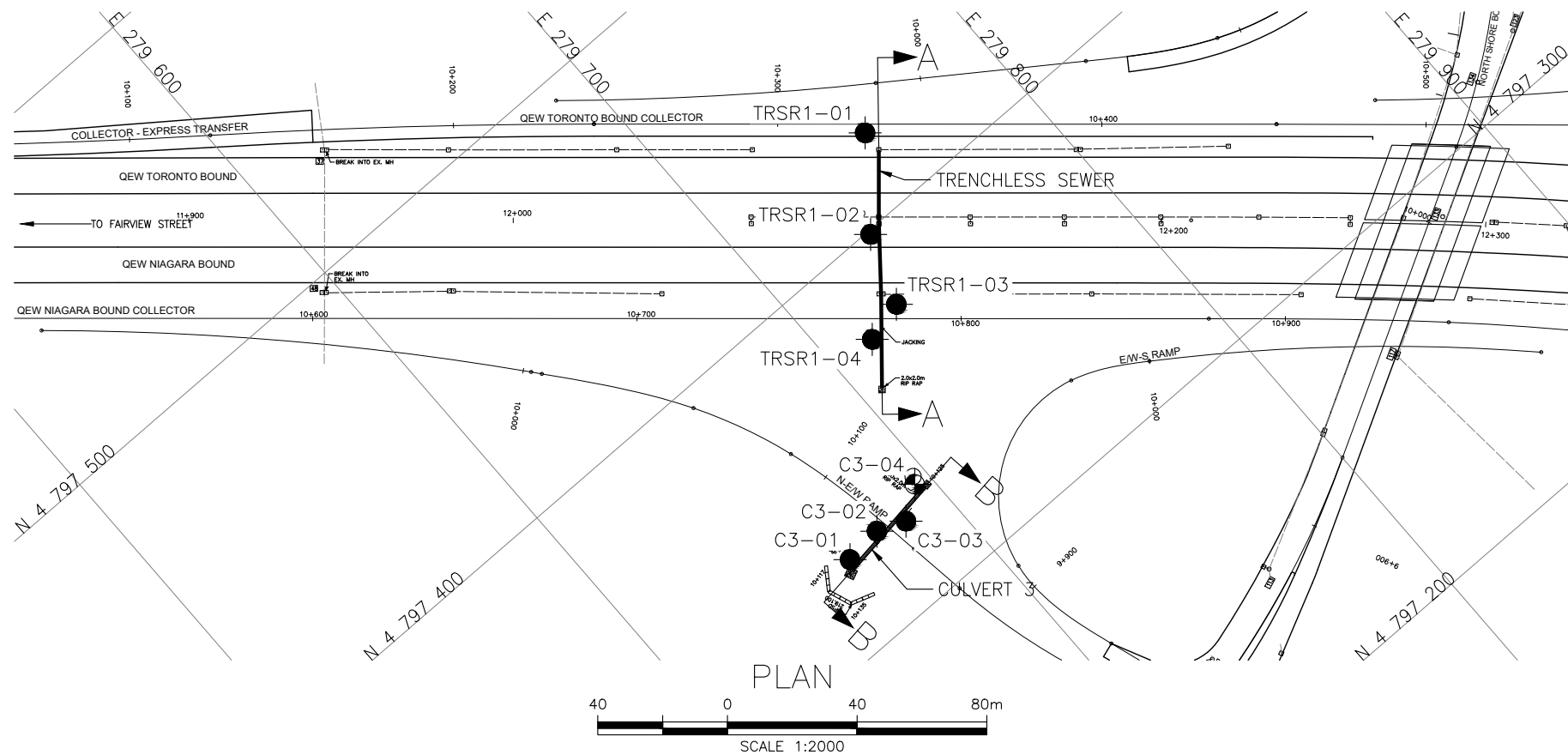
Pink Copy - Client

Yellow & White Copy - SGS



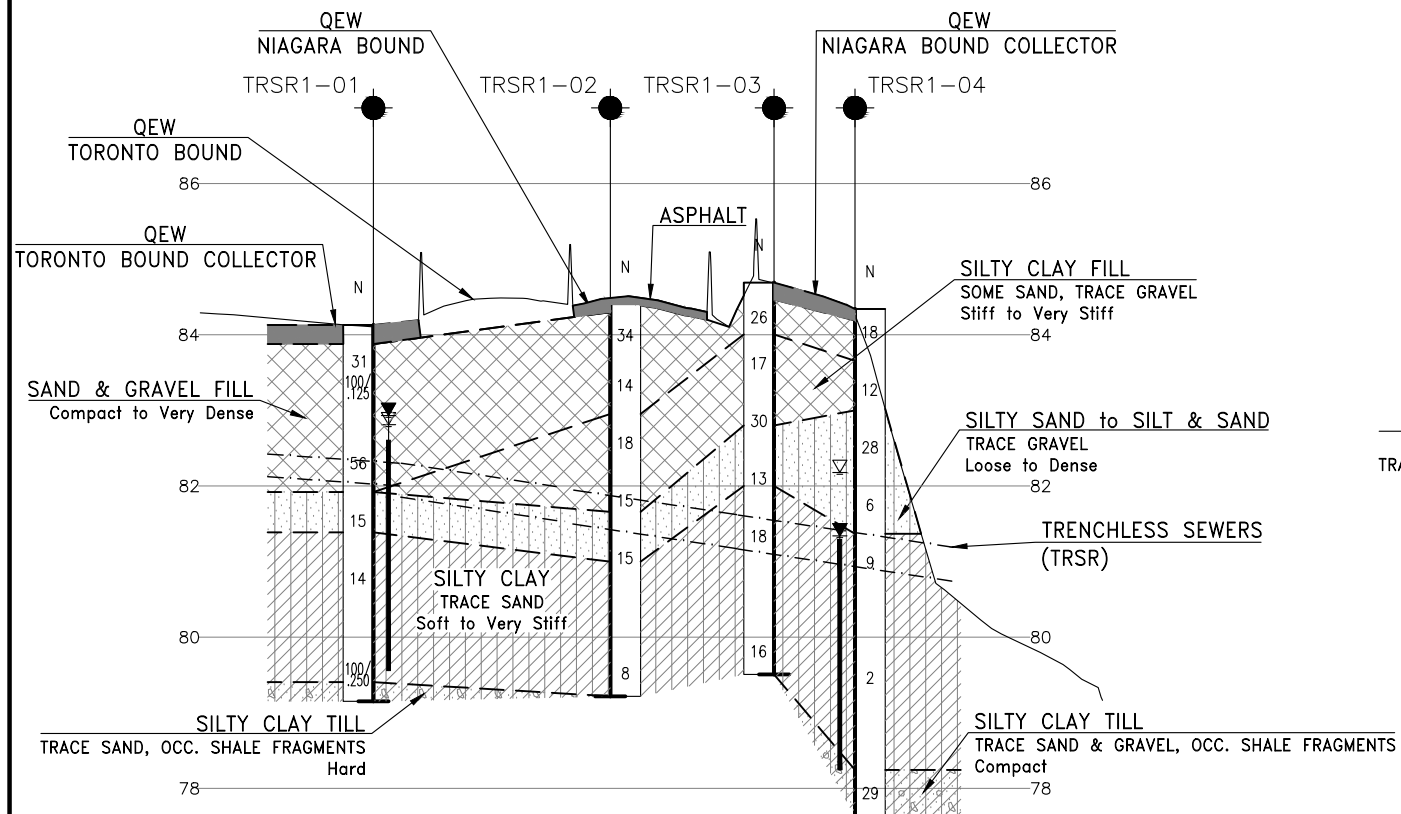
Appendix E

Borehole Location and Soil Strata Drawings

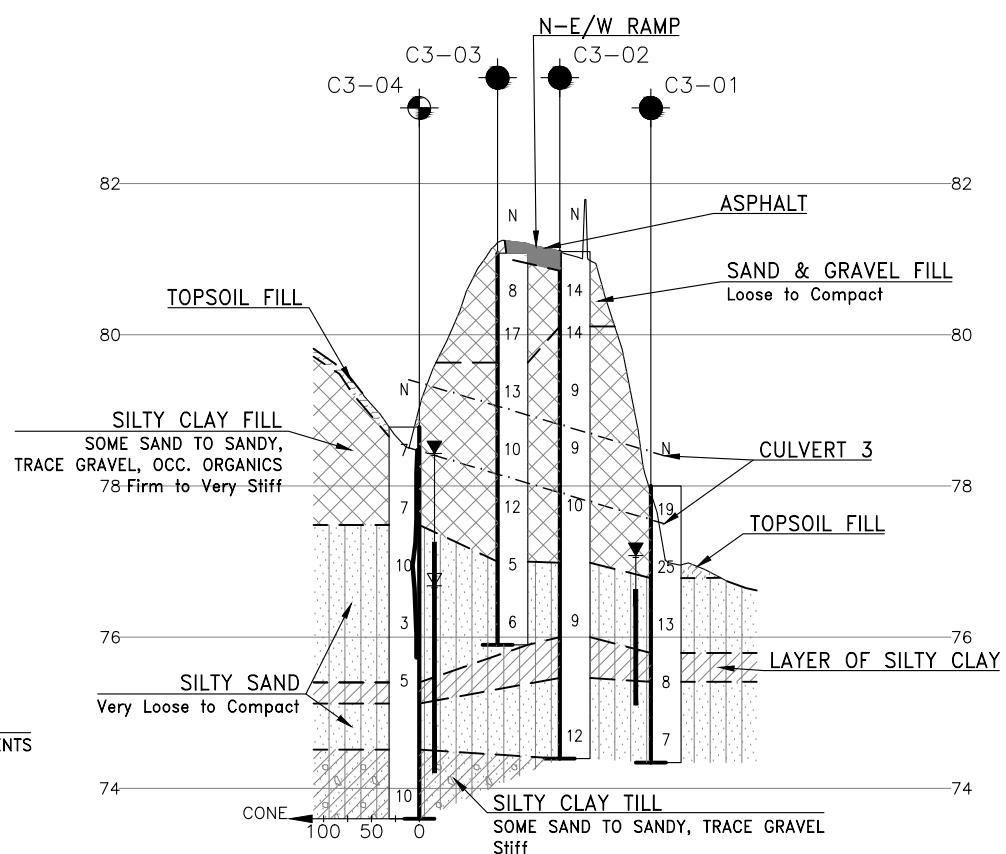


PLAN

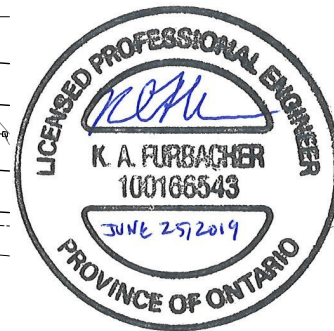
SCALE 1:2000



SECTION A-A

20 0 20 40m H 1:1000
2 0 2 4m V 1:100

SECTION B-B

20 0 20 40m H 1:1000
2 0 2 4m V 1:100METRIC
DIMENSIONS ARE IN METRES
AND/OR MILLIMETRES
UNLESS OTHERWISE SHOWNCONT No
WP No 2117-15-00Q.E.W.
CULVERT AND STORM
SEWER INSTALLATIONS
BOREHOLE LOCATIONS AND SOIL STRATA

KEYPLAN

LEGEND

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

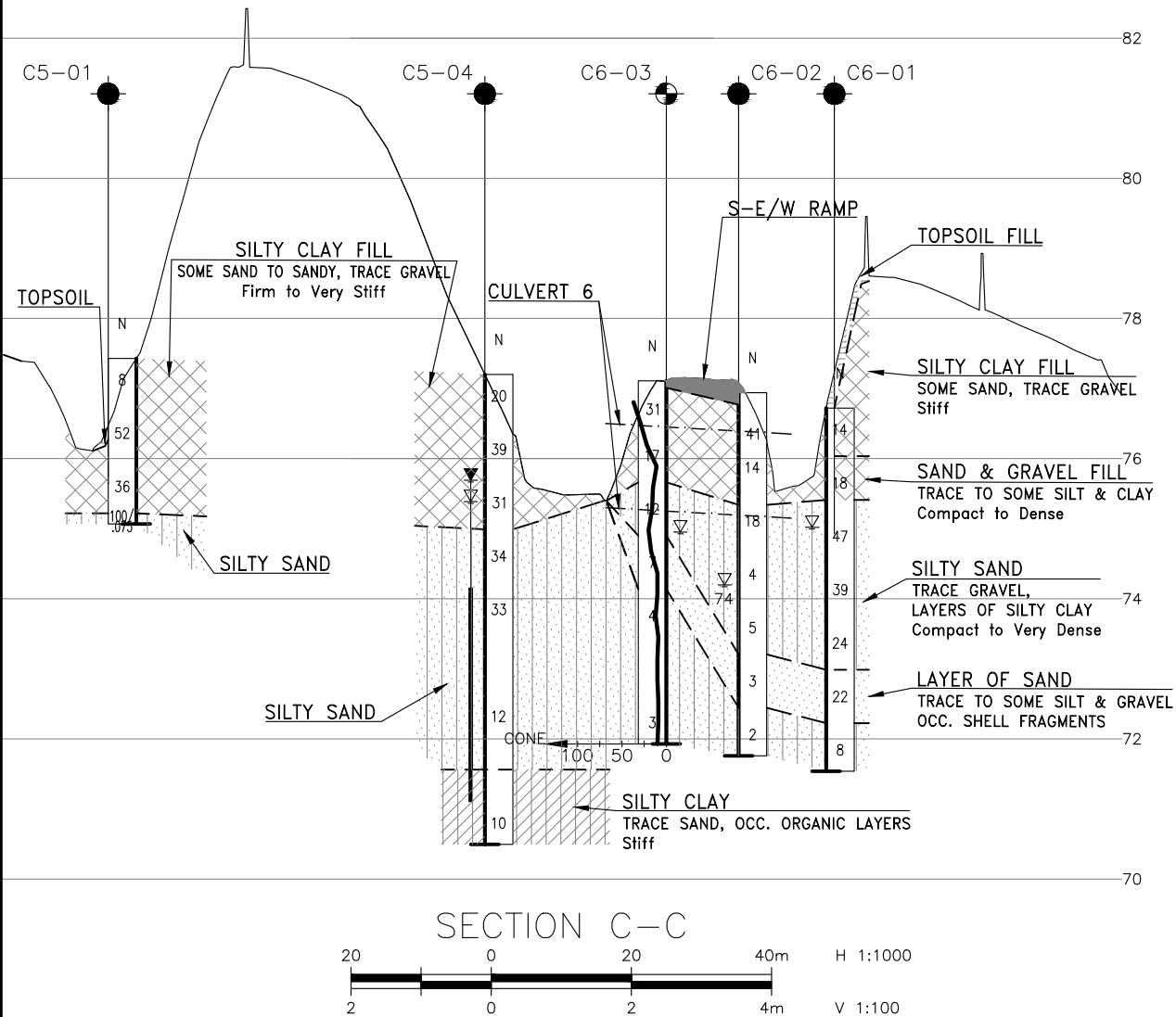
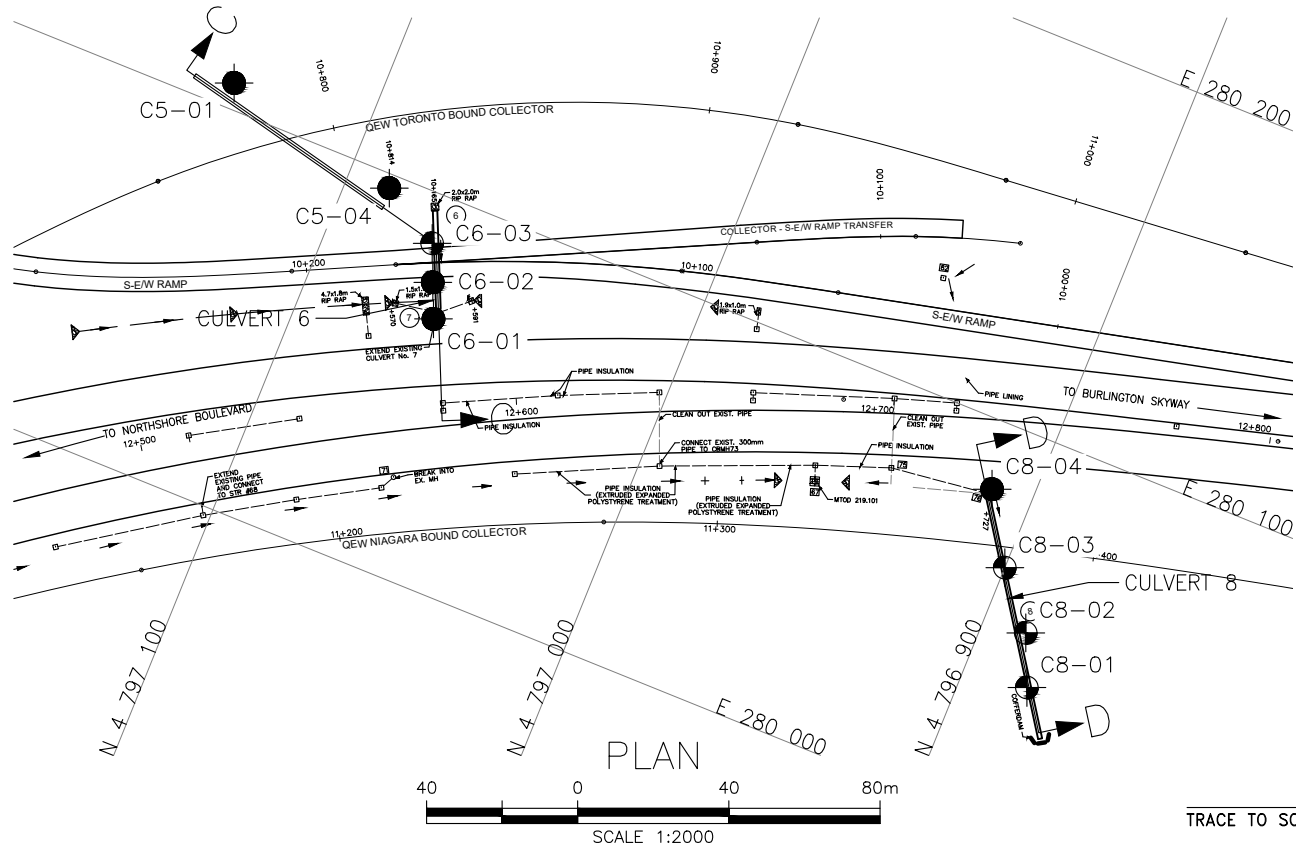
NO	ELEVATION	NORTHING	EASTING
TRSR1-01	84.1	4797423.6	279 754.2
TRSR1-02	84.4	4797398.8	279 735.0
TRSR1-03	84.7	4797377.3	279 726.9
TRSR1-04	84.3	4797374.2	279 714.2
C3-01	78.0	4797327.1	279 664.6
C3-02	81.1	4797328.3	279 676.6
C3-03	81.1	4797324.8	279 685.4

-NOTES-

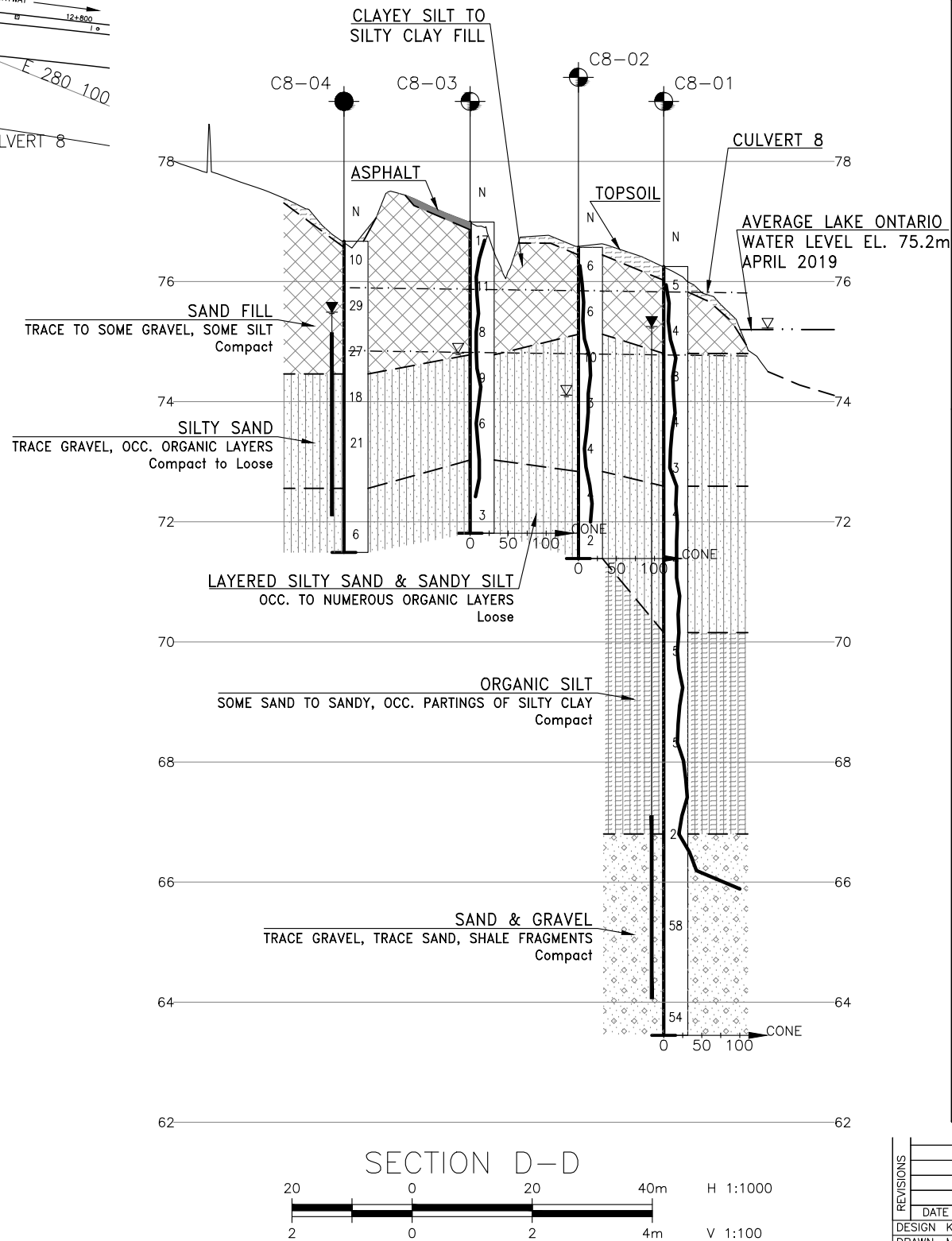
- The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.
- This drawing is for subsurface information only. Surface details and features are for conceptual illustration.
- Coordinate system is MTM NAD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

GEOCRES No. 30M5-330

REVISIONS	DATE	BY	DESCRIPTION
DESIGN	KF	CHK MRA	CODE
DRAWN	MFA	CHK KF	SITE
			STRUCT
			DWG 1
			DATE MAY 2019



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



CONT No
WP No 2117-15-00

CULVERT AND STORM
SEWER INSTALLATIONS
BOREHOLE LOCATIONS AND SOIL STRATA



LEGEND

●	Borehole
○	Borehole and Cone
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
C5-01	77.4	4797137.1	280 106.8
C5-04	77.2	4797088.6	280 096.4
C6-01	76.7	4797064.8	280 068.7
C6-02	76.9	4797068.6	280 077.6
C8-04	76.7	4796910.9	280 082.3
TRSR1-01	84.1	4797423.6	279 754.2
TRSR1-02	84.4	4797398.8	279 735.0
TRSR1-03	84.7	4797377.3	279 726.9
TRSR1-04	84.3	4797374.2	279 714.2

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. 30M5-330

REVISIONS	DATE	BY	DESCRIPTION
DESIGN	KF	CHK MRA	CODE
DRAWN	MFA	CHK KF	SITE
LOAD			
STRUCT			
DWG	2		
DATE	MAY 2019		