FOUNDATION INVESTIGATION AND DESIGN REPORT
STORMWATER MANAGEMENT PONDS
HWY 401 WIDENING, HWY 410 TO CREDIT RIVER
MISSISSAUGA, ONTARIO
G.W.P. 2107-05-00

Geocres Number: 30M12-279

Report to

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April 20, 2009
File: 19-1423-11

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PART 1: FACTUAL INFORMATION

1 INTRODUCTION

This report presents the factual findings obtained from a geotechnical investigation for the detailed design of two proposed stormwater management ponds (SWMP) at the Highway 401 and Highway 410 interchange. Construction of the SWMP is part of the Highway 401 widening from Highway 410 to Credit River in Mississauga, Ontario.

The purpose of the investigation was to explore the subsurface conditions at the proposed SWMP locations 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.

2 SITE DESCRIPTION

Two SWMP's are proposed on the northwest and southwest sides of Highway 401 and Highway 410 interchange in Mississauga, Ontario.

The northwest and southwest lands adjacent to the Highway 401 and Highway 410 interchange are generally vacant and undeveloped. Vegetation is moderate consisting mainly of tall grass and shrubs. In general the lands to the east and 300 m west of Highway 410 have been developed for commercial and industrial uses. The topography is typically flat, sloping gently towards 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 deposit typically less than 1.0 m to 7.0 m thick which is underlain by grey shale bedrock with hard limestone and siltstone interbeds.

3 SITE INVESTIGATION AND FIELD TESTING

Site investigation and field testing consisted of drilling and sampling four boreholes within the two SWMP areas. A summary of the borehole designations for the two SWMP is provided in Table 3.1.

Table 3.1 – Borehole Designations

SWMP	Location	Borehole	Drilling Date (2009)	Borehole Termination Depth (m)	Stratum at Termination Depth
1	Northwest quadrant of Highway 401 and Highway 410 interchange	SWMP-01	March 13	6.2	Shale bedrock
		SWMP-02	March 13	7.6	Shale bedrock
2	Southwest quadrant of Highway 401 and Highway 410 interchange	SWMP-03	March 31	12.1	Shale bedrock
		SWMP-04	April 1	12.1	Shale bedrock

The approximate borehole locations are shown on the Borehole Location Drawing in Appendix D. The coordinates and elevations of the boreholes are given on this drawing and on the individual Record of Borehole Sheets in Appendix A.

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

Solid stem augers were used to advance the boreholes in the overburden and into the shale. Samples were obtained at selected intervals using a 50 mm diameter split spoon sampler in conjunction with Standard Penetration Testing (SPT). NQ rock coring equipment was used to recover core samples of the bedrock in the boreholes.

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

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

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

Table 3.2 – Borehole Completion Details

SWMP	Location	Borehole	Piezometer Tip Depth/ Elevation (m)	Completion Details
1	Northwest quadrant of Highway 401 and Highway 410 interchange	SWMP-01	6.1/179.8	Piezometer with 1.5 m slotted screen installed with sand filter to 4.3 m, holeplug from 4.3 m to surface.
		SWMP-02	No Installation	Holeplug to surface.
2	Southwest quadrant of Highway 401 and Highway 410 interchange	SWMP-03	No Installation	Holeplug to surface.
		SWMP-04	12.1/172.7	Piezometer with 1.5 m slotted screen installed with sand filter to 10.1 m, holeplug from 10.1 m to surface.

4 LABORATORY TESTING

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

Core samples of the shale bedrock were carefully protected to prevent drying during transport to the laboratory. Point load tests were carried out on selected samples of intact shale, limestone and siltstone interbeds 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 for the proposed SWM Ponds. Reference is made to the Records of Borehole sheets in Appendix A. Details of the encountered soil and rock stratigraphy are presented in the appendix. An overall description of the stratigraphy encountered in Boreholes SWMP-01 to SWMP-04 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 and fill underlain by native silty clay till deposit. Weathered shale bedrock was contacted below the silty clay till deposit. More detailed descriptions of the individual stratum are presented below.

5.1 Topsoil

Topsoil was identified at ground surface in Boreholes SWMP-03 and SWMP-04. The topsoil thickness was 75 mm. The topsoil thickness may vary between and beyond the borehole locations and this limited data is not intended for the purpose of estimating quantities.

5.2 Fill

Fill was encountered below the topsoil in Boreholes SWMP-03 and SWMP-04 and surficially in Boreholes SWMP-01 and SWMP-02.

In Boreholes SWMP-03 and SWMP-04, the fill consists of brown to grey silty clay containing some sand to sandy, trace of gravel and occasional shale fragments. In Boreholes SWMP-01 and SWMP-02, the fill consists of grey shale. Thickness of the fill ranged from 0.7 m to 2.3 m.

The depth to the base of the fill ranged from 0.8 m to 2.3 m (Elevations 182.7 to 184.1).

Based on recorded SPT N-values ranging from 9 to 77 blows for 0.3 m of penetration, the silty clay fill and shale fill layers are described as stiff to hard. An SPT N-value of 50 blows per 0.15 m penetration was observed within the shale fill, indicating a hard consistency.

The natural moisture contents of the fill samples obtained ranged approximately from 5% to 19%.

Grain size distribution curves for two fill samples tested are presented on the Record of Borehole sheets and on Figure B1 of Appendix B. The results of laboratory gradation tests are summarized as follows:

Soil Particles	(%)
Gravel	1 to 3
Sand	25 to 30
Silt	48
Clay	19 to 27

5.3 Silty Clay Till

Naive brown silty clay till containing trace sand to sandy and trace gravel was contacted below the fill in Boreholes SWMP-01, SWMP-02 and SWMP-04. Thickness of the till deposits ranged from 1.5 m to 3.1 m.

The depth to the base of the silty clay till deposits ranged from 2.3 m to 4.6 m (Elevations 181.1 to 182.5 m).

Based on SPT N-values ranging from 12 to 28 blows for 0.3 m of penetration, the silty clay till is described as stiff to very stiff.

The natural moisture contents of the samples recovered from the silty clay till layer ranged from 15% to 20%.

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

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

Soil Particles	(%)
Gravel	0 to 1
Sand	18 to 30
Silt	46 to 47
Clay	22 to 36

Index Property	(%)
Liquid Limit	33 to 38
Plastic Limit	18 to 19

The above results show that the silty clay till is of low to medium plasticity with group symbols of CL-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 bedrock.

5.4 Bedrock

The soils described above were found to be underlain by grey and reddish brown shale bedrock. The shale encountered in the boreholes is described as thinly bedded and contains numerous hard interbedded siltstone and limestone layers. The shale bedrock is typically highly weathered within the upper zone with the degree of weathering decreasing with depth. SPT N-values obtained in the upper part of the shale bedrock were higher than 50 blows for less than 0.05 m penetration. Moisture contents of disturbed shale samples ranged from 17% to 21%. Elevations of the top of bedrock are shown in Table 5.1.

Table 5.1 – Elevation of Top of Weathered Bedrock

SWMP	Location	Borehole	Depth to Weathered Bedrock (m)	Top of Weathered Bedrock Elevation (m)
1	Northwest quadrant of Highway 401 and Highway 410 interchange	SWMP-01*	4.3	181.6
		SWMP-02*	4.6	181.1
2	Southwest quadrant of Highway 401 and Highway 410 interchange	SWMP-03*	2.3	182.7
		SWMP-04*	2.3	182.5

* Proved by coring below augered depth

Bedrock cores were collected using NQ sized coring equipment. Total Core Recovery (TCR) in the bedrock was 100% in all the core runs.

The RQD values recorded for most of the core runs ranged from 51% to 100% indicating fair to excellent rock quality. An RQD value of 26% was measured in Run 1 of Borehole SWMP-03. Fracture Index (FI) of the rock, expressed as fractures per 0.3 m of core, ranged from 0 to greater than 5.

The results of Point Load tests conducted on intact core samples were as follows:

Rock Type	Inferred Unconfined Compressive Strength (UCS) (MPa)
Shale	2 to 60
Limestone	32 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 be too weak for point load testing. Broken zones were observed within the cores at various depths.

The shale is highly weathered in the upper 1.0 m to 2.0 m below which the shale is slightly weathered. The strength of the shale increases with depth. The shale bedrock also 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 indicate that

these hard 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.

5.5 Water Levels

Water level was observed in the boreholes during and upon completion of drilling. Two standpipe piezometers were installed to monitor water levels after completion of drilling. The water levels measured in the piezometers are summarized in Table 5.2.

Table 5.2 – Measured Groundwater Levels

SWMP	Location	Borehole	Date (2009)	Water Level (m)		Comment
				Depth	Elevation	
1	Northwest quadrant of Highway 401 and Highway 410 interchange	SWMP-01	March 26 April 7 April 16	6.0 5.9 5.8	179.9 180.0 180.1	In piezometer
		SWMP-02	March 13	6.1	179.5	In open borehole
2	Southwest quadrant of Highway 401 and Highway 410 interchange	SWMP-03	March 31	0.9	184.1	In open borehole
		SWMP-04	April 7 April 16	5.3 5.3	179.5 179.5	In piezometer

The above table indicates that the groundwater levels range from Elevations 179.5 m to 184.1 m.

The above values are short-term readings and seasonal fluctuations of the groundwater level are to be expected. In particular, the groundwater level may be at a higher elevation after the spring snowmelt or after periods of heavy rainfall.

6 MISCELLANEOUS

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

The drilling and sampling equipment was supplied and operated by DBW Drilling of Ajax, Ontario and 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 Mr. David E. Elwood, P.Eng. and Ms. R. Palomeque Reyna, P.Eng. Interpretation of the field data and preparation of the investigation report was conducted by Ms. Rocío Palomeque Reyna, P.Eng. and Mr. A. Gorman, P. Eng.
Dr. P.K. Chatterji, P.Eng., a Designated Principal Contact for MTO Foundations Projects, reviewed the report.

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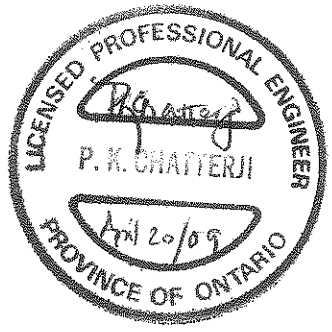

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PART 2: ENGINEERING DISCUSSION AND RECOMMENDATIONS

7 GENERAL

This section of the report presents geotechnical recommendations for the design of the proposed stormwater management ponds (SWMP).

Two SWMP are proposed on the west side of Highway 401 and Highway 410 interchange in Mississauga, Ontario.

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 STORMWATER MANAGEMENT POND RECOMMENDATIONS

Information on the general layout of the proposed locations of the SWMP was provided to Thurber by MMM Group Limited during preparation of this report. The design configurations of the ponds are summarized in Table 8.1.

Table 8.1 – SWMP Design Configurations

SWMP	Location	Maximum Water Level (m)	Permanent Pool Elevation (m)	Pond Base Elevation (m)	Side Slope Inclination
1 Triangular shape	Northwest quadrant of Highway 401 and Highway 410 interchange	182.9	181.4	179.9	3H:1V from El. 179.9 to 181.4 5H:1V from El. 181.4 to 182.9 3H:1V above El. 182.9 m
2 Rectangular shape	Southwest quadrant of Highway 401 and Highway 410 interchange	180.8	178.8	176.3	2H:1V from El. 176.3 to 178.8 5H:1V from El. 178.8 to 180.5 3H:1V above El. 180.8 m

The subsurface stratigraphy revealed in the boreholes drilled in the SWMP areas consists of topsoil or fill overlying stiff to very stiff silty clay till underlain by shale bedrock encountered at 2.3 to 4.6 m depth (Elevations 181.1 to 182.7). Existing ground surface at the borehole locations ranges from elevations 184.8 to 185.9. Both SWMP will be excavated through shale and silty clay fill, stiff to very stiff silty clay till and into shale bedrock, extending to depths and elevations shown in Table 8.2.

Table 8.2 – Excavation depths and elevations

SWMP	Location	Borehole	Total depth of excavation from ground surface to pond base (m)	Depth of earth excavation (m)	Depth of excavation into bedrock (m)
1	Northwest quadrant of Highway 401 and Highway 410 interchange	SWMP-01 SWMP-02	5.7 to 6.0	4.3 to 4.6	1.2 to 1.7
2	Southwest quadrant of Highway 401 and Highway 410 interchange	SWMP-03 SWMP-04	8.5 to 8.7	2.3	6.2 to 6.4

Permanent pond slopes excavated into the native silty clay till and shale bedrock are expected to be stable at the proposed slope inclinations in indicated in Table 8.1.

Use of a hydraulic excavator should be suitable for excavation in the stiff to very stiff silty clay till. The equipment should be capable of handling and removing possible cobbles, boulders and fragments/slabs of shale and limestone in the till.

The bulk of the excavation will extend into relatively sound shale with hard limestone and siltstone interbeds. The upper 1.0 m to 2.0 m of the shale is typically highly weathered and excavation in the

highly weathered bedrock should be possible using heavy excavation equipment and rippers, supplemented by pneumatic rock breakers where thick layers of hard material are encountered. The shale becomes less weathered and harder with depth, and intensive use of pneumatic/hydraulic breakers or other methods of loosening the bedrock may be required. The contract documents should contain an NSSP alerting the contract bidders that rock excavation may require the use of such equipment. Suggested wording for this NSSP is provided in Appendix C.

Water was measured in the piezometers installed in Boreholes SWMP-01 and SWMP-02 at 5.9 m and 5.3 m depth, (Elevations 180.0 and 179.5), respectively. The measured groundwater levels with respect to the SWMP design parameters are as follows:

SWMP 1 -
- 0.1 m above the proposed pond base
- 1.4 m below the permanent pool level
- 1.6 m below the bedrock surface

SWMP 2 -
- 3.2 m above the proposed pond base
- 0.7 m above the permanent pool level
- 3.0 m below the bedrock surface

In general, the silty clay till and the shale are expected to have a relatively low permeability and therefore groundwater control using sumps and pumps is considered feasible during construction.

The possibility exists that concentrated seepage may be experienced from localized seams or fractures in the shale bedrock. The NSSP for shale excavation provided in Appendix C includes a comment in this regard. The design of any dewatering system that may be required is the responsibility of the Contractor.

The shale encountered at this site may not retain water at the proposed permanent pool levels without the addition of some form of liner.

Gravel sheeting or other measures may also be required in areas of persistent ongoing seepage exhibiting surficial instability. These areas are best identified by examination after pond excavation. The need for and design of supplementary slope treatment procedures should be as directed by the Contract Administrator in consultation with the design engineer. An NSSP to advise the contractor of this requirement is provided in Appendix C.

Exposed shale above the permanent pool level will be subject to weathering and slope protection will be required, as discussed below.

Erosion protection such as hydroseeding and vegetation, and rip-rap in areas of high flow velocities subject to erosion (such as at the pond inlet and outlet), should be established on all exposed soil and shale bedrock slopes. General reference may be made to OPSS 511, OPSS 572 and related special provision(s) for more detailed requirements, where applicable.

9 CONSTRUCTION CONCERNS

Potential construction concerns during SWMP construction include, but are not necessarily limited to:

1. Excavation difficulties

   - The till soils may contain shale and limestone slabs/fragments, and possibly cobbles and boulders, that must be dislodged and removed during excavation or utility installation.
   - The shale becomes harder with depth and contains hard interbeds of limestone, siltstone or calcareous shale that may slow production and/or require intensive use of rippers and rock breakers to penetrate. Excavation of the shale bedrock may require the use of rock excavation methods such as pneumatic rock breakers to penetrate hard limestone interbeds.

10 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. Chatterji, P.Eng., a Designated Principal Contact for MTO Foundations Projects.

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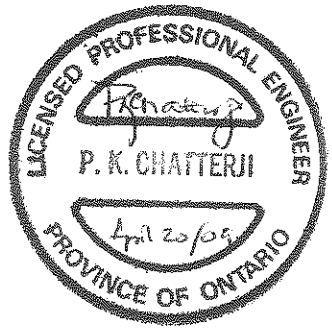

TABLE 1 -Point Load and Unconfined Compression Test Results
Highway 401 Widening – STORMWATER MANAGEMENT PONDS

SWMP-3	DEPTH FT.	DEPTH IN.	FORCE (kN)	AXIAL / DIAMETRIC	DISTANCE (mm)	BREAK	UCS (Mpa)	Rock Type
RUN #1	10	6	14.5	A	50.00	OK	116.31	Limestone
	12	2	6.0	D	78.00	OK	29.56	Limestone
	14	4	11.0	A	48.00	OK	90.05	Limestone
RUN #2	15	2	16.0	D	93.50	OK	60.07	Limestone
	16	8	2.0	A	55.00	OK	16.56	Shale
	17	4	9.5	A	64.50	OK	69.64	Shale
	19	3	0.0	A	69.50	LOW	3.00	Shale
RUN #3	20	7	9.0	D	110.50	OK	26.30	Limestone
	21	0	0.0	A	64.50	LOW	3.00	Limestone
	22	6	12.5	D	163.00	OK	11.84	Limestone
	24	5	0.0	A	55.00	LOW	3.00	Shale
RUN #4	25	6	0.0	A	59.50	LOW	3.00	Shale
	26	5	2.5	D	86.00	OK	9.39	Limestone
	27	8	1.0	A	67.00	OK	6.93	Limestone
	29	2	0.0	A	50.00	LOW	3.00	Shale
	29	9	0.0	A	48.50	LOW	3.00	Shale
RUN #5	30	1	0.0	A	59.50	LOW	3.00	Shale
	31	2	12.5	A	58.00	OK	95.86	Limestone
	32	3	0.0	A	61.50	LOW	3.00	Shale
	33	7	3.5	D	190.00	OK	2.32	Limestone
	34	10	1.5	A	49.50	OK	12.09	Shale
RUN #6	36	0	0.0	A	54.50	LOW	3.00	Shale
	36	8	1.0	A	62.00	OK	7.54	Shale
	38	0	18.0	D	68.00	OK	108.55	Limestone
	39	6	21.5	D	67.50	OK	0.00	Limestone

UC Test Average			
RUN #1:			
	AVERAGE	MAX	MIN
Shale			
Siltstone			
Shale/Siltstone			
Limestone	78.64	116.31	29.56
RUN #2:			
Shale	29.74	0.00	0.00
Siltstone			
Shale/Siltstone			
Limestone	60.07	60.07	60.07
RUN #3:			
Shale	3.00	0.00	0.00
Siltstone			
Shale/Siltstone			
Limestone	13.71	26.30	3.00
RUN #4:			
Shale	3.00	0.00	0.00
Siltstone			
Shale/Siltstone			
Limestone	8.16	9.39	6.93
RUN #5:			
Shale	6.03	0.00	0.00
Siltstone			
Shale/Siltstone			
Limestone	49.09	95.86	2.32
RUN #6:			
Shale	7.54	0.00	0.00
Siltstone			
Shale/Siltstone			
Limestone	54.28	108.55	0.00
SUMMARY	AVERAGE	MAX	MIN
Shale	10.82	69.64	3.00
Siltstone			
Shale/Siltstone			
Limestone	43.09	116.31	0.00

TABLE 1 -Point Load and Unconfined Compression Test Results
Highway 401 Widening – STORMWATER MANAGEMENT PONDS

SWMP-4	DEPTH FT.	DEPTH IN.	FORCE (kN)	AXIAL / DIAMETRIC	DISTANCE (mm)	BREAK	UCS (Mpa)	Rock Type
RUN #1	12	11	0.5	A	51.50	OK	3.95	Shale
	15	6	11.5	D	74.50	OK	60.70	Limestone
RUN #2	16	6	1.5	A	72.50	OK	9.99	Shale
	17	3	9.5	D	93.00	OK	35.95	Limestone
	19	0	0.0	A	58.00	LOW	3.00	Shale
	19	6	10.5	D	94.50	OK	38.79	Limestone
	20	1	7.0	D	68.00	OK	42.37	Limestone
RUN #3	26	6	0.5	A	72.50	OK	3.33	Shale
	27	9	7.5	D	96.50	OK	26.85	Limestone
	29	0	15.5	A	60.00	OK	113.49	Limestone
	30	2	0.0	A	76.50	LOW	3.00	Shale
RUN #4	26	4	0.0	A	58.00	LOW	3.00	Shale
	27	8	12.0	A	64.00	OK	85.08	Limestone
	29	3	14.0	D	68.50	OK	83.81	Limestone
	29	10	14.0	A	46.50	OK	116.44	Shale
	30	7	11.0	D	196.00	OK	13.61	Limestone
						LOW		
RUN #5	31	2	0.5	A	46.50	OK	4.16	Shale
	32	3	3.0	D	61.00	OK	21.37	Limestone
	33	2	4.5	A	46.00	OK	37.63	Limestone
	34	0	7.5	D	65.50	OK	48.02	Limestone
	35	7	2.5	A	48.50	OK	20.36	Limestone
RUN #6	36	4	11.0	D	180.00	OK	15.46	Limestone
	37	6	16.5	D	91.50	OK	63.99	Limestone
	38	2	0.0	A	45.50	LOW	3.00	Shale
	39	5	0.0	A	74.00	LOW	3.00	Shale

UC Test Average			
RUN #1:			
	AVERAGE	MAX	MIN
Shale	3.95	3.95	3.95
Siltstone			
Shale/Siltstone			
Limestone	60.70	60.70	60.70
RUN #2:			
Shale	6.50	0.00	0.00
Siltstone			
Shale/Siltstone			
Limestone	39.04	42.37	35.95
RUN #3:			
Shale	3.00	0.00	0.00
Siltstone			
Shale/Siltstone			
Limestone	70.17	113.49	26.85
RUN #4:			
Shale	59.72	0.00	0.00
Siltstone			
Shale/Siltstone			
Limestone	60.83	85.08	13.61
RUN #5:			
Shale	4.16	0.00	0.00
Siltstone			
Shale/Siltstone			
Limestone	31.85	48.02	20.36
RUN #6:			
Shale	3.00	0.00	0.00
Siltstone			
Shale/Siltstone			
Limestone	39.72	63.99	15.46
SUMMARY	AVERAGE	MAX	MIN
Shale	15.29	116.44	3.00
Siltstone			
Shale/Siltstone			
Limestone	47.17	113.49	13.61

Appendix A

Record of Borehole Sheets

SYMBOLS, ABBREVIATIONS AND TERMS USED ON RECORDS OF BOREHOLES

1. TEXTURAL CLASSIFICATION OF SOILS

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

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

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

3. TERMS DESCRIBING CONSISTENCY (COHESIVE SOILS ONLY)

DESCRIPTIVE TERM	UNDRAINED SHEAR STRENGTH (kPa)	APPROXIMATE SPT[(1)] '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

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

$\overline{\blacktriangledown}$ Water Level

C_{pen} Shear Strength Determination by Pocket Penetrometer

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

(2) DCPT Dynamic Cone Penetration Test – Continuous penetration of a 50 mm outside diameter, 60° conical steel point attached to "A" size rods driven by a 63.5 kg hammer free falling a height of 0.76 m. The resistance to cone penetration is the number of hammer blows required for each 0.3 m advance of the conical point into undisturbed ground.

UNIFIED SOILS CLASSIFICATION

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

Ministry of Transportation
Ontario

THURBER

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

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (O UNCONFINED, + FIELD VANE, ● QUICK TRIAXIAL, × LAB VANE) (40 80 120 160 200)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
185.9	Geodetic										
0.0	**SHALE**, highly weathered Very Stiff to Hard Grey Moist (FILL)		1	SS	18				o		
			2	SS	50/ 0.150		185		o		
			3	SS	77				o		
183.6							184				
2.3	Silty **CLAY**, some sand, trace gravel Very Stiff Brown (TILL)		4	SS	18				o |		0 20 47 33
			5	SS	27		183		o		0 18 46 36
181.6							182				
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		▼	181			FI 2 0 0	RUN 1# TCR=100%, SCR=98%, RQD=90%, UCS=2MPa
179.7							180			0	(Shale) UCS=140MPa (Limestone)
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

$+^3$, $\times^3$: Numbers refer to Sensitivity

20 / 15 5 / 10 (%) STRAIN AT FAILURE

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THURBER

RECORD OF BOREHOLE No SWMP-02 1 OF 1 METRIC

G.W.P. 2107-05-00 LOCATION N 4 833 248.9 E 291 607.7 ORIGINATED BY GA
HWY 401 BOREHOLE TYPE Solid Stem Augers/NQ2 Coring Equipment COMPILED BY AN
DATUM Geodetic DATE 2009.03.13 - 2009.13.13 CHECKED BY RPR

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa 40 80 120 160 200 (O UNCONFINED, ⊗ QUICK TRIAXIAL, + FIELD VANE, × LAB VANE)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
185.6	Geodetic										
0.0	**SHALE**, highly weathered Very Stiff to Hard Grey (FILL)		1	SS	30		185		o		
			2	SS	26				o		
184.1							184				
1.5	Silty **CLAY**, some sand to sandy, trace gravel, occasional iron oxidized staining Stiff to Very Stiff Brown (TILL)		3	SS	12				o		
			4	SS	12		183		o		0 29 47 24
			5	SS	28				o ⊢		1 30 47 22
181.1							182				
4.6	**SHALE**, highly weathered Grey Coring started at 4.9m. Moderately to slightly weathered Rubble zone from 4.7 to 4.8m and 5.8 to 5.9m. Limestone interbeds at 4.5 to 4.7m, 5.3 to 5.4m, 5.5m and 5.6 to 5.7m. Horizontal joints at 4.5, 4.6, 4.7, 4.8, 4.9, 5.2 and 5.3m. Clay layers at 5.3m.		1	RUN			181			FI 5 1 2 9	RUN 1# TCR=100%, SCR=90%, RQD=83%, Average UCS=3MPa (Shale) UCS=32MPa (Limestone)
	Slightly weathered to fresh Highly broken zone from 6.0m to 6.2m and 6.3m. Limestone interbeds at 6.1m, 6.6m, 6.8m, 6.9m, 7.0m, 7.2m, 7.3m and 7.5m. Horizontal joints at 6.2m, 6.3m, 6.6m and 7.4m.		2	RUN			180			1	RUN 2# TCR=100%, SCR=86%, RQD=63%, Average UCS=8MPa (Shale) UCS=35MPa (Limestone)
178.0							179				
7.6	END OF BOREHOLE AT 7.6m. BOREHOLE OPEN AT WATER LEVEL AT 6.1m UPON COMPLETION OF DRILLING. BOREHOLE BACKFILLED WITH HOLEPLUG TO SURFACE.										

$+^3$, $\times^3$: Numbers refer to Sensitivity

20
15 ⊕ 5
10
(%) STRAIN AT FAILURE

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THURBER

RECORD OF BOREHOLE No SWMP-03 1 OF 2 METRIC

G.W.P. 2107-05-00 LOCATION N 4 833 079.9 E 291 736.4 ORIGINATED BY GA

HWY 401 BOREHOLE TYPE Solid Stem Augers/NQ2 Coring Equipment COMPILED BY AN

DATUM Geodetic DATE 2009.03.31 - 2009.03.31 CHECKED BY RPR

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE) (40 80 120 160 200)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
185.0	Geodetic										
~~0.0~~	TOPSOIL (75mm)						185				
0.1	Silty CLAY, some sand to sandy, trace gravel, occasional shale fragments Very Stiff to Stiff Brown (FILL)		1	SS	20				○		
			2	SS	25		184		○		1 25 48 27
			3	SS	11				○		
182.7							183				
2.3	SHALE, highly weathered, Very Dense Grey to Reddish Brown Wet Coring started at 2.7m.		4	SS	50/0.100				○		
	Moderately to slightly weathered Limestone interbeds from 3.0m to 3.3m, 3.4m, 3.6m, 3.7m, 3.8m and 4.3m. Highly broken zone at 3.0m, 3.3m, 3.4m, 3.5m, 3.7m, 3.8m to 4.0m and 4.2m to 4.3m. Horizontal joints at 3.0m, 3.1m, 3.3m, 3.4m, 3.5m, 3.9m, 4.0m, 4.1m, 4.2m, 4.3m and 4.4m.		1	RUN			182			FI 4 5 5 10 3	RUN 1# TCR=100%, SCR=65%, RQD=26%, Average UCS=78MPa (Limestone)
	Slightly weathered, weak Limestone interbeds from 4.5m to 4.6m, 4.7m to 4.8m, 4.9m, 5.2m and 5.7 to 5.8m. Horizontal joints at 5.2m, 5.5m, 5.6m and 5.7m. Highy broken zone at 5.5m and 5.6m.		2	RUN			181			0 0 1 3 0	RUN 2# TCR=100%, SCR=95%, RQD=83%, Average UCS=30MPa (Shale) UCS=60MPa (Limestone)
	Limestone interbeds at 6.2m to 6.3m, 6.5m, 6.6m, 6.7m, 6.8m, 7.0m, 7.1m, 7.2m, 7.4 and 7.5m.		3	RUN			180			0 0 0 0 0	RUN 3# TCR=100%, SCR=100%, RQD=100%, Average UCS=3MPa (Shale) UCS=13MPa (Limestone)
	Moderately to highly weathered Shale interbeds at 7.6m, 7.7m, 7.8m, 7.9m, 8.0m, 8.1m, 8.3m, 8.6m, 8.9m, 9.0m and 9.1m.		4	RUN			179			0 0 0 0 0	RUN 4# TCR=100%, SCR=100%, RQD=100%, Average UCS=3MPa (Shale) UCS=8MPa (Limestone)
	Shale interbeds at 9.1m, 9.2m, 9.5m, 9.6m, 9.7m and 10.3m. Limestone interbeds at 9.1m, 9.2m, 9.5m, 9.6m, 9.9m, 10.0m, 10.2m, 10.4m and 10.5m.		5	RUN			178			0 0 0 0 0	RUN 5# TCR=100%, SCR=100%, RQD=100%, Average UCS=6MPa
							177				
							176				

Continued Next Page

$+^3$, $\times^3$: Numbers refer to Sensitivity

(%) STRAIN AT FAILURE

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Ontario

THURBER

RECORD OF BOREHOLE No SWMP-03 2 OF 2 METRIC

G.W.P. 2107-05-00 LOCATION N 4 833 079.9 E 291 736.4 ORIGINATED BY GA

HWY 401 BOREHOLE TYPE Solid Stem Augers/NQ2 Coring Equipment COMPILED BY AN

DATUM Geodetic DATE 2009.03.31 - 2009.03.31 CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 40 80 120 160 200	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES						GR SA SI CL
	Continued From Previous Page						175			0	(Shale) UCS=49MPa (Limestone)
	Fresh Limestone interbeds at 10.6m, 10.8m, 10.9m, 11.1m, 11.2m to 11.4m, 11.5m, 11.6m and 12.0m.									0	
										0	RUN 6# TCR=100%, SCR=100%, RQD=100%, Average UCS=7MPa (Shale) UCS=54MPa (Limestone)
			6	RUN			174			0	
										0	
172.9										0	
							173			0	
12.1	END OF BOREHOLE AT 12.1m. BOREHOLE OPEN AND WATER LEVEL AT 0.9m UPON COMPLETION OF DRILLING. BOREHOLE BACKFILLED WITH HOLEPLUG TO SURFACE.										

$+^3$, $\times^3$: Numbers refer to Sensitivity

20 / 15 ⊕ 5 / 10 (%) STRAIN AT FAILURE

ONTMT4S 2311HML.GPJ 4/9/09

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No SWMP-04 1 OF 2 METRIC

G.W.P. 2107-05-00 LOCATION N 4 833 107.6 E 291 815.1 ORIGINATED BY GA

HWY 401 BOREHOLE TYPE Solid Stem Augers/NQ2 Coring Equipment COMPILED BY AN

DATUM Geodetic DATE 2009.03.31 - 2009.04.01 CHECKED BY RPR

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (40 80 120 160 200) O UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
184.8	Geodetic										
0.0 / 0.1	**TOPSOIL** (75mm)										
	Silty **CLAY**, some sand to sandy, trace gravel, occasional shale fragments Stiff Grey (FILL)		1	SS	9						3 30 48 19
184.0 / 0.8	Silty **CLAY**, trace to some sand, trace gravel Very Stiff Brown (TILL)		2	SS	15		184				
			3	SS	27		183				
182.5 / 2.3	**SHALE**, highly weathered, thinly bedded Very Dense Grey		4	SS	50/ 0.050		182				
	Coring started at 3.0m.										
	Limestone interbeds at 3.4m and 4.0m. Highly broken zone at 3.4m, 3.5m to 3.8m and 4.1m to 4.5m. Horizontal joints at 3.4m, 3.5m, 3.6m, 3.8m, 4.0m and 4.6m.		1	RUN			181			FI 5 5 1 0	RUN 1# TCR=100%, SCR=73%, RQD=51%, UCS=3MPa (Shale) UCS=60MPa (Limestone)
	Horizontal joints at 4.9m, 5.0m, 5.2m, 5.5m, 5.6m and 5.7m. Highly broken zone at 5.1m, 5.5m to 5.6m and 5.7m. Limestone interbeds at 5.2m, 5.8m, 5.9m and 6.1m. Clay seam at 5.6m.		2	RUN			180			1 5 2 5 0	RUN 2# TCR=100%, SCR=85%, RQD=70%, UCS=6MPa (Shale) UCS=40MPa (Limestone)
	Limestone interbeds at 6.5m, 6.6m, 7.0m, 7.3m, 7.5m and 7.8m.		3	RUN			179 178			0 0 0 0 0	RUN 3# TCR=100%, SCR=100%, RQD=100%, UCS=3MPa (Shale) UCS=70MPa (Limestone)
	Limestone interbeds at 7.9m, 8.1m, 8.2m to 8.4m, 8.5m, 8.6m, 8.7m, 8.9m to 9.0m and 9.2m to 9.4m.		4	RUN			177 176			0 0 0 0 0	RUN 4# TCR=100%, SCR=100%, RQD=100%, UCS=60MPa (Shale) UCS=240MPa (Limestone)
	Siltstone interbeds, occasional shale interbeds						175			0 0 0	RUN 5# TCR=100%, SCR=100%,

Continued Next Page

+ ^{3}, × ^{3} Numbers refer to Sensitivity

20 / 15 5 / 10 (%) STRAIN AT FAILURE

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Ontario

RECORD OF BOREHOLE No SWMP-04 2 OF 2 METRIC

G.W.P. 2107-05-00 LOCATION N 4 833 107.6 E 291 815.1 ORIGINATED BY GA
HWY 401 BOREHOLE TYPE Solid Stem Augers/NQ2 Coring Equipment COMPILED BY AN
DATUM Geodetic DATE 2009.03.31 - 2009.04.01 CHECKED BY RPR

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (20 40 60 80 100; 40 80 120 160 200)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	Continued From Previous Page										
	Shale interbeds at 9.9m, 10.0m to 10.1m, 10.5m, 10.9m to 11.1m and 11.2m.		5	RUN						0	RQD=100%, UCS=4MPa
										0	(Shale) UCS=31MPa
							174			0	(Limestone)
	Shale, slightly weathered to fresh Limestone interbeds at 10.9m to 11.1m, 11.3m, 11.4m to 11.5m and 11.6m.		6	RUN						0	RUN 6# TCR=100%,
										0	SCR=100%,
										0	RQD=100%,
										0	UCS=15MPa
172.7							173				(Shale)
12.1	END OF BOREHOLE AT 12.1m. Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen.									0	UCS=47MPa (Limestone)

WATER LEVEL READINGS:

DATE	DEPTH (m)	ELEV. (m)
2009.04.07	5.3	179.5
2009.04.15	5.3	179.5

SHEAR STRENGTH kPa: ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE

$+^3$, $\times^3$: Numbers refer to Sensitivity

20 / 15 ⊕ 5 / 10 (%) STRAIN AT FAILURE

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Appendix B

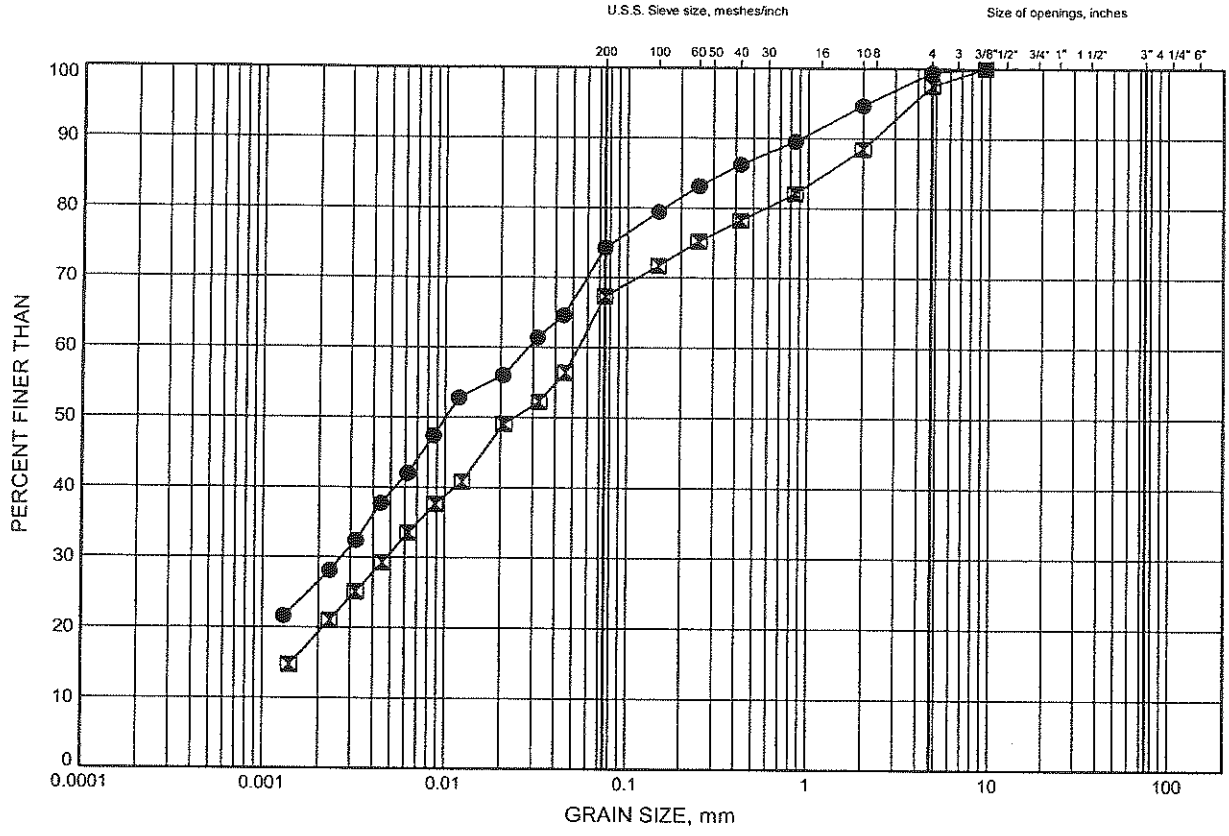
Laboratory Test Results

Hwy 401 Widening

GRAIN SIZE DISTRIBUTION

FIGURE B1

Silty Clay FILL



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	SWMP-03	1.07	183.96
⊠	SWMP-04	0.30	184.51

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

THURBER

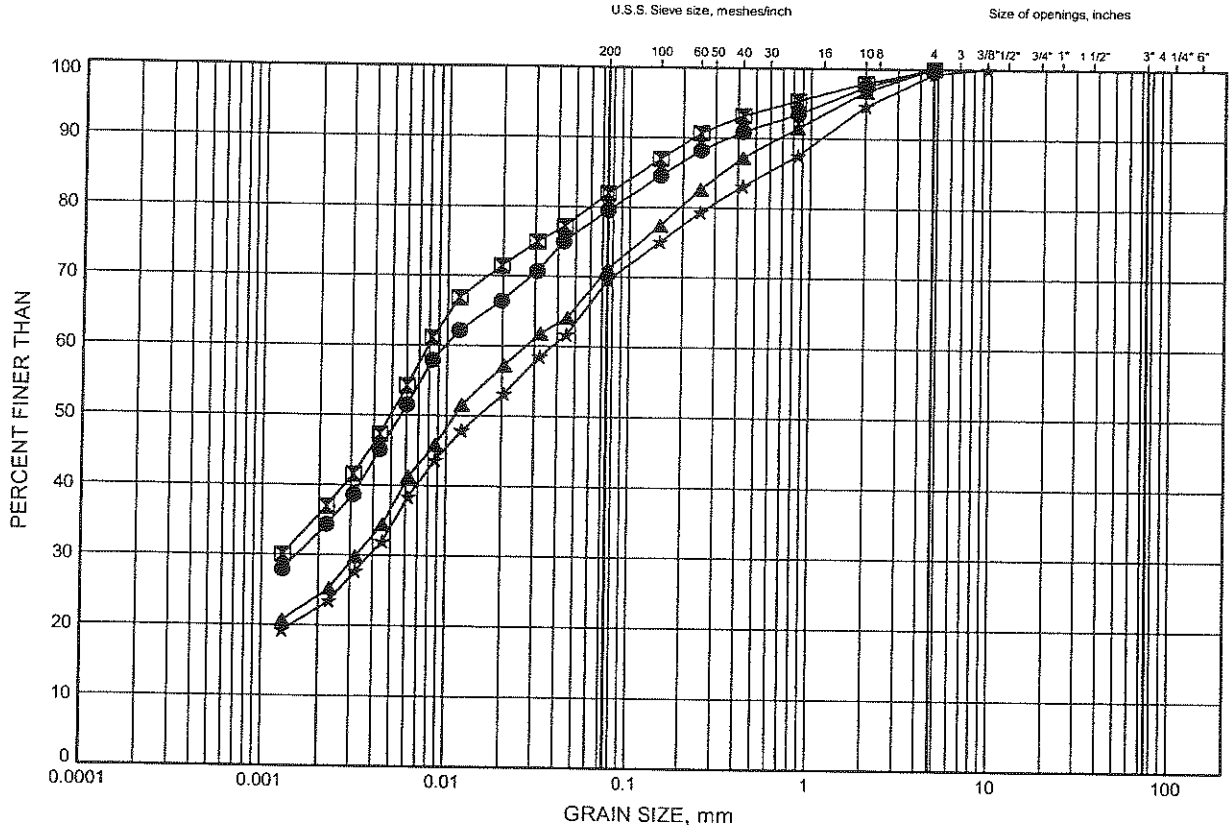
GRAIN SIZE DISTRIBUTION - THURBER 2311HML.GPJ 4/9/09

Hwy 401 Widening

GRAIN SIZE DISTRIBUTION

FIGURE B2

Silty Clay TILL



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	SWMP-01	2.59	183.30
⊠	SWMP-01	3.35	182.54
▲	SWMP-02	2.59	183.04
★	SWMP-02	3.35	182.28

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

THURBER

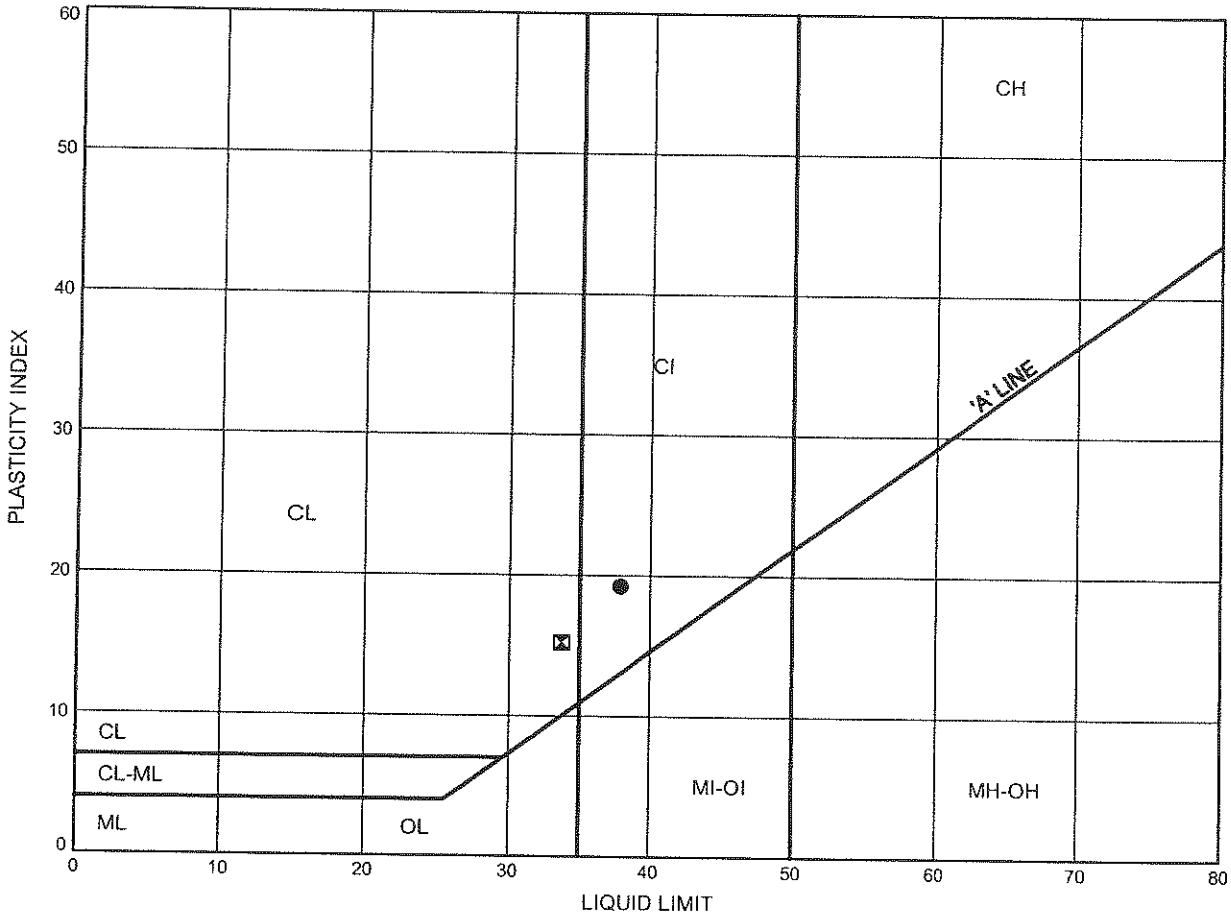
GRAIN SIZE DISTRIBUTION - THURBER 2311HML.GPJ 4/9/09

Hwy 401 Widening

ATTERBERG LIMITS TEST RESULTS

FIGURE B3

Silty Clay TILL



SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	SWMP-01	2.59	183.30
⊠	SWMP-02	3.35	182.28

Date April 2009

Project 2107-05-00

THURBER

Prep'd AN

Chkd. RPR

THURBALT 2311HML.GPJ 4/9/09

Appendix C

List of Special Provisions

and

Suggested Text for NSSP

List of Special Provisions Referenced in this Report

- SP539SO1
- OPSS 511
- OPSS 572

Suggested Text for NSSP on "Contingency for SWM Pond Slope Treatment"

Although shale bedrock is intrinsically of low permeability, the possibility exists that concentrated seepage may be experienced from localized seams or fractures in the rock. Means to handle this seepage, such as additional pumps, should be made available. Granular sheeting or other measures may be required in areas of persistent ongoing seepage exhibiting surficial instability.

Areas requiring supplementary slope treatment and the design of such treatments will be determined by the Contract Administrator in consultation with the design engineer after pond excavation.

Suggested Text for NSSP on "Rock Excavation"

The strength of the shale bedrock increases with depth and there is presence of very hard limestone and/or siltstone interbeds within the shale bedrock. Bulk excavation through the sound shale and the hard interbeds may be difficult. As such, rock coring equipment, pneumatic rock splitting/breaking equipment and ripping machinery should be available on site to assist in excavation and drilling.

Excavation through the till may encounter cobbles, boulders and slabs of rock and the excavation equipment should be capable of dislodging and removing such obstructions.

Appendix D

Borehole Location Drawings

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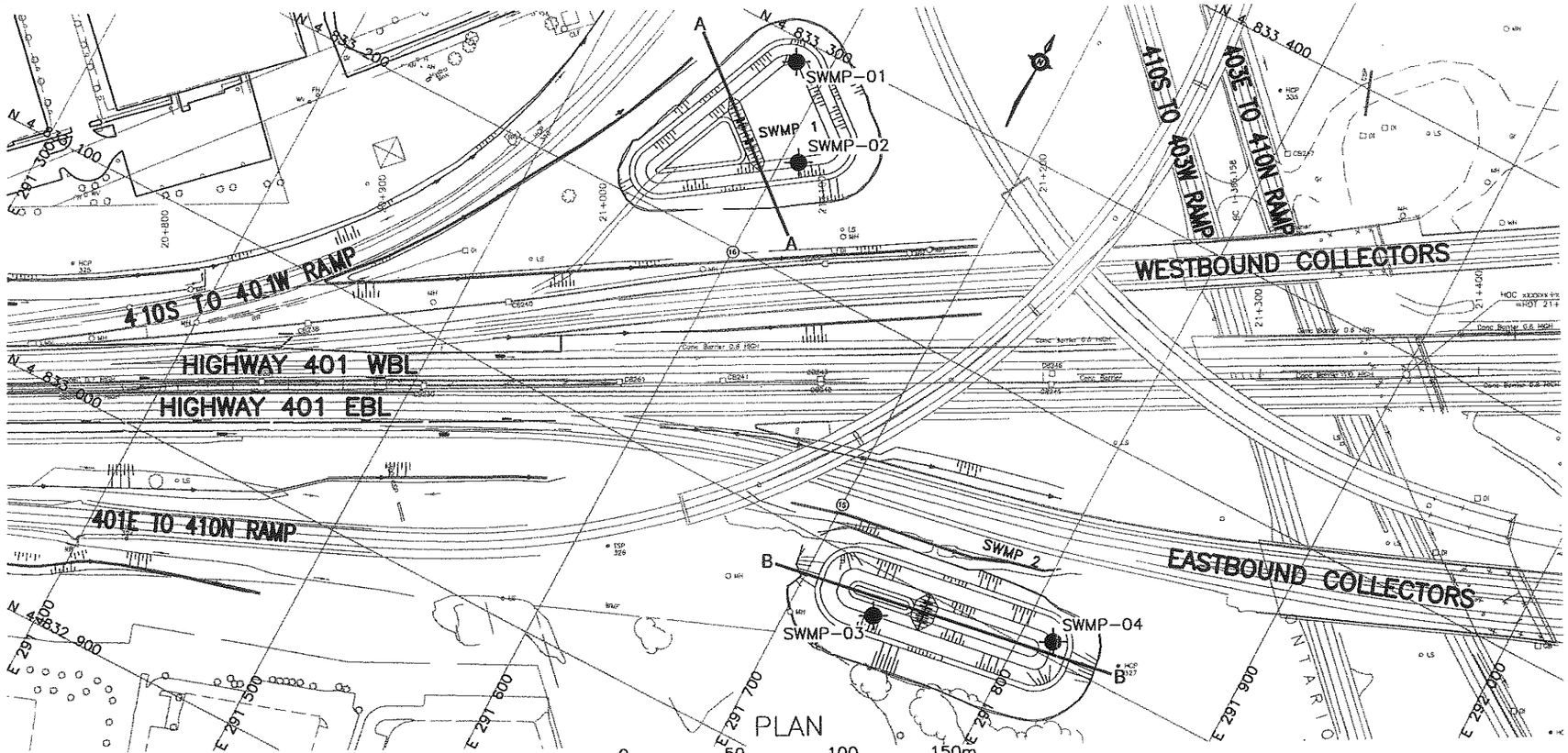
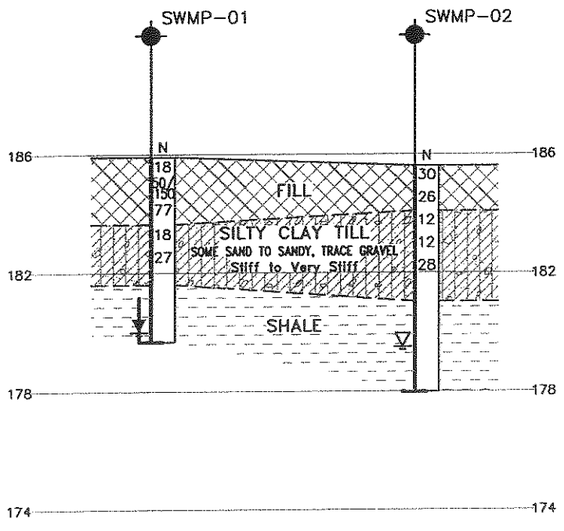




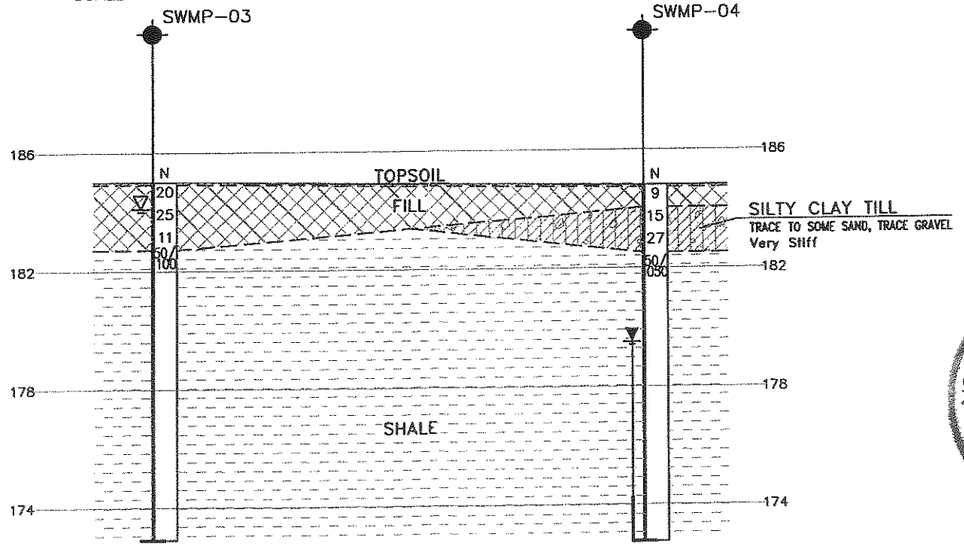
SECTION A–A

0 20 40 60m

0 4 8 12m

HOR 1:1000

VER 1:200



SECTION B–B

0 20 40 60m

0 4 8 12m

HOR 1:1000

VER 1:200

METRIC

DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN

CONT No

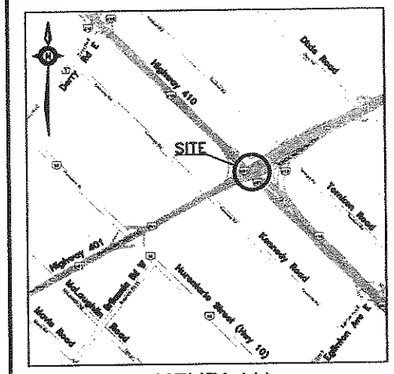
GWP No

HIGHWAY 401
AT HIGHWAY 410
STORMWATER MANAGEMENT PONDS
BOREHOLE LOCATIONS AND SOIL STRATA

SHEET

MMM GROUP

THURBER ENGINEERING LTD.
GEOTECHNICAL • ENVIRONMENTAL • MATERIALS



KEYPLAN

LEGEND

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

NO	ELEVATION	NORTHING	EASTING
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	4 833 079.9	291 736.4
SWMP-04	184.8	4 833 107.6	291 815.1

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-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. 30M12-279

REVISIONS		
DATE	BY	DESCRIPTION

DESIGN	RPR	CHK	PKC	CODE	LOAD
DRAWN	MFA	CHK	AEC	SITE	STRUCT

DATE APR. 2009
DWG 1

FILENAME: H:\Drafting\19\11423\11 Hwy 401\sd2311-SWMP.dwg
PLOTDATE: Apr 20, 2009 - 8:30am