

**FOUNDATION INVESTIGATION AND DESIGN REPORT  
HIGH MAST LIGHTING POLES  
HWY 401 WIDENING, HWY 410 TO CREDIT RIVER  
MISSISSAUGA, ONTARIO  
G.W.P. 2107-05-00**

**Geocres Number: 30M12-275**

**Report to**

**MMM Group Limited**

Thurber Engineering Ltd.  
2010 Winston Park Drive, Suite 103  
Oakville, Ontario  
L6H 5R7  
Phone: (905) 829 8666  
Fax: (905) 829 1166

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**PART 1: FACTUAL INFORMATION**

**1 INTRODUCTION**

This report presents the factual findings obtained from a foundation investigation for the detailed design of high mast lighting (HML) poles at the Highway 401 and Hurontario Street interchange, which is part of the Highway 401 widening from Highway 410 to Credit River in Mississauga, Ontario.

The purpose of the investigation was to explore the subsurface conditions in the general vicinities of the proposed HML poles and, based on the data obtained, to provide a borehole location plan, records of boreholes, laboratory test results 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.

In the preparation of this report and in addition to the boreholes drilled for the HML poles, general reference has been made to information on subsurface conditions contained in other foundation reports. The titles of these reports are listed as follows:

- Thurber Engineering Ltd. report titled “Draft Foundation Investigation and Design Report, Highway 401 Widening, Highway 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, 19-1423-11, prepared for MMM Group Limited, dated September 14, 2007 (Reference 1).
- Thurber Engineering Ltd. report titled “Draft Foundation Investigation and Design Report, Hurontario Street Underpass, Highway 401 Widening, Highway 410 to Credit River, Mississauga, Ontario, G.W.P. 2149-01-00 & 2150-01-00, Site 24-132,

19-1423-11, prepared for MMM Group Limited, dated September 13, 2007 (Reference 2).

- Thurber Engineering Ltd. report titled “Draft Foundation Investigation and Design Report, Hurontario Street South to Highway 401 East Ramp, Highway 401 Widening, Highway 410 to Credit River, Mississauga, Ontario, G.W.P. 2107-05-00, WP 2107-05-02, Site 24-757, 19-1423-11, prepared for MMM Group Limited, dated December 18, 2007 (Reference 3).
- Thurber Engineering Ltd. report titled “Draft Foundation Investigation and Design Report, Hurontario North Access Road / N-W Ramp Structure and Retaining Walls, Highway 401 Widening, Highway 410 to Credit River, Mississauga, Ontario, G.W.P. 2107-05-00, WP 2107-05-04, Site 24-759, 19-1423-11, prepared for MMM Group Limited, dated January 22, 2007 (Reference 4).
- Thurber Engineering Ltd. report titled “Draft Foundation Investigation and Design Report, Hurontario Street South Access Road Structure and Retaining Walls, Highway 401 Widening, Highway 410 to Credit River, Mississauga, Ontario, G.W.P. 2107-05-00, WP 2107-05-03, Site 24-758, 19-1423-11, prepared for MMM Group Limited, dated February 8, 2007 (Reference 5).
- Thurber Engineering Ltd. report titled “Draft Foundation Investigation and Design Report, Patrol Yard, Highway 401 Widening, Highway 410 to Credit River, Mississauga, Ontario, G.W.P. 2107-05-00, 19-1423-11, prepared for MMM Group Limited, dated March 11, 2007 (Reference 6).
- Thurber Engineering Ltd. report titled “Draft Foundation Investigation and Design Report, Culverts, Highway 401 Widening, Highway 410 to Credit River, Mississauga, Ontario, G.W.P. 2107-05-00, prepared for MMM Group Limited, dated March, 2007 (Reference 7).

Records of boreholes from these reports relevant to the HML poles are attached in Appendix C for reference.

## 2 SITE DESCRIPTION

A total of ten HML poles are proposed at the Highway 401 and Hurontario Street interchange in Mississauga, Ontario. Five HML poles are proposed along the Highway 401 median on the east side of Hurontario Street. Three additional HML poles will be placed along the proposed Hwy 401 WB Express to Hurontario Street N/S Ramp, located approximately 400 m east of Highway 401 and Hurontario Street interchange. Three other HML poles will be placed within the patrol yard. Reference 6 provides recommendations for foundation design for the three HML poles within the Patrol Yard.

The lands at the northwest quadrant of Highway 401 and Hurontario Street are generally vacant and undeveloped. Vegetation is moderate consisting mainly of tall grass and shrubs. To the east of Hurontario Street and south of Highway 401, lands have been developed for commercial and industrial uses. The topography is typically 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 typically less than 1 m to 7 m thick which is underlain by reddish brown shale of the Queenston Formation with grey limestone and siltstone interbeds.

### 3 SITE INVESTIGATION AND FIELD TESTING

Site investigation and field testing for the proposed High Mast Lighting (HML) poles consisted of drilling and sampling a total of 5 boreholes at selected locations in the vicinities of the poles. This report focuses on the boreholes drilled and sampled for the HML poles as well as other boreholes relevant to the HML poles in References 1 to 7. A summary of the borehole designations for the HML poles that are not referenced elsewhere is provided in Table 3.1.

**Table 3.1 – Borehole Designations**

<b>Borehole</b>	<b>Location</b>	<b>Drilling Date (2007)</b>	<b>Borehole Termination Depth (m)</b>	<b>Stratum at Termination Depth</b>
HML-01	Northwest quadrant of Highway 401 and Hurontario Street interchange	October 3	5.7	Shale bedrock
HML-02	Southwest quadrant of Highway 401 and Hurontario Street interchange	October 22	6.1	Shale bedrock
HML-03	Northeast quadrant of Highway 401 and Hurontario Street interchange	October 5	10.4	Shale bedrock
HML-04	Southeast quadrant of Highway 401 and Hurontario Street interchange	September 17 and 24	11.0	Shale bedrock
HML-05	Highway 401 WB Collectors, approximate Station 19+672	September 28 and October 1	11.3	Shale bedrock

The approximate borehole locations are shown on the Borehole Location Drawings in Appendix E. The coordinates and elevations of the boreholes are given on these drawings and on the individual Record of Borehole Sheets in Appendix A.

The detailed subsurface soil and groundwater conditions encountered in the boreholes included in References 1 to 7 drilled in the interchange area and which are relevant to the HML locations, are presented on the Records of Boreholes in Appendix C.

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 Standard Penetration Testing (SPT). NQ rock coring equipment was used to recover core samples of the bedrock in the boreholes.

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.

All rock cores were logged, and the Total Core Recovery (TCR), Rock Quality Designation (RQD) and the Fracture Indices (FI) were determined.

Groundwater conditions in the open boreholes were observed throughout the drilling operations. Five standpipe piezometers consisting of 19 mm PVC pipes with screens were installed in the boreholes to permit monitoring of groundwater levels. Details of the piezometer installations and other borehole completion details are as shown in Table 3.2.

**Table 3.2 – Borehole Completion Details**

<b>Borehole</b>	<b>Piezometer Tip Depth/ Elevation (m)</b>	<b>Completion Details</b>
HML-01	5.7/185.5	Sand from 5.7 m to 3.7 m, bentonite grout to surface.
HML-02	6.1/184.1	Sand from 6.1 m to 4.0 m, bentonite grout to surface.
HML-03	10.4/182.1	Sand from 10.4 m to 8.5 m, bentonite grout to surface.
HML-04	11.0/181.1	Sand from 11.0 m to 9.1 m, bentonite grout to surface.
HML-05	11.1/186.3	Sand from 11.1 m to 9.2 m, bentonite grout to surface.

#### **4 LABORATORY TESTING**

All recovered soil and rock samples were subjected to Visual Identification (VI) and geological logging. Moisture content determinations were carried out on all soil samples. At least 25% of the recovered soil samples were also subjected to grain size distribution analyses (sieve and hydrometer) and Atterberg Limits testing where appropriate. The results of this testing program are presented 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, limestone and siltstone upon arrival at the laboratory to assist evaluation of the compressive strength of the bedrock. The results of point load tests on the selected rock core samples are shown on the Record of Borehole sheets and in Table 1, immediately following the text.

## **5 DESCRIPTION OF SUBSURFACE CONDITIONS**

This section presents a generalized summary of the subsurface conditions encountered at the borehole locations drilled specifically for the HML poles (Boreholes HML-01 to HML-05). Reference is made to the Records of Borehole sheets in Appendix A. Records of relevant Borehole Sheets from other recent investigations in the vicinity are included in Appendix C. Details of the encountered soil and rock stratigraphy are presented in these appendices. An overall description of the stratigraphy encountered in Boreholes HML-01 to HML-05 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 topsoil overlying fill which is underlain by native silty clay/clayey silt till deposits. Weathered shale bedrock was contacted below the till deposits. More detailed descriptions of the individual stratum are presented below.

### **5.1 Topsoil**

Topsoil was identified at ground surface in the boreholes, except in Borehole HML-02. The topsoil thickness generally ranged from 25 mm to 100 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**

Fill was encountered below the topsoil in Boreholes HML-01, HML-04 and HML-05. In Boreholes HML-04 and HML-05, the fill consists of brown silty clay containing trace to some sand, trace of gravel and occasional rootlets. In Borehole HML-01, the fill consists of reddish brown shale with trace of gravel. Thickness of the fill ranged from 0.6 m to 0.7 m.

Based on recorded SPT N-values ranging between 20 and 26 blows for 0.3 m of penetration, the silty clay fill is described as very stiff. An SPT N-value of 50 blows per 0.15 m penetration was observed within the shale fill, indicating a hard consistency.

The natural moisture contents of the fill samples obtained were approximately 17% in the clay fill and 3% in the shale fill.

The depth to the base of the fill ranged from 0.6 m to 0.8 m (Elevations 190.6 m to 196.6).

### **5.3 Silty Clay Till and Clayey Silt Till**

Deposits of native brown/reddish brown to grey silty clay till and clayey silt till with sand to some sand, trace of gravel, occasional rootlets and red shale fragments were contacted below the fill and topsoil in all the boreholes. Thickness of the till deposits ranged from 0.9 m to 6.5 m.



Based on SPT N-values ranging from 16 blows for 0.3 m of penetration to greater than 50 blows for 0.1 m of penetration, the silty clay till and clayey silt till are described as very stiff to hard.

The natural moisture contents of the samples recovered from the silty clay till and clayey silt till layers ranged from 8 to 21%.

Grain size distribution curves for the samples tested are presented on the Record of Borehole sheets and on Figures B1 and B2 of Appendix B. Atterberg Limit test results are presented on Figures B3 and B4 of Appendix B.

The results of laboratory gradation and Atterberg Limits tests are summarized as follows:

<b>Soil Particles</b>	<b>(%)</b>
Gravel	0 to 2
Sand	16 to 54
Silt	33 to 61
Clay	12 to 27

<b>Index Property</b>	<b>(%)</b>
Liquid Limit	20 to 32
Plastic Limit	12 to 17
Plasticity Index	8 to 15

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

The depth to the base of the till deposits ranged from 1.0 m to 6.7 m (Elevations 185.4 m to 193.7 m).

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 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 fine-grained, thinly bedded and contains numerous hard interbedded siltstone and limestone layers. The shale bedrock is typically highly weathered within the upper zone with the degree of weathering decreasing with depth. SPT N-values obtained in the upper part of the shale bedrock ranged from 80 blows per 0.3 m of penetration to greater than 100 blows per less than 0.3 m penetration. Moisture contents of disturbed shale samples ranged from 2 to 7%. Elevations of the top of bedrock are shown in Table 5.1.

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

<b>Borehole</b>	<b>Depth to Weathered Bedrock (m)</b>	<b>Top of Weathered Bedrock Elevation (m)</b>
HML-01*	1.5	189.6
HML-02*	1.0	189.2
HML-03*	6.6	186.0
HML-04*	6.7	185.4
HML-05*	3.7	193.7

\* Proved by coring below augered depth

The depth and elevation of shale bedrock in the other boreholes reported in References 1 to 7 which are relevant to the HML poles are presented in Table 5.2.

**Table 5.2 – Elevation of Top of Weathered Bedrock**

<b>Borehole</b>	<b>Depth to Weathered Bedrock (m)</b>	<b>Top of Weathered Bedrock Elevation (m)</b>
BW01	11.8*	189.9
BW02-07	10.8**	191.1
BW05	1.2	193.9
BW07	1.6*	191.6
BW10	4.0*	190.6
BW11	4.0*	188.6
BW12	4.1	190.0
H2	13.7	186.1
H6	11.7*	187.9
H7	-	-
H8	8.8	189.2
NAR08	5.5*	188.2
NAR15	4.3	190.1
RW1-1	1.5	188.3
RW1-2	0.6	190.1
RW2-1	0.8	189.5
RW2-2	1.2	189.8
RW3-1	1.5	189.4
RW3-2	3.1	190.1
C3-1	0.6	185.6
C3-2	0.6	184.4
C4-1	-	-
C4-2	-	-
C4-3	5.2	186.6
C4-4	5.5	185.2
HAR-15	7.3*	189.3
HAR-16	6.7	189.4
HAR18	5.8	189.2
RSE-17	4.0	187.3

\*Proved by coring below augered depth

\*\* Auger refusal

Bedrock cores were collected using NQ sized coring equipment. Total Core Recovery (TCR) in the bedrock ranged from 91% to 100% in most core runs, except in Borehole HML-05 Run 1 where the TCR was 23%.

The RQD values recorded for five of the core runs ranged from 57% to 100% indicating fair to excellent rock quality. Fracture Index (FI) of the rock, expressed as fractures per 0.3 m of core, ranged from 0 to greater than 10.

The results of Point Load tests conducted on rock layers/interbeds of intact core samples were as follows:

<b>Rock Type</b>	<b>Inferred Unconfined Compressive Strength (UCS) (MPa)</b>
Shale or shale/siltstone	3 to 27
Siltstone	40 to 85
Limestone	60 to 167

It must be noted, however, that point load tests were possible only on less weathered shale or higher strength limestone and siltstone interbed samples as the more typically weathered shale cores tended to be too weak for point load testing. Broken zones were observed within the cores at various depths.

The shale bedrock 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 approximately from 20 to 300 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.

## **5.5 Water Levels**

Water level was observed in the boreholes during and upon completion of drilling. Standpipe piezometers were installed in the five boreholes to monitor water levels after completion of drilling. The water levels measured in the piezometers are summarized in Table 5.3.

**Table 5.3 – Measured Groundwater Levels**

HML	Borehole	Date (2007)	Water Level (m)		Comment
			Depth	Elevation	
1	HML-1	October 5	2.0	189.2	In piezometer
		October 18	1.5	189.7	
		November 1	1.5	189.7	
		November 15	1.3	189.9	
2	HML-2	November 1	3.7	186.5	In piezometer
		November 15	3.9	186.3	
3	HML-3	October 18	1.3	191.2	In piezometer
		November 1	1.2	191.3	
		November 15	1.3	191.2	
4	HML-4	October 18	1.4	190.8	In piezometer
		November 1	1.0	191.2	
		November 15	1.1	191.0	
5	HML-5	October 5	3.0	194.4	In piezometer
		October 18	3.0	194.4	
		November 1	3.1	194.3	
		November 15	3.0	194.4	

The above table, indicates that the groundwater levels range from Elevations 186.3 m to 194.4 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 interbeds 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, interpretation of the field data and preparation of the investigation report was conducted by Mr. 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.

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**HIGH MAST LIGHTING POLES**  
**HWY 401 WIDENING, HWY 410 TO CREDIT RIVER**  
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**PART 2: ENGINEERING DISCUSSION AND RECOMMENDATIONS**

## **7 INTRODUCTION**

This section of the report presents foundation recommendations for the design of the proposed HML poles.

Information on the general layout of the proposed locations of the HML was provided to Thurber by MMM Group Limited. A total of eighteen (18) HML poles are proposed to be erected in the vicinity of the Highway 401/ Hurontario Street interchange. Based on the proposed design layout, Boreholes HML-01 to HML-05 (covered by this report) were drilled near some of the proposed HML locations. It was envisaged that these boreholes, in addition to other boreholes drilled for this project (References 1 to 7), would provide adequate subsurface information for detailed foundation design of the HML poles.

All relevant boreholes drilled in the vicinity of the 18 HML poles are included in Appendices A and C. Table 2 provides a listing of boreholes relevant to the design of each HML pole.

The discussion and recommendations presented in this report are based on Thurber's understanding of the project and on the factual data obtained in the course of this investigation.

## **8 FOUNDATION DESIGN PARAMETERS**

For design of the HML pole foundations, reference should be made to the following documents:

- Canadian Highway Bridge Design Code and Commentary (2006). CAN/CSA-S6-06 and S6.1-06.

It is understood that a typical HML pole is supported on a single conventional augered caisson (drilled shaft). Most of the caissons for the HML poles for this project will be embedded into shale bedrock. Table 2 presents the recommended foundation design parameters for the HML caisson foundations.

In order to take into account frost action and surficial disturbance, the ultimate lateral passive resistance in front of a caisson within the upper 1.2 m below final grade should be neglected in the foundation design. It is recommended that all topsoil and organics be neglected in determining lateral resistance.

Where downward sloping embankment fill or native soil exists in front of a caisson, reduction of lateral passive resistance should be taken into account during design. For foundation design at the caissons, it can be assumed that full lateral resistance can only be mobilized where the width of the soil in front of or behind the caisson is equal to or greater than approximately 4 times the diameter of the caissons. For sloping ground in front of a caisson, the magnitude of the mobilized passive resistance can be estimated by interpolating between zero passive resistance at the level where the slope face intersects the pile, and full passive resistance at the level where the slope face is equal to or greater than 4 times the diameter of the caisson.

Where an unconfined compressive strength,  $q_u$ , ( $q_u = 2 \times C_u$ , undrained shear strength) is provided for a cohesive soil (silty clay till and clayey silt till), the ultimate lateral passive resistance should be calculated in conjunction with the total soil unit weight. When designing for portions of the caissons below the groundwater level in cohesionless soils (sands, silts and weathered shale), the submerged soil unit weight,  $\gamma'$ , should be used. The required depth of the drilled shaft will be governed by lateral loads, including wind loads, acting on the pole. The length of the caisson should also be sufficient to counteract frost jacking (upward) forces.

There is currently no design requirement for regrading around the new high mast lighting poles. Should placement of new fill be required, it is recommended that the parameters for new compacted fill as presented in Table 2 be used.

An equivalent caisson width equal to 2 times the caisson diameter may be assumed for lateral resistance calculations. Appropriate load and resistance factors should be applied for caisson design.

## **9 CAISSON INSTALLATION**

Caisson installation should generally be carried out in accordance with SP 903S01.

The contract documents should contain an NSSP alerting the contract bidders of the specific aspects relating to caisson construction for HML pole foundations at this site. Suggested wordings for this NSSP are provided in Appendix D.

Cobbles, boulders and other obstructions may be present in the glacial till and fill. Caisson installation equipment must be able to dislodge, handle and remove cobbles and boulders, and to penetrate hard rock slabs, limestone or siltstone interbeds. The shale generally becomes harder with depth below the upper weathered zone.

It must be noted that the depth to the top of weathered shale bedrock is variable across the site and may be encountered at a higher elevation than that shown in the borehole logs. Contractor's caisson installation equipment must be capable of drilling/coring through the bedrock to the design depth of the caisson.

Groundwater levels are at relatively shallow depth below existing ground surface. Soil sloughing and water seepage may also occur in unsupported holes. Temporary liners should be available to support the caisson sidewalls and provide seepage cut-off where required.

## **10 CONSTRUCTION CONCERNS**

Concerns during caisson construction mainly involve the handling and removal of cobbles or boulders, drilling through the shale, penetrating hard zones of rock slabs and limestone interbeds, soil sloughing and water seepage from caisson sidewalls. Recommendations on how to address these issues have been outlined in the previous section.

## **11 CONSTRUCTION INSPECTION AND TESTING**

Caisson construction should be monitored by qualified geotechnical personnel (as per SP 903S01) to verify the soil and rock conditions and to confirm that those conditions are consistent with the design assumptions in this report.

## **12 CLOSURE**

Engineering analysis and preparation of the foundation design report was conducted by Dr. Sydney Pang, P.Eng. and Ms. R. Palomeque Reyna, P.Eng. The report was reviewed by Dr. P. K. Chatteriji, P.Eng., a Designated Principal Contact for MTO Foundations Projects.



THURBER ENGINEERING LTD.

Rocío Palomeque Reyna, P.Eng.  
Geotechnical Engineer



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



P.K. Chatterji, P.Eng.  
Review Principal



**TABLE 1 -Point Load Results**  
Highway 401 Widening – High Mast Lighting Poles

HML-1	DEPTH			Is (MPa)	Is50 (MPa)	UCS (Mpa)	Rock Type	UC Test Average			
	FT.	IN.	(m)								
RUN #1	9	5	2.87	0.000	0.000	3.00	shale, siltstone	RUN #1:			
	10	6	3.20	0.000	0.000	3.00	shale		AVERAGE	MAX	MIN
	11	10	3.61	0.428	0.463	11.12	shale, siltstone	Shale	3.0	3.0	3.0
	13	10	4.22	0.000	0.000	3.00	shale, siltstone	Siltstone	39.6	39.6	39.6
	9	9	2.97	1.812	1.651	39.62	siltstone	Shale/Siltstone	5.7	11.1	3.0
RUN #2								Limestone			
	14	4	4.37	0.000	0.000	3.00	shale, siltstone	RUN #2:			
	15	1	4.60	1.984	2.572	61.72	limestone	Shale			
	16	5	5.00	0.234	0.279	6.71	shale, siltstone	Siltstone			
	17	4	5.28	0.000	0.000	3.00	shale, siltstone	Shale/Siltstone	4.2	6.7	3.0
	18	6	5.64	1.332	1.604	38.49	limestone	Limestone	50.1	61.7	38.5
								SUMMARY	AVERAGE	MAX	MIN
								Shale	3.0	3.0	3.0
								Siltstone	39.6	39.6	39.6
								Shale/Siltstone	5.0	11.1	3.0
								Limestone	50.1	61.7	38.5

HML-2	DEPTH			Is (MPa)	Is50 (MPa)	UCS (Mpa)	Rock Type	UC Test Average			
	FT.	IN.	(m)								
RUN #1	12	1	3.68	4.613	3.725	89.40	limestone	RUN #1:			
	13	2	4.01	0.677	0.672	16.14	limestone		AVERAGE	MAX	MIN
	14	9	4.50	0.000	0.000	3.00	shale, siltstone	Shale			
								Siltstone			
RUN #2								Shale/Siltstone	3.0	3.0	3.0
								Limestone	52.8	89.4	16.1
	14	4	4.37	0.000	0.000	3.00	shale, siltstone	RUN #2:			
	15	1	4.60	1.984	2.572	61.72	limestone	Shale			
	16	5	5.00	0.234	0.279	6.71	shale, siltstone	Siltstone			
	17	4	5.28	0.000	0.000	3.00	shale, siltstone	Shale/Siltstone	4.2	6.7	3.0
	18	6	5.64	1.332	1.604	38.49	limestone	Limestone	50.1	61.7	38.5
								SUMMARY	AVERAGE	MAX	MIN
								Shale			
								Siltstone			
								Shale/Siltstone	3.9	6.7	3.0
								Limestone	51.4	89.4	16.1

**TABLE 1 -Point Load Results**  
Highway 401 Widening – High Mast Lighting Poles

HML-3	DEPTH			Is (MPa)	Is50 (MPa)	UCS (Mpa)	Rock Type	UC Test Average			
	FT.	IN.	(m)								
RUN #1	24	10	7.57	7.890	6.968	167.23	limestone	RUN #1:	AVERAGE	MAX	MIN
	25	5	7.75	0.000	0.000	3.00	shale				
	26	6	8.08	0.000	0.000	3.00	shale				
	27	8	8.43	0.563	0.531	12.75	shale, siltstone				
	28	10	8.79	2.200	2.200	52.80	siltstone				
RUN #2								Shale	3.0	3.0	3.0
								Siltstone	52.8	52.8	52.8
								Shale/Siltstone	12.8	12.8	12.8
								Limestone	167.2	167.2	167.2
RUN #1	29	9	9.07	3.140	3.294	79.05	limestone	RUN #2:	AVERAGE	MAX	MIN
	30	5	9.27	0.000	0.000	3.00	shale				
	31	4	9.55	0.444	0.472	11.32	shale, siltstone				
	32	11	10.03	0.477	0.565	13.56	shale, siltstone				
	33	5	10.19	2.778	3.043	73.03	limestone				
RUN #2	33	7	10.24	0.778	1.157	27.76	limestone	SUMMARY	AVERAGE	MAX	MIN
								Shale	3.0	3.0	3.0
								Siltstone	52.8	52.8	52.8
								Shale/Siltstone	12.5	13.6	11.3
								Limestone	86.8	167.2	27.8

HML-4	DEPTH			Is (MPa)	Is50 (MPa)	UCS (Mpa)	Rock Type	UC Test Average			
	FT.	IN.	(m)								
RUN #1	27	10	8.48	0.331	0.333	7.98	shale, siltstone	RUN #1:	AVERAGE	MAX	MIN
	29	2	8.89	0.770	0.949	22.77	shale, siltstone				
	31	0	9.45	0.000	0.000	3.00	shale				
RUN #2								Shale	3.0	3.0	3.0
								Siltstone			
								Shale/Siltstone	15.4	22.8	22.8
								Limestone			
RUN #1	32	4	9.86	1.093	1.131	27.14	shale, siltstone	RUN #2:	AVERAGE	MAX	MIN
	33	3	10.13	0.393	0.363	8.70	shale				
	34	1	10.39	1.063	1.115	26.77	shale				
	34	9	10.59	3.109	3.531	84.75	siltstone				
	35	10	10.92	2.571	2.931	70.35	siltstone				
RUN #2								SUMMARY	AVERAGE	MAX	MIN
								Shale	12.8	26.8	3.0
								Siltstone	77.5	84.7	70.3
								Shale/Siltstone	19.3	27.1	8.0
								Limestone			

**TABLE 1 -Point Load Results**  
Highway 401 Widening – High Mast Lighting Poles

HML-5	DEPTH			Is (MPa)	Is50 (MPa)	UCS (Mpa)	Rock Type	UC Test Average			
	FT.	IN.	(m)								
RUN #1	27	10	8.48	0.000	0.000	3.00	shale	RUN #1:	AVERAGE	MAX	MIN
	28	9	8.76	0.000	0.000	3.00	shale, siltstone				
	29	11	9.12	0.643	0.733	17.59	shale, siltstone				
	30	9	9.37	2.522	3.079	73.90	limestone				
								Shale			
								Siltstone			
								Shale/Siltstone	10.3	17.6	3.0
								Limestone	73.9	73.9	73.9
RUN #2	32	11	10.03	0.696	0.763	18.31	shale, siltstone	RUN #2:	AVERAGE	MAX	MIN
	34	0	10.36	0.000	0.000	3.00	shale, siltstone				
	34	11	10.64	0.000	0.000	3.00	shale				
	35	10	10.92	0.658	0.741	17.79	shale, siltstone				
	36	10	11.23	0.590	0.544	13.05	shale, siltstone				
	33	2	10.11	3.125	2.795	67.08	limestone				
								SUMMARY			
								Shale	3.0	3.0	3.0
								Siltstone			
								Shale/Siltstone	12.1	18.3	3.0
								Limestone	70.5	73.9	67.1

**TABLE 2**  
**GEOTECHNICAL DESIGN PARAMETERS**  
**HIGH MAST LIGHTING POLES**  
**Highway 401 Widening – High Mast Lighting Poles**

HML Pole Number and Location	Reference Borehole <sup>1</sup>	Recommended Subsurface Stratigraphy For Design	Depth Below Existing Ground Surface (m)	Geotechnical Design Parameters					
				q <sub>u</sub> (kPa)	φ' (deg.)	γ (kN/m <sup>3</sup> )	γ' (kN/m <sup>3</sup> )	K <sub>p</sub>	Groundwater Depth (m) (below existing ground surface)
<u>P-10-8-40</u>  Northwest quadrant of Highway 401 and Hurontario Street interchange	NAR08 NAR15	Silty Clay (FILL) (Firm to very stiff)	0.0 – 1.5	50	-	19	-	-	1.0
		Silt and Sand Till (Dense to Very dense)	1.5 – 2.7	-	32	21	11	3.2	
		Sandy Silt (Very dense)	2.7 – 4.7						
		Silty Clay Till (Hard)	4.7 – 5.5	160	-	21	11	-	
		SHALE (weathered) SHALE	5.5 – 7.5 7.5 – 9.5	- 800	40 -	23 24	13 -	4.6 -	
<u>P-9-10-40</u>  Northwest quadrant of Highway 401 and Hurontario Street interchange	HML-01 RW2-2 RW2-3	Silty Clay (FILL) (Hard to very stiff)	0.0 – 1.5	100	-	19	-	-	1.3
		Shale (FILL)	1.5 – 3.0	-	30	20	10	3.0	
		Silty Clay Till (Hard)	3.0 – 3.7	200	-	21	11	-	
		SHALE (weathered)	3.7 – 6.1	-	40	23	13	4.6	

## Highway 401 Widening – High Mast Lighting Poles

HML Pole Number and Location	Reference Borehole <sup>1</sup>	Recommended Subsurface Stratigraphy For Design	Depth Below Existing Ground Surface (m)	Geotechnical Design Parameters					
				$q_u$ (kPa)	$\phi'$ (deg.)	$\gamma$ (kN/m <sup>3</sup> )	$\gamma'$ (kN/m <sup>3</sup> )	$K_p$	Groundwater Depth (m) (below existing ground surface)
P-8-10-40 Northwest quadrant of Highway 401 and Hurontario Street interchange	HML-01 RW1-1 RW1-2 RW2-1	Silty Clay (FILL) (Hard)	0.0 – 0.8	100	-	21	-	-	1.0
		Clayey Silt Till (Very Stiff)	0.8 – 1.5	150	-	20	10	-	
		SHALE (weathered)	1.5 – 3.0	-	40	23	13	4.6	
		SHALE	3.0 – 5.7	800	-	24	-	-	
P-14-10-40 Southwest quadrant of Highway 401 and Hurontario Street interchange	HML-02	Silty Clay Till (Very stiff)	0.0 – 1.0	160	-	20	-	-	3.5
		SHALE (weathered)	1.0 – 3.7	-	40	23	13	4.6	
		SHALE	3.7 – 6.1	800	-	24	-	-	

## Highway 401 Widening – High Mast Lighting Poles

HML Pole Number and Location	Reference Borehole <sup>1</sup>	Recommended Subsurface Stratigraphy For Design	Depth Below Existing Ground Surface (m)	Geotechnical Design Parameters					
				$q_u$ (kPa)	$\phi'$ (deg.)	$\gamma$ (kN/m <sup>3</sup> )	$\gamma'$ (kN/m <sup>3</sup> )	$K_p$	Groundwater Depth (m) (below existing ground surface)
P-15-10-40  Southwest quadrant of Highway 401 and Hurontario Street interchange	H8 RW3-1 RW3-2	Silty Clay (FILL) (Firm to very stiff)	0.0 – 1.5	60	-	20	-	-	2.7
			1.5 – 7.0	100	-	20	10	-	
		Silty Clay Till (Hard)	7.0 – 8.8	200	-	21	11	-	
		SHALE (weathered)	8.8 – 9.4	-	40	23	13	4.6	
P-11-12-40  Northeast quadrant of Highway 401 and Hurontario Street interchange	HML-03 H2 H7	Gravelly Sand (FILL) (Very dense)	0.0 – 1.5	-	30	20	10	3.0	1.3
		Silty Clay (FILL) (Very stiff to hard)	1.5 – 9.4	100	-	21	11	-	
		Silty Clay Till (Hard)	9.4 – 13.7	200	-	21	11	-	
		SHALE (weathered)	13.7 – 15.3	-	40	23	13	4.6	

## Highway 401 Widening – High Mast Lighting Poles

HML Pole Number and Location	Reference Borehole <sup>1</sup>	Recommended Subsurface Stratigraphy For Design	Depth Below Existing Ground Surface (m)	Geotechnical Design Parameters					
				$q_0$ (kPa)	$\phi'$ (deg.)	$\gamma$ (kN/m <sup>3</sup> )	$\gamma'$ (kN/m <sup>3</sup> )	$K_p$	Groundwater Depth (m) (below existing ground surface)
<u>P-12-10-40</u> Northeast quadrant of Highway 401 and Hurontario Street interchange	HML-03	Silty Clay Till (Very stiff to hard)	0.0 – 4.6	160	-	21	11	-	1.3
		Clayey Silt Till (Hard)	4.6 – 6.1	200	-	21	11	-	
		Silty Clay Till (Hard)	6.1 – 6.6						
		SHALE (weathered)	6.6 – 8.8	-	40	23	13	4.6	
		SHALE	8.8 – 10.4	800	-	24	-	-	
<u>P-16-8-40</u> Southeast quadrant of Highway 401 and Hurontario Street interchange	HAR 15 HAR 16 HAR 18 RSE17	Sand/Gravel/Clay/Shale (FILL) (Very dense/hard)	0.0 – 4.6	-	30	20	10	3.0	4.0
		Silty Clay Till (Hard)	4.6 – 7.3	200	-	21	11	-	
		SHALE (weathered)	7.3 – 10.1	-	40	23	13	4.6	
		SHALE	10.1 – 11.6	800	-	24	-	-	



## Highway 401 Widening – High Mast Lighting Poles

HML Pole Number and Location	Reference Borehole <sup>1</sup>	Recommended Subsurface Stratigraphy For Design	Depth Below Existing Ground Surface (m)	Geotechnical Design Parameters					
				$q_u$ (kPa)	$\phi'$ (deg.)	$\gamma$ (kN/m <sup>3</sup> )	$\gamma'$ (kN/m <sup>3</sup> )	$K_p$	Groundwater Depth (m) (below existing ground surface)
<u>P-17-10-40</u> Southeast quadrant of Highway 401 and Hurontario Street interchange	HML-04 H6 C4-3 C4-4	Sand/Gravel/Silt (FILL) (Dense)	0.0 – 1.5	-	30	20	10	3.0	0.7
		Silty Clay (FILL) (Stiff to very stiff)	1.5 – 8.5	100	-	19	9	-	
		Silty Clay Till (Hard)	8.5 – 11.7	200	-	21	11	-	
		SHALE (weathered) SHALE	11.7 – 13.7 13.7 – 16.8	- 800	40 -	23 24	13 -	4.6 -	
<u>P-18-10-40</u> Southeast quadrant of Highway 401 and Hurontario Street interchange	HML-04	Silty Clay (FILL) (Very stiff)	0.0 – 0.7	100	-	20	-	-	1.0
		Silty Clay Till/Clayey Silt Till (Hard)	0.7 – 6.7	200	-	21	11	-	
		SHALE (weathered) SHALE	6.7 – 8.5 8.5 – 11.0	- 800	40 -	23 24	13 -	4.6 -	

## Highway 401 Widening – High Mast Lighting Poles

HML Pole Number and Location	Reference Borehole <sup>1</sup>	Recommended Subsurface Stratigraphy For Design	Depth Below Existing Ground Surface (m)	Geotechnical Design Parameters					
				$q_u$ (kPa)	$\phi'$ (deg.)	$\gamma$ (kN/m <sup>3</sup> )	$\gamma'$ (kN/m <sup>3</sup> )	$K_p$	Groundwater Depth (m) (below existing ground surface)
P-19-6-35 Highway 401 WB Collectors, approximate Station 19+300	HML-05	Silty Clay (FILL) (Very stiff)	0.0 – 0.8	100	-	20	-	-	3.0
		Clayey Silt Till (Hard)	0.8 – 3.7	200	-	21	-	-	
		SHALE (weathered)	3.7 – 8.4	-	40	23	13	4.6	
		SHALE	8.4 – 11.3	800	-	24	-	-	
P-13-10-40 P-20-8-35 Highway 401 Median									
P-21-8-35 Highway 401 WB Collectors, approximate Station 19+625	BW01 BW02-07	Silty Clay/Silt/Shale (FILL) (Stiff to very stiff/very dense)	0.0 – 9.8	-	30	20	10	3.0	2.0
		Sand till (Very dense)	9.8 – 11.8	-	34	21	11	3.5	
		SHALE (weathered)	11.8 – 13.8	-	40	23	13	4.6	
		SHALE	13.8 – 17.0	800	-	24	-	-	
P-22-8-35 Highway 401 Median									

## Highway 401 Widening – High Mast Lighting Poles

HML Pole Number and Location	Reference Borehole <sup>1</sup>	Recommended Subsurface Stratigraphy For Design	Depth Below Existing Ground Surface (m)	Geotechnical Design Parameters					
				$q_u$ (kPa)	$\phi'$ (deg.)	$\gamma$ (kN/m <sup>3</sup> )	$\gamma'$ (kN/m <sup>3</sup> )	$K_p$	Groundwater Depth (m) (below existing ground surface)
P-23-8-35 Highway 401 WB Collectors, approximate Station 19+625	BW05 BW07	Silty Clay (FILL) (Firm)	0.0 – 0.6	50	-	19	-	-	0.3
		Silty Clay (Very stiff)	0.6 – 1.6	100	-	20	10	-	
		SHALE (weathered)	1.6 – 6.7	-	40	23	13	4.6	
P-24-10-35 Highway 401 Median	BW10 BW11 BW12	Silty Clay (FILL) (Firm)	0.0 – 0.8	50	-	19	-	-	1.0
		Sandy Silt (FILL) (Compact)	0.8 – 1.5	-	30	20	10	3.0	
		Silty Clay (FILL) (Firm)	1.5 – 2.3	50	-	19	9	-	
		Silty Clay (Stiff to Very stiff)	2.3 – 4.1	80	-	20	10	-	
Approx. Station 20+080		SHALE (weathered)	4.1 – 4.8	-	40	23	13	4.6	

## Highway 401 Widening – High Mast Lighting Poles

HML Pole Number and Location	Reference Borehole	Recommended Subsurface Stratigraphy For Design	Depth Below Existing Ground Surface (m)	Geotechnical Design Parameters					
				$q_u$ (kPa)	$\phi'$ (deg.)	$\gamma$ (kN/m <sup>3</sup> )	$\gamma'$ (kN/m <sup>3</sup> )	$K_p$	Groundwater Depth (m) (below existing ground surface)
All Locations	-	New Fill - SSM (see Note 4)	Variable height above original ground	-	30	20	-	3.0	Below base of new fill

NOTES:

1. Refer to Records of Boreholes for details.
2. This table must be read in conjunction with the text of this report.
3. In order to take into account frost action and surficial disturbance, the ultimate lateral passive resistance in front of the caisson within the upper 1.2 m below final grade should be neglected in the foundation design.
4. It is possible that new fill may be placed as part of the Highway 401/Hurontario Street reconstruction. It is therefore anticipated that some caissons may be partially embedded within new fill.

LEGEND:

- $q_u$  = Unconfined Compressive Strength ( $= 2 \times C_u$ , undrained shear strength) (kPa)  
 $\phi'$  = Angle of Internal Friction (degrees)  
 $\gamma$  = Soil Unit Weight (kN/m<sup>3</sup>)  
 $\gamma'$  = Submerged Soil Unit Weight (kN/m<sup>3</sup>)

**Appendix A**

**Record of Borehole Sheets**

**(HML 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			

# RECORD OF BOREHOLE No HML-01

1 OF 1

METRIC

G.W.P. 2107-05-00 LOCATION NW Quadrant of HWY 401 & Hurontario St. Int., N 4 832 243.630 E 289 771.988 ORIGINATED BY GA  
 HWY 401 BOREHOLE TYPE Solid Stem Augers/NQ Coring COMPILED BY ES  
 DATUM Geodetic DATE 2007-03-10 - 2007-03-10 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					
191.2								20 40 60 80 100					
191.2	TOPSOIL: (25mm)		1	SS	50/		191						
190.6	SHALE, trace gravel, hard, reddish brown, moist (FILL)				.150								
0.6	Clayey SILT with sand, trace gravel Very Stiff Brown (TILL)		2	SS	28		190						1 35 47 17
189.6			3	SS	50/								
1.5	SHALE, highly to moderately weathered, thinly bedded, reddish brown, with green-grey siltstone and grey limestone interbeds		4	SS	0/		189						
					.000								
	Coring started at 2.7m Horizontal joint at 2.84, 2.92, 3.02, 3.33, 3.38, 3.94, 4.17, and 4.11m Green-grey siltstone interbeds at 2.74 to 2.79m, 2.90, 3.05, 3.30, 3.40, 3.45, 3.66, 4.14 and 4.19m Highly broken zones at 3.96 to 4.14 and 2.79 to 2.87m		1	RUN			188						RUN 1# TCR=100%, SCR=70%, RQD=57%, UCS=6MPa (Shale/Siltstone) UCS = 39 MPa (Siltstone)
	Moderately to slightly weathered Green-grey siltstone interbeds at 4.39, 4.45 to 4.47, 4.52 to 4.57, 5.18 and 5.38m Limestone interbeds at 4.62 to 4.70, 4.93 to 4.95, 5.23 to 5.28 and 5.64 to 5.69m Horizontal joints at 5.23, 5.28, 5.38 and 5.44m		2	RUN			187						RUN 2# TCR=100%, SCR=92%, RQD=94%, UCS=4MPa (Shale/Siltstone) UCS = 50 MPa (Limestone)
185.5							186						
5.7	END OF BOREHOLE AT 5.69m. BOREHOLE OPEN UPON COMPLETION. Piezometer installation consists of 19mm diameter schedule 40 PVC pipe. WATER LEVEL READINGS: DATE DEPTH(m) ELEV.(m) Oct 05/07 2.0 189.2 Oct 18/07 1.5 189.7 Nov 01/07 1.5 189.7 Nov 15/07 1.3 189.9												



# RECORD OF BOREHOLE No HML-02

1 OF 1

METRIC

G.W.P. 2107-05-00 LOCATION SW Quadrant of HWY 401 & Hurontario St. Int., N 4 832 097.475 E 289 804.136 ORIGINATED BY VS  
 HWY 401 BOREHOLE TYPE Solid Stem Augers/NQ Coring COMPILED BY ES  
 DATUM Geodetic DATE 2007-10-22 - 2007-10-22 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									
190.2								20	40	60	80	100					
0.0	Silty CLAY, some sand, trace gravel Very Stiff Brown (TILL)		1	SS	25		190										2 19 52 27
189.2			2	SS	26												
1.0	SHALE, highly weathered, thinly to very thinly bedded, reddish brown, with green-grey siltstone and grey limestone interbeds		3	SS	80		189										
			4	SS	82		188										
	Slightly weathered to fresh Coring started at 3.1m Siltstone interbeds at 3.12 to 3.15, 3.40 to 3.45, 3.91 to 3.94 and 4.47 to 4.52m Highly broken zones at 3.05 to 3.40m Limestone interbeds at 3.61, 3.68 and 3.96 to 4.04m		1	RUN			187										RUN 1# TCR=91%, SCR=83%, RQD=83% UCS = 3 MPa (Shale/Siltstone) UCS = 53 MPa (Limestone)
	Fresh, thinly bedded  Siltstone interbeds at 5.33 to 5.41, 5.44, 5.46, 5.54, 5.64 to 5.66 and 5.89 to 5.92m Limestone interbeds at 4.75, 4.80, 5.21, 5.72 to 5.79, 5.84 and 5.94 to 6.25m		2	RUN			186										RUN 2# TCR=100%, SCR=100%, RQD=100% UCS = 4 MPa (Shale/Siltstone) UCS = 50 MPa (Limestone)
184.1							185										
6.1	END OF BOREHOLE AT 6.1m. Piezometer installation consists of 19mm diameter schedule 40 PVC pipe. WATER LEVEL READINGS: DATE    DEPTH (m)    ELEV. (m) Nov 01/07    3.7        186.5 Nov 15/07    3.9        186.3																

# RECORD OF BOREHOLE No HML-03

1 OF 2

METRIC

G.W.P. 2107-05-00 LOCATION NE Quadrant of HWY 401 & Hurontario St. Int., N 4 832 357.348 E 290 008.800 ORIGINATED BY GA  
 HWY 401 BOREHOLE TYPE Solid Stem Augers/NQ Coring COMPILED BY ES  
 DATUM Geodetic DATE 2007-10-05 - 2007-10-05 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					
192.5							20 40 60 80 100	PLASTIC LIMIT w <sub>p</sub>		NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>		
0.0							20 40 60 80 100	○ UNCONFINED		+ FIELD VANE			
0.1	TOPSOIL: (100mm)							● QUICK TRIAXIAL		x LAB VANE	WATER CONTENT (%)		
	Silty CLAY, some sand, occasional rootlets Very stiff Brown to mottled brown-grey (TILL)		1	SS	20								
			2	SS	16								
			3	SS	17								
			4	SS	26								
	Hard Occasional iron oxidized stains		5	SS	50/ 150								0 16 61 23
188.0													
4.6	Clayey SILT with sand, trace gravel Hard Brown to grey (TILL)		6	SS	69/ 150								1 31 68 (SI+CL)
186.4													
6.1	Silty CLAY, trace to some sand, trace gravel Hard Grey to reddish brown (TILL)		7	SS	152								
186.0													
6.6	SHALE, highly weathered, thinly bedded, reddish brown, with limestone and green-grey siltstone interbeds, occasional clay seams Coring started at 7.3m Highly broken zones at 7.31 to 7.59 and 7.67 to 7.72m Limestone interbeds at 7.47 and 7.59 to 7.62m Green-grey siltstone interbeds at 7.39, 7.57, 7.70 to 7.77, 8.03, 8.46 to 8.51, 8.56, 8.61, 8.69 to 8.71 and 8.79 to 8.84m Horizontal joints at 8.26, 8.28 and 8.33m Clay seams at 7.72 and 8.38m Limestone interbeds at 9.07 to 9.12, 10.21 to 10.26 and 10.31 to 10.36m Green-grey siltstone interbeds at 8.86 to 8.89, 9.02, 9.04, 9.19, 9.22, 9.40, 9.47, 9.53 to 9.58, 9.75, 9.80, 9.86, 9.91 to 9.96, 10.01 to 10.06 and		1	RUN									FI >10 5 0 0 0 0 0 0 0
			2	RUN									RUN 1# TCR=100%, SCR=70%, ROD=66%, UCS=3MPa Average (Shale) UCS = 12 MPa (Shale/Siltstone) UCS = 52 MPa (Siltstone) UCS = 167 MPa (Limestone) RUN 2# TCR=100%, SCR=100%, ROD=100%, UCS=3MPa Average (Shale) UCS = 12 MPa (Shale/Siltstone)

Continued Next Page

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

20  
15  
10

(%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No HML-03

2 OF 2

METRIC

G.W.P. 2107-05-00 LOCATION NE Quadrant of HWY 401 & Hurontario St. Int., N 4 832 357.348 E 290 008.800 ORIGINATED BY GA  
 HWY 401 BOREHOLE TYPE Solid Stem Augers/NQ Coring COMPILED BY ES  
 DATUM Geodetic DATE 2007-10-05 - 2007-10-05 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									
							20	40	60	80	100	W <sub>p</sub>	W	W <sub>L</sub>			
	Continued From Previous Page																
182.2	10.19m Horizontal joints at 9.45 and 9.70 to															0	GR SA SI CL UCS = 60 MPa (Limestone)
10.4	9.73m  END OF BOREHOLE AT 10.36m. BOREHOLE OPEN UPON COMPLETION. Piezometer installation consists of 19mm diameter schedule PVC pipe. WATER LEVEL READINGS: DATE DEPTH(m) ELEV.(m) Oct 18/07 1.3 191.2 Nov 01/07 1.2 191.3 Nov 15/07 1.3 191.2						182										

ONTMT4S 2311 GPJ 3/6/08

# RECORD OF BOREHOLE No HML-04

1 OF 2

METRIC

G.W.P. 2107-05-00 LOCATION SE Quadrant of HWY 401 & Hurontario St. Int., N 4 832 240.061 E 290 085.531 ORIGINATED BY GA  
 HWY 401 BOREHOLE TYPE Solid Stem Augers/NQ Coring COMPILED BY MFA  
 DATUM Geodetic DATE 2007-09-17 - 2007-09-24 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				
								WATER CONTENT (%)				
192.1												
0.0												
0.1	TOPSOIL: (75mm)											
	Silty CLAY, trace to some sand, trace gravel, occasional rootlets		1	SS	26							
191.5	Very Stiff											
0.7	Brown (FILL)											
	Silty CLAY, trace to some sand, trace gravel		2	SS	32							
	Hard											
	Brown											
	(TILL)											
	Occasional iron oxidized stains		3	SS	64							
			4	SS	89							
			5	SS	101							
	Brown to Reddish Brown		6	SS	113							
186.4												
5.8	Clayey SILT with sand, some shale fragments											
	Hard											
	Reddish Brown											
	(TILL)		7	SS	105							
185.4												
6.7	SHALE, highly weathered, thinly bedded, reddish brown, with green-grey siltstone interbeds, occasional limestone interbeds, and occasional clay seams											
			8	SS	50/ 000							



# RECORD OF BOREHOLE No HML-05

1 OF 2

METRIC

G.W.P. 2107-05-00 LOCATION Highway 401 WB Collector, N 4 832 548.750 E 290 380.492 ORIGINATED BY GA  
 HWY 401 BOREHOLE TYPE Solid Stem Augers/NQ Coring COMPILED BY ES  
 DATUM Geodetic DATE 2007-09-28 - 2007-10-01 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 (%)
197.4								20	40	60	80	100					
0.0	TOPSOIL: (100mm)							○ UNCONFINED	+	FIELD VANE							
0.1	Silty CLAY, some sand, some gravel, occasional rootlets Very stiff		1	SS	20		197	● QUICK TRIAXIAL	x	LAB VANE							
196.6	Brown (FILL)																
0.8	Clayey SILT with sand, trace gravel Hard Brown to reddish brown (TILL)		2	SS	56		196										
			3	SS	47											2	38 44 16
			4	SS	50/ .150		195										
	Iron oxidized stains		5	SS	50/ .100		194									1	54 33 12
193.7	Boulder (350mm)																
3.7	Coring started at 3.7m SHALE, highly to slightly weathered, thinly bedded, reddish brown, with grey limestone and green-grey siltstone interbeds  Augering to 8.1m depth without coring/sampling		1	RUN			193										RUN 1# TCR=23%, SCR=23%, RQD=23% Average UCS = 10 MPa (Shale/Siltstone) UCS = 73 MPa (Limestone)
							192										
							191										
							190										
							189									FI	
							188									2	RUN 2# TCR=100%, SCR=83%, RQD=67% Average UCS = 3 MPa (Shale) UCS = 12 MPa (Shale/Siltstone) UCS = 70 MPa (Limestone)
	Siltstone interbeds at 8.79, 8.84, 9.04, 9.14, 9.17, 9.27 to 9.30 and 9.68 to 9.73m Limestone interbeds at 8.99 and 9.37 to 9.45m Highly broken zones at 8.64 to 8.76m		2	RUN												>5	
																1	
																1	
																0	
	Slightly weathered to fresh															0	RUN 3# TCR=100%

Continued Next Page

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

RECORD OF BOREHOLE No HML-05

2 OF 2

METRIC

G.W.P. 2107-05-00 LOCATION Highway 401 WB Collector, N 4 832 548.750 E 290 380.492 ORIGINATED BY GA  
 HWY 401 BOREHOLE TYPE Solid Stem Augers/NQ Coring COMPILED BY ES  
 DATUM Geodetic DATE 2007-09-28 - 2007-10-01 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 (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100	W <sub>p</sub>	W	W <sub>L</sub>		
	Continued From Previous Page																
186.1	Siltstone interbeds at 9.78, 9.88, 10.01, 10.16, 10.41, 10.44, 10.92, 10.97 and 11.15 to 11.23m Limestone interbeds at 9.80 to 9.83, 10.11 and 10.31m		3	RUN												GR SA SI CL	
11.3	END OF BOREHOLE AT 11.28m. Piezometer installation consists of 19mm diameter schedule PVC pipe with a 1.52m slotted screen. WATER LEVEL READINGS: DATE      DEPTH (m)      ELEV. (m) Oct 05/07      3.0      194.4 Oct 18/07      3.0      194.4 Nov 01/07      3.1      194.3 Nov 15/07      3.0      194.4																

## **Appendix B**

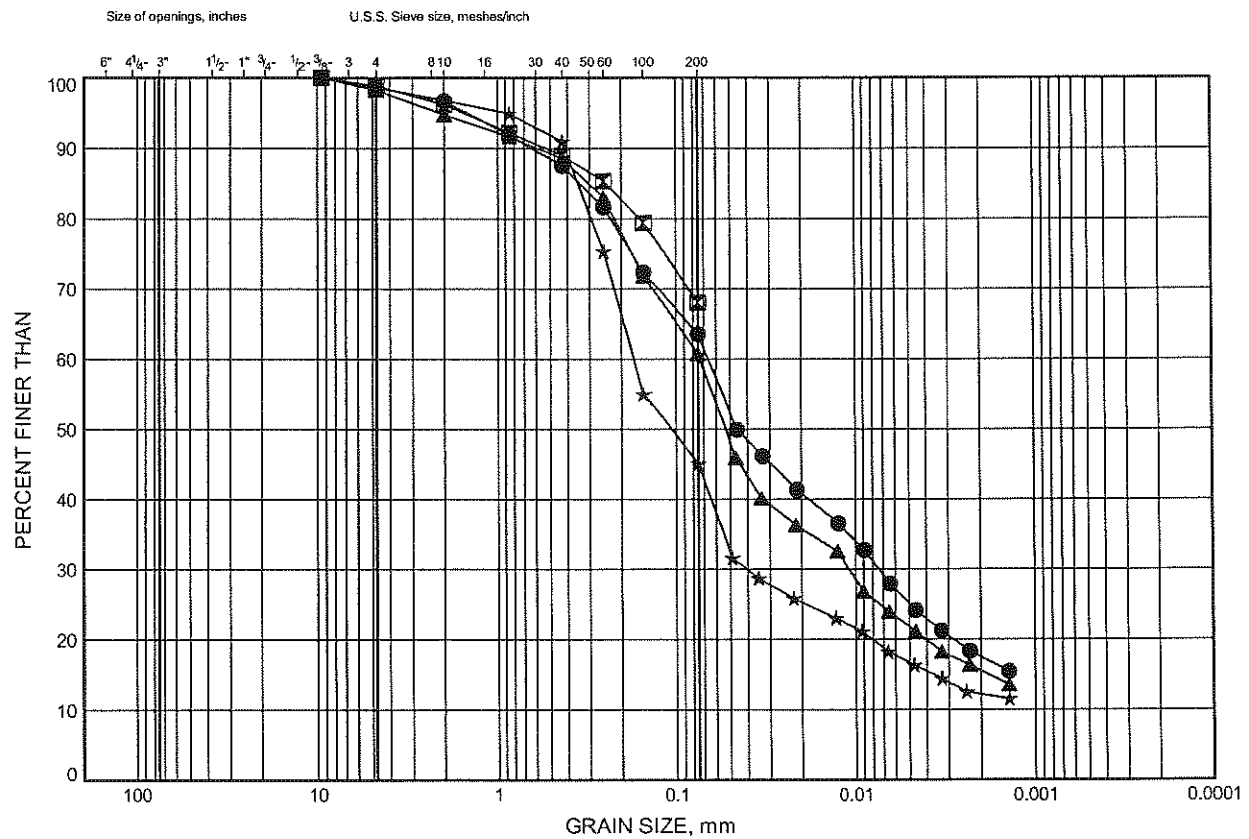
### **Laboratory Test Results**



# Hwy 401/410 to Credit River GRAIN SIZE DISTRIBUTION

FIGURE B1

## Clayey Silt with Sand

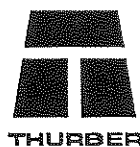


COBBLE SIZE	COARSE	FINE	COARSE	MEDIUM	FINE	SILT and CLAY
	GRAVEL		SAND			FINE GRAINED

SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	HML-01	1.07	190.10
⊠	HML-03	4.72	187.80
▲	HML-05	1.83	195.55
★	HML-05	3.35	194.03

Date January 2008

Project 2107-05-00



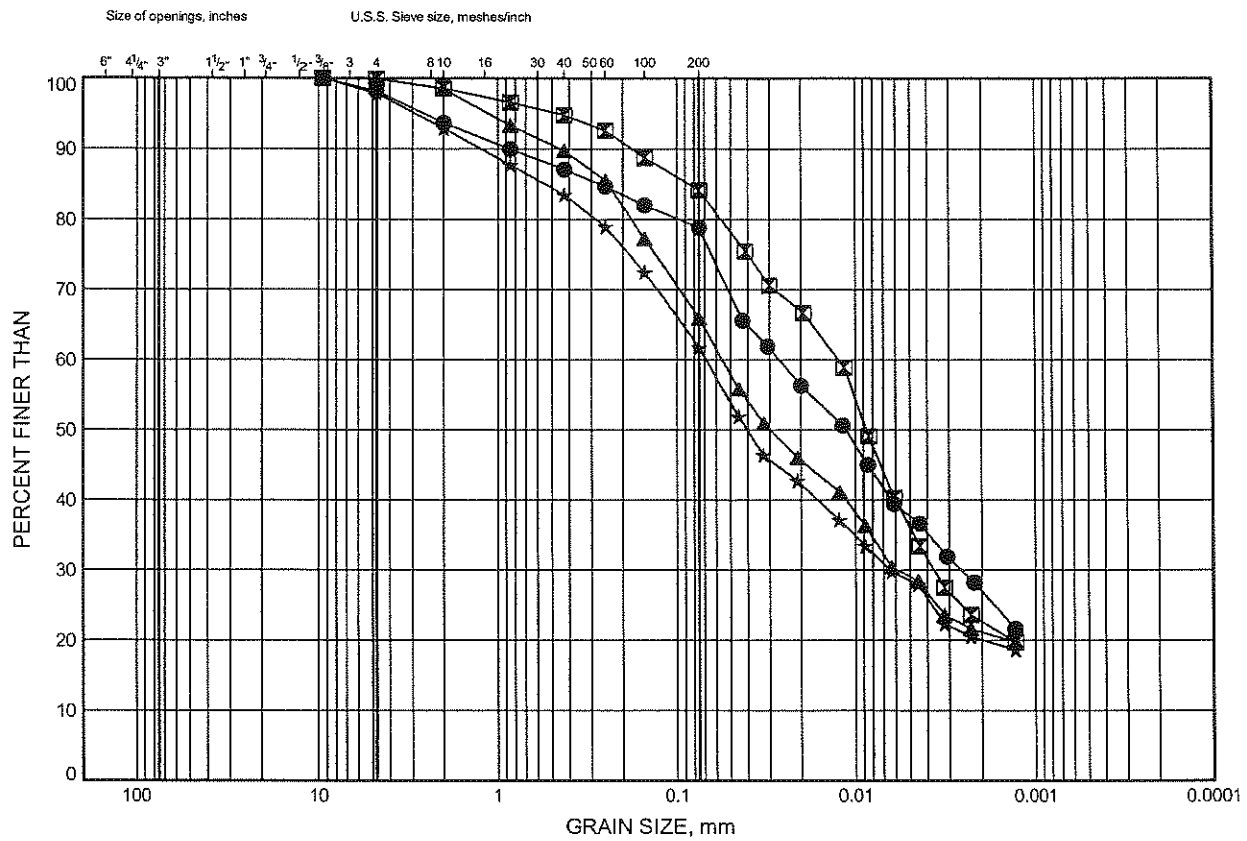
Prep'd MFA

Chkd. RPR

# Hwy 401/410 to Credit River GRAIN SIZE DISTRIBUTION

FIGURE B2

## Silty Clay Till

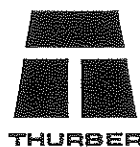


COBBLE SIZE	COARSE	FINE	COARSE	MEDIUM	FINE	SILT and CLAY
	GRAVEL		SAND			FINE GRAINED

SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	HML-02	0.30	189.94
⊠	HML-03	2.59	189.94
▲	HML-04	1.83	190.32
★	HML-04	3.35	188.80

Date January 2008

Project 2107-05-00



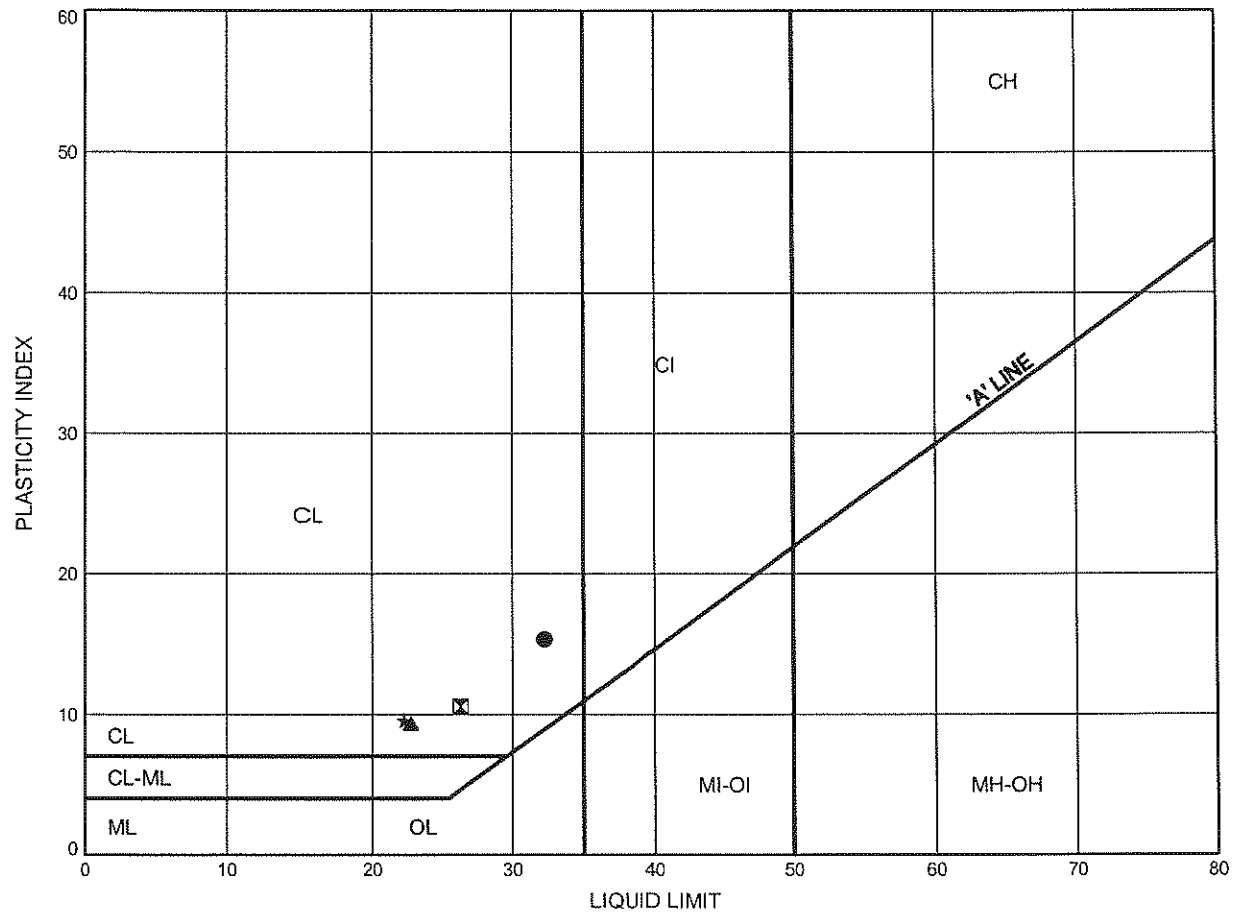
Prep'd MFA

Chkd. RPR

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

FIGURE B3

Silty Clay Till



SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	HML-02	0.30	189.94
⊠	HML-03	2.59	189.94
▲	HML-04	1.83	190.32
★	HML-04	3.35	188.80

Date January 2008

Project 2107-05-00



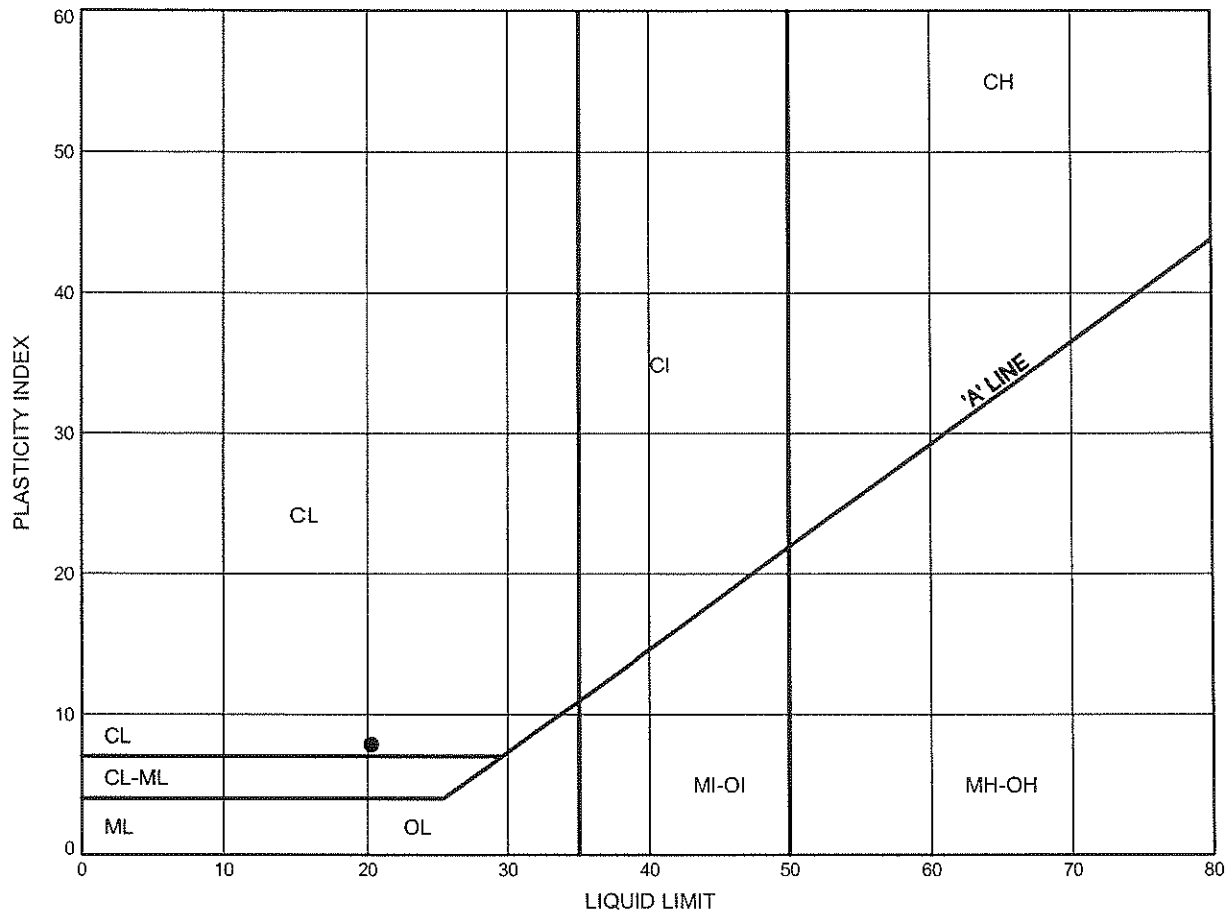
Prep'd MFA

Chkd. RPR

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

FIGURE B4

Clayey Silt with Sand



SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	HML-05	1.83	195.55

Date January 2008

Project 2107-05-00



Prep'd MFA

Chkd. RPR

**Appendix C**  
**Record of Borehole Sheets**  
**(Adjacent Structure Investigations)**

# 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					WATER CONTENT (%)		
								20	40	60			80	100	20
201.7															
8.8	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	Sandy SILT, trace gravel and clay Very Dense Brown Moist (FILL)		6	SS	55										
192.8	reddish brown SHALE, with grey limestone layers (FILL)		7	SS	50/ .125										
191.9	Coring started at 9.52m														
9.8	SAND, some gravel, trace silt,														

Continued Next Page

+ 3 x 3: Numbers refer to  
Sensitivity

20  
15 5  
10 (%) 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

HWY 401

BOREHOLE TYPE

Solid Stem Augers/NO Coring

ORIGINATED BY SLL

DATUM Geodetic

DATE

2006-10-26 - 2006-10-27

COMPILED BY MFA

CHECKED BY RPR

## SOIL PROFILE

## SAMPLES

## DYNAMIC CONE PENETRATION RESISTANCE PLOT

20 40 60 80 100  
SHEAR STRENGTH kPa  
○ UNCONFINED + FIELD VANE  
● QUICK TRIAXIAL x LAB VANE  
20 40 60 80 100

PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT  
W<sub>P</sub> W W<sub>L</sub>  
WATER CONTENT (%)  
20 40 60

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

GROUND WATER CONDITIONS

ELEVATION SCALE

189.9

11.8

Continued From Previous Page  
SAND, some gravel, trace silt, occasional cobbles  
Very Dense  
Grey  
Moist to Wet (TILL)

Highly weathered, thinly bedded, very weak, reddish brown, SHALE, with grey limestone layers

8

SS

50/

100

191

9

SS

74

190

1

RUN

189

2

RUN

188

3

RUN

187

186

185

FI

8

9

5

4

6

4

>10

2

RUN 1#  
TCR=77%,  
SCR=63%,  
RQD=37%,  
UCS=53MPa

RUN 2#  
TCR=100%,  
SCR=97%,  
RQD=23%,  
UCS=3MPa

RUN 3#  
TCR=100%,  
SCR=94%,  
RQD=54%,  
UCS=3MPa

END OF BOREHOLE AT 17.00 m.  
BOREHOLE GROUTED WITH BENTONITE TO SURFACE.

184.7

17.0

+<sup>3</sup>, x<sup>3</sup>: 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					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						
201.9								20 40 60 80 100						
0.0	Silty CLAY, with shale and limestone fragments Stiff Brown / Grey (WEATHERED SHALE FILL)							○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE						
			1	SS	11									
			2	SS	14									
	Becoming Very Stiff		3	SS	21									
			4	SS	52									
	Becoming Hard		5	SS	62/ 225									
196.0								20 40 60 80 100						
5.9	END OF BOREHOLE AT 5.94 m. BOREHOLE GROUTED WITH BENTONITE TO SURFACE.							20 40 60 80 100						

+ 3 . x 3 : Numbers refer to  
Sensitivity

20  
15 5  
10 (%) 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			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							
201.9								20 40 60 80 100							
0.0	SAND, GRAVEL and SILTY CLAY, with shale and limestone fragments Brown / Grey (FILL)							○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE							GR SA SI CL
	* Refer to Borehole BW02 for details of fill layer.							20 40 60 80 100							

Continued Next Page

+ 3 . × 3 : Numbers refer to  
Sensitivity

20  
15 10 5  
(%) 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 Stern 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

20 40 60 80 100

SHEAR STRENGTH kPa

○ UNCONFINED + FIELD VANE

● QUICK TRIAXIAL × LAB VANE

20 40 60 80 100

PLASTIC  
LIMIT

NATURAL  
MOISTURE  
CONTENT

LIQUID  
LIMIT

W<sub>P</sub>

W

W<sub>L</sub>

WATER CONTENT (%)

20 40 60

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

Continued From Previous Page

SILT, trace to some sand  
Very Dense  
Grey  
Moist to wet  
(TILL)

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.

191.1

10.8

4

SS

100/

150

191

# 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				UNIT WEIGHT γ 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		
195.1	TOPSOIL: (150 mm)												
0.0	Silty CLAY, occasional sand layer Firm Brown		1	SS	4		195						
194.5													
0.6	Sandy SILT, trace clay, trace rootlets Compact Brown Moist		2	SS	22		194						
193.9													
1.2	Highly weathered, thinly bedded, very weak, reddish brown, SHALE, with grey limestone layers		3	SS	48		193						
			4	SS	50/ .075								
							192						
191.5			5	SS	62								
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												

+<sup>3</sup> . X<sup>3</sup> : 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

HWY 401

BOREHOLE TYPE

Solid Stem Augers

ORIGINATED BY SLL

DATUM Geodetic

DATE

2006-10-24 - 2006-10-25

COMPILED BY MFA

CHECKED BY RPR

## SOIL PROFILE

## SAMPLES

## GROUND WATER

## DYNAMIC CONE PENETRATION RESISTANCE PLOT

## SHEAR STRENGTH kPa

○ UNCONFINED + FIELD VANE  
● QUICK TRIAXIAL × LAB VANE

PLASTIC LIMIT  
NATURAL MOISTURE CONTENT  
LIQUID LIMIT  
W<sub>P</sub> — W — W<sub>L</sub>  
WATER CONTENT (%)

UNIT WEIGHT  
γ  
kN/m<sup>3</sup>

REMARKS &  
GRAIN SIZE  
DISTRIBUTION  
(%)  
GR SA SI CL

ELEV  
DEPTH  
DESCRIPTION

STRAT PLOT

NUMBER  
TYPE  
"N" VALUES

GROUND WATER  
CONDITIONS

ELEVATION SCALE

20 40 60 80 100  
20 40 60 80 100

20 40 60  
20 40 60

193.2  
0.0  
0.2  
192.6  
0.6  
191.6

193  
192  
191  
190  
189  
188  
187

TOPSOIL: (150 mm)

Silly CLAY, mixed with topsoil, trace roots  
Firm  
Brown  
(FILL)

Silly CLAY, some sand, trace gravel  
Very Stiff  
Brown

Highly weathered, thinly bedded, very weak, reddish brown, SHALE, with grey limestone layers  
Limestone interbed at 2.08m to 2.13m  
Coring started at 2.1m

Limestone interbed at 3.61m to 3.71m

Limestone interbeds at  
5.20m to 5.30m, 6.28m to 6.30m,  
6.35m to 6.37m

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

RUN 1#  
TCR=20%,  
SCR=15%,  
RQD=0%,  
UCS=3MPa

RUN 2#  
TCR=80%,  
SCR=53%,  
RQD=0%,  
UCS=51MPa

RUN 3#  
TCR=100%,  
SCR=90%,  
RQD=7%,  
UCS=29MPa

# 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			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							
194.5															
0.1	TOPSOIL: (50 mm)		1	SS	24		194								
	Sandy SILT, gravelly, trace to some clay Compact to Loose Grey to Brown Moist (FILL)		2	SS	7										
193.0							193								
1.5	Silty CLAY, some sand, trace gravel, some black staining Very Stiff Brown (FILL)		3	SS	26										
192.2							192								
2.3	Silty CLAY, trace sand, occasional oxide staining Stiff to Very Stiff Mottled grey-brown (Cl)		4	SS	11										
			5	SS	26		191								
190.6							190								
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			189								
			2	RUN			188								
186.8							187								
7.7	END OF BOREHOLE AT 7.72 m. BOREHOLE GROUTED TO SURFACE.														

# 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			20 40 60 80 100	20 40 60 80 100					
192.6	TOPSOIL: (75 mm)		1	SS	4		192							
0.0 0.1	Silty CLAY, some sand, trace rootlets, occasional black staining Soft to Stiff (FILL)		2	SS	8		191							
191.1	Silty CLAY, some sand, trace gravel, trace rootlets Very Stiff Brown		3	SS	15		190							
190.3	Silty CLAY, some sand, trace gravel Hard Brown (TILL)		4	SS	34		189							
2.3			5	SS	66/ 125		188							
188.6	Highly weathered, thinly bedded, very weak, reddish brown, SHALE		6	SS	50/ .075		187							
4.0	Coring started at 4.67m  Clay seam at 4.93m to 5.00m		1	RUN			186							
			2	RUN			185							
184.9	END OF BOREHOLE AT 7.72 m. Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen.													
7.7	WATER LEVEL READINGS: DATE DEPTH(m) ELEV.(m) 29/01/07 1.0 191.6													

+ 3, x 3, 20  
Sensitivity 15 5  
10 (%) 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					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		
194.1	TOPSOIL: (50 mm)						194							
0.0	Silty CLAY, some sand, trace rootlets Firm Dark Brown (FILL)		1	SS	5									
193.4														
0.8	Sandy SILT, trace gravel Compact Brown Moist (FILL)		2	SS	20		193							
192.6														
1.5	Silty CLAY, trace sand, trace gravel, trace rootlets Firm Mottled brown-grey (FILL)		3	SS	6		192							
191.9														
2.3	Silty CLAY, trace sand Stiff to Very Stiff Mottled brown-grey (CI)		4	SS	12		191							
			5	SS	18									
190.0							190							
4.1	Highly weathered, thinly bedded, very weak, reddish brown, SHALE													
189.3			6	SS	50/									
4.8	END OF BOREHOLE AT 4.81 m. BOREHOLE BACKFILLED WITH HOLEPLUG.				.075									

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

### METRIC

CHECKED BY RPR

(%) STRAIN AT FAILURE



# RECORD OF BOREHOLE No H2

2 OF 2

METRIC

G.W.P. 2149-01-00 & 2150-01-00 LOCATION Proposed Hurontario St. Underpass N 4 832 276.4 E 289 882.0 ORIGINATED BY GA/JHL  
 HWY 401 BOREHOLE TYPE Solid Stem Augers COMPILED BY JHL  
 DATUM Geodetic DATE 2006-10-30 - 2006-11-03 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													
							○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT w <sub>p</sub> w w <sub>L</sub> WATER CONTENT (%)									
							20 40 60 80 100					20 40 60									
Continued From Previous Page																					
Silty CLAY, some sand, trace gravel, occasional siltstone and limestone fragments Hard Grey (TILL)																					
							10 SS 50/														

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

# RECORD OF BOREHOLE No H6

1 OF 2

METRIC

G.W.P. 2149-01-00 & 2150-01-00 LOCATION Proposed Hurontario St. Underpass N 4 832 190.6 E 289 977.1 ORIGINATED BY GA  
 HWY 401 BOREHOLE TYPE Solid Stem Augers/NQ Coring COMPILED BY JHL  
 DATUM Geodetic DATE 2006-11-06 - 2006-11-07 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					
199.7							20	40	60	80	100		
0.0	ASPHALT: (150 mm)												
0.2	SAND AND GRAVEL Dense Brown Moist (FILL)		1	SS	32								
198.9													
0.8	Sandy SILT, trace gravel, occasional shale fragments Dense Brown (FILL)		2	SS	32								
198.1													
1.5	Silty CLAY, some sand to sandy, trace gravel Stiff to Very Stiff Reddish Brown (FILL)		3	SS	12								
			4	SS	16								1 28 47 24
			5	SS	13								
			6	SS	10								
			7	SS	15								
			8	SS	45								
	occasional asphalt fragments Hard												
191.1													
8.5	Silty CLAY, some sand, trace gravel Hard Brown (TILL)		9	SS	57								1 32 46 21

Continued Next Page

+ 3 x 3 Numbers refer to  
Sensitivity

20  
15 5  
10 (%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No H6

2 OF 2

METRIC

G.W.P. 2149-01-00 & 2150-01-00 LOCATION Proposed Hurontario St. Underpass N 4 832 190.6 E 289 977.1 ORIGINATED BY GA  
 HWY 401 BOREHOLE TYPE Solid Stem Augers/NQ Coring COMPILED BY JHL  
 DATUM Geodetic DATE 2006-11-06 - 2006-11-07 CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100					
	Continued From Previous Page																
187.9	Silty CLAY, some sand, trace gravel Hard Brown (TILL)		10	SS	144		189										
11.7	SHALE, highly to moderately weathered, thinly bedded, reddish brown, grey limestone layers		11	SS	106		188										
							187										
			12	SS	100/		186										
					.125												
	Rubble zones from 14.10m to 14.14m, 14.53m to 14.56m																
	Limestone interbeds at 14.51m to 14.56m, 14.68m to 14.71m, 14.75m to 14.80m, 14.99m to 15.04m		1	RUN			185										
	Limestone interbeds at 15.73m to 15.80m, 16.00m to 16.05m		2	RUN			184										
182.8							183										
16.8	END OF BOREHOLE AT 16.84 m. BOREHOLE OPEN TO BOTTOM UPON COMPLETION. Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen.  WATER LEVEL READINGS: DATE DEPTH(m) ELEV.(m) 14.11.06 7.1 192.6																

ONTMT4S 2311.GPJ 3/4/08

# RECORD OF BOREHOLE No H7

1 OF 1

METRIC

G.W.P. 2149-01-00 & 2150-01-00 LOCATION Proposed Hurontario St. Underpass N 4 832 287.0 E 289 859.4 ORIGINATED BY JHL  
 HWY 401 BOREHOLE TYPE Solid Stem Augers COMPILED BY JHL  
 DATUM Geodetic DATE 2006-10-31 - 2006-10-31 CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT W <sub>P</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT  γ  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)  GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED    + FIELD VANE ● QUICK TRIAXIAL    × LAB VANE								WATER CONTENT (%)
199.2 0.0 0.1	ASPHALT: (100 mm)  SAND, trace silt Very Dense Brown Moist (FILL)		1	SS	56	199										
198.3 0.9	Silty CLAY, some sand, trace gravel, occasional shale fragments Firm to Hard Brown (FILL)		2	SS	56											
			3	SS	18		198									
			4	SS	21											
	occasional rock fragments Becoming Reddish Brown to Brown		5	SS	8		197									
			6	SS	11											
193.1 6.1	Silty CLAY, some sand, trace gravel Stiff to Very Siff Grey (TILL)		7	SS	14		193									
			8	SS	28											
191.1 8.1	END OF BOREHOLE AT 8.08 m. BOREHOLE GROUTED WITH BENTONITE TO SURFACE. WATER NOT OBSERVED IN BOREHOLE UPON COMPLETION OF DRILLING.															

ONTMT4S 2311.GPJ 3/4/08

ONTMT4S 2311.GPJ 3/4/08

# RECORD OF BOREHOLE No H8

1 OF 2

METRIC

G.W.P. 2149-01-00 & 2150-01-00 LOCATION Proposed Hurontario St. Underpass N 4 832 133.0 E 289 989.3 ORIGINATED BY GA  
 HWY 401 BOREHOLE TYPE Solid Stem Augers COMPILED BY JHL  
 DATUM Geodetic DATE 2006-11-09 - 2006-11-09 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						
198.0								20 40 60 80 100						
0.0	TOPSOIL: (225 mm)						198							
0.2	Silty CLAY, some sand, some asphalt fragments, organics and rootlets Firm to Very Stiff Brown to Reddish Brown (FILL)		1	SS	8									
			2	SS	7		197							
			3	SS	15		196							
			4	SS	14		195							
			5	SS	10		194							
			6	SS	11		193							0 27 46 27
			7	SS	20		192							
191.0							191							
7.0	Silty CLAY, some sand, trace gravel Hard Brown (TILL)		8	SS	42		190							6 21 46 27
189.2							189							
8.8	SHALE, highly weathered, thinly bedded, reddish brown, grey limestone layers		9	SS	106									
188.6														
9.4	END OF BOREHOLE AT 9.45 m. BOREHOLE OPEN AND DRY TO BOTTOM UPON COMPLETION.													

Continued Next Page

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

20  
15  
10

(%) STRAIN AT FAILURE

## METRIC

CHECKED BY RPR

+ 3, X 3: Numbers refer to Sensitivity

# RECORD OF BOREHOLE No RW1-1

1 OF 1

METRIC

G.W.P. 2107-05-00 LOCATION Hurontario St. North - HWY 401 West Ramp, N 4 832 167.797 E 289 673.658 ORIGINATED BY GA  
 HWY 401 BOREHOLE TYPE Solid Stem Augers COMPILED BY ES  
 DATUM Geodetic DATE 2007-10-04 - 2007-10-04 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								
189.8								20	40	60	80	100				
0.0	TOPSOIL: (75mm)		1	SS	37											
0.1	Silty CLAY, trace sand, trace shale fragments, occasional rootlets															
189.0	Hard															
0.8	Reddish brown (FILL)		2	SS	17											1 26 53 20
	Silty CLAY, some sand, trace gravel, occasional shale fragments															
188.3	Very stiff															
1.5	Brown to reddish brown (TILL)		3	SS	50/ .150											
	SHALE, highly weathered, fine grained, thinly bedded, reddish brown															
	Occasional green siltstones		4	SS	100/ .125											
186.7																
3.0	END OF BOREHOLE AT 3.05m. AUGER REFUSAL ON PROBABLE LIMESTONE LAYER. BOREHOLE OPEN AND DRY TO BOTTOM UPON COMPLETION. Piezometer installation consists of 19mm diameter schedule PVC pipe. WATER LEVEL READINGS: DATE DEPTH(m) ELEV.(m) Oct 18/07 1.4 188.4 Nov 01/07 0.9 188.9 Nov 15/07 1.3 188.5															

# RECORD OF BOREHOLE No RW1-2

1 OF 1

METRIC

G.W.P. 2107-05-00 LOCATION Hurontario St. North - HWY 401 West Ramp, N 4 832 201.428 E 289 703.136 ORIGINATED BY GA  
 HWY 401 BOREHOLE TYPE Solid Stem Augers COMPILED BY ES  
 DATUM Geodetic DATE 2007-10-04 - 2007-10-04 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						
190.7							20	40	60	80	100			
0.0	TOPSOIL: (50mm)		1	SS	34									
190.1	Silty CLAY, trace to some sand, trace gravel, occasional rootlets													
0.6	Hard		2	SS	50/									
	Brown to reddish brown (TILL)				.075									
	SHALE, highly weathered, fine grained, thinly bedded, reddish brown		3	SS	100/									
					.150									
	Moderate to slightly weathered, 50mm thick limestone layer		4	SS	100/									
					.125									
			5	SS	100/									
					.075									
187.0														
3.7	END OF BOREHOLE AT 3.66m. AUGER REFUSAL ON PROBABLE LIMESTONE LAYER. BOREHOLE OPEN AND DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO SURFACE.													



# RECORD OF BOREHOLE No RW2-1

1 OF 1

METRIC

G.W.P. 2107-05-00 LOCATION Northwest Quadrant of HWY 401 & Hurontario St., N 4 832 206.495 E 289 756.121 ORIGINATED BY GA  
 HWY 401 BOREHOLE TYPE Solid Stem Augers COMPILED BY ES  
 DATUM Geodetic DATE 2007-10-03 - 2007-10-03 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 ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE				WATER CONTENT (%) w <sub>p</sub> w w <sub>L</sub>				
190.3								20	40	60	80	100				
0.0	TOPSOIL: (75mm)		1	SS	20		190									
0.1	Silty CLAY, some sand, trace gravel, occasional rootlets Very stiff Brown															
189.5	(TILL)		2	SS	50/ .150											
0.8	SHALE, highly to moderately weathered, fine grained, thinly bedded, reddish brown		3	SS	100/ .150		189									
	Occasional green siltstone interbeds		4	SS	100/ .150		188									
			5	SS	50/ .000		187									
186.6																
3.7	END OF BOREHOLE AT 3.66m. AUGER REFUSAL ON PROBABLE LIMESTONE LAYER. BOREHOLE OPEN AND DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO SURFACE.															

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

20  
15 5  
10 (%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No RW2-2

1 OF 1

METRIC

G.W.P. 2107-05-00 LOCATION Northwest Quadrant of HWY 401 & Hurontario St., N 4 832 232.272 E 289 800.127 ORIGINATED BY GA  
 HWY 401 BOREHOLE TYPE Solid Stem Augers COMPILED BY ES  
 DATUM Geodetic DATE 2007-10-03 - 2007-10-03 CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT      NATURAL LIMIT                  MOISTURE CONTENT      LIQUID 	
--------------	--	--	---------	--	--	----------------------------	-----------------	---	--	--	--

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

# RECORD OF BOREHOLE No RW2-3

1 OF 1

METRIC

G.W.P. 2107-05-00 LOCATION Northwest Quadrant of HWY 401 & Hurontario St., N 4 832 256.327 E 289 842.838 ORIGINATED BY GA  
 HWY 401 BOREHOLE TYPE Solid Stem Augers COMPILED BY ES  
 DATUM Geodetic DATE 2007-03-10 - 2007-03-10 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										
								WATER CONTENT (%)										
194.9							20	40	60	80	100	PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	GR	SA	SI	CL
0.0	TOPSOIL: (75mm)																	
0.1	Silty CLAY, trace to some sand, trace gravel, occasional rootlets Hard to Very Stiff Brown to Mottled Grey and Brown (FILL)		1	SS	48													
			2	SS	23													
193.3																		
1.5	SHALE, highly weathered, thinly bedded, reddish brown (FILL)		3	SS	8													
			4	SS	20													
191.9																		
3.0	Silty CLAY, some sand, trace gravel, occasional rootlets Hard Dark grey (TILL)		5	SS	71													
191.2																		
3.7	SHALE, highly weathered, fine grained, thinly bedded, reddish brown		6	SS	100/ .125													
188.8																		
6.1	END OF BOREHOLE AT 6.10m. AUGER REFUSAL ON PROBABLE LIMESTONE LAYER. BOREHOLE OPEN AND DRY UPON COMPLETION. Piezometer installation consists of 19mm diameter schedule PVC pipe. WATER LEVEL READINGS: DATE DEPTH(m) ELEV.(m) Oct 05/07 5.0 189.9 Oct 18/07 2.8 192.1 Nov 01/07 2.9 192.0 Nov 15/07 2.7 192.2																	

# RECORD OF BOREHOLE No RW3-1

1 OF 1

METRIC

G.W.P. 2107-05-00 LOCATION Hurontario St. South Access Road N 4 832 020.551 E 289 930.652 ORIGINATED BY GA  
 HWY 401 BOREHOLE TYPE Solid Stem Augers COMPILED BY ES  
 DATUM Geodetic DATE 2007-11-10 - 2007-11-10 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									
190.9								20	40	60	80	100					
0.0	TOPSOIL: (100mm)							○ UNCONFINED	+	FIELD VANE							
0.1	Silty CLAY, some sand, occasional rootlets Very Stiff to Hard Brown (FILL)		1	SS	16			● QUICK TRIAXIAL	x	LAB VANE							
			2	SS	50/ .100												
189.4																	
1.5	Highly to moderately weathered, thinly bedded, reddish brown SHALE		3	SS	42												
			4	SS	50/ .150												
			5	SS	109												
	Grinding at 3.66m to 4.27m		6	SS	100/ .150												
185.4																	
5.5	END OF BOREHOLE AT 5.49m UPON AUGER REFUSAL. BOREHOLE OPEN AND DRY UPON COMPLETION. Piezometer installation consists of 19mm diameter schedule PVC pipe. WATER LEVEL READINGS: DATE      DEPTH(m)    ELEV.(m) Oct 18/07    Dry           - Nov 15/07    2.7            188.2																

# RECORD OF BOREHOLE No RW3-2

1 OF 1

METRIC

G.W.P. 2107-05-00 LOCATION Hurontario St. South Access Road N 4 832 040.894 E 289 977.204 ORIGINATED BY CA  
 HWY 401 BOREHOLE TYPE Solid Stem Augers COMPILED BY ES  
 DATUM Geodetic DATE 2007-11-10 - 2007-11-10 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							
193.2 0.0 0.1	TOPSOIL: (100mm)  Silty CLAY, with sand, trace gravel, occasional rootlets Very Stiff Brown (FILL)  oxidized stains Brown to Grey		1	SS	27		193								1 31 44 24
			2	SS	20		192								
			3	SS	15		191								
			4	SS	19		190								
			5	SS	50/ .075		189								
190.1 3.1	Highly weathered, thinly bedded, reddish brown SHALE		6	SS	100/ .150		188								
			7	SS	100/ .125		187								
			8	SS	100/ .100		186								
							185								
184.3 8.9	END OF BOREHOLE AT 8.89m UPON AUGER REFUSAL. BOREHOLE OPEN AND DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO SURFACE.														

ONTMT4S 2311.GPJ 2/5/08

# RECORD OF BOREHOLE No NAR08

1 OF 2

METRIC

G.W.P. 2107-05-00 LOCATION Proposed North Access Road/N-W Ramp N 4 832 324.6 E 289 752.5 ORIGINATED BY GA  
 HWY 401 BOREHOLE TYPE Solid Stem Augers/NO Coring COMPILED BY MFA  
 DATUM Geodetic DATE 2006-10-17 - 2006-10-17 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 (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					
								20 40 60 80 100					
								20 40 60 80 100					
193.7													
0.0	TOPSOIL: (100 mm)												
0.1	Silty CLAY, some sand, trace gravel, occasional rootlets Firm to Very Stiff Mottled Brown to Grey (FILL)		1	SS	6								
			2	SS	24								
192.1													
1.5	SAND and SILT, some clay, trace gravel Dense to Very Dense Brown Moist (TILL)		3	SS	43								
			4	SS	50/ .150								4 36 47 13
190.9													
2.7	Sandy SILT, trace clay Very Dense Brown Moist  becoming Grey		5	SS	50/ .150								0 27 69 4
188.9			6	SS	80								
4.7	Silty CLAY, trace sand, trace gravel, occasional shale fragments Hard Reddish Brown (TILL)												
188.2													
5.5	SHALE, highly to moderately weathered, fine grained, thinly bedded, reddish brown, with frequent rubble zones and limestone interbeds  Rubble zone from 6.43m to 6.74m  Limestone interbeds at 6.76m to 6.79m, 7.52m to 7.55m  Moderately to slightly weathered Limestone interbeds at 7.77m to 7.89m, 8.28m to 8.33m, 8.72m to 8.77m, 8.92m to 9.07m, 9.14m to 9.17m, 9.24m to 9.30m		7	SS	50/ .150							F1 >10 >10 5 5 4 5 5 3 2 1	RUN 1# TCR=100%, SCR=75%, ROD=22%          RUN 2# TCR=100%, SCR=97%, ROD=53%
184.4													
9.3	END OF BOREHOLE AT 9.30m. BOREHOLE OPEN TO BOTTOM UPON COMPLETION.												

Continued Next Page

+ 3 . x 3 Numbers refer to  
Sensitivity

20  
15  
10

(%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No NAR08

2 OF 2

METRIC

G.W.P. 2107-05-00 LOCATION Proposed North Access Road/N-W Ramp N 4 832 324.6 E 289 752.5 ORIGINATED BY GA  
 HWY 401 BOREHOLE TYPE Solid Stem Augers/NQ Coring COMPILED BY MFA  
 DATUM Geodetic DATE 2006-10-17 - 2006-10-17 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 (%)					
	Continued From Previous Page													
	Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen.  WATER LEVEL READINGS: DATE DEPTH(m) ELEV.(m) 08.12.06 0.80 192.8 29.01.07 0.70 193.0 01.11.07 5.89 187.8													

ONTMT4S 2311.GPJ 2/25/08

# RECORD OF BOREHOLE No NAR15

1 OF 1

METRIC

G.W.P. 2107-05-00 LOCATION Proposed North Access Road/N-W Ramp N 4 832 342.5 E 289 748.0 ORIGINATED BY GA  
 HWY 401 BOREHOLE TYPE Solid Stem Augers COMPILED BY ES  
 DATUM Geodetic DATE 2007-10-02 - 2007-10-02 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					
194.3								20 40 60 80 100					
0.0	TOPSOIL 0.08m												
0.1													
193.9	SAND, some gravel, trace silt, trace clay, some gravel, occasional rootlets Very Dense Brown Moist (FILL)		1	SS	84		194						
0.5													
192.8	Silty CLAY, trace to some sand, trace gravel Hard Mottled Brown/Reddish Brown (FILL)		2	SS	54		193						
1.5													
	Silty CLAY, with sand, trace gravel Hard Brown (TILL)		3	SS	58								2 29 47 22
			4	SS	50/ .150		192						
191.3													
3.0	SAND and SILT, trace gravel, trace to some clay, occasional iron oxide staining Very Dense Brown (TILL)		5	SS	50/ .150		191						4 48 39 9
	Grinding at 3.96m to 4.27m												
190.1													
4.3	SHALE, highly weathered, fine grained, thinly bedded Reddish Brown		6	SS	100/ .125		190						
188.2			7	SS	100/ .075		189						
6.2	END OF BOREHOLE AT 6.17m. 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



## METRIC

CONTMT4S 2311.GPJ 3/6/08

20  
15-5  
10 (%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No HAR-15

2 OF 2

METRIC

G.W.P. 2107-05-00 LOCATION Hurontario St. South Access Road N 4 832 097.821 E 290 058.189 ORIGINATED BY GA  
 HWY 401 BOREHOLE TYPE Solid Stem Augers COMPILED BY ES  
 DATUM Geodetic DATE 2007-10-17 - 2007-10-17 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									
	Continued From Previous Page							20	40	60	80	100					
	8.81 to 8.99 and 9.20 to 9.32m Weak to strong																
	Green siltstone interbeds at 10.08 to 10.11, 10.90, 10.97, 11.15 to 11.20, 11.25 to 11.28, 11.30 to 11.41 and 11.56 to 11.58m Grey limestone interbeds at 10.26, 10.49 to 10.52, 11.33 and 11.51 to 11.56m		2	RUN			186										RUN 2# TCR=100%, SCR=100%, RQD=100%, UCS=28MPa (Shale/Siltstone) UCS=105MPa (Siltstone) UCS=86MPa (Limestone)
185.1																	
11.6	END OF BOREHOLE AT 11.58m. BOREHOLE OPEN AND WATER LEVEL AT 4.88m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE TO 0.9m, CONCRETE to 0.15m AND COLD PATCH TO SURFACE.																

# RECORD OF BOREHOLE No HAR-16

1 OF 1

METRIC

G.W.P. 2107-05-00 LOCATION Hurontario St. South Access Road N 4 832 110.129 E 290 065.885 ORIGINATED BY GA  
HWY 401 BOREHOLE TYPE Solid Stem Augers COMPILED BY MFA  
DATUM Geodetic DATE 2007-09-14 - 2007-09-14 CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONES 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						
196.1								20 40 60 80 100						
0.0	TOPSOIL: (100mm)							○ UNCONFINED + FIELD VANE						
0.1	SAND, some silt, trace clay, trace gravel Compact to Dense Brown (FILL)		1	SS	40			● QUICK TRIAXIAL × LAB VANE						
			2	SS	16									
	Loose		3	SS	9									
193.9								20 40 60 80 100		20 40 60				
2.2	Silty CLAY, trace to some sand, trace gravel Stiff Brown to Reddish Brown (FILL)		4	SS	12									
193.2														
3.0	Silty CLAY, with sand, trace gravel, occasional iron oxidized stains Hard Mottled Brown and Grey (TILL)		5	SS	16									
			6	SS	49									
	Brown to Reddish Brown		7	SS	60/ 150									
189.4														
6.7	SHALE, highly weathered, thinly bedded, reddish brown													
188.5														
7.6	END OF BOREHOLE AND AUGER REFUSAL AT 7.6m. BOREHOLE OPEN AND DRY TO 7.6m. Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen. WATER LEVEL READINGS: DATE DEPTH(m) ELEV.(m) Sep 19/07 4.8 191.3 Sep 28/07 4.5 191.6 Oct 05/07 4.6 191.5 Oct 18/07 4.2 191.9 Nov 01/07 4.5 191.6 Nov 15/07 4.7 191.4		8	SS	50/ .000									

+ 3 . X 3 : Numbers refer to  
Sensitivity

20  
15 5  
10 (%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No HAR-18

1 OF 1

METRIC

G.W.P. 2107-05-00 LOCATION Hurontario St. South Access Road N 4 832 069.279 E 290 058.058 ORIGINATED BY GA  
 HWY 401 BOREHOLE TYPE Solid Stem Augers COMPILED BY ES  
 DATUM Geodetic DATE 2007-10-09 - 2007-10-09 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						
195.0								20	40	60	80	100		
0.0	TOPSOIL: (100mm)						195							
0.1	SAND, trace clay, trace silt, trace gravel, occasional rootlets		1	SS	24									
194.2	Compact Brown (FILL)													
0.8	Silty CLAY, with sand, trace gravel		2	SS	16		194							
	Very Stiff													
	Mottled Dark Grey-Brown (FILL)		3	SS	18		193							
			4	SS	13		192							9 33 43 15
	Brown to Mottled Brown-Reddish		5	SS	19		191							
			6	SS	50/ .150		190							
	Hard													
189.2	SHALE, highly weathered, thinly bedded, reddish brown, with occasional sand seams		7	SS	100/ .150		189							
							188							
187.4	END OF BOREHOLE AT 7.62m UPON AUGER REFUSAL. BOREHOLE OPEN AND DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO SURFACE.													
7.6														

ONTMT4S 2311.GPJ 3/6/08

# RECORD OF BOREHOLE No RSE-17

1 OF 1

METRIC

G.W.P. 2107-05-00 LOCATION Hurontario St. South to HWY 401 East Ramp N 4 832 134.2 E 290 109.1 ORIGINATED BY GA  
 HWY 401 BOREHOLE TYPE Solid Stem Augers COMPILED BY MFA  
 DATUM Geodetic DATE 2013-09-07 - 2013-09-07 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									WATER CONTENT (%)
								○ UNCONFINED	+ FIELD VANE	● QUICK TRIAXIAL	× LAB VANE						
191.3							20	40	60	80	100	20	40	60			
0.0	TOPSOIL: (75mm)																
0.1	Silty CLAY, trace to some sand, trace gravel, occasional rootlets Very Stiff to Hard Brown (FILL)		1	SS	17		191										
			2	SS	36												
189.9							190										
1.4	Silty CLAY, trace sand, occasional rootlets, organic odour Very Stiff Grey		3	SS	16												
189.1																	
2.2	Silty CLAY, some sand, trace gravel Very Stiff to Hard Mottled Brown/Grey (TILL)		4	SS	21		189										
			5	SS	68		188										
187.3																	
4.0	SHALE, highly weathered, thinly bedded, reddish brown						187										
186.7			6	SS	50/ .000												
4.6	END OF BOREHOLE AND AUGER REFUSAL AT 4.6m. BOREHOLE OPEN AND DRY TO 4.6m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO SURFACE.																

# RECORD OF BOREHOLE No C4-3

1 OF 1

METRIC

G.W.P. 2107-05-00 LOCATION Highway 401 Station 19+200 N 4 832 243.563 E 290 019.052 ORIGINATED BY GA  
 HWY 401 BOREHOLE TYPE Solid Stem Augers COMPILED BY MFA  
 DATUM Geodetic DATE 2007-09-13 - 2007-09-13 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																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																			
191.8 0.0 0.1	TOPSOIL: (100mm)  Silty CLAY, trace to some sand, trace gravel, occasional rootlets Stiff to Very Stiff Brown to Greenish Grey (FILL)		1	SS	12																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																						

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

# RECORD OF BOREHOLE No C4-4

1 OF 1

METRIC

G.W.P. 2107-05-00 LOCATION Highway 401 Station 19+200 N 4 832 225.335 E 290 034.664 ORIGINATED BY GA  
 HWY 401 BOREHOLE TYPE Solid Stem Augers COMPILED BY MFA  
 DATUM Geodetic DATE 2007-11-13 - 2007-11-13 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 (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa		WATER CONTENT (%)				
190.7								20 40 60 80 100		20 40 60				
0.0	TOPSOIL: (125mm)													
0.1	Silty CLAY, trace to some sand, trace gravel, occasional rootlets Stiff Brown (FILL)		1	SS	13		190							
			2	SS	10									
189.2							189							
1.4	Silty CLAY with sand, occasional oxide stains Firm to Hard Mottled Brown-Grey to Brown (TILL)		3	SS	8									
			4	SS	49		188							
			5	SS	50/ .150		187						2 34 46 18	
186.1							186						2 44 44 10	
4.6	SAND and SILT, some clay, trace gravel Very Dense Grey Damp to Moist (TILL)		6	SS	50/ .150		185							
185.2														
5.5	SHALE, highly weathered, thinly bedded, reddish brown													
184.4			7	SS	100/ .150									
6.2	END OF BOREHOLE AT 6.2m UPON AUGER REFUSAL. BOREHOLE OPEN TO 6.2m AND WATER LEVEL AT 1.5m UPON COMPLETION OF DRILLING. Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen. WATER LEVEL READINGS: DATE DEPTH(m) ELEV.(m) Sep 14/07 0.9 189.8 Sep 19/07 0.8 189.9 Sep 28/07 1.0 189.7 Oct 05/07 0.8 189.9 Oct 18/07 0.8 189.9 Nov 01/07 0.8 189.9 Nov 15/07 0.7 190.0													

ONTMT4S 2311.GPJ 3/5/08

**Appendix D**  
**List of Special Provisions**  
**and**  
**Suggested Text for NSSP**



**List of Special Provisions Referenced in this Report**

SP 903S01

**Suggested Text for NSSP on “Caisson Construction for HML Pole Foundations”**

The Contractor is advised that variable types of subsurface materials may be encountered at the high mast lighting (HML) pole locations. For additional information regarding soil and rock conditions, the Contractor is referred to the Foundation Investigation Report.

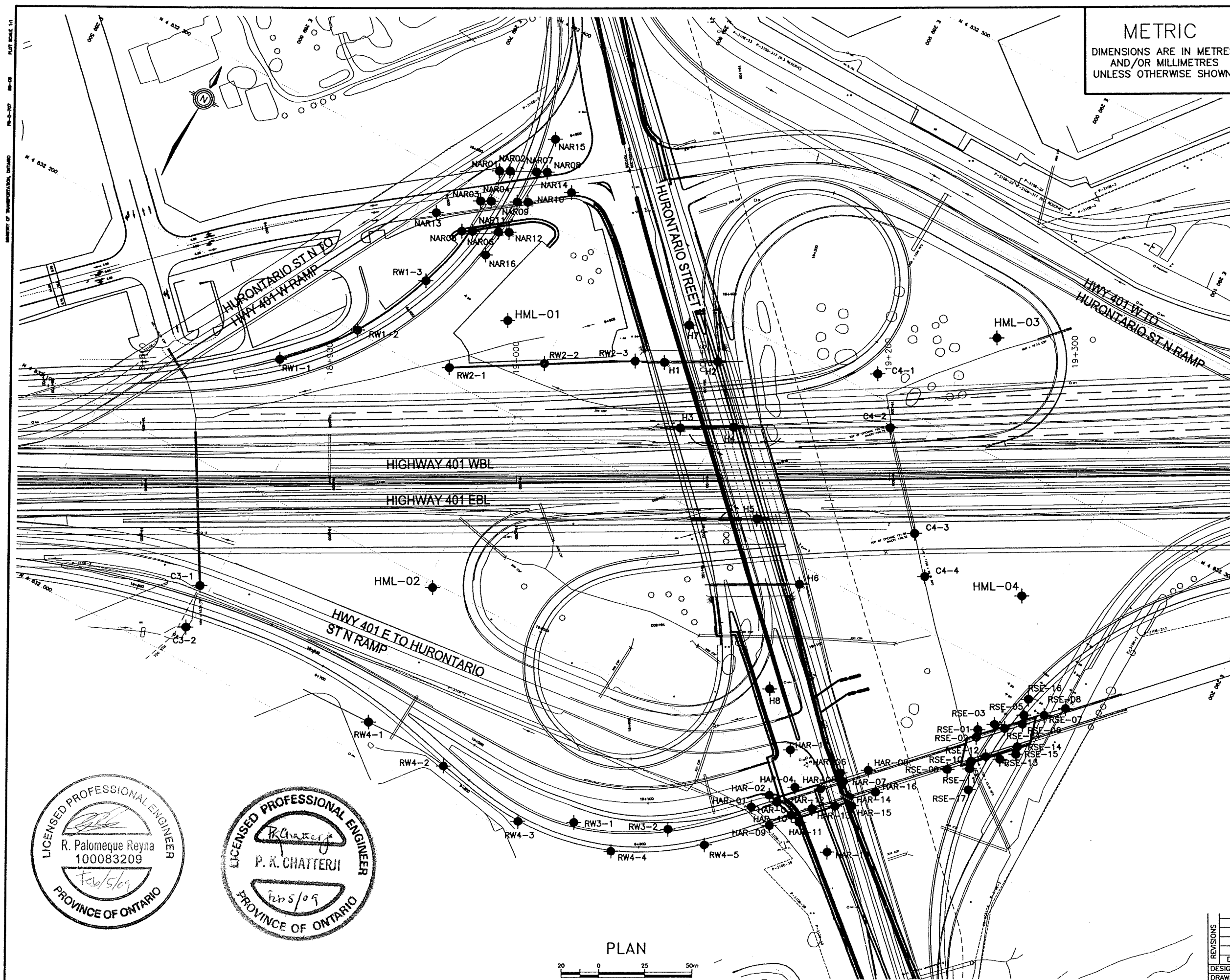
For bidding purposes, the Contractor shall assume the following:

1. The subsurface conditions at a HML location are the same as those encountered in the borehole closest to the subject HML location.
2. There is a probability that occasional cobbles and boulders may be encountered within the glacial till deposits. Obstructions may also be present within the fill. The strength of the shale bedrock increases with depth below the upper 1 to 2 m (weathered) zone, and hard limestone and siltstone interbeds are present in the shale. Caisson installation equipment must be able to penetrate these obstructions and hard layers.
3. The depth to the top of weathered shale bedrock is variable across the site and may be encountered at a higher elevation at a HML location than that shown in the nearest borehole logs. Contractor's caisson installation equipment must be capable of drilling/coring through the bedrock to the design depth of the caisson.
4. Water seepage and/or soil sloughing into the caisson hole will occur from existing fill at some locations. The cohesionless soils would be susceptible to disturbance under conditions of unbalanced hydrostatic head. Temporary liners shall be available on site, or be made available on very short notice, to support the caisson sidewalls and provide seepage cut-off where required.

The Contractor is responsible for constructing the high mast pole foundations without disturbing the material at the sides or bases of the foundations.

## **Appendix E**

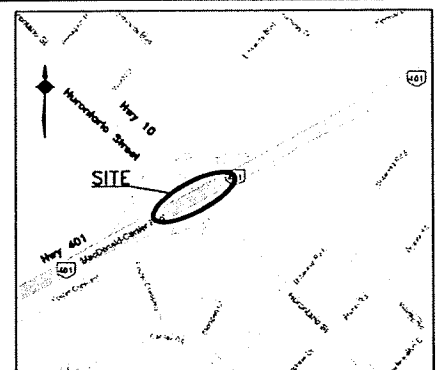
### **Borehole Location Drawings**








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

HWY 401
SITE No
GWP No 2107-05-00

HIGHWAY 401  
HIGH MAST LIGHTING POLES  
BOREHOLE LOCATION PLAN



KEYPLAN  
LEGEND

- |   |   |
|---|---|
|    | Borehole (Present Investigation, 2007 and 2006) |
|    | Borehole and Cone                               |
| 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
HML-01	191.2	4 832 243.6	289 772.0
HML-02	190.2	4 832 097.5	289 804.1
HML-03	192.5	4 832 357.3	290 008.8
HML-04	192.1	4 832 240.1	290 085.5
HML-05	197.4	4 832 548.8	290 380.5

**-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. 30M12-275**

A circular professional engineer seal for the Province of Ontario. The outer ring contains the text "LICENSED PROFESSIONAL ENGINEER" at the top and "PROVINCE OF ONTARIO" at the bottom. The center of the seal features a stylized signature, the name "R. Palomeque Reyna", the license number "100083209", and the date "Feb/5/09".

A circular professional seal for a Licensed Professional Engineer in the Province of Ontario. The outer ring contains the text "LICENSED PROFESSIONAL ENGINEER" at the top and "PROVINCE OF ONTARIO" at the bottom. The center of the seal features the name "P. K. CHATTERJI" and the license number "7205/09".

## PLAN

[illegible]

HWY 401  
SITE No  
GWP No 2107-05-00

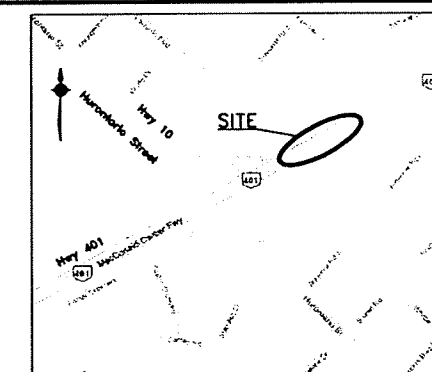


HIGHWAY 401  
HIGH MAST LIGHTING POLES  
BOREHOLE LOCATION PLAN

SHEET








**THURBER ENGINEERING LTD.**  
GEOTECHNICAL • ENVIRONMENTAL • MATERIALS



## KEYPLAN

## LEGEND

- |   |   |
|---|---|
|    | Borehole (Present Investigation, 2007 and 2006) |
|    | Borehole and Cone                               |
| 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
HML-01	191.2	4 832 243.6	289 772.0
HML-02	190.2	4 832 097.5	289 804.1
HML-03	192.5	4 832 357.3	290 008.8
HML-04	192.1	4 832 240.1	290 085.5
HML-05	197.4	4 832 548.8	290 380.5

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[illegible]

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 DATE: Feb 08, 2009 - 8:49am

