



Terraprobe

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

**FOUNDATION INVESTIGATION REPORT
RETAINING STRUCTURES
HIGHWAY 406 TWINNING
PORT ROBINSON ROAD TO EAST MAIN STREET
AGREEMENT No. 2008-E-0016, W.P. 280-99-00
GEOCRES No. 30M3-266**

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Appendix B1 – Laboratory Test Results

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Site 2

Appendix A2 – Record of Borehole Sheets

Appendix B2 – Laboratory Test Results

Appendix C2 – Drawings titled “Borehole Locations and Soil Strata”

Site 3

Appendix A3 – Record of Borehole Sheets

Appendix B3 – Laboratory Test Results

Appendix C3 – Drawings titled “Borehole Locations and Soil Strata”

Site 4

Appendix A4 – Record of Borehole Sheets

Appendix B4 – Laboratory Test Results

Appendix C4 – Drawings titled “Borehole Locations and Soil Strata”



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RETAINING STRUCTURES
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ONTARIO
AGREEMENT No. 2008-E-0016, W.P. 280-99-00,
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PART 1: FACTUAL INFORMATION

1 INTRODUCTION

This report presents the factual findings obtained from foundation investigations conducted at four sites where retaining structures are proposed within a project area that extends from East Main Street, City of Welland to about 1.0 km north of Port Robinson Road, City of Thorold, Ontario.

The purpose of this investigation was to explore the subsurface conditions at the four sites and based on the data obtained, to provide borehole location plans, records of boreholes, stratigraphic profiles, laboratory test results and a description of the subsurface conditions. Models of the subsurface conditions were 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:

- Terraprobe Inc., “Foundation Investigation and Design Report, Ramp Woodlawn E/W-S Bridge at Trillium Railway”, Highway 406 Twinning, Port Robinson Road to East Main Street, City of Welland, Ontario, W.P. 280-99-00, Site 34-464/3, GEOCRES 30M3-258, dated September 10, 2010.
- Terraprobe Inc., “Foundation Investigation and Design Report, Trillium Overhead, Highway 406 SBL”, Highway 406 Twinning, Port Robinson Road to East Main Street, City of Welland, Ontario, W.P. 280-99-00, Site 34-464/2, GEOCRES 30M3-256, dated September 10, 2010.
- Terraprobe Inc., “Foundation Investigation and Design Report, Trillium Overhead, Highway 406 NBL”, Highway 406 Twinning, Port Robinson Road to East Main Street, City of Welland, Ontario, W.P. 280-99-00, Site 34-464/1, GEOCRES 30M3-255, dated September 03, 2010.
- Terraprobe Inc., “Foundation Investigation and Design Report, Ramp 406S-Woodlawn E/W Bridge at Trillium Railway”, Highway 406 Twinning, Port Robinson Road to East Main Street, City of Welland, Ontario, W.P. 280-99-00, Site 34-464/4, GEOCRES 30M3-257, dated September 17, 2010.



- Terraprobe Inc., “Foundation Investigation and Design Report, Woodlawn Road Overpass, Highway 406 SBL”, Highway 406 Twinning, Port Robinson Road to East Main Street, City of Welland, Ontario, W.P. 280-99-00, Site 34-463/2, GEOCRE 30M3-260, dated September 29, 2010.
- Terraprobe Inc., “Foundation Investigation and Design Report, Woodlawn Road Overpass, Highway 406 NBL”, Highway 406 Twinning, Port Robinson Road to East Main Street, City of Welland, Ontario, W.P. 280-99-00, Site 34-463/1, GEOCRE 30M3-259, dated September 29, 2010.
- Terraprobe Inc., “Foundation Investigation and Design Report, High Fills, Merritt Road Interchange”, Highway 406 Twinning, Port Robinson Road to East Main Street, City of Thorold, Ontario, W.P. 280-99-00, GEOCRE 30M3-252, dated September 03, 2010.

For reporting purposes the investigated sections are identified as follows:

Site 1: Right of Highway 406 NBL from Sta. 11+816 to Sta. 11+947.

Site 2: Immediately north and south of Trillium Railway. The north alignment extends from Sta. 9+930 to Sta. 10+091 and the south alignment extends from Sta. 9+916 to Sta. 10+057. Station numbering is referenced to the Trillium Railway alignment.

Site 3: Immediately north and south of Woodlawn Road. The north alignment extends from Sta. 9+909 to Sta. 9+997 and the south alignment extends from Sta. 9+890 to Sta. 9+992. Station numbering is referenced to ramp stationing.

Site 4: Right side of the new Merritt Road from about Sta. 9+700 to Sta. 9+910.

2 SITE DESCRIPTION & PHYSIOGRAPHY

The south limit of the project is Sta. 10+000 located at the existing Highway 406 terminus at East Main Street in the City of Welland. The north limit is about Sta. 6+400 approximately 1.0 km north of Port Robinson Road in the City of Thorold. This approximately 6.5 km long route traverses across generally flat terrain and intersects Woodlawn Road, Merritt Road and Port Robinson Road. There is an at grade railway intersection (Trillium Railway) about 265 m south of Woodlawn Road. The alignment also crosses the Welland River and Old Welland Canal.

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 basins¹.

¹ Chapman and Putnam, “The Physiography of South Ontario”, 3rd Edition, 1984.



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 units within the project limits consist of the Salina Formation and Guelph Formation of Upper Silurian Age². The Salina Formation 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. The Guelph Formation consists essentially of unweathered, grey, laminated argillaceous dolostone.

3 SITE INVESTIGATION AND FIELD TESTING

The site investigation and field testing at the four sites are outlined below:

Site 1: Four boreholes drilled and sampled to depths of 11.2 m during the period June 28, 2010 to June 30, 2010. The approximate borehole locations are shown on the attached Borehole Locations and Soil Strata drawing in Appendix C1.

Site 2: Twenty-seven boreholes drilled and sampled to depths ranging from 11.2 m to 35.0 m during the period of November 04, 2009 to July 27, 2010. The approximate borehole locations are shown on the attached Borehole Locations and Soil Strata drawing in Appendix C2.

Site 3: Sixteen boreholes drilled and sampled to depths ranging from 11.2 m to 32.2 m during the period of November 10, 2009 to June 30, 2010. The approximate borehole locations are shown on the attached Borehole Locations and Soil Strata drawing in Appendix C3.

Site 4: Four boreholes drilled and sampled to depths ranging from 7.5 m to 17.3 m during the period of September 09, 2009 to June 24, 2010. The approximate borehole locations are shown on the attached Borehole Locations and Soil Strata drawing in Appendix C4.

The borehole locations were marked in the field by surveyors from Callon Dietz Inc. who also provided Terraprobe with their coordinates and geodetic elevations. Access to some borehole locations was difficult due to locally steep slopes, utilities and existing structures. These boreholes were therefore relocated to be as close as feasible to the staked out location while allowing safe operation of the drill rig. Utility clearances were obtained by Terraprobe prior to drilling.

² Ontario Division of Mines, "Quaternary Geology Of The Welland Area", Preliminary Map P.796, 1972.



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. Some of the boreholes were also drilled at proposed bridge abutments and these boreholes were advanced into bedrock by NQ size diamond coring techniques.

Ground water conditions in the open boreholes were observed throughout the drilling operations and standpipe piezometers consisting of 19 mm diameter PVC pipe with a slotted screen enclosed in sand were installed in selected boreholes to permit longer term ground water level monitoring. 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 provided in Tables 3.1 to 3.4.

Table 3.1 – Piezometer Installation Details (Site #1)

Piezometer Location	Piezometer Details	
	Tip Depth/ Elevation (m)	Completion Details
RW1	10.7/179.3	Piezometer with 1.5 m slotted screen installed with filter sand to 8.5 m, bentonite seal from 8.5 m to 7.9 m, silty clay cuttings from 7.9 m to 0.6 m and bentonite seal from 0.6 m to ground surface.
RW3	10.7/181.1	Piezometer with 1.5 m slotted screen installed with filter sand to 8.5 m, bentonite seal from 8.5 m to 7.9 m, silty clay cuttings from 7.9 m to 0.6 m and bentonite seal from 0.6 m to ground surface.
RW4	6.1/185.4	Hole sealed to 6.1 m with bentonite, piezometer with 1.5 m slotted screen installed with filter sand to 4.0 m, bentonite seal from 4.0 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.



Table 3.2 – Piezometer Installation Details (Site #2)

Piezometer Location	Piezometer Details	
	Tip Depth/ Elevation (m)	Completion Details
NBL 12+375Lt	11.1/172.2	Piezometer with 3.0 m slotted screen installed with filter sand to 7.1 m, bentonite seal from 7.1 m to 6.5 m, silty clay cuttings from 6.5 m to 0.6 m and bentonite seal from 0.6 m to ground surface.
NBL 12+440Rt	12.2/170.8	Piezometer with 3.0 m slotted screen installed with filter sand to 8.5 m, bentonite seal from 8.5 m to 7.9 m, silty clay cuttings from 7.9 m to 0.3 m and bentonite seal from 0.3 m to ground surface.
SBL 12+360CL	12.2/170.7	Piezometer with 3.0 m slotted screen installed with filter sand to 9.0 m, bentonite seal from 9.0 m to 8.4 m, silty clay cuttings from 8.4 m to 0.6 m and bentonite seal from 0.6 m to ground surface.
SBL 12+410CL	12.2/170.3	Piezometer with 1.5 m slotted screen installed with filter sand to 10.3 m, bentonite seal from 10.3 m to 10.0 m, silty clay cuttings from 10.0 m to 0.3 m and bentonite seal from 0.3 m to ground surface.
S-EW 10+050CL	12.2/171.2	Piezometer with 3.0 m slotted screen installed with filter sand to 8.5 m, bentonite seal from 8.5 m to 8.1 m, silty clay cuttings from 8.1 m to 0.5 m and bentonite seal from 0.5 m to ground surface.
TEW1	15.2/167.3	Hole sealed to 15.2 m with bentonite, piezometer with 1.5 m slotted screen installed with filter sand to 12.8 m and bentonite seal from 12.8 m to ground surface.
TEW4	28.3/154.3	Hole sealed to 28.3 m with bentonite, piezometer with 1.5 m slotted screen installed with filter sand to 26.2 m and bentonite seal from 26.2 m to ground surface.
TN2	25.9/158.3	Hole sealed to 25.9 m with bentonite, piezometer with 1.5 m slotted screen installed with filter sand to 23.5 m, bentonite seal from 23.5 m to 1.5 m, sand from 1.5 m to 0.3 m and a flush mounted casing installation from 0.15 m to ground surface.
TN3	19.8/164.3	Hole sealed to 19.8 m with bentonite, piezometer with 1.5 m slotted screen installed with filter sand to 17.7 m, bentonite seal from 17.7 m to 0.3 m, and a flush mounted casing installation from 0.3 m to ground surface.
TRW1	10.7/172.5	Piezometer with 1.5 m slotted screen installed with filter sand to 8.8 m, bentonite seal from 8.8 m to 8.2 m, silty clay cuttings from 8.2 m to 0.6 m and bentonite seal from 0.6 m to ground surface.
TRW2	13.7/168.8	Piezometer with 1.5 m slotted screen installed with filter sand to 11.6 m, bentonite seal from 11.6 m to 11.0 m, silty clay cuttings from 11.0 m to 0.6 m and bentonite seal from 0.6 m to ground surface.
TRW3	16.8/166.3	Piezometer with 1.5 m slotted screen installed with filter sand to 14.6 m, bentonite seal from 14.6 m to 14.0 m, silty clay cuttings from 14.0 m to 0.6 m and bentonite seal from 0.6 m to ground surface.
TRW4	12.2/171.8	Hole sealed to 12.2 m with bentonite, piezometer with 1.5 m slotted screen installed with filter sand to 10.1 m, bentonite seal from 10.1 m to 9.4 m, silty clay cuttings from 9.4 m to 0.6 m and bentonite seal from 0.6 m to ground surface.
TS1	28.0/154.6	Hole sealed to 28.0 m with bentonite, piezometer with 1.5 m slotted screen installed with filter sand to 25.0 m and bentonite seal from 25.0 m to ground surface.
TS4	28.3/154.1	Hole sealed to 28.3 m with bentonite, piezometer with 3.0 m slotted screen installed with filter sand to 24.7 m and bentonite seal from 24.7 m to ground surface.
TSEW2	24.2/159.1	Silty clay cuttings to 25.0 m, hole sealed to 24.4 m with bentonite, piezometer with 1.5 m slotted screen installed with filter sand to 21.6 m and bentonite seal from 21.6 m to ground surface.
TSEW4	22.9/160.6	Hole sealed to 23.2 m with bentonite, piezometer with 1.5 m slotted screen installed with filter sand to 20.4 m and bentonite seal from 20.4 m to ground surface.
WE-S 10+345CL	12.6/170.2	Piezometer with 1.5 m slotted screen installed with filter sand to 10.7 m, bentonite seal from 10.7 m to 10.1 m, silty clay cuttings from 10.1 m to 0.6 m and bentonite seal from 0.6 m to ground surface.



Table 3.3 – Piezometer Installation Details (Site #3)

Piezometer Location	Piezometer Details	
	Tip Depth/ Elevation (m)	Completion Details
NBL 12+695Lt	12.2/170.7	Piezometer with 3.0 m slotted screen installed with filter sand to 8.5 m, bentonite seal from 8.5 m to 7.9 m, silty clay cuttings from 7.9 m to 0.3 m and bentonite seal from 0.3 m to ground surface.
NBL 12+750Rt	12.6/170.2	Piezometer with 3.0 m slotted screen installed with filter sand to 9.0 m, bentonite seal from 9.0 m to 8.4 m, silty clay cuttings from 8.4 m to 0.6 m and bentonite seal from 0.6 m to ground surface.
SBL 12+685CL	10.7/172.0	Piezometer with 3.0 m slotted screen installed with filter sand to 7.0 m, bentonite seal from 7.0 m to 6.4 m, silty clay cuttings from 6.4 m to 0.3 m, bentonite seal from 0.3 m to ground surface with a flush mounted casing installation.
SBL 12+750CL	10.5/172.4	Piezometer with 3.0 m slotted screen installed with filter sand to 6.9 m, bentonite seal from 6.9 m to 6.6 m, silty clay cuttings from 6.6 m to 0.3 m and bentonite seal from 0.3 m to ground surface.
WN2	26.3/155.3	Hole sealed to 26.3 m with bentonite, piezometer with 1.8 m slotted screen installed with filter sand to 24.1 m, bentonite seal from 24.1 m to ground surface.
WN3	22.6/159.5	Hole sealed to 22.6 m with bentonite, piezometer with 1.5 m slotted screen installed with filter sand to 20.7 m, bentonite seal from 20.7 m to ground surface with a flush mounted casing installation.
WRW2	15.2/167.4	Piezometer with 1.5 m slotted screen installed with filter sand to 12.8 m, bentonite seal from 12.8 m to 12.2 m, silty clay cuttings from 12.2 m to 0.6 m and bentonite seal from 0.6 m to ground surface.
WRW3	10.7/173.0	Piezometer with 1.5 m slotted screen installed with filter sand to 8.6 m, bentonite seal from 8.6 m to 8.0 m, silty clay cuttings from 8.0 m to 0.6 m and bentonite seal from 0.6 m to ground surface.
WRW4	15.2/167.8	Piezometer with 1.5 m slotted screen installed with filter sand to 12.8 m, bentonite seal from 12.8 m to 12.2 m, silty clay cuttings from 12.2 m to 0.6 m and bentonite seal from 0.6 m to ground surface.
WS1	22.9/159.8	Hole sealed to 22.9 m with bentonite, piezometer with 1.5 m slotted screen installed with filter sand to 20.4 m, bentonite seal from 20.4 m to ground surface.
WS4	24.4/158.3	Hole sealed to 24.4 m with bentonite, piezometer with 1.5 m slotted screen installed with filter sand to 21.9 m, bentonite seal from 21.9 m to ground surface.

Table 3.4 – Piezometer Installation Details (Site #4)

Piezometer Location	Piezometer Details	
	Tip Depth/ Elevation (m)	Completion Details
MR 9+850Rt	6.1/173.7	Piezometer 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.
MRW1	10.3/170.1	Silty clay cuttings to 10.3 m, piezometer with 1.5 m slotted screen installed with filter sand to 8.2 m, bentonite seal from 8.2 m to 7.6 m, silty clay cuttings from 7.6 m to 0.6 m and bentonite seal from 0.6 m to ground surface with a flush mounted casing installation.
MRW3	10.7/169.8	Piezometer with 1.5 m slotted screen installed with filter sand to 8.5 m, bentonite seal from 8.5 m to 7.9 m, silty clay cuttings from 7.9 m to 0.6 m and bentonite seal from 0.6 m to ground surface with a flush mounted casing installation.



The drilling, sampling and in-situ testing operations were observed on a full time basis by members of Terraprobe's technical staff who logged the boreholes and processed the recovered soil and rock 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, unconfined compression tests and undrained shear strength testing with a laboratory vane. The results of this testing program are shown on the Record of Borehole sheets in Appendices A1 – A4 and the Figures in Appendices B1 – B4.

5 DESCRIPTION OF SUBSURFACE CONDITIONS

5.1 Site 1 – Sta. 11+816 to Sta. 11+947

Reference is made to the Record of Borehole sheets in Appendix A1. Details of the encountered soil stratigraphy are presented in this appendix and on the “Borehole Locations and Soil Strata” drawing in Appendix C1. An overall description of the stratigraphy is given in the following paragraphs. However, the factual data presented in the Record of Borehole Sheets governs any interpretation of the site conditions.

In general, the site is underlain by topsoil, fill material (silty sand and silty clay) and a native silty clay deposit.

5.1.1 Topsoil

Topsoil ranging from 150 mm to 200 mm thick was encountered at this site. Topsoil thickness may vary between and beyond the boreholes.

5.1.2 Fill – Silty Sand

Silty sand fill material was encountered in Borehole RW2. This fill material extends to a depth of 0.7 m (Elev. ± 190.3 m) below ground surface.

A Standard Penetration test in this fill gave an ‘N’ value of 23 blows for 0.3 m penetration. Based on this result the fill is considered to have a compact relative density. The moisture content of a sample of this fill was 18% by weight.

5.1.3 Fill – Silty Clay

Silty clay fill material was encountered in all of the boreholes extending to depths ranging from 7.1 m to 8.6 m below ground surface or to elevations of ± 183.2 m to ± 182.9 m.

Samples of the silty clay fill were subjected to grain size distribution tests and the results are presented in Figures B1-1 and B1-2. These results show grain size distributions consisting of 0-10% gravel, 2-6% sand, 54-63% silt and 31-43% clay size particles.



Samples of the fill were also subjected to Atterberg Limits tests and the results are plotted on the plasticity charts, Figures B1-3 and B1-4. The index values from these tests are summarized below:

Liquid Limit:	30-40%
Plastic Limit:	17-20%
Plasticity Index:	13-20%
Natural Moisture Content:	14-23%

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

Standard Penetration tests in the silty clay fill gave 'N' values that ranged from 5 to 47 blows for 0.3 m penetration and field vane tests gave in-situ undrained shear strengths ranging from 60 kPa to in excess of 100 kPa. Based on these results the fill is considered to have a firm to hard consistency. The moisture content of samples of this fill ranged from 10% to 33% by weight.

5.1.4 Silty Clay

A silty clay deposit was encountered across the site extending to borehole termination depths of 11.2 m below ground surface or to elevations ranging from ± 180.6 m to ± 178.8 m.

The grain size distribution plots of tested samples of the silty clay (Figure B1-5) show a grain size distribution consisting of 0% gravel, 1-10% sand, 43-52% silt and 41-56% clay size particles.

Samples were also subjected to Atterberg Limits tests and the results are illustrated on the plasticity chart, Figure B1-6. The index values from these tests are summarized below:

Liquid Limit:	38-48%
Plastic Limit:	20-24%
Plasticity Index:	18-24%
Natural Moisture Content:	20-21%

These values indicate that the silty clay has a generally intermediate plasticity.

The blow counts from Standard Penetration tests conducted in this stratum ranged from 26 to 65 blows for 0.3 m penetration indicating that the silty clay has a very stiff to hard consistency. The moisture content of samples of the silty clay ranged from 19% to 22% by weight.



5.1.5 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 5.1.1.

Table 5.1.1 – Water Level Measurements

Borehole	Date	Water Levels	
		Depth (m)	Elevation (m)
RW1	July 07, 2010	6.3	183.7
	July 14, 2010	6.3	183.7
	July 21, 2010	6.2	183.8
RW3	July 07, 2010	8.3	183.5
	July 14, 2010	6.6	185.2
	July 21, 2010	7.1	184.7
	July 28, 2010	7.0	184.8
RW4	July 07, 2010	Dry	-
	July 14, 2010	5.7	185.8
	July 21, 2010	5.0	186.5
	July 28, 2010	4.9	186.6

The ground water table was estimated based on the recorded water levels in the standpipe piezometers and our review of moisture contents of the retrieved samples. This interpretation indicates that the ground water table generally follows the topography of the land. The water level is estimated to be at Elev. ± 183.8 m at the south limit of the alignment, rising gradually to about Elev. ± 184.8 at Sta. 11+900 and increasing to the north limit where it is estimated to be at Elev. ± 186.6 m. Perched water can also be expected to occur where permeable layers of silty sand are underlain by more impermeable silty clay soils.

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

5.2 Site 2 – North and South of Trillium Railway

Reference is made to the Record of Borehole sheets in Appendix A2. Details of the encountered soil and rock stratigraphy are presented in this appendix and on the “Borehole Locations and Soil Strata” drawings in Appendix C2. An overall description of the stratigraphy is given in the following paragraphs. However, the factual data presented in the Record of Borehole Sheets governs any interpretation of the site conditions.

In general, the site is underlain by topsoil and about 28.4 m to 30.6 m of overburden soils consisting of fill material (gravelly sand to sandy gravel, silty sand and silty clay) and native deposits of silty clay, silty clay to clayey silt till, sand, silty sand to sandy silt till, and gravelly sand to sandy gravel till. These soils are underlain by bedrock consisting primarily of dolostone and shale of the Salina formation.

5.2.1 Topsoil

Topsoil ranging from 30 mm to 380 mm in thickness was encountered on this site. Topsoil thickness may vary between and beyond the boreholes.



5.2.2 Fill – Gravelly Sand to Sandy Gravel

Some of the boreholes encountered granular fill material ranging in composition from gravelly sand to sandy gravel. This fill extends to depths ranging from 0.7 m to 0.8 m below ground surface or to elevations ranging from ± 183.4 m to ± 182.6 m.

The grain size distribution plots of tested samples of this granular fill are depicted in Figure B2-1. These results show a grain size distribution consisting of 10-72% gravel, 17-76% sand, 7-25% silt and up to 15% clay size particles.

Standard Penetration tests in the granular fill gave 'N' values that ranged from 6 to 53 blows for 0.3 m penetration, but generally 'N' values ranged from 19 to 53 blows for 0.3 m penetration. Based on these results the fill is considered to have a generally compact to very dense relative density with occasional loose zones. The moisture content of samples of the fill ranged from 1% to 29% by weight.

5.2.3 Fill – Silty Sand

Silty sand fill material was encountered in Borehole TN1 extending to a depth of 1.4 m (Elev. ± 182.1 m) below ground surface.

The grain size distribution plot (Figure B2-2) of a tested sample of this fill is depicted shows a grain size distribution consisting of 13% gravel, 65% sand and 22% silt and clay size particles.

Standard Penetration tests in this fill gave 'N' values ranging from 14 to 16 blows for 0.3 m penetration. Based on this result the fill is considered to have a compact relative density. The moisture content of samples of this fill ranged from 14% to 19% by weight.

5.2.4 Fill – Silty Clay

Silty clay fill material was encountered at this site extending to depths ranging from 0.7 m (Elev. ± 182.7 m) to 2.9 m (Elev. ± 180.1 m) below ground surface.

Samples of the silty clay fill were subjected to grain size analysis and the results (Figure B2-3) show a grain size distribution consisting of 0-15% gravel, 3-18% sand, 33-58% silt and 22-64% clay size particles.

Samples of the fill material were 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:	24-62%
Plastic Limit:	14-27%
Plasticity Index:	10-35%
Natural Moisture Content:	15-27%

These values indicate that fill is generally a low to intermediate plasticity silty clay with occasional high plasticity silty clay inclusions.



Standard Penetration tests in the silty clay fill gave 'N' values that ranged from 2 to 35 blows for 0.3 m penetration, but generally 'N' values ranged from 5 to 35 blows for 0.3 m penetration. Based on these results, the fill is considered to have a generally firm to hard consistency with infrequent soft zones. The moisture content of samples of this fill ranged from 6% to 44% by weight.

5.2.5 Silty Clay

A major silty clay deposit was encountered across the site. Boreholes NBL 12+375Lt, NBL 12+440Rt, SBL 12+360CL, SBL 12+410CL, SEW 10+050CL, TRW1, TRW2, WE-S 10+295CL, and WE-S 10+345CL were terminated in this deposit at depths ranging from 11.2 m (Elev. ± 172.0 m) to 14.6 m (Elev. ± 168.2 m) below ground surface. This deposit was fully penetrated in all of the remaining boreholes where it extended to depths ranging from 14.6 m to 15.8 m below ground surface or to elevations of ± 169.5 m to ± 166.8 m.

The grain size distribution plots of tested samples of the silty clay are presented in Figures B2-5 to B2-22 inclusive. These results show a grain size distribution consisting of 0-7% gravel, 1-13% sand, 36-87% silt and 12-62% clay size particles. One tested sample from borehole TN3 at approximately 5.5 m depth (Elev. ± 178.6 m) contained 41% sand.

Samples were also subjected to Atterberg Limits tests and the results are illustrated on the plasticity charts, Figures B2-23 to B2-39 inclusive. The index values from these tests are summarized below:

Liquid Limit:	23-58%
Plastic Limit:	11-25%
Plasticity Index:	5-33%
Natural Moisture Content:	12-33%

These values indicate that the silty clay has a generally low to intermediate plasticity with occasional zones of high plasticity and infrequent clayey silt zones.

The Atterberg Limits test results are plotted against elevation, Figure B2-54. These results illustrate that the natural moisture contents are generally at or below the plastic limit down to about Elev. ± 177.0 m. Below Elev. ± 177.0 m the data indicates that the moisture contents generally exist between the plastic and liquid limits.

Standard Penetration tests in this stratum gave 'N' values that ranged from 3 to 77 blows for 0.3 m penetration and field vane tests gave in-situ undrained shear strengths ranging from 40 kPa to in excess of 120 kPa. Unconfined compression tests gave undrained shear strength ranging from 65 kPa to 93 kPa and laboratory vane tests on relatively undisturbed Shelby tube samples gave undrained shear strengths ranging from 34 kPa to 140 kPa. These values indicate that the consistency of the silty clay is generally stiff to hard with occasional firm zones. The moisture content of samples of the silty clay range from 6% to 33% by weight and the unit weight of tested samples ranged from 20.4 to 20.8 kN/m³.



The variation of undrained shear strength with elevation is depicted in Figure B2-55. The plot illustrates a wide scatter in the data with no obvious trend with depth and an interpreted dashed line is shown representing a lower bound trend with depth for the data. The upper portion of this deposit down to about Elev. ± 177.0 m is estimated to have relatively high shear strength i.e. in excess of 100 kPa. Below Elev. ± 177.0 m the undrained shear strength decreases with depth and is about 50 kPa from Elev. ± 172.0 m to Elev. ± 170.0 m. Below Elev. ± 170.0 m the trend indicates increasing undrained shear strength with depth.

Consolidation tests were also performed on Shelby tube samples retrieved from Boreholes WE-S 10+345CL, SBL 12+360CL, NBL 12+375Lt, SEW 10+050CL, WE-S 10+295CL, SBL 12+410CL, NBL 12+440Rt, and TSEW3 and the results are presented in Figures B2-56 to B2-79. 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 in the following table.

Borehole/Sample No.	Sample Depth/Elevation (m)	P _c (kPa)	C _c	C _r	e _o
WE-S 10+345CL TW10	10.7/172.1	230 – 370	0.183	0.019	0.56
SBL 12+360CL TW10	10.7/172.2	340 – 500	0.201	0.030	0.57
NBL 12+375Lt TW9	9.1/174.2	310	0.204	0.036	0.60
SEW 10+050CL TW9	9.1/174.3	310 – 400	0.221	0.027	0.63
WE-S 10+295CL TW10	9.1/173.7	350	0.160	0.028	0.55
SBL 12+410CL TW9	9.1/173.4	300 – 350	0.205	0.031	0.60
NBL 12+440Rt TW10	10.7/172.3	370 – 480	0.193	0.025	0.59
TSEW3 TW13	12.2/171.1	230 – 300	0.208	0.037	0.62

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

5.2.6 Silty Clay to Clayey Silt Till

Discontinuous layers of silty clay to clayey silt till were encountered at this site extending to depths ranging from 23.8 m (Elev. ± 158.9 m) to 28.4 m (Elev. ± 155.1 m) below ground surface. Boreholes TRW3 and TRW4 were terminated in this deposit at depths of 17.3 m (Elev. ± 165.8 m) and 15.7 m (Elev. ± 168.3 m) below ground surface respectively.

The grain size distribution plots of tested samples from these strata are presented in Figures B2-40 to B2-43 inclusive. These results show a grain size distribution consisting of 0-28% gravel, 2-39% sand, 32-63% silt and 12-42% clay size particles. Till soils will also contain random cobble and boulder inclusions.



Selected samples were also subjected to Atterberg Limits tests and the results are presented in Figures B2-44 to B2-48 inclusive. The index values from these tests are summarized below:

Liquid Limit:	17-32%
Plastic Limit:	11-16%
Plasticity Index:	5-16%
Natural Moisture Content:	7-29%

These values are characteristic of clayey soils of low plasticity.

Standard Penetration tests in these deposits yielded 'N' values ranging from 10 to more than 100 blows per 0.3 m penetration and field vane tests gave in-situ undrained shear strengths ranging from 88 kPa to in excess of 100 kPa. Based on these results, the silty clay to clayey silt till is considered to have a stiff to hard consistency. The moisture content of samples from these deposits varies from 1% to 29% by weight.

5.2.7 Sand

Discontinuous layers of sand and gravel to gravelly sand were encountered at this site. These deposits are approximately 0.8 m to 2.4 m thick and extend to depths ranging from 23.1 m (Elev. ± 159.6 m) to 26.2 m (Elev. ± 157.1 m) below ground surface.

Samples from these strata were subjected to grain size analysis and the results are illustrated in Figure B2-49. These results show a grain size distribution consisting of 31-32% gravel, 56-57% sand, 10-12% silt and up to 2% clay size particles.

Standard Penetration tests in these deposits gave 'N' values that ranged from 34 to more than 100 blows per 0.3 m penetration. Based on these results, the deposits are considered to have a dense to very dense relative density. The moisture content of samples from these strata ranged from 5% to 14% by weight.

5.2.8 Silty Sand to Sandy Silt Till

Deposits of silty sand to sandy silt till were encountered at this site extending to depths ranging from 23.9 m to 30.6 below ground surface or to elevations ranging from ± 160.3 m to ± 153.0 m.

Samples from these deposits were subjected to grain size distribution tests and the results are illustrated in Figures B2-50 and B2-51. These results show a grain size distribution consisting of 4-35% gravel, 28-72% sand, 15-38% silt and 6-17% clay size particles. Till soils will also contain random cobble and boulder inclusions.

Standard Penetration tests in these deposits gave 'N' values that ranged from 29 to more than 100 blows per 0.3 m penetration indicating a compact to very dense relative density. The moisture content of samples from these strata ranged from 4% to 28% by weight.



5.2.9 Gravelly Sand to Sandy Gravel Till

Till deposits consisting of sandy gravel to sand and gravel were encountered in some of the deep boreholes drilled at this site. These deposits were found to extend to depths ranging from 28.4 m to 30.5 m below the ground surface or to elevations ranging from ± 154.5 m to ± 153.6 m.

Grain size distribution tests were performed on samples from these deposits and the results are illustrated in Figures B2-52 and B2-53. These results show grain size distributions consisting of 2-51% gravel, 26-95% sand, 3-29% silt and 5-8% clay size particles. Random cobble and boulder inclusions are also expected to occur in till soils.

The blow counts from Standard Penetration tests conducted in these deposits ranged from 18 to more than 100 blows for 0.3 m penetration indicating a compact to very dense relative density. The moisture content of samples from these strata ranged from 1% to 16% by weight.

5.2.10 Bedrock (Salina Formation)

The overburden soils described above are underlain by the Salina Formation. Bedrock was proved by coring at the abutment locations of the proposed bridge structures. Table 5.2.1 summarizes the bedrock depth and the elevations to the top of bedrock.

Table 5.2.1 – Depth to Bedrock

Bridge	Location	BH Number	Depth to Bedrock (m)	Top of Bedrock Elevation (m)
Trillium E/W-S	South Abutment	TEW1	28.8	153.7
		TEW2	28.7	154.0
	North Abutment	TEW3	28.9	153.7
		TEW4	28.7	153.9
Trillium NBL	South Abutment	TN1	30.5	153.0
		TN2	30.5	153.7
	North Abutment	TN3	29.6	154.5
		TN4	30.6	153.4
Trillium SBL	South Abutment	TS1	28.4	154.2
		TS2	29.4	153.9
	North Abutment	TS3	28.7	153.8
		TS4	28.4	154.0
Trillium S-E/W	South Abutment	TSEW1	29.7	153.8
		TSEW2	29.6	153.7
	North Abutment	TSEW3	29.7	153.6
		TSEW4	29.5	154.0

The bedrock is described as unweathered interbedded dolostone and shale and its colour is generally grey. It is thinly laminated with white unweathered gypsum and calcite veins and coarse grained calcitic vugs.

Total core recovery in the bedrock ranged from 20% to 100%. The RQD values ranged widely from 0% to 84% but generally, most of the RQD values were below 50%. An RQD of 0% was obtained in Run 1 of Boreholes TEW3, TN2, TN4, TS3, and TSEW4 and in Run 2 of Boreholes TEW4 and TSEW4. Rubble and highly fractured zones were observed in the rock cores, which contributed to the relatively low RQD values. The core data also reveals that there is no trend of



improving rock quality with depth. Based on these results the rock quality is considered to be very poor to poor with occasional zones of fair to good quality rock.

5.2.11 Water Levels

Standpipe piezometers were installed in selected boreholes and the water level readings measured on separate visits made after the completion of drilling are presented in the following tables.

Table 5.2.2 – Water Level Measurements (South Alignment)

Borehole	Date	Water Levels	
		Depth (m)	Elevation (m)
TRW1	July 05, 2010	1.5	181.7
	July 12, 2010	1.6	181.6
	July 19, 2010	1.9	181.3
	July 28, 2010	2.2	181.0
	August 06, 2010	2.4	180.8
WE-S 10+345CL	November 19, 2009	4.0	178.8
	November 30, 2009	3.4	179.4
	December 07, 2009	3.1	179.7
	December 15, 2009	3.0	179.8
	January 11, 2010	2.6	180.2
	January 27, 2010	2.7	180.1
TEW1	January 19, 2010	3.2	179.3
	January 27, 2010	2.4	180.1
	February 08, 2010	2.4	180.1
TS1	January 19, 2010	10.6	172.0
	January 27, 2010	10.4	172.2
	February 08, 2010	10.5	172.1
SBL 12+360CL	November 19, 2009	5.0	177.9
	November 30, 2009	2.6	180.3
	December 07, 2009	2.4	180.5
	December 15, 2009	2.3	180.6
	January 04, 2010	2.1	180.8
	January 11, 2010	2.1	180.8
NBL 12+375Lt	November 19, 2009	5.8	177.5
	November 30, 2009	3.2	180.1
	December 07, 2009	1.3	182.0
	December 15, 2009	1.8	181.5
	January 19, 2010	1.7	181.6
TN2	April 16, 2010	2.6	181.6
	April 29, 2010	1.6	182.6
	May 04, 2010	6.2	178.0
	May 06, 2010	6.2	178.0
S-EW 10+050CL	December 08, 2009	2.4	181.0
	December 15, 2009	2.4	181.0
	January 04, 2010	2.4	181.0
	January 11, 2010	2.4	181.0
TSEW2	January 11, 2010	8.5	174.8
	January 19, 2010	8.6	174.7
	January 27, 2010	8.8	174.5
	February 08, 2010	8.8	174.5
TRW2	July 12, 2010	2.8	179.7
	July 19, 2010	2.9	179.6



Table 5.2.3 – Water Level Measurements (North Alignment)

Borehole	Date	Water Levels	
		Depth (m)	Elevation (m)
TRW3	July 05, 2010	2.3	180.8
	July 12, 2010	3.2	179.9
	July 19, 2010	2.3	180.8
	July 28, 2010	3.5	179.6
	August 06, 2010	3.5	179.6
TEW4	January 11, 2010	10.2	172.4
	January 19, 2010	10.6	172.0
	January 27, 2010	10.5	172.1
	February 08, 2010	10.6	172.0
TS4	January 11, 2010	9.4	173.0
	January 19, 2010	9.9	172.5
	January 27, 2010	10.2	172.2
	February 08, 2010	10.4	172.0
SBL 12+410CL	November 30, 2009	1.7	180.8
	December 07, 2009	1.4	181.1
	December 15, 2009	1.3	181.2
TN3	April 16, 2010	3.9	180.2
	April 29, 2010	4.7	179.4
	May 04, 2010	8.7	175.4
	May 06, 2010	9.4	174.7
	May 18, 2010	3.8	180.3
TSEW4*	-	-	-
NBL 12+440Rt	November 09, 2009	8.2	174.8
	November 19, 2009	2.1	180.9
	November 30, 2009	1.9	181.1
	December 08, 2009	1.9	181.1
TRW4	July 28, 2010	10.6	173.4
	August 06, 2010	3.4	180.6
	August 13, 2010	2.9	181.1
	August 23, 2010	3.1	180.9

* Piezometer destroyed after installation.

The ground water table was estimated based on the recorded water levels in the standpipe piezometers and our review of moisture contents of the retrieved samples. This interpretation indicates a ground water table that is estimated to range between Elev. ± 179.5 m and Elev. ± 181.0 m. Perched water can also be expected to occur where permeable layers of sand and gravel and sand and silts are underlain by more impermeable silty clay soils.

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

5.3 Site 3 – North and South of Woodlawn Road

Reference is made to the Record of Borehole sheets in Appendix A3. Details of the encountered soil and rock stratigraphy are presented in this appendix and on the “Borehole Locations and Soil Strata” drawings in Appendix C3. An overall description of the stratigraphy is given in the following paragraphs. However, the factual data presented in the Record of Borehole Sheets governs any interpretation of the site conditions.



In general, the site is underlain by topsoil and about 25.9 m to 27.5 m of overburden soils consisting of topsoil, fill material (sand and gravel and silty clay) and native deposits of silty clay, silt, silty clay to clayey silt till and silty sand to sandy silt till. These soils are underlain by bedrock of the Salina Formation.

5.3.1 Topsoil

Topsoil ranging from 25 mm to 200 mm in thickness was encountered at this site. Topsoil thickness may vary between and beyond the boreholes.

5.3.2 Fill – Sand and Gravel

Boreholes SBL 12+685CL and WN3 were extended through the gravel shoulders of existing roadways where they encountered fill material consisting of sand and gravel. This fill is approximately 470 mm to 700 mm thick and extends to depths ranging from 0.5 m (Elev. ± 182.2 m) to 0.7 m (Elev. ± 181.4 m) below ground surface.

The grain size distribution plots of tested samples of this granular fill are shown in Figure B3-1. These results show a grain size distribution consisting of 41% gravel, 42-44% sand, 13% silt and 2-4% clay size particles.

Standard Penetration tests in the granular fill gave 'N' values that ranged from 11 to 48 blows for 0.3 m penetration. Based on these results the fill is considered to have a compact to dense relative density. The moisture content of samples of the fill ranged from 4% to 6% by weight.

5.3.3 Fill – Silty Clay

Silty clay fill material was encountered at this site extending to depths ranging from 0.7 m (Elev. ± 183.0 m) to 3.7 m (Elev. ± 178.8 m) below ground surface.

The grain size distribution plots of tested samples of this fill are illustrated in Figures B3-2 and B3-3. These results show a grain size distribution consisting of 0-5% gravel, 2-4% sand, 35-67% silt and 31-63% clay size particles.

Samples of the fill were also subjected to Atterberg Limits tests and the results are presented in Figure B3-4. The index values from these tests are summarized below:

Liquid Limit:	27-58%
Plastic Limit:	16-26%
Plasticity Index:	11-32%
Natural Moisture Content:	16-27%

These values indicate that the fill material consists of generally intermediate to high plasticity soils with infrequent low plasticity silty clay inclusions.

Standard Penetration tests in the silty clay fill gave 'N' values ranging from 3 to 43 blows for 0.3 m penetration, but generally 'N' values ranged from 7 to 43 blows for 0.3 m penetration. Based on these results the fill is considered to have a firm to hard consistency with occasional soft zones. The moisture content of samples of the silty clay fill ranged from 16% to 31% by weight.



5.3.4 Silty Clay

A major silty clay deposit was encountered at this site. This deposit was fully penetrated in some of the boreholes at depths ranging from 13.2 m (Elev. ± 168.4 m) to 14.7 m (Elev. ± 167.8 m) below ground surface. Boreholes NBL 12+695Lt, NBL 12+750Rt, SBL 12+685CL, SBL 12+750CL, WRW1 and WRW3 were terminated in this deposit at depths ranging from 11.2 m (Elev. ± 172.5 m) to 13.7 m (Elev. ± 169.1 m) below ground surface.

The grain size distribution plots of tested samples of the silty clay are presented in Figures B3-5 to B3-14 inclusive. These results show a grain size distribution consisting of 0-17% gravel, 0-10% sand, 31-83% silt and 12-68% clay size particles.

Samples were also subjected to Atterberg Limits tests and the results are illustrated on the plasticity charts, Figures B3-15 to B3-24 inclusive. The index values from these tests are summarized below:

Liquid Limit:	24-49%
Plastic Limit:	14-23%
Plasticity Index:	8-27%
Natural Moisture Content:	16-24%

These values indicate that the silty clay has a low to intermediate plasticity.

The Atterberg Limits tests results are plotted against elevation, Figure B3-32. These results illustrate that the natural moisture contents are generally at or below the plastic limit above Elev. ± 178.0 m. Below Elev. ± 178.0 m the moisture content increases and is generally between the plastic and liquid limits.

Standard Penetration tests in this stratum gave 'N' values that ranged from 1 to 61 blows for 0.3 m penetration and field vane tests gave in-situ undrained shear strengths ranging from 48 kPa to in excess of 100 kPa. Unconfined compression tests gave undrained shear strengths ranging from 36 kPa to 77 kPa and laboratory vane tests on relatively undisturbed Shelby tube samples gave undrained shear strengths ranging from 49 kPa to in excess of 120 kPa. These values indicate that the consistency of the silty clay is generally stiff to hard with occasional firm zones. The moisture content of samples from this stratum ranged from 12% to 27% by weight and the unit weight of tested samples ranged between 20.6 and 21.1 kN/m³.

The variation of undrained shear strength with elevation is depicted in Figure B3-33. The plot illustrates a wide scatter in the data with no obvious trend with depth and an interpreted dashed line is shown representing a lower bound trend with depth for the data. The upper portion of this deposit down to about Elev. ± 178.0 m is estimated to have relatively high shear strength i.e. in excess of 100 kPa. Below Elev. ± 178.0 m the undrained shear strength decreases with depth and is about 50 kPa between Elev. ± 175.0 m and Elev. ± 172.0 m. Below Elev. ± 172.0 m the trend indicates increasing undrained shear strength with depth.



Consolidation tests were performed on Shelby tube samples retrieved from Boreholes NBL 12+695Lt, NBL 12+750Rt, SBL 12+685CL, and SBL 12+750CL and the results are presented in Figures B3-34 to B3-45 inclusive. 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
NBL 12+695Lt TW11	12.2/170.7	320 – 450	0.224	0.028	0.60
NBL 12+750Rt TW9	9.1/173.7	320 – 340	0.194	0.026	0.57
SBL 12+685CL TW10	10.7/172.0	370 – 550	0.233	0.027	0.59
SBL 12+750CL TW10	9.9/173.0	370 – 380	0.171	0.020	0.50

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

5.3.5 Silt

A discontinuous silt deposit was encountered at this site. The deposit is approximately 0.5 m to 1.5 m thick and extends to depths ranging from 3.5 m (Elev. ±178.1 m) to 5.9 m (Elev. ±176.8 m) below ground surface. Based on visual and tactile examinations of the retrieved samples, the unit is essentially a cohesionless silt with frequent cohesive silty clay seams and partings.

The grain size distribution plots of tested samples of the silt are presented in Figure B3-25. These results show a grain size distribution consisting of 0-1% gravel, 0-2% sand, 75-84% silt and 15-22% clay size particles.

The deposit is considered to have a loose to very dense relative density based on SPT 'N' values that ranged from 9 to 64 blows for 0.3 m penetration. The moisture content of samples from this deposit ranged from 16% to 22% by weight.

5.3.6 Silty Clay to Clayey Silt Till

Layers of silty clay to clayey silt till were encountered at this site. An upper silty clay to clayey silt till unit was encountered directly underlying the native silty clay deposit. This unit was fully penetrated in the deep boreholes drilled at the proposed Woodlawn Overhead structures where it was found to extend to depths ranging from 16.2 m (Elev. ±165.4 m) to 18.7 m (Elev. ±164.0 m) below ground surface. Boreholes WRW2 and WRW4 were terminated within the upper silty clay to clayey silt till stratum at a depth of 15.7 m below ground surface, corresponding to elevations of ±166.9 m and ±167.3 m respectively. Boreholes WS1, WS2 and WS3 encountered a lower deposit of clayey silt till approximately 1.6 m to 2.5 m thick that extends to depths of 22.3 m below ground surface or to elevations of ±160.8 m to ±160.4 m.



The grain size distribution plots of samples of the silty clay to clayey silt till deposits are presented in Figures B3-26 and B3-27. These results show a grain size distribution consisting of 2-17% gravel, 9-35% sand, 35-62% silt and 15-25% clay size particles. Till soils can also be expected to contain random cobble and boulder inclusions.

Samples of the silty clay to clayey silt till were also subjected to Atterberg Limits tests and the results are presented in Figures B3-28 and B3-29. The index values from these tests are summarized below:

Liquid Limit:	15-26%
Plastic Limit:	11-22%
Plasticity Index:	4-11%
Natural Moisture Content:	7-19%

These values indicate low plasticity silty clay and clayey silt soils.

Standard Penetration tests in the silty clay to clayey silt till yielded 'N' values ranging from 18 to more than 100 blows for 0.3 m penetration. Field vane tests were also attempted in these deposits and the results (no-turn on vane) indicate undrained shear strengths more than 100 kPa. These values indicate that the consistency of the silty clay to clayey silt till is very stiff to hard. The moisture contents of samples of the silty clay to clayey silt till range from 7% to 19% by weight.

5.3.7 Silty Sand to Sandy Silt Till

Till deposits ranging in composition from silty sand to sandy silt were encountered at this site extending to depths ranging from 25.9 m (Elev. ± 157.1 m) to 27.5 m (Elev. ± 155.2 m) below ground surface.

The results of grain size distribution tests conducted on samples obtained from these till deposits are illustrated in Figures B3-30 and B3-31. These results show grain size distributions of 2-26% gravel, 10-48% sand, 31-72% silt and 4-16% clay size particles. Till soils will also contain random cobble and boulder inclusions.

Standard Penetration tests in these deposits gave 'N' values that ranged from 28 to more than 100 blows per 0.3 m penetration indicating a compact to very dense relative density. The moisture content of samples from these strata ranged from 3% to 13% by weight.



5.3.8 Bedrock (Salina Formation)

The overburden soils described above are underlain by the Salina Formation. Bedrock was proved by coring at the abutment locations of the proposed bridge structures on the NBL and SBL alignments. Table 5.3.1 summarizes the bedrock depth and the elevations to the top of bedrock.

Table 5.3.1 – Depth to Bedrock

Bridge	Location	BH Number	Depth to Bedrock (m)	Top of Bedrock Elevation (m)
Woodlawn NBL	South Abutment	WN1	27.4	155.7
		WN2	25.9	155.7
	North Abutment	WN3	26.4	155.7
		WN4	26.0	156.5
Woodlawn SBL	South Abutment	WS1	27.5	155.2
		WS2	27.3	155.8
	North Abutment	WS3	25.9	157.1
		WS4	26.3	156.4

The bedrock is described as unweathered interbedded dolostone and shale and its colour is generally grey. It is thinly laminated with white unweathered gypsum and calcite veins.

Total core recovery in the bedrock ranged from 19% to 100%. The RQD values ranged widely from 0% to 70% but generally most of the RQD values were below 50%. An RQD of 0% was obtained in Run 1 of Boreholes WN3 and WS1. Rubble and highly fractured zones were observed in the rock cores, which contributed to the relatively low RQD values. The core data also reveals that there is no trend of improving rock quality with depth. Based on these results the rock quality is considered to be very poor to poor with occasional zones of fair quality rock.

5.3.9 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 the following tables.

Table 5.3.2 – Water Level Measurements (South Alignment)

Borehole	Date	Water Levels	
		Depth (m)	Elevation (m)
WS1	January 27, 2010	6.8	175.9
	February 08, 2010	6.8	175.9
SBL 12+685CL*	-	-	-
NBL 12+695Lt	November 30, 2009	9.3	173.6
	December 15, 2009	3.4	179.5
	January 04, 2010	3.2	179.7
	January 11, 2010	3.3	179.6
	January 19, 2010	3.4	179.5
WN2	January 04, 2010	5.2	176.4
	January 11, 2010	4.2	177.4
	January 19, 2010	5.2	176.4
	January 27, 2010	5.2	176.4
WRW2	July 05, 2010	9.7	172.9
	July 13, 2010	4.4	178.2
	July 21, 2010	3.6	179.0
	July 27, 2010	3.6	179.0



Table 5.3.3 – Water Level Measurements (North Alignment)

Borehole	Date	Water Levels	
		Depth (m)	Elevation (m)
WRW3	July 05, 2010	3.2	180.5
	July 13, 2010	3.2	180.5
	July 20, 2010	2.9	180.8
	July 27, 2010	2.6	181.1
	August 06, 2010	3.4	180.3
	August 13, 2010	3.6	180.1
WS4	February 08, 2010	4.7	178.0
	April 16, 2010	2.1	180.6
	April 29, 2010	5.1	177.6
	May 04, 2010	5.7	177.0
	May 06, 2010	4.1	178.6
	May 18, 2010	5.9	176.8
SBL 12+750CL	November 19, 2009	4.6	178.3
	November 30, 2009	7.8	175.1
	December 08, 2009	4.1	178.8
	December 15, 2009	3.2	179.7
	January 04, 2010	2.7	180.2
	January 11, 2010	2.7	180.2
	January 19, 2010	2.6	180.3
WN3	April 16, 2010	7.7	174.4
	April 29, 2010	3.9	178.2
	May 04, 2010	5.2	176.9
	May 06, 2010	4.8	177.3
NBL 12+750Rt	December 15, 2009	5.1	177.7
	January 04, 2010	2.7	180.1
	January 11, 2010	2.7	180.1
	January 19, 2010	2.8	180.0
WRW4	July 05, 2010	9.7	173.3
	July 13, 2010	4.7	178.3
	July 21, 2010	4.1	178.9
	July 27, 2010	3.0	180.0
	August 06, 2010	2.6	180.4
	August 13, 2010	3.3	179.7
	August 23, 2010	3.5	179.5

* Piezometer destroyed after installation.

The ground water table was estimated based on the recorded water levels in the standpipe piezometers and our review of moisture contents of the retrieved samples. This interpretation indicates a ground water table that is estimated to range between Elev. ± 179.5 m and Elev. ± 181.0 m. Perched water can also be expected to occur where permeable layers of sand and gravel and sand and silts are underlain by more impermeable silty clay soils.

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 Site 4 – Right Side of Merritt Road Sta. 9+700 to 9+910

Reference is made to the Record of Borehole sheets in Appendix A4. Details of the encountered soil stratigraphy are presented in this appendix and on the “Borehole Locations and Soil Strata” drawing in Appendix C4. An overall description of the stratigraphy is given in the following paragraphs. However, the factual data presented in the Record of Borehole Sheets governs any interpretation of the site conditions.

In general, the site is underlain by topsoil, fill material (gravel and sand to sandy gravel, silty sand, and silty clay) and native overburden deposits of silty clay, silt and silty clay to clayey silt.

5.4.1 Topsoil

A 60 mm thick layer of topsoil was encountered in Borehole MR 9+850Rt. Topsoil thickness may vary between and beyond the boreholes.

5.4.2 Fill – Gravel and Sand to Sandy Gravel

Boreholes MRW1, MRW2 and MRW3 were drilled through the existing shoulder of Merritt Road. These boreholes encountered approximately 460 mm to 700 mm thick layers of granular fill material ranging in composition from gravel and sand to gravelly sand. This fill extends to depths ranging from 0.5 m (Elev. ± 180.3 m) to 0.7 m (Elev. ± 179.7 m) below ground surface.

The grain size distribution plot of a tested sample of this granular fill is depicted in Figure B4-1. These results show a grain size distribution consisting of 31% gravel, 53% sand, 14% silt and 2% clay size particles.

Standard Penetration tests in the granular fill gave ‘N’ values that ranged from 19 to 27 blows for 0.3 m penetration. Based on these results the fill is considered to have a compact relative density. The moisture content of samples of the fill ranged from 2% to 3% by weight.

5.4.3 Fill – Silty Sand

Silty sand fill material was encountered underlying the gravel and sand to gravelly sand fill in Boreholes MRW1, MRW2 and MRW3. This fill material is approximately 0.7 m to 2.1 m thick and extends to depths ranging from 1.4 m (Elev. ± 179.0 m) to 2.6 m (Elev. ± 178.2 m) below ground surface.

The grain size distribution plots of tested samples of the silty sand fill are depicted in Figure B4-2. These results show a grain size distribution consisting of 0-7% gravel, 68-70% sand, 21-25% silt and 4-5% clay size particles.

Standard Penetration tests in this fill gave ‘N’ values ranging from 2 to 20 blows for 0.3 m penetration. Based on these results the fill is considered to have a very loose to compact relative density. The moisture content of samples of this fill ranged from 6% to 25% by weight.



5.4.4 Fill – Silty Clay

Silty clay fill material was encountered at this site in Borehole MRW3 extending to a depth of 2.9 m (Elev. ± 177.6 m) below ground surface.

A sample of the silty clay fill was subjected to a grain size distribution test and the results are presented in Figure B4-3. These results show a grain size distribution consisting of 0% gravel, 5% sand, 59% silt and 36% clay size particles.

A sample of the fill was also subjected to an Atterberg Limits test and the results are presented in Figure B4-4. The index values from these tests are summarized below:

Liquid Limit:	39%
Plastic Limit:	20%
Plasticity Index:	19%
Natural Moisture Content:	21%

These values are characteristic of clayey soils of intermediate plasticity.

A Standard Penetration test in the silty clay fill gave an 'N' value of 14 blows for 0.3 m penetration. Based on this result the fill is considered to have a stiff consistency. The moisture content of samples of this fill ranged from 21% to 24% by weight.

5.4.5 Silty Clay

A major silty clay deposit was encountered across the site. Borehole MR 9+850Rt was terminated within this deposit at a depth of 7.5 m (Elev. ± 172.3 m) below ground surface. The deposit was fully penetrated in the remaining boreholes where it was found to extend to depths ranging from 8.6 m (Elev. ± 171.9 m) to 10.1 m (Elev. ± 170.3 m) below ground surface.

The grain size distribution plots of tested samples of the silty clay are presented in Figures B4-5 and B4-6. These results show a grain size distribution consisting of 0% gravel, 0-4% sand, 33-66% silt and 33-67% clay size particles.

Samples were also subjected to Atterberg Limits tests and the results are illustrated on the plasticity charts, Figures B4-7 and B4-8. The index values from these tests are summarized below:

Liquid Limit:	31-40%
Plastic Limit:	17-21%
Plasticity Index:	14-20%
Natural Moisture Content:	19-33%

These values indicate that the silty clay has a generally low to intermediate plasticity.

The Atterberg Limits test results are plotted against elevation, Figure B4-12. These results illustrate that the natural moisture contents within the silty clay stratum are generally at or below the plastic limit above Elev. ± 177.0 m. Below Elev. ± 177.0 m the moisture content increases and is generally between the plastic and liquid limits.



Standard Penetration tests in this stratum gave 'N' values that ranged from 1 to 27 blows for 0.3 m penetration and field vane tests gave in-situ undrained shear strengths ranging from 40 kPa to in excess of 100 kPa. A laboratory vane test on a relatively undisturbed Shelby tube sample gave undrained shear strength of 30 kPa. These values indicate that the consistency of the silty clay is generally firm to very stiff with infrequent soft zones. The moisture content of samples of the silty clay ranged from 18% to 45% by weight and the unit weight of a tested sample was 18.3 kN/m³.

The variation of undrained shear strength with elevation is depicted in Figure B4-13. There is a wide scatter in the data and an interpreted dashed line is shown representing a lower bound trend with depth for the data. The upper portion of this deposit down to about Elev. ± 176.0 m is estimated to have shear strength in excess of 85 kPa. Below Elev. ± 176.0 m the undrained shear strength decreases with depth and is about 50 kPa at Elev. ± 173.0 m. The trend also indicates increasing undrained shear strength below Elev. ± 173.0 m.

Consolidation tests were also performed on a Shelby tube sample retrieved from Borehole MR 9+850Rt and the results are presented in Figures B4-14 to B4-16 inclusive. 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	6.1/173.7	280	0.478	0.091	1.06

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

5.4.6 Silt

A native silt deposit was encountered at this site. The deposit is approximately 1.6 m to 3.1 m thick and extends to depths of 11.7 m below ground surface or to elevations ranging from ± 169.1 m to ± 168.7 m. Based on visual and tactile examinations of the retrieved samples, the unit is essentially a cohesionless silt with occasional cohesive silty clay seams and partings.

The grain size distribution plot of a tested sample from the silt deposit is presented in Figure B4-9. The results show a grain size distribution consisting of 0% gravel, 1% sand, 93% silt and 6% clay size particles.

The deposit is considered to have a loose to compact relative density based on SPT 'N' values that ranged from 7 to 16 blows for 0.3 m penetration. The moisture content of samples from this deposit ranged from 20% to 22% by weight.



5.4.7 Silty Clay to Clayey Silt

A lower silty clay to clayey silt deposit was encountered at this site. Boreholes MRW1, MRW2 and MRW3 were terminated within this deposit at depths of 17.3 m below ground surface or at elevations ranging from ± 163.5 m to ± 163.1 m.

The grain size distribution plots of tested samples of the silty clay to clayey silt are presented in Figure B4-10. These results show grain size distributions consisting of 0-1% gravel, 1-3% sand, 77-82% silt and 17-19% clay size particles.

Samples were also subjected to Atterberg Limits tests and the results are illustrated on the plasticity chart, Figure B4-11. The index values from these tests are summarized below:

Liquid Limit:	24%
Plastic Limit:	16-17%
Plasticity Index:	7-8%
Natural Moisture Content:	17-18%

These values indicate that the silty clay to clayey silt is of low plasticity.

The Atterberg Limits test results are plotted against elevation, Figure B4-12. These results illustrate that the natural moisture contents of the silty clay to clayey silt stratum are generally near the plastic limit.

Standard Penetration tests in this stratum gave 'N' values that ranged from 4 to 31 blows for 0.3 m penetration and field vane tests gave in-situ undrained shear strengths ranging from 64 kPa to in excess of 100 kPa. These values indicate that the consistency of the silty clay is generally stiff to hard with occasional firm zones. The moisture content of samples of the silty clay ranged from 16% to 22% by weight.

The variation of undrained shear strength with elevation is depicted in Figure B4-13. The plot illustrates a wide scatter in the data with no obvious trend with depth and an interpreted dashed line is shown representing a lower bound trend with depth for the data. The upper portion of this deposit is estimated to have shear strength of about 50 kPa. The undrained shear strength increases with depth within this deposit and is about 75 kPa at Elev. ± 166.0 m.



5.4.8 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 5.4.1.

Table 5.4.1 – Water Level Measurements

Borehole	Date	Water Levels	
		Depth (m)	Elevation (m)
MR 9+850Rt	September 10, 2009	6.0	173.8
	September 11, 2009	4.6	175.2
	September 15, 2009	3.9	175.9
MRW1	July 05, 2010	1.5	178.9
	July 13, 2010	1.4	179.0
	July 20, 2010	1.6	178.8
	July 27, 2010	1.3	179.1
	August 06, 2010	2.0	178.4
	August 13, 2010	2.7	177.7
	August 23, 2010	2.1	178.3
MRW3	July 05, 2010	1.8	178.7
	July 13, 2010	1.4	179.1
	July 20, 2010	1.5	179.0

The ground water table was estimated based on the recorded water levels in the standpipe piezometers and our review of moisture contents of the retrieved samples. This interpretation indicates a ground water table that is estimated to exist at about Elev. ± 179.0 m. Perched water can also be expected to occur where permeable layers of sand and gravel and silty sand are underlain by more impermeable silty clay soils.

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

5.5 Miscellaneous

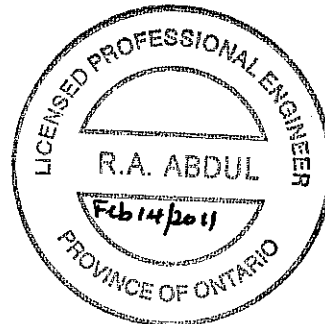
The drilling, sampling and in-situ testing operations were conducted with track and truck mounted drill rigs owned and operated by Groundworks Drilling Limited of Toronto, Ontario, DBW Drilling Limited of Ajax, Ontario, Determination Drilling & Soil Investigations of Hamilton, Ontario, Strong Soil Search Inc. of Claremont, Ontario, and Kodiak Drilling of Oakville, Ontario. The boreholes were advanced using both solid stem and hollow-stem auger drilling techniques and casing and washboring methods. NQ size rock cores of the bedrock were obtained using diamond drilling techniques.

Messrs. Phil Khuu, B.A.T., Marc Paoliello, E.I.T., Alexander Winkelmann, E.I.T., Lucas Yu, E.I.T., and Brady Lin, P.Eng. observed and recorded the field work. 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.



R. Abdul

Prepared by:
R. Abdul, P.Eng.,
Senior Geotechnical Engineer



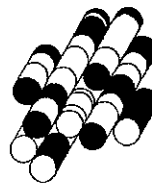
Michael Tanos

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



APPENDICES

Terraprobe Inc.



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

This report was prepared for the express use of the Ministry of Transportation, its retained design consultants and Giffels Associates Ltd./IBI Group. It is not for use by others. This report is copyright of Terraprobe Inc. and no part of this report may be reproduced by any means, in any form, without the prior written permission of Terraprobe Inc. The Ministry of Transportation, its retained design consultants and Giffels Associates Ltd./IBI Group, are authorized users.

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 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
$\epsilon_1, \epsilon_2, \epsilon_3$	%	PRINCIPAL STRAINS
E	kPa	MODULUS OF LINEAR DEFORMATION
G	kPa	MODULUS OF SHEAR DEFORMATION
μ	1	COEFFICIENT OF FRICTION

MECHANICAL PROPERTIES OF SOIL

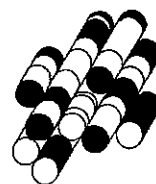
m_v	kPa ⁻¹	COEFFICIENT OF VOLUME CHANGE
C_c	1	COMPRESSION INDEX
C_s	1	SWELLING INDEX
C_α	1	RATE OF SECONDARY CONSOLIDATION
C_v	m ² /s	COEFFICIENT OF CONSOLIDATION
H	m	DRAINAGE PATH
T_v	1	TIME FACTOR
U	%	DEGREE OF CONSOLIDATION
σ'_{vo}	kPa	EFFECTIVE OVERBURDEN PRESSURE
σ'_p	kPa	PRECONSOLIDATION PRESSURE
τ_s	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_r	1	SENSITIVITY = c_u / τ_r

PHYSICAL PROPERTIES OF SOIL

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

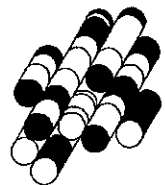
SITE 1

TERRAPROBE INC.



A1

TERRAPROBE INC.



RECORD OF BOREHOLE No RW1

1 OF 1

METRIC

W.P. 280-99-00 LOCATION Coords: N:4763366.8 E:327685.6 ORIGINATED BY BL
DIST HWY 406 BOREHOLE TYPE Hollow Stem Augers COMPILED BY DB
DATUM Geodetic DATE 6.28.10 CHECKED BY RA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	20 40 60 80 100					
190.0	Ground Surface													
189.9	150mm TOPSOIL													
0.2	FILL - Silty Clay, trace sand, stiff to hard, brown, damp to moist		1	SS	8									
			2	SS	34		189							0 5 61 34
			3	SS	15		188							
			4	SS	17									
	----- frequent silt seams and partings -----		5	SS	10		187							
			6	SS	12		186							
			7	SS	18		185							0 3 54 43
			8	SS	17		184							
182.9	SILTY CLAY trace sand, hard, brown, damp to moist		9	SS	31		183							
7.1			10	SS	55		182							
							181							0 2 48 50
			11	SS	57		180							
178.8	End of Borehole						179							
11.2	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) July 07.10 6.3 183.7 July 14.10 6.3 183.7 July 21.10 6.2 183.8													

+³, X³: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

ON_MOT_1-09-4135 RW RET WALLS.GPJ ON_MOT.GDT 9/3/10

RECORD OF BOREHOLE No RW2

1 OF 1

METRIC

W.P. 280-99-00 LOCATION Coords: N:4763410.3 E:327684.3 ORIGINATED BY BL
 DIST HWY 406 BOREHOLE TYPE Hollow Stem Augers COMPILED BY DB
 DATUM Geodetic DATE 6.29.10 CHECKED BY RA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT		UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	20 40 60 80 100	W _p W W _L	WATER CONTENT (%)		
191.0	Ground Surface												
190.9	150mm TOPSOIL												
0.2	FILL - Silty Sand, trace organics, compact, brown, moist to wet		1	SS	23								
190.3													
0.7	FILL - Silty Clay, trace sand, stiff to very stiff, brown, damp to moist		2	SS	24		190						
			3	SS	21		189						
			4	SS	15		188						0 2 61 37
			5	SS	11		187						
	some gravel		6	SS	11		186						10 5 54 31
			7	SS	9		185						
			8	SS	15		184						
183.1	topsoil stained		9	SS	32		183						
7.9	SILTY CLAY trace sand, hard, brown, damp to moist		10	SS	39		182						
			11	SS	41		181						
179.8							180						0 4 52 44
11.2	End of Borehole												
	Borehole was dry (not stabilized) and hole open to 10.4m on completion.												

+³, X³: Numbers refer to Sensitivity O 3% STRAIN AT FAILURE

ON MOT 1-09-4135 RW/RET WALLS.GPJ ON MOT.GDT 9/3/10

RECORD OF BOREHOLE No RW3

1 OF 1

METRIC

W.P. 280-99-00 LOCATION Coords: N:4763453.1 E:327683.4 ORIGINATED BY BL
DIST HWY 406 BOREHOLE TYPE Hollow Stem Augers COMPILED BY DB
DATUM Geodetic DATE 6.29.10 CHECKED BY RA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
191.8	Ground Surface							20 40 60 80 100						
191.6	200mm TOPSOIL							20 40 60 80 100						
0.2	FILL - Silty Clay, trace sand, occasional gravel inclusions, firm to hard, brown, damp to moist		1	SS	15		191							
			2	SS	38									
			3	SS	16		190							0 5 61 34
			4	SS	10									
			5	SS	7		189							
														0 2 63 35
			6	SS	7		188							
	SILTY CLAY trace to some sand, very stiff to hard, brown, damp to moist		7	SS	7		187							
							186							
							185							
			8	SS	13		184							
183.2			9	SS	26		183							0 10 49 41
8.6							182							
180.6	End of Borehole		10	SS	30		181							
11.2														
Sampler wet at 4.6m.														
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)														
July.07.10 8.3 183.5														
July.14.10 6.6 185.2														
July.21.10 7.1 184.7														
July.28.10 7.0 184.8														

+³, X³: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

ON_MOT_1-09-4135 RW RET WALLS.GPJ ON_MOT.GDT 9/3/10

RECORD OF BOREHOLE No RW4

1 OF 1

METRIC

W.P. 280-99-00 LOCATION Coords: N:4763494.5 E:327678.7 ORIGINATED BY BL
DIST HWY 406 BOREHOLE TYPE Hollow Stem Augers COMPILED BY DB
DATUM Geodetic DATE 6.30.10 CHECKED BY RA

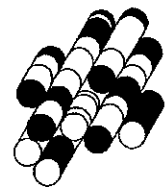
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	20 40 60 80 100					
191.5	Ground Surface													
191.4	150mm TOPSOIL													
0.2	FILL - Silty Clay, trace sand, firm to hard, brown, damp to moist		1	SS	40		191							
			2	SS	47		190							
			3	SS	21		189							
			4	SS	13		188							0 5 61 34
			5	SS	8		187							
			6	SS	5		186							0 6 57 37
			7	SS	5		185							
			8	SS	14		184							
			9	SS	13		183							
182.9	SILTY CLAY trace sand, hard, brown, damp to moist		10	SS	54		182							0 1 43 56
8.6			11	SS	65		181							
180.3	End of Borehole													
11.2	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) July.07.10 dry - July.14.10 5.7 185.8 July.21.10 5.0 186.5 July.28.10 4.9 186.6													

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

ON MOT 1-09-4195 RW RET WALLS GPJ ON MOT GDT 9/3/10

B1

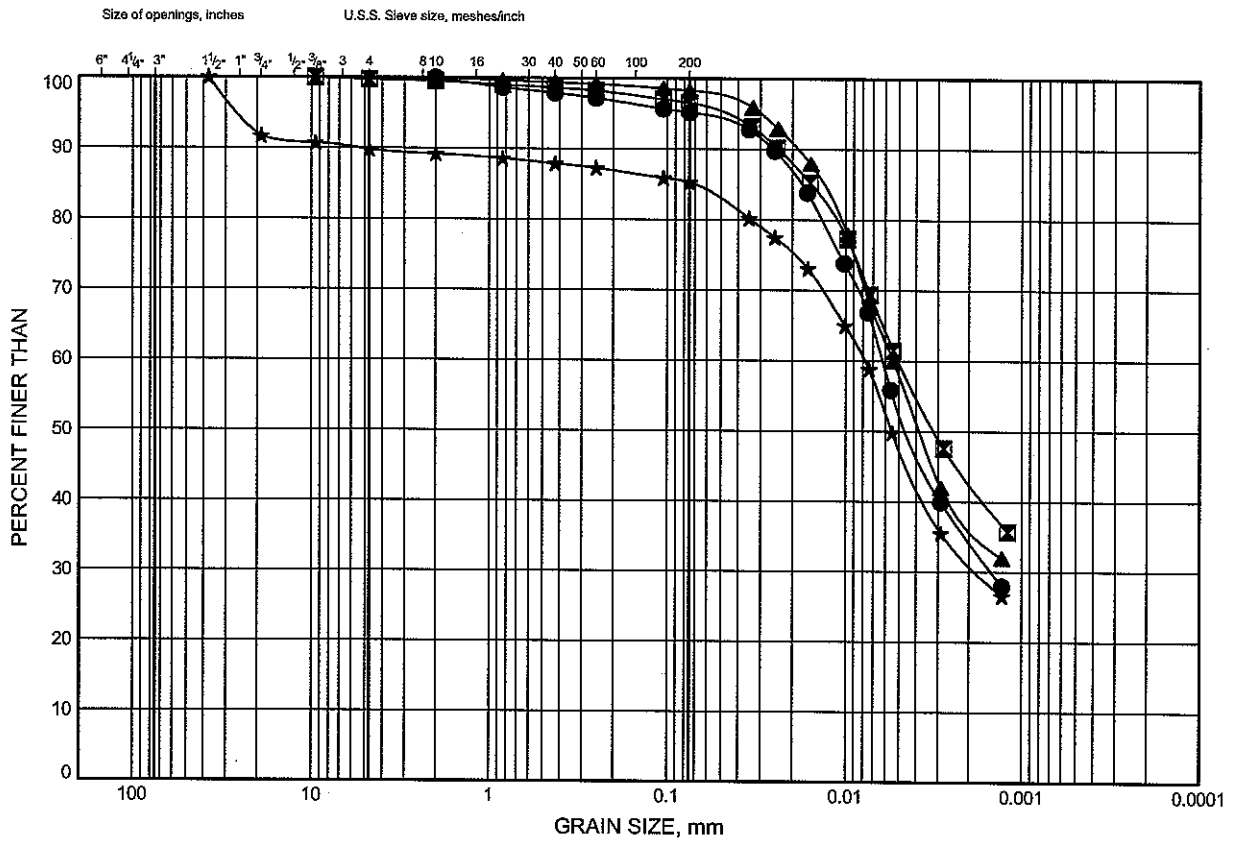
TERRAPROBE INC.



GRAIN SIZE DISTRIBUTION

FIGURE B1-1

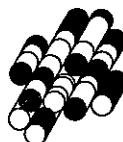
FILL - Silty Clay



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

SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	RW1	1.0	189.0
■	RW1	4.7	185.3
▲	RW2	2.5	188.5
★	RW2	4.0	187.0

Date August 2010
Project 1-09-4135



Prep'd DB
Chkd. MP

GRAIN SIZE DISTRIBUTION

FIGURE B1-2

FILL - Silty Clay

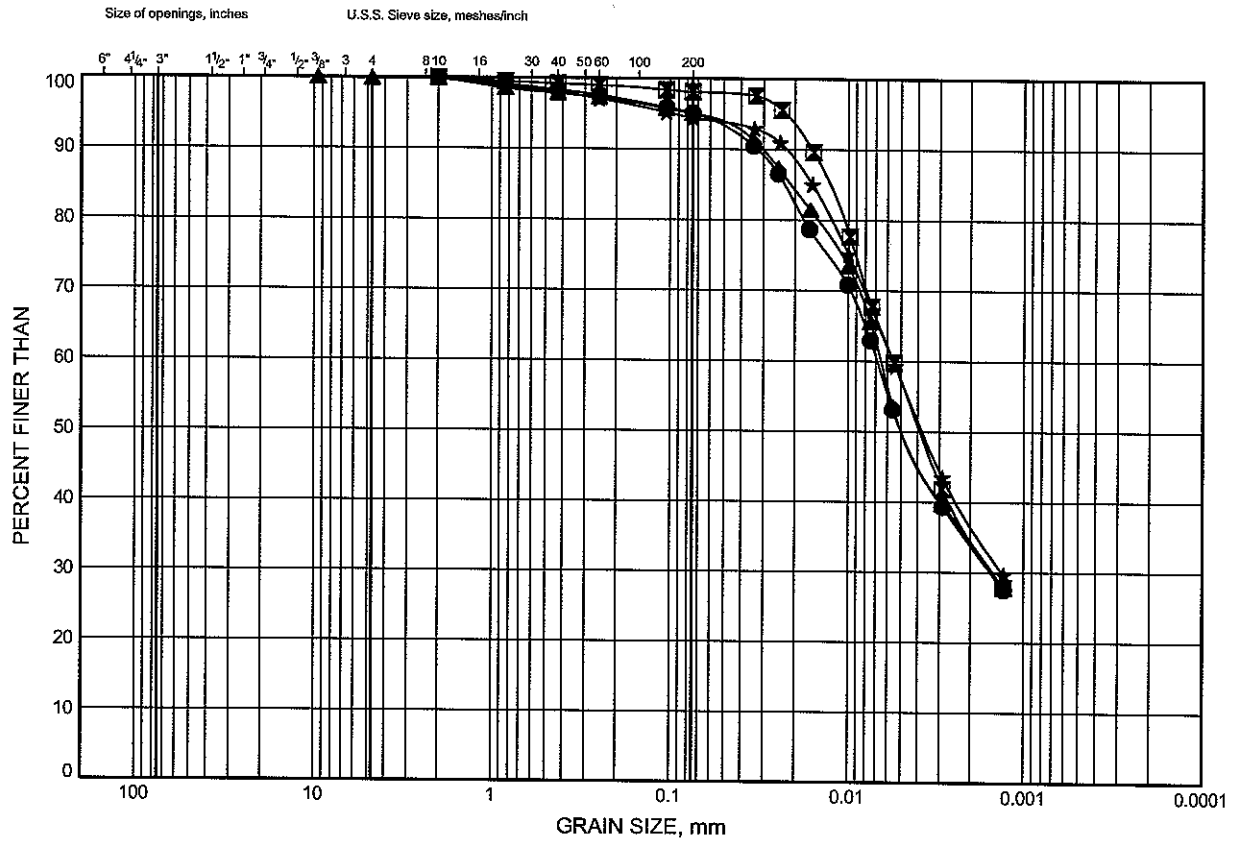
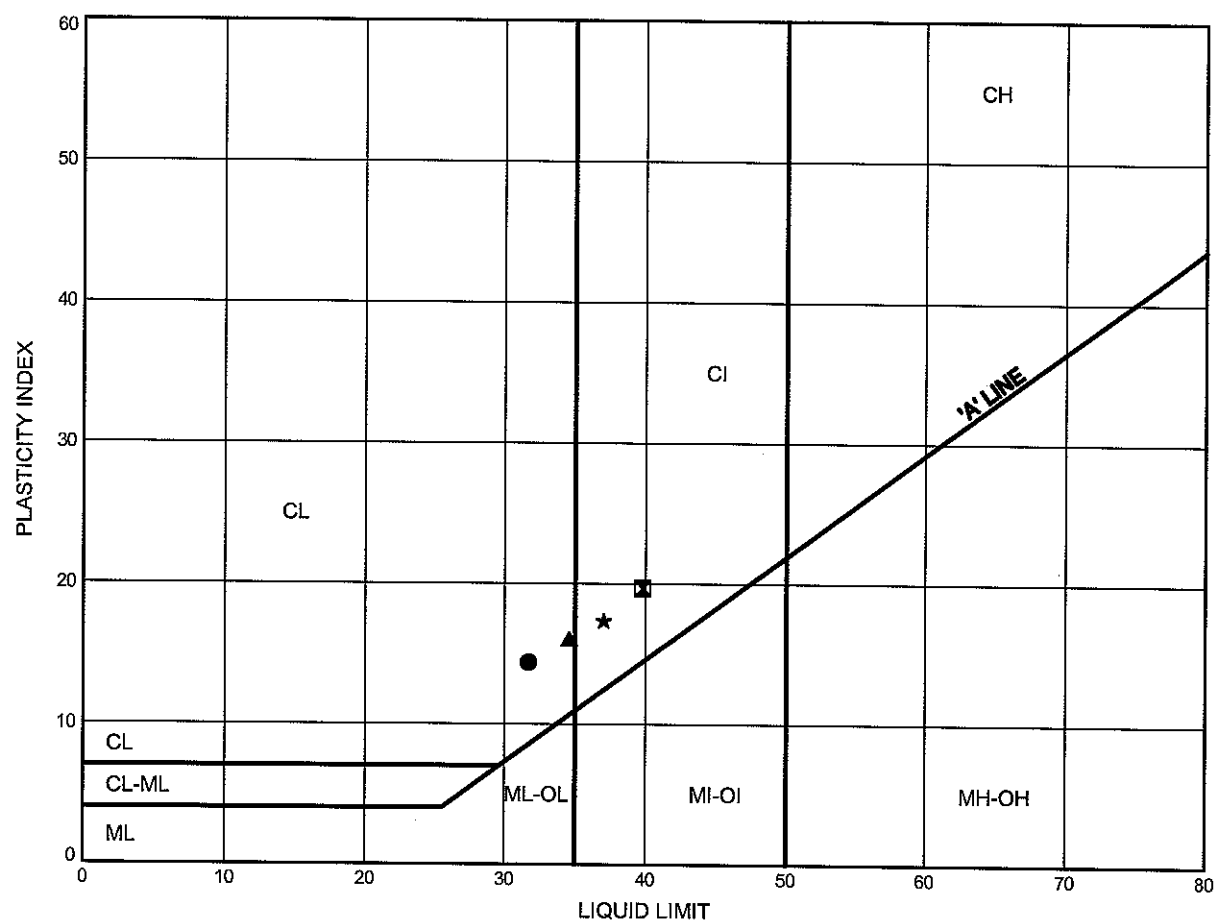


FIGURE B1-3

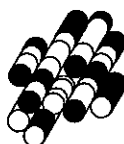
FILL - Silty Clay



SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	RW1	1.0	189.0
☒	RW1	4.7	185.3
▲	RW2	2.5	188.5
★	RW2	4.0	187.0

Date August 2010.....

Project 1-09-4135...



Prep'dDB.....

Chkd.MP.....

FIGURE B1-4

The chart is a plasticity chart used for soil classification. The Y-axis represents the Plasticity Index (PI) from 0 to 60, and the X-axis represents the Liquid Limit (LL) from 0 to 80. The chart is divided into several regions based on these values:

- CL (Clay Low Plasticity):** PI < 7, LL < 35.
- CH (Clay High Plasticity):** PI > 7, LL < 35.
- CI (Clay Intermediate Plasticity):** PI > 7, LL > 35.
- MI-OI (Silt Low Plasticity):** PI < 7, LL > 35.
- MH-OH (Silt High Plasticity):** PI > 7, LL > 35.
- ML (Silt Low Plasticity):** PI < 4, LL < 25.
- CL-ML (Clay Low Plasticity):** 4 < PI < 7, LL < 25.
- ML-OL (Silt Low Plasticity):** 4 < PI < 7, LL > 25.

A diagonal line labeled **'A' LINE** separates the CL/CH regions from the MI-OH regions. A vertical line at LL = 35 separates the ML-OL region from the MI-OI region.

A data point is plotted at LL = 30 and PI = 13, marked with an asterisk and a tractor icon. This point falls within the **ML-OL** region.

SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	RW3	1.7	190.1
⊠	RW3	3.2	188.6
▲	RW4	2.5	189.0
★	RW4	4.0	187.5

Date August 2010

Project 1-09-4135

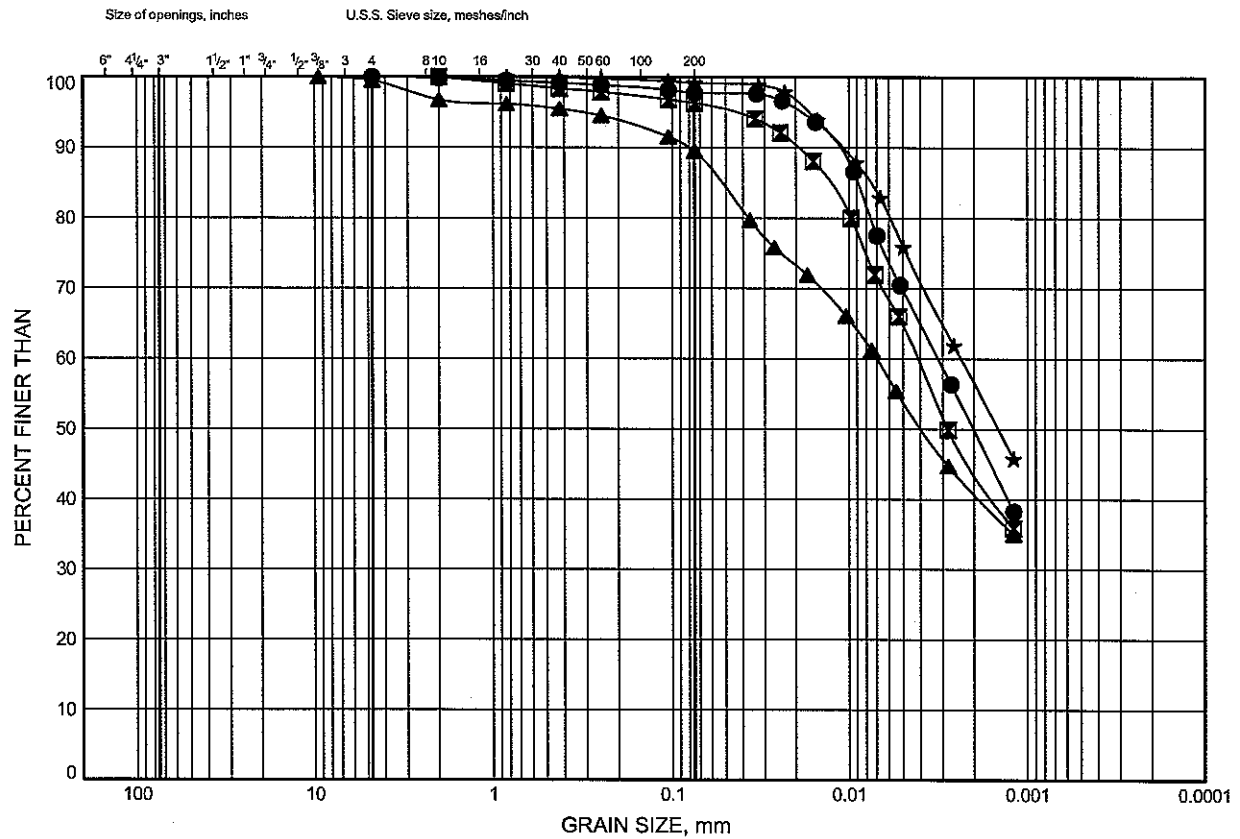
Prep'd DB

Chkd. MP

GRAIN SIZE DISTRIBUTION

FIGURE B1-5

SILTY CLAY



SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	RW1	9.3	180.7
⊠	RW2	10.9	180.1
▲	RW3	9.3	182.5
★	RW4	9.3	182.2

Date August 2010
Project 1-09-4135

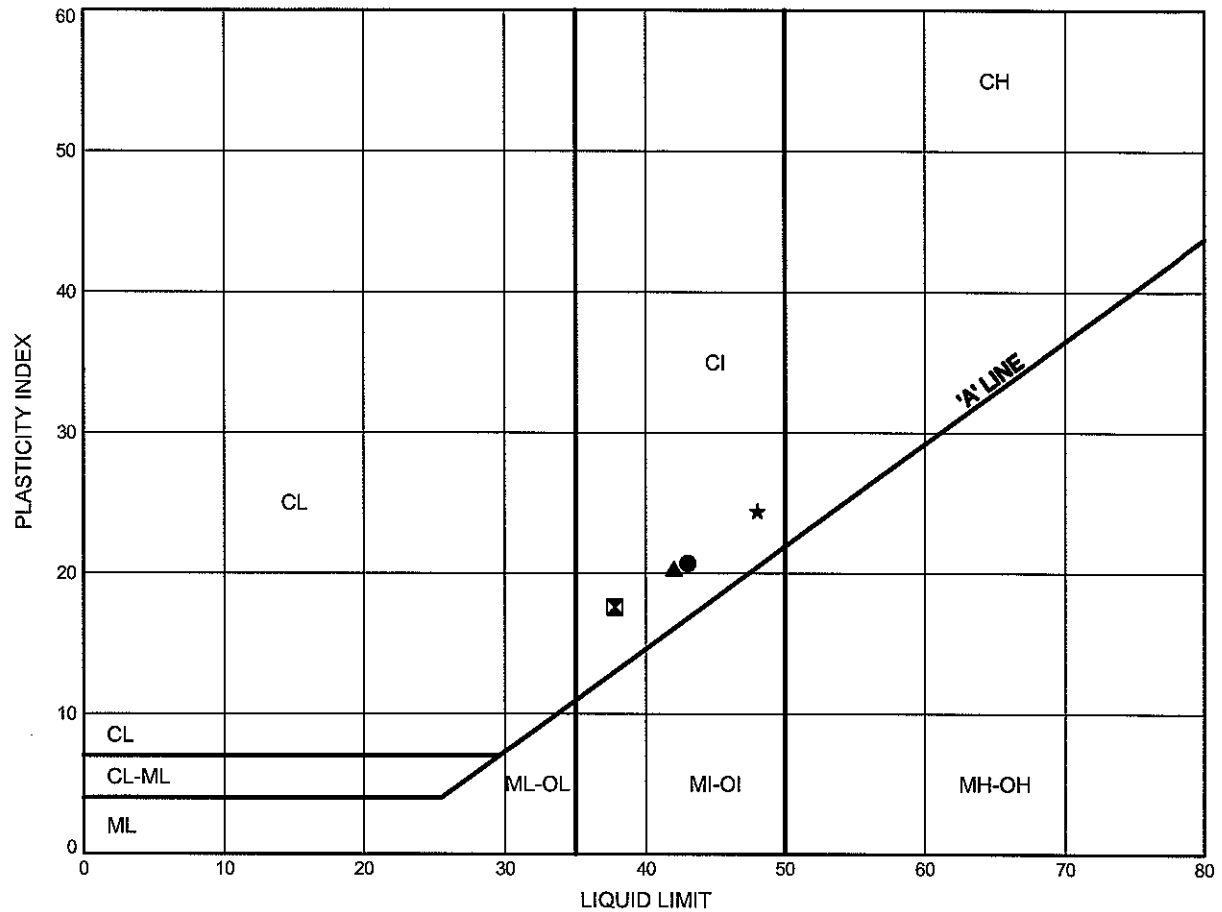


Prep'd DB
Chkd. MP

ATTERBERG LIMITS TEST RESULTS

FIGURE B1-6

SILTY CLAY



SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	RW1	9.3	180.7
⊠	RW2	10.9	180.1
▲	RW3	9.3	182.5
★	RW4	9.3	182.2

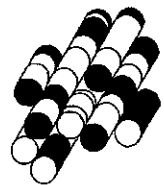
Date August 2010
Project 1-09-4135

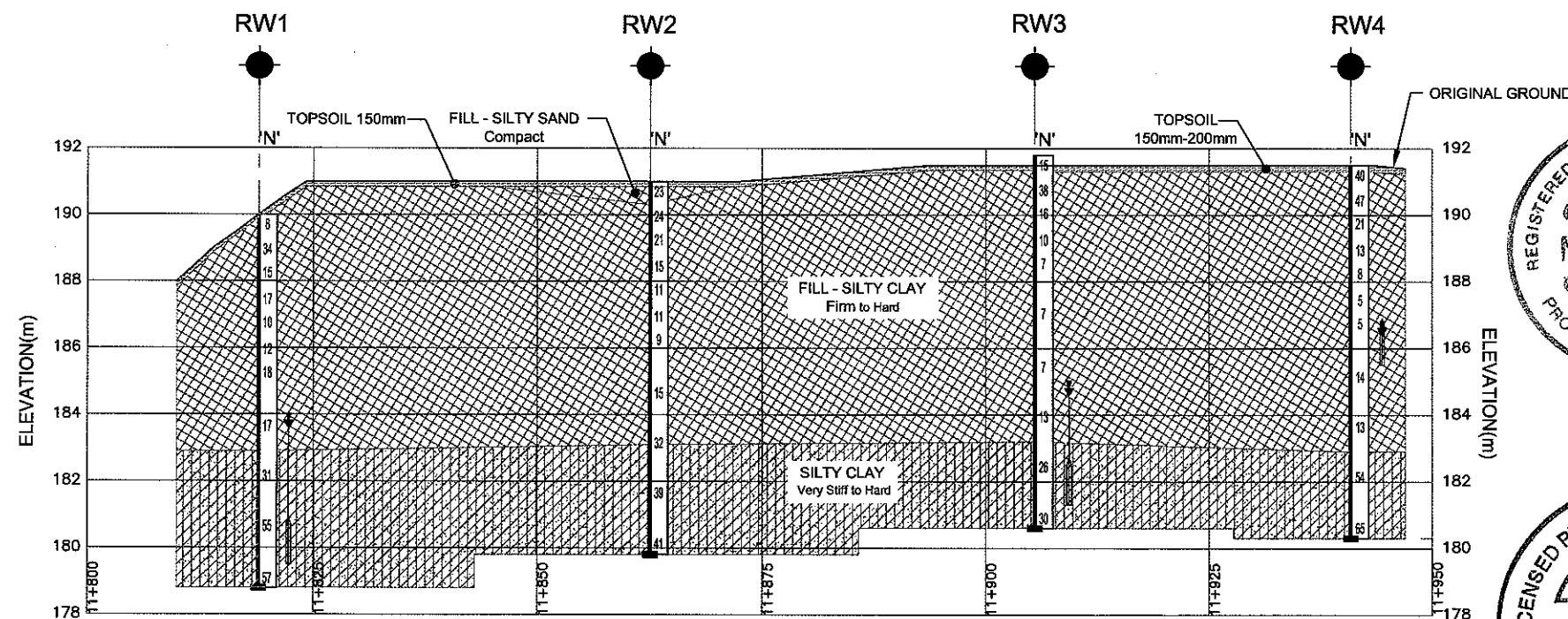
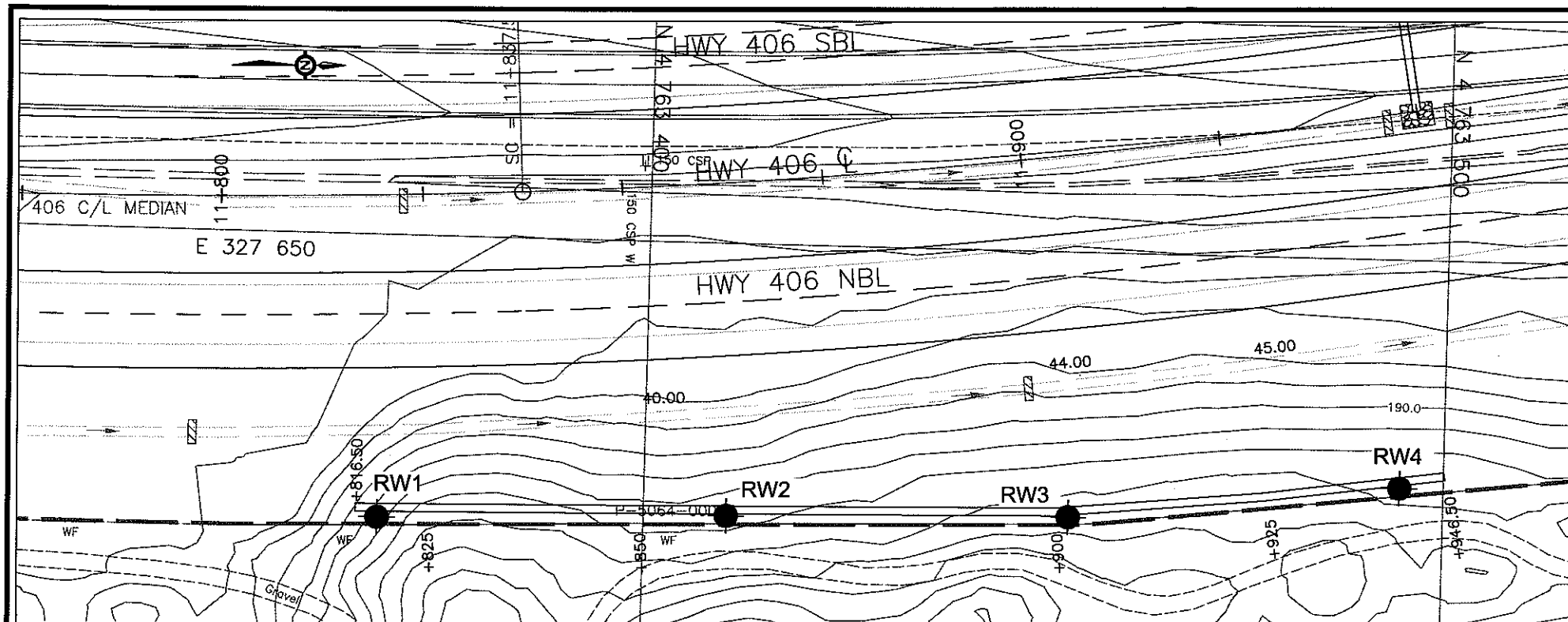


Prep'd DB
Chkd. MP

C1

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

CONT No 2011-2005
WP No 280-99-00

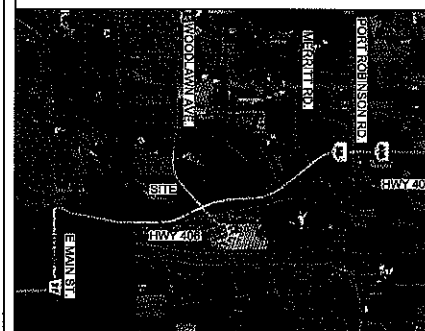


HIGHWAY 406
Sta. 11+816 to 11+947 RETAINING WALL
BOREHOLE LOCATIONS AND SOIL STRATA

SHEET



Terraprobe Inc.
Consulting Geotechnical & Environmental Engineering
Construction Materials Engineering, Inspection & Testing
10 Bram Court - Brampton Ontario L6W 3R6 (905) 796-2650

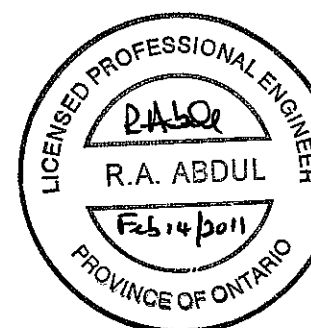


LEGEND	
	Bore Hole
	Dynamic Cone Penetration Test
	Bore Hole And Cone
	Blows/0.3m (Std Pen Test, 475 J/blow)
	Blows/0.3m (60' Cone, 475 J/blow)
	WL at Time of Investigation
	WL in Piezometer (JULY. 2010)
	Piezometer
	Rock Quality Designation
	Auger Refusal

No	ELEV.	COORDINATES	
		NORTHING	EASTING
RW1	190.0	4 763 366.8	327 685.6
RW2	191.0	4 763 410.3	327 684.3
RW3	191.8	4 763 453.1	327 683.4
RW4	191.5	4 763 494.5	327 678.7

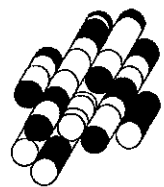
NOTE
The boundaries between soil strata have been established only at Bore Hole locations. Between Bore Holes the boundaries are assumed from geological evidence.
This drawing is for subsurface information only. Surface details and features are for conceptual illustration.

REVISIONS			
DATE	BY	DESCRIPTION	
DESIGN R.A.	CODE CHBDC2006	LOAD	DATE FEB. 2011
DRAWN K.C.	CHK R.A.	STRUCT	GEOCRES 30M3-265



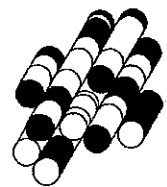
SITE 2

TERRAPROBE INC.




A2

TERRAPROBE INC.



METRIC

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT	PLASTIC LIMIT w_p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w_L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					
183.2	Ground Surface						 ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	WATER CONTENT (%)	10 20 30				GR SA SL CL ML CL

172.0	173	174	175	176	177	178	179	180	181	182	183
0.7											
0.2											
182.5											
183.0											

230mm TOPSOIL

FILL - Silty Clay, trace sand, trace organics, very stiff, dark brown, moist

SILTY CLAY
trace sand,
very stiff to hard,
brown, damp to moist

occasional silt seams and partings

1	SS	18
2	SS	40
3	SS	64
4	SS	33
5	SS	33
6	SS	29
7	SS	23
8	SS	33
9	SS	27
10	SS	26
11	SS	31

0 3 63 3

0 3 67 30

0 3 66 31

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)
July.05.10	1.5	181.7
July.12.10	1.6	181.6
July.19.10	1.9	181.3
July.28.10	2.2	181.0
Aug.06.10	2.4	180.8

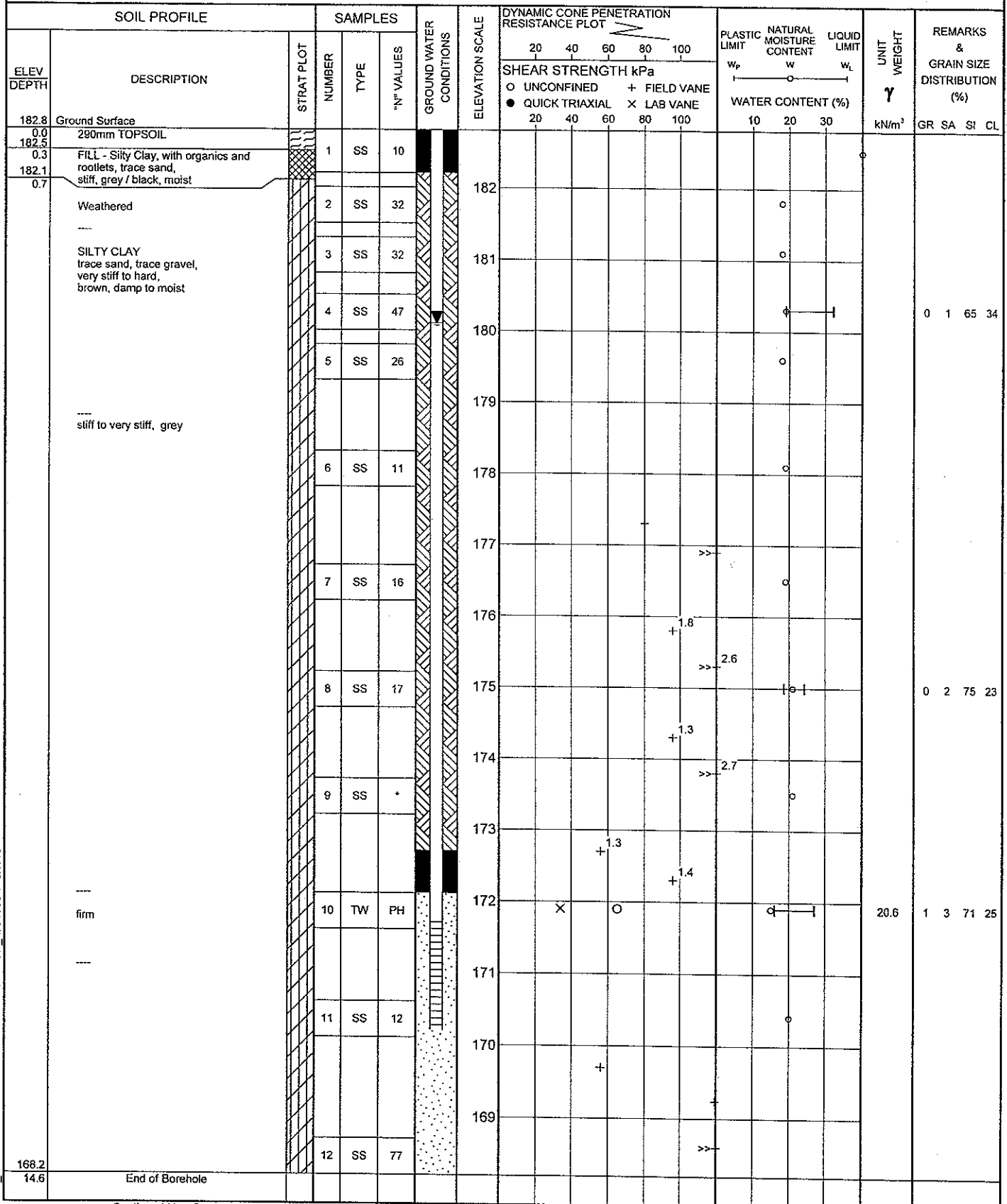
+³, X³: Numbers refer to Sensitivity ○^{3%} STRAIN AT FAILURE

RECORD OF BOREHOLE No WE-S 10+345CL

1 OF 2

METRIC

W.P. 280-99-00 LOCATION Coords: N:4763845.9 E:327457.4 ORIGINATED BY AW
DIST HWY 406 BOREHOLE TYPE Hollow Stem Augers COMPILED BY DB
DATUM Geodetic DATE 11.4.09 CHECKED BY RA



Continued Next Page

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

RECORD OF BOREHOLE No WE-S 10+345CL

2 OF 2

METRIC

W.P. 280-99-00 LOCATION Coords: N:4763845.9 E:327457.4 ORIGINATED BY AW
DIST HWY 406 BOREHOLE TYPE Hollow Stem Augers COMPILED BY DB
DATUM Geodetic DATE 11.4.09 CHECKED BY RA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC NATURAL LIQUID LIMIT MOISTURE LIMIT CONTENT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL																			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100	W _p	W	W _L																					
	<p>* TW sampling attempted at 9.1m. No recovery, split spoon sample collected.</p> <p>Consolidation test performed on TW 10.</p> <p>Borehole was dry (not stabilized) and hole open to full depth on completion.</p> <p>Piezometer installation consists of a 19mm diameter, Schedule 40 PVC pipe with a 1.52m slotted screen.</p> <p>Water Level Readings:</p> <table border="1"> <thead> <tr> <th>Date</th> <th>Depth(m)</th> <th>Elevation(m)</th> </tr> </thead> <tbody> <tr> <td>Nov.19.09</td> <td>4.0</td> <td>178.8</td> </tr> <tr> <td>Nov.30.09</td> <td>3.4</td> <td>179.4</td> </tr> <tr> <td>Dec.07.09</td> <td>3.1</td> <td>179.7</td> </tr> <tr> <td>Dec.15.09</td> <td>3.0</td> <td>179.8</td> </tr> <tr> <td>Jan.11.10</td> <td>2.6</td> <td>180.2</td> </tr> <tr> <td>Jan.27.10</td> <td>2.7</td> <td>180.1</td> </tr> </tbody> </table>	Date	Depth(m)	Elevation(m)	Nov.19.09	4.0	178.8	Nov.30.09	3.4	179.4	Dec.07.09	3.1	179.7	Dec.15.09	3.0	179.8	Jan.11.10	2.6	180.2	Jan.27.10	2.7	180.1														
Date	Depth(m)	Elevation(m)																																		
Nov.19.09	4.0	178.8																																		
Nov.30.09	3.4	179.4																																		
Dec.07.09	3.1	179.7																																		
Dec.15.09	3.0	179.8																																		
Jan.11.10	2.6	180.2																																		
Jan.27.10	2.7	180.1																																		

RECORD OF BOREHOLE No TEW1

1 OF 3

METRIC

W.P. 280-99-00

LOCATION

Coords: N:4763851.9 E:327450.6

ORIGINATED BY MP

DIST HWY 406

BOREHOLE TYPE

Hollow Stem Augers / Casing and Washboring / NQ Rock Coring

COMPILED BY DB

DATUM Geodetic

DATE

12.23.09 - 1.8.10

CHECKED BY RA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)					
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40						60	80	100	20	40
182.5	Ground Surface																		
182.3	230mm TOPSOIL																		
0.2	FILL - Silty Clay, trace sand, trace organics, firm, brown, damp to moist		1	SS	7														
181.8							182												
0.7	SILTY CLAY trace sand, occasional gravel inclusions, stiff to hard, brown, damp to moist		2	SS	27		181												
			3	SS	34														
			4	SS	54		180												
			5	SS	35		179												
			6	SS	31		178												
			7	SS	18														
							177												
			8	TW	PH		176												
							175												
			9	SS	22		174												
							173												
			10	SS	18		172												
							171												
			11	SS	16		170												
							169												
			12	SS	19		168												
			13	SS	32														

Continued Next Page

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

RECORD OF BOREHOLE No TEW1

2 OF 3

METRIC

W.P. 280-99-00 LOCATION Coords: N:4763851.9 E:327450.6 ORIGINATED BY MP
 DIST HWY 406 BOREHOLE TYPE Hollow Stem Augers / Casing and Washboring / NQ Rock Coring COMPILED BY DB
 DATUM Geodetic DATE 12.23.09 - 1.8.10 CHECKED BY RA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	20 40 60 80 100					
167.3 15.2	CLAYEY SILT TO SILTY CLAY sandy, trace to some gravel, hard, brown, damp (GLACIAL TILL)		14	SS	33		167							
			15	SS	79		166							11 30 43 16
	occasional cobbles		16	SS	170		165							commence casing and washboring
163.3 19.2	SAND and gravel, trace to some silt, very dense, grey, wet						164							Dec.23
162.5 20.0	CLAYEY SILT sandy, trace to some gravel, hard, brown, damp (GLACIAL TILL)		17	SS	94		163							Jan.05
161.2 21.3	SAND gravelly, trace clay, trace silt, dense to very dense, grey, wet		18	SS	70		162							
159.4 23.1	SILTY CLAY some gravel, trace to some sand, hard, brown, damp (GLACIAL TILL)		19	SS	34		161							32 56 10 2
158.3 24.2	SAND AND SILT some gravel, trace clay, occasional cobbles, very dense, brown, moist to wet (GLACIAL TILL)		20	SS	75		160							
			21	SS	99		159							15 40 38 7
			22	SS	125		158							
153.7 28.8	BEDROCK		1	RUN	NQ		157							Jan.05
							156							Jan.08
							155							RUN#1 TCR=88% SCR=78% RQD=48%
							154							
							153							

Continued Next Page

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

ON MOT 1-09-4135 TRW RET WALLS.GPJ ON MOT.GDT 9/7/10

RECORD OF BOREHOLE No TEW1

3 OF 3

METRIC

W.P. 280-99-00 LOCATION Coords: N:4763851.9 E:327450.6 ORIGINATED BY MP
 DIST HWY 406 BOREHOLE TYPE Hollow Stem Augers / Casing and Washboring / NQ Rock Coring COMPILED BY DB
 DATUM Geodetic DATE 12.23.09 - 1.8.10 CHECKED BY RA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa										
								20	40	60	80	100						
								○ UNCONFINED	+	FIELD VANE	● QUICK TRIAXIAL	x						LAB VANE
							20	40	60	80	100							

+³, X³: Numbers refer to Sensitivity

○ 3% STRAIN AT FAILURE

RECORD OF BOREHOLE No TEW2

1 OF 3

METRIC

W.P. 280-99-00 LOCATION Coords: N:4763860.7 E:327455.5 ORIGINATED BY MP
DIST HWY 406 BOREHOLE TYPE Hollow Stem Augers / NQ Rock Coring COMPILED BY DB
DATUM Geodetic DATE 12.18.09 - 12.22.09 CHECKED BY RA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	20 40 60 80 100					
182.7	Ground Surface													
182.4	300mm TOPSOIL		1	SS	8		182							
0.3	FILL - Silty Clay, trace sand, trace organics, firm to stiff, brown, moist													
182.0														
0.7	SILTY CLAY trace sand, occasional gravel inclusions, stiff to hard, brown, damp to moist		2	SS	27		181							
			3	SS	28									
			4	SS	28		180							0 1 52 47
			5	SS	42									
			6	SS	36		179							
			7	SS	14		178							
			8	SS	19		177							
							176							
			9	SS	17		175							
							174							
			10	SS	22									
							173							
			11	TW	PH		172							
							171							
			12	TW	PH		170							
							169							4 6 66 24
			13	SS	21									
							168							
167.8														

Continued Next Page

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

2 OF 3

METRIC

SOIL PROFILE			SAMPLES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100	PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT w_p — w — w_L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER TYPE "N" VALUES		SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL X LAB VANE	WATER CONTENT (%) 20 40 60 80 100 10 20 30			
14.9	CLAYEY SILT TO SILTY CLAY sandy, trace gravel, occasional cobbles, hard, brown, damp to moist (GLACIAL TILL) — sand and gravel, grey, wet ----	[Pattern]	14 SS 88		167				8 26 48 18
163.1					166				
19.6	SAND and gravel, trace to some silt, very dense, grey, moist to wet	[Pattern]	15 SS 100/ 13cm		165				Dec.18 Dec.21
162.3					164				
20.4	CLAYEY SILT and sand, some gravel, hard, brown, damp (GLACIAL TILL)	[Pattern]	16 SS 166/ 28cm		163				
160.8					162				
21.9	SAND some gravel, very dense, grey, moist	[Pattern]	17 SS 100/ 14cm		161				
159.6					160				
23.1	SILT CLAY trace to some sand, trace gravel, hard, brown, damp (GLACIAL TILL)	[Pattern]	18 SS 127		159				
158.9					158				2 95 (3)
23.8	SAND trace gravel to gravelly, trace to some silt, trace clay, occasional cobbles, compact to very dense, grey, wet (GLACIAL TILL)	[Pattern]	19 SS 148		157				
					156				
					155				26 54 12 8
154.0	BEDROCK	[Pattern]	20 SS 40		154				RUN#1 TCR=93% SCR=75% ROD=46%
28.7			21 SS 21		153				
			22 SS 105						
			1 RUN NQ						

ON MOT 1-09-4135 TRW RET WALLS.GPJ ON MOT.GDT 9/7/10

Continued Next Page

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

RECORD OF BOREHOLE No TEW2

3 OF 3

METRIC

W.P. 280-99-00 LOCATION Coords: N:4763860.7 E:327455.5 ORIGINATED BY MP
 DIST HWY 406 BOREHOLE TYPE Hollow Stem Augers / NQ Rock Coring COMPILED BY DB
 DATUM Geodetic DATE 12.18.09 - 12.22.09 CHECKED BY RA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL X LAB VANE									
							20	40	60	80	100						
							20	40	60	80	100						
							10	20	30								

+ 3, X 3: Numbers refer to Sensitivity

○ 3% STRAIN AT FAILURE

RECORD OF BOREHOLE No TS1

1 OF 3

METRIC

W.P. 280-99-00 LOCATION Coords: N:4763865.7 E:327459.1 ORIGINATED BY MP
DIST HWY 406 BOREHOLE TYPE Hollow Stem Augers / Casing and Washboring / NQ Rock Coring COMPILED BY DB
DATUM Geodetic DATE 1.11.10 - 1.13.10 CHECKED BY RA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa								WATER CONTENT (%)
								○ UNCONFINED	+ FIELD VANE	×						
								● QUICK TRIAXIAL	×	LAB VANE						
182.6	Ground Surface						20	40	60	80	100					
0.0	380mm TOPSOIL															
182.2																
0.4	FILL - Silty Clay, some organics, trace sand, soft, black, moist		1	SS	2											
181.9																
0.7	SILTY CLAY trace sand, stiff to hard, brown, damp to moist		2	SS	20											
			3	SS	23											
			4	SS	37											
			5	SS	38											
			6	SS	26											
			7	SS	22											
			8	SS	24											
			9	SS	17											

Continued Next Page

+³, X³: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

RECORD OF BOREHOLE No TS1

2 OF 3

METRIC

W.P. 280-99-00 LOCATION Coords: N:4763865.7 E:327459.1 ORIGINATED BY MP
DIST HWY 406 BOREHOLE TYPE Hollow Stem Augers / Casing and Washboring / NQ Rock Coring COMPILED BY DB
DATUM Geodetic DATE 1.11.10 - 1.13.10 CHECKED BY RA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa							WATER CONTENT (%)
								○ UNCONFINED	+ FIELD VANE						
								● QUICK TRIAXIAL	× LAB VANE						
						20 40 60 80 100	20 40 60 80 100	10 20 30							
166.9	CLAYEY SILT TO SILTY CLAY some sand to sandy, trace to some gravel, hard, brown, damp to moist (GLACIAL TILL) occasional to frequent cobbles		14	SS	16			1.4							
15.7															
			15	SS	164										
			16	SS	110										
			17	SS	100/ 10cm										
161.8	SAND gravelly, some silt, frequent cobbles, very dense, grey, wet														
20.8															
161.0	CLAYEY SILT some gravel, trace sand, hard, brown, damp (GLACIAL TILL)		18	SS	175										
21.6															
160.2	SAND gravelly, trace silt, occasional cobbles, dense to very dense, grey, moist to wet														
22.4															
			19	SS	98										
157.8	CLAYEY SILT sandy, trace gravel, hard, brown, damp (GLACIAL TILL)		20	SS	40										
24.8															
			21	SS	38										
155.7	SAND AND GRAVEL trace to some silt, frequent cobbles, very dense, grey / brown, moist (GLACIAL TILL)														
26.9															
			22	SS	100/ 13cm										
154.2	BEDROCK														
28.4															
			1	RUN	NQ										
			2	RUN	NQ										

ON MOT 1-09-4135 TRW RET WALLS.GPJ ON MOT.GDT 9/7/10

RUN#1
TCR=75%
SCR=16%
RQD=16%

RUN#2
TCR=100%
SCR=90%
RQD=76%

ON MOT 1-09-4135 TRW RET WALLS.GPJ ON MOT.GDT 9/7/10

Continued Next Page

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

METRIC

SOIL PROFILE				SAMPLES		GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI C
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	20 40 60 80 100	W _p W W _L				
151.4 31.2	<p>BEDROCK - INTERBEDDED DOLOSTONE AND SHALE Unweathered, thinly laminated, grey, medium strength, argillaceous with unweathered, laminated, white, very low strength gypsum and calcite layers / veins and frequent unweathered, white, low strength, coarse grained calcitic vugs.</p> <p>End of Borehole</p> <p>Piezometer installation consists of a 19mm diameter, Schedule 40 PVC pipe with a 1.52m slotted screen.</p> <p>Water Level Readings: Date Depth(m) Elevation(m) Jan.19.10 10.6 172.0 Jan.27.10 10.4 172.2 Feb.08.10 10.5 172.1</p> <p>Borehole sealed with bentonite slurry from 31.2m to 28.1m and from 25.0m to ground surface.</p>		3	RUN	NQ		152							<p>RUN#3 TCR=96% SCR=81% RQD=72%</p>

ON MOT 1-09-4135 TRW RET WALLS,GPJ ON MOT.GDT 9/7/10

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

RECORD OF BOREHOLE No SBL 12+360CL

1 OF 2

METRIC

W.P. 280-99-00

LOCATION

Coords: N:4763866.5 E:327470.3

ORIGINATED BY AW

DIST HWY 406

BOREHOLE TYPE Hollow Stem Augers

COMPILED BY DB

DATUM Geodetic

DATE

11.17.09

CHECKED BY RA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa							WATER CONTENT (%)
								○ UNCONFINED	+ FIELD VANE						
182.9	Ground Surface							20 40 60 80 100	20 40 60 80 100	10 20 30				GR SA SI CL	
0.0	40mm TOPSOIL		1	SS	19										
182.2	FILL - Silty Clay, trace to some sand, trace gravel, trace organics, very stiff, dark brown, moist														
0.7	SILTY CLAY trace sand, stiff to very stiff, brown, moist		2	SS	25		182							0 1 50 49	
			3	SS	14		181								
			4	SS	23										
			5	SS	18		180							0 1 52 47	
							179								
			6	SS	15		178								
							177								
			7	SS	19		176								
							175							0 3 65 32	
			8	SS	12		174								
			9	SS	10		173								
							172							20.7 0 2 74 24	
			10	TW	PH		171								
			11	SS	21									0 1 83 16	
170.2	End of Borehole														
12.7	Water level at 9.8m (not stabilized) and hole open to full depth on completion. Consolidation test performed on TW 10.														

Continued Next Page

Continued Next Page

+³, X³: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

2 OF 2

METRIC

LOCATION

Coords: N:4763866.5 E:327470.3

ORIGINATED BY AW

DIST _____ HWY 406

BOREHOLE TYPE

Hollow Stem Augers

COMPILED BY D8

DATUM Geodetic

DATE _____

11.17.09

CHECKED BY RA

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

RECORD OF BOREHOLE No TS2

1 OF 3

METRIC

W.P. 280-99-00 LOCATION Coords: N:4763881.2 E:327466.3 ORIGINATED BY PK
DIST HWY 406 BOREHOLE TYPE Hollow Stem Augers / NQ Rock Coring COMPILED BY DB
DATUM Geodetic DATE 11.30.09 - 12.8.09 CHECKED BY RA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT Y	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
183.3	Ground Surface							20 40 60 80 100	20 40 60 80 100	10 20 30				GR SA SI CL
0.0	FILL - Silty Clay, trace sand, trace gravel, trace organics, stiff to very stiff, dark brown / brown, damp to moist		1	SS	12		183							
			2	SS	12		182							3 7 58 32
			3	SS	21									
181.2							181							Nov.30
2.1	SILTY CLAY trace sand, trace gravel, very stiff to hard, brown, damp to moist		4	SS	32									Dec.03
			5	SS	61		180							
			6	SS	25									
			7	SS	25		179							
			8	SS	21		178							1 3 66 30
			9	SS	15		177							
							176							
			10	SS	13		175							
			11	SS	16		174							0 3 67 30
			12	SS	14		173							
			13	SS	14		172							
			14	SS	18		171							
			15	TW	PH		170							
							169							7 1 66 26

Continued Next Page

+³, X³: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

RECORD OF BOREHOLE No TS2

2 OF 3

METRIC

W.P. 280-99-00 LOCATION Coords: N:4763881.2 E:327466.3 ORIGINATED BY PK
DIST HWY 406 BOREHOLE TYPE Hollow Stem Augers / NQ Rock Coring COMPILED BY DB
DATUM Geodetic DATE 11.30.09 - 12.8.09 CHECKED BY RA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	20 40 60 80 100					
168.1 15.2	SILTY CLAY trace to some sand, trace gravel, very stiff to hard, brown, damp to moist (GLACIAL TILL)		16	SS	22		168							8 15 50 27 Dec.03 Dec.04
			17	SS	26		167							
			18	SS	124		166							
	frequent wet sand and gravel inclusions		19	SS	47		165							
162.5 20.8	SAND gravelly, some silt, dense, brown, wet		20	SS	50		162							31 57 (12)
160.9 22.4	CLAYEY SILT and sand, trace gravel, very stiff, brown, damp (GLACIAL TILL)		21	SS	30		161							7 39 38 16
159.4 23.9	SAND gravelly, trace silt, dense, grey, moist to wet		22	SS	47		160							
157.1 26.2	CLAYEY SILT sandy, trace gravel, hard, brown, damp (GLACIAL TILL)		23	SS	61		159							Dec.04 Dec.07
156.2 27.1	SAND AND GRAVEL some silt, trace to some clay, occasional cobbles, very dense, brown / grey, moist (GLACIAL TILL)		24	SS	77		158							
153.9 29.4	BEDROCK		25	SS	155/ 18cm		157							Dec.07 Dec.08

Continued Next Page

+³, X³: Numbers refer to
Sensitivity ○ 3% STRAIN AT FAILURE

ON MOT 1-09-4135 TRW RET WALLS.GPJ ON MOT.GDT 9/7/10

METRIC

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC NATURAL LIQUID LIMIT MOISTURE CONTENT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI C
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa		WATER CONTENT (%)			
						20 40 60 80 100	20 40 60 80 100	W _p	W	W _L			
						○ UNCONFINED	+ FIELD VANE						
						● QUICK TRIAXIAL	× LAB VANE						
150.8	BEDROCK - INTERBEDDED DOLOSTONE AND SHALE Unweathered, thinly laminated, grey, medium strength, argillaceous with unweathered, laminated, white, very low strength gypsum and calcite layers / veins and frequent unweathered, white, low strength, coarse grained calcitic vugs.		1	RUN	NQ		153						RUN#1 TCR=74% SCR=60% RQD=28%
32.5			2	RUN	NQ		152						
							151						
	End of Borehole												
	No sample recovery at SS22. Sampler redriven and disturbed sample collected.												
	Borehole sealed with bentonite slurry to ground surface.												

ON MOT 1-09-4135 TRW RET WALLS.GPJ ON MOT.GDT 9/7/10

+³, X³: Numbers refer to Sensitivity

RECORD OF BOREHOLE No NBL 12+375Lt

1 OF 2

METRIC

W.P. 280-99-00

LOCATION

Coords: N:4763888.1 E:327476.6

ORIGINATED BY AW

DIST HWY 406

BOREHOLE TYPE

Hollow Stem Augers

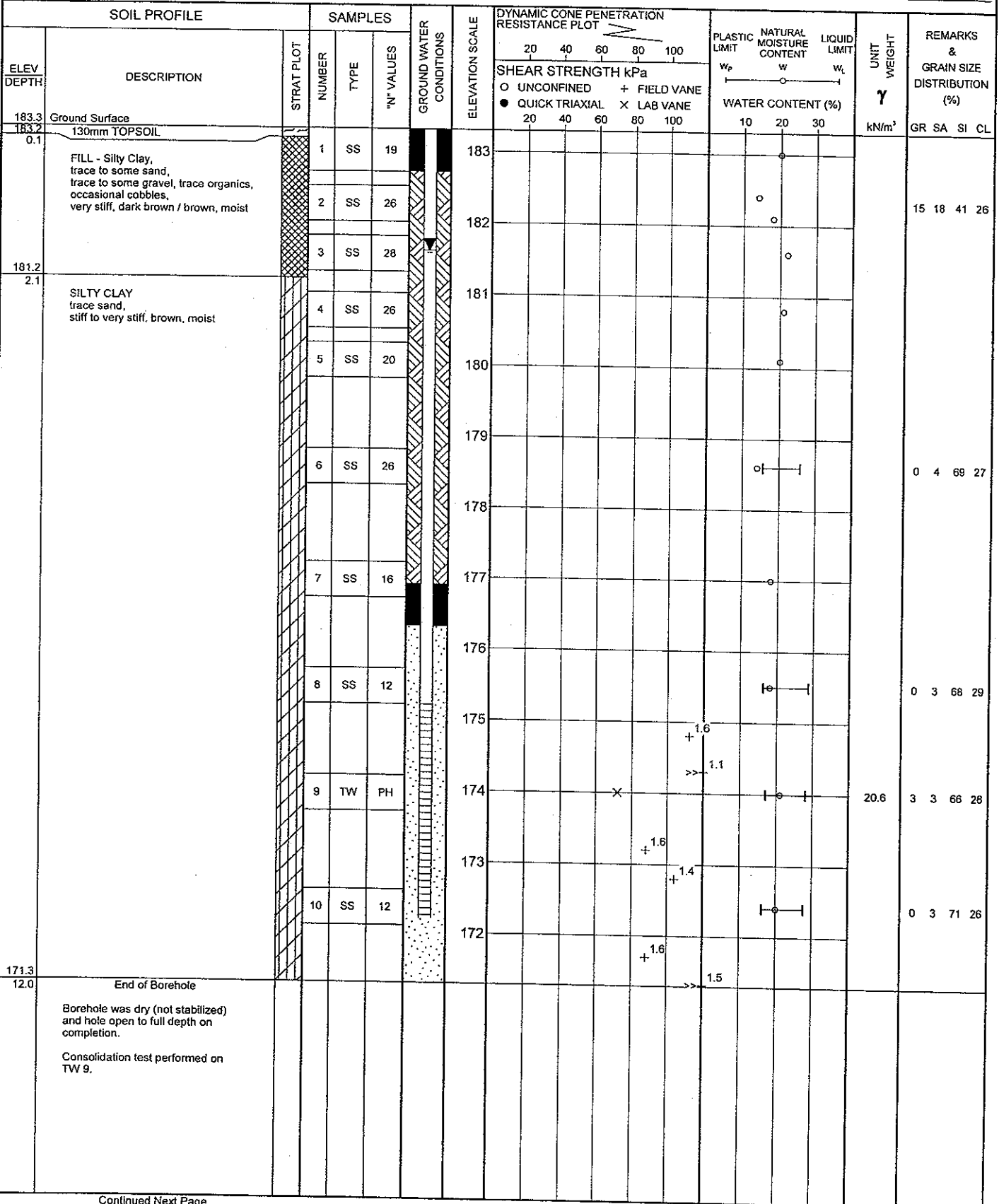
COMPILED BY DB

DATUM Geodetic

DATE

11.18.09

CHECKED BY RA



Continued Next Page

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

RECORD OF BOREHOLE No NBL 12+375Lt

2 OF 2

METRIC

W.P. 280-99-00 LOCATION Coords: N:4763888.1 E:327476.6
 DIST HWY 406 BOREHOLE TYPE Hollow Stem Augers
 DATUM Geodetic DATE 11.18.09
 ORIGINATED BY AW
 COMPILED BY DB
 CHECKED BY RA

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa												
						20	40	60	80	100	○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100					WATER CONTENT (%) 10 20 30				
	Piezometer installation consists of a 19mm diameter, Schedule 40 PVC pipe with a 3.0m slotted screen. Water Level Readings: Date Depth(m) Elevation(m) Nov.19.09 5.8 177.5 Nov.30.09 3.2 180.1 Dec.07.09 1.3 182.0 Dec.15.09 1.8 181.5 Jan.19.10 1.7 181.6																			

RECORD OF BOREHOLE No TN1

1 OF 3

METRIC

W.P. 280-99-00 LOCATION Coords: N:4763901.9 E:327473.4 ORIGINATED BY MP
DIST HWY 406 BOREHOLE TYPE Hollow Stem Augers / Casing and Washboring / NQ Rock Coring COMPILED BY DB
DATUM Geodetic DATE 12.10.09 - 12.14.09 CHECKED BY RA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa							WATER CONTENT (%)			
183.5	Ground Surface						20	40	60	80	100							
0.1	50mm TOPSOIL		1	SS	16													
	FILL - Silty Sand, some gravel, trace organics, compact, black / brown, moist		2	SS	14											13 65 (22)		
182.1			3	SS	24													
1.4	SILTY CLAY trace sand, occasional gravel inclusions, stiff to hard, brown, damp to moist		4	SS	33											0 1 41 58		
			5	SS	36													
			6	SS	36													
			7	SS	21											1 4 54 41		
			8	SS	32													
			9	SS	22													
			10	SS	19											0 2 68 30		
			11	SS	15											commence casing and washboring		
			12	SS	20											1 7 69 23		
			13	TW	PH													
			14	SS	23													
168.8																		
14.7																		
Continued Next Page																		

Continued Next Page

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

RECORD OF BOREHOLE No TN1

2 OF 3

METRIC

W.P. 280-99-00 LOCATION Coords: N:4763901.9 E:327473.4 ORIGINATED BY MP
DIST HWY 406 BOREHOLE TYPE Hollow Stem Augers / Casing and Washboring / NQ Rock Coring COMPILED BY DB
DATUM Geodetic DATE 12.10.09 - 12.14.09 CHECKED BY RA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa								WATER CONTENT (%)		
								20	40	60							80	100
								20	40	60							80	100
	SILTY CLAY trace to some sand, trace gravel, very stiff to hard, brown, damp to moist (GLACIAL TILL)		15	SS	22										4 12 57 27			
			16	SS	133/ 28cm													
			17	SS	117													

Continued Next Page

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

ON MOT 1-09-4135 TRW RET WALLS.GPJ ON MOT.GDT 9/7/10

RECORD OF BOREHOLE No TN1

3 OF 3

METRIC

W.P. 280-99-00 LOCATION Coords: N:4763901.9 E:327473.4 ORIGINATED BY MP
DIST HWY 406 BOREHOLE TYPE Hollow Stem Augers / Casing and Washboring / NQ Rock Coring COMPILED BY DB
DATUM Geodetic DATE 12.10.09 - 12.14.09 CHECKED BY RA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa										WATER CONTENT (%)			
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE	20	40	60	80						100	10	20	30
153.0 30.5	BEDROCK - INTERBEDDED DOLOSTONE AND SHALE Unweathered, thinly laminated, grey, medium strength, argillaceous with unweathered, laminated, white, very low strength gypsum and calcite layers / veins and frequent unweathered, white, low strength, coarse grained calcitic vugs.		1	RUN	NQ		153									RUN#1 TCR=95% SCR=87% RQD=59% RUN#2 TCR=93% SCR=83% RQD=67%					
								152													
					2	RUN	NQ		151												
150.0 33.6	End of Borehole						150														
	Borehole open to full depth and filled with drill water upon completion of drilling. Unable to push vane to 16.4m and 28.6m. Borehole sealed with bentonite slurry to ground surface.																				

+ ³ , X ³ : Numbers refer to
Sensitivity

○ 3% STRAIN AT FAILURE

RECORD OF BOREHOLE No TN2

1 OF 3

METRIC

W.P. 280-99-00 LOCATION Coords: N:4763920.1 E:327481.1 ORIGINATED BY AW
 DIST HWY 406 BOREHOLE TYPE Hollow Stem Augers / NQ Rock Coring COMPILED BY DB
 DATUM Geodetic DATE 2.5.10 - 2.17.10 CHECKED BY RA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa								WATER CONTENT (%)
								○ UNCONFINED	+ FIELD VANE	● QUICK TRIAXIAL						
184.2 0.0	Ground Surface						20 40 60 80 100								GR SA SI CL	
183.4 0.8	800mm FILL - Sandy Gravel, trace silt, very dense, grey, dry		1	SS	19											
			2	SS	35										13 12 53 22	
	FILL - Silty Clay, trace to some sand, trace to some gravel, trace organics, very stiff to hard, brown / dark brown, damp to moist		3	SS	18											
182.1 2.1			4	SS	37											
	SILTY CLAY trace sand, occasional gravel inclusions, stiff to hard, brown, damp to moist		5	SS	42										0 2 44 54	
			6	SS	32										Jan.26	
			7	SS	19										Feb.05	
			8	SS	21											
			9	SS	17										0 2 60 38	
			10	SS	19											
			11	SS	10										0 5 65 30	
			12	SS	11											
			13	TW	PH											
	firm		14	SS	16										1 3 72 24	
169.5 14.7																

Continued Next Page

+³, X³: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

RECORD OF BOREHOLE No TN2

2 OF 3

METRIC

W.P. 280-99-00 LOCATION Coords: N:4763920.1 E:327481.1 ORIGINATED BY AW
 DIST HWY 406 BOREHOLE TYPE Hollow Stem Augers / NQ Rock Coring COMPILED BY DB
 DATUM Geodetic DATE 2.5.10 - 2.17.10 CHECKED BY RA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa							WATER CONTENT (%)			
								20 40 60 80 100										
								20 40 60 80 100										

Continued Next Page

+³, X³: Numbers refer to Sensitivity O³% STRAIN AT FAILURE

3 OF 3

METRIC

+³, X³: Numbers refer to Sensitivity ○^{3%} STRAIN AT FAILURE

RECORD OF BOREHOLE No TSEW1

1 OF 3

METRIC

W.P. 280-99-00 LOCATION Coords: N:4763922.8 E:327487.0 ORIGINATED BY AW
 DIST HWY 406 BOREHOLE TYPE Hollow Stem Augers / Casing and Washboring / NQ Rock Coring COMPILED BY DB
 DATUM Geodetic DATE 1.8.10 - 1.18.10 CHECKED BY RA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	20 40 60 80 100					
183.5	Ground Surface													
0.0	30mm TOPSOIL		1	SS	32		183				o			30 30 25 15
182.8	FILL - Sand and Gravel, silty, some clay, dense, moist to wet													
0.7	SILTY CLAY trace sand, trace gravel, stiff to hard, brown, damp to moist		2	SS	16		182				o			
			3	SS	27						o		50	0 3 40 57
			4	SS	40		181				o			
			5	SS	34		180				o			
			6	SS	34		179				o			0 2 66 32
			7	SS	42		178				o			
			8	SS	23		177				o			
			9	SS	24		176				o			1 3 70 26
			10	SS	21		175				o			
			11	SS	16		174				o			2 3 66 29
			12	TW	PH		173				o			
			13	SS	13		172				o			1 2 70 27
			14	SS	13		171				o			
168.8							170				o			
14.7							169				o			

Continued Next Page

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

ON MOT 1-09-4135 TRW RET WALLS.GPJ ON MOT.GDT 9/7/10

2 OF 3

METRIC

LOCATION

Coords: N:4763922.8 E:327487.0

ORIGINATED BY AW

DIST _____ HWY 406

BOREHOLE TYPE

Hollow Stem Augers / Casing and Washboring / NQ Rock Coring

COMPILED BY DB

DATUM Geodetic

DATE _____

1.8.10 - 1.18.10

CHECKED BY RA

ON MOT 1-09-4135 TRW RET WALLS.GPJ ON MOT.GDT 9/7/10

+³, ×³: Numbers refer to Sensitivity

○ 3% STRAIN AT FAILURE

RECORD OF BOREHOLE No TSEW1

3 OF 3

METRIC

W.P. 280-99-00 LOCATION Coords: N:4763922.8 E:327487.0 ORIGINATED BY AW
DIST HWY 406 BOREHOLE TYPE Hollow Stem Augers / Casing and Washboring / NQ Rock Coring COMPILED BY DB
DATUM Geodetic DATE 1.8.10 - 1.18.10 CHECKED BY RA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa										WATER CONTENT (%)		
								20 40 60 80 100										10 20 30		
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE												
	BEDROCK - INTERBEDDED DOLOSTONE AND SHALE Unweathered, thinly laminated, grey, medium strength, argillaceous with unweathered, laminated, white, very low strength gypsum and calcite layers / veins and frequent unweathered, white, low strength, coarse grained calcitic vugs.		1	RUN	NQ		153									RUN#1 TCR=89% SCR=75% RQD=54%				
			2	RUN	NQ		152										RUN#2 TCR=93% SCR=81% RQD=52%			
150.8							151													
32.7	End of Borehole																			
	Borehole sealed with bentonite slurry to ground surface.																			
	No sample recovery at SS16 and SS17. Sampler redriven and disturbed sample collected.																			
	Resistance to augering at 19.8m and 23.8m.																			
	Unable to push vane beyond 6.6m and 15.7m and 26.4m.																			

RECORD OF BOREHOLE No S-EW 10+050CL

1 OF 2

METRIC

W.P. 280-99-00 LOCATION Coords: N:4763920.4 E:327494.1 ORIGINATED BY AW
DIST HWY 406 BOREHOLE TYPE Hollow Stem Augers COMPILED BY DB
DATUM Geodetic DATE 11.24.09 - 11.25.09 CHECKED BY RA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
183.4	Ground Surface							20 40 60 80 100	10 20 30					GR SA SI CL
0.1	120mm TOPSOIL		1	SS	29		183							
182.7	FILL - Silty Clay, trace sand, trace gravel, trace organics, very stiff, brown, moist													
0.7	SILTY CLAY trace sand, occasional gravel inclusions, stiff to hard, brown, damp to moist		2	SS	30		182							
			3	SS	31		181							
			4	SS	30		180							
			5	SS	20		179							
			6	SS	18		178							
			7	SS	20		177							
			8	SS	15		176							
			9	TW	PH		175							
			10	SS	13		174							
			11	SS	15		173							
169.8	End of Borehole						172							
13.6	Water level at 7.6m (not stabilized) and hole open to full depth on completion.						171							
	Consolidation test performed on TW9.						170							

Continued Next Page

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

ON MOT 1-08-4135 TRW RET WALLS.GPJ ON MOT.GDT 9/7/10

RECORD OF BOREHOLE No S-EW 10+050CL 2 OF 2 METRIC

W.P. 280-99-00 LOCATION Coords: N:4763920.4 E:327494.1 ORIGINATED BY AW
DIST HWY 406 BOREHOLE TYPE Hollow Stem Augers COMPILED BY DB
DATUM Geodetic DATE 11.24.09 - 11.25.09 CHECKED BY RA

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC NATURAL LIQUID LIMIT MOISTURE LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL															
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	20	40	60	80	100	w _p	w			w _L														
	<p>Piezometer installation consists of a 19mm diameter, Schedule 40 PVC pipe with a 3.0m slotted screen.</p> <p>Water Level Readings:</p> <table border="1"> <thead> <tr> <th>Date</th> <th>Depth(m)</th> <th>Elevation(m)</th> </tr> </thead> <tbody> <tr> <td>Dec.08.09</td> <td>2.4</td> <td>181.0</td> </tr> <tr> <td>Dec.15.09</td> <td>2.4</td> <td>181.0</td> </tr> <tr> <td>Jan.04.10</td> <td>2.4</td> <td>181.0</td> </tr> <tr> <td>Jan.11.10</td> <td>2.4</td> <td>181.0</td> </tr> </tbody> </table>	Date	Depth(m)	Elevation(m)	Dec.08.09	2.4	181.0	Dec.15.09	2.4	181.0	Jan.04.10	2.4	181.0	Jan.11.10	2.4	181.0															
Date	Depth(m)	Elevation(m)																													
Dec.08.09	2.4	181.0																													
Dec.15.09	2.4	181.0																													
Jan.04.10	2.4	181.0																													
Jan.11.10	2.4	181.0																													

ON_MOT 1-09-4135 TRW RET WALLS.GPJ ON_MOT.GDT 9/7/10

RECORD OF BOREHOLE No TSEW2

1 OF 3

METRIC

W.P. 280-99-00 LOCATION Coords: N:4763936.1 E:327490.9 ORIGINATED BY AW
DIST HWY 406 BOREHOLE TYPE Hollow Stem Augers / Casing and Washboring / NQ Rock Coring COMPILED BY DB
DATUM Geodetic DATE 1.5.10 - 1.7.10 CHECKED BY RA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100		
183.3 0.0	Ground Surface													
182.6 0.7	FILL - Sand, some gravel, some silt, compact, brown, wet		1	SS	25		183							10 76 (14)
			2	SS	26		182						58	0 1 43 56
	SILTY CLAY trace sand, occasional gravel inclusions, stiff to hard, brown, moist		3	SS	40		181							
			4	SS	31		180							0 2 37 61
			5	SS	26		179							
			6	SS	24		178							
			7	SS	22		177							
	dark brown		8	SS	25		176							
			9	SS	20		175							0 2 68 30
			10	TW	PH		174							commence casing and washboring
			11	SS	12		173							1 3 66 30
			12	SS	22		172							Jan.05
			13	SS	23		171							Jan.06
	reddish brown		14	SS	13		170							
168.6 14.7							169							

Continued Next Page

+ ³/_X ³/_; Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

METRIC

SOIL PROFILE							DYNAMIC CONE PENETRATION RESISTANCE PLOT	PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	SAMPLES NUMBER TYPE "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE	w _p	w	w _L			
162.9 20.4	SILTY CLAY TO CLAYEY SILT trace to some sand, trace gravel, occasional cobbles, hard, brown, damp to moist (GLACIAL TILL)	[Pattern]	15 SS 36	[Bar]	168							
			16 SS 74		167							
			17 SS 70		166							
			18 SS 129		165							
			19 SS 76		164							
			20 SS 52		163							
			21 SS 104		162							
157.9 25.4	SILTY CLAY trace sand, trace gravel, occasional cobbles, hard, reddish brown, moist (GLACIAL TILL)	[Pattern]	22 SS 33		161							
156.4 26.9	SAND AND GRAVEL silty, trace clay, occasional cobbles, compact to very dense, grey, moist to wet (GLACIAL TILL)	[Pattern]	23 SS 29		160							
			24 SS 100/ 10cm		159							
153.7 29.6	BEDROCK	[Pattern]			158							

ON MOT 1-09-4135 TRW RET WALLS.GPJ ON MOT.GDT 9/7/10

Continued Next Page

+³, X³: Numbers refer to Sensitivity ○^{3%} STRAIN AT FAILURE

RECORD OF BOREHOLE No TRW2

1 OF 2

METRIC

W.P. 280-99-00 LOCATION Coords: N:4763963.4 E:327497.0 ORIGINATED BY PK
 DIST HWY 406 BOREHOLE TYPE Solid Stem Augers COMPILED BY DB
 DATUM Geodetic DATE 7.5.10 - 7.6.10 CHECKED BY RA

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa					
182.5	Ground Surface						20 40 60 80 100						
0.1	80mm TOPSOIL		1	SS	17								
	SILTY CLAY trace sand, very stiff to hard, brown, damp to moist		2	SS	28								
			3	SS	52								
			4	SS	58								
			5	SS	37								
			6	SS	31								
	----- frequent silt seams and partings -----		7	SS	28								
			8	SS	25								
			9	SS	28								
			10	TW	PH								
			11	SS	20								
			12	SS	19								
			13	SS	35								
168.3	End of Borehole												
14.2	Unable to push vane beyond 10.1m.												

Continued Next Page

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

ON MOT 1-09-4135 TRW RET WALLS.GPJ ON MOT.GDT 9/7/10

RECORD OF BOREHOLE No TRW2

2 OF 2

METRIC

W.P. 280-99-00 LOCATION Coords: N:4763963.4 E:327497.0 ORIGINATED BY PK
 DIST HWY 406 BOREHOLE TYPE Solid Stem Augers COMPILED BY DB
 DATUM Geodetic DATE 7.5.10 - 7.6.10 CHECKED BY RA

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa								
	<p>Borehole was dry (not stabilized) and hole open to full depth on completion.</p> <p>Piezometer installation consists of a 19mm diameter, Schedule 40 PVC pipe with a 1.52m slotted screen.</p> <p>Water Level Readings: Date Depth(m) Elevation(m) July.12.10 2.8 179.7 July.19.10 2.9 179.6</p>															

RECORD OF BOREHOLE No TRW3

1 OF 2

METRIC

W.P. 280-99-00 LOCATION Coords: N:4763855.8 E:327427.4 ORIGINATED BY PK
DIST HWY 406 BOREHOLE TYPE Solid Stem Augers COMPILED BY DB
DATUM Geodetic DATE 6.29.10 CHECKED BY RA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	20 40 60 80 100					
183.1	Ground Surface						183							
0.1	80mm TOPSOIL		1	SS	8		183							0 8 52 40
182.4	FILL - Silty Clay, trace sand, trace organics, firm to stiff, brown / black stained, moist													
0.7	SILTY CLAY trace sand, very stiff to hard, brown, damp to moist		2	SS	41		182							
			3	SS	35		181							
			4	SS	40		180							
			5	SS	35		179							
			6	SS	35		178							
			7	SS	22		177							0 3 69 28
			8	SS	27		176							
			9	TW	PH		175							
	occasional gravel inclusions		10	SS	17		174							
			11	SS	17		173							
			12	SS	37		172							2 4 70 24
			13	SS	27		171							
168.4							170							
14.7							169							

ON MOT 1-09-4135 TRW RET WALLS.GPJ ON MOT.GDT 9/7/10

Continued Next Page

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

RECORD OF BOREHOLE No TRW3

2 OF 2

METRIC

W.P. 280-99-00 LOCATION Coords: N:4763855.8 E:327427.4 ORIGINATED BY PK
DIST HWY 406 BOREHOLE TYPE Solid Stem Augers COMPILED BY DB
DATUM Geodetic DATE 6.29.10 CHECKED BY RA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC NATURAL LIQUID LIMIT MOISTURE LIMIT CONTENT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100	w _p	w	w _L				
	SILTY CLAY trace sand, trace gravel, stiff to hard, brown, damp to moist (GLACIAL TILL.)		14	SS	12		168												
							167												
165.8			15	SS	78		166												
17.3	End of Borehole No sample recovery at SS12. Sampler redriven and disturbed sample collected. 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) July.05.10 2.3 180.8 July.12.10 3.2 179.9 July.19.10 2.3 180.8 July.28.10 3.5 179.6 Aug.06.10 3.5 179.6																		

RECORD OF BOREHOLE No TEW3

1 OF 3

METRIC

W.P. 280-99-00 LOCATION Coords: N:4763877.2 E:327436.9 ORIGINATED BY AW
DIST HWY 406 BOREHOLE TYPE Hollow Stem Augers / NQ Rock Coring COMPILED BY DB
DATUM Geodetic DATE 12.7.09 - 12.10.09 CHECKED BY RA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT w_p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w_L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa							WATER CONTENT (%)			
								20 40 60 80 100										
								20 40 60 80 100										
182.6	Ground Surface																	
0.1	120mm TOPSOIL		1	SS	8		182											
181.9	FILL - Silty Clay, trace sand, trace organics, firm to stiff, brown, moist																	
0.7	SILTY CLAY trace sand, occasional gravel inclusions, very stiff to hard, brown, damp to moist		2	SS	33		181											
			3	SS	26		180											
			4	SS	31		179											
			5	SS	25		178											
			6	SS	33		177											
			7	SS	26		176											
			8	SS	31		175											
			9	SS	33		174											
			10	SS	38		173											
			11	SS	32		172											
			12	SS	23		171											
			13	TW	PH		170											
			14	SS	22		169											
							168											

Continued Next Page

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

ON MOT 1-09-4135 TRW RET WALLS.GPJ ON MOT.GDT 9/7/10

RECORD OF BOREHOLE No TEW3

2 OF 3

METRIC

W.P. 280-99-00 LOCATION Coords: N:4763877.2 E:327436.9 ORIGINATED BY AW
DIST HWY 406 BOREHOLE TYPE Hollow Stem Augers / NQ Rock Coring COMPILED BY DB
DATUM Geodetic DATE 12.7.09 - 12.10.09 CHECKED BY RA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa							
						20	40	60	80	100					
166.8	CLAYEY SILT TO SILTY CLAY some sand to sandy, trace gravel, hard, brown, damp to moist (GLACIAL TILL)		15	SS	26										
15.8															
			16	SS	61										4 13 62 21
			17	SS	42										
			18	SS	38										
			19	SS	31									5 30 46 19	
														Dec.07	
														Dec.08	
			20	SS	38										
157.9	SILTY SAND some gravel to gravelly, trace clay, compact to dense, brown, damp to moist (GLACIAL TILL)		21	SS	100/ 13cm										
24.7															
			22	SS	29										
			23	SS	38									25 38 29 8	
														Dec.08	
														Dec.09	
153.7	BEDROCK		1	RUN	NQ									RUN#1 TCR=52% SCR=40% RQD=0%	
28.9														RUN#2 TCR=95% SCR=83% RQD=49%	

ON MOT 1-09-4135 TRW RET WALLS.GPJ ON MOT.GDT 9/7/10

Continued Next Page

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

RECORD OF BOREHOLE No TEW3

3 OF 3

METRIC

W.P. 280-99-00 LOCATION Coords: N:4763877.2 E:327436.9 ORIGINATED BY AW
 DIST HWY 406 BOREHOLE TYPE Hollow Stem Augers / NQ Rock Coring COMPILED BY DB
 DATUM Geodetic DATE 12.7.09 - 12.10.09 CHECKED BY RA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ KN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100	W _p	W	W _L		
	BEDROCK - INTERBEDDED DOLOSTONE AND SHALE Unweathered, thinly laminated, grey, medium strength, argillaceous with unweathered, laminated, white, very low strength gypsum and calcite layers / veins and frequent unweathered, white, low strength, coarse grained calcitic vugs.		2	RUN	NQ												
			3	RUN	NQ												
150.5 32.1	End of Borehole																
	Water level at 15.2m (not stabilized) on completion of overburden sampling. Unable to push vane beyond 15.1m and 16.5m. Borehole sealed with bentonite slurry to ground surface.																

ON MOT 1-09-4135 TRW RET WALLS.GPJ ON MOT.GDT 9/7/10

RECORD OF BOREHOLE No TEW4

1 OF 3

METRIC

W.P. 280-99-00 LOCATION Coords: N:4763885.4 E:327439.2 ORIGINATED BY AW
 DIST HWY 406 BOREHOLE TYPE Hollow Stem Augers / Casing and Washboring / NQ Rock Coring COMPILED BY DB
 DATUM Geodetic DATE 12.10.09 - 12.15.09 CHECKED BY RA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
								○ UNCONFINED + FIELD VANE									
								● QUICK TRIAXIAL X LAB VANE									
							20	40	60	80	100	WATER CONTENT (%)					
												10	20	30			
182.6	Ground Surface																
0.1	110mm TOPSOIL		1	SS	9		182									0 2 58 40	
181.9	FILL - Silty Clay, trace sand, trace organics, stiff, brown, moist																
0.7	SILTY CLAY trace sand, occasional gravel inclusions, very stiff to hard, brown, damp to moist		2	SS	47		181										
			3	SS	55		180										
			4	SS	49		179										
			5	SS	55		178									0 3 67 30	
			6	SS	42		177										
			7	SS	41		176										
			8	SS	30		175										
			9	SS	30		174										
			10	SS	24		173									0 7 69 24	
			11	SS	24		172									Dec.10	
			12	SS	12		171									Dec.11	
			13	SS	19		170										
			14	TW	PH		169										
168.0							168										
14.6																	

Continued Next Page

+³, X³; Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

ON MOT -09-4135 TRW RET WALLS.GPJ ON MOT.GDT 9/7/10

RECORD OF BOREHOLE No TEW4

2 OF 3

METRIC

W.P. 280-99-00 LOCATION Coords: N:4763885.4 E:327439.2 ORIGINATED BY AW
DIST HWY 406 BOREHOLE TYPE Hollow Stem Augers / Casing and Washboring / NQ Rock Coring COMPILED BY DB
DATUM Geodetic DATE 12.10.09 - 12.15.09 CHECKED BY RA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE	WATER CONTENT (%) 10 20 30					
	CLAYEY SILT TO SILTY CLAY some sand to sandy, trace to some gravel, occasional cobbles, very stiff to hard, brown, damp to moist (GLACIAL TILL)		15	SS	30		167							5 17 58 20
			16	SS	100/ 0cm		166							commence casing and washboring
			17	SS	70		164							
			18	SS	78		162							
			19	SS	60		161							
			20	SS	68		160							
			21	SS	87		158							
			22	SS	34		156							
			23	SS	100/ 14cm		155							
157.8 24.8	SILTY SAND some gravel to gravelly, trace clay, occasional cobbles, dense to very dense, brown, damp to moist (GLACIAL TILL)						154							
153.9 28.7	frequent cobbles		1	RUN	NQ									
	BEDROCK		2	RUN	NQ		153							

Continued Next Page

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


ON_MOT_1-09-4135 TRW RET WALLS.GPJ ON_MOT.GDT 9/7/10

RECORD OF BOREHOLE No TEW4

3 OF 3

METRIC

W.P. 280-99-00 LOCATION Coords: N:4763885.4 E:327439.2 ORIGINATED BY AW
 DIST HWY 406 BOREHOLE TYPE Hollow Stem Augers / Casing and Washboring / NQ Rock Coring COMPILED BY DB
 DATUM Geodetic DATE 12.10.09 - 12.15.09 CHECKED BY RA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100					
151.2	BEDROCK - INTERBEDDED DOLOSTONE AND SHALE. Unweathered, thinly laminated, grey, medium strength, argillaceous with unweathered, laminated, white, very low strength gypsum and calcite layers / veins and frequent unweathered, white, low strength, coarse grained calcitic vugs.		3	RUN	NQ		152										RUN#3 TCR=100% SCR=74% RQD=22%
31.4	End of Borehole Borehole filled with drill water upon completion of coring. Unable to push vane beyond 14.9m. No sample recovery at SS10, SS16, SS20, SS21, SS23. Sampler redriven and disturbed sample collected. 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) Jan.11.10 10.2 172.4 Jan.19.10 10.6 172.0 Jan.27.10 10.5 172.1 Feb.08.10 10.6 172.0																

RECORD OF BOREHOLE No WE-S 10+295CL

1 OF 1

METRIC

W.P. 280-99-00 LOCATION Coords: N:4763889.2 E:327432.2 ORIGINATED BY AW
DIST HWY 406 BOREHOLE TYPE Hollow Stem Augers COMPILED BY DB
DATUM Geodetic DATE 11.4.09 CHECKED BY RA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
182.8	Ground Surface							20	40	60	80	100					
0.0	FILL - Silty Clay, trace sand, stiff to very stiff, brown, damp to moist		1	SS	8		182										
			2	SS	27												
181.4																	
1.4	SILTY CLAY trace sand, trace gravel, very stiff to hard, brown, damp to moist		3	SS	32		181										
			4	SS	45												
			5	SS	40		180										0 3 66 31
							179										
			6	SS	67		178										
			7	SS	32												
	---- grey						177										
			8	SS	33												
							176										
			9	SS	37		175										2 4 66 28
							174										
			10	TW	PH							>>X				20.8	0 3 73 24
							173										
			11	SS	17		172										
171.6																	
11.2	End of Borehole																
	Borehole was dry (not stabilized) and hole open to full depth on completion.																
	Consolidation test performed on TW 10.																

RECORD OF BOREHOLE No TS3

1 OF 3

METRIC

W.P. 280-99-00 LOCATION Coords: N:4763891.8 E:327445.1 ORIGINATED BY LY
DIST HWY 406 BOREHOLE TYPE Hollow Stem Augers / NQ Rock Coring COMPILED BY DB
DATUM Geodetic DATE 12.15.09 - 12.16.09 CHECKED BY RA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	20 40 60 80 100					
182.5	Ground Surface													
0.0	FILL - Silty Clay, trace sand, trace gravel, trace organics, firm, brown, moist		1	SS	5		182							
181.8														
0.7	SILTY CLAY trace sand, very stiff to hard, brown, damp to moist		2	SS	46		181							0 2 36 62
			3	SS	39									
			4	SS	32		180							
			5	SS	36		179							
			6	SS	44		178							0 6 61 33
			7	SS	46		177							
			8	SS	28		176							0 3 64 33
			9	SS	29		175							
			10	SS	19		174							Dec.15
			11	TW	PH		173							Dec.16
			12	SS	18		172							0 3 69 28
			13	SS	18		171							
			14	SS	26		170							
							169							
							168							
167.8														
14.7														

Continued Next Page

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

ON MOT. 1-09-4135 TRW/RET WALLS.GPJ ON MOT.GDT 9/7/10

METRIC

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE			"N" VALUES	20 40 60 80 100	W _p W W _L	WATER CONTENT (%)	10 20 30		
							SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL X LAB VANE 20 40 60 80 100						

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT	PLASTIC LIMIT w_p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w_L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE					
								20 40 60 80 100 WATER CONTENT (%) 10 20 30					
	CLAYEY SILT TO SILTY CLAY some sand to sandy, trace to some gravel, occasional cobbles, hard, brown, damp (GLACIAL TILL)		15	SS	73		167						
			16	SS	83		166						
			17	SS	66		164						
			18	SS	53		162						
161.7 20.8	SAND gravelly, trace silt, very dense, grey, moist		19	SS	82		161						
160.6 21.9	CLAYEY SILT trace sand, trace gravel, occasional cobbles, very stiff, brown, damp (GLACIAL TILL)		20	SS	21		159						
159.1 23.4	SAND and gravel, trace silt, very dense, grey, moist		21	SS	83		158						
157.7 24.8	SILTY CLAY trace sand, trace gravel, occasional cobbles, hard, brown, moist (GLACIAL TILL)		22	SS	31		157						
156.2 26.3	SANDY GRAVEL some silt, trace clay, frequent cobbles, very dense, brown, moist (GLACIAL TILL)		23	SS	102		155						
153.8 28.7	BEDROCK		1	RUN	NQ		154						
							153						

ON MOT 1-09-4135 TRW RET WALLS.GPJ ON MOT.GDT 9/7/10


Continued Next Page

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

3 OF 3

METRIC

SOIL PROFILE	SAMPLES			DYNAMIC CONE PENETRATION				
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SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa								
							20	40	60	80	100					
							○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE									
							20	40	60	80	100	10	20	30		
	BEDROCK - INTERBEDDED DOLOSTONE AND SHALE Unweathered, thinly laminated, grey, medium strength, argillaceous with unweathered, laminated, white, very low strength gypsum and calcite layers / veins and frequent unweathered, white, low strength, coarse grained calcitic vugs.		2	RUN	NQ		152									SCR=56% RQD=22%
			3	RUN	NQ		151									RUN#3 TCR=92% SCR=82% RQD=34%
149.9 32.6	End of Borehole Unable to push vane beyond 13.3m and 14.4m. No sample recovery at SS19. Borehole sealed with bentonite slurry to ground surface.						150									

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

RECORD OF BOREHOLE No TS4

1 OF 3

METRIC

W.P. 280-99-00 LOCATION Coords: N:4763903.8 E:327455.3 ORIGINATED BY LY
DIST HWY 406 BOREHOLE TYPE Hollow Stem Augers / Casing and Washboring / NQ Rock Coring COMPILED BY DB
DATUM Geodetic DATE 12.17.09 - 12.22.09 CHECKED BY RA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40						60	80
182.4	Ground Surface															
0.0	FILL - Silty Clay, trace sand, trace gravel, trace organics, firm, brown, moist		1	SS	6		182									
181.7																
0.7	SILTY CLAY trace sand, stiff to hard, brown, damp to moist		2	SS	51		181									
			3	SS	36		180									
			4	SS	39		179									
			5	SS	52		178									
			6	SS	29		177									
			7	SS	26		176									
			8	SS	16		175									
			9	TW	PH		174									
			10	SS	14		173									
			11	SS	27		172									
			12	SS	13		171									
			13	SS	17		170									
167.7							169									
14.7							168									

ON MOT 1-09-4135 TRW RET WALLS.GPJ ON MOT.GDT 9/7/10

Continued Next Page

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

RECORD OF BOREHOLE No TS4

2 OF 3

METRIC

W.P. 280-99-00 LOCATION Coords: N:4763903.8 E:327455.3 ORIGINATED BY LY
 DIST HWY 406 BOREHOLE TYPE Hollow Stem Augers / Casing and Washboring / NQ Rock Coring COMPILED BY DB
 DATUM Geodetic DATE 12.17.09 - 12.22.09 CHECKED BY RA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kNm ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa							WATER CONTENT (%)
								○ UNCONFINED ● QUICK TRIAXIAL	+ FIELD VANE × LAB VANE						
							20 40 60 80 100	20 40 60 80 100	10 20 30						
164.3 18.1	CLAYEY SILT TO SILTY CLAY some sand, some gravel, frequent cobbles, stiff to hard, brown, damp (GLACIAL TILL)		14	SS	10									16 19 49 16	
			15	SS	100/ 28cm										
			16	SS	77										
			17	SS	80										
			18	SS	76										
			19	SS	100/ 28cm										
158.5 23.9	CLAYEY SILT trace sand, trace gravel, very stiff, brown, damp (GLACIAL TILL)		20	SS	25										
157.0 25.4	GRAVEL AND SAND some silt, occasional cobbles, very dense, grey, moist to wet (GLACIAL TILL)		21	SS	100/ 25cm										
			22	SS	100/ 18cm									45 41 (14)	
154.0 28.4	BEDROCK		1	RUN	NQ									Dec.21 RUN#1 TCR=90% SCR=72% RQD=41%	
														RUN#2	

Continued Next Page

+ 3 x 3: Numbers refer to
Sensitivity

○ 3% STRAIN AT FAILURE

ONTARIO MOT. 1-09-4135 TS BRIDGE.GPJ ONTARIO MOT.GDT 05/20/10

RECORD OF BOREHOLE No TS4

3 OF 3

METRIC

W.P. 280-99-00 LOCATION Coords: N:4763903.8 E:327455.3 ORIGINATED BY LY
 DIST HWY 406 BOREHOLE TYPE Hollow Stem Augers / Casing and Washboring / NQ Rock Coring COMPILED BY DB
 DATUM Geodetic DATE 12.17.09 - 12.22.09 CHECKED BY RA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE									
							20	40	60	80	100						
							20	40	60	80	100						

+ 3, X 3: Numbers refer to
Sensitivity

○ 3% STRAIN AT FAILURE

RECORD OF BOREHOLE No SBL 12+410CL

1 OF 2

METRIC

W.P. 280-99-00

LOCATION

Coords: N:4763911.8 E:327444.8

ORIGINATED BY PK

DIST HWY 405

BOREHOLE TYPE

Hollow Stem Augers

COMPILED BY DB

DATUM Geodetic

DATE

11.18.09

CHECKED BY RA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	20 40 60 80 100					
182.5	Ground Surface													
182.3	180mm TOPSOIL													
0.2	FILL - Silty Clay, trace sand, trace organics, stiff, brown, moist		1	SS	13		182							
181.8														
0.7	SILTY CLAY trace sand, stiff to hard, brown, moist		2	SS	45		181							
			3	SS	36		180							0 3 62 35
			4	SS	39		179							
			5	SS	40		178							0 4 66 30
			6	SS	20		177							
			7	SS	20		176							
			8	SS	14		175							
	trace gravel		9	TW	PH		174							
			10	SS	11		173						20.4	1 3 70 26
			11	SS	16		172							0 2 72 26
168.9	End of Borehole						171							
13.6	Borehole was dry (not stabilized) and hole open to full depth on completion. Consolidation test performed on TW 9.						170							
							169							

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+³ X³: Numbers refer to Sensitivity O 3% STRAIN AT FAILURE

ON_MOT_1-09-4135 TRW RET WALLS.GPJ ON_MOT_GDT_97/10

RECORD OF BOREHOLE No SBL 12+410CL

2 OF 2

METRIC

W.P. 280-99-00 LOCATION Coords: N:4763911.8 E:327444.8 ORIGINATED BY PK
 DIST HWY 406 BOREHOLE TYPE Hollow Stem Augers COMPILED BY DB
 DATUM Geodetic DATE 11.18.09 CHECKED BY RA

SOIL PROFILE		SAMPLES				GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC NATURAL LIQUID LIMIT MOISTURE CONTENT LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100	W _p	W	W _L		
	<p>No sample recovery at SS8. Sampler redriven and disturbed sample collected.</p> <p>Piezometer installation consists of a 19mm diameter, Schedule 40 PVC pipe with a 1.52m slotted screen.</p> <p>Water Level Readings: Date Depth(m) Elevation(m) Nov.30.09 1.7 180.8 Dec.07.09 1.4 181.1 Dec.15.09 1.3 181.2</p>																

ON MOT 1-09-4135 TRW RET WALLS.GPJ ON MOT.GDT 9/7/10

RECORD OF BOREHOLE No TN3

1 OF 3

METRIC

W.P. 280-99-00 LOCATION Coords: N:4763930.0 E:327463.7 ORIGINATED BY MP
DIST HWY 406 BOREHOLE TYPE Solid Stem Augers / Casing and Washboring / NQ Rock Coring COMPILED BY DB
DATUM Geodetic DATE 2.2.10 - 2.11.10 CHECKED BY RA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
184.1 0.0	Ground Surface							20 40 60 80 100	20 40 60 80 100	10 20 30				GR SA SI CL
183.3 0.8	800mm FILL - Sandy Gravel, trace silt, very dense, grey, dry		1	SS	53									66 27 (7)
	FILL - Silty Clay, trace to some sand, trace gravel, trace to some organics, very stiff to hard, black / brown, damp to moist		2	SS	27									
			3	SS	19									
			4	SS	32									
181.2 2.9	SILTY CLAY trace sand, trace gravel, stiff to hard, brown, damp to moist		5	SS	42									
			6	SS	44									0 2 49 49
			7	SS	35									
	sandy		8	SS	24									1 41 36 22
			9	SS	22									
			10	TW	PH									
			11	SS	12									1 3 65 31
	firm		12	SS	17									
			13	TW	21									
			14	SS	18									Feb.02 Feb.04
														1 3 72 24

Continued Next Page

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

ON MOT. 1-09-4135 TRW RET WALLS.GPJ ON MOT.GDT 9/7/10

RECORD OF BOREHOLE No TN3

2 OF 3

METRIC

W.P. 280-99-00 LOCATION Coords: N:4763930.0 E:327463.7 ORIGINATED BY MP
DIST HWY 406 BOREHOLE TYPE Solid Stem Augers / Casing and Washboring / NQ Rock Coring COMPILED BY DB
DATUM Geodetic DATE 2.2.10 - 2.11.10 CHECKED BY RA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	20 40 60 80 100					
168.9 15.2	SILTY CLAY some sand, trace gravel, very stiff to hard, brown, damp to moist (GLACIAL TILL)		15	SS	27		169	+ 1.2					4 17 56 23	commence casing and washboring
							168	>> 1.6						
				16	SS		26	167	1.4					
								166	>> 1.8					
				17	SS		74	165						
				18	SS		100	164						
162.5 21.6	SANDY SILT TO SILTY SAND some gravel, trace clay, dense to very dense, brown, moist (GLACIAL TILL)		19	120	100/ 13cm		163						31 33 29 7	Feb.04 Feb.08
							162							
				20	SS		71	161						
				21	SS		48	160						
157.2 26.9	CLAYEY SILT TO SILTY CLAY trace sand, trace gravel, hard, brown, moist (GLACIAL TILL)						159						Feb.08 Feb.09	
156.4 27.7			22	SS	43		158							
	SAND AND GRAVEL silty, trace clay, very dense, brown, moist (GLACIAL TILL)						157							
			23	SS	112		156							
154.5 29.6	BEDROCK						155							Feb.09 Feb.11

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

ON MOT 1-09-4135 TRW RET WALLS.GPJ ON MOT.GDT 9/7/10

3 OF 3

METRIC

+3, X3: Numbers refer to Sensitivity □ 3% STRAIN AT FAILURE

RECORD OF BOREHOLE No TN4

1 OF 3

METRIC

W.P. 280-99-00

LOCATION

Coords: N:4763941.4 E:327469.8

ORIGINATED BY MP

DIST HWY 406

BOREHOLE TYPE

Solid Stem Augers / NO Rock Coring

COMPILED BY DB

DATUM Geodetic

DATE

1.26.10 - 2.17.10

CHECKED BY RA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	20 40 60 80 100					
184.0 0.0	Ground Surface													
183.3 0.7	740mm FILL - Gravel, some sand, trace to some silt, dense, grey, damp		1	SS	41									72 17 (11)
181.9 2.1	FILL - Silty Clay, some gravel, trace sand, trace organics, stiff, dark brown / brown, damp to moist		2	SS	10		183							
			3	SS	15		182							
	SILTY CLAY trace sand, stiff to hard, brown, damp to moist		4	SS	29		181						44	0 3 47 50
			5	SS	36		180							
			6	SS	50		179							0 3 74 23
			7	SS	43		178							
			8	SS	23		177							Jan.26
			9	SS	17		176							Feb.05
			10	SS	23		175							0 3 65 32
			11	SS	9		174							
			12	TW	PH		173							
			13	SS	16		172							
			14	SS	17		171							
169.3 14.7							170							

Continued Next Page

+ 3, X 3: Numbers refer to
Sensitivity

○ 3% STRAIN AT FAILURE

2 OF 3

METRIC

LOCATION

Coords: N:4763941.4 E:327469.8

ORIGINATED BY MP

DIST HWY 406

BOREHOLE TYPE

Solid Stem Augers / NQ Rock Coring

COMPILED BY DB

DATUM Geodetic

DATE _____

1.26.10 - 2.17.10

CHECKED BY RA

+³, X³: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

RECORD OF BOREHOLE No TN4

3 OF 3

METRIC

W.P. 280-99-00 LOCATION Coords: N:4763941.4 E:327469.8
 DIST HWY 406 BOREHOLE TYPE Solid Stem Augers / NQ Rock Coring
 DATUM Geodetic DATE 1.26.10 - 2.17.10
 ORIGINATED BY MP
 COMPILED BY DB
 CHECKED BY RA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa													
								○ UNCONFINED	+	FIELD VANE											
								● QUICK TRIAXIAL	x	LAB VANE											
							20	40	60	80	100										

+3, x3: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

RECORD OF BOREHOLE No TSEW4

1 OF 3

METRIC

W.P. 280-99-00 LOCATION Coords: N:4763951.2 E:327473.9 ORIGINATED BY PK
 DIST HWY 406 BOREHOLE TYPE Hollow Stem Augers / NQ Rock Coring COMPILED BY DB
 DATUM Geodetic DATE 12.2.09 - 12.7.09 CHECKED BY RA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	20 40 60 80 100					
183.5 0.0	Ground Surface													
	FILL - Silty Clay, some sand, trace gravel, trace organics, stiff to very stiff, dark brown / brown, moist		1	SS	11		183				o			
	firm		2	SS	18		182				o			3 11 48 38
181.4 2.1	SILTY CLAY trace sand, trace gravel, stiff to very stiff, brown, damp to moist		3	SS	6		181				o			0 1 54 45
			4	SS	14		180				o			
			5	SS	18		179				o			
	some sand		6	SS	19		178				o			
			7	SS	18		177				o			
			8	SS	13		176				o			
			9	SS	11		175				o			
			10	SS	7		174				o			
			11	SS	3		173				o			
			12	SS	8		172				o			
			13	SS	9		171				o			
			14	TW	PH		170				o			
168.8 14.7							169				o			

Continued Next Page

+³.X³: Numbers refer to
Sensitivity

○ 3% STRAIN AT FAILURE

2 OF 3

METRIC

DATUM Geodetic DATE 12.2.09 - 12.7.09 CHECKED BY RA

ON MOT 1-09-4135 TRW RET WALLS.GPJ ON MOT.GDT 9/7/10

+3, X3: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

RECORD OF BOREHOLE No TSEW4

3 OF 3

METRIC

W.P. 280-99-00 LOCATION Coords: N:4763951.2 E:327473.9 ORIGINATED BY PK
 DIST HWY 406 BOREHOLE TYPE Hollow Stem Augers / NQ Rock Coring COMPILED BY DB
 DATUM Geodetic DATE 12.2.09 - 12.7.09 CHECKED BY RA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
								20 40 60 80 100									

RECORD OF BOREHOLE No NBL 12+440Rt

1 OF 2

METRIC

W.P. 280-99-00

LOCATION

Coords: N:4763962.9 E:327465.8

ORIGINATED BY MP

DIST HWY 406

BOREHOLE TYPE Hollow Stem Augers

COMPILED BY DB

DATUM Geodetic

DATE

11.4.09

CHECKED BY RA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC NATURAL LIQUID LIMIT MOISTURE CONTENT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	20 40 60 80 100	W _p	w	W _L		
183.0	Ground Surface													
182.9	130mm TOPSOIL													
0.1	FILL - Silty Clay, trace sand, trace gravel, trace organics, firm to stiff, brown, damp to moist		1	SS	6									
			2	SS	12									
			3	SS	13									
			4	SS	14									
180.1	SILTY CLAY trace sand, occasional gravel inclusions, stiff to very stiff, brown, moist		5	SS	17									
2.9			6	SS	26									
			7	SS	15									
			8	SS	25									
			9	SS	10									
			10	TW	PH									
			11	SS	12									
169.6	End of Borehole													
13.4	Borehole was dry (not stabilized) and hole open to full depth on completion. Consolidation test performed on TW 10.													

Continued Next Page

+ 3, X 3, Numbers refer to
Sensitivity

O 3% STRAIN AT FAILURE

ON MOT 1-09-4135 TRW RET WALLS.GPJ ON MOT.GDT 9/7/10

2 OF 2

METRIC

W.P. 280-99-00

LOCATION

Coords: N:4763962.9 E:327465.8

ORIGINATED BY MP

DIST _____ HWY 406

BOREHOLE TYPE

Hollow Stem Augers

COMPILED BY DB

DATUM Geodetic

DATE _____

11.4.09

CHECKED BY RA

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

RECORD OF BOREHOLE No TSEW3

1 OF 3

METRIC

W.P. 280-99-00 LOCATION Coords: N:4763960.8 E:327478.6 ORIGINATED BY LY
DIST HWY 406 BOREHOLE TYPE Hollow Stem Augers / Casing and Washboring / NQ Rock Coring COMPILED BY DB
DATUM Geodetic DATE 12.8.09 - 12.10.09 CHECKED BY RA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100					
183.3	Ground Surface																
0.0																	
182.6	FILL - Sand and Gravel, trace silt, loose, grey, dry		1	SS	6		183										
0.7																	
182.0	FILL - Silty Clay, some sand, some gravel, firm, grey, damp to moist		2	SS	5		182										
1.3																	
	SILTY CLAY trace sand, trace gravel, stiff to very stiff, brown, moist		3	SS	18		181										
			4	SS	18												
			5	SS	24		180									45	0 2 46 52
			6	SS	24		179										
			7	SS	12		178										1 4 61 34
			8	SS	10		177										
			9	SS	14		176										
			10	SS	16		175										
			11	SS	9		174										0 4 64 32
			12	SS	9		173										4 5 67 24
			13	TW	PH		171									20.8	2 2 75 21
			14	SS	12		170										3 3 70 24
168.6							169										
14.7																	

Continued Next Page

+ 3, X 3: Numbers refer to
Sensitivity

○ 3% STRAIN AT FAILURE

ON MOT 1-09-4135 TRW RET WALLS.GPJ ON MOT.GDT 9/7/10

METRIC

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40						60
								SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE							
								20	40	60	80	100	10	20	30

Station	Description	SS (%)	GS (%)
164.0 19.3	SILTY CLAY TO CLAYEY SILT trace sand, trace gravel, occasional cobbles, very stiff to hard, brown, damp to moist (GLACIAL TILL)	15	15
		16	52
		17	54
		18	72
		19	30
		20	59
		21	42
157.9 25.4	SILTY CLAY sandy, gravelly, occasional cobbles, hard, brown, moist (GLACIAL TILL)	22	100/ 25cm
156.4 26.9	SAND AND GRAVEL silty, trace clay, compact, brown, moist (GLACIAL TILL)	23	18
153.6 29.7	BEDROCK		

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

3 OF 3

METRIC

LOCATION

Coords: N:4763960.8 E:327478.6

ORIGINATED BY LY

DIST HWY 406

BOREHOLE TYPE

Hollow Stem Augers / Casing and Washboring / NQ Rock Coring

COMPILED BY DB

DATUM Geodetic

DATE _____

12.8.09 - 12.10.09

CHECKED BY RA

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

RECORD OF BOREHOLE No TRW4

1 OF 2

METRIC

W.P. 280-99-00 LOCATION Coords: N:4764001.2 E:327484.0 ORIGINATED BY BL
 DIST HWY 406 BOREHOLE TYPE Solid Stem Augers COMPILED BY DB
 DATUM Geodetic DATE 07.27.10 CHECKED BY RA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	*N* VALUES			SHEAR STRENGTH kPa						
184.0	Ground Surface							20 40 60 80 100						GR SA SI CL
0.2	150mm TOPSOIL		1	SS	18			○ UNCONFINED + FIELD VANE						
	SILTY CLAY trace sand, occasional gravel inclusions, very stiff to hard, brown, damp to moist		2	SS	48		183	● QUICK TRIAXIAL × LAB VANE						
			3	SS	39		182							
			4	SS	33		181						1 3 47 49	
			5	SS	48		180							
			6	SS	42		179						0 2 69 29	
			7	SS	46		178							
			8	SS	27		177							
			9	SS	22		176						2 5 64 29	
			10	SS	24		175							
			11	SS	29		174							
			12	SS	32		173							
			13	SS	36		172							
		frequent silt seams and partings					171							
						170							0 2 67 31	
169.3														
14.7														

Continued Next Page

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

ON MOT 1-09-4135 TRW RET WALLS.GPJ ON MOT.GDT 11/04/10

RECORD OF BOREHOLE No TRW4

2 OF 2

METRIC

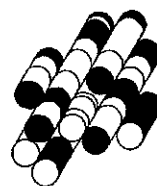
W.P. 280-99-00 LOCATION Coords: N:4764001.2 E:327484.0 ORIGINATED BY BL
DIST HWY 406 BOREHOLE TYPE Solid Stem Augers COMPILED BY DB
DATUM Geodetic DATE 7.27.10 CHECKED BY RA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC NATURAL LIQUID LIMIT MOISTURE CONTENT LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100	W _p	W	W _L		
168.3	SILTY CLAY trace sand, trace gravel, hard, brown, damp to moist (GLACIAL TILL)		14	SS	37												
15.7	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) July.28.10 10.6 173.4 Aug.06.10 3.4 180.6 Aug.13.10 2.9 181.1 Aug.23.10 3.1 180.9																

ON MOT 1-09-4135 TRW RET WALLS.GPJ ON MOT.GDT 9/7/10

B2

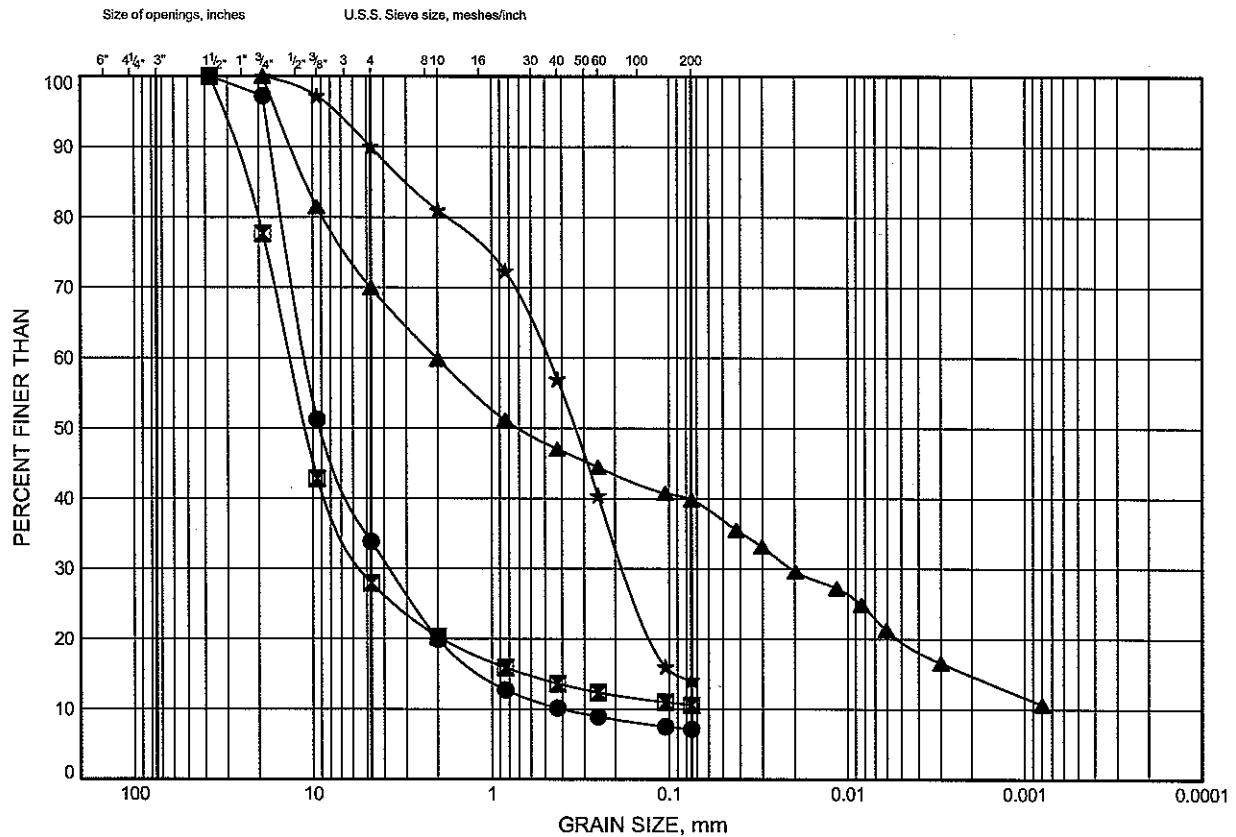
TERRAPROBE INC.



GRAIN SIZE DISTRIBUTION

FIGURE B2-1

FILL - Gravelly Sand to Sandy Gravel



SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	TN3	0.3	183.8
■	TN4	0.3	183.7
▲	TSEW1	0.3	183.2
★	TSEW2	0.3	183.0

Date August 2010

Project 1-09-4135



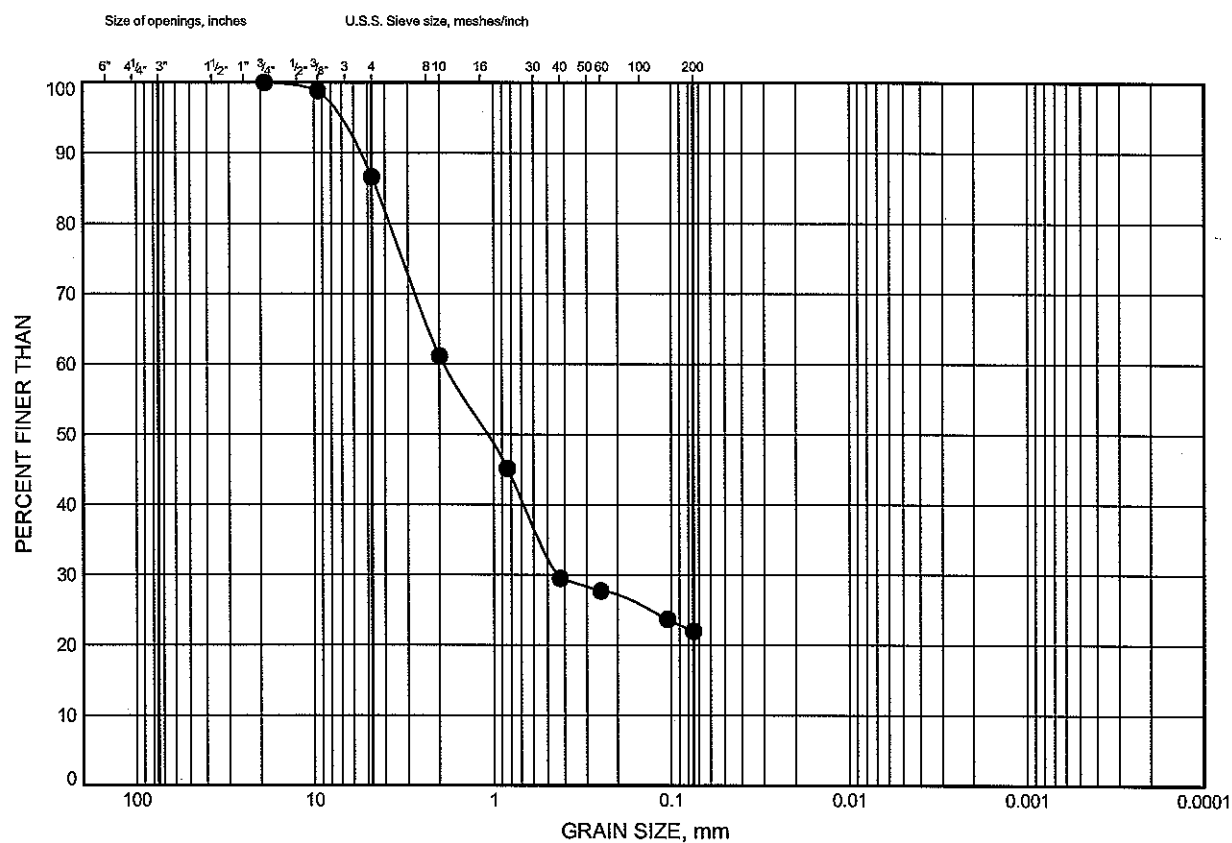
Prep'd DB

Chkd. MP

GRAIN SIZE DISTRIBUTION

FIGURE B2-2

FILL - Silty Sand



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

SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	TN1	1.0	182.5

Date August 2010
Project 1-09-4135

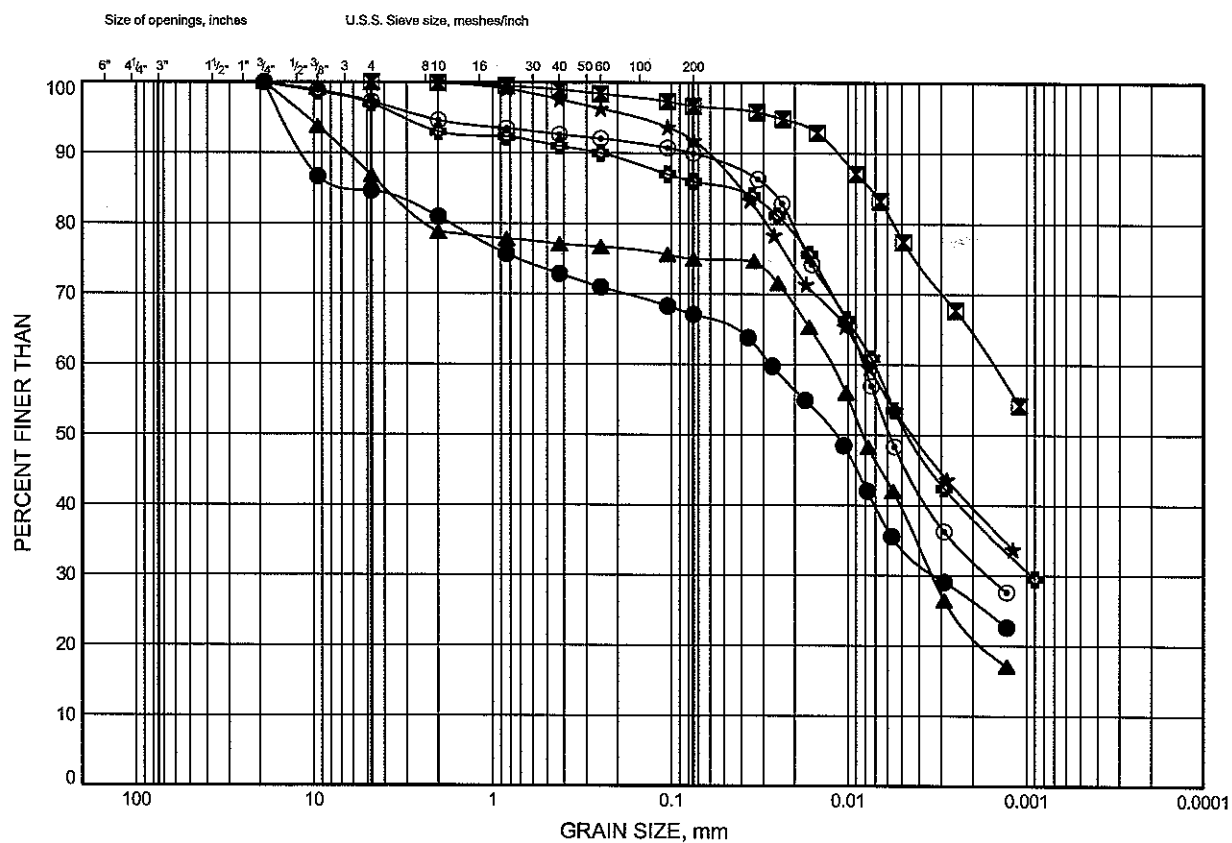


Prep'd DB
Chkd. MP

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)
●	NBL 12+375Lt	1.0	182.3
⊠	TEW1	0.3	182.2
▲	TN2	1.0	183.2
★	TRW3	0.3	182.8
⊙	TS2	1.0	182.3
⊕	TSEW4	1.0	182.5

Date August 2010
Project 1-09-4135

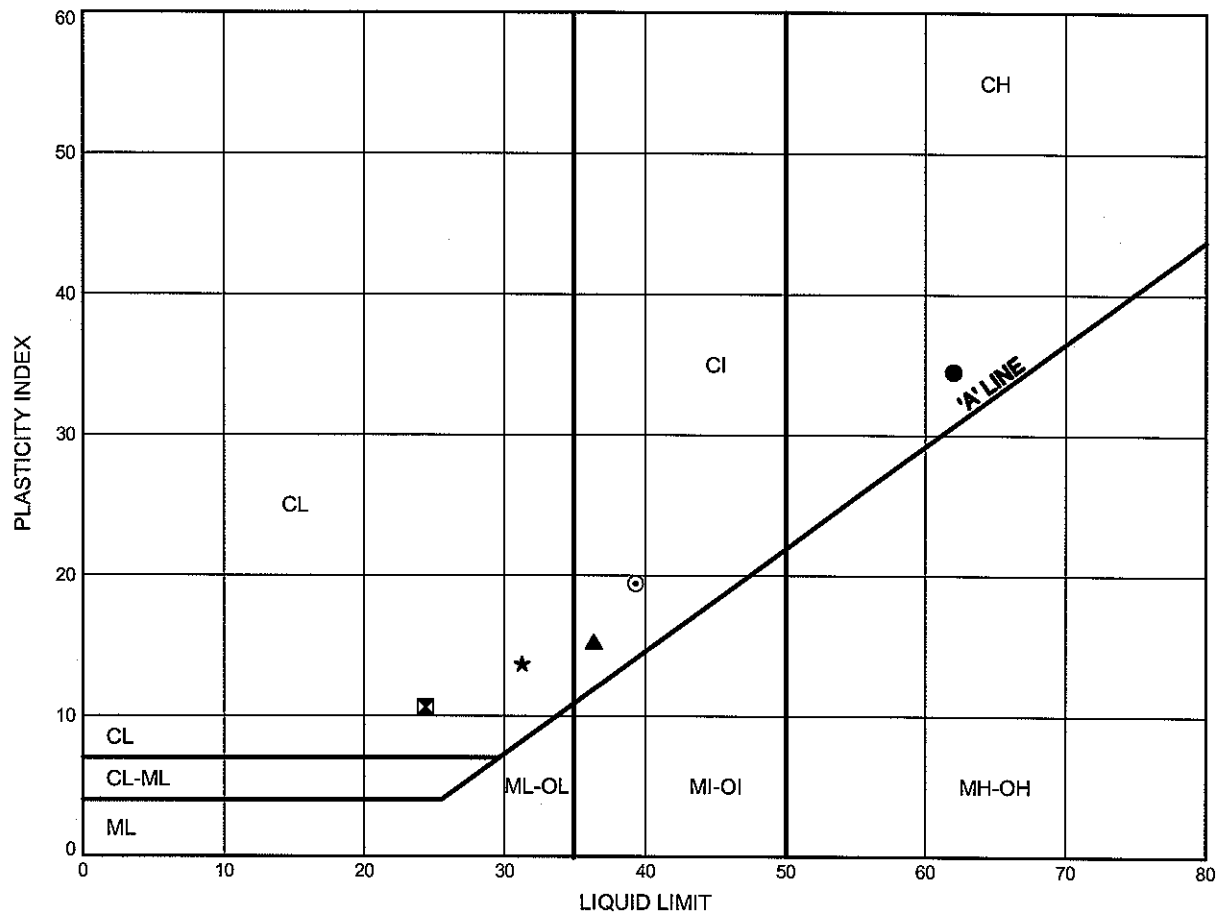


Prep'd DB
Chkd. MP

ATTERBERG LIMITS TEST RESULTS

FIGURE B2-4

FILL - Silty Clay



SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	TEW1	0.3	182.2
⊠	TN2	1.0	183.2
▲	TRW3	0.3	182.8
★	TS2	1.0	182.3
⊙	TSEW4	1.0	182.5

Date August 2010

Project 1-09-4135



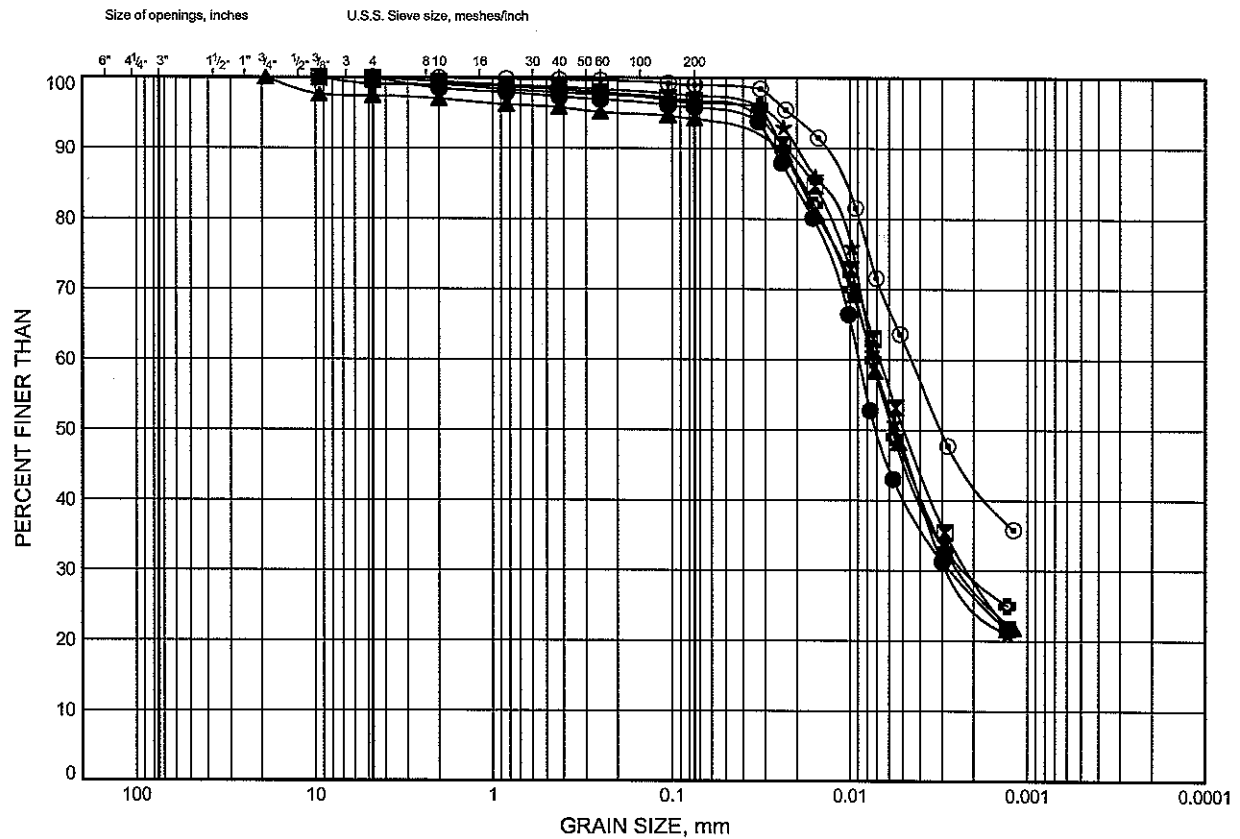
Prep'd JS

Chkd. MP

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)
●	NBL 12+375Lt	4.7	178.6
▣	NBL 12+375Lt	7.8	175.5
▲	NBL 12+375Lt	9.3	174.0
★	NBL 12+375Lt	10.9	172.4
⊙	NBL 12+440Rt	3.2	179.8
⊕	NBL 12+440Rt	6.3	176.7

Date August 2010
Project 1-09-4135

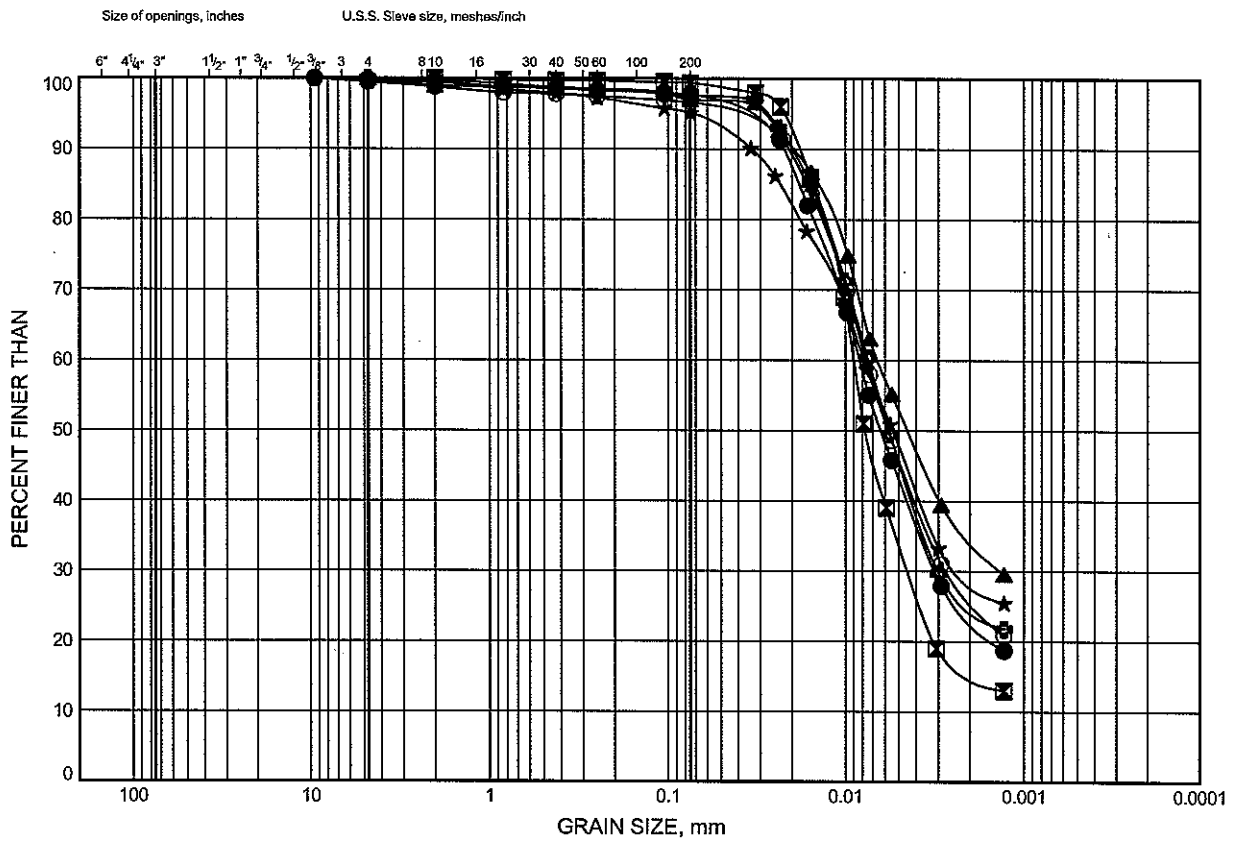


Prep'd DB
Chkd. MP

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)
●	SBL 12+360CL	10.9	172.0
⊠	SBL 12+360CL	12.4	170.5
▲	SBL 12+410CL	1.7	180.8
★	SBL 12+410CL	4.7	177.8
⊙	SBL 12+410CL	9.3	173.2
⊕	SBL 12+410CL	10.9	171.6

Date August 2010

Project 1-09-4135



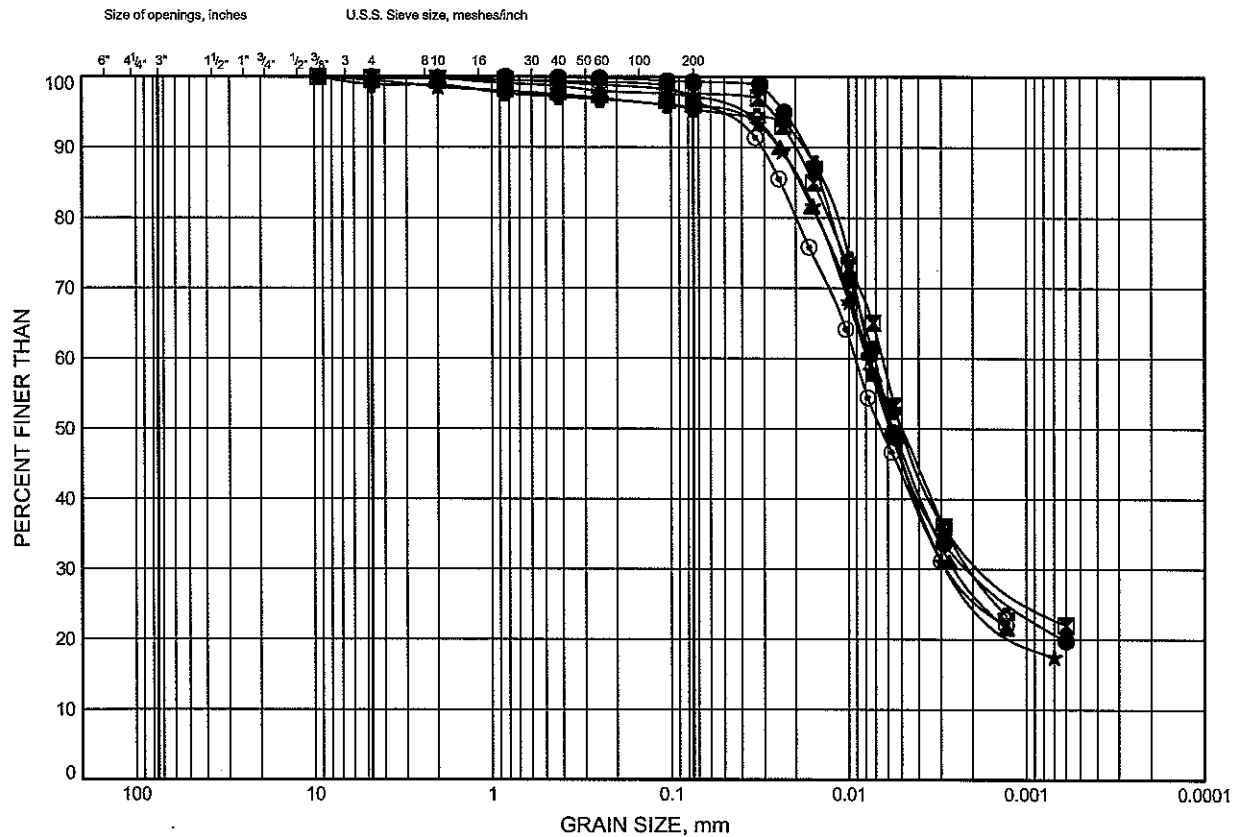
Prep'd DB

Chkd. MP

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)
●	S-EW 10+050CL	3.2	180.2
■	S-EW 10+050CL	6.3	177.1
▲	S-EW 10+050CL	9.3	174.1
★	S-EW 10+050CL	10.9	172.5
⊙	TEW1	2.5	180.0
⊕	TEW1	4.7	177.8

Date August 2010
Project 1-09-4135

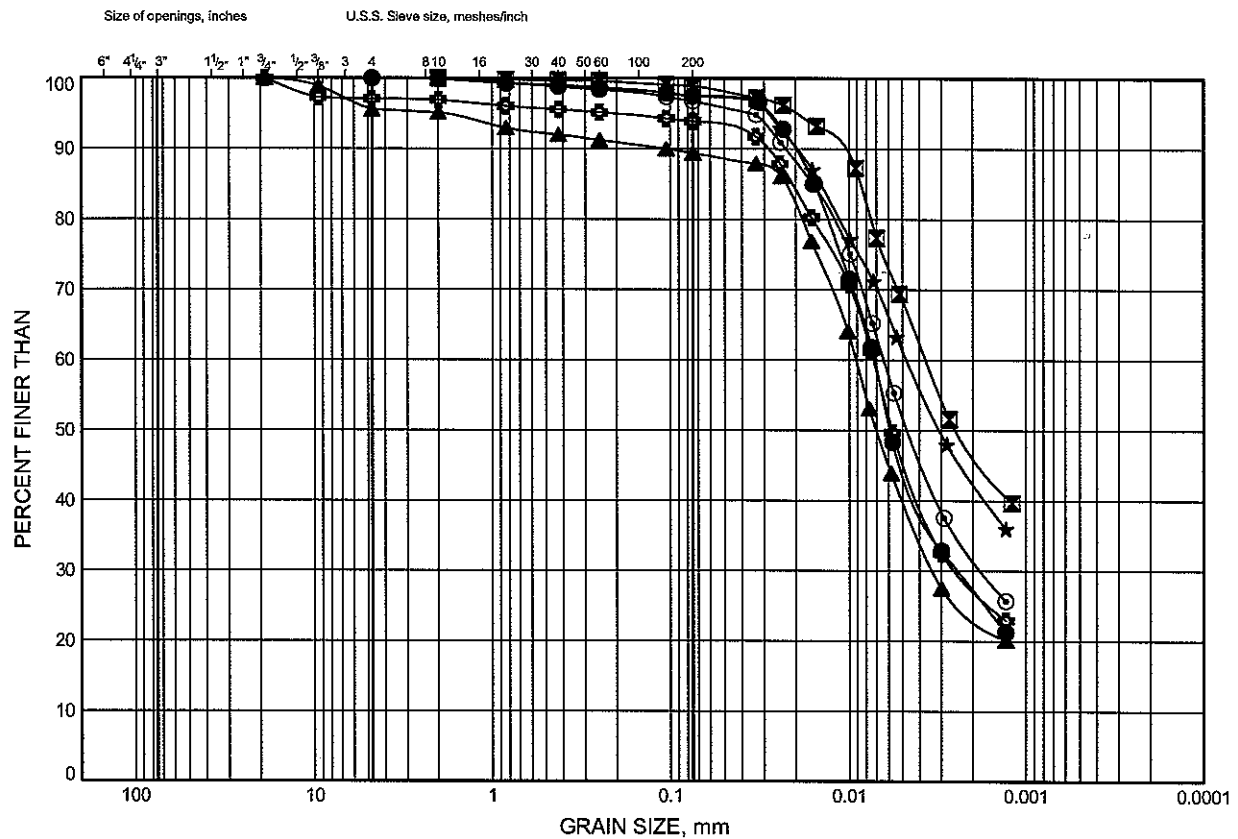


Prep'd DB
Chkd. MP

GRAIN SIZE DISTRIBUTION

FIGURE B2-9

SILTY CLAY



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

SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	TEW1	9.3	173.2
⊠	TEW2	2.5	180.2
▲	TEW2	13.9	168.8
★	TEW3	3.2	179.4
⊙	TEW3	4.7	177.9
⊕	TEW3	7.8	174.8

Date August 2010
Project 1-09-4135

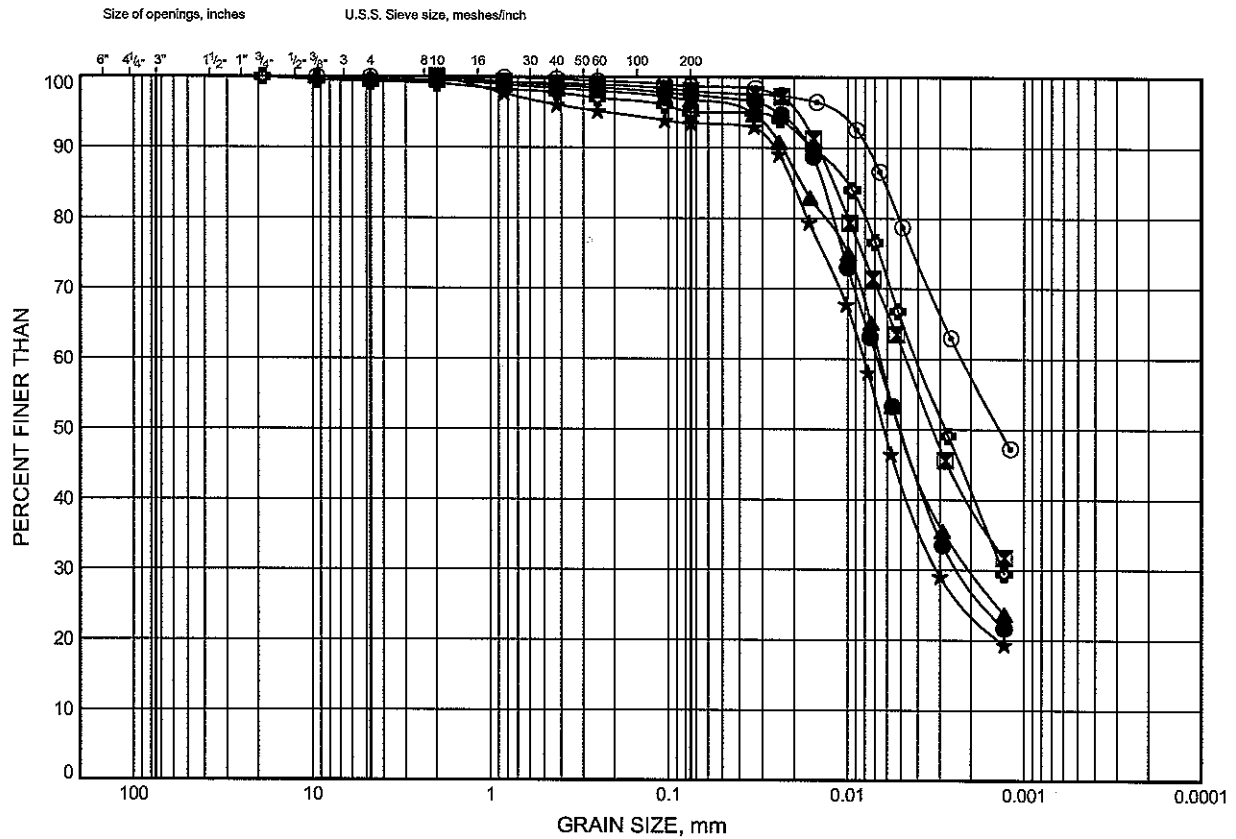


Prep'd DB
Chkd. MP

GRAIN SIZE DISTRIBUTION

FIGURE B2-10

SILTY CLAY



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

SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	TEW3	10.9	171.7
⊠	TEW4	1.0	181.6
▲	TEW4	4.7	177.9
★	TEW4	9.3	173.3
⊙	TN1	2.5	181.0
⊛	TN1	4.7	178.8

Date August 2010
Project 1-09-4135

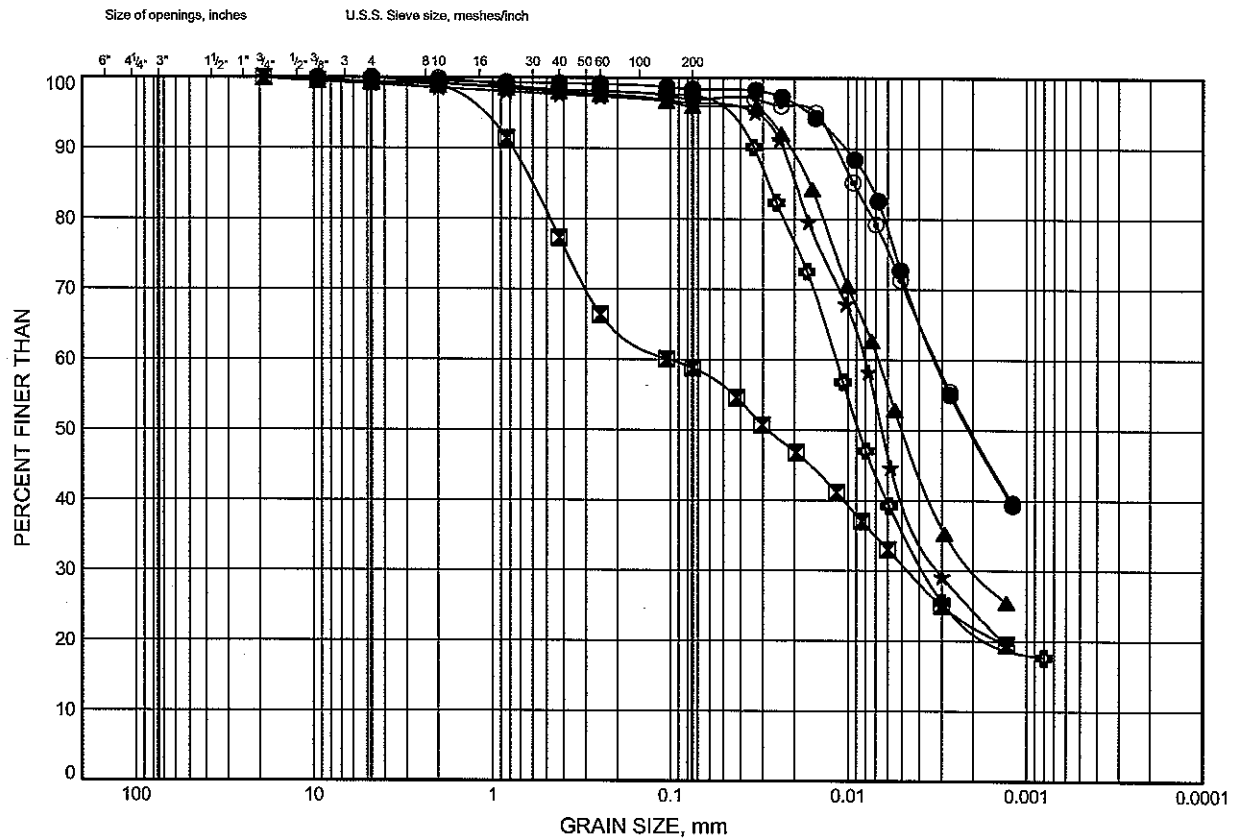


Prep'd DB
Chkd. MP

GRAIN SIZE DISTRIBUTION

FIGURE B2-12

SILTY CLAY



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

SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	TN3	4.0	180.1
⊠	TN3	5.5	178.6
▲	TN3	9.3	174.8
★	TN3	13.9	170.2
⊙	TN4	2.5	181.5
⊞	TN4	4.0	180.0

Date August 2010
Project 1-09-4135

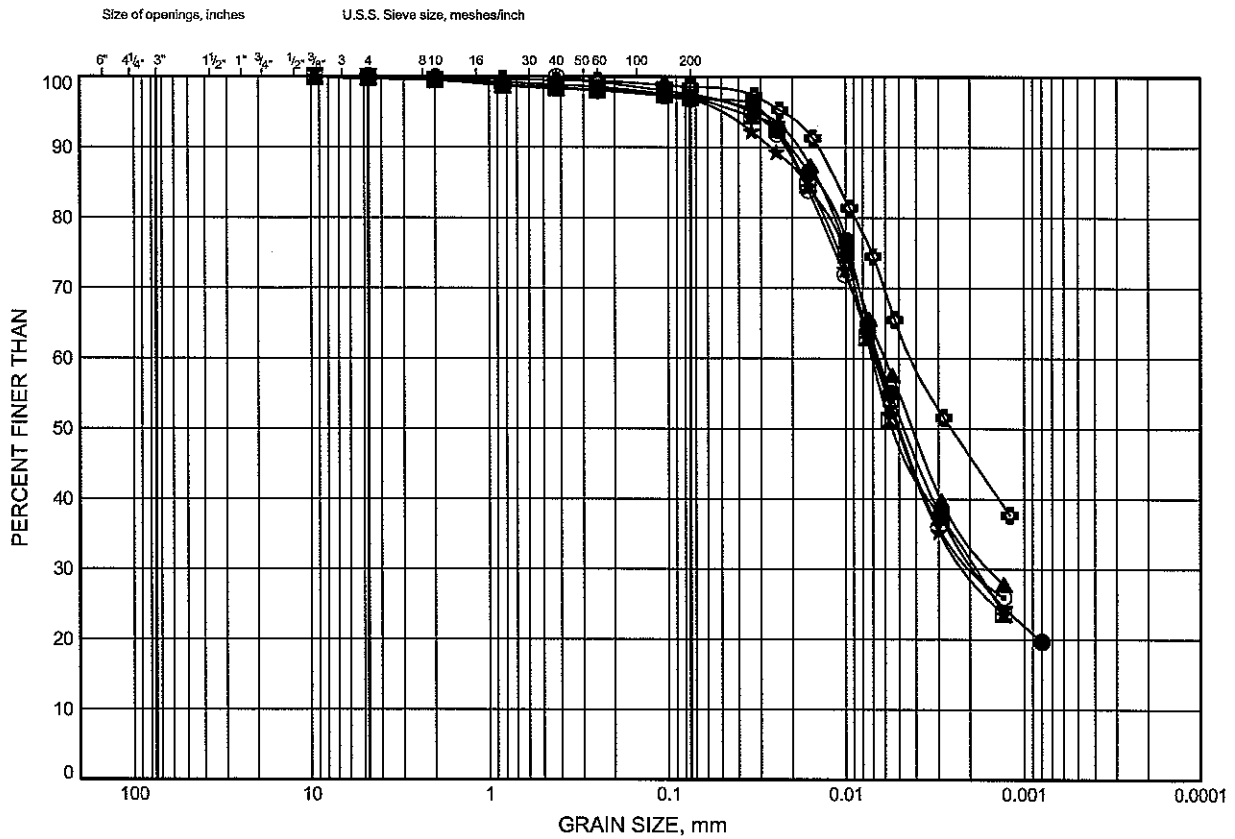


Prep'd DB
Chkd. MP

GRAIN SIZE DISTRIBUTION

FIGURE B2-13

SILTY CLAY



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

SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	TN4	5.5	178.5
⊠	TN4	9.3	174.7
▲	TRW1	3.2	180.0
★	TRW1	4.7	178.5
⊙	TRW1	10.9	172.3
⊕	TRW2	1.0	181.5

Date August 2010
Project 1-09-4135

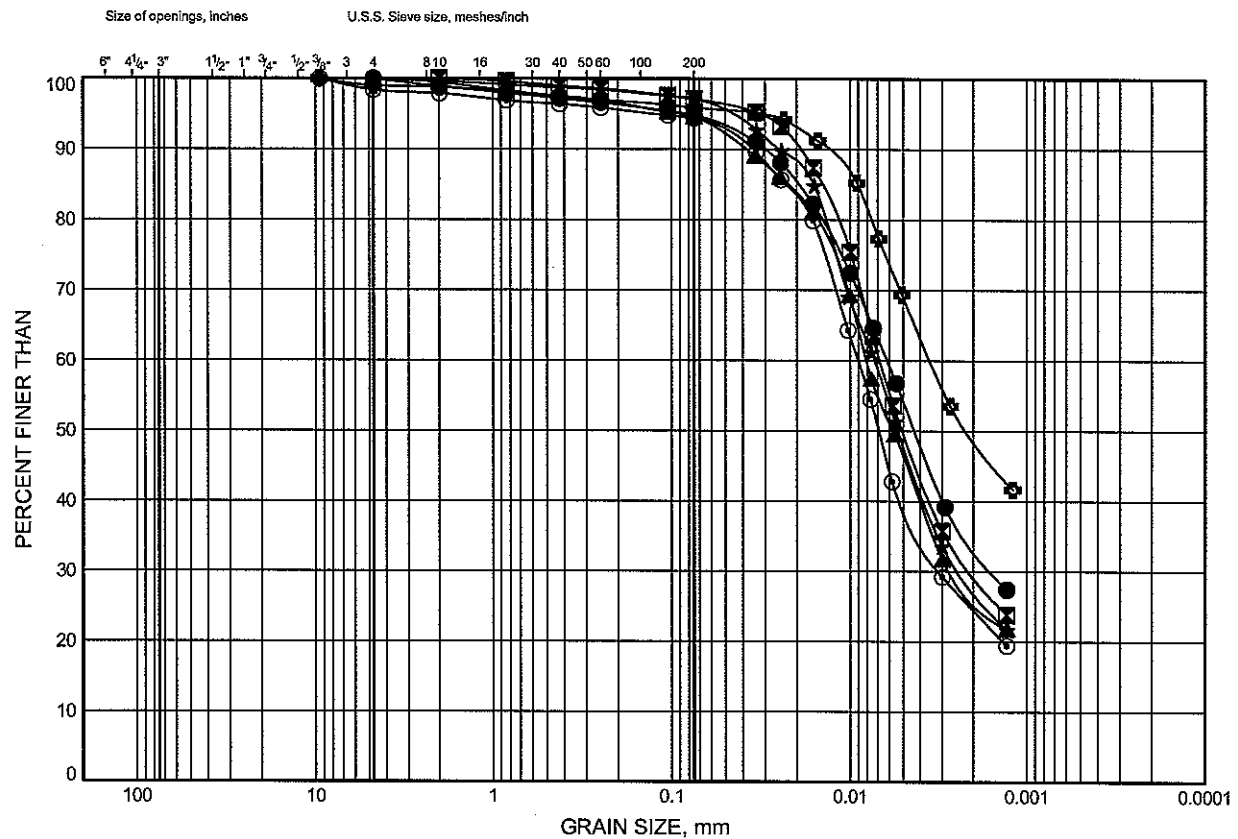


Prep'd DB
Chkd. MP

GRAIN SIZE DISTRIBUTION

FIGURE B2-14

SILTY CLAY



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

SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	TRW2	4.0	178.5
⊠	TRW2	7.8	174.7
▲	TRW2	13.9	168.6
★	TRW3	4.7	178.4
⊙	TRW3	10.9	172.2
⊕	TRW4	2.5	181.5

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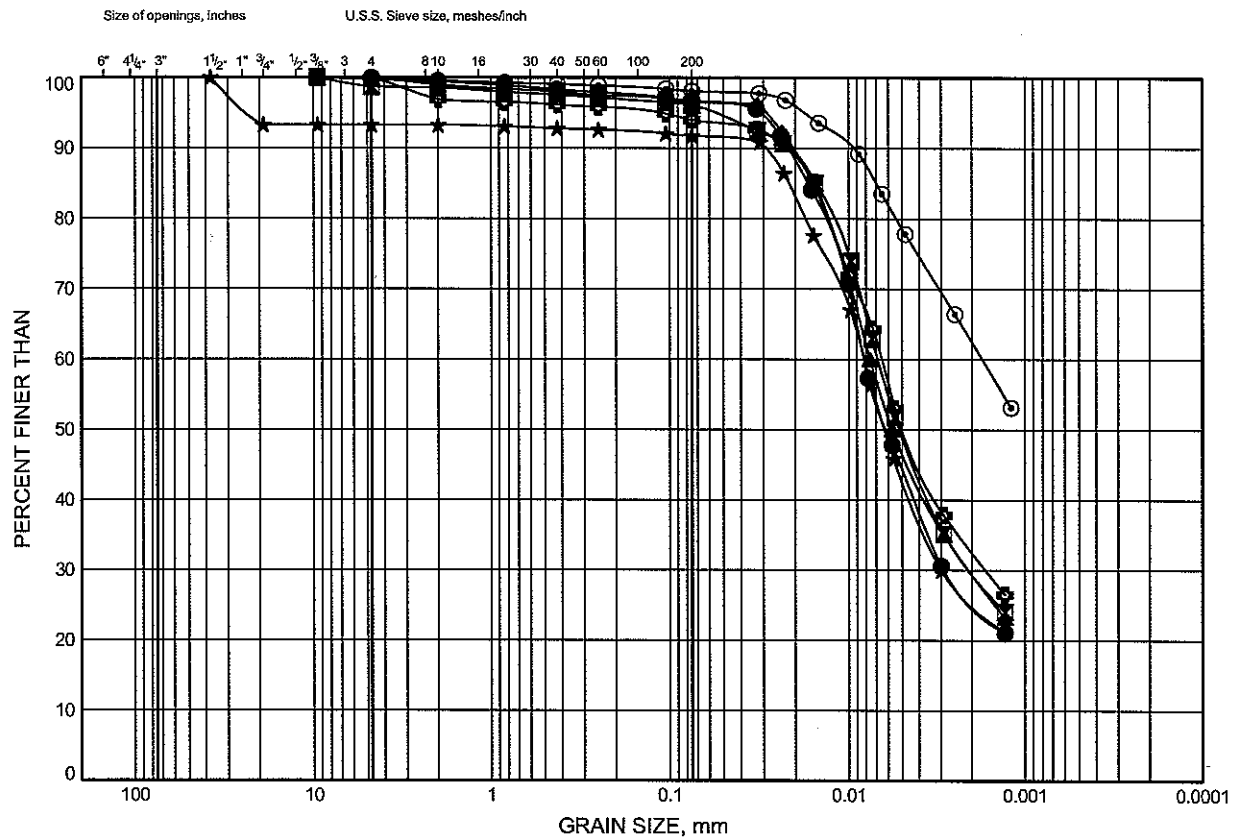


Prep'd DB
Chkd. MP

GRAIN SIZE DISTRIBUTION

FIGURE B2-16

SILTY CLAY



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

SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	TS1	13.9	168.7
⊠	TS2	5.5	177.8
▲	TS2	9.3	174.0
★	TS2	13.9	169.4
⊙	TS3	1.7	180.8
⊕	TS3	4.0	178.5

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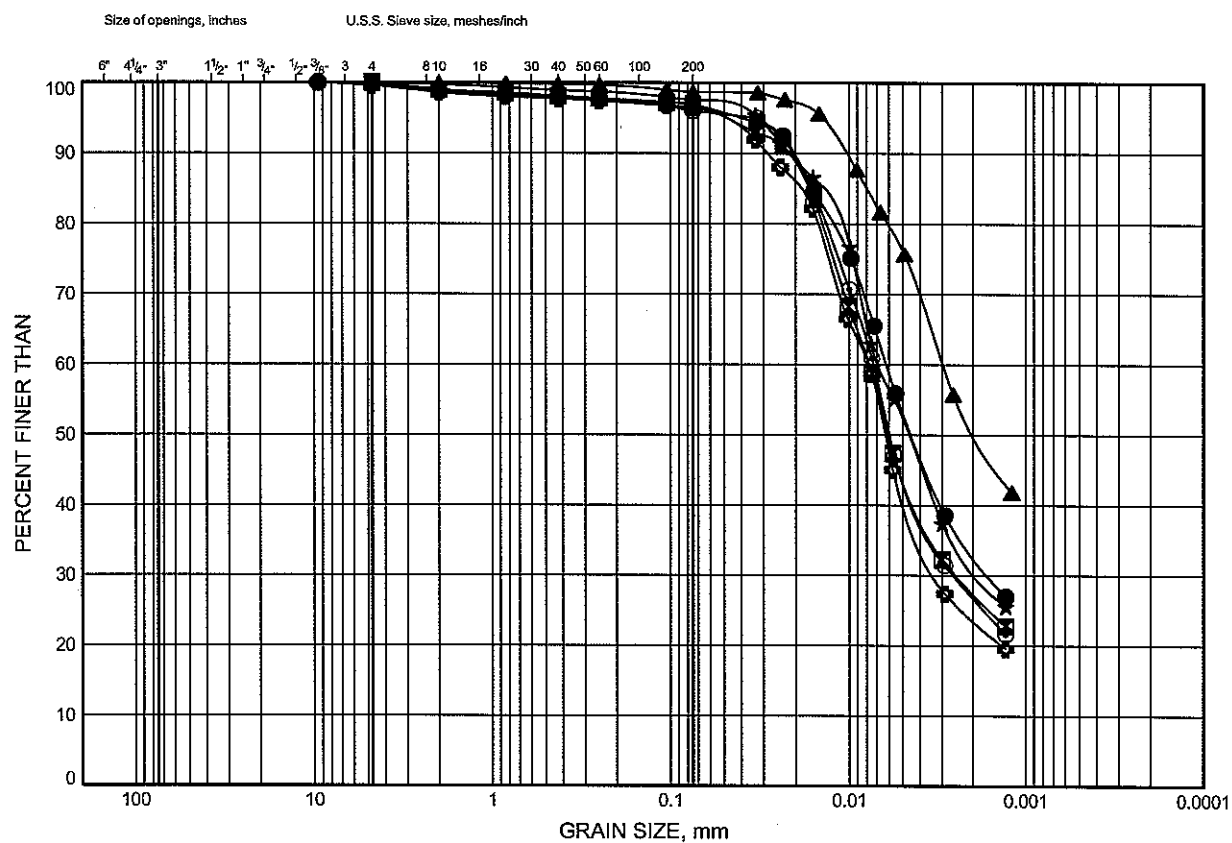


Prep'd DB
Chkd. MP

GRAIN SIZE DISTRIBUTION

FIGURE B2-17

SILTY CLAY



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

SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	TS3	6.3	176.2
⊠	TS3	10.9	171.6
▲	TS4	1.0	181.4
★	TS4	3.2	179.2
⊙	TS4	6.3	176.1
⊛	TS4	9.3	173.1

Date August 2010
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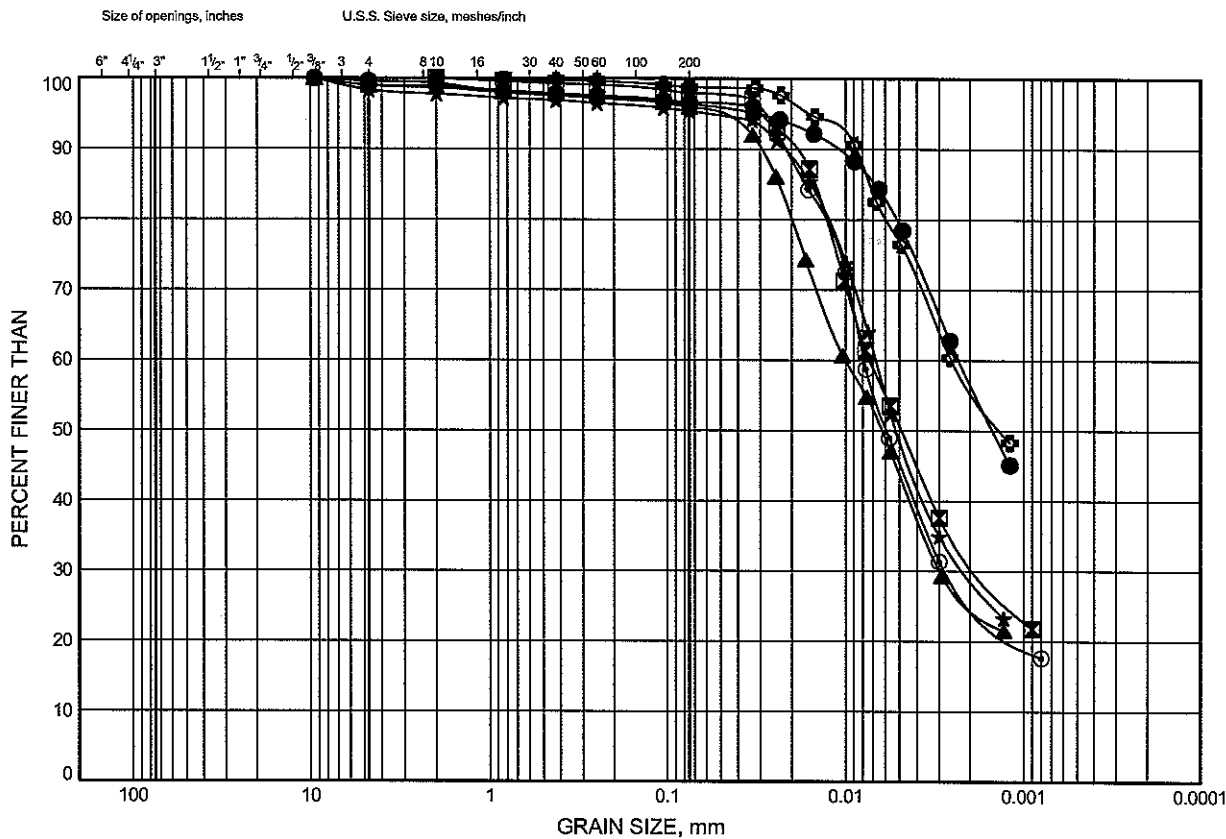


Prep'd DB
Chkd. MP

GRAIN SIZE DISTRIBUTION

FIGURE B2-18

SILTY CLAY



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

SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	TSEW1	1.7	181.8
⊠	TSEW1	4.0	179.5
▲	TSEW1	6.3	177.2
★	TSEW1	9.3	174.2
⊙	TSEW1	12.4	171.1
⊕	TSEW2	1.0	182.3

Date August 2010
Project 1-09-4135

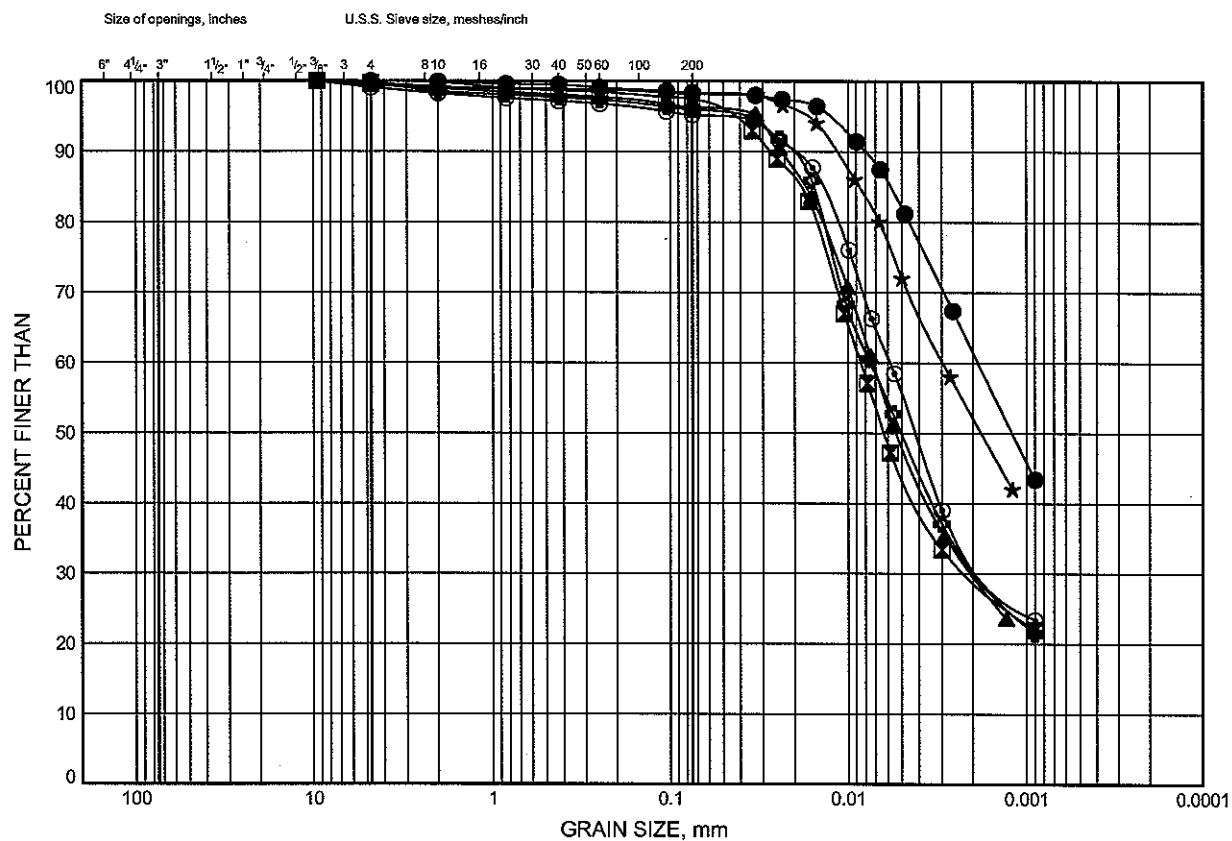


Prep'd DB
Chkd. MP

GRAIN SIZE DISTRIBUTION

FIGURE B2-19

SILTY CLAY



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

SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	TSEW2	2.5	180.8
⊠	TSEW2	5.5	177.8
▲	TSEW2	9.3	174.0
★	TSEW3	3.2	180.1
⊙	TSEW3	4.7	178.6
⊕	TSEW3	9.3	174.0

Date August 2010
Project 1-09-4135

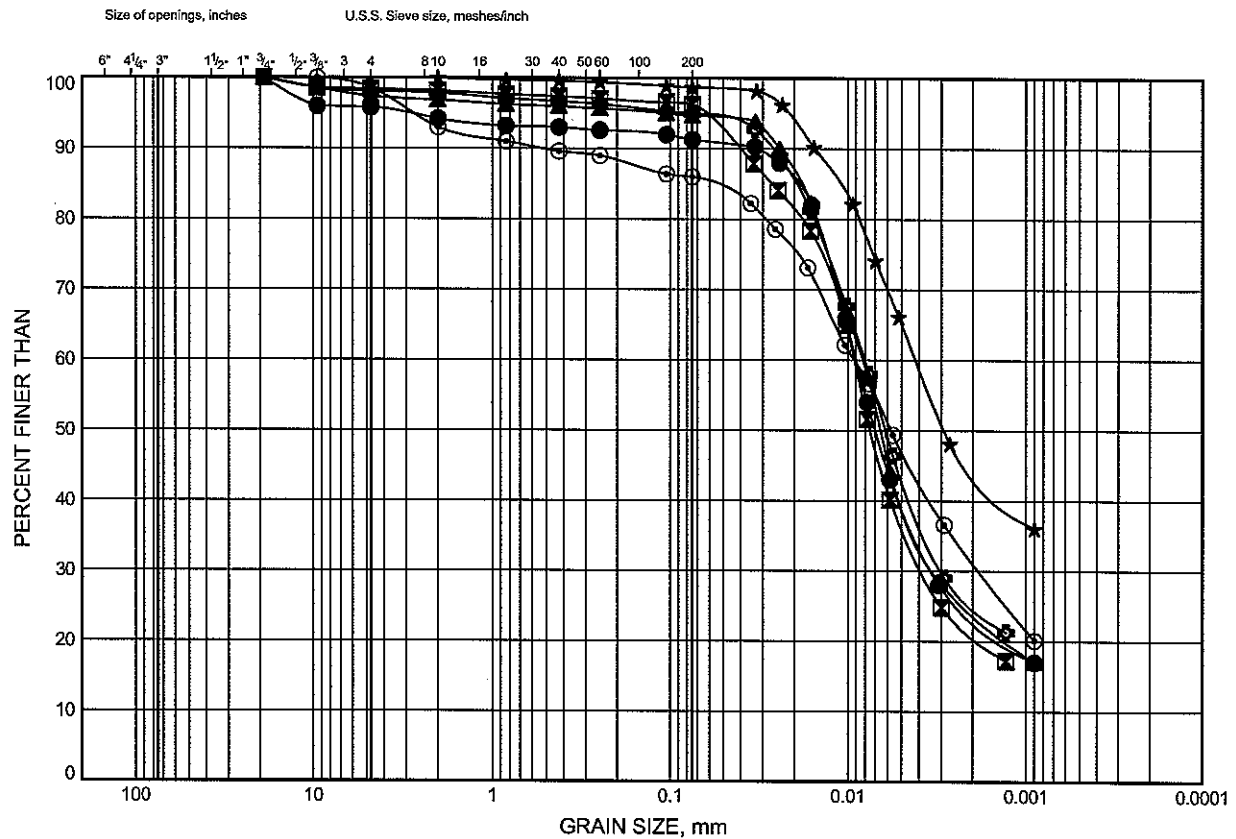


Prep'd DB
Chkd. MP

GRAIN SIZE DISTRIBUTION

FIGURE B2-20

SILTY CLAY



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

SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	TSEW3	10.9	172.4
⊠	TSEW3	12.4	170.9
▲	TSEW3	13.9	169.4
★	TSEW4	2.5	181.0
⊙	TSEW4	4.7	178.8
⊗	TSEW4	7.8	175.7

Date August 2010
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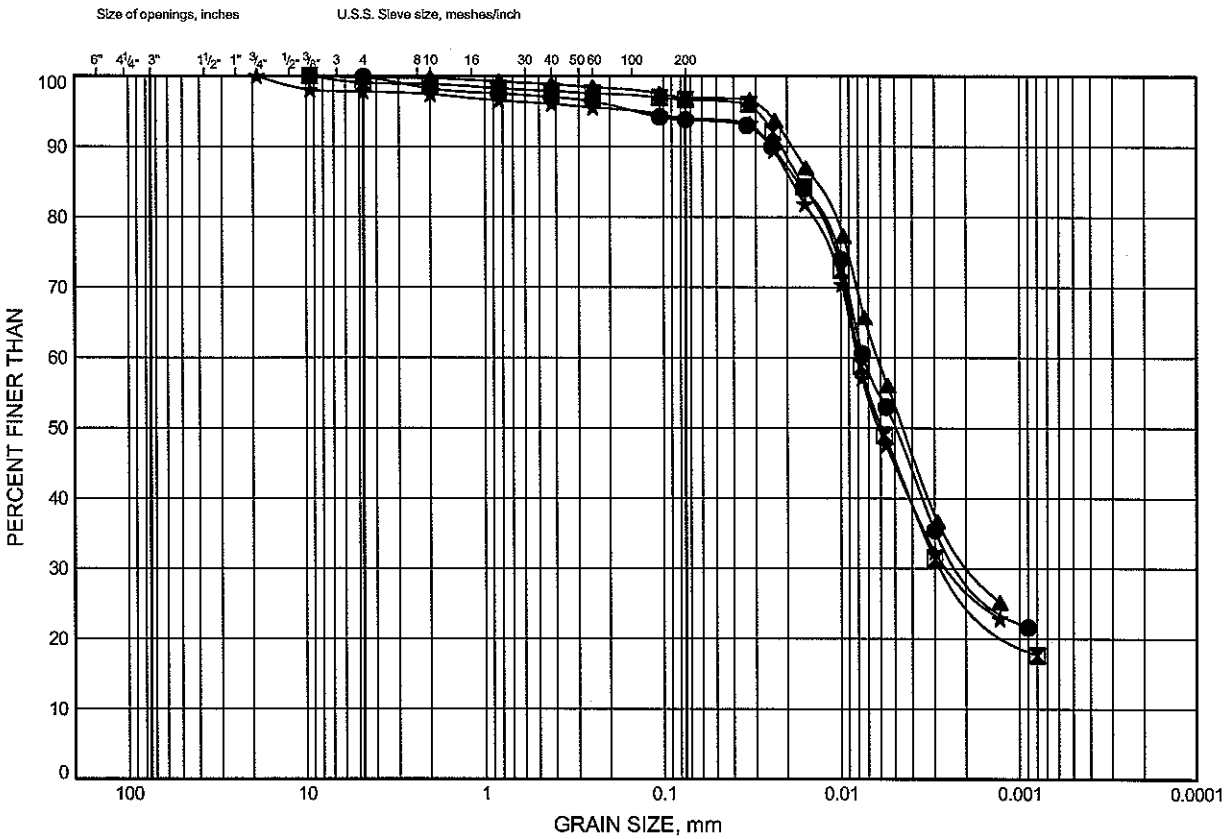


Prep'd DB
Chkd. MP

GRAIN SIZE DISTRIBUTION

FIGURE B2-21

SILTY CLAY



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

SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	TSEW4	9.3	174.2
⊠	TSEW4	12.4	171.1
▲	WE-S 10+295CL	2.5	180.3
★	WE-S 10+295CL	7.8	175.0

Date August 2010
 Project 1-09-4135

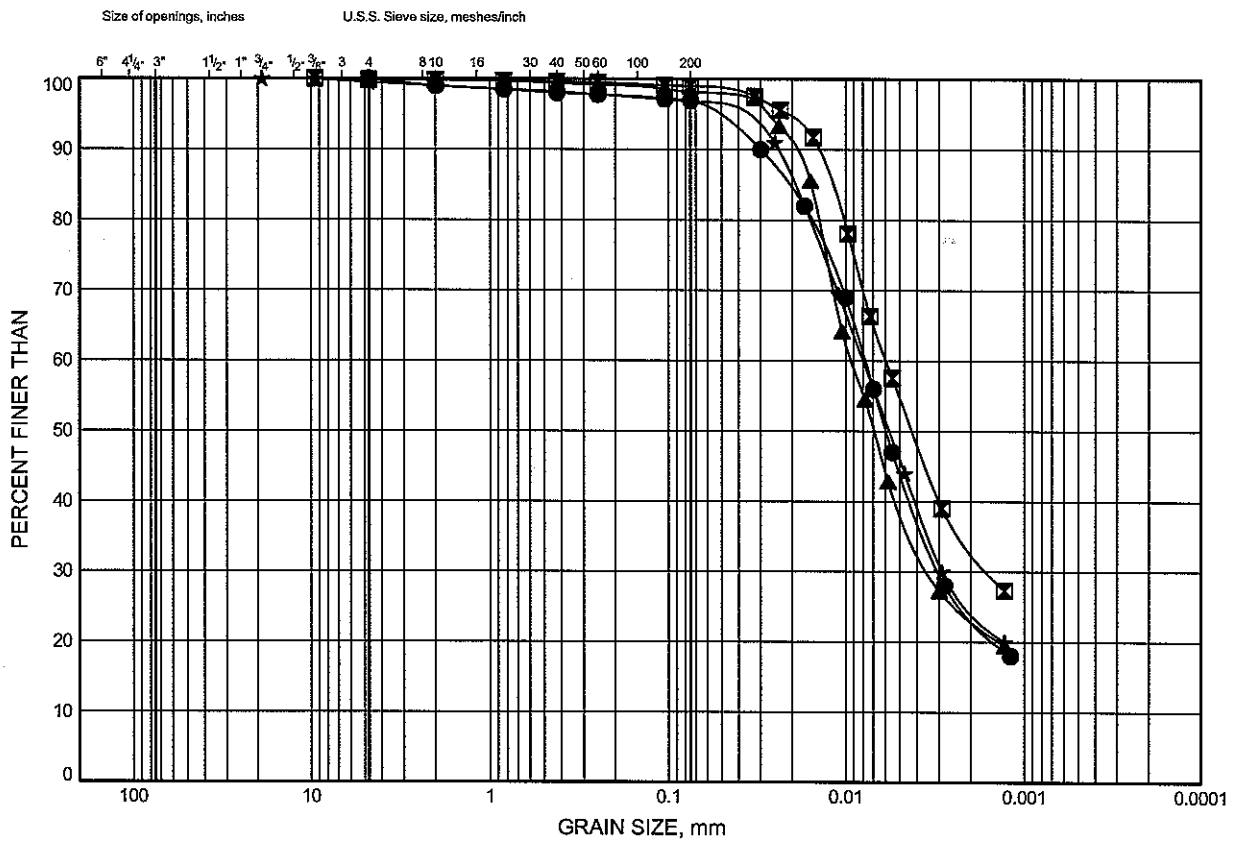


Prep'd DB
 Chkd. MP

GRAIN SIZE DISTRIBUTION

FIGURE B2-22

SILTY CLAY



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

SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	WE-S 10+295CL	9.3	173.5
■	WE-S 10+345CL	2.5	180.3
▲	WE-S 10+345CL	7.8	175.0
★	WE-S 10+345CL	10.9	171.9

Date August 2010
Project 1-09-4135

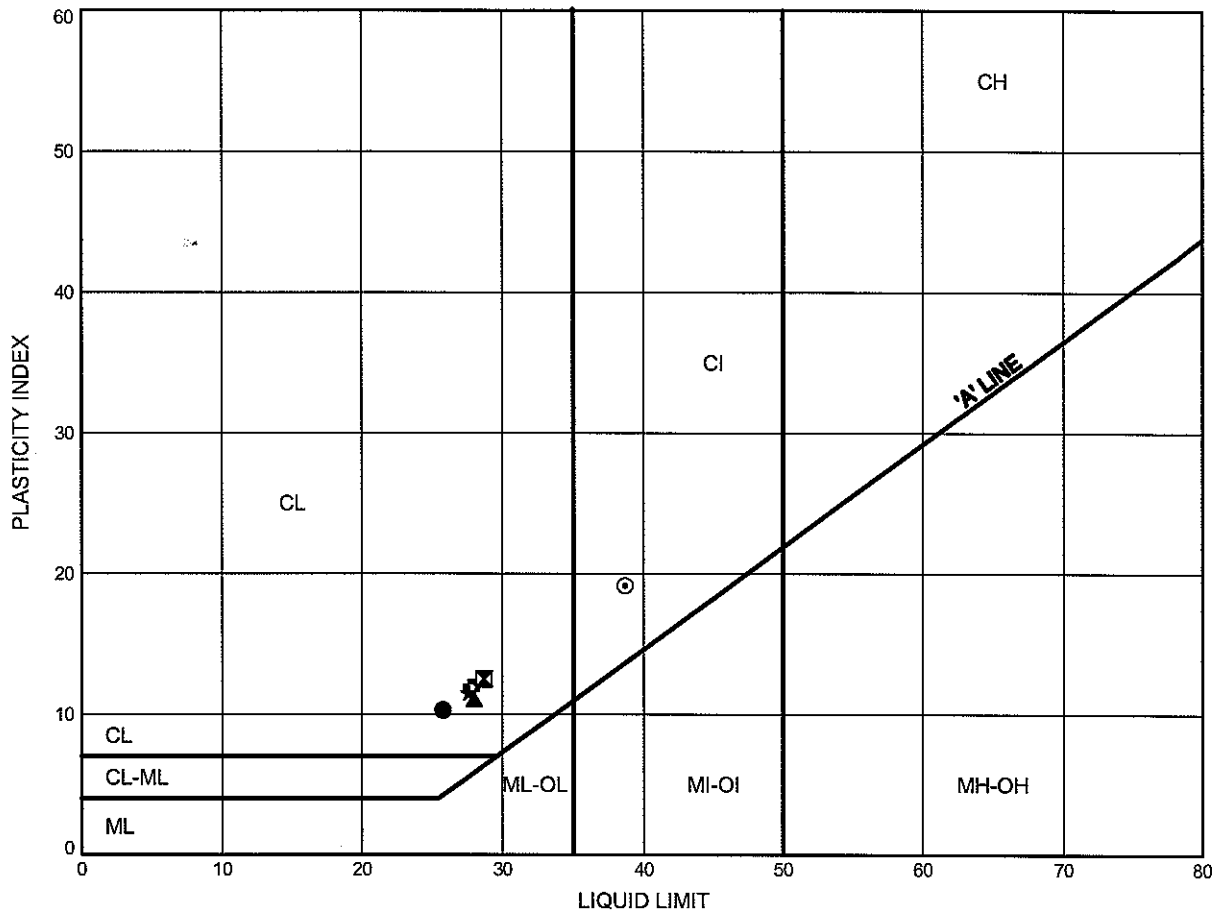


Prep'd DB
Chkd. MP

ATTERBERG LIMITS TEST RESULTS

FIGURE B2-23

SILTY CLAY



SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	NBL 12+375Lt	4.7	178.6
⊠	NBL 12+375Lt	7.8	175.5
▲	NBL 12+375Lt	9.3	174.0
★	NBL 12+375Lt	10.9	172.4
⊙	NBL 12+440Rt	3.2	179.8
⊕	NBL 12+440Rt	6.3	176.7

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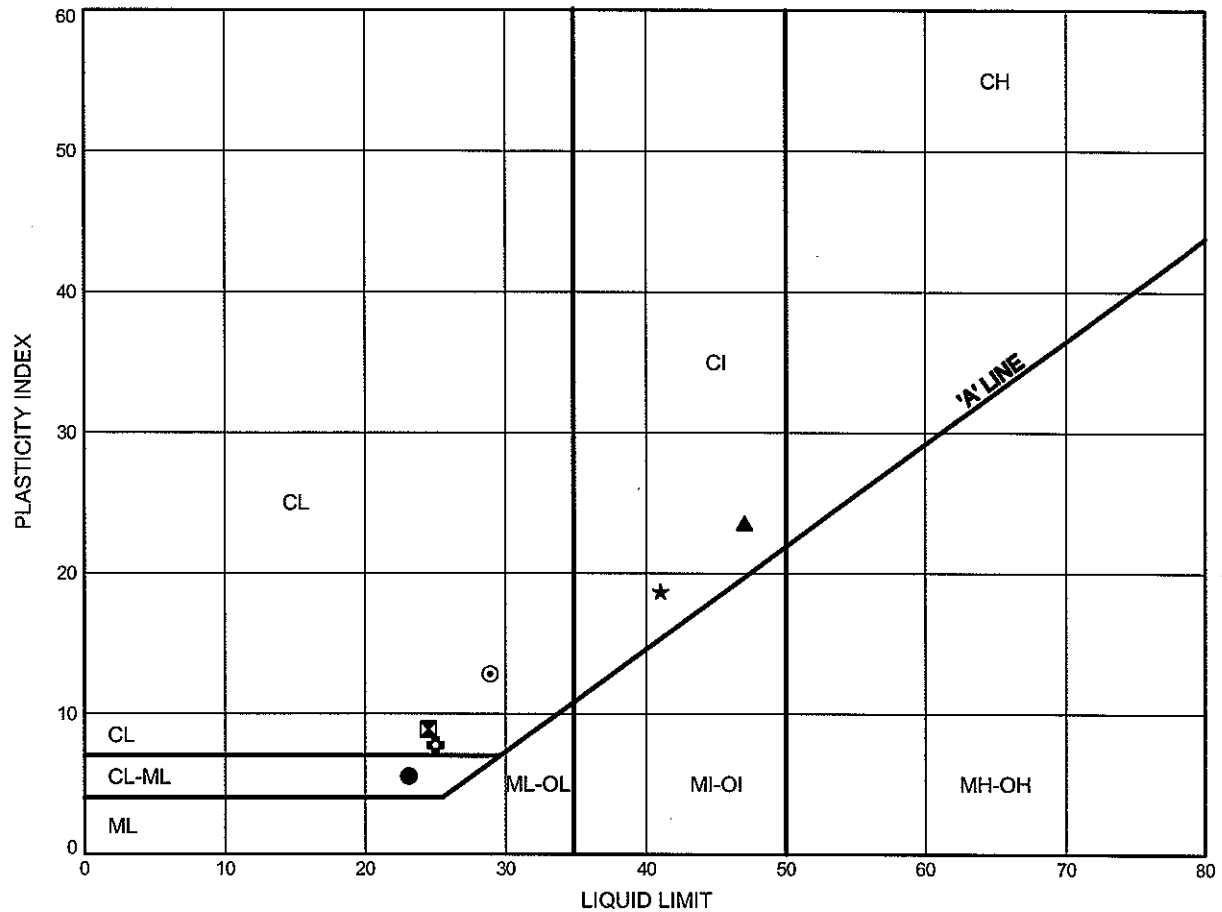


Prep'd JS
Chkd. MP

ATTERBERG LIMITS TEST RESULTS

FIGURE B2-24

SILTY CLAY



SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	NBL 12+440Rt	7.8	175.2
⊠	NBL 12+440Rt	12.4	170.6
▲	SBL 12+360CL	1.0	181.9
★	SBL 12+360CL	3.2	179.7
⊙	SBL 12+360CL	7.8	175.1
⊛	SBL 12+360CL	12.4	170.5

Date August 2010

Project 1-09-4135



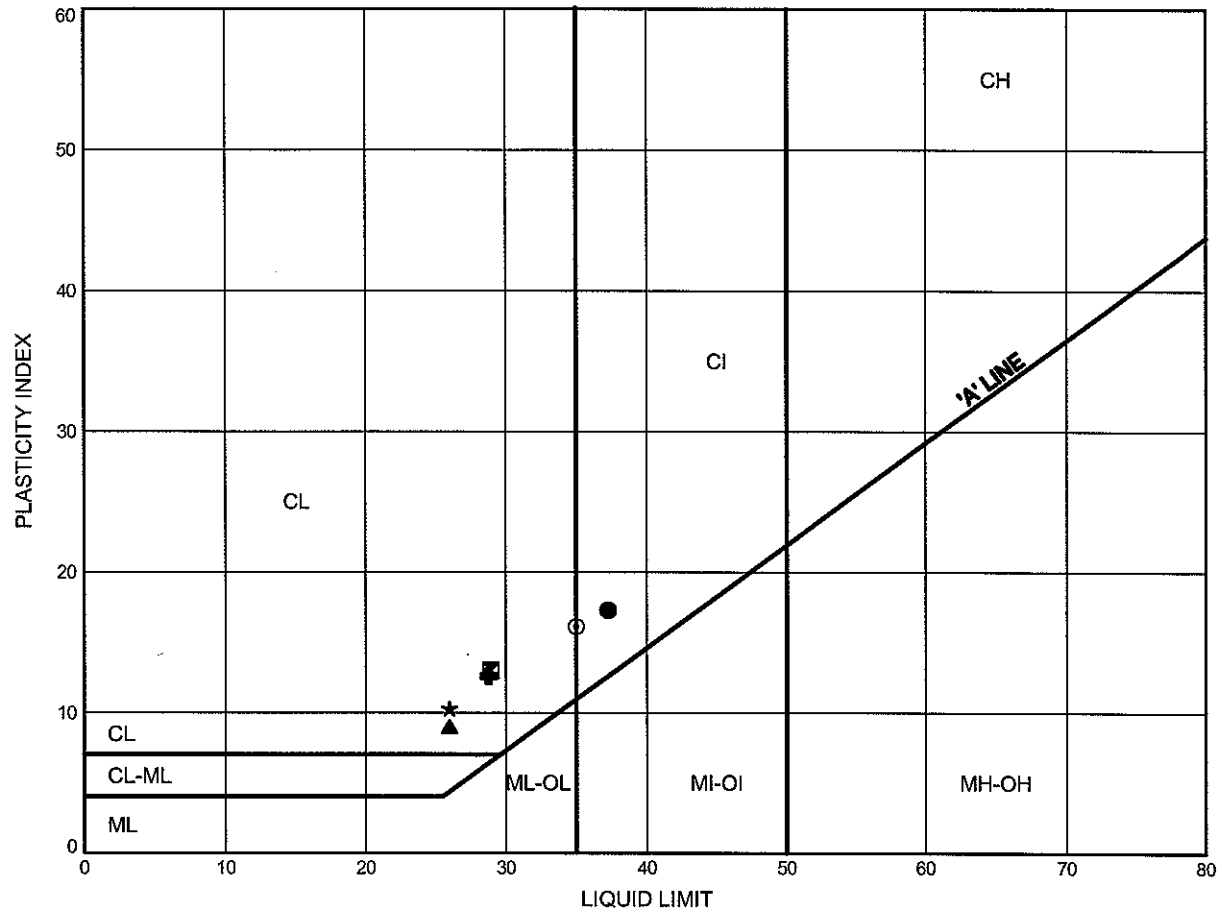
Prep'd JS

Chkd. MP

ATTERBERG LIMITS TEST RESULTS

FIGURE B2-25

SILTY CLAY



SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	SBL 12+410CL	1.7	180.8
⊠	SBL 12+410CL	4.7	177.8
▲	SBL 12+410CL	9.3	173.2
★	SBL 12+410CL	10.9	171.6
⊙	S-EW 10+050CL	3.2	180.2
⊕	S-EW 10+050CL	6.3	177.1

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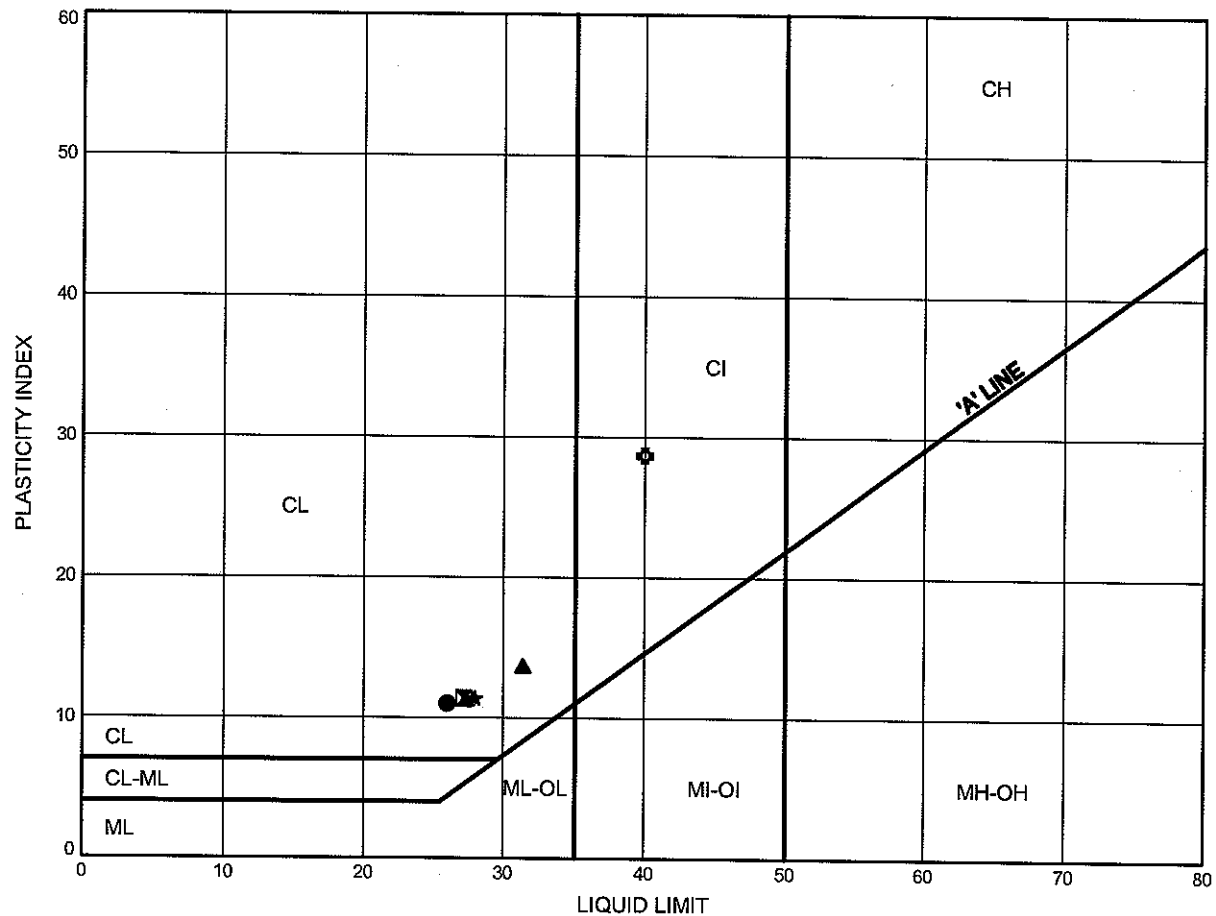
Prep'd JS

Chkd. MP

ATTERBERG LIMITS TEST RESULTS

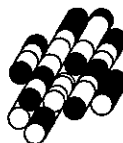
FIGURE B2-26

SILTY CLAY



SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	S-EW 10+050CL	9.3	174.1
⊠	S-EW 10+050CL	10.9	172.5
▲	TEW1	2.5	180.0
★	TEW1	4.7	177.8
⊙	TEW1	9.3	173.2
⊕	TEW2	2.5	180.2

Date August 2010
Project 1-09-4135

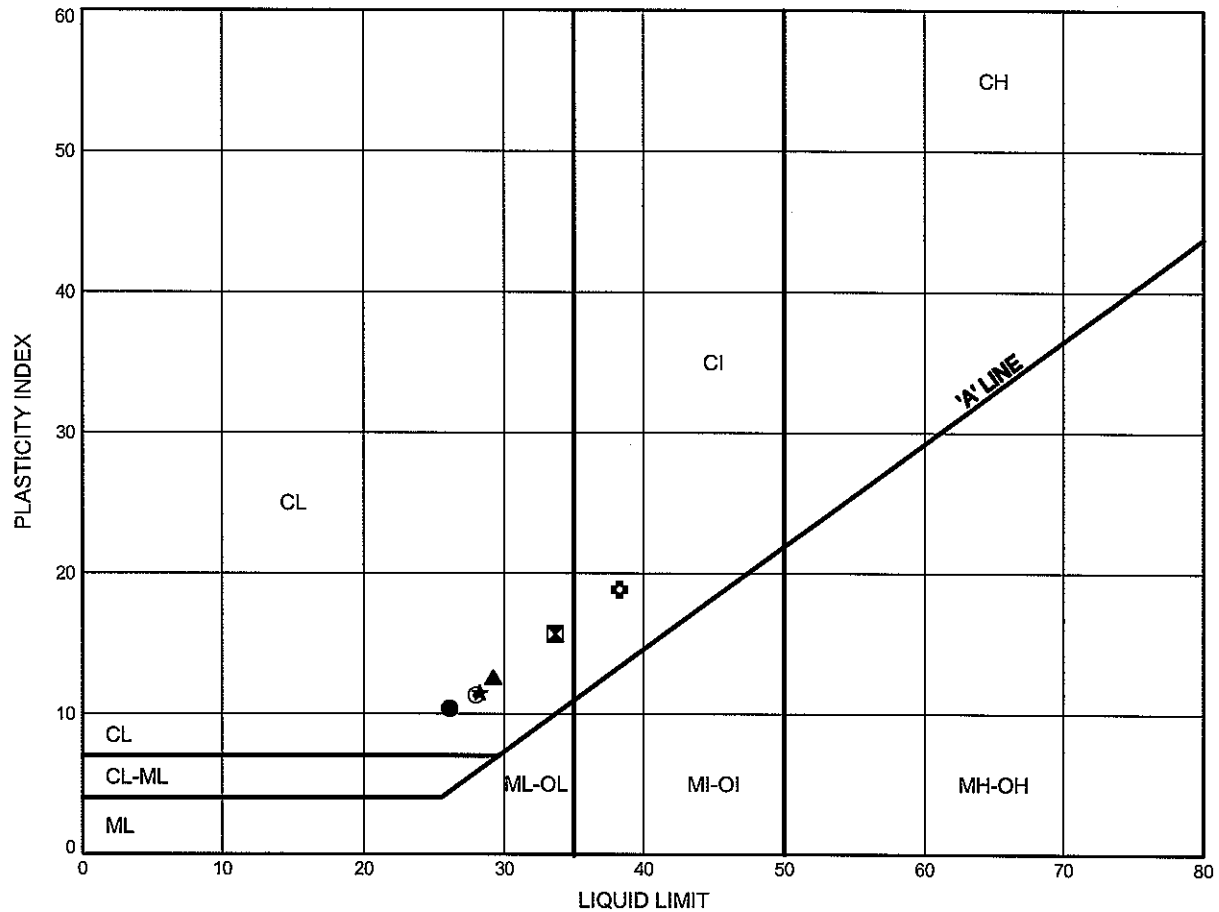


Prep'd JS
Chkd. MP

ATTERBERG LIMITS TEST RESULTS

FIGURE B2-27

SILTY CLAY



SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	TEW2	13.9	168.8
⊠	TEW3	3.2	179.4
▲	TEW3	4.7	177.9
★	TEW3	7.8	174.8
⊙	TEW3	10.9	171.7
⊕	TEW4	1.0	181.6

Date August 2010
Project 1-09-4135

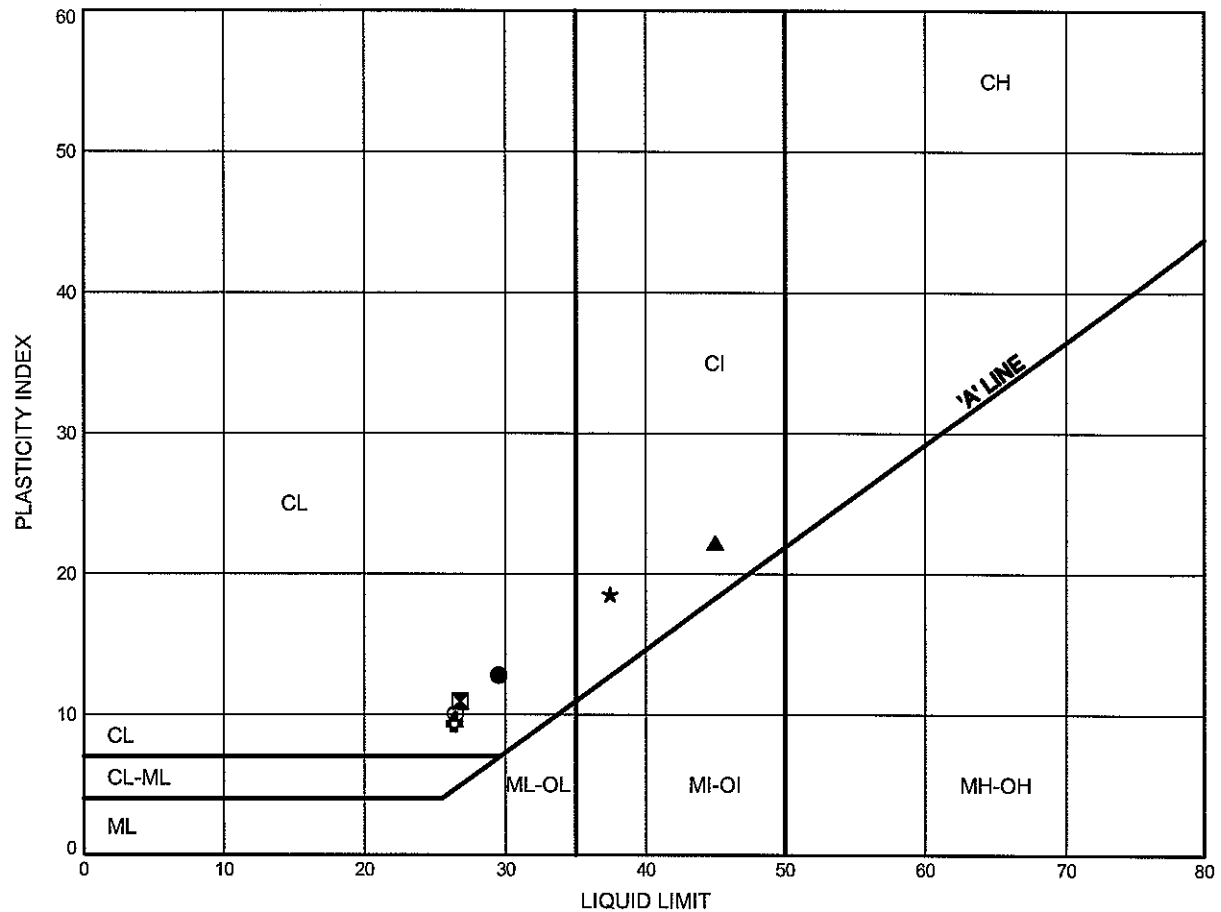


Prep'd JS
Chkd. MP

ATTERBERG LIMITS TEST RESULTS

FIGURE B2-28

SILTY CLAY



SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	TEW4	4.7	177.9
⊠	TEW4	9.3	173.3
▲	TN1	2.5	181.0
★	TN1	4.7	178.8
⊙	TN1	7.8	175.7
⊕	TN1	10.9	172.6

Date August 2010
Project 1-09-4135

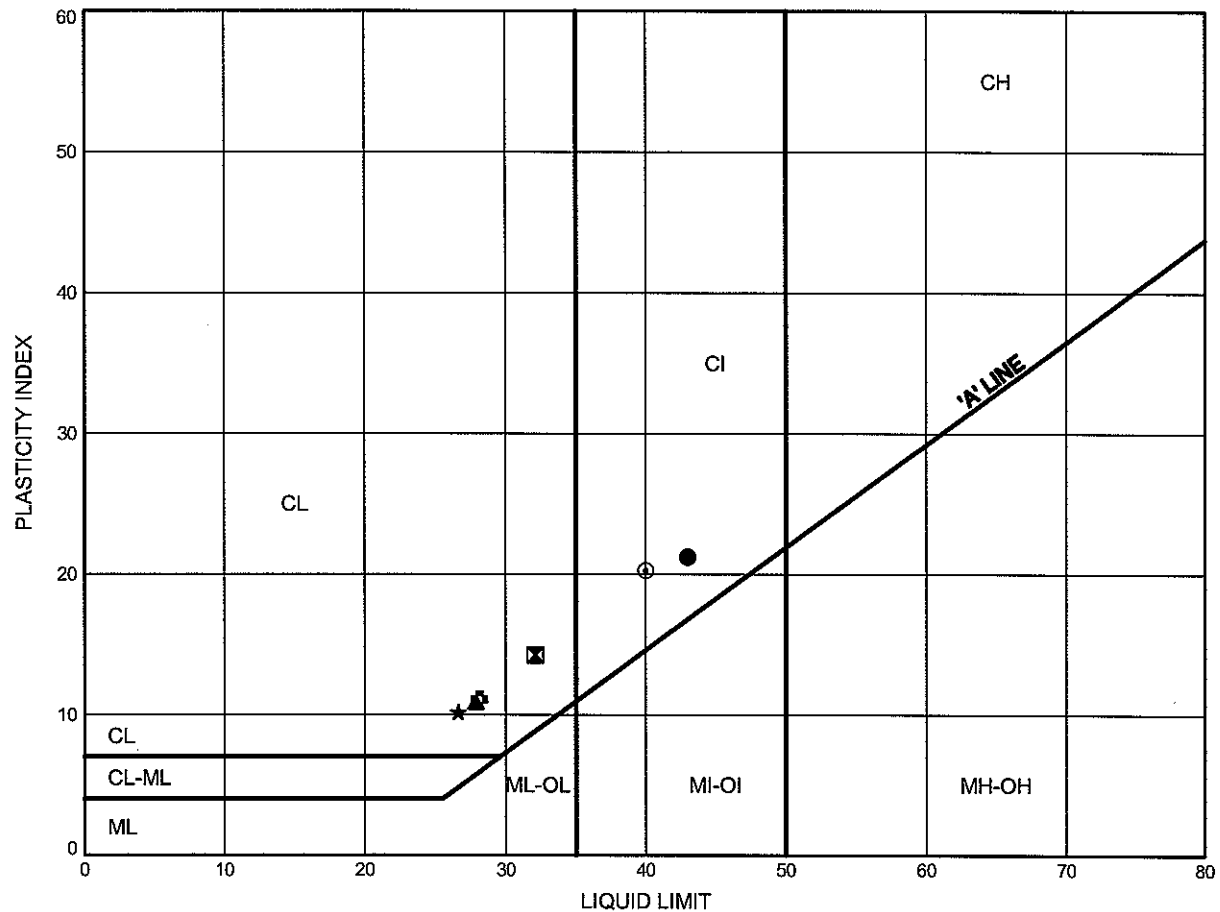


Prep'd DB
Chkd. MP

ATTERBERG LIMITS TEST RESULTS

FIGURE B2-29

SILTY CLAY



SYMBOL BOREHOLE DEPTH (m) ELEVATION (m)

●	TN2	3.2	181.0
⊠	TN2	5.5	178.7
▲	TN2	9.3	174.9
★	TN2	13.9	170.3
⊙	TN3	4.0	180.1
⊕	TN3	5.5	178.6

Date August 2010
Project 1-09-4135

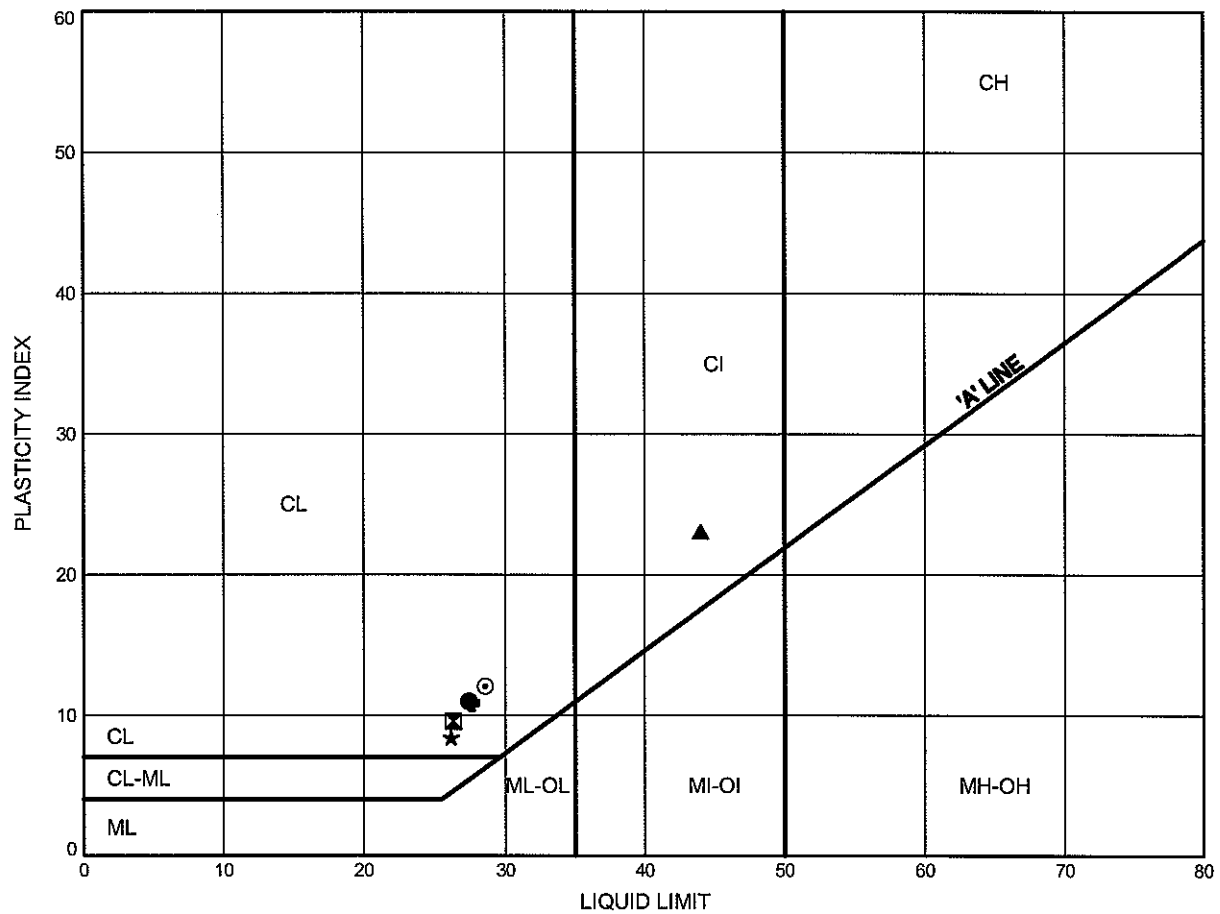


Prep'd DB
Chkd. MP

ATTERBERG LIMITS TEST RESULTS

FIGURE B2-30

SILTY CLAY



SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	TN3	9.3	174.8
⊠	TN3	13.9	170.2
▲	TN4	2.5	181.5
★	TN4	4.0	180.0
⊙	TN4	5.5	178.5
⊕	TN4	9.3	174.7

Date August 2010

Project 1-09-4135



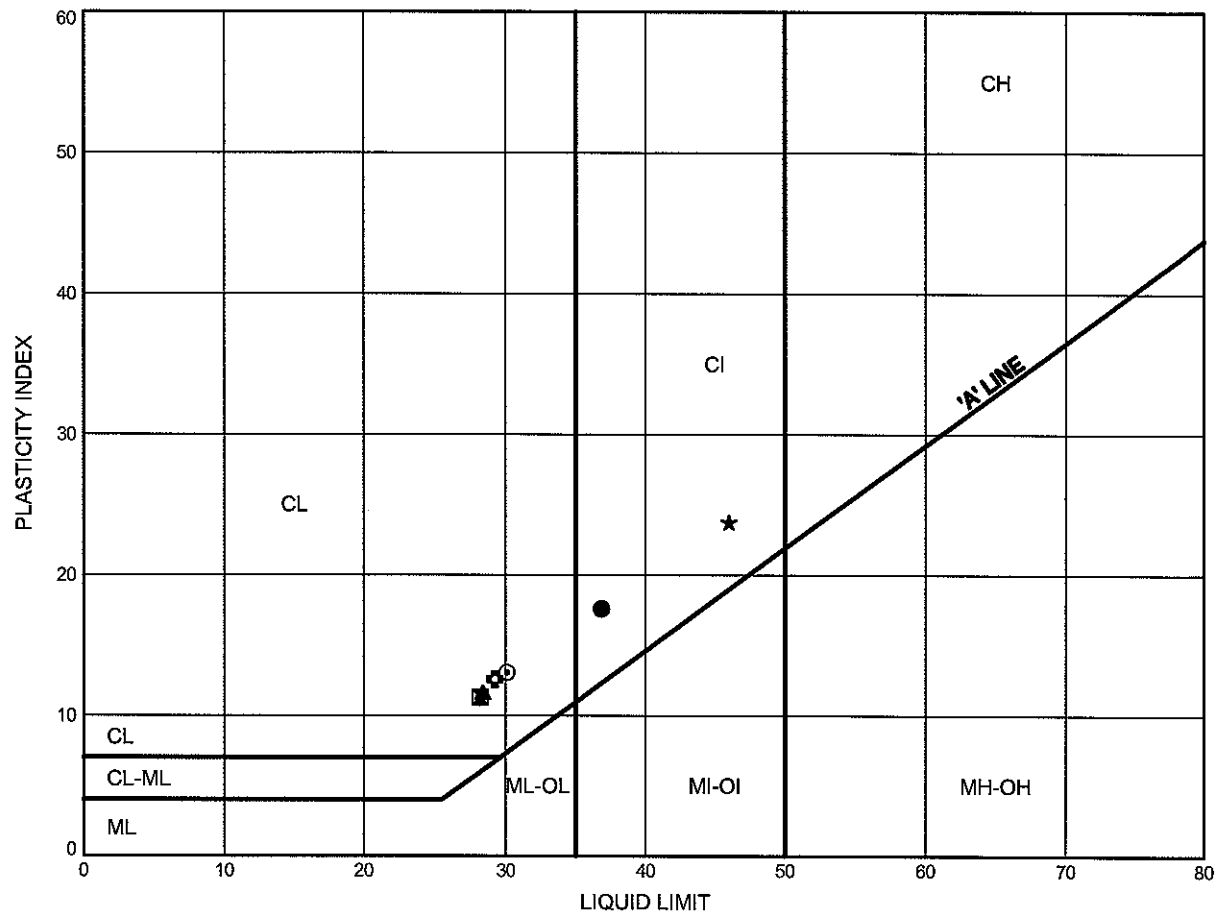
Prep'd DB

Chkd. MP

ATTERBERG LIMITS TEST RESULTS

FIGURE B2-31

SILTY CLAY



SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	TRW1	3.2	180.0
⊠	TRW1	4.7	178.5
▲	TRW1	10.9	172.3
★	TRW2	1.0	181.5
⊙	TRW2	4.0	178.5
⊕	TRW2	7.8	174.7

Date August 2010

Project 1-09-4135



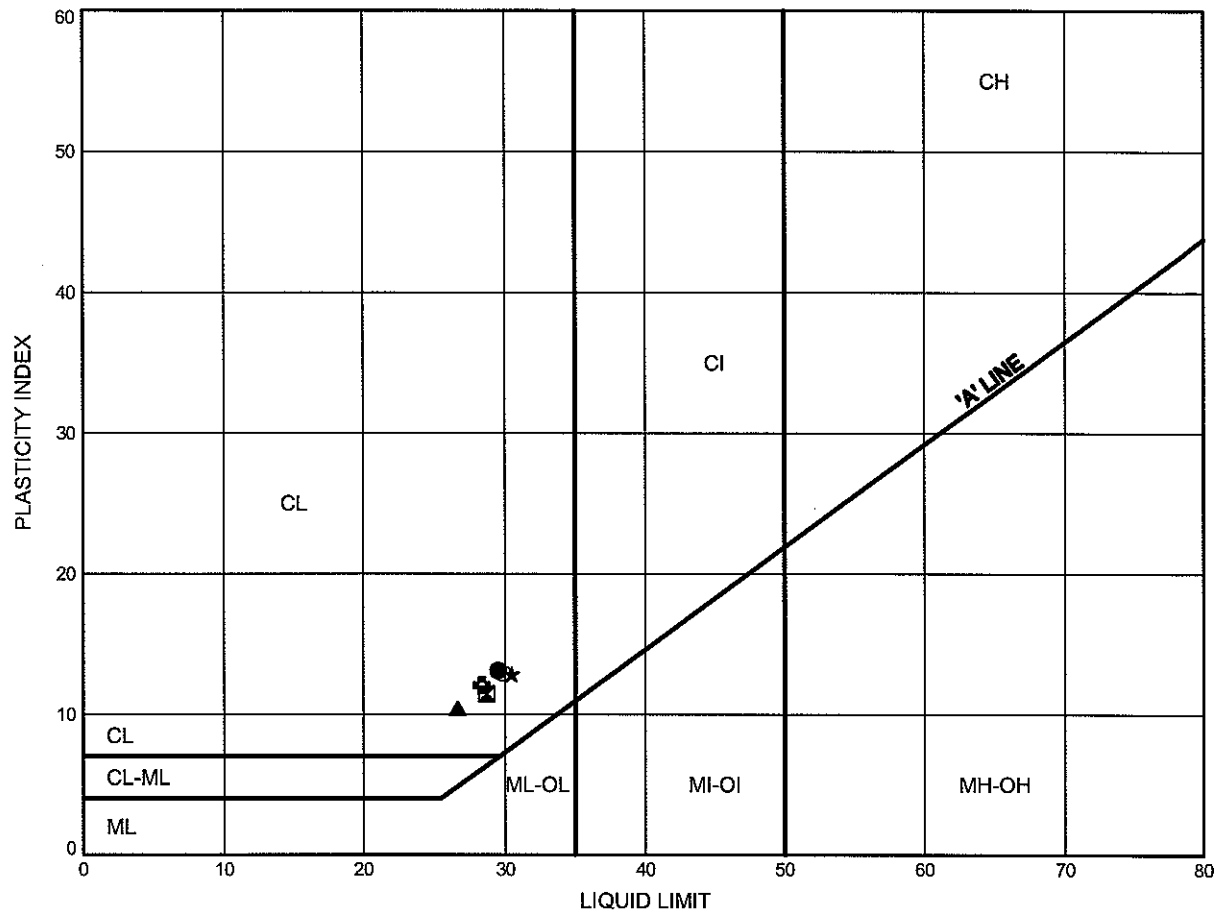
Prep'd DB

Chkd. MP

ATTERBERG LIMITS TEST RESULTS

FIGURE B2-32

SILTY CLAY



SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	TRW2	13.9	168.6
⊠	TRW3	4.7	178.4
▲	TRW3	10.9	172.2
★	TRW4	2.5	181.5
⊙	TRW4	4.7	179.3
⊕	TRW4	7.8	176.2

Date August 2010

Project 1-09-4135



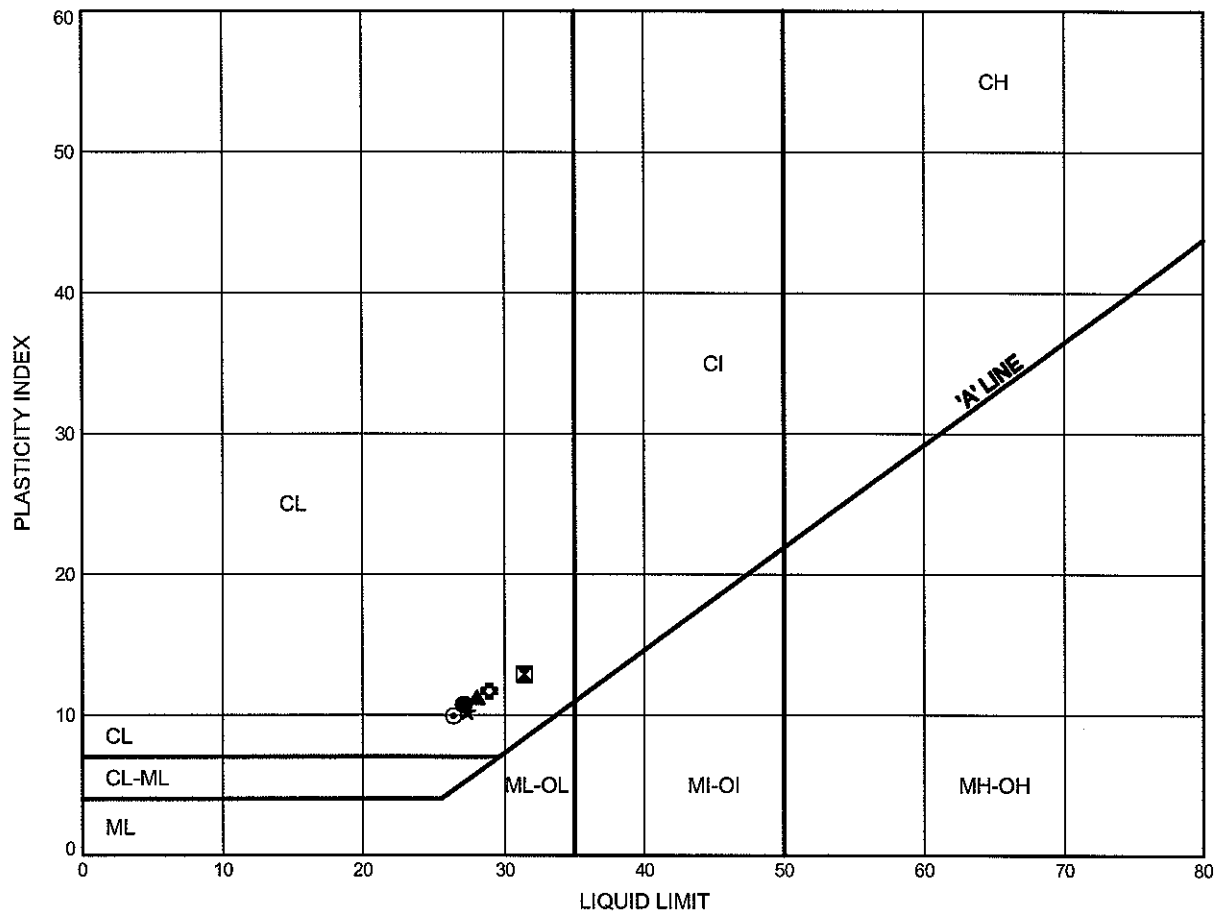
Prep'd DB

Chkd. MP

ATTERBERG LIMITS TEST RESULTS

FIGURE B2-33

SILTY CLAY



SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	TRW4	12.4	171.6
⊠	TS1	2.5	180.1
▲	TS1	4.7	177.9
★	TS1	9.3	173.3
⊙	TS1	13.9	168.7
⊕	TS2	5.5	177.8

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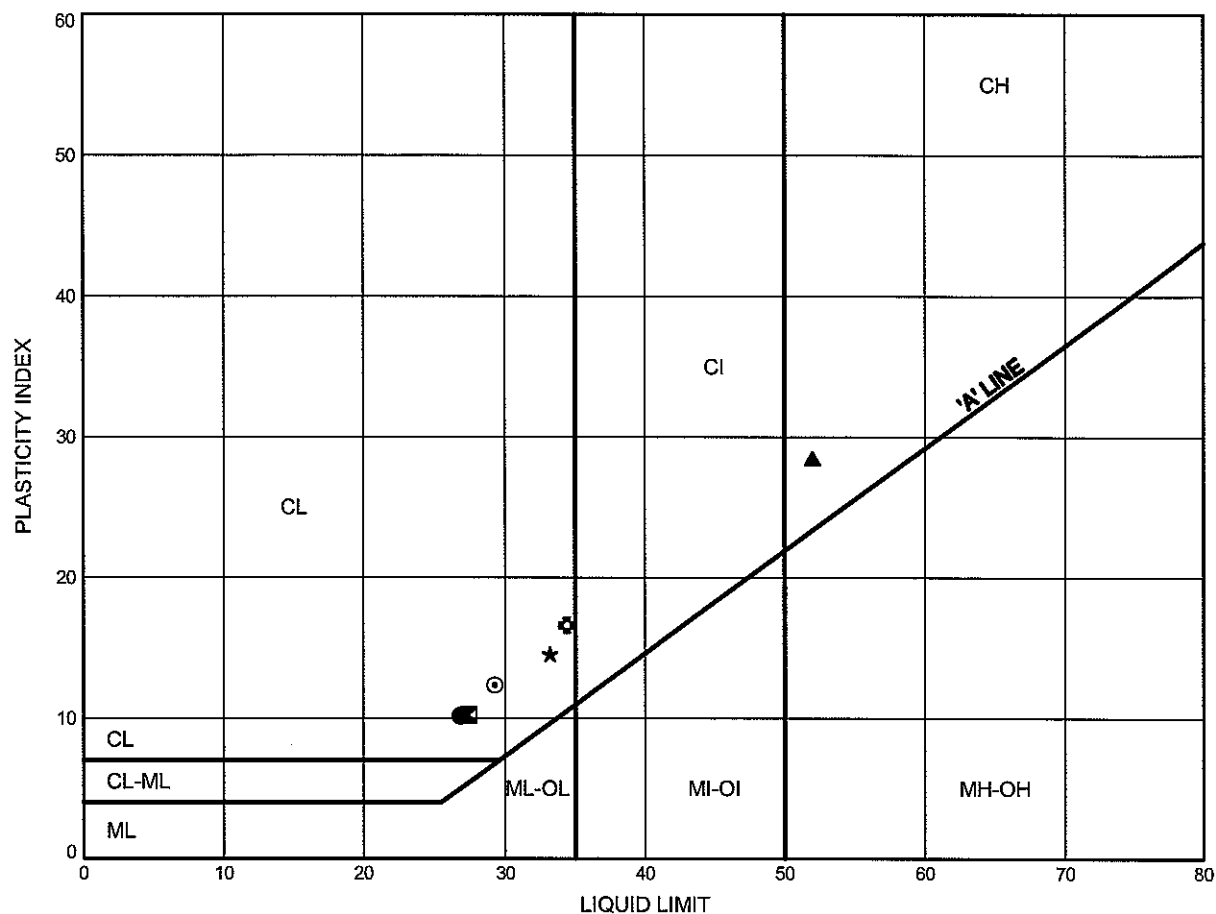
Prep'd DB

Chkd. MP

ATTERBERG LIMITS TEST RESULTS

FIGURE B2-34

SILTY CLAY



SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	TS2	9.3	174.0
⊠	TS2	13.9	169.4
▲	TS3	1.7	180.8
★	TS3	4.0	178.5
⊙	TS3	6.3	176.2
⊕	TS3	10.9	171.6

Date August 2010

Project 1-09-4135



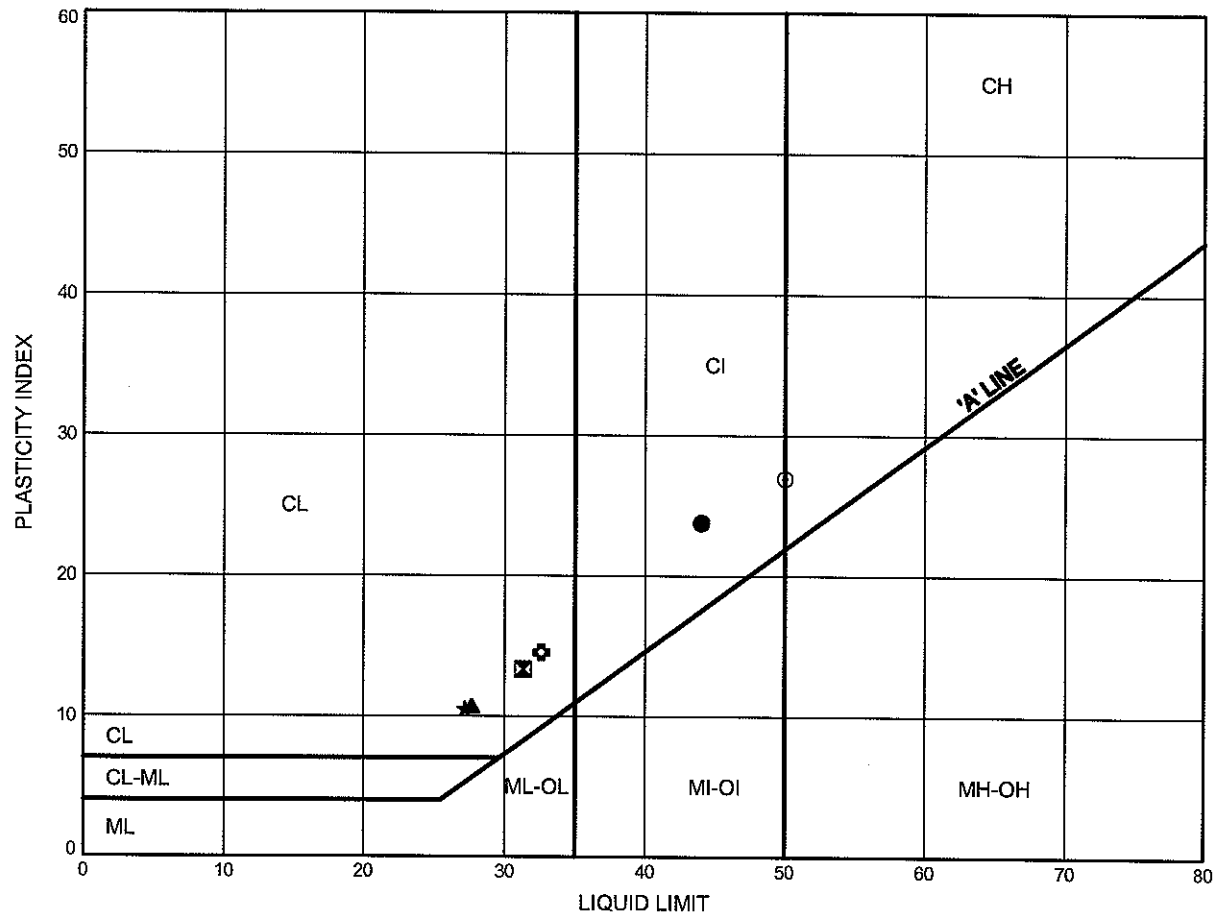
Prep'd DB

Chkd. MP

ATTERBERG LIMITS TEST RESULTS

FIGURE B2-35

SILTY CLAY



SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	TS4	1.0	181.4
⊠	TS4	3.2	179.2
▲	TS4	6.3	176.1
★	TS4	9.3	173.1
⊙	TSEW1	1.7	181.8
⊕	TSEW1	4.0	179.5

Date August 2010
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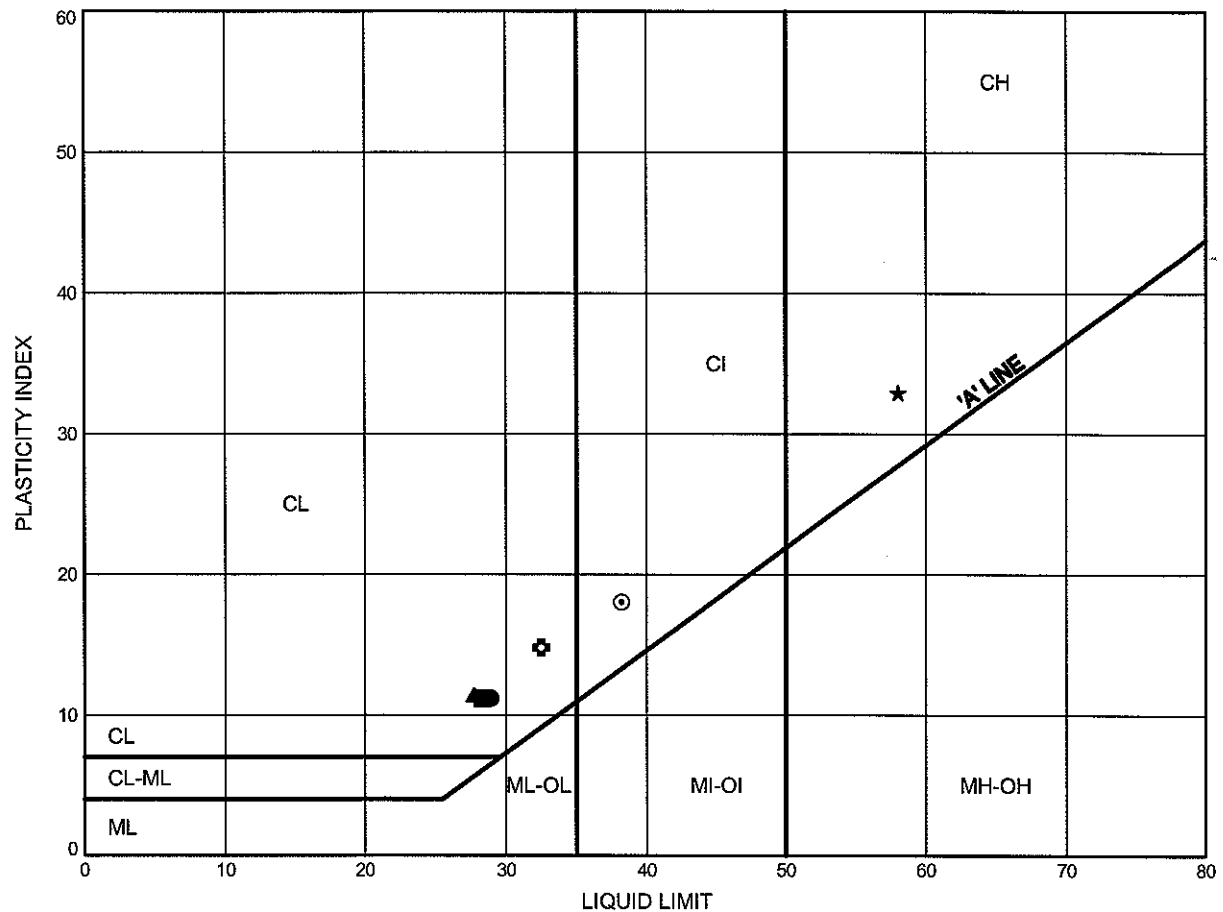


Prep'd DB
 Chkd. MP

ATTERBERG LIMITS TEST RESULTS

FIGURE B2-36

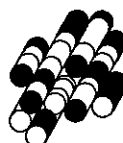
SILTY CLAY



SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	TSEW1	6.3	177.2
⊠	TSEW1	9.3	174.2
▲	TSEW1	12.4	171.1
★	TSEW2	1.0	182.3
⊙	TSEW2	2.5	180.8
⊛	TSEW2	5.5	177.8

Date August 2010.....

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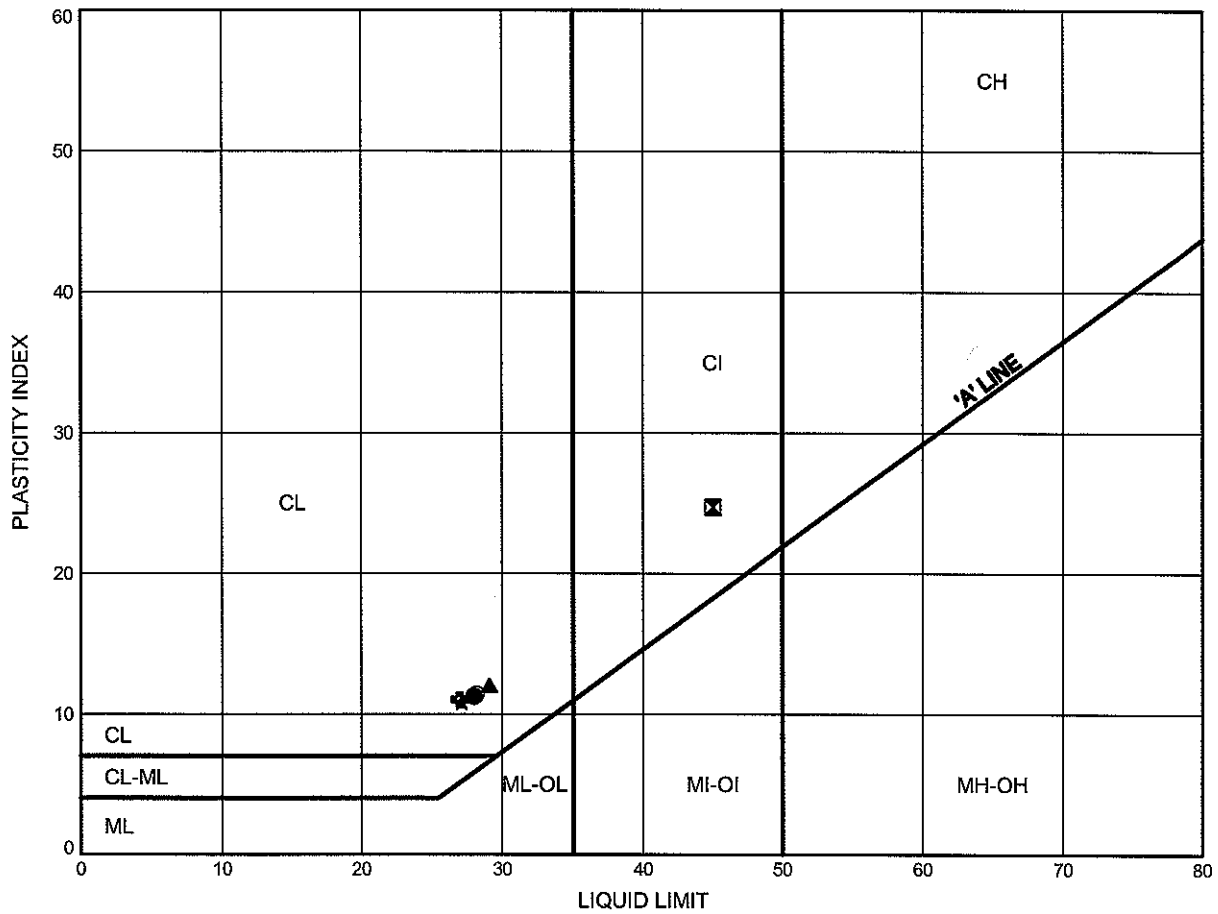
Prep'd DB.....

Chkd. MP.....

ATTERBERG LIMITS TEST RESULTS

FIGURE B2-37

SILTY CLAY



SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	TSEW2	9.3	174.0
⊠	TSEW3	3.2	180.1
▲	TSEW3	4.7	178.6
★	TSEW3	9.3	174.0
⊙	TSEW3	10.9	172.4
⊛	TSEW3	12.4	170.9

Date August 2010

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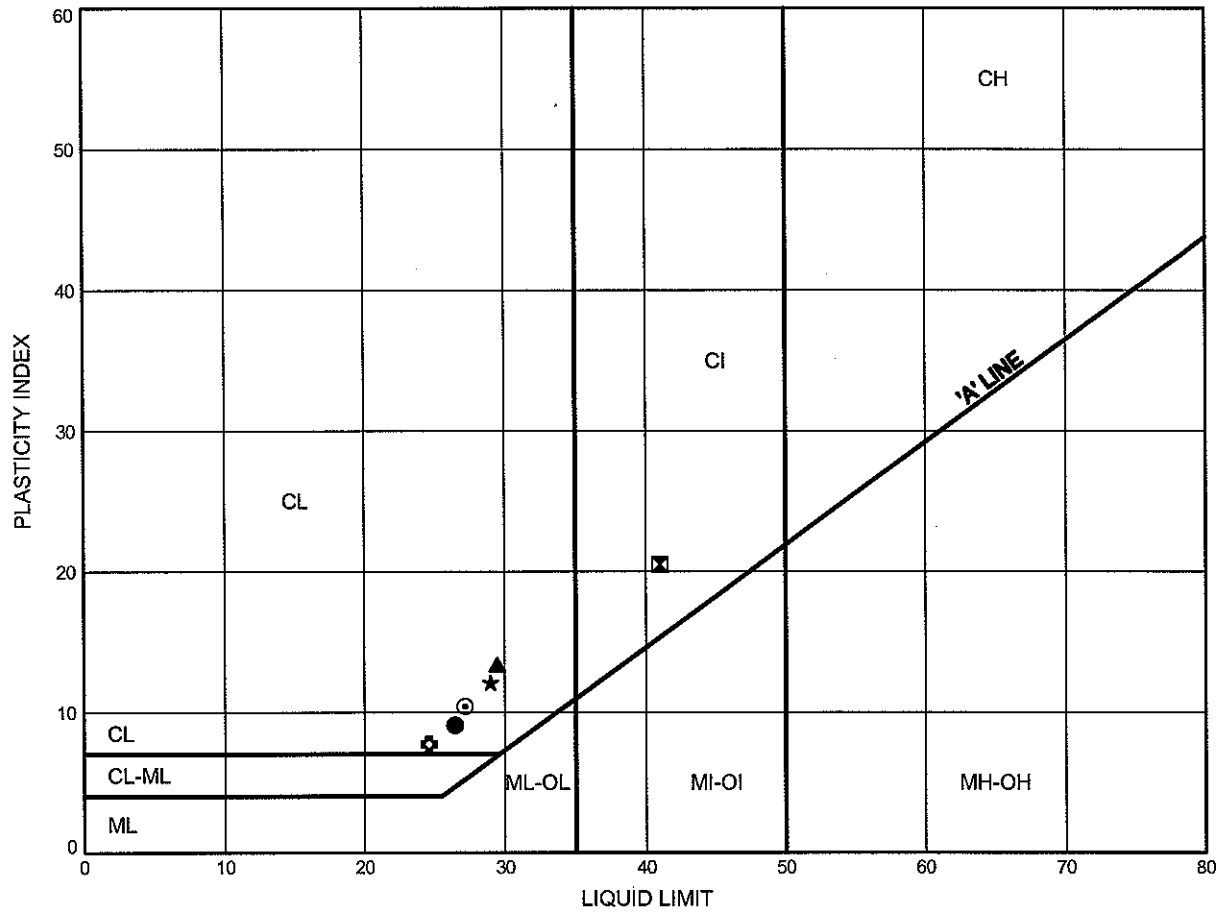
Prep'd DB

Chkd. MP

ATTERBERG LIMITS TEST RESULTS

FIGURE B2-38

SILTY CLAY



SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	TSEW3	13.9	169.4
⊠	TSEW4	2.5	181.0
▲	TSEW4	4.7	178.8
★	TSEW4	7.8	175.7
⊙	TSEW4	9.3	174.2
⊕	TSEW4	12.4	171.1

Date August 2010.....

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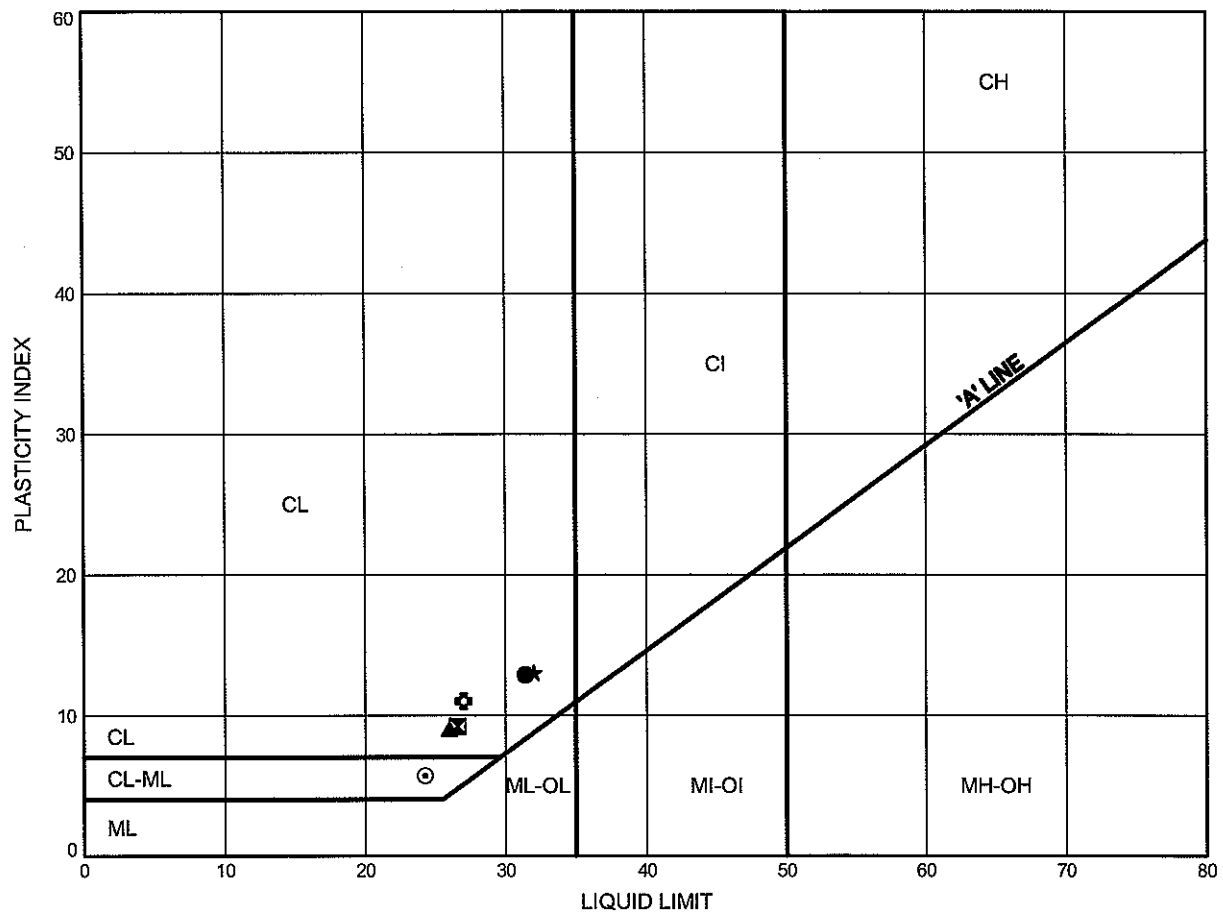
Prep'd DB.....

Chkd. MP.....

ATTERBERG LIMITS TEST RESULTS

FIGURE B2-39

SILTY CLAY



SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	WE-S 10+295CL	2.5	180.3
⊠	WE-S 10+295CL	7.8	175.0
▲	WE-S 10+295CL	9.3	173.5
★	WE-S 10+345CL	2.5	180.3
⊙	WE-S 10+345CL	7.8	175.0
⊕	WE-S 10+345CL	10.9	171.9

Date August 2010.....

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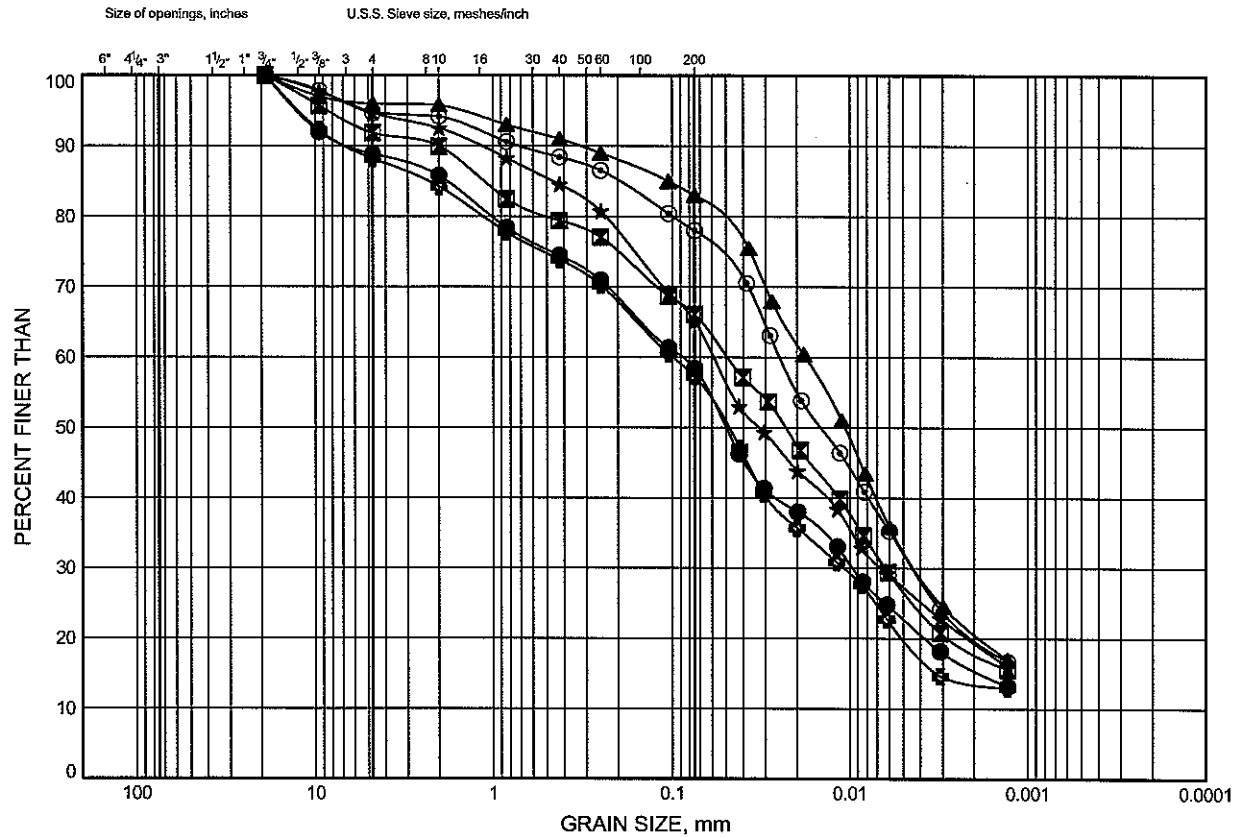
Prep'dDB.....

Chkd.MP.....

GRAIN SIZE DISTRIBUTION

FIGURE B2-40

SILTY CLAY TO CLAYEY SILT TILL



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

SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	TEW1	17.0	165.5
⊠	TEW2	15.4	167.3
▲	TEW3	17.0	165.6
★	TEW3	21.5	161.1
⊙	TEW4	15.4	167.2
⊕	TEW4	20.0	162.6

Date August 2010

Project 1-09-4135



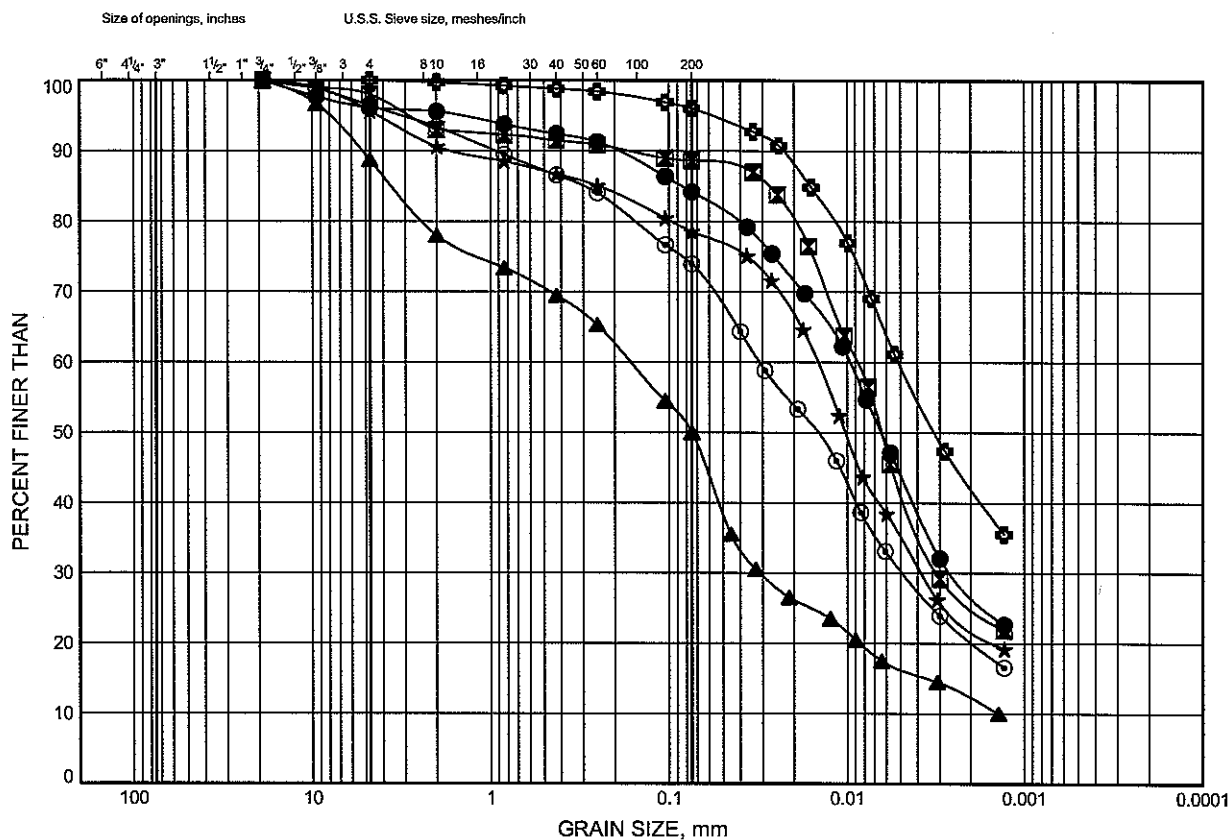
Prep'd DB

Chkd. MP

GRAIN SIZE DISTRIBUTION

FIGURE B2-41

SILTY CLAY TO CLAYEY SILT TILL



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

SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	TN1	15.4	168.1
⊠	TN2	15.4	168.8
▲	TN2	26.1	158.1
★	TN3	17.0	167.1
⊙	TN4	17.0	167.0
⊕	TN4	27.6	156.4

Date August 2010
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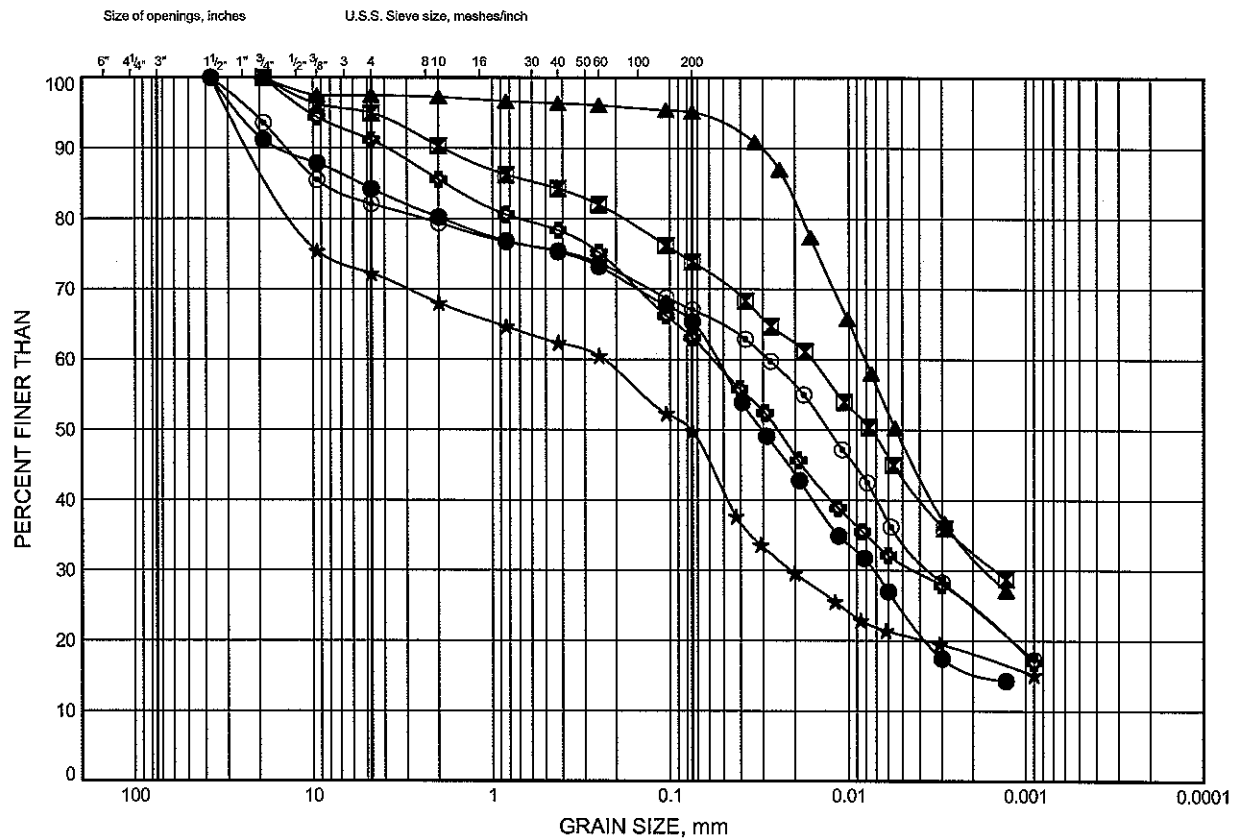


Prep'd DB
Chkd. MP

GRAIN SIZE DISTRIBUTION

FIGURE B2-43

SILTY CLAY TO CLAYEY SILT TILL

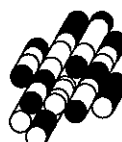


COBBLE SIZE	COARSE	FINE	COARSE	MEDIUM	FINE	SILT and CLAY
	GRAVEL		SAND			FINE GRAINED

SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	TS4	15.4	167.0
⊠	TSEW1	26.1	157.4
▲	TSEW2	26.1	157.2
★	TSEW3	26.1	157.2
⊙	TSEW4	18.5	165.0
⊕	TSEW4	26.1	157.4

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Project 1-09-4135



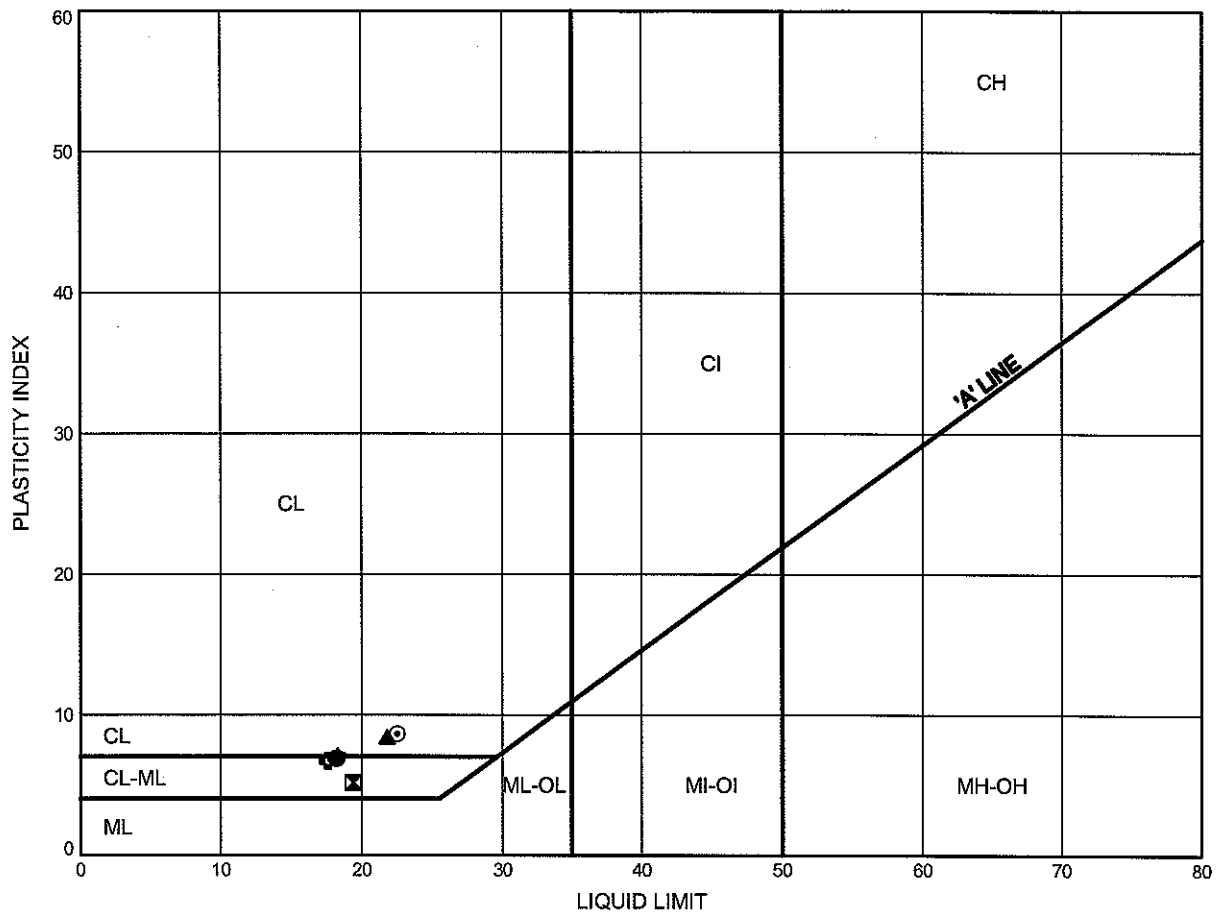
Prep'd DB

Chkd. MP

ATTERBERG LIMITS TEST RESULTS

FIGURE B2-44

SILTY CLAY TO CLAYEY SILT TILL



SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	TEW1	17.0	165.5
⊠	TEW2	15.4	167.3
▲	TEW3	17.0	165.6
★	TEW3	21.5	161.1
⊙	TEW4	15.4	167.2
⊕	TEW4	20.0	162.6

Date August 2010
 Project 1-09-4135

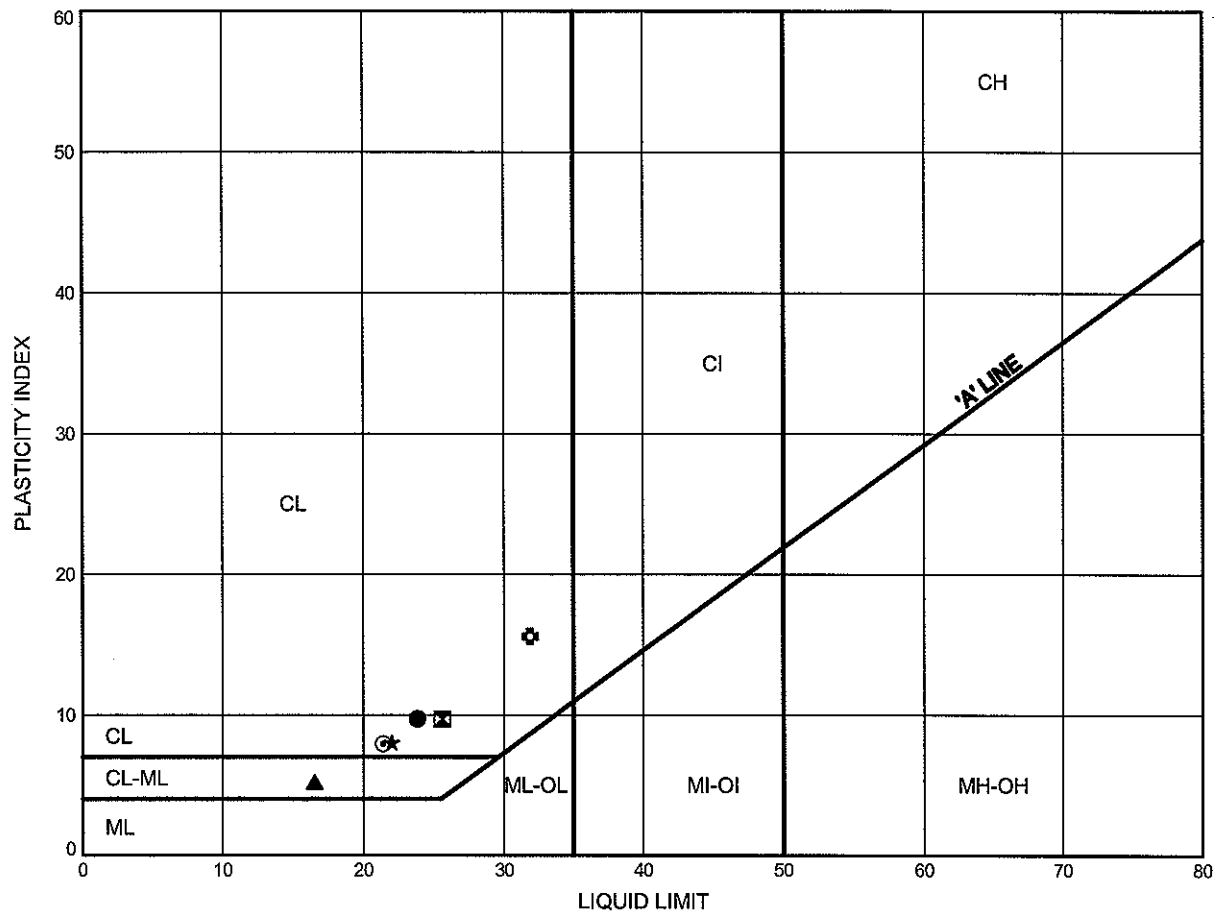


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 Chkd. MP

ATTERBERG LIMITS TEST RESULTS

FIGURE B2-45

SILTY CLAY TO CLAYEY SILT TILL



SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	TN1	15.4	168.1
⊠	TN2	15.4	168.8
▲	TN2	26.1	158.1
★	TN3	17.0	167.1
⊙	TN4	17.0	167.0
⊕	TN4	27.6	156.4

Date August 2010
 Project 1-09-4135

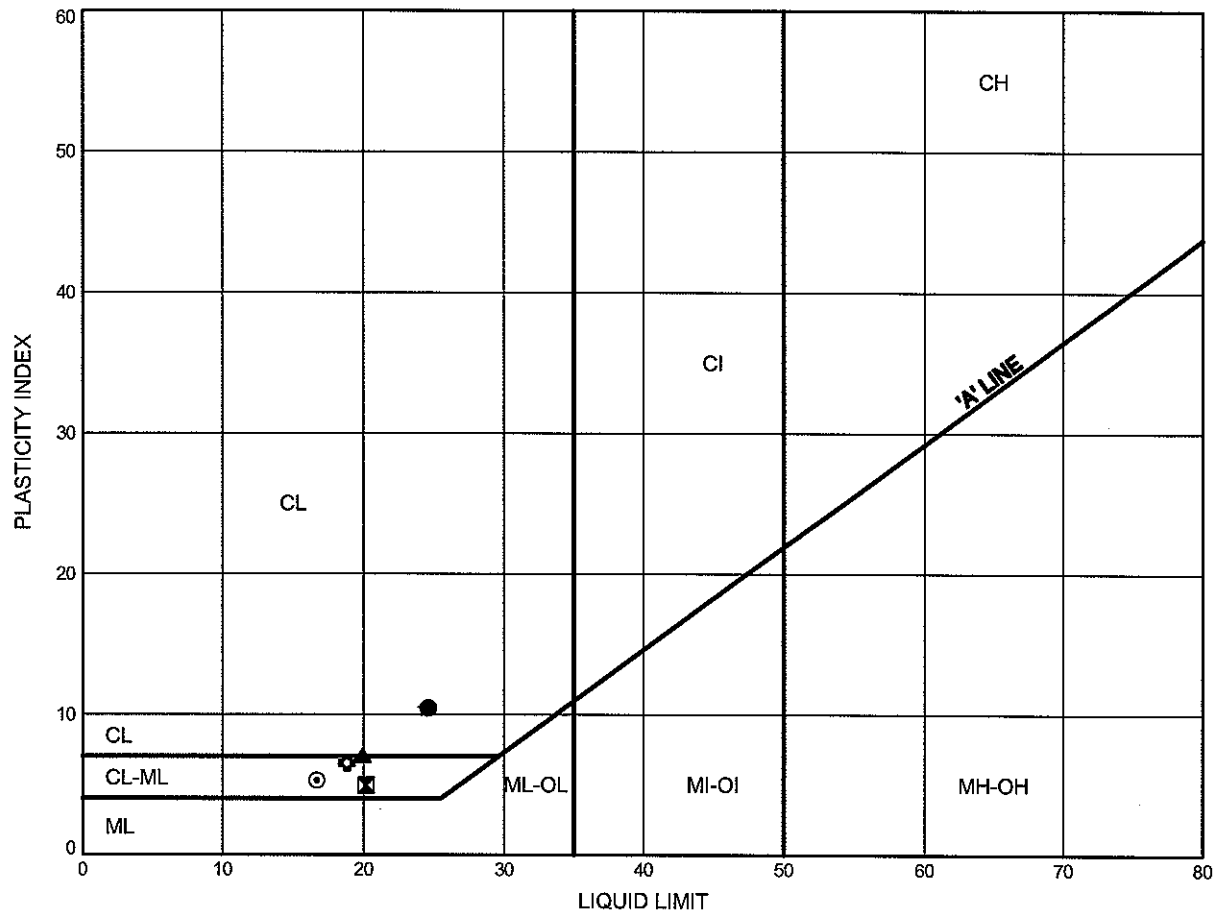


Prep'd DB
 Chkd. MP

ATTERBERG LIMITS TEST RESULTS

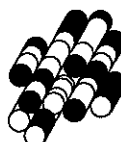
FIGURE B2-46

SILTY CLAY TO CLAYEY SILT TILL



SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	TRW3	15.4	167.7
⊠	TS1	17.0	165.6
▲	TS1	26.1	156.5
★	TS2	15.4	167.9
⊙	TS2	23.1	160.2
⊕	TS3	18.5	164.0

Date August 2010
 Project 1-09-4135

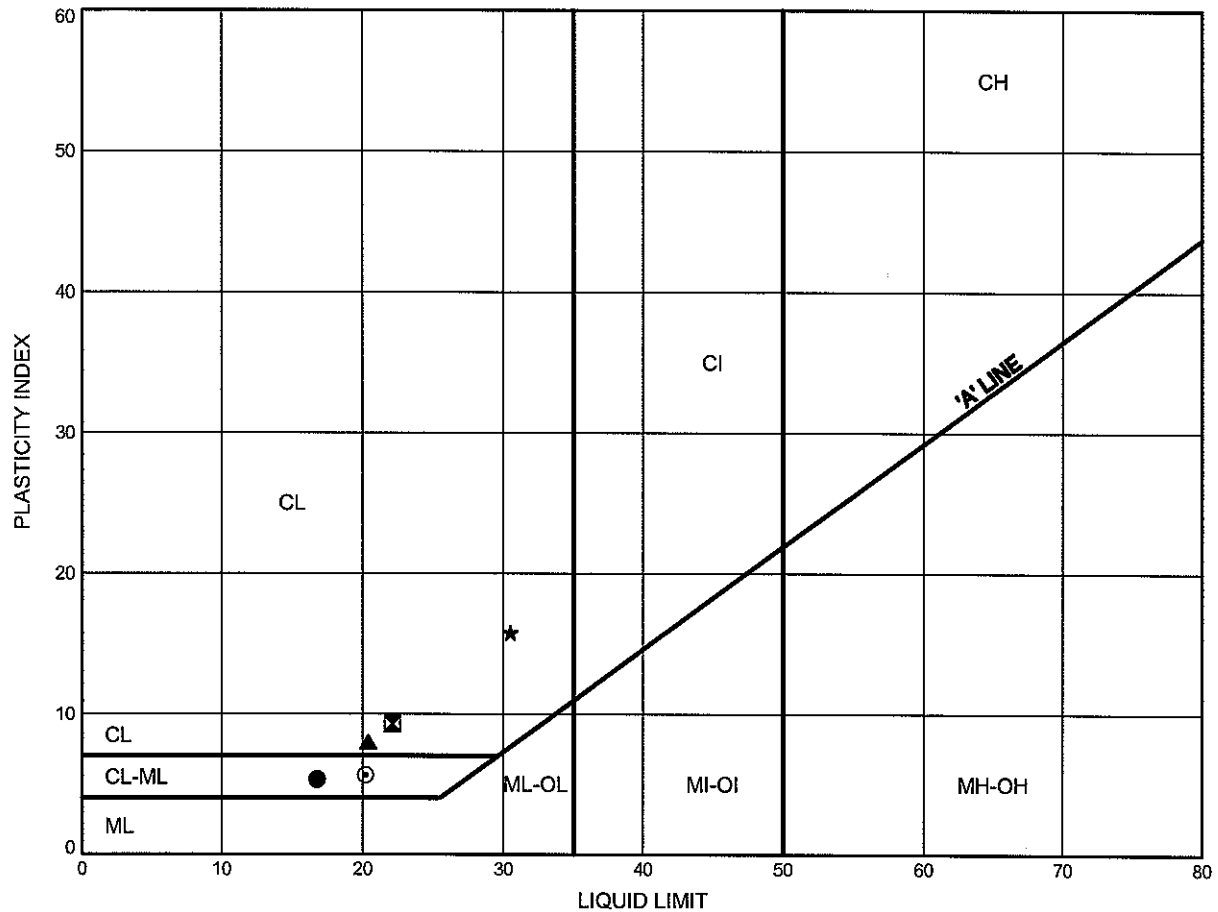


Prep'd DB
 Chkd. MP

ATTERBERG LIMITS TEST RESULTS

FIGURE B2-47

SILTY CLAY TO CLAYEY SILT TILL



SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	TS3	23.1	159.4
⊠	TS3	26.1	156.4
▲	TS4	15.4	167.0
★	TSEW1	26.1	157.4
⊙	TSEW2	18.5	164.8

Date August 2010

Project 1-09-4135



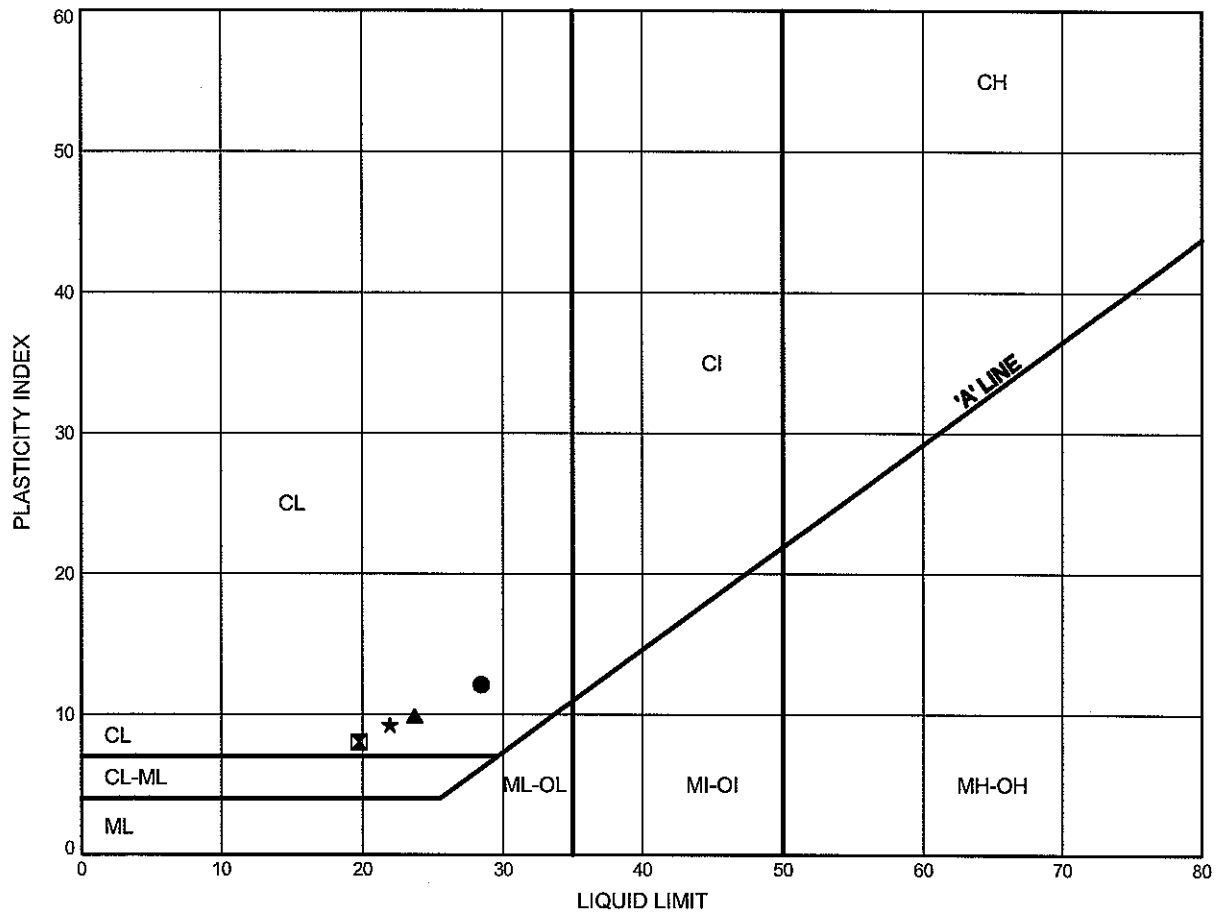
Prep'd DB

Chkd. MP

ATTERBERG LIMITS TEST RESULTS

FIGURE B2-48

SILTY CLAY TO CLAYEY SILT TILL



SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	TSEW2	26.1	157.2
⊠	TSEW3	26.1	157.2
▲	TSEW4	18.5	165.0
★	TSEW4	26.1	157.4

Date August 2010

Project 1-09-4135



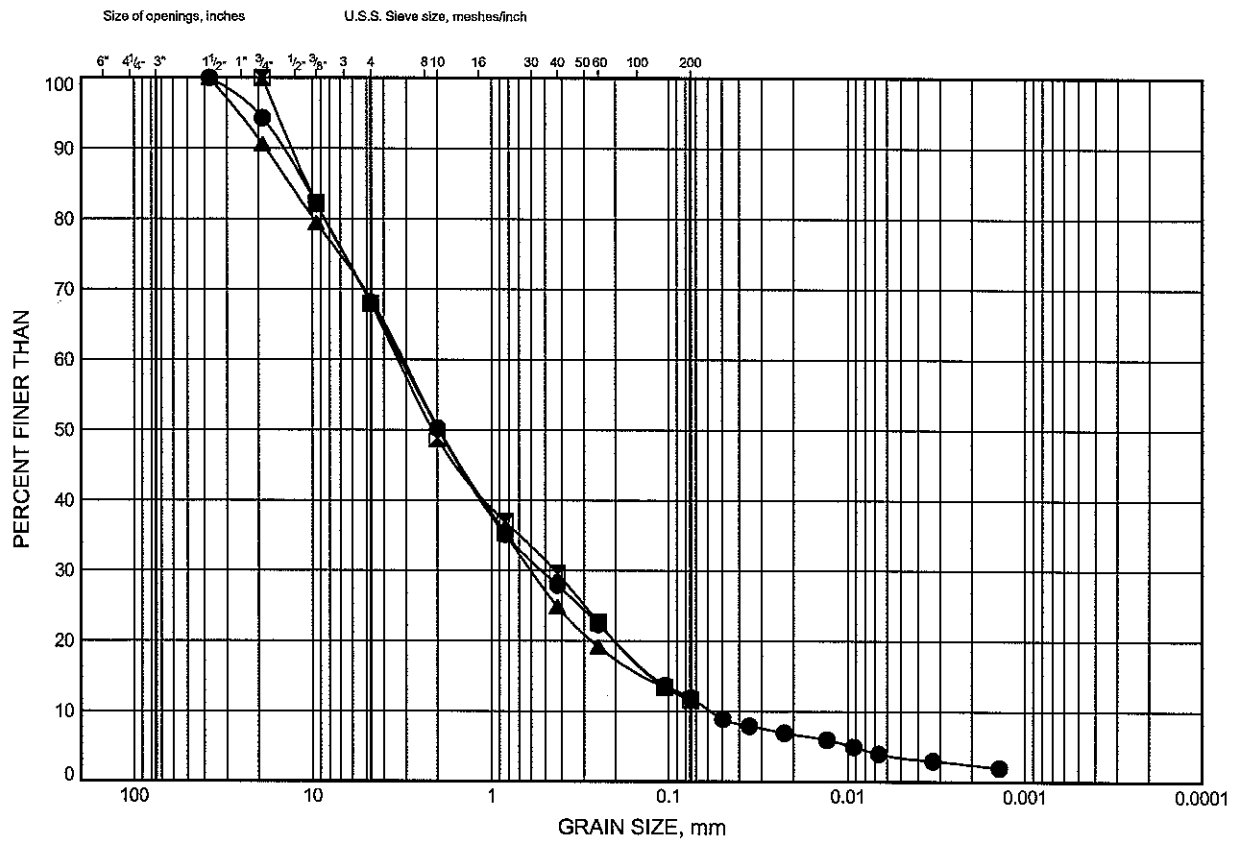
Prep'd DB

Chkd. MP

GRAIN SIZE DISTRIBUTION

FIGURE B2-49

SAND



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

SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	TEW1	21.5	161.0
■	TS1	21.4	161.2
▲	TS2	21.5	161.8

Date August 2010
Project 1-09-4135

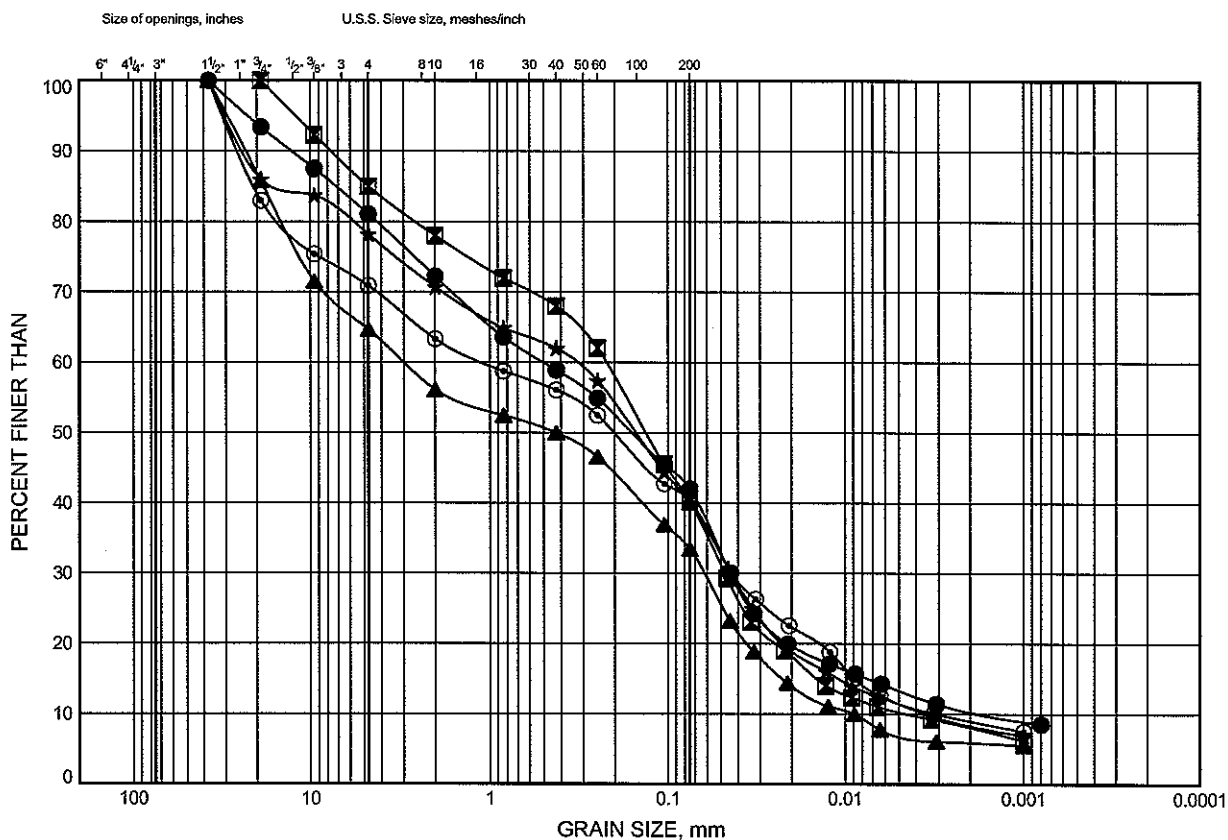


Prep'd DB
Chkd. MP

GRAIN SIZE DISTRIBUTION

FIGURE B2-51

SILTY SAND TO SANDY SILT TILL



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

SYMBOL BOREHOLE DEPTH (m) ELEVATION (m)

●	TN4	29.2	154.8
⊠	TSEW3	20.0	163.3
▲	TSEW3	23.1	160.2
★	TSEW4	20.0	163.5
⊙	TSEW4	23.1	160.4

Date August 2010

Project 1-09-4135



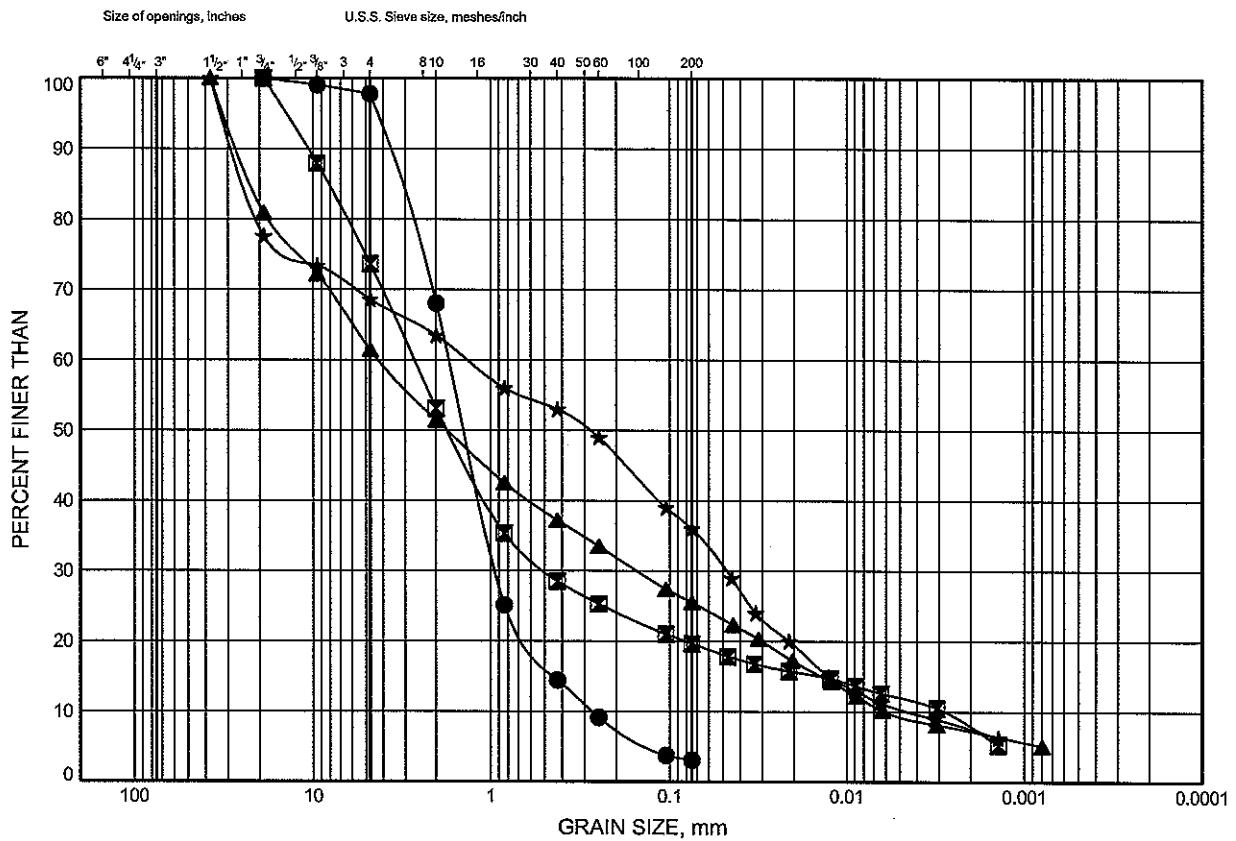
Prep'd DB

Chkd. MP

GRAIN SIZE DISTRIBUTION

FIGURE B2-52

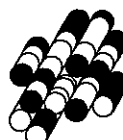
GRAVELLY SAND TO SANDY GRAVEL TILL



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

SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	TEW2	24.6	158.1
⊠	TEW2	27.6	155.1
▲	TN2	29.2	155.0
★	TN3	29.2	154.9

Date August 2010
Project 1-09-4135

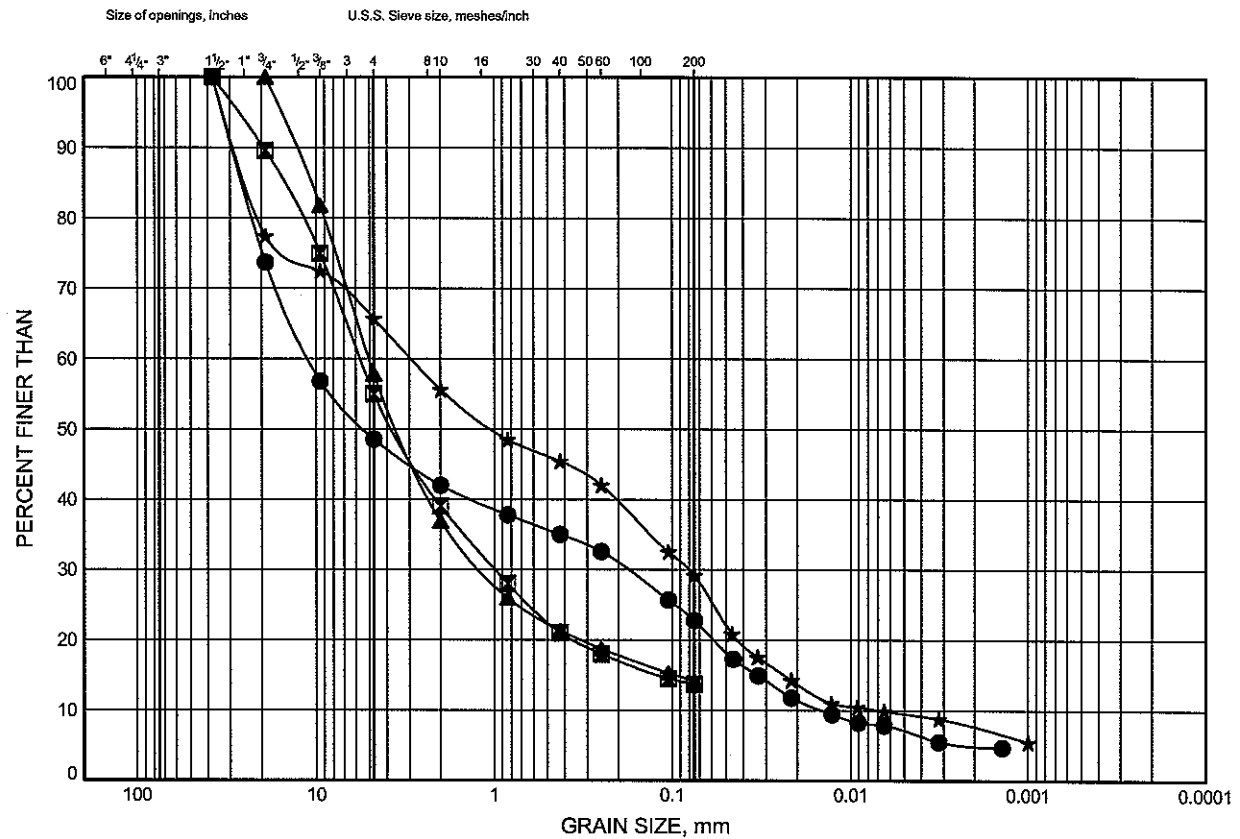


Prep'd DB
Chkd. MP

GRAIN SIZE DISTRIBUTION

FIGURE B2-53

GRAVELLY SAND TO SANDY GRAVEL TILL



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

SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	TS3	27.6	154.9
⊠	TS4	27.5	154.9
▲	TSEW1	29.2	154.3
★	TSEW3	27.6	155.7

Date August 2010

Project 1-09-4135



Prep'd DB

Chkd. MP

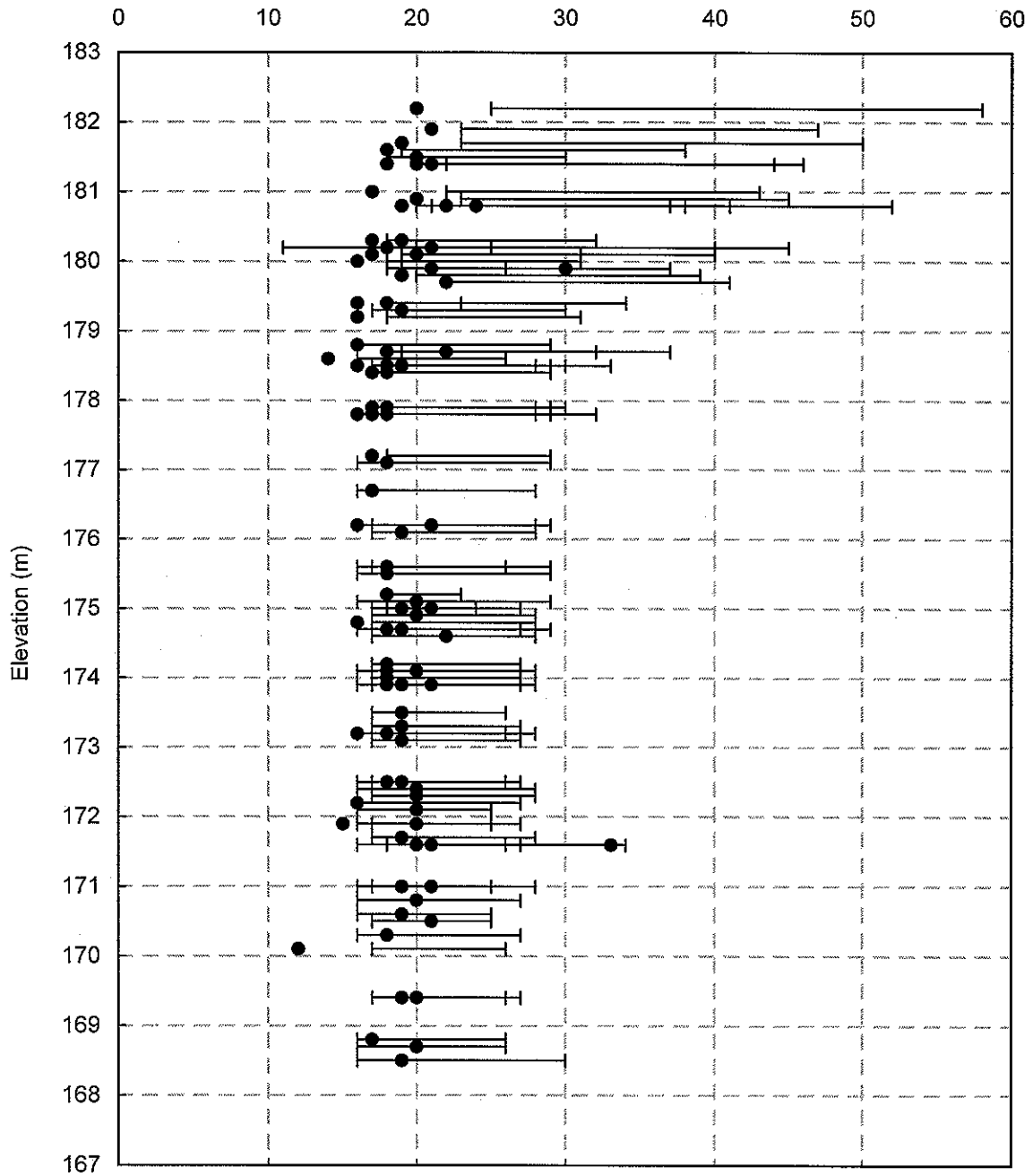
ATTERBERG LIMITS AND WATER CONTENTS

FIGURE B2-54

HWY 406 TWINNING - RETAINING WALL SITE #2

Silty Clay

Atterberg Limits & Water Contents (%)



Project No. : 1-09-4135

Date : November, 2010



Terraprobe Inc.

Prepared By : HW

Checked By : RA

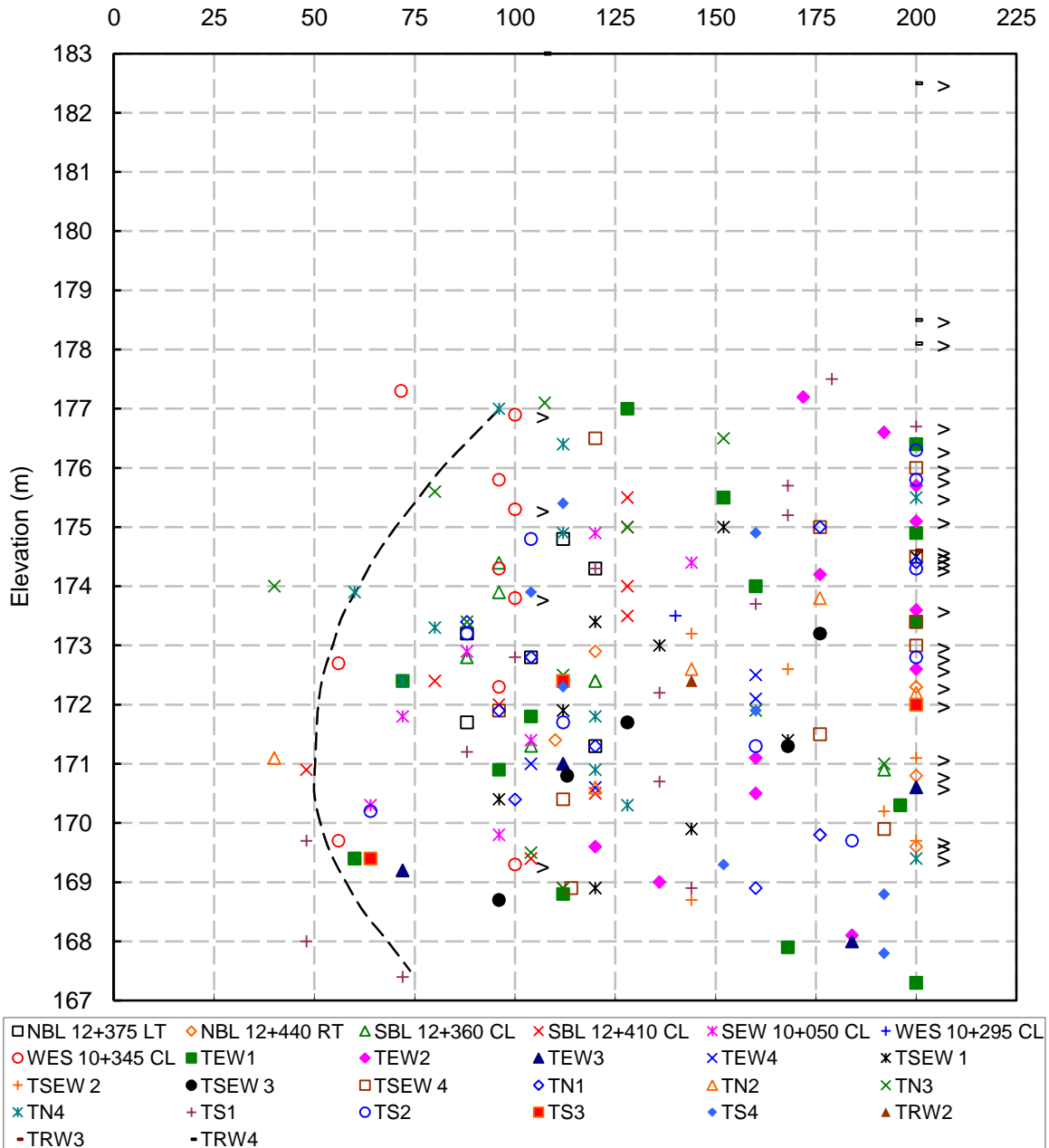
CORRECTED UNDRAINED SHEAR STRENGTH

FIGURE B2-55

HWY 406 TWINNING - RETAINING WALL SITE #2

Silty Clay

Corrected Cu (kPa)



Field Shear Vane Correction

Morris & Williams (1994)

($\mu = 1.18 \text{ EXP}(-0.08 \text{ Ip}) + 0.57$)

Applied Correction Factors

0.89 (Elev.>177m)

1.00 (Elev.<177m)

Project No. : 1-09-4135

Date : November, 2010



Terraprobe Inc.

Prepared By : HW

Checked By : RA

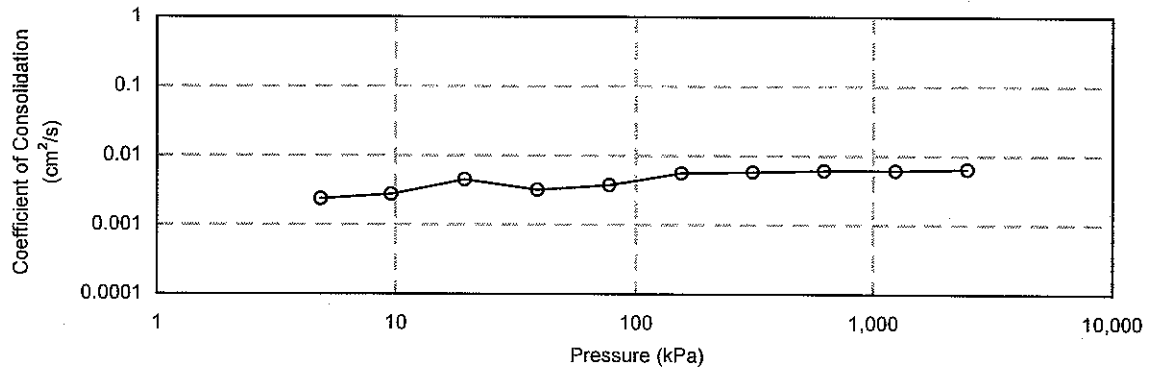
HWY 406 TWINNING - RETAINING WALL SITE #2

FIGURE B2-56

CONSOLIDATION TEST

Cv vs Pressure

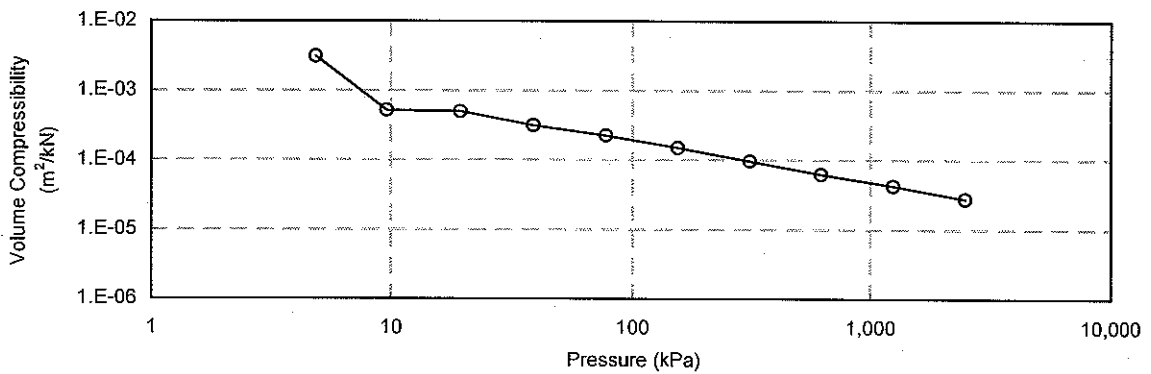
NBL 12+375 LT, TW9



CONSOLIDATION TEST

mv vs Pressure

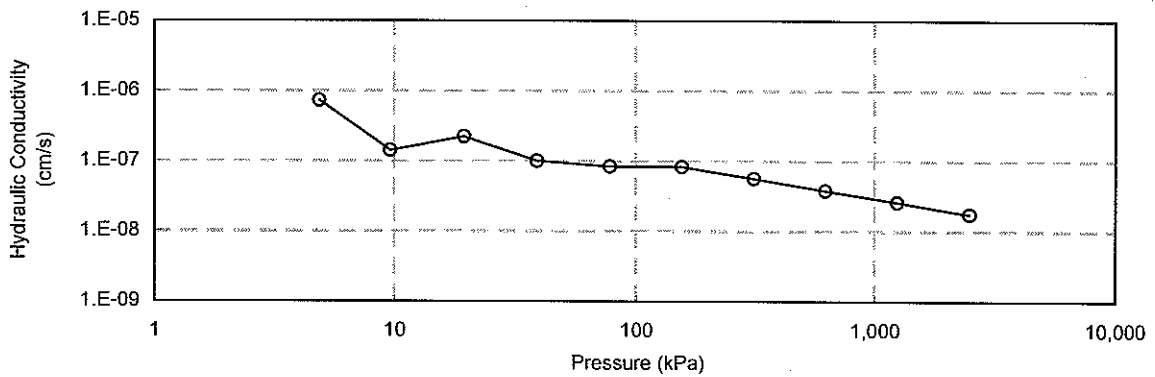
NBL 12+375 LT, TW9



CONSOLIDATION TEST

k vs Pressure

NBL 12+375 LT, TW9



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



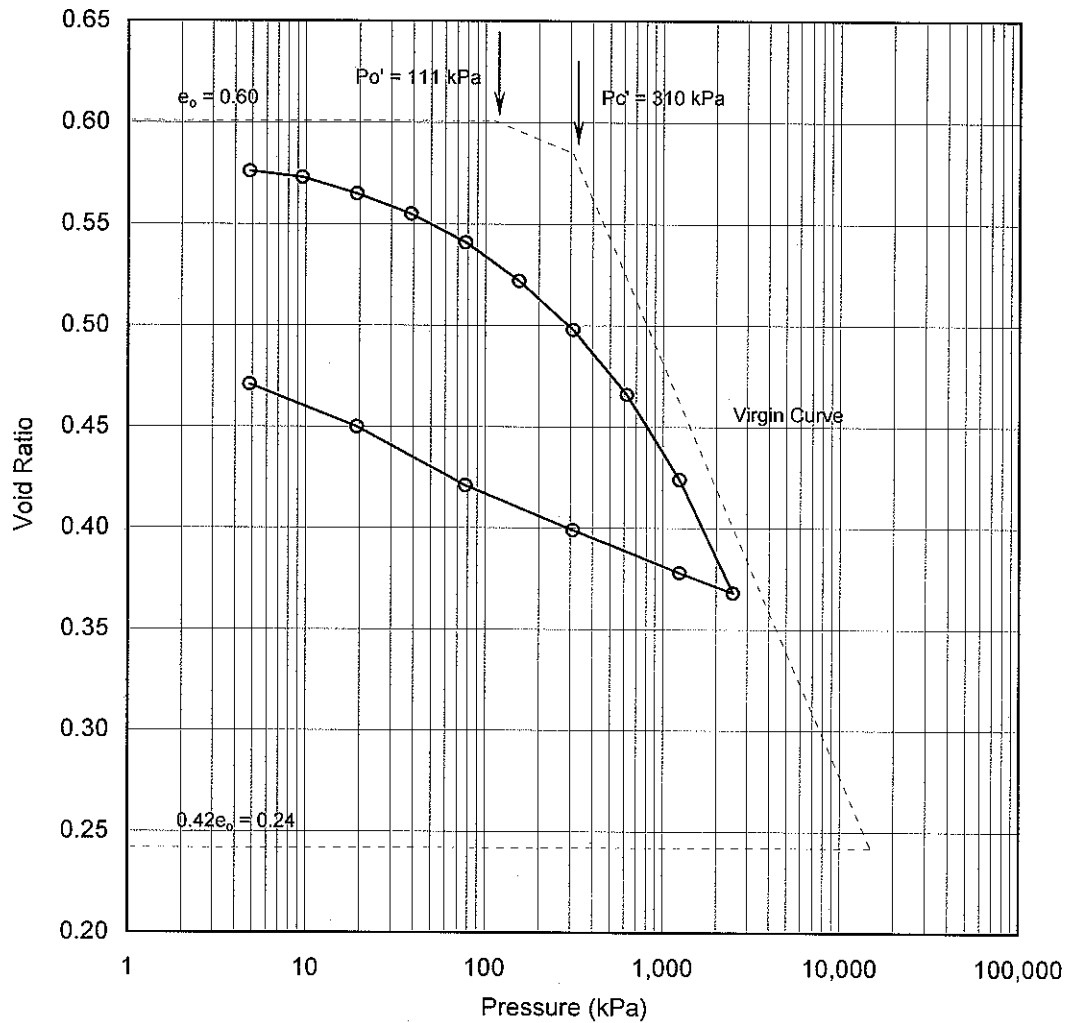
Terraprobe Inc.

Prepared By : HW
Checked By : RA

CONSOLIDATION TEST

e vs Pressure

NBL 12+375 LT, TW9



Soil Type : Silty Clay

$e_o =$	0.60	$\omega_L =$	28%	$P_{o'} =$	111 kPa
$\omega =$	21%	$\omega_p =$	16%	$P_{c'} =$	310 kPa
$\gamma =$	20.6 kN/m ³	PI =	12%	Cc =	0.204
Gs =	2.77			Cr =	0.036

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



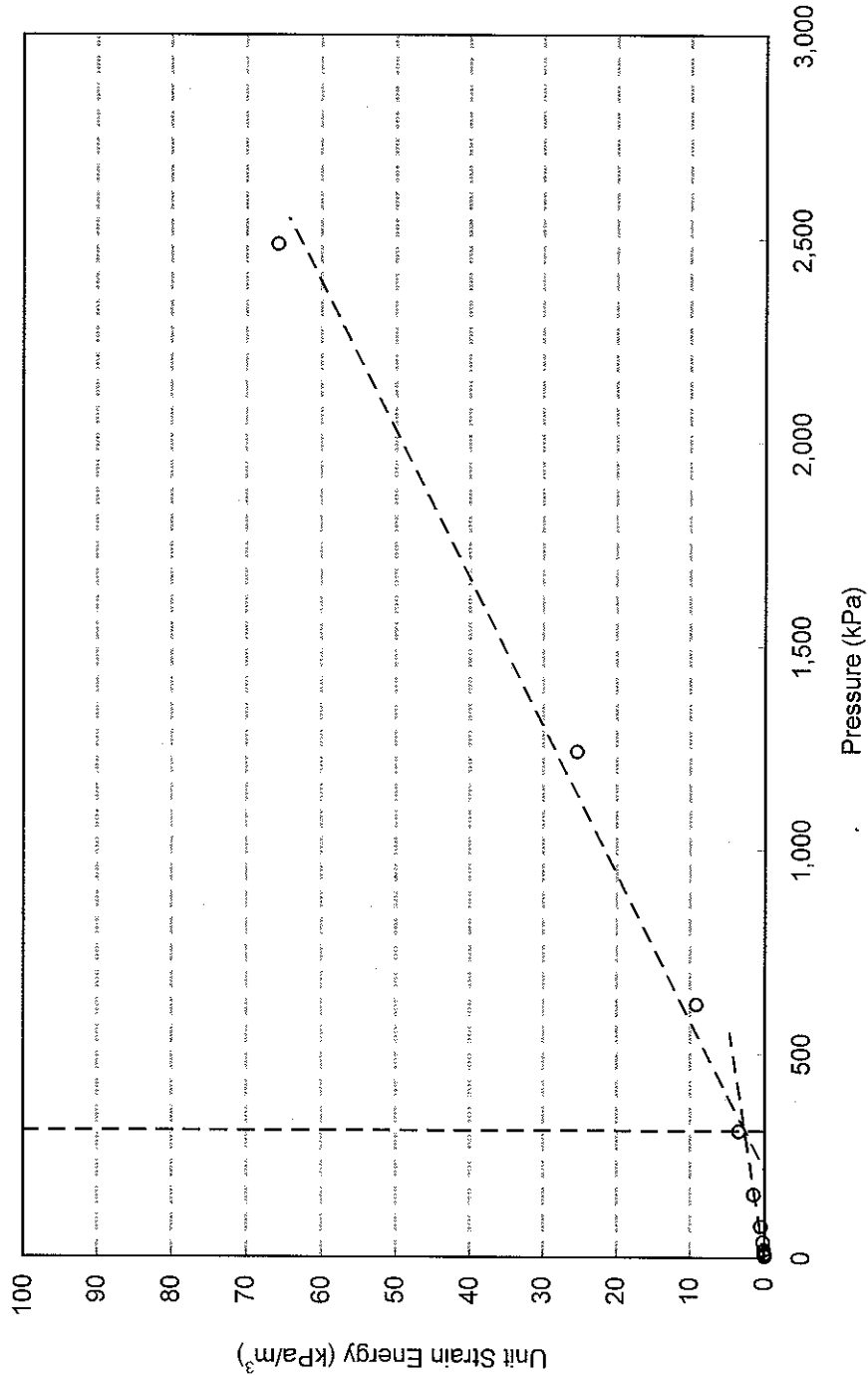
Terraprobe Inc.

Prepared By : HW
 Checked By : RA

HWY 406 TWINNING - RETAINING WALL SITE #2

FIGURE B2-58

CONSOLIDATION TEST Unit Strain Energy vs Pressure NBL 12+375 LT, TW9



$P_c = 310 \text{ kPa}$

Project No. : 1-09-4135

Date : November 2010



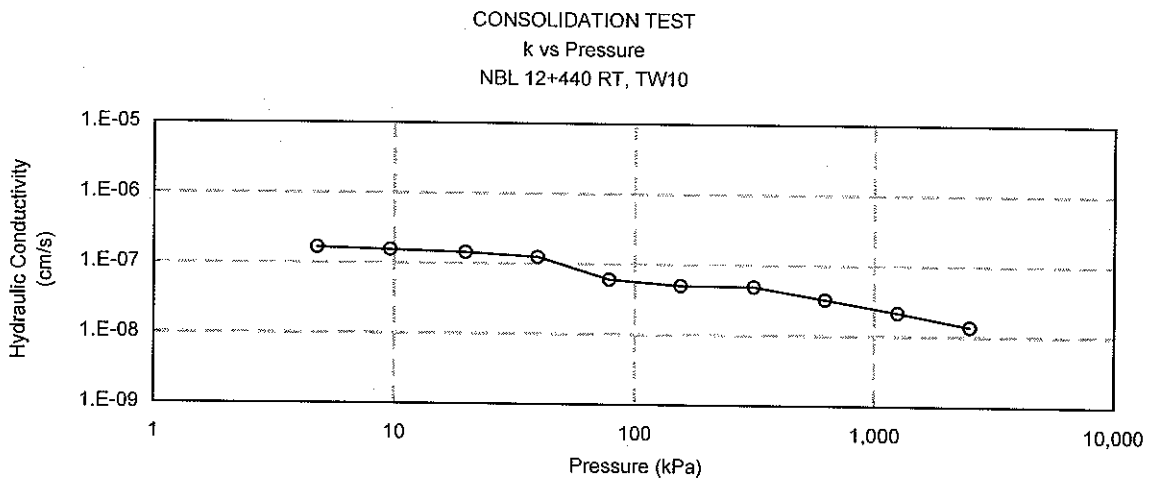
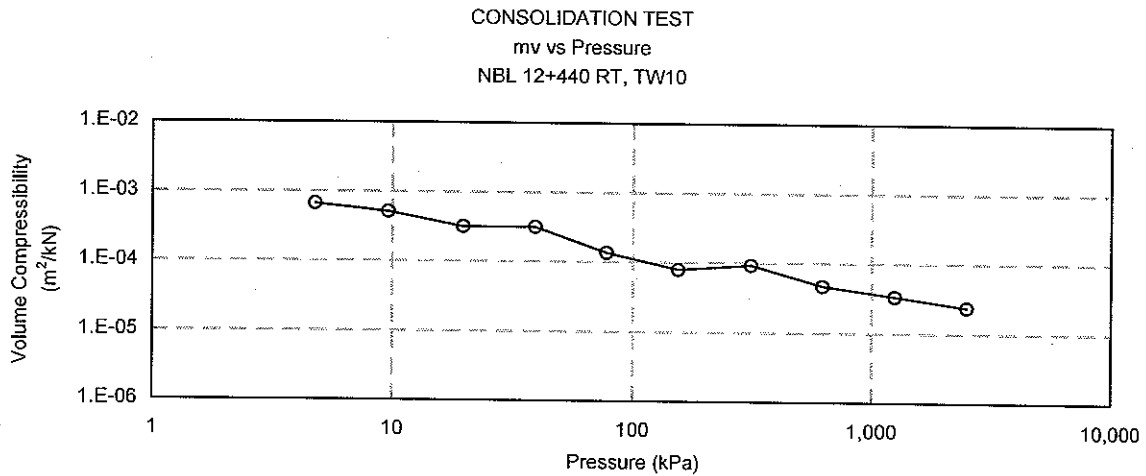
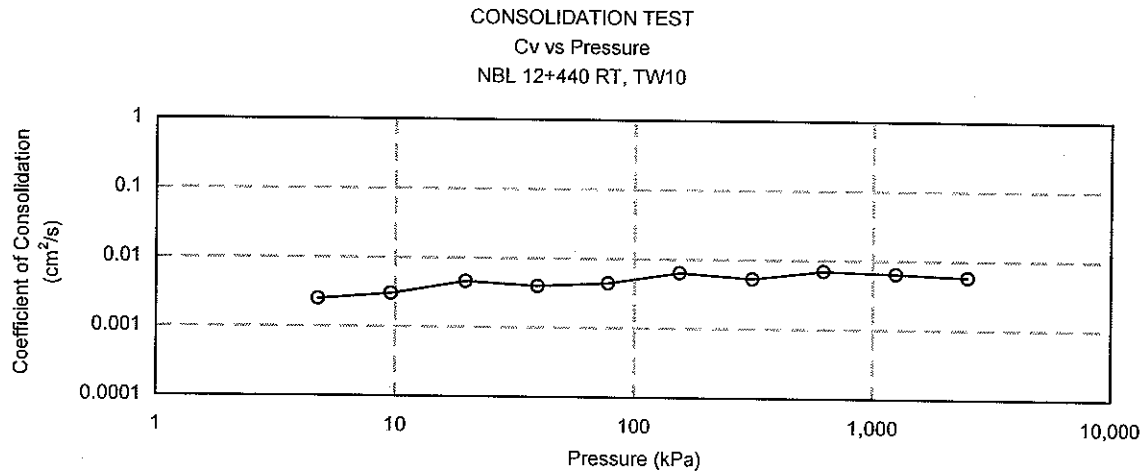
Terraprobe Inc.

Prepared By : HW

Checked By : RA

HWY 406 TWINNING - RETAINING WALL SITE #2

FIGURE B2-59



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



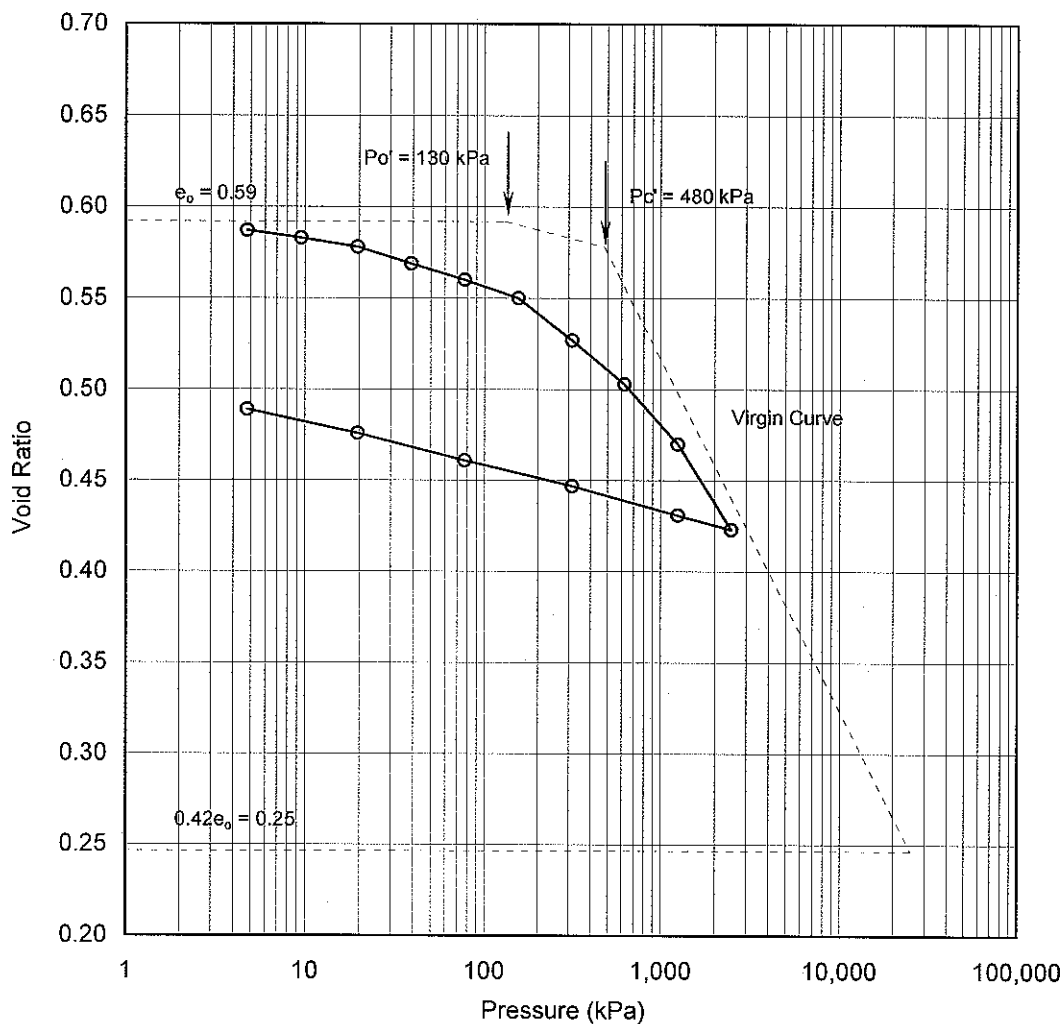
Terraprobe Inc.

Prepared By : HW
Checked By : RA

CONSOLIDATION TEST

e vs Pressure

NBL 12+440 RT, TW10



Soil Type : Silty Clay

$e_o =$	0.59	$\omega_L =$	25%	$P_{o'} =$	130 kPa
$\omega =$	21%	$\omega_P =$	15%	$P_{c'} =$	480 kPa
$\gamma =$	20.7 kN/m ³	PI =	10%	Cc =	0.193
Gs =	2.79			Cr =	0.025

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



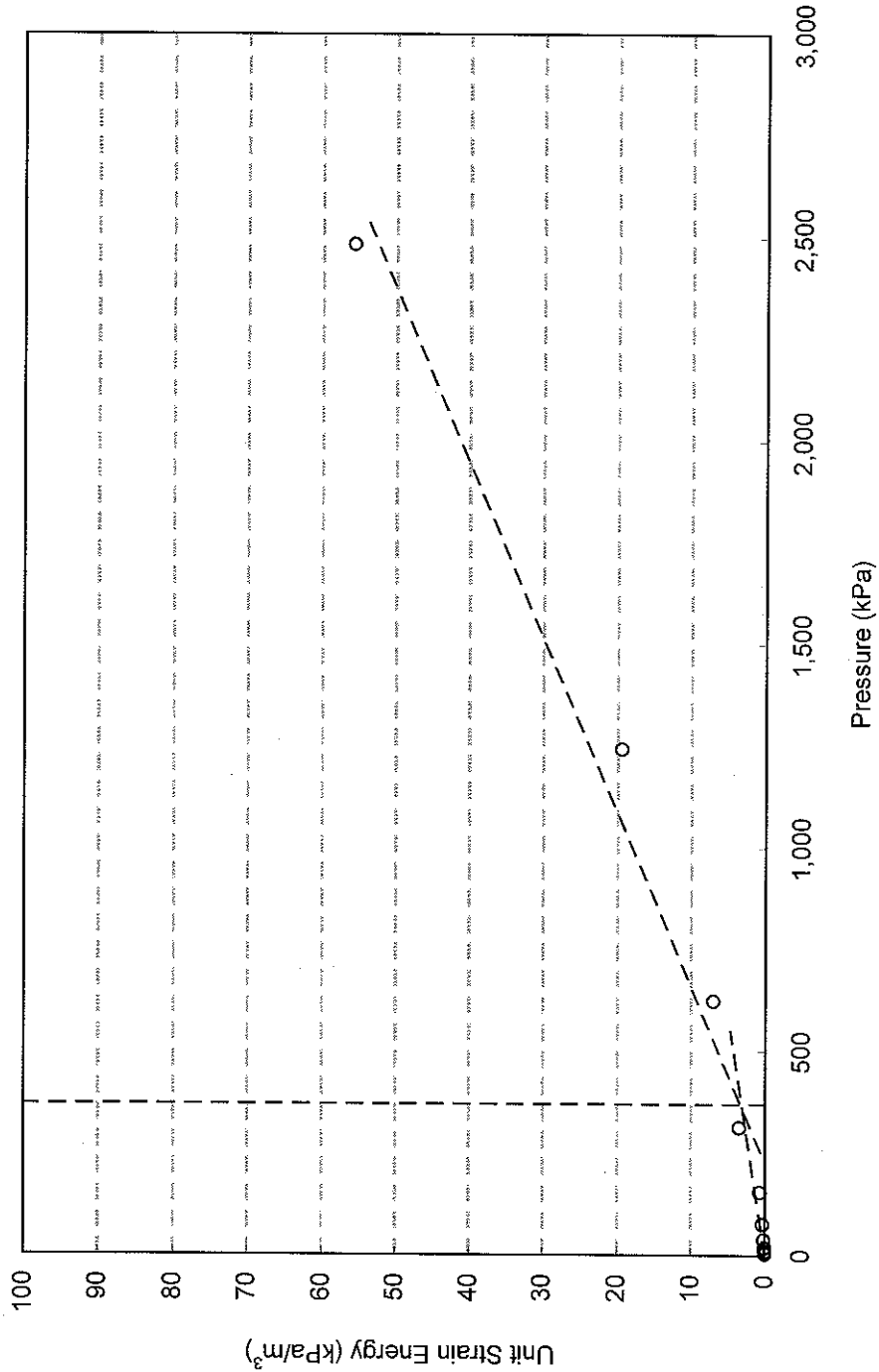
Terraprobe Inc.

Prepared By : HW
 Checked By : RA

HWY 406 TWINNING - RETAINING WALL SITE #2

FIGURE B2-61

CONSOLIDATION TEST
Unit Strain Energy vs Pressure
NBL 12+440 RT, TW10



Project No. : 1-09-4135

Date : November 2010



Terraprobe Inc.

Prepared By : HW

Checked By : RA

HWY 406 TWINNING - RETAINING WALL SITE #2

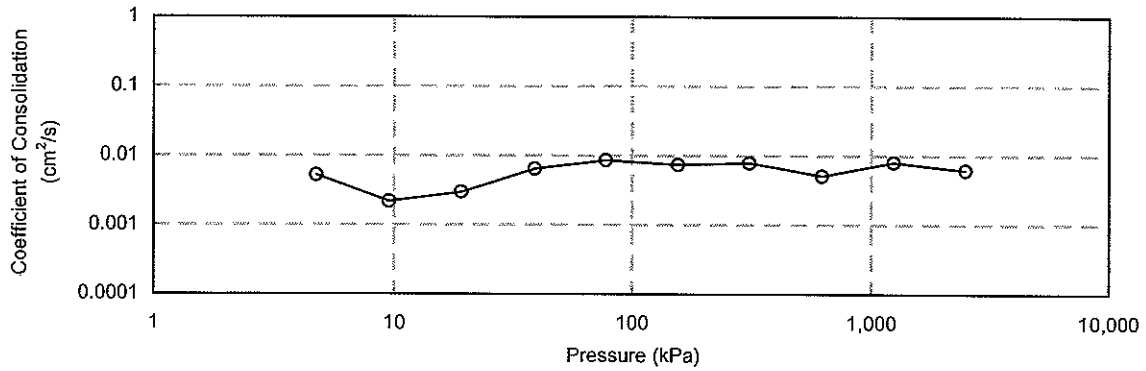
FIGURE B2-62

c:\Documents and Settings\Admin\My Documents\Marc P\Projects 2008\Hwy 406 Expansion\1-09-4135 (Hwy 406 Foundations)\Culverts and Retaining Walls\Retaining Walls\Lab Results\1-09-4135R3 Consolidation Results.xls

CONSOLIDATION TEST

Cv vs Pressure

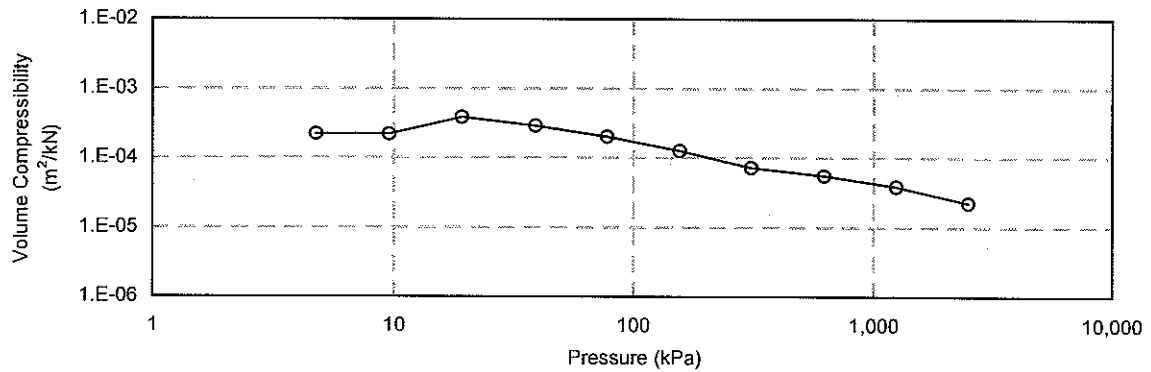
SBL 12+360 CL, TW10



CONSOLIDATION TEST

mv vs Pressure

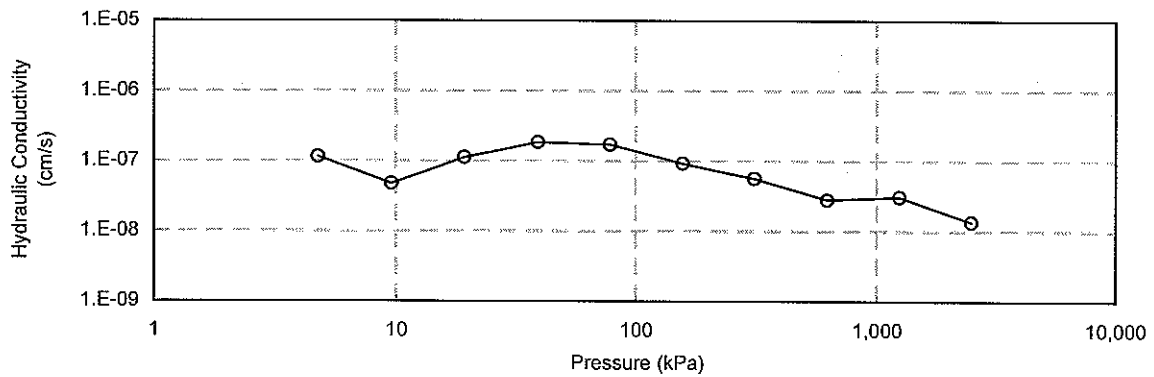
SBL 12+360 CL, TW10



CONSOLIDATION TEST

k vs Pressure

SBL 12+360 CL, TW10



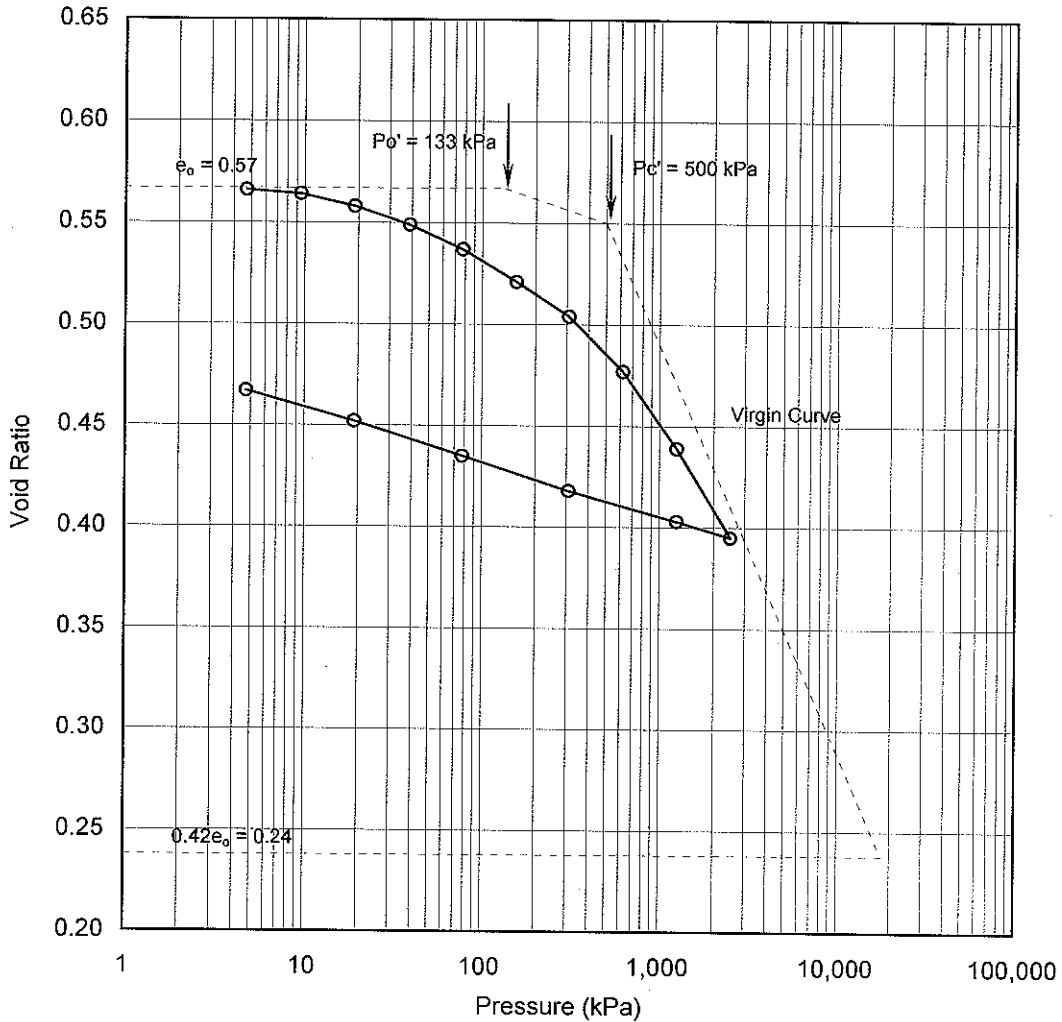
Project No. : 1-09-4135
Date : November 2010



Terraprobe Inc.

Prepared By : HW
Checked By : RA

CONSOLIDATION TEST
e vs Pressure
SBL 12+360 CL, TW10



Soil Type : Silty Clay

$e_0 =$	0.57	$\omega_L =$	25%	$P_{o'} =$	133 kPa
$\omega =$	21%	$\omega_p =$	17%	$P_{c'} =$	500 kPa
$\gamma =$	20.7 kN/m ³	PI =	8%	Cc =	0.201
Gs =	2.74			Cr =	0.030

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



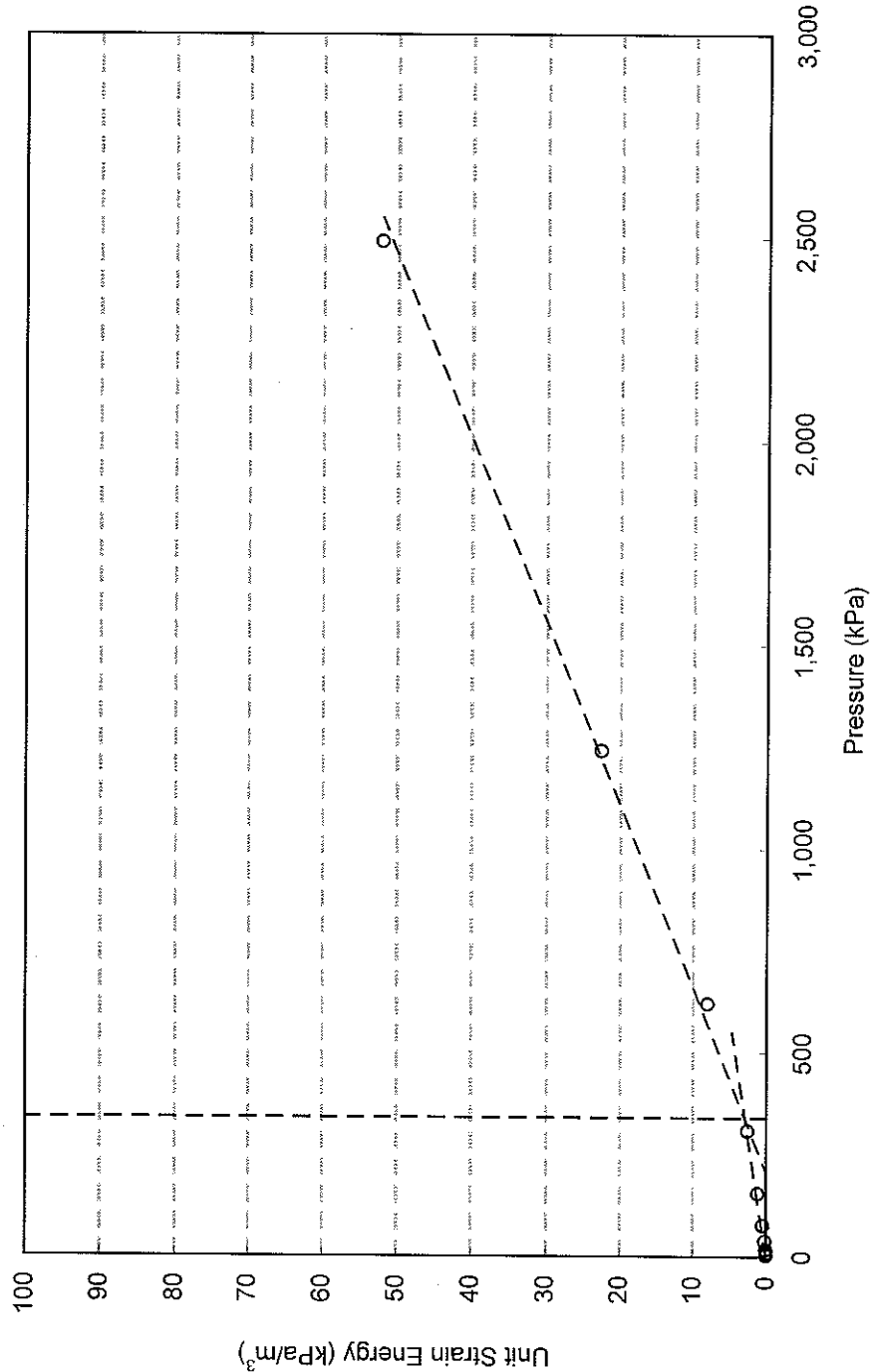
Terraprobe Inc.

Prepared By : HW
Checked By : RA

HWY 406 TWINNING - RETAINING WALL SITE #2

FIGURE B2-64

CONSOLIDATION TEST Unit Strain Energy vs Pressure SBL 12+360 CL, TW10



$P_c = 340 \text{ kPa}$

Project No. : 1-09-4135

Date : November 2010



Terraprobe Inc.

Prepared By : HW

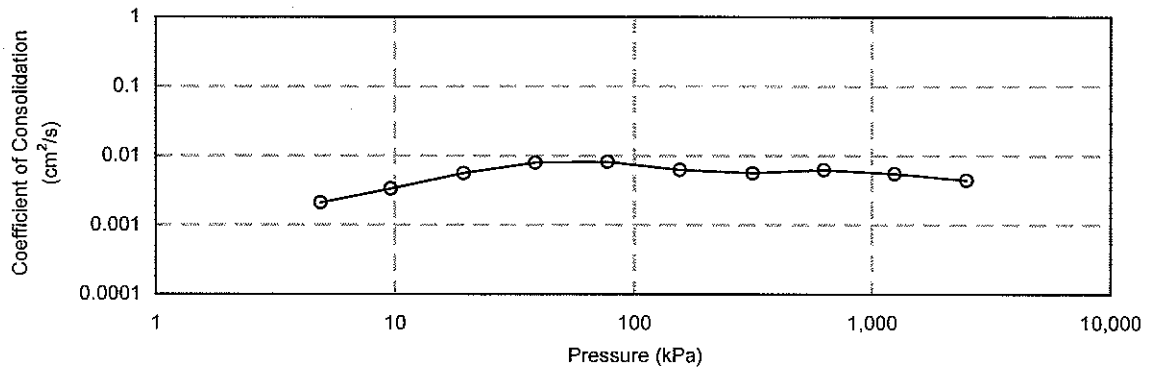
Checked By : RA

HWY 406 TWINNING - RETAINING WALL SITE #2

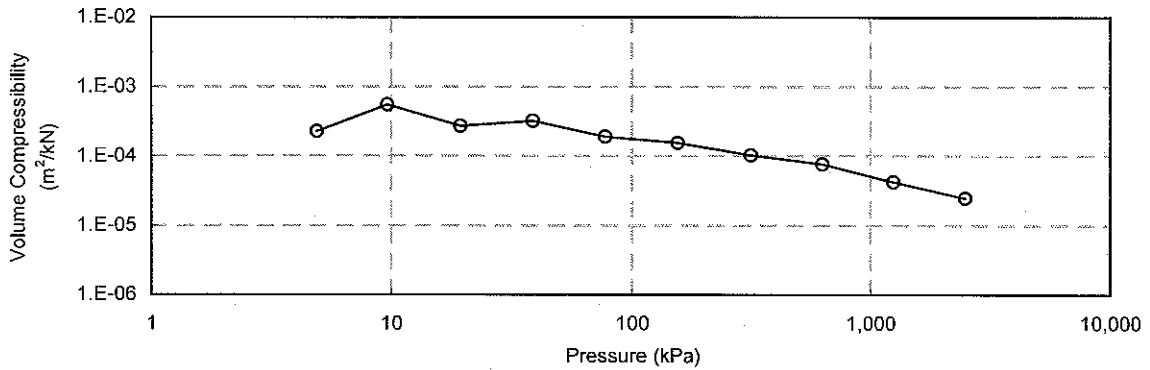
FIGURE B2-65

C:\Documents and Settings\Admin\My Documents\Marc P\Projects 2009\Hwy 406 Expansion\1-09-4135 (Hwy 406 Foundations)\Culverts and Retaining Walls\Retaining Walls\Lab Results\Results.xls

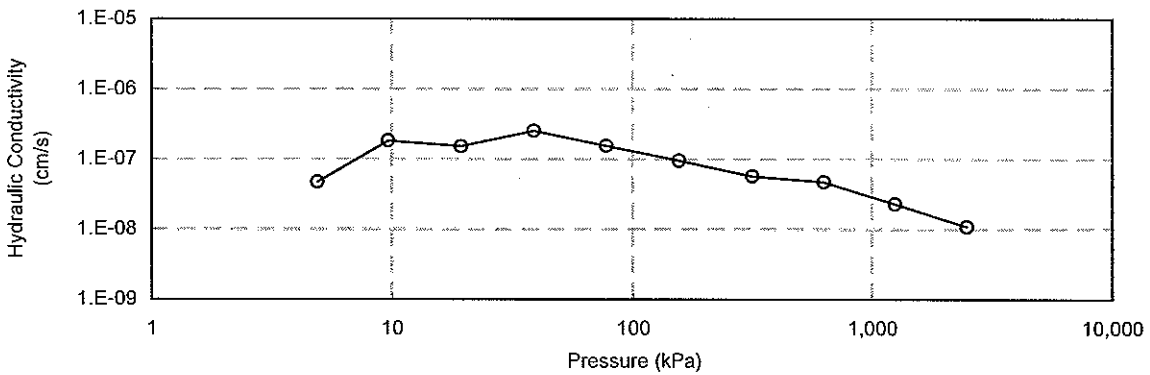
CONSOLIDATION TEST
Cv vs Pressure
SBL 12+410 CL, TW9



CONSOLIDATION TEST
mv vs Pressure
SBL 12+410 CL, TW9



CONSOLIDATION TEST
k vs Pressure
SBL 12+410 CL, TW9



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



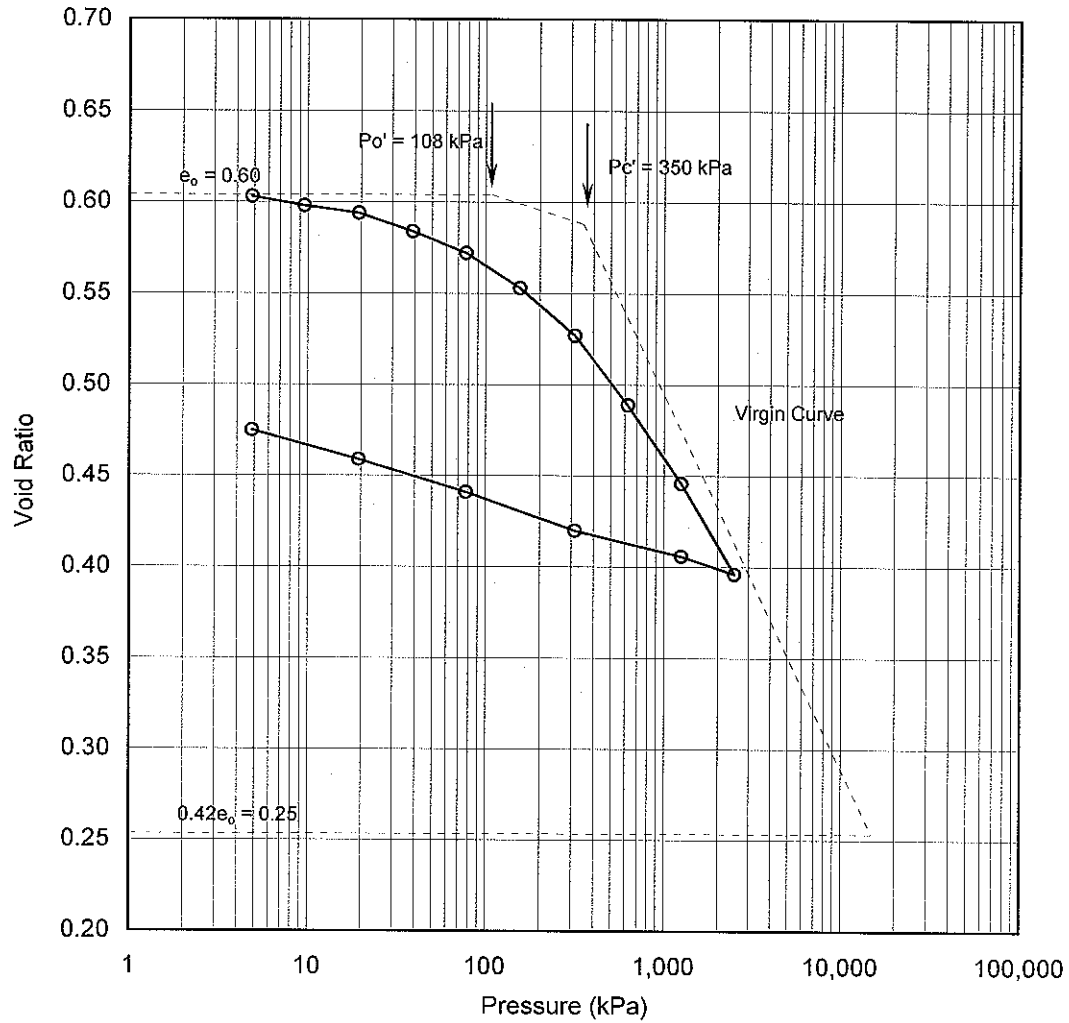
Terraprobe Inc.

Prepared By : HW
Checked By : RA

CONSOLIDATION TEST

e vs Pressure

SBL 12+410 CL, TW9



Soil Type : Silty Clay

$e_o =$	0.60	$\omega_L =$	26%	$P_o' =$	108 kPa
$\omega =$	21%	$\omega_p =$	17%	$P_c' =$	350 kPa
$\gamma =$	20.4 kN/m ³	$PI =$	9%	$C_c =$	0.205
$G_s =$	2.76			$Cr =$	0.031

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



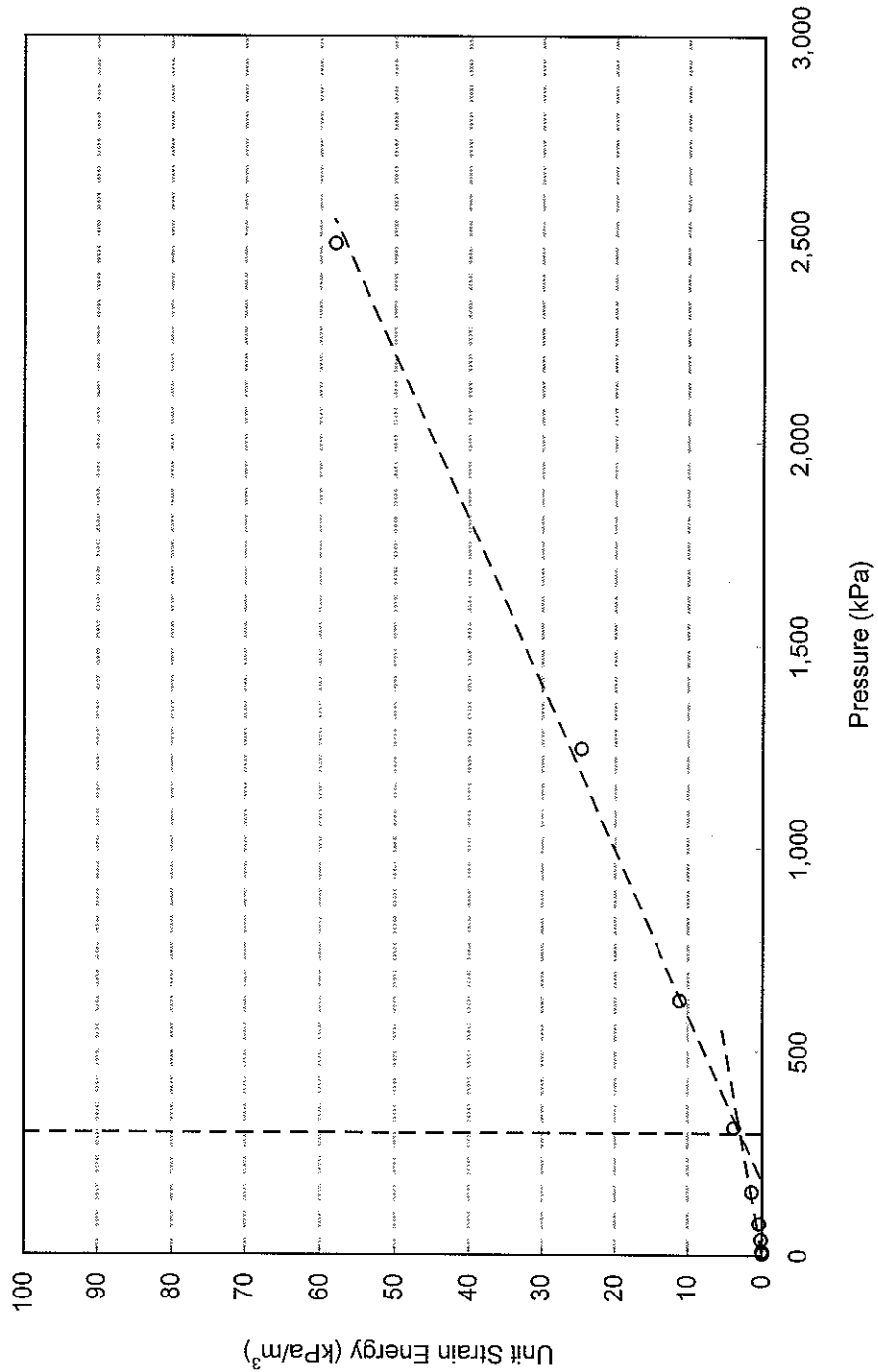
Terraprobe Inc.

Prepared By : HW
Checked By : RA

HWY 406 TWINNING - RETAINING WALL SITE #2

FIGURE B2-67

CONSOLIDATION TEST Unit Strain Energy vs Pressure SBL 12+410 CL, TW9



Project No. : 1-09-4135

Date : November 2010



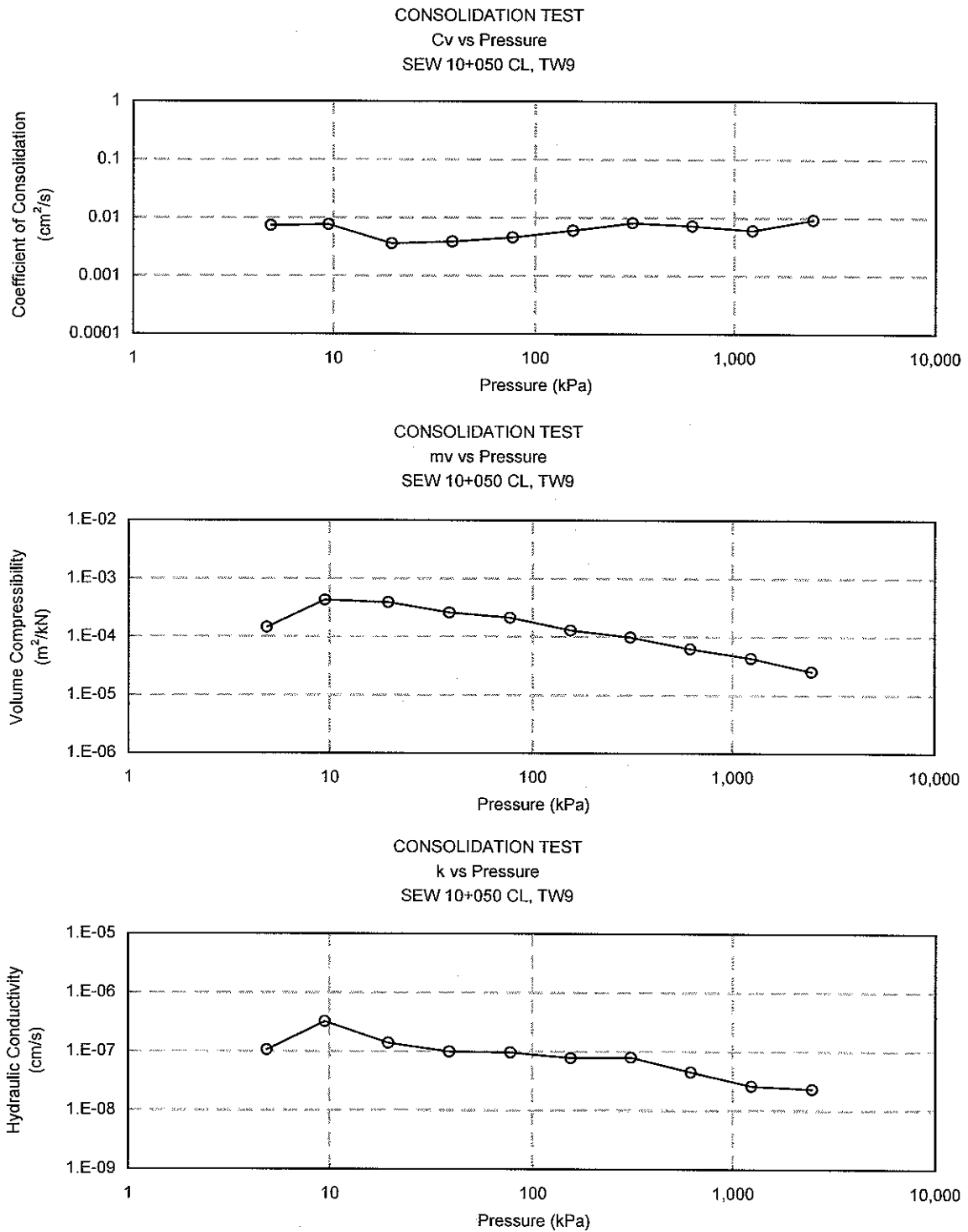
Terraprobe Inc.

Prepared By : HW

Checked By : RA

HWY 406 TWINNING - RETAINING WALL SITE #2

FIGURE B2-68



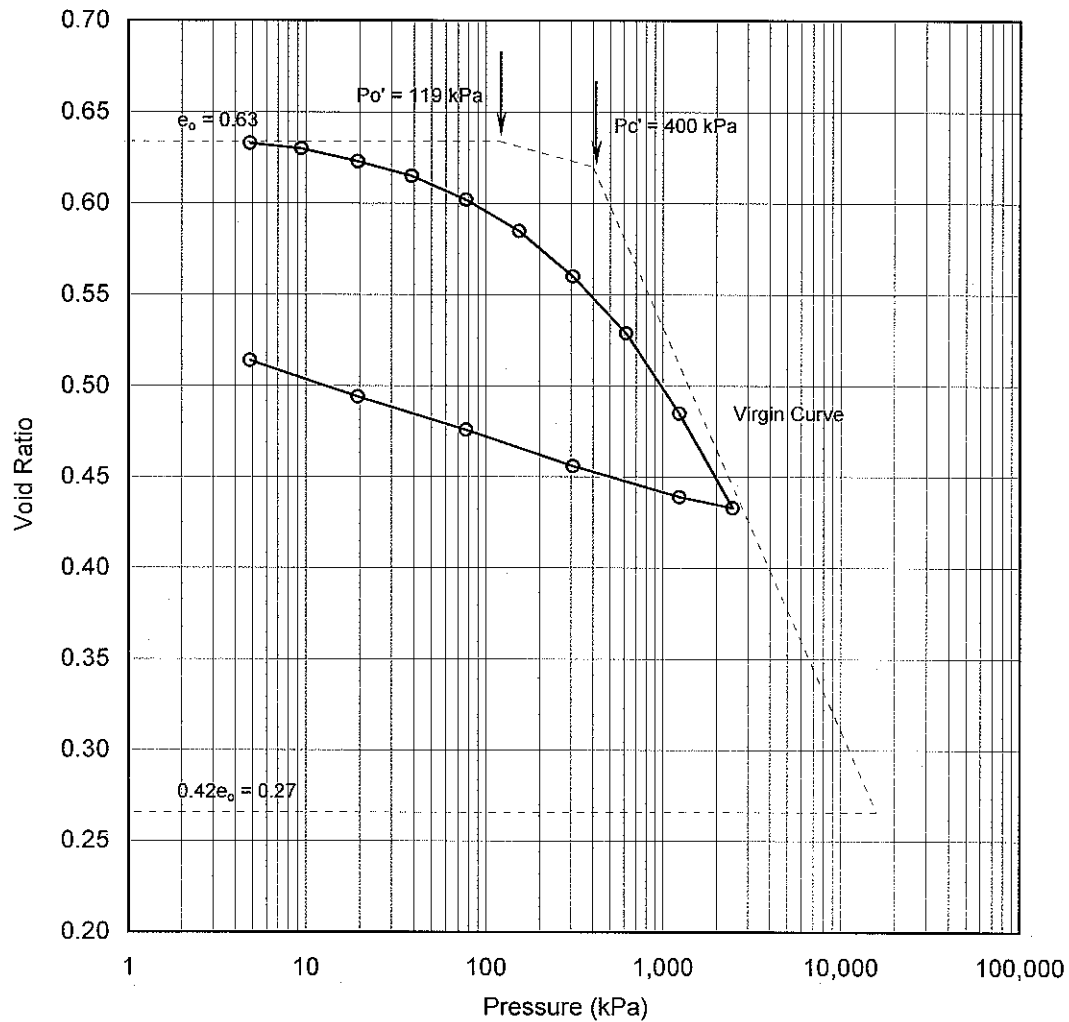
Project No. : 1-09-4135
Date : November 2010



Terraprobe Inc.

Prepared By : HW
Checked By : RA

CONSOLIDATION TEST
e vs Pressure
SEW 10+050 CL, TW9



Soil Type : Silty Clay

$e_o =$	0.63	$\omega_L =$	27%	$P_o' =$	119 kPa
$\omega =$	22%	$\omega_p =$	16%	$P_c' =$	400 kPa
$\gamma =$	20.4 kN/m ³	PI =	11%	Cc =	0.221
Gs =	2.78			Cr =	0.027

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



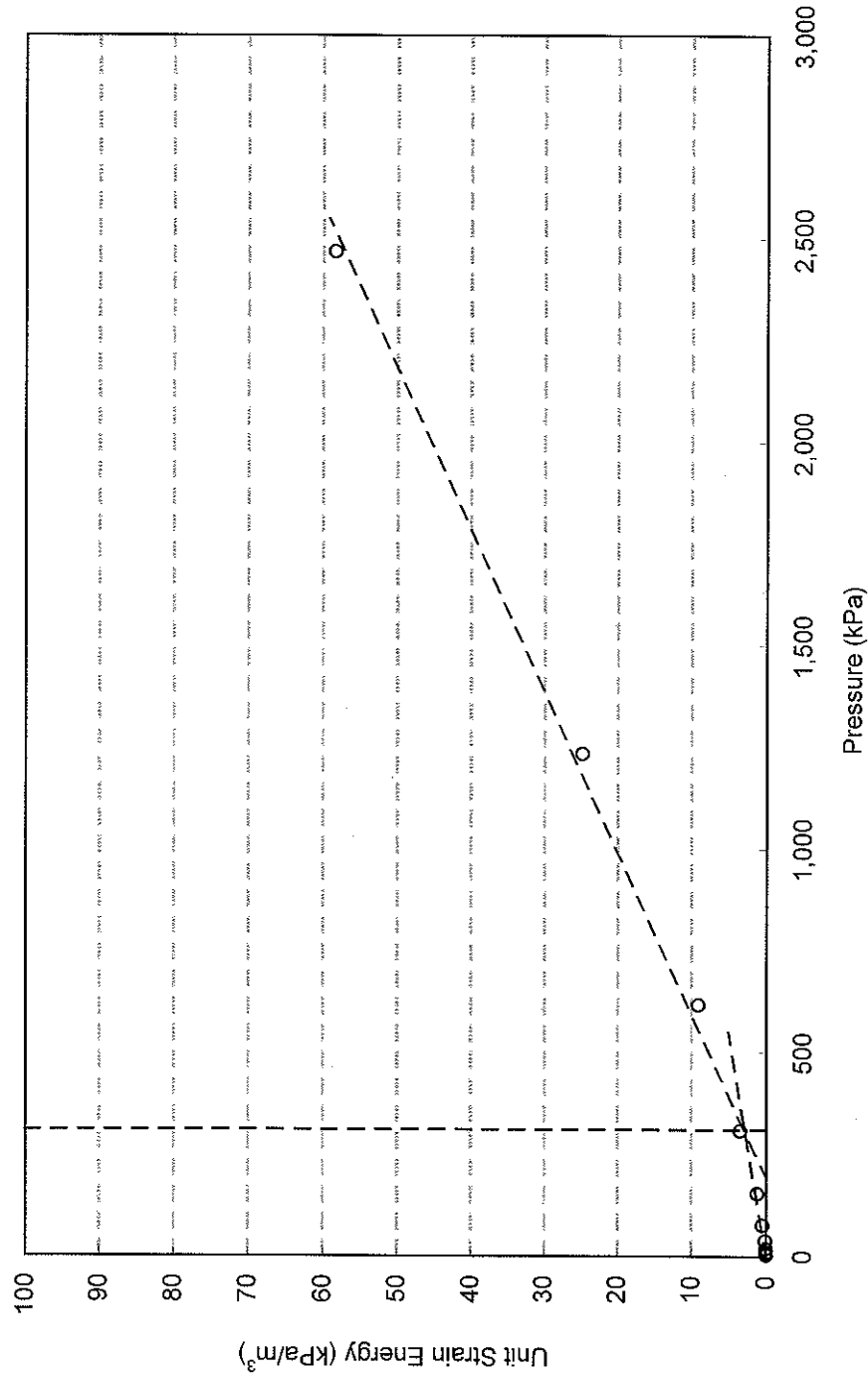
Terraprobe Inc.

Prepared By : HW
Checked By : RA

HWY 406 TWINNING - RETAINING WALL SITE #2

FIGURE B2-70

CONSOLIDATION TEST Unit Strain Energy vs Pressure SEW 10+050 CL, TW9



Project No. : 1-09-4135

Date : November 2010



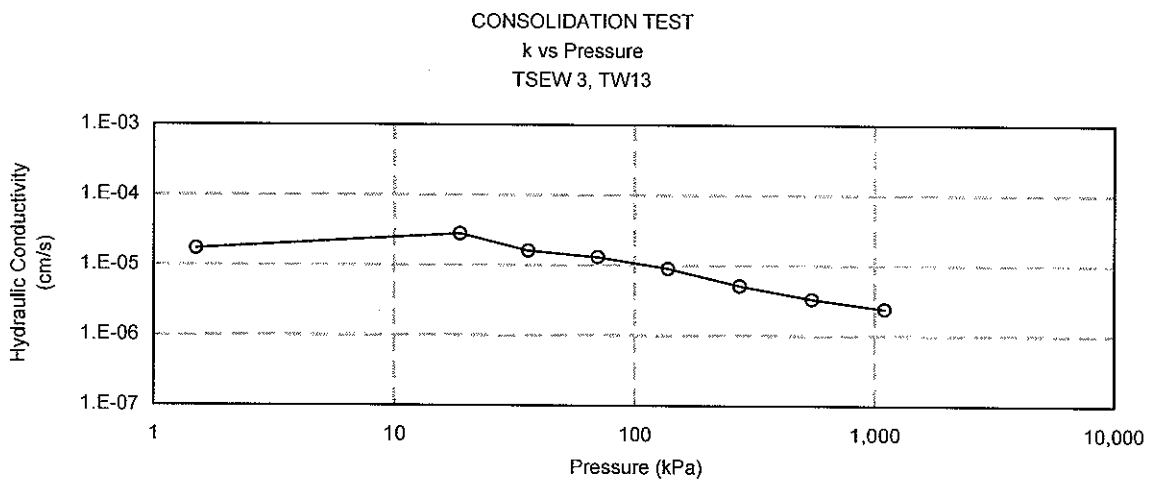
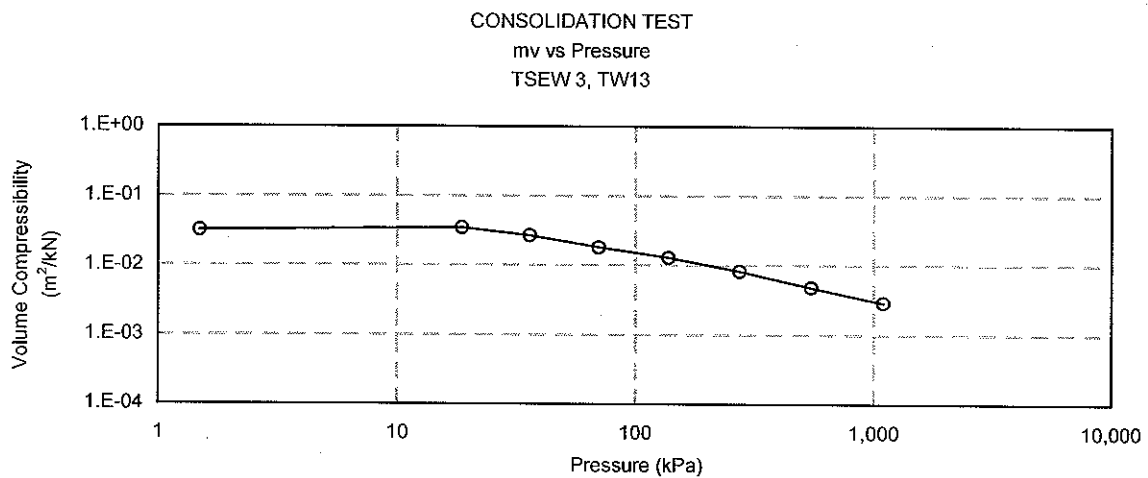
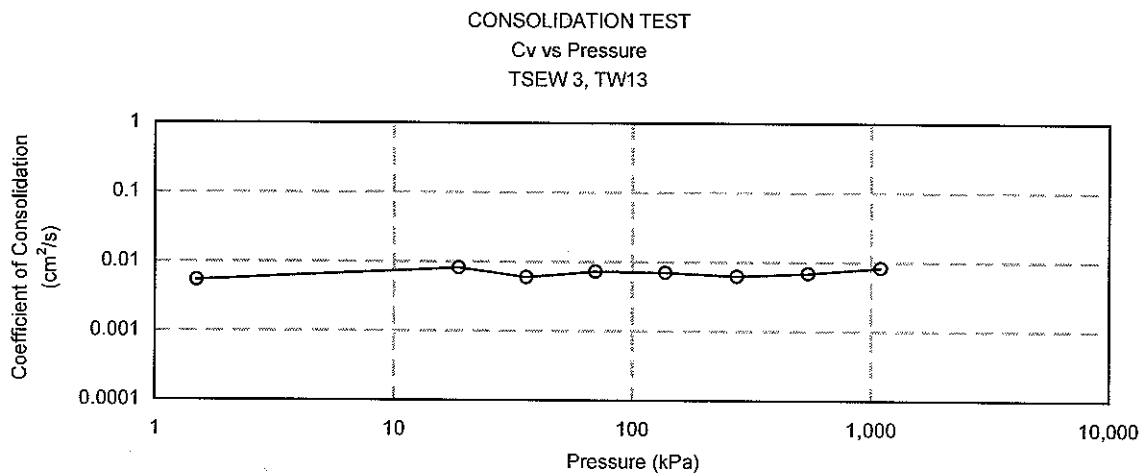
Terraprobe Inc.

Prepared By : HW

Checked By : RA

HWY 406 TWINNING - RETAINING WALL SITE #2

FIGURE B2-71



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



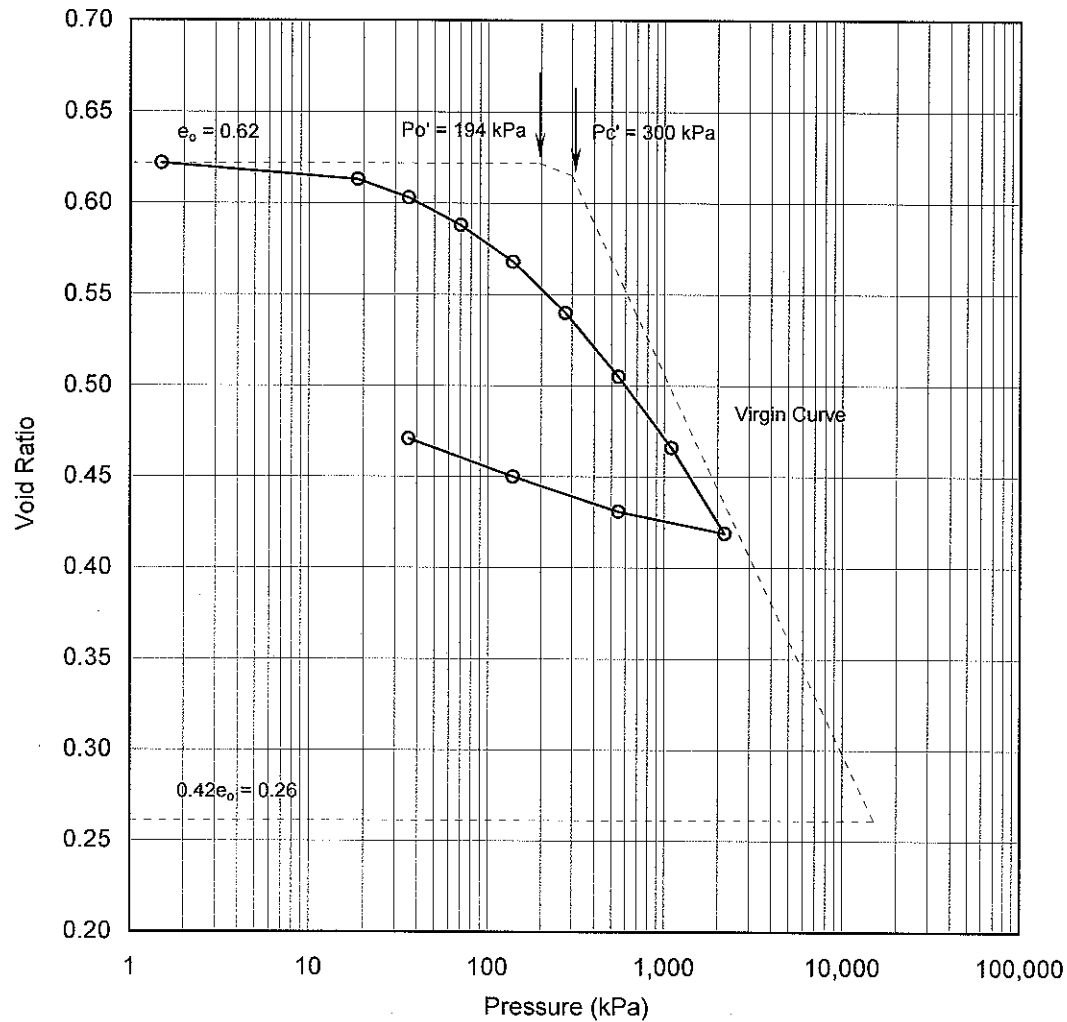
Terraprobe Inc.

Prepared By : HW
Checked By : RA

CONSOLIDATION TEST

e vs Pressure

TSEW 3, TW13



Soil Type : Silty Clay

$e_o =$	0.62	$\omega_L =$	27%	$Po' =$	194 kPa
$\omega =$	20%	$\omega_p =$	16%	$Pc' =$	300 kPa
$\gamma =$	20.8 kN/m ³	PI =	10%	Cc =	0.208
Gs =	2.75			Cr =	0.037

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



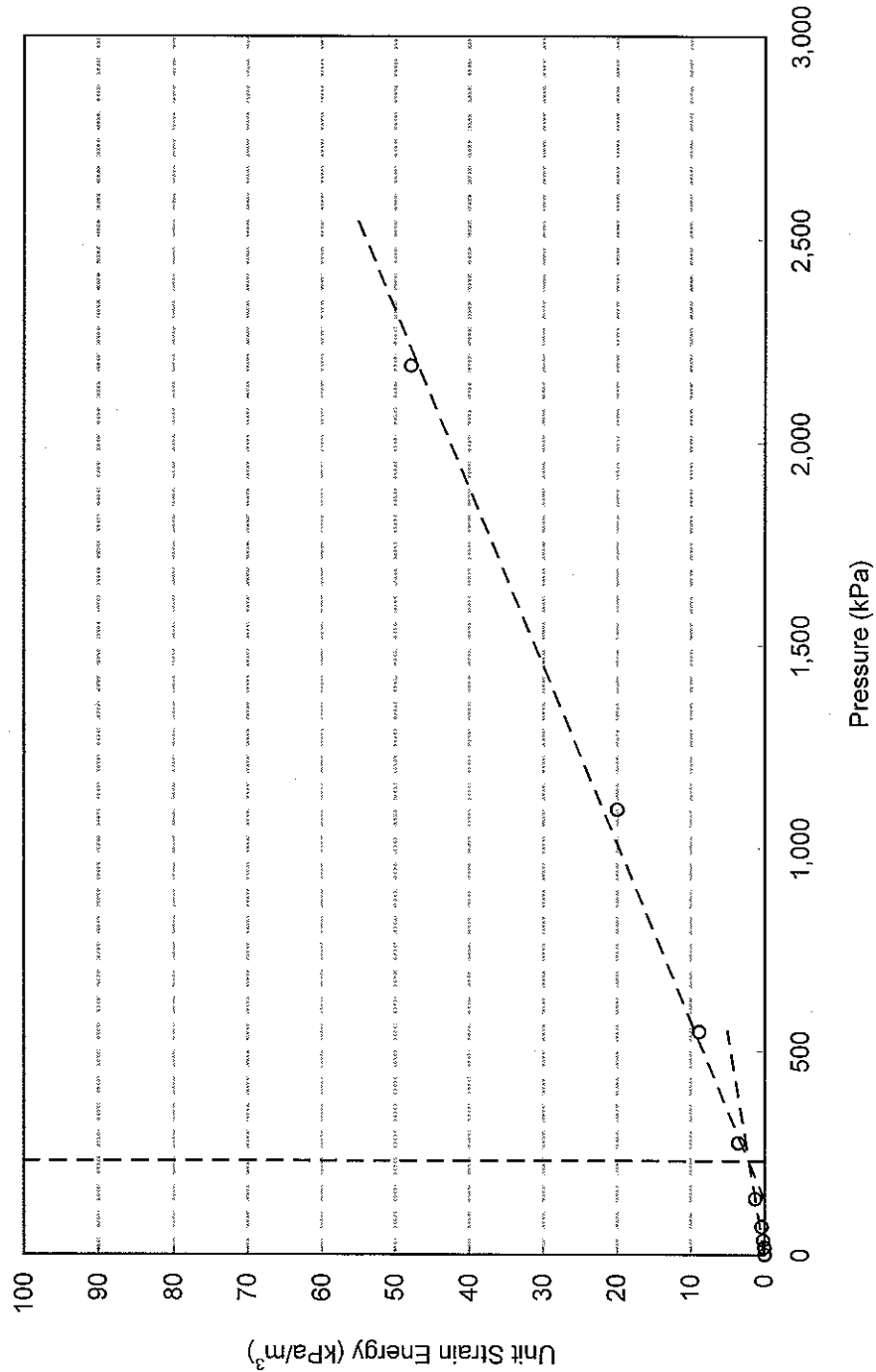
Terraprobe Inc.

Prepared By : HW
 Checked By : RA

HWY 406 TWINNING - RETAINING WALL SITE #2

FIGURE B2-73

CONSOLIDATION TEST Unit Strain Energy vs Pressure TSEW 3, TW13



Pc = 230 kPa

Project No. : 1-09-4135

Date : November 2010



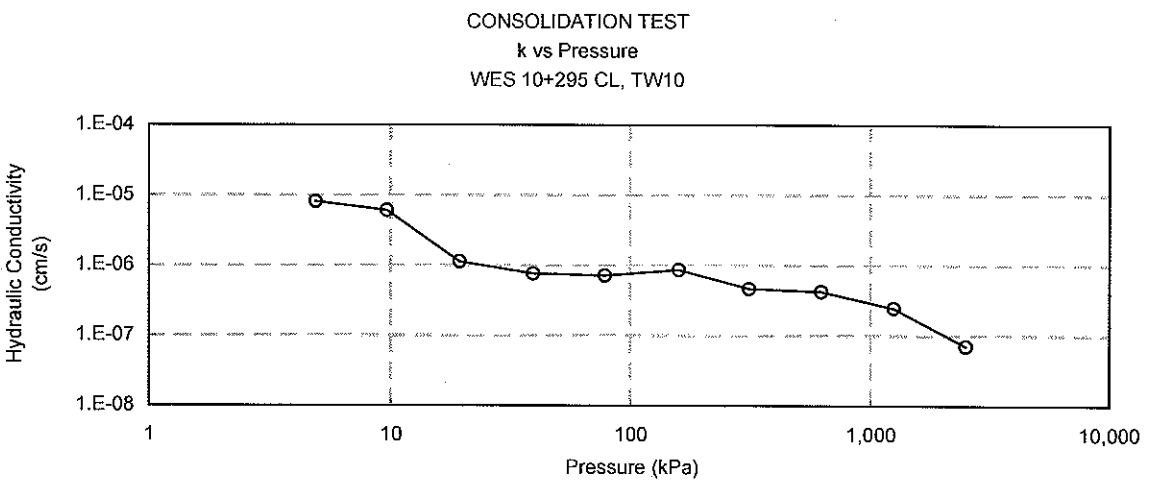
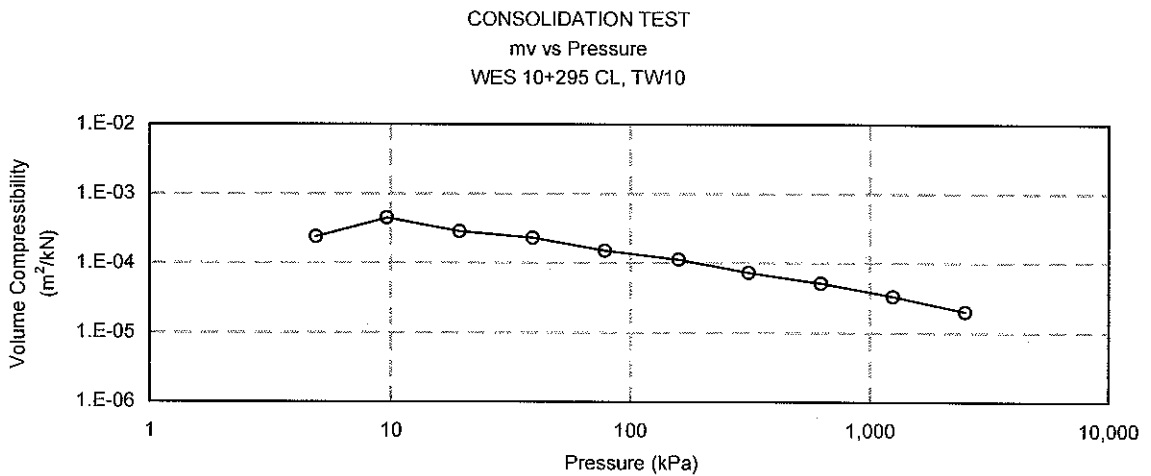
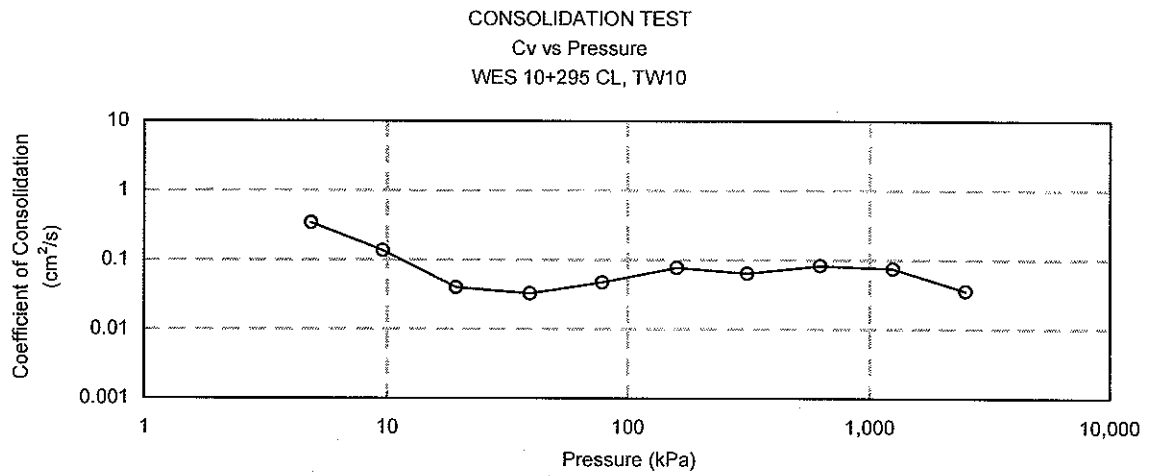
Terraprobe Inc.

Prepared By : HW

Checked By : RA

HWY 406 TWINNING - RETAINING WALL SITE #2

FIGURE B2-74



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



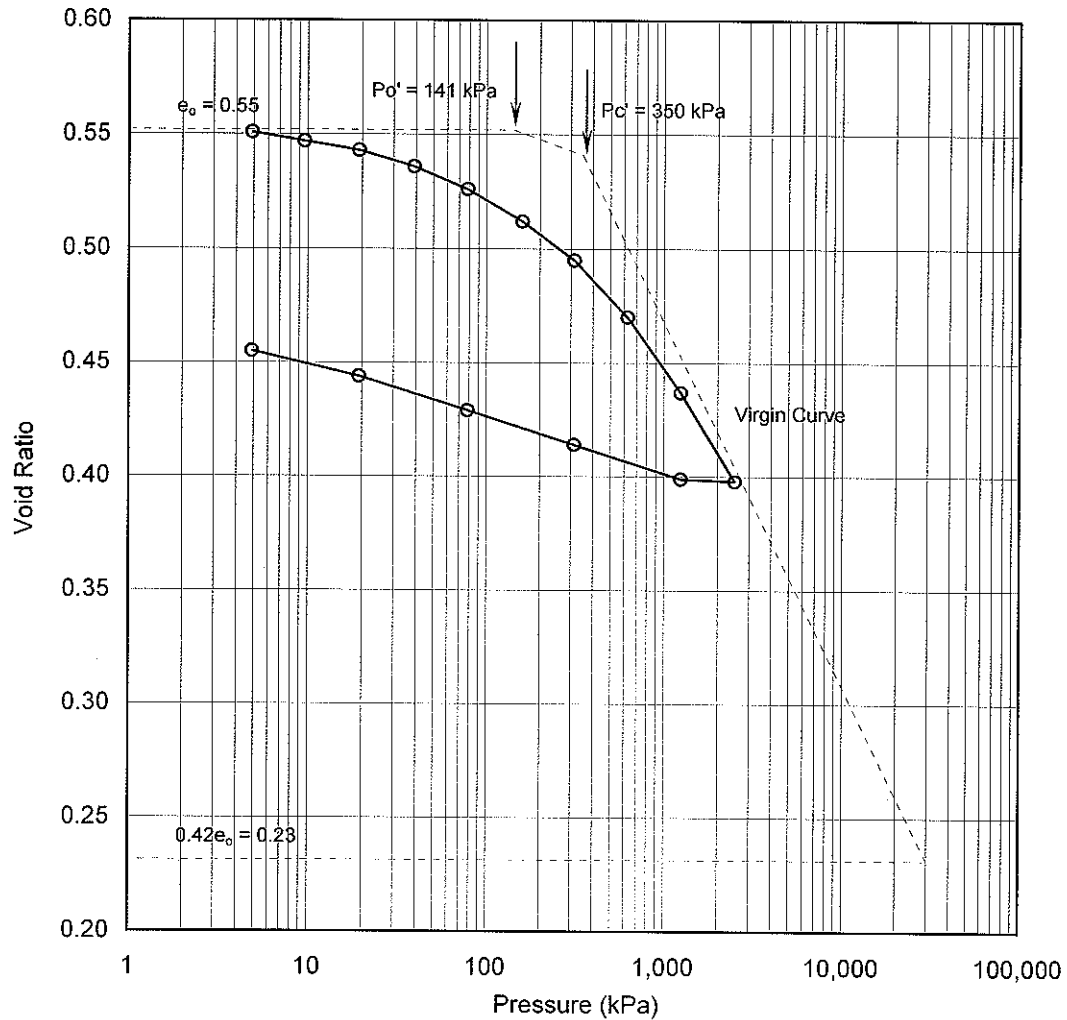
Terraprobe Inc.

Prepared By : HW
Checked By : RA

CONSOLIDATION TEST

e vs Pressure

WES 10+295 CL, TW10



Soil Type : Silty Clay

$e_o =$	0.55	$\omega_L =$	26%	$P_{o'} =$	141 kPa
$\omega =$	19%	$\omega_p =$	17%	$P_{c'} =$	350 kPa
$\gamma =$	20.8 kN/m ³	PI =	9%	Cc =	0.160
Gs =	2.77			Cr =	0.028

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



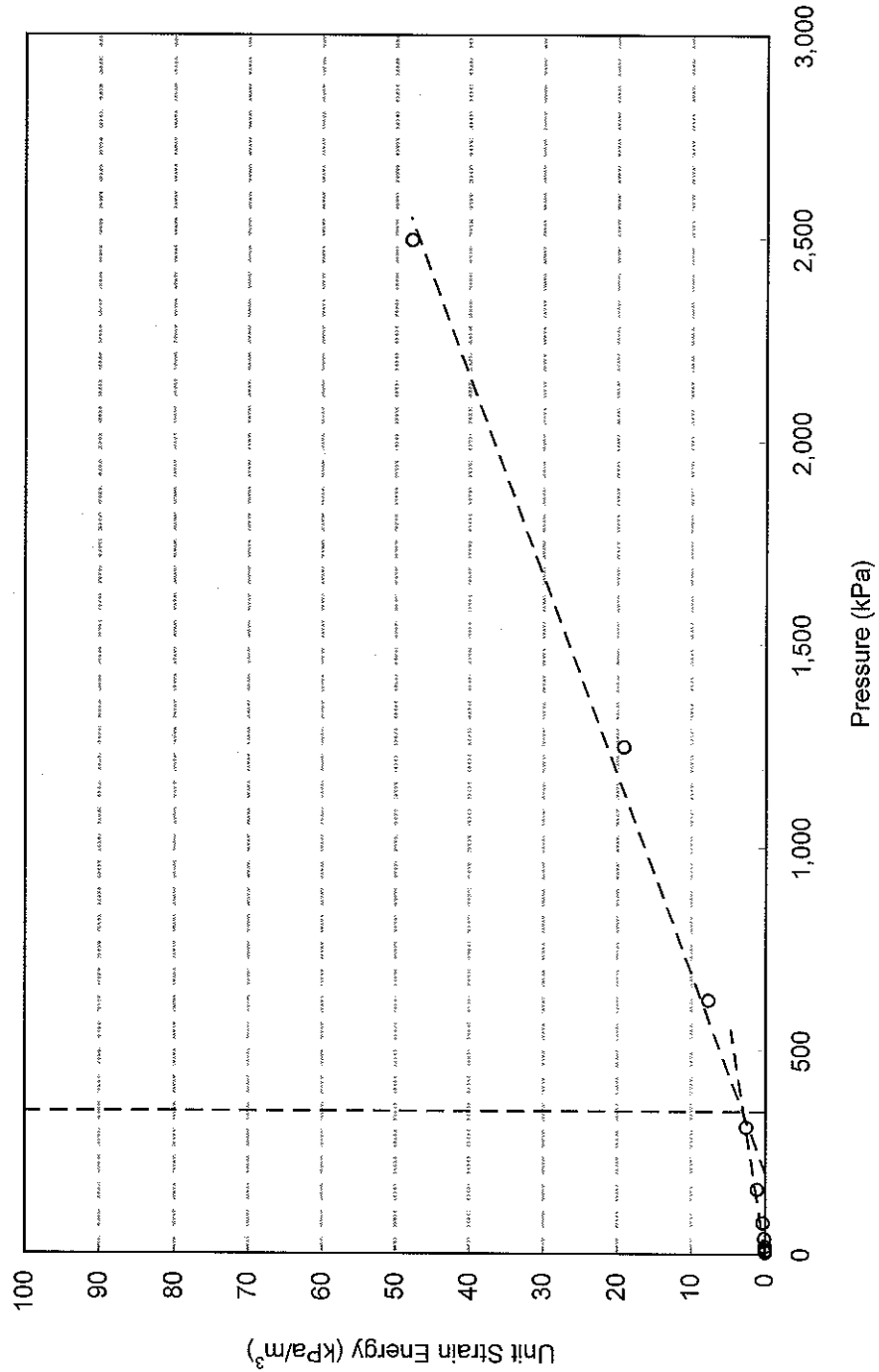
Terraprobe Inc.

Prepared By : HW
 Checked By : RA

HWY 406 TWINNING - RETAINING WALL SITE #2

FIGURE B2-76

CONSOLIDATION TEST Unit Strain Energy vs Pressure WES 10+295 CL, TW10



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

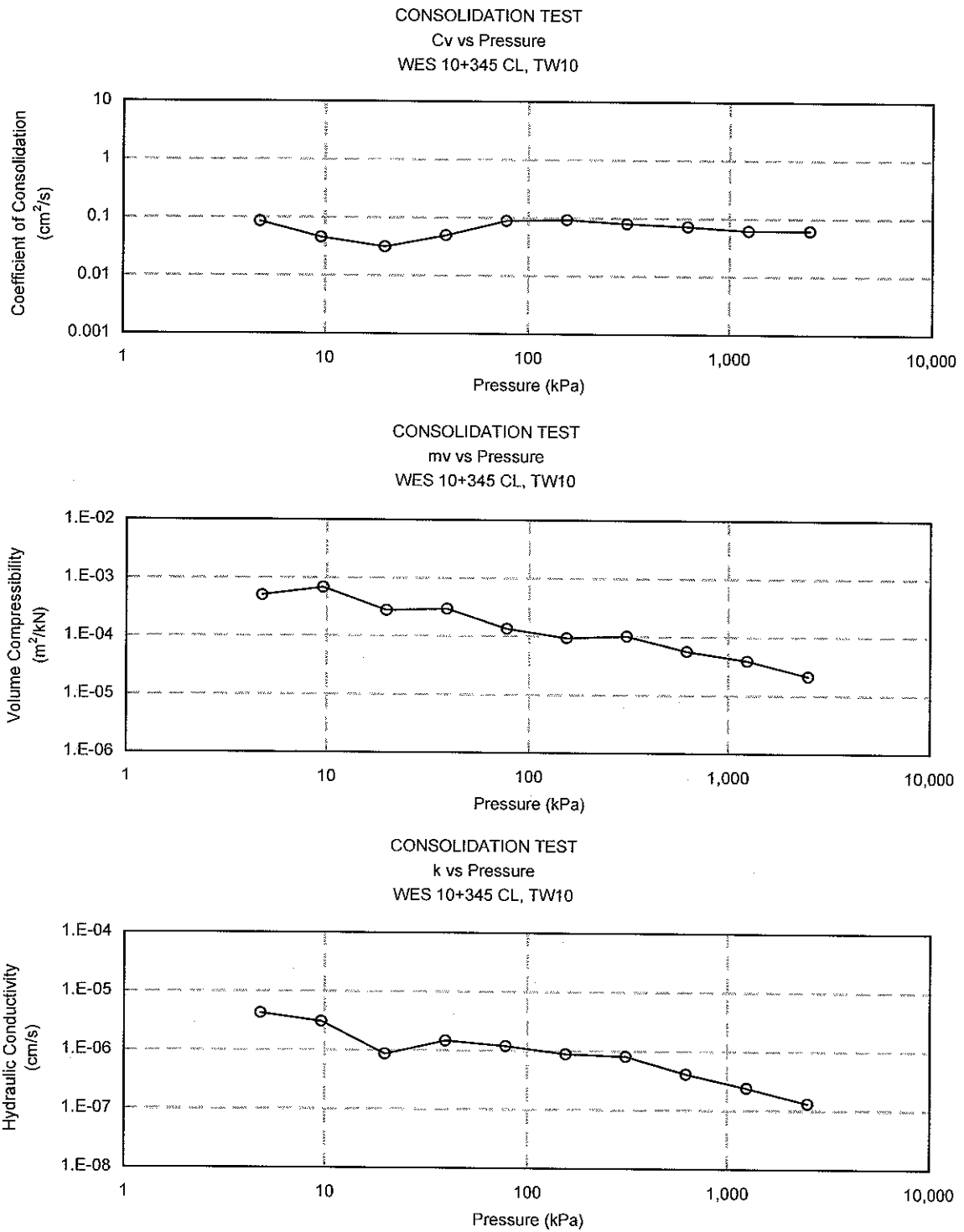


Terraprobe Inc.

Prepared By : HW
Checked By : RA

HWY 406 TWINNING - RETAINING WALL SITE #2

FIGURE B2-77



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



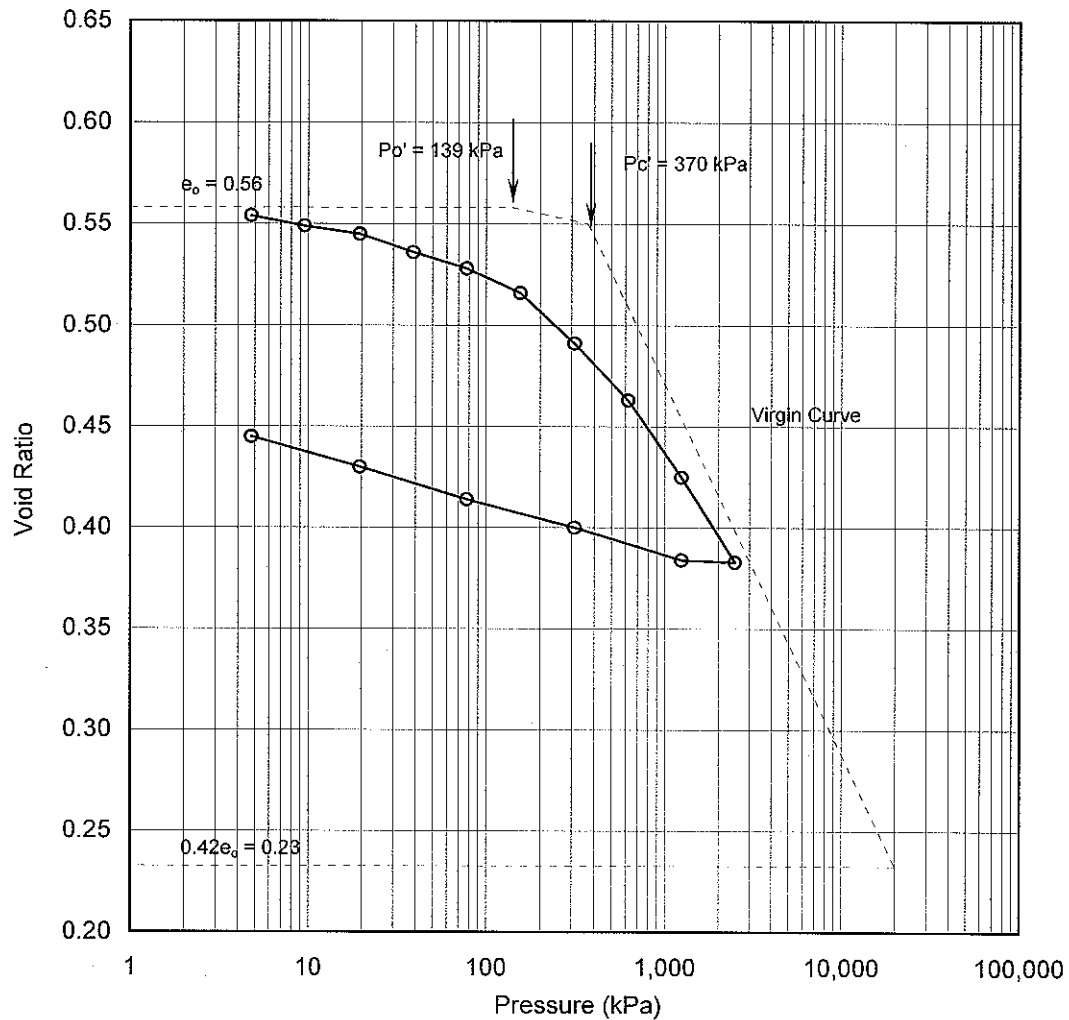
Terraprobe Inc.

Prepared By : HW
Checked By : RA

CONSOLIDATION TEST

e vs Pressure

WES 10+345 CL, TW10



Soil Type : Silty Clay

$e_0 =$	0.56	$\omega_L =$	27%	$P_{o'} =$	139 kPa
$\omega =$	21%	$\omega_P =$	16%	$P_{c'} =$	370 kPa
$\gamma =$	20.7 kN/m ³	PI =	11%	Cc =	0.183
Gs =	2.70			Cr =	0.019

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



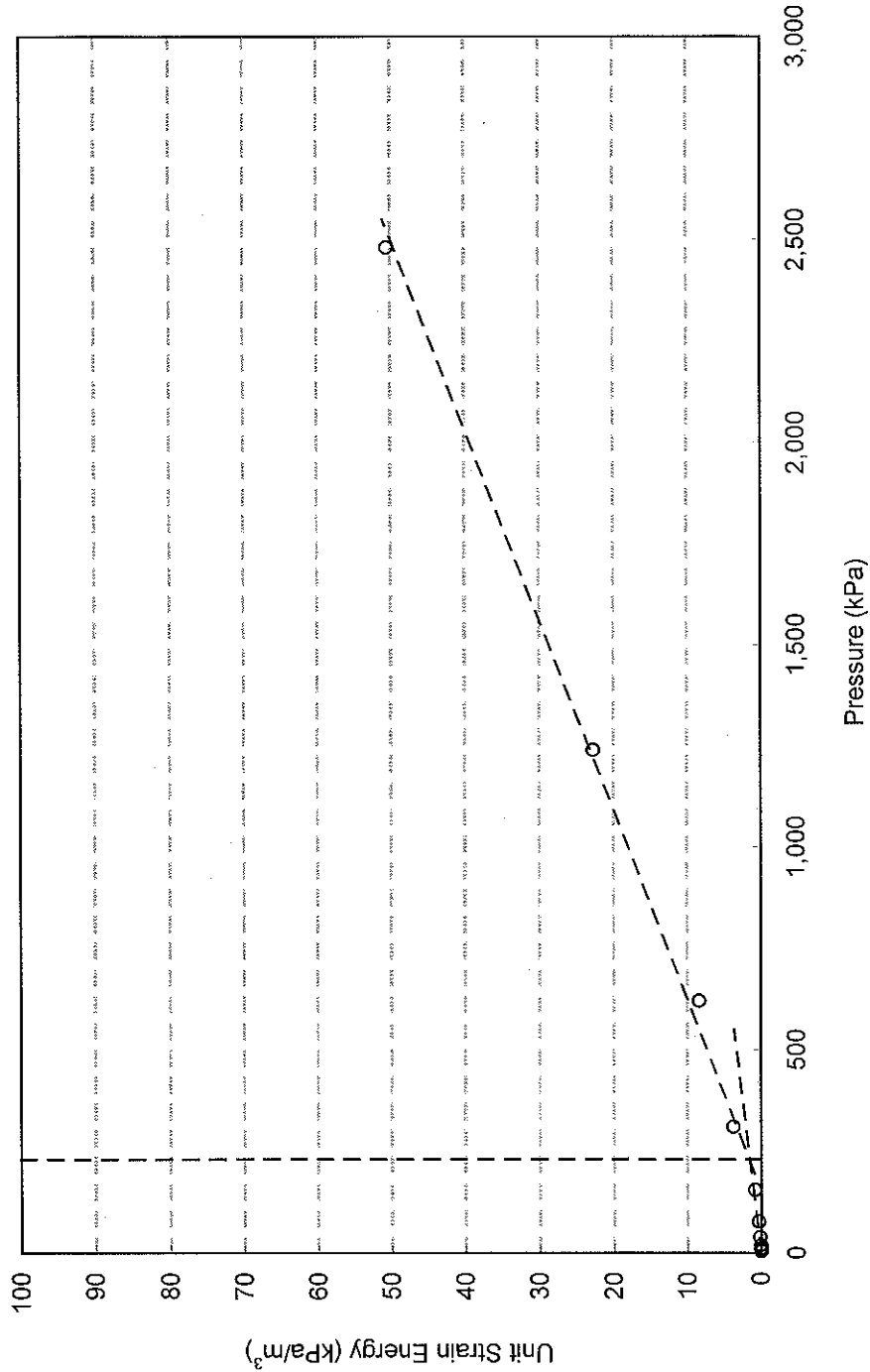
Terraprobe Inc.

Prepared By : HW
 Checked By : RA

HWY 406 TWINNING - RETAINING WALL SITE #2

FIGURE B2-79

CONSOLIDATION TEST
Unit Strain Energy vs Pressure
WES 10+345 CL, TW10



Project No. : 1-09-4135

Date : November 2010



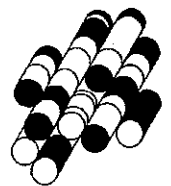
Terraprobe Inc.

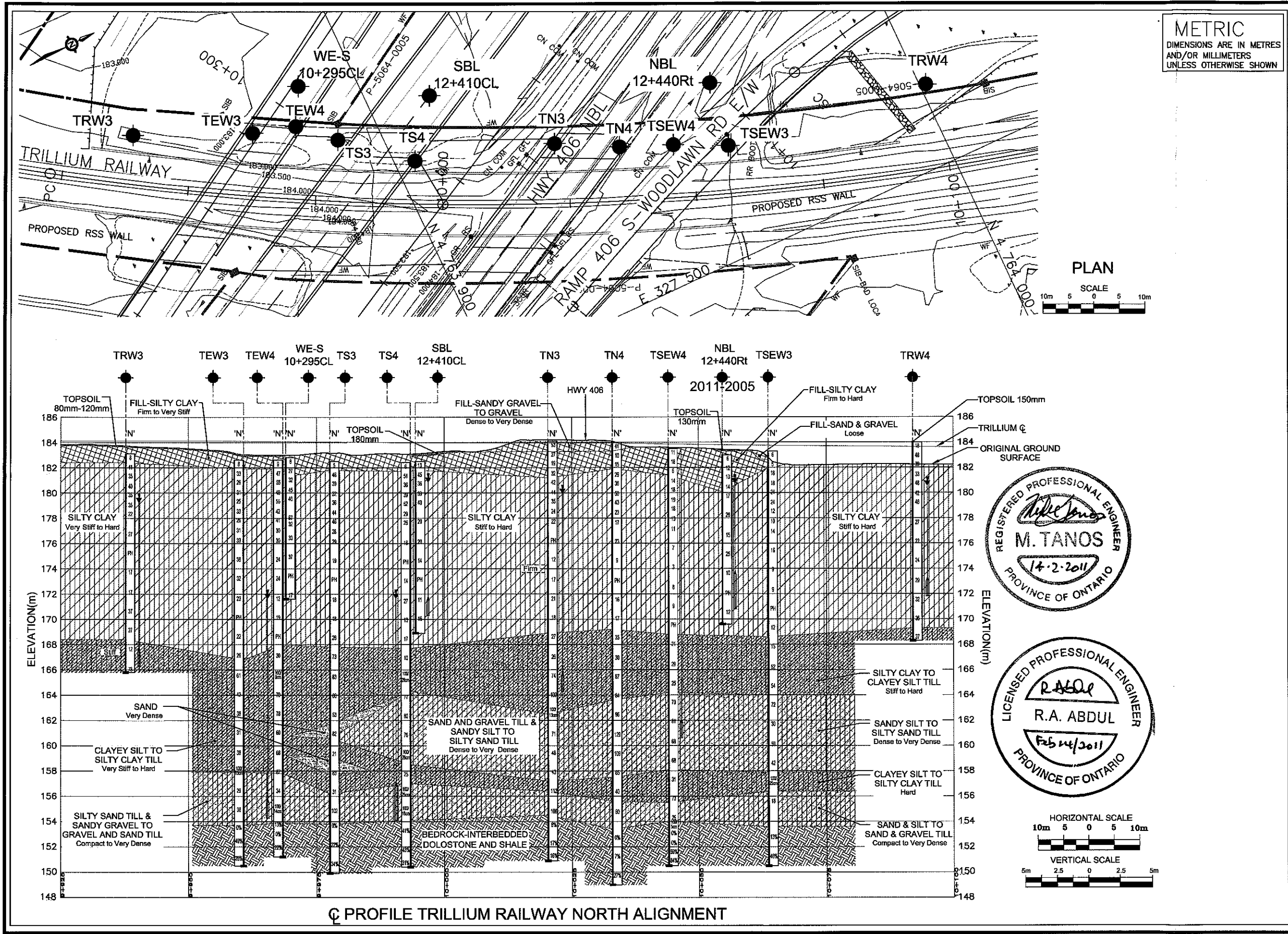
Prepared By : HW

Checked By : RA

C2

TERRAPROBE INC.





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

CONT No 2011-2005
WP No 280-99-00

HIGHWAY 406
TRILLIUM RAILWAY NORTH RETAINING WALL
BOREHOLE LOCATIONS AND SOIL STRATA

IBI GROUP

Terraprobe Inc.
Consulting Geotechnical & Environmental Engineering
Construction Materials Engineering, Inspection & Testing
10 Bram Court - Brampton Ontario L6W 3R6 (905) 796-2650

KEY PLAN

LEGEND

- Bore Hole
- Dynamic Cone Penetration Test
- Bore Hole And Cone
- Blows/0.3m (Std Pen Test, 475 J/blow)
- Blows/0.3m (60' Cone, 475 J/blow)
- WL at Time of Investigation
- WL in Piezometer (AUG. 2010)
- Piezometer
- 90% Rock Quality Designation
- Auger Refusal

No	ELEV.	COORDINATES	
		NORTHING	EASTING
NBL12+440Rt	183.0	4 763 962.9	327 465.8
SBL 12+410CL	182.5	4 763 911.8	327 444.8
TEW3	182.6	4 763 877.2	327 436.9
TEW4	182.6	4 763 885.4	327 439.2
TN3	184.1	4 763 930.0	327 463.7
TN4	184.0	4 763 941.4	327 469.8
TRW3	183.1	4 763 855.8	327 427.4
TRW4	184.0	4 764 001.2	327 484.0
TS3	182.5	4 763 891.8	327 445.1
TS4	182.4	4 763 903.8	327 455.3
TSEW3	183.3	4 763 960.8	327 478.6
TSEW4	183.5	4 763 951.2	327 473.9
WE-S 10+295CL	182.8	4 763 889.2	327 432.2

NOTE

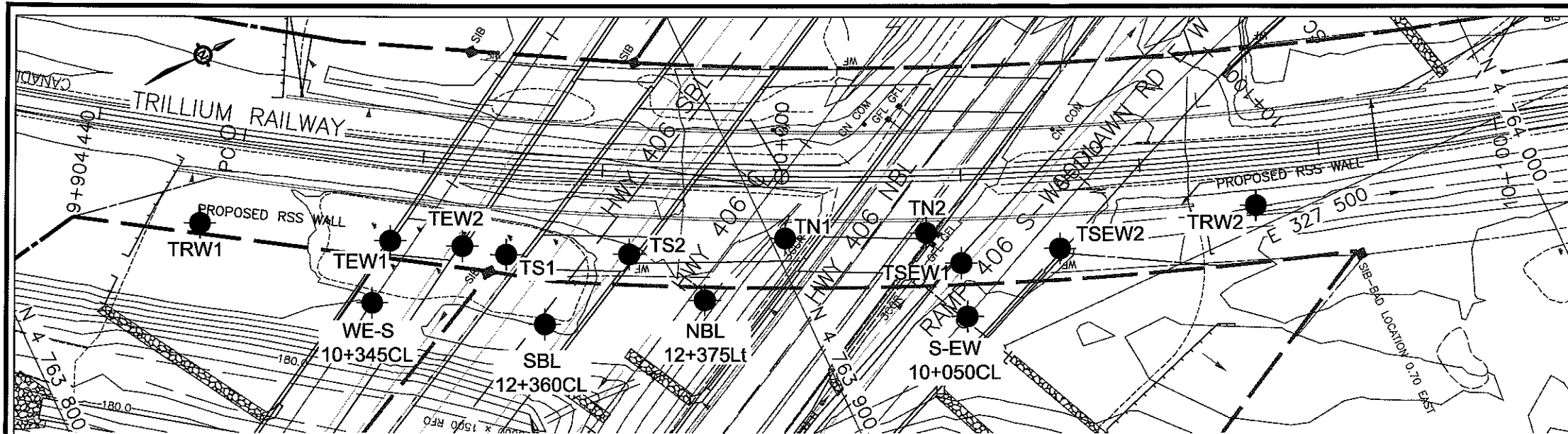
The boundaries between soil strata have been established only at Bore Hole locations. Between Bore Holes the boundaries are assumed from geological evidence.

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

REVISIONS	DATE	BY	DESCRIPTION

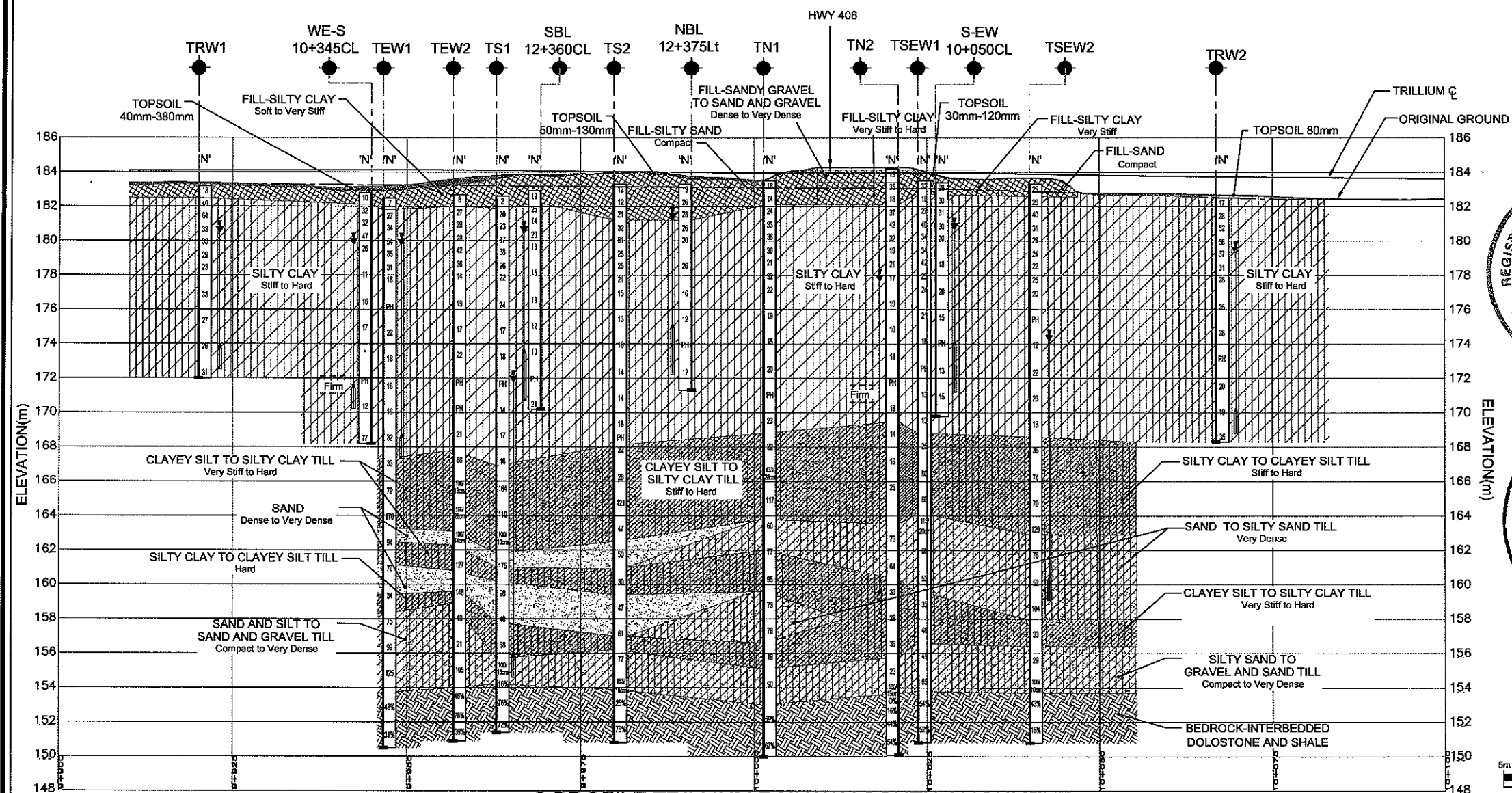
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DRAWN	K.C.	CHK	R.A.	STRUCT	GEORES 30M3-268	

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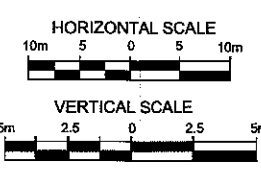
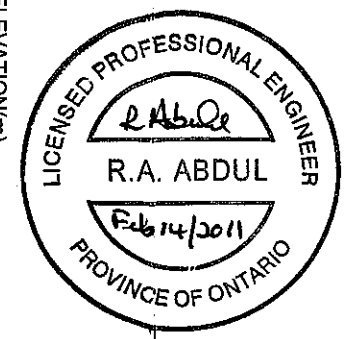


METRIC
DIMENSIONS ARE IN METRES
AND/OR MILLIMETERS
UNLESS OTHERWISE SHOWN

PLAN



CH PROFILE TRILLIUM RAILWAY SOUTH ALIGNMENT

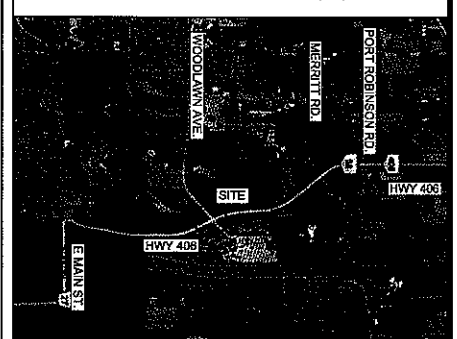


CONT No 2011-2005
WP No 280-99-00

HIGHWAY 406
TRILLIUM RAILWAY SOUTH RETAINING WALL
BOREHOLE LOCATIONS AND SOIL STRATA



Terraprobe Inc.
Consulting Geotechnical & Environmental Engineering
Construction Materials Engineering, Inspection & Testing
10 Bram Court - Brampton Ontario L6W 3R6 (905) 796-2650



KEY PLAN

- LEGEND
- Bore Hole
 - Dynamic Cone Penetration Test
 - Bore Hole And Cone
 - Blows/0.3m (Std Pen Test, 475 J/blow)
 - Blows/0.3m (60' Cone, 475 J/blow)
 - WL at Time of Investigation
 - WL in Piezometer (AUG. 2010)
 - Piezometer
 - 90% Rock Quality Designation
 - Auger Refusal

No	ELEV.	COORDINATES	
		NORTHING	EASTING
NBL 12+375Lt	183.3	4 763 888.1	327 476.6
SBL 12+360CL	182.9	4 763 866.5	327 470.3
S-EW 10+050CL	183.4	4 763 920.4	327 494.1
TEW1	182.5	4 763 851.9	327 480.6
TEW2	182.7	4 763 880.7	327 455.5
TN1	183.5	4 763 901.9	327 473.4
TN2	184.2	4 763 920.1	327 481.1
TRW1	183.2	4 763 828.9	327 437.2
TRW2	182.5	4 763 963.4	327 487.0
TS1	182.6	4 763 885.7	327 459.1
TS2	183.3	4 763 881.2	327 466.3
TSEW1	183.5	4 763 922.8	327 487.0
TSEW2	183.3	4 763 936.1	327 490.9
WE-S 10+345CL	182.8	4 763 845.9	327 457.4

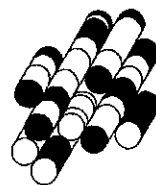
NOTE

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
DRAWN	K.C.	CHK	R.A.
		LOAD	
		STRUCT	
		DATE	FEB. 2011
			GEOCRES 30M3-266

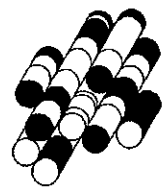
SITE 3

TERRAPROBE INC.



A3

TERRAPROBE INC.



RECORD OF BOREHOLE No WRW1

1 OF 1

METRIC

W.P. 280-99-00 LOCATION Coords: N:4764145.1 E:327283.6 ORIGINATED BY PK
DIST HWY 406 BOREHOLE TYPE Solid Stem Augers COMPILED BY DB
DATUM Geodetic DATE 6.24.10 CHECKED BY RA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa										WATER CONTENT (%)
								○ UNCONFINED	+ FIELD VANE	● QUICK TRIAXIAL	× LAB VANE							
182.9	Ground Surface							20	40	60	80	100						
182.7	180mm TOPSOIL							20	40	60	80	100						
0.2	FILL - Silty Clay, trace sand, trace organics, stiff, brown, moist		1	SS	9											58	0 2 44 54	
182.2																		
0.7	SILTY CLAY trace sand, very stiff to hard, brown, damp to moist		2	SS	33		182											
			3	SS	37		181											
			4	SS	46		180											
			5	SS	30		179										0 2 69 29	
			6	SS	37		178											
			7	SS	31		177											
			8	SS	26		176											
			9	SS	21		175										0 3 72 25	
			10	SS	24		174											
			11	SS	29		173											
171.7							172											
11.2	End of Borehole																	
	Water level at 6.2m (not stabilized) and hole open to full depth on completion.																	

ON MOT 1-09-4135 WRW RET WALLS.GPJ ON MOT.GDT 9/3/10

RECORD OF BOREHOLE No WS1

1 OF 3

METRIC

W.P. 280-99-00 LOCATION Coords: N:4764163.6 E:327303.9 ORIGINATED BY MP
DIST HWY 406 BOREHOLE TYPE Solid Stem Augers / Casing and Washboring / NQ Rock Coring COMPILED BY DB
DATUM Geodetic DATE 1.19.10 - 4.29.10 CHECKED BY RA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT		NATURAL MOISTURE CONTENT		LIQUID LIMIT		UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	20 40 60 80 100	W _p	W	W _L	W _p	W	W _L		
182.7	Ground Surface																
0.1	80mm TOPSOIL		1	SS	7		182										
	FILL - Silty Clay, trace sand, firm to hard, brown, damp		2	SS	28												0 2 36 62
			3	SS	37		181										
180.6																	
2.1	SILTY CLAY trace sand, trace gravel, hard, brown, damp		4	SS	32		180										
			5	SS	33												
			6	SS	52		179										
178.3																	
4.4	SILT trace sand, trace gravel, frequent silty clay seams and partings, dense, brown, damp		7	SS	47		178										1 2 75 22
			8	SS	39												
176.8							177										
5.9	SILTY CLAY trace sand, trace gravel, very stiff to hard, brown, damp to moist		9	SS	15												
							176										
			10	SS	23		175										0 5 83 12
							174										
			11	SS	25												0 4 62 34
							173										
			12	TW	PH		172										
							171										
			13	SS	41												
							170										
			14	SS	28		169										1 3 72 24
168.0																	
14.7							168										

Continued Next Page

+³, X³: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

ON MOT 1-09-4135 WRW RET WALLS.GPJ ON MOT.GDT 9/3/10

2 OF 3

METRIC

SOIL PROFILE	SAMPLES	DYNAMIC CONE PENETRATION
--------------	---------	--------------------------

ON MOT 1-09-4135 WRW RET WALLS.GPJ ON MOT.GDT 9/3/10

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

3 OF 3

METRIC

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

RECORD OF BOREHOLE No SBL 12+685CL

1 OF 1

METRIC

W.P. 280-99-00 LOCATION Coords: N:4764160.4 E:327319.7 ORIGINATED BY MP
DIST HWY 406 BOREHOLE TYPE Hollow Stem Augers COMPILED BY DB
DATUM Geodetic DATE 11.17.09 CHECKED BY RA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100					
182.7	Ground Surface																
0.0	470mm FILL - Sand and Gravel, some silt, trace clay, compact, grey, damp		1	SS	11												41 42 13 4
182.2	SILTY CLAY trace sand, occasional gravel inclusions, very stiff, brown, moist		2	SS	18		182										
0.5			3	SS	15		181										
			4	SS	16		180									42	0 1 50 49
			5	SS	19		179										
			6	SS	15		178										
			7	SS	13		177										
			8	SS	11		176										
			9	SS	8		175										
			10	TW	PH		174										
							173										
							172										
							171										
170.5	End of Borehole																
12.2	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 3.0m slotted screen. Water Level Readings: Date Depth(m) Elevation(m) Piezometer destroyed after drilling. Consolidation test performed on TW 10.																

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

ON MOT 1-09-4135 WRW RET WALLS.GPJ ON MOT.GDT 9/3/10

RECORD OF BOREHOLE No WS2

1 OF 3

METRIC

W.P. 280-99-00 LOCATION Coords: N:4764174.7 E:327313.4 ORIGINATED BY AW
 DIST HWY 406 BOREHOLE TYPE Hollow Stem Augers / NQ Rock Coring COMPILED BY DB
 DATUM Geodetic DATE 1.28.10 - 2.1.10 CHECKED BY RA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa							WATER CONTENT (%)
								○ UNCONFINED	+ FIELD VANE						
183.1	Ground Surface							20 40 60 80 100						GR SA SI CL	
0.0	firm		1	SS	7		183				○				
	SILTY CLAY trace sand, trace gravel, hard, brown, damp		2	SS	38		182				○	45		2 3 37 58	
			3	SS	43						○				
			4	SS	36		181				○	47		0 1 51 48	
			5	SS	29		180				○				
			6	SS	24		179				○				
178.7	SILT trace sand, frequent silty clay seams and partings, dense, brown, damp		7	SS	37		178				○			0 1 79 20	
4.4			8	SS	36						○				
177.2	SILTY CLAY trace sand, trace gravel, stiff to very stiff, brown, damp to moist		9	SS	21		177				○			0 5 68 27	
5.9			10	SS	22		176				○				
			11	TW	PH		174		>>		○				
			12	SS	10		173	1.6	1.2		○			0 3 70 27	
			13	SS	15		171	1.1			○			0 2 72 26	
			14	SS	28		170	1.3	2.5		○				
168.4							169								
14.7															



Continued Next Page

+³, X³: Numbers refer to
Sensitivity

○ 3% STRAIN AT FAILURE

2 OF 3

METRIC

ELEV. DEPTH	SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
	DESCRIPTION		STRAT.PLOT	NUMBER	TYPE			"N" VALUES						
								20 40 60 80 100 SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE	W _p W W _L WATER CONTENT (%) 10 20 30					

[illegible]

Continued Next Page

+³, X³: Numbers refer to Sensitivity ○^{3%} STRAIN AT FAILURE

ON MOT 1-09-4135 WRW RET WALLS.GPJ ON MOT.GDT 9/3/10

RECORD OF BOREHOLE No WS2

3 OF 3

METRIC

W.P. 280-99-00 LOCATION Coords: N:4764174.7 E:327313.4 ORIGINATED BY AW
DIST HWY 406 BOREHOLE TYPE Hollow Stem Augers / NQ Rock Coring COMPILED BY DB
DATUM Geodetic DATE 1.28.10 - 2.1.10 CHECKED BY RA

SOIL PROFILE		SAMPLES				GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100					
29.9	End of Borehole No sample recovery at SS12. Sampler redriven and disturbed sample collected. Unable to push vane beyond 12m. Borehole open to full depth and filled with drill water upon completion of drilling. Borehole sealed with bentonite slurry to ground surface.																

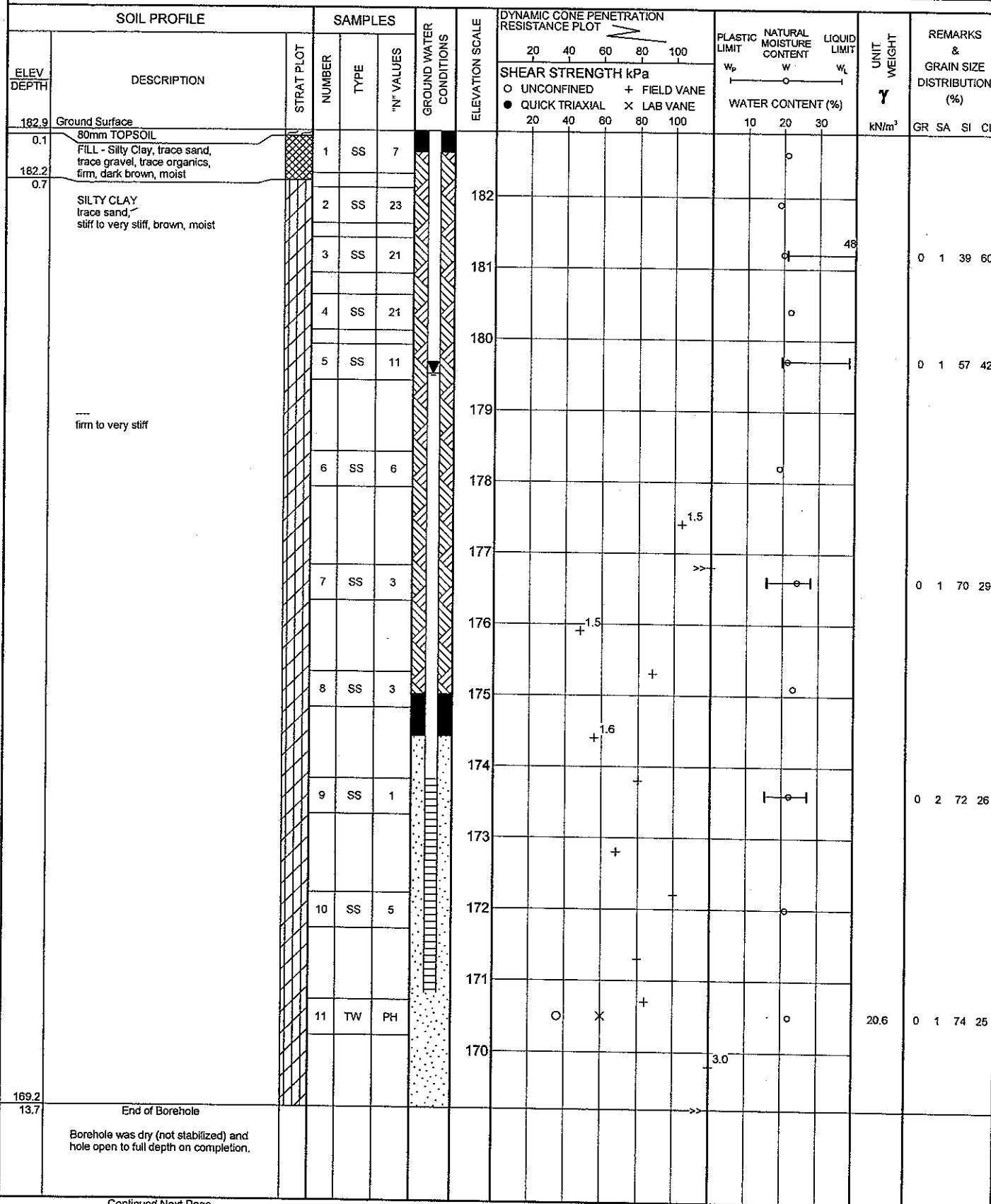
ON MOT 1-09-4135 WRWRET WALLS.GPJ ON MOT.GDT 9/3/10

RECORD OF BOREHOLE No NBL 12+695Lt

1 OF 2

METRIC

W.P. 280-99-00 LOCATION Coords: N:4764175.1 E:327333.0 ORIGINATED BY MP
DIST HWY 406 BOREHOLE TYPE Hollow Stem Augers COMPILED BY DB
DATUM Geodetic DATE 11.18.09 CHECKED BY RA



Continued Next Page

+³, X³: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

RECORD OF BOREHOLE No NBL 12+695Lt

2 OF 2

METRIC

W.P. 280-99-00 LOCATION Coords: N:4764175.1 E:327333.0 ORIGINATED BY MP
DIST HWY 406 BOREHOLE TYPE Hollow Stem Augers COMPILED BY DB
DATUM Geodetic DATE 11.18.09 CHECKED BY RA

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL																		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa					WATER CONTENT (%)																					
						20	40	60	80	100	W _p	W	W _L																					
	<p>Piezometer installation consists of a 19mm diameter, Schedule 40 PVC pipe with a 3.0m slotted screen.</p> <p>Water Level Readings:</p> <table border="1"> <thead> <tr> <th>Date</th> <th>Depth(m)</th> <th>Elevation(m)</th> </tr> </thead> <tbody> <tr> <td>Nov.30.09</td> <td>9.3</td> <td>173.6</td> </tr> <tr> <td>Dec.15.09</td> <td>3.4</td> <td>179.5</td> </tr> <tr> <td>Jan.04.10</td> <td>3.2</td> <td>179.7</td> </tr> <tr> <td>Jan.11.10</td> <td>3.3</td> <td>179.6</td> </tr> <tr> <td>Jan.19.10</td> <td>3.4</td> <td>179.5</td> </tr> </tbody> </table> <p>Consolidation test performed on TW 11.</p>	Date	Depth(m)	Elevation(m)	Nov.30.09	9.3	173.6	Dec.15.09	3.4	179.5	Jan.04.10	3.2	179.7	Jan.11.10	3.3	179.6	Jan.19.10	3.4	179.5															
Date	Depth(m)	Elevation(m)																																
Nov.30.09	9.3	173.6																																
Dec.15.09	3.4	179.5																																
Jan.04.10	3.2	179.7																																
Jan.11.10	3.3	179.6																																
Jan.19.10	3.4	179.5																																

ON_MOT 1-09-4135 WRW RET WALLS.GPJ ON_MOT.GDT 9/3/10

RECORD OF BOREHOLE No WN1

1 OF 3

METRIC

W.P. 280-99-00 LOCATION Coords: N:4764187.0 E:327332.0 ORIGINATED BY AW
 DIST HWY 406 BOREHOLE TYPE Hollow Stem Augers / NQ Rock Coring COMPILED BY DB
 DATUM Geodetic DATE 2.16.10 - 2.18.10 CHECKED BY RA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa								WATER CONTENT (%)
								○ UNCONFINED	+ FIELD VANE	● QUICK TRIAXIAL						
183.1	Ground Surface						20	40	60	80	100	10	20	30		
0.1	80mm TOPSOIL		1	SS	13											
	FILL - Silty Clay, trace sand, trace organics, stiff to very stiff, brown, moist		2	SS	23										0 2 35 63	
			3	SS	24											
181.0																
2.1	SILTY CLAY trace sand, stiff to very stiff, brown, moist		4	SS	25											
			5	SS	14										0 1 54 45	
			6	SS	15											
178.7																
4.4	SILT frequent silty clay seams and partings, compact, brown, moist		7	SS	16										0 0 80 20	
177.9																
5.2	SILTY CLAY trace sand, stiff to very stiff, brown, damp to moist		8	SS	11											
			9	SS	11										0 3 65 32	
			10	SS	11										0 9 70 21	
			11	TW	PH											
			12	SS	8										0 2 71 27	
			13	SS	9											
			14	SS	10										0 2 70 28	
168.4																
14.7																

Continued Next Page

+³, X³: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

ON MOT 1-09-4135 WRW RET WALLS.GPJ ON MOT.GDT 9/3/10

METRIC

[illegible]

+³, X³: Numbers refer to Sensitivity ○^{3%} STRAIN AT FAILURE

RECORD OF BOREHOLE No WN2

1 OF 3

METRIC

W.P. 280-99-00 LOCATION Coords: N:4764202.3 E:327354.1 ORIGINATED BY PK
 DIST HWY 406 BOREHOLE TYPE Hollow Stem Augers / NQ Rock Coring COMPILED BY DB
 DATUM Geodetic DATE 12.10.09 - 12.14.09 CHECKED BY RA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	20 40 60 80 100	20 40 60 80 100	20 40 60 80 100		
181.6	Ground Surface												
181.5	150mm TOPSOIL												
0.2													
	SILTY CLAY trace sand, stiff to very stiff, brown, damp to moist		1	SS	8		181						
			2	SS	16								0 2 55 43
			3	SS	16		180						
179.3													
2.3	SILT trace sand, frequent silty clay seams and partings, compact, brown, moist		4	SS	19		179						0 1 80 19
			5	SS	12								
178.1							178						
3.5	SILTY CLAY trace sand, trace gravel, firm to very stiff, brown, moist		6	SS	6								0 3 64 33
			7	SS	7		177						
							176						
			8	SS	6								1 5 65 29
							175						
							174						
			9	SS	2								
							173						
							172						
							171						Dec.10 Dec.11
			11	SS	8								1 2 73 24
							170						
							169						
168.4							168						
13.2	SILTY CLAY TO CLAYEY SILT some sand, trace gravel, very stiff to hard, brown, damp (GLACIAL TILL)		12	SS	9								
							167						8 19 54 19

Continued Next Page

+³, X³: Numbers refer to
Sensitivity

○ 3% STRAIN AT FAILURE

ON MOT 1-09-4135 WRW RET WALLS.GPJ ON MOT.GDT 9/3/10

RECORD OF BOREHOLE No WN2

2 OF 3

METRIC

W.P. 280-99-00 LOCATION Coords: N:4764202.3 E:327354.1 ORIGINATED BY PK
 DIST HWY 406 BOREHOLE TYPE Hollow Stem Augers / NQ Rock Coring COMPILED BY DB
 DATUM Geodetic DATE 12.10.09 - 12.14.09 CHECKED BY RA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa							WATER CONTENT (%)			
20 40 60 80 100																		
○ UNCONFINED + FIELD VANE																		
● QUICK TRIAXIAL x LAB VANE																		
20 40 60 80 100																		
10 20 30																		
GR SA SI CL																		
165.4	some clay SILTY SAND TO SANDY SILT trace to some gravel, trace clay, frequent cobbles, very dense, brown, damp to moist (GLACIAL TILL)		14	SS	35													
16.2																		

Continued Next Page

+³, x³: Numbers refer to
Sensitivity

○ 3% STRAIN AT FAILURE

ON MOT 1-09-4135 WRW RET WALLS.GPJ ON MOT.GDT 9/3/10

RECORD OF BOREHOLE No WN2

3 OF 3

METRIC

W.P. 280-99-00 LOCATION Coords: N:4764202.3 E:327354.1 ORIGINATED BY PK
 DIST HWY 405 BOREHOLE TYPE Hollow Stem Augers / NQ Rock Coring COMPILED BY DB
 DATUM Geodetic DATE 12.10.09 - 12.14.09 CHECKED BY RA

SOIL PROFILE		SAMPLES				GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
						○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL X LAB VANE					WATER CONTENT (%)						
						20 40 60 80 100					10	20	30	kN/m ³	GR SA SI CL		
	Borehole open to full depth and filled with drill water upon completion of drilling. No sample recovery at SS7. Sampler redriven and disturbed sample collected. Resistance to augering from 18.2m to 19.2m, 22.9m to 23.2m and at 25.1m. Unable to push vane beyond 13.1m. Piezometer installation consists of a 19mm diameter, Schedule 40 PVC pipe with a 1.9m slotted screen. Water Level Readings: Date Depth(m) Elevation(m) Jan.04.10 5.2 176.4 Jan.11.10 4.2 177.4 Jan.19.10 5.2 176.4 Jan.27.10 5.2 176.4																

RECORD OF BOREHOLE No WRW2

1 OF 2

METRIC

W.P. 280-99-00 LOCATION Coords: N:4764215.1 E:327368.0 ORIGINATED BY PK
 DIST HWY 406 BOREHOLE TYPE Solid Stem Augers COMPILED BY DB
 DATUM Geodetic DATE 6.30.10 CHECKED BY RA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	20 40 60 80 100					
182.6	Ground Surface													
0.1	80mm TOPSOIL		1	SS	17		182				o			
181.9	FILL - Silty Clay, trace sand, very stiff, brown, damp to moist													
0.7	SILTY CLAY trace sand, hard, brown, damp to moist		2	SS	32		181				o			0 1 47 52
			3	SS	41						o			
			4	SS	35		180				o			
			5	SS	30						o			
			6	SS	42		179				o			
178.4	SILT - occasional silty clay seams and partings, compact to dense, brown, moist to wet		7	SS	26		178				o			
4.2														
177.9	SILTY CLAY trace sand, stiff to very stiff, brown, damp to moist		8	SS	16		177				o			
4.7			9	TW	PH		176				o			0 1 74 25
			10	SS	11		175				o			
			11	SS	12		174				o			
			12	SS	14		173				o			
			13	SS	16		172				o			
							171				o			
							170				o			0 3 72 25
							169				o			
							168				o			
167.9														
14.7														

Continued Next Page

+³, X³: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

RECORD OF BOREHOLE No WRW2

2 OF 2

METRIC

W.P. 280-99-00 LOCATION Coords: N:4764215.1 E:327368.0 ORIGINATED BY PK
 DIST HWY 406 BOREHOLE TYPE Solid Stem Augers COMPILED BY DB
 DATUM Geodetic DATE 6.30.10 CHECKED BY RA

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			20	40	60	80	100					
166.9	SILTY CLAY TO CLAYEY SILT some sand, trace gravel, hard, brown, damp to moist (GLACIAL TILL)		14	SS	65											4 12 61 23
15.7	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) July.05.10 9.7 172.9 July.13.10 4.4 178.2 July.21.10 3.6 179.0 July.27.10 3.6 179.0															

+ 3, X 3: Numbers refer to
Sensitivity

○ 3% STRAIN AT FAILURE

RECORD OF BOREHOLE No WRW3

1 OF 1

METRIC

W.P. 280-99-00 LOCATION Coords: N:4764178.3 E:327273.3 ORIGINATED BY PK
DIST HWY 406 BOREHOLE TYPE Solid Stem Augers COMPILED BY DB
DATUM Geodetic DATE 6.25.10 CHECKED BY RA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa							
183.7	Ground Surface							20 40 60 80 100							
183.6	130mm TOPSOIL							20 40 60 80 100							
0.1	FILL - Silty Clay, trace to some sand, trace organics, very stiff, brown, damp to moist		1	SS	17		183								
183.0															
0.7	SILTY CLAY trace sand, very stiff to hard, brown, damp to moist		2	SS	32		182								
			3	SS	41		181								
			4	SS	35		180								
			5	SS	35		179								
			6	SS	44		178								
			7	SS	41		177								
			8	SS	33		176								
			9	SS	37		175								
			10	SS	20		174								
			11	SS	23		173								
172.5	End of Borehole														
11.2	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) July.05.10 3.2 180.5 July.13.10 3.2 180.5 July.20.10 2.9 180.8 July.27.10 2.6 181.1 Aug.06.10 3.4 180.3 Aug.13.10 3.6 180.1														

ON MOT 1-09-4135 WRW RET WALLS.GPJ ON MOT.GDT 9/3/10

RECORD OF BOREHOLE No WS3

1 OF 2

METRIC

W.P. 280-99-00 LOCATION Coords: N:4764192.6 E:327292.7 ORIGINATED BY MP
DIST HWY 406 BOREHOLE TYPE Solid Stem Augers / NQ Rock Coring COMPILED BY DB
DATUM Geodetic DATE 1.20.10 - 1.22.10 CHECKED BY RA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa							WATER CONTENT (%)
								○ UNCONFINED ● QUICK TRIAXIAL	+ FIELD VANE x LAB VANE						
183.0	Ground Surface							20 40 60 80 100							
0.1	50mm TOPSOIL		1	SS	17										
	FILL - Silty Clay, trace sand, very stiff to hard, brown, damp		2	SS	23										
			3	SS	36										
			4	SS	43										
180.1			5	SS	39										
2.9	SILTY CLAY trace sand, trace gravel, stiff to hard, brown, damp		6	SS	30										
			7	SS	24										
			8	SS	20										
			9	TW	PH										
			10	SS	9										
			11	SS	13										
			12	SS	17										
		13	SS	23											
		14	SS	23											
168.3															
14.7															

Continued Next Page

+³, X³: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

ON MOT 1-09-4135 WRW RET WALLS.GPJ ON MOT.GDT 9/3/10

METRIC

ELEV DEPTH	SOIL PROFILE		SAMPLES		GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ KN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	20 40 60 80 100	W _p W W _L	WATER CONTENT (%)			
							SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL X LAB VANE						
							20 40 60 80 100		10 20 30				

[illegible]

ON_MOT 1-09-4135 WRW RET WALLS.GPJ ON MOT.GDT 9/3/10

+³, X³: Numbers refer to Sensitivity ○^{3%} STRAIN AT FAILURE

RECORD OF BOREHOLE No WS4

1 OF 3

METRIC

W.P. 280-99-00 LOCATION Coords: N:4764202.3 E:327305.2 ORIGINATED BY MP
 DIST HWY 406 BOREHOLE TYPE Solid Stem Augers / NQ Rock Coring COMPILED BY DB
 DATUM Geodetic DATE 1.28.10 - 2.1.10 CHECKED BY RA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE ELEVATION DEPTH	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100					
182.7	Ground Surface																
0.0	25mm TOPSOIL		1	SS	13												
	FILL - Silty Clay, trace sand, trace gravel, stiff to very stiff, brown, damp to moist		2	SS	17		182										
			3	SS	13		181										
180.6			4	SS	45		180									45	1 1 48 50
2.1	SILTY CLAY trace sand, trace gravel, hard, brown, damp		5	SS	45		179										
			6	SS	43		178										
			7	SS	61		177										
177.7			8	SS	64		176										
5.0	SILT trace clay, trace sand, frequent silty clay seams and partings, very dense, brown, damp		9	SS	37		175										
			10	SS	37		174										
176.8			11	SS	20		173										0 3 67 30
5.9	SILTY CLAY trace sand, trace gravel, stiff to hard, brown, damp		12	TW	PH		172										
			13	SS	25		171										1 6 71 22
			14	SS	23		170										
168.0							169										
14.7							168										

Continued Next Page

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

ON MOT 1-09-4135 WRW RET WALLS.GPJ ON MOT.GDT 9/3/10

2 OF 3

METRIC

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

RECORD OF BOREHOLE No WS4

3 OF 3

METRIC

W.P. 280-99-00 LOCATION Coords: N:4764202.3 E:327305.2 ORIGINATED BY MP
DIST HWY 406 BOREHOLE TYPE Solid Stem Augers / NQ Rock Coring COMPILED BY DB
DATUM Geodetic DATE 1.28.10 - 2.1.10 CHECKED BY RA

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL																					
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL X LAB VANE					W _p	W			W _L																				
						20	40	60	80	100		10	20	30																							
	<p>Water level at approx. 9.1m (not stabilized) and hole open to full depth on completion.</p> <p>Unable to push vane beyond 14.7m.</p> <p>Resistance to augering from 25.0m to 25.8m.</p> <p>Piezometer installation consists of a 19mm diameter, Schedule 40 PVC pipe with a 1.52m slotted screen.</p> <p>Water Level Readings:</p> <table border="1"> <thead> <tr> <th>Date</th> <th>Depth(m)</th> <th>Elevation(m)</th> </tr> </thead> <tbody> <tr> <td>Feb.08.10</td> <td>4.7</td> <td>178.0</td> </tr> <tr> <td>Apr.16.10</td> <td>2.1</td> <td>180.6</td> </tr> <tr> <td>Apr.29.10</td> <td>5.1</td> <td>177.6</td> </tr> <tr> <td>May.04.10</td> <td>5.7</td> <td>177.0</td> </tr> <tr> <td>May.06.10</td> <td>4.1</td> <td>178.6</td> </tr> <tr> <td>May.18.10</td> <td>5.9</td> <td>176.8</td> </tr> </tbody> </table>	Date	Depth(m)	Elevation(m)	Feb.08.10	4.7	178.0	Apr.16.10	2.1	180.6	Apr.29.10	5.1	177.6	May.04.10	5.7	177.0	May.06.10	4.1	178.6	May.18.10	5.9	176.8															
Date	Depth(m)	Elevation(m)																																			
Feb.08.10	4.7	178.0																																			
Apr.16.10	2.1	180.6																																			
Apr.29.10	5.1	177.6																																			
May.04.10	5.7	177.0																																			
May.06.10	4.1	178.6																																			
May.18.10	5.9	176.8																																			

ON_MOT 1-09-4135 WRW RET WALLS.GPJ ON_MOT.GDT 9/3/10

RECORD OF BOREHOLE No SBL 12+750CL

1 OF 1

METRIC

W.P. 280-99-00 LOCATION Coords: N:4764219.9 E:327296.2 ORIGINATED BY PK
DIST HWY 406 BOREHOLE TYPE Hollow Stem Augers COMPILED BY DB
DATUM Geodetic DATE 11.10.09 CHECKED BY RA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
182.9	Ground Surface							20	40	60	80	100					
182.7	200mm TOPSOIL							20	40	60	80	100					
0.2	FILL - Silty Clay, trace sand, trace organics, stiff, dark brown, moist		1	SS	8												
182.2																	
0.7	SILTY CLAY trace sand, very stiff to hard, brown, moist		2	SS	24		182										
			3	SS	37		181										
			4	SS	46		180										
			5	SS	33		179										
			6	SS	20		178										0 0 60 40
							177										
			7	SS	27		176										
							175										0 4 68 28
	----- trace gravel		8	SS	34		174										
			9	SS	21		173										
			10	TW	PH		172										
171.6																	
11.3	End of Borehole																
	Water level at 10.4m (not stabilized) and hole open to full depth on completion.																
	Piezometer installation consists of a 19mm diameter, Schedule 40 PVC pipe with a 3.0m slotted screen.																
	Water Level Readings:																
	Date Depth(m) Elevation(m)																
	Nov.19.09 4.6 178.3																
	Nov.30.09 7.8 175.1																
	Dec.08.09 4.1 178.8																
	Dec.15.09 3.2 179.7																
	Jan.04.10 2.7 180.2																
	Jan.11.10 2.7 180.2																
	Jan.19.10 2.6 180.3																
	Consolidation test performed on TW 10.																

ON MOT 1-09-4135 WRW RET WALLS.GPJ ON MOT.GDT 9/3/10

RECORD OF BOREHOLE No WN3

1 OF 3

METRIC

W.P. 280-99-00 LOCATION Coords: N:4764212.0 E:327314.7 ORIGINATED BY KB
 DIST HWY 406 BOREHOLE TYPE Hollow Stem Augers / NQ Rock Coring COMPILED BY DB
 DATUM Geodetic DATE 2.18.10 - 2.22.10 CHECKED BY RA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa								WATER CONTENT (%)		
								○ UNCONFINED	+ FIELD VANE	● QUICK TRIAXIAL							× LAB VANE	
182.1	Ground Surface						182	20	40	60	80	100						
0.0	FILL - Sand and Gravel, some silt, trace clay, dense, grey, damp		1	SS	48												41 44 13 2	
181.4																		
0.7	firm		2	SS	6		181											
	—																	
	SILTY CLAY trace sand, trace gravel, very stiff, brown, damp		3	SS	22		180											
			4	SS	14													
			5	SS	27		179											
178.4																		
3.7	SILT trace sand, frequent silty clay seams and partings, compact, brown, damp		6	SS	26		178										0 1 84 15	
177.4			7	SS	9													
4.7	SILTY CLAY trace sand, trace gravel, stiff to hard, brown, damp		8	SS	12		177											
			9	SS	10		176											
			10	SS	11		175											
							174										0 3 70 27	
							173										1 3 69 27	
							172											
			12	TW	PH		171											
							170											
			13	SS	17		169										1 2 72 25	
167.8			14	SS	60		168											
14.3																		

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

ON MOT 1-09-4135 WRW RET WALLS.GPJ ON MOT.GDT 9/3/10

2 OF 3

METRIC

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

RECORD OF BOREHOLE No WN3										3 OF 3		METRIC				
W.P. 280-99-00		LOCATION Coords: N:4764212.0 E:327314.7				ORIGINATED BY KB										
DIST _____ HWY 406		BOREHOLE TYPE Hollow Stem Augers / NQ Rock Coring				COMPILED BY DB										
DATUM Geodetic		DATE 2.18.10 - 2.22.10				CHECKED BY RA										
SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa								
							20	40	60	80	100					
							○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL X LAB VANE					WATER CONTENT (%)				
							20	40	60	80	100	10	20	30		
30.0	End of Borehole Borehole open to full depth and filled with drill water upon completion of drilling. 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) Apr.16.10 7.7 174.4 Apr.29.10 3.9 178.2 May.04.10 5.2 176.9 May.06.10 4.8 177.3															

ON_MOT 1-09-4135 WPRW RET WALLS.GPJ ON_MOT.GDT 9/3/10

RECORD OF BOREHOLE No WN4

1 OF 3

METRIC

W.P. 280-99-00 LOCATION Coords: N:4764228.4 E:327343.4 ORIGINATED BY PK
DIST HWY 406 BOREHOLE TYPE Hollow Stem Augers / NQ Rock Coring COMPILED BY DB
DATUM Geodetic DATE 12.14.09 - 12.15.09 CHECKED BY RA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	20 40 60 80 100					
182.5	Ground Surface													
182.4	150mm TOPSOIL													
0.2	soft		1	SS	3		182							
	FILL - Silty Clay, trace sand, trace gravel, firm to stiff, brown, damp		2	SS	6									0 2 67 31
			3	SS	9		181							
			4	SS	8		180							5 3 56 36
			5	SS	5		179							
178.8														
3.7	SILT trace clay, trace sand, frequent silty clay seams and partings, compact, brown, damp		6	SS	16		178							
			7	SS	22		177							
177.6														
4.9	SILTY CLAY trace to some gravel, trace sand, stiff to very stiff, brown, damp		8	SS	5		176							17 10 37 36
			9	SS	10		175							
			10	TW	PH		174							
			11	SS	9		173							1 2 72 25
			12	SS	8		172							1 3 73 23
			13	SS	12		171							Dec.14 Dec.15
			14	SS	12		170							
							169							
167.8							168							1 8 68 23
14.7														

Continued Next Page


+³, X³: Numbers refer to
Sensitivity

○ 3% STRAIN AT FAILURE

ON MOT. 1-09-4135 MRW RET WALLS.GPJ ON MOT.GDT 9/3/10

2 OF 3

METRIC

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT		UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	20 40 60 80 100		W _p W W _L		
							SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL X LAB VANE 20 40 60 80 100		WATER CONTENT (%) 10 20 30			GR SA SI

[illegible]

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

ON_MOT 1-09-4135 WRW RET WALLS.GPJ ON MOT.GDT 9/3/10

RECORD OF BOREHOLE No WN4

3 OF 3

METRIC

W.P. 280-99-00 LOCATION Coords: N:4764228.4 E:327343.4 ORIGINATED BY PK
DIST HWY 406 BOREHOLE TYPE Hollow Stem Augers / NQ Rock Coring COMPILED BY DB
DATUM Geodetic DATE 12.14.09 - 12.15.09 CHECKED BY RA

SOIL PROFILE		SAMPLES				GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
	<p>Borehole open to full depth and filled with drill water upon completion of drilling.</p> <p>Borehole sealed with bentonite slurry to ground surface.</p> <p>Resistance to augering at 22.9m and 24.3m.</p> <p>Unable to push vane beyond 13.1m and 14.2m.</p>																

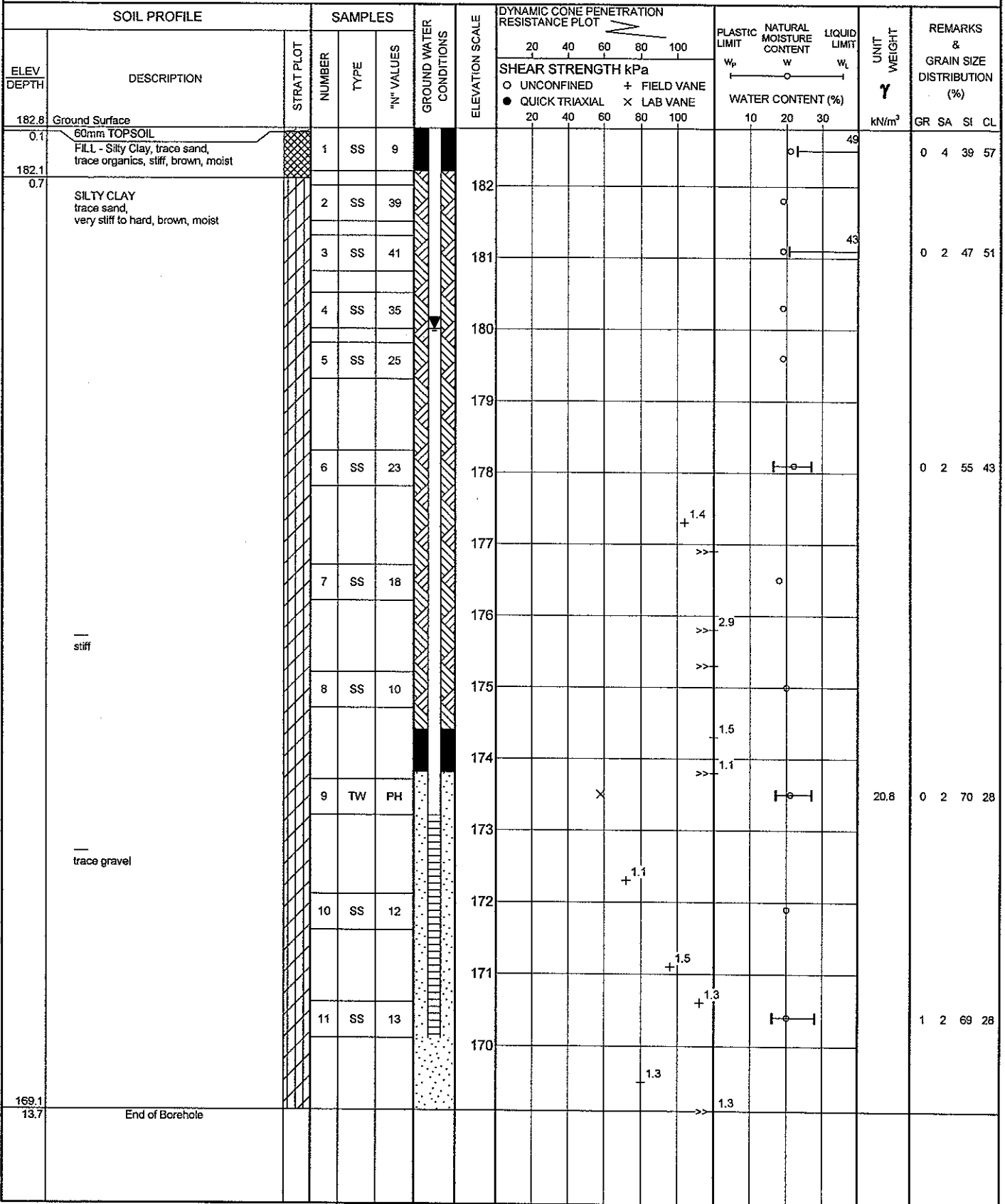
ON MOT 1-09-4135 WRW RET WALLS.GPJ ON MOT.GDT 9/3/10

RECORD OF BOREHOLE No NBL 12+750Rt

1 OF 2

METRIC

W.P. 280-99-00 LOCATION Coords: N:4764237.5 E:327341.9 ORIGINATED BY AW
DIST HWY 406 BOREHOLE TYPE Hollow Stem Augers COMPILED BY KL
DATUM Geodetic DATE 12.2.09 CHECKED BY RA



2 OF 2

METRIC

LOCATION

Coords: N:4764237.5 E:327341.9

ORIGINATED BY AW

DIST _____ HWY 406

BOREHOLE TYPE

Hollow Stem Augers

COMPILED BY KL

DATUM Geodetic

DATE _____

12.2.09

CHECKED BY RA

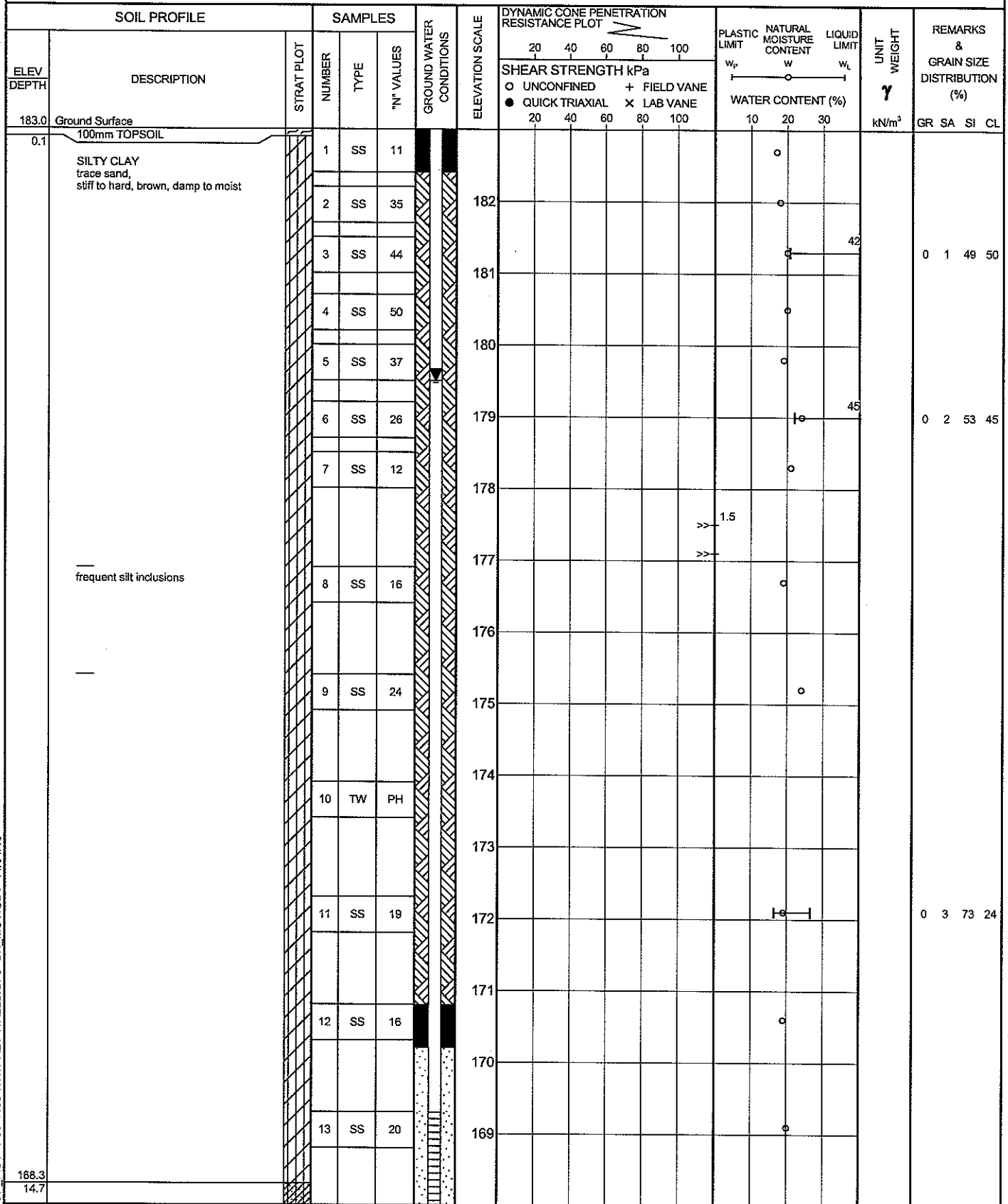
+³, ×³: Numbers refer to Sensitivity ○^{3%} STRAIN AT FAILURE

RECORD OF BOREHOLE No WRW4

1 OF 2

METRIC

W.P. 280-99-00 LOCATION Coords: N:4764237.6 E:327355.1 ORIGINATED BY PK
 DIST HWY 406 BOREHOLE TYPE Solid Stem Augers COMPILED BY DB
 DATUM Geodetic DATE 06.30.10 CHECKED BY RA



Continued Next Page

+³, X³: Numbers refer to
Sensitivity

○ 3% STRAIN AT FAILURE

RECORD OF BOREHOLE No WRW4

2 OF 2

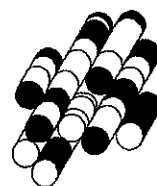
METRIC

W.P. 280-99-00 LOCATION Coords: N:4764237.6 E:327355.1 ORIGINATED BY PK
DIST HWY 406 BOREHOLE TYPE Solid Stem Augers COMPILED BY DB
DATUM Geodetic DATE 6.30.10 CHECKED BY RA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100	W _p	W	W _L		
167.3	SILTY CLAY trace sand, trace gravel, hard, brown, damp to moist (GLACIAL TILL)		14	SS	52											4 9 62 25	
15.7	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) July.05.10 9.7 173.3 July.13.10 4.7 178.3 July.21.10 4.1 178.9 July.27.10 3.0 180.0 Aug.06.10 2.6 180.4 Aug.13.10 3.3 179.7 Aug.23.10 3.5 179.5																

B3

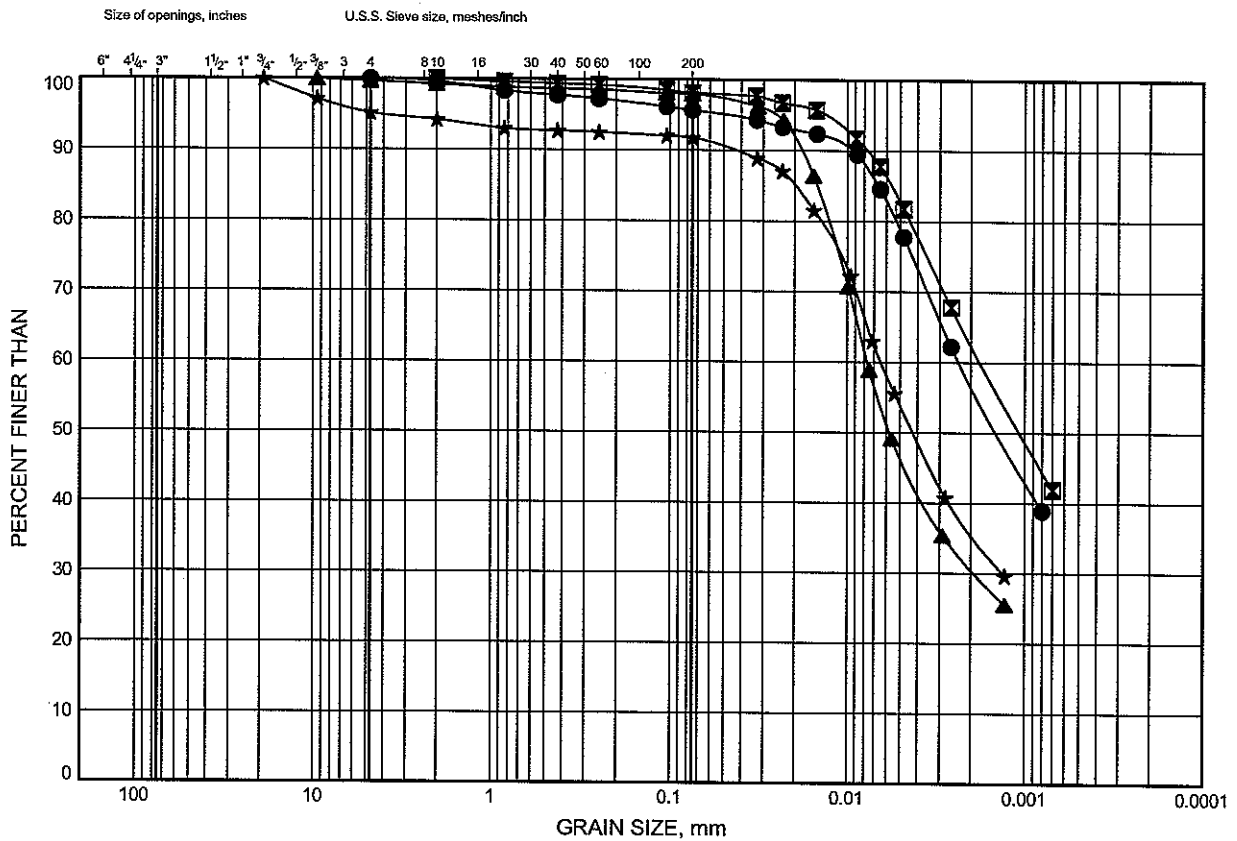
TERRAPROBE INC.



GRAIN SIZE DISTRIBUTION

FIGURE B3-2

FILL - Silty Clay



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

SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	NBL 12+750Rt	0.3	182.5
⊠	WN1	1.0	182.1
▲	WN4	1.0	181.5
★	WN4	2.5	180.0

Date August 2010
Project 1-09-4135

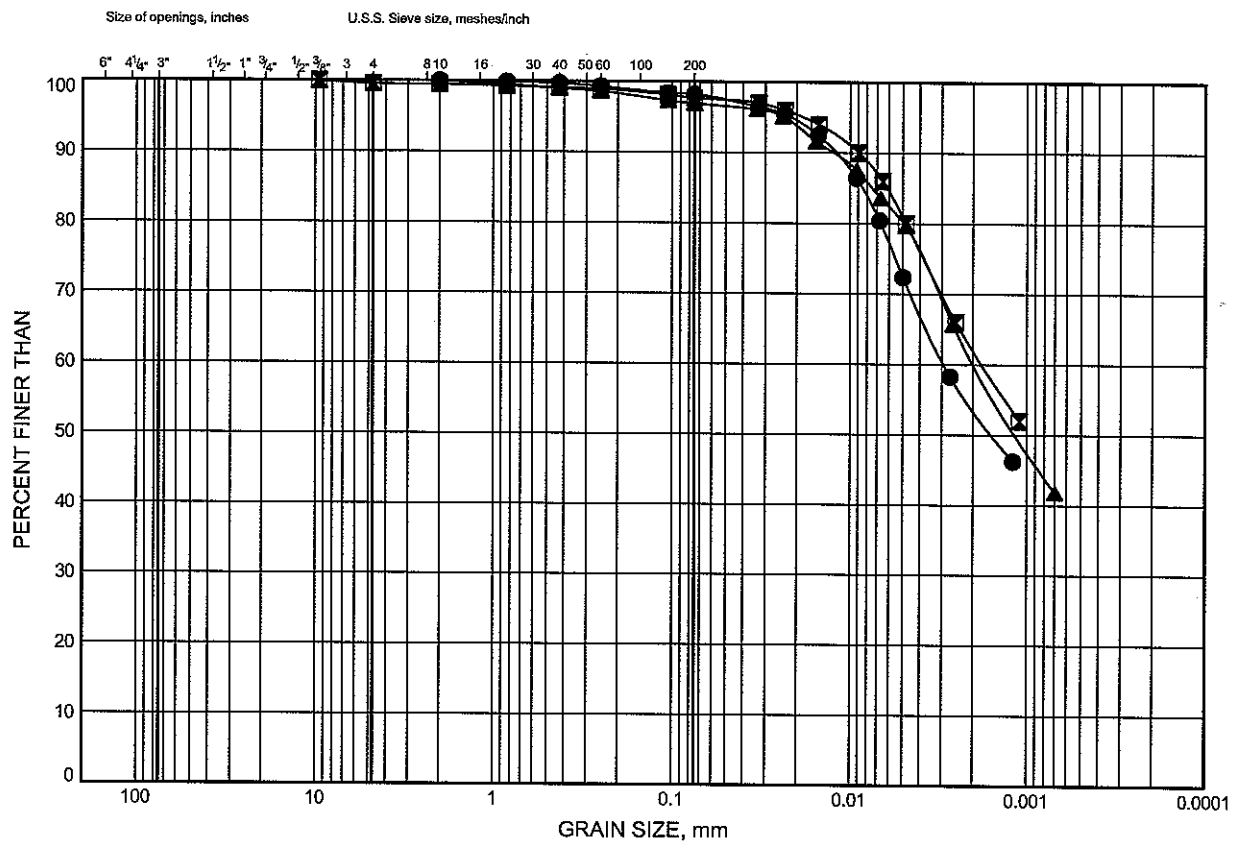


Prep'd JS
Chkd. MP

GRAIN SIZE DISTRIBUTION

FIGURE B3-3

FILL - Silty Clay



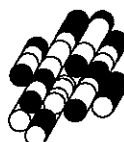
COBBLE SIZE	COARSE	FINE	COARSE	MEDIUM	FINE	SILT and CLAY
	GRAVEL		SAND			FINE GRAINED

SYMBOL BOREHOLE DEPTH (m) ELEVATION (m)

●	WRW1	0.3	182.6
■	WS1	1.0	181.7
▲	WS3	1.7	181.3

Date August 2010

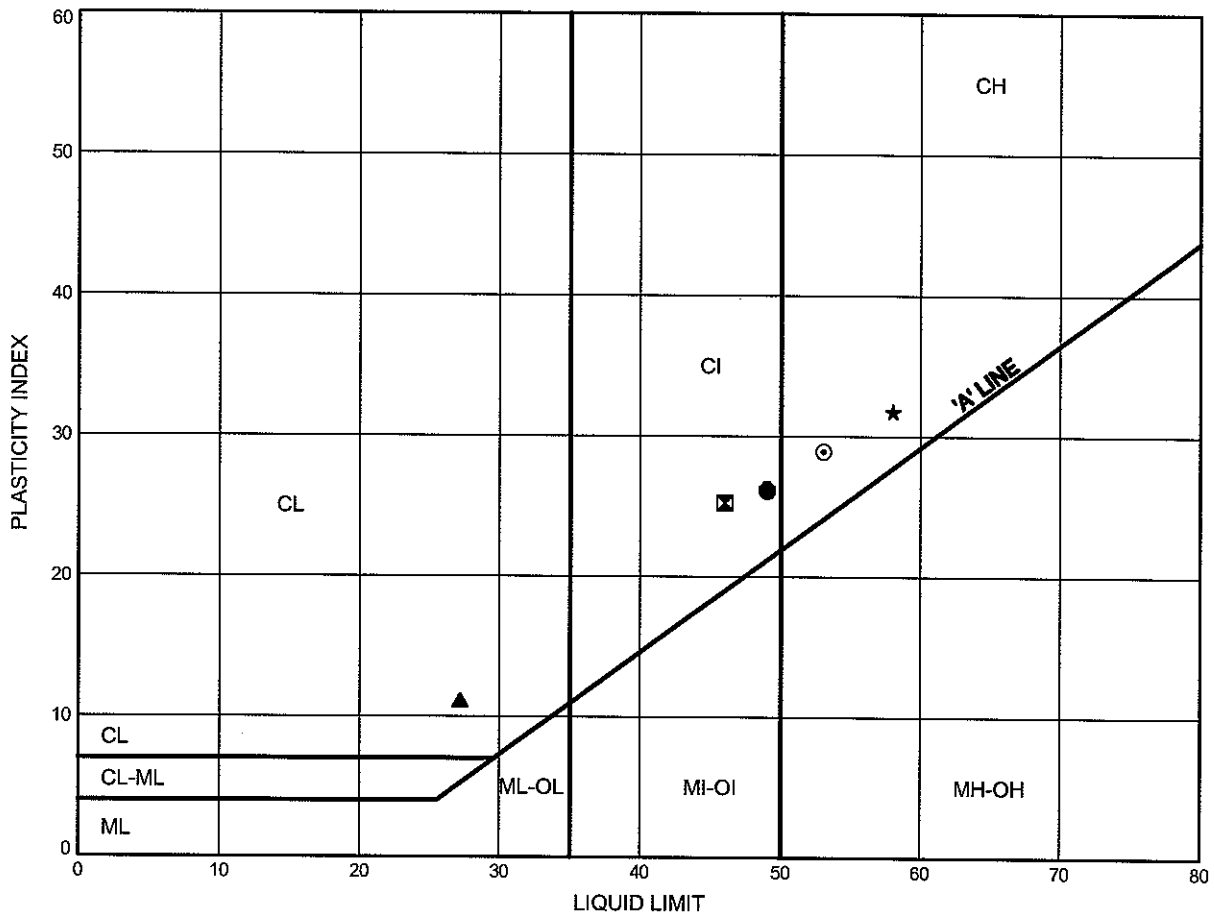
Project 1-09-4135



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Chkd. MP

FIGURE B3-4



SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	NBL 12+750Rt	0.3	182.5
⊠	WN1	1.0	182.1
▲	WN4	1.0	181.5
★	WRW1	0.3	182.6
⊙	WS1	1.0	181.7
⊕	WS3	1.7	181.3

Date August 2010
Project 1-09-4135

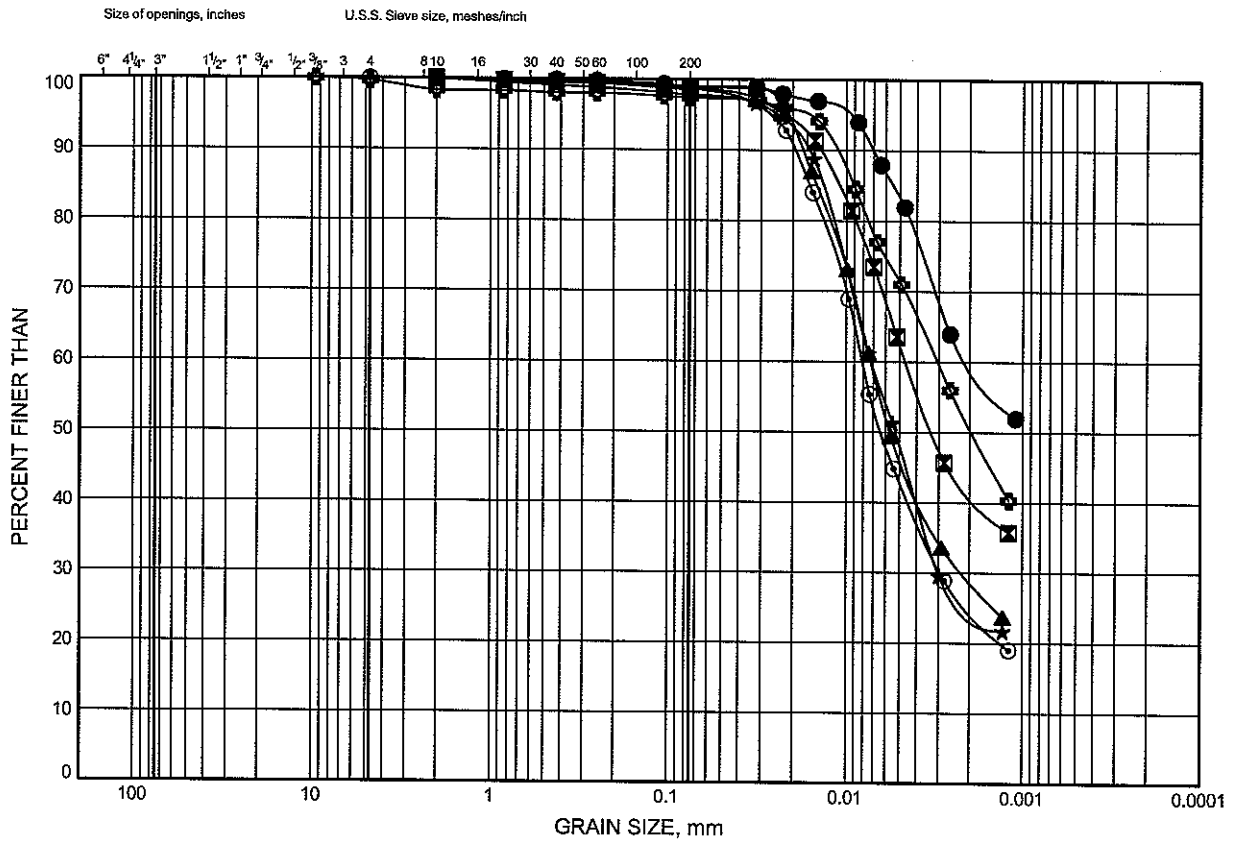


Prep'd JS
Chkd. MP

GRAIN SIZE DISTRIBUTION

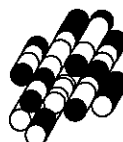
FIGURE B3-5

SILTY CLAY



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

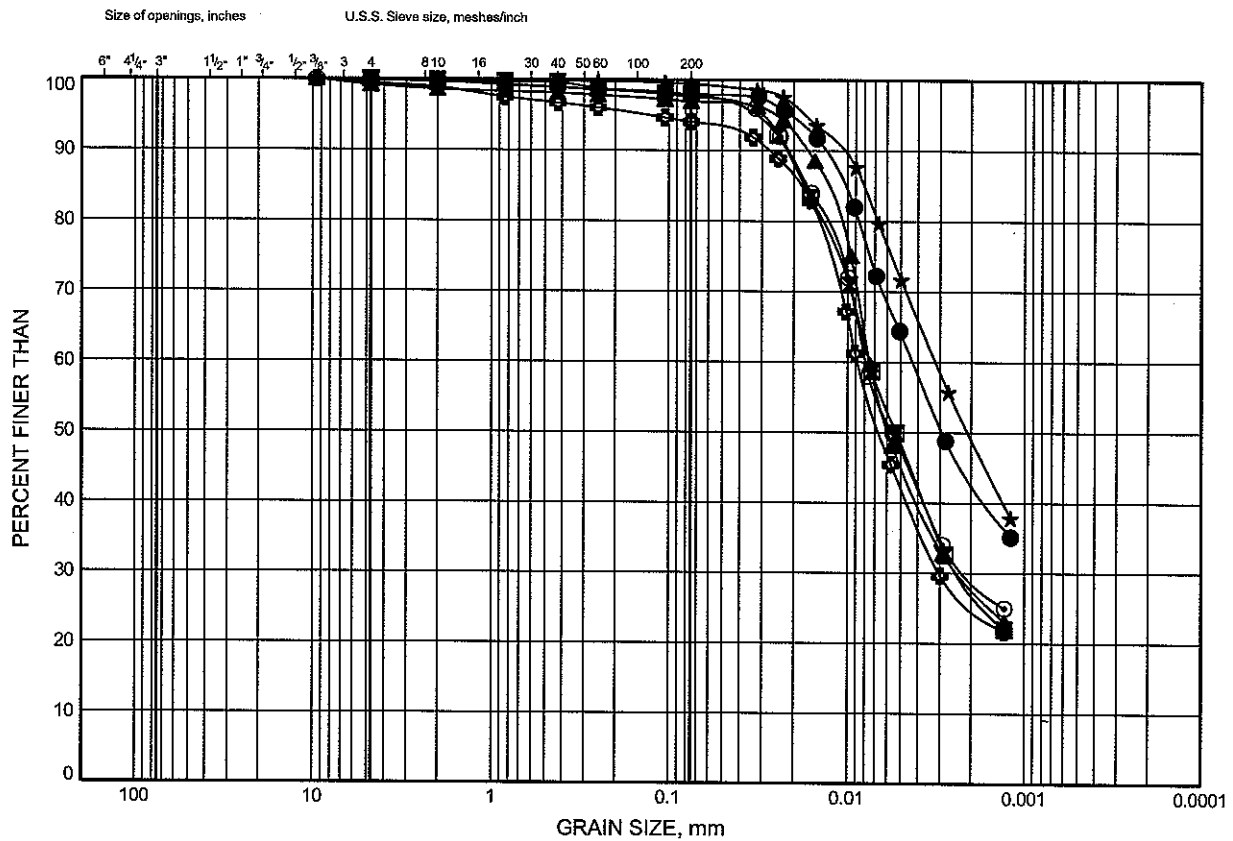
SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	NBL 12+695Lt	1.7	181.2
⊠	NBL 12+695Lt	3.2	179.7
▲	NBL 12+695Lt	6.3	176.6
★	NBL 12+695Lt	9.3	173.6
⊙	NBL 12+695Lt	12.4	170.5
⊕	NBL 12+750Rt	1.7	181.1



GRAIN SIZE DISTRIBUTION

FIGURE B3-6

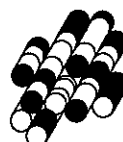
SILTY CLAY



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

SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	NBL 12+750Rt	4.7	178.1
⊠	NBL 12+750Rt	9.3	173.5
▲	NBL 12+750Rt	12.4	170.4
★	SBL 12+685CL	2.5	180.2
⊙	SBL 12+685CL	6.3	176.4
⊕	SBL 12+685CL	9.3	173.4

Date August 2010
Project 1-09-4135

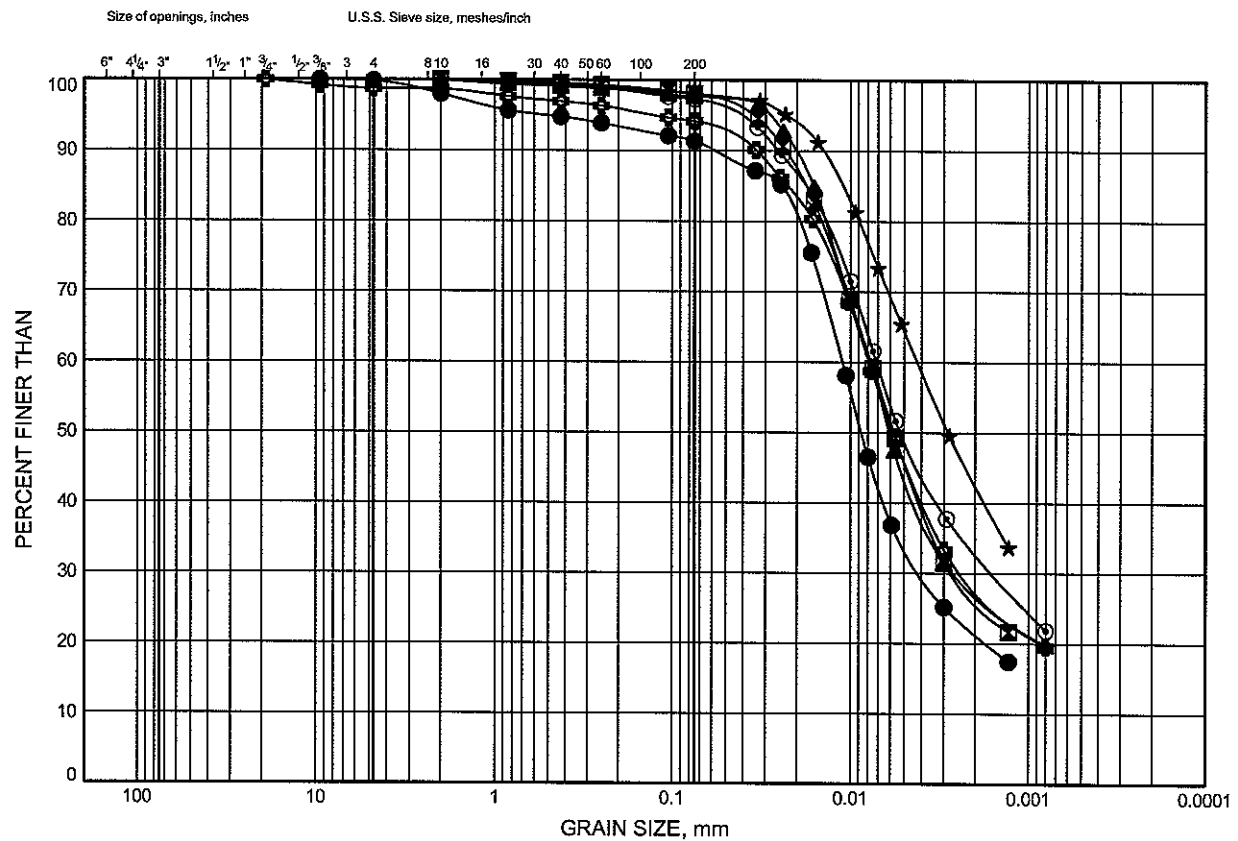


Prep'd JS
Chkd. MP

GRAIN SIZE DISTRIBUTION

FIGURE B3-8

SILTY CLAY

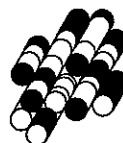


COBBLE SIZE	COARSE	FINE	COARSE	MEDIUM	FINE	SILT and CLAY
	GRAVEL		SAND			FINE GRAINED

SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	WN1	7.8	175.3
⊠	WN1	10.9	172.2
▲	WN1	13.9	169.2
★	WN2	1.0	180.6
⊙	WN2	4.0	177.6
⊕	WN2	6.3	175.3

Date August 2010

Project 1-09-4135



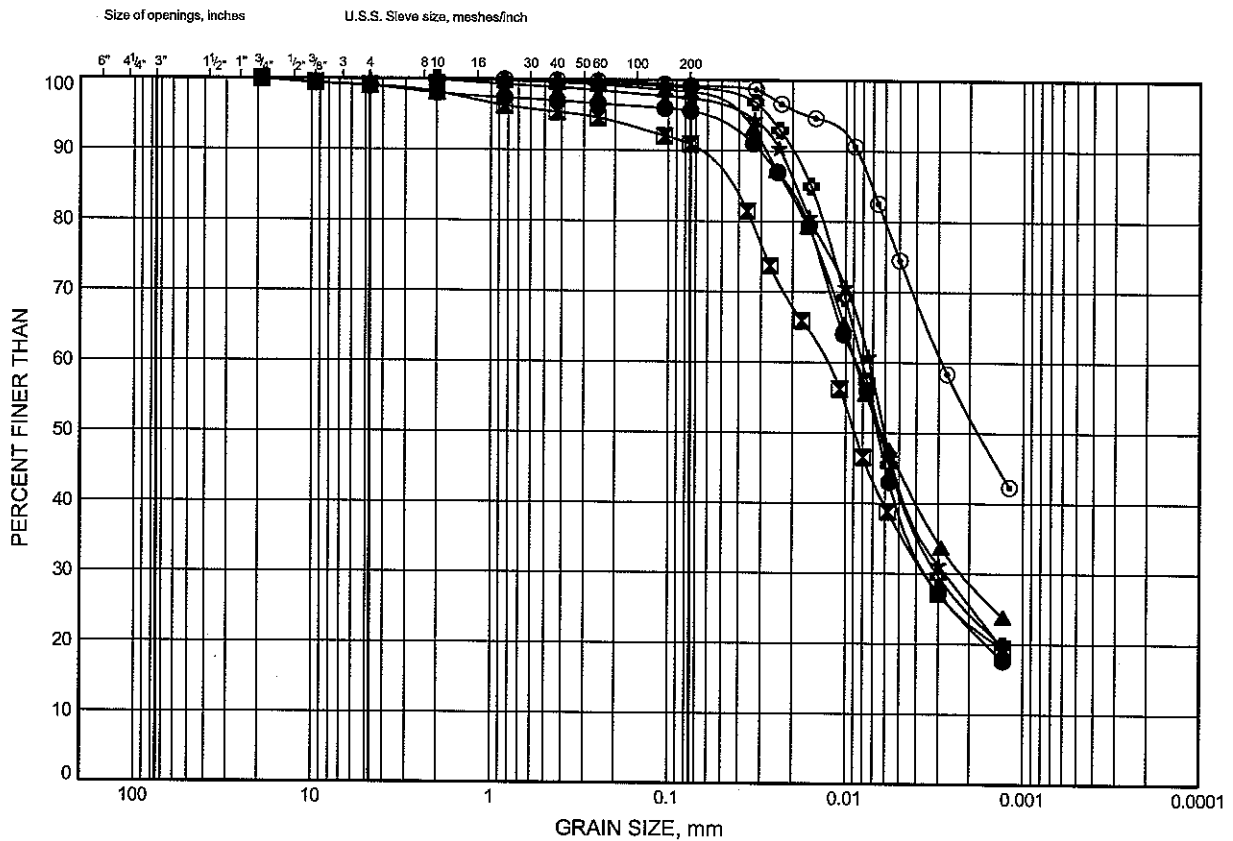
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GRAIN SIZE DISTRIBUTION

FIGURE B3-10

SILTY CLAY



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

SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	WN4	10.9	171.6
⊠	WN4	13.9	168.6
▲	WRW1	3.2	179.7
★	WRW1	7.8	175.1
⊙	WRW2	1.7	180.9
⊕	WRW2	6.3	176.3

Date August 2010
Project 1-09-4135

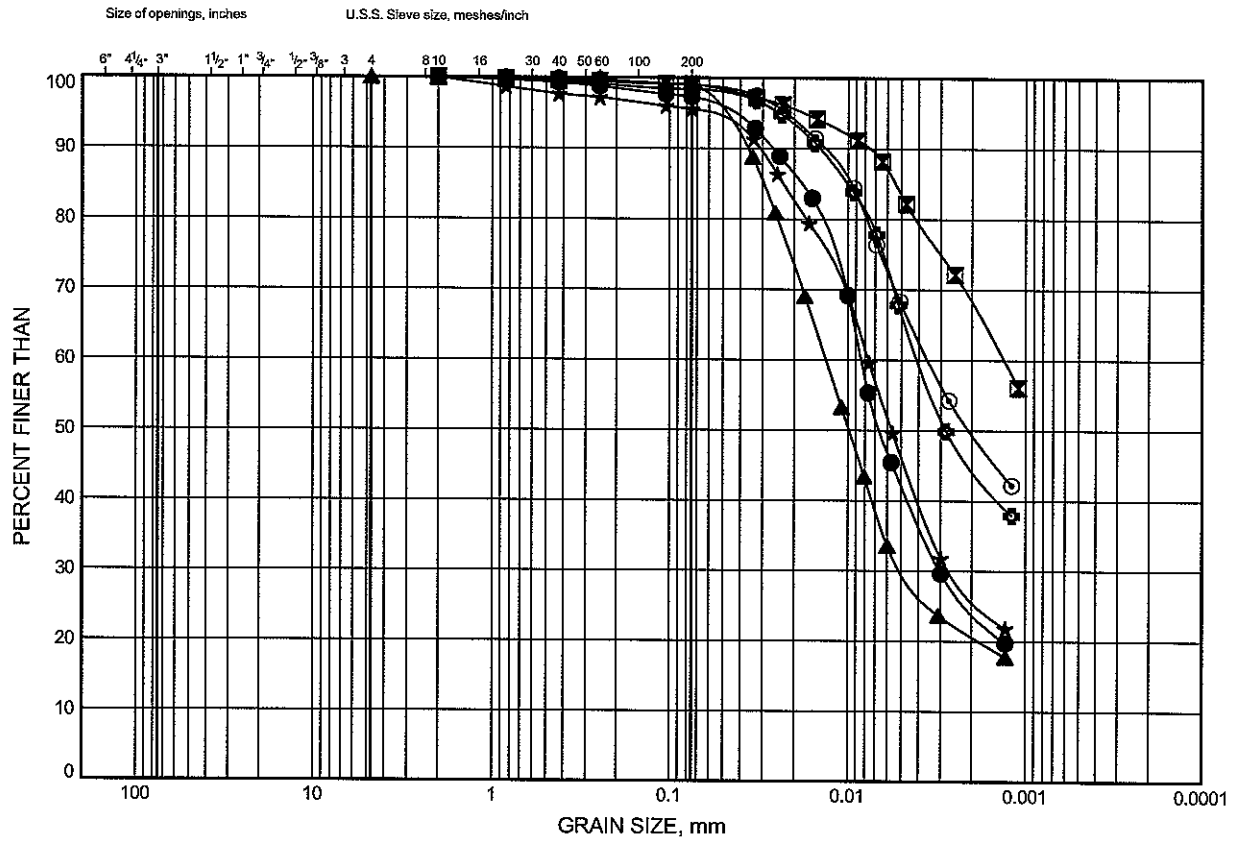


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Chkd. MP

GRAIN SIZE DISTRIBUTION

FIGURE B3-11

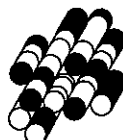
SILTY CLAY



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

SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	WRW2	12.4	170.2
⊠	WRW3	2.5	181.2
▲	WRW3	4.7	179.0
★	WRW3	7.8	175.9
⊙	WRW4	1.7	181.3
⊕	WRW4	4.0	179.0

Date August 2010
Project 1-09-4135

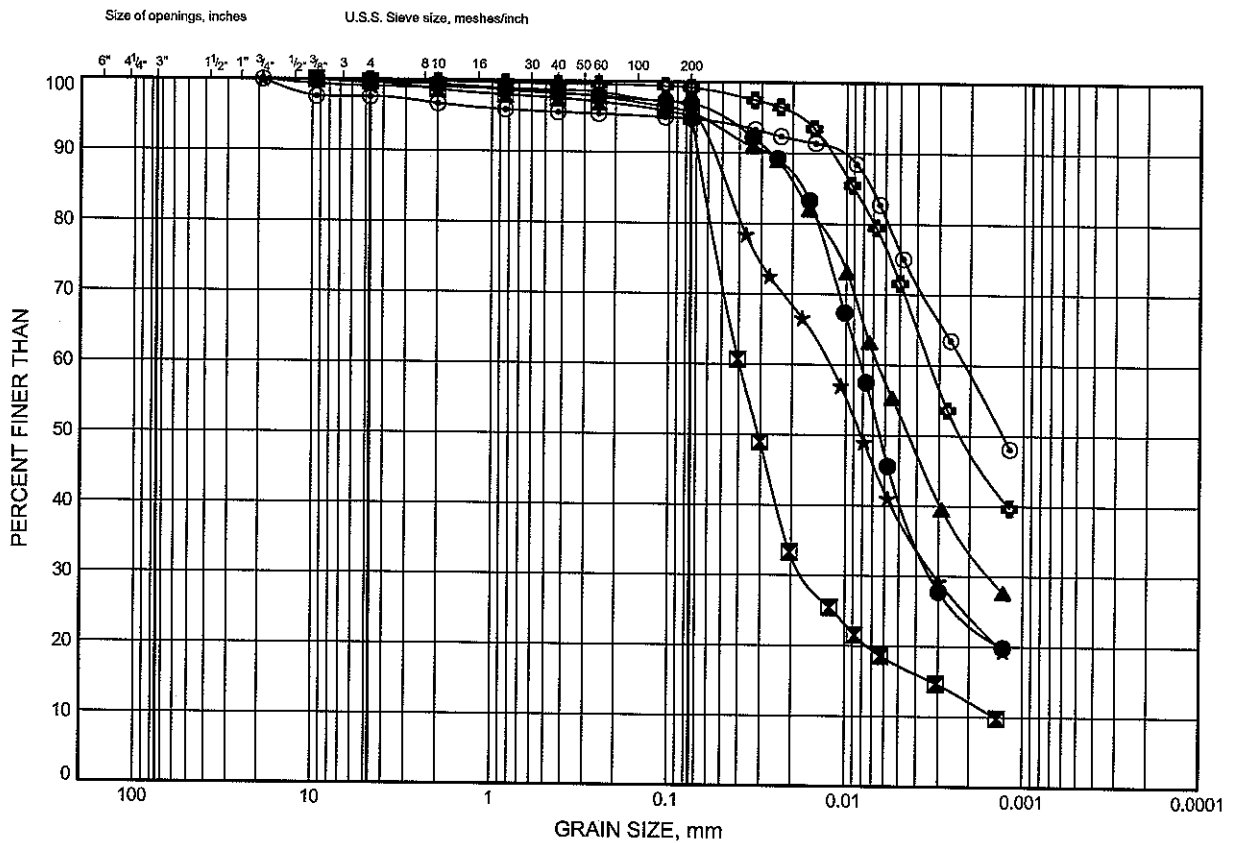


Prep'd JS
Chkd. MP

GRAIN SIZE DISTRIBUTION

FIGURE B3-12

SILTY CLAY



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

SYMBOL BOREHOLE DEPTH (m) ELEVATION (m)

●	WRW4	10.9	172.1
⊠	WS1	7.8	174.9
▲	WS1	9.3	173.4
★	WS1	13.9	168.8
⊙	WS2	1.0	182.1
⊕	WS2	2.5	180.6

Date August 2010

Project 1-09-4135



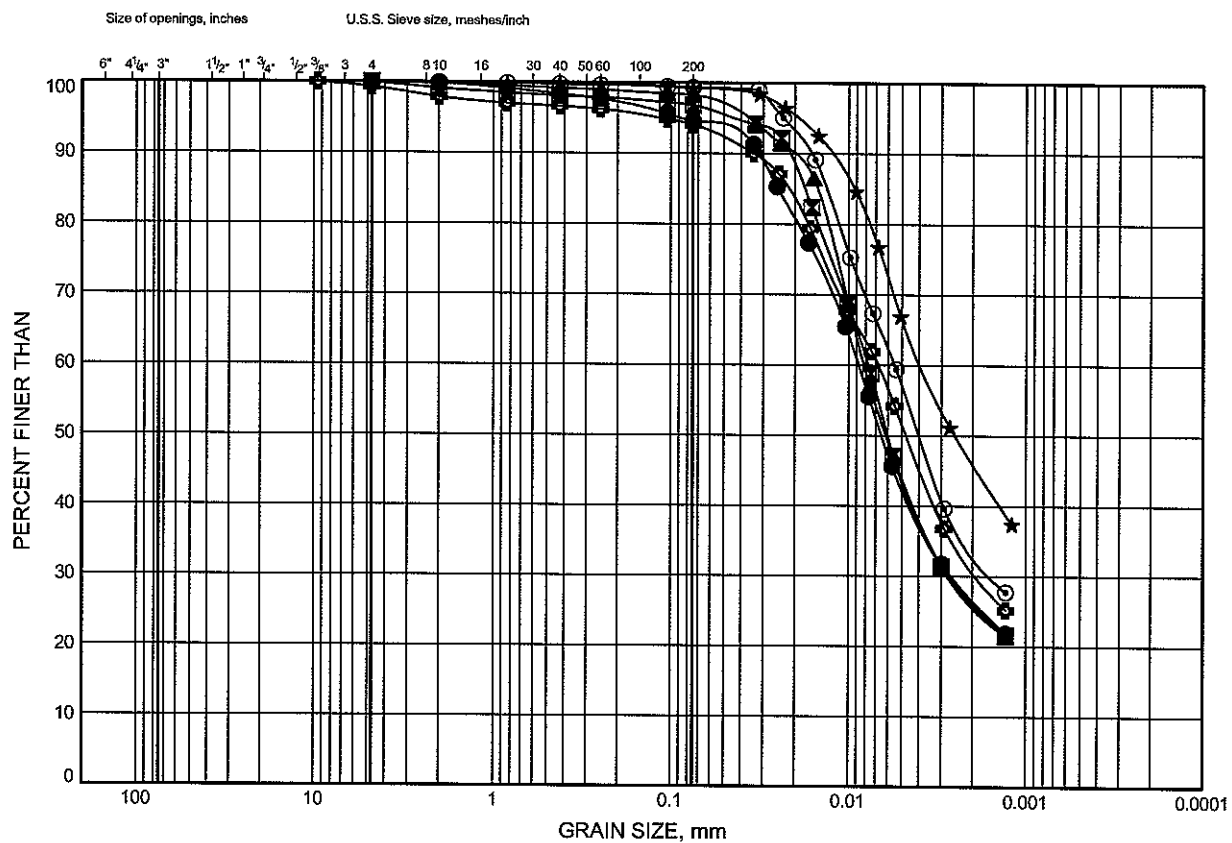
Prep'd JS

Chkd. MP

GRAIN SIZE DISTRIBUTION

FIGURE B3-13

SILTY CLAY



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

SYMBOL BOREHOLE DEPTH (m) ELEVATION (m)

●	WS2	6.3	176.8
⊠	WS2	10.9	172.2
▲	WS2	12.4	170.7
★	WS3	3.2	179.8
⊙	WS3	4.7	178.3
⊕	WS3	7.8	175.2

Date August 2010

Project 1-09-4135



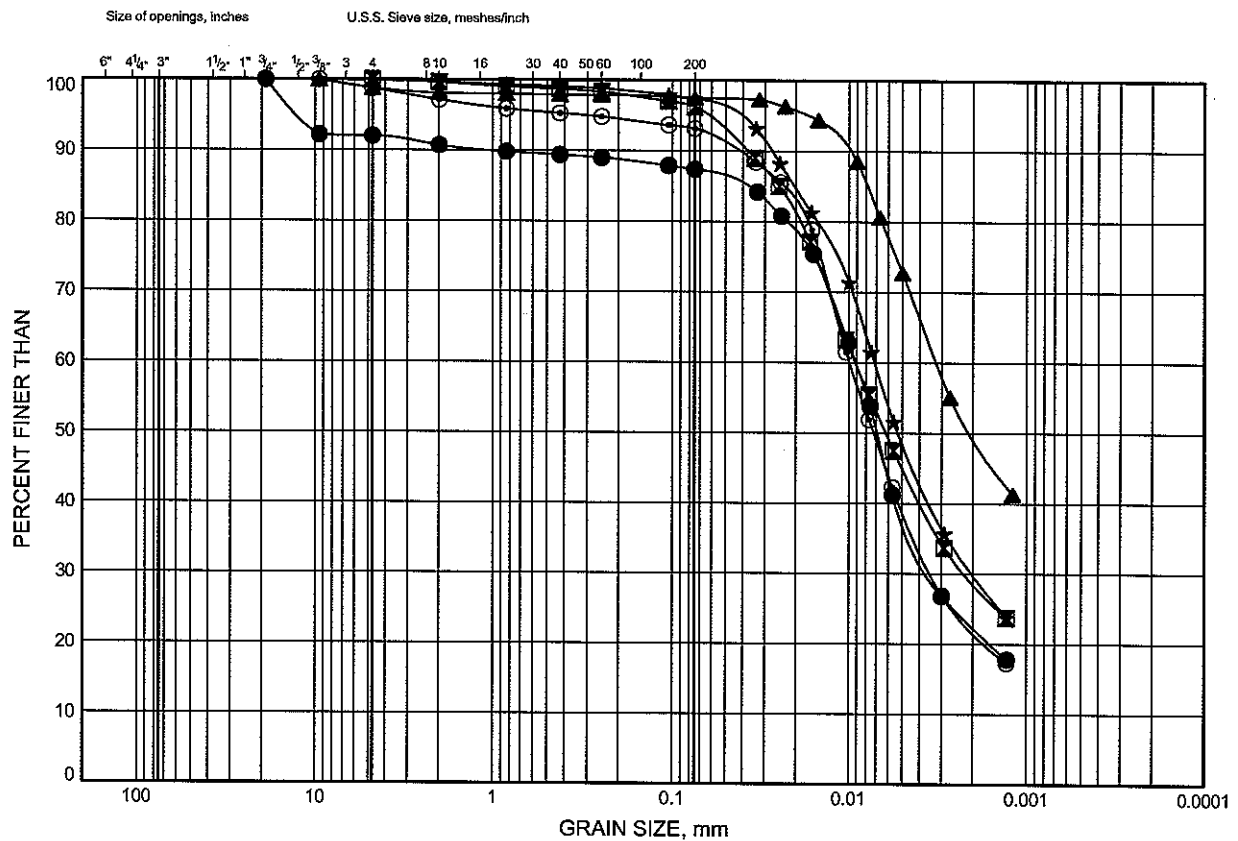
Prep'd JS

Chkd. MP

GRAIN SIZE DISTRIBUTION

FIGURE B3-14

SILTY CLAY

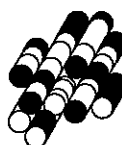


COBBLE SIZE	COARSE	FINE	COARSE	MEDIUM	FINE	SILT and CLAY
	GRAVEL		SAND			FINE GRAINED

SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	WS3	10.9	172.1
⊠	WS3	13.9	169.1
▲	WS4	2.5	180.2
★	WS4	9.3	173.4
⊙	WS4	12.4	170.3

Date August 2010

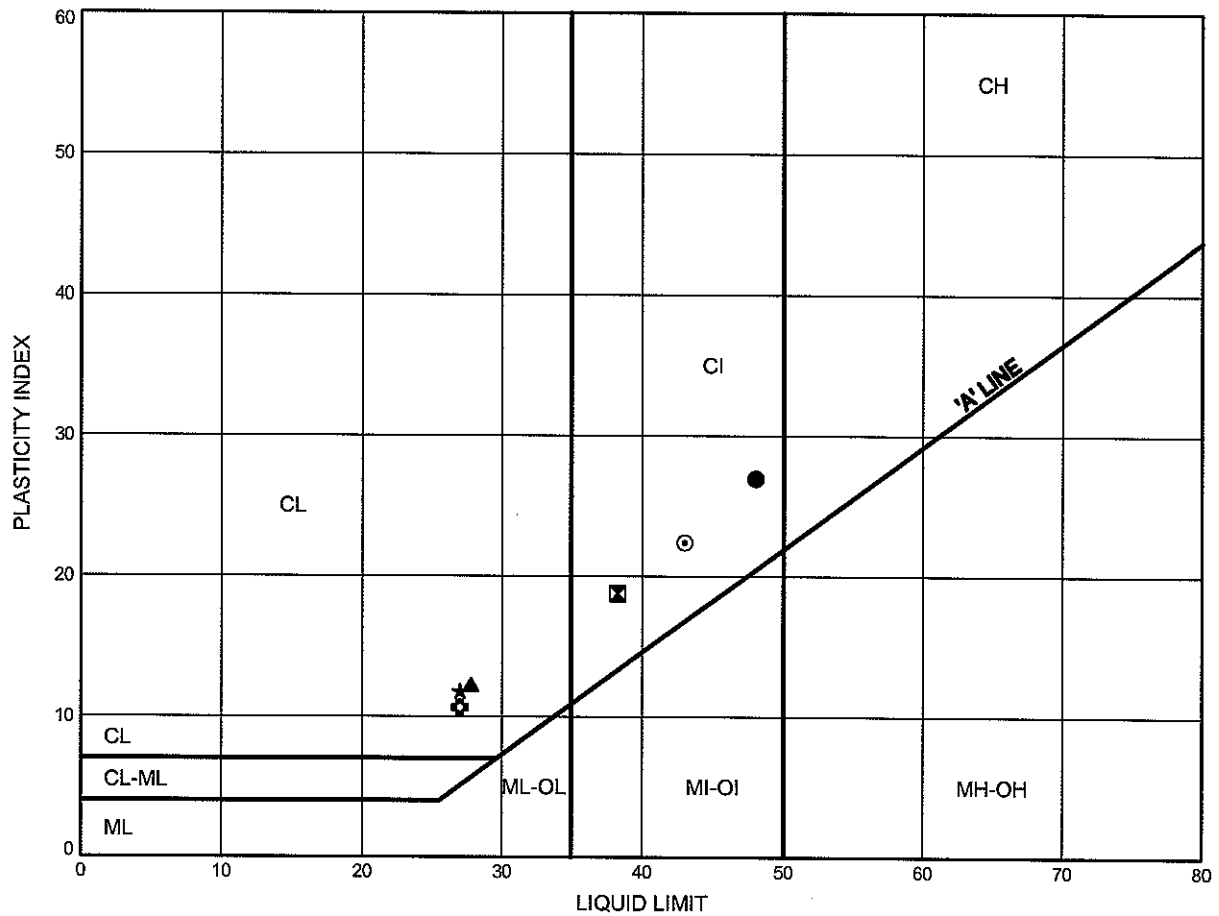
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FIGURE B3-15



SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	NBL 12+695Lt	1.7	181.2
⊠	NBL 12+695Lt	3.2	179.7
▲	NBL 12+695Lt	6.3	176.6
★	NBL 12+695Lt	9.3	173.6
⊙	NBL 12+750Rt	1.7	181.1
⊕	NBL 12+750Rt	4.7	178.1

Date August 2010
Project 1-09-4135

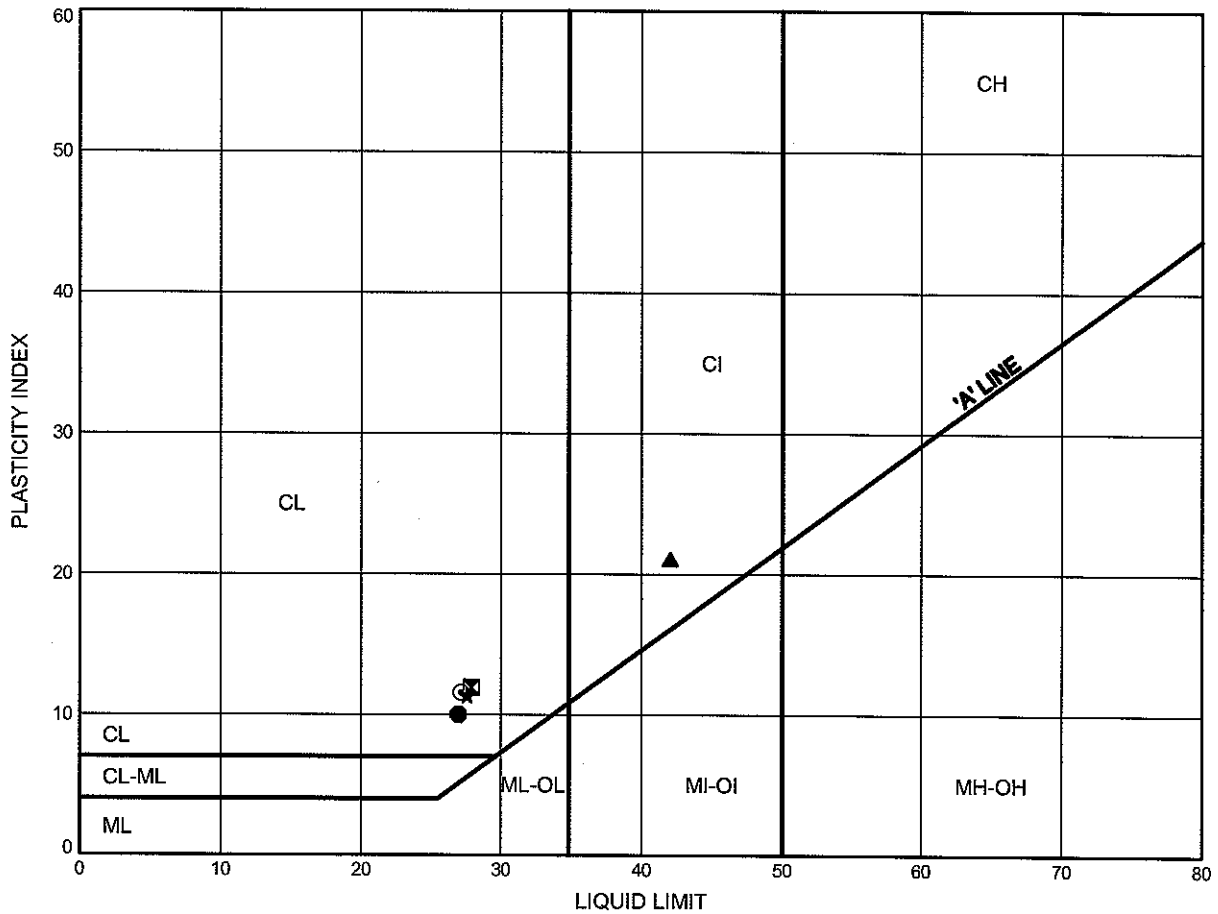


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Chkd. MP

ATTERBERG LIMITS TEST RESULTS

FIGURE B3-16

SILTY CLAY



SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	NBL 12+750Rt	9.3	173.5
⊠	NBL 12+750Rt	12.4	170.4
▲	SBL 12+685CL	2.5	180.2
★	SBL 12+685CL	6.3	176.4
⊙	SBL 12+685CL	9.3	173.4
⊕	SBL 12+685CL	10.9	171.8

Date August 2010
Project 1-09-4135

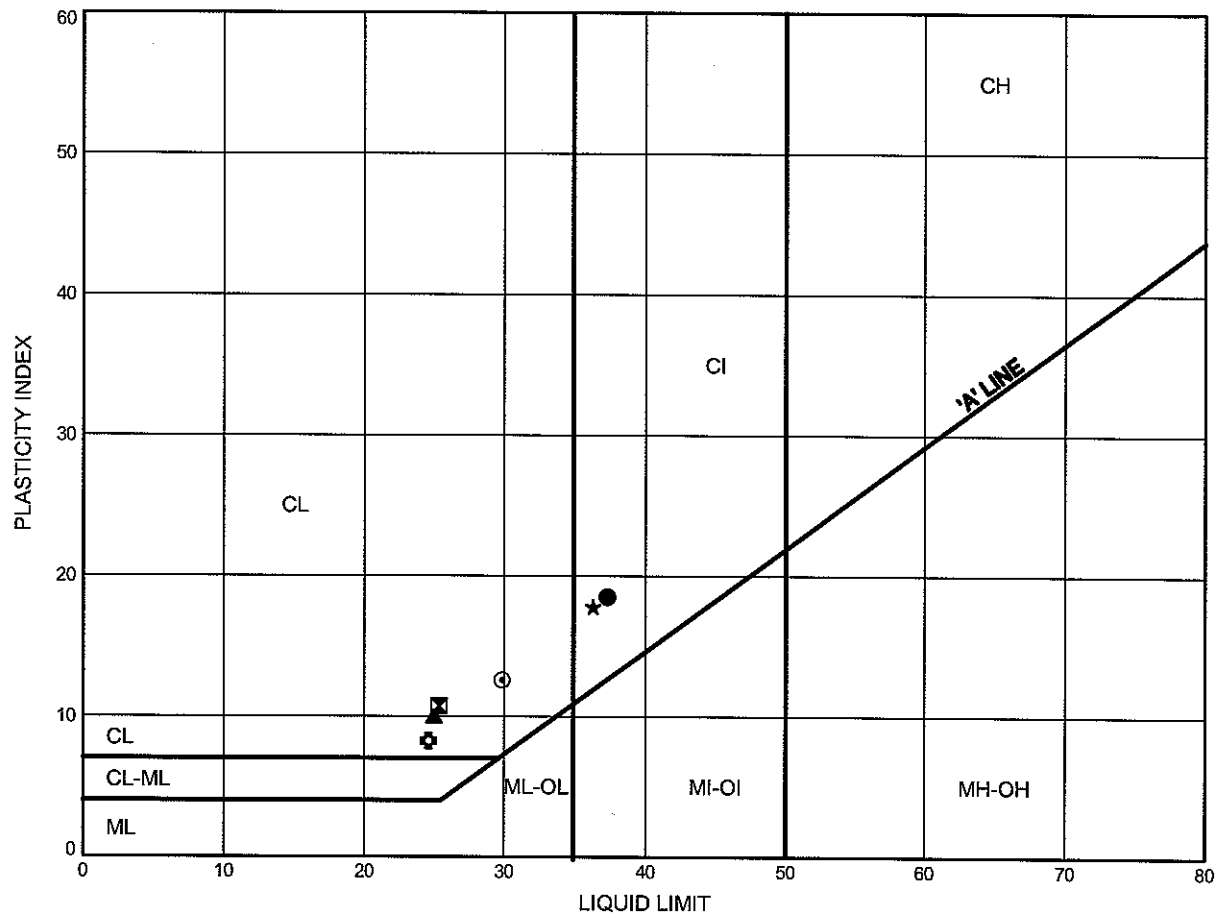


Prep'd JS
Chkd. MP

ATTERBERG LIMITS TEST RESULTS

FIGURE B3-17

SILTY CLAY



SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	SBL 12+750CL	3.2	179.7
⊠	SBL 12+750CL	7.8	175.1
▲	SBL 12+750CL	10.1	172.8
★	WN1	3.2	179.9
⊙	WN1	6.3	176.8
⊕	WN1	7.8	175.3

Date August 2010

Project 1-09-4135



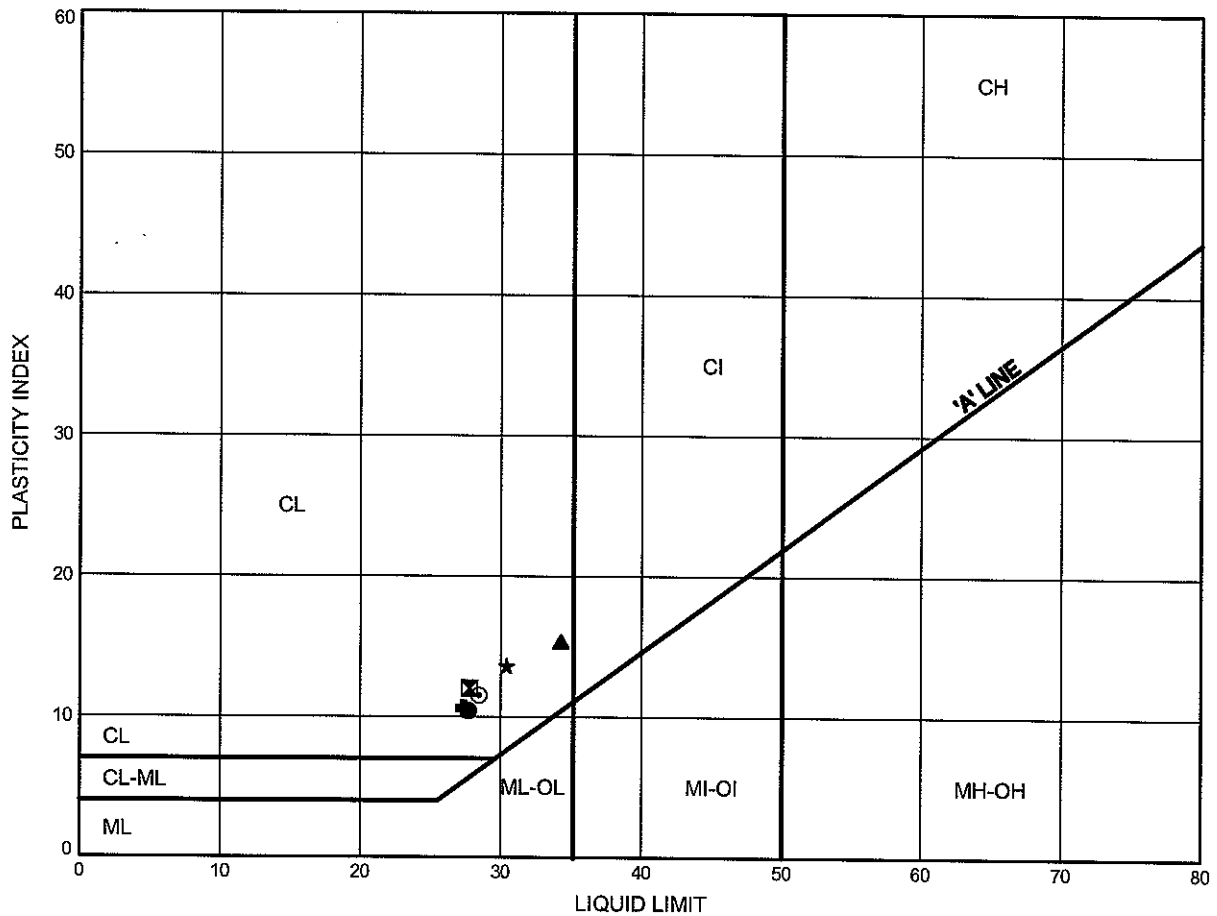
Prep'd JS

Chkd. MP

ATTERBERG LIMITS TEST RESULTS

FIGURE B3-18

SILTY CLAY



SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	WN1	10.9	172.2
⊠	WN1	13.9	169.2
▲	WN2	1.0	180.6
★	WN2	4.0	177.6
⊙	WN2	6.3	175.3
⊕	WN2	10.9	170.7

Date August 2010

Project 1-09-4135



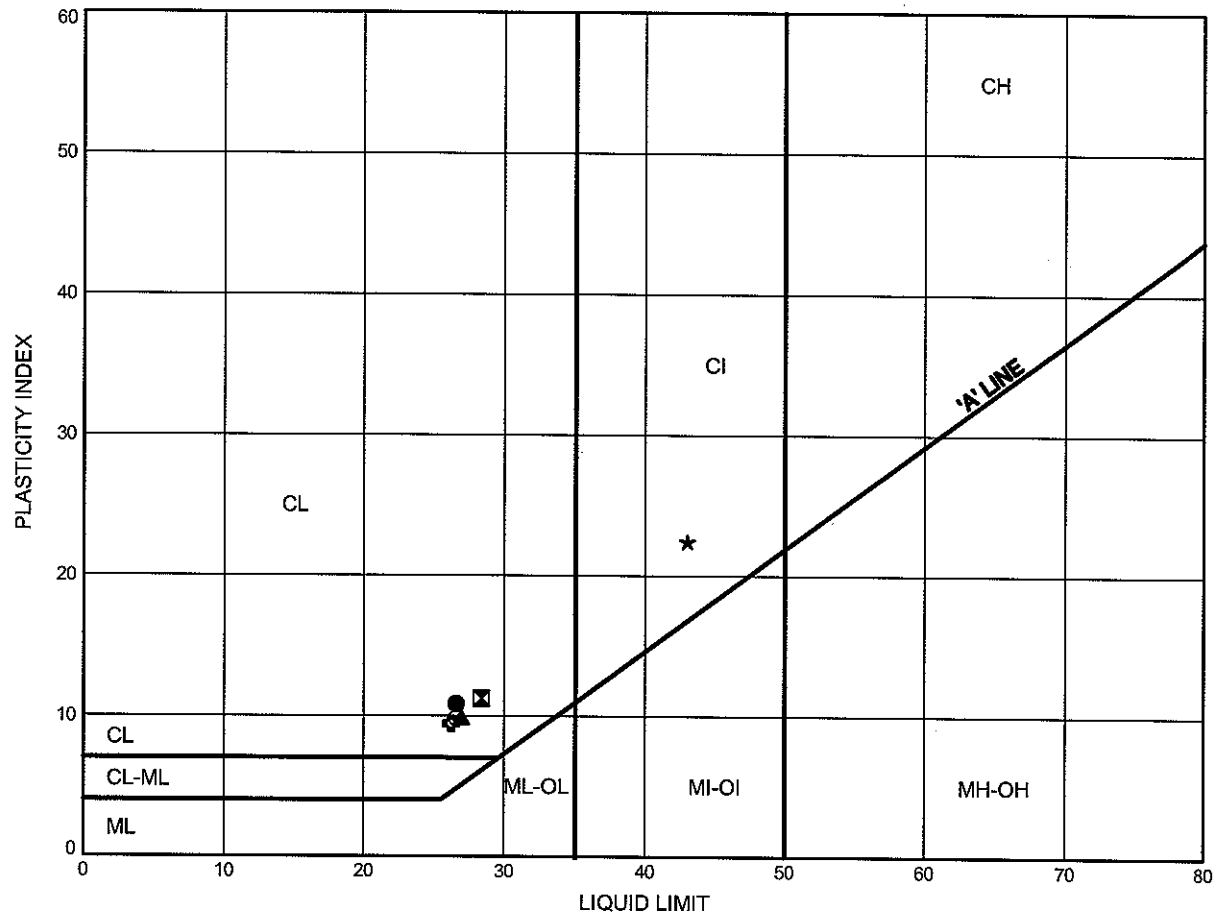
Prep'd JS

Chkd. MP

ATTERBERG LIMITS TEST RESULTS

FIGURE B3-19

SILTY CLAY



SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	WN3	7.8	174.3
⊠	WN3	9.3	172.8
▲	WN3	12.4	169.7
★	WN4	5.5	177.0
⊙	WN4	9.3	173.2
⊕	WN4	10.9	171.6

Date August 2010

Project 1-09-4135



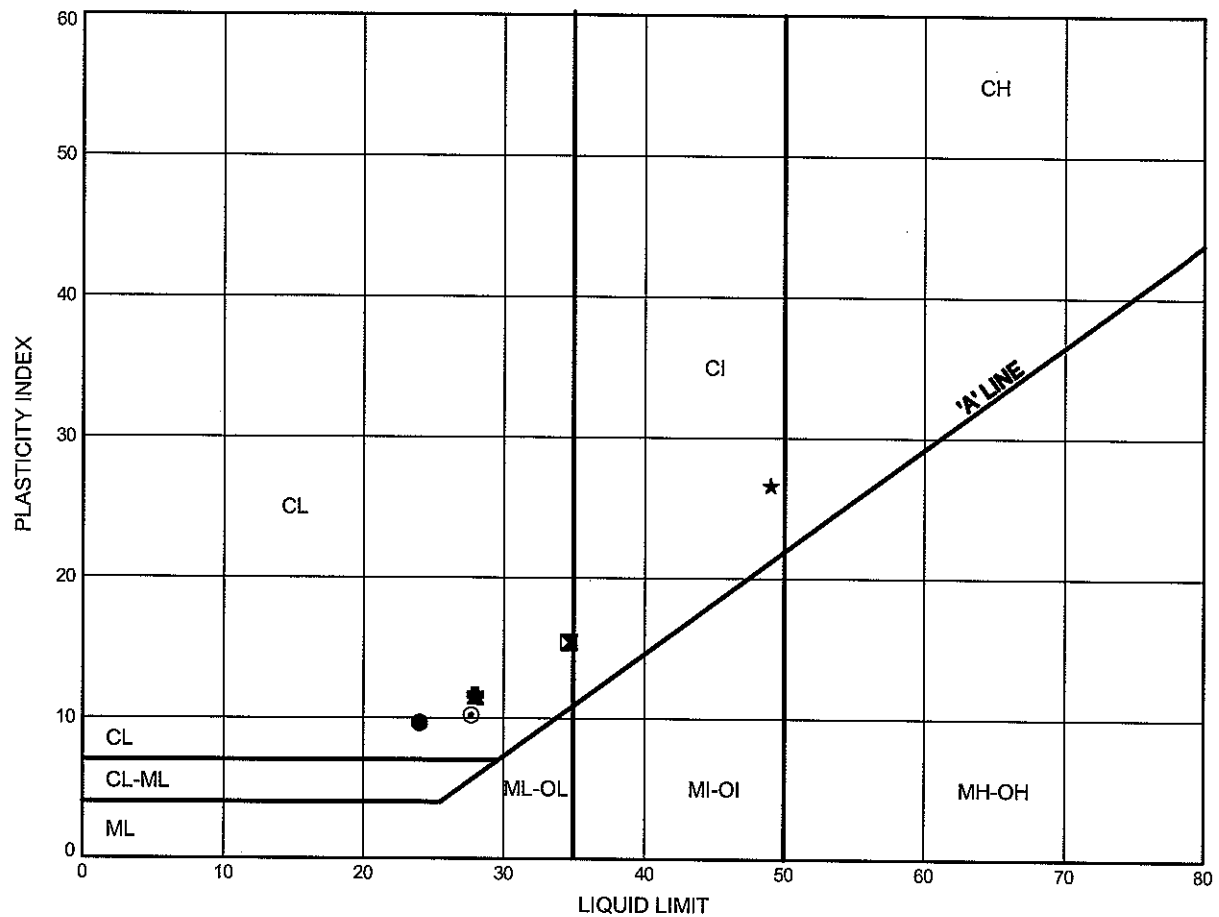
Prep'd JS

Chkd. MP

ATTERBERG LIMITS TEST RESULTS

FIGURE B3-20

SILTY CLAY



SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	WN4	13.9	168.6
⊠	WRW1	3.2	179.7
▲	WRW1	7.8	175.1
★	WRW2	1.7	180.9
⊙	WRW2	6.3	176.3
⊕	WRW2	12.4	170.2

Date August 2010

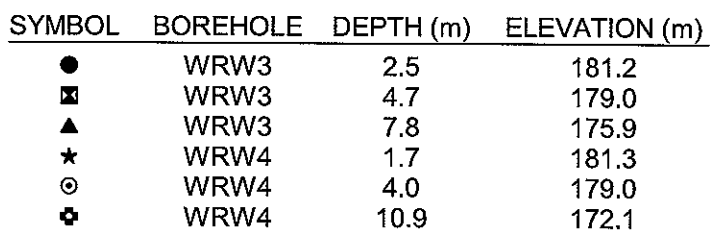
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FIGURE B3-21

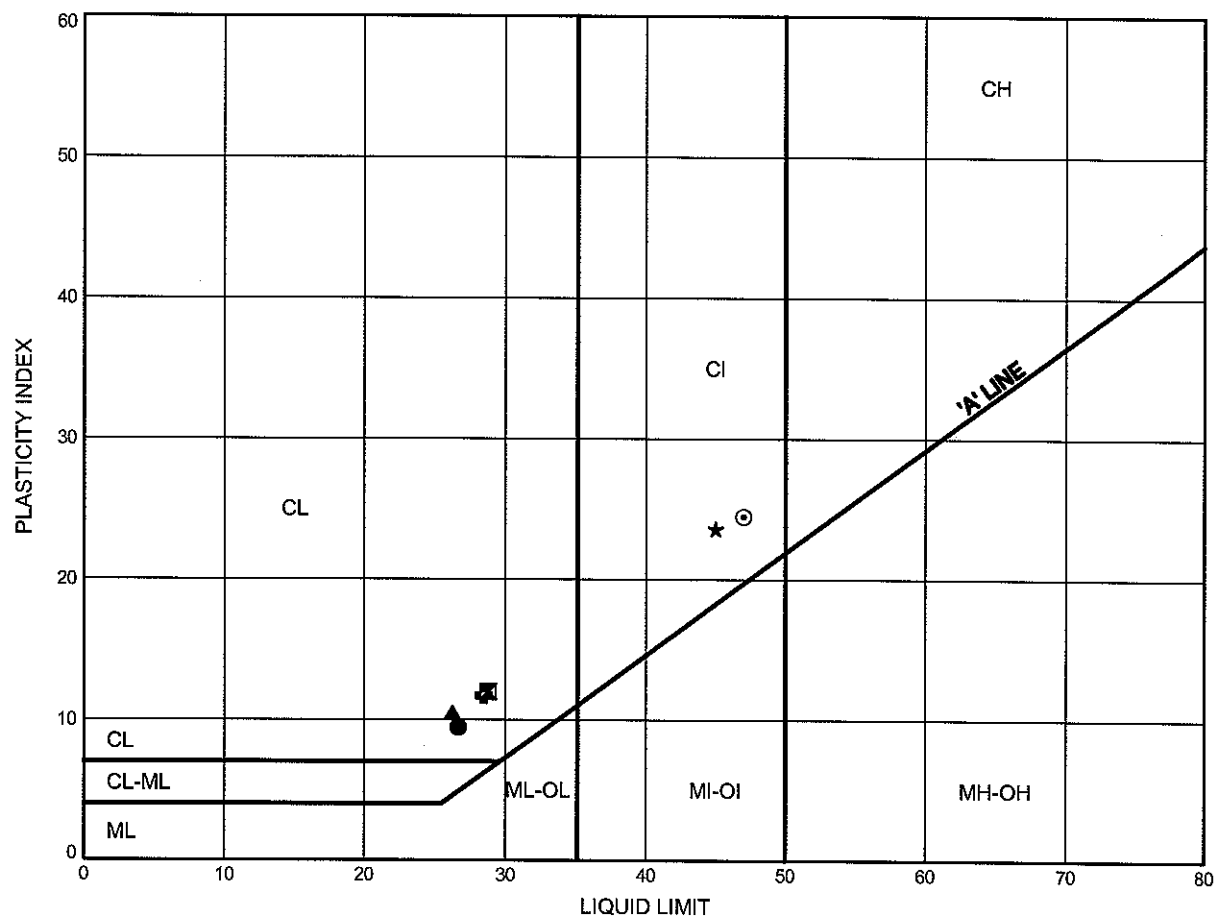


Prep'dJS.....
Chkd.MP.....

ATTERBERG LIMITS TEST RESULTS

FIGURE B3-22

SILTY CLAY



SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	WS1	7.8	174.9
⊠	WS1	9.3	173.4
▲	WS1	13.9	168.8
★	WS2	1.0	182.1
⊙	WS2	2.5	180.6
⊕	WS2	6.3	176.8

Date August 2010

Project 1-09-4135



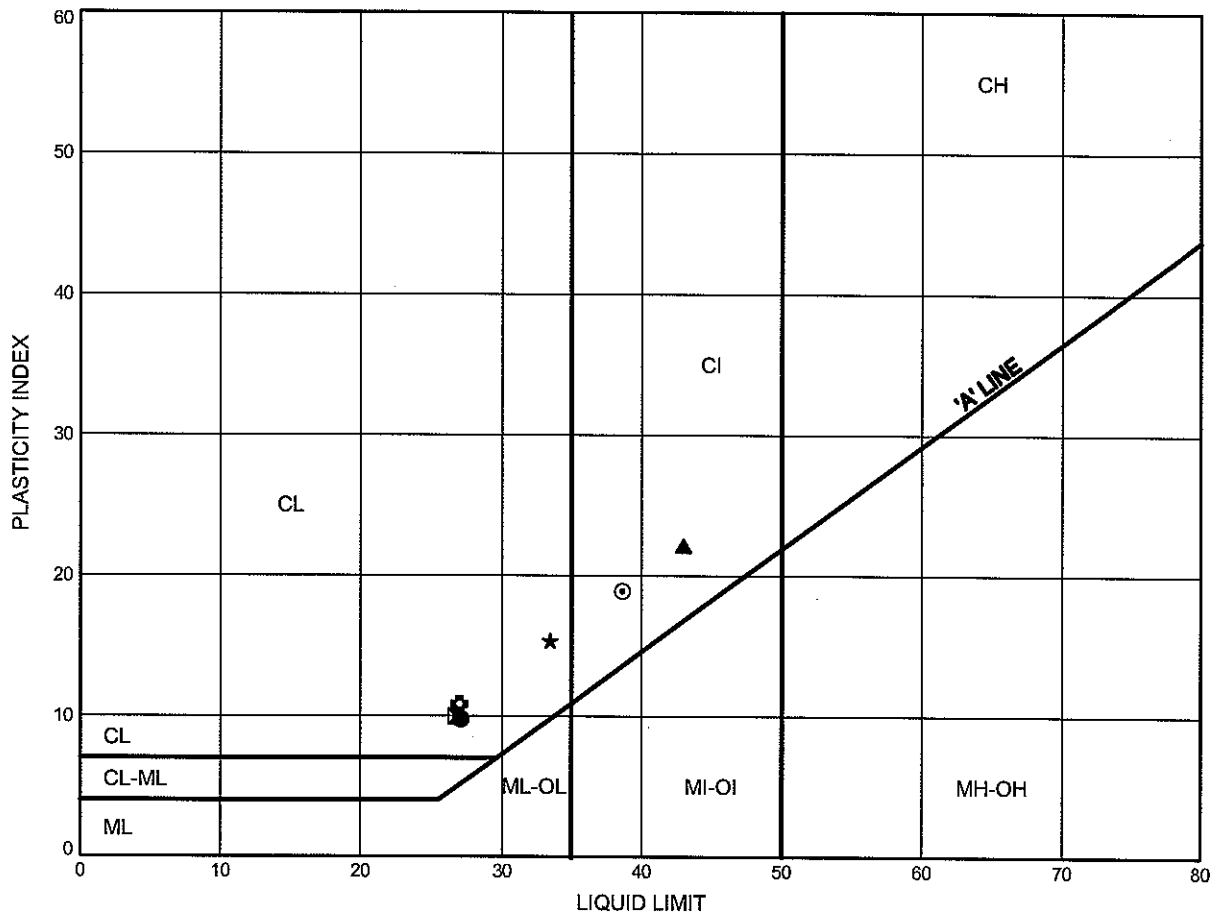
Prep'd JS

Chkd. MP

ATTERBERG LIMITS TEST RESULTS

FIGURE B3-23

SILTY CLAY



SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	WS2	10.9	172.2
⊠	WS2	12.4	170.7
▲	WS3	3.2	179.8
★	WS3	4.7	178.3
⊙	WS3	7.8	175.2
⊕	WS3	10.9	172.1

Date August 2010

Project 1-09-4135



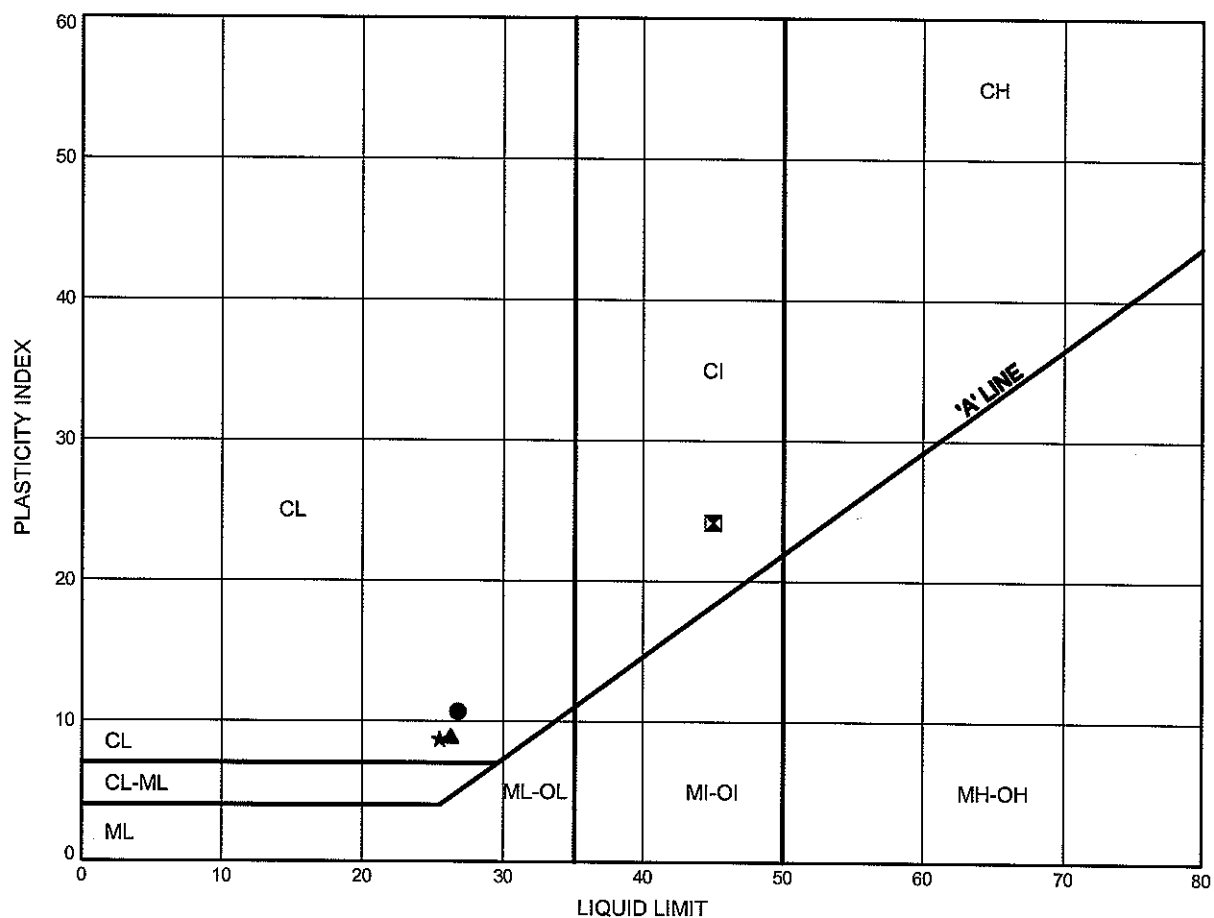
Prep'd JS

Chkd. MP

ATTERBERG LIMITS TEST RESULTS

FIGURE B3-24

SILTY CLAY



SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	WS3	13.9	169.1
⊠	WS4	2.5	180.2
▲	WS4	9.3	173.4
★	WS4	12.4	170.3

Date August 2010
Project 1-09-4135

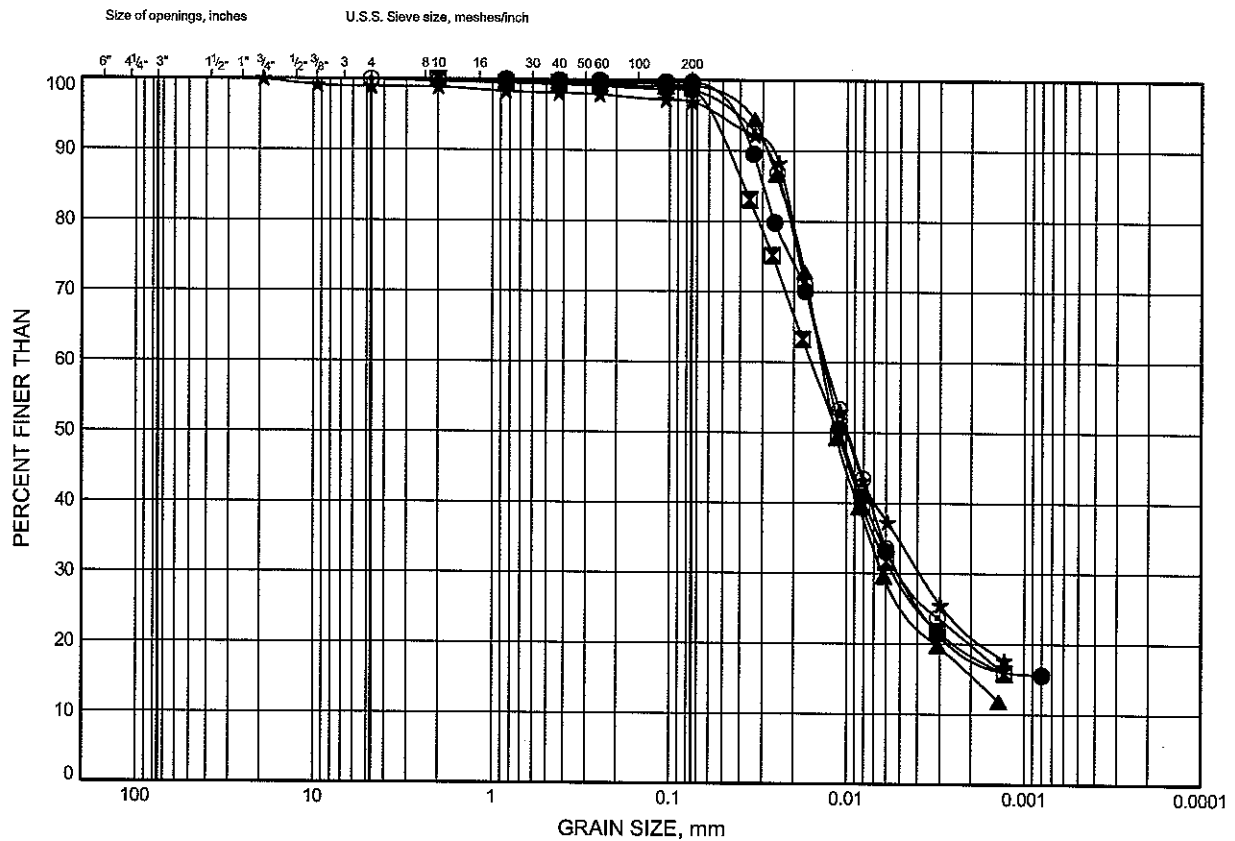


Prep'd JS
Chkd. MP

GRAIN SIZE DISTRIBUTION

FIGURE B3-25

SILT



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

SYMBOL BOREHOLE DEPTH (m) ELEVATION (m)

●	WN1	4.7	178.4
⊠	WN2	2.5	179.1
▲	WN3	4.0	178.1
★	WS1	4.7	178.0
⊙	WS2	4.7	178.4

Date August 2010
Project 1-09-4135

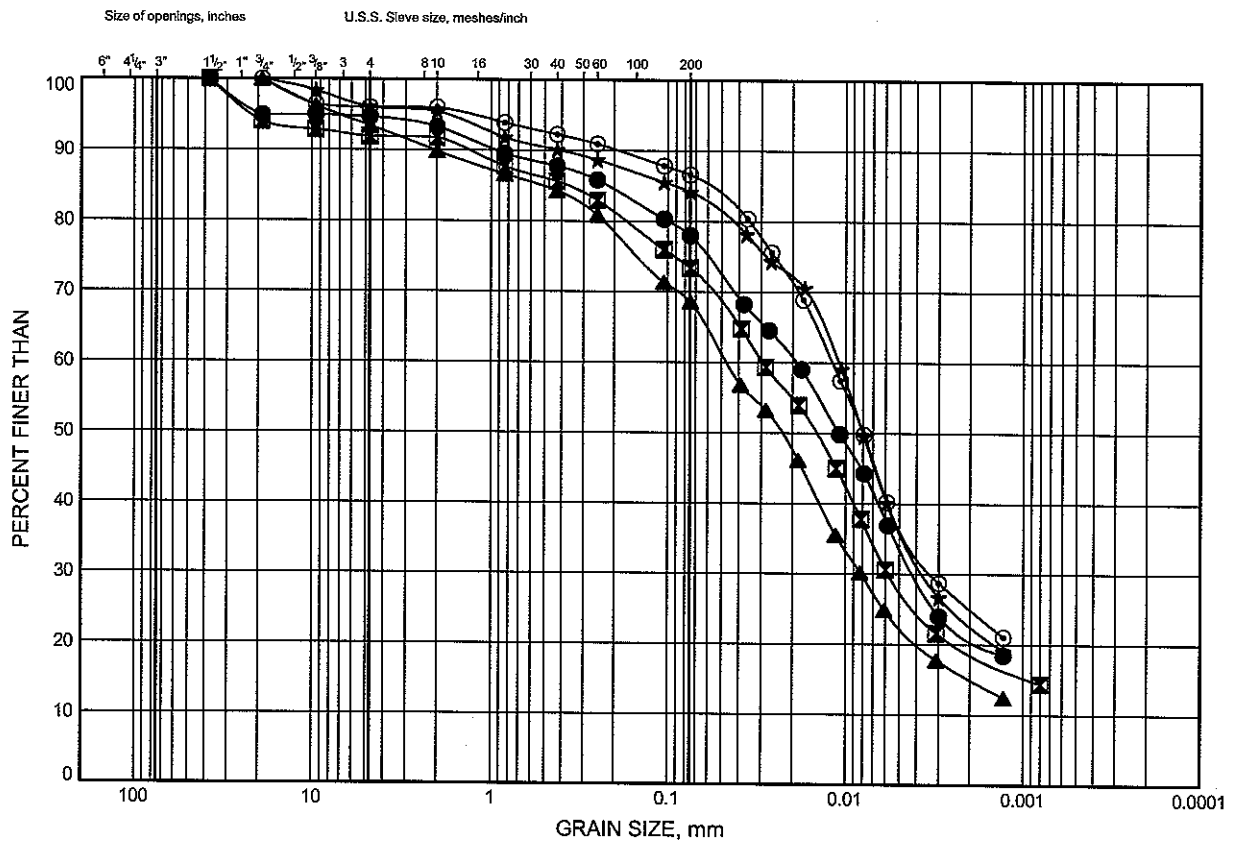


Prep'd JS
Chkd. MP

GRAIN SIZE DISTRIBUTION

FIGURE B3-26

SILTY CLAY TO CLAYEY SILT TILL



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

SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	WN1	15.4	167.7
⊠	WN2	13.9	167.7
▲	WN3	15.4	166.7
★	WRW2	15.4	167.2
⊙	WRW4	15.4	167.6

Date August 2010
Project 1-09-4135

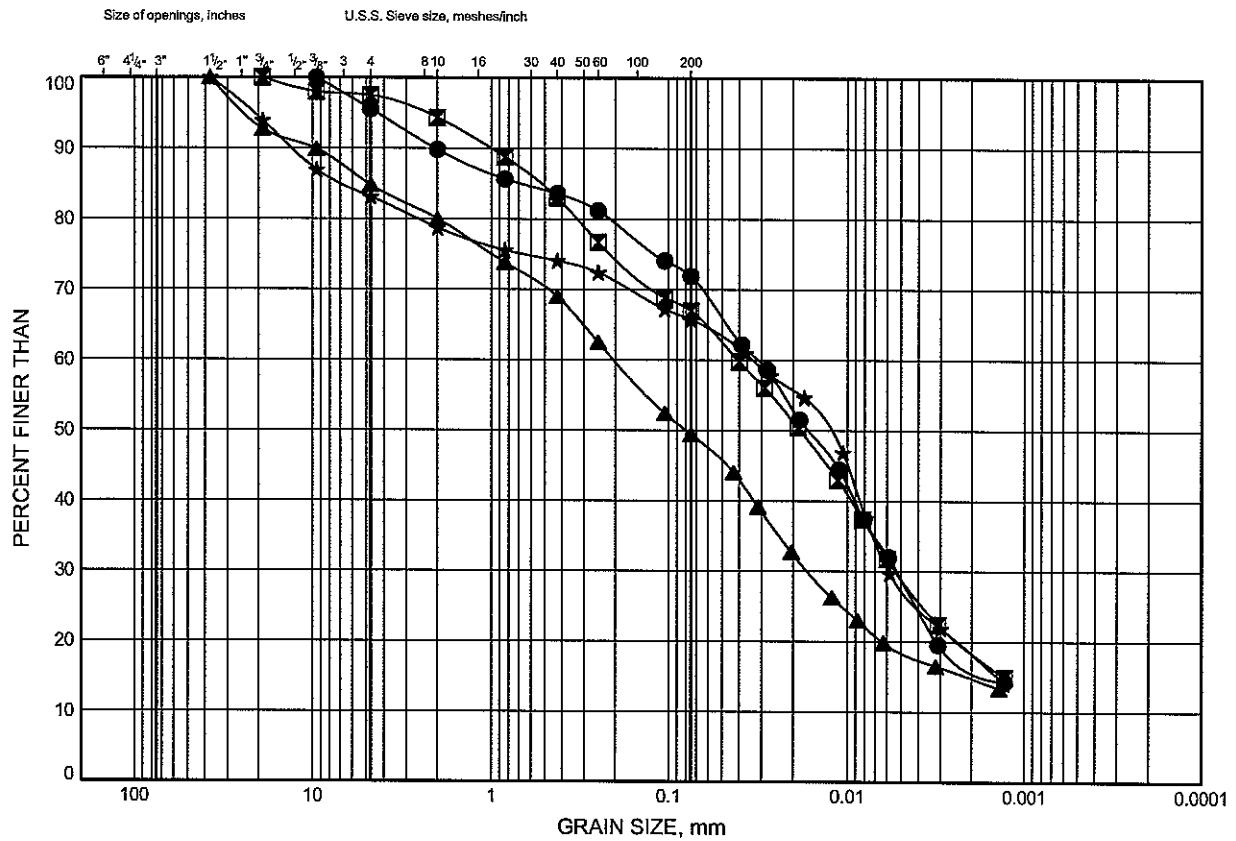


Prep'd JS
Chkd. MP

GRAIN SIZE DISTRIBUTION

FIGURE B3-27

SILTY CLAY TO CLAYEY SILT TILL



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

SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	WS1	15.4	167.3
■	WS1	21.5	161.2
▲	WS2	21.5	161.6
★	WS4	15.4	167.3

Date August 2010
Project 1-09-4135

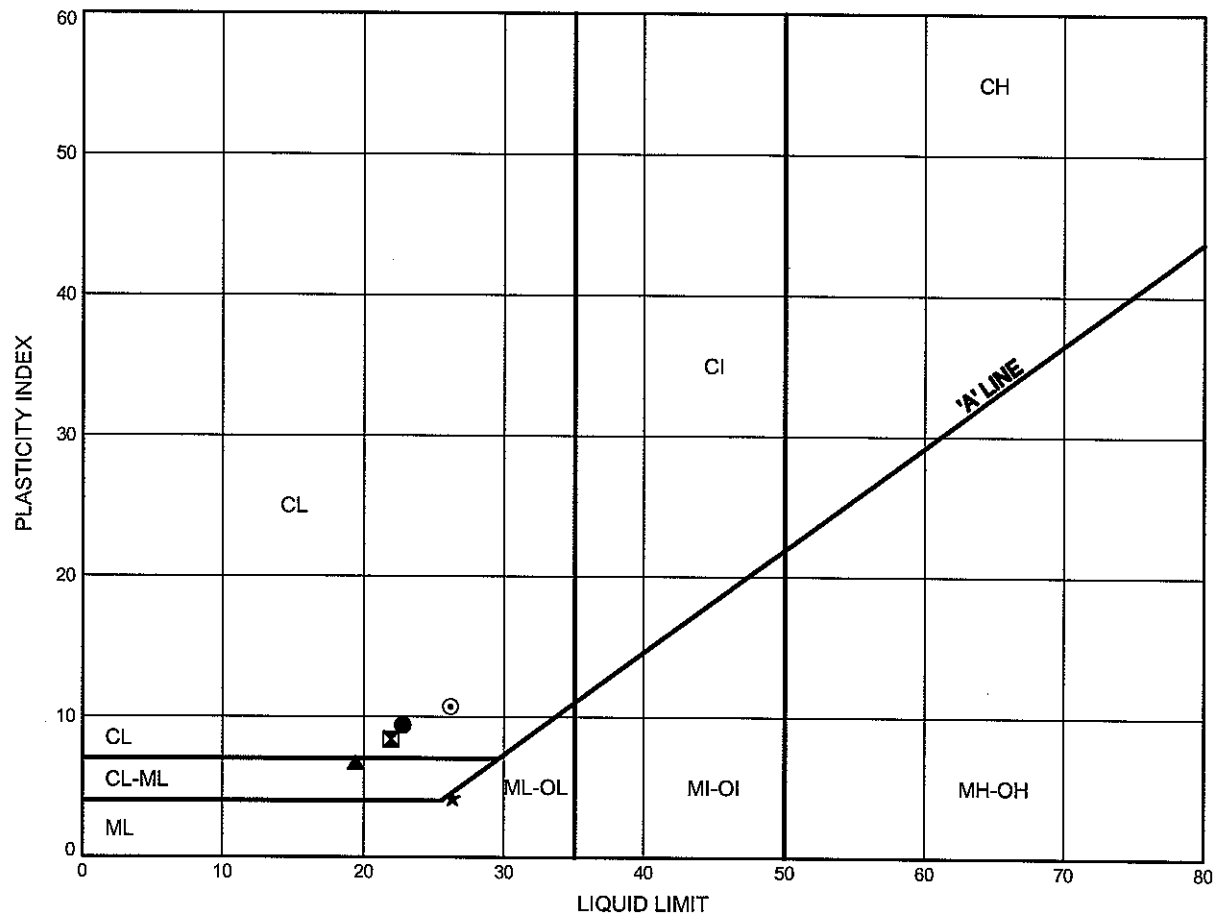


Prep'd JS
Chkd. MP

ATTERBERG LIMITS TEST RESULTS

FIGURE B3-28

SILTY CLAY TO CLAYEY SILT TILL



SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	WN1	15.4	167.7
⊠	WN2	13.9	167.7
▲	WN3	15.4	166.7
★	WRW2	15.4	167.2
⊙	WRW4	15.4	167.6

Date August 2010

Project 1-09-4135



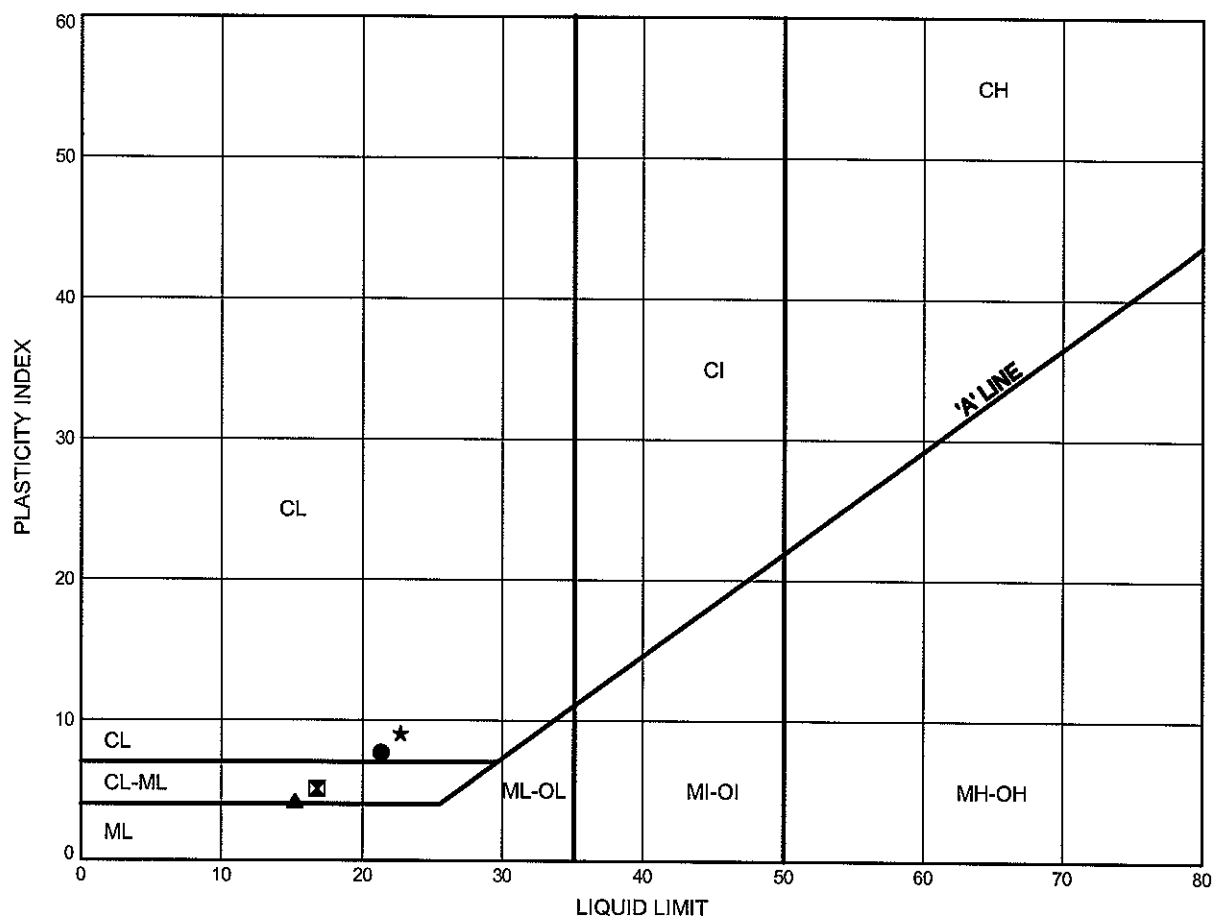
Prep'd JS

Chkd. MP

ATTERBERG LIMITS TEST RESULTS

FIGURE B3-29

SILTY CLAY TO CLAYEY SILT TILL



SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	WS1	15.4	167.3
⊠	WS1	21.5	161.2
▲	WS2	21.5	161.6
★	WS4	15.4	167.3

Date August 2010
Project 1-09-4135

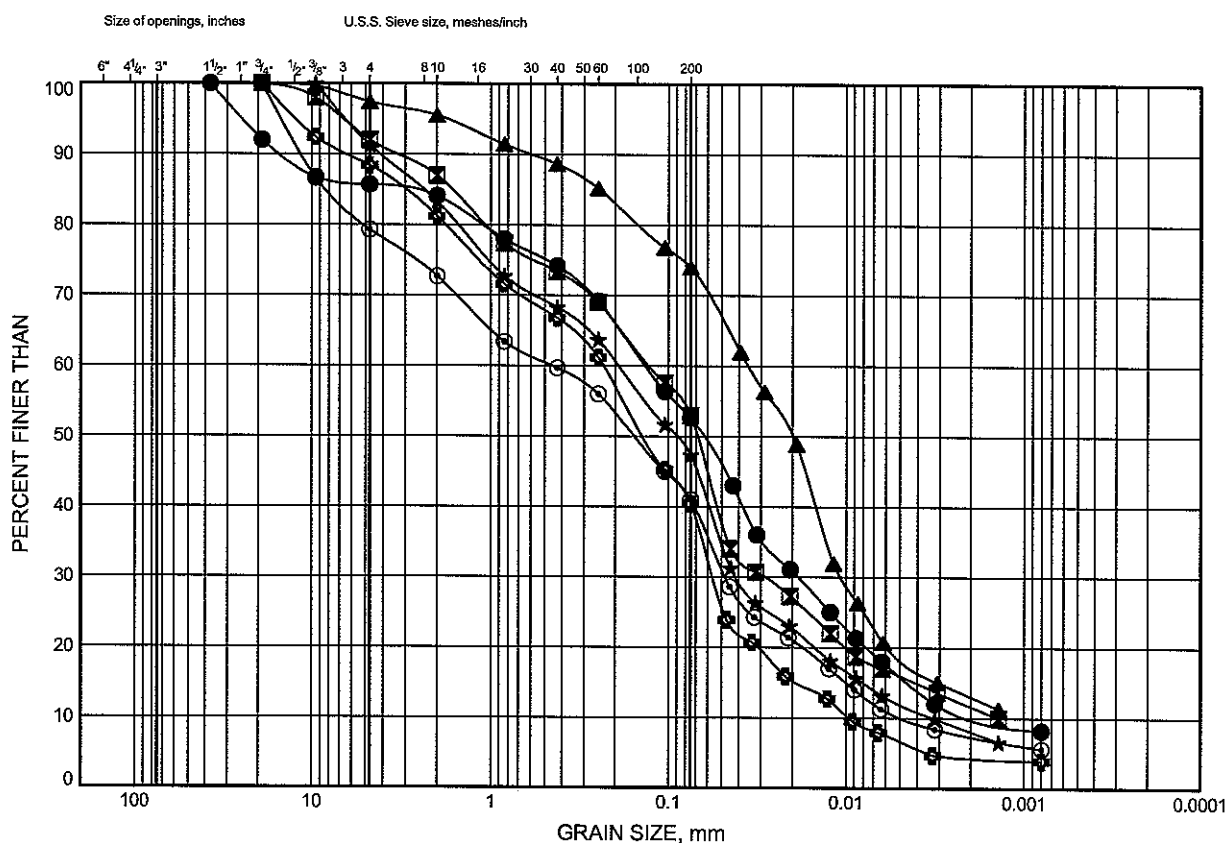


Prep'd JS
Chkd. MP

GRAIN SIZE DISTRIBUTION

FIGURE B3-30

SILTY SAND TO SANDY SILT TILL



SYMBOL BOREHOLE DEPTH (m) ELEVATION (m)

●	WN1	18.5	164.6
⊠	WN1	24.6	158.5
▲	WN2	17.0	164.6
★	WN2	20.0	161.6
⊙	WN2	21.5	160.1
⊕	WN3	18.5	163.6

Date August 2010

Project 1-09-4135...



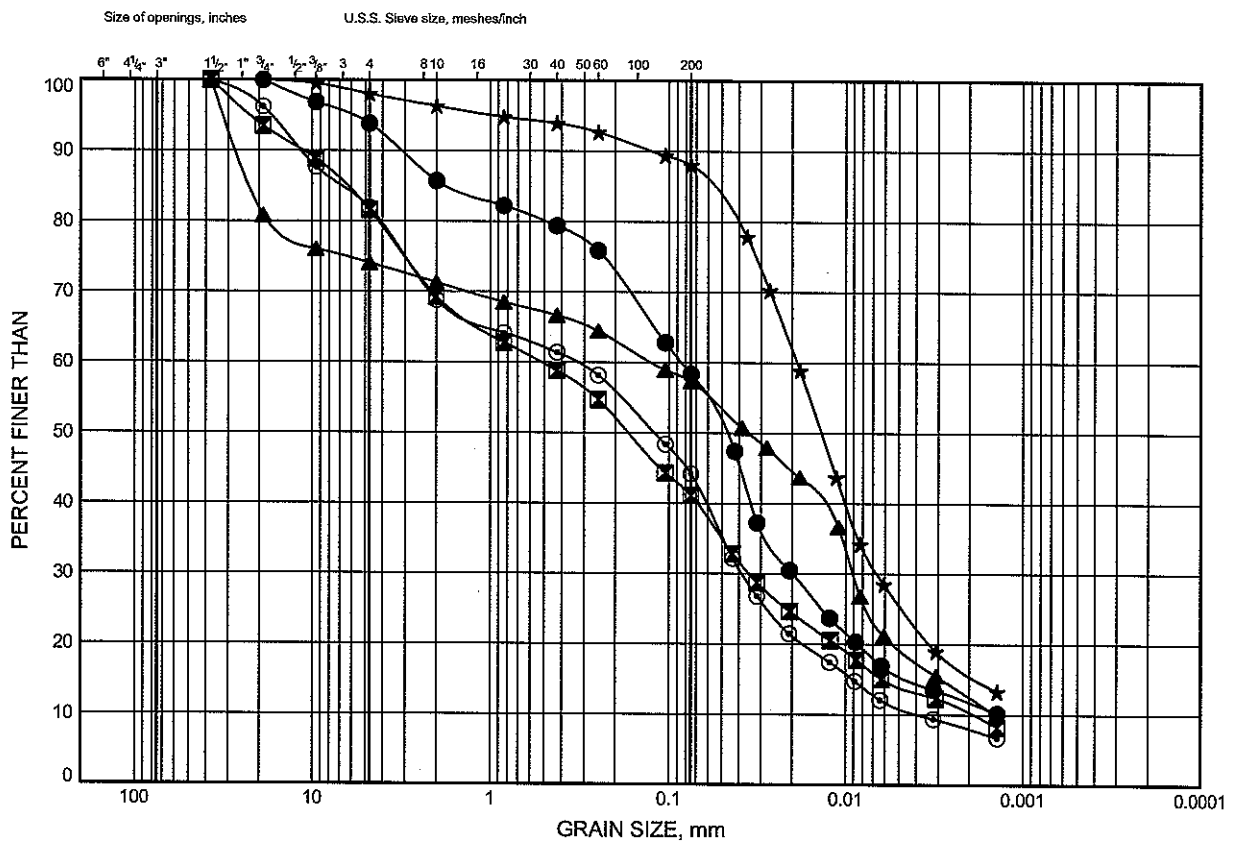
Prep'd JS

Chkd. MP

GRAIN SIZE DISTRIBUTION

FIGURE B3-31

SILTY SAND TO SANDY SILT TILL



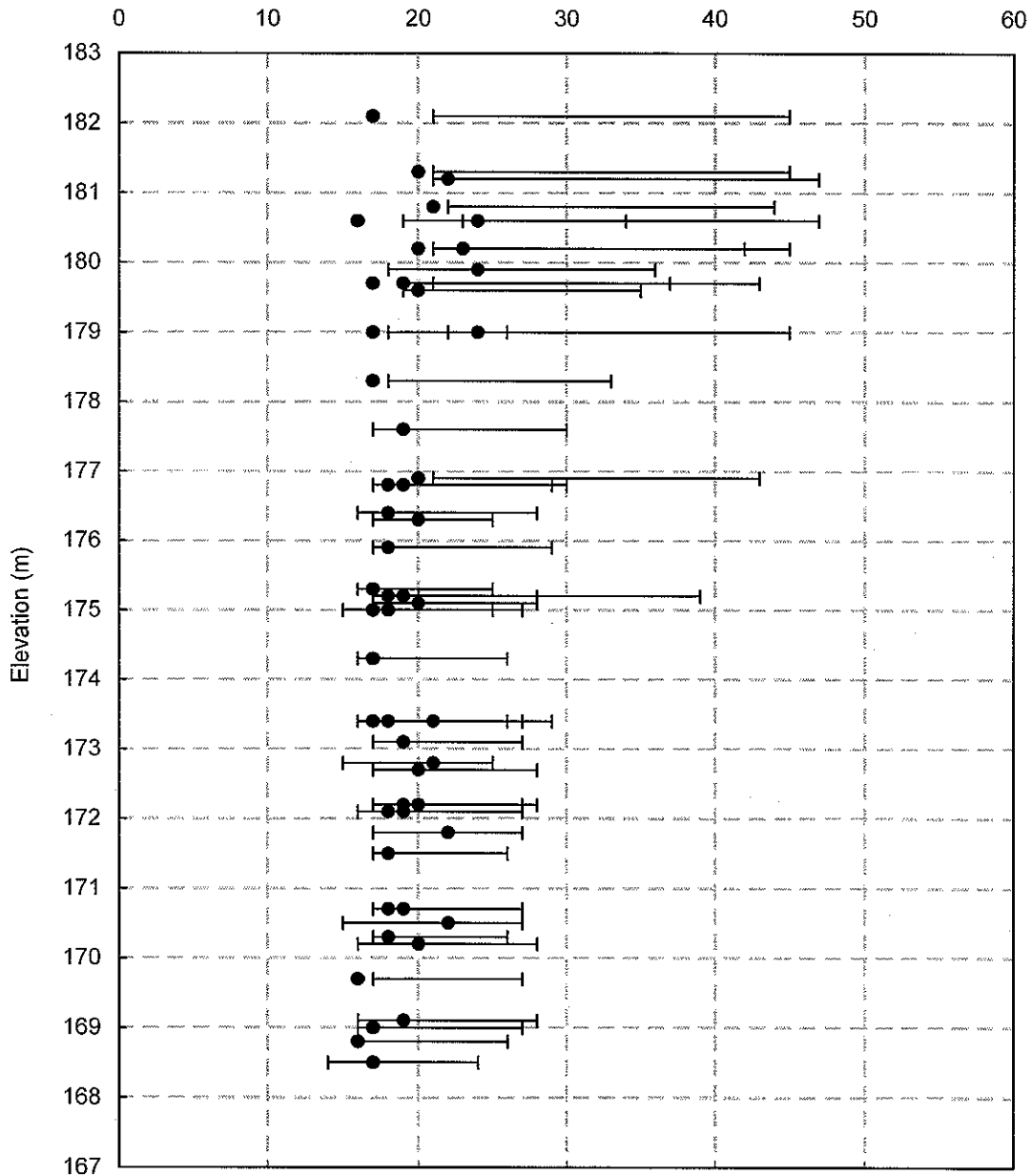
ATTERBERG LIMITS AND WATER CONTENTS

FIGURE B3-32

HWY 406 TWINNING - RETAINING WALL SITE #3

Silty Clay

Atterberg Limits & Water Contents (%)



Project No. : 1-09-4135

Date : November, 2010



Terraprobe Inc.

Prepared By : HW

Checked By : RA

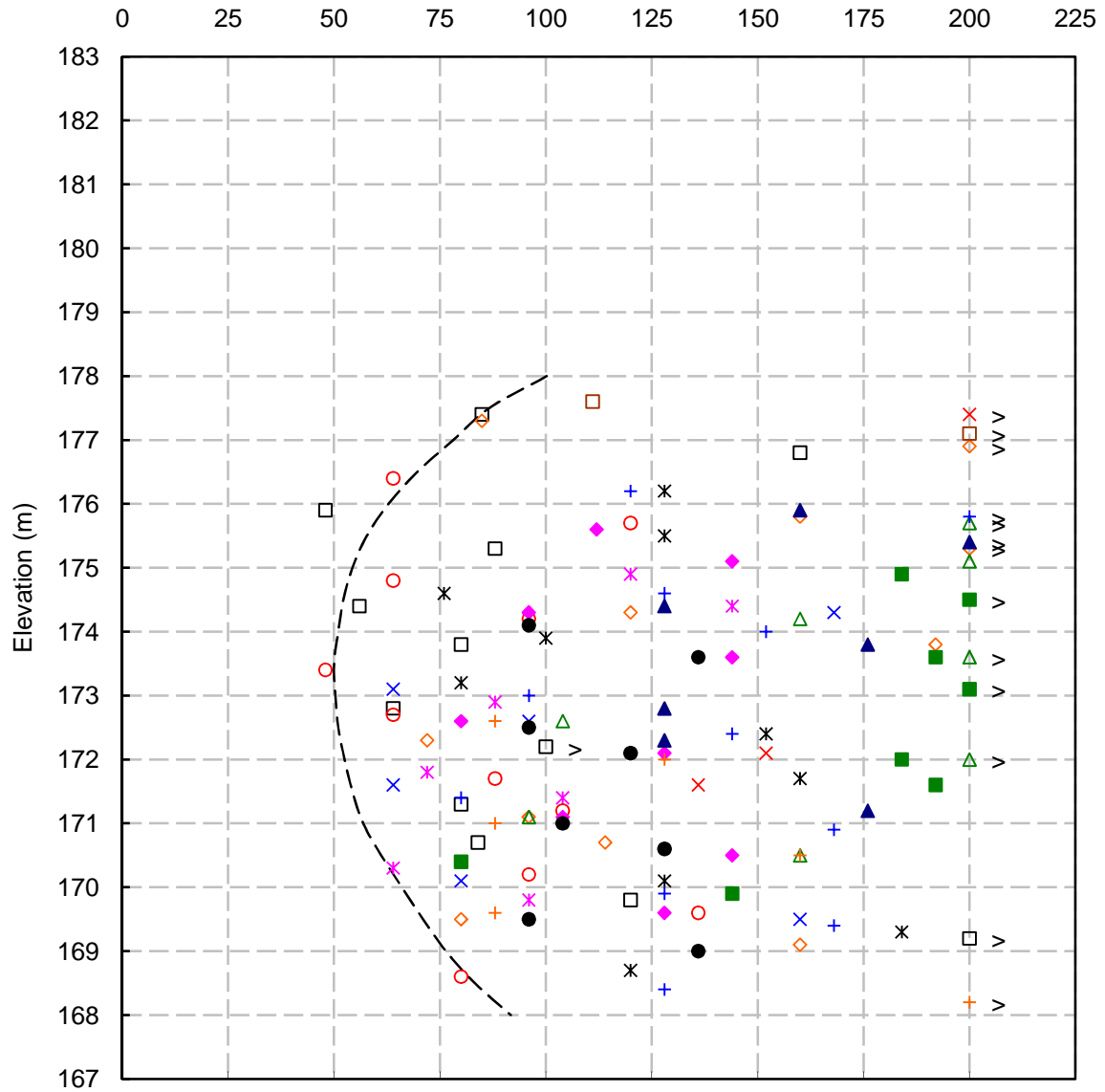
CORRECTED UNDRAINED SHEAR STRENGTH

FIGURE B3-33

HWY 406 TWINNING - RETAINING WALL SITE #3

Silty Clay

Corrected Cu (kPa)



□ NBL 12+695 LT	◇ NBL 12+750 RT	△ SBL 12+685 CL	× SBL 12+750 CL	* SEW 10+050 CL
+ WN1	○ WN2	■ WN3	◆ WN4	▲ WS1
× WS2	* WS3	+ WS4	● WRW2	□ WRW4

Field Shear Vane Correction

Morris & Williams (1994)

$$(\mu = 1.18 \text{ EXP}(-0.08 \text{ Ip}) + 0.57)$$

Applied Correction Factors

0.82 (Elev.>177m)

1.00 (Elev.<177m)

Project No. : 1-09-4135

Date : November, 2010



Terraprobe Inc.

Prepared By : HW

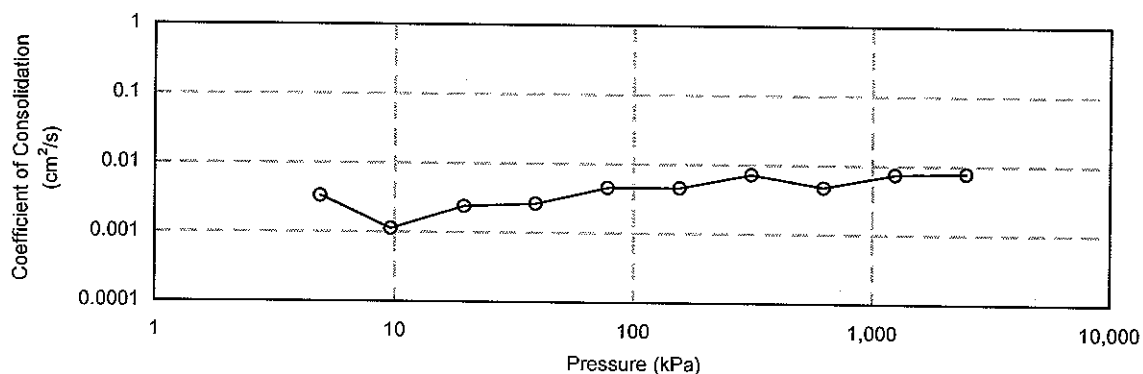
Checked By : RA

HWY 406 TWINNING - RETAINING WALL SITE #3

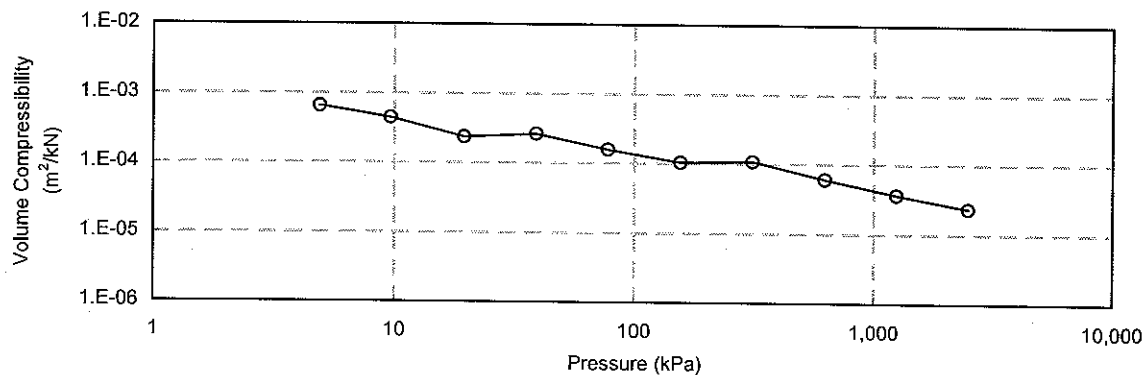
FIGURE B3-34

C:\Documents and Settings\Admin\My Documents\Marc P\Projects 2009\Hwy 406 Expansion\1-09-4135 (Hwy 406 Foundations)\Culverts and Retaining Walls\Lab Results\1-09-4135R4 Consolidation Results.xls

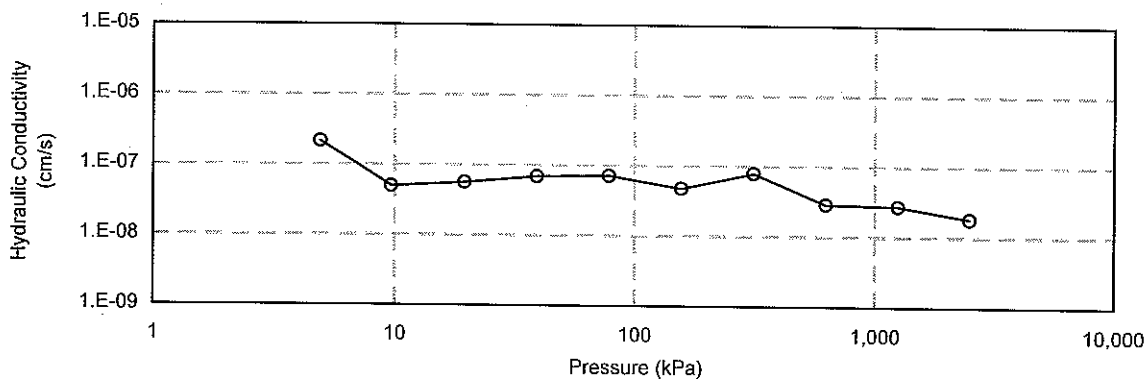
CONSOLIDATION TEST
Cv vs Pressure
NBL 12+695 LT, TW11



CONSOLIDATION TEST
mv vs Pressure
NBL 12+695 LT, TW11



CONSOLIDATION TEST
k vs Pressure
NBL 12+695 LT, TW11



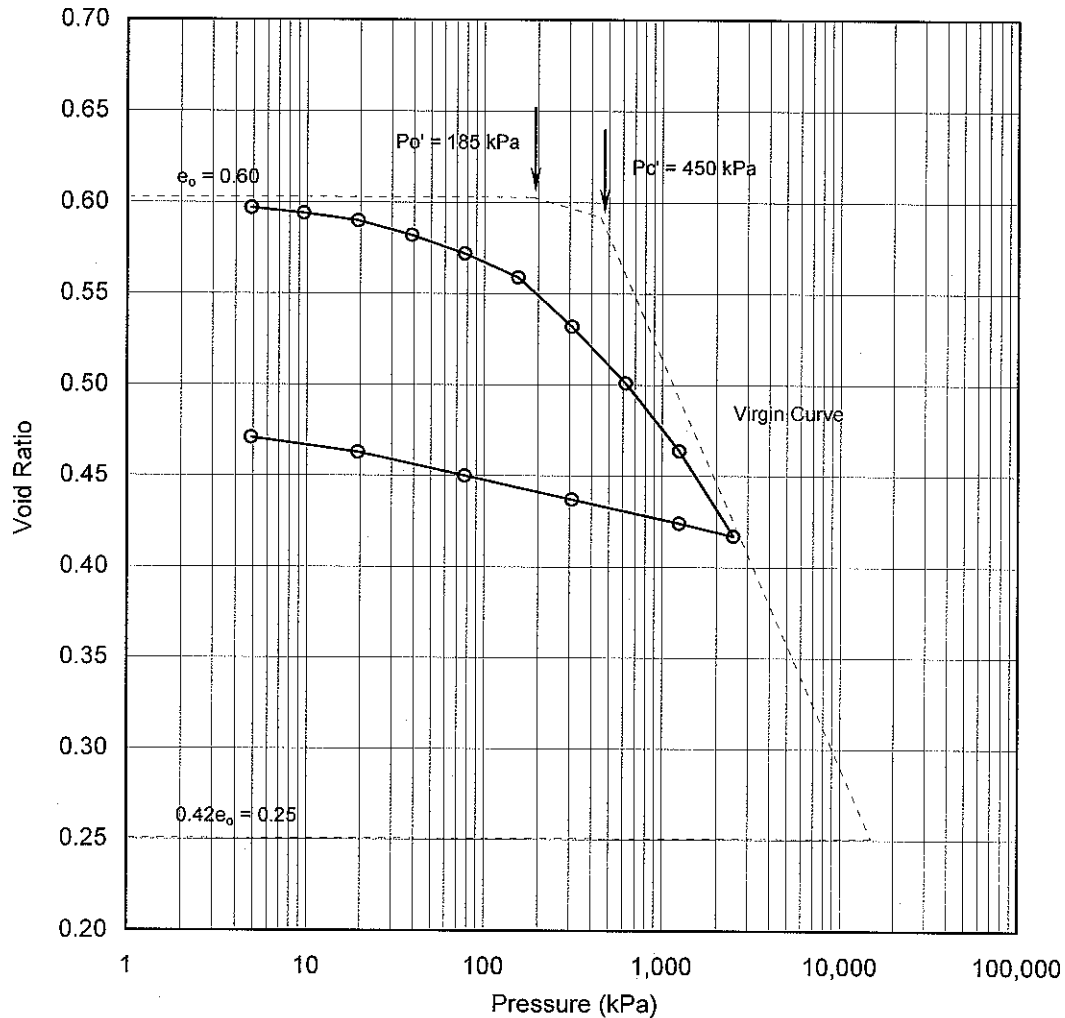
Project No. : 1-09-4135
Date : November 2010



Terraprobe Inc.

Prepared By : HW
Checked By : RA

CONSOLIDATION TEST
e vs Pressure
NBL 12+695 LT, TW11



Soil Type : Silty Clay

$e_0 =$	0.60	$\omega_L =$	25%	$P_{o'} =$	185 kPa
$\omega =$	22%	$\omega_p =$	15%	$P_{c'} =$	450 kPa
$\gamma =$	20.6 kN/m ³	PI =	10%	Cc =	0.224
Gs =	2.76			Cr =	0.028

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



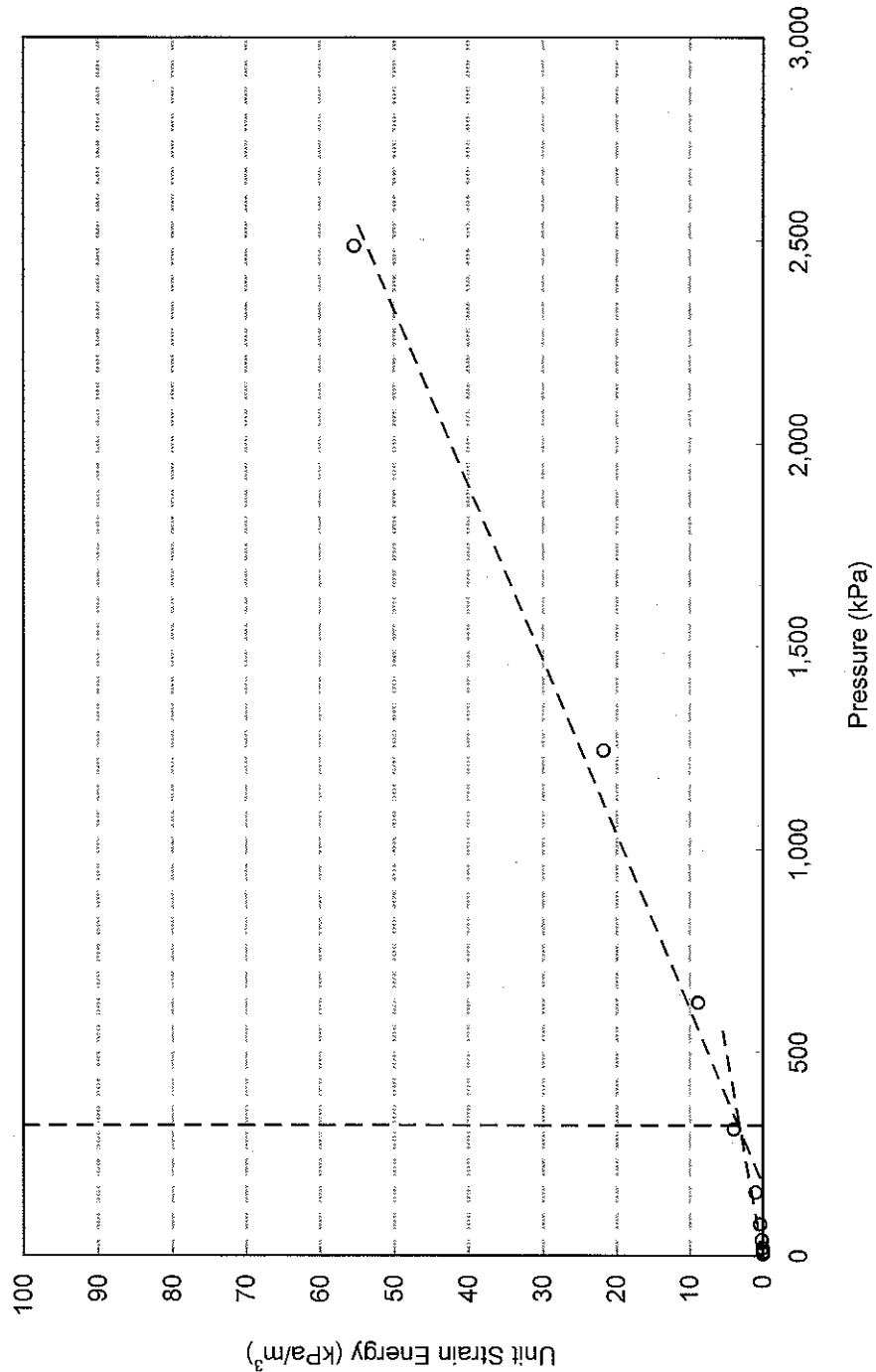
Terraprobe Inc.

Prepared By : HW
Checked By : RA

HWY 406 TWINNING - RETAINING WALL SITE #3

FIGURE B3-36

CONSOLIDATION TEST Unit Strain Energy vs Pressure NBL 12+695 LT, TW11



Pc = 320 kPa

Project No. : 1-09-4135

Date : November 2010



Terraprobe Inc.

Prepared By : HW

Checked By : RA

HWY 406 TWINNING - RETAINING WALL SITE #3

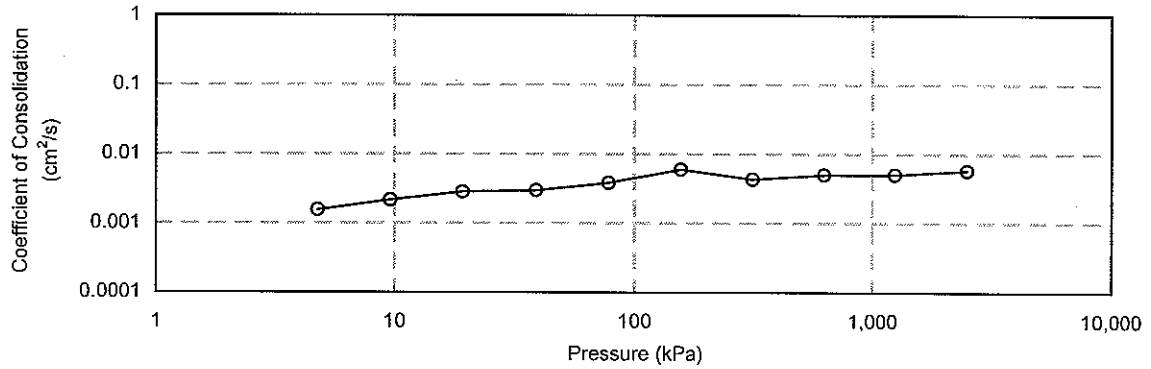
FIGURE B3-37

C:\Documents and Settings\Admin\My Documents\Marc P\Projects 2009\Hwy 406 Expansion\1-09-4135 (Hwy 406 Foundations)\Culverts and Retaining Walls\Retaining Walls\Lab Results\1-09-4135R4 Consolidation Results.xls

CONSOLIDATION TEST

Cv vs Pressure

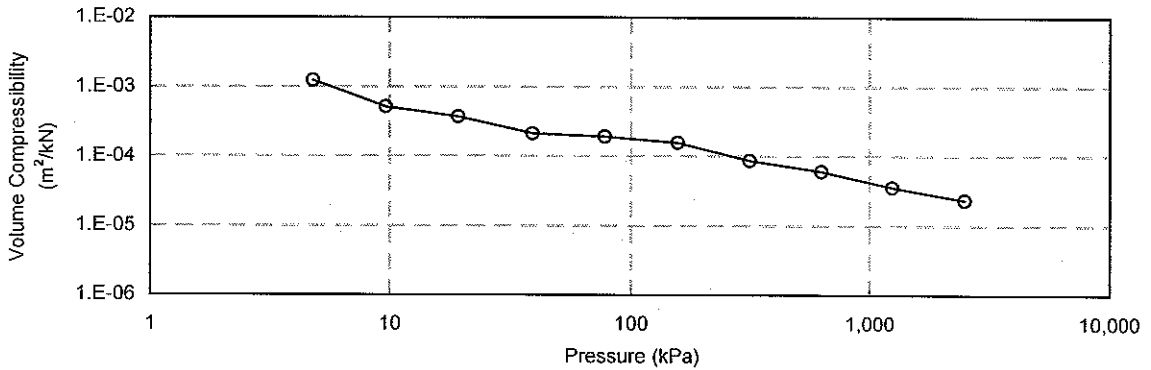
NBL 12+750 RT, TW9



CONSOLIDATION TEST

mv vs Pressure

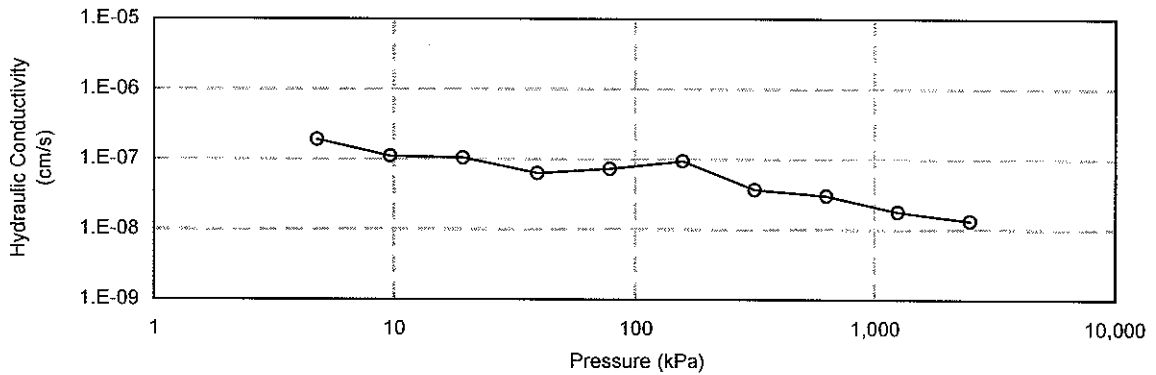
NBL 12+750 RT, TW9



CONSOLIDATION TEST

k vs Pressure

NBL 12+750 RT, TW9



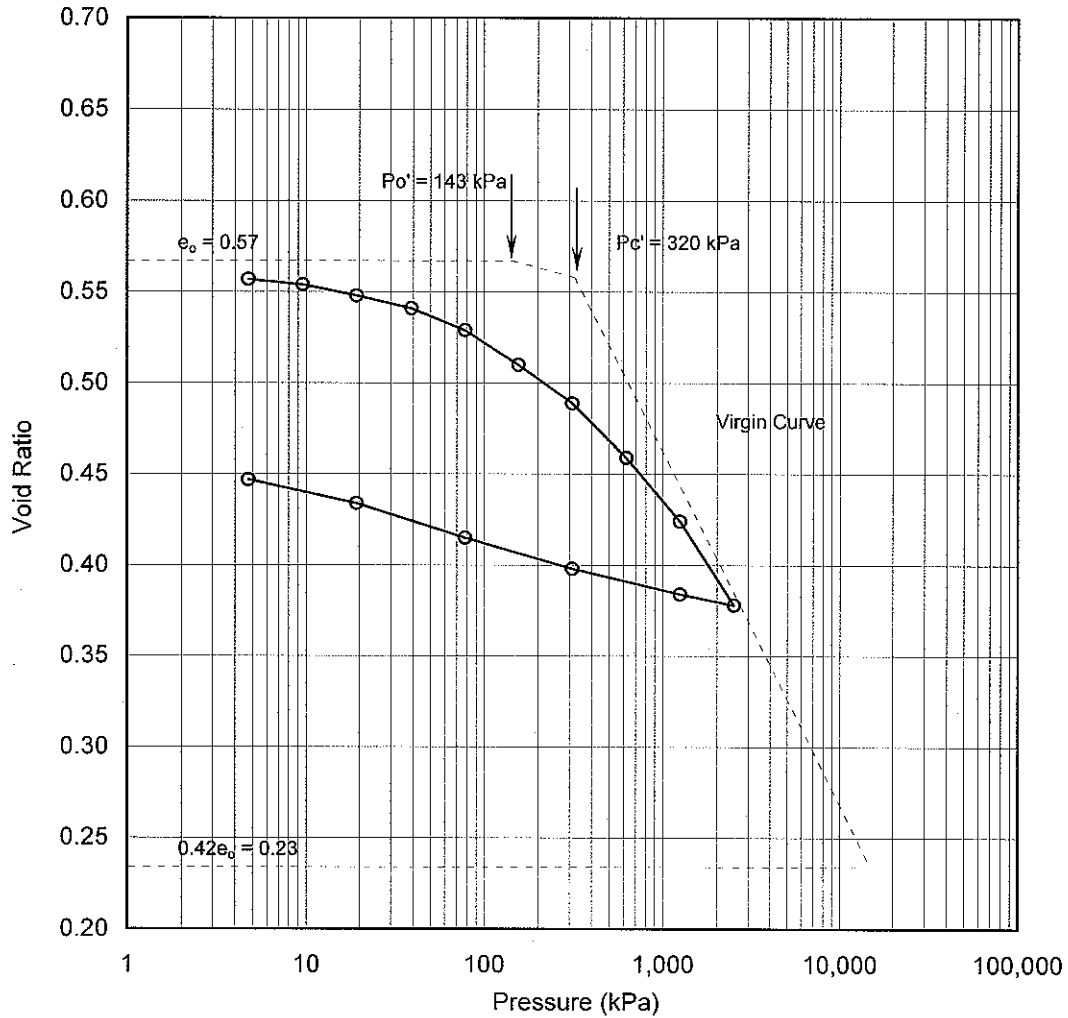
Project No. : 1-09-4135
Date : November 2010



Terraprobe Inc.

Prepared By : HW
Checked By : RA

CONSOLIDATION TEST
e vs Pressure
NBL 12+750 RT, TW9



Soil Type : Silty Clay

$e_o =$	0.57	$\omega_L =$	27%	$P_o' =$	143 kPa
$\omega =$	21%	$\omega_P =$	17%	$P_c' =$	320 kPa
$\gamma =$	20.8 kN/m ³	PI =	10%	Cc =	0.194
Gs =	2.74			Cr =	0.026

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



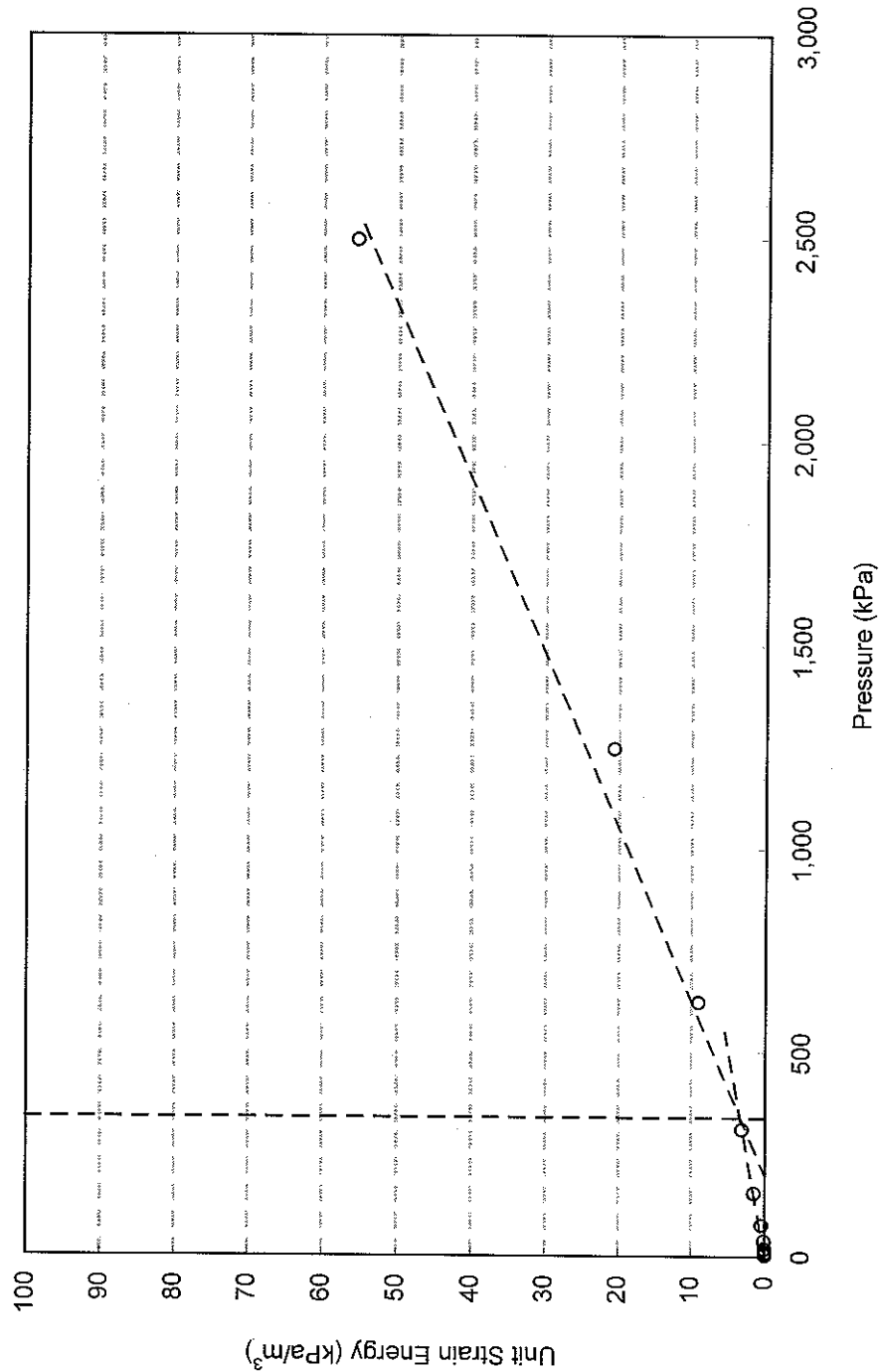
Terraprobe Inc.

Prepared By : HW
Checked By : RA

HWY 406 TWINNING - RETAINING WALL SITE #3

FIGURE B3-39

CONSOLIDATION TEST Unit Strain Energy vs Pressure NBL 12+750 RT, TW9



Project No. : 1-09-4135

Date : November 2010



Terraprobe Inc.

Prepared By : HW

Checked By : RA

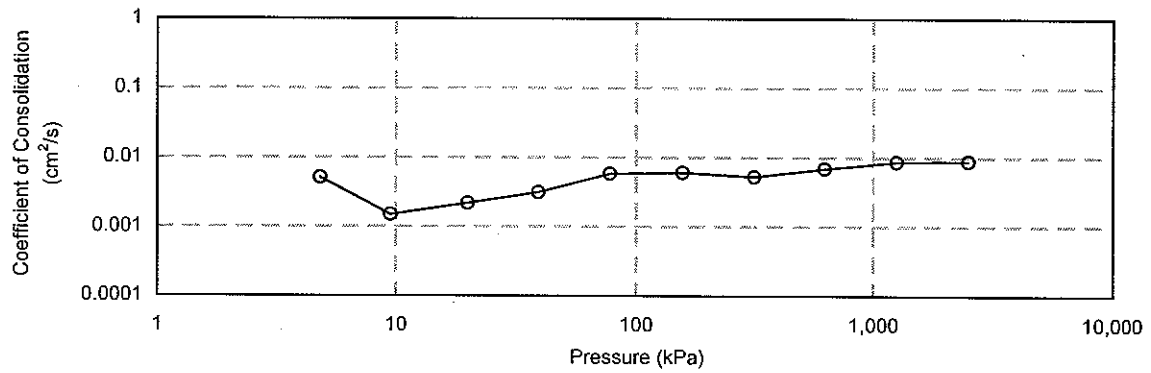
HWY 406 TWINNING - RETAINING WALL SITE #3

FIGURE B3-40

CONSOLIDATION TEST

Cv vs Pressure

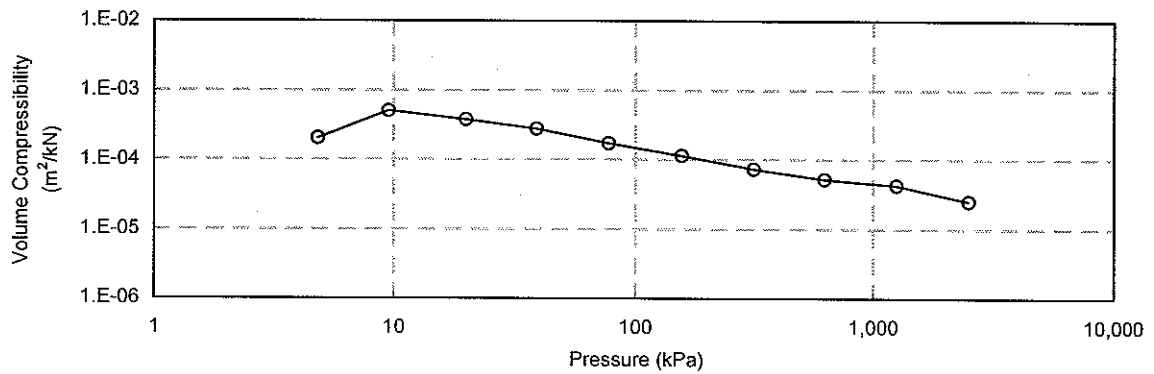
SBL 12+685 CL, TW10



CONSOLIDATION TEST

mv vs Pressure

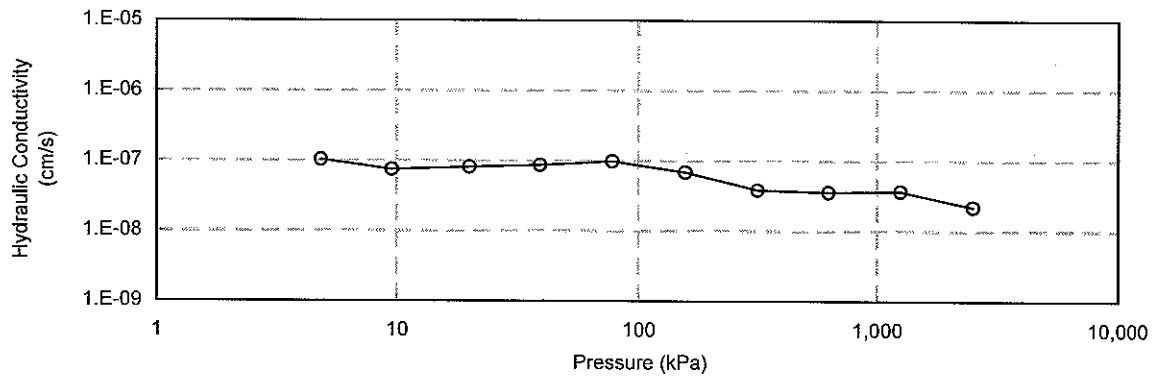
SBL 12+685 CL, TW10



CONSOLIDATION TEST

k vs Pressure

SBL 12+685 CL, TW10



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



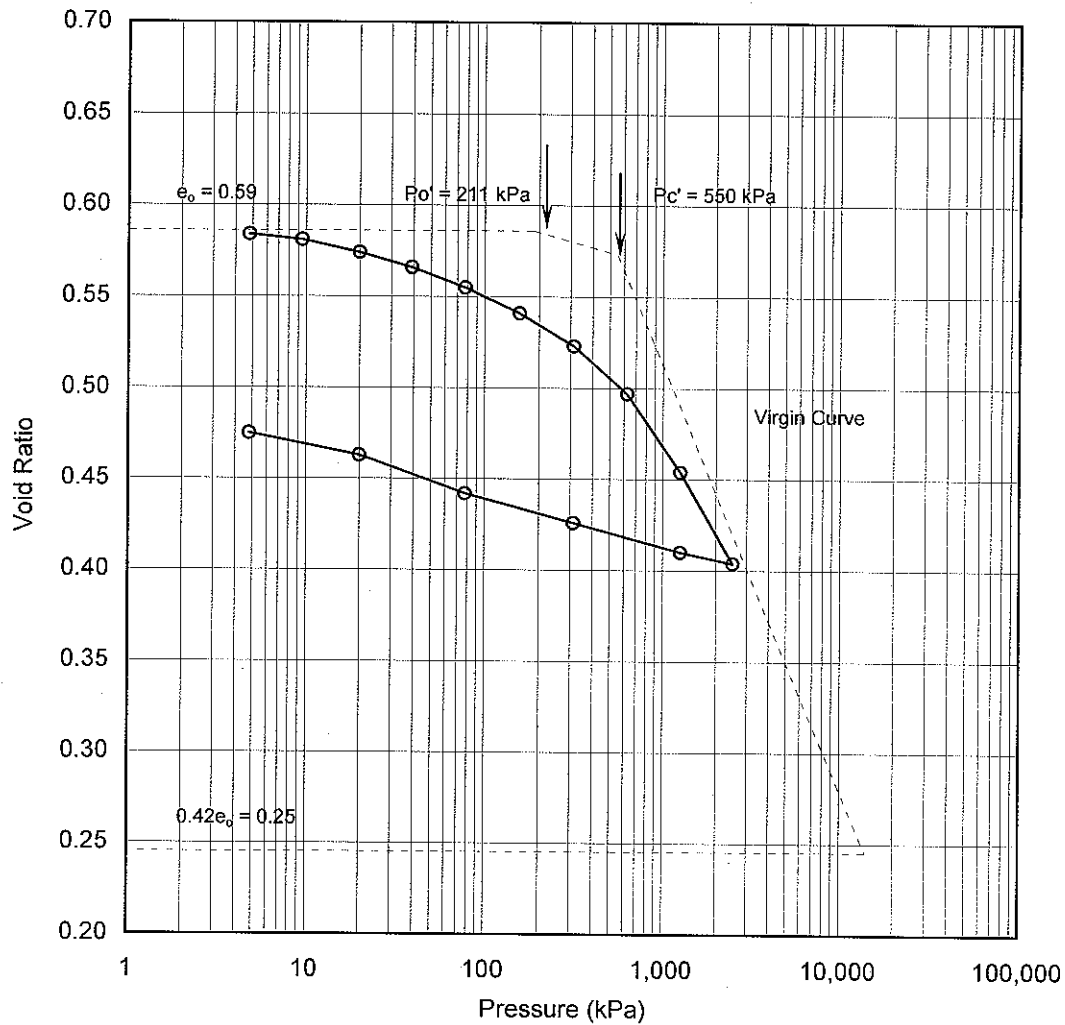
Terraprobe Inc.

Prepared By : HW
Checked By : RA

CONSOLIDATION TEST

e vs Pressure

SBL 12+685 CL, TW10



Soil Type : Silty Clay

$e_o =$	0.59	$\omega_L =$	27%	$Po' =$	185 kPa
$\omega =$	22%	$\omega_p =$	17%	$Pc' =$	550 kPa
$\gamma =$	20.7 kN/m ³	PI =	10%	Cc =	0.233
Gs =	2.75			Cr =	0.027

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



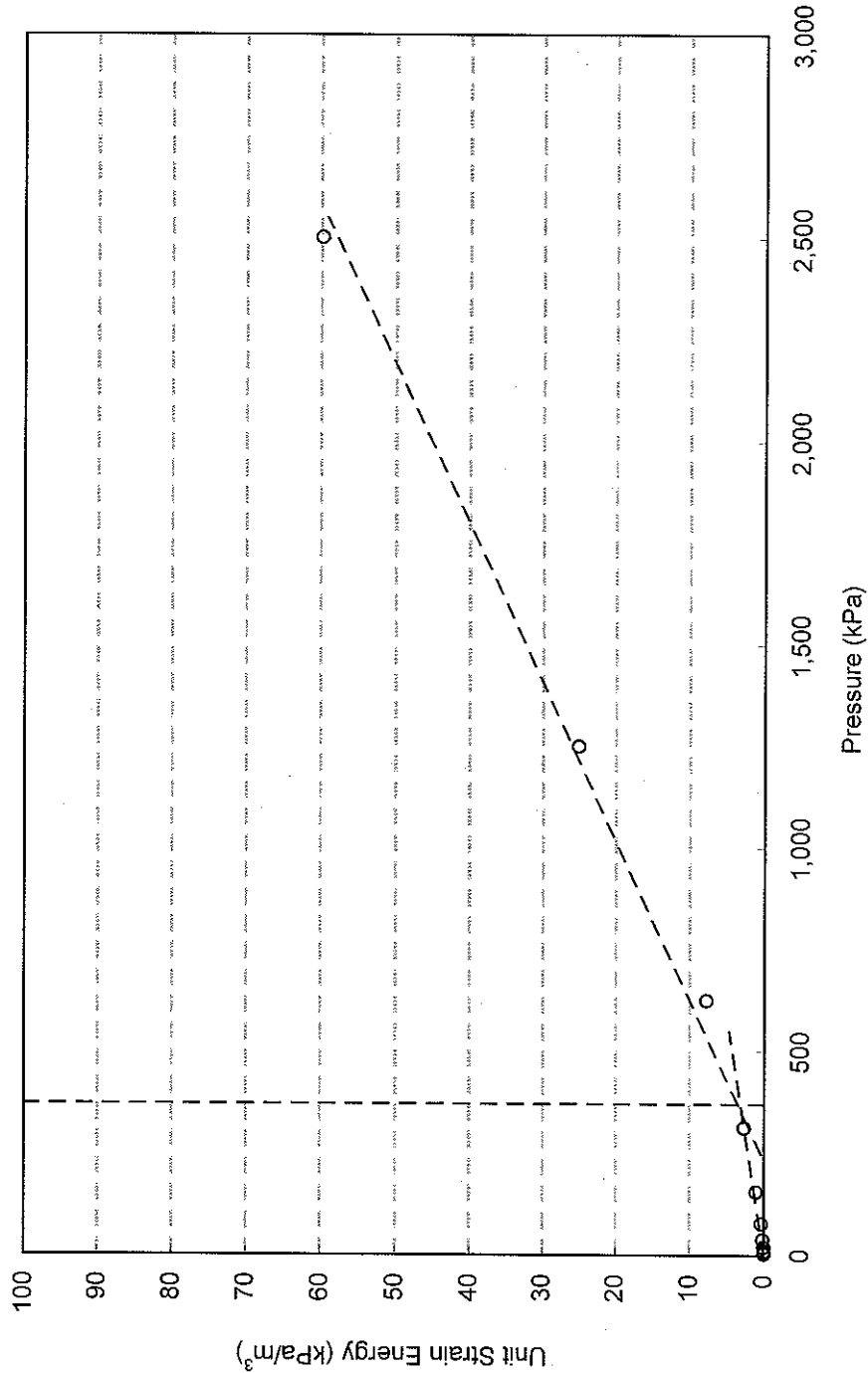
Terraprobe Inc.

Prepared By : HW
 Checked By : RA

HWY 406 TWINNING - RETAINING WALL SITE #3

FIGURE B3-42

CONSOLIDATION TEST Unit Strain Energy vs Pressure SBL 12+685 CL, TW10



Project No. : 1-09-4135

Date : November 2010



Terraprobe Inc.

Prepared By : HW

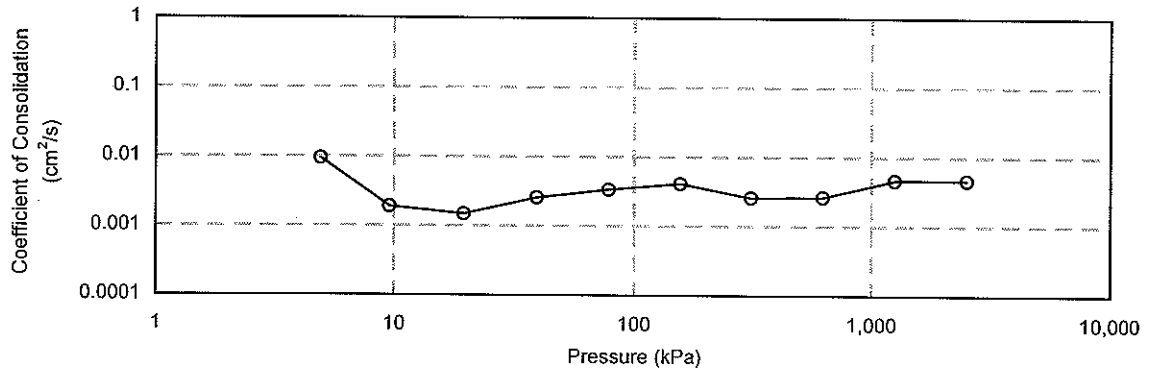
Checked By : RA

HWY 406 TWINNING - RETAINING WALL SITE #3

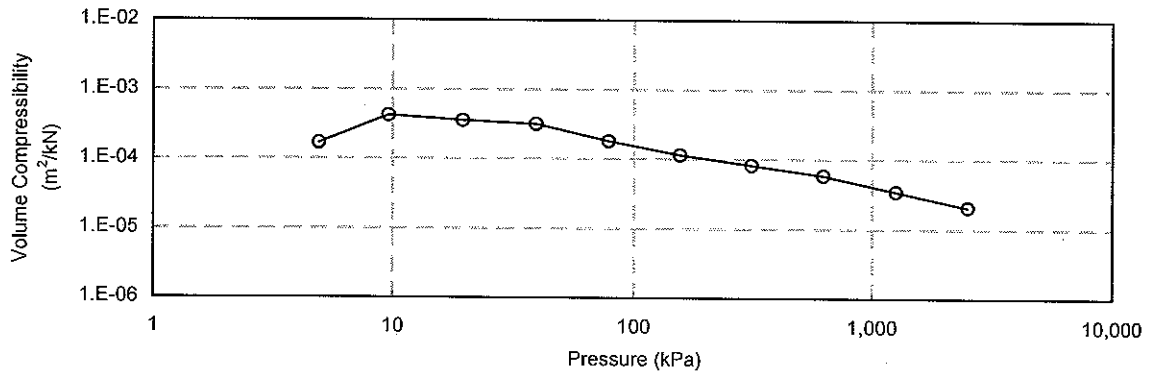
FIGURE B3-43

C:\Documents and Settings\Admin\My Documents\Marc P\Projects 2009\Hwy 406 Expansion\1-09-4135 (Hwy 406 Foundations)\Culverts and Retaining Walls\Retaining Walls\Lab Results\1-09-4135R4 Consolidation Results.xls

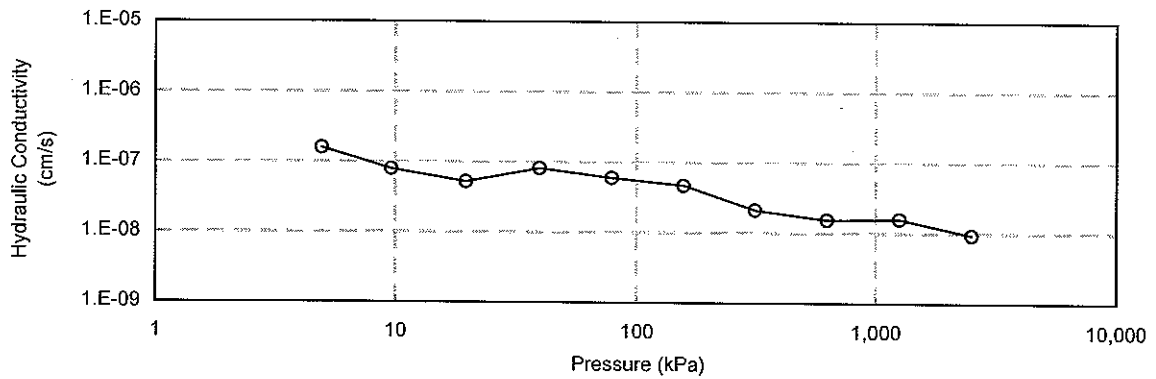
CONSOLIDATION TEST
Cv vs Pressure
SBL 12+750 CL, TW10



CONSOLIDATION TEST
mv vs Pressure
SBL 12+750 CL, TW10



CONSOLIDATION TEST
k vs Pressure
SBL 12+750 CL, TW10



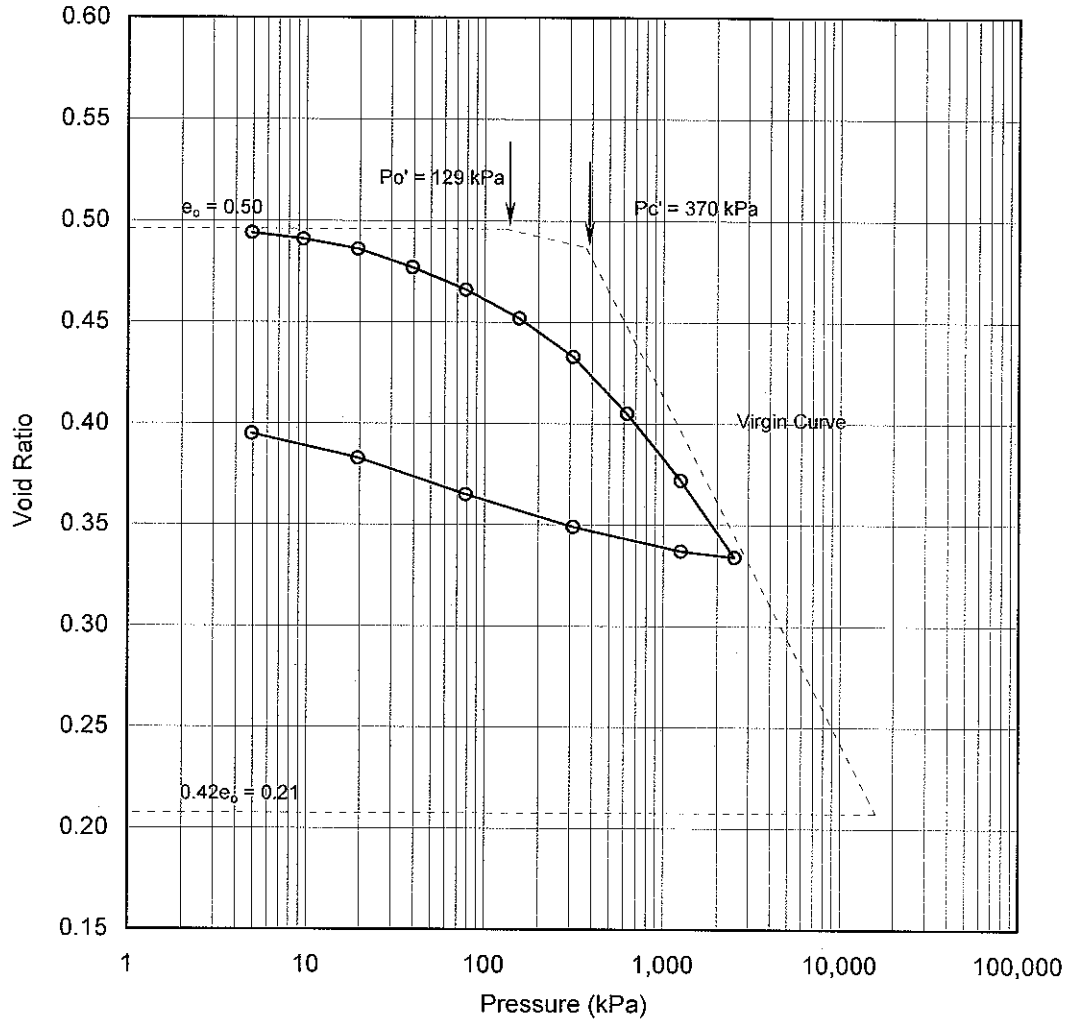
Project No. : 1-09-4135
Date : November 2010



Terraprobe Inc.

Prepared By : HW
Checked By : RA

CONSOLIDATION TEST
e vs Pressure
SBL 12+750 CL, TW10



Soil Type : Silty Clay

$e_0 = 0.50$

$\omega_L = 25\%$

$Po' = 129 \text{ kPa}$

$\omega = 19\%$

$\omega_P = 15\%$

$Pc' = 370 \text{ kPa}$

$\gamma = 21.1 \text{ kN/m}^3$

$PI = 10\%$

$Cc = 0.171$

$G_s = 2.70$

$Cr = 0.020$

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



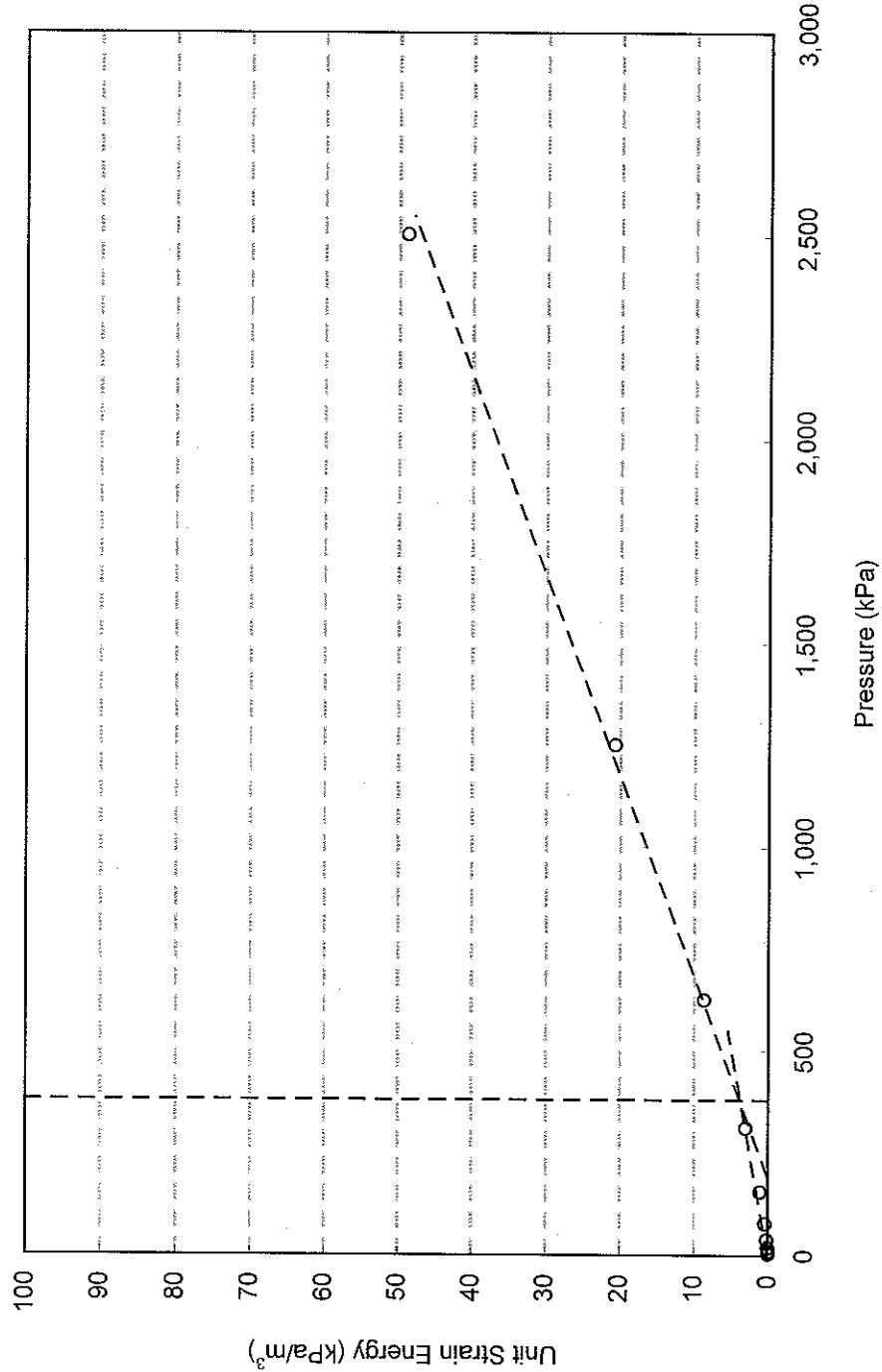
Terraprobe Inc.

Prepared By : HW
Checked By : RA

HWY 406 TWINNING - RETAINING WALL SITE #3

FIGURE B3-45

CONSOLIDATION TEST Unit Strain Energy vs Pressure SBL 12+750 CL, TW10



Project No. : 1-09-4135

Date : November 2010



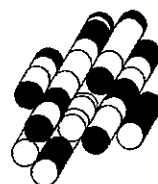
Terraprobe Inc.

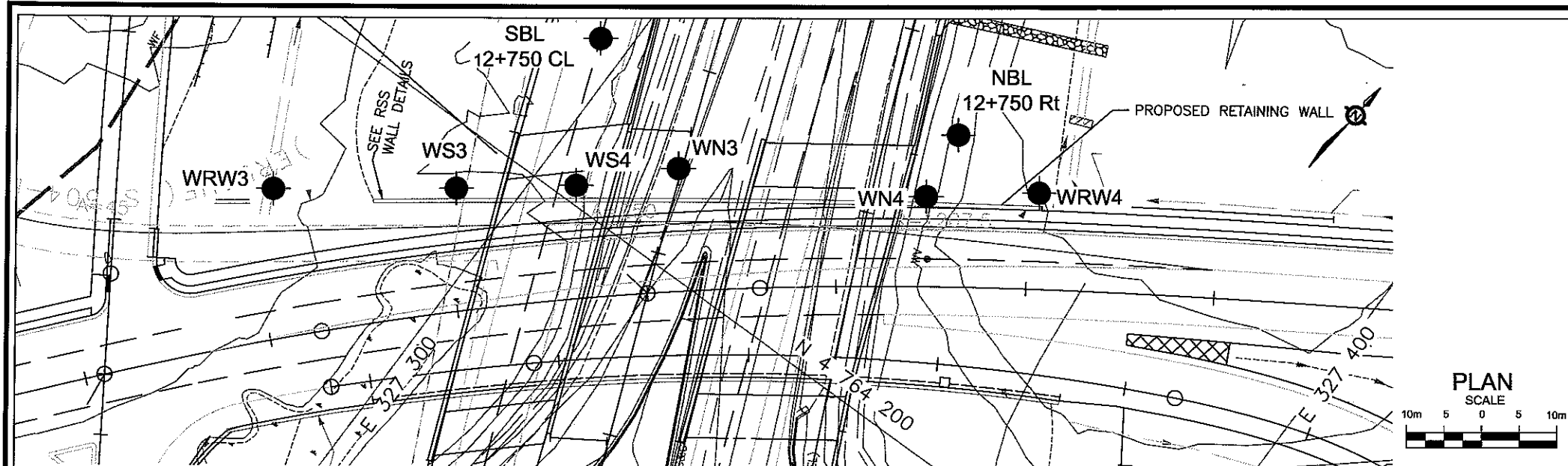
Prepared By : HW

Checked By : RA

C3

TERRAPROBE INC.





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

CONT No 2011-2005
WP No 280-99-00



HIGHWAY 406
WOODLAWN RD NORTH RETAINING WALL
BOREHOLE LOCATIONS AND SOIL STRATA

SHEET
505



Terraprobe Inc.
Consulting Geotechnical & Environmental Engineering
Construction Materials Engineering, Inspection & Testing
10 Bram Court - Brampton Ontario L6W 3R6 (905) 796-2660



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 (AUG. 2010)
- ⊥ Piezometer
- 90% Rock Quality Designation
- A/R Auger Refusal

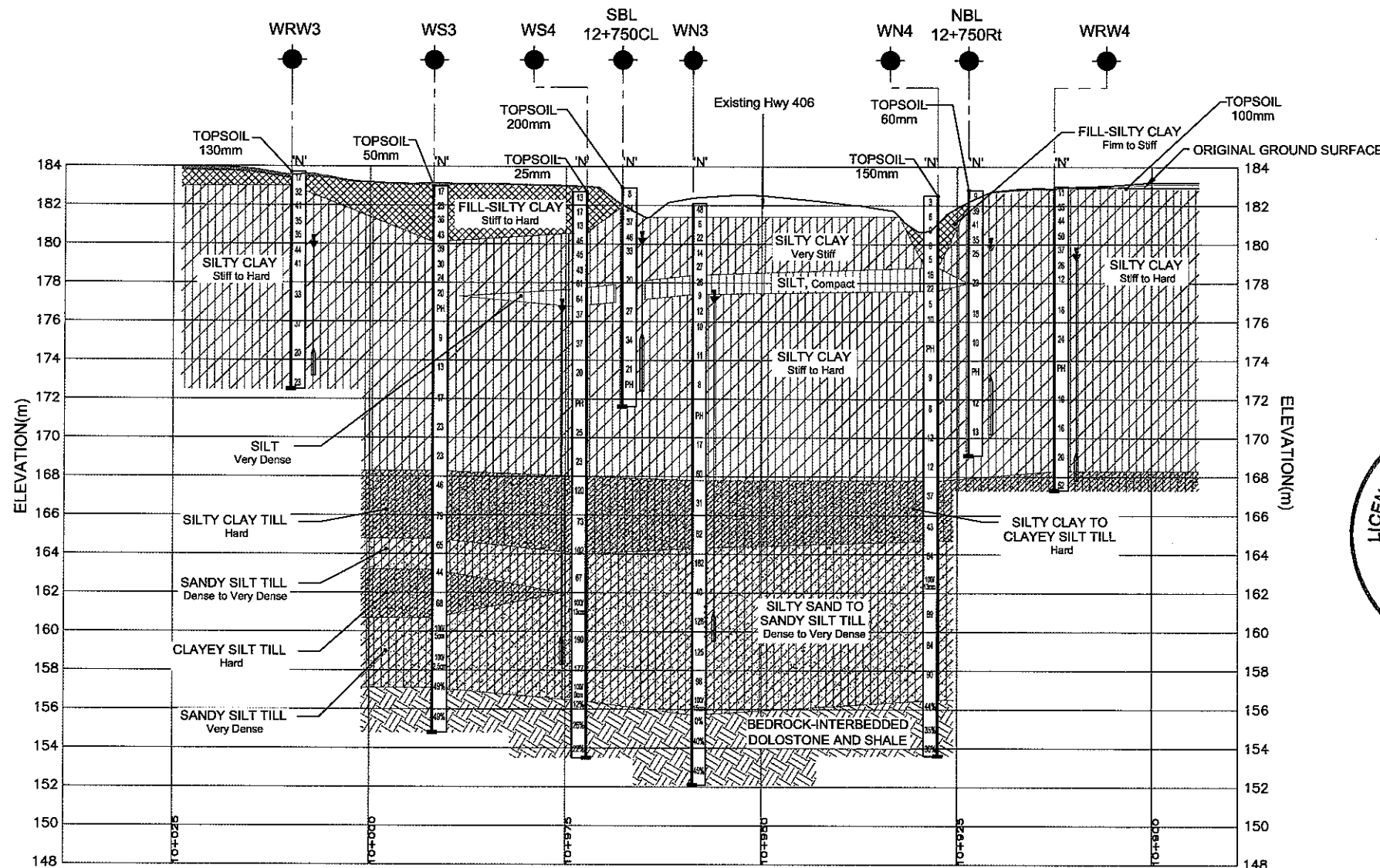
No	ELEV.	COORDINATES	
		NORTHING	EASTING
NBL 12+750Rt	182.8	4 764 237.5	327 341.9
SBL 12+750CL	182.9	4 764 219.9	327 296.2
WN3	182.1	4 764 212.0	327 314.7
WN4	182.5	4 764 228.4	327 343.4
WRW3	183.7	4 764 178.3	327 273.3
WRW4	183.0	4 764 237.8	327 355.1
WS3	183.0	4 764 192.6	327 292.7
WS4	182.7	4 764 202.3	327 305.2

NOTE

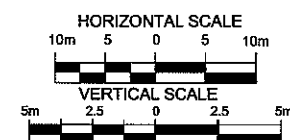
The boundaries between soil strata have been established only at Bore Hole locations. Between Bore Holes the boundaries are assumed from geological evidence.

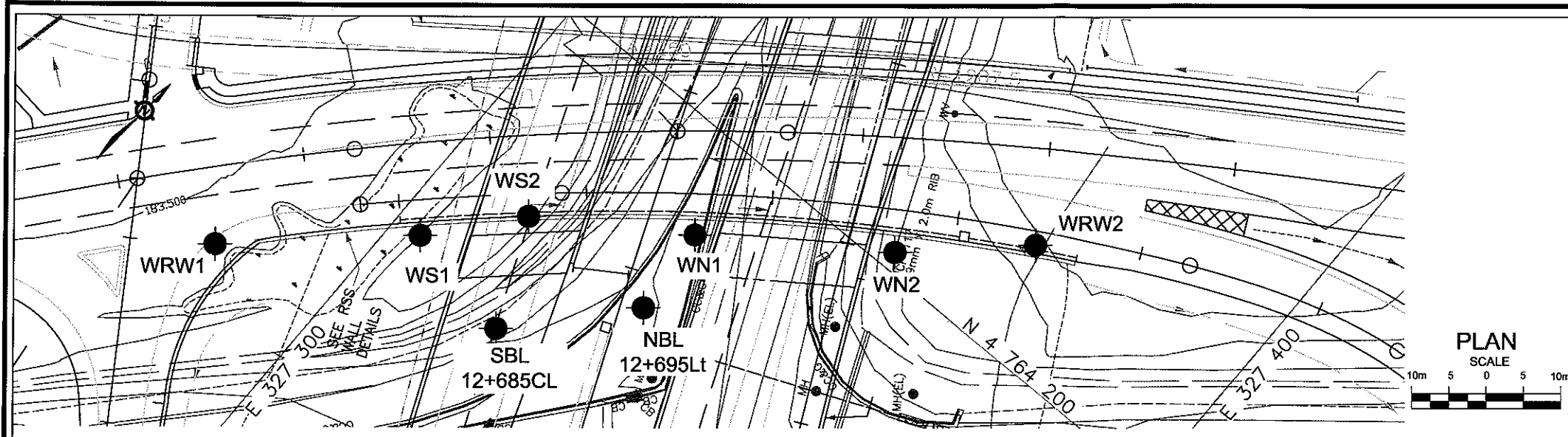
This drawing is for subsurface information only. Surface details and features are for conceptual illustration.

REVISIONS				
	DATE	BY	DESCRIPTION	
DESIGN	RA	CODE	CHB0C2006	LOAD
DRAWN	K.C	CHK	RA	STRUCT
				DATE FEB. 2011
				GEOCRE'S 3043-296



CL PROFILE WOODLAWN ROAD NORTH ALIGNMENT





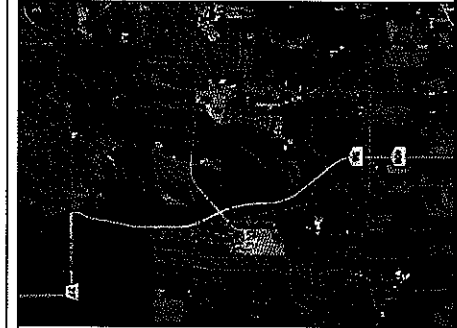
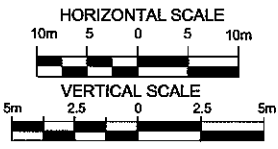
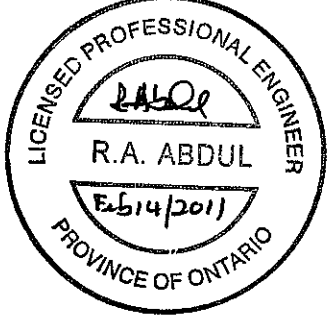
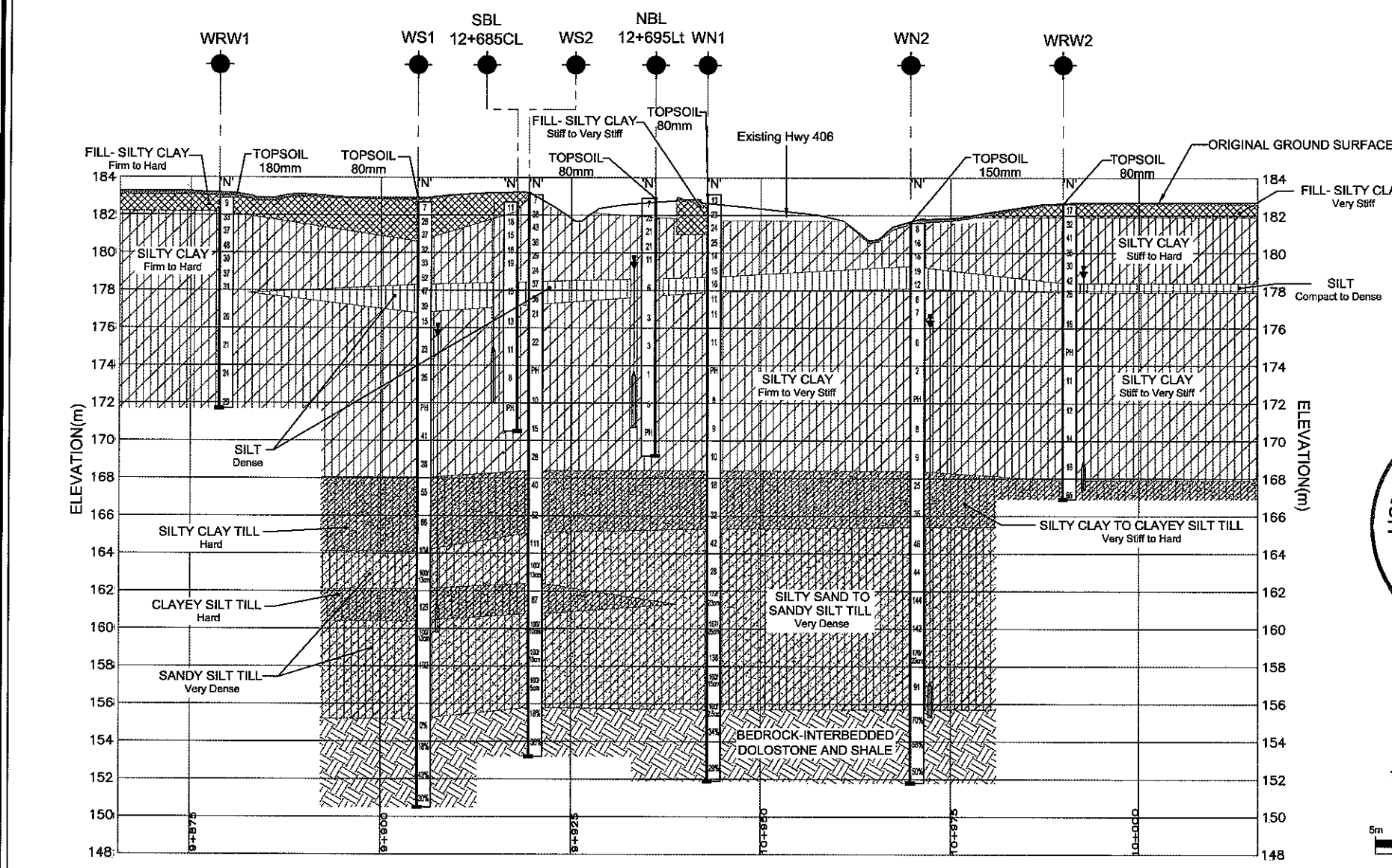
METRIC
DIMENSIONS ARE IN METRES
AND/OR MILLIMETERS
UNLESS OTHERWISE SHOWN

CONT No 2011-2005
WP No 280-99-00

HIGHWAY 406
WOODLAWN RD SOUTH RETAINING WALL
BOREHOLE LOCATIONS AND SOIL STRATA

IBI GROUP

Terraprobe Inc.
Consulting Geotechnical & Environmental Engineering
Construction Materials Engineering, Inspection & Testing
10 Bram Court - Brampton Ontario L6W 3R6 (905) 796-2650



KEY PLAN			
LEGEND			
	Bore Hole		
	Dynamic Cone Penetration Test		
	Bore Hole And Cone		
	Blows/0.3m (Std Pen Test, 475 J/blow)		
	Blows/0.3m (60° Cone, 475 J/blow)		
	WL at Time of Investigation		
	WL in Piezometer (JULY, 2010)		
	Piezometer		
	90% Rock Quality Designation		
	Auger Refusal		

No	ELEV.	COORDINATES	
		NORTHING	EASTING
NBL 12+695Lt	182.9	4 764 175.1	327 333.0
SBL 12+685CL	182.7	4 764 160.4	327 319.7
WN1	183.1	4 764 187.0	327 332.0
WN2	181.6	4 764 202.3	327 354.1
WRW1	182.9	4 764 145.1	327 283.6
WRW2	182.6	4 764 215.1	327 368.0
WS1	182.7	4 764 163.6	327 303.9
WS2	183.1	4 764 174.7	327 313.4

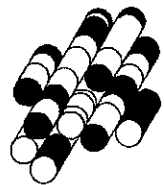
NOTE
The boundaries between soil strata have been established only at Bore Hole locations. Between Bore Holes the boundaries are assumed from geological evidence.
This drawing is for subsurface information only. Surface details and features are for conceptual illustration.

REVISIONS			
DATE	BY	DESCRIPTION	
DESIGN	RA	CODE	CHBCC2006
DRAWN	K.C.	CHK	RA
		LOAD	
		STRUCT	
		DATE	FEB. 2011
		GEORES	30M3-266

C PROFILE WOODLAWN ROAD SOUTH ALIGNMENT

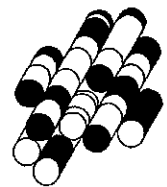
SITE 4

TERRAPROBE INC.



A4

TERRAPROBE INC.

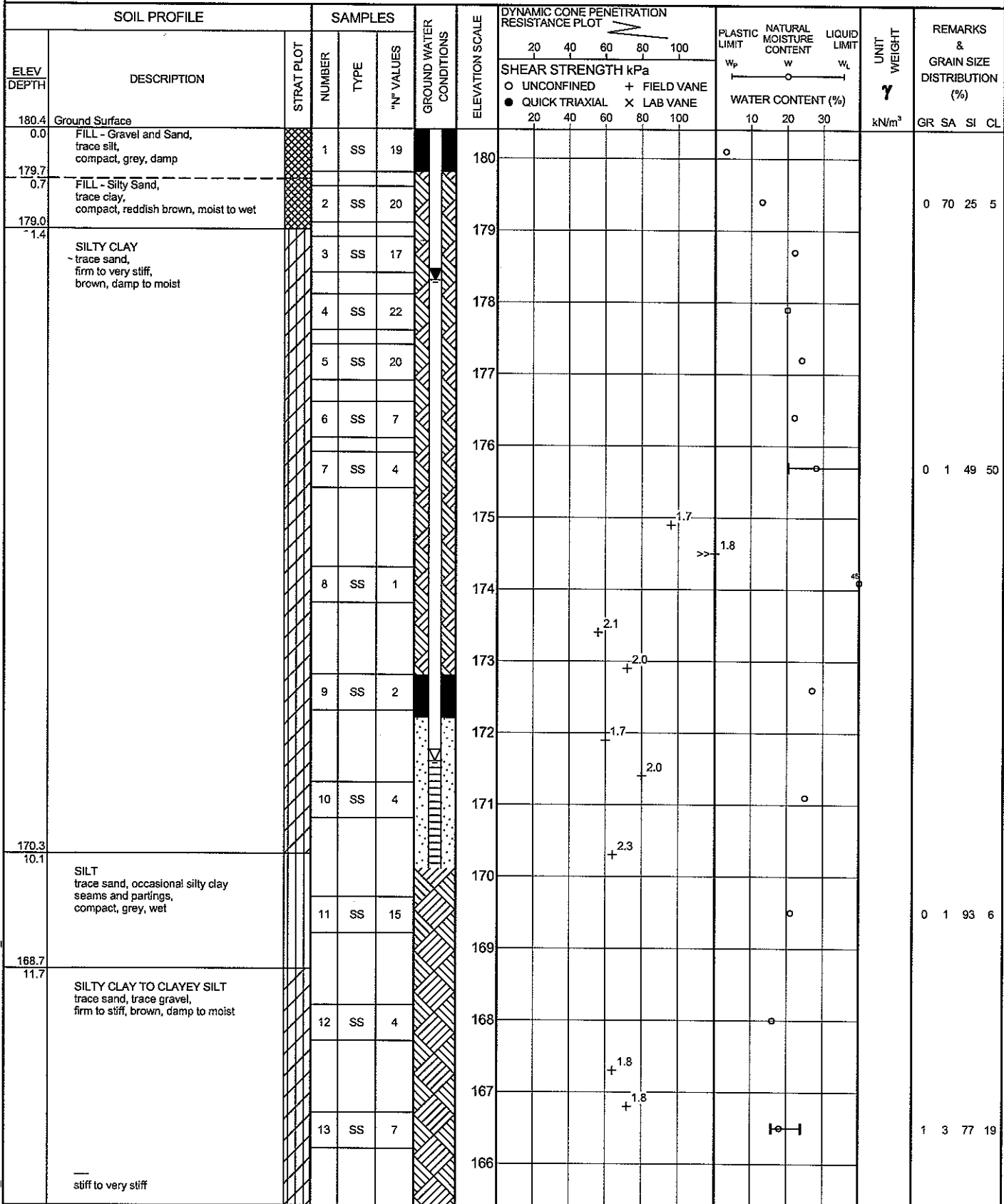


RECORD OF BOREHOLE No MRW1

1 OF 2

METRIC

W.P. 280-99-00 LOCATION Coords: N:4765961.0 E:326513.2 ORIGINATED BY BL
DIST HWY 406 BOREHOLE TYPE Hollow Stem Augers COMPILED BY DB
DATUM Geodetic DATE 06.24.10 CHECKED BY RA



ON MOT 1-09-4135 MRW RET WALLS.GPJ ON MOT.GDT 11/04/10

Continued Next Page

+³, X³: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

METRIC

+³, X³: Numbers refer to Sensitivity ○ ^{3%} STRAIN AT FAILURE

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

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40						60	80	100	10
179.8	Ground Surface																	
0.1	60mm TOPSOIL		1	SS	10													
	firm																	
	----		2	SS	26													
	SILTY CLAY																	
	very stiff,		3	SS	27													
	brown to 4.0m, grey below,																	
	damp to moist		4	SS	21													
	----		5	SS	10													
	firm to stiff																	
			6	SS	3													
			7	TW	PH													
172.3	End of Borehole																	
7.5																		
	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 TW 7.																	

ON MOT 1-09-4135 MRW RET WALLS.GPJ ON MOT GDT 09/02/10

RECORD OF BOREHOLE No MRW2

1 OF 2

METRIC

W.P. 280-99-00 LOCATION Coords: N:4765920.3 E:326420.3 ORIGINATED BY BL
 DIST HWY 406 BOREHOLE TYPE Hollow Stem Augers COMPILED BY DB
 DATUM Geodetic DATE 06.21.10 CHECKED BY RA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
180.8	Ground Surface							20 40 60 80 100						
0.0	460mm FILL - Gravelly Sand, trace silt, compact, grey, damp		1	SS	27									
180.3														
0.5	FILL - Silty Sand, trace clay, trace gravel, very loose to compact, reddish brown, moist to wet		2	SS	11									
			3	SS	3									
178.2			4	SS	2									
2.6	SILTY CLAY trace sand, firm to very stiff, brown, damp to moist		5	SS	10									
			6	SS	10									
			7	SS	8									
			8	SS	5									
	soft		9	SS	3									
			10	TW	PH									
171.7														
9.1	SILT trace sand, trace gravel, occasional silty clay seams and partings, loose to compact, brown, wet		11	SS	7									
			12	SS	10									
169.1														
11.7	SILTY CLAY TO CLAYEY SILT trace sand, firm to very stiff, brown, damp to moist		13	SS	4									
			14	SS	8									
												</		

ON_MOT_1-09-4135 MRW RET WALLS.GPJ ON_MOT.GDT 09/02/10

Continued Next Page

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

RECORD OF BOREHOLE No MRW2

2 OF 2

METRIC

W.P. 280-99-00 LOCATION Coords: N:4765920.3 E:326420.3 ORIGINATED BY BL
DIST HWY 406 BOREHOLE TYPE Hollow Stem Augers COMPILED BY DB
DATUM Geodetic DATE 06.21.10 CHECKED BY RA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100					
163.5	hard		15	SS	23												
17.3			16	SS	31												
	<p>End of Borehole</p> <p>Sampler wet at 1.5m.</p> <p>Water level at 2.4m (not stabilized) and hole open to 12.5m on completion.</p>																

ON MOT 1-09-4135 MRW RET WALLS.GPJ ON MOT.GDT 06/02/10

RECORD OF BOREHOLE No MRW3

1 OF 2

METRIC

W.P. 280-99-00 LOCATION Coords: N:4765895.0 E:326376.6 ORIGINATED BY BL
DIST HWY 406 BOREHOLE TYPE Hollow Stem Augers COMPILED BY DB
DATUM Geodetic DATE 06.23.10 - 06.24.10 CHECKED BY RA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa							WATER CONTENT (%)
								○ UNCONFINED ● QUICK TRIAXIAL	+ FIELD VANE × LAB VANE						
180.5	Ground Surface							20 40 60 80 100							
0.0	460mm FILL - Gravelly Sand, some silt, trace clay, compact, grey, damp		1	SS	25					○				31 53 14 2	
180.0															
0.5	FILL - Silty Sand, very loose to compact, brown, wet		2	SS	10					○					
178.6			3	SS	2						○				
1.9	FILL - Silty Clay, trace sand, trace organics, stiff, grey / brown, moist											○			
			4	SS	14									0 5 59 36	
177.6															
2.9	SILTY CLAY stiff to very stiff, brown, moist		5	SS	21						○				
			6	SS	12							○			
			7	SS	8								○	0 0 51 49	
										>>					
			8	SS	2								○		
									1.3						
			9	SS	2									0 0 61 39	
171.9															
8.6	SILT trace sand, frequent silty clay seams and partings, compact, brown, wet		10	SS	11							○			
			11	SS	16								○		
168.8															
11.7	SILTY CLAY TO CLAYEY SILT trace sand, trace gravel, stiff to very stiff, brown, damp to moist		12	SS	10							○			
										>>					
			13	SS	9								○		
										>>	1.9				

Continued Next Page

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

ON MOT 1-09-4135 MRW RET WALLS.GPJ ON MOT.GDT 09/02/10

METRIC

ON MOT 1-09-4135 MRW RET WALLS.GPJ ON_MOT.GDI 09/02/10

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

B4

TERRAPROBE INC.

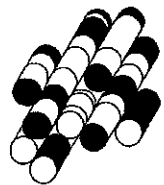


FIGURE B4-1

Size of openings, inches

U.S.S. Sieve size, meshes/inch

PERCENT FINER THAN

GRAIN SIZE, mm

Grain Size (mm)	U.S.S. Sieve Size (meshes/inch)	Size of Opening (inches)	Percent Finer (%)
100	10	2.0	100
47.5	4	0.75	100
25	2	0.425	100
10	20	0.15	83
4.75	40	0.075	69
2.0	10	0.025	53
0.85	20	0.015	34
0.425	40	0.0075	27
0.25	60	0.00425	23
0.15	100	0.0025	18
0.106	140	0.0015	16
0.075	200	0.001	12
0.06	250	0.00085	10
0.0475	325	0.000475	8
0.03	50	0.0006	5
0.025	60	0.000425	4
0.015	100	0.00025	2
0.0085	200	0.00015	1

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

SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	MRW3	0.3	180.2

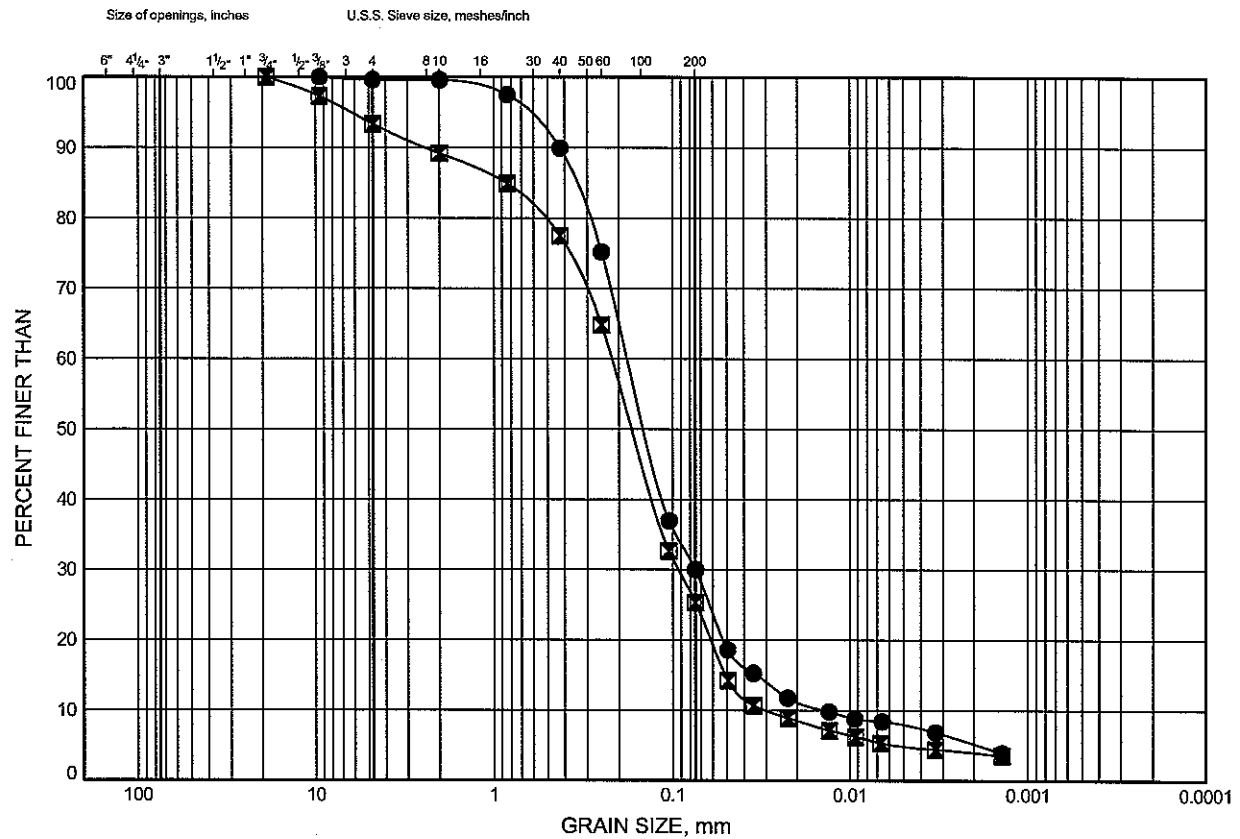
Chkd.MP.....



GRAIN SIZE DISTRIBUTION

FIGURE B4-2

FILL - Silty Sand



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

SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	MRW1	1.0	179.4
⊠	MRW2	1.7	179.1

Date August 2010

Project 1-09-4135



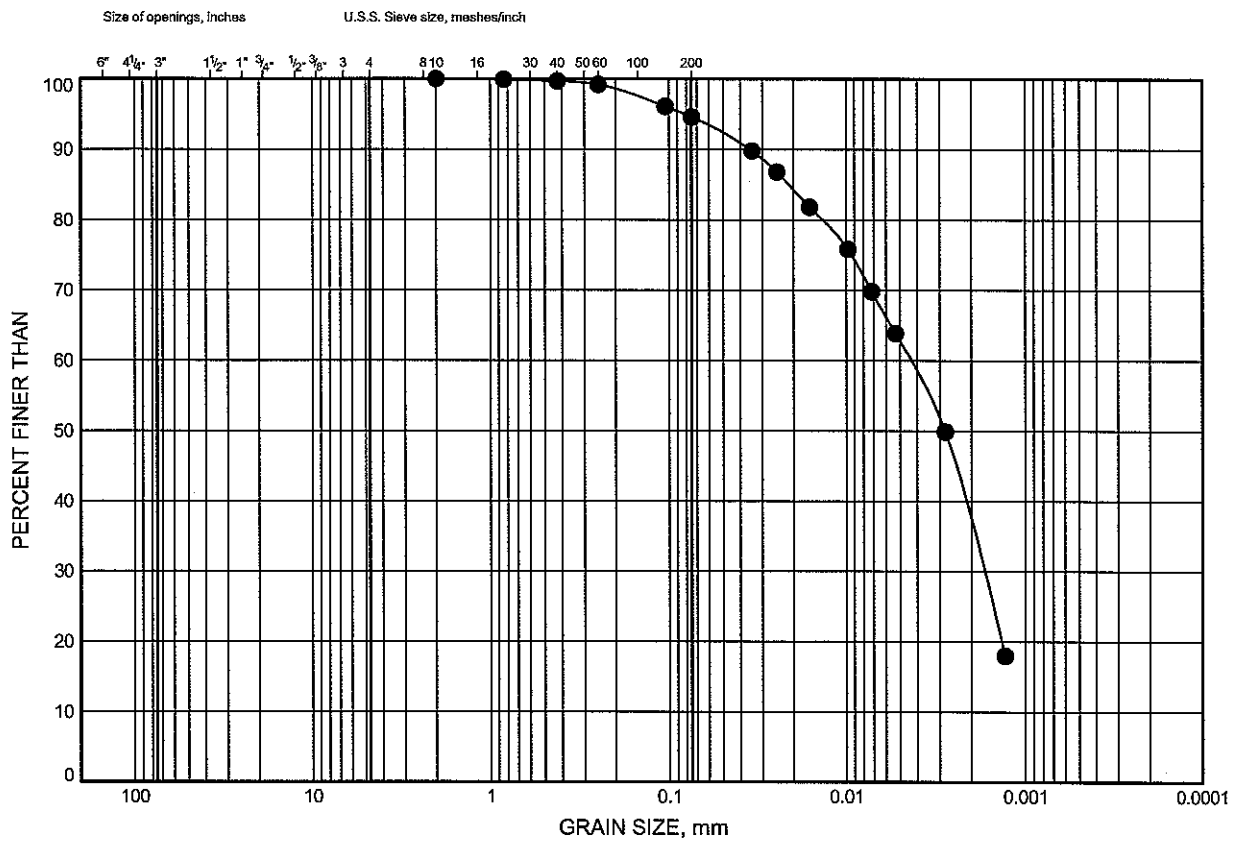
Prep'd JS

Chkd. MP

GRAIN SIZE DISTRIBUTION

FIGURE B4-3

FILL- Silty Clay



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

SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	MRW3	2.5	178.0

Date August 2010.....

Project 1-09-4135....



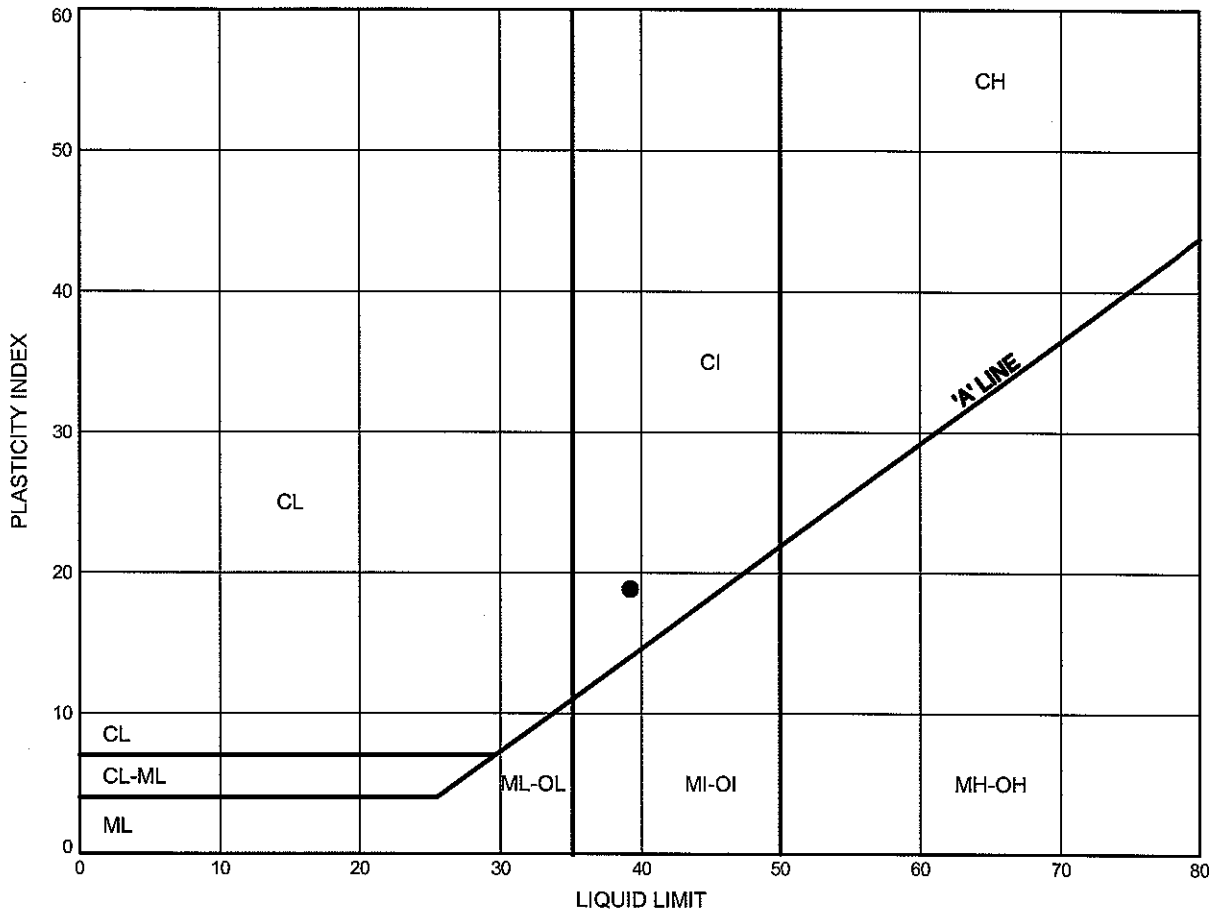
Prep'd JS.....

Chkd. MP.....

ATTERBERG LIMITS TEST RESULTS

FIGURE B4-4

FILL - Silty Clay



SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	MRW3	2.5	178.0

Date August 2010.....

Project 1-09-4135.....



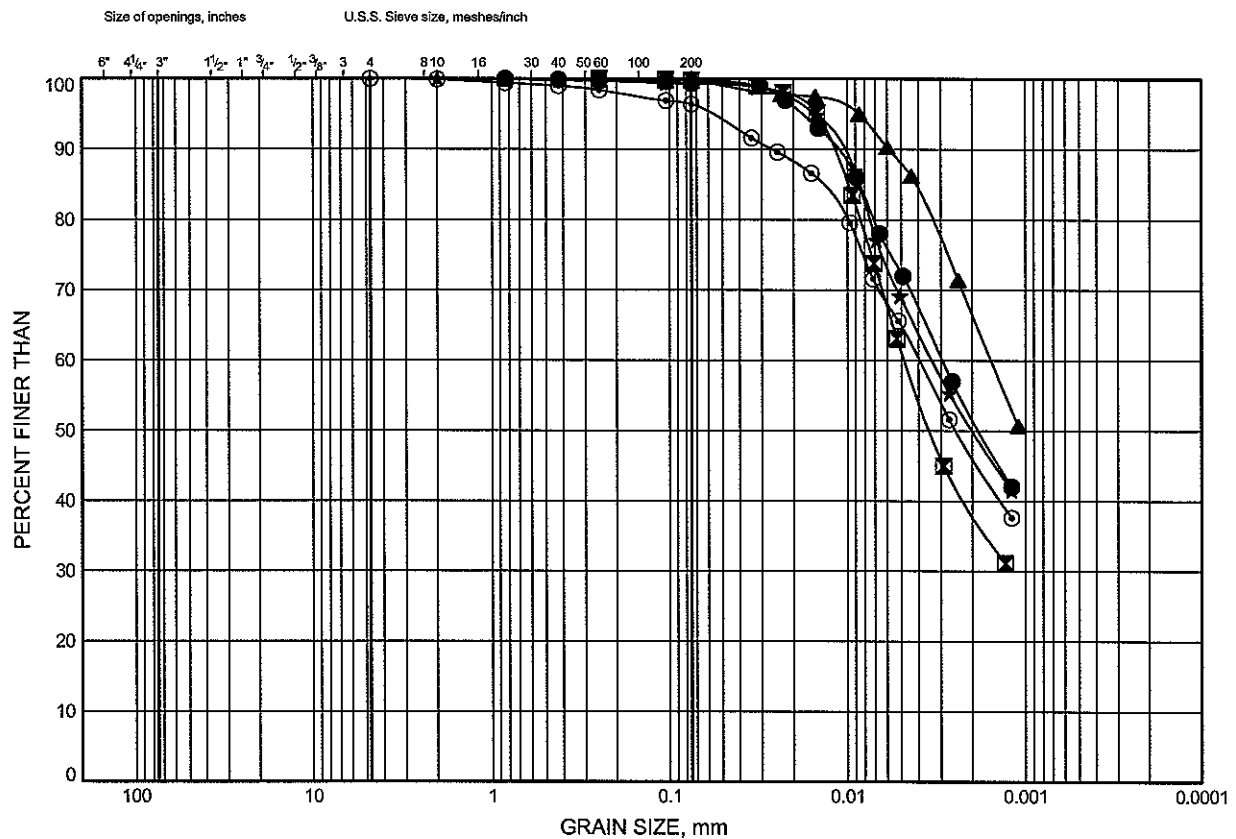
Prep'd JS.....

Chkd. MP.....

GRAIN SIZE DISTRIBUTION

FIGURE B4-5

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
★	MRW1	4.7	175.7
⊙	MRW2	3.2	177.6

Date August 2010.....

Project 1-09-4135.....



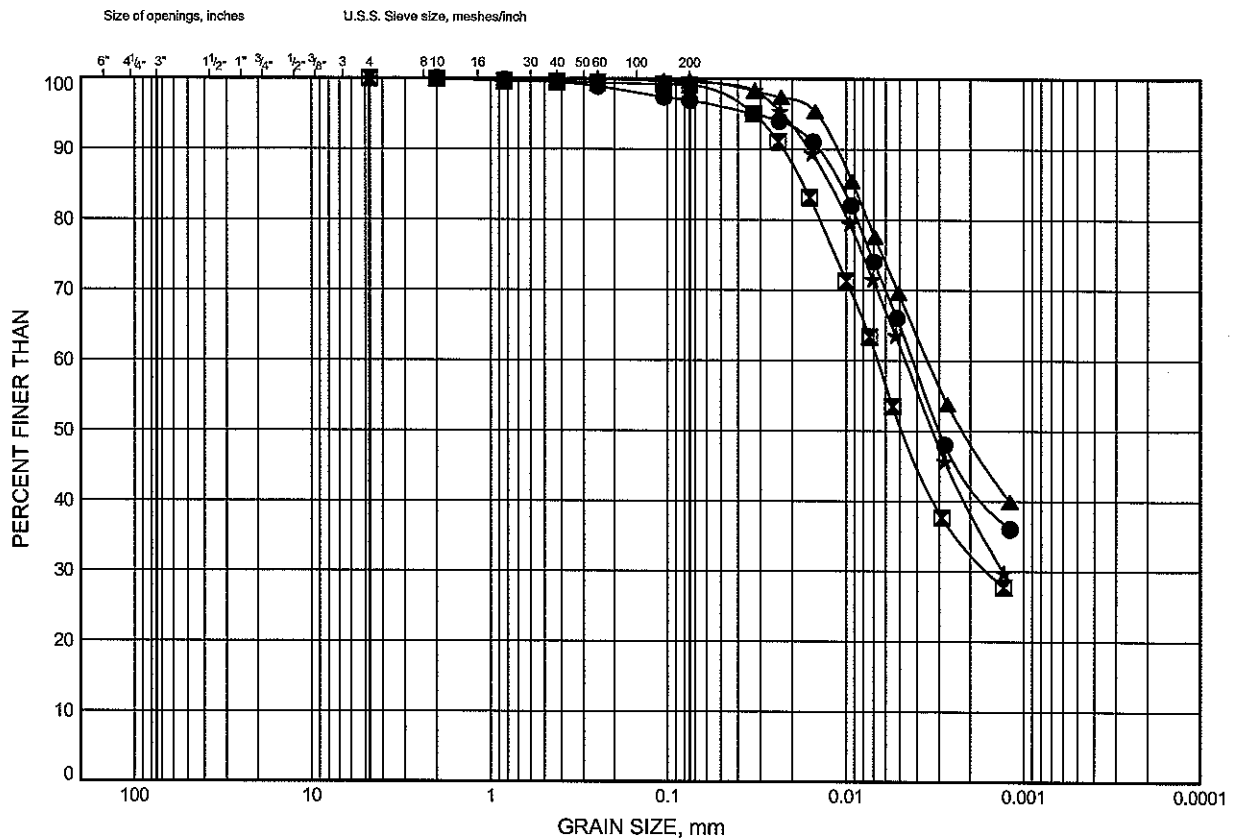
Prep'd JS.....

Chkd. MP.....

GRAIN SIZE DISTRIBUTION

FIGURE B4-6

SILTY CLAY



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

SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	MRW2	4.7	176.1
■	MRW2	7.8	173.0
▲	MRW3	4.7	175.8
★	MRW3	7.8	172.7

Date August 2010

Project 1-09-4135



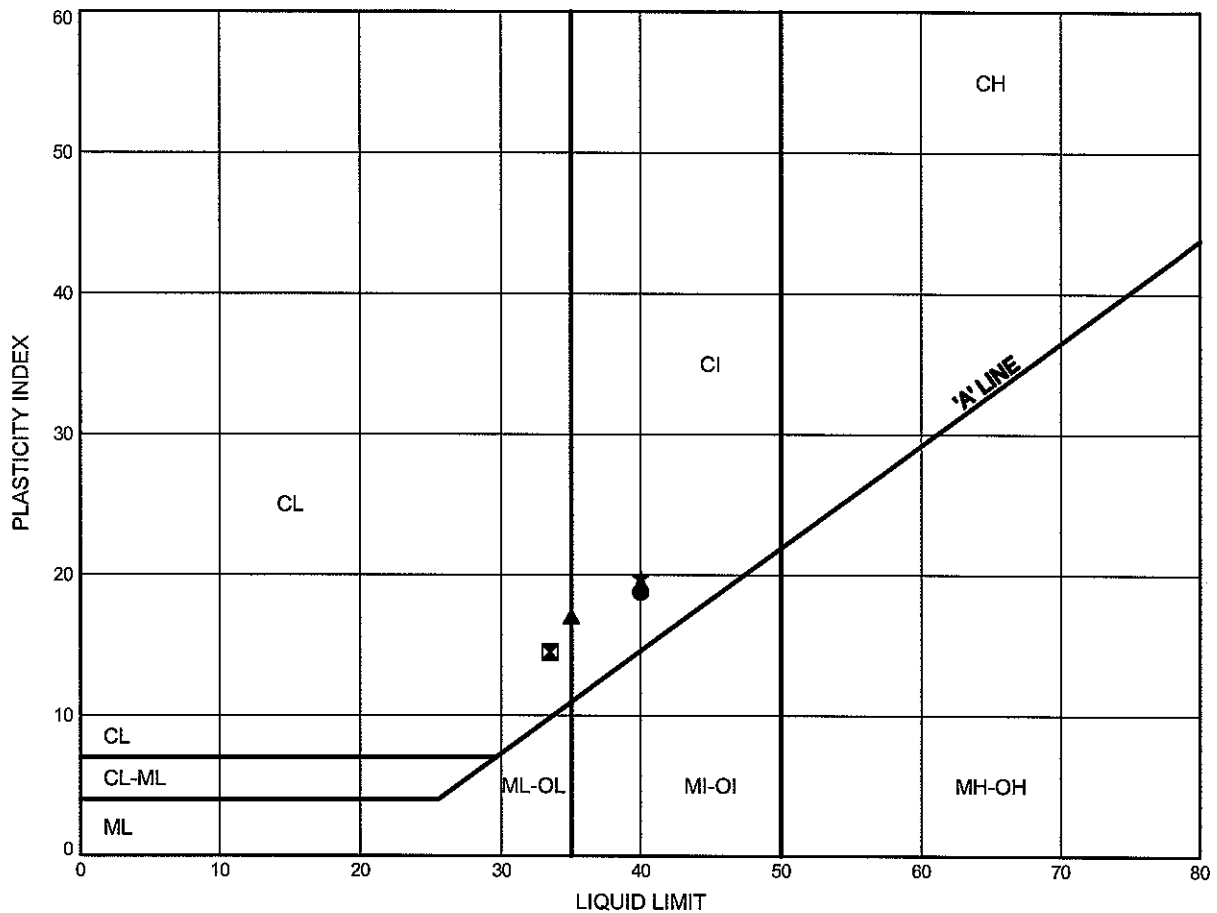
Prep'd JS

Chkd. MP

ATTERBERG LIMITS TEST RESULTS

FIGURE B4-7

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
★	MRW1	4.7	175.7

Date August 2010

Project 1-09-4135



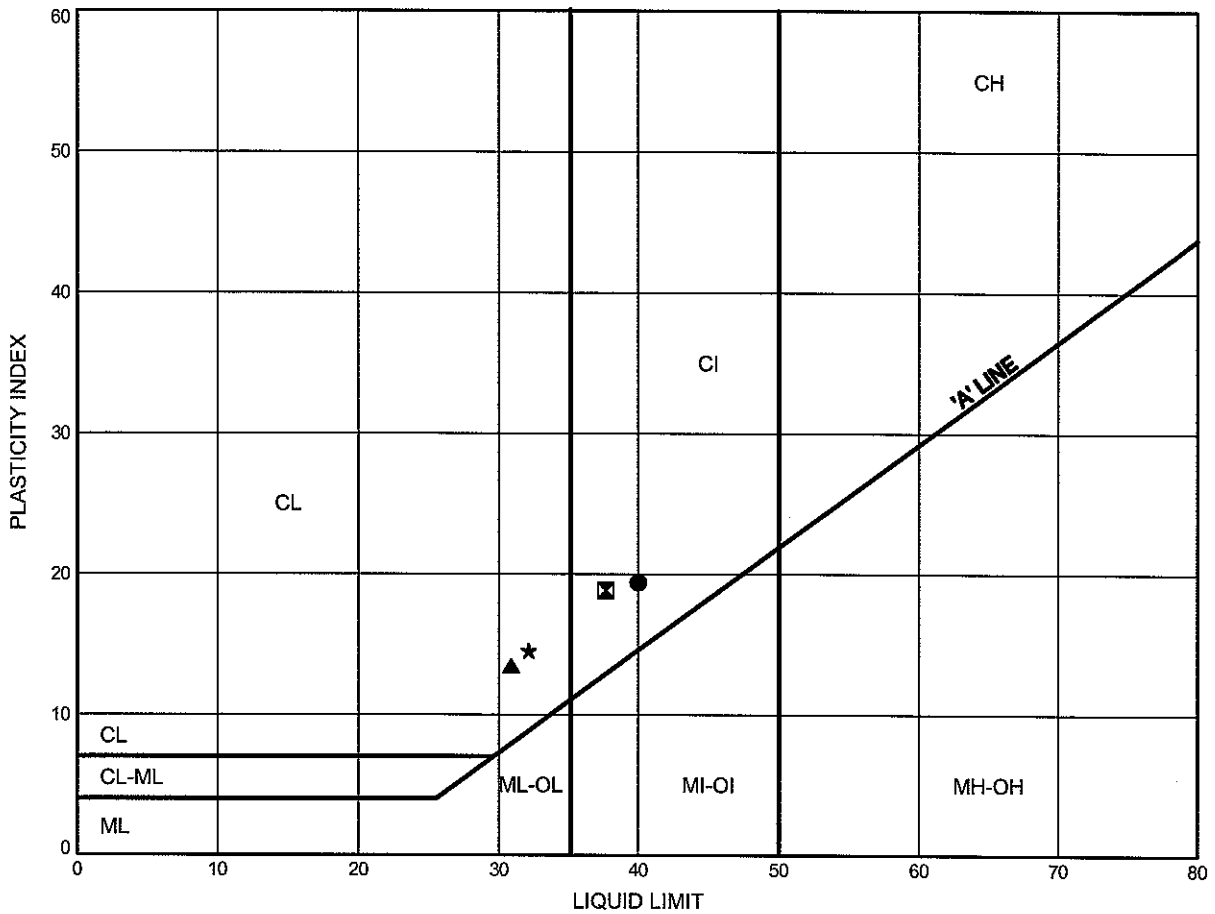
Prep'd JS

Chkd. MP

ATTERBERG LIMITS TEST RESULTS

FIGURE B4-8

SILTY CLAY



SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	MRW2	3.2	177.6
⊠	MRW2	4.7	176.1
▲	MRW2	7.8	173.0
★	MRW3	7.8	172.7

Date August 2010

Project 1-09-4135



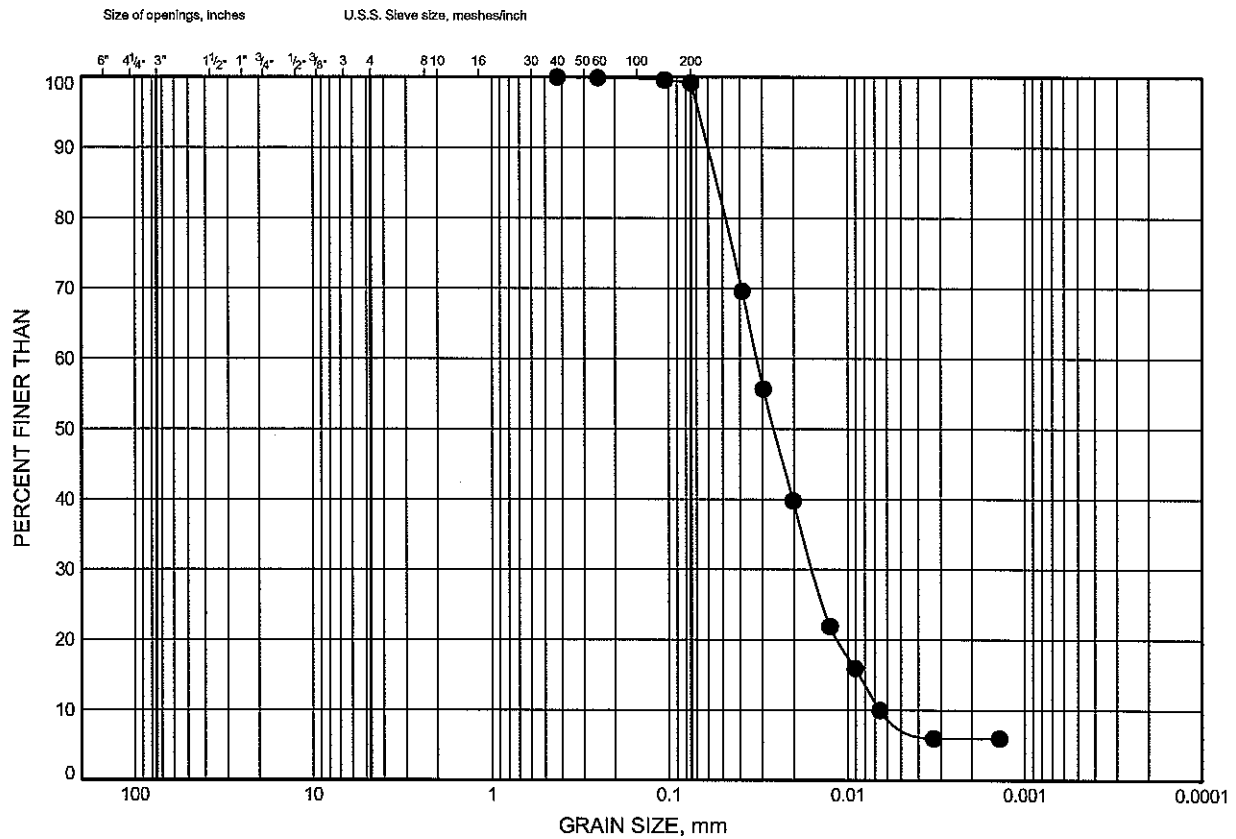
Prep'd JS

Chkd. MP

GRAIN SIZE DISTRIBUTION

FIGURE B4-9

SILT



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

SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	MRW1	10.9	169.5

Date August 2010

Project 1-09-4135



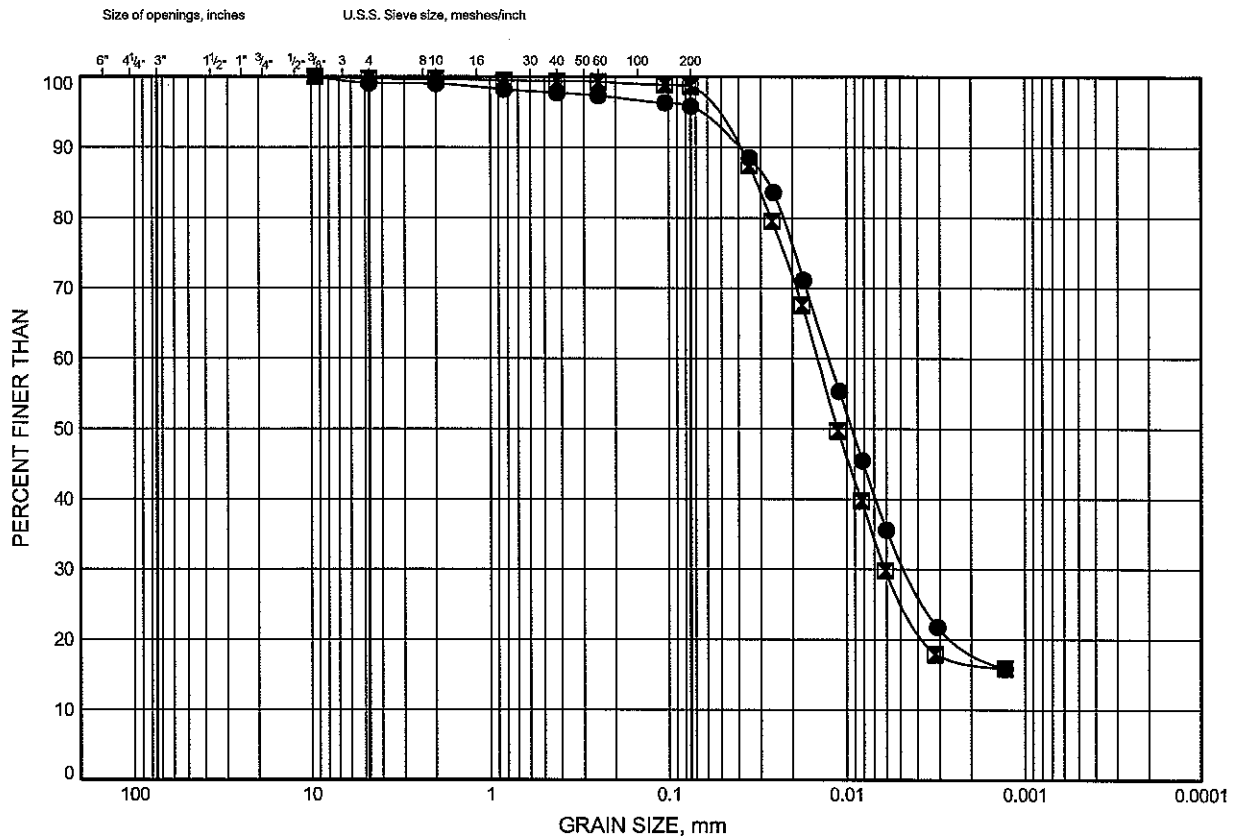
Prep'd JS

Chkd. MP

GRAIN SIZE DISTRIBUTION

FIGURE B4-10

SILTY CLAY TO CLAYEY SILT



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

SYMBOL BOREHOLE DEPTH (m) ELEVATION (m)

● MRW1 13.9 166.5

■ MRW2 13.9 166.9

Date August 2010

Project 1-09-4135



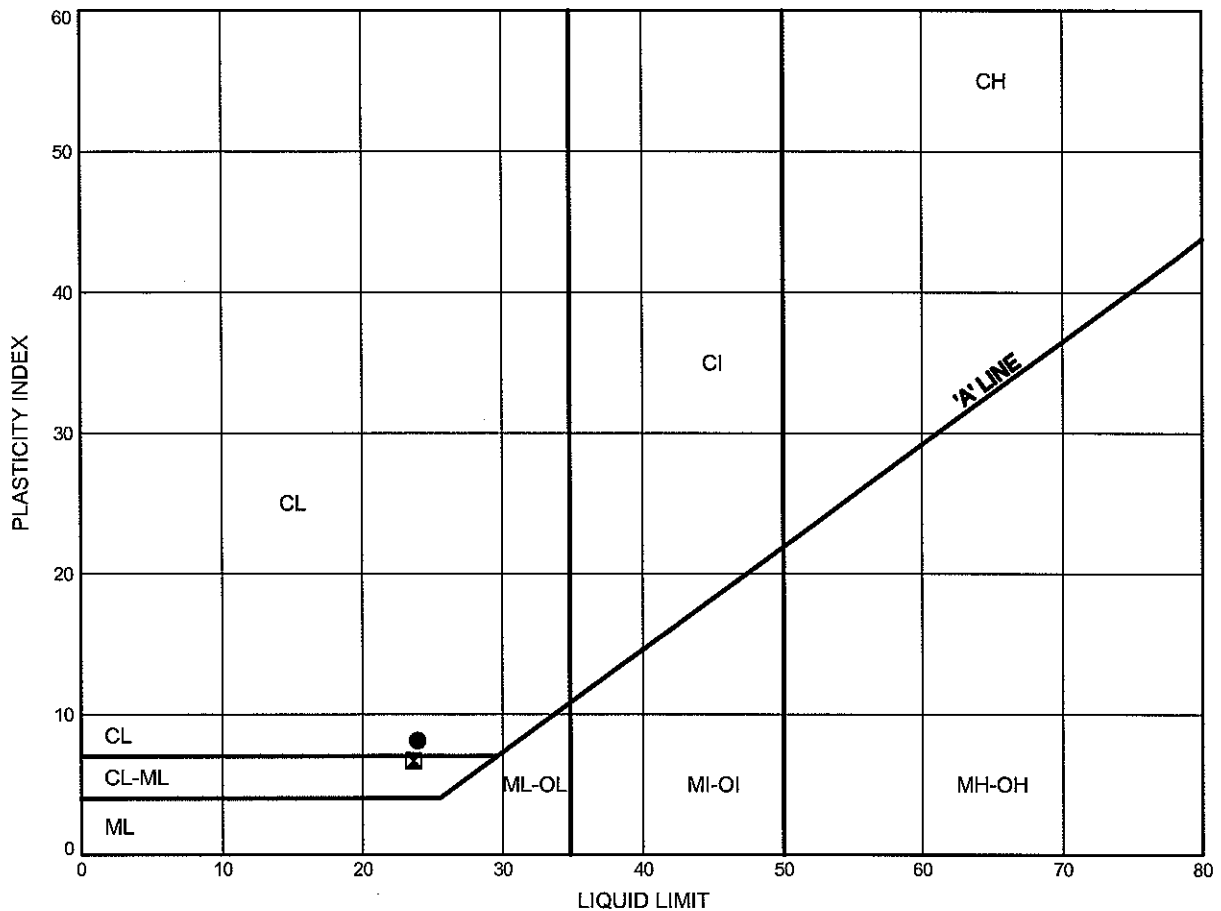
Prep'd JS

Chkd. MP

ATTERBERG LIMITS TEST RESULTS

FIGURE B4-11

SILTY CLAY TO CLAYEY SILT



SYMBOL	BOREHOLE	DEPTH (m)	ELEVATION (m)
●	MRW1	13.9	166.5
⊠	MRW2	13.9	166.9

Date August 2010.....

Project 1-09-4135.....



Prep'dJS.....

Chkd.MP.....

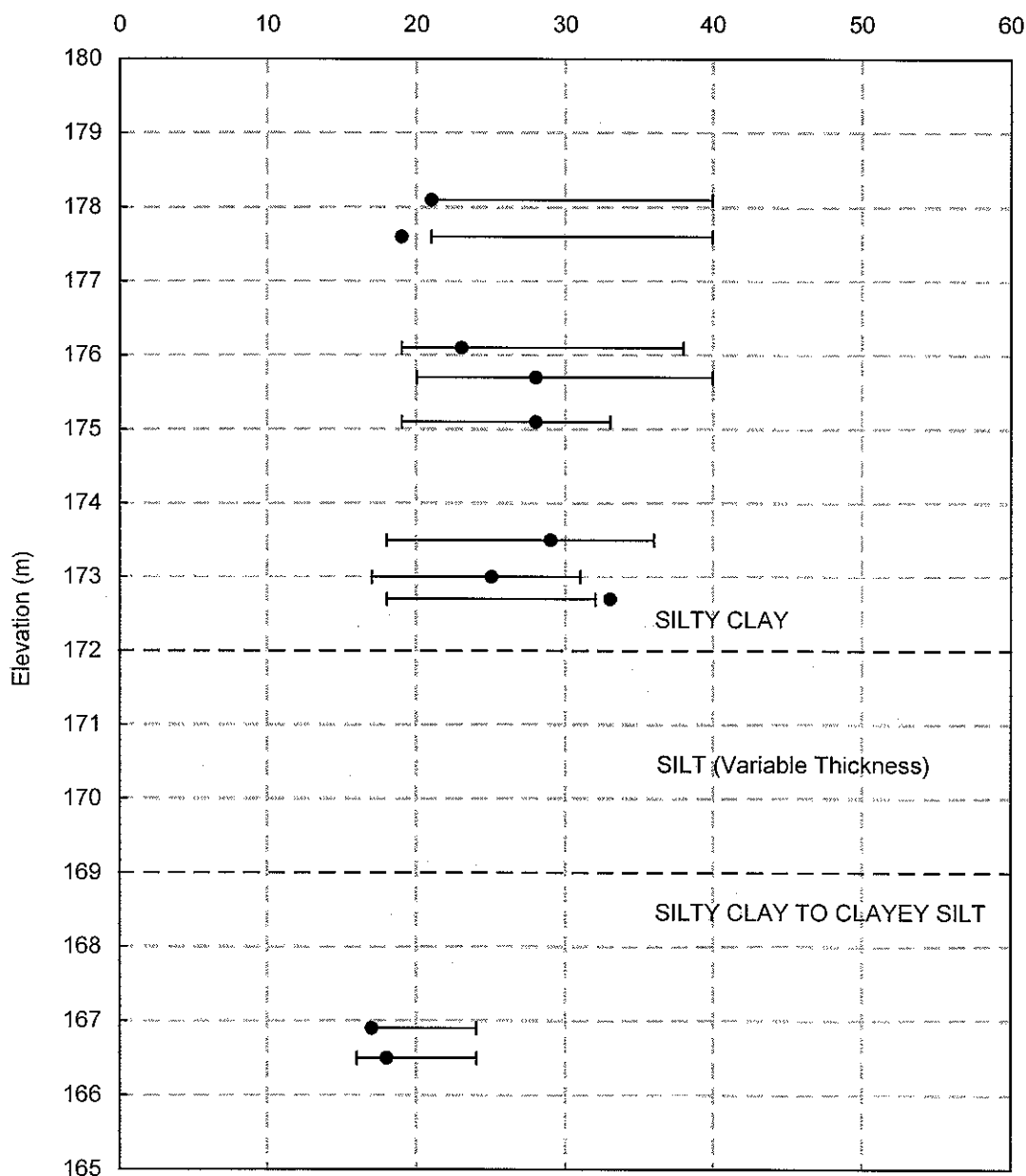
ATTERBERG LIMITS AND WATER CONTENTS

FIGURE B4-12

HWY 406 TWINNING - RETAINING WALL SITE #4

Silty Clay / Silty Clay to Clayey Silt

Atterberg Limits & Water Contents (%)



Project No. : 1-09-4135

Date : November, 2010



Terraprobe Inc.

Prepared By : HW

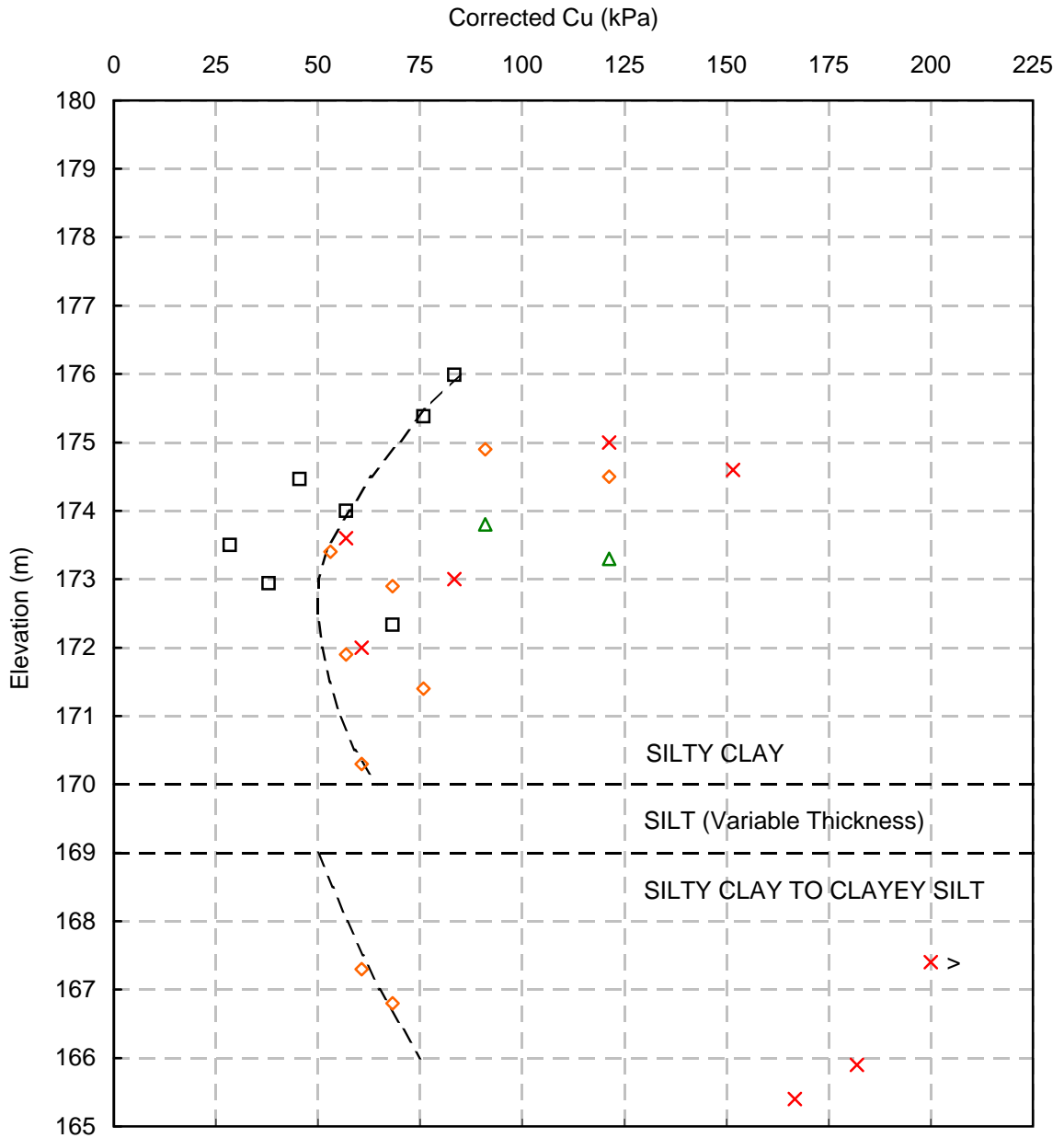
Checked By : RA

CORRECTED UNDRAINED SHEAR STRENGTH

FIGURE B4-13

HWY 406 TWINNING - RETAINING WALL SITE #4

Silty Clay / Silty Clay to Clayey Silt



□ MR 9+850 RT

◇ MRW1

△ MRW2

× MRW3

Field Shear Vane Correction

Morris & Williams (1994)

($\mu = 1.18 \text{ EXP}(-0.08 \text{ Ip}) + 0.57$)

Applied Correction Factors

0.83 (Elev. > 177m)

0.95 (Elev. < 177m)

Project No. : 1-09-4135

Date : November, 2010



Terraprobe Inc.

Prepared By : HW

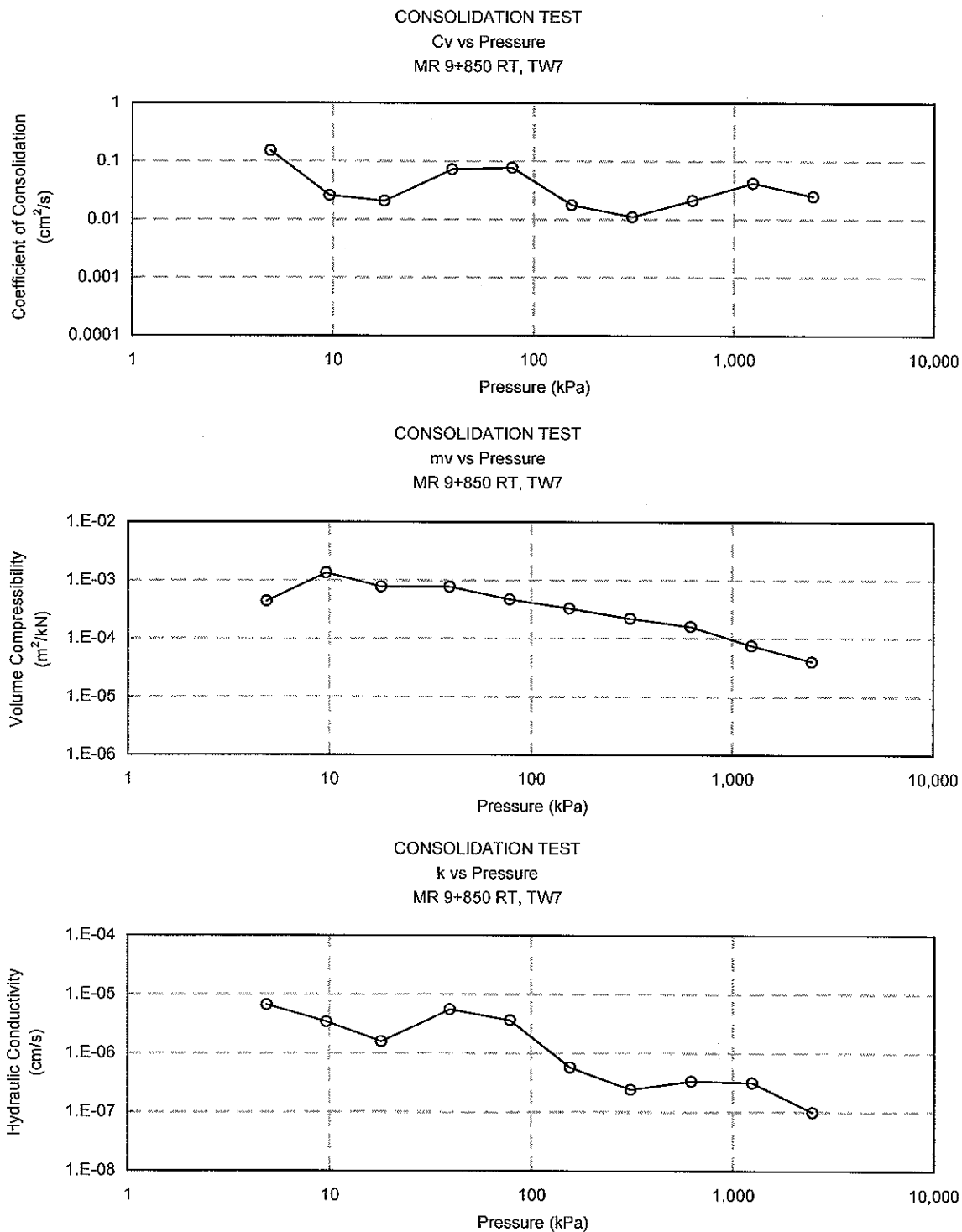
Checked By : RA

C:\Documents and Settings\Admin\My Documents\Marc P\Projects 2009\Hwy 406 Expansion\1-09-4135 (Hwy 406 Foundations)\Culverts and Retaining Walls\Retaining Walls\1-09-4135R4 Soil Parameter Estimation.xls

HWY 406 TWINNING - RETAINING WALL SITE #4

FIGURE B4-14

C:\Documents and Settings\Admin\My Documents\Marc P\Projects 2009\Hwy 406 Expansion\1-09-4135 (Hwy 406 Foundations)\Culverts and Retaining Walls\Retaining Walls\Lab Results\1-09-4135R5 Consolidation Results.xls



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



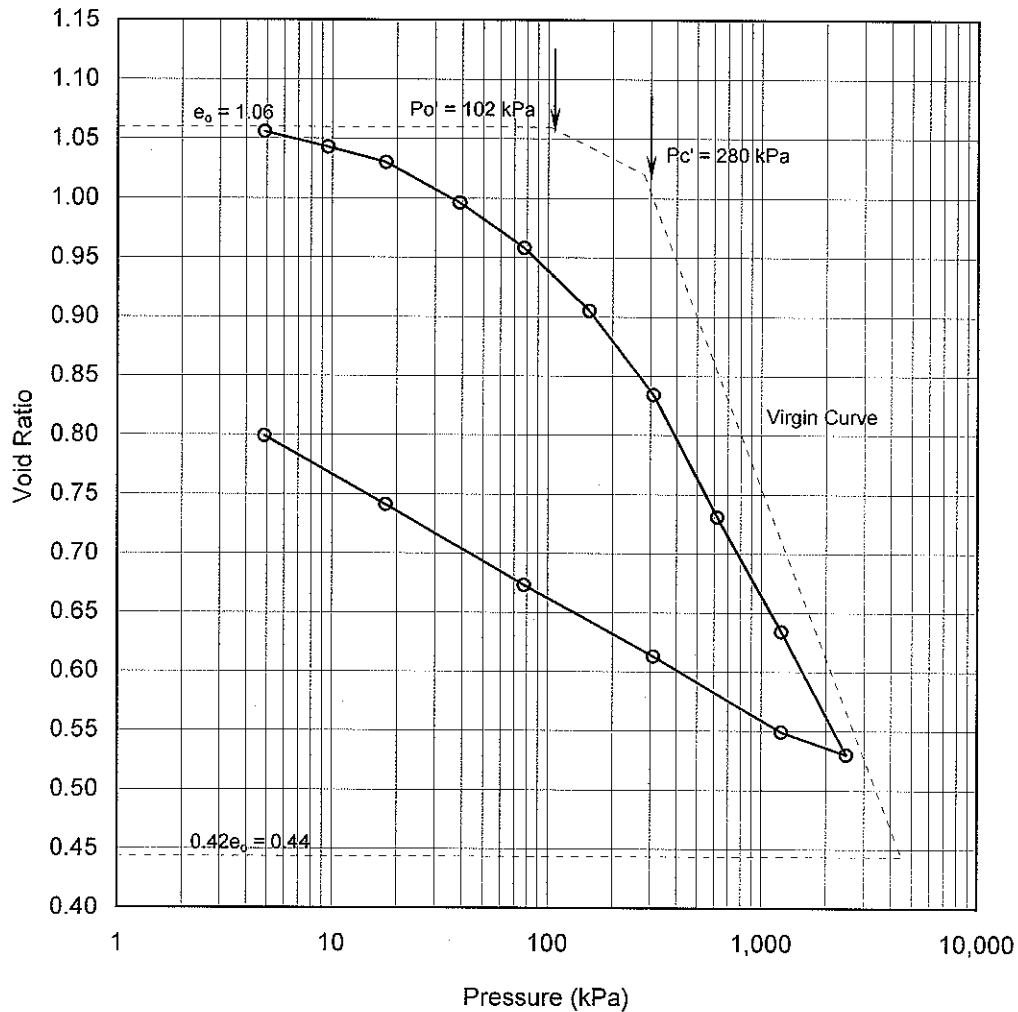
Terraprobe Inc.

Prepared By : HW
Checked By : RA

CONSOLIDATION TEST

e vs Pressure

MR 9+850 RT, TW7



Soil Type : Silty Clay

$e_0 =$	1.06	$\omega_L =$	36%	$P_0' =$	102 kPa
$\omega =$	29%	$\omega_P =$	18%	$P_c' =$	280 kPa
$\gamma =$	18.3 kN/m ³	PI =	18%	Cc =	0.478
Gs =	2.78			Cr =	0.091

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



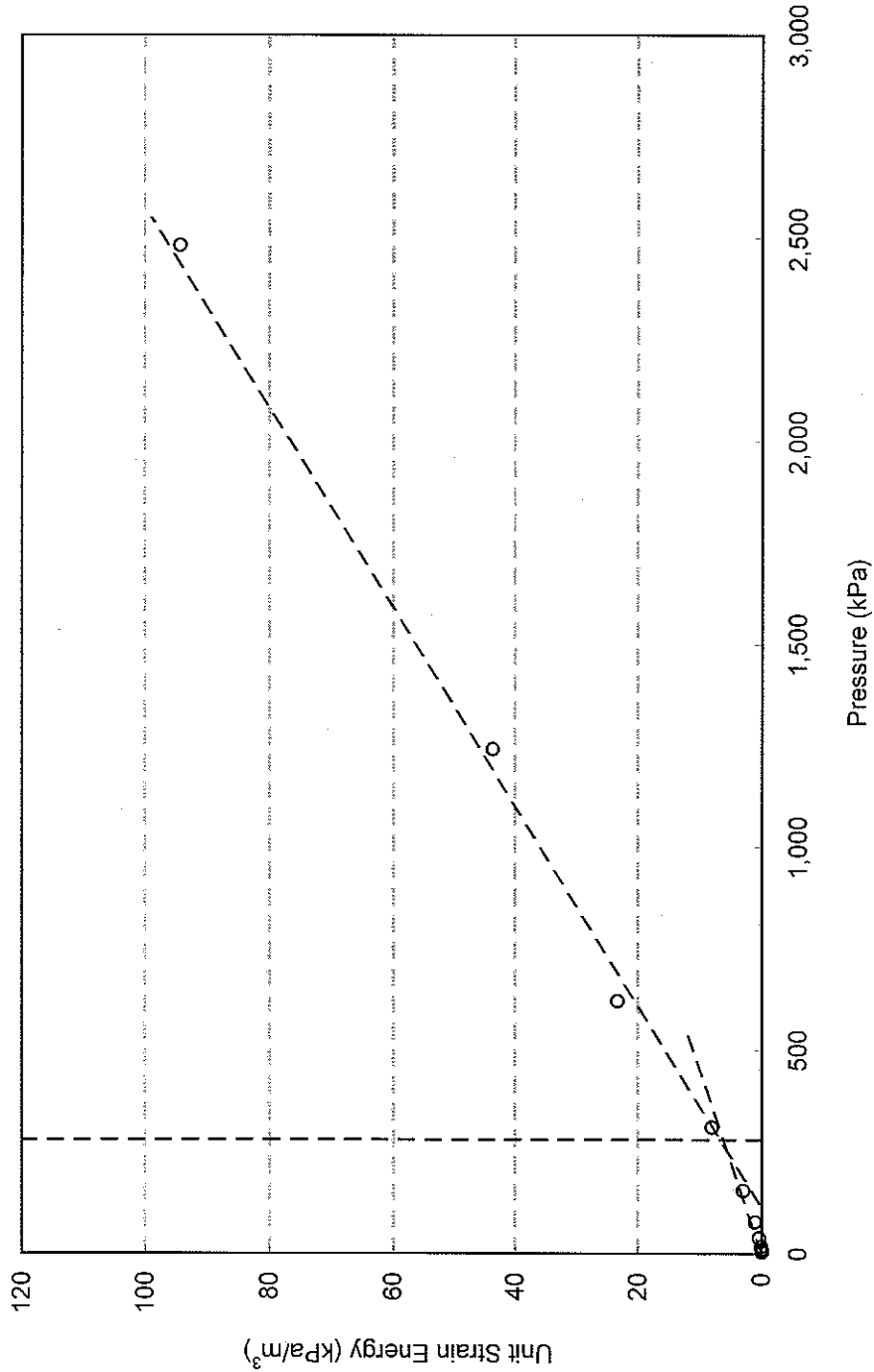
Terraprobe Inc.

Prepared By : HW
Checked By : RA

HWY 406 TWINNING - RETAINING WALL SITE #4

FIGURE B4-16

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



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

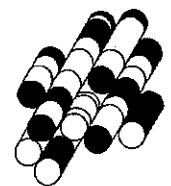


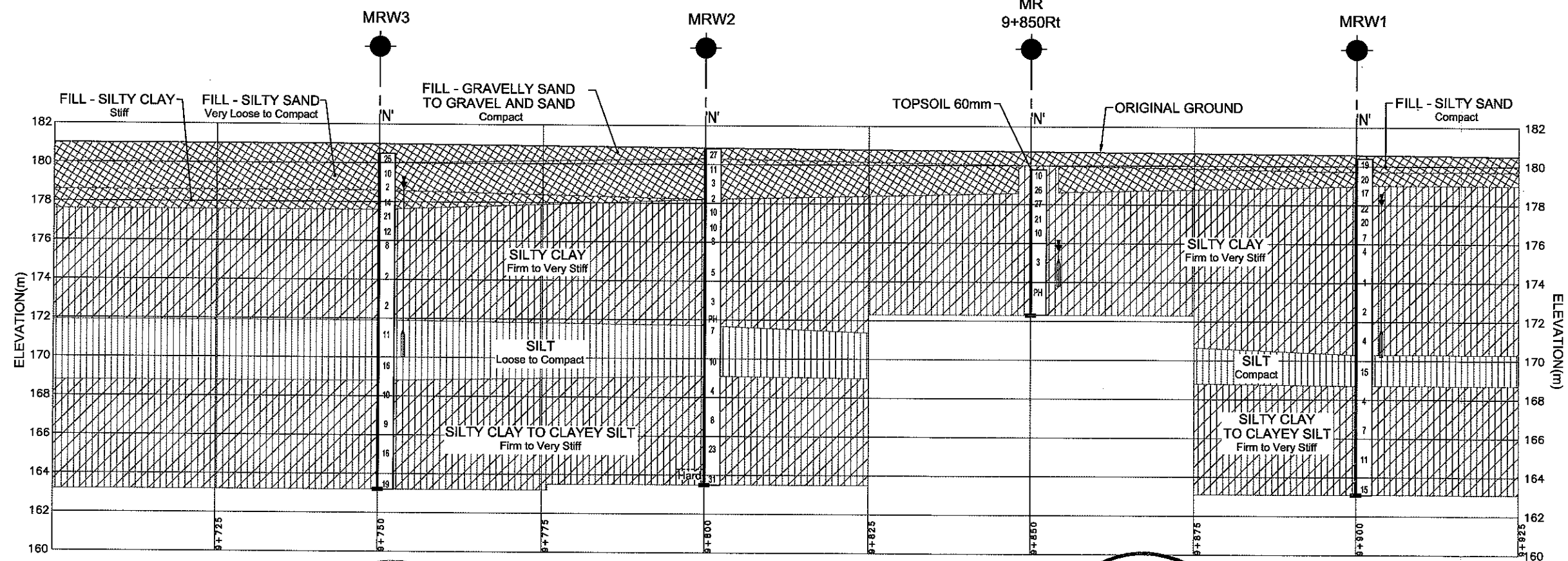
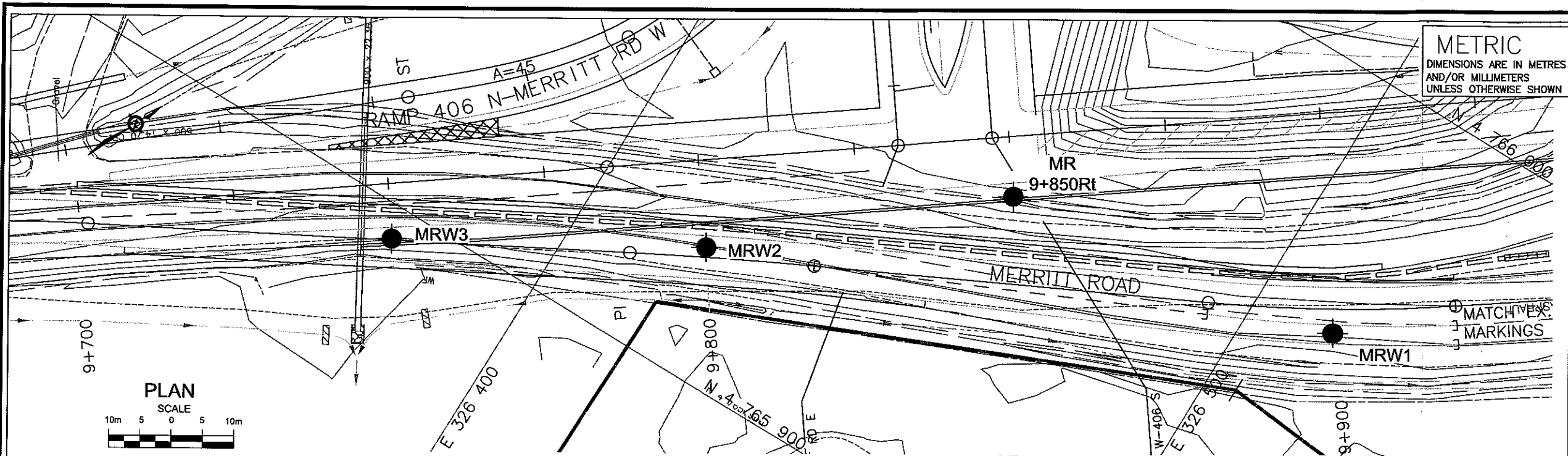
Terraprobe Inc.

Prepared By : HW
Checked By : RA

C4

TERRAPROBE INC.





Q PROFILE MERRITT ROAD ALIGNMENT

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

CONT No 2011-2005
WP No 280-99-00

HIGHWAY 406
MERRITT RD TEMPORARY RETAINING WALL
BOREHOLE LOCATIONS AND SOIL STRATA

IBI
GROUP

Terraprobe Inc.
Consulting Geotechnical & Environmental Engineering
Construction Materials Engineering, Inspection & Testing
10 Bram Court - Brampton Ontario L6W 3R6 (905) 796-2650



KEY PLAN

LEGEND	
	Bore Hole
	Dynamic Cone Penetration Test
	Bore Hole And Cone
	Blows/0.3m (Std Pen Test, 475 J/blow)
	Blows/0.3m (60° Cone, 475 J/blow)
	WL at Time of Investigation
	WL in Piezometer (AUG. 2010)
	Piezometer
	90% Rock Quality Designation
	A/R Auger Refusal

No	ELEV.	COORDINATES	
		NORTHING	EASTING
MR 9+850Rt	179.8	4 765 953.0	326 458.1
MRW1	180.4	4 765 961.0	326 513.2
MRW2	180.8	4 765 920.3	326 420.3
MRW3	180.5	4 765 895.0	326 376.6

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 CHBDC2008	LOAD	DATE FEB. 2011
DRAWN K.C.	CHK R.A.	STRUCT	GEOCRE 30M3-266

