



**THURBER** ENGINEERING LTD.

**FOUNDATION INVESTIGATION REPORT  
CULVERT C1 REPLACEMENT WITH  
PROPOSED TWIN CULVERTS (C1 & C2)  
HIGHWAY 404  
NORTH OF MAJOR MACKENZIE DRIVE  
MARKHAM, ONTARIO  
G.W.P. 2930-02-00**

**GEOCRES NO. 30M14-471**

**Report**

to

**WSP Canada Inc.**

Date: February 16, 2018  
File: 15786



## TABLE OF CONTENTS

### PART 1: FACTUAL INFORMATION

1.	INTRODUCTION .....	1
2.	PROJECT AND SITE DESCRIPTION .....	1
3.	SITE INVESTIGATION AND FIELD TESTING .....	2
4.	LABORATORY TESTING .....	4
5.	DESCRIPTION OF SUBSURFACE CONDITIONS .....	4
5.1	Asphalt .....	4
5.2	Topsoil .....	4
5.3	Granular Fill .....	4
5.4	Clayey Silt to Silty Clay Fill .....	5
5.5	Silty Clay Till .....	6
5.6	Groundwater Conditions .....	7
6.	CORROSIVITY TEST RESULTS .....	8
7.	MISCELLANEOUS .....	9

### APPENDICES

Appendix A	Record of Borehole Sheets
Appendix B	Geotechnical and Analytical Laboratory Test Results
Appendix C	Selected Site Photographs
Appendix D	Borehole Locations and Soil Strata Drawing



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**PART 1: FACTUAL INFORMATION**

**1. INTRODUCTION**

This report presents the factual findings obtained from a foundation investigation conducted for the replacement of an existing culvert (designated as C1) that crosses under Highway 404 at Station 18+522 north of Major Mackenzie Drive in the City of Markham, Ontario.

The purpose of this investigation was to explore the subsurface conditions at selected locations near the alignment, and based on the data obtained, to provide a borehole location plan, 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.

For preparation of this report, reference has been made to culvert design information provided by WSP.

**2. PROJECT AND SITE DESCRIPTION**

The existing culvert is located on Highway 404, near Station 18+522, approximately 290 m north of Major Mackenzie Drive in Markham, Ontario. The general location of the proposed culvert replacement is shown on the key plan on the Borehole Locations and Soil Strata Drawing in Appendix D.

Client: WSP  
File No.: 15786

Date: February 16, 2018  
Page: 1 of 10

E file: H:\15000-15999\15786 Hwy 404 Widening 2016-E-0014\Reports and Memos\Culvert C1\Final\15786 Hwy 404  
Culvert C1 FIDR feb 18.docx



The existing culvert is a 1830 mm x 1220 mm open footing concrete culvert (OFCC). The Highway 404 grade at the existing culvert is at approximate Elevation 212.5 m. The culvert invert is at approximate Elevation 209.4 m at the inlet (~Station 18+590) and 207.7 m at the outlet (~Station 18+460).

The land use adjacent to this section of Highway 404 is largely rural and agricultural, although there is increasing residential and commercial development in recent years. The vegetation cover beyond the paved areas of the highway comprises grasses, bushes and stands of trees. Photographs of the culvert and surrounding area are presented in Appendix C.

The culvert site is located within the physiographic region known as 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 borehole investigation and field testing program for this site was carried out from November 26 to December 21, 2017, and consisted of drilling and sampling five (5) boreholes. Four of the boreholes, designated as Boreholes C1-01 to C1-04, were drilled and sampled near the proposed culvert alignment to depths ranging from 9.8 to 12.8 m (Elevations 199.0m to 202.2 m). A previously drilled borehole by Thurber, designated as Borehole MS-64 (originally drilled and sampled to 6.7 m for the median sewer), was deepened to a depth of 11.3 m (Elevation 201.2 m).

Lane closures and traffic control were carefully planned for drilling each borehole. Prior to commencement of drilling, utility clearances were obtained for all borehole locations.

The approximate locations of the boreholes are shown on the Borehole Locations and Soil Strata Drawing included in Appendix D. Northing and easting coordinates at the borehole locations were obtained by Thurber using a Trimble GPS Pathfinder ProXRT, and the corresponding ground surface elevations were provided by WSP based on the project DTM survey. The coordinates and elevations of the boreholes are given on these drawings and on the individual Record of Borehole Sheets in Appendix A.



The boreholes were advanced using a truck-mounted D-90 drill rig. Solid stem and hollow stem augers were used to advance the boreholes, and soil samples were obtained at selected intervals using a 50mm 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. Standpipe piezometers were installed in selected boreholes to permit monitoring of groundwater levels. The piezometers consisted of 25 mm PVC pipes with slotted screens. Upon completion, the boreholes were abandoned in general accordance with Ontario Regulation 903 amended by Ontario Reg. 372 (O.Reg. 903). Once the field investigation is completed, the piezometers will be decommissioned in general accordance with O.Reg. 903. The details of borehole completion are summarized in Table 3.1.

**Table 3.1 – Borehole Completion Details**

Borehole No.	Borehole Depth / Base Elevation (m)	Piezometer Tip Elevation (m)	Completion Details
C1-01	9.8/202.2	9.4/202.6	Borehole backfilled with a sand filter from 9.8 m to 5.8 m, bentonite holeplug and cuttings from 5.8 m to 0.3 m, then cement to surface.
C1-02	10.9/201.5	10.7/201.7	Borehole backfilled with a sand filter from 10.9 m to 7.2 m, bentonite holeplug and cuttings from 7.2 m to 0.3 m, then cement to surface.
C1-03	12.8/201.6	None installed	Borehole open to 12.8 m, backfilled with bentonite holeplug and auger cuttings from 12.8 m to 0.15 m, then cement to surface.
C1-04	9.8/199.0	None installed	Borehole open to 9.8 m, backfilled with bentonite holeplug and auger cuttings from 12.8 m to surface
MS-64	11.3/201.2	None installed	Borehole open to 11.3 m, backfilled with bentonite holeplug and auger cuttings from 11.3 m to 0.3 m, concrete from 0.3 to 0.15 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 are summarized on the Record of Borehole sheets and on the accompanying figures in Appendix B.

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

Reference is made to the Record of Borehole sheets in Appendix A for details of the encountered soil stratigraphy. A soil profile along the culvert 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 consist of a pavement structure (asphalt and/or sand fill) or topsoil overlying clayey silt to silty clay fill, which is in turn underlain by native silty clay till deposits. The groundwater level in the open boreholes were generally below about 5 m depth upon completion of drilling.

More detailed descriptions of the individual stratum are presented below.

##### **5.1 Asphalt**

The asphalt thickness was 100 mm in Borehole MS-64.

##### **5.2 Topsoil**

Topsoil was encountered at ground surface in Boreholes C1-01 and C1-04 with a thickness of 150 mm.

##### **5.3 Granular Fill**

Pavement granular fill was encountered at ground surface or below the asphalt in Boreholes MS-64, C1-02 and C1-03, or below the topsoil in Borehole C1-04. The granular fill consisted

Client: WSP

Date: February 16, 2018

File No.: 15786

Page: 4 of 10

E file: H:\15000-15999\15786 Hwy 404 Widening 2016-E-0014\Reports and Memos\Culvert C1\Final\15786 Hwy 404 Culvert C1 FIDR feb 18.docx



of brown sand and dark brown silty sand, about 0.7 m to 1.5 m in thickness (base Elevations 207.1 m to 213.6 m).

SPT 'N' values recorded in the granular fill ranged from 3 to 18 blows per 0.3 m of penetration, indicating a very loose to compact condition. Measured moisture content of the granular fill were between 5 percent and 33 percent.

The results of grain size distribution analysis carried out on samples of sand to silty sand fill are presented on the Record of Borehole Sheets included in Appendix A and on Figure B1 of Appendix B. Results of the gradation testing are summarized below:

Soil Particles	Percentage (%)	
Gravel	5 to 18	
Sand	38 to 68	
Silt	48	18 to 19
Clay		9 to 12

#### 5.4 Clayey Silt to Silty Clay Fill

The surficial sand to silty sand fill and topsoil were underlain by cohesive fill at all borehole locations, except for Borehole C1-04. This fill consisted of brown to grey clayey silt to silty clay with sand and trace gravel. The fill ranged from 1.3 m to 4.8 m in thickness and extended to depths ranging from 1.4 m to 5.6 m (base Elevations 208.8 to 210.6).

SPT 'N' values recorded in the clayey silt to silty clay fill ranged from 7 to 31 blows per 0.3 m of penetration indicating a firm to hard consistency. Measured moisture contents of samples of the cohesive fill varied between 7 percent and 33 percent.

The results of grain size distribution analyses carried out on two samples of this cohesive fill are presented on the Record of Borehole Sheets included in Appendix A and on Figure B2 of Appendix B. The results of the gradation testing are summarized below:

Soil Particles	Percentage (%)
Gravel	0 to 2
Sand	19 to 39



Soil Particles	Percentage (%)
Silt	33 to 38
Clay	21 to 48

## 5.5 Silty Clay Till

Underlying the clayey silt to silty clay fill at all five borehole locations was a deposit of brown to grey native silty clay till with sand, containing trace gravel and occasional cobbles. All boreholes were terminated within the silty clay till at 9.8 m to 12.8 m depths (Elevations 202.2 to 199.0 m).

SPT 'N' values recorded in the silty clay till typically ranged from 14 to 91 blows per 0.3 m of penetration indicating a stiff to hard consistency. Occasional SPT 'N' values of greater than 50 blows for less than 0.3 m of penetration were measured in Boreholes C1-02 to C1-04, which inferred the presence of cobbles below approximate Elevation 206 m. Measured moisture contents of samples of the silty clay till varied between 9 percent and 34 percent.

The results of grain size distribution analyses carried out on samples of the silty clay till are presented on the Record of Borehole Sheets included in Appendix A and on Figures B3 and B4 of Appendix B. The results of the gradation testing are summarized below:

Soil Particles	Percentage (%)
Gravel	0 to 5
Sand	35 to 41
Silt	34 to 44
Clay	18 to 26

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





Index Property	Percentage (%)
Plastic Limit	9 to 12
Liquid Limit	17 to 19
Plasticity Index	7 to 9

The results of the Atterberg Limits testing indicate that this deposit has low plasticity with a group symbol of CL to CL-ML.

Glacially derived soils inherently contain cobbles and boulders. It was also noted that auger refusal was encountered in Borehole C1-04 at a depth of 4.3 m (Elevation 204.5 m) due to inferred cobbles and boulders.

## 5.6 Groundwater Conditions

Groundwater levels in the boreholes were observed during the drilling operations and measured upon completion of drilling. Standpipe piezometers were installed in Boreholes C1-01 and C1-02 to permit longer term monitoring. The recorded water levels in open boreholes and piezometers are presented below.

**Table 5-1. Groundwater Level Measurements**

Borehole Number	Date	Groundwater Level		Comments
		Depth (m)	Elevation (m)	
C1-01	December 18, 2017	4.9	207.1	Open borehole
	January 3, 2018	frozen	-	Piezometer
	January 5, 2018	0.6	211.4	
	February 15, 2018	frozen	-	
C1-02	November 26, 2017	6.1	206.3	Open borehole
	January 3, 2018	covered by ice	-	Piezometer
	January 12, 2018	0.1	212.3	
	February 15, 2018	2.3	210.1	
C1-03	November 26, 2017	5.5	208.9	Open borehole
C1-04	December 20, 2017	5.6	203.2	Open borehole



Borehole Number	Date	Groundwater Level		Comments
		Depth (m)	Elevation (m)	
MS-64	August 10, 2017 / November 28, 2017	6.1	206.4	Open borehole

Information from a near-by existing piezometer just north of the existing C1 culvert (Borehole MS-63) suggests that the water level in the vicinity of the proposed culvert is at 2.9 m below grade (Elevation 210.7 m)

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. CORROSIVITY TEST RESULTS

A sample of each of the silty clay till and silty sand fill from Boreholes C1-01 and C1-04, respectively, were submitted for analytical testing of corrosivity parameters. The results of the analytical tests are shown in Table 6.1 below. The laboratory certificates of analysis are presented in Appendix B.

**Table 6.1- Analytical Test Results**

Parameter	Units (Soil)	Test Results	
		C1-01 SS 3 Depth 1.7 m	C1-04 SS 2 Depth 1.0 m
		(Soil Sample)	(Soil Sample)
Sulphide	%	<0.05	<0.05
Chloride	µg/g	25	475
Sulphate	µg/g	10	29
pH	-	8.14	7.78
Electrical Conductivity	µS/cm	160	873

Client: WSP

File No.: 15786

E file: H:\15000-15999\15786 Hwy 404 Widening 2016-E-0014\Reports and Memos\Culvert C1\Final\15786 Hwy 404 Culvert C1 FIDR feb 18.docx

Date: February 16, 2018

Page: 8 of 10



Parameter	Units (Soil)	Test Results	
		C1-01 SS 3 Depth 1.7 m	C1-04 SS 2 Depth 1.0 m
		(Soil Sample)	(Soil Sample)
Resistivity	Ohm.cm	6250	1150
Redox Potential	mV	176	118

## 7. MISCELLANEOUS

Thurber staked and/or marked the borehole locations in the field and obtained utility clearances prior to drilling. Northing and easting coordinates at the borehole locations were obtained by Thurber using a Trimble GPS Pathfinder ProXRT, and the corresponding ground surface elevations were provided by WSP.

Walker Drilling of Utopia, Ontario, supplied and operated a track mounted D-52 and truck-mounted D-90 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. Jilesh Patel 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. Rod de Castro, 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.

Client: WSP  
File No.: 15786

E file: H:\15000-15999\15786 Hwy 404 Widening 2016-E-0014\Reports and Memos\Culvert C1\Final\15786 Hwy 404  
Culvert C1 FIDR feb 18.docx

Date: February 16, 2018  
Page: 9 of 10



THURBER ENGINEERING LTD.



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Client: WSP

File No.: 15786

E file: H:\15000-15999\15786 Hwy 404 Widening 2016-E-0014\Reports and Memos\Culvert C1\Final\15786 Hwy 404  
Culvert C1 FIDR feb 18.docx

Date: February 16, 2018

Page: 10 of 10



## **Appendix A**

### **Record of Borehole Sheets**

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

### 1. TEXTURAL CLASSIFICATION OF SOILS

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

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

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

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

DESCRIPTIVE TERM	UNDRAINED SHEAR STRENGTH (kPa)	APPROXIMATE SPT <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


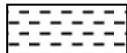



$C_{pen}$  Shear Strength Determination by Pocket Penetrometer

- (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			

## EXPLANATION OF ROCK LOGGING TERMS

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

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

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



# RECORD OF BOREHOLE No C1-01

1 OF 2

METRIC

W.P. 2930-02-00 LOCATION SB N 4 860 558.0 E 314 386.8 ORIGINATED BY JP  
 HWY 404 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MP  
 DATUM Geodetic DATE 2017.12.17 - 2017.12.18 CHECKED BY RD

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											
212.0	GROUND SURFACE							20	40	60	80	100							
0.0	TOPSOIL: (150mm)							20	40	60	80	100							
0.2	Clayey <b>SILT</b> , some sand, trace gravel Firm to Stiff Dark Brown Moist (FILL)		1	SS	7		211												
			2	SS	15														
210.6																			
1.4	Silty <b>CLAY</b> , with sand, trace gravel Very Stiff to Hard Brown to Grey Moist to Wet (TILL)		3	SS	21		210												
			4	SS	55		209											0 35 42 23	
			5	SS	42														
							208												
			6	SS	33		207											0 35 43 22	
			7	SS	16		206											0 38 44 18	
							205												
			8	SS	25		204												
			9	SS	37		203												
202.2																			
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 C1-01

2 OF 2

METRIC

W.P. 2930-02-00 LOCATION SB N 4 860 558.0 E 314 386.8 ORIGINATED BY JP  
 HWY 404 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MP  
 DATUM Geodetic DATE 2017.12.17 - 2017.12.18 CHECKED BY RD

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																
	WATER LEVEL AT 4.9m UPON COMPLETION. Piezometer installation consists of 25mm diameter Schedule 40 PVC pipe with a 3.1m slotted screen.  WATER LEVEL READINGS DATE      DEPTH(m)    ELEV.(m) 2018.01.03    Frozen      - 2018.01.05      0.6     211.4 2018.02.15    Frozen      -																

ONTMT4S MTO-15786.GPJ 2017TEMPLATE(MTO).GDT 2/21/18

# RECORD OF BOREHOLE No C1-02

1 OF 2

METRIC

W.P. 2930-02-00 LOCATION NB N 4 860 561.0 E 314 449.9 ORIGINATED BY JP  
 HWY 404 BOREHOLE TYPE Solid Stem Augers COMPILED BY MP  
 DATUM Geodetic DATE 2017.11.26 - 2017.11.27 CHECKED BY RD

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT      NATURAL MOISTURE      LIQUID CONTENT			UNIT WEIGHT  γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa				WATER CONTENT (%)								
212.4	GROUND SURFACE							20	40	60	80	100	W <sub>P</sub>	W	W <sub>L</sub>	GR	SA	SI	CL	
0.0	<b>SAND</b> , some gravel, trace silt and clay Compact Brown Moist (FILL)		1	SS	18		212						○							
211.5																				
0.9	Silty <b>CLAY</b> , some sand, trace gravel, black staining Stiff to Very Stiff Brown Moist (FILL)		2	SS	16		211						○							
			3	SS	11								○							
			4	SS	18		210						○				0	19	33	48
209.4																				
3.0	Silty <b>CLAY</b> , with sand, trace gravel, buried topsoil at 3.0m± Very Stiff to Hard Grey Moist (TILL)		5	SS	16		209						○							
			6	SS	25		208						○							
			7	SS	75		206						4	1			0	37	38	25
			8	SS	79		205						○							
			9	SS	90/ 0.250		203						○				2	36	38	24

Continued Next Page

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

# RECORD OF BOREHOLE No C1-02

2 OF 2

METRIC

W.P. 2930-02-00 LOCATION NB N 4 860 561.0 E 314 449.9 ORIGINATED BY JP  
 HWY 404 BOREHOLE TYPE Solid Stem Augers COMPILED BY MP  
 DATUM Geodetic DATE 2017.11.26 - 2017.11.27 CHECKED BY RD

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																
201.5	Silty <b>CLAY</b> , with sand, trace gravel Very Stiff to Hard Grey Moist (TILL)		10	SS	50/		202										
10.9	END OF BOREHOLE AT 10.9m. BOREHOLE OPEN TO 10.9m AND WATER LEVEL AT 6.1m UPON COMPLETION. Piezometer installation consists of 25mm diameter Schedule 40 PVC pipe with a 3.1m slotted screen.  WATER LEVEL READINGS DATE DEPTH(m) ELEV.(m) 2018.01.12 0.1 212.3 2018.02.15 2.3 210.1				0.125												

ONTMT4S MTO-15786.GPJ 2017TEMPLATE(MTO).GDT 2/21/18

# RECORD OF BOREHOLE No C1-03

1 OF 2

METRIC

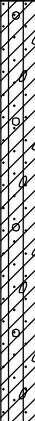
W.P. 2930-02-00 LOCATION NB N 4 860 574.0 E 314 478.1 ORIGINATED BY JP  
 HWY 404 BOREHOLE TYPE Solid Stem Augers COMPILED BY MP  
 DATUM Geodetic DATE 2017.11.26 - 2017.11.27 CHECKED BY RD

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				UNIT WEIGHT  γ  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED      + FIELD VANE ● QUICK TRIAXIAL    × LAB VANE						PLASTIC LIMIT W <sub>P</sub> NATURAL MOISTURE CONTENT W      LIQUID LIMIT W <sub>L</sub>
214.4	GROUND SURFACE							20 40 60 80 100						GR SA SI CL
0.0	Silty <b>SAND</b> , some gravel Compact Brown Wet (FILL)		1	SS	17		214					○		14 38 48 (SI+CL)
213.6														
0.8	Clayey <b>SILT</b> , with sand, trace gravel Very Stiff to Hard Brown Moist (FILL)		2	SS	18		213					○		
			3	SS	25							○		
			4	SS	31		212					○		
			5	SS	31		211					○		2 39 38 21
							210							
			6	SS	26							○		
							209							
208.8														
5.6	Silty <b>CLAY</b> , with sand, trace gravel, buried topsoil at 5.6m± Stiff to Hard Grey Moist to Wet (TILL)		7	SS	14		208					○		
							207							
			8	SS	44							○		0 41 34 25
							206							
			9	SS	50/ 0.100		205					○		

Continued Next Page

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

## METRIC

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT      NATURAL LIMIT      MOISTURE CONTENT			UNIT WEIGHT  γ  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)  GR   SA   SI   CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa				WATER CONTENT (%)				
								20   40   60   80   100 ○ UNCONFINED    + FIELD VANE ● QUICK TRIAXIAL    × LAB VANE				W <sub>p</sub> W                      W <sub>L</sub> —————				
Continued From Previous Page																
201.6	Silty <b>CLAY</b> , with sand, trace gravel Stiff to Hard Grey Moist to Wet (TILL)						204									
			10	SS	50/ 0.100											
12.8	END OF BOREHOLE AT 12.8m. BOREHOLE OPEN TO 12.8m AND WATER LEVEL AT 5.5m. BOREHOLE BACKFILLED WITH HOLEPLUG AND AUGER CUTTINGS TO 0.1m THEN CONCRETE TO SURFACE.		11	SS	91		202									3   38   35   24

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

**METRIC**

SOIL PROFILE			SAMPLES		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES
208.8	GROUND SURFACE				
0.0	TOPSOIL				
0.2	SAND, some silt, trace gravel, trace clay, some organics Very Loose to Loose Dark Brown to Brown Wet to Saturated (FILL)		1	SS	3
			2	SS	5
207.1	Silty CLAY, with sand, trace gravel Firm to Hard Brown to Grey Moist (TILL)		3	SS	7
1.7			4	SS	38
			5	SS	50/ 0.100
	- inferred cobbles and boulders		6	SS	63
			7	SS	59
			8	SS	54
			9	SS	57
199.0	END OF BOREHOLE AT 9.8m.				
9.8					

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

ONTMT4S MTO-15786.GPJ 2017TEMPLATE(MTO).GDT 2/14/18

## METRIC

[illegible]



# RECORD OF BOREHOLE No MS-64

1 OF 2

METRIC

W.P. 2930-02-00 LOCATION SB N 4 860 553.3 E 314 413.8 ORIGINATED BY TM  
HWY 404 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN  
DATUM Geodetic DATE 2017.08.10 - 2017.08.10 CHECKED BY PP

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					
								20 40 60 80 100					
212.5	GROUND SURFACE												
0.0	ASPHALT: (100mm)												
0.1	SAND, some gravel, some silt, some clay Brown Moist (FILL)		1	GS			212						18 51 19 12
211.7													
0.8	Clayey SILT, some gravel, some sand Very Stiff Brown Moist (FILL)		1	SS	21		211						
			2	SS	25								
210.3													
2.2	Silty CLAY, with sand, trace gravel Very Stiff to Hard Brown Moist (TILL)		3	SS	16		210						
			4	SS	21		209						
							208						
			5	SS	42								
							207						
			6	SS	35		206						3 35 36 26
													Drilled on 11/26/2017 from 6.7m to 11.3m
							205						
			7	SS	49								
							204						
			8	SS	66		203						0 37 40 23

Continued Next Page

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

20  
15  
10

(%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No MS-64

2 OF 2

METRIC

W.P. 2930-02-00 LOCATION SB N 4 860 553.3 E 314 413.8 ORIGINATED BY TM  
 HWY 404 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN  
 DATUM Geodetic DATE 2017.08.10 - 2017.08.10 CHECKED BY PP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	UNIT WEIGHT  γ  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)  GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
	Continued From Previous Page																
201.2	Silty <b>CLAY</b> , with sand, trace gravel Very Stiff to Hard Brown Moist (TILL)		9	SS	79												
11.3	END OF BOREHOLE AT 11.3m. WATER LEVEL AT 6.1m. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO 0.5m, DRY MIX CEMENT TO 0.2m, THEN COLD PATCH ASPHALT TO SURFACE.																



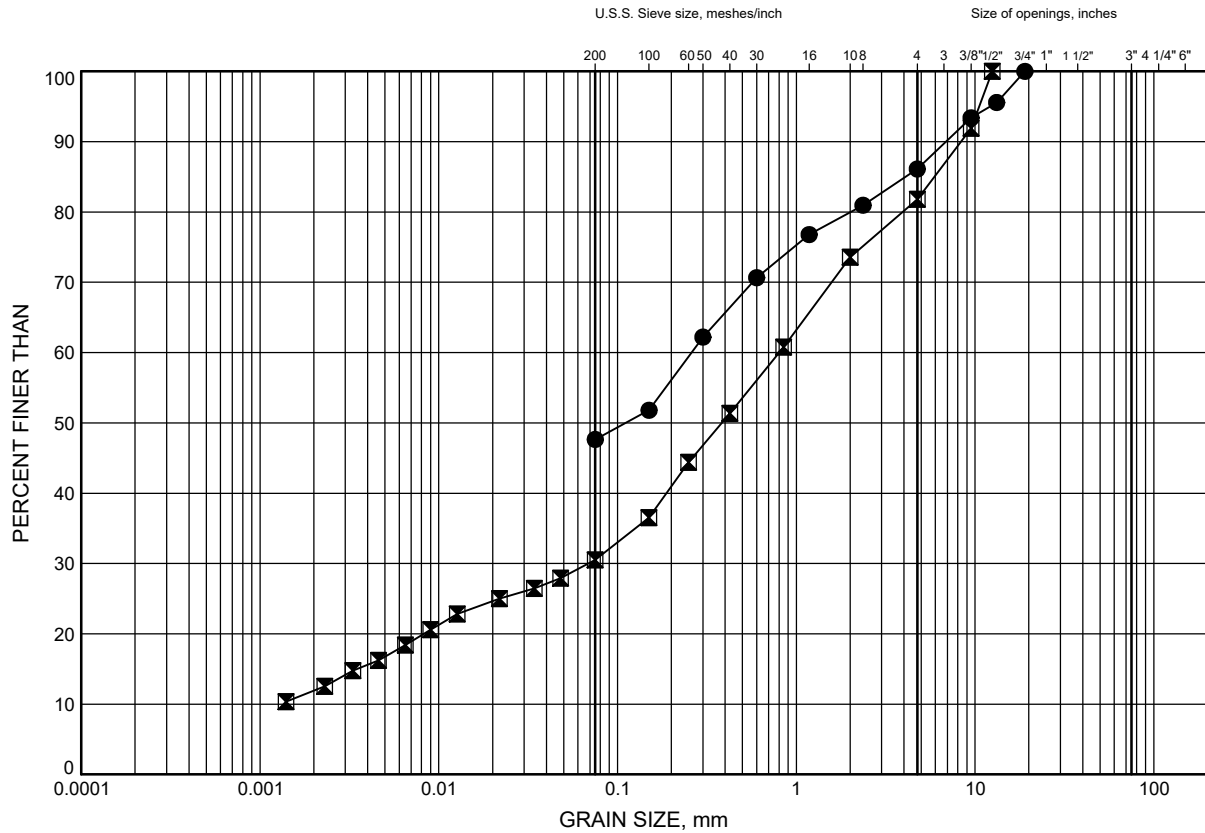
## **Appendix B**

### **Geotechnical and Analytical Laboratory Test Results**

# HWY 404 Widening GRAIN SIZE DISTRIBUTION

FIGURE B1

## SAND FILL



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

### LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	C1-03	0.3	214.1
⊠	MS-64	0.3	212.2

Date December 2017  
W.P. 2930-02-00

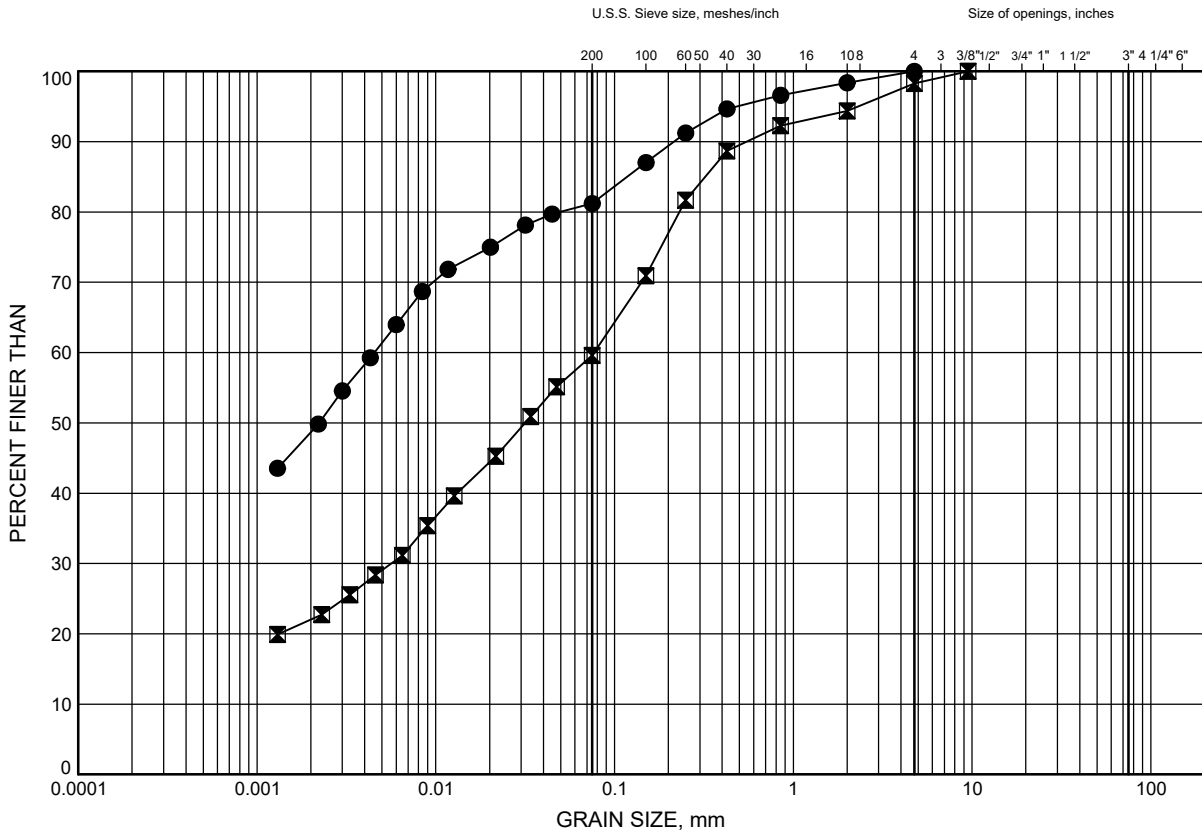


Prep'd AN  
Chkd. RD

# HWY 404 Widening GRAIN SIZE DISTRIBUTION

FIGURE B2

### Silty CLAY to Clayey SILT FILL



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

### LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	C1-02	2.6	209.8
⊠	C1-03	3.4	211.0

Date December 2017  
W.P. 2930-02-00

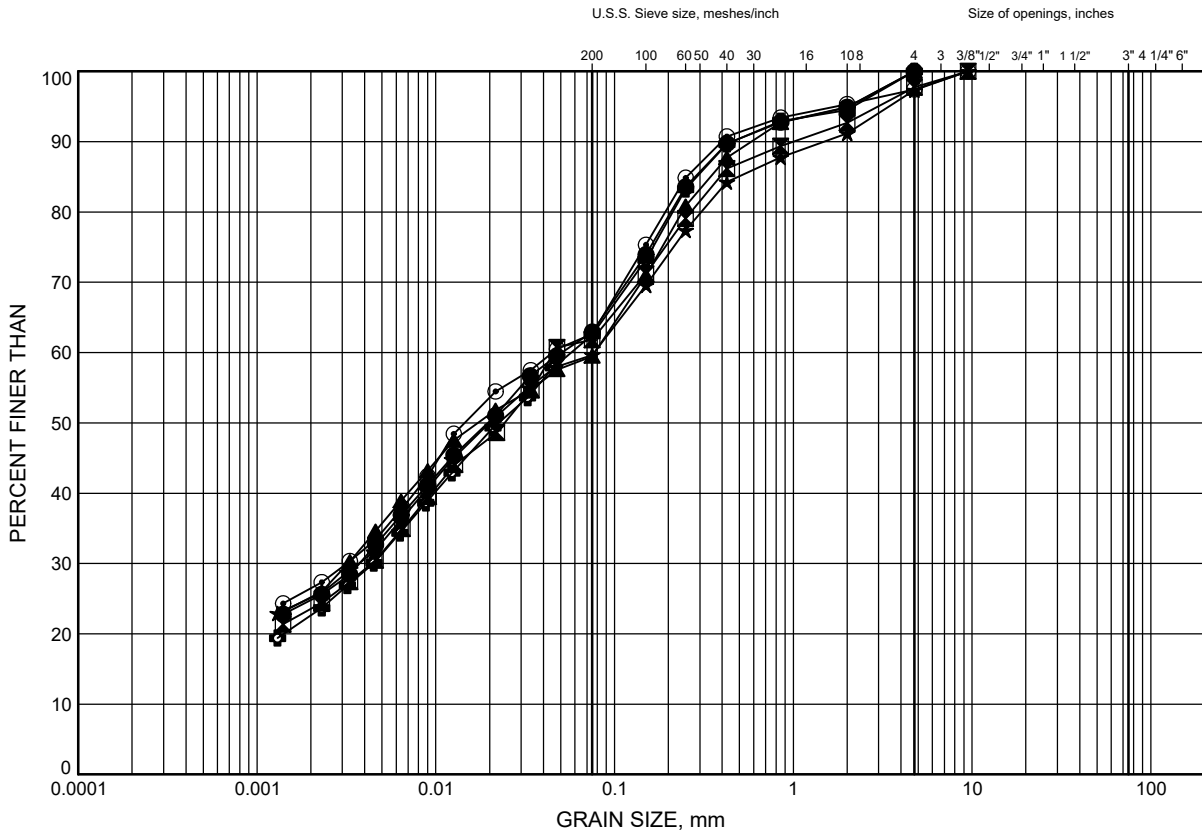


Prep'd AN  
Chkd. RD

# HWY 404 Widening GRAIN SIZE DISTRIBUTION

FIGURE B3

## Silty CLAY TILL



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

### LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	C1-02	6.4	206.0
⊠	C1-02	9.3	203.1
▲	C1-03	7.9	206.5
★	C1-03	12.5	201.9
⊙	MS-64	6.4	206.1
⊕	MS-64	9.4	203.1

Date December 2017  
W.P. 2930-02-00

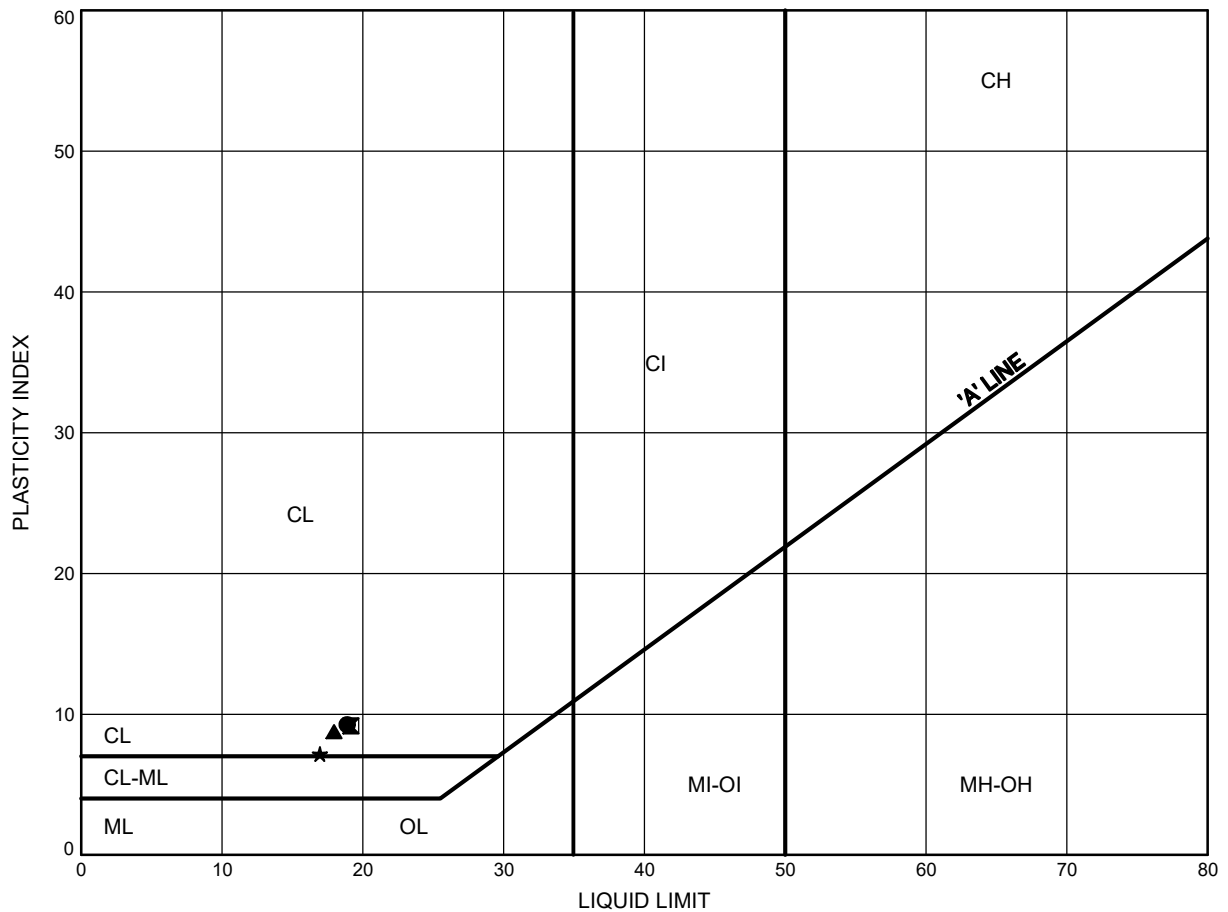


Prep'd AN  
Chkd. RD

# HWY 404 Widening ATTERBERG LIMITS TEST RESULTS

FIGURE B4

Silty CLAY TILL



### LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	C1-02	6.4	206.0
⊠	C1-03	7.9	206.5
▲	MS-64	6.4	206.1
★	MS-64	9.4	203.1

Date December 2017  
W.P. 2930-02-00



Prep'd AN  
Chkd. RD

CLIENT NAME: THURBER ENGINEERING LTD  
SUITE 103, 2010 WINSTON PARK DRIVE  
OAKVILLE, ON L6H5R7  
(905) 829-8666

ATTENTION TO: Rod de Castro

PROJECT: Hwy 404 Widening 2016-E-0014

AGAT WORK ORDER: 17T297254

SOIL ANALYSIS REVIEWED BY: Yris Verastegui, Report Reviewer

DATE REPORTED: Dec 28, 2017

PAGES (INCLUDING COVER): 5

VERSION\*: 1

Should you require any information regarding this analysis please contact your client services representative at (905) 712-5100

\*NOTES

All samples will be disposed of within 30 days following analysis. Please contact the lab if you require additional sample storage time.





**AGAT** Laboratories

## Certificate of Analysis

AGAT WORK ORDER: 17T297254

PROJECT: Hwy 404 Widening 2016-E-0014

5835 COOPERS AVENUE  
MISSISSAUGA, ONTARIO  
CANADA L4Z 1Y2  
TEL (905)712-5100  
FAX (905)712-5122  
<http://www.agatlabs.com>

CLIENT NAME: THURBER ENGINEERING LTD

ATTENTION TO: Rod de Castro

SAMPLING SITE:

SAMPLED BY:

### Corrosivity Package

DATE RECEIVED: 2017-12-21

DATE REPORTED: 2017-12-28

		SAMPLE DESCRIPTION:		C1-01 SS3	C1-04 SS2
		SAMPLE TYPE:		Soil	Soil
		DATE SAMPLED:		2017-12-18	2017-12-21
Parameter	Unit	G / S	RDL	8990650	8990654
Sulfide (S2-)	%		0.05	<0.05	<0.05
Chloride (2:1)	µg/g		2	25	475
Sulphate (2:1)	µg/g		2	10	29
pH (2:1)	pH Units		NA	8.14	7.78
Electrical Conductivity (2:1)	mS/cm		0.005	0.160	0.873
Resistivity (2:1)	ohm.cm		1	6250	1150
Redox Potential (2:1)	mV		5	176	118

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard

8990650-8990654 EC/Resistivity, pH, Chloride, Sulphate and Redox Potential were determined on the extract obtained from the 2:1 leaching procedure (2 parts DI water: 1 part soil).

\*Sulphide analyzed at AGAT 5623 McAdam

Certified By:

*Iris Veraístegui*

## Quality Assurance

CLIENT NAME: THURBER ENGINEERING LTD

AGAT WORK ORDER: 17T297254

PROJECT: Hwy 404 Widening 2016-E-0014

ATTENTION TO: Rod de Castro

SAMPLING SITE:

SAMPLED BY:

### Soil Analysis

RPT Date: Dec 28, 2017			DUPLICATE			Method Blank	REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD		Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper
Corrosivity Package															
Sulfide (S2-)	8990650	8990650	<0.05	<0.05	NA	< 0.05	99%	80%	120%						
Chloride (2:1)	8990650	8990650	25	25	0.0%	< 2	110%	80%	120%	104%	80%	120%	99%	70%	130%
Sulphate (2:1)	8990650	8990650	10	10	1.6%	< 2	104%	80%	120%	105%	80%	120%	106%	70%	130%
pH (2:1)	8990650	8990650	8.14	8.15	0.1%	NA	100%	90%	110%	NA			NA		
Electrical Conductivity (2:1)	8990650	8990650	0.160	0.165	3.1%	< 0.005	99%	90%	110%	NA			NA		
Redox Potential (2:1)	8990650	8990650	176	183	3.5%	< 5	104%	70%	130%	NA			NA		

Comments: NA signifies Not Applicable.

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

Certified By:



## Method Summary

CLIENT NAME: THURBER ENGINEERING LTD

AGAT WORK ORDER: 17T297254

PROJECT: Hwy 404 Widening 2016-E-0014

ATTENTION TO: Rod de Castro

SAMPLING SITE:

SAMPLED BY:

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Soil Analysis			
Sulfide (S <sup>2-</sup> )	MIN-200-12025	ASTM E1915-09	GRAVIMETRIC
Chloride (2:1)	INOR-93-6004	McKeague 4.12 & SM 4110 B	ION CHROMATOGRAPH
Sulphate (2:1)	INOR-93-6004	McKeague 4.12 & SM 4110 B	ION CHROMATOGRAPH
pH (2:1)	INOR 93-6031	MSA part 3 & SM 4500-H+ B	PH METER
Electrical Conductivity (2:1)	INOR-93-6036	McKeague 4.12, SM 2510 B	EC METER
Resistivity (2:1)	INOR-93-6036	McKeague 4.12, SM 2510 B, SSA #5 Part 3	CALCULATION
Redox Potential (2:1)		McKeague 4.12 & SM 2510 B	REDOX POTENTIAL ELECTRODE



5835 Coopers Avenue  
Mississauga, Ontario L4Z 1Y2  
Ph: 905.712.5100 Fax: 905.712.5122  
[webearth.agatlabs.com](http://webearth.agatlabs.com)

**If this is a Drinking Water sample, please use Drinking Water Chain of Custody Form** (potable water consumed by humans)

**Report Information:**

Company: Thurben Engineering Ltd  
Contact: Rodolfo Castro  
Address: 2010 Winston Park Drive Unit 103  
Oakville ON, L6H 5E7  
Phone: 905.829.8666 Fax: 905.829.1166  
Reports to be sent to:  
1. Email: ~~rod~~ roldcastro@thurben.ca  
2. Email: spang@thurben.ca

### Project Information:

Project: Highway 404 Widening 2016-E-0014  
Site Location: Mark Hwy 404, Markham, Ontario  
Sampled By: JP  
AGAT Quote #: PO:

**Invoice Information:**

Bill To Same: Yes ☒ No ☐

Company: \_\_\_\_\_  
Contact: \_\_\_\_\_  
Address: \_\_\_\_\_  
Email: \_\_\_\_\_

Regulatory Requirements: ☐ No Regulatory Requirement

(Please check all applicable boxes)

<input type="checkbox"/> Regulation 153/04	<input type="checkbox"/> Sewer Use	<input type="checkbox"/> Regulation 558
Table _____ <i>Indicate One</i>	<input type="checkbox"/> Sanitary	<input type="checkbox"/> CCME
<input type="checkbox"/> Ind/Com	<input type="checkbox"/> Storm	<input type="checkbox"/> Prov. Water Quality Objectives (PWQO)
<input type="checkbox"/> Res./Park		<input type="checkbox"/> Other
<input type="checkbox"/> Agriculture		
Soil Texture <i>(Check One)</i>	Region _____ <i>Indicate One</i>	
<input type="checkbox"/> Coarse		
<input type="checkbox"/> Fine	<input type="checkbox"/> MISA	
		_____ <i>Indicate One</i>

Is this submission for a  
**Record of Site Condition?**

☐ Yes      ☐ No

### Report Guideline on Certificate of Analysis

☐ Yes      ☐ No

### Sample Matrix Legend

<b>B</b>	Biota
<b>GW</b>	Ground Water
<b>O</b>	Oil
<b>P</b>	Paint
<b>S</b>	Soil
<b>SD</b>	Sediment
<b>SW</b>	Surface Water

Field Filtered - Metals, Hg, CrVI

O. Reg 153

**Metals and Inorganics**

☐ All Metals ☐ 153 Metals (excl. Hydrides)

☐ Hydride Metals ☐ 153 Metals (Incl. Hydrides)

ORPs: ☐ B-HWS ☐ Cl ☐ CN<sup>-</sup>  
☐ Cr<sup>6+</sup> ☐ EC ☐ FOC ☐ Hg

Full Metals Scan

Regulation/Custom Metals

Nutrients: ☐ TP ☐ NH<sub>3</sub> ☐ TKN  
☐ NO<sub>3</sub> ☐ NO<sub>2</sub> ☐ NO<sub>3</sub>+NO<sub>2</sub>

☐ Volatiles: ☐ VOC ☐ BTEX ☐ THM

PHCs F1 - F4

ABNS

PAHS

PCBs: ☐ Total ☐ Aroclors

Organochlorine Pesticides

| TRCLP: | ☐ M&I | ☐ VOCs | ☐ ABNs | ☐ B(a)P | ☐ PCBs |

Sewer Use

Corrosivity, Package

--

--

7	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100
---	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	-----

[illegible]

1000

[illegible]

Samples Relinquished By (Print Name and Sign): <i>R. C. [Signature]</i>	Date <i>Dec 24/17</i>	Time <i>10:10</i>	Samples Received By (Print Name and Sign): <i>[Signature]</i>	Date <i>12/21/17</i>	Time <i>19:10</i>	Page ____ of ____
Samples Relinquished By (Print Name and Sign): <i>[Signature]</i>	Date <i>12/21/17</i>	Time <i>11:00</i>	Samples Received By (Print Name and Sign):	Date	Time	

No: **T 061806**



## **Appendix C**

### **Selected Site Photographs**



**Photo 1: Highway 404 looking north**



**Photo 2: East embankment at outlet of proposed twin culverts**





**Photo 3: Highway 404 looking south**



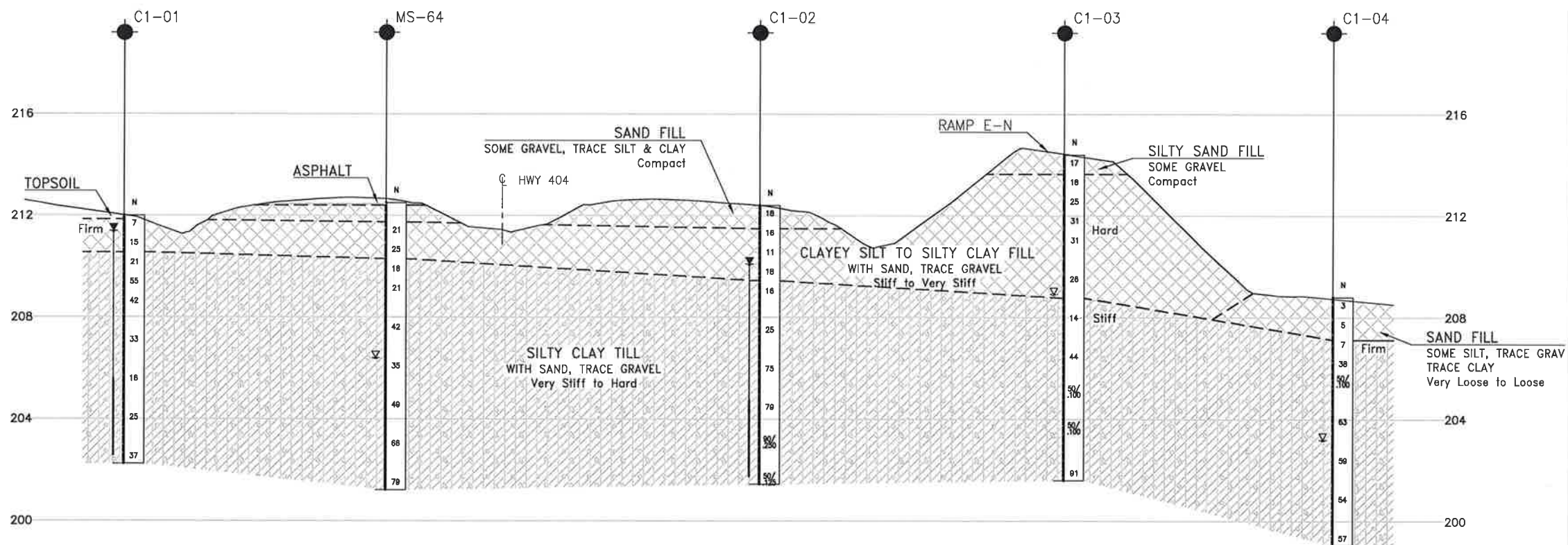
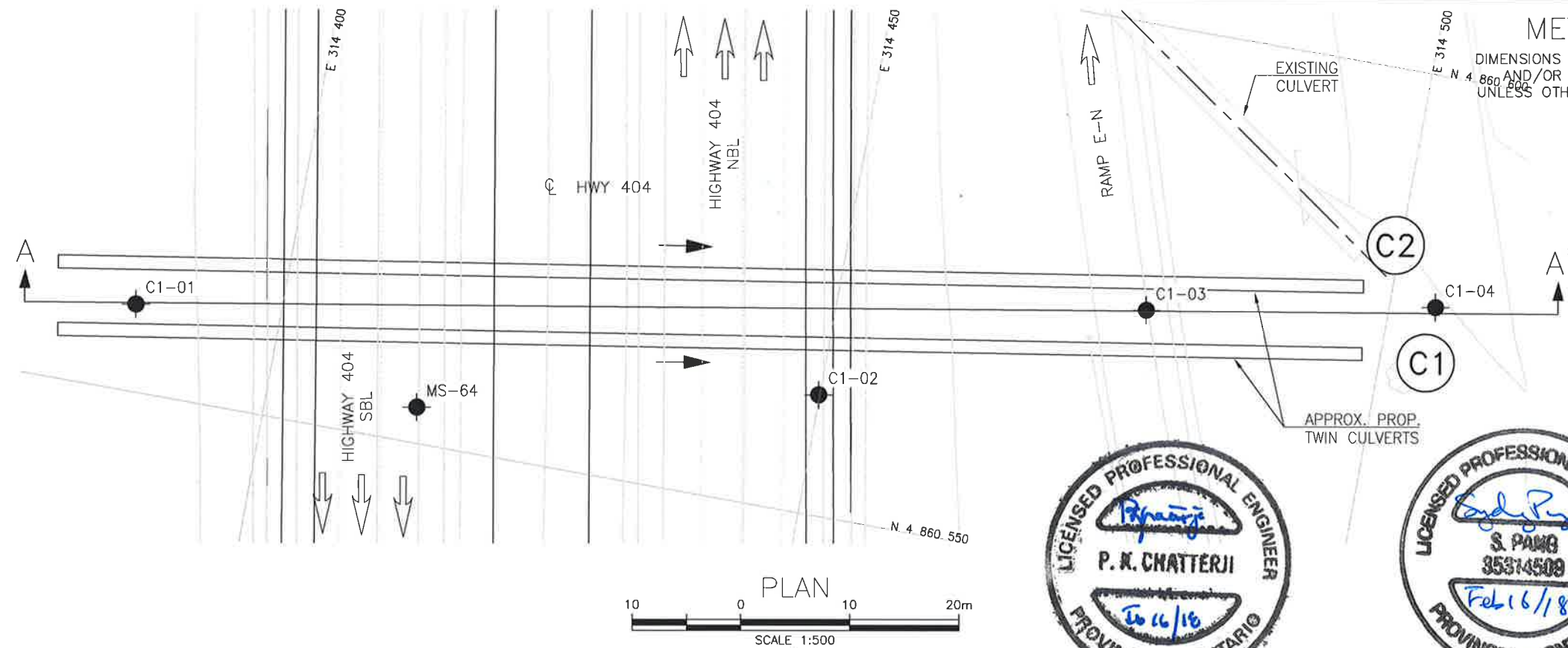
**Photo 4: West embankment at inlet of proposed twin culverts**



## **Appendix D**

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





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



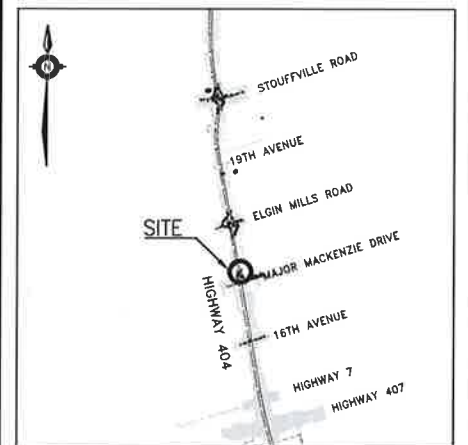
CONT No 2017-2045  
WP No 2930-02-00

HIGHWAY 404 WIDENING  
CULVERTS C1 & C2  
STA 18+456 & STA 18+462  
BOREHOLE LOCATIONS AND SOIL STRATA

wsp



THURBER ENGINEERING LTD.



KEYPLAN

LEGEND

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

NO	ELEVATION	NORTHING	EASTING
C1-01	212.0	4 860 558.0	314 386.8
C1-02	212.4	4 860 561.0	314 449.9
C1-03	214.4	4 860 574.0	314 478.1
C1-04	208.8	4 860 579.0	314 504.2
MS-64	212.5	4 860 553.3	314 413.8

-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.

GEOCREs No. 30M14-471

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