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Subject: Foundation Investigation and Design Report
Highway 427 Expansion – (100% Submission)
Storm Water Management Ponds – Package 6, 7, 8

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1. INTRODUCTION

This report provides foundation recommendations for the design of the proposed Package 6, 7 and 8 storm water management ponds (SWMP) to be installed at selected locations along the new extension of Highway 427. The installation of SWMP constitutes part of the Highway 427 Expansion in the City of Vaughan, Ontario.

Recommendations on the foundation aspects of the SWMPs design presented in this report were based on the interpretation of the subsurface information collected during recently completed geotechnical investigation by Thurber Engineering Ltd (TEL).

The SWMP referenced in this report were numbered as follows:

- Package 6: Pond 1, Pond 2
- Package 7: Pond 3, Pond 4, Pond 5
- Package 8: Pond 6, Pond 7, Pond 8

The information on the locations of the proposed SWMPs, designed depths, base elevations and bank inclinations were obtained from WSP. The approximate locations and available design information on the SWMPs have been summarized in Tables 1, 2 and 3 following the text of this report. Comments related to slope stability and construction of the ponds are also included in the table.

It is a condition of this report that Thurber's performance of its professional services is subject to the attached Statement of Limitations and Conditions.

2. SITE DESCRIPTION AND GEOLOGY BACKGROUND

The SWMP sites of the proposed Highway 427 extension encompasses a 6.6 km section of the new alignment from Highway 7 to Major Mackenzie Drive in the City of Vaughan, Ontario. There are eight SWMPs located within the Package 6, 7 and 8 portions of the project (two in Package 6, three in Package 7, and three in Package 8). The locations of the SWMPs are shown on the Borehole Location Drawings in Appendix C. Lands surrounding the Package 6, 7 and 8 portion of the project alignment are used for a mixture of residential, agricultural, commerical and industrial purposes.

The project site is situated within the Peel Plain physiographic region which generally comprises clayey silt to silty clay Halton till with interlayers of sand and silt. Localized recent deposits of sands, silts and soft clays formed in small glacial meltwater ponds throughout the region may be encountered near the river and creek valleys. The site is underlain by shale bedrock of the Georgian Bay Formation with siltstone and limestone interbeds.

3. GEOTECHNICAL INVESTIGATION

The field investigation for the eight SWMPs, which are the subject of this report, consisted of eighteen sampled boreholes that were drilled as part of the larger investigation for the entire project. The boreholes were drilled between May 23, 2017 and July 21, 2017 and are summarized in the table below.

Pond Number	Borehole
1	P01 17-01, P01 17-02
2	P02 17-01, P02 17-02, P02 17-03
3	P03 17-01, P03 17-02
4	P04 17-01, P04 17-02, STM 17-27
5	P05 17-01, P05 17-02
6	P06 17-01, P06 17-02
7	P07 17-01, P07 17-02
8	P08 17-01, P08 17-02

Borehole coordinates and ground surface elevations at the borehole locations were provided by CJV.

Soil samples were obtained at selected intervals using a 50 mm nominal inner diameter split spoon sampler in conjunction with Standard Penetration Testing (SPT) procedures as per ASTM D1586. The drilling and sampling operations were supervised on a full-time basis by members of Thurber's technical staff. The supervisors logged the boreholes and processed the recovered soil samples for transport to Thurber's laboratory for further examination and testing.

Groundwater conditions were observed in the open boreholes throughout the drilling operations and upon completion of drilling. Monitoring wells were installed in selected boreholes, as detailed on the Record of Borehole sheets. Boreholes without piezometers have been decommissioned as per Ontario Reg. 903. After the final water level readings, the piezometers will be decommissioned in general accordance with Ontario Reg. 903.

The Record of Borehole sheets (which includes the approximate locations in MTM NAD 83, Zone 10 coordinates) are enclosed in Appendix A of this report. The locations of boreholes, as well as the proposed storm water management ponds are shown on the Borehole Location Plan enclosed in Appendix C.

At Pond 2, two boreholes drilled for the Langstaff Road Underpass (LR 17-02 and LR 17-04) were also relied upon to prepare this report.

4. SUBSURFACE CONDITIONS

A general description of the stratigraphy is given in the following paragraphs. However, the factual data presented on the Record of Borehole sheets takes precedence over this general description which was prepared for interpretation of the site conditions. Subsurface soil conditions may vary between and beyond borehole locations.

In general, the subsurface conditions at the eight SWMP locations consist of topsoil/organics and fill layers overlying, native clayey silt to silty clay overlying cohesive till. A layer of cohesionless till was encountered underlying the cohesive till at Ponds P1, P4 and P6. Occasional cobbles and boulders were reported in the till deposits.

Further descriptions of the various units are presented below.

4.1 Topsoil/Organics

Topsoil/organics, with a thickness ranging from 75 mm to 600 mm, was encountered at the ground surface in the boreholes drilled at all SWMPs except for Boreholes P02 17-01 and P02 17-03.

4.2 Fill

Fill consisting of sand and gravel with trace to some silt, trace rootlets, and occasional asphalt fragments was found in Boreholes P02 17-01 and P02 17-03 at ground surface. This fill extended to a depth of 0.9 m below ground surface (Elev. 187.6 m and 186.9 m). The SPT-N values within the fill ranged from 10 to 34 blows per 0.3 m of penetration indicating a compact to dense relative density.

4.3 Clayey Silt to Silty Clay

A 0.4 m to 2.0 m thick layer of clayey silt to silty clay containing trace to some sand, trace gravel was encountered at all ponds except Pond 2. Trace to some amounts of organic material and rootlets were found in some boreholes. The clayey silt to silty clay was found underlying the topsoil. This layer extended to depths ranging from 0.6 m to 2.1 m below the ground surface (Elev. 205.8 m to 180.1 m). The SPT N-values within this layer ranged from 4 to 14 blows per 0.3 m of penetration indicating a firm to stiff consistency.

4.4 Clayey Silt to Silty Clay Till

A cohesive till deposit described as clayey silt to silty clay containing trace sand to sandy, trace gravel, and occasional cobbles was encountered in all boreholes. The cohesive till was found either below the topsoil, sand and gravel fill or clayey silt to silty clay layer. Where fully penetrated, the cohesive till extended to depths of 5.3 to 7.2 m below ground surface (Elev. 197.2 m to 175.3 m).

The SPT-N values within the cohesive till ranged from 7 to 63 blows per 0.3 m of penetration indicating a firm to hard consistency, typically very stiff to hard. A cobble was encountered in Borehole P03 17-01 which accounts for the high SPT-N value of 50 blows per 100 mm of penetration recorded at 7.8m depth. Glacial till inherently contains cobbles and boulders.

The results of grain size analyses are presented on Figure B1 and B2 and the results of Atterberg Limits testing are presented on Figures B5 to B8 in Appendix B.

4.5 Silty Sand to Sandy Silt Till

A cohesionless till deposit described as silty sand to sandy silt till containing trace to some clay and trace to some gravel was encountered below the cohesive till in the Boreholes P01 17-01, P01 17-02, P04 17-02, P06 17-01 and P06 17-02. The top of the cohesionless till deposit was encountered at depths ranging between 5.3 and 7.2 m below the ground surface (Elev. 196.5 and 175.3 m). The sand and silt till was fully penetrated in Borehole P06 17-01 at a depth of 7.5m (Elev. 193.5 m)

The SPT-N values within the cohesionless till ranged from 25 blows per 0.3 m penetration to 50 blows per 0.075 m of penetration indicating a compact to very dense relative density.

The results of grain size analyses are presented on Figure B3.

4.6 Silty Clay

A layer of silty clay was encountered underlying the cohesive till in Borehole P08 17-02. The top of the silty clay was encountered at a depth of 7.2 m below the ground surface (Elev. 197.2 m).

An SPT N-values of 16 blows per 0.3 m of penetration was measured in this layer indicating a very stiff consistency.

The results of a grain size analysis are presented on Figure B4 and the results of Atterberg Limits testing are presented on Figure B9 in Appendix B.

4.7 Groundwater Conditions

Groundwater levels were observed in open boreholes and upon completion of drilling. Water levels measured in the installed monitoring wells are summarized in Table 4.1.

Table 4-1 – Measured Groundwater Levels

Pond Number	Borehole	Date	Water Level (m)	
			Depth	Elevation
1	P01 17-01	October 25, 2017	1.4	180.1
2	P02 17-01	June 19, 2017 July 10, 2017 October 18, 2017	0.6 0.4 2.3	187.9 188.1 186.2
2	P02 17-03	June 19, 2017 October 18, 2017	0.2 2.1	187.6 185.7
3	P03 17-02	June 19, 2017 October 20, 2017	4.3 3.2	185.5 186.6
4	P04 17-02	June 19, 2017 July 11, 2017 October 23, 2017	1.4 1.0 2.3	191.4 191.8 190.5
5	P05 17-01	June 29, 2017 October 23, 2017	0.7 1.9	195.8 194.6
6	P06 17-02	June 29, 2017 October 23, 2017	2.0 4.0	199.8 197.8
7	P07 17-01	July 10, 2017 October 23, 2017	7.5 2.0	198.3 203.8
8	P08 17-02	June 29, 2017 October 23, 2017	7.3 1.9	197.1 202.5

The above water levels are short-term readings and seasonal fluctuations of the groundwater level are to be expected. The groundwater level may be at a higher elevation after the spring snowmelt or after periods of heavy rainfall. Further, perched water may be encountered at higher levels in zones of more permeable sands and silts to be expected within the heterogeneous tills, or within the embankment fill.

5. ENGINEERING DISCUSSION AND RECOMMENDATIONS

5.1 Storm Water Management Ponds

The proposed SWMP locations, bank inclinations and base elevations were provided by WSP, and are listed in Tables 1, 2 and 3, that follows the text of the report. A summary of the subsurface conditions (simplified soil stratigraphy) encountered at each SWMP location, groundwater levels and comments on slope stability are also provided in Tables 1, 2 and 3. We understand that all Ponds within the limits of the Packages 6, 7 and 8 areas are being designed as dry ponds.

This report addresses only geotechnical aspects of the SWMPs and the associated inlet and outlet structures, including description of the soil and groundwater conditions and comments on stability of the pond banks and bases. Comments on construction are provided only when they may impact the design of the ponds.

5.1.1 Temporary Excavation and Groundwater Control

Based on the borehole data, excavations for the SWMPs will extend through the topsoil/organics, fill (where present), native clayey silt to silty clay and into the cohesive till deposit. The soil stratigraphy in the pond areas and groundwater observations are summarized in Tables 1, 2 and 3.

All temporary excavation should be carried out in accordance with the current Occupational Health and Safety Act (OHSA) of Ontario, and local regulations. The sand and gravel fill and the clayey silt to silty clay can be classified as Type 3 soils. The cohesive till where very stiff or hard is classified as a Type 2 soil and where firm to stiff is classified as a Type 3 soil. Temporary excavation should be sloped as per OHSA regulations based on the soil types presented above.

Use of a hydraulic excavator should be suitable for pond excavation in the fill and native soils. Provision should be made for handling of topsoil, possible obstructions in the fill, and cobbles and boulders in the till during excavation.

Excavation slopes should be inspected during construction on a regular basis for any signs of instability, especially following periods of heavy rain, spring thaw, or when the excavation has been left open for an extended period. Any sloughing should be remediated by slope flattening or provision of gravel sheeting.

At Pond 2 the excavation will extend to approximately 7 m below the measured groundwater level mostly through relatively low permeability cohesive till. At this pond location, local dewatering from within the excavation with sumps and pumps is considered feasible. However, due to the depth of excavation below the groundwater table, additional pumps may be required to handle the groundwater seepage. Some additional seepage should be expected from sand and silt seams and more permeable zones in the cohesive till. Water seepage from granular fill should also be anticipated.

At Ponds 1, 3, 4, 5, 6, 7, and 8 the excavations will extend up to a few metres below the measured groundwater level through relatively low permeability cohesive till. At these pond locations, local dewatering from within the excavation with sumps and pumps is also considered feasible. Some additional seepage should be expected from sand and silt seams and more permeable zones in the cohesive till. Water seepage from granular fill that may be encountered around existing utilities should also be anticipated.

Surface runoff and any temporary water course, if present, should be diverted away from all excavations.

Dewatering operations should be in accordance with OPSS 517 (Construction Dewatering) and OPSS 518 (Control of Water from Dewatering Operations).

5.1.2 Slope Stability

Current plans show SWMP slopes ranging from inclinations of 2:1 to 4:1 horizontal to vertical. Limit equilibrium stability analysis was performed to assess the stability of the slopes of selected critical ponds using the commercially available program Slope/w, employing Morgenstern-Price method of analysis. Proposed pond slope inclination, the pond depth, and the soil and groundwater conditions were used as the criteria to select the most critical ponds for analysis. All of these criteria are summarized in Tables 1, 2 and 3 included at the end of the text of this report. Based on these criteria Ponds 2 and 7 were selected for analysis. Results of the analysis are provided on Figures 1 to 4 in Appendix D.

Results of the analyses indicate that adequate factors of safety (greater than 1.3 under short-term conditions (undrained), and greater than 1.5 under long-term conditions (drained) can be maintained for global stability in both the cases analysed for Ponds 2 and 7. Based on the results of the slope stability analysis for Ponds 2 and 7, the slopes of Ponds 1, 3, 4, 5, 6 and 8 are assumed to be stable as they were assessed to be less critical based on the criteria outlined in the paragraph above.

5.1.3 Basal Stability

As measured groundwater levels in the cohesionless till deposits are above the proposed base of the ponds, basal stability of the excavations was considered. However due to the relatively low permeability of the cohesive till at the base of the ponds, and the presence of a thick layer of very stiff to hard cohesive till below the base of the excavation and above the cohesionless till, basal stability is not considered to be an issue at these locations.

5.1.4 Pond Design

It is understood that all the ponds are designed to be dry ponds. The design drawings indicate that a clay liner will be installed in these ponds. For design purposes, the following hydraulic conductivity may be assumed:

- Clayey silt to silty clay till: 10^{-6} cm/s

For geotechnical design recommendations related to pond liner design refer to Memorandum No. MEM-253 dated May 15, 2019.

5.1.5 Erosion Control

Provision of erosion protection for the pond banks will be critical for surficial stability of the pond slopes. Erosion protection will also be required at the storm sewer outlets discharging into ponds. Design of the erosion protection measures should consider hydrologic, hydraulic and environmental concerns and should be carried out by specialists experienced in this field.

Rip-rap may be provided over all surfaces with which flow from the storm sewer is likely to be in contact. Typically, treatment at the outlets should be in accordance with OPSD 810.010. A vegetation cover should be established on all other exposed earth surfaces to protect against surficial erosion, in general accordance with OPSS 804.

5.2 Inlet and Outlet Structures

Foundation recommendations are made with reference to the 90% Pond drawings dated January 25, 2019 for SWMPs included in Packages 6 and 8 and with reference to the 50% Pond drawings dated January 21, 2019 for

SWMPs included in Package 7. Recommendations are for inlet and outlet structures consisting of manholes and headwalls.

5.2.1 Geotechnical Resistances

The recommended factored geotechnical resistances for the inlet and outlet structures founded at the proposed base elevations are summarized below.

Pond Number	Approx. Base Elevation (m)		Bearing Stratum	Factored Geotechnical Resistance (kPa)	
	Inlet Structure	Outlet Structure		ULS	SLS
1	-	177.5 – 178.0	Hard Clayey Silt to Silty Clay Till	450	300
2	-	177.5 – 178.5	Very Stiff Clayey Silt to Silty Clay Till	250	150
3	-	185.5 – 186.0	Stiff to Very Stiff Clayey Silt to Silty Clay Till	250	150
4	-	188.0 – 189.0	Very Stiff Clayey Silt to Silty Clay Till	250	150
5	-	190.5 – 192.0	Very Stiff Clayey Silt to Silty Clay Till	250	150
6	-	196.0 – 196.5	Stiff to Very Stiff Clayey Silt to Silty Clay Till	250	150
7	-	199.5 – 201.0	Stiff Clayey Silt to Silty Clay Till	200	125
8	-	200.0 – 198.5	Stiff to Very Stiff Clayey Silt to Silty Clay Till	250	150

The value of the factored Geotechnical Resistance at SLS given above is for up to 25 mm of settlement. The recommended geotechnical resistances are based on a minimum 3 m wide footing subjected to vertical, concentric loading. In the case of eccentric or inclined loading, the geotechnical resistances should be modified as indicated in the CHBDC (2014) Clause 6.10.3 and Clause 6.10.4.

5.2.2 Backfill to Headwalls

Backfill to the concrete headwalls should be Granular A or Granular B Type II material meeting the requirements of OPSS.PROV 1010. The backfill should be in accordance with OPSS 902. Compaction equipment to be used adjacent to headwalls should be restricted in accordance with OPSS 501.

5.2.3 Lateral Earth Pressure

Lateral earth pressures acting on the headwalls may be assumed to be triangular and to be governed by the characteristics of the backfill. For a fully drained condition, the pressures should be computed in accordance with the CHBDC but are generally given by the expression:

$$Ph = K * (\gamma h + q)$$

Where:

Ph = horizontal pressure on the wall at depth h (kPa)

K = lateral earth pressure coefficient
γ = unit weight of retained soil (kN/m3)
h = depth below the top of fill where the pressure is computed (m)
q = value of any surcharge (kPa)

In accordance with Clause 6.12.3 of the CHBDC (2014), a compaction surcharge should be added.
Earth pressure coefficients for backfill to the headwalls are dependent on properties of the backfill. Typical values are shown in the table below.

Loading Condition	OPSS Granular A or Granular B Type II ϕ = 35°, γ = 22.8 kN/m3		OPSS Granular B Type I or Type III ϕ = 32°, γ = 21.2 kN/m3	
	Horizontal Backfill	Sloping Backfill (2H:1V)	Horizontal Backfill	Sloping Backfill (2H:1V)
Active (Ka) (Unrestrained Wall)	0.27	0.38	0.31	0.46
Passive (Kp)	3.7	-	3.3	-
At-rest (K_0) (Restrained Wall)	0.43	0.62	0.47	0.68

The coefficient of earth pressure at-rest (K_0) should be used for restrained headwalls and the active earth pressure coefficient (Ka) should be used for unrestrained headwalls. The passive resistance of the soil within the frost depth should be neglected when checking lateral stability (sliding and overturning) of the headwalls.

It is recommended that the walls be designed to be free-draining and include a subdrain.

5.2.4 Temporary Excavation and Groundwater Control

Excavations for the outlet and inlet structures will penetrate through the topsoil, fill (where present), native clayey silt to silty clay and into the cohesive till deposits. For the purposes of the OHSA, the sand and gravel fill and the clayey silt to silty clay can be classified as Type 3 soils. The cohesive till where very stiff or hard is classified as a Type 2 soil and where firm to stiff is classified as a Type 3 soil. Temporary excavation should be sloped as per OHSA regulations based on the soil types presented above. Flatter slopes may be required at locations where the soils are less competent or where water seepage affects surficial stability. The native till may contain cobbles and boulders.

The excavation and backfilling for the structures should be carried out in accordance with OPSS 902.

Given the consistency and relatively low permeability of the silty clay/clayey silt soils, groundwater control measures such as pumping from filtered sumps may be sufficient to remove any accumulation of water from the excavation and lower the groundwater table to below the base of excavation.

The excavations are expected to extend below the groundwater table at the ponds. The excavations will extend mostly through relatively low permeability cohesive till. Given the consistency and relatively low permeability of the silty clay/clayey silt, groundwater control measures such as perimeter ditches and pumping from filtered sumps

should be sufficient to remove any accumulation of surface water from run-offs and perched water. However, some groundwater inflow into the excavations should be expected through the more permeable sand interlayers.

The structure installations should be carried out in the dry. Clayey silt to silty clay till subgrade should be covered as soon as practical upon exposure and be protected from any disturbances that may weaken the material.

5.2.5 Subgrade Preparation for Structures

After the foundation excavation reaches the design subgrade level, the exposed surface should be inspected to confirm that the subgrade is suitable and uniformly competent. Any topsoil/organics, disturbed soils, loose/soft deposits and deleterious materials within the structure footprint must be removed and replaced with suitable earth material compacted as per OPSS.PROV 501.The work should be carried out in accordance with OPSS PROV 902 and construction should be carried out in the dry.

A minimum 300 mm thick layer of bedding material conforming to OPSS.PROV 1010 Granular A or Granular B Type II requirements should be provided under the base of the manholes, headwalls, and pipes, as shown on OPSD 803.010. The bedding material should be placed on the prepared subgrade as soon as practicable following its inspection and approval. Given size of inlet and outlet structure excavation and time required for construction, appropriate measures should be taken to minimize the subgrade disturbance from construction traffic and weather elements.

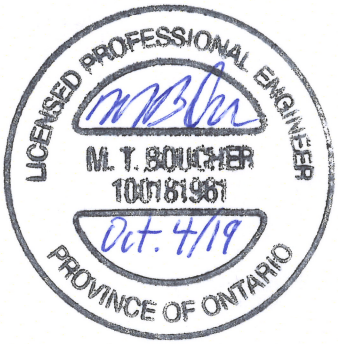
Construction equipment should not be allowed to travel on the bedding or the prepared subgrade, which should be protected from disturbance during construction.

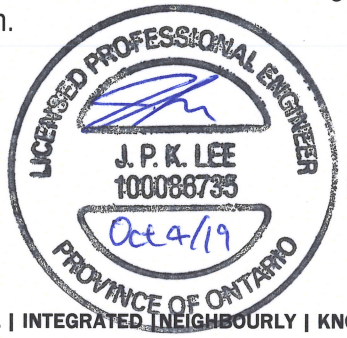
Resistance to lateral forces/sliding between concrete inlet and outlet structures and the underlying bedding material should be evaluated assuming an unfactored ultimate coefficient of friction of 0.5.

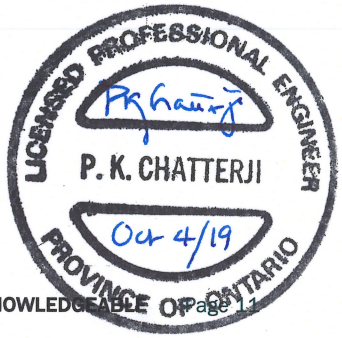
6. CONSTRUCTION CONCERNS

Potential construction concerns identified for this project include the following:

- Glacial deposit inherently contains cobbles and boulders, and any fill may contain similar obstructions. The selected equipment and methodology should be adequate to handle such obstructions.
- Groundwater control will be required for construction of SWMP. Sump pumping is expected to effectively control groundwater inflow at the ponds. Surface runoff must be always diverted away from excavations.
- Prior to excavation for the pond construction, the locations and depths of the existing underground utilities should be confirmed. Relocation of the existing underground utilities may be required.
- Prior to excavating Pond 2 to the final design elevation, we recommend excavating a test pit to confirm the ground conditions at the elevation of the pond bottom.







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This Report has been prepared in accordance with generally accepted engineering or environmental consulting practices in the applicable jurisdiction. No other warranty, expressed or implied, is intended or made.

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All documents, records, data and files, whether electronic or otherwise, generated as part of this assignment are a part of the Report, which is of a summary nature and is not intended to stand alone without reference to the instructions given to Thurber by the Client, communications between Thurber and the Client, and any other reports, proposals or documents prepared by Thurber for the Client relative to the specific site described herein, all of which together constitute the Report.

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a) Nature and Exactness of Soil and Contaminant Description: Classification and identification of soils, rocks, geological units, contaminant materials and quantities have been based on investigations performed in accordance with the standards set out in Paragraph 1. Classification and identification of these factors are judgmental in nature. Comprehensive sampling and testing programs implemented with the appropriate equipment by experienced personnel may fail to locate some conditions. All investigations utilizing the standards of Paragraph 1 will involve an inherent risk that some conditions will not be detected and all documents or records summarizing such investigations will be based on assumptions of what exists between the actual points sampled. Actual conditions may vary significantly between the points investigated and the Client and all other persons making use of such documents or records with our express written consent should be aware of this risk and the Report is delivered subject to the express condition that such risk is accepted by the Client and such other persons. Some conditions are subject to change over time and those making use of the Report should be aware of this possibility and understand that the Report only presents the conditions at the sampled points at the time of sampling. If special concerns exist, or the Client has special considerations or requirements, the Client should disclose them so that additional or special investigations may be undertaken which would not otherwise be within the scope of investigations made for the purposes of the Report.

b) Reliance on Provided Information: The evaluation and conclusions contained in the Report have been prepared on the basis of conditions in evidence at the time of site inspections and on the basis of information provided to Thurber. Thurber has relied in good faith upon representations, information and instructions provided by the Client and others concerning the site. Accordingly, Thurber does not accept responsibility for any deficiency, misstatement or inaccuracy contained in the Report as a result of misstatements, omissions, misrepresentations, or fraudulent acts of the Client or other persons providing information relied on by Thurber. Thurber is entitled to rely on such representations, information and instructions and is not required to carry out investigations to determine the truth or accuracy of such representations, information and instructions.

c) Design Services: The Report may form part of design and construction documents for information purposes even though it may have been issued prior to final design being completed. Thurber should be retained to review final design, project plans and related documents prior to construction to confirm that they are consistent with the intent of the Report. Any differences that may exist between the Report's recommendations and the final design detailed in the contract documents should be reported to Thurber immediately so that Thurber can address potential conflicts.

d) Construction Services: During construction Thurber should be retained to provide field reviews. Field reviews consist of performing sufficient and timely observations of encountered conditions in order to confirm and document that the site conditions do not materially differ from those interpreted conditions considered in the preparation of the report. Adequate field reviews are necessary for Thurber to provide letters of assurance, in accordance with the requirements of many regulatory authorities.

6. RELEASE OF POLLUTANTS OR HAZARDOUS SUBSTANCES

Geotechnical engineering and environmental consulting projects often have the potential to encounter pollutants or hazardous substances and the potential to cause the escape, release or dispersal of those substances. Thurber shall have no liability to the Client under any circumstances, for the escape, release or dispersal of pollutants or hazardous substances, unless such pollutants or hazardous substances have been specifically and accurately identified to Thurber by the Client prior to the commencement of Thurber's professional services.

7. INDEPENDENT JUDGEMENTS OF CLIENT

The information, interpretations and conclusions in the Report are based on Thurber's interpretation of conditions revealed through limited investigation conducted within a defined scope of services. Thurber does not accept responsibility for independent conclusions, interpretations, interpolations and/or decisions of the Client, or others who may come into possession of the Report, or any part thereof, which may be based on information contained in the Report. This restriction of liability includes but is not limited to decisions made to develop, purchase or sell land.

TABLE 1
STORM WATER MANAGEMENT PONDS (SWMP) – PACKAGE 6
HIGHWAY 427 EXTENSION
SUMMARY OF SUBSURFACE CONDITIONS AND DESIGN REQUIREMENTS

SWM Pond Designation	Location	Relevant Boreholes	Ground Surface Elevation (m)	Borehole Depth (m)	Simplified Soil Stratigraphy	Soil Strata Depth Below Existing Grade (m)		Ground Water Level Depth/Elevation (m)		SWMP Design Details		Comments on Slope Stability	Comments on Construction
						Top	Bottom	Upon Completion Borehole	In Piezometer	Depth / Base Elevation (m)	Pond Bank Slope		
1 (Dry Pond)	East of Hwy 427 / North of Hwy 7	P01 17-01 P01 17-02	181.5 180.9	7.8 8.0	Topsoil Clayey Silt – stiff Clayey Silt / Silty Clay Till – v. stiff to hard Sandy Silt Till – v. dense	0.0 0.1 0.8 5.6	0.1 0.8 5.6 Not fully penetrated	Both dry	1.4 / 180.1	~4.5 / 178.3	4:1	- No global stability concerns anticipated for design bank slopes. - We recommend that the pond be excavated prior to fill placement for embankment widening.	- Water inflow to the pond should be expected.
2 (Dry Pond)	East of Ramp N-EW at Langstaff Rd	P02 17-01 P02 17-02 P02 17-03 LR 17-02 LR 17-04	188.5 187.7 187.8 188.2 188.2	8.2 8.2 8.2 27.3 27.4	Topsoil/Organics Sand and Gravel Fill – compact to dense Clayey Silt/ Silty Clay Till – stiff to hard Sand and Silt Till – very dense Shale Bedrock	0.0 0.0 0.6 / 0.9 22.1 23.2	0.6 0.9 22.1 23.2 Not fully penetrated	All dry	2.3 / 186.2 2.1 / 185.7 5.5 / 182.7 5.4 / 182.8	~10.0 / 178.5	2:1 to 4:1	- No global stability concerns anticipated for design bank slopes.	- Water inflow to the pond should be expected.

Notes :
1. Approximate borehole locations are shown on the Borehole Location Plan (attached); borehole coordinates (northings and eastings) are provided on the Record of Borehole sheets.
2. This table should be read in conjunction with the text of the report.

TABLE 2
STORM WATER MANAGEMENT PONDS (SWMP) – PACKAGE 7
HIGHWAY 427 EXTENSION
SUMMARY OF SUBSURFACE CONDITIONS AND DESIGN REQUIREMENTS

SWM Pond Designation	Location	Relevant Boreholes	Ground Surface Elevation (m)	Borehole Depth (m)	Simplified Soil Stratigraphy	Soil Strata Depth Below Existing Grade (m)		Ground Water Level Depth/Elevation (m)		SWMP Design Details		Comments on Slope Stability	Comments on Construction
						Top	Bottom	Upon Completion Borehole	In Piezometer	Depth / Base Elevation (m)	Pond Bank Slope		
3 (Dry Pond)	East of Hwy 427 / North of Langstaff Rd	P03 17-01 P03 17-02	189.8 189.8	7.9 8.2	Topsoil Silty Clay – firm Clayey Silt / Silty Clay Till – stiff to hard	0.0 0.2 0.6	0.2 0.6 Not fully penetrated	Both dry	3.2 / 186.6	~3.8 / 186.2	3:1 to 4:1	- No global stability concerns anticipated for design bank slopes.	- Water inflow to the pond should be expected.
4 (Dry Pond)	East of Ramp S-EW at Rutherford Rd	P04 17-01 P04 17-02 STM 17-27	191.7 192.8 192.2	8.2 8.2 6.7	Topsoil Silty Clay – firm Clayey Silt / Silty Clay Till – v. stiff to hard Silty Sand Till –dense	0.0 0.1 0.7 7.2	0.1 0.7 7.2 / Not fully penetrated Not fully penetrated	7.3 / 185.5	2.3 / 190.5	~3.8 / 189.2	3:1 to 4:1	- No global stability concerns anticipated for design bank slopes.	- Water inflow to the pond should be expected.
5 (Dry Pond)	West of Ramp N-EW at Rutherford Rd	P05 17-01 P05 17-02	196.5 196.8	8.2 8.2	Topsoil Silty Clay – firm Clayey Silt / Silty Clay Till – v. stiff to hard	0.0 0.2 0.7	0.2 0.7 Not fully penetrated	6.4 / 190.4	1.9 / 194.6	~4.5 / 192.0	4:1	- No global stability concerns anticipated for design bank slopes.	- Water inflow to the pond should be expected.

Notes : 1. Approximate borehole locations are shown on the Borehole Location Plan (attached); borehole coordinates (northings and eastings) are provided on the Record of Borehole sheets.
2. This table should be read in conjunction with the text

TABLE 3
STORM WATER MANAGEMENT PONDS (SWMP) – PACKAGE 8
HIGHWAY 427 EXTENSION
SUMMARY OF SUBSURFACE CONDITIONS AND DESIGN REQUIREMENTS

SWM Pond Designation	Location	Relevant Boreholes	Ground Surface Elevation (m)	Borehole Depth (m)	Simplified Soil Stratigraphy	Soil Strata Depth Below Existing Grade (m)		Ground Water Level Depth/Elevation (m)		SWMP Design Details		Comments on Slope Stability	Comments on Construction
						Top	Bottom	Upon Completion Borehole	In Piezometer	Depth / Base Elevation (m)	Pond Bank Slope		
6 (Dry Pond)	East of Hwy 427 / South of McGillivray Rd	P06 17-01 P06 17-02	201.0 201.8	8.2 8.2	Topsoil Silty Clay – firm Clayey Silt / Silty Clay Till – stiff to v. stiff Sand and Silt Till – compact to v. dense Clayey Silt / Silty Clay Till – stiff	0.0 0.1 / 0.2 0.7 5.3 / 6.4 7.5	0.1 / 0.2 0.7 5.3 / 6.4 7.5 / Not fully penetrated Not fully penetrated	7.3 / 194.5	4.0 / 197.8	~5.5 / 196.3	3:1 to 4:1	- No global stability concerns anticipated for design bank slopes.	- Water inflow to the pond should be expected.
7 (Dry Pond)	East of Hwy 427 / North of Hwy 7	P07 17-01 P07 17-02	205.8 206.6	8.2 8.2	Topsoil Clayey Silt – firm Clayey Silt / Silty Clay Till – stiff to v. stiff	0.0 0.1 0.8	0.1 0.8 Not fully penetrated	Both dry	2.0 / 203.8	~5.7 / 200.9	3:1 to 4:1	- No global stability concerns anticipated for design bank slopes.	- Water inflow to the pond should be expected.
8 (Dry Pond)	North of SW Ramp at Major Mackenzie Dr / West of Huntington Rd	P08 17-01 P08 17-02	204.7 204.4	8.2 8.2	Topsoil Clayey Silt – firm to stiff Clayey Silt / Silty Clay Till – stiff to hard Silty Clay – v. stiff	0.0 0.2 1.1 7.2	0.2 1.1 / 2.1 7.2 / Not fully penetrated Not fully penetrated	Both dry	1.9 / 202.5	~4.8 / 199.9	4:1	- No global stability concerns anticipated for design bank slopes.	- Water inflow to the pond should be expected.

Notes : 1. Approximate borehole locations are shown on the Borehole Location Plan (attached); borehole coordinates (northings and eastings) are provided on the Record of Borehole sheets.
2. This table should be read in conjunction with the text

THURBER

STATEMENT OF LIMITATIONS AND CONDITIONS

1. STANDARD OF CARE

This Report has been prepared in accordance with generally accepted engineering or environmental consulting practices in the applicable jurisdiction. No other warranty, expressed or implied, is intended or made.

2. COMPLETE REPORT

All documents, records, data and files, whether electronic or otherwise, generated as part of this assignment are a part of the Report, which is of a summary nature and is not intended to stand alone without reference to the instructions given to Thurber by the Client, communications between Thurber and the Client, and any other reports, proposals or documents prepared by Thurber for the Client relative to the specific site described herein, all of which together constitute the Report.

IN ORDER TO PROPERLY UNDERSTAND THE SUGGESTIONS, RECOMMENDATIONS AND OPINIONS EXPRESSED HEREIN, REFERENCE MUST BE MADE TO THE WHOLE OF THE REPORT. THURBER IS NOT RESPONSIBLE FOR USE BY ANY PARTY OF PORTIONS OF THE REPORT WITHOUT REFERENCE TO THE WHOLE REPORT.

3. BASIS OF REPORT

The Report has been prepared for the specific site, development, design objectives and purposes that were described to Thurber by the Client. The applicability and reliability of any of the findings, recommendations, suggestions, or opinions expressed in the Report, subject to the limitations provided herein, are only valid to the extent that the Report expressly addresses proposed development, design objectives and purposes, and then only to the extent that there has been no material alteration to or variation from any of the said descriptions provided to Thurber, unless Thurber is specifically requested by the Client to review and revise the Report in light of such alteration or variation.

4. USE OF THE REPORT

The information and opinions expressed in the Report, or any document forming part of the Report, are for the sole benefit of the Client. NO OTHER PARTY MAY USE OR RELY UPON THE REPORT OR ANY PORTION THEREOF WITHOUT THURBER'S WRITTEN CONSENT AND SUCH USE SHALL BE ON SUCH TERMS AND CONDITIONS AS THURBER MAY EXPRESSLY APPROVE. Ownership in and copyright for the contents of the Report belong to Thurber. Any use which a third party makes of the Report, is the sole responsibility of such third party. Thurber accepts no responsibility whatsoever for damages suffered by any third party resulting from use of the Report without Thurber's express written permission.

5. INTERPRETATION OF THE REPORT

a) Nature and Exactness of Soil and Contaminant Description: Classification and identification of soils, rocks, geological units, contaminant materials and quantities have been based on investigations performed in accordance with the standards set out in Paragraph 1. Classification and identification of these factors are judgmental in nature. Comprehensive sampling and testing programs implemented with the appropriate equipment by experienced personnel may fail to locate some conditions. All investigations utilizing the standards of Paragraph 1 will involve an inherent risk that some conditions will not be detected and all documents or records summarizing such investigations will be based on assumptions of what exists between the actual points sampled. Actual conditions may vary significantly between the points investigated and the Client and all other persons making use of such documents or records with our express written consent should be aware of this risk and the Report is delivered subject to the express condition that such risk is accepted by the Client and such other persons. Some conditions are subject to change over time and those making use of the Report should be aware of this possibility and understand that the Report only presents the conditions at the sampled points at the time of sampling. If special concerns exist, or the Client has special considerations or requirements, the Client should disclose them so that additional or special investigations may be undertaken which would not otherwise be within the scope of investigations made for the purposes of the Report.

b) Reliance on Provided Information: The evaluation and conclusions contained in the Report have been prepared on the basis of conditions in evidence at the time of site inspections and on the basis of information provided to Thurber. Thurber has relied in good faith upon representations, information and instructions provided by the Client and others concerning the site. Accordingly, Thurber does not accept responsibility for any deficiency, misstatement or inaccuracy contained in the Report as a result of misstatements, omissions, misrepresentations, or fraudulent acts of the Client or other persons providing information relied on by Thurber. Thurber is entitled to rely on such representations, information and instructions and is not required to carry out investigations to determine the truth or accuracy of such representations, information and instructions.

c) Design Services: The Report may form part of design and construction documents for information purposes even though it may have been issued prior to final design being completed. Thurber should be retained to review final design, project plans and related documents prior to construction to confirm that they are consistent with the intent of the Report. Any differences that may exist between the Report's recommendations and the final design detailed in the contract documents should be reported to Thurber immediately so that Thurber can address potential conflicts.

d) Construction Services: During construction Thurber should be retained to provide field reviews. Field reviews consist of performing sufficient and timely observations of encountered conditions in order to confirm and document that the site conditions do not materially differ from those interpreted conditions considered in the preparation of the report. Adequate field reviews are necessary for Thurber to provide letters of assurance, in accordance with the requirements of many regulatory authorities.

6. RELEASE OF POLLUTANTS OR HAZARDOUS SUBSTANCES

Geotechnical engineering and environmental consulting projects often have the potential to encounter pollutants or hazardous substances and the potential to cause the escape, release or dispersal of those substances. Thurber shall have no liability to the Client under any circumstances, for the escape, release or dispersal of pollutants or hazardous substances, unless such pollutants or hazardous substances have been specifically and accurately identified to Thurber by the Client prior to the commencement of Thurber's professional services.

7. INDEPENDENT JUDGEMENTS OF CLIENT

The information, interpretations and conclusions in the Report are based on Thurber's interpretation of conditions revealed through limited investigation conducted within a defined scope of services. Thurber does not accept responsibility for independent conclusions, interpretations, interpolations and/or decisions of the Client, or others who may come into possession of the Report, or any part thereof, which may be based on information contained in the Report. This restriction of liability includes but is not limited to decisions made to develop, purchase or sell land.

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

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

▼ 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

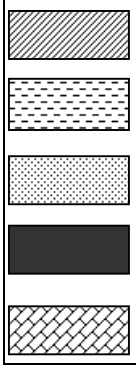
ROCK WEATHERING CLASSIFICATION

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			

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RECORD OF BOREHOLE No LR 17-02 1 OF 3 METRIC

W.P. _____ LOCATION Langstaff Road Underpass N 4 849 929.8 E 293 687.9 ORIGINATED BY TF

HWY 427 BOREHOLE TYPE Hollow Stem Augers/Tricone/HQ Coring COMPILED BY AN

DATUM Geodetic DATE 2017.05.19 - 2017.05.22 CHECKED BY ME

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 × 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
188.2	GROUND SURFACE										
0.0	**ASPHALT:** (75mm)										
0.1	Silty **SAND**, trace clay, trace organics Loose Dark Brown Moist (FILL)		1	SS	10		188				
187.4											
0.8	Clayey **SILT** to Silty **CLAY**, some sand to sandy, trace gravel, occasional cobbles and boulders Stiff to Hard Brown Moist (TILL)		2	SS	12		187				
			3	SS	21		186				
			4	SS	19						
			5	SS	20		185				
			6	SS	18		184				
			7	SS	30	▼	183				
			8	SS	38		182				
			9	SS	24		181				
							180				
							179				

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+ ³, × 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 LR 17-02 2 OF 3 METRIC

W.P. _____ LOCATION Langstaff Road Underpass N 4 849 929.8 E 293 687.9 ORIGINATED BY TF

HWY 427 BOREHOLE TYPE Hollow Stem Augers/Tricone/HQ Coring COMPILED BY AN

DATUM Geodetic DATE 2017.05.19 - 2017.05.22 CHECKED BY ME

SOIL PROFILE			SAMPLES			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 × 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 (%)
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES						GR SA SI CL
	Continued From Previous Page										
	Clayey **SILT** to Silty **CLAY**, some sand to sandy, trace gravel, occasional cobbles and boulders Stiff to Hard Brown Moist (TILL)		10	SS	80/ 0.125		178				
	Refusal on suspected boulder at 10.2m						177				
	Becoming grey		11	SS	32		176				
			12	SS	27		175				
			13	SS	41		174				
			14	SS	31		173				
			15	SS	39		172				
			16	SS	42		171				
							170				
							169				

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

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

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Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No LR 17-02 3 OF 3 METRIC

W.P. _____ LOCATION Langstaff Road Underpass N 4 849 929.8 E 293 687.9 ORIGINATED BY TF

HWY 427 BOREHOLE TYPE Hollow Stem Augers/Tricone/HQ Coring COMPILED BY AN

DATUM Geodetic DATE 2017.05.19 - 2017.05.22 CHECKED BY ME

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
	Continued From Previous Page										
	Clayey **SILT** to Silty **CLAY**, some sand to sandy, trace gravel, occasional cobbles and boulders Hard Brown Moist (TILL)						168				
			17	SS	48		167		○		0 21 52 27
			18	SS	77		166		○		
164.6							165				
23.6	**SHALE**, highly to slightly weathered, thinly laminated, weak with strong limestone interbeds, grey: (Georgian Bay Formation)		1	RUN					○	FI >10	RUN #1 TCR=45% SCR=0% RQD=0%
	Clay seam (75mm) at 23.6m						164			>10 4	
	Sub-vertical fracture (100mm) at 25.3m		2	RUN			163			3 2 4	RUN #2 TCR=100% SCR=87% RQD=43% UCS=6.1MPa (Shale)
	Sub-vertical fracture (75mm) at 26.1m and (100mm) at 26.5m		3	RUN			162			5 2 3	RUN #3 TCR=100% SCR=87% RQD=73% UCS=13.4MPa (Shale) UCS=64.8MPa (Limestone)
	Limestone interbed (125mm) at 26.8m									1 3	
160.9							161			1	
27.3	END OF BOREHOLE AT 27.3m. Piezometer installation consists of 25mm diameter Schedule 40 PVC pipe with a 3.05m slotted screen. WATER LEVEL READINGS DATE DEPTH(m) ELEV.(m) 2017.08.08 5.5 182.7										

+ ³, × ³: Numbers refer to Sensitivity

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

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Ontario

THURBER

RECORD OF BOREHOLE No LR 17-04 1 OF 3 METRIC

W.P. _____ LOCATION Langstaff Road Underpass N 4 849 934.7 E 293 728.7 ORIGINATED BY TF

HWY 427 BOREHOLE TYPE Hollow Stem Augers/Tricone/HQ Coring COMPILED BY AN

DATUM Geodetic DATE 2017.05.17 - 2017.05.18 CHECKED BY ME

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 + 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/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
188.2	GROUND SURFACE										
0.0	**ASPHALT:** (75mm)										
0.1											
187.8	Sandy **SILT**, some gravel, trace organics		1	SS	12		188				
0.4	Compact Dark Brown Moist (FILL)		2	SS	7		187				
	Clayey **SILT**, trace sand, trace gravel Stiff Dark Brown to Black Moist (FILL)		3	SS	13		186				
186.7											
1.5	Clayey **SILT** to Silty **CLAY**, some sand to sandy, trace gravel, occasional cobbles Stiff to Hard Brown Moist (TILL)		4	SS	16		185				
			5	SS	17		184				0 23 42 35
			6	SS	20		183				
	Becoming grey		7	SS	16	▼	182				
			8	SS	18		181				
			9	SS	29		180				
							179				

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

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

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Ontario

THURBER

RECORD OF BOREHOLE No LR 17-04 2 OF 3 METRIC

W.P. _____ LOCATION Langstaff Road Underpass N 4 849 934.7 E 293 728.7 ORIGINATED BY TF

HWY 427 BOREHOLE TYPE Hollow Stem Augers/Tricone/HQ Coring COMPILED BY AN

DATUM Geodetic DATE 2017.05.17 - 2017.05.18 CHECKED BY ME

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
	Continued From Previous Page										
	Clayey **SILT** to Silty **CLAY**, some sand to sandy, trace gravel, occasional cobbles Hard Brown Moist (TILL)		10	SS	31		178				0 21 52 27
							177				
			11	SS	35		176				
			12	SS	27		175				
			13	SS	45		174				
			14	SS	21		173				
			15	SS	12		172				
			16	SS	22		171				
							170				
							169				

Continued Next Page

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

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

ONTMT4S MTO-19484.GPJ 2017TEMPLATE(MTO).GDT 12/5/17

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No LR 17-04 3 OF 3 METRIC

W.P. _____ LOCATION Langstaff Road Underpass N 4 849 934.7 E 293 728.7 ORIGINATED BY TF

HWY 427 BOREHOLE TYPE Hollow Stem Augers/Tricone/HQ Coring COMPILED BY AN

DATUM Geodetic DATE 2017.05.17 - 2017.05.18 CHECKED BY ME

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
	Continued From Previous Page										
	Clayey **SILT** to Silty **CLAY**, some sand to sandy, trace gravel, occasional cobbles Very Stiff Brown Moist (TILL)						168				
			17	SS	27		167		○		
166.1											
22.1	**SAND** and **SILT**, some clay, some gravel Very Dense Grey Moist (TILL)		18	SS	80		166		○		11 45 34 10
165.0									○	FI	
23.2	**SHALE**, highly to slightly weathered, thinly laminated, very weak to weak with strong limestone interbeds, grey: (Georgian Bay Formation)		1	RUN			165			>10	RUN #1 TCR=100% SCR=71% RQD=25%
	Clay seam (275mm) at 23.2m									4	
	Sub-vertical fracture at 23.9m									4	
							164			3	
	Highly fractured zone (175mm) at 24.4m		2	RUN						>10	RUN #2 TCR=87% SCR=67% RQD=30%
	Clay seam at 24.9m									4	
	Limestone layer (100mm) at 25.1m						163			1	
										4	
										3	
			3	RUN			162			>10	RUN #3 TCR=100% SCR=73% RQD=40% UCS=7.3MPa (Shale) UCS=50.4MPa (Limestone)
	Vertical fracture (150mm) at 27.2m									5	
160.8							161			3	
										3	
										5	
27.4	END OF BOREHOLE AT 27.4m. Piezometer installation consists of 25mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen.										

WATER LEVEL READINGS

DATE	DEPTH(m)	ELEV.(m)
2017.08.08	5.5	182.7
2017.10.25	5.4	182.8

+ ³, × ³: Numbers refer to Sensitivity

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

ONTMT4S MTO-19484.GPJ 2017TEMPLATE(MTO).GDT 12/5/17

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No P01 17-01 1 OF 1 METRIC

W.P. _____ LOCATION N 4 847 963.3 E 294 092.6 ORIGINATED BY TF

HWY 427 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN

DATUM Geodetic DATE 2017.07.21 - 2107.07.21 CHECKED BY ME

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 (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE)	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
181.5	GROUND SURFACE										
0.0	**TOPSOIL:** (100mm)										
0.1	Clayey **SILT**, trace sand, trace gravel, trace organics (rootlets) Stiff Brown Moist		1	SS	12		181				
180.7											
0.8	Clayey **SILT** to Silty **CLAY**, some sand to sandy, trace gravel Very Stiff to Hard Brown to Grey Moist (TILL)		2	SS	23	▼	180				
			3	SS	27						
			4	SS	36		179				
			5	SS	63		178				7 32 40 21
			6	SS	46		177				
175.9							176				
5.6	Sandy **SILT**, trace clay, occasional cobbles Very Dense Grey Moist (TILL)		7	SS	50/ 0.075		175				
173.7			8	SS	50/		174				
7.8	END OF BOREHOLE AT 7.8m. BOREHOLE DRY UPON COMPLETION. Well installation consists of 50mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen. WATER LEVEL READINGS DATE DEPTH(m) ELEV.(m) 2017.10.25 1.4 180.1				0.075						

+ ³, × ³: Numbers refer to Sensitivity

15 20 10 5 (%) STRAIN AT FAILURE

ONTMT4S MTO-19484.GPJ 2017TEMPLATE(MTO).GDT 10/5/18

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No P01 17-02 1 OF 1 METRIC

W.P. _____ LOCATION N 4 847 926.2 E 294 138.2 ORIGINATED BY TF

HWY 427 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN

DATUM Geodetic DATE 2017.07.21 - 2017.07.21 CHECKED BY ME

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/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
180.9	GROUND SURFACE										
0.0	**TOPSOIL:** (100mm)										
0.1	Clayey **SILT**, some sand, trace gravel, trace organics (rootlets) Stiff Brown Moist		1	SS	11				○		
180.1											
0.8	Clayey **SILT** to silty **CLAY**, some sand to sandy, trace gravel Very Stiff to Hard Brown to Grey Moist (TILL)		2	SS	28		180		○		
			3	SS	29		179		○		
			4	SS	43				○		0 20 39 41
	Occasional oxide stains		5	SS	58		178		○		
							177				
			6	SS	28		176		○		
175.3											
5.6	Sandy **SILT**, trace to some clay, trace gravel, occasional cobbles Very Dense Grey Moist (TILL)		7	SS	50/ 0.075		175		○		
							174				
172.9			8	SS	50/ 0.075		173		○		
8.0	END OF BOREHOLE AT 8.0m. BOREHOLE DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND CUTTINGS TO SURFACE.										

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

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

ONTMT4S MTO-19484.GPJ 2017TEMPLATE(MTO).GDT 10/5/18

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No P02 17-01 1 OF 1 METRIC

W.P. _____ LOCATION N 4 850 073.1 E 293 636.3 ORIGINATED BY CAR

HWY 427 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN

DATUM Geodetic DATE 2017.05.24 - 2017.05.24 CHECKED BY ME

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 × 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
188.5	GROUND SURFACE										
0.0	**SAND** and **GRAVEL**, trace silt, occasional asphalt fragments Compact Dark Brown Moist (FILL)		1	SS	10		188				
187.6											
0.9	Clayey **SILT** to Silty **CLAY**, some sand to sandy, trace gravel, trace rootlets in the upper 0.5m zone Stiff to Hard Brown to Grey Moist (TILL)		2	SS	8		187				
			3	SS	14						
			4	SS	17		186				
			5	SS	31		185				
			6	SS	26						
			7	SS	17		184				
			8	SS	21		183				
			9	SS	19						
			10	SS	22		182				
			11	SS	23		181				
180.3											
8.2	END OF BOREHOLE AT 8.2m. Well installation consists of 50mm diameter Schedule 40 PVC pipe with a 3.05m slotted screen.										

WATER LEVEL READINGS

DATE	DEPTH(m)	ELEV.(m)
2017.06.19	0.6	187.9
2017.07.10	0.4	188.1
2017.10.18	2.3	186.2

+ ³, × ³: Numbers refer to Sensitivity

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

ONTMT4S MTO-19484.GPJ 2017TEMPLATE(MTO).GDT 10/5/18

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No P02 17-02 1 OF 1 METRIC

W.P. _____ LOCATION N 4 850 155.6 E 293 589.4 ORIGINATED BY CAR

HWY 427 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN

DATUM Geodetic DATE 2017.05.23 - 2017.05.23 CHECKED BY ME

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/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
187.7	GROUND SURFACE										
0.0	**TOPSOIL/ORGANICS** (600mm)		1	SS	8				○		
187.1											
0.6	Clayey **SILT** to Silty **CLAY**, some sand, trace gravel Very Stiff Brown to Grey Moist (TILL)		2	SS	15		187		○		
			3	SS	18		186		○		0 16 43 41
			4	SS	20		185		○		
			5	SS	18				○		
							184				
			6	SS	20		183		○		
							182				
			7	SS	19		181		○		
			8	SS	16		180		○		
179.5											
8.2	END OF BOREHOLE AT 8.2m. BOREHOLE OPEN TO 6.7m AND DRY. BORE HOLE BACKFILLED WITH BENTONITE HOLEPLUG AND CUTTINGS TO SURFACE.										

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

20
15 5
10
(%) STRAIN AT FAILURE

ONTMT4S MTO-19484.GPJ 2017TEMPLATE(MTO).GDT 10/5/18

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No P02 17-03 1 OF 1 METRIC

W.P. _____ LOCATION N 4 850 183.0 E 293 634.7 ORIGINATED BY CAR

HWY 427 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN

DATUM Geodetic DATE 2017.05.24 - 2017.05.24 CHECKED BY ME

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/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
187.8	GROUND SURFACE										
0.0	**SAND** and **GRAVEL**, some silt, trace rootlets Dense (FILL)		1	SS	34				○		
186.9							187				
0.9	Clayey **SILT** to Silty **CLAY**, some sand to sandy, trace gravel Firm to Very Stiff Brown to Grey Moist (TILL)		2	SS	7				○		
			3	SS	15	▼	186		○		
			4	SS	17				○		
			5	SS	17		185		○		0 24 44 32
			6	SS	28		184		○		
			7	SS	19		183		○		
			8	SS	18				○		
			9	SS	18		182		○		
							181				
			10	SS	18		180		○		
179.6											
8.2	END OF BOREHOLE AT 8.2m. Well installation consists of 50mm diameter Schedule 40 PVC pipe with a 3.05m slotted screen.										

WATER LEVEL READINGS

DATE	DEPTH(m)	ELEV.(m)
2017.06.19	0.2	187.6
2017.10.18	2.1	185.7

+ ³, × ³: Numbers refer to Sensitivity

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

ONTMT4S MTO-19484.GPJ 2017TEMPLATE(MTO).GDT 10/5/18

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No P03 17-01 1 OF 1 METRIC

W.P. _____ LOCATION N 4 850 875.5 E 293 726.6 ORIGINATED BY CAR

HWY 427 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN

DATUM Geodetic DATE 2017.06.02 - 2017.06.02 CHECKED BY ME

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/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
189.8	GROUND SURFACE										
0.0	**TOPSOIL:** (175mm)										
0.2	Silty **CLAY**, trace sand, trace gravel, trace rootlets		1	SS	7						
189.2	Firm										
0.6	Brown Moist										
	Clayey **SILT** to Silty **CLAY**, trace to some sand, trace gravel, occasional cobbles Very Stiff to Hard Brown to Grey Moist (TILL)		2	SS	19		189				
			3	SS	17		188				
			4	SS	24		187				
			5	SS	20		186				
			6	SS	16		185				
			7	SS	15		184				
							183				
181.9	cobble at 7.8m		8	SS	50/		182				
7.9	END OF BOREHOLE AT 7.9m. BOREHOLE OPEN TO 5.2m AND DRY. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND CUTTINGS TO SURFACE.				0.100						

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

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

ONTMT4S MTO-19484.GPJ 2017TEMPLATE(MTO).GDT 10/5/18

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No P03 17-02 1 OF 1 METRIC

W.P. _____ LOCATION N 4 850 971.8 E 293 709.9 ORIGINATED BY CAR

HWY 427 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN

DATUM Geodetic DATE 2017.06.05 - 2017.06.05 CHECKED BY ME

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/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
189.8	GROUND SURFACE										
0.0	**TOPSOIL:** (150mm)										
0.2	Silty **CLAY**, trace sand, trace gravel, some organics, rootlets Firm Brown Moist		1	SS	4				○		
189.2											
0.6	Silty **CLAY**, trace to some sand, trace gravel, occasional cobbles Stiff to Very Stiff Brown to Grey Moist (TILL)		2	SS	18		189		○		0 7 49 44
			3	SS	17		188		○		
			4	SS	29		187		○		
			5	SS	18	▼	186		○		
			6	SS	10		185		○		
			7	SS	13		184		⊢○⊣		
			8	SS	16		183				
181.6							182		○		
8.2	END OF BOREHOLE AT 8.2m. Well installation consists of 50mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen.										

WATER LEVEL READINGS

DATE	DEPTH(m)	ELEV.(m)
2017.06.19	4.3	185.5
2017.10.20	3.2	186.6

+ ³, × ³: Numbers refer to Sensitivity

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

ONTMT4S MTO-19484.GPJ 2017TEMPLATE(MTO).GDT 10/5/18

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No P04 17-01 1 OF 1 METRIC

W.P. _____ LOCATION N 4 851 507.0 E 293 485.0 ORIGINATED BY OA

HWY 427 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN

DATUM Geodetic DATE 2017.06.07 - 2017.06.07 CHECKED BY ME

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/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
191.7	GROUND SURFACE										
0.0	**TOPSOIL:** (100mm)										
0.1	Silty **CLAY**, trace sand, trace gravel, trace organics Firm Brown Moist		1	SS	5		191		○		
191.0											
0.7	Clayey **SILT** to Silty **CLAY**, trace to some sand, trace gravel Stiff to Very Stiff Brown to Grey Moist (TILL)		2	SS	13				○ ⊢		
			3	SS	17		190		○		
			4	SS	24		189		○		
			5	SS	28				○ ⊢		
							188				
			6	SS	19		187		○		
							186				
			7	SS	14				○ ⊢		
							185				
			8	SS	12		184		○		
183.5											
8.2	END OF BOREHOLE AT 8.2m. BOREHOLE DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND CUTTINGS TO SURFACE.										

+ ³, × ³: Numbers refer to Sensitivity

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

ONTMT4S MTO-19484.GPJ 2017TEMPLATE(MTO).GDT 10/5/18

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No P04 17-02 1 OF 1 METRIC

W.P. _____ LOCATION N 4 851 578.8 E 293 423.2 ORIGINATED BY OA

HWY 427 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN

DATUM Geodetic DATE 2017.06.05 - 2017.06.05 CHECKED BY ME

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE
192.8	GROUND SURFACE						
0.0	**TOPSOIL:** (100mm)						
0.1	Silty **CLAY**, trace sand, trace gravel Firm Brown		1	SS	6		
192.1	Moist						
0.7	Clayey **SILT** to Silty **CLAY**, trace to some sand, trace gravel Very Stiff Brown to Grey Moist (TILL)		2	SS	16		192
			3	SS	16		191
			4	SS	19		190
			5	SS	16		189
			6	SS	15		188
			7	SS	16		187
185.6							186
7.2	Silty **SAND**, some clay, trace gravel Dense Brown Moist (TILL)		8	SS	40		185
184.6							
8.2	END OF BOREHOLE AT 8.2m. WATER LEVEL AT 7.3m. Piezometer installation consists of 50mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen.						

WATER LEVEL READINGS

DATE	DEPTH(m)	ELEV.(m)
2017.06.19	1.4	191.4
2017.07.11	1.0	191.8
2017.10.23	2.3	190.5

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
6	42	34	18

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

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

ONTMT4S MTO-19484.GPJ 2017TEMPLATE(MTO).GDT 10/5/18

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No P05 17-01 1 OF 1 METRIC

W.P. _____ LOCATION N 4 852 057.8 E 292 758.2 ORIGINATED BY JZ

HWY 427 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN

DATUM Geodetic DATE 2017.06.08 - 2017.06.08 CHECKED BY ME

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 + 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/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
196.5	GROUND SURFACE										
0.0	**TOPSOIL:** (225mm)										
0.2	Silty **CLAY**, trace sand, trace gravel Firm Brown		1	SS	4		196				
195.8											
0.7	Moist Clayey **SILT** to Silty **CLAY**, trace to some sand, trace gravel, occasional cobbles Very Stiff Brown to Grey Moist (TILL)		2	SS	18		195				
			3	SS	23	▼					
			4	SS	28		194				
			5	SS	19		193				
			6	SS	16		192				0 16 84 (SI+CL)
			7	SS	19		191				
			8	SS	19		190				
188.3							189				
8.2	END OF BOREHOLE AT 8.2m. BOREHOLE DRY UPON COMPLETION. Piezometer installation consists of 25mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen. WATER LEVEL READINGS DATE DEPTH(m) ELEV.(m) 2017.06.29 0.7 195.8 2017.10.23 1.9 194.6										

+ ³, × ³: Numbers refer to Sensitivity

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

ONTMT4S MTO-19484.GPJ 2017TEMPLATE(MTO).GDT 10/5/18

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No P05 17-02 1 OF 1 METRIC

W.P. _____ LOCATION N 4 852 209.8 E 292 677.6 ORIGINATED BY JZ

HWY 427 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN

DATUM Geodetic DATE 2017.06.08 - 2017.06.08 CHECKED BY ME

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/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
196.8	GROUND SURFACE										
0.0	**TOPSOIL:** (175mm)										
0.2	Silty **CLAY**, trace sand, trace gravel Firm Brown		1	SS	6		196				
196.1	Moist										
0.7	Clayey **SILT** to Silty **CLAY**, trace to some sand, trace gravel, occasional cobbles Very Stiff to Hard Brown to Grey Moist (TILL)		2	SS	26						
			3	SS	34		195				0 18 42 40
			4	SS	26		194				
			5	SS	20		193				
			6	SS	27		192				
			7	SS	17	▽	191				
			8	SS	16		190				
188.6							189				
8.2	END OF BOREHOLE AT 8.2m. WATER LEVEL AT 6.4m. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND CUTTINGS TO SURFACE.										

+ ³, × ³: Numbers refer to Sensitivity

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

ONTMT4S MTO-19484.GPJ 2017TEMPLATE(MTO).GDT 10/5/18

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No P06 17-01 1 OF 1 METRIC

W.P. _____ LOCATION N 4 853 199.5 E 292 452.7 ORIGINATED BY JZ

HWY 427 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN

DATUM Geodetic DATE 2017.06.14 - 2017.06.14 CHECKED BY ME

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
201.0	GROUND SURFACE										
0.0	**TOPSOIL:** (125mm)										
0.1	Silty **CLAY**, trace sand, trace gravel, trace organics, rootlets		1	SS	7						
200.3	Firm										
0.7	Brown										
	Moist										
	Clayey **SILT** to Silty **CLAY**, trace to some sand, trace gravel		2	SS	22		200				
	Very Stiff										
	Brown to Grey										
	Moist										
	(TILL)		3	SS	27		199				
			4	SS	28		198				
			5	SS	27		197				
			6	SS	19		196				
194.6							195				
6.4	**SAND** and **SILT**, some gravel, trace to some clay		7	SS	27						12 39 36 13
	Compact						194				
	Grey										
	Moist										
193.5	(TILL)										
7.5	Clayey **SILT** to Silty **CLAY**, trace to some sand, trace gravel		8	SS	9		193				
	Stiff										
	Grey										
192.8	Moist										
	(TILL)										
8.2	END OF BOREHOLE AT 8.2m. BOREHOLE DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND CUTTINGS TO SURFACE.										

+ ³, × ³: Numbers refer to Sensitivity

15 20 10 5 (%) STRAIN AT FAILURE

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THURBER

RECORD OF BOREHOLE No P06 17-02 1 OF 1 METRIC

W.P. _____ LOCATION N 4 853 305.0 E 292 384.2 ORIGINATED BY JZ

HWY 427 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN

DATUM Geodetic DATE 2017.06.14 - 2017.06.14 CHECKED BY ME

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/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
201.8	GROUND SURFACE										
0.0	**TOPSOIL:** (225mm)										
0.2	Silty **CLAY**, trace sand, trace gravel, trace organics, rootlets		1	SS	5						
201.1	Firm										
0.7	Brown Moist						201				
	Clayey **SILT** to Silty **CLAY**, trace to some sand, trace gravel Stiff to Very Stiff Brown to Grey Moist (TILL)		2	SS	22						
			3	SS	18		200				
			4	SS	25		199				
			5	SS	22		198				
			6	SS	10		197				
196.5											
5.3	**SAND** and **SILT**, trace to some clay, trace to some gravel Compact to Very Dense Grey Moist (TILL)		7	SS	74		196				19 36 35 10
							195				
			8	SS	25		194				4 42 46 8
193.6											
8.2	END OF BOREHOLE AT 8.2m. WATER LEVEL AT 7.3m. Piezometer installation consists of 50mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen.										

WATER LEVEL READINGS

DATE	DEPTH(m)	ELEV.(m)
2017.06.29	2.0	199.8
2017.10.23	4.0	197.8

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

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

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RECORD OF BOREHOLE No P07 17-01 1 OF 1 METRIC

W.P. _____ LOCATION N 4 854 036.5 E 291 756.5 ORIGINATED BY OA

HWY 427 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN

DATUM Geodetic DATE 2017.07.07 - 2017.07.07 CHECKED BY ME

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/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
205.8	GROUND SURFACE										
0.0	**TOPSOIL:** (75mm)										
0.1	Clayey **SILT**, some sand, trace gravel, trace organics Firm Brown Moist		1	SS	4						
205.0							205				
0.8	Clayey **SILT** to Silty **CLAY**, trace to some sand, trace gravel Stiff to Very Stiff Brown to Grey Moist (TILL)		2	SS	15						
			3	SS	14		204				
			4	SS	23		203				
			5	SS	14		202				
			6	SS	14		201				
			7	SS	10		200				
							199				
			8	SS	9		198				
197.6											
8.2	END OF BOREHOLE AT 8.2m. BOREHOLE DRY UPON COMPLETION. Well installation consists of 50mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen. WATER LEVEL READINGS DATE / DEPTH(m) / ELEV.(m) 2017.07.10 / 7.5 / 198.3 2017.10.23 / 2.0 / 203.8										

+ ³, × ³: Numbers refer to Sensitivity

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

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THURBER

RECORD OF BOREHOLE No P07 17-02 1 OF 1 METRIC

W.P. _____ LOCATION N 4 854 124.7 E 291 659.0 ORIGINATED BY OA

HWY 427 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN

DATUM Geodetic DATE 2017.07.07 - 2017.07.07 CHECKED BY ME

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 + 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
206.6	GROUND SURFACE										
0.0 / 0.1	**TOPSOIL:** (75mm)										
	Clayey **SILT**, some sand, trace gravel Firm Brown Moist		1	SS	4		206				
205.8 / 0.8	Clayey **SILT** to Silty **CLAY**, trace to some sand, trace gravel Stiff to Very Stiff Brown to Grey Moist (TILL)		2	SS	11		205				
			3	SS	17		204				
			4	SS	17		203				
			5	SS	18		202				0 6 38 56
			6	SS	8		201				
			7	SS	10		200				
			8	SS	11		199				
198.4 / 8.2	END OF BOREHOLE AT 8.2m. BOREHOLE DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND CUTTINGS TO SURFACE.										

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

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

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RECORD OF BOREHOLE No P08 17-01 1 OF 1 METRIC

W.P. _____ LOCATION N 4 853 679.1 E 291 555.9 ORIGINATED BY ES

HWY 427 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN

DATUM Geodetic DATE 2017.06.22 - 2017.06.22 CHECKED BY ME

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 + 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/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
204.7	GROUND SURFACE										
0.0	**TOPSOIL:** (175mm)										
0.2	Clayey **SILT**, some sand, trace gravel, trace rootlets Firm Brown Moist		1	SS	5		204		○		
203.6			2	SS	12				○		
1.1	Clayey **SILT** to Silty **CLAY**, trace to some sand, trace gravel Stiff to Hard Brown to Grey Moist (TILL)		3	SS	20		203		○		
			4	SS	18		202		○		
			5	SS	16		201		⊖		0 6 36 58
			6	SS	12		200		○		
			7	SS	35		199		○		
			8	SS	13		198		○		
196.5							197				
8.2	END OF BOREHOLE AT 8.2m. BOREHOLE OPEN AND DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND CUTTINGS TO SURFACE.										

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

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

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THURBER

RECORD OF BOREHOLE No P08 17-02 1 OF 1 METRIC

W.P. _____ LOCATION N 4 853 700.7 E 291 613.9 ORIGINATED BY ES

HWY 427 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN

DATUM Geodetic DATE 2017.06.26 - 2017.06.26 CHECKED BY ME

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 × 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
204.4	GROUND SURFACE										
0.0	**TOPSOIL:** (150mm)										
0.2	Clayey **SILT**, some sand, trace gravel, trace organics Firm to Stiff Brown Moist		1	SS	5		204				
			2	SS	8		203				
202.3			3	SS	14	▼					
2.1	Clayey **SILT** to Silty **CLAY**, trace to some sand, trace gravel, occasional oxide staining Very Stiff Brown to Grey Moist (TILL)		4	SS	27		202				
			5	SS	29		201				
			6	SS	22		200				
			7	SS	20		199				
	occasional cobbles						198				
197.2											
7.2	Silty **CLAY** Very Stiff Grey Moist		8	SS	16		197				0 0 61 39
196.2											
8.2	END OF BOREHOLE AT 8.2m. BOREHOLE DRY UPON COMPLETION. Well installation consists of 50mm diameter Schedule 40 PVC pipe with a 3.05m slotted screen.										

WATER LEVEL READINGS

DATE	DEPTH(m)	ELEV.(m)
2017.06.29	7.3	197.1
2017.10.23	1.9	202.5

+ ³, × ³: Numbers refer to Sensitivity

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

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RECORD OF BOREHOLE No STM 17-27 1 OF 1 METRIC

W.P. _____ LOCATION N 4 851 484.4 E 293 450.9 ORIGINATED BY OA

HWY 427 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN

DATUM Geodetic DATE 2017.06.07 - 2017.06.07 CHECKED BY ME

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
192.2	GROUND SURFACE										
0.0	**TOPSOIL:** (75mm)										
0.1	Silty **CLAY**, trace sand, trace gravel Firm Brown		1	SS	4		192		○		
191.5	Moist										
0.7	Clayey **SILT** to Silty **CLAY**, trace to some sand, trace gravel Stiff to Hard Brown to Grey Moist (TILL)		2	SS	21		191		○		
			3	SS	11		190		○		
			4	SS	25				○		
			5	SS	53		189		○		
			6	SS	16		188		○		
			7	SS	19		187		○		
185.5							186				
6.7	END OF BOREHOLE AT 6.7m. BOREHOLE DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND CUTTINGS TO SURFACE.										

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

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

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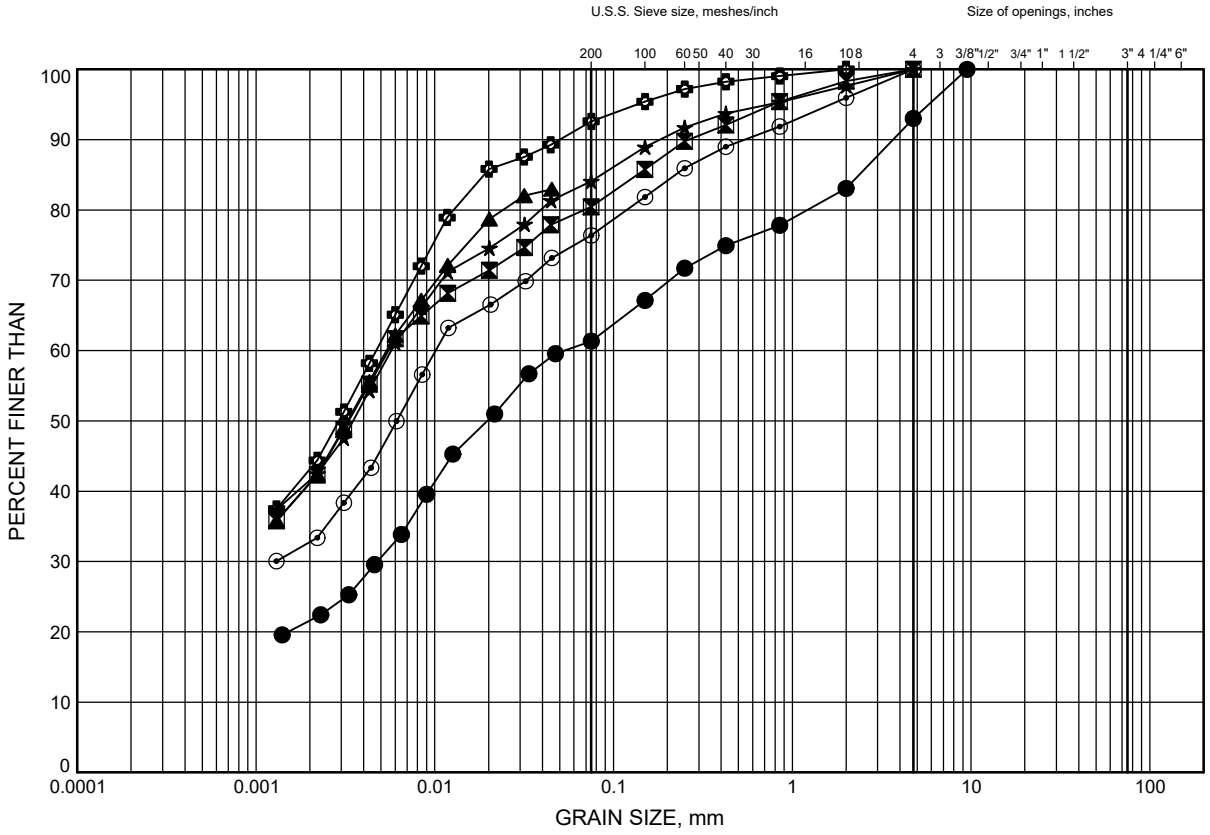
Appendix B

Laboratory Test Results

GRAIN SIZE DISTRIBUTION

FIGURE B1

Clayey SILT to Silty CLAY TILL



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	P01 17-01	3.4	178.1
⊠	P01 17-02	2.6	178.3
▲	P02 17-01	4.9	183.6
★	P02 17-02	1.8	185.9
⊙	P02 17-03	3.4	184.4
✿	P03 17-02	1.1	188.7

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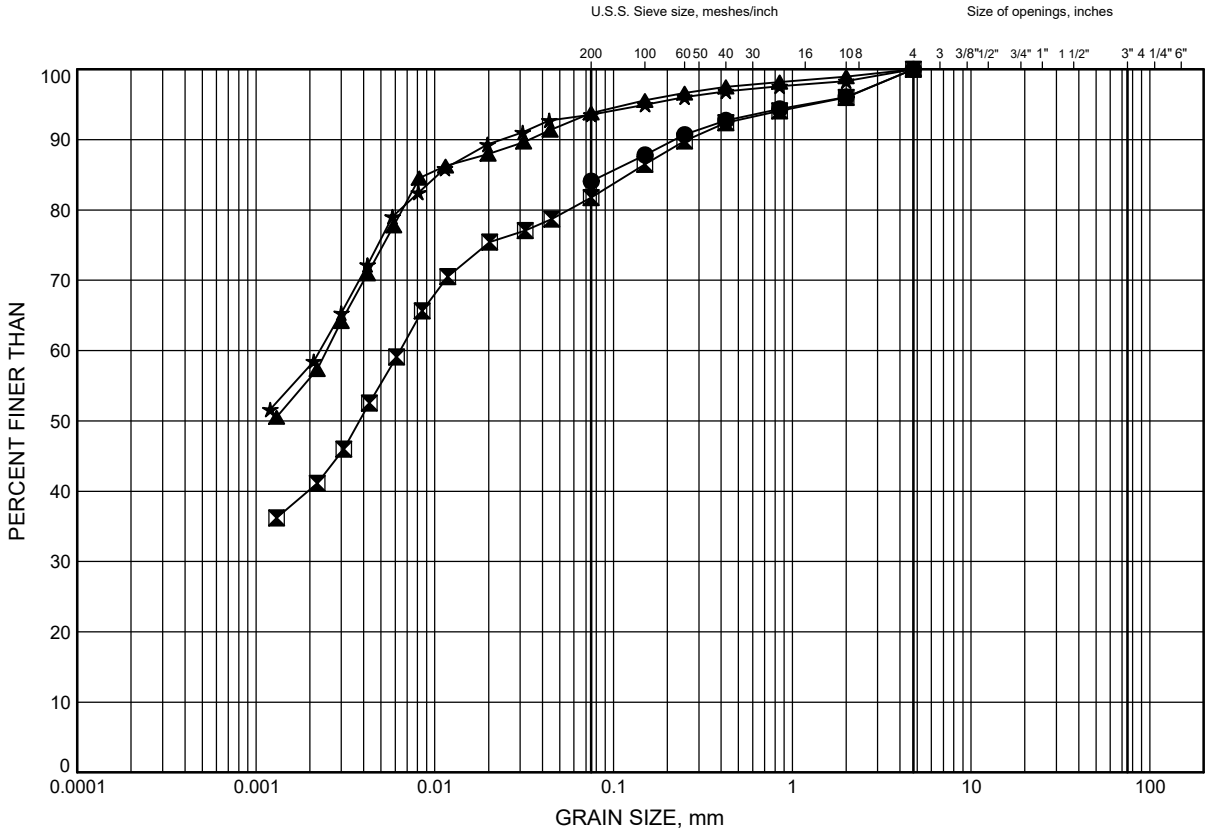
GRAIN SIZE DISTRIBUTION - THURBER MTO-19484.GPJ 10/5/18

GRAIN SIZE DISTRIBUTION

FIGURE B2

Clayey SILT to Silty CLAY TILL



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	P05 17-01	4.9	191.6
⊠	P05 17-02	1.8	195.0
▲	P07 17-02	3.4	203.2
★	P08 17-01	3.4	201.3

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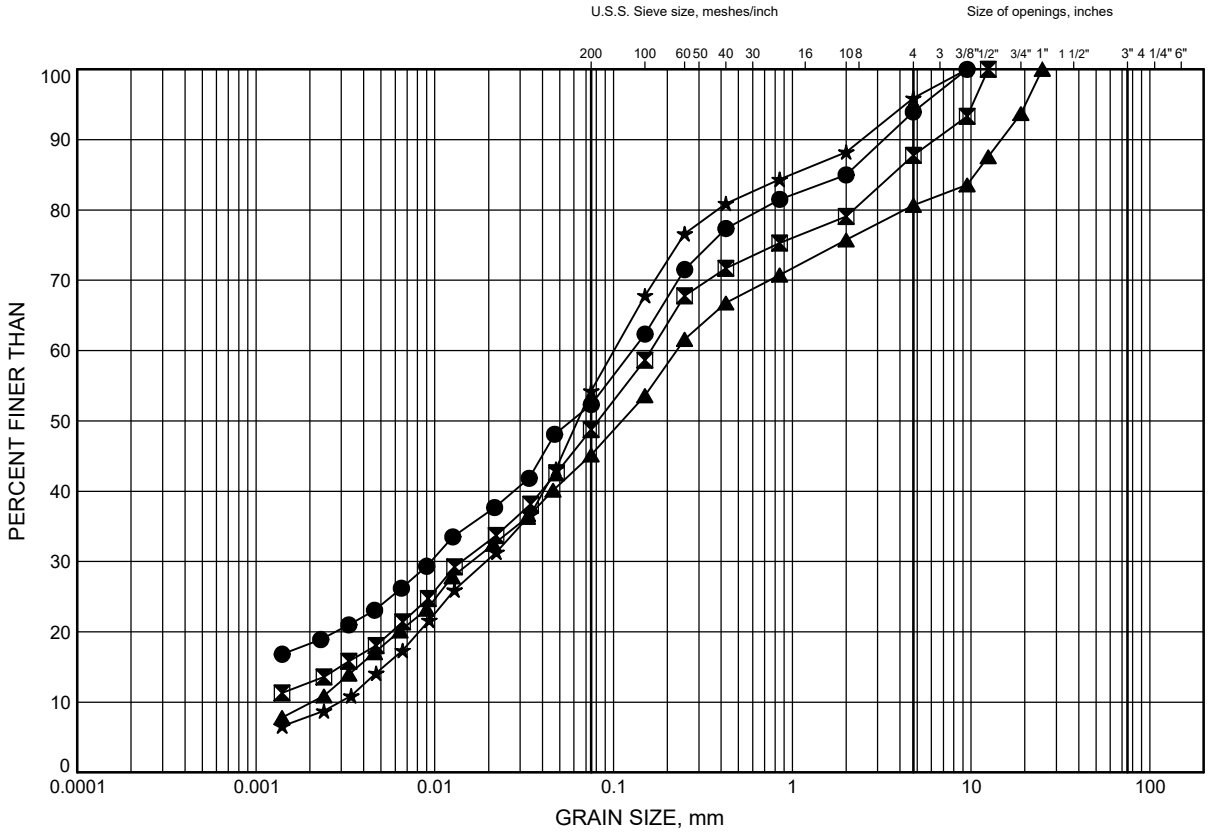
GRAIN SIZE DISTRIBUTION - THURBER MTO-19484.GPJ 10/5/18

GRAIN SIZE DISTRIBUTION

FIGURE B3

Silty SAND to Sandy SILT TILL



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	P04 17-02	7.9	184.9
⊠	P06 17-01	6.6	194.4
▲	P06 17-02	6.4	195.4
★	P06 17-02	7.9	193.9

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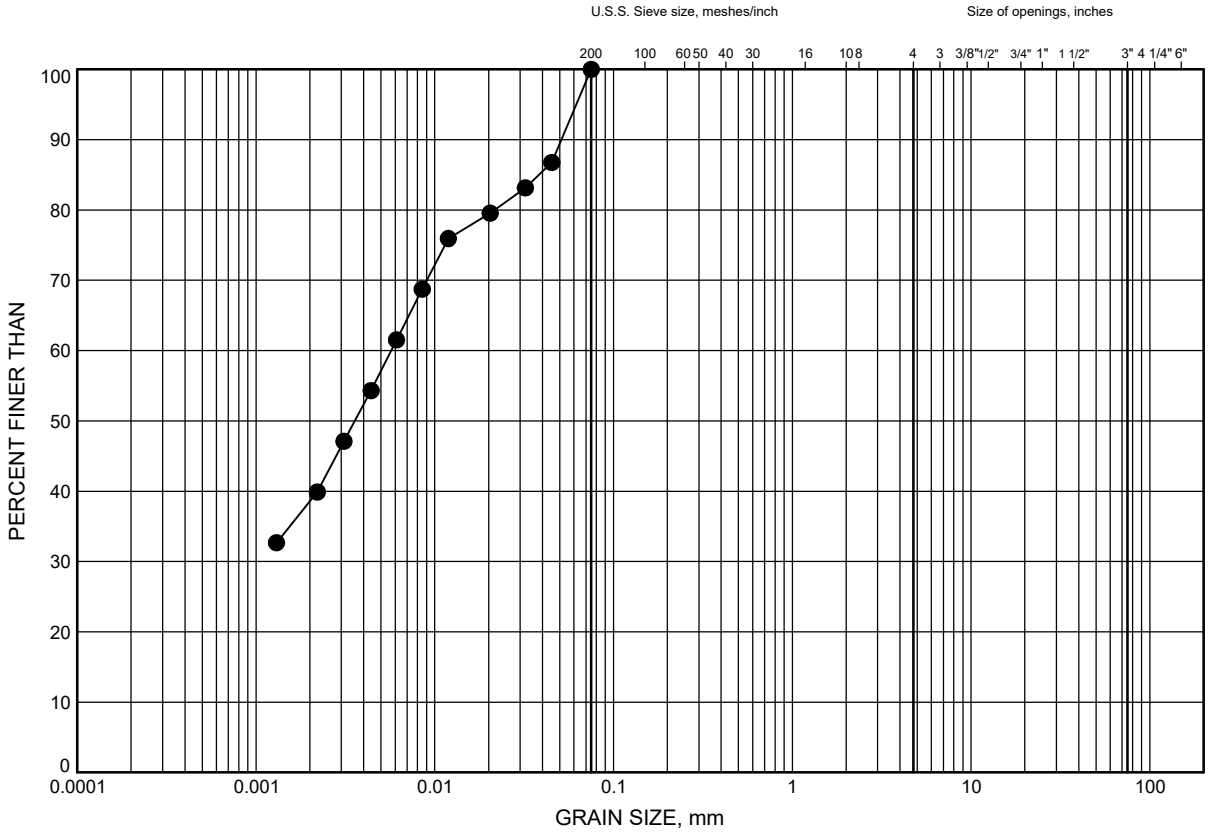
GRAIN SIZE DISTRIBUTION

FIGURE B4

Silty CLAY



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	P08 17-02	7.9	196.5

Date October 2018

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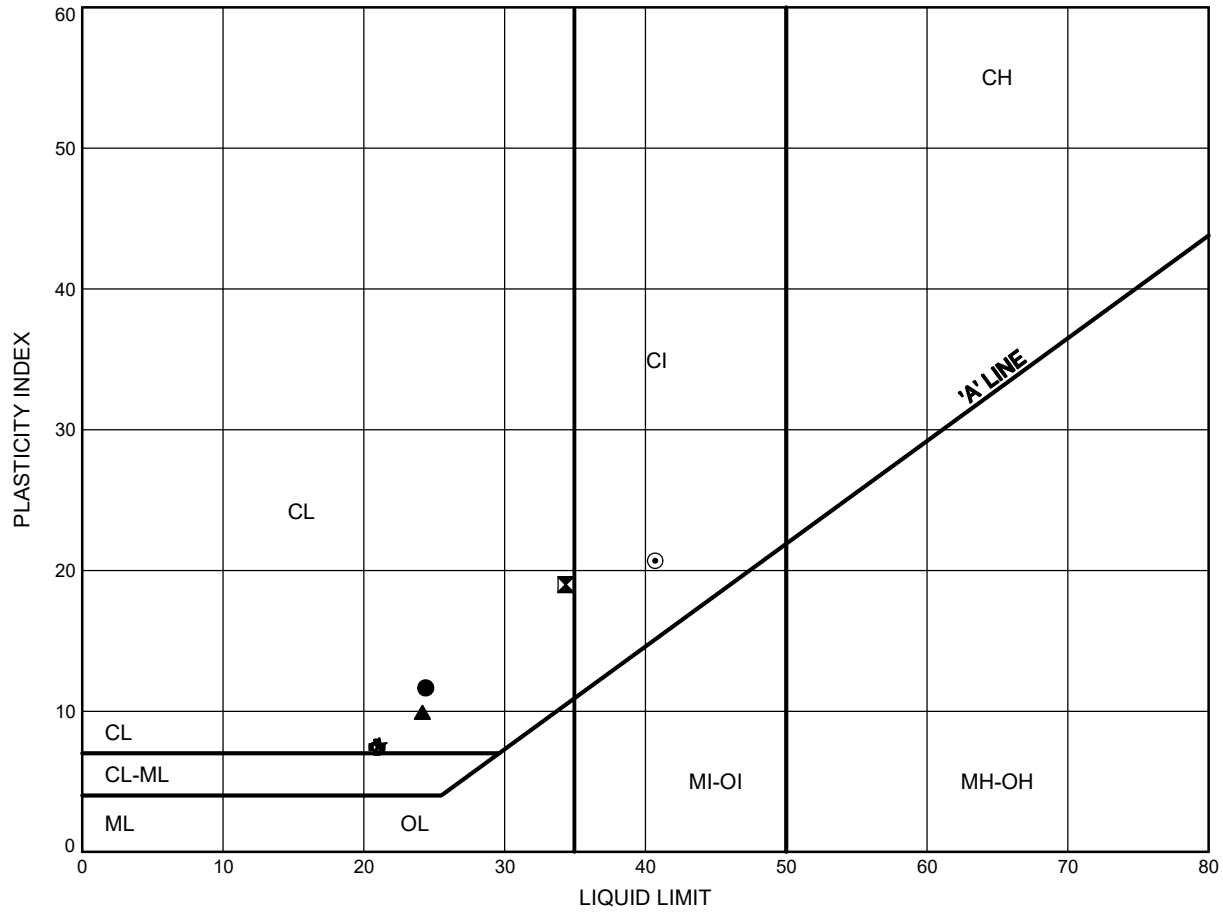
GRAIN SIZE DISTRIBUTION - THURBER MTO-19484.GPJ 10/5/18

ATTERBERG LIMITS TEST RESULTS

FIGURE B5

Clayey SILT to Silty CLAY TILL



LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	P01 17-01	3.4	178.1
⊠	P01 17-02	2.6	178.3
▲	P02 17-01	4.9	183.6
★	P02 17-02	1.8	185.9
⊙	P03 17-01	3.4	186.4
✿	P03 17-02	6.4	183.4

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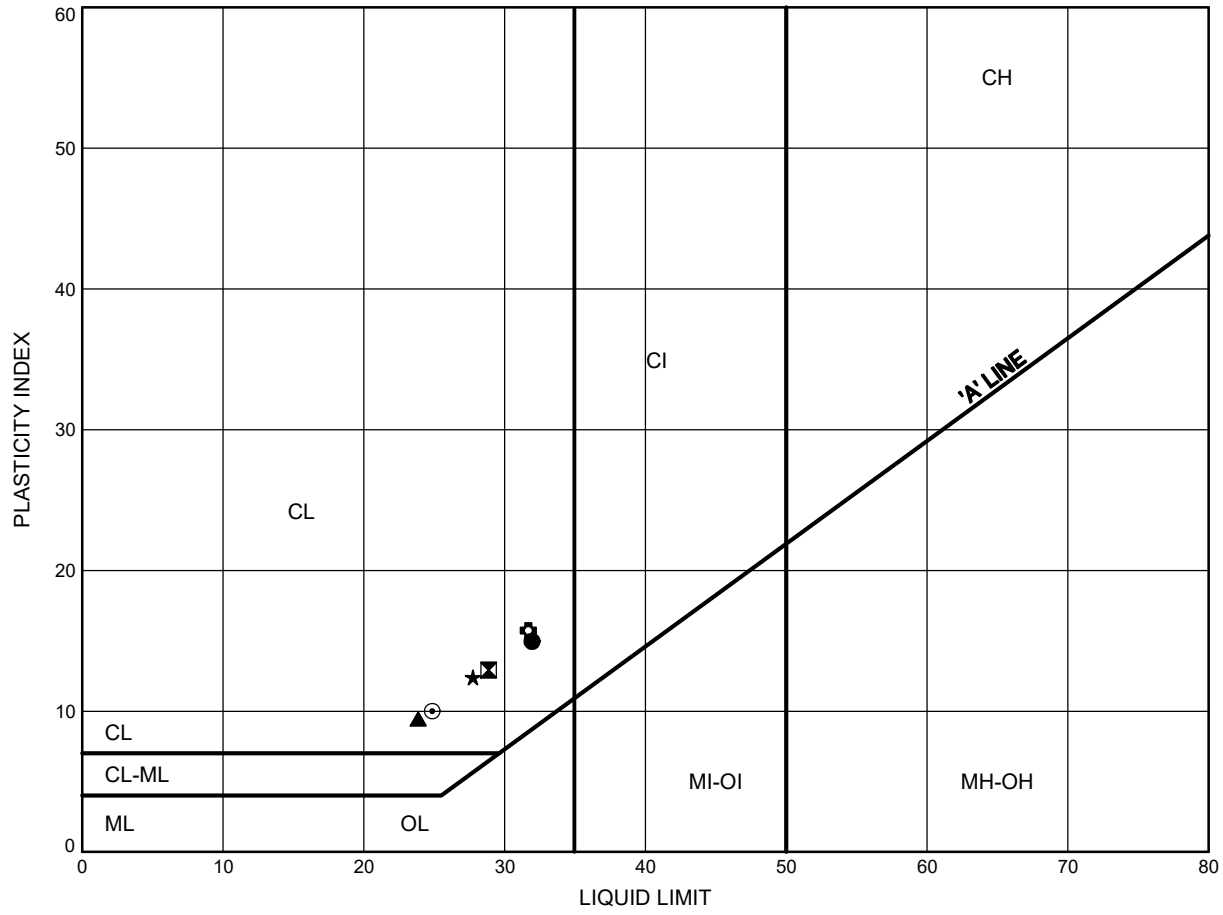
THURBALT MTO-19484.GPJ 10/5/18

ATTERBERG LIMITS TEST RESULTS

FIGURE B6

Clayey SILT to Silty CLAY TILL



LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	P04 17-01	1.1	190.6
⊠	P04 17-01	3.4	188.3
▲	P04 17-01	6.4	185.3
★	P04 17-02	3.4	189.4
⊙	P04 17-02	6.4	186.4
✿	P05 17-01	4.9	191.6

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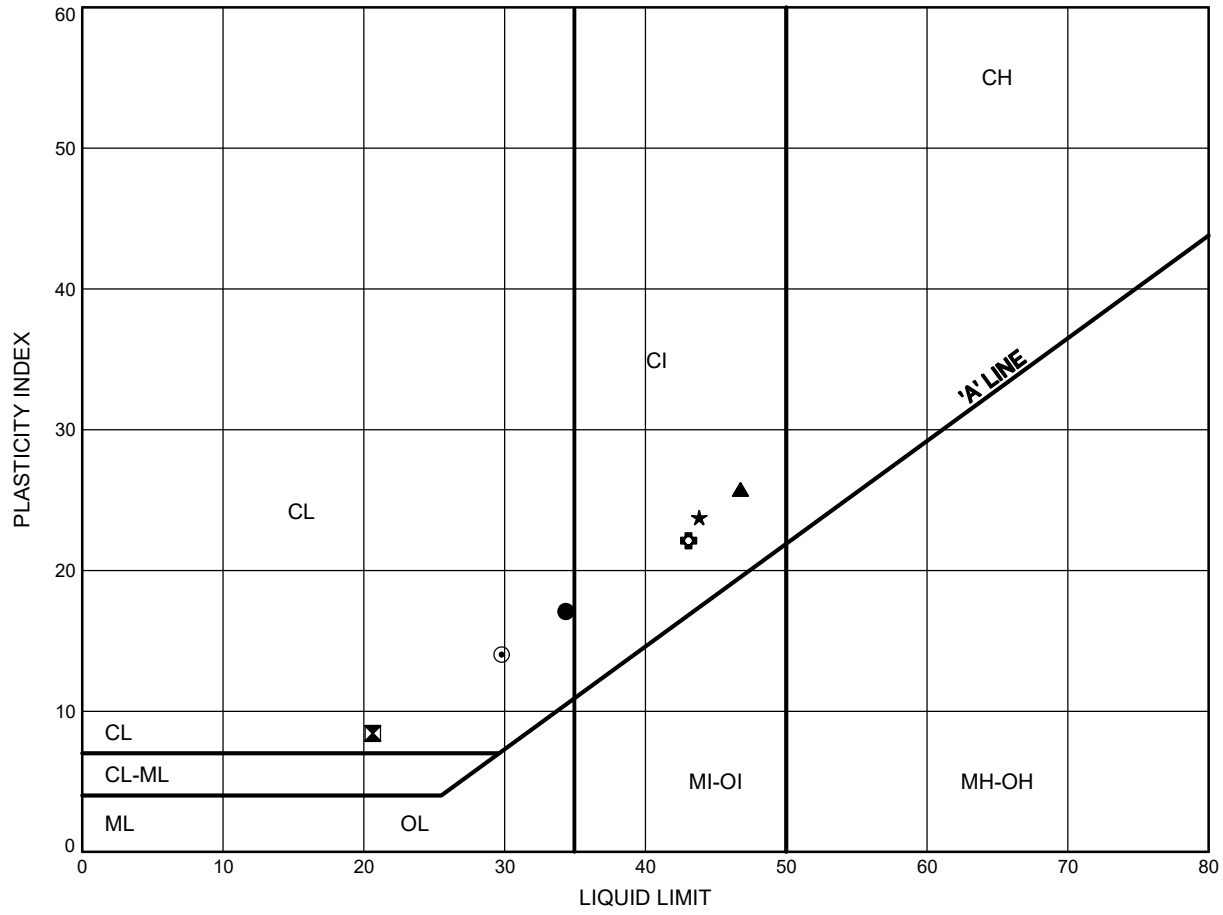
THURBALT MTO-19484.GPJ 10/5/18

ATTERBERG LIMITS TEST RESULTS

FIGURE B7

Clayey SILT to Silty CLAY TILL



LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	P05 17-02	1.8	195.0
⊠	P05 17-02	6.4	190.4
▲	P06 17-01	2.6	198.4
★	P06 17-02	4.9	196.9
⊙	P07 17-01	6.4	199.4
✿	P07 17-02	3.4	203.2

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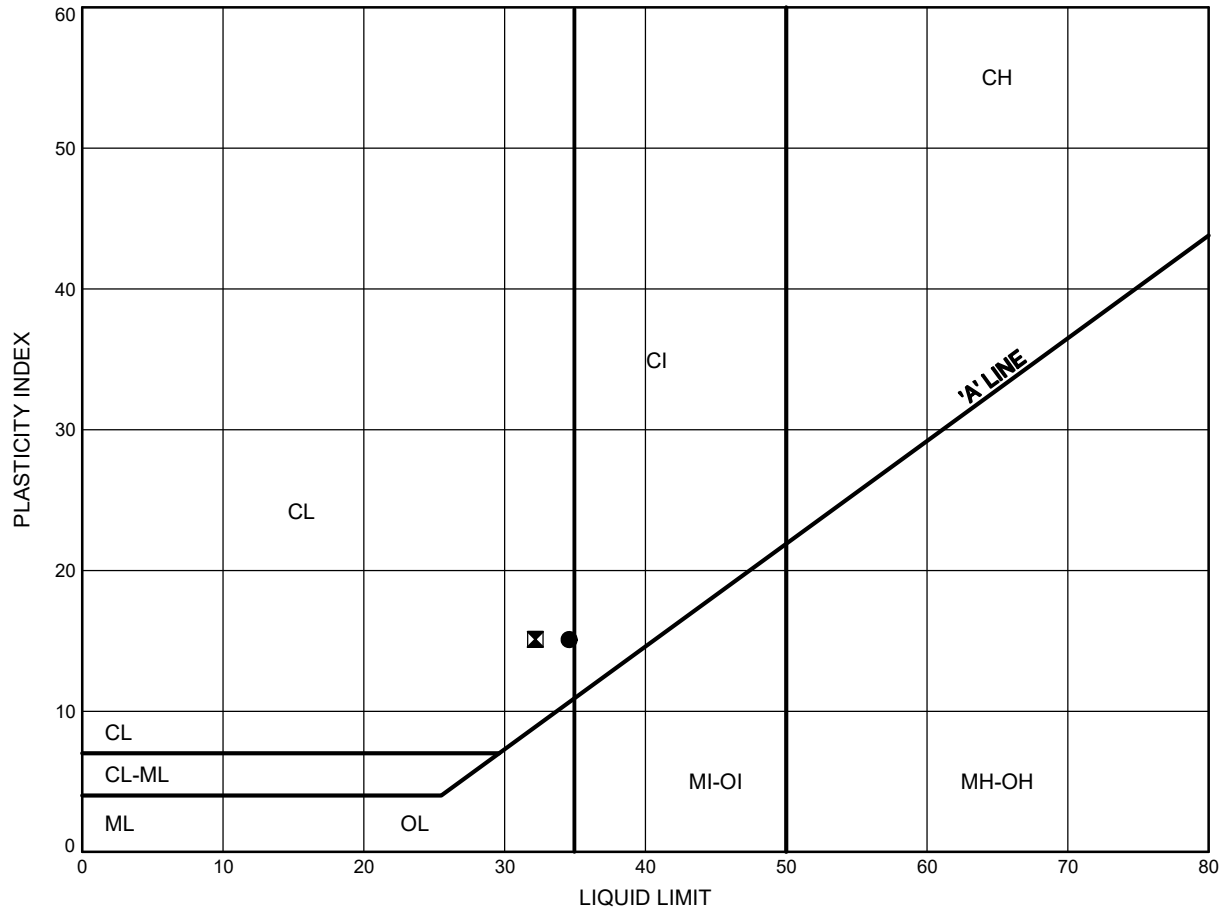
ATTERBERG LIMITS TEST RESULTS

FIGURE B8

Clayey SILT to Silty CLAY TILL



LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	P08 17-01	3.4	201.3
⊠	STM 17-27	2.6	189.6

Date October 2018

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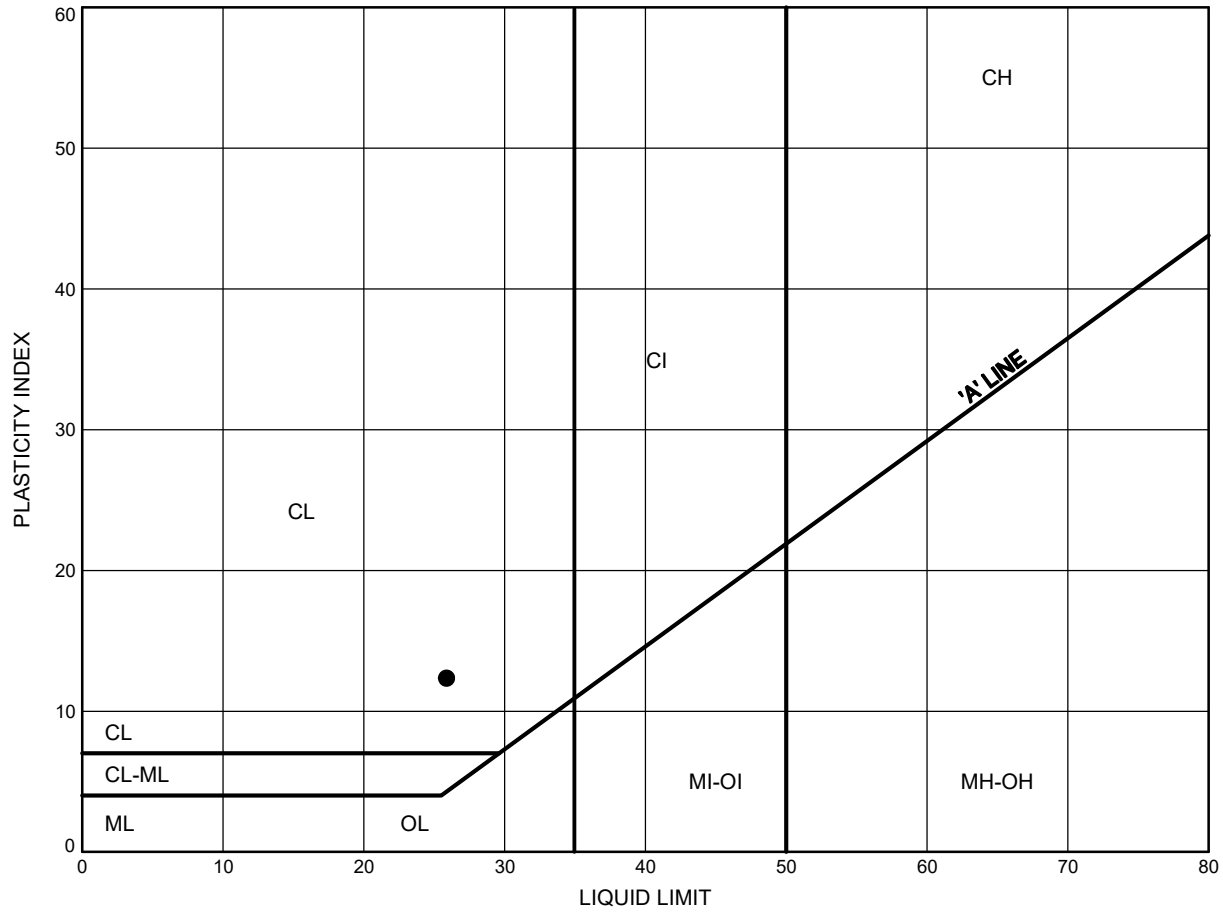
ATTERBERG LIMITS TEST RESULTS

FIGURE B9

Silty CLAY



LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	P08 17-02	7.9	196.5

Date October 2018

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THURBER

Prep'd AN

Chkd. GRL

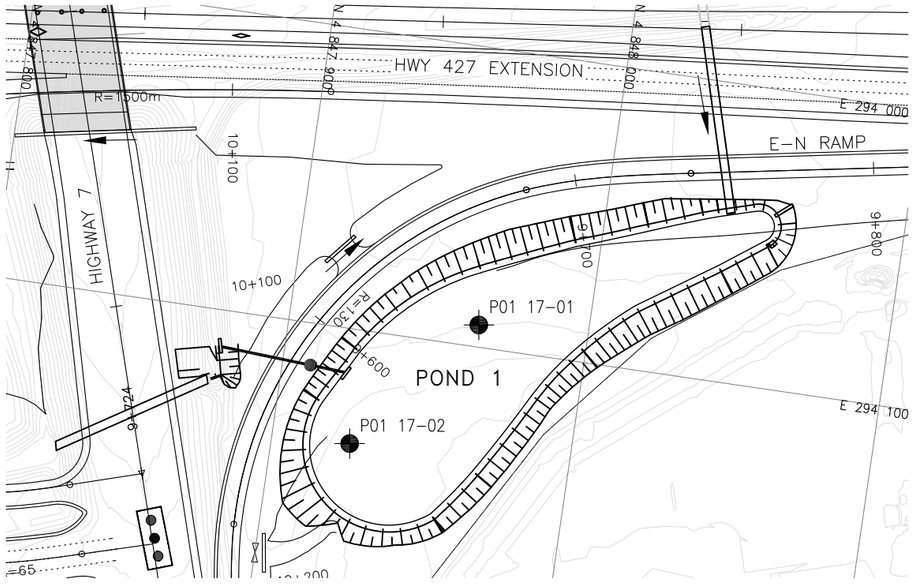
THURBALT MTO-19484.GPJ 10/5/18

Appendix C

Borehole Location Plans

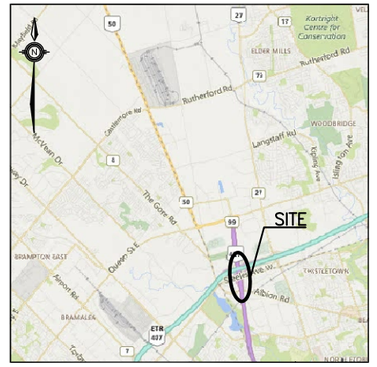
METRIC

DIMENSIONS ARE IN METRES
AND/OR MILLIMETRES
UNLESS OTHERWISE SHOWN



PLAN

THURBER ENGINEERING LTD.



KEYPLAN

LEGEND

- Borehole (By Thurber)
- Borehole (By Others)

NO	ELEVATION	NORTHING	EASTING
P01 17-01	181.5	4 847 963.3	294 092.6
P01 17-02	180.9	4 847 926.2	294 138.2

-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.

NO.	DATE	REVISIONS	BY	CHK	LEAD. DISC.	PROJ. MAN.
A	19/02/01	90% SUBMISSION TO CA	AN	MB	JL	JL

SCALE :

10m 0 20m
1:2000
Metres

CONSULTANT

DESIGNED	M. BOUCHER	MB	19/02/01
DRAWN	A. NOOR	AN	19/02/01
CHECKED	M. BOUCHER	MB	19/02/01
APPROVED LEAD ENGINEER	J. LEE	JL	19/02/01
APPROVED PROJ. MANAGER	J. LEE	JL	19/02/01
	NAME (PRINT)	INIT.	DATE

Ontario

link427
LOCAL | INTEGRATED | NEIGHBOURLY | KNOWLEDGEABLE

TITLE

HWY 427 EXPANSION
STORM WATER MANAGEMENT
PONDS - PACKAGE 6, 7 AND 8

BOREHOLE LOCATIONS PLAN

PROJECT ID.	STAGE INDENTIFIER	DESIGN PACKAGE NUMBER	DISCIPLINE	STRUCTURE NUMBER	DOCUMENT TYPE	DRAWING NUMBER	REVISION NUMBER
H427-D	N	0	FND		DWG		A

FILENAME: H:\Drafting\19000\19484\TED\19484-PLAN-HWY 427 (StormWaterManagementPonds).dwg
PLOTDATE: 2/1/2019 10:49 AM

METRIC

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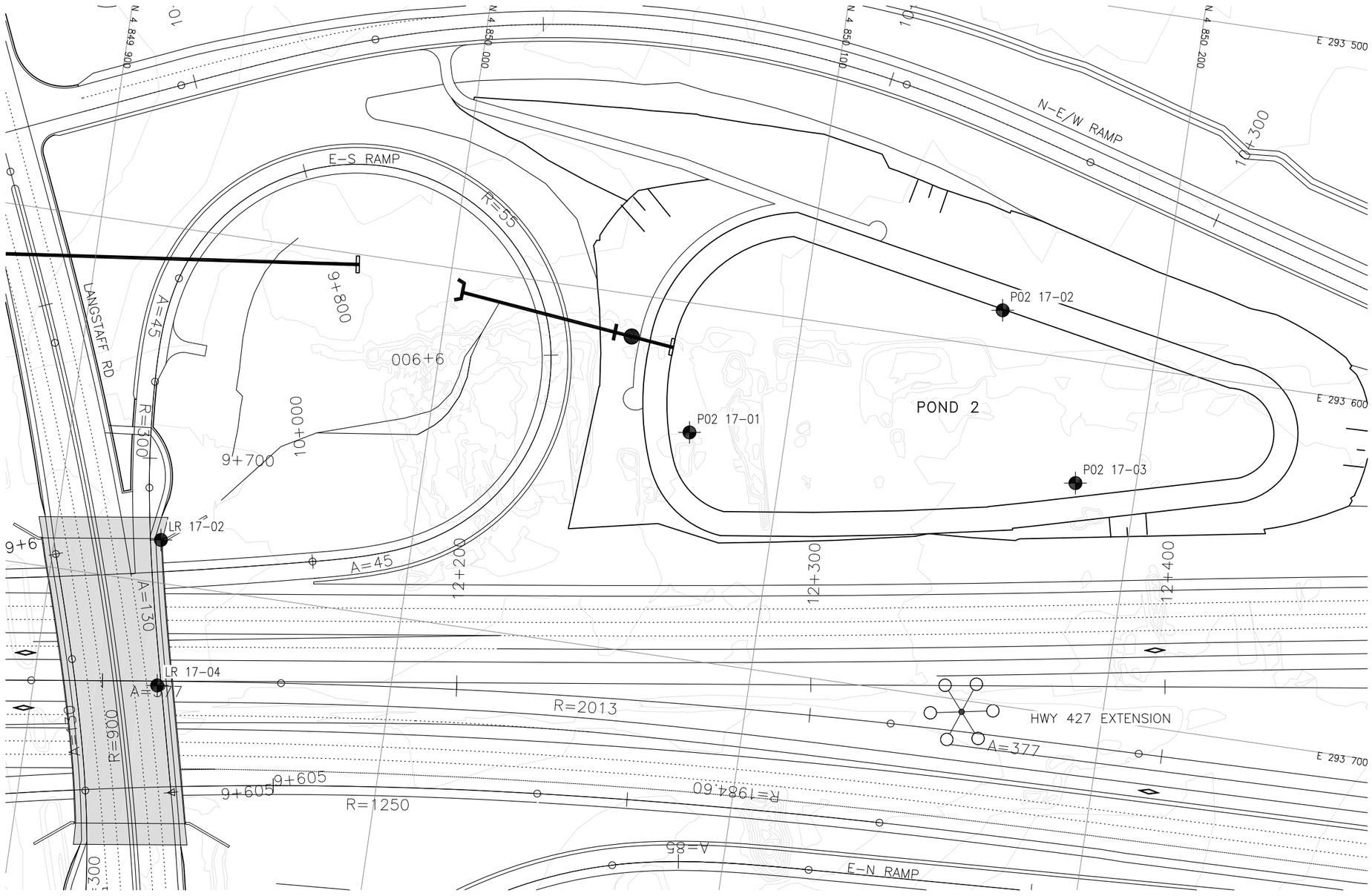
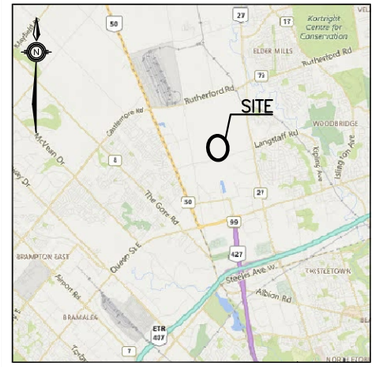


PLAN



KEYPLAN

LEGEND

- Borehole (By Thurber)
- Borehole (By Others)

NO	ELEVATION	NORTHING	EASTING
LR 17-02	188.2	4 849 929.8	293 687.9
LR 17-04	188.2	4 849 934.7	293 728.7
P02 17-01	188.5	4 850 073.1	293 636.3
P02 17-02	187.7	4 850 155.6	293 589.4
P02 17-03	187.8	4 850 183.0	293 634.7

-NOTES-

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GEOCRES No.

NO.	DATE	REVISIONS	BY	CHK	LEAD. DISC.	PROJ. MAN.
A	19/02/01	90% SUBMISSION TO CA	AN	MB	JL	JL

SCALE :

6.25m 0 12.5m

1:1250
Metres

CONSULTANT

DESIGNED	M. BOUCHER	MB	19/02/01
DRAWN	A. NOOR	AN	19/02/01
CHECKED	M. BOUCHER	MB	19/02/01
APPROVED LEAD ENGINEER	J. LEE	JL	19/02/01
APPROVED PROJ. MANAGER	J. LEE	JL	19/02/01
	NAME (PRINT)	INIT.	DATE

TITLE

HWY 427 EXPANSION STORM WATER MANAGEMENT PONDS - PACKAGE 6, 7 AND 8

BOREHOLE LOCATIONS PLAN

PROJECT ID.	STAGE INDENTIFIER	DESIGN PACKAGE NUMBER	DISCIPLINE	STRUCTURE NUMBER	DOCUMENT TYPE	DRAWING NUMBER	REVISION NUMBER
H427-D	N	0	FND		DWG		A

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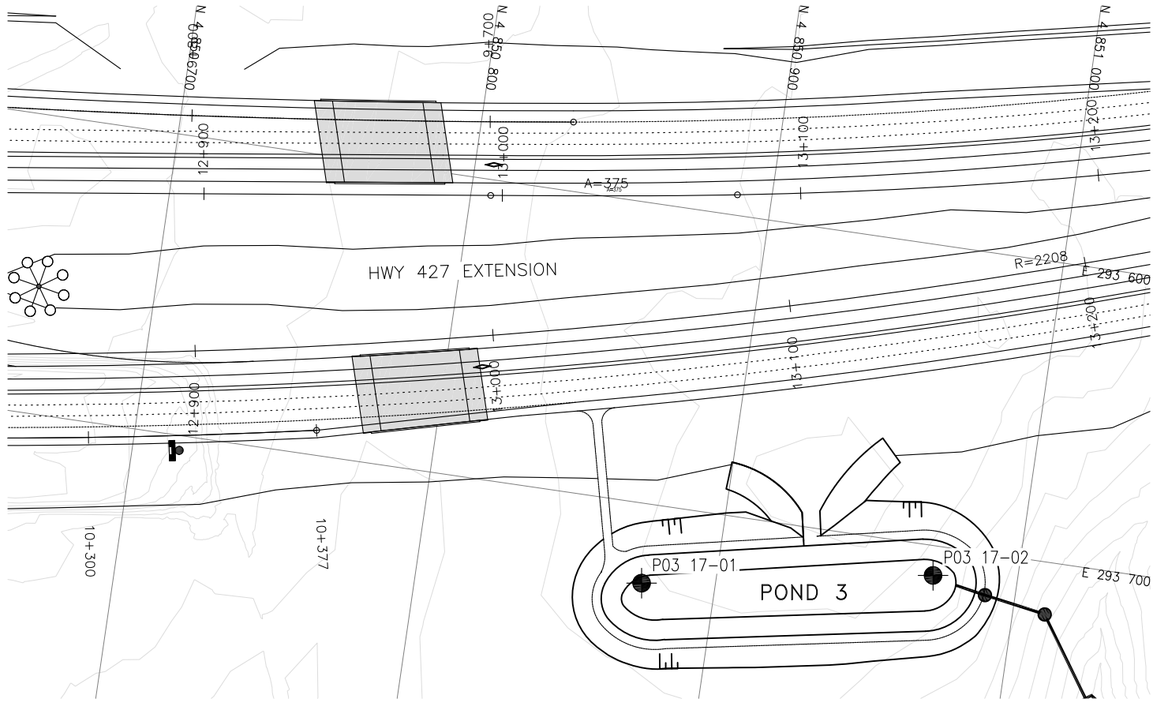
PLOTDATE: 5/2/2019 1:48 PM

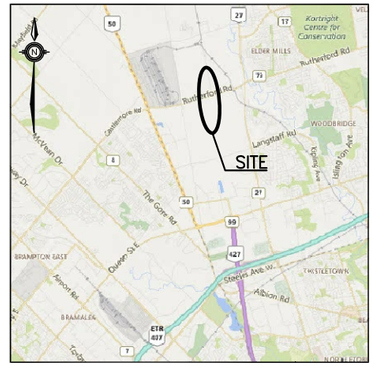
METRIC

DIMENSIONS ARE IN METRES
AND/OR MILLIMETRES
UNLESS OTHERWISE SHOWN



PLAN

THURBER ENGINEERING LTD.



KEYPLAN

LEGEND

- Borehole (By Thurber)
- Borehole (By Others)

NO	ELEVATION	NORTHING	EASTING
P03 17-01	189.8	4 850 875.5	293 726.6
P03 17-02	189.8	4 850 971.8	293 709.9
P04 17-01	191.7	4 851 507.0	293 485.0
P04 17-02	192.8	4 851 578.8	293 423.2
P05 17-01	196.5	4 852 057.8	292 758.2
P05 17-02	196.8	4 852 209.8	292 677.6
STM 17-27	192.2	4 851 484.4	293 450.9

-NOTES-

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GEOCRES No.

NO.	DATE	REVISIONS	BY	CHK	LEAD. DISC.	PROJ. MAN.
A	19/02/01	90% SUBMISSION TO CA	AN	MB	JL	JL

SCALE :

10m 0 20m
1:2000
Metres

CONSULTANT

DESIGNED	M. BOUCHER	MB	19/02/01
DRAWN	A. NOOR	AN	19/02/01
CHECKED	M. BOUCHER	MB	19/02/01
APPROVED LEAD ENGINEER	J. LEE	JL	19/02/01
APPROVED PROJ. MANAGER	J. LEE	JL	19/02/01
		NAME (PRINT)	INIT.	DATE

Ontario

link427
LOCAL | INTEGRATED | NEIGHBOURLY | KNOWLEDGEABLE

TITLE

HWY 427 EXPANSION
STORM WATER MANAGEMENT
PONDS - PACKAGE 6, 7 AND 8

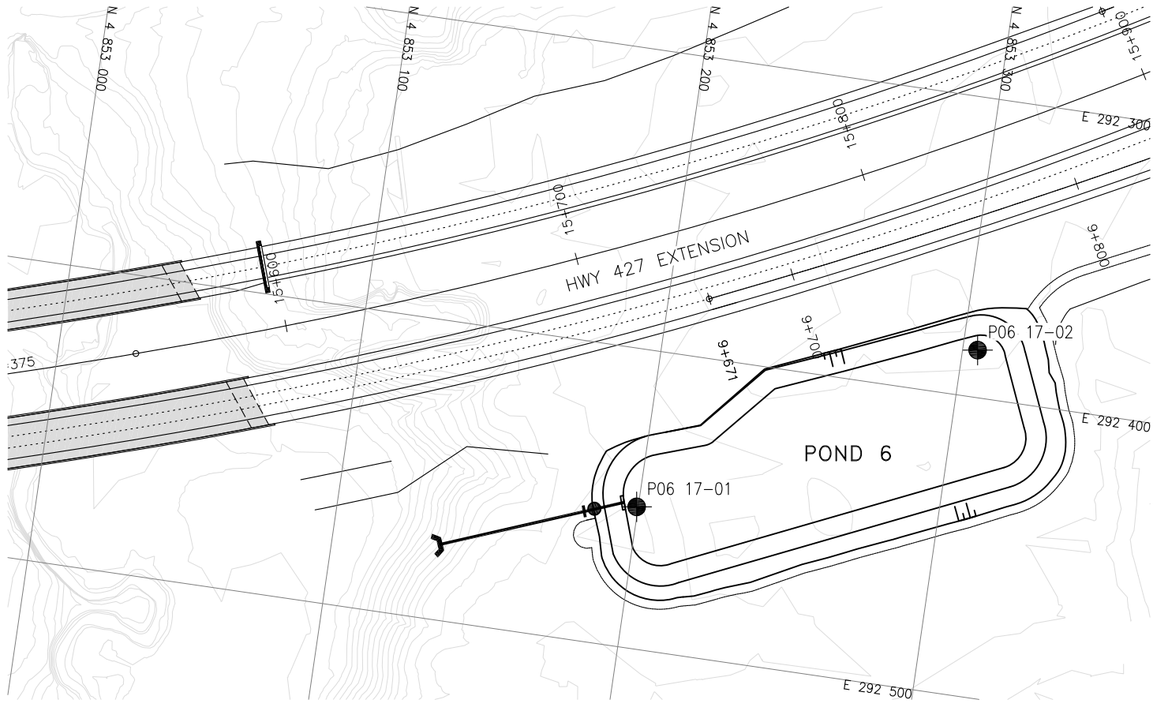
BOREHOLE LOCATIONS PLAN

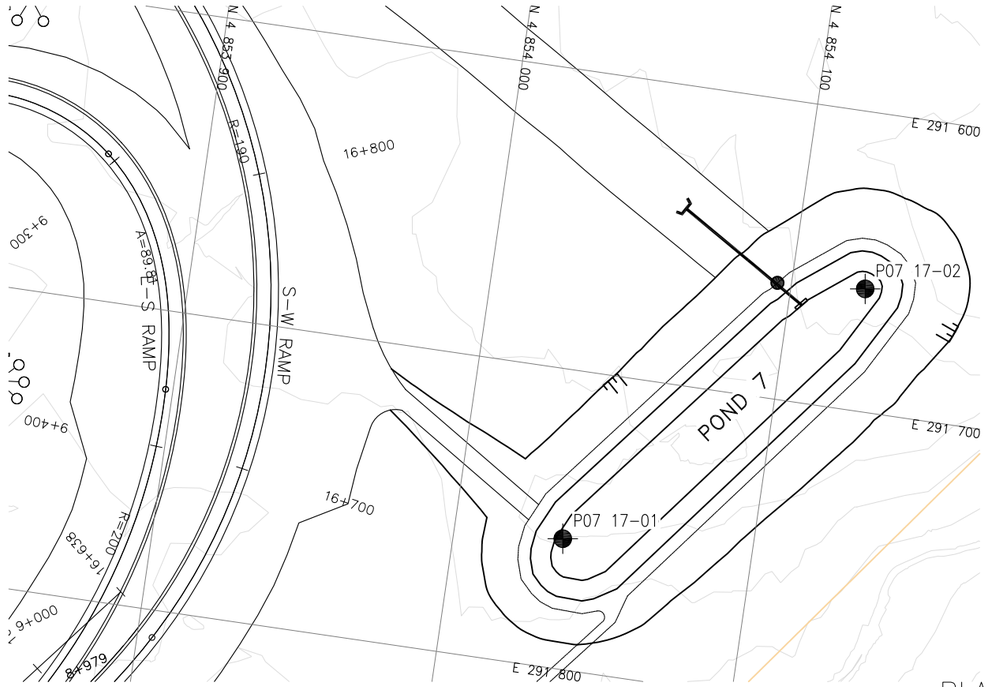
PROJECT ID.	STAGE INDENTIFIER	DESIGN PACKAGE NUMBER	DISCIPLINE	STRUCTURE NUMBER	DOCUMENT TYPE	DRAWING NUMBER	REVISION NUMBER
H427-D	N	0	FND		DWG		A

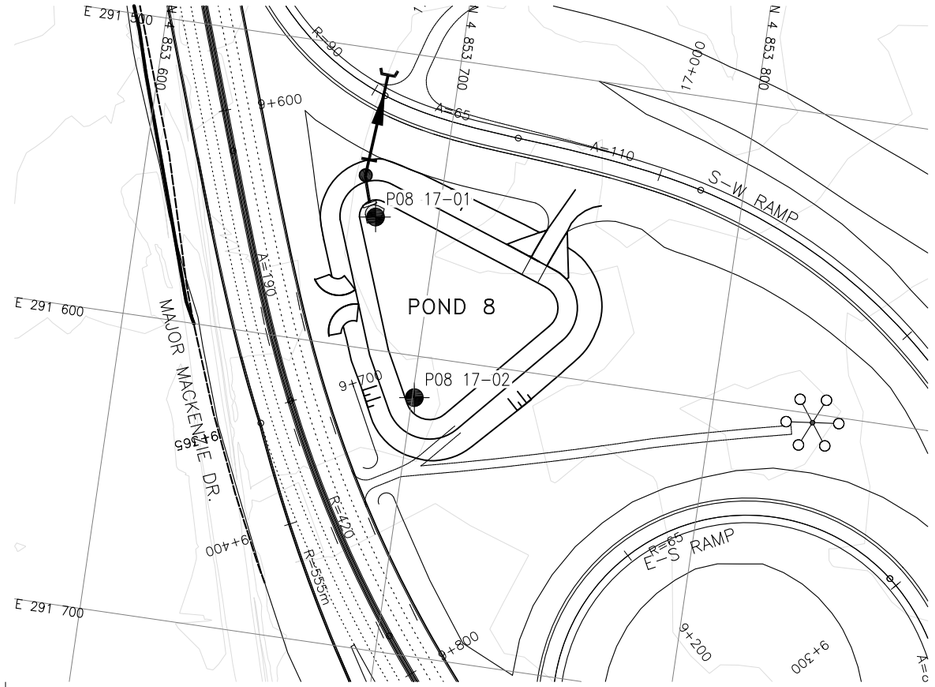
FILENAME: H:\Drafting\19000\19484\TED19484-PLAN-HWY 427 (StormWaterManagementPonds).dwg
PLOTDATE: 2/1/2019 10:52 AM

METRIC

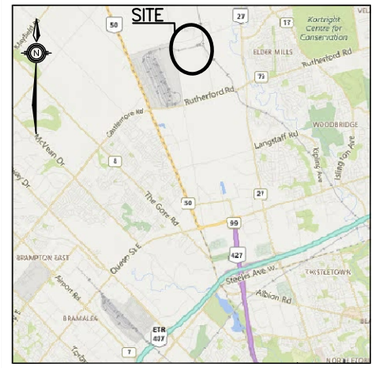
DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN







PLAN



KEYPLAN

LEGEND

- Borehole (By Thurber)
- Borehole (By Others)

NO	ELEVATION	NORTHING	EASTING
P06 17-01	201.0	4 853 199.5	292 452.7
P06 17-02	201.8	4 853 305.0	292 384.2
P07 17-01	205.8	4 854 036.5	291 756.5
P07 17-02	206.6	4 854 124.7	291 659.0
P08 17-01	204.7	4 853 679.1	291 555.9
P08 17-02	204.4	4 853 700.7	291 613.9

-NOTES-

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2) This drawing is for subsurface information only. Surface details and features are for conceptual illustration.

GEOCRES No.

NO.	DATE	REVISIONS	BY	CHK	LEAD. DISC.	PROJ. MAN.
A	19/02/01	90% SUBMISSION TO CA	AN	MB	JL	JL

SCALE :

10m 0 20m

1:2000
Metres

CONSULTANT				
DESIGNED	M. BOUCHER	MB	19/02/01
DRAWN	A. NOOR	AN	19/02/01
CHECKED	M. BOUCHER	MB	19/02/01
APPROVED LEAD ENGINEER	J. LEE	JL	19/02/01
APPROVED PROJ. MANAGER	J. LEE	JL	19/02/01
	NAME (PRINT)	INIT.	DATE

THURBER ENGINEERING LTD.

Ontario

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TITLE

HWY 427 EXPANSION
STORM WATER MANAGEMENT
PONDS - PACKAGE 6, 7 AND 8

BOREHOLE LOCATIONS PLAN

PROJECT ID.	STAGE INDENTIFIER	DESIGN PACKAGE NUMBER	DISCIPLINE	STRUCTURE NUMBER	DOCUMENT TYPE	DRAWING NUMBER	REVISION NUMBER
H427-D	N	0	FND		DWG		A

FILENAME: H:\Drafting\19000\19484\TED19484-PLAN-HWY 427 (StormWaterManagementPonds).dwg
PLOTDATE: 2/11/2019 10:54 AM

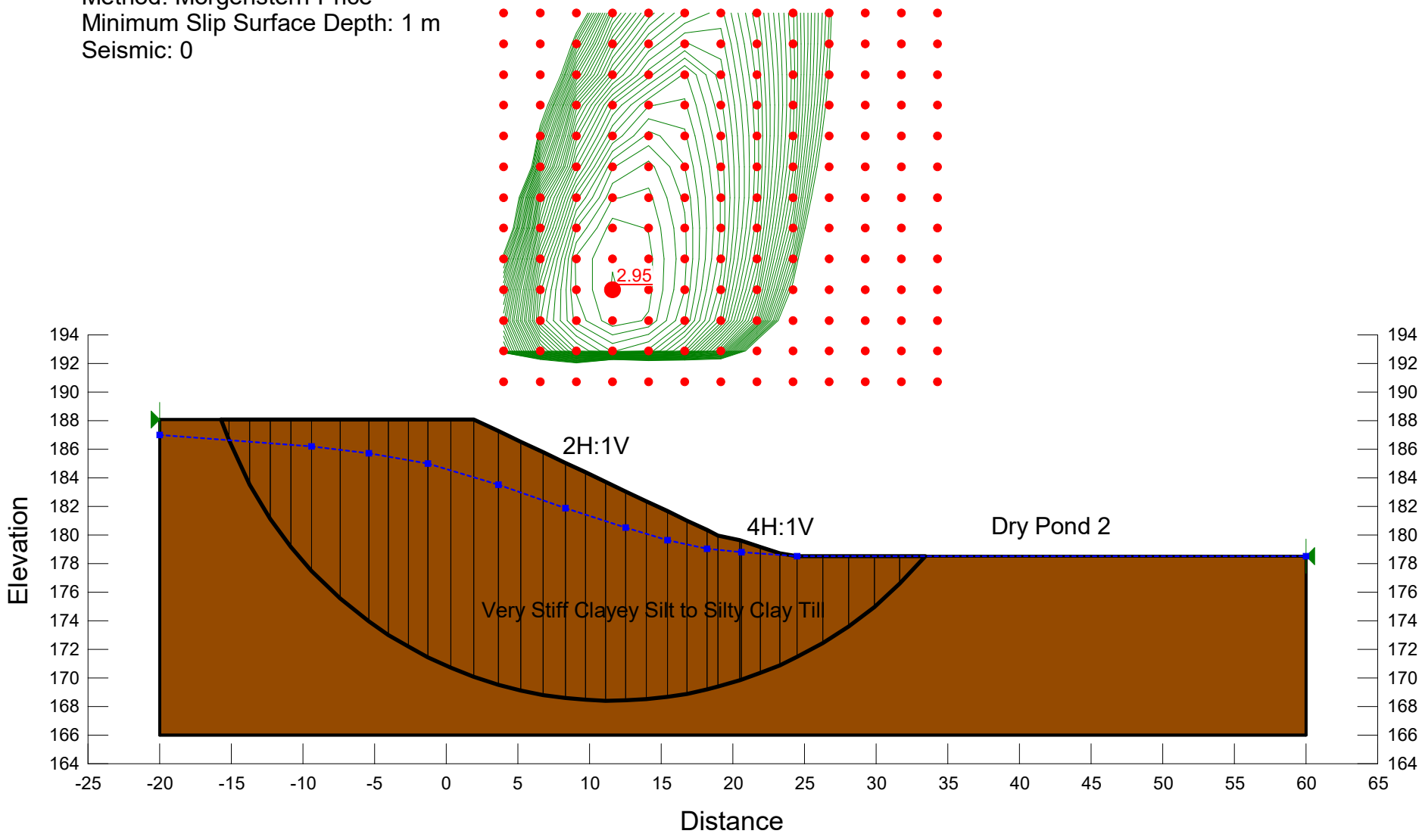
Appendix D

Slope Stability Analysis Output

POND 2 STABILITY
SHORT-TERM CONDITION

File Name: Pond 2 Section A-A (Long-Term).gsz
Last Edited By: Geoff Lay
Date: 1/31/2019
Method: Morgenstern-Price
Minimum Slip Surface Depth: 1 m
Seismic: 0

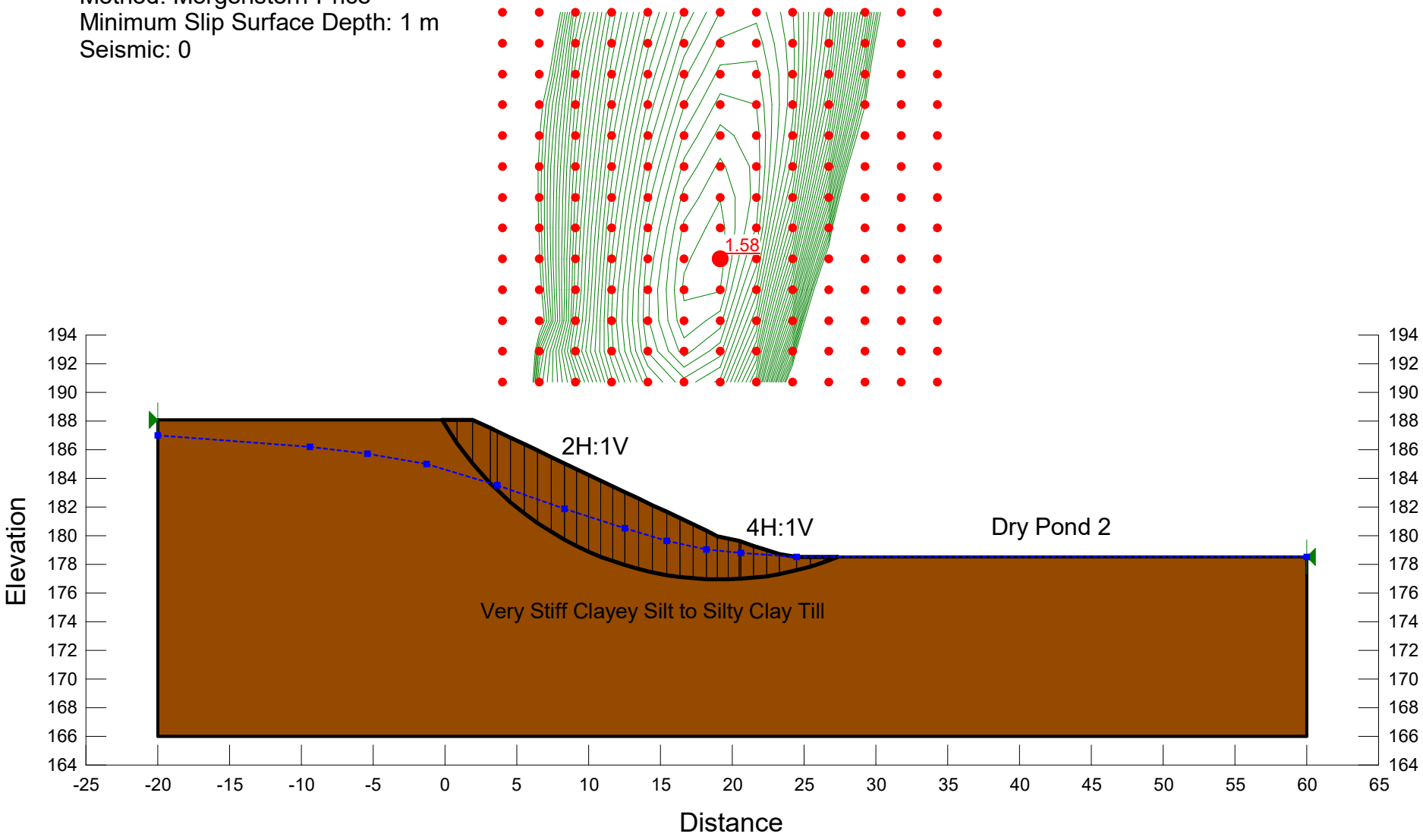
Very Stiff Clayey Silt to Silty Clay Till 21 kN/m³ 100 kPa 0 °



POND 2 STABILITY
LONG-TERM CONDITION

File Name: Pond 2 Section A-A (Short-Term).gsz
Last Edited By: Geoff Lay
Date: 1/31/2019
Method: Morgenstern-Price
Minimum Slip Surface Depth: 1 m
Seismic: 0

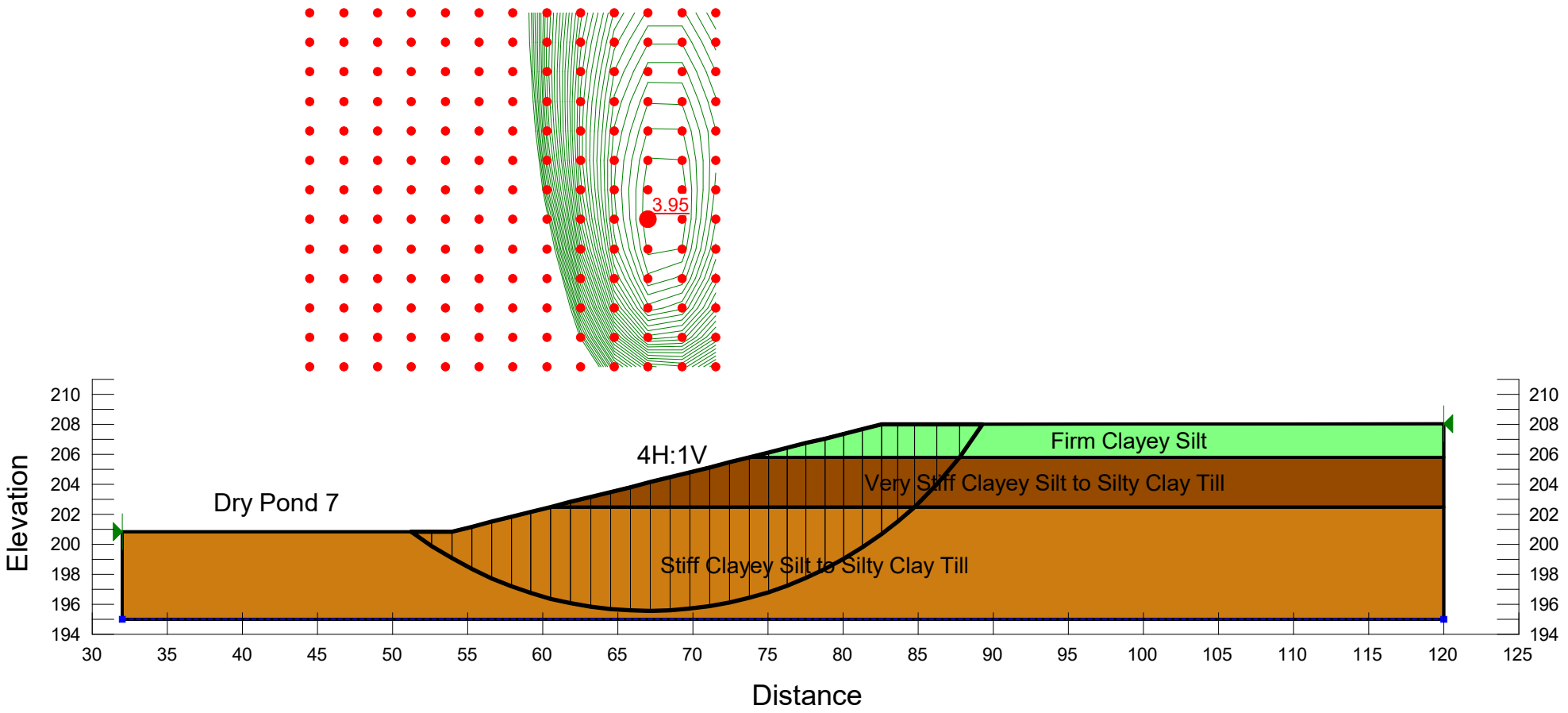
Very Stiff Clayey Silt to Silty Clay Till 21 kN/m³ 5 kPa 31 °



POND 7 STABILITY
SHORT-TERM CONDITION

File Name: Pond 7 Section B-B (Short-Term).gsz
Last Edited By: Geoff Lay
Date: 1/31/2019
Method: Morgenstern-Price
Minimum Slip Surface Depth: 1 m
Seismic: 0

Very Stiff Clayey Silt to Silty Clay Till	21 kN/m³	100 kPa	0 °
Stiff Clayey Silt to Silty Clay Till	19 kN/m³	75 kPa	0 °
Firm Clayey Silt	18 kN/m³	50 kPa	0 °



POND 7 STABILITY
LONG-TERM CONDITION

File Name: Pond 7 Section B-B (Long-Term).gsz
Last Edited By: Geoff Lay
Date: 1/31/2019
Method: Morgenstern-Price
Minimum Slip Surface Depth: 1 m
Seismic: 0

Very Stiff Clayey Silt to Silty Clay Till	21 kN/m³	5 kPa	31 °
Stiff Clayey Silt to Silty Clay Till	19 kN/m³	5 kPa	30 °
Firm Clayey Silt	18 kN/m³	5 kPa	28 °