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Terraprobe

Consulting Geotechnical & Environmental Engineering
Construction Materials Engineering, Inspection & Testing

FOUNDATION INVESTIGATION & DESIGN REPORT
PROPOSED HIGH MAST LIGHT POLES
HIGHWAY 410 EXTENSION – PHASE III
FROM 300 m EAST OF HEART LAKE ROAD TO HIGHWAY 10
AGREEMENT No. 2005-A-000230, W.P. 105-00-00,

CONT 2007-2264

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PART 1: FACTUAL INFORMATION

1 INTRODUCTION

This report presents the factual findings obtained from a foundation investigation conducted for High Mast Light Pole (HML) installations along the alignment of the proposed four-lane of Highway 410 between Sta. 22+100 and Sta. 25+750 in the Town of Caledon, Regional Municipality of Peel, Ontario.

The purpose of this investigation was to explore the subsurface conditions along the alignment and, based on the data obtained, to provide a borehole location plan, records of boreholes, laboratory test results and a description of the subsurface conditions.

Terraprobe conducted the investigation as a sub-consultant to Giffels Associates Ltd., under the Ministry of Transportation Ontario (MTO) Agreement Number 2005-A-000230.

2 SITE DESCRIPTION

The southeast limit of the project is Sta. 22+100 located about 300 m north of Mayfield Road and 300 m east of Heart Lake Road. The northwest limit is Sta. 25+750 on Highway 10. This approximately 3.7 km long alignment traverses across rolling to gently undulating terrain and crosses Heart Lake Road, Kennedy Road and Valleywood Boulevard to eventually merge with Highway 10. The alignment is dissected by the north-south oriented Etobicoke Creek.

From the southeast limit to the east bank of Etobicoke Creek the alignment traverses through farmed land. Further west beyond the west bank of Etobicoke Creek the alignment traverses between subdivision developments and then merges with Highway 10.

The site is located in the physiographic region of Southern Ontario referred to as the Peel Plain whose topography slopes gradually and gently towards Lake Ontario. Etobicoke Creek and other rivers have cut deep valleys across the Peel Plain.

The Peel Plain is known to consist of generally clayey and silty soils that cover the central portion of the regions of York, Peel and Halton[1]. There are exceptions to be noted in these major soil groups. Trains of sandy alluvium can be found at various places in the stream valleys.

[1] Chapman and Putnam, "The Physiography of South Ontario", 3rd Edition, 1984.

3 SITE INVESTIGATION AND FIELD TESTING

The site investigation and field testing for this project were carried out during the period January 27 to April 19, 2005 and consisted of drilling and sampling fifteen boreholes to depths ranging from 9.6 m to 33.8 m. The boreholes were numbered HML1 to HML10. Boreholes, EC2, EC5, VB3 and VB4 were drilled at proposed structure locations and the data from these boreholes are also included in this report. The approximate borehole locations are shown on the attached Borehole Locations Drawing in Appendix C.

The borehole locations were established in the field by surveyors from Shiu Geomatics Limited who also provided Terraprobe with their coordinates and geodetic elevations. Utility clearances were obtained by Terraprobe prior to drilling.

The drilling, sampling and in-situ testing operations were conducted with a track mounted CME 75 drill rig owned and operated by Groundworks Drilling Limited of Toronto, Ontario. Solid and hollow-stem auger drilling techniques and casing and washboring methods were used to advance the boreholes. Samples were obtained at selected intervals using a split spoon sampler in conjunction with Standard Penetration Testing (SPT) in the overburden soils. Borehole EC2 was also advanced 3.1 m into bedrock by NQ size diamond coring techniques.

Groundwater conditions in the open boreholes were observed throughout the drilling operations. Standpipe piezometers consisting of 19 mm PVC pipe with a slotted screen (enclosed either in sand or geotextile fabric) were installed in boreholes extended for the bridge structures. The locations and completion details of the piezometers are shown in Table 3.1.

Table 3.1 – Piezometer Installation Details

Piezometer Location	Piezometer Details	
	Tip Depth/ Elevation (m)	Completion Details
VB3	26.2/233.0	Piezometer with 1.5 m slotted screen wrapped in filter cloth, drill cuttings from 26.2 m to 0.6 m and bentonite seal from 0.6 m to ground surface.
EC-2	21.3/232	Piezometer with 1.5 m slotted screen installed with filter sand to 19.5 m, bentonite seal from 19.5 m to 18.9 m, drill cuttings from 18.9 m to 0.6 m and bentonite seal from 0.6 m to ground surface.
EC-5	27.6/219.3	Piezometer with 1.5 m slotted screen installed with filter sand to 25.6 m, bentonite seal from 25.6 m to 25.3 m, drill cuttings from 25.3 m to 0.9 m and bentonite seal from 0.9 m to ground surface.

Members of Terraprobe's technical staff supervised the drilling and sampling operations on a full time basis. The supervisors logged the boreholes and processed the recovered soil samples and rock cores for transport to Terraprobe's Brampton laboratory for further examination and testing.

4 LABORATORY TESTING

The recovered soil samples were subjected to Visual Identification (VI) and natural moisture content determination. Selected samples were also subjected to gradation analysis. Atterberg Limits tests and bulk unit weight tests were also conducted on selected samples retrieved from the cohesive deposits. The results of this testing program are shown on the Record of Borehole sheets in Appendix A. The grain size distribution curves and plasticity charts are illustrated in Appendix B.

5 DESCRIPTION OF SUBSURFACE CONDITIONS

Reference is made to the Record of Borehole sheets in Appendix A for details of the encountered soil stratigraphy. An overall description of the stratigraphy is given in the following paragraphs. However, the factual data presented in the Record of Borehole Sheets governs any interpretation of the site conditions.

In general, the site is underlain by topsoil and overburden deposits of clayey silt, clayey silt till, sand and silt till, sands and silts and gravelly sand.

5.1 Topsoil

Topsoil approximately 150 mm to 500 mm thick was encountered across the site. Topsoil thickness may vary between and beyond the boreholes.

5.2 Upper Clayey Silt

A surficial layer of clayey silt containing trace to some sand, trace gravel and trace to some organics was encountered in some of the boreholes. This layer extends to depths ranging from 0.7 m (Elev. 268.0 m) to 1.4 m (Elev. 251.9 m) below ground surface.

Standard Penetration tests in this clayey silt layer yielded 'N' values ranging from 4 to 14 blows for 0.3 m penetration indicating a firm to stiff consistency. The moisture content of samples from this deposit ranged from 18% to 28% by weight.

5.3 Clayey Silt Till

Layers of clayey silt till were encountered along the alignment. In some of the boreholes this deposit was fully penetrated at depths of 2.1 m to 13.2 m below ground surface or elevations ranging between 261.6 m and 244.8 m. Some boreholes were terminated in this clayey silt till at depths of 11.1 m and 11.2 m below ground surface i.e. at elevations of 255.3 m to 246.1 m.

Borehole EC 2 drilled near the west bank of Etobicoke Creek encountered a lower layer of clayey silt till that extends to a depth of 30.7 m (Elev. 222.6 m) below ground surface.

The grain size distribution curves of tested samples of this clayey silt till are shown in Figures B1 to B4. These results show a grain size distribution consisting of 0-30% gravel, 6-45% sand, 25-69% silt and 11-38% clay size particles. Till soils are also known to contain cobbles and boulders.

Samples were also subjected to Atterberg Limits tests and the results are plotted on the plasticity charts in Figures B5 and B6. The index values from these tests are summarized below:

Liquid Limit:	19-28%
Plastic Limit:	14-17%
Plasticity Index:	5-13%
Natural Moisture Content:	9-16%

These values are characteristic of clayey soils of low plasticity.

Standard Penetration tests in the clayey silt till gave 'N' values ranging from 3 to more than 100 blows for 0.3 m penetration but generally most of the recorded 'N' values ranged from 18 to more than 100 blows for 0.3 m penetration. Based on these results the clayey silt till is considered to have a generally very stiff to hard consistency with occasional soft to stiff zones.

The moisture content of samples from these deposits ranged from 7% to 23% by weight and the bulk unit weight of samples ranged between 21 kN/m^3 and 23.1 kN/m^3.

5.4 Sand and Silt and Silty Sand Till

Layers of sand and silt and silty sand till were encountered below ground surface. These layers were fully penetrated in some of the boreholes at depths of 6.9 m to 28.4 m below ground surface or to elevations ranging from 258.2 m to 224.9 m. Some of the boreholes were terminated in this deposit at depths ranging from 9.6 m to 27.6 m below ground surface i.e. at elevations of 259.1 m to 219.3 m.

The results of grain size distribution tests conducted on samples obtained from these deposits are shown in Figures B7 and B8. These results show grain size distributions consisting of 0-35% gravel, 28-79% sand, 11-49% silt and 3-9% clay size particles. Cobbles and boulders can also be expected in till soils.

Standard Penetration tests in the sand and silt till gave 'N' values that ranged from 16 to more than 100 blows for 0.3 m penetration indicating a generally compact to very dense relative density. The moisture content of samples from this stratum ranged from 3% to 18% by weight.

5.5 Silty Sand

Silty sand layers were encountered in Boreholes VB3, EC2, EC5 and HML10. The silty sand extends to depths ranging from 16.2 m to 22.3 m below ground surface or to elevations ranging from 239.0 m to 230.7 m. In Borehole HML 10 the silty sand deposit extends to a borehole termination depth of 15.7 m (Elev. 251.1 m).

Refer to Figure B9 for three grain size distribution curves of samples of this silty sand. The results show a grain size distribution consisting of 0% gravel, 60-86% sand, 10-33% silt and 4-7% clay size particles.

Standard Penetration tests in this silty sand deposit yielded 'N' values ranging from 2 to 91 blows for 0.3 m penetration but generally 'N' values of 11 to 91 blows for 0.3 m penetration were obtained. Based on these results the silty sand deposit is considered to have a generally compact to very dense relative density with occasional very loose zones. The moisture content of samples from this deposit ranged from 4% to 30% by weight.

5.6 Lower Clayey Silt

Boreholes VB3, VB4 and EC5 encountered a lower layer of clayey silt. In Boreholes VB3 and VB4 the clayey silt layer extends to borehole termination depths of 26.2 m i.e. at elevations of 233 m to 232.6 m. In Borehole EC5 this lower clayey silt deposit extends to a depth of 13.2 m (Elev. 233.7 m) below ground surface.

The grain size distribution curves of samples of this clayey silt are presented in Figure B10. These results show a grain size distribution consisting of 0% gravel, 1-7% sand, 65-81% silt and 18-34% clay size particles.

An Atterberg Limits test was conducted on a sample of the clayey silt and the results are illustrated in Figure B11. The index values from these tests are summarized below:

Liquid Limit:	24%
Plastic Limit:	19%
Plasticity Index:	5%
Natural Moisture Content:	20%

These values are characteristic of clayey soils of low plasticity.

Standard Penetration tests in this lower clayey silt layer yielded 'N' values ranging from 84 to more than 100 blows for 0.3 m penetration indicating a hard consistency. The moisture content of samples from this deposit ranged from 11% to 20% by weight.

5.7 Silt

Silt soils were encountered in Boreholes HML4, HML5A and EC2. This silt layer extends to a depth of 17.8 m (Elev. 235.5 m) below ground surface in Borehole EC2 and to borehole termination depths of 11.2 m (Elev. 248.0 m) and 14.2 m (Elev. 245.9 m) in Boreholes HML4 and HML5A respectively.

The grain size distribution curves of samples of the silt are illustrated in Figure B12. These results show a grain size distribution consisting of 0-2% gravel, 0-32% sand, 63-93% silt and 5-9% clay size particles.

The silt deposit is considered to have a compact to very dense relative density based on SPT 'N' values that ranged from 22 to more than 100 blows for 0.3 m penetration. The moisture content of samples from the deposit ranges from 15% to 26% by weight.

5.8 Sandy Silt

Boreholes EC2 and EC5 encountered a layer of sandy silt. This sandy silt layer extends to depths ranging from 22.3 m to 23.9 m below ground surface or to elevations ranging from 229.4 m to 224.6 m.

The grain size distribution curves of two samples from this deposit are illustrated in Figure B13. These results show a grain size distribution consisting of 0% gravel, 27-34% sand, 56-69% silt and 4-10% clay size particles.

The sandy silt deposit is considered to have a loose to very dense relative density based on SPT 'N' values that ranged from 7 to 51 blows for 0.3 m penetration. The moisture content of samples from the deposit ranges from 19% to 24% by weight.

5.9 Gravelly Sand

Gravelly sand and sand and gravel deposits were encountered at some locations along the alignment. A surficial sand and gravel deposit was encountered in Borehole EC2 extending to a depth of 2.1 m (Elev. 251.2 m) below ground surface. The gravelly sand layer extends to borehole termination depths of 15.3 m (Elev. 256.3 m) and 10.8 m (Elev. 256 m) below ground surface in Boreholes HML9 and HML10 respectively.

Refer to Figure B14 for the grain size distribution results of two samples from this deposit. These results illustrate a grain size distribution that consists of 26-36 % gravel, 47-67 % sand, 7-9 % silt and 8 % clay size particles.

SPT 'N' values ranged from 30 to more than 100 blows for 0.3 m penetration in the deposit indicating a dense to very dense relative density. The moisture content by weight of samples generally ranges from 3% to 4% but a value of 27% was recorded for the surficial sample retrieved at the Etobicoke Creek location.

5.10 Bedrock

Bedrock was encountered in Borehole EC2 at a depth of 30.7 m (Elev. 222.6 m) below ground surface. Bedrock was proved by coring. The bedrock is described as moderately to highly weathered and its colour is grey. It is thin to medium bedded with medium strong to strong fossiliferous limestone interbeds. Core recovery in this borehole ranged from 63% to 85%. The RQD values generally ranged from 10% to 20% indicating very poor

rock quality. Vertical and subvertical joints were observed in the rock cores which contributed to the relatively low RQD values.

5.11 Water Levels

Groundwater observations were made in the open boreholes during the drilling and after completing each borehole.

The boreholes drilled at the structure locations were also instrumented with a standpipe piezometer. The water level readings were measured on separate visits made after the completion of drilling and the piezometric data from these selected boreholes are presented in Table 5.1.

Table 5.1 – Water Level Measurements

Borehole	Date	Water Levels	
		Depth (m)	Elevation (m)
VB3	April 18, 2005	8.5	250.7
	Sept. 09, 2005	9.2	250.0
EC-2	April 18, 2005	4.0	249.3
	May 17, 2005	3.9	249.4
EC-5*	April, 18, 2005	0.4	247.3
	May 17, 2005	1.1	248.0

* Artesian Condition

The groundwater table along the alignment is estimated based on the water level observations in the open boreholes, the change of the colour of the native soil from brown to grey, the moisture contents of the soil samples and the piezometric data given in Table 5.1.

Based on this data the groundwater table is believed to be generally at about Elev. 250 to 252 m at the northwest limit of the project falling easterly to about Elev. 249.5 at about Sta. 24+400. The groundwater table continues to fall gradually and further to the east where it is estimated to be just below ground surface i.e. Elev. 246 m at Etobicoke Creek. The groundwater table then rises easterly beyond the east bank of Etobicoke Creek following the ground surface contours to reach an estimated elevation of 259.5 m at about Sta. 23+300. Further east and towards the southwest limit of the project the groundwater table falls with the contour of the land and is estimated to be at about Elev. 252 m at the southwest project limit.

Excess hydrostatic pressure exists in the silty sand and sandy silt soils encountered below Elev. 233.7 m in Borehole EC5.

Perched water can also be expected to occur in the surficial permeable layers of sands, gravel and silts that are underlain by relatively impermeable layers of clayey silt and clayey silt till.

All groundwater observations at this site are short term and the levels are expected to fluctuate seasonally and after severe weather events. The groundwater table of the alignment near to Etobicoke Creek will be controlled by the free water level in the creek.

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FOUNDATION DESIGN REPORT
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PART 2: ENGINEERING DISCUSSION AND RECOMMENDATIONS

6 GENERAL

This report provides geotechnical recommendations for the design of the proposed Highmast Light Poles (HML).

It is understood that the proposed Highway 410 alignment will be illuminated by luminaries mounted on Highmast Light Poles to be located along the median centre line and also within the Valleywood Boulevard interchange area. The route commences from about Sta. 22+100 about 300 m east of Heart Lake Road and concludes at Sta. 25+750 on Highway 10.

The discussion and recommendations presented in this report are based on our understanding of the project and on the factual data obtained in the course of the investigations.

7 SUMMARIZED SUBSURFACE CONDITIONS

In general, the site is underlain by topsoil and overburden deposits of clayey silt, clayey silt till, sand and silt till, sands and silts and gravelly sand.

The groundwater table along the alignment is generally at about Elev. 250-252 m at the northwest project limit falling easterly to about Elev. 249.5 at Sta. 24+400. The groundwater table continues to fall gradually and further to the east and it is estimated to be just below ground surface i.e. Elev. 246 at Etobicoke Creek. The groundwater table rises easterly beyond the east bank of Etobicoke Creek following the ground surface contours to reach an estimated elevation of 259.5 m at about Sta. 23+300. Further east near the southwest project limit the groundwater table falls to an estimated elevation of about 252 m.

Excess hydrostatic pressure exists in the silty sand and sandy silt soils encountered below Elev. 233.7 m in Borehole EC5.

8 DESIGN CONSIDERATIONS

Generally, each HML can be supported on a single caisson (i.e. drilled and cast-in-place concrete pile) foundation. The depth of the caisson is typically 8 to 9 m, but would vary depending on the height of the HML and the subsurface conditions encountered at each pole location. The design can be carried out in accordance with the following documents and papers.

- Canadian Highway Bridge Design Code and Commentary (2000). CAN/CSA-S6-00 and S6.1-00.
- Ministry of Transportation, Ontario (1994) "Procedures for the Design of High Mast Pole Foundations", Design Section, Structural Office.
- BROMS, B.B.: Lateral Resistance of Piles in Cohesive Soils, Journal of the Soil Mechanics and Foundation Division, ASCE, Vol. 90 No. SM2, Paper No. 3825, March 1964.
- BROMS, B.B.: Lateral Resistance of Piles in Cohesive Soils, Journal of the Soil Mechanics and Foundation Division, ASCE, Vol. 90 No. SM3, Paper No. 3909, March 1964.
- BROMS, B.B.: Design of Laterally Loaded Piles, Journal of the Soil Mechanics and Foundation Division, ASCE, Vol. 91. Paper No. SM3, May 1965.

The recommended soil parameters for the design of augered caisson foundation units are given in Table 8.0.

Table 8.0 – Recommended Soil Parameters

BH No.	Elevation (m) From	To	Type of Soil	Consistency or Compactness Condition	q_u (kPa)	ϕ (degrees)	γ (kN/m^3)	Water Level Depth (Elevation) (m)
HML 1	261.7	261.4	Cohesive	Firm	50	-	19.0	10.6♦ (251.5)♦
	261.4	260.7	Cohesive	Very Stiff	300	-	21.0	
	260.7	258.1	Cohesive	Hard	450	-	21.5	
	258.1	253.7	Cohesive	Very Stiff	300	-	21.0	
	253.7	250.9	Cohesive	Hard	450	-	21.5	
VB 3	258.7	257.8	Cohesive	Stiff	150	-	21.0	8.5 (250.7)
	257.8	249.1	Cohesive	Very Stiff to Hard	300	-	21.5	
	249.1	246.0	Cohesive	Stiff to Very Stiff	200	-	21.0	
	246.0	239.9	Cohesionless	Dense to Very Dense	-	35	22.0	
	239.9	239.0	Cohesionless	Dense	-	35	21.0	
	239.0	237.7	Cohesionless	Very Dense	-	35	22.5	
	237.7	233.0	Cohesive	Hard	450	-	21.5	
VB 4	258.3	253.2	Cohesive	Stiff to Very Stiff	200	-	21.0	7.8♦ (251.0)♦
	253.2	251.7	Cohesive	Hard	450	-	21.5	
	251.7	245.6	Cohesive	Stiff to Very Stiff	200	-	21.0	
	245.6	241.0	Cohesionless	Very Dense	-	35	22.5	
	241.0	239.5	Cohesionless	Compact	-	33	21.0	
	239.5	238.0	Cohesionless	Very Dense	-	35	22.5	
	238.0	232.6	Cohesive	Hard	450	-	21.5	
HML 2	257.3	256.6	Cohesive	Stiff	100	-	19.0	6.3♦ (251.0)♦
	256.6	255.2	Cohesive	Very Stiff	300	-	21.0	
	255.2	246.1	Cohesive	Hard	450	-	21.5	

Table 8.0 – Recommended Soil Parameters

BH No.	Elevation (m) From	To	Type of Soil	Consistency or Compactness Condition	q_u (kPa)	ϕ (degrees)	γ (kN/m^3)	Water Level Depth (Elevation) (m)
HML 3	259.0	258.3	Cohesive	Stiff	200	-	19.0	7.5♦ (251.5)♦
	258.3	255.0	Cohesive	Very Stiff	300	-	21.0	
	255.0	247.8	Cohesive	Hard	450	-	21.5	
HML 4	259.2	258.5	Cohesive	Stiff	150	-	19.0	7.7♦ (251.5)♦
	258.5	257.1	Cohesive	Stiff to Very Stiff	150	-	21.0	
	257.1	253.8	Cohesive	Hard	450	-	22.0	
	253.8	252.3	Cohesionless	Very Dense	-	35	22.5	
	252.3	249.1	Cohesionless	Dense to Very Dense	-	35	22.0	
	249.1	248.0	Cohesionless	Compact	-	33	20.5	
HML 5	259.9	259.4	Cohesive	Soft to Firm	50	-	19.0	10.6♦ (249.5)♦
	259.4	252.1	Cohesive	Very Stiff to Hard	400	-	21.5	
	252.1	249.1	Cohesionless	Very Dense	-	35	22.5	
HML 5A	249.4	245.9	Cohesionless	Very Dense	-	35	22.5	See HML 5
EC 2	253.1	252.6	Cohesionless	Very Loose	-	27	18.0	3.9 (249.4)
	252.6	251.9	Cohesive	Firm	100	-	19.0	
	251.9	251.2	Cohesionless	Compact	-	30	21.0	
	251.2	250.4	Cohesive	Very Stiff	300	-	21.0	
	250.4	246.2	Cohesionless	Dense to Very Dense	-	35	22.0	
	246.2	244.7	Cohesionless	Compact	-	30	21.0	
	244.7	243.2	Cohesionless	Very Dense	-	35	22.5	
	243.2	238.6	Cohesionless	Dense to Very Dense	-	35	21.5	
	238.6	237.1	Cohesionless	Compact	-	30	21.0	
	237.1	235.5	Cohesionless	Dense	-	35	21.5	
	235.5	234.0	Cohesionless	Dense	-	35	21.5	
	234.0	232.5	Cohesionless	Compact	-	33	21.0	
	232.5	231.0	Cohesionless	Dense	-	35	21.5	
	231.0	229.4	Cohesionless	Very Dense	-	35	22.5	
	229.4	227.9	Cohesionless	Very Dense	-	35	22.5	
	227.9	224.9	Cohesionless	Compact to Dense	-	33	21.5	
	224.9	222.6	Cohesive	Hard	450	-	21.5	
EC 5	246.7	245.5	Cohesionless	Compact	-	30	19.0	0.9♦ (246.0)♦ 1.1♦♦ (248.0)♦♦
	245.5	244.8	Cohesive	Very Stiff	300	-	21.0	
	244.8	244.0	Cohesionless	Compact	-	33	19.0	
	244.0	242.7	Cohesionless	Very Dense	-	35	22.5	
	242.7	239.8	Cohesionless	Compact to Dense	-	33	21.0	
	239.8	238.3	Cohesionless	Very Dense	-	35	22.5	
	238.3	233.7	Cohesive	Hard	450	-	21.5	
	233.7	230.7	Cohesionless	Compact	-	30	19.0	
	230.7	224.6	Cohesionless	Loose to Compact	-	30	19.0	
	224.6	219.3	Cohesionless	Very Dense	-	35	22.5	
HML 6	262.4	261.9	Cohesive	Firm	100	-	19.0	4.1♦ (258.5)♦
	261.9	260.5	Cohesive	Stiff	150	-	21.0	
	260.5	257.0	Cohesive	Very Stiff	300	-	21.5	
	257.0	255.5	Cohesive	Hard	450	-	21.5	
	255.5	251.7	Cohesionless	Very Dense	-	35	22.5	
	251.7	249.4	Cohesionless	Dense	-	35	21.5	
	249.4	248.4	Cohesionless	Compact	-	30	19.0	
HML 7	266.2	265.7	Cohesive	Soft to Firm	50	-	19.0	6.9♦ (259.5)♦
	265.7	265.0	Cohesive	Firm	100	-	19.0	
	265.0	264.3	Cohesive	Very Stiff	300	-	21.0	
	264.3	260.9	Cohesive	Hard	450	-	21.5	
	260.9	257.9	Cohesionless	Very Dense	-	35	22.5	
	257.9	255.3	Cohesive	Hard	450	-	21.5	

Table 8.0 – Recommended Soil Parameters

BH No.	Elevation (m) From	To	Type of Soil	Consistency or Compactness Condition	q_u (kPa)	ϕ (degrees)	γ (kN/m^3)	Water Level Depth (Elevation) (m)
HML 8	268.5	268.0	Cohesive	Firm	50	-	19.0	Below 9.6♦ (Below 259.1)♦
	268.0	266.6	Cohesive	Stiff to Very Stiff	300	-	21.0	
	266.6	261.6	Cohesive	Hard	450	-	21.5	
	261.6	259.1	Cohesionless	Very Dense	-	35	22.5	
HML 9	271.5	270.9	Cohesive	Soft	50	-	19.0	Below 15.3♦ (Below 256.3)♦
	270.9	270.2	Cohesive	Very Stiff	300	-	21.0	
	270.2	260.7	Cohesive	Hard	450	-	21.5	
	260.7	257.9	Cohesionless	Very Dense	-	35	22.5	
	257.9	256.3	Cohesionless	Very Dense	-	35	22.5	
HML 10	266.1	261.2	Cohesive	Hard	450	-	21.5	14.8♦ (252.0)♦
	261.2	258.2	Cohesionless	Very Dense	-	35	22.5	
	258.2	256.0	Cohesionless	Very Dense	-	35	22.5	
	256.0	251.1	Cohesionless	Very Dense	-	35	22.5	

♦ = estimated
♦♦ = Artesian conditions in the lower granular deposits.

The notations used in Table 8.0 are defined below:

ϕ = apparent angle of friction for cohesionless soils in degrees.
q_u = unconfined compressive strength in kPa ($q_u=2xC_u$) for cohesive soils
C_u = undrained shear strength in kPa.
γ = bulk unit weight of soil in kN/m^3.

In order to take into account frost action and surficial disturbance, the ultimate lateral passive resistance in front of a caisson and caisson sidewall adhesion within the upper 1.2 m below final grade, should be neglected in the foundation design. It is also recommended that all surficial weak or variable soils be neglected in determining lateral resistance.

Where Highmast Light Poles are located on or near to sloping ground the sloping ground will result in reduced lateral passive resistance that should be taken into account during design. When designing for the portion of a caisson below the groundwater level, the submerged unit weight should be used.

The required depth of the drilled shaft will be governed by lateral loads, including wind loads. Appropriate load and resistance factors should be applied for caisson design.

9 CONSTRUCTION CONSIDERATIONS

The glacial till deposits can be expected to contain random cobbles and boulders. Cobbles and boulders if encountered during excavation can increase the level of construction effort required for caisson installation, such as increasing the time required for drilling etc. Bidders should be advised of these conditions and be required to provide adequate equipment to handle the obstructions.

The clayey silt and clayey silt till deposits are expected to be self-supporting. Due to the relatively low permeability of these strata minor water seepage is expected in caisson holes, even below the groundwater table.

Where relatively more pervious and granular soils (i.e. sand and silt till, sands and silts and gravelly sand) are encountered dry cave-ins may occur in unsupported holes made in these cohesionless soils above the groundwater table. Below the groundwater table, these water bearing soils can be expected to yield significant amounts of water and may cause instability problems during the installation of the caissons. The use of dewatering techniques to lower the groundwater table during construction is unlikely to be economically viable due to the limited construction effort required.

Where the water bearing layers are rather thin and the soil is relatively fine grained, it may be possible to effect construction by pouring the concrete rapidly upon completion of the excavation. In other cases, however, the coarse tills and the sand layers may cause cave-ins and/or excessive groundwater seepage in unlined caisson holes.

In view of these conditions, it is recommended that temporary liner(s) be available on site to support the caisson sidewalls and to provide seepage cut-off as and where required.

The concrete should be poured expeditiously on completion of the caisson hole. It is recommended that the concrete be placed by the tremie method as soon as the hole reaches its desired depth. The liner should be withdrawn as concrete is placed. During liner withdrawal, the level of concrete in the caisson hole must always be at least 0.6 m above the bottom of the temporary liner.

We recommend that the following notes be included in the contract documents:

- At the various foundation locations the strata may consist of clayey silt, clayey silt till, sand and silt till, sands and silts and gravelly sand. Groundwater is likely to be encountered above the base of the excavations.
- The contractor shall maintain the stability of the soil along the sides and in the bases of the holes for the concrete footings at all times from the commencement of their construction to the placing of the concrete.
- Dewatering may be required to maintain a sufficiently dry condition for proper installation of the caisson hole and the placement of concrete.
- At Etobicoke Creek the silty sand and sandy silt soils below Elev. 233.7 m in Borehole EC5 are under excess hydrostatic pressure and these soils are susceptible to conditions of unbalanced hydrostatic head and seepage forces. A quick condition "boiling" may occur if excavations penetrate into these layers.

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

Engineering Analysis and Report Preparation by:
R. Abdul, P.Eng.,
Geotechnical Engineer

Report Reviewed by:
Michael Tanos, P.Eng.,
Review Principal

APPENDIX A

Record of Borehole Sheets

Terraprobe Limited

LIMITATIONS AND RISK

Procedures

The soil conditions were confirmed at the borehole locations only and conditions may vary between and beyond the boreholes. The boundaries between the various strata as shown on the logs are based on non-continuous sampling. These boundaries represent an inferred transition between the various strata, rather than a precise plane of stratigraphic change.

This investigation has been carried out using investigation techniques and engineering analysis methods consistent with those ordinarily exercised by Terraprobe and other engineering practitioners, working under similar conditions and subject to the time, financial and physical constraints applicable to this project. The discussions and recommendations that have been presented are based on the factual data obtained.

It must be recognized that there are special risks whenever engineering or related disciplines are applied to identify subsurface conditions. Even a comprehensive sampling and testing programme implemented in accordance with the most stringent level of care may fail to detect certain conditions. Terraprobe has assumed for the purposes of providing design parameters and advice, that the conditions that exist between sampling points are similar to those found at the sample locations. The conditions that Terraprobe has interpreted to exist between sampling points can differ from those that actually exist.

It may not be possible to drill a sufficient number of boreholes or sample and report them in a way that would provide all the subsurface information that could affect construction costs, techniques, equipment and scheduling. Contractors bidding on or undertaking work on the project should be directed to draw their own conclusions as to how the subsurface conditions may affect them, based on their own investigations and their own interpretations of the factual investigation results, cognizant of the risks implicit in the subsurface investigation activities.

Changes In Site And Scope

It must be recognized that the passage of time, natural occurrences, and direct or indirect human intervention at or near the site have the potential to alter subsurface conditions. Groundwater levels are particularly susceptible to seasonal fluctuations.

The design advice is based on the factual data obtained from this investigation made at the site by Terraprobe and are intended for use by the owner and its retained designers in the design phase of the project. If there are changes to the project scope and development features, or there is any additional information relevant to the interpretations made of the subsurface information, the geotechnical design parameters and comments relating to constructibility issues and quality control may not be relevant or complete for the revised project. Terraprobe should be retained to review the implications of such changes with respect to the contents of this report

EXPLANATION OF TERMS USED IN REPORT

N VALUE: THE STANDARD PENETRATION TEST (SPT) N VALUE IS THE NUMBER OF BLOWS REQUIRED TO CAUSE A STANDARD 51mm O.D. SPLIT BARREL SAMPLER TO PENETRATE 0.3m INTO UNDISTURBED GROUND IN A BOREHOLE WHEN DRIVEN BY A HAMMER WITH A MASS OF 63.5kg. FALLING FREELY A DISTANCE OF 0.76m. FOR PENETRATIONS OF LESS THAN 0.3m N VALUES ARE INDICATED AS THE NUMBER OF BLOWS FOR THE PENETRATION ACHIEVED. AVERAGE N VALUE IS DENOTED THUS $\bar{N}$.

DYNAMIC CONE PENETRATION TEST: CONTINUOUS PENETRATION OF A CONICAL STEEL POINT (51mm O.D. 60° CONE ANGLE) DRIVEN BY 475J IMPACT ENERGY ON 'A' SIZE DRILL RODS. THE RESISTANCE TO CONE PENETRATION IS MEASURED AS THE NUMBER OF BLOWS FOR EACH 0.3m ADVANCE OF THE CONICAL POINT INTO THE UNDISTURBED GROUND.

SOILS ARE DESCRIBED BY THEIR COMPOSITION AND CONSISTENCY OR DENSENESS.

CONSISTENCY: COHESIVE SOILS ARE DESCRIBED ON THE BASIS OF THEIR UNDRAINED SHEAR STRENGTH (c_u) AS FOLLOWS:

c_u (kPa)	0 – 12	12 – 25	25 – 50	50 – 100	100 – 200	>200
	VERY SOFT	*SOFT*	*FIRM*	*STIFF*	*VERY STIFF*	*HARD*

DENSENESS: COHESIONLESS SOILS ARE DESCRIBED ON THE BASIS OF DENSENESS AS INDICATED BY SPT N VALUES AS FOLLOWS:

N (BLOWS/0.3m)	0 – 5	5 – 10	10 – 30	30 – 50	>50
	VERY LOOSE	*LOOSE*	*COMPACT*	*DENSE*	*VERY DENSE*

ROCKS ARE DESCRIBED BY THEIR COMPOSITION AND STRUCTURAL FEATURES AND/OR STRENGTH.

RECOVERY: SUM OF ALL RECOVERED ROCK CORE PIECES FROM A CORING RUN EXPRESSED AS A PERCENT OF THE TOTAL LENGTH OF THE CORING RUN.

MODIFIED RECOVERY: SUM OF THOSE INTACT CORE PIECES, 100mm+ IN LENGTH EXPRESSED AS A PERCENT OF THE LENGTH OF THE CORING RUN. THE ROCK QUALITY DESIGNATION (RQD), FOR MODIFIED RECOVERY IS:

RQD (%)	0 – 25	25 – 50	50 – 75	75 – 90	90 – 100
	VERY POOR	*POOR*	*FAIR*	*GOOD*	*EXCELLENT*

JOINTING AND BEDDING:

SPACING	50mm	50 – 300mm	0.3m – 1m	1m – 3m	>3m
JOINTING	*VERY CLOSE*	*CLOSE*	*MOD. CLOSE*	*WIDE*	*VERY WIDE*
BEDDING	*VERY THIN*	*THIN*	*MEDIUM*	*THICK*	*VERY THICK*

ABBREVIATIONS AND SYMBOLS

FIELD SAMPLING

SS	SPLIT SPOON	TP	THINWALL PISTON
WS	WASH SAMPLE	OS	OSTERBERG SAMPLE
ST	SLOTTED TUBE SAMPLE	RC	ROCK CORE
BS	BLOCK SAMPLE	PH	TW ADVANCED HYDRAULICALLY
CS	CHUNK SAMPLE	PM	TW ADVANCED MANUALLY
TW	THINWALL OPEN	FS	FOIL SAMPLE

STRESS AND STRAIN

u_w	kPa	PORE WATER PRESSURE
r_u	1	PORE PRESSURE RATIO
σ	kPa	TOTAL NORMAL STRESS
σ'	kPa	EFFECTIVE NORMAL STRESS
τ	kPa	SHEAR STRESS
$\sigma_1, \sigma_2, \sigma_3$	kPa	PRINCIPAL STRESSES
ε	%	LINEAR STRAIN
$\varepsilon_1, \varepsilon_2, \varepsilon_3$	%	PRINCIPAL STRAINS
E	kPa	MODULUS OF LINEAR DEFORMATION
G	kPa	MODULUS OF SHEAR DEFORMATION
μ	1	COEFFICIENT OF FRICTION

MECHANICAL PROPERTIES OF SOIL

m_v	kPa^{-1}	COEFFICIENT OF VOLUME CHANGE
C_c	1	COMPRESSION INDEX
C_s	1	SWELLING INDEX
C_α	1	RATE OF SECONDARY CONSOLIDATION
C_v	m^2/s	COEFFICIENT OF CONSOLIDATION
H	m	DRAINAGE PATH
T_v	1	TIME FACTOR
U	%	DEGREE OF CONSOLIDATION
σ'_{vo}	kPa	EFFECTIVE OVERBURDEN PRESSURE
σ'_p	kPa	PRECONSOLIDATION PRESSURE
τ_f	kPa	SHEAR STRENGTH
c'	kPa	EFFECTIVE COHESION INTERCEPT
ϕ'	- °	EFFECTIVE ANGLE OF INTERNAL FRICTION
c_u	kPa	APPARENT COHESION INTERCEPT
ϕ_u	- °	APPARENT ANGLE OF INTERNAL FRICTION
τ_R	kPa	RESIDUAL SHEAR STRENGTH
τ_r	kPa	REMOULDED SHEAR STRENGTH
S_t	1	SENSITIVITY = c_u / τ_r

PHYSICAL PROPERTIES OF SOIL

ρ_s	kg/m^3	DENSITY OF SOLID PARTICLES	e	1,%	VOID RATIO	e_{min}	1,%	VOID RATIO IN DENSEST STATE
γ_s	kN/m^3	UNIT WEIGHT OF SOLID PARTICLES	n	1,%	POROSITY	I_D	1	DENSITY INDEX = $\frac{e_{max} - e}{e_{max} - e_{min}}$
ρ_w	kg/m^3	DENSITY OF WATER				D	mm	GRAIN DIAMETER
γ_w	kN/m^3	UNIT WEIGHT OF WATER	w	1,%	WATER CONTENT	D_n	mm	n PERCENT - DIAMETER
ρ	kg/m^3	DENSITY OF SOIL	S_r	%	DEGREE OF SATURATION	C_u	1	UNIFORMITY COEFFICIENT
γ	kN/m^3	UNIT WEIGHT OF SOIL	w_L	%	LIQUID LIMIT	h	m	HYDRAULIC HEAD OR POTENTIAL
ρ_d	kg/m^3	DENSITY OF DRY SOIL	w_P	%	PLASTIC LIMIT	q	m^3/s	RATE OF DISCHARGE
γ_d	kN/m^3	UNIT WEIGHT OF DRY SOIL	w_S	%	SHRINKAGE LIMIT	v	m/s	DISCHARGE VELOCITY
ρ_{sat}	kg/m^3	DENSITY OF SATURATED SOIL	I_P	%	PLASTICITY INDEX = $(w_L - w_P)$	I	1	HYDRAULIC GRADIENT
γ_{sat}	kN/m^3	UNIT WEIGHT OF SATURATED SOIL	I_L	1	LIQUIDITY INDEX = $(w - w_P)/I_P$	k	m/s	HYDRAULIC CONDUCTIVITY
ρ'	kg/m^3	DENSITY OF SUBMERGED SOIL	I_C	1	CONSISTENCY INDEX = $(w_L - w)/I_P$	j	kN/m^3	SEEPAGE FORCE
γ'	kN/m^3	UNIT WEIGHT OF SUBMERGED SOIL	e_{max}	1,%	VOID RATIO IN LOOSEST STATE			

RECORD OF BOREHOLE No HML1

1 OF 2

METRIC

W.P. 105-00-00 LOCATION N:4844725.9 E:277770.0 ORIGINATED BY MS

DIST HWY Highway 410 BOREHOLE TYPE Solid Stem Augers COMPILED BY DB

DATUM Geodetic DATE 14.02.05 - 15.02.05 CHECKED BY RA

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE
262.1							262
0.0	**450mm SANDY TOPSOIL** trace gravel, loose, dark brown		1	SS	5		
261.7							
0.5	**CLAYEY SILT** - trace gravel, trace sand, trace organics, moist, firm, brown						
261.4			2	SS	22		261
0.7	**CLAYEY SILT** trace gravel,sandy, occasional sand seams and partings, damp to moist, very stiff to hard (GLACIAL TILL)		3	SS	39		
			4	SS	41		260
			5	SS	39		259
	brown						
	grey						258
			6	SS	22		
							257
			7	SS	29		256
			8	SS	21		255
							254

DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100)

SHEAR STRENGTH kPa (20 40 60 80 100)
- O UNCONFINED
- ● QUICK TRIAXIAL
- + FIELD VANE
- × LAB VANE

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L

WATER CONTENT (%) (10 20 30)

UNIT WEIGHT γ kN/m³

22.3

REMARKS & GRAIN SIZE DISTRIBUTION (%)

GR	SA	SI	CL
5	33	43	19

Continued Next Page

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

$O^{3\%}$ STRAIN AT FAILURE

Transportation
Ontario

RECORD OF BOREHOLE No HML1 2 OF 2 METRIC

W.P. 105-00-00 LOCATION N:4844725.9 E:277770.0 ORIGINATED BY MS
DIST HWY Highway 410 BOREHOLE TYPE Solid Stem Augers COMPILED BY DB
DATUM Geodetic DATE 14.02.05 - 15.02.05 CHECKED BY RA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa: ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L; WATER CONTENT (%) 10 20 30	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES						GR SA SI CL
	CLAYEY SILT trace gravel, trace sand to sandy, occasional sand seams and partings, damp to moist, very stiff to hard, brown (continued)		9	SS	30		253		○		
	(GLACIAL TILL)						252				
250.9			10	SS	53		251		○ ⊢		1 6 67 26
11.2	End of Borehole * Borehole dry (not stabilized) and hole open to full depth on completion.										

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

ONTARIO MOT 1-00-0350 HWY 410 HML.GPJ ONTARIO MOT.GDT 18/10/05

RECORD OF BOREHOLE No VB3 1 OF 2 METRIC

W.P. 105-00-00 LOCATION N4844645.2;E278064.4 ORIGINATED BY MS

DIST HWY 410 Phase III BOREHOLE TYPE Solid Stem Augers & Hollow Stem Augers COMPILED BY DB

DATUM Geodetic DATE 18.02.05 - 22.02.05 CHECKED BY RA

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) (20 40 60 80 100)	PLASTIC LIMIT W_P / NATURAL MOISTURE CONTENT W / LIQUID LIMIT W_L WATER CONTENT (%) (10 20 30)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
259.2											
0.0 / 258.7	**500mm TOPSOIL** moist, compact, dark brown		1	SS	12		259				
0.5	weathered, trace rootlets		2	SS	12		258				
	stiff		3	SS	17					21.3	
	very stiff to hard		4	SS	18		257				9 33 42 16
			5	SS	31		256			21.6	
	brown / grey						255				
	CLAYEY SILT - Sandy, trace gravel, damp to moist (GLACIAL TILL)		6	SS	16		254				
			7	SS	37		253				
			8	SS	26		252				
			9	SS	20		251				4 18 40 38
							250				Feb. 17, 2005
	stiff		10	SS	16		249				Feb. 18, 2005
			11	SS	14		248				
246.0 / 13.2	**SAND AND SILT** trace to some gravel, trace clay, moist to wet, very dense, grey (GLACIAL TILL)		12	SS	65		247				
							246				
							245				

Continued Next Page

+ 3, × 3: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

RECORD OF BOREHOLE No VB3

2 OF 2 **METRIC**

W.P. 105-00-00 LOCATION N4844645.2;E278064.4 ORIGINATED BY MS

DIST HWY 410 Phase III BOREHOLE TYPE Solid Stem Augers & Hollow Stem Augers COMPILED BY DB

DATUM Geodetic DATE 18.02.05 - 22.02.05 CHECKED BY RA

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 (%) (10 20 30)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	SAND AND SILT trace to some gravel, trace clay, moist to wet, dense to very dense, grey (GLACIAL TILL) *(continued)*		13	SS	80		244				
							243				
			14	SS	118		242				
							241				
			15	SS	34						3 39 49 9
239.9							240				
19.3	**SILTY FINE SAND** wet, dense, grey		16	SS	51		239				
239.0											
20.2	**SAND AND SILT** trace to some gravel, trace clay, moist, very dense inferred, grey (Possible Till)						238				
237.7			17	SS	119						
21.5	**CLAYEY SILT** trace sand, occasional silty fine sand seams and partings, moist, hard, grey						237				
			18	SS	100		236				Feb. 18, 2005
							235				Feb. 21, 2005 0 1 65 34
			19	SS	103		234				Feb. 21, 2005
233.0			20	SS	100/14cm		233				Feb. 22, 2005
26.2	End of Borehole Wet cave at 10.7m on completion. Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen wrapped with filter cloth. WATER LEVEL READINGS Date / Depth(m) / Elevation(m) Ap.18.05 / 8.5 / 250.7 Sept.09.05 / 9.2 / 250.0										

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

ONTARIO MOT 1-00-0350 HWY 410 VALLEYWOOD BLVD.GPJ ONTARIO MOT.GDT 20/09/05

RECORD OF BOREHOLE No VB4 1 OF 2 METRIC

W.P. 105-00-00 LOCATION N4844646.5;E278081.6 ORIGINATED BY MS

DIST HWY 410 Phase III BOREHOLE TYPE Solid Stem Augers COMPILED BY DB

DATUM Geodetic DATE 17.02.05 CHECKED BY RA

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × 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
258.8											
0.0 / 258.3	**500mm TOPSOIL** moist, very loose, dark brown		1	SS	3						
0.5	weathered, trace rootlets		2	SS	14		258				
			3	SS	24		257			22.2	
	brown		4	SS	20		256				
	grey		5	SS	12		255				
			6	SS	15		254				5 31 46 18
	stiff to very stiff						253				
	hard		7	SS	34		252				
	stiff to very stiff										
	CLAYEY SILT - Sandy, trace gravel, damp to moist (GLACIAL TILL)		8	SS	13		251				
			9	SS	13		250			21.0	
			10	SS	13		249				
			11	SS	16		248				
245.6							247				
13.2	**SAND AND SILT** - Gravelly, trace clay, damp to moist, very dense, grey (GLACIAL TILL)		12	SS	100/ 18cm		246				
							245				35 28 29 8
							244				

Continued Next Page

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

RECORD OF BOREHOLE No VB4

2 OF 2 **METRIC**

W.P. 105-00-00 LOCATION N4844646.5;E278081.6 ORIGINATED BY MS

DIST _____ HWY 410 Phase III BOREHOLE TYPE Solid Stem Augers COMPILED BY DB

DATUM Geodetic DATE 17.02.05 CHECKED BY RA

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 (%) (10 20 30)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	SAND AND SILT - Gravelly, trace clay, damp to moist, grey (GLACIAL TILL) *(continued)*		13	SS	95		243	○	○		
	very dense		14	SS	90		242	○	○		
	compact		15	SS	25		241		○		
	very dense		16	SS	61		240		○		
238.0							239				
20.8	**CLAYEY SILT** trace sand, occasional silty fine sand seams and partings, damp, hard, grey		17	SS	123		238		○		
			18	SS	118		237		○		0 7 70 23
			19	SS	126		236		○		
232.6			20	SS	100/15cm		235		○		
26.2	End of Borehole Water level at 10.7m (not stabilized) and hole open to 18.9 on completion. Attempted piezometer installation. Pipe dropped into hole during backfilling.						234				
							233				

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

RECORD OF BOREHOLE No HML2 1 OF 2 METRIC

W.P. 105-00-00 LOCATION N:4844756.4 E:278291.4 ORIGINATED BY MS

DIST _____ HWY Highway 410 BOREHOLE TYPE Solid Stem Augers COMPILED BY DB

DATUM Geodetic DATE 27.01.05 CHECKED BY RA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (10 20 30)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES						GR SA SI CL
257.3											
0.0	**CLAYEY SILT** trace gravel, trace sand, trace to some organics, moist, stiff, brown		1	SS	9		257				
256.6											
0.7	**CLAYEY SILT** trace gravel, trace sand to sandy, moist, very stiff to hard (GLACIAL TILL)		2	SS	25		256				
			3	SS	27						
			4	SS	33		255				7 28 42 23
			5	SS	35		254				
	brown — grey		6	SS	67		253				
			7	SS	42		252				
							251				
			8	SS	36		250				0 8 62 30
							249				

Continued Next Page

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

RECORD OF BOREHOLE No HML2

METRIC

W.P. 105-00-00	LOCATION N:4844756.4 E:276291.4		ORIGINATED BY MS
DIST	HWY Highway 410	BOREHOLE TYPE Solid Stem Augers	COMPILED BY DB
DATUM Geodetic	DATE 27.01.05		CHECKED BY RA

ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa	WATER CONTENT (%)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	CLAYEY SILT trace gravel, trace sand to sandy, moist, hard (GLACIAL TILL) *(continued)*		9	SS	42		248		o		
							247				
			10	SS	32	* ▽			o		
246.1 / 11.2	End of Borehole * Water level at 11.0m (not stabilized) and hole open to full depth on completion.										

Legend: SHEAR STRENGTH kPa — O UNCONFINED, + FIELD VANE, ● QUICK TRIAXIAL, × LAB VANE. PLASTIC LIMIT W_P, NATURAL MOISTURE CONTENT W, LIQUID LIMIT W_L.

+ 3, × 3: Numbers refer to Sensitivity   O 3% STRAIN AT FAILURE

RECORD OF BOREHOLE No HML3

1 OF 2

METRIC

W.P. 105-00-00 LOCATION N:4844781.6 E:278388.1 ORIGINATED BY MS

DIST _____ HWY Highway 410 BOREHOLE TYPE Solid Stem Augers COMPILED BY DB

DATUM Geodetic DATE 27.01.05 CHECKED BY RA

SOIL PROFILE			SAMPLES			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 (%) (10 20 30)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES						GR SA SI CL
259.0											
0.0	**CLAYEY SILT** trace gravel, trace sand, trace to some organics, moist, stiff, brown		1	SS	14						
258.3											
0.7	**CLAYEY SILT** trace gravel, trace sand to sandy, occasional sand seams and partings, damp to moist, very stiff to hard (GLACIAL TILL)		2	SS	18		258				
			3	SS	24		257				
			4	SS	26						
			5	SS	25		256				9 34 41 16
	brown ⟵ grey		6	SS	49		255				
			7	SS	66		254				
			8	SS	40		253				
							252				2 7 69 22
							251				

Continued Next Page

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

RECORD OF BOREHOLE No HML3 2 OF 2 METRIC

W.P. 105-00-00 LOCATION N:4844781.6 E:278388.1 ORIGINATED BY MS

DIST HWY Highway 410 BOREHOLE TYPE Solid Stem Augers COMPILED BY DB

DATUM Geodetic DATE 27.01.05 CHECKED BY RA

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 (%) (10 20 30)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	CLAYEY SILT trace gravel, trace sand to sandy, occasional sand seams and partings, damp to moist, hard, grey (GLACIAL TILL) *(continued)*		9	SS	42				○		
							249				
247.8			10	SS	36	*▽	248		○		
11.2	End of Borehole * Water level at 11.0m (not stabilized) and hole open to full depth on completion.										

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

RECORD OF BOREHOLE No HML4 1 OF 2 METRIC

W.P. 105-00-00 LOCATION N:4844909.2 E:278507.9 ORIGINATED BY MS

DIST HWY Highway 410 BOREHOLE TYPE Solid Stem Augers COMPILED BY DB

DATUM Geodetic DATE 28.01.05 CHECKED BY RA

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS
259.2						
0.0	**CLAYEY SILT** trace gravel, trace sand, trace organics, damp to moist, stiff, brown		1	SS	12	
258.5						
0.7	**CLAYEY SILT** trace gravel, trace to some sand, damp to moist, stiff to 1.4m, very stiff to hard below (GLACIAL TILL)		2	SS	11	
			3	SS	25	
			4	SS	34	
			5	SS	46	
			6	SS	50/ 15cm	
253.8						
5.4	**SAND AND SILT** trace gravel, moist, very dense, brown (GLACIAL TILL)		7	SS	50/ 15cm	
252.3						
6.9	**SILT** trace to some sand, trace clay, trace gravel, moist to wet, very dense brown ---- grey		8	SS	83/ 25cm	

ELEVATION SCALE: 259, 258, 257, 256, 255, 254, 253, 252, 251

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 (%)
10 20 30

UNIT WEIGHT γ kN/m³

REMARKS & GRAIN SIZE DISTRIBUTION (%)

GR	SA	SI	CL
0	11	83	6

Continued Next Page

+³, ×³: Numbers refer to Sensitivity ○³% STRAIN AT FAILURE

ONTARIO MOT 1-00-0350 HWY 410 HML.GPJ ONTARIO MOT.GDT 18/10/05

RECORD OF BOREHOLE No HML4 2 OF 2 METRIC

W.P. 105-00-00 LOCATION N:4844909.2 E:278507.9 ORIGINATED BY MS

DIST HWY Highway 410 BOREHOLE TYPE Solid Stem Augers COMPILED BY DB

DATUM Geodetic DATE 28.01.05 CHECKED BY RA

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 (%) 10 20 30	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	SILT trace to some sand, trace clay, trace gravel, moist to wet, very dense *(continued)*		9	SS	36		250		○		
	compact						249				
248.0			10	SS	29	*▽			○		2 2 90 6
11.2	End of Borehole * Water level at 10.8m (not stabilized) and hole open to full depth on completion.										

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

RECORD OF BOREHOLE No HML5 1 OF 2 METRIC

W.P. 105-00-00 LOCATION N:4645049.4 E:278636.1 ORIGINATED BY MS

DIST HWY Highway 410 BOREHOLE TYPE Solid Stem Augers COMPILED BY DB

DATUM Geodetic DATE 14.02.05 CHECKED BY RA

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 (%) 10 20 30	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
260.1											
0.0 / 259.9	**200mm TOPSOIL**						260				
0.2 / 259.4	**CLAYEY SILT** - trace gravel, trace sand, trace organics, moist to wet, firm, dark brown		1	SS	4						
0.7	**CLAYEY SILT** trace gravel, trace sand to sandy, damp to moist, very stiff to hard (GLACIAL TILL)		2	SS	27		259				
			3	SS	37		258				
			4	SS	37						
	brown		5	SS	33		257			23.1	
	grey						256				
			6	SS	29		255				
			7	SS	27		254				6 25 40 29
252.1			8	SS	100/ 20cm		253				
8.0	**SAND AND SILT** trace gravel, damp to moist, very dense, brown (GLACIAL TILL)						252				

Continued Next Page

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

RECORD OF BOREHOLE No HML5 2 OF 2 METRIC

W.P. 105-00-00 LOCATION N:4845049.4 E:278636.1 ORIGINATED BY MS

DIST HWY Highway 410 BOREHOLE TYPE Solid Stem Augers COMPILED BY DB

DATUM Geodetic DATE 14.02.05 CHECKED BY RA

SOIL PROFILE			SAMPLES										
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) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (10 20 30)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	SAND AND SILT trace gravel, damp to moist, very dense, brown (GLACIAL TILL) *(continued)*		9	SS	100/ 20cm		251		○		
							250				
249.1			10	SS	50/ 7cm				○		
11.0	End of Borehole * Borehole dry (not stabilized) and hole open to full depth on completion.										

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

RECORD OF BOREHOLE No HML5A 1 OF 2 METRIC

W.P. 105-00-00 LOCATION N:4845049.4 E:278636.1 ORIGINATED BY MS

DIST HWY Highway 410 BOREHOLE TYPE Solid Stem Augers COMPILED BY DB

DATUM Geodetic DATE 05.04.05 CHECKED BY RA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa: O UNCONFINED, + FIELD VANE, ● QUICK TRIAXIAL, × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L WATER CONTENT (%) 10 20 30	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES						
260.1 / 0.0	**Augered to 10.7m without sampling** Refer to Borehole HML5 for inferred soil stratigraphy.						260 259 258 257 256 255 254 253 252				

Continued Next Page

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

RECORD OF BOREHOLE No HML5A 2 OF 2 METRIC

W.P. 105-00-00 LOCATION N:4845049.4 E:278636.1 ORIGINATED BY MS

DIST HWY Highway 410 BOREHOLE TYPE Solid Stem Augers COMPILED BY DB

DATUM Geodetic DATE 05.04.05 CHECKED BY RA

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 (%) 10 20 30	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
249.4	**Augered to 10.7m without sampling** Refer to Borehole HML5 for inferred soil stratigraphy. *(continued)*						251 250				
10.7	**SILT** trace to some sand, trace clay, moist to wet, very dense brown grey		1	SS	50/ 15cm		249		○		0 14 77 9
			2	SS	50/ 15cm		248 247		○		
245.9			3	SS	75	*▽	246		○		0 32 63 5
14.2	End of Borehole * Water level at 13.7m (not stabilized) and hole open to full depth on completion.										

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

ONTARIO MOT 1-00-0350 HWY 410 HML.GPJ ONTARIO MOT.GDT 18/10/05

RECORD OF BOREHOLE No EC-2

1 OF 3

METRIC

W.P. 105-00-00 LOCATION Coords: N:4845168.1 E:278764.5 (Etobicoke Creek) ORIGINATED BY MS

DIST _____ HWY 410 Phase III BOREHOLE TYPE Solid Stem Augers, Hollow Stem Augers, Casing and NQ Coring COMPILED BY DB

DATUM Geodetic DATE 05.04.05 - 07.04.05 CHECKED BY RA

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE
253.3	Ground Surface						
253.0 / 0.2	**150mm TOPSOIL** - Sandy, dark brown		1	SS	2		253
252.6 / 0.7	**SILTY SAND** - trace gravel, trace rootlets and wood pieces, moist, very loose, brown		2	SS	8		252
251.9 / 1.4	**CLAYEY SILT** trace gravel, trace sand, moist, firm, brown		3	SS	30*		251
251.2 / 2.1	**SAND AND GRAVEL** trace silt, trace clay, damp, compact, brown		4	SS	26		250
250.4 / 2.9	**CLAYEY SILT** - Sandy, some gravel, moist, very stiff, brown (GLACIAL TILL)		5	SS	34		249
	SAND AND SILT trace gravel, trace clay, damp to moist, dense to very dense, brown (GLACIAL TILL)		6	SS	77		248
			7	SS	32		247
			8	SS	45		246
			9	SS	30		245
	compact		10	SS	17		244
	grey		11	SS	74		243
243.2 / 10.1	**SILT** trace sand, trace clay, moist to wet, dense to very dense, grey		12	SS	57		242
			13	SS	35		241
			14	SS	31		240
							239

DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100)

SHEAR STRENGTH kPa (20 40 60 80 100)
○ UNCONFINED + FIELD VANE
● QUICK TRIAXIAL × LAB VANE

PLASTIC LIMIT W_P — NATURAL MOISTURE CONTENT W — LIQUID LIMIT W_L

WATER CONTENT (%) (10 20 30)

UNIT WEIGHT γ kN/m³

REMARKS & GRAIN SIZE DISTRIBUTION (%)

	GR	SA	SI	CL
4	36	47	9	8
4	23	41	25	11
12	0	0	91	9

April05,2005

April06,2005

Continued Next Page

+³, ×³: Numbers refer to Sensitivity ○³% STRAIN AT FAILURE

RECORD OF BOREHOLE No EC-2 2 OF 3 METRIC

W.P. 105-00-00 LOCATION Coords: N:4845168.1 E:278764.5 (Etobicoke Creek) ORIGINATED BY MS

DIST HWY 410 Phase III BOREHOLE TYPE Solid Stem Augers, Hollow Stem Augers, Casing and NQ Coring COMPILED BY DB

DATUM Geodetic DATE 05.04.05 - 07.04.05 CHECKED BY RA

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 (%) (10 20 30)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	SILT trace sand, trace clay, moist to wet, compact to dense, grey *(continued)*		15	SS	22		238				0 2 93 5
							237				
			16	SS	45		236				
235.5											
17.8	**SILTY SAND** trace clay, wet, compact to dense, grey		17	SS	45		235				0 86 10 4
							234				
			18	SS	18		233				
			19	SS	37		232				
231.0											
22.3	**SANDY SILT** trace gravel, trace clay, wet, very dense, reddish brown to grey		20	SS	51		231				
229.4							230				April06,2005 / April07,2005
23.9	**SAND AND SILT** some gravel ,trace clay, moist, compact to very dense, reddish brown (GLACIAL TILL)		21	SS	86		229				
							228				
			22	SS	29		227				17 38 37 8
							226				
			23	SS	30		225				
224.9											
26.4	**CLAYEY SILT** trace gravel, damp, hard, grey (GLACIAL TILL)		24	SS	120/ 8cm		224				

Continued Next Page

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

RECORD OF BOREHOLE No EC-2 3 OF 3 METRIC

W.P. 105-00-00 LOCATION Coords: N:4845168.1 E:278764.5 (Etobicoke Creek) ORIGINATED BY MS

DIST HWY 410 Phase III BOREHOLE TYPE Solid Stem Augers, Hollow Stem Augers, Casing and NQ Coring COMPILED BY DB

DATUM Geodetic DATE 05.04.05 - 07.04.05 CHECKED BY RA

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 (%) 10 20 30	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
222.6			25	SS	119/ 10cm		223				
30.7	**SHALE BEDROCK** moderately to highly weathered, thinly to medium bedded, grey, very weak to weak with slightly weathered, medium strong to strong fossiliferous limestone interbeds. vertical to subvertical joints at 32.3m and 32.9m. Clay seam from 31.5m to 31.7m. (Georgian Bay Formation)		1	RUN	NQ		222				RUN#1 TCR=63% SCR=37% RQD=10%
			2	RUN	NQ		221				RUN#2 TCR=85% SCR=53% RQD=20%
219.5							220				
33.8	End of Borehole *Auger refusal at 1.8m, probably due to boulders. Borehole moved 0.8m South and redrilled. Wet cave at 21.3m upon completion. Piezometer installation consists of 19mm diameter, schedule 40 PVC pipe with a 1.52m slotted screen. Water Level Readings: Date Depth(m) Elevation(m) Apr.18.05 4.0 249.3 May.17.05 3.9 249.4										

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

RECORD OF BOREHOLE No EC-5 1 OF 3 METRIC

W.P. 105-00-00 LOCATION Coords: N:4845223.0 E:278835.8 (Etobicoke Creek) ORIGINATED BY MS

DIST HWY 410 Phase III BOREHOLE TYPE Hollow Stem Augers, D.C.P.T. COMPILED BY DB

DATUM Geodetic DATE 24.03.05 - 28.03.05 CHECKED BY RA

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 (%) (10 20 30)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
246.9	Ground Surface										
246.9	**200mm TOPSOIL** - black										
246.7 / 0.2	**SILTY SAND** - topsoil stained, trace rootlets, damp to moist, compact, brown		1	SS	16						
			2	SS	11		246				
245.5 / 1.4	**CLAYEY SILT** - sandy, some gravel, moist, very stiff, grey/brown (GLACIAL TILL)		3	SS	25		245				13 28 38 21
244.8 / 2.1	**SILTY SAND** trace gravel, trace clay, moist to wet, grey, (GLACIAL TILL) compact		4	SS	19		244				
	very dense		5	SS	62						3 79 11 7
			6	SS	100/ 13cm		243				
	compact to dense		7	SS	18		242				
			8	SS	30		241				
			9	SS	19		240				
			10	SS	40		239				
238.3 / 8.6	**CLAYEY SILT** trace sand, damp, hard, grey		11	SS	106		238				0 1 81 18
			12	SS	121		237				
			13	SS	84		236				
233.7 / 13.2	**SILTY SAND** trace clay, wet, compact, grey		14	SS	11		235				0 60 33 7
							234				
							233				March 24, 2005
							232				March 28, 2005

Continued Next Page

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

RECORD OF BOREHOLE No EC-5 2 OF 3 METRIC

W.P. 105-00-00 LOCATION Coords: N:4845223.0 E:278835.8 (Etobicoke Creek) ORIGINATED BY MS

DIST HWY 410 Phase III BOREHOLE TYPE Hollow Stem Augers, D.C.P.T. COMPILED BY DB

DATUM Geodetic DATE 24.03.05 - 28.03.05 CHECKED BY RA

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 (%) (10 20 30)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	SILTY SAND trace clay, wet, compact, grey *(continued)*		15	SS	15		231		○		
230.7											
16.2	**SANDY SILT** trace to some clay, wet, loose to compact, reddish brown to grey		16	SS	9		230		○		0 34 56 10
			17	SS	7		229		○		
			18	SS	14		228		○		
			19	SS	10		227		○		0 27 69 4
224.6							226				
22.3	**SAND AND SILT** some gravel, trace clay, moist, very dense, reddish brown (GLACIAL TILL)		20	SS	84		225		○		13 47 36 4
			21	SS	113		224		○		
			22	SS	113		223		○		18 45 34 3
219.3			23	SS	100/ 5cm		222		○		
27.6	End of Borehole						221				
	Auger refusal at 27.6m, probably on cobbles and boulders.						220				
	Attempted Dynamic Cone Penetration Test (D.C.P.T.), refusal at 27.6m.										
	Water level above ground surface (artesian condition) upon completion.										

Continued Next Page

+ 3, × 3: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

RECORD OF BOREHOLE No EC-5

3 OF 3

METRIC

W.P. 105-00-00 LOCATION Coords: N:4845223.0 E:278835.8 (Etobicoke Creek) ORIGINATED BY MS

DIST HWY 410 Phase III BOREHOLE TYPE Hollow Stem Augers, D.C.P.T. COMPILED BY DB

DATUM Geodetic DATE 24.03.05 - 28.03.05 CHECKED BY RA

SOIL PROFILE			SAMPLES						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 (%) (10 20 30)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE					

Piezometer Installation consists of 19mm diameter, schedule 40 PVC pipe with a 1.52m slotted screen.

Water Level Readings:

Date	Height(m)	Elevation(m)
Apr.18.05	0.4	247.3
May17.05	1.1	248.0

+ ³, × ³: Numbers refer to Sensitivity ○ ³% STRAIN AT FAILURE

RECORD OF BOREHOLE No HML6 1 OF 2 METRIC

W.P. 105-00-00 LOCATION N:4845430.9 E:279153.7 ORIGINATED BY MS

DIST HWY Highway 410 BOREHOLE TYPE Solid Stem Augers COMPILED BY DB

DATUM Geodetic DATE 19.04.05 CHECKED BY RA

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) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) (10 20 30)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
262.6											
0.0 / 262.4	**200mm TOPSOIL**										
0.2 / 261.9	**CLAYEY SILT** - trace gravel, trace sand, trace organics, moist, firm, brown		1	SS	8		262				
0.7	**CLAYEY SILT** trace gravel, trace sand to sandy, moist, stiff, brown (GLACIAL TILL)		2	SS	13						
			3	SS	13		261				
			4	SS	25		260				4 36 43 17
			5	SS	23						
	brown ---- grey, gravelly						259				
			6	SS	27		258				30 28 28 14
			7	SS	67		257				
255.5 / 7.1	**SAND AND SILT** trace clay, trace gravel, damp to moist, very dense, grey (GLACIAL TILL)		8	SS	100/ 23cm		256				
							255				
							254				

Continued Next Page

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

RECORD OF BOREHOLE No HML6 2 OF 2 METRIC

W.P. 105-00-00 LOCATION N:4845430.9 E:279153.7 ORIGINATED BY MS

DIST HWY Highway 410 BOREHOLE TYPE Solid Stem Augers COMPILED BY DB

DATUM Geodetic DATE 19.04.05 CHECKED BY RA

ELEV / DEPTH	SOIL PROFILE: DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (O UNCONFINED, ● 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 (%) 10 20 30	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	SAND AND SILT trace clay, trace gravel, damp to moist, very dense, grey (GLACIAL TILL) *(continued)*		9	SS	100/ 25cm	*	253		O		
	---- compact to dense						252				
			10	SS	44		251		O		
							250				
248.4			11	SS	16		249		O		
14.2	End of Borehole * Water level at 9.1m (not stabilized) and hole open to 12.2m on completion.										

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

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RECORD OF BOREHOLE No HML7 1 OF 2 METRIC

W.P. 105-00-00 LOCATION N:4845625.2 E:279420.5 ORIGINATED BY MS

DIST HWY Highway 410 BOREHOLE TYPE Solid Stem Augers COMPILED BY DB

DATUM Geodetic DATE 19.04.05 CHECKED BY RA

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE
266.4							
0.0 / 266.3	**150mm TOPSOIL**						
0.2 / 265.7	**CLAYEY SILT** - trace gravel, trace sand, trace organics, moist, soft, brown		1	SS	4		266
0.7	**CLAYEY SILT** trace gravel, trace sand to sandy, damp to moist, firm to 1.4m, very stiff to hard below, brown (GLACIAL TILL)		2	SS	7		
			3	SS	20		265
			4	SS	34		264
			5	SS	37		263
			6	SS	65		262
260.9 / 5.5	**SAND AND SILT** trace gravel, trace clay, damp to moist, very dense, brown (GLACIAL TILL)		7	SS	100/ 13cm		261
	brown — grey						260
			8	SS	100/ 20cm		259
257.9 / 8.5							258

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 (%) 10 20 30

UNIT WEIGHT γ kN/m³

REMARKS & GRAIN SIZE DISTRIBUTION (%)

	GR	SA	SI	CL
6	5	43	36	16

Continued Next Page

+³, ×³: Numbers refer to Sensitivity ○³% STRAIN AT FAILURE

RECORD OF BOREHOLE No HML7 2 OF 2 METRIC

W.P. 105-00-00 LOCATION N:4845625.2 E:279420.5 ORIGINATED BY MS

DIST HWY Highway 410 BOREHOLE TYPE Solid Stem Augers COMPILED BY DB

DATUM Geodetic DATE 19.04.05 CHECKED BY RA

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 (%) 10 20 30	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	CLAYEY SILT trace gravel, sandy, moist, hard, grey (GLACIAL TILL) *(continued)*		9	SS	84		257		○ ⊢		6 22 56 16
						*▽	256				
255.3			10	SS	100/ 20cm				○		
11.1	End of Borehole										

* Water level at 10.5m (not stabilized) and hole open to full depth on completion.

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

RECORD OF BOREHOLE No HML8 1 OF 2 METRIC

W.P. 105-00-00 LOCATION N:4845836.5 E:279673.8 ORIGINATED BY MS

DIST HWY Highway 410 BOREHOLE TYPE Solid Stem Augers COMPILED BY DB

DATUM Geodetic DATE 19.04.05 CHECKED BY RA

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
268.7 / 0.0	**150mm TOPSOIL**								
268.6 / 0.2	**CLAYEY SILT** - trace gravel, trace sand, trace organics, moist, firm, dark brown		1	SS	5				
268.0 / 0.7	**CLAYEY SILT** trace gravel, sandy, damp, very stiff to hard (GLACIAL TILL)		2	SS	18		268		
			3	SS	26		267		2 24 52 22
			4	SS	32		266		
			5	SS	37		265		
	brown grey		6	SS	43		264		
	some gravel		7	SS	84		263		11 45 32 12
261.6 / 7.1	**SAND AND SILT** trace gravel, damp, very dense, grey (POSSIBLE TILL)		8	SS	100/ 25cm		262 261 260		

DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100

SHEAR STRENGTH kPa 20 40 60 80 100
○ UNCONFINED + FIELD VANE
● QUICK TRIAXIAL × LAB VANE

PLASTIC LIMIT w_P NATURAL MOISTURE CONTENT w LIQUID LIMIT w_L
WATER CONTENT (%) 10 20 30

Continued Next Page

+³, ×³: Numbers refer to Sensitivity ○³% STRAIN AT FAILURE

ONTARIO MOT 1-00-0350 HWY 410 HML.GPJ ONTARIO MOT.GDT 18/10/05

RECORD OF BOREHOLE No HML8 2 OF 2 METRIC

W.P. 105-00-00 LOCATION N:4845836.5 E:279673.8 ORIGINATED BY MS

DIST HWY Highway 410 BOREHOLE TYPE Solid Stem Augers COMPILED BY DB

DATUM Geodetic DATE 19.04.05 CHECKED BY RA

SOIL PROFILE			SAMPLES			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 (%) (10 20 30)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES						
259.1	**SAND AND SILT** trace gravel, damp, very dense, grey (POSSIBLE TILL)		9	SS	71				○		
9.6	End of Borehole * Borehole dry (not stabilized) and hole open to full depth on completion.										

+ ³, × ³: Numbers refer to Sensitivity ○ ³% STRAIN AT FAILURE

RECORD OF BOREHOLE No HML9 1 OF 2 METRIC

W.P. 105-00-00 LOCATION N:4846055.6 E:279885.6 ORIGINATED BY MS

DIST HWY Highway 410 BOREHOLE TYPE Solid Stem Augers COMPILED BY DB

DATUM Geodetic DATE 19.04.05 CHECKED BY RA

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
271.6									
271.4 0.2	**150mm TOPSOIL**								
	CLAYEY SILT trace gravel, trace sand to sandy, occasional sand seams and partings, damp, stiff to 0.7m, very stiff to hard below (GLACIAL TILL)		1	SS	3		271		
			2	SS	20				7 33 45 15
			3	SS	30		270		
			4	SS	38		269		
			5	SS	28		268		
	grey		6	SS	38		267		
			7	SS	29		266		
							265		
			8	SS	44		264		5 34 47 14
							263		

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 (%) 10 20 30

Continued Next Page

+ 3, × 3: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

RECORD OF BOREHOLE No HML9 2 OF 2 METRIC

W.P. 105-00-00 LOCATION N:4846055.8 E:279885.6 ORIGINATED BY MS

DIST HWY Highway 410 BOREHOLE TYPE Solid Stem Augers COMPILED BY DB

DATUM Geodetic DATE 19.04.05 CHECKED BY RA

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 (%) 10 20 30	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	CLAYEY SILT trace gravel, trace sand to sandy, occasional sand seams and partings, damp, stiff to 0.7m, very stiff to hard below (GLACIAL TILL) *(continued)*		9	SS	43		262 261		○		6 42 36 16
260.7 10.9	**SAND AND SILT** trace gravel, damp, very dense, brown (GLACIAL TILL)		10	SS	100/ 20cm		260 259		○		
257.9 13.7	**GRAVELLY SAND** damp, very dense, brown		11	SS	100/ 10cm		258 257		○		
256.3 15.3	End of Borehole * Borehole dry (not stabilized) and hole open to full depth on completion.										

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

Ministry of Transportation
Ontario

RECORD OF BOREHOLE No HML10 1 OF 2 METRIC

W.P. 105-00-00 LOCATION N:4846288.0 E:280204.9 ORIGINATED BY MS

DIST HWY Highway 410 BOREHOLE TYPE Solid Stem Augers COMPILED BY DB

DATUM Geodetic DATE 08.04.05 CHECKED BY RA

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE
266.8							
0.0 / 266.6	**200mm TOPSOIL**						
0.2 / 266.1	**CLAYEY SILT** - trace gravel, trace sand, trace to some organics, wet, dark brown		1	AS	-		
0.7	**CLAYEY SILT** trace to some gravel, sandy, damp to moist, hard, brown (GLACIAL TILL)		2	SS	38		266
			3	SS	40		265
			4	SS	100/ 18cm		
			5	SS	47		264
			6	SS	46		263
261.2 / 5.6	**SILTY SAND** trace clay, some gravel, moist, very dense, brown (GLACIAL TILL)		7	SS	100/ 23cm		262
			8	SS	101		261
							260
							259
258.2 / 8.6							258

DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100)

SHEAR STRENGTH kPa (20 40 60 80 100)
○ UNCONFINED + FIELD VANE
● QUICK TRIAXIAL × LAB VANE

PLASTIC LIMIT w_P | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w_L

WATER CONTENT (%) (10 20 30)

UNIT WEIGHT γ kN/m³

REMARKS & GRAIN SIZE DISTRIBUTION (%)	GR	SA	SI	CL
	13	39	33	15
	20	45	31	4

Continued Next Page

+ 3, × 3: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

RECORD OF BOREHOLE No HML10 2 OF 2 METRIC

W.P. 105-00-00 LOCATION N:4846288.0 E:280204.9 ORIGINATED BY MS

DIST HWY Highway 410 BOREHOLE TYPE Solid Stem Augers COMPILED BY DB

DATUM Geodetic DATE 08.04.05 CHECKED BY RA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa	PLASTIC LIMIT / NATURAL MOISTURE CONTENT / LIQUID LIMIT	UNIT WEIGHT	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE	w_P w w_L WATER CONTENT (%)	γ kN/m³	GR SA SI CL
	GRAVELLY SAND trace silt, damp, very dense, brown *(continued)*		9	SS	100/ 18cm		257		○		26 67 (7)
256.0							256				
10.8	**SILTY SAND** trace clay, damp to wet, very dense, brown		10	SS	70		255		○		0 74 19 7
							254				
							253				
						▽*	252				
			11	SS	91				○		
251.1											
15.7	End of Borehole										

* Water level at 14.9m (not stabilized) and hole open to full depth on completion.

+ 3, × 3: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

ONTARIO MOT 1-00-0350 HWY 410 HML.GPJ ONTARIO MOT.GDT 18/10/05

APPENDIX B

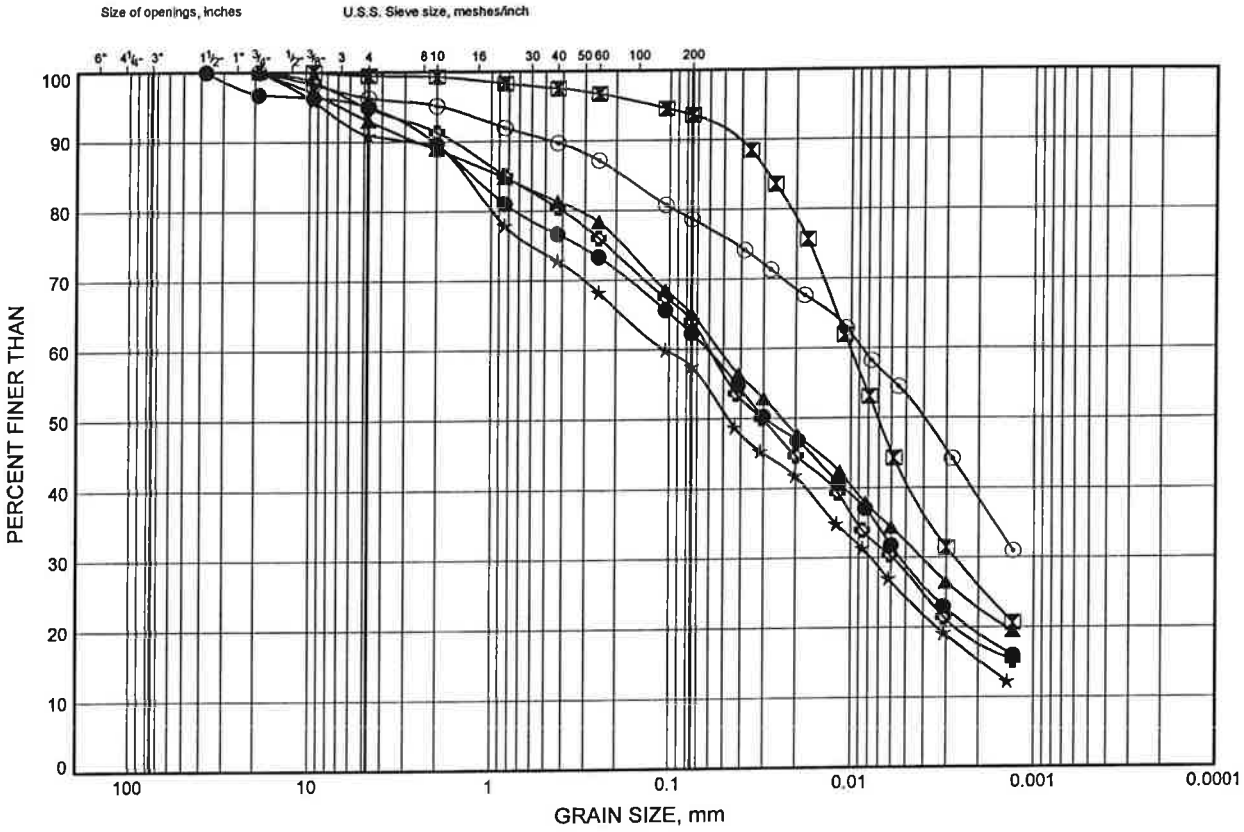
Laboratory Test Results

Terraprobe Limited

GRAIN SIZE DISTRIBUTION

FIGURE B1

Clayey Silt Till



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

SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	HML1	1.7	260.4
⊠	HML1	10.9	251.2
▲	HML2	2.5	254.8
★	VB3	2.5	256.7
⊙	VB3	9.3	249.9
✿	VB4	4.7	254.1

Date October 2005

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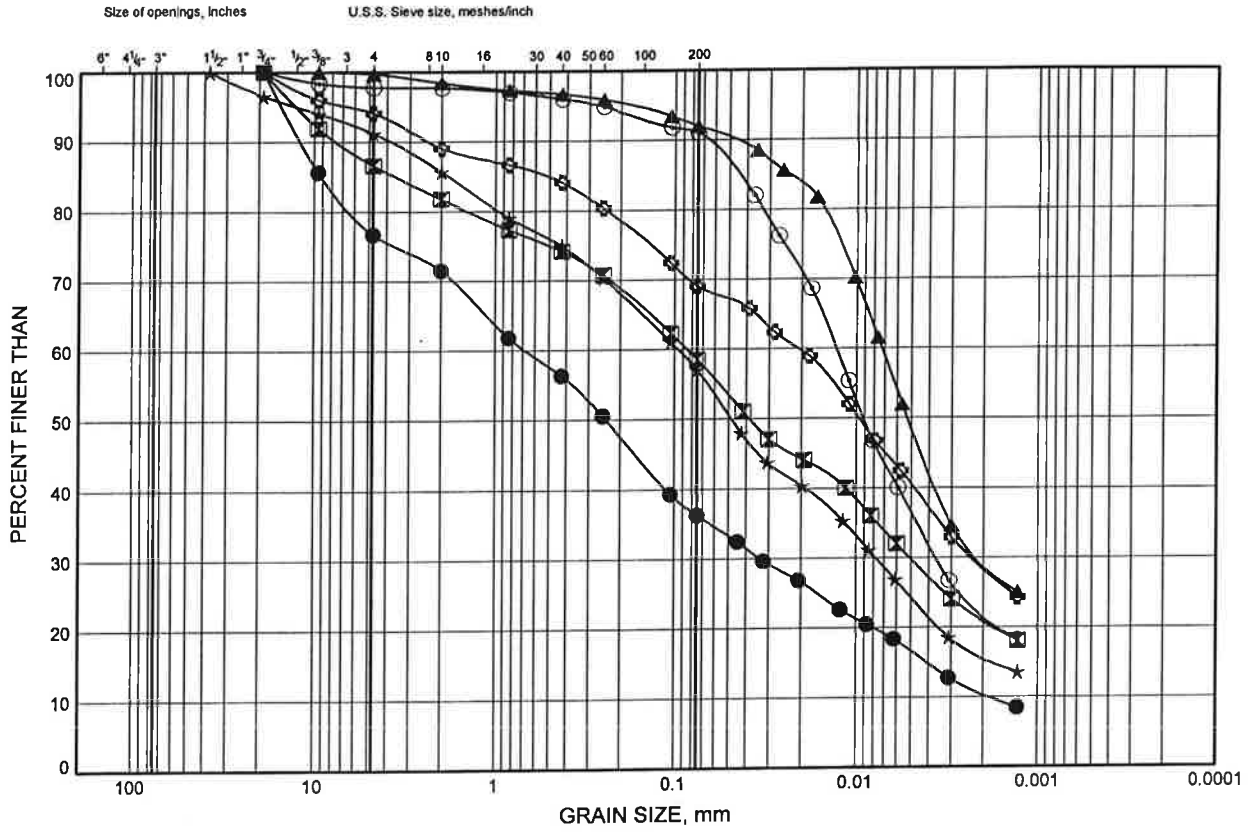
GRAIN SIZE DISTRIBUTION

FIGURE B2

Clayey Silt Till



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

SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	EC-2	2.5	250.8
⊠	EC-5	1.7	245.2
▲	HML2	7.8	249.5
★	HML3	3.2	255.8
⊙	HML3	7.8	251.2
✿	HML5	6.3	253.8

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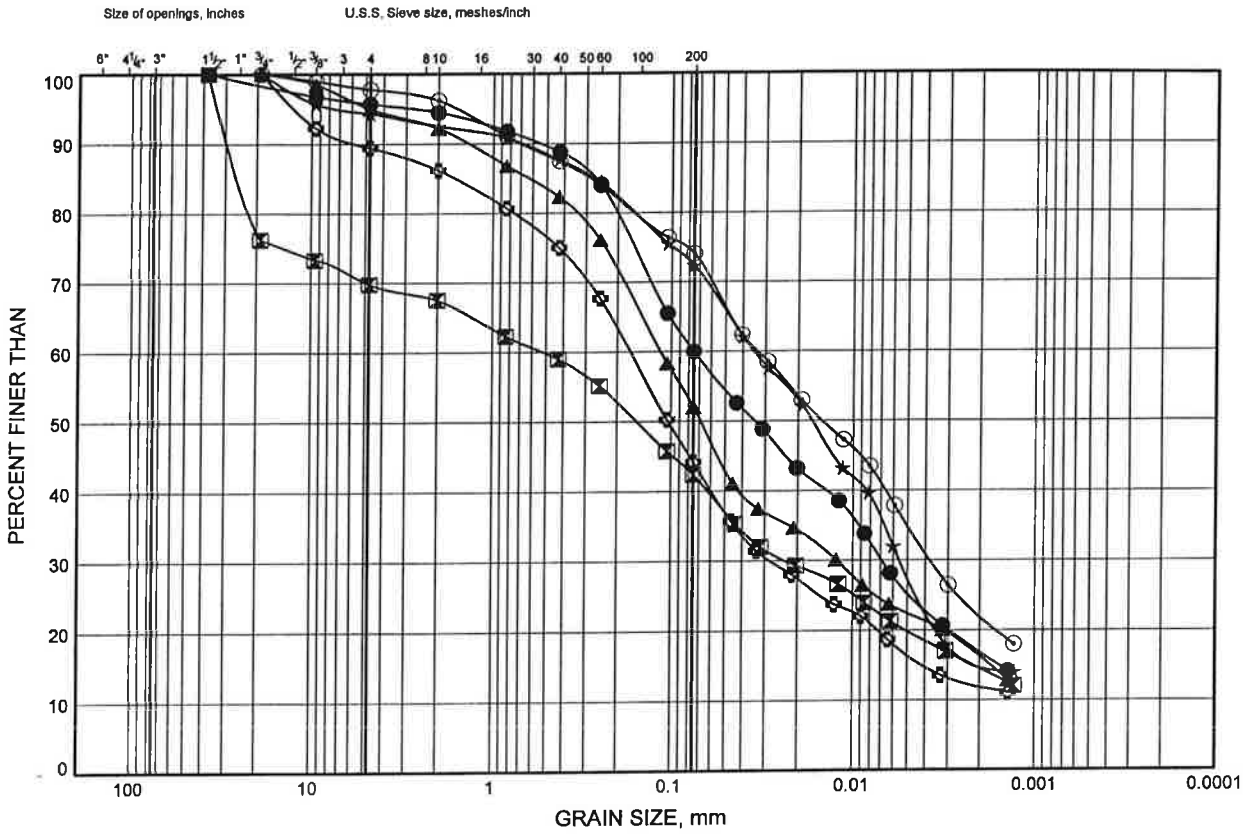
GRAIN SIZE DISTRIBUTION

FIGURE B3

Clayey Silt Till



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

SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	HML6	2.5	260.1
⊠	HML6	4.7	257.9
▲	HML7	4.7	261.7
★	HML7	9.3	257.1
⊙	HML8	1.7	267.0
✿	HML8	6.3	262.4

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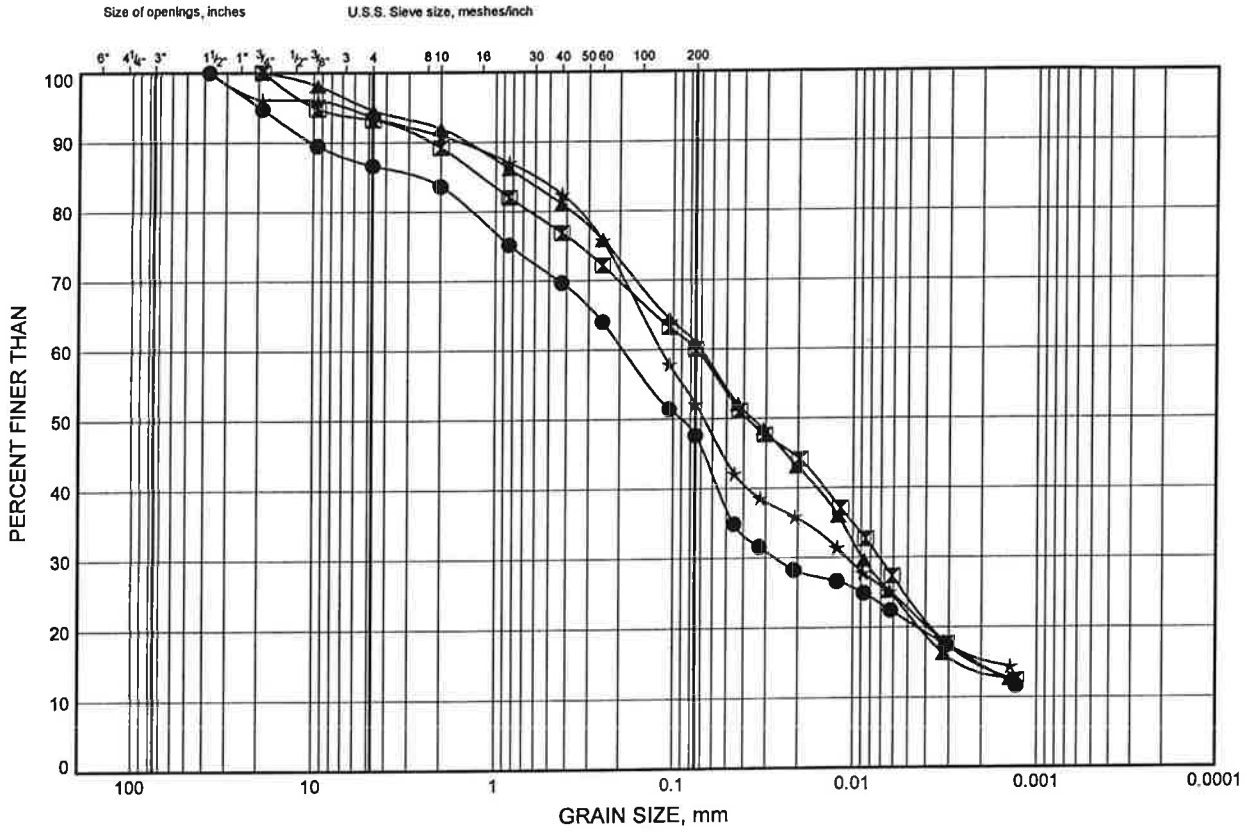
GRAIN SIZE DISTRIBUTION

FIGURE B4

Clayey Silt Till



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

SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	HML10	3.2	263.6
⊠	HML9	1.0	270.6
▲	HML9	7.8	263.8
★	HML9	9.3	262.3

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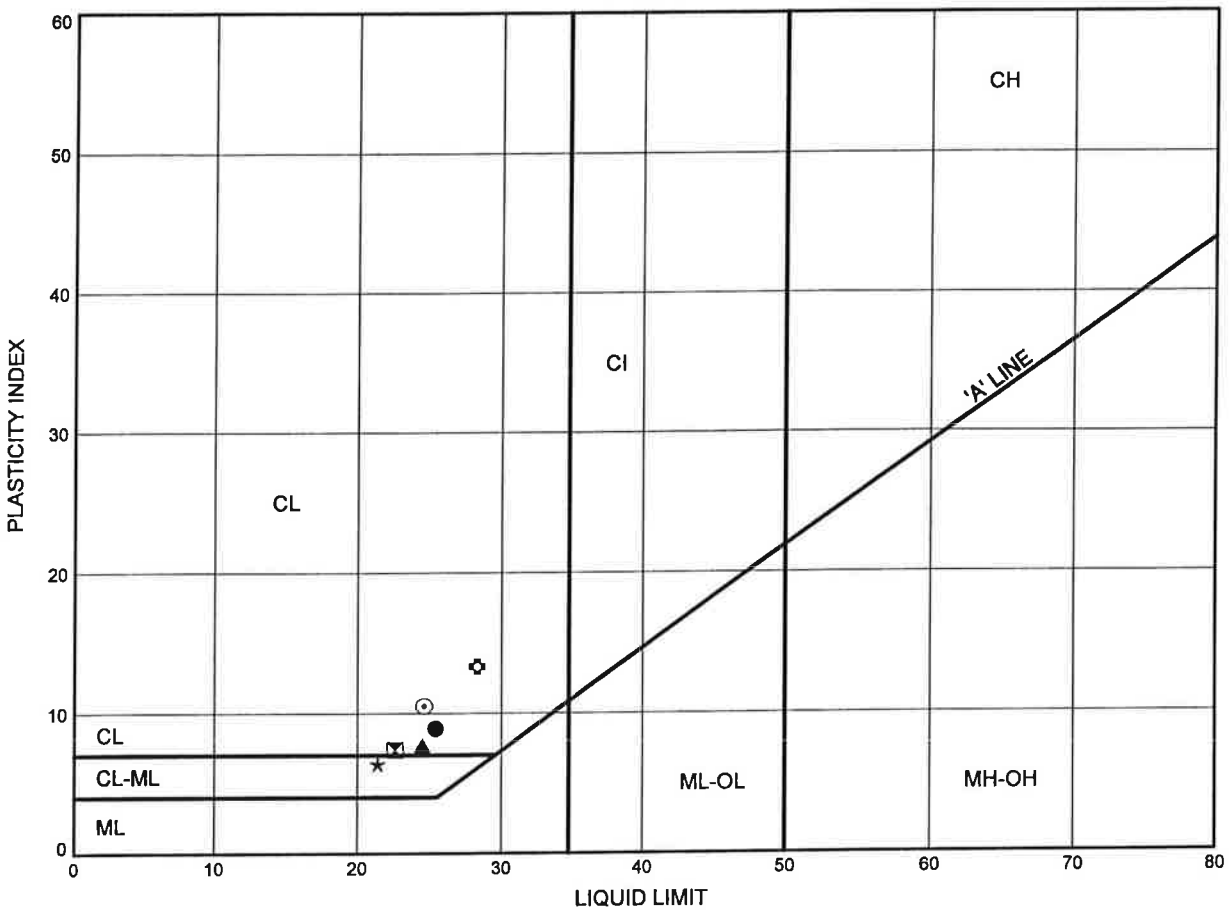
ATTERBERG LIMITS TEST RESULTS

FIGURE B5

Clayey Silt Till



SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	HML1	1.7	260.4
⊠	HML1	10.9	251.2
▲	HML2	7.8	249.5
★	HML3	7.8	251.2
⊙	HML5	6.3	253.8
✿	VB3	9.3	249.9

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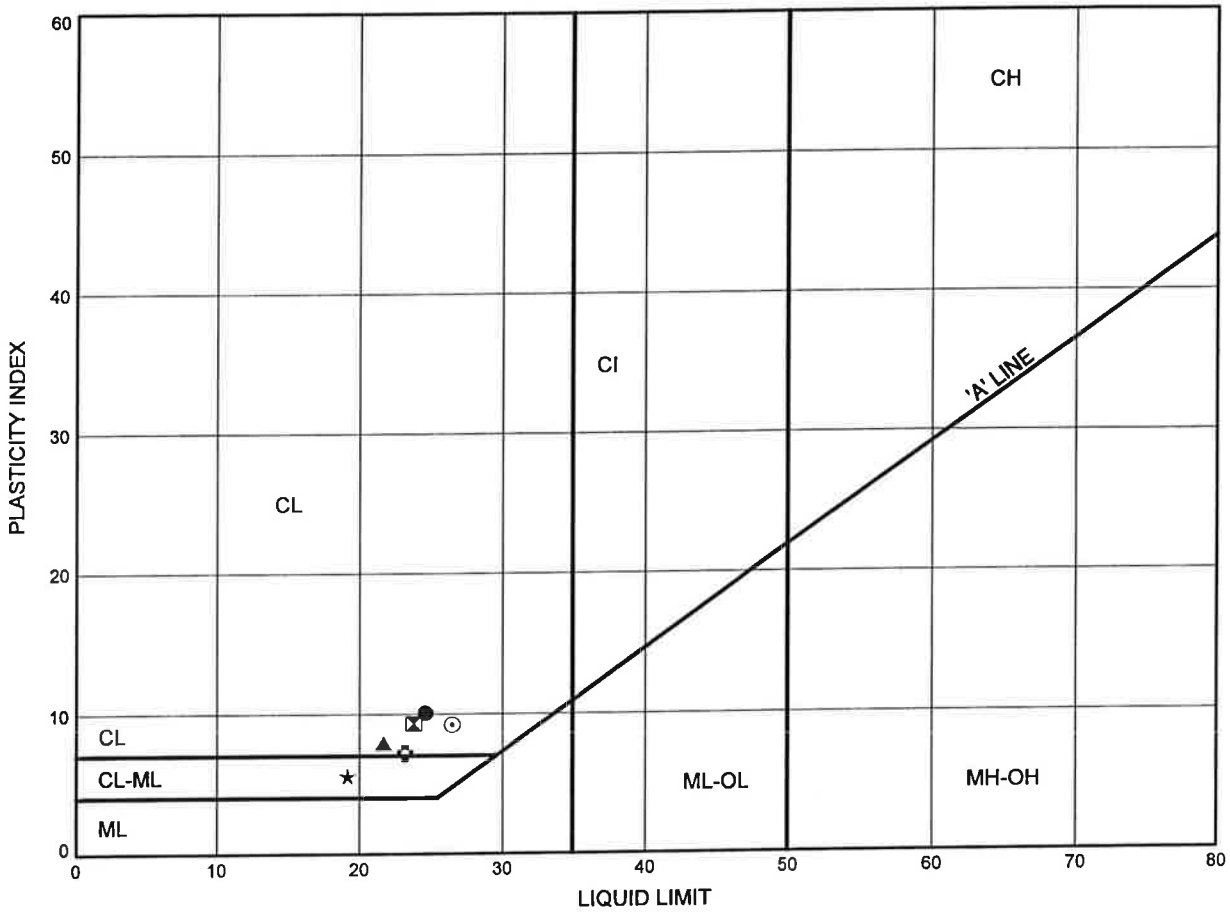
ATTERBERG LIMITS TEST RESULTS

FIGURE B6

Clayey Silt Till



SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	EC-2	1.7	251.6
⊠	EC-2	2.5	250.8
▲	HML10	3.2	263.6
★	HML7	9.3	257.1
⊙	HML8	1.7	267.0
✿	HML9	1.0	270.6

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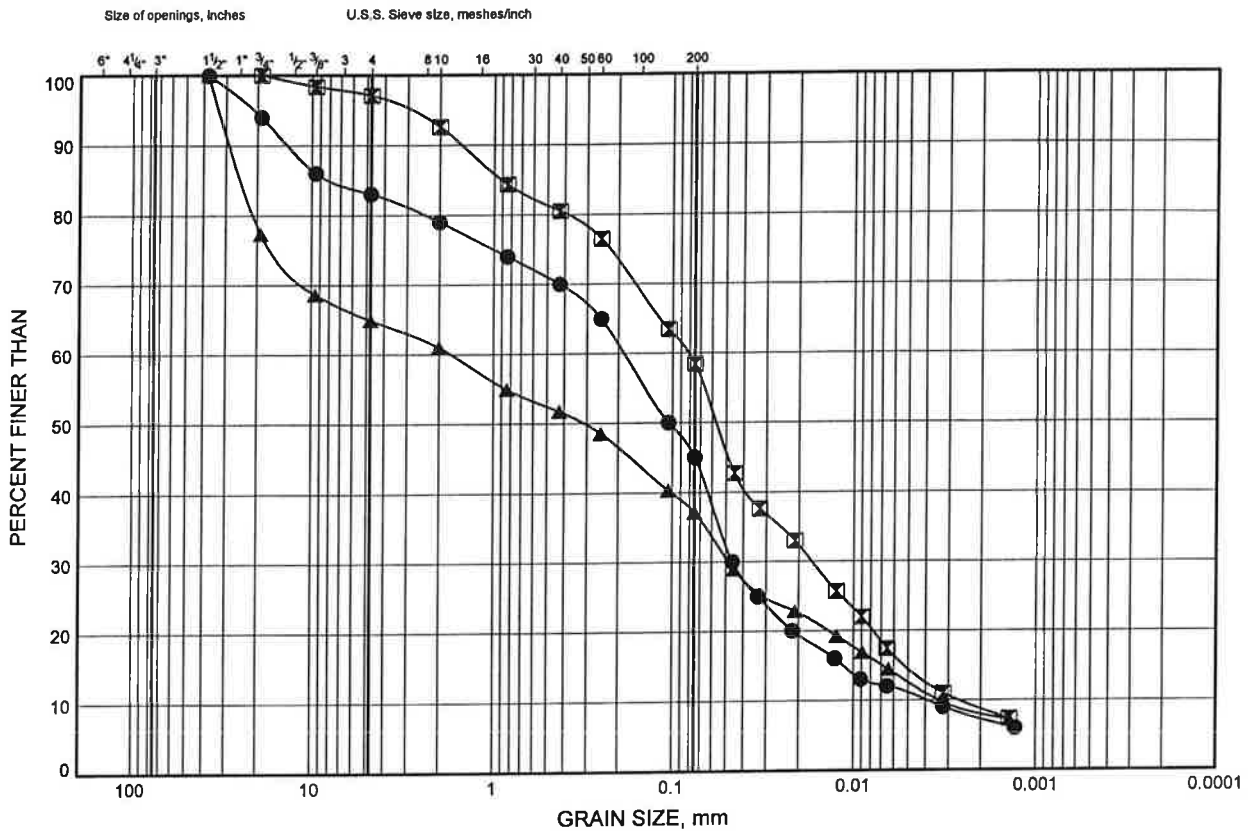
GRAIN SIZE DISTRIBUTION

FIGURE B7

Sand and Silt Till



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

SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	EC-2	26.1	227.2
⊠	VB3	18.5	240.7
▲	VB4	13.9	245.0

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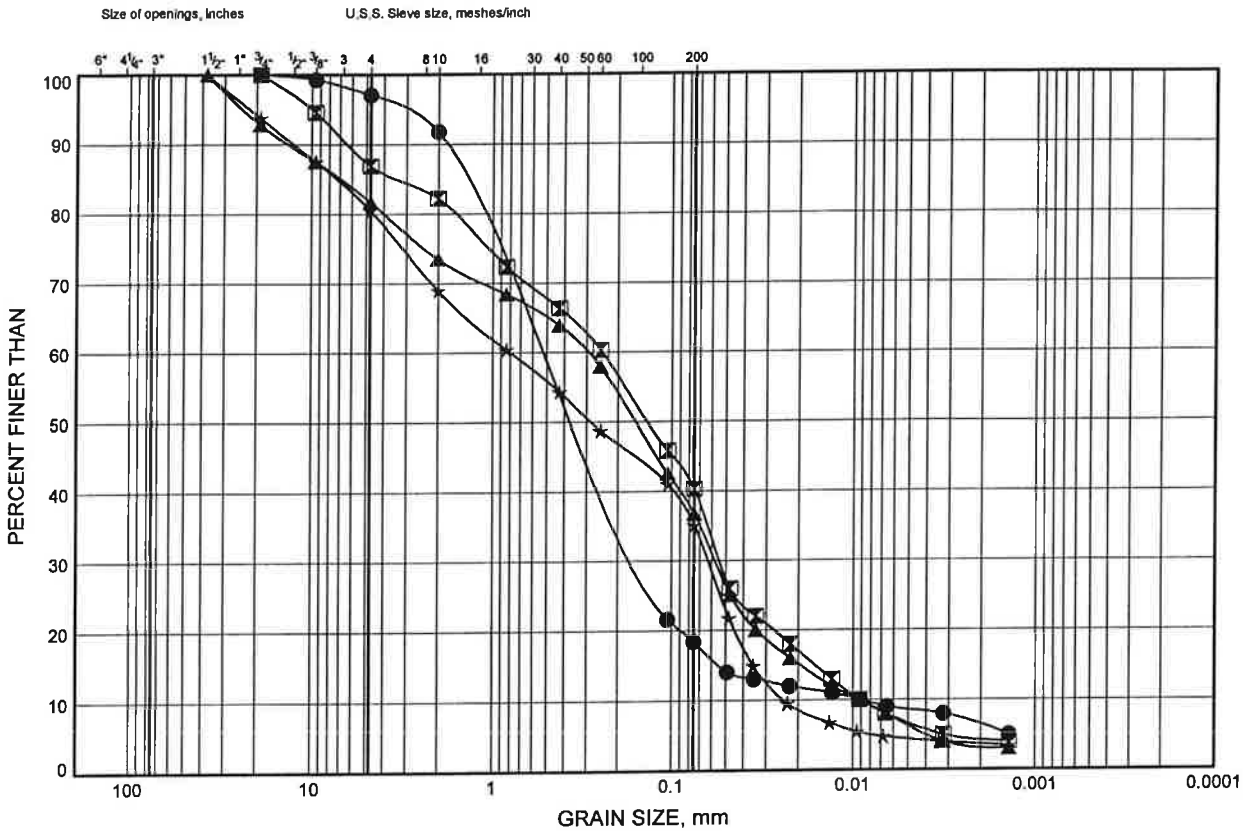
GSD 1-00-0350 HWY 410 HML.GPJ 18/10/05

GRAIN SIZE DISTRIBUTION

FIGURE B8

Sand and Silt Till



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

SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	EC-5	3.2	243.7
⊠	EC-5	23.1	223.8
▲	EC-5	26.1	220.8
★	HML10	7.8	259.0

Date October 2005

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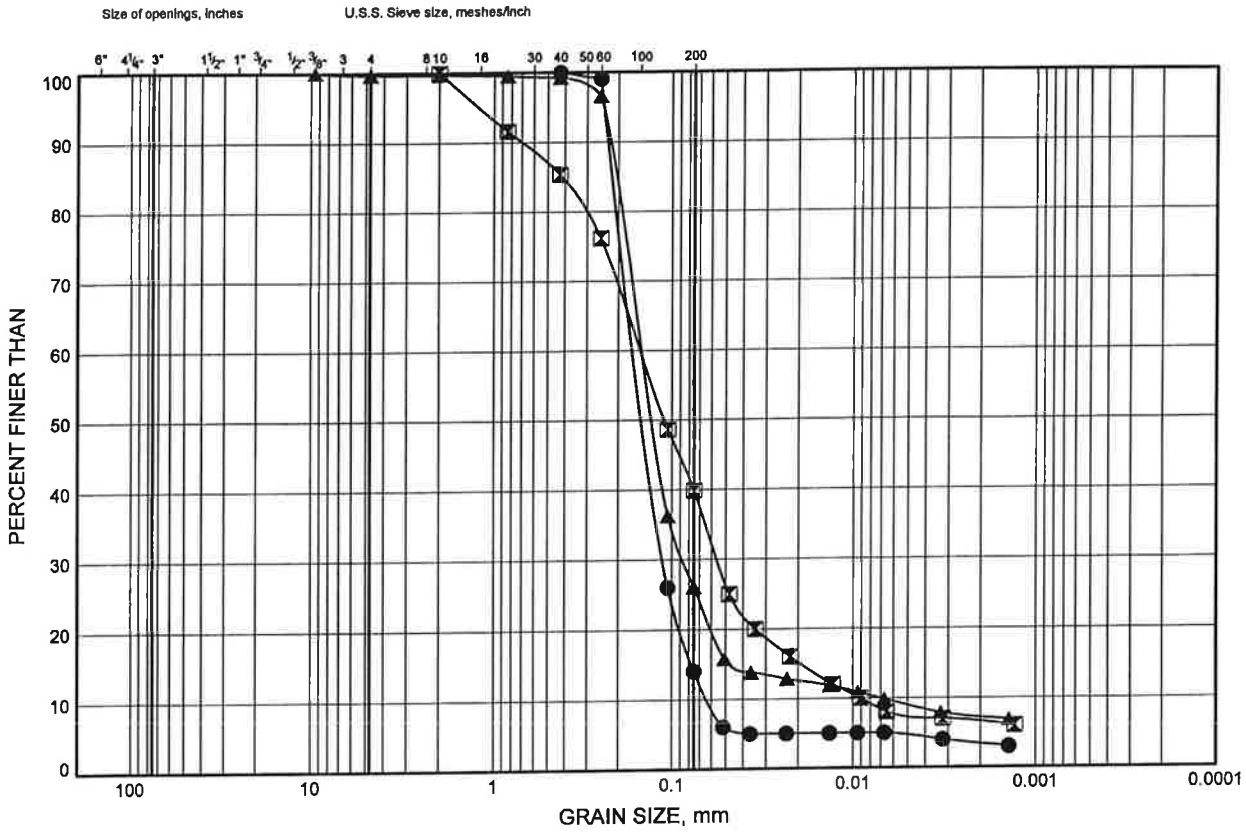
GSD 1-00-0350 HWY 410 HML.GPJ 18/10/05

GRAIN SIZE DISTRIBUTION

FIGURE B9

Silty Sand



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

SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	EC-2	18.5	234.8
⊠	EC-5	13.9	233.0
▲	HML10	12.3	254.5

Date October 2005

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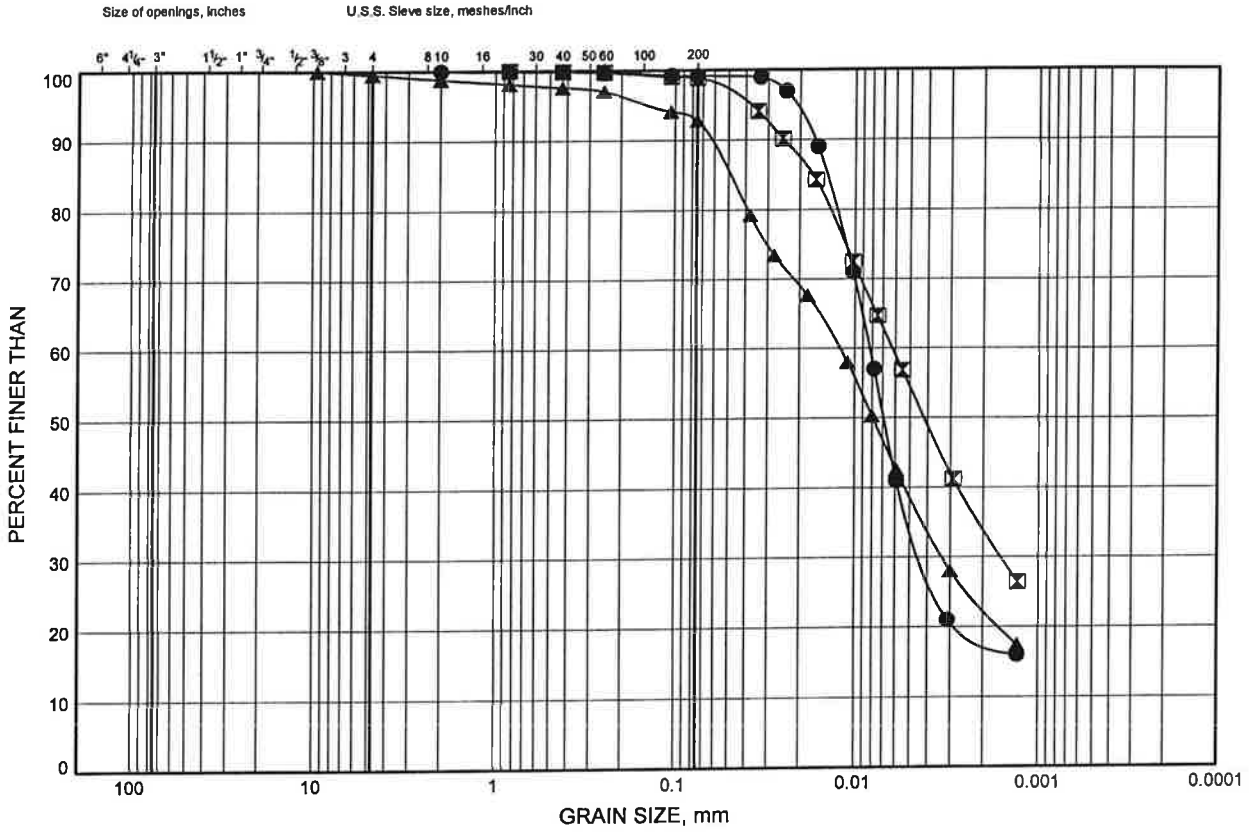
GSD 1-00-0350 HWY 410 HML.GPJ 18/10/05

GRAIN SIZE DISTRIBUTION

FIGURE B10

Lower Clayey Silt



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

SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	EC-5	9.3	237.6
⊠	VB3	24.6	234.6
▲	VB4	23.1	235.7

Date October 2005

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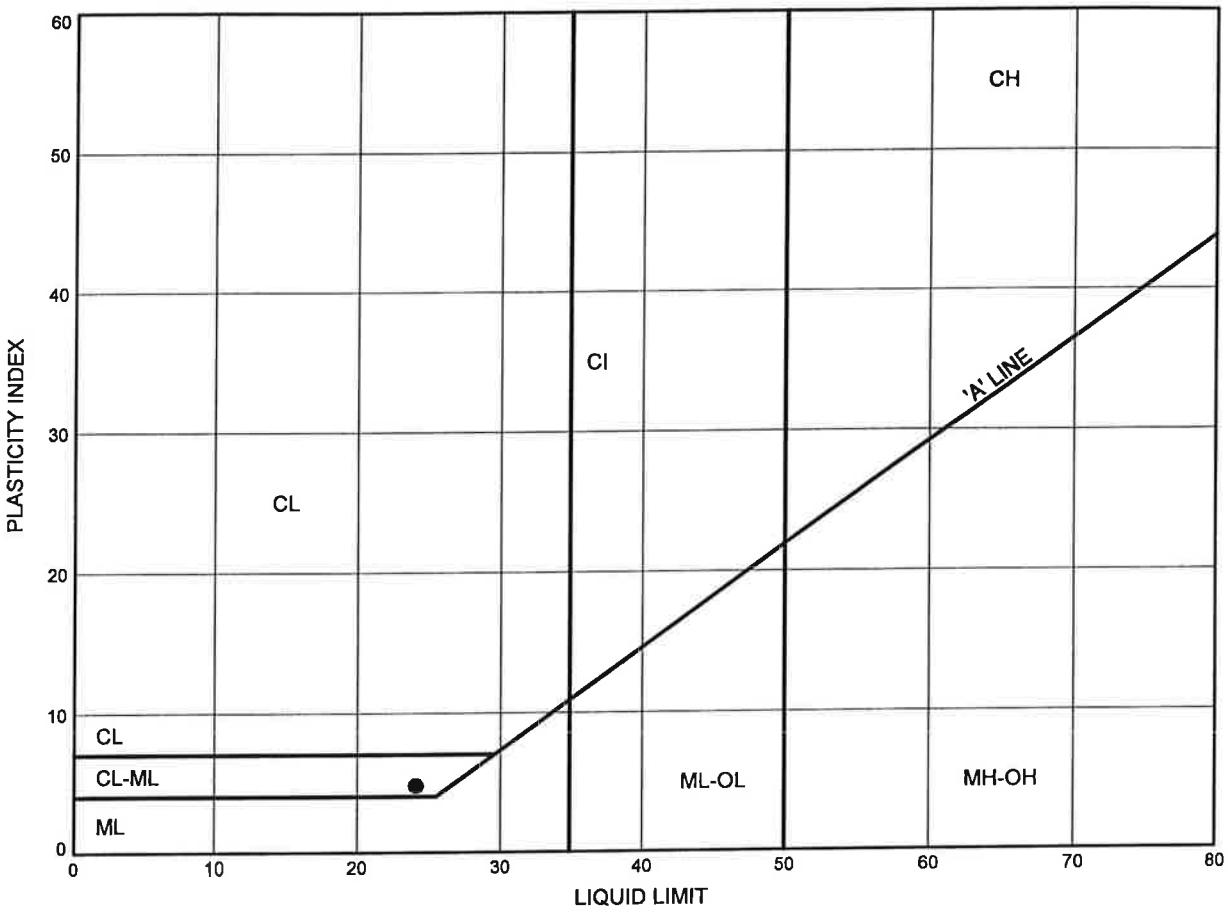
GSD 1-00-0350 HWY 410 HML.GPJ 19/10/05

ATTERBERG LIMITS TEST RESULTS

FIGURE B11

Lower Clayey Silt



SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	VB3	24.6	234.6

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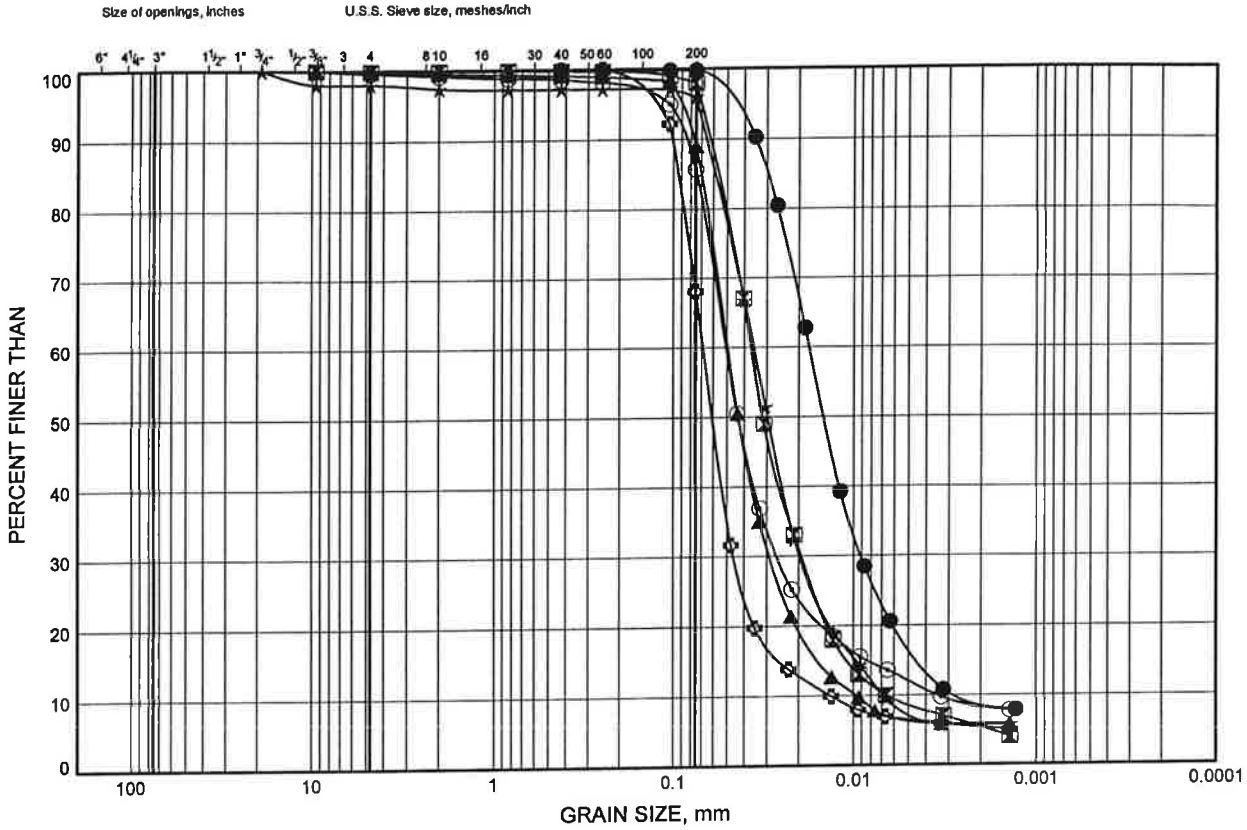
ALTR 1-00-0350 HWY 410 HML.GPJ 18/10/05

GRAIN SIZE DISTRIBUTION

FIGURE B12

Silt



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

SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	EC-2	10.9	242.4
⊠	EC-2	15.4	237.9
▲	HML4	7.8	251.4
★	HML4	10.9	248.3
⊙	HML5A	10.8	249.3
✿	HML5A	13.8	246.3

Date October 2005

Project 105-00-00

Prep'd DB

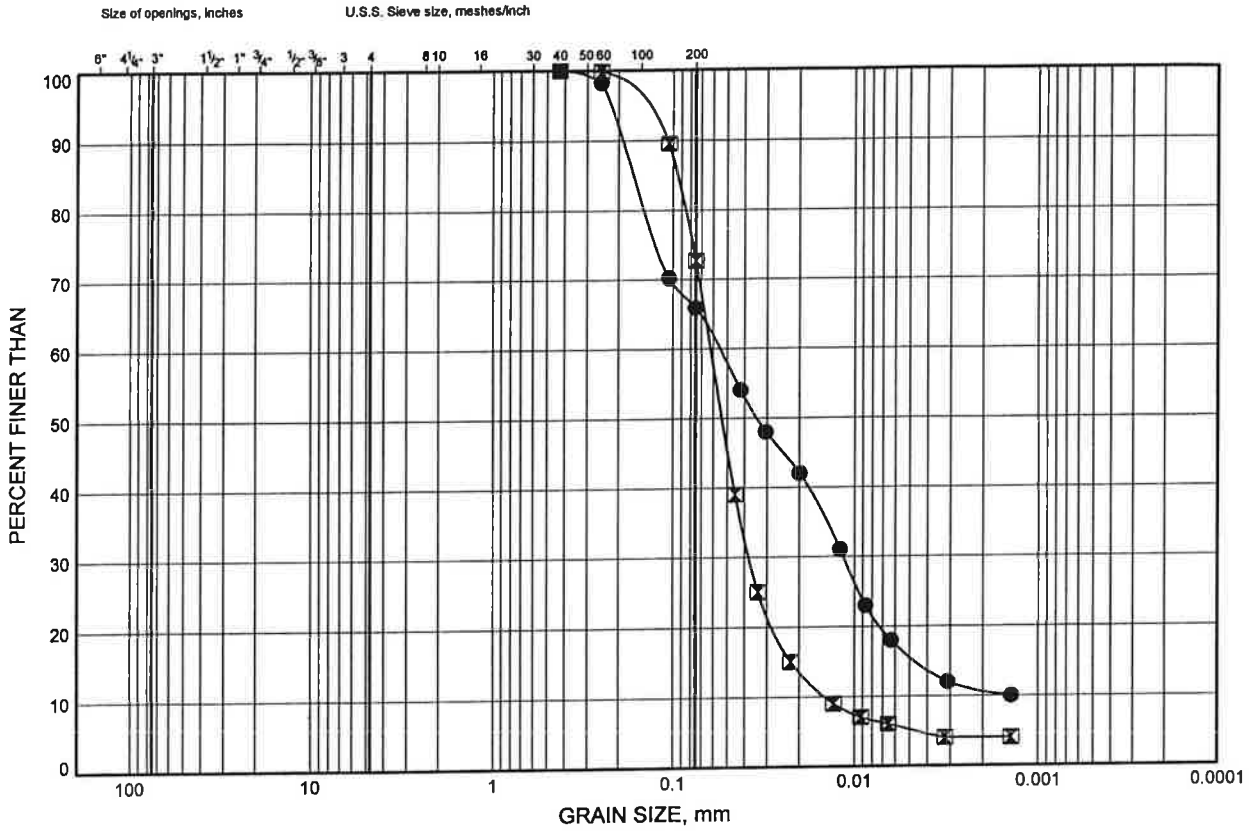
Chkd. RA

GSD 1-00-0350 HWY 410 HML.GPJ 19/10/05

GRAIN SIZE DISTRIBUTION

FIGURE B13

Sandy Silt



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

SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	EC-5	17.0	229.9
⊠	EC-5	21.5	225.4

Date October 2005

Project 105-00-00

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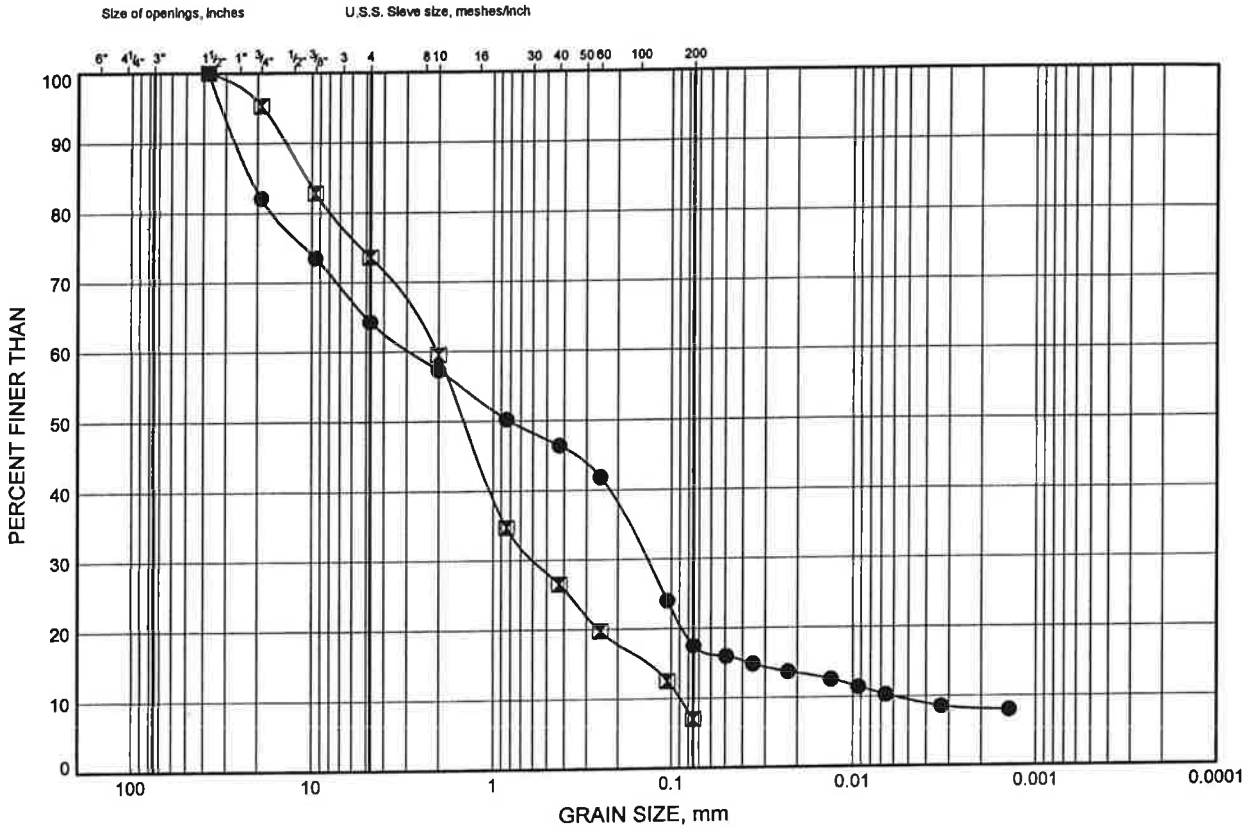
GSD 1-00-0350 HWY 410 HML.GPJ 18/10/05

GRAIN SIZE DISTRIBUTION

FIGURE B14

Gravelly Sand



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

SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	EC-2	1.7	251.6
⊠	HML10	9.3	257.6

Date October 2005

Project 105-00-00

Prep'd DB

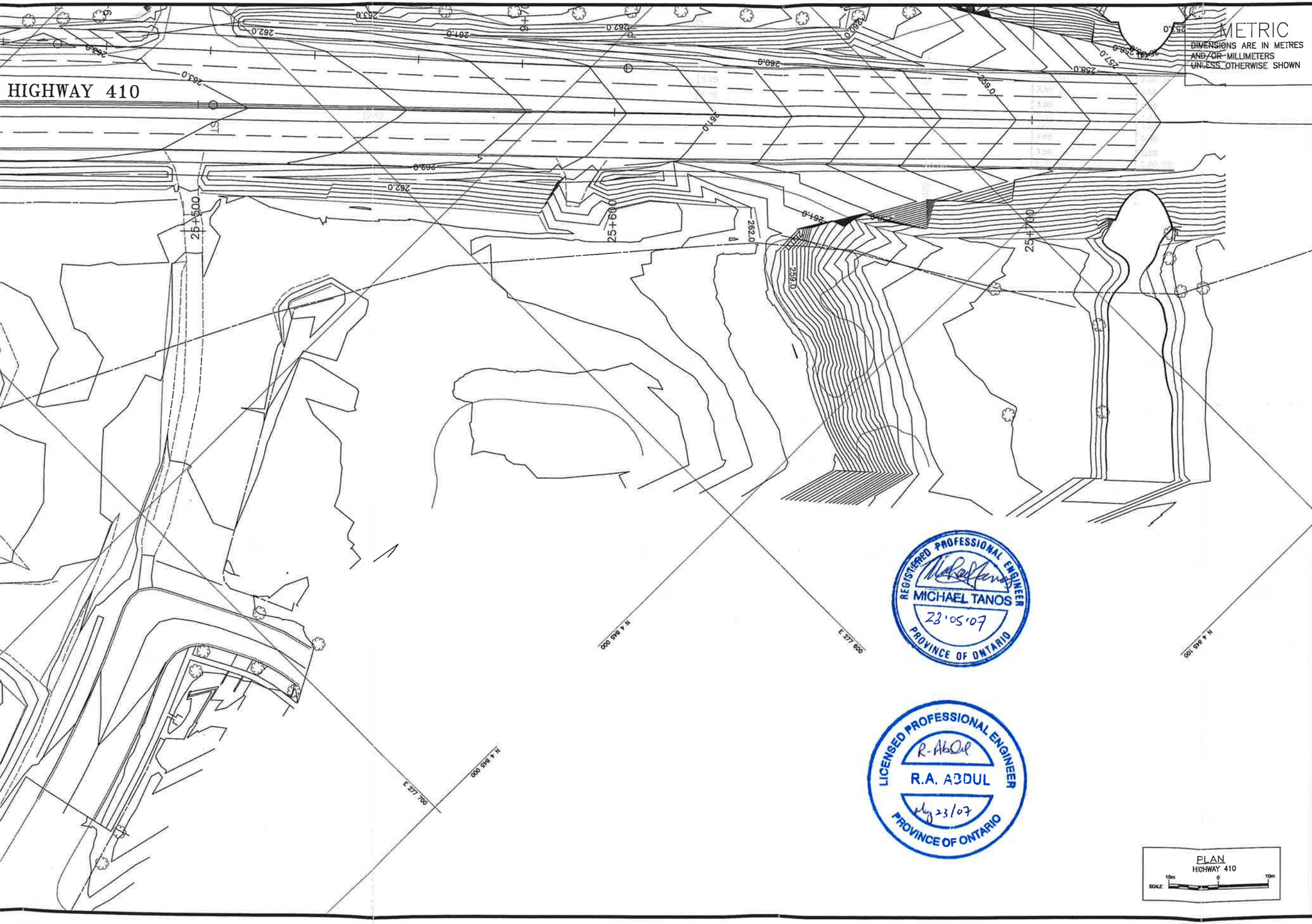
Chkd. RA

GSD 1-00-0350 HWY 410 HML.GPJ 18/10/05

APPENDIX C

Drawing titled "High Mast Light Poles Borehole Locations"

Terraprobe Limited



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

CONT No
WP No105-00-00

HIGHWAY 410 PHASE III
HIGH MAST LIGHT POLES
BOREHOLE LOCATIONS

SHEET 1OF4

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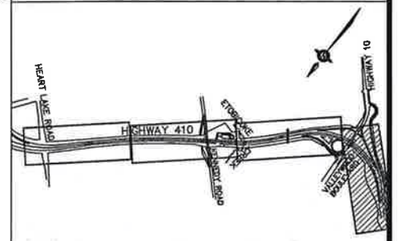
Construction Materials Engineering, Inspection & Testing



KEY PLAN

LEGEND

- Bore Hole
- Bore Hole And Cone

No	ELEVATION	COORDINATES NORTHING	COORDINATES EASTING
BH-HML1	262.1	4844725.9	277770.0
BH-VB3	259.2	4844645.2	278084.4
BH-VB4	258.8	4844646.5	278081.6
BH-HML2	257.3	4844756.4	278291.4
BH-HML3	259.0	4844781.6	278388.1
BH-HML4	259.2	4844909.2	278507.9
BH-HML5	260.1	4845049.4	278636.1
BH-HML5A	260.1	4845049.4	278636.1
BH-EC2	253.3	4845168.1	278764.5
BH-EC5	246.9	4845223.0	278835.8
BH-HML6	262.6	4845430.9	279153.7
BH-HML7	266.4	4845625.2	279420.5
BH-HML8	268.7	4845836.5	279673.8
BH-HML9	271.6	4846055.8	279885.6
BH-HML10	266.8	4846288.0	280204.9

NOTE
The boundaries between soil strata have been established only at Bore Hole locations. Between Bore holes the boundaries are assumed from geological evidence.

REGISTERED PROFESSIONAL ENGINEER
MICHAEL TANOS
23.05.07
PROVINCE OF ONTARIO

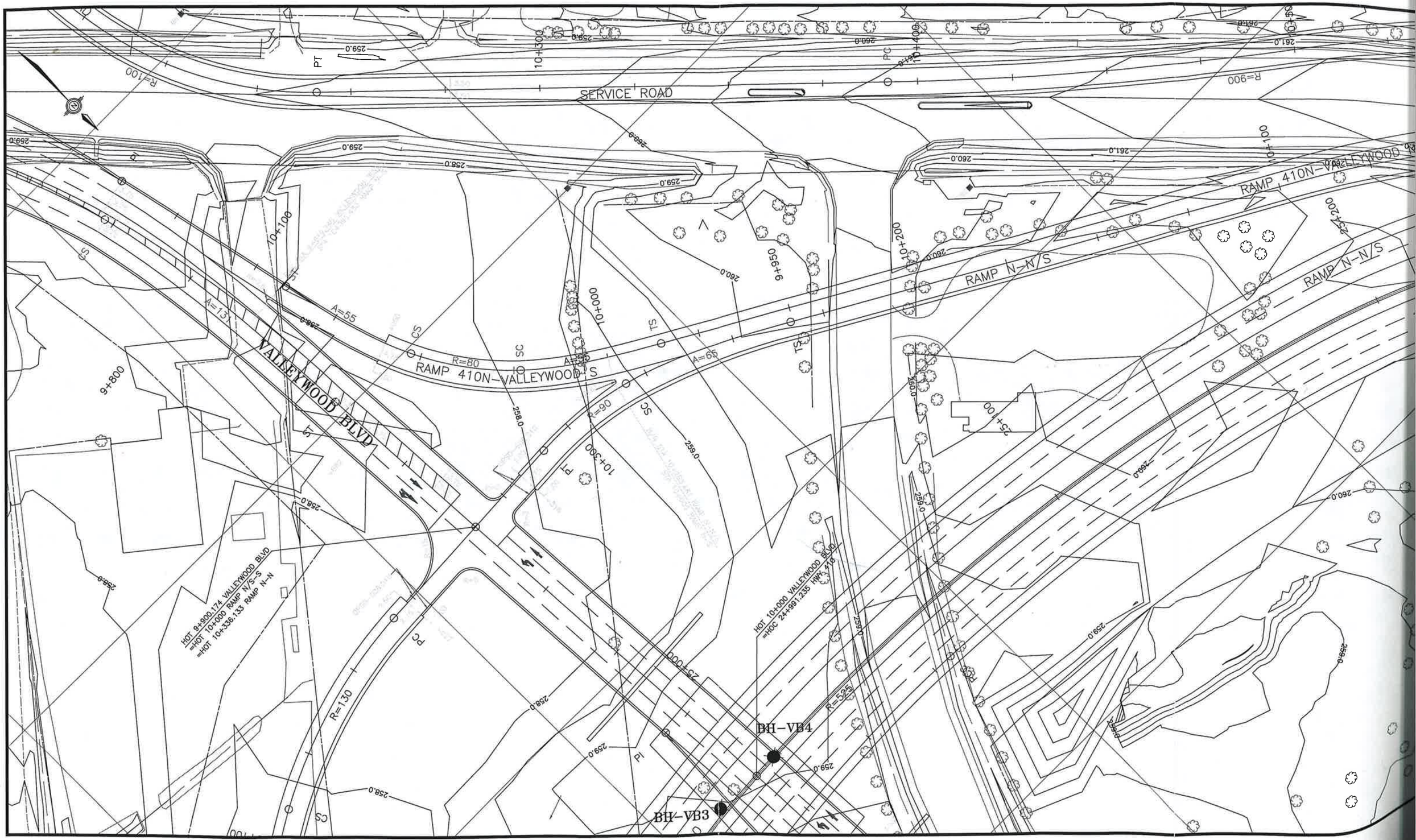
LICENSED PROFESSIONAL ENGINEER
R.A. ABDUL
23/07
PROVINCE OF ONTARIO

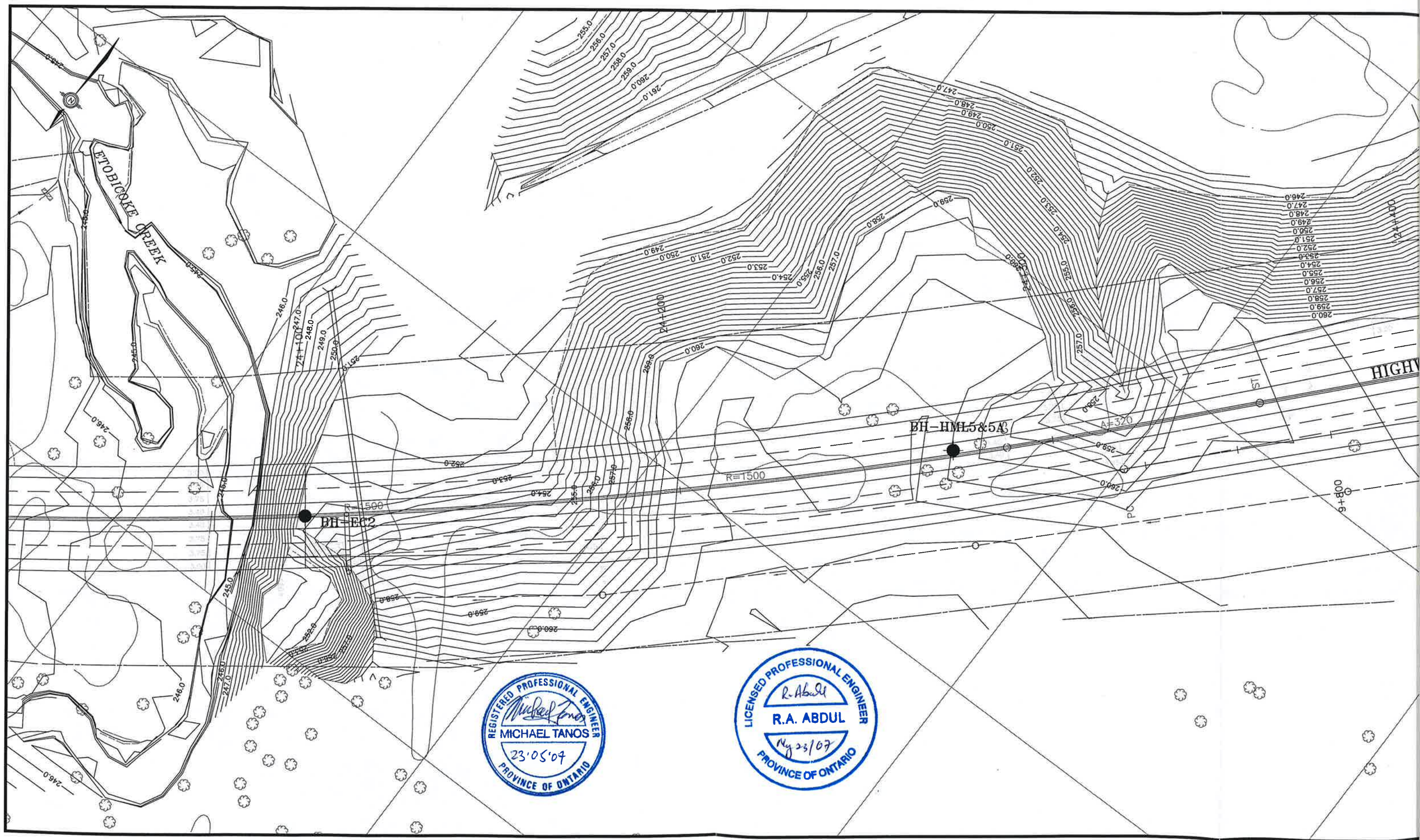
PLAN
HIGHWAY 410
SCALE 10m 0 10m

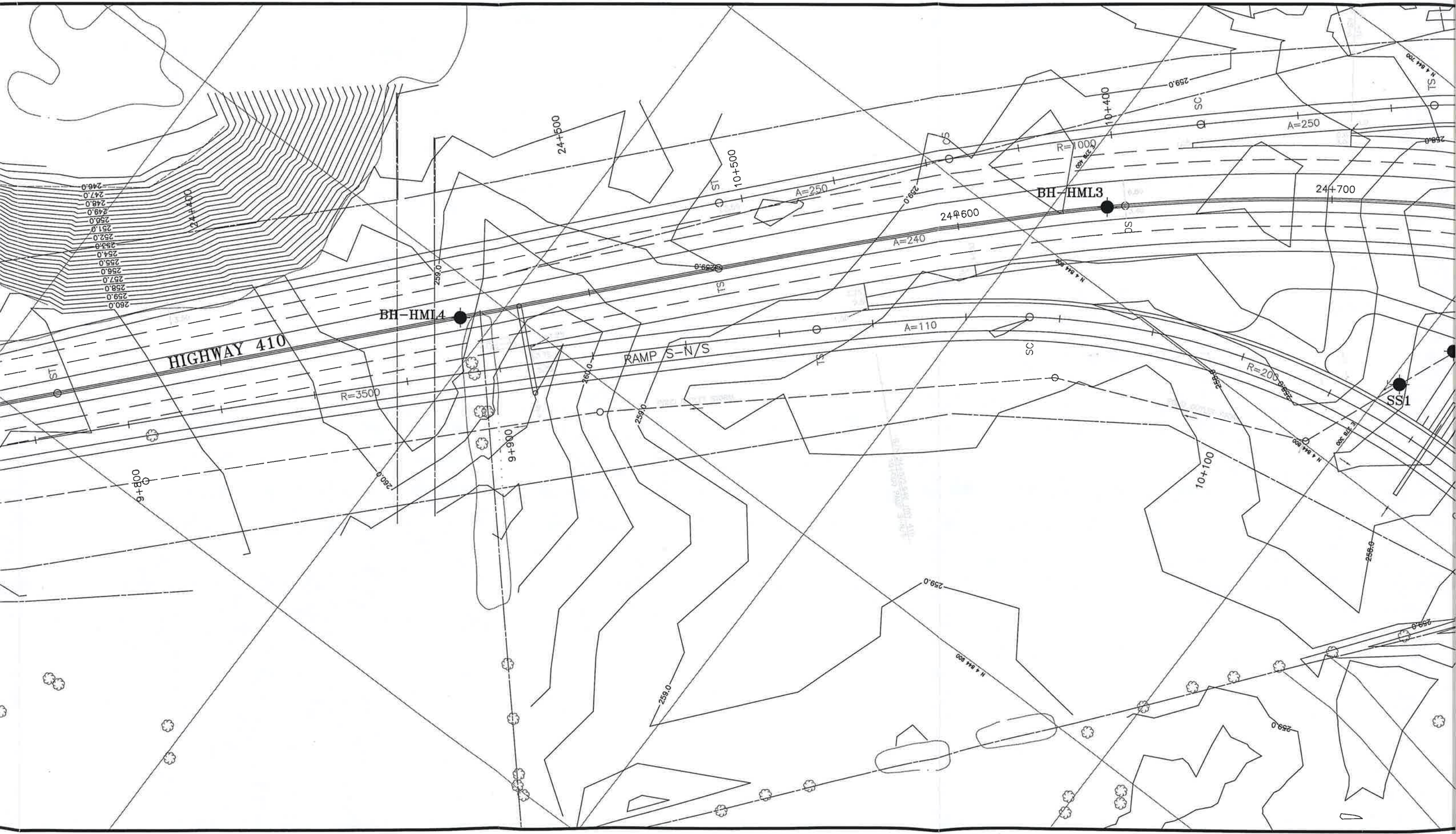
REVISIONS	DATE	BY	DESCRIPTION

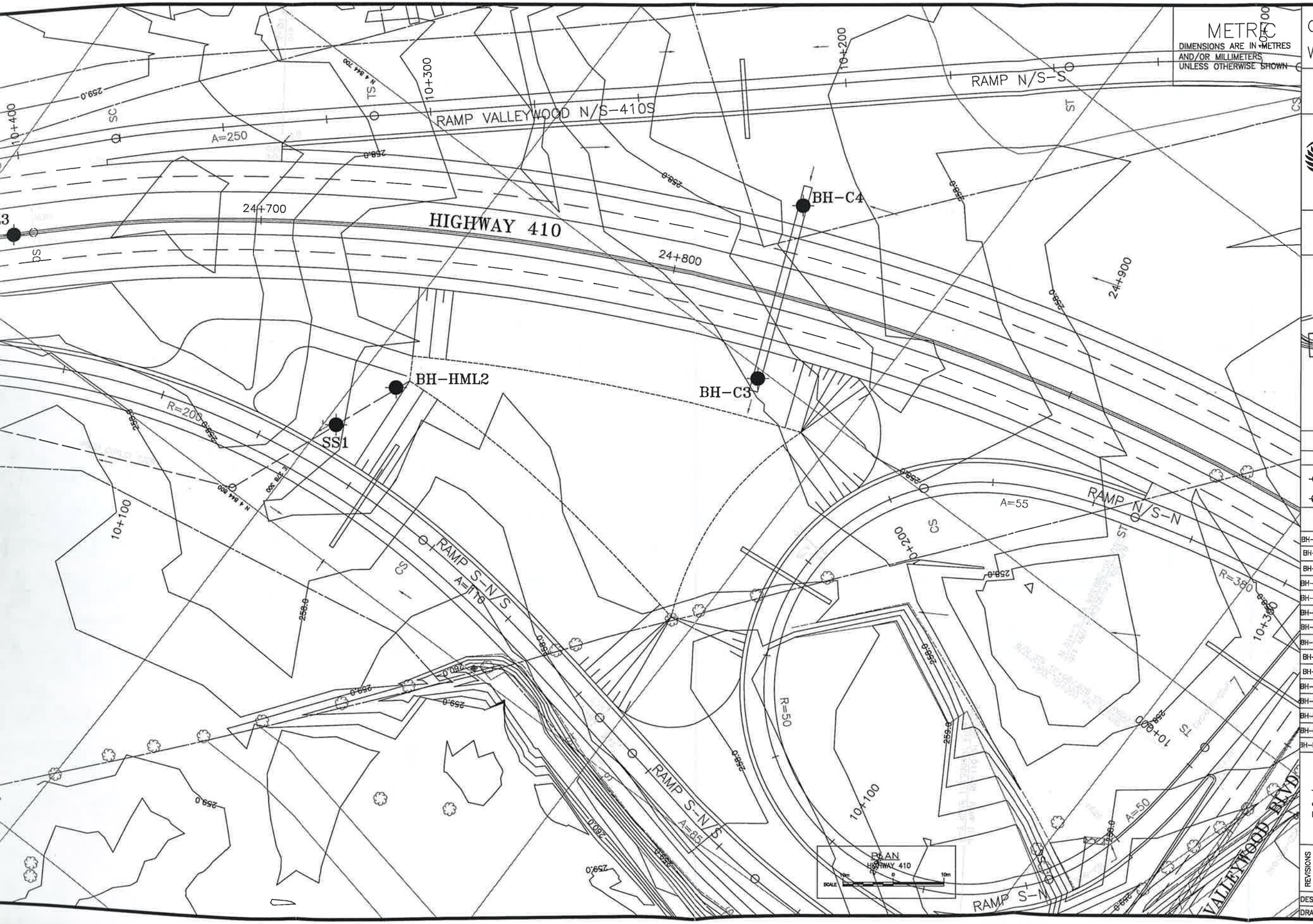
DESIGN	R.A	CODE	CHBDC2000	LOAD		DATE	OCT. 2005
DRAWN	P.S	CHK	R.A	SITE	STRUCT	SCHEME	DWG 2

262.0
261.0
260.0
259.0
25+100
25+200
25+300
25+400
BH-HM1.1
RAMP N-N/S
RAMP I-10N-VAUCLUWOOD
R=900
ST
CS
PC


SERVICE ROAD
VALLEYWOOD BLVD
RAMP 410N–VALLEYWOOD S
RAMP N–N/S
RAMP N–N/S
BH–VB4
BH–VB3
HOT 9+900.174 VALLEYWOOD BLVD
=HOT 10+000 RAMP N/S-S
=HOT 10+336.133 RAMP N–N
HOT 10+000 VALLEYWOOD BLVD
=HOC 24+991.235 HWY 416
R=100
R=900
R=80
R=90
R=130
R=525
A=55
A=65
A=135
PT
PC
PI
CS
SC
ST
9+550
10+000
10+100
10+200
10+300
10+400
24+200
25+100
25+000
8+800


ETOBICOKE CREEK
BH-EC2
BH-HML5&5A
R=1500
R=1500
A=320
HIGHW
24+200
24+400
9+000
246.0
247.0
248.0
249.0
250.0
251.0
252.0
253.0
254.0
255.0
256.0
257.0
258.0
259.0
260.0
261.0
REGISTERED PROFESSIONAL ENGINEER
MICHAEL TANOS
23'05'07
PROVINCE OF ONTARIO
LICENSED PROFESSIONAL ENGINEER
R.A. ABDUL
May 23/07
PROVINCE OF ONTARIO


HIGHWAY 410
RAMP S-N/S
BH-HML4
BH-HML3
SS1
R=3500
R=1000
R=200
A=250
A=240
A=110
TS
SC
CS
ST
24+400
24+500
24+600
24+700
10+400
10+500
10+100
9+800
9+900
259.0
260.0
258.0
N 4 844 800
N 4 844 700
N 4 844 600
N 4 844 500
E 278 300



CONT No

WP No105-00-00

HIGHWAY 410 PHASE III
HIGH MAST LIGHT POLES
BOREHOLE LOCATIONS

SHEET 2OF4

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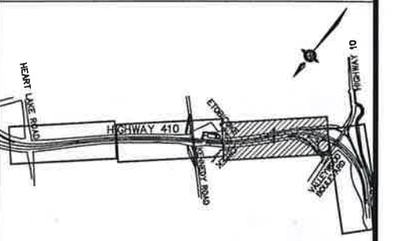
An Ingenium Group Company

Terraprobe
Consulting Geotechnical & Environmental Engineering
Construction Materials Engineering, Inspection & Testing



KEY PLAN

LEGEND

Bore Hole

Bore Hole And Cone

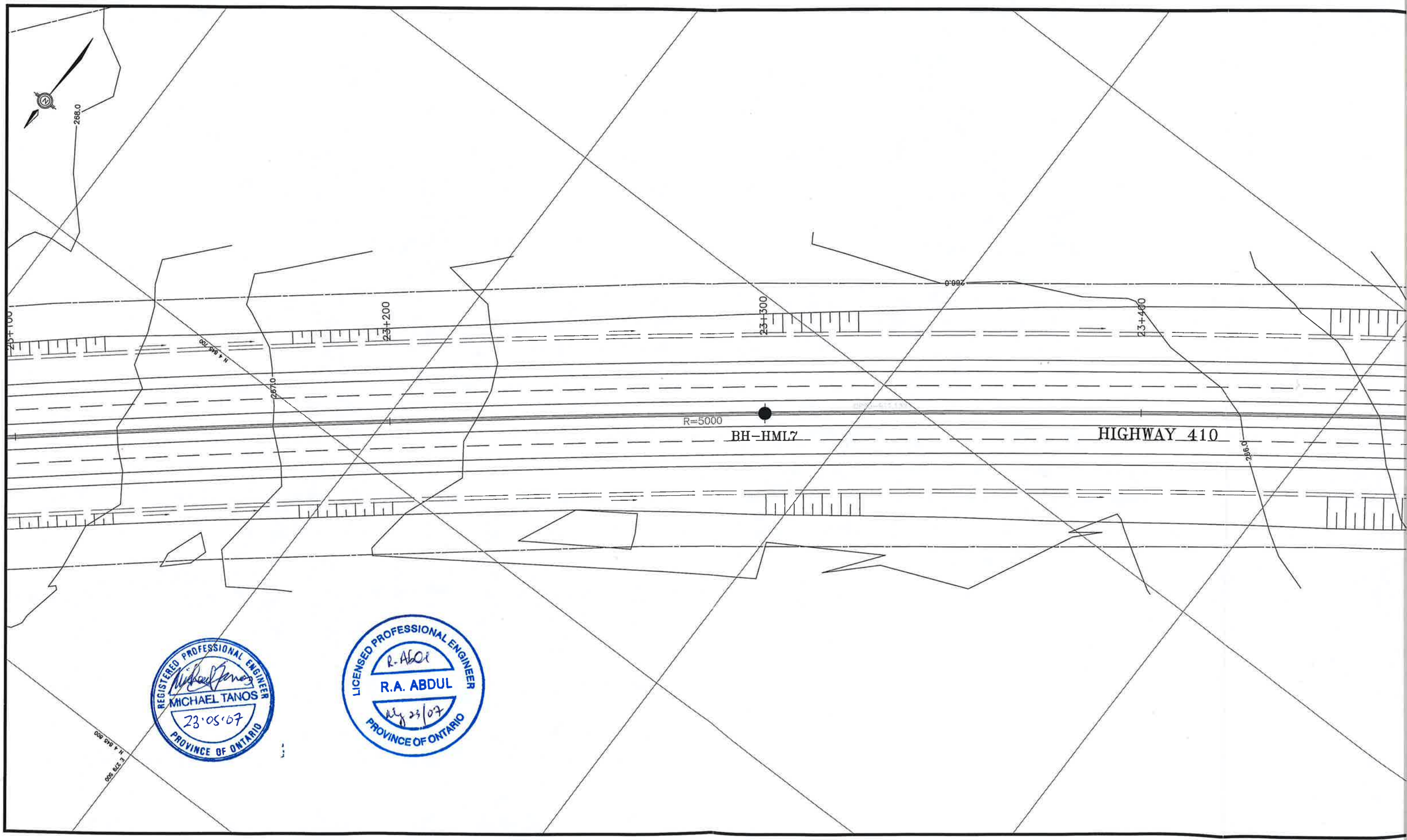
No	ELEVATION	COORDINATES	
		NORTHING	EASTING
BH-HML1	262.1	4844725.9	277770.0
BH-VB3	259.2	4844645.2	278064.4
BH-VB4	258.8	4844646.5	278081.6
BH-HML2	257.3	4844756.4	278291.4
BH-HML3	259.0	4844781.6	278388.1
BH-HML4	259.2	4844909.2	278507.9
BH-HML5	260.1	4845049.4	278636.1
BH-HML5A	260.1	4845049.4	278636.1
BH-EC2	253.3	4845168.1	278764.5
BH-EC5	246.9	4845223.0	278835.8
BH-HML6	262.6	4845430.9	279153.7
BH-HML7	266.4	4845625.2	279420.5
BH-HML8	268.7	4845836.5	279673.8
BH-HML9	271.6	4846055.8	279885.6
BH-HML10	266.8	4846288.0	280204.9

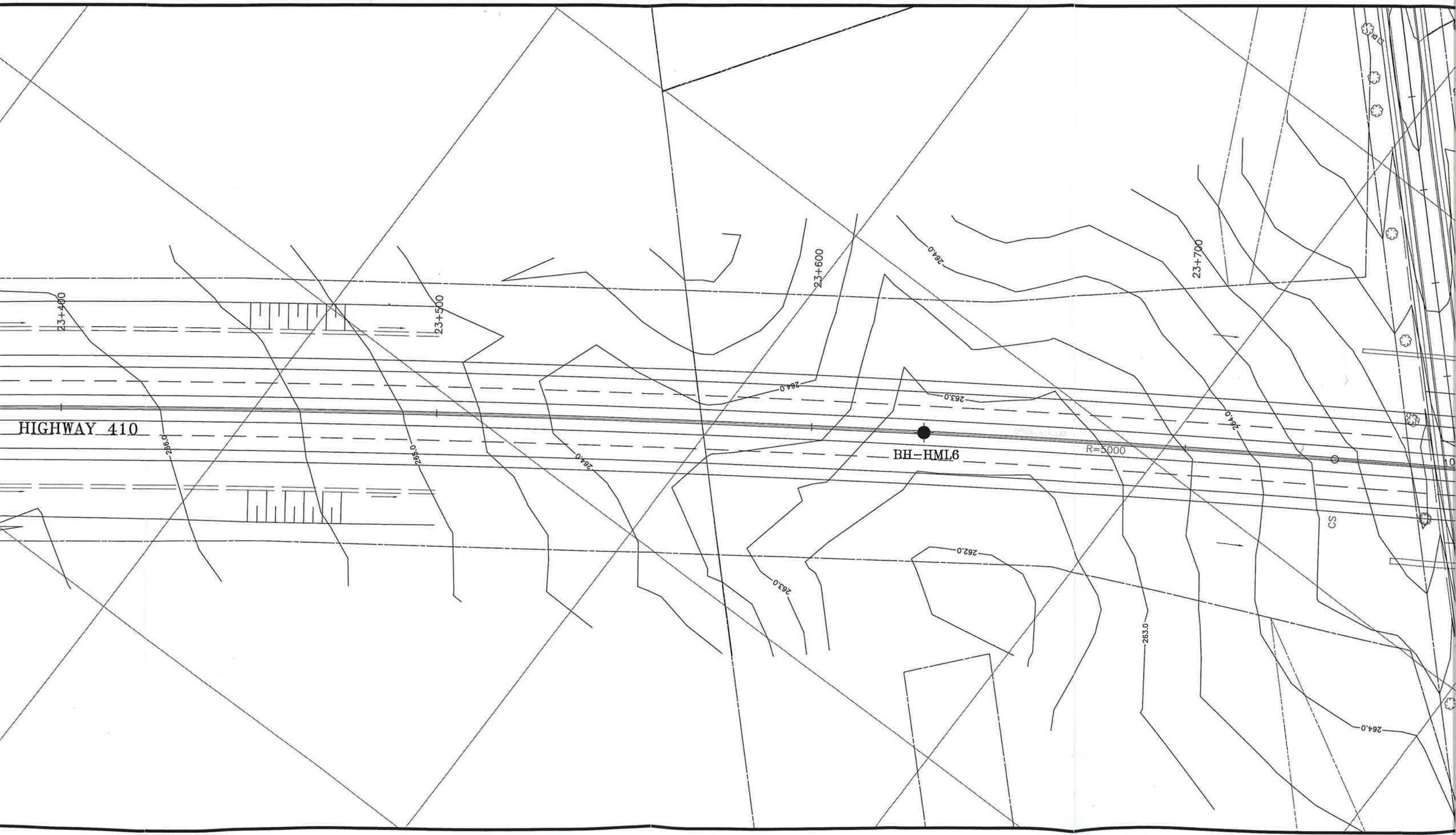
NOTE

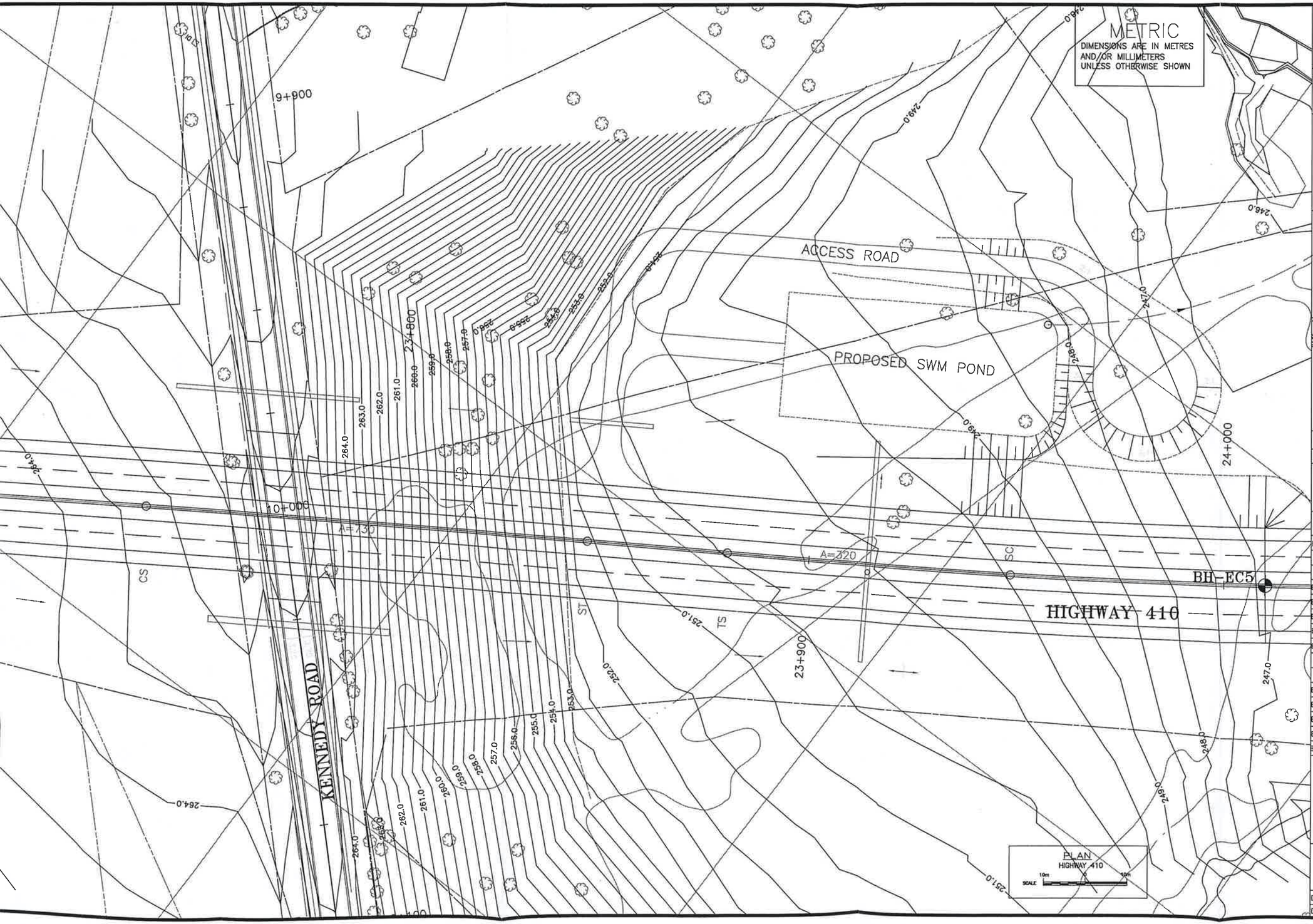
The boundaries between soil strata have been established only at Bore Hole locations. Between Bore holes the boundaries are assumed from geological evidence.

REVISIONS	DATE	BY	DESCRIPTION

DESIGN	R.A	CODE	CHBDC2000	LOAD	DATE	OCT. 2005	
DRAWN	P.S	CHK	R.A	SITE	STRUCT	SCHEME	DWG 2


268.0
23+100
23+200
23+300
23+400
266.0
256.0
R=5000
BH-HML7
HIGHWAY 410
REGISTERED PROFESSIONAL ENGINEER
MICHAEL TANOS
23.05.07
PROVINCE OF ONTARIO
LICENSED PROFESSIONAL ENGINEER
R-4601
R.A. ABDUL
May 23/07
PROVINCE OF ONTARIO


HIGHWAY 410
BH-HML6
23+400
23+500
23+600
23+700
R=5000
256.0
263.0
264.0
263.0
262.0
263.0
264.0
263.0
264.0
CS



CONT No

WP No105-00-00

HIGHWAY 410 PHASEIII

HIGH MAST LIGHT POLES
BOREHOLE LOCATIONS

SHEET
3OF4

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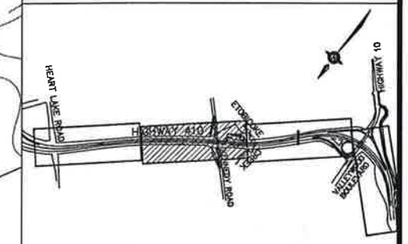
Construction Materials Engineering, Inspection & Testing



KEY PLAN

LEGEND

Bore Hole

Bore Hole And Cone

No	ELEVATION	COORDINATES	
		NORTHING	EASTING
BH-HML1	262.1	4844725.9	277770.0
BH-VB3	259.2	4844645.2	278064.4
BH-VB4	258.8	4844646.5	278081.6
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BH-HML3	259.0	4844781.6	278388.1
BH-HML4	259.2	4844909.2	278507.9
BH-HML5	260.1	4845049.4	278636.1
BH-HML5A	260.1	4845049.4	278636.1
BH-EC2	253.3	4845168.1	278764.5
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BH-HML6	262.6	4845430.9	279153.7
BH-HML7	266.4	4845625.2	279420.5
BH-HML8	268.7	4845836.5	279673.8
BH-HML9	271.6	4846055.8	279885.6
BH-HML10	266.8	4846288.0	280204.9

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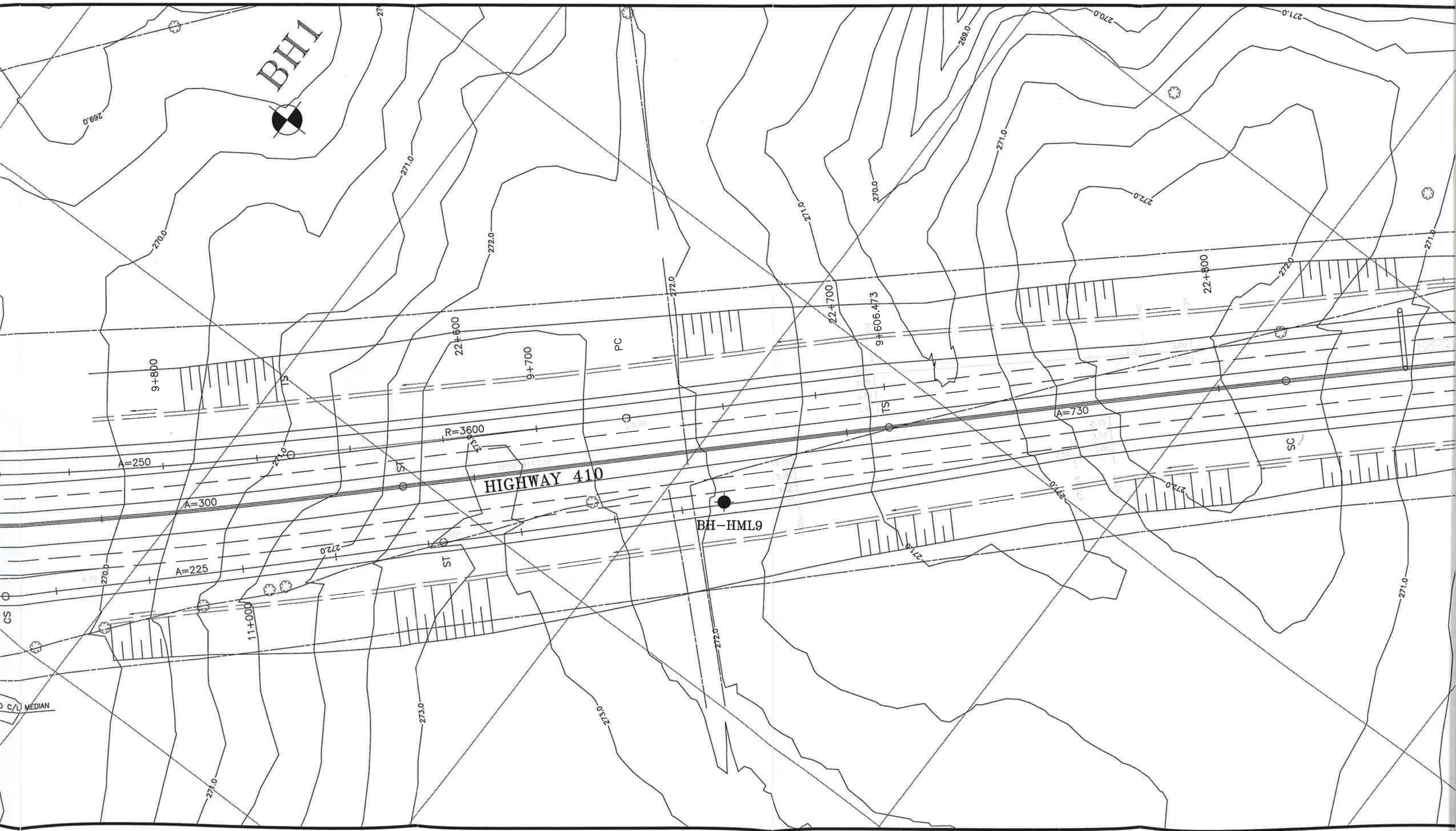
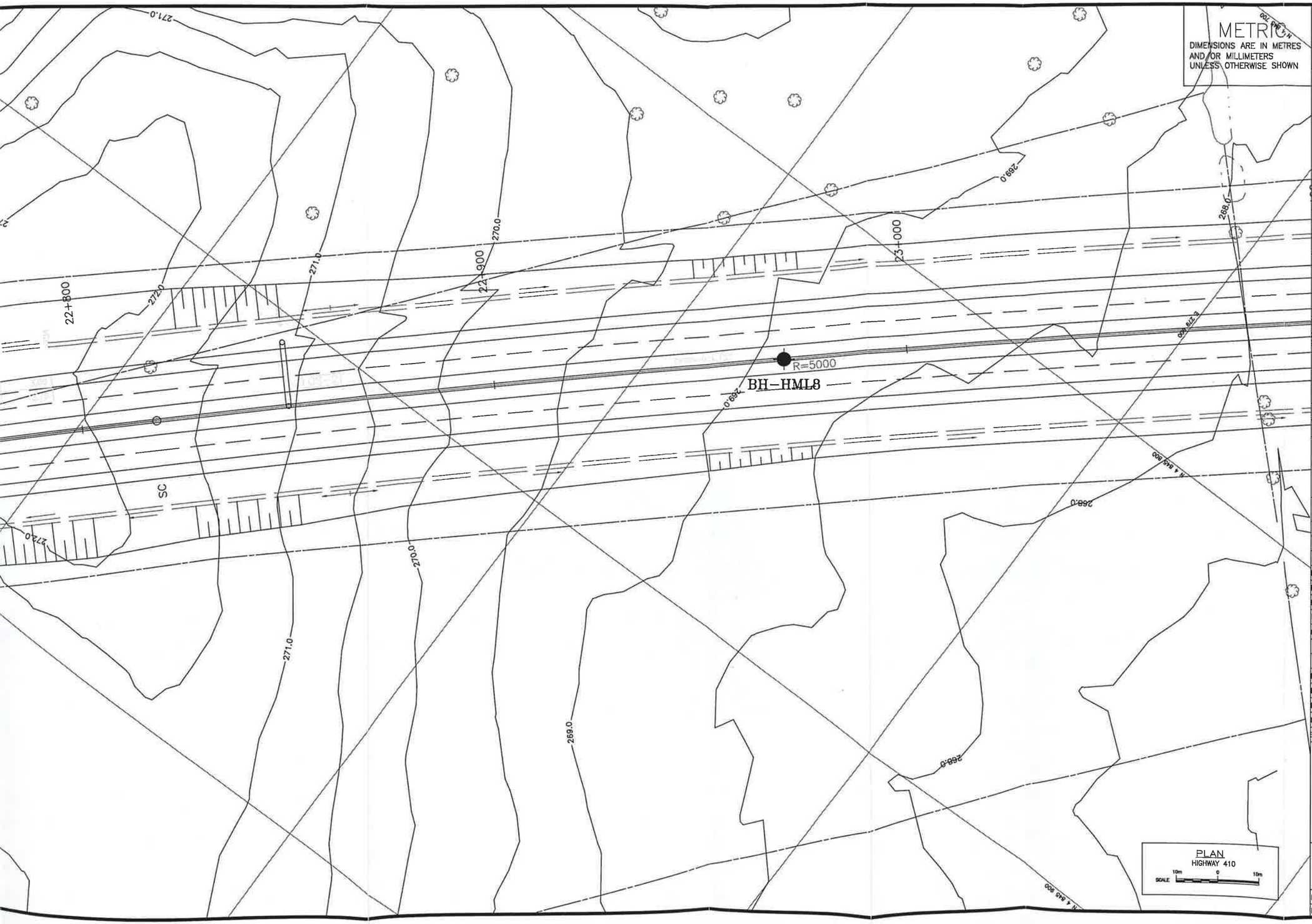
REVISIONS			
	DATE	BY	DESCRIPTION

DESIGN	R.A	CODE	CHBDC2000	LOAD		DATE	OCT. 2005
DRAWN	P.S	CHK	R.A	SITE	STRUCT	SCHEME	DWG 2


LIMIT OF ENTRANCE #12109
RECONSTRUCTION STA 10+055
HEART LAKE ROAD
RAMP 410N-MAYFIELD E/W
RAMP MAYFIELD E-410N
BH-HML10
R=650
R=800
R=800
A=180
A=250
A=300
A=225
SC
CS
SC
CS
10+100
22+200
10+000
9+900
9+800
10+700
10+800
22+400
10+900
11+000
HOC 22+389.459 HWY 410 C/L MEDIAN 22.65° RT
HOC 10+829.811 E-N RAMP
HOC 22+405.452 HWY 410 C/L MEDIAN
=HOT 10+000 E-N RAMP
REGISTERED PROFESSIONAL ENGINEER
MICHAEL TANOS
23-05-07
PROVINCE OF ONTARIO
LICENSED PROFESSIONAL ENGINEER
R.A. ABDUL
PROVINCE OF ONTARIO


BH1
HIGHWAY 410
BH-HML9
9+800
22+600
9+700
PC
22+700
9+606.473
22+800
TS
SC
ST
R=3600
A=250
A=300
A=225
A=730
11+000
C/L MEDIAN



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

CONT No
WP No 105-00-00

HIGHWAY 410 PHASEIII
HIGH MAST LIGHT POLES
BOREHOLE LOCATIONS

SHEET
40F4

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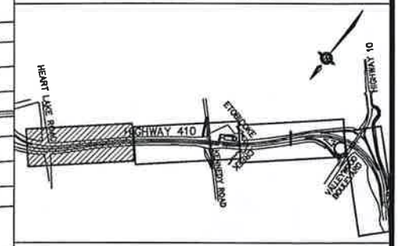
Terraprobe
Consulting Geotechnical & Environmental Engineering
Construction Materials Engineering, Inspection & Testing



KEY PLAN

LEGEND

Bore Hole

Bore Hole And Cone

No	ELEVATION	COORDINATES	
		NORTHING	EASTING
BH-HML1	262.1	4844725.9	277770.0
BH-VB3	259.2	4844645.2	278064.4
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BH-HML10	266.8	4846288.0	280204.9

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PLAN
HIGHWAY 410
SCALE 10m 0 10m

REVISIONS	DATE	BY	DESCRIPTION

DESIGN	R.A	CODE	CHBDC2000	LOAD		DATE	OCT. 2005
DRAWN	P.S	CHK	R.A	SITE	STRUCT	SCHEME	DWG 2

Dist. T. Last - MTO
D. Dundas - MTO
S. Chiu
File

Terraprobe

Consulting Geotechnical and Environmental Engineering
Construction Materials Engineering, Inspection and Testing

Brampton

Geotechnical Investigation, Engineering, & Design

Pavement Evaluation & Design

Environmental Assessment & Remediation Services

Hydrogeology

Dam Safety & Assessment

Building Systems & Sciences

Construction Materials Engineering Inspection & Testing

Earthworks, Design, Inspection & Compaction Testing

CSA Certified Concrete Testing

CCIL Certified Aggregates & Asphalt Testing

CWB Certified Welding & Structural Steel Inspection

File No. 1-00-0350
May 23, 2007

Giffels Associates Ltd.
30 International Blvd.
Toronto, ON

Attn: Mr. Stephen Chiu, P.Eng.

Re: WP 105-00-00, Agreement No. 2005-A-000230
Hwy 410 Extension Phase 3 – East of Heart Lake Road to Hwy 10.
Draft Foundation Investigation and Design Report (January 17, 2007)
1200 mm Storm Sewer

Dear Sirs:

We perused MTO's memorandum of May 07, 2007 concerning their review of our Draft Foundation Investigation and Design Report – 1200 mm Storm Sewer. We wish to thank Messrs. Z. Khan, P.Eng., and D. Dundas, P.Eng., for their review and advice.

Our comments to MTO's memorandum are provided below.

Signatures on Draft Reports

The reports were issued as drafts and therefore were not signed. The final Foundation Investigation Report and Foundation Investigation and Design Report are signed and sealed as per MTO's requirements.

Additional Comments

A separate foundation investigation report was prepared for inclusion with the contract package.

Greater Toronto
10 Bram Court,
Brampton, Ont. L6W 3R6
Tel: (905) 796-2650
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brampton@terraprobe.ca

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220 Bayview Drive, Unit 25
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Tel: (705) 739-8355
Fax: (705) 739-8369
barrie@terraprobe.ca

Hamilton-Niagara
903 Barton Street
Stoney Creek, Ont. L8E 5P5
Tel: (905) 643-7560
Fax: (905) 643-7559
stoneycreek@terraprobe.ca

Northern Ontario
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Sudbury, Ont. P3E 5P4
Tel: (705) 670-0460
Fax: (705) 670-0558
sudbury@terraprobe.ca

www.terraprobe.ca

Yours truly,

Terraprobe Limited

R. Abdul, P.Eng.,
Senior Geotechnical Engineer

Michael Tanos, P.Eng.,
Review Principal

Terraprobe

Consulting Geotechnical and Environmental Engineering
Construction Materials Engineering, Inspection and Testing

Brampton

Geotechnical Investigation, Engineering, & Design

Pavement Evaluation & Design

Environmental Assessment & Remediation Services

Hydrogeology

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Building Systems & Sciences

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CSA Certified Concrete Testing

CCIL Certified Aggregates & Asphalt Testing

CWB Certified Welding & Structural Steel Inspection

File No. 1-00-0350
May 23, 2007

Giffels Associates Ltd.
30 International Blvd.
Toronto, ON

Attn: Mr. Stephen Chiu, P.Eng.

Re: WP 105-00-00, Agreement No. 2005-A-000230
Hwy 410 Extension Phase 3 – East of Heart Lake Road to Hwy 10.
Draft Foundation Investigation and Design Report (October 19, 2005)
Proposed High Mast Light Poles

Dear Sirs:

We perused MTO's memorandum of May 07, 2007 concerning their review of our Draft Foundation Investigation and Design Report - Proposed High Mast Light Poles. We wish to thank Messrs. Z. Khan, P.Eng., and D. Dundas, P.Eng., for their review and advice.

Our comments to MTO's memorandum are provided below.

Signatures on Draft Reports

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Brampton, Ont. L6W 3R6
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brampton@terraprobe.ca

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Fax: (705) 739-8369
barrie@terraprobe.ca

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Northern Ontario
1012 Kelly Lake Road,#1
Sudbury, Ont. P3E 5P4
Tel: (705) 670-0460
Fax: (705) 670-0558
sudbury@terraprobe.ca

www.terraprobe.ca

Yours truly,

Terraprobe Limited

R. Abdul, P.Eng.,
Senior Geotechnical Engineer

Michael Tanos, P.Eng.,
Review Principal

Terraprobe

Consulting Geotechnical and Environmental Engineering
Construction Materials Engineering, Inspection and Testing

Brampton

Geotechnical Investigation, Engineering, & Design

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CSA Certified Concrete Testing

CCIL Certified Aggregates & Asphalt Testing

CWB Certified Welding & Structural Steel Inspection

File No. 1-00-0350
May 31, 2007

Giffels Associates Ltd.
30 International Blvd.
Toronto, ON

Attn: Mr. Stephen Chiu, P.Eng.

Re: WP 105-00-00, Agreement No. 2005-A-000230
Hwy 410 Extension Phase 3 – East of Heart Lake Road to Hwy 10.
Draft Foundation Investigation and Design Report (December 09, 2005)
Deep Cuts and High Fill Areas

Dear Sirs:

We perused MTO's memorandum of May 07, 2007 concerning their review of our Draft Foundation Investigation and Design Report – Deep Cuts and High Fill Areas. We wish to thank Messrs. Z. Khan, P.Eng., and D. Dundas, P.Eng., for their review and advice.

Our comments to MTO's memorandum are provided below.

Signatures on Draft Reports

The reports were issued as drafts and therefore were not signed. The final Foundation Investigation Report and Foundation Investigation and Design Report are signed and sealed as per MTO's requirements.

Additional Comments

A separate foundation investigation report was prepared for inclusion with the contract package.

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Yours truly,

Terraprobe Limited

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