

**FOUNDATION INVESTIGATION REPORT  
MTO PATROL YARD  
MISSISSAUGA, ONTARIO  
G.W.P. 2107-05-00, WP 2153-07-00**

**Geocres Number: 30M12-271**

**Report to**

**MMM Group Limited**

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Memos\Patrol Yard\19142311-patrol yard- FR-FINAL.doc

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## **FOUNDATION INVESTIGATION REPORT**

### **MTO PATROL YARD**

### **MISSISSAUGA, ONTARIO**

**G.W.P. 2107-05-00, WP 2153-07-00**

**Geocres Number: 30M12-271**

## **PART 1: FACTUAL INFORMATION**

### **1 INTRODUCTION**

This report presents the factual findings obtained from a foundation investigation conducted at the site of a proposed MTO Patrol Yard located northern of Highway 401 immediately east of Hurontario Street in Mississauga, Ontario.

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, borehole logs and a written description of the subsurface conditions.

Thurber carried out the investigation as a sub-consultant to MMM Group Limited (MMM) under the Ministry of Transportation Ontario (MTO) Agreement Number 2005-A-000347.

### **2 SITE DESCRIPTION**

The site is located immediately north of Highway 401, east of Hurontario Street in Mississauga, Ontario.

The site is currently occupied by an existing patrol yard which includes a small vehicle maintenance building, office, sand and salt storage domes, brine facility, access roads and parking lots. Riding surfaces of existing roads consist of asphalt over granular material. Currently, the surfaces of the parking lots consist of gravel. The site terrain is generally flat.

The general site area is located within the physiographic region known as the Peel Plain, characterized by a level to undulating cohesive glacial till plain underlain by reddish brown shale with limestone and siltstone interbeds of the Queenston Formation.

### 3 SITE INVESTIGATION AND FIELD TESTING

The site investigation and field testing for this project were carried out from September 25 to 29, 2007 and consisted of drilling and sampling eighteen boreholes (numbered 01 to 05, P01 to P11, T1 and T2) at the site. Boreholes were drilled at locations of the proposed maintenance building, paved areas, parking lots, salt, sand and brine storage areas, and along the north access road.

Sixteen boreholes were terminated upon auger refusal in shale bedrock at depths of 6.1m to 6.4 m (elevations 190.1 m to 191.3 m). Two boreholes (P01 and P02) were terminated in native soils at 6.2 m depth (elevations 190.4 m and 191.1 m).

The approximate borehole locations are shown on the Borehole Locations and Soil Strata Drawing in Appendix C. The coordinates and elevations of the boreholes are given on these drawings and on the individual Record of Borehole Sheets in Appendix A.

Prior to commencement of drilling, utility clearances were obtained for all borehole locations.

Solid stem augers were used to advance the boreholes in the overburden and into the shale. Samples were obtained at selected intervals using a 50 mm diameter split spoon sampler in conjunction with the Standard Penetration Testing (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 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. Five standpipe piezometers consisting of 19 mm PVC pipes with slotted screens were installed in selected boreholes to permit monitoring of groundwater levels. Details of the piezometer installations and other borehole completion details are as shown in Table 3.1.

**Table 3.1 – Borehole Completion Details**

Location	Borehole	Piezometer Tip Depth/ Elevation (m)	Completion Details
North access road	01	None installed	Bentonite grout to surface.
	03	5.2/191.3	Sand from 5.2 m to 3.4 m, bentonite grout to 0.3 m and sand and gravel to surface.
	04	None installed	Bentonite grout to surface.
	05	6.1/190.7	Sand from 6.1 m to 4.3 m, bentonite grout to surface.
Proposed Maintenance Building	P03	None installed	Bentonite grout to surface.
	P04	None installed	Bentonite grout to surface.
	P05	None installed	Bentonite grout to surface.
	P06	None installed	Bentonite grout to surface.
	P07	None installed	Bentonite grout to surface.
Proposed Vehicle Shed	P01	None installed	Bentonite grout to surface.
	P02	None installed	Bentonite grout to surface.
Proposed Sand/salt storage building	P08	5.2/191.8	Sand from 5.2 m to 3.4 m, bentonite grout to surface.
	P09	None installed	Bentonite grout to surface.
	P10	None installed	Bentonite grout to surface.
Proposed parking lot, paved areas and near existing sand/salt domes	02	6.1/190.9	Sand from 6.1 m to 4.3 m, bentonite grout to surface.
	P11	6.1/190.4	Sand from 6.1 m to 4.3 m, bentonite grout to surface.
	T1	None installed	Bentonite grout to surface.
	T2	None installed	Bentonite grout to surface.

#### 4 LABORATORY TESTING

All recovered soil and rock samples were subjected to Visual Identification (VI) and moisture content determination. At least 25% of the recovered samples of soil were also subjected to grain size distribution analyses (sieve and hydrometer) and Atterberg Limits testing where appropriate. The results of this testing program are shown on the Record of Borehole sheets in Appendix A and on the figures contained in Appendix B.

#### 5 SUBSURFACE CONDITIONS

Reference is made to the Records of Borehole sheets in Appendix A. Details of the encountered soil and rock stratigraphy are presented in this appendix and on the Borehole Locations and Soil Strata Drawing in Appendix C. 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.

In general terms, the soil stratigraphy encountered at this site consists of fill overlying native silty clay/clayey silt till which is generally underlain by sand and silt till deposits. Weathered shale bedrock was contacted below the till deposits. More detailed descriptions of the individual strata are presented below.

### 5.1 Pavement Structure

Pavement structure consisting of approximately 80 mm of asphalt overlying granular (sand with some gravel fill) road base was encountered in Boreholes T2 drilled on an existing paved area.

### 5.2 Fill

Fill was encountered surficially in all the boreholes, except in Borehole T2 where it was contacted below the asphalt. The fill generally consists of intermixed layers of various soils:

- Brown, reddish brown to grey silty clay containing some sand, trace gravel, occasional rootlets, glass pieces and wood fibers.
- Brown, dark brown to grey sand with some gravel trace silt, trace clay, fragments of slag, concrete and crushed limestone, occasional rootlets and glass pieces.
- Brown sand and gravel.
- Brown gravelly sand with trace of silt, trace of clay and slag fragments.
- Slabs of concrete were contacted in the following boreholes:

Borehole	Depth (m)	Elevation (m)	Thickness (mm)
03	1.8 to 2.3	194.7 to 194.2	500
P05	0.5 to 0.8	196.5 to 196.2	300

This concrete could be remnants of a slab or building rubble mixed in the fill.

The depth to the base of the fill layer ranged from 0.5 m to 2.3 m (from Elevations 194.2 m to 196.5 m).

Based on recorded SPT values ranging from 11 to 85 blows for 0.3 m of penetration, the silty clay fill is described as stiff to hard. SPT values of 50 blows per 0.15 m penetration were observed within the clay fill in Borehole P03.

SPT values measured in the cohesionless fill were 10 to 39 blows per 0.3 m penetration indicating compact to dense conditions. SPT values greater than 50 blows per 0.15 m penetration were observed within the sand fill in Boreholes 04, P01, P05, T1 and T2.

The natural moisture content of the samples obtained from the fill layer ranged from 3% to 21%.

Grain size distribution curves for the cohesionless fill samples tested are presented on the Record of Borehole sheets and on Figures B1 and B2 in Appendix B. Grain size distribution results of the cohesive fill are presented on the Record of Borehole sheets and on Figure B3 in Appendix B.

The results of gradation conducted on cohesive and cohesionless samples of fill are summarized below:

Soil	Cohesive Fill (%)	Cohesionless Fill (%)
Gravel	3	4 to 23
Sand	46	64 to 82
Silt and Clay	-	9 to 15
Silt	34	-
Clay	17	-

### 5.3 Silty Clay Till and Clayey Silt Till

Deposits of native brown to grey silty clay till and clayey silt till with sand, trace of gravel and occasional cobbles and rootlets were contacted below the fill in all the boreholes.

The depth to the base of the till deposit ranged from 2.3 m to 6.2 m (Elevations 190.4 m to 195.1 m).

Based on SPT N-values ranging from 8 to 85 blows for 0.3 m of penetration, the silty clay till and clayey silt till are described as being stiff to hard. SPT-N values greater than 50 blows for 0.15 m of penetration were observed below elevations 194.0 m to 194.5 m (2.0 m to 3.3 m below ground surface) in Boreholes 01, 03, 04, P01, P04, P05, P06 and P08. The natural moisture contents of the samples recovered from the silty clay till and clayey silt till layers ranged from 5 to 21%.

Grain size distribution curves for the samples tested are presented on the Record of Borehole sheets and on Figures B4 to B8 of Appendix B. Atterberg Limit test results are presented on Figures B10 to B12 of Appendix B.

The results of laboratory tests carried out on several till samples were as follows:

Soil Particles	(%)
Gravel	0 to 6
Sand	28 to 52
Silt	33 to 47
Clay	12 to 25

Index Property	(%)
Liquid Limit	17 to 26
Plastic Limit	11 to 15
Plasticity Index	6 to 13

The above results show that the silty clay till and clayey silt till are typically of low plasticity with a group symbol of CL.

Although not encountered in the boreholes, glacial tills inherently contain cobbles and boulders and the lower part of the till may contain pieces and slabs of bedrock which may account for some high blow counts and resistance to augering.

#### 5.4 Silty Sand Till and Sandy Silt Till

Brown to grey silty sand and sandy silt till containing trace to some clay and trace of gravel were contacted below the cohesive till in Boreholes 04, 05, P02, P03, P09, P10, T1 and T2.

The depth to the base of these deposits ranged from 3.7 m to 6.2 m (Elevations 191.1 m to 193.1 m).

Based on recorded SPT N-values ranging from 45 blows for 0.3 m penetration to greater than 50 blows for 0.150 m of penetration, these cohesionless soils are described as dense to very dense. The natural moisture content of the samples obtained from these deposits ranged from 5 to 9%.

Grain size distribution curves for the samples tested are presented on the Record of Borehole sheets and on Figure B9.

The results of laboratory tests carried out on a sample of the sand and silt till were as follows:

Soil Particles	(%)
Gravel	2 to 5
Sand	48 to 50
Silt	37 to 39
Clay	7 to 10



Although not encountered in the boreholes, glacial tills inherently contain cobbles and boulders which may account for some high N-values and resistance to augering.

## 5.5 Bedrock

The soils described above were found to be underlain by shale bedrock of the Queenston Formation. The reddish brown shale encountered in the boreholes is described as fine grained, thinly bedded and is known to contain numerous hard interbedded siltstone and limestone layers. The upper part of the shale bedrock is highly weathered and the weathering decreases with depth. The bedrock is known to get harder with depth. The siltstone and limestone interbeds can be significantly harder than the shale itself. The distribution, thickness and strength of these layers vary from location to location, and these layers typically exhibit less pronounced weathering than the shale.

SPT N-values obtained in the upper weathered shale bedrock were greater than 100 blows per 0.15 m penetration. Moisture contents measured within this zone ranged from 3 to 10%. Depth and elevations of the top of weathered bedrock are shown in Table 5.1.

**Table 5.1 – Depth and Elevation of Top of Bedrock**

Location	Borehole	Depth to Weathered Bedrock (m)	Elevation of Top of Weathered Bedrock (m)
North access road	01	3.7	192.5
	03	5.5	191.0
	04	5.5	191.5
	05	3.7	193.1
Proposed Maintenance Building	P03	5.2	192.2
	P04	3.4	193.4
	P05	3.4	193.7
	P06	5.2	192.1
	P07	4.3	193.1
Proposed Vehicle Shed	P01	-	-
	P02	-	-
Proposed Sand/salt storage building	P08	5.3	191.6
	P09	5.2	192.2
	P10	4.6	192.7
Proposed parking lot, paved areas and near existing sand/salt domes	02	3.7	193.3
	P11	3.0	193.5
	T1	4.3	193.1
	T2	4.6	192.7

## **5.6 Water Levels**

Water levels were observed in the boreholes during and upon completion of drilling. Standpipe piezometers were installed in five boreholes to monitor water levels after completion of drilling. The water levels measured in the piezometers are summarized in Table 5.2, along with the measurements in the boreholes upon completion of drilling.

**Table 5.2 – Measured Groundwater Levels**

Borehole	Date (2007)	Water Level (m)		Comment
		Depth	Elevation	
01	September 25	Dry	-	In open borehole
02	September 28	Dry	-	In piezometer
	October 5	2.1	194.9	
	October 18	2.1	194.9	
	November 1	2.3	194.7	
	November 15	2.2	194.8	
03	September 28	1.0	195.5	In piezometer
	October 5	1.2	195.3	
	October 18	1.2	195.3	
	November 1	1.3	195.2	
	November 15	1.2	195.3	
04	September 26	Dry	-	In open borehole
05	September 28	2.3	194.5	In piezometer
	October 5	2.5	194.3	
	October 18	2.5	194.3	
	November 1	2.7	194.1	
	November 15	2.5	194.3	
P01	September 26	Dry	-	In open borehole
P02	September 26	Dry	-	In open borehole
P03	September 26	Dry	-	In open borehole
P04	September 25	Dry	-	In open borehole
P05	September 25	Dry	-	In open borehole
P06	September 26	5.8	191.5	In open borehole
P07	September 25	Dry	-	In open borehole
P08	September 28	1.7	195.2	In piezometer
	October 5	1.8	195.1	
	October 18	1.7	195.2	
	November 1	1.8	195.1	
	November 15	1.6	195.3	
P09	September 27	Dry	-	In open borehole
P10	September 27	Dry	-	In open borehole
P11	September 28	Dry	-	In piezometer
	October 5	4.6	191.9	
	October 18	3.2	193.3	
	November 1	2.9	193.6	
	November 15	2.4	194.1	
T1	September 27	Dry	-	In open borehole
T2	September 27	Dry	-	In open borehole

The piezometric readings indicate that the groundwater levels range from Elevations 194.1 m to 195.3 m.

The above values 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 the spring snowmelt or after periods of heavy rainfall. Further, perched water may be encountered at higher levels in pockets or zones of more permeable sands and silts within the heterogeneous tills, or within the fill.

## **6 MISCELLANEOUS**

Borehole locations and ground surface elevations were supplied to Thurber by MMM Group Limited.

The drilling and sampling equipment was supplied and operated by DBW Drilling of Ajax Ontario. The field work was supervised on a full time basis by Mr. George Azzopardi of Thurber Engineering Ltd.

Laboratory testing was carried out at Thurber's Laboratory in Oakville, Ontario.

Supervision of the field program and interpretation of the field data was carried out by Ms. R. Palomeque Reyna, P.Eng. The investigation report was prepared by Dr. Sydney Pang, P. Eng. and Ms. R. Palomeque Reyna, P.Eng.

Dr. P.K. Chatterji, P.Eng., a Designated Principal Contact for MTO Foundations Projects, reviewed the report.

THURBER ENGINEERING LTD.

Rocío Palomeque Reyna, P.Eng.  
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## **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<sub>pen</sub>

Shear Strength Determination by Pocket Penetrometer





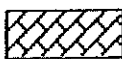
- (1) SPT 'N' Value      Standard Penetration Test 'N' Value – refers to the number of blows from a 63.5kg hammer free falling a height of 0.76m to advance a standard 50 mm outside diameter split spoon sampler for 0.3 m depth into undisturbed ground.
- (2) DCPT              Dynamic Cone Penetration Test – 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

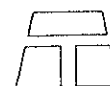
MAJOR DIVISIONS		GROUP SYMBOL	TYPICAL DESCRIPTION
COARSE GRAINED SOILS	GRAVEL AND GRAVELLY SOILS	GW	Well-graded gravels or gravel-sand mixtures, little or no fines.
		GP	Poorly-graded gravels or gravel-sand mixtures, little or no fines.
		GM	Silty gravels, gravel-sand-silt mixtures.
		GC	Clayey gravels, 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
CLAY SHALE			
SANDSTONE			
SILTSTONE			
CLAYSTONE			
COAL			



## EXPLANATION OF ROCK LOGGING TERMS

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

DISCONTINUITY SPACING		STRENGTH CLASSIFICATION			
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				
Very thinly bedded	20 to 60mm	Strong	50-100	7,500 to 15,000	Requires more than one blow of geological hammer to break
Laminated	6 to 20mm				
Thinly Laminated	Less than 6mm	Medium Strong	25.0 to 50.0	3,500 to 7,500	Breaks under single blow of geological hammer.
<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.	Very Weak	1.0 to 5.0	150 to 750	Can be peeled by a pocket knife, crumbles under firm blows of geological pick.
Solid Core Recovery: (SCR)	Percent Ratio of solid core of full cylindrical shape recovered. Expressed with respect to the total length of core run.	Extremely Weak (Rock)	0.25 to 1.0	35 to 150	Indented by thumbnail
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				
Fracture Index: (FI)	Frequency of natural fractures per 0.3 m of core run.				



# RECORD OF BOREHOLE No 01

1 OF 1

METRIC

G.W.P. 2107-05-00 LOCATION Patrol Yard N 4 832 749.806 E 290 319.536 ORIGINATED BY GA  
 HWY 401 BOREHOLE TYPE Solid Stem Augers COMPILED BY ES  
 DATUM Geodetic DATE 2007-09-25 - 2007-09-25 CHECKED BY RPR

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

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

20  
15  
10

(%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No 02

1 OF 1

METRIC

G.W.P. 2107-05-00 LOCATION Patrol Yard N 4 832 693.029 E 290 387.277 ORIGINATED BY GA  
 HWY 401 BOREHOLE TYPE Solid Stem Augers COMPILED BY ES  
 DATUM Geodetic DATE 2007-09-28 - 2007-09-28 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 Y	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa								WATER CONTENT (%)		
							20	40	60	80	100	20	40	60	GR	SA	SI	CL
197.0																		
0.0	<b>SAND</b> , some gravel, trace silt, trace clay, occasional rootlets, occasional glass pieces		1	SS	18											12	77	11
196.4	Compact Brown Moist (FILL)																	
0.6	Clayey SILT with sand Stiff to Hard Brown (TILL)		2	SS	8													
	occasional rootlets		3	SS	36													
			4	SS	42											0	50	33
			5	SS	85													
193.3																		
3.7	Highly weathered, thinly bedded, reddish brown SHALE		6	SS	103/.150													
190.8																		
6.2	END OF BOREHOLE AT 6.20m. BOREHOLE OPEN AND DRY UPON COMPLETION. Piezometer installation consists of 19mm diameter pipe. WATER LEVEL READINGS: DATE DEPTH (m) ELEV. (m) Sep 28/07 Dry - Oct 05/07 2.1 194.9 Oct 18/07 2.1 194.9 Nov 01/07 2.3 194.7 Nov 15/07 2.2 194.8		7	SS	100/.100													

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

# RECORD OF BOREHOLE No 03

1 OF 1

METRIC

G.W.P. 2107-05-00 LOCATION Patrol Yard N 4 832 581.647 E 290 178.595 ORIGINATED BY GA  
 HWY 401 BOREHOLE TYPE Solid Stem Augers COMPILED BY ES  
 DATUM Geodetic DATE 2007-09-26 - 2007-09-26 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					
196.5								20 40 60 80 100					
0.0	SAND, some gravel, trace silt, trace clay Compact Brown Moist (FILL)		1	SS	22		196	o UNCONFINED + FIELD VANE					18 73 9 (SI+CL)
195.9								o QUICK TRIAXIAL x LAB VANE					
0.6	Silty CLAY with sand, trace gravel, occasional rootlets Hard Mottled Brown-Grey (FILL)		2	SS	58		195						
194.7			3	SS	85								
1.8	Concrete Slab (500mm thick)												
194.2													
2.3	Clayey SILT with sand, trace gravel Hard Brown (TILL)		4	SS	100/ .100		194						
	Grey		5	SS	100/ .75		193						2 39 47 12
			6	SS	100/ .100		192						
191.0	Highly weathered, thinly bedded, reddish brown SHALE						191						
5.5													
190.2			7	SS	123/ .150								
6.2	END OF BOREHOLE AT 6.25m. BOREHOLE OPEN TO 5.18m AND DRY UPON COMPLETION. Piezometer installation consists of 19mm diameter pipe. WATER LEVEL READINGS: DATE DEPTH (m) ELEV. (m) Sep 28/07 1.0 195.5 Oct 05/07 1.2 195.3 Oct 18/07 1.2 195.3 Nov 01/07 1.3 195.2 Nov 15/07 1.2 195.3												




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

# RECORD OF BOREHOLE No 04

1 OF 1

METRIC

G.W.P. 2107-05-00 LOCATION Patrol Yard N 4 832 625.432 E 290 215.294 ORIGINATED BY GA  
 HWY 401 BOREHOLE TYPE Solid Stem Augers COMPILED BY ES  
 DATUM Geodetic DATE 2007-09-26 - 2007-09-26 CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				UNIT WEIGHT  γ  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
197.0							20 40 60 80 100	○ UNCONFINED	+ FIELD VANE	PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT		
0.0	<b>SAND</b> , trace to some silt, trace gravel, occasional slag fragments Very Dense Dark Brown Moist (FILL)  Clayey <b>SILT</b> , with sand, trace gravel, occasional rootlets Very Stiff to Hard Brown to Grey (TILL)		1	SS	50/ .150									
196.5														
0.5														
			2	SS	16									
			3	SS	23								1 44 39 16	
			4	SS	50/ .150									
193.9														
3.0	<b>SILT</b> and <b>SAND</b> , trace clay, trace gravel Very Dense Brown Moist (TILL)		5	SS	50/ .150								2 50 39 9	
			6	SS	113/ .150									
191.5														
5.5	Highly weathered, thinly bedded, reddish brown <b>SHALE</b>													
190.9														
6.1	END OF BOREHOLE AND AUGER REFUSAL AT 6.10m. BOREHOLE OPEN AND DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO SURFACE.													






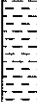
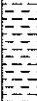
+ 3, × 3: Numbers refer to Sensitivity 20 15 10 5 (%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No 05

1 OF 1

METRIC

G.W.P. 2107-05-00 LOCATION Patrol Yard N 4 832 687.472 E 290 267.292 ORIGINATED BY GA  
 HWY 401 BOREHOLE TYPE Solid Stem Augers COMPILED BY ES  
 DATUM Geodetic DATE 2007-09-25 - 2007-09-25 CHECKED BY RPR  
 RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				UNIT WEIGHT  Y 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 ● QUICK TRIAXIAL	+ FIELD VANE × LAB VANE	WATER CONTENT (%) W <sub>P</sub> W W <sub>L</sub>			
196.8						20 40 60 80 100							
0.0	Silty <b>CLAY</b> , some sand, trace gravel, occasional rootlets Stiff Brown (FILL)  occasional wood fibers and rootlets Dark Grey to Brown		1	SS	24								
			2	SS	16								
195.3													
1.5	Clayey <b>SILT</b> , with sand, trace gravel Stiff to Hard Brown (TILL)		3	SS	12								
			4	SS	34								
193.8													
3.0	<b>SAND</b> and <b>SILT</b> , trace clay, trace gravel, iron oxide stains Very Dense Brown (TILL)		5	SS	50/ .150								
193.1													
3.7	Highly weathered, thinly bedded, reddish brown <b>SHALE</b>		6	SS	120/ .150								
													
190.7													
6.1	END OF BOREHOLE AT 6.10m. BOREHOLE OPEN AND DRY UPON COMPLETION.  Piezometer installation consists of 30mm diameter schedule 40 PVC pipe with a 1.52m slotted screen. WATER LEVEL READINGS: DATE DEPTH (m) ELEV. (m) Sep 28/07 2.3 194.5 Oct 05/07 2.5 194.3 Oct 18/07 2.5 194.3 Nov 01/07 2.7 194.1 Nov 15/07 2.5 194.3												

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

# RECORD OF BOREHOLE No P01

1 OF 1

METRIC

G.W.P. 2107-05-00 LOCATION Patrol Yard N 4 832 586.708 E 290 215.640 ORIGINATED BY GA  
 HWY 401 BOREHOLE TYPE Solid Stem Augers COMPILED BY ES  
 DATUM Geodetic DATE 2007-09-26 - 2007-09-26 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							
196.7								20 40 60 80 100							
0.0	SAND, trace silt, trace gravel, occasional slag fragments Very Dense Dark Brown (FILL)		1	SS	50/ .150										
196.0															
0.7			Silty CLAY, with sand, trace gravel, occasional iron oxidized stains Very Stiff to Hard Brown (TILL)		2	SS	17								
	3	SS			32										
			4	SS	41										
193.6	Clayey SILT, with sand, trace gravel, occasional iron oxidized stains Hard Brown Moist (TILL)		5	SS	50/ .125										
3.0															
			6	SS	108/ .150										
			7	SS	100/ .150										
190.4	END OF BOREHOLE AT 6.25m. BOREHOLE OPEN AND DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO SURFACE.														
6.2															

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



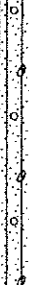
20  
15 5  
10 (%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No P02

1 OF 1

METRIC

G.W.P. 2107-05-00 LOCATION Patrol Yard N 4 832 631.542 E 290 253.217 ORIGINATED BY GA  
 HWY 401 BOREHOLE TYPE Solid Stem Augers COMPILED BY ES  
 DATUM Geodetic DATE 2007-09-26 - 2007-09-26 CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT  γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa								WATER CONTENT (%)		
								○ UNCONFINED    + FIELD VANE										
197.3							● QUICK TRIAXIAL    x LAB VANE	20	40	60	80	100	20	40	60	kn/m <sup>3</sup>	GR SA SI CL	
0.0	SAND, trace to some gravel, trace silt, trace clay, occasional slag and concrete fragments Compact Brown Moist (FILL)		1	SS	20													
			2	SS	17													
195.8																	13 74 12 (SI+CL)	
1.5	Clayey SILT, with sand, trace gravel, occasional cobbles Very Stiff to Hard Brown to Dark Grey (TILL)		3	SS	21													
			4	SS	42													
			5	SS	56													
193.1																	3 41 39 16	
4.3	SAND and SILT, some clay, trace gravel Very Dense Grey (TILL)		6	SS	507 .075													
191.1			7	SS	116/ .150													
6.2	END OF BOREHOLE AT 6.25m. BOREHOLE OPEN AND DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO SURFACE.																	

+ 3, X 3: Numbers refer to  
Sensitivity

20  
15  
10

(%) STRAIN AT FAILURE



# RECORD OF BOREHOLE No P03

1 OF 1

METRIC

G.W.P. 2107-05-00 LOCATION Patrol Yard N 4 832 650.166 E 290 255.127 ORIGINATED BY GA  
 HWY 401 BOREHOLE TYPE Solid Stem Augers COMPILED BY ES  
 DATUM Geodetic DATE 2007-09-26 - 2007-09-26 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						
197.3								20	40	60	80	100		
0.0	<b>SAND and GRAVEL</b> Compact Brown Moist (FILL)						197							
196.7			1	SS	23									
0.7	Silty <b>CLAY</b> , some sand to sandy, some gravel, occasional rootlets Hard Dark Grey to Brown (FILL)		2	SS	50/ .150									
195.8							196							
1.5	<b>SAND</b> , some gravel, trace silt, oxide present Compact Grey (FILL)		3	SS	10									
195.1							195							
2.3	Silty <b>CLAY</b> , with sand, trace gravel Hard Brown to Grey (TILL)		4	SS	59									2 41 38 19
			5	SS	79		194							
193.1														
4.3	<b>SAND and SILT</b> , trace gravel, trace clay Very Dense Grey Moist (TILL)		6	SS	107/ .150		193							4 51 39 7
192.2														
5.2	Highly weathered, thinly bedded, reddish brown <b>SHALE</b>						192							
191.1			7	SS	113/ .150									
6.2	END OF BOREHOLE AT 6.25m. BOREHOLE OPEN AND DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO SURFACE.													

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

20  
15 10 5  
10 (%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No P04

1 OF 1

METRIC

G.W.P. 2107-05-00 LOCATION Patrol Yard N 4 832 705.970 E 290 301.898 ORIGINATED BY GA  
 HWY 401 BOREHOLE TYPE Solid Stem Augers COMPILED BY ES  
 DATUM Geodetic DATE 2007-09-25 - 2007-09-25 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 $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa								
196.8								20	40	60	80	100				
0.0 0.1	SAND and GRAVEL: (250mm)(FILL)  Silty CLAY, trace to some sand, trace gravel, occasional rootlets and wood fibers Very Stiff to Stiff Brown to Dark Grey (FILL)		1	SS	23											
			2	SS	13											
195.3																
1.5	Silty CLAY, with sand, trace gravel, iron oxidized stains Stiff to Hard Mottled Brown-Grey to Reddish Brown (TILL)		3	SS	13											
			4	SS	50/ .150											
193.4			5	SS	50/ .150											
3.4	Highly weathered, thinly bedded, reddish brown SHALE															
			6	SS	104/ .150											
190.6																
6.2	END OF BOREHOLE AT 6.17m. BOREHOLE OPEN AND DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO SURFACE.		7	SS	50/ .075											

# RECORD OF BOREHOLE No P05

1 OF 1

METRIC

G.W.P. 2107-05-00 LOCATION Patrol Yard N 4 832 684.941 E 290 326.989 ORIGINATED BY GA  
 HWY 401 BOREHOLE TYPE Solid Stem Augers COMPILED BY ES  
 DATUM Geodetic DATE 2007-09-25 - 2007-09-25 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					
197.0								20 40 60 80 100					
0.0	Gravelly <b>SAND</b> , trace silt Very Dense Brown to Black		1	SS	70/ .150		197						
196.5	Moist (FILL)												
0.5													
196.2	Concrete slab												
0.8	Silty <b>CLAY</b> , with sand, trace gravel Stiff Mottled Dark Grey-Brown (FILL) Grey to Mottled Grey-Reddish Brown		2	SS	13		196						3 46 34 17
			3	SS	11		195						
194.7													
2.3	Silty <b>CLAY</b> , with sand, trace gravel Very Stiff to Hard Brown (TILL)		4	SS	28		194						1 35 44 20
193.7			5	SS	50/ .150		193						
3.4	Highly weathered, thinly bedded, reddish brown <b>SHALE</b> augers grinding 3.66m to 4.57m												
			6	SS	50/ .000		192						
190.8			7	SS	100/ .125		191						
6.2	END OF BOREHOLE AT 6.22m. BOREHOLE OPEN AND DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO SURFACE.												

+ 3, X 3: Numbers refer to  
Sensitivity

20  
15  
10

(%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No P06

1 OF 1

METRIC

G.W.P. 2107-05-00 LOCATION Patrol Yard N 4 832 629.137 E 290 280.218 ORIGINATED BY GA  
 HWY 401 BOREHOLE TYPE Solid Stem Augers COMPILED BY ES  
 DATUM Geodetic DATE 2007-09-26 - 2007-09-26 CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100		
197.3														
0.0	Silty CLAY, with sand, trace gravel Very Stiff to Hard Brown (FILL)  Dark Grey		1	SS	30		197							
			2	SS	15		196							
195.7														
1.5	Silty SAND, some clay, trace gravel Compact Dark Grey Moist (FILL)		3	SS	22									
195.1							195							
2.1	Clayey SILT, with sand, trace gravel Very Stiff to Hard Brown to Reddish Brown (TILL)		4	SS	21									1 44 41 14
			5	SS	84		194							
							193							
			6	SS	50/ .150									2 45 42 11
192.1							192							
5.2	Highly weathered, thinly bedded, reddish brown SHALE													
190.8			7	SS	69/ 150		191							
6.4	END OF BOREHOLE AT 6.40m. BOREHOLE OPEN TO 6.40m AND WATER LEVEL AT 5.80m. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO SURFACE.													

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

20  
15 5  
10 (%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No P07

1 OF 1

METRIC

G.W.P. 2107-05-00 LOCATION Patrol Yard N 4 832 667.554 E 290 291.058 ORIGINATED BY GA  
 HWY 401 BOREHOLE TYPE Solid Stem Augers COMPILED BY ES  
 DATUM Geodetic DATE 2007-09-26 - 2007-09-29 CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100		
197.4														
0.0	Gravelly SAND, trace silt, trace clay, slag fragments Compact to Dense Dark Brown to Grey Moist (FILL)		1	SS	28		197							
			2	SS	39									23 64 13 (SI+CL)
195.9							196							
1.5	Silty CLAY with sand, trace gravel, occasional iron oxidized stains Very Stiff to Stiff Mottled Brown-Grey (TILL) occasional rootlets		3	SS	18									
			4	SS	11		195							
194.4														
3.0	Clayey SILT with sand, trace gravel Hard Brown (TILL)		5	SS	33		194							
193.1							193							
4.3	Highly weathered, thinly bedded, reddish brown SHALE		6	SS	50/ .150									0 46 39 15
							192							
191.2														
6.2	BOREHOLE ENDED AT 6.17m. BOREHOLE OPEN AND DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO SURFACE.		7	SS	110/ .75									

+ 3, X 3: Numbers refer to  
Sensitivity

20  
15 5  
10 (%) STRAIN AT FAILURE

## METRIC

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					
196.9							SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE				kN/m <sup>3</sup>	GR SA SI

+ 3, × 3. Numbers refer to Sensitivity

# RECORD OF BOREHOLE No P09

1 OF 1

METRIC

G.W.P. 2107-05-00 LOCATION Patrol Yard N 4 832 559.348 E 290 294.141 ORIGINATED BY GA  
 HWY 401 BOREHOLE TYPE Solid Stem Augers COMPILED BY ES  
 DATUM Geodetic DATE 2007-09-27 - 2007-09-27 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							
197.4								20 40 60 80 100							
0.0	<b>SAND</b> , trace silt, trace to some gravel Compact Dark Brown		1	SS	23		197								
196.9	Moist (FILL)														
0.5	Silty <b>CLAY</b> , trace sand, occasional rootlets Very Stiff Dark brown (FILL)		2	SS	19		196								
195.8															
1.5	Silty <b>CLAY</b> , with sand, trace gravel Hard Mottled Brown-Grey (TILL)		3	SS	33		195							1 28 46 25	
195.1															
2.3	<b>SAND</b> and <b>SILT</b> , some clay, trace gravel, occasional iron oxidized stains Dense to Very Dense Brown Moist (TILL)		4	SS	45		194								
				5	SS	61/ .150		193							
	Grey														
			6	SS	72/ .150		192							5 48 37 10	
192.2															
5.2	Highly weathered, thinly bedded, reddish brown <b>SHALE</b>														
191.3															
6.1	END OF BOREHOLE AT 6.10m. BOREHOLE OPEN AND DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO SURFACE.		7	SS	50/ .000										

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



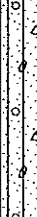

20  
15 10 5  
(%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No P10

1 OF 1

METRIC

G.W.P. 2107-05-00 LOCATION Patrol Yard N 4 832 597.217 E 290 306.973 ORIGINATED BY GA  
 HWY 401 BOREHOLE TYPE Solid Stem Augers COMPILED BY ES  
 DATUM Geodetic DATE 2007-09-27 - 2007-09-27 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 (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa								
197.3							20	40	60	80	100					
0.0	<b>SAND and GRAVEL</b> 200mm crusher run limestone layer Dense to Compact Brown Wet (FILL)		1	SS	35											18 71 11 (SI+CL)
196.1			2	SS	18											
1.2	Clayey <b>SILT</b> , with sand, trace gravel Very Stiff to Hard Mottled Brown-Grey to Brown (TILL)		3	SS	16											
			4	SS	48											6 47 33 14
194.3																
3.0	<b>SAND and SILT</b> , some clay, trace gravel, iron oxidized stains Very Dense Brown (TILL)		5	SS	50/ .150											
192.7																
4.6	Highly weathered, thinly bedded, reddish brown <b>SHALE</b>		6	SS	103											
191.1			7	SS	100/ .125											
6.2	END OF BOREHOLE AT 6.22m. BOREHOLE OPEN AND DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO SURFACE.				.125											

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

20  
15  
10

(%) STRAIN AT FAILURE



# RECORD OF BOREHOLE No P11

1 OF 1

METRIC

G.W.P. 2107-05-00 LOCATION Patrol Yard N 4 832 729.887 E 290 343.302 ORIGINATED BY GA  
 HWY 401 BOREHOLE TYPE Solid Stem Augers COMPILED BY ES  
 DATUM Geodetic DATE 2007-09-25 - 2007-09-25 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						
								20 40 60 80 100		PLASTIC LIMIT W <sub>P</sub>		NATURAL MOISTURE CONTENT W		
							WATER CONTENT (%)					GR SA SI CL		
196.5														
0.0	Sandy SILT, some clay, trace gravel, occasional rootlets Compact Brown Damp to Moist (FILL)		1	SS	20									
195.8														
0.8	Silty CLAY, trace to some sand, trace gravel Stiff to Very Stiff Mottled Grey-Reddish Brown to Brown (FILL)		2	SS	11									
			3	SS	18									
194.2														
2.3	Silty CLAY, with sand, trace gravel Very Stiff Reddish Brown (TILL)		4	SS	17									2 42 36 20
193.5														
3.0	Highly weathered, thinly bedded, reddish brown SHALE with occasional siltstone interbeds		5	SS	60/ 150									
			6	SS	100/ 125									
190.4														
6.1	END OF BOREHOLE AT 6.10m UPON AUGER REFUSAL. BOREHOLE OPEN AND DRY UPON COMPLETION. Piezometer installation consists of 19mm diameter PVC pipe. WATER LEVEL READINGS: DATE DEPTH(m) ELEV (m) Sep 28/07 Dry Oct 05/07 4.6 191.9 Oct 18/07 3.2 193.3 Nov 01/07 2.9 193.6 Nov 15/07 2.4 194.1													

+ 3, x 3: Numbers refer to  
Sensitivity

20  
15 5  
10 (%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No T1

1 OF 1

METRIC

G.W.P. 2107-05-00 LOCATION Patrol Yard N 4 832 640.957 E 290 326.316 ORIGINATED BY GA  
 HWY 401 BOREHOLE TYPE Solid Stem Augers COMPILED BY ES  
 DATUM Geodetic DATE 2007-09-27 - 2007-09-27 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						
								20 40 60 80 100						
197.4								20 40 60 80 100						
0.0	CRUSHER RUN LIMESTONE Compact Brown (FILL)		1	SS	27		197							
196.8														
0.6	SAND, some silt and clay, trace gravel Very Dense Brown Moist (FILL)		2	SS	50/ .150		196							4 82 14 (SI+CL)
195.9														
1.4	Silty CLAY, trace to some sand, trace gravel, occasional iron oxidized stains, occasional rootlets Very Stiff Brown (FILL)		3	SS	20		195							
195.1														
2.3	Silty CLAY, with sand, trace gravel Brown to Reddish Brown Very Stiff to Hard (TILL)		4	SS	15		194							3 35 43 19
			5	SS	50		193							
193.7														
3.7	SAND and SILT, some clay, trace gravel Very Dense Brown Moist (TILL)													
193.1														
4.3	Highly weathered, thinly bedded, reddish brown SHALE		6	SS	102/ .300		192							
			7	SS	102/ .150									
191.1														
6.2	END OF BOREHOLE AT 6.25m. BOREHOLE OPEN AND DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO SURFACE.													

+ 3, x 3: Numbers refer to  
Sensitivity

20  
15 5  
10 (%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No T2

1 OF 1

METRIC

G.W.P. 2107-05-00 LOCATION Patrol Yard N 4 832 611.216 E 290 350.328 ORIGINATED BY GA  
 HWY 401 BOREHOLE TYPE Solid Stem Augers COMPILED BY ES  
 DATUM Geodetic DATE 2007-09-27 - 2007-09-27 CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	20 40 60 80 100	20 40 60 80 100	20 40 60 80 100		
197.3 0.0 0.1	ASPHALT: (80mm)  SAND, some gravel, some silt, some clay Compact Brown Damp to Wet (FILL)		1	SS	50/ .150		197						13 72 15 (SI+CL)
195.9 1.4	Silty CLAY, with sand, trace gravel Hard Brown to reddish brown (TILL)		2	SS	22		196						
			3	SS	40		195						
			4	SS	46		194						
194.1 3.2	SAND and SILT, some clay, trace gravel, iron oxidized stains Very dense Brown Moist (TILL)		5	SS	107		193						
192.7 4.6	Highly weathered, thinly bedded, reddish brown SHALE  augers grinding from 5.49m to 5.79m.		6	SS	100/ .125		192						
191.2 6.1	END OF BOREHOLE AT 6.1m UPON AUGER REFUSAL. BOREHOLE OPEN AND DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO SURFACE.												

+ 3. X 3. Numbers refer to  
Sensitivity

20  
15  
10

(%) STRAIN AT FAILURE

## **Appendix B**

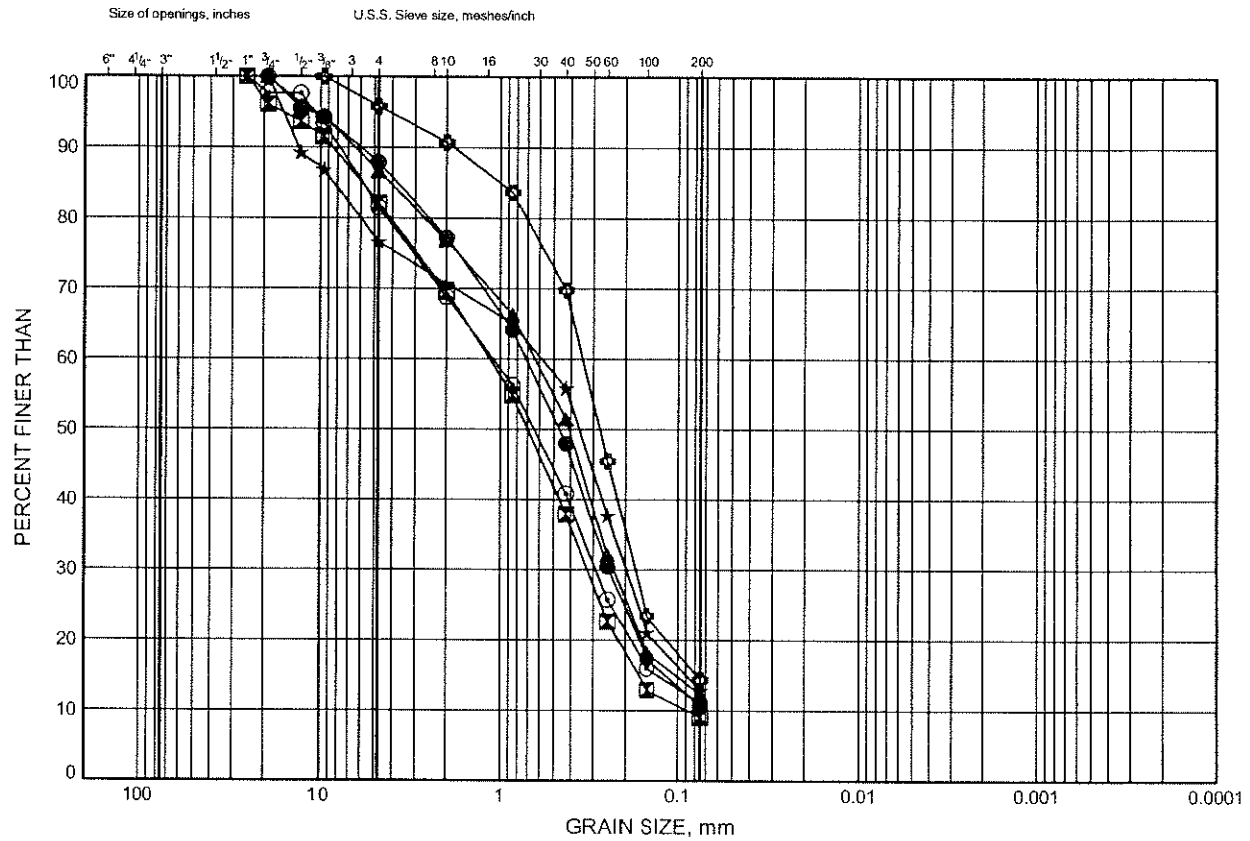
### **Laboratory Test Results**

# Hwy 401/410 to Credit River

## GRAIN SIZE DISTRIBUTION

FIGURE B1

### Sand Fill



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

SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	02	0.30	196.68
⊠	03	0.30	196.18
▲	P02	1.07	196.27
★	P07	1.07	196.35
⊙	P10	0.30	197.00
⊗	T1	1.07	196.30

Date February 2008  
Project 2107-05-00

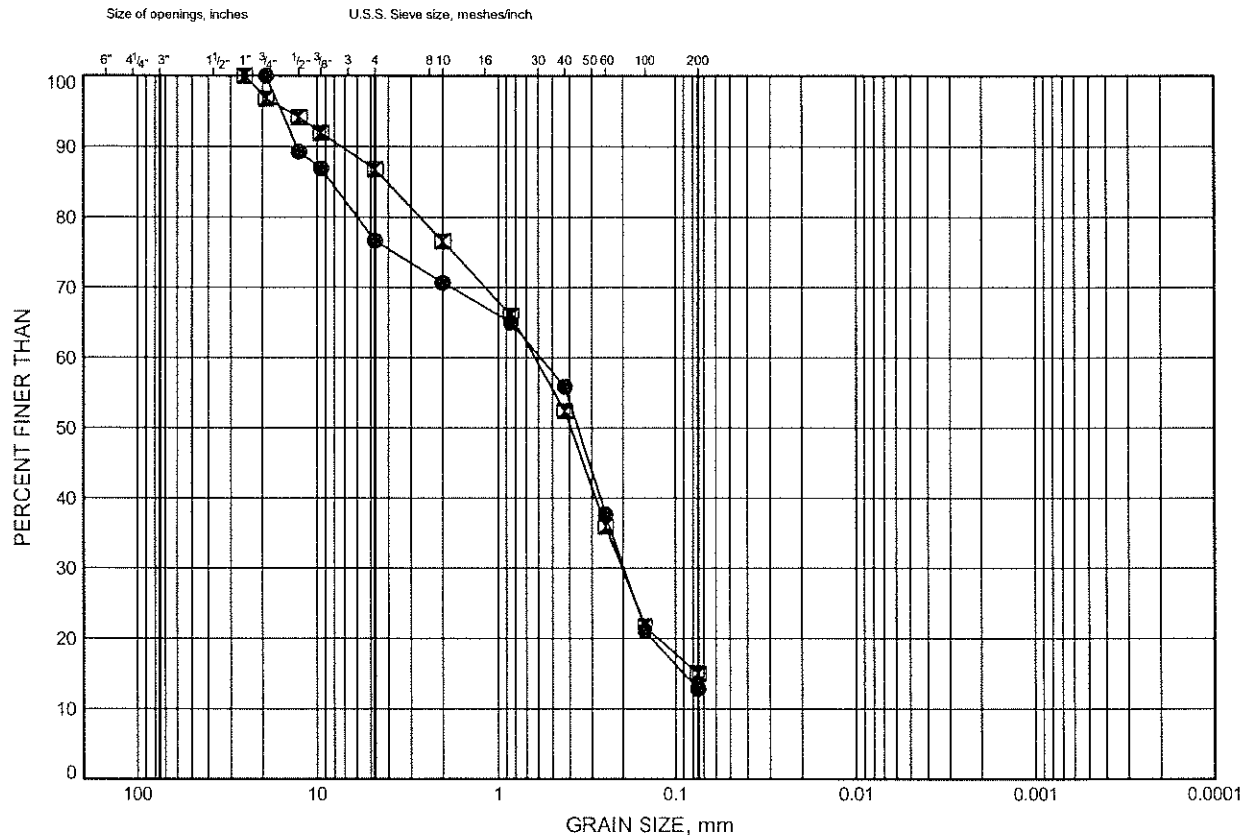


Prep'd MFA  
Chkd. RPR

# Hwy 401/410 to Credit River GRAIN SIZE DISTRIBUTION

FIGURE B2

## Sand Fill and Gravelly Sand Fill



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

SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	P07	1.07	196.35
☒	T2	0.15	197.16

Date February 2008

Project 2107-05-00



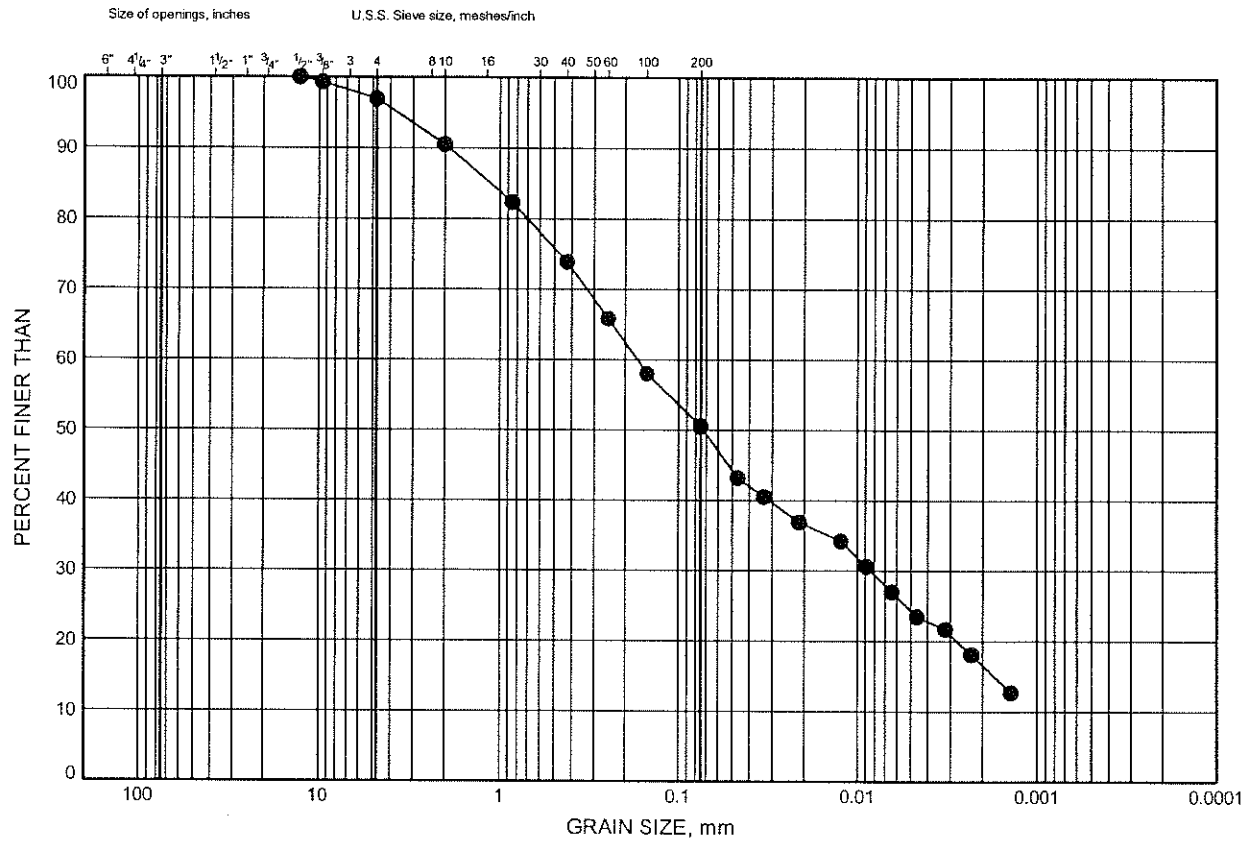
Prep'd MFA

Chkd. RPR

Hwy 401/410 to Credit River  
**GRAIN SIZE DISTRIBUTION**

FIGURE B3

**Silty Clay Fill**



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

SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	P05	1.07	195.94

Date February 2008  
 Project 2107-05-00



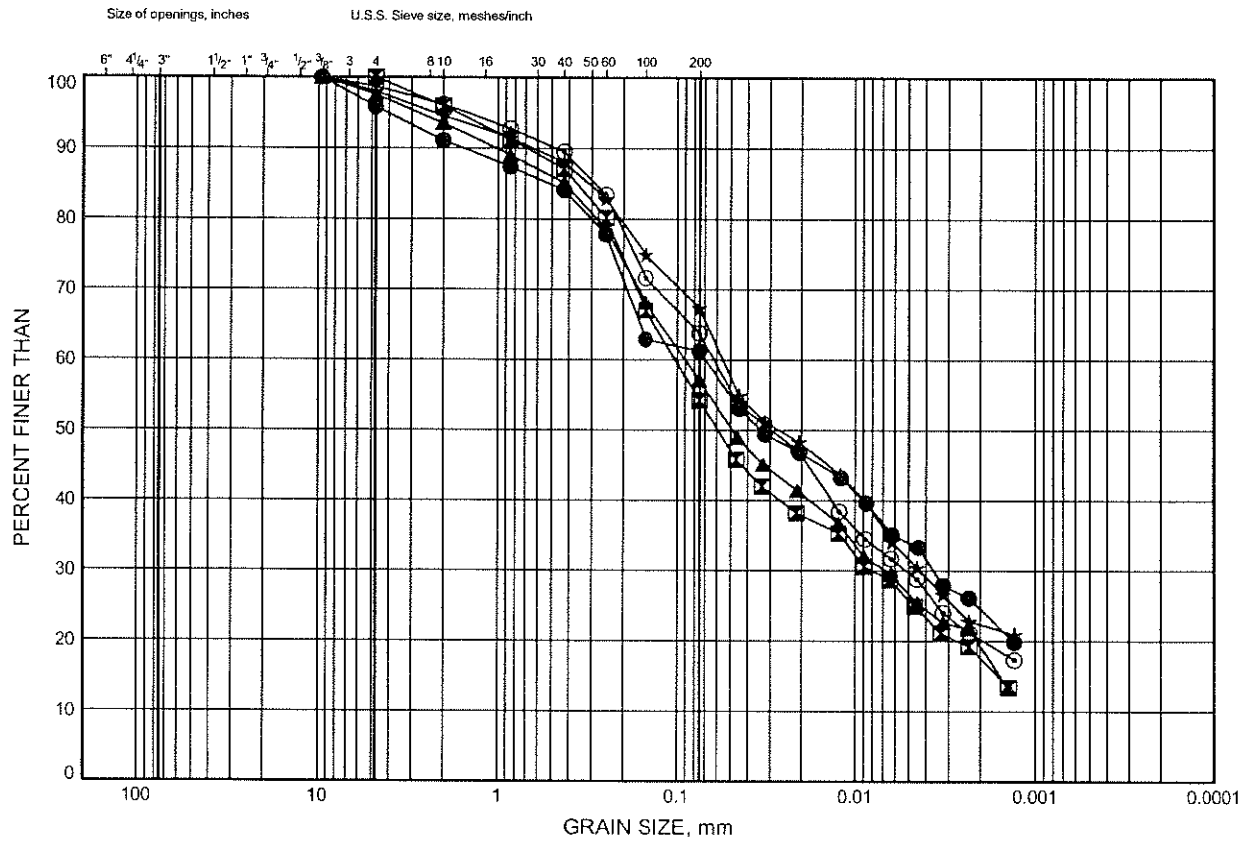
Prep'd MFA  
 Chkd. RPR

# Hwy 401/410 to Credit River

## GRAIN SIZE DISTRIBUTION

FIGURE B4

### Silty Clay Till with Sand



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

SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	01	1.83	194.33
⊠	P01	1.07	195.60
▲	P03	2.59	194.76
★	P04	2.59	194.18
⊙	P05	2.59	194.42

Date February 2008  
Project 2107-05-00



Prep'd MFA  
Chkd. RPR

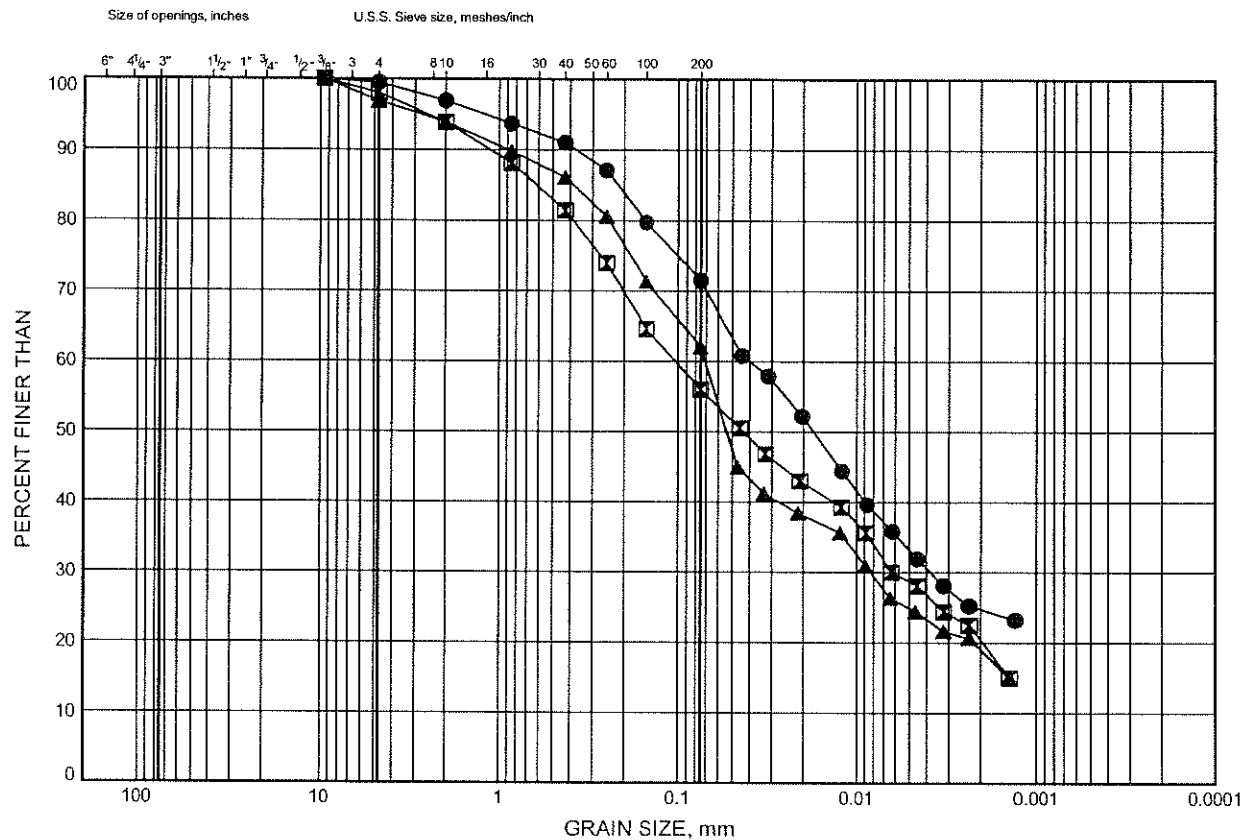


# Hwy 401/410 to Credit River

## GRAIN SIZE DISTRIBUTION

FIGURE B5

### Silty Clay Till with Sand

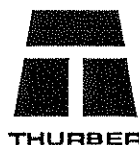


COBBLE SIZE	COARSE	FINE	COARSE	MEDIUM	FINE	SILT and CLAY
	GRAVEL		SAND			FINE GRAINED

SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	P09	1.83	195.54
■	P11	2.50	194.01
▲	T1	2.59	194.77

Date February 2008

Project 2107-05-00



Prep'd MFA

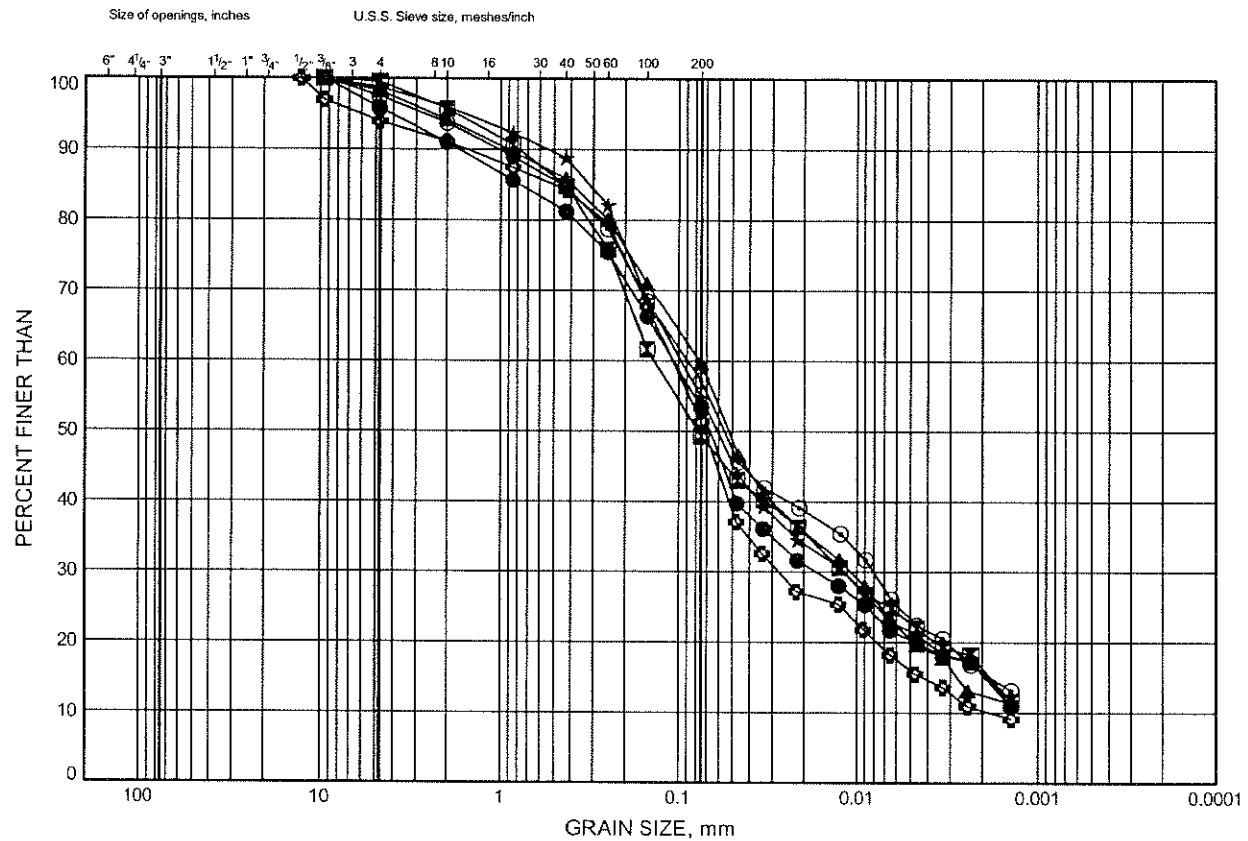
Chkd. RPR

# Hwy 401/410 to Credit River

## GRAIN SIZE DISTRIBUTION

FIGURE B6

### Clayey Silt Till with Sand



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

SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	01	3.12	193.03
⊠	02	2.59	194.39
▲	03	3.35	193.13
★	04	1.83	195.13
⊙	05	2.59	194.21
⊕	P01	3.12	193.54

Date February 2008  
Project 2107-05-00



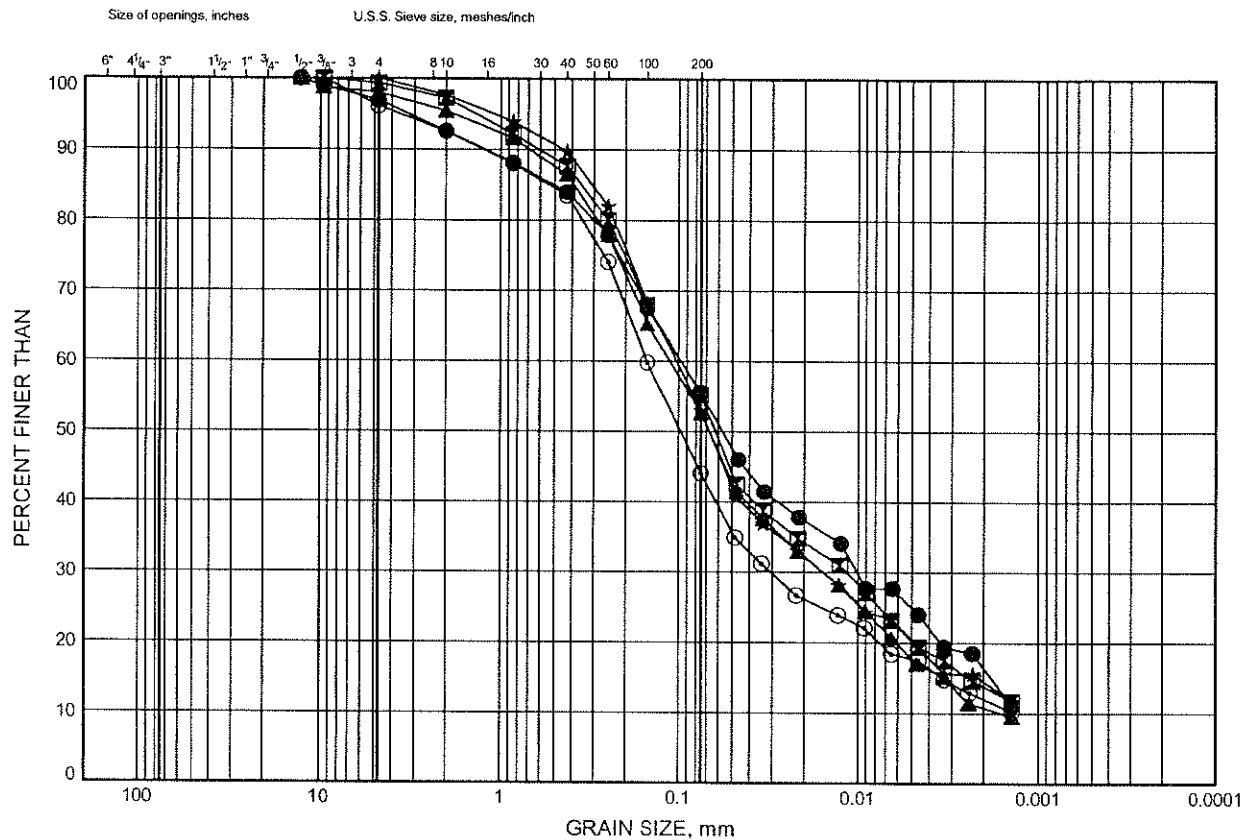
Prep'd MFA  
Chkd. RPR

# Hwy 401/410 to Credit River

## GRAIN SIZE DISTRIBUTION

FIGURE B7

### Clayey Silt Till with Sand



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

SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	P02	3.35	193.98
⊠	P06	2.59	194.66
▲	P06	4.65	192.60
★	P07	4.65	192.76
⊙	P08	3.35	193.58

Date February 2008  
Project 2107-05-00



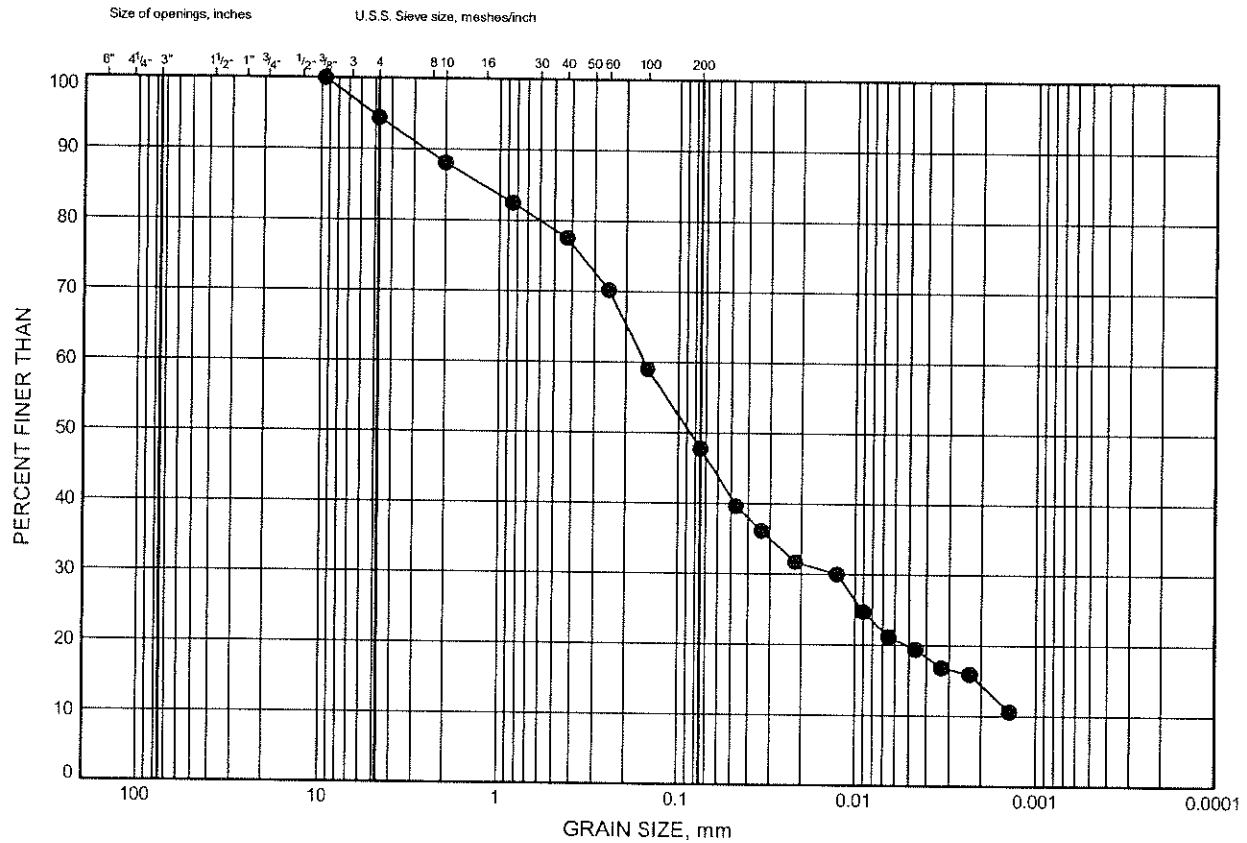
Prep'd MFA  
Chkd. RPR

# Hwy 401/410 to Credit River

## GRAIN SIZE DISTRIBUTION

FIGURE B8

### Clayey Silt Till with Sand



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

SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	P10	2.59	194.71



Date February 2008  
Project 2107-05-00

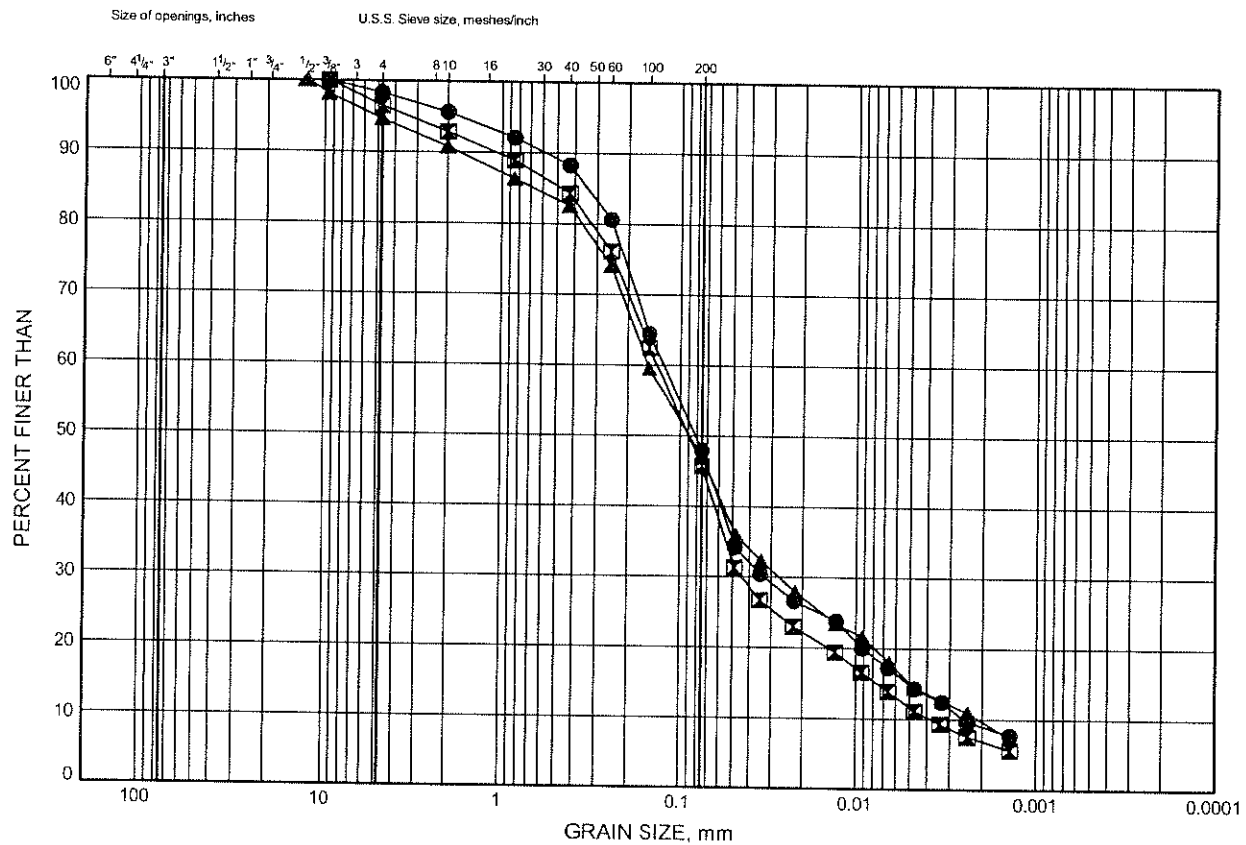
Prep'd MFA  
Chkd. RPR

# Hwy 401/410 to Credit River

## GRAIN SIZE DISTRIBUTION

FIGURE B9

Silt and Sand Till, trace Clay



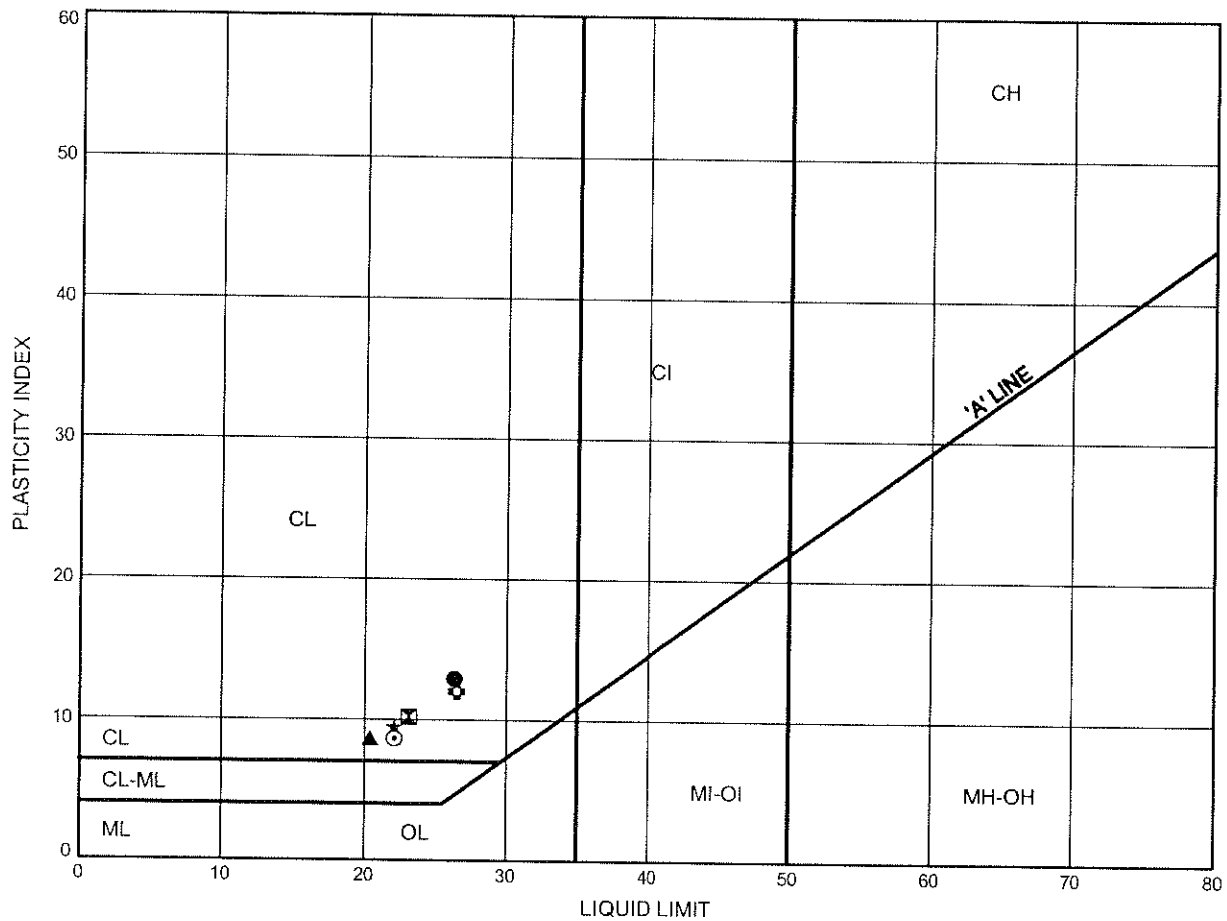
COBBLE SIZE	COARSE	FINE	COARSE	MEDIUM	FINE	SILT and CLAY
	GRAVEL		SAND			FINE GRAINED

SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	04	3.12	193.84
⊠	P03	4.65	192.70
▲	P09	4.88	192.50

Hwy 401/410 to Credit River  
**ATTERBERG LIMITS TEST RESULTS**

FIGURE B10

Silty Clay Till with Sand

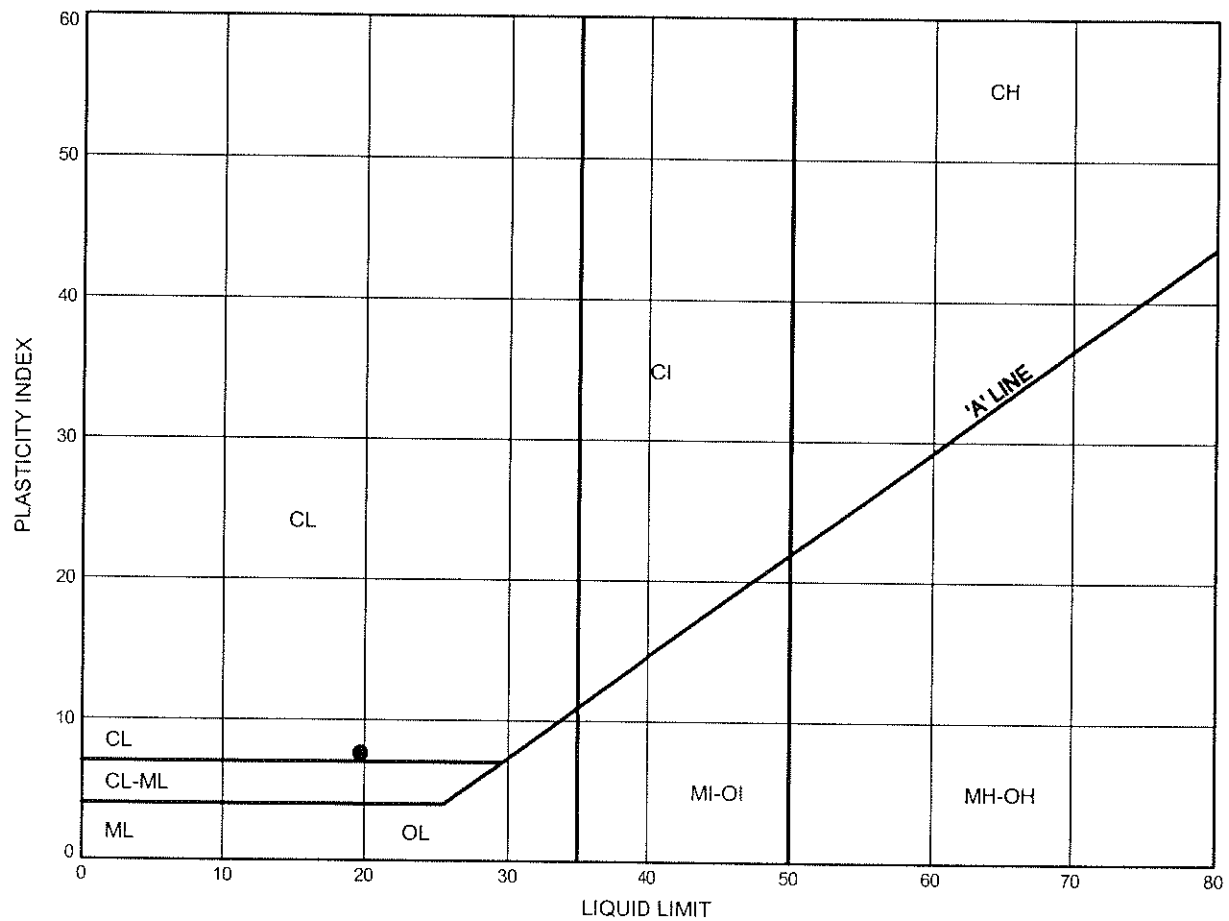


SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	01	1.83	194.33
⊠	P01	1.07	195.60
▲	P03	2.59	194.76
★	P04	2.44	194.34
⊙	P05	2.59	194.42
⊗	P09	1.83	195.54

Hwy 401/410 to Credit River  
**ATTERBERG LIMITS TEST RESULTS**

FIGURE B11

Silty Clay Till with Sand



SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	T1	2.59	194.77

Date February 2008  
 Project 2107-05-00

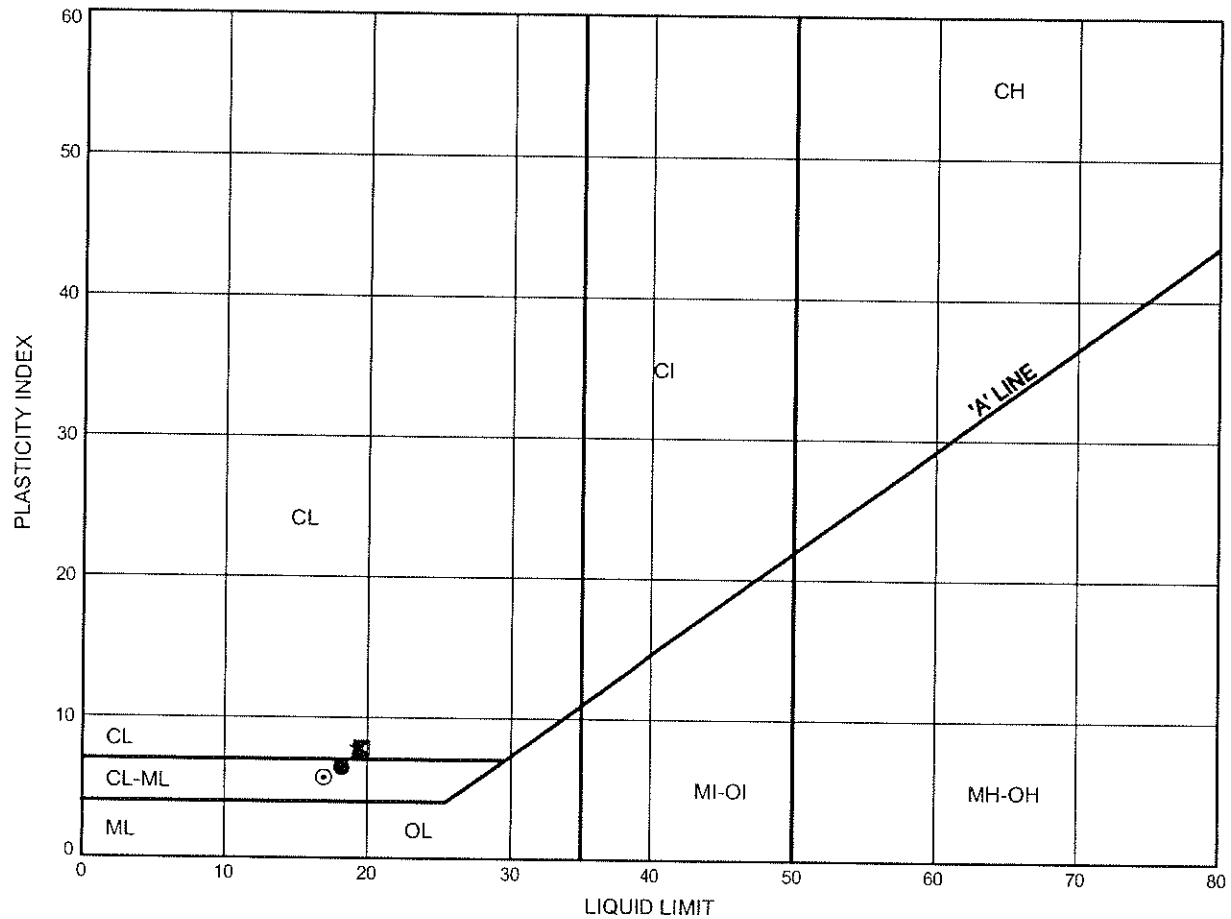


Prep'd MFA  
 Chkd. RPR

Hwy 401/410 to Credit River  
**ATTERBERG LIMITS TEST RESULTS**

FIGURE B12

Clayey Silt Till with Sand



SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	04	1.83	195.13
⊠	05	2.59	194.21
▲	P02	3.35	193.98
★	P06	2.59	194.66
⊙	P10	2.59	194.71



Date February 2008  
 Project 2107-05-00

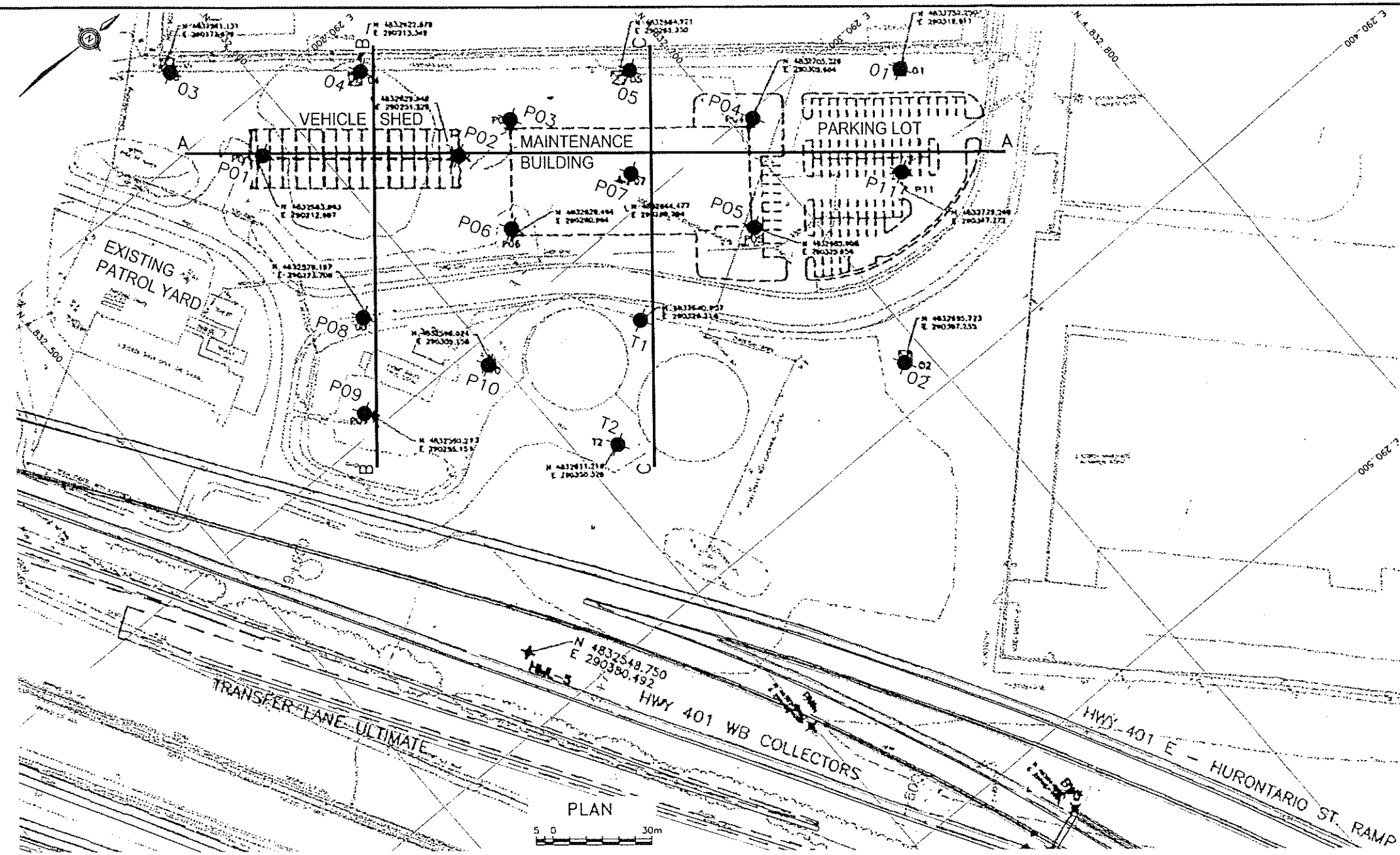
Prep'd MFA  
 Chkd. RPR



## **Appendix C**

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

PROJECT SCALE 1:1  
DATE: 05-21-2008  
DRAWING NAME: BOREHOLE LOCATIONS AND SOIL STRATA  
CREATED: 05-21-2008

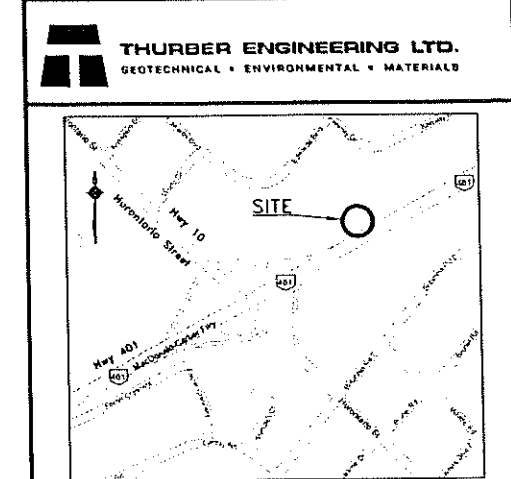


METRIC  
DIMENSIONS ARE IN METRES  
AND/OR MILLIMETRES  
UNLESS OTHERWISE SHOWN

HWY 401  
SITE No  
GWP No 2107-05-00

PATROL YARD  
EAST OF HURONTARIO  
BOREHOLE LOCATIONS AND SOIL STRATA

MMM GROUP



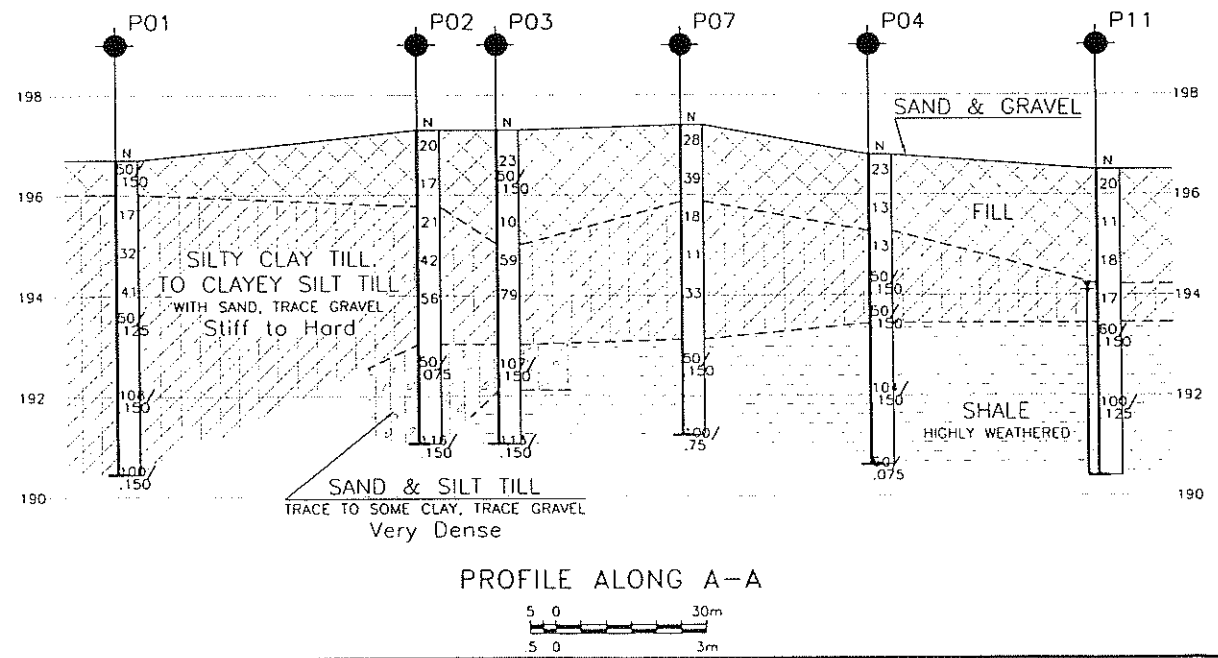
KEYPLAN  
LEGEND

- Borehole (Present Investigation, 2007)
- Borehole and Cone
- Blows /0.3m (Std Pen Test, 475J/blow)
- Blows /0.3m (60" Cone, 475J/blow)
- Pressure, Hydraulic
- Water Level
- Head Artesian Water
- Piezometer
- Rock Quality Designation (RQD)
- Auger Refusal

NO	ELEVATION	NORTHING	EASTING
01	196.2	4 832 749.8	290 319.5
02	197.0	4 832 693.0	290 387.3
03	196.5	4 832 581.6	290 178.6
04	197.0	4 832 625.4	290 215.3
05	196.8	4 832 687.5	290 267.3
P01	196.7	4 832 586.7	290 215.6
P02	197.3	4 832 631.5	290 253.2
P03	197.3	4 832 650.2	290 255.1
P04	196.8	4 832 706.0	290 301.9
P05	197.0	4 832 684.9	290 326.9
P06	197.3	4 832 629.1	290 280.2
P07	197.4	4 832 667.6	290 291.1
P08	196.9	4 832 578.0	290 271.9
P09	197.4	4 832 559.3	290 294.1
P10	197.3	4 832 597.2	290 307.0
P11	196.5	4 832 729.9	290 343.3
T1	197.4	4 832 641.0	290 326.3
T2	197.3	4 832 611.2	290 350.3

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.

GEOCRE No. 30M12-271



REVISIONS																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																				
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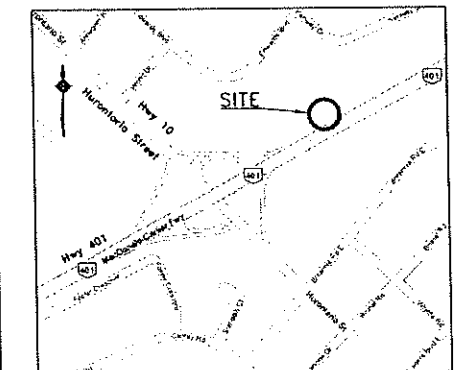
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PLOTDATE: May 21, 2008 - 10:00am

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

HWY 401  
SITE No  
GWP No 2107-05-00

PATROL YARD  
EAST OF HURONTARIO  
BOREHOLE LOCATIONS AND SOIL STRATA

SHEET



KEYPLAN

LEGEND

- Borehole (Present Investigation, 2007)
- ⊕ 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
- H Head Artesian Water
- P Piezometer
- 90% Rock Quality Designation (RQD)
- A/R Auger Refusal

NO	ELEVATION	NORTHING	EASTING
01	196.2	4 832 749.8	290 319.5
02	197.0	4 832 693.0	290 387.3
03	196.5	4 832 581.6	290 178.6
04	197.0	4 832 625.4	290 215.3
05	196.8	4 832 687.5	290 267.3
P01	196.7	4 832 586.7	290 215.6
P02	197.3	4 832 631.5	290 253.2
P03	197.3	4 832 650.2	290 255.1
P04	196.8	4 832 706.0	290 301.9
P05	197.0	4 832 684.9	290 326.9
P06	197.3	4 832 629.1	290 280.2
P07	197.4	4 832 667.6	290 291.1
P08	196.9	4 832 578.0	290 271.9
P09	197.4	4 832 559.3	290 294.1
P10	197.3	4 832 597.2	290 307.0
P11	196.5	4 832 729.9	290 343.3
T1	197.4	4 832 641.0	290 326.3
T2	197.3	4 832 611.2	290 350.3

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. 30M12-271

REVISIONS	DATE	BY	DESCRIPTION
DESIGN	RPR	CHK	PKC/CODE
DRAWN	MFA	CHK	PKC/SITE
LOAD			
STRUCT			
SCHEME			
DWG			

