



**THURBER** ENGINEERING LTD.

**FOUNDATION INVESTIGATION REPORT  
STORM SEWER CROSSING NORTH OF 16<sup>TH</sup> AVENUE  
HIGHWAY 404 HOV LANE EXPANSION AND REHABILITATION  
CONTRACT 2  
MARKHAM, ONTARIO  
G.W.P. 2930-17-00**

**GEOCRES NO. 30M14-504**

**Latitude 43.865635°  
Longitude -79.375491°**

**Report**

to

**WSP Canada Inc.**

Date: March 28, 2019  
File: 15786



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**PART 1: FACTUAL INFORMATION**

**1. INTRODUCTION**

This report presents the factual findings obtained from a foundation investigation conducted for the design and installation of a proposed sewer crossing to be located on the north side of 16<sup>th</sup> Avenue, at the Highway 404 and 16<sup>th</sup> Avenue interchange in the Regional Municipality of York, Ontario. The proposed work forms a part of the project which includes elongation and widening of the Highway 404 overpass structures at 16<sup>th</sup> Avenue.

The purpose of the investigation was to explore the subsurface conditions at the site and, based on the data obtained, provide a borehole location plan, record of boreholes, a stratigraphic profile, and a written description of the subsurface conditions. A model of the subsurface conditions was developed to describe the geotechnical conditions influencing design and installation of the sewer.

Thurber was retained by WSP Canada Inc. (WSP) to carry out this foundation investigation under the Ministry of Transportation Ontario (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:

- Foundation Investigation Report, Highway 404 16<sup>th</sup> Avenue Overpass, Replacement and Widening, Highway 404 HOV Lane Expansion and Rehabilitation, Contract 2, Markham, Ontario, Site 37-366, G.W.P. 2930-02-00, Geocres No. 30M14-487, prepared by Thurber Engineering Ltd., dated January 30, 2018. (Reference 1).

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



## **2. PROJECT AND SITE DESCRIPTION**

The site is located on the north side of the Highway 404 and 16<sup>th</sup> Avenue Overpass in the Region of York.

The project involves installation of a storm sewer, which will cross under the Highway 404 southbound lanes (SBL) and northbound lanes (NBL) from east to west, and will be located approximately 50 m north of the existing 16<sup>th</sup> Avenue centreline, or in the order of 10 m to 12 m north of the crest of the proposed permanent cut as part of the 16<sup>th</sup> Avenue widening.

The proposed sewer pipe is 900 mm in diameter and approximately 88 m long. The crown cover above the pipe will be in the order of 3 m to 4 m.

The approximate location of the proposed sewer is shown on the key plan on the Borehole Locations and Soil Strata Drawing in Appendix D.

The land use adjacent to the site is largely commercial. Buttonville Airport is located on the southeast side of the Highway 404 overpass at 16<sup>th</sup> Avenue.

The site is located within the physiographic region known as the Peel Plain. The topography is flat to 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**

The current borehole investigation and field testing program for this site was carried out on March 18 and 19, 2019, and consisted of drilling and sampling four (4) boreholes, designated as Boreholes TUN-01 to TUN-04. These four boreholes were drilled near the alignment of the proposed sewer crossing. Boreholes TUN-01 and TUN-02 were drilled near the existing Ramp E-S and the Highway 404 SBL, and terminated at 9.8 m depth (Elevations 186.4 and 186.6). Boreholes TUN-03 and TUN-04 were drilled near the Highway 404 NBL and Ramp S-E/W and terminated at 11.3 m depth (Elevations 185.0 and 184.8). The Record of Borehole sheets for the boreholes from this current investigation are included in Appendix A.



Reference has been made to Boreholes 16TH-01, 16TH-02 and 16TH-05 drilled during a previous foundation investigation (Reference 1) at the Highway 404 and 16<sup>th</sup> Avenue overpass. The Record of Borehole sheets of the boreholes from the previous investigation are included in Appendix C.

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 locations of the boreholes from the current and previous investigations are shown on the Borehole Locations and Soil Strata Drawing included in Appendix D. The coordinates and elevations of the boreholes are given on this drawing 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 elevation is the same as that of the DTM survey.

The current boreholes were advanced using truck-mounted D-27 and D-90 drill rigs. 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). During the previous investigation, in situ vane shear testing was carried out to assess the undrained shear strength of firm cohesive deposits.

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 current drilling operations. Upon completion, the boreholes were abandoned in general accordance with Ontario Regulation 903 amended by Ontario Reg. 372 (O.Reg. 903). The details of borehole completion are summarized in Table 3.1.



**Table 3.1 – Borehole Completion Details**

<b>Borehole</b>	<b>Borehole Depth / Base Elevation (m)</b>	<b>Piezometer Tip Depth/ Elevation (m)</b>	<b>Completion Details</b>
TUN-01	9.8/186.4	None installed	Borehole backfilled with bentonite holeplug and auger cuttings to 0.6 m, cement from 0.6 m to 0.2 m, then asphalt to surface.
TUN-02	9.8/186.6	None installed	Borehole backfilled with bentonite holeplug and auger cuttings to 0.5 m, cement from 0.5 m to 0.2 m, then asphalt to surface.
TUN-03	11.3/185.0	None installed	Borehole backfilled with bentonite holeplug and auger cuttings to 1.5 m, auger cuttings from 1.5 m to 0.2 m, then asphalt to surface.
TUN-04	11.3/184.8	None installed	Borehole backfilled with bentonite holeplug and auger cuttings to 1.5 m, auger cuttings from 1.5 m to 0.2 m, then asphalt to surface.

#### **4. LABORATORY TESTING**

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

#### **5. DESCRIPTION OF SUBSURFACE CONDITIONS**

Reference is made to the Record of Borehole sheets in Appendices A and C for details of the encountered soil stratigraphy. A soil profile along the proposed sewer alignment is presented on the “Borehole Locations and Soil Strata” drawing in Appendix D. 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 that soil conditions may vary between and beyond borehole locations.



In general, the subsurface conditions encountered in the boreholes drilled during the current and previous investigations consist of topsoil or pavement structure (asphalt over granular base) overlying embankment fill which typically consists of layers of sand and silty clay. Below the fill lies a native layer of firm to hard silty clay till with interlayers of loose to dense sand to sand and silt. Deeper boreholes drilled during the previous investigation, revealed the presence of compact to dense silty sand till/sand and silt till underlain by a lower layer of silty clay till. During the current investigation, boreholes caved to depths ranging from 5.5 m to 6.7 m, and groundwater levels were measured in the open boreholes at depths ranging from 5.1 m to 6.1 m (Elevations 190.0 to 191.1).

More detailed descriptions of the individual stratum are presented below.

### **5.1 Topsoil**

Topsoil was encountered surficially in Boreholes 16TH-01, 16TH-02 and 16TH-05. The thickness of the topsoil was 125 mm in Boreholes 16TH-01 and 16TH-02, and 800 mm in Borehole 16TH-05.

The topsoil thickness may vary between and beyond the borehole locations, and the data is not intended for the purpose of estimating quantities.

### **5.2 Pavement Structure**

Pavement structure consisting of approximately 150 mm to 200 mm of asphalt overlying granular (sand and gravel fill) road base was encountered in Boreholes TUN-01 to TUN-04. The thickness of the granular road fill varied from 500 mm to 525 mm.

SPT 'N' values, where measured, for the sand and gravel fill were 51 blows per 0.3 m penetration and 100 blows per 0.125 m of penetration, indicating a very dense state. Measured moisture contents of the granular road base were 3 percent and 8 percent.



### 5.3 Embankment Fill

Embankment fill was contacted below the pavement structure and the topsoil in Boreholes TUN-01 to TUN-04, 16TH-01, 16TH-02 and 16TH-05. The embankment fill generally consists of layers of cohesionless and cohesive soils.

The cohesionless fill consists of brown to grey sand containing trace to some gravel and trace silt, and silty sand containing some clay, trace to some gravel and clay pockets. The cohesive fill consists of brown to grey silty clay containing trace to some sand and trace gravel. Occasional black staining, organics, decayed wood pieces and rootlets were noted in the fill material. The thickness of the embankment fill ranged from 0.5 m to 2.6 m.

In general, the depths to the base of the fill ranged from 0.6 m to 3.3 m depth (Elevations 193.0 to 194.8).

SPT 'N' values for the cohesionless fill layer typically ranged from 11 to 37 blows per 0.3 m penetration indicating a generally compact to dense state. Measured moisture contents of the cohesionless fill samples ranged from 8 percent to 18 percent.

SPT 'N' values measured in the cohesive fill ranged from 13 to 21 blows per 0.3 m penetration, indicating a stiff to very stiff consistency. Moisture contents measured in the cohesive fill ranged from 14 percent to 20 percent.

The results of grain size distribution analyses carried out on a selected sample of the cohesionless fill are presented on the Record of Borehole sheets included in Appendix A. Grain size distribution curve of the fill sample tested, is presented in Figure B1 of Appendix B. The results of the grain size distribution analyses are summarized below:

Soil Particle	Silty Sand Fill (percent)
Gravel	7
Sand	43
Silt	33
Clay	17





#### **5.4 Silty Clay Till with Sand and Silt Interlayers**

A native deposit of brown to grey silty clay till containing some sand to with sand and trace gravel was contacted below the fill at depths ranging from 0.6 m to 3.3 m.

Interlayers of sand, silt, silty sand, sandy silt and, sand and silt were encountered within the silty clay till at various depths. An upper sand/sandy silt layer was contacted in Boreholes 16TH-01, 16TH-02 and 16TH-05 at depths ranging from 1.0 m to 1.6 m. A deeper layer of sands and silts was contacted in Boreholes 16TH-01, 16TH-02, 16TH-05 and TUN-01 to TUN-04, at depths ranging from 3.7 m to 5.8 m and at 7.2 m in Borehole 16TH-05. The sand and silt interlayers varied in thickness from 0.7 m to 5.0 m.

The depth to the base of the upper silty clay till was 23.3 m (Elevation 172.0) in Borehole 16TH-05. Boreholes 16TH-01, 16TH-02, and TUN-01 to TUN-04 were terminated within the silty clay till at depths ranging from 9.8 m to 11.3 m (Elevations 184.1 to 186.6).

SPT 'N' values for the silty clay till ranged from 5 to 64 blows per 0.3 m penetration, indicating a firm to hard consistency. Moisture contents in the cohesive glacial till ranged from 10 to 31 percent.

SPT 'N' values measured in the sand and silt interlayers typically ranged from 4 to 47 blows per 0.3 m of penetration, indicating a loose to dense state. Moisture contents in the interlayers of sands and silts varied between 8 and 28 percent.

The results of grain size distribution analyses carried out on selected samples of the silty clay till and the interbedded sands and silts are presented on the Record of Borehole sheets included in Appendices A and C. Grain size distribution curves of samples of the silty clay till and sand/silt layers are presented in Figures B2 to B4 of Appendix B. The results of the grain size distribution analyses are summarized below:



Soil Particle	Silty Clay Till (percent)	Sand and Silt Interlayers (percent)
Gravel	0 to 2	0 to 5
Sand	3 to 28	3 to 76
Silt	29 to 77	16 to 93
Clay	20 to 60	3 to 7

The results of Atterberg Limits tests conducted on samples of the silty clay till of the present and previous investigations are provided on the Record of Borehole sheets in Appendices A and C, and illustrated in Figures B5 and B6 of Appendix B. The results are summarized as follows:

Index Property	Percentage (%)
Liquid Limit	20 to 43
Plasticity Index	7 to 23

The results of the Atterberg Limits testing indicate that the silty clay till is generally of low plasticity with a group symbol of CL, and contains zones of medium plasticity with a group symbol of CI.

Glacial tills inherently contain cobbles and boulders.

## 5.5 Groundwater Conditions

Groundwater levels in the boreholes were observed during the drilling operations and measured upon completion of drilling. During the previous investigation, a standpipe piezometer was installed in Borehole 16TH-01 to permit monitoring of groundwater levels. Water levels measured in the installed standpipe and open boreholes are presented in Table 5.1 below.



**Table 5.1- Groundwater Level Measurements**

Location	Borehole	Date	Groundwater Level		Comments
			Depth (m)	Elevation (m)	
Sewer Crossing (north of 16 <sup>th</sup> Avenue)	TUN-01	March 18, 2019	5.1	191.1	Borehole caved to 6.2 m.
	TUN-02	March 19, 2019	6.1	190.3	Borehole caved to 6.7 m.
	TUN-03	March 18, 2019	6.1	190.2	Borehole caved to 6.4 m.
	TUN-04	March 19, 2019	6.1	190.0	Borehole caved to 5.5 m.
North Approach	16TH-01	June 4, 2018	4.6	190.9	Open borehole
		August 22, 2018	5.7	189.8	Piezometer
		November 23, 2018	4.8	190.7	Piezometer
	16TH-02	June 1, 2018	6.1	189.3	Open borehole

The values shown in Table 5.1 are short-term readings, and seasonal fluctuations of the groundwater level are to be expected. In particular, the groundwater level 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. Thurber obtained the northing and easting coordinates at this site, and WSP provided the ground surface elevations.

Walker Drilling of Utopia, Ontario and DBW Drilling Limited of Ajax, Ontario, supplied and operated truck-mounted drill rigs to carry out the drilling, sampling and in-situ testing operations for 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 Ms. Rocío Palomeque Reyna, 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.



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Client: WSP  
File No.: 15786

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## **Appendix A**

### **Record of Borehole Sheets (Present Site Investigation)**

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

### 1. TEXTURAL CLASSIFICATION OF SOILS

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

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

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

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

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

NOTE: Hierarchy of Soil Strength Prediction

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



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

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

### 5. LEGEND FOR RECORDS OF BOREHOLES

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

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

 Water Level  
 Shear Strength Determination by Pocket Penetrometer


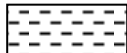



- (1) SPT 'N' Value      Standard Penetration Test 'N' Value – refers to the number of blows from a 63.5kg hammer free falling a height of 0.76m to advance a standard 50 mm outside diameter split spoon sampler for 0.3 m depth into undisturbed ground.
- (2) DCPT      Dynamic Cone Penetration Test – Continuous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

# UNIFIED SOILS CLASSIFICATION

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



## EXPLANATION OF ROCK LOGGING TERMS

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

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

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

# RECORD OF BOREHOLE No TUN-01

1 OF 2

METRIC

GWP# 2930-17-00 LOCATION N 4 858 407.9 E 314 779.3 ORIGINATED BY KK  
 HWY 404 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN  
 DATUM Geodetic DATE 2019.03.18 - 2019.03.18 LATITUDE 43.865575 LONGITUDE -79.375847 CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)							
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa												
196.2	GROUND SURFACE							20	40	60	80	100								
0.0	ASPHALT: (175mm)							20	40	60	80	100								
0.2	SAND and GRAVEL, trace silt Very Dense Brown Moist (FILL)		1	SS	51		196													
195.5																				
0.7	Silty SAND, some clay, trace gravel, occasional black staining, occasional clay pockets		2	SS	15		195													7 43 33 17
194.8	Compact Dark Grey Moist (FILL)		3	SS	21															
1.4																				
193.8	Silty CLAY, some sand, trace gravel, trace silt, occasional decayed wood pieces and rootlets Very Stiff Grey Moist (FILL)		4	SS	15		194													
2.4																				
192.3	Silty CLAY, some sand, trace gravel, oxidized stains Stiff to Very Stiff Brown Moist (TILL)		5	SS	17		193													0 11 29 60
3.9	SILT, trace gravel, trace clay Compact Grey Wet		6	SS	20		192													
			7	SS	13															0 3 93 4
							191													
190.6																				
5.6	Silty CLAY, with sand, trace gravel Stiff to Very Stiff Grey Moist (TILL)		8	SS	15		190													
							189													
			9	SS	26		188													
							187													
	Hard		10	SS	64															
186.4																				
9.8	END OF BOREHOLE AT 9.8m.																			

Continued Next Page

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

RECORD OF BOREHOLE No TUN-01

2 OF 2

METRIC

GWP# 2930-17-00 LOCATION N 4 858 407.9 E 314 779.3 ORIGINATED BY KK  
 HWY 404 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN  
 DATUM Geodetic DATE 2019.03.18 - 2019.03.18 LATITUDE 43.865575 LONGITUDE -79.375847 CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100					
	Continued From Previous Page BOREHOLE CAVED TO 6.2m AND WATER LEVEL AT 5.1m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND AUGER CUTTINGS TO 0.6m, CEMENT TO 0.2m, THEN ASPHALT TO SURFACE.																

ONTMT452 MTO-15786.GPJ 2017TEMPLATE(MTO).GDT 3/28/19

# RECORD OF BOREHOLE No TUN-02

1 OF 2

METRIC

GWP# 2930-17-00 LOCATION N 4 858 416.0 E 314 795.6 ORIGINATED BY KK  
 HWY 404 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN  
 DATUM Geodetic DATE 2019.03.19 - 2019.03.19 LATITUDE 43.865648 LONGITUDE -79.375644 CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT  <b>γ</b>  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)  GR SA SI CL		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED      + FIELD VANE ● QUICK TRIAXIAL    × LAB VANE							WATER CONTENT (%) W <sub>P</sub> W                      W <sub>L</sub>	
196.4	GROUND SURFACE															
0.0	ASPHALT: (200mm)															
0.2	SAND and GRAVEL, trace silt Very Dense Brown		1	SS	100/											
195.7	Moist (FILL)				0.125											
0.7	Silty SAND, some clay, trace gravel, clay pockets Compact Brown to Grey Moist (FILL) Layer of silty clay fill at 1.2m (200mm) Decayed wood pieces at 1.5m		2	SS	15											
			3	SS	25											
194.0																
2.4	Silty CLAY, some sand, trace gravel, oxidized stains Very Stiff to Hard Brown Moist (TILL)		4	SS	16											
			5	SS	31											
			6	SS	25											
191.9																
4.5	Sandy SILT, trace gravel, trace clay Compact Grey Wet		7	SS	27											
			8	SS	26											
	Some clay		9	SS	13											
187.7																
8.7	Silty CLAY, with sand, trace gravel Hard Grey Moist (TILL)															
			10	SS	53											
186.6																
9.8	END OF BOREHOLE AT 9.8m.															

Continued Next Page

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

20  
15  
10  
(%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No TUN-02

2 OF 2

METRIC

GWP# 2930-17-00 LOCATION N 4 858 416.0 E 314 795.6 ORIGINATED BY KK  
 HWY 404 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN  
 DATUM Geodetic DATE 2019.03.19 - 2019.03.19 LATITUDE 43.865648 LONGITUDE -79.375644 CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
	Continued From Previous Page																
	BOREHOLE CAVED TO 6.7m AND WATER LEVEL AT 6.1m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND AUGER CUTTINGS TO 0.5m, CEMENT TO 0.2m, THEN ASPHALT TO SURFACE.																

# RECORD OF BOREHOLE No TUN-03

1 OF 2

METRIC

GWP# 2930-17-00 LOCATION N 4 858 417.0 E 314 819.0 ORIGINATED BY BL  
 HWY 404 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN  
 DATUM Geodetic DATE 2019.03.18 - 2019.03.18 LATITUDE 43.865656 LONGITUDE -79.375353 CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				UNIT WEIGHT  <b>γ</b>  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)						
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa											
196.3	GROUND SURFACE							20	40	60	80	100							
0.0	ASPHALT: (175mm)							20	40	60	80	100							
0.2	SAND and GRAVEL, trace silt Compact Brown		1	GS			196												
195.6	Moist (FILL)																		
0.7	Silty CLAY, some sand, trace gravel Very Stiff Grey		1	SS	20		195												
194.9	Moist (FILL)																		
1.4	Silty SAND, trace gravel, trace clay, clay pockets Compact Grey		2	SS	20		194												
194.1	Moist (FILL)																		
2.2	Silty CLAY, trace sand, trace gravel, occasional decayed wood pieces Stiff Grey		3	SS	13		194												
193.0	Moist (FILL)																		
3.3	Silty CLAY, some sand, trace gravel Very Stiff Grey		4	SS	11		193												
	Moist (FILL)																		
	Silty CLAY, some sand, trace gravel Very Stiff Grey		5	SS	23		192												
	Moist (TILL)																		
			6	SS	22		191												
190.7							191												
5.6	SAND, some silt, trace gravel, trace clay Loose to Compact Grey Wet to Moist		7	SS	5		190												
							189												
188.4			8	SS	15		188												
7.9	Silty CLAY, with sand, trace gravel Stiff to Very Stiff Grey Moist (TILL)						188												
			9	SS	26		187												

Continued Next Page


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

# RECORD OF BOREHOLE No TUN-03

2 OF 2

METRIC

GWP# 2930-17-00 LOCATION N 4 858 417.0 E 314 819.0 ORIGINATED BY BL  
 HWY 404 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN  
 DATUM Geodetic DATE 2019.03.18 - 2019.03.18 LATITUDE 43.865656 LONGITUDE -79.375353 CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100					
	Continued From Previous Page																
185.0	Silty <b>CLAY</b> , with sand, trace gravel Hard Grey Moist (TILL)		10	SS	62												
11.3	END OF BOREHOLE AT 11.3m. BOREHOLE CAVED TO 6.4m AND WATER LEVEL AT 6.1m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND AUGER CUTTINGS TO 1.5m, AUGER CUTTINGS TO 0.2m, THEN ASPHALT TO SURFACE.																

# RECORD OF BOREHOLE No TUN-04

1 OF 2

METRIC

GWP# 2930-17-00 LOCATION N 4 858 428.9 E 314 838.5 ORIGINATED BY BL  
 HWY 404 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN  
 DATUM Geodetic DATE 2019.03.19 - 2019.03.19 LATITUDE 43.865763 LONGITUDE -79.375110 CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				UNIT WEIGHT  <b>γ</b>  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)  GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					
								WATER CONTENT (%)					
196.1	GROUND SURFACE												
0.0	ASPHALT: (150mm)												
0.2	SAND and GRAVEL, trace silt Brown Moist (FILL)		1	GS									
195.4													
0.7	Silty SAND, some gravel, trace clay, clay pockets Compact Brown to Grey Moist (FILL)		1	SS	24								
			2	SS	28								
	Occasional decayed wood pieces		3	SS	20								
193.1													
3.0	Silty CLAY, trace to some sand, trace gravel Stiff to Very Stiff Grey Moist (TILL)		4	SS	10								
			5	SS	20								
			6	SS	15								
190.5													
5.6	SAND and SILT, trace gravel, trace clay Compact Grey Moist to Wet		7	SS	16								
			8	SS	14								
187.4													
8.7	Silty CLAY, with sand, trace gravel Very Stiff Grey Moist (TILL)		9	SS	23								

Continued Next Page

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

20  
15  
10  
(%) STRAIN AT FAILURE




RECORD OF BOREHOLE No TUN-04

2 OF 2

METRIC

GWP# 2930-17-00 LOCATION N 4 858 428.9 E 314 838.5 ORIGINATED BY BL  
 HWY 404 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN  
 DATUM Geodetic DATE 2019.03.19 - 2019.03.19 LATITUDE 43.865763 LONGITUDE -79.375110 CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100					
	Continued From Previous Page																
184.8	Silty <b>CLAY</b> , with sand, trace gravel Very Stiff Grey Moist (TILL)		10	SS	28		186										
185																	
11.3	END OF BOREHOLE AT 11.3m. WATER LEVEL AT 6.1m BEFORE BOREHOLE CAVING TO 5.5m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND AUGER CUTTINGS TO 1.5m, AUGER CUTTINGS TO 0.2m, THEN ASPHALT TO SURFACE.																

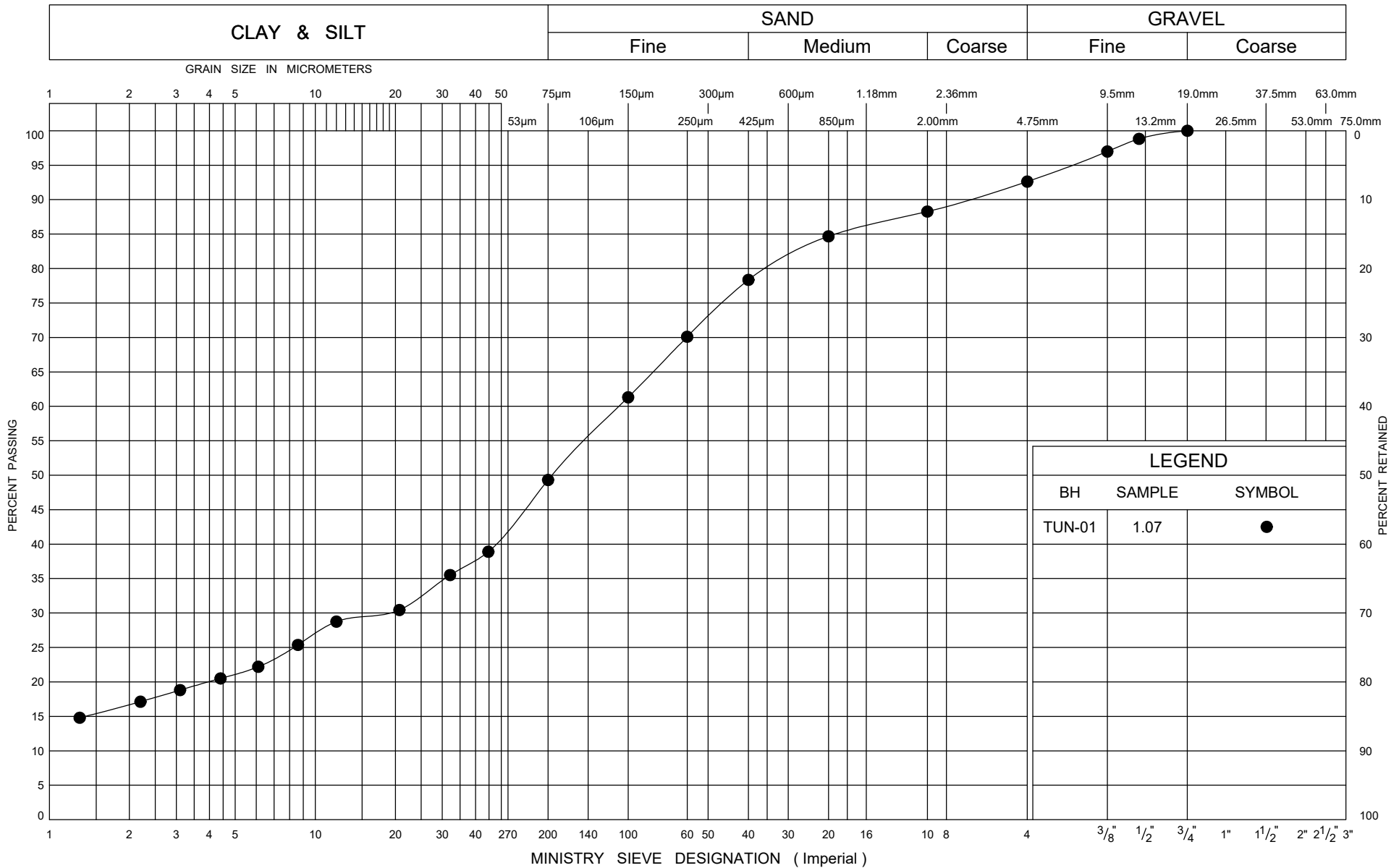
+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to  
Sensitivity

20  
15  
10  
5  
0  
5  
10  
15  
20  
(%) STRAIN AT FAILURE



## **Appendix B**

### **Geotechnical Laboratory Test Results (Present and Previous Site Investigation)**



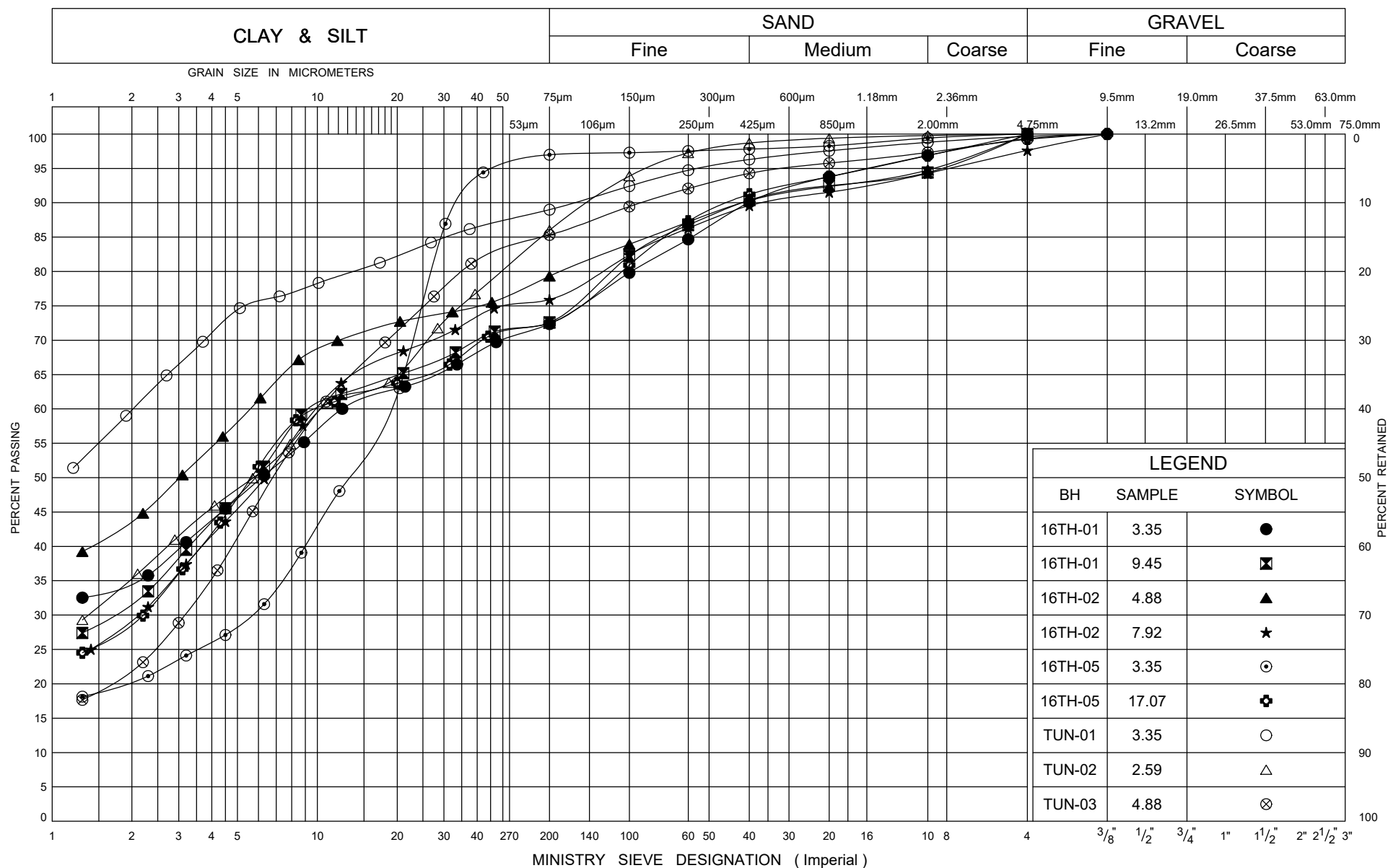
Ministry of  
Transportation

## GRAIN SIZE DISTRIBUTION

### Silty SAND FILL

FIG No B1

W P 2930-17-00



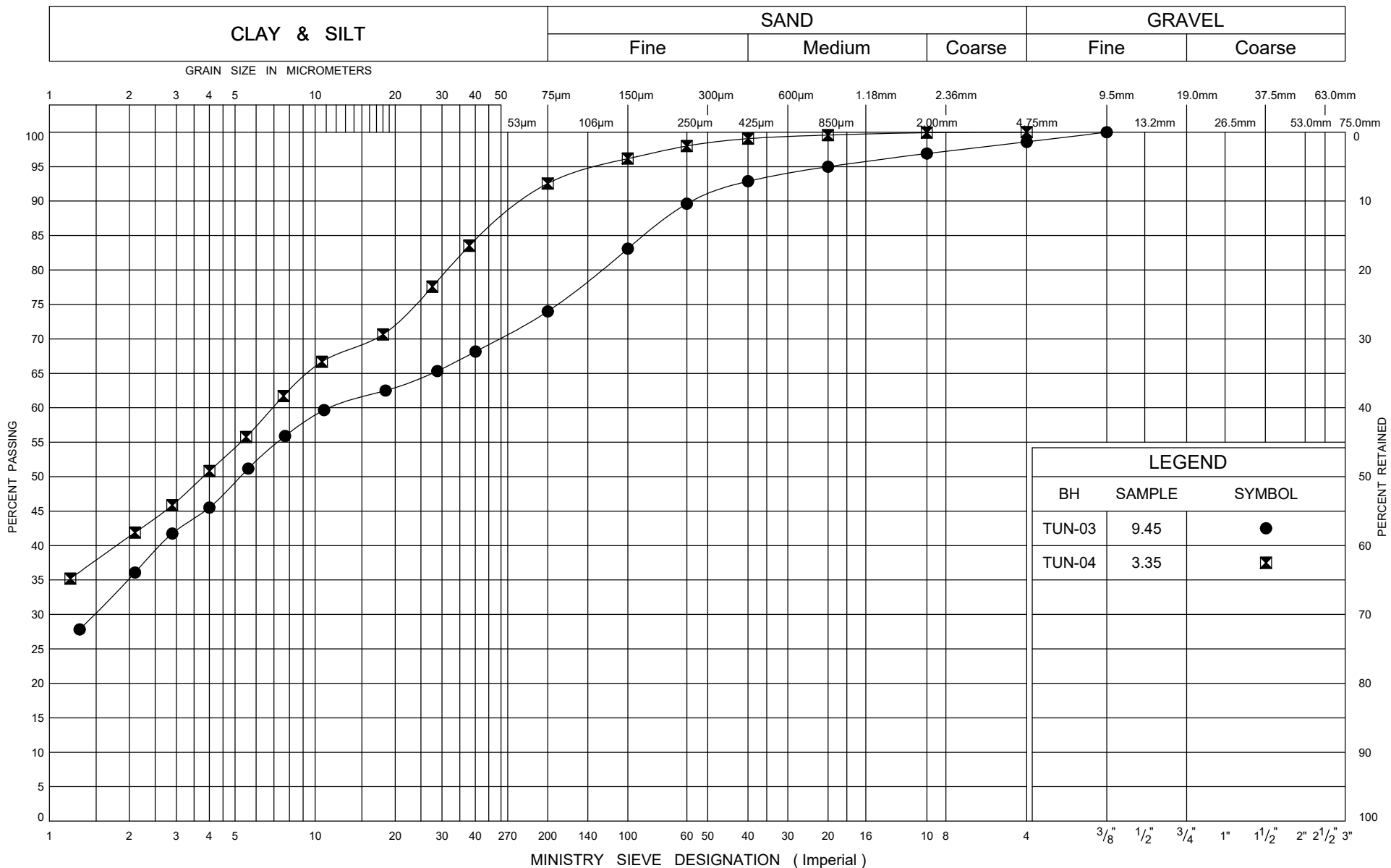
Ministry of  
Transportation

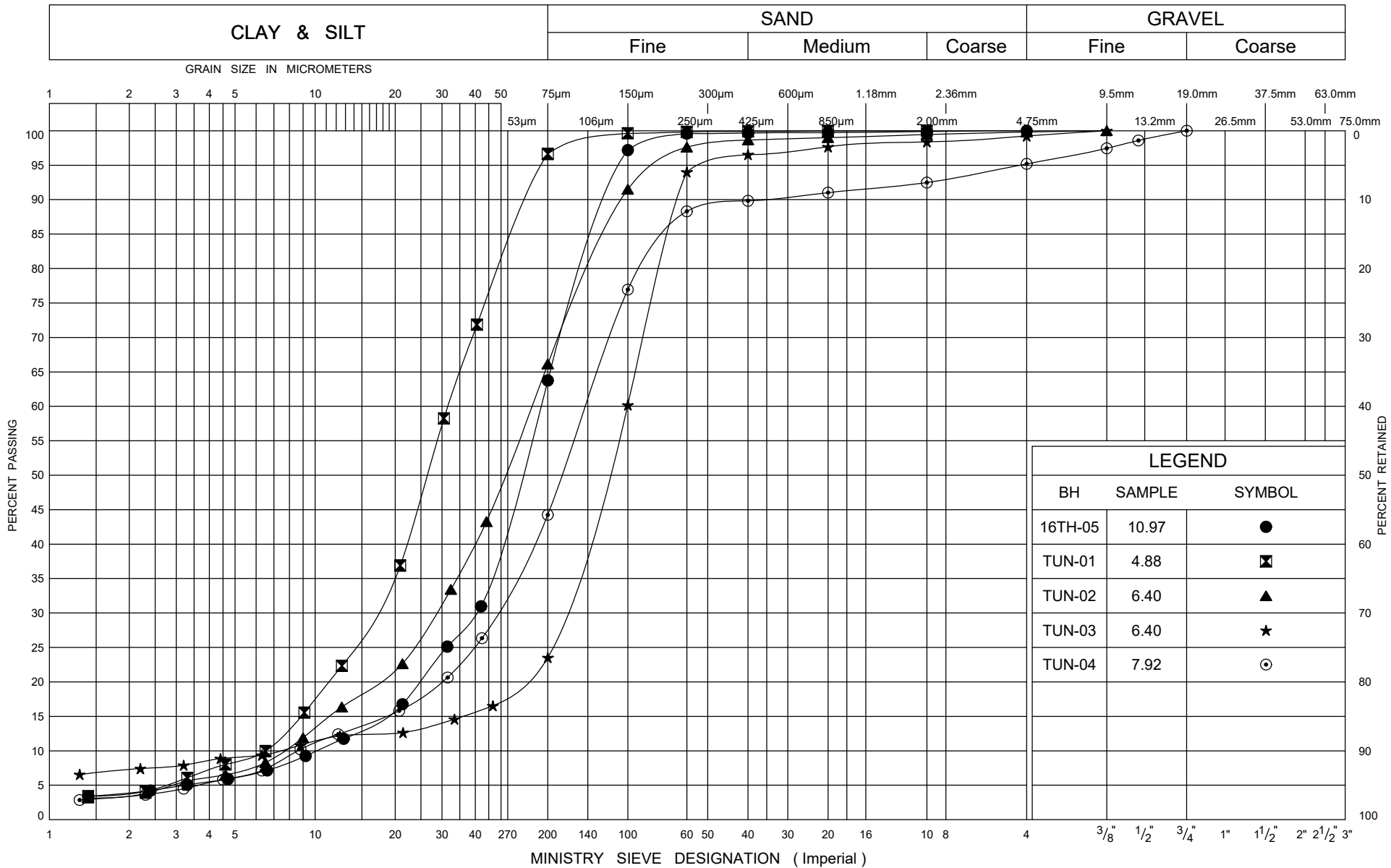
## GRAIN SIZE DISTRIBUTION

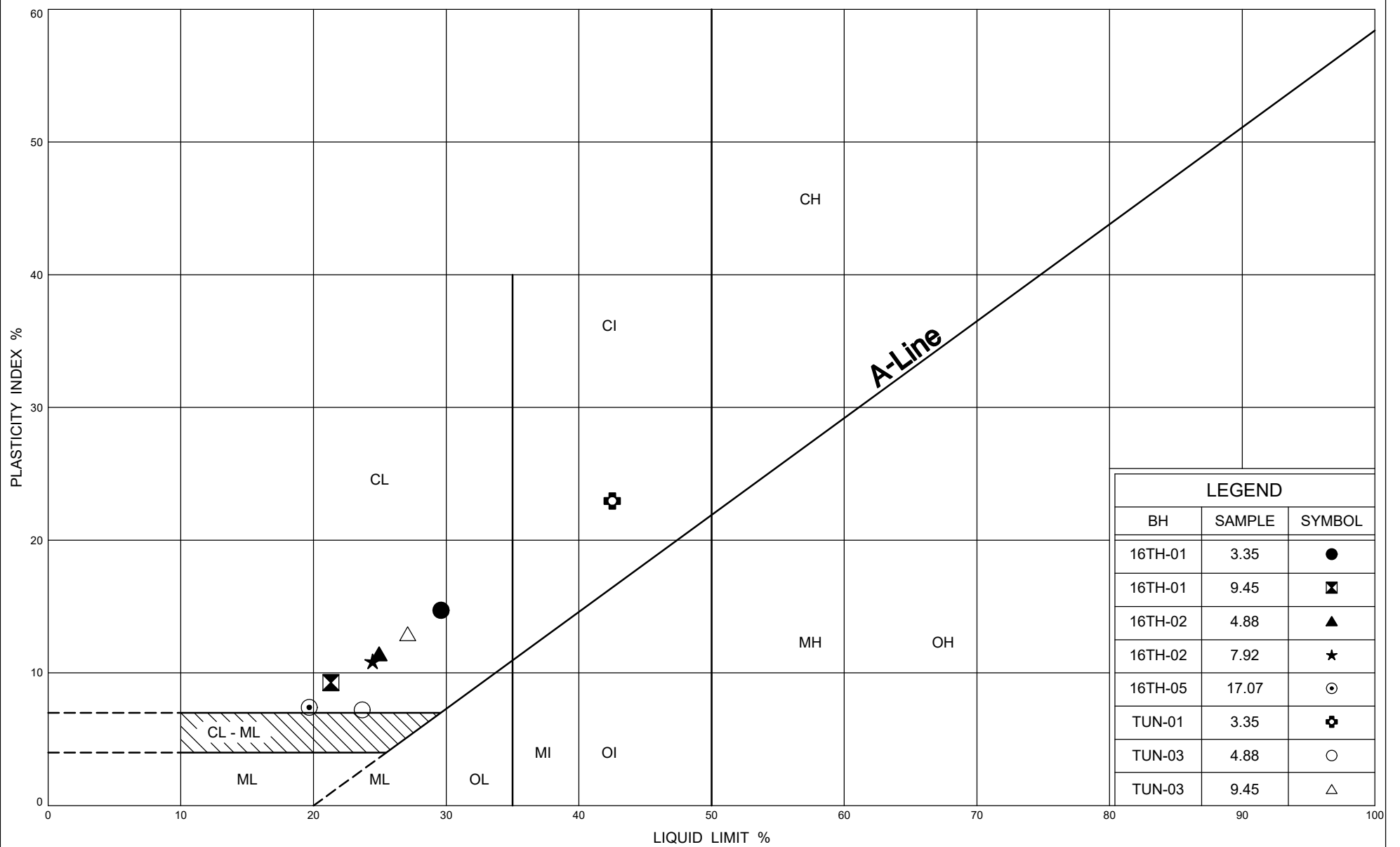
### Silty CLAY TILL

FIG No B2

W P 2930-17-00







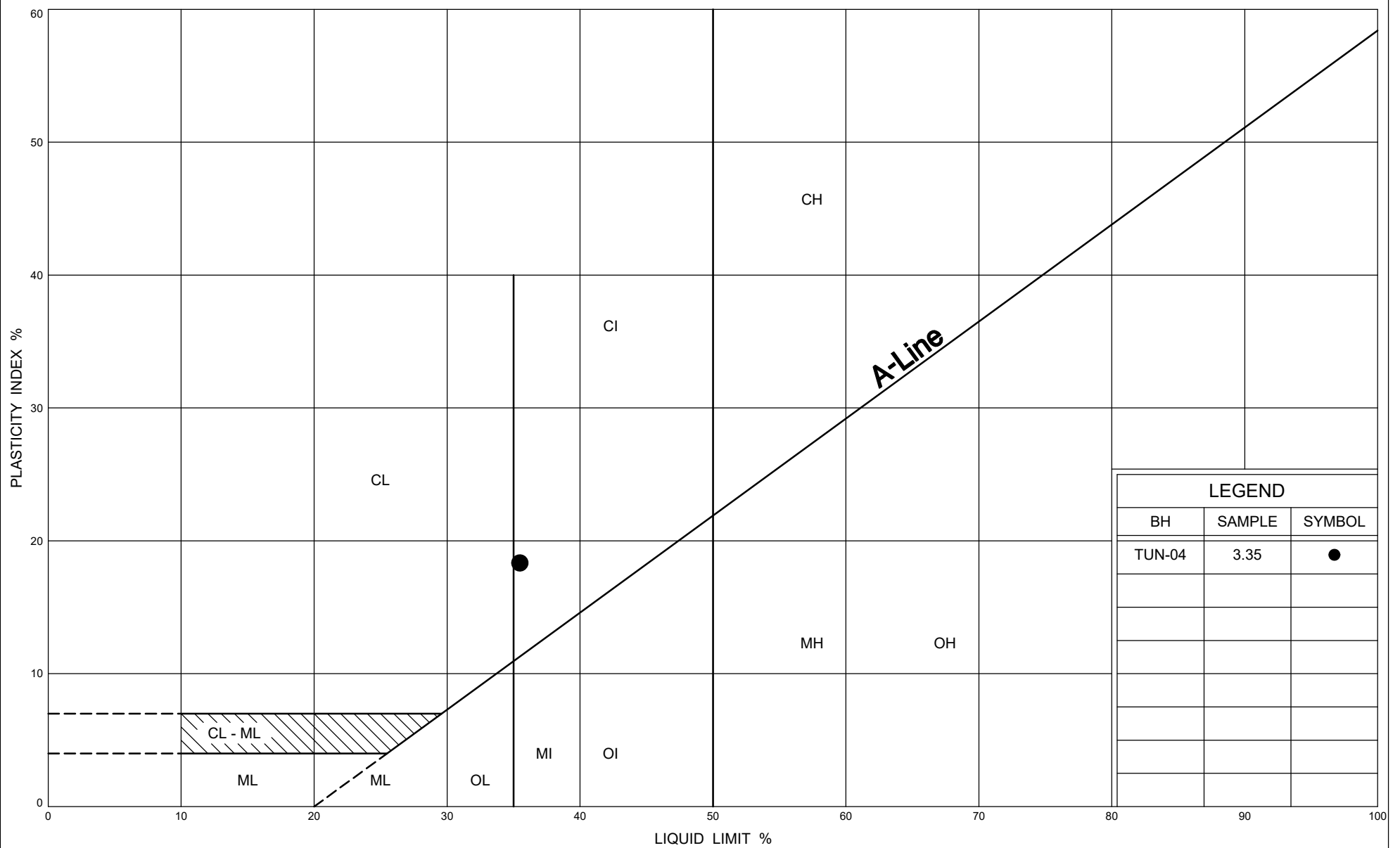
Ministry of  
Transportation

## PLASTICITY CHART

Silty CLAY TILL

FIG No B5

W P 2930-17-00







## **Appendix C**

### **Record of Borehole Sheets (Previous Site Investigation)**

# RECORD OF BOREHOLE No 16TH-01

1 OF 2

METRIC

GWP# 2930-17-00 LOCATION 16th Ave. Overpass, MTM NAD 83 Zone10: N 4 858 407.9 E 314 803.6 ORIGINATED BY SB  
 HWY 404 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN  
 DATUM Geodetic DATE 2018.06.01 - 2018.06.04 LATITUDE 43.865575 LONGITUDE -79.375544 CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
195.5	GROUND SURFACE							20	40	60	80	100		
0.0	TOPSOIL: (125mm)													
0.1	SAND, trace silt, trace gravel Compact Brown		1	SS	19		195							
194.7	Moist (FILL)													
0.8	Silty CLAY, with sand, trace gravel Very Stiff Brown		2	SS	18		194							
193.9	Moist (TILL)													
1.6	SAND, some silt Compact Brown		3	SS	14		193							
193.2	Moist													
2.3	Silty CLAY, with sand, trace gravel Stiff to Very Stiff Brown to Grey Moist (TILL)		4	SS	10		192							
191.8			5	SS	17		191							
3.7	SAND, some silt, occasional cobbles Compact Grey Wet						190							
			6	SS	11		189							
189.4							188							
6.1	Silty CLAY, with sand, trace gravel Stiff Grey Wet (TILL)		7	SS	12		187							
			8	SS	15		186							
186.7														
8.8	SAND, some silt Grey Wet													
186.3														
9.2	Hard		9	SS	59									

Continued Next Page

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

RECORD OF BOREHOLE No 16TH-01 2 OF 2 METRIC

GWP# 2930-17-00 LOCATION 16th Ave. Overpass, MTM NAD 83 Zone10: N 4 858 407.9 E 314 803.6 ORIGINATED BY SB  
 HWY 404 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN  
 DATUM Geodetic DATE 2018.06.01 - 2018.06.04 LATITUDE 43.865575 LONGITUDE -79.375544 CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE									
184.2	Silty <b>CLAY</b> , with sand, trace gravel Hard Grey Wet (TILL)		10	SS	50		185										
11.3	END OF BOREHOLE AT 11.3m. WATER LEVEL AT 4.6m UPON COMPLETION. Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 3.05m slotted screen.  WATER LEVEL READINGS DATE      DEPTH(m)    ELEV.(m) 2018.08.22      5.7      189.8 2018.11.23      4.8      190.7																

## METRIC

[illegible]

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

ONTMT4S2 MTO-15786.GPJ 2017TEMPLATE(MTO).GDT 3/28/19

# RECORD OF BOREHOLE No 16TH-02

2 OF 2

METRIC

GWP# 2930-17-00 LOCATION 16th Ave. Overpass, MTM NAD 83 Zone10: N 4 858 407.4 E 314 812.8 ORIGINATED BY SB  
 HWY 404 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN  
 DATUM Geodetic DATE 2018.06.01 - 2018.06.01 LATITUDE 43.865570 LONGITUDE -79.375430 CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE									
184.1	Continued From Previous Page Silty <b>CLAY</b> , with sand, trace gravel Very Stiff Grey Moist (TILL)		10	SS	25		185										
11.3	END OF BOREHOLE AT 11.3m. WATER LEVEL AT 6.1m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND AUGER CUTTINGS TO SURFACE.																

# RECORD OF BOREHOLE No 16TH-05

1 OF 4

METRIC

GWP# 2930-17-00 LOCATION 16th Ave. Overpass, MTM NAD 83 Zone10: N 4 858 416.6 E 314 847.4 ORIGINATED BY BL/JNP  
 HWY 404 BOREHOLE TYPE Hollow Stem Augers/Tricone COMPILED BY AN  
 DATUM Geodetic DATE 2018.08.29 - 2018.09.04 LATITUDE 43.865652 LONGITUDE -79.375000 CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		UNIT WEIGHT  <b>γ</b>  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa			
195.3	GROUND SURFACE							20 40 60 80 100	PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT		
0.0	<b>TOPSOIL</b> , rootlets, grass Dark Brown Moist (800mm)		1	GS				20 40 60 80 100	W <sub>P</sub> W W <sub>L</sub>		
194.5											
0.8	<b>SAND</b> , trace gravel Dense Brown Moist (FILL)		1	SS	37						
193.9											
1.4	Sandy <b>SILT</b> , trace gravel, trace clay Compact Brown Moist		2	SS	29						
			3	SS	19						
192.3											
3.0	Silty <b>CLAY</b> , trace sand, trace gravel Stiff to Firm Grey Moist (TILL)		4	SS	9						
			5	SS	7						
			6	SS	5						
188.1											
7.2	<b>SAND</b> and <b>SILT</b> , trace to some clay, trace gravel Compact to Dense Grey Moist		7	SS	26						
			8	SS	32						

195

194

193

192

191

190

189

188

187

186

0

20

40

60

80

100

7.0

19.1

Augers grinding  
at 9.9m

Continued Next Page

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

# RECORD OF BOREHOLE No 16TH-05

2 OF 4

METRIC

GWP# 2930-17-00 LOCATION 16th Ave. Overpass, MTM NAD 83 Zone10: N 4 858 416.6 E 314 847.4 ORIGINATED BY BL/JNP  
 HWY 404 BOREHOLE TYPE Hollow Stem Augers/Tricone COMPILED BY AN  
 DATUM Geodetic DATE 2018.08.29 - 2018.09.04 LATITUDE 43.865652 LONGITUDE -79.375000 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  <b>γ</b>  kN/m <sup>3</sup>	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 <sub>P</sub> w      w <sub>L</sub>				
	Continued From Previous Page							20	40	60	80	100				
183.1	<b>SAND</b> and <b>SILT</b> , trace to some clay, trace gravel Dense Grey Moist		9	SS	47		185							○		0   36   60   4
							184									
12.2	Silty <b>CLAY</b> , with sand, trace to some gravel Stiff Grey Moist (TILL)		10	SS	14		183							○		
							182									
			11	SS	13		181							○		
							180							○		
			12	SS	11		179									
							178							⊕		1   27   44   28
	Hard to Very Stiff		13	SS	47		177							○		
			14	SS	29		176									

Continued Next Page

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

20  
15  
10  
(%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No 16TH-05

3 OF 4

METRIC

GWP# 2930-17-00 LOCATION 16th Ave. Overpass, MTM NAD 83 Zone10: N 4 858 416.6 E 314 847.4 ORIGINATED BY BL/JNP  
 HWY 404 BOREHOLE TYPE Hollow Stem Augers/Tricone COMPILED BY AN  
 DATUM Geodetic DATE 2018.08.29 - 2018.09.04 LATITUDE 43.865652 LONGITUDE -79.375000 CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT  <b>γ</b>  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)  GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
	Continued From Previous Page							20 40 60 80 100						
								○ UNCONFINED + FIELD VANE						
								● QUICK TRIAXIAL × LAB VANE						
								20 40 60 80 100						
								PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT						
								W <sub>P</sub> W W <sub>L</sub>						
								WATER CONTENT (%)						
								20 40 60						

Augers grinding at 24.4m

8 45 34 13

Continued Next Page

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



## METRIC

[illegible]

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



## **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 WIDENING  
STORM SEWER CROSSING  
NORTH OF 16TH AVENUE  
BOREHOLE LOCATIONS AND SOIL STRATA

SHEET



THURBER ENGINEERING LTD.



KEYPLAN

LEGEND

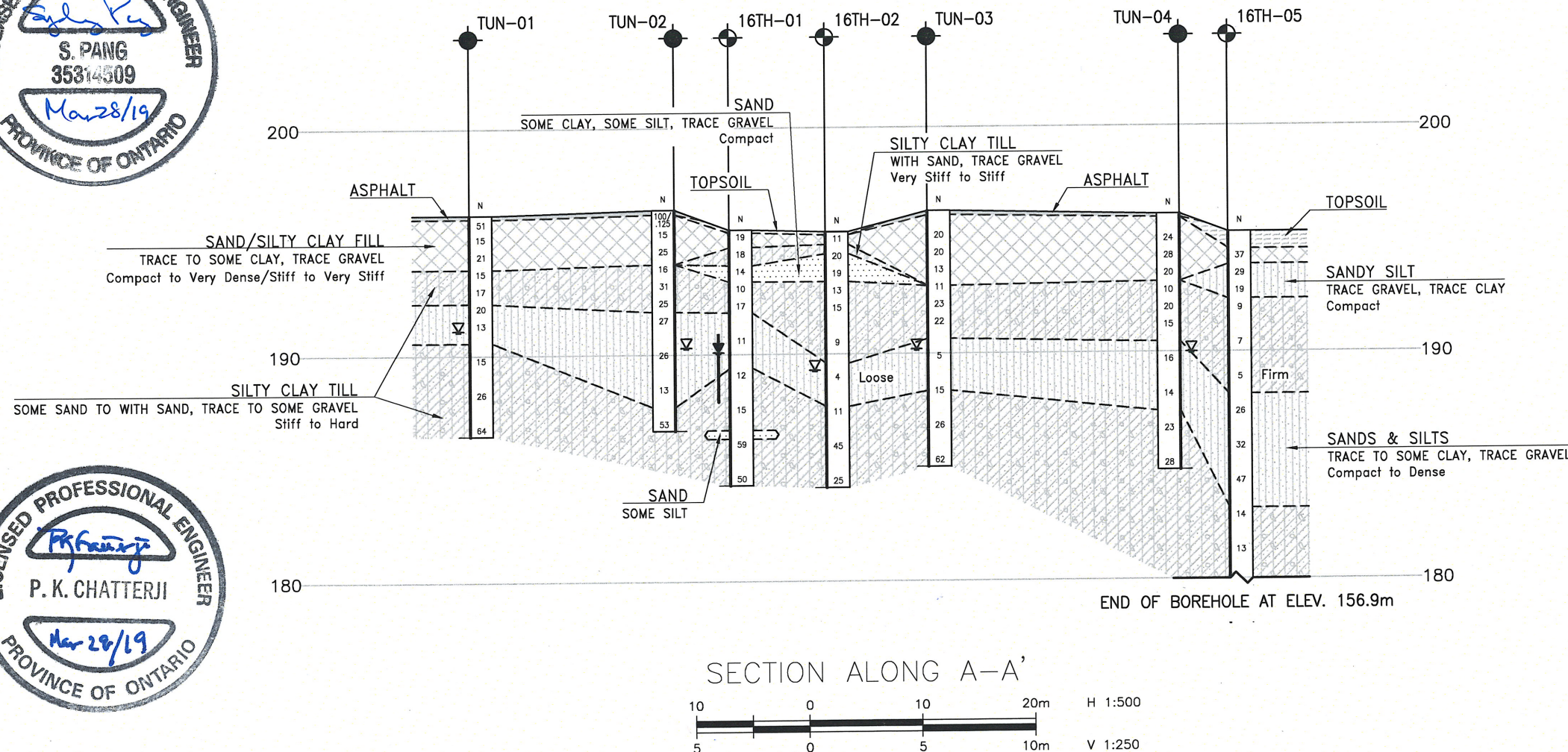
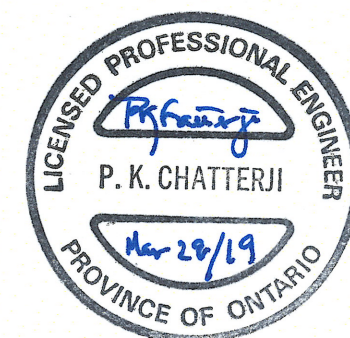
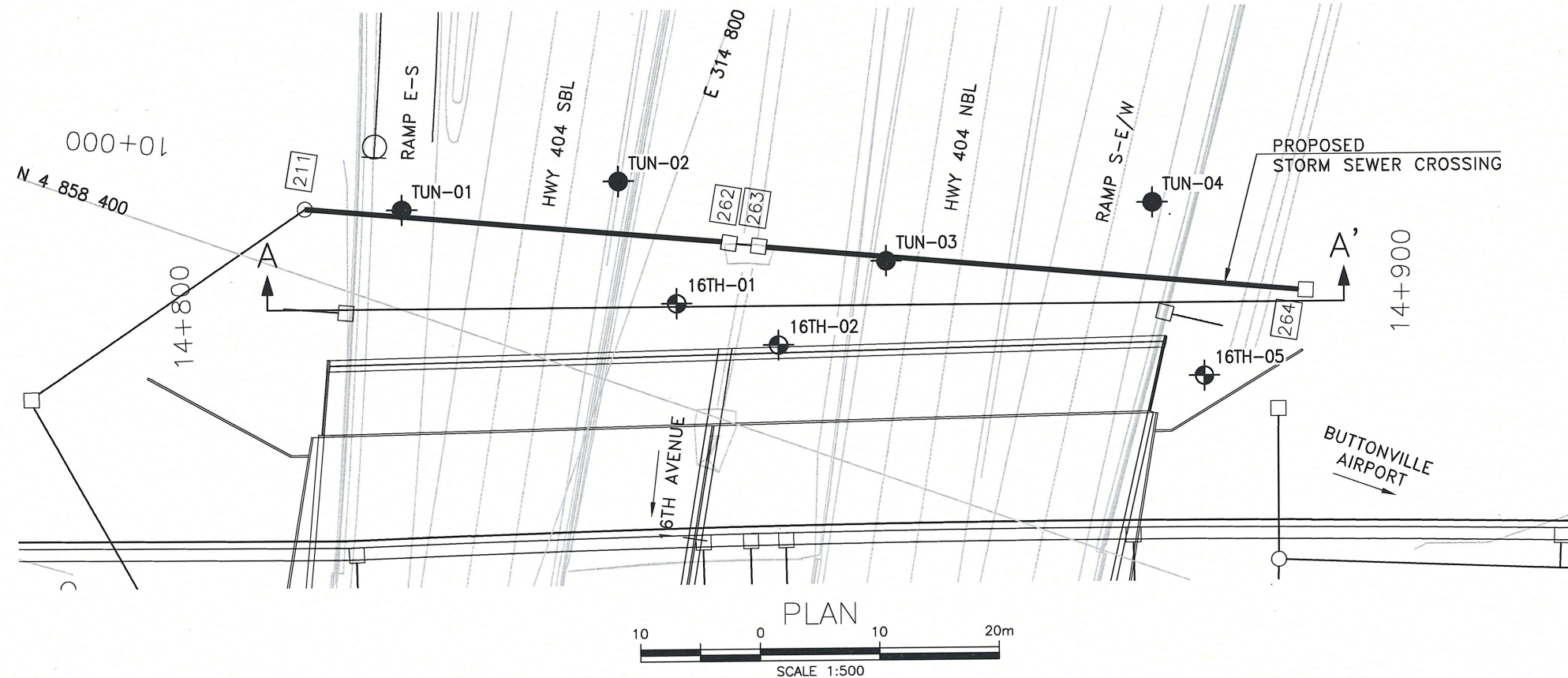
- Borehole (Current Investigation)
- Borehole (Previous Investigations)
- N
- Blows /0.3m (Std Pen Test, 475J/blow)
- Blows /0.3m (60' Cone, 475J/blow)
- Pressure, Hydraulic
- Water Level (Open Borehole)
- Piezometer
- Rock Quality Designation (RQD)
- Auger Refusal

NO	ELEVATION	NORTHING	EASTING
16TH-01	195.5	4 858 407.9	314 803.6
16TH-02	195.4	4 858 407.4	314 812.8
16TH-05	195.3	4 858 416.6	314 847.4
TUN-01	196.2	4 858 407.9	314 779.3
TUN-02	196.4	4 858 416.0	314 795.6
TUN-03	196.3	4 858 417.0	314 819.0
TUN-04	196.1	4 858 428.9	314 838.5

-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. 30M14-504



REVISIONS	DATE	BY	DESCRIPTION
DESIGN	RPR	CHK SKP	CODE
DRAWN	AN	CHK RPR	SITE
			STRUCT
			DWG 1