



THURBER ENGINEERING LTD.

**FOUNDATION INVESTIGATION REPORT
16th AVENUE STORM SEWERS
HIGHWAY 404 HOV LANE EXPANSION AND REHABILITATION
CONTRACT 2
FROM HIGHWAY 407 TO MAJOR MACKENZIE DRIVE
MARKHAM, ONTARIO
G.W.P. 2930-17-00**

GEOCRES NO. 30M14-503

**Latitude 43.865272
Longitude -79.374941**

Report

to

WSP Canada Inc.

Date: March 28, 2019
File: 15786



TABLE OF CONTENTS

PART 1: FACTUAL INFORMATION

1.	INTRODUCTION	1
2.	PROJECT AND SITE DESCRIPTION.....	2
3.	SITE INVESTIGATION AND FIELD TESTING.....	2
4.	LABORATORY TESTING	4
5.	DESCRIPTION OF SUBSURFACE CONDITIONS	5
5.1	Organic Sand and Silt.....	5
5.2	Asphalt	6
5.3	Sand and Gravel to Sand Fill	6
5.4	Silt	7
5.5	Sand.....	7
5.6	Silty Sand to Sandy Silt	7
5.7	Upper Clayey Silt Till	8
5.8	Lower Clayey Silt to Silty Clay Till.....	9
5.9	Groundwater Conditions	10
6.	MISCELLANEOUS	11

APPENDICES

Appendix A	Record of Borehole Sheets (current investigation)
Appendix B	Laboratory Test Results
Appendix C	Record of Borehole Sheets (previous investigation)
Appendix D	Borehole Locations and Soil Strata Drawings



**FOUNDATION INVESTIGATION REPORT
16th AVENUE STORM SEWERS
HIGHWAY 404 HOV LANE EXPANSION AND REHABILITATION
CONTRACT 2
FROM HIGHWAY 407 TO MAJOR MACKENZIE DRIVE
MARKHAM, ONTARIO
G.W.P. 2930-17-00**

GEOCRES NO. 30M14-503

1. INTRODUCTION

This report presents the factual findings obtained from a foundation investigation conducted for the proposed 16TH Avenue storm sewers (Contract 2) under Highway 404 from the Highway 404 Ramp N/E-W, (approximately STA 14+675) to approximately 100 m west of Catchet Woods Court (approximately STA 15+227) in the City of Markham, Ontario.

The purpose of this investigation was to explore the subsurface conditions at selected locations along the alignment and based on the data obtained, to provide borehole location plans, stratigraphic profiles, records of boreholes, laboratory test results, and a written description of the subsurface conditions.

Thurber was retained by WSP Canada Inc. (WSP) to carry out this foundation investigation under the MTO Assignment Number 2016-E-0014.

Reference has been made to information on subsurface conditions contained in a previous foundation report prepared for this site. The title of this report is as below:

- Foundation Investigation Report for Highway 404 16th Avenue Overpass, Replacement and Widening, Highway 404 HOV Lane Expansion and Rehabilitation, Contract 2, Markham, Ontario, Site 37-666, G.W.P. 2930-17-00, GEOCRES No. 30M14-487 prepared by Thurber Engineering, dated January 30, 2019 (Reference 1).

Specifically, Boreholes 16TH-06 and 16TH-07 were referenced from this report.

Client: WSP
File No.: 15786

Date: March 28, 2019
Page: 1 of 12

E file: H:\15000-15999\15786 Hwy 404 Widening 2016-E-0014\Reports and Memos\Contract 2\16th Avenue Sewer\15786 Contract 2 16th Ave Sewer Hwy 404 FIR mar19.docx



2. PROJECT AND SITE DESCRIPTION

There are two storm sewer alignments covered in this report, both of which extend along 16th Avenue from the Highway 404 Ramp N/E-W (approximately STA 14+675) to approximately 100m west of Catchet Woods Court (approximately STA 15+227). The southern alignment runs approximately along the existing right eastbound lane of 16th Avenue, and the northern alignment runs approximately 10 m north of the north edge of 16th Avenue. Each sewer will be in the order of 500 m in length with pipe diameters ranging between 300 mm and 450 mm, except for the portion just north of the north abutment where the diameter will be 1,200 mm. The general locations of the proposed works are shown on the key plan and on the Borehole Locations and Soil Strata Drawings in Appendix D.

The land use adjacent to the north side of 16th Avenue consists of commercial office buildings and the grassy lands making up the Hwy 404 and 16th Avenue interchange. Along the south side of 16th Avenue to the west of Highway 404, the land use is also commercial with office buildings and parking lots. Buttonville Airport occupies the southeast quadrant of the site.

The project alignment is located within the physiographic region known as the Peel Plain. The topography is flat and gently undulating. The soil cover in the region typically comprises silty clay glacial tills with sand and silt layers. Shale bedrock of the Georgian Bay Formation is anticipated at an approximate depth of 50 m.

3. SITE INVESTIGATION AND FIELD TESTING

Site investigation and field testing for the proposed sewers consisted of drilling and sampling a total of 10 boreholes to depths ranging from 6.1 m to 6.7 m (Elevations 191.5 m to 184.3 m). Deeper boreholes drilled for previous investigations in the area (Boreholes 16TH-06 and 16TH-07 from Reference 1), varied in depth from 34.6 m to 39.2 m (Elevations 155.4 m to 150.8 m). All boreholes for the current investigation were drilled within the period of March 12 to March 18, 2019.

Lane closures and traffic control were implemented for drilling each borehole for the current investigation. Prior to commencement of drilling, utility clearances were obtained for all borehole locations.

The approximate borehole locations are shown on the Borehole Locations and Soil Strata Drawings in Appendix D. The coordinates and elevations of the boreholes are given on these



drawings and on the individual Record of Borehole Sheets in Appendices A and C. Northing and easting co-ordinates at the current borehole locations were obtained by Thurber using a GPS unit, and the corresponding ground surface elevations were provided by WSP based on the project DTM survey. The precision of the horizontal survey of the boreholes is rated at within 1 m, whereas the precision of the elevations is the same as that of the DTM survey.

The current boreholes were advanced using track-mounted D-25 and truck mounted D-90 drill rigs. The drill rigs were operated using half-mast for most of the boreholes due to height restrictions imposed by the airport. Solid stem augers were used to advance the boreholes, and soil samples were obtained at selected intervals using a 50-mm diameter split spoon sampler in conjunction with the Standard Penetration Test (SPT).

A member of Thurber’s engineering staff supervised the drilling and sampling operations on a full-time basis. The supervisor logged the boreholes, visually examined the recovered soil samples, and transported them to Thurber’s laboratory for further examination and testing.

Groundwater conditions in the open boreholes were observed throughout the drilling operations. Two standpipe piezometers were installed during the current investigation in Boreholes SS-02 and SS-06 to permit monitoring of groundwater levels. The standpipe piezometers consisted of a 19 mm diameter Schedule 40 PVC pipe with a 1.5 m long slotted screen and were installed within a column of filter sand. Upon completion, the boreholes were abandoned in general accordance with Ontario Regulation 903 amended by Ontario Reg. 372 (O.Reg. 903). Once the final water level readings are taken, the piezometers will be decommissioned in general accordance with O.Reg. 903. The details of the current borehole completion are summarized in Table 3.1.

Table 3.1 – Borehole Completion Details

Borehole	Borehole Depth / Base Elevation (m)	Piezometer Tip Depth/ Elevation (m)	Completion Details
SS-01	6.4/186.0	None installed	Borehole backfilled with bentonite holeplug and auger cuttings, then asphalt patch to surface.
SS-02	6.5/187.0	6.5/187.0	Piezometer with 1.5 m slotted screen installed with sand filter from 6.5 m to 4.3 m, bentonite holeplug from 4.3 m to 0.5 m, then auger cuttings from 0.5 m to ground surface.



Borehole	Borehole Depth / Base Elevation (m)	Piezometer Tip Depth/ Elevation (m)	Completion Details
SS-03	6.7/184.3	None installed	Borehole backfilled with bentonite holeplug and auger cuttings, then asphalt patch to surface.
SS-04	6.7/186.0	None installed	Borehole backfilled with bentonite holeplug to 1.5 m, then auger cuttings to surface.
SS-05	6.1/184.5	None installed	Borehole backfilled with bentonite holeplug and auger cuttings, then asphalt patch to surface.
SS-06	6.7/185.3	6.1/185.9	Piezometer with 1.5 m slotted screen installed with sand filter from 6.7 m to 3.3 m, bentonite holeplug from 3.3 m to 1.2 m, bentonite mixed with auger cuttings from 1.2 m to ground surface.
SS-07	6.7/187.1	None installed	Borehole backfilled with bentonite holeplug and auger cuttings, then asphalt patch to surface.
SS-08	6.7/189.8	None installed	Borehole backfilled with bentonite holeplug and auger cuttings to 0.5 m, then dry cement to 0.2 m, then asphalt patch to surface.
SS-09	6.7/190.7	None installed	Borehole backfilled with bentonite holeplug and auger cuttings to 0.5 m, then dry cement to 0.2 m, then asphalt patch to surface.
SS-10	6.7/191.5	None installed	Borehole backfilled with bentonite holeplug and auger cuttings to 0.5 m, then dry cement to 0.2 m, then asphalt patch to surface.

4. LABORATORY TESTING

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



5. DESCRIPTION OF SUBSURFACE CONDITIONS

This section presents a generalized summary of the subsurface conditions encountered at the boreholes drilled along the proposed sewer alignments. Borehole location plans and stratigraphic profiles along the sewer alignments are presented on the Borehole Locations and Soil Strata Drawings in Appendix D. Records of Borehole sheets and laboratory testing data are also included in Appendices A to C.

Boreholes 16TH-06 and 16TH-07 from Reference 1 are used in this discussion of subsurface conditions. The soil conditions in these boreholes below depths of 6.7 m are not discussed in this report but can be further reviewed in the report from Reference 1.

In general, the soil stratigraphy encountered along the proposed sewer alignment typically consists of pavement structure (asphalt on granular) and fill overlying native soils which typically comprised compact to dense sandy silt to silty sand overlying stiff to hard clayey silt to silty clay till.

More detailed descriptions of the individual stratum are presented below.

5.1 Organic Sand and Silt

Organic sand and silt, with some gravel and clay was encountered at the surface in Boreholes SS-02, SS-04, and SS-06. The thickness of the layer ranged from 0.3 m to 0.7 m. The thickness of the organic soils may vary between and beyond the borehole locations, and the data is not intended for the purpose of estimating quantities.

SPT 'N' values recorded in the organic sand and silt ranged from 9 to 16 blows for 0.3 m penetration with one value exceeding 100 blows for 0.15 m penetration, indicating a typically loose to compact condition. The higher 'N' value may be attributed to the presence of cobbles. Moisture contents between 11 percent and 35 percent were measured in the organic sand and silt.

The result of a grain size distribution analysis carried out on a selected sample of the organic sand and silt is presented on the Record of Borehole sheets included in Appendix A and on Figure B1 of Appendix B. The results of the grain size analysis are summarized below:



Soil Particle	Percentage (%)
Gravel	12
Sand	38
Silt	37
Clay	13

5.2 Asphalt

Boreholes SS-01, SS-03, SS-05, SS-07 to SS-10, 16TH-06 and 16TH-07 were drilled through paved sections 16th Avenue. The asphalt ranged in thickness from 100 mm to 200 mm.

5.3 Sand and Gravel to Sand Fill

Fill consisting of sand and gravel to sand, some gravel and trace to some silt and clay was encountered beneath the asphalt in Boreholes SS-01, SS-03, SS-05, SS-07 to SS-10, 16TH-06 and 16TH-07 drilled within the paved portion of 16th Avenue. The sand and gravel to sand fill had a thickness of between 0.6 m and 1.9 m and extended to depths of approximately 0.8 m to 2.0 m (Elevation 189.2 to 196.8).

SPT 'N' values within the gravelly sand to sand fill ranged from 9 blows for 0.3 m of penetration to 100 blows for 0.15 m of penetration, indicating a loose to very dense condition. Moisture contents between 1 percent and 18 percent were measured in the fill.

The results of grain size distribution analyses carried out on selected samples of the gravelly sand to sand fill are presented on the Record of Borehole sheets included in Appendix A and on Figure B2 of Appendix B. The results of the grain size analyses are summarized below:

Soil Particle	Percentage (%)
Gravel	11 to 29
Sand	54 to 74
Silt and Clay	15 to 18



5.4 Silt

A layer of silt, containing trace clay and trace sand, was encountered in Borehole SS-08 beneath the gravelly sand fill at a depth of approximately 1.4 m (Elevation 195.1 m). The silt layer was approximately 0.8 m thick and extended to a depth of approximately 2.2 m (Elevation 194.3 m).

An SPT 'N' value measured in the silt was 27 blows for 0.3 m penetration, indicating a compact condition. A moisture content of 20 percent was measured in the silt.

The result of a grain size distribution analysis carried out on a selected sample of the silt is presented on the Record of Borehole sheets included in Appendix A and on Figure B3 of Appendix B. The results of the grain size analysis are summarized below:

Soil Particle	Percentage (%)
Gravel	0
Sand	4
Silt	86
Clay	10

5.5 Sand

Sand, containing trace gravel and trace silt, was encountered in Boreholes 16TH-06 and 16TH-07 beneath the sand and gravel fill at a depth of approximately 0.8 m (Elevation 189.2 m). The sand was approximately 0.7 m to 1.5 m thick and extended to depths of 1.5 m and 2.3 m (Elevations 188.5 m and 187.7 m).

SPT 'N' values within the sand ranged from 23 to 41 blows for 0.3 m of penetration, indicating a compact to dense condition. Moisture contents between 4 percent and 19 percent were measured in the sand.

5.6 Silty Sand to Sandy Silt

Silty sand to sandy silt was encountered in Boreholes SS-05 to SS-10 at depths of between 0.7 m and 2.2 m (Elevations 189.2 m and 196.0 m). Where fully penetrated in Boreholes SS-05, SS-06, SS-07, and SS-09, the silty sand to sandy silt layer was approximately 0.8 m to 5.1 m thick and extended to depths of approximately between 1.5 m and 6.5 m (Elevations 188.4 m and 190.9



m). Boreholes SS-08 and SS-10 were terminated within the silty sand to sandy silt layer at a depth of 6.7 m (Elevations 189.8 m and 191.5 m, respectively).

SPT 'N' values within the silty sand to sandy silt ranged from 5 to 71 blows for 0.3 m of penetration, with typical values between 18 and 46 blows, indicating a compact to dense condition. Moisture contents between 4 percent and 20 percent were measured in the silty sand to sandy silt.

The results of grain size distribution analyses carried out on selected samples of the silty sand to sandy silt are presented on the Record of Borehole sheets included in Appendix A and on Figure B4 of Appendix B. The results of the grain size analyses are summarized below:

Soil Particle	Percentage (%)
Gravel	0 to 1
Sand	20 to 76
Silt	21 to 78
Clay	2 to 5

5.7 Upper Clayey Silt Till

An upper layer of clayey silt till, with sand, and trace gravel, was encountered in Borehole SS-10 at a depth of 1.4 m (Elevation 196.8 m). This till was approximately 0.8 m thick and extended to a depth of approximately 2.2 m (Elevation 196.0 m).

An SPT 'N' value measured in the upper clayey silt till was 13 blows for 0.3 m penetration, indicating a stiff consistency. A moisture content of 22 percent was measured in the clayey silt till.

The result of a grain size distribution analysis carried out on a sample of the upper clayey silt till is presented on the Record of Borehole sheets included in Appendix A and on Figure B5 of Appendix B. The results of the grain size analysis are summarized below:

Soil Particle	Percentage (%)
Gravel	3
Sand	38
Silt	40
Clay	19

Glacial tills inherently contain cobbles and boulders.



5.8 Lower Clayey Silt to Silty Clay Till

A lower layer of clayey silt to silty clay till, with sand and trace gravel, was encountered in Boreholes SS-01 to SS-07, SS-09, 16TH-06 and 16TH-07 at depths of between 0.3 m to 6.5 m (Elevations 187.7 m to 193.2 m). Boreholes SS-01 to SS-07, and SS-09 were terminated within the lower clayey silt to silty clay till layer at depths of between 6.1 m to 6.7 m (Elevations 184.3 m to 190.7 m).

SPT 'N' values within the lower clayey silt to silty clay till ranged from 4 blows for 0.3 m of penetration to 100 blows for 0.075 m penetration, with typical values between 12 and 30 blows, indicating a stiff to hard condition. In-situ vane shear tests conducted in Boreholes 16TH-06 and 16TH-07 indicated undrained shear strengths of 32 to 86 kPa, which corresponds to a firm to stiff consistency. Grinding of augers was observed below 4.5 m within the 100-blow till in Boreholes SS-01 and SS-02. Moisture contents between 8 percent and 25 percent were measured in the lower clayey silt to silty clay till.

The results of grain size distribution analyses and Atterberg Limits testing carried out on selected samples of the clayey silt to silty clay till are presented on the Record of Borehole sheets included in Appendix A and on Figures B6, B7 and B8 of Appendix B. The results of the grain size analyses are summarized below:

Soil Particle	Percentage (%)
Gravel	0 to 15
Sand	2 to 43
Silt	31 to 77
Clay	11 to 61

The results of Atterberg Limits testing are summarized below:

Index Property	Percentage (%)
Plastic Index	7 to 17
Liquid Limit	19 to 32

The results of the Atterberg Limits testing indicate this till to be of low plasticity with group symbol CL.

Glacial tills inherently contain cobbles and boulders.



5.9 Groundwater Conditions

Groundwater conditions were observed during drilling operations, and groundwater levels were measured in the open boreholes upon completion of drilling. Standpipe piezometers were installed in Boreholes SS-02 and SS-06 from the current investigation to monitor the groundwater level at the site. Piezometers were also installed in Boreholes 16TH-06 and 16TH-07 from the previous investigation. The groundwater levels measured in the open boreholes and in the standpipe piezometers are summarized below.

Table 5.4- Measured Groundwater Levels

Borehole	Date	Water Level (m)		Remark
		Depth	Elevation	
SS-01	March 13, 2019	5.8	186.6	Open borehole.
SS-02	March 17, 2019	Dry	Dry	Standpipe piezometer
	March 26, 2019	2.0	191.5	
SS-03	March 13, 2019	4.6	186.4	Open borehole
SS-04	March 18, 2019	3.0	189.7	Borehole caved to 3.4 m upon completion
SS-05	March 12, 2019	1.2	189.4	Borehole caved to 1.2 m upon completion
SS-06	March 17, 2019	1.5	190.5	Standpipe piezometer
	March 26, 2019	0.6	191.4	
SS-07	March 12, 2019	2.9	190.9	Borehole caved to 2.9 m upon completion
SS-08	March 17, 2019	4.2	192.3	Open borehole
SS-09	March 17, 2019	4.8	192.6	Open borehole
SS-10	March 17, 2019	5.8	192.4	Open borehole
16TH-06	October 9, 2018	3.1	186.9	Piezometer
	November 22, 2018	0.0	190.0	
16TH-07	August 20, 2018	0.0	190.0	Piezometer
	October 9, 2018	0.8	189.2	

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



6. MISCELLANEOUS

Thurber staked and/or marked the borehole locations in the field and obtained utility clearances prior to drilling. WSP provided the ground surface elevations based on northing and eastings coordinates obtained with a GPS unit.

DBW Drilling of Toronto, Ontario, and Walker Drilling of Utopia, Ontario, supplied and operated a truck-mounted D-90 and a track mounted D-25 drill rigs, respectively, to carry out the drilling, sampling and in-situ testing operations in the boreholes.

The drilling and sampling operations in the field were supervised on a full-time basis by Mr. Kevin Kweon and Mr. Bryan Lui of Thurber. Geotechnical laboratory testing was carried out by Thurber in its MTO-approved laboratory. Overall supervision of the field program was carried out by Mr. Stephane Loranger, CET.

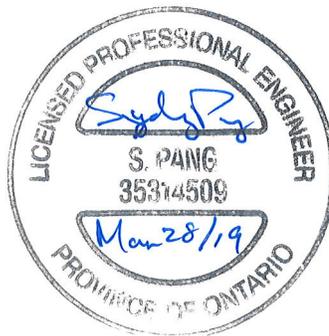
Overall project management was provided by Dr. Sydney Pang, P.Eng. Interpretation of the field data and preparation of this report was completed by Mr Cory Zanatta, P.Eng. The report was reviewed by Dr. Sydney Pang, P.Eng. and Dr. P.K. Chatterji, P.Eng., a Designated Principal Contact for MTO Foundations Projects.



THURBER ENGINEERING LTD.



Cory Zanatta, P.Eng.
Geotechnical Engineer



Sydney Pang, P.Eng.
Associate, Senior Foundations Engineer



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

Client: WSP
File No.: 15786

Date: March 28, 2019
Page: 12 of 12

E file: H:\15000-15999\15786 Hwy 404 Widening 2016-E-0014\Reports and Memos\Contract 2\16th Avenue Sewer\15786 Contract 2 16th Ave Sewer Hwy 404 FIR mar19.docx

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.

UNIFIED SOILS CLASSIFICATION

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



Appendix A

Record of Borehole Sheets (current investigation)

RECORD OF BOREHOLE No SS-01 1 OF 1 METRIC

GWP# 2930-17-00 LOCATION N 4 858 315.0 E 314 701.0 ORIGINATED BY BC
 HWY 404 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2019.03.13 - 2019.03.13 LATITUDE 43.864740 LONGITUDE -79.376823 CHECKED BY CZ

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV. DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
						20 40 60 80 100 ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE WATER CONTENT (%) 20 40 60								
192.4	GROUND SURFACE													
0.0	ASPHALT: (100mm)													
0.1	SAND, some gravel, some silt Loose to Dense Brown Moist (FILL)		1	GS										
			1	SS	37								11 74 15 (SI+CL)	
			2	SS	9									
190.4	Clayey SILT, with sand, trace gravel Stiff to Very Stiff Grey Moist (TILL)		3	SS	12									
2.0			4	SS	19								2 30 46 22	
	Hard		5	SS	100/ 0.275								Augers grinding below 4.5m	
			6	SS	100/ 0.150									
186.0	END OF BOREHOLE AT 6.4m. BOREHOLE OPEN AND WATER LEVEL AT 5.8m COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND CUTTINGS, THEN ASPHALT PATCH TO SURFACE.													
6.4														

ONTMT4S2_MTO-15786.GPJ_2017TEMPLATE(MTO).GDT_3/26/19

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

RECORD OF BOREHOLE No SS-02 1 OF 1 METRIC

GWP# 2930-17-00 LOCATION N 4 858 330.0 E 314 675.0 ORIGINATED BY BC
 HWY 404 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2019.03.17 - 2019.03.17 LATITUDE 43.864874 LONGITUDE -79.376325 CHECKED BY CZ

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV. DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
						20 40 60 80 100 ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE WATER CONTENT (%) 20 40 60 W _p W W _L								
193.5	GROUND SURFACE													
0.0	Organic SAND and SILT, some clay, some gravel		1	SS	100/0.150									
193.2	Very Dense Brown Moist													
0.3	Silty CLAY, with sand, trace gravel Hard to Very Stiff Brown Moist (TILL)		2	SS	33								3 23 39 35	
			3	SS	24									
191.3			4	SS	17									
2.2	Clayey SILT, with sand, trace gravel Very Stiff Brown Moist (TILL)		5	SS	22								2 26 54 18	
191.3			6	SS	100/0.075									
	Hard													
189.0		7	SS	100/0.225										
187.0	END OF BOREHOLE AT 6.5m. BOREHOLE OPEN AND DRY UPON COMPLETION. Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen.												Augers grinding below 4.5m	
6.5	WATER LEVEL READINGS DATE DEPTH(m) ELEV.(m) 2019.03.26 3.1 190.4													

ONTMT4S2_MTO-15786.GPJ_2017TEMPLATE(MTO).GDT_3/27/19

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

RECORD OF BOREHOLE No SS-03

1 OF 1

METRIC

GWP# 2930-17-00 LOCATION N 4 858 330.0 E 314 741.0 ORIGINATED BY BC
 HWY 404 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2019.03.13 - 2019.03.13 LATITUDE 43.864875 LONGITUDE -79.377146 CHECKED BY CZ

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV. DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa								WATER CONTENT (%)
191.0	GROUND SURFACE															
0.0	ASPHALT: (150mm)															
0.2	Gravelly SAND, some silt and clay Dense Brown Moist (FILL)	[Strat Plot]	1	GS												
189.7			1	SS	37										21 61 18 (SI+CL)	
1.3	Clayey SILT, with sand, trace gravel Very Stiff to Hard Grey Moist (TILL)	[Strat Plot]	2	SS	20											
			3	SS	21											
			4	SS	37											
			5	SS	38											
			6	SS	40											
184.3	END OF BOREHOLE AT 6.7m. WATER LEVEL AT 4.6m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND CUTTINGS, THEN ASPHALT PATCH TO SURFACE.															

ONT/MT/4S2_MTO-15786.GPJ_2017TEMPLATE(MTO).GDT_3/26/19

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

RECORD OF BOREHOLE No SS-04 1 OF 1 **METRIC**

GWP# 2930-17-00 LOCATION N 4 858 373.0 E 314 770.0 ORIGINATED BY BL
 HWY 404 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2019.03.18 - 2019.03.18 LATITUDE 43.865261 LONGITUDE -79.375963 CHECKED BY CZ

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV. DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
						20 40 60 80 100 ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE WATER CONTENT (%) 20 40 60 W _p W W _L								
192.7	GROUND SURFACE													
0.0	Organic SAND and SILT , some clay, some gravel Compact Brown Moist		1	SS	16								12 38 37 13	
192.0														
0.7	Silty CLAY , with sand, trace gravel Firm to Stiff Grey Moist (TILL)		2	SS	8									
			3	SS	7								0 16 55 29	
			4	SS	9									
			5	SS	31									
	Hard													
			6	SS	5									
	Firm to Stiff													
			7	SS	8									
186.0	END OF BOREHOLE AT 6.7m. BOREHOLE CAVED TO 3.4m AND WATER LEVEL AT 3.0m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO 1.5m, THEN CUTTINGS TO SURFACE.													

ONT/MT452_MTO-15786.GPJ_2017TEMPLATE(MTO).GDT_3/26/19

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

RECORD OF BOREHOLE No SS-05 1 OF 1 METRIC

GWP# 2930-17-00 LOCATION N 4 858 381.0 E 314 878.0 ORIGINATED BY BC
 HWY 404 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2019.03.12 - 2019.03.12 LATITUDE 43.865332 LONGITUDE -79.374620 CHECKED BY CZ

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								
						○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE				WATER CONTENT (%)						
						20	40	60	80	100	20	40	60			
190.6	GROUND SURFACE															
0.0	ASPHALT: (200mm)															
0.2	Gravelly SAND, some silt and clay Grey/Brown Moist (FILL)		1	GS												
	Very Dense		1	SS	64										29 54 17 (SI+CL)	
189.2	Silty SAND, trace gravel, trace clay Compact Grey Wet		2	SS	22											
188.4	Silty CLAY, with sand, trace gravel Very Stiff Grey Moist (TILL)		3	SS	17										2 30 42 26	
			4	SS	22											
			5	SS	24											
184.5	END OF BOREHOLE AT 6.1m. BOREHOLE CAVED TO 1.2m AND WATER LEVEL AT 1.2m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND CUTTINGS, THEN ASPHALT PATCH TO SURFACE.		6	GS												

ONTMT4S2_MTO-15786.GPJ_2017TEMPLATE(MTO).GDT_3/26/19

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

RECORD OF BOREHOLE No SS-07

1 OF 1

METRIC

GWP# 2930-17-00 LOCATION N 4 858 425.0 E 315 005.0 ORIGINATED BY BC
 HWY 404 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2019.03.12 - 2019.03.12 LATITUDE 43.865726 LONGITUDE -79.373039 CHECKED BY CZ

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
193.8	GROUND SURFACE													
0.0	ASPHALT: (200mm)													
0.2	Gravelly SAND, trace silt Very Dense Brown Moist (FILL)		1	GS										
				1	SS	100/ 0.150								
192.4	Sandy SILT, trace gravel, trace clay Very Dense to Compact Grey Moist													
1.4			2	SS	71									
				3	SS	18								
190.8	Silty SAND, trace gravel, trace clay Loose Brown/Grey Wet													
3.0			4	SS	5									
				5	SS	7								
188.2	Clayey SILT, with sand, trace gravel Very Stiff Grey Moist (TILL)													
5.6			6	SS	28									
187.1	6.7													
END OF BOREHOLE AT 6.7m. BOREHOLE CAVED TO 2.9m AND WATER LEVEL AT 2.9m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND CUTTINGS, THEN ASPHALT PATCH TO SURFACE.														

ONT/MT/4S2_MTO-15786.GPJ_2017TEMPLATE(MTO).GDT_3/26/19

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

RECORD OF BOREHOLE No SS-08 1 OF 1 METRIC

GWP# 2930-17-00 LOCATION N 4 858 452.0 E 315 082.0 ORIGINATED BY KK
 HWY 404 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2019.03.17 - 2019.03.17 LATITUDE 43.865968 LONGITUDE -79.372080 CHECKED BY CZ

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV. DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					
						20 40 60 80 100 ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE WATER CONTENT (%) 20 40 60							
196.5	GROUND SURFACE												
0.0	ASPHALT: (200mm)												
0.2	Gravelly SAND, trace silt Dense to Very Dense Brown Moist (FILL)		1	SS	33								
			2	SS	51								
195.1	SILT, trace sand, trace to some clay Compact Brown Moist		3	SS	27							0 4 86 10	
194.3	SAND and SILT, trace clay Compact to Dense Brown to Grey Moist		4	SS	27							0 42 53 5	
			5	SS	30								
			6	SS	25								
			7	SS	35								
189.8	END OF BOREHOLE AT 6.7m. BOREHOLE OPEN UPON COMPLETION AND WATER LEVEL AT 4.2m BELOW GROUND SURFACE. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND CUTTINGS TO 0.5m, DRY CEMENT TO 0.2m, THEN ASPHALT TO SURFACE.												

ONTMT4S2_MTO-15786.GPJ_2017TEMPLATE(MTO).GDT_3/26/19

RECORD OF BOREHOLE No SS-09 1 OF 1 METRIC

GWP# 2930-17-00 LOCATION N 4 858 478.0 E 315 110.0 ORIGINATED BY KK
 HWY 404 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2019.03.17 - 2019.03.17 LATITUDE 43.866183 LONGITUDE -79.371072 CHECKED BY CZ

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 ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE							
197.4	GROUND SURFACE														
0.0	ASPHALT: (175mm)														
0.2	Gravelly SAND, trace silt Dense to Compact Brown Moist (FILL)		1	SS	39										
			2	SS	19										
196.0			3	SS	24										
1.4			4	SS	25										0 52 44 4
			5	SS	20										
	SAND and SILT, trace clay Compact Brown Moist														
			6	SS	28										
190.9			7	SS	49										
190.9	Clayey SILT, trace sand													0 6 77 17	
6.7	Hard Grey Wet (TILL)														
	END OF BOREHOLE AT 6.7m. BOREHOLE OPEN UPON COMPLETION AND WATER LEVEL AT 4.8m BELOW GROUND SURFACE. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND CUTTINGS TO 0.5m, DRY CEMENT TO 0.2m, THEN ASPHALT TO SURFACE.														

ONT/MT452_MTO-15786.GPJ_2017TEMPLATE(MTO).GDT_3/26/19

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

RECORD OF BOREHOLE No SS-10 1 OF 1 METRIC

GWP# 2930-17-00 LOCATION N 4 858 476.0 E 315 163.0 ORIGINATED BY KK
 HWY 404 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2019.03.17 - 2019.03.17 LATITUDE 43.866202 LONGITUDE -79.371731 CHECKED BY CZ

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	NATURAL MOISTURE CONTENT		
198.2	GROUND SURFACE											
0.0	ASPHALT: (175mm)											
0.2	Gravelly SAND Very Dense to Compact Brown Moist (FILL)		1	SS	57							
			2	SS	17							
196.8	Clayey SILT, with sand, trace gravel Stiff Brown Moist (TILL)		3	SS	13							3 38 40 19
196.0	SAND and SILT, trace clay Dense Brown Moist		4	SS	46							
			5	SS	45							
			6	SS	31							0 62 35 3
			7	SS	31							
191.5	END OF BOREHOLE AT 6.7m. BOREHOLE OPEN UPON COMPLETION AND WATER LEVEL AT 5.8m BELOW GROUND SURFACE. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND CUTTINGS TO 0.5m, DRY CEMENT TO 0.2m, THEN ASPHALT TO SURFACE.											

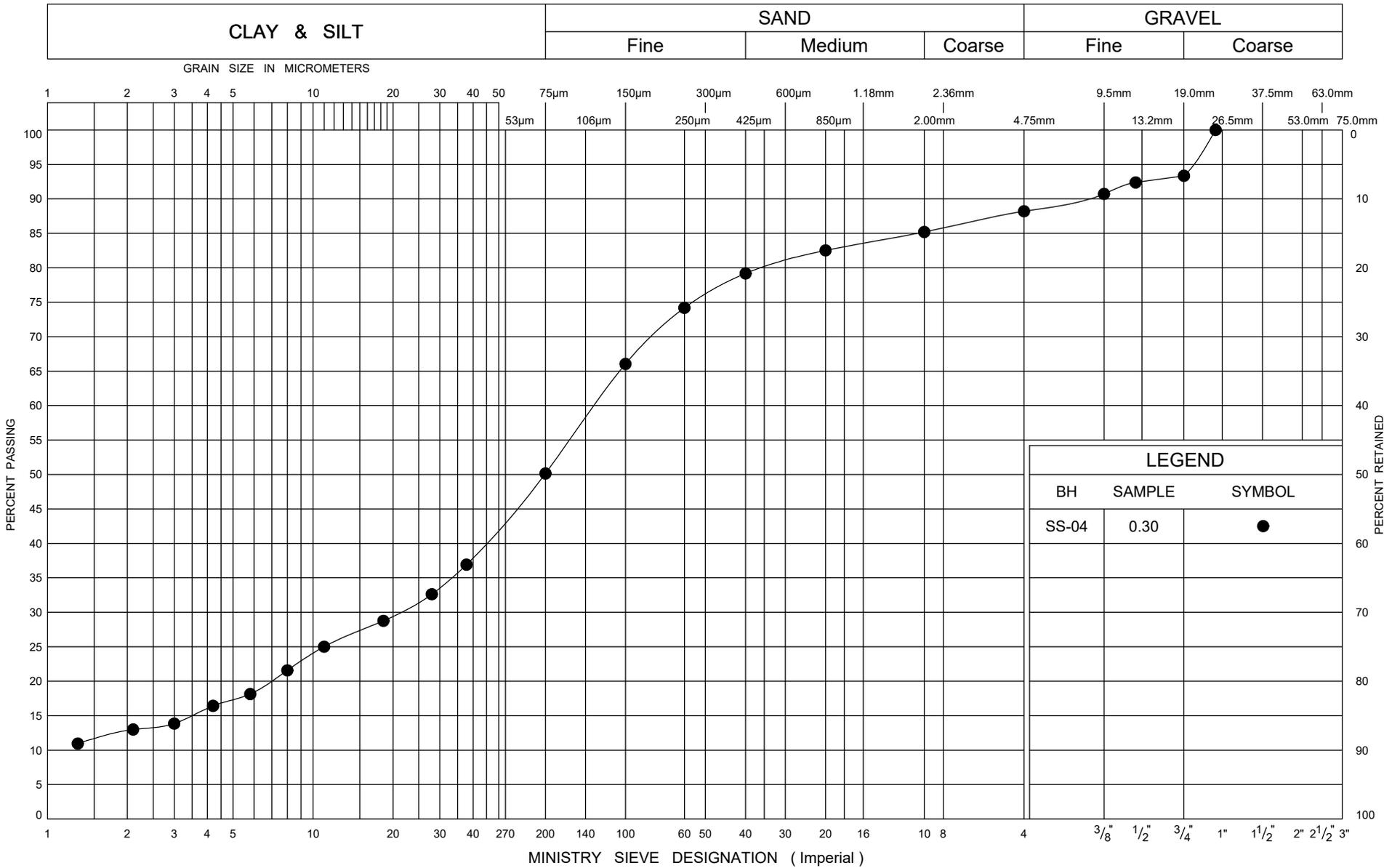
ONT/MT/4S2_MTO-15786.GPJ_2017TEMPLATE(MTO).GDT_3/26/19

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



Appendix B

Laboratory Test Results



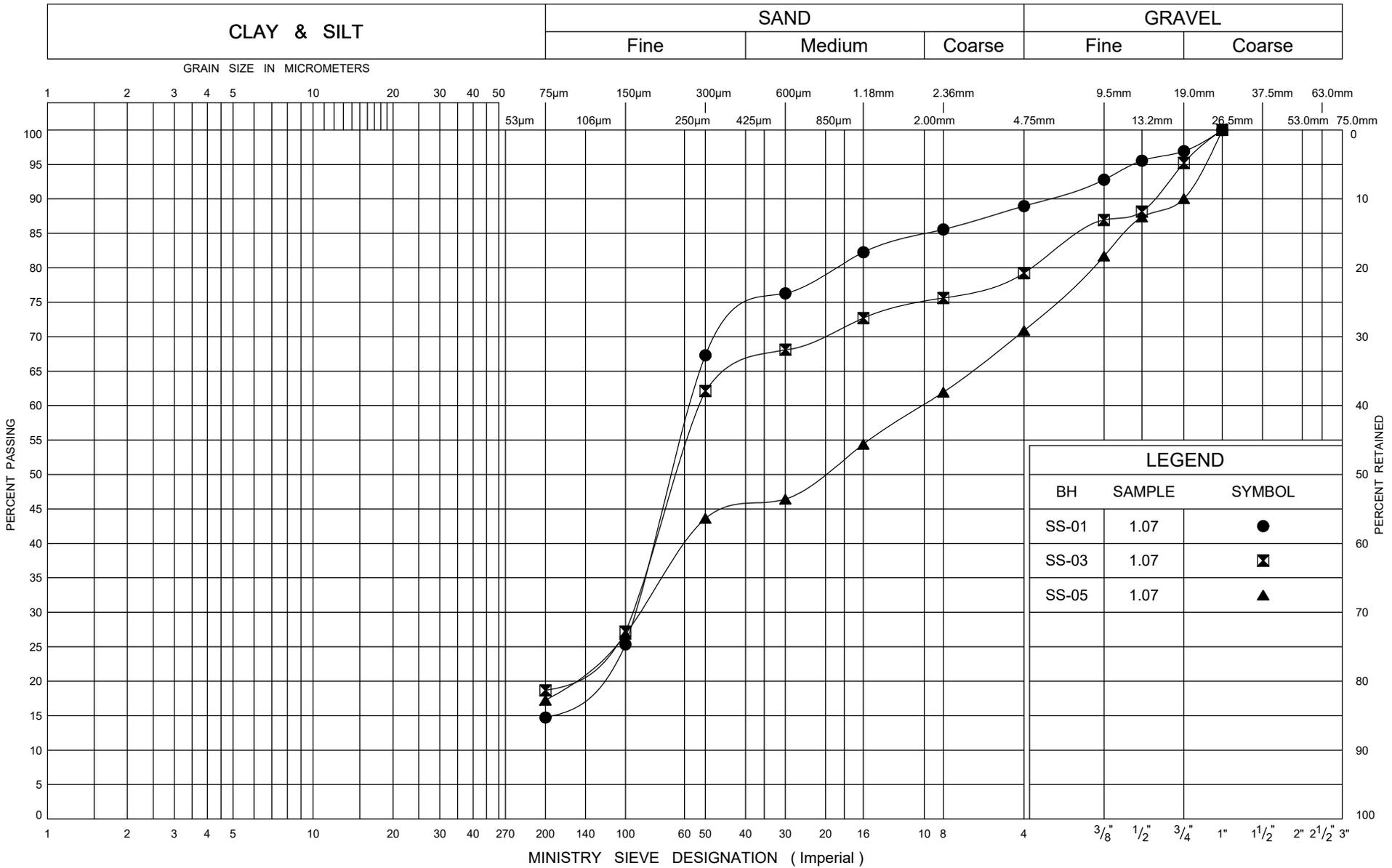
ONTARIO MOT GRAIN SIZE 2X_MTO-15786.GPJ_ONTARIO MOT.GDT_3/26/19



GRAIN SIZE DISTRIBUTION

Organic SAND and SILT

FIG No B1
W P 2930-17-00



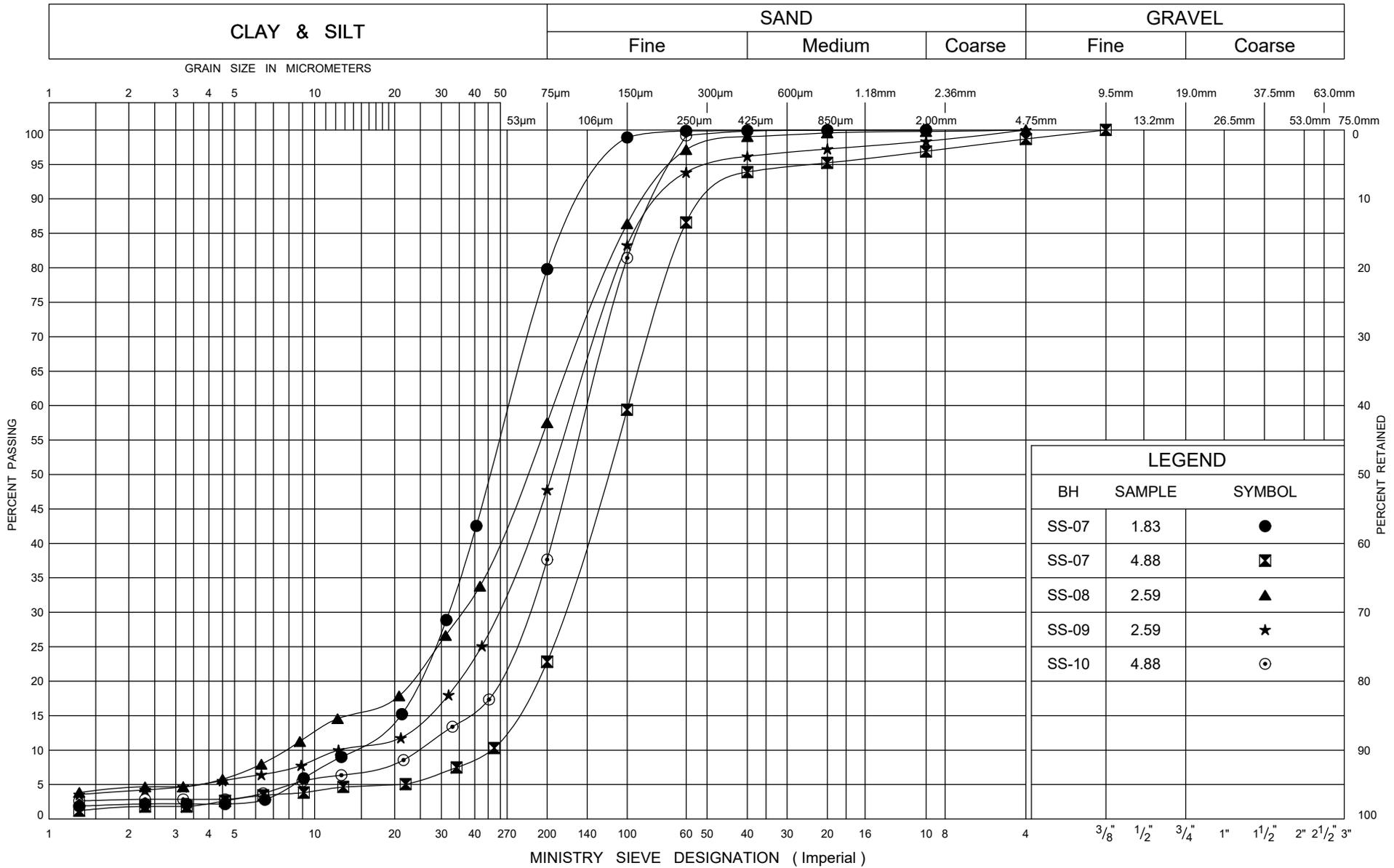
ONTARIO MOT GRAIN SIZE 2X_MTO-15786.GPJ_ONTARIO MOT.GDT_3/26/19



GRAIN SIZE DISTRIBUTION
SAND and GRAVEL to SAND FILL

FIG No B2

W P 2930-17-00



LEGEND		
BH	SAMPLE	SYMBOL
SS-07	1.83	●
SS-07	4.88	⊠
SS-08	2.59	▲
SS-09	2.59	★
SS-10	4.88	⊙

ONTARIO MOT GRAIN SIZE 2X_MTO-15786.GPJ_ONTARIO MOT.GDT_3/26/19

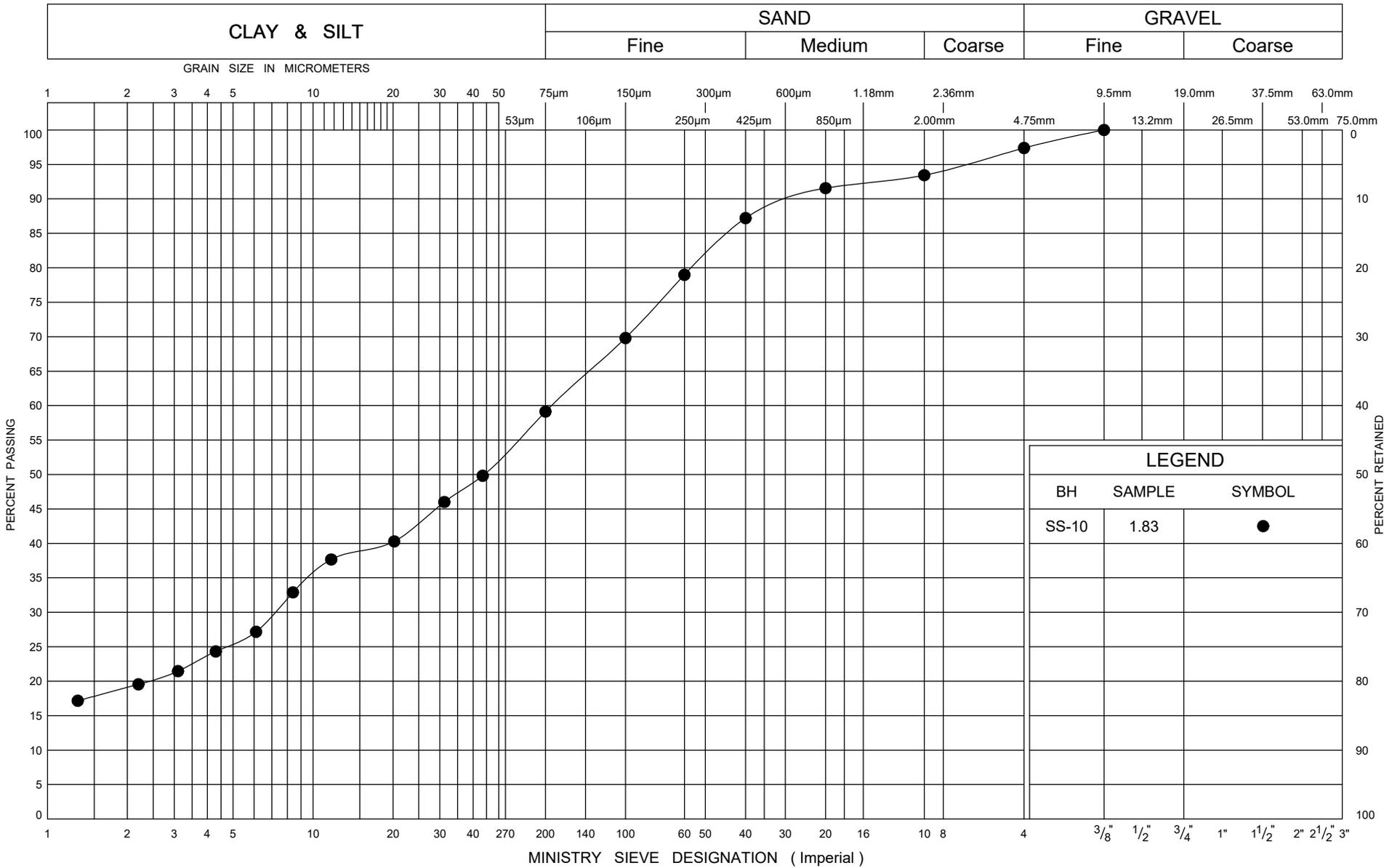


GRAIN SIZE DISTRIBUTION

Silty SAND to Sandy SILT

FIG No B4

W P 2930-17-00



ONTARIO MOT GRAIN SIZE 2X_MTO-15786.GPJ_ONTARIO MOT.GDT_3/26/19

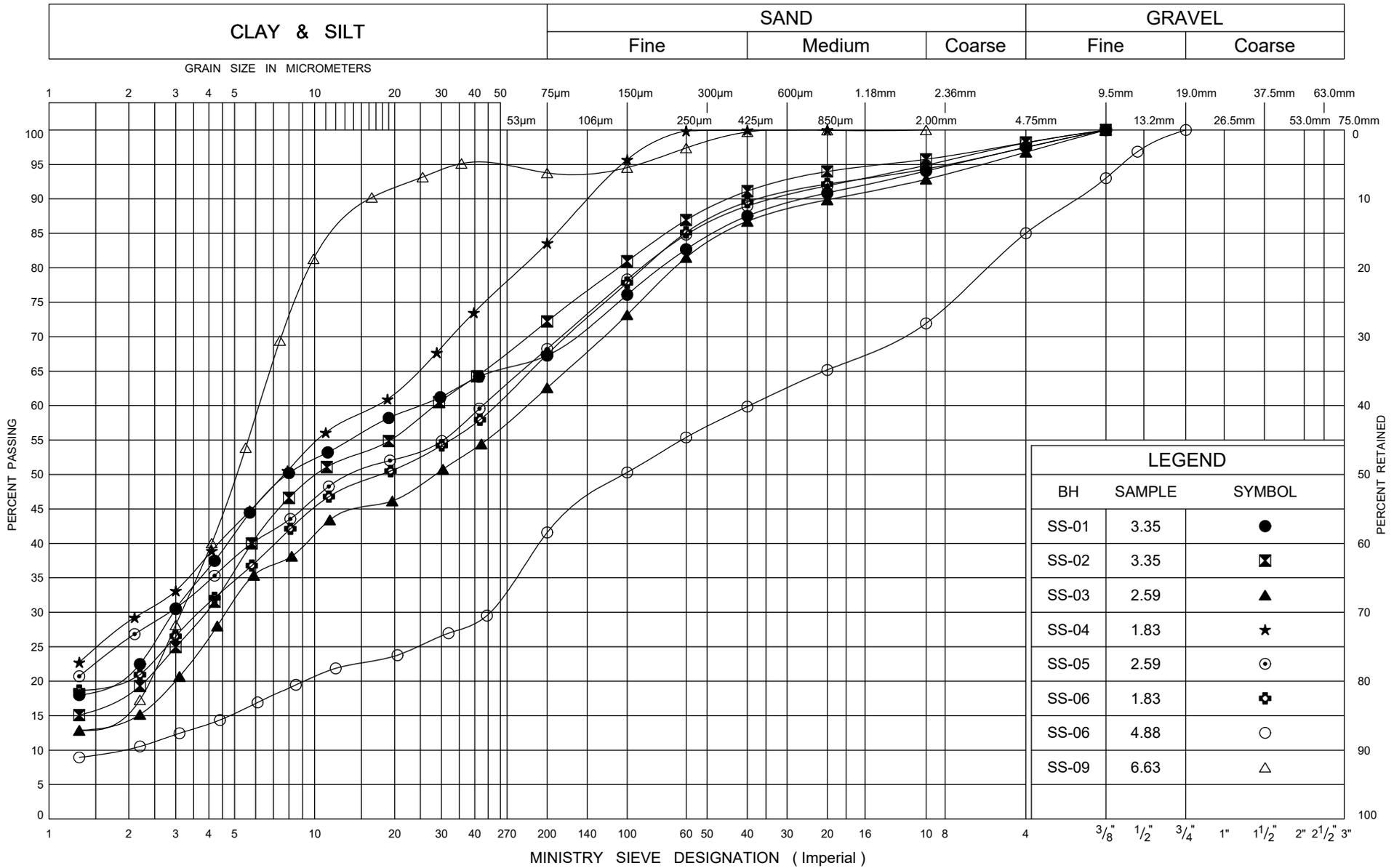


GRAIN SIZE DISTRIBUTION

Upper Clayey SILT TILL

FIG No B5

W P 2930-17-00



LEGEND		
BH	SAMPLE	SYMBOL
SS-01	3.35	●
SS-02	3.35	⊠
SS-03	2.59	▲
SS-04	1.83	★
SS-05	2.59	⊙
SS-06	1.83	⊕
SS-06	4.88	○
SS-09	6.63	△

ONTARIO MOT GRAIN SIZE 2X_MTO-15786.GPJ_ONTARIO MOT.GDT_3/26/19

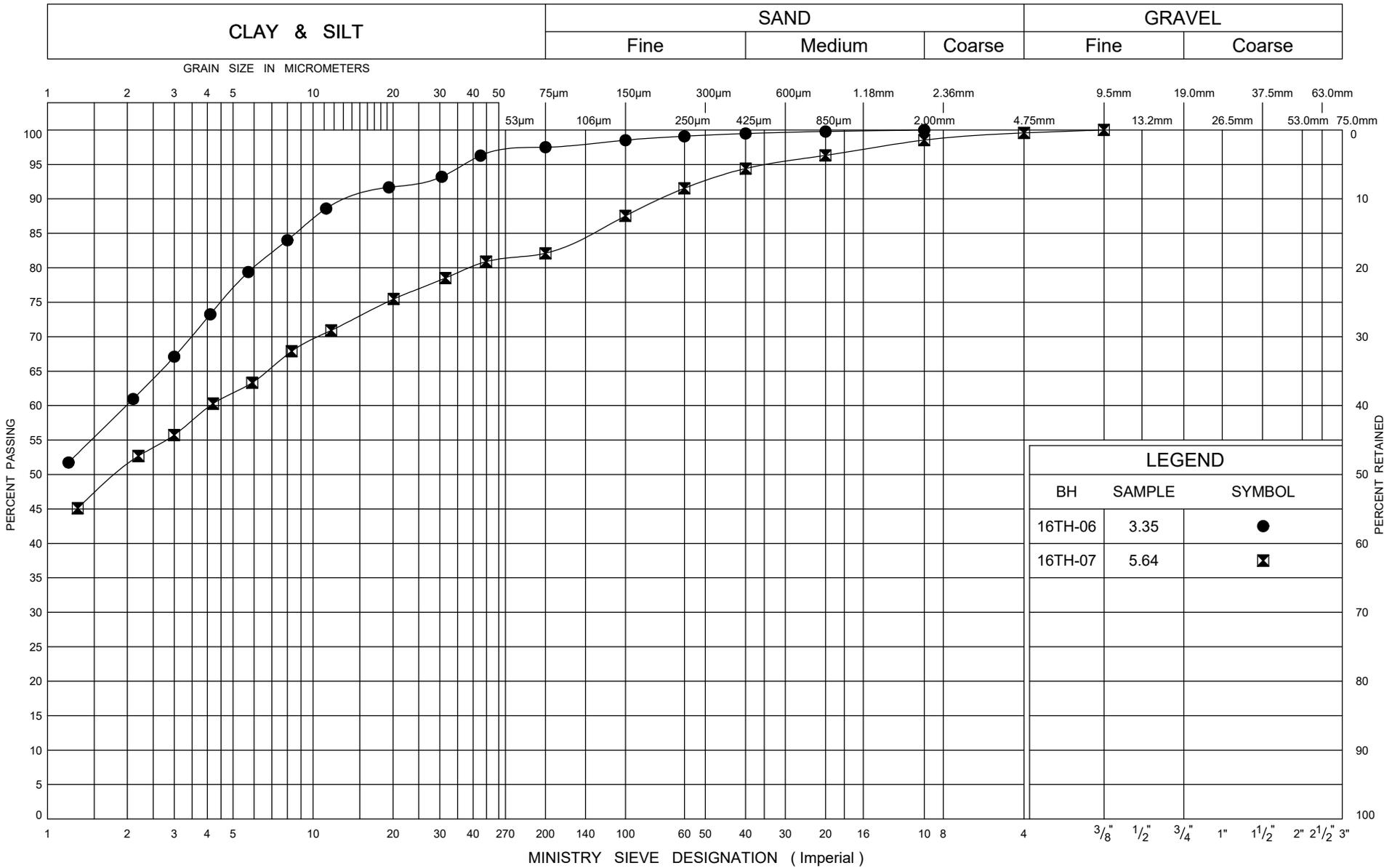


GRAIN SIZE DISTRIBUTION

Lower Clayey SILT to Silty CLAY TILL

FIG No B6

W P 2930-17-00



LEGEND		
BH	SAMPLE	SYMBOL
16TH-06	3.35	●
16TH-07	5.64	⊠

ONTARIO MOT GRAIN SIZE 2X_MTO-15786.GPJ_ONTARIO MOT.GDT_3/26/19

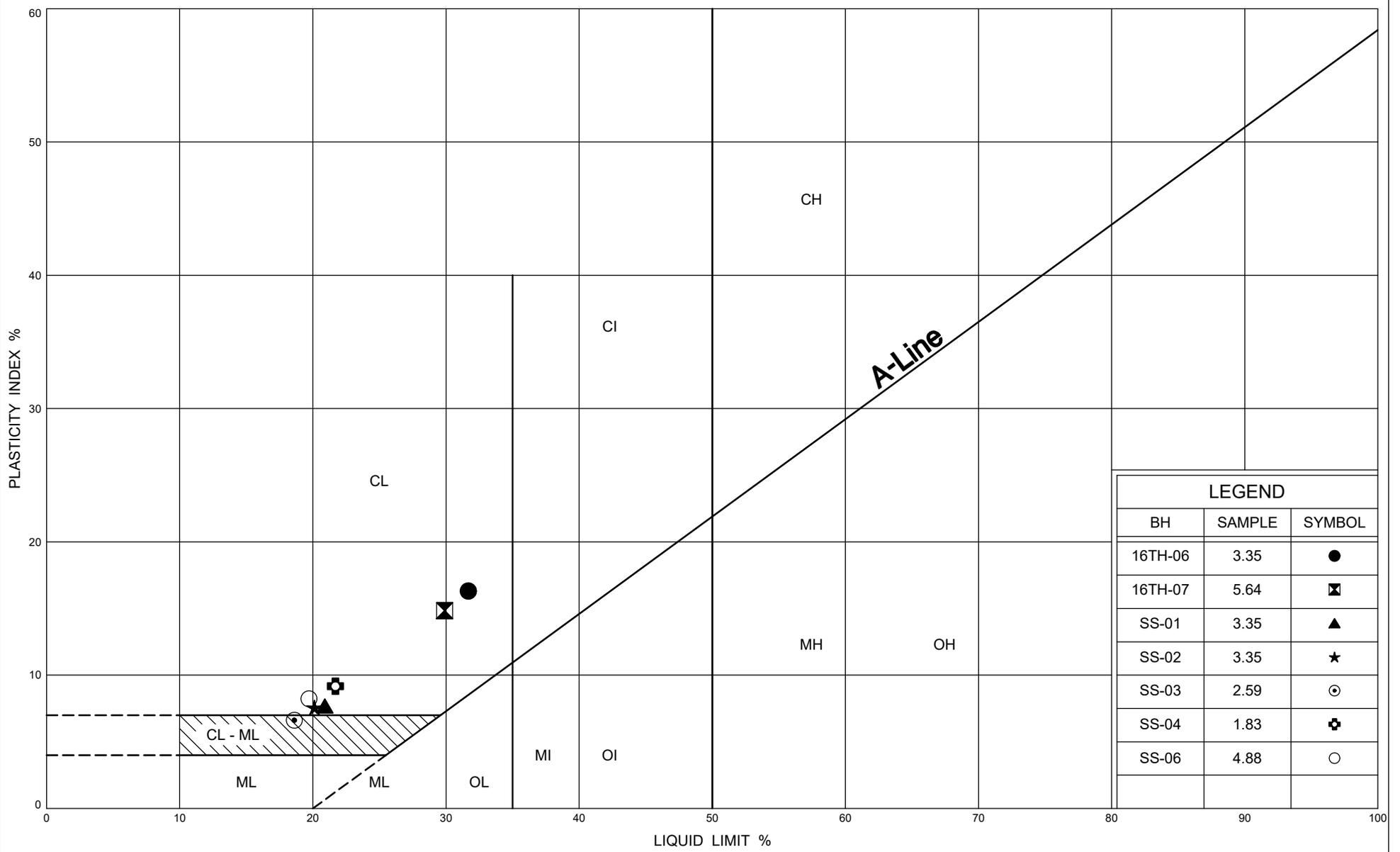


GRAIN SIZE DISTRIBUTION

Lower Silty CLAY TILL

FIG No B7

W P 2930-17-00



LEGEND		
BH	SAMPLE	SYMBOL
16TH-06	3.35	●
16TH-07	5.64	⊠
SS-01	3.35	▲
SS-02	3.35	★
SS-03	2.59	⊙
SS-04	1.83	⊕
SS-06	4.88	○

ONTARIO MOT PLASTICITY CHART MTO-15786.GPJ ONTARIO MOT.GDT 3/26/19



PLASTICITY CHART

Lower Silty CLAY TILL

FIG No B8

W P 2930-17-00



Appendix C

Record of Borehole Sheets (previous investigation)

RECORD OF BOREHOLE No 16TH-06 1 OF 5 METRIC

GWP# 2930-17-00 LOCATION 16th Ave. Overpass, MTM NAD 83 Zone10: N 4 858 374.0 E 314 817.1 ORIGINATED BY SB
 HWY 404 BOREHOLE TYPE Hollow Stem Augers/Tricone COMPILED BY AN
 DATUM Geodetic DATE 2018.06.13 - 2018.06.15 LATITUDE 43.865269 LONGITUDE -79.375377 CHECKED BY RPR

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			20 40 60 80 100	PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W		
190.0	GROUND SURFACE											
0.0	ASPHALT: (175mm)											
0.2	SAND and GRAVEL Brown Moist (FILL)		1	GS								
189.2												
0.8	SAND, trace gravel, trace silt Dense to Compact Brown to Grey Moist		1	SS	33							
187.7			2	SS	23							
2.3	Silty CLAY, trace sand, trace gravel Very Stiff to Firm Grey Moist (TILL)		3	SS	21							
			4	SS	6							
			5	SS	5							
			6	SS	12							
	Stiff											
183.3	Silty SAND, trace clay Compact Grey Wet		7	SS	20							
181.3	Silty CLAY, some sand, trace gravel Very Stiff Grey Wet (TILL)		8	SS	22							
8.7												

ONTMT452, MTO-15786.GPJ 2017TEMPLATE(MTO).GDT 1/31/19

Continued Next Page

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

RECORD OF BOREHOLE No 16TH-06 2 OF 5 **METRIC**

GWP# 2930-17-00 LOCATION 16th Ave. Overpass, MTM NAD 83 Zone10: N 4 858 374.0 E 314 817.1 ORIGINATED BY SB
 HWY 404 BOREHOLE TYPE Hollow Stem Augers/Tricone COMPILED BY AN
 DATUM Geodetic DATE 2018.06.13 - 2018.06.15 LATITUDE 43.865269 LONGITUDE -79.375377 CHECKED BY RPR

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			20	40	60	80		
Continued From Previous Page													
	Silty CLAY , some sand, trace gravel Stiff Grey Moist (TILL)	9	SS	11								○	
		10	SS	12								○	
177.5 12.5		11	SS	58								○	
	Hard	12	SS	75								○	
		13	SS	57								○	
		14	SS	30								○	
		15	SS	27								○	
170.4 19.6	Silty SAND , some gravel Compact												0 5 66 29

ONT/MT/452_MTO-15786.GPJ_2017TEMPLATE(MTO).GDT_1/31/19

Continued Next Page

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

RECORD OF BOREHOLE No 16TH-06 4 OF 5 **METRIC**

GWP# 2930-17-00 LOCATION 16th Ave. Overpass, MTM NAD 83 Zone10: N 4 858 374.0 E 314 817.1 ORIGINATED BY SB
 HWY 404 BOREHOLE TYPE Hollow Stem Augers/Tricone COMPILED BY AN
 DATUM Geodetic DATE 2018.06.13 - 2018.06.15 LATITUDE 43.865269 LONGITUDE -79.375377 CHECKED BY RPR

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	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE							
Continued From Previous Page														
157.4	Silty SAND , trace gravel, trace clay Very Dense Grey Wet (TILL)	19	SS	100/ 0.125									4 70 18 8	
32.6	Silty CLAY , with sand, trace gravel Hard Grey Moist (TILL)	20	SS	68										
		21	SS	100/ 0.200										
		22	SS	100/ 0.250									0 22 38 40	
150.8		23	SS	100/ 0.175										
39.2	END OF BOREHOLE AT 39.2m. Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen.													

ONTMT452, MTO-15786.GPJ 2017TEMPLATE(MTO).GDT 1/31/19

Continued Next Page

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

RECORD OF BOREHOLE No 16TH-06 5 OF 5 METRIC

GWP# 2930-17-00 LOCATION 16th Ave. Overpass, MTM NAD 83 Zone10: N 4 858 374.0 E 314 817.1 ORIGINATED BY SB
 HWY 404 BOREHOLE TYPE Hollow Stem Augers/Tricone COMPILED BY AN
 DATUM Geodetic DATE 2018.06.13 - 2018.06.15 LATITUDE 43.865269 LONGITUDE -79.375377 CHECKED BY RPR

SOIL PROFILE			SAMPLES				GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV. DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	20			40	60	80	100					
	Continued From Previous Page WATER LEVEL READINGS DATE DEPTH(m) ELEV.(m) 2018.10.09 3.1 186.9 2018.11.22 0.0 190.0																

ONTMT4S2_MTO-15786.GPJ_2017TEMPLATE(MTO).GDT_1/31/19

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

RECORD OF BOREHOLE No 16TH-07 2 OF 4 **METRIC**

GWP# 2930-17-00 LOCATION 16th Ave. Overpass, MTM NAD 83 Zone10: N 4 858 357.8 E 314 812.8 ORIGINATED BY SB
 HWY 404 BOREHOLE TYPE Tricone COMPILED BY AN
 DATUM Geodetic DATE 2018.06.25 - 2018.06.27 LATITUDE 43.865124 LONGITUDE -79.375431 CHECKED BY RPR

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	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
Continued From Previous Page					20 40 60 80 100 ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE				WATER CONTENT (%)				
					20 40 60 80 100 W _p W W _L				20 40 60				
10.0	Silty CLAY , some sand, trace gravel Very Stiff to Hard Grey Wet (TILL)	8	SS	17									
		9	SS	17									
		10	SS	17									
		11	SS	62									
		12	SS	35									
		13	SS	21									
		14	SS	19									
171.1		Silty SAND , some clay, trace gravel Compact Grey Wet (TILL)											
18.9													
170.0													

ONTMT452_MTO-15786.GPJ_2017TEMPLATE(MTO).GDT_1/31/19

Continued Next Page

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

RECORD OF BOREHOLE No 16TH-07 4 OF 4 METRIC

GWP# 2930-17-00 LOCATION 16th Ave. Overpass, MTM NAD 83 Zone10: N 4 858 357.8 E 314 812.8 ORIGINATED BY SB
 HWY 404 BOREHOLE TYPE Tricone COMPILED BY AN
 DATUM Geodetic DATE 2018.06.25 - 2018.06.27 LATITUDE 43.865124 LONGITUDE -79.375431 CHECKED BY RPR

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV. DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa							
	Continued From Previous Page					20 40 60 80 100									
157.7	SAND and SILT Very Dense Grey Wet (TILL)	0.200	19	SS	100/										
32.3	Silty CLAY , some sand, trace gravel Hard Grey Moist (TILL)	0.100	20	SS	65										
155.4		0.175	21	SS	100/										
34.6	END OF BOREHOLE AT 34.6m. Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 6.10m slotted screen. WATER LEVEL READINGS DATE DEPTH(m) ELEV.(m) 2018.08.20 0.0 190.0 2018.10.09 0.8 189.2														

ONT/MT452_MTO-15786.GPJ_2017TEMPLATE(MTO).GDT_1/31/19

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



Appendix D

Borehole Locations and Soil Strata Drawings

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

CONT No
GWP No 2930-17-00



HIGHWAY 404
AT 16TH AVENUE
STORM SEWER
BOREHOLE LOCATIONS AND SOIL STRATA

SHEET



THURBER ENGINEERING LTD.



KEYPLAN

LEGEND

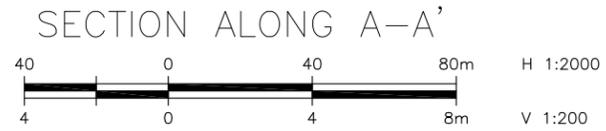
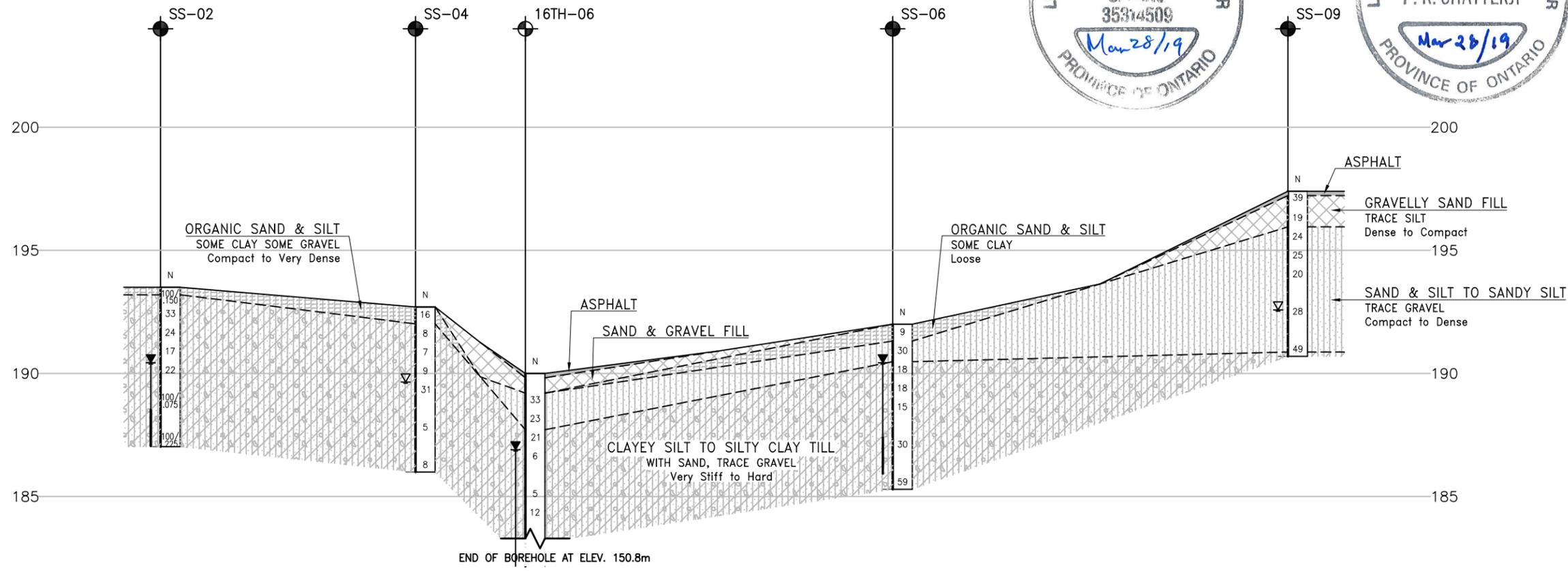
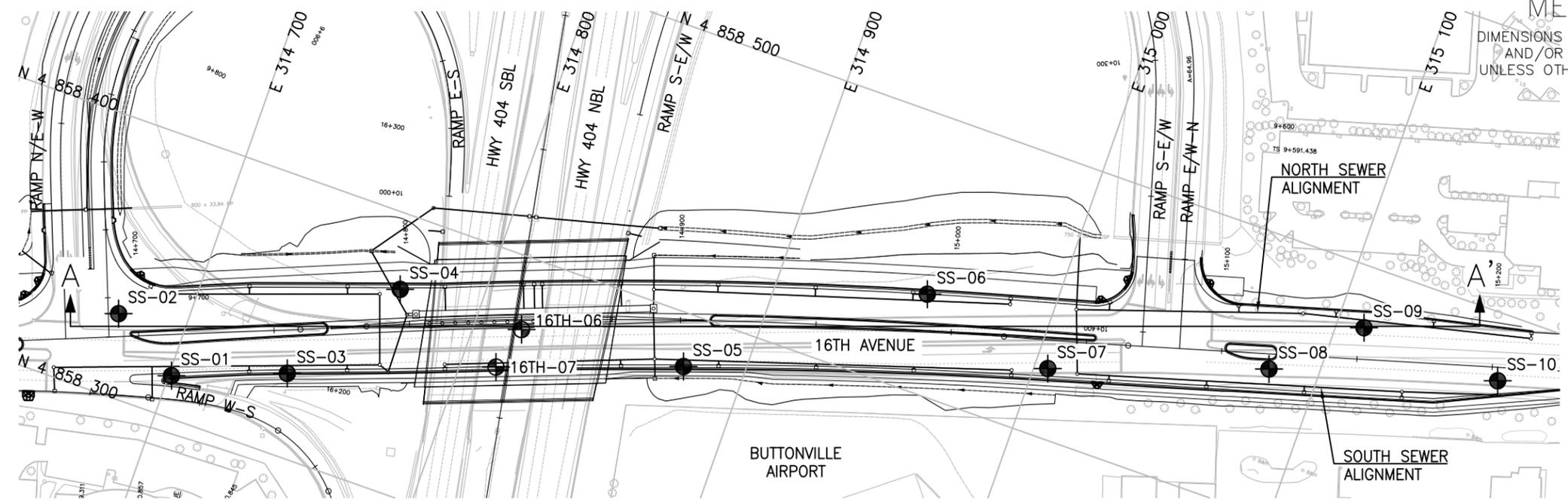
- Borehole (Current Investigation)
- ⊕ Borehole (Previous Investigations)
- N Blows /0.3m (Std Pen Test, 475J/blow)
- CONE Blows /0.3m (60' Cone, 475J/blow)
- PH Pressure, Hydraulic
- ▽ Water Level (Open Borehole)
- ⊥ Piezometer
- 90% Rock Quality Designation (RQD)
- A/R Auger Refusal

NO	ELEVATION	NORTHING	EASTING
16TH-06	190.0	4 858 374.0	314 817.1
16TH-07	190.0	4 858 357.8	314 812.8
SS-01	192.4	4 858 315.0	314 701.0
SS-02	193.5	4 858 330.0	314 675.0
SS-03	191.0	4 858 330.0	314 741.0
SS-04	192.7	4 858 373.0	314 770.0
SS-05	190.6	4 858 381.0	314 878.0
SS-06	192.0	4 858 436.0	314 954.0
SS-07	193.8	4 858 425.0	315 005.0
SS-08	196.5	4 858 452.0	315 082.0
SS-09	197.4	4 858 478.0	315 110.0
SS-10	198.2	4 858 476.0	315 163.0

-NOTES-

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

GEOCREs No. 30M14-503



REVISIONS	DATE	BY	DESCRIPTION

DESIGN	CHK	SKP	CODE	LOAD	DATE	MAR 2019
DRAWN	AN	CHK	CZ	SITE	STRUCT	DWG 1

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

CONT No
GWP No 2930-17-00



HIGHWAY 404
AT 16TH AVENUE
STORM SEWER
BOREHOLE LOCATIONS AND SOIL STRATA

SHEET



THURBER ENGINEERING LTD.



KEYPLAN

LEGEND

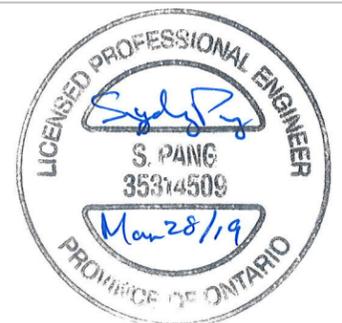
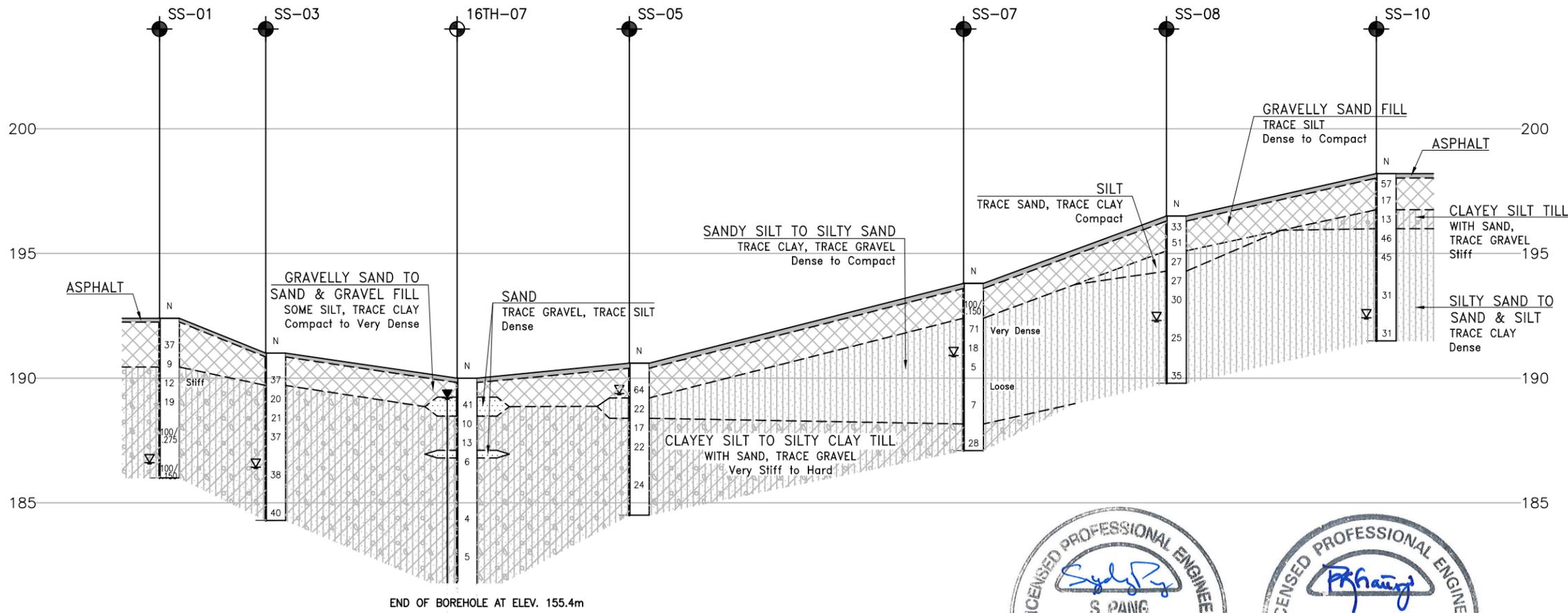
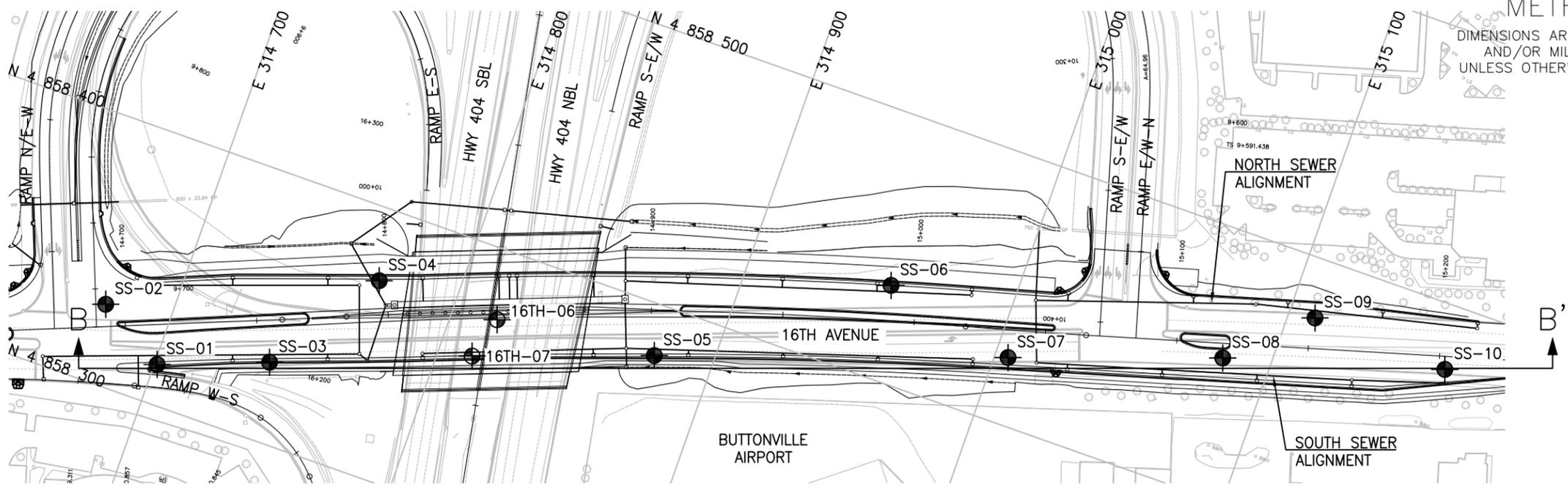
- Borehole (Current Investigation)
- ⊙ Borehole (Previous Investigations)
- N Blows /0.3m (Std Pen Test, 475J/blow)
- CONE Blows /0.3m (60' Cone, 475J/blow)
- PH Pressure, Hydraulic
- ▽ Water Level (Open Borehole)
- ⊥ Piezometer
- 90% Rock Quality Designation (RQD)
- A/R Auger Refusal

NO	ELEVATION	NORTHING	EASTING
16TH-06	190.0	4 858 374.0	314 817.1
16TH-07	190.0	4 858 357.8	314 812.8
SS-01	192.4	4 858 315.0	314 701.0
SS-02	193.5	4 858 330.0	314 675.0
SS-03	191.0	4 858 330.0	314 741.0
SS-04	192.7	4 858 373.0	314 770.0
SS-05	190.6	4 858 381.0	314 878.0
SS-06	192.0	4 858 436.0	314 954.0
SS-07	193.8	4 858 425.0	315 005.0
SS-08	196.5	4 858 452.0	315 082.0
SS-09	197.4	4 858 478.0	315 110.0
SS-10	198.2	4 858 476.0	315 163.0

-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. 30M14-503



REVISIONS	DATE	BY	DESCRIPTION