



# Terraprobe

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

GEOCRES No:  
30M12-322

**FOUNDATION INVESTIGATION & DESIGN REPORT  
DEEP CUT & HIGH FILL AREAS  
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**

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## TABLE OF CONTENTS

### Part 1

1	INTRODUCTION .....	1
2	SITE DESCRIPTION .....	1
3	SITE INVESTIGATION AND FIELD TESTING.....	2
4	LABORATORY TESTING .....	4
5	DESCRIPTION OF SUBSURFACE CONDITIONS .....	4
5.1	SITE 1: CUT SECTION AT KENNEDY ROAD, STA. 23+650 TO 23+750 .....	4
5.1.1	Topsoil .....	4
5.1.2	Clayey Silt .....	4
5.1.3	Upper Clayey Silt Till.....	5
5.1.4	Sand & Silt Till.....	5
5.1.5	Lower Clayey Silt Till .....	6
5.1.6	Water Levels.....	6
5.2	SITE 2: FILL SECTION, ETOBICOKE CREEK VALLEY, STA. 23+875 TO 24+000 .....	6
5.2.1	Topsoil .....	7
5.2.2	Gravel and Sand.....	7
5.2.3	Silty Sand.....	7
5.2.4	Sand and Silt to Silty Sand Till.....	7
5.2.5	Clayey Silt Till.....	8
5.2.6	Water Levels.....	8
5.3	SITE 3: CUT SECTION WEST OF ETOBICOKE CREEK, STA. 24+175 TO 24+275.....	9
5.3.1	Topsoil .....	10
5.3.2	Clayey Silt .....	10
5.3.3	Clayey Silt Till.....	10
5.3.4	Sand .....	11
5.3.5	Water Levels.....	11
6	DISCUSSION AND RECOMMENDATIONS.....	13
6.1	SITE 1: CUT SECTION AT KENNEDY ROAD, STA. 23+650 TO 23+750 .....	13
6.1.1	General.....	13
6.1.2	Design Considerations.....	13
6.1.3	Construction Considerations.....	14
6.2	SITE 2: FILL SECTION, ETOBICOKE CREEK VALLEY, STA. 23+875 TO 24+000 ...	14
6.2.1	General.....	14
6.2.2	Embankment Settlement .....	15
6.2.3	Embankment Stability .....	15
6.2.4	Construction Considerations.....	16
6.3	SITE 3: CUT SECTION WEST OF ETOBICOKE CREEK, STA. 24+175 TO 24+275.....	17
6.3.1	General.....	17
6.3.2	Design Considerations.....	18



6.3.3 Construction Considerations.....	18
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## **Appendices**

### **Site 1**

Appendix A1	Record of Borehole Sheets
Appendix B1	Laboratory Test Results
Appendix C1	Borehole Locations and Stratigraphic Sections

### **Site 2**

Appendix A2	Record of Borehole Sheets
Appendix B2	Laboratory Test Results
Appendix C2	Borehole Locations and Stratigraphic Sections

### **Site 3**

Appendix A3	Record of Borehole Sheets
Appendix B3	Laboratory Test Results
Appendix C3	Borehole Locations and Stratigraphic Sections



**FOUNDATION INVESTIGATION REPORT**  
**DEEP CUT & HIGH FILL AREAS**  
**HIGHWAY 410 EXTENSION – PHASE III**  
**ONTARIO**  
**AGREEMENT No. 2005-A-000230, W.P. 105-00-00**  
**PART 1: FACTUAL INFORMATION**

## **1 INTRODUCTION**

This report presents the factual findings obtained from a foundation investigation conducted at the deep cut and high fill areas on the alignment of the proposed four-lanes of Highway 410 in the Town of Caledon, Regional Municipality of Peel, Ontario.

The purpose of this investigation was to explore the subsurface conditions along the identified sections and, based on the data obtained, to provide a borehole location plan, stratigraphic sections, 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.

For reporting purposes the investigated sections are designated as Sites 1, 2 and 3 as follows:

Site 1: Cut section at Kennedy Road, Sta. 23+650 to 23+750 approximately.

Site 2: Fill section, Etobicoke Creek Valley, Sta. 23+875 to 24+000 approximately.

Site 3: Cut section west of Etobicoke Creek, Sta. 24+175 to 24+275 approximately.

## **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 route 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<sup>1</sup>. 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.

### 3 SITE INVESTIGATION AND FIELD TESTING

The site investigation and field testing for this project were carried out during the period January 07 to April 05, 2005 and consisted of drilling and sampling sixteen boreholes to depths ranging from 6.6 m to 14.2 m. The approximate borehole locations are shown on the attached Borehole Locations Drawings in Appendix C1, C2 and C3.

The borehole locations were established in the field by surveyors from Shiu Geomatics Limited who also provided Terraprobe with their coordinates and geodetic elevations. Access to some specific borehole locations at Sites 2 and 3 was difficult due to the locally steep slopes and the locations of these boreholes were selected to be as close as feasible to the staked out location while allowing safe operation of the drill rig. Utility clearances were obtained by Terraprobe prior to drilling.

The drilling, sampling and in-situ testing operations were conducted with a track mounted CME 55 drill rig owned and operated by Groundworks Drilling Limited of Toronto, Ontario. Solid stem auger drilling techniques 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.

Groundwater conditions in the open boreholes were observed throughout the drilling operations. Site 1 is privately owned farmed land and access to drill on this property was granted subject to Terraprobe removing all survey stakes and backfilling the boreholes immediately upon completion of drilling. Therefore, piezometric installations were not possible at this site. Sites 2 and 3 were instrumented with standpipe piezometers consisting of 19 mm PVC pipe with a slotted screen (enclosed in sand). The locations and completion details of the piezometers are shown in Table 3.1.

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<sup>1</sup> Chapman and Putnam, "The Physiography of South Ontario", 3<sup>rd</sup> Edition, 1984.



**Table 3.1 – Piezometer Installation Details**

<b>Piezometer Details (Site 2)</b>		
<b>Piezometer Location</b>	<b>Tip Depth/ Elevation (m)</b>	<b>Completion Details</b>
23+875 Lt. of CL	6.1/244.1	Piezometer with 1.5 m slotted screen installed with filter sand to 4.6 m, drill cuttings from 4.6 m to 0.9 m and bentonite seal from 0.9 m to ground surface.
23+875 Rt. of CL	6.1/244.9	Piezometer with 1.5 m slotted screen installed with filter sand to 4.6 m, drill cuttings from 4.6 m to 0.9 m and bentonite seal from 0.9 m to ground surface.
23+920 CL	6.1/243.1	Piezometer with 1.5 m slotted screen installed with filter sand to 4.6 m, drill cuttings from 4.6 m to 0.9 m and bentonite seal from 0.9 m to ground surface.
23+975 Rt. of CL	7.6/241.4	Piezometer with 1.5 m slotted screen installed with filter sand to 6.1 m, drill cuttings from 6.1 m to 1.2 m and bentonite seal from 1.2 m to ground surface.
24+000 Lt. of CL	7.6/239.3	Piezometer with 1.5 m slotted screen installed with filter sand to 6.1 m, drill cuttings from 6.1 m to 1.2 m and bentonite seal from 1.2 m to ground surface.
<b>Piezometer Details (Site 3)</b>		
<b>Piezometer Location</b>	<b>Tip Depth/ Elevation (m)</b>	<b>Completion Details</b>
24+200 CL	7.6/253.1	Piezometer with 1.5 m slotted screen installed with filter sand to 6.1 m, drill cuttings from 6.1 m to 1.2 m and bentonite seal from 1.2 m to ground surface.
24+236 Lt. of CL	7.6/253.1	Piezometer with 1.5 m slotted screen installed with filter sand to 5.5 m, bentonite seal from 5.5 m to 4.6 m, drill cuttings from 4.6 m to 0.6 m and bentonite seal from 0.6 m to ground surface.
24+238 CL	7.6/253.1	Piezometer with 1.5 m slotted screen installed with filter sand to 5.5 m, bentonite seal from 5.5 m to 4.6 m, drill cuttings from 4.6 m to 0.6 m and bentonite seal from 0.6 m to ground surface.
24+238 Rt. of CL	7.6/254.0	Piezometer with 1.5 m slotted screen installed with filter sand to 5.5 m, bentonite seal from 5.5 m to 4.6 m, drill cuttings from 4.6 m to 0.6 m and bentonite seal from 0.6 m to ground surface.
24+275 CL	6.5/253.6	Piezometer with 1.5 m slotted screen installed with filter sand to 4.3 m, bentonite seal from 4.3 m to 3.7 m, drill cuttings from 3.7 m to 0.6 m and bentonite seal from 0.6 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 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 A1, A2 and A3. The grain size distribution curves and plasticity charts are illustrated in Appendix B1, B2 and B3.

#### **5 DESCRIPTION OF SUBSURFACE CONDITIONS**

##### **5.1 SITE 1: CUT SECTION AT KENNEDY ROAD, STA. 23+650 TO 23+750**

Site 1 is privately owned farm land that is actively cultivated. The site is located immediately east of Kennedy Road. The ground surface is relatively flat through this section but falls steeply on the west side of Kennedy Road towards the flood plain of Etobicoke Creek.

Reference is made to the Record of Borehole sheets in Appendix A1 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 and sand and silt till.

##### **5.1.1 Topsoil**

Topsoil approximately 200 mm to 700 mm thick was encountered across the site. Topsoil thickness may vary between and beyond the boreholes.

##### **5.1.2 Clayey Silt**

A surficial layer of clayey silt containing trace to some sand and trace gravel was encountered in some of the boreholes. This layer extends to depths of 0.7 m or to elevations ranging from 263.8 m to 263.6 m below ground surface.

Standard Penetration tests in this clayey silt layer yielded 'N' values ranging from 4 to 6 blows for 0.3 m penetration indicating a soft to firm consistency. The moisture content of samples from this deposit ranged from 21% to 24% by weight.



### 5.1.3 Upper Clayey Silt Till

A major deposit of clayey silt till was encountered across the site. In some of the boreholes this deposit was fully penetrated at depths of 7.1 m to 8.6 m below ground surface or at elevations ranging between 256.7 m and 257.2 m. The boreholes drilled at Sta. 23+650 and offset right and left of the Highway 410 centre line were terminated in this clayey silt till at depths of 6.6 m below ground surface i.e. at elevations of 256.7 m and 255.2 m.

The grain size distribution curves of tested samples of this clayey silt till are shown in Figure B1-1. These results show a grain size distribution consisting of 1-4% gravel, 19-39% sand, 38-55% silt and 19-25% 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 chart in Figure B1-2. The index values from these tests are summarized below:

Liquid Limit:	22-26%
Plastic Limit:	11-18%
Plasticity Index:	8-11%
Natural Moisture Content:	10-17%

These values are characteristic of clayey soils of low plasticity.

Standard Penetration tests in the clayey silt till gave 'N' values ranging from 5 to 51 blows for 0.3 m penetration. Based on these results the clayey silt till is considered to have a firm to hard consistency.

The moisture content of samples from this deposit ranged from 7% to 26% by weight and the bulk unit weight of tested samples ranged from 19.7 kN/m<sup>3</sup> to 22.5 kN/m<sup>3</sup>

### 5.1.4 Sand & Silt Till

Sand and silt till was encountered in the boreholes drilled at Sta. 23+700 and Sta. 23+750. This till deposit was fully penetrated in some of the boreholes at depths of 11.7 m and 13.0 m below ground surface or at elevations ranging from 252.8 m to 252.3 m. Borehole 23+700 CL was terminated in this deposit at a depth of 9.3 m (Elev. 255.0 m) below ground surface.

The grain size distribution results of a sample of the sand and silt till are illustrated in Figure B1-3. These results show a grain size distribution consisting of 10% gravel, 42% sand, 39% silt and 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 of more than 50 blows for 0.3 m penetration indicating a very dense relative density. The moisture content of samples from this stratum ranged from 6% to 11% by weight.





### **5.1.5 Lower Clayey Silt Till**

The boreholes drilled at Sta. 23+750 encountered a lower layer of clayey silt till that extends to borehole termination depths of 14.2 m or to elevations ranging from 251.1 m to 250.3 m.

The grain size distribution curve of a sample of this clayey silt till is presented in Figure B1-4. These results show a grain size distribution consisting of 1% gravel, 43% sand, 43% silt and 13% clay size particles. Cobbles and boulders can also be expected in till soils.

Standard Penetration tests in this lower clayey silt till yielded 'N' values ranging from 43 to 57 blows for 0.3 m penetration indicating a hard consistency. The moisture content of samples from this deposit ranged from 9% to 16% by weight.

### **5.1.6 Water Levels**

As mentioned previously, this site is privately owned farm land at the time of investigation. Terraprobe's permission to access and drill on this property was based on the understanding that all survey stakes would be removed and the boreholes backfilled immediately upon completion of drilling. Consequently, piezometric installations were not possible and the groundwater observations were limited to recording water levels in the open boreholes during drilling and after completing each borehole.

The groundwater table is estimated based on the water level observations in the open boreholes, the change in colour of the native soil from brown to grey and the moisture contents of the soil samples. Since the site is in close proximity to Kennedy Road (for which a foundation investigation was undertaken and groundwater levels were monitored as part of this assignment); the piezometric data obtained at the Kennedy Road bridge site was extrapolated in order to estimate the groundwater level at this site. .

Based on this data, the groundwater table is believed to be generally at about Elev. 260±m. Perched water can also be expected to occur in the relatively permeable silty sand seams and pockets existing within the clayey silt till deposit.

The groundwater level is expected to fluctuate seasonally and after severe weather events.

## **5.2 SITE 2: FILL SECTION, ETOBICOKE CREEK VALLEY, STA. 23+875 TO 24+000**

Site 2 is located between Kennedy Road and Etobicoke Creek in the Etobicoke Creek valley. Immediately west of Kennedy Road the valley wall is steep becoming flatter near the bottom approaching the flood plain level. Vegetation at this site consists of planted conifers in the flood plain and occasional stands of mature trees and light vegetation consisting of grass and small shrubs.

Reference is made to the Record of Borehole sheets in Appendix A2 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 sand and gravel, silty sand, sand and silt till and clayey silt till.

#### **5.2.1 Topsoil**

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

#### **5.2.2 Gravel and Sand**

Layers of gravel and sand and sand and gravel were encountered in some of the boreholes at depths ranging from 1.4 m to 2.1 m below ground surface or at elevations ranging from 248.9 m to 247.6 m.

Refer to Figure B2-1 where the grain size distribution curves of three samples of these deposits are illustrated. The results show a grain size distribution consisting of 37-45% gravel, 30-43% sand, 14-16% silt and 5-9% clay size particles.

Standard Penetration tests conducted in these deposits yielded 'N' values ranging from 14 to 22 blows for 0.3 m penetration. Based on these results the deposit is considered to have a generally compact relative density. The moisture content of samples from this deposit ranged from 12% to 18% by weight.

#### **5.2.3 Silty Sand**

A layer of silty sand was encountered in Borehole 24+000 Lt. of CL. The silty sand extends to a depth of 1.4 m (Elev. 245.5 m).

Standard Penetration tests in this silty sand deposit yielded 'N' values of 8 and 21 blows for 0.3 m penetration indicating a loose to compact relative density. The moisture content of samples from this deposit ranged from 18% to 25% by weight.

#### **5.2.4 Sand and Silt to Silty Sand Till**

Discontinuous layers of sand and silt and silty sand till were encountered below ground surface extending to depths ranging from 4.0 m (Elev. 247 m) to 8.1 m (Elev. 238.8 m) below ground surface.

The results of grain size distribution tests conducted on samples obtained from these deposits are shown in Figure B2-2. These results show grain size distributions consisting of 1-16% gravel, 20-53% sand, 34-68% silt and 5-8% clay size particles. Cobbles and boulders can also be expected in till soils.

Standard Penetration tests in this till deposit gave 'N' values that ranged from 10 to 90 blows for less than 0.3 m penetration indicating a compact to very dense relative density. The moisture content of samples from this stratum ranged from 7% to 20% by weight.



### 5.2.5 Clayey Silt Till

Layers of clayey silt till were encountered in some of the boreholes. This deposit extends to depths ranging from 1.4 m (Elev. 246.2 m) to 8.1 m (Elev. 240.9 m) below ground surface.

The grain size distribution curves of tested samples of this clayey silt till are shown in Figure B2-3. These results show a grain size distribution consisting of 0-14% gravel, 1-42% sand, 34-85% silt and 10-26% 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 chart in Figures B2-4. The index values from these tests are summarized below:

Liquid Limit:	18-26%
Plastic Limit:	12-15%
Plasticity Index:	6-11%
Natural Moisture Content:	12-16%

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 78 blows for 0.3 m penetration but generally most of the recorded 'N' values ranged from 17 to 78 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 zones.

The moisture content of samples from these deposits ranged from 10% to 24% by weight and the bulk unit weight of a sample was 22.9 kN/m<sup>3</sup>.

### 5.2.6 Water Levels

Groundwater observations were made in the open boreholes during the drilling and after completing each borehole. The boreholes were also instrumented with standpipe piezometers and the water level readings were measured on separate visits made after the completion of drilling. The water level readings are presented in Table 5.2.1.



**Table 5.2.1 – Water Level Measurements**

Borehole	Date	Water Levels	
		Depth (m)	Elevation (m)
23+875 Lt. of CL	Feb. 01, 2005	1.1	249.1
	April 18, 2005	0.7	249.5
	May 17, 2005	1.0	249.2
23+875 Rt. of CL	Feb. 01, 2005	1.1	249.9
	April 18, 2005	0.6	250.4
	May 17, 2005	1.2	249.8
23+920 CL	Feb. 02, 2005	0.6	248.6
	April 18, 2005	0.9	248.3
	May 17, 2005	1.2	248.0
23+975 Rt. of CL	Feb. 01, 2005	1.7	247.3
	April 18, 2005	0.9	248.1
	May 17, 2005	1.2	247.8
24+000 Lt. of CL	Feb. 01, 2005	0.9	246.0
	April 18, 2005	0.0	246.9
	May 17, 2005	0.8	246.1

These observations infer that the local groundwater level ranges between Elev. 249.5± m and 250.4± m at Sta. 23+875 falling gradually to Elev. 246.9± m at Sta. 24+000.

All groundwater observations at this site are short term and the levels are expected to fluctuate seasonally and after severe weather events.

### 5.3 SITE 3: CUT SECTION WEST OF ETOBICOKE CREEK, STA. 24+175 TO 24+275

This site is located on the west side of Etobicoke Creek. A north-south oriented scarp runs parallel to the west bank of Etobicoke Creek near the east limit of the site. Along the alignment of the highway the ground surface rises to the west and reaches a high point at about Sta. 24+225 and then begins to fall further to the west. The terrain also slopes downwards from north to south across the alignment.

Reference is made to the Record of Borehole sheets in Appendix A3 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 deposits of clayey silt, clayey silt till and sand.



### 5.3.1 Topsoil

A layer of topsoil approximately 150 mm to 400 mm thick was encountered across the site. Topsoil thickness may vary between and beyond the boreholes.

### 5.3.2 Clayey Silt

Two boreholes encountered a layer of clayey silt that extends to depths of 0.7 m or elevations ranging from 260 m to 259.4 m below ground surface.

Standard Penetration tests in this clayey silt layer yielded 'N' values of 5 and 6 blows for 0.3 m penetration indicating a firm consistency. The moisture content of samples from this deposit ranged from 21% to 22% by weight.

### 5.3.3 Clayey Silt Till

A major deposit of clayey silt till was encountered along this section of the alignment. In Borehole 24+236 Lt of CL this deposit was fully penetrated at a depth of 7.1 m (Elev. 253.6 m) below ground surface. The remaining boreholes were terminated in this clayey silt till layer at depths ranging from 6.6 m to 8.1 m below ground surface or at elevations ranging between 253.5 m and 252.6 m.

The grain size distribution curves of tested samples of this clayey silt till are illustrated in Figure B3-1. These results show a grain size distribution consisting of 3-15% gravel, 28-32% sand, 37-46% silt and 18-22% clay size particles. Till soils are also known to contain cobbles and boulders.

Samples retrieved from this deposit were also subjected to Atterberg Limits tests and the results are plotted on the plasticity charts in Figure B3-2. The index values from these tests are summarized below:

Liquid Limit:	23-25%
Plastic Limit:	14-16%
Plasticity Index:	7-11%
Natural Moisture Content:	11-13%

These values are characteristic of clayey soils of low plasticity.

Standard Penetration tests in the clayey silt till gave 'N' values ranging from 5 to 58 blows for 0.3 m penetration but generally most of the recorded 'N' values ranged from 13 to 58 blows for 0.3 m penetration. Based on these results the clayey silt till is considered to have a generally stiff to hard consistency with occasional firm zones.

The moisture content of samples from this deposit ranged from 10% to 20% by weight and the bulk unit weight of samples ranged between 22 kN/m<sup>3</sup> and 23 kN/m<sup>3</sup>.



### 5.3.4 Sand

A layer of sand with some gravel was encountered in Borehole 24+236 Lt. of CL. This granular layer extends to a borehole termination depth of 8.1 m (Elev. 252.6 m) and possibly beyond.

Refer to Figure B3-3 for the grain size distribution results of a sample from this deposit. The results illustrate a grain size distribution consisting of 20 % gravel, 67 % sand, 10 % silt and 3 % clay size particles.

An SPT 'N' value of 58 blows for 0.3 m penetration was recorded in this layer indicating a very dense relative density. The moisture content of a sample was 9% by weight.

### 5.3.5 Water Levels

Groundwater observations were made in the open boreholes during the drilling and after completing each borehole. The boreholes were also instrumented with standpipe piezometers and the water level readings were measured on separate visits made after the completion of drilling. The water level readings are presented in Table 5.3.1.

**Table 5.3.1 – Water Level Measurements**

Borehole	Date	Water Levels	
		Depth (m)	Elevation (m)
24+200 CL	Feb. 02, 2005	5.8	254.9
	April 18, 2005	4.3	256.4
	May 17, 2005	4.4	256.3
24+236 Lt. of CL	Feb. 02, 2005	4.5	256.2
	April 18, 2005	3.1	257.6
	May 17, 2005	3.5	257.2
24+238 CL	Feb. 02, 2005	4.3	256.4
	April 18, 2005	3.0	257.7
	May 17, 2005	3.3	257.4
24+238 Rt. of CL	Feb. 02, 2005	4.1	257.5
	April 18, 2005	3.7	257.9
	May 17, 2005	3.9	257.7
24+275 CL	Feb. 02, 2005	0.6	259.5
	April 18, 2005	0.5	259.6
	May 17, 2005	0.5	259.6

Based on these observations, the local groundwater level is at approximately Elev. 256.4± m at Sta. 24+200 rising gradually to 259.6± m at Sta. 24+275.

Perched water can also be expected to occur in the relatively permeable silty sand seams and pockets existing within the clayey silt till deposit.



All groundwater observations at this site are short term and the levels are expected to fluctuate seasonally and after severe weather events.

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*Michael Tanos*

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Review Principal



**FOUNDATION DESIGN REPORT  
DEEP CUT & HIGH FILL AREAS  
HIGHWAY 410 EXTENSION – PHASE III  
ONTARIO  
AGREEMENT No. 2005-A-000230, W.P. 105-00-00**

**PART 2: ENGINEERING DISCUSSION AND RECOMMENDATIONS**

**6 DISCUSSION AND RECOMMENDATIONS**

**6.1 SITE 1: CUT SECTION AT KENNEDY ROAD, STA. 23+650 TO 23+750**

**6.1.1 General**

The profile and cross-section drawings indicate that the design grade of the highway decreases with increasing chainage. A design elevation of 258.9 m is proposed at Sta. 23+650 decreasing to an elevation of 255.9m at Sta. 23+750. The height of cut measured from ground surface to the design ditch elevation is estimated to range from 5± m to 6.5± m at Sta. 23+650 increasing to 11± m to 12± m at Sta. 23+750.

The site is underlain by layers of topsoil and soft to firm clayey silt. These surficial deposits are further underlain by deposits of firm to hard clayey silt till and very dense sand and silt till. The groundwater level is believed to be generally at Elev. 260± m.

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

**6.1.2 Design Considerations**

Based on the cross-section drawings and the subsurface information excavations will be made in the clayey silt till and the sand and silt till.

For the purpose of stability analyses, the commercially available slope stability program Slope W developed by Geo-Slope International Ltd. was used. The Bishop's simplified method for stability analysis was employed.

The proposed cross-section geometry (2H:1V side slopes) at Sta. 23+650, 23+700 and 23+750 were analysed for global stability. Both undrained (short term) and drained (long term) stability analyses were conducted on the selected cross-sections.

Factors of safety against global failure of 1.4 and greater were obtained. Therefore, the proposed design side slopes (2H:1V) of the selected cross-sections are considered to be stable.





Where cut slopes are higher than 6 m, mid-height berms should be incorporated in the design. The berms should:

- extend for the length through which the cut section height exceeds 6 m
- be at least 2 m wide
- have 2% positive drainage to shed run-off water.

### **6.1.3 Construction Considerations**

Groundwater is likely to be encountered during excavation. Groundwater seepage may have to be controlled especially if relatively pervious sand seams or layers are encountered within the clayey silt till.

The design of the unwatering system should be the responsibility of the Contractor. However, a suitable system that might be employed is a system of interceptor trenches and pumping from strategically located filtered sumps. Consideration can also be given to trenching around the perimeter of the excavation by completing the construction of the roadway ditches as soon as possible.

The excavated soils will most likely require moisture conditioning before they can be re-used as fill. Excavation and grading should be performed in accordance with OPSS 206.

Proper erosion control measures should be implemented both during construction and permanently. Temporary erosion and sediment control must be provided in accordance with OPSS 577. Cut slopes must be provided with permanent erosion protection in accordance with OPSS 571 and/or OPSS 572.

## **6.2 SITE 2: FILL SECTION, ETOBICOKE CREEK VALLEY, STA. 23+875 TO 24+000**

### **6.2.1 General**

At this site an embankment is required in order to achieve the design grade profile of the highway. The profile and cross section drawings indicate that the design grade of the highway will range from about Elev. 252.7± m at Sta. 23+875 to about Elev. 252± m at Sta. 24+000. The maximum embankment height measured from the centre line profile of the highway to the founding elevation of the embankment is estimated to be about 6.5± m at Sta. 24+000 decreasing in height towards Sta. 23+875.

A storm water detention pond will be located at the toe of the embankment on the south side of the highway between Sta. 23+890 and Sta. 23+995 approximately. The pond will be approximately 65 m long and about 30 m wide. The design water level in the pond will range from Elev. 248 m to Elev. 250.15 m.

The site is underlain by topsoil and overburden deposits consisting of compact sand and gravel, loose to compact silty sand, compact to very dense sand and silt till and very stiff



to hard clayey silt till. The local groundwater level ranges between Elev. 249.5± m and 250.4± m at Sta. 23+875 falling gradually to Elev. 246.9± m at Sta. 24+000.

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

#### **6.2.2 Embankment Settlement**

Based on estimated stripping depths obtained from the Record of Boreholes data and the profile drawings, the height of fill is estimated to range from about 2.2± m at Sta. 23+875 to a maximum of 6.5± m at Sta. 24+000.

The estimated settlement under the weight of the proposed embankment will range from about 25 mm at Sta. 23+875 to 75 mm at Sta. 24+000. However, due to the non-plastic nature of most of the foundation soils, most of the settlement will be immediate and essentially complete when construction of the embankment is completed.

The embankments will also experience settlement resulting from consolidation of the non-cohesive earth fill. This settlement is expected to be about 25 mm for 2.5± m high embankment and 65 mm for a 6.5± m high embankment. The settlement within the non-cohesive fill should be immediate in nature and essentially be complete shortly after construction has been completed.

#### **6.2.3 Embankment Stability**

Embankment construction using either non-cohesive earth fill or rock fill is feasible provided the embankment is constructed on the underlying compact sand and gravel, compact sandy silt till or the very stiff clayey silt till.

The global, internal and surficial stability of the approach embankment fill will depend on the slope geometry and also to a large degree on the material used to construct the embankment. The supplied cross sections show that the proposed embankment side slopes are variable. Embankment side slopes of 2H:1V are proposed at Sta. 24+000 becoming as shallow as 4H:1V at Sta. 23+975. Between Sta. 23+975 and Sta. 23+875 embankment side slopes of 4H:1V are proposed on the north side and 3H:1V on the south side.

For the purpose of embankment stability analyses, the commercially available slope stability program Slope W developed by Geo-Slope International Ltd. was used. The Bishop's simplified method for stability analysis was employed.

Global stability analyses were conducted on the proposed embankment geometries at selected stations assuming SSM or earth fill embankment and rock fill embankment. The proposed embankment geometry at Sta. 23+875, 23+900, 23+925, 23+975 and 24+000 were analysed for undrained (short term) and drained (long term) stability.

The influence of fluctuating water levels in the storm water pond and its effects on embankment stability were also considered. Stability assessments were undertaken



assuming a dry pond, pond with water level at Elev. 248 m and pond with water level at elevation 250± m. Rapid drawdown conditions were also taken into consideration assuming a change in water level from Elev. 250± m to Elev. 248 m.

Factors of safety against global failure of 1.4 and greater were obtained for the embankment geometries analysed. These factors of safety are based on the assumption that the embankment will be constructed on the underlying compact sand and gravel, compact sandy silt till or the very stiff clayey silt till encountered within this section.

A short section of the embankment located in the vicinity of Sta. 24+000 near the west bank of Etobicoke Creek may become partially submerged during storm events. The embankment geometry at Sta. 24+000 was analysed for storm conditions assuming a static H.W.L of Elev. 248± m in Etobicoke Creek. The subsurface conditions at this section were obtained from Record of Borehole No. 24+000 Lt. of CL.

Consideration was initially given to constructing the embankment on the loose to compact silty sand layer encountered at Elev. 246.5 m but factors of safety less than 1.3 were obtained under rapid drawdown conditions based on a static H.W.L of Elev. 248± m. Therefore at this location the underlying silty sand layer encountered between Elev. 246.5 m and Elev. 245.5 m must be removed in order to maintain a desirable factor of safety of 1.4 for design side slopes of 2H:1V during storm events. For estimating purposes assume the silty sand layer to be removed extends across the entire width of the footprint of the embankment from Sta. 23+995 to the east limit of the east approach embankment of the Etobicoke Creek bridge.

Where earth fill embankments are higher than 8 m, mid-height berms should be incorporated in the design. The berms should:

- extend for the length through which the embankment height exceeds 8 m
- be at least 2 m wide
- have 2% positive drainage to shed run-off water.

Where rock fill embankments are higher than 10 m, mid-height berms should be incorporated in the design. The berms should:

- extend for the length through which the embankment height exceeds 10 m
- be at least 2 m wide

#### **6.2.4 Construction Considerations**

It is recommended that the topsoil, any deleterious material and soft/loose and other unsuitable soils be removed within an envelope given by an imaginary slope not steeper than 1H:1V from the toe of the proposed embankment. Based on the borehole data, the thickness of unsuitable soils to be stripped is variable but an average value of 0.7 m is recommended for estimating purposes.



After stripping, the exposed subgrade should be inspected, approved and properly compacted from the surface, using a suitably sized compactor. This should however be done at the discretion of the Quality Verification Engineer, as it may be infeasible to effect surface compaction due to the high water table at this site. If necessary, a high water table may necessitate some unwatering by pumping from open sumps in low-lying areas in order to achieve proper compaction of earth fill. In addition, the first one to two lifts of the fill may need to be thicker than normal (i.e., thicker than 300 mm lifts) in order to achieve compaction while maintaining trafficability of construction equipment.

Materials used for constructing the embankment can consist of either approved earth fill or rock fill. Earth fill should be placed in lifts not exceeding 300 mm before compaction and each lift should be uniformly compacted to at least 95 % of the material's Standard Proctor Maximum Dry Density (SPMDD). Embankment construction should be in accordance with OPSS 501 and OPSS 206, as amended by Special Provision "Amendment to OPSS 206, December 1993", dated November 2002.

If rock fill is used, the rock fill should be placed in lifts not exceeding 1.5 m. Rock fill should be compacted by overlapping track prints of the construction equipment. Depending on the size and type of equipment used, six to eight passes along each path may be required. The surface voids of each layer of rock fill should be filled with rock fragments before the next layer is placed. The final surface of the rock fill should be compacted by at least two additional passes and should be blinded by compacted fine fill material prior to installing the road sub base.

The groundwater table at this site is near the existing ground surface. This aspect should be taken into consideration when carrying out stripping and backfilling. If necessary, dewatering by gravity drainage and pumping from strategically positioned sumps may be required in order to facilitate construction operations. The design of the unwatering system should be the responsibility of the Contractor.

Proper erosion control measures should be implemented both during construction and permanently. Temporary erosion and sediment control must be provided in accordance with OPSS 577. Earth fill embankment slopes must be provided with permanent erosion protection in accordance with OPSS 571 and/or OPSS 572.

### **6.3 SITE 3: CUT SECTION WEST OF ETOBICOKE CREEK, STA. 24+175 TO 24+275**

#### **6.3.1 General**

The profile and cross-section drawings indicate that the design grade of the highway within this section will range from Elev. 254.5± m (Sta. 24+175) to Elev. 256.5± m (Sta. 24+275). The height of cut measured from ground surface to the design ditch elevation is estimated to range from 8± m at Sta. 24+175 to 6± m at Sta. 24+275.



The site is underlain by surficial layers of topsoil and firm clayey silt. These surficial deposits are further underlain by a major deposit of stiff to hard clayey silt till and very dense sand. The groundwater level is at approximately Elev. 256.4± m at Sta. 24+200 rising gradually to Elev. 259.6± m at Sta. 24+275.

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

### **6.3.2 Design Considerations**

Based on the design elevations shown on the cross-section drawings and the subsurface information it is envisaged that excavations will be made in the clayey silt till.

For the purpose of stability analyses, the commercially available slope stability program Slope W developed by Geo-Slope International Ltd. was used. The Bishop's simplified method for stability analysis was employed.

A design side slope of 2H:1V is proposed at this site. The geometry of selected cross-sections at Sta. 24+175, 24+200, 24+250 and 24+275 were analysed for global stability. Both undrained (short term) and drained (long term) stability analyses were conducted on the selected cross-sections.

Factors of safety against global failure of 1.4 and greater were obtained indicating stable 2H:1V side slopes of the selected cross-sections.

Where cut sections are higher than 6 m, mid-height berms should be incorporated in the design. The berms should:

- extend for the length through which the cut section height exceeds 6 m
- be at least 2 m wide
- have 2% positive drainage to shed run-off water.

### **6.3.3 Construction Considerations**

The piezometric data indicates that groundwater will be encountered during excavation. Groundwater seepage may have to be controlled especially if relatively pervious sand seams or layers are encountered within the clayey silt till.

The design of the unwatering system should be the responsibility of the Contractor. However, a suitable system that might be employed is a system of interceptor trenches and pumping from strategically located filtered sumps. Consideration can also be given to trenching around the perimeter of the excavation by completing the construction of the roadway ditches as soon as possible.

The excavated soils will most likely require moisture conditioning before they can be re-used as fill. Excavation and grading should be performed in accordance with OPSS 206.

Proper erosion control measures should be implemented both during construction and permanently. Temporary erosion and sediment control must be provided in accordance



with OPSS 577. Cut slopes must be provided with permanent erosion protection in accordance with OPSS 571 and/or OPSS 572.

*Rehman Abdul*

Engineering Analysis and Report Preparation by:  
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*Michael Tanos*

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



# APPENDICES

**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

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## 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
$\sigma$	kPa	TOTAL NORMAL STRESS
$\sigma'$	kPa	EFFECTIVE NORMAL STRESS
$\tau$	kPa	SHEAR STRESS
$\sigma_1, \sigma_2, \sigma_3$	kPa	PRINCIPAL STRESSES
$\epsilon$	%	LINEAR STRAIN
$\epsilon_1, \epsilon_2, \epsilon_3$	%	PRINCIPAL STRAINS
E	kPa	MODULUS OF LINEAR DEFORMATION
G	kPa	MODULUS OF SHEAR DEFORMATION
$\mu$	1	COEFFICIENT OF FRICTION

### MECHANICAL PROPERTIES OF SOIL

$m_v$	kPa <sup>-1</sup>	COEFFICIENT OF VOLUME CHANGE
$C_c$	1	COMPRESSION INDEX
$C_e$	1	SWELLING INDEX
$C_\alpha$	1	RATE OF SECONDARY CONSOLIDATION
$C_v$	m <sup>2</sup> /s	COEFFICIENT OF CONSOLIDATION
H	m	DRAINAGE PATH
$T_v$	1	TIME FACTOR
U	%	DEGREE OF CONSOLIDATION
$\sigma'_{vo}$	kPa	EFFECTIVE OVERBURDEN PRESSURE
$\sigma'_p$	kPa	PRECONSOLIDATION PRESSURE
$\tau_f$	kPa	SHEAR STRENGTH
$c'$	kPa	EFFECTIVE COHESION INTERCEPT
$\phi'$	- °	EFFECTIVE ANGLE OF INTERNAL FRICTION
$c_u$	kPa	APPARENT COHESION INTERCEPT
$\phi_u$	- °	APPARENT ANGLE OF INTERNAL FRICTION
$\tau_R$	kPa	RESIDUAL SHEAR STRENGTH
$\tau_r$	kPa	REMOULDED SHEAR STRENGTH
$S_r$	1	SENSITIVITY = $c_u / \tau_r$

## PHYSICAL PROPERTIES OF SOIL

$\rho_s$	kg/m <sup>3</sup>	DENSITY OF SOLID PARTICLES	$e$	1, %	VOID RATIO	$e_{min}$	1, %	VOID RATIO IN DENSEST STATE
$\gamma_s$	kN/m <sup>3</sup>	UNIT WEIGHT OF SOLID PARTICLES	$n$	1, %	POROSITY	$I_D$	1	DENSITY INDEX = $\frac{e_{max} - e}{e_{max} - e_{min}}$
$\rho_w$	kg/m <sup>3</sup>	DENSITY OF WATER				D	mm	GRAIN DIAMETER
$\gamma_w$	kN/m <sup>3</sup>	UNIT WEIGHT OF WATER	w	1, %	WATER CONTENT	$D_n$	mm	n PERCENT - DIAMETER
$\rho$	kg/m <sup>3</sup>	DENSITY OF SOIL	$S_r$	%	DEGREE OF SATURATION	$C_u$	1	UNIFORMITY COEFFICIENT
$\gamma$	kN/m <sup>3</sup>	UNIT WEIGHT OF SOIL	$w_L$	%	LIQUID LIMIT	h	m	HYDRAULIC HEAD OR POTENTIAL
$\rho_d$	kg/m <sup>3</sup>	DENSITY OF DRY SOIL	$w_p$	%	PLASTIC LIMIT	q	m <sup>2</sup> /s	RATE OF DISCHARGE
$\gamma_d$	kN/m <sup>3</sup>	UNIT WEIGHT OF DRY SOIL	$w_s$	%	SHRINKAGE LIMIT	v	m/s	DISCHARGE VELOCITY
$\rho_{sat}$	kg/m <sup>3</sup>	DENSITY OF SATURATED SOIL	$I_p$	%	PLASTICITY INDEX = $(w_L - w_p)$	i	1	HYDRAULIC GRADIENT
$\gamma_{sat}$	kN/m <sup>3</sup>	UNIT WEIGHT OF SATURATED SOIL	$I_L$	1	LIQUIDITY INDEX = $(w - w_p)/I_p$	k	m/s	HYDRAULIC CONDUCTIVITY
$\rho'$	kg/m <sup>3</sup>	DENSITY OF SUBMERGED SOIL	$I_c$	1	CONSISTENCY INDEX = $(w_L - w)/I_p$	j	kN/m <sup>2</sup>	SEEPAGE FORCE
$\gamma'$	kN/m <sup>3</sup>	UNIT WEIGHT OF SUBMERGED SOIL	$e_{max}$	1, %	VOID RATIO IN LOOSEST STATE			

# **SITE 1**

# **APPENDIX A 1**

**Record of Borehole Sheets**

**Terraprobe Limited**



# RECORD OF BOREHOLE No 23+650 LT OF CL 1 OF 1 METRIC

W.P. 105-00-00 LOCATION Coords: N:4845399.0 E:279151.1 (SITE 1) ORIGINATED BY MS  
 DIST HWY 410 Phase III BOREHOLE TYPE Solid Stem Augers COMPILED BY DB  
 DATUM Geodetic DATE 07.01.05 CHECKED BY RA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT   NATURAL MOISTURE CONTENT   LIQUID LIMIT			UNIT WEIGHT  γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa							WATER CONTENT (%)			
								○ UNCONFINED      + FIELD VANE ● QUICK TRIAXIAL    × LAB VANE							W <sub>p</sub>	W	W <sub>L</sub>	
263.3	Ground Surface						20	40	60	80	100	10	20	30	GR	SA	SI	CL
0.0	200mm TOPSOIL																	
0.2	firm, weathered above 0.7m		1	SS	5		263											
	CLAYEY SILT some sand, trace gravel, occasional silty fine sand partings and pockets damp, very stiff to hard, brown  (GLACIAL TILL)		2	SS	22		262											
			3	SS	23		261											1 19 55 25
			4	SS	46		260											
			5	SS	28		259											
			6	SS	24		258											
	grey below 5.6m		7	SS	45		257											
256.7	End of Borehole																	
6.6	* Water level at 6.5m (not stabilized) and hole open to full depth on completion.																	

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

RECORD OF BOREHOLE No 23+650 RT OF CL 1 OF 1 METRIC

W.P. 105-00-00 LOCATION Coords: N:4845440.5 E:279123.2 (SITE 1) ORIGINATED BY MS  
DIST HWY 410 Phase III BOREHOLE TYPE Solid Stem Augers COMPILED BY DB  
DATUM Geodetic DATE 07.01.05 CHECKED BY RA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa										WATER CONTENT (%)
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE										
261.8	Ground Surface					*												
0.0	200mm TOPSOIL																	
0.2	weathered above 0.7m		1	SS	11													
	CLAYEY SILT - Sandy, trace gravel, occasional silty fine sand partings and pockets damp, brown  (GLACIAL TILL)		2	SS	9													
			3	SS	10													
			4	SS	21													
	stiff to very stiff		5	SS	31													
	hard																	
			6	SS	43													
	grey below 5.6m																	
			7	SS	37													
255.2	End of Borehole																	
6.6	* Borehole was dry (not stabilized) and hole open to full depth on completion.																	

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

# RECORD OF BOREHOLE No 23+700 CL

1 OF 1

METRIC

W.P. 105-00-00 LOCATION Coords: N:4845392.1 E:279095.5 (SITE 1) ORIGINATED BY MS  
DIST HWY 410 Phase III BOREHOLE TYPE Solid Stem Augers COMPILED BY DB  
DATUM Geodetic DATE 07.01.05 CHECKED BY RA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa							WATER CONTENT (%)
								○ UNCONFINED ● QUICK TRIAXIAL	+ FIELD VANE × LAB VANE						
264.3	Ground Surface							20 40 60 80 100							
0.0	200mm TOPSOIL						264								
0.2	CLAYEY SILT trace sand, trace gravel, damp, soft, brown		1	SS	4										
263.6															
0.7	CLAYEY SILT - Sandy, trace gravel, occasional silty fine sand partings and pockets, very stiff to hard, brown  (GLACIAL TILL)		2	SS	19		263								
			3	SS	26										
			4	SS	31		262								
			5	SS	29		261							3 25 49 23	
			6	SS	40		260								
	100mm thick sand seam at 4.9m						259								
	grey below 5.6m		7	SS	51		258								
257.2							257							10 42 39 9	
7.1	SAND AND SILT trace gravel, trace clay, damp, very dense, grey  (GLACIAL TILL)		8	SS	50/ 15cm		256								
255.0			9	SS	50/ 15cm										
9.3	End of Borehole														
	* Water level at 4.6m (not stabilized) and hole open to 7.6m on completion.														

ONTARIO MOT 1-00-0350 HWY 410.GPJ ONTARIO MOT.GDT 31/10/05

# RECORD OF BOREHOLE No 23+750 LT OF CL 1 OF 1 METRIC

W.P. 105-00-00 LOCATION Coords: N:4845343.8 E:279067.2 (SITE 1) ORIGINATED BY MS  
 DIST HWY 410 Phase III BOREHOLE TYPE Solid Stem Augers COMPILED BY DB  
 DATUM Geodetic DATE 10.01.05 CHECKED BY RA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT   NATURAL MOISTURE CONTENT   LIQUID LIMIT			UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR   SA   SI   CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa		WATER CONTENT (%)					
								20   40   60   80   100	w <sub>p</sub> w   w <sub>L</sub>						
						○ UNCONFINED   + FIELD VANE ● QUICK TRIAXIAL   × LAB VANE									
265.3	Ground Surface														
0.0	SANDY TOPSOIL with rootlets, moist, loose, dark brown		1	SS	8										
264.6															
0.7	CLAYEY SILT some sand, trace gravel, occasional silty fine sand partings and pockets, very stiff to hard, brown  (GLACIAL TILL)		2	SS	25										
			3	SS	29										
			4	SS	30										
			5	SS	29										
			6	SS	28										
	**** grey below 5.6m		7	SS	15										
			8	SS	51										
256.7			9	SS	50/ 10cm										
8.6	SAND AND SILT trace gravel, trace clay, damp, very dense, grey  (GLACIAL TILL)		10	SS	50/ 13cm										
			11	SS	50/ 15cm										
252.3	CLAYEY SILT trace to some sand, trace gravel, damp, hard, grey  (GLACIAL TILL)		12	SS	43										
13.0															
251.1	End of Borehole														
14.2	* Borehole dry (not stabilized) and hole open to full depth on completion.														

ONTARIO MOT 1-00-0350 HWY410.GPJ ONTARIO MOT.GDT 31/10/05

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

# RECORD OF BOREHOLE No 23+750 RT OF CL

1 OF 1

METRIC

W.P. 105-00-00 LOCATION Coords: N:4845385.88 E:279040.1 (SITE 1) ORIGINATED BY MS  
DIST HWY 410 Phase III BOREHOLE TYPE Solid Stem Augers COMPILED BY DB  
DATUM Geodetic DATE 10.01.05 CHECKED BY RA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)  GR SA SI CL			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa								WATER CONTENT (%)		
264.5	Ground Surface							20 40 60 80 100										
0.0	200mm TOPSOIL					*	264											
0.2	CLAYEY SILT		1	SS	6													
263.8	trace to some sand, trace gravel, firm																	
0.7			2	SS	8													
	weathered above 1.4m							263										
	CLAYEY SILT - Sandy, trace gravel, occasional silty fine sand partings and pockets, firm to 1.4m, very stiff to hard below, brown		3	SS	22													
	(GLACIAL TILL)		4	SS	25			262										
			5	SS	26									22.5				
								261										
	grey below 4.0m		6	SS	36			260										
								259										
			7	SS	36			258							4 39 38 19			
257.4																		
7.1	SAND AND SILT		8	SS	50/ 15cm		257											
	trace gravel, trace clay, damp, very dense, grey						256											
	(GLACIAL TILL)		9	SS	50/ 15cm		255											
							254											
	some clay		10	SS	84**		253							**Sampler wet				
252.8																		
11.7	CLAYEY SILT		11	SS	57		252							1 43 43 13				
	and sand, trace gravel, damp, hard, grey						251											
	(GLACIAL TILL)		12	SS	56													
250.3																		
14.2	End of Borehole																	
	* Borehole dry (not stabilized) and hole open to full depth on completion.																	

ONTARIO MOT 1-00-0350 HWY410.GPJ ONTARIO MOT.GDT 31/10/05

+ 3, × 3: Numbers refer to  
Sensitivity

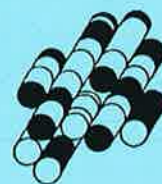
○ 3% STRAIN AT FAILURE

# **SITE 1**

# **APPENDIX B 1**

**Laboratory Test Results**

**Terraprobe Limited**

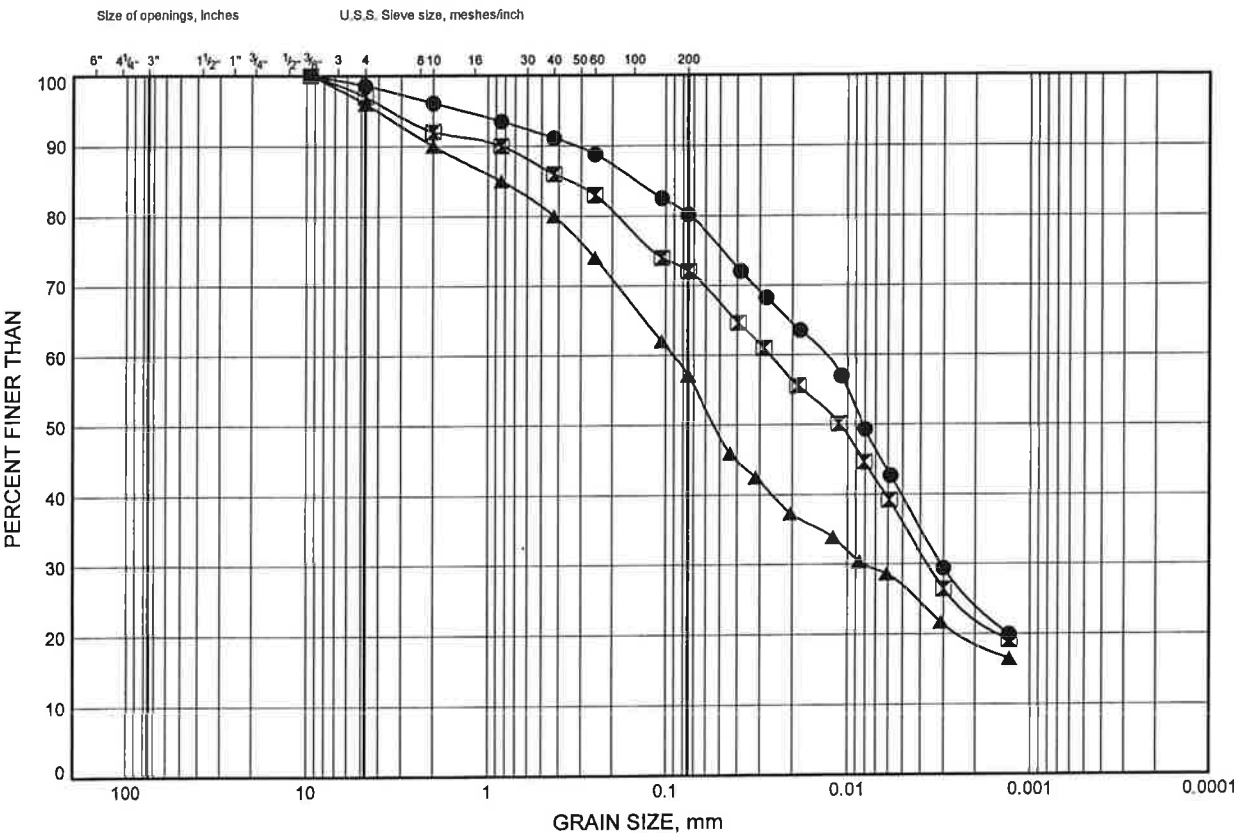




# GRAIN SIZE DISTRIBUTION

FIGURE B1-1

## Upper Clayey Silt Till



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

SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	23+650 LT OF CL	1.7	261.6
◻	23+700 CL	3.2	261.1
▲	23+750 RT OF CL	6.3	258.2

GSD 1-00-0350 HWY410.GPJ 03/11/05

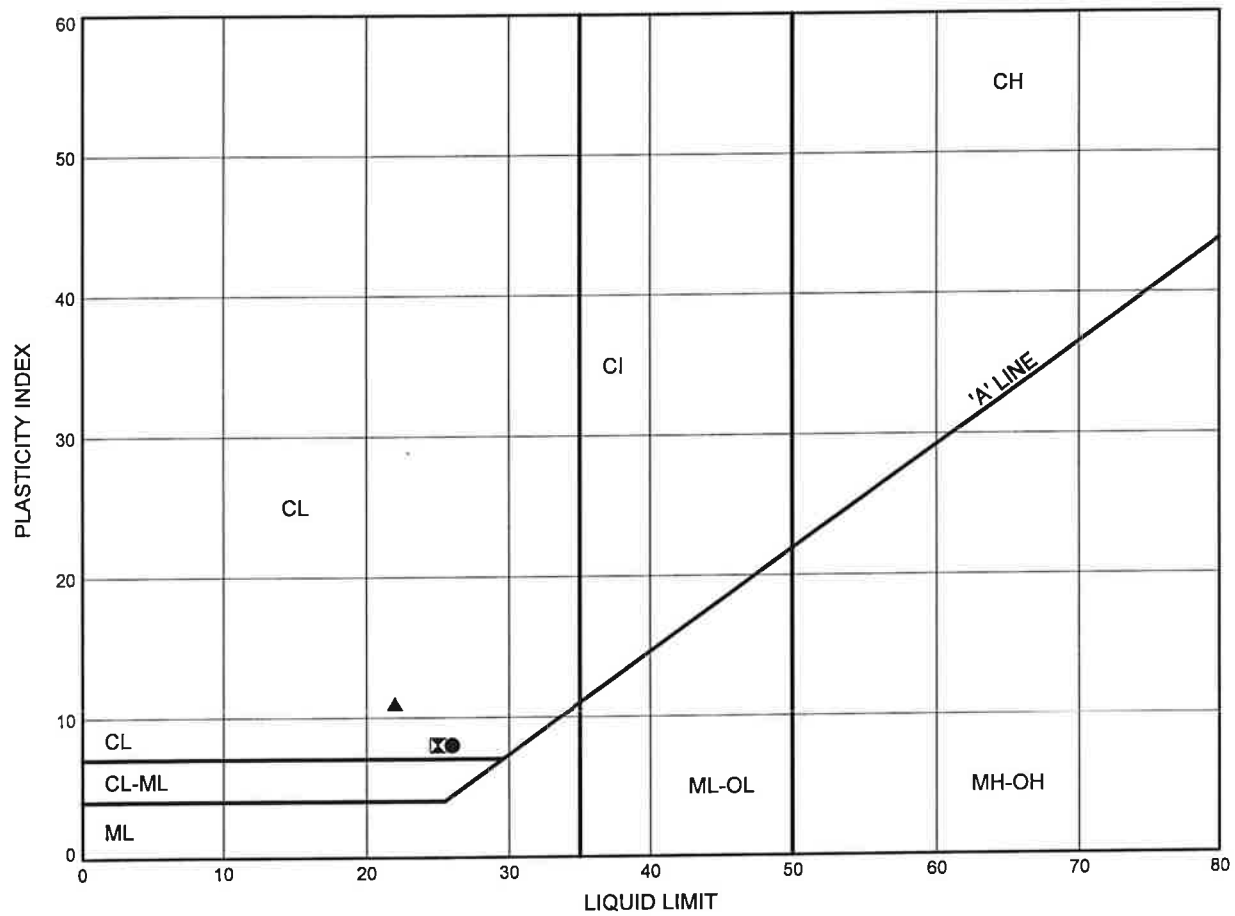
Date November 2005  
Project 105-00-00



Prep'd DB  
Chkd. RA

# 

FIGURE B1-2



SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	23+650 LT OF CL	1.7	261.6
⊠	23+700 CL	3.2	261.1
▲	23+750 RT OF CL	6.3	258.2

Date November 2005

Project 105-00-00



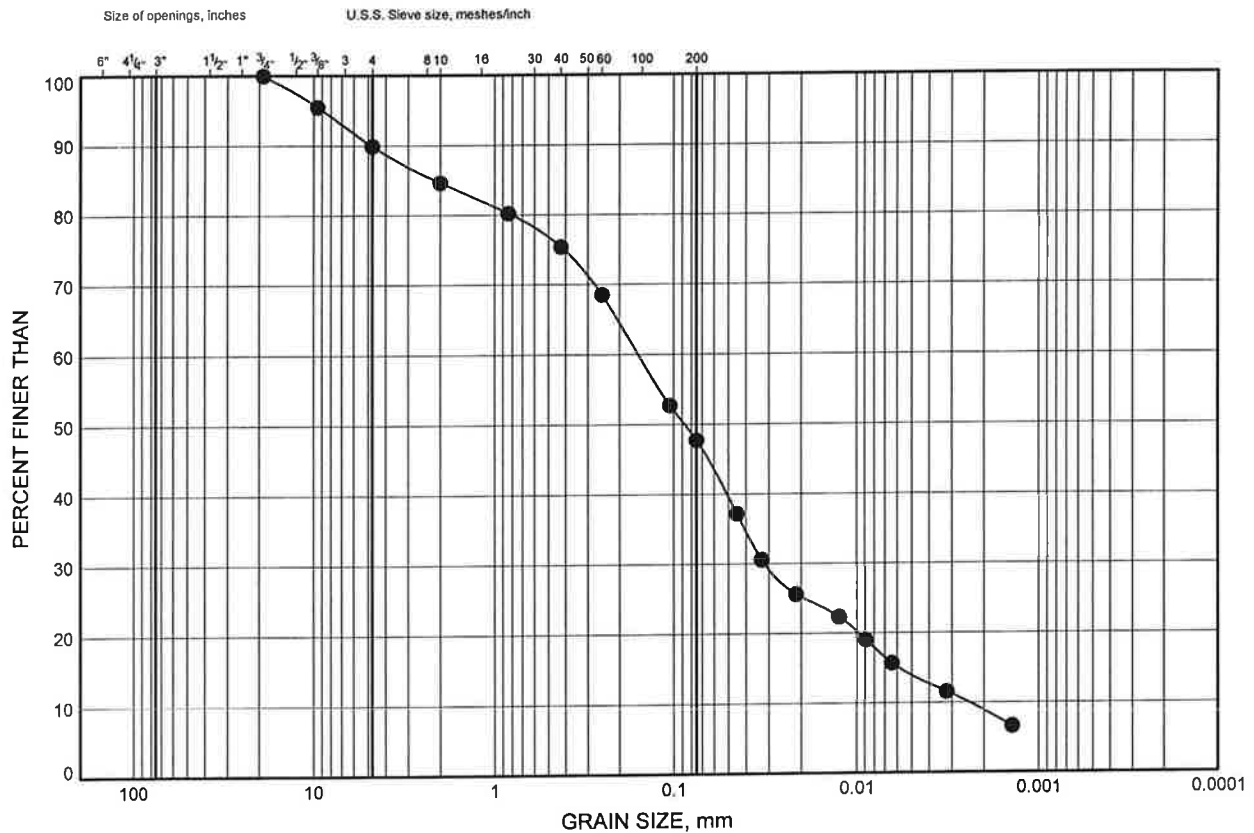
Prep'd DB

Chkd. RA

# GRAIN SIZE DISTRIBUTION

FIGURE B1-3

## Sand and Silt Till



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

SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	23+700 CL	7.8	256.6

Date November 2005  
Project 105-00-00

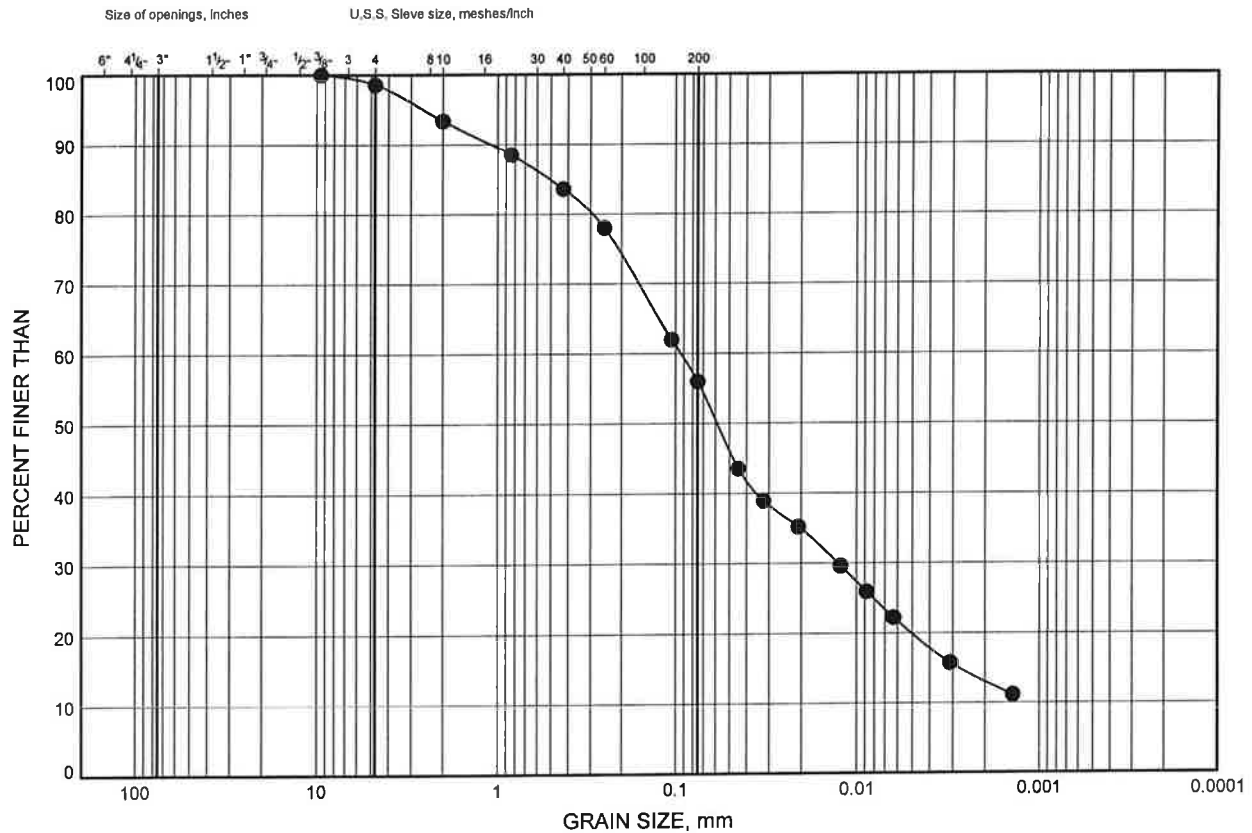


Prep'd DB  
Chkd. RA

# GRAIN SIZE DISTRIBUTION

FIGURE B1-4

## Lower Clayey Silt Till



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

SYMBOL   BOREHOLE   DEPTH (m)   ELEVATION (m)

●   23+750 RT OF CL   12.3   252.2

Date November 2005  
Project 105-00-00



Prep'd DB  
Chkd. RA

# **SITE 1**

# **APPENDIX C 1**

**Borehole Locations and  
Stratigraphic Sections**

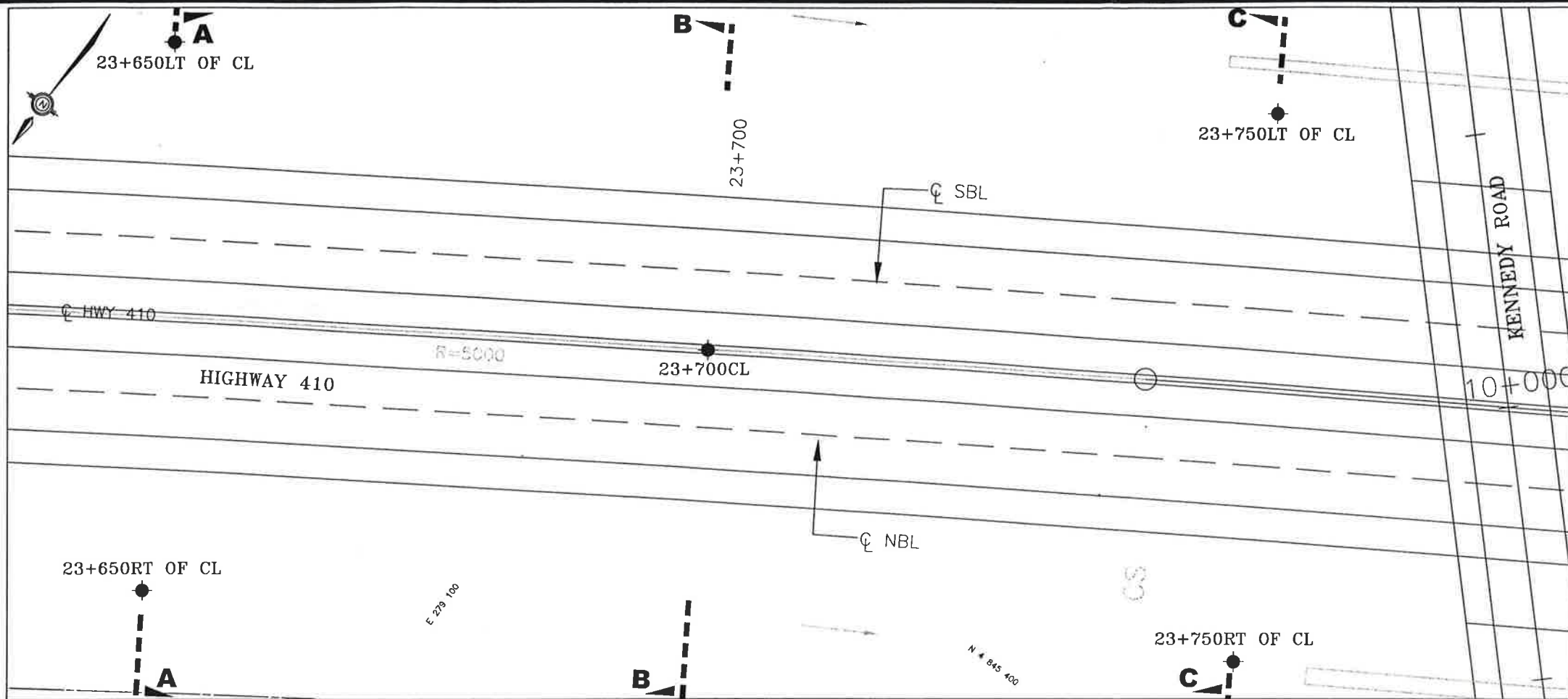
**Terraprobe Limited**



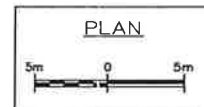








METRIC  
DIMENSIONS ARE IN METRES  
AND/OR MILLIMETERS  
UNLESS OTHERWISE SHOWN



CONT No  
WP No105-00-00

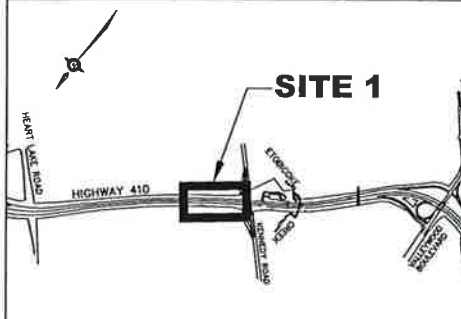
HIGHWAY 410 PHASE III  
BOREHOLE LOCATIONS  
AND SOIL STRATIGRAPHY  
SITE 1 (SBL PROFILE)  
Sta 23+650 TO Sta. 23+750



SHEET  
20F3

**Giffels**  
An Ingenium Group Company

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



KEY PLAN

LEGEND

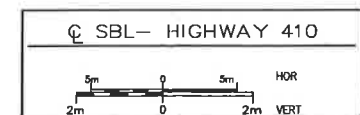
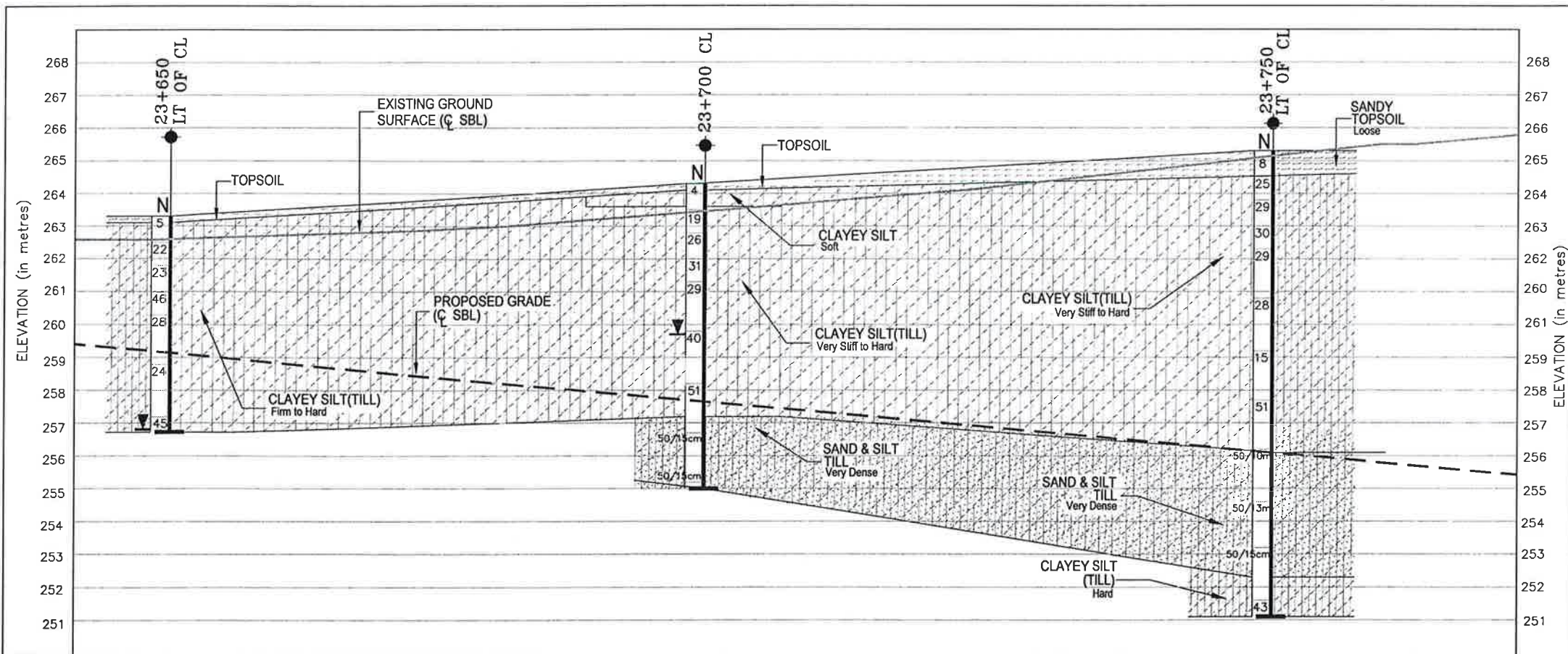
- Bore Hole
- ⊕ Dynamic Cone Penetration Test
- ⊙ Bore Hole And Cone
- 'N' Blows/0.3m (Std Pen Test, 475 J/blow)
- CONE Blows/0.3m (60° Cone, 475 J/blow)
- WL at Time of Investigation
- WL in Piezometer 2005, 05
- Piezometer
- 90% Rock Quality Designation
- A/R Auger Refusal

No	ELEVATION	COORDINATES	
		NORTHING	EASTING
23+650 LT	263.3	4845399.0	279151.1
23+650 RT	261.8	4845440.5	279123.2
23+700 CL	264.3	4845392.1	279095.5
23+750 LT	265.3	4845343.8	279067.2
23+750 RT	264.5	4845385.8	279040.1

NOTE

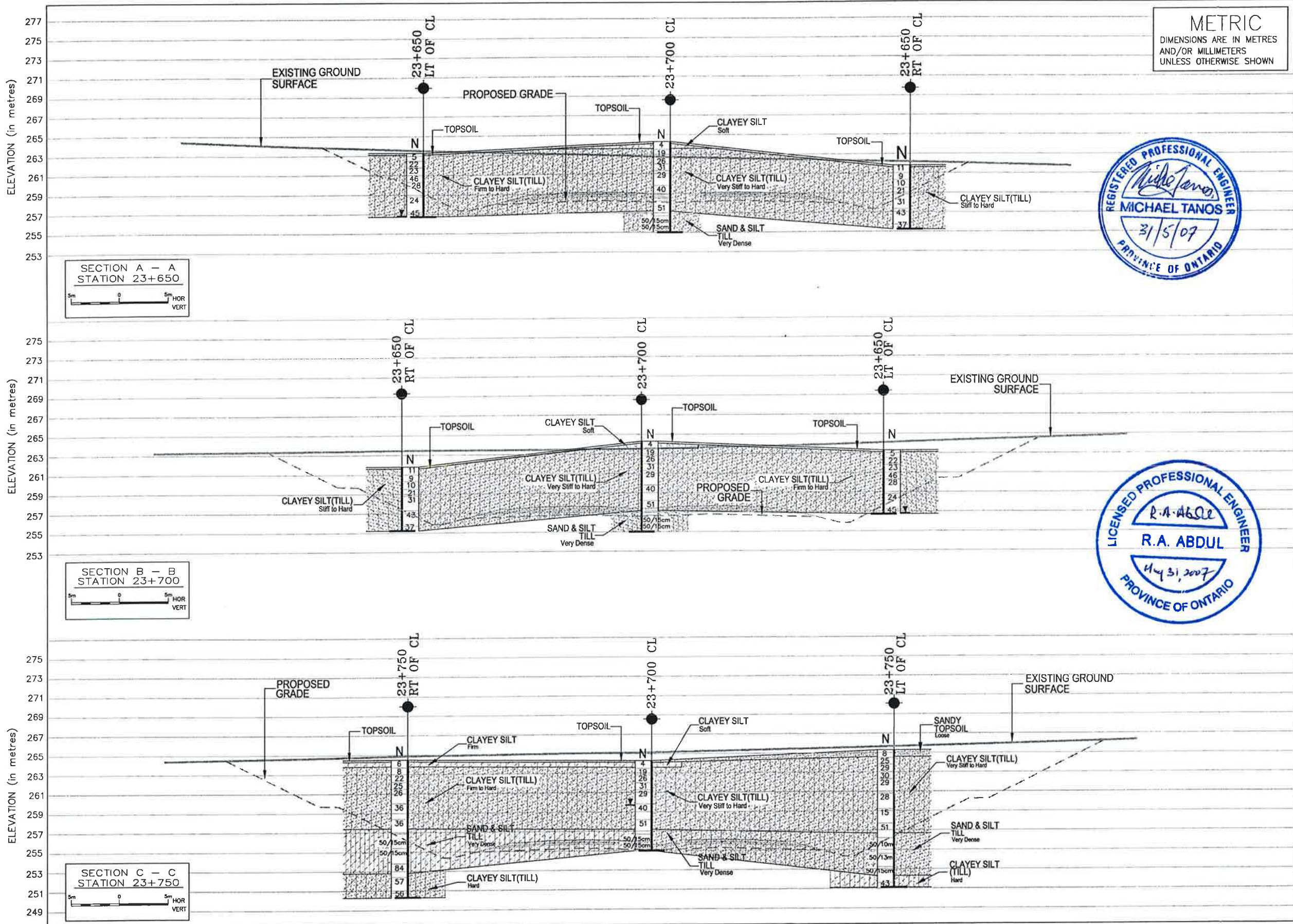
The boundaries between soil strata have been established only at Bore Hole locations. Between Bore holes the boundaries are assumed from geological evidence.

REVISIONS	DATE	BY	DESCRIPTION
DESIGN R.A.	CODE	CHBDC2000	LOAD
DRAWN P.S.	CHK R.A.	SITE	STRUCT
			SCHEME
			DWG 2



DRAWING NOT TO BE SCALED  
100mm ON ORIGINAL DRAWING





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



CONT No  
WP No 105-00-00

HIGHWAY 410 PHASE III  
BOREHOLE LOCATIONS  
AND SOIL STRATIGRAPHY  
SITE 1 (CROSS-SECTIONS)  
Sta. 23+650 TO Sta. 23+750

**Giffels**  
An Ingenium Group Company

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

KEY PLAN

LEGEND

Bore Hole

Dynamic Cone Penetration Test

Bore Hole And Cone

Blows/0.3m (Std Pen Test, 475 J/blow)

Blows/0.3m (60' Cone, 475 J/blow)

WL at Time of Investigation

WL in Piezometer 2005, 05

Piezometer

Rock Quality Designation

Auger Refusal

No	ELEVATION	COORDINATES	
		NORTHING	EASTING
23+650 LT	263.3	4845399.0	279151.1
23+650 RT	261.8	4845440.5	279123.2
23+700 CL	264.3	4845392.1	279095.5
23+750 LT	265.3	4845343.8	279067.2
23+750 RT	264.5	4845385.8	279040.1

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	NOV. 2005
DRAWN	P.S.	CHK	R.A.	SITE	STRUCT	SCHEME
				DWG	2	



# **SITE 2**

# **APPENDIX A 2**

**Record of Borehole Sheets**

**Terraprobe Limited**



RECORD OF BOREHOLE No 23+875 LT OF CL 1 OF 1 METRIC

W.P. 105-00-00 LOCATION Coords: N:4845280.0 E:278959.4 (SITE 2) ORIGINATED BY MS  
DIST HWY 410 Phase III BOREHOLE TYPE Solid Stem Augers COMPILED BY DB  
DATUM Geodetic DATE 11.01.05 CHECKED BY RA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				UNIT WEIGHT  $\gamma$  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					
								20 40 60 80 100		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			
250.2	Ground Surface												
0.0 249.8	300mm TOPSOIL												
0.3	SAND AND GRAVEL some silt, trace clay, trace organics, damp, compact, brown		1	SS	32*								
			2	SS	18								37 43 14 6
248.8	SAND AND SILT some gravel, trace clay, damp to moist, compact to 2.1m, dense to very dense below, brown  (GLACIAL TILL)		3	SS	28								
1.4			4	SS	42								
			5	SS	66								16 39 37 8
			6	SS	90/ 25cm								
	**** grey below 4.0m												
243.6			7	SS	49								
6.6	End of Borehole												
	Piezometer installation consists of 19mm diameter schedule 40 PVC pipe with a 1.52m slotted screen.												
	Water Level Readings:												
	Date      Depth(m)      Elev.(m)												
	Feb.01.05      1.1      249.1												
	Apr.18.05      0.7      249.5												
	May.17.05      1.0      249.2												
	* Cobble in tip of sampler.												

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

# RECORD OF BOREHOLE No 23+875 RT OF CL

1 OF 1

METRIC

W.P. 105-00-00 LOCATION Coords: N:4845315.5 E:278936.9 (SITE 2) ORIGINATED BY MS  
DIST HWY 410 Phase III BOREHOLE TYPE Solid Stem Augers COMPILED BY DB  
DATUM Geodetic DATE 11.01.05 CHECKED BY RA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					
								WATER CONTENT (%)					
251.0	Ground Surface												
0.0	400mm TOPSOIL - Sandy, trace rootlets, loose		1	SS	6								
250.6													
0.4	GRAVEL AND SAND some silt, trace clay, wet, compact, brown		2	SS	14								
			3	SS	22								
248.9													
2.1	SAND AND SILT trace gravel, trace clay, damp, very dense, brown  (GLACIAL TILL)		4	SS	39								
			5	SS	82/ 25cm								
247.0													
4.0	CLAYEY SILT trace to some sand, trace gravel, damp, hard, grey  (GLACIAL TILL)		6	SS	39								
244.4			7	SS	33							22.9	
6.6	End of Borehole												
	Piezometer installation consists of 19mm diameter schedule 40 PVC pipe with a 1.52m slotted screen.												
	Water Level Readings:												
	Date      Depth(m)      Elev.(m)												
	Feb.01.05      1.1      249.9												
	Apr.18.05      0.6      250.4												
	May.17.05      1.2      249.8												

+ 3, X 3: Numbers refer to  
Sensitivity

○ 3% STRAIN AT FAILURE

RECORD OF BOREHOLE No 23+920 CL

1 OF 1

METRIC

W.P. 105-00-00 LOCATION Coords: N:4845273.6 E:278910.2 (SITE 2) ORIGINATED BY MS  
DIST HWY 410 Phase III BOREHOLE TYPE Solid Stem Augers COMPILED BY DB  
DATUM Geodetic DATE 12.01.05 CHECKED BY RA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
249.2	Ground Surface							20 40 60 80 100						
0.0	400mm TOPSOIL		1	SS	22		249							
248.8														
0.4	SANDY SILT trace gravel, trace clay, moist, compact, brown  (GLACIAL TILL)		2	SS	21		248							
			3	SS	29									5 20 68 7
247.1							247							
2.1	CLAYEY SILT some sand to sandy, trace gravel, damp to moist, grey, very stiff to hard  (GLACIAL TILL)		4	SS	27									
			5	SS	37		246							
245.2														
4.0	SILTY SAND trace gravel, trace clay, wet, compact, grey  (GLACIAL TILL)		6	SS	20		245							7 53 34 6
							244							
242.6			7	SS	17		243							
6.6	End of Borehole													
	Piezometer installation consists of 19mm diameter schedule 40 PVC pipe with a 1.52m slotted screen.  Water Level Readings:  Date      Depth(m)    Elev.(m)  Feb.01.05    0.6      248.6 Apr.18.05    0.9      248.3 May.17.05    1.2      248.0													

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

RECORD OF BOREHOLE No 23+975 RT OF CL 1 OF 1 METRIC

W.P. 105-00-00 LOCATION Coords: N:4845269.5 E:278846.2 (SITE 2) ORIGINATED BY MS  
DIST HWY 410 Phase III BOREHOLE TYPE Solid Stem Augers COMPILED BY DB  
DATUM Geodetic DATE 12.01.05 CHECKED BY RA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									WATER CONTENT (%)		
								20 40 60 80 100									10 20 30		

249.0	Ground Surface															
0.0	500mm TOPSOIL - Sandy, compact		1	SS	15											
248.5																
0.5	GRAVEL AND SAND some silt, trace clay, moist, compact, brown		2	SS	19											42 39 14 5
247.6																
1.4	CLAYEY SILT - Sandy, some gravel, moist, very stiff, brown (GLACIAL TILL)		3	SS	28											14 42 34 10
246.9																
2.1	trace clay to 2.9m		4	SS	21											
	SAND AND SILT trace gravel, wet, compact to dense, grey (POSSIBLE TILL)		5	SS	36											
			6	SS	20											
			7	SS	43											
241.9																
7.1	CLAYEY SILT trace sand, damp, hard, grey (GLACIAL TILL)		8	SS	78											0 1 85 14
240.9																
8.1	End of Borehole															
	Piezometer installation consists of 19mm diameter schedule 40 PVC pipe with a 1.52m slotted screen.															
	Water Level Readings:															
	Date      Depth(m)      Elev.(m)															
	Feb.01.05      1.7      247.3															
	Apr.18.05      0.9      248.1															
	May.17.05      1.2      247.8															

ONTARIO MOT 1-00-0350 HWY410.GPJ ONTARIO MOT.GDT 08/12/05

# RECORD OF BOREHOLE No EC-6

1 OF 1

METRIC

W.P. 105-00-00 LOCATION Coords: N:4845231.7 E:278854.4 (Etobicoke Creek) ORIGINATED BY MS  
DIST HWY 410 Phase III 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			PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)  GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa								WATER CONTENT (%)
								○ UNCONFINED	+ FIELD VANE	● QUICK TRIAXIAL						
247.6	Ground Surface						20	40	60	80	100					
0.0	150mm TOPSOIL						20	40	60	80	100					
0.2	CLAYEY SILT - Sandy, trace gravel, trace rootlets, moist, brown, soft to 0.7m, very stiff below		1	SS	3											
	(GLACIAL TILL)		2	SS	17											
246.2			3	SS	21											
1.4	SAND AND SILT trace gravel, trace clay, moist to wet, compact to dense, grey (GLACIAL TILL)		4	SS	19											
			5	SS	45											
			6	SS	10											
			7	SS	16											
			8	SS	19											
			9	SS	46											

ONTARIO MOT 1-00-0350 HWY 410 ETOBICOKE CREEK GPJ ONTARIO MOT. GDT 28/07/05

# RECORD OF BOREHOLE No 24+000 LT OF CL

1 OF 1

METRIC

W.P. 105-00-00 LOCATION Coords: N:4845212.3 E:278855.3 (SITE 2) ORIGINATED BY MS  
DIST HWY 410 Phase III BOREHOLE TYPE Solid Stem Augers COMPILED BY DB  
DATUM Geodetic DATE 12.01.05 CHECKED BY RA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT  γ  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)  GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa								
								20 40 60 80 100								
								20 40 60 80 100								
246.9	Ground Surface															
0.0	400mm TOPSOIL		1	SS	8											
246.5																
0.4	SILTY SAND damp, loose to compact, brown		2	SS	21											
245.5																
1.4	SAND AND SILT trace gravel, moist to wet, dense to very dense, grey  (GLACIAL TILL)		3	SS	34											
			4	SS	43											
			5	SS	58											
			6	SS	29											
			7	SS	34											
			8	SS	25											
238.8																
8.1	End of Borehole															
	Piezometer installation consists of 19mm diameter schedule 40 PVC pipe with a 1.52m slotted screen.															
	Water Level Readings:															
	Date      Depth(m)      Elev.(m)															
	Feb.01.05      0.9      246.0															
	Apr.18.05      0.0      246.9															
	May.17.05      0.8      246.1															

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

# **SITE 2**

# **APPENDIX B 2**

**Laboratory Test Results**

**Terraprobe Limited**

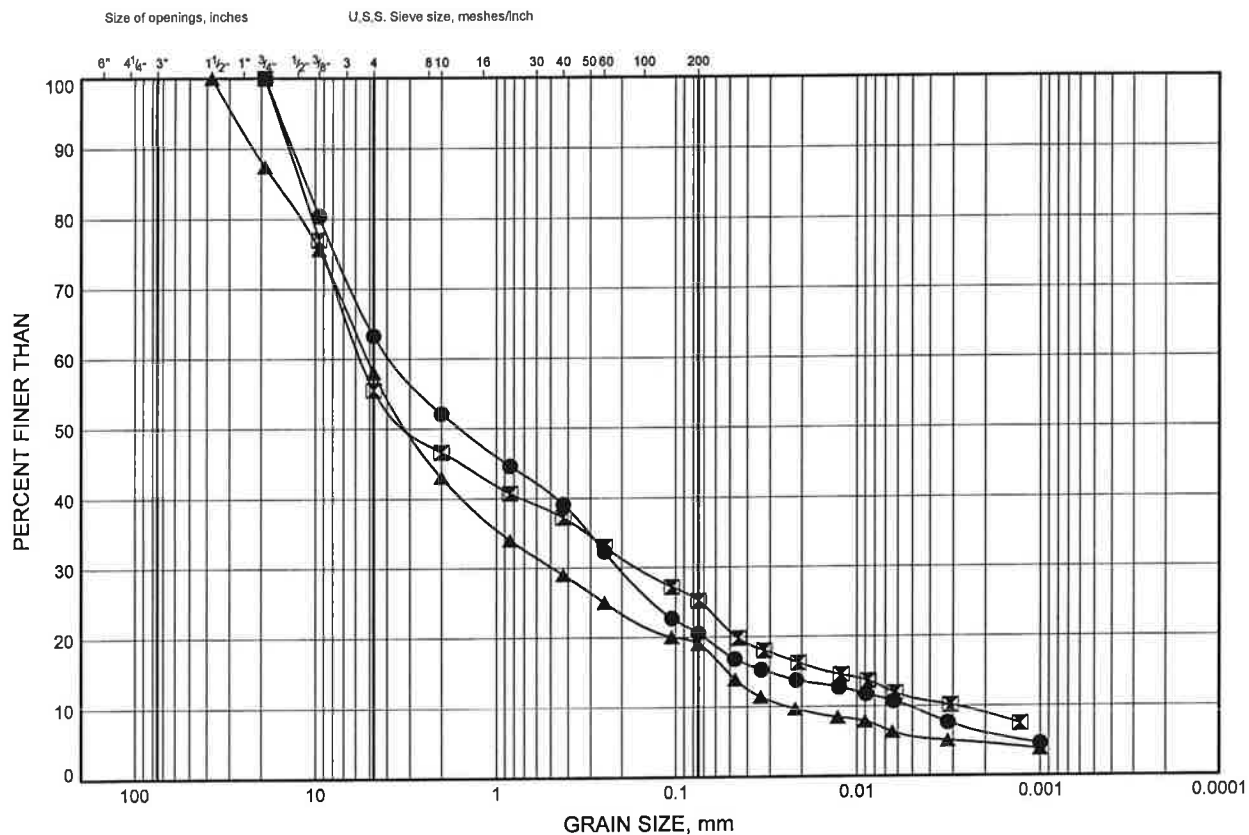




# GRAIN SIZE DISTRIBUTION

FIGURE B2-1

## Gravel and Sand



SYMBOL BOREHOLE DEPTH (m) ELEVATION (m)

● 23+875 LT OF CL 1.0 249.2  
 □ 23+875 RT OF CL 1.0 250.0  
 ▲ 23+975 RT OF CL 1.0 248.0

Date November 2005  
 Project 105-00-00

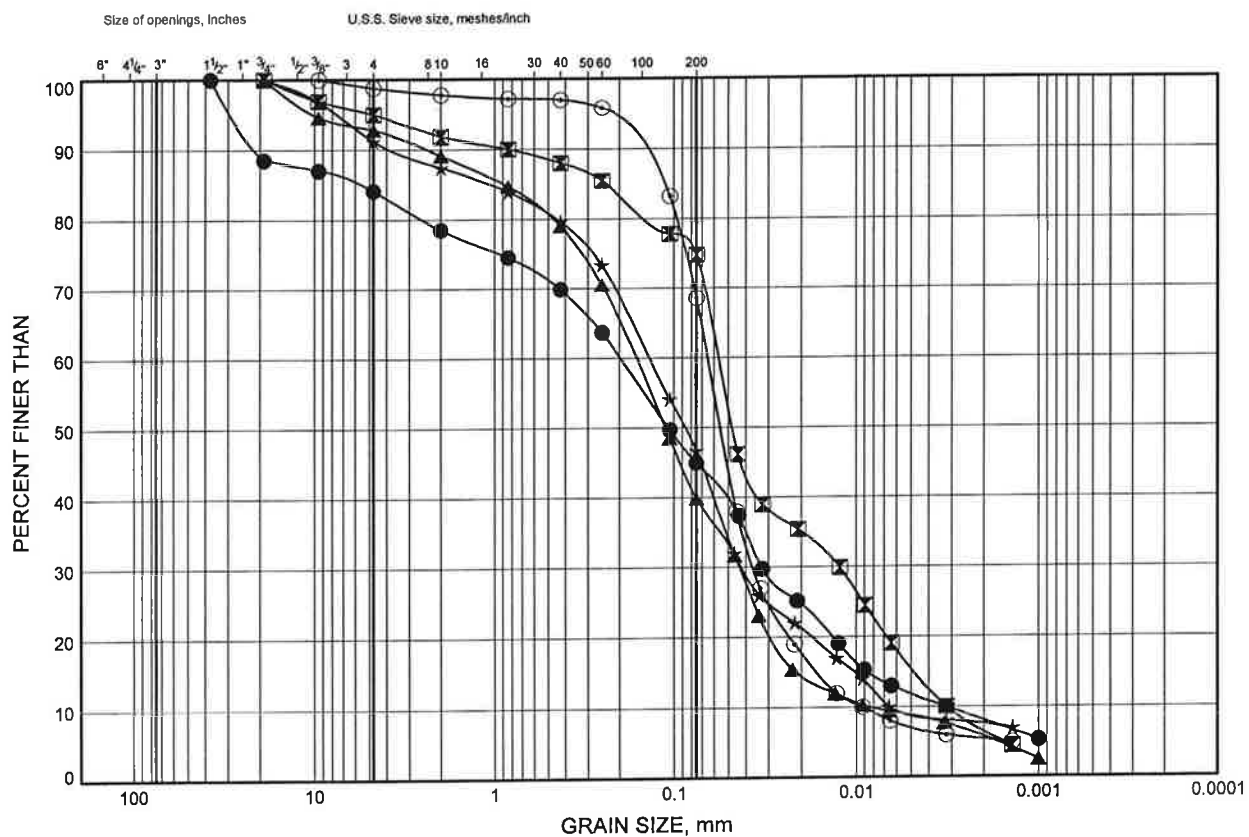


Prep'd DB  
 Chkd. RA

# GRAIN SIZE DISTRIBUTION

FIGURE B2-2

## Sand and Silt Till



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

SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	23+875 LT OF CL	3.2	247.0
⊠	23+920 CL	1.7	247.5
▲	23+920 CL	4.7	244.5
★	EC-6	3.2	244.4
⊙	EC-6	7.8	239.8

Date November 2005  
Project 105-00-00

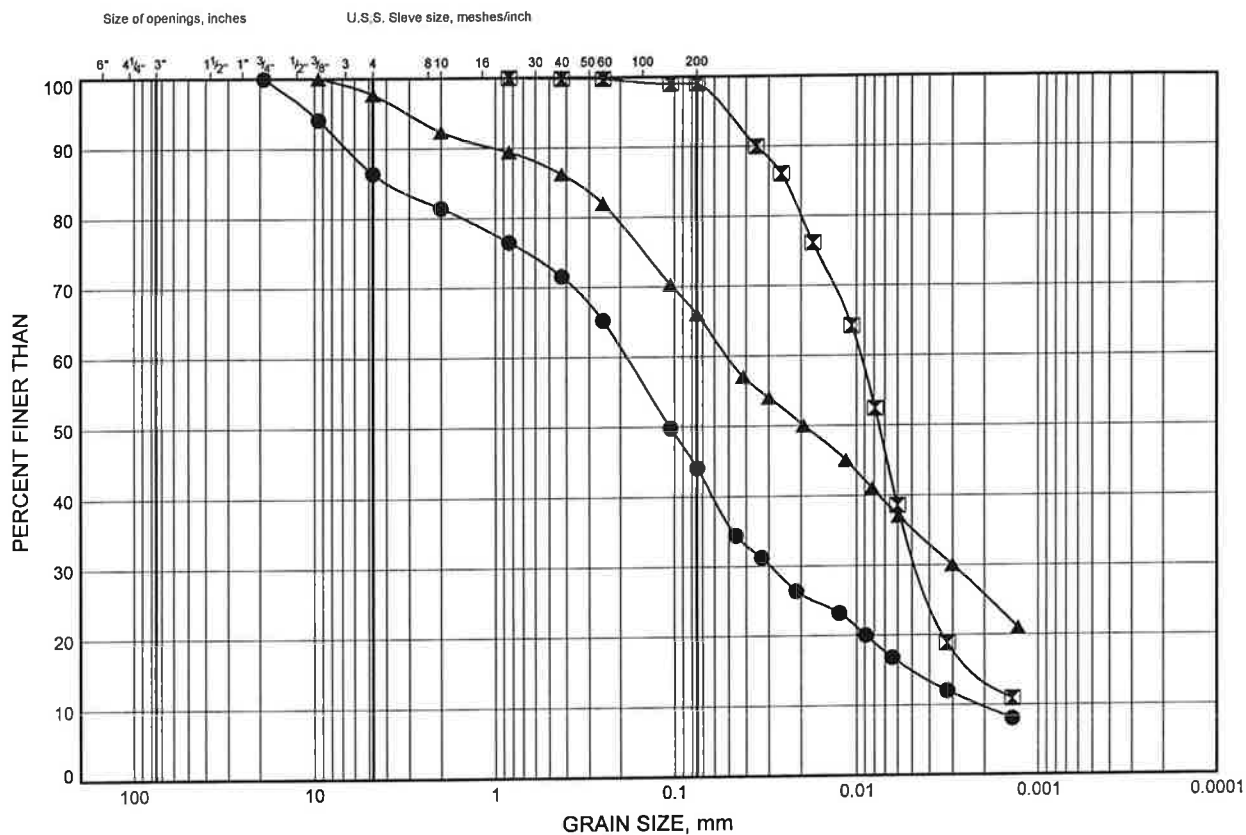


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Chkd. RA

# GRAIN SIZE DISTRIBUTION

FIGURE B2-3

## Clayey Silt Till



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

SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	23+975 RT OF CL	1.7	247.3
◻	23+975 RT OF CL	7.8	241.2
▲	EC-6	1.0	246.6

Date November 2005

Project 105-00-00



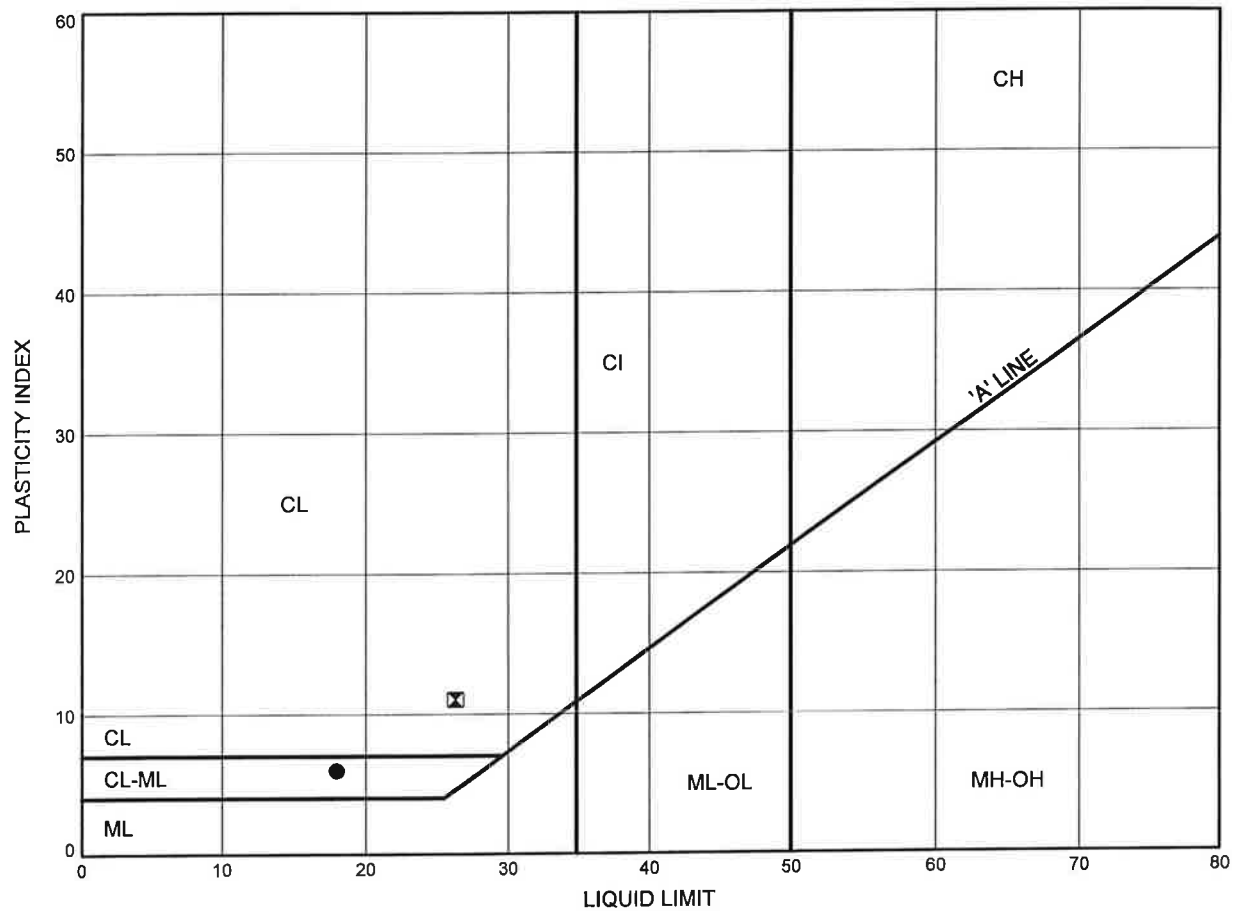
Prep'd DB

Chkd. RA

# ATTERBERG LIMITS TEST RESULTS

FIGURE B2-4

## Clayey Silt Till



SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	23+975 RT OF CL	1.7	247.3
⊠	EC-6	1.0	246.6

ALTR 1-00-0350 HWY410.GPJ 03/11/05

Date November 2005  
Project 105-00-00



Prep'd DB  
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# **SITE 2**

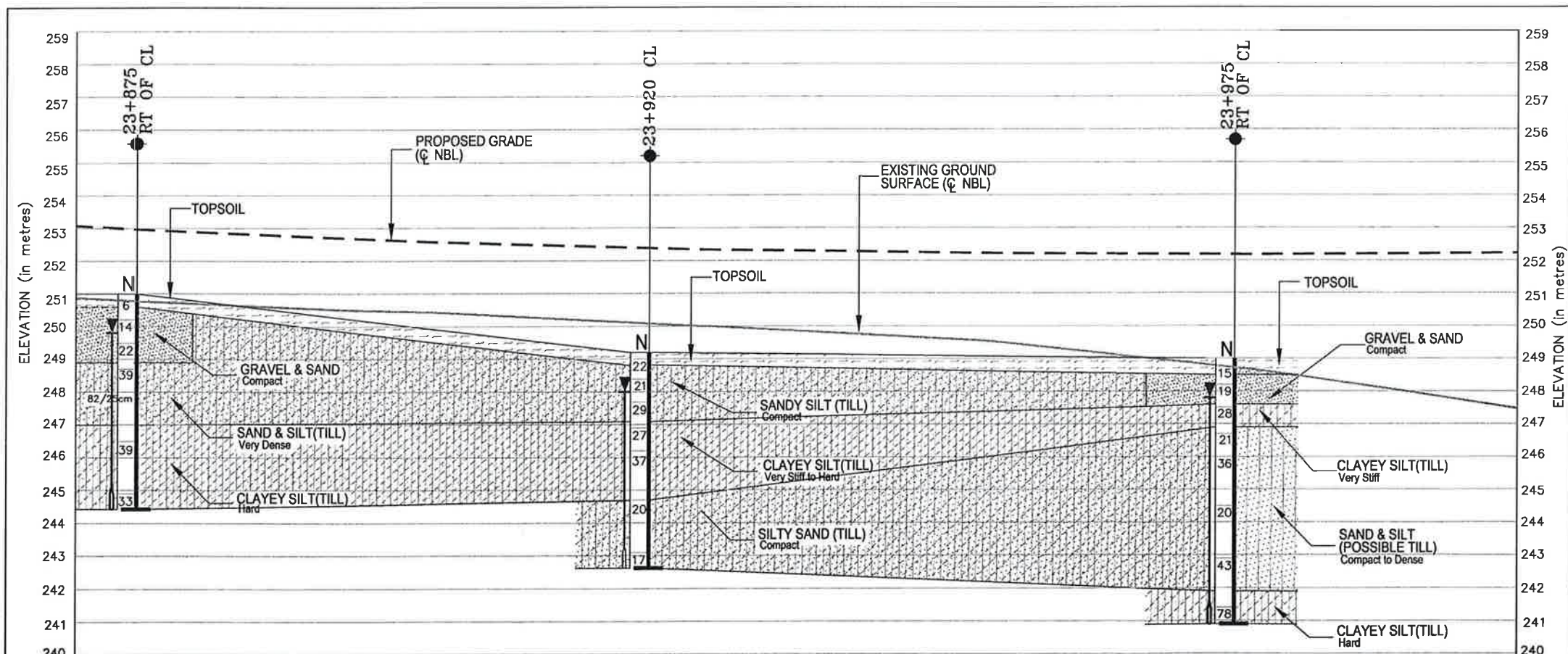
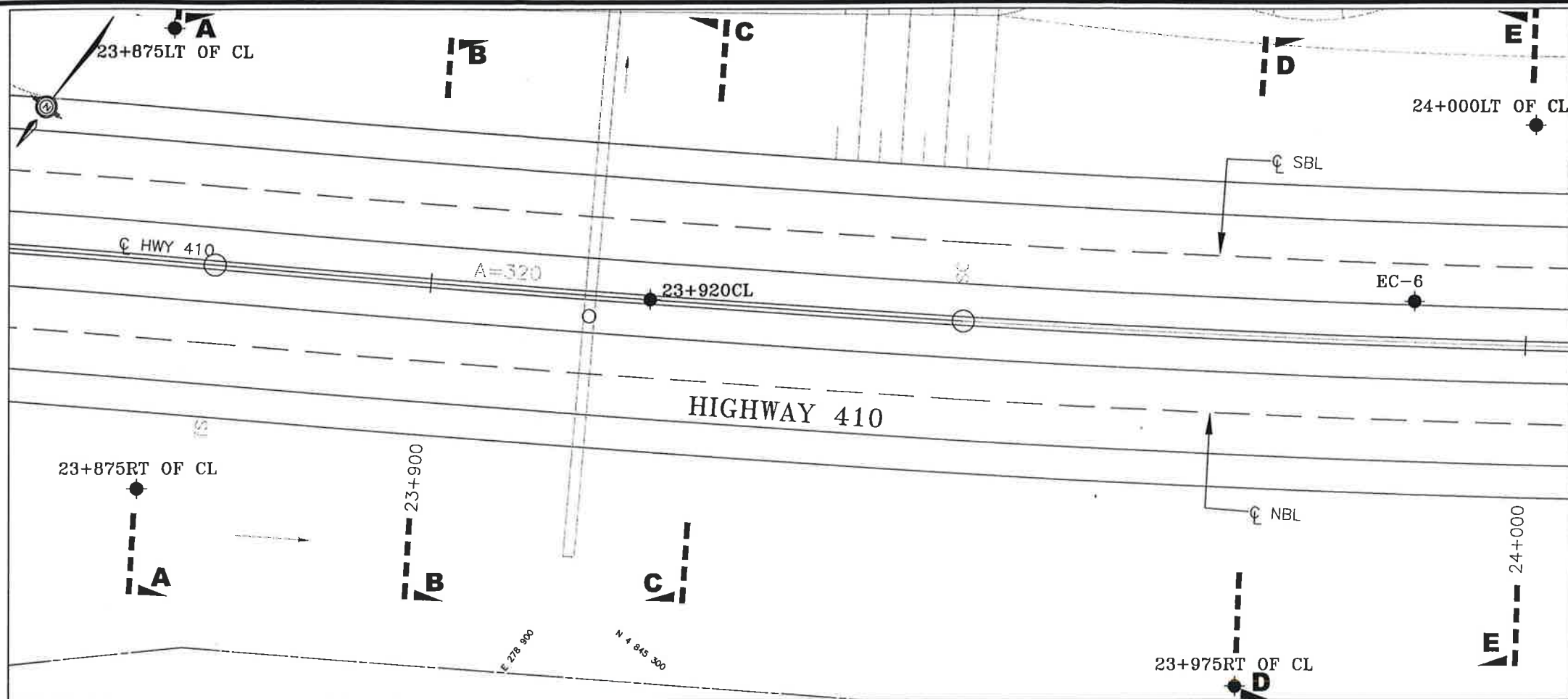
# **APPENDIX C 2**

**Borehole Locations and  
Stratigraphy Sections**

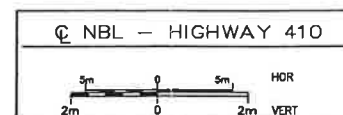
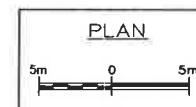
**Terraprobe Limited**







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



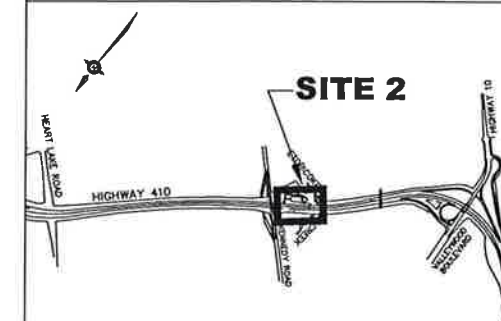
DRAWING NOT TO BE SCALED  
100mm ON ORIGINAL DRAWING

CONT No  
WP No 105-00-00

HIGHWAY 410 PHASE III  
BOREHOLE LOCATIONS  
AND SOIL STRATIGRAPHY  
SITE 2 (NBL PROFILE)  
Sta. 23+875 TO Sta. 24+000

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



KEY PLAN

LEGEND

- Bore Hole
- ⊕ Dynamic Cone Penetration Test
- ⊙ Bore Hole And Cone
- 'N' Blows/0.3m (Std Pen Test, 475 J/blow)
- CONE Blows/0.3m (60' Cone, 475 J/blow)
- WL at Time of Investigation
- WL in Piezometer 2005, 05
- Piezometer
- 90% Rock Quality Designation
- A/R Auger Refusal

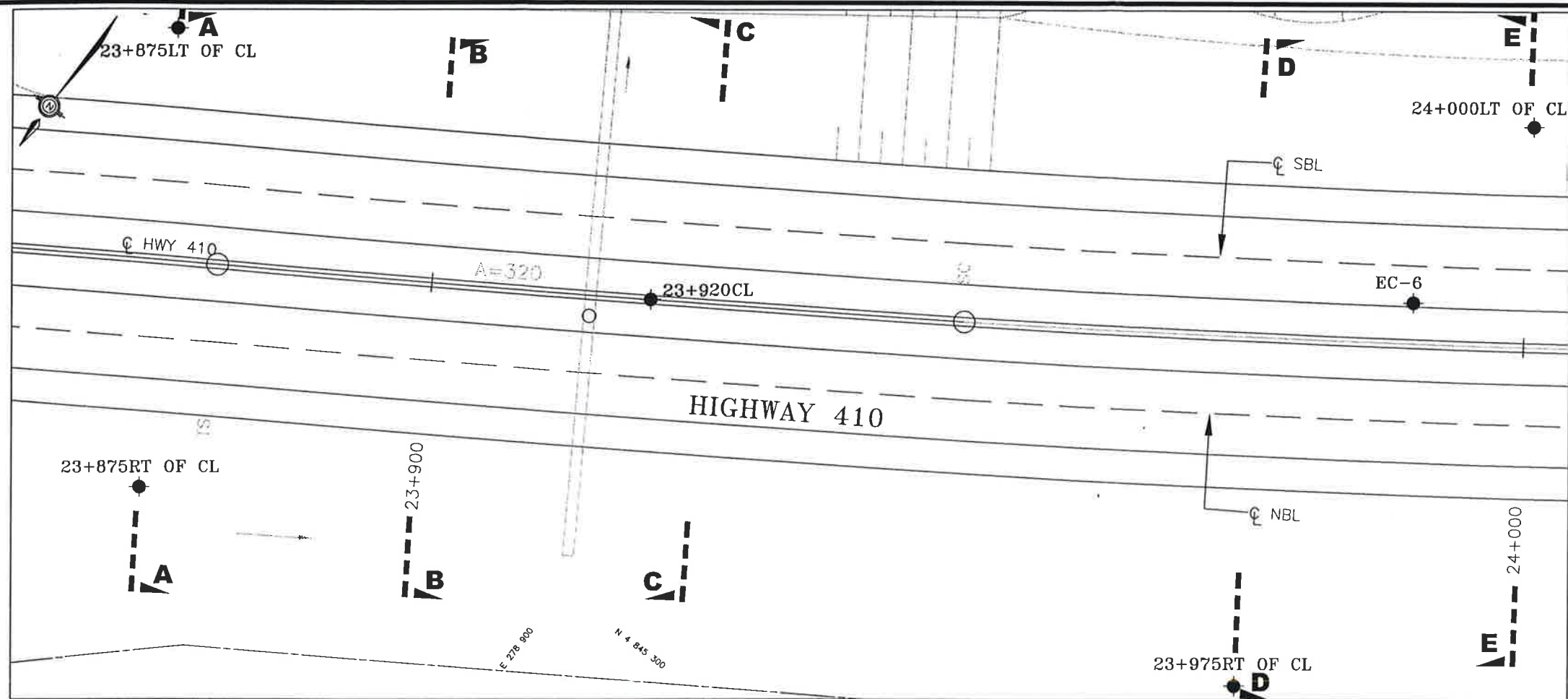
No	ELEVATION	COORDINATES	
		NORTHING	EASTING
23+875 LT	250.2	4845280.0	278959.4
23+875 RT	251.0	4845315.5	278936.9
23+920 CL	249.2	4845273.6	278910.2
23+975 RT	249.0	4845269.5	278846.2
EC-6	247.6	4845231.7	278854.4
24+000 LT	246.9	4845212.3	278855.3

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	NOV. 2005
DRAWN	P.S.	CHK	R.A.	SITE	STRUCT	SCHEME DWG 2





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



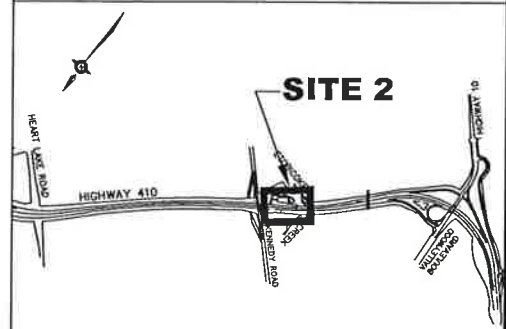
CONT No  
WP No 105-00-00

HIGHWAY 410 PHASE III  
BOREHOLE LOCATIONS  
AND SOIL STRATIGRAPHY  
SITE 2 (SBL PROFILE)  
Sta. 23+875 TO Sta. 24+000

SHEET  
20F4

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



KEY PLAN

LEGEND

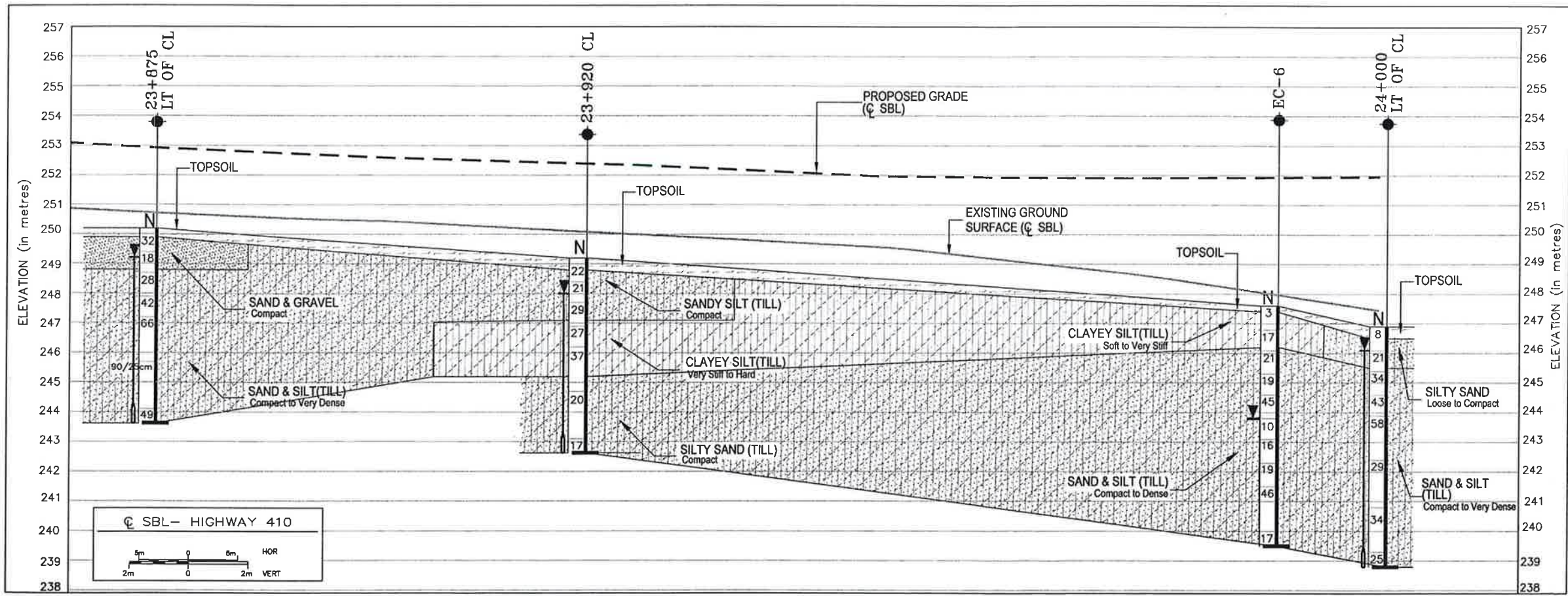
- Bore Hole
- ⊕ Dynamic Cone Penetration Test
- ⊙ Bore Hole And Cone
- 'N' Blows/0.3m (Std Pen Test, 475 J/blow)
- CONE Blows/0.3m (60° Cone, 475 J/blow)
- ↓ WL at Time of Investigation
- ↓ WL in Piezometer 2005, 05
- ⊕ Piezometer
- 90% Rock Quality Designation
- A/R Auger Refusal

No	ELEVATION	COORDINATES	
		NORTHING	EASTING
23+875 LT	250.2	4845280.0	278959.4
23+875 RT	251.0	4845315.5	278936.9
23+920 CL	249.2	4845273.6	278910.2
23+975 RT	249.0	4845269.5	278846.2
EC-6	247.6	4845231.7	278854.4
24+000 LT	246.9	4845212.3	278855.3

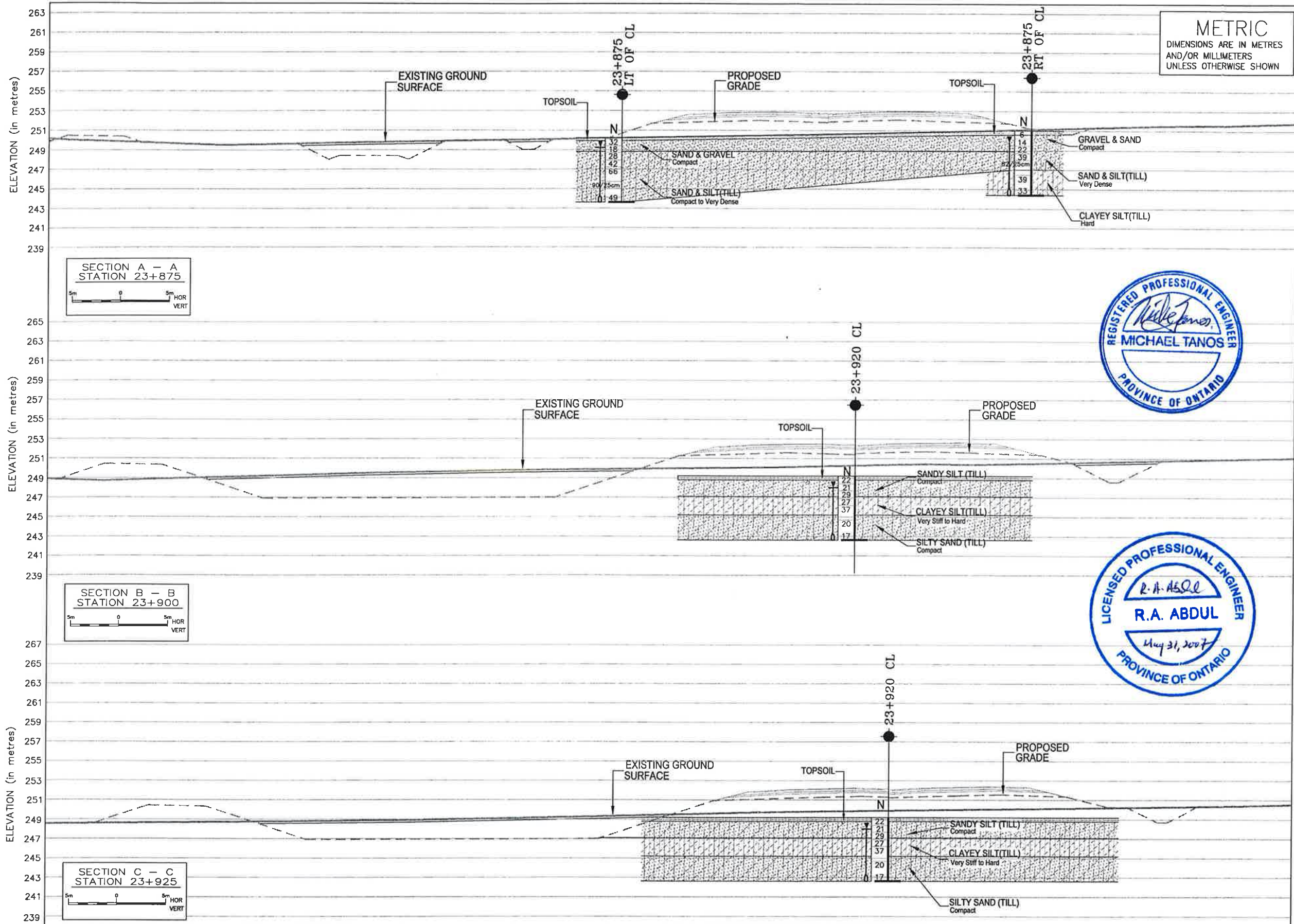
NOTE

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

REVISIONS				DESCRIPTION
	DATE	BY		
DESIGN	R.A.	CODE	CHBDC2000	LOAD
DRAWN	P.S.	CHK	R.A.	SITE
				STRUCT
				SCHEME
				DWG 2
				DATE NOV. 2005



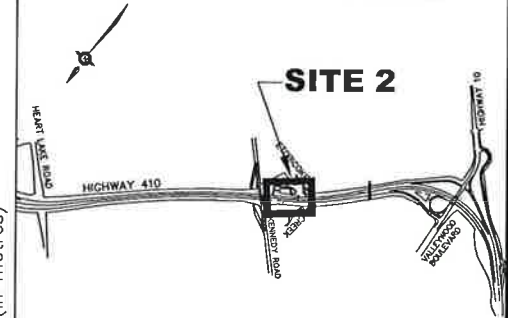




CONT No  
WP No 105-00-00

HIGHWAY 410 PHASE III  
BOREHOLE LOCATIONS  
AND SOIL STRATIGRAPHY  
SITE 2 (CROSS-SECTIONS)

SHEET  
30F4



KEY PLAN

LEGEND

- Bore Hole
- Dynamic Cone Penetration Test
- Bore Hole And Cone
- Blows/0.3m (Std Pen Test, 475 J/blow)
- Blows/0.3m (60' Cone, 475 J/blow)
- WL at Time of Investigation
- WL in Piezometer 2005, 05
- Piezometer
- Rock Quality Designation
- Auger Refusal

No	ELEVATION	COORDINATES	
		NORTHING	EASTING
23+875 LT	250.2	4845280.0	278959.4
23+875 RT	251.0	4845315.5	278936.9
23+920 CL	249.2	4845273.6	278910.2
23+975 RT	249.0	4845269.5	278846.2
EC-6	247.6	4845231.7	278854.4
24+000 LT	246.9	4845212.3	278855.3

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



ELEVATION (in metres)

ELEVATION (in metres)

271  
269  
267  
265  
263  
261  
259  
257  
255  
253  
251  
249  
247  
245  
243  
241  
239  
237  
235  
233

267  
265  
263  
261  
259  
257  
255  
253  
251  
249  
247  
245  
243  
241  
239  
237  
235  
233  
231  
229  
227

SECTION D - D  
STATION 23+975

SECTION E - E  
STATION 24+000

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

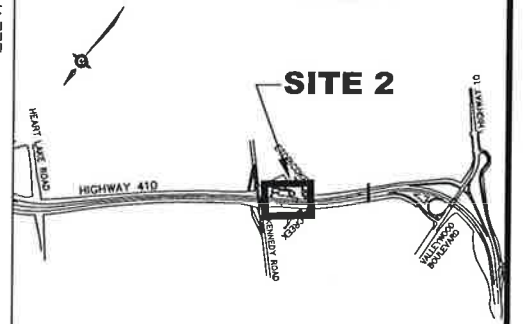
CONT No  
WP No 105-00-00

HIGHWAY 410 PHASE III  
BOREHOLE LOCATIONS  
AND SOIL STRATIGRAPHY  
SITE 2 (CROSS-SECTIONS)

SHEET  
4 OF 4

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



LEGEND

- Bore Hole
- Dynamic Cone Penetration Test
- Bore Hole And Cone
- 'N' Blows/0.3m (Std Pen Test, 475 J/blow)
- CONE Blows/0.3m (60° Cone, 475 J/blow)
- WL at Time of Investigation
- WL in Piezometer 2005, 05
- Piezometer
- 90% Rock Quality Designation
- A/R Auger Refusal

No	ELEVATION	COORDINATES	
		NORTHING	EASTING
23+875 LT	250.2	4845280.0	278959.4
23+875 RT	251.0	4845315.5	278936.9
23+920 CL	249.2	4845273.6	278910.2
23+975 RT	249.0	4845269.5	278846.2
EC-6	247.6	4845231.7	278854.4
24+000 LT	246.9	4845212.3	278855.3

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	NOV. 2005		
			DRAWN	P.S. CHK	R.A. SITE	STRUCT
			SCHEME	DWG	2	

DRAWING NOT TO BE SCALED  
100mm ON ORIGINAL DRAWING

# **SITE 3**

# **APPENDIX A 3**

**Record of Borehole Sheets**

**Terraprobe Limited**



# RECORD OF BOREHOLE No 24+200 CL

1 OF 1

METRIC

W.P. 105-00-00 LOCATION Coords: N:4845102.0 E:278689.4 (SITE 3) ORIGINATED BY MS  
DIST HWY 410 Phase III BOREHOLE TYPE Solid Stem Augers COMPILED BY DB  
DATUM Geodetic DATE 13.01.05 CHECKED BY RA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100		
260.7	Ground Surface													
0.0	200mm TOPSOIL													
0.2	CLAYEY SILT - trace sand, trace gravel, trace rootlets, damp, firm, brown		1	SS	5		260							
260.0														
0.7	CLAYEY SILT - Sandy, trace gravel, occasional silty fine sand partings and pockets, very stiff to hard, brown (GLACIAL TILL)		2	SS	22		259							
			3	SS	26		258							
			4	SS	28		257							
			5	SS	28		256							
			6	SS	24		255							
			7	SS	16		254							
			8	SS	51		253							
252.6	End of Borehole													
8.1	Piezometer installation consists of 19mm diameter schedule 40 PVC pipe with a 1.52m slotted screen.  Water Level Readings:  Date Depth(m) Elev.(m) Feb.02.05 5.8 254.9 Apr.18.05 4.3 256.4 May.17.05 4.4 256.3													

ONTARIO MOT 1-00-0350 HWY410.GPJ ONTARIO MOT.GDT 02/11/05

# RECORD OF BOREHOLE No 24+236 LT OF CL 1 OF 1 METRIC

W.P. 105-00-00 LOCATION Coords: N:4845061.3 E:278678.8 (SITE 3) ORIGINATED BY MS  
 DIST HWY 410 Phase III BOREHOLE TYPE Solid Stem Augers COMPILED BY DB  
 DATUM Geodetic DATE 14.01.05 CHECKED BY RA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)					
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa							PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>		
								○ UNCONFINED	+ FIELD VANE	● QUICK TRIAXIAL	× LAB VANE	WATER CONTENT (%)							
260.7	Ground Surface							20	40	60	80	100							
0.0 260.4	300mm TOPSOIL		1	SS	5														
0.3	weathered above 0.7m																		
	CLAYEY SILT some sand, trace to some gravel, occasional silty fine sand partings and pockets, damp, very stiff to hard, brown (GLACIAL TILL)		2	SS	23														
			3	SS	40														
			4	SS	37														
			5	SS	34														
			6	SS	21														
			7	SS	16														
253.6	SAND some gravel, trace silt, trace clay, wet, very dense, grey		8	SS	58														
252.6	End of Borehole																		
8.1	Piezometer installation consists of 19mm diameter schedule 40 PVC pipe with a 1.52m slotted screen.  Water Level Readings:  Date      Depth(m)      Elev.(m)  Feb.02.05      4.5      256.2 Apr.18.05      3.1      257.6 May.17.05      3.5      257.2																		

ONTARIO MOT 1-00-0350 HWY410.GPJ ONTARIO MOT.GDT 08/12/05



# RECORD OF BOREHOLE No 24+238 CL

1 OF 1

METRIC

W.P. 105-00-00 LOCATION Coords: N:4845075.4 E:278662.3 (SITE 3) ORIGINATED BY MS  
DIST HWY 410 Phase III BOREHOLE TYPE Solid Stem Augers COMPILED BY DB  
DATUM Geodetic DATE 14.01.05 CHECKED BY RA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT  γ  kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa		WATER CONTENT (%)				
260.7	Ground Surface							20 40 60 80 100						
0.0	400mm TOPSOIL							○ UNCONFINED + FIELD VANE						
260.3	loose		1	SS	5			● QUICK TRIAXIAL × LAB VANE						
0.4	weathered above 0.7m						260							
	CLAYEY SILT some sand, trace gravel, occasional silty fine sand partings and pockets, damp, very stiff to hard, brown (GLACIAL TILL)		2	SS	22		259						22.0	
			3	SS	36		258							
			4	SS	38		257							
			5	SS	33		256							
							255							
			6	SS	44		254							
							253							
	grey below 4.9m		7	SS	41									
			8	SS	58									
252.6	End of Borehole													
8.1	Piezometer installation consists of 19mm diameter schedule 40 PVC pipe with a 1.52m slotted screen.  Water Level Readings:  Date      Depth(m)    Elev.(m)  Feb.02.05    4.3      256.4 Apr.18.05    3.0      257.7 May.17.05    3.3      257.4													

ONTARIO MOT 1-00-0350 HWY410.GPJ ONTARIO MOT.GDT 08/12/05

# RECORD OF BOREHOLE No 24+238 RT OF CL

1 OF 1

METRIC

W.P. 105-00-00 LOCATION Coords: N:4845093.5 E:278644.5 (SITE 3) ORIGINATED BY MS  
DIST HWY 410 Phase III BOREHOLE TYPE Solid Stem Augers COMPILED BY DB  
DATUM Geodetic DATE 14.01.05 CHECKED BY RA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT   NATURAL MOISTURE CONTENT   LIQUID LIMIT			UNIT WEIGHT  γ  kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa		W <sub>p</sub>	W	W <sub>L</sub>		
								○ UNCONFINED   + FIELD VANE	● QUICK TRIAXIAL   × LAB VANE					
261.6	Ground Surface							20 40 60 80 100						GR SA SI CL
0.0	150mm TOPSOIL							20 40 60 80 100						
0.2	weathered to 0.7m		1	SS	13		261							
	CLAYEY SILT - Sandy, trace gravel, occasional silty fine sand partings and pockets, stiff to 0.7m, very stiff to hard below, brown  (GLACIAL TILL)		2	SS	20		260							
			3	SS	42		260							3 30 45 22
			4	SS	43		259							
			5	SS	49		258							
							258							
	grey below 4.0m		6	SS	23		257							
							256							
			7	SS	23		255							
							254							
253.5	End of Borehole		8	SS	46									
8.1	Piezometer installation consists of 19mm diameter schedule 40 PVC pipe with a 1.52m slotted screen.  Water Level Readings:  Date      Depth(m)    Elev.(m)  Feb.02.05    4.1    257.5 Apr.18.05    3.7    257.9 May.17.05    3.9    257.7													

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

# RECORD OF BOREHOLE No 24+275 CL

1 OF 1

METRIC

W.P. 105-00-00 LOCATION Coords: N:4845049.3 E:278636.0 (SITE 3) ORIGINATED BY MS  
DIST HWY 410 Phase III BOREHOLE TYPE Solid Stem Augers COMPILED BY DB  
DATUM Geodetic DATE 14.01.05 CHECKED BY RA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT  γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa		WATER CONTENT (%)				
260.1	Ground Surface							20 40 60 80 100						
0.0	300mm TOPSOIL		1	SS	6									
259.8	CLAYEY SILT trace sand, trace gravel, trace organics, trace rootlets moist, firm  CLAYEY SILT - Sandy, trace gravel, occasional silty fine sand partings and pockets, damp, very stiff to hard, brown  (GLACIAL TILL)      grey below 5.6m													
0.3			2	SS	20									
259.4			3	SS	44									
0.7			4	SS	50									
			5	SS	42									
			6	SS	41									
			7	SS	30									
253.5	End of Borehole													
6.6	Piezometer installation consists of 19mm diameter schedule 40 PVC pipe with a 1.52m slotted screen.  Water Level Readings:  Date      Depth(m)      Elev.(m)  Feb.02.05      0.6      259.5 Apr.18.05      0.5      259.6 May.17.05      0.5      259.6													

ONTARIO MOT 1-00-0350 HWY410.GPJ ONTARIO MOT.GDT 08/12/05

# **SITE 3**

# **APPENDIX B 3**

**Laboratory Test Results**

**Terraprobe Limited**

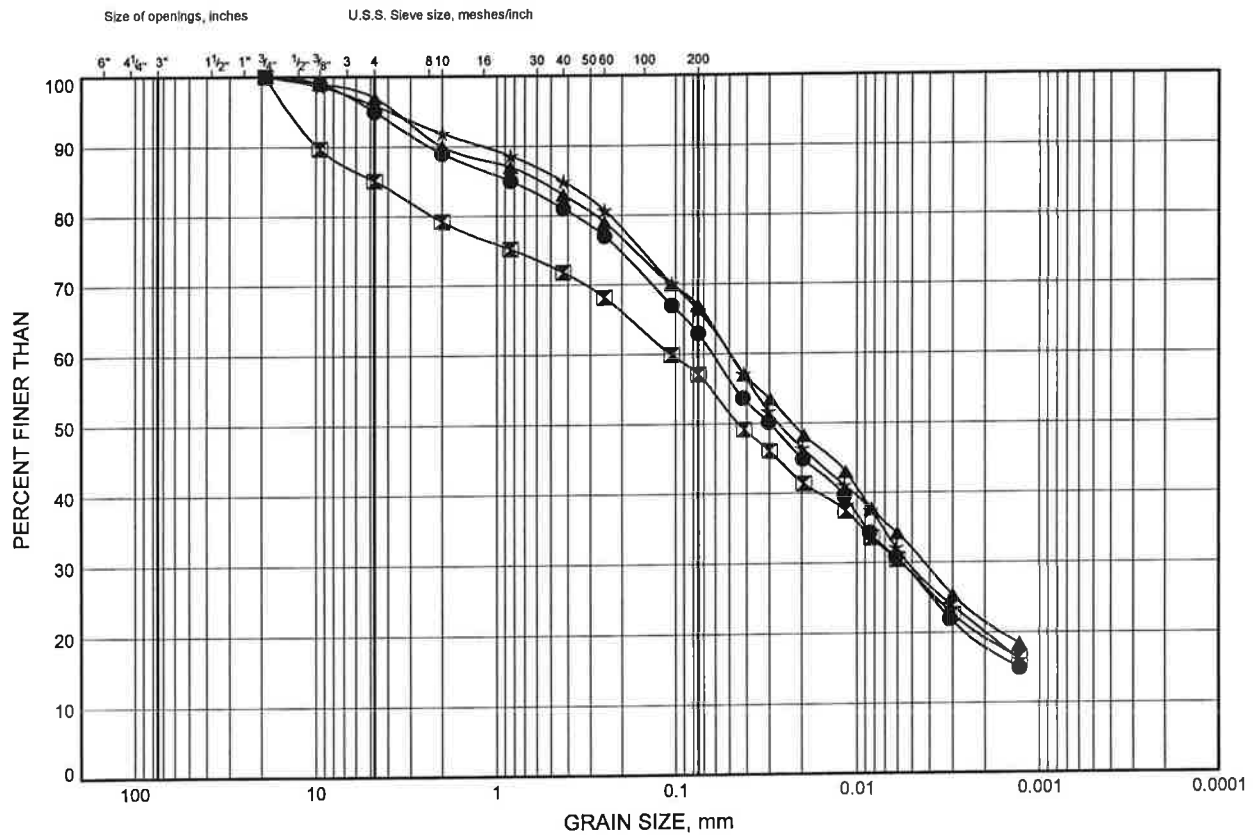




# GRAIN SIZE DISTRIBUTION

FIGURE B3-1

## Clayey Silt Till



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

SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	24+200 CL	2.5	258.2
⊠	24+236 LT OF CL	3.2	257.5
▲	24+238 RT OF CL	1.7	259.9
★	24+275 CL	4.7	255.4

Date November 2005  
Project 105-00-00

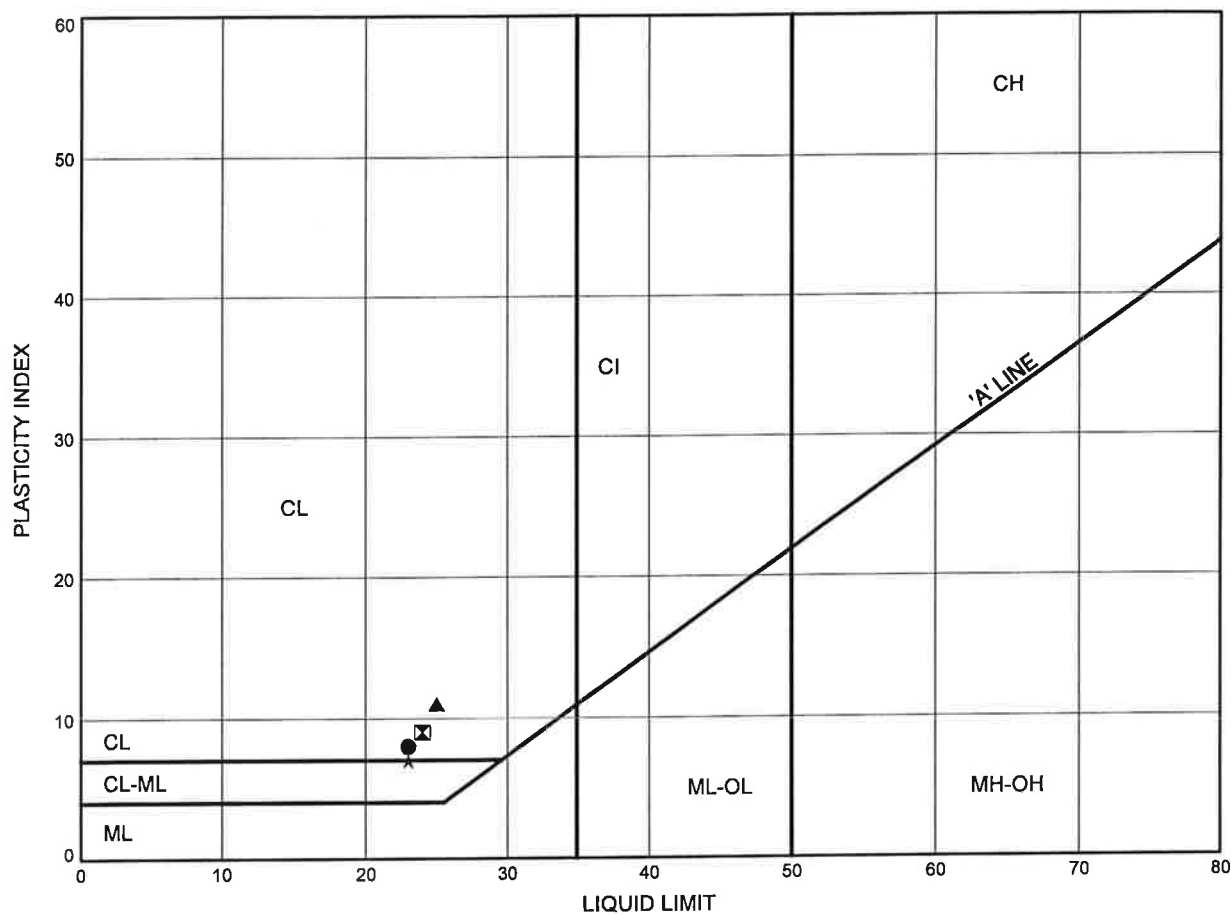


Prep'd DB  
Chkd. RA

# ATTERBERG LIMITS TEST RESULTS

FIGURE B3-2

## Clayey Silt Till



SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	24+200 CL	2.5	258.2
⊠	24+236 LT OF CL	3.2	257.5
▲	24+238 RT OF CL	1.7	259.9
★	24+275 CL	4.7	255.4

Date November 2005

Project 105-00-00



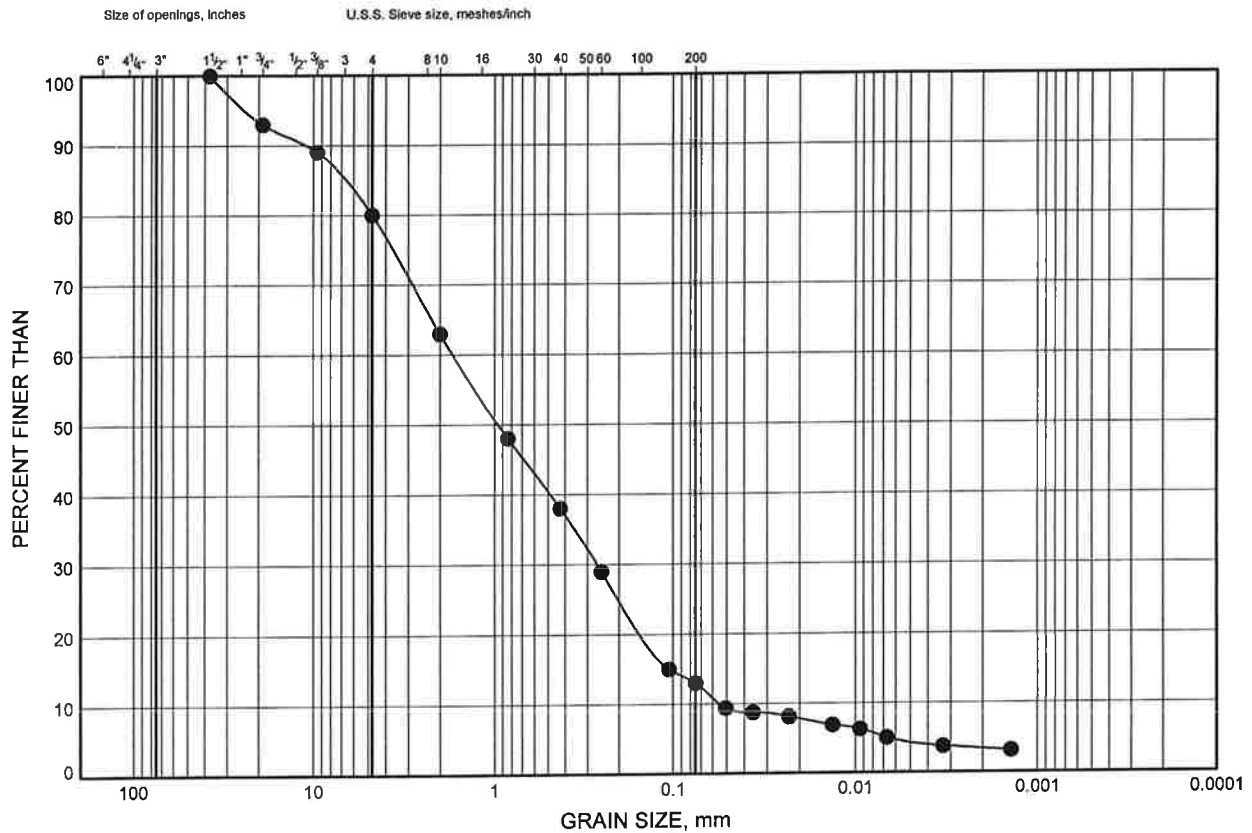
Prep'd DB

Chkd. RA

# GRAIN SIZE DISTRIBUTION

FIGURE B3-3

## Sand, Some Gravel



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

SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	24+236 LT OF CL	7.8	252.9

Date November 2005

Project 105-00-00



Prep'd DB

Chkd. RA

# **SITE 3**

# **APPENDIX C 3**

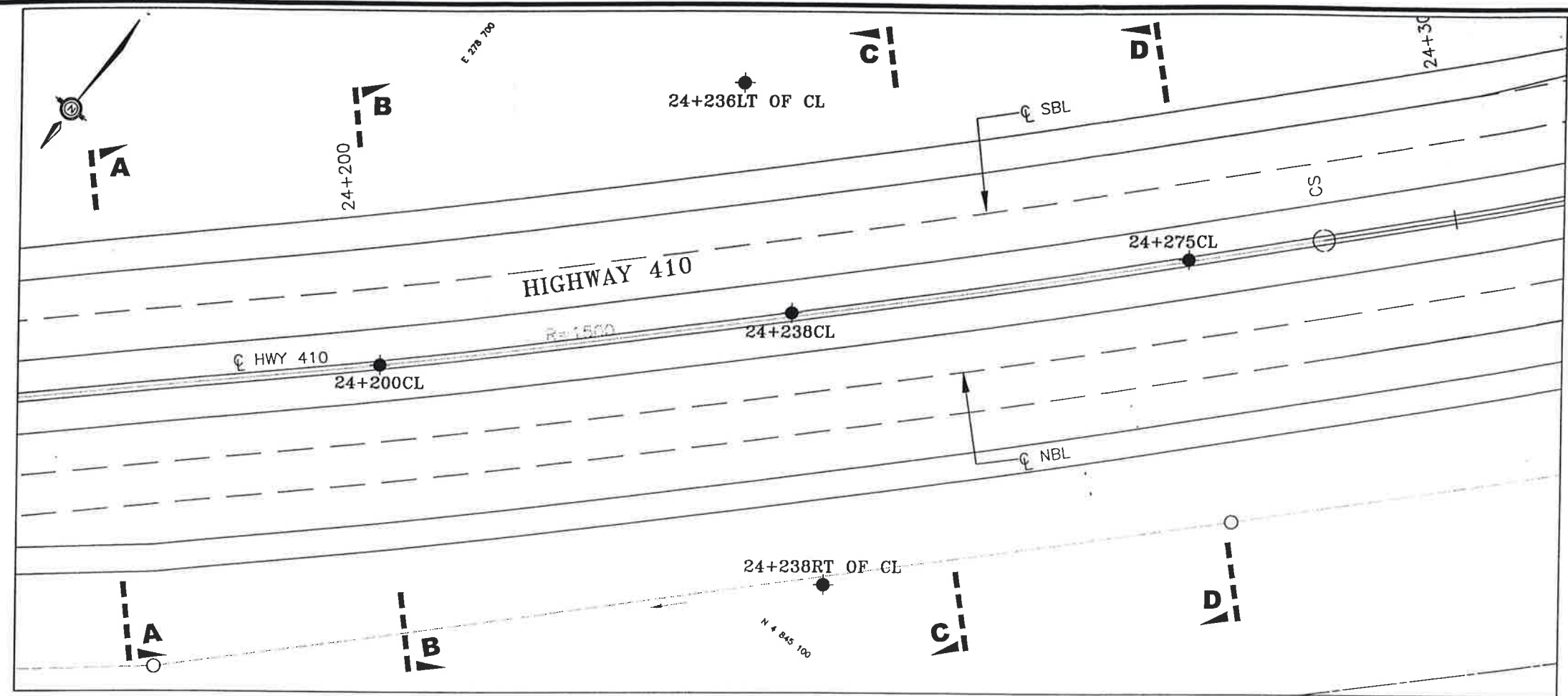
**Borehole Locations and  
Stratigraphic Sections**

**Terraprobe Limited**

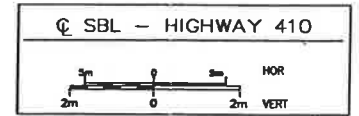
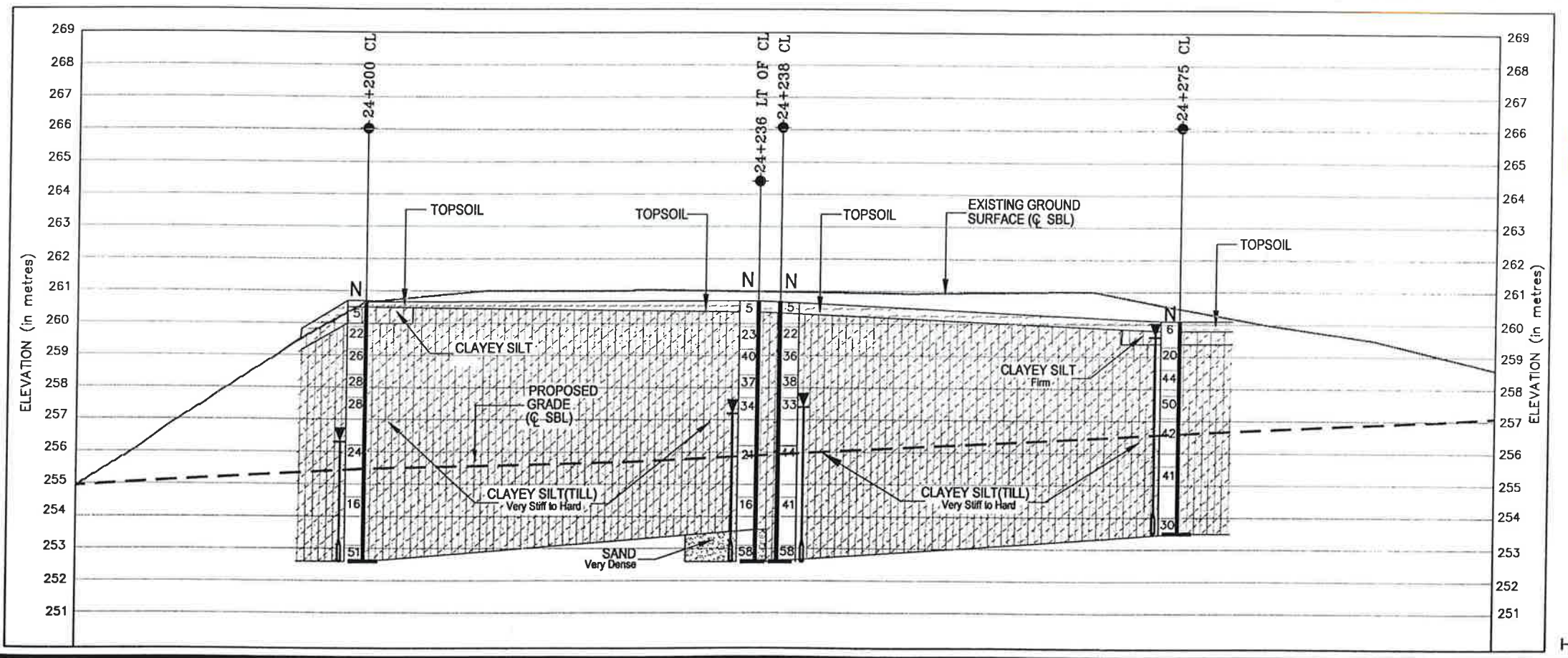








METRIC  
DIMENSIONS ARE IN METRES  
AND/OR MILLIMETERS  
UNLESS OTHERWISE SHOWN



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100mm ON ORIGINAL DRAWING

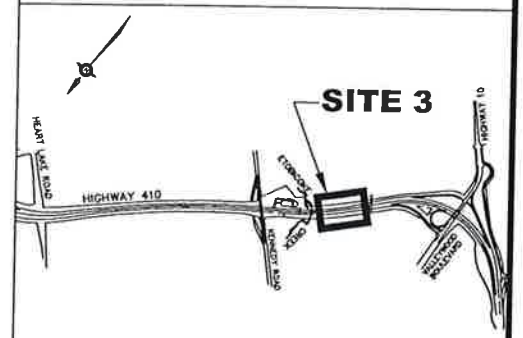
CONT No  
WP No 105-00-00

HIGHWAY 410 PHASE III  
BOREHOLE LOCATIONS  
AND SOIL STRATIGRAPHY  
SITE 3 (SBL PROFILE)  
Sta. 24+175 TO Sta. 24+275

SHEET  
20F4

**Giffels**  
An Ingenium Group Company

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



KEY PLAN  
LEGEND

- Bore Hole
- ⊕ Dynamic Cone Penetration Test
- ⊙ Bore Hole And Cone
- 'N' Blows/0.3m (Std Pen Test, 475 J/blow)
- CONE Blows/0.3m (60° Cone, 475 J/blow)
- ↓ WL at Time of Investigation
- ⬇ WL in Piezometer 2005, 05
- ⬇ Piezometer
- 90% Rock Quality Designation
- A/R Auger Refusal

No	ELEVATION	COORDINATES	
		NORTHING	EASTING
24+200 CL	260.7	4845102.0	278689.4
24+236 LT	260.7	4845061.3	278678.8
24+238 CL	260.7	4845075.4	278662.3
24+238 RT	261.6	4845093.5	278644.5
24+275 CL	260.1	4845049.3	278636.0

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	NOV. 2005
DRAWN	P.S.	CHK	R.A.	SITE	STRUCT	SCHEME DWG 2



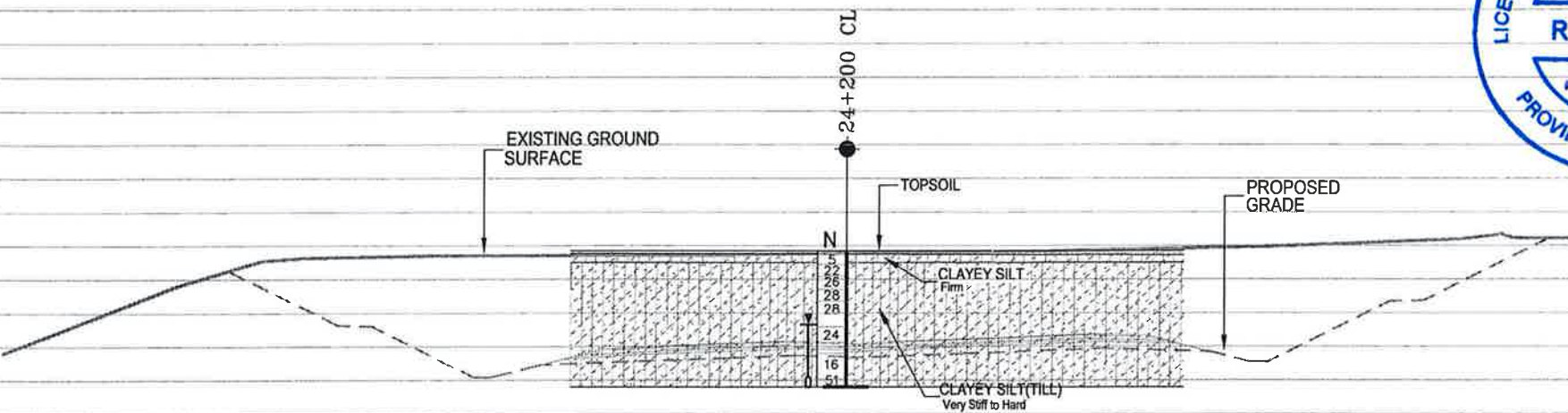
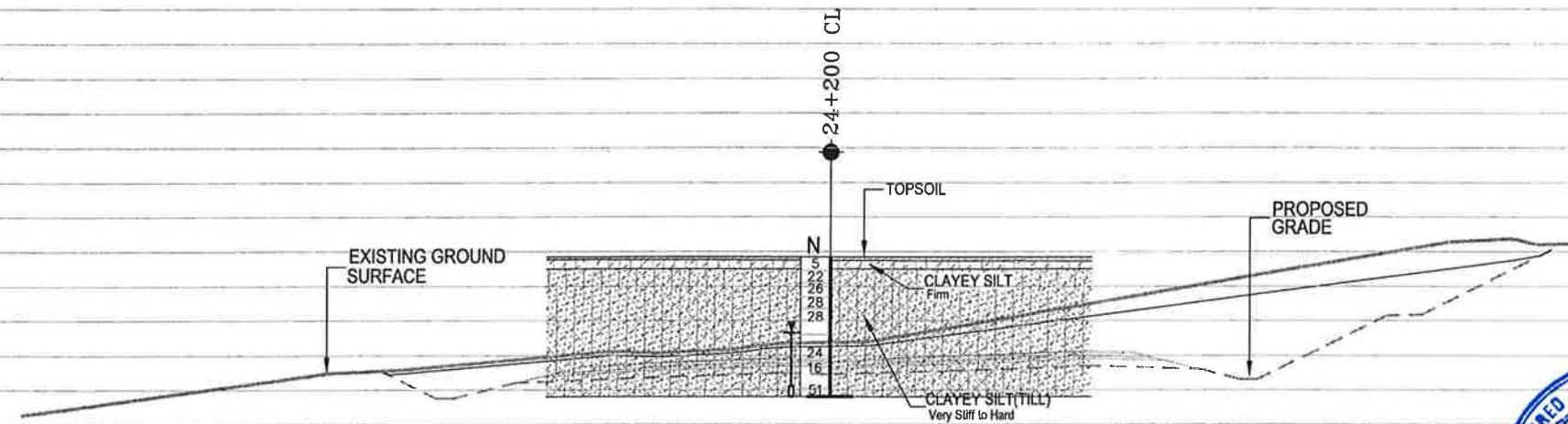
ELEVATION (in metres)

ELEVATION (in metres)

SECTION A - A  
STATION 24+175

SECTION B - B  
STATION 24+200

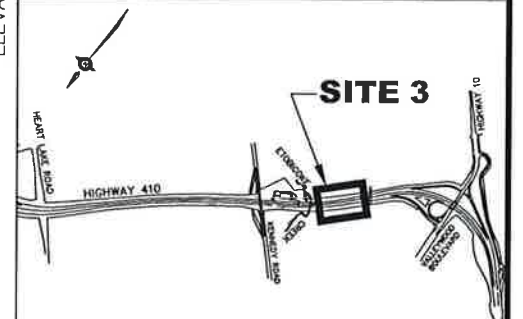
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AND/OR MILLIMETERS  
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CONT No  
WP No 105-00-00

HIGHWAY 410 PHASE III  
BOREHOLE LOCATIONS  
AND SOIL STRATIGRAPHY  
SITE 3 ( CROSS-SECTIONS)  
Sta. 24+175 TO Sta. 24+275

SHEET  
30F4



KEY PLAN  
LEGEND

	Bore Hole
	Dynamic Cone Penetration Test
	Bore Hole And Cone
	Blows/0.3m (Std Pen Test, 475 J/blow)
	Blows/0.3m (60' Cone, 475 J/blow)
	WL at Time of Investigation
	WL in Piezometer 2005, 05
	Piezometer
	Rock Quality Designation
	Auger Refusal

No	ELEVATION	COORDINATES	
		NORTHING	EASTING
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REVISIONS	DATE	BY	DESCRIPTION
DESIGN R.A.	CODE	CHBDC2000	LOAD
DRAWN P.S.	CHK	RA	SITE
		STRUCT	SCHEME
			DWG 2
			DATE NOV. 2005

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METRIC  
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AND/OR MILLIMETERS  
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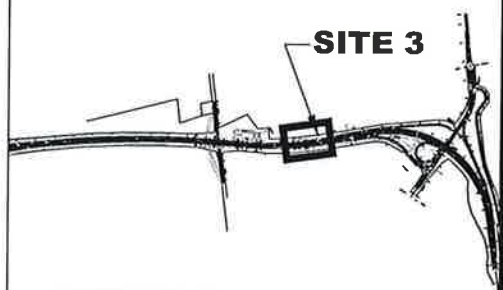
CONT No  
WP No105-00-00

HIGHWAY 410 PHASE III  
BOREHOLE LOCATIONS  
AND SOIL STRATIGRAPHY  
SITE 3 ( CROSS-SECTIONS)  
Sta. 24+175 TO Sta. 24+275

SHEET  
4 OF 4

**Giffels**  
An Ingenium Group Company

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



KEY PLAN

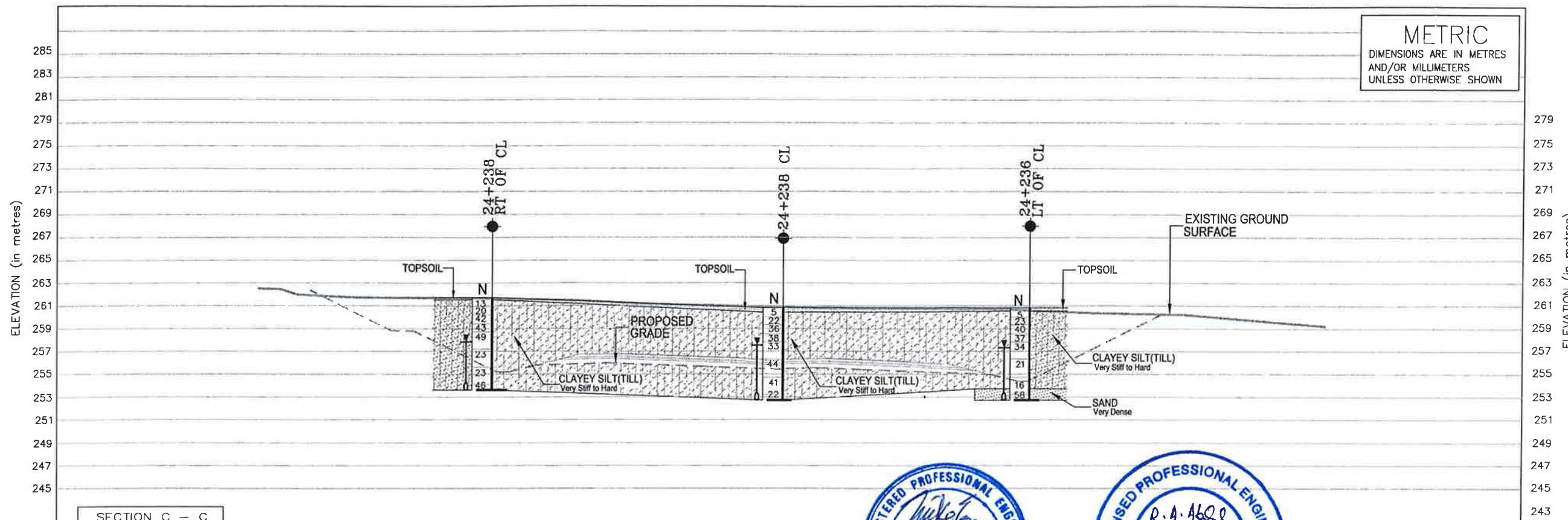
LEGEND

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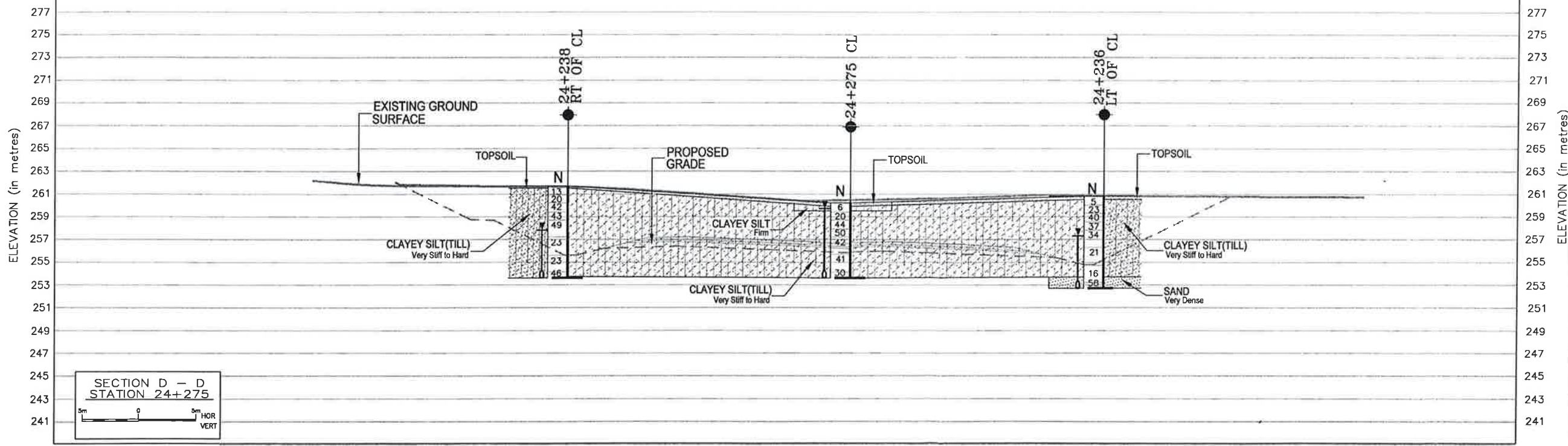
No	ELEVATION	COORDINATES	
		NORTHING	EASTING
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REVISIONS	DATE	BY	DESCRIPTION
DESIGN	R.A.	CODE	CHBDC2000
DRAWN	P.S.	CHK	R.A. SITE
LOAD	DATE	NOV. 2005	
STRUCT	SCHEME	DWG	2



SECTION C - C  
STATION 24+250



SECTION D - D  
STATION 24+275

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100mm ON ORIGINAL DRAWING



**QUALITY CONTROL RECORD**

**Project** Highway 410 Extension – Phase III From 300 m East of Heart Lake Road to Highway 10  
**Agreement No.** 2005-A-000230 **W.P. No.** 105-00-00  
**Site.** Deep Cuts & High Fills **Terraprobe File No.** 1-00-0350

**Task No./Description**

- Final Foundation Investigation and Design Report & Response to MTO's comments on draft report.

**Items Submitted for Review**

- MTO's Memorandum of
- Final Foundation Investigation & Design Report
- Terraprobe's letter of response to MTO's comments.

Submitted for review by: Rehman Akbar on (M/D/Y) 05/30/2007

Item Reviewed by: Jeff Jones on (M/D/Y) 05/30/2007

- ☒ Accepted As Is  
☐ Accepted with Minor Revisions  
☐ Revisions Required Item to be Resubmitted

Comments:

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