Terraprobe

Consulting Geotechnical & Environmental Engineering
Construction Materials Inspection & Testing

FOUNDATION INVESTIGATION & DESIGN REPORT

HIGH FILLS

MERRITT ROAD INTERCHANGE

HIGHWAY 406 TWINNING

PORT ROBINSION ROAD TO EAST MAIN STREET

AGREEMENT No. 2008-E-0016, W.P. 280-99-00

GEOCRES No. 30M3-252

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PART 1: FACTUAL INFORMATION

1 INTRODUCTION

This report presents the factual findings obtained from a foundation investigation for the proposed high fill embankments at the Merritt Road Interchange. The project area is located at the existing at grade intersection of Highway 406 and Merritt Road in the City of Thorold, Ontario.

Preliminary and detailed foundation investigations were conducted for the Merritt Road Underpass and the factual data from these investigations have been used as general reference for the preparation of this report.

The purpose of this investigation was to explore the subsurface conditions at the site and based on the data obtained, to provide a borehole location plan, records of boreholes, stratigraphic profile and cross-sections, laboratory test results and a written description of the subsurface conditions. A model of the subsurface conditions was developed from the data obtained.

Terraprobe conducted the investigation as a sub-consultant to Giffels Associates Ltd./IBI Group, under the Ministry of Transportation Ontario (MTO) Agreement Number 2008-E-0016.

The following documents are referenced in the preparation of this report:

- Peto MacCallum Ltd., “Preliminary Foundation Investigation and Design Report for Merritt Road Underpass”, Highway 406 Four-Laning, G.W.P. 280-99-00, City of Thorold, Ontario, GEOCRES 30M03-233, dated November 20, 2008.
- Peto MacCallum Ltd., “Foundation Investigation and Design Report for Merritt Road Underpass, Site No. 34-460”, Highway 406 Four-Laning, G.W.P. 280-99-00, City of Thorold, Ontario, GEOCRES 30M03-240, dated April 06, 2009.

2 SITE DESCRIPTION & PHYSIOGRAPHY

The site is located at the existing intersection of Highway 406 and Merritt Road in the City of Thorold, Regional Municipality of Niagara. The Merritt Road underpass is currently under construction approximately 30 m north of this intersection.

The topography is generally flat with scattered man-made high ground areas in the vicinity of the proposed bridge approaches. Vegetation at this site consists primarily of deciduous trees and wild bush.

The site is located between the Niagara Escarpment and Lake Erie in the physiographic region of Southern Ontario referred to as the Haldimand Clay Plain. The Haldimand Clay Plain is best described as falling into a series of parallel belts with the highest ground adjacent to the Escarpment. Generally this region is flat and poorly drained although it includes several distinctive landforms such as dunes, cobble, clay and sand beaches, limestone pavements and back-shore wetland basins[1].

The Niagara Region is underlain by a sequence of very gently south-dipping dolostones, limestones, shales and sandstones overlying Precambrian basement rock. The key elements in the bedrock geology of the region are the multiple layers of softer sedimentary limestones, shale, sandstone and dolostone.

The bedrock unit at this site is the Salina Formation of Upper Silurian Age[2]. This unit consists essentially of easily weathered, grey, very finely crystalline, laminated argillaceous dolostone with grey, calcareous shale partings and gypsum veins and lenses of varying thicknesses.

3 SITE INVESTIGATION AND FIELD TESTING

The site investigation and field testing for this project were carried out between August 31 and September 10, 2009 and consisted of drilling and sampling thirty nine boreholes to depths ranging from 3.5 m to 15.3 m. The approximate borehole locations are shown on the attached Borehole Locations and Soil Strata Drawing in Appendix D.

The borehole locations were marked in the field by surveyors from Callon Dietz Inc. who also provided Terraprobe with their coordinates and geodetic elevations. Utility clearances were obtained by Terraprobe prior to drilling.

Samples of the overburden soils were obtained at selected intervals using a split spoon sampler in conjunction with Standard Penetration Testing (SPT), as specified in ASTM Method D1586. In the cohesive (clayey) deposits the undrained shear strength of the soil was measured in-situ by means of field vane tests using an MTO type field vane. Relatively undisturbed soil samples were also collected with thin-walled Shelby Tube samplers.

[1] Chapman and Putnam, "The Physiography of South Ontario", 3rd Edition, 1984.
[2] Ontario Division of Mines, "Quaternary Geology Of The Welland Area", Preliminary Map P.796, 1972.

Ground water conditions in the open boreholes were observed throughout the drilling operations and either standpipe piezometers or monitoring wells were installed in selected boreholes to permit longer term ground water level monitoring. The standpipe piezometers consisted of 19 mm diameter PVC pipe with a slotted screen enclosed in sand and the monitoring wells consisted of 50 mm diameter PVC pipe with a slotted screen enclosed in sand. The remaining boreholes were abandoned in accordance with MOE Regulation 903 by sealing/grouting with a clay slurry mixture after drilling was complete.

The locations and completion details of the piezometers are shown in Tables 3.1 and 3.2.

Table 3.1 – Piezometer Installation Details (South East Quadrant)

Piezometer Location	Piezometer Details	
	Tip Depth/ Elevation (m)	Completion Details
SEW 10+200CL	4.6/174.1	Piezometer with 1.5 m slotted screen installed with filter sand to 2.4 m and bentonite seal from 2.4 m to ground surface.
C1	4.0/174.5	Piezometer with 1.5 m slotted screen installed with filter sand to 2.1 m and bentonite seal from 2.1 m to ground surface.
C2	3.0/175.4	Piezometer with 1.5 m slotted screen installed with filter sand to 1.2 m and bentonite seal from 1.2 m to ground surface.
SEW 10+300CL	6.1/172.8	Piezometer with 1.5 m slotted screen installed with filter sand to 4.3 m, bentonite seal from 4.3 m to 3.4 m, silty clay cuttings from 3.4 m to 0.6 m and bentonite seal from 0.6 m to ground surface.
SEW 10+350Rt.	6.1/173.0	Monitoring well with 3.0 m slotted screen installed with filter sand to 2.6 m and bentonite seal from 2.6 m to ground surface.
WN 10+000Rt.	10.7/169.7	Monitoring well with 3.0 m slotted screen installed with filter sand to 6.9 m, bentonite seal from 6.9 m to ground surface.
WN 10+050CL	5.8/175.0	Piezometer with 1.5 m slotted screen installed with filter sand to 3.6 m, bentonite seal from 3.6 m to 3.4 m, silty clay cuttings from 3.4 m to 0.3 m and bentonite seal from 0.3 m to ground surface.
EWN 10+150CL	5.2/173.5	Piezometer with 1.5 m slotted screen installed with filter sand to 3.4 m, bentonite seal from 3.4 m to 2.4 m, silty clay cuttings from 2.4 m to 0.6 m and bentonite seal from 0.6 m to ground surface.
C3	3.0/176.0	Piezometer with 1.5 m slotted screen installed with filter sand to 1.2 m and bentonite seal from 1.2 m to ground surface.
C4	3.0/175.8	Piezometer with 1.5 m slotted screen installed with filter sand to 1.2 m and bentonite seal from 1.2 m to ground surface.
MR 10+075Lt.	13.7/172.5	Piezometer with 1.5 m slotted screen installed with filter sand to 11.9 m, bentonite seal from 11.9 m to 11.0 m, silty clay cuttings from 11.0 m to 0.9 m and bentonite seal from 0.9 m to ground surface.
MR 10+100CL	13.7/171.7	Monitoring well with 1.5 m slotted screen installed with filter sand to 11.6 m and bentonite seal from 11.6 m to ground surface.
MR 10+150Lt.	6.7/173.3	Piezometer with 1.5 m slotted screen installed with filter sand to 4.9 m, bentonite seal from 4.9 m to 4.0 m, silty clay cuttings from 4.0 m to 0.9 m and bentonite seal from 0.9 m to ground surface.

Table 3.2 – Piezometer Installation Details (North West Quadrant)

Piezometer Location	Piezometer Details	
	Tip Depth/ Elevation (m)	Completion Details
NEW 10+350CL	5.2/175.7	Piezometer with 1.5 m slotted screen installed with filter sand to 3.4 m, bentonite seal from 3.4 m to 2.4 m, silty clay cuttings from 2.4 m to 0.9 m and bentonite seal from 0.9 m to ground surface.
NW 10+000Rt.	5.2/175.0	Piezometer with 1.5 m slotted screen installed with filter sand to 3.4 m, bentonite seal from 3.4 m to 2.4 m, silty clay cuttings from 2.4 m to 0.9 m and bentonite seal from 0.9 m to ground surface.
NE 10+450CL	8.7/171.5	Monitoring well with 3.0 m slotted screen installed with filter sand to 5.0 m and bentonite seal from 5.0 m to ground surface.
ES 10+000Rt.	13.0/171.9	Monitoring well with 3.0 m slotted screen installed with filter sand to 9.8 m and bentonite seal from 9.8 m to ground surface.
ES 10+050CL	12.2/173.7	Piezometer with 1.5 m slotted screen installed with filter sand to 10.0 m and bentonite seal from 10.0 m to ground surface.
EWS 10+100Rt.	5.7/175.0	Piezometer with 1.5 m slotted screen installed with filter sand to 3.7 m, bentonite seal from 3.7 m to 3.4 m, silty clay cuttings from 3.4 m to 0.3 m and bentonite seal from 0.3 m to ground surface.
EWS 10+150CL	4.6/176.5	Piezometer with 1.5 m slotted screen installed with filter sand to 2.4 m, bentonite seal from 2.4 m to 2.1 m, silty clay cuttings from 2.1 m to 0.3 m and bentonite seal from 0.3 m to ground surface.
WS 10+025CL	7.6/172.6	Piezometer with 1.5 m slotted screen installed with filter sand to 5.5 m, bentonite seal from 5.5 m to 5.2 m, silty clay cuttings from 5.2 m to 0.3 m and bentonite seal from 0.3 m to ground surface.
MR 9+850Rt.	6.1/173.7	Monitoring well with 1.5 m slotted screen installed with filter sand to 4.3 m, bentonite seal from 4.3 m to 4.0 m, silty clay cuttings from 4.0 m to 0.3 m and bentonite seal from 0.3 m to ground surface.
MR 9+950Rt.	9.1/171.1	Piezometer with 1.5 m slotted screen installed with filter sand to 7.0 m, bentonite seal from 7.0 m to 6.7 m, silty clay cuttings from 6.7 m to 0.6 m, bentonite seal from 0.6 m to 0.3 m and a flush mounted well cap at ground surface.

The drilling, sampling and in-situ testing operations were observed on a full time basis by members of Terraprobe's technical staff. Staff 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. Select samples were also subjected to a laboratory testing programme consisting of gradation analysis and Atterberg Limits tests, consolidation tests, unit weight and undrained shear strength testing with a laboratory vane. Unconfined compressive strength tests were also conducted on selected Shelby tube samples. The results of this testing program are shown on the Record of Borehole sheets in Appendix A and the figures in Appendix B.

5 DESCRIPTION OF SUBSURFACE CONDITIONS

Reference is made to the Record of Borehole sheets in Appendix A. Details of the encountered soil and stratigraphy are presented in these appendices and on the "Borehole Locations and Soil Strata" drawings in Appendix D. The previously drilled boreholes for the proposed new Merritt Road bridge are presented in Appendix C.

An overall description of the stratigraphy of the current investigations is provided in the following paragraphs under two sections viz. Merritt Road I/C (South East Quadrant) and Merritt Road I/C (North West Quadrant). However, the factual data presented in the Record of Borehole Sheets governs any interpretation of the site conditions.

In general, the south east quadrant of the site is underlain by topsoil, fill material consisting of compact sand and gravel and firm to stiff silty clay. These soils are further underlain by native deposits of loose to dense silty sand to sandy silt, a major deposit of firm to hard silty clay and a lower deposit of compact silt.

The north west quadrant of the site is underlain by topsoil, a flexible pavement, and fill material consisting of loose to compact silt to sandy silt and firm to hard silty clay. Amorphous peat, organic sandy silt and a layer of silty fine sand were encountered below the stockpile material at Borehole ES 10+000Lt. These soils are further underlain by a major deposit of firm to hard silty clay followed by a compact silt deposit.

5.1 Merritt Road I/C – South East Quadrant

5.1.1 Topsoil

The topsoil encountered in this area ranged in thickness from 50 mm to 205 mm. Topsoil thickness may vary between and beyond the boreholes.

5.1.2 Fill – Sand and Gravel

Some of the boreholes were advanced through the shoulders of Merritt Road where they encountered a layer of sand and gravel fill that extends to depths ranging from 0.4 m (Elev. 180.4 m) to 0.8 m (Elev. 179.7 m) below ground surface.

The grain size distribution plot of a tested sample of this fill is presented in Figure B1-1. These results show a grain size distribution consisting of 36% gravel, 41% sand, 19% silt and 4% clay size particles.

In this fill the SPT 'N' values ranged from 11 to 19 blows for 0.3 m penetration indicating a compact relative density. The moisture content of samples of the sand and gravel fill varies from 3% to 4% by weight.

5.1.3 Fill – Silty Clay

Silty clay fill was encountered at this site extending to depths ranging from 0.3 m to 7.0 m below ground surface or to elevations ranging from Elev. 180.1 m to Elev. 177.7 m. The fill generally extends to a maximum depth of 0.7 m across the site but up to 7.0 m deep fill exists in the area of an existing fill stockpile in the vicinity of the west bridge approach. The three boreholes that were drilled through this stockpile are MR10+050CL, MR10+075Lt. and MR10+100CL.

The grain size distribution plots of tested samples of this fill are presented in Figures B1-2. These results show a grain size distribution consisting of 0-24% gravel, 2-16% sand, 30-40% silt and 20-68% clay size particles. Zones of sandy and gravelly fill were also encountered in the fill stockpile.

Samples were also subjected to Atterberg Limits tests and the results are presented in Figures B1-3. The index values from these tests are summarized below:

Liquid Limit:	27-61%
Plastic Limit:	17-28%
Plasticity Index:	10-33%
Natural Moisture Content:	17-23%

These values indicate that the fill material has a low to high plasticity.

Standard Penetration tests in this silty clay fill gave 'N' values that ranged from 6 to 27 blows per 0.3 m penetration. Based on these results the silty clay fill is considered to have a firm to very stiff consistency. The moisture content (by weight) of samples of this fill ranged from 11% to 26%.

5.1.4 Silty Sand to Sandy Silt

Silty sand to sandy silt deposits were encountered in this quadrant extending to depths ranging from 0.7 m to 2.1 m below ground surface or to elevations ranging from 177.9 m to 176.8 m.

The grain size distribution plots of tested samples of these native soils are presented in Figure B1-4. These results show a grain size distribution consisting of 0% gravel, 35-54% sand, 30-47% silt and 8-18% clay size particles.

The blow counts from Standard Penetration tests in this deposit ranged from 4 to 31 blows per 0.3 m penetration. Based on these results these soils are considered to have a loose to dense relative density. The moisture content of samples from these strata ranged from 15% to 27% by weight.

5.1.5 Silty Clay

A major silty clay deposit was encountered in all of the boreholes in this quadrant of the interchange. This silty clay deposit was fully penetrated in Borehole WN10+000Rt. at a depth of 10.5 m (Elev. 169.9 m) below ground surface. In the remaining boreholes the investigations were terminated in this layer.

The grain size distribution plots of tested samples of the silty clay are presented in Figures B1-5 to B1-10. These results show a grain size distribution consisting of 0-2% gravel, 0-5% sand, 30-66% silt and 33-67% clay size particles.

Samples were also subjected to Atterberg Limits tests and the results are plotted on the plasticity charts in Figures B1-11 to B1-16. The index values from these tests are summarized below:

Liquid Limit:	24-54%
Plastic Limit:	16-26%
Plasticity Index:	7-28%
Natural Moisture Content:	18-40%

These values are characteristic of clayey soils of generally low to intermediate plasticity with infrequent zones of high plasticity.

Standard Penetration tests in this deposit yielded 'N' values ranging from 0 to 43 blows for 0.3 m penetration and field vane tests gave in-situ undrained shear strengths ranging from 32 kPa to in excess of 100 kPa. An unconfined compression test gave an undrained shear strength of 30 kPa and laboratory vane tests on Shelby Tube samples gave undrained shear strengths ranging from 47 kPa to 67 kPa. These values indicate that the consistency of the silty clay is generally firm to hard.

The variation of undrained shear strength with depth is depicted in the attached plot of field vane test results versus depth, Figure B1-18. There is a trend in the variation of shear strength with depth. The upper portion of this deposit up to about Elev. 175.5 m has a relatively higher undrained shear strength i.e. in excess of 100 kPa. Below Elev. 175.5 m the undrained shear strength decreases with depth and then begins to increase again below Elev. 172.0 m.

The results of the Atterberg Limits tests are also plotted against elevation (Figure B1-19). Up to about Elev. 176.0 m the natural moisture content is at or close to the plastic limit. Below Elev. 176.0 m the plot depicts a trend of increasing liquidity index with depth.

Four consolidation tests were also performed on relatively undisturbed samples retrieved from Borehole SEW10+300CL, SEW10+350Rt., WN10+000Rt. and WN10+050CL and the results are attached in Figures B1-20 to B1-31. Preconsolidation pressures were estimated from the e-log p curves. Due to the rounded nature of the curves the preconsolidation pressures were also assessed based on the 'Work' – method proposed by Becker et al. (1987).

The details of the test results are summarized below.

Borehole/Sample No.	Sample Depth/Elevation (m)	P_c (kPa)	C_c	C_r	e_o
SEW 10+300CL TW6	4.6/174.3	280 – 400	0.439	0.089	1.09
SEW 10+350Rt. TW6	4.6/174.5	300 – 420	0.177	0.029	0.65
WN 10+000Rt. TW7	6.0/174.4	240 – 330	0.549	0.114	1.14
WN 10+050CL TW6	4.6/176.2	280 – 300	0.211	0.049	0.64

Where: P_c = Preconsolidation pressure
C_c = Compression index
C_r = Recompression index
e_o = Initial void ratio

The field and laboratory data indicate that the silty clay deposit consists of a generally stiff to hard overconsolidated desiccated crust that is estimated to extend to about Elev. 176.0 m. Below Elev. 176.0 m the silty clay deposit is generally firm to very stiff.

5.1.6 Silt

A lower silt deposit was encountered in Borehole WN 10+000Rt. at a depth of 10.5 m (Elev. 169.9 m) and it extends to at least the termination depth of the borehole or deeper.

A sample of this soil was subjected to a grain size distribution test and the results are depicted on the grain size distribution curve in Figure B1-17. These results show a grain size distribution consisting of 0% gravel, 1% sand, 91% silt and 8% clay size particles.

A Standard Penetration test conducted in this deposit gave an 'N' value of 13 blows for 0.3 m penetration indicating a compact relative density. The moisture content (by weight) of a sample of the silt was 29%.

5.2 Merritt Road I/C – North West Quadrant

5.2.1 Topsoil

The topsoil encountered in this quadrant of the interchange ranged in thickness from 25 mm to 230 mm. Topsoil thickness may vary between and beyond the boreholes.

5.2.2 Flexible Pavement

Borehole MR 9+950 was located on the existing Ramp Hwy. 406 N - Merritt Road-W. The borehole data indicates a flexible pavement consisting of 100 mm thick asphalt concrete underlain by a layer of sand and gravel fill that extends to a depth of 0.6 m (Elev. 179.6 m) below ground surface.

The grain size distribution plot of a sample of the sand and gravel fill is presented in Figure B2-1. These results show a grain size distribution consisting of 21% gravel, 50% sand, 24% silt and 5% clay size particles.

A Standard Penetration test conducted in this fill material gave an 'N' value of 16 blows for 0.3 m penetration indicating a compact relative density. The moisture content of the sand and gravel fill was 6% by weight.

5.2.3 Fill – Silt to Silty Sand

Fill material ranging from silt some sand to silty sand were encountered in this quadrant extending to depths ranging from 0.7 m to 5.6 m below ground surface or to elevations ranging from 180.4 m to 179.2 m.

The grain size distribution plots of tested samples of this fill are presented in Figure B2-2. These results show a grain size distribution consisting of 0% gravel, 12-56% sand, 30-72% silt and 13-16% clay size particles.

The blow counts from Standard Penetration tests in this deposit ranged from 6 to 19 blows per 0.3 m penetration. Based on these results the deposit is considered to have a loose to compact relative density. The moisture content of samples from this stratum ranged from 9% to 23% by weight.

5.2.4 Fill – Silty Clay

Silty clay fill was encountered at this site extending to depths ranging from 0.7 m to 7.0 m below ground surface or to elevations ranging from Elev. 181.0 m to Elev. 177.9 m. There is an existing fill stockpile in this quadrant and the fill depth ranges from about 5.6 m to 7.0 m. The boreholes that were drilled through this stockpile are ES10+000Rt, ES10+050CL and MR9+900CL.

The grain size distribution plots of tested samples of this fill are presented in Figure B2-3. These results show a grain size distribution consisting of 0-6% gravel, 3-17% sand, 38-49% silt and 28-59% clay size particles.

A sample of the fill material was also subjected to Atterberg Limits tests and the results are presented in Figure B2-4. The index values from these tests are summarized below:

Liquid Limit:	27-43%
Plastic Limit:	16-24%
Plasticity Index:	11-19%
Natural Moisture Content:	13-20%

These values are characteristic of clayey soils of low to intermediate plasticity.

Standard Penetration tests in this silty clay fill gave 'N' values that ranged from 4 to 34 blows per 0.3 m penetration. Based on these results the silty clay fill is considered to have a firm to hard consistency. The moisture content (by weight) of samples of this fill generally ranged from 13% to 38% and a value of 45% was obtained where the sampled material contained organics.

5.2.5 Peat, Organic Sandy Silt and Silty Fine Sand

A 0.8 m thick layer of amorphous peat was encountered below the stockpile material in Borehole ES10+000Lt. The peat extends to a depth of 6.4 (Elev. 178.6 m) and is further underlain by a 300 mm thick layer of organic sandy silt that extends to a depth of 6.7 m (Elev. 178.3 m).

The peat and organic silt in Borehole ES10+000Lt. are underlain by a 300 mm thick layer of wet silty fine sand that extends to a depth of 7.0m (Elev. 178.0 m).

A Standard Penetration test in these strata gave an 'N' value of 20 blows per 0.3 m penetration. Based on these results the peat is considered to have a very stiff consistency. The moisture content (by weight) of samples of these soils ranged from 20% to 66%.

5.2.6 Silty Clay

A major silty clay deposit was encountered in all of the boreholes in this quadrant of the interchange. This silty clay deposit was fully penetrated in Boreholes NE10+450CL and MR9+950Rt. at depths of 8.9 m (Elev. 171.3 m) and 8.7 m (Elev. 171.5 m) respectively. In the remaining boreholes the investigations were terminated in this layer.

The grain size distribution plots of tested samples of the silty clay are presented in Figures B2-5 to B2-9. These results show a grain size distribution consisting of 0% gravel, 0-14% sand, 31-69% silt and 31-69% clay size particles.

Samples were also subjected to Atterberg Limits tests and the results are plotted on the plasticity charts in Figures B2-10 to B2-14. The index values from these tests are summarized below:

Liquid Limit:	26-47%
Plastic Limit:	16-24%
Plasticity Index:	10-27%
Natural Moisture Content:	19-35%

These values are characteristic of clayey soils of generally low to intermediate plasticity.

Standard Penetration tests in this deposit yielded 'N' values ranging from 1 to 55 blows for 0.3 m penetration and field vane tests gave in-situ undrained shear strengths ranging from 32 kPa to in excess of 100 kPa. An unconfined compression test gave an undrained shear strength of 33 kPa and laboratory vane tests on Shelby Tube samples gave undrained shear strengths ranging from 30 kPa to 56 kPa. These values indicate that the consistency of the silty clay is generally firm to hard.

The variation of undrained shear strength with depth is depicted in the attached plot of field vane test results versus depth, Figure B2-16. There is a trend in the variation of shear strength with depth. The upper portion of this deposit up to about Elev. 175.5 m has a relatively higher undrained shear strength i.e. in excess of 100 kPa. Below Elev. 175.5 m the undrained shear strength decreases then increases again below Elev. 172.0 m.

The results of the Atterberg Limits tests are also plotted against elevation (Figure B2-17). Up to about Elev. 177.0 m the natural moisture content is at or close to the plastic limit. Below Elev. 177.0 m the plot indicates a trend of increasing liquidity index.

Three consolidation tests were also performed on relatively undisturbed samples retrieved from Borehole MR9+850Rt., NE10+450CL and EWS10+100Rt. and the results are attached in Figures B2-18 to B2-26. Preconsolidation pressures were estimated from the e-log p curves. Due to the rounded nature of the curves the preconsolidation pressures were also assessed based on the 'Work' – method proposed by Becker et al. (1987). The details of the test results are summarized below.

Borehole/Sample No.	Sample Depth/Elevation (m)	P_c (kPa)	C_c	C_r	e_o
MR 9+850Rt. TW7	6.0/173.8	280	0.478	0.091	1.06
NE 10+450 CL TW8	7.6/172.6	190 – 220	0.254	0.045	0.68
EWS 10+100Rt. TW7	6.0/174.7	290 – 400	0.433	0.073	0.99

Where: P_c = Preconsolidation pressure
C_c = Compression index
C_r = Recompression index
e_o = Initial void ratio

The field and laboratory data indicate that the silty clay deposit consists of a generally stiff to hard overconsolidated desiccated crust that is estimated to extend to about Elev. 176.5 m. Below Elev. 176.5 m the silty clay deposit is generally firm to very stiff.

5.2.7 Silt

A lower silt deposit was encountered in Boreholes NE 10+450CL and MR 9+950Rt at depths of 8.9 m (Elev. 171.3 m) and 8.7 m (Elev. 171.5 m) respectively. The silt deposit extends to at least the termination depths of the boreholes or deeper.

A sample of this soil was subjected to a grain size distribution test and the results are depicted on the grain size distribution curve in Figure B2-15. These results show a grain size distribution consisting of 1% gravel, 1% sand, 91% silt and 7% clay size particles.

Standard Penetration tests conducted in this deposit gave 'N' values that ranged from 7 to 32 blows for 0.3 m penetration indicating a compact relative density. The moisture content (by weight) of a sample of the silt was 23%.

5.3 Water Levels

A standpipe piezometer was installed in selected boreholes. The water level readings measured on separate visits made after the completion of drilling are presented in Table 5.2.

Table 5.2 – Water Level Measurements (South East Quadrant)

Borehole	Date	Water Levels	
		Depth (m)	Elevation (m)
SEW 10+200CL	September 09, 2009	3.7	175.0
	September 10, 2009	3.0	175.7
C1	September 09, 2009	Dry	-
	September 10, 2009	Dry	-
	September 11, 2009	Dry	-
	September 15, 2009	2.4	176.1
C2	September 09, 2009	1.2	177.2
	September 10, 2009	1.3	177.1
	September 11, 2009	1.3	177.1
	September 15, 2009	1.4	177.0
SEW 10+300CL	September 09, 2009	1.4	177.5
	September 10, 2009	1.3	177.6
	September 15, 2009	1.0	177.9
SEW 10+350Rt.	September 09, 2009	5.5	173.6
	September 11, 2009	5.4	173.7
	September 15, 2009	5.0	174.1
WN 10+000Rt.	September 09, 2009	2.4	178.0
	September 10, 2009	2.5	177.9
	September 11, 2009	2.5	177.9
	September 15, 2009	2.6	177.8
WN 10+050CL	September 09, 2009	4.6	176.2
	September 11, 2009	3.9	176.9
	September 15, 2009	3.9	176.9
EWN 10+150CL	September 09, 2009	4.8	173.9
	September 10, 2009	4.7	174.0
	September 15, 2009	4.6	174.1
C3	September 09, 2009	2.8	176.2
	September 10, 2009	2.7	176.3
	September 11, 2009	2.2	176.8
	September 15, 2009	2.1	176.9
C4	September 09, 2009	Dry	-
	September 10, 2009	Dry	-
	September 11, 2009	Dry	-
	September 15, 2009	Dry	-
MR 10+075Lt.	September 09, 2009	7.2	179.0
	September 10, 2009	7.0	179.2
	September 11, 2009	6.9	179.3
	September 15, 2009	6.8	179.4
MR 10+100CL	September 09, 2009	12.3	173.1
	September 11, 2009	12.3	173.1
	September 15, 2009	10.3	175.1
MR 10+150Lt.	Destroyed by Construction Activity	-	-

Table 5.2 – Water Level Measurements (North West Quadrant)

Borehole	Date	Water Levels	
		Depth (m)	Elevation (m)
NEW 10+350CL	September 10, 2009	4.9	176.0
	September 11, 2009	4.3	176.6
	September 15, 2009	4.2	176.7
NW 10+000Rt.	September 10, 2009	Dry	-
	September 11, 2009	Dry	-
	September 15, 2009	4.4	175.8
NE 10+450CL	September 10, 2009	1.9	178.3
	September 11, 2009	1.8	178.4
	September 15, 2009	1.5	178.7
ES 10+000Rt.	September 10, 2009	12.6	172.3
	September 11, 2009	12.0	172.9
	September 15, 2009	11.2	173.7
ES 10+050CL	September 10, 2009	12.3	173.6
	September 11, 2009	12.3	173.6
	September 15, 2009	12.2	173.7
EWS 10+100Rt.	September 10, 2009	Dry	-
	September 11, 2009	Dry	-
	September 15, 2009	Dry	-
EWS 10+150CL	September 10, 2009	Dry	-
	September 11, 2009	Dry	-
	September 15, 2009	Dry	-
WS 10+025CL	September 10, 2009	7.9	172.3
	September 11, 2009	7.3	172.9
	September 15, 2009	6.6	173.6
MR 9+850Rt.	September 10, 2009	6.0	173.8
	September 11, 2009	4.6	175.2
	September 15, 2009	3.9	175.9
MR 9+950Rt.	Destroyed by Construction Activity	-	-

The groundwater table was estimated based on the recorded water levels in standpipe piezometers, our review of moisture contents of the retrieved samples and the change in colour of the soil matrix from brown to grey.

This interpretation indicates a groundwater table that is estimated to range between Elev. ±176.0 m and Elev. ±177.0 m. Perched water can also be expected to occur where permeable layers of sands and silts and sand and gravel are underlain by relatively impermeable silty clay layers.

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

5.4 Miscellaneous

The drilling, sampling and in-situ testing operations were conducted with track and truck mounted drill rigs owned and operated by Groundworks Drilling Limited of Toronto, Ontario, DBW Drilling Limited of Ajax, Ontario and Determination Drilling & Soil Investigations of Hamilton, Ontario. The boreholes were advanced using both solid stem and hollow-stem auger drilling techniques.

Messrs. Sajjad Shah, E.I.T, Marc Paoliello, E.I.T, and Bob Racher, C.E.T., carried out the field supervision. The laboratory testing was performed at Terraprobe's Brampton laboratory and the Mississauga laboratory of Golder Associates. The report was written by Rehman Abdul, P.Eng. and reviewed by Michael Tanos, P.Eng.

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FOUNDATION DESIGN REPORT

HIGH FILLS AT MERRITT ROAD INTERCHANGE

HIGHWAY 406 TWINNING

ONTARIO

AGREEMENT No. 2008-E-0016, W.P. 280-99-00, GEOCRES No.: 30M3-252

PART 2: ENGINEERING DISCUSSION AND RECOMMENDATIONS

6 GENERAL

This report contains interpretation of the geotechnical data in the factual report and presents geotechnical design recommendations to assist the design team to select and design suitable embankments for the proposed interchange.

Seven ramps will be constructed as part of this interchange. Ramp 406N-Merritt Road W, Ramp 406N-Merritt Road E, Merritt Road E-406S and Merritt Road W-406S will be constructed in the northwest quadrant of the interchange. Ramp 406S-Merritt Road E/W, Merritt Road E-406N and Merritt Road W-406N will occupy the southeast quadrant. Merritt Road will cross over Highway 406 via an underpass that is currently under construction.

The Merritt Road underpass and portions of its approach embankments are currently under construction under Contract No. 2009-2003, W.P. 2024-08-00. The limits of this contract on Merritt Road extend from Sta. 9+752 to Sta. 10+173.

The west approach will extend approximately 50 m from the west bridge abutment to Sta. 9+915 where the design grade will be approximately Elev. ±188 m. From Sta. 9+915 the embankment will be sloped at 2H:1V with a temporary toe at Sta. 9+895. The east approach will extend about 22 m from the east bridge abutment to Sta. 10+060 where the design grade will be approximately Elev. ±188.5 m. From Sta. 10+060 the approach embankment will be sloped at 2H:1V with a temporary toe at Sta. 10+075.

Design grades and embankment heights at this interchange are outlined below.

- Merritt Road. The embankment height approaches 4 m (Elev. ±185 m) at Sta. 9+790 increasing to a maximum height of about 8.5 m (Profile Elev. ±188 m) at Sta. 9+915. Further west the embankment height will be about 9.5m at Sta. 10+060 decreasing gradually to approximately 4 m (Elev. ±185 m) at Sta. 10+200.
- Ramp 406N-Merritt Road W. At Sta. 10+000 the embankment height is approximately 4 m (Profile Elev. 184.7 m) increasing to ±4.8 (Profile Elev. 185 m) at Sta. 10+025 then falling gradually to Sta. 10+110 where the height of the embankment is estimated to be about 4 m (Profile Elev. ±183.1).

- Ramp 406N-Merritt Road E. At Sta. 10+390 the embankment height is approximately 4 m (Profile Elev. 184.5 m) increasing to ±6 m (Profile Elev. 186 m) at Sta. 10+455.
- Merritt Road E-406S. At Sta. 10+000 the embankment will be about 8 m high (Profile Elev. 188 m) gradually reducing to 4 m height (Profile Elev. ±184.7 m) at Sta. 10+110.
- Merritt Road W-406S. At Sta. 10+000 the embankment will be about 6.5 m high (Profile Elev. 186.5 m) gradually reducing in height to 5.5 m (Profile Elev. ±185.8 m) at Sta. 10+045.
- Ramp 406S-Merritt Road E/W. The embankment height will be approximately 4 m (Profile Elev. ±182.6 m) at Sta. 10+225 increasing to a maximum height of about 6 m (Profile Elev. ±186 m) at Sta. 10+375.
- Ramp Merritt Road W-406N. The maximum embankment height of the W-N Ramp will be about 8 m (Profile Elev. ±188 m) at Sta. 10+000 decreasing to about 4 m at Sta. 10+170 where a design grade of Elv. ±182.5 is proposed.
- Ramp Merritt Road E-406N. The E-N ramp is approximately 50 m long and based on an approximate design grade of Elev. ±186.5 m the height of this embankment is estimated to be about 6.5 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.

7 EMBANKMENT STABILITY

Embankments constructed at conventional 2H:1V slopes in the Niagara area have historically performed below par. Shallow surficial failures usually occur on the face of these slopes thereby requiring frequent maintenance in order to prevent more significant deep-seated failures.

Recent studies conducted by the Ministry indicate that these shallow surficial failures occur because of the mineralogy of the local soils and its inherent effect on the effective shear strength of the local clay fill. Poor performance was also attributed to climatic effects including precipitation, wetting and drying cycles, snow melt and freezing and thawing cycles.

The historical performance of existing embankments was considered when selecting embankment alternatives for this project. The selected alternatives are outlined below and a summary of the advantages, disadvantages, risks/consequences and approximate costs of each alternative is presented in Appendix E.

- Embankments consisting of local earth borrow.
- Composite embankment consisting of a local earth borrow core protected with a Granular A face.
- Embankments consisting of SSM imported from a designated source.
- Reinforced earth embankments consisting of local earth borrow.
- Embankments consisting of lightweight fill.

The global, internal and surficial stability of the embankments will depend on their slope geometries and also to a large degree on the material used to construct the embankment. For the purpose of embankment stability analyses, the commercially available slope stability program Slide 5.0 developed by Rocscience Inc. was used. The Janbu, Morgenstern-Price and Bishop's simplified method for stability analysis were employed and a minimum target factor of safety 1.3 was established.

For the undrained (short-term) analyses, the measured field vane results were corrected by applying a vane shear correction factor (intended to compensate for pore-pressure and shearing-rate effects during field testing) in accordance with Morris and Williams (1994)[3]. The corrected undrained shear strengths were plotted against elevation (Figures F1 and F2) and a design shear strength line was established. The soil parameters used for the slope stability analyses are presented in Table 7.1.

Table 7.1 – Soil Parameters

Material Type	Short-Term Analysis			Long-Term Analysis		
	ϕ (degrees)	c (kPa)	γ (kN/m^3)	ϕ' (degrees)	c' (kPa)	γ (kN/m^3)
Local Earth Fill	31	0	19.0	31	0	19.0
Granular A	35	0	22.8	35	0	22.8
Select Subgrade Material	32	0	20.0	32	0	20.0
Lightweight Fill*	35	0	14.5	35	0	14.5
Ultra Lightweight Fill*	35	0	11.5	35	0	11.5
Upper Silty Clay	0	100	20.5	29	7	20.5
Lower Silty Clay	0	50-55	20.0	27	5	20.0

* Pelletized Blast Furnace Slag – Reference Lafarge Canada Inc.

In our analysis we incorporated a 2 m wide mid-height berm for embankment heights equal to or greater than 8 m. A reinforcement length equivalent to 70% of the embankment height was used for the analysis of RSS embankments.

The composite embankment was modelled as a core of local earth fill material with a Granular "A' facing as depicted in Figure F3. Constructing this type of embankment requires benching the earth core/Granular 'A' interface in accordance with OPSD 208.010.

Numerous stability analyses were conducted and the minimum factors of safety obtained for the various embankment options are summarized in Tables 7.2 and 7.3. The slope stability models and results are also illustrated in Appendix F.

Table 7.2 – Merritt Road – South East Quadrant

Embankment Composition	Design Side Slope	Minimum Factor of Safety Short-Term	Minimum Factor of Safety Long-Term
Local Earth Fill (Fig. 1's)	3H:1V	1.7	2.1
Composite Embankment Fig. 2's)	2.5H:1V	1.6	1.8
SSM Embankment (Fig. 3's)	2H:1V	1.5	1.4
RSS Embankment (Fig. 4's)	2H:1V	1.7	1.8
Light Weight Fill (Fig. 5's)	2H:1V	1.6	1.6
Ultra Light Weight Fill (Fig. 6's)	2H:1V	1.6	1.6

[3] Morris, P.M., and Williams, D.T. (1994). "Effective Stress Vane Shear Strength Correction Factor Correlations," Canadian Geotechnical Journal, Vol.31, No.3, pp. 335-342.

Table 7.3 - Merritt Road – North West Quadrant

Embankment Composition	Design Side Slope	Minimum Factor of Safety Short-Term	Minimum Factor of Safety Long-Term
Local Earth Fill (Fig. 7's)	3H:1V	1.7	2.1
Composite Embankment (Fig. 8's)	2.5H:1V	1.6	1.8
SSM Embankment (Fig. 9's)	2H:1V	1.4	1.4
RSS Embankment (Fig. 10's)	2H:1V	1.7	1.8
Light Weight Fill (Fig. 11's)	2H:1V	1.6	1.6
Ultra Lightweight Fill (Fig. 12's)	2H:1V	1.6	1.6

Where earth fill, SSM or lightweight 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.

8 EMBANKMENT SETTLEMENT

To predict the magnitude and time rate of settlement of the underlying silty clay soils the commercially available program Settle 3D developed by Rocscience Inc. was used. The highest embankment sections (next to the bridge approaches) and the areas where the off-ramps will tie into the Merritt Road embankments were selected as critical sections.

The deformation parameters used for the analyses were established from data obtained from consolidation tests as well as from predictions based on undrained shear strengths, laboratory index tests and soil moisture contents.

Pre-consolidation pressures were estimated from the consolidation test e-log p curves and the Strain-Energy method proposed by Becker (1987). The empirical correlation suggested in the literature by Skempton (1957) was also used to estimate preconsolidation pressures. Profiles of the preconsolidation pressure design lines (representing a design range) versus elevation are illustrated in Figures G1 and G2. The vertical effective overburden stress is also plotted on these figures.

Values of the compression index (C_c) and recompression index (C_r) were estimated from the consolidation tests as well as from laboratory index test data using empirical correlations proposed in literature by Kulhawy and Mayne (1990), Terzaghi and Peck (1967) and Nagaraj and Murty (1985). Profiles of the design lines (representing a design range) versus elevation are shown on Figures G3 to G6.

Initial void ratio (e_o) values were estimated from the consolidation tests as well as from empirical correlations proposed in the literature by Moh and Kol (1989), Cozzolino (1961), Nishida (1956) and Rendon-Herro (1983). Profiles of the design lines (representing a design range) versus elevation are shown on Figures G7 and G8.

The data indicates that an over-consolidated desiccated upper crust exists within the silty clay stratum. There is a wide scatter in the data and a slight variation of P_c with depth. Therefore the two rows of data represent the range of values for the upper and lower half of the two strata. The parameters used for the settlement calculations are tabulated as follows.

Table 8.1 – Settlement Parameters - Merritt Road Interchange

Parameter	South East Quadrant		North West Quadrant	
	Upper Crust	Lower Silty Clay	Upper Crust	Lower Silty Clay
Preconsolidation Pressure Range - P_c (kPa)	600 to 450 500 to 400	450 to 300 400 to 300	600 to 450 500 to 400	450 to 300 400 to 300
Coefficient of Compressibility - C_c	0.25 to 0.275	0.20 to 0.23	0.25 to 0.275	0.20 to 0.23
Recompression Index - C_r	0.04	0.03 to 0.04	0.04	0.03 to 0.04
Initial Void Ratio e_o	0.65 to 0.9	1.0	0.65 to 0.9	1.0

Settlement analyses were undertaken for various embankment compositions and geometries and the estimated range of total settlements at the embankment centreline are provided in Table 8.2.

Table 8.2 – Estimated Total Consolidation Settlement At Embankment Centreline

Type of Fill	Unit Weight of Fill (kN/m^3)	Side Slope Geometry	Settlement (mm)	
			South East Quadrant (mm)	North West Quadrant (mm)
Local Earth Fill	19.0	3H:1V	95 - 145	95 – 145
Composite Embankment	19.5	2.5H:1V	95 - 145	95 - 145
SSM & RSS	20.0	2H:1V	95 – 150	95 – 150
Lightweight Fill*	14.5	2H:1V	80 – 125	80 – 125
Ultra Lightweight Fill*	11.5	2H:1V	70 – 110	70 – 110

* Pelletized Blast Furnace Slag – Reference Lafarge Canada Inc.

The embankment fill will also settle (fill compression) and this settlement is expected to be about 1% of the fill height for local earth fill, composite, SSM & RSS embankments. A value of 0.5% of the fill height is recommended for Lightweight and Ultra Lightweight fill embankments. The settlement within non-cohesive fill should be immediate in nature and essentially be complete shortly after construction is complete.

The length of time required to complete consolidation settlement of the foundation strata is a function of the value of the coefficient of consolidation of the native silty clay strata and the assumed depth of drainage path. Given the very stiff to hard consistency, heavily over-consolidated and likely fractured nature of the desiccated upper crust, it is reasonable to assume that consolidation/recompression will occur quickly in the crust and that the rate of consolidation will be primarily controlled by the coefficient of consolidation and thickness of the underlying firm to stiff silty clay stratum. The coefficient of consolidation was estimated to range between $2.8x10^{-2}$ cm^2/s and $3.2x10^{-2}$ cm^2/s.

Tabulated below is the range of predicted settlements at various time periods.

Embankment Type	Settlement At Various Time Periods (mm)				Total Settlement (mm)
	6 months	12 months	18 months	24 months	
Local Earth Fill	75 – 100	85 – 110	90 – 115	95 – 140	95 – 145
Composite Embankment	75 – 100	85 – 110	90 – 115	95 – 140	95 – 145
SSM & RSS	75 – 105	85 – 115	90 – 120	95 – 140	95 – 150
Lightweight Fill*	65 – 85	70 – 95	75 – 100	80 – 120	80 – 125
Ultra Lightweight Fill*	60 – 80	65 – 85	65 – 90	70 - 105	70 – 110

* Pelletized Blast Furnace Slag – Reference Lafarge Canada Inc.

It is understood that a maximum allowable post construction settlement of about 50 mm would be considered acceptable for this project and the analysis indicates that after embankment construction, an approximate 6 month waiting period is required in order to meet this performance criteria. Given the uncertainty in predicting accurately the time rate of settlement, we recommend that conventional temporary surcharging be carried out (2 m of additional earth fill height) to accelerate the settlement and ensure full consolidation within the target 6 months after embankment construction. Other means/methods of accelerating the settlement such as wick drains are therefore not warranted.

Surcharged embankments were analysed for stability in accordance with the recommended side slopes in Figures I1 to I3 and the analyses yielded factors of safety equal to or greater than a target factor of safety of 1.3.

Settlement monitoring is a requirement to confirm that most of the settlement is complete prior to commencing paving operations. A special provision for the supply and installation of embankment monitoring equipment is provided in Appendix H.

9 SOIL STRUCTURE INTERACTION

It is noted that the Merritt Road underpass and portions of the approach embankments are currently being constructed under Contract No. 2009-2003, W.P. 2024-08-00. Construction drawings indicate that approximately 50 m of the west approach and about 22 m of east approach (measured from the bridge abutments) will be constructed with the structure.

These previously completed approach embankments would have imparted downdrag loads on the foundations of the new structure. Although new embankments will subject the underlying soils to additional loads, these loads will be equal to or less than the applied loads of the existing embankments. Hence, placing new fill against the existing embankments is not expected to increase the magnitude of the current downdrag loads on the structure foundations.

10 SEISMIC CONSIDERATIONS

10.1 Liquefaction Potential

Liquefaction is not considered to be an issue at this site. The underlying silty clay soils are not prone to liquefaction.

11 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. Borrow material must meet the requirements of OPSS 212, (2008). Grading shall be undertaken in accordance with OPSS 201, (2007) and OPSS 206, (2009). Based on the borehole data and information from Contract No. 2009-2003, the recommended stripping depths and subgrade elevations of the proposed embankments are:

Location	From Station	To Station	Average Stripping Depth (m)	Recommended Subgrade Elevation (m)
Merritt Road West Approach	9+750	9+790	±0.3	±181.0
	9+790	9+850	±0.2	±180.0
	9+850	9+895	±0.5	±179.5*
Merritt Road East Approach	10+075	10+140	±1.0	±179.0*
	10+140	10+225	±0.3 to ± 1.0	±179.5

* Based on excavating existing stockpile material to Elev. 180 m under Contract No. 2009-2003, W.P. 2024-08-00

Location	From Station	To Station	Estimated Stripping Depth (m)	Recommended Subgrade Elevation (m)
Ramp N-Merritt Road W	10+000	10+075	±0.7	±179.5
	10+075	10+110	±0.7	±179.0
Ramp 406N-Merritt Road E	10+350	10+460	±0.2 to ± 0.9	±180.0

Location	From Station	To Station	Estimated Stripping Depth (m)	Recommended Subgrade Elevation (m)
Ramp Merritt Road E-406S	10+025	10+070	±0.0	±180.0*
	10+070	10+100	±0.5 to ± 0.7	±180.0
	10+100	10+150	±0.6	±180.5
Ramp Merritt Road W-406S	10+000	10+045	±0.2 to ± 0.7	±180.0

* Based on excavating existing stockpile material to Elev. 180 m under Contract No. 2009-2003, W.P. 2024-08-00

Location	From Station	To Station	Estimated Stripping Depth (m)	Recommended Subgrade Elevation (m)
Ramp 406S-Merritt Road E/W	10+200	10+275	±0.4 to ± 0.7	±178.0
	10+325	10+365	±0.0 to ± 0.5	±179.0
	10+365	10+380	±0.5	±180.0

Location	From Station	To Station	Estimated Stripping Depth (m)	Recommended Subgrade Elevation (m)
Ramp Merritt Road W-406N	10+000	10+025	±0.0 to 0.4	±180.0*
	10+025	10+060	±0.3	±180.5
	10+060	10+175	±0.0 to ± 0.2	±179.0
Ramp Merritt Road E-406N	10+000	10+020	±0.5	±180.0
	10+020	10+045	±0.2 to ± 0.5	±179.0

* Based on excavating existing stockpile material to Elev. 180 m under Contract No. 2009-2003, W.P. 2024-08-00

After stripping, the exposed subgrade should be inspected, approved and properly compacted from the surface in accordance with OPSS 501. If the silty clay soils at this site become wet they will be weakened when subjected to construction traffic. To facilitate construction operations in inclement weather (when stripping to the recommended subgrade elevation) surface water runoff should be controlled by gravity drainage and a system of interceptor trenches. In wet weather an approximately 200 mm thick free draining granular layer would also be required to minimize disturbance and maintain trafficability of construction equipment.

Materials used for embankment construction 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. Bonding between the embankment fill and the existing embankments should be established by benching as per OPSD 208.010.

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

It is also imperative that the designs include provisions for preventing the flow of surface water down the face of slopes. Consideration can be given to using a mountable curb and gutter arrangement to control and divert surface water away from the top of the slope. Surface water must be directed to armoured outfalls/outlets designed to drain into roadside ditches.

Engineering Analysis and Report Preparation by:
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Report Reviewed by:
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Review Principal

TABLE

TERRAPROBE INC.

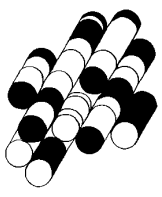
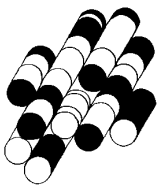


TABLE 1

DOCUMENT	TITLE
OPSS 201	Construction Specification for Clearing, Close Cut Clearing, Grubbing and Removal of Surface and Piled Boulders.
OPSS 206	Construction Specification for Grading.
OPSS 212	Construction Specification of Borrow.
OPSS 501	Construction Specification for Compacting.
OPSS 571	Construction Specification for Sodding.
OPSS 572	Construction Specification for Seed and Cover.
OPSS 577	Construction Specification for Temporary Erosion and Sediment Control Measures.
OPSD 208.010	Benching of Earth Slopes.

APPENDICES

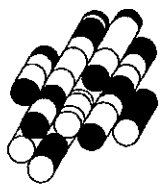
TERRAPROBE INC.



APPENDIX A

Log of Borehole Sheets (South East Quadrant)

Terraprobe Inc.



EXPLANATION OF TERMS USED IN REPORT

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

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

SOILS ARE DESCRIBED BY THEIR COMPOSITION AND CONSISTENCY OR DENSENESS.

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

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

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

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

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

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

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

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

JOINTING AND BEDDING:

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

ABBREVIATIONS AND SYMBOLS

FIELD SAMPLING

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

STRESS AND STRAIN

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

MECHANICAL PROPERTIES OF SOIL

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

PHYSICAL PROPERTIES OF SOIL

ρ_s	kg/m^3	DENSITY OF SOLID PARTICLES
γ_s	kN/m^3	UNIT WEIGHT OF SOLID PARTICLES
ρ_w	kg/m^3	DENSITY OF WATER
γ_w	kN/m^3	UNIT WEIGHT OF WATER
ρ	kg/m^3	DENSITY OF SOIL
γ	kN/m^3	UNIT WEIGHT OF SOIL
ρ_d	kg/m^3	DENSITY OF DRY SOIL
γ_d	kN/m^3	UNIT WEIGHT OF DRY SOIL
ρ_{sat}	kg/m^3	DENSITY OF SATURATED SOIL
γ_{sat}	kN/m^3	UNIT WEIGHT OF SATURATED SOIL
ρ'	kg/m^3	DENSITY OF SUBMERGED SOIL
γ'	kN/m^3	UNIT WEIGHT OF SUBMERGED SOIL

e	1,%	VOID RATIO
n	1,%	POROSITY
w	1,%	WATER CONTENT
S_r	%	DEGREE OF SATURATION
w_L	%	LIQUID LIMIT
w_P	%	PLASTIC LIMIT
w_S	%	SHRINKAGE LIMIT
I_P	%	PLASTICITY INDEX = $(w_L - w_P)$
I_L	1	LIQUIDITY INDEX = $(w - w_P)/I_P$
I_C	1	CONSISTENCY INDEX = $(w_L - w)/I_P$
e_{max}	1,%	VOID RATIO IN LOOSEST STATE

e_{min}	1,%	VOID RATIO IN DENSEST STATE
I_D	1	DENSITY INDEX = $\frac{e_{max} - e}{e_{max} - e_{min}}$
D	mm	GRAIN DIAMETER
D_n	mm	n PERCENT - DIAMETER
C_u	1	UNIFORMITY COEFFICIENT
h	m	HYDRAULIC HEAD OR POTENTIAL
q	m^3/s	RATE OF DISCHARGE
v	m/s	DISCHARGE VELOCITY
i	1	HYDRAULIC GRADIENT
k	m/s	HYDRAULIC CONDUCTIVITY
j	kN/m^3	SEEPAGE FORCE

LIMITATIONS AND RISK

Procedures

The soil conditions were confirmed at the borehole and test pit 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

RECORD OF BOREHOLE No SEW 10+200 CL 1 OF 1 METRIC

W.P. 280-99-00 LOCATION Coords: N:4765982.3 E:326771.7 ORIGINATED BY SS

DIST HWY 406 BOREHOLE TYPE Solid Stem Augers COMPILED BY DB

DATUM Geodetic DATE 09.02.09 CHECKED BY RA

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%) (10 20 30)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
178.7	Ground Surface										
178.6 / 0.1	100mm TOPSOIL										
178.0	FILL - Silty Clay, trace sand, trace rootlets, stiff, brown, damp		1	SS	10						
0.7	SILTY CLAY trace sand, stiff to very stiff, brown to 4.0m, grey below, damp to moist		2	SS	20		178				
			3	SS	14		177				
			4	SS	23		176				0 1 49 50
			5	SS	20*		175				
	---- firm to stiff										
			6	SS	4		174				0 4 50 46
172.9							173				
5.8	End of Borehole										

Borehole was dry (not stabilized) and hole open to full depth on completion.

* Moved 1m away from original location and drilled to 3.0m to obtain TW sample at 3.0m.

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

Water Level Readings:

Date	Depth(m)	Elevation(m)
Sep.09.09	3.7	175.0
Sep.10.09	3.0	175.7

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

RECORD OF BOREHOLE No C1

1 OF 1

METRIC

W.P. 280-99-00 LOCATION Coords: N:4765568.0 E:327000.6 ORIGINATED BY SS

DIST HWY 406 BOREHOLE TYPE Solid Stem Augers COMPILED BY DB

DATUM Geodetic DATE 09.02.09 CHECKED BY RA

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
178.5	Ground Surface										
178.4	130mm TOPSOIL										
0.1	occasional sand pockets, trace rootlets		1	SS	7		178				
	SILTY CLAY firm to very stiff, brown, damp to moist		2	SS	18						
			3	SS	28		177				
	grey / brown		4	SS	19		176				
			5	SS	12		175				
174.2											
4.3	End of Borehole										

Borehole was dry (not stabilized) and hole open to full depth on completion.

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

Water Level Readings:

Date	Depth(m)	Elevation(m)
Sep.09.09	Dry	-
Sep.10.09	Dry	-
Sep.11.09	Dry	-
Sep.15.09	2.4	176.1

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

RECORD OF BOREHOLE No C2 1 OF 1 METRIC

W.P. 280-99-00 LOCATION Coords: N:4766023.8 E:326775.9 ORIGINATED BY SS

DIST HWY 406 BOREHOLE TYPE Solid Stem Augers COMPILED BY DB

DATUM Geodetic DATE 09.02.09 CHECKED BY RA

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 10 20 30	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
178.4	Ground Surface										
178.2	205mm TOPSOIL										
0.2 / 177.7	FILL - Silty Clay, trace sand, stiff, grey, damp		1	SS	8		178				
0.7	frequent silty fine sand seams and partings --- SILTY CLAY very stiff, brown, damp to moist --- grey		2	SS	16		177				
			3	SS	18						
			4	SS	23		176				
174.9			5	SS	20		175				
3.5	End of Borehole Borehole was dry (not stabilized) and hole open to full depth on completion. Piezometer installation consists of a 19mm diameter, Schedule 40 PVC pipe with a 1.52m slotted screen. Water Level Readings: Date Depth(m) Elevation(m) Sep.09.09 1.2 177.2 Sep.10.09 1.3 177.1 Sep.11.09 1.3 177.1 Sep.15.09 1.4 177.0										

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

RECORD OF BOREHOLE No SEW 10+250 Lt 1 OF 1 METRIC

W.P. 260-99-00 LOCATION Coords: N:4766032.0 E:326766.9 ORIGINATED BY SS

DIST HWY 406 BOREHOLE TYPE Solid Stem Augers COMPILED BY DB

DATUM Geodetic DATE 09.03.09 CHECKED BY RA

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
178.6	Ground Surface										
178.6 / 0.1	90mm TOPSOIL										
	SANDY SILT - trace to some clay, trace gravel, loose, brown, wet		1	SS	7				○		0 35 47 18
177.9 / 0.7	SILTY CLAY occasional silt seams, hard, brown to 2.9m, grey below, damp to moist		2	SS	33		178		○		
			3	SS	32		177		○		
			4	SS	35		176		○		
	---- stiff to very stiff		5	SS	22				○		0 2 52 46
							175				
			6	SS	12		174		○		
									1.5		
172.7 / 5.9	End of Borehole						173				
	Borehole was dry (not stabilized) and hole open to full depth on completion.										

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

RECORD OF BOREHOLE No SEW 10+250 Rt 1 OF 1 METRIC

W.P. 280-99-00 LOCATION Coords: N:4766032.5 E:326766.6 ORIGINATED BY SS

DIST HWY 406 BOREHOLE TYPE Solid Stem Augers COMPILED BY DB

DATUM Geodetic DATE 09.02.09 CHECKED BY RA

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 10 20 30	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
178.6	Ground Surface										
178.4	205mm TOPSOIL										
0.2 / 177.9	SILTY SAND - gravelly, trace clay, trace organics, loose, brown, moist to wet		1	SS	4		178				
0.7	SILTY CLAY very stiff, brown to 2.1m, grey below, damp to moist		2	SS	17			---- sampler wet at 1.0m			
			3	SS	16		177				0 5 46 49
			4	SS	24		176				
			5	SS	20		175				
	---- firm					▽					
			6	SS	7		174		42		0 3 30 67
172.8							173				
5.8	End of Borehole										
	Water level at 4.4m (not stabilized) and hole open to full depth on completion.										

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

RECORD OF BOREHOLE No SEW 10+300 CL 1 OF 1 METRIC

W.P. 280-99-00 LOCATION Coords: N:4766080.2 E:326759.9 ORIGINATED BY BR

DIST HWY 406 BOREHOLE TYPE Hollow Stem Augers COMPILED BY DB

DATUM Geodetic DATE 09.02.09 CHECKED BY RA

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
178.9	Ground Surface										
0.0	trace rootlets, firm		1	SS	7						
	very stiff		2	SS	16		178				
	firm to stiff		3	SS	19		177				0 1 66 33
	SILTY CLAY - trace sand, weathered to 1.4m, brown to 2.9m, grey below, damp to moist		4	SS	9		176				
			5	SS	5		175	1.8, 1.7			
			6	TW	PH		174	1.6, 1.3	42	18.3	0 2 37 61
			7	SS	2		173				
171.6							172	1.0, 2.2			
7.3	End of Borehole										

Water level at 5.9m (not stabilized) and hole open to full depth on completion.

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

Water Level Readings:

Date	Depth(m)	Elevation(m)
Sep.09.09	1.4	177.5
Sep.10.09	1.3	177.6
Sep.15.09	1.0	177.9

Consolidation test performed on TW 6.

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

ONTARIO MOT 1-09-4135 MERRITT RD 2.GPJ ONTARIO MOT.GDT 05/10/10

RECORD OF BOREHOLE No SEW 10+350 Lt 1 OF 1 METRIC

W.P. 280-99-00 LOCATION Coords: N:4766119.2 E:326728.7 ORIGINATED BY BR

DIST HWY 406 BOREHOLE TYPE Hollow Stem Augers COMPILED BY DB

DATUM Geodetic DATE 09.02.09 CHECKED BY RA

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
179.5	Ground Surface										
179.3	180mm TOPSOIL										
0.2	SILTY SAND trace to some clay, loose, brown, moist to wet		1	SS	9		179				
			2	SS	7						0 54 30 16
177.8							178				
1.7	SILTY CLAY very stiff, brown, damp to moist		3	SS	22						
			4	SS	23		177				0 1 51 48
			5	SS	22						
	--- firm to very stiff						176				
			6	SS	10		175				0 0 60 40
							174				
			7	SS	6						
172.2							173	1.7, 1.3			
7.3	End of Borehole										

Borehole was dry (not stabilized) and hole open to full depth on completion.

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

RECORD OF BOREHOLE No SEW 10+350 Rt 1 OF 1 METRIC

W.P. 280-99-00 LOCATION Coords: N:4766123.7 E:326734.7 ORIGINATED BY BR

DIST HWY 406 BOREHOLE TYPE Hollow Stem Augers COMPILED BY DB

DATUM Geodetic DATE 09.02.09 CHECKED BY RA

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
179.1	Ground Surface										
0.0	SILTY CLAY trace sand to 0.7m depth, firm to stiff, brown, damp to moist		1	SS	7		179				
			2	SS	11		178				
177.7											
1.4	SILTY SAND trace organics, compact, brown / dark brown, wet		3	SS	11		177				
177.0											
2.1	SILTY CLAY very stiff, brown to 5.6m, grey below, damp to moist		4	SS	16						
			5	SS	16		176	---- no sample recovery at 3.0m on first attempt			
	---- firm to stiff						175				
			6	TW	PH		174			20.2	0 1 63 36
							173				
			7	SS	7						
171.8							172				
7.3	End of Borehole										

Borehole was dry (not stabilized) and hole open to full depth on completion.

Monitoring well installation consists of a 50mm diameter, Schedule 40 PVC pipe with a 3.0m slotted screen.

Water Level Readings:

Date	Depth(m)	Elevation(m)
Sep.09.09	5.5	173.6
Sep.11.09	5.4	173.7
Sep.15.09	5.0	174.1

Consolidation test performed on TW6.

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

ONTARIO MOT 1-09-4135 MERRITT RD 2.GPJ ONTARIO MOT.GDT 05/10/10

RECORD OF BOREHOLE No WN 10+000 Rt 1 OF 1 METRIC

W.P. 280-99-00 LOCATION Coords: N:4766077.8 E:326540.4 ORIGINATED BY BR

DIST HWY 406 BOREHOLE TYPE Hollow Stem Augers COMPILED BY DB

DATUM Geodetic DATE 09.01.09 CHECKED BY RA

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 10 20 30	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
180.4	Ground Surface										
0.0 / 179.7	FILL - Silty Clay, trace rootlets, stiff, brown, damp		1	SS	9		180				
0.7	SILTY CLAY trace sand, very stiff to hard, brown, damp to moist		2	SS	25		179				
			3	SS	28						
			4	SS	43	▼	178				
			5	SS	16		177				1 2 50 47
	--- firm to stiff, grey							2.7			
			6	SS	6		176				0 1 52 47
							175	2.0, 1.8			
			7	TW	PH		174		44	17.9	0 0 37 63
							173	1.6, 1.2			
			8	SS	4						
							172	2.6, 2.2			
			9	SS	4		171				0 0 57 43
169.9						▽		2.1			
10.5	SILT trace clay, trace sand, compact, grey, wet						170	2.4			
169.2			10	SS	13						0 1 91 8
11.2	End of Borehole										

Wet cave at 10.2m upon completion.

Monitoring well installation consists of a 50mm diameter, Schedule 40 PVC pipe with a 3.0m slotted screen.

Water Level Readings:

Date	Depth(m)	Elevation(m)
Sep.09.09	2.4	178.0
Sep.10.09	2.5	177.9
Sep.11.09	2.5	177.9
Sep.15.09	2.6	177.8

Consolidation test performed on TW7.

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

ONTARIO MOT 1-09-4135 MERRITT RD 2.GPJ ONTARIO MOT.GDT 05/10/10

RECORD OF BOREHOLE No WN 10+050 CL 1 OF 1 METRIC

W.P. 280-99-00 LOCATION Coords: N:4766096.3 E:326684.8 ORIGINATED BY MP

DIST HWY 406 BOREHOLE TYPE Solid Stem Augers COMPILED BY DB

DATUM Geodetic DATE 09.01.09 CHECKED BY RA

ELEV / DEPTH	DESCRIPTION	NUMBER	TYPE	"N" VALUES	GR	SA	SI	CL	UNIT WEIGHT γ kN/m³
180.8	Ground Surface								
0.0 / 180.4	FILL - Sand and Gravel, trace to some silt, compact, brown, dry to damp	1	SS	19					
0.4 / 180.1	FILL - Silty Clay, trace sand, inferred stiff, brown, dry to damp								
0.7	Weathered	2	SS	11	0	1	46	53	
	SILTY CLAY, trace sand, firm to stiff, brown, damp to moist	3	SS	11	0	1	52	47	
		4	SS	6					
		5	SS	10					
	trace gravel	6	TW	PH	2	4	55	39	20.4
		7	SS	0*					
173.5									
7.3	End of Borehole								

Borehole was dry (not stabilized) and hole open to full depth on completion.

* Sample sinking under weight of hammer and / or rods.

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

Water Level Readings:

Date	Depth(m)	Elevation(m)
Sep.09.09	4.6	176.2
Sep.11.09	3.9	176.9
Sep.15.09	3.9	176.9

Consolidation test performed on TW 6.

ELEVATION SCALE: 180, 179, 178, 177, 176, 175, 174

DYNAMIC CONE PENETRATION RESISTANCE PLOT: 20 40 60 80 100

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

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

WATER CONTENT (%): 10 20 30

1.8
1.3
1.8
1.2

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

ONTARIO MOT 1-09-4135 MERRITT RD 2.GPJ ONTARIO MOT.GDT 05/10/10

RECORD OF BOREHOLE No EN 10+025 CL 1 OF 1 METRIC

W.P. 280-99-00 LOCATION Coords: N:4766125.3 E:326710.0 ORIGINATED BY MP

DIST HWY 406 BOREHOLE TYPE Solid Stem Augers COMPILED BY DB

DATUM Geodetic DATE 09.01.09 CHECKED BY RA

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
180.5	Ground Surface										
0.0 / 179.8	660mm FILL - Sand and Gravel, some silt, trace clay, compact, brown, dry to damp		1	SS	18		180				36 41 19 4
0.7	SILTY CLAY - trace sand, weathered to 2.9m, stiff to very stiff, brown, damp to moist		2	SS	11		179				
			3	SS	21		178		46		0 1 47 52
			4	SS	16		177				
	--- stiff, grey / brown		5	SS	0*		176	sampler wet at 4.5m; 1.8			
			6	SS	0*		175	1.7			0 0 66 34
173.2							174	1.3, 1.8			
7.3	End of Borehole										

Borehole was dry (not stabilized) and hole open to full depth on completion.

* Sampler sinking under weight of hammer and / or rods.

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

ONTARIO MOT 1-09-4135 MERRITT RD 2.GPJ ONTARIO MOT.GDT 05/10/10

RECORD OF BOREHOLE No EWN 10+100 Lt 1 OF 1 METRIC

W.P. 280-99-00 LOCATION Coords: N:4766088.4 E:326736.2 ORIGINATED BY SS

DIST HWY 406 BOREHOLE TYPE Solid Stem Augers COMPILED BY DB

DATUM Geodetic DATE 09.02.09 CHECKED BY RA

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
179.2	Ground Surface										
0.1	50mm TOPSOIL										
	Weathered, trace rootlets		1	SS	8						
	SILTY CLAY trace sand, stiff to very stiff, brown, damp to moist		2	SS	21						
			3	SS	21						
			4	SS	24						0 1 52 47
			5	SS	11						
	firm to stiff		6	SS	2						
			7	SS	1						0 1 55 44
171.9											
7.3	End of Borehole										
	Borehole was dry (not stabilized) and hole open to full depth on completion.										

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

RECORD OF BOREHOLE No EWN 10+100 Rt 1 OF 1 METRIC

W.P. 280-99-00 LOCATION Coords: N:4766081.3 E:326729.7 ORIGINATED BY SS

DIST HWY 406 BOREHOLE TYPE Solid Stem Augers COMPILED BY DB

DATUM Geodetic DATE 09.02.09 CHECKED BY RA

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 10 20 30	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
179.1	Ground Surface										
179.0	100mm TOPSOIL										
0.1 / 178.4	FILL - Silty Clay, trace rootlets, stiff, brown, damp		1	SS	11		179				
0.7	occasional silt inclusions		2	SS	21		178				
	SILTY CLAY stiff to very stiff, brown to 4.4m, grey below, damp to moist		3	SS	24		177				
			4	SS	24						
			5	SS	12		176				
	firm to stiff		6	SS	5		175				
			7	SS	2		174	+ 1.1, + 1.5			
171.8							173				0 0 61 39
7.3	End of Borehole						172	+ 2.1, + 1.1			

Borehole was dry (not stabilized) and hole open to full depth on completion.

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

ONTARIO MOT 1-09-4135 MERRITT RD 2.GPJ ONTARIO MOT.GDT 05/10/10

RECORD OF BOREHOLE No EWN 10+150 CL 1 OF 1 METRIC

W.P. 280-99-00 LOCATION Coords: N:4766038.4 E:326749.7 ORIGINATED BY SS

DIST HWY 406 BOREHOLE TYPE Hollow Stem Augers COMPILED BY DB

DATUM Geodetic DATE 09.03.09 CHECKED BY RA

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
178.7	Ground Surface										
178.6 / 0.1	80mm TOPSOIL										
178.0 / 0.7	FILL - Silty Clay, with sand, trace gravel, stiff, brown, damp to moist		1	SS	13						
176.8 / 1.9	SAND AND SILT trace clay, dense, brown, wet		2	SS	31		178				0 52 40 8
			3	SS	26		177				
	SILTY CLAY trace sand, very stiff to hard, brown to 2.1m, grey below, damp to moist		4	SS	38		176				0 1 51 48
			5	SS	22		175				
			6	TW	PH		174		42		0 0 44 56
									2.7		
172.6 / 6.1	End of Borehole						173		1.8		

Borehole was dry (not stabilized) and hole open to full depth on completion.

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

Water Level Readings:

Date	Depth(m)	Elevation(m)
Sep.09.09	4.8	173.9
Sep.10.09	4.7	174.0
Sep.15.09	4.6	174.1

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

RECORD OF BOREHOLE No C3 1 OF 1 METRIC

W.P. 280-99-00 LOCATION Coords: N:4765991.3 E:326660.7 ORIGINATED BY SS

DIST HWY 406 BOREHOLE TYPE Solid Stem Augers COMPILED BY DB

DATUM Geodetic DATE 09.08.09 CHECKED BY RA

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 10 20 30	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
179.0	Ground Surface										
178.9	150mm TOPSOIL										
0.2	trace sand, trace rootlets ----		1	SS	9				○		
	SILTY CLAY stiff to hard, brown, damp to moist		2	SS	19		178		○		
			3	SS	35		177		○		
			4	SS	29				○		
	---- grey / brown		5	SS	24		176		○		
175.5											
3.5	End of Borehole										

Borehole was dry (not stabilized) and hole open to full depth on completion.

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

Water Level Readings:

Date	Depth(m)	Elevation(m)
Sep.09.09	2.8	176.2
Sep.10.09	2.7	176.3
Sep.11.09	2.2	176.8
Sep.15.09	2.1	176.9

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

RECORD OF BOREHOLE No C4 1 OF 1 METRIC

W.P. 280-99-00 LOCATION Coords: N:4766003.4 E:326657.8 ORIGINATED BY SS

DIST HWY 406 BOREHOLE TYPE Solid Stem Augers COMPILED BY DB

DATUM Geodetic DATE 09.08.09 CHECKED BY RA

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
178.8	Ground Surface							20 40 60 80 100	10 20 30		
178.6	180mm TOPSOIL										
0.2	topsoil stained, trace rootlets --- SILTY CLAY occasional sandy silt inclusions and silt seams to 2.1m depth, stiff to hard, brown, damp to moist		1	SS	14		178				
			2	SS	26		177				
			3	SS	33		176				
			4	SS	26		175				
			5	SS	18						
174.5											
4.3	End of Borehole										

Borehole was dry (not stabilized) and hole open to full depth on completion.

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

Date	Depth(m)	Elevation(m)
Sep.09.09	Dry	-
Sep.10.09	Dry	-
Sep.11.09	Dry	-
Sep.15.09	Dry	-

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

RECORD OF BOREHOLE No MR 10+050 CL 1 OF 2 METRIC

W.P. 280-99-00 LOCATION Coords: N:4766077.8 E:326614.6 ORIGINATED BY SS

DIST HWY 406 BOREHOLE TYPE Hollow Stem Augers COMPILED BY DB

DATUM Geodetic DATE 08.31.09 CHECKED BY RA

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	GR	SA	SI	CL
186.4	Ground Surface									
186.3	100mm TOPSOIL									
0.1	FILL - Silty Clay, trace to some sand, trace gravel, firm to very stiff, brown, damp to moist		1	SS	17					
			2	SS	6					
			3	SS	10					
			4	SS	15					
			5	SS	12					
	---- gravelly		6	SS	27		24	16	40	20
	---- trace organics, dark brown		7	SS	13					
179.4										
7.0	SILTY CLAY trace sand, hard, brown to 10.1m, grey below, damp to moist		8	SS	34					
	---- stiff to very stiff		9	SS	20		0	3	52	45
			10	SS	7					
			11	SS	5					
			12	SS	0*					

ELEVATION SCALE: 186, 185, 184, 183, 182, 181, 180, 179, 178, 177, 176, 175, 174, 173

DYNAMIC CONE PENETRATION RESISTANCE PLOT: 20 40 60 80 100

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

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

WATER CONTENT (%): 10 20 30

UNIT WEIGHT γ kN/m³

REMARKS & GRAIN SIZE DISTRIBUTION (%)

1.9
1.6
1.1
1.0

Continued Next Page

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

ONTARIO MOT 1-09-4135 MERRITT RD 2.GPJ ONTARIO MOT.GDT 05/10/10

RECORD OF BOREHOLE No MR 10+050 CL 2 OF 2 METRIC

W.P. 280-99-00 LOCATION Coords: N:4766077.8 E:326614.6 ORIGINATED BY SS

DIST HWY 406 BOREHOLE TYPE Hollow Stem Augers COMPILED BY DB

DATUM Geodetic DATE 08.31.09 CHECKED BY RA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P NATURAL MOISTURE CONTENT w LIQUID LIMIT w_L WATER CONTENT (%) 10 20 30	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES						GR SA SI CL
171.3 / 15.1	End of Borehole * Sample sinking under weight of hammer and / or rods.										

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

RECORD OF BOREHOLE No MR 10+075 Lt 1 OF 2 METRIC

W.P. 280-99-00 LOCATION Coords: N:4766107.2 E:326624.3 ORIGINATED BY SS

DIST HWY 406 BOREHOLE TYPE Hollow Stem Augers COMPILED BY DB

DATUM Geodetic DATE 08.31.09 CHECKED BY RA

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
186.2	Ground Surface										
0.0	trace rootlets		1	SS	17		186				

	FILL - Silty Clay, trace sand, trace gravel, stiff to very stiff, brown, damp to moist		2	SS	12		185				
			3	SS	9						
			4	SS	22		184				
	----										
	sandy		5	SS	12		183				

			6	SS	12		182				
			7	SS	14		181				
179.2							180				
7.0	SILTY CLAY trace sand, firm to very stiff, brown to 11.7m, grey below, damp to moist		8	SS	27		179		43		0 0 44 56
			9	SS	21		178				
			10	SS	5		177				
			11	SS	1		176	1.0, 1.5, 1.3, 2.0, 1.6, 1.8	50		0 4 32 64
172.0			12	SS	3		175				
14.2	End of Borehole						174				
							173				
							172				

Continued Next Page

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

RECORD OF BOREHOLE No MR 10+075 Lt 2 OF 2 METRIC

W.P. 280-99-00 LOCATION Coords: N:4766107.2 E:326624.3 ORIGINATED BY SS

DIST HWY 406 BOREHOLE TYPE Hollow Stem Augers COMPILED BY DB

DATUM Geodetic DATE 08.31.09 CHECKED BY RA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa	PLASTIC LIMIT / NATURAL MOISTURE CONTENT / LIQUID LIMIT	UNIT WEIGHT	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	w_P w w_L	γ	GR SA SI CL
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE	WATER CONTENT (%) 10 20 30	kN/m³	

Borehole was dry (not stabilized) and hole open to full depth on completion.

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

Water Level Readings:

Date	Depth(m)	Elevation(m)
Sep.09.09	7.2	179.0
Sep.10.09	7.0	179.2
Sep.11.09	6.9	179.3
Sep.15.09	6.8	179.4

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

RECORD OF BOREHOLE No MR 10+100 CL 1 OF 2 METRIC

W.P. 280-99-00 LOCATION Coords: N:4766108.7 E:326654.0 ORIGINATED BY SS

DIST HWY 406 BOREHOLE TYPE Hollow Stem Augers COMPILED BY DB

DATUM Geodetic DATE 09.01.09 CHECKED BY RA

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
185.4	Ground Surface										
0.0	FILL - Silty Clay, trace sand, trace gravel, stiff to very stiff, brown, damp to moist		1	SS	14		185				
			2	SS	13		184				
			3	SS	12		183				
			4	SS	12		182				
			5	SS	15		181				
			6	SS	15		180				
178.4			7	SS	20		179		61		0 2 30 68
7.0	SILTY CLAY very stiff to hard, brown to 11.5m, grey below, damp to moist		8	SS	36		178				0 0 53 47
			9	SS	16		177				
	firm to stiff		10	SS	9		176				
			11	SS	3		175	1.5, 2.0, 1.4, 1.9			
			12	SS	2		174	1.5, 2.5			0 0 64 36
170.5							173				
							172				
							171				

Continued Next Page

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

RECORD OF BOREHOLE No MR 10+100 CL 2 OF 2 METRIC

W.P. 280-99-00 LOCATION Coords: N:4766108.7 E:326654.0 ORIGINATED BY SS

DIST HWY 406 BOREHOLE TYPE Hollow Stem Augers COMPILED BY DB

DATUM Geodetic DATE 09.01.09 CHECKED BY RA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P NATURAL MOISTURE CONTENT w LIQUID LIMIT w_L WATER CONTENT (%) 10 20 30	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES						
14.9	End of Borehole Borehole was dry (not stabilized) and hole open to full depth on completion. Monitoring well installation consists of a 50mm diameter, Schedule 40 PVC pipe with a 1.52m slotted screen. Water Level Readings: Date Depth(m) Elevation(m) Sep.09.09 12.3 173.1 Sep.11.09 12.3 173.1 Sep.15.09 10.3 175.1										

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

RECORD OF BOREHOLE No MR 10+150 Lt 1 OF 1 METRIC

W.P. 280-99-00 LOCATION Coords: N:4766144.7 E:326689.8 ORIGINATED BY SS

DIST HWY 406 BOREHOLE TYPE Hollow Stem Augers COMPILED BY DB

DATUM Geodetic DATE 09.01.09 CHECKED BY RA

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
180.0	Ground Surface										
179.9	80mm TOPSOIL										
0.1	FILL - Silty Clay, trace sand, stiff, dark brown, moist		1	SS	9						
179.3											
0.7	SILTY CLAY trace sand, very stiff, brown to 5.6m, grey below, damp to moist		2	SS	16		179				0 5 51 44
			3	SS	22		178				
			4	SS	30						
			5	SS	17		177				
							176	>			
	--- firm to very stiff		6	TW	PH			>			
							175	1.3 + >			
			7	SS	4		174				
							173	1.5 +	2.2		
172.7											
7.3	End of Borehole										

Borehole was dry (not stabilized) and hole open to full depth on completion.

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

Water Level Readings:

Date Depth(m) Elevation(m)

Piezometer destroyed by construction activity.

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

RECORD OF BOREHOLE No MR 10+200 Lt 1 OF 1 METRIC

W.P. 280-99-00 LOCATION Coords: N:4766173.9 E:326730.3 ORIGINATED BY SS

DIST HWY 406 BOREHOLE TYPE Solid Stem Augers COMPILED BY DB

DATUM Geodetic DATE 09.01.09 CHECKED BY RA

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
179.8	Ground Surface										
179.7	80mm TOPSOIL										
179.5 / 0.3	FILL - Silty Clay, trace organics, stiff, dark brown, damp		1	SS	14						
	SILTY CLAY trace sand, firm to very stiff, brown to 4.4m, grey below, damp to moist		2	SS	22		179				
			3	SS	20		178		54		0 1 42 57
			4	SS	26						
			5	SS	13		177				
							176	>			
			6	SS	7		175				0 1 52 47
174.0								5.8			
5.8	End of Borehole						174				

Borehole was dry (not stabilized) and hole open to full depth on completion.

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

RECORD OF BOREHOLE No MR 10+200 Rt 1 OF 1 METRIC

W.P. 280-99-00 LOCATION Coords: N:4766160.5 E:326739.9 ORIGINATED BY MP

DIST HWY 406 BOREHOLE TYPE Solid Stem Augers COMPILED BY DB

DATUM Geodetic DATE 08.31.09 CHECKED BY RA

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
180.5	Ground Surface							20 40 60 80 100	10 20 30		
0.0	790mm FILL - Sand and Gravel, trace silt, compact, brown, dry		1	SS	11		180		○		
179.7											
0.8	Weathered		2	SS	9				○		
	----						179				
	SILTY CLAY stiff to very stiff, brown, damp to moist		3	SS	15				○		
			4	SS	21		178		○		
	----										
	occasional silt partings		5	SS	17				○		
	----						177				
			6	SS	10		176		○		
175.0								+3.0 +2.1			
5.5	End of Borehole						175				

Borehole was dry (not stabilized) and hole open to full depth on completion.

Resistance to augering at 3.6-4.0m.

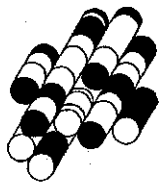
+3, ×3: Numbers refer to Sensitivity ○3% STRAIN AT FAILURE

ONTARIO MOT 1-09-4135 MERRITT RD 2.GPJ ONTARIO MOT.GDT 05/10/10

APPENDIX A

Log of Borehole Sheets (North West Quadrant)

Terraprobe Inc.



RECORD OF BOREHOLE No NEW 10+350 CL 1 OF 1 METRIC

W.P. 280-99-00 LOCATION Coords: N:4766042.9 E:326379.6 ORIGINATED BY SS

DIST HWY 406 BOREHOLE TYPE Hollow Stem Augers COMPILED BY DB

DATUM Geodetic DATE 09.09.09 CHECKED BY RA

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (10 20 30)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
180.9	Ground Surface										
180.8	150mm TOPSOIL										
0.2	FILL - Silty Clay, sandy, trace rootlets, firm, brown, damp		1	SS	5				○		
180.2											
0.7	SILTY CLAY stiff to hard, brown, damp to moist		2	SS	29		180		○		
			3	SS	26		179		○		
			4	SS	57				○		
	---- grey						178		○		
			5	SS	26		177				
			6	TW	PH		176	+ 1.3			
174.8							175		1.5		
6.1	End of Borehole										

Borehole was dry (not stabilized) and hole open to full depth on completion.

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

Water Level Readings:

Date	Depth(m)	Elevation(m)
Sep.10.09	4.9	176.0
Sep.11.09	4.3	176.6
Sep.15.09	4.2	176.7

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

RECORD OF BOREHOLE No NW 10+000 Rt 1 OF 1 METRIC

W.P. 280-99-00 LOCATION Coords: N:4765995.8 E:326390.9 ORIGINATED BY SS

DIST HWY 406 BOREHOLE TYPE Hollow Stem Augers COMPILED BY DB

DATUM Geodetic DATE 09.09.09 CHECKED BY RA

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
180.2	Ground Surface										
180.1 / 0.1	150mm TOPSOIL										
0.2 / 179.5	FILL - Silt, some sand, frequent clayey inclusions, trace rootlets, compact, brown, moist		1	SS	12		180				0 12 72 16
0.7	SILTY CLAY hard, brown to grey / brown, damp to moist		2	SS	43		179				
			3	SS	41						0 1 49 50
			4	SS	51		178				
	---- firm to stiff		5	SS	8		177	2.1	47		0 1 44 56
			6	TW	PH		176				
							175	3.1, 1.8			
174.1 / 6.1	End of Borehole										

Borehole dry (not stabilized) and hole open to full depth on completion.

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

Water Level Readings:

Date	Depth(m)	Elevation(m)
Sep.10.09	Dry	-
Sep.11.09	Dry	-
Sep.15.09	4.4	175.8

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

RECORD OF BOREHOLE No NW 10+050 CL 1 OF 1 METRIC

W.P. 280-99-00 LOCATION Coords: N:4765948.1 E:326394.7 ORIGINATED BY MP

DIST HWY 406 BOREHOLE TYPE Solid Stem Augers COMPILED BY DB

DATUM Geodetic DATE 09.03.09 CHECKED BY RA

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (10 20 30)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
180.2	Ground Surface										
180.1 / 0.1	130mm TOPSOIL										
	firm ----		1	SS	7		180				
	SILTY CLAY very stiff to hard, brown to 4.0m, grey below, damp to moist		2	SS	29		179				
			3	SS	32				42		0 0 48 52
			4	SS	36		178				
			5	SS	33		177				
	---- stiff to very stiff						176				
			6	SS	10						0 0 58 42
							175		2.0 1.2		
174.4 / 5.8	End of Borehole Borehole was dry (not stabilized) and hole open to full depth on completion.										

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

RECORD OF BOREHOLE No NW 10+100 Rt 1 OF 1 METRIC

W.P. 280-99-00 LOCATION Coords: N:4765913.2 E:326359.9 ORIGINATED BY MP

DIST HWY 406 BOREHOLE TYPE Solid Stem Augers COMPILED BY DB

DATUM Geodetic DATE 09.03.09 CHECKED BY RA

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 10 20 30	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
179.8	Ground Surface										
0.0 / 179.6	230mm TOPSOIL										
0.2	firm ---- SILTY CLAY very stiff, brown to 2.1m, grey below, damp to moist		1	SS	4		179		○		
			2	SS	23				○		
			3	SS	26		178		○		
			4	SS	26		177		○		
			5	SS	17				○		
			6	TW	PH		176				
							175				
174.4											
5.4	End of Borehole Borehole was dry (not stabilized) and hole open to full depth on completion.										

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

ONTARIO MOT 1-09-4135 MERRITT RD 2.GPJ ONTARIO MOT.GDT 05/10/10

RECORD OF BOREHOLE No NE 10+400 Lt 1 OF 1 METRIC

W.P. 280-99-00 LOCATION Coords: N:4766001.9 E:326406.6 ORIGINATED BY SS

DIST HWY 406 BOREHOLE TYPE Solid Stem Augers COMPILED BY DB

DATUM Geodetic DATE 09.10.09 CHECKED BY RA

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa: ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (10 20 30)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
180.2	Ground Surface										
180.0	190mm TOPSOIL										
0.2	trace rootlets --- SILTY CLAY stiff to hard, brown, damp to moist		1	SS	13		180				
			2	SS	45		179				
			3	SS	37						
			4	SS	25		178				
			5	SS	17		177				
	--- grey		6	SS	12		176				
174.3							175	1.6			
5.9	End of Borehole Borehole was dry (not stabilized) and hole open to full depth on completion.										

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

ONTARIO MOT 1-09-4135 MERRITT RD 2.GPJ ONTARIO MOT.GDT 05/10/10

RECORD OF BOREHOLE No NE 10+450 CL 1 OF 1 METRIC

W.P. 280-99-00 LOCATION Coords: N:4765958.5 E:326432.0 ORIGINATED BY MP

DIST HWY 406 BOREHOLE TYPE Hollow Stem Augers COMPILED BY DB

DATUM Geodetic DATE 09.09.09 CHECKED BY RA

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 10 20 30	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
180.2	Ground Surface										
180.1 / 0.1	100mm TOPSOIL										
	SILTY CLAY stiff to hard, brown to 2.1m, grey below, damp to moist		1	SS	12		180				
			2	SS	24		179				
			3	SS	36	▼					0 1 46 53
			4	SS	26		178		46		0 0 38 62
			5	SS	22		177				
	---- firm to stiff										
			6	SS	10		176				
							175	1.9, 1.3			
			7	SS	5		174				
							173	2.2, 2.4, ○, ×			
			8	TW	PH		172	3.3, 1.8		20.1	0 0 62 38
171.3											
8.9 / 170.6	SILT trace clay, dense, grey, wet		9	SS	32		171				
9.6	End of Borehole										

Borehole was dry (not stabilized) and hole open to full depth on completion.

Monitoring well installation consists of a 50mm diameter, Schedule 40 PVC pipe with a 3.0m slotted screen.

Water Level Readings:

Date	Depth(m)	Elevation(m)
Sep.10.09	1.9	178.3
Sep.11.09	1.8	178.4
Sep.15.09	1.5	178.7

Consolidation test performed on TW 8.

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

ONTARIO MOT 1-09-4135 MERRITT RD 2.GPJ ONTARIO MOT.GDT 05/10/10

RECORD OF BOREHOLE No ES 10+000 Lt 1 OF 2 METRIC

W.P. 280-99-00 LOCATION Coords: N:4766013.3 E:326507.0 ORIGINATED BY MP

DIST HWY 406 BOREHOLE TYPE Hollow Stem Augers COMPILED BY DB

DATUM Geodetic DATE 09.04.09 CHECKED BY RA

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES 'N' VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
185.0	Ground Surface										
0.1	50mm TOPSOIL		1	SS	9						
	FILL - Silty Clay, trace to some sand, trace gravel, firm to stiff, brown, damp to moist		2	SS	9		184				6 17 49 28
			3	SS	11		183				
	---- occasional wood pieces		4	SS	7						
	---- trace sand, trace gravel		5	SS	6		182	sampler wet at 3.0m			
181.0											
4.0	FILL - Sand and Silt, occasional silty clay inclusions, trace rootlets, loose, brown, moist		6	SS	8		181				0 46 40 14
179.4							180				
5.6	PEAT - amorphous, inferred very stiff, black, damp						179				
178.6			7	SS	20						
6.4	300mm ORGANIC SANDY SILT						178				
178.3											
6.7	SILTY FINE SAND - brown, wet										
178.0											
7.0	SILTY CLAY very stiff, brown, damp to moist		8	SS	18		177				
			9	SS	19		176				
	---- firm to stiff, grey		10	SS	8		175				
			11	SS	3	▽	174	2.2			0 0 64 36
							173	2			
			12	SS	4		172	1.8 2.1			
							171	1.6 2.9			
170.0											

Continued Next Page

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

RECORD OF BOREHOLE No ES 10+000 Lt 2 OF 2 METRIC

W.P. 280-99-00 LOCATION Coords: N:4766013.3 E:326507.0 ORIGINATED BY MP

DIST HWY 406 BOREHOLE TYPE Hollow Stem Augers COMPILED BY DB

DATUM Geodetic DATE 09.04.09 CHECKED BY RA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L / WATER CONTENT (%) 10 20 30	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES						
15.0	End of Borehole Water level at 13.1m (not stabilized) on completion.										

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

RECORD OF BOREHOLE No ES 10+000 Rt 1 OF 2 METRIC

W.P. 280-99-00 LOCATION Coords: N:4766020.5 E:326509.5 ORIGINATED BY MP

DIST HWY 406 BOREHOLE TYPE Hollow Stem Augers COMPILED BY DB

DATUM Geodetic DATE 09.03.09 CHECKED BY RA

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 10 20 30	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
184.9	Ground Surface										
184.8 / 0.1	80mm TOPSOIL										
	FILL - Clayey Silt to Silty Clay, trace to some sand, firm to very stiff, damp to moist		1	SS	12		184				
			2	SS	14						
			3	SS	8		183				
			4	SS	4		182				
			5	SS	4		181				
	---- topsoil stained, trace rootlets ----		6	SS	23		180				
			7	SS	20		179	---- no sample recovery			
177.9 / 7.0	SILTY CLAY very stiff, brown to 10.1m, grey below, damp to moist		8	SS	19		178				
	---- firm to stiff		9	SS	8		177				0 0 51 49
			10	SS	1		176	1.8, 2.2			
			11	SS	4		175	2.4, 2.2			
			12	TW	PH		174	2, 1.8			
							173				
							172				
							171				
							170	2.1			

Continued Next Page

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

RECORD OF BOREHOLE No ES 10+000 Rt 2 OF 2 METRIC

W.P. 280-99-00 LOCATION Coords: N:4766020.5 E:326509.5 ORIGINATED BY MP

DIST HWY 406 BOREHOLE TYPE Hollow Stem Augers COMPILED BY DB

DATUM Geodetic DATE 09.03.09 CHECKED BY RA

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%) (10 20 30)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
169.6											
15.3	End of Borehole										

Borehole dry (not stabilized) and hole open to full depth on completion.

Resistance to augering at 0.0-0.6m, 1.8-2.1m, and 4.6-7.0m.

Monitoring well installation consists of a 50mm diameter PVC pipe with a 3.0m slotted screen.

Water Level Readings:

Date	Depth(m)	Elevation(m)
Sep.10.09	12.6	172.3
Sep.11.09	12.0	172.9
Sep.15.09	11.2	173.7

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

RECORD OF BOREHOLE No ES 10+050 CL 1 OF 2 METRIC

W.P. 280-99-00 LOCATION Coords: N:4766001.5 E:326463.7 ORIGINATED BY MP

DIST HWY 406 BOREHOLE TYPE Hollow Stem Augers COMPILED BY DB

DATUM Geodetic DATE 09.08.09 CHECKED BY RA

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
185.9	Ground Surface										
0.1	50mm TOPSOIL		1	SS	12		185				
	FILL - Silty Clay, trace sand, firm to very stiff, brown, damp to moist		2	SS	17						
			3	SS	11		184				
			4	SS	6						
			5	SS	4		183				
							182				
	trace rootlets		6	SS	4			---- sample wet at 4.5m			
180.3							181				
5.6	Weathered, occasional black sand pockets		7	SS	12		180				
	SILTY CLAY trace sand, stiff to hard, brown to 10.1m, grey below, damp to moist		8	SS	38		179		2.2		
	firm to stiff		9	SS	9		178				0 1 51 48
			10	SS	3		177				
			11	SS	3		176	1.4, 1.3			
			12	SS	5		175	1.2			
							174	1.5	43		0 0 35 65
							173	2.2, 2			
							172	2.1, 2.3			
							171				

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

RECORD OF BOREHOLE No ES 10+050 CL 2 OF 2 METRIC

W.P. 280-99-00 LOCATION Coords: N:4766001.5 E:326463.7 ORIGINATED BY MP

DIST HWY 406 BOREHOLE TYPE Hollow Stem Augers COMPILED BY DB

DATUM Geodetic DATE 09.08.09 CHECKED BY RA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa: ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L / WATER CONTENT (%) 10 20 30	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES						GR SA SI CL
170.8 / 15.1	End of Borehole										

Water level at 12.8m (not stabilized) and hole open to full depth on completion.

Resistance to augering from 0.0-0.6m.

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

Water Level Readings:

Date	Depth(m)	Elevation(m)
Sep.10.09	12.3	173.6
Sep.11.09	12.3	173.6
Sep.15.09	12.2	173.7

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

RECORD OF BOREHOLE No EWS 10+100 Lt 1 OF 1 METRIC

W.P. 280-99-00 LOCATION Coords: N:4766010.6 E:326413.2 ORIGINATED BY SS

DIST HWY 406 BOREHOLE TYPE Solid Stem Augers COMPILED BY DB

DATUM Geodetic DATE 09.10.09 CHECKED BY RA

ELEV / DEPTH	DESCRIPTION	NUMBER	TYPE	"N" VALUES	GR	SA	SI	CL
180.5	Ground Surface							
180.3	180mm TOPSOIL							
0.2 / 179.8	FILL - Sand and Silt, occasional clay lumps, compact, brown, damp	1	SS	11	0	47	40	13
0.7	trace sand, trace rootlets	2	SS	41				

	SILTY CLAY very stiff to hard, brown to 2.9m, grey below, damp to moist	3	SS	55	0	0	51	49
		4	SS	29				
		5	SS	15				
	---- stiff	6	SS	9				
		7	SS	7	0	0	31	69
173.0								
7.5	End of Borehole							
	Borehole was dry (not stabilized) and hole open to full depth on completion.							

GROUND WATER CONDITIONS

ELEVATION SCALE: 180, 179, 178, 177, 176, 175, 174, 173

DYNAMIC CONE PENETRATION RESISTANCE PLOT: 20 40 60 80 100

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

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

UNIT WEIGHT γ kN/m³

REMARKS & GRAIN SIZE DISTRIBUTION (%)

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

RECORD OF BOREHOLE No EWS 10+100 Rt 1 OF 1 METRIC

W.P. 280-99-00 LOCATION Coords: N:4766016.9 E:326419.0 ORIGINATED BY MP

DIST HWY 406 BOREHOLE TYPE Hollow Stem Augers COMPILED BY DB

DATUM Geodetic DATE 09.10.09 CHECKED BY RA

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (10 20 30)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
180.7	Ground Surface										
180.6	80mm TOPSOIL										
0.1	FILL - Sand and Silt, occasional clay lumps, compact, brown, dry to damp		1	SS	11						
180.0							180				
0.7	FILL - Silty Clay, trace sand, very stiff to hard, brown, damp to moist		2	SS	34				43		0 3 38 59
			3	SS	29		179				
178.6											
2.1	Weathered		4	SS	31		178				0 1 43 56
	---- very stiff to hard		5	SS	22						
	---- SILTY CLAY firm to stiff, brown to 4.2m, grey below, damp to moist		6	SS	6		177				
							176	2.1			0 0 48 52
							175	1.6	47		
			7	TW	PH			×		18.6	0 0 58 42
173.2							174	1.5			
7.5	End of Borehole							1.2			

Borehole was dry (not stabilized) and hole open to 5.8m on completion.

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

Water Level Readings:

Date	Depth(m)	Elevation(m)
Sep.10.09	Dry	-
Sep.11.09	Dry	-
Sep.15.09	Dry	-

Consolidation test performed on TW 7.

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

ONTARIO MOT 1-09-4135 MERRITT RD 2.GPJ ONTARIO MOT.GDT 05/10/10

RECORD OF BOREHOLE No EWS 10+150 CL 1 OF 1 METRIC

W.P. 280-99-00 LOCATION Coords: N:4766059.9 E:326399.4 ORIGINATED BY MP

DIST HWY 406 BOREHOLE TYPE Solid Stem Augers COMPILED BY DB

DATUM Geodetic DATE 09.10.09 CHECKED BY RA

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
181.1	Ground Surface										
0.0 / 180.4	FILL - Sand and Silt, trace clay, compact, brown, dry to damp		1	SS	19		181				0 52 35 13
0.7 / 179.7	FILL - Silty Clay, trace sand, trace gravel, very stiff, brown, damp		2	SS	24		180				
1.4 / 175.2	SILTY CLAY stiff to hard, brown, damp to moist		3	SS	29		179				
			4	SS	24						
			5	SS	31		178				
			6	SS	11		177				
							176				
5.9	End of Borehole										

Borehole dry (not stabilized) and hole open to full depth on completion.

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

Water Level Readings:

Date	Depth(m)	Elevation(m)
Sep.10.09	Dry	-
Sep.11.09	Dry	-
Sep.15.09	Dry	-

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

RECORD OF BOREHOLE No WS 10+025 CL 1 OF 1 METRIC

W.P. 280-99-00 LOCATION Coords: N:4765979.6 E:326435.7 ORIGINATED BY MP

DIST HWY 406 BOREHOLE TYPE Solid Stem Augers COMPILED BY DB

DATUM Geodetic DATE 09.09.09 CHECKED BY RA

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (10 20 30)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
180.2	Ground Surface										
180.0	205mm TOPSOIL										
0.2 / 179.2	FILL - Silty Sand, frequent clayey inclusions, loose, moist		1	SS	6		180				0 56 30 14
			2	SS	12		179				
1.0	SILTY CLAY stiff to very stiff, brown to 4.0m, grey below, damp to moist		3	SS	20						
			4	SS	29		178		43		0 1 53 46
			5	SS	17		177				
							176				
			6	SS	9		175	1.7, 1.8			
	---- firm to stiff		7	SS	2		174	1.8	45		0 1 37 62
							173	1.6			
			8	SS	9		172	2.1, 2.0			
171.2											
9.0	End of Borehole										

Borehole was dry (not stabilized) and hole open to full depth on completion.

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

Water Level Readings:

Date	Depth(m)	Elevation(m)
Sep.10.09	7.9	172.3
Sep.11.09	7.3	172.9
Sep.15.09	6.6	173.6

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

RECORD OF BOREHOLE No MR 9+800 CL 1 OF 1 METRIC

W.P. 280-99-00 LOCATION Coords: N:4765935.2 E:326409.3 ORIGINATED BY MP

DIST HWY 406 BOREHOLE TYPE Solid Stem Augers COMPILED BY DB

DATUM Geodetic DATE 09.03.09 CHECKED BY RA

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
180.0	Ground Surface							20 40 60 80 100	10 20 30		
179.9	150mm TOPSOIL										
0.2	SILTY CLAY stiff to hard, brown, damp to moist		1	SS	14						
			2	SS	27		179				
			3	SS	32		178				
			4	SS	23						
			5	SS	11		177	1.1			
							176				
			6	TW	PH		175	1.1			
173.9							174	1.5			
6.1	End of Borehole Borehole was dry (not stabilized) and hole open to full depth on completion.										

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

ONTARIO MOT 1-09-4135 MERRITT RD 2.GPJ ONTARIO MOT.GDT 05/10/10

RECORD OF BOREHOLE No MR 9+850 Rt 1 OF 1 METRIC

W.P. 280-99-00 LOCATION Coords: N:4765953.0 E:326458.1 ORIGINATED BY MP

DIST HWY 406 BOREHOLE TYPE Hollow Stem Augers COMPILED BY DB

DATUM Geodetic DATE 09.09.09 CHECKED BY RA

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 10 20 30	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
179.8	Ground Surface										
179.7 / 0.1	60mm TOPSOIL										
	firm		1	SS	10		179				

	SILTY CLAY very stiff, brown to 4.0m, grey below, damp to moist		2	SS	26						
			3	SS	27		178				0 1 47 52
			4	SS	21		177				
	---- firm to stiff		5	SS	10			1.4			
			6	SS	3		176	2.0			0 0 61 39
							175	1.8			
			7	TW	PH		174	×		18.3	0 0 33 67
172.3							173	1.2	2.5		
7.5	End of Borehole										

Borehole was dry (not stabilized) and hole open to full depth on completion.

Monitoring well installation consists of a 50mm diameter, Schedule 40 PVC pipe with a 1.52m slotted screen.

Water Level Readings:

Date	Depth(m)	Elevation(m)
Sep.10.09	6.0	173.8
Sep.11.09	4.6	175.2
Sep.15.09	3.9	175.9

Consolidation test performed on TW7.

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

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

ONTARIO MOT 1-09-4135 MERRITT RD 2.GPJ ONTARIO MOT.GDT 05/10/10

RECORD OF BOREHOLE No MR 9+900 CL 1 OF 2 METRIC

W.P. 280-99-00 LOCATION Coords: N:4765994.9 E:326489.5 ORIGINATED BY MP

DIST HWY 406 BOREHOLE TYPE Hollow Stem Augers COMPILED BY DB

DATUM Geodetic DATE 09.06.09 CHECKED BY RA

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
185.3	Ground Surface										
0.0	25mm TOPSOIL										
	FILL - Silty Clay, trace sand to sandy, occasional gravel inclusions below 1.4m, firm to stiff, brown / dark brown, damp to moist		1	SS	10		185				
			2	SS	10		184				
			3	SS	7						
			4	SS	7		183	---- sampler wet at 2.2m			
			5	SS	4		182				
			6	SS	5		181				
179.7							180				
5.6	some sand		7	SS	21		179				0 14 47 39
	---- SILTY CLAY very stiff, brown to 7.1m, grey below, damp to moist		8	SS	27		178				
			9	SS	26		177				
	---- firm to stiff		10	SS	9		176				
			11	SS	6	▽	175				0 1 51 48
			12	SS	4		174	1.8			
							173	1.7			
							172	1.7			
							171	1.1			0 0 69 31
								1.2			

Continued Next Page

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

RECORD OF BOREHOLE No MR 9+900 CL 2 OF 2 METRIC

W.P. 280-99-00 LOCATION Coords: N:4765994.9 E:326489.5 ORIGINATED BY MP

DIST HWY 406 BOREHOLE TYPE Hollow Stem Augers COMPILED BY DB

DATUM Geodetic DATE 09.08.09 CHECKED BY RA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (10 20 30)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES						GR SA SI CL
170.2 / 15.1	End of Borehole										
	Borehole was dry (not stabilized) and hole open to full depth on completion.										
	Resistance to augering from 0.0-0.6m, and 3.6-4.6m.										

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

RECORD OF BOREHOLE No MR 9+950 Rt 1 OF 1 METRIC

W.P. 280-99-00 LOCATION Coords: N:4766011.5 E:326537.9 ORIGINATED BY MP

DIST HWY 406 BOREHOLE TYPE Solid Stem Augers COMPILED BY DB

DATUM Geodetic DATE 09.02.09 CHECKED BY RA

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
180.2	Ground Surface										
180.1 / 0.1	100mm ASPHALT										
179.6 / 0.6	FILL - Sand and Gravel, trace to some silt, compact, brown, dry		1	SS	16		180				21 50 24 5
	SILTY CLAY stiff to very stiff, brown, damp to moist		2	SS	14						0 1 42 57
			3	SS	28		179				
			4	SS	14		178				
	soft to stiff, grey		5	SS	2		177				
			6	SS	1		176				
			7	SS	1		175				
			8	TW	PH		174				0 0 37 63
171.5 / 8.7	SILT trace clay, trace sand, trace gravel, loose, grey, wet		9	SS	7		173				
170.6 / 9.6	End of Borehole						172				
							171				1 1 91 7

Borehole was dry (not stabilized) and hole open to full depth on completion.

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

Water Level Readings:

Date Depth(m) Elevation(m)

Piezometer destroyed by construction activity.

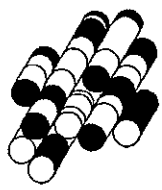
+ 3, × 3: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

ONTARIO MOT 1-09-4135 MERRITT RD 2.GPJ ONTARIO MOT.GDT 05/10/10

APPENDIX B

Laboratory Test Results
(South East Quadrant)

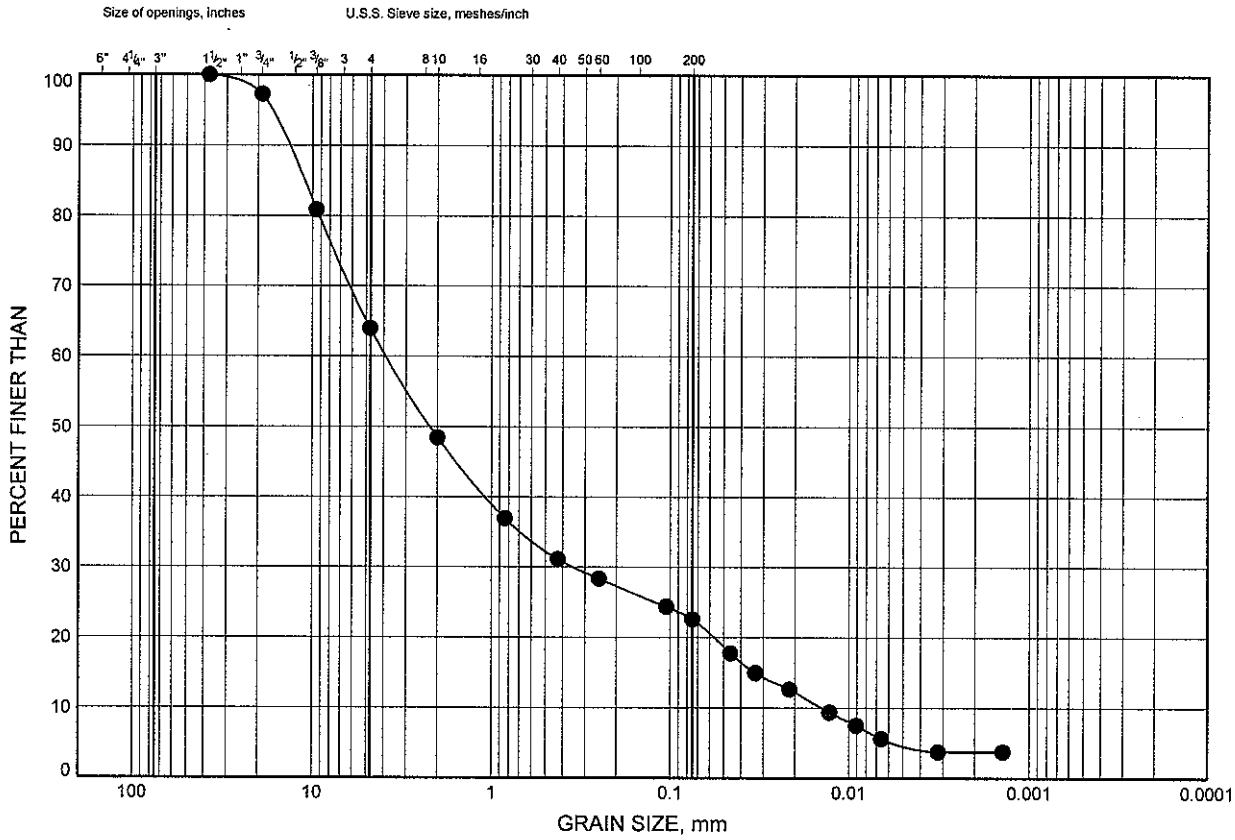
Terraprobe Inc.



GRAIN SIZE DISTRIBUTION

FIGURE B1-1

FILL - Sand and Gravel



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

SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	EN 10+025 CL	0.3	180.2

Date May 2010

Project 1-09-4135

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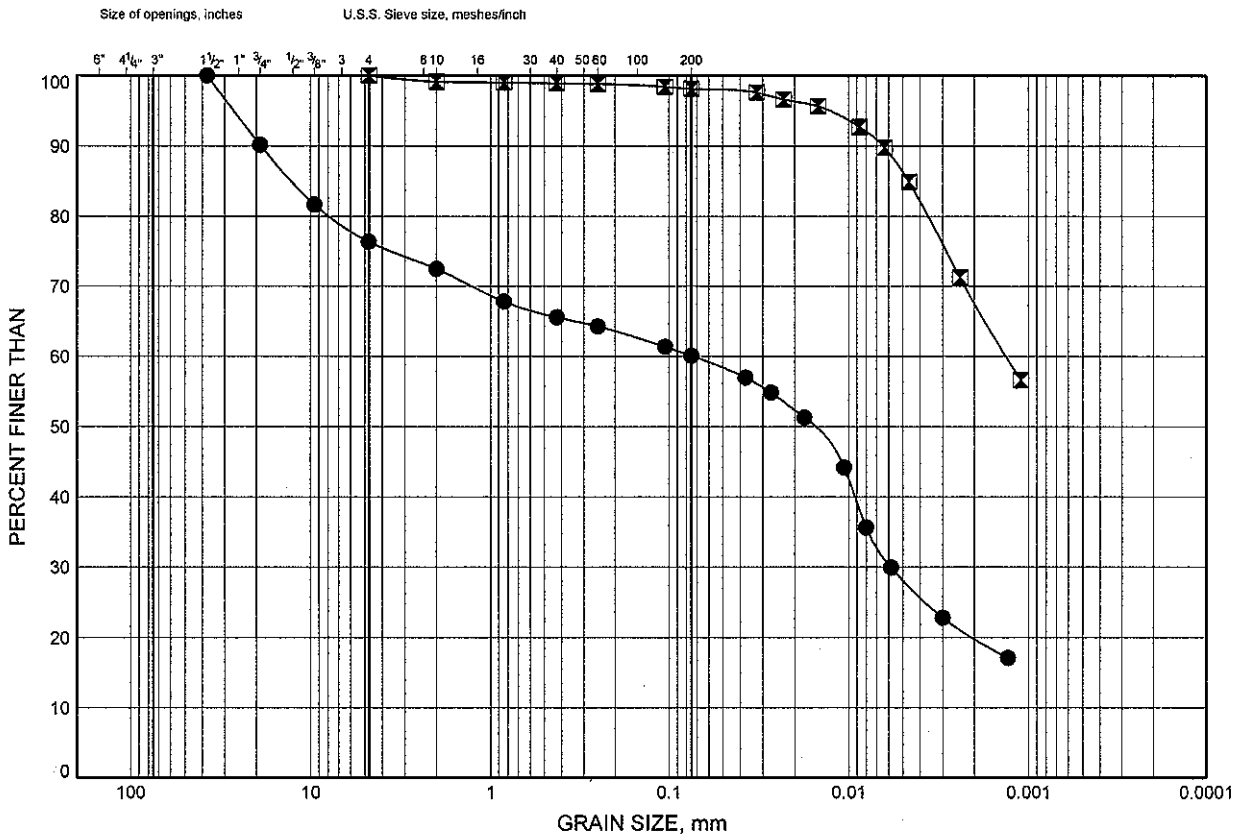
GSD 1-09-4135 MERRITT RD 2.GPJ 05/07/10

GRAIN SIZE DISTRIBUTION

FIGURE B1-2

FILL - Silty Clay



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

SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	MR 10+050 CL	4.7	181.7
⧓	MR 10+100 CL	6.3	179.1

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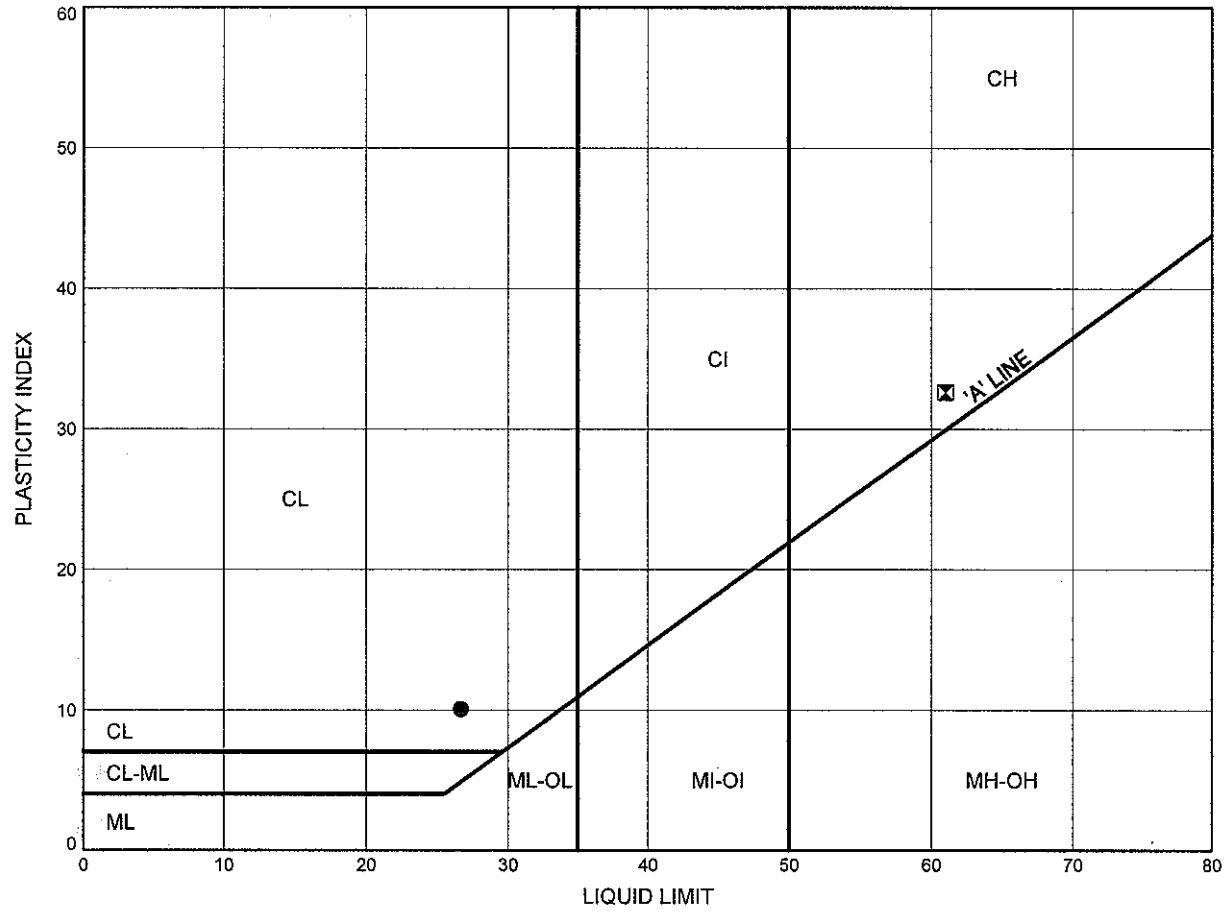
ATTERBERG LIMITS TEST RESULTS

FIGURE B1-3

FILL - Silty Clay



SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	MR 10+050 CL	4.7	181.7
⊠	MR 10+100 CL	6.3	179.1

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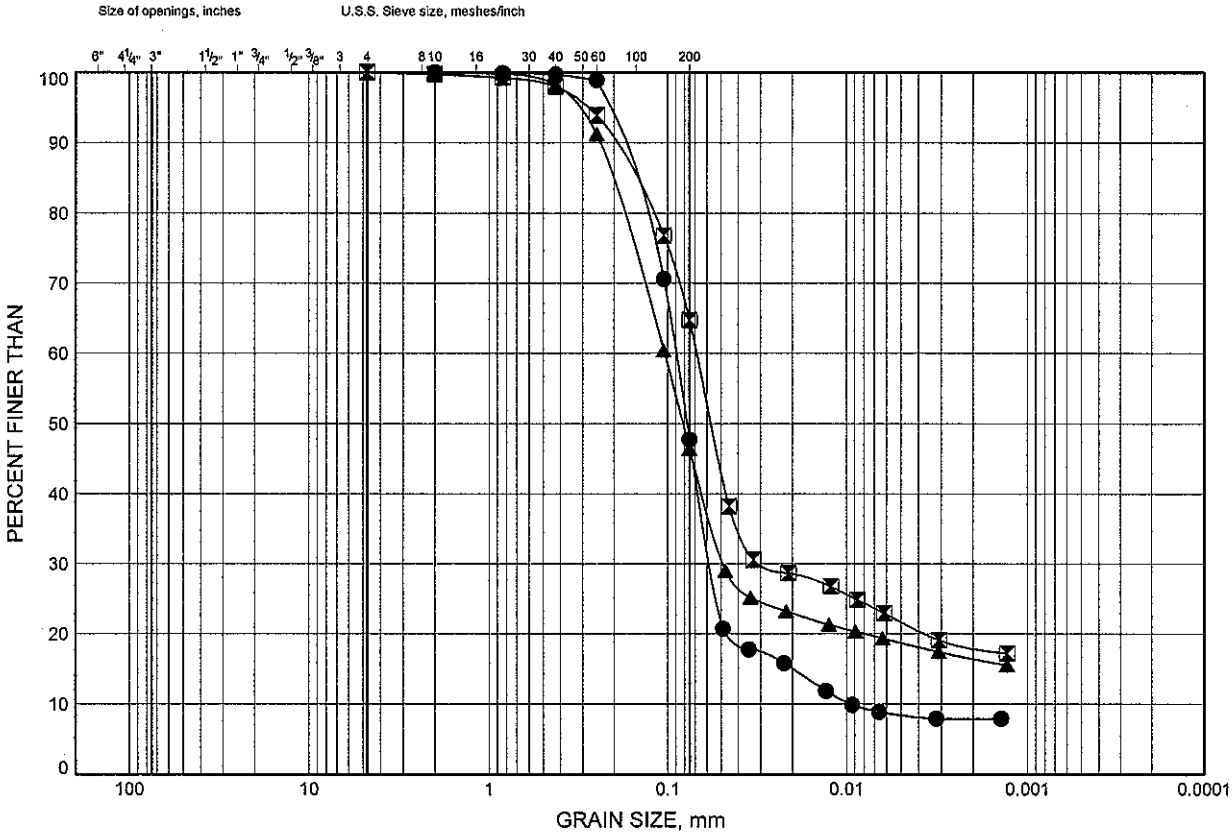
GRAIN SIZE DISTRIBUTION

FIGURE B1-4

SILTY SAND TO SANDY SILT



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

SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	EWN 10+150 CL	1.0	177.7
⊠	SEW 10+250 Lt	0.3	178.3
▲	SEW 10+350 Lt	1.0	178.5

Date May 2010

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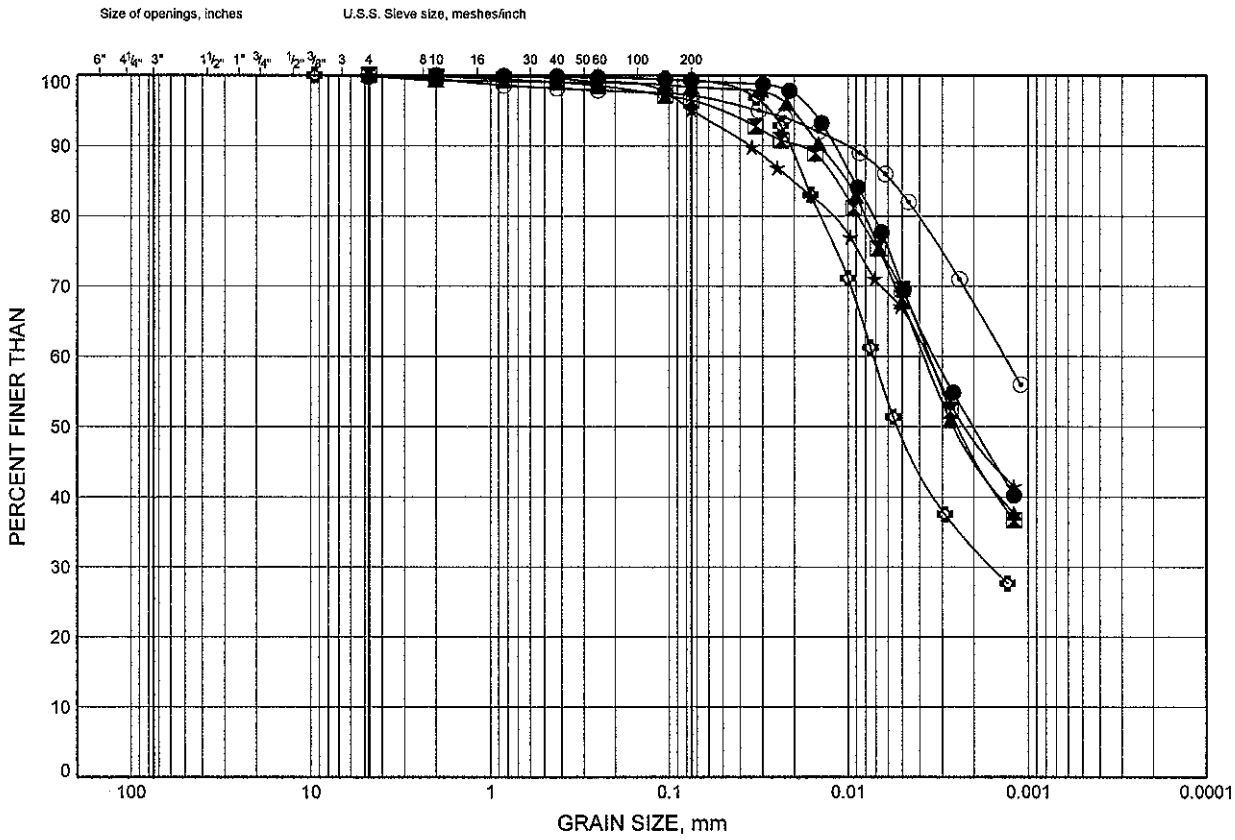
GRAIN SIZE DISTRIBUTION

FIGURE B1-5

SILTY CLAY



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

SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	SEW 10+200 CL	2.5	176.2
⊠	SEW 10+200 CL	4.7	174.0
▲	SEW 10+250 Lt	3.2	175.4
★	SEW 10+250 Rt	1.7	176.9
⊙	SEW 10+250 Rt	4.7	173.9
✿	SEW 10+300 CL	1.7	177.2

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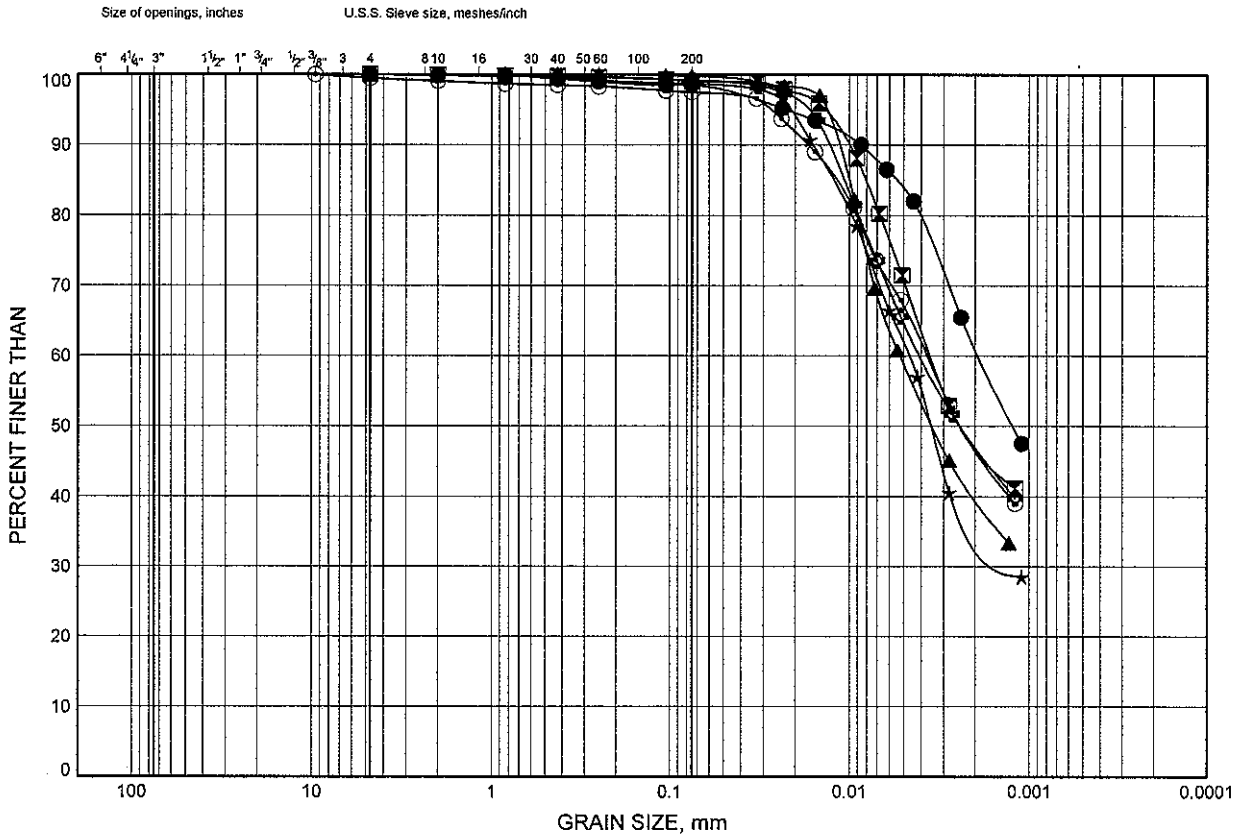
GRAIN SIZE DISTRIBUTION

FIGURE B1-6

SILTY CLAY



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

SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	SEW 10+300 CL	4.9	174.0
⊠	SEW 10+350 Lt	2.5	177.0
▲	SEW 10+350 Lt	4.7	174.8
★	SEW 10+350 Rt	4.9	174.2
⊙	WN 10+000 Rt	3.2	177.2
✿	WN 10+000 Rt	4.7	175.7

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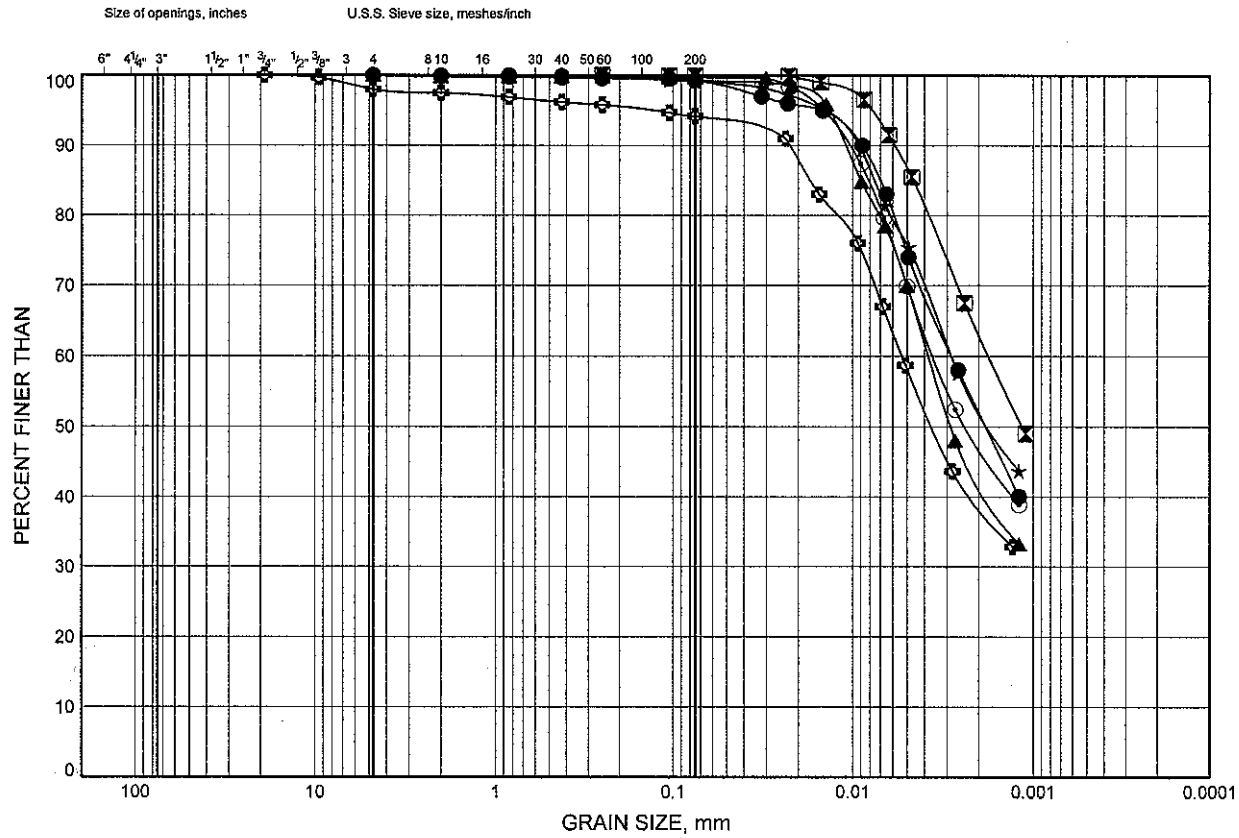
GRAIN SIZE DISTRIBUTION

FIGURE B1-7

SILTY CLAY



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

SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	EN 10+025 CL	2.5	178.0
⧓	WN 10+000 Rt	6.4	174.0
▲	WN 10+000 Rt	9.3	171.1
★	WN 10+050 CL	1.0	179.8
⊙	WN 10+050 CL	1.7	179.1
✿	WN 10+050 CL	4.7	176.1

Date May 2010

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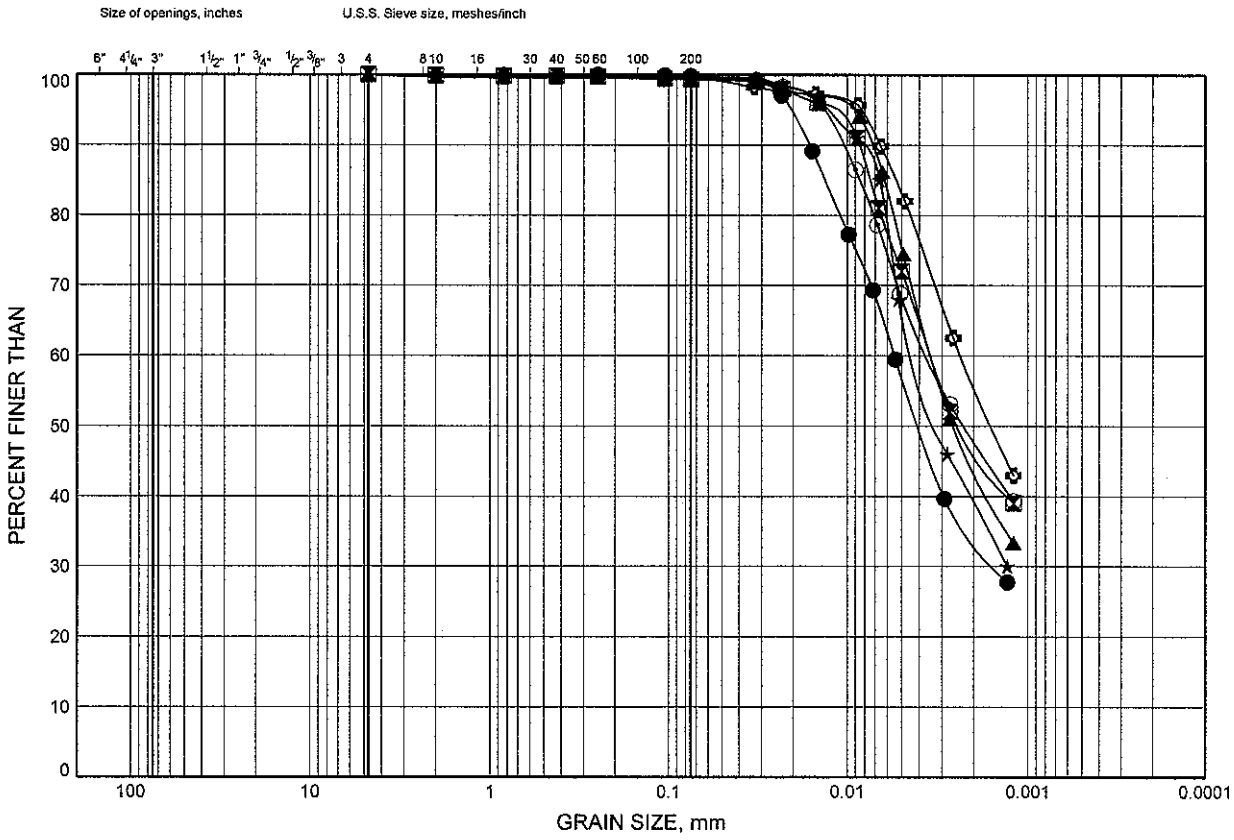
GRAIN SIZE DISTRIBUTION

FIGURE B1-8

SILTY CLAY



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

SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	EN 10+025 CL	6.3	174.2
⊠	EWN 10+100 Lt	2.5	176.7
▲	EWN 10+100 Lt	6.3	172.9
★	EWN 10+100 Rt	6.3	172.8
⊙	EWN 10+150 CL	2.5	176.2
✿	EWN 10+150 CL	4.8	173.9

Date May 2010

Project 1-09-4135

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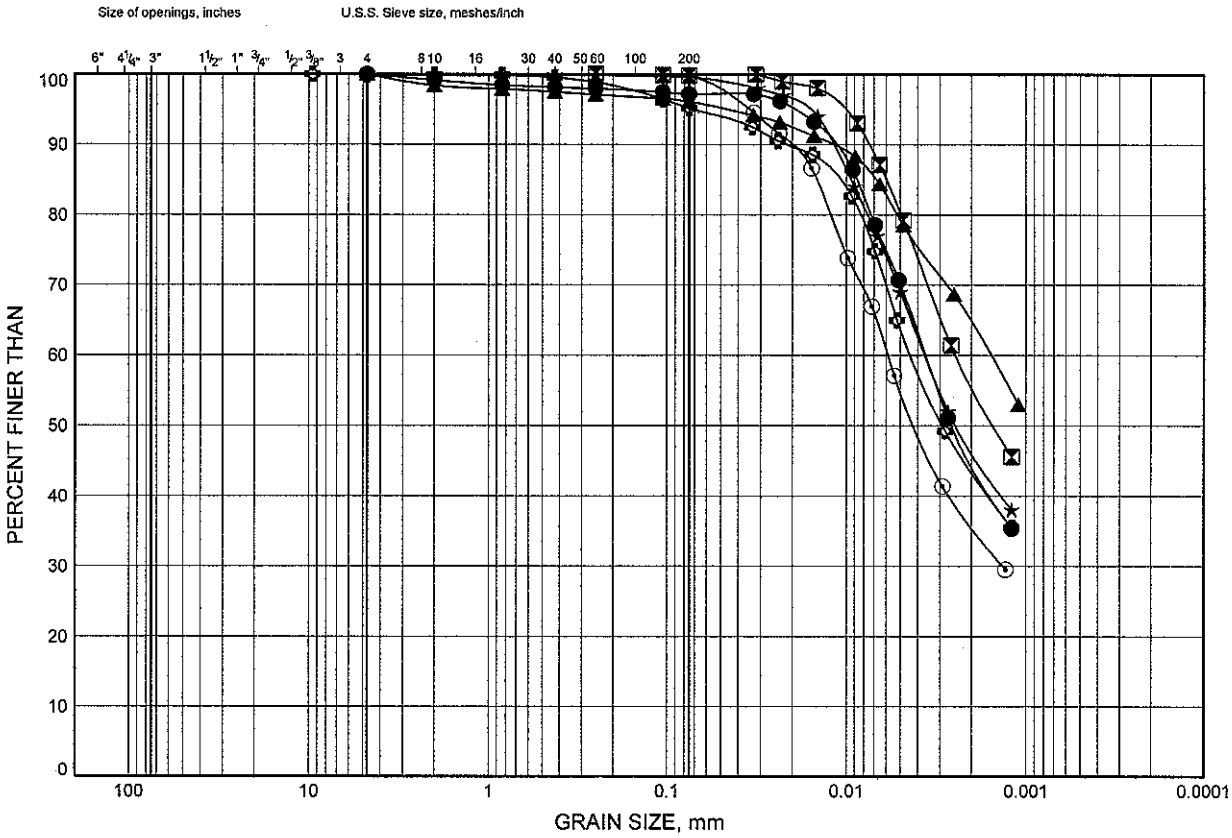
GSD 1-09-4135 MERRITT RD 2.GPJ 05/07/10

GRAIN SIZE DISTRIBUTION

FIGURE B1-9



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

SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	MR 10+050 CL	9.3	177.1
⧓	MR 10+075 Lt	7.8	178.4
▲	MR 10+075 Lt	12.4	173.8
★	MR 10+100 CL	7.8	177.6
⊙	MR 10+100 CL	13.9	171.5
✿	MR 10+150 Lt	1.0	179.0

Date May 2010

Project 1-09-4135

Prep'd DB

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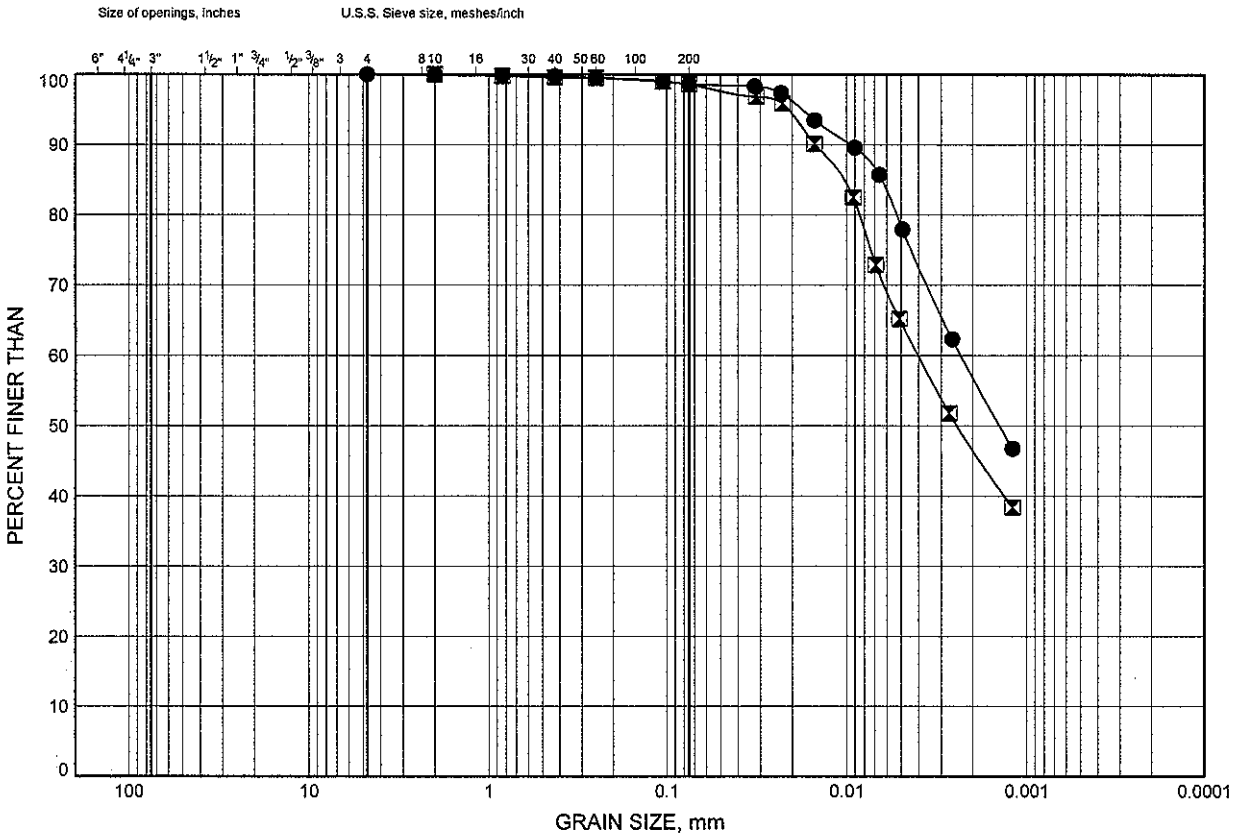
GSD 1-09-4135 MERRITT RD 2.GPJ 05/07/10

GRAIN SIZE DISTRIBUTION

FIGURE B1-10

SILTY CLAY



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

SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	MR 10+200 Lt	1.7	178.1
⊠	MR 10+200 Lt	4.7	175.1

Date May 2010

Project 1-09-4135

Prep'd DB

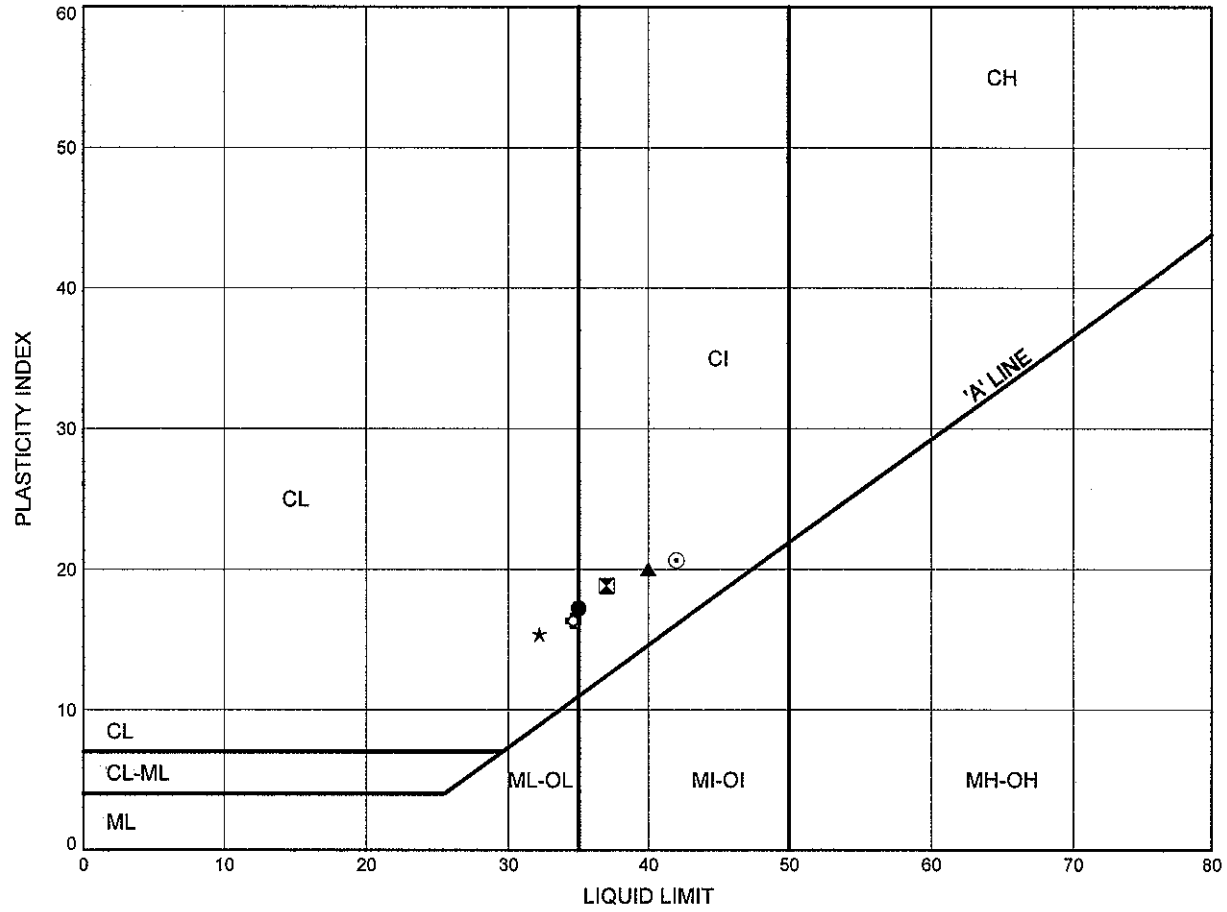
Chkd. RA

GSD 1-09-4135 MERRITT RD 2.GPJ 05/07/10

ATTERBERG LIMITS TEST RESULTS

FIGURE B1-11

SILTY CLAY



SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	SEW 10+200 CL	2.5	176.2
⊠	SEW 10+200 CL	4.7	174.0
▲	SEW 10+250 Lt	3.2	175.4
★	SEW 10+250 Rt	1.7	176.9
⊙	SEW 10+250 Rt	4.7	173.9
✿	SEW 10+300 CL	1.7	177.2

Date May 2010

Project 1-09-4135

Prep'd DB

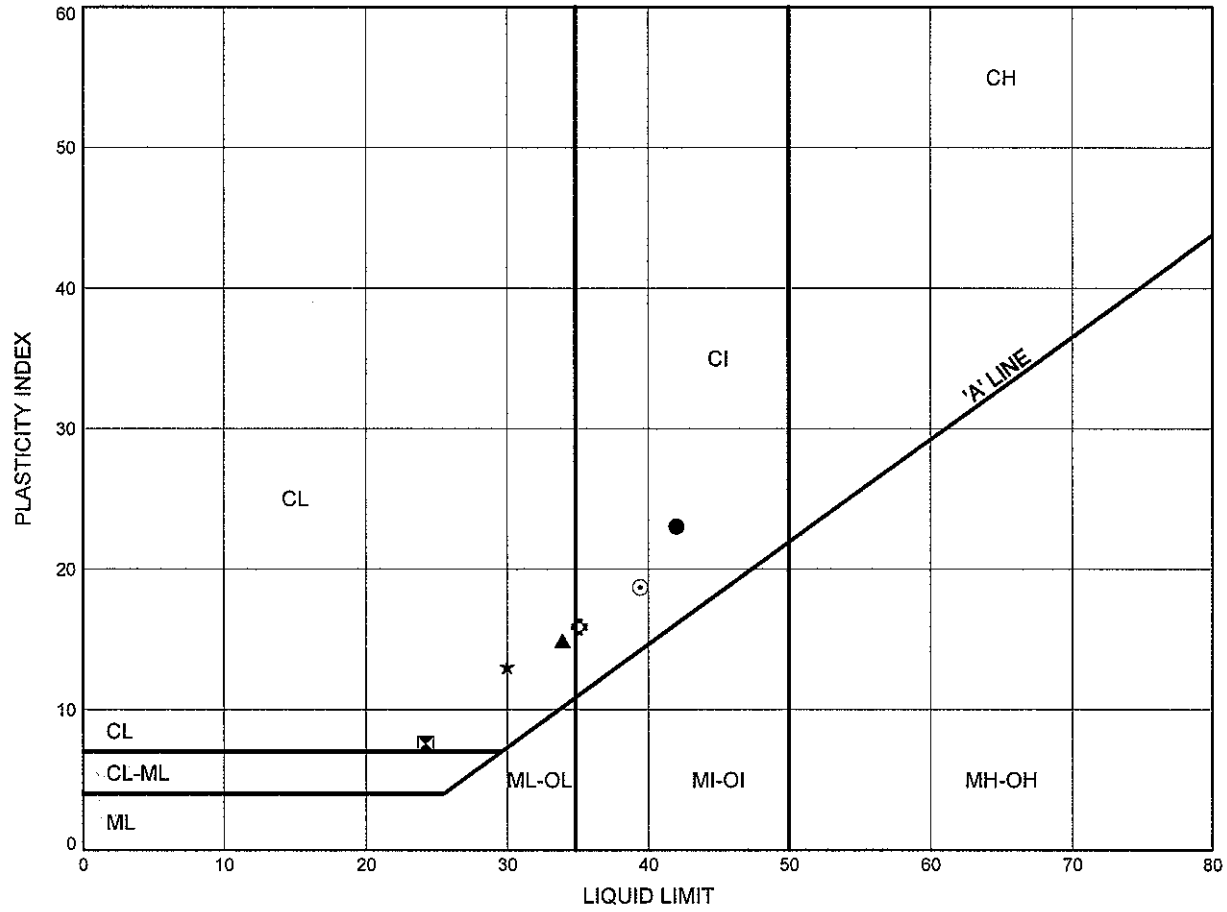
Chkd. RA

ALTR 1-09-4135 MERRITT RD 2.GPJ 05/07/10

ATTERBERG LIMITS TEST RESULTS

FIGURE B1-12

SILTY CLAY



SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	SEW 10+300 CL	4.9	174.0
⊠	SEW 10+350 Lt	2.5	177.0
▲	SEW 10+350 Lt	4.7	174.8
★	SEW 10+350 Rt	4.9	174.2
⊙	WN 10+000 Rt	3.2	177.2
✿	WN 10+000 Rt	4.7	175.7

Date May 2010

Project 1-09-4135

Prep'd DB

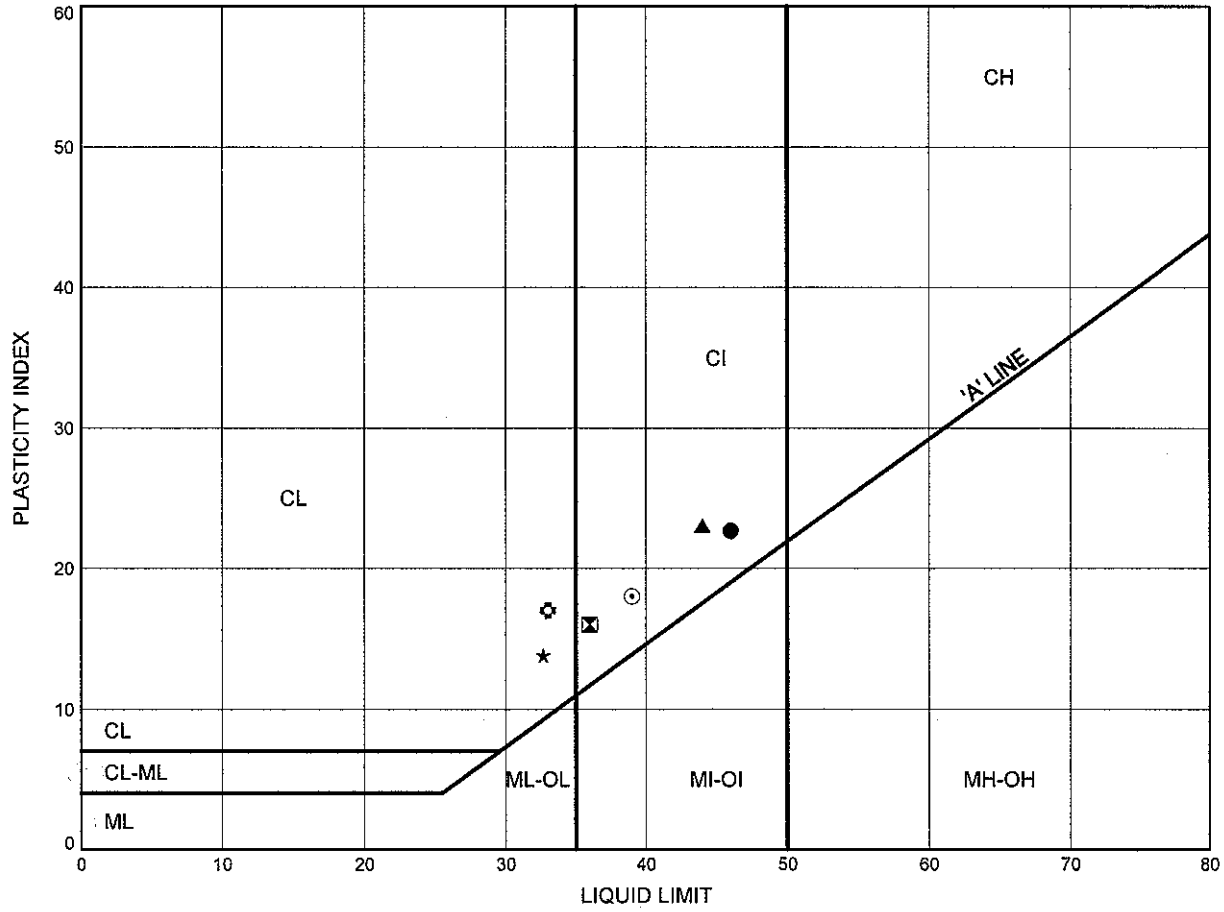
Chkd. RA

ALTR 1-09-4135 MERRITT RD 2.GPJ 05/07/10

ATTERBERG LIMITS TEST RESULTS

FIGURE B1-13

SILTY CLAY



SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	EN 10+025 CL	2.5	178.0
⊠	EN 10+025 CL	6.3	174.2
▲	WN 10+000 Rt	6.4	174.0
★	WN 10+000 Rt	9.3	171.1
⊙	WN 10+050 CL	1.0	179.8
✿	WN 10+050 CL	4.7	176.1

Date May 2010

Project 1-09-4135

Prep'd DB

Chkd. RA

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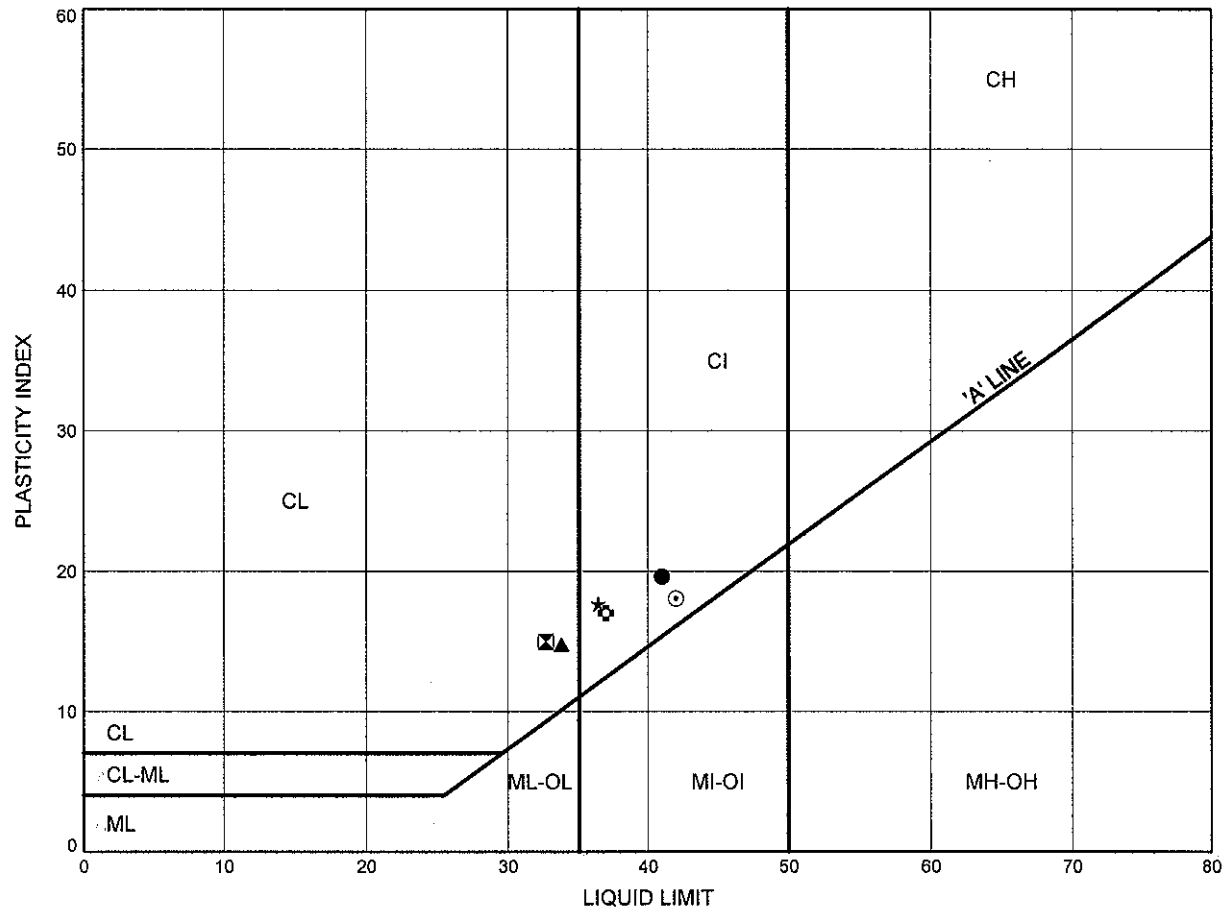
ATTERBERG LIMITS TEST RESULTS

FIGURE B1-14

SILTY CLAY



SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	EWN 10+100 Lt	2.5	176.7
⊠	EWN 10+100 Lt	6.3	172.9
▲	EWN 10+100 Rt	6.3	172.8
★	EWN 10+150 CL	2.5	176.2
⊙	EWN 10+150 CL	4.8	173.9
✿	MR 10+050 CL	9.3	177.1

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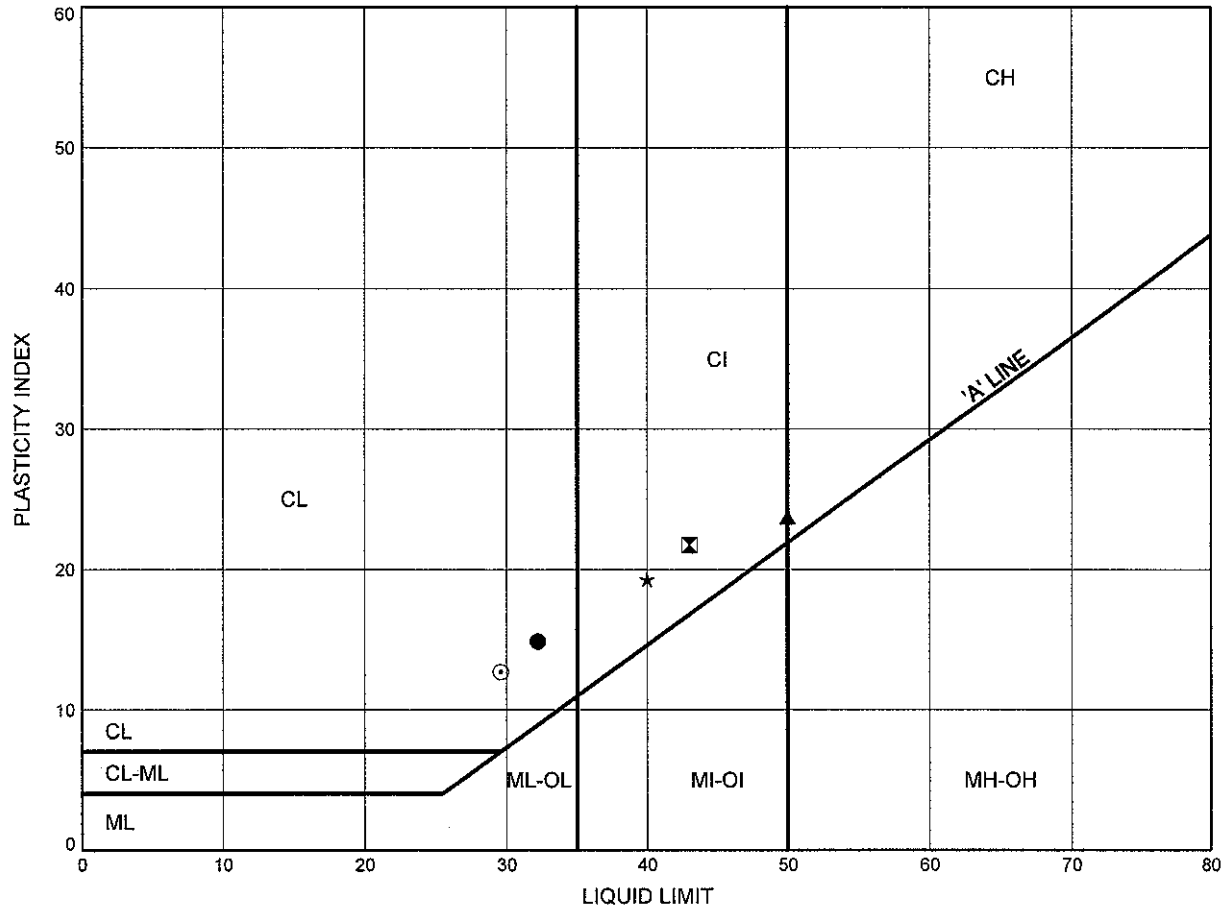
ATTERBERG LIMITS TEST RESULTS

FIGURE B1-15

SILTY CLAY



SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	MR 10+050 CL	13.9	172.5
⧓	MR 10+075 Lt	7.8	178.4
▲	MR 10+075 Lt	12.4	173.8
★	MR 10+100 CL	7.8	177.6
⊙	MR 10+100 CL	13.9	171.5

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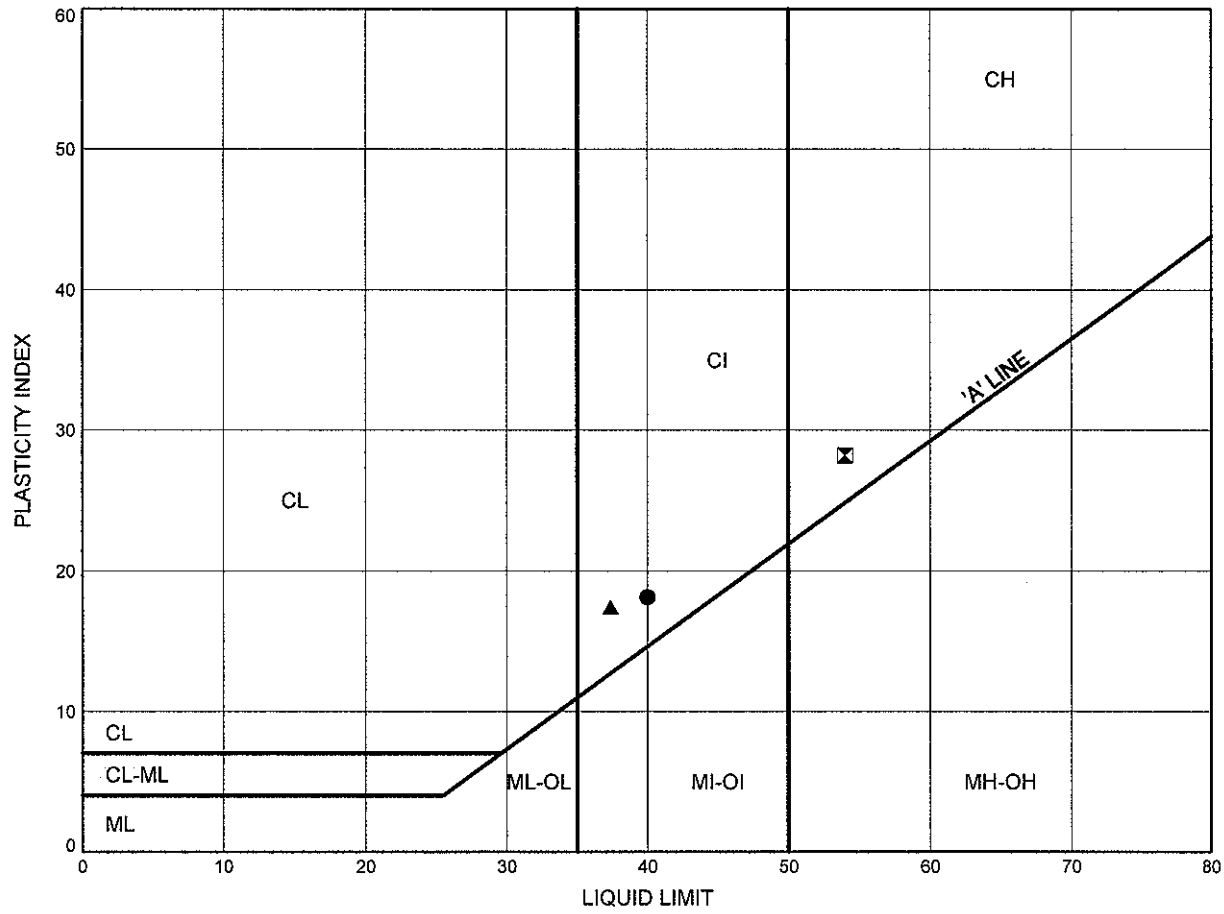
ATTERBERG LIMITS TEST RESULTS

FIGURE B1-16

SILTY CLAY



SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	MR 10+150 Lt	1.0	179.0
⊠	MR 10+200 Lt	1.7	178.1
▲	MR 10+200 Lt	4.7	175.1

Date May 2010

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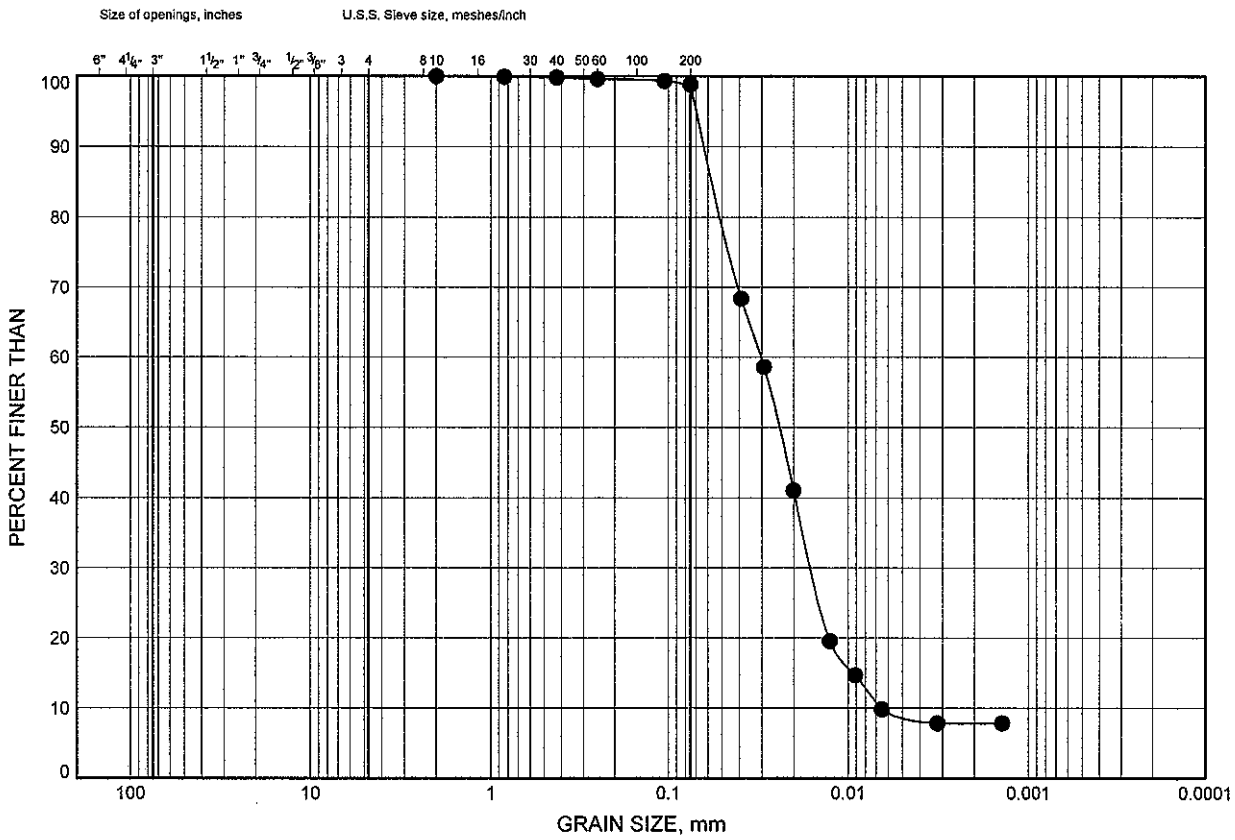
GRAIN SIZE DISTRIBUTION

FIGURE B1-17

SILT



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

SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	WN 10+000 Rt	10.9	169.5

Date May 2010

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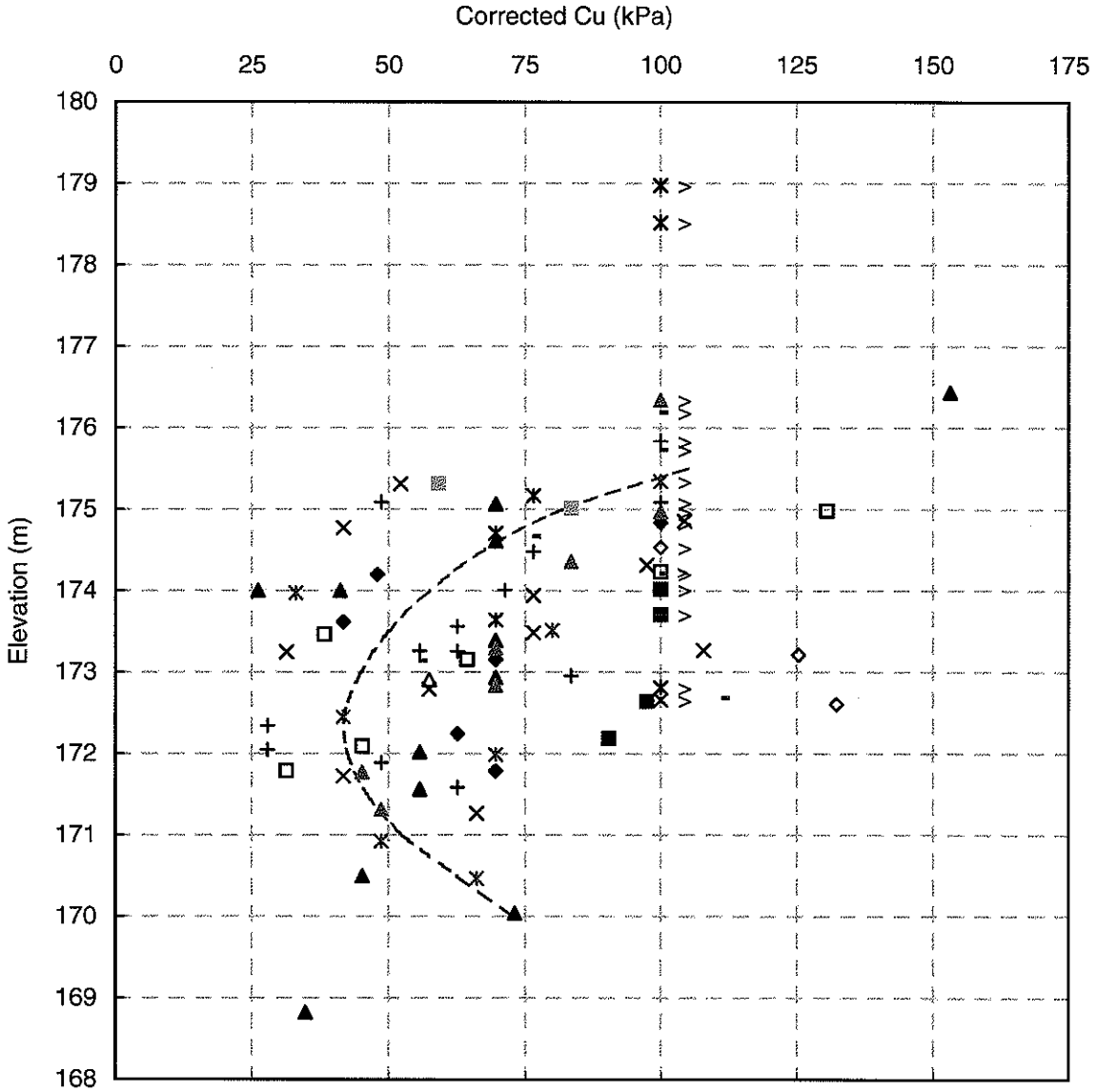
CORRECTED UNDRAINED SHEAR STRENGTH	FIGURE B1-18

MERRITT ROAD INTERCHANGE - SOUTHEAST QUADRANT

Silty Clay



□ C1	◇ C4	△ SEW 10+200 CL	× SEW 10+250 LT	✱ SEW 10+250 RT
+ SEW 10+300 CL	■ SEW 10+350 LT	◆ SEW 10+350 RT	▲ WN 10+000 RT	× WN 10+050 CL
✱ EN 10+025 CL	+ EWN 10+100 LT	□ EWN 10+100 RT	◇ EWN 10+150 CL	▲ MR 10+050 CL
× MR 10+075 LT	✱ MR 10+100 CL	- MR 10+150 LT	+ MR 10+200 LT	▨ MR 10+200 RT

Field Shear Vane Correction

Morris & Williams (1994)

(μ = 1.18 EXP(-0.08 Ip) + 0.57)

Applied Correction Factors

0.84 (Elev.>176.5m) 0.87 (Elev.<176.5m)

Project No. : 1-09-4135

Date : September, 2010

Terraprobe Inc.

Prepared By : HW

Checked By : RA

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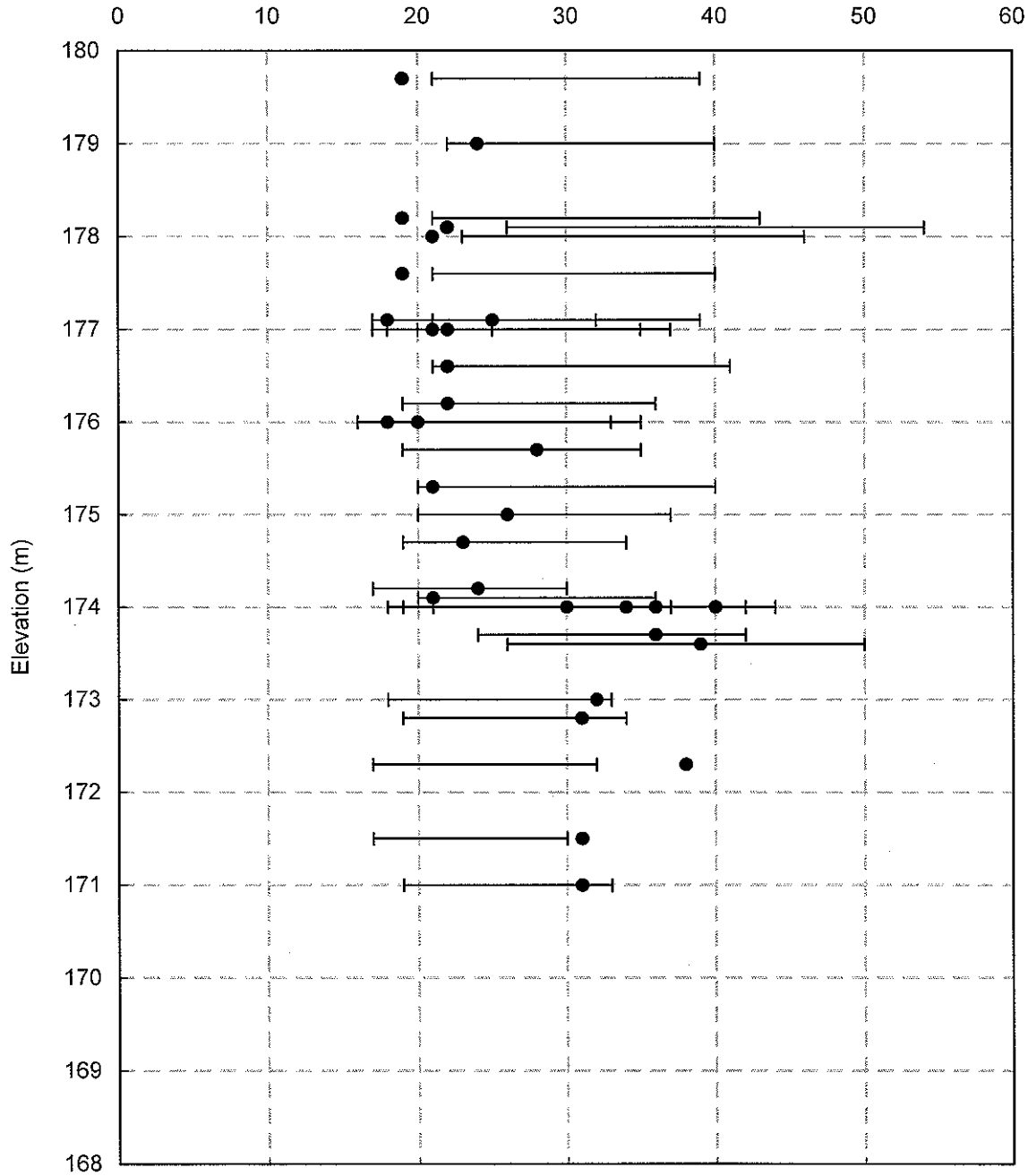
ATTERBERG LIMITS AND WATER CONTENTS	FIGURE B1-19

MERRITT ROAD INTERCHANGE - SOUTHEAST QUADRANT

Silty Clay

Atterberg Limits & Water Contents (%)



Project No. : 1-09-4135

Date : May, 2010

Terraprobe Inc.

Prepared By : HW

Checked By : RA

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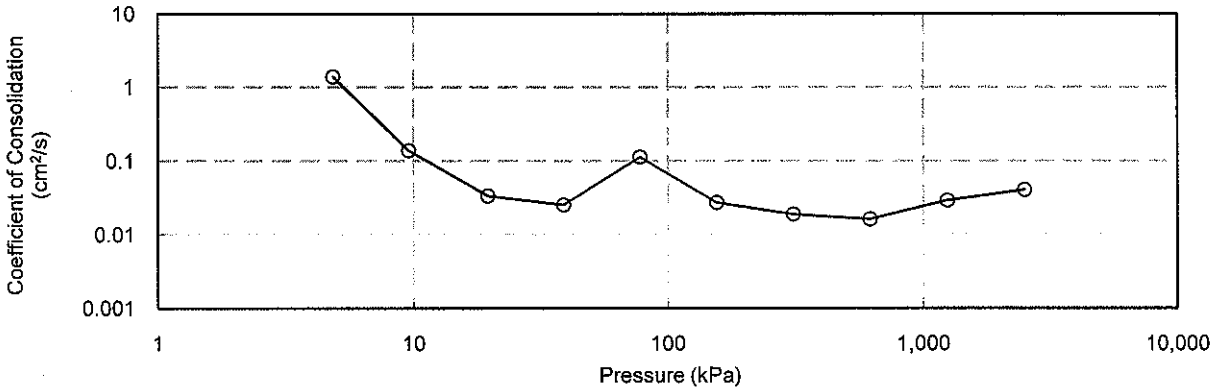
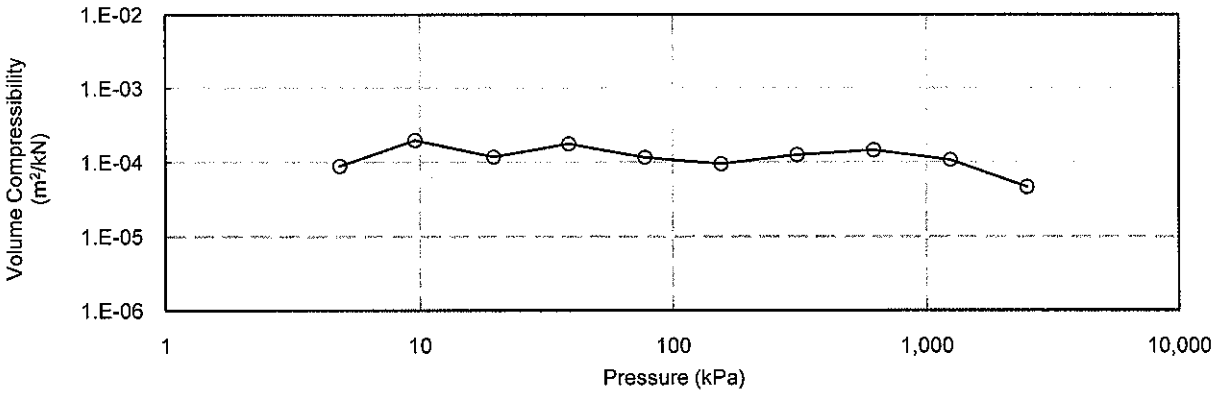
HWY 406 TWINNING - MERRITT ROAD	FIGURE B1-20

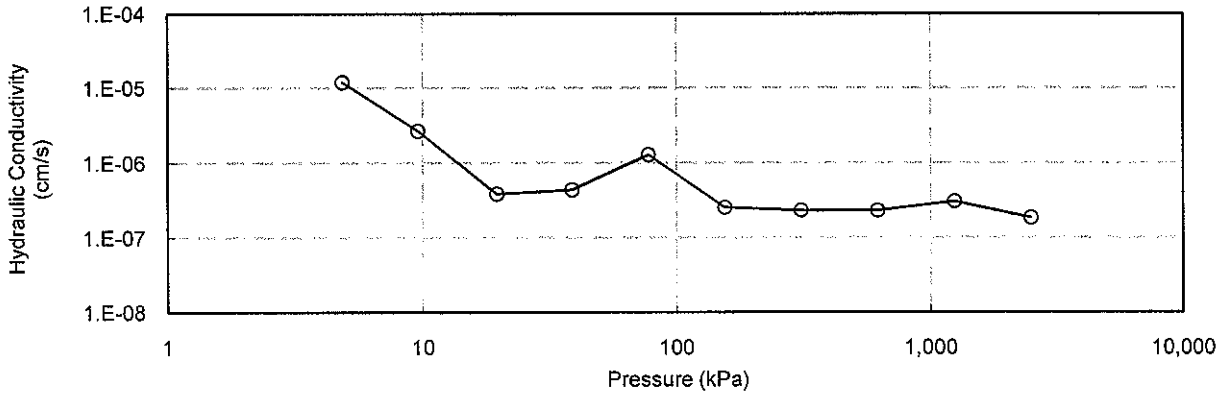
CONSOLIDATION TEST
Cv vs Pressure
SEW 10+300 CL, TW6



CONSOLIDATION TEST
mv vs Pressure
SEW 10+300 CL, TW6



CONSOLIDATION TEST
k vs Pressure
SEW 10+300 CL, TW6



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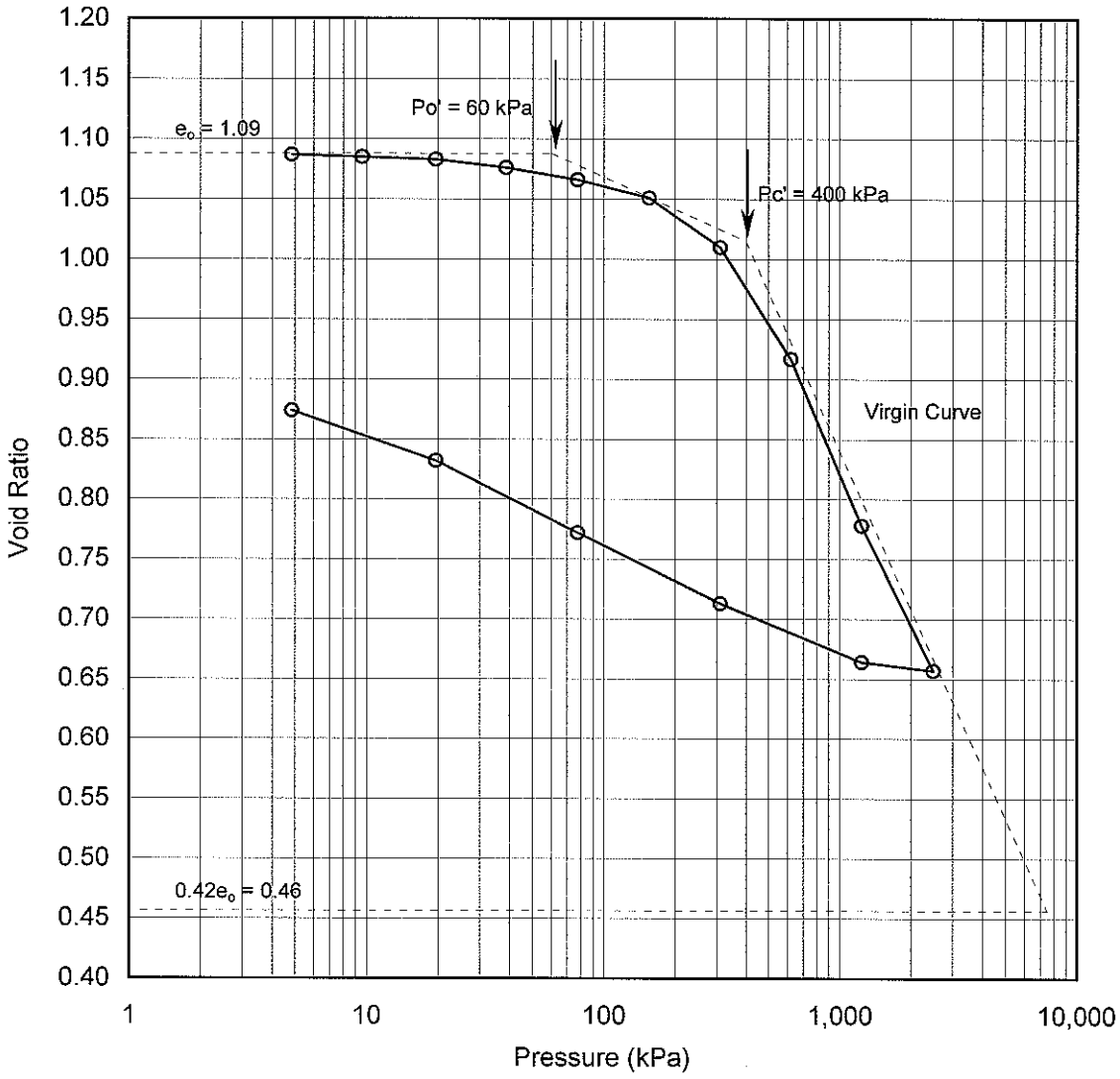
Project No. :	1-09-4135		Terraprobe Inc.	Prepared By :	HW
Date :	May 2010			Checked By :	RA

HWY 406 TWINNING - MERRITT ROAD	FIGURE B1-21

CONSOLIDATION TEST
e vs Pressure
SEW 10+300 CL, TW6



Soil Type :	Silty Clay				
e_o =	1.09	ω_L =	43%	Po' =	60 kPa
ω =	36%	ω_P =	19%	Pc' =	400 kPa
γ =	18.3 kN/m^3	PI =	23%	Cc =	0.439
Gs =	2.81			Cr =	0.089

Project No. : 1-09-4135
Date : May 2010

Terraprobe Inc.

Prepared By : HW
Checked By : RA

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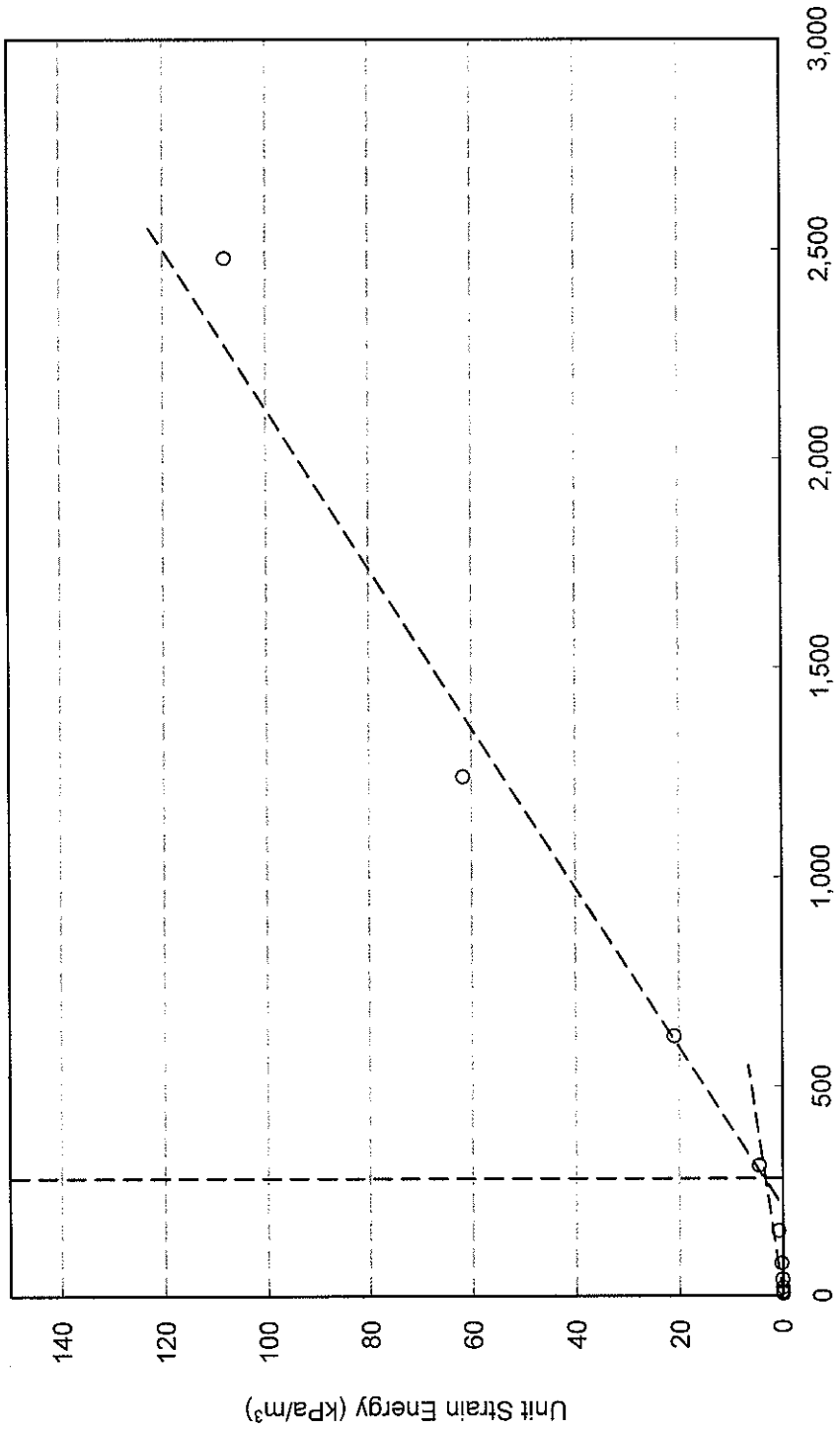
HWY 406 TWINNING - MERRITT ROAD

FIGURE B1-22

CONSOLIDATION TEST
Unit Strain Energy vs Pressure
SEW 10+300 CL, TW6



Project No. : 1-09-4135

Date : May 2010

Terraprobe Inc.

Prepared By : HW

Checked By : RA

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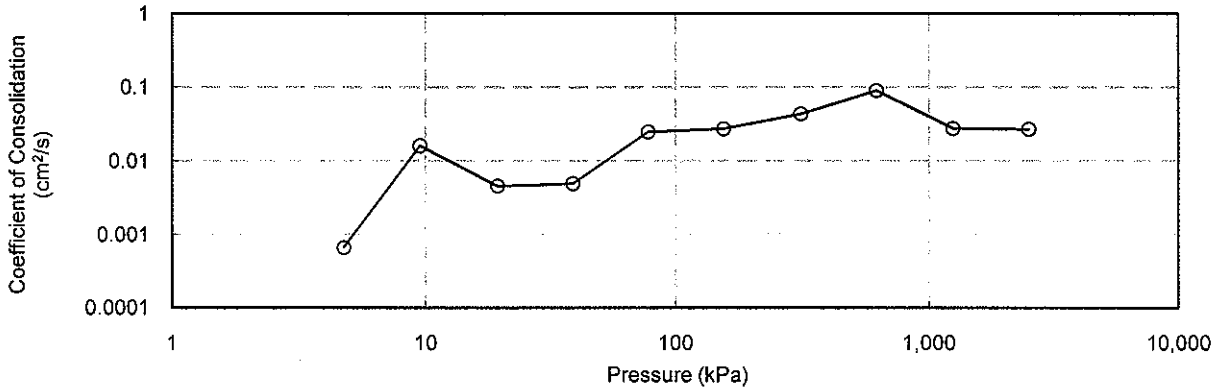
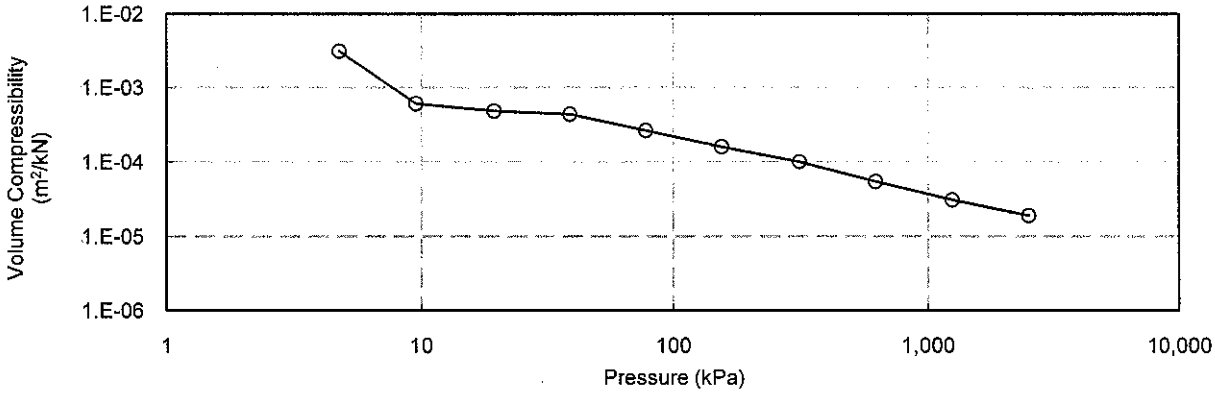
HWY 406 TWINNING - MERRITT ROAD	FIGURE B1-23

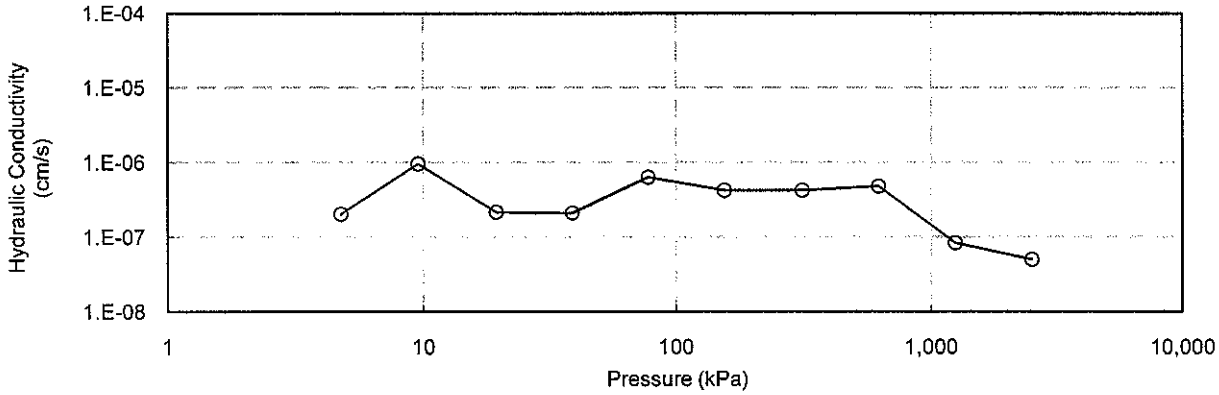
CONSOLIDATION TEST
Cv vs Pressure
SEW 10+350 RT, TW6



CONSOLIDATION TEST
mv vs Pressure
SEW 10+350 RT, TW6



CONSOLIDATION TEST
k vs Pressure
SEW 10+350 RT, TW6



Project No. : 1-09-4135
Date : May 2010

Terraprobe Inc.

Prepared By : HW
Checked By : RA

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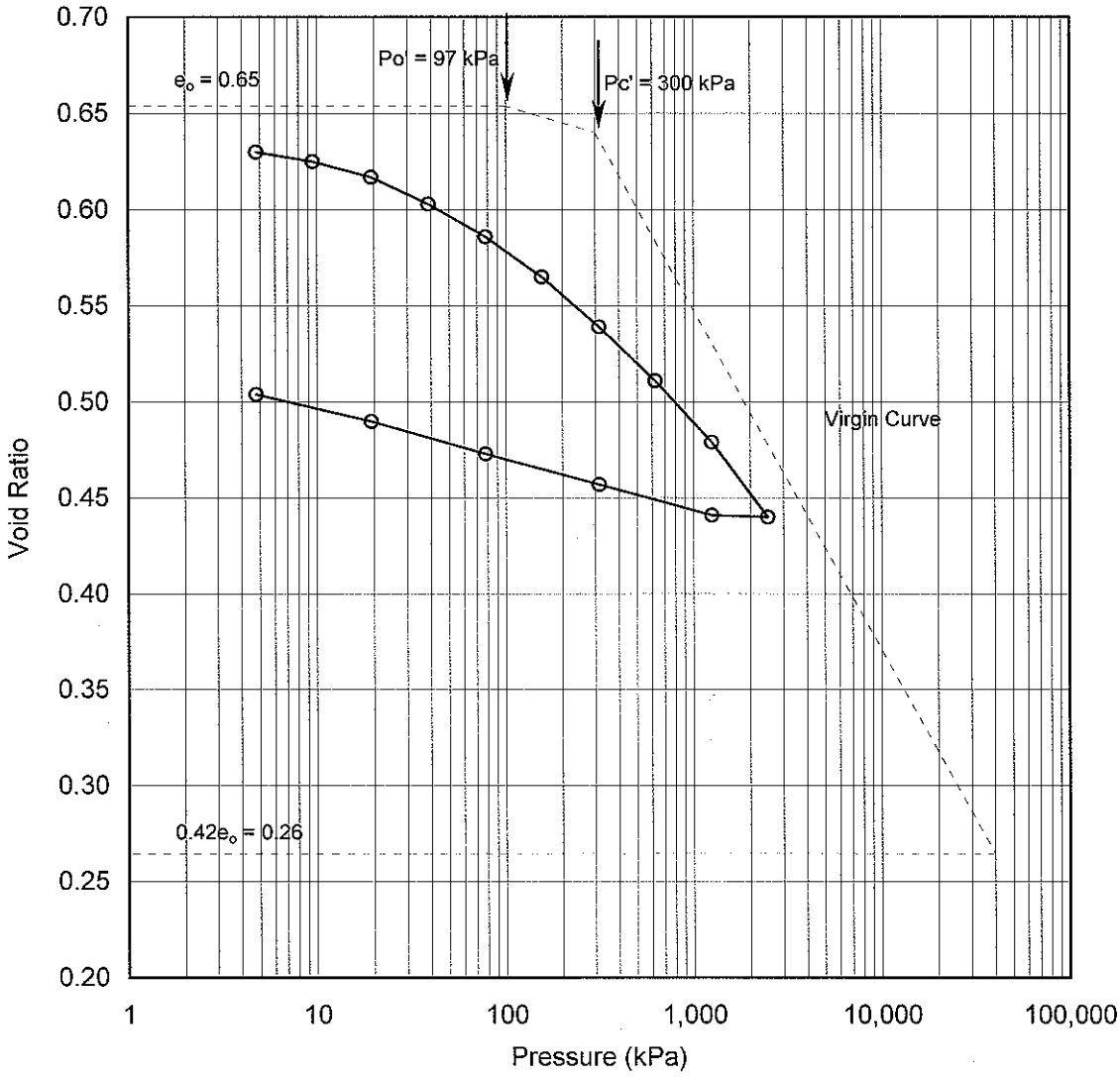
HWY 406 TWINNING - MERRITT ROAD	FIGURE B1-24

CONSOLIDATION TEST
e vs Pressure
SEW 10+350 RT, TW6



Soil Type :	Silty Clay				
e_o =	0.65	ω_L =	30%	Po' =	97 kPa
ω =	24%	ω_P =	17%	Pc' =	300 kPa
γ =	20.2 kN/m^3	PI =	12%	Cc =	0.177
Gs =	2.76			Cr =	0.029

Project No. : 1-09-4135
Date : May 2010

Terraprobe Inc.

Prepared By : HW
Checked By : RA

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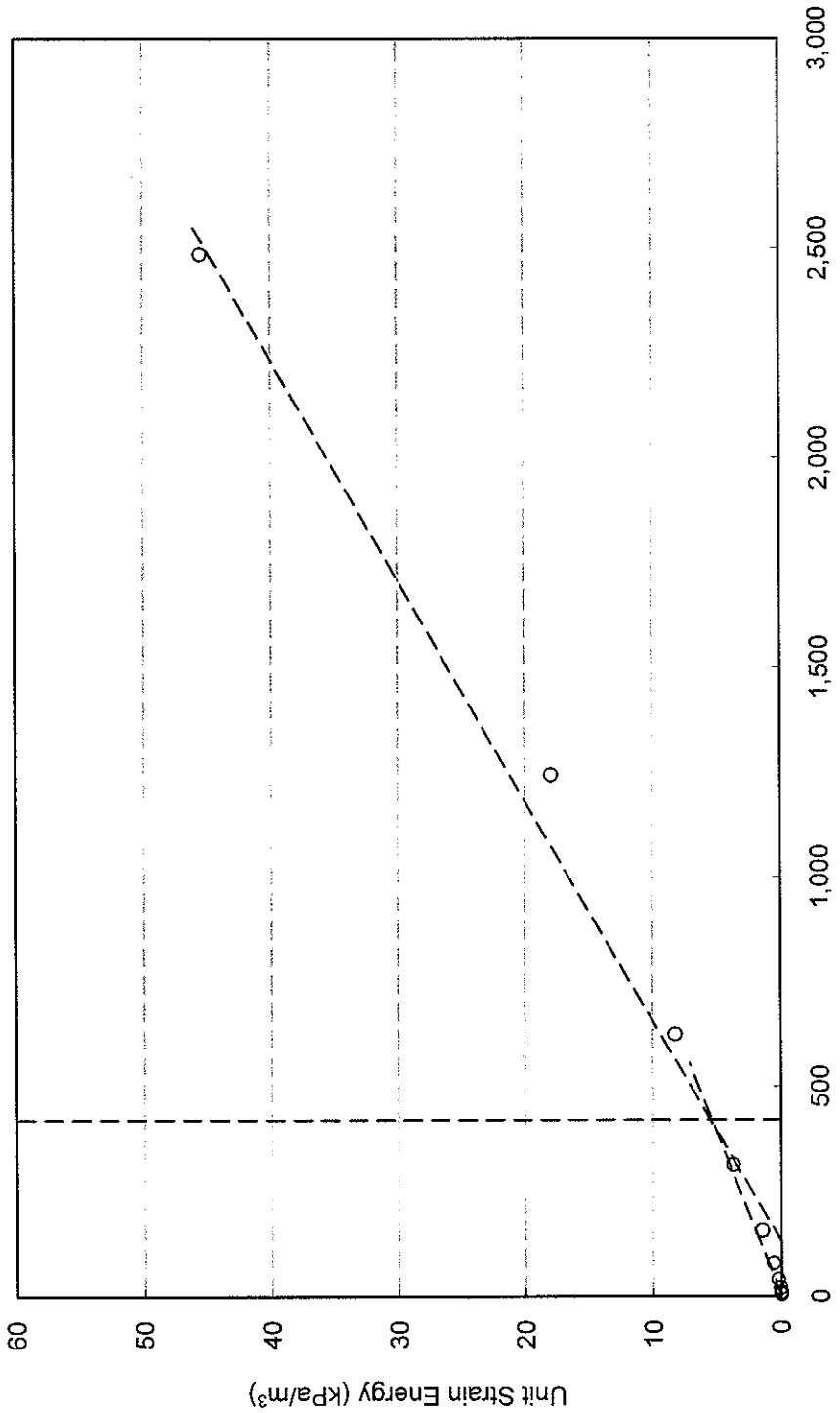
HWY 406 TWINNING - MERRITT ROAD

FIGURE B1-25

CONSOLIDATION TEST
Unit Strain Energy vs Pressure
SEW 10+350 RT, TW6



Project No. : 1-09-4135

Date : May 2010

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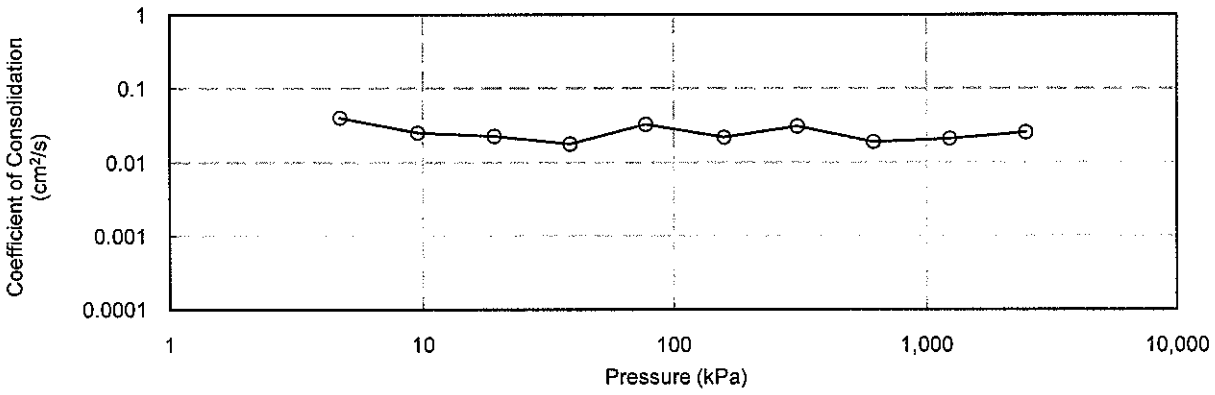
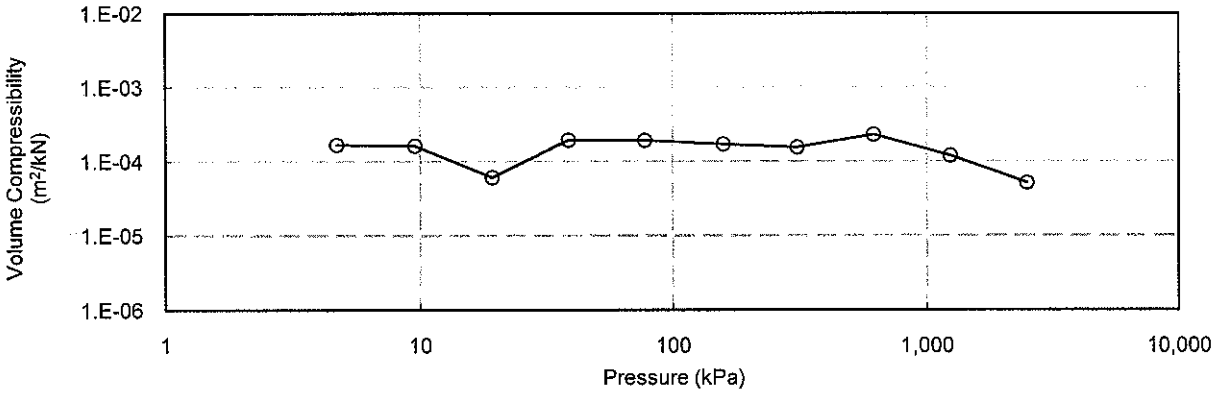
HWY 406 TWINNING - MERRITT ROAD	FIGURE B1-26

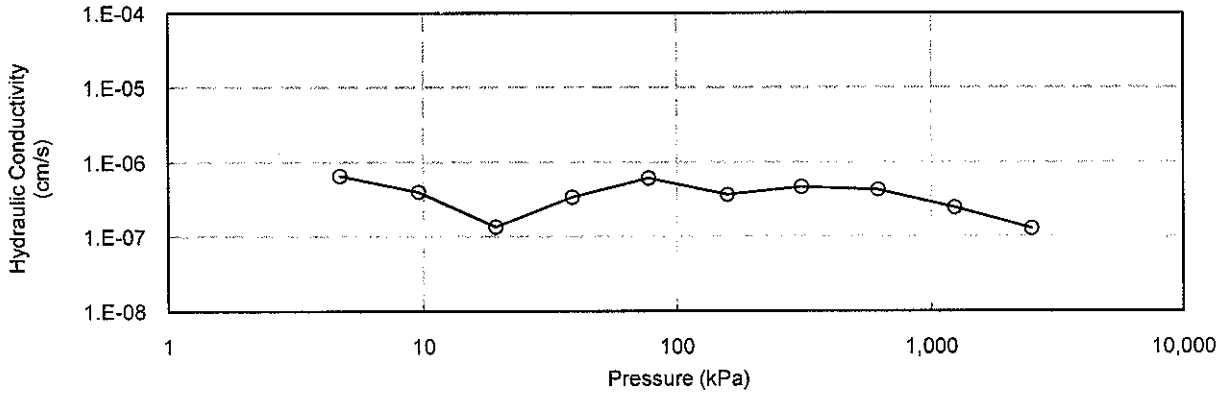
CONSOLIDATION TEST
Cv vs Pressure
WN 10+000 RT, TW7



CONSOLIDATION TEST
mv vs Pressure
WN 10+000 RT, TW7



CONSOLIDATION TEST
k vs Pressure
WN 10+000 RT, TW7



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Date : May 2010

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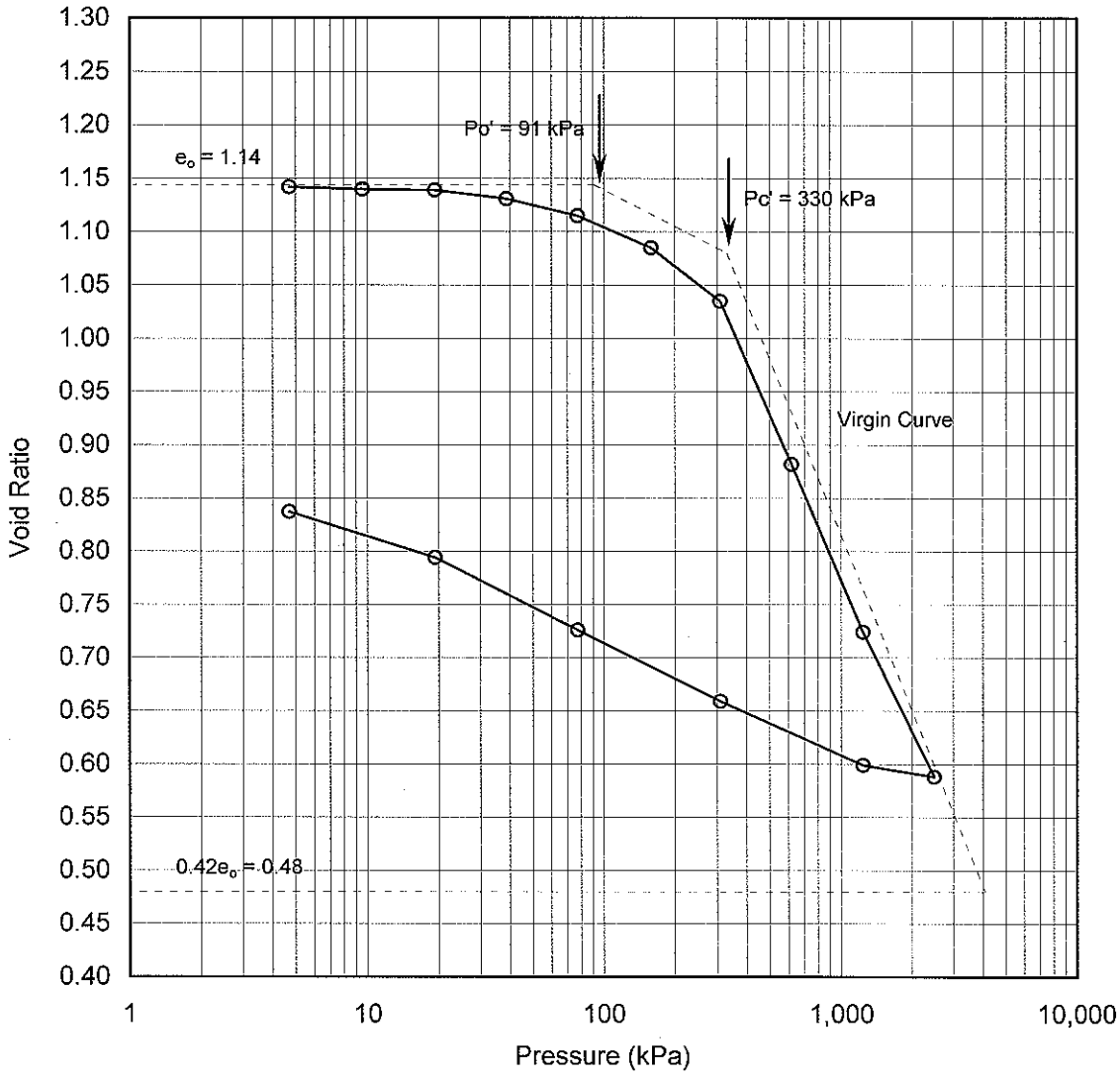
Checked By : RA

HWY 406 TWINNING - MERRITT ROAD	FIGURE B1-27

CONSOLIDATION TEST
e vs Pressure
WN 10+000 RT, TW7



Soil Type :	Silty Clay				
e_o =	1.14	ω_L =	44%	Po' =	91 kPa
ω =	40%	ω_P =	21%	Pc' =	330 kPa
γ =	17.9 kN/m^3	PI =	23%	Cc =	0.549
Gs =	2.78			Cr =	0.114

Project No. : 1-09-4135
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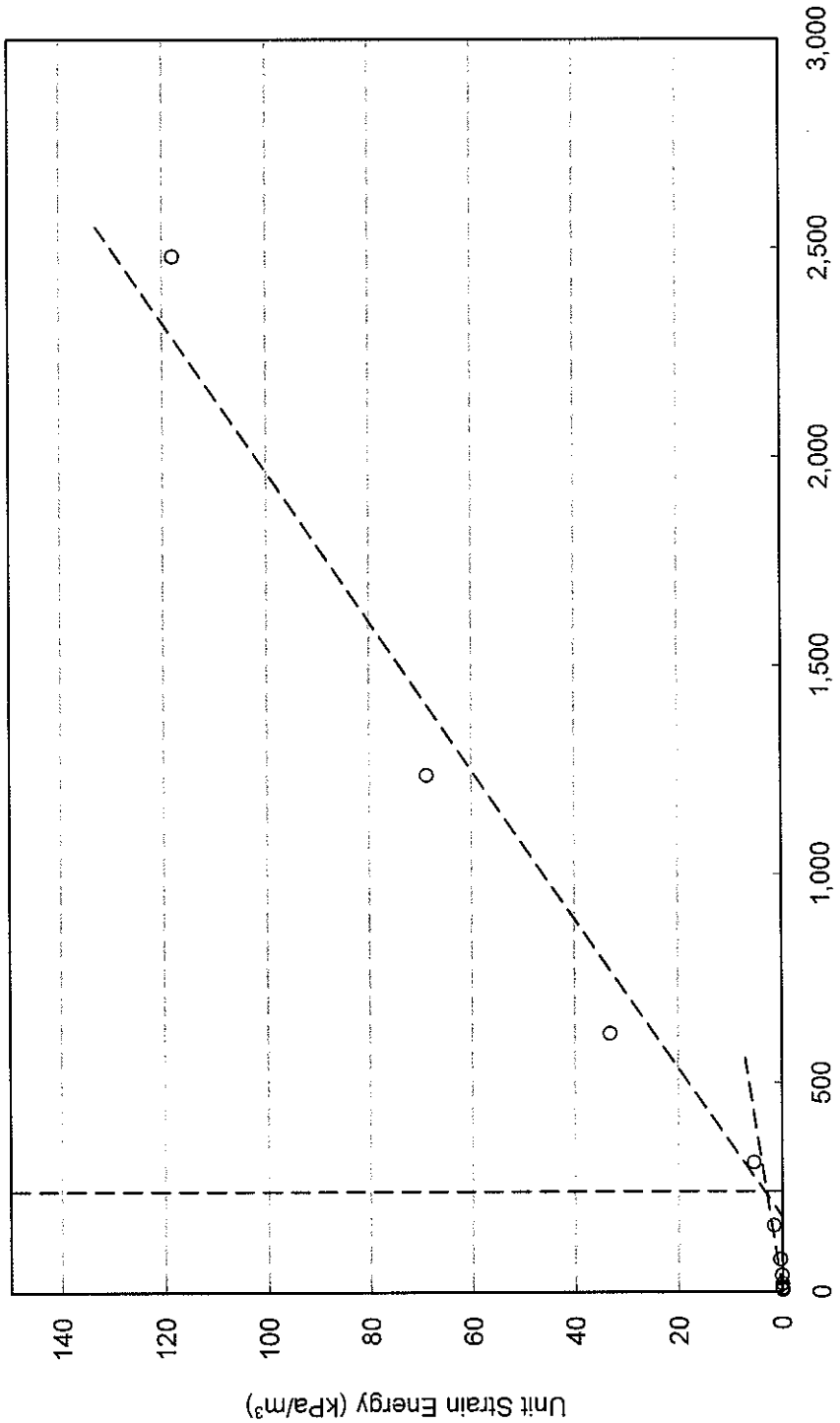
HWY 406 TWINNING - MERRITT ROAD

FIGURE B1-28

CONSOLIDATION TEST
Unit Strain Energy vs Pressure
WN 10+000 RT, TW7



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Date : May 2010

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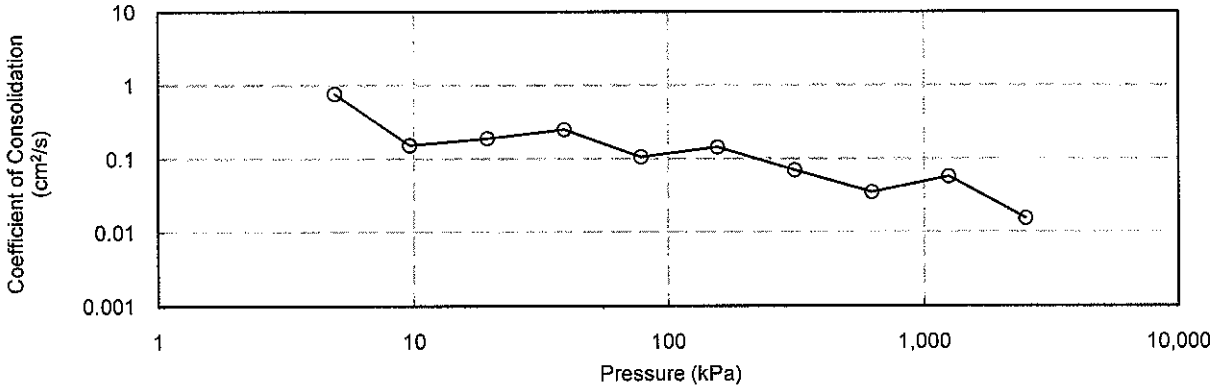
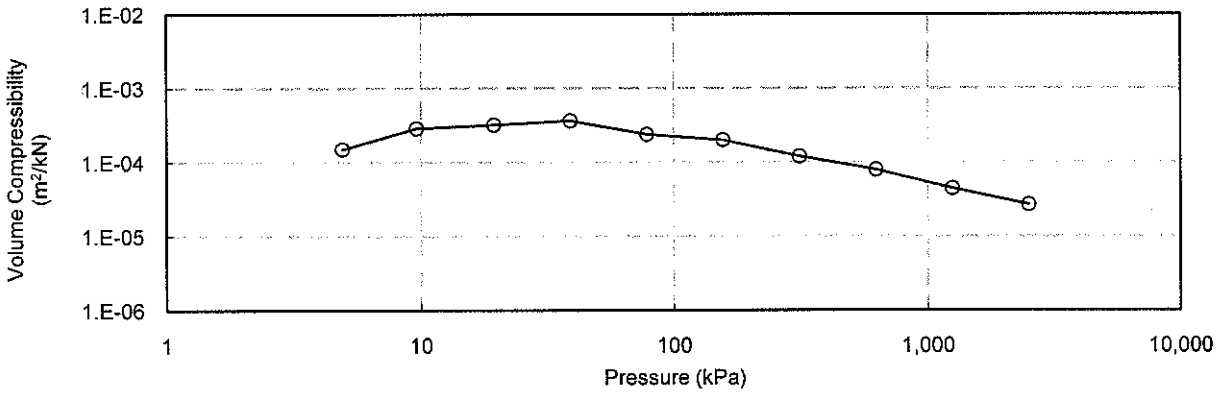
HWY 406 TWINNING - MERRITT ROAD	FIGURE B1-29

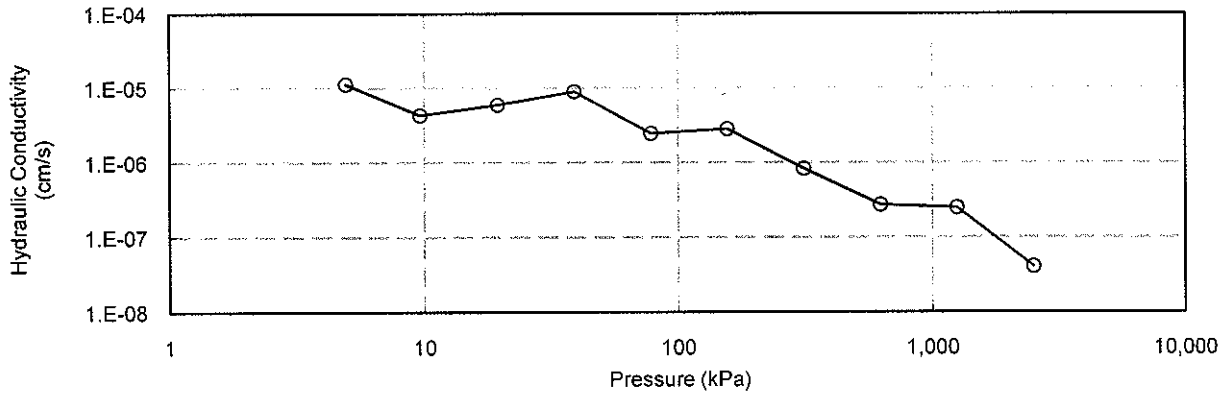
CONSOLIDATION TEST
Cv vs Pressure
WN 10+050 CL, TW6



CONSOLIDATION TEST
mv vs Pressure
WN 10+050 CL, TW6



CONSOLIDATION TEST
k vs Pressure
WN 10+050 CL, TW6



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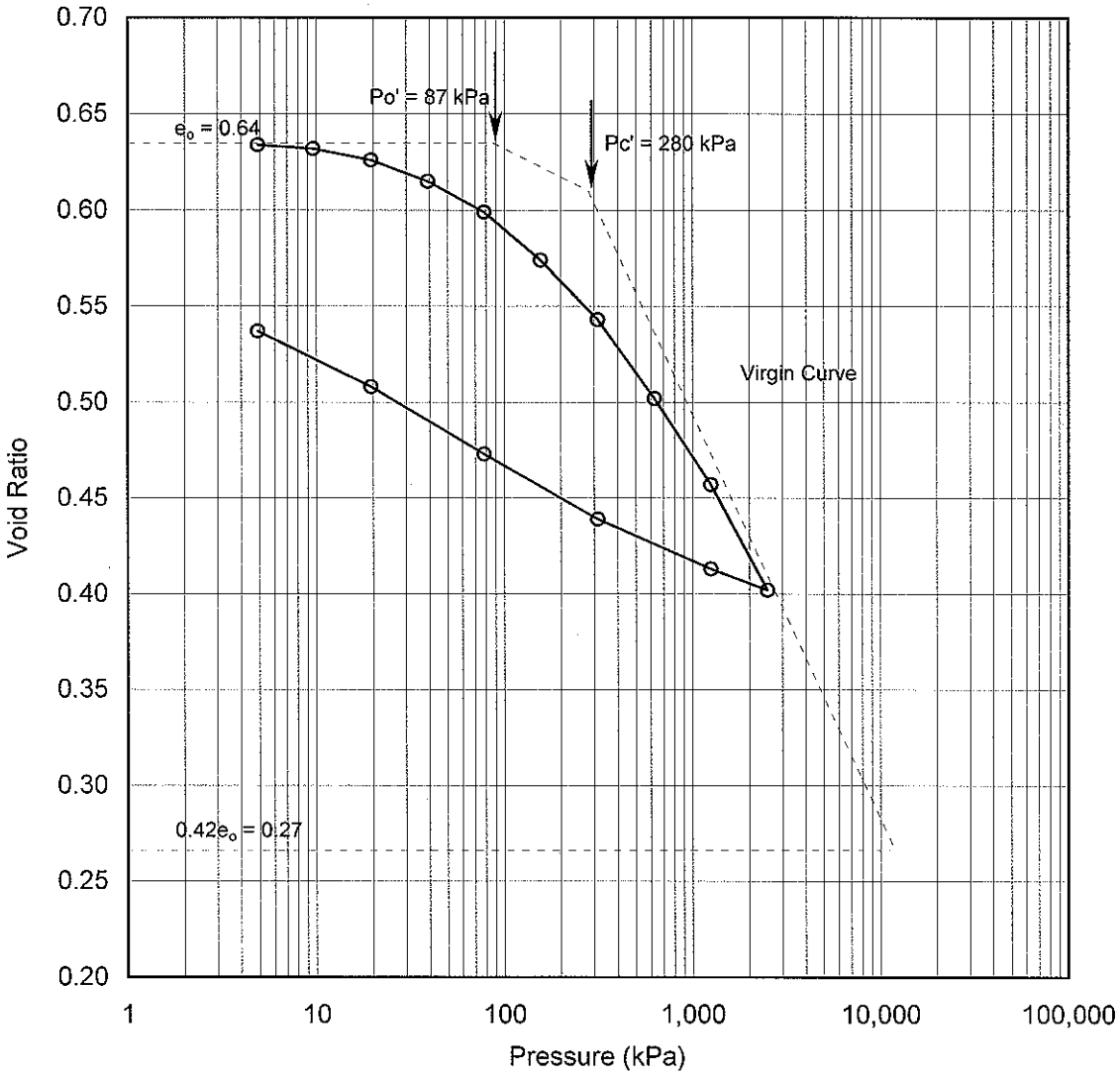
Checked By : RA

HWY 406 TWINNING - MERRITT ROAD	FIGURE B1-30

CONSOLIDATION TEST
e vs Pressure
WN 10+050 CL, TW6



Soil Type :	Silty Clay				
e_o =	0.64	ω_L =	33%	Po' =	87 kPa
ω =	20%	ω_P =	17%	Pc' =	280 kPa
γ =	20.4 kN/m^3	PI =	17%	Cc =	0.211
Gs =	2.77			Cr =	0.049

Project No. : 1-09-4135
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Prepared By : HW
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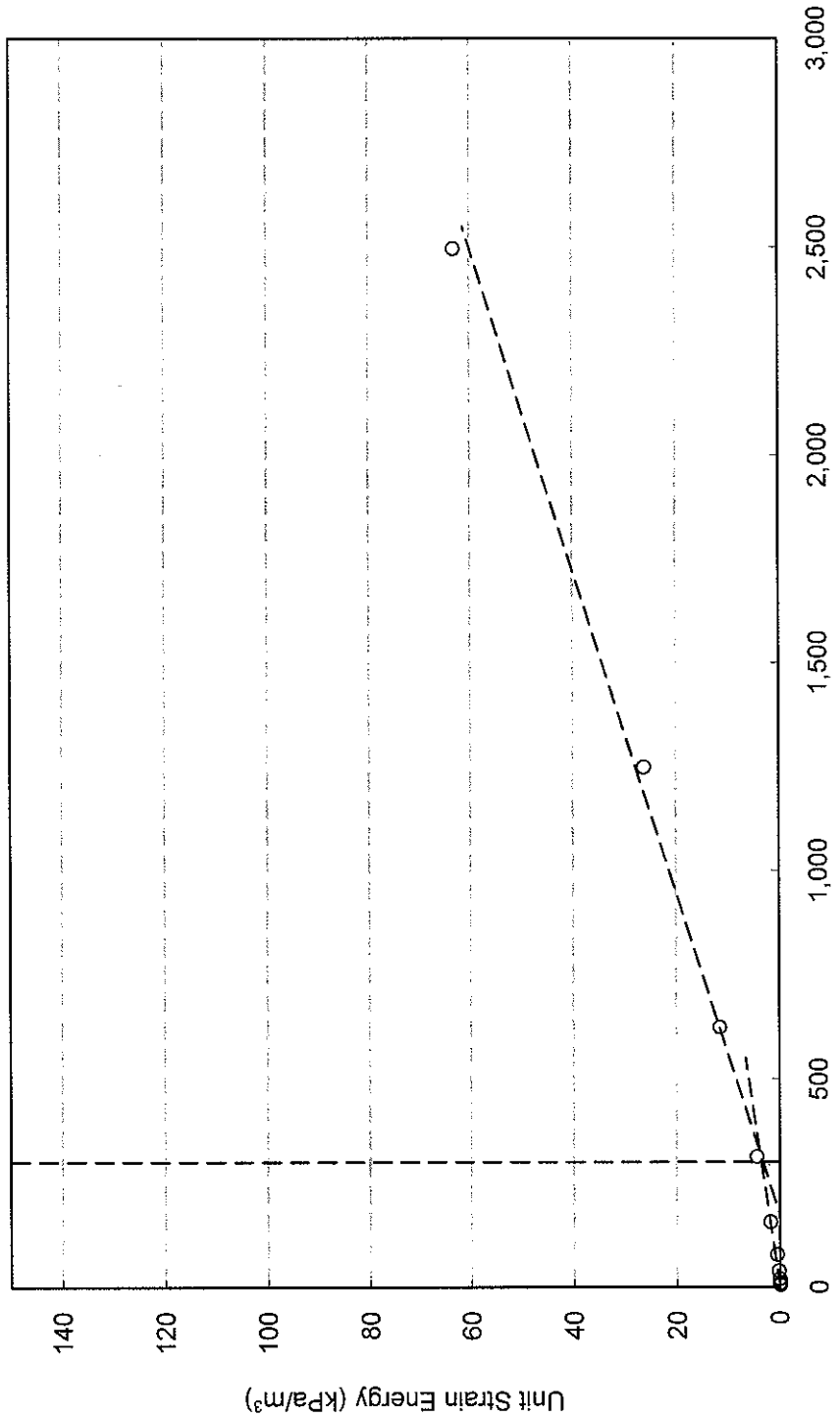
HWY 406 TWINNING - MERRITT ROAD | **FIGURE B1-31**

CONSOLIDATION TEST
Unit Strain Energy vs Pressure
WN 10+050 CL, TW6



Project No. : 1-09-4135
Date : May 2010

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APPENDIX B

Laboratory Test Results (North West Quadrant)

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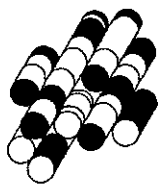
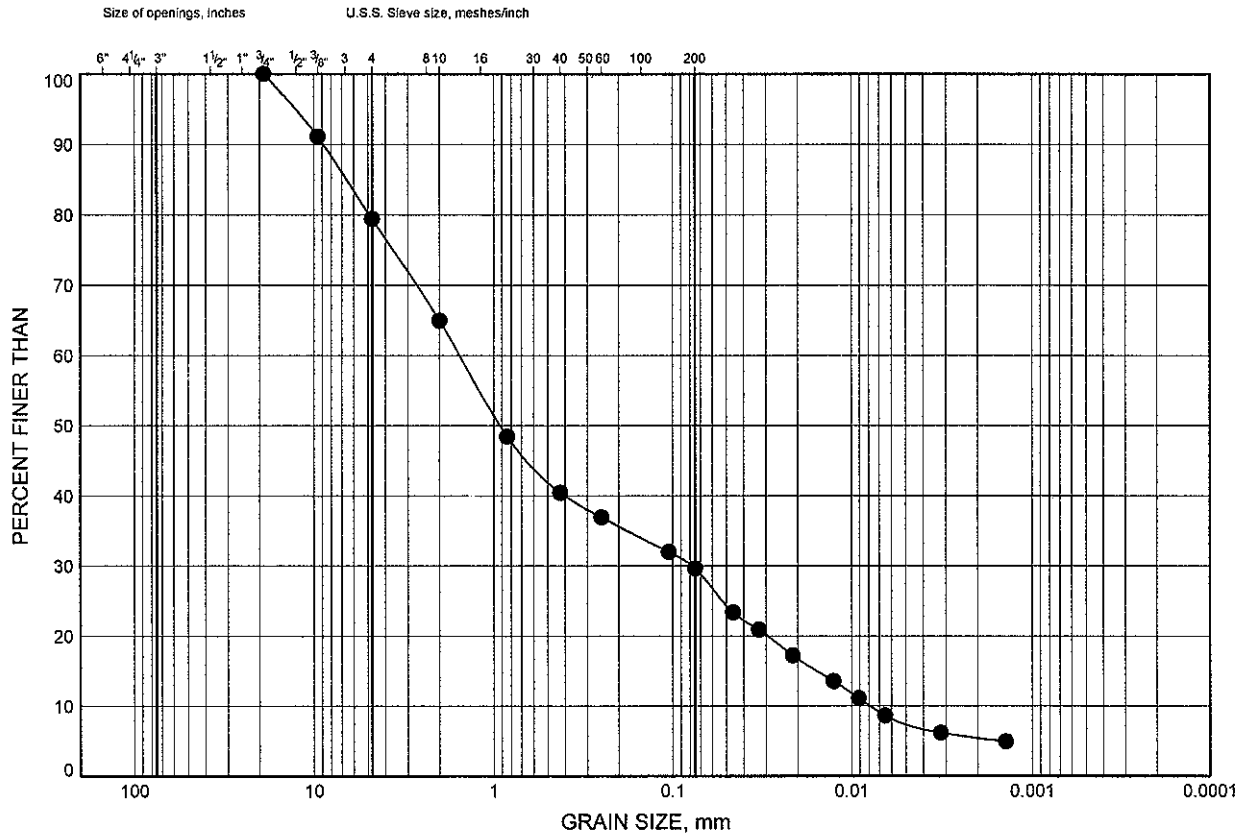


GRAIN SIZE DISTRIBUTION

FIGURE B2-1

FILL - Sand and Gravel



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

SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	MR 9+950 Rt	0.3	179.9

Date May 2010

Project 1-09-4135

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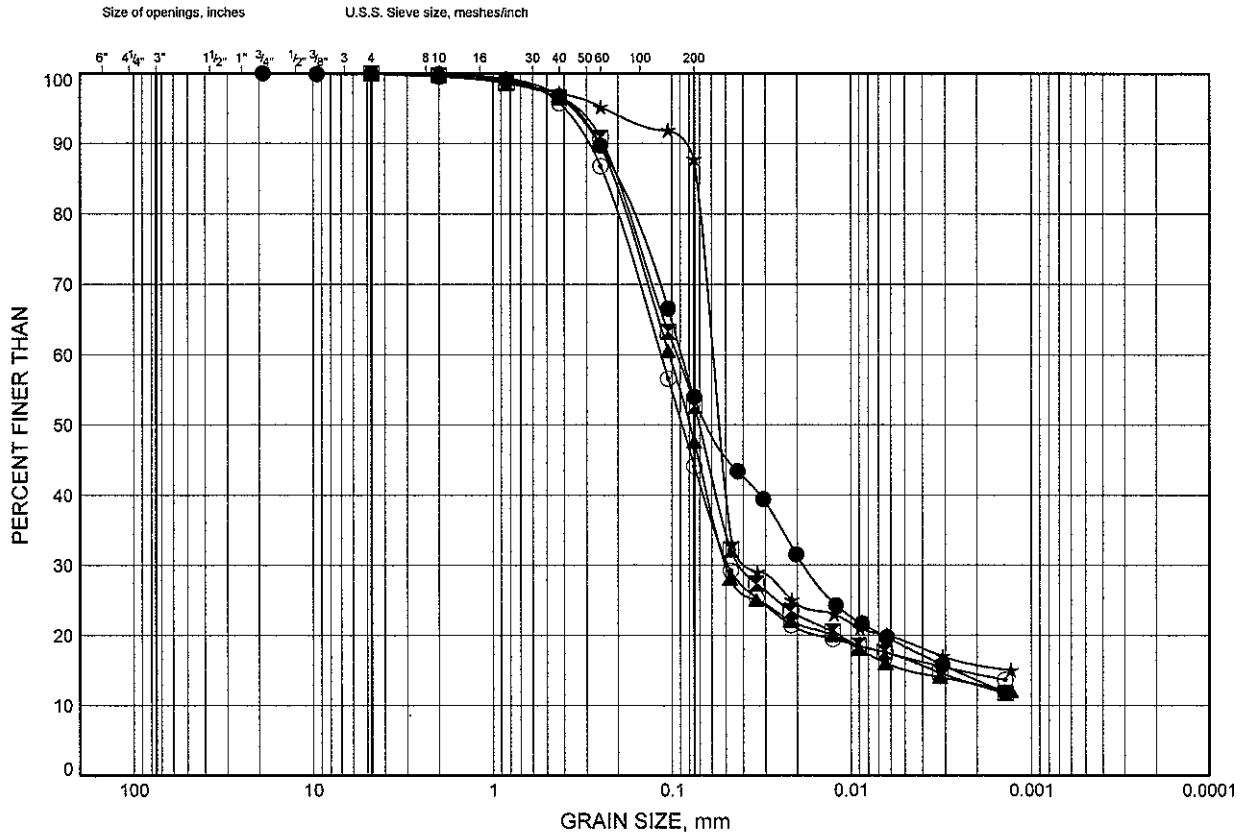
GRAIN SIZE DISTRIBUTION

FIGURE B2-2

FILL - Silt to Silty Sand



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

SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	ES 10+000 Lt	4.7	180.3
⊠	EWS 10+100 Lt	0.3	180.2
▲	EWS 10+150 CL	0.3	180.8
★	NW 10+000 Rt	0.3	179.9
⊙	WS 10+025 CL	0.3	179.9

Date May 2010

Project 1-09-4135

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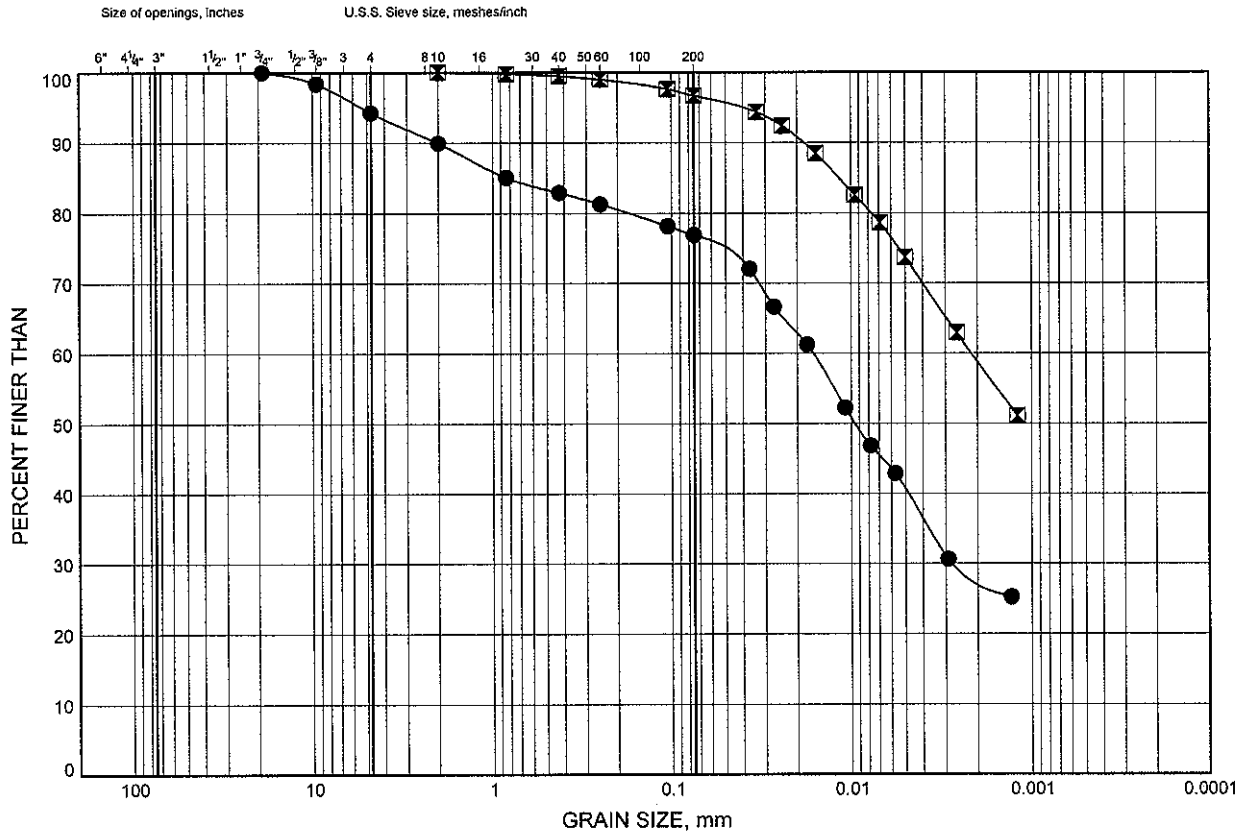
GSD 1-09-4135 MERRITT RD 2.GPJ 05/07/10

GRAIN SIZE DISTRIBUTION

FIGURE B2-3

FILL - Silty Clay



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

SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	ES 10+000 Lt	1.0	184.0
⧓	EWS 10+100 Rt	1.0	179.7

Date May 2010

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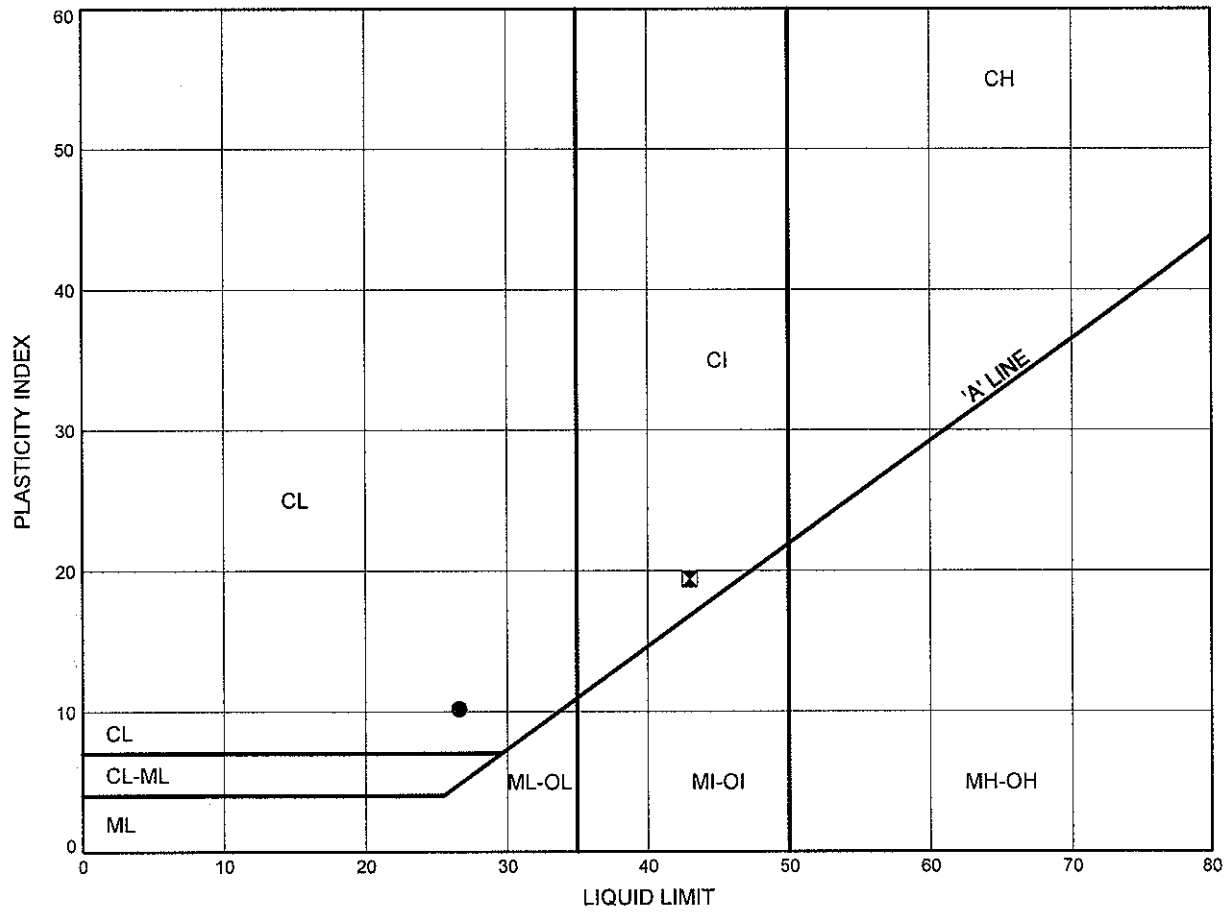
GSD 1-09-4135 MERRITT RD 2.GPJ 05/07/10

ATTERBERG LIMITS TEST RESULTS

FIGURE B2-4

FILL - Silty Clay



SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	ES 10+000 Lt	1.0	184.0
⊠	EWS 10+100 Rt	1.0	179.7

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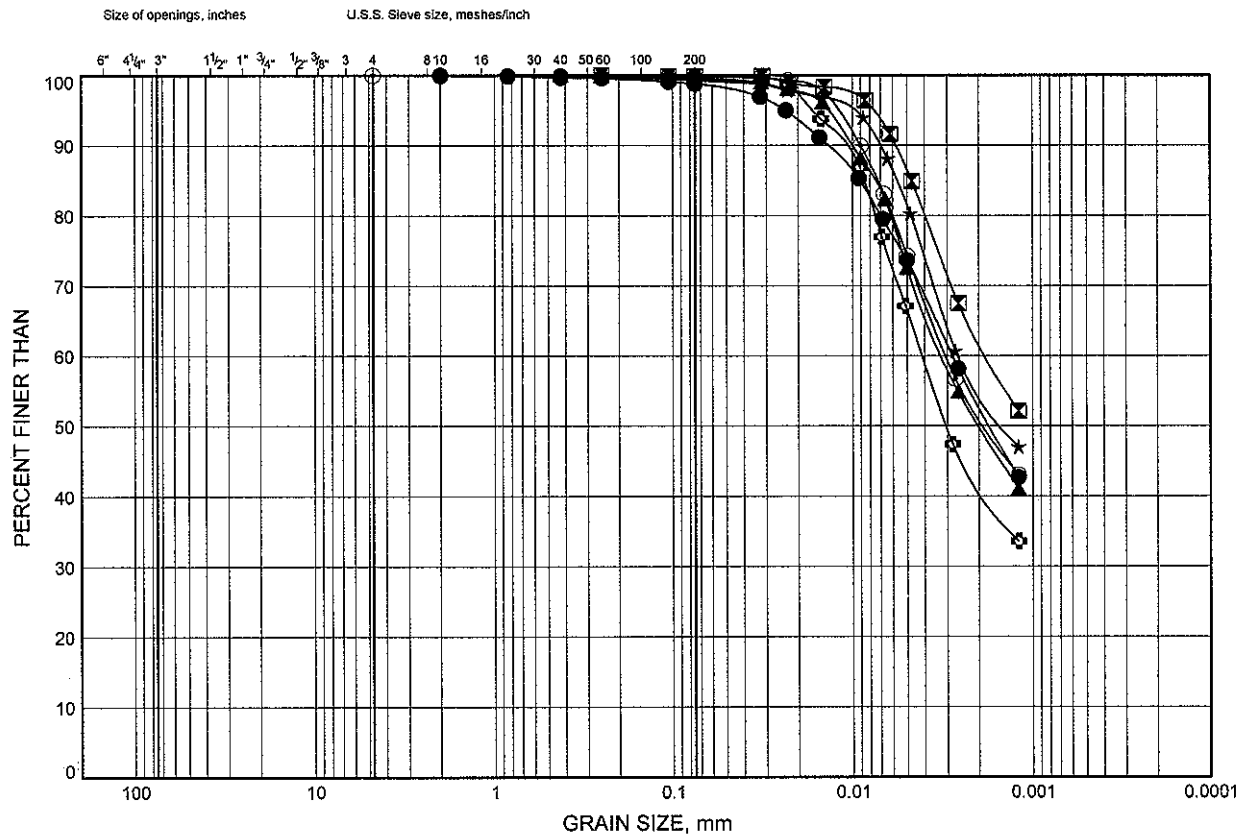
GRAIN SIZE DISTRIBUTION

FIGURE B2-5

SILTY CLAY



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

SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	NE 10+450 CL	1.7	178.5
⊠	NE 10+450 CL	2.5	177.7
▲	NW 10+000 Rt	1.7	178.5
★	NW 10+000 Rt	3.2	177.0
⊙	NW 10+050 CL	1.7	178.5
✿	NW 10+050 CL	4.7	175.5

Date May 2010

Project 1-09-4135

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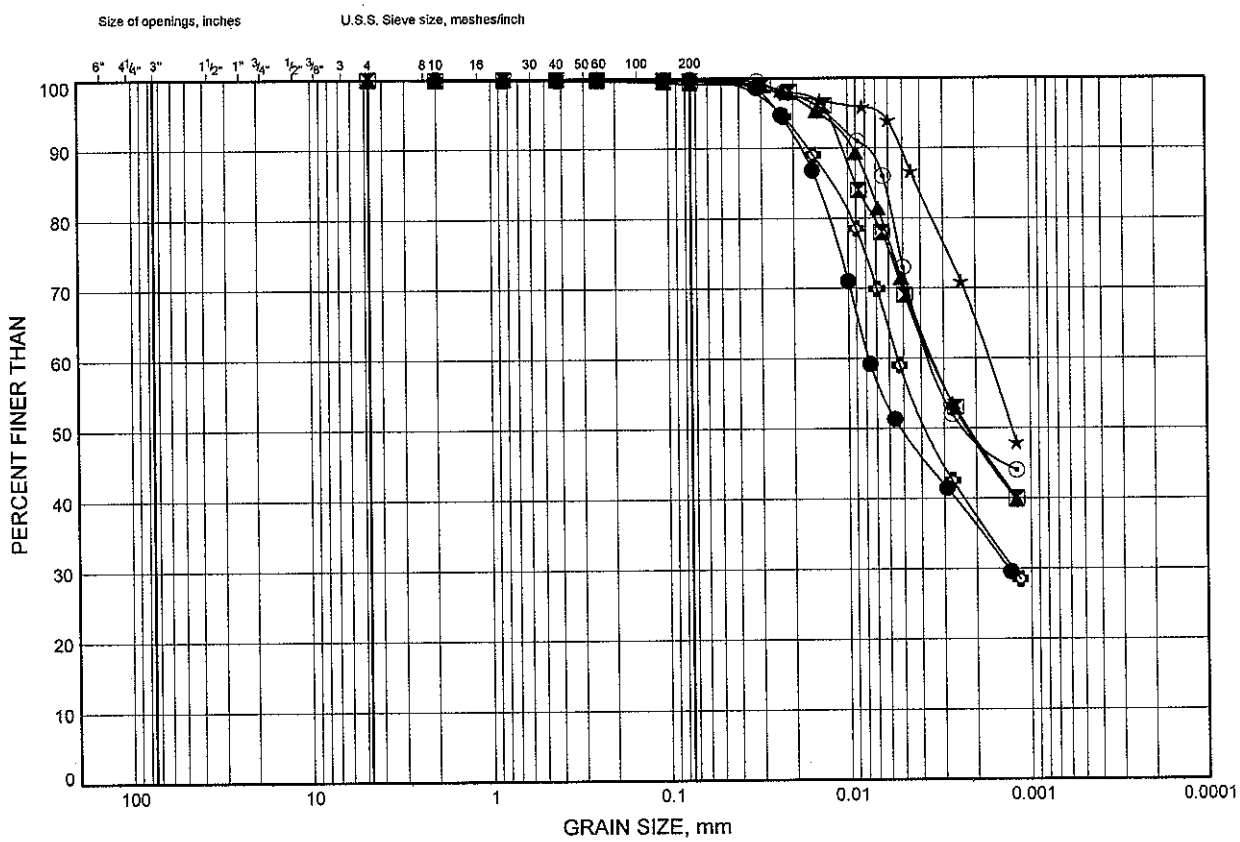
GSD 1-09-4135 MERRITT RD 2.GPJ 05/07/10

GRAIN SIZE DISTRIBUTION

FIGURE B2-6

SILTY CLAY



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

SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	ES 10+000 Lt	12.4	172.6
⊠	ES 10+000 Rt	9.3	175.6
▲	ES 10+050 CL	7.8	178.1
★	ES 10+050 CL	12.4	173.5
⊙	EWS 10+100 Lt	1.7	178.8
✿	NE 10+450 CL	7.8	172.4

Date May 2010

Project 1-09-4135

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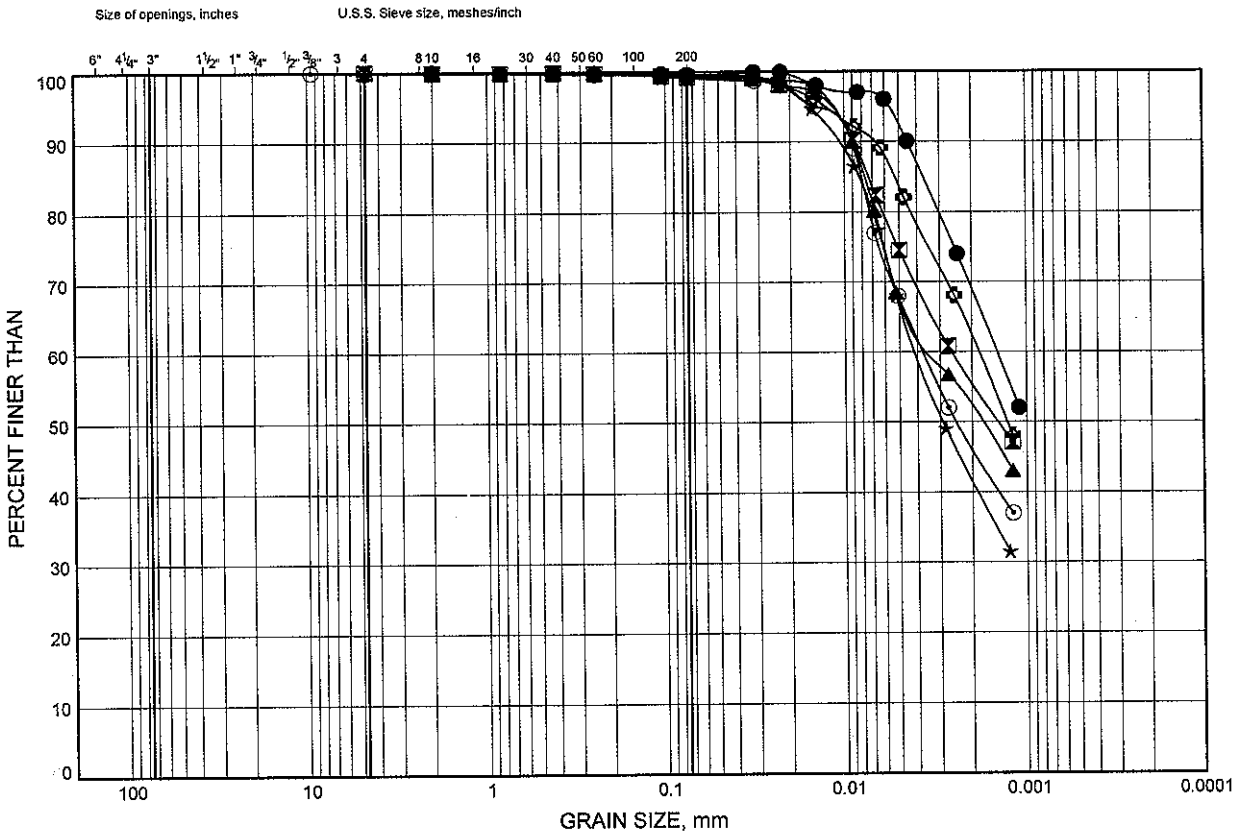
GSD 1-09-4135 MERRITT RD 2.GPJ 05/07/10

GRAIN SIZE DISTRIBUTION

FIGURE B2-7

SILTY CLAY



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

SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	EWS 10+100 Lt	6.3	174.2
⊠	EWS 10+100 Rt	2.5	178.2
▲	EWS 10+100 Rt	4.7	176.0
★	EWS 10+100 Rt	6.3	174.4
⊙	WS 10+025 CL	2.5	177.7
✿	WS 10+025 CL	6.3	173.9

Date May 2010

Project 1-09-4135

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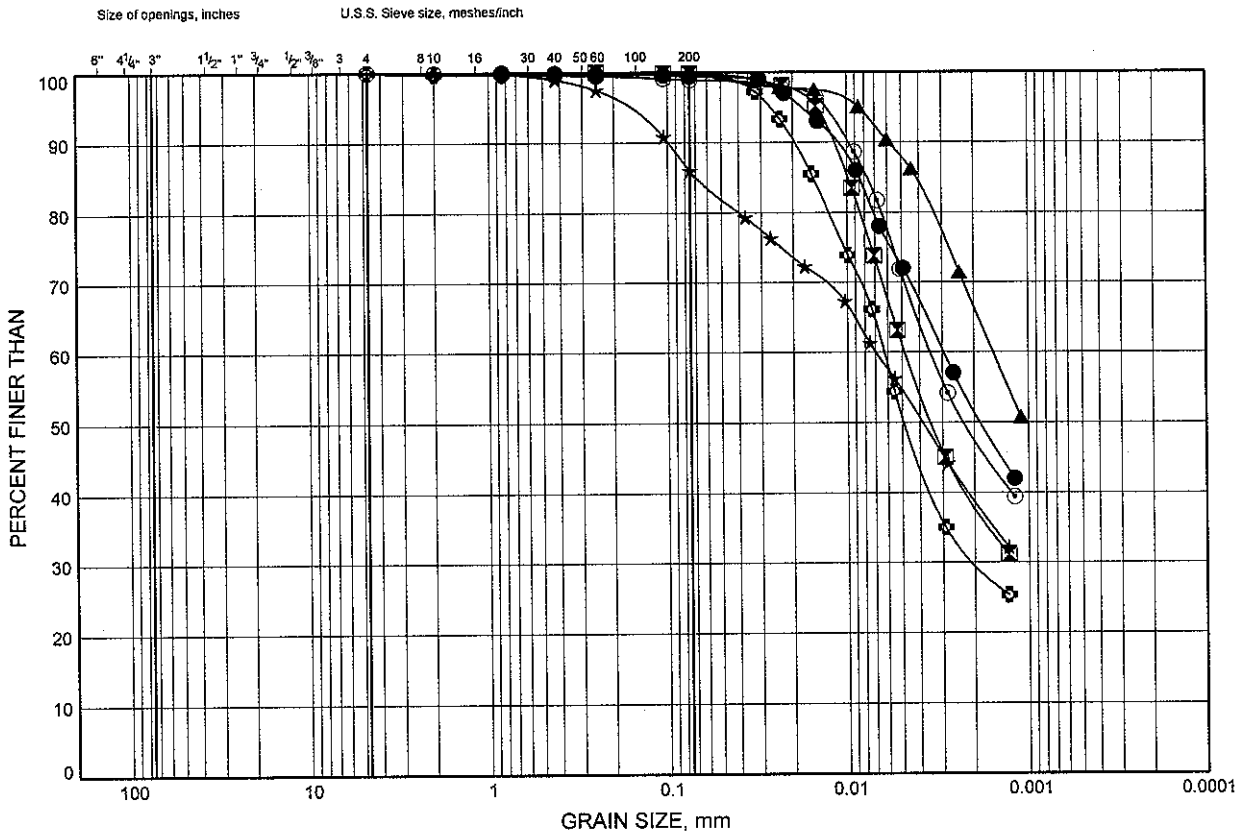
GRAIN SIZE DISTRIBUTION

FIGURE B2-8

SILTY CLAY



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

SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	MR 9+850 Rt	1.7	178.1
⊠	MR 9+850 Rt	4.7	175.1
▲	MR 9+850 Rt	6.3	173.5
★	MR 9+900 CL	6.3	179.0
⊙	MR 9+900 CL	10.9	174.4
✿	MR 9+900 CL	13.9	171.4

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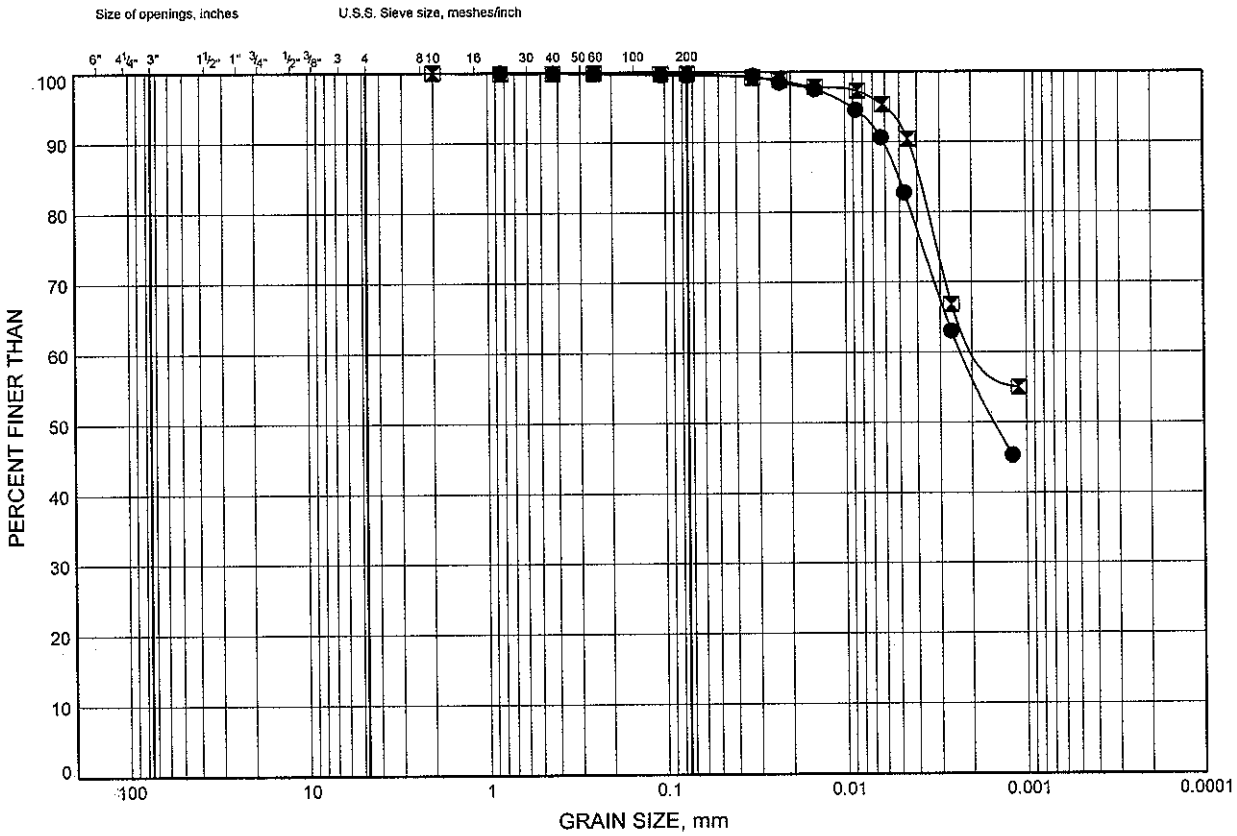
GRAIN SIZE DISTRIBUTION

FIGURE B2-9

SILTY CLAY



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

SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	MR 9+950 Rt	0.9	179.3
⊠	MR 9+950 Rt	6.3	173.9

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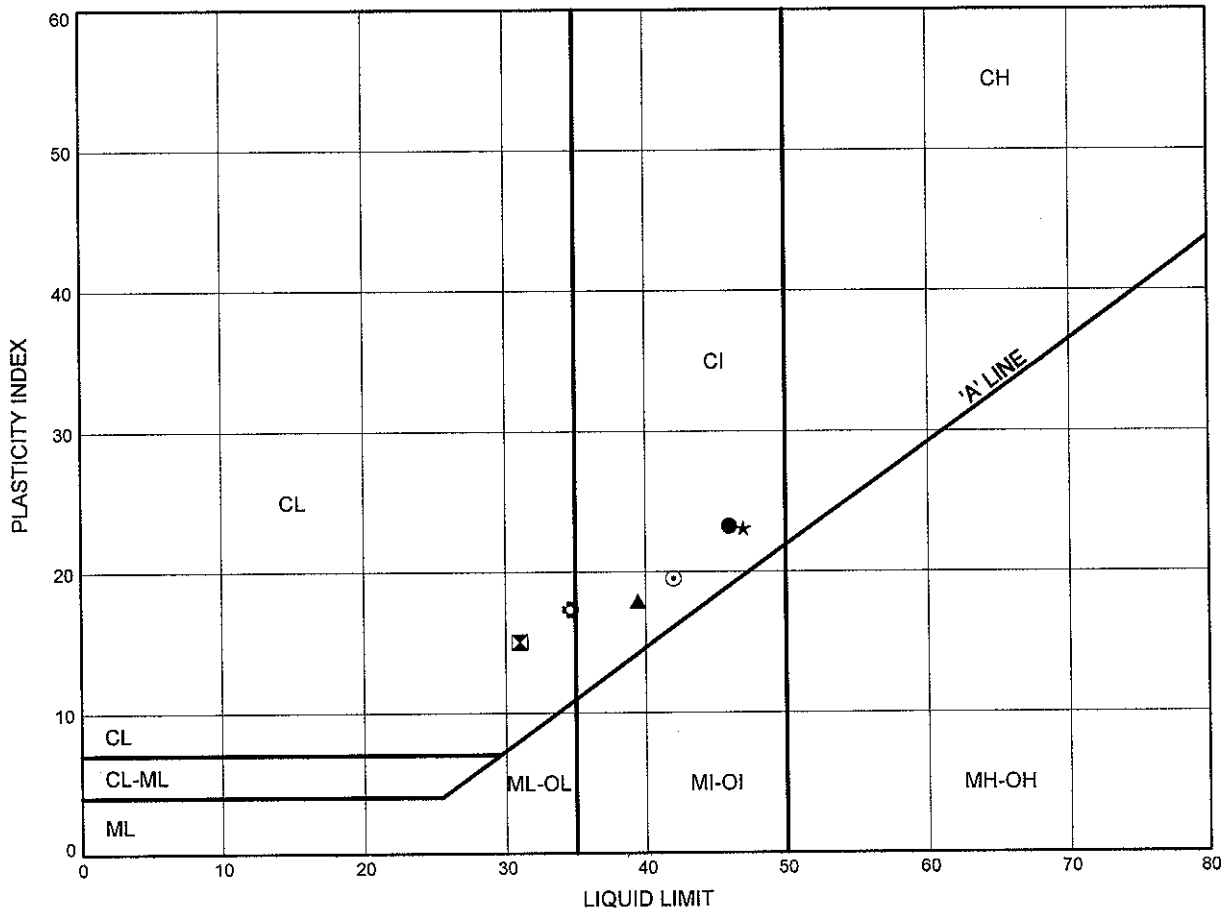
GSD 1-09-4135 MERRITT RD 2.GPJ 05/07/10

ATTERBERG LIMITS TEST RESULTS

FIGURE B2-10

SILTY CLAY



SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	NE 10+450 CL	2.5	177.7
⊠	NE 10+450 CL	7.8	172.4
▲	NW 10+000 Rt	1.7	178.5
★	NW 10+000 Rt	3.2	177.0
⊙	NW 10+050 CL	1.7	178.5
✿	NW 10+050 CL	4.7	175.5

Date May 2010

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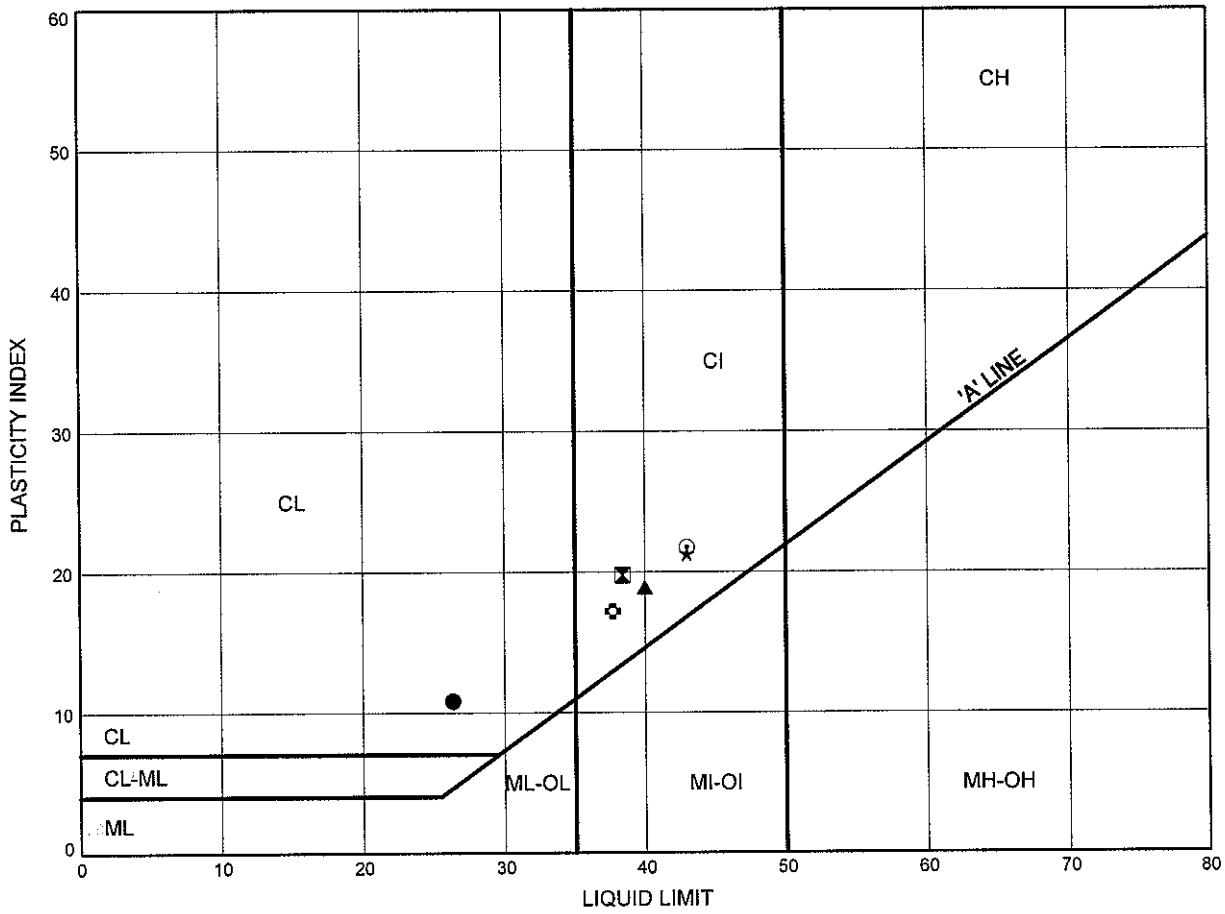
ALTR 1-09-4135 MERRITT RD 2.GPJ 05/07/10

ATTERBERG LIMITS TEST RESULTS

FIGURE B2-11

SILTY CLAY



SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	ES 10+000 Lt	12.4	172.6
⊠	ES 10+000 Rt	9.3	175.6
▲	ES 10+050 CL	7.8	178.1
★	ES 10+050 CL	12.4	173.5
⊙	EWS 10+100 Lt	1.7	178.8
✿	EWS 10+100 Lt	6.3	174.2

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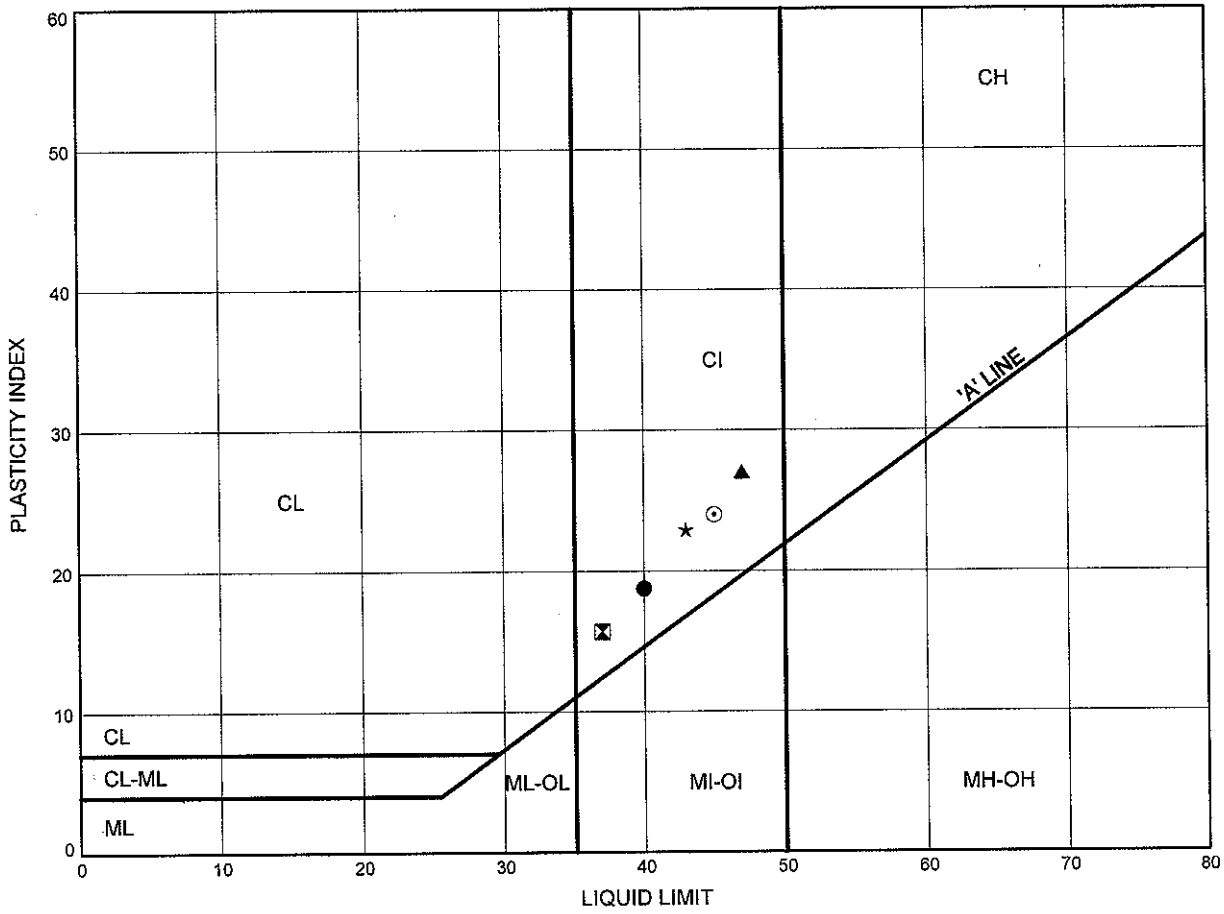
ALTR 1-09-4135 MERRITT RD 2.GPJ 05/07/10

ATTERBERG LIMITS TEST RESULTS

FIGURE B2-12

SILTY CLAY



SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	EWS 10+100 Rt	2.5	178.2
⊠	EWS 10+100 Rt	4.7	176.0
▲	EWS 10+100 Rt	6.3	174.4
★	WS 10+025 CL	2.5	177.7
⊙	WS 10+025 CL	6.3	173.9

Date May 2010

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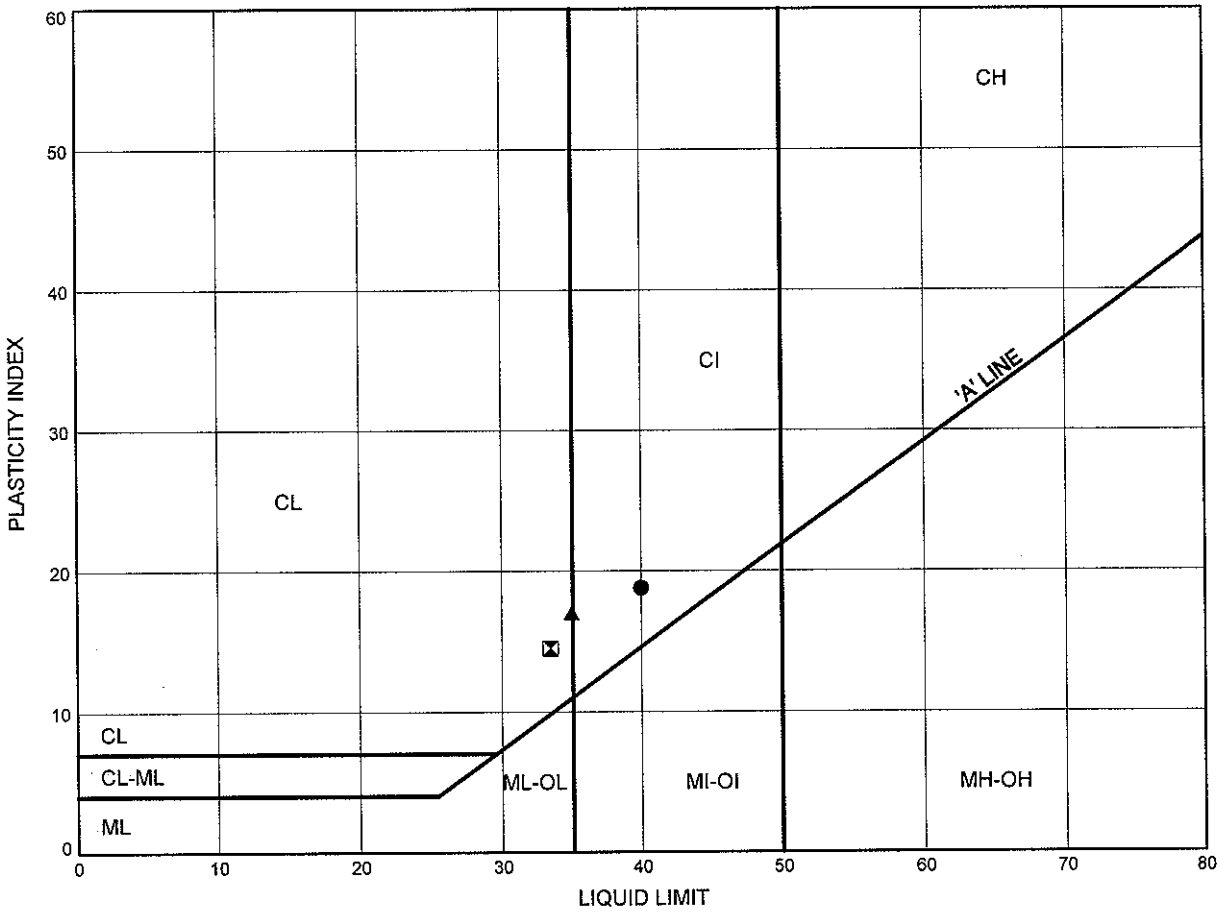
ALTR 1-09-4135 MERRITT RD 2.GPJ 05/07/10

ATTERBERG LIMITS TEST RESULTS

FIGURE B2-13

SILTY CLAY



SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	MR 9+850 Rt	1.7	178.1
⊠	MR 9+850 Rt	4.7	175.1
▲	MR 9+850 Rt	6.3	173.5

Date May 2010

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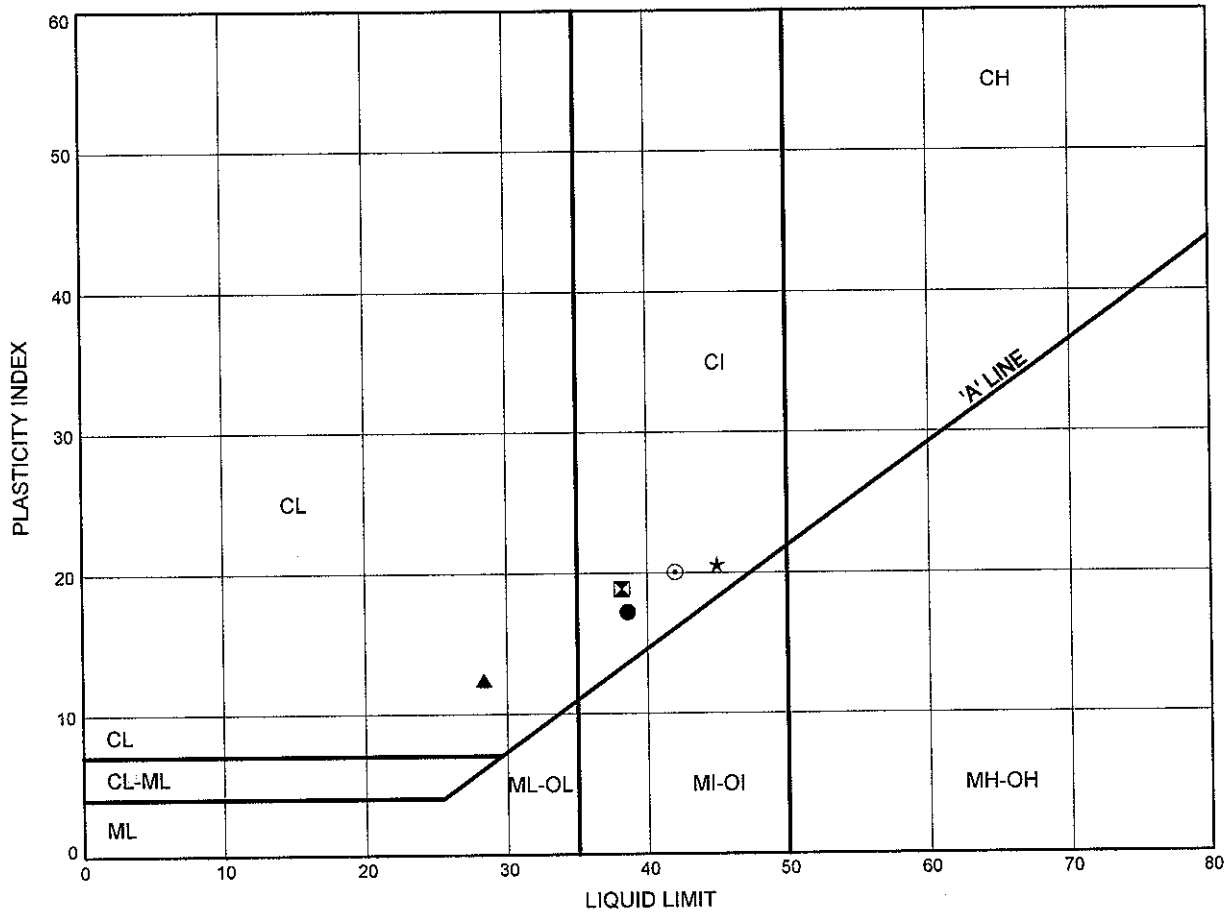
ALTR 1-09-4135 MERRITT RD 2.GPJ 05/07/10

ATTERBERG LIMITS TEST RESULTS

FIGURE B2-14

SILTY CLAY



SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	MR 9+900 CL	6.3	179.0
⊠	MR 9+900 CL	10.9	174.4
▲	MR 9+900 CL	13.9	171.4
★	MR 9+950 Rt	0.9	179.3
⊙	MR 9+950 Rt	6.3	173.9

Date May 2010

Project 1-09-4135

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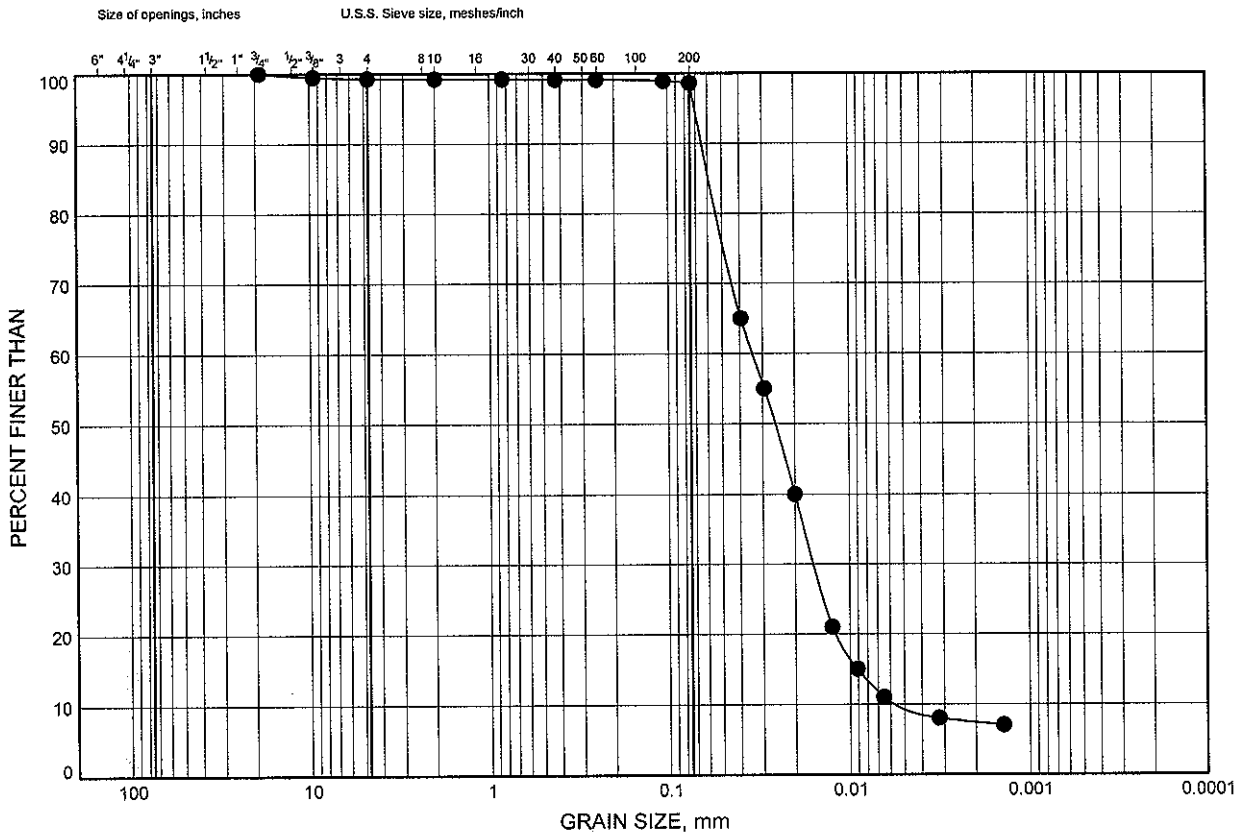
ALTR 1-09-4135 MERRITT RD 2.GPJ 05/07/10

GRAIN SIZE DISTRIBUTION

FIGURE B2-15

SILT



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

SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	MR 9+950 Rt	9.3	170.9

Date May 2010

Project 1-09-4135

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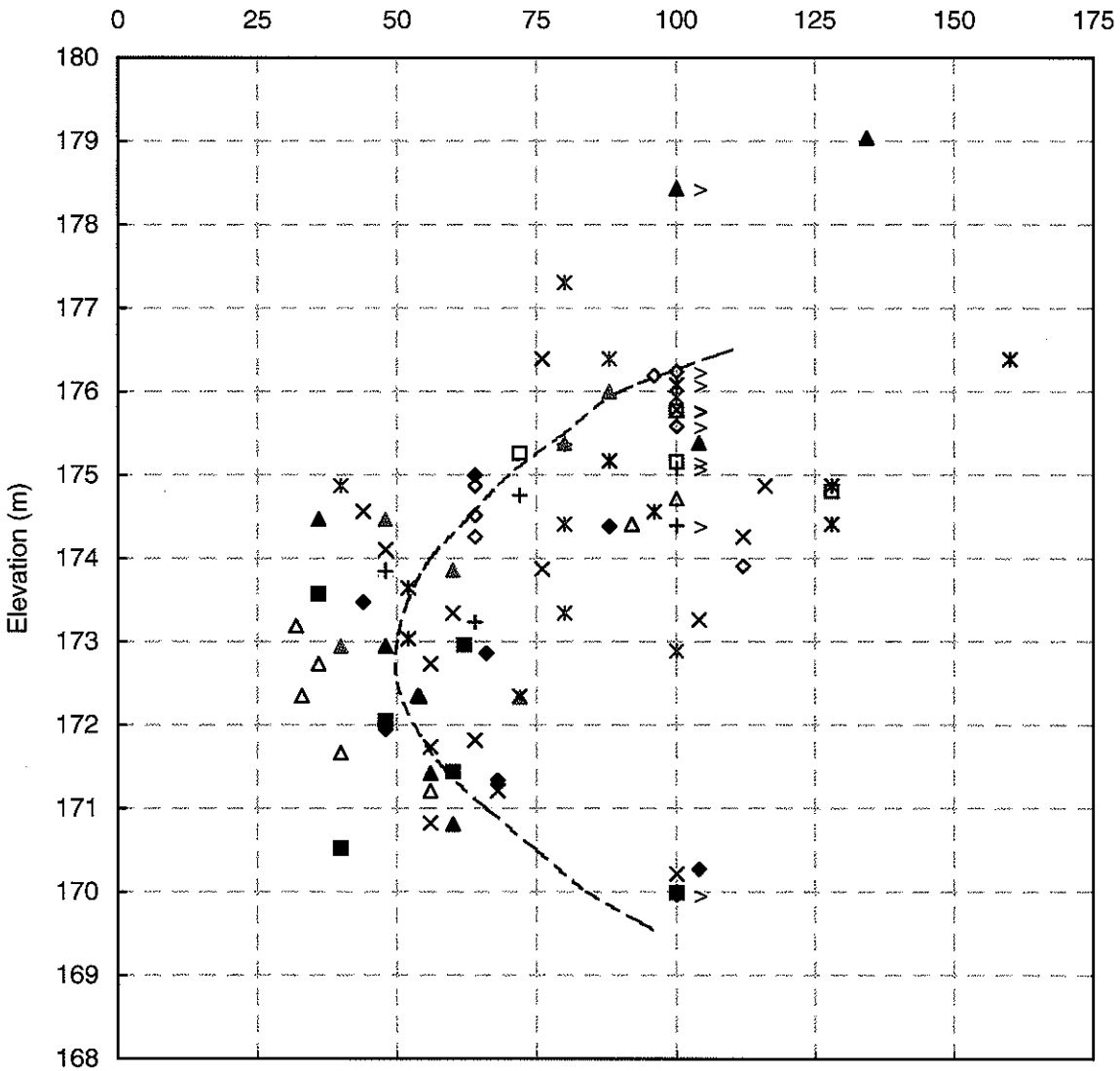
GSD 1-09-4135 MERRITT RD 2.GPJ 05/07/10

CORRECTED UNDRAINED SHEAR STRENGTH	FIGURE B2-16

MERRITT ROAD INTERCHANGE - NORTHWEST QUADRANT

Silty Clay



□ NEW 10+350 CL	◇ NE 10+400 LT	△ NE 10+450 CL	× NW 10+000 RT	✱ NW 10+050 CL
+ NW 10+100 RT	■ ES 10+000 LT	◆ ES 10+000 RT	▲ ES 10+050 CL	× WS 10+025 CL
✱ EWS 10+100 LT	+ EWS 10+100 RT	□ EWS 10+150 CL	◇ MR 9+800 CL	▲ MR 9+850 RT
× MR 9+900 CL	✱ MR 9+950 RT			

Field Shear Vane Correction

Morris & Williams (1994)

(μ = 1.18 EXP(-0.08 Ip) + 0.57)

Applied Correction Factors

0.80 (Elev.>176.5m) 0.85 Elev.<176.5m

Project No. : 1-09-4135

Date : September, 2010

Terraprobe Inc.

Prepared By : HW

Checked By : RA

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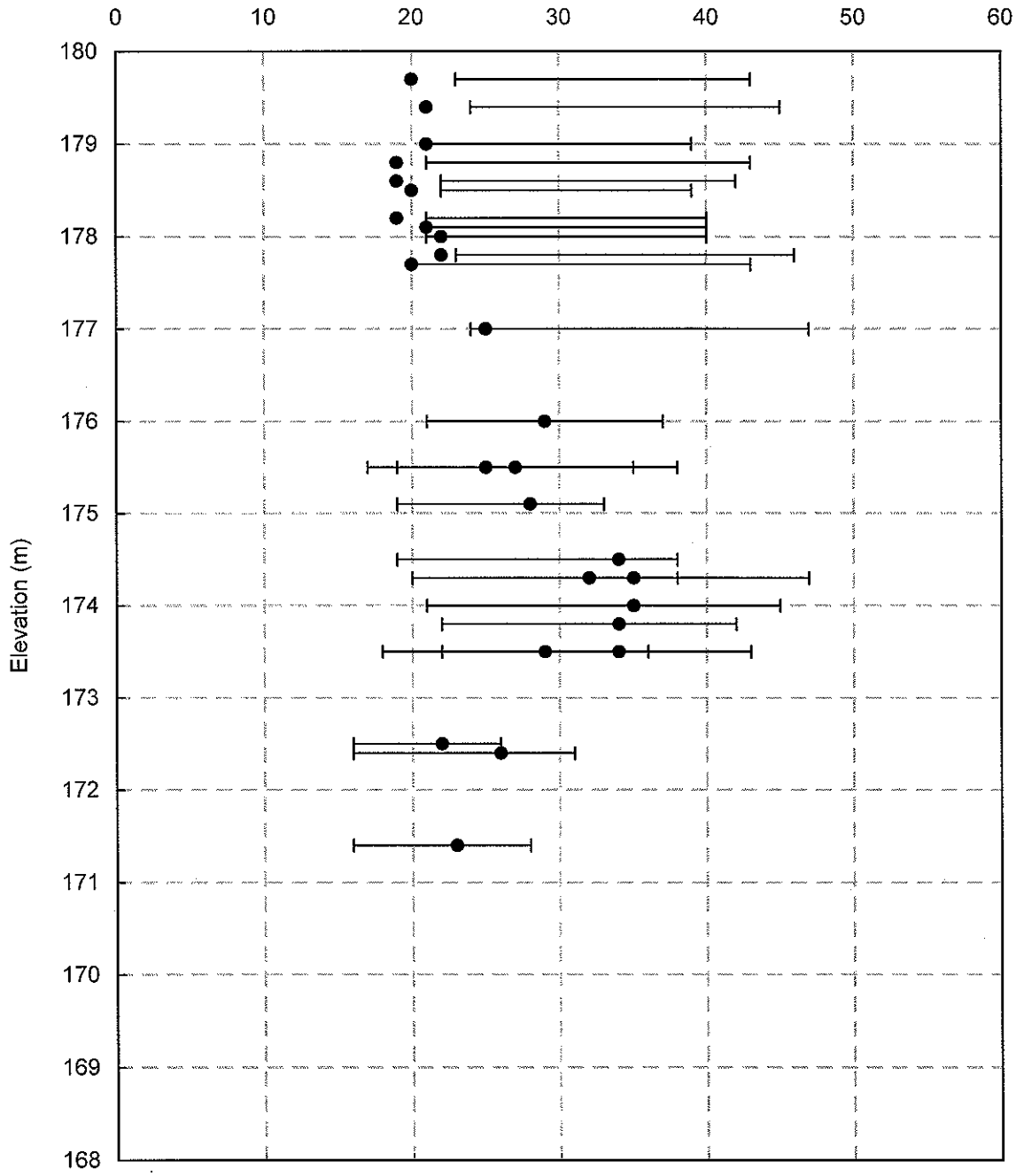
ATTERBERG LIMITS AND WATER CONTENTS	FIGURE B2-17

MERRITT ROAD INTERCHANGE - NORTHWEST QUADRANT

Silty Clay

Atterberg Limits & Water Contents (%)



Project No. : 1-09-4135

Date : May, 2010

Terraprobe Inc.

Prepared By : HW

Checked By : RA

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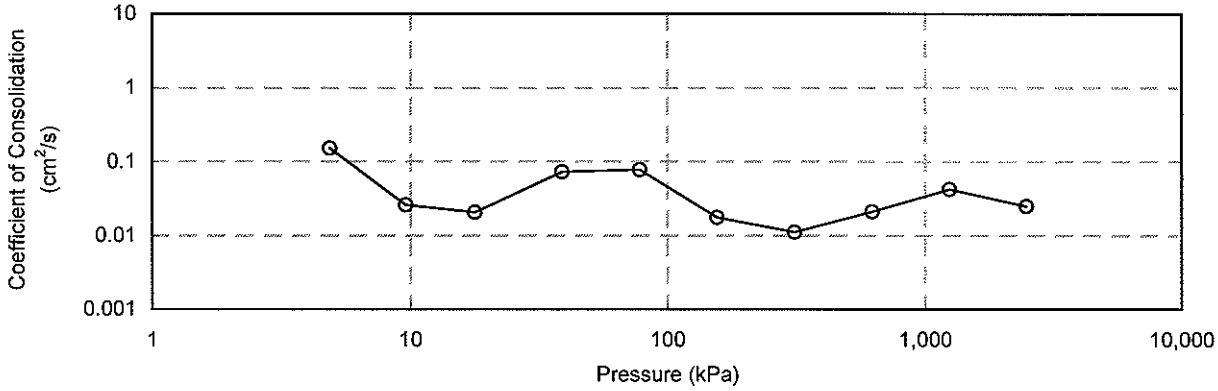
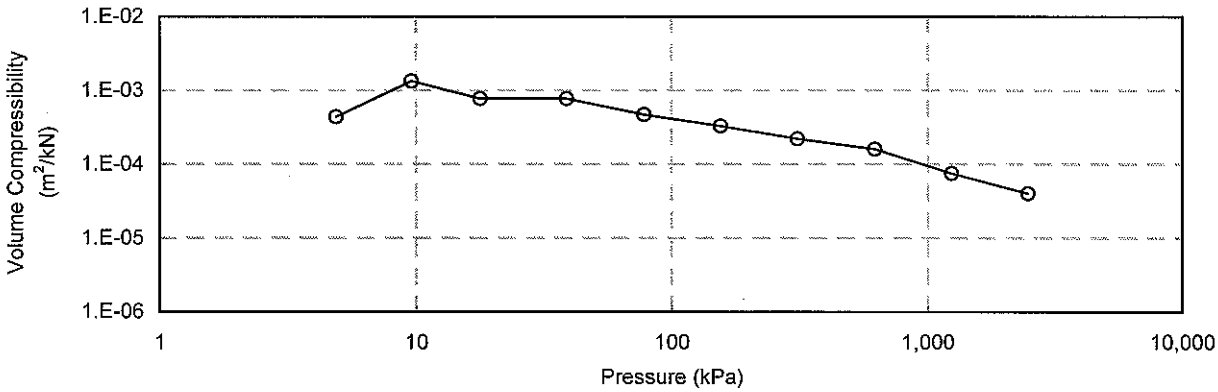
HWY 406 TWINNING - MERRITT ROAD	FIGURE B2-18

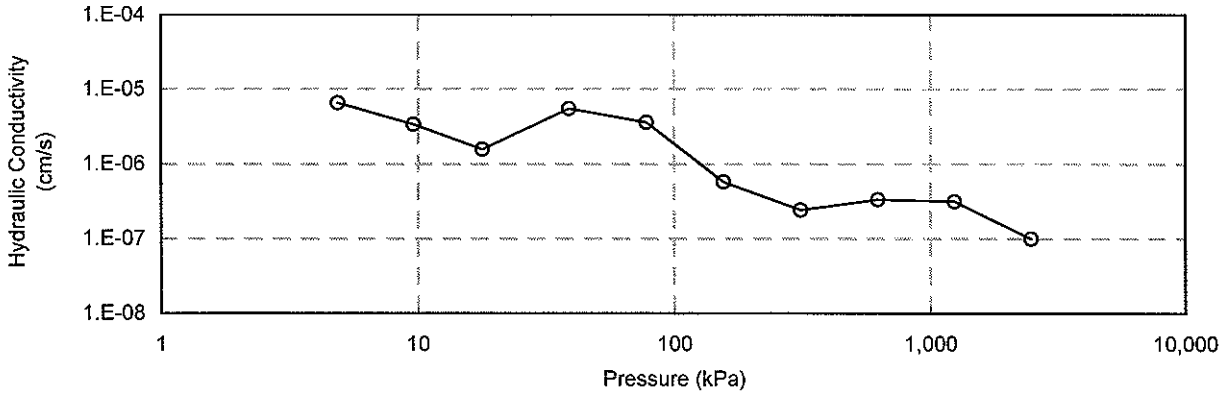
CONSOLIDATION TEST
Cv vs Pressure
MR 9+850 RT, TW7



CONSOLIDATION TEST
mv vs Pressure
MR 9+850 RT, TW7



CONSOLIDATION TEST
k vs Pressure
MR 9+850 RT, TW7



Project No. : 1-09-4135
Date : May 2010

Terraprobe Inc.

Prepared By : HW
Checked By : RA

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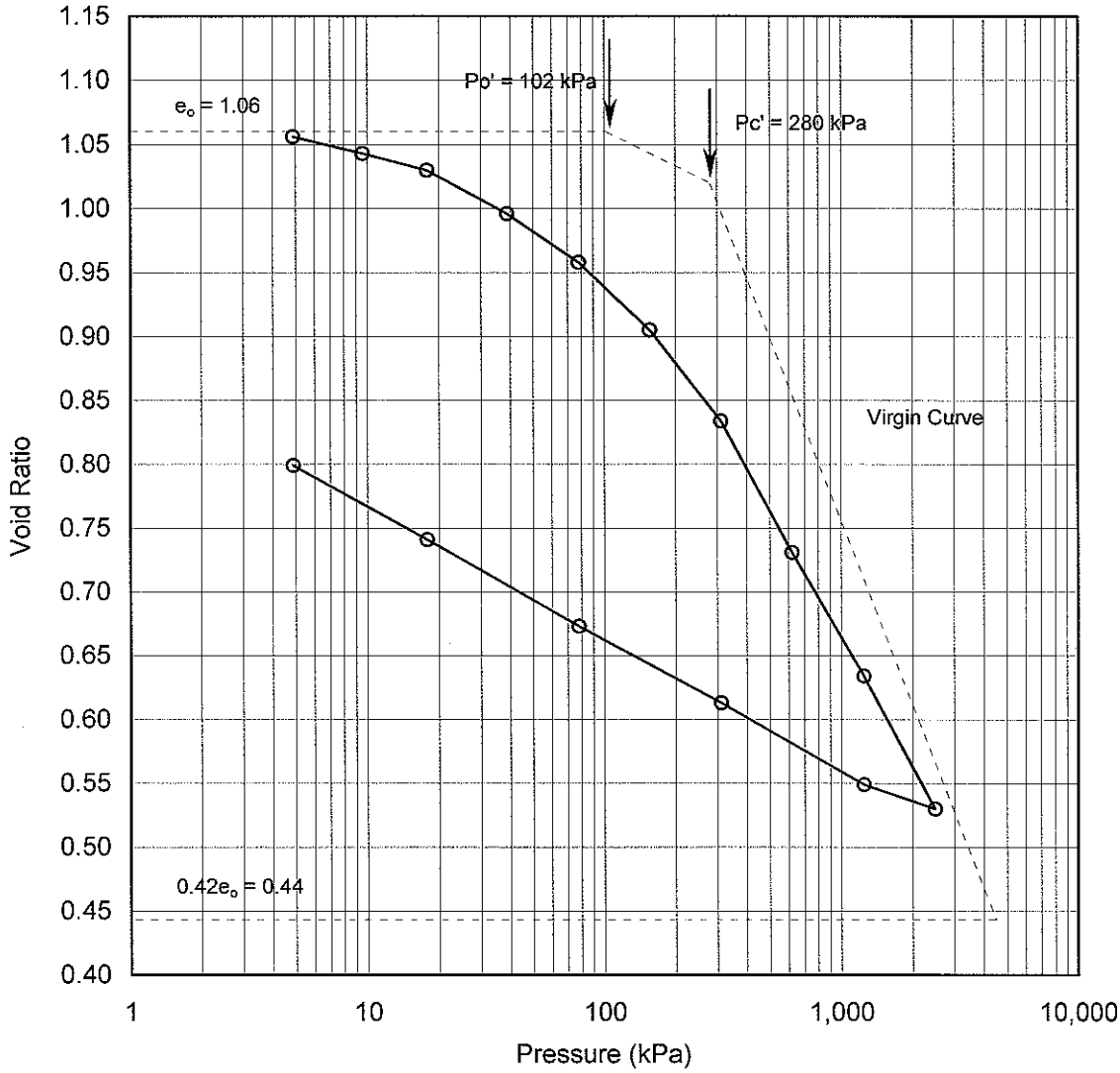
HWY 406 TWINNING - MERRITT ROAD	FIGURE B2-19

CONSOLIDATION TEST
e vs Pressure
MR 9+850 RT, TW7



Soil Type :	Silty Clay				
e_o =	1.06	ω_L =	36%	Po' =	102 kPa
ω =	29%	ω_P =	18%	Pc' =	280 kPa
γ =	18.3 kN/m^3	PI =	18%	Cc =	0.478
Gs =	2.78			Cr =	0.091

Project No. : 1-09-4135
Date : May 2010

Terraprobe Inc.

Prepared By : HW
Checked By : RA

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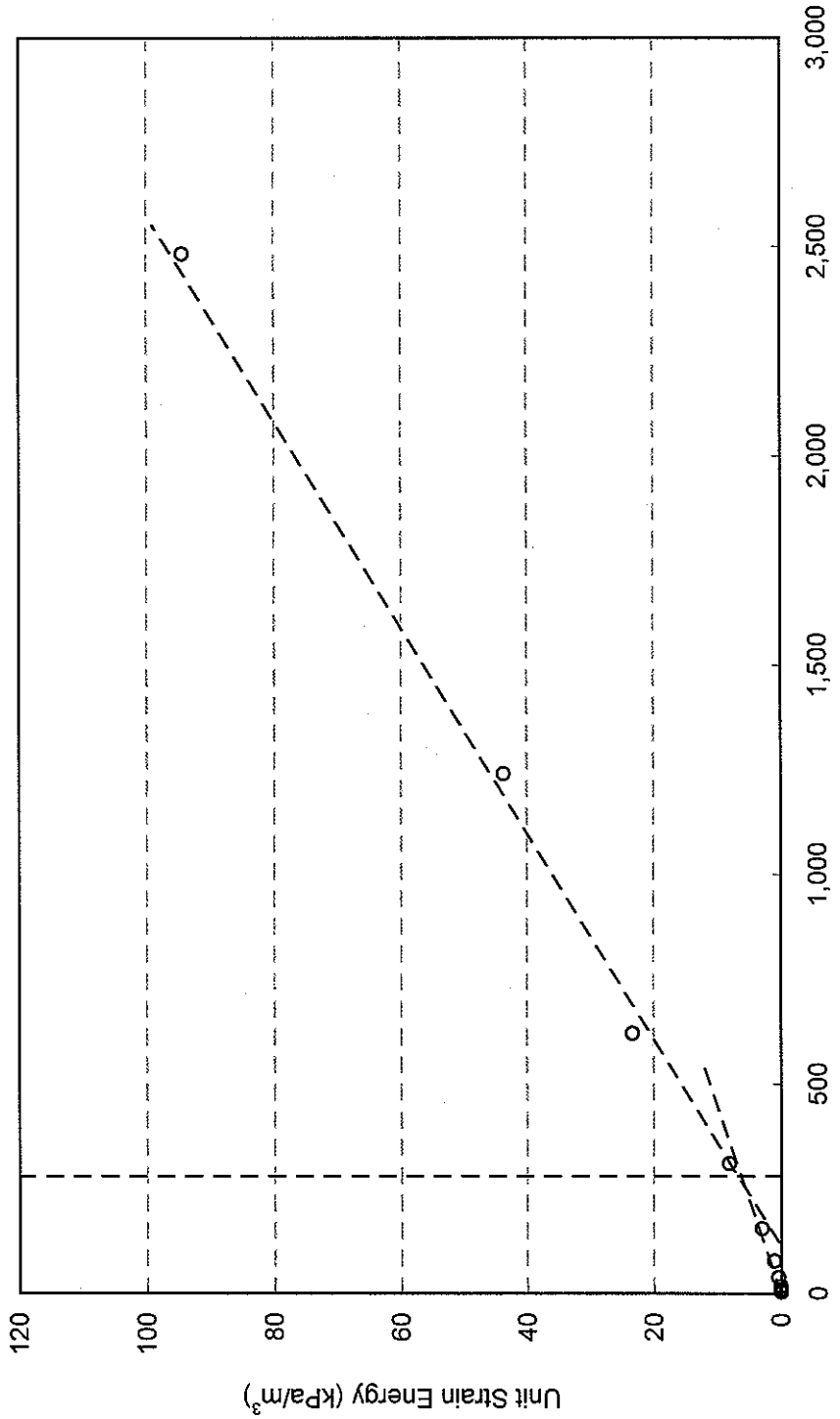
HWY 406 TWINNING - MERRITT ROAD	FIGURE B2-20

CONSOLIDATION TEST
Unit Strain Energy vs Pressure
MR 9+850 RT, TW7



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Date :	May 2010		Checked By : RA

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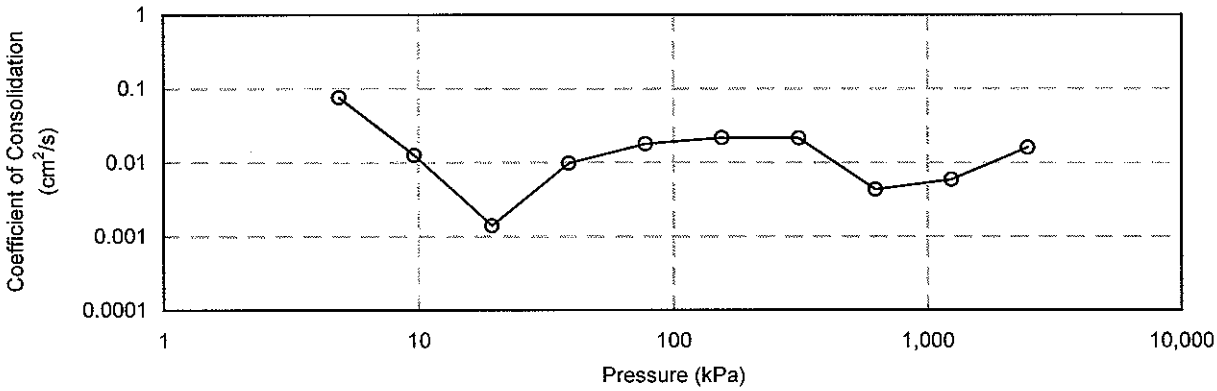
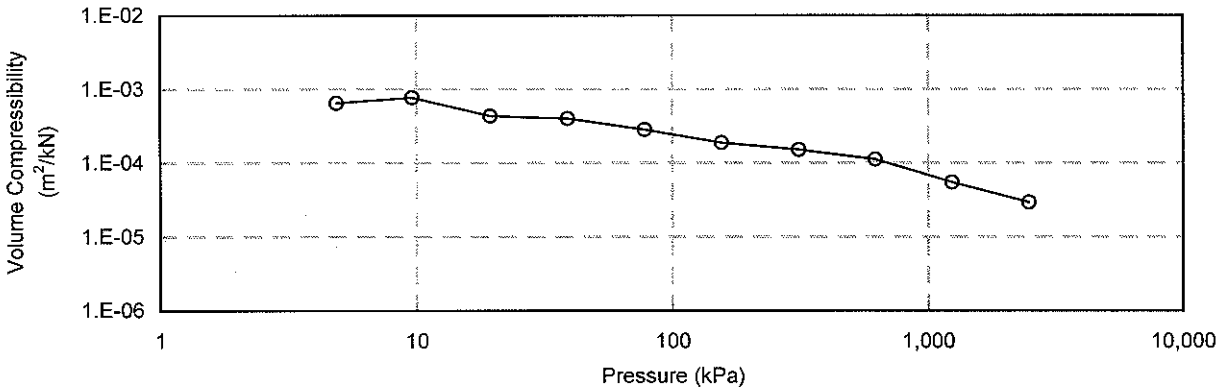
HWY 406 TWINNING - MERRITT ROAD	FIGURE B2-21

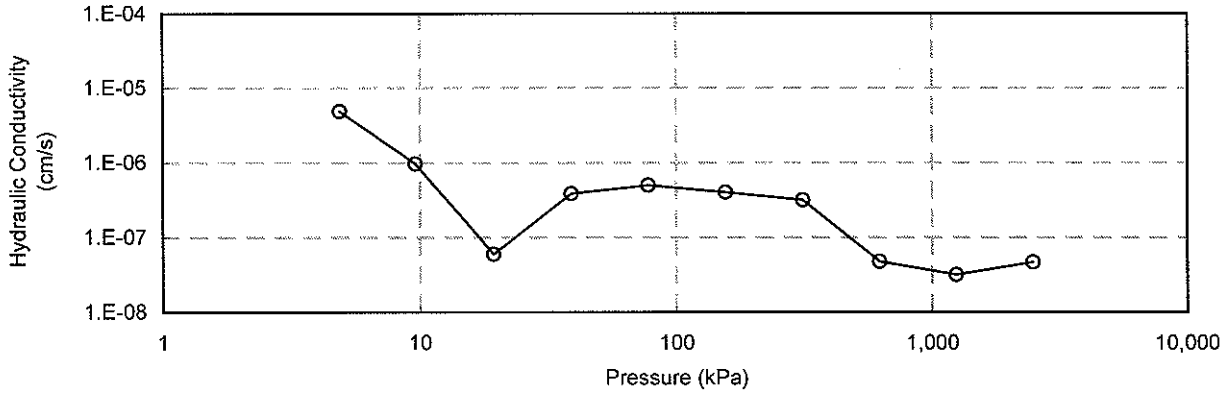
CONSOLIDATION TEST
Cv vs Pressure
NE 10+450 CL, TW8



CONSOLIDATION TEST
mv vs Pressure
NE 10+450 CL, TW8



CONSOLIDATION TEST
k vs Pressure
NE 10+450 CL, TW8



Project No. : 1-09-4135
Date : May 2010

Terraprobe Inc.

Prepared By : HW
Checked By : RA

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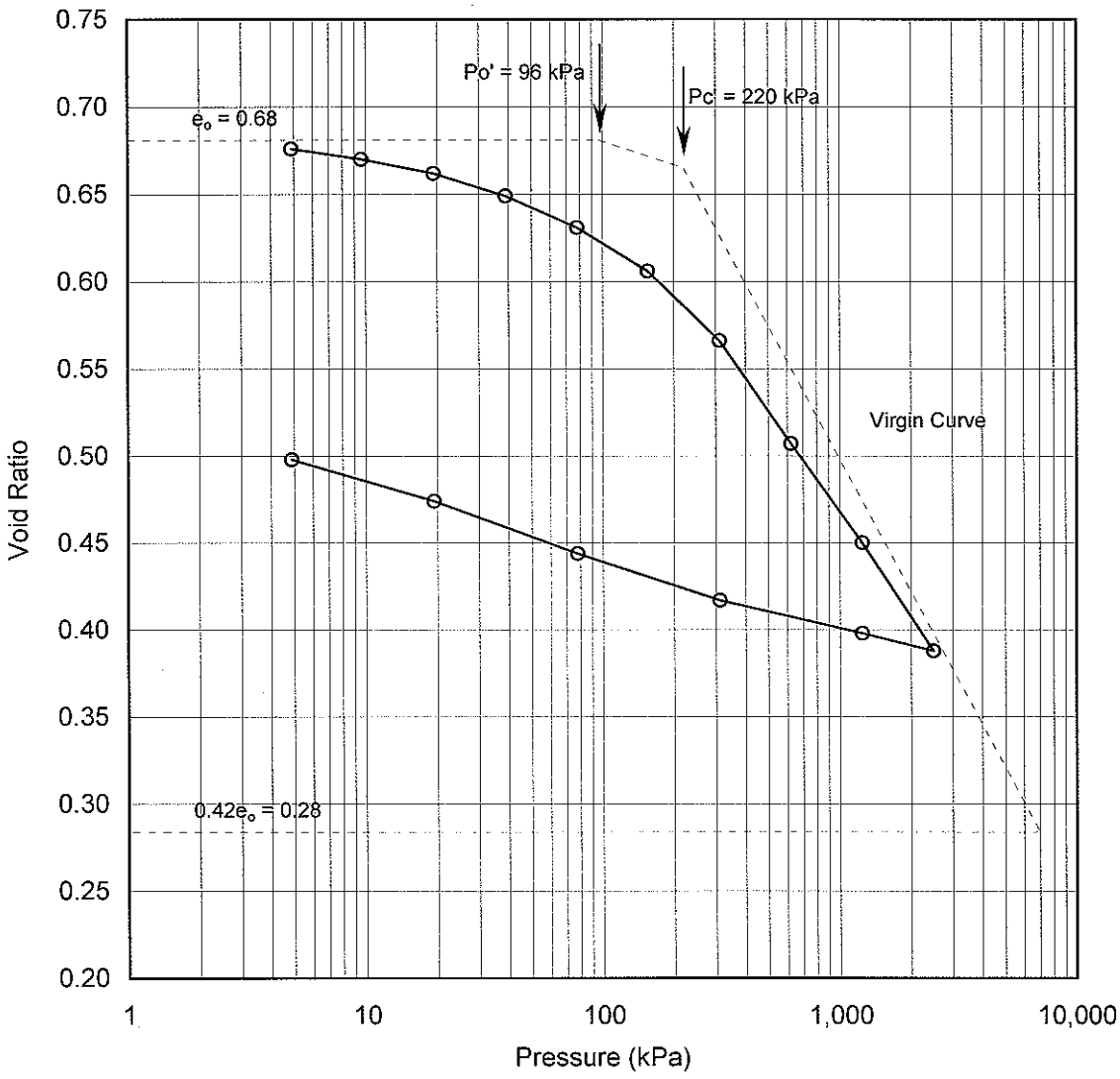
HWY 406 TWINNING - MERRITT ROAD	FIGURE B2-22

CONSOLIDATION TEST
e vs Pressure
NE 10+450 CL, TW8



Soil Type :	Silty Clay				
e_o =	0.68	ω_L =	31%	Po' =	96 kPa
ω =	26%	ω_P =	16%	Pc' =	220 kPa
γ =	20.1 kN/m^3	PI =	15%	Cc =	0.254
Gs =	2.77			Cr =	0.045

Project No. : 1-09-4135
Date : May 2010

Terraprobe Inc.

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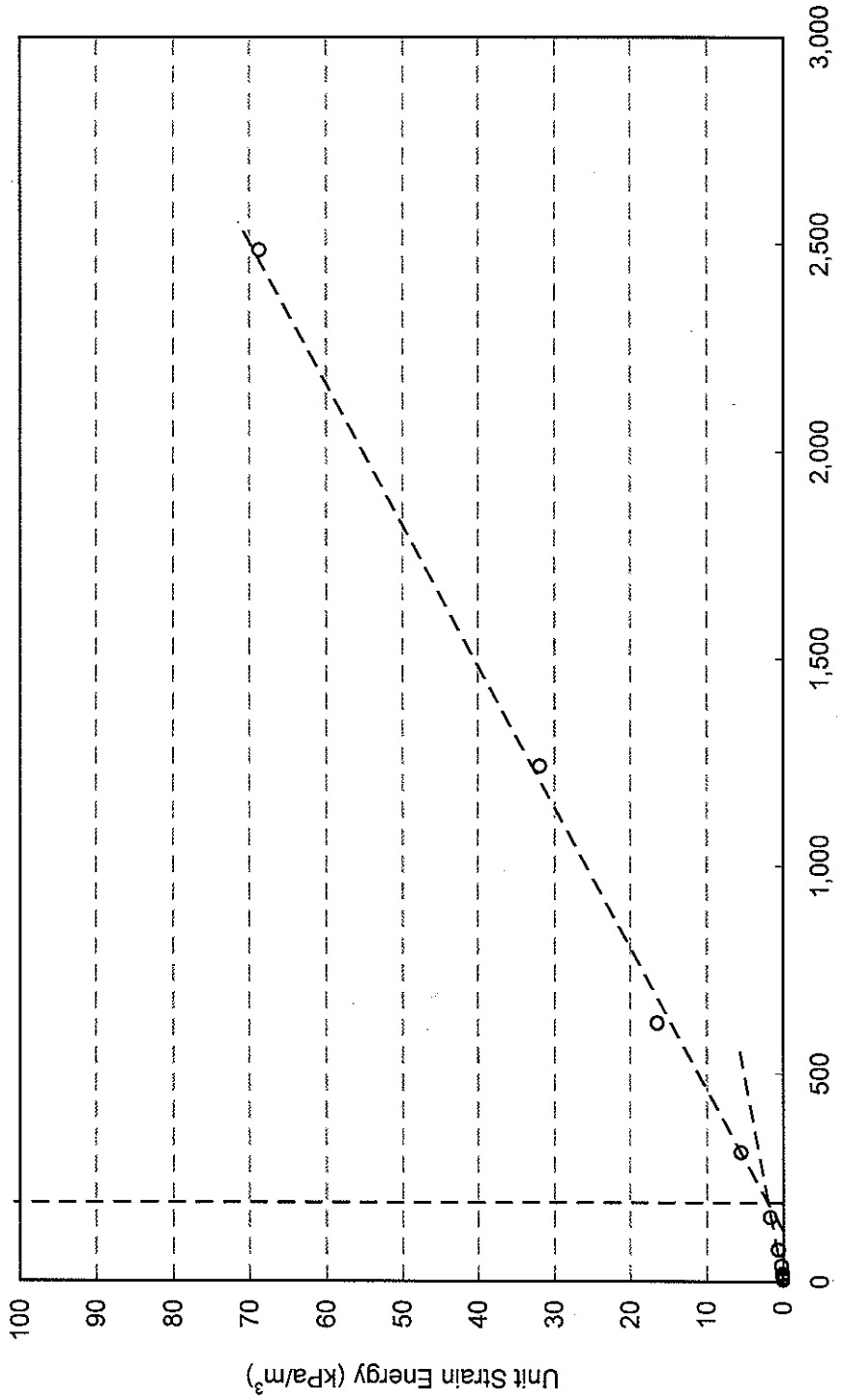
HWY 406 TWINNING - MERRITT ROAD	FIGURE B2-23

CONSOLIDATION TEST
Unit Strain Energy vs Pressure
NE 10+450 CL, TW8



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Date : May 2010

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Prepared By : HW
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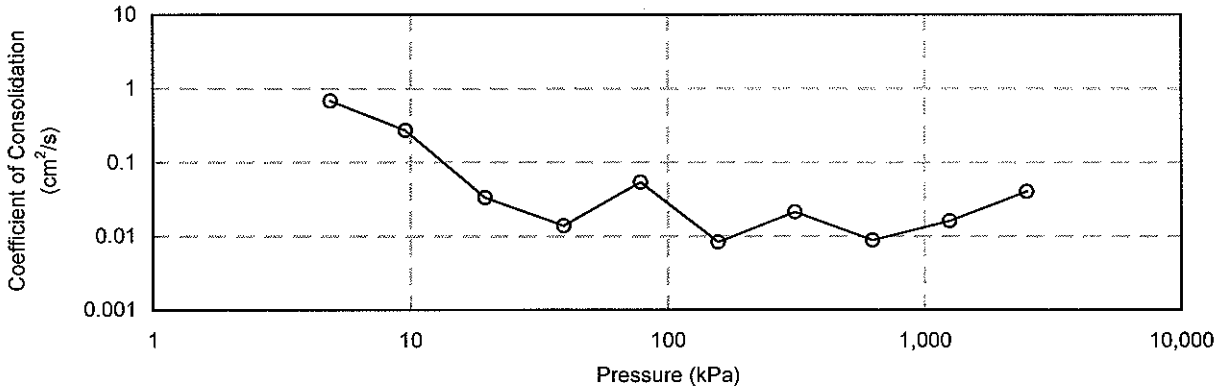
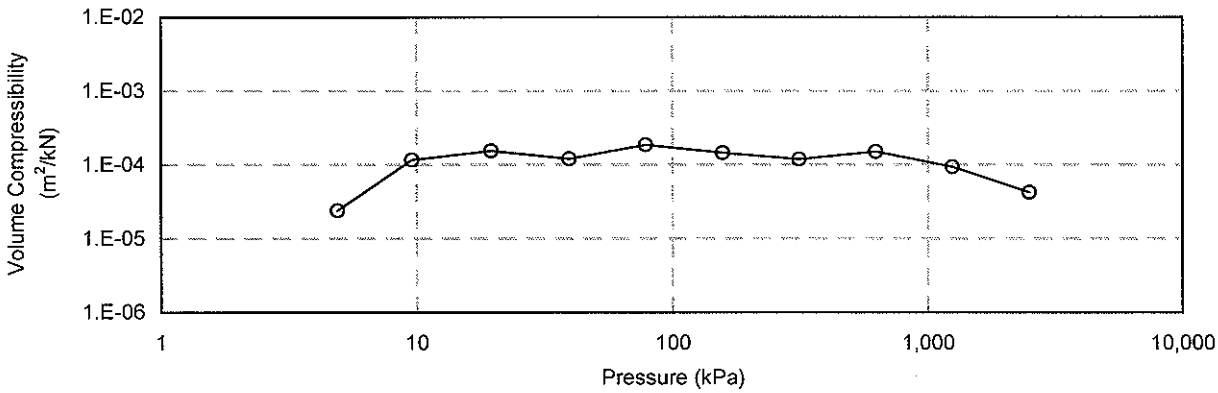
HWY 406 TWINNING - MERRITT ROAD	FIGURE B2-24

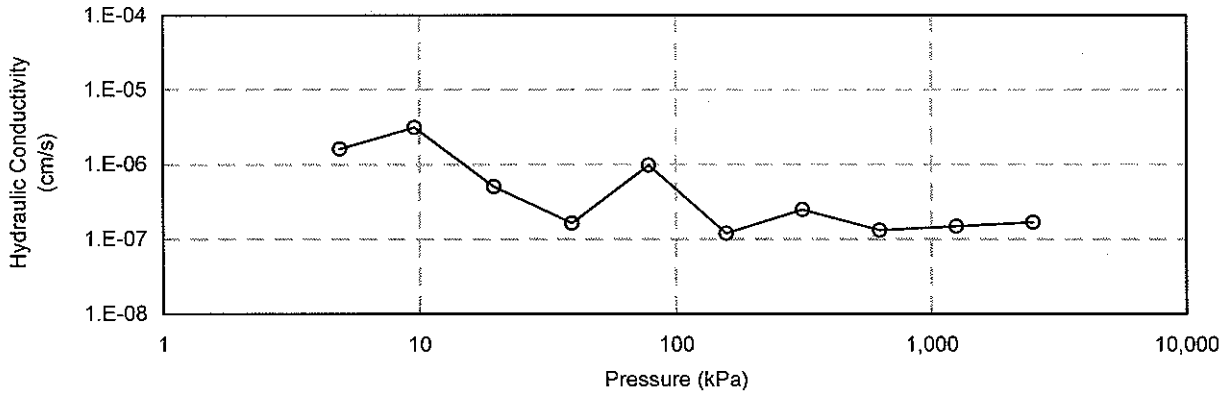
CONSOLIDATION TEST
Cv vs Pressure
EWS 10+100 RT, TW7



CONSOLIDATION TEST
mv vs Pressure
EWS 10+100 RT, TW7



CONSOLIDATION TEST
k vs Pressure
EWS 10+100 RT, TW7



Project No. : 1-09-4135
Date : May 2010

Terraprobe Inc.

Prepared By : HW
Checked By : RA

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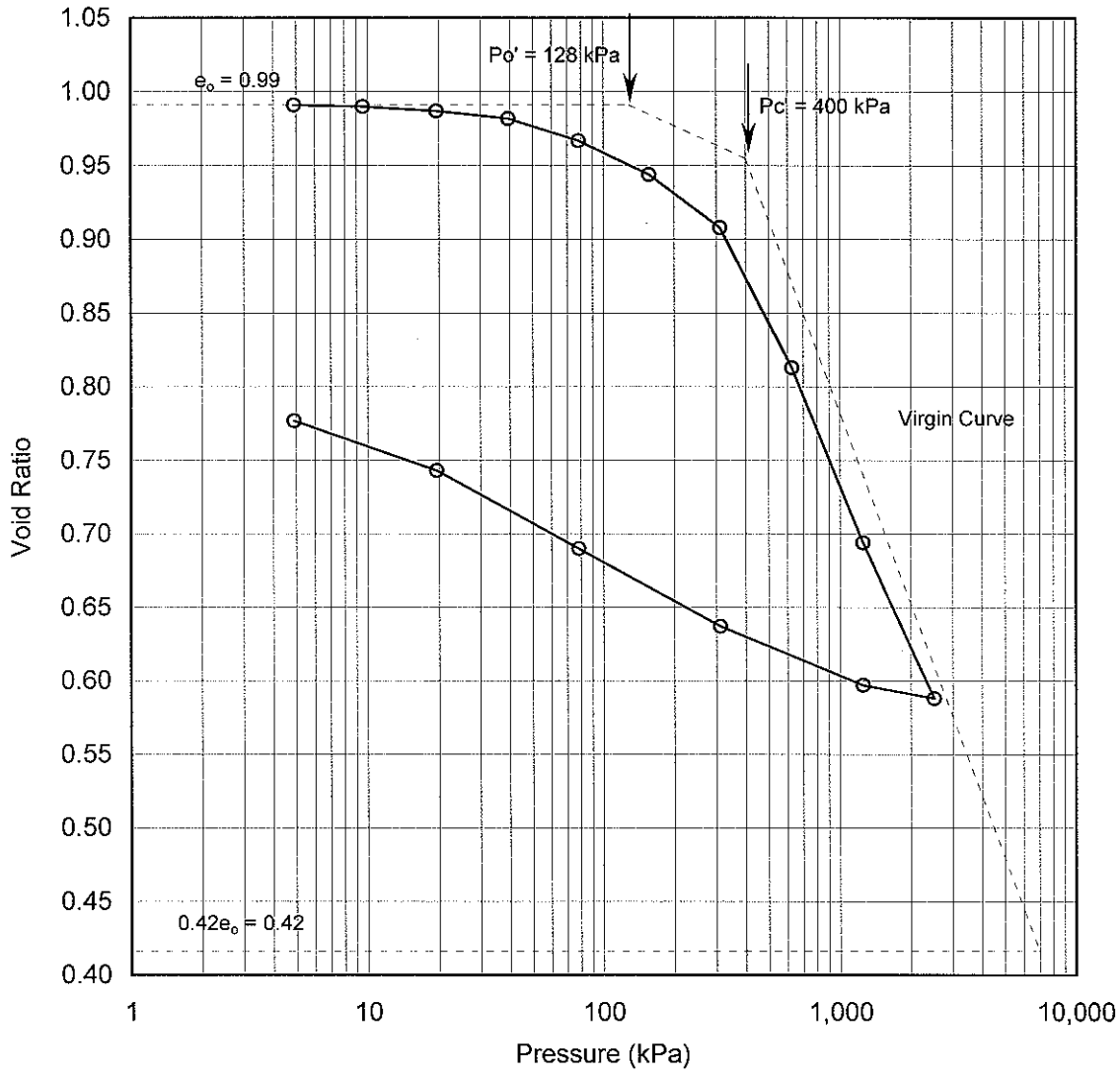
HWY 406 TWINNING - MERRITT ROAD	FIGURE B2-25

CONSOLIDATION TEST
e vs Pressure
EWS 10+100 RT, TW7



Soil Type :	Silty Clay				
e_o =	0.99	ω_L =	47%	Po' =	128 kPa
ω =	35%	ω_P =	20%	Pc' =	400 kPa
γ =	18.6 kN/m^3	PI =	27%	Cc =	0.433
Gs =	2.78			Cr =	0.073

Project No. : 1-09-4135
Date : May 2010

Terraprobe Inc.

Prepared By : HW
Checked By : RA

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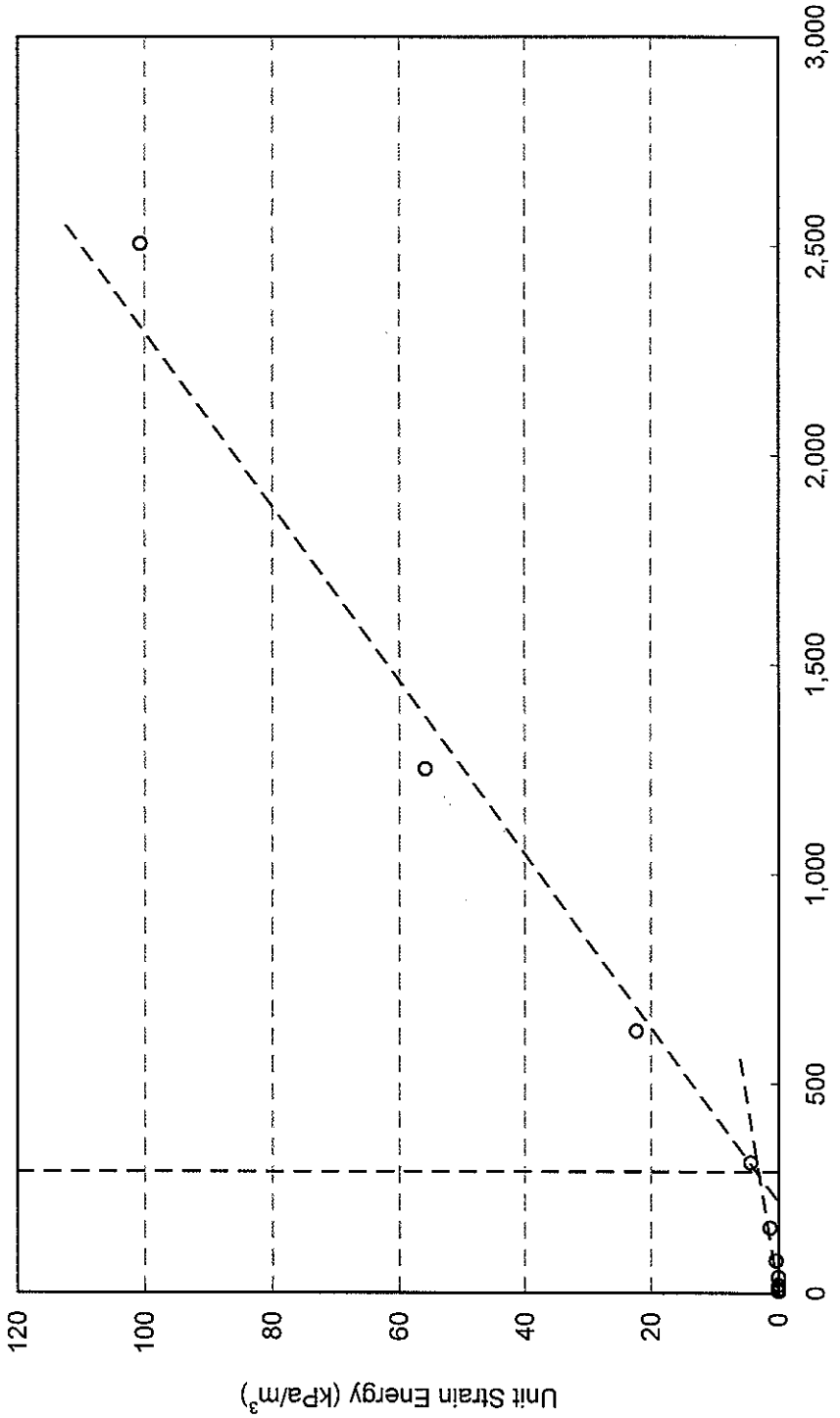
HWY 406 TWINNING - MERRITT ROAD	FIGURE B2-26

CONSOLIDATION TEST
Unit Strain Energy vs Pressure
EWS 10+100 RT, TW7



Project No. :	1-09-4135	Terraprobe Inc.	Prepared By : HW
Date :	May 2010		Checked By : RA

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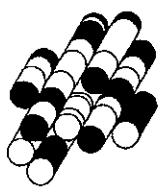
APPENDIX C

Record of Borehole Sheets
(Previous Investigations)

Terraprobe Inc.



Ministry of Transportation
Ontario

Peto MacCallum Ltd.
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RECORD OF BOREHOLE No 101 1 of 2 METRIC

G.W.P. 280-99-00 LOCATION Co-ords: 4 765 994 N; 326 490 E ORIGINATED BY M.R.

DIST CR HWY 406 BOREHOLE TYPE Continuous Flight Solid Stem Augers COMPILED BY N.R.

DATUM Geodetic DATE October 27, 2008 CHECKED BY C.N.

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION kPa RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
185.2	Ground Surface						185				
0.0	Clayey silt some sand, trace gravel Firm Brown Moist (FILL)		1	SS	6						
			2	SS	7		184			Org. 0.8%	5 9 66 20
	Soft Mottled brown/grey		3	SS	2						
			4	SS	3		183				7 14 52 27
	Firm		5	SS	8		182				
180.9			6	SS	5		181				
4.3	Topsoil										
180.5											
4.7	Clayey silt and Sand trace gravel Firm to stiff Brown Wet		7	SS	5						2 42 40 16
179.4			8	SS	12		180				
5.8	Silty clay, trace sand Hard to stiff Reddish Moist brown		9	SS	31		179				0 5 42 53
			10	SS	21		178				
			11	SS	9		177				
	thin silt partings Firm to stiff		12	TW	PH		176				
				FV			175				
			13	SS	4		174	+3			
				FV			173				0 1 59 40
			14	SS	2		172	+2			
				FV			171	+			
170.2	Cont'd										

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+7, ×5: Numbers refer to Sensitivity

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

Ministry of Transportation
Ontario

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RECORD OF BOREHOLE No 101 2 of 2 METRIC

G.W.P. 280-99-00 LOCATION Co-ords: 4 765 994 N; 326 490 E ORIGINATED BY M.R.

DIST CR HWY 406 BOREHOLE TYPE Continuous Flight Solid Stem Augers COMPILED BY N.R.

DATUM Geodetic DATE October 27, 2008 CHECKED BY C.N.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION kPa RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa O UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES						GR SA SI CL
170.2						*					
15.0											
170.0 / 15.2	Silt, trace sand		15	SS	12		170		o		0 5 90 5
169.4 / 15.8	Compact Reddish Moist brown										
	End of borehole										

* Borehole dry upon completion of drilling

■ Penetrometer test

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$+^{7}$, $\times^{5}$: Numbers refer to Sensitivity

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

Ministry of Transportation
Ontario

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RECORD OF BOREHOLE No 102 1 of 1 METRIC

G.W.P. 280-99-00 LOCATION Co-ords: 4 766 012 N; 326 508 E ORIGINATED BY W.L.

DIST CR HWY 406 BOREHOLE TYPE Continuous Flight Solid Stem Augers COMPILED BY N.R.

DATUM Geodetic DATE September 24, 2008 CHECKED BY C.N.

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION kPa RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
184.8	Ground Surface										
0.0	Topsoil		1	SS	10		184				
	Silty clay, trace sand										
	Stiff to soft Brown Moist		2	SS	7						
	trace gravel						183				
			3	SS	5						
			4	SS	3	▼*	182				
	Clayey silt and sand some gravel topsoil inclusions		5	SS	3						
	Soft Wet					▽*	181				
	(FILL)		6	SS	3						
			7	SS	2		180				12 36 37 15
179.3											
5.5	Peat		8	SS	3		179			Org. 35.6%	
178.6											
6.2	Sandy silt, trace clay		9	SS	2		178				
178.1	Very loose Brown Moist										
6.7	Silty clay, trace sand layers of sandy silt		10	SS	3						
	Soft to stiff Brown Moist to wet		11	SS	9		177				
							176				
			12	SS	12						
175.0							175				
9.8	End of borehole										

* 2008 09 24

▽ Water level observed during drilling

▼ Water level measured after drilling

■ Penetrometer test

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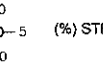
$+^{7}$, $\times^{5}$: Numbers refer to Sensitivity



(%) STRAIN AT FAILURE

Ministry of Transportation
Ontario

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RECORD OF BOREHOLE No 103 1 of 2 METRIC

G.W.P. 280-99-00 LOCATION Co-ords: 4 766 016 N; 326 529 E ORIGINATED BY M.R.

DIST CR HWY 406 BOREHOLE TYPE C.F.H.S.A. and Dynamic Cone Penetration Test COMPILED BY N.R.

DATUM Geodetic DATE October 24, 2008 CHECKED BY C.N.

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%): GR SA SI CL
180.4	Ground Surface						180		
0.0	Silty clay some sand, some gravel		1	SS	4				
	Soft Brown Moist Silty sand								
179.2	Compact Brown Moist (FILL)		2	SS	12		179		
1.2	Silty clay, trace sand								
	Hard Brown/ grey Moist		3	SS	11				0 1 50 49
	Reddish brown		4	SS	13		178		
	thin layers of silt								
	Very stiff		5	SS	10		177		
	Stiff		6	SS	6				0 1 44 55
			7	TW	PH		176	19.6	
				FV					
	Grey						175		
			8	SS	2		174		
				FV					
172.9							173		
7.5	Clayey silt, trace sand								
	Stiff Reddish Moist brown		9	TW	PH			19.8	0 1 63 36
				FV			172		
170.4			10	SS	5		171		
10.0	Silt, trace sand								
	Compact Reddish Wet brown						170		
			11	SS	12				0 3 91 6
168.2							169		
12.2	End of borehole						168		
	Probable clayey silt								
	Firm to hard						167		
							166		
165.4	Cont'd								

DYNAMIC CONE PENETRATION kPa RESISTANCE PLOT: 20 40 60 80 100

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

PLASTIC LIMIT w_P NATURAL MOISTURE CONTENT w LIQUID LIMIT w_L

WATER CONTENT (%): 20 40 60

213 225 150

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$+^{7}$, $\times^{5}$: Numbers refer to Sensitivity

(%) STRAIN AT FAILURE: 20, 15, 5, 10

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Foundation Design

RECORD OF BOREHOLE No 103 2 of 2 METRIC

G.W.P. 280-99-00 LOCATION Co-ords: 4 766 016 N; 326 529 E ORIGINATED BY M.R.

DIST CR HWY 406 BOREHOLE TYPE C.F.H.S.A. and Dynamic Cone Penetration Test COMPILED BY N.R.

DATUM Geodetic DATE October 24, 2008 CHECKED BY C.N.

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION kPa RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (O UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
165.4						*					
15.0	Cont'd Probable clayey silt Firm to hard						165 164 163 162 161 160				
159.0							159				
21.4	Probable clayey silt Hard (TILL)						158 157				
156.6								140			
23.8	End of dynamic cone penetration test * Borehole dry upon completion of drilling ■ Penetrometer test C.F.H.S.A: denotes Continuous Flight Hollow Stem Augers										

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+7, ×5: Numbers refer to Sensitivity

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

Ministry of Transportation
Ontario

Peto MacCallum Ltd.
Foundation Design

RECORD OF BOREHOLE No 104 1 of 3 METRIC

G.W.P. 280-99-00 LOCATION Co-ords: 4 766 020 N; 326 551 E ORIGINATED BY M.R.

DIST CR HWY 406 BOREHOLE TYPE Continuous Flight Hollow Stem Augers COMPILED BY N.R.

DATUM Geodetic DATE October 22 and 23, 2008 CHECKED BY C.N.

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION kPa RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
179.7	Ground Surface										
0.0 / 179.4	Silty clay, trace sand		1	SS	6		179				
0.3	Firm Mottled Moist brown (FILL)										
	Silty clay, trace sand thin lenses of silt		2	SS	23						
	Very stiff Mottled Moist brown		3	SS	17		178				
	Stiff		4	SS	3		177				0 1 44 55
				FV		▼*	176	+2			
	thin partings of silt		5	SS	1		175				0 4 46 50
				FV				+3			
			6	SS	3		174				
				FV			173	+3			
			7	TW	PH		172				
171.0				FV				+3			
8.7	Silt trace sand, trace clay						171				
	Loose Reddish Moist brown to wet		8	SS	7						0 2 93 5
168.8							170				
10.9	Clayey silt trace sand, trace gravel		9	SS	7		169				
	Firm Reddish Moist brown						168				
			10	SS	7		167				1 6 70 23
			11	TW	PH		166				
164.7	Cont'd						165				

ON_MOT VER3 08TF005.GPJ ON_MOT.GDT 1/24/2009 8:41:44 AM

+7, ×5: Numbers refer to Sensitivity

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

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Ontario

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RECORD OF BOREHOLE No 104 2 of 3 METRIC

G.W.P. 280-99-00 LOCATION Co-ords: 4 766 020 N; 326 551 E ORIGINATED BY M.R.

DIST CR HWY 406 BOREHOLE TYPE Continuous Flight Hollow Stem Augers COMPILED BY N.R.

DATUM Geodetic DATE October 22 and 23, 2008 CHECKED BY C.N.

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION kPa RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P NATURAL MOISTURE CONTENT w LIQUID LIMIT w_L WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
164.7											
15.0	Stiff		12	SS	9		164		○		
	layers of silty clay Firm Reddish Wet brown/grey		13	SS	6		163		⊢○		0 1 67 32
	no gravel thin layers of silt		14	SS	WH**		162		⊢○⊣		0 1 64 35
159.6							161				
20.1	Clayey silt some sand, some gravel Stiff Reddish Moist brown (TILL)		15	SS	13		160		○		
157.3							159				
22.4	Sand and silt with gravel, trace clay Very dense Reddish Moist brown/grey (TILL)		16	SS	79		158		○‖		23 32 35 10
153.5							157				
26.2	Silty clay, trace sand thin lenses of silt Stiff Reddish Moist brown/grey		17	SS	16		156				
149.7	Cont'd						155				
							154				
							153				
							152		■ ○		
							151				
							150				

+7, ×5: Numbers refer to Sensitivity

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

Ministry of Transportation
Ontario

Peto MacCallum Ltd.
Foundation Design

RECORD OF BOREHOLE No 104 3 of 3 METRIC

G.W.P. 280-99-00 LOCATION Co-ords: 4 766 020 N; 326 551 E ORIGINATED BY M.R.

DIST CR HWY 406 BOREHOLE TYPE Continuous Flight Hollow Stem Augers COMPILED BY N.R.

DATUM Geodetic DATE October 22 and 23, 2008 CHECKED BY C.N.

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION kPa RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
149.7											
30.0	layers of silty sand										
			18	SS	1		149				
148.3											
31.4	Sand and silt, trace clay Very dense Reddish Moist brown/grey (TILL)						148				
							147				
			19	SS	50/10cm		146				
							145				
							144				
143.6											
36.1	End of borehole Refusal on probable bedrock										

Sample 19: sampler bouncing

* 2008 10 24

▼ Water level measured after drilling

■ Penetrometer test

WH** denotes penetration due of weight of rods and hammer

Low 'N' values in samples 14 and 18 are due to hydraulic disturbance in silt and silty sand layers.

+7, ×5: Numbers refer to Sensitivity

20
15 5
10

(%) STRAIN AT FAILURE

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Ontario

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RECORD OF BOREHOLE No 105 1 of 3 METRIC

G.W.P. 280-99-00 LOCATION Co-ords: 4 766 049 N; 326 574 E ORIGINATED BY M.R.

DIST CR HWY 406 BOREHOLE TYPE C.F.H.S.A. + Rotary Diamond Coring COMPILED BY N.R.

DATUM Geodetic DATE October 29 and 31, 2008 CHECKED BY C.N.

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE
180.4	Ground Surface						
0.0 / 179.6	Sand and gravel, granular "A", crushed limestone Brown Moist (FILL)						
0.8	Silty clay, trace sand Very stiff Brown Moist		1	SS	15		
	layers of silty sand		2	SS	17		
	Reddish brown		3	SS	22		
	Firm to stiff		4	SS	4		
				FV			
			5	SS	3		
				FV			
			6	TW	PH		
				FV			
	silt layers		7	SS	6		
170.6 / 9.8	Silt trace sand, trace clay Loose Reddish/ brown Moist to wet		8	SS	5		
168.7 / 11.7	Clayey silt, trace sand Firm Reddish brown Moist		9	SS	7		
	Stiff		10	SS	9		
165.4	Cont'd						

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

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

PLASTIC LIMIT w_P | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w_L
WATER CONTENT (%) (20 40 60)

UNIT WEIGHT γ kN/m³

REMARKS & GRAIN SIZE DISTRIBUTION (%)
GR SA SI CL
0 1 36 63

ELEVATION SCALE: 180 179 178 177 176 175 174 173 172 171 170 169 168 167 166

$+^{7}$, $\times^{5}$: Numbers refer to Sensitivity

20
15 — 5
10
(%) STRAIN AT FAILURE

Ministry of Transportation
Ontario

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RECORD OF BOREHOLE No 105 2 of 3 METRIC

G.W.P. 280-99-00 LOCATION Co-ords: 4 766 049 N; 326 574 E ORIGINATED BY M.R.

DIST CR HWY 406 BOREHOLE TYPE C.F.H.S.A. + Rotary Diamond Coring COMPILED BY N.R.

DATUM Geodetic DATE October 29 and 31, 2008 CHECKED BY C.N.

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION kPa RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
165.4											
15.0	Cont'd										
	Clayey silt, trace sand Stiff Reddish Moist brown		11	SS	11		165		○		
							164				
			12	SS	12				⊠		0 2 77 21
							163				
			13	SS	11		162		○		
							161				
160.3											
20.1	Sand and silt, trace clay Compact Reddish Moist brown/grey (TILL)						160				
			14	SS	28		159		○		
							158				
							157				
			15	SS	26		156		○		
							155				
							154				
	Very dense		16	SS	80		153		○		
							152				
							151				
150.4	Cont'd										

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+7, ×5: Numbers refer to Sensitivity

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

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RECORD OF BOREHOLE No 105 3 of 3 METRIC

G.W.P. 280-99-00 LOCATION Co-ords: 4 766 049 N; 326 574 E ORIGINATED BY M.R.

DIST CR HWY 406 BOREHOLE TYPE C.F.H.S.A. + Rotary Diamond Coring COMPILED BY N.R.

DATUM Geodetic DATE October 29 and 31, 2008 CHECKED BY C.N.

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION kPa RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa O UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
150.4											
30.0	Dense		17	SS	33		150		o		
							149				
							148				
	Very dense		18	SS	60/10cm		147				
							146				
							145				
144.2											
36.2	Bedrock		19	RC NQ	REC 100%		144				RQD 0%
	Dolomitic limestone										
	Light grey to blue grey		20	RC NQ	REC 100%						RQD 0%
143.1	Medium strength										
37.3	Weathered						143				
	Very poor quality		21	RC NQ	REC 100%						RQD 52%
	Dolostone						142				
	Dark brown to grey										
	Medium strength										
	Unweathered										
	Fair quality		22	RC NQ	REC 100%		141				RQD 58%
140.0											
40.4	End of borehole						140				

Sample 18: sampler bouncing

* Borehole charged with drilling water

■ Penetrometer test

C.F.H.S.A: denotes Continuous Flight Hollow Stem Augers

$+^{7}$, $\times^{5}$: Numbers refer to Sensitivity

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

Ministry of Transportation
Ontario

Peto MacCallum Ltd.
Foundation Design

RECORD OF BOREHOLE No 106 1 of 3 METRIC

G.W.P. 280-99-00 LOCATION Co-ords: 4 766 074 N; 326 590 E ORIGINATED BY M.R.

DIST CR HWY 406 BOREHOLE TYPE C.F.H.S.A. + Rotary Diamond Coring COMPILED BY N.R.

DATUM Geodetic DATE October 20 to 22, 2008 CHECKED BY C.N.

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION kPa RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
180.4	Ground Surface										
180.2	Topsoil		1	SS	4		180				
0.2	Clayey silt, some sand oxidized stains										
179.7	Soft Dark brown Moist		2	SS	7		179	175			0 1 50 49
0.7	Silty clay, trace sand										
	Very stiff Mottled brown Moist		3	SS	18		178				
	thin partings of silt										
	Stiff		4	SS	9		177				
			5	SS	1		176				
				FV			175	1			
			6	TW	PH		174			17.6	
				FV				2			
172.9							173				
7.5	Clayey silt, trace sand		7	SS	WH**						0 1 62 37
	Stiff Grey Moist to wet			FV			172	2			
	thin layers of silt										
	Reddish brown		8	SS	2		171				
				FV				1			
170.0						▼*	170				
10.4	Silt trace sand, trace clay		9	SS	7						0 2 94 4
	Loose Reddish brown Moist						169				
168.1											
12.3	Clayey silt some sand, trace gravel		10	SS	7		168				2 13 65 20
	Firm Reddish brown Moist						167				
			11	SS	4						
165.4	Cont'd						166				

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+7, ×5: Numbers refer to Sensitivity

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

Ministry of Transportation
Ontario

Peto MacCallum Ltd.
Foundation Design

RECORD OF BOREHOLE No 106 2 of 3 METRIC

G.W.P. 280-99-00 LOCATION Co-ords: 4 766 074 N; 326 590 E ORIGINATED BY M.R.

DIST CR HWY 406 BOREHOLE TYPE C.F.H.S.A. + Rotary Diamond Coring COMPILED BY N.R.

DATUM Geodetic DATE October 20 to 22, 2008 CHECKED BY C.N.

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION kPa RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
165.4											
15.0	trace sand Very stiff		12	SS	6		165		○		
				FV				+2			
							164				
			13	SS	9		163		○		
							162				
			14	SS	9				⊢●		1 1 74 24
							161				
	Firm						160				
			15	SS	4		159		⊢●		0 1 69 30
157.2							158				
23.2	Clayey silt with sand, with gravel Hard Reddish Moist brown (TILL)						157				
			16	SS	50/25cm		156		○		
							155				
							154				
			17	SS	61		153		○		
151.4							152				
29.0	Sand and silt, trace clay Dense Reddish Moist brown/grey (TILL) Cont'd						151				
150.4											

ON_MOT VER3 08TF005.GPJ ON_MOT.GDT 1/24/2009 8:41:49 AM

+7, ×5: Numbers refer to Sensitivity

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

Ministry of Transportation
Ontario

Peto MacCallum Ltd.
Foundation Design

RECORD OF BOREHOLE No 106 3 of 3 METRIC

G.W.P. 280-99-00 LOCATION Co-ords: 4 766 074 N; 326 590 E ORIGINATED BY M.R.

DIST CR HWY 406 BOREHOLE TYPE C.F.H.S.A. + Rotary Diamond Coring COMPILED BY N.R.

DATUM Geodetic DATE October 20 to 22, 2008 CHECKED BY C.N.

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION kPa RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
150.4											
30.0	some clay, some gravel		18	SS	42		150		o		15 38 35 12
							149				
							148				
	Very dense		19	SS	50/10cm		147				
							146				
							145				
143.4							144				
37.0	Bedrock Dolostone Dark brown to grey Medium strength Unweathered Fair to good quality		20	RC NQ	REC 100%		143				RQD 90%
			21	RC NQ	REC 100%		142				RQD 71%
140.0			22	RC NQ	REC 100%		141				RQD 75%
40.4	End of borehole						140				

Samples 16 and 19: sampler bouncing

* 2008 10 22

▼ Water level measured after drilling

■ Penetrometer test

WH** denotes penetration due of weight of rods and hammer

* C.F.H.S.A: denotes Continuous Flight Hollow Stem Augers

+7, ×5: Numbers refer to Sensitivity

20
15 5
10
(%) STRAIN AT FAILURE

Ministry of Transportation
Ontario

Peto MacCallum Ltd.
Foundation Design

RECORD OF BOREHOLE No 107 1 of 2 METRIC

G.W.P. 280-99-00 LOCATION Co-ords: 4 766 083 N; 326 618 E ORIGINATED BY W.L.

DIST CR HWY 406 BOREHOLE TYPE Continuous Flight Hollow Stem Augers COMPILED BY N.R.

DATUM Geodetic DATE September 24, 2008 CHECKED BY C.N.

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION kPa RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa (O UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE) 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
186.4	Ground Surface										
0.0	Topsoil		1	SS	5		186		o		
	Silty clay, some sand some gravel to 1.5m										
	Firm Brown Moist		2	SS	6				o		
							185				
			3	SS	4				o		
	trace gravel		4	SS	8		184		o		
	some gravel to 5.3m cobbles		5	SS	20		183		o		
	Very stiff										
	Stiff to firm		6	SS	14				o		
	(FILL)						182				
			7	SS	16				o		
180.7			8	SS	6		181		o		
5.7	Topsoil										
			9	SS	5		180		o		Org. 4.8%
179.6											
6.8	Silty clay, trace sand										
	Very stiff Brown Moist		10	SS	15		179		o		
			11	SS	22				o		
							178				
	sandy silt layers										
	Stiff Reddish brown		12	SS	8		177		■ o		
	Firm Grey Wet		13	SS	4						
							176				
			14	SS	5						
							175				
	Stiff		15	TW	PH						
				FV			174	$+^2$			
			16	SS	WH**		173				
				FV				$+^2$			
171.4	Cont'd						172				

ON_MOT VER3 08TF005.GPJ ON_MOT.GDT 1/24/2009 8:41:51 AM

$+^7$, $\times^5$: Numbers refer to Sensitivity

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

Ministry of Transportation
Ontario

Peto MacCallum Ltd.
Foundation Design

RECORD OF BOREHOLE No 107 2 of 2 METRIC

G.W.P. 280-99-00 LOCATION Co-ords: 4 766 083 N; 326 618 E ORIGINATED BY W.L.

DIST CR HWY 406 BOREHOLE TYPE Continuous Flight Hollow Stem Augers COMPILED BY N.R.

DATUM Geodetic DATE September 24, 2008 CHECKED BY C.N.

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION kPa RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (O UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
171.4											
15.0	Very stiff		17	SS	1		171				
				FV				173			
169.7							170				
16.7	Silt, some clay trace sand, trace gravel Compact Reddish Wet brown		18	SS	13	▼*	169		o		1 3 81 15
	trace clay Loose		19	SS	7		168				
167.5											
18.9	End of borehole										

* 2008 09 24

▼ Water level measured after drilling

■ Penetrometer test

WH** denotes penetration due of weight of rods and hammer

$+^{7}$, $\times^{5}$: Numbers refer to Sensitivity

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

Ministry of Transportation
Ontario

Peto MacCallum Ltd.
Foundation Design

RECORD OF BOREHOLE No 108 1 of 2 METRIC

G.W.P. 280-99-00 LOCATION Co-ords: 4 766 107 N; 326 655 E ORIGINATED BY M.R.

DIST CR HWY 406 BOREHOLE TYPE Continuous Flight Solid Stem Augers COMPILED BY N.R.

DATUM Geodetic DATE October 20, 2008 CHECKED BY C.N.

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
185.3	Ground Surface								
0.0	Silty clay, trace sand layers of silt Firm to stiff Mottled Moist brown						185		
			1	SS	7			Org. 1.6%	4 4 42 50
	trace gravel		2	SS	6		184		
	lenses of clayey silt		3	SS	6		183		
	Clayey silt some sand, trace gravel asphalt inclusions thin lenses of topsoil		4	SS	8		182	Org. 1.9%	4 15 47 34
	(FILL)		5	SS	13			Org. 1.3%	2 11 54 33
			6	SS	9		181		
179.7									
5.6			7	SS	7		180		
179.5	Topsoil								
5.8	Silty clay, trace sand Very stiff Brown Moist		8	SS	15		179		
	thin partings of silt		9	SS	18		178		0 1 42 57
	Stiff						177		
			10	SS	4		176		
				FV					
							175		
			11	TW	PH			19.3	0 1 49 50
	Grey			FV			174		
			12	SS	WH**		173		
172.0				FV					
13.3	End of borehole						172		

Cont'd

DYNAMIC CONE PENETRATION kPa RESISTANCE PLOT 20 40 60 80 100

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

PLASTIC LIMIT w_P NATURAL MOISTURE CONTENT w LIQUID LIMIT w_L
WATER CONTENT (%) 20 40 60

+7 , ×5 : Numbers refer to Sensitivity

20
15 5
10
(%) STRAIN AT FAILURE

Ministry of Transportation
Ontario

Peto MacCallum Ltd.
Foundation Design

RECORD OF BOREHOLE No 108 2 of 2 METRIC

G.W.P. 280-99-00 LOCATION Co-ords: 4 766 107 N; 326 655 E ORIGINATED BY M.R.

DIST CR HWY 406 BOREHOLE TYPE Continuous Flight Solid Stem Augers COMPILED BY N.R.

DATUM Geodetic DATE October 20, 2008 CHECKED BY C.N.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION kPa RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa O UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES						
170.3						*					

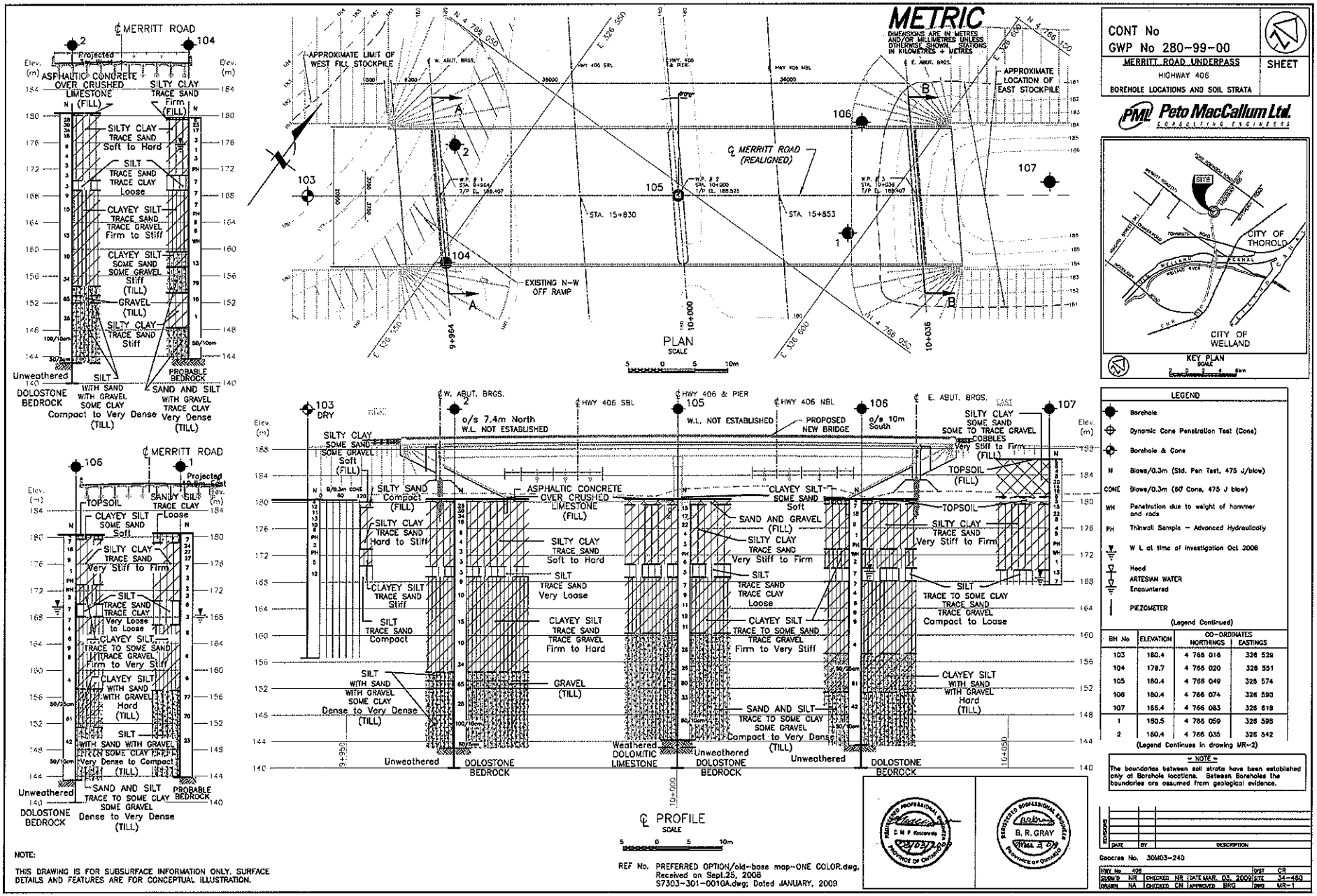
* Borehole dry upon completion of drilling

■ Penetrometer test

WH** denotes penetration due of weight of rods and hammer

$+^{7}$, $\times^{5}$: Numbers refer to Sensitivity

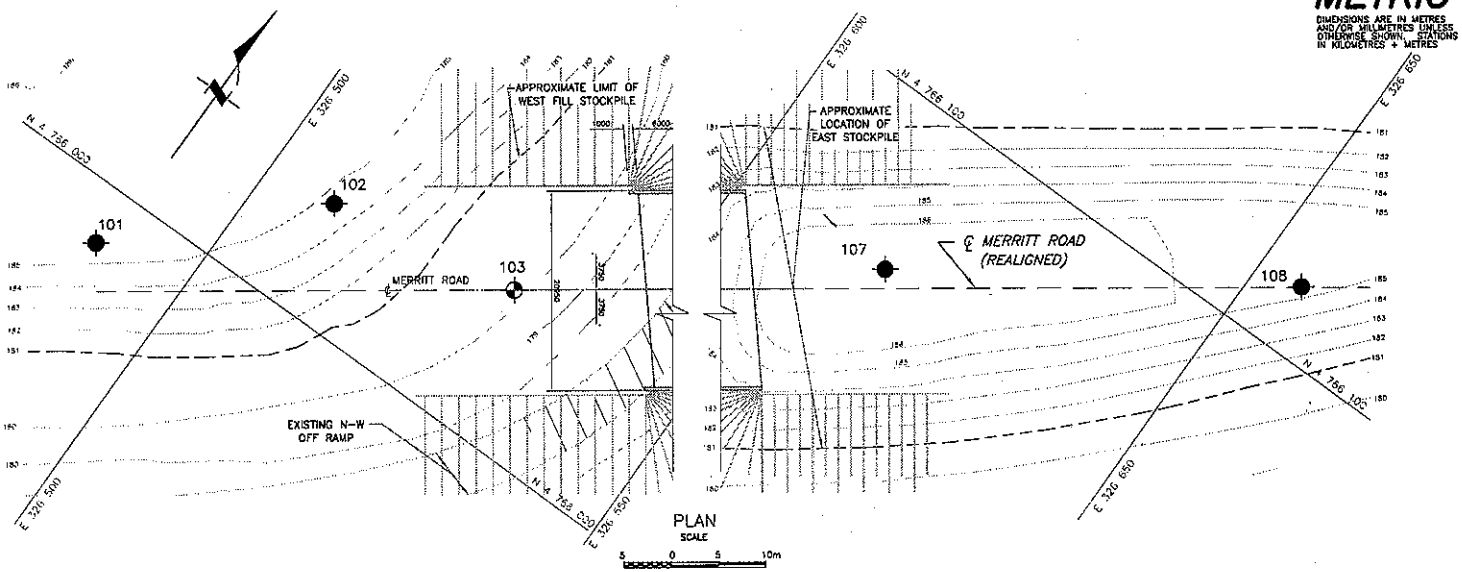
20 / 15 5 / 10 (%) STRAIN AT FAILURE

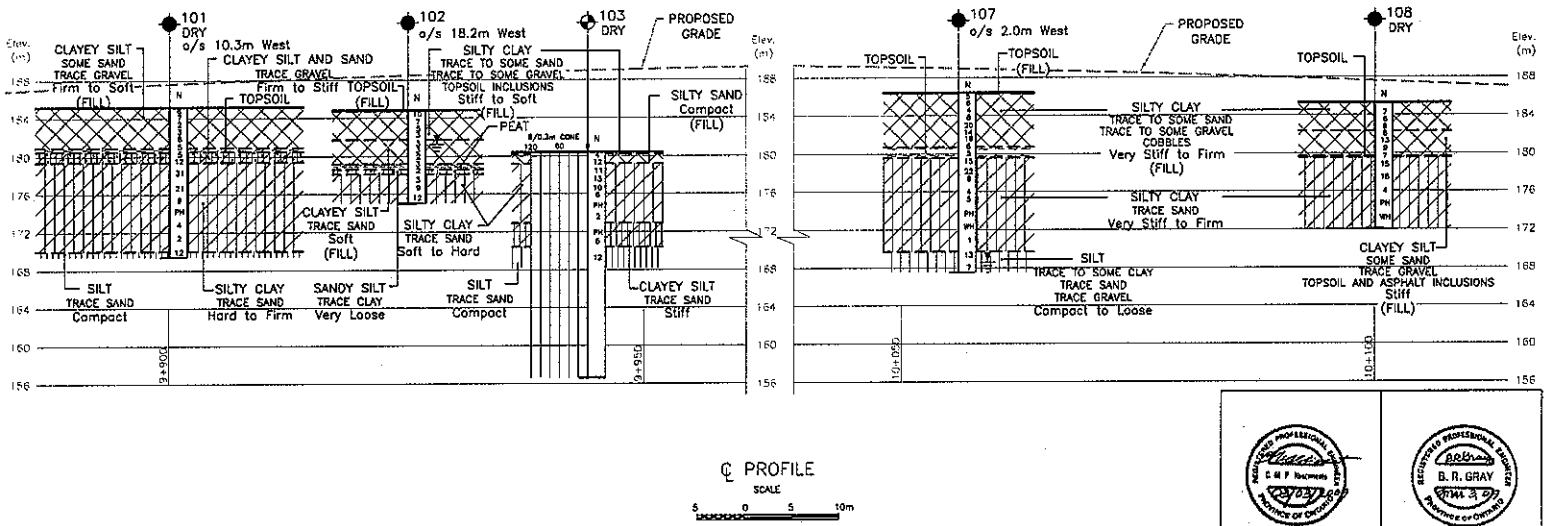

METRIC
DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN. STATIONS IN KILOMETRES + METRES
APPROXIMATE LIMIT OF WEST FILL STOCKPILE
APPROXIMATE LOCATION OF EAST STOCKPILE
℄ MERRITT ROAD (REALIGNED)
EXISTING N-W OFF RAMP
STA. 15+830
STA. 15+853
PLAN
SCALE
℄ MERRITT ROAD
Projected
ASPHALTIC CONCRETE OVER CRUSHED LIMESTONE (FILL)
SILTY CLAY TRACE SAND Firm (FILL)
SILTY CLAY TRACE SAND Soft to Hard
SILT TRACE SAND TRACE CLAY Loose
CLAYEY SILT TRACE SAND TRACE GRAVEL Firm to Stiff
CLAYEY SILT SOME SAND SOME GRAVEL Stiff (TILL)
GRAVEL (TILL)
SILTY CLAY TRACE SAND Stiff
SILT WITH SAND WITH GRAVEL SOME CLAY Compact to Very Dense (TILL)
SAND AND SILT WITH GRAVEL TRACE CLAY Very Dense (TILL)
Unweathered DOLOSTONE BEDROCK
PROBABLE BEDROCK
℄ MERRITT ROAD
Projected
TOPSOIL
SANDY SILT TRACE CLAY
CLAYEY SILT SOME SAND Loose Soft
SILTY CLAY TRACE SAND Very Stiff to Firm
SILT TRACE SAND TRACE CLAY Very Loose to Loose (TILL)
CLAYEY SILT TRACE TO SOME SAND TRACE GRAVEL Firm to Very Stiff
CLAYEY SILT WITH SAND WITH GRAVEL Hard (TILL)
SILT WITH SAND WITH GRAVEL SOME CLAY Very Dense to Compact (TILL)
SAND AND SILT TRACE TO SOME CLAY SOME GRAVEL Dense to Very Dense (TILL)
Unweathered DOLOSTONE BEDROCK
PROBABLE BEDROCK
℄ W. ABUT. BRGS.
℄ HWY 406 SBL
℄ HWY 406 & PIER
℄ HWY 406 NBL
℄ E. ABUT. BRGS.
103 DRY
2 o/s 7.4m North W.L. NOT ESTABLISHED
105 W.L. NOT ESTABLISHED
PROPOSED NEW BRIDGE
106 o/s 10m South
107
SILTY CLAY SOME SAND SOME GRAVEL Soft (FILL)
SILTY SAND Compact (FILL)
ASPHALTIC CONCRETE OVER CRUSHED LIMESTONE (FILL)
SILTY CLAY TRACE SAND Hard to Stiff
SILTY CLAY TRACE SAND Soft to Hard
SILT TRACE SAND Very Loose
CLAYEY SILT TRACE SAND Stiff
SILT TRACE SAND Compact
CLAYEY SILT TRACE SAND TRACE GRAVEL Firm to Hard
SILT WITH SAND WITH GRAVEL SOME CLAY Dense to Very Dense (TILL)
GRAVEL (TILL)
Weathered DOLOMITIC LIMESTONE
Unweathered DOLOSTONE BEDROCK
CLAYEY SILT SOME SAND Soft
SAND AND GRAVEL (FILL)
SILTY CLAY TRACE SAND Very Stiff to Firm
SILT TRACE SAND TRACE CLAY Loose
CLAYEY SILT TRACE TO SOME SAND TRACE GRAVEL Firm to Very Stiff
SAND AND SILT TRACE TO SOME CLAY SOME GRAVEL Compact to Very Dense (TILL)
Unweathered DOLOSTONE BEDROCK
SILTY CLAY SOME SAND SOME TO TRACE GRAVEL COBBLES Very Stiff to Firm (FILL)
TOPSOIL (FILL)
SILTY CLAY TRACE SAND Very Stiff to Firm
SILT TRACE TO SOME CLAY TRACE SAND TRACE GRAVEL Compact to Loose
CLAYEY SILT WITH SAND WITH GRAVEL Hard (TILL)
DOLOSTONE BEDROCK
℄ PROFILE
SCALE
CONT No
GWP No 280-99-00
MERRITT ROAD UNDERPASS
HIGHWAY 406
BOREHOLE LOCATIONS AND SOIL STRATA
SHEET
Peto MacCallum Ltd.
CONSULTING ENGINEERS
SITE
CITY OF THOROLD
CITY OF WELLAND
KEY PLAN
SCALE
LEGEND
Borehole
Dynamic Cone Penetration Test (Cone)
Borehole & Cone
N Blows/0.3m (Std. Pen Test, 475 J/blow)
CONE Blows/0.3m (60° Cone, 475 J blow)
WH Penetration due to weight of hammer and rods
PH Thinwall Sample – Advanced Hydraulically
W L at time of investigation Oct 2008
Head ARTESIAN WATER Encountered
PIEZOMETER
(Legend Continued)
BH No | ELEVATION | CO-ORDINATES NORTHINGS | EASTINGS
103 | 180.4 | 4 765 016 | 326 529
104 | 178.7 | 4 765 020 | 326 551
105 | 180.4 | 4 765 049 | 325 574
106 | 180.4 | 4 766 074 | 326 590
107 | 186.4 | 4 766 083 | 326 619
1 | 180.5 | 4 765 059 | 325 598
2 | 180.4 | 4 765 035 | 325 542
(Legend Continues in drawing MR-2)
NOTE
The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.
NOTE:
THIS DRAWING IS FOR SUBSURFACE INFORMATION ONLY. SURFACE DETAILS AND FEATURES ARE FOR CONCEPTUAL ILLUSTRATION.
REF No. PREFERRED OPTION/old-base map-ONE COLOR.dwg, Received on Sept.25, 2008
S7303-301-0010A.dwg; Dated JANUARY, 2009
PROFESSIONAL ENGINEERS PROVINCE OF ONTARIO C.M.F. Reciprocity 2009
REGISTERED PROFESSIONAL ENGINEER B. R. GRAY POWER OF ONTARIO
REVISIONS
DATE | BY | DESCRIPTION
Geocres No. 30M03-240
HWY No 406 | DIST CR
SURV'D NR | CHECKED NR | DATE MAR. 03, 2009 | SITE 54-450
DRAWN NA | CHECKED CM | APPROVED BRG | DWG MR-1

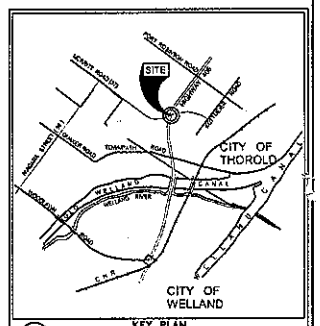
METRIC
DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN. STATIONS IN KILOMETRES + METRES

CONT No
GWP No 280-99-00
MERRITT ROAD UNDERPASS
HIGHWAY 406
BOREHOLE LOCATIONS AND SOIL STRATA
SHEET

Peto MacCallum Ltd.
CONSULTING ENGINEERS







LEGEND

- Borehole
- Dynamic Cone Penetration Test (Cone)
- Borehole & Cone
- N — Blows/0.3m (Std. Pen Test, 475 J/blow)
- CONE — Blows/0.3m (60 Cone, 475 J blow)
- WH — Penetration due to weight of hammer and rods
- PH — Thinwall Sample – Advanced Hydraulically
- W L at time of investigation Sept–Oct 2008
- Head
- ARTESIAN WATER Encountered
- PIEZOMETER

(Legend Continued)

BH No	ELEVATION	CO-ORDINATES NORTHINGS	EASTINGS
101	185.2	4 765 994	326 490
102	184.8	4 765 012	326 508
103	180.4	4 765 016	326 529
107	186.4	4 765 053	326 518
108	185.3	4 766 107	326 555

(Legend Continues in drawing MR-1)

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

NOTE:
1. THIS DRAWING IS FOR SUBSURFACE INFORMATION ONLY. SURFACE DETAILS AND FEATURES ARE FOR CONCEPTUAL ILLUSTRATION.

REGISTERED PROFESSIONAL ENGINEER C. M. F. Nachvak PROVINCE OF ONTARIO
REGISTERED PROFESSIONAL ENGINEER B. R. GRAY PROVINCE OF ONTARIO

REF No. PREFERRED OPTION/old-base map-ONE COLOR.dwg. Received on Sept.25, 2008
S7303-301-001GA.dwg; Dated JANUARY, 2009

RECORDS	DATE	BY	DESCRIPTION

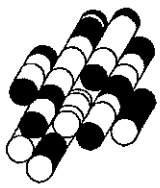
Geocres No. 30M03-240

HWY No.	406			DIST	CR
SUBJECT	NR	CHECKED	NR	DATE MAR. 03, 2009	SHT. 34-460
DRAWN	NA	CHECKED	CN	APPROVED BRG	DWG MR-2

APPENDIX D

Drawings titled "Borehole Locations and Soil Strata"

Terraprobe Inc.



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

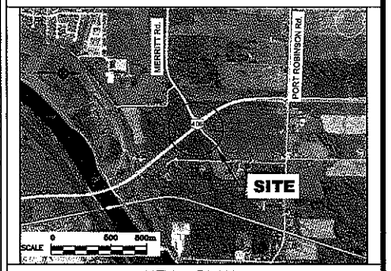
CONT No
WP No 280-99-00

HIGHWAY 406
MERRITT ROAD INTERCHANGE
BOREHOLE LOCATIONS

SHEET 1 OF 6

Giffels Associates Limited
Consulting Engineers and Architects
An IBI 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/Monitoring Well
	Piezometer/Monitoring Well
90%	Rock Quality Designation
A/R	Auger Refusal

No	ELEV.	COORDINATES NORTHING	COORDINATES EASTING
REFER TO SHEETS 2 TO 6 FOR THIS DATA.			

NOTE

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

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

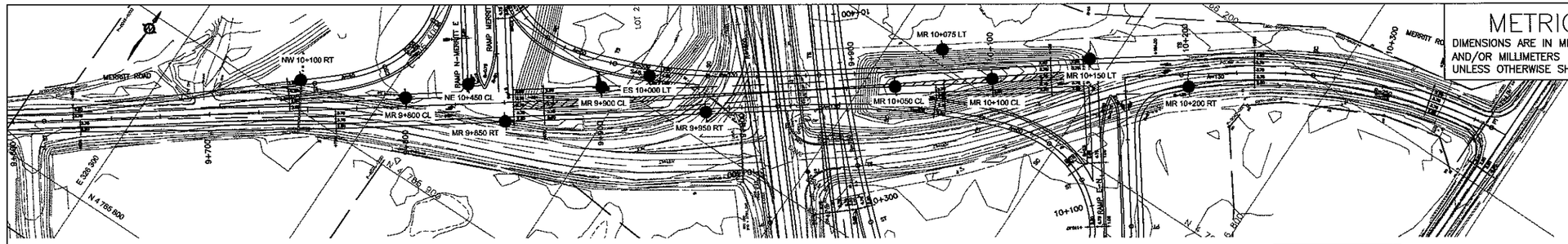
REVISIONS	DATE	BY	DESCRIPTION

DESIGN R.A	CODE CHBDC2006	LOAD	DATE SEPT. 2010
DRAWN K.L	CHK R.A	STRUCT	GEOCRES 30M3-252

LICENSED PROFESSIONAL ENGINEER R.A. ABDUL Sept 03/2010 PROVINCE OF ONTARIO

REGISTERED PROFESSIONAL ENGINEER M. TANOS 03.09.2010 PROVINCE OF ONTARIO

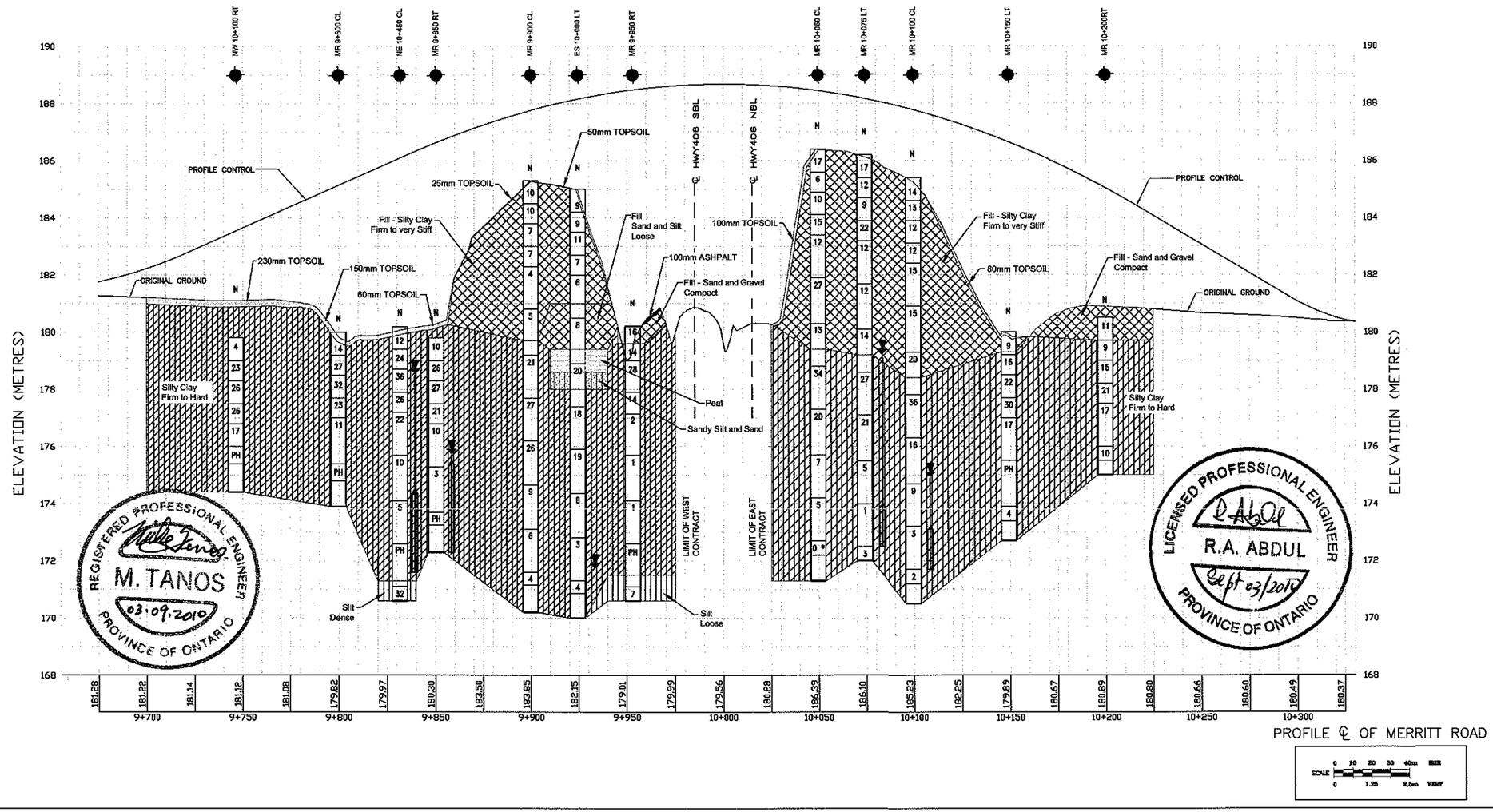
C:\Users\krwel\Documents\11-09-4135 HWY 406 - MERRITT ROAD\11-09-4135 Merritt Road Borehole Location Plan.dwg, KRWAL



METRIC

DIMENSIONS ARE IN METRES AND/OR MILLIMETERS UNLESS OTHERWISE SHOWN

MERRITT RD.



PROFILE ℄ OF MERRITT ROAD

SCALE 0 10 20 30 40m HOR
0 1.25 2.5m VERT

REGISTERED PROFESSIONAL ENGINEER
M. TANOS
03.09.2010
PROVINCE OF ONTARIO

LICENSED PROFESSIONAL ENGINEER
R.A. ABDUL
Sept 03/2010
PROVINCE OF ONTARIO

CONT No

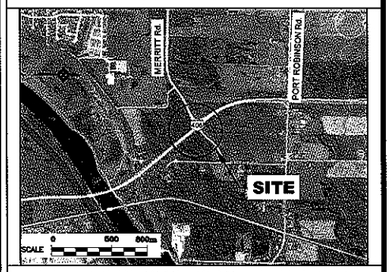
WP No 280-99-00

HIGHWAY 406
MERRITT ROAD INTERCHANGE
BOREHOLE LOCATIONS

SHEET 2 OF 6

Giffels Associates Limited
Consulting Engineers and Architects
An IBI 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/Monitoring Well
▮	Piezometer/Monitoring Well
90%	Rock Quality Designation
A/R	Auger Refusal

No	ELEV.	COORDINATES	
		NORTHING	EASTING
NW 10+100 RT	179.8	4 765 913.2	326 359.9
MR 9+ 800 CL	180.0	4 765 935.2	326 409.3
NE 10+450 CL	180.2	4 765 958.5	326 432.0
MR 9+850 RT	179.8	4 765 953.0	326 458.1
MR 9+900 CL	185.3	4 765 994.9	326 489.5
ES 10+000 LT	185.0	4 766 013.3	326 507.0
MR 9+950 RT	180.2	4 766 011.5	326 537.9
MR 10+050 CL	186.4	4 766 077.8	326 614.6
MR 10+075 LT	186.2	4 766 107.2	326 624.3
MR 10+100 CL	185.4	4 766 108.7	326 654.0
MR 10+150 LT	180.0	4 766 144.7	326 689.8
MR 10+200 RT	180.5	4 766 160.5	326 739.9

NOTE

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

REVISIONS	DATE	BY	DESCRIPTION

DESIGN	R.A	CODE	CHBDC2006	LOAD	DATE SEPT. 2010
DRAWN	K.L	CHK	R.A	STRUCT	GEOCRES 30M3-252

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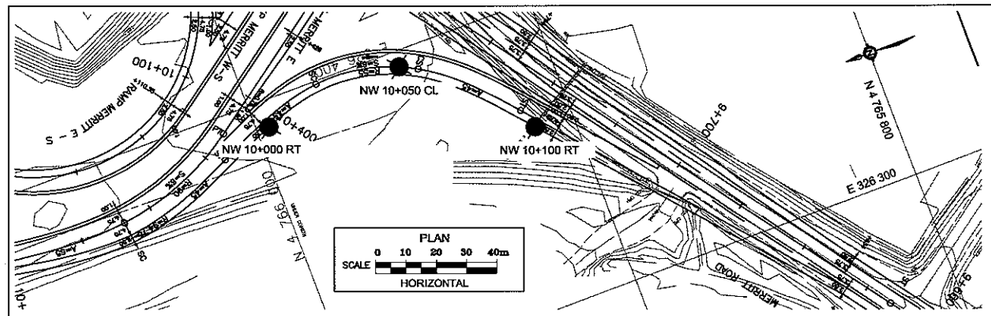
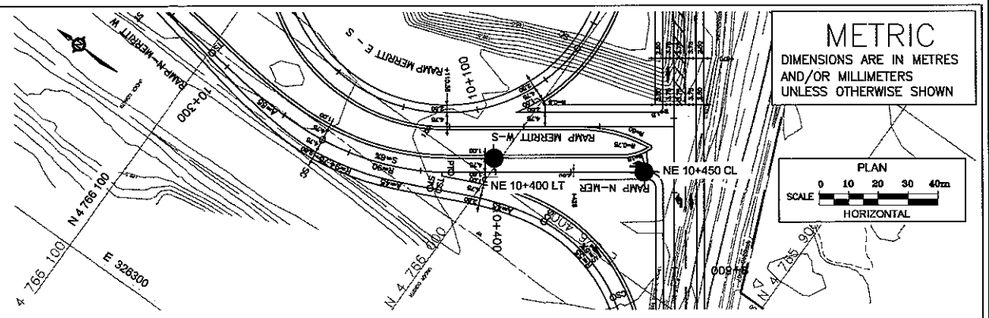
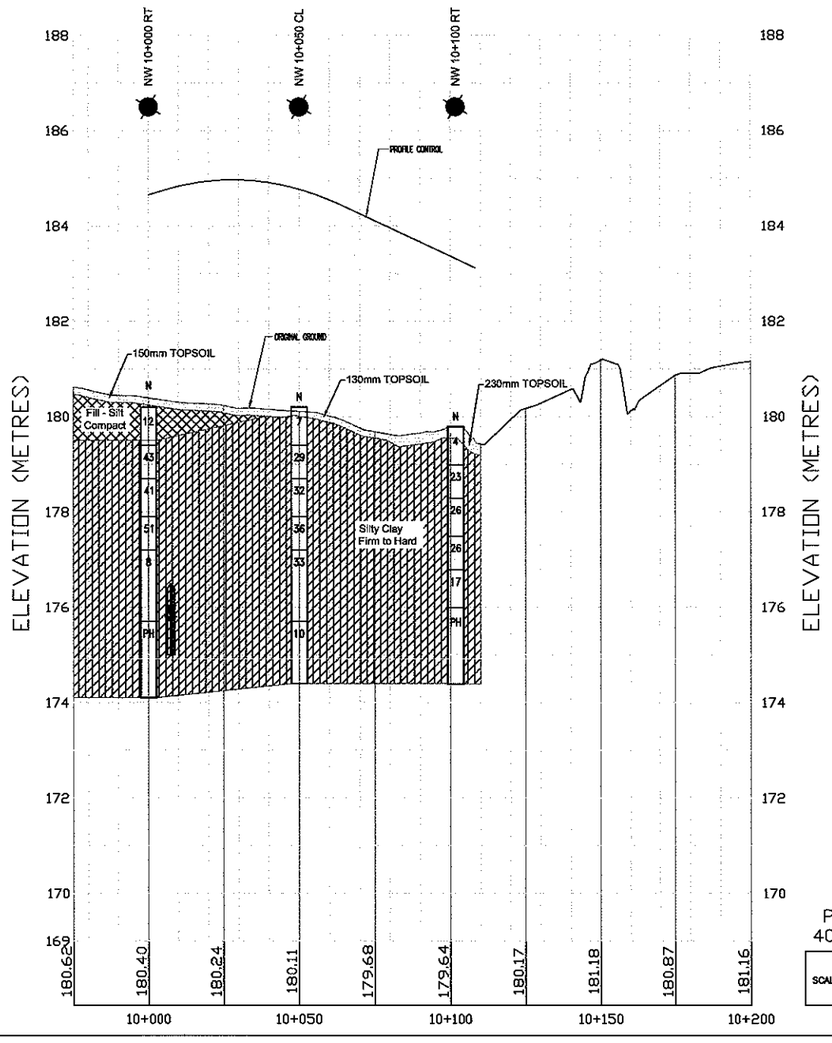




METRIC
DIMENSIONS ARE IN METRES AND/OR MILLIMETERS UNLESS OTHERWISE SHOWN

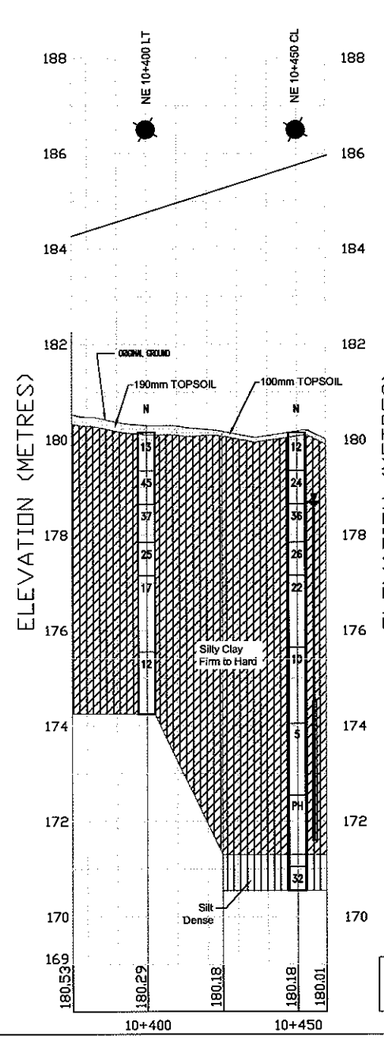
406 N-W MERRITT RAMP



PROFILE ℄ OF RAMP
406 N-MERRITT RD. W

SCALE 0 10 20 30 40m HOR
0 1.25 2.5m VERT

406 N-E MERRITT RAMP



PROFILE ℄ OF RAMP
406 N-MERRITT RD. E

SCALE 0 10 20 30 40m HOR
0 1.25 2.5 VERT

REGISTERED PROFESSIONAL ENGINEER
M. TANOS
03.09.2010
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LICENSED PROFESSIONAL ENGINEER
R.A. ABDUL
Sept 03/2010
PROVINCE OF ONTARIO

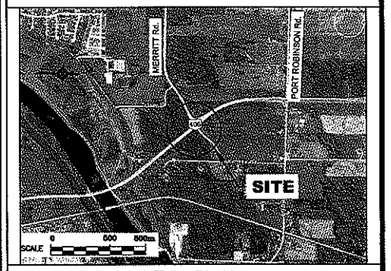
CONT No
WP No 280-99-00

HIGHWAY 406
MERRITT ROAD INTERCHANGE
BOREHOLE LOCATIONS

SHEET
3 OF 6

Giffels Associates Limited
Consulting Engineers and Architects
An IBI 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/Monitoring Well
▮	Piezometer/Monitoring Well
90%	Rock Quality Designation
A/R	Auger Refusal

No	ELEV.	COORDINATES	
		NORTHING	EASTING
NW 10+000 RT	180.2	4 765 995.8	326 390.9
NW 10+050 CL	180.2	4 765 948.1	326 394.7
NW 10+100 RT	179.8	4 765 913.2	326 359.9
NE 10+ 400 LT	180.2	4 766 001.9	326 406.6
NE 10+ 450 CL	180.2	4 765 958.5	326 432.0

NOTE

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REVISIONS			
	DATE	BY	DESCRIPTION

DESIGN	R.A	CODE	CHBDC2006	LOAD	DATE SEPT. 2010
DRAWN	K.L	CHK	R.A	STRUCT	GEOCRES 30M3-252

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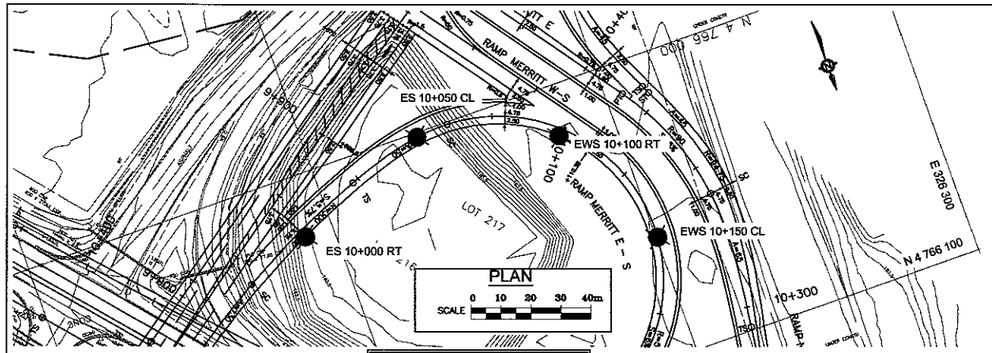
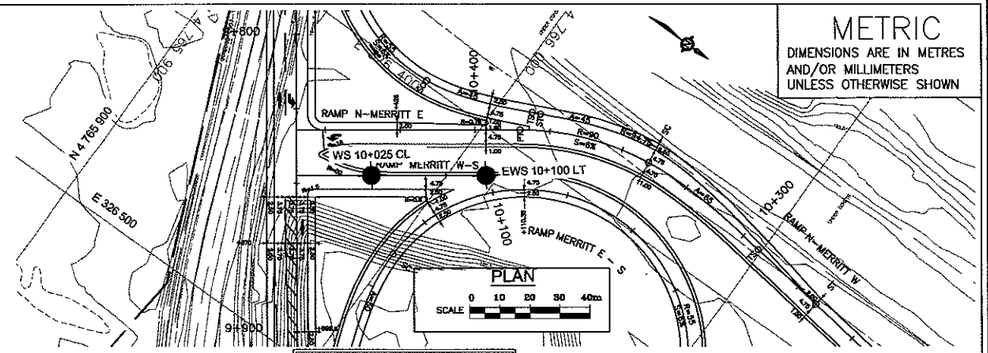
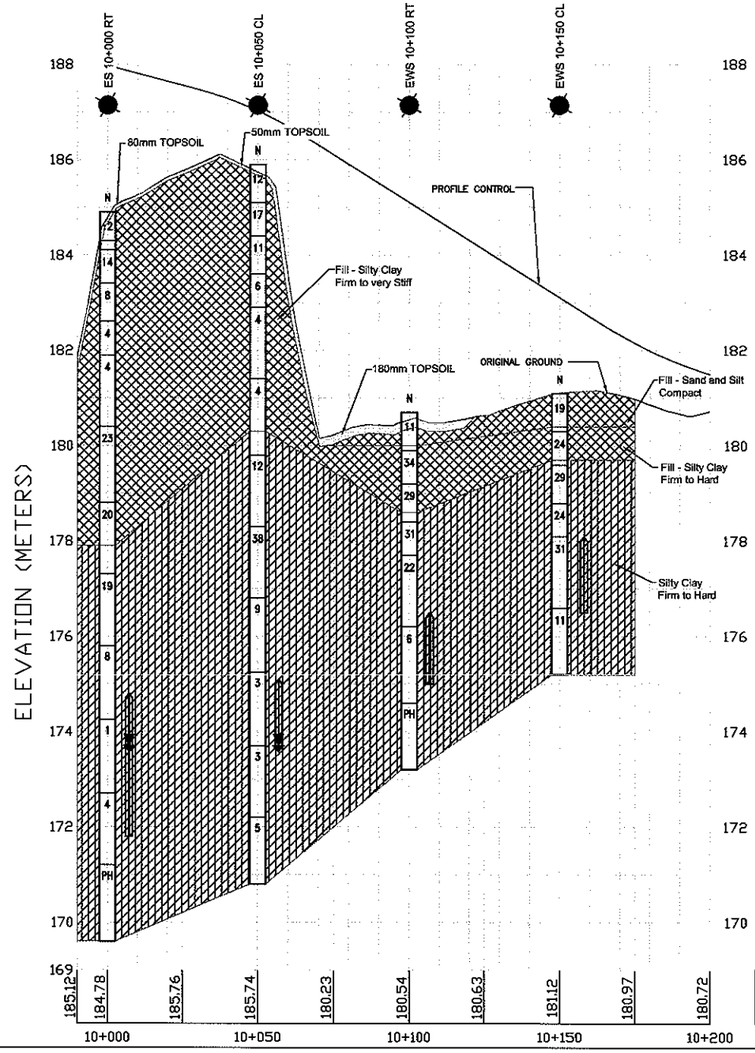


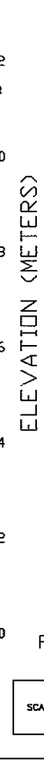


METRIC
DIMENSIONS ARE IN METRES AND/OR MILLIMETERS UNLESS OTHERWISE SHOWN

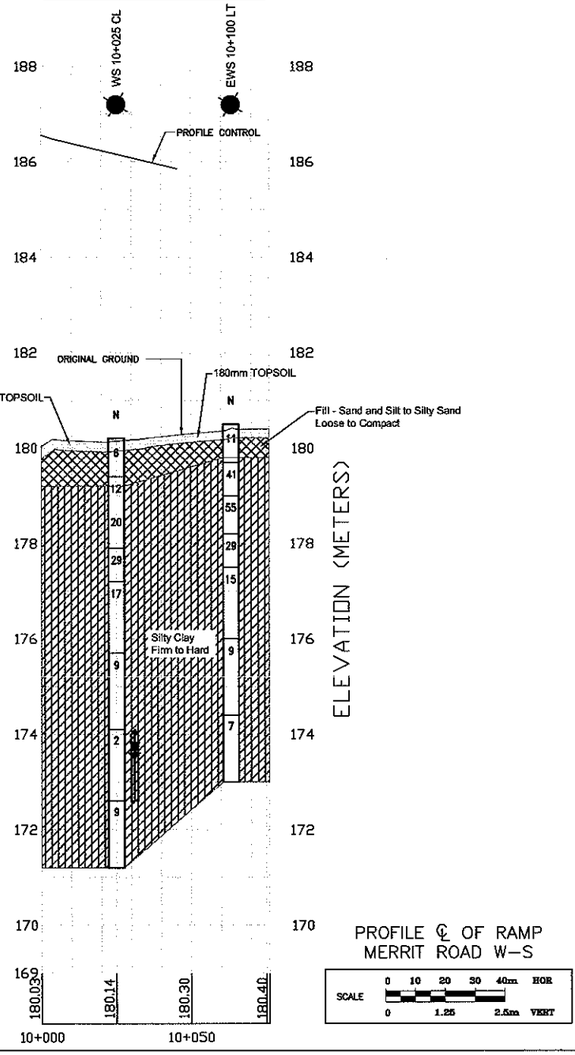
MERRITT E-S RAMP



PROFILE ℄ OF RAMP
MERRITT ROAD E-S



MERRITT W-S RAMP



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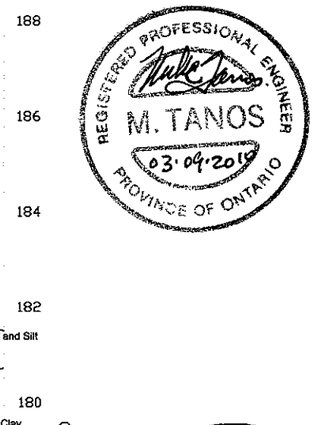
MERRIT ROAD W-S



CONT No
WP No 280-99-00

HIGHWAY 406
MERRITT ROAD INTERCHANGE
BOREHOLE LOCATIONS

SHEET
4 OF 6

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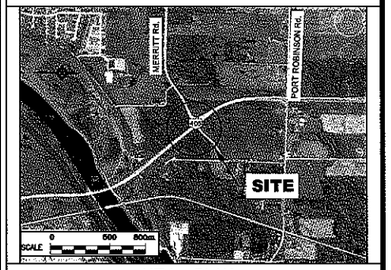
Consulting Engineers and Architects
An IBI Group Company

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/Monitoring Well
	Piezometer/Monitoring Well
90%	Rock Quality Designation
A/R	Auger Refusal

No	ELEV.	COORDINATES	
		NORTHING	EASTING
ES 10+000 RT	184.9	4 766 020.5	326 509.5
ES 10+050 CL	185.9	4 766 001.5	326 463.7
EWS 10+100 RT	180.7	4 766 016.9	326 419.0
EWS 10+150 CL	181.1	4 766 059.9	326 399.4
WS 10+025 CL	180.2	4 765 979.6	326 435.7
EWS 10+100 LT	180.5	4 766 010.6	326 413.2

NOTE

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

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REVISIONS			
	DATE	BY	DESCRIPTION

DESIGN R.A	CODE CHBDC2006	LOAD	DATE SEPT. 2010
DRAWN K.L	CHK R.A	STRUCT	GEOCRES 30M3-252

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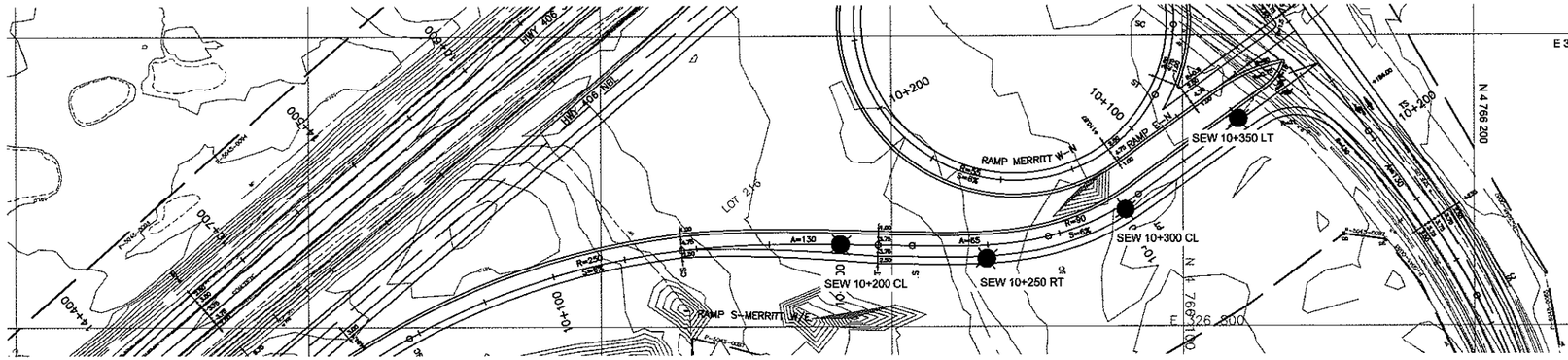
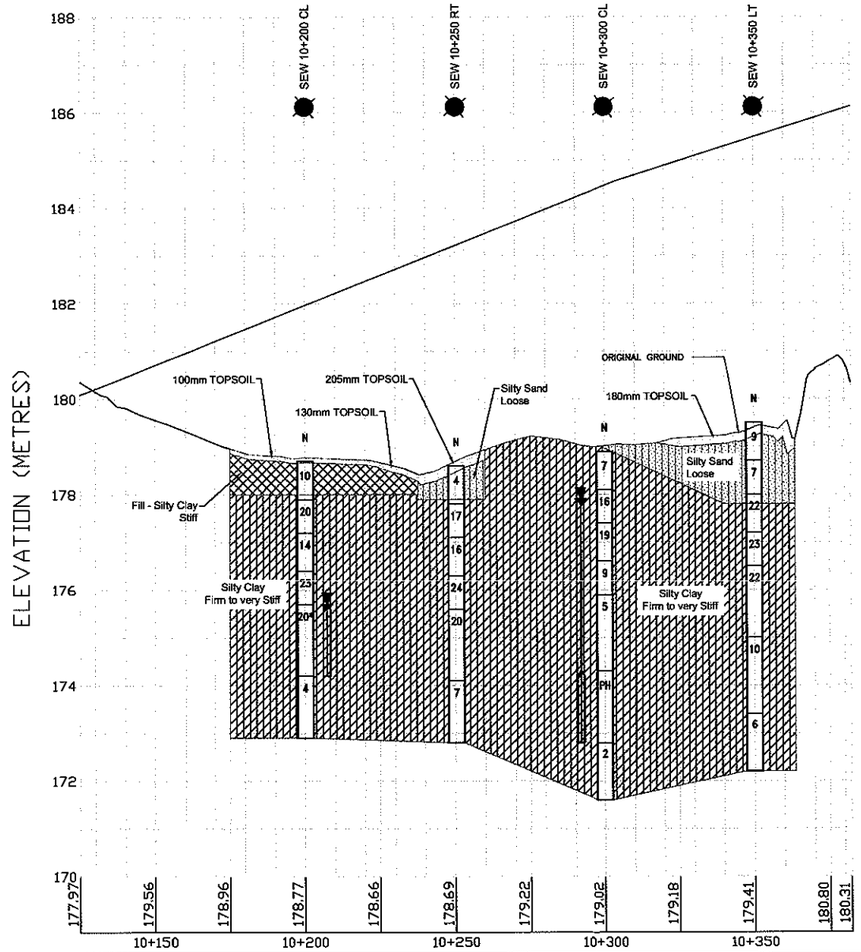


406 S-E/W RAMP



PROFILE ℄ OF RAMP
406 S – E/W

SCALE 0 10 20 30 40m HOR
0 1.25 2.5m VERT

REGISTERED PROFESSIONAL ENGINEER
M. TANOS
03.09.2010
PROVINCE OF ONTARIO

LICENSED PROFESSIONAL ENGINEER
R.A. ABDUL
Sept 03 2010
PROVINCE OF ONTARIO

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

CONT No
WP No 280-99-00

HIGHWAY 406
MERRITT ROAD INTERCHANGE
BOREHOLE LOCATIONS

SHEET 5 OF 6

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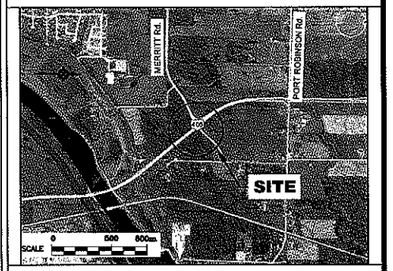
Construction Materials Engineering, Inspection & Testing



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/Monitoring Well
	Piezometer/Monitoring Well
90%	Rock Quality Designation
A/R	Auger Refusal

No	ELEV.	COORDINATES	
		NORTHING	EASTING
SEW 10+200 CL	178.7	4 765 982.3	326 771.7
SEW 10+250 RT	178.6	4 766 032.5	326 766.6
SEW 10+300 CL	178.9	4 766 080.2	326 759.9
SEW 10+350 LT	179.5	4 766 119.2	326 728.7

NOTE

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REVISIONS			
	DATE	BY	DESCRIPTION

DESIGN R.A	CODE CHBDC2006	LOAD	DATE SEPT. 2010
DRAWN K.L	CHK R.A	STRUCT	GEOCRES 30M3-252

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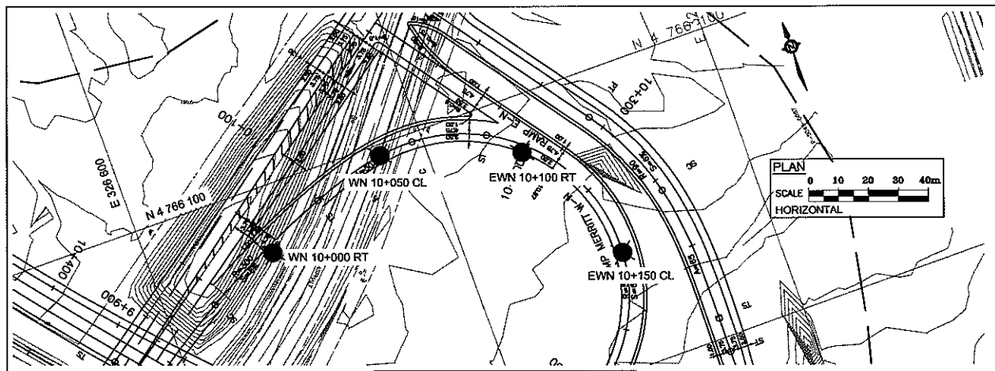
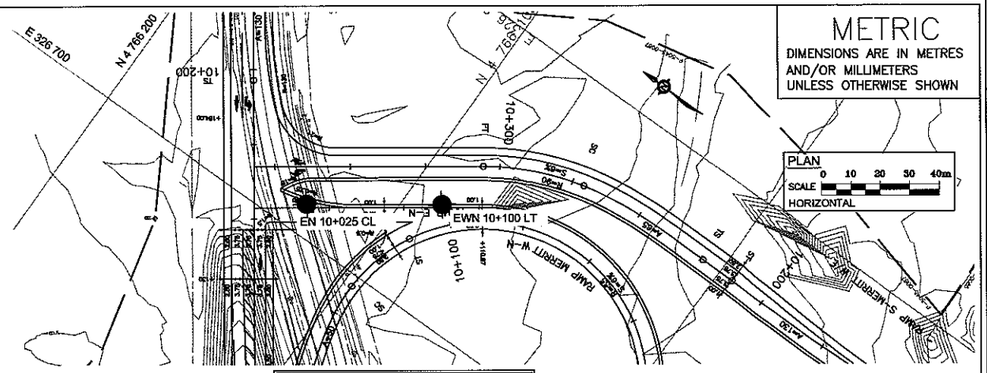
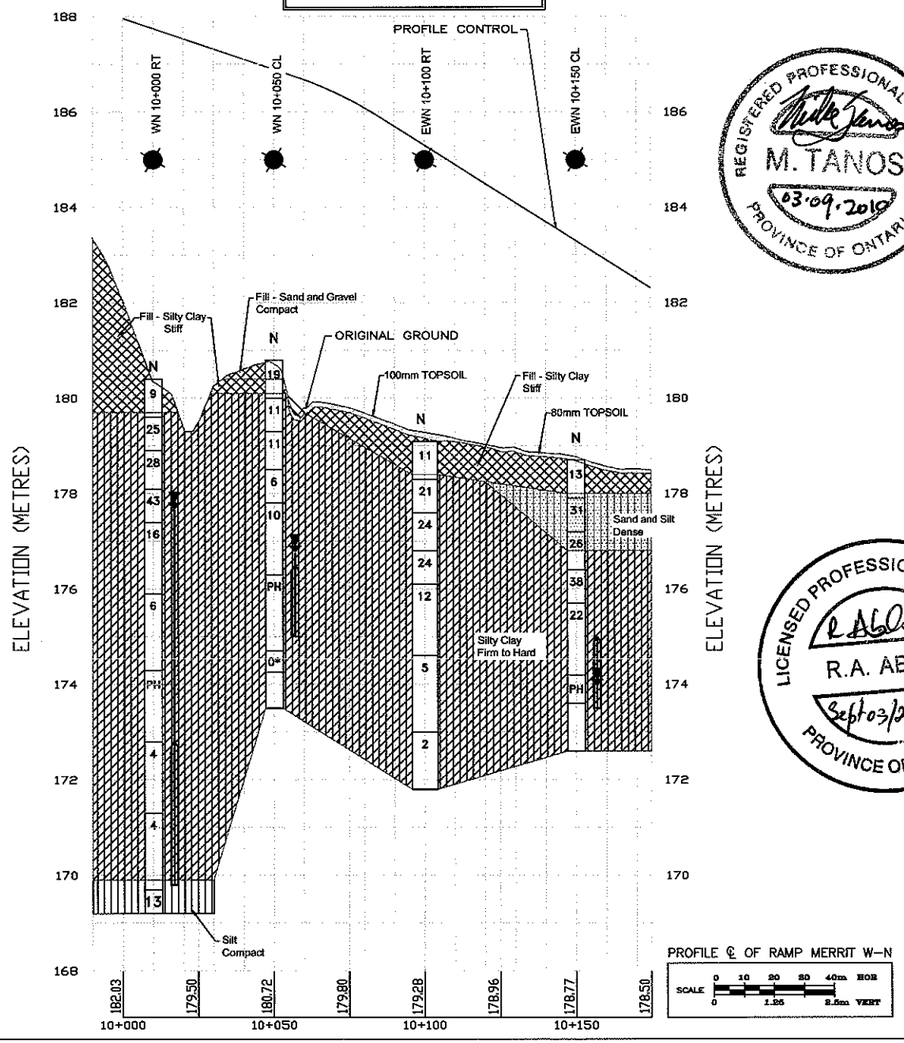




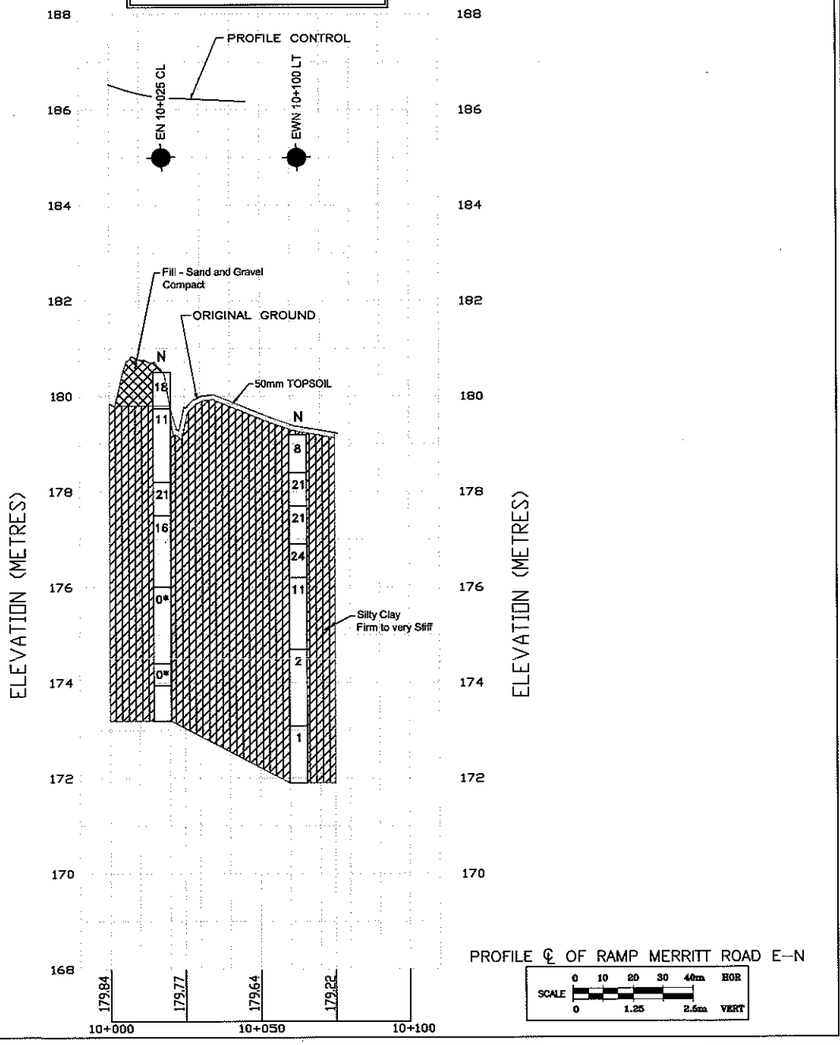
METRIC
DIMENSIONS ARE IN METRES AND/OR MILLIMETERS UNLESS OTHERWISE SHOWN

MERRITT W–N RAMP



PROFILE ℄ OF RAMP MERRITT W–N
SCALE 0 10 20 30 40m HOR
0 1.25 2.5m VERT

MERRITT E–N RAMP



PROFILE ℄ OF RAMP MERRITT ROAD E–N
SCALE 0 10 20 30 40m HOR
0 1.25 2.5m VERT

REGISTERED PROFESSIONAL ENGINEER
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03.09.2010
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LICENSED PROFESSIONAL ENGINEER
R.A. ABDUL
Sept 03/2010
PROVINCE OF ONTARIO

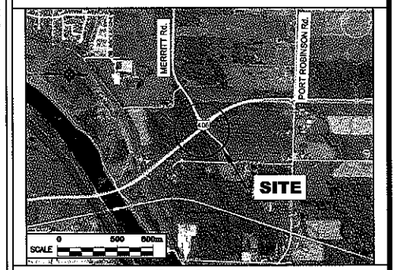
CONT No
WP No 280-99-00

HIGHWAY 406
MERRITT ROAD INTERCHANGE
BOREHOLE LOCATIONS

SHEET 6 OF 6

Giffels Associates Limited
Consulting Engineers and Architects
An IBI 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/Monitoring Well
	Piezometer/Monitoring Well
90%	Rock Quality Designation
A/R	Auger Refusal

No	ELEV.	COORDINATES NORTHING	COORDINATES EASTING
WN 10+000 RT	180.4	4 766 077.8	326 640.4
WN 10+050 CL	180.8	4 766 096.3	326 684.8
EWN 10+100 RT	179.1	4 766 081.3	326 729.7
EWN 10+150 CL	178.7	4 766 038.4	326 749.7
EN 10+025 CL	180.5	4 766 125.3	326 710.0
EWN 10+100 LT	179.2	4 766 088.4	326 736.2

NOTE

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REVISIONS	DATE	BY	DESCRIPTION

DESIGN R.A	CODE CHBDC2006	LOAD	DATE SEPT. 2010
DRAWN K.L	CHK R.A	STRUCT	GEOCRES 30M3-252

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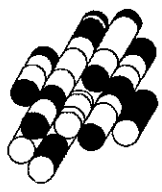
APPENDIX E

Comparison of Embankment Alternatives

Terraprobe Inc.



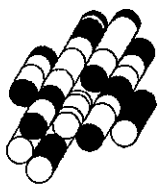
COMPARISON OF EMBANKMENT ALTERNATIVES

Local Earth Borrow	Composite Embankment	SSM Embankment	RSS Embankment	Light Weight Fill
Advantages: i. Material readily available and less costly to import. ii. Easy to place and compact. ***Disadvantages:*** i. Requires relatively flat 3H:1V side slopes because of known performance related issues with cohesive fill. ii. Requires a larger embankment footprint that may conflict with adjacent highway elements. iii. Must be instrumented and monitored until consolidation settlement is complete.	***Advantages:*** i. Can be constructed at steeper side slopes compared to local earth borrow. ii. Smaller embankment footprint than local earth borrow. ***Disadvantages:*** i. Relatively high construction effort required i.e. benching and placement of dissimilar materials. ii. More costly than using local earth borrow. iii. Little MTO case history on performance. iv. Must be instrumented and monitored until consolidation settlement is complete	***Advantages:*** i. Can be constructed at conventional 2H:1V slopes. ii. Conventional embankment footprint. iii. Proven reliable performance on MTO projects. ***Disadvantages:*** i. More costly than earth borrow. ii. Requires stringent quality control to ensure that only approved material is selected and used. iii. Must be instrumented and monitored until consolidation settlement is complete	***Advantages:*** i. Can be constructed at 2H:1V slopes or steeper. ii. Small embankment footprint. iii. Proven reliable performance on MTO projects. ***Disadvantages:*** i. More costly than earth borrow. ii. Higher construction effort required to widen embankments in the future. iii. Must be instrumented and monitored until consolidation settlement is complete	***Advantages:*** i. Can be constructed at 2H:1V slopes. ii. Conventional embankment footprint used. iii. Proven reliable performance on MTO projects. iv. Will induce the least amount of settlement of underlying soils. ***Disadvantages:*** i. Relatively high cost compared to other options. ii. Must be instrumented and monitored until consolidation settlement is complete.
Risks/Consequences i. Low risk of future stability issues and less costly preventative maintenance provided 3H:1V slopes are used. ii. Larger footprint area may conflict with adjacent highway elements.	***Risks/Consequences*** i. Low risk of shallow failures. ii. No documented MTO case history on performance. iii. Large footprint area may conflict with adjacent highway elements.	***Risks/Consequences*** i. Very low risk of failure. ii. Relatively higher material cost.	***Risks/Consequences*** i. Very low risk of failure. ii. Higher construction effort required to widen embankment in the future.	***Risks/Consequences*** i. Very low risk of failure.
APPROXIMATE COSTS				
$ 7.65 per cubic metre	$ 46.00 per cubic metre	$ 23.00 per cubic metre	$98.00 per square metre	$80.00 per cubic metre

APPENDIX F

Slope Stability Data and Results

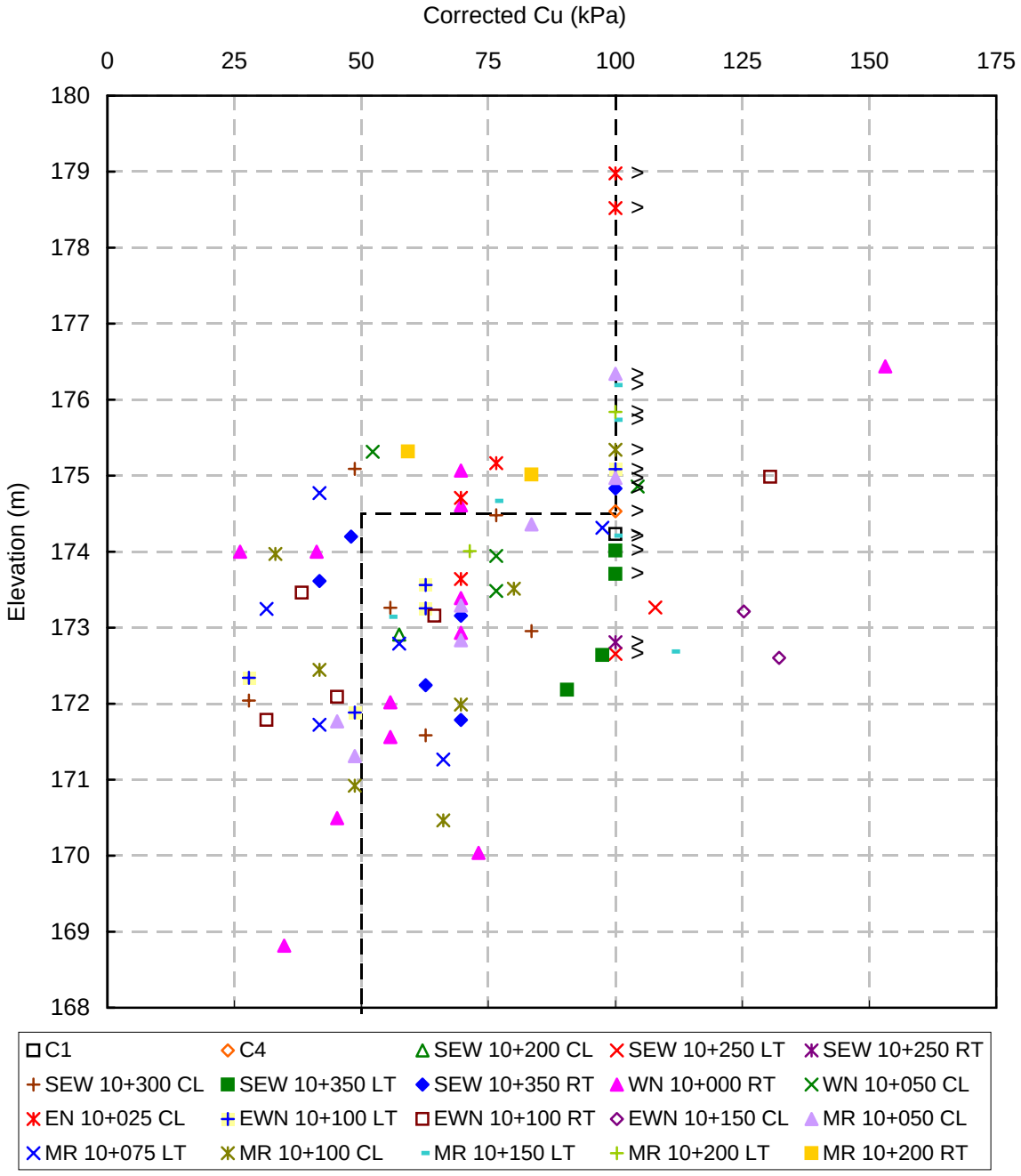
Terraprobe Inc.



CORRECTED UNDRAINED SHEAR STRENGTH	FIGURE F1

MERRITT ROAD INTERCHANGE - SOUTHEAST QUADRANT

Silty Clay



Field Shear Vane Correction

Morris & Williams (1994)

(μ = 1.18 EXP(-0.08 Ip) + 0.57)

Applied Correction Factors

0.84 (Elev.>176.5m) 0.87 (Elev.<176.5m)

Project No. : 1-09-4135

Date : September, 2010

Terraprobe Inc.

Prepared By : HW

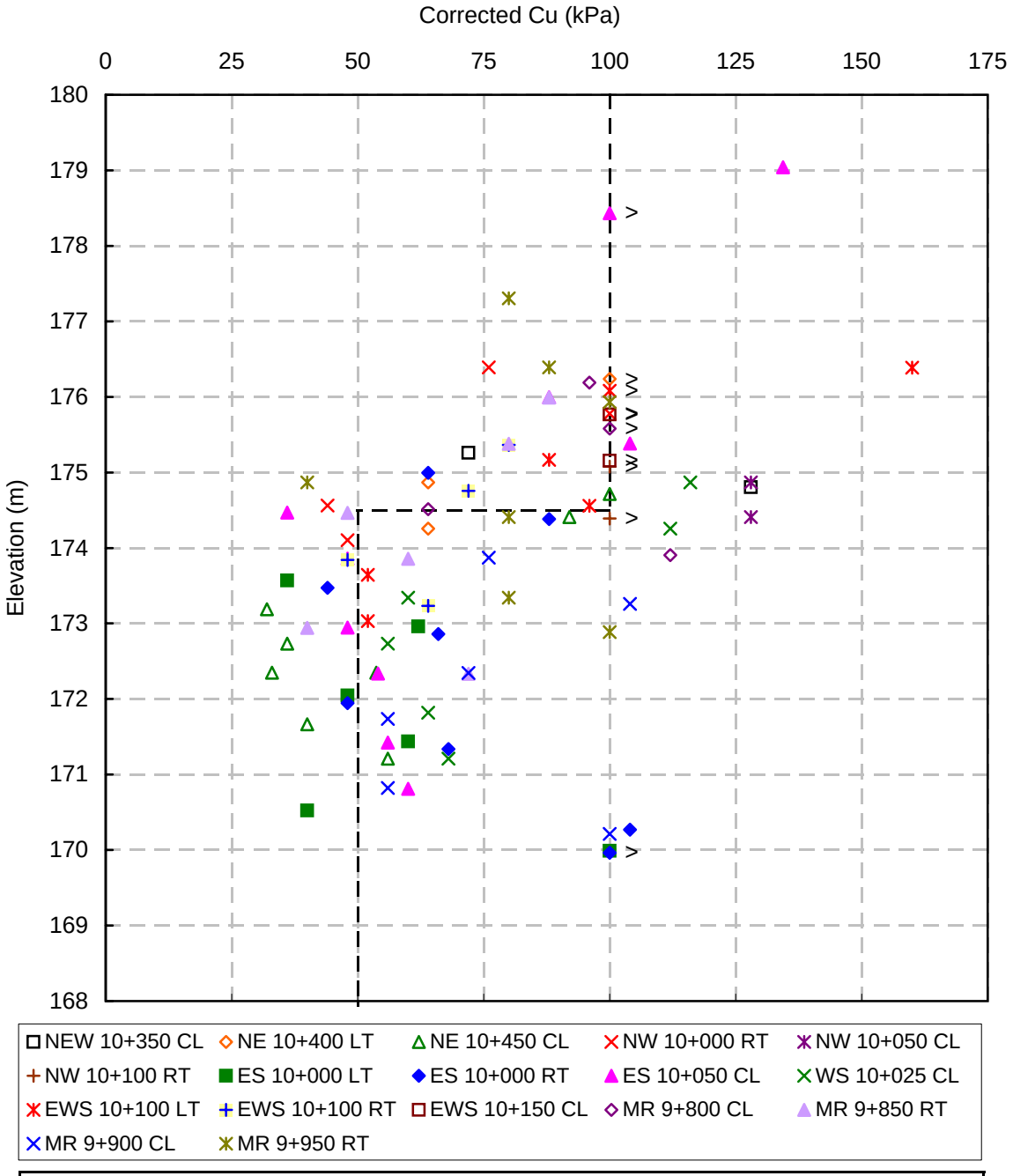
Checked By : RA

C:\Documents and Settings\Hongliu\My Documents\Project 2009\1-09-4135 - HWY 406 Foundations\Merritt Road\Soil Parameter\1-09-4135 Soil Parameter Estimation-Merritt SE.xls

CORRECTED UNDRAINED SHEAR STRENGTH	FIGURE F2

MERRITT ROAD INTERCHANGE - NORTHWEST QUADRANT

Silty Clay



Field Shear Vane Correction

Morris & Williams (1994)

(μ = 1.18 EXP(-0.08 Ip) + 0.57)

Applied Correction Factors

0.80 (Elev.>176.5m) 0.85 (Elev.<176.5m)

Project No. : 1-09-4135

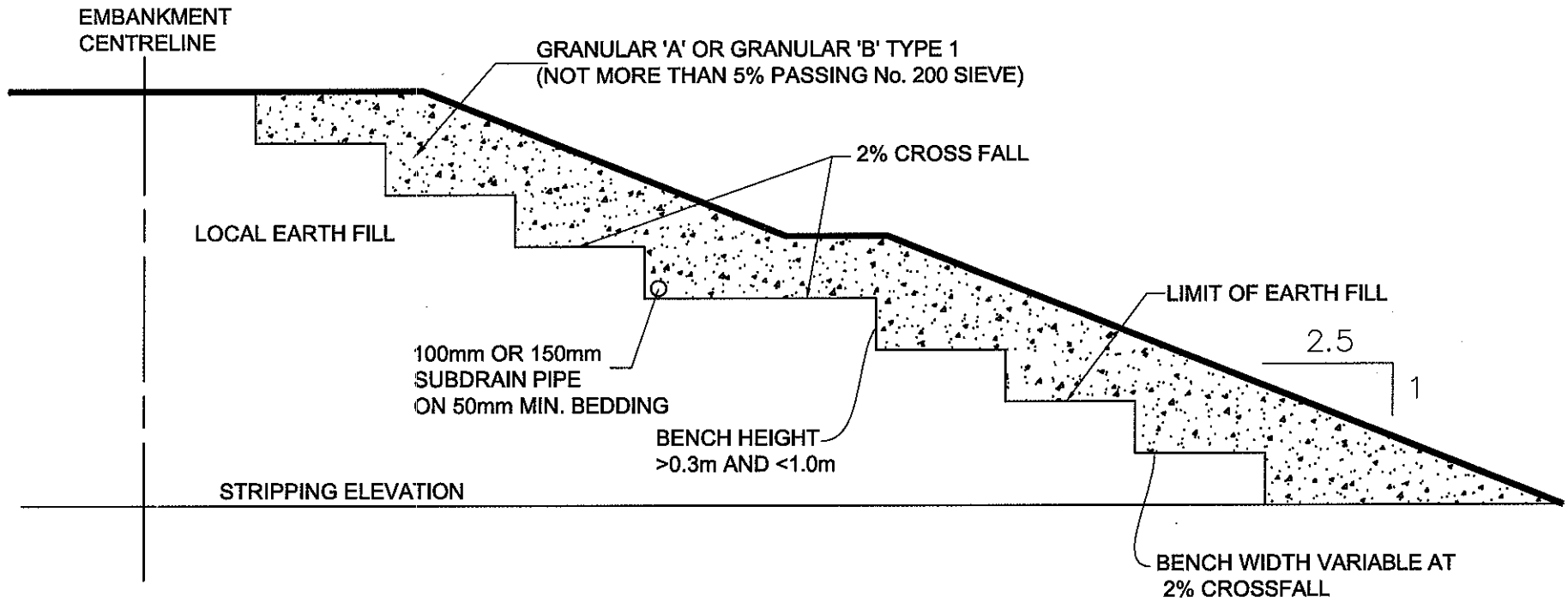
Date : September, 2010

Terraprobe Inc.

Prepared By : HW

Checked By : RA

C:\Documents and Settings\Hongliu\My Documents\Project 2009\1-09-4135 - HWY 406 Foundations\Merritt Road\Soil Parameter\1-09-4135 Soil Parameter Estimation-Merritt NW.xls



NOTES: FLOW FROM SUBDRAIN PIPE TO OUTLET FREELY AND BE DIRECTED TO ARMOURED OUTFALLS /OUTLETS DESIGNED TO DRAIN INTO ROADSIDE DITCHES.

N.T.S.

COMPOSITE EMBANKMENT DETAILS

TERRAPROBE

FIGURE F3

FIGURE 1AA (LOCAL EARTH FILL)

Terraprobe

Job No.: 1-09-4135
Section: Merritt Road, South East Quadrant
Method: Bishop simplified
Slope: 3H:1V
Condition: Undrained

MATERIAL PROPERTIES

1 Material: Local Earth Fill
Unit Weight: 19 kN/m3
Cohesion: 0 kPa
Friction Angle: 31 degrees

2 Material: Upper Silty Clay
Unit Weight: 20.5 kN/m3
Cohesion: 100 kPa
Friction Angle: 0 degrees

3 Material: Lower Silty Clay
Unit Weight: 20 kN/m3
Cohesion: 50 kPa
Friction Angle: 0 degrees

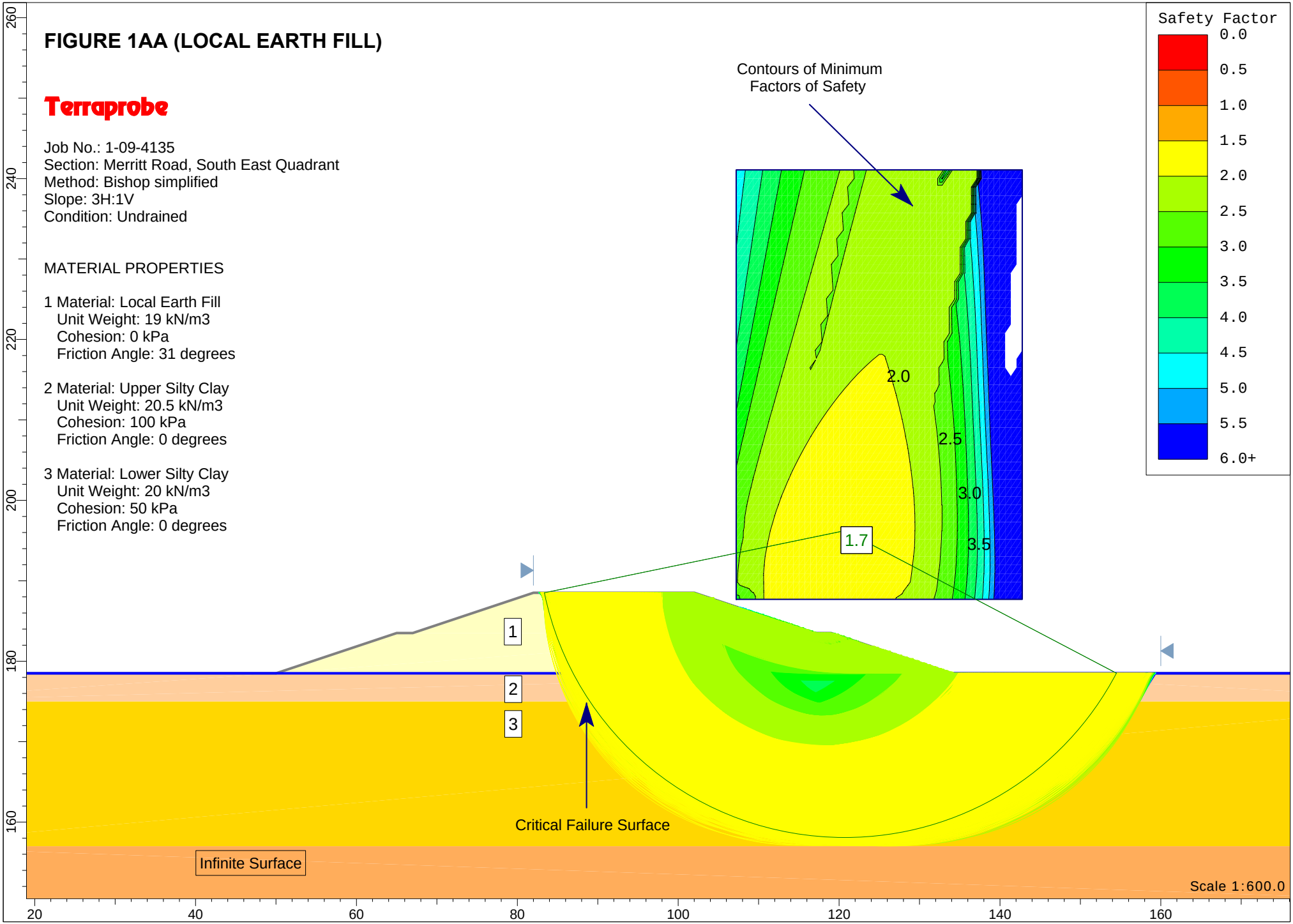


FIGURE 1BB (LOCAL EARTH FILL)

Terraprobe

Job No.: 1-09-4135
Section: Merritt Road, South East Quadrant
Method: Bishop simplified
Slope: 3H:1V
Condition: Drained

MATERIAL PROPERTIES

1 Material: Local Earth Fill
Unit Weight: 19 kN/m3
Cohesion: 0 kPa
Friction Angle: 31 degrees

2 Material: Upper Silty Clay
Unit Weight: 20.5 kN/m3
Cohesion: 7 kPa
Friction Angle: 29 degrees

3 Material: Lower Silty Clay
Unit Weight: 20 kN/m3
Cohesion: 5 kPa
Friction Angle: 27 degrees

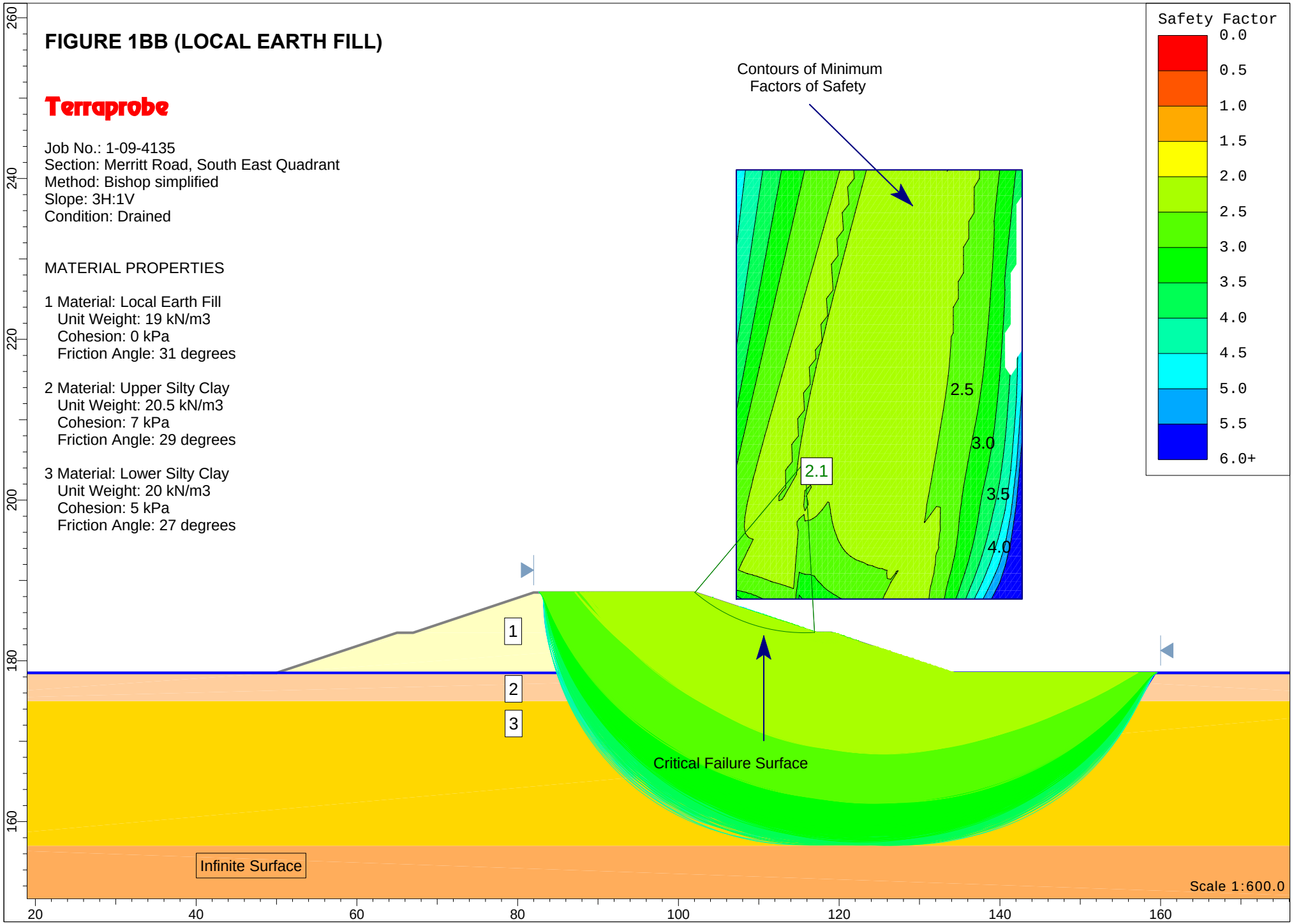


FIGURE 2AA (COMPOSITE)

Terraprobe

Job No.: 1-09-4135
Section: Merritt Road, South East Quadrant
Method: Bishop simplified
Slope: 2.5H:1V
Condition: Undrained

MATERIAL PROPERTIES

1 Material: Local Earth Fill
Unit Weight: 19 kN/m3
Cohesion: 0 kPa
Friction Angle: 31 degrees

2 Material: Upper Silty Clay
Unit Weight: 20.5 kN/m3
Cohesion: 100 kPa
Friction Angle: 0 degrees

3 Material: Lower Silty Clay
Unit Weight: 20 kN/m3
Cohesion: 50 kPa
Friction Angle: 0 degrees

4 Material: Granular A
Unit Weight: 22.8 kN/m3
Cohesion: 0 kPa
Friction Angle: 35 degrees

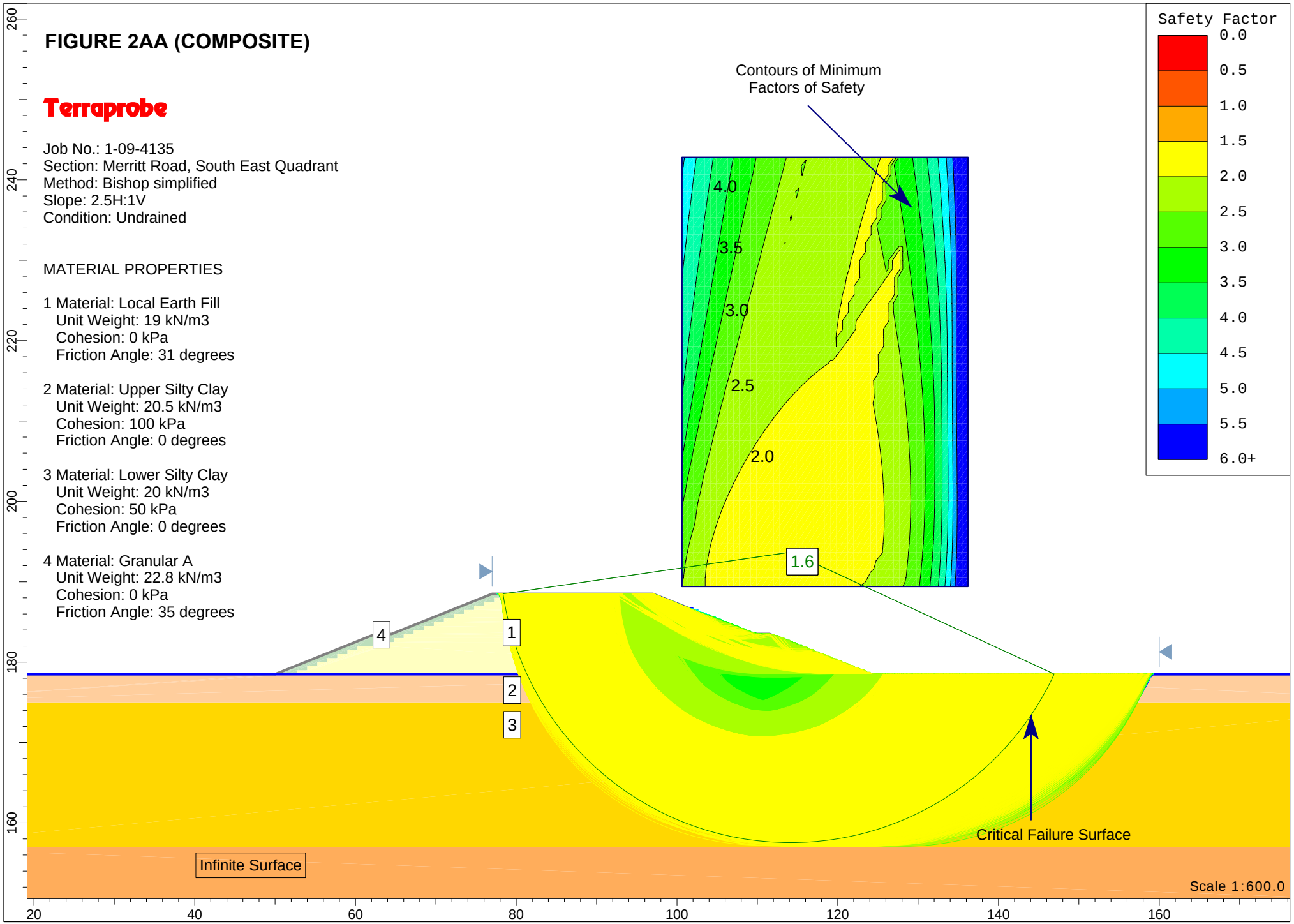


FIGURE 2BB (COMPOSITE)

Terraprobe

Job No.: 1-09-4135
Section: Merritt Road, South East Quadrant
Method: Bishop simplified
Slope: 2.5H:1V
Condition: Drained

MATERIAL PROPERTIES

1 Material: Local Earth Fill
Unit Weight: 19 kN/m3
Cohesion: 0 kPa
Friction Angle: 31 degrees

2 Material: Upper Silty Clay
Unit Weight: 20.5 kN/m3
Cohesion: 7 kPa
Friction Angle: 29 degrees

3 Material: Lower Silty Clay
Unit Weight: 20 kN/m3
Cohesion: 5 kPa
Friction Angle: 27 degrees

4 Material: Granular A
Unit Weight: 22.8 kN/m3
Cohesion: 0 kPa
Friction Angle: 35 degrees

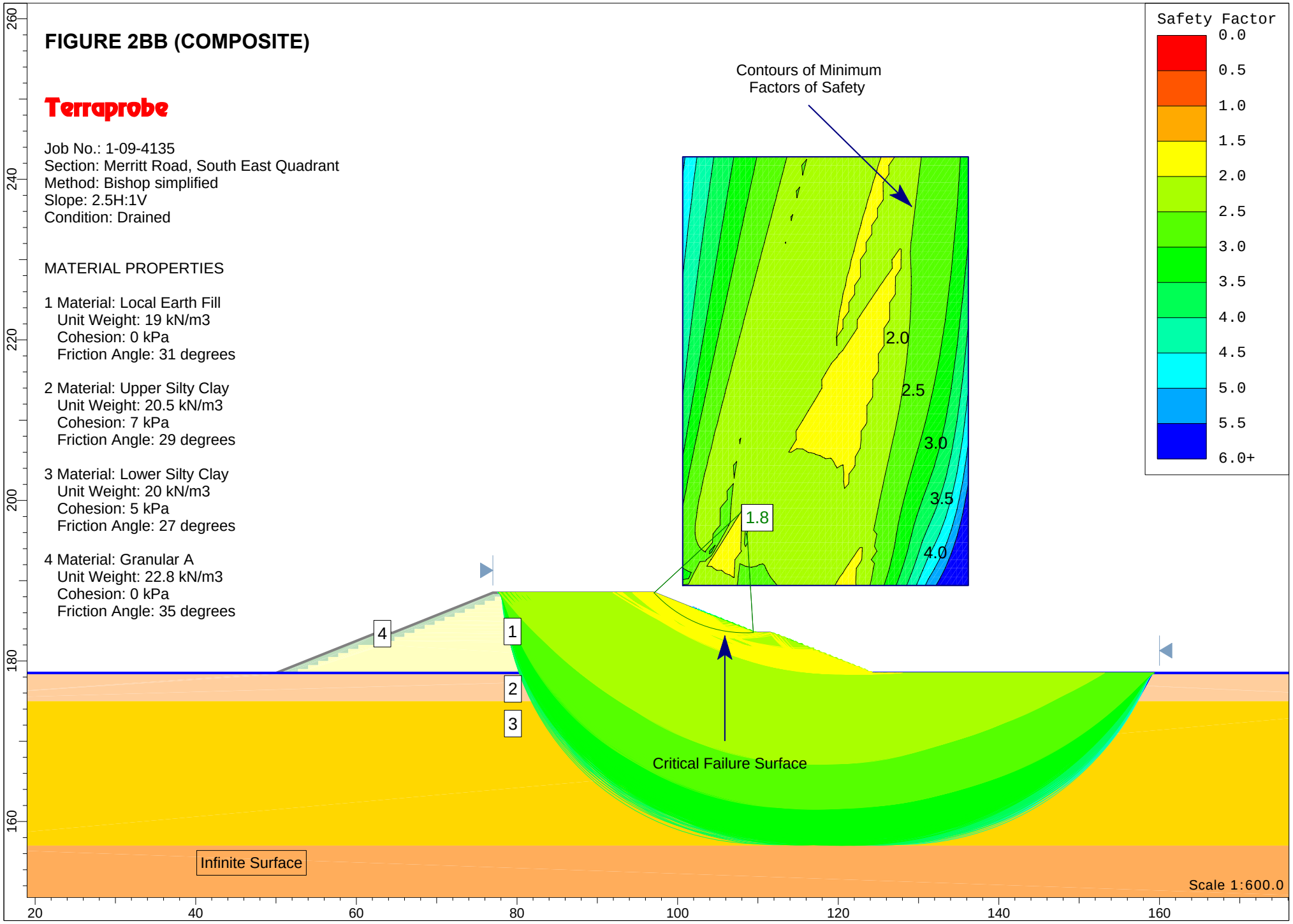


FIGURE 3AA (SSM)

Terraprobe

Job No.: 1-09-4135
Section: Merritt Road, South East Quadrant
Method: Bishop simplified
Slope: 2H:1V
Condition: Undrained

MATERIAL PROPERTIES

1 Material: SSM
Unit Weight: 20 kN/m3
Cohesion: 0 kPa
Friction Angle: 32 degrees

2 Material: Upper Silty Clay
Unit Weight: 20.5 kN/m3
Cohesion: 100 kPa
Friction Angle: 0 degrees

3 Material: Lower Silty Clay
Unit Weight: 20 kN/m3
Cohesion: 50 kPa
Friction Angle: 0 degrees

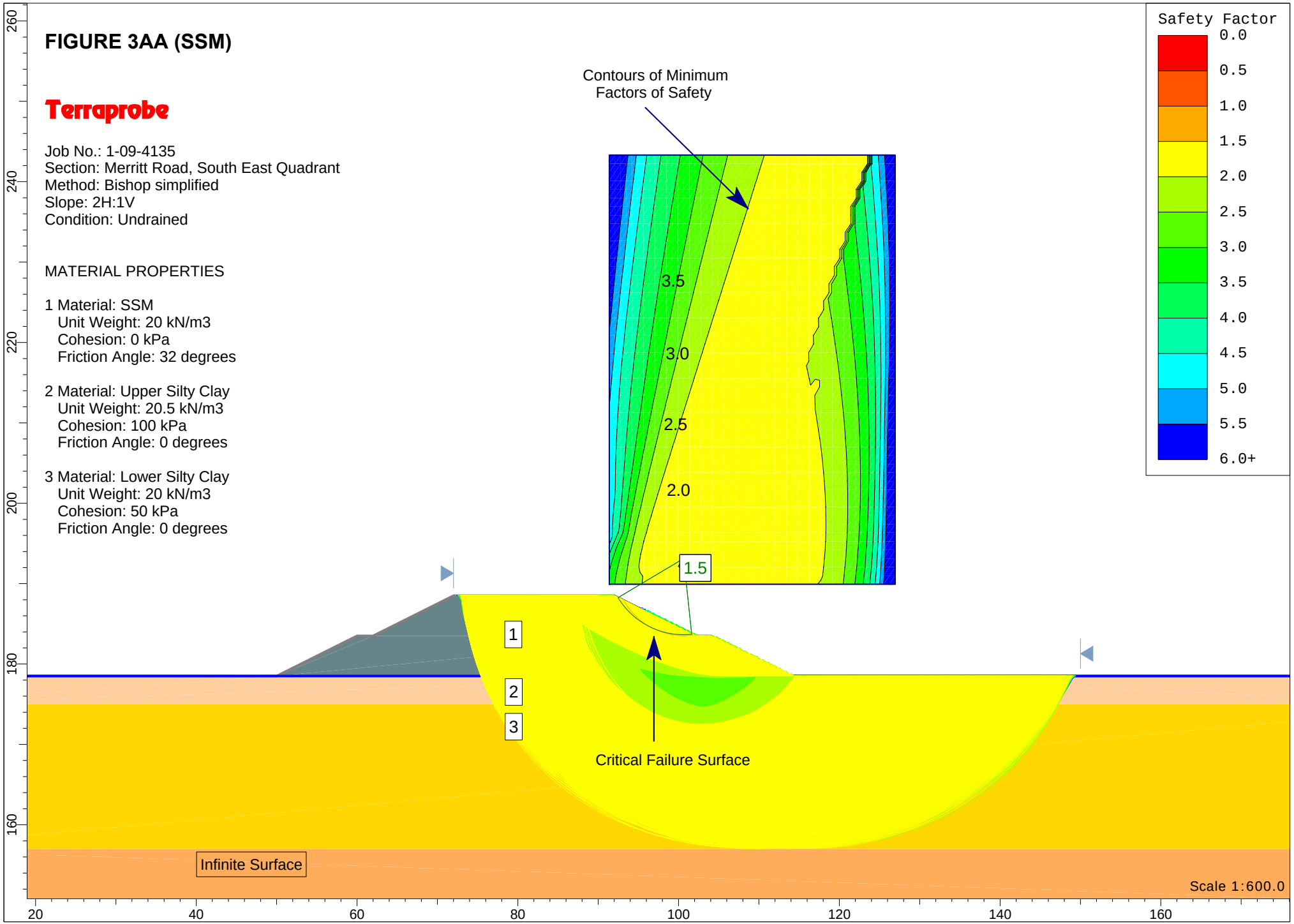


FIGURE 3BB (SSM)

Terraprobe

Job No.: 1-09-4135
Section: Merritt Road, South East Quadrant
Method: Bishop simplified
Slope: 2H:1V
Condition: Drained

MATERIAL PROPERTIES

1 Material: SSM
Unit Weight: 20 kN/m3
Cohesion: 0 kPa
Friction Angle: 32 degrees

2 Material: Upper Silty Clay
Unit Weight: 20.5 kN/m3
Cohesion: 7 kPa
Friction Angle: 29 degrees

3 Material: Lower Silty Clay
Unit Weight: 20 kN/m3
Cohesion: 5 kPa
Friction Angle: 27 degrees

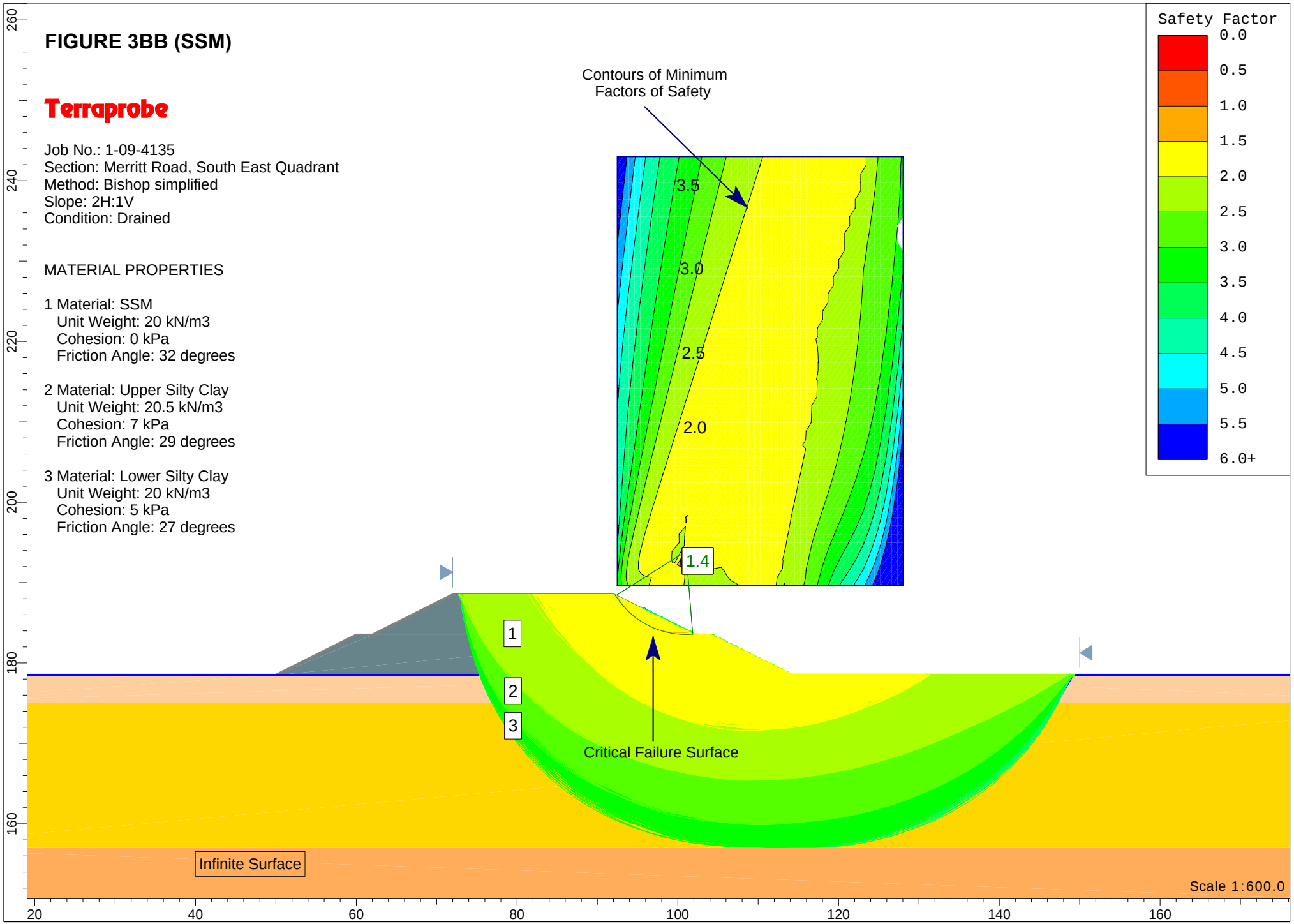


FIGURE 4AA (RSS)

Terraprobe

Job No.: 1-09-4135
Section: Merritt Road, South East Quadrant
Method: Bishop simplified
Slope: 2H:1V
Condition: Undrained

MATERIAL PROPERTIES

1 Material: Local Earth Fill
Unit Weight: 19 kN/m3
Cohesion: 0 kPa
Friction Angle: 31 degrees

2 Material: Upper Silty Clay
Unit Weight: 20.5 kN/m3
Cohesion: 100 kPa
Friction Angle: 0 degrees

3 Material: Lower Silty Clay
Unit Weight: 20 kN/m3
Cohesion: 50 kPa
Friction Angle: 0 degrees

4 Material: RSS
Unit Weight: 20 kN/m3
Cohesion: Infinite
Friction Angle: Infinite

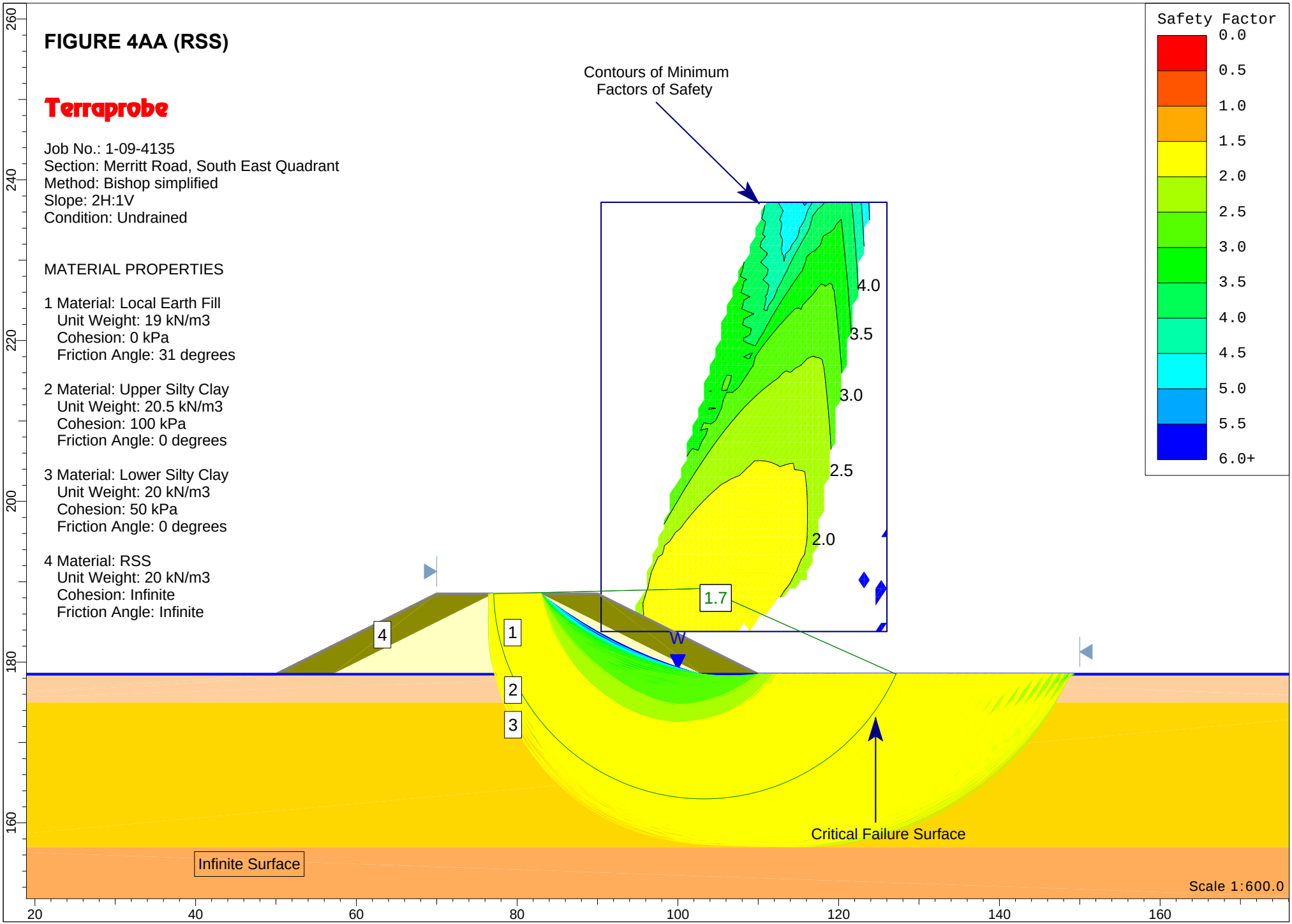


FIGURE 4BB (RSS)

Terraprobe

Job No.: 1-09-4135
Section: Merritt Road, South East Quadrant
Method: Bishop simplified
Slope: 2H:1V
Condition: Drained

MATERIAL PROPERTIES

1 Material: Local Earth Fill
Unit Weight: 19 kN/m3
Cohesion: 0 kPa
Friction Angle: 31 degrees

2 Material: Upper Silty Clay
Unit Weight: 20.5 kN/m3
Cohesion: 7 kPa
Friction Angle: 29 degrees

3 Material: Lower Silty Clay
Unit Weight: 20 kN/m3
Cohesion: 5 kPa
Friction Angle: 27 degrees

4 Material: RSS
Unit Weight: 20 kN/m3
Cohesion: Infinite
Friction Angle: Infinite

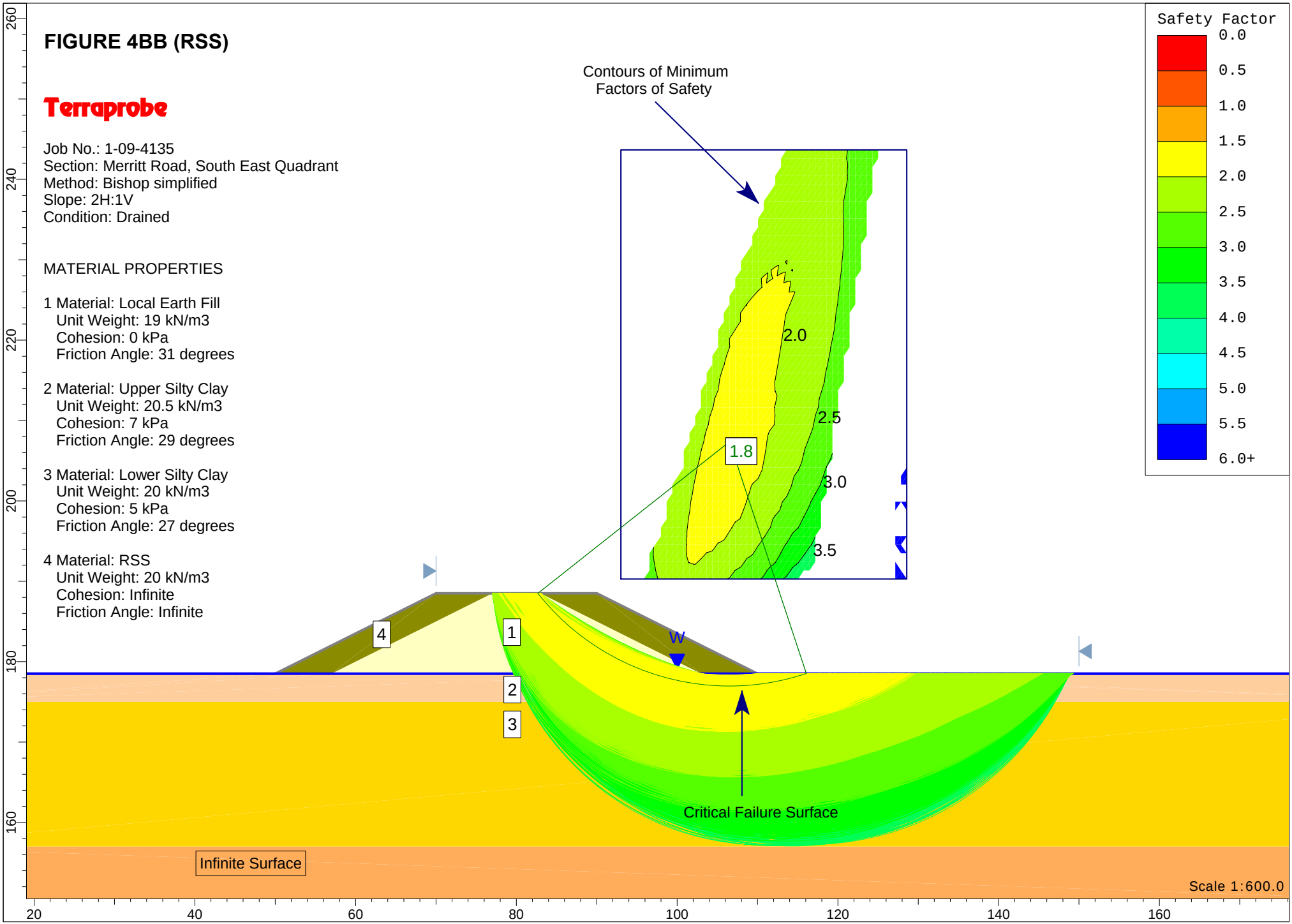


FIGURE 5AA (LIGHT WEIGHT FILL)

Terraprobe

Job No.: 1-09-4135
Section: Merritt Road, South East Quadrant
Method: Bishop simplified
Slope: 2H:1V
Condition: Undrained

MATERIAL PROPERTIES

1 Material: Light Weight Fill
Unit Weight: 14.5 kN/m3
Cohesion: 0 kPa
Friction Angle: 35 degrees

2 Material: Upper Silty Clay
Unit Weight: 20.5 kN/m3
Cohesion: 100 kPa
Friction Angle: 0 degrees

3 Material: Lower Silty Clay
Unit Weight: 20 kN/m3
Cohesion: 50 kPa
Friction Angle: 0 degrees

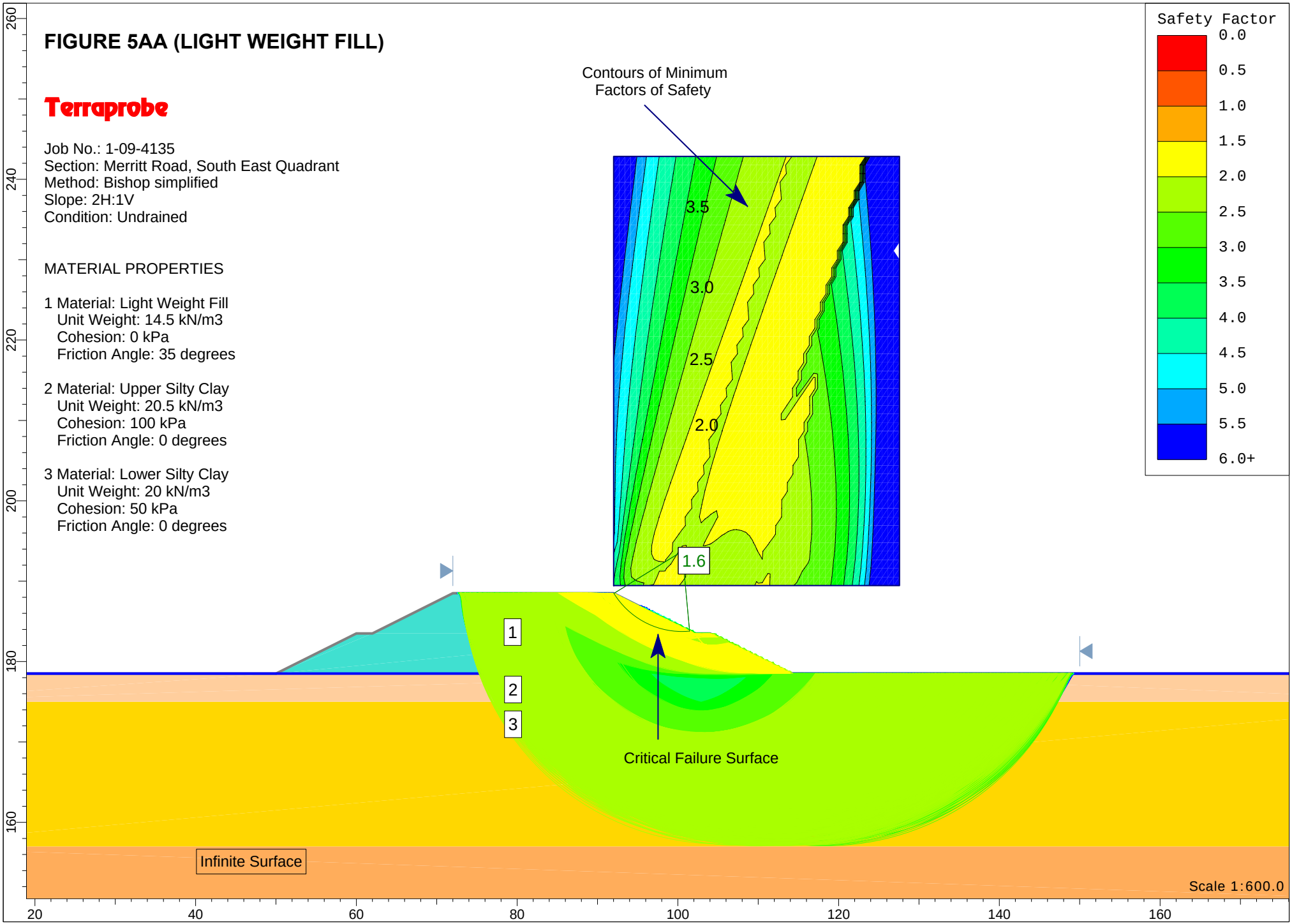


FIGURE 5BB (LIGHT WEIGHT FILL)

Terraprobe

Job No.: 1-09-4135
Section: Merritt Road, South East Quadrant
Method: Bishop simplified
Slope: 2H:1V
Condition: Drained

MATERIAL PROPERTIES

1 Material: Light Weight Fill
Unit Weight: 14.5 kN/m3
Cohesion: 0 kPa
Friction Angle: 35 degrees

2 Material: Upper Silty Clay
Unit Weight: 20.5 kN/m3
Cohesion: 7 kPa
Friction Angle: 29 degrees

3 Material: Lower Silty Clay
Unit Weight: 20 kN/m3
Cohesion: 5 kPa
Friction Angle: 27 degrees

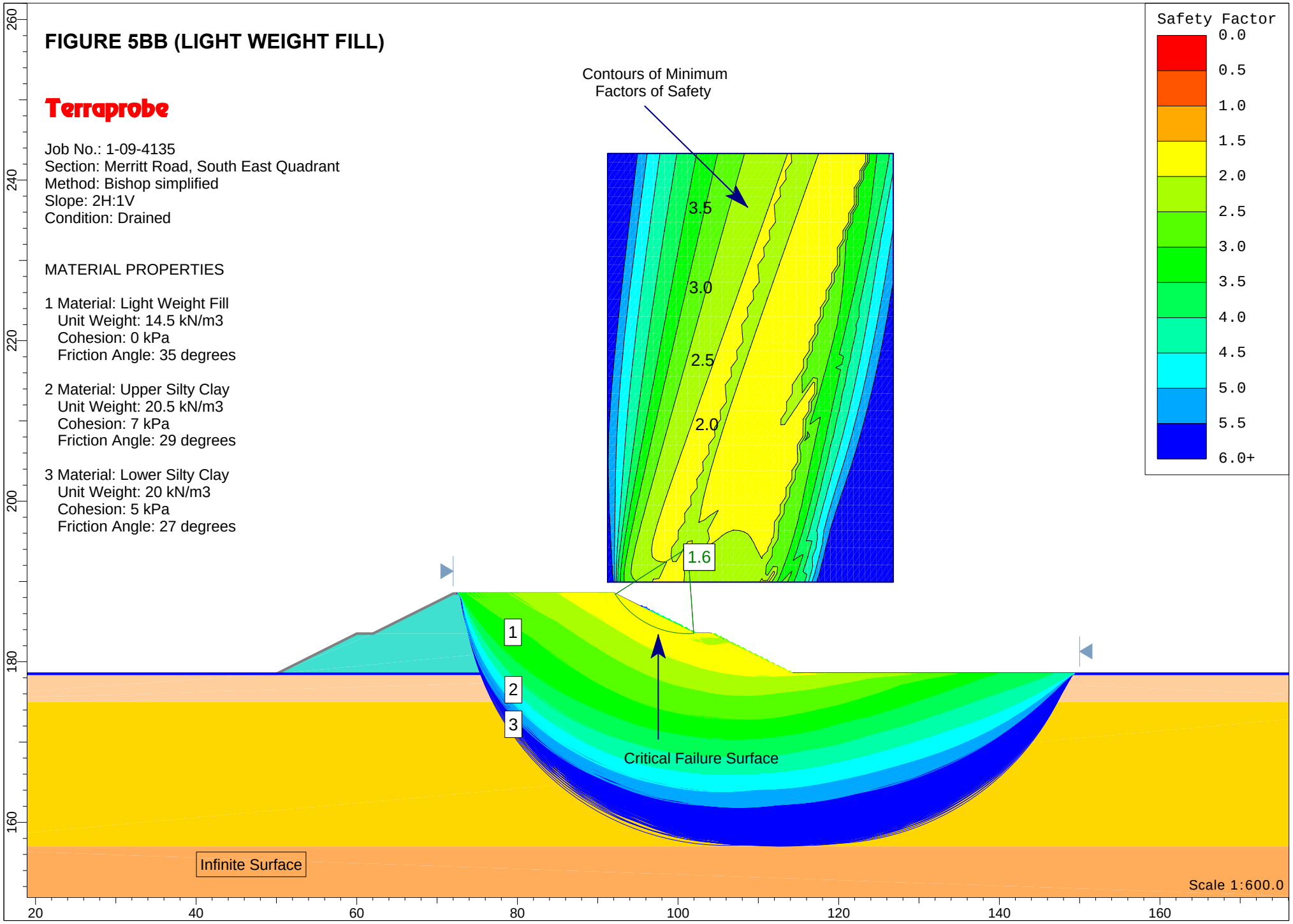


FIGURE 6AA (ULTRA LIGHT WEIGHT FILL)

Terraprobe

Job No.: 1-09-4135
Section: Merritt Road, South East Quadrant
Method: Bishop simplified
Slope: 2H:1V
Condition: Undrained

MATERIAL PROPERTIES

1 Material: Ultra Light Weight Fill
Unit Weight: 11.5 kN/m3
Cohesion: 0 kPa
Friction Angle: 35 degrees

2 Material: Upper Silty Clay
Unit Weight: 20.5 kN/m3
Cohesion: 100 kPa
Friction Angle: 0 degrees

3 Material: Lower Silty Clay
Unit Weight: 20 kN/m3
Cohesion: 50 kPa
Friction Angle: 0 degrees

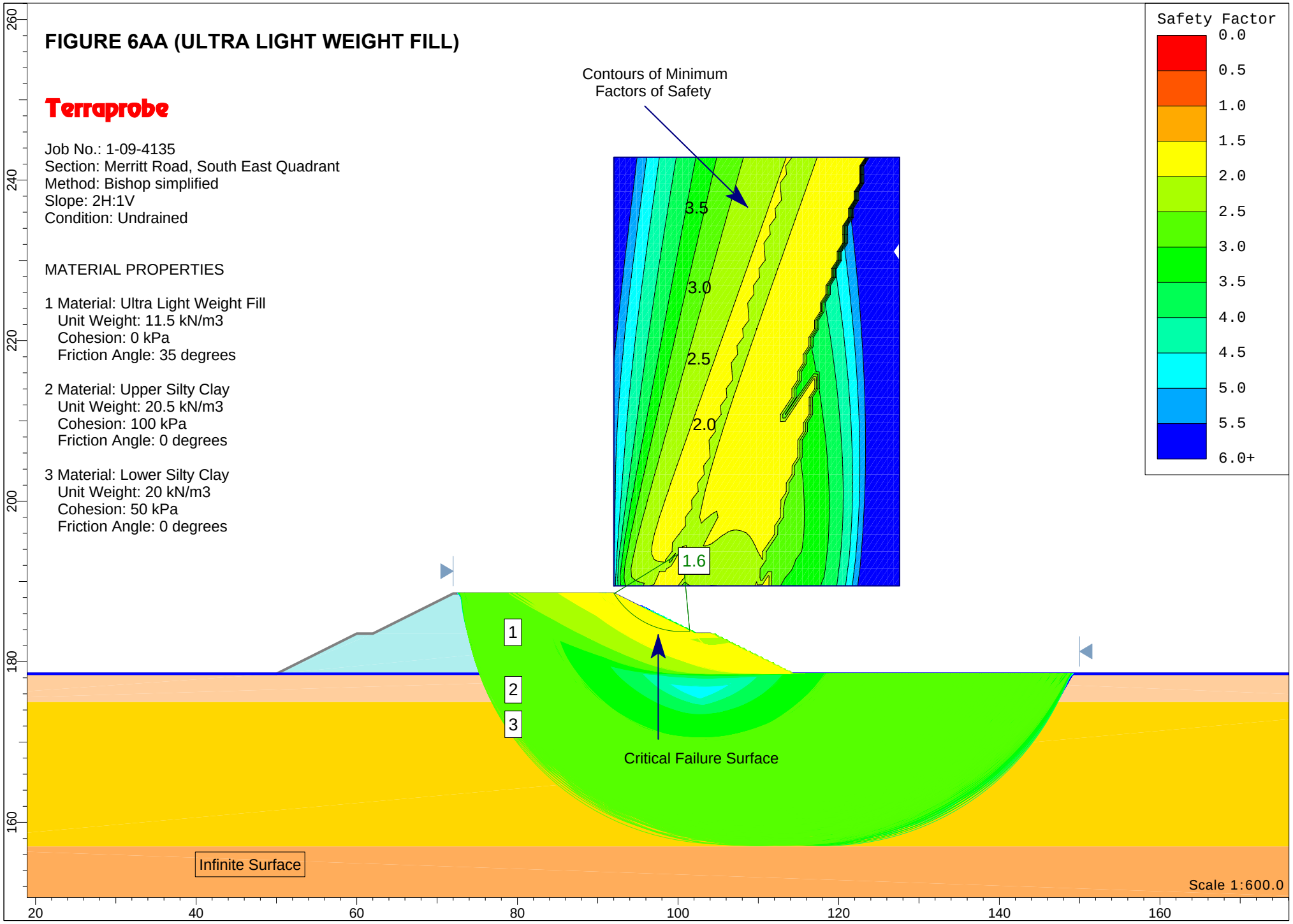


FIGURE 6BB (ULTRA LIGHT WEIGHT FILL)

Terraprobe

Job No.: 1-09-4135
Section: Merritt Road, South East Quadrant
Method: Bishop simplified
Slope: 2H:1V
Condition: Drained

MATERIAL PROPERTIES

1 Material: Ultra Light Weight Fill
Unit Weight: 11.5 kN/m3
Cohesion: 0 kPa
Friction Angle: 35 degrees

2 Material: Upper Silty Clay
Unit Weight: 20.5 kN/m3
Cohesion: 7 kPa
Friction Angle: 29 degrees

3 Material: Lower Silty Clay
Unit Weight: 20 kN/m3
Cohesion: 5 kPa
Friction Angle: 27 degrees

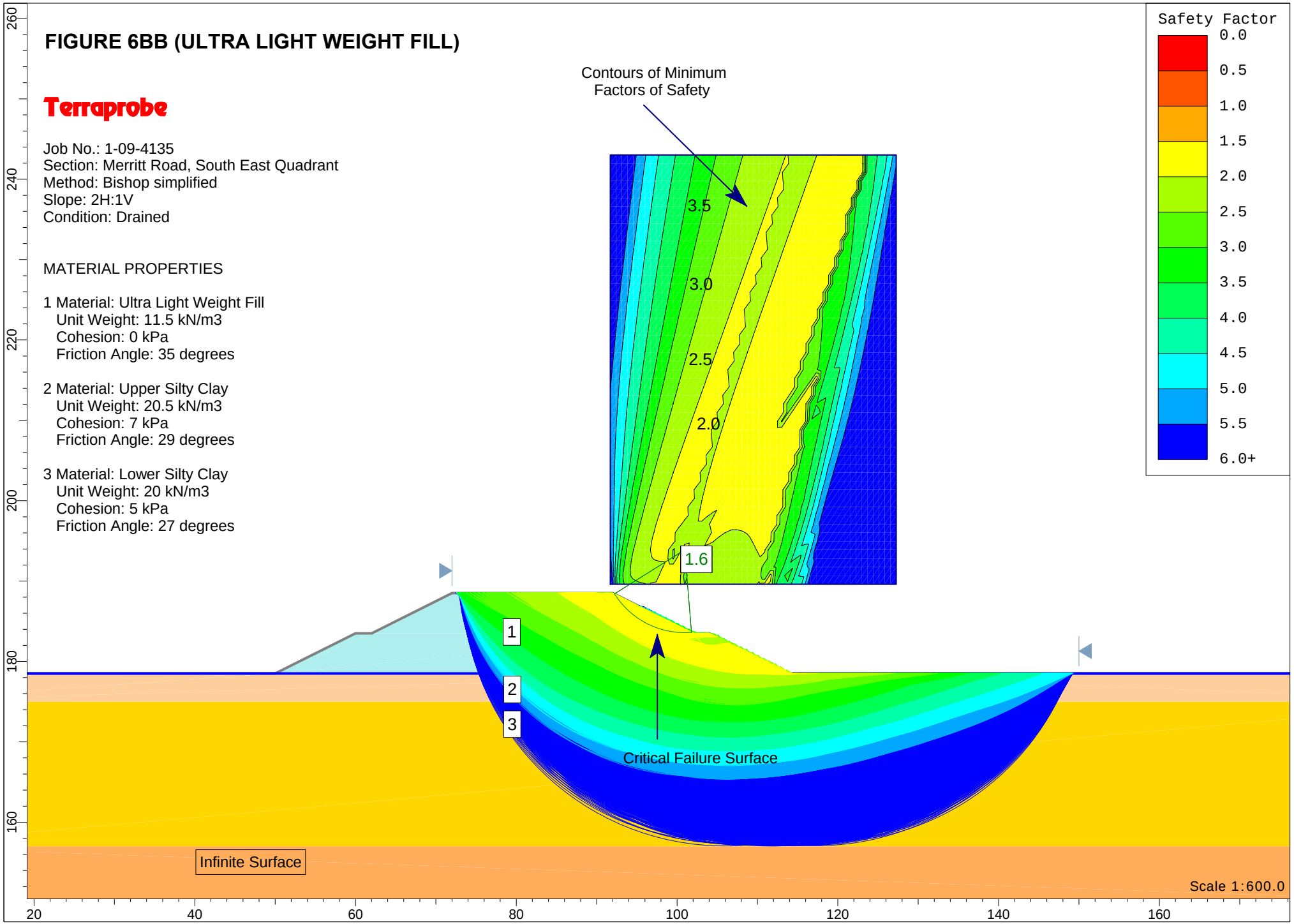


FIGURE 7AA (LOCAL EARTH FILL)

Terraprobe

Job No.: 1-09-4135
Section: Merritt Road, North West Quadrant
Method: Bishop simplified
Slope: 3H:1V
Condition: Undrained

MATERIAL PROPERTIES

1 Material: Local Earth Fill
Unit Weight: 19 kN/m3
Cohesion: 0 kPa
Friction Angle: 31 degrees

2 Material: Upper Silty Clay
Unit Weight: 20.5 kN/m3
Cohesion: 100 kPa
Friction Angle: 0 degrees

3 Material: Lower Silty Clay
Unit Weight: 20 kN/m3
Cohesion: 55 kPa
Friction Angle: 0 degrees

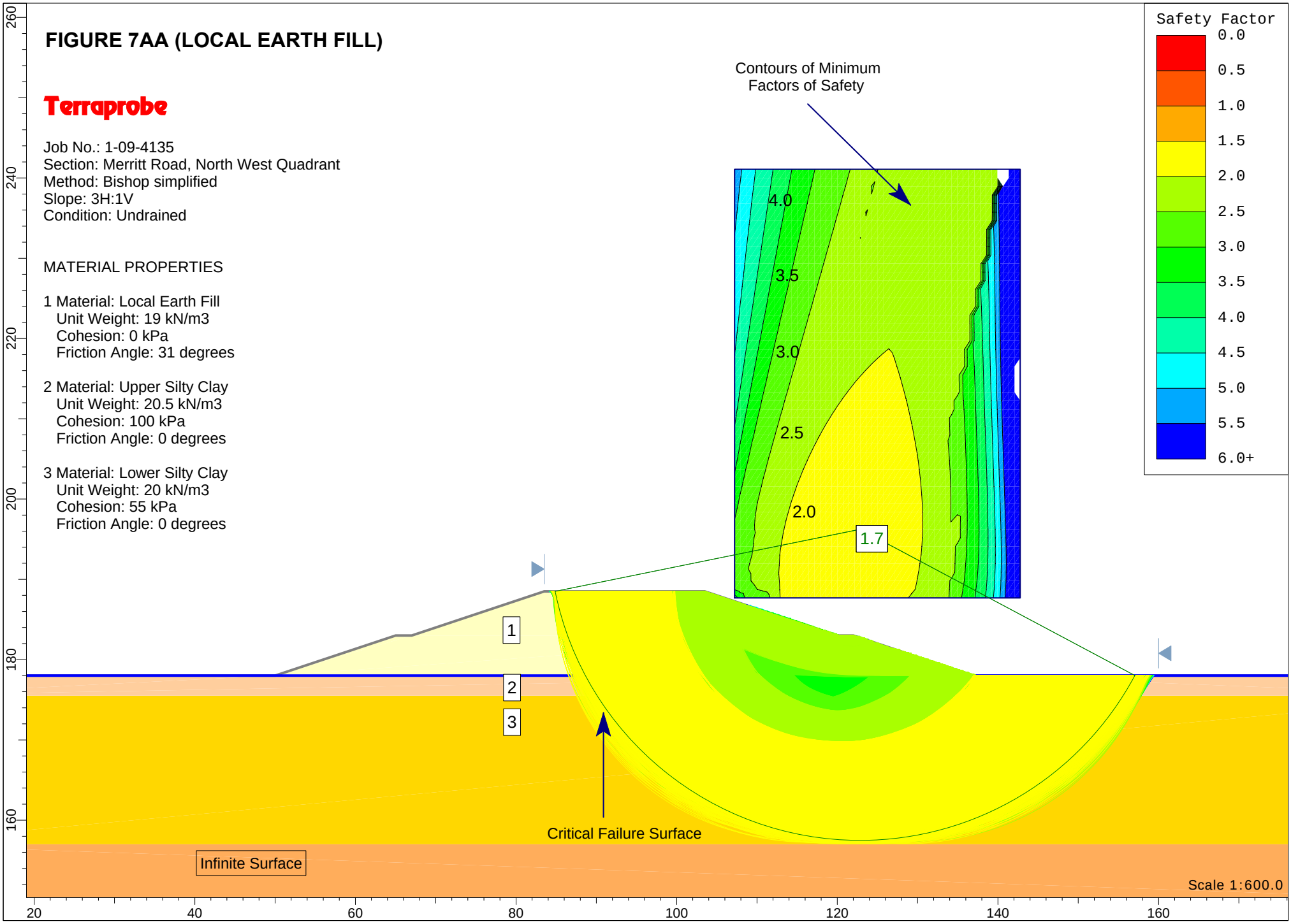


FIGURE 7BB (LOCAL EARTH FILL)

Terraprobe

Job No.: 1-09-4135
Section: Merritt Road, North West Quadrant
Method: Bishop simplified
Slope: 3H:1V
Condition: Drained

MATERIAL PROPERTIES

1 Material: Local Earth Fill
Unit Weight: 19 kN/m3
Cohesion: 0 kPa
Friction Angle: 31 degrees

2 Material: Upper Silty Clay
Unit Weight: 20.5 kN/m3
Cohesion: 7 kPa
Friction Angle: 29 degrees

3 Material: Lower Silty Clay
Unit Weight: 20 kN/m3
Cohesion: 5 kPa
Friction Angle: 27 degrees

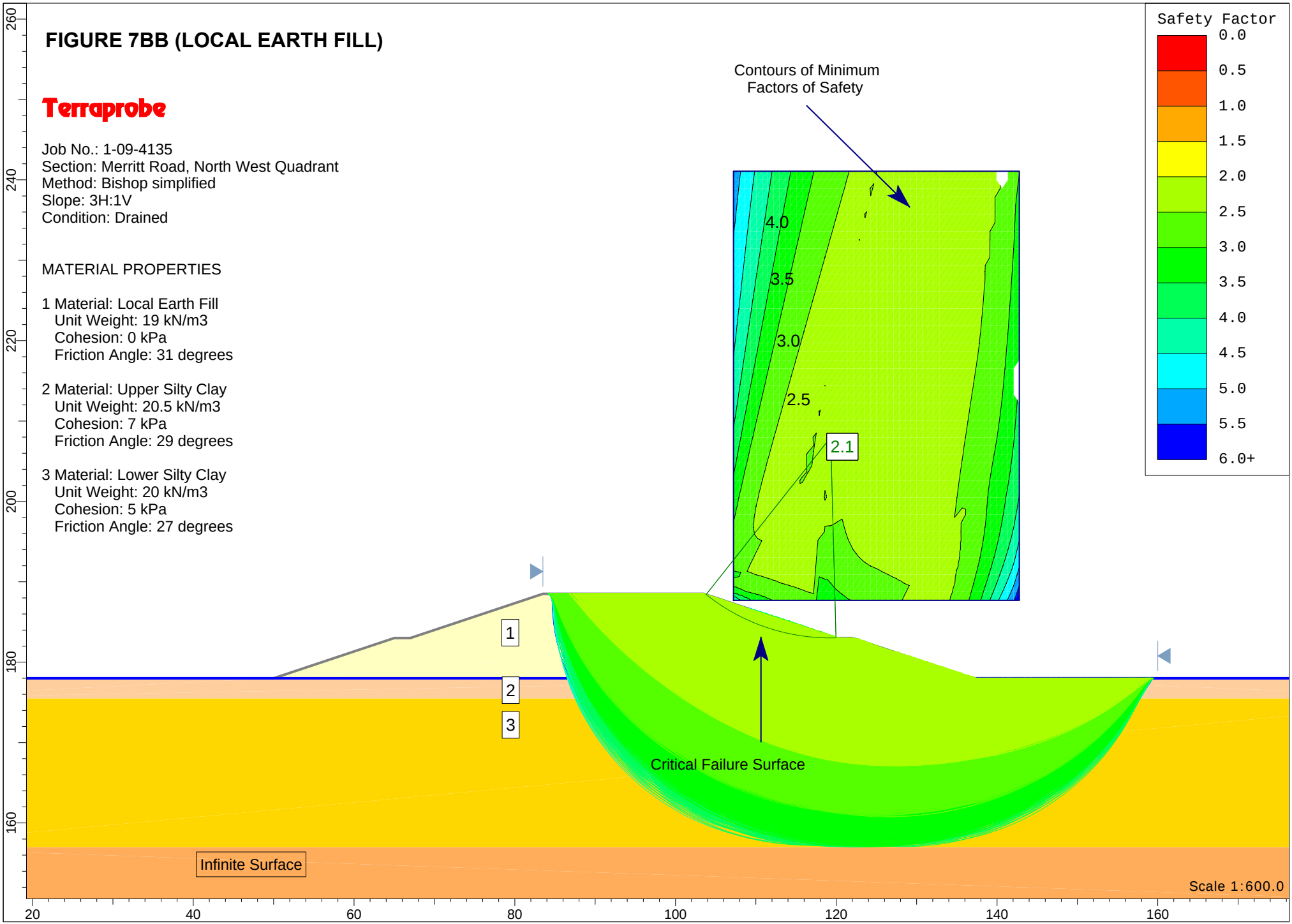


FIGURE 8AA (COMPOSITE)

Terraprobe

Job No.: 1-09-4135
Section: Merritt Road, North West Quadrant
Method: Bishop simplified
Slope: 2.5H:1V
Condition: Undrained

MATERIAL PROPERTIES

1 Material: Local Earth Fill
Unit Weight: 19 kN/m3
Cohesion: 0 kPa
Friction Angle: 31 degrees

2 Material: Upper Silty Clay
Unit Weight: 20.5 kN/m3
Cohesion: 100 kPa
Friction Angle: 0 degrees

3 Material: Lower Silty Clay
Unit Weight: 20 kN/m3
Cohesion: 55 kPa
Friction Angle: 0 degrees

4 Material: Granular A
Unit Weight: 22.8 kN/m3
Cohesion: 0 kPa
Friction Angle: 35 degrees

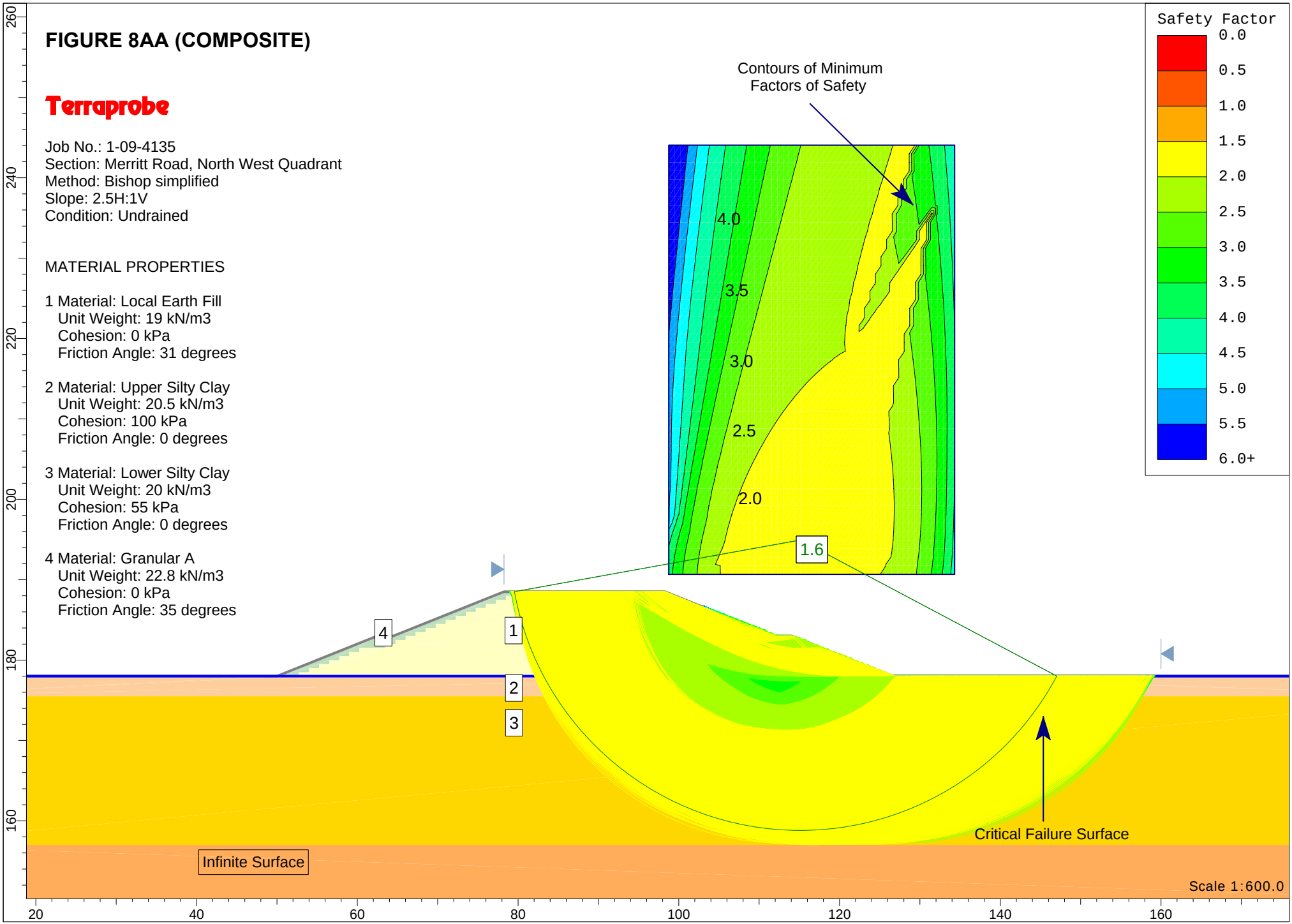


FIGURE 8BB (COMPOSITE)

Terraprobe

Job No.: 1-09-4135
Section: Merritt Road, North Westt Quadrant
Method: Bishop simplified
Slope: 2.5H:1V
Condition: Drained

MATERIAL PROPERTIES

1 Material: Local Earth Fill
Unit Weight: 19 kN/m3
Cohesion: 0 kPa
Friction Angle: 31 degrees

2 Material: Upper Silty Clay
Unit Weight: 20.5 kN/m3
Cohesion: 7 kPa
Friction Angle: 29 degrees

3 Material: Lower Silty Clay
Unit Weight: 20 kN/m3
Cohesion: 5 kPa
Friction Angle: 27 degrees

4 Material: Granular A
Unit Weight: 22.8 kN/m3
Cohesion: 0 kPa
Friction Angle: 35 degrees

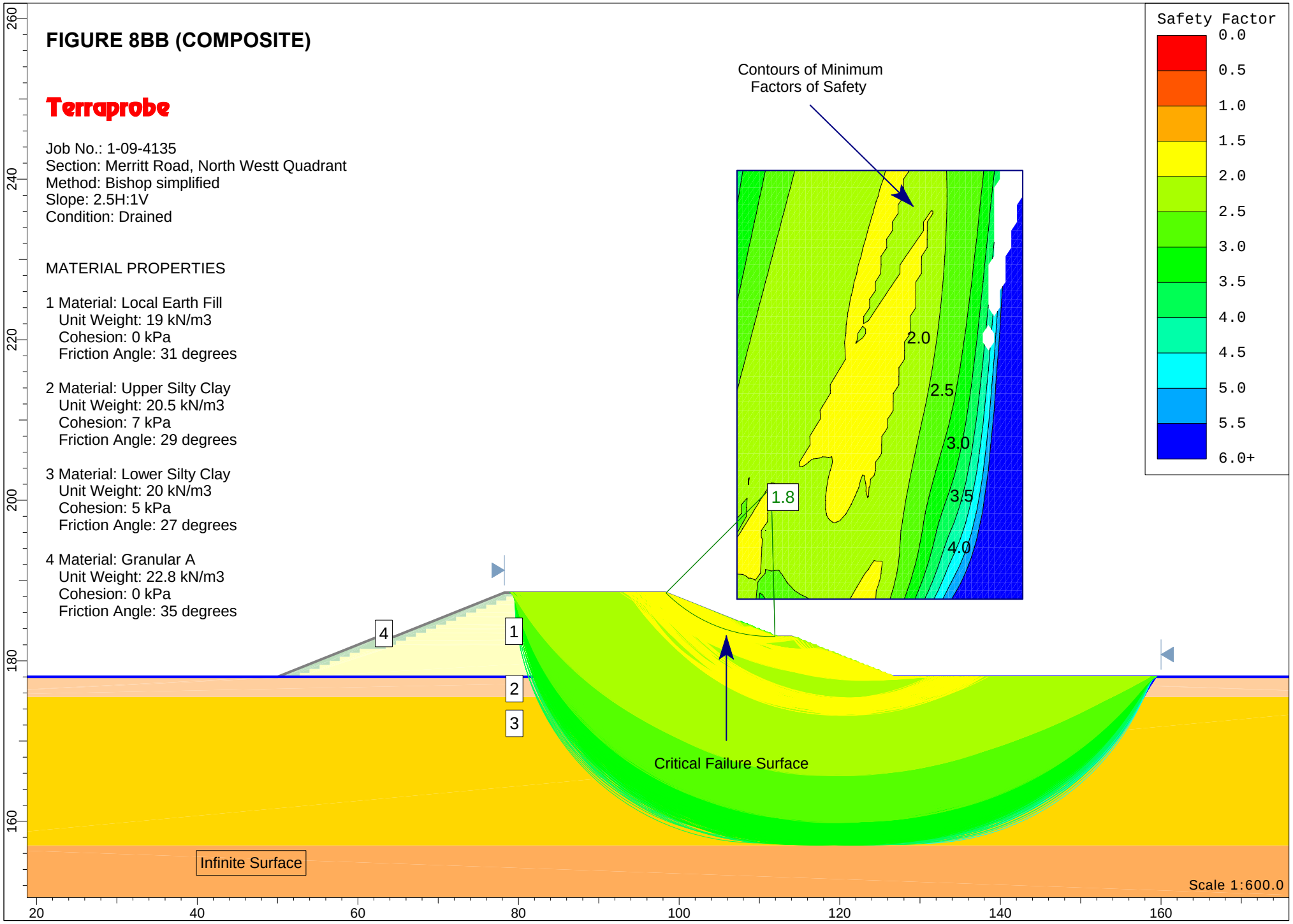


FIGURE 9AA (SSM)

Terraprobe

Job No.: 1-09-4135
Section: Merritt Road, North West Quadrant
Method: Bishop simplified
Slope: 2H:1V
Condition: Undrained

MATERIAL PROPERTIES

1 Material: SSM
Unit Weight: 20 kN/m3
Cohesion: 0 kPa
Friction Angle: 32 degrees

2 Material: Upper Silty Clay
Unit Weight: 20.5 kN/m3
Cohesion: 100 kPa
Friction Angle: 0 degrees

3 Material: Lower Silty Clay
Unit Weight: 20 kN/m3
Cohesion: 55 kPa
Friction Angle: 0 degrees

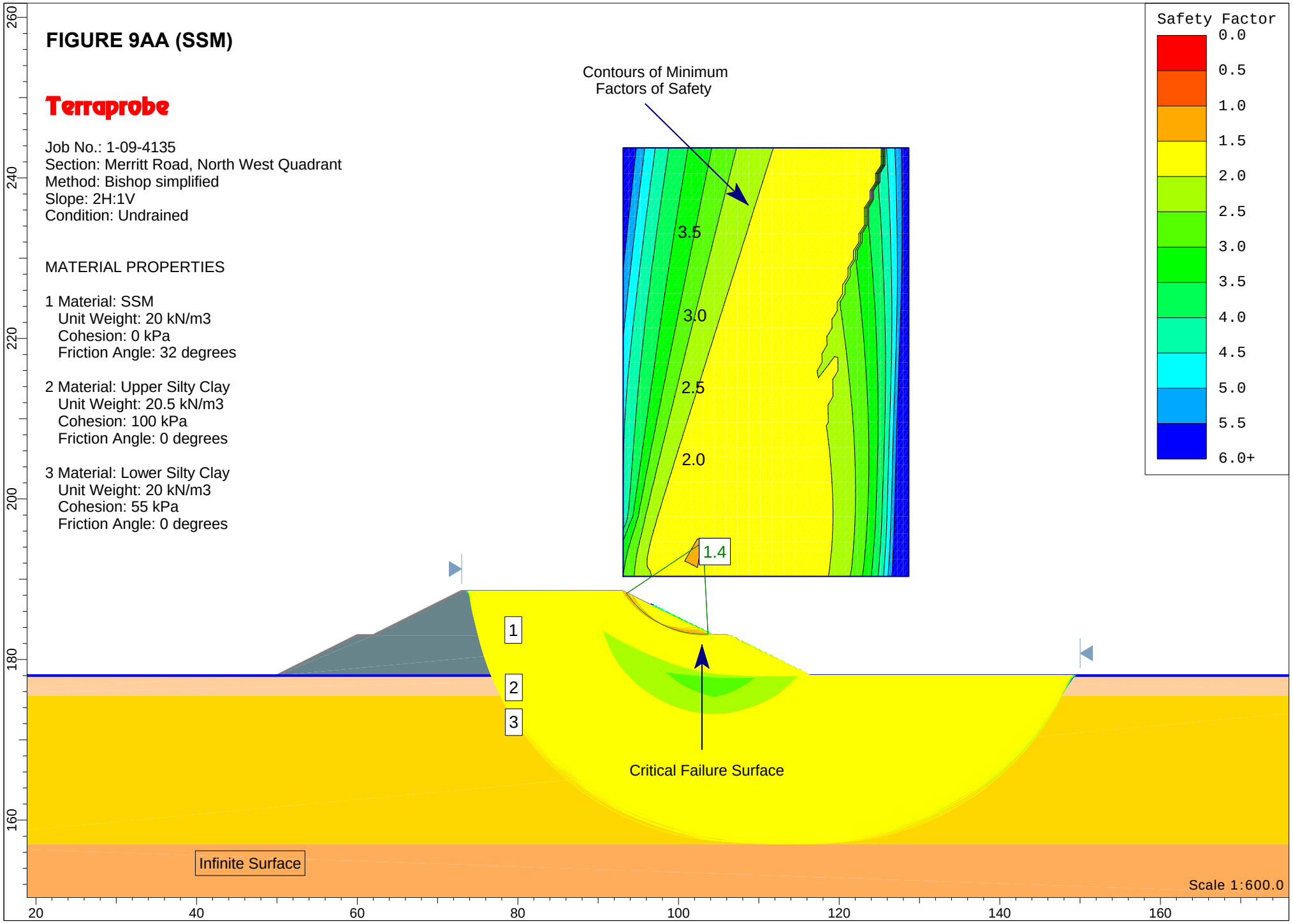


FIGURE 9BB (SSM)

Terraprobe

Job No.: 1-09-4135
Section: Merritt Road, North West Quadrant
Method: Bishop simplified
Slope: 2H:1V
Condition: Drained

MATERIAL PROPERTIES

1 Material: SSM
Unit Weight: 20 kN/m3
Cohesion: 0 kPa
Friction Angle: 32 degrees

2 Material: Upper Silty Clay
Unit Weight: 20.5 kN/m3
Cohesion: 7 kPa
Friction Angle: 29 degrees

3 Material: Lower Silty Clay
Unit Weight: 20 kN/m3
Cohesion: 5 kPa
Friction Angle: 27 degrees

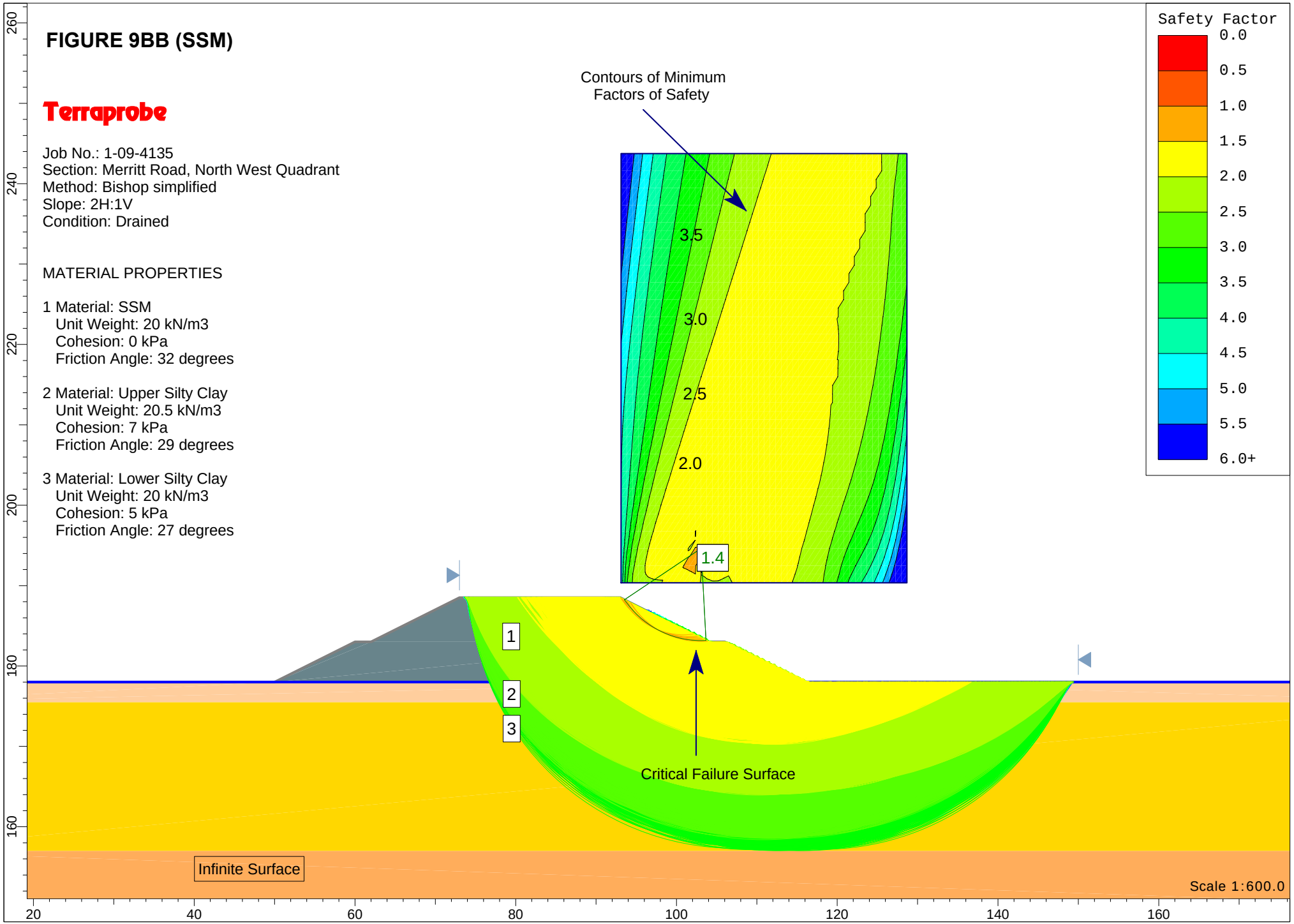


FIGURE 10AA (RSS)

Terraprobe

Job No.: 1-09-4135
Section: Merritt Road, North West Quadrant
Method: Bishop simplified
Slope: 2H:1V
Condition: Undrained

MATERIAL PROPERTIES

1 Material: Local Earth Fill
Unit Weight: 19 kN/m3
Cohesion: 0 kPa
Friction Angle: 31 degrees

2 Material: Upper Silty Clay
Unit Weight: 20.5 kN/m3
Cohesion: 100 kPa
Friction Angle: 0 degrees

3 Material: Lower Silty Clay
Unit Weight: 20 kN/m3
Cohesion: 55 kPa
Friction Angle: 0 degrees

4 Material: RSS
Unit Weight: 20 kN/m3
Cohesion: Infinite
Friction Angle: Infinite

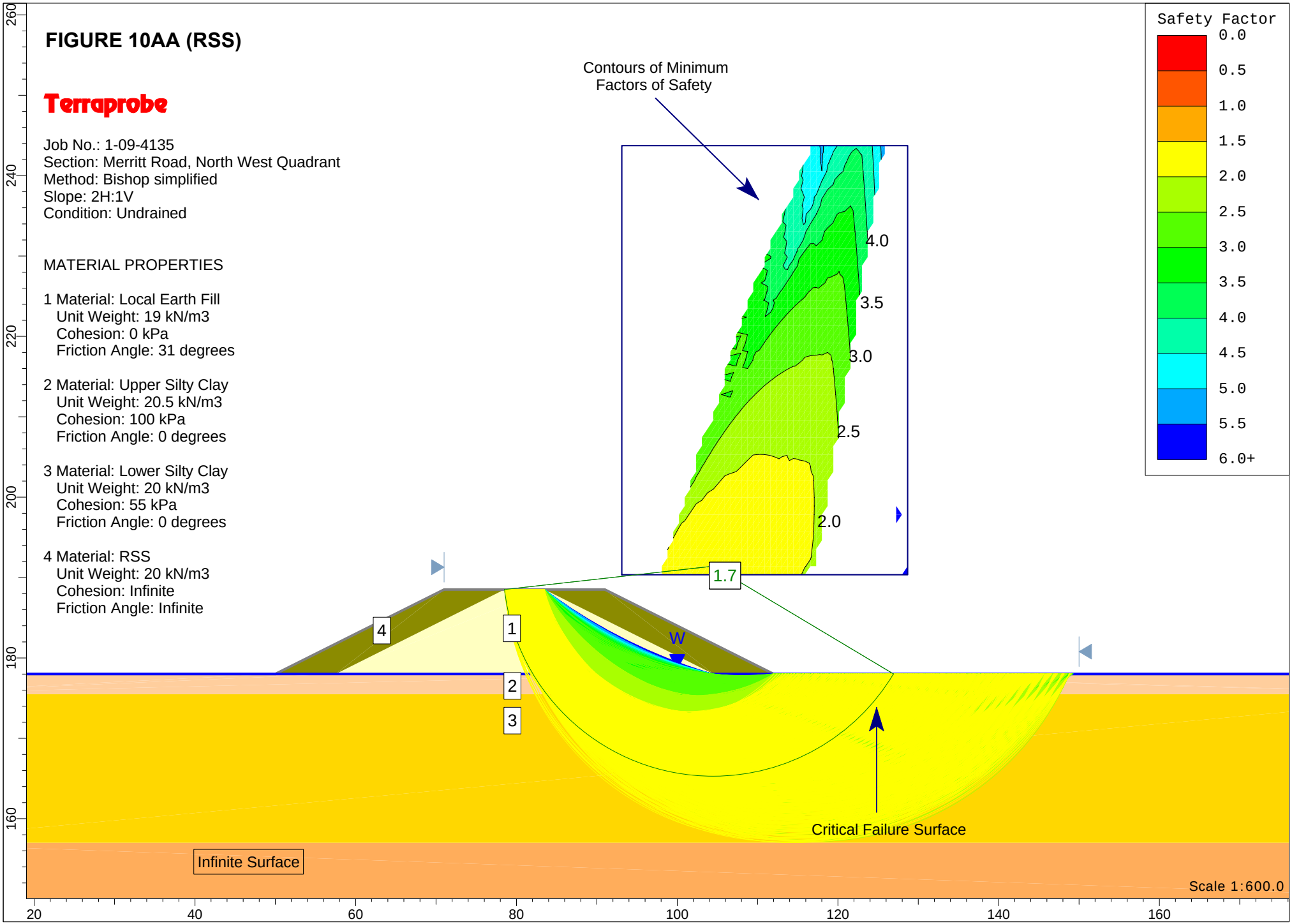


FIGURE 10BB (RSS)

Terraprobe

Job No.: 1-09-4135
Section: Merritt Road, North West Quadrant
Method: Bishop simplified
Slope: 2H:1V
Condition: Drained

MATERIAL PROPERTIES

1 Material: Local Earth Fill
Unit Weight: 19 kN/m3
Cohesion: 0 kPa
Friction Angle: 31 degrees

2 Material: Upper Silty Clay
Unit Weight: 20.5 kN/m3
Cohesion: 7 kPa
Friction Angle: 29 degrees

3 Material: Lower Silty Clay
Unit Weight: 20 kN/m3
Cohesion: 5 kPa
Friction Angle: 27 degrees

4 Material: RSS
Unit Weight: 20 kN/m3
Cohesion: Infinite
Friction Angle: Infinite

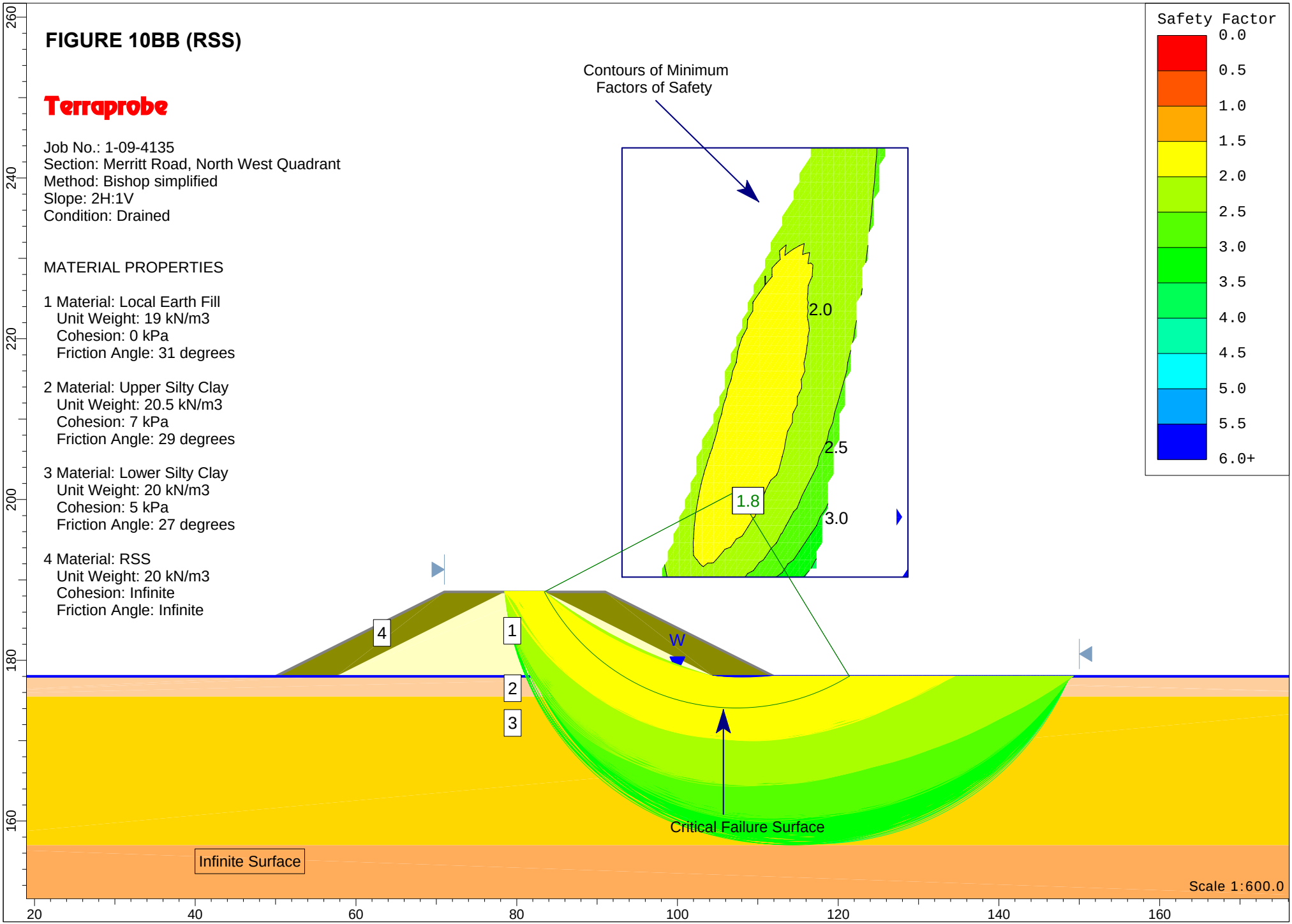


FIGURE 11AA (LIGHT WEIGHT FILL)

Terraprobe

Job No.: 1-09-4135
Section: Merritt Road, North West Quadrant
Method: Bishop simplified
Slope: 2H:1V
Condition: Undrained

MATERIAL PROPERTIES

1 Material: Light Weight Fill
Unit Weight: 14.5 kN/m3
Cohesion: 0 kPa
Friction Angle: 35 degrees

2 Material: Upper Silty Clay
Unit Weight: 20.5 kN/m3
Cohesion: 100 kPa
Friction Angle: 0 degrees

3 Material: Lower Silty Clay
Unit Weight: 20 kN/m3
Cohesion: 55 kPa
Friction Angle: 0 degrees

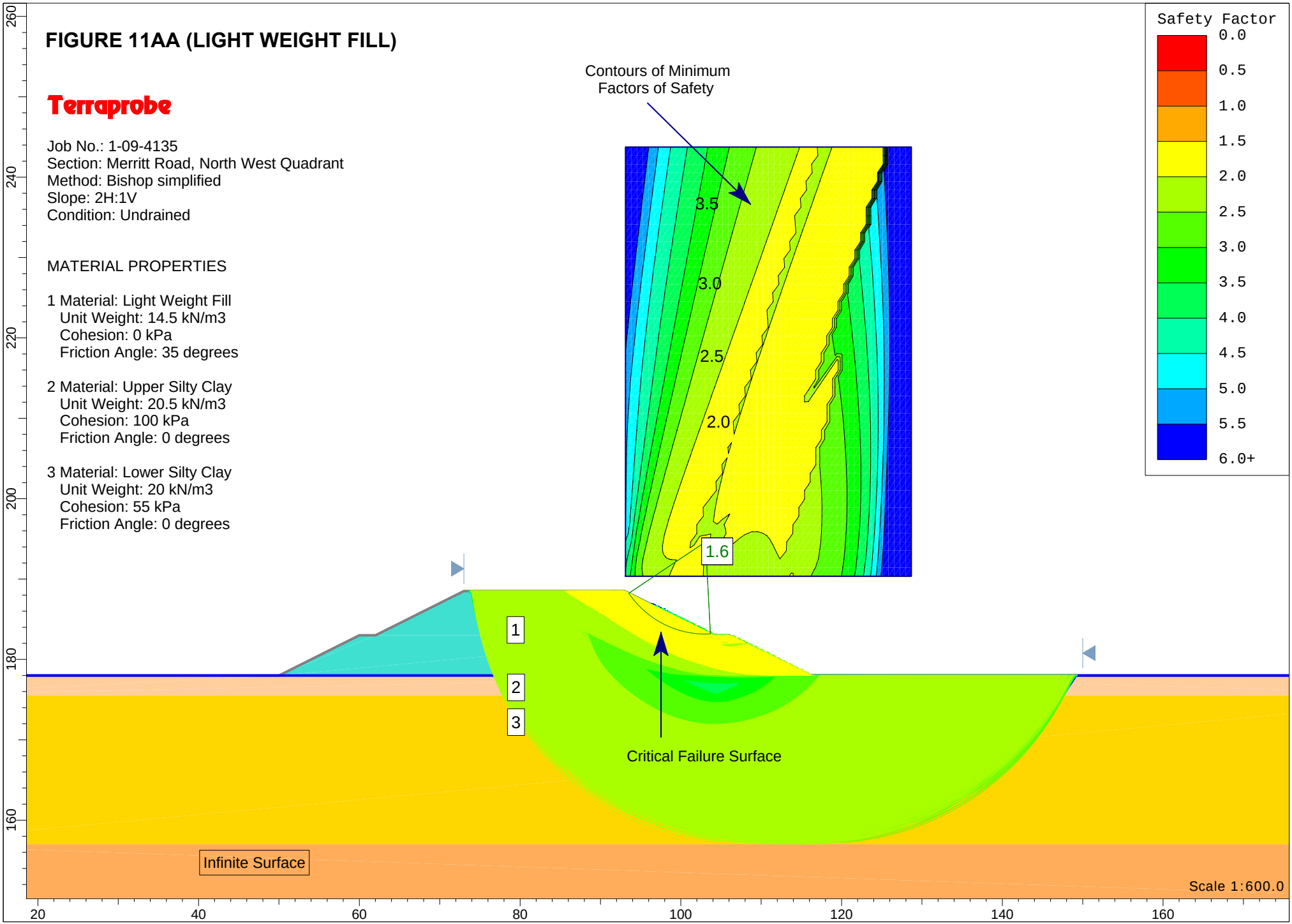


FIGURE 11BB (LIGHT WEIGHT FILL)

Terraprobe

Job No.: 1-09-4135
Section: Merritt Road, North West Quadrant
Method: Bishop simplified
Slope: 2H:1V
Condition: Drained

MATERIAL PROPERTIES

1 Material: Light Weight Fill
Unit Weight: 14.5 kN/m3
Cohesion: 0 kPa
Friction Angle: 35 degrees

2 Material: Upper Silty Clay
Unit Weight: 20.5 kN/m3
Cohesion: 7 kPa
Friction Angle: 29 degrees

3 Material: Lower Silty Clay
Unit Weight: 20 kN/m3
Cohesion: 5 kPa
Friction Angle: 27 degrees

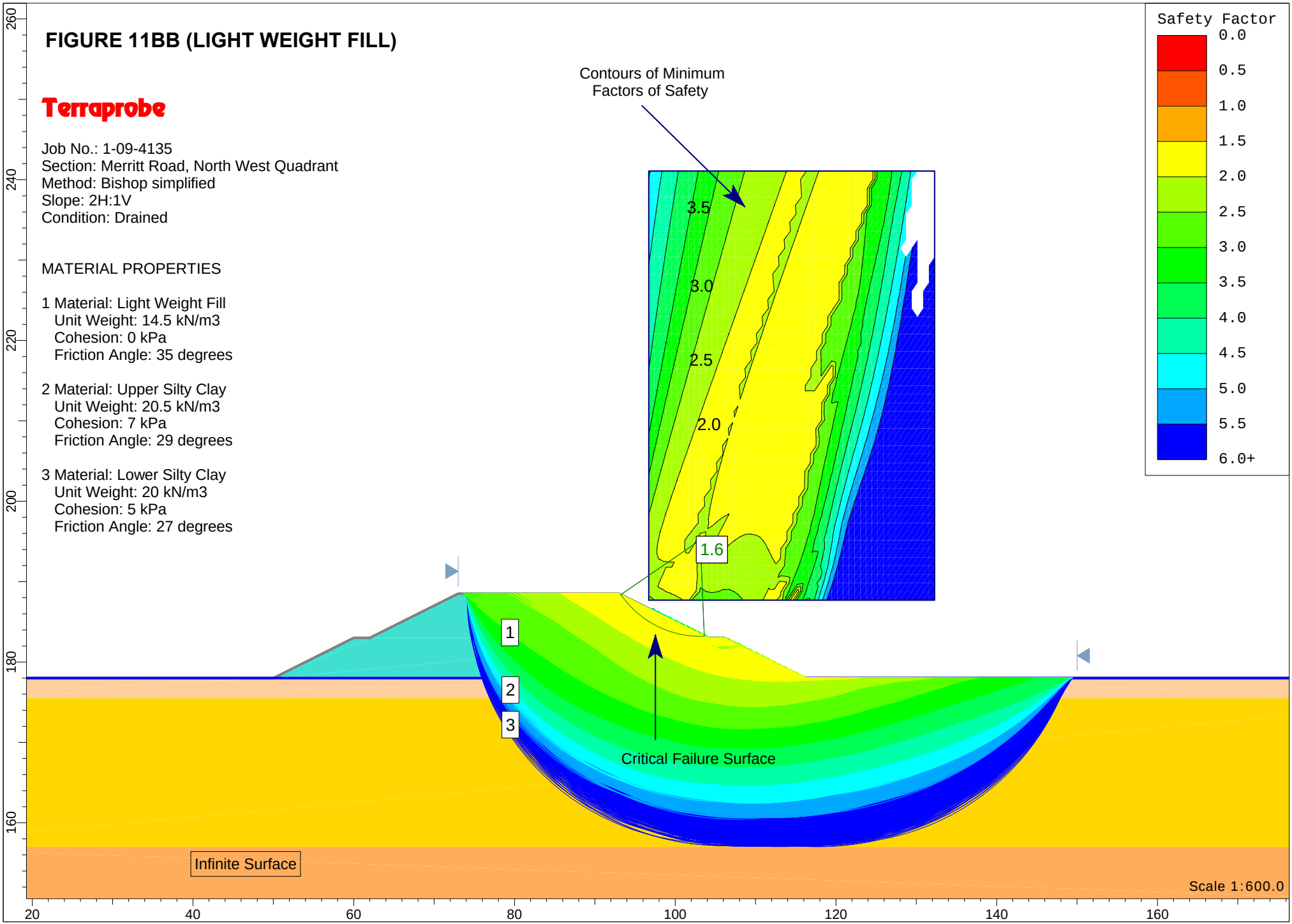


FIGURE 12AA (ULTRA LIGHT WEIGHT FILL)

Terraprobe

Job No.: 1-09-4135
Section: Merritt Road, North West Quadrant
Method: Bishop simplified
Slope: 2H:1V
Condition: Undrained

MATERIAL PROPERTIES

1 Material: Ultra Light Weight Fill
Unit Weight: 11.5 kN/m3
Cohesion: 0 kPa
Friction Angle: 35 degrees

2 Material: Upper Silty Clay
Unit Weight: 20.5 kN/m3
Cohesion: 100 kPa
Friction Angle: 0 degrees

3 Material: Lower Silty Clay
Unit Weight: 20 kN/m3
Cohesion: 55 kPa
Friction Angle: 0 degrees

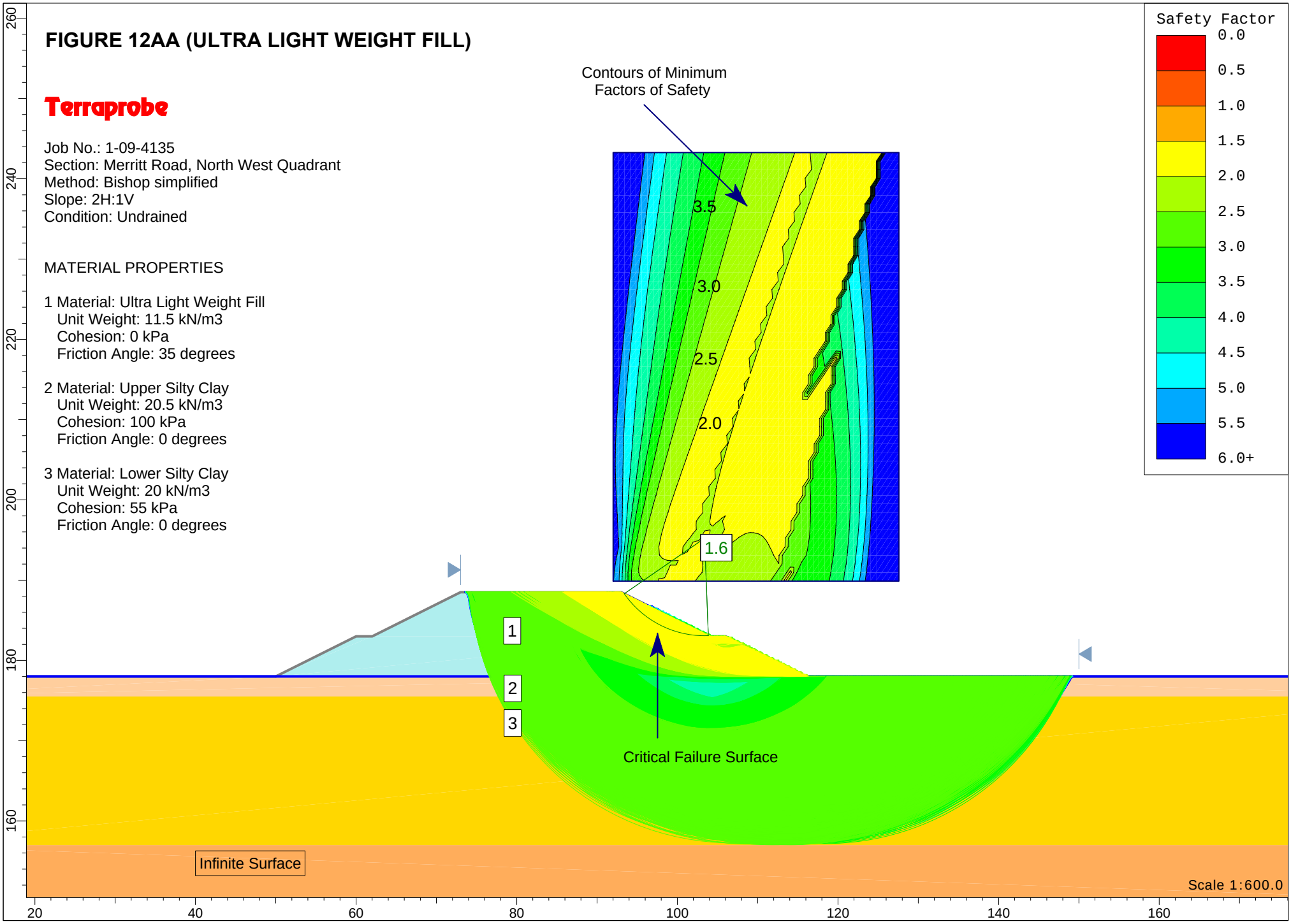


FIGURE 12BB (ULTRA LIGHT WEIGHT FILL)

Terraprobe

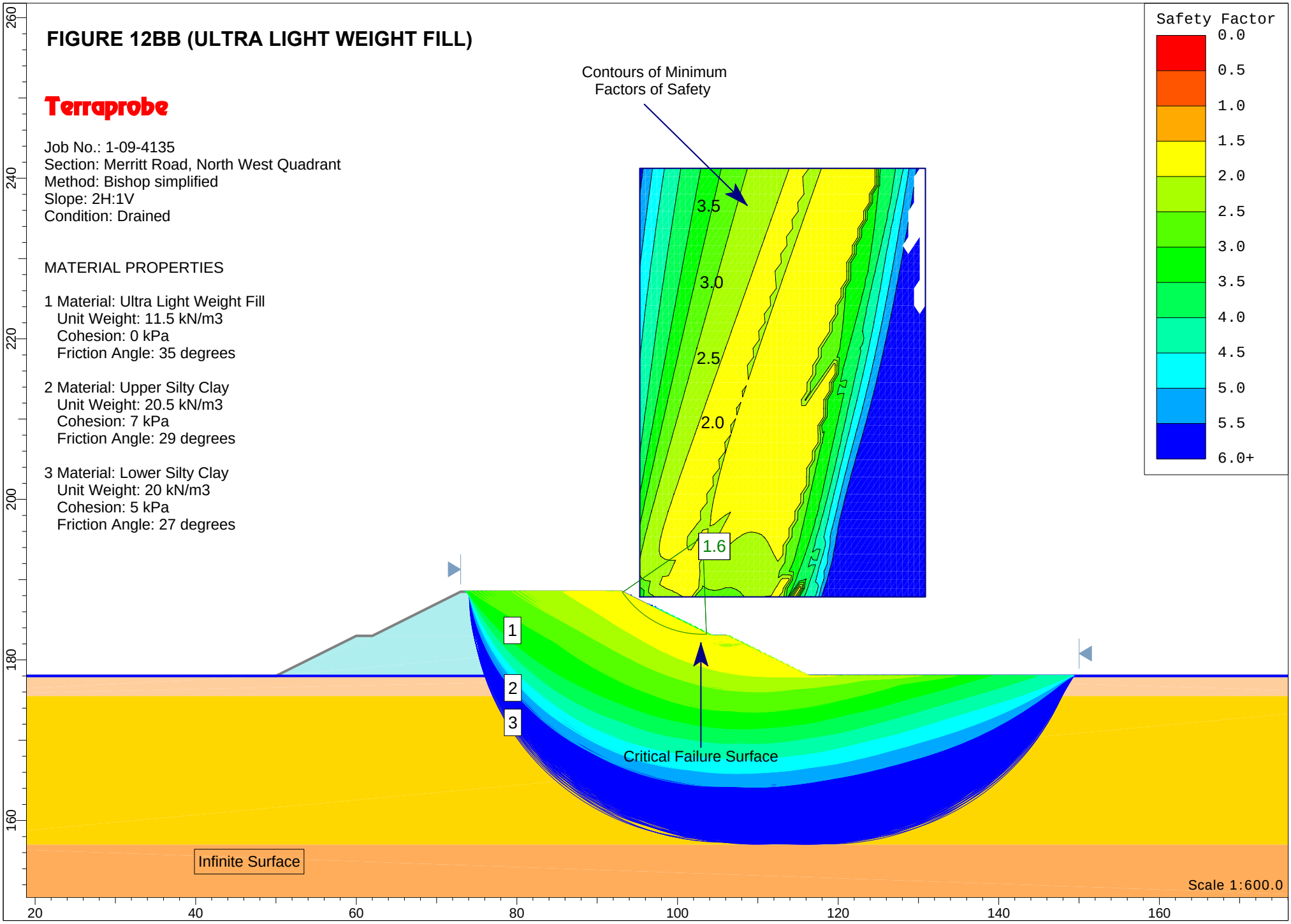
Job No.: 1-09-4135
Section: Merritt Road, North West Quadrant
Method: Bishop simplified
Slope: 2H:1V
Condition: Drained

MATERIAL PROPERTIES

1 Material: Ultra Light Weight Fill
Unit Weight: 11.5 kN/m3
Cohesion: 0 kPa
Friction Angle: 35 degrees

2 Material: Upper Silty Clay
Unit Weight: 20.5 kN/m3
Cohesion: 7 kPa
Friction Angle: 29 degrees

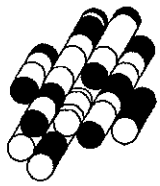
3 Material: Lower Silty Clay
Unit Weight: 20 kN/m3
Cohesion: 5 kPa
Friction Angle: 27 degrees



APPENDIX G

Settlement Parameters and Results

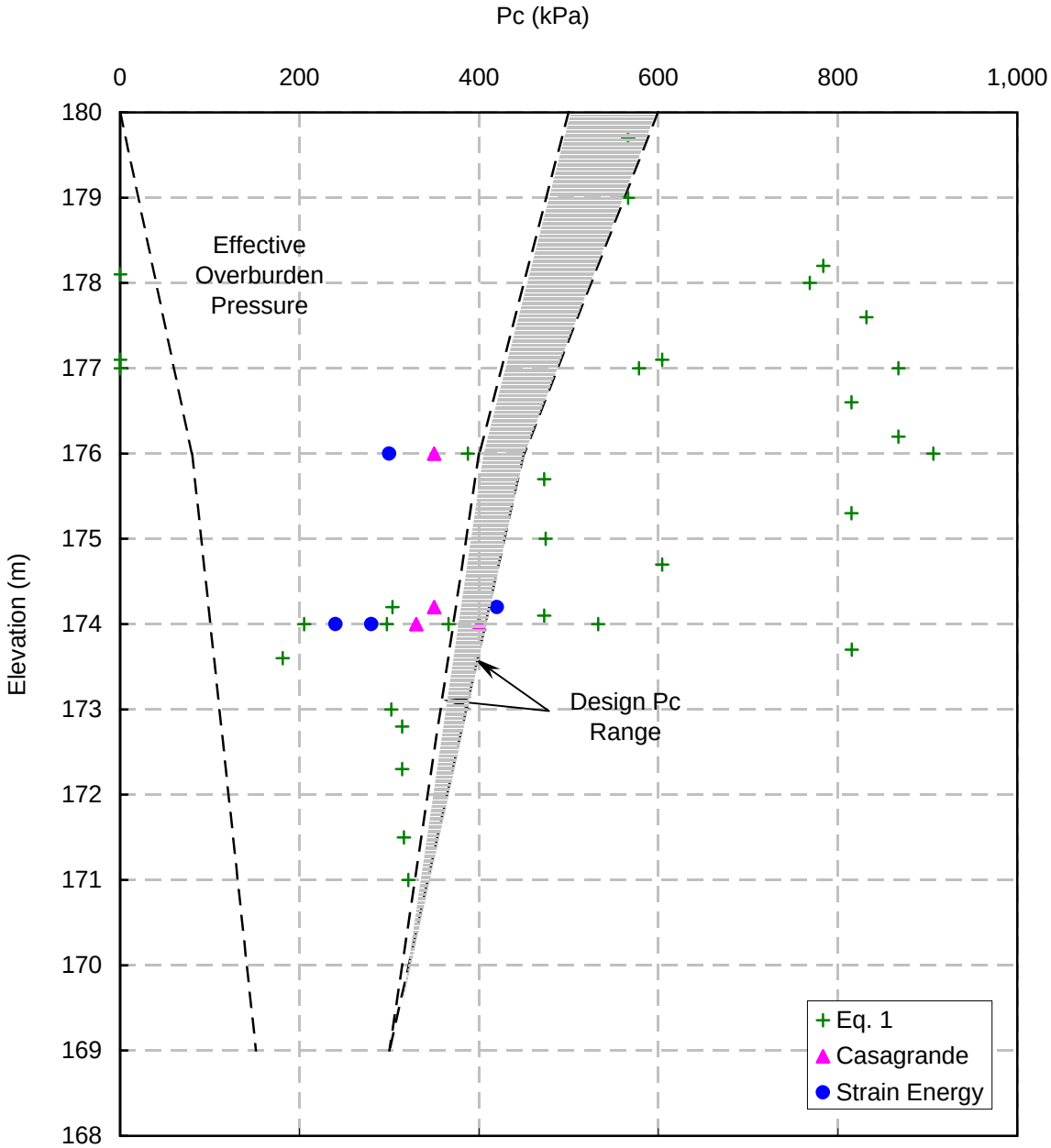
Terraprobe Inc.



PREDICTED AND MEASURED PRECONSOLIDATION STRESS	FIGURE G1

MERRITT ROAD INTERCHANGE - SOUTHEAST QUADRANT

Silty Clay



Eq. 1 $Pc = Cu / (0.11 + 0.0037 * I_P)$ Skempton (1957)

Project No. : 1-09-4135

Date : September, 2010

Terraprobe Inc.

Prepared By : HW

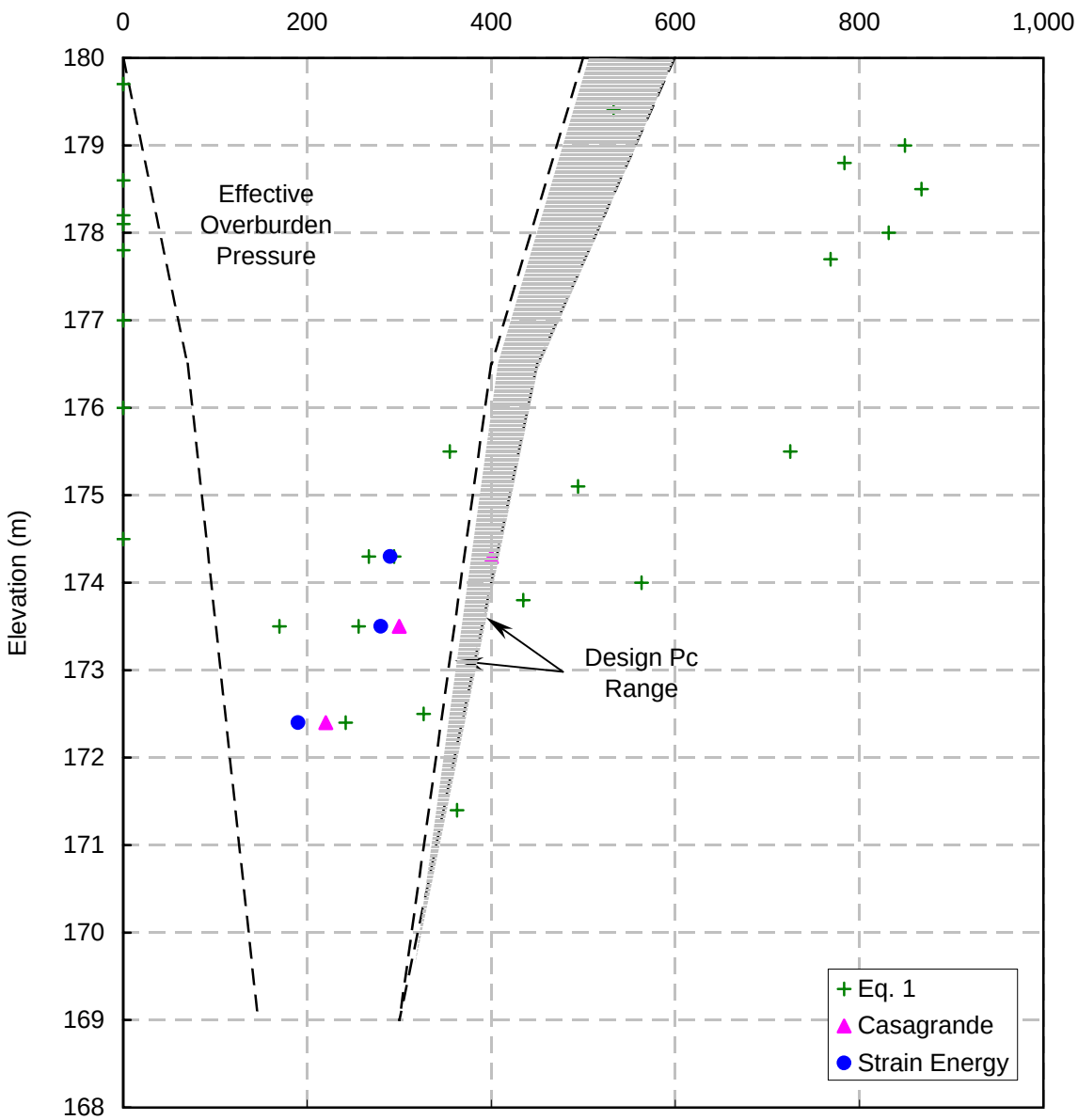
Checked By : RA

F:\1-09-4135 Soil Parameter Estimation-Merritt SE.xls

PREDICTED AND MEASURED PRECONSOLIDATION STRESS	FIGURE G2

MERRITT ROAD INTERCHANGE - NORTHWEST QUADRANT

Silty Clay



Eq. 1 $Pc = Cu / (0.11 + 0.0037 * I_P)$ Skempton (1957)

Project No. : 1-09-4135

Date : September, 2010

Terraprobe Inc.

Prepared By : HW

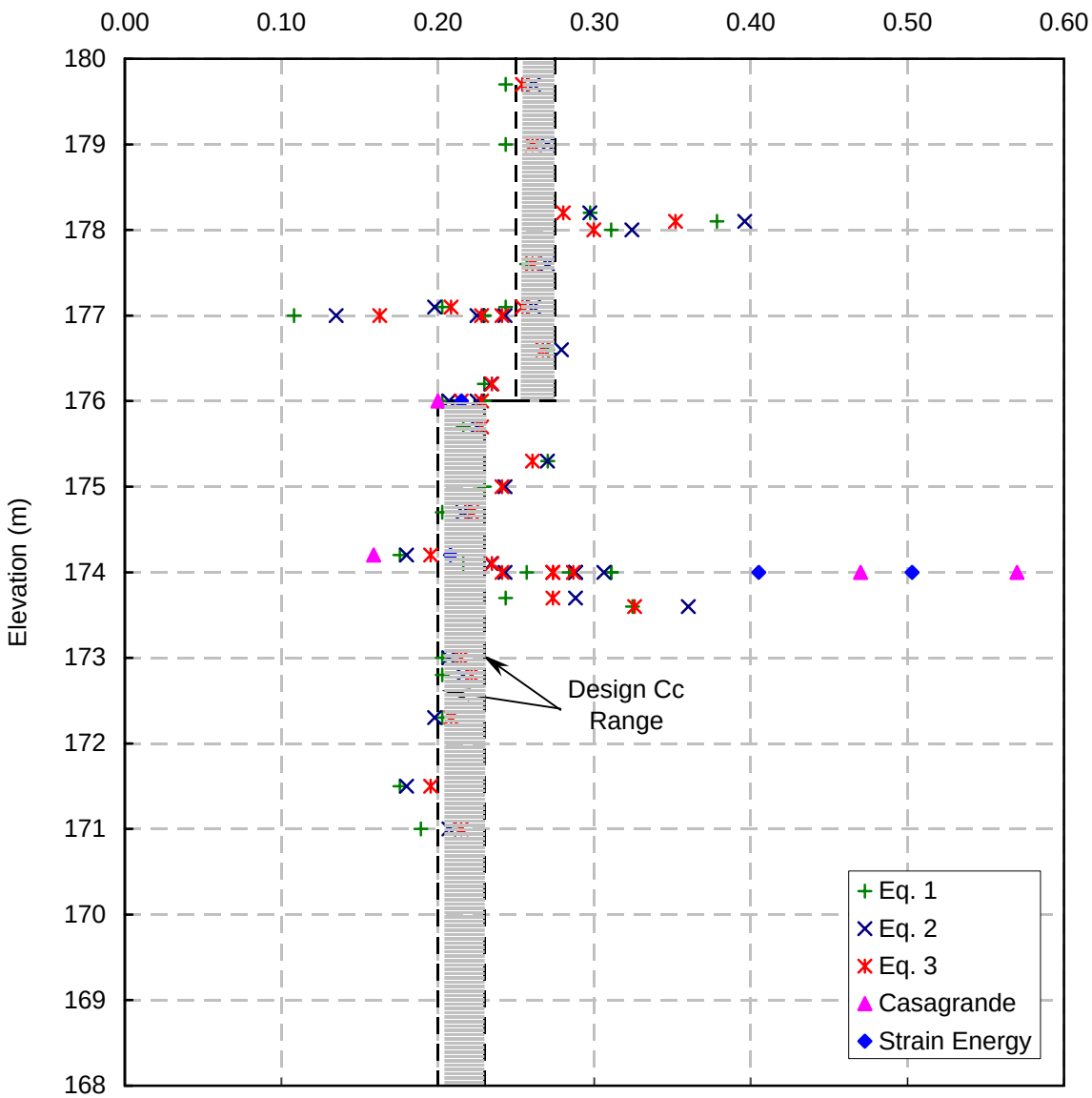
Checked By : RA

F:\1-09-4135 Soil Parameter Estimation-Merritt NW.xls

PREDICTED AND MEASURED COMPRESSION INDEX	FIGURE G3

MERRITT ROAD INTERCHANGE - SOUTHEAST QUADRANT

Silty Clay



Eq. 1	Cc = Ip / 74	Kulhawy & Mayne (1990)
Eq. 2	Cc = 0.009 * (LL - 10)	Terzaghi & Peck (1967)
Eq. 3	Cc = 0.2343 * LL * Gs	Nagaraj & Murty (1985)

Project No. : 1-09-4135

Date : September, 2010

Terraprobe Inc.

Prepared By : HW

Checked By : RA

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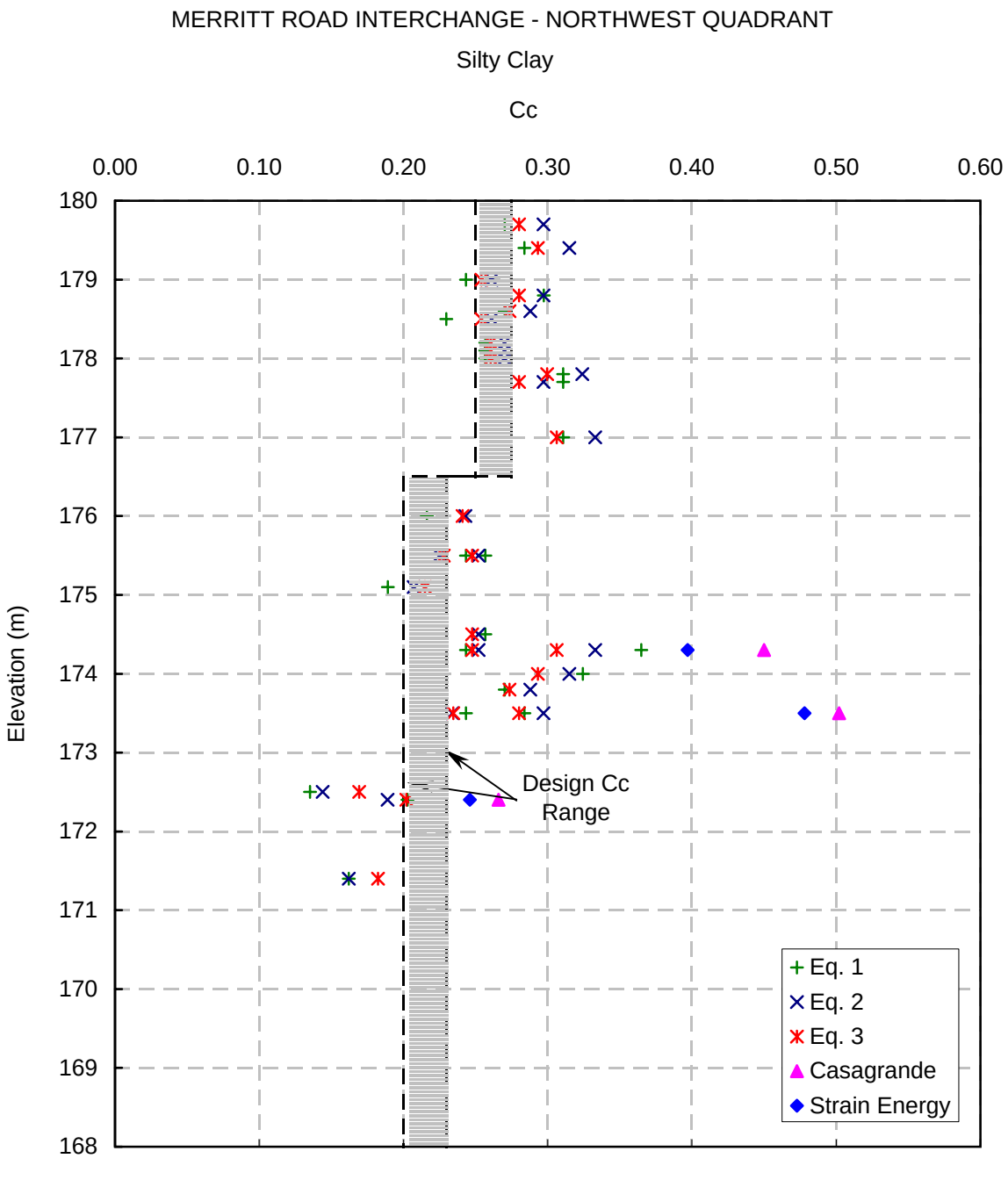
PREDICTED AND MEASURED COMPRESSION INDEX	FIGURE G4



Eq. 1	Cc = Ip / 74	Kulhawy & Mayne (1990)
Eq. 2	Cc = 0.009 * (LL - 10)	Terzaghi & Peck (1967)
Eq. 3	Cc = 0.2343 * LL * Gs	Nagaraj & Murty (1985)

Project No. : 1-09-4135
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Terraprobe Inc.

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Checked By : RA

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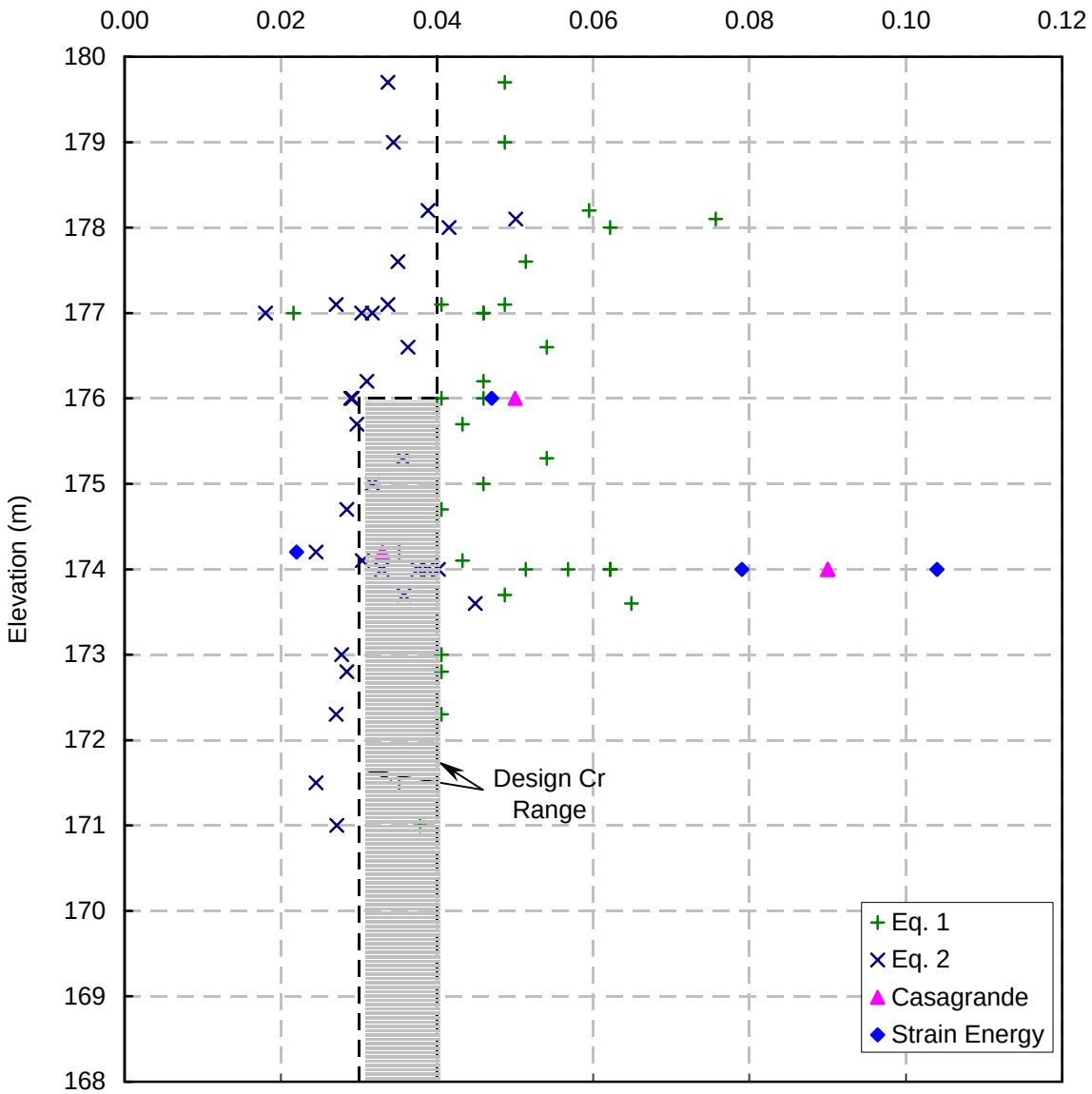
PREDICTED AND MEASURED RECOMPRESSION INDEX	FIGURE G5

MERRITT ROAD INTERCHANGE - SOUTHEAST QUADRANT

Silty Clay



Eq. 1 Cr = Ip / 370 Kulhawy & Mayne (1990)

Eq. 2 Cr = Cc / 5 ~ Cc / 10

Project No. : 1-09-4135

Date : September, 2010

Terraprobe Inc.

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Checked By : RA

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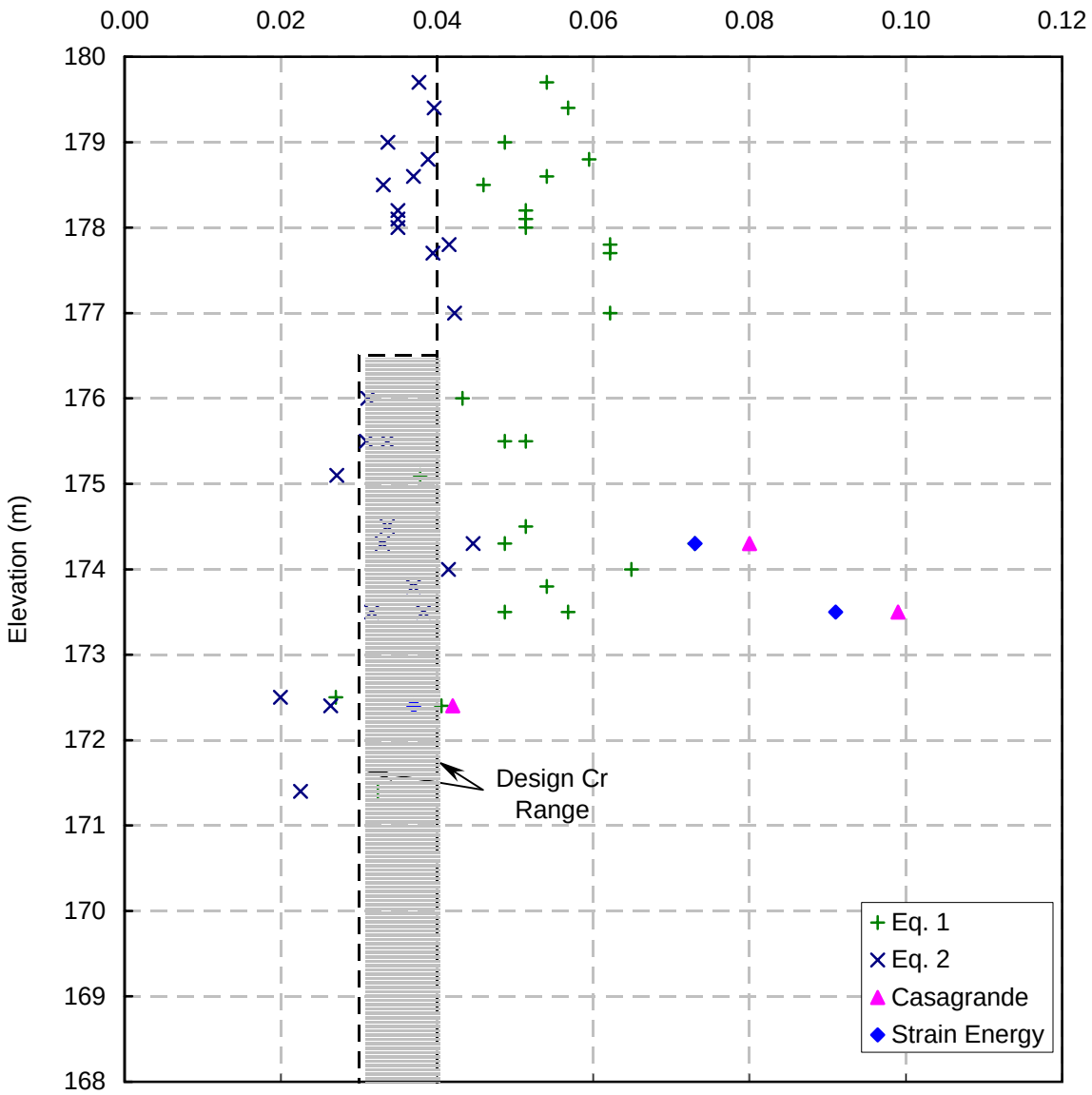
PREDICTED AND MEASURED RECOMPRESSION INDEX	FIGURE G6

MERRITT ROAD INTERCHANGE - NORTHWEST QUADRANT

Silty Clay



Eq. 1 Cr = Ip / 370 Kulhawy & Mayne (1990)

Eq. 2 Cr = Cc / 5 ~ Cc / 10

Project No. : 1-09-4135

Date : September, 2010

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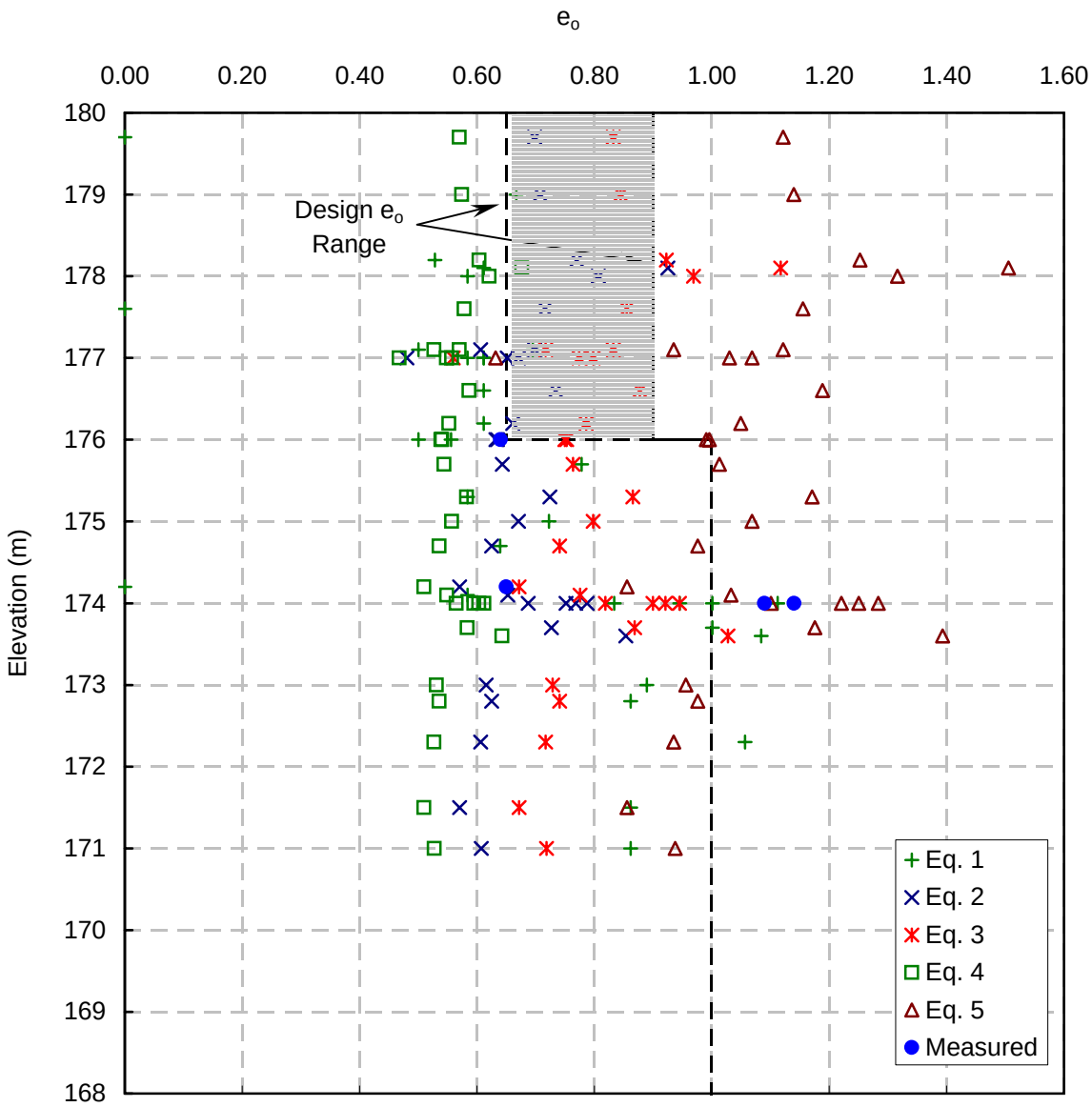
PREDICTED AND MEASURED VOID RATIO	FIGURE G7

MERRITT ROAD INTERCHANGE - SOUTHEAST QUADRANT

Silty Clay



Eq. 1	$e_o = \omega * Gs$	when saturated
Eq. 2	$e_o = Cc / 0.54 + 0.23$	Moh & Kol (1989)
Eq. 3	$e_o = (Cc - 0.256) / 0.43 + 0.84$	Cozzolino (1961)
Eq. 4	$e_o = Cc / 1.15 + 0.35$	Nishida (1956)
Eq. 5	$e_o = (Cc / 0.141)^{0.4202} * Gs^{0.4958} - 1$	Rendon - Herrero (1983)

Project No. : 1-09-4135

Date : September, 2010

Terraprobe Inc.

Prepared By : HW

Checked By : RA

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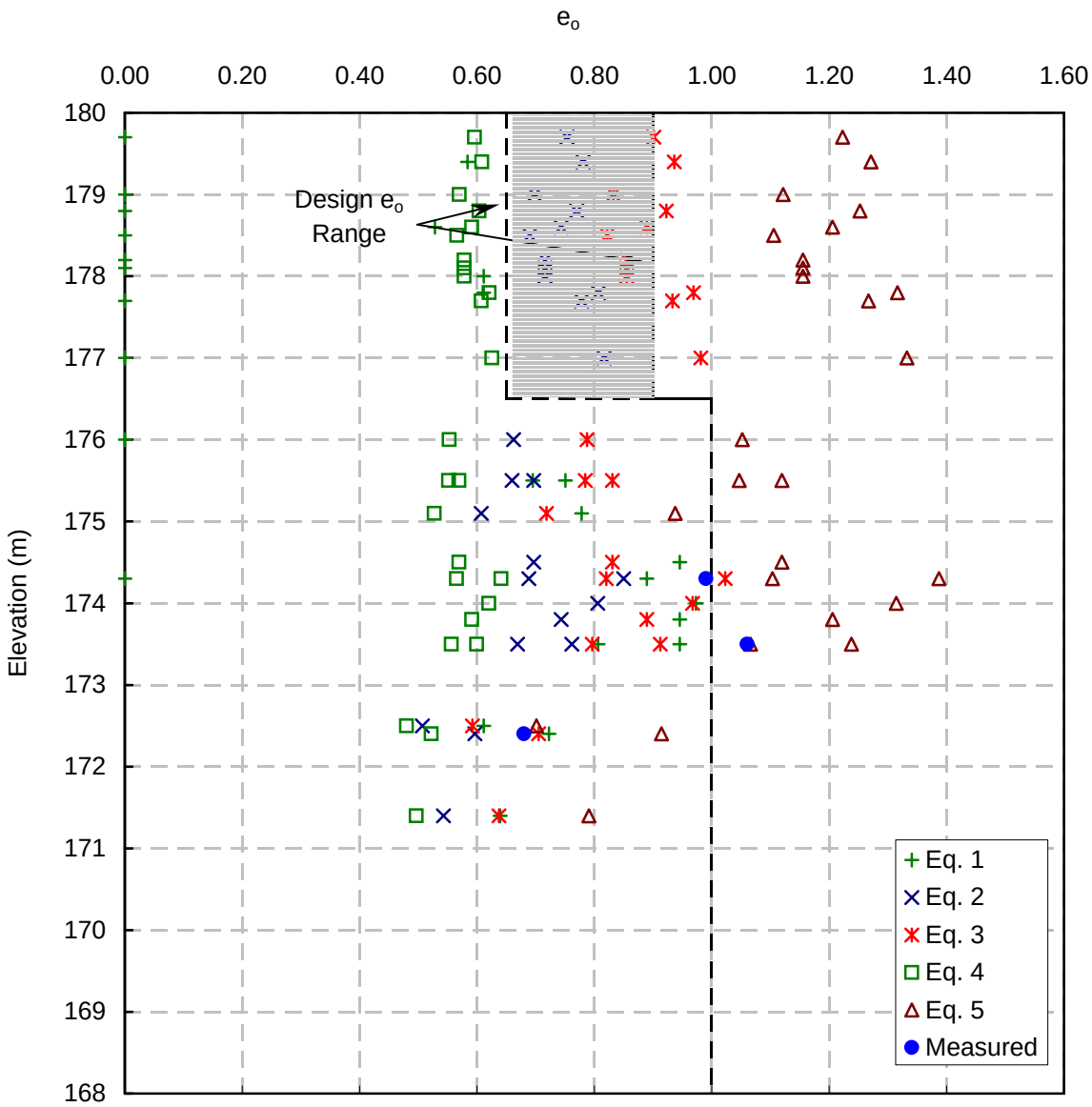
PREDICTED AND MEASURED VOID RATIO	FIGURE G8

MERRITT ROAD INTERCHANGE - NORTHWEST QUADRANT

Silty Clay



Eq. 1	$e_o = \omega * Gs$	when saturated
Eq. 2	$e_o = Cc / 0.54 + 0.23$	Moh & Kol (1989)
Eq. 3	$e_o = (Cc - 0.256) / 0.43 + 0.84$	Cozzolino (1961)
Eq. 4	$e_o = Cc / 1.15 + 0.35$	Nishida (1956)
Eq. 5	$e_o = (Cc / 0.141)^{0.4202} * Gs^{0.4958} - 1$	Rendon - Herrero (1983)

Project No. : 1-09-4135

Date : September, 2010

Terraprobe Inc.

Prepared By : HW

Checked By : RA

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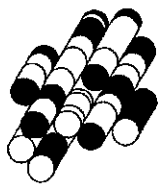
APPENDIX H

Special Provision Supply & Installation of Embankment Monitoring Equipment

Terraprobe Inc.



SUPPLY AND INSTALLATION OF EMBANKMENT MONITORING EQUIPMENT – Item No.

Special Provision

1.0 GENERAL

1.1 Scope

This special provision contains the requirements for the supply and installation of the following geotechnical instruments:

- Settlement Plates (SP)
- Survey Benchmark/s (BM)

1.2 Purpose

The purpose of these instruments is to monitor settlements in the foundation soils under the new embankments. The data will be used for planning final paving operations. Settlements will be measured by level surveying of the top of the settlement rods.

The final paving operations shall be controlled by the instrumentation readings.

1.3 Personnel

The Contractor shall retain a Geotechnical Consultant with MTO classification of "Geotechnical (Structures and Embankments) – Medium Complexity", to undertake the supply and installation of geotechnical instruments.

The Contractor (as referenced herein) shall be understood to refer to the Contractor and their Geotechnical Consultant.

1.4 Or equal

The term "or equal" shall be understood to indicate that the equal product is the same or better than the specified product in function, performance, reliability, quality and general configuration.

1.5 Notification

The Contract Administrator shall be notified a minimum of 15 working days in advance of commencing the installation of instruments.

1.6 Submission Requirements

The Contractor shall submit details of proposed installations including:

- Design and construction drawings, including equipment layout;
- Installation methodology and timing;
- Equipment and material specifications, data sheets;
- Location and types of survey benchmarks; and
- Installation schedule.

Submissions shall be made to the Contract Administrator a minimum of 15 days before the start of the instrument installation.

1.7 Subsurface Conditions

The subsurface conditions at the site(s) are described in the report:

- Foundation Investigation Report – High Fills, Merritt Road Interchange, Highway 406 Twinning, Ontario, W.P. 280-99-00, dated September 03, 2010, by Terraprobe Inc.

The owner warrants that the information provided in the report can be relied upon with the following exceptions.

1. Any interpretations of the data or opinions expressed in the report are not warranted; and
2. Although the raw measured data presented is warranted, the Contractor must satisfy himself as to the sufficiency of the information presented and obtain any updated or additional information, and perform any studies, analysis or investigations the Contractor deems necessary in order to prepare his design, at no additional cost to the Owner.

1.8 Equipment Operation and Weather Conditions

All installations and monitoring equipment and associated materials shall be capable of withstanding the range of temperatures possible for their location within the ground or on the surface. The instruments shall be capable of operating within the manufacturer's stated accuracy throughout the temperature range. Monitoring shall be conducted year round and the Contractor is advised that the equipment should be accessible for monitoring throughout the duration of the Contract.

2.0 INSTALLATION

A summary of instrumentation requirements is given in Table 2.1. Details and specific material requirements are presented elsewhere in this special provision.

Table 2.1 – Settlement Plates & Benchmark Quantities and Locations

INSTRUMENT I.D.	STATION	OFFSET FROM CENTRELINE	NO. OF INSTRUMENTS SP
South East Quadrant			
SP1	406S-E/W 10+250	CL	1
SP2	406S-E/W 10+300	CL	1
SP3	406S-E/W 10+350	CL	1
SP4	Merritt W-N 10+025	CL	1
SP5	Merritt W-N 10+075	CL	1
SP6	Merritt W-N 10+125	CL	1
SP7	Merritt W-N 10+175	CL	1
SP8	Merritt E-N 10+040	CL	1
SP9	Merritt Road 10+075	CL	1
SP10	Merritt Road 10+125	CL	1
SP11	Merritt Road 10+150	CL	1
SP12	Merritt Road 10+175	CL	1
SP13	Merritt Road 10+200	CL	1
BM1	N/A	N/A	1
North West Quadrant			
SP14	406N-E 10+375	CL	1
SP15	406N-E 10+425	CL	1
SP16	406N-W 10+025	CL	1
SP17	406N-W 10+075	CL	1
SP18	Merritt E-S 10+075	CL	1
SP19	Merritt E-S 10+100	CL	1
SP20	Merritt E-S 10+125	CL	1
SP21	Merritt Road 9+775	CL	1
SP22	Merritt Road 9+825	CL	1
SP23	Merritt Road 9+875	CL	1
SP24	Merritt Road 9+900	CL	1
BM2	N/A	N/A	1
Total Instruments			**26**

2.1 Instrument Location

Prior to the installation of instruments, the Contractor shall accurately survey and stake the location of each instrument and obtain a ground surface elevation at each instrument location.

2.2 Survey Benchmarks (BM)

The Contractor shall provide a minimum of two non-yielding deep seated survey benchmarks (BM) at the site. Alternatively the contractor may select stable non-settling points on existing structures within the area subject to approval by the contract administrator.

The number and locations(s) of benchmark(s) shall be such that direct sighting is possible from all settlement rods to at least one benchmark.

2.3 Accuracy of Surveying for Elevations

Elevations shall be surveyed referenced to Geodetic datum to an accuracy of ± 2 mm or better.

2.4 Monitoring Instrument Location

All monitoring instruments shall be located in MTM NAD83 northing and easting coordinates.

2.5 Materials and Equipment

The Contractor shall supply all materials and equipment required for the installation of instrumentation unless noted otherwise.

2.6 Underground Utilities

The Contractor shall be responsible for locating and protecting all underground utilities prior to drilling boreholes for installing instruments. Any damage to underground utilities caused by the Contractor's work shall be repaired by the Contractor, at no cost to the Ministry.

2.7 Marking and Labelling

The location of any above ground monitoring fixture shall be made clearly visible to nearby traffic before, during and after embankment construction. Marking shall be of sufficient size to be visible from a reversing vehicle and after heavy snow falls.

Instruments shall be clearly labelled in the field, each instrument having a unique identifier. The labelling shall remain legible for at least 1 year.

2.8 Protection of Instruments

All instruments shall be adequately protected by the Contractor such that they are not damaged during construction. Any instrument damaged by the Contractor's work shall be immediately replaced at no cost to the Ministry.

2.9 Installation Program

Instrument installation shall be completed before any embankment construction. Table 2.2 provides a summary of the installation schedule requirements.

Table 2.2 – Installation Program

TYPE	START INSTALLATION	FINISH INSTALLATION
SP	After excavating to recommended subgrade	On completion of embankment construction
BM	Before commencement of embankment construction	Before commencement of embankment construction

3.0 BENCHMARK (BM) – SUPPLY & INSTALLATION

3.1 GENERAL

3.1.1 Scope

This Section contains the requirements for the supply and installation of benchmark/s (BM).

The purpose of the benchmark is to provide non-settling references for the surveying of settlement rods.

3.1.2 General Procedure

The benchmark shall be installed prior to embankment construction. The number and locations of benchmarks shall be such that direct sighting is possible from all settlement rods to at least one benchmark. Elevations shall be surveyed to an accuracy of ± 2mm or better.

Prior to the installation of instruments, the Contractor shall accurately survey and stake the locations of each instrument and obtain a ground elevation at each instrument location.

3.1.3 Location

Benchmarks shall be located and installed outside of the area of construction activity. Notwithstanding the installation details provided herein the contractor may select stable non-settling points on existing structures within the area subject to approval by the contract administrator.

Table 3 – Approximate Bench Mark Locations

Station	Offset (m)	No. of BM	Estimated Rod Anchor Elevation (m)
South East Quadrant			
Outside of Construction Area	N/A	BM1	174.0
North West Quadrant			
Outside of Construction Area	N/A	BM2	173.0

3.2 MATERIALS

3.2.1 General

The Contractor shall supply all materials and equipment required for the installation of the benchmark.

3.2.2 Rod

The Contractor shall supply a steel pipe Schedule 40 with an outside diameter not less than 25.4 mm (1”), supplied in lengths as required to complete the installation as described.

The top end of each length of rod shall be threaded to receive a cap. A rounded cap shall be installed at the top of the rod in such a way that a single survey point can be clearly identified and returned to.

3.2.3 Sand

The Contractor shall supply clean washed sand. The sand shall be Sakcrete washed general-purpose sand – or equal.

3.2.4 Grout

The Contractor shall supply cement-bentonite grout. A suitable grout mix design consists of 23 kg of bentonite (OPSS 1205), 143 litres of water and 40 kg of cement (Type G.U. – OPSS 1301).

3.2.5 Rod Anchor Grout

The Contractor shall supply cement-bentonite grout. A suitable grout mix design consists of 14 kg of bentonite (OPSS 1205), 49 litres of water and 40 kg of cement (Type G.U. – OPSS 1301).

3.2.6 Friction Reducing Sleeve

The Contractor shall supply a friction reducing sleeve consisting of Schedule 50 – 50.8 mm (2”) O.D. PVC pipe cut perpendicular to the axis of the pipe.

3.3 INSTALLATION

3.3.1 General

The Contractor shall install the benchmark in accordance with the information below.

3.3.2 Borehole Installation

The borehole shall be advanced to the rod anchor elevations provided in Table 3 using suitable drilling techniques. The diameter of the borehole shall be sufficient to fit the rod, friction reducing sleeve and rod anchor. The sides of the borehole shall be stable and the borehole shall be free of drilling mud and debris.

3.3.3 Rod

The coupling of the rods shall be such that all sections have the same axis and no separation or contraction will occur at the couplings.

3.3.4 Rod Anchor

The rod shall be installed vertically in the borehole with its bottom end resting at the bottom of the borehole. The bottom portion of the rod shall be fixed against the surrounding native soil by grouting the bottom 0.5 m of the borehole to form a concrete/soil anchor.

Once grouting is completed and the rod anchor grout has set, the Contractor shall pour 0.5 m of clean sand in the borehole above the concrete/soil anchor to create a base for the end of the friction reducing sleeve to rest on.

The elevation of the bottom of the rod anchor shall be determined by measuring the length of the rod to the ground surface elevation.

3.3.5 Friction Reducing Sleeve

The friction reducing sleeve shall be over the entire length of the rod above the rod anchor and sand.

3.3.6 Installation Details

The elevation, easting and northing of the top of the benchmark rod shall be surveyed.

3.4 COORDINATION WITH MONITORING

3.4.1 Notification

The Contractor shall notify the Contract Administrator no later than 3 days after installing a benchmark. At this time the Contractor shall also supply the following information to the Contract Administrator.

- Location of the rod anchor and elevation top of rod;
- Dates of installation;
- Stratigraphic log of subsurface conditions at the benchmark, including drilling method notes;
- Installation notes/sketches; and
- Description of benchmarks, sleeve and rod anchor.

3.4.2 Monitoring

Monitoring of settlements with reference to the benchmark shall be done by others. Monitoring shall be conducted during and following the embankment construction at the north and south approaches and ramp sections. The Contractor shall provide installation information as specified above and provide access to the benchmark for monitoring including, but not limited to snow clearing in the winter. The Contractor shall provide electric power and general area lighting as needed.

3.5 REPORTING

The Contractor shall record and report relevant installation details to the Contract Administrator. These include, but are not limited to:

- Benchmark easting, northing in MTM NAD83 coordinates;
- Elevation of bottom of rod anchor and top of rod relative to Geodetic datum;
- Dates of installation; and
- Installation notes/sketches.

4.0 SETTLEMENT PLATES (SP) – SUPPLY & INSTALLATION

4.1 GENERAL

4.1.1 Scope

This Section contains the requirements for the supply and installation of settlement plates.

The purpose of the settlement plates is to monitor settlements of the foundation soils below the embankment base. The settlement readings shall help to establish the timing for the final paving operations. Settlement is measured by survey of the top of the rod with reference to stable, non-settling benchmarks.

4.1.2 General Procedure

The settlement rods shall be attached to a plate at the existing ground surface. As embankment construction proceeds the rods shall be extended above the new top of embankment.

Sleeves around the rods shall be installed to reduce friction and allow uninhibited movement of the rod with the plate.

A protective surround shall be extended with the rods as embankment construction proceeds.

4.1.3 Location

The locations of the settlement plates are shown on the Contract Drawings and are given in Table 4.

Table 4 – Approximate Settlement Plate Locations

Station	Offset (m)	No. of Settlement Plate(s)	Estimated Thickness of Embankment (m)*
South East Quadrant			
406S-E/W 10+250	CL	1	5.3
406S-E/W 10+300	CL	1	6.5
406S-E/W 10+350	CL	1	6.5
Merritt W-N 10+025	CL	1	7.5
Merritt W-N 10+075	CL	1	7.3
Merritt W-N 10+125	CL	1	5.3
Merritt W-N 10+175	CL	1	3.3
Merritt E-N 10+040	CL	1	7.2
Merritt Road 10+075	CL	1	9.2
Merritt Road 10+125	CL	1	8.3
Merritt Road 10+150	CL	1	7.0
Merritt Road 10+175	CL	1	6.5
Merritt Road 10+200	CL	1	5.5

Table 4 – Approximate Settlement Plate Locations (Continued)

Station	Offset (m)	No. of Settlement Plate(s)	Estimated Thickness of Embankment (m)*
North West Quadrant			
406N-E 10+375	CL	1	4.3
406N-E 10+425	CL	1	5.3
406N-W 10+025	CL	1	5.5
406N-W 10+075	CL	1	5.3
Merritt E-S 10+075	CL	1	6.0
Merritt E-S 10+100	CL	1	5.0
Merritt E-S 10+125	CL	1	3.5
Merritt Road 9+775	CL	1	3.5
Merritt Road 9+825	CL	1	6.0
Merritt Road 9+875	CL	1	7.8
Merritt Road 9+900	CL	1	8.3

Notes: * Embankment thickness based on surface elevation of removal levels/stripping Depths and does not include 2 m surcharge height.

4.2 MATERIALS

4.2.1 General

The Contractor shall supply all materials and equipment required for the installation of the settlement plates.

4.2.2 Plate

The Contractor shall supply a steel plate with thickness of at least 6.35 mm. The plate shall be at least 0.5 m by 0.5 m.

4.2.3 Rod

The Contractor shall supply a steel pipe Schedule 40 with an outside diameter not less than 25.4 mm (1”), supplied in lengths as required to complete the installation as described in Section 4.3.

The top end of each length of rod shall be threaded to receive a cap. A rounded cap shall be installed at the top of the rod in such a way that a single survey point can be clearly identified and returned to.

4.2.4 Friction Reducing Sleeve

The Contractor shall supply a friction reducing sleeve consisting of Schedule 40 – 50.8mm (2”) O.D. PVC pipe cut perpendicular to the axis of the pipe.

4.2.5 Protective Surround

The Contractor shall supply a protective surround for the portion of the rod within the embankment. The surround shall consist of 300 mm diameter corrugated steel pipe (CSP – OPSS 1801) with the ends cut perpendicular to the axis of the pipe and free of burrs and sharp edges. The space between the CSP and the Friction Reduction Sleeve (PVC pipe) shall be filled with medium to coarse sand.

4.3 INSTALLATION

4.3.1 General

The Contractor shall install settlement plates as per the Contract Drawings provided in addition to what is stated or emphasized below.

4.3.2 Settlement Plate

The settlement plate shall be installed horizontally after subgrade preparation is completed and prior to fill placement.

The elevation of the base of the plate shall be surveyed before backfilling.

4.3.3 Rod

The rod shall be fixed to the center of the plate and installed perpendicular to the plate.

The coupling of the rods shall be such that all sections have the same axis and no separation or contraction will occur at the couplings.

4.3.4 Friction Reducing Sleeve

The friction reducing sleeve shall be over the entire length of the rod that is below ground and within the embankment fill except that the cap on top of the settlement rod shall extend 25 mm above the top of the friction sleeve at all times.

4.4 EXTENSION OF ROD

The settlement rods shall be extended upwards as the embankment is constructed so that the top of the rod is always at least 0.3 m but not more than 2 m above the surrounding fill.

4.4.1 Protective Surround

The CSP, Friction Reducing Sleeve and sand protective surround shall be extended with the rods.

The settlement rod shall be in the center of the CSP and friction-reducing sleeve.

The annulus between the CSP and the friction-reducing sleeve shall be filled with sand to a level not higher than the top of the sleeve.

4.4.2 Installation Details

The elevation, easting and northing of the center of the base of the plate shall be surveyed.

The elevation, easting and northing of the top of the rod shall be surveyed.

The total distance from the base of the plate to the top of the rod shall be measured to an accuracy of ± 2 mm or better.

4.5 COORDINATION WITH MONITORING

4.5.1 Notification

The Contractor shall notify the Contract Administrator no later than 3 days after installing a settlement plate. At this time the Contractor shall also supply the following information to the Contract Administrator.

- Elevation of plate and rod referenced to Geodetic datum;
- Dates of installation;
- Installation notes/sketches; and
- Description of settlement rods, sleeve and plate.

Adjustments in the length of any settlement rod shall be coordinated with the Contract Administrator to allow surveying by others of the elevation of the top of the rod immediately before and immediately after adjustment. This surveying is necessary to accurately track the settlement data.

4.5.2 Monitoring

Monitoring of the settlement plates shall be done by others. Monitoring shall be conducted during the embankment construction and preload period. A target settlement of 100 mm is specified. A minimum preload period of 4 months is required. The Contractor shall provide installation information as specified above and provide access to the settlement rods for monitoring including, but not limited to a level scaffolding platform and ladder, if required and snow clearing in the winter. The Contractor shall provide electric power and general area lighting as needed for reading the instruments.

4.6 REPORTING

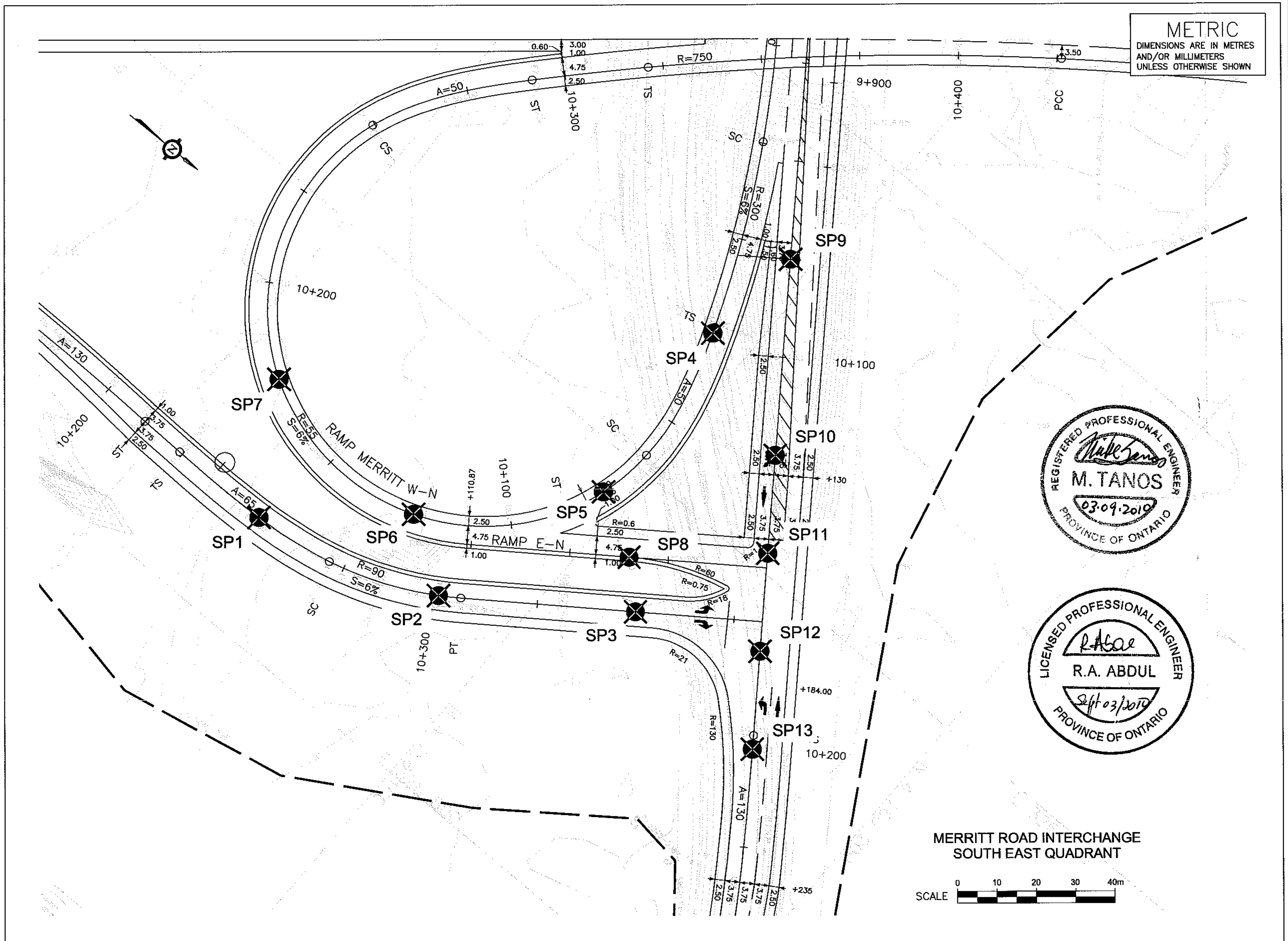
The Contractor shall record and report relevant installation details to the Contract Administrator. These include, but are not limited to:

- Settlement rod easting, northing referenced to MTM NAD83 coordinates;
- Elevation of the plate and the top of the rod referenced to Geodetic datum;
- Distance between base of plate and top of rod;
- Dates of installation; and
- Installation notes/sketches.

5.0 PAYMENT

Basis Of Payment

Payment at the Lump Sum price for this tender item shall be full compensation for all labour, monitoring equipment and material to do the work.



CONT No
WP No 280-99-00

MERRITT ROAD INTERCHANGE
SETTLEMENT MONITORING
INSTRUMENT LAYOUT

Terraprobe Inc.
Consulting Geotechnical & Environmental Engineering
Construction Materials, Inspection & Testing
10 Bram Court - Brampton Ontario L6W 3R6 (905) 796-2650

GENERAL NOTES:

1. THIS DRAWING TO BE READ IN CONJUCTION WITH INSTRUMENT DETAILS DRAWING.

LEGEND

(SP1) APPROXIMATE LOCATION OF SETTLEMENT PLATE (SP)

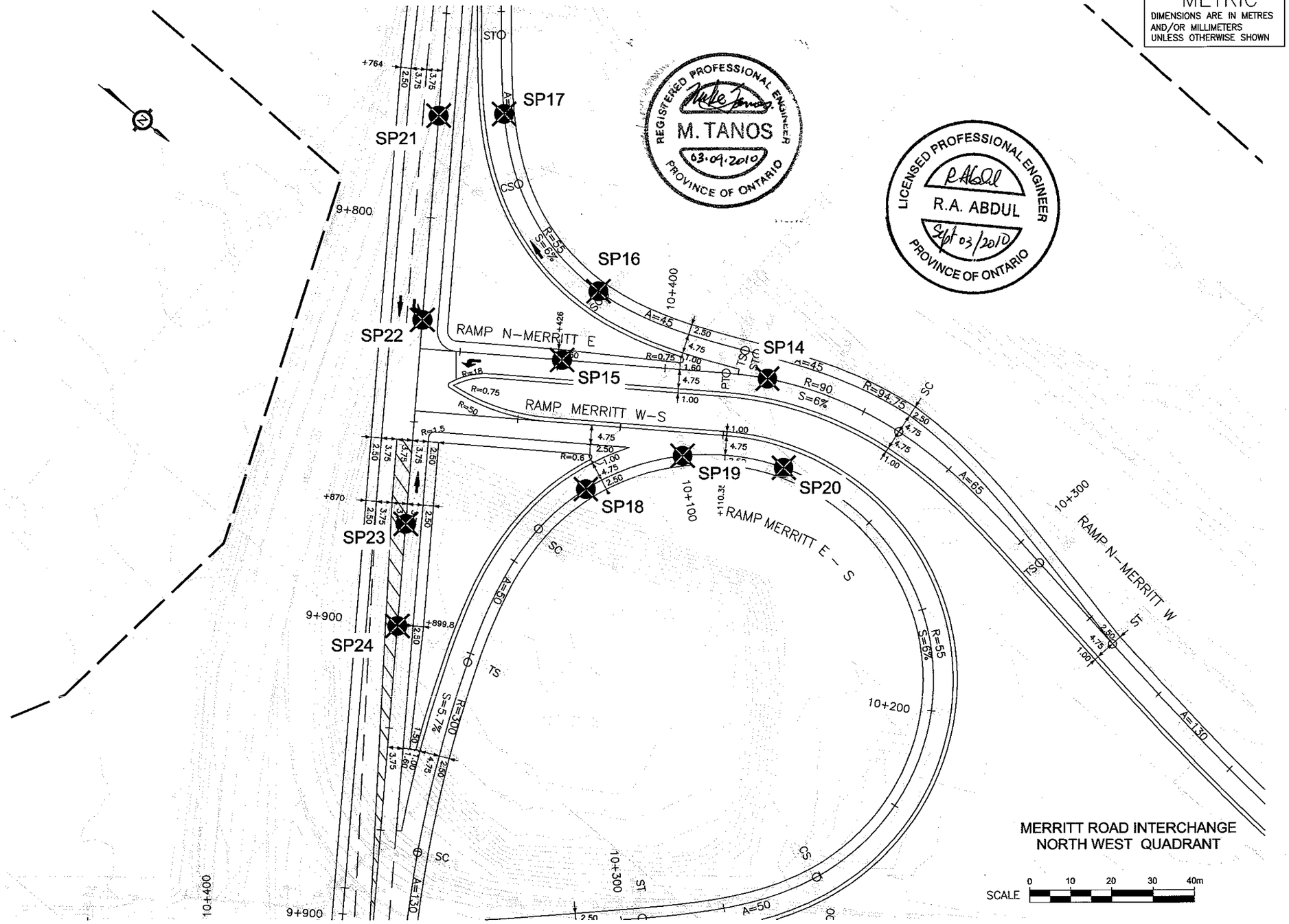
INSTRUMENT LOCATIONS

I.D.	LOCATION	STATION	OFFSET FROM CENTRELINE(m)
SOUTH EAST QUADRANT			
SP1	406S-E/W	10+250	0
SP2	406S-E/W	10+300	0
SP3	406S-E/W	10+350	0
SP4	MERRITT W-N	10+025	0
SP5	MERRITT W-N	10+075	0
SP6	MERRITT W-N	10+125	0
SP7	MERRITT W-N	10+175	0
SP8	MERRITT E-N	10+040	0
SP9	MERRITT ROAD	10+075	0
SP10	MERRITT ROAD	10+125	0
SP11	MERRITT ROAD	10+150	0
SP12	MERRITT ROAD	10+175	0
SP13	MERRITT ROAD	10+200	0

REVISIONS	DATE	BY	DESCRIPTION

DESIGN R.A	CODE CHBDC2006	LOAD	DATE SEPT. 2010
DRAWN K.C	CHK R.A	STRUCT	

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



MERRITT ROAD INTERCHANGE
NORTH WEST QUADRANT

REGISTERED PROFESSIONAL ENGINEER
M. TANOS
03.09.2010
PROVINCE OF ONTARIO

LICENSED PROFESSIONAL ENGINEER
R.A. ABDUL
Sept 03/2010
PROVINCE OF ONTARIO

CONT No
WP No 280-99-00

MERRITT ROAD INTERCHANGE
SETTLEMENT MONITORING
INSTRUMENT LAYOUT

Terraprobe Inc.
Consulting Geotechnical & Environmental Engineering
Construction Materials, Inspection & Testing
10 Bram Court - Brampton Ontario L6W 3R6 (905) 796-2650

GENERAL NOTES:

1. THIS DRAWING TO BE READ IN CONJUCTION WITH INSTRUMENT DETAILS DRAWING.

LEGEND

SP1 APPROXIMATE LOCATION OF SETTLEMENT PLATE (SP)

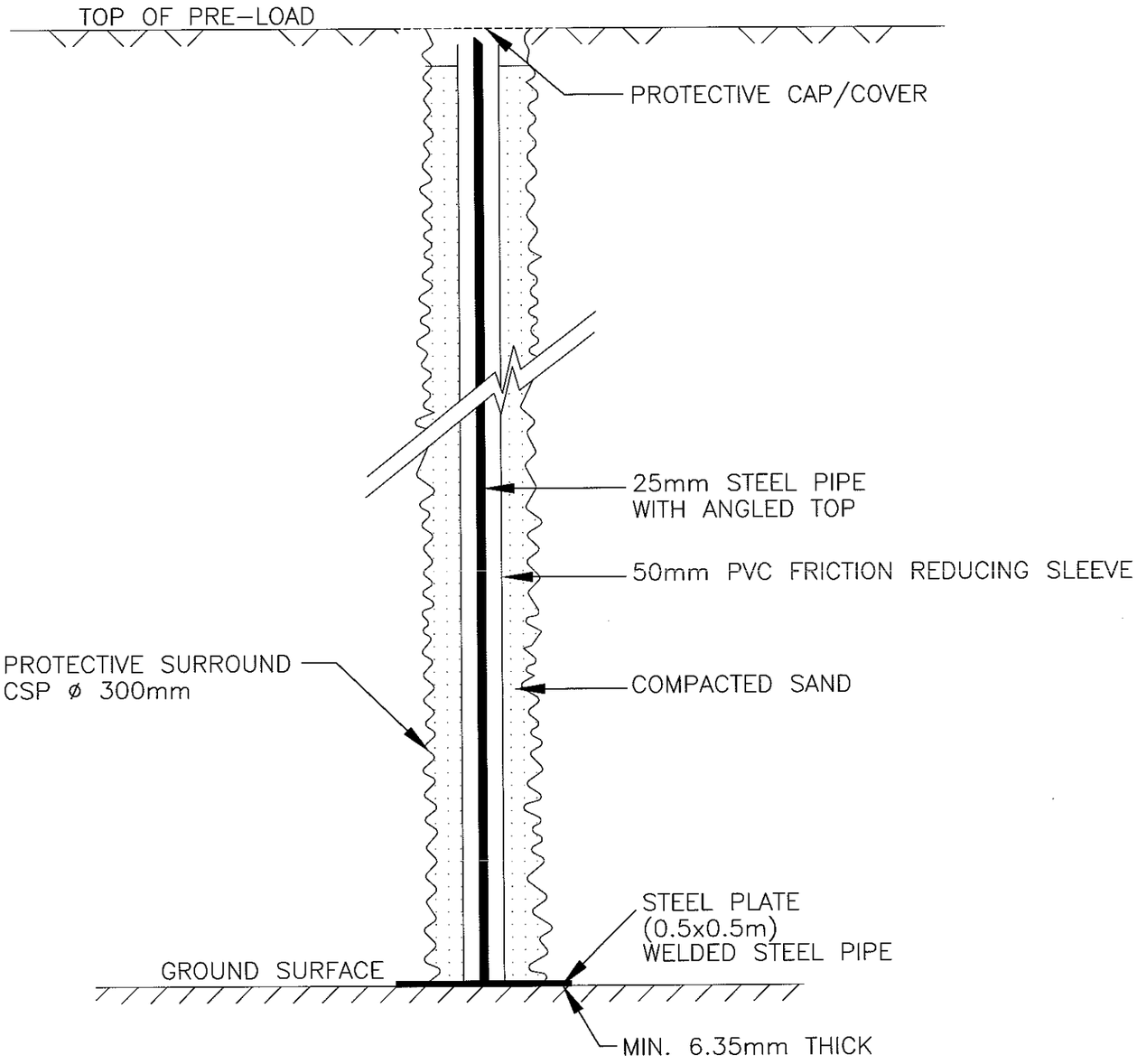
INSTRUMENT LOCATIONS

I.D.	LOCATION	STATION	OFFSET FROM CENTRELINE(m)
NORTH WEST QUADRANT			
SP14	406 N-E	10+375	0
SP15	406 N-E	10+425	0
SP16	406 N-W	10+025	0
SP17	406 N-W	10+075	0
SP18	MERRITT E-S	10+075	0
SP19	MERRITT E-S	10+100	0
SP20	MERRITT E-S	10+125	0
SP21	MERRITT ROAD	9+775	0
SP22	MERRITT ROAD	9+825	0
SP23	MERRITT ROAD	9+875	0
SP24	MERRITT ROAD	9+900	0

REVISIONS	DATE	BY	DESCRIPTION

DESIGN	R.A	CODE	CHBDC2006	LOAD	DATE SEPT. 2010
DRAWN	K.C	CHK	R.A	STRUCT	

\\TERRADOCS\ProServer\Terraprobe Limited\All Projects\2009 Files\1-09-4100-4199\1-09-4135\6. Reports Final\Final_MERRITT RD SETTLEMENT PLATES\1-09-4135 Merritt Road Settlement Plates (SP) Plan.dwg, KAHAL



SETTLEMENT PLATE (SP)

N.T.S.

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

CONT No
WP No 280-99-00

MERRITT ROAD INTERCHANGE
SETTLEMENT MONITORING
INSTRUMENT DETAILS

Terraprobe Inc.
Consulting Geotechnical & Environmental Engineering
Construction Materials, Inspection & Testing
10 Bram Court - Brampton Ontario L6W 3R6 (905) 796-2650

GENERAL NOTES:

1. THIS DRAWING TO BE READ IN CONJUCTION WITH THE SETTLEMENT MONITORING INSTRUMENT LAYOUT DWG.

REGISTERED PROFESSIONAL ENGINEER
M. TANOS
03.09.2010
PROVINCE OF ONTARIO

LICENSED PROFESSIONAL ENGINEER
R.A. ABDUL
09/03/2010
PROVINCE OF ONTARIO

REVISIONS		
DATE	BY	DESCRIPTION

DESIGN	R.A	CODE	CHBDC2006	LOAD	
DRAWN	K.C	CHK	R.A	STRUCT	
				DATE	SEPT. 2010

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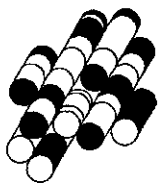
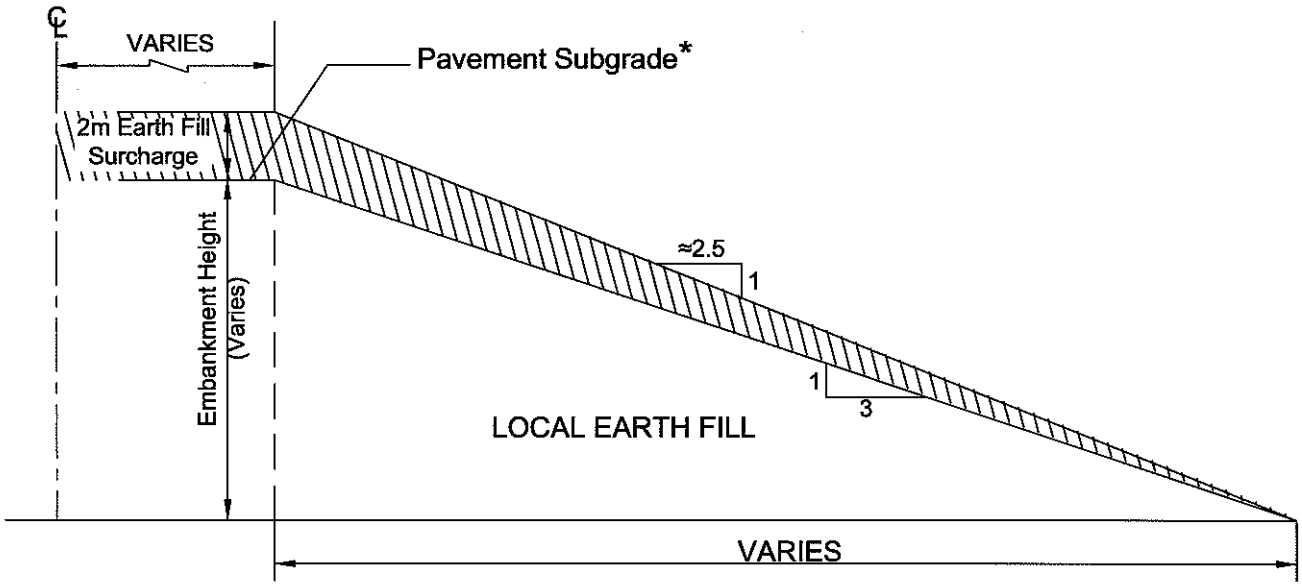
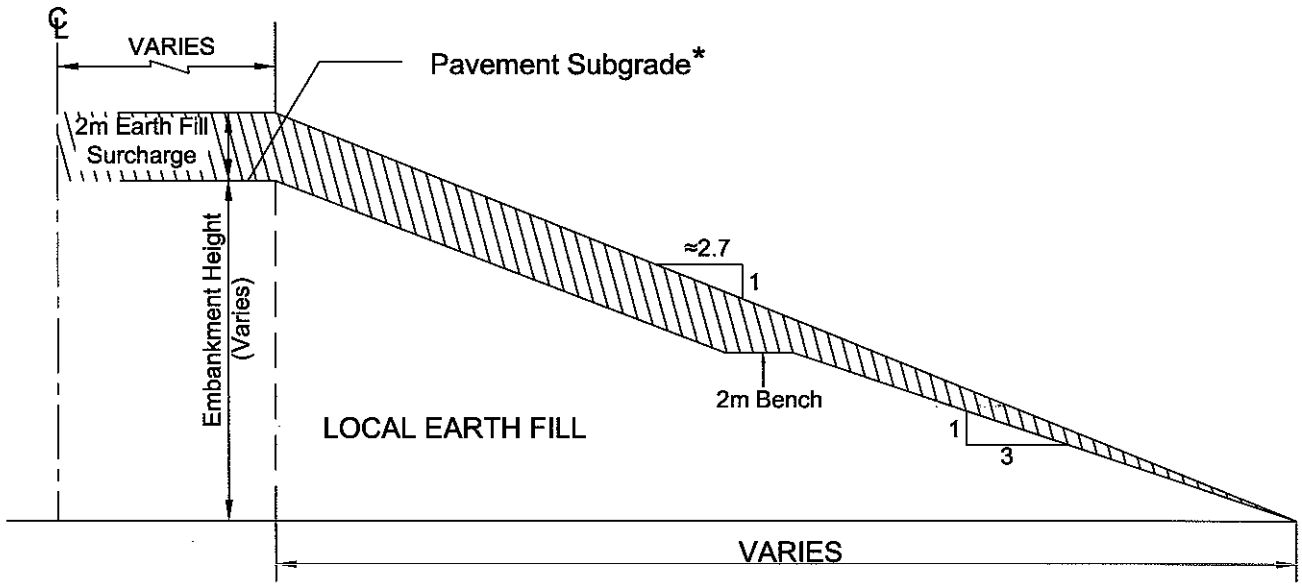
APPENDIX I
Figures

Terraprobe Inc.





Local Earth Fill Embankment < 8m



Local Earth Fill Embankment 8m ≥ 12m

* Notes- Pavement subgrade to be established after removal of surcharge

N.T.S

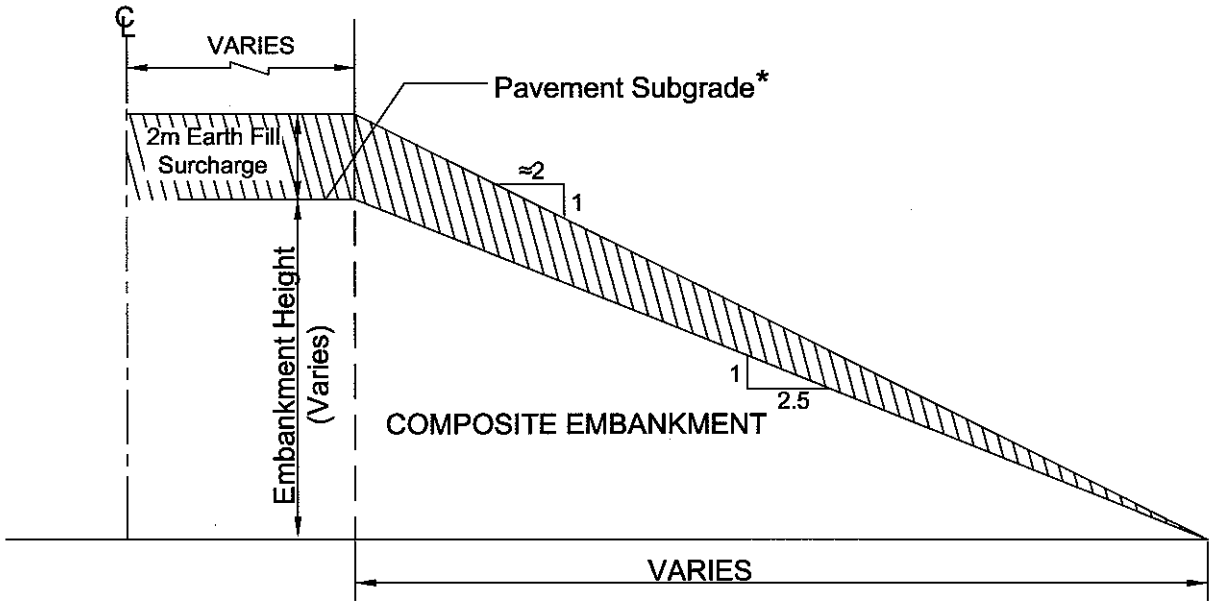
SURCHARGE ARRANGEMENT

TERRAPROBE

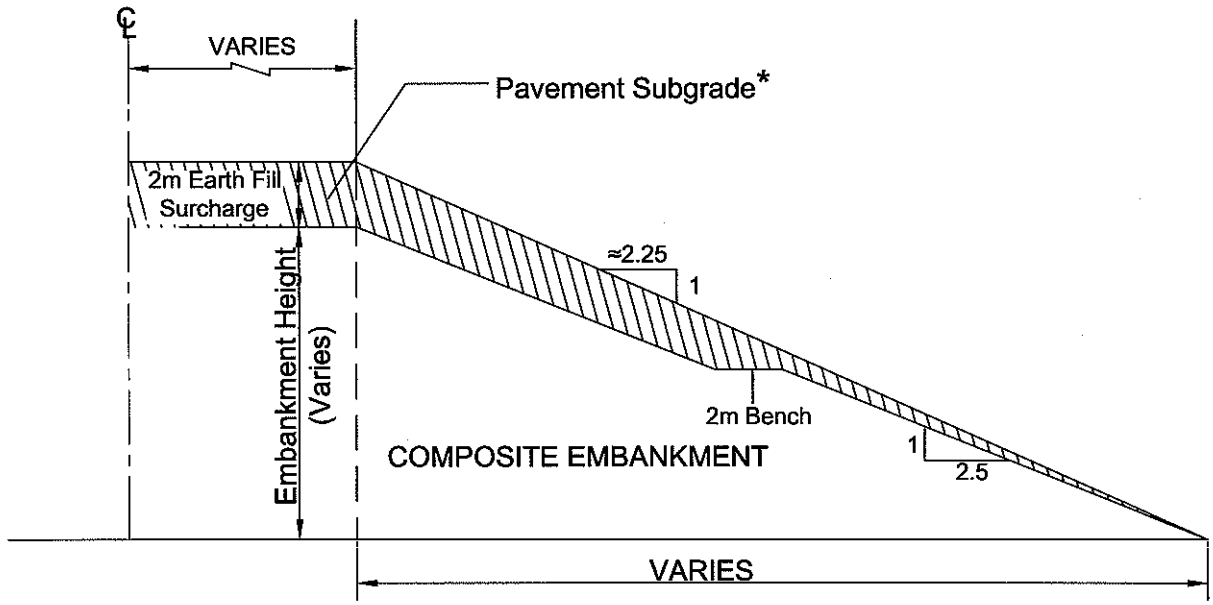
File No. 1-09-4135

FIGURE I1

C:\Users\tmer\Documents\COMPOSITE EMBANKMENT DETAILS 406.dwg, KAMAL



Composite Embankment <8m



Composite Embankment 8m ≥12m

* Notes- Pavement subgrade to be established after removal of surcharge.
Embankment and surcharge constructed initially with local earth fill and granular face installed after removal of surcharge.

N.T.S

SURCHARGE ARRANGEMENT

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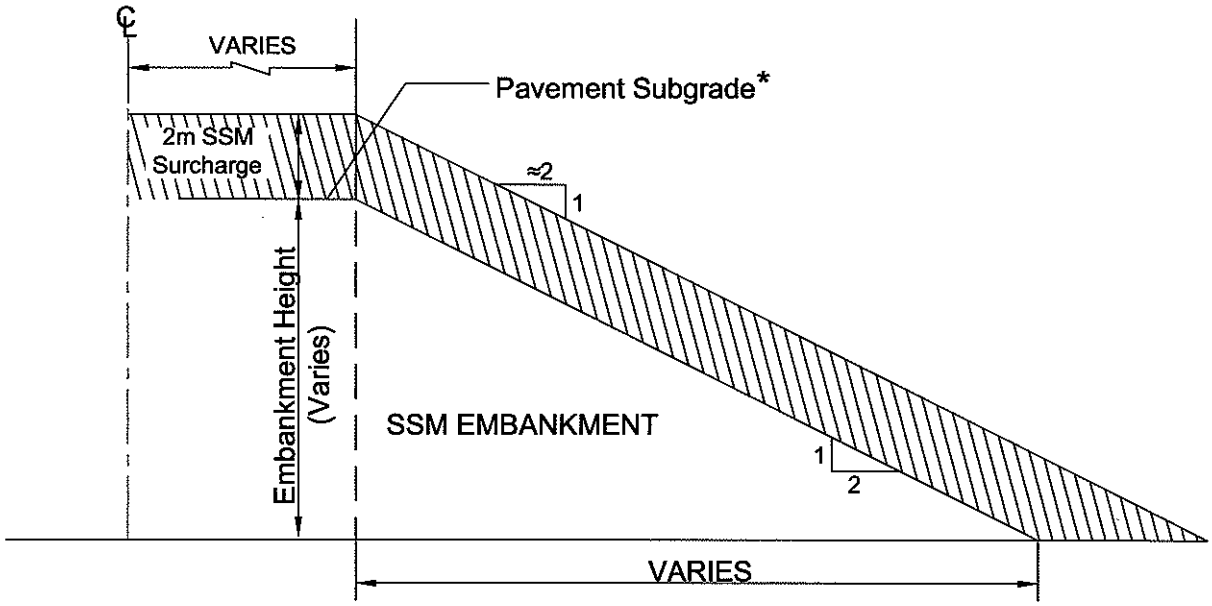
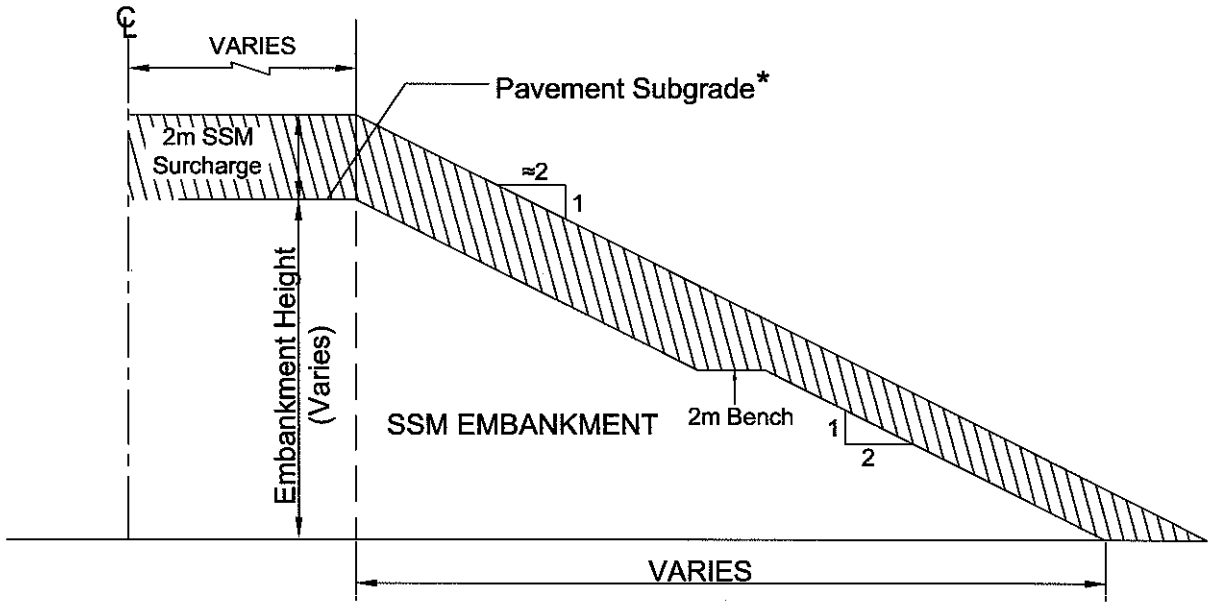
FIGURE I2



SSM Embankment <8m



SSM Embankment 8m ≥12m

* Notes- Pavement subgrade to be established after removal of surcharge.
Only SSM surcharge recommended in order to minimize handling/sorting and compaction of dissimilar materials.

N.T.S

SURCHARGE ARRANGEMENT

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FIGURE I3

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