

**FOUNDATION INVESTIGATION REPORT**  
**HWY 401 WIDENING, HWY 410 TO CREDIT RIVER**  
**HWY 401 WB EXPRESS TO HURONTARIO STREET N/S RAMP**  
**MISSISSAUGA, ONTARIO**  
**G.W.P. 2149-01-00 & 2150-01-00, SITE 24-756**

**Geocres Number: 30M12-269**

**Report to**

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**PART 1: FACTUAL INFORMATION**

**1 INTRODUCTION**

This report presents the factual findings obtained from a foundation investigation conducted for a proposed structure to carry Ramp HWY 401 WB Express to HWY 10 N/S under the proposed Highway 401 Collector Westbound lanes (Basketweave). The proposed structure will be located on the north side of Highway 401 and east of the Hurontario Street interchange in Mississauga, Ontario. A previous, geotechnical investigation was conducted at the site in 1994; the factual data from that investigation has been incorporated into this report.

The purpose of the investigation was to explore the subsurface conditions at the site and, based on the data obtained, to provide a borehole location plan, borehole logs, stratigraphic profile and cross-sections and a written description of the subsurface conditions. A model of the subsurface conditions was developed to describe the geotechnical conditions influencing design and construction of the foundations and approach embankments for the structure, as well for associated cuts and retaining walls.

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.

In the preparation of this report and in addition to the boreholes drilled for the proposed structure, general reference has been made to information on subsurface conditions contained in a previous foundation report under G.W.P. 54-82-06. The title of this report is listed as follows:

- Engineering Materials Office, Foundation Design Section, report titled "Highway 401 Westbound Collector transfer ramp to ramp E-N/S, District 6, Toronto", G.W.P. 54-82-06, Site 24-682, GEOCRES No. 30M12-223, dated December 1994 (Reference 1).

## 2 SITE DESCRIPTION

The site is located on the north side of Highway 401 Westbound lanes, between Hurontario Street and Kennedy Road in Mississauga, Ontario.

The lands to the north and south of Highway 401 have been developed for commercial and industrial uses. The topography is typically flat. A fill stockpile, approximately 200 m long and comprising various materials (excavated weathered shale, clay and sand) is located adjacent to the proposed structure. The fill stockpile probably originated from surplus materials from previous constructions in the area. Vegetation is moderate consisting mainly of tall grass and shrubs.

The general site area is located within the physiographic region known as Peel Plain, characterized by a level to undulating till plain underlain by Queenston Formation shale bedrock with limestone layers.

## 3 SITE INVESTIGATION AND FIELD TESTING

The site investigation and field testing for this project were carried out from October 23 to 27, 2006 and on December 11 and 12, 2006 and consisted of drilling and sampling sixteen boreholes (numbered BW1 to BW16) at the site. Borehole BW02 was re-drilled on October 23 and 25, 2007 to fully penetrate the fill stockpile; the supplementary data is reported as Borehole BW-02-07. Boreholes were drilled at the structure abutments, approaches and retaining walls along the alignment of the proposed Ramp HWY 401 WB Express to HWY 10 N/S under the proposed Highway 401 Collector Westbound lanes (Basketweave). A number of these boreholes were drilled from the top of the existing fill stockpile.

Solid stem augers were used to advance the boreholes in the overburden and into the shale. Samples were obtained at selected intervals using a split spoon sampler in conjunction with Standard Penetration Testing (SPT) in accordance with ASTM D1586. NQ rock coring equipment was used to recover core samples of the underlying bedrock.

Generally boreholes were terminated in shale bedrock at depths ranging from 2.6 to 17.0 m, corresponding to Elevations 184.7 to 192.4 m. Borehole BW02-07 was terminated in silt till at 10.8 m depth, Elevation 191.1 and to Borehole BW 15 was terminated on auger refusal at a depth of 1.0 m, Elevation 193.6.

Seven of the boreholes were advanced into the bedrock by NQ diamond coring techniques to total depths of 5.6 to 17.0 m, corresponding to Elevations 189.1 to 184.7 m. A minimum of 3 m of rock core was recovered in each of these seven boreholes.

The present and previous borehole locations are shown on the Borehole locations and soil strata Drawing in Appendix D. The coordinates and elevations of the boreholes are given on this drawing and on the individual Record of Borehole Sheets in Appendix A. Records of Boreholes drilled during the previous investigation (1994) are enclosed in Appendix C.

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

Standpipe piezometers, consisting of 19 mm PVC pipes with slotted tip, were installed in selected boreholes to monitor groundwater levels. Details of the piezometer installations are as shown in Table 3.1.

**Table 3.1 – Borehole Completion Details**

Foundation Element	Borehole	Piezometer Tip (Sand Filter) Details			Backfill
		Depth (m)	Elevation (m)	Stratum	
<b><u>North Abutment</u></b>					
West End	BW3	9.7 – 12.5	191.2 – 189.1	Shale Bedrock	Bentonite and grout to surface.
	BW5	1.0 – 3.7	194.1 – 191.5	Shale Bedrock	Bentonite to surface.
East End	BW7	4.2 – 6.7	189.0 – 186.6	Shale Bedrock	Bentonite to 3.9 m, holeplug to surface.
	BW9	2.5 – 4.6	191.1 – 188.9	Silty Clay Till and Shale Bedrock	Bentonite to 0.15 m and cuttings to surface.
	BW11	5.8 – 7.7	186.8 – 184.9	Shale Bedrock	Bentonite and grout to surface.
	BW16	None installed			Bentonite to surface
<b><u>South Abutment</u></b>					
West End	BW4 BW6 BW15	None installed			Bentonite to surface
East End	BW8				Drill cuttings
	BW10				Bentonite to surface
<b><u>Retaining Wall</u></b>					
Southeast	BW12	None installed			Grout to surface.
	BW13	2.8 – 4.6	191.0 – 189.2	Silty Clay Till and Shale Bedrock	Bentonite and grout to surface.
	BW14	None installed			Bentonite to surface
Southwest	BW1 BW2/BW02-07	None installed			Bentonite to surface

#### 4 LABORATORY TESTING

All recovered samples were subjected to Visual Identification (VI) and geological logging. The results of this testing are shown on the Record of Borehole sheets in Appendix A. Moisture content

determinations were carried out on all soil samples. Approximately 25% of the recovered samples were also subjected to grain size distribution analyses (sieve and hydrometer) and Atterberg Limits testing. 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.

Core samples of the shale bedrock were carefully protected to prevent drying during transport to the laboratory. Point load tests were carried out on selected samples of intact shale upon arrival at the laboratory to assist evaluation of the compressive strength of the bedrock.

## **5 DESCRIPTION OF SUBSURFACE CONDITIONS**

Details of the encountered soil stratigraphy are presented on the Record of Borehole sheets in Appendix A and 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.

In general terms, the soil stratigraphy encountered at this site comprises topsoil overlying fill underlain by native silty clay, silty clay till and layers of sandy silt to sandy silt till. Weathered shale bedrock was contacted below the till deposits. More detailed descriptions of the individual strata are presented in the following paragraphs.

### **5.1 Topsoil**

Topsoil was identified surficially in all the boreholes, except in Boreholes BW2, BW13 and BW14. The topsoil thickness generally ranged from 50 to 200 mm. The topsoil thickness may vary between and beyond the borehole locations and the data is not intended for the purpose of estimating quantities.

### **5.2 Fill**

The site is partially occupied by a stockpile of fill up to 10 m high above original ground surface. BW1, BW2, BW02-07 and BW3 were drilled through this fill stockpile and the thickness of fill in these three boreholes range from 7.0 to 9.8 m. The fill has been logged as being predominantly clay with limestone fragments. Anecdotally, it is understood that the stockpile consists of excavated shale that was placed approximately twenty years ago and has since softened due to exposure to air and water.

The SPT N-values in this fill ranges from 11 to 50 blows for 0.075 m penetration indicating the fill to be stiff to hard. Cobbles and boulders, rock slabs or other obstructions may be present in this fill. The moisture content of this fill ranges from 4 to 18%.

No fill was encountered in Boreholes BW4 to BW6.

Fill was encountered in Boreholes BW7 to BW14 and BW15. The fill thickness in these boreholes ranges from 0.4 to 2.3 m. The fill in these boreholes ranges from silty clay mixed

with topsoil and sandy silty to clay with shale and limestone fragments which may be softened excavated weathered shale. The SPT blow counts in this fill ranges from 4 to 34 blows indicating a firm to hard consistency. The moisture content of samples collected ranged from 6 to 28%. Higher moisture contents, 41% and 62%, were observed in Boreholes BW7, BW8 and BW13.

### 5.3 Silty Clay

Native brown silty clay with trace to some sand, trace of gravel and occasional rootlets was encountered below the fill, except in Boreholes BW1, BW2, BW02-07, BW3 and BW13 to BW15. The cohesive material extended to depths ranging from 0.6 m to 4.1 m (elevations 190.0 to 195.3 m). Thickness of the silty clay layer varies from 0.4 m to 1.8 m.

The results of gradation and Atterberg Limit Tests conducted on samples of native silty clay are summarized below:

Soil	(%)
Gravel	0 to 1
Sand	2 to 10
Silt	47
Clay	44 to 53

Liquid Limit	24 to 44
Plastic Limit	14 to 22

Grain size distribution results from the silty clay are presented on the Record of Borehole sheets and Figure B1 of Appendix B. Atterberg Limit testing results are shown in Figures B4 and B5 of Appendix B. The Atterberg Limit Tests indicate the clay to be low to medium plastic.

SPT N-values in the silty clay ranged from 4 to 36 blows per 0.3 m of penetration, indicating soft to hard consistency. The moisture content of samples collected ranged from 4% to 23%. Higher moisture contents, 40% to 75%, were observed in Boreholes BW4, BW5, BW13 and BW15.

### 5.4 Sand Till, Silt Till and Sandy Silt

Layers of cohesionless soils sand till, silt till and sandy silt with trace of gravel and clay and occasional rootlets were contacted in three boreholes as indicted in Table 5.1.

**Table 5.1 – Depths and Elevations of Cohesionless Soils**

<b>Borehole</b>	<b>Depth (m)</b>	<b>Elevation (m)</b>	<b>Soil Type</b>
BW1	9.8	191.9	Sand till
BW02-07	9.1	192.8	Silt till
BW5	0.6	194.5	Sandy silt

The results of a gradation test conducted on one sample of native sand are summarized below:

<b>Soil</b>	<b>(%)</b>
Gravel	23
Sand	46
Silt & Clay	13

Grain size distribution results from the sand are presented on the Record of Borehole sheets and Figure B3 of Appendix B.

SPT N-values of the cohesionless soils ranged from 22 blows per 0.3 m of penetration, to greater than 50 blows per 0.1 m penetration, indicating compact to very dense relative density. The moisture content of samples collected ranged from 11% to 19%.

### 5.5 Silty Clay Till

A deposit of brown silty clay till with trace to some sand and trace of gravel was contacted below the native silty clay in Boreholes BW02-07, BW3, BW6, BW9, BW11 and BW13 to BW16. The deposit was contacted at depths ranging from 0.6 m to 3.0 m (elevations 189.6 m to 194.0 m) and locally at 7.0 and 7.5 m (elevations 194.9m and 194.1 m) in Boreholes BW02-07 and BW3, respectively. The thickness of the till layer ranges from 0.4 m to 2.1 m.

The results of gradation and Atterberg Limit Tests conducted on samples of native silty clay till are summarized below:

<b>Soil</b>	<b>(%)</b>
Gravel	0 to 1
Sand	3 to 39
Silt	39 to 65
Clay	20 to 45

Liquid Limit	24 to 41
Plastic Limit	13 to 22



Grain size distribution results from the silty clay till are presented on the Record of Borehole sheets and Figure B2 of Appendix B. Atterberg Limit testing results are shown in Figure B6 of Appendix B. The results indicate the till to be low to medium plastic.

Based on SPT N-values generally ranging from 15 to 83 blows for 0.3 m of penetration, the deposit is classified as very stiff to hard in consistency. SPT N-values higher than 50 blows per 0.125 m penetration were observed in Boreholes BW11 and BW15. The measured natural moisture contents range from 10% to 18% and 35% in Borehole BW3.

Although not encountered in the boreholes, glacial till may contain cobbles and large boulders.

## **5.6 Bedrock**

The soils described above were found to be underlain by shale bedrock of the Queenston Formation. The shale encountered in the boreholes is described as thinly bedded and contains numerous hard interbedded siltstone and limestone layers. The shale bedrock is highly weathered to weathered with degree of weathering decreasing with depth. SPT N-values obtained in the upper part of the shale bedrock ranged from 35 to greater than 50 blows per 0.125 m penetration. Moisture contents ranged from 5 to 21%.

Elevations of the top of bedrock encountered in the boreholes are shown in Table 5.1. The shale bedrock lies at elevation ranging from 188.6 to 195.3 m.

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

<b>Foundation Unit</b>	<b>Borehole</b>	<b>Depth (m)</b>	<b>Bedrock Elevation (m)</b>
<u>North Abutment:</u>			
West End	BW3	8.8	192.8
	BW5	1.2	193.9
East End	BW7	1.6	191.6
	BW9	4.1	189.4
	BW11	4.0	188.6
	BW16	4.0	188.6
<u>South Abutment:</u>			
West End	BW4	1.7	195.3
	BW6	1.4	192.4
	BW15	1.0	193.6*
East End	BW8	1.4	191.9
	BW10	4.0	190.6
<u>Retaining Wall:</u>			
Southeast	BW12	4.1	190.0
	BW13	4.0	189.8
	BW14	1.4	192.3
Southwest	BW1	11.8	189.9
	BW2/BW02-07	-	-

\* Auger refusal

Bedrock core was collected using NQ sized coring equipment. Total core recovery (TCR) in the bedrock ranged from 77% to 100% in most core runs. Lower TCR values of 20% was observed in Borehole BW7.

The RQD values recorded for three of the core runs ranged from 7% to 54% indicating very poor to fair rock quality. Fracture Index (FI) of the rock, expressed as fractures per 0.3 m of core, ranged from 1 to 10 in Boreholes BW10 and BW14.

The results of Point Load tests conducted on shale core samples indicated unconfined compressive strength (UCS) values of 3 to 53 MPa (estimated from point load tests on intact samples) indicating a weak to strong rock. It must be noted however that point load tests were possible only on less weathered shale or higher strength limestone interbed samples as the more typical weathered shale cores tended to be too weak for point load testing.

Shale typically contains layers of siltstone and limestone that 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. The logs indicated that these hard interbeds range from 20 to 150 mm in thickness. Sampling and interpretation from small diameter boreholes may underestimate the frequency, thickness and

strength of the strong layers and therefore geological expertise and past experience must be applied in any decision making process regarding the bedrock.

### 5.7 Water Levels

Standpipe piezometers were installed in six boreholes to monitor water levels after completion of drilling. The water levels measured in the piezometers are summarized in Table 5.2.

**Table 5.2 – Measured Groundwater Levels**

Borehole	Date	Water Level (m)		Comment
		Depth	Elevation	
BW3	27-Oct-2006	7.1	194.5	In piezometer
	13-Nov-2006	7.2	194.4	
	11-Dec-2006	7.0	194.6	
	29-Jan-2007	7.2	194.4	
BW5	27-Oct-2006	0.5	194.7	In piezometer
	13-Nov-2006	0.70	194.4	
	11-Dec-2006	0.20	194.9	
	29-Jan-2007	0.30	194.8	
BW7	27-Oct-2006	0.50	192.7	In piezometer
	13-Nov-2006	0.55	192.6	
	17-Dec-2006	0.50	192.7	
	29-Jan-2007	0.50	192.7	
BW9	27-Oct-2006	3.4	190.2	In piezometer
	13-Nov-2006	2.5	191.1	
	12-Dec-2006	1.4	192.2	
	29-Jan-2007	1.3	192.3	
BW11	29-Jan-2007	1.0	191.6	In piezometer
BW13	29-Jan-2007	1.7	192.1	In piezometer

The groundwater levels range from elevations 190.2 to 194.9 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 and Mr. Stephane Loranger, C.E.T. of Thurber Engineering Ltd.

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

Supervision of the field program, interpretation of the field data and preparation of the investigation report was conducted by Mr. A. E. Gorman, 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.

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**Appendix A**

**Record of Borehole Sheets  
(present investigation)**

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

### 1. TEXTURAL CLASSIFICATION OF SOILS

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

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

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

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

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

NOTE: Hierarchy of Soil Strength Prediction

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

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

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

### 5. LEGEND FOR RECORDS OF BOREHOLES

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

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



Water Level



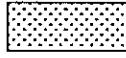


C<sub>pen</sub> Shear Strength Determination by Pocket Penetrometer

- (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	Peat and other highly organic soils.
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.
		Weak	5.0 to 25.0	750 to 3,500	Can be peeled by a pocket knife with difficulty
		Very Weak	1.0 to 5.0	150 to 750	Can be peeled by a pocket knife, crumbles under firm blows of geological pick.
		Extremely Weak (Rock)	0.25 to 1.0	35 to 150	Indented by thumbnail

TERMS	
Total Core Recovery: (TCR)	Core recovered as a percentage of total core run length.
Solid Core Recovery: (SCR)	Percent Ratio of solid core of full cylindrical shape recovered. Expressed with respect to the total length of core run.
Rock Quality Designation: (RQD)	Total length of sound core recovered in pieces 0.1m in length or larger as a percentage of total core run length.
Uniaxial Compressive Strength (UCS)	Axial stress required to break the specimen
Fracture Index: (FI)	Frequency of natural fractures per 0.3m of core run.



# RECORD OF BOREHOLE No BW01

1 OF 2

METRIC

G.W.P. 2149-01-00 & 2150-01-00 LOCATION Hwy 401 WBL Core - Hurontario Street N/S Ramp N 4 832 599.1 E 290 453.4 ORIGINATED BY SLL  
 HWY 401 BOREHOLE TYPE Solid Stem Augers/NQ Coring COMPILED BY MFA  
 DATUM Geodetic DATE 2006-10-26 - 2006-10-27 CHECKED BY 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				
								20 40 60 80 100				
								20 40 60 80 100				
201.7												
0.0	TOPSOIL: (50 mm)											
	CLAY, with limestone fragments Stiff to Very Stiff Brown / Grey (WEATHERED SHALE FILL)		1	SS	19							
			2	SS	22							
			3	SS	12							
			4	SS	50/ .075							
	Hard		5	SS	12							
194.2			6	SS	55							
7.4	Sandy SILT, trace gravel and clay Very Dense Brown Moist (FILL)		7	SS	50/ .125							
192.8												
8.9	reddish brown SHALE, with grey limestone layers (FILL)											
191.9	Coring started at 9.52m											
9.8	SAND, some gravel, trace silt,											

Continued Next Page

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

20  
15 10 5  
(%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No BW01

2 OF 2

METRIC

G.W.P. 2149-01-00 & 2150-01-00

LOCATION

Hwy 401 WBL Core - Hurontario Street N/S Ramp N 4 832 599.1 E 290 453.4

ORIGINATED BY SLL

HWY 401

BOREHOLE TYPE

Solid Stem Augers/NQ Coring

COMPILED BY MFA

DATUM Geodetic

DATE

2006-10-26 - 2006-10-27

CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	UNIT WEIGHT  γ  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa								WATER CONTENT (%)		
								20 40 60 80 100										

	Continued From Previous Page														
	SAND, some gravel, trace silt, occasional cobbles Very Dense Grey Moist to Wet (TILL)		8	SS	50/ .100		191								41 46 13 (SI+CL)
189.9							190								
11.8	Highly weathered, thinly bedded, very weak, reddish brown, SHALE, with grey limestone layers		9	SS	74		189								
			1	RUN			188								RUN 1# TCR=77%, SCR=63%, RQD=37%, UCS=53MPa
			2	RUN			187								RUN 2# TCR=100%, SCR=97%, RQD=23%, UCS=3MPa
			3	RUN			186								RUN 3# TCR=100%, SCR=94%, RQD=54%, UCS=3MPa
184.7							185								
17.0	END OF BOREHOLE AT 17.00 m. BOREHOLE GROUTED WITH BENTONITE TO SURFACE.														

+ 3, x 3: Numbers refer to  
Sensitivity


20  
15 5  
10 (%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No BW02

1 OF 1

METRIC

G.W.P. 2149-01-00 & 2150-01-00 LOCATION Hwy 401 WBL Core - Hurontario Street N/S Ramp N 4 832 614.5 E 290 489.9 ORIGINATED BY SLL  
 HWY 401 BOREHOLE TYPE Solid Stem Augers COMPILED BY MFA  
 DATUM Geodetic DATE 2007-01-10 - 2007-02-10 CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	UNIT WEIGHT  γ  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa								W <sub>P</sub>	W	W <sub>L</sub>
								○ UNCONFINED	+ FIELD VANE	● QUICK TRIAXIAL								
201.9							20	40	60	80	100	20	40	60	GR	SA	SI	C
0.0	Silty CLAY, with shale and limestone fragments Stiff Brown / Grey (WEATHERED SHALE FILL)																	
			1	SS	11													
			2	SS	14													
	Becoming Very Stiff																	
			3	SS	21													
	Becoming Hard																	

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

20  
15 10 5  
(%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No BW02-07

1 OF 2

METRIC

G.W.P. 2149-01-00 & 2150-01-00

LOCATION Basketweave Hurontario

ORIGINATED BY GA

HWY 401

BOREHOLE TYPE Hollow Stem Auger

COMPILED BY ES

DATUM Geodetic

DATE 2006-10-23 - 2006-10-25

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			20 40 60 80 100	PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	
201.9 0.0	SAND, GRAVEL and SILTY CLAY, with shale and limestone fragments Brown / Grey (FILL)						202					
							201					
							200					
							199					
							198					
							197					
							196					
			1	SS	63							
194.9 7.0	CLAY, silty, some sand, trace gravel Hard Mottled brown-grey (TILL)						195					
							194					
			2	SS	83							
192.8 9.1	SILT, trace to some sand Dense Grey Damp (TILL)						193					
							192					
			3	SS	49							

Continued Next Page

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

20  
15 5  
10 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No BW02-07

2 OF 2

METRIC

G.W.P. 2149-01-00 & 2150-01-00 LOCATION Basketweave Hurontario ORIGINATED BY GA  
HWY 401 BOREHOLE TYPE Hollow Stem Auger COMPILED BY ES  
DATUM Geodetic DATE 2006-10-23 - 2006-10-25 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  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										
								20 40 60 80 100										
Continued From Previous Page							○ UNCONFINED + FIELD VANE					WATER CONTENT (%)						
							● QUICK TRIAXIAL × LAB VANE					20 40 60 80 100						
191.1	SILT, trace to some sand Very Dense Grey Moist to wet (TILL)		4	SS	100/ .150		191											
10.8	Lots of Grinding at 10.8m																	
	END OF BOREHOLE AT 10.82m. AUGER REFUSAL ON POSSIBLE BEDROCK. BOREHOLE OPEN AND DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO SURFACE.																	

# RECORD OF BOREHOLE No BW03

1 OF 2

METRIC

G.W.P. 2149-01-00 & 2150-01-00

LOCATION

Hwy 401 WBL Core - Hurontario Street N/S Ramp N 4 832 643.1 E 290 524.1

ORIGINATED BY SLL

HWY 401

BOREHOLE TYPE Solid Stem Augers/NQ Coring

COMPILED BY MFA

DATUM Geodetic

DATE

2006-10-25 - 2006-10-26

CHECKED BY RPR

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	20 40 60	W <sub>p</sub> W W <sub>L</sub>	WATER CONTENT (%)			
201.6	TOPSOIL: (50 mm)												
8.8	Silty CLAY, with shale and limestone fragments Very Stiff to Hard Brown / Grey (WEATHERED SHALE FILL)	1	SS	18									
		2	SS	43									
		3	SS	58									
		4	SS	50	.050								
	Becoming Stiff	5	SS	12									
194.1	Silty CLAY, some sand, trace gravel, trace rootlets Very Stiff Mottled Brown (TILL)	6	SS	24									
192.8	Highly weathered, thinly bedded, very weak, reddish brown, SHALE, with grey limestone layers	7	SS	50	.150								
8.8	Coring started at 9.5m												

Continued Next Page

+ 3, x 3. Numbers refer to  
Sensitivity


20  
15 5  
10 (%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No BW03

2 OF 2

METRIC

G.W.P. 2149-01-00 & 2150-01-00 LOCATION Hwy 401 WBL Core - Hurontario Street N/S Ramp N 4 832 643.1 E 290 524.1 ORIGINATED BY SLL  
 HWY 401 BOREHOLE TYPE Solid Stem Augers/NQ Coring COMPILED BY MFA  
 DATUM Geodetic DATE 2006-10-25 - 2006-10-26 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										
								20 40 60 80 100										
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL X LAB VANE										
Continued From Previous Page							WATER CONTENT (%)					GR	SA	SI	CL			
							20 40 60											
189.1	Limestone interbeds at 10.85m to 11.00m, 11.15m to 11.17m, 11.19m to 11.31m, 12.12m to 12.19m		1	RUN			191											
12.5	END OF BOREHOLE AT 12.5m. Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen.																	
	WATER LEVEL READINGS: DATE DEPTH(m) ELEV.(m) 10/27/06 7.1 194.5 11/13/06 7.2 194.4 12/11/06 7.0 194.6 29/01/07 7.2 194.5																	

# RECORD OF BOREHOLE No BW04

1 OF 1

METRIC

G.W.P. 2149-01-00 & 2150-01-00

LOCATION

Hwy 401 WBL Core - Hurontario Street N/S Ramp N 4 832 628.6 E 290 529.0

ORIGINATED BY SLL

HWY 401

BOREHOLE TYPE

Solid Stem Augers

COMPILED BY MFA

DATUM Geodetic

DATE

2006-10-23 - 2006-10-23

CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W <sub>P</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40					
197.0														
0.0	TOPSOIL: (125 mm)													
0.1	Silty CLAY, with stained topsoil, trace roots and rootlets Firm to Hard Brown		1	SS	7									
	Sand seams and layers		2	SS	33									
195.3														
1.7	Highly weathered, thinly bedded, very weak, reddish brown, SHALE, with grey limestone layers		3	SS	71/ 275									
			4	SS	50/ 100									
			5	SS	50/ 125									
192.4														
4.6	END OF BOREHOLE AT 4.62 m BOREHOLE OPEN AND DRY TO BOTTOM ON COMPLETION. BOREHOLE GROUTED WITH BENTONITE TO SURFACE.		6	SS	50/ 1050									

+ 3, x 3: Numbers refer to  
Sensitivity

20  
15  
10  
(%) STRAIN AT FAILURE



# RECORD OF BOREHOLE No BW05

1 OF 1

METRIC

G.W.P. 2149-01-00 & 2150-01-00

LOCATION

Hwy 401 WBL Core - Hurontario Street N/S Ramp N 4 832 660.8 E 290 579.7

ORIGINATED BY SLL

HWY 401

BOREHOLE TYPE Solid Stem Augers

COMPILED BY MFA

DATUM Geodetic

DATE

2006-10-23 - 2006-10-23

CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa	WATER CONTENT (%)					
195.1														
0.0	TOPSOIL: (150 mm)													
0.2	Silty CLAY, occasional sand layer Firm Brown		1	SS	4									
194.5														
0.6	Sandy SILT, trace clay, trace rootlets Compact Brown Moist		2	SS	22									
193.9														
1.2	Highly weathered, thinly bedded, very weak, reddish brown, SHALE, with grey limestone layers		3	SS	48									
			4	SS	50/ .075									
			5	SS	62									
191.5														
3.7	END OF BOREHOLE AT 3.66 m. Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen.  WATER LEVEL READINGS: DATE DEPTH(m) ELEV.(m) 10/27/06 0.5 194.7 11/13/06 0.7 194.4 12/12/06 0.2 194.9 29/01/07 0.3 194.8													

+ 3, x 3. Numbers refer to  
Sensitivity

20  
15 5  
10 (%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No BW06

1 OF 1

METRIC

G.W.P. 2149-01-00 & 2150-01-00

LOCATION

Hwy 401 WBL Core - Hurontario Street N/S Ramp N 4 832 846.1 E 290 584.2

ORIGINATED BY SLL

HWY 401

BOREHOLE TYPE

Solid Stem Augers/NQ Coring

COMPILED BY MFA

DATUM Geodetic

DATE

2006-10-25 - 2006-10-25

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 (%)  GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			SHEAR STRENGTH kPa					
								WATER CONTENT (%)					
193.8													
0.0	TOPSOIL: (175 mm)												
0.2	CLAY, silty, trace rootlets Firm Brown		1	SS	6								
193.1													
0.7	CLAY, silty, trace gravel Hard Brown (TILL)		2	SS	33								
192.4													
1.4	Highly weathered, thinly bedded, very weak, reddish brown, SHALE, with grey limestone layers		3	SS	70								
			4	SS	88/ 225								
	Coring started at 3.2m		5	SS	50/ 100								
	Limestone interbed at 3.61m to 3.68m		1	RUN									
	Limestone interbeds at 5.23m to 5.25m, 5.79m to 5.94m, 6.22m to 6.25m		2	RUN									
187.6													
6.2	END OF BOREHOLE AT 6.25 m BOREHOLE GROUTED WITH BENTONITE TO SURFACE.												

+ 3, X 3

Numbers refer to  
Sensitivity

20  
15  
10

(%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No BW07

1 OF 1

METRIC

G.W.P. 2149-01-00 & 2150-01-00

LOCATION

Hwy 401 WBL Core - Hurontario Street N/S Ramp N 4 832 678.6 E 290 637.1

ORIGINATED BY SLL

HWY 401

BOREHOLE TYPE

Solid Stem Augers

COMPILED BY MFA

DATUM Geodetic

DATE

2006-10-24 - 2006-10-25

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 γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			SHEAR STRENGTH kPa							WATER CONTENT (%)
								○ UNCONFINED ● QUICK TRIAXIAL	+ FIELD VANE × LAB VANE						
193.2							20	40	60	80	100	20	40	60	GR SA SI CL
0.0	TOPSOIL: (150 mm)														
0.2	Silty CLAY, mixed with topsoil, trace roots		1	SS	4										
192.6	Firm														
0.6	Brown (FILL)														
	Silty CLAY, some sand, trace gravel		2	SS	16										
	Very Stiff														
	Brown														
191.6															
1.6	Highly weathered, thinly bedded, very weak, reddish brown, SHALE, with grey limestone layers		3	SS	46										
	Limestone interbed at 2.08m to 2.13m														RUN 1#
	Coring started at 2.1m														TCR=20%,
			1	RUN											SCR=15%,
															RQD=0%,
															UCS=3MPa
	Limestone interbed at 3.61m to 3.71m														
			2	RUN											RUN 2#
															TCR=80%,
															SCR=53%,
															RQD=0%,
															UCS=51MPa
	Limestone interbeds at 5.20m to 5.30m, 6.28m to 6.30m, 6.35m to 6.37m														
			3	RUN											RUN 3#
															TCR=100%,
															SCR=90%,
															RQD=7%,
															UCS=29MPa
186.6															
6.7	END OF BOREHOLE AT 6.65 m. Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen.														
	WATER LEVEL READINGS: DATE DEPTH(m) ELEV.(m) 10/27/06 0.5 192.7 11/13/06 0.6 192.6 12/17/06 0.5 192.7 29/01/07 0.5 192.7														

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

# RECORD OF BOREHOLE No BW08

1 OF 1

METRIC

G.W.P. 2149-01-00 & 2150-01-00

LOCATION Hwy 401 WBL Core - Hurontario Street N/S Ramp N 4 832 664.0 E 290 641.6

ORIGINATED BY SLL

HWY 401

BOREHOLE TYPE Solid Stem Augers

COMPILED BY MFA

DATUM Geodetic

DATE 2006-10-23 - 2006-10-23

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	● QUICK TRIAXIAL						
193.3							20	40	60	80	100	20	40	60	GR SA SI CL	
0.0	TOPSOIL: (200 mm)															
0.2	Silty CLAY, trace sand seams, mixed with topsoil		1	SS	4											
192.7	Soft to Firm Brown (FILL)															
0.6	Silty CLAY, some sand, trace gravel Very Stiff Brown		2	SS	20											
191.9	Highly weathered, thinly bedded, very weak, reddish brown, SHALE, with grey limestone layers		3	SS	35											
1.4																
190.7			4	SS	50/											
2.6	END OF BOREHOLE AT 2.56 m. BOREHOLE OPEN TO BOTTOM UPON COMPLETION BOREHOLE BACKFILLED WITH DRILL CUTTINGS.				.125											

+ 3, × 3. Numbers refer to  
Sensitivity

20  
15 5  
10 (%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No BW09

1 OF 1

METRIC

G.W.P. 2149-01-00 & 2150-01-00 LOCATION Hwy 401 WBL Core - Hurontario Street N/S Ramp N 4 832 699.7 E 290 701.3 ORIGINATED BY SLL  
 HWY 401 BOREHOLE TYPE Solid Stem Augers COMPILED BY MFA  
 DATUM Geodetic DATE 2006-10-23 - 2006-10-23 CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	UNIT WEIGHT  γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	20 40 60 80 100					
193.6 0.0 0.1	TOPSOIL: (75 mm)													
	Silty CLAY, some gravel, occasional limestone fragments Stiff to Hard Brown (FILL)		1	SS	10									
			2	SS	34									
			3	SS	20									
191.3 2.2	Silty CLAY, some sand Hard Mottled Brown to Grey		4	SS	30									
190.6 3.0	Silty CLAY, trace gravel Hard Brown (TILL)		5	SS	51									
189.4 4.1	Highly weathered, thinly bedded, very weak, reddish brown, SHALE													
188.9 4.6	END OF BOREHOLE AT 4.62 m. Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen.													
	WATER LEVEL READINGS: DATE DEPTH(m) ELEV.(m) 10/27/06 3.4 190.2 11/13/06 2.5 191.1 12/12/06 1.4 192.2													

# RECORD OF BOREHOLE No BW10

1 OF 1

METRIC

G.W.P. 2149-01-00 & 2150-01-00

LOCATION

Hwy 401 WBL Core - Hurontario Street N/S Ramp N 4 832 685.2 E 290 706.5

ORIGINATED BY BJ

HWY 401

BOREHOLE TYPE

Solid Stem Augers/NQ Coring

COMPILED BY WM

DATUM Geodetic

DATE

2006-12-12 - 2006-12-12

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  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						
194.5								20 40 60 80 100						
0.0	TOPSOIL: (50 mm)		1	SS	24									
	Sandy SILT, gravelly, trace to some clay Compact to Loose Grey to Brown Moist (FILL)		2	SS	7									
193.0														
1.5	Silty CLAY, some sand, trace gravel, some black staining Very Stiff Brown (FILL)		3	SS	26									
192.2														
2.3	Silty CLAY, trace sand, occasional oxide staining Stiff to Very Stiff Mottled grey-brown (C)		4	SS	11									
			5	SS	26									
190.6														
4.0	Highly weathered, thinly bedded, very weak to weak, reddish brown, SHALE, occasional siltstone layers  Coring started at 4.67m		6	SS	50/ .100									
			1	RUN										
			2	RUN										
186.8														
7.7	END OF BOREHOLE AT 7.72 m. BOREHOLE GROUTED TO SURFACE.													

+3, X3: Numbers refer to Sensitivity 20 15 10 5 0 (%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No BW11

1 OF 1

METRIC

G.W.P. 2149-01-00 & 2150-01-00

LOCATION

Hwy 401 WBL Core - Hurontario Street N/S Ramp N 4 832 718.3 E 290 748.9

ORIGINATED BY BJ

HWY 401

BOREHOLE TYPE Solid Stem Augers/NQ Coring

COMPILED BY WM

DATUM Geodetic

DATE

2006-11-12 - 2006-11-12

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	● QUICK TRIAXIAL	+ FIELD VANE	× LAB VANE						20	40
192.6							20	40	60	80	100	20	40	60	kN/m <sup>3</sup>	GR SA SI CL		
0.0 0.1	TOPSOIL: (75 mm)		1	SS	4													
	Silty CLAY, some sand, trace rootlets, occasional black staining Soft to Stiff (FILL)		2	SS	8													
191.1																		
1.5	Silty CLAY, some sand, trace gravel, trace rootlets Very Stiff Brown		3	SS	15											1 10 45 44		
190.3																		
2.3	Silty CLAY, some sand, trace gravel Hard Brown (TILL)		4	SS	34													
			5	SS	66/ 125											1 39 40 20		
188.6																		
4.0	Highly weathered, thinly bedded, very weak, reddish brown, SHALE		6	SS	50/ .075													
	Coring started at 4.67m  Clay seam at 4.93m to 5.00m		1	RUN												RUN 1# TCR=100%, SCR=100%, RQD=45%		
			2	RUN												RUN 2# TCR=92%, SCR=92%, RQD=40%		
184.9																		
7.7	END OF BOREHOLE AT 7.72 m. Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen.  WATER LEVEL READINGS: DATE DEPTH(m) ELEV.(m) 29/01/07 1.0 191.6																	

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

20  
15 10 5 0  
(%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No BW12

1 OF 1

METRIC

G.W.P. 2149-01-00 & 2150-01-00

LOCATION Hwy 401 WBL Core - Hurontario Street N/S Ramp N 4 832 704.3 E 290 755.2

ORIGINATED BY BJ

HWY 401

BOREHOLE TYPE Solid Stem Augers

COMPILED BY WM

DATUM Geodetic

DATE 2006-12-12 - 2006-12-12

CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	20 40 60 80 100	20 40 60 80 100					
194.1	TOPSOIL: (50 mm)		1	SS	5		194								
0.0	Silty CLAY, some sand, trace rootlets Firm Dark Brown (FILL)														
193.4	Sandy SILT, trace gravel Compact Brown Moist (FILL)		2	SS	20		193								
0.8	Silty CLAY, trace sand, trace gravel, trace rootlets Firm Mottled brown-grey (FILL)		3	SS	6										
192.6	Silty CLAY, trace sand Stiff to Very Stiff Mottled brown-grey (CI)		4	SS	12		192								
1.5			5	SS	18		191								
191.9															
2.3															
190.0	Highly weathered, thinly bedded, very weak, reddish brown, SHALE		6	SS	50/		190								
4.1															
189.3	END OF BOREHOLE AT 4.81 m. BOREHOLE BACKFILLED WITH HOLEPLUG.				.075										
4.8															



# RECORD OF BOREHOLE No BW13

1 OF 1

METRIC

G.W.P. 2149-01-00 & 2150-01-00 LOCATION Hwy 401 WBL Core - Hurontario Street N/S Ramp N 4 832 728.0 E 290 805.4 ORIGINATED BY BJ  
 HWY 401 BOREHOLE TYPE Solid Stem Augers/NO Coring COMPILED BY WM  
 DATUM Geodetic DATE 2006-12-12 - 2006-12-12 CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa							WATER CONTENT (%)
193.8								20 40 60 80 100	20 40 60						
0.0	Silty CLAY, some black staining, trace sand, trace gravel Stiff (FILL)		1	SS	8										
	trace wood fragments, trace rootlets		2	SS	15										
	organics mixed with PEAT Black		3	SS	8										
191.5															
2.3	Silty CLAY, some sand Very Stiff Mottled brown-grey (TILL)		4	SS	15										
			5	SS	22										
189.8															
4.0	Highly weathered, thinly bedded, very weak, reddish brown, SHALE														
189.2															
4.6	END OF BOREHOLE AT 4.62 m. Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen.														
	WATER LEVEL READINGS: DATE DEPTH(m) ELEV.(m) 29/01/07 1.7 192.1				.050										

# RECORD OF BOREHOLE No BW14

1 OF 1

METRIC

G.W.P. 2149-01-00 & 2150-01-00

LOCATION

Hwy 401 WBL Core - Hurontario Street N/S Ramp N 4 832 753.0 E 290 854.3

ORIGINATED BY BJ

HWY 401

BOREHOLE TYPE

Solid Stem Augers/NQ Coring

COMPILED BY WM

DATUM Geodetic

DATE

2006-12-12 - 2006-12-12

CHECKED BY 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 + FIELD VANE ● QUICK TRIAXIAL × LAB VANE						PLASTIC LIMIT w <sub>p</sub> NATURAL MOISTURE CONTENT w LIQUID LIMIT w <sub>L</sub>					
193.7								20	40	60	80	100							
0.0	Clayey SILT, some sand, trace gravel Compact Reddish Brown (FILL)		1	SS	14														
192.9																			
0.8	Silty CLAY, trace sand, some shale fragments, occasional greenish limy interbeds Very Stiff Reddish Brown (TILL)		2	SS	24														
192.3																			
1.4	SHALE, moderately to highly weathered, thinly bedded, reddish brown, very weak		3	SS	50/ 100														
	Clay seams at 2.69m to 2.98m, 3.63m to 3.74m Rubble zones from 2.69m to 2.98m, 3.51m to 3.59m Coring started at 2.7m		1	RUN															
	Rubble zones from 4.21m to 4.69m, 5.23m to 5.28m		2	RUN															

+ 3, X 3: Numbers refer to  
Sensitivity

20  
15 5  
10 (%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No BW15

1 OF 1

METRIC

G.W.P. 2149-01-00 & 2150-01-00 LOCATION Hwy 401 WBL Core - Hurontario Street N/S Ramp N 4 832 616.3 E 290 533.1 ORIGINATED BY SLI  
 HWY 401 BOREHOLE TYPE Solid Stem Augers COMPILED BY  
 DATUM Geodetic DATE 2006-10-23 - 2006-10-23 CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	UNIT WEIGHT  γ  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)  GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
194.6								20	40	60	80	100					
0.0	TOPSOIL: (125 mm)																
0.1	Silty CLAY, some rootlets		1	SS	7												
194.0	Firm																
0.6	Brown																
193.6	Silty CLAY, some sand, trace gravel		2	SS	50/												
1.0	Hard																
	Brown				.075												
	(TILL)																
	END OF BOREHOLE AT 1.01 m. AUGER REFUSAL ON PROBABLE BEDROCK OR BOULDERS. BOREHOLE OPEN AND DRY TO BOTTOM UPON COMPLETION. BOREHOLE BACKFILLED WITH DRILL CUTTINGS.																

+ 3, x 3. Numbers refer to  
Sensitivity

20  
15 5  
10 (%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No BW16

1 OF 1

METRIC

G.W.P. 2149-01-00 & 2150-01-00 LOCATION Hwy 401 WBL Core - Hurontario Street N/S Ramp N 4 832 711.8 E 290 697.1 ORIGINATED BY SLL  
 HWY 401 BOREHOLE TYPE Solid Stem Augers COMPILED BY  
 DATUM Geodetic DATE 2006-10-23 - 2006-10-23 CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT   NATURAL MOISTURE CONTENT   LIQUID LIMIT			UNIT WEIGHT  $\gamma$  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)  GR SA SI C
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa		WATER CONTENT (%)				
192.6								20 40 60 80 100		20 40 60				
192.6	TOPSOIL: (50 mm)		1	SS	18									
	Silty CLAY, mixed with topsoil Very Stiff Brown (FILL)		2	SS	20									
190.7			3	SS	27									
190.7	Silty CLAY, some sand Very Stiff to Hard Brown		4	SS	36									
189.6			5	SS	56									
189.6	Silty CLAY, some sand, trace gravel Hard Brown (TILL)													
188.6														
188.6	Highly weathered, thinly bedded, very weak, reddish brown, SHALE, with grey limestone layers													
187.9			6	SS	57									
187.9	END OF BOREHOLE AT 4.65 m. BOREHOLE OPEN AND DRY TO BOTTOM UPON COMPLETION. BOREHOLE GROUTED WITH BENTONITE TO SURFACE.				.075									

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

20  
15  
10  
(%) STRAIN AT FAILURE

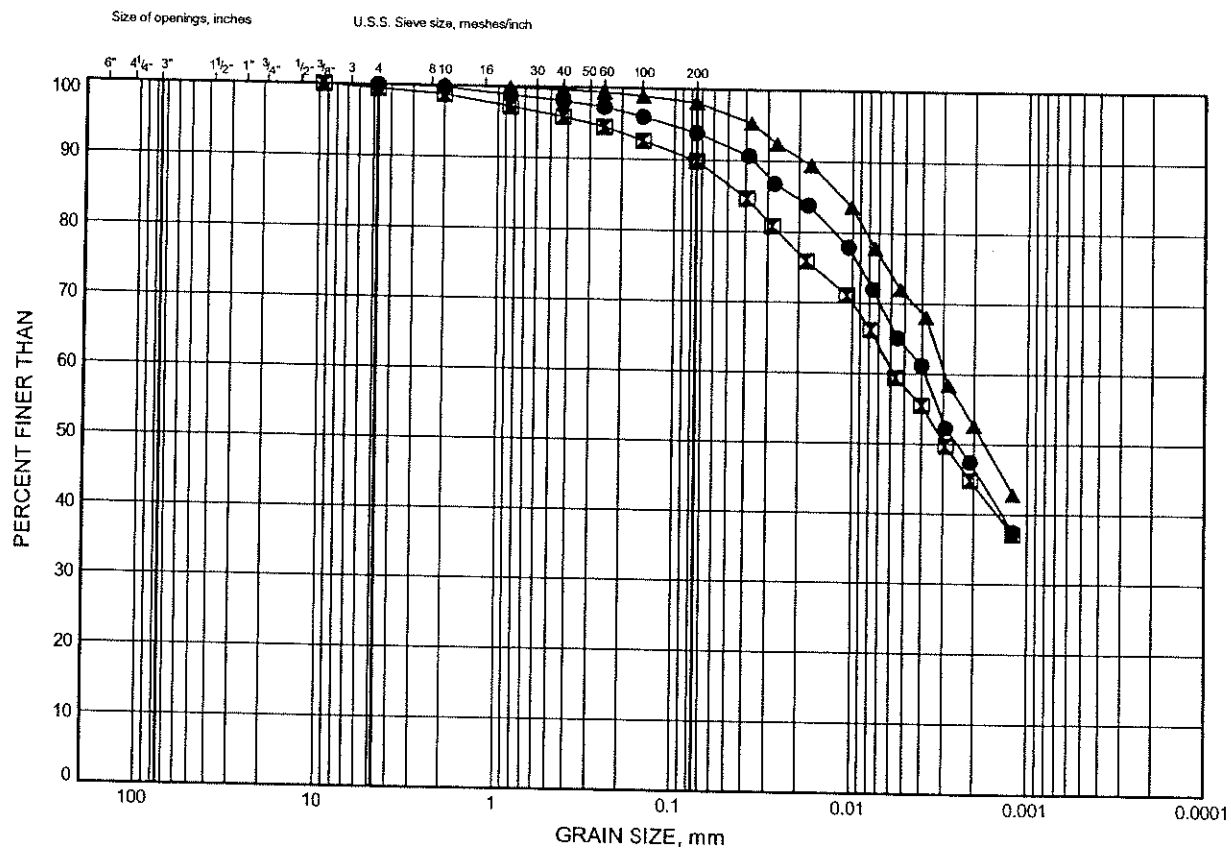
## **Appendix B**

### **Laboratory Test Results**

# Hwy 401/410 to Credit River GRAIN SIZE DISTRIBUTION

FIGURE B1

## SILTY CLAY



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

SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	BW10	2.59	191.94
⊠	BW11	1.83	190.80
▲	BW12	3.35	190.79



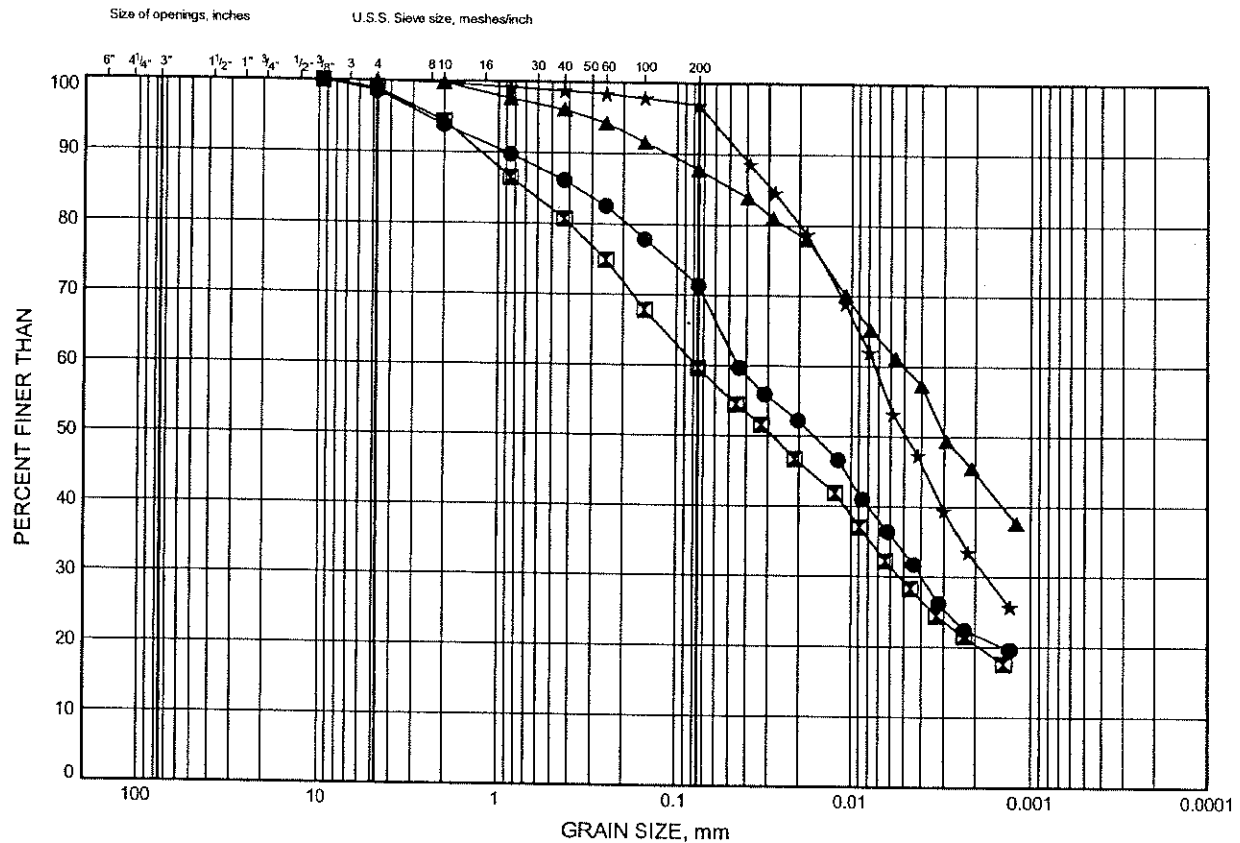
Date February 2008  
Project 2149-01-00 & 2150-01-00

Prep'd MFA  
Chkd. RPR

# Hwy 401/410 to Credit River GRAIN SIZE DISTRIBUTION

FIGURE B2

## SILTY CLAY TILL



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

SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	BW02-07	7.92	194.02
⊠	BW11	3.35	189.28
▲	BW13	2.59	191.20
★	BW14	1.07	192.64

Date February 2008  
Project 2149-01-00 & 2150-01-00

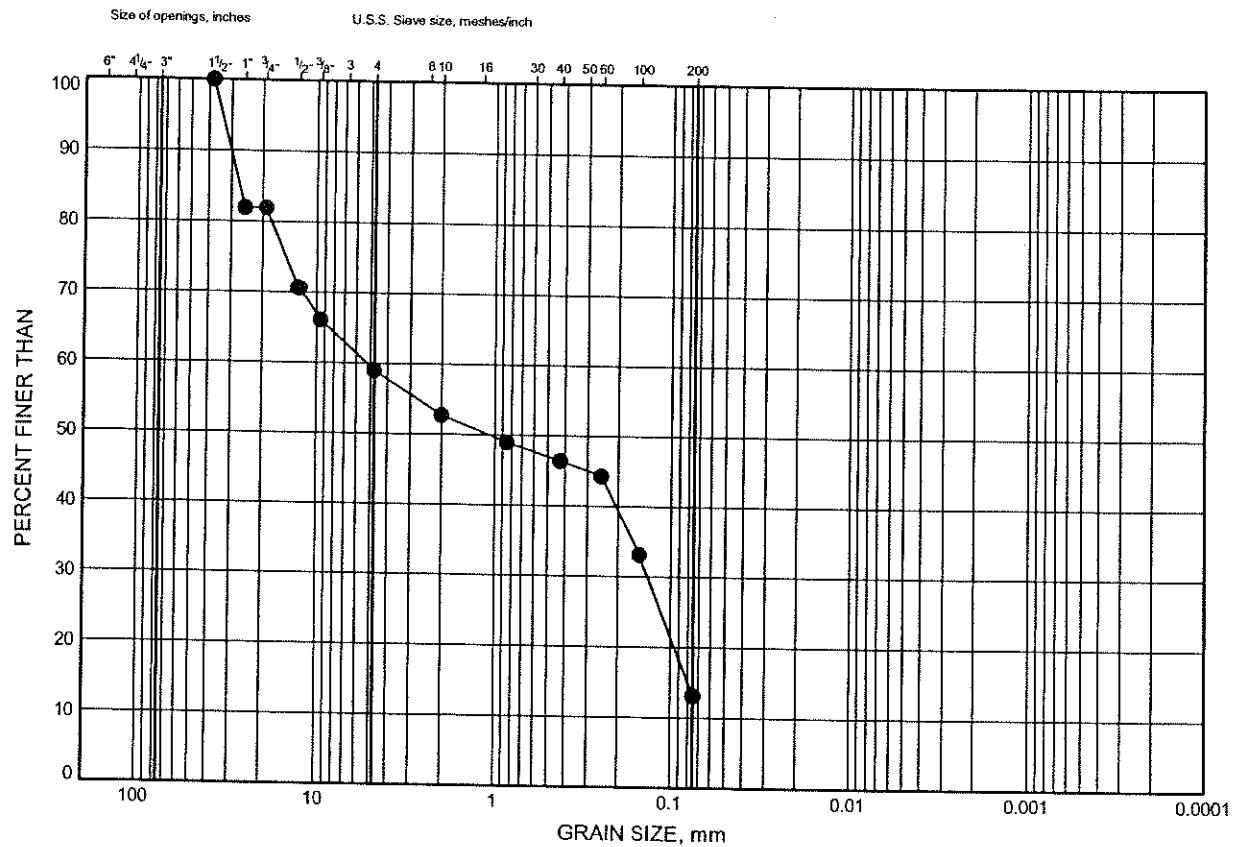


Prep'd MFA  
Chkd. RPR

# Hwy 401/410 to Credit River GRAIN SIZE DISTRIBUTION

FIGURE B3

## SAND

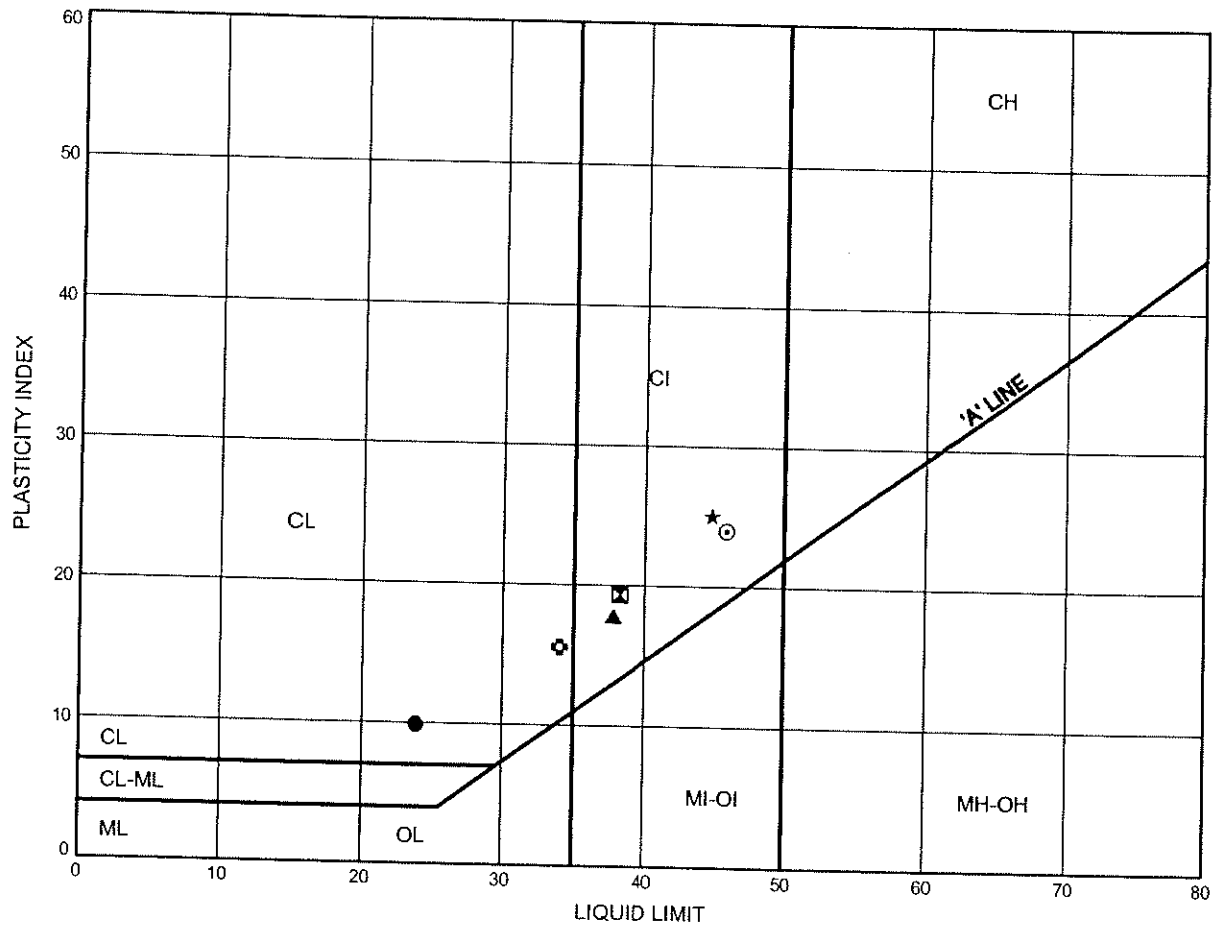




Hwy 401/410 to Credit River  
**ATTERBERG LIMITS TEST RESULTS**

FIGURE B4

**SILTY CLAY**



SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	BW04	0.99	196.04
⊠	BW08	1.07	192.24
▲	BW10	2.59	191.94
★	BW11	1.83	190.80
⊙	BW12	3.35	190.79
⊛	BW16	1.96	190.60

Date February 2008

Project 2149-01-00 & 2150-01-00



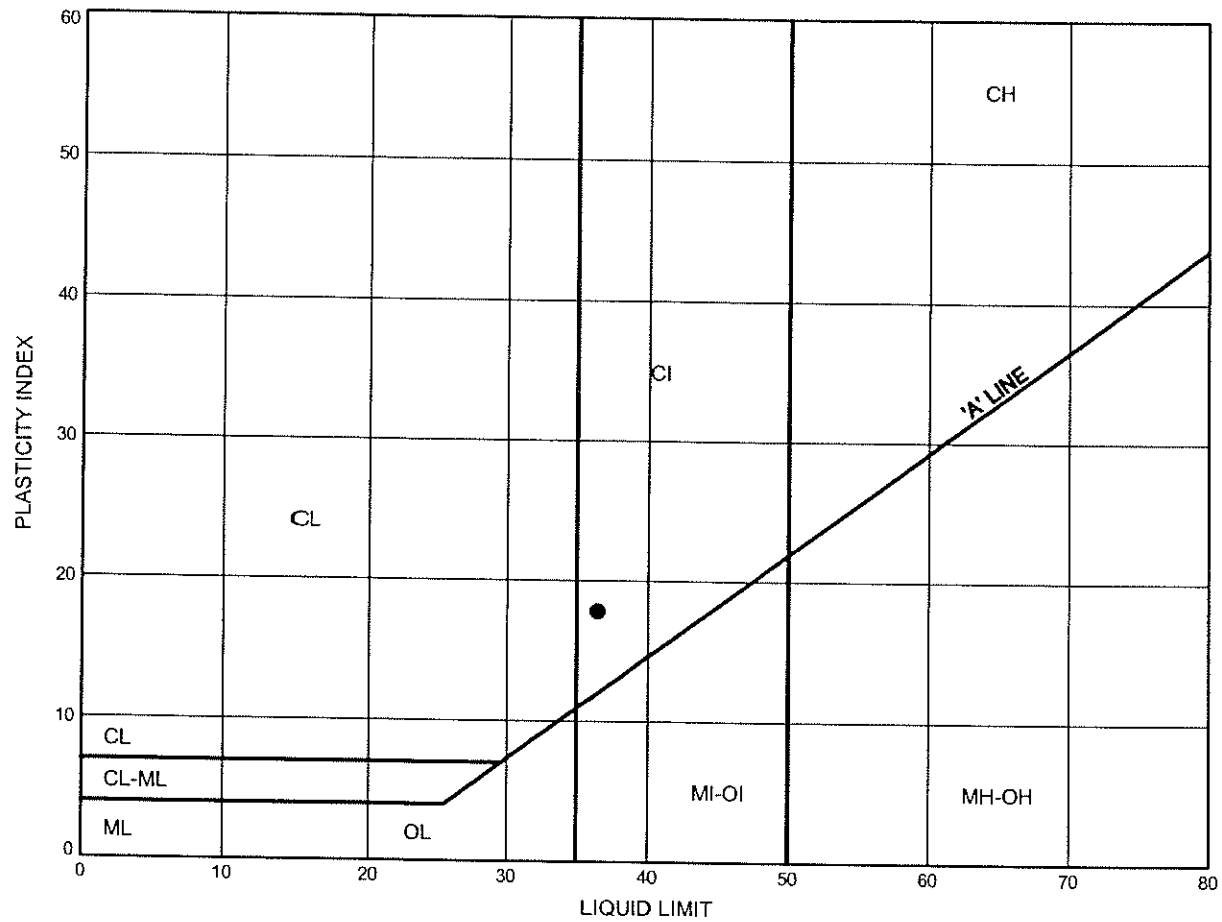
Prep'd MFA

Chkd. RPR

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

FIGURE B5

**SILTY CLAY**

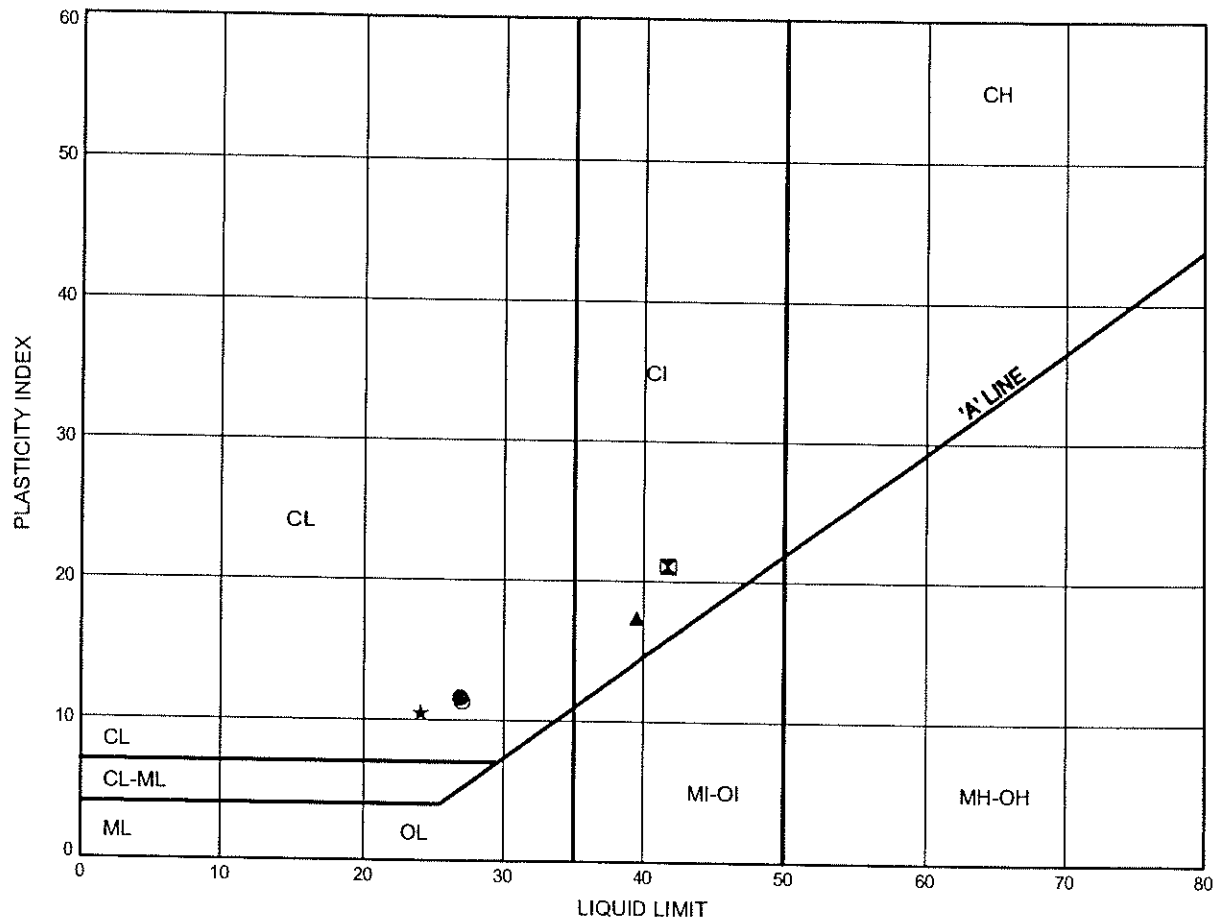


SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	BW09	2.59	190.96

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

FIGURE B6

**SILTY CLAY TILL**



SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	BW02-07	7.92	194.02
⊠	BW13	2.59	191.20
▲	BW14	1.07	192.64
★	BW15	0.87	193.74
⊙	BW16	3.35	189.20

Date February 2008

Project 2149-01-00 & 2150-01-00



Prep'd MFA

Chkd. RPR

## **Appendix C**

### **Record of Borehole Sheets**

**(previous investigation)**

### **Laboratory Test Results**

# RECORD OF BOREHOLE No 1

1 OF 1 METRIC

W.P. 54-82-06 LOCATION N 4 832 504, E 290 684 ORIGINATED BY \_\_\_\_\_  
 DIST 6 HWY 401 BOREHOLE TYPE Hollow Stem Auger, NXL Core COMPILED BY \_\_\_\_\_  
 DATUM Geodetic DATE 83 08 26-29 CHECKED BY JDM

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>P</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ KN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100									
								SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100									
192.8	Ground Surface																
0.0	CLAYEY SILT to SILTY CLAY Some Sand Trace to Some Gravel Occ. Sandy silt zones Trace Organics		1	AS													
			2	SS	10												
	Stiff to Hard		3	SS	44												
	(Glacial Till)		4	SS	70												
189.8																	
2.9	BEDROCK Queensston Shale Highly Weathered																
			6	SS	110												
			7	NX	78 % rec												
186.9																	
5.8	End of Borehole																

# RECORD OF BOREHOLE No 4

1 OF 1

METRIC

W.P. 54-82-06 LOCATION N 4 832 550 E 290 780 ORIGINATED BY \_\_\_\_\_  
 DIST 6 HWY 401 BOREHOLE TYPE Hollow Stem Auger COMPILED BY JDM  
 DATUM Geodetic DATE 83 08 26-30 CHECKED BY JDM

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					NATURAL MOISTURE CONTENT			UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100	W <sub>p</sub>	W	W <sub>L</sub>		
192.9	Ground Surface																
0.0	Trace Organics		1	AS													
	CLAYEY SILT to SILTY CLAY		2	SS	26										20.4		
	Some Sand Trace to Some Gravel Occ. sandy silt zones		3	SS	44										21.4		
190.6	Stiff to Hard (Glacial Till)		4	SS	73										21.1		
2.3	BEDROCK		5	SS	100												
	Queenston Shale Highly Weathered																
188.2																	
-4.7	End of Borehole																

# RECORD OF BOREHOLE No E-1

1 OF 1

METRIC

W.P. 54-82-05 LOCATION Coords.: N 4 832 535, E 290 793 ORIGINATED BY L.O.  
 DIST 6 HWY 401 BOREHOLE TYPE Solid Stem Auger, BW Casing, BQ Rock Core COMPILED BY L.O.  
 DATUM Geodetic DATE 1994 06 28 CHECKED BY B.B.

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 (%) GR SA SI CL
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	20 40 60 80 100		
192.5	Ground Surface													
0.0	CLAYEY SILT TO SILTY CLAY Trace to Some Gravel Some Sand Stiff to Very Stiff (Glacial Till)		1	SS	11		192							
190.4	Brown Red		2	SS	21									17 31 (52)
2.1			3	SS	102	/18cm	190							
	BEDROCK Queenston Shale		4	SS	85	/13cm								
			5	SS	85	/13cm								
	Highly Weathered Slightly Weathered		6	RC	REC 79%		188							ROD OK
186.2														
6.3	End of Borehole													

# RECORD OF BOREHOLE No P-1

1 of 1

METRIC

W.P. 54-82-06 LOCATION Coor. N 4 832 527 E 290 697 ORIGINATED BY L.O.  
 DIST 6 HWY 401 BOREHOLE TYPE Hollow Stem Auger COMPILED BY L.O.  
 DATUM Geodetic DATE 1994 06 29 CHECKED BY B.B.

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			20 40 60 80 100							PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>
								SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100									
WATER CONTENT (%) 10 20 30																	
198.4	Ground Surface																
0.0	WEATHERED SHALE FRAGMENTS Fine Grained to Cobble / Boulder Size Grey Stiff to Hard (Fill Material)		1	SS	11												
			2	SS	12												
			3	SS	19												
			4	SS	46												
			5	SS	10												
			6	SS	13												
193.0	CLAYEY SILT TO SILTY CLAY Some Sand Trace to Some Gravel Stiff to Hard (Glacial Till)		7	SS	8												
5.4			8	SS	11												
			9	SS	17												
			10	SS	16												
			11	SS	106												
189.7	BEDROCK		12	SS	85	/9cm											
8.7	Queenston Shale																
189.0	Highly Weathered																
9.4	End of Borehole																



# RECORD OF BOREHOLE No P-2 1 OF 1 METRIC

W.P. 54-82-06 LOCATION Coords.: N 4 832 508, E 290 701 ORIGINATED BY L.O.  
 DIST 6 HWY 401 BOREHOLE TYPE Solid Stem Auger, BW Casing, BQ Rock Core COMPILED BY L.O.  
 DATUM Geodetic DATE 1994 06 27 CHECKED BY B.B.

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			20 40 60 80 100	PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	WATER CONTENT (%) 10 20 30		
192.5	Ground Surface													
0.0	CLAYEY SILT TO SILTY CLAY Trace to Some Gravel Some Sand      Trace Organics Occ. Silty Sand Zones Stiff to Hard (Glacial Till)		1	SS	6	/13cm	192							
			2	SS	22									
189.8			3	SS	55		190							
2.7	BEDROCK Queenston Shale  Highly Weathered Slightly Weathered		4	SS	102									
			5	RC	REC 59%		188							
			6	RC	REC 95%		186							
185.2														
7.3	End of Borehole													

# RECORD OF BOREHOLE No P-3

1 OF 1

METRIC

W.P. 54-82-06 LOCATION Coords.: N 4 832 541, E 290 757 ORIGINATED BY L.O.  
 DIST 6 HWY 401 BOREHOLE TYPE Solid Stem Auger COMPILED BY L.O.  
 DATUM Geodetic DATE 1994 06 23 CHECKED BY B.B.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
192.5	Ground Surface																
0.0	CLAYEY SILT TO SILTY CLAY Trace to Some Gravel Some Sand Stiff to Hard (Glacial Till)		1	SS	12		192										
	Trace Organics		2	SS	20		191										
189.8	Brown Red		3	SS	100	/29cm	190										1 10 (89)
2.7	BEDROCK Queenston Shale Highly Weathered		4	SS	105	/12cm	189										
			5	SS	87	/6cm	188										
			6	SS	85	/6cm											
187.1			7	SS	85	/6cm											
5.4	End of Borehole																

# RECORD OF BOREHOLE No P-4

1 OF 1

METRIC

W.P. 54-82-06 LOCATION Coords.: N 4 832 527, E 290 761 ORIGINATED BY L.O.  
 DIST 6 HWY 401 BOREHOLE TYPE Solid Stem Auger COMPILED BY L.O.  
 DATUM Geodetic DATE 1994 06 24 CHECKED BY B.B.

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			20 40 60 80 100	20 40 60 80 100	20 40 60 80 100	20 40 60 80 100	20 40 60 80 100		
192.5	Ground Surface													
0.0	CLAYEY SILT TO SILTY CLAY Trace Sand Trace Gravel Occ. Silty Sand Zones Firm to Hard (Glacial Till)		1	SS	6		192							
			2	SS	20									
189.9	Some Sand		3	SS	57		190							
2.6			4	SS	92	/15cm								
	BEDROCK Queensston Shale Highly Weathered		5	SS	92	/13cm								
			6	SS	82	/15cm	188							
187.1			7	SS	100	/10cm								
5.4	End of Borehole													

# RECORD OF BOREHOLE No R-1

1 OF 1

METRIC

W.P. 54-82-06 LOCATION Coords.: N 4 832 457, E 290 615 ORIGINATED BY L.O.  
 DIST 6 HWY 401 BOREHOLE TYPE Hollow Stem Auger COMPILED BY L.O.  
 DATUM Geodetic DATE 1994 06 30 CHECKED BY B.B.

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 (%) GR SA SI CL
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	20 40 60 80 100		
199.3	Ground Surface													
0.0						DRY								
			1	SS	13									
			2	SS	19		198							
			3	SS	9									
	WEATHERED SHALE FRAGMENTS Fine Grained to Cobble / Boulder Size Grey Soft to Hard (Fill Material)		4	SS	55		196							11 44 29 18
			5	SS	37									
			6	SS	8									
	CLAYEY SILT Trace to Some Gravel Some Sand (Fill Material)		7	SS	10		194							
192.9			8	SS	11									
6.4	Trace Organics													6 22 (72)
	CLAYEY SILT TO SILTY CLAY Some Sand Trace to Some Gravel Soft to Hard Brown (Glacial Till)		9	SS	42		192							5 27 (68)
191.3			10	SS	86									
8.0			11	SS	100	/27cm								
	BEDROCK Queenston Shale Highly Weathered		12	SS	95	/23cm	190							
189.5														
9.8	End of Borehole													

# RECORD OF BOREHOLE No R-2

1 OF 1

METRIC

W.P. 54-82-06 LOCATION Coords.: N 4 832 566, E 290 836  
 DIST 6 HWY 401 BOREHOLE TYPE Solid Stem Auger  
 DATUM Geodetic DATE 1994 06 23  
 ORIGINATED BY L.O.  
 COMPILED BY L.O.  
 CHECKED BY B.B.

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			20 40 60 80 100	20 40 60 80 100	20 40 60 80 100	20 40 60 80 100	20 40 60 80 100		
194.1	Ground Surface													
0.0	CLAYEY SILT TO SILTY CLAY Some Sand Trace to Some Gravel Red Very Stiff to Hard (Glacial Till) Trace Organics		1	SS	25									
			2	SS	50									
191.4			3	SS	98		192						24.7	2 8 (90)
2.7			4	SS	100	/15cm								
			5	SS	100	/9cm								
	BEDROCK Queensland Shale Highly Weathered		6	SS	100	/15cm	190							
			7	SS	100	/8cm								
			8	SS	110	/14cm	188							
187.1			9	SS	100	/11cm								
7.0	End of Borehole													

## METRIC

ORIGINATED BY LO

COMPILED BY LO

— CHECKED BY B.B.

+3, x<sup>5</sup>: Numbers refer to 20  
LEAD (4) CTD 17 11 11 11

# RECORD OF BOREHOLE No W-1

1 OF 1

METRIC

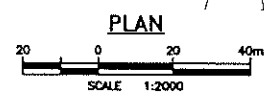
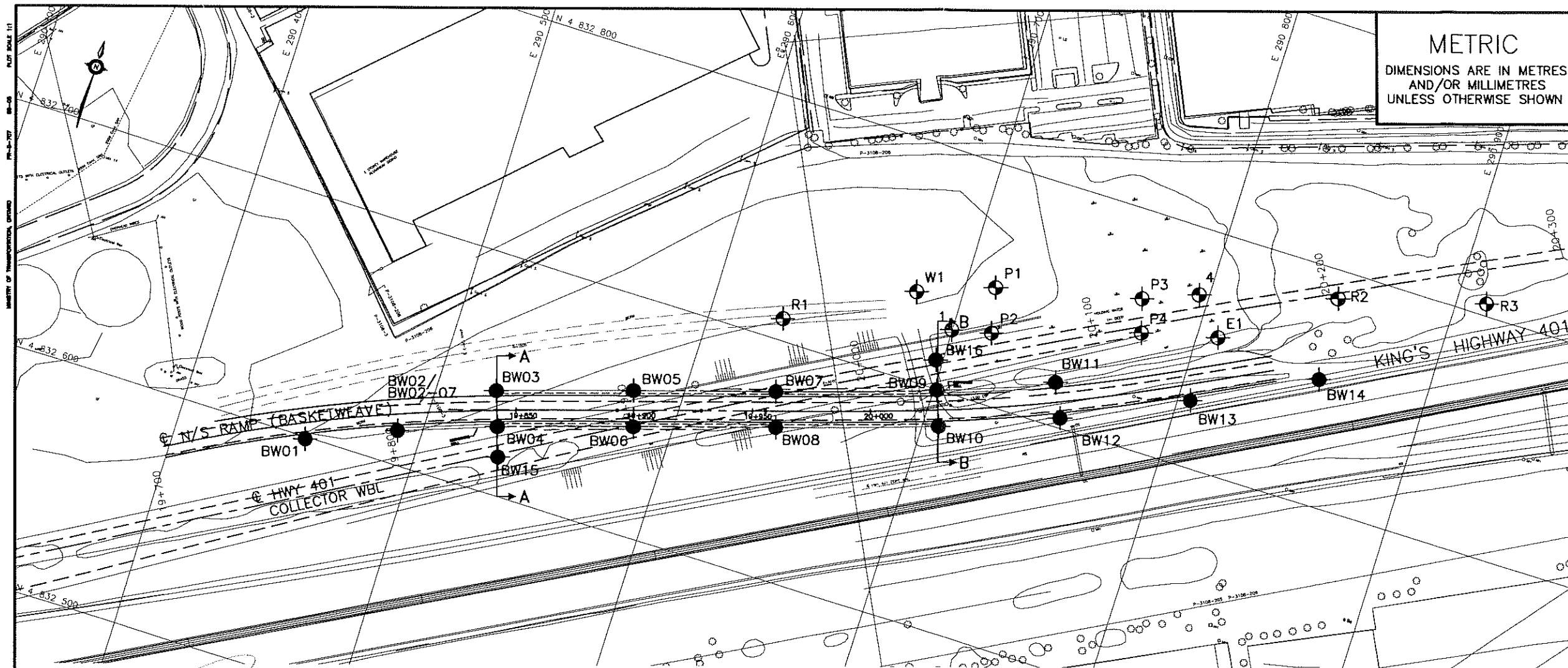
W.P. 54-82-06 LOCATION Coords.: N 4 832 515, E 290 665 ORIGINATED BY L.O.  
 DIST 6 HWY 401 BOREHOLE TYPE Solid Stem Auger COMPILED BY L.O.  
 DATUM Geodetic DATE 1994 06 27 CHECKED BY B.B.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100					
198.6	Ground Surface																
0.0																	
	WEATHERED SHALE FRAGMENTS Fine Grained to Cobble / Boulder Size Gray Stiff to Hard (Fill Material)		1	SS	10		198										
			2	SS	14												
			3	SS	9		195										
			4	SS	19												
			5	SS	53												
			6	SS	19		194										
			7	SS	88												
191.9			8	SS	16												
6.7	CLAYEY SILT TO SILTY CLAY Some Sand Trace to Some Gravel Very Stiff to Hard (Glacial Till) Brown Red		9	SS	19		192										
			10	SS	44												
190.1			11	SS	104	/25cm	190										
8.5	BEDROCK Queenston Shale Highly Weathered Slightly Weathered		12	SS	85	/9cm											
			13	SS	90	/13cm											
187.1			14	RC	REC 70%		188										
11.5	End of Borehole																

## **Appendix D**

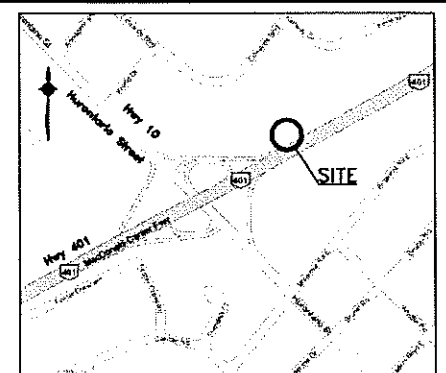
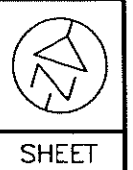
### **Borehole Locations and Soil Strata Drawing**





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

HWY 401  
SITE No 24-759  
GWP No 2149-01-00 & 2150-01-00  
HWY 401 WB EXPRESS TO  
HURONTARIO STREET RAMP  
BOREHOLE LOCATIONS AND SOIL STRATA



KEYPLAN  
LEGEND

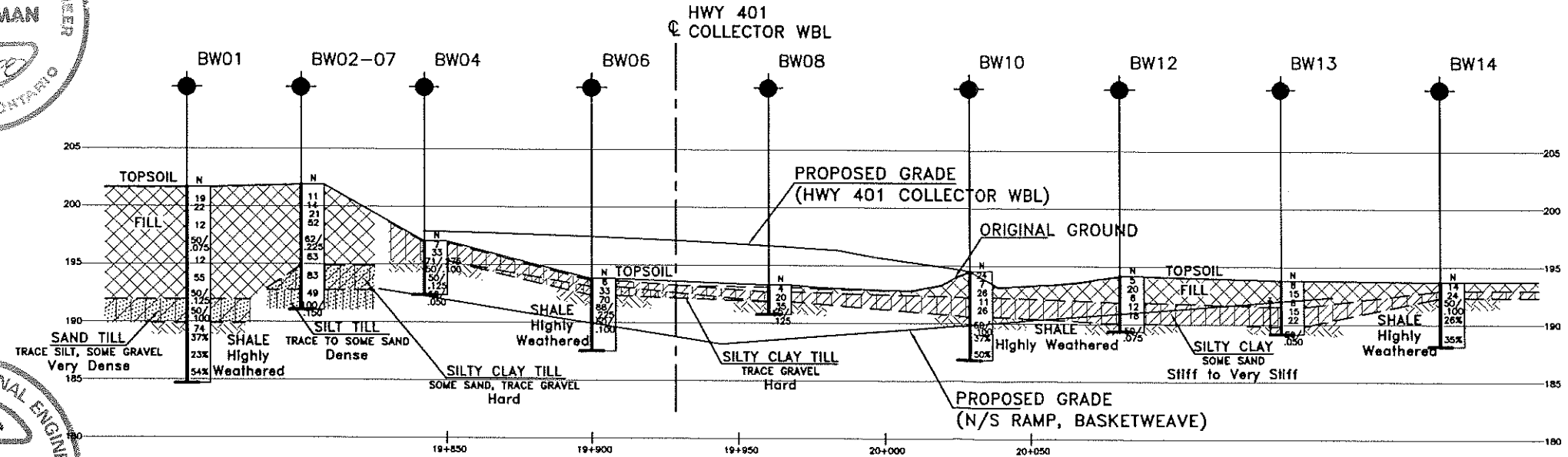
- BoreHole (Present Investigation, 2007)
- ⊕ BoreHole and Cone
- ⊙ BoreHole (Previous Investigation, 1994)
- N Blows /0.3m (Std Pen Test, 475J/blow)
- CONE Blows /0.3m (60° Cone, 475J/blow)
- PH Pressure, Hydraulic
- Water Level
- Head Artesian Water
- Piezometer
- 90% Rock Quality Designation (RQD)
- A/R Auger Refusal

NO	ELEVATION	NORTHING	EASTING
BW01	201.7	4 832 599.1	290 453.4
BW02/BW02-07	201.9	4 832 614.5	290 489.9
BW03	201.6	4 832 643.1	290 524.1
BW04	197.0	4 832 628.6	290 529.0
BW05	195.1	4 832 660.8	290 579.7
BW06	193.8	4 832 646.1	290 584.2
BW07	193.2	4 832 678.6	290 637.1
BW08	193.3	4 832 664.0	290 641.6
BW09	193.6	4 832 699.7	290 701.3
BW10	194.5	4 832 685.2	290 706.5
BW11	192.6	4 832 718.3	290 748.9
BW12	194.1	4 832 704.3	290 755.2
BW13	193.8	4 832 728.0	290 805.4
BW14	193.7	4 832 753.0	290 854.3
BW15	194.6	4 832 616.3	290 533.1
BW16	192.6	4 832 711.8	290 697.1

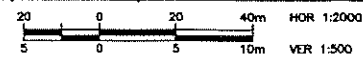
NOTES:

- 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. 30M12-269

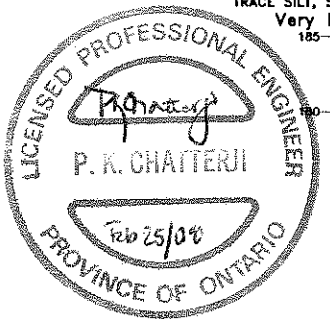


PROFILE @ N/S RAMP (BASKETWEAVE TUNNEL)



Refer to DWG 2 for Sections A-A and B-B

DATE	BY	DESCRIPTION
DESIGN	RPR	CHK PKC/CODE
DRAWN	JHL	CHK PKC/SITE
LOAD		DATE: FEB 2008
STRUCT		SCHEME
		DWG 1



DRAWING NAME:  
CREATED:

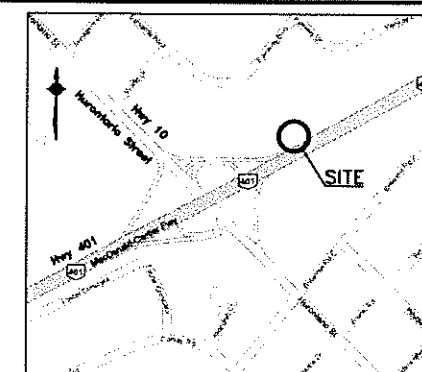
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METRIC  
DIMENSIONS ARE IN METRES  
AND/OR MILLIMETRES  
UNLESS OTHERWISE SHOWN

HWY 401  
SITE No 24-759  
GWP No 2149-01-00 & 2150-01-00






HWY 401 WB EXPRESS TO  
HURONTARIO STREET RAMP  
BOREHOLE LOCATIONS AND SOIL STRATA

SHEET



## KEYPLAN

## LEGEND

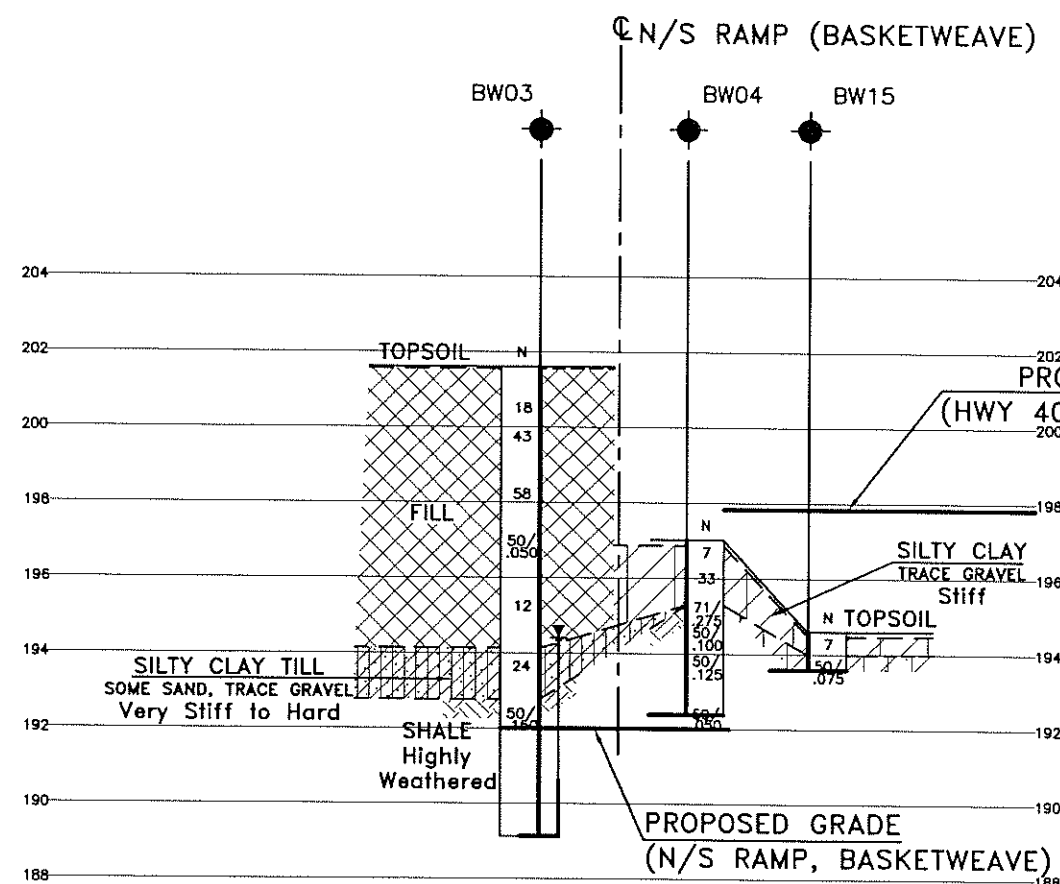
- |   |   |
|---|---|
|    | BoreHole (Present Investigation, 2007)  |
|    | BoreHole and Cone                       |
|    | BoreHole (Previous Investigation, 1994) |
| N   | Blows /0.3m (Std Pen Test, 475J/blow)   |
| CONE  | Blows /0.3m (60° Cone, 475J/blow)       |
| PH  | Pressure, Hydraulic                     |
|  | Water Level                             |
|  | Head Artesian Water                     |
|   | Piezometer                              |
| 90%   | Rock Quality Designation (RQD)          |
| A/R   | Auger Refusal                           |

NO	ELEVATION	NORTHING	EASTING
BW01	201.7	4 832 599.1	290 453.4
BW02/BW02-07	201.9	4 832 614.5	290 489.9
BW03	201.6	4 832 643.1	290 524.1
BW04	197.0	4 832 628.6	290 529.0
BW05	195.1	4 832 660.8	290 579.7
BW06	193.8	4 832 646.1	290 584.2
BW07	193.2	4 832 678.6	290 637.1
BW08	193.3	4 832 664.0	290 641.6
BW09	193.6	4 832 699.7	290 701.3
BW10	194.5	4 832 685.2	290 706.5
BW11	192.6	4 832 718.3	290 748.9
BW12	194.1	4 832 704.3	290 755.2
BW13	193.8	4 832 728.0	290 805.4
BW14	193.7	4 832 753.0	290 854.3
BW15	194.6	4 832 616.3	290 533.1
BW16	192.6	4 832 711.8	290 697.1

-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.

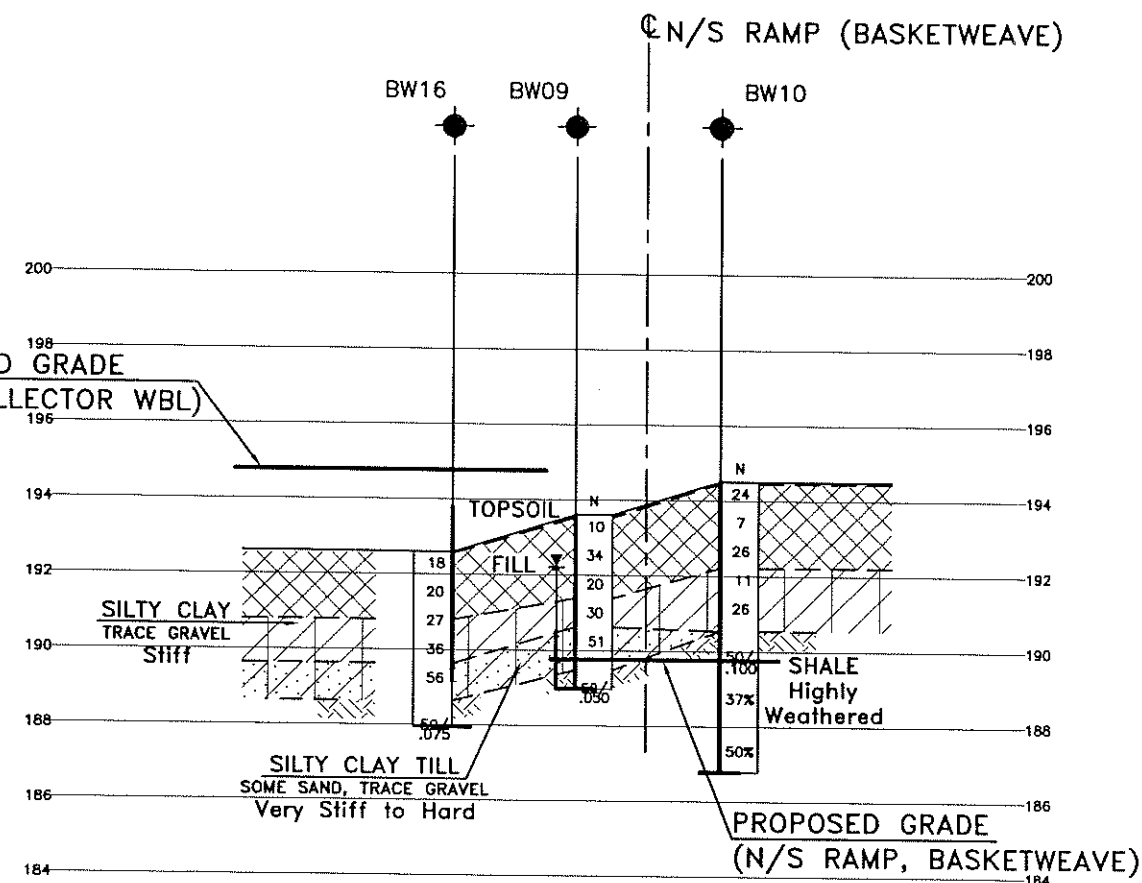
GEOCRES No. 30M12-269



**SECTION A-A**

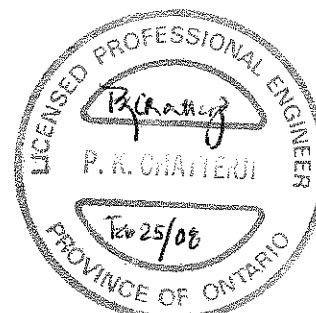
2 0 5 10m  
1 0 2.5 5m

HOR  
VER



**SECTION B-B**

2 0 5 10m HOR  
1 0 2.5 5m VER



Refer to DWG 1 for locations of Sections A-A and B-B

REVISIONS						DESCRIPTION			DATE FEB 2008	
	DATE	BY				LOAD	ISCH	IRWG		
	DESIGN	RPR	CHK	PKC	CODE					
	DRAWN	JHL	CHK	PKC	SITE	ISTRUCT	ISCH	IRWG	2	

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