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FOUNDATION INVESTIGATION AND DESIGN REPORT
HIGH-OCCUPANCY TOLL AND
HIGH-OCCUPANCY TOLL HMS SIGN SUPPORTS
HIGHWAY 400 16TH SIDEROAD TO
1.2 KM NORTH OF LLOYDTOWN-AURORA ROAD
TOWNSHIP OF KING, ONTARIO
G.W.P. 2085-15-00

GEOCRES NO. 30M13-220

Submitted

to

WSP / MMM Group

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PART 1 FACTUAL INFORMATION

1.0 INTRODUCTION

This report presents the factual data obtained from a foundation investigation for the detailed design of High-Occupancy Toll (HOT) and High-Occupancy Toll HMS (HOT HMS) sign supports to be constructed at locations along Highway 400 northbound lanes (NBL) and southbound lanes (SBL), from 16th Sideroad to 1.2 Km north of Lloydtown-Aurora Road, in the Township of King, Ontario. It is understood that the Ministry of Transportation Ontario (MTO) requires the design to accommodate the ultimate 10-lane configuration including one HOT lane in each direction, while the current MTO right-of-way is to be maintained.

Thurber has been retained by WSP / MMM Group (MMM) to carry out this investigation under the Ministry of Transportation Ontario (MTO) Agreement No. 2015-E-0008.

The purpose of this investigation was to explore the subsurface conditions near the locations of those proposed HOT and HOT HMS signs where there is no available subsurface information on record in the immediate vicinity. At the remaining sign locations, existing subsurface information from the Geocres library has been referenced. Based on the data obtained, a borehole locations plan, records of boreholes, laboratory test results, and a written description of the subsurface conditions are provided.

Reference has been made to subsurface information contained in previous foundation reports for this area. The titles of these reports are as follows:

- Golder Associates report titled “Foundation Investigation and Design Report, High Mast Light Poles and Sign Supports, Highway 400 Widening from North of King Road to South Canal Bank Road, Regional Municipality of York”, G.W.P.

2835-02-00, Geocres No. 30M13-215, Report to AECOM, Report No. 09-1111-0018-13, dated January 29, 2016. (Reference 1).

- Golder Associates report titled “Foundation Investigation and Design Report, Lloydtown-Aurora Road Underpass, Highway 400 Widening from North of King Road to South Canal Bank Road, Regional Municipality of York”, G.W.P. 2835-02-00, Geocres No. 31D-550, Report to URS Canada Inc., Report No. 09-1111-0018-1, dated November 2012. (Reference 2).

- Golder Associates report titled “Foundation Investigation and Design Report, Culverts at Lloydtown-Aurora Road, Highway 400 Widening from North of King road to South Canal Road”, G.W.P. 2835-02-00, Geocres No. 31D-612, Report to AECOM, Report No. 09-1111-0018-9, dated August 25, 2015. (Reference 3).

2.0 SITE DESCRIPTION

There are a total of twelve (12) HOT and HOT HMS sign locations proposed along the alignment of the proposed Highway 400 widening, between 16th Sideroad to about 1.2 km north of Lloydtown-Aurora Road (from approximate Stations 16+200 to 17+200, and 19+900 to 22+500) in the Township of King, Ontario.

The lands adjacent to the subject section of Highway 400 is largely of rural and agricultural usage, although there is increasing residential and commercial developments in recent years. The terrain in the general vicinity of the site gently slopes downwards from south to north.

The project area is located within the transition zone between physiographic regions known as the South Slope and the Oak Ridges Moraine. The South Slope is comprised predominantly of the Halton Till which is an interbedded complex of clayey silt to silt till and sand. This till comprises a slightly hummocky till plain into which the surface watercourses have eroded 10 to 15 m deep gullies. The Oak Ridges Moraine is comprised of till overlying sands and gravels, sometimes with artesian conditions, in this area.

3.0 INVESTIGATION PROCEDURES

3.1 Field Investigation

The current site investigation and field testing for this project was carried out on February 27 and March 2, 2017, and consisted of drilling and sampling seven (7) boreholes (numbered 17-H01 to 17-H07) near the locations of selected HOT and HOT HMS signs. The boreholes were drilled close to the Highway 400 median. All the boreholes were terminated at depths ranging from 6.7 m to 8.2 m (Elevations 275.8 to 340.5).

Reference has also been made to previously drilled Boreholes C38-2, C5-6-3, C40-2 and LA4 during the preparation of this report. The current and previous boreholes referenced in this report were drilled at the following locations:

Borehole	Approximate Station
17-H01	16+300
17-H02	16+000
17-H03	17+090
17-H04	19+955
17-H05	20+750
17-H06	21+620
17-H07	22+400
C38-2	20+300
LA4	21+200
C40-2	22+020
C5-6-3	21+300

Prior to the start of drilling, the borehole locations of the current investigation were marked/staked in the field and utility clearances were obtained. The co-ordinates and elevations of the as-drilled boreholes were subsequently provided by MMM. The approximate locations of the boreholes are shown on Borehole Locations drawing

included in Appendix D. The coordinates and elevations of these boreholes are given on this drawing and on the individual Record of Borehole Sheets in Appendix A.

A truck-mounted D90 drill rig was used to drill and sample the boreholes. Solid stem augers were used to advance the boreholes until the target depth was reached. In general, soil samples were obtained at selected intervals using a 50 mm diameter split spoon sampler in conjunction with Standard Penetration Testing (SPT).

The drilling and sampling operations were supervised on a full time basis by a member of Thurber's technical staff. The supervisor logged the boreholes and processed the recovered soil samples for transport to Thurber's laboratory for further examination and testing. Results of field drilling and sampling are presented on the Record of Borehole sheets in Appendices A and B.

The record of boreholes sheets of four boreholes (numbered C38-2, C5-6-3, C40-2 and LA4) drilled during previous investigations are included in Appendix C.

Groundwater conditions in the open boreholes were observed throughout the drilling operations.

3.2 Laboratory Testing

Geotechnical laboratory testing consisted of natural moisture content determination and visual identification of all soil samples in accordance with the current MTO standards. Grain size distribution analysis and Atterberg Limits tests were also conducted on selected samples. The results of these laboratory tests are summarized on the Record of Borehole sheets included in Appendix A.

4.0 SUBSURFACE CONDITIONS

4.1 General

Details of the encountered soil stratigraphy are presented on the Record of Borehole sheets in Appendix A. A general description of the stratigraphy established at relevant boreholes near the proposed HOT and HOT HMS sign support is presented in the following paragraphs. The factual data presented in the records of boreholes governs

any interpretation of the site conditions. Applicable borehole information from previous investigations has been incorporated. It should be noted that the subsurface conditions may vary between and beyond the borehole locations.

In general, the subsurface conditions encountered in the boreholes consist of pavement structure and embankment fill overlying deposits of native sands and silts. Native clayey silt to clayey silt till deposits were found interlayered with the sands and silts. Where observed, the groundwater level was between 0.6 m and 6.1 m depths upon completion of drilling. The remaining boreholes were dry upon completion.

4.2 Pavement Structure

Pavement structure consisting of asphalt overlying granular fill materials was encountered in Boreholes 17-H01 to 17-H07 drilled during the current investigation, and in Boreholes C5-6-3 and LA4, drilled during the previous investigation. The thickness of the asphalt ranged between 200 mm and 430 mm.

The granular fill consists of sand, silty sand, gravelly sand to sand and gravel, and ranges between 0.4 m and 1.4 m in thickness. These soils are in a typically compact state as indicated by SPT 'N' values mostly ranging from 12 to 46 blows per 0.3 m penetration. In Borehole 17-H07, an SPT 'N' value of 52 blows per 0.3 m of penetration indicated a very dense condition, whereas in Borehole C5-6-3, an 'N' value of 7 blows indicated a loose zone. The measured moisture contents of the granular fill ranged from 3 percent to 8 percent.

4.3 Embankment Fill

Below the pavement structure, embankment fill was encountered in Boreholes 17-H04 to 17-H07, C5-6-3 and LA4. Embankment fill was contacted at ground surface in Boreholes C38-2 and C40-2. The composition of the embankment fill is as follows:

- Brown clayey silt fill with sand to some sand, trace gravel, occasional cobbles, trace organics in Boreholes 17-H04 to 17-H06, C5-6-3, C40-2 and LA4.
- Brown sand and silt fill with some clay, trace to some gravel, organics and occasional sandy silt seams in Boreholes 17-H07, C38-2 and C40-2.

The thickness of the embankment fill ranged from 1.4 m to 3.4 m. The depth to the base of the embankment fill ranged from 2.0 m to 4.5 m (Elevations 279.2 to 308.4).

SPT 'N' values recorded in the cohesionless embankment fill varied from 5 to 15 blows per 0.3 m penetration indicating a loose to compact state. The cohesive embankment fill has measured 'N' values ranging from 3 to 23 blows per 0.3 m of penetration indicating a soft to very stiff consistency. An SPT 'N" value of 55 blows per 0.3 m of penetration was measured in the clayey silt fill in Borehole 17-H04 indicating a hard zone. The measured moisture contents ranged from 8 percent to 16 percent in the cohesionless fill, and from 3 percent to 34 percent in the cohesive fill.

The results of grain size analyses conducted, during the present investigation, on embankment fill samples are presented on the Record of Borehole sheets in Appendix A, and are illustrated in Figures B1 and B2 of Appendix B. The laboratory test results are summarized in the following table.

Soil Particles	Cohesive Embankment Fill Percentage (%)	Cohesionless Embankment Fill Percentage (%)
Gravel	0 to 4	5
Sand	32 to 38	47
Silt	43	37
Clay	15 to 25	11

4.4 Organics

A 200 mm thick layer of black organics mixed with clayey silt was contacted at 3.0 m depth in Borehole 17-H04. The depth to the base of the organics was at 3.2 m (Elevation 308.2). A moisture content of 35 percent was measured in the organics.

4.5 Silty Sand to Sand and Silt

Underlying the fill and cohesive soils are deposits of native, brown to grey cohesionless soils, consisting of sands and silts of varying proportions with trace to some clay, trace gravel, occasional silt seams and occasional cobbles, in most of the boreholes except in Borehole C40-2. The silty sand, sand and silt to silt were contacted at various depths

ranging from 0.8 m to 8.0 m. Where fully penetrated in Boreholes 17-H05 and LA4, the thickness of the sand and silt to sand ranged from 1.1 m to 6.8 m. In these two boreholes, the depth to the base of these layers varied from 4.1 m to 14.8 m (Elevations 290.0 to 303.3). Boreholes 17-H01 to 17-H04, 17-H06, 17-H07 and C38-2 were terminated within the sands and silts at depths ranging from 6.7 m to 15.9 m (Elevations 275.8 to 340.5).

The majority of SPT 'N' values measured in the sands and silts ranged from 12 to 47 blows for 0.3 m penetration, indicating a compact to dense condition. SPT 'N' values of greater than 50 blows per 0.3 m of penetration measured at lower depths in Boreholes 17-H02, 17-H03 and 17-H07 indicated the very dense zones. In Boreholes C38-2, LA4 and C5-6-3, the 'N' values in the sand and silt ranged from 44 to greater than 100 blows indicating dense to very dense conditions. Measured moisture contents of samples of the sands and silts ranged from 2 percent to 22 percent.

The results of a grain size analyses conducted during the present investigation on the silty sand to sand and silt samples are presented on the Record of Borehole sheets in Appendix A, and are illustrated in Figures B3 and B4 of Appendix B. The laboratory test results are summarized in the following table.

Soil Particles	Sandy Silt/Silty Sand Percentage (%)
Gravel	0 to 6
Sand	22 to 71
Silt	23 to 64
Clay	3 to 15

4.6 Clayey Silt

A layer of brown to grey clayey silt with sand to trace sand, trace gravel was contacted in Boreholes 17-H03, 17-H04, C38-2 and C5-6-3, at depths ranging from 0.8 m to 3.2 m. The thickness of the silty clay ranged from 0.7 m to 2.6 m. The depths to the base of the clayey silt varied from 2.9 m to 5.6 m (Elevations 300.7 to 345.4). In Borehole LA4, the clayey silt was encountered at 14.8 m depth. Borehole LA4 was terminated within the clayey silt at 17.4 m depth (Elevation 287.4).

SPT 'N' values measured in these clayey silt layers typically ranged from 10 to 21 blows for 0.3 m penetration indicating a stiff to very stiff consistency. An SPT 'N' value of 5 blows per 0.3 m of penetration, indicating a firm consistency, was measured in Borehole 17-H04 near Elevation 308.0. SPT 'N' values measured in Borehole LA4, below Elevation 290.0, were 72 and 87 blows per 0.3 m of penetration indicating hard consistency. Measured moisture contents of the clayey silt samples generally ranged from 9 percent to 22 percent.

The results of a grain size analyses conducted during the present investigation, on clayey silt samples are presented on the Record of Borehole sheets in Appendix A, and are illustrated in Figure B5 of Appendix B. The laboratory test results are summarized in the following table.

Soil Particles	Clayey Silt Percentage (%)
Gravel	0 to 2
Sand	23 to 28
Silt	46 to 58
Clay	19 to 24

The results of Atterberg Limits tests conducted on a sample of the clayey silt are provided on the Record of Borehole sheets in Appendix A and illustrated in Figure B7 of Appendix B. The results are summarized as follows:

Index Property	Percentage (%)
Liquid Limit	18
Plastic Limit	11
Plasticity Index	7

The results of the Atterberg Limits tests show that the clayey silt is low plastic with a group symbol of CL to CL-ML.

4.7 Silt

A layer of brown silt containing some sand and trace clay was contacted at 9.1 m depth in Borehole C38-2, drilled during the previous investigation. Borehole C38-2 was terminated within the silt layer at 15.9 m depth (Elevation 293.8).

SPT 'N' values of the silt ranged from 33 to 80 blows per 0.3 m of penetration, indicating a dense to very dense state. Moisture content in the silt varied from 16 percent to 21 percent.

4.8 Sand

Grey sand containing trace to some silt was encountered at 10.1 m depth in Borehole 5-6-3, drilled in the previous investigation, which was terminated within the sand layer at 12.6 m depth (Elevation 291.8).

SPT 'N' values of the sand layer were 81 blows per 0.3 m of penetration and 95 blows for less than 0.3 m of penetration indicating a very dense state.

4.9 Clayey Silt Till

A till deposit consisting of clayey silt till with sand and trace to some gravel was encountered in Borehole 17-H05 at 4.1 m depth and in Borehole C5-6-3 at 3.7 m depth. The thickness of the clayey silt till was 3.4 m in Borehole C5-6-3. The depth to the base of the clayey silt till was 7.1 m (Elevation 297.3) in Borehole C5-6-3. Borehole 17-H05 was terminated within the clayey silt till at 6.7 m depth (Elevation 300.7).

SPT 'N' values measured in this cohesive till deposit ranged from 18 to 62 blows for 0.3m penetration indicating a very stiff to hard consistency. Measured moisture contents of the clayey silt till samples generally ranged from 9 percent to 11 percent.

The results of a grain size analyses on a clayey silt till sample form the current investigation are presented on the Record of Borehole sheets in Appendix A, and are illustrated in Figure B6 of Appendix B. The laboratory test results are summarized in the following table.

Soil Particles	Clayey Silt Till Percentage (%)
Gravel	2
Sand	49
Silt	34
Clay	15

Glacial tills inherently contain cobbles and boulders.

4.10 Sand and Silt Till

A sand and silt till deposit was encountered in Boreholes C40-2 and LA4. The cohesionless till was contacted at depths ranging from 2.0 m to 3.2 m. Where fully penetrated in Borehole LA4, the thickness of this till is 4.8 m. The depth to the base of this till was 8.0 m (Elevation 296.8). Borehole C40-2 was terminated within this till at 6.3m depth (Elevation 285.9).

SPT 'N' values recorded in the sand and silt till typically ranged from 59 blows for 0.3 m penetration to greater than 100 blows for less than 0.3 m penetration. These 'N' values indicate a very dense condition throughout, and possible presence of cobbles and boulders in the deposit. An occasional 'N' value of 17 blows in Borehole LA4 indicated a compact zone. Measured moisture contents of the sand and silt till samples ranged from 8 percent to 10 percent.

4.11 Groundwater Conditions

Groundwater conditions were observed during drilling and in the open boreholes upon completion of drilling. Boreholes 17-H01 to 17-H05 and 17-H07 were dry upon completion. The water levels measured in the open boreholes drilled during the previous investigation are summarized below.

Table 4.1 Water Level Measurements in Open Boreholes

Borehole Number	Station	Date	Depth (m)	Elevation (m)	Comments
C38-2	20+330	November 26,	6.1	303.5	Open Borehole
C5-6-3	21+200	December 2, 2013	Dry		Open Borehole
17-H06	21+620	March 2, 2017	0.6	301.1	Open Borehole
C40-2	22+020	December 9, 2010	1.4	290.8	Open Borehole

Based on the observations in the open boreholes, the water level varies between 0.6 m and 6.1 m depth below ground surface (Elevations 209.8 to 303.5). It should be noted that these are very short term observations and groundwater levels are subject to seasonal fluctuations and severe climatic events.

5.0 MISCELLANEOUS

Thurber staked and/or marked the borehole locations of the current investigation in the field and obtained utility clearances prior to drilling. MMM provided the northing and easting coordinates and ground surface elevations.

DBW Drilling of Ajax, Ontario, supplied and operated a truck-mounted D90 drill rig to carry out the drilling, sampling and in-situ testing operations for the boreholes.

The drilling and sampling operations in the field were supervised on a full time basis by Mr. Troy MacKinnon of Thurber. Geotechnical laboratory testing was carried out by Thurber in its MTO-approved laboratory. Overall supervision of the field program was carried out by Mr. Stephane Loranger, CET.

Overall project management was provided by Dr. Sydney Pang, P.Eng. Interpretation of the field data and preparation of this report was completed by Ms. R. Palomeque Reyna, P. Eng. and Dr. Sydney Pang, P.Eng. The report was reviewed by Dr. P.K. Chatterji, P.Eng., a Designated Principal Contact for MTO Foundations Projects.

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PART 2 ENGINEERING DISCUSSION AND RECOMMENDATIONS

6.0 GENERAL

This section of the report presents foundation recommendations for the design of the proposed High-Occupancy Toll (HOT) and High-Occupancy Toll HMS (HOT HMS) sign supports along Highway 400, from 16th Sideroad to 1.2 km north of Lloydtown-Aurora Road in the Township of King, Ontario.

Twelve (12) HOT and HOT HMS signs are proposed. Table 6.1 indicates that proposed sign numbers and locations:

Borehole	Sign Support Type	Sign Support Number	Approximate Station	Location Relative to Highway 400
17-H02	HOT	TS3	16+000	Northbound lane (NBL)
17-H04	HOT HMS	HMS 02	19+955	
C38-2	HOT	TS5	20+330	
17-H05	HOT	TS6A	20+750	
LA4, C5-6-3C5-6-3	HOT	TS6	21+225	
C40-2	HOT	TS7	22+000	
17-H07	HOT	TS9	22+420	Southbound lane (SBL)
17-H07	HOT HMS	HMS 03	22+400	
17-H06	HOT	TS10	21+620	
LA4	HOT	T11	21+130	
C38-2	HOT	T12	20+330	
17-H01	HOT	TS17	16+300	

Information on the proposed locations of the signs was provided to Thurber by MMM. Based on the proposed design layout, boreholes drilled during the current and previous investigations, and in close proximity to each proposed sign location, were selected to provide subsurface information for foundation design. The Record of Borehole sheets for these boreholes are presented in Appendices A and C. Tables 1 and 2 immediately following the text of this report provide foundation design parameters for each sign location.

6.1 Foundation Design Parameters

Design of the sign support foundations should be carried out in accordance with the following document.

- Ministry of Transportation, Ontario (2015) “Sign Support Manual”, Highway Standards Branch, Bridge Office (Reference 1).

Reference should also be made to the following documents.

- Ministry of Transportation, Ontario (2004) “Guidelines for the Design of High Mast Pole Foundations”, Fourth Edition, BRO-009, Engineering Standards Branch, Bridge Office (Reference 2).

- Canadian Highway Bridge Design Code and Commentary (2010). CAN/CSA-S6-00 and S6.1-00 (Reference 3).

It is understood that a typical HOT sign support consists of a single conventional augered caisson (drilled shaft). A HOT HMS sign support is designed for two supports. Tables 1 and 2 following the text of this report present the recommended parameters for foundation design of such caissons.

It is recommended that MTO’s standard designs in Reference 1 be used as a basis for the sign support foundations. The foundation design parameters in Tables 1 and 2 should be used in conjunction with References 1 and 2 to confirm that the standard designs are adequate.

In order to take into account frost action and surficial disturbance, the ultimate lateral passive resistance in front of a caisson within the upper 1.4 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 fill or native soil exists in front of a caisson, reduction of lateral passive resistance should be taken into consideration during design. The stabilized groundwater level may be higher. For foundation design at the caissons, it should 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 four (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 at a horizontal distance equal to or greater than four (4) times the diameter of the caisson.

Where an unconfined compressive strength, q_u, (q_u = 2 x C_u, undrained shear strength) is provided for a cohesive soils (clayey silt to silty clay fill and native, silty clay till or 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 sands and silts, the submerged soil unit weight, γ', should be used. The required depth of the drilled shaft will be governed by lateral loads, including wind loads, acting on the sign. The length of the caisson should also be sufficient to counteract frost jacking (upward) forces.

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

6.2 Caisson Installation

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

The contract documents should contain an NSSP alerting the contract bidders of the specific aspects relating to caisson construction for HOT and HOT HMS foundation supports at this site. Suggested wordings for this NSSP are provided in Appendix E.

Caisson installation equipment must be able to dislodge, handle, remove cobbles and boulders, to penetrate obstructions within the fill and to drill through hard or very dense layers, where encountered.

The short term groundwater levels were measured to be between 1.4 m and 6.1 m depth below existing ground surface. The stabilized groundwater levels may be higher. Soil sloughing and water seepage may occur in unsupported holes especially in sands and silts below the groundwater level. Temporary liners must be available to support the caisson sidewalls and to provide seepage cut-off where required. Any accumulated water may have to be pumped out from the hole prior to placing concrete. Should it be considered impractical to remove the accumulated water inside the hole, it is recommended that the concrete be placed by the tremie method.

6.4 Construction Concerns

Concerns during caisson construction mainly involve the handling and removal of cobbles or boulders, or other obstructions in the fill and till, drilling through hard/very dense soils, soil sloughing and water seepage from caisson sidewalls, and basal instability. Recommendations on how to address these issues have been outlined in the previous section.

6.5 Construction Inspection and Testing

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

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TABLE 1
FOUNDATION DESIGN PARAMETERS
HOT AND HOT HMS SIGN SUPPORTS ALONG THE NBL
HIGHWAY 400 WIDENING
LLOYDTOWN-AURORA ROAD
G.W.P. 2085-13-00

HOT Number	HOT Station	Reference Borehole	Reference Simplified Subsurface Stratigraphy For Design	Depth Below Existing Ground Surface (m)	Foundation Design Parameters						
					q_u (kPa)	ϕ' (deg.)	n_h (kN/m^3)	K_P	γ (kN/m^3)	γ' (kN/m^3)	Ground water Depth (m)
TS3	16+000	17-H02	Sand (Fill) Sand and Silt Sandy Silt	0.3 – 0.8 0.8 – 5.0 5.0 – 8.2	- - -	30 31 32	2,500 4,000 4,000	3.0 3.1 3.3	20 20 -	- - 11	5 (below existing grade)
HMS 02	19+955	17-H04	Sand/Clayey Silt (Fill) Clayey Silt Sand and Silt	0.4 – 3.2 3.2 – 4.3 4.3 – 6.7	- 60 -	30 - 31	2,500 - 2,500	3.0 - 3.1	20 18 -	- - 10	5 (below existing grade)
TS5	20+330	C38-2	Sand and Silt (Fill) Clayey Silt Sand and Silt Silt	0.0 – 3.0 3.0 – 5.6 5.6 – 9.1 9.1 – 15.9	- 120 - -	30 - 32 32	2,500 - 4,000 4,000	3.0 - 3.2 3.3	20 19 - -	- - 11 11	5 (below existing grade)
TS6A	20+750	17-H05	Sand/Clayey Silt (Fill) Sand and Silt Clayey Silt Till	0.4 – 3.0 3.0 – 4.1 4.1 – 6.7	- - 160	30 31 -	2,500 4,000 -	3.0 3.1 -	20 20 20	- - -	5 (below existing grade)

Notes: 1. This table must be read in conjunction with the text of this report.
2. 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.
3. If new fill is placed, some caissons may be partially embedded within the new fill.

HOT Number	HOT Station	Reference Borehole	Reference Simplified Subsurface Stratigraphy For Design	Depth Below Existing Ground Surface (m)	Foundation Design Parameters						
					q_u (kPa)	ϕ' (deg.)	n_h (kN/m^3)	K_P	γ (kN/m^3)	γ' (kN/m^3)	Ground water Depth (m)
TS6	21+225	LA4 C5-6-3	Clayey Silt/Sand (Fill) Sand and Silt Till Sand and Silt Clayey Silt	0.4 – 3.2 3.2 – 8.0 8.0 – 14.8 14.8 – 17.4	- - - 300	30 33 33 -	2,500 6,000 5,000 -	3.0 3.4 3.4 -	20 21 - -	- 11 11 11	5 (below existing grade)
TS7	22+000	C40-2	Sand, Silt, Clayey Silt (Fill) Sand and Silt Till	0.0 – 2.0 2.0 – 6.3	- -	29 34	2,000 6,500	2.9 3.5	19 21	- 11	1.4 (below existing grade)
All Locations		-	New Fill (see Note 3)	Variable height above ground surface	-	30	3.0	3.0	20	-	Below base of new fill

LEGEND

q_u = Unconfined Compressive Strength (= 2 x C_u, undrained shear strength) (kPa)
ϕ' = Angle of Internal Friction (degrees)
n_h = Coefficient of Horizontal Subgrade Reaction (MN/m^3 or X 10^3 kN/m^3)
K_p = Coefficient of Passive Earth Pressure
γ = Soil Unit Weight (kN/m^3)
γ' = Submerged Soil Unit Weight (kN/m^3) – to be used only for cohesionless soils below the groundwater table

Notes: 1. This table must be read in conjunction with the text of this report.
2. 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.
3. If new fill is placed, some caissons may be partially embedded within the new fill.

TABLE 2
FOUNDATION DESIGN PARAMETERS
HOT AND HOT HMS SIGN SUPPORTS ALONG THE SBL
HIGHWAY 400 WIDENING
LLOYDTOWN-AURORA ROAD
G.W.P. 2085-13-00

HOT Number	HOT Station	Reference Borehole	Reference Simplified Subsurface Stratigraphy For Design	Depth Below Existing Ground Surface (m)	Foundation Design Parameters						
					q_u (kPa)	ϕ' (deg.)	n_h (kN/m^3)	K_P	γ (kN/m^3)	γ' (kN/m^3)	Ground water Depth (m)
TS9	22+420	17-H07	Sand, Silt (Fill) Sand and Silt	0.3 – 4.5 4.5 – 7.9	- -	29 31	2,000 3,500	2.9 3.1	19 20	- 10	5 (below existing grade)
HMS 03	22+400	17-H07	Sand, Silt (Fill) Sand and Silt	0.3 – 4.5 4.5 – 7.9	- -	29 31	2,000 3,500	2.9 3.1	19 20	- 10	5 (below existing grade)
TS10	21+620	17-H06	Sand/Clayey Silt (Fill) Silty Sand Sand and Silt	0.3 – 2.2 2.2 – 4.1 4.1 – 8.2	- - -	30 31 31	2,500 3,500 3,500	3.0 3.1 3.1	20 20 20	- - 10	0.6 (below existing grade)
T11	21+130	LA4	Clayey Silt/Sand (Fill) Sand and Silt Till Sand and Silt Clayey Silt	0.4 – 3.2 3.2 – 8.0 8.0 – 14.8 14.8 – 17.4	- - - 300	30 33 33 -	2,500 6,000 5,000 -	3.0 3.4 3.4 -	20 21 - -	- 11 11 11	5 (below existing grade)
T12	20+330	C38-2	Sand and Silt (Fill) Clayey Silt Sand and Silt Silt	0.0 – 3.0 3.0 – 5.6 5.6 – 9.1 9.1 – 15.9	- 120 - -	30 - 32 32	2,500 - 4,000 4,000	3.0 - 3.2 3.2	20 19 - -	- - 11 11	5 (below existing grade)

Notes: 1. This table must be read in conjunction with the text of this report.
2. 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.
3. If new fill is placed, some caissons may be partially embedded within the new fill.

HOT Number	HOT Station	Reference Borehole	Reference Simplified Subsurface Stratigraphy For Design	Depth Below Existing Ground Surface (m)	Foundation Design Parameters						
					q_u (kPa)	ϕ' (deg.)	n_h (kN/m^3)	K_P	γ (kN/m^3)	γ' (kN/m^3)	Ground water Depth (m)
TS17	16+300	17-H01	Gravelly Sand (Fill) Silty Sand	0.3 – 1.4 1.4 – 8.2	- -	30 33	2,500 6,000	3.0 3.4	20 21	- 11	5 (below existing grade)
All Locations		-	New Fill (see Note 3)	Variable height above ground surface	-	30	3.0	3.0	20	-	Below base of new fill

LEGEND

q_u = Unconfined Compressive Strength (= 2 x C_u, undrained shear strength) (kPa)
ϕ' = Angle of Internal Friction (degrees)
n_h = Coefficient of Horizontal Subgrade Reaction (MN/m^3 or X 10^3 kN/m^3)
K_p = Coefficient of Passive Earth Pressure
γ = Soil Unit Weight (kN/m^3)
γ' = Submerged Soil Unit Weight (kN/m^3) – to be used only for cohesionless soils below the groundwater table

Notes: 1. This table must be read in conjunction with the text of this report.
2. 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.
3. If new fill is placed, some caissons may be partially embedded within the new fill.

Appendix A

Record of Boreholes of

Current 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[(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

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

▼ 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.

EXPLANATION OF ROCK LOGGING TERMS

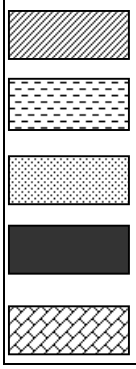
ROCK WEATHERING CLASSIFICATION

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

DISCONTINUITY SPACING

Bedding	**Bedding Plane Spacing**
Very thickly bedded	Greater than 2m
Thickly bedded	0.6 to 2m
Medium bedded	0.2 to 0.6m
Thinly bedded	60mm to 0.2m
Very thinly bedded	20 to 60mm
Laminated	6 to 20mm
Thinly Laminated	Less than 6mm

SYMBOLS



CLAYSTONE

SILTSTONE

SANDSTONE

COAL

BEDROCK

STRENGTH CLASSIFICATION

Rock Strength	**Approximate Uniaxial Compressive Strength (MPa)**	**(psi)**	**Field Estimation of Hardness***
Extremely Strong	Greater than 250	Greater than 36,000	Specimen can only be chipped with a geological hammer
Very Strong	100-250	15,000 to 36,000	Requires many blows of geological hammer to break
Strong	50-100	7,500 to 15,000	Requires more than one blow of geological hammer to break
Medium Strong	25.0 to 50.0	3,500 to 7,500	Breaks under single blow of geological hammer.
Weak	5.0 to 25.0	750 to 3,500	Can be peeled by a pocket knife with difficulty
Very Weak	1.0 to 5.0	150 to 750	Can be peeled by a pocket knife, crumbles under firm blows of geological pick.
Extremely Weak (Rock)	0.25 to 1.0	35 to 150	Indented by thumbnail

TERMS

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

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 17-H01 1 OF 1 METRIC

W.P. 2085-13-00 LOCATION Sta. 16+300, N 4 868 700.6 E 298 777.3 ORIGINATED BY TM

HWY 400 BOREHOLE TYPE Soild Stem Augers COMPILED BY AN

DATUM Geodetic DATE 2017.02.27 - 2017.02.27 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) (20 40 60 80 100)	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
339.6	GROUND SURFACE										
0.0 / 339.3	**ASPHALT:** (275mm)										
0.3 / 338.2	Gravelly **SAND**, trace silt, occasional cobbles Compact to Dense Brown Moist (FILL)		1	SS	20		339		○		
			2	SS	33				○		
1.4	Silty **SAND**, trace clay, trace gravel, occasional cobbles Compact to Dense Brown Moist		3	SS	45		338		○		5 66 23 6
			4	SS	28		337		○		
			5	SS	36				○		
							336				
			6	SS	47		335		○		
							334				
	Occasional clayey silt seams below 6.5m		7	SS	18				○		0 71 25 4
							333				
			8	SS	38		332		○		
331.4											
8.2	END OF BOREHOLE AT 8.2m. BOREHOLE OPEN AND DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND AUGER CUTTINGS TO 0.6m, DRY MIX CONCRETE TO 0.5m, THEN ASPHALT COLD PATCH TO SURFACE.										

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

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

ONTMT4S MTO-12187.GPJ 2015TEMPLATE(MTO).GDT 3/30/17

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No 17-H02 1 OF 1 METRIC

W.P. 2085-13-00 LOCATION Sta. 16+000, N 4 868 404.8 E 298 827.4 ORIGINATED BY TM

HWY 400 BOREHOLE TYPE Soild Stem Augers COMPILED BY AN

DATUM Geodetic DATE 2017.02.27 - 2017.02.27 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 20 40 60 80 100	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
348.7	GROUND SURFACE										
0.0 / 348.4	**ASPHALT:** (275mm)										
0.3 / 347.9	**SAND**, trace to some silt, trace gravel Dense Brown Moist (FILL)		1	SS	33		348		○		
0.8	**SAND** and **SILT**, trace clay, trace gravel, occasional silt seams Compact Brown Moist		2	SS	21				○		
			3	SS	16		347		○		
			4	SS	18				○		0 38 58 4
			5	SS	16		346		○		
	Dense to Very Dense		6	SS	36		345		○		0 61 36 3
			7	SS	41		344		○		
			8	SS	67		343		○		
340.5							342				
8.2	END OF BOREHOLE AT 8.2m. BOREHOLE OPEN AND DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND AUGER CUTTINGS TO 0.6m, DRY MIX CONCRETE TO 0.5m, THEN ASPHALT COLD PATCH TO SURFACE.						341				

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

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

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Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No 17-H03 1 OF 1 METRIC

W.P. 2085-13-00 LOCATION Sta. 17+090, N 4 869 482.3 E 298 643.5 ORIGINATED BY TM

HWY 400 BOREHOLE TYPE Soild Stem Augers COMPILED BY AN

DATUM Geodetic DATE 2017.02.27 - 2017.02.27 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 (20 40 60 80 100): ○ 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/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
348.3	GROUND SURFACE										
0.0 / 348.0	**ASPHALT:** (300mm)						348				
0.3 / 347.5	Silty **SAND**, trace gravel Compact Brown		1	SS	20			○			
0.8	Moist (FILL)		2	SS	16		347	○			
	Clayey **SILT**, with sand, trace gravel Stiff to Very Stiff Brown Moist		3	SS	12			⊖			2 28 46 24
345.4			4	SS	21		346	○			
2.9	Silty **SAND**, trace clay Compact to Dense Brown Moist		5	SS	30		345	○			
			6	SS	21		344	○			0 68 29 3
			7	SS	34		343				
							342	○			
	Very Dense		8	SS	64		341	○			
340.1											
8.2	END OF BOREHOLE AT 8.2m. BOREHOLE OPEN AND DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND AUGER CUTTINGS TO 0.6m, DRY MIX CONCRETE TO 0.5m, THEN ASPHALT COLD PATCH TO SURFACE.										

+ ³, × ³: Numbers refer to Sensitivity

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

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THURBER

RECORD OF BOREHOLE No 17-H04 1 OF 1 METRIC

W.P. 2085-13-00 LOCATION Sta. 19+955, N 4 872 296.9 E 298 161.5 ORIGINATED BY TM

HWY 400 BOREHOLE TYPE Soild Stem Augers COMPILED BY AN

DATUM Geodetic DATE 2017.03.02 - 2017.03.02 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 + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	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
311.4	GROUND SURFACE										
0.0 / 311.0	**ASPHALT:** (375mm)										
0.4 / 310.6	**SAND**, trace silt Dense Brown Moist (FILL)		1	SS	37		311	○	○		Augers grinding
0.8	Clayey **SILT**, with sand, occasional sand seams Hard to Very Stiff Brown Moist (FILL)		2	SS	55			○	○		4 38 43 15
			3	SS	15		310		○		
			4	SS	17		309		○		
308.4											
3.0 / 308.2	**ORGANICS**, mixed with clayey silt Black										
3.2	Moist (200mm)		5	SS	5		308		○		0 23 58 19
307.1	Clayey **SILT**, some sand Firm Brown Moist										
4.3	**SAND** and **SILT**, some clay, trace gravel Compact Brown Moist		6	SS	14		307		○		0 43 44 13
							306				
	Dense		7	SS	43		305		○		
304.7											
6.7	END OF BOREHOLE AT 6.7m. BOREHOLE OPEN AND DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND AUGER CUTTINGS TO 0.6m, DRY MIX CONCRETE TO 0.2m, THEN COLD PATCH ASPHALT TO SURFACE.										

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

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

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Ontario

THURBER

RECORD OF BOREHOLE No 17-H05 1 OF 1 METRIC

W.P. 2085-13-00 LOCATION Sta. 20+750, N 4 873 084.9 E 298 009.8 ORIGINATED BY TM

HWY 400 BOREHOLE TYPE Soild Stem Augers COMPILED BY AN

DATUM Geodetic DATE 2017.03.02 - 2017.03.02 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 (20 40 60 80 100): ○ 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
307.4	GROUND SURFACE										
0.0 / 307.0	**ASPHALT:** (430mm)										
0.4 / 306.6	**SAND** and **GRAVEL**, trace silt Dense Brown Moist (FILL)		1	SS	30		307	○	○		
0.8	Clayey **SILT**, with sand, trace gravel Stiff to Very Stiff Brown Moist (FILL)		2	SS	11			○			
			3	SS	21		306	○			0 32 43 25
	Some organics pockets at 2.4m		4	SS	16		305		○		
304.4											
3.0	**SAND** and **SILT**, some clay, trace gravel, occasional organics Compact Brown Moist		5	SS	19		304	○			3 49 37 11
303.3											
4.1	Clayey **SILT**, with sand, trace gravel Very Stiff to Hard Brown Moist (TILL)		6	SS	21		303	○			2 49 34 15
			7	SS	37		302				
300.7							301	○			
6.7	END OF BOREHOLE AT 6.7m. BOREHOLE OPEN AND DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND AUGER CUTTINGS TO 0.6m, DRY MIX CONCRETE TO 0.2m, THEN COLD PATCH ASPHALT TO SURFACE.										

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

$\frac{20}{15 \quad 5}$ (%) STRAIN AT FAILURE
$\frac{10}{}$

ONTMT4S MTO-12187.GPJ 2015TEMPLATE(MTO).GDT 3/30/17

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No 17-H06 1 OF 1 METRIC

W.P. 2085-13-00 LOCATION Sta. 21+620, N 4 873 930.8 E 297 806.1 ORIGINATED BY TM

HWY 400 BOREHOLE TYPE Soild Stem Augers COMPILED BY AN

DATUM Geodetic DATE 2017.03.02 - 2017.03.02 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 + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	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
301.7	GROUND SURFACE										
0.0 / 301.4	**ASPHALT:** (300mm)										
0.3 / 300.9	**SAND**, trace to some gravel, trace silt Dense Brown		1	SS	46	▽	301	○	○		
0.8	Moist (FILL)		2	SS	23			○			
299.5	Clayey **SILT**, some sand, trace gravel, occasional cobbles Very Stiff to Stiff Brown Moist (FILL)		3	SS	9		300	○			
2.2	Silty **SAND**, some clay, trace gravel Compact Brown Moist		4	SS	13		299	○			6 44 35 15
297.6			5	SS	16		298	○			
4.1	**SAND** and **SILT**, trace clay, occasional clayey silt seams Compact Brown Moist		6	SS	14		297	○			0 53 40 7
	Occasional sandy silt seams at 6.0m		7	SS	25		296	○			
293.5			8	SS	28		295 294	○			
8.2	END OF BOREHOLE AT 8.2m. BOREHOLE OPEN AND WATER LEVEL AT 0.6m. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND AUGER CUTTINGS TO 0.6m, DRY MIX CONCRETE TO 0.2m, THEN COLD PATCH ASPHALT TO SURFACE.										

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

$\frac{20}{15 \oplus 5}$ (%) STRAIN AT FAILURE
10

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Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No 17-H07 1 OF 1 METRIC

W.P. 2085-13-00 LOCATION Sta. 22+400, N 4 874 690.4 E 297 623.8 ORIGINATED BY TM

HWY 400 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN

DATUM Geodetic DATE 2017.03.02 - 2017.03.02 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 + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	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
283.7	GROUND SURFACE										
0.0 / 283.4	**ASPHALT:** (300mm)										
0.3	Gravelly **SAND**, trace silt, occasional cobbles Very Dense Brown Moist (FILL)		1	SS	52		283		○		
282.6 / 1.1			2	SS	22				○		
	SAND and **SILT**, some clay, trace gravel, occasional sandy silt seams Compact to Loose Brown Moist (FILL)		3	SS	9		282		○		
			4	SS	9		281		○		5 47 37 11
			5	SS	7				○		
279.2							280				
4.5	**SAND** and **SILT**, some clay, trace gravel, occasional organics seams, occasional roots and rootlets, topsoil stained Compact to Very Dense Dark Brown Moist		6	SS	12		279		○		5 39 45 11
							278				
	Brown		7	SS	31				○		0 22 64 14
275.8			8	SS	40/ 0.125		277 / 276		○		
7.9	END OF BOREHOLE AT 7.9m. BOREHOLE OPEN AND DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND AUGER CUTTINGS TO 0.6m, DRY MIX CONCRETE TO 0.2m, THEN COLD PATCH ASPHALT TO SURFACE.										

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

$\frac{20}{15 \oplus 5}$ (%) STRAIN AT FAILURE
10

ONTMT4S MTO-12187.GPJ 2015TEMPLATE(MTO).GDT 3/30/17

THURBER

60 YEARS

Appendix B

Laboratory Test Results of

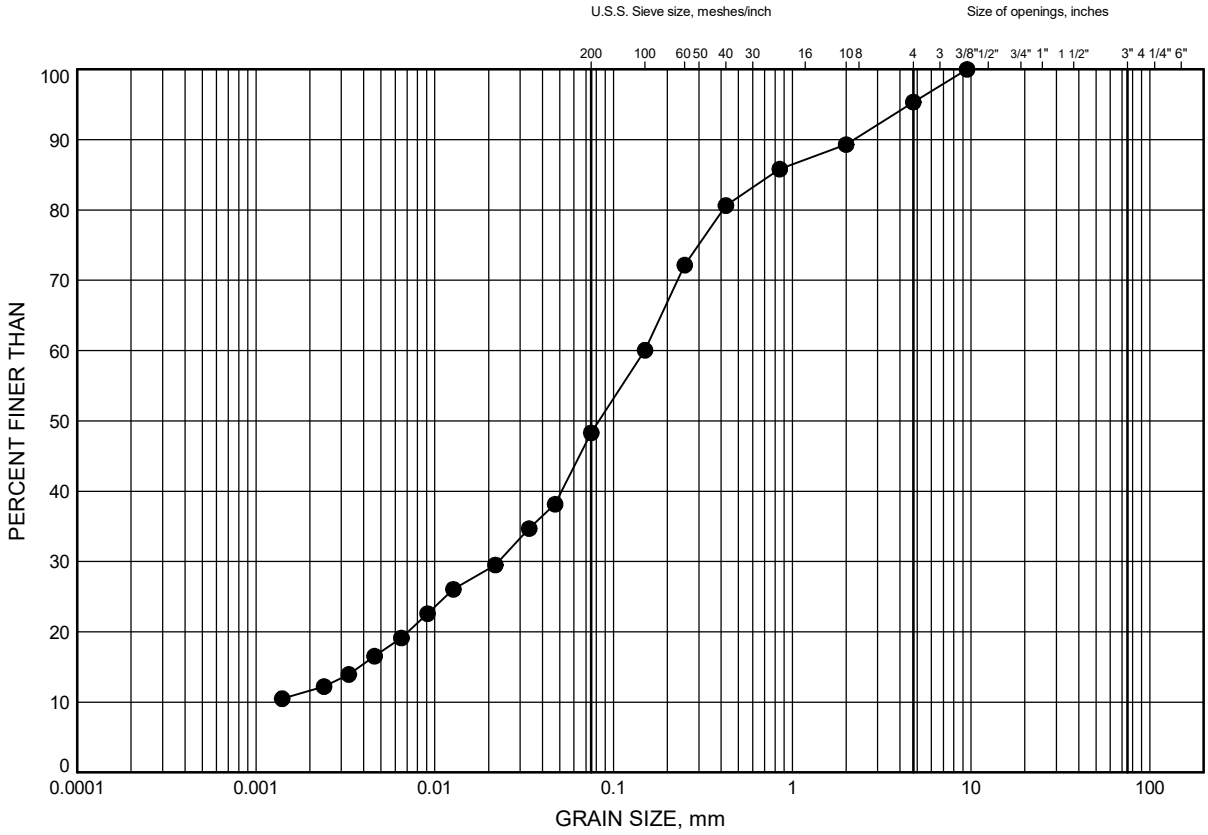
Current Investigation

HOT & HOT HMS Sign Supports

GRAIN SIZE DISTRIBUTION

FIGURE B1

SAND and SILT FILL



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	17-H07	2.59	281.11

Date March 2017

W.P. 2085-13-00

THURBER

Prep'd MFA

Chkd. SKP

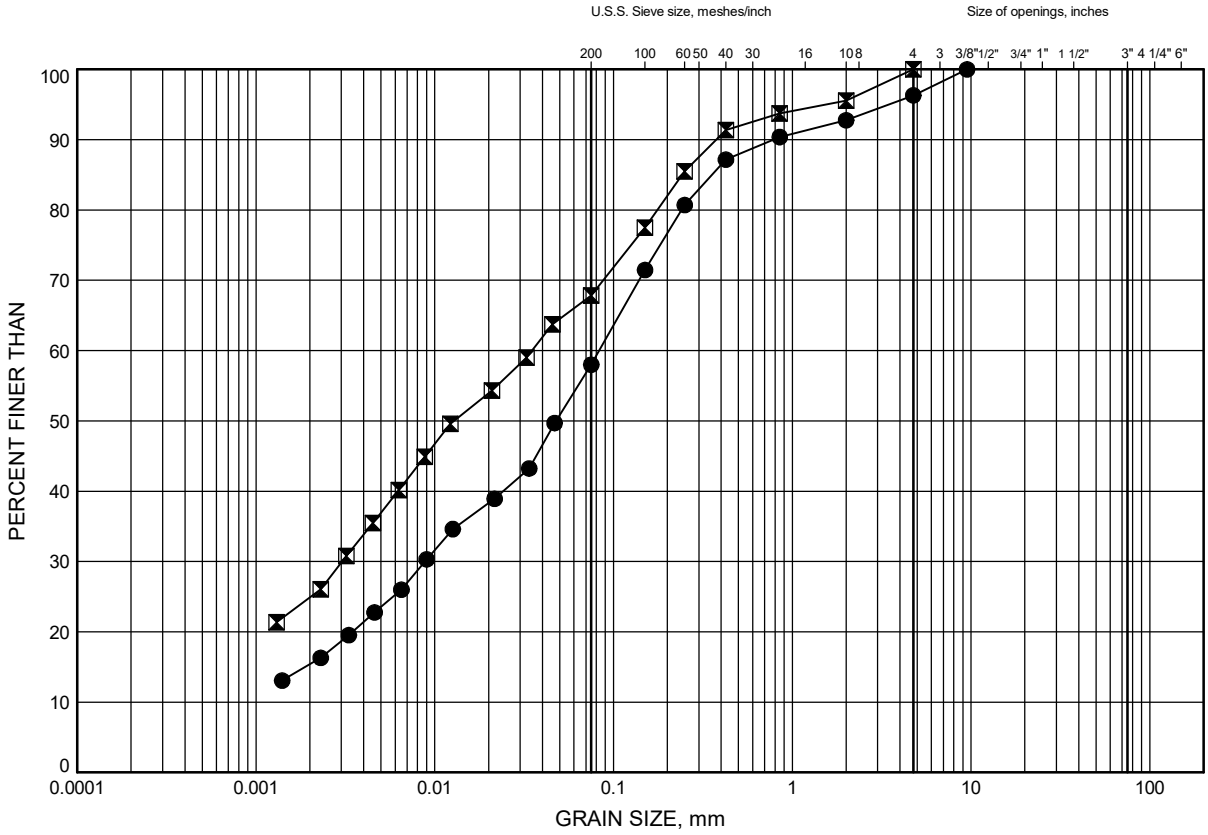
GRAIN SIZE DISTRIBUTION - THURBER MTO-12187.GPJ 3/30/17

HOT & HOT HMS Sign Supports

GRAIN SIZE DISTRIBUTION

FIGURE B2

Clayey SILT FILL



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	17-H04	1.07	310.33
⊠	17-H05	1.83	305.57

Date March 2017

W.P. 2085-13-00

THURBER

Prep'd MFA

Chkd. SKP

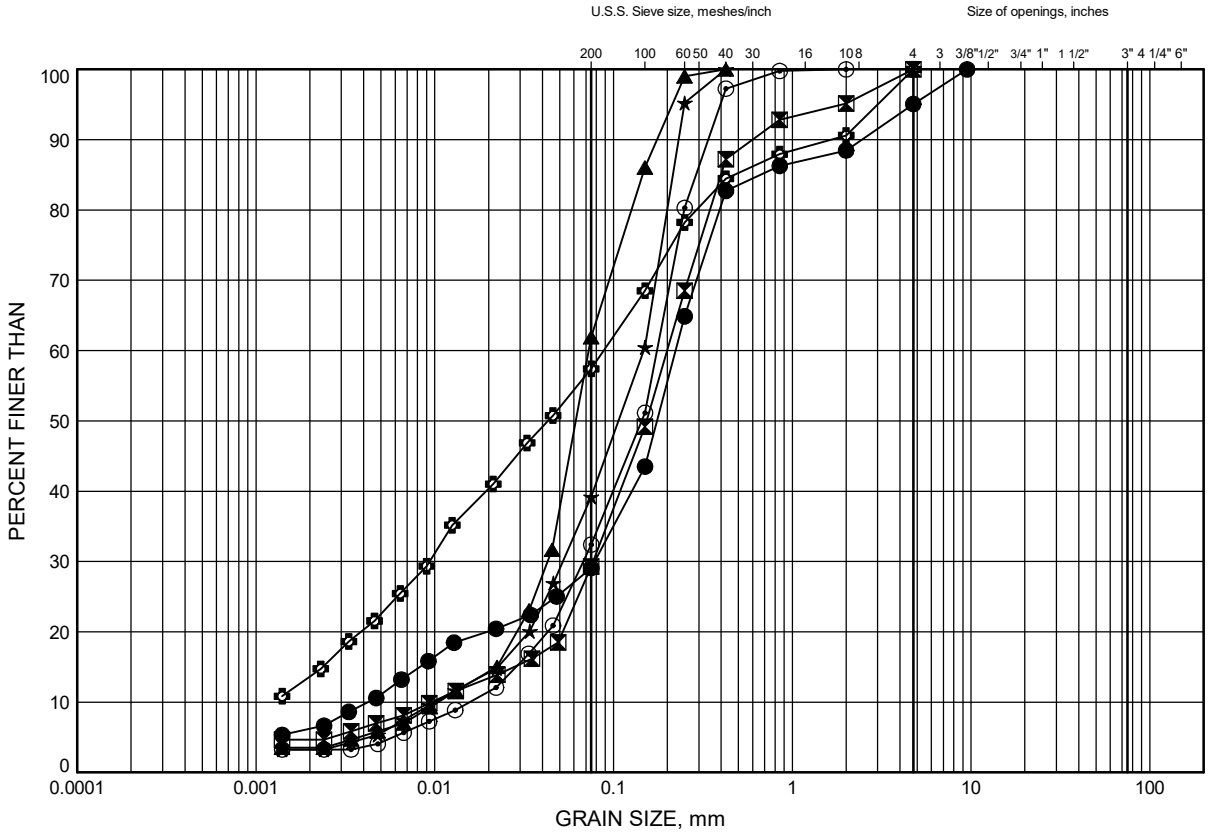
GRAIN SIZE DISTRIBUTION - THURBER MTO-12187.GPJ 3/30/17

HOT & HOT HMS Sign Supports

GRAIN SIZE DISTRIBUTION

FIGURE B3

Silty SAND to SAND and SILT



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	17-H01	1.83	337.77
⊠	17-H01	6.40	333.20
▲	17-H02	2.59	346.11
★	17-H02	4.88	343.82
⊙	17-H03	4.88	343.42
✿	17-H04	4.88	306.52

Date March 2017

W.P. 2085-13-00

THURBER

Prep'd MFA

Chkd. SKP

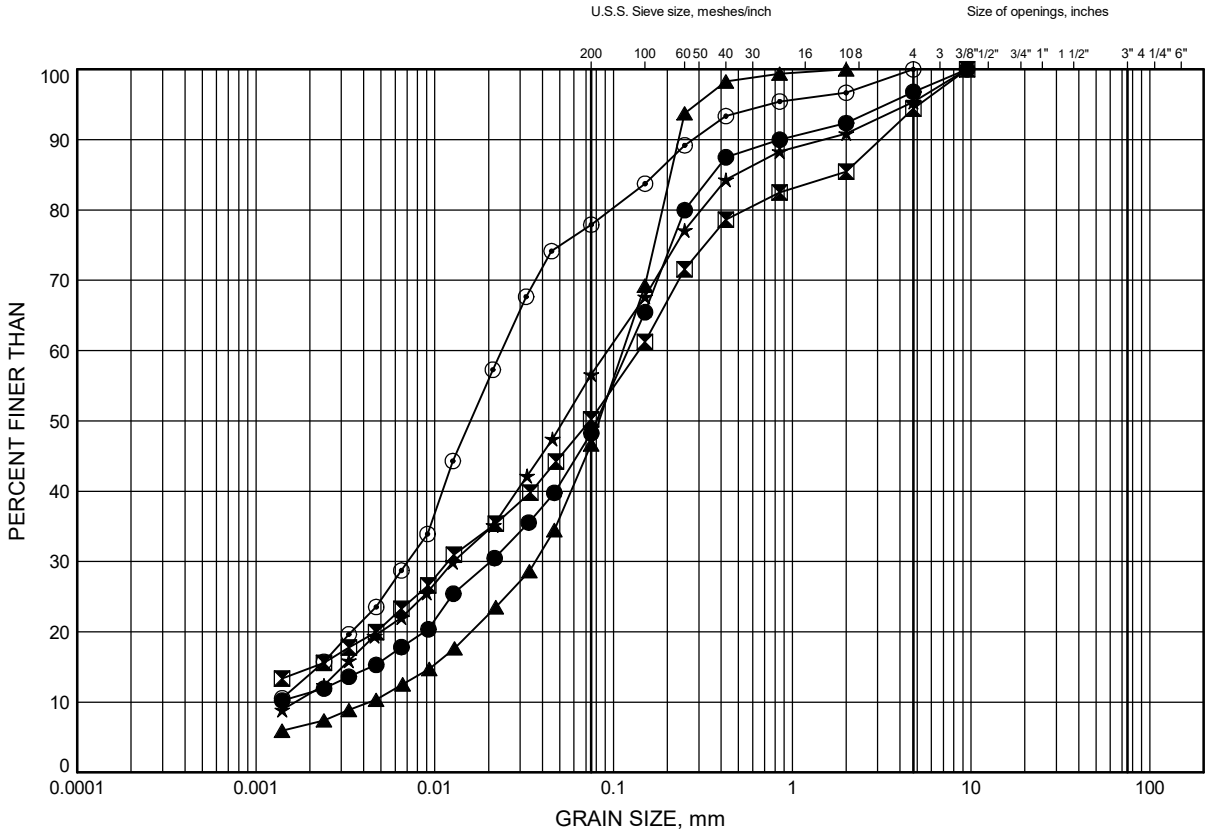
GRAIN SIZE DISTRIBUTION - THURBER MTO-12187.GPJ 3/30/17

HOT & HOT HMS Sign Supports

GRAIN SIZE DISTRIBUTION

FIGURE B4

Silty SAND to SAND and SILT



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	17-H05	3.35	304.05
⊠	17-H06	2.59	299.11
▲	17-H06	4.88	296.82
★	17-H07	4.88	278.82
⊙	17-H07	6.40	277.30

Date March 2017

W.P. 2085-13-00

THURBER

Prep'd MFA

Chkd. SKP

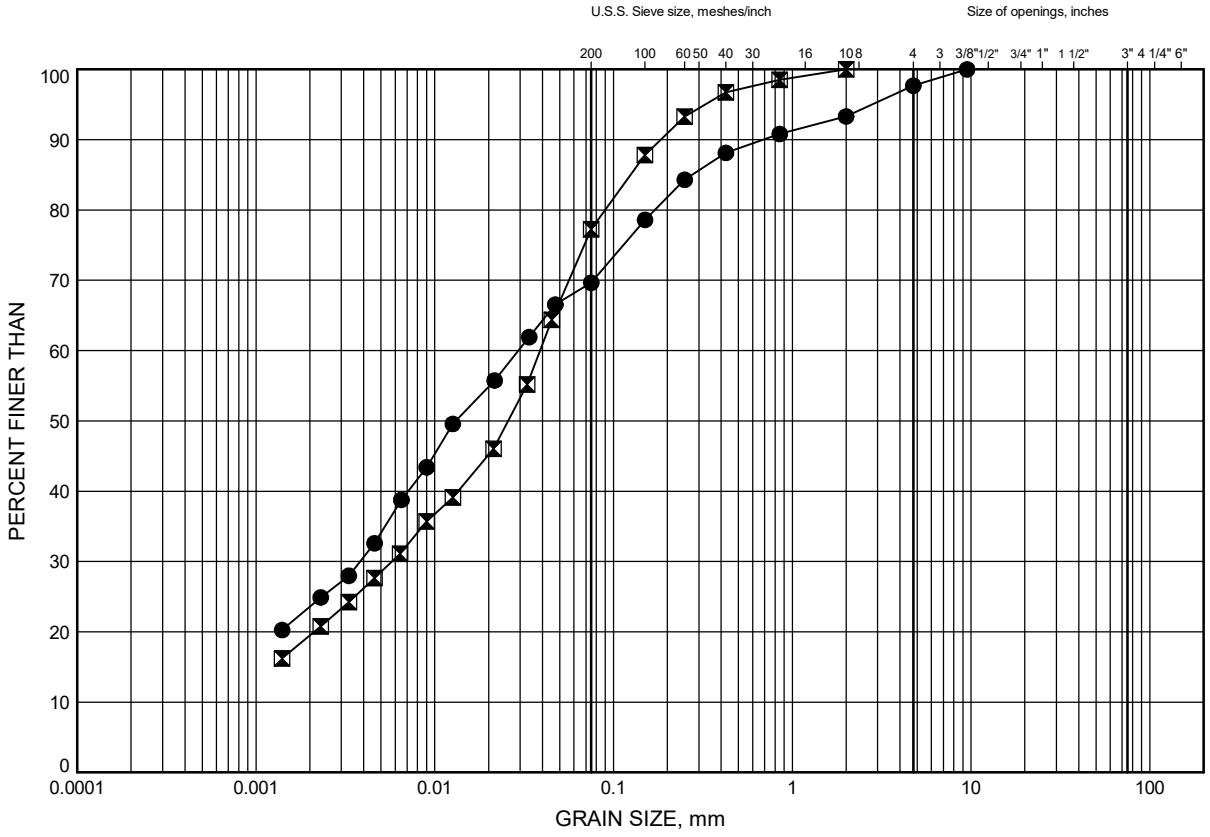
GRAIN SIZE DISTRIBUTION - THURBER MTO-12187.GPJ 3/30/17

HOT & HOT HMS Sign Supports

GRAIN SIZE DISTRIBUTION

FIGURE B5

Clayey SILT



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	17-H03	1.83	346.47
⊠	17-H04	3.35	308.05

Date March 2017

W.P. 2085-13-00

THURBER

Prep'd MFA

Chkd. SKP

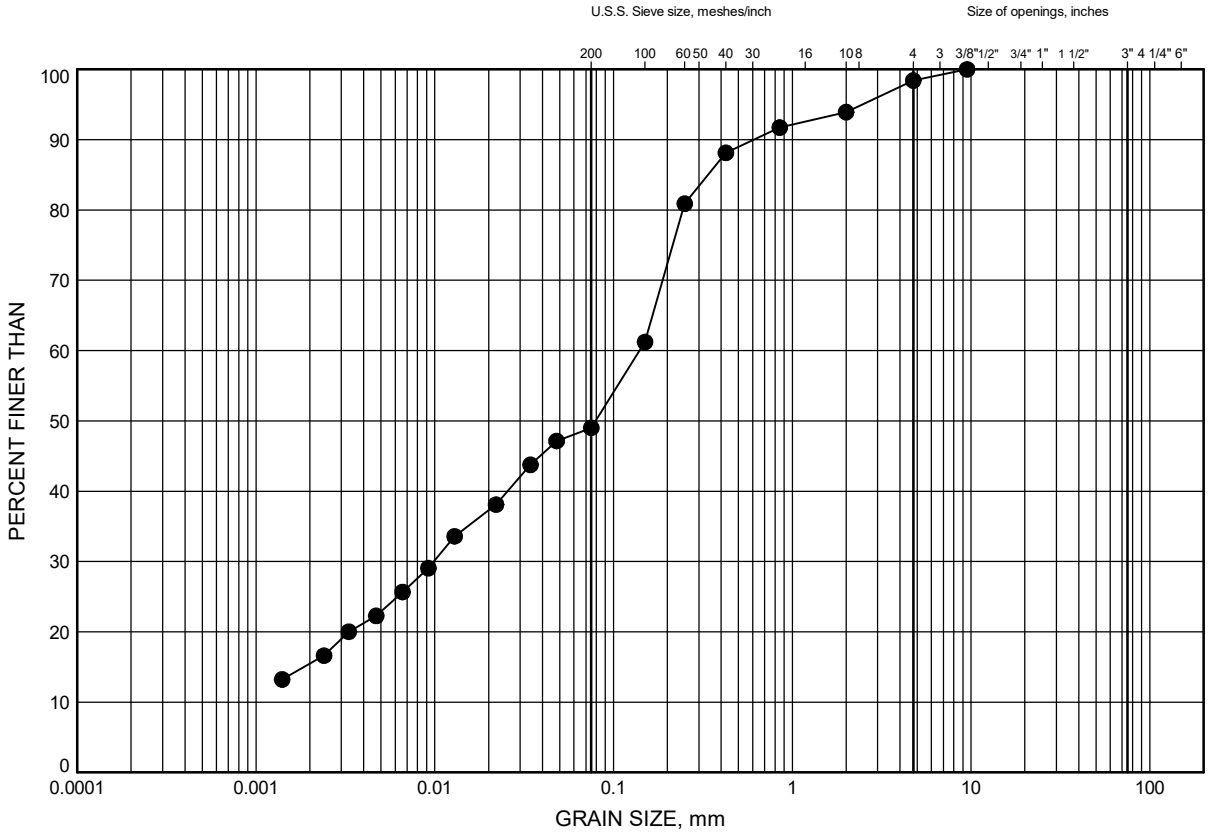
GRAIN SIZE DISTRIBUTION - THURBER MTO-12187.GPJ 3/30/17

HOT & HOT HMS Sign Supports

GRAIN SIZE DISTRIBUTION

FIGURE B6

Clayey SILT TILL



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	17-H05	4.88	302.52

Date March 2017

W.P. 2085-13-00

THURBER

Prep'd MFA

Chkd. SKP

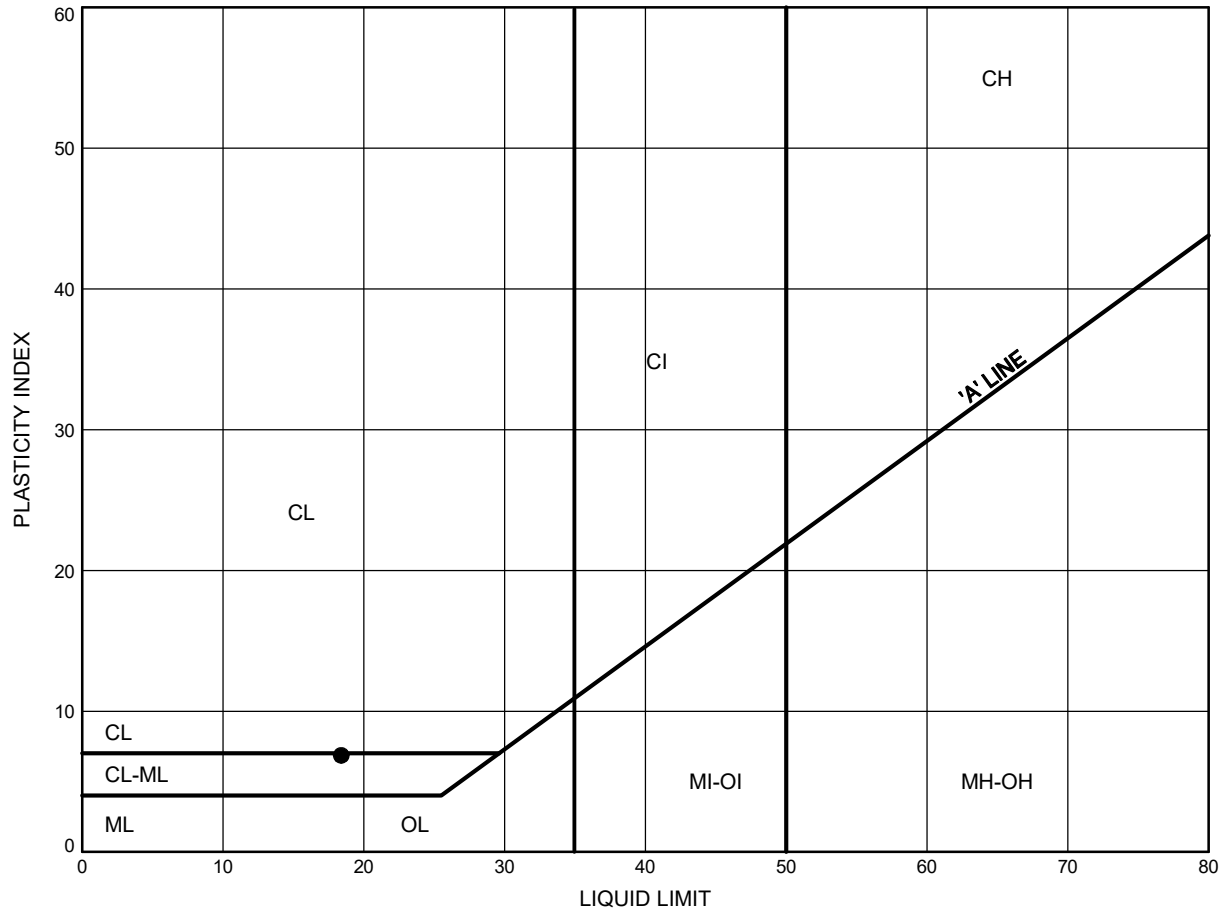
GRAIN SIZE DISTRIBUTION - THURBER MTO-12187.GPJ 3/30/17

HOT & HOT HMS Sign Supports

ATTERBERG LIMITS TEST RESULTS

FIGURE B7

Clayey SILT



LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	17-H03	1.83	346.47

Date March 2017

W.P. 2085-13-00

THURBER

Prep'd MFA

Chkd. SKP

THURBALT MTO-12187.GPJ 3/30/17

Appendix C

Record of Boreholes of

Previous Investigation

Golder Associates

RECORD OF BOREHOLE No C38-2

SHEET 1 OF 2

METRIC

PROJECT 09-1111-0018
G.W.P. 2835-02-00
DIST Central HWY 400
DATUM Geodetic
LOCATION N 4872639.6 ;E 298082.1
BOREHOLE TYPE D-90 Truck Mount, 108 mm Inner Diameter Hollow Stem Augers
DATE November 25 and 26, 2010
ORIGINATED BY SB
COMPILED BY TT/HS
CHECKED BY LCC

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	TYPE	"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 × REMOULDED; 20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (10 20 30)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
309.6	GROUND SURFACE										
0.0	Sand and silt, some clay, trace to some gravel (FILL) Loose to compact Brown Moist		1	SS	10		309				
			2	SS	12						
			3	SS	5		308				12 44 30 14
			4	SS	6		307				
306.6											
3.0	CLAYEY SILT, trace to some sand, trace organics to a depth of 3.7 m Stiff Brown and black to brown below 3.7 m Moist		5	SS	10		306				
			6	SS	11						0 8 54 38
			7	SS	11		305				
304.0											
5.6	SAND and SILT, trace clay, trace gravel Dense to very dense Brown Moist		8	SS	44	▽	304				
			9	SS	100		303				2 46 43 9
300.5							302				
9.1	SILT, some sand, trace clay Very loose to very dense Brown Wet		10	SS	WR		301				
			11	SS	41		300				
			12	SS	80		299				
			13	SS	67		298				0 18 78 4
							297				
							296				
							295				

Continued Next Page

$+^3$, $\times^3$: Numbers refer to Sensitivity $\circ^{3\%}$ STRAIN AT FAILURE

Golder Associates

PROJECT 09-1111-0018

RECORD OF BOREHOLE No C38-2

SHEET 2 OF 2

METRIC

G.W.P. 2835-02-00 LOCATION N 4872639.6 ;E 298082.1 ORIGINATED BY SB

DIST Central HWY 400 BOREHOLE TYPE D-90 Truck Mount, 108 mm Inner Diameter Hollow Stem Augers COMPILED BY TT/HS

DATUM Geodetic DATE November 25 and 26, 2010 CHECKED BY LCC

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 + FIELD VANE ● QUICK TRIAXIAL × REMOULDED) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%) (10 20 30)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	— CONTINUED FROM PREVIOUS PAGE —										
293.8	SILT, some sand, trace clay Very loose to very dense Brown Wet		14	SS	33		294		□		
15.9	END OF BOREHOLE										
	NOTE: 1. Water level in open borehole at a depth of 6.1 m (Elev. 303.5 m) upon completion of drilling.										

$+^3, \times^3$: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

Golder Associates

RECORD OF BOREHOLE No C40-2

SHEET 1 OF 1 **METRIC**

PROJECT 09-1111-0018
G.W.P. 2835-02-00 LOCATION N 4874318.3 ;E 297691.6 ORIGINATED BY TT
DIST Central HWY 400 BOREHOLE TYPE D-50 Track Mount, 108 mm Diameter Solid Stem Augers COMPILED BY SKB/HS
DATUM Geodetic DATE December 9, 2010 CHECKED BY LCC

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	TYPE	"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 × REMOULDED)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (10 20 30)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
292.2	GROUND SURFACE										
0.0	Organic silty sand, containing rootlets (FILL)		1A	SS	4		292				
0.3	Loose, Black, Moist		1B								
291.1	Clayey silt, some sand (FILL)		2A	SS	4						
1.1	Soft, Brown, Moist		2B			▽	291				
290.2	Sand and silt, trace gravel, trace clay, trace organics (FILL)		3A	SS	15						
2.0	Firm to stiff, Brown, Moist to wet		3B				290				
	SAND and SILT, trace to some gravel, trace clay, containing sand pockets (TILL)		4	SS	59						5 45 45 5
	Very dense, Brown to grey below 5.4 m, Moist		5	SS	104		289				16 41 40 3
	Augers grinding at a depth of 3.7 m		6	SS	100/.23		288				
			7	SS	100/.20						
							287				
285.9			8	SS	100/.18		286				3 41 49 7
6.3	END OF BOREHOLE										

NOTE:

1. Water level in open borehole at a depth of 1.4 m (Elev. 290.8 m) upon completion of drilling.

$+^3$, $\times^3$: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

Golder Associates

RECORD OF BOREHOLE No C5-6-3

SHEET 1 OF 1

METRIC

PROJECT 09-1111-0018
G.W.P. 2835-02-00
DIST Central HWY 400
DATUM Geodetic
LOCATION N 4873624.5 ;E 297880.6
BOREHOLE TYPE 200 mm O.D. Continuous Flight Hollow Stem Augers
DATE December 1 and 2, 2013
ORIGINATED BY RA
COMPILED BY HS/NK
CHECKED BY LCC

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	TYPE	"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 × REMOULDED) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (10 20 30)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
304.4	GROUND SURFACE						304				
0.0	ASPHALT (200 mm)										
303.8	Sand and gravel (FILL) Brown Moist		1	AS	-						
0.6	Sand, trace silt (FILL) Loose Brown Moist		2A 2B	SS	7		303				
303.3	Clayey silt with sand, trace gravel, containing organics and topsoil inclusions (FILL) Soft to stiff Brown Moist		3	SS	13						3 39 46 12
1.1			4	SS	3		302				
301.4											
3.0	CLAYEY SILT, trace to some sand, trace gravel Stiff Brown Moist		5	SS	12		301				
300.7											
3.7	CLAYEY SILT with sand, trace to some gravel (TILL) Very stiff to hard Brown becoming grey below 6.1 m Moist Augers grinding between depths of 5.0 m and 7.6 m		6	SS	18		300				
			7	SS	62						8 40 43 9
			8	SS	56		298				2 42 43 13
297.3											
7.1	SAND and SILT, trace clay, trace to some gravel Very dense Grey Moist to wet below 8.5 m		9	SS	50/0.13		297				
			10	SS	59		295				0 66 33 1
294.3											
10.1	SAND, trace to some silt Very dense Grey Wet		11	SS	81		294				
			12	SS	95/0.28		292				
291.8											
12.6	END OF BOREHOLE										

NOTE:

1. Borehole dry on completion of drilling.

$+^3$, $\times^3$: Numbers refer to Sensitivity $\circ^{3\%}$ STRAIN AT FAILURE

Golder Associates

RECORD OF BOREHOLE No LA4

SHEET 1 OF 2

METRIC

PROJECT 09-1111-0018
G.W.P. 2835-02-00
DIST Central HWY 400
DATUM Geodetic

LOCATION N 4873526.5 ;E 297904.2
BOREHOLE TYPE 210 mm Outside Diameter Continuous Flight Hollow Stem Auger, Wash Boring
DATE November 1-2, 2010

ORIGINATED BY TT
COMPILED BY SKB
CHECKED BY SMM

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (20 40 60 80 100): ○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × REMOULDED	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (10 20 30)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
304.8	GROUND SURFACE										
0.0 / 304.5	ASPHALT										
0.4	Sand, some silt, trace gravel, trace clay, containing clayey silt layers (FILL) Loose to compact Brown Moist		1	SS	12		304				
303.0			2	SS	4		303				
1.8	Clayey silt, trace to some sand, trace gravel (FILL) Firm Brown Moist		3	SS	5		302				2 11 54 33
301.6			4	SS	17						
3.2	SAND and SILT, trace gravel, trace clay (TILL) Compact to very dense Brown Moist		5	SS	61		301				6 49 39 6
			6	SS	101		300				
	- Containing sand pockets between the depths of 6.1 m and 6.7 m (Elev. 298.7 m and 298.1 m)		7	SS	84	▽	299				2 47 44 7
296.8			8	SS	53		298				
8.0	SAND, some silt, trace clay to SAND and SILT Very dense Brown Wet		9	SS	57		297				0 86 12 2
			10	SS	61		296				
			11	SS	101		295				
			12	SS	87		294				
290.0							293				
14.8							292				
							291				
							290				

Continued Next Page

$+^3, \times^3$: Numbers refer to Sensitivity $\circ^{3\%}$ STRAIN AT FAILURE

Golder Associates

RECORD OF BOREHOLE No LA4

SHEET 2 OF 2 **METRIC**

PROJECT 09-1111-0018
G.W.P. 2835-02-00 LOCATION N 4873526.5 ;E 297904.2 ORIGINATED BY TT
DIST Central HWY 400 BOREHOLE TYPE 210 mm Outside Diameter Continuous Flight Hollow Stem Auger, Wash Boring COMPILED BY SKB
DATUM Geodetic DATE November 1-2, 2010 CHECKED BY SMM

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 (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × REMOULDED)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	--- CONTINUED FROM PREVIOUS PAGE ---							20 40 60 80 100	10 20 30		
	CLAYEY SILT, trace to some sand, trace gravel Hard Grey Moist		13	SS	72		289				0 8 65 27
287.4			14	SS	87		288				
17.4	END OF BOREHOLE NOTE: 1. A hydrostatic head of water and drilling fluid was required inside the augers at a depth of 6.5 m below ground surface (Elev. 298.3 m) in order to advance the borehole due to "blowing " sands; water level could not be determined upon completion of drilling.										

$+^{3}, \times^{3}$: Numbers refer to Sensitivity $O^{3\%}$ STRAIN AT FAILURE

GTA-MTO 001 0911110018.GPJ GAL-GTA.GDT 11/22/12 SIB

THURBER

60 YEARS

Appendix D

Borehole Location Drawing

METRIC

DIMENSIONS ARE IN METRES AND FOR MILLIMETRES UNLESS OTHERWISE SHOWN

PLAN

80 0 80 160m

SCALE 1:4000

LICENSED PROFESSIONAL ENGINEER
P. N. CHATTERJI
May 11/17
PROVINCE OF ONTARIO

LICENSED PROFESSIONAL ENGINEER
S. PANG
35314509
May 11/17
PROVINCE OF ONTARIO

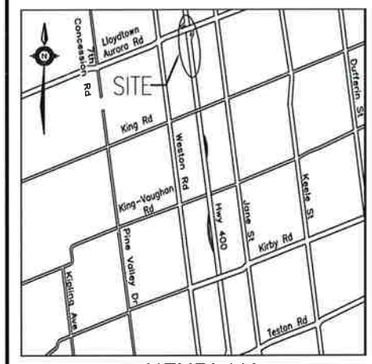
CONT No
WP No 2085–13–00

HIGHWAY 400
HOT AND HOT HMS
SIGN SUPPORTS
BOREHOLE LOCATIONS PLAN

SHEET

MMM GROUP

THURBER ENGINEERING LTD.



KEYPLAN

LEGEND

⊕	Borehole (Current Investigation By Thurber)
⊕	Borehole (Previous Investigation By Others)
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
17H–01	339.6	4 868 700.6	298 777.3
17H–02	348.7	4 868 404.8	298 827.4
17H–03	348.4	4 869 482.3	298 643.5
17H–04	311.4	4 872 296.9	298 161.5
17H–05	307.4	4 873 084.9	298 009.8
17H–06	301.7	4 873 930.8	297 806.1
17H–07	283.7	4 874 690.4	297 623.8
C38–2	309.6	4 872 639.6	298 082.1
C40–2	292.2	4 874 318.3	297 691.6
C5–6–3	304.4	4 873 624.5	297 880.6
LA4	304.8	4 873 526.5	297 904.2

-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. 30M13-220

REVISIONS		
DATE	BY	DESCRIPTION

DESIGN	RPR	CHK SKP	CODE	LOAD	DATE MAY 2017
DRAWN	AN	CHK RPR	SITE	STRUCT	DWG 1

FILENAME: H:\Drafting\12000\12187\TED-12187-BHPL-HGT.dwg
PLOTDATE: 5/5/2017 3:22 PM

THURBER

60 YEARS

Appendix E

List of Special Provisions

And

Suggested Text for NSSP

List of Special Provisions Referenced in this Report

OPSS 903

Suggested Text for NSSP on:

"Augered Caisson Construction for HOT and HOT HMS Support Foundations"

The Contractor is advised that variable types of subsurface materials may be encountered at the locations of the HOT and HOT HMS foundations. For additional information regarding subsurface conditions, the Contractor is referred to the Foundation Investigation Report.

For bidding purposes, the Contractor shall assume the following:

1. The subsurface conditions at an augered caisson location are the same as those encountered in the borehole closest to the subject caisson location.

2. Cobbles, boulders and rock fragments may be encountered within the glacial till deposits. Obstructions including rubble, cobbles and boulders may also be present within the embankment fills. The soil matrix is anticipated to become harder or denser with depth. Caisson installation equipment must be able to dislodge, handle, remove or otherwise penetrate these obstructions and hard/very dense layers.

3. Water seepage and/or soil sloughing into the caisson hole will occur from existing fill and cohesionless soils 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. All concrete should be placed in the dry. Should it be impractical to remove accumulated water in the caisson hole, consideration could be given to using the tremie technique to place the concrete.

The Contractor is responsible for constructing the HOT and HOT HMS foundations without disturbing the material at the sides or bases of the foundations.