

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

**Geocres Number: 30M12-278**

**Report to**

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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 along Highway 401 from Dixie Road to McLaughlin Road, which is part of the Highway 401 widening from Highway 410 to the Credit River in Mississauga, Ontario.

The purpose of the investigation was to explore the subsurface conditions in the general vicinity 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 “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, prepared for MMM Group Limited, dated February 25, 2008 (Reference 1).
- Thurber Engineering Ltd. report titled “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, prepared for MMM Group Limited, dated March 4, 2008 (Reference 2).



- Thurber Engineering Ltd. report titled “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, prepared for MMM Group Limited, dated February 25, 2008 (Reference 3).
- Thurber Engineering Ltd. report titled “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, prepared for MMM Group Limited, dated February 25, 2008 (Reference 4).
- Thurber Engineering Ltd. report titled “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, prepared for MMM Group Limited, dated March 20, 2008 (Reference 5).
- Thurber Engineering Ltd. report titled “Foundation Investigation and Design Report, Patrol Yard, Highway 401 Widening, Highway 410 to Credit River, Mississauga, Ontario, G.W.P. 2107-05-00, prepared for MMM Group Limited, dated March 30, 2009 (Reference 6).
- Thurber Engineering Ltd. report titled “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 February 5, 2009 (Reference 7).
- Thurber Engineering Ltd. report titled “Foundation Investigation and Design Report, High Mast Lighting Poles, Highway 401 Widening, Highway 410 to Credit River, Mississauga, Ontario, G.W.P. 2107-05-00, prepared for MMM Group Limited, dated February 5, 2009 (Reference 8).

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

## 2 SITE DESCRIPTION

The lands north of Highway 401 between McLaughlin Road and Hurontario Street are generally vacant and undeveloped. Vegetation is moderate consisting mainly of tall grass and shrubs. To the east of Hurontario Street to Dixie Road and throughout the length of the project limits south of Highway 401, the lands have been developed for commercial and industrial uses. The topography is generally level though slopes gently towards Lake Ontario to the south.

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 either the reddish brown shale of the Queenston Formation or the grey shale and limestone of the Georgian Bay Formation.

### 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 33 boreholes at selected locations in the vicinities of the poles. This report compiles the boreholes drilled and sampled for the HML poles as well as other boreholes relevant to the HML poles in References 1 to 8. A summary of the borehole designations for the HML poles is provided in Table 3.1.

**Table 3.1 – Borehole Designations**

<b>Borehole</b>	<b>Location</b>	<b>Drilling Date (2009)</b>	<b>Borehole Termination Depth (m)</b>	<b>Stratum at Termination Depth</b>
P-02	Highway 410 in the centre median, north of Highway 401	February 3	5.7	Shale bedrock
P-03	Northwest quadrant of Highway 401 and Highway 410 interchange	February 24	7.0	Shale bedrock
P-07	Northeast quadrant of Highway 401 and Highway 410 interchange	February 9	5.0	Shale bedrock
P-09	Northwest quadrant of Highway 401 and Highway 410 interchange	February 23/24	8.5	Shale bedrock
P-12	Northeast quadrant of Highway 401 and Highway 410 interchange	February 10	6.3	Shale bedrock
P-14	North side Highway 401 west of Tomken Road	February 10	4.3	Shale bedrock
P-15/A	Southeast quadrant of Highway 401 and Highway 410 interchange	February 11/12	7.5/6.2	Shale bedrock
P-16	Southeast quadrant of Highway 401 and Highway 410 interchange	February 11	11.0	Shale bedrock
P-20	Southwest quadrant of Highway 401 and Highway 410 interchange	February 19	6.4	Shale bedrock
P-23	Southwest quadrant of Highway 401 and Highway 410 interchange	February 26/27	6.5	Shale bedrock
P-27	Southeast quadrant of Highway 401 and Highway 410 interchange	February 12	5.2	Shale bedrock
P-29	Centre median of Highway 410 at southeast Highway 401 interchange	February 13	6.2	Shale bedrock
P-30	Southeast quadrant of Highway 401 and Highway 410 interchange	February 17	5.9	Shale bedrock

Table 3.1 – Borehole Designations (Cont'd)

Borehole	Location	Drilling Date (2009)	Borehole Termination Depth (m)	Stratum at Termination Depth
P-32	Southeast quadrant of Highway 401 and Highway 410 interchange	February 25	5.8	Shale bedrock
P-33	North side of Highway 401, east of Tomken Road	February 19	7.8	Shale bedrock
P-36	North side of Highway 401, east of the Basket weave	February 26	6.9	Shale bedrock
P-38	North side of Highway 401, east of the Basket weave	February 24	9.8	Silty clay till
P-41	Centre median of Highway 401 east of the Highway 410 interchange	March 1	6.4	Shale bedrock
P-43	Centre median of Highway 401 east of the Highway 410 interchange	February 25	8.6	Shale bedrock
P-45	Centre median of Highway 401 east of the Highway 410 interchange	February 23	7.8	Shale bedrock
P-47	Southeast quadrant of Highway 401 and Highway 410 interchange	February 17	6.6	Shale bedrock
P-49	South side of Highway 401, east of Tomken Road	February 18	6.1	Shale bedrock
LSOP-02	North side of Highway 401, west of the Hurontario interchange	March 4	9.7	Silty clay till
LSOP-07	Northeast quadrant of Highway 401 and Hurontario interchange	March 3	10.7	Shale bedrock
LSOP-10	Southwest quadrant of Highway 401 and Hurontario interchange	March 3	5.8	Shale bedrock
LSOP-12	Southeast quadrant of Highway 401 and Hurontario interchange	March 9	9.0	Shale bedrock
LSOP-16	North of Highway 401, 800 m east of Hurontario Street.	March 4	5.6	Shale bedrock
LSOP-17	Southeast quadrant of Highway 401 and Hurontario interchange	March 3	9.2	Shale bedrock
LSOP-19	South side of Highway 401, east of the Hurontario interchange	March 3	9.8	Shale bedrock
LSOP-23	North side of Highway 401, west of Kennedy Road	February 25	11.4	Shale bedrock
LSOP-27	North side of Highway 401, west of the Hurontario interchange	March 4	9.8	Clayey silt till
LSOP-29	North of Highway 401, approx. 300 m east of McLaughlin Road	March 6	9.0	Clayey silt till
OHS-09	North side of Highway 401, west of Kennedy Road	March 11	7.0	Shale bedrock
OHS-10	North side of Highway 401, east of Kennedy Road	March 11	5.8	Shale bedrock
OHS-12	Northwest quadrant of Highway 401 and Highway 410 interchange	March 10	7.0	Shale bedrock
SWMP-01	Northwest quadrant of Highway 401 and Highway 410 interchange	March 13	6.2	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 where available.

The detailed subsurface soil and groundwater conditions encountered in the boreholes included in References 1 to 8 drilled along the Highway 401 and Highway 410 interchange areas and along the length of Highway 401 near Hurontario Street 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). HQ2 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. Ten standpipe piezometers consisting of 19 mm PVC pipes with screens were installed in the boreholes to permit longer 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**

Borehole	Piezometer Installations			Completion Details
	Screen Tip (m)	Screen El. (m)	Sand Filter Stratum	
P-02	5.7	170.6	Shale Bedrock	Sand filter from 5.7 m to 3.7 m, bentonite grout to surface.
P-12	6.3	174.3	Shale Bedrock	Sand from 6.3 m to 4.3 m, bentonite grout to 0.3 m, cuttings to surface.
P-14	4.3	168.2	Shale Bedrock	Sand from 4.3 m to 2.4 m, bentonite grout to 0.3 m, cuttings to surface.
P-23	6.5	175.2	Shale Bedrock	Sand from 6.5 m to 4.6 m, bentonite grout to surface.
P-27	5.2	175.7	Shale Bedrock	Sand from 5.2 m to 3.4 m, bentonite grout to surface.
P-32	5.8	169.7	Shale Bedrock	Sand from 5.8 m to 4.0 m, bentonite grout to surface.
P-36	6.9	156.2	Shale Bedrock	Sand from 6.9 m to 4.9 m, bentonite grout to surface.
P-49	6.1	162.6	Shale Bedrock	Sand from 6.1 m to 4.0 m, bentonite grout to surface.
LSOP-07	8.2	185.0	Shale Bedrock	Sand from 8.2 m to 6.4 m, bentonite grout to surface.
LSOP-10	5.8	189.0	Shale Bedrock	Sand from 5.8 m to 4.0 m, bentonite grout to surface.
OHS-10	5.8	183.4	Shale Bedrock	Sand from 5.8 m to 4.0 m, bentonite grout to surface.
OHS-12	7.0	179.4	Shale Bedrock	Sand from 7.0 m to 5.2 m, bentonite grout to surface.
SWMP-01	6.2	179.8	Shale Bedrock	Sand filter from 6.2 m to 4.3 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 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 minimize 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 P-02 to P-49 and LSOP-02 to LSOP-29). 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 P-02 to P-49 (Eastern limit of the site) and Boreholes LSOP-02 to LSOP-29 (Western limit of the site) 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 or pavement structure overlying fill which is underlain by native silty clay/clayey silt till deposits which are occasionally interbedded with cohesionless sand and silty sand 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 all boreholes, except in Boreholes P-02, P-15A, P-38, P-41, P-43, P-45, LSOP-02, LSOP-17 to LSOP-29 and SWMP-01. The topsoil thickness generally ranged from 25 to 125 mm, though was typically around 50 mm thick. The topsoil thickness may vary between and beyond the borehole locations and the data is not intended for the purpose of estimating quantities.

A 760 mm layer of peat was encountered from the surface in Borehole LSOP-16.

### 5.2 Pavement

In Boreholes P-38, P-41, P-45, LSOP-02 and LSOP-17 to LSOP-29 a layer of asphaltic cement was encountered at the ground surface. The thickness of the asphalt ranged from 10 to 300 mm. The asphalt was underlain by a layer of granular fill that ranged in thickness from 0.5 to 1.3 m. The surface of the granular material was contacted from between El. 162.0 to 195.3 m. The base of the granular layer was encountered from between El. 161.3 to 194.2 m.

### 5.3 Fill

Fill was encountered from ground surface in Boreholes P-02, P-15A and P-43; below the topsoil in Boreholes P-03, P-07, P-09, P-16, P-20, P-23, P-27, P-30, P-32, LSOP-07, LSOP-12, OHS-09, OHS-10 and OHS-12; below the pavement structure in Boreholes P-38, P-41, LSOP-02, LSOP-17, LSOP-19 and LSOP-27. In all of the boreholes except P-02, P-07, P-09, P-20, P-32, LSOP-17 and OHS-10, the fill consists of brown silty clay containing trace to some sand, trace of gravel and occasional rootlets and pieces of shale and limestone. In Boreholes P-02, P-09, OHS-09 and SWMP-01 the fill consists of a grey shale. The remaining boreholes encountered a fill layer that was composed of a sand to a silty sand material. The

thickness of the fill ranged from 0.2 to 2.1 m. The lower extent of the fill layers were encountered between El. 159.8 to 192.4 m. At some locations the fill contains pieces of shale and limestone bedrock.

The SPT N-values recorded in the cohesive fill layers were observed to range from 6 to 80 blows for 0.3 m of penetration, corresponding with a firm to hard consistency. One SPT N-value of 50 blows for 0.15 m penetration was observed within the silty clay fill. The SPT N-values recorded in the shale fill ranged from 6 to 30 blows for 0.3 m of penetration, indicating a firm to hard consistency. One SPT N-value in the shale fill was recorded to be 50 blows for 0.15 m of penetration indicating a hard consistency. SPT N-values in the cohesionless fill were observed to range from 16 to 64 blows for 0.3 m of penetration indicating a compact to very dense relative density. A single SPT test within the cohesionless fill resulted in a blow count greater than 50 blows for 0.1 m of penetration.

Grain size analyses conducted on samples of the fill are presented on Figures B1 to B2 in Appendix B. The results of grain size analyses carried out on five (5) samples and the results of Atterberg limits testing conducted on three (3) samples of the cohesive fill are tabulated below. The results of Atterberg limits testing are shown on Figure B9 in Appendix B.

<u>Cohesive Fill</u>		<u>Cohesionless Fill</u>	
Gravel %	0 to 5	Gravel %	3
Sand %	21 to 38	Sand %	46
Silt %	34 to 48	Silt %	40
Clay %	23 to 35	Clay %	11
Liquid Limit %	28 to 38		
Plastic Limit %	15 to 20		

The natural moisture contents of the various fill samples recovered ranged from approximately 5 to 38% in the clay fill, from approximately 5 to 17% in the shale fill and from approximately 4 to 15% in the cohesionless fill.

#### 5.4 Silty Clay

A layer of silty clay with trace gravel, occasional shale fragments and rootlets was encountered below the topsoil in Boreholes P-12, P-14 and P-15 and below the shale fill in Borehole OHS-09. The thickness of the silty clay was observed to range from 0.1 to 1.3 m and was first encountered at a depth of 0.1 to 1.5 m below the ground surface (El. 172.5 to 189.6 m) in each of the boreholes. The lower limit of the cohesive deposit was contacted at depths ranging from 0.2 to 2.3 m below the ground surface (El. 172.2 to 188.8 m).

SPT N-values in the silty clay ranged from 7 to 16 blows for 0.3 m of penetration indicating a firm to very stiff consistency. Two N-values were recorded to be greater than 70 blows for 0.25 m of penetration corresponding with a hard consistency.

Grain size analyses conducted on samples of the cohesionless layers are presented on Figure B3 in Appendix B. The result of a grain size analysis carried out on one (1) sample is tabulated below.

Gravel %	0
Sand %	14
Silt %	46
Clay %	40

Natural moisture contents were measured to range from 7 to 24% in the recovered samples.

### 5.5 Sand and Silty Sand

A layer of sand to silty sand with trace to some clay, trace gravel and shale fragments was found to be interbedded within the various cohesive deposits in Boreholes P-38, LSOP-12, LSOP-17 and LSOP-19 and immediately above the bedrock in Boreholes LSOP-07 and LSOP-12. The thickness of the cohesionless deposit was observed to range from 0.8 to 3.2 m and was initially encountered at depths ranging from 1.5 to 7.6 m below the ground surface (El. 154.5 to 192.3 m) in all of the boreholes. The lower limit of the cohesionless deposits was contacted at depths ranging from 2.3 to 9.1 m below the ground surface (El. 153.0 to 190.4 m). A second layer of cohesionless material was encountered in Borehole LSOP-12 at a depth of 4.6 m (El. 188.1) and extended to a depth of 5.5 m (El. 187.2 m).

SPT N-values in the sand to silty sand ranged from 6 to 74 blows for 0.3 m of penetration indicating a loose to very dense relative density.

Grain size analyses conducted on samples of the cohesionless layers are presented on Figure B4 in Appendix B. The results of grain size analyses carried out on four (4) samples are tabulated below.

Gravel %	0 to 21
Sand %	35 to 63
Silt %	22 to 49
Clay %	8 to 13

Natural moisture contents were measured to range from 9 to 16% in the recovered samples.

### 5.6 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 with red and grey shale and limestone pieces were contacted at depths ranging from 0.1 to 6.2 m below the ground surface (El. 159.8 to 194.7 m). The silty clay till was not encountered in Borehole OHS-10. The lower bound of the glacial till was encountered at depths ranging from 0.4 to 9.8 m below the ground surface (El. 154.5 to 192.6 m). A second layer of cohesive till with bedrock pieces was encountered in Boreholes P-38 and LSOP-17 immediately above the surface of the bedrock at depths of 9.1 and 6.1 m (El.



153.0 and 188.5 m) respectively. The thickness of the till deposits ranged from 0.3 m to 9.0 m.

SPT N-values range widely from 6 to 94 blows for 0.3 m of penetration. Several SPT tests indicated N-values greater than 50 blows for 0.075 m of penetration, the silty clay till and clayey silt till are described as firm to hard.

The natural moisture contents of the samples recovered from the silty clay till and clayey silt till layers ranged widely from 4 to 50%.

Grain size distribution curves for the thirty (30) samples tested are presented on the Record of Borehole sheets and on Figures B5 to B8 of Appendix B. Atterberg Limit test results for twenty four (24) samples are presented on Figures B10 to B14 of Appendix B.

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

Gravel %	0 to 10
Sand %	3 to 47
Silt %	35 to 67
Clay %	9 to 45
Liquid Limit %	19 to 48
Plastic Limit %	13 to 25

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

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 the shale and limestone bedrocks which may account for some high blow counts and resistance to augering.

## **5.7 Bedrock**

The soils described above were found to be underlain by shale bedrock of the Queenston and Georgian Bay Formations. The shale encountered in the boreholes is described as fine-grained, thinly bedded and contains numerous strong to very strong interbedded layers of siltstone and limestone. 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 highly weathered to weathered portion of the shale bedrock ranged from 32 blows for 0.3 m of penetration to greater than 100 blows for less than 0.05 m penetration.

In general the rock core samples in the vicinity of Hurontario Road are comprised of the Queenston Formation. The bedrock core samples recovered from the east of the site east of Kennedy Road except P-29 and P-45 were generally composed of the Georgian Bay Formation.

Moisture contents of disturbed shale samples ranged from 4 to 27%.

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>
P-02	2.1	174.2
P-03	2.0	178.8
P-07	1.4	176.7
P-09	4.7	180.2
P-12	3.0	177.6
P-14	0.4	172.2
P-15/A	0.2/0.8	176.7/176.1
P-16	7.1	171.5
P-20	3.2	182.6
P-23	2.7	179.0
P-27	1.5	179.3
P-29	2.2	179.4
P-30	2.3	176.4
P-32	0.8	174.8
P-33	3.0	170.3
P-36	3.4	159.7
P-38	Not Encountered	-
P-41	1.5	164.9
P-43	5.5	158.7
P-45	5.6	157.4
P-47	1.8	175.4
P-49	0.4	168.3
LSOP-02	Not Encountered	-
LSOP-07	7.0	186.1
LSOP-10	2.1	192.6
LSOP-12	5.5	187.2
LSOP-16	1.5	-
LSOP-17	8.7	185.9
LSOP-19	8.8	186.6
LSOP-23	4.6	187.7
LSOP-27	Not Encountered	-
LSOP-29	Not Encountered	-
OHS-09	3.7	187.4
OHS-10	0.8	188.4
OHS-12	4.0	182.4
SWMP-01	4.3	181.6

The depth and elevation of shale bedrock in the other boreholes reported in References 1 to 8 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>
BW10	4.0	190.6
H6	11.7	187.9
NAR08	5.5	188.2
NAR15	4.3	190.1
RW2-3	3.7	191.2
C4-3	5.2	186.6
C4-4	5.5	185.2
HAR-15	7.3	189.3
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
5	1.8	189.1
C-7	2.0	182.5
C20a	3.2	180.4
C-9	2.0	182.6
C13	0.5	180.7
50-4	1.8	170.4

Bedrock cores were collected using HQ2 sized coring equipment. Total Core Recovery (TCR) in the bedrock ranged from 60% to 100% in most core runs. TCR values of 0 were recorded in core samples recovered from Boreholes P-09 Run 2 and P-15 Run 4. Values of TCR between 0 and 60 occurred but were relatively rare.

The RQD values recorded in all of the core runs ranged from 0 to 100% indicating very poor to excellent rock quality. A total of fifteen runs recorded an RQD of 0. Fracture Index (FI) of the rock, expressed as fractures for 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	2 to 14
Siltstone	14 to 55
Limestone	5 to 160

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 disintegrate during point load testing, which rendered the results of the test unreliable. Fractured 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 strong to very strong interbeds range approximately from 10 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. In general, the strength of the shale bedrock increases with depth.

## **5.8 Groundwater Levels**

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

Table 5.3 – Measured Groundwater Levels

Borehole	Date (2009)	Water Level (m)		Comment
		Depth	Elevation	
P-02	March 12	4.18	172.1	In Piezometer
	March 26	3.71	172.6	
	April 16	3.5	172.8	
P-12	March 3	5.89	174.7	In Piezometer
	March 12	5.58	175.0	
	March 26	5.79	174.8	
	April 16	5.8	174.8	
P-14	March 3	2.94	169.7	In Piezometer
	March 12	2.89	169.7	
	March 26	2.79	169.8	
	April 16	3.0	169.8	
P-23	March 3	4.96	176.8	In Piezometer
	March 12	5.25	176.4	
	March 26	5.26	176.4	
	April 16	5.2	176.5	
P-27	March 12	4.00	176.9	In Piezometer
	March 26	4.10	176.8	
	April 16	4.4	176.5	
P-32	March 3	4.72	170.8	In Piezometer
	March 12	3.98	171.5	
	March 26	3.98	171.5	
	April 16	3.9	171.6	
P-36	March 3	1.26	161.9	In Piezometer
	March 12	1.38	161.7	
	March 26	1.58	161.5	
	April 16	1.5	161.6	
P-49	March 3	3.91	164.8	In Piezometer
	March 12	3.94	164.8	
	March 26	3.85	164.8	
	April 16	3.7	165.0	
LSOP-07	March 12	1.09	192.1	In Piezometer
	March 26	0.85	192.3	
	April 16	0.6	181.9	
LSOP-10	March 12	1.89	192.9	In Piezometer
	March 26	0.91	193.9	
	April 16	0.4	194.4	
OHS-10	March 12	1.89	187.3	In Piezometer
	March 26	2.91	186.3	
	April 16	2.9	186.3	
OHS-12	March 12	2.87	183.5	In Piezometer
	March 26	3.23	183.2	
	April 16	3.2	183.2	
SWMP-01	March 26	6.02	179.9	In Piezometer
	April 7	5.9	180.0	
	April 16	5.8	180.1	

The above table indicates that the depth to the groundwater level ranges from 0.85 to 5.89 m below the ground surface (El. 161.5 to 193.9 m).

The above values are shorter 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 lenses 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 Walker Drilling Ltd. of Utopia 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.

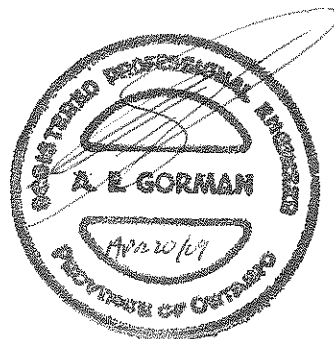
Supervision of the field program, was conducted by Ms. R. Palomeque Reyna, P.Eng. Interpretation of the field data and preparation of the investigation report was conducted by Ms. Rocio Palomeque Reyna P.Eng. and Mr. David E. Elwood, P.Eng. and Dr. P.K. Chatterji, P.Eng., a Designated Principal Contact for MTO Foundations Projects, reviewed the report.

### THURBER ENGINEERING LTD.

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**FOUNDATION INVESTIGATION AND DESIGN REPORT  
HIGH MAST LIGHTING POLES  
FROM DIXIE ROAD TO MCLAUGHLIN ROAD  
HWY 401 WIDENING, HWY 410 TO CREDIT RIVER  
MISSISSAUGA, ONTARIO  
Geocres Number: 30M12-278**

**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 seventy seven (77) HML poles are proposed to be erected along Highway 401 from Dixie Road to McLaughlin Road. Based on the proposed design layout, Boreholes P-02 to P-49 and LSOP-02 to LSOP-29 (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 8), would provide adequate subsurface information for detailed foundation design of the HML poles.

All relevant boreholes drilled in the vicinity of the 77 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:

- Ministry of Transportation, Ontario (2003) "Guidelines for the Design of High Mast Pole Foundations", Third Edition, BRO-006, Engineering Standards Branch, Bridge Office.

- 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 stonger 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**

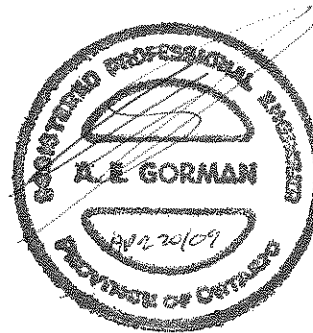
Engineering analysis and preparation of the foundation design report was conducted by Ms. Rocío Palomeque Reyna, P.Eng. The report was reviewed by Mr. Alastair E. Gorman, P.Eng. and Dr. P. K. Chatteriji, P.Eng., a Designated Principal Contact for MTO Foundations Projects.

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**TABLE 1 -Point Load and Unconfined Compression Test Results  
Highway 401 Widening – High Mast Lighting Poles**

BH P-02	DEPTH			FORCE (kN)	AXIAL / DIAMETRIC	DISTANCE (mm)	BREAK	UCS (Mpa)	Rock Type	UC Test Average			
	FT.	IN.	(m)										
RUN #1	12	9	3.89	23.0	D	106.00	OK	71.53	Limestone	RUN #1:			
	13	3	4.04	10.0	A	75.50	OK	65.27	Limestone		AVERAGE	MAX	MIN
										Shale			
										Siltstone			
										Shale/Siltstone			
										Limestone	68.40	71.53	65.27
RUN #2	15	1	4.60	23.5	A	66.50	OK	163.45	Limestone	RUN #2:			
	16	9	5.11	3.5	D	76.50	OK	17.58	Shale	Shale	9.50	0.00	0.00
	17	4	5.28	1.0	A	77.00	OK	7.90	Shale	Siltstone			
	17	10	5.44	0.0	A	51.50	LOW	3.00	Shale	Shale/Siltstone			
										Limestone	163.45	163.45	163.45
										SUMMARY	AVERAGE	MAX	MIN
										Shale	9.50	17.58	3.00
										Siltstone			
										Shale/Siltstone			
										Limestone	100.08	163.45	65.27

BH P-03	DEPTH			FORCE (kN)	AXIAL / DIAMETRIC	DISTANCE (mm)	BREAK	UCS (Mpa)	Rock Type	UC Test Average			
	FT.	IN.	(m)										
RUN #1	15	10	4.83	1.0	D	43.00	OK	12.04	Shale	RUN #1:			
	17	7	5.36	0.0	D	30.00	LOW	3.00	Shale		AVERAGE	MAX	MIN
	18	10	5.74	0.0	A	60.50	LOW	3.00	Shale	Shale	6.01	12.04	3.00
										Siltstone			
										Shale/Siltstone			
										Limestone			
RUN #2	19	3	5.87	1.0	D	115.00	OK	2.75	Shale	RUN #2:			
	20	8	6.30	0.0	A	71.00	LOW	3.00	Shale	Shale	3.11	0.00	0.00
	21	6	6.55	0.5	A	62.50	OK	3.34	Shale	Siltstone			
	22	6	6.86	0.5	A	72.00	OK	3.34	Shale	Shale/Siltstone			
										Limestone			
										SUMMARY	AVERAGE	MAX	MIN
										Shale	4.35	12.04	2.75
										Siltstone			
										Shale/Siltstone			
										Limestone			

BH	DEPTH			FORCE (kN)	AXIAL / DIAMETRIC	DISTANCE (mm)	BREAK	UCS (Mpa)	Rock Type	UC Test Average			
	FT.	IN.	(m)										
P-07													
RUN #1	7	4	2.24	17.0	A	45.45	OK	143.02	Limestone	RUN #1:			
	7	5	2.26	8.0	D	45.27	OK	89.15	Limestone		AVERAGE	MAX	MIN
RUN #2										Shale			
										Siltstone			
										Shale/Siltstone			
										Limestone	116.08	143.02	89.15
	8	6	2.59	14.5	D	46.75	OK	153.96	Limestone	RUN #2:			
	10	4	3.15	0.0	A	45.89	LOW	3.00	shale	Shale	4.12	0.00	0.00
	10	10	3.30	0.5	D	46.89	OK	5.22	shale	Siltstone			
	11	5	3.48	0.5	A	47.27	OK	4.12	shale	Shale/Siltstone			
RUN #3										Limestone	153.96	153.96	153.96
	12	7	3.84	0.5	D	47.25	OK	5.23	shale	RUN #3:			
	13	6	4.11	0.5	A	46.71	OK	4.17	shale	Shale	4.52	0.00	0.00
	14	8	4.47	0.5	A	46.15	OK	4.17	shale	Siltstone			
										Shale/Siltstone			
										Limestone	78.67	153.96	40.72
										SUMMARY	AVERAGE	MAX	MIN
										Shale	4.32	5.23	3.00
										Siltstone			
										Shale/Siltstone			
										Limestone	128.71	153.96	89.15

**TABLE 1 -Point Load and Unconfined Compression Test Results  
Highway 401 Widening – High Mast Lighting Poles**

BH P-09	DEPTH			FORCE (kN)	AXIAL / DIAMETRIC	DISTANCE (mm)	BREAK	UCS (Mpa)	Rock Type	UC Test Average			
	FT.	IN.	(m)										
RUN #1	19	8	5.99	13.0	D	105.50	OK	40.72	Limestone	RUN #1:			
										AVERAGE	MAX	MIN	
										Shale			
										Siltstone			
										Shale/Siltstone			
										Limestone	40.72	40.72	40.72
RUN #3	24	8	7.52	12.0	D	68.00	OK	72.63	Limestone	RUN #3:			
	25	4	7.72	7.5	A	52.00	OK	53.81	Limestone	Shale	13.83	0.00	0.00
	26	1	7.95	3.5	D	62.50	OK	13.03	Shale	Siltstone			
	27	1	8.26	2.5	A	94.00	OK	14.62	Shale	Shale/Siltstone			
										Limestone	63.22	72.63	53.81
										SUMMARY	AVERAGE	MAX	MIN
										Shale	13.83	14.62	13.03
										Siltstone			
										Shale/Siltstone			
										Limestone	55.72	72.63	40.72

BH P12 east	DEPTH			FORCE (kN)	AXIAL / DIAMETRIC	DISTANCE (mm)	BREAK	UCS (Mpa)	Rock Type	UC Test Average			
	FT.	IN.	(m)										
RUN #1	12	0	3.66	23.5	A	46.87	OK	194.69	Limestone	RUN #1:			
	12	10	3.91	14.5	D	46.87	OK	153.82	Limestone	AVERAGE	MAX	MIN	
	13	2	4.01	7.4	D	46.78	OK	78.08	Limestone	Shale			
	13	3	4.04	8.5	A	46.78	OK	70.49	Limestone	Siltstone			
										Shale/Siltstone			
										Limestone	124.27	194.69	70.49
RUN #2	15	9	4.80	4.0	D	46.85	OK	42.34	Limestone	RUN #3:			
	15	10	4.83	7.5	A	46.90	OK	62.11	Limestone	Shale	9.26	0.00	0.00
	17	0	5.18	0.0	D	46.90	LOW	3.00	Shale	Siltstone			
	17	1	5.21	0.5	A	46.90	OK	4.14	Shale	Shale/Siltstone			
	18	2	5.54	5.3	D	47.00	OK	55.83	Limestone	Limestone	65.92	103.41	42.34
	18	3	5.56	12.5	A	47.00	OK	103.41	Limestone				
	19	4	5.89	2.5	A	47.20	OK	20.64	Shale				
										SUMMARY	AVERAGE	MAX	MIN
										Shale	9.26	20.64	3.00
										Siltstone			
										Shale/Siltstone			
										Limestone	95.10	194.69	42.34

BH P-14	DEPTH			FORCE (kN)	AXIAL / DIAMETRIC	DISTANCE (mm)	BREAK	UCS (Mpa)	Rock Type	UC Test Average			
	FT.	IN.	(m)										
RUN #1	7	8	2.34	6.4	A	47.24	OK	52.81	Limestone	RUN #1:			
	8	1	2.46	9.1	D	46.90	OK	96.16	Limestone	AVERAGE	MAX	MIN	
	8	4	2.54	18.5	A	46.90	OK	153.22	Limestone	Shale			
										Siltstone			
										Shale/Siltstone			
										Limestone	100.73	153.22	52.81
RUN #2	9	11	3.02	12.0	A	47.25	OK	99.01	Limestone	RUN #2:			
	9	11	3.02	6.5	D	47.25	OK	67.93	Limestone	Shale	7.77	0.00	0.00
	11	0	3.35	0.5	D	47.25	OK	5.23	shale	Siltstone			
	11	3	3.43	1.0	A	47.23	OK	8.25	shale	Shale/Siltstone			
	12	6	3.81	0.5	D	47.26	OK	5.22	shale	Limestone	83.47	99.01	67.93
	12	8	3.86	1.5	A	47.26	OK	12.38	shale				
										SUMMARY	AVERAGE	MAX	MIN
										Shale	7.77	12.38	5.22
										Siltstone			
										Shale/Siltstone			
										Limestone	93.83	153.22	52.81

**TABLE 1 -Point Load and Unconfined Compression Test Results  
Highway 401 Widening – High Mast Lighting Poles**

BH P-15A	DEPTH			FORCE (kN)	AXIAL / DIAMETRIC	DISTANCE (mm)	BREAK	UCS (Mpa)	Rock Type	UC Test Average			
	FT.	IN.	(m)										
RUN #1	8	6	2.59	9.0	D	42.00	OK	112.23	Limestone	RUN #1:			
	9	11	3.02	1.0	A	47.00	OK	8.27	shale		AVERAGE	MAX	MIN
										Shale	8.27	8.27	8.27
										Siltstone			
										Shale/Siltstone			
										Limestone	112.23	112.23	112.23
RUN #2	12	6	3.81	9.0	D	123.00	OK	22.39	Limestone	RUN #2:			
	13	2	4.01	12.0	D	63.00	OK	99.85	Limestone	Shale	7.22	0.00	0.00
	14	0	4.27	1.0	A	55.00	OK	7.65	shale	Siltstone			
										Shale/Siltstone			
										Limestone	67.30	99.85	22.39
RUN #3	16	5	5.00	1.0	D	70.00	OK	5.80	shale	RUN #3:			
	17	6	5.33	0.0	A	53.00	LOW	3.00	shale	Shale	7.11	0.00	0.00
	18	0	5.49	1.0	A	42.00	OK	8.75	shale	Siltstone			
	18	8	5.69	2.0	D	115.00	OK	10.88	shale	Shale/Siltstone			
	19	4	5.89	12.0	A	73.00	OK	79.66	limestone	Limestone	73.20	112.23	22.39
										SUMMARY	AVERAGE	MAX	MIN
										Shale	7.39	10.88	3.00
										Siltstone			
										Shale/Siltstone			
										Limestone	78.53	112.23	22.39

BH P-15	DEPTH			FORCE (kN)	AXIAL / DIAMETRIC	DISTANCE (mm)	BREAK	UCS (Mpa)	Rock Type	UC Test Average			
	FT.	IN.	(m)										
RUN #5	20	5	6.22	12.0	D	53.00	OK	105.56	limestone	RUN #1:			
	22	0	6.71	15.0	A	60.00	OK	109.83			AVERAGE	MAX	MIN
										Shale			
										Siltstone			
										Shale/Siltstone			
										Limestone	107.70	109.83	105.56
										SUMMARY	AVERAGE	MAX	MIN
										Shale			
										Siltstone			
										Shale/Siltstone			
										Limestone	107.70	109.83	105.56

BH P-16	DEPTH			FORCE (kN)	AXIAL / DIAMETRIC	DISTANCE (mm)	BREAK	UCS (Mpa)	Rock Type	UC Test Average			
	FT.	IN.	(m)										
EAST RUN #1	26	7	8.10	15.5	D	65.51	OK	99.22	limestone	RUN #1:			
	27	11	8.51	0.1	D	56.48	OK	0.80	shale		AVERAGE	MAX	MIN
	28	11	8.81	0.2	A	38.64	OK	1.82	shale	Shale	1.14	1.82	0.78
	30	1	9.17	0.1	D	57.29	OK	0.78	shale	Siltstone			
	30	11	9.42	23.0	D	54.60	OK	193.49	limestone	Shale/Siltstone			
										Limestone	146.36	193.49	99.22
RUN #2	31	5	9.58	0.5	D	41.29	OK	6.40	shale	RUN #2:			
	32	5	9.88	9.0	A	38.59	OK	72.52	limestone	Shale	3.28	0.00	0.00
	33	7	10.24	0.2	D	49.54	OK	2.20	shale	Siltstone			
	34	10	10.62	6.0	D	45.71	OK	74.66	limestone	Shale/Siltstone			
	35	5	10.80	0.1	D	42.06	OK	1.24	shale	Limestone	73.59	74.66	72.52
										SUMMARY	AVERAGE	MAX	MIN
										Shale	2.21	6.40	0.78
										Siltstone			
										Shale/Siltstone			
										Limestone	109.97	193.49	72.52

**TABLE 1 -Point Load and Unconfined Compression Test Results  
Highway 401 Widening – High Mast Lighting Poles**

BH P-20	DEPTH			FORCE (kN)	AXIAL / DIAMETRIC	DISTANCE (mm)	BREAK	UCS (Mpa)	Rock Type	UC Test Average			
	FT.	IN.	(m)										
RUN #1	11	10	3.61	14.1	D	62.80	OK	96.16	Limestone	RUN #1:			
	13	8	4.17	13.8	D	62.75	OK	94.23	Limestone		AVERAGE	MAX	MIN
	14	2	4.32	26.3	A	62.84	OK	188.17	Limestone				
										Shale			
										Siltstone			
										Shale/Siltstone			
										Limestone	126.19	188.17	94.23
RUN #2	14	9	4.50	7.3	A	62.80	OK	52.25	Limestone	RUN #2:			
	15	6	4.72	9.3	D	62.78	OK	63.46	Limestone				
										Shale			
										Siltstone			
										Shale/Siltstone			
										Limestone	55.74	63.46	47.95
RUN #3	16	2	4.93	8.9	D	72.68	OK	47.95	Limestone	RUN #3:			
	18	1	5.51	10.3	D	70.30	OK	59.31	Limestone				
										Shale	6.33	0.00	0.00
										Siltstone			
										Shale/Siltstone			
										Limestone	83.14	233.98	3.00
										SUMMARY	AVERAGE	MAX	MIN
										Shale			
										Siltstone			
										Shale/Siltstone			
										Limestone	85.93	188.17	47.95

BH 23	DEPTH			FORCE (kN)	AXIAL / DIAMETRIC	DISTANCE (mm)	BREAK	UCS (Mpa)	Rock Type	UC Test Average			
	FT.	IN.	(m)										
EAST RUN #1	12	3	3.73	24.0	D	78.50	OK	117.12	Limestone	RUN #1:			
	13	6	4.11	0.5	A	44.00	OK	4.28	Limestone		AVERAGE	MAX	MIN
	13	11	4.24	1.5	D	55.50	OK	12.31	Shale	Shale	12.31	12.31	12.31
	14	8	4.47	9.5	A	54.00	OK	73.32	Limestone	Siltstone			
	15	10	4.83	3.0	D	38.50	OK	42.62	Limestone	Shale/Siltstone			
RUN #2										Limestone	59.34	117.12	4.28
	16	6	5.03	6.0	D	40.00	OK	80.50	Limestone	RUN #2:			
	17	4	5.28	16.0	D	135.50	OK	51.57	Limestone	Shale	6.40	0.00	0.00
	18	5	5.61	14.0	D	103.50	OK	134.40	Limestone	Siltstone			
	19	8	5.99	19.0	A	50.00	OK	121.63	Limestone	Shale/Siltstone			
	20	8	6.30	1.0	A	78.50	OK	6.40	Shale	Limestone	97.03	134.40	51.57
										SUMMARY	AVERAGE	MAX	MIN
										Shale	9.36	12.31	6.40
										Siltstone			
										Shale/Siltstone			
										Limestone	78.18	134.40	4.28

BH P-27	DEPTH			FORCE (kN)	AXIAL / DIAMETRIC	DISTANCE (mm)	BREAK	UCS (Mpa)	Rock Type	UC Test Average			
	FT.	IN.	(m)										
east RUN #1	8	0	2.44	24.0	A	87.50	OK	145.52	Limestone	RUN #1:			
	9	8	2.95	0.0	D	98.50	LOW	3.00	Limestone		AVERAGE	MAX	MIN
	10	7	3.23	0.0	A	65.00	LOW	3.00	Shale	Shale	3.00	3.00	3.00
										Siltstone			
										Shale/Siltstone			
										Limestone	74.26	145.52	3.00
RUN #2	13	1	3.99	0.5	A	49.50	OK	4.03	Shale	RUN #2:			
	14	6	4.42	0.0	A	70.00	LOW	3.00	Shale	Shale	4.78	0.00	0.00
	15	7	4.75	1.0	A	60.00	OK	7.32	Shale	Siltstone			
	16	10	5.13	5.5	D	85.00	OK	23.82	Limestone	Shale/Siltstone			
										Limestone	23.82	23.82	23.82
										SUMMARY	AVERAGE	MAX	MIN
										Shale	4.34	7.32	3.00
										Siltstone			
										Shale/Siltstone			
										Limestone	57.45	145.52	3.00

**TABLE 1 -Point Load and Unconfined Compression Test Results  
Highway 401 Widening – High Mast Lighting Poles**

BH P-29 east	DEPTH			FORCE (kN)	AXIAL / DIAMETRIC	DISTANCE (mm)	BREAK	UCS (Mpa)	Rock Type	UC Test Average			
	FT.	IN.	(m)										
RUN #1	8	3	2.51	8.5	D	46.81	OK	90.08	Limestone	RUN #1:			
										AVERAGE	MAX	MIN	
										Shale			
										Siltstone			
										Shale/Siltstone			
										Limestone	90.08	90.08	90.08
RUN #2	10	8	3.25	5.0	A	46.81	OK	41.45	Limestone	RUN #2:			
	10	8	3.25	13.8	D	46.81	OK	145.13	Limestone	Shale	7.30	0.00	0.00
	12	4	3.76	10.0	A	47.05	OK	82.69	Limestone	Siltstone			
	12	8	3.66	20.3	D	47.12	OK	213.02	Limestone	Shale/Siltstone			
	14	6	4.42	25.0	A	47.10	OK	206.61	Limestone	Limestone	144.10	233.98	41.45
RUN #3	17	0	5.18	1.0	D	47.19	OK	10.47	shale	RUN #3:			
	17	1	5.21	9.0	A	47.19	OK	74.30	Limestone	Shale	7.30	0.00	0.00
	17	7	5.36	0.5	A	47.20	OK	4.13	shale	Siltstone			
	18	9	5.72	28.3	A	47.13	OK	233.98	Limestone	Shale/Siltstone			
	19	10	6.05	14.8	D	47.06	OK	155.60	Limestone	Limestone	146.23	233.98	41.45
										SUMMARY	AVERAGE	MAX	MIN
										Shale	7.30	10.47	4.13
										Siltstone			
										Shale/Siltstone			
										Limestone	138.10	233.98	41.45

BH P-30	DEPTH			FORCE (kN)	AXIAL / DIAMETRIC	DISTANCE (mm)	BREAK	UCS (Mpa)	Rock Type	UC Test Average			
	FT.	IN.	(m)										
RUN #1	9	6	2.90	11.0	D	56.00	OK	89.09	Limestone	RUN #1:			
	10	5	3.18	9.0	A	66.50	OK	62.60	Limestone	AVERAGE	MAX	MIN	
	12	9	3.89	7.0	D	89.50	OK	28.06	Limestone	Shale			
	14	3	4.34	7.0	A	62.00	OK	50.42	Limestone	Siltstone			
										Shale/Siltstone			
										Limestone	57.54	89.09	28.06
RUN #2	15	0	4.57	12.0	D	80.00	OK	56.92	Limestone	RUN #2:			
	15	8	4.78	2.0	A	56.50	OK	14.41	Limestone	Shale			
	16	6	5.03	3.0	A	62.00	OK	20.94	Limestone	Siltstone			
	17	7	5.36	3.0	D	66.00	OK	33.73	Limestone	Shale/Siltstone			
	18	11	5.77	2.0	A	45.00	OK	16.91	Limestone	Limestone	28.58	56.92	14.41
										SUMMARY	AVERAGE	MAX	MIN
										Shale			
										Siltstone			
										Shale/Siltstone			
										Limestone	41.45	89.09	14.41

BH P-32 EAST	DEPTH			FORCE (kN)	AXIAL / DIAMETRIC	DISTANCE (mm)	BREAK	UCS (Mpa)	Rock Type	UC Test Average			
	FT.	IN.	(m)										
RUN #1	9	4	2.84	1.5	A	74.00	OK	9.89	Shale	RUN #1:			
	11	3	3.43	2.5	D	63.00	OK	16.97	Limestone	AVERAGE	MAX	MIN	
	12	4	3.76	19.0	A	72.50	OK	126.56	Limestone	Shale	9.89	9.89	9.89
	13	0	3.96	14.0	D	132.00	OK	31.33	Limestone	Siltstone			
										Shale/Siltstone			
										Limestone	58.29	126.56	16.97
RUN #2	14	8	4.47	18.0	D	200.00	OK	21.60	Limestone	RUN #2:			
	15	9	4.80	11.0	D	119.50	OK	75.56	Limestone	Shale			
	16	8	5.08	2.0	A	62.50	OK	13.81	Limestone	Siltstone			
	17	4	5.28	21.5	A	67.50	OK	86.12	Limestone	Shale/Siltstone			
	18	2	5.54	9.5	D	200.50	OK	11.36	Limestone	Limestone	41.69	86.12	11.36
										SUMMARY	AVERAGE	MAX	MIN
										Shale	9.89	9.89	9.89
										Siltstone			
										Shale/Siltstone			
										Limestone	47.91	126.56	11.36

**TABLE 1 -Point Load and Unconfined Compression Test Results  
Highway 401 Widening – High Mast Lighting Poles**

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**TABLE 1 -Point Load and Unconfined Compression Test Results  
Highway 401 Widening – High Mast Lighting Poles**

BH P-43	DEPTH			FORCE (kN)	AXIAL / DIAMETRIC	DISTANCE (mm)	BREAK	UCS (Mpa)	Rock Type	UC Test Average			
	FT.	IN.	(m)										
RUN #1	22	2	6.76	8.0	A	42.00	OK	70.01	Limestone	RUN #1:			
	24	7	7.49	0.0	A	47.00	LOW	3.00	Shale	AVERAGE MAX MIN			
										Shale	3.00	3.00	3.00
										Siltstone	#DIV/0!	0.00	0.00
										Shale/Siltstone	#DIV/0!	0.00	0.00
										Limestone	70.01	70.01	70.01
RUN #2	25	9	7.85	0.5	A	51.00	OK	3.97	Shale	RUN #2:			
	26	10	8.18	0.0	A	65.00	LOW	3.00	Shale	AVERAGE MAX MIN			
	27	11	8.51	0.0	D	83.50	LOW	3.00	Shale	Shale	3.32	0.00	0.00
										Siltstone	#DIV/0!	0.00	0.00
										Shale/Siltstone	#DIV/0!	0.00	0.00
										Limestone	#DIV/0!	0.00	0.00
										SUMMARY			
										Shale	3.24	3.97	3.00
										Siltstone	#DIV/0!	0.00	0.00
										Shale/Siltstone	#DIV/0!	0.00	0.00
										Limestone	70.01	70.01	70.01

BH P-47	DEPTH			FORCE (kN)	AXIAL / DIAMETRIC	DISTANCE (mm)	BREAK	UCS (Mpa)	Rock Type	UC Test Average			
	FT.	IN.	(m)										
RUN #1	10	9	3.28	14.0	D	125.00	OK	34.00	Limestone	RUN #1:			
	14	4	4.37	13.0	D	65.00	OK	84.20	Limestone	AVERAGE MAX MIN			
										Shale	#DIV/0!	0.00	0.00
										Siltstone	#DIV/0!	0.00	0.00
										Shale/Siltstone	#DIV/0!	0.00	0.00
										Limestone	59.10	84.20	34.00
RUN #3	16	8	5.08	1.0	A	66.00	OK	6.98	Shale	RUN #3:			
	17	10	5.44	1.0	D	46.00	OK	13.42	Shale	AVERAGE MAX MIN			
	18	10	5.74	0.0	A	40.00	LOW	3.00	Shale	Shale	6.60	0.00	0.00
	20	1	6.12	0.0	A	50.00	LOW	3.00	Shale	Siltstone	#DIV/0!	0.00	0.00
	21	4	6.50	9.0	D	78.50	OK	43.92	Limestone	Shale/Siltstone	#DIV/0!	0.00	0.00
										Limestone	43.92	43.92	43.92
										SUMMARY			
										Shale	6.60	13.42	3.00
										Siltstone	#DIV/0!	0.00	0.00
										Shale/Siltstone	#DIV/0!	0.00	0.00
										Limestone	54.04	84.20	34.00

BH P-49	DEPTH			FORCE (kN)	AXIAL / DIAMETRIC	DISTANCE (mm)	BREAK	UCS (Mpa)	Rock Type	UC Test Average			
	FT.	IN.	(m)										
RUN #1	10	5	3.18	0.0	A	47.00	LOW	3.00	Shale	RUN #1:			
	11	8	3.56	1.0	D	47.00	OK	10.53	Shale	AVERAGE MAX MIN			
	12	7	3.84	0.5	A	65.00	OK	3.52	Shale	Shale	5.01	10.53	3.00
	14	1	4.29	0.0	A	55.00	LOW	3.00	Shale	Siltstone	#DIV/0!	0.00	0.00
										Shale/Siltstone	#DIV/0!	0.00	0.00
										Limestone	#DIV/0!	0.00	0.00
RUN #2	15	2	4.62	0.0	A	56.00	LOW	3.00	Shale	RUN #2:			
	16	4	4.98	11.0	D	83.00	OK	58.65	Limestone	AVERAGE MAX MIN			
	17	4	5.28	0.0	A	74.00	LOW	3.00	Shale	Shale	2.81	0.00	0.00
	18	5	5.61	0.5	A	84.50	OK	2.44	Shale	Siltstone	#DIV/0!	0.00	0.00
	19	6	5.94	14.0	D	135.50	OK	30.13	Limestone	Shale/Siltstone	#DIV/0!	0.00	0.00
										Limestone	44.39	58.65	30.13
										SUMMARY			
										Shale	4.07	10.53	2.44
										Siltstone	#DIV/0!	0.00	0.00
										Shale/Siltstone	#DIV/0!	0.00	0.00
										Limestone	44.39	58.65	30.13

**TABLE 1 -Point Load and Unconfined Compression Test Results  
Highway 401 Widening – High Mast Lighting Poles**

BH	DEPTH				AXIAL /	DISTANCE		UCS	Rock Type		UC Test Average			
LSOP-07	FT.	IN.	(m)	FORCE (kN)	DIAMETRIC	(mm)	BREAK	(Mpa)						
RUN #1	28	10	8.79	0.0	A	69.00	LOW	3.00	Shale		RUN #1:			
	29	6	8.99	0.0	A	43.00	LOW	3.00	Shale			AVERAGE	MAX	MIN
											Shale	3.00	3.00	3.00
											Siltstone			
											Shale/Siltstone			
											Limestone			
RUN #3	31	0	9.45	0.0	A	63.50	LOW	3.00	Shale, Siltstone		RUN #3:			
	32	6	9.91	6.0	D	42.00	OK	54.31	siltstone		Shale			
	33	3	10.13	1.5	A	52.00	OK	10.03	Shale, Siltstone		Siltstone	54.31	54.31	54.31
	24	10	7.57	0.0	A	72.00	LOW	3.00	Shale, Siltstone		Shale/Siltstone	5.34	10.03	3.00
											Limestone			
											SUMMARY	AVERAGE	MAX	MIN
											Shale	3.00	3.00	3.00
											Siltstone	54.31	54.31	54.31
											Shale/Siltstone	5.34	10.03	3.00
											Limestone			

BH LSOP-10	DEPTH			FORCE (kN)	AXIAL / DIAMETRIC	DISTANCE (mm)	BREAK	UCS (Mpa)	Rock Type	UC Test Average			
	FT.	IN.	(m)										
RUN #1	9	9	2.97	1.5	A	79.50	OK	9.54	siltstone	RUN #1:			
	10	5	3.18	0.0	D	92.50	LOW	3.00	siltstone		AVERAGE	MAX	MIN
	12	2	3.71	0.0	A	91.00	LOW	3.00	Shale	Shale	3.00	3.00	3.00
	13	9	4.19	0.0	D	985.00	LOW	3.00	Shale	Siltstone	6.27	9.54	3.00
										Shale/Siltstone			
										Limestone			
RUN #3	14	9	4.50	0.5	A	92.50	OK	2.95	Shale	RUN #3:			
	16	11	5.16	1.5	D	102.50	OK	7.39	siltstone	Shale	2.95	34.89	7.39
	17	7	5.36	4.5	A	78.00	OK	34.89	siltstone	Siltstone	21.14	34.89	7.39
	18	10	5.74	0.5	D	53.50	OK	4.34	Limestone	Shale/Siltstone			
										Limestone	4.34	4.34	4.34
										SUMMARY	AVERAGE	MAX	MIN
										Shale	2.98	3.00	2.95
										Siltstone	13.71	34.89	3.00
										Shale/Siltstone			
										Limestone	4.34	4.34	4.34

[illegible]

**TABLE 1 -Point Load and Unconfined Compression Test Results  
Highway 401 Widening – High Mast Lighting Poles**

[illegible]

BH	DEPTH				AXIAL /	DISTANCE		UCS	Rock Type		UC Test Average			
LSOP-17	FT.	IN.	(m)	FORCE (kN)	DIAMETRIC	(mm)	BREAK	(Mpa)						
west														
RUN #2	33	8	10.26	0.0	D	78.50	LOW	3.00	shale		RUN #1:			
	34	10	10.62	0.0	A	44.00	LOW	3.00	shale			AVERAGE	MAX	MIN
	35	3	10.74	0.0	A	55.50	LOW	3.00	shale		Shale	3.00	3.00	3.00
	35	8	10.87	0.0	D	54.00	LOW	3.00	shale		Siltstone			
											Shale/Siltstone			
											Limestone			
RUN #3	36	2	11.02	0.5	A	40.00	OK	4.48	shale		RUN #2:			
	38	4	11.68	1.0	D	135.50	OK	1.88	Limestone		Shale	3.74	0.00	0.00
	39	0	11.89	0.5	D	103.50	OK	1.12	Limestone		Siltstone			
	40	3	12.27	0.0	D	50.00	LOW	3.00	shale		Shale/Siltstone			
											Limestone	1.50	1.88	1.12
											SUMMARY	AVERAGE	MAX	MIN
											Shale	3.25	4.48	3.00
											Siltstone			
											Shale/Siltstone			
											Limestone	1.50	1.88	1.12

BH LSOP-23	DEPTH			FORCE (kN)	AXIAL / DIAMETRIC	DISTANCE (mm)	BREAK	UCS (Mpa)	Rock Type	UC Test Average			
	FT.	IN.	(m)										
WEST													
RUN #2	29	6	8.99	4.5	D	105.20	OK	14.16	Limestone	RUN #1:			
										AVERAGE	MAX	MIN	
										Shale			
										Siltstone			
										Shale/Siltstone			
RUN #3										Limestone	14.16	14.16	14.16
	34	1	10.39	12.5	D	106.30	OK	38.71	Limestone	RUN #2:			
	35	9	10.90	16.0	A	54.30	OK	104.58	Limestone	Shale	3.00	0.00	0.00
	36	6	11.13	0.0	D	75.30	LOW	3.00	Shale	Siltstone			
										Shale/Siltstone			
										Limestone	71.64	104.58	38.71
										SUMMARY	AVERAGE	MAX	MIN
										Shale	3.00	3.00	3.00
										Siltstone			
										Shale/Siltstone			
										Limestone	52.48	104.58	14.16

**TABLE 2**  
**GEOTECHNICAL DESIGN PARAMETERS**  
**HIGH MAST LIGHTING POLES FROM DIXIE ROAD TO KENNEDY ROAD**  
**Highway 401 Widening – High Mast Lighting Poles**

HML Pole Number and Location	Reference Borehole <sup>2</sup>	Subsurface Stratigraphy <sup>2</sup> 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)
<b>P2, P4</b> NW quadrant of Highway 401 and Highway 410 interchange	P-02	Shale (FILL) (Very stiff to hard)	0.0 – 2.1	-	30	20	-	3.0	2.7
		SHALE (weathered)	2.1 – 5.7	-	40	23	13	4.6	
<b>P3</b> NW quadrant of Highway 401 and Highway 410 interchange	P-03	Silty Clay (FILL) (Stiff)	0.0 – 0.8	70	-	19	-	-	2.0
		Silty Clay Till (Very stiff to hard)	0.8 – 2.0	175	-	21	-	-	
		SHALE (weathered)	2.0 – 5.0	-	40	23	13	4.6	
		SHALE	5.0 – 7.0	800	-	24	-	-	
<b>P5, P6</b> NW quadrant of Highway 401 and Highway 410 interchange	SWMP-01	Shale (FILL) (Very stiff to hard)	0.0 – 2.3	-	30	20	-	3.0	6.0
		Silty Clay Till (Very stiff)	2.3 – 4.3	180	-	21	11	-	
		SHALE (weathered)	4.3 – 5.0	-	40	23	13	4.6	
		SHALE	5.0 – 6.2	800	-	24	-	-	
<b>P7</b> NE quadrant of Highway 401 and Highway 410 interchange	P-07	Sand (FILL) (Very dense)	0.0 – 0.4	-	30	20	-	3.0	3.0
		Silty Clay Till (Hard)	0.4 – 1.4	200	-	21	-	-	
		SHALE (weathered)	1.4 – 5.0	-	40	23	13	4.6	

## Highway 401 Widening – High Mast Lighting Poles from Kennedy Road to McLaughlin Drive

HML Pole Number and Location	Reference Borehole <sup>2</sup>	Subsurface Stratigraphy <sup>2</sup> For Design	Depth Below Existing Ground Surface (m)	Geotechnical Design Parameters						Groundwater Depth ( m) (below existing ground surface)
				$q_u$ (kPa)	$\phi'$ (deg.)	$\gamma$ (kN/m <sup>3</sup> )	$\gamma'$ (kN/m <sup>3</sup> )	$K_p$		
<b>P8</b> NW quadrant of Highway 401 and Highway 410 interchange	OHS-12	Silty Clay Till (Firm to Hard)	0.1 – 2.4 2.4 – 4.0	120 200	- -	21 21	- 11	- -	3.0	
		SHALE (weathered) SHALE	4.0 – 5.4 5.4 – 7.0	- 800	40 -	23 24	13 -	4.6 -		
<b>P9</b> NW quadrant of Highway 401 and Highway 410 interchange <b>P10</b> Highway 401 median, west of Highway 410	P-09	Silty Clay Till (Stiff to very stiff)	0.0 – 2.1	-	30	20	-	3.0	1.8	
		Silty Clay Till (Very stiff)	2.1 – 4.7	180	-	21	11	-		
		SHALE (weathered) SHALE	4.7 – 7.4 7.4 – 8.5	- 800	40 -	23 24	13 -	4.6 -		
<b>P11,P12</b> NE quadrant of Highway 401 and Highway 410 interchange	P-12	Silty Clay (Stiff to Very stiff)	0.0 – 1.4	100	-	19	-	-	5.5	
		Silty Clay Till (Hard) SHALE (weathered)	1.4 – 3.0	200	-	21	-	-		
			3.0 – 6.3	-	40	23	13	4.6		
<b>P13,P14</b> NE quadrant of Highway 401 and Highway 410 interchange, West of Tomken Rd.	P-14	Silty Clay (Hard)	0.1 – 0.4	150	-	20	-	-	3.0	
		SHALE (weathered) SHALE	0.4 – 3.2 3.2 – 4.3	- 800	40 -	23 24	13 -	4.6 -		

## Highway 401 Widening – High Mast Lighting Poles from Kennedy Road to McLaughlin Drive

HML Pole Number and Location	Reference Borehole <sup>2</sup>	Subsurface Stratigraphy <sup>2</sup> For Design	Depth Below Existing Ground Surface (m)	Geotechnical Design Parameters					Groundwater Depth (m) (below existing ground surface)
				q <sub>u</sub> (kPa)	φ' (deg.)	γ (kN/m <sup>3</sup> )	γ' (kN/m <sup>3</sup> )	K <sub>p</sub>	
<b>P15</b> SE quadrant of Highway 401 and Highway 410 interchange	P-15, P-15A	Silty Clay (FILL) (Hard)	0.0 – 0.8	100	-	20	-	-	1.0
		SHALE (weathered) SHALE	0.8 – 5.0 5.0 – 7.5	- 800	40 -	23 24	13 -	4.6 -	
<b>P16, P17</b> SE quadrant of Highway 401 and Highway 410 interchange	P-16	Silty Clay (FILL) (Stiff to Hard)	0.1 – 2.0	100	-	20	10	-	2.0
		Silty Clay Till (Stiff to Hard)	2.0 – 7.1	150	-	21	11	-	
		SHALE (weathered) SHALE	7.1 – 9.0 9.0 – 11.0	- 800	40 -	23 24	13 -	4.6 -	
<b>P18, P19</b> Highway 401, 500 m west of Highway 410	OHS-10	Sand (FILL) (Compact)	0.0 – 0.8	-	30	20	-	3.0	1.9
		SHALE (weathered) SHALE	0.8 – 2.7 2.7 – 5.8	- 800	40 -	23 24	13 -	4.6 -	
<b>P20</b> SW quadrant of Highway 401 and Highway 410 interchange	P-20	Sand (FILL) (Compact)	0.0 – 0.7	-	30	20	-	3.0	2.0
		Silty Clay (Stiff to Very stiff)	0.7 – 3.2	150	-	19	9	-	
		SHALE (weathered)	3.2 – 6.4	-	40	23	13	4.6	

HML Pole Number and Location	Reference Borehole <sup>2</sup>	Subsurface Stratigraphy <sup>2</sup> 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)
<b>P21</b> SW quadrant of Highway 401 and Highway 410 interchange	C20	Silty Clay (Very soft to Firm)	0.0 – 2.0	50	-	19	-	-	2.0
		SHALE (weathered) SHALE	2.0 – 3.6 3.6 – 6.1	- 800	40 -	23 24	13 -	4.6 -	
<b>P22, P23</b> SW quadrant of Highway 401 and Highway 410 interchange	P-23	Silty Clay (FILL) (Firm)	0.1 – 1.2	50	-	19	-	-	5.0
		Silty Clay (Firm to Hard)	1.2 – 2.7	150	-	19	-	-	
		SHALE (weathered) SHALE	2.7 – 4.7 4.7 – 6.5	- 800	40 -	23 24	13 -	4.6 -	
<b>P24, P25</b> SE quadrant of Highway 401 and Highway 410 interchange	C13	Silty Clay Till (Hard)	0.0 – 0.5	150	-	21	-	-	1.0
		SHALE (weathered) SHALE	0.5 – 3.7 3.7 – 4.8	- 800	40 -	23 24	13 -	4.6 -	
<b>P26, P27, P28</b> SE quadrant of Highway 401 and Highway 410 interchange	P-27	Silty Clay (FILL) (Stiff to Very stiff)	0.1 – 1.5	100	-	20	-	-	4.0
		SHALE (weathered) SHALE	1.5 – 3.7 3.7 – 5.2	- 800	40 -	23 24	13 -	4.6 -	

## Highway 401 Widening – High Mast Lighting Poles from Kennedy Road to McLaughlin Drive

HML Pole Number and Location	Reference Borehole <sup>2</sup>	Subsurface Stratigraphy <sup>2</sup> For Design	Depth Below Existing Ground Surface (m)	Geotechnical Design Parameters						Groundwater Depth ( m) (below existing ground surface)
				q <sub>u</sub> (kPa)	ϕ' (deg.)	γ (kN/m <sup>3</sup> )	γ' (kN/m <sup>3</sup> )	K <sub>p</sub>		
<b>P29</b> SE quadrant of Highway 401 and Highway 410 interchange	P-29	Silty Clay Till (Very stiff to Hard)	0.1 – 2.2	200	-	21	11	-	2.0	
		SHALE (weathered)	2.2 – 6.2	-	40	23	13	4.6		
<b>P30</b> SE quadrant of Highway 401 and Highway 410 interchange	P-30	Silty Clay (FILL) (Hard)	0.1 – 1.5	100	-	20	10	-	1.0	
		Silty Clay Till (Hard)	1.5 – 2.3	200	-	21	11	-		
		SHALE (weathered) SHALE	2.3 – 4.7 4.7 – 5.9	- 800	40 -	23 24	13 -	4.6 -		
<b>P31, P32</b> SE quadrant of Highway 401 and Highway 410 interchange	P-32	Sand (FILL) Compact	0.0 – 0.8	-	30	20	-	3.0	4.0	
		SHALE (weathered) SHALE	0.8 – 3.5 3.5 – 5.8	- 800	40 -	23 24	13 -	4.6 -		
<b>P33, P34</b> Highway 401 WBL Collector, 100 m to 250 m east of Tomken Rd.	P-33	Silty Clay Till (Firm to Hard)	0.1 – 3.0	200	-	19	9.0	-	0.5	
		SHALE (weathered) SHALE	3.0 – 6.3 6.3 – 7.8	- 800	40 -	23 24	13 -	4.6 -		



## Highway 401 Widening – High Mast Lighting Poles from Kennedy Road to McLaughlin Drive

HML Pole Number and Location	Reference Borehole <sup>2</sup> Location	Subsurface Stratigraphy <sup>2</sup> For Design	Depth Below Existing Ground Surface (m)	Geotechnical Design Parameters						Groundwater Depth ( m) (below existing ground surface)
				q <sub>u</sub> (kPa)	ϕ' (deg.)	γ (kN/m <sup>3</sup> )	γ' (kN/m <sup>3</sup> )	K <sub>p</sub>		
<u>P35</u> Highway 401 WBL Collector, 400 m to 700 m east of Tomken Rd.	P-41	Sand (FILL)	0.0 – 0.9	-	30	20	-	3.0	2.0	
		Silty Clay Till (Hard)	0.9 – 1.5	200	-	21	-	-		
		SHALE (weathered) SHALE	1.5 – 4.4 4.4 – 6.4	- 800	40 -	23 24	13 -	4.6 -		
<u>P36</u> Highway 401 WBL Collector, 400 m to 700 m east of Tomken Rd.	P-36	Silty Clay Till (Stiff to Hard)	0.1 – 3.4	180	-	21	11	-	1.2	
		SHALE (weathered) SHALE	3.4 – 5.0 5.0 – 6.9	- 800	40 -	23 24	13 -	4.6 -		
<u>P37</u> Highway 401 WBL Collector, 400 m to 700 m east of Tomken Rd.	P-45	Sand (FILL)	0.0 – 0.7	-	30	20	-	3.0	2.0	
		Silty Clay (Very stiff to Hard)	0.7 – 5.6	180	-	21	11	-		
		SHALE (weathered)	5.6 – 7.8	-	40	23	13	4.6		

## Highway 401 Widening – High Mast Lighting Poles from Kennedy Road to McLaughlin Drive

HML Pole Number and Location	Reference Borehole <sup>2</sup>	Subsurface Stratigraphy <sup>2</sup> For Design	Depth Below Existing Ground Surface (m)	Geotechnical Design Parameters						Groundwater Depth (m) (below existing ground surface)
				q <sub>u</sub> (kPa)	ϕ' (deg.)	γ (kN/m <sup>3</sup> )	γ' (kN/m <sup>3</sup> )	K <sub>p</sub>		
<b>P38</b> Highway 401 WBL, 1 km east of Tomken Rd.	P-38	Sand/Silty Clay (FILL) (Stiff to Very stiff)	0.1 – 2.3	120	-	20	-	-	7.0	
		Silty Clay Till (Stiff to Hard)	2.3 – 7.6	180	-	21	11	-		
		Sand (Very dense)	7.6 – 9.1	-	32	20	10	3.3		
		Silty Clay Till (Hard)	9.1 -9.8	200	-	21	11	-		
<b>P39</b> Highway 401, West of Tomken Rd.	50-4	Silty Clay Till/Sand&Gravel (Stiff to Hard)	0.0 – 1.8	180	-	20	-	-	2.0	
		SHALE (weathered) SHALE	1.8 – 4.5 4.5 – 6.4	- 800	40 -	23 24	13 -	4.6 -		
		Sand (FILL)	0.0 – 0.9	-	30	20	-	3.0		
<b>P40, P41,P42</b> Highway 401, 100 m to 200 m east of Tomken Rd.	P-41	Silty Clay Till (Hard)	0.9 – 1.5	200	-	21	-	-	2.0	
		SHALE (weathered) SHALE	1.5 – 4.4 4.4 – 6.4	- 800	40 -	23 24	13 -	4.6 -		

## Highway 401 Widening – High Mast Lighting Poles from Kennedy Road to McLaughlin Drive

HML Pole Number and Location	Reference Borehole <sup>2</sup>	Subsurface Stratigraphy <sup>2</sup> For Design	Depth Below Existing Ground Surface (m)	Geotechnical Design Parameters						Groundwater Depth (m) (below existing ground surface)
				q <sub>u</sub> (kPa)	ϕ <sup>2</sup> (deg.)	γ (kN/m <sup>3</sup> )	γ' (kN/m <sup>3</sup> )	K <sub>p</sub>		
<b>P43, P44</b> Highway 401 EBL, 300 m to 400 m east of Tomken Rd.	P-43	Sand (FILL)	0.0 – 1.5	100	-	19	9	-	1.2	
		Silty Clay Till (Very stiff to Hard)	1.5 – 6.3	200	-	21	11	-		
		SHALE (weathered) SHALE	6.3 – 7.4 7.4 – 8.6	- 800	40 -	23 24	13 -	4.6 -		
<b>P45, P46</b> Highway 401, 800 m east of Tomken Rd.	P-45	Sand (FILL)	0.0 – 0.7	-	30	20	-	3.0	2.0	
		Silty Clay (Very stiff to Hard)	0.7 – 5.6	180	-	21	11	-		
		SHALE (weathered)	5.6 – 7.8	-	40	23	13	4.6		
<b>P47</b> SE quadrant of Highway 401 and Highway 410 interchange	P-47	Silty Clay (Stiff to Hard)	0.1 – 1.8	120	-	20	-	-	1.8	
		SHALE (weathered) SHALE	1.8 – 5.0 5.0 – 6.6	- 800	40 -	23 24	13 -	4.6 -		
<b>P48, P49</b> Highway 401 EBL Collector, east/west of Tomken Rd.	P-49	Silty Clay Till (Hard)	0.0 – 0.4	200	-	21	-	-	4.0	
		SHALE (weathered) SHALE	0.4 – 5.0 5.0 – 6.1	- 800	40 -	23 24	13 -	4.6 -		

## Highway 401 Widening – High Mast Lighting Poles from Kennedy Road to McLaughlin Drive

HML Pole Number and Location	Reference Borehole <sup>2</sup>	Subsurface Stratigraphy <sup>2</sup> For Design	Depth Below Existing Ground Surface (m)	Geotechnical Design Parameters					Groundwater Depth (m) (below existing ground surface)
				q <sub>u</sub> (kPa)	φ' (deg.)	γ (kN/m <sup>3</sup> )	γ' (kN/m <sup>3</sup> )	K <sub>p</sub>	
<b>P1, P2, P3</b> Hwy 401, 400 to 700 m west of Huronario St.	LSOP-02	Sand (FILL)	0.0 – 0.8	-	30	20	-	3.0	8.5
		Silty Clay (FILL) (Firm to Stiff)	0.8 – 2.3	100	-	19	-	-	
		Silty Clay Till (Very stiff to Hard)	2.3 -9.7	180	-	21	11	-	
<b>P4, P6</b> NW quadrant of Highway 401 and Huronario Street interchange	HML-01	Shale (FILL) (Hard)	0.0 – 0.6	-	30	20	10	3.0	1.0
		Clayey Silt Till (Very Stiff to Hard)	0.6 – 1.5	180	-	21	11	-	
		SHALE (weathered) SHALE	1.5 – 3.7 3.7 – 5.7	- 800	40 -	23 24	13 -	4.6 -	
	RW2-3	Silty Clay and Shale (FILL) (Hard to very stiff)	0.0 – 3.0	-	30	20	10	3.0	2.5
		Silty Clay Till (Hard) SHALE (weathered)	3.0 – 3.7 3.7 – 6.1	200 -	- 40	21 23	- 13	- 4.6	
RW2-2	Silty Clay (FILL) (Hard)	0.0 – 0.6	100	-	20	-	-	-	2.5
	Silty Clay Till (Hard)	0.6 – 1.2	200	-	21	11	-	-	
	SHALE (weathered)	1.2 – 3.0	-	40	23	13	4.6	4.6	

## Highway 401 Widening – High Mast Lighting Poles from Kennedy Road to McLaughlin Drive

HML Pole Number and Location	Reference Borehole <sup>2</sup>	Subsurface Stratigraphy <sup>2</sup> For Design	Depth Below Existing Ground Surface (m)	Geotechnical Design Parameters					Groundwater Depth (m) (below existing ground surface)
				$q_u$ (kPa)	$\phi'$ (deg.)	$\gamma$ (kN/m <sup>3</sup> )	$\gamma'$ (kN/m <sup>3</sup> )	$K_p$	
<u>P5</u> NW quadrant of Highway 401 and Hurontario Street interchange	NAR08	Silty Clay (FILL) (Firm to very stiff)	0.0 – 1.5	100	-	19	-	-	1.0
		Silt and Sand Till (Dense to Very dense) Sandy Silt (Very dense)	1.5 – 2.7 2.7 – 4.7	-	32	21	11	3.3	
		Silty Clay Till (Hard)	4.7 – 5.5	200	-	21	11	-	
		SHALE (weathered) SHALE	5.5 – 7.5 7.5 – 9.3	- 800	40 -	23 24	13 -	4.6 -	
		Sand/ Silty Clay (FILL) (Very dense/Hard)	0 – 1.5	-	30	20	10	3.0	
	NAR15	Silty Clay Till (Hard)	1.5 – 3.0	200	-	21	11	-	2.0
		Silt and Sand Till (Very dense) SHALE (weathered)	3.0 – 4.3 4.3 – 6.2	- -	32 40	21 23	11 13	3.3 4.6	

## Highway 401 Widening – High Mast Lighting Poles from Kennedy Road to McLaughlin Drive

HML Pole Number and Location	Reference Borehole <sup>2</sup>	Subsurface Stratigraphy <sup>2</sup> For Design	Depth Below Existing Ground Surface (m)	Geotechnical Design Parameters					Groundwater Depth (m) (below existing ground surface)
				q <sub>u</sub> (kPa)	ϕ' (deg.)	γ (kN/m <sup>3</sup> )	γ' (kN/m <sup>3</sup> )	K <sub>p</sub>	
<b>P7</b> NE quadrant of Highway 401 and Hurontario Street interchange	LSOP-07	Silty Clay (FILL) (Firm to Stiff)	0.1 – 0.8	75	-	19	9	-	1.0
		Silty Clay Till (Very stiff to Hard)	0.8 – 6.1	180	-	21	11	-	
		Sand (Very dense)	6.1 -7.0	-	32	21	11	3.3	
		SHALE (weathered) SHALE	7.0 – 9.0 9.0 – 10.7	- 800	40 -	23 24	13 -	4.6 -	
<b>P8</b> NE quadrant of Highway 401 and Hurontario Street interchange	HML-03	Silty Clay Till (Very stiff to hard)	0.0 – 4.6	180	-	21	11	-	1.0
		Clayey Silt Till (Hard)	4.6 – 6.1	200	-	21	11	-	
		Silty Clay Till (Hard)	6.1 – 6.6	-	-	-	-	-	
		SHALE (weathered) SHALE	6.6 – 8.8 8.8 – 10.4	- 800	40 -	23 24	13 -	4.6 -	
<b>P9</b> SW quadrant of Highway 401 and Hurontario Street interchange	HML-02	Silty Clay Till (Very stiff)	0.0 – 1.0	120	-	21	11	-	3.5
		SHALE (weathered) SHALE	1.0 – 3.7 3.7 – 6.1	- 800	40 -	23 24	13 -	4.6 -	
<b>P10</b> SW quadrant of Highway 401 and Hurontario Street interchange	LSOP-10	Silty Clay Till (Very stiff)	0.1 – 2.1	120	-	21	11	-	1.0
		SHALE (weathered) SHALE	2.1 – 4.1 4.1 – 5.8	- 800	40 -	23 24	13 -	4.6 -	

HML Pole Number and Location	Reference Borehole <sup>2</sup>	Subsurface Stratigraphy <sup>2</sup> For Design	Depth Below Existing Ground Surface (m)	Geotechnical Design Parameters					Groundwater Depth (m) (below existing ground surface)
				$q_u$ (kPa)	$\phi^s$ (deg.)	$\gamma$ (kN/m <sup>3</sup> )	$\gamma'$ (kN/m <sup>3</sup> )	$K_p$	
<b>P11, P13</b>  SE quadrant of Highway 401 and Hurontario Street interchange	HML-04	Silty Clay (FILL) (Very stiff)	0.0 – 0.7	120	-	19	-	-	1.0
		Silty Clay Till/Clayey Silt Till (Hard)	0.7 – 6.7	200	-	21	-	-	
		SHALE (weathered) SHALE	6.7 – 7.5 7.5 – 11.0	- 800	40 -	23 24	13 -	4.6 -	
	H6	Sand/Gravel/Silt (FILL) (Dense)	0.0 – 1.5	-	30	20	10	3.0	7.0
		Silty Clay (FILL) (Stiff to very stiff)	1.5 – 8.5	120	-	19	-	-	
		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 -	
		Silty Clay (FILL) (Very stiff)	0.0 – 1.4	120	-	19	9	-	
	C4-3 C4-4	Silty Clay Till (Firm to Stiff) Silty Clay Till (Hard)	1.4 – 2.0 2.0 – 4.6	120 200	- -	20 21	10 11	- -	1.0
		Sand and Silt Till (Very dense)	4.6 – 5.5	-	32	21	11	3.2	
		SHALE (weathered)	5.5 – 6.2	-	40	23	13	4.6	

## Highway 401 Widening – High Mast Lighting Poles from Kennedy Road to McLaughlin Drive

HML Pole Number and Location	Reference Borehole <sup>2</sup>	Subsurface Stratigraphy <sup>2</sup> For Design	Depth Below Existing Ground Surface (m)	Geotechnical Design Parameters					Groundwater Depth ( m ) (below existing ground surface)
				q <sub>u</sub> (kPa)	φ' (deg.)	γ (kN/m <sup>3</sup> )	γ' (kN/m <sup>3</sup> )	K <sub>p</sub>	
<b>P12</b> SE quadrant of Highway 401 and Hurontario Street interchange	LSOP-12	Silty Clay (FILL) (Stiff)	0.1 – 1.5	100	-	19	-	-	1.5
		Sand (Loose)	1.5 – 2.3	-	30	20	10	3.0	
		Silty Clay Till (Very stiff)	2.3 – 4.6	175	-	21	11	-	
		Silty Sand Till (Dense)	4.6 – 5.5	-	30	20	10	3.0	
		SHALE (weathered) SHALE	5.5 – 7.0 7.0 – 9.0	- 800	40 -	23 24	13 -	4.6 -	
<b>P14, P15</b> Highway 401 W/B Collectors,	HML-05	Silty Clay (FILL) (Very stiff)	0.0 – 0.8	120	-	20	-	-	3.0
		Clayey Silt Till (Hard)	0.8 – 3.7	200	-	21	11	-	
		SHALE (weathered) SHALE	3.7 – 8.4 8.4 – 11.3	- 800	40 -	23 24	13 -	4.6 -	
<b>P16</b>	LSOP-16	Peat	0.0 – 0.8						1.0
		Silty Clay Till (Stiff)	0.8 – 1.5	120	-	21	11	-	
		SHALE (weathered) SHALE	1.5 – 3.5 3.5 – 5.6	- 800	40 -	23 24	13 -	4.6 -	



## Highway 401 Widening – High Mast Lighting Poles from Kennedy Road to McLaughlin Drive

HML Pole Number and Location	Reference Borehole <sup>2</sup>	Subsurface Stratigraphy <sup>2</sup> For Design	Depth Below Existing Ground Surface (m)	Geotechnical Design Parameters					Groundwater Depth ( m) (below existing ground surface)
				q <sub>u</sub> (kPa)	ϕ' (deg.)	γ (kN/m <sup>3</sup> )	γ' (kN/m <sup>3</sup> )	K <sub>p</sub>	
<b>P17, P18</b> Highway 401 WBL, 400 m east of Hurontario Street	LSOP-17	Sand/Silty sand (FILL) (compact to very dense)	0.2 – 2.3	-	30	20	10	3.0	4.5
		Silty Clay Till (Very stiff)	2.3 – 3.2	200	-	21	11	-	
		Silty Sand Till (Very Dense)	3.2 – 6.1	-	32	21	11	3.3	
		Silty Clay Till (Hard)	6.1 – 8.7	200	-	21	11	-	
		SHALE (weathered)	8.7 -9.2	-	40	23	13	4.6	
<b>P19, P20</b> Highway 401 WBL, 600 m east of Hurontario Street	LSOP-19	Sand/Silty sand (FILL) (compact to very dense)	0.1 – 3.0	-	30	20	-	3.0	6.0
		Sand (Compact to dense)	3.0 – 6.2	-	30	20	10	3.0	
		Silty Clay Till (Hard)	6.2 – 8.8	200	-	21	11	-	
		SHALE (weathered)	8.8 – 9.8	-	40	23	13	4.6	
<b>P21</b> Highway 401 WBL, 900 m east of Hurontario Street	BW10	Sandy silt /Silty Clay (FILL) (Loose to compact / Very stiff)	0.0 – 2.3	-	30	20	10	3.0	2.0
		Silty Clay (Stiff to Very stiff)	2.3 – 4.0	150	-	19	9	-	
		SHALE (weathered) SHALE	4.0 – 6.0 6.0 – 7.7	- 800	40 -	23 24	13 -	4.6 -	

## Highway 401 Widening – High Mast Lighting Poles from Kennedy Road to McLaughlin Drive

HML Pole Number and Location	Reference Borehole <sup>2</sup>	Subsurface Stratigraphy <sup>2</sup> For Design	Depth Below Existing Ground Surface (m)	Geotechnical Design Parameters						Groundwater Depth (m) (below existing ground surface)
				q <sub>u</sub> (kPa)	φ' (deg.)	γ (kN/m <sup>3</sup> )	γ' (kN/m <sup>3</sup> )	K <sub>p</sub>		
<b>P22, P23</b> Highway 401 WBL, 1.0 km to 1.3 km east of Hurontario Street	LSOP-23	Sand/Silty sand (FILL)	0.1 – 1.0	-	30	20	-	3.0	2.0	
		Silty Clay Till (Stiff to hard)	1.0 – 4.6	180	-	21	11	-		
		SHALE (weathered) SHALE	4.6-7.5 7.5 – 11.4	- 800	40 -	23 24	13 -	4.6 -		
<b>P24</b> Highway 401 WBL, 1.0 km to 1.3 km east of Hurontario Street	OHS-09	Shale (FILL)	0.0- 1.5	-	30	20	-	3.0	0.5	
		Silty Clay (Firm)	1.5 – 2.3	75	-	19	9	-		
		Silty Clay Till (Very Stiff)	2.3 – 3.7	200	-	21	11	-		
<b>P25</b> Highway 401 WBL, east of Kennedy Rd.	OHS-10	SHALE (weathered) SHALE	3.7 – 5.5 5.5 – 7.0	- 800	40 -	23 24	13 -	4.6 -	1.9	
		Sand (FILL) (Compact)	0.0 – 0.8	-	30	20	-	3.0		
		SHALE (weathered) SHALE	0.8 – 2.7 2.7 – 5.8	- 800	40 -	23 24	13 -	4.6 -		
<b>P26</b> Highway 401 WBL, east of Kennedy Rd.	OHS-12	Silty Clay Till (Firm to Hard)	0.1 – 2.4 2.4 – 4.0	120 200	- -	21 21	- 11	-	3.0	
		SHALE (weathered) SHALE	4.0 – 5.4 5.4 – 7.0	- 800	40 -	23 24	13 -	4.6 -		

## Highway 401 Widening – High Mast Lighting Poles from Kennedy Road to McLaughlin Drive

HML Pole Number and Location	Reference Borehole <sup>2</sup>	Subsurface Stratigraphy <sup>2</sup> For Design	Depth Below Existing Ground Surface (m)	Geotechnical Design Parameters					Groundwater Depth ( m ) (below existing ground surface)
				q <sub>u</sub> (kPa)	φ' (deg.)	γ (kN/m <sup>3</sup> )	γ' (kN/m <sup>3</sup> )	K <sub>p</sub>	
<b>P27, P28</b> Highway 401 WBL, 400 m to 550 m east of McLaughlin Rd.	LSOP-27	Sand (FILL)	0.1 – 1.1	-	30	20	10	3.0	2.0
		Silty Clay (FILL) (Stiff)	1.1 – 2.0	100	-	19	9	-	
		Silty Clay Till (Stiff to Very stiff)	2.0 – 9.8	160	-	21	11	-	
<b>P29</b> Highway 401 WBL, 200 m east of McLaughlin Rd.	LSOP-29	Sand (FILL)	0.1 – 0.8	-	30	20	10	3.0	3.0
		Silty Clay to Clayey Silt Till (Stiff to Very stiff)	0.8 – 9.8	160	-	21	11	-	
<b>All Locations</b>	-	New Fill – SSM (see Note 4)	Variable height above ground surface	-	30	20	-	3.0	Below base of new fill

NOTES:

1. This table must be read in conjunction with the text of this report.
2. Refer to Records of Boreholes for details.
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

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


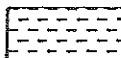
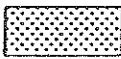


$\nabla$  Water Level  
 $C_{pen}$  Shear Strength Determination by Pocket Penetrometer

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

# UNIFIED SOILS CLASSIFICATION

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

## EXPLANATION OF ROCK LOGGING TERMS

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

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

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



RECORD OF BOREHOLE No P-02

1 OF 1

METRIC

G.W.P. 2107-05-00 LOCATION N 4 833 635.5 E 291 494.5 ORIGINATED BY GA  
HWY 401 BOREHOLE TYPE Solid Stem Augers/HQ2 Coring Equipment COMPILED BY AN  
DATUM Geodetic DATE 2009.02.03 - 2009.02.09 CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				UNIT WEIGHT  $\gamma$  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)  GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					
								20 40 60 80 100 40 80 120 160 200 ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE					
176.3	Geodetic												
0.0	SHALE Highly weathered Very Stiff to Hard Grey Moist (FILL)		1	SS	30								
			2	SS	28								
			3	SS	21								
174.2	SHALE, highly to moderately weathered, thinly bedded Grey		4	SS	50/ 0.150								
2.1	Coring started at 3.0m. Moderately weathered, very weak to weak, occasional limestone interbeds Clay layers at 3.2m. Rubble zone at 3.0m to 3.1m, 3.3m to 3.6m, 4.1m to 4.2m and 4.3m to 4.5m. Vertical joints at 3.6m to 3.7m. Limestone interbeds at 3.1m, 3.2m, 3.6m, 3.8m, 4.0m and 4.2m. Occasional fractures		1	RUN									RUN 1# TCR=100%, SCR=48%, RQD=18%, UCS=68MPa (Limestone)
	Limestone interbeds at 4.5m, 4.7m and 4.9m. Rubble zone at 5.5m to 5.6m. Horizontal joints at 5.0m.		2	RUN									RUN 2# TCR=100%, SCR=86%, RQD=86%, UCS=10MPa (Shale) UCS=160MPa (Limestone)
170.6													
5.7	END OF BOREHOLE AT 5.7m. BOREHOLE OPEN AND WATER LEVEL AT 2.7m 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) 2009.03.12 4.2 172.1 2009.03.26 3.7 172.6 2009.04.16 3.5 172.8												



RECORD OF BOREHOLE No P-03

1 OF 1

METRIC

G.W.P. 2107-05-00 LOCATION N 4 833 487.1 E 291 561.2 ORIGINATED BY GA  
HWY 401 BOREHOLE TYPE Solid Stem Augers/HQ2 Coring Equipment COMPILED BY AN  
DATUM Geodetic DATE 2009.02.24 - 2009.02.24 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						
180.8	Geodetic							20 40 60 80 100						
0.0	TOPSOIL (50mm)							40 80 120 160 200						
180.0	Silty CLAY, trace sand, trace gravel Stiff Grey (FILL)		1	SS	9									
0.8	Silty CLAY, trace to some sand, trace gravel, occasional rootlets Very Stiff to Hard Brown (TILL)		2	SS	17		180							1 24 43 32
178.8	SHALE, highly to slightly weathered, thinly bedded		3	SS	94/ 0.300		179							
2.0			4	SS	50/ 0.150		178							
			5	SS	50/ 0.150		177							
	Coring started at 4.3m. Slightly weathered to fresh, thinly bedded, grey shale Occasional limestone interbeds, occasional mechanical fractures Horizontal joints at 4.3m, 4.9m and 5.6m. Limestone interbeds at 4.2m, 4.8m and 5.2m. Rubble zone at 4.4m to 4.6m, 4.8m to 4.9m and 5.2m to 5.3m.		1	RUN			176							RUN 1# TCR=100%, SCR=80%, RQD=60%, UCS=6.0MPa (Shale)
	Fresh, thinly bedded, grey shale. Limestone interbeds at 6.0m.		2	RUN			175							RUN 2# TCR=100%, SCR=100%, RQD=100%, UCS=3.0MPa (Shale)
173.8							174							
7.0	END OF BOREHOLE AT 7.0m. BOREHOLE OPEN AND WATER LEVEL AT 2.0m UPON COMPLETION OF DRILLING. BOREHOLE BACKFILLED WITH HOLEPLUG TO SURFACE.													

ONTMT4S 231THML.GPJ 4/21/09

# RECORD OF BOREHOLE No P-07

1 OF 1

METRIC

G.W.P. 2107-05-00 LOCATION N 4 833 467.0 E 291 761.0 ORIGINATED BY SLI  
 HWY 401 BOREHOLE TYPE Solid Stem Augers/HQ2 Coring Equipment COMPILED BY ES  
 DATUM Geodetic DATE 2009.02.09 - 2009.02.09 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				
178.1	Geodetic						20 40 60 80 100					
0.8	TOPSOIL: (25mm)		1	SS	50		20 40 60 80 100					
177.7	SAND, occasional limestone fragments Very dense Brown Moist (FILL)		2	SS	43							
176.7	Silty CLAY, trace gravel, occasional rootlets Hard Brown (TILL) Limestone fragments Grey		1	RUN								
1.4	SHALE, highly weathered to fresh Grey Coring started at 1.42m Rubble zone at 2.34 to 2.41m Clay seam at 2.08 to 2.11m Rubble zones at 2.51 to 2.54, 2.74 to 2.77, 3.02 to 3.05 and 3.12 to 3.18m Clay layers at 2.64 and 3.54 to 3.59m fractured zones at 3.71 to 3.76m		2	RUN								
	Vertical joints at 3.91 to 3.96, 3.99 to 4.04, 4.41 to 4.46 and 4.85 to 4.93m		3	RUN								
173.1	END OF BOREHOLE AT 5.03m. BOREHOLE BACKFILLED WITH HOLEPLUG TO SURFACE.											
5.0												

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

20  
15  
10  
5  
0  
(%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No P-09

1 OF 1

METRIC

G.W.P. 2107-05-00 LOCATION N 4 833 220.0 E 291 620.9 ORIGINATED BY GA  
 HWY 401 BOREHOLE TYPE Solid Stem Augers/HQ2 Coring Equipment COMPILED BY AN  
 DATUM Geodetic DATE 2009.02.23 - 2009.02.24 CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			UNIT WEIGHT  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa				
								WATER CONTENT (%)				
184.9	Geodetic											
0.0	TOPSOIL (50mm)											
	SHALE, highly weathered Very Stiff to Stiff Grey Moist (FILL)		1	SS	18							
			2	SS	24							
			3	SS	9							
182.8												
2.1	Silty CLAY, trace to some sand, trace gravel Very Stiff Brown (TILL)		4	SS	26							
			5	SS	34							
180.2												
4.7	SHAILE, highly weathered, thinly bedded Coring started at 4.8m. Highly to moderately weathered, thinly bedded shale, occasional limestone interbeds Rubble zone at 5.7m to 5.8m and 6.3m to 6.4m. Limestone interbeds at 6.1m to 6.2m.		6	SS	50/ 0.150							
			1	RUN								
			2	RUN								
			3	RUN								
	Slightly weathered Rubble zone at 7.6m to 7.7m and 8.0m to 8.1m Limestone interbeds at 7.6m, 7.7m, 8.0m and 8.1m. Horizontal joints at 7.3m, 7.4m, 7.9m, 8.0m and 8.3m											
176.4												
8.5	END OF BOREHOLE AT 8.5m. BOREHOLE OPEN TO 8.2m AND WATER LEVEL AT 1.8m UPON COMPLETION OF DRILLING. BOREHOLE BACKFILLED WITH HOLEPLUG TO SURFACE.											

# RECORD OF BOREHOLE No P-12

1 OF 1

METRIC

G.W.P. 2107-05-00 LOCATION N 4 833 462.2 E 292 010.4 ORIGINATED BY SLL  
 HWY 401 BOREHOLE TYPE Solid Stem Augers/HQ2 Coring Equipment COMPILED BY ES  
 DATUM Geodetic DATE 2009.02.10 - 2009.02.10 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			20 40 60 80 100	120 140 160 180 200	PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>		
180.6	Geodetic							SHEAR STRENGTH kPa						
0.0	TOPSOIL: (50mm)							○ UNCONFINED + FIELD VANE						
0.1	Silty CLAY, trace gravel, trace rootlets Stiff to Very Stiff Brown		1	SS	10			● QUICK TRIAXIAL x LAB VANE						
	Sand layer (150mm)		2	SS	16			WATER CONTENT (%)						
179.1								20 40 60						
1.4	Silty CLAY, trace gravel, occasional limestone fragments Hard Brown to grey (TILL)		3	SS	54									
			4	SS	41									
177.6														
3.0	SHALE, weathered Grey Coring started at 3.2m Weathered to fresh Rubble zones at 3.25m to 3.35m, 3.76m to 3.91m, 3.96m to 4.01m, 4.11 to 4.32m, 4.4m to Clay layers in rubble zones		5	SS	100/ .100									
			1	RUN										3 36 40 21 RUN 1# TCR=70%, SCR=33%, ROD=0%, UCS=124MPa (Limestone)
			2	RUN										RUN 2# TCR=95%, SCR=95%, ROD=50%, UCS=40MPa (Limestone)
174.3	END OF BOREHOLE AT 6.30m.													
6.3	Piezometer installation consists of 19mm diameter schedule 40 PVC pipe with a 1.83m slotted screen. WATER LEVEL READINGS: DATE DEPTH (m) ELEV. (m) 2009.03.03 5.9 174.7 2009.03.12 5.6 175.0 2009.03.26 5.8 174.8 2009.04.16 5.8 174.8													

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

# RECORD OF BOREHOLE No P-14

1 OF 1

METRIC

G.W.P. 2107-05-00 LOCATION N 4 833 633.3 E 292 310.0 ORIGINATED BY SLL  
 HWY 401 BOREHOLE TYPE Solid Stem Augers/HQ2 Coring Equipment COMPILED BY ES  
 DATUM Geodetic DATE 2009.02.10 - 2009.02.10 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						
172.6	Geodetic							20 40 60 80 100						
0.0	TOPSOIL: (50mm)		1	SS	57/ 250									
172.2	Silty CLAY, occasional shale fragments Hard Brown		2	SS	50/ 125									
0.4	SHALE, highly weathered Grey													
	Coring started at 1.3m													
	Rubble zone at 1.52 to 1.60m Clay layers at 1.62 to 1.93m Mechanical break at 2.74 to 2.82m		1	RUN										RUN 1# TCR=83%, SCR=24%, RQD=50%, UCS=100MPa (Limestone)
	Rubble zones at 2.95 to 3.00m Thin clay layers at 2.95 to 3.00 and 3.15 to 3.20m Vertical joints at 3.10 to 3.12 and 3.25 to 3.26m		2	RUN										RUN 2# TCR=100%, SCR=50%, RQD=86%, UCS=33MPa (Limestone)
168.2														
4.3	END OF BOREHOLE AT 4.34m.													
	Piezometer installation consists of 19mm diameter schedule 40 PVC pipe with a 1.52m slotted screen. WATER LEVEL READINGS: DATE DEPTH (m) ELEV. (m) 2009.03.03 2.9 169.7 2009.03.12 2.9 169.7 2009.03.26 2.8 169.8 2009.04.16 3.0 169.6													

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

20  
15  
10

(%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No P-15

1 OF 1

METRIC

G.W.P. 2107-05-00 LOCATION N 4 833 265.8 E 291 952.1 ORIGINATED BY SLI/GA  
 HWY 401 BOREHOLE TYPE Solid Stem Augers/HQ2 Coring Equipment COMPILED BY ES  
 DATUM Geodetic DATE 2009.02.11 - 2009.02.12 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 (%)
								○ UNCONFINED	+ FIELD VANE	● QUICK TRIAXIAL			
176.9	Geodetic						20	40	60	80	100		
0.0	TOPSOIL: (50mm)		1	SS	70/ 250								
0.1	Silty CLAY, trace rootlets												
0.2	Stiff Brown												
	SHALE, highly weathered, with clay layers Grey Coring started at 0.6m.		1	RUN			176						RUN 1# TCR=49%, SCR=32%, RQD=0%, UCS=MPa
							175						RUN 2# TCR=12%, SCR=3%, RQD=0%, UCS=MPa
			2	RUN			174						
							173						RUN 3# TCR=15%, SCR=15%, RQD=7%, UCS=MPa
			3	RUN			172						
							171						RUN 4# TCR=0%, SCR=0%, RQD=0%, UCS=MPa
	Slightly weathered, thinly bedded		4	RUN			170						RUN 5# TCR=20%, SCR=14%, RQD=0%, UCS=105MPa (Limestone)
			5	RUN									
169.4	END OF BOREHOLE AT 7.47m. BOREHOLE OPEN AND WATER LEVEL AT 1.22m UPON COMPLETION. BOREHOLE BACKFILLED WITH HOLEPLUG TO SURFACE.												
7.5													

ONTMT4S 2311HML.GPJ 30/3/09

# RECORD OF BOREHOLE No P-15A

1 OF 1

METRIC

G.W.P. 2107-05-00 LOCATION N 4 833 267.9 E 291 954.2 ORIGINATED BY GA  
 HWY 401 BOREHOLE TYPE Solid Stem Augers/HQ2 Coring Equipment COMPILED BY ES  
 DATUM Geodetic DATE 2009.02.12 - 2009.02.12 CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
178.5	Geodetic							20	40	60	80	100					
0.0	Silty <b>CLAY</b> , trace gravel, occasional wood fibres, occasional shale fragments		1	SS	50/												
	Hard Grey (FILL)					.150											
177.7			2	SS	100/												
0.8	<b>SHALE</b> , slightly weathered, thinly bedded					.075											
	Grey																
	Coring started at 1.68m. Occasional mechanical fractures		3	SS	115/												
						.150											
	Rubble zone at 2.59 to 3.20m		1	RUN													
	Highly to slightly weathered, thinly bedded, occasional limestone interbeds																
	Grey																
	Limestone interbeds at 3.81 to 3.94 and 4.01 to 4.06m	2	RUN														
	Clay seam at 4.42m																
	Rubble zone at 4.62 to 4.72m																
	Horizontal joint at 3.94, 3.96, 4.01, 4.06 and 4.37m																
	Rubble zones at 4.72 to 4.98 and 5.18 to 5.26m	3	RUN														
	Horizontal joints.																
172.3	END OF BOREHOLE AT 6.25m. BOREHOLE OPEN AND WATER LEVEL AT 0.91m UPON COMPLETION. BOREHOLE BACKFILLED WITH HOLEPLUG TO SURFACE.																
6.2																	

# RECORD OF BOREHOLE No P-16

1 OF 2

METRIC

G.W.P. 2107-05-00 LOCATION N 4 833 359.9 E 291 107.1 ORIGINATED BY SLL  
 HWY 401 BOREHOLE TYPE Solid Stem Augers/HQ2 Coring Equipment COMPILED BY ES  
 DATUM Geodetic DATE 2009.02.11 - 2009.02.11 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					
								○ UNCONFINED	+ FIELD VANE	● QUICK TRIAXIAL	× LAB VANE		
178.6	Geodetic						20 40 60 80 100						
8.0 0.1	TOPSOIL: (50mm)		1	SS	55								
	Silty CLAY, occasional limestone fragments Hard to stiff Brown (FILL)		2	SS	12								2 21 48 29
176.6			3	SS	8								
2.0	Silty CLAY, trace gravel, trace rootlets Stiff to Hard Brown (TILL)		4	SS	12								
	Occasional shale fragments Grey		5	SS	14								
			6	SS	30								
			7	SS	13								
171.5													
7.1	SHALE, highly weathered, occasional silty clay layers Grey		8	SS	50/.075								
	Coring started at 8.0m Weathered to fresh		1	RUN									RUN 1# TCR=96%, SCR=93%, RQD=56%, UCS=1MPa (Shale) UCS=145MPa (Limestone)
													RUN 2# TCR=100%, SCR=98%,

Continued Next Page

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



RECORD OF BOREHOLE No P-16

2 OF 2

METRIC

G.W.P. 2107-05-00 LOCATION N 4 833 359.9 E 291 107.1 ORIGINATED BY SLL  
 HWY 401 BOREHOLE TYPE Solid Stem Augers/HQ2 Coring Equipment COMPILED BY ES  
 DATUM Geodetic DATE 2009.02.11 - 2009.02.11 CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					WATER CONTENT (%)				
							20	40	60	80	100	20	40	60			
	Continued From Previous Page																
	SHAILE, weathered to fresh Grey		2	RUN												ROD=55%, UCS=3MPa (Shale) UCS=70MPa (Limestone)	
167.6							168										
11.0	END OF BOREHOLE AT 10.97m. BOREHOLE BACKFILLED WITH HOLEPLUG TO 0.60m THEN AUGER CUTTINGS TO SURFACE.																

# RECORD OF BOREHOLE No P-20

1 OF 1

METRIC

G.W.P. 2107-05-00 LOCATION N 4 833 034.5 E 291 537.1 ORIGINATED BY SLL  
 HWY 401 BOREHOLE TYPE Hollow Stem Augers/HQ2 Coring Equipment COMPILED BY ES  
 DATUM Geodetic DATE 2009.02.19 - 2009.02.19 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					
								20 40 60 80 100					
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE					
							WATER CONTENT (%)						
							20 40 60						
							PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT						
							w <sub>p</sub> w w <sub>L</sub>						
185.8	Geodetic												
0.9	TOPSOIL: (50mm)												
185.1	SAND, some gravel Compact Brown		1	SS	22								
0.7	Compact (FILL)												
	Silty CLAY, trace gravel Very stiff Brown (TILL)		2	SS	17								1 35 41 23
			3	SS	7								
			4	SS	21								
182.6	SHALE, weathered Grey Coring started at 3.5m.		5	SS	50/ .100								
3.2	Rubble zone at 4.1 and 4.2m Clay seam at 3.8, 3.9, 4.1 and 4.2m Rubble zone at 4.7m		1	RUN									RUN 1# TCR=100%, SCR=70%, RQD=18%, UCS=MPa
	Clay seam and joints at 4.5, 4.6 and 4.7m Weathered to fresh, Clay seam at 5.0, 5.1 and 5.2m END OF BOREHOLE AT 6.4m.		2	RUN									RUN 2# TCR=100%, SCR=90%, RQD=42%, UCS=MPa
			3	RUN									RUN 3# TCR=100%, SCR=100%, RQD=56%, UCS=MPa
179.3	BOREHOLE BACKFILLED WITH HOLEPLUG TO SURFACE.		4	RUN									RUN 4# TCR=100%, SCR=20%, RQD=0%, UCS=MPa
6.4													

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

20  
15  
10  
(%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No P-23

1 OF 1

METRIC

G.W.P. 2107-05-00 LOCATION N 4 833 071.4 E 291 975.2 ORIGINATED BY GA  
 HWY 401 BOREHOLE TYPE Solid Stem Augers/HQ2 Coring Equipment COMPILED BY AN  
 DATUM Geodetic DATE 2009.02.26 - 2009.02.27 CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	UNIT WEIGHT  γ  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
181.7	Geodetic							20 40 60 80 100						
0.0	TOPSOIL (75mm)							40 80 120 160 200						
0.1	Silty CLAY, trace to some sand, trace gravel Firm Brown (FILL)		1	SS	6		181							
180.5			2	SS	6									
1.2	Silty CLAY, trace to some sand, trace gravel Firm to Hard Brown (TILL)		3	SS	14		180							5 24 45 26
			4	SS	58									
179.0	Occasional shale fragments						179							
2.7	SHALE, highly weathered, thinly bedded, grey Limestone fragments  Coring started at 3.5m.  Limestone interbeds at 3.8m, 3.9m, 4.1m, 4.6m, 4.7m and 4.9m. Horizontal joints at 3.7m, 3.8m, 4.0m, 4.1m, 4.5m and 4.9m. Rubble zones at 3.6m to 3.7m and 4.0m to 4.1m. Clay layers at 4.5m to 4.9m.  Limestone interbeds, occasional mechanical fractures Limestone interbeds at 5.0m, 5.2m, 5.3m, 5.4m, 5.5m, 5.9m, 6.0m and 6.4m. Clay seam at 5.7m.		1	RUN			178						RUN 1# TCR=100%, SCR=90%, RQD=64%, UCS=12MPa (Limestone) UCS=60MPa (Limestone)	
			2	RUN			177							RUN 2# TCR=100%, SCR=100%, RQD=100%, UCS=6.0MPa (Shale) UCS=95MPa (Limestone)
175.2							176							
6.5	END OF BOREHOLE AT 6.5m. BOREHOLE OPEN TO 6.5m AND WATER LEVEL AT 0.2m 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) 2009.03.03 4.9 176.8 2009.03.12 5.3 176.4 2009.03.26 5.3 176.4 2009.04.16 5.2 176.5													

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

# RECORD OF BOREHOLE No P-27

1 OF 1

METRIC

G.W.P. 2107-05-00 LOCATION N 4 833 091.0 E 292 249.9 ORIGINATED BY GA  
 HWY 401 BOREHOLE TYPE Solid Stem Augers/HQ2 Coring Equipment COMPILED BY ES  
 DATUM Geodetic DATE 2009.02.12 - 2009.02.12 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 (%)  GR SA SI C
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
								WATER CONTENT (%)						
180.9	Geodetic													
0.1	TOPSOIL: (50mm)		1	SS	16									
	Silty CLAY, trace to some sand, trace gravel, occasional rootlets													
	Stiff to very stiff		2	SS	22									
	Grey (FILL)													
179.3														
1.5	SHALE, highly to moderately weathered, thinly bedded Grey		3	SS	50/ .150									
	Coring started at 2.4m. Moderately to slightly weathered, thinly bedded Occasional limestone interbeds Horizontal joints at 2.5, 2.9, 3.0 and 3.3m Limestone interbeds at 2.4, 2.9, 3.3 and 3.4m Rubble zones at 2.5m to 2.7 and 3.5m to 3.6m Slightly weathered to fresh, thinly bedded, grey Occasional limestone interbeds Limestone interbeds at 3.9, 4.5, 4.7, 4.8, 5.0 and 5.1m Horizontal joints at 3.7, 3.8, 4.6 and 4.7m		1	RUN										
			2	RUN										
175.7														
5.2	END OF BOREHOLE AT 5.2m. BOREHOLE OPEN AND WATER LEVEL AT 2.4m 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) 2009.03.12 4.0 176.9 2009.03.26 4.1 176.8 2009.04.16 4.4 176.5													

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

20  
15 5  
10 (%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No P-29

1 OF 1

METRIC

G.W.P. 2107-05-00 LOCATION N 4 832 889.6 E 292 236.1 ORIGINATED BY SLL  
 HWY 401 BOREHOLE TYPE Solid Stem Augers/HQ2 Coring Equipment COMPILED BY ES  
 DATUM Geodetic DATE 2009.02.13 - 2009.02.13 CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			UNIT WEIGHT  γ  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					WATER CONTENT (%)
								○ UNCONFINED ● QUICK TRIAXIAL	+ FIELD VANE × LAB VANE				
181.5	Geodetic						20 40 60 80 100						
0.1	TOPSOIL: (50mm)												
	Silty CLAY some sand, trace gravel Very stiff Brown (TILL) Occasional limestone fragments		1	SS	15								
			2	SS	58							7 37 38 18	
			3	SS	100								
179.4													
2.2	SHALE, weathered Reddish brown Coring started at 2.4m. Weathered to fresh, with clay seam Clay layers at 2.59 to 2.64 and 2.72 to 2.73m Vertical joint at 2.44 to 4.29m		4	SS	50/ .150							RUN 1# TCR=60%, SCR=60%, RQD=4%, UCS=90MPa (Limestone)	
	Clay layers at 3.83 to 3.86, 4.42 to 4.44 and 4.50 to 4.52m Vertical joints at 3.86 to 3.91 and 4.44 to 4.50m		1	RUN									
	Clay layers at 5.08 to 5.16m Rubble zones at 4.72 to 4.80 and 5.61 to 5.64m		2	RUN								RUN 2# TCR=70%, SCR=60%, RQD=35%, UCS=116MPa (Limestone)	
			3	RUN								RUN 3# TCR=93%, SCR=80%, RQD=18%, UCS=45MPa (Limestone)	
175.3													
6.2	END OF BOREHOLE AT 6.25m. BOREHOLE BACKFILLED WITH HOLEPLUG TO 0.30m THEN AUGER CUTTINGS TO SURFACE.												

+ 3, X 3: Numbers refer to  
Sensitivity

20  
15  
10

(%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No P-30

1 OF 1

METRIC

G.W.P. 2107-05-00 LOCATION N 4 833 004.1 E 292 386.3 ORIGINATED BY GA  
 HWY 401 BOREHOLE TYPE Solid Stem Augers/HQ2 Coring Equipment COMPILED BY ES  
 DATUM Geodetic DATE 2009.02.17 - 2009.02.17 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						
178.7	Geodetic							20	40	60	80	100		
0.0	TOPSOIL: (50mm)							○ UNCONFINED	+ FIELD VANE					
	Silty CLAY, trace to some sand, trace gravel, occasional rootlets		1	SS	30		178	● QUICK TRIAXIAL	x LAB VANE					
	Hard Brown (FILL)		2	SS	80									
	Occasional shale fragments													
177.1														
1.5	Silty CLAY, trace to some sand, trace gravel		3	SS	50/		177							
	Hard Brown (TILL)				.075									
176.4			4	SS	50/									
2.3	SHALE, highly weathered, thinly bedded				.075		176							
	Grey													
	Coring started at 2.9m. Moderate to slightly weathered, occasional limestone interbeds													
	Limestone interbeds at 2.90, 3.12, 3.86, 3.94 to 4.01, 4.04 and 4.37m		1	RUN			175							RUN 1# TCR=88%, SCR=27%, RQD=13%, UCS=55MPa (Limestone) UCS=60MPa (Limestone)
	Rubble zones at 3.02, 3.22 to 3.51, 3.73 to 3.86 and 4.11 to 4.34m													
	Frequent horizontal joints													
	Vertical joints at 3.86 to 3.91m													
	Limestone interbeds at 4.57, 4.65 to 4.72, 4.72 to 4.80, 4.90 to 5.03, 5.36 to 5.54 and 5.61 to 5.74m		2	RUN			174							RUN 2# TCR=100%, SCR=92%, RQD=80%, UCS=20MPa (Limestone) UCS=55MPa (Limestone)
	Sub-vertical joint at 4.55m													
	Horizontal joints at 4.44, 4.50, 4.55, 4.65, 4.75 and 4.78m													
172.7							173							
5.9	END OF BOREHOLE AT 5.94m. BOREHOLE OPEN AND WATER LEVEL AT 1.22m UPON COMPLETION. BOREHOLE BACKFILLED WITH HOLEPLUG TO SURFACE.													

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

# RECORD OF BOREHOLE No P-32

1 OF 1

METRIC

G.W.P. 2107-05-00 LOCATION N 4 832 843.9 E 292 419.5 ORIGINATED BY GA  
 HWY 401 BOREHOLE TYPE Solid Stem Augers/HQ2 Coring Equipment COMPILED BY AN  
 DATUM Geodetic DATE 2009.02.25 - 2009.02.25 CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa							WATER CONTENT (%)
								20 40 60 80 100							
175.5	Geodetic														
0.0	TOPSOIL (50mm)		1	SS	20										
174.8	SAND, trace silt, trace gravel, some clay Compact Brown (FILL)														
0.8	SHALE, highly to moderately weathered, thinly bedded Grey		2	SS	39										
			3	SS	50/ 0.150										
			4	SS	50/ 0.150										
	Coring started at 2.7m. Very weak to weak Occasional mechanical fractures Limestone interbeds at 2.7, 3.2, 3.6, 3.7 and 3.9m. Rubble zone at 2.7, 3.3 and 3.4m. Horizontal joints at 2.8, 2.9, 3.1, 3.2, 3.3, 3.4, 3.5, 3.6 and 4.2m.		1	RUN											
	Slightly weathered to fresh Limestone interbeds at 4.4, 4.6, 4.7, 5.4 and 5.6m.		2	RUN											
169.7															
5.8	END OF BOREHOLE AT 5.8m. BOREHOLE OPEN TO 5.8m 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) 2009.03.03 4.7 170.8 2009.03.12 4.0 171.5 2009.03.26 3.9 171.6 2009.04.16 3.9 171.6														

+ 3 . X 3 : Numbers refer to Sensitivity

20  
15 5  
10 (%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No P-33

1 OF 1

METRIC

G.W.P. 2107-05-00 LOCATION N 4 833 721.1 E 292 453.9 ORIGINATED BY GA  
 HWY 401 BOREHOLE TYPE Solid Stem Augers/HQ2 Coring Equipment COMPILED BY ES  
 DATUM Geodetic DATE 2009.02.19 - 2009.02.19 CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT  $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
								UNCONFINED      +      FIELD VANE						
								● QUICK TRIAXIAL      X LAB VANE						
							WATER CONTENT (%)							
							PLASTIC      NATURAL      LIQUID LIMIT      MOISTURE      LIMIT 							



# RECORD OF BOREHOLE No P-36

1 OF 1

METRIC

G.W.P. 2107-05-00 LOCATION N 4 833 996.1 E 292 959.8 ORIGINATED BY GA  
 HWY 401 BOREHOLE TYPE Solid Stem Augers/HQ2 Coring Equipment COMPILED BY AN  
 DATUM Geodetic DATE 2009.02.26 - 2009.02.26 CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				UNIT WEIGHT  γ  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)  GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					
								○ UNCONFINED	+ FIELD VANE	● QUICK TRIAXIAL	× LAB VANE		
163.1	Geodetic						20 40 60 80 100						
0.0	TOPSOIL (75mm)						40 80 120 160 200						
0.1	Silty CLAY, trace to some sand, trace gravel Stiff to Hard Brown (TILL)		1	SS	15								
			2	SS	18								5 33 37 25
			3	SS	34								
			4	SS	32								
159.7			5	SS	75								7 45 35 13
3.4	SHALE, moderately to slightly weathered, thinly bedded, grey Occasional limestone interbeds Rubble zone at 3.9m to 4.1m.												
	Limestone interbeds at 4.1m, 4.2m, 4.4m, 4.5m, 4.9m, 5.1m and 5.4m. Horizontal joints at 4.1m, 4.4m and 4.7m.		1	RUN									RUN 1# TCR=100%, SCR=66%, RQD=78%, UCS=6.0MPa (Shale) UCS=80MPa (Limestone)
	Slightly weathered to fresh, thinly bedded Limestone interbeds at 5.6m, 6.2m and 6.3m. Horizontal joints at 5.6m. Rubble zone at 6.1m to 6.2m.		2	RUN									RUN 2# TCR=100%, SCR=100%, RQD=100%, UCS=5.0MPa (Shale)
156.2													
6.9	END OF BOREHOLE AT 6.9m. BOREHOLE OPEN TO 6.9m AND WATER LEVEL AT 0.2m 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) 2009.03.03 1.2 161.9 2009.03.12 1.4 161.7 2009.03.26 1.6 161.5 2009.04.16 1.5 161.6												

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

20  
15  
10  
(%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No P-38

1 OF 2

METRIC

G.W.P. 2107-05-00 LOCATION N 4 834 083.5 E 293 310.1 ORIGINATED BY ES  
 HWY 401 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN  
 DATUM Geodetic DATE 2009.02.24 - 2009.02.24 CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			UNIT WEIGHT  γ  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)  GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa				
								WATER CONTENT (%)				
162.1	Geodetic						20 40 60 80 100	PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>		
0.0	ASPHALT (75mm)						20 40 60 80 100					
0.1	SAND, some gravel Brown Moist (FILL)		1	AS			162					
161.3												
0.8	Silty CLAY, trace sand, trace gravel Stiff to Very Stiff Brown (FILL)		1	SS	15		161					
			2	SS	26							
159.8							160					0 33 40 27
2.3	Silty CLAY, trace sand, trace gravel Stiff to Hard Brown (TILL)		3	SS	22							
	Occasional sand layers		4	SS	31		159					
			5	SS	13		158					1 35 40 25
			6	SS	100/ 0.150		156					
							155					
154.5												
7.6	Silty SAND, trace clay, trace gravel, occasional shale fragments Very Dense Grey Wet		7	SS	74		154					3 35 49 13
153.0							153					
9.1	Silty CLAY, trace sand, trace gravel, occasional shale fragments Hard Grey (TILL)		8	SS	41							
152.3												
9.8												

Continued Next Page

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

# RECORD OF BOREHOLE No P-38

2 OF 2

METRIC

G.W.P. 2107-05-00 LOCATION N 4 834 083.5 E 293 310.1 ORIGINATED BY ES  
 HWY 401 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN  
 DATUM Geodetic DATE 2009.02.24 - 2009.02.24 CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC NATURAL LIQUID LIMIT MOISTURE LIMIT CONTENT			UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL X LAB VANE					W <sub>P</sub>	W	W <sub>L</sub>		
	Continued From Previous Page																
	END OF BOREHOLE AT 9.8m. BOREHOLE OPEN AND WATER LEVEL AT 7.0m UPON COMPLETION OF DRILLING. BOREHOLE BACKFILLED WITH HOLEPLUG TO 0.1m THEN ASPHALT TO SURFACE.																

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

# RECORD OF BOREHOLE No P-41

1 OF 1

METRIC

G.W.P. 2107-05-00 LOCATION N 4 833 745.5 E 292 683.8 ORIGINATED BY ES  
 HWY 401 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN  
 DATUM Geodetic DATE 2009.02.25 - 2009.03.01 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									
166.4	Geodetic						20	40	60	80	100						
0.0	ASPHALT (100mm)						20	40	60	80	100						
0.1	SAND, some gravel Brown Damp (FILL)		1	AS													
165.7																	
165.8	Silty CLAY, trace sand, trace gravel, occasional shale fragments Hard Brown (FILL)		1	SS	45												1 29 47 23
0.9																	
164.9	Silty CLAY, trace sand, trace gravel, occasional shale fragments Hard Grey (TILL)		2	SS	91/ 0.225												
1.5	SHALE, highly weathered, thinly bedded Grey		3	SS	50/ 0.075												
			4	SS	50/ 0.075												
	Coring started at 4.4m.		1	RUN													RUN 1# TCR=33%, SCR=0%, ROD=0%, UCS=MPa
	Moderately to slightly weathered, thinly bedded, limestone interbeds Occasional limestone interbeds, occasional mechanical fractures, clay layers Limestone interbeds at 5.3m, 5.4m and 6.0m. Sub-vertical fractures at 5.3m to 5.4m. Rubble zone at 5.3m to 5.4m and 5.9m to 6.0m.		2	RUN													RUN 2# TCR=100%, SCR=78%, ROD=66%, (Shale), UCS=70 MPa (Limestone)
160.0	END OF BOREHOLE AT 6.4m. BOREHOLE BACKFILLED WITH HOLEPLUG TO 0.1m THEN ASPHALT TO SURFACE.																
6.4																	

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

20  
15  
10  
(%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No P-43

1 OF 1

METRIC

G.W.P. 2107-05-00 LOCATION N 4 833 793.4 E 292 906.9 ORIGINATED BY GA  
 HWY 401 BOREHOLE TYPE Solid Stem Augers/HQ2 Coring Equipment COMPILED BY AN  
 DATUM Geodetic DATE 2009.02.25 - 2009.02.25 CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT  γ  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)  GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa							
164.2	Geodetic						20	40	60	80	100	PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	
0.0	SAND, trace clay, trace gravel														
163.9	Compact														
0.3	Brown		1	SS	17							o			
	Moist														
	(FILL)(SP)														
	Silty CLAY, trace to some sand, trace gravel		2	SS	14							o			
	Stiff														
162.7	Grey														
1.5	(FILL)														
	Silty CLAY, trace to some sand, trace gravel		3	SS	24							o	—		0 30 46 24
	Very Stiff to Hard														
	Brown														
	(TILL)														
	Layer of silty sand (700mm)		4	SS	47							o			0 31 59 9
			5	SS	47							o			
			6	SS	37							o	—		0 42 36 21
158.7															
5.5	SHALE, highly weathered, thinly bedded														
	Grey														
	Coring started at 6.0m.														
	Highly to slightly weathered, thinly bedded shale														
	Occasional limestone interbeds														
	Limestone interbeds at 6.1m and 6.5m.		1	RUN											RUN 1#
	Rubble zone at 6.0m to 6.1m, 6.4m to 6.5m, 6.8m to 7.4m.														TCR=71%,
	Occasional clay layers at 6.6m, 7.2m and 7.3m.														SCR=16%,
															RQD=12%,
															UCS=3.5MPa
															(Shale)
			2	RUN											RUN 2#
															TCR=100%,
															SCR=100%,
															RQD=100%,
															UCS=3.0MPa
															(Shale)
155.6															
8.6	END OF BOREHOLE AT 8.6m.														
	BOREHOLE OPEN TO 8.6m AND														
	WATER LEVEL AT 1.2m UPON														
	COMPLETION OF DRILLING.														
	BOREHOLE BACKFILLED WITH														
	HOLEPLUG TO SURFACE.														

# RECORD OF BOREHOLE No P-45

1 OF 1

METRIC

G.W.P. 2107-05-00 LOCATION N 4 833 965.4 E 293 080.1 ORIGINATED BY SLL  
 HWY 401 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN  
 DATUM Geodetic DATE 2009.02.23 - 2009.02.23 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			SHEAR STRENGTH kPa					
								○ UNCONFINED + FIELD VANE					
								● QUICK TRIAXIAL × LAB VANE					
							WATER CONTENT (%)						
							w <sub>p</sub> — w — w <sub>L</sub>						
							20 40 60 80 100						
							20 40 60						
163.0	Geodetic						163						
0.0	ASPHALT (300mm)												
0.2	Gravelly SAND		1	GS									
162.3	Brown												
0.7	Frozen (FILL)												
	Silty CLAY, trace gravel, occasional limestone fragments Very Stiff to Hard Brown (TILL)		1	SS	19		162						
			2	SS	16		161						0 30 40 30
			3	SS	21		160						
			4	SS	25		159						
			5	SS	31		158						2 47 37 14
157.4	SHALE, highly weathered						157						
5.6	Hard		6	SS	100/		156						
	Brown				0.150								
	Moist		1	RUN									RUN 1# TCR=51%, SCR=0%, ROD=0%, UCS=MPa
155.2			7	SS	100/								
7.8	END OF BOREHOLE AT 7.8m. BOREHOLE OPEN AND DRY UPON COMPLETION OF DRILLING. BOREHOLE BACKFILLED WITH 0.2m WITH BENTONITE HOLEPLUG AND THEN ASPHALT TO SURFACE.				0.050								

# RECORD OF BOREHOLE No P-47

1 OF 1

METRIC

G.W.P. 2107-05-00 LOCATION N 4 833 330.1 E 292 406.1 ORIGINATED BY GA  
 HWY 401 BOREHOLE TYPE Solid Stem Augers/HQ2 Coring Equipment COMPILED BY ES  
 DATUM Geodetic DATE 2009.02.17 - 2009.02.17 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				
177.3	Geodetic						20 40 60 80 100	○ UNCONFINED + FIELD VANE	PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	
0.0 0.1	TOPSOIL: (75mm)						20 40 60 80 100	● QUICK TRIAXIAL x LAB VANE	w <sub>p</sub>	w	w <sub>L</sub>	
	Silty CLAY, trace to some sand, trace gravel, occasional rootlets Stiff to hard Brown to Grey (TILL)		1	SS	8		177					
			2	SS	11		176					0 19 43 38
	Occasional limestone interbeds		3	SS	50/ .125							
175.4												
1.8	SHALE, highly weathered, thinly bedded Grey		4	SS	50/ .075		175					
	Coring started at 2.9m. Highly to slightly weathered, occasional limestone interbeds  Limestone interbeds at 2.92, 3.18, 3.22 to 3.38 and 4.34m Rubble zones at 3.05 to 3.20 and 3.35 to 3.45m		1	RUN			174					RUN 1# TCR=42%, SCR=12%, RQD=8%, UCS=60MPa (Limestone)
	Highly to moderately weathered Rubble zone at 4.42 to 5.03m		2	RUN			173					RUN 2# TCR=100%, SCR=13%, RQD=0%, UCS=MPa
	Slightly weathered to fresh		3	RUN			172					RUN 3# TCR=100%, SCR=100%, RQD=87%, UCS=5.0MPa (Shale) UCS=40MPa (Limestone)
170.7							171					
6.6	END OF BOREHOLE AT 6.55m. BOREHOLE OPEN AND WATER LEVEL AT 1.83m UPON COMPLETION. BOREHOLE BACKFILLED WITH HOLEPLUG TO SURFACE.											

# RECORD OF BOREHOLE No P-49

1 OF 1

METRIC

G.W.P. 2107-05-00 LOCATION N 4 833 532.6 E 292 653.3 ORIGINATED BY GA  
 HWY 401 BOREHOLE TYPE Solid Stem Augers/HQ2 Coring Equipment COMPILED BY ES  
 DATUM Geodetic DATE 2009.02.18 - 2009.02.18 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						
168.7	Geodetic							20 40 60 80 100						
0.1	TOPSOIL: (50mm)		1	SS	65			○ UNCONFINED + FIELD VANE						
168.3	Silty CLAY, trace to some sand, trace gravel, occasional rootlets							● QUICK TRIAXIAL X LAB VANE						
0.4	Hard Brown (TILL)		2	SS	50/			40 80 120 160 200						
	SHALE, highly weathered, thinly bedded				.150									
	Grey		3	SS	50/									
					.075									
			4	SS	50/									
					.075									
	Coring started at 3.05m.													
	Slightly weathered to fresh, occasional limestone interbeds, occasional mechanical fractures													
	Limestone interbeds at 3.05, 3.25, 3.43 and 3.61 to 3.79m		1	RUN										
	Vertical joint at 3.61 to 3.79m													
	Horizontal joints at 3.10, 3.15, 3.33, 3.38, 3.58, 3.81, 4.04, 4.06, 4.19, 4.42 and 4.50m													
	Rubble zones at 3.07 to 3.12, 3.33 to 3.38 and 4.42 to 4.52m													
	Fresh													
	Limestone interbeds at 4.78, 4.95 and 5.92 to 6.04m		2	RUN										
162.6	END OF BOREHOLE AT 6.10m. BOREHOLE OPEN AND WATER LEVEL AT 0.91m UPON COMPLETION.													
6.1	Piezometer installation consists of 19mm diameter schedule 40 PVC pipe with a 1.52m slotted screen.													
	WATER LEVEL READINGS:													
	DATE DEPTH (m) ELEV. (m)													
	2009.03.03 3.9 164.8													
	2009.03.12 3.9 164.8													
	2009.03.26 3.8 164.9													
	2009.04.16 3.7 165.0													

RUN 1#  
TCR=100%,  
SCR=87%,  
RQD=65%,  
UCS=5.0MPa  
(Shale)

RUN 2#  
TCR=100%,  
SCR=100%,  
RQD=100%,  
UCS=3.0MPa  
(Shale)  
UCS=45MPa  
(Limestone)



## METRIC

DATUM	Geodetic	DATE	2009.03.03 - 2009.03.03	CHECKED BY	RPR
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Continued Next Page

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

RECORD OF BOREHOLE No LSOP-07

2 OF 2

METRIC

G.W.P. 2107-05-00 LOCATION N 4 832 362.2 E 289 908.1 ORIGINATED BY GA  
 HWY 401 BOREHOLE TYPE Solid Stem Augers/HQ2 Coring Equipment COMPILED BY AN  
 DATUM Geodetic DATE 2009.03.03 - 2009.03.03 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 $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
	Continued From Previous Page and 10.6m.						183							
182.5														
10.7	END OF BOREHOLE AT 10.7m. BOREHOLE OPEN AND WATER LEVEL AT 9.7m. Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen.  WATER LEVEL READINGS: DATE      DEPTH (m)      ELEV. (m) 2009.03.12      1.1      192.1 2009.03.26      0.9      192.3 2009.04.16      0.6      181.9													



# RECORD OF BOREHOLE No LSOP-12

1 OF 1

METRIC

G.W.P. 2107-05-00 LOCATION N 4 832 097.9 E 290 102.7 ORIGINATED BY GA  
 HWY 401 BOREHOLE TYPE Solid Stem Augers/HQ2 Coring Equipment COMPILED BY AN  
 DATUM Geodetic DATE 2009.03.03 - 2009.03.09 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							
192.7	Geodetic						20	40	60	80	100	PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	
0.0	TOPSOIL (75mm)						20	40	60	80	100	WATER CONTENT (%)			
0.1	Silty CLAY, trace to some sand, trace gravel Stiff Brown (FILL)		1	SS	9										
			2	SS	8										
191.2															
1.5	SAND, trace clay, trace gravel Loose Brown Wet		3	SS	6										21 45 22 11
190.4															
2.3	Silty CLAY, trace to some sand, trace gravel Very Stiff Brown (TILL)		4	SS	16										
			5	SS	21										
188.1															
4.6	Silty SAND, trace gravel Dense Brown Damp (TILL)		6	SS	33										
187.2															
5.5	SHALE, highly weathered Brown														
	Coring started at 6.0m. Slightly weathered to fresh, occasional limestone and siltstone interbeds Rubble zone at 6.0m to 6.1m. Horizontal joints at 6.1, 6.2, 6.4 and 6.5m Limestone interbeds at 6.4, 6.9 and 7.2m. Siltstone interbeds at 6.0, 6.3, 6.4, 6.5, 6.6, 6.7, 6.8, 7.2 and 7.6m.		1	RUN											RUN 1# TCR=100%, SCR=93%, RQD=83%, UCS=42MPa (Limestone) UCS=7.0MPa (Siltstone)
	Limestone interbeds at 8.2 and 8.4m. Siltstone interbeds at 7.6, 7.7, 7.9, 8.0, 8.1, 8.3, 8.5, 8.6 and 8.7m.		2	RUN											RUN 2# TCR=100%, SCR=100%, RQD=90%, UCS=20MPa (Limestone) UCS=5.0MPa (Siltstone)
184															
183.7															
9.0	END OF BOREHOLE AT 9.0m. BOREHOLE OPEN AND WATER LEVEL AT 1.5m UPON COMPLETION OF DRILLING. BOREHOLE BACKFILLED WITH BENTONITE TO SURFACE.														

+ 3, x 3: Numbers refer to  
Sensitivity

20  
15  
10



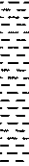
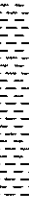
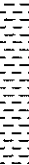
(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No LSOP-16

1 OF 1

METRIC

G.W.P. 2107-05-00 LOCATION N 4 832 676.7 E 290 601.9 ORIGINATED BY GA  
 HWY 401 BOREHOLE TYPE Solid Stem Augers/HQ2 Coring Equipment COMPILED BY AN  
 DATUM Geodetic DATE 2009.03.04 - 2009.03.04 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									WATER CONTENT (%)		
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE											
194.6	Geodetic						20	40	60	80	100								
0.0	PEAT, clayey, occasional rootlets: (760mm) Firm Dark Brown		1	SS	6														
193.8																			
0.8	Silty CLAY, trace to some sand, trace gravel Stiff Reddish Brown (TILL)		2	SS	11														
193.1																			
1.5	SHALE, highly weathered Reddish Brown		3	SS	51														
			4	SS	50/ .100														
	Coring started at 2.7m. Medium weathered to slightly weathered, very weak Rubble zone at 2.7m to 2.9m and 3.2m to 3.3m. Limestone interbeds at 2.8 and 3.9m. Shale interbeds at 2.9, 3.0, 3.3, 3.7, 3.9, 4.0 and 4.2m.		1	RUN															
	Slightly weathered to fresh, occasional mechanical fractures Limestone interbeds at 4.2, 4.3, 4.4, 5.0, 5.1, 5.2 and 5.4m. Siltstone interbeds at 4.3, 4.4, 4.7, 5.2, 5.5 and 5.6m. Rubble zone at 4.6 to 4.8m and 4.9 to 5.0m.		2	RUN															
189.0																			
5.6	END OF BOREHOLE AT 5.6m. BOREHOLE OPEN AND WATER LEVEL AT 1.0m UPON COMPLETION OF DRILLING. BOREHOLE BACKFILLED WITH HOLEPLUG TO SURFACE.																		

# RECORD OF BOREHOLE No LSOP-17

1 OF 2

METRIC

G.W.P. 2107-05-00 LOCATION N 4 832 268.2 E 290 252.0 ORIGINATED BY ES  
 HWY 401 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN  
 DATUM Geodetic DATE 2009.03.03 - 2009.03.03 CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa								WATER CONTENT (%)		
								○ UNCONFINED	+ FIELD VANE	● QUICK TRIAXIAL							x LAB VANE	
194.6	Geodetic						20	40	60	80	100	20	40	60	GR SA SI CL			
0.0	ASPHALT (150mm)																	
0.2	SAND, trace to some gravel, trace silt Compact Brown Damp to Moist (FILL)		1	AS														
			2	SS	25													
193.1																		
1.5	Silty SAND, occasional clay layers, occasional oxidized staining Very Dense Brown Damp (FILL)		3	SS	62										3 46 40 10			
192.3																		
2.3	Silty CLAY, some sand, trace gravel, occasional sand layers Very Stiff Grey (TILL)		4	SS	29													
191.4																		
3.2	SAND and SILT, some clay, trace gravel Very Dense Grey to Brown Moist		5	SS	70										3 41 47 10			
			6	SS	74/ 0.300													
188.5																		
6.1	Silty CLAY, trace sand, trace gravel, occasional silt layers Hard Brown (TILL)		7	SS	66													
	Occasional limestone fragments		8	SS	84/ 0.200										2 16 67 15			
185.9																		
8.7	SHALE, highly weathered with limestone fragments Brown																	
185.4																		
9.2	END OF BOREHOLE AT 9.2m. BOREHOLE OPEN AND WATER LEVEL AT 7.6m UPON COMPLETION OF DRILLING. BOREHOLE BACKFILLED WITH				0.050													

Continued Next Page

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

20  
15  
10  
(%) STRAIN AT FAILURE

## METRIC

[illegible]

ONTMT4S 2311HML.GPJ 30/3/09

# RECORD OF BOREHOLE No LSOP-19

1 OF 2

METRIC

G.W.P. 2107-05-00 LOCATION N 4 832 507.4 E 290 511.1 ORIGINATED BY ES  
 HWY 401 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN  
 DATUM Geodetic DATE 2009.03.03 - 2009.03.03 CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				UNIT WEIGHT  γ  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					
								WATER CONTENT (%)					
195.4	Geodetic												
0.0	ASPHALT (130mm)												
0.1	SAND, some to trace gravel Compact Brown Moist (FILL)		1	AS									
194.2			1	SS	16								
1.2	Silty CLAY, some sand Stiff to Hard Brown (FILL)		2	SS	64/ 0.300								
193.1													
2.3	Sandy SILT, some clay Dense Light Brown Damp (FILL)		3	SS	35								
192.3													
3.0	Silty SAND, trace clay Compact to Dense Brown Wet		4	SS	29								0 63 29 8
	Occasional oxidized staining Grey		5	SS	31								
189.1													
6.2	Clayey SILT, some sand, trace gravel Hard Brown (TILL)		6	SS	81								0 22 60 19
	Occasional shale fragments		7	SS	50/ 0.125								
186.6													
8.8	SHALE, highly weathered Dense Brown Wet		8	SS	32								
185.6													
9.8	END OF BOREHOLE AT 9.7m.												

Continued Next Page

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



RECORD OF BOREHOLE No LSOP-19

2 OF 2

METRIC

G.W.P. 2107-05-00 LOCATION N 4 832 507.4 E 290 511.1 ORIGINATED BY ES  
 HWY 401 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN  
 DATUM Geodetic DATE 2009.03.03 - 2009.03.03 CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT  γ  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)  GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
	Continued From Previous Page							20	40	60	80	100					
	BOREHOLE OPEN TO 8.5m AND WATER LEVEL AT 6.0m UPON COMPLETION OF DRILLING. BOREHOLE BACKFILLED WITH HOLEPLUG TO 0.1m THEN ASPHALT TO SURFACE.																

# RECORD OF BOREHOLE No LSOP-23

1 OF 2

METRIC

G.W.P. 2107-05-00 LOCATION N 4 832 837.6 E 290 995.3 ORIGINATED BY ES  
 HWY 401 BOREHOLE TYPE Solid Stem Augers/HQ2 Coring Equipment COMPILED BY AN  
 DATUM Geodetic DATE 2009.02.25 - 2009.02.25 CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa								WATER CONTENT (%)			
192.3	Geodetic						20 40 60 80 100												
0.0	ASPHALT (125mm)						20 40 60 80 100												
0.1	SAND, some gravel Brown Damp (FILL)		1	AS															
191.3																			
1.0	Silty CLAY, trace sand, trace gravel, occasional clay layers Stiff to Hard Brown (TILL)		1	SS	11														
			2	SS	12														
			3	SS	34														
	Occasional shale fragments		4	SS	34														
187.7																			
4.6	SHALE, highly weathered, occasional limestone fragments Brown Damp		5	SS	80/ 0.225														
			6	SS	50/ 0.100														
	Clay layers																		
	Moderately weathered Horizontally laminated with frequent limestone interbeds Occasional clay infilling Brown		1	RUN															
			2	RUN															

RUN 1#  
TCR=33%,  
SCR=0%,  
RQD=0%,  
UCS=MPa

RUN 2#  
TCR=100%,  
SCR=32%,  
RQD=32%,  
UCS=MPa

Continued Next Page

+ 3 . X 3 : Numbers refer to  
Sensitivity

20  
15 5 10  
(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No LSOP-23

2 OF 2

METRIC

G.W.P. 2107-05-00 LOCATION N 4 832 837.6 E 290 995.3 ORIGINATED BY ES  
 HWY 401 BOREHOLE TYPE Solid Stem Augers/HQ2 Coring Equipment COMPILED BY AN  
 DATUM Geodetic DATE 2009.02.25 - 2009.02.25 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							
								○ UNCONFINED    + FIELD VANE							
								● QUICK TRIAXIAL    X LAB VANE							
									20 40 60 80 100						
										20 40 60					

+ 3 . X 3 : Numbers refer to  
Sensitivity

20  
15 5  
10 (%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No LSOP-27

1 OF 2

METRIC

G.W.P. 2107-05-00 LOCATION N 4 831 851.6 E 289 163.9 ORIGINATED BY ES  
 HWY 401 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN  
 DATUM Geodetic DATE 2009.03.04 - 2009.03.04 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 (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa				
								WATER CONTENT (%)				
187.8	Geodetic											
0.0	ASPHALT (100mm)											
0.1	SAND, some to trace gravel Brown Damp (FILL)		1	AS								
186.8			1	SS	11		187					
1.1	Silty CLAY, trace sand, trace gravel Stiff Brown to Grey (FILL)											
185.9			2	SS	10		186					
2.0	Clayey SILT, trace sand, trace gravel, occasional silt layers Stiff to Very Stiff Brown (TILL)		3	SS	19							
	Occasional cobbles, occasional clay layers		4	SS	21		185					7 35 37 22
							184					
	Occasional oxidized staining		5	SS	27		183					
			6	SS	14		182					5 36 38 21
			7	SS	19		181					
			8	SS	28		180					
179.1							179					3 29 47 21
9.8	END OF BOREHOLE AT 9.8m.											

Continued Next Page

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

RECORD OF BOREHOLE No LSOP-27

2 OF 2

METRIC

G.W.P. 2107-05-00 LOCATION N 4 831 851.6 E 289 163.9 ORIGINATED BY ES  
 HWY 401 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN  
 DATUM Geodetic DATE 2009.03.04 - 2009.03.04 CHECKED BY RPR

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa					WATER CONTENT (%)			
							20	40	60	80	100	W <sub>p</sub>	W	W <sub>L</sub>		
	Continued From Previous Page BOREHOLE OPEN AND DRY UPON COMPLETION OF DRILLING. BOREHOLE BACKFILLED WITH HOLEPLUG TO 0.1m THEN ASPHALT TO SURFACE.															

# RECORD OF BOREHOLE No LSOP-29

1 OF 2

METRIC

G.W.P. 2107-05-00 LOCATION N 4 831 700.1 E 288 882.1 ORIGINATED BY ES  
 HWY 401 BOREHOLE TYPE Solid Stem Augers/HQ2 Coring Equipment COMPILED BY AN  
 DATUM Geodetic DATE 2009.03.06 - 2009.03.06 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						
189.0	Geodetic						20 40 60 80 100							
0.0	ASPHALT (100mm)						40 80 120 160 200							
0.1	SAND, trace to some gravel Brown Damp (FILL)		1	AS										
188.2														
0.8	Silty CLAY, trace sand, trace gravel Stiff to Very Stiff Brownish Grey (TILL)		1	SS	10									
			2	SS	13									3 17 42 38
	Occasional silt layers													
			3	SS	22									
			4	SS	22									
			5	SS	20									6 34 37 23
183.7	Grey													
5.3	Clayey SILT, trace sand, trace gravel, occasional silt layers Stiff to Very Stiff Brown (TILL)													
			6	SS	11									
			7	SS	17									10 34 38 18
			8	SS	23									
179.2														
9.8	END OF BOREHOLE AT 9.8m.													

Continued Next Page

+ 3, X 3, Numbers refer to  
Sensitivity

20  
15 5  
10 (%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No LSOP-29

2 OF 2

METRIC

G.W.P. 2107-05-00 LOCATION \_\_\_\_\_ ORIGINATED BY ES  
 HWY 401 BOREHOLE TYPE Solid Stem Augers/HQ2 Coring Equipment COMPILED BY AN  
 DATUM Geodetic DATE 2009.03.06 - 2009.03.06 CHECKED BY RPR

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC NATURAL LIQUID LIMIT MOISTURE CONTENT LIMIT			UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa					WATER CONTENT (%)			
							20	40	60	80	100	W <sub>p</sub>	W	W <sub>L</sub>		
	Continued From Previous Page															
	BOREHOLE OPEN AND DRY UPON COMPLETION OF DRILLING. BOREHOLE BACKFILLED WITH HOLEPLUG TO 2.4m, AUGER CUTTINGS TO 0.1m THEN ASPHALT TO SURFACE.															

# RECORD OF BOREHOLE No OHS-09

1 OF 1

METRIC

G.W.P. 2107-05-00 LOCATION N 4 832 860.5 E 291 099.7 ORIGINATED BY GA  
 HWY 401 BOREHOLE TYPE Solid Stem Augers/HQ2 Coring Equipment COMPILED BY AN  
 DATUM Geodetic DATE 2009.03.11 - 2009.03.11 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						
191.1	Geodetic							20 40 60 80 100						GR SA SI CL
0.0	TOPSOIL (75mm)							20 40 60 80 100						
0.1	SHALE, highly weathered Stiff to Firm Reddish Brown Moist (FILL)		1	SS	9		191							
			2	SS	6		190							
189.6														
1.5	Silty CLAY, trace sand, occasional rootlets Firm Brown		3	SS	7		189							0 14 46 40
188.8														
2.3	Silty CLAY, some sand, trace gravel Very Stiff Brown (TILL)		4	SS	21		188							
			5	SS	48		187							2 31 46 22
187.4														
3.7	SHALE, highly weathered Reddish Brown Coring started at 3.9m. Medium to slightly weathered, very weak to weak Occasional mechanical fractures Siltstone interbeds at 3.9, 4.1, 4.2, 4.4, 4.6, 4.8, 4.9, 5.2, 5.4 and 5.5m. Horizontal joints at 4.0 and 4.1m. Rubble zone at 4.0 and 4.1m. Limestone interbeds from 5.5 to 5.6m.  Slightly weathered to fresh, weak to strong Siltstone interbeds at 5.4, 5.7, 6.0, 6.1, 6.2, 6.5 and 6.6m. Limestone interbeds at 6.7 and 6.8m.		1	RUN		187							RUN 1# TCR=100%, SCR=95%, RQD=95%, UCS=MPa	
			2	RUN		186								RUN 2# TCR=100%, SCR=100%, RQD=100%, UCS=MPa
184.1														
7.0	END OF BOREHOLE AT 7.0m. BOREHOLE OPEN AND WATER LEVEL AT 0.6m. BOREHOLE BACKFILLED WITH 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 OHS-10

1 OF 1

METRIC

G.W.P. 2107-05-00 LOCATION N 4 832 953.0 E 291 210.0 ORIGINATED BY GA  
 HWY 401 BOREHOLE TYPE Solid Stem Augers/HQ2 Coring Equipment COMPILED BY AN  
 DATUM Geodetic DATE 2009.03.11 - 2009.03.11 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 (%)				
189.2	Geodetic											
0.0	TOPSOIL (50mm)											
	SAND, trace gravel		1	SS	15							
	Compact											
	Brown											
188.4	Wet		2	SS	50/							
0.8	(FILL)				0.100							
	SHALE, highly weathered											
	Reddish Brown											
	Layer of siltstone		3	SS	50/							
					0.050							
	</											

+ 3. x 3. Numbers refer to Sensitivity

20  
15 5  
10 (%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No OHS-12

1 OF 1

METRIC

G.W.P. 2107-05-00 LOCATION N 4 833 070.2 E 291 489.8 ORIGINATED BY GA  
 HWY 401 BOREHOLE TYPE Solid Stem Augers/HQ2 Coring Equipment COMPILED BY AN  
 DATUM Geodetic DATE 2009.03.10 - 2009.03.10 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	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						w <sub>p</sub>	w	w <sub>L</sub>
186.4	Geodetic						20	40	60	80	100								
0.0	TOPSOIL (75mm)						40	80	120	160	200								
0.1	Silty CLAY, trace to some sand, trace gravel Firm to Hard Brown (TILL)		1	SS	7														
			2	SS	10														
			3	SS	12														
			4	SS	30														
			5	SS	51														
182.4	SHALE, slightly weathered to fresh Grey Coring started at 3.9m Horizontal joints at 4.1, 4.2 and 4.4m. Limestone interbeds at 4.0 to 4.1m and 4.7 to 4.8m. Rubble zone at 4.9 to 5.0m, 5.3 to 5.4m.		1	RUN															
4.0	Slightly weathered to fresh, weak to strong Limestone interbeds at 5.5, 5.6, 5.7, 5.9, 6.2, 6.3, 6.4, 6.5, 6.7, 6.8 and 6.9m. Horizontal joints at 6.8m.		2	RUN															
179.4	END OF BOREHOLE AT 7.0m. BOREHOLE OPEN AND WATER LEVEL AT 0.9m UPON COMPLETION OF DRILLING. Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen.																		
7.0	WATER LEVEL READINGS: DATE DEPTH (m) ELEV. (m) 2009.03.12 2.9 183.5 2009.03.26 3.2 183.2 2009.04.16 3.2 183.2																		

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

# RECORD OF BOREHOLE No SWMP-01

1 OF 1

METRIC

G.W.P. 2107-05-00 LOCATION N 4 833 289.8 E 291 584.8 ORIGINATED BY GA  
 HWY 401 BOREHOLE TYPE Solid Stem Augers/NQ2 Coring Equipment COMPILED BY AN  
 DATUM Geodetic DATE 2009.03.13 - 2009.03.13 CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT  γ  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)  GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa							WATER CONTENT (%)  w <sub>p</sub> w      w <sub>L</sub>
								○ UNCONFINED	+ FIELD VANE	● QUICK TRIAXIAL	× LAB VANE	PLASTIC LIMIT			
185.9	Geodetic						20	40	60	80	100				
0.0	SHALE, highly weathered Very Stiff to Hard Grey Moist (FILL)		1	SS	18										
			2	SS	50/ 0.150										
			3	SS	77										
183.6															
2.3	Silty CLAY, some sand, trace gravel Very Stiff Brown (TILL)		4	SS	18										0 20 47 33
			5	SS	27										0 18 46 36
181.6															
4.3	SHALE, highly weathered Grey  Coring started at 4.9m. Slightly weathered, weak, occasional mechanical fractures Limestone interbeds at 4.8, 5.2, 5.5, 5.8, 6.0, 6.1 and 6.2m. Horizontal joints at 4.9 and 5.0m. Iron oxide staining at 5.2m.		1	RUN											RUN 1# TCR=100%, SCR=98%, RQD=90%, UCS=2MPa  (Shale) UCS=140MPa (Limestone)
179.7															
6.2	END OF BOREHOLE AT 6.2m. Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen.  WATER LEVEL READINGS: DATE      DEPTH (m)      ELEV. (m) 2009.03.26      6.0      179.9 2009.04.07      5.9      180.0 2009.04.16      5.8      180.1														

+ 3, x 3. Numbers refer to  
Sensitivity

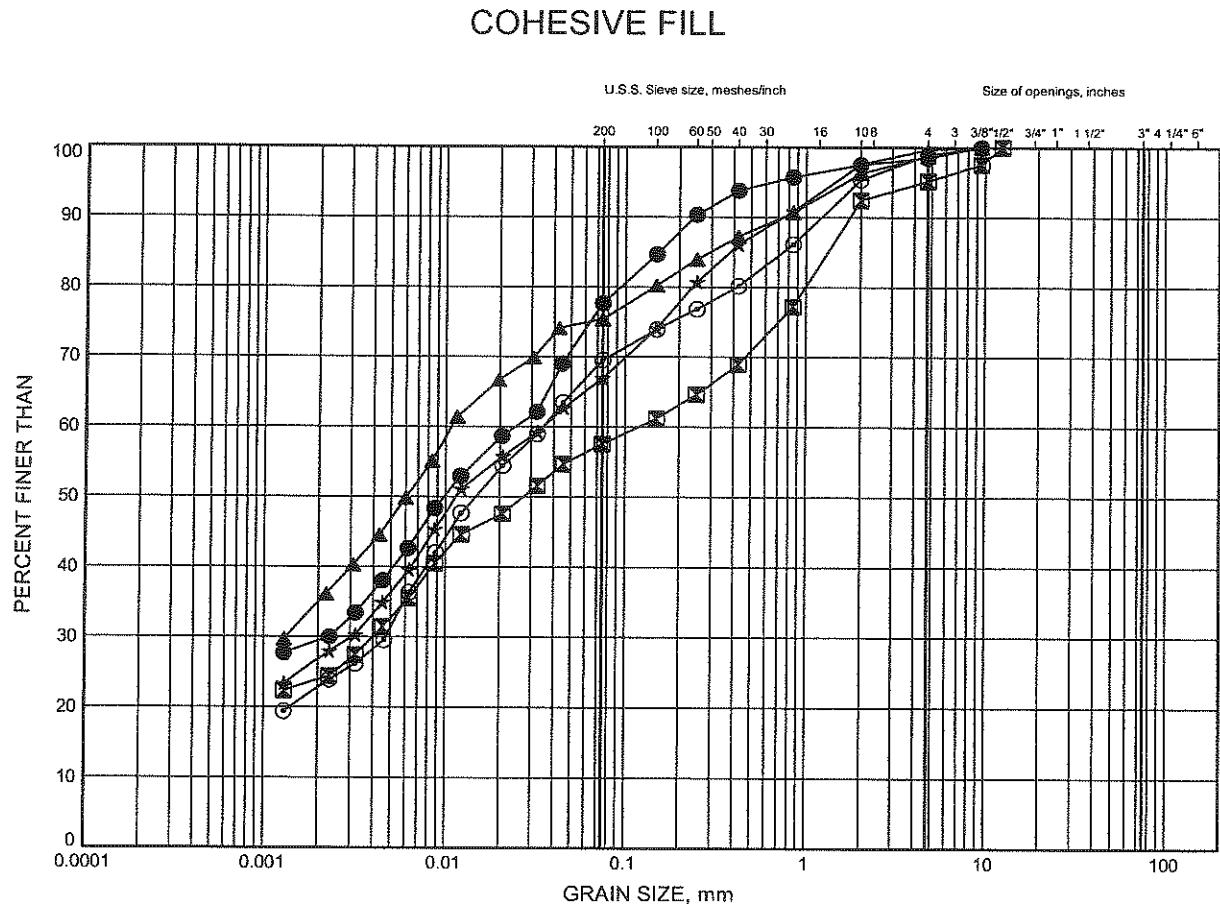
20  
15 5  
10 (%) STRAIN AT FAILURE

## **Appendix B**

### **Laboratory Test Results**

# Hwy 401 Widening GRAIN SIZE DISTRIBUTION

FIGURE B1



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

## LEGEND

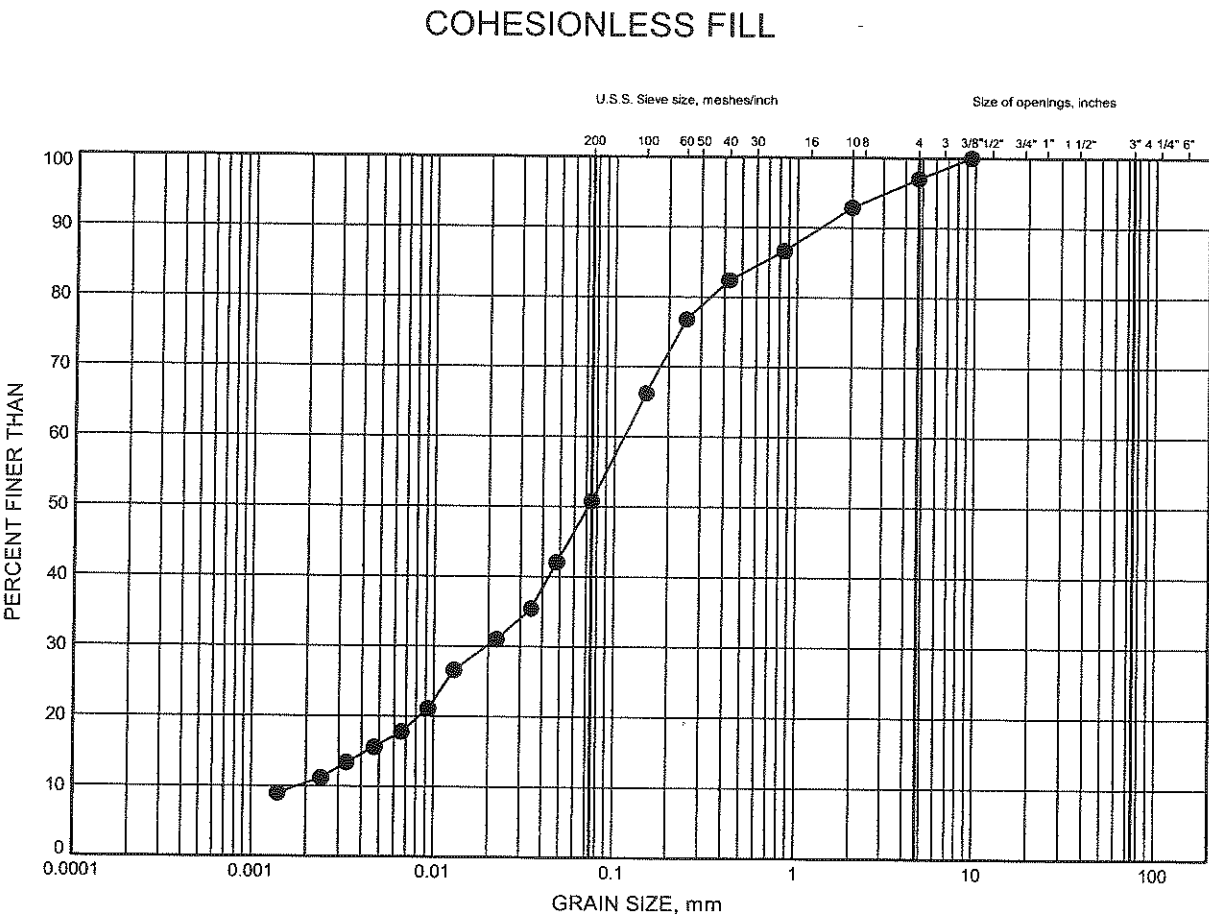
SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	P-16	1.07	177.49
⊠	P-27	1.07	179.80
▲	P-30	1.07	177.59
★	P-38	1.83	160.27
⊙	P-41	0.84	165.58



W.P.# .2107-05-00.....  
Prepared By .MFA.....  
Checked By .DEE.....

Hwy 401 Widening  
GRAIN SIZE DISTRIBUTION

FIGURE B2



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	LSOP-17	1.83	192.78



THURBER

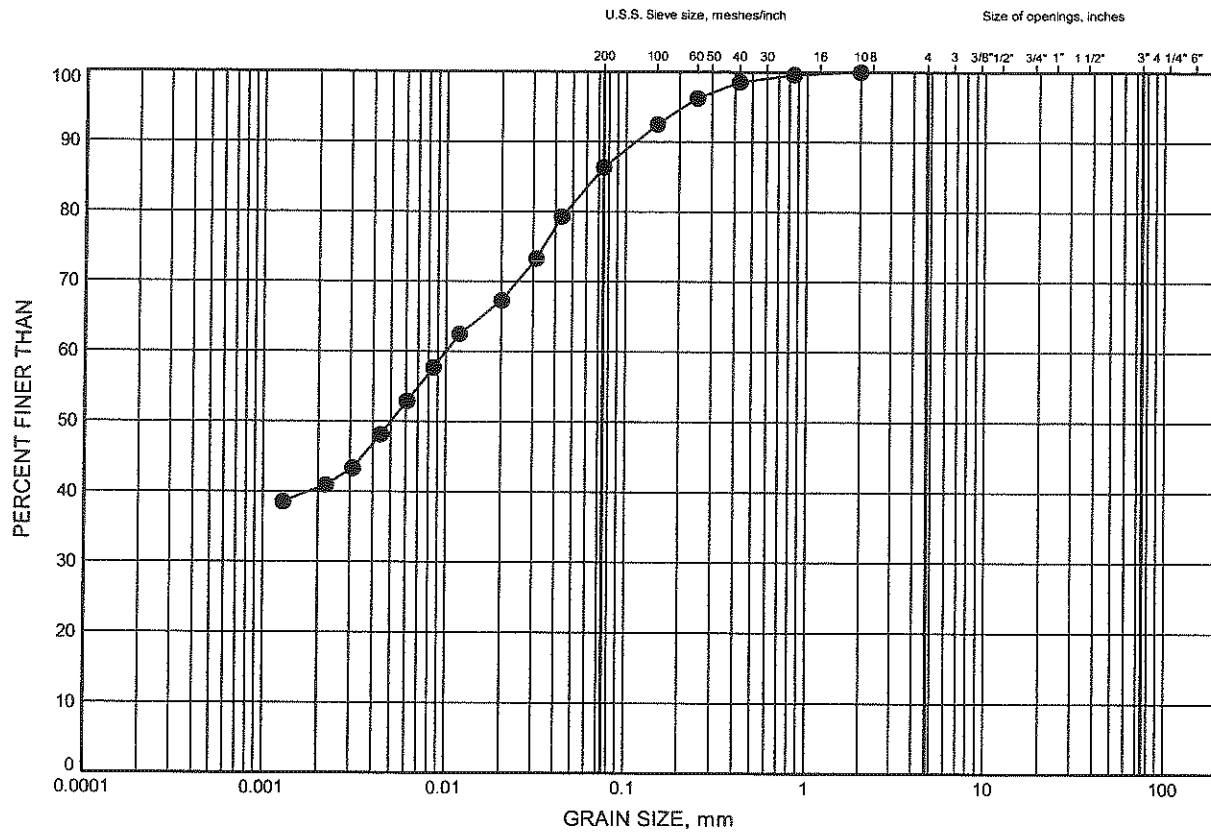
GRAIN SIZE DISTRIBUTION - THURBER 2311HML.GPJ 27/3/09

W.P.# 2107-05-00  
Prepared By MFA  
Checked By DEE

# Hwy 401 Widening GRAIN SIZE DISTRIBUTION

FIGURE B3

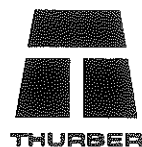
## SILTY CLAY



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

### LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	OHS-09	1.83	189.27

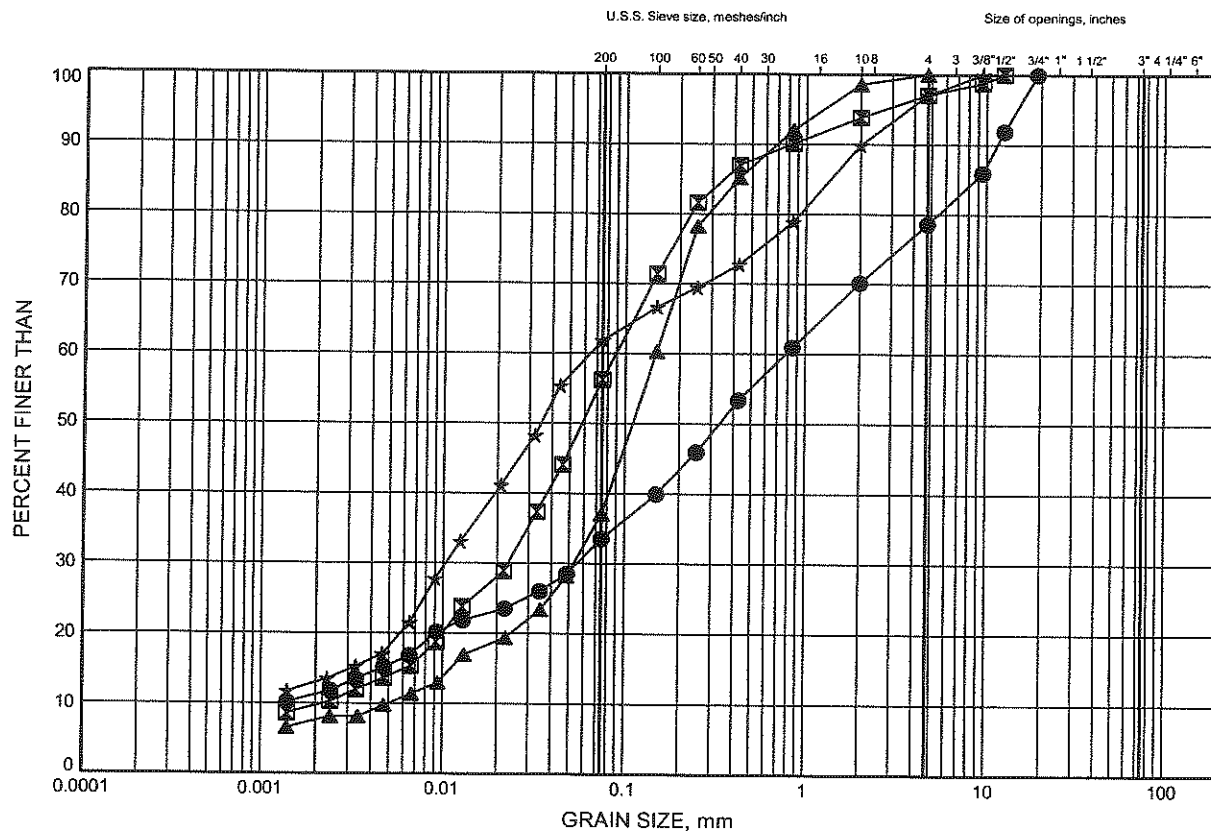


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Prepared By MFA.....  
Checked By DEE.....

# Hwy 401 Widening GRAIN SIZE DISTRIBUTION

FIGURE B4

## SAND to SILTY SAND



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

### LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	LSOP-12	1.83	190.89
⊠	LSOP-17	3.35	191.26
▲	LSOP-19	3.35	192.04
★	P-38	7.92	154.17



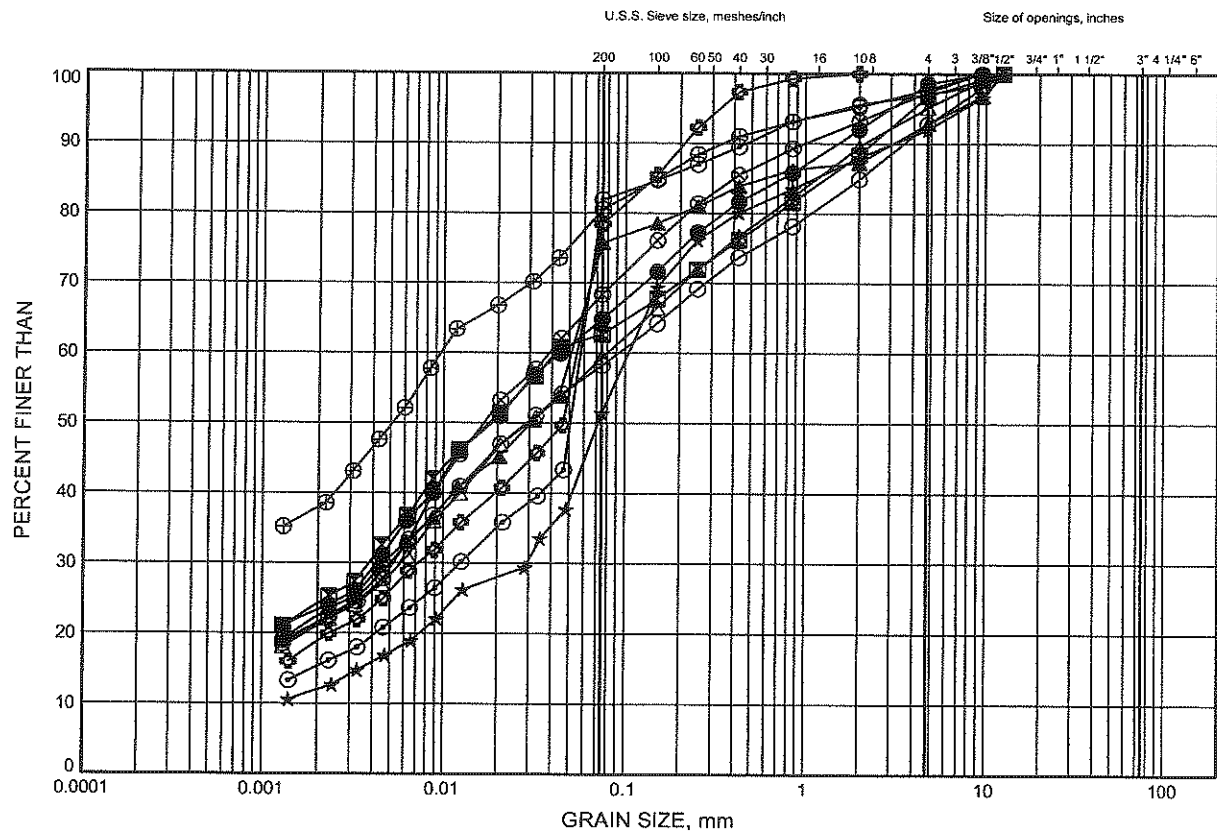
W.P.# .2107-05-00.....  
Prepared By .MFA.....  
Checked By .DEE.....



# Hwy 401 Widening GRAIN SIZE DISTRIBUTION

FIGURE B5

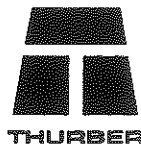
## SILT CLAY TILL to CLAYEY SILT TILL



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

### LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	LSOP-02	2.59	185.14
⊠	LSOP-02	6.40	181.33
▲	LSOP-02	9.44	178.29
★	LSOP-07	3.35	189.81
⊙	LSOP-17	7.80	186.81
⊗	LSOP-19	6.32	189.07

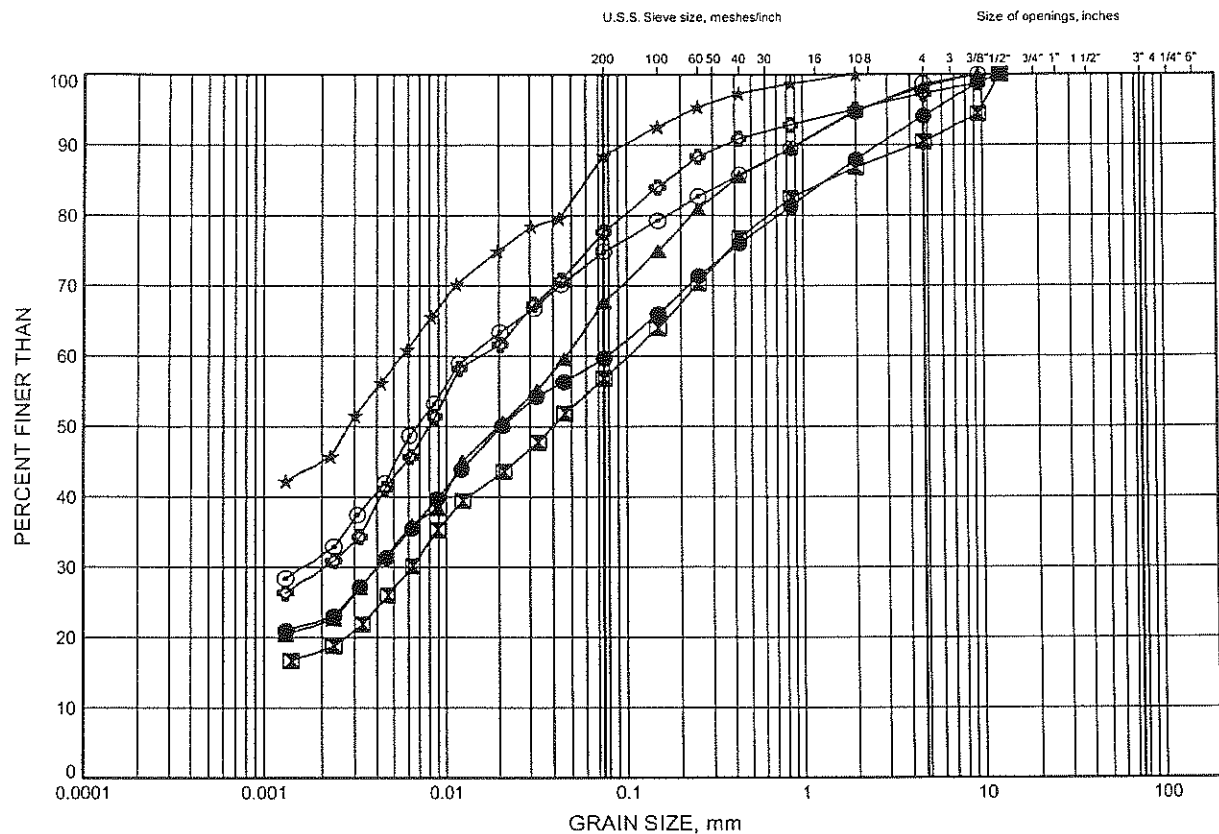


W.P.# 2107-05-00  
Prepared By MFA  
Checked By DEE

# Hwy 401 Widening GRAIN SIZE DISTRIBUTION

FIGURE B6

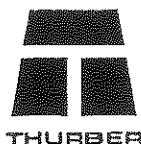
## SILTY CLAY TILL to CLAYEY SILT TILL



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

### LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	LSOP-29	4.88	184.12
⊠	LSOP-29	7.92	181.08
▲	OHS-09	3.35	187.75
★	OHS-12	1.83	184.57
⊙	P-03	1.07	179.73
⊗	P-07	1.07	177.05

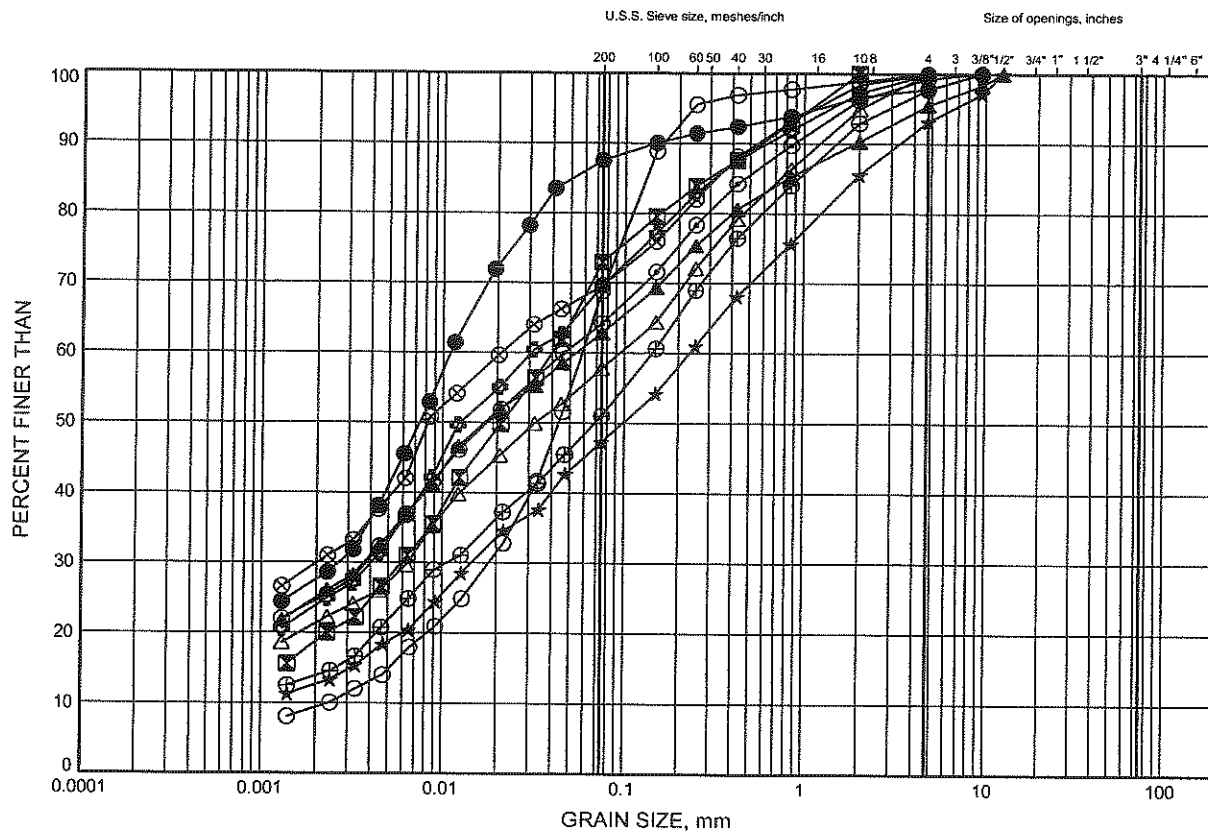


W.P.# 2107-05-00.....  
Prepared By .AN.....  
Checked By .RPR.....

# Hwy 401 Widening GRAIN SIZE DISTRIBUTION

FIGURE B7

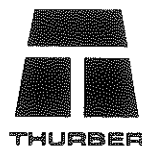
## SILTY CLAY TILL to CLAYEY SILT TILL



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

### LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	P-33	1.07	172.30
⊠	P-33	2.59	170.78
▲	P-36	1.07	162.03
★	P-36	3.35	159.74
⊙	P-38	4.88	157.22
⊗	P-43	1.83	162.38

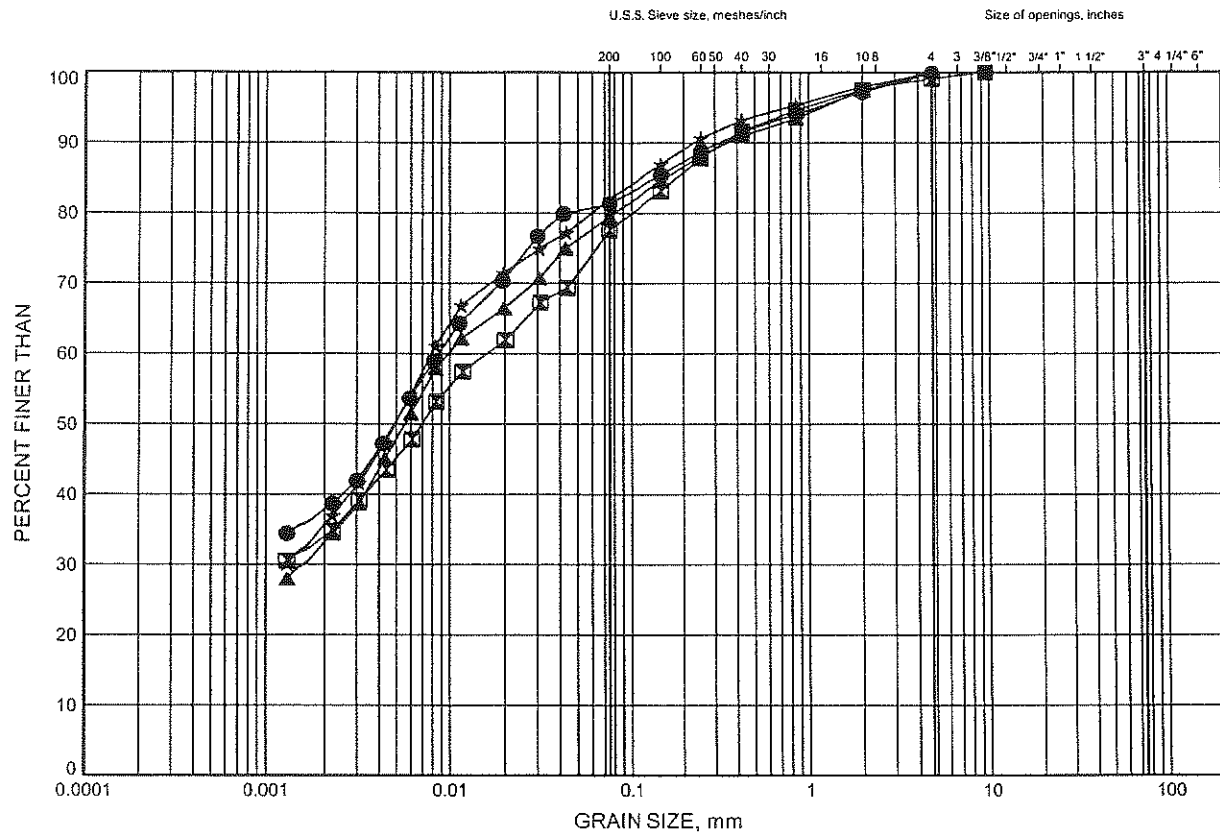


W.P.# .2107-05-00.....  
Prepared By .MFA.....  
Checked By .DEE.....

# Hwy 401 Widening GRAIN SIZE DISTRIBUTION

FIGURE B8

## SILTY CLAY TILL to CLAYEY SILT TILL



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

### LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	P-47	1.07	176.20
⊠	P-49	0.30	168.36
▲	SWMP-01	2.59	183.31
★	SWMP-01	3.35	182.55

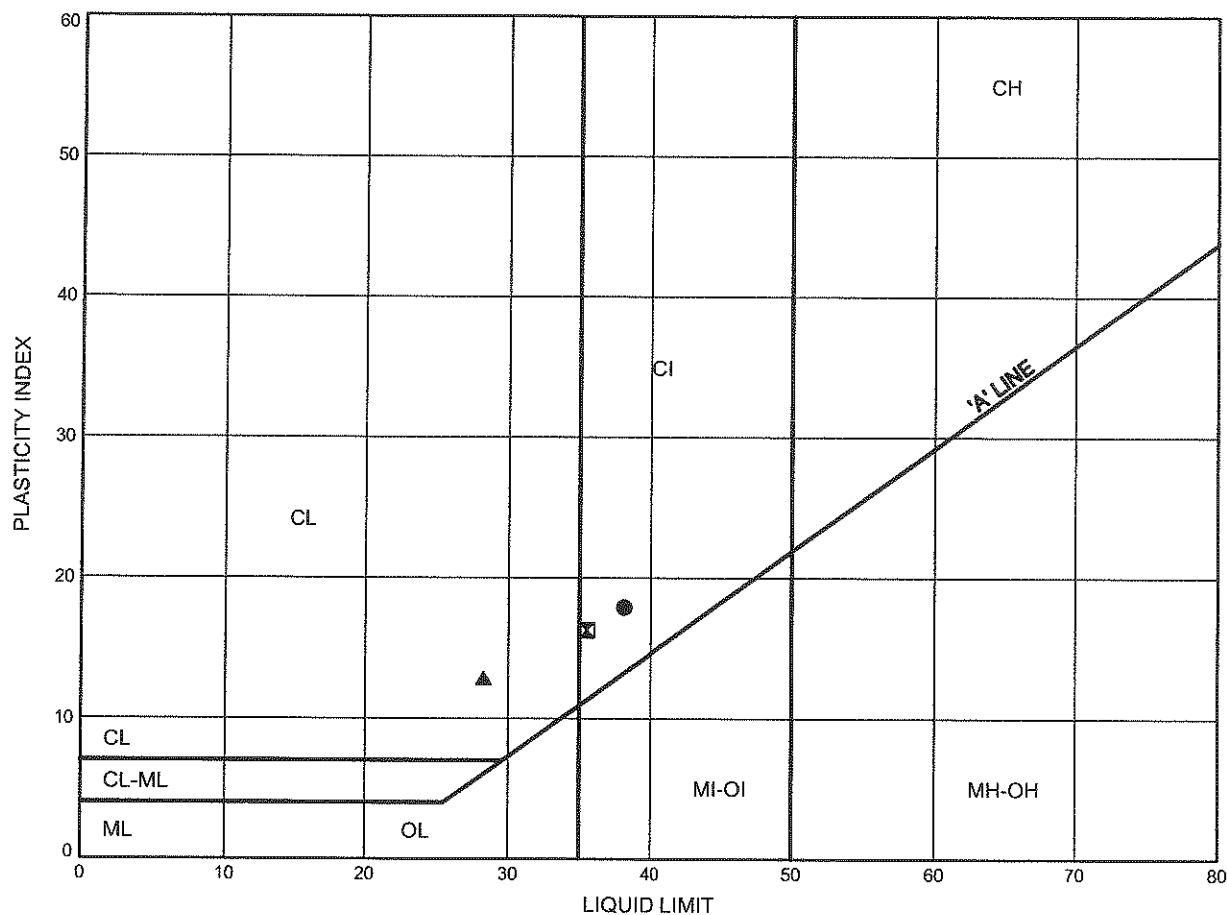


W.P.# 2107-05-00.....  
Prepared By AN.....  
Checked By RPR.....

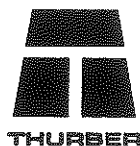
Hwy 401 Widening  
**ATTERBERG LIMITS TEST RESULTS**

FIGURE B9

**COHESIVE FILL**



SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	P-27	1.07	179.80
⊠	P-30	1.07	177.59
▲	P-38	1.83	160.27



Date April 2009

Project 2107-05-00

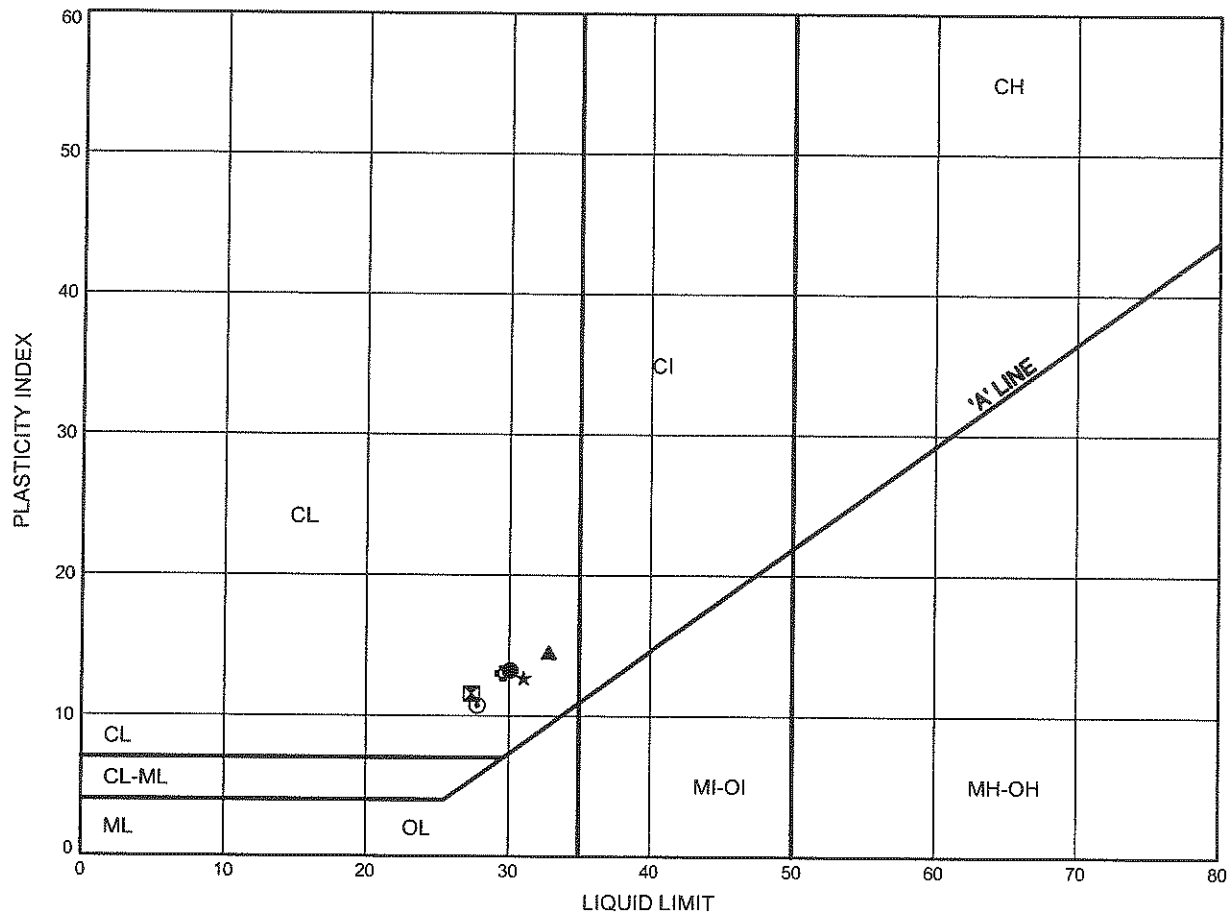
Prep'd MFA

Chkd. DEE

# Hwy 401 Widening ATTERBERG LIMITS TEST RESULTS

FIGURE B10

## SILTY CLAY TILL to CLAYEY SILT TILL

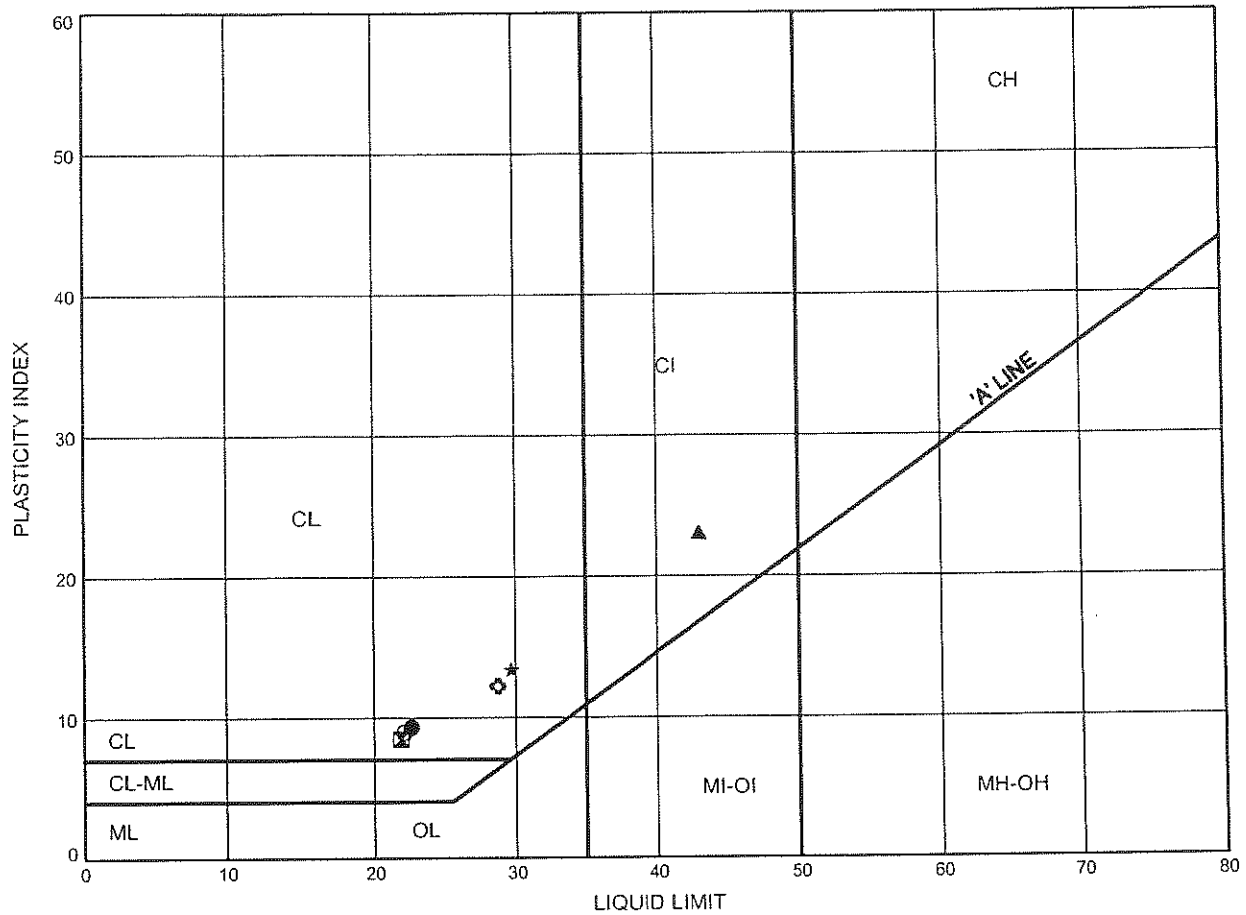


SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	LSOP-02	2.59	185.14
⊗	LSOP-02	6.40	181.33
▲	LSOP-02	9.43	178.30
★	LSOP-17	7.80	186.81
⊙	LSOP-19	6.32	189.07
⊕	LSOP-27	2.59	185.23

Hwy 401 Widening  
**ATTERBERG LIMITS TEST RESULTS**

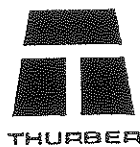
FIGURE B11

**SILTY CLAY TILL to CLAYEY SILT TILL**



SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	LSOP-27	6.40	181.42
⊠	LSOP-27	9.45	178.37
▲	LSOP-29	1.83	187.17
★	LSOP-29	4.88	184.12
⊙	LSOP-29	7.92	181.08
⊗	OHS-09	3.35	187.75

Date April 2009  
 Project 2107-05-00

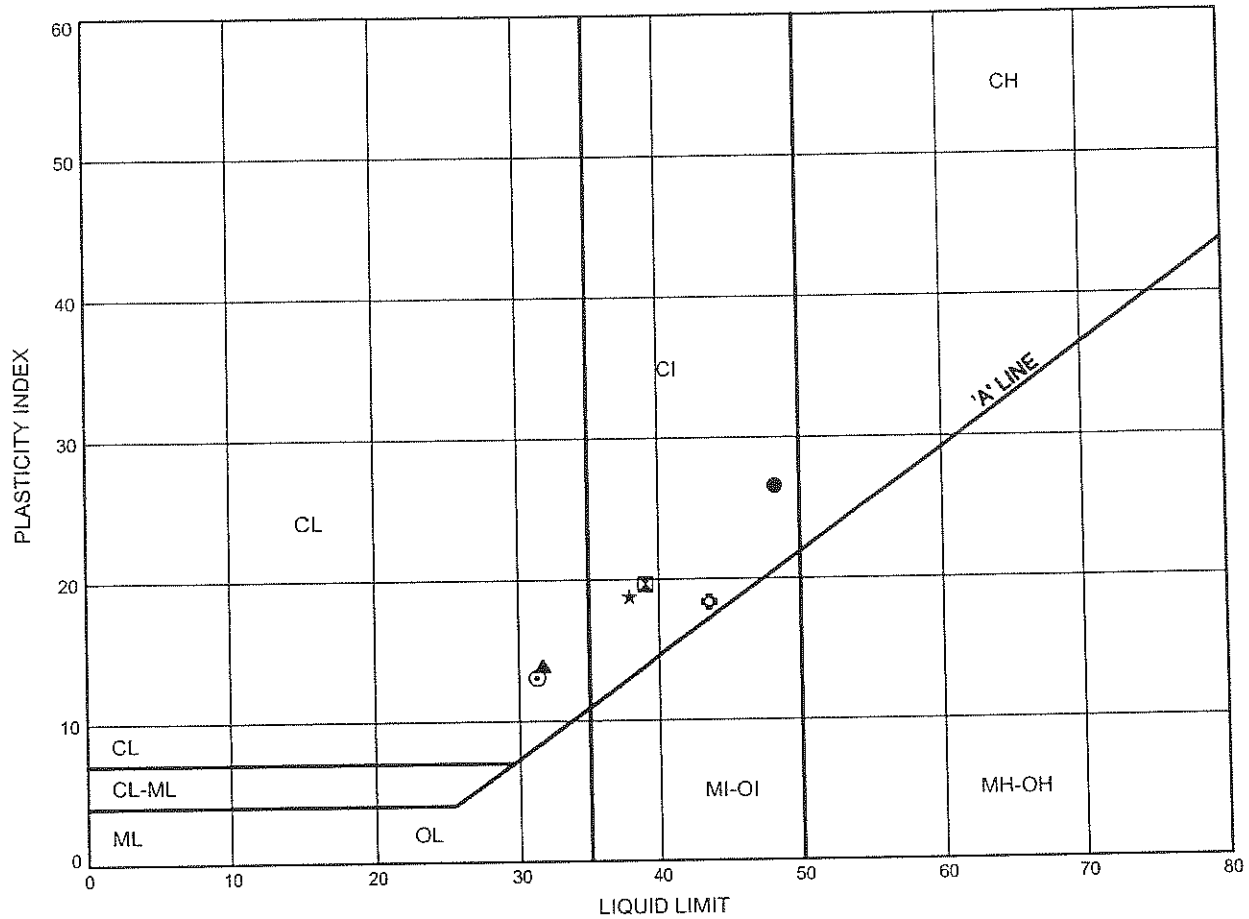


Prep'd AN  
 Chkd. RPR

Hwy 401 Widening  
**ATTERBERG LIMITS TEST RESULTS**

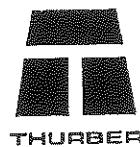
FIGURE B12

SILTY CLAY TILL to CLAYEY SILT TILL



SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	OHS-12	1.83	184.57
⊠	P-03	1.07	179.73
▲	P-07	1.07	177.05
★	P-09	2.59	182.33
⊙	P-20	1.07	184.70
⊗	P-33	1.07	172.30

Date April 2009  
 Project 2107-05-00



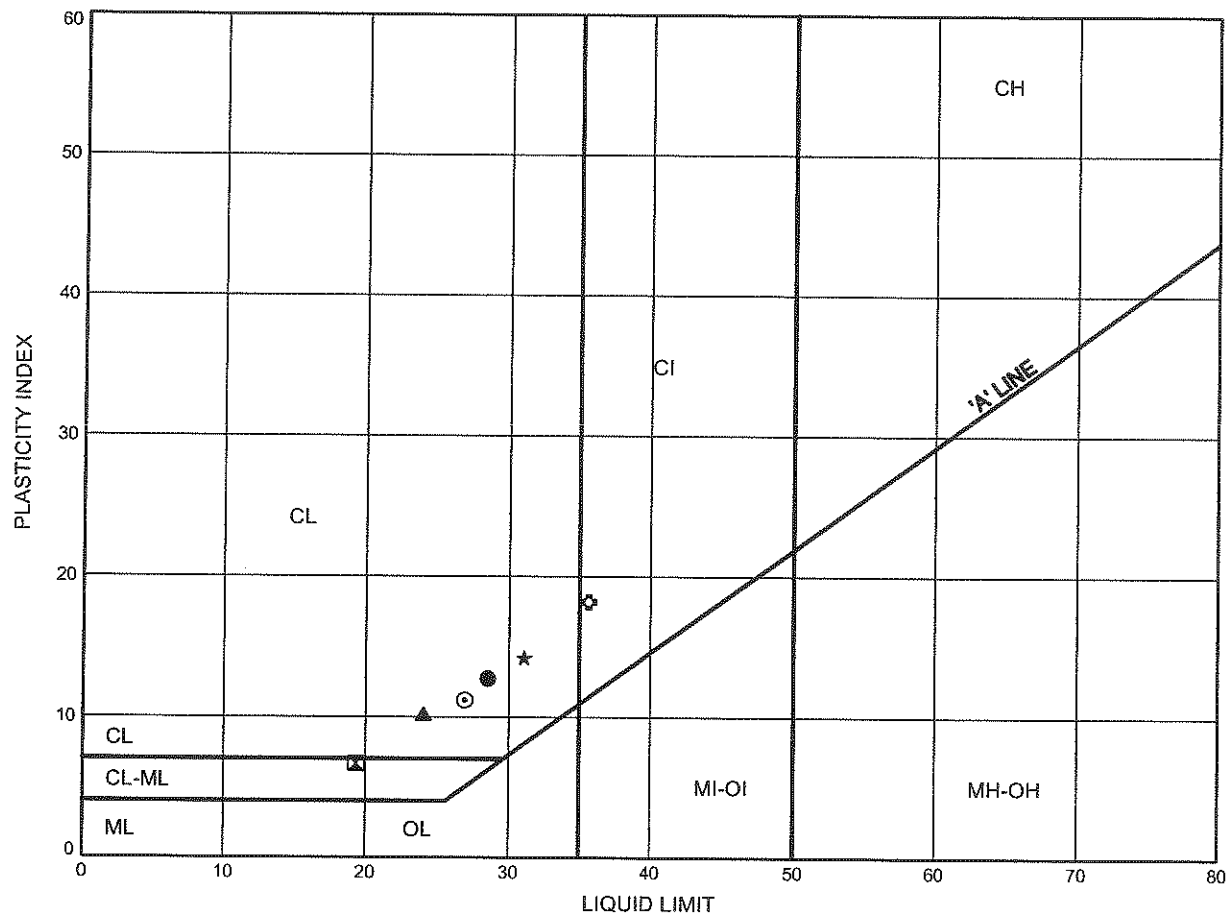
Prep'd AN  
 Chkd. RPR



# Hwy 401 Widening ATTERBERG LIMITS TEST RESULTS

FIGURE B13

## SILTY CLAY TILL to CLAYEY SILT TILL

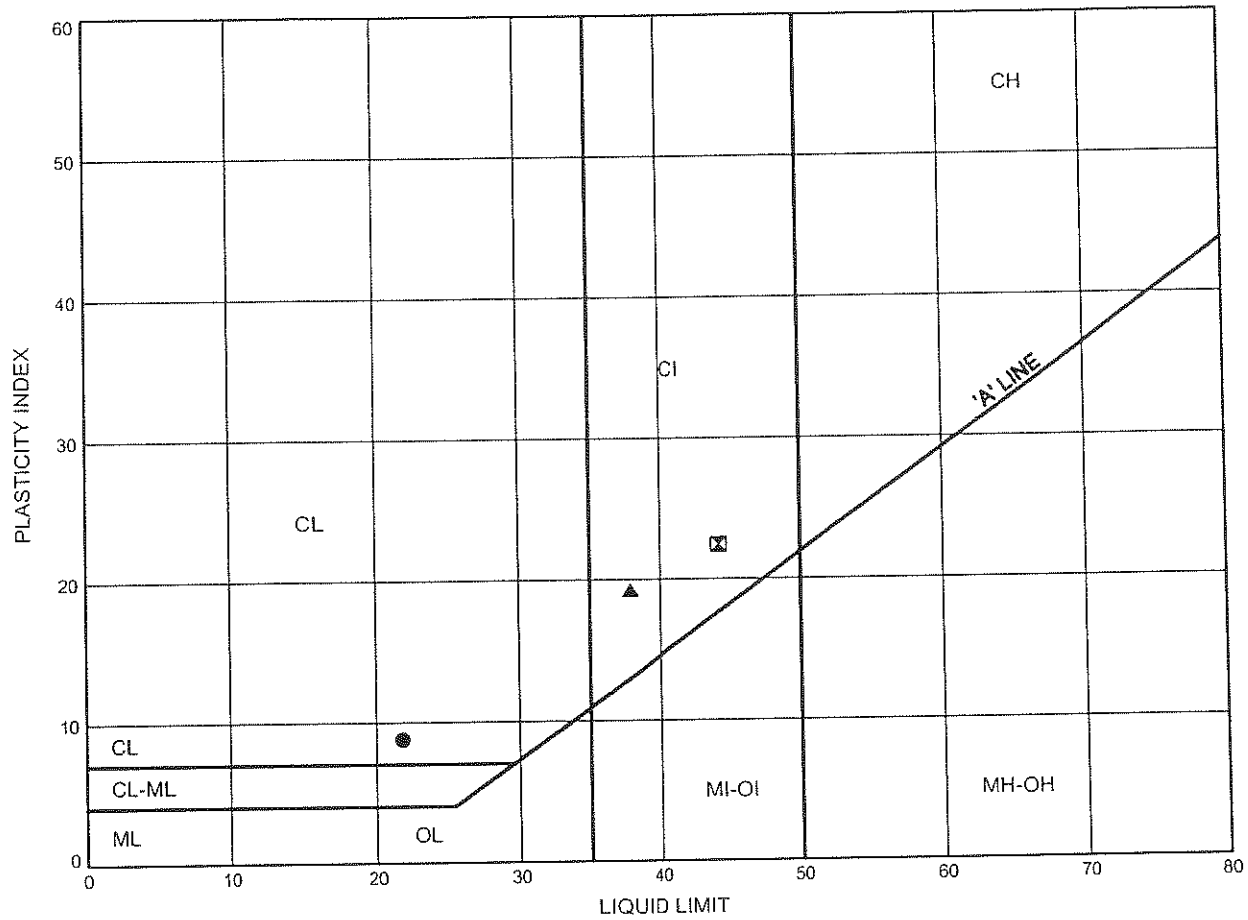


SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	P-36	1.07	162.03
⊠	P-36	3.35	159.74
▲	P-38	4.88	157.22
★	P-43	1.83	162.38
⊙	P-43	4.88	159.33
⊕	P-45	1.83	161.16

Hwy 401 Widening  
**ATTERBERG LIMITS TEST RESULTS**

FIGURE B14

**SILTY CLAY TILL to CLAYEY SILT TILL**



SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	P-45	4.88	158.11
⊠	P-47	1.07	176.20
▲	SWMP-01	2.59	183.31

Date April 2009  
 Project 2107-05-00



Prep'd AN  
 Chkd. RPR

## **Appendix C**

### **Record of Borehole Sheets (Adjacent Structure Investigations)**

# RECORD OF BOREHOLE No 5

METRIC

W P 54-B2-05 LOCATION CO-ORDS. 4,832,692N; 291,181E  
DIST 6 HWY 401 BOREHOLE TYPE SOLID STEM AUGER ORIGINATED BY H.C.  
DATUM GEODETIC DATE 1983.09.07 COMPILED BY F.L.  
CHECKED BY I.P.L.

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					
190.9	Ground Level																
0.0	75 mm Asphalt 175 mm Concrete Sandy gravel (Fill)																
190.1																	
0.8	Reddish, hard Silty clay till, with shale fragments		1	SS	70		190										
189.3			2	SS	50/	0.12m											
1.8	Reddish Shale some greyish shale and limestone seams						189										
			3	RC NXL	93%		188										
			4	RC NXL	86%		187										
			5	RC NXL	100%		186										
185.1																	
5.8	End of Borehole																

Augering  
+  
Diamond  
Drilling

Borehole dry  
on complet-  
ion of  
augering.

\* 3, \* 5 : Numbers refer to  
Sensitivity

20  
15 \* 5 (%) STRAIN AT FAILURE  
10



3112-192

# RECORD OF BOREHOLE No C-7

METRIC

W P 54-82-04 LOCATION Co-ords: N 4832930.4; E 291504.9 ORIGINATED BY BD  
DIST 6 HWY 401 BOREHOLE TYPE SS Auger, 3 Core & Cone Test COMPILED BY BD  
DATUM GEODETIC DATE 85 11 15 CHECKED BY BD

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 SHEAR STRENGTH ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE	PLASTIC LIMIT W <sub>p</sub> NATURAL MOISTURE CONTENT W LIQUID LIMIT W <sub>L</sub> WATER CONTENT (%)	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES						
184.5 0.0	GROUND SURFACE										
	Silty Clay (CL) Trace/Some Sand Trace Gravel Hard		1	SS	51		184				
182.5 2.0			2	SS	39		183				
			3	RC	REC 48%		182				
	Bedrock Shale and Limestone Georgian Bay Formation		4	RC	REC 69%		181				
			5	RC	REC 90%		180				
178.6 5.9	Weathered Sound						179				
	END OF BOREHOLE										

+3, x5: Numbers refer to Sensitivity  
20  
15  
10  
5 (%) STRAIN AT FAILURE

11.7' cored



RECORD OF BOREHOLE No C-9

METRIC

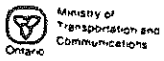
W P 54-82-04 LOCATION Co-ords: N 4832873.5; E 291696.8 ORIGINATED BY BD  
DIST 6 HWY 401 BOREHOLE TYPE SS Auger, B Core & Cone Test COMPILED BY BD  
DATUM GEODETIC DATE 85 11 20/21 CHECKED BY BD

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 SHEAR STRENGTH ○ UNCONFINED    × FIELD VANE ● QUICK TRIAXIAL    x LAB VANE	PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES								
184.6 0.0	GROUND SURFACE					*							
	Silty Clay (CL) with Sand and Gravel Very soft to firm		1	SS	4		184						
182.6 2.0			2	SS	10		183						
			3	SS	70	/10cm	182						
	weathered sound		4	RC	Rec 90%		181						
	Bedrock Shale and Limestone Georgian Bay Formation		5	RC	Rec 95%		180						
178.5							179						
6.1	END OF BOREHOLE *Groundwater elevation not determined												

+<sup>3</sup>, x<sup>5</sup>: Numbers refer to  
Sensitivity

20  
15 5 (%) STRAIN AT FAILURE  
10

30M12-146



# RECORD OF BOREHOLE No C13

METRIC

W P 54-82-09 LOCATION Co-ords. N 4 833 015.8; E 292 102.0 ORIGINATED BY JD  
 DIST 6 HWY 401/410 IC BOREHOLE TYPE SS Auger, B Core, Cone Test COMPILED BY JD  
 DATUM Geodetic DATE 86 06 19 CHECKED BY DD

## SOIL PROFILE

## SAMPLES

## GROUND WATER CONDITIONS

## DYNAMIC CONE PENETRATION RESISTANCE PLOT

20 40 60 80 100

## SHEAR STRENGTH

○ UNCONFINED    + FIELD VANE  
 ● QUICK TRIAXIAL    x LAB VANE

PLASTIC LIMIT

W<sub>p</sub>

NATURAL MOISTURE CONTENT

W

LIQUID LIMIT

W<sub>L</sub>

WATER CONTENT (%)

UNIT WEIGHT  
γ

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

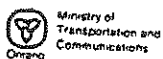
ELEV DEPTH	DESCRIPTION	STRAI PLOT	NUMBER	TYPE	'N' VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT	PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
181.2	Ground Surface												
0.0	Silty Clay (cl) * (Till)					Dry	181						
180.7													
0.5	Bedrock Shale and Limestone Georgian Bay Formation		1	SS	90								
			1A	SS	60/0cm								
			2	RC	28% rec		180						
			3	RC	24% rec								
			4	RC	100% rec		179						
			5	RC	43% rec								
			6	RC	66% rec		178						
	Weathered Unweathered		7	RC	100% rec		177						
176.4													
4.8	End Of Borehole												

\*Some Sand  
Trace Gravel  
occ. Shaly Zones  
Hard

+<sup>3</sup>, x<sup>5</sup>: Numbers refer to Sensitivity

20  
15  
10  
5 (%) STRAIN AT FAILURE

30M12-196



# RECORD OF BOREHOLE No C20a

METRIC

W P 54-82-09 LOCATION CO-ORDS: N 4 833 129.8; E 291 684.3 ORIGINATED BY JD  
 DIST 6 HWY 401/410 IC BOREHOLE TYPE SS Auger, Cone Test, B Core COMPILED BY JD  
 DATUM Geodetic DATE 86 06 04 CHECKED BY DD

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100	SHEAR STRENGTH ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE	PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT Y	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE									
182.6 0.0	Ground Surface												
	Silty Clay (cl) Some Sand Trace Gravel Occ. Shaly Zones (Till) Stiff to Hard		1	SS	17								
			2	SS	33								
			3	SS	38								
180.4 3.2			4	SS	60/	13 cm							
			5	RC	46% rec								
			6	RC	25% rec								
			7	RC	0% rec								
	Bedrock Shale and Limestone Georgian Bay Formation Weathered		8	RC	fragments rec								
175.8 7.8	End of Borehole		9	SS	60/	5 cm							

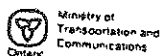
OFFICE REPORT ON SOIL EXPLORATION

+3, x5: Numbers refer to Sensitivity

20  
15 ± 5 (%) STRAIN AT FAILURE  
10



Drill 170



# RECORD OF BOREHOLE No C206

METRIC

W P 54-82-09 LOCATION CO-ORDS: N 4 833 129.8; E 291 684.3  
 DIST 6 HWY 401/410 IC BOREHOLE TYPE SS Auger, B Core  
 DATUM Geodetic DATE 86 06 05  
 ORIGINATED BY JD  
 COMPILED BY JD  
 CHECKED BY DD

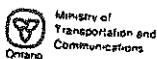
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100				
183.6	Ground Surface															
0.0						DRY										
							183									
							182									
							181									
							180									
							179									
							178									
							177									
							176									
175.8	Refer to BH #20a						175									
7.8	Bedrock Shale and Limestone Georgian Bay Formation Weathered		10	RC	72% rec		174									
			11	RC	18% rec		173									
			12	WS												
172.5																
11.1	End of Borehole															

+3, x5: Numbers refer to Sensitivity  
 20  
 15 5 (%) STRAIN AT FAILURE  
 10

OFFICE REPORT ON SOIL EXPLORATION

9.9

SUM 12-196



# RECORD OF BOREHOLE No C20c

METRIC

W P 54-82-09 LOCATION CO-ORDS: N 4 833 129.8; E 291 684.3 ORIGINATED BY JD  
 DIST 6 HWY 401/410 IC BOREHOLE TYPE SS Auger, B Core COMPILED BY JD  
 DATUM Geodetic DATE 86 06 09 CHECKED BY DD

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 SHEAR STRENGTH ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE	PLASTIC LIMIT Wp	NATURAL MOISTURE CONTENT W	LIQUID LIMIT Wl	UNIT WEIGHT Y	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE								
183.6 0.0	Ground Surface											
					DRY							
						183						
						182						
						181						
						180						
						179						
						178						
			13	SS	60	5 cm						
						177						
			14	SS	60	5 cm						
						176						
						175						
						174						
						173						
172.5	Refer to BH #20a and BH #20b					172						
11.1	Weathered Unweathered Bedrock Shale and Limestone Georgian Bay Formation		15	RC	83% rec							
171.3												
12.3	End of Borehole											

+3, x5: Numbers refer to Sensitivity

20  
15 ÷ 5 (%) STRAIN AT FAILURE  
10

3.6

# RECORD OF BOREHOLE No 50-4

METRIC

W P 54-82-14/16 LOCATION Co-ords: N 4 833 386.3; E 292 442.3 ORIGINATED BY DC  
 DIST 6 HWY 401 BOREHOLE TYPE Solid Stem Auger, BW Casing, BXL Core Barrel & COMPILED BY DC  
 DATUM Geodetic DATE 89 09 19 Cone Test CHECKED BY TCK

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 SHEAR STRENGTH kPa O UNCONFINED + FIELD VANE X QUICK TRIAXIAL X LAB VANE	PLASTIC LIMIT W <sub>p</sub> NATURAL MOISTURE CONTENT W LIQUID LIMIT W <sub>L</sub>	WATER CONTENT (%) 10 20 30	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	N° VALUES							
172.2 0.0	Ground Level											
170.4 1.8	Heterogeneous Mixture of Silty Clay, Sand and Gravel Brown to Grey (Glacial Till) Stiff to Hard		1	SS	19		172					
			2	SS	90/	10cm	171					3 14 58 25
	Bedrock Shale and Dolostone Dark Grey to Medium Black		3	BXL RC	REC 72%		170					RQD = 0%
	Weathered Unweathered		4	BXL RC	REC 88%		169					RQD = 0%
			5	BXL RC	REC 98%		168					RQD = 0%
165.8 6.4	End of Borehole						167					
	* Note Water level was not Encountered during the Site Investigation						166					

OFFICE REPORT ON SOIL EXPLORATION

# RECORD OF BOREHOLE No BW10

1 OF 1

METRIC

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

LOCATION

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

ORIGINATED BY BJ

HWY 401

BOREHOLE TYPE Solid Stem Augers/INQ Coring

COMPILED BY WM

DATUM Geodetic

DATE

2006-12-12 - 2006-12-12

CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT W <sub>P</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT  Y  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)					
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa								WATER CONTENT (%)				
194.5							20	40	60	80	100									
8.9	TOPSOIL: (50 mm)		1	SS	24															
	Sandy SILT, gravelly, trace to some clay Compact to Loose Grey to Brown Moist (FILL)		2	SS	7															
193.0																				
1.5	Silty CLAY, some sand, trace gravel, some black staining Very Stiff Brown (FILL)		3	SS	26															
192.2																				
2.3	Silty CLAY, trace sand, occasional oxide staining Stiff to Very Stiff Mottled grey-brown (CI)		4	SS	11															
			5	SS	26															
190.6																				
4.0	Highly weathered, thinly bedded, very weak to weak, reddish brown. SHALES, occasional siltstone layers  Coring started at 4.67m		6	SS	50 .100															
			1	RUN																
			2	RUN																
186.8																				
7.7	END OF BOREHOLE AT 7.72 m. BOREHOLE GROUTED TO SURFACE.																			

+ 3 X 3: Numbers refer to Sensitivity 20 15 10 (% 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/NO 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			SHEAR STRENGTH kPa						
199.7								20 40 60 80 100	20 40 60					
0.0	ASPHALT: (150 mm)													
0.2	SAND AND GRAVEL Dense Brown Moist (FILL)		1	SS	32									
198.9							199							
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		198							
			4	SS	16									
			5	SS	13		197							1 28 47 24
			6	SS	10		196							
			7	SS	15		195							
							194							
							193							
	occasional asphalt fragments Hard		8	SS	45		192							
191.1														
8.5	Silty CLAY, some sand, trace gravel Hard Brown (TILL)		9	SS	57		191							
							190							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/NO 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					
								20 40 60 80 100					
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE					
							WATER CONTENT (%)						
							PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT						
							w <sub>p</sub> w w <sub>L</sub>						
							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/ .125		186						
	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												

+ 3 x 3 Numbers refer to  
Sensitivity

20  
15 5  
10 (%) STRAIN AT FAILURE

# 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/NO 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 γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100		
191.2	TOPSOIL: (25mm)		1	SS	50/		191							GR SA SI CL
190.6	SHAPE, trace gravel, hard, reddish brown, moist (FILL)				.150									
189.6	Clayey SILT with sand, trace gravel Very Stiff Brown (TILL)		2	SS	28		190							1 35 47 17
189.6	SHAPE, highly to moderately weathered, thinly bedded, reddish brown, with green-grey siltstone and gray limestone interbeds		3	SS	50/		189							
			4	SS	0/		189							
	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	.000		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	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						186							

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

# 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					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		
190.2														
0.0	Silty CLAY, some sand, trace gravel Very Stiff Brown (TILL)		1	SS	25		190							GR SA SI CL
189.2			2	SS	26									2 19 52 27
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							
	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							
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		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						
192.5								20 40 60 80 100						
0.0	TOPSOIL: (100mm)							○ UNCONFINED + FIELD VANE						
0.1	Silty CLAY, some sand, occasional rootlets Very stiff Brown to mottled brown-grey (TILL)		1	SS	20		192	● QUICK TRIAXIAL × LAB VANE						
			2	SS	16		191							
			3	SS	17		190							
			4	SS	26		189							
	Hard Occasional iron oxidized stains		5	SS	50/ .150		188							0 16 61 23
188.0							187							
4.6	Clayey SILT with sand, trace gravel Hard Brown to grey (TILL)		6	SS	69/ .150		186							1 31 68 (SI+CL)
							185							
186.4							184							
6.1	Silty CLAY, trace to some sand, trace gravel Hard		7	SS	152		183							
186.0	Grey to reddish brown (TILL)						182							
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										
			2	RUN										

Continued Next Page



+ 3, x 3: Numbers refer to Sensitivity  
 20  
 15 5  
 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 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									
	Continued From Previous Page							20	40	60	80	100					
182.2	10.19m Horizontal joints at 9.45 and 9.70 to 9.73m																GR SA SI CL
10.4	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									0	UCS = 60 MPa (Limestone)

# 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		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						
							20 40 60 80 100	20 40 60 80 100	20 40 60					
192.1	TOPSOIL: (75mm)		1	SS	26									
191.5	Silty CLAY, trace to some sand, trace gravel, occasional rootlets Very Stiff Brown (FILL)		2	SS	32									
190.7	Silty CLAY, trace to some sand, trace gravel Hard Brown (TILL)		3	SS	64									
	Occasional iron oxidized stains		4	SS	89									
			5	SS	101									
			6	SS	113									
186.4	Clayey SILT with sand, some shale fragments Hard Reddish Brown (TILL)		7	SS	105									
185.4	SHALE, highly weathered, thinly bedded, reddish brown, with green-grey siltstone interbeds, occasional limestone interbeds, and occasional clay seams		8	SS	50/ .000									
	Coring started at 8.23m Slightly weathered to fresh Clay seam at 8.72, 9.09, and 9.14m Green-grey siltstone interbeds at 8.46 to 8.51, 8.56 to 8.61, 8.71, 8.81 to 8.84, 8.80 to 8.92, 9.02 to 9.04, 9.09 to 9.24, 9.24 to 9.30, and 9.30 to 9.45m		1	RUN										
	Limestone interbeds at 9.91 to 9.93 and 10.01 to 10.08m													

Continued Next Page

+ 3 x 3 Numbers refer to  
Sensitivity

20  
15  
10  
(%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No HML-04

2 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					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												
	Continued From Previous Page							20 40 60 80 100					w <sub>p</sub> w w <sub>L</sub>					
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE					WATER CONTENT (%)					
								20 40 60 80 100					20 40 60					

+ 3 × 3 Numbers refer to  
Sensitivity

20  
15 5  
10 (%) STRAIN AT FAILURE

## METRIC

ORIGINATED BY GA

COMPILED BY ES

CHECKED BY RPR

ONTMT4S 2311.GPJ 3/6/08

+ 3, X 3: Numbers refer to Sensitivity

## METRIC

[illegible]

# 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					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		
191.0														
0.0	Silty CLAY, trace to some sand, trace gravel, occasional rootlets		1	SS	50/		191							
190.4	Hard Brown (FILL)				.150									
0.6	Silty CLAY, some sand, trace gravel, occasional rootlets		2	SS	50/									
189.8	Hard Dark grey (TILL)				.150		190							1 16 57 26
1.2	SHALE, highly weathered, fine grained, thinly bedded, reddish brown		3	SS	100/									
					.125									
			4	SS	100/		189							
					.150									
188.0														
3.0	END OF BOREHOLE AT 3.05m. AUGER REFUSAL ON PROBABLE LIMESTONE BEDROCK. BOREHOLE OPEN AND DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO SURFACE.													

+ 3 . x 3 : Numbers refer to  
Sensitivity

20  
15  
10  
(%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No 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 289 842.836 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  Y  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)  GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
194.9								20	40	60	80	100		
0.0	TOPSOIL: (75mm)		1	SS	48									
0.1	Silty CLAY, trace to some sand, trace gravel, occasional rootlets Hard to Very Stiff Brown to Mottled Grey and Brown (FILL)		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													

+ 3 x 3: Numbers refer to Sensitivity

20  
15  
10  
(%) STRAIN AT FAILURE



# 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/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			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 w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	
193.7 0.0 0.1	TOPSOIL: (100 mm)  Silty CLAY, some sand, trace gravel, occasional rootlets Firm to Very Stiff Mottled Brown to Grey (FILL)		1	SS	6		193					GR SA SI CL
			2	SS	24							
192.1 1.5	SAND and SILT, some clay, trace gravel Dense to Very Dense Brown Moist (TILL)		3	SS	43		192					4 36 47 13
			4	SS	50/ .150							
190.9 2.7	Sandy SILT, trace clay Very Dense Brown Moist  becoming Grey		5	SS	50/ .150		191					0 27 69 4
							190					
188.9 4.7	Silty CLAY, trace sand, trace gravel, occasional shale fragments Hard Reddish Brown (TILL)		6	SS	80		189					FI >10 >10 5 5 4 5 3 2 1
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		188					
			1	RUN			187					RUN 1# TCR=100%, SCR=75%, ROD=22%  RUN 2# TCR=100%, SCR=97%, ROD=53%
			2	RUN			186					
184.4 9.3	END OF BOREHOLE AT 9.30m. BOREHOLE OPEN TO BOTTOM UPON COMPLETION.						185					

Continued Next Page

+ 3 x 3 Numbers refer to  
Sensitivity

20  
15 5  
10 (%) STRAIN AT FAILURE

## METRIC

SOIL PROFILE F

+ 3, x 3. Numbers refer to Sensitivity

# 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			PLASTIC LIMIT W <sub>P</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa								WATER CONTENT (%)
								○ UNCONFINED	+ FIELD VANE	● QUICK TRIAXIAL						
194.3							20	40	60	80	100					
0.0	TOPSOIL 0.08m		1	SS	84										GR SA SI CL	
0.1																
193.9	SAND, some gravel, trace silt, trace clay, some gravel, occasional rootlets Very Dense Brown Moist (FILL)		2	SS	54											
0.5																
192.8	Silty CLAY, trace to some sand, trace gravel Hard Mottled Brown/Reddish Brown (FILL)		3	SS	58											
1.5																
191.3	Silty CLAY, with sand, trace gravel Hard Brown (TILL)		4	SS	50/ .150										2 29 47 22	
3.0																
191.3	SAND and SILT, trace gravel, trace to some clay, occasional iron oxide staining Very Dense Brown (TILL)		5	SS	50/ .150											
190.1	Grinding at 3.96m to 4.27m															
4.3																
190.1	SHALE, highly weathered, fine grained, thinly bedded Reddish Brown		6	SS	100/ .125										4 48 39 9	
188.2																
6.2	END OF BOREHOLE AT 6.17m. BOREHOLE OPEN AND DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO SURFACE.		7	SS	100/ .075											

+ 3, x 3 Numbers refer to  
Sensitivity

20  
15 5  
10 (%) STRAIN AT FAILURE

## METRIC

ORIGINATED BY GA

COMPILED BY ES

CHECKED BY RPR

ONTMT4S 2311.GPJ 3/6/08

(%) 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 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
	Continued From Previous Page																		
	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															
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 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				PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa				W <sub>p</sub>	W	W <sub>L</sub>		
191.8	TOPSOIL: (100mm)							20 40 60 80 100								GR SA SI CL
0.0 0.1	Silty CLAY, trace to some sand, trace gravel, occasional rootlets Stiff to Very Stiff Brown to Greenish Grey (FILL)		1	SS	12		191									
			2	SS	20											
190.3	Silty CLAY with sand, trace gravel Stiff to Hard Brown to Mottled Brown/Grey (TILL)		3	SS	13		190									
1.4	occasional oxidized stains		4	SS	38		189									2 33 50 15
	occasional shale fragments		5	SS	50/ .150		188									
187.2	SAND and SILT, some clay, trace gravel, occasional shale fragments Very Dense Reddish Brown (TILL)		6	SS	103		187									6 42 38 14
4.6 186.6	SHALE, highly weathered, thinly bedded, reddish brown						186									
5.2	END OF BOREHOLE AT 6.1m UPON AUGER REFUSAL. BOREHOLE OPEN AND DRY TO 6.1m. BOREHOLE BACKFILLED WITH HOLEPLUG TO SURFACE.															
185.7																
6.1																

+<sup>3</sup> X<sup>3</sup> Numbers refer to Sensitivity 20 15 10 5 0 (%) 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 W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									WATER CONTENT (%)	
								○ UNCONFINED	+ FIELD VANE	● QUICK TRIAXIAL	× LAB VANE						W <sub>p</sub>	W <sub>L</sub>
190.7							20	40	60	80	100	20	40	60	GR	SA	SI	CL
0.0	TOPSOIL: (125mm)																	
0.1	Silty CLAY, trace to some sand, trace gravel, occasional rootlets Stiff Brown (FILL)		1	SS	13													
			2	SS	10													
189.2																		
1.4	Silty CLAY with sand, occasional oxide stains Firm to Hard Mottled Brown-Grey to Brown (TILL)		3	SS	8													
			4	SS	49													
			5	SS	50/ .150													2 34 46 18
186.1																		
4.6	SAND and SILT, some clay, trace gravel Very Dense Grey Damp to Moist (TILL)		6	SS	50/ .150													2 44 44 10
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 3/6/08

# 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				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	x LAB VANE					
194.9							20	40	60	80	100					
0.0 0.1	TOPSOIL: (75mm)		1	SS	48											
	Silty CLAY, trace to some sand, trace gravel, occasional rootlets Hard to Very Stiff Brown to Mottled Grey and Brown (FILL)		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															



**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.

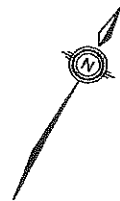
For bidding purposes, the Contractor shall assume the following:

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 in the shale and limestone bedrock.
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

CONT No  
GWP No

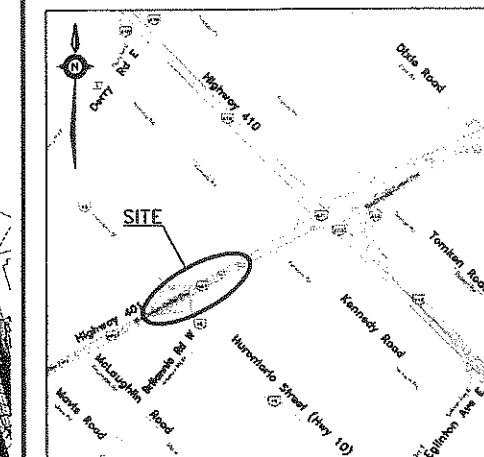
HIGHWAY 401  
HIGH MAST LIGHTING POLES  
WEST OF KENNEDY ROAD  
BOREHOLE LOCATION PLAN



SHEET

**MMM GROUP**

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



**KEYPLAN  
LEGEND**

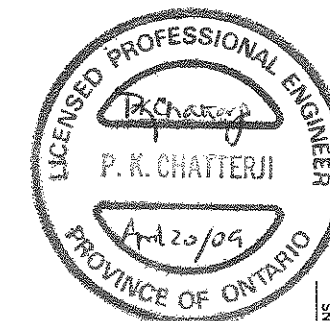
- ◆ Borehole (Present Investigation)
- ◇ Borehole (Previous Investigation)
- N Blows /0.3m (Std Pen Test, 475J/blow)
- CONE Blows /0.3m (60° Cone, 475J/blow)
- PH Pressure, Hydraulic
- W Water Level
- HA Head Artesian Water
- PM Piezometer
- 90% Rock Quality Designation (RQD)
- A/R Auger Refusal

NO	ELEVATION	NORTHING	EASTING	NO	ELEVATION	NORTHING	EASTING
OHS-03	190.6	4 832 130.7	289 746.8	LSOP-02	187.7	4 832 002.1	289 444.2
OHS-05	195.2	4 832 562.0	290 592.5	LSOP-07	193.2	4 832 362.2	289 908.1
OHS-06	192.6	4 832 762.8	290 815.9	LSOP-10	194.8	4 832 087.8	289 929.3
OHS-07	194.1	4 832 725.4	290 852.1	LSOP-12	192.7	4 832 097.9	290 102.7
OHS-08	194.9	4 832 772.6	290 976.3	LSOP-16	194.6	4 832 676.7	290 601.9
OHS-09	191.1	4 832 860.5	291 099.7	LSOP-17	194.6	4 832 368.2	290 252.0
T-03	188.8	4 832 124.3	289 673.4	LSOP-19	195.4	4 832 507.4	290 511.1
T-04	188.4	4 832 075.6	289 699.9	LSOP-23	192.2	4 832 837.6	290 995.3
T-05	186.1	4 832 038.7	289 701.6	LSOP-27	187.8	4 831 851.6	289 163.9
				LSOP-29	189.0	4 831 700.1	288 882.1
				OHS-01	187.8	4 831 676.8	288 985.0
				OHS-02	186.0	4 831 985.0	289 564.3

**-NOTES-**

- 1) The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.
- 2) This drawing is for subsurface information only. Surface details and features are for conceptual illustration.

GEOCRES No. 30M12-278



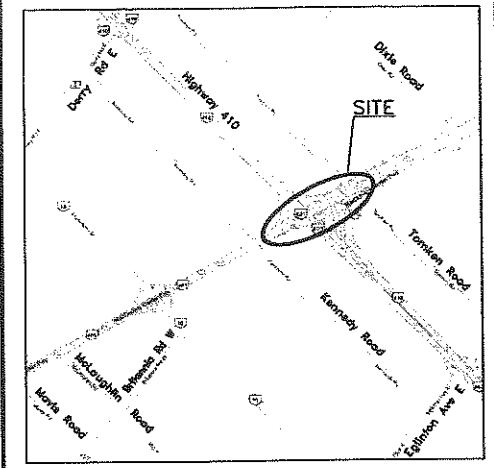
80 0 100 200m  
SCALE 1:8000

REVISIONS	DATE	BY	DESCRIPTION
DESIGN	RPR	CHK AEG	CODE
DRAWN	MFA	CHK PKS	SITE
			STRUCT
			DWG 1
			DATE APR. 2009

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



CONT No	
GWP No	
HIGHWAY 401 HIGH MAST LIGHTING POLES EAST OF KENNEDY ROAD BOREHOLE LOCATION PLAN	
MMM GROUP	



KEYPLAN

LEGEND

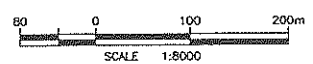
- ◆ Borehole (Present investigation)
- ◇ Borehole (Previous investigation)
- N Blows /0.3m (Std Pen Test, 475J/blow)
- CONE Blows /0.3m (60° Cone, 475J/blow)
- PH Pressure, Hydraulic
- W Water Level
- HA Head Artesian Water
- P Piezometer
- 90% Rock Quality Designation (RQD)
- A/R Auger Refusal

NO	ELEVATION	NORTHING	EASTING	NO	ELEVATION	NORTHING	EASTING
P20	185.8	4 833 034.5	291 537.1	OHS-10	189.2	4 832 953.0	291 210.0
P23	181.7	4 833 071.4	291 975.2	OHS-11	187.5	4 832 950.7	291 376.7
P27	180.9	4 833 091.0	292 249.9	OHS-12	186.4	4 833 070.2	291 489.8
P29	181.5	4 832 889.6	292 236.1	P02	176.3	4 833 635.5	291 494.6
P30	178.7	4 833 004.1	292 386.3	P03	180.8	4 833 487.1	291 561.2
P32	175.5	4 832 844.0	292 419.5	P07	178.1	4 833 467.0	291 761.0
P33	173.4	4 833 721.1	292 453.9	P09	184.9	4 833 220.0	291 620.9
P36	163.1	4 833 996.1	292 959.8	P12	180.6	4 833 462.2	292 010.4
P38	162.1	4 834 083.5	293 310.1	P14	172.6	4 833 633.3	292 310.0
P41	166.4	4 833 745.5	292 683.8	P15	176.9	4 833 265.8	291 952.1
P43	164.2	4 833 793.4	292 906.9	P15A	178.5	4 833 267.9	291 954.2
P45	163.0	4 833 965.4	293 080.1	P16	178.6	4 833 359.9	292 107.1
P47	177.3	4 833 330.1	292 406.1				
P49	168.7	4 833 532.6	292 653.3				
SWMP-01	185.9	4 833 289.8	291 584.8				
SWMP-02	185.6	4 833 248.9	291 607.7				
SWMP-03	185.0	4 833 080.0	291 736.4				
SWMP-04	184.8	4 833 107.6	291 815.1				
T-01	184.9	4 833 013.9	291 488.9				
T-02	184.3	4 832 983.0	291 518.8				

-NOTES-

- The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.
- This drawing is for subsurface information only. Surface details and features are for conceptual illustration.

GEOCRES No. 30M12-278



REVISIONS		DATE		BY		DESCRIPTION	
DESIGN	RPR	CHK	AEG	CODE	LOAD	DATE	APR. 2009
DRAWN	MFA	CHK	PKS	SITE	STRUCT	DATE	APR. 2009