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Subject: Foundation Investigation and Design Report
Highway 427 Expansion – Package 9 (100% Submission)
Sign Supports

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1. INTRODUCTION

This report provides foundation recommendations for the design and construction of the proposed sign support foundations to be installed at selected locations along the new extension of Highway 427. This report discusses sign support foundations located within the Package 9 limits. The installation of the sign support foundations constitutes part of the Highway 427 Expansion project in the City of Vaughan, Ontario.

Recommendations on the foundation aspects of the sign support foundation design presented in this report were based on the interpretation of the subsurface information obtained during recently completed geotechnical investigation by Thurber Engineering Ltd. (Thurber) as well as previous investigations the results of which were presented in the reports listed below:

1. GEOCRE 30M12-292: Foundation Investigation Report, Proposed Sewer Pipe Crossings, Hwy 427 Inside Widening from Fasken Drive to Steeles Avenue, Toronto, Ontario, G.W.P. 202-95-00, dated March 16, 2010, prepared by Thurber Engineering Ltd.
2. GEOCRE 30M12-291: Foundation Investigation Report, Highway 427 Widening from Fasken Drive to Steeles Avenue, High Mast Light Poles, Overhead Sign Supports, Toronto, Ontario, G.W.P. 202-95-00, dated March 12, 2010, prepared by Thurber Engineering Ltd.
3. GEOCRE 30M13-176: Preliminary Foundation Investigation and Design Report, Culverts, Highway 427 Extension (NBL and SBL) from Highway 7 to Major Mackenzie Drive, Ministry of Transportation, Ontario, W.O. 05-20012, dated August 2009, prepared by Golder Associates.

The discussion and recommendations for design presented in this report were based on drawings provided by WSP showing the proposed highway alignment and sign support locations. The approximate locations of the signs have been listed in the table attached to this report and are shown on the Borehole Location Plans in Appendix C.

Geotechnical design parameters for the sign support foundations have been provided in a tabularized format following the text of the report.

A number of boreholes, as indicated in the attached table and on the attached drawing in Appendix C, have not yet been drilled due to access issues. Once these boreholes have been drilled and the borehole information is available, an addendum to this report will be issued to provide the additional borehole data and associated foundation recommendations.

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 project site of the Highway 427 Expansion project includes a widening section between Finch Avenue and Highway 7 and the 6.6 km long expansion from Highway 7 to Major Mackenzie Drive in the City of Vaughan, Ontario. Package 9, the subject of this report, is located within the widening section between Finch Avenue and Highway 7. The proposed sign supports are distributed throughout the widening area, as shown on the Borehole Location Drawing in Appendix C. A total of thirty-five (35) signs are included in Package 9 and are addressed in this report. Lands surrounding Package 9 area are mostly developed and are used for a mix of commercial and industrial purposes.

The site is situated within the physiographic region known as the Peel Plain (*The Physiography of Southern Ontario* by L.J. Chapman and D.F. Putnam, 1984). The subsurface conditions in the region generally comprise

clayey silt to silty clay till (Halton Till) with interlayers of sand and silt till. Localized recent deposits of sands, silts and soft clays formed in small glacial meltwater ponds throughout the region and 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 interlayers.

3. GEOTECHNICAL INVESTIGATION

A combination of boreholes drilled during the recent investigations by Thurber, both specifically for the sign support foundations and for other structures, and boreholes drilled in previous investigations by other consultants were used to prepare this report. A total of 24 borehole logs were reviewed in the preparation of this report. An additional 20 boreholes are proposed to provide information for additional sign support foundation locations and will be drilled once the access issues are resolved.

The ground surface elevations at the borehole locations as well as borehole coordinates were provided to Thurber by WSP. The coordinate system MTM NAD 83, Zone 16 was used to establish locations of the boreholes.

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. Standpipe piezometers were installed in selected boreholes, as detailed on the Record of Borehole sheets. Boreholes without piezometers have been decommissioned in general accordance with 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 from the current investigation are enclosed in Appendix A following the text of this report. The locations of boreholes, as well as the proposed sign supports are shown on the Borehole Location Plans enclosed in Appendix C. Boreholes from previous investigation utilized in this report are enclosed in Appendix B.

4. SUBSURFACE CONDITIONS

Details of the encountered soil stratigraphy are presented on the Record of Borehole sheets included in Appendix A. Also, selected boreholes from previous investigations referenced in Section 1 were used in preparation of this report. The Record of Borehole sheets from previous investigations are included in Appendix B.

In general, the soil stratigraphy encountered at this site consisted of either asphalt, topsoil or surficial silty clay to clayey silt overlying a cohesive till deposit. In some boreholes a cohesionless till deposit was encountered below the cohesive till. Occasional cobbles were reported in the till deposit. Cobbles and boulders are inherently present in the till deposits and should be expected during excavations/construction.

The simplified soil stratigraphy, borehole coordinates and design ground water levels at each sign support location are provided in the attached tables.

5. FOUNDATION DESIGN FOR SIGN SUPPORTS

5.1 Foundation Parameters

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

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

Reference should also be made to the following documents.

- Ministry of Transportation, Ontario (2004) "Guidelines for the Design of High Mast Pole Foundations", Fourth Edition, BRO-009, Engineering Standards Branch, Bridge Office, (Reference 2) and
- Canadian Highway Bridge Design Code and Commentary, 2014 or the most recent edition (Reference 3)

It is understood that a typical sign support consists of an augered caisson (drilled shaft). Some signs will be supported by two caissons while others will be supported by a single caisson. The recommended parameters for foundation design of caissons are provided in the table following the text of this report.

It is recommended that MTO's standard designs in References 1 and 2 be used as a basis for the support foundations design.

To account for frost action and surficial disturbance, the ultimate lateral passive resistance in front of a caisson within the upper 1.2 m below final grade should be neglected in the foundation design. It is recommended that all topsoil and organic deposits also be neglected in determination of lateral resistance.

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

Where an unconfined compressive strength, q_u , ($q_u = 2 \times c_u$, where c_u is undrained shear strength) is provided for cohesive soils (clayey silt to silty clay fill, native clayey silt or silty clay or clayey silt to silty clay till), the ultimate lateral passive resistance should be calculated in conjunction with the total soil unit weight.

When designing for portions of the caissons below the groundwater level in cohesionless sands and silts, the submerged soil unit weight, γ' , should be used.

The design parameters were provided for the soils encountered beneath the existing ground surface at the borehole locations. The sign supports may be installed through the embankment fill to be placed for the proposed highway. The embankment fill may consist of either granular fill or cohesive fill (reused soils excavated on site). Providing the fills are properly placed and compacted as per specifications, the design parameters presented in the table below may be used for design of the sign supports in fills.

Fill Material	q_u (kPa)	ϕ' (deg.)	γ (kN/m ³)	n_h (MN/m ³)	K_p
Granular Fill - compact	-	32	22	5000	3.3
Cohesive Fill – firm to stiff	80	-	20	-	-

The stabilized groundwater level may be at higher elevation than indicated on the Record of Borehole sheets. The required depth of the drilled shaft will be governed by lateral loads, including wind loads. The length of the caisson should also be sufficient to counteract frost action (upward forces).

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

5.2 Caisson Installation

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

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

The short term groundwater levels were measured to be at various depths below existing ground surface. The stabilized groundwater levels may be higher than indicated on the record of Borehole sheets. Soil sloughing and water seepage may occur in unsupported holes especially in sands and silts below the groundwater level. The cohesionless soils would also be susceptible to disturbance (basal and sidewall instability) under conditions of unbalanced hydrostatic head. Temporary liners must be available to support the caisson sidewalls and to provide seepage cut-off where required. Any accumulated water may have to be pumped out from the hole prior to placing concrete. A balancing water head or suitable drilling mud should be used inside the caisson hole in cases where the caisson base is within sands and silts. Should it be considered impractical to remove the accumulated water inside the hole, it is recommended that the concrete be placed by the tremie method.

5.3 Construction Concerns

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

5.4 Construction Inspection and Testing

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



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

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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.

TABLE TS - 9
HIGHWAY 427 EXTENSION - DESIGN PACKAGE 9
SIGN SUPPORTS
FOUNDATION DESIGN PARAMETERS

[illegible]

Sign Number	Approx. Sign Station	Relevant BHs	Simplified Stratigraphy	Ground Surface Elev. (m)	Depth Below Existing Grade (m)	Foundation Design Parameters							Foundation Type
						q_u (kPa)	ϕ' (deg.)	γ (kN/m ³)	γ' (kN/m ³)	n_h (MN/m ³)	K_p	Ground water depth (m)	
GMS-N3	10+855	TS 17-09	Clayey Silt Fill – v. stiff Clayey Silt Till – v. stiff to hard	175.6	0 – 0.8 0.8 – 6.7	150 200	- -	19 20	- -	- -	- -	1 (below existing grade)	Standard
OHS-S11	10+980	HM 17-04 (east leg)	Asphalt Sand and Gravel Fill – compact to dense Silty Clay/Clayey Silt Till – stiff Silty Clay/Clayey Silt Till – v. stiff	176.5	0 – 0.1 0.1 – 2.2 2.2 – 4.0 4.0 – 8.2	- - 125 150	- 32 - -	- 20 19 20	- - - -	- 5000 - -	- 3.3 - -	2 (below existing grade)	Standard
		TS 18-05*											*
OHS-N3	11+230	TS 17-10 (east leg)	Clayey Silt – very stiff Silty Clay Till – very stiff	179.3	0 – 0.8 0.8 – 6.7	150 175	- -	19 20	- -	- -	- -	2 (below existing grade)	Standard
		CNH-01 (west leg)	Topsoil Silty Clay Fill – very stiff Silty Clay Till – hard	180.3	0 – 0.1 0.1 – 9.1 9.1 – 19.8	- 150 200	- - -	- 19 20	- - -	- - -	- - -	2 (below existing grade)	Standard
HMS-S5 GMS-S4	11+350	CNH-08 (east leg)	Asphalt Gravelly Sand Fill – very dense Silt and Sand Fill – loose to compact (awl) Silt and Sand Fill – loose to compact (bwl) Silty Clay Fill – stiff to v.stiff Silty Clay Till - hard	181.3	0.0 – 0.1 0.1 – 1.1 1.1 – 2.0 2.0 – 4.6 4.6 – 9.8 9.8 – 15.6	- - - - 150 200	- 38 30 30 - -	- 20 20 - 19 20	- - - 10 - -	- 17000 3000 2000 - - -	- 4.2 3.0 3.0 - - -	2 (below existing grade)	Standard
		PC-25 (HMS-S5 west leg, GMS-S4)	Asphalt Gravelly Sand Fill – compact Silt and Sand Fill – compact (awl) Silt and Sand Fill – compact (bwl) Silty Clay Fill – stiff to very stiff	181.2	0.0 – 0.2 0.2 – 0.6 0.6 – 2.0 2.0 – 4.9 4.9 – 9.8	- - - - 125	- 32 30 30 -	- 20 20 - 19	- - - 10 -	- 5000 3000 2000 -	- 3.3 3.0 3.0 -		Standard

Sign Number	Approx. Sign Station	Relevant BHs	Simplified Stratigraphy	Ground Surface Elev. (m)	Depth Below Existing Grade (m)	Foundation Design Parameters							Foundation Type
						q_u (kPa)	ϕ' (deg.)	γ (kN/m ³)	γ' (kN/m ³)	n_h (MN/m ³)	K_p	Ground water depth (m)	
HMS-N2 TS07	11+550	TS 18-10* (east leg)											*
		TS 18-09* (west leg)											*
OHS-S10	11+700	PC-30	Asphalt Sand Fill Silty Clay Fill – firm to stiff Sandy Silt Fill – compact Silty Clay Till – stiff Silty Clay Till – very stiff to hard	180.0	0.0 – 0.1 0.1 – 0.6 0.6 – 4.3 4.3 – 5.8 5.8 – 7.4 7.4 – 9.8	- - 100 - 100 200	- - - 33 - -	- - 19 - 19 20	- - - 10 - -	- - - 4500 - -	- - - 3.4 - -	4 (below existing grade)	Standard
OHS-N4	11+870	TS 18-06*											*
OHS-S9	12+060	TS 18-12* (east leg)											*
		TS 18-13* (west leg)											*
TS10 HMS-S4	12+410	TS 17-12 (east leg)	Sand Fill – compact Silty Clay/Clayey Silt – stiff Silty Clay Till – hard	180.2	0.0 – 0.6 0.6 – 3.0 3.0 – 6.5	- 125 200	32 - -	19 19 20	- - -	5000 - -	3.2 - -	6 (below existing grade)	Standard
		TS 17-13 (west leg)	Clayey Silt – very stiff Silty Clay Till – stiff Silty Clay Till – very stiff to hard	180.2	0.0 – 0.7 0.7 – 1.5 1.5 – 6.3	150 125 175	- - -	19 19 20	- - -	- - -	- - -		Standard
GMS-S3	12+465	TS 19-04*											*
OHS-N5	12+580	HM 17-06 (west leg)	Clayey Silt – stiff Silty Clay/Clayey Silt Till – stiff/v. stiff Silty Clay/Clayey Silt Till - hard Silty Sand Till – very dense	179.1	0.0 – 0.8 0.8 – 2.5 2.5 – 7.6 7.6 – 9.1	125 150 200 -	- - - 38	19 19 20 -	- - - 11	- - - 11000	- - - 4.2	7 (below existing grade)	Standard
		TS 18-14* (east leg)											*

[illegible]

Sign Number	Approx. Sign Station	Relevant BHs	Simplified Stratigraphy	Ground Surface Elev. (m)	Depth Below Existing Grade (m)	Foundation Design Parameters							Foundation Type
						q_u (kPa)	ϕ' (deg.)	γ (kN/m ³)	γ' (kN/m ³)	n_h (MN/m ³)	K_p	Ground water depth (m)	
VMS-S2	13+490	TS 18-16* (west leg)											*
		TS 18-17 (east leg)	Clayey Silt Fill – soft to firm Clayey Silt to Silty Clay Till – hard	0.0 – 0.6 0.6 – 8.2		50 200	- -	18 20	- -	- -	- -	1 (below existing grade)	Standard
OHS-N7	13+580	TS 18-18* (east leg)											*
		HM 17-12 (west leg)	Sand and Gravel Fill – loose Silty Clay/Clayey Silt Till – hard	177.7	0.0 – 0.8 0.8 – 8.5	- 200	30 -	19 20	- -	2800 -	3.0 -	1 (below existing grade)	Standard
OHS-M1	10+280 RAMP	STM 17-10 (west leg)	Asphalt	179.2	0.0 – 0.1	-	-	-	-	-	-	2 (below existing grade)	Standard
			Gravelly Sand – compact		0.1 – 0.8	-	31	20	-	3500	3.1		Standard
			Silty Clay – firm to stiff		0.8 – 2.3	100	-	19	-	-	-		
			Silty Clay/Clayey Silt Till – firm		2.3 – 4.4	100	-	19	-	-	-		
OHS-M1	10+280 RAMP	TS 18-19 (east leg)	Silt – very dense to dense		4.4 – 6.7	-	38	-	10	11000	4.2		
			Topsoil		0.0 – 0.1	-	-	-	-	-	-		Standard
			Clayey Silt – Stiff		0.1 – 0.8	100	-	19	-	-	-		
			Clayey Silt/Silty Clay Till – very stiff		0.8 – 2.3	175	-	19	-	-	-		
TS15	13+980	UC 17-03	Silty Sand Till – dense		2.3 – 2.7	-	36	-	10	8000	3.8	1 (below existing ground level)	Standard
			Clayey Silt to Silty Clay Till – hard		2.7 – 5.6	200	-	20	-	-	-		
			Clayey Silt to Silty Clay Till – very stiff		5.6 – 8.2	175	-	20	-	-	-		
TS15	13+980	UC 17-03	Sand and Gravel Fill	178.6	0.0 – 0.3	-	-	-	-	-	-	1 (below existing ground level)	Standard
			Silty Clay - v.stiff		0.3 – 0.8	175	-	19	-	-	-		
			Silty Clay/Clayey Silt Till – hard		0.8 – 4.3	200	-	20	-	-	-		
			Silt – very dense		4.3 – 5.8	-	38	-	10	11000	4.2		
			Silty Clay/Clayey Silt – hard		5.8 – 9.6	200	-	20	-	-	-		

Sign Number	Approx. Sign Station	Relevant BHs	Simplified Stratigraphy	Ground Surface Elev. (m)	Depth Below Existing Grade (m)	Foundation Design Parameters							Foundation Type
						q_u (kPa)	ϕ' (deg.)	γ (kN/m ³)	γ' (kN/m ³)	n_h (MN/m ³)	K_p	Ground water depth (m)	
TS16	10+040	C2	Asphalt	179.9	0.0 – 0.1	-	-	-	-	-	-	2 (below existing ground level)	Standard
			Sand and Gravel Fill		0.1 – 0.6	-	28	19	-	2000	2.7		
			Clayey Silt Till – hard		0.6 – 3.8	175	-	20	-	-	-		
			Silt – very dense		3.8 – 5.6	-	38	-	10	11000	4.2		
			Clayey Silt – Hard		5.6 – 9.5	175	-	20	-	-	-		
			Clayey Silt Till - Hard		9.5 – 9.8	175	-	20	-	-	-		

* borehole to be completed to confirm ground conditions

Legend:

q_u	=	unconfined compressive strength, ($q_u = 2 \times c_u$, where c_u is undrained shear strength) (kPa)
ϕ'	=	angle of internal friction (degrees)
γ	=	bulk unit weight (kN/m ³)
γ'	=	submerged unit weight (kN/m ³) – to be used for cohesionless soils below the groundwater table
n_h	=	coefficient of horizontal subgrade reaction (MN/m ³)
K_p	=	coefficient of passive earth pressures

Notes:

1. Traffic sign stations are approximate.
2. For approximate borehole locations reference should be made to the Borehole Location Plan (attached). Borehole coordinates (northings and eastings) are provided on the Record of Borehole sheets.
3. This table should be read in conjunction with the text of this report.
4. To account for frost action and surficial soil disturbance, the ultimate lateral passive resistance in front of the caisson within the upper 1.2 m below final grade should be neglected in the foundation design.
5. If new fill is placed, some caissons may be partially embedded within the new fill.

Appendix A

Record of Borehole Sheets – Recent Investigation

SYMBOLS, ABBREVIATIONS AND TERMS USED ON RECORDS OF BOREHOLES

1. TEXTURAL CLASSIFICATION OF SOILS

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

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

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

3. TERMS DESCRIBING CONSISTENCY (COHESIVE SOILS ONLY)

DESCRIPTIVE TERM	UNDRAINED SHEAR STRENGTH (kPa)	APPROXIMATE SPT ⁽¹⁾ 'N' VALUE
Very Soft	12 or less	Less than 2
Soft	12 to 25	2 to 4
Firm	25 to 50	4 to 8
Stiff	50 to 100	8 to 15
Very Stiff	100 to 200	15 to 30
Hard	Greater than 200	Greater than 30

NOTE: Hierarchy of Soil Strength Prediction

- 1) Laboratory Triaxial Testing
- 2) Field Insitu Vane Testing
- 3) Laboratory Vane Testing
- 4) SPT value
- 5) Pocket Penetrometer


4. TERMS DESCRIBING DENSITY (COHESIONLESS SOILS ONLY)

DESCRIPTIVE TERM	SPT "N" VALUE
Very Loose	Less than 4
Loose	4 to 10
Compact	10 to 30
Dense	30 to 50
Very Dense	Greater than 50

5. LEGEND FOR RECORDS OF BOREHOLES

SYMBOLS AND ABBREVIATIONS FOR SAMPLE TYPE	SS Split Spoon Sample	WS Wash Sample	AS Auger (Grab) Sample
	TW Thin Wall Shelby Tube Sample	TP Thin Wall Piston Sample	
	PH Sampler Advanced by Hydraulic Pressure	PM Sampler Advanced by Manual Pressure	
	WH Sampler Advanced by Self Static Weight	RC Rock Core	SC Soil Core

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

 Water Level

C_{pen} Shear Strength Determination by Pocket Penetrometer

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

EXPLANATION OF ROCK LOGGING TERMS


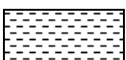

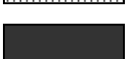

ROCK WEATHERING CLASSIFICATION

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

DISCONTINUITY SPACING

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

SYMBOLS

	CLAYSTONE
	SILTSTONE
	SANDSTONE
	COAL
	BEDROCK

STRENGTH CLASSIFICATION

Rock Strength	Approximate Uniaxial Compressive Strength		Field Estimation of Hardness*
	(MPa)	(psi)	
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			

RECORD OF BOREHOLE No HM 17-01

1 OF 1

METRIC

W.P. _____ LOCATION N 4 844 299.0 E 294 469.7 ORIGINATED BY OA
 HWY 427 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2017.07.21 - 2017.07.21 CHECKED BY ME

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE				WATER CONTENT (%) w _p w w _L				
170.3	GROUND SURFACE							20	40	60	80	100				
0.0 0.1	ASPHALT: (75mm)															
	Gravelly SAND Dense to Compact Grey Moist (FILL)		1	SS	36		170									
			2	SS	11		169									
168.8																
1.5	Silty CLAY , trace sand, trace gravel Firm Brown Moist		3	SS	4		168									
168.1																
2.2	Silty CLAY , trace to some sand, trace gravel Stiff to Very Stiff Brown Moist (TILL)		4	SS	14		167									
			5	SS	21		166									
			6	SS	21		165									
164.4							164									
5.9	Silty SAND , some gravel, some clay Very Dense Brown Moist (TILL)		7	SS	46		163									
			8	SS	72											
162.1																
8.2	END OF BOREHOLE AT 8.2m. WATER LEVEL AT 7.6m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND CUTTINGS TO SURFACE.															

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

RECORD OF BOREHOLE No HM 17-04

1 OF 1

METRIC

W.P. _____ LOCATION N 4 844 725.9 E 294 405.9 ORIGINATED BY KK
 HWY 427 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2017.07.24 - 2017.07.24 CHECKED BY ME

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
176.5	GROUND SURFACE							<div>20 40 60 80 100</div> <div>○ UNCONFINED + FIELD VANE</div> <div>● QUICK TRIAXIAL × LAB VANE</div> <div>20 40 60 80 100</div>						
0.0	ASPHALT: (100mm)							<div>PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT</div> <div>W_P W W_L</div> <div>WATER CONTENT (%)</div> <div>20 40 60</div>						
0.1	SAND and GRAVEL, trace silt Compact to Dense Brown Moist (FILL)		1	SS	46		176							
			2	SS	37									
			3	SS	10		175							
174.3			4	SS	10		174							
2.2	Clayey SILT to Silty CLAY, some sand, trace gravel Stiff to Very Stiff Brown Moist (TILL)		5	SS	14		173							
			6	SS	18		172							
							171							
			7	SS	23		170							
			8	SS	20		169							
168.2														
8.2	END OF BOREHOLE AT 8.2m. BOREHOLE DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH CUTTINGS THEN ASPHALT TO SURFACE.													

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

RECORD OF BOREHOLE No HM 17-06

1 OF 2

METRIC

W.P. _____ LOCATION N 4 846 369.0 E 294 159.2 ORIGINATED BY TF
 HWY 427 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2017.07.18 - 2017.07.18 CHECKED BY ME

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _P	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
								20	40	60	80	100					
179.1	GROUND SURFACE																
0.0	Clayey SILT , trace gravel, trace sand, trace organics (rootlets) Stiff Brown Moist		1	SS	12		179										
178.4																	
0.8	Clayey SILT to Silty CLAY , trace to some sand, trace gravel, occasional cobbles Firm to Hard Brown to Grey Moist (TILL)		2	SS	19		178										
			3	SS	8		177										
			4	SS	22		176										
			5	SS	33		175										
			6	SS	41		174										
			7	SS	50/ 0.075		173										
							172										
171.5																	
7.6	Silty SAND , some clay, some gravel Very Dense Grey Wet (TILL)		8	SS	50/ 0.075		171										17 41 31 11
170.0																	
9.1	END OF BOREHOLE AT 9.1m. BOREHOLE CAVED TO 6.7m AND WATER LEVEL AT 8.0m BELOW GROUND SURFACE. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND						170										

Continued Next Page

+³, ×³: Numbers refer to
Sensitivity

20
15
10
(%) STRAIN AT FAILURE

METRIC

[illegible]

RECORD OF BOREHOLE No HM 17-12

1 OF 1

METRIC

W.P. _____ LOCATION N 4 847 352.9 E 294 059.2 ORIGINATED BY TF
 HWY 427 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2017.07.13 - 2017.07.13 CHECKED BY ME

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _P	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
177.7	GROUND SURFACE							20	40	60	80	100					
0.0	SAND and GRAVEL , some silt, trace clay, trace organics (rootlets) Loose Brown Moist (FILL)		1	SS	8										○		
176.9																	
0.8	Clayey SILT to Silty CLAY , some sand, trace gravel, occasional cobbles Hard Brown Moist (TILL)		2	SS	62										○		
			3	SS	125										○		
			4	SS	50/ 0.075										○		
	Cobbles		5	SS	146										○		
			6	SS	80										○		
			7	SS	58										○		
			8	SS	104/ 0.225										○		
169.1																	
8.5	END OF BOREHOLE AT 8.5m. BOREHOLE CAVED TO 5.8m AND DRY UPON COMPLETION OF DRILLING. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND CUTTINGS TO SURFACE.																

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+³, ×³: Numbers refer to
Sensitivity

20
15
10

(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No HM 17-38

1 OF 1

METRIC

W.P. _____ LOCATION N 4 843 901.3 E 294 528.9 ORIGINATED BY OA
 HWY 427 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2017.07.21 - 2017.07.21 CHECKED BY ME

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W _P	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									WATER CONTENT (%)
166.2	GROUND SURFACE							20	40	60	80	100					
0.0	ASPHALT: (200mm)							20	40	60	80	100					
0.1	Gravelly SAND Dense to Compact Grey Moist (FILL)		1	SS	60		166										
			2	SS	25		165										
164.8	Clayey SILT, sandy, some gravel Compact to Very Dense Grey Moist (TILL)		3	SS	25		164										
1.4			4	SS	21		163										
			5	SS	35		162										
			6	SS	50/ 0.150		161										
			7	SS	50/ 0.125		160										
			8	SS	50/ 0.150		159										
158.3	END OF BOREHOLE AT 7.9m. BOREHOLE DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND CUTTINGS TO SURFACE.																
7.9																	

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

RECORD OF BOREHOLE No STM 17-05

1 OF 1

METRIC

W.P. _____ LOCATION N 4 846 481.1 E 294 104.7 ORIGINATED BY TF
 HWY 427 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2017.07.25 - 2017.07.25 CHECKED BY ME

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _P	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE									
175.4	GROUND SURFACE							20	40	60	80	100					
0.0	TOPSOIL: (100mm)							20	40	60	80	100					
0.1	Clayey SILT , trace gravel, trace organics Firm to Stiff Brown Moist		1	SS	6		175							○			
			2	SS	14									○			
174.0							174										
1.4	Clayey SILT to Silty CLAY , trace to some sand, trace gravel Hard Brown to Grey Moist (TILL)		3	SS	35									○	—		0 17 37 46
			4	SS	60		173							○			
			5	SS	100/ 0.150		172							○			
			6	SS	133		171							○			
							170										
169.8																	
5.6	Sandy SILT , trace gravel Very Dense Grey Moist to Wet (TILL)		7	SS	100/ 0.150									○			
169.2																	
6.2	END OF BOREHOLE AT 6.2m. Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen. WATER LEVEL READINGS DATE DEPTH(m) ELEV.(m) 2017.10.25 4.2 171.2																

+³, ×³: Numbers refer to Sensitivity
 20
 15 10 5 0
 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No STM 17-10

1 OF 1

METRIC

W.P. _____ LOCATION N 4 847 737.1 E 294 151.9 ORIGINATED BY OA
 HWY 427 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2017.07.19 - 2017.07.19 CHECKED BY ME

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
179.2	GROUND SURFACE													
0.0	ASPHALT: (100mm)													
0.1	Gravelly SAND , some silt Compact Dark Grey Moist (FILL)		1	SS	15									29 59 12 (SI+CL)
178.4														
0.8	Silty CLAY , trace sand, trace gravel Firm to Stiff Brown Moist		2	SS	7									
			3	SS	9									
176.9														
2.3	Clayey SILT to Silty CLAY , some sand, trace gravel Firm Brown Moist (TILL)		4	SS	8									
			5	SS	8									
174.8														
4.4	SILT , some clay, trace to some sand Very Dense Grey Moist		6	SS	50/ 0.125									
			7	SS	45									
172.5														
6.7	END OF BOREHOLE AT 6.7m. 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) 2017.10.25 2.8 176.4													

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RECORD OF BOREHOLE No TS 17-07

1 OF 1

METRIC

W.P. _____ LOCATION N 4 844 311.3 E 294 435.4 ORIGINATED BY TF
 HWY 427 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2017.07.25 - 2017.07.25 CHECKED BY ME

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa		WATER CONTENT (%)				
169.9	GROUND SURFACE							20 40 60 80 100		W _P W W _L				
0.0	ASPHALT: (200mm)							20 40 60 80 100						
0.2	SAND and SILT, trace clay, some gravel Compact Brown Moist (FILL)		1	SS	15									
169.1														
0.8	Clayey SILT to Silty CLAY, trace sand, trace gravel, occasional cobbles Stiff to Hard Brown to Grey Moist (TILL)		2	SS	18		169							
			3	SS	10		168							
			4	SS	27		167							
			5	SS	34		166							
							165							
			6	SS	56		164							
			7	SS	105									
163.2														
6.7	END OF BOREHOLE AT 6.7m. 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) 2017.10.25 Dry -													

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RECORD OF BOREHOLE No TS 17-09

1 OF 1

METRIC

W.P. _____ LOCATION N 4 844 682.1 E 294 442.0 ORIGINATED BY TF
 HWY 427 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2017.07.27 - 2017.07.27 CHECKED BY ME

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
							20	40	60	80	100						
175.6	GROUND SURFACE																
0.0	Clayey SILT , some sand, trace gravel Very Stiff Brown Moist (FILL)		1	SS	20												
174.8																	
0.8	Clayey SILT , trace sand, trace gravel Very Stiff to Hard Brown to Grey Moist (TILL)		2	SS	29												
			3	SS	28												
			4	SS	31												
			5	SS	15												
			6	SS	41												
			7	SS	69												
168.9																	
6.7	END OF BOREHOLE AT 8.1m. BOREHOLE DRY UPON COMPLETION. Well installation consists of 25mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen.																

ONTMT4S MTO-19484.GPJ 2017TEMPLATE(MTO).GDT 6/5/18

RECORD OF BOREHOLE No TS 17-10

1 OF 1

METRIC

W.P. _____ LOCATION N 4 845 046.0 E 294 392.5 ORIGINATED BY TF
 HWY 427 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2017.07.27 - 2017.07.27 CHECKED BY ME

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
179.3	GROUND SURFACE													
0.0	Clayey SILT , some sand, trace gravel Very Stiff Light to Dark Brown Moist		1	SS	15									
178.5														
0.8	Silty CLAY , some sand to sandy, trace gravel Very Stiff to Hard Brown to Grey Moist (TILL)		2	SS	19									
			3	SS	18									
			4	SS	13									
			5	SS	30									
			6	SS	26									
			7	SS	16									
172.6														
6.7	END OF BOREHOLE AT 6.7m. BOREHOLE CAVED TO 5.8m AND DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND CUTTINGS TO SURFACE.													

ONTMT4S MTO-19484.GPJ 2017TEMPLATE(MTO).GDT 2/13/19

RECORD OF BOREHOLE No TS 17-12

1 OF 1

METRIC

W.P. _____ LOCATION N 4 846 190.0 E 294 164.9 ORIGINATED BY TF
 HWY 427 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 0217.07.26 - 2017.07.26 CHECKED BY ME

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					
180.2	GROUND SURFACE							20 40 60 80 100					
0.0	SAND , some silt, trace clay, trace gravel Compact Brown Moist (FILL)		1	SS	22		180						
179.6													
0.6	Clayey SILT to Silty CLAY , some trace gravel Stiff Brown Moist		2	SS	12		179						
			3	SS	12		178						
			4	SS	12		177						
177.2													
3.0	Silty CLAY , with sand, trace gravel, occasional cobbles Hard Grey Moist (TILL)		5	SS	36		176						
			6	SS	50/ 0.075		175						
			7	SS	50/ 0.075		174						
173.7													
6.5	END OF BOREHOLE AT 6.5m. BOREHOLE DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND CUTTINGS TO SURFACE.												

ONTMT4S MTO-19484.GPJ 2017TEMPLATE(MTO).GDT 2/13/19

RECORD OF BOREHOLE No TS 17-13

1 OF 1

METRIC

W.P. _____ LOCATION N 4 846 194.3 E 294 184.3 ORIGINATED BY TF
 HWY 427 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2017.07.19 - 2017.07.19 CHECKED BY ME

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
								20 40 60 80 100						
180.2	GROUND SURFACE													
0.0	Clayey SILT , trace sand, trace gravel Very Stiff Brown Moist		1	SS	21		180							
179.5														
0.7	Silty CLAY , trace to some sand, trace gravel Stiff to Hard Brown to Grey Moist (TILL)		2	SS	12		179							
			3	SS	41		178							
			4	SS	25		177							
			5	SS	20		176							
			6	SS	66		175							
173.9			7	SS	50/		174							
6.3	END OF BOREHOLE AT 6.3m. BOREHOLE CAVED TO 5.5m AND DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND CUTTINGS TO SURFACE.				0.075									

ONTMT4S MTO-19484.GPJ 2017TEMPLATE(MTO).GDT 2/13/19

RECORD OF BOREHOLE No TS 17-14

1 OF 1

METRIC

W.P. _____ LOCATION N 4 846 482.8 E 294 167.6 ORIGINATED BY TF
 HWY 427 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2017.07.18 - 2017.07.18 CHECKED BY ME

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa							
179.1	GROUND SURFACE							20 40 60 80 100							
0.0	Clayey SILT , trace gravel, organics Stiff Brown Moist		1	SS	10		179								
178.3															
0.8	Clayey SILT to Silty CLAY , trace to some sand, trace gravel Stiff to Hard Brown to Grey Moist (TILL)		2	SS	13		178								
			3	SS	10		177								
			4	SS	8		176								
			5	SS	27		175								
			6	SS	53		174								
173.5															
5.6	Sandy SILT , some clay, trace gravel Very Dense Grey Moist (TILL)		7	SS	111		173								
							172								
171.5															
7.6	END OF BOREHOLE AT 7.6m. BOREHOLE DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND CUTTINGS TO SURFACE.														

ONTMT4S MTO-19484.GPJ 2017TEMPLATE(MTO).GDT 2/13/19

RECORD OF BOREHOLE No TS 17-16

1 OF 1

METRIC

W.P. _____ LOCATION N 4 846 954.0 E 294 083.3 ORIGINATED BY TF
 HWY 427 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2017.07.14 - 2017.07.14 CHECKED BY ME

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
177.5	GROUND SURFACE							20	40	60	80	100					
0.0	Clayey SILT , trace gravel Very Stiff Brown Moist		1	SS	29		177										
176.7																	
0.8	Clayey SILT , trace to some sand, trace gravel, occasional cobbles Hard Brown to Grey Moist (TILL)		2	SS	48		176										
			3	SS	101												
			4	SS	50/ 0.075		175										
			5	SS	50/ 0.050		174										
			6	SS	76/ 0.175		173										
			7	SS	134		171										
169.9							170										
7.6	END OF BOREHOLE AT 7.6m. BOREHOLE CAVED TO 4.9m AND DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND CUTTINGS TO SURFACE.																

ONTMT4S MTO-19484.GPJ 2017TEMPLATE(MTO).GDT 2/13/19

RECORD OF BOREHOLE No TS 17-17

1 OF 1

METRIC

W.P. _____ LOCATION N 4 846 955.9 E 294 114.2 ORIGINATED BY ES
 HWY 427 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2017.08.01 - 2017.08.01 CHECKED BY ME

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE										
175.8	GROUND SURFACE						20	40	60	80	100							
0.0	SAND , trace gravel Loose Brown Moist (FILL)		1	SS	7													
175.0																		
0.8	Sandy SILT , trace gravel Dense to Very Dense Brown Moist (FILL)		2	SS	32													
174.3																		
1.5	Clayey SILT , some sand, trace gravel, occasional cobbles Hard Brown Moist (TILL)		3	SS	50/ 0.125													
			4	SS	50/ 0.100													
			5	SS	50/ 0.100													
171.8																		
4.0	SILT , trace clay, trace to some sand, trace gravel Very Dense Grey Moist (TILL)		6	SS	83													
170.2																		
5.6	Clayey SILT , trace to some sand, trace gravel, occasional cobbles Hard Grey Moist (TILL)																	
169.1																		
6.7	END OF BOREHOLE AT 6.7m. BOREHOLE OPEN AND DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND CUTTINGS TO SURFACE.																	

+³, ×³: Numbers refer to
Sensitivity

20
15
10

(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No TS 18-07

1 OF 1

METRIC

W.P. _____ LOCATION N 4 846 658.4 E 294 118.2 ORIGINATED BY JM
 HWY 427 BOREHOLE TYPE Solid Stem Augers COMPILED BY MP
 DATUM Geodetic DATE 2018.08.16 - 2018.08.16 CHECKED BY ME

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa							WATER CONTENT (%)		
								20 40 60 80 100							20 40 60		
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE							W _P W W _L		
176.5	GROUND SURFACE																
0.0	Clayey SILT , trace to some sand, trace gravel, trace organics Stiff Brown Moist		1	SS	13		176										
175.8																	
0.8	Clayey SILT to Silty CLAY , some sand to sandy, trace gravel Very Stiff to Hard Brown Moist (TILL)		2	SS	25		175										
			3	SS	29									1 25 40 34			
			4	SS	38		174										
			5	SS	42		173										
							172										
	Becoming grey		6	SS	30		171										
							170										
168.9							169										
7.6	SILT , trace clay and sand Compact Grey Moist		8	SS	20									0 3 88 9			
168.3																	
8.2	END OF BOREHOLE AT 8.2m. BOREHOLE CAVED TO 7.2m AND WATER LEVEL AT 7.5m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND CUTTINGS TO SURFACE.																

ONTMT4S MTO-19484.GPJ 2017TEMPLATE(MTO).GDT 2/13/19

RECORD OF BOREHOLE No TS 18-17

1 OF 1

METRIC

W.P. _____ LOCATION N 4 847 261.3 E 294 068.4 ORIGINATED BY JM
 HWY 427 BOREHOLE TYPE Solid Stem Augers COMPILED BY MP
 DATUM Geodetic DATE 2018.08.16 - 2018.08.16 CHECKED BY ME

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT NATURAL LIMIT MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE				WATER CONTENT (%) w _p w w _L				
177.0	GROUND SURFACE							20	40	60	80	100				
0.0	Clayey SILT , trace sand, trace gravel, trace rootlets Soft to Firm Brown Moist (FILL)		1	SS	4									○		
176.4																
0.6	Clayey SILT to Silty CLAY , some sand to sandy, trace gravel Hard Brown Moist (TILL)		2	SS	45									○		
175.2														○		
1.8	Gravelly layer		3	SS	86									○		
174.9																
2.1																
														○		
														○		
														○		

ONTMT4S MTO-19484.GPJ 2017TEMPLATE(MTO).GDT 2/13/19

RECORD OF BOREHOLE No TS 18-19

1 OF 1

METRIC

W.P. _____ LOCATION N 4 847 694.7 E 294 162.5 ORIGINATED BY JM
 HWY 427 BOREHOLE TYPE Solid Stem Augers COMPILED BY MP
 DATUM Geodetic DATE 2018.08.28 - 2018.08.28 CHECKED BY ME

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
180.0	GROUND SURFACE							<div><div>20406080100</div><div>○ UNCONFINED + FIELD VANE</div><div>● QUICK TRIAXIAL × LAB VANE</div></div>						
0.0 0.1	TOPSOIL: (75mm)							<div><div>204060</div><div>W_P W W_L</div><div>PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT</div><div>WATER CONTENT (%)</div></div>						
179.2	Clayey SILT , trace sand, trace gravel Stiff Brown Moist		1	SS	10									
0.8	Clayey SILT to Silty CLAY , some sand, trace gravel Very Stiff Brown Moist (TILL)		2	SS	21		179							
			3	SS	33		178							
177.7														
2.3	Silty SAND , some clay, trace gravel Dense Brown Moist (TILL)		4	SS	41		177							9 54 22 15
177.3			5	SS	68									
2.7	Clayey SILT to Silty CLAY , some sand to sandy, trace to some gravel, occasional cobbles Hard Brown Moist (TILL)						176							
			6	SS	36		175							1 33 56 10
			7	SS	22		174							
							173							
			8	SS	27		172							
171.7	END OF BOREHOLE AT 8.2m. Piezometer installation consists of 25mm diameter Schedule 40 PVC pipe with a 1.5m slotted screen.													
8.2	WATER LEVEL READINGS DATE DEPTH(m) ELEV.(m) 2018.08.28 4.2 175.8													

+³, ×³: Numbers refer to
Sensitivity

20
15
10
(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No UC 17-03

1 OF 2

METRIC

W.P. _____ LOCATION N 4 847 747.6 E 294 014.8 ORIGINATED BY CAR
 HWY 427 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2017.07.11 - 2017.07.11 CHECKED BY ME

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
178.6	GROUND SURFACE							20 40 60 80 100						
0.0 178.3	SAND and GRAVEL , asphalt fragments (FILL)		1	SS	25		178							
0.3	Silty CLAY , trace sand, trace gravel, organics													
177.8	Hard Brown Moist		2	SS	51									
0.8	Clayey SILT to Silty CLAY , trace to some sand, trace gravel						177							
	Hard Brown Moist (TILL)		3	SS	98									
			4	SS	96		176							
			5	SS	95		175							
174.3	SILT , some sand, trace clay Very Dense Grey Dry		6	SS	64/ 0.125		174							
172.8	Clayey SILT to Silty CLAY Hard Grey Moist		7	SS	95		172							
			8	SS	60		171							
	Trace weathered shale		9	SS	66/ 0.125		170							
169.0	END OF BOREHOLE AT 9.8m. BOREHOLE OPEN TO 7.6m AND DRY.													
9.6														

Continued Next Page

+³, ×³: Numbers refer to
Sensitivity

20
15
10
(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No UC 17-03

2 OF 2

METRIC

W.P. _____ LOCATION N 4 847 747.6 E 294 014.8 ORIGINATED BY CAR
 HWY 427 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2017.07.11 - 2017.07.11 CHECKED BY ME

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
	Continued From Previous Page																
	BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND CUTTINGS TO SURFACE.																

Appendix B

Record of Borehole Sheets – Previous Investigations

PROJECT <u>06-1111-012</u>		RECORD OF BOREHOLE No C2		1 OF 1 METRIC	
W.O. <u>05-20012</u>		LOCATION <u>N 4847873.3 :E 294009.8</u>		ORIGINATED BY <u>TB</u>	
DIST <u>Central</u> HWY <u>427</u>		BOREHOLE TYPE <u>108 mm Diameter Solid Stem Augers</u>		COMPILED BY <u>JEB</u>	
DATUM <u>Geodetic</u>		DATE <u>May 13, 2009</u>		CHECKED BY <u>SMM</u>	

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL						
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa							WATER CONTENT (%)					
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × REMOULDED												
179.9	GROUND SURFACE						20	40	60	80	100	10	20	30						
0.0	ASPHALT																			
0.1	Sand and gravel (FILL)																			
179.3																				
0.6	CLAYEY SILT, some sand, trace gravel (TILL), containing oxidation staining Hard Brown Moist		1	SS	43															
			2	SS	57															
			3	SS	100/0.1															
			4	SS	43															
178.1																				
3.8	SILT, trace clay Very dense Grey Moist		5	SS	101															
			6	SS	76															
174.3																				
5.6	CLAYEY SILT Hard Grey Moist		7	SS	59															
			8	SS	42															
	Stratified with layers of sand and silt																			
170.5			9	SS	54															
170.2	CLAYEY SILT, trace sand, trace gravel (TILL) Hard Greenish brown Moist																			
9.8	END OF BOREHOLE																			
NOTES: 1. Borehole dry upon completion of drilling. 2. Borehole backfilled with bentonite.																				

MIS-MTO 001 06-1111-012.GPJ GAL-MISS.GDT 8/6/09 SAC/DD

RECORD OF BOREHOLE No CNH-01

1 OF 4

METRIC

G.W.P. 202-95-00 LOCATION N 4 845 049.2 E 294 356.2 ORIGINATED BY GA
 HWY 427 BOREHOLE TYPE Solid Stem Auger COMPILED BY AN
 DATUM Geodetic DATE 2008.12.01 - 2008.12.03 CHECKED BY SKP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC NATURAL LIQUID LIMIT MOISTURE CONTENT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	W P W L	W P W L	W P W L			
180.3	TOPSOIL (50mm)		1	SS	16									
179.9	Silty CLAY, with sand, trace gravel Stiff to Very Stiff Brown (FILL)		2	SS	17									8 24 34 34
178.8			3	SS	27									
177.8			4	SS	30									
176.8			5	SS	15									7 31 37 25
175.8			6	SS	24									
174.8			7	SS	50									
171.1	Silty CLAY, trace to some sand, trace gravel, occasional iron oxide Hard Brown (TILL)													

ONTMT4S 9270.GPJ 6/29/09

Continued Next Page

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

RECORD OF BOREHOLE No CNH-01

2 OF 4

METRIC

G.W.P. 202-95-00

LOCATION N 4 845 049.2 E 294 356.2

ORIGINATED BY GA

HWY 427

BOREHOLE TYPE Solid Stem Auger

COMPILED BY AN

DATUM Geodetic

DATE 2008.12.01 - 2008.12.03

CHECKED BY SKP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		WATER CONTENT (%)			UNIT WEIGHT Y kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	T _N VALUES			20 40 60 80 100	PLASTIC LIMIT W _P	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	20 40 60		
	Continued From Previous Page													
	Silty CLAY, trace to some sand, trace gravel, occasional iron oxide Hard Brown (TILL)		8	SS	70		170							0 4 79 17
	Occasional layers of clayey silt						169							
			9	SS	63		168							
							167							
			10	SS	81		166							
							165							
	with sand		11	SS	41		164							6 35 43 16
							163							
			12	SS	51		162							
							161							
160.5														
19.8														

ONTMT4S 9270.GPJ 6/29/09

Continued Next Page

+³ × 1³: Numbers refer to Sensitivity 20 15 10 5 (%) STRAIN AT FAILURE

METRIC

CHECKED BY SKP

+ 3, X 3: Numbers refer to Sensitivity

RECORD OF BOREHOLE No CNH-01

4 OF 4

METRIC

G.W.P. 202-95-00 LOCATION N 4 845 049.2 E 294 356.2 ORIGINATED BY GA
 HWY 427 BOREHOLE TYPE Solid Stem Auger COMPILED BY AN
 DATUM Geodetic DATE 2008.12.01 - 2008.12.03 CHECKED BY SKP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT Y kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL X LAB VANE					WATER CONTENT (%)				
	Continued From Previous Page																
149.4	SHALE, moderately weathered, thinly bedded, frequent limestone and siltstone interbeds Grey		3	RUN			150									RUN 3# TCR=100%, SCR=23%, RQD=7%	
30.9	END OF BOREHOLE AT 30.9m. BOREHOLE BACKFILLED WITH BENTONITE GROUT TO SURFACE.																

ONTMT4S 9270.GPJ 6/29/09

RECORD OF BOREHOLE No CNH-08

1 OF 2

METRIC

G.W.P. 202-95-00

LOCATION N 4 845 128.7 E 294 354.8

ORIGINATED BY WB

HWY 427

BOREHOLE TYPE Solid Stem Auger

COMPILED BY AN

DATUM Geodetic

DATE 2008.12.18 - 2008.12.18

CHECKED BY SKP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC NATURAL LIQUID LIMIT MOISTURE CONTENT			UNIT WEIGHT Y kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	W _p W W _L	WATER CONTENT (%)	20 40 60			
181.3	ASPHALT: (75mm)													
0.0 0.1	Gravelly SAND Very Dense Brown Moist (FILL)		1	SS	53		181							
180.3							180							
1.1	SILT and SAND, trace clay Loose Brown Moist (FILL)		2	SS	7		179							
							178							0 55 39 6
176.8							177							
4.6	Silty CLAY, with sand, trace gravel Hard Brown (TILL)		3	SS	30		176							
							175							0 22 45 33
	Occasional layers of silty sand		4	SS	42		174							
							173							
			5	SS	30		172							

Continued Next Page

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

RECORD OF BOREHOLE No CNH-08

2 OF 2

METRIC

G.W.P. 202-95-00

LOCATION N 4 845 128.7 E 294 354.8

ORIGINATED BY WB

HWY 427

BOREHOLE TYPE Solid Stem Auger

COMPILED BY AN

DATUM Geodetic

DATE 2008.12.18 - 2008.12.18

CHECKED BY SKP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					
	Continued From Previous Page							20 40 60 80 100	PLASTIC LIMIT W _P	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L		
								40 80 120 160 200	WATER CONTENT (%)				
									O UNCONFINED + FIELD VANE				
									● QUICK TRIAXIAL X LAB VANE				
	Silty CLAY, with sand, trace gravel Hard Brown (TILL)		6	SS	35		171						1 21 38 40
			7	SS	100/ 0.275		170						
			8	SS	100/ 0.225		169						
			9	SS	100/ 0.250		168						
165.7	Hard augering						167						
15.6	END OF BOREHOLE AT 15.6m. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO 0.075m THEN ASPHALT TO SURFACE.						166						4 32 43 21

+³ X³: Numbers refer to
Sensitivity 20
15 5
10 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No PC-25

1 OF 2

METRIC

G.W.P. 202-95-00 LOCATION N 4 845 118.7 E 294 324.3 ORIGINATED BY LRB
 HWY 427 BOREHOLE TYPE Solid Stem Auger COMPILED BY AN
 DATUM Geodetic DATE 2010.01.12 - 2010.01.12 CHECKED BY MEF

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES		20	40	60	80	100		
181.2													
0.0	ASPHALT: (225mm)					181							
0.2	Gravelly SAND, trace silt												25 66 9
180.5	Brown Damp (FILL)												(SI+CL)
0.6	SILT and SAND Compact Brown Damp (FILL)		1	SS	23	180							
	trace clay		2	SS	17	179							
			3	SS	20	178							
	becoming Wet		4	SS	17	177							0 48 48 4
176.3			5	SS	12	176							
4.9	Silty CLAY, some sand, trace gravel Stiff to Very Stiff Brown (FILL)(CI)		6	SS	10	175							1 18 39 42
			7	SS	13	174							
			8	SS	13	173							
			9	SS	19	172							
171.4													
9.8	END OF BOREHOLE AT 9.8m.												

Continued Next Page

+³, X³: Numbers refer to
Sensitivity

20
15 5
10
(%) STRAIN AT FAILURE

METRIC

ONTMT4S 9270.GPJ 1/25/10

RECORD OF BOREHOLE No PC-30

1 OF 2

METRIC

G.W.P. 202-95-00 LOCATION N 4 845 453.9 E 294 289.8 ORIGINATED BY SLL
 HWY 427 BOREHOLE TYPE Solid Stem Auger COMPILED BY AN
 DATUM Geodetic DATE 2010.01.04 - 2010.01.04 CHECKED BY MEF

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
								20 40 60 80 100						
180.0														
0.0	ASPHALT: (135mm)													
0.1	SAND, some gravel, some silt Brown Moist (FILL)		1	GS										
179.4														
0.6	Silty CLAY, sandy, trace gravel Stiff to Firm Grey (FILL)(CL)		1	SS	13									
			2	SS	10									
			3	SS	7									
			4	SS	8									
175.7			5	SS	6									
4.3	Sandy SILT, trace clay Compact Brown to Grey Moist to Wet (FILL)													
			6	SS	28									
174.2														
5.8	Silty CLAY, some sand, trace gravel Stiff Grey (TILL)		7	SS	9									
172.6														
7.4	Sandy SILT Brown Moist													
172.2														
7.8	Silty CLAY, sandy, trace gravel Very Stiff to Hard Brown (TILL)(CL)		8	SS	18									
			9	SS	40									
170.2														
9.8	END OF BOREHOLE AT 9.8m.													

ONTMT4S 9270.GPJ 1/22/10

Continued Next Page

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

RECORD OF BOREHOLE No PC-30

2 OF 2

METRIC

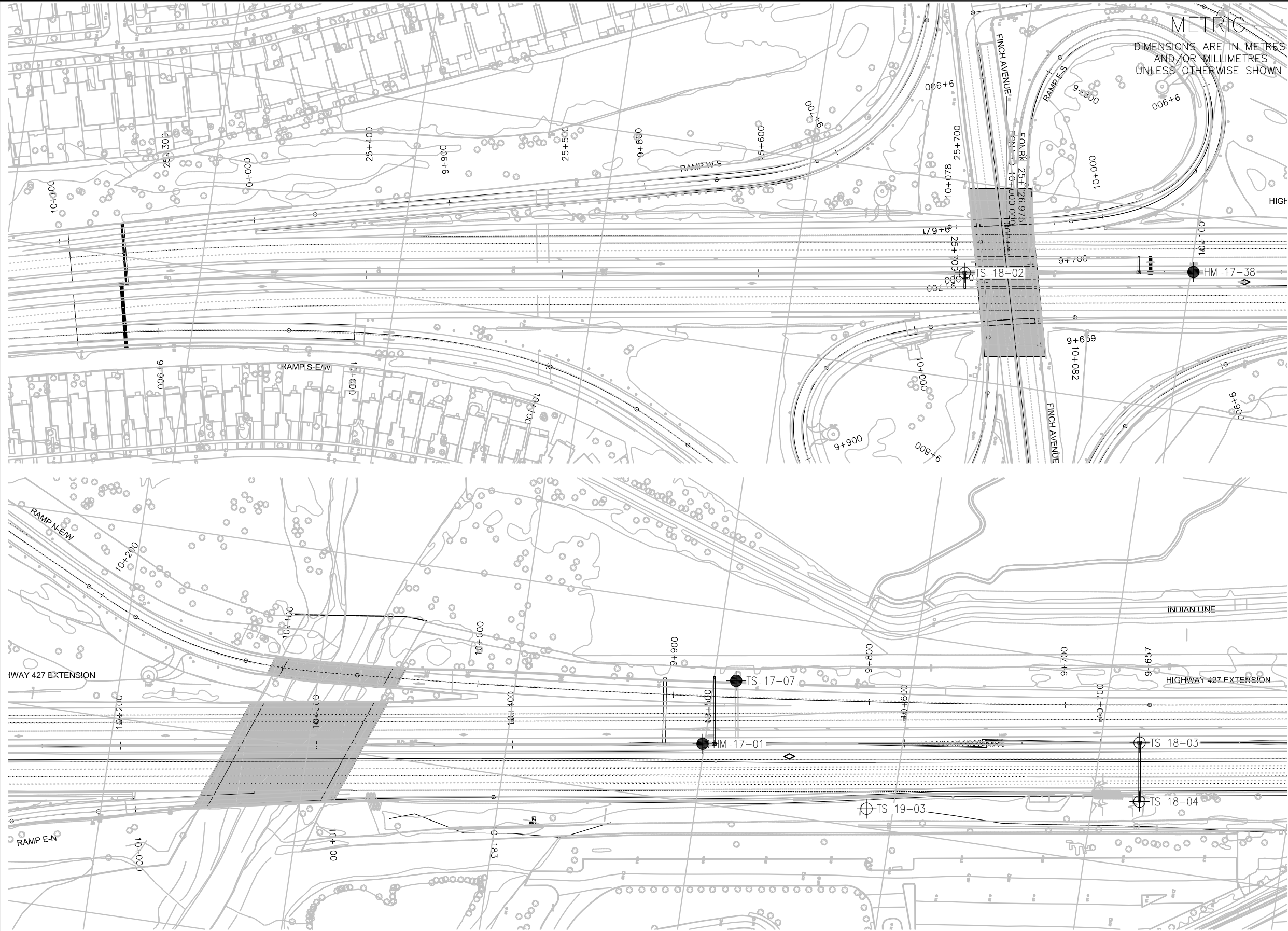
G.W.P. 202-95-00 LOCATION N 4 845 453.9 E 294 289.8 ORIGINATED BY SLL
 HWY 427 BOREHOLE TYPE Solid Stem Auger COMPILED BY AN
 DATUM Geodetic DATE 2010.01.04 - 2010.01.04 CHECKED BY MEF

SOIL PROFILE		SAMPLES				GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT Y kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					WATER CONTENT (%)				
							20	40	60	80	100	W _p	W	W _L			
	Continued From Previous Page																
	BOREHOLE OPEN TO 5.2m, DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO 2.6m, THEN CUTTINGS TO 0.2m, THEN ASPHALT TO SURFACE.																

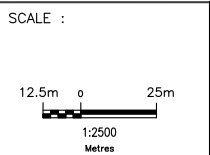
Appendix C

Borehole Location Plans

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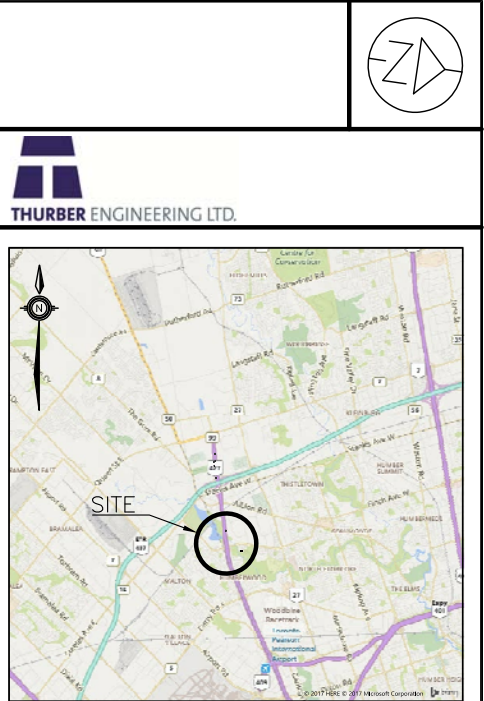
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NO.	DATE	REVISIONS				BY	CHK	LEAD DRG.	PROJ. MGR.	



CONSULTANT	DESIGNED	M. BOUCHER	19/08/02
	DRAWN	A. NOOR	19/08/02
	CHECKED	M. BOUCHER	19/08/02
	APPROVED LEAD ENGINEER	J. LEE	19/08/02
	APPROVED PROJ. MANAGER	J. LEE	19/08/02
	NAME (PRINT)	INIT.	DATE



TITLE							HWY 427 EXPANSION SIGN SUPPORTS FINCH AVENUE TO HIGHWAY 407 PACKAGE 9 BOREHOLE LOCATIONS PLAN			
PROJECT ID.	STAGE IDENTIFIER	DESIGN PACKAGE NUMBER	DISCIPLINE	STRUCTURE NUMBER	DOCUMENT TYPE	DRAWING NUMBER	REVISION NUMBER			
H427-D	I	9	FND		DWG		A			



KEYPLAN

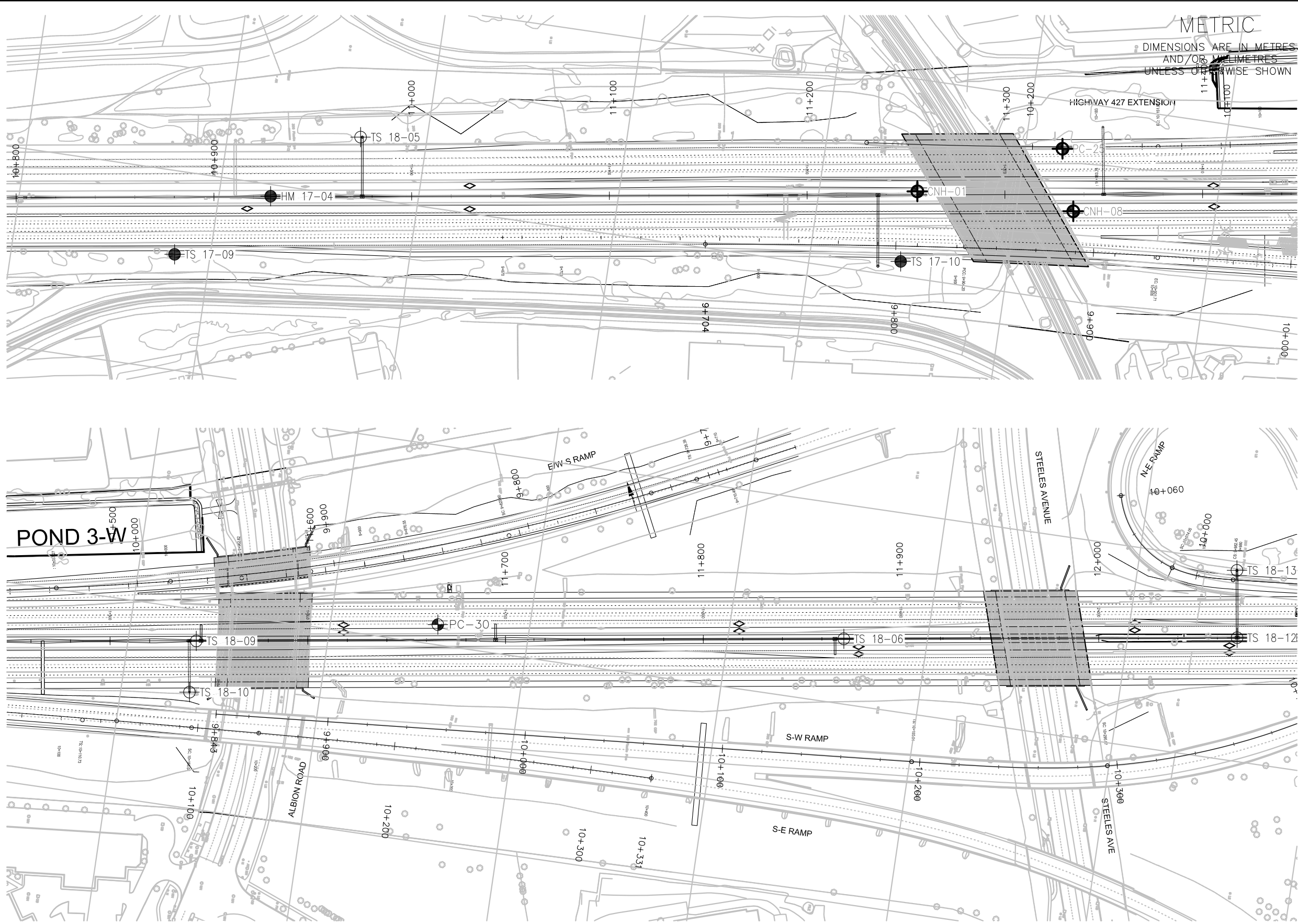
LEGEND

	Borehole (By Thurber)
	Borehole (By Others)
	Proposed Borehole

NO	ELEVATION	NORTHING	EASTING
HM 17-01	170.3	4 844 299.0	294 469.7
HM 17-38	166.2	4 843 901.3	294 528.9
TS 17-07	169.9	4 844 311.3	294 435.4
TS 18-02	-	4 843 786.0	294 546.2
TS 18-03	-	4 844 519.6	294 436.9
TS 18-04	-	4 844 523.8	294 466.6
TS 19-03	-	4 844 386.6	294 490.3

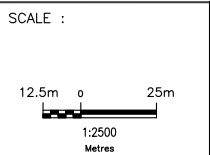
- NOTES-**
- The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.
 - This drawing is for subsurface information only. Surface details and features are for conceptual illustration.

GEOCRES No.



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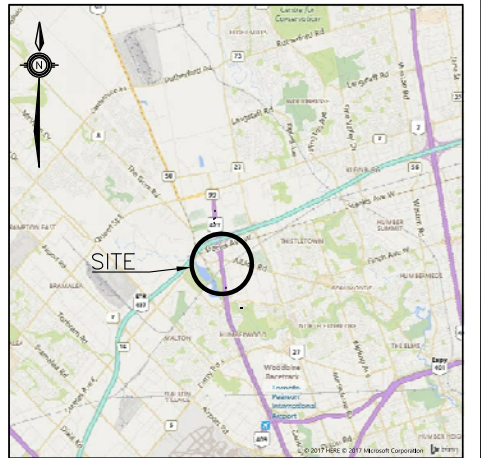
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NO.	DATE	REVISIONS				BY	CHK	LEAD DRG.	PROJ. MGR.	



CONSULTANT	DESIGNED	M. BOUCHER	19/08/02
	DRAWN	A. NOOR	19/08/02
	CHECKED	M. BOUCHER	19/08/02
	APPROVED LEAD ENGINEER	J. LEE	19/08/02
	APPROVED PROJ. MANAGER	J. LEE	19/08/02
	NAME (PRINT)	INIT.	DATE



TITLE						
HWY 427 EXPANSION SIGN SUPPORTS FINCH AVENUE TO HIGHWAY 407 PACKAGE 9 BOREHOLE LOCATIONS PLAN						
PROJECT ID.	STAGE IDENTIFIER	DESIGN PACKAGE NUMBER	DISCIPLINE	STRUCTURE TYPE	DOCUMENT TYPE	DRAWING NUMBER
H427-D	I	9	FND		DWG	A



KEYPLAN

LEGEND

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

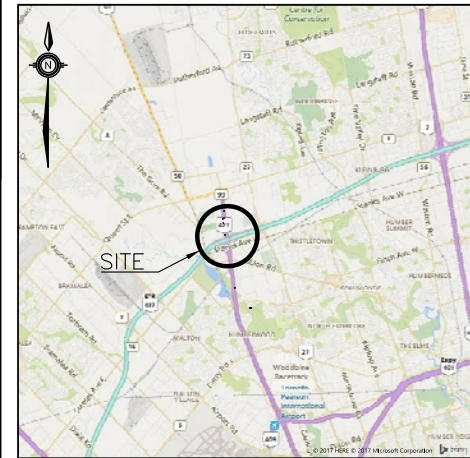
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CNH-08	181.3	4 845 128.7	294 354.8
HM 17-04	176.5	4 844 725.9	294 405.9
PC-25	181.2	4 845 118.7	294 324.3
PC-30	180.0	4 845 453.9	294 289.8
TS 17-09	175.6	4 844 682.1	294 442.0
TS 17-10	179.3	4 845 046.0	294 392.5
TS 18-05	-	4 844 766.6	294 369.8
TS 18-06	-	4 845 658.1	294 267.3
TS 18-09	-	4 845 334.2	294 315.6
TS 18-10	-	4 845 334.5	294 341.8
TS 18-12	181.1	4 845 854.8	294 238.0
TS 18-13	-	4 845 849.8	294 204.3

-NOTES-

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

GEOCRES No.

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



KEYPLAN
LEGEND

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

NO	ELEVATION	NORTHING	EASTING
HM 17-06	179.1	4 846 369.0	294 159.2
STM 17-05	175.4	4 846 481.1	294 104.7
TS 17-12	180.2	4 846 190.0	294 164.9
TS 17-13	180.2	4 846 194.3	294 184.3
TS 17-14	179.1	4 846 482.7	294 144.3
TS 18-14	-	4 846 363.2	294 190.2
TS 19-04	-	4 846 246.4	294 149.2

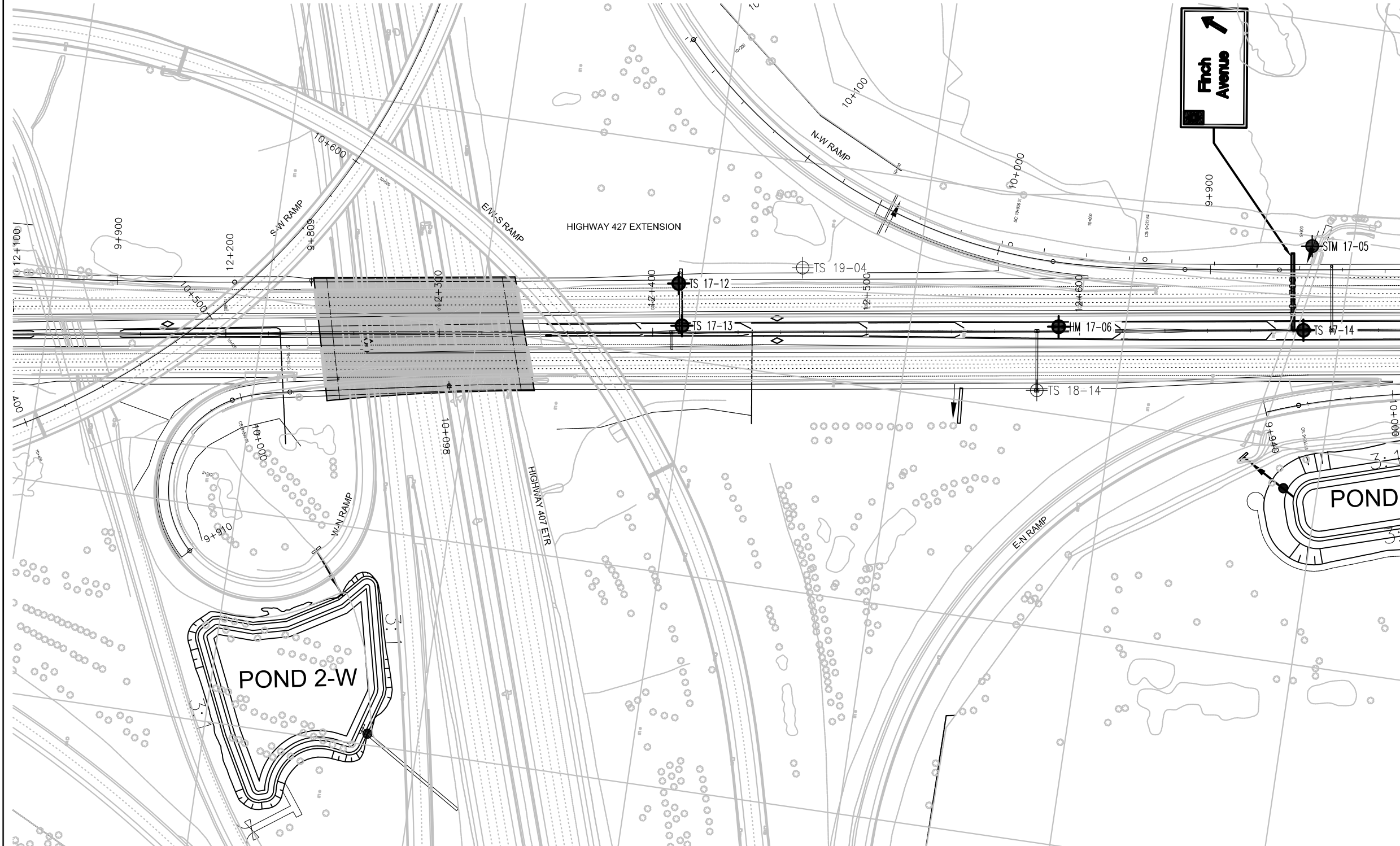
-NOTES-

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GEOCRES No.

HWY 427 EXPANSION
SIGN SUPPORTS
FINCH AVENUE TO HIGHWAY 407
PACKAGE 9
BOREHOLE LOCATIONS PLAN

PROJECT ID.	STAGE IDENTIFIER	DESIGN PACKAGE NUMBER	DISCIPLINE	STRUCTURE NUMBER	DOCUMENT TYPE	DRAWING NUMBER	REVISION NUMBER
H427-D	I	9	FND		DWG		A



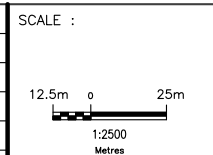
POND 2-W

POND



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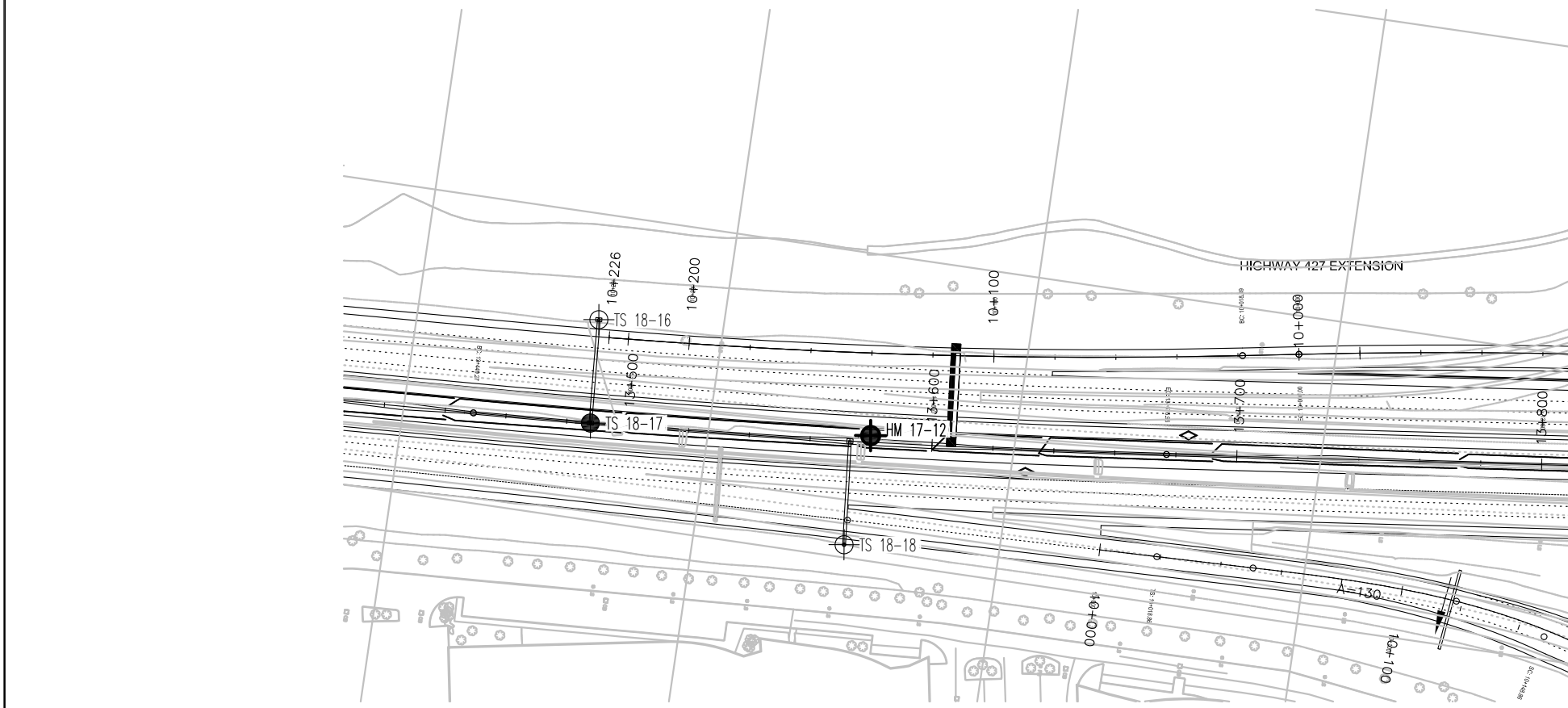
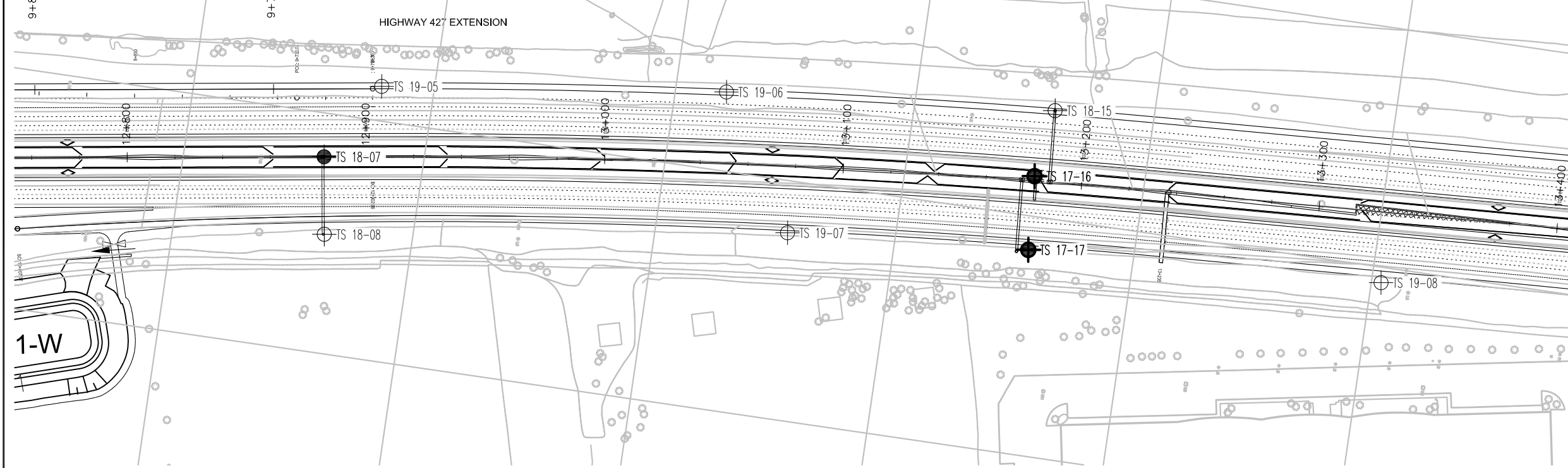
NO.	DATE	REVISIONS	BY	CHK	LEAD DRG.	PROJ. MGR.
A	19/08/02	ISSUED FOR CONSTRUCTION	AN	MB	JL	JL



DESIGNED	M. BOUCHER	19/08/02
DRAWN	A. NOOR	19/08/02
CHECKED	M. BOUCHER	19/08/02
APPROVED LEAD ENGINEER	J. LEE	19/08/02
APPROVED PROJ. MANAGER	J. LEE	19/08/02
NAME (PRINT)	INIT.	DATE



PROJECT ID.	STAGE IDENTIFIER	DESIGN PACKAGE NUMBER	DISCIPLINE	STRUCTURE NUMBER	DOCUMENT TYPE	DRAWING NUMBER	REVISION NUMBER
H427-D	I	9	FND		DWG		A



LEGEND

- | NO | ELEVATION | NORTHING | EASTING |
|----------|-----------|-------------|-----------|
| HM 17-12 | 177.7 | 4 847 352.9 | 294 059.2 |
| TS 17-16 | 177.5 | 4 846 954.0 | 294 083.3 |
| TS 17-17 | 175.8 | 4 846 955.9 | 294 114.2 |
| TS 18-07 | 176.5 | 4 846 658.4 | 294 118.2 |
| TS 18-08 | - | 4 846 663.2 | 294 150.4 |
| TS 18-15 | - | 4 846 958.6 | 294 054.9 |
| TS 18-16 | - | 4 847 259.2 | 294 034.5 |
| TS 18-17 | 177.0 | 4 847 261.4 | 294 068.4 |
| TS 18-18 | - | 4 847 349.4 | 294 095.8 |
| TS 19-05 | — | 4 846 678.0 | 294 085.6 |
| TS 19-06 | — | 4 846 821.3 | 294 067.0 |
| TS 19-07 | — | 4 846 855.1 | 294 121.7 |
| TS 19-08 | — | 4 847 104.1 | 294 106.5 |

- 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.

HWY 427 EXPANSION
SIGN SUPPORTS
FINCH AVENUE TO HIGHWAY 407
PACKAGE 9
BOREHOLE LOCATIONS PLAN

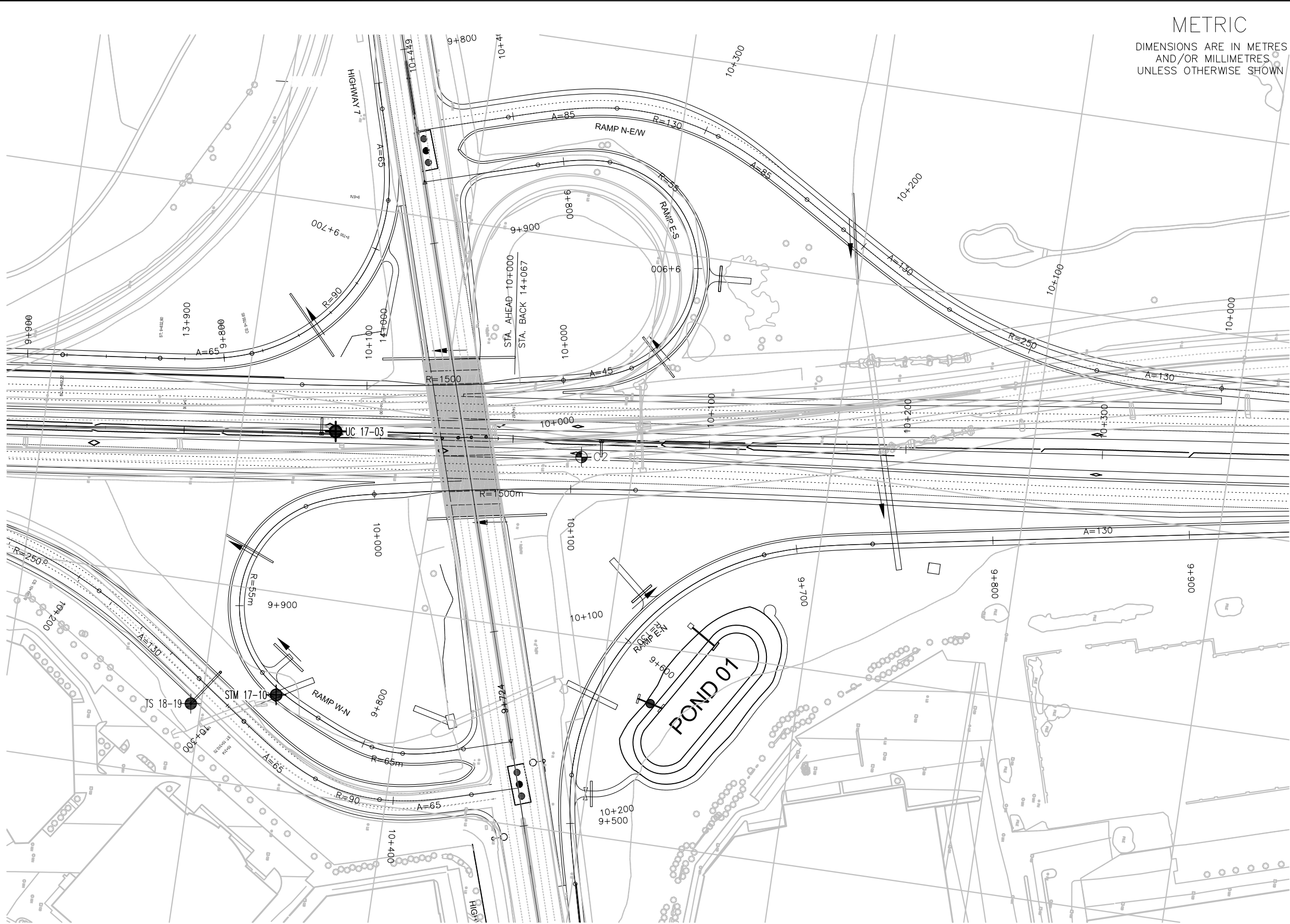
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H427-D	I	9	FND		DWG		A

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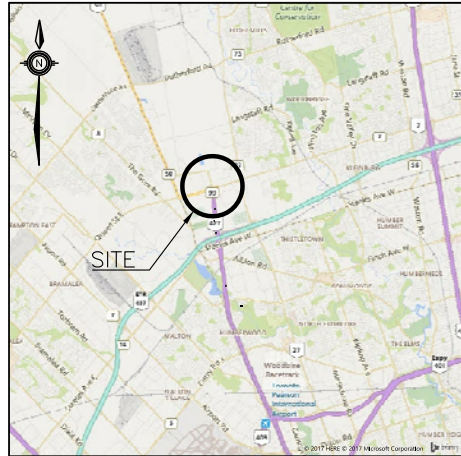
CONSULTANT	DESIGNED	M. BOUCHER		19/08/01
	DRAWN	A. NOOR		19/08/01
	CHECKED	M. BOUCHER		19/08/01
	APPROVED LEAD ENGINEER	J. LEE		19/08/01
	APPROVED PROJ. MANAGER	J. LEE		19/08/01
	NAME (PRINT)	INIT.	DATE	



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PLOTDATE: 8/1/2019 10:57 AM



METRIC
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KEYPLAN

LEGEND

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

NO	ELEVATION	NORTHING	EASTING
C2	179.9	4 847 873.3	294 009.6
STM 17-10	179.2	4 847 737.1	294 151.9
TS 18-19	180.0	4 847 694.7	294 162.5
UC 17-03	178.6	4 847 747.7	294 014.8

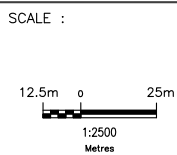
-NOTES-

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GEOCRES No.

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NO.	DATE	REVISIONS	BY	CHK	LEAD DSC.	PROJ. MAN.
A	19/08/02	ISSUED FOR CONSTRUCTION	AN	MB	JL	JL



DESIGNED	M. BOUCHER	19/08/02
DRAWN	A. NOOR	19/08/02
CHECKED	M. BOUCHER	19/08/02
APPROVED LEAD ENGINEER	J. LEE	19/08/02
APPROVED PROJ. MANAGER	J. LEE	19/08/02
NAME (PRINT)	INIT.	DATE



TITLE						
HWY 427 EXPANSION SIGN SUPPORTS FINCH AVENUE TO HIGHWAY 407 PACKAGE 9 BOREHOLE LOCATIONS PLAN						
PROJECT ID.	STAGE IDENTIFIER	DESIGN PACKAGE NUMBER	DISCIPLINE	STRUCTURE NUMBER	DOCUMENT TYPE	DRAWING NUMBER
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