

**FOUNDATION INVESTIGATION REPORT
DEEP CUTS AND HIGH FILL EMBANKMENTS
RECONSTRUCTION AND WIDENING OF HIGHWAY 8
FROM 1.0 KM NORTH OF GRAND RIVER, SOUTHERLY
TO SPORTSWORLD DRIVE, KITCHENER, ONTARIO
G.W.P. 277-97-00**

Geocres Number: 40P8-148

Report to

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HighFill\Deep Cut FINAL FIR.doc

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PART 1: FACTUAL INFORMATION

1 INTRODUCTION

This report presents the factual findings obtained from a foundation investigation conducted for a proposed deep cut and a proposed high fill embankment required for the planned widening of Highway 8 in Kitchener, Ontario.

Highway 8 will be widened from four to eight lanes from 1 km north of the Grand River southerly to Sportsworld Drive. The project will include a deep cut between Stations 13+400 and 13+650, and a high fill embankment between Stations 13+650 and 14+500 located in the Grand River floodplain.

The purpose of this investigation was to explore the subsurface conditions along the deep cut and high fill embankment alignments and, based on the data obtained, to provide a borehole location plan, records of boreholes, stratigraphic profile and cross-sections, laboratory test results and a written description of the subsurface conditions. A model of the subsurface conditions was developed from the data obtained in the course of the investigation.

Thurber carried out the investigation as a sub-consultant to Morrison Hershfield Limited, under the Ministry of Transportation Ontario (MTO) Agreement Number 3005-E-0035.

2 SITE DESCRIPTION

The site is located along existing Highway 8 in Kitchener, Ontario. Within this section, existing Highway 8 descends through a cut section in an elevated land area on the north side of the Grand River, crosses the Grand River bridge, and extends over the river floodplain to the south of the river on a fill embankment. Existing highway grades fall from near elevation 303 m at Station 13+400 at the north limit of the deep cut section, to elevation 288.3 m through the floodplain (approximate Stations 13+950 to 14+200), and rise again to elevation 297 m at the south limit of the high fill embankment (Station 14+500).

The existing Highway 8 cut extends from the north end of the Grand River bridge to approximately 250 m north, with a depth of up to 13 m below the adjacent tableland. The ground surface on the tableland above the cut typically rises from about elevation 307 m at the north limit of the cut section to elevation 310 m near the centre, and then falls gradually to elevation 308 m near the crest of the slope to the Grand River. The valley slope to the river is some 25 m high and inclined at approximately 2H:1V. Trees, brush and several residential dwellings are present on the tablelands.

The existing highway embankment in the river floodplain ranges in height from approximately 3.5 to 12 m and extends from the south end of the Grand River bridge to approximately 650 m south. The floodplain is generally level at approximate elevation 285 m, with a gentle slope towards the river channel. The floodplain is mainly vegetated with grass, shrubs and some sparse trees.

The preliminary profile drawing provided by Morrison Hershfield indicates a water level of elevation 282.5 m in the Grand River. The water depth measured in the river during the concurrent foundation investigation for the new bridge was approximately 1.5 m to 2.3 m at the borehole locations. The river flow is controlled by the local conservation authority.

Geologically, the site area is located within the physiographic region known as the Waterloo Hills, which is characterized by sandy hills consisting of ridges of sandy till as well as kames and kame moraines, with outwash sands occupying the intervening hollows. Locally, the Grand River spillway system contains alluvial terraces of uniform sandy and gravelly materials. The soils overlie Silurian limestone bedrock of the Guelph Formation.

3 SITE INVESTIGATION AND FIELD TESTING

The site investigation and field testing for the cut section were carried out during the period September 19 to 25, 2006 and consisted of drilling and sampling six boreholes (Nos. 06-28 to 06-33) to depths of 12.5 to 20.1 m. The site investigation and field testing for the fill section were carried out between August 8 and 16, 2006 and consisted of drilling and sampling 13 boreholes (Nos. 06-34 to 06-46) to depths of 2.8 to 9.7 m, including two boreholes encountering auger refusal.

Several other boreholes (Nos. 06-11, 06-12, 06-13, 06-64 and 06-73), drilled in the fill area for concurrent investigation at other project-related structures, were referenced and are included in this report.

The approximate borehole locations are shown on the Borehole Locations and Soil Strata Drawings in Appendix D. The coordinates and elevations of the boreholes are given on these drawings and on the individual Record of Borehole Sheets in Appendix A.

Prior to commencement of drilling, utility clearances were obtained for all borehole locations. Permission to Enter was obtained before entering private properties.

Hollow stem augers were used to advance the boreholes. Samples were obtained at selected intervals using a split spoon sampler in conjunction with Standard Penetration Testing (SPT). A

member of Thurber's engineering staff supervised the drilling and sampling operations on a full time basis. The inspector logged the boreholes, visually examined the recovered samples, and transported them to Thurber's laboratory for further examination and testing.

Standpipe piezometers, consisting of 19 or 25 mm PVC pipes with slotted tip, were installed in selected boreholes to monitor groundwater levels. The remaining boreholes were grouted on completion of drilling. The completion details of the boreholes and piezometers are shown in Table C1 of Appendix C. The piezometers will be decommissioned in accordance with MOE Reg. 903.

4 LABORATORY TESTING

The recovered soil samples were subjected to Visual Identification (VI) and to natural moisture content determination. The results of this testing are shown on the Record of Borehole sheets in Appendix A. Approximately 25% of the recovered samples were also subjected to grain size distribution analyses (sieve and hydrometer) and Atterberg Limits testing. The results of this testing program are shown on the Record of Borehole sheets in Appendix A and on the figures contained in Appendix B.

5 DESCRIPTION OF SUBSURFACE CONDITIONS

Details of the encountered soil stratigraphy are presented on the Record of Borehole sheets in Appendix A and on the Borehole Locations and Soil Strata Drawing in Appendix D. 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.

5.1 Deep Cut - Station 13+400 to 13+650 Boreholes 06-28 to 06-33

In general terms, the site was found to be underlain by a unit of sand to silt and sand, overlying silty clay till with interbeds of sandy silt till and sand and gravel. A deposit of sandy silt to silty sand till underlies the cohesive till. More detailed descriptions of the individual strata are presented below.

5.1.1 Topsoil

A 100 to 275 mm thick layer of topsoil was encountered at the ground surface in all boreholes drilled in the cut area. The topsoil thickness may vary between and beyond the borehole locations and the data is not intended for the purpose of estimating quantities.

5.1.2 Sand Fill

A layer of sand fill extending to 1.4 m depth (elevation 306.6 m) was encountered below the topsoil in borehole 06-33. The fill was loose with a recorded SPT N-value of 8 blows/0.3 m. The moisture content was about 10%.

5.1.3 Sand to Silt and Sand

Native deposits of brown, non-cohesive sand to silt and sand were encountered below the topsoil and fill in all boreholes. These deposits typically contained a trace to some gravel and locally contained cobbles. Grain size distribution results for the sand to silt and sand are presented on the Record of Borehole sheets and Figures B1 and B2 of Appendix B. The silt content in the tested samples varied widely from 5 to 81%, and clay contents of 6 to 14% were determined.

The lower boundary of the sand/silt material was encountered at depths of 3.1 to 6.3 m, increasing towards the south (elevation 301.7 to 305.0 m, highest near Station 13+500).

SPT N-values in the sand to silt and sand deposits varied widely from 7 to 63 blows/0.3 m penetration, with several counts exceeding 50 blows/0.15 m. The relative density indicated by the N-values ranges from loose to very dense. It must be noted however that only two N-values of less than 10 blows (loose) were obtained, and that N-values greater than 50 may reflect the presence of cobbles or boulders.

Moisture contents in this material ranged from 1% to 13%, with one sample of wet silt and sand indicating 22%.

5.1.4 Silty Clay Till

The upper sand to silt and sand layer is underlain by a deposit of brown to grey silty clay till. The upper boundary at which clay till was first encountered in the boreholes ranged from depths of 3.1 to 9.2 m (elevation 298.8 to 305.0 m). In boreholes 06-28 and 06-30, 0.5 to 2.8 m thick layers of sand and gravel to gravelly sand were encountered below the initial 0.7 to 1.1 m of clay till, with the till resuming at depths of 7.0 and 9.2 m (elevation 300.1 and 301.3 m). Zones of sandy silt till, 1.3 to 3.5 m thick, were encountered in or above the clay till in boreholes 06-31 and 06-32. In borehole 06-33, a 2.9 m thick layer of sand and gravel was encountered between the upper sand deposit and the clay till.

The lower boundary of the silty clay till was encountered at depths of 11.6 to 16.0 m (elevation 294.0 to 296.3 m).

Standard Penetration Tests conducted in the clay till yielded N-values ranging from 40 blows/0.3 m penetration to 50 blows/0.075 m, indicating a hard consistency. The higher N-values may reflect the presence of cobbles in the till. Glacial till is known to contain cobbles and boulders.

Moisture contents generally ranged from 12 to 20%, with localized values as low as 3% likely resulting from the presence of gravel particles in the sample tested.

Samples from this deposit were subjected to grain size distribution and Atterberg Limits tests. The results of the grain size analyses are reported on the Record of Borehole Sheets

and plotted in Figures B4 and B5 of Appendix B. The Atterberg Limits, plotted on Figures B7 and B8, indicate that the silt clay till has a medium to high plasticity.

5.1.5 Sand and Gravel, Gravelly Sand, and Sandy Silt Till

Localized deposits of sand and gravel to gravelly sand were encountered within or above the silty clay till stratum in boreholes 06-28, 06-30 and 06-33. The sand and gravel deposits were 0.5 to 2.8 m thick, with an upper boundary contacted at depths of 4.2 to 7.3 m (elevation 301.7 to 304.3 m). SPT N-values in these layers ranged from 27 to 88 blows/0.3 m, indicating a compact to very dense condition. Moisture contents ranged from 7 to 19%. The results of grain size analyses conducted on this material are reported on the Record of Borehole Sheets and plotted in Figure B3 of Appendix B.

Zones of sandy silt till were encountered within or above the clay till locally in boreholes 06-31 and 06-32. These zones ranged in thickness from 1.3 to 3.5 m, with upper boundaries at depths of 5.1 to 10.4 m (elevation 299.6 to 304.8 m). N-values of 25 blows/0.3 m to 50 blows/0.1 m were obtained, indicating a compact to very dense condition. Moisture contents ranged from 7 to 12%. Glacial till is known to contain cobbles and large boulders.

5.1.6 Sandy Silt to Silty Sand Till

Very dense, grey sandy silt to silty sand till was encountered below the clay till in all boreholes. The upper boundary of this till was encountered at depths of 11.6 to 16.0 m (elevation 294.0 to 296.3 m). Drilling was terminated in the till at depths of 12.5 to 20.1 m (elevation 288.0 to 294.6 m).

Samples from this deposit were subjected to grain size distribution tests. The results of the sieve and hydrometer analyses are presented on the Record of Borehole Sheets and Figure B6 of Appendix B. Moisture contents from this deposit ranged from 4 to 11%, with one value of 19% obtained locally.

All SPT test conducted in the silt/sand till deposit achieved 50 blows for less than 150 mm of penetration, indicating a very dense condition. Glacial till is known to contain cobbles and large boulders.

5.1.7 Groundwater Conditions

The sand and gravel and/or upper sand/silt deposits immediately above or within the upper part of the clay till unit were described as wet in four of the boreholes (Nos. 06-28, 06-30, 06-31 and 06-33). The wet conditions indicate that groundwater may be perched in the non-cohesive soils above or within the less permeable clay till.

Standpipe piezometers were installed in the boreholes to monitor water levels after completion of drilling. The water levels measured in the piezometers are summarized in Table 5.1.

Table 5.1 – Measured Groundwater Levels

Borehole	Date	Water Level (m)	
		Depth	Elevation
06-28	18-Sept-2006	11.3	295.8
	20-Sept-2006	11.4	295.7
	21-Sept-2006	11.4	295.7
	22-Sept-2006	11.5	295.6
	29-Sept-2006	11.5	295.6
06-29	20-Sept-2006	17.0	291.2
	21-Sept-2006	13.4	294.8
	22-Sept-2006	13.3	294.9
	29-Sept-2006	13.3	294.9
06-30	21-Sept-2006	11.8	298.7
	22-Sept-2006	12.2	298.3
	29-Sept-2006	15.9	294.6
06-31	21-Sept-2006	19.7	290.3
	22-Sept-2006	14.5	295.5
	29-Sept-2006	16.3	293.7
06-32	29-Sept-2006	17.5	291.7
06-33	22-Sept-2006	16.0	292.0
	25-Sept-2006	17.5	290.5
	29-Sept-2006	17.6	290.4

The above values are short-term readings and seasonal fluctuations of the groundwater level are to be expected. In particular, the groundwater level may be at a higher elevation after the spring snowmelt or after periods of heavy rainfall. Further, perched water may be encountered at higher levels in zones of more permeable sand and gravel, or sand/silt above or within the clay till.

5.2 High Fill Embankment - Station 13+650 to 14+500 Boreholes 06-11 to 06-13, 06-34 to 06-46, 06-64 and 06-73

A separate Foundation Investigation Report has been prepared for the Grand River bridge and approach fills within 20 m of the abutments. The bridge report documents the subsurface conditions between approximate Stations 13+627 and 13+859. This report addresses the section beyond (south of) Station 13+859, and references three boreholes drilled at the south abutment of the proposed bridge.

In general terms, boreholes drilled on the Grand River floodplain encountered alluvial deposits of sand, silt and clay overlying a layer of sand and gravel. Boreholes drilled on the south part of the site ascended the existing embankment slope and encountered sand fill overlying a sand layer. At the extreme south limit of the investigation area, units of native silty clay, sandy silty clay till and silty sand till were encountered above the sand layer instead of fill. The sand and gravel and sand layers throughout the site are underlain by a heterogeneous till grading from silty sand to sandy silty clay, and interrupted by discontinuous layers of sand. More detailed descriptions of the individual strata are presented below.

5.2.1 Topsoil

A topsoil layer was encountered at the ground surface in all boreholes. The thickness of the surficial topsoil layer ranged from 25 to 150 mm in all boreholes except borehole 06-39 where the topsoil/organics extended to 800 mm depth. In borehole 06-38, a second layer of topsoil/organics, 600 mm thick, was encountered below fill at 0.8 m depth. In addition, a 75 mm thick topsoil layer was encountered below fill at depths of 500 and 100 mm in boreholes 06-11 and 06-13 at the bridge abutment.

The topsoil thickness may vary between and beyond the borehole locations and the data is not intended for the purpose of estimating quantities.

5.2.2 Sand Fill

Boreholes 06-40 to 06-46 were drilled at locations ascending the existing highway embankment, rising towards the south. In these boreholes, the fill thickness generally increases towards the south, from 2.2 m in borehole 06-41 to 7.0 m in borehole 06-45, and then decreases to 0.2 m in borehole 06-46. The lower boundary of the embankment fill typically ranges from elevation 284.2 to 286.1 m, rising to elevation 295.1 m in borehole 06-46 at the south limit.

The fill comprises sand containing a trace of gravel to gravelly, a trace of silt to silty, and cobbles. The results of the grain size distribution analyses conducted on the fill are reported on the Record of Borehole Sheets and plotted in Figure B9 of Appendix B. The results indicate fines contents (silt and clay) of 13 to 22%.

Standard Penetration Tests conducted in the fill typically yielded N-values of 16 to 67 blows/0.3 m penetration, indicating a compact to very dense condition. Lower N-values of 7 to 9 blows/0.3 m (loose) were obtained locally in boreholes 06-40 and 06-45. Several N-values of 50 blows for less than 150 mm are believed to reflect the presence of cobbles in the fill. Moisture contents generally ranged from 3 to 12%, with one value of 21% measured in a basal sample containing organics.

Thin layers of sand or gravel fill extending to depths of 0.2 to 0.8 m (elevation 283.5 to 284.4 m) were encountered in boreholes 06-11 to 06-13 and 06-38 drilled in the floodplain. This fill was loose to compact with N-values of 9 to 13 blows/0.3 m.

5.2.3 Alluvial Deposits (Sand to Sandy Silt, Clayey Silt to Silty Clay)

Alluvial deposits consisting of cohesionless sand to sandy silt and cohesive clayey silt to silty clay were encountered in boreholes 06-34 to 06-39, 06-64 and 06-73 drilled in the floodplain. These deposits are typically dark brown and contain organics. The lower boundary of the alluvium was encountered at depths of 0.8 to 3.0 m (elevation 282.1 to 283.7 m).

SPT N-values typically ranged from 3 to 22 blows/0.3m, indicating a very loose to compact condition or a soft to very stiff consistency. Moisture contents ranged from 14 to 41%, typically 17 to 25%.

5.2.4 Upper Silty Clay, Sandy Silty Clay Till, and Silty Sand Till

Borehole 06-46 was drilled at the south limit of the fill section and encountered several native deposits not encountered in the other boreholes. These deposits consisted of silty clay, sandy silty clay till, and silty sand till.

The silty clay layer was 2.8 m thick and was encountered between depths of 0.2 and 3.0 m (elevation 295.1 and 292.4 m). N-values of 14 to 20 blows/0.3 m indicate that this layer is very stiff. Moisture contents range from 21 to 23%. The results of a grain size analysis and Atterberg Limits testing conducted on the clay are presented on Figures B15 and B17, respectively. The results indicate the clay is highly plastic.

The underlying till consists of sandy silty clay, grading to silty sand at 4.7 m depth (elevation 290.6 m). N-values of 50 blows/0.3 m (hard) and 80/0.225 m (very dense) were obtained in the clay till and sand till, respectively. Moisture contents of about 18% were obtained. The results of a grain size analysis conducted on the silty sand till are presented on Figure B15, Appendix B. Borehole 06-46 was terminated in the till at 5.0 m depth (elevation 290.4 m).

5.2.5 Sand to Silty Sand

A layer of sand to silty sand was encountered below the embankment fill on the south half of the site (boreholes 06-41 to 06-45) at depths of 2.2 to 7.0 m (elevation 285.3 to 286.1

m). Where fully penetrated, the sand layer was 1.4 to 3.3 m thick with a lower boundary at depths of 4.6 to 8.4 m (elevation 282.1 to 284.7 m). Boreholes 06-43 and 06-44 were terminated in the sand at 5.9 and 7.8 m (elevation 284.0 and 283.9 m).

SPT N-values obtained in the sand varied significantly from 12 to 69 blows/0.3 m, indicating a compact to very dense condition. One value of 50 blows/0.025 m likely resulted from driving on a cobble. Moisture contents typically ranged from 9 to 15%, with local values of 5 and 22% obtained. The results of the grain size distribution analyses conducted on samples from this deposit are presented on the Record of Borehole Sheets and Figure B12 of Appendix B.

5.2.6 Sand and Gravel

On the north half of the site (boreholes 06-11 to 06-13, 06-34 to 06-41, 06-64 and 06-73), a layer of sand and gravel was encountered below the alluvial deposits, localized fill and sand layer. The upper boundary of the sand and gravel layer was encountered at depths of 0.2 to 4.6 m (elevation 282.1 to 284.2 m), and the lower boundary was encountered at depths of 2.9 to 6.0 m (elevation 278.5 to 282.1 m). The thickness of this layer ranged from 0.8 to 4.6 m where fully penetrated. Boreholes 06-34 and 06-36 were terminated in this deposit at depths of 2.8 and 3.9 m upon suspected boulders.

SPT N-values obtained in the sand and gravel varied significantly from 8 blows/0.3 m to 50 blows/0.125 m, indicating a loose to very dense condition. Moisture contents ranged from 4 to 19%. The results of the grain size distribution analyses conducted on samples from this deposit, presented on the Record of Borehole Sheets and Figures B10 and B11 of Appendix B, indicate silt contents of 8 to 17%.

5.2.7 Silty Sand to Silty Clay Till

Glacial till was encountered below the sand layer and sand and gravel layer in 13 of the boreholes. The till varies in gradation, as evidenced by the results of particle size distribution analyses presented on Figures B13 and B14 of Appendix B. These gradation variations result in soil classifications ranging from non-cohesive sandy silt to silty sand, and cohesive clayey silt to silty clay. Atterberg Limits tests conducted on samples of the sandy silty clay till, Figure B16 of Appendix B, indicate that the cohesive zones are of low plasticity.

The upper boundary of the till was encountered at depths of 2.9 to 6.3 m (elevation 278.5 to 282.1 m), and locally 8.4 m (elevation 284.7 m) near the south limit of the investigation. In general, the boreholes were terminated in the till at depths of 6.2 to 9.7 m (elevation 276.9 to 283.4 m). The till was underlain by gravelly sand at 9.4 and 11.6 m depth (elevation 275.1 and 272.6 m) in boreholes 06-11 and 06-12 drilled at the bridge abutment, and by sand at 7.0 m depth (elevation 277.6 m) in borehole 06-64. In addition, a sand layer was encountered within the till between 5.6 and 8.6 m depth in borehole 06-11.

The till is compact to very dense or hard, as indicated by N-values ranging from 22 blows/0.3 m to 50 blows/0.05 m. Moisture contents from this deposit ranged from 7 to 14%. As noted on the borehole logs, the till contains cobbles. Glacial till is also known to contain large boulders.

5.2.8 Silty Sand to Gravelly Sand

Discontinuous deposits of sand were encountered in three boreholes: a 1.3 m thick layer of loose silty sand was encountered between the sand and gravel layer and underlying till in borehole 06-35; a 3.0 m thick layer of very dense sand was encountered within the till in borehole 06-11; and very dense sand was encountered below the till in borehole 06-64.

Very dense gravelly sand was encountered below the till at depths of 9.4 and 11.6 m (elevation 275.1 and 272.6 m) in boreholes 06-11 and 06-12 drilled at the bridge abutment. All SPT N-values obtained in this stratum exceeded 50 blows/0.3 m. Moisture contents of 8 to 23% were measured. The gravelly sand mantled bedrock or probable bedrock at 14.0 and 14.6 m depth (elevation 270.5 and 269.6 m).

5.2.9 Bedrock

The overburden soils described above are underlain by limestone bedrock, contacted at 14.0 and 14.6 m depth (elevation 270.5 and 269.6 m) in boreholes 06-11 and 06-12, respectively. The bedrock was proved by coring in borehole 06-12 at the south abutment. The bedrock is described as highly to moderately weathered, thinly bedded and grey, with occasional pitted zones and rubble zones.

Core recovery in the bedrock was between 55% and 100%. The RQD values ranged from 0 to 50%, indicating very poor to poor rock quality. The estimated unconfined compressive strength of the rock cores, based on point load tests, ranges between 73 to 155 MPa, indicating a strong to very strong rock.

5.2.10 Groundwater Conditions

Standpipe piezometers were installed in selected boreholes to monitor groundwater levels after completion of drilling. The water levels measured in the piezometers are summarized in Table 5.2.

Table 5.2 – Measured Groundwater Levels

Borehole	Date	Water Level (m)	
		Depth	Elevation
06-11	10-Aug-2006	1.3	283.2
	11-Aug-2006	1.2	283.3
	14-Aug-2006	1.2	283.3
	15-Aug-2006	1.2	283.3
	16-Aug-2006	1.2	283.3
	29-Sept-2006	1.5	283.0
06-40	15-Aug-2006	2.8	284.4
	16-Aug-2006	3.1	284.1
	29-Sept-2006	3.2	284.0
06-43	29-Sept-2006	5.2	284.7
06-46	29-Sept-2006	4.3	291.0
06-64	11-Aug-2006	1.3	283.3
	14-Aug-2006	1.5	283.1
	15-Aug-2006	1.5	283.1
	16-Aug-2006	1.5	283.1
	29-Sept-2006	1.4	283.2
06-73	10-Aug-2006	1.9	283.2
	11-Aug-2006	1.9	283.2
	14-Aug-2006	2.0	283.1
	15-Aug-2006	2.0	283.1
	16-Aug-2006	2.0	283.1
	29-Sept-2006	1.5	283.6

The above values are short-term readings and seasonal fluctuations of the groundwater level are to be expected. The groundwater level may be higher after the spring snowmelt or after periods of heavy rainfall.

In particular, the groundwater levels in the floodplain will be governed by the water level in the adjacent Grand River. A preliminary profile provided by Morrison Hershfield indicates a water level of elevation 282.5 m in the river. The river flow is controlled by the Grand River Conservation Authority.

6 MISCELLANEOUS

Thurber Engineering Ltd. selected the borehole locations in the field relative to existing site features with consideration of access restraints, terrain conditions, and utility locations. Callon Dietz Inc., retained by Morrison Hershfield, subsequently established the co-ordinates and ground surface elevations at the staked borehole locations.

All-Terrain Drilling of Waterloo supplied and operated the drilling and sampling equipment used for the investigation. Full time supervision of the field activities, including obtaining utility clearances, was carried out by Mr. Stephane Loranger.

Interpretation of the field data and preparation of the investigation report were conducted by Mr. Murray Anderson, P.Eng. Overall supervision of the field program and review of the report was provided by Mr. Alastair Gorman, P.Eng. The report was reviewed by Dr. P.K. Chatterji, P.Eng., a Designated Principal Contact for MTO Foundations Projects.

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Appendix A

Record of Borehole Sheets

Deep Cut – Boreholes 06-28 to 06-33

High Fill – Boreholes 06-11 to 06-13, 06-34 to 06-46, 06-64 and 06-73

SYMBOLS, ABBREVIATIONS AND TERMS USED ON RECORDS OF BOREHOLES

1. TEXTURAL CLASSIFICATION OF SOILS

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

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

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

3. TERMS DESCRIBING CONSISTENCY (COHESIVE SOILS ONLY)

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

NOTE: Hierarchy of Soil Strength Prediction

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

4. TERMS DESCRIBING DENSITY (COHESIONLESS SOILS ONLY)

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

5. LEGEND FOR RECORDS OF BOREHOLES

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

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



Water Level



Shear Strength Determination by Pocket Penetrometer

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

UNIFIED SOILS CLASSIFICATION

MAJOR DIVISIONS		GROUP SYMBOL	TYPICAL DESCRIPTION
COARSE GRAINED SOILS	GRAVEL AND GRAVELLY SOILS	GW	Well-graded gravels or gravel-sand mixtures, little or no fines.
		GP	Poorly-graded gravels or gravel-sand mixtures, little or no fines.
		GM	Silty gravels, gravel-sand-silt mixtures.
		GC	Clayey gravels, gravel-sand-clay mixtures.
	SAND AND SANDY SOILS	SW	Well-graded sands or gravelly sands, little or no fines.
		SP	Poorly-graded sands or gravelly sands, little or no fines.
		SM	Silty sands, sand-silt mixtures.
		SC	Clayey sands, sand-clay mixtures.
FINE GRAINED SOILS	SILTS AND CLAYS $W_L < 50\%$	ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity.
		CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays. ($W_L < 30\%$).
		CI	Inorganic clays of medium plasticity, silty clays. ($30\% < W_L < 50\%$).
		OL	Organic silts and organic silty-clays of low plasticity.
	SILTS AND CLAYS $W_L > 50\%$	MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts.
		CH	Inorganic clays of high plasticity, fat clays.
		OH	Organic clays of medium to high plasticity, organic silts.
HIGHLY ORGANIC SOILS	Pt	Peat and other highly organic soils.	
CLAY SHALE			
SANDSTONE			
SILTSTONE			
CLAYSTONE			
COAL			

EXPLANATION OF ROCK LOGGING TERMS

ROCK WEATHERING CLASSIFICATION		SYMBOLS		
Fresh (FR)	No visible signs of weathering.			
Fresh Jointed (FJ)	Weathering limited to the surface of major discontinuities.			CLAYSTONE
Slightly Weathered (SW)	Penetrative weathering developed on open discontinuity surfaces, but only slight weathering of rock material.			SILTSTONE
Moderately Weathered (MW)	Weathering extends throughout the rock mass, but the rock material is not friable.			SANDSTONE
Highly Weathered (HW)	Weathering extends throughout the rock mass and the rock is partly friable.			COAL
Completely Weathered (CW)	Rock is wholly decomposed and in a friable condition, but the rock texture and structure are preserved.			Bedrock (general)
DISCONTINUITY SPACING		STRENGTH CLASSIFICATION		
Bedding	Bedding Plane Spacing	Rock Strength	Approximate Uniaxial Compressive Strength	Field Estimation of Hardness*
Very thickly bedded	Greater than 2m	Extremely Strong	Greater than 250 (MPa) Greater than 36,000 (psi)	Specimen can only be chipped with a geological hammer
Thickly bedded	0.6 to 2m	Very Strong	100-250	15,000 to 36,000
Medium bedded	0.2 to 0.6m	Strong	50-100	7,500 to 15,000
Thinly bedded	60mm to 0.2m	Medium Strong	25.0 to 50.0	3,500 to 7,500
Very thinly bedded	20 to 60mm	Weak	5.0 to 25.0	750 to 3,500
Laminated	6 to 20mm	Very Weak	1.0 to 5.0	150 to 750
Thinly Laminated	Less than 6mm	Extremely Weak (Rock)	0.25 to 1.0	35 to 150
TERMS				
Total Core Recovery: (TCR)	Core recovered as a percentage of total core run length.			
Solid Core Recovery: (SCR)	Percent Ratio of solid core of full cylindrical shape recovered. Expressed with respect to the total length of core run.			
Rock Quality Designation: (RQD)	Total length of sound core recovered in pieces 0.1m in length or larger as a percentage of total core run length.			
Uniaxial Compressive Strength (UCS)	Axial stress required to break the specimen			
Fracture Index: (FI)	Frequency of natural fractures per 0.3m of core run.			



RECORD OF BOREHOLE No 06-11

1 OF 2

METRIC

G.W.P. 277-97-00 LOCATION Grand River Overpass SBL N 4 809 300.78 E 230 631.30 ORIGINATED BY SLL
 HWY 8 BOREHOLE TYPE Hollow Stem Augers COMPILED BY JHL
 DATUM Geodetic DATE 08.08.06 - 09.08.06 CHECKED BY MEF

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 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	20 40 60 80 100	20 40 60 80 100						
284.5														
0.0	TOPSOIL: (125 mm)													
0.1	SAND, some gravel, trace silt Loose		1	SS	9				○					
284.0	Dark brown								○					
283.9	Moist (FILL)													
0.6	TOPSOIL: (75 mm)													
	SAND and GRAVEL, trace silt, occasional cobbles Compact to Dense Brown Moist		2	SS	14									
			3	SS	30				○					
			4	SS	45				○					
			5	SS	39				○				49 42 9 (SI+CL)	
280.9	SILT and SAND, some clay, trace gravel Very Dense Brown Moist (TILL)		6	SS	71				○				1 37 49 13	
3.6														
278.9	SAND, trace to some silt, some gravel Very dense Grey Moist to wet		7	SS	90/ 275				○					
5.6														
275.9	Silty CLAY, trace sand Hard Grey (TILL)		8	SS	88/ 275				○					
8.6														
275.1	Gravelly SAND, trace silt Very Dense Grey		9	SS	50/ .050				○					
9.4														

ONTMTAS 7938.GPJ 20/03/07

Continued Next Page

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

RECORD OF BOREHOLE No 06-11

2 OF 2

METRIC

G.W.P. 277-97-00 LOCATION Grand River Overpass SBL N 4 809 300.78 E 230 631.30 ORIGINATED BY SLL
 HWY 8 BOREHOLE TYPE Hollow Stem Augers COMPILED BY JHL
 DATUM Geodetic DATE 08.08.06 - 09.08.06 CHECKED BY MEF

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
270.5	Wet		10	SS	50/ 075													
			11	SS	70/ 275													
			12	SS	50/ 050													
14.0	END OF BOREHOLE AT 14.02 m. AUGER REFUSAL ON PROBABLE BEDROCK OR BOULDERS. Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen. WATER LEVEL READINGS: DATE DEPTH(m) ELEV.(m) 10.08.06 1.27 283.2 11.08.06 1.21 283.3 14.08.06 1.23 283.3 15.08.06 1.20 283.3 16.08.06 1.24 283.3 29.09.06 1.50 283.0														0 93 2 (SI+CL)			

ONTMT4S 7938.GPJ 20/03/07

+³ × 3³: Numbers refer to Sensitivity 20 15 10 5 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 06-12

1 OF 2

METRIC

G.W.P. 277-97-00 LOCATION Grand River Overpass SBL N 4 809 286.20 E 230 626.37 ORIGINATED BY SLL
 HWY 8 BOREHOLE TYPE Hollow Stem Augers / NQ Core Barrel COMPILED BY JHL
 DATUM Geodetic DATE 08.08.06 - 08.08.06 CHECKED BY MEF

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					
284.2														
0.0	TOPSOIL: (100 mm)													
0.1	SAND, some silt, trace clay, trace gravel, topsoil stained, trace roots Compact		1	SS	13									
283.5	Dark brown													
0.7	Moist (FILL)													
	SAND AND GRAVEL, some silt Compact to Very Dense		2	SS	21									
	Brown													
	Moist													
	Occasional cobbles, wet		3	SS	61									
			4	SS	50/ .125									
			5	SS	40									47 41 12 (SI+CL)
280.6	Sandy SILT, some clay, trace gravel, occasional cobbles Very Dense													
3.6	Grey Moist (TILL)		6	SS	74									
			7	SS	50/ .100									3 32 55 11
			8	SS	50/ .125									
			9	SS	50/ .100									

Continued Next Page

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

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RECORD OF BOREHOLE No 06-12

2 OF 2

METRIC

G.W.P. 277-97-00 LOCATION Grand River Overpass SBL N 4 809 286.20 E 230 626.37 ORIGINATED BY SLL
 HWY 8 BOREHOLE TYPE Hollow Stem Augers / NQ Core Barrel COMPILED BY JHL
 DATUM Geodetic DATE 08.08.06 - 08.08.06 CHECKED BY MEF

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						
						20	40	60	80	100	20	40	60	GR SA SI CL
274.1 10.1	Silty CLAY, trace sand, trace gravel Very stiff Grey (TILL)(CL)		10	SS	24									1 4 62 34
272.6 11.6	Gravelly SAND, silty, trace clay, occasional cobbles Very dense Grey Wet		11	SS	50/ .125									
269.6 14.6	Highly to moderately weathered, thinly bedded, grey, strong to very strong, LIMESTONE BEDROCK, with occasional rubble zones, occasional pitted zones		1	RUN										10 RUN 1# 5 TCR=100%, SCR=43%, RQD=0%, UCS=MPa >10 RUN 2# 7 TCR=92%, SCR=75%, RQD=50%, UCS=73MPa 7 RUN 3# >10 TCR=60%, SCR=44%, RQD=12%, UCS=86MPa 3 RUN 4# 6 TCR=55%, SCR=42%, RQD=23%, UCS=155MPa
266.1 18.1	END OF BOREHOLE AT 18.12 m. BOREHOLE GROUTED WITH BENTONITE UPON COMPLETION.		4	RUN										

ONTM14S 7938.GPJ 20/03/07

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

RECORD OF BOREHOLE No 06-13

1 OF 1

METRIC

G.W.P. 277-97-00 LOCATION Grand River Overpass SBL N 4 809 280.86 E 230 645.36 ORIGINATED BY SLL
 HWY 8 BOREHOLE TYPE Hollow Stem Augers COMPILED BY JHL
 DATUM Geodetic DATE 11.08.06 - 11.08.06 CHECKED BY MEF

SOIL PROFILE		STRAT PLOT	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		NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa								
						20	40	60	80	100	20	40	60	KN/m ³	GR SA SI CL	
284.3																
0.0	TOPSOIL: (50 mm)															
0.1	GRAVEL: (FILL)															
0.2	TOPSOIL: (75 mm)															
	SAND and GRAVEL, trace silt Compact to Very Dense Brown Moist		1	SS	25											
			2	SS	34											
			3	SS	100/ .275											
			4	SS	61										38 55 8 (SI+CL)	
281.0			5	SS	30											
3.4	SILT and SAND, some clay, trace gravel, occasional cobbles Dense to Very Dense Grey Moist (TILL)		6	SS	36										5 40 44 11	
278.0			7	SS	50/ .075											
6.3	END OF BOREHOLE AT 6.33 m. BOREHOLE GROUTED WITH BENTONITE TO SURFACE.															

ONTMT4S 7938.GPJ 20/03/07

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

RECORD OF BOREHOLE No 06-28

1 OF 2

METRIC

G.W.P. 277-97-00 LOCATION Hwy 8 Widening, Grand River to Sportsworld Dr. N 4 809 498.24 E 230 248.75 ORIGINATED BY SLL
 HWY 8 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MFA
 DATUM Geodetic DATE 19.09.06 - 19.09.06 CHECKED BY MEF

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						
307.1														
0.0	TOPSOIL: (250mm), black													
306.8														
0.3	SILT and SAND, some clay, trace gravel Compact Brown Moist: (TILL)		1	SS	11								0 38 48 14	
304.8			2	SS	22									
2.3	SAND, trace silt, trace gravel Very dense Brown Moist to wet		3	SS	63									
303.9														
3.1	Silty CLAY, trace sand Hard Brown (TILL)		4	SS	71									
302.9														
4.2	Gravelly SAND, some silt Compact to Dense Brown Wet		5	SS	27								33 53 13 (SI+CL)	
300.1			6	SS	38									
7.0	Silty CLAY, trace sand, trace gravel Hard Grey (TILL)(CH)		7	SS	56									
			8	SS	72								0 2 35 63	

ONTMT4S 7938.GPJ 20/03/07

Continued Next Page

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

RECORD OF BOREHOLE No 06-28

2 OF 2

METRIC

G.W.P. 277-97-00 LOCATION Hwy 8 Widening, Grand River to Sportsworld Dr. N 4 809 498.24 E 230 248.75 ORIGINATED BY SLL
 HWY 8 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MFA
 DATUM Geodetic DATE 19.09.06 - 19.09.06 CHECKED BY MEF

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL																		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	PLASTIC LIMIT W P	NATURAL MOISTURE CONTENT W			LIQUID LIMIT W L																	
295.5	11.6	[Hatched Strat Plot]	9	SS	76/ 275	[Ground Water Diagram]	297																							
								296																						
294.6	12.5		10	SS	50/ .150		295																							
<p>END OF BOREHOLE AT 12.50m. Piezometer installation consists of 25mm 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>ELEV.(m)</th> </tr> </thead> <tbody> <tr> <td>18/09/06</td> <td>11.32</td> <td>295.76</td> </tr> <tr> <td>20/09/06</td> <td>11.35</td> <td>295.73</td> </tr> <tr> <td>21/09/06</td> <td>11.41</td> <td>295.67</td> </tr> <tr> <td>22/09/06</td> <td>11.45</td> <td>295.63</td> </tr> <tr> <td>29/09/06</td> <td>11.49</td> <td>295.59</td> </tr> </tbody> </table>													DATE	DEPTH(m)	ELEV.(m)	18/09/06	11.32	295.76	20/09/06	11.35	295.73	21/09/06	11.41	295.67	22/09/06	11.45	295.63	29/09/06	11.49	295.59
DATE	DEPTH(m)	ELEV.(m)																												
18/09/06	11.32	295.76																												
20/09/06	11.35	295.73																												
21/09/06	11.41	295.67																												
22/09/06	11.45	295.63																												
29/09/06	11.49	295.59																												

ONTMT4S 7938.GPJ 20/03/07

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

RECORD OF BOREHOLE No 06-29

1 OF 3

METRIC

G.W.P. 277-97-00 LOCATION Hwy 8 Widening, Grand River to Sportsworld Dr. N 4 809 480.35 E 230 275.72 ORIGINATED BY SLL
 HWY 8 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MFA
 DATUM Geodetic DATE 19.09.06 - 20.09.06 CHECKED BY MEF

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
308.2 0.0	TOPSOIL: (200mm), black																	
0.2	SAND, some gravel, trace silt, with cobbles Compact to Very Dense Brown Moist		1	SS	14													
			2	SS	21													
	becoming sand and gravel		3	SS	48													41 49 10 (SI+CL)
			4	SS	50/ .125													
304.4 3.8	Silty CLAY, trace sand Hard Grey (TILL)(CI)		5	SS	41													0 1 51 49
			6	SS	53													
			7	SS	48													
			8	SS	83													

Continued Next Page

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

ONTM/TAS 7938.GPJ 20/03/07

RECORD OF BOREHOLE No 06-29

2 OF 3

METRIC

G.W.P. 277-97-00 LOCATION Hwy 8 Widening, Grand River to Sportsworld Dr. N 4 809 480.35 E 230 275.72 ORIGINATED BY SLL
 HWY 8 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MFA
 DATUM Geodetic DATE 19.09.06 - 20.09.06 CHECKED BY MEF

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	UNIT WEIGHT Y KN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	20 40 60 80 100					
296.3			9	SS	44							0 2 37 62	
11.9	SILT and SAND, trace clay, trace gravel Very dense Grey Moist: (TILL)		10	SS	50/ .125								
			11	SS	50/ .125							2 41 41 16	
			12	SS	50/ .125								
			13	SS	50/ .025								
			14	SS	50/ .125								
288.3			15	SS	50/								

Continued Next Page

ONTMT4S 7938.GPJ 20/03/07

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

RECORD OF BOREHOLE No 06-29

3 OF 3

METRIC

G.W.P. 277-97-00 LOCATION Hwy 8 Widening, Grand River to Sportsworld Dr. N 4 809 480.35 E 230 275.72 ORIGINATED BY SLL
 HWY 8 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MFA
 DATUM Geodetic DATE 19.09.06 - 20.09.06 CHECKED BY MEF

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					
19.9	END OF BOREHOLE AT 19.94M. Piezometer installation consists of 25mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen. WATER LEVEL READINGS: DATE DEPTH(m) ELEV.(m) 20/09/06 17.00 291.19 21/09/06 13.38 294.81 22/09/06 13.28 294.91 29/09/06 13.33 294.86				.125										

ONTMT4S 7938.GPJ 20/03/07

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

RECORD OF BOREHOLE No 06-30

1 OF 3

METRIC

G.W.P. 277-97-00 LOCATION Hwy 8 Widening, Grand River to Sportsworld Dr. N 4 809 440.12 E 230 337.88 ORIGINATED BY SLL
 HWY 8 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MFA
 DATUM Geodetic DATE 20.09.06 - 20.09.06 CHECKED BY MEF

ELEV DEPTH	SOIL PROFILE DESCRIPTION	STRAT PLOT	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 (%)
			NUMBER	TYPE	"N" VALUES			20	40	60					
310.5															
0.0 310.3	TOPSOIL: (250mm), black														
0.3	SILT and SAND, trace gravel, trace clay Loose to Compact Brown Moist		1	SS	8		310								
308.5			2	SS	11		309							1 39 52 8	
2.0	SAND, trace silt Compact Brown Moist		3	SS	28		308								
			4	SS	24		307							0 95 5 (SI+CL)	
306.5															
4.0	SILT and SAND, trace gravel, trace clay Dense Brown Wet		5	SS	35		306								
305.0															
5.5	Silty CLAY, trace sand, trace gravel Grey (TILL)						305								
304.3															
6.2	SAND and GRAVEL, trace silt Very dense Grey Wet		6	SS	72		304								
303.8															
6.7	Silty CLAY, trace sand, trace gravel Grey (TILL)						303								
303.2															
7.3	SAND and GRAVEL, trace silt Very dense Grey Wet		7	SS	88		302							38 56 6 (SI+CL)	
301.3															
9.2	Silty CLAY, trace sand, trace gravel Hard Grey (TILL)(CH)		8	SS	50/ 150		301								

ONTMT4S 7938.GPJ 20/03/07

Continued Next Page

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

RECORD OF BOREHOLE No 06-30

2 OF 3

METRIC

G.W.P. 277-97-00 LOCATION Hwy 8 Widening, Grand River to Sportsworld Dr. N 4 809 440.12 E 230 337.88 ORIGINATED BY SLL
 HWY 8 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MFA
 DATUM Geodetic DATE 20.09.06 - 20.09.06 CHECKED BY MEF

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
295.7			9	SS	66													
14.8	SILT and SAND, some clay, trace gravel, occasional cobbles Very dense Grey Moist: (TILL)		10	SS	40									0	2	33	65	
			11	SS	50/ .125													
				12	SS	50/ .150												
				13	SS	50/ .125									5	40	39	16
				14	SS	50/ .125												
290.6			15	SS	50/ .125													

ONTMT4S 7938.GPJ 20/03/07

Continued Next Page

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

RECORD OF BOREHOLE No 06-30

3 OF 3

METRIC

G.W.P. 277-97-00 LOCATION Hwy 8 Widening, Grand River to Sportsworld Dr. N 4 809 440.12 E 230 337.88 ORIGINATED BY SLL
 HWY 8 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MFA
 DATUM Geodetic DATE 20.09.06 - 20.09.06 CHECKED BY MEF

SOIL PROFILE		SAMPLES				GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	UNIT WEIGHT Y kn/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60					
19.9	END OF BOREHOLE AT 19.94m. Piezometer installation consists of 25mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen. WATER LEVEL READINGS: DATE DEPTH(m) ELEV.(m) 21/09/06 11.84 298.67 22/09/06 12.19 298.32 29/09/06 15.95 294.56				.125										

ONTMT4S 7938.GPJ 20/03/07

RECORD OF BOREHOLE No 06-31

1 OF 3

METRIC

G.W.P. 277-97-00 LOCATION Hwy 8 Widening, Grand River to Sportsworld Dr. N 4 809 416.03 E 230 366.92 ORIGINATED BY SLL
 HWY 8 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MFA
 DATUM Geodetic DATE 21.09.06 - 21.09.06 CHECKED BY MEF

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	UNIT WEIGHT Y kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV. DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60					
310.0															
0.0	TOPSOIL: (100mm), black														
0.1	SAND, trace silt, trace gravel Dense to Compact Brown Moist		1	SS	44										
			2	SS	32										
			3	SS	27										
307.0															
2.9	SILT, some sand to sandy, trace clay Compact Brown Moist to wet		4	SS	23										0 13 81 6
			5	SS	13										
304.8															
5.1	Sandy SILT, some clay, trace gravel Compact Grey Moist: (TILL)		6	SS	25										8 28 48 16
			7	SS	71										
302.3															
7.6	Silty CLAY, trace sand, occasional cobbles Hard Grey (TILL)		8	SS	64										

Continued Next Page

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

ONTMT4S 7938.GPJ 20/03/07

RECORD OF BOREHOLE No 06-31

2 OF 3

METRIC

G.W.P. 277-97-00 LOCATION Hwy 8 Widening, Grand River to Sportsworld Dr. N 4 809 416.03 E 230 366.92 ORIGINATED BY SLL
 HWY 8 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MFA
 DATUM Geodetic DATE 21.09.06 - 21.09.06 CHECKED BY MEF

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	NUMBER	TYPE	"N" VALUES			20	40	60					
299.6 10.4	Sandy SILT, some clay, trace gravel, occasional cobbles Very dense Grey Moist: (TILL)	9	SS	50/ .125										
298.2 11.7	Silly CLAY, trace sand, occasional cobbles Hard Grey (TILL)(CH)	10	SS	90									0 1 36 64	
294.0 16.0	Silly SAND, some gravel, occasional cobbles Very Dense Grey Moist: (TILL)	13	SS	50/ .125										
		12	SS	50/ .125										
		11	SS	50/ .125										
		14	SS	50/ .125									24 48 28 (SI+CL)	
290.0		15	SS	50/										

ONTMT4S 7938.GPJ 20/03/07

Continued Next Page

+³ × 3³: Numbers refer to Sensitivity
 20
 15 5
 10 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 06-31

3 OF 3

METRIC

G.W.P. 277-97-00 LOCATION Hwy 8 Widening, Grand River to Sportsworld Dr. N 4 809 416.03 E 230 366.92 ORIGINATED BY SLL
 HWY 8 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MFA
 DATUM Geodetic DATE 21.09.06 - 21.09.06 CHECKED BY MEF

SOIL PROFILE		SAMPLES				GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	UNIT WEIGHT Y KN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
							20	40	60	80	100	W _p	W	W _L			
19.9	END OF BOREHOLE AT 19.94m. Piezometer installation consists of 25mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen. WATER LEVEL READINGS: DATE DEPTH(m) ELEV.(m) 21/09/06 19.68 290.28 22/09/06 14.48 295.48 29/09/06 16.28 293.68				.125												

ONTMT4S 7938.GPJ 20/03/07

RECORD OF BOREHOLE No 06-32

1 OF 3

METRIC

G.W.P. 277-97-00 LOCATION Hwy 8 Widening, Grand River to Sportsworld Dr. N 4 809 393.01 E 230 412.34 ORIGINATED BY SLL
 HWY 8 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MFA
 DATUM Geodetic DATE 22.09.06 - 25.09.06 CHECKED BY MEF

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
309.2																		
0.0	TOPSOIL: (275mm), black																	
308.9																		
0.3	SAND, trace silt, trace gravel Compact Brown Moist		1	SS	10													
			2	SS	12													
307.0																		
2.2	SAND, some silt to silty, trace gravel Dense to Compact Brown Moist		3	SS	33													0 76 24 (SI+CL)
			4	SS	17													
			5	SS	37													1 86 13 (SI+CL)
303.6																		
5.6	Silty CLAY, trace sand, trace gravel Hard Grey (TILL)		6	SS	47													
302.0																		
7.2	Sandy SILT, some clay, trace gravel Very dense Grey Moist: (TILL)		7	SS	50/ .100													
			8	SS	50/ .100													

ONTMT4S 7938.GPJ 20/03/07

Continued Next Page

+³, ×³: Numbers refer to
Sensitivity

20
15
10
5
0

(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 06-32

2 OF 3

METRIC

G.W.P. 277-97-00 LOCATION Hwy 8 Widening, Grand River to Sportsworld Dr. N 4 809 393.01 E 230 412.34 ORIGINATED BY SLL
 HWY 8 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MFA
 DATUM Geodetic DATE 22.09.06 - 25.09.06 CHECKED BY MEF

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					
298.5	Silty CLAY, trace sand Hard Grey (TILL)(C1)		9	SS	60/ .100									
10.7			10	SS	92/ 250									0 1 35 63
			11	SS	50/ .075									
294.3	Sandy SILT, some clay, trace gravel Very dense Grey Moist: (TILL)		12	SS	50/ .100									
14.9			13	SS	50/ .075									
			14	SS	50/ .125									
289.3			15	SS	50/									

ONTMT4S 7938.GPJ 20/03/07

Continued Next Page

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

RECORD OF BOREHOLE No 06-32

3 OF 3

METRIC

G.W.P. 277-97-00 LOCATION Hwy 8 Widening, Grand River to Sportsworld Dr. N 4 809 393.01 E 230 412.34 ORIGINATED BY SLL
 HWY 8 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MFA
 DATUM Geodetic DATE 22.09.06 - 25.09.06 CHECKED BY MEF

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	UNIT WEIGHT Y kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa							
						20	40	60	80	100	W _p	W	W _L		
19.9	END OF BOREHOLE AT 19.91m. Piezometer installation consists of 25mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen. WATER LEVEL READINGS: DATE DEPTH(m) ELEV.(m) 29/09/06 17.49 291.72				100										

ONTM14S 7938.GPJ 20/03/07

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

RECORD OF BOREHOLE No 06-33

2 OF 3

METRIC

G.W.P. 277-97-00 LOCATION Hwy 8 Widening, Grand River to Sportsworld Dr. N 4 809 377.69 E 230 442.29 ORIGINATED BY SLL
 HWY 8 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MFA
 DATUM Geodetic DATE 21.09.06 - 22.09.06 CHECKED BY MEF

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	NUMBER	TYPE	"N" VALUES			20	40	60					
298.5	Occasional cobbles	9	SS	80									0 2 40 58	
296.5		10	SS	50/.125										
294.5		11	SS	50/.100										
293.5	SILT and SAND, some clay, trace gravel, occasional cobbles, occasional sand layers Very dense Grey Moist: (TILL)	12	SS	50/.125									4 38 43 15	
291.5		13	SS	50/.125										
289.5		14	SS	50/.125										
287.5		15	SS	50/										

Continued Next Page

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

ONTMT4S 7938.GPJ 20/03/07

RECORD OF BOREHOLE No 06-33

3 OF 3

METRIC

G.W.P. 277-97-00 LOCATION Hwy 8 Widening, Grand River to Sportsworld Dr. N 4 809 377.69 E 230 442.29 ORIGINATED BY SLL
 HWY 8 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MFA
 DATUM Geodetic DATE 21.09.06 - 22.09.06 CHECKED BY MEF

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	UNIT WEIGHT Y kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa								
						20	40	60	80	100	W _p	W	W _L			
288.0 20.1	END OF BOREHOLE AT 20.07m. Piezometer installation consists of 25mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen. WATER LEVEL READINGS: DATE DEPTH(m) ELEV.(m) 22/09/06 16.03 292.00 25/09/06 17.50 290.53 29/09/06 17.62 290.41				100											

ONTMT4S 7938.GPJ 20/03/07

RECORD OF BOREHOLE No 06-34

1 OF 1

METRIC

G.W.P. 277-97-00 LOCATION Hwy 8 Widening, Grand River to Sportsworld Dr. N 4 809 259.39 E 230 677.71 ORIGINATED BY SLL
 HWY 8 BOREHOLE TYPE Hollow Stem Augers COMPILED BY JHL
 DATUM Geodetic DATE 11.08.06 - 11.08.06 CHECKED BY MEF

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						
284.5														
0.0	TOPSOIL: (100 mm)													
0.1	SAND, some gravel Compact Brown Moist		1	SS	17									
283.7														
0.8	SAND and GRAVEL, some silt Very Dense Brown Moist		2	SS	56									
			3	SS	72									
			4	SS	100									42 45 12 (SI+CL)
281.6														
2.8	END OF BOREHOLE AT 2.82 m. AUGER REFUSAL AT 2.82 m ON PROBABLE BEDROCK OR BOULDERS. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND DRILL CUTTINGS TO SURFACE.													

ONTMT4S 7938.GPJ 20/03/07

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

RECORD OF BOREHOLE No 06-35

1 OF 1

METRIC

G.W.P. 277-97-00 LOCATION Hwy 8 Widening, Grand River to Sportsworld Dr. N 4 809 223.85 E 230 711.74 ORIGINATED BY SLL
 HWY 8 BOREHOLE TYPE Hollow Stem Augers COMPILED BY JHL
 DATUM Geodetic DATE 10.08.06 - 10.08.06 CHECKED BY MEF

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						
284.4														
0.0	TOPSOIL: (125 mm)													
0.1	SAND, some silt Loose Dark Brown Wet		1	SS	4									
283.5														
0.9	SAND and GRAVEL, trace silt, occasional cobbles Loose to Compact Brown Moist		2	SS	8									
	Becoming Very Dense occasional boulders		3	SS	12									
	Becoming Grey		4	SS	63									
			5	SS	74								49 43 8 (SI+CL)	
280.1														
4.3	Silty SAND, some gravel Loose Grey Wet		6	SS	8									
278.8														
5.6	Silty SAND, some gravel Very Dense Grey Wet		7	SS	50/									
278.2	(TILL)													
6.2	END OF BOREHOLE AT 6.20 m. BOREHOLE GROUTED WITH BENTONITE TO SURFACE.				.100									

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RECORD OF BOREHOLE No 06-36

1 OF 1

METRIC

G.W.P. 277-97-00 LOCATION Hwy 8 Widening, Grand River to Sportsworld Dr. N 4 809 204.75 E 230 760.97 ORIGINATED BY SLL
 HWY 8 BOREHOLE TYPE Hollow Stem Augers COMPILED BY JHL
 DATUM Geodetic DATE 10.08.06 - 10.08.06 CHECKED BY MEF

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 (%)		
						20	40	60	80	100	20	40	60	GR	SA	SI	CL	
284.8																		
0.0	TOPSOIL: (125 mm)																	
0.1	Clayey SILT, trace organics Firm Brown to Dark Brown		1	SS	8													
			2	SS	6													
283.0																		
1.8	SAND and GRAVEL, some silt, occasional cobbles Compact to Very Dense Brown Wet		3	SS	20													
			4	SS	34													
			5	SS	56													
280.9																		
3.9	END OF BOREHOLE AT 3.89 m. AUGER REFUSAL AT 3.89 m ON PROBABLE BEDROCK OR BOULDERS. BOREHOLE GROUTED WITH BENTONITE TO SURFACE.																	

47 38 15
(SI+CL)

ONTMT4S 7938.GPJ 20/03/07

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

RECORD OF BOREHOLE No 06-37

1 OF 1

METRIC

G.W.P. 277-97-00 LOCATION Hwy 8 Widening, Grand River to Sportsworld Dr. N 4 809 177.28 E 230 798.64 ORIGINATED BY SLL
 HWY 8 BOREHOLE TYPE Hollow Stem Augers COMPILED BY JHL
 DATUM Geodetic DATE 10.08.06 - 10.08.06 CHECKED BY MEF

ELEV DEPTH	SOIL PROFILE DESCRIPTION	STRAT PLOT	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
			NUMBER	TYPE	"N" VALUES			20	40					
284.9	TOPSOIL: (125 mm)													
0.0	SAND, some gravel, trace silt, trace organics Loose to Compact Brown to Dark Brown Moist		1	SS	4									
0.1			2	SS	8									
			3	SS	14									
282.7	SAND and GRAVEL, some silt, occasional cobbles Dense Brown Wet		4	SS	46								59 30 11 (SI+CL)	
2.2			5	SS	44									
281.4	Sandy SILT, trace clay, trace gravel Compact Brown Moist (TILL)													
3.5			6	SS	22									
279.3	Sandy, Silty CLAY Hard Grey (TILL)(CL)													
5.6			7	SS	44								0 31 47 20	
277.8	Sandy SILT, trace clay, trace gravel, occasional cobbles Very dense Grey Moist (TILL)													
7.2			8	SS	76/ 275									
276.9	END OF BOREHOLE AT 8.05 m. BOREHOLE GROUTED WITH BENTONITE TO SURFACE.													
8.1														

ONTMT4S 7938.GPJ 20/03/07

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

RECORD OF BOREHOLE No 06-38

1 OF 1

METRIC

G.W.P. 277-97-00 LOCATION Hwy 8 Widening, Grand River to Sportsworld Dr. N 4 809 141.34 E 230 838.70 ORIGINATED BY SLL
 HWY 8 BOREHOLE TYPE Hollow Stem Augers COMPILED BY JHL
 DATUM Geodetic DATE 10.08.06 - 10.08.06 CHECKED BY MEF

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
285.2	TOPSOIL: (125mm)													
0.0	SAND, trace silt and gravel		1	SS	12									
0.1	Compact													
284.4	Brown													
0.8	Moist (FILL)													
283.7	TOPSOIL, mixed with clayey silt		2	SS	9									
	Stiff													
	Dark Brown													
1.4	Sandy SILT, some topsoil													
	Loose to Compact													
	Brown													
	Moist		3	SS	5									
			4	SS	22									
282.1	SAND and GRAVEL, trace silt													
3.0	Dense		5	SS	34								38	53
	Brown													9
	Moist													(SI+CL)
281.4	SILT AND SAND, trace clay, trace gravel, occasional cobbles													
3.8	Dense to Very Dense													
	Grey													
	Moist (TILL)		6	SS	47									
			7	SS	34								6	42
														46
														6
277.3	END OF BOREHOLE AT 7.90 m		8	SS	50/									
7.9	BOREHOLE GROUTED WITH BENTONITE TO SURFACE				.125									

ONTMT4S 7938.GPJ 20/03/07

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

RECORD OF BOREHOLE No 06-39

1 OF 1

METRIC

G.W.P. 277-97-00 LOCATION Hwy 8 Widening, Grand River to Sportsworld Dr. N 4 809 107.47 E 230 868.98 ORIGINATED BY SLL
 HWY 8 BOREHOLE TYPE Hollow Stem Augers COMPILED BY JHL
 DATUM Geodetic DATE 14.08.06 - 14.08.06 CHECKED BY MEF

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 (%)
						20	40	60	80	100	20	40	60	kn/m ³	GR SA SI CL	
284.9	TOPSOIL, some roots Loose Black Moist		1	SS	7											
284.1																
0.8	Sandy SILT Loose Dark Brown Moist		2	SS	4											
283.5																
1.4	SAND and GRAVEL, some silt, occasional cobbles Very Dense to Compact Brown Wet		3	SS	82										52	36 13 (SI+CL)
			4	SS	24											
282.0																
2.9	Sandy SILT, trace clay, trace gravel, occasional cobbles Compact to Very Dense Grey Moist (TILL)		5	SS	25											
			6	SS	68										3	32 53 7
278.4			7	SS	85/ 225											
6.5	END OF BOREHOLE AT 6.48 m. BOREHOLE GROUTED WITH BENTONITE TO SURFACE.															

ONTMT4S 7938.GPJ 20/03/07

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

RECORD OF BOREHOLE No 06-40

1 OF 1

METRIC

G.W.P. 277-97-00 LOCATION Hwy 8 Widening, Grand River to Sportsworld Dr. N 4 809 080.05 E 230 915.85 ORIGINATED BY SLL
 HWY 8 BOREHOLE TYPE Hollow Stem Augers COMPILED BY JHL
 DATUM Geodetic DATE 14.08.06 - 14.08.06 CHECKED BY MEF

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	NUMBER	TYPE	"N" VALUES			20	40						60
287.2	TOPSOIL: (75 mm) SAND, some silt, trace gravel Compact to Loose Brown Moist (FILL) Occasional cobbles	1	SS	18										
0.0 0.1		2	SS	18										
		3	SS	23										
		4	SS	9										
284.2	SAND and GRAVEL, trace silt, occasional cobbles Very dense Brown Moist to wet	5	SS	82										
3.0		6	SS	92/ 275									42 49 9 (SI-CL)	
281.4	Sandy SILT, trace gravel Compact Grey Moist (TILL)	7	SS	28										
5.8		8	SS	91/ 250									0 18 64 16	
279.9	Clayey SILT, some sand, trace gravel Hard Grey Moist (TILL)													
7.3														
279.2	END OF BOREHOLE AT 8.03 m. Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen. WATER LEVEL READINGS: DATE DEPTH(m) ELEV.(m) 15.08.06 2.81 284.37 16.08.06 3.12 284.06 29.09.06 3.25 283.95													

ONTMT4S 7938.GPJ 20/03/07

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

RECORD OF BOREHOLE No 06-41

1 OF 1

METRIC

G.W.P. 277-97-00 LOCATION Hwy 8 Widening, Grand River to Sportsworld Dr. N 4 809 045.34 E 230 953.06 ORIGINATED BY SLL
 HWY 8 BOREHOLE TYPE Hollow Stem Augers COMPILED BY JHL
 DATUM Geodetic DATE 14.08.06 - 14.08.06 CHECKED BY MEF

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					
287.5	TOPSOIL: (50 mm) SAND, trace silt Compact Brown Moist (FILL)	[Cross-hatched]	1	SS	16										
	trace gravel	[Cross-hatched]	2	SS	28										
	occasional cobbles	[Cross-hatched]	3	SS	23										
285.3	SAND, some gravel, some silt, occasional cobbles Compact Brown Moist	[Dotted]	4	SS	14										
		[Dotted]	5	SS	17										
282.9	SAND and GRAVEL, some silt, occasional cobbles Very Dense Grey Moist	[Dotted]	6	SS	83									42 41 17 (SI+CL)	
282.1	Sandy, Silty CLAY Hard Grey (TILL)(CL)	[Diagonal lines]	7	SS	35									1 31 48 20	
279.4	occasional cobbles	[Diagonal lines]	8	SS	95/ 250										
8.0	END OF BOREHOLE AT 8.03 m. BOREHOLE GROUTED WITH BENTONITE TO SURFACE.														

ONTMT4S 7938.GPJ 20/03/07

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

RECORD OF BOREHOLE No 06-42

1 OF 1

METRIC

G.W.P. 277-97-00 LOCATION Hwy 8 Widening, Grand River to Sportsworld Dr. N 4 809 012.79 E 230 991.33 ORIGINATED BY SLL
 HWY 8 BOREHOLE TYPE Hollow Stem Augers COMPILED BY JHL
 DATUM Geodetic DATE 2006-08-15 - 2006-08-15 CHECKED BY MEF

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	UNIT WEIGHT 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	W _p	W	W _L	
288.4														
0.0 0.1	TOPSOIL: (75 mm)													
	Gravelly SAND, some silt Dense to Compact Brown Moist (FILL)		1	SS	31									
			2	SS	20									
			3	SS	44									32 51 17 (SI+CL)
			4	SS	35									
285.4														
3.0	Silty SAND, some gravel Compact to Dense Brown Moist to wet		5	SS	12									
			6	SS	30									21 55 24 (SI+CL)
282.1														
6.3	Sandy SILT, trace gravel Compact to Very Dense Grey Moist (TILL)		7	SS	24									
280.5														
7.9	END OF BOREHOLE AT 7.90 m. BOREHOLE GROUTED WITH BENTONITE TO SURFACE.		8	SS	50/ .125									

ONTMT4S 7938.GPJ 6/26/07

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

RECORD OF BOREHOLE No 06-43

1 OF 1

METRIC

G.W.P. 277-97-00 LOCATION Hwy 8 Widening, Grand River to Sportsworld Dr. N 4 808 981.61 E 231 029.48 ORIGINATED BY SLL
 HWY 8 BOREHOLE TYPE Hollow Stem Augers COMPILED BY JHL
 DATUM Geodetic DATE 15.08.06 - 15.08.06 CHECKED BY MEF

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT Y kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	W P	W	W L	20 40 60		
289.9 0.0 0.1	TOPSOIL: (50 mm) Gravelly SAND, some silt to silty, occasional cobbles Very Dense to Compact Brown Moist (FILL)	1	SS	50/ .125									
		2	SS	54									
		3	SS	39									
		4	SS	91/ .225									27 51 22 (SI+CL)
		5	SS	22									
286.1 3.8	Silty SAND, some gravel, occasional cobbles Very dense Brown to grey Moist	6	SS	69									21 48 30 (SI+CL)
284.0 5.9	END OF BOREHOLE AT 5.87 m. Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen. WATER LEVEL READINGS: DATE DEPTH(m) ELEV.(m) 29.09.06 5.19 284.71												

ONT/MT/4S 7938.GPJ 20/03/07

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

RECORD OF BOREHOLE No 06-44

1 OF 1

METRIC

G.W.P. 277-97-00 LOCATION Hwy 8 Widening, Grand River to Sportsworld Dr. N 4 808 948.45 E 231 068.08 ORIGINATED BY SLL
 HWY 8 BOREHOLE TYPE Hollow Stem Augers COMPILED BY JHL
 DATUM Geodetic DATE 15.08.06 - 15.08.06 CHECKED BY MEF

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	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa								WATER CONTENT (%)			
						20	40	60	80	100	20	40	60	GR	SA	SI	CL	
291.7	TOPSOIL: (50 mm) Gravelly SAND, some silt, occasional cobbles Dense to Very Dense Brown Moist (FILL)	1	SS	38														
		2	SS	65														
		3	SS	50/ .125														
		4	SS	67														
		5	SS	61														
287.1	Sandy SILT, trace gravel, trace clay, occasional cobbles Dense Grey Moist (FILL)	6	SS	31														
285.7		Silty SAND, some gravel Dense to Very Dense Brown with topsoil staining Moist	7	SS	47													
283.9	8		SS	50/ .025														
7.8	END OF BOREHOLE AT 7.80 m. BOREHOLE GROUTED WITH BENTONITE TO SURFACE.																	

ONTMT4S 7938.GPJ 20/03/07

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

RECORD OF BOREHOLE No 06-45

1 OF 2

METRIC

G.W.P. 277-97-00 LOCATION Hwy 8 Widening, Grand River to Sportsworld Dr. N 4 808 921.39 E 231 098.77 ORIGINATED BY SLL
 HWY 8 BOREHOLE TYPE Hollow Stem Augers COMPILED BY JHL
 DATUM Geodetic DATE 16.08.06 - 16.08.06 CHECKED BY MEF

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	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
						20 40 60 80 100		20 40 60			kN/m ³	GR SA SI CL	
293.1													
8.8	TOPSOIL: (25 mm) SAND, trace to some gravel, trace to some silt, occasional cobbles Very Dense to Loose Brown Moist (FILL)	1	SS	52									
		2	SS	9									
		3	SS	34									
		4	SS	36									
		5	SS	39									
		6	SS	8									
	Dark Brown, trace organics	7	SS	7								25 62 13 (SI+CL)	
286.0													
7.0	SAND, some gravel, some silt Very dense Grey Wet	8	SS	64									
284.7													
8.4	Sandy, Silty CLAY Hard Brown Moist (TILL)(CL)	9	SS	35									
283.4													
9.7	END OF BOREHOLE AT 9.68 m. BOREHOLE GROUTED WITH											0 26 49 23	

ONTMT4S 7938.GPJ 20/03/07

Continued Next Page

+³ × 3³: Numbers refer to Sensitivity $\frac{20}{15} \times \frac{5}{10}$ (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 06-45

2 OF 2

METRIC

G.W.P. 277-97-00 LOCATION Hwy 8 Widening, Grand River to Sportsworld Dr. N 4 808 921.39 E 231 098.77 ORIGINATED BY SLL
 HWY 8 BOREHOLE TYPE Hollow Stem Augers COMPILED BY JHL
 DATUM Geodetic DATE 16.08.06 - 16.08.06 CHECKED BY MEF

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 kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	20	40	60	80					
	BENTONITE TO SURFACE.															

ONTMT4S 7938.GPJ 20/03/07

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

RECORD OF BOREHOLE No 06-46

1 OF 1

METRIC

G.W.P. 277-97-00 LOCATION Hwy 8 Widening, Grand River to Sportsworld Dr. N 4 808 886.60 E 231 145.17 ORIGINATED BY SLL
 HWY 8 BOREHOLE TYPE Hollow Stem Augers COMPILED BY JHL
 DATUM Geodetic DATE 16.08.06 - 16.08.06 CHECKED BY MEF

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 kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	20 40 60 80 100					
295.3	TOPSOIL: (25 mm)												
0.2	SAND, trace silt Compact Brown Moist (FILL)	1	SS	14									
	Silly CLAY, trace sand Very stiff Brown (CH)	2	SS	15									
		3	SS	20									0 2 35 64
	Becoming Grey	4	SS	19									
292.4	Sandy, Silty CLAY, trace gravel, occasional cobbles Hard Grey (TILL)	5	SS	50									
290.6	Silty SAND, some gravel, occasional cobbles Very dense Grey Moist (TILL)	6	SS	80/ 225									17 54 28 (SI+CL)
4.7 290.4	END OF BOREHOLE AT 4.95 m. Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen.												
5.0	WATER LEVEL READINGS: DATE DEPTH(m) ELEV.(m) 29.09.06 4.28 291.04												

ONTMT4S 7935.GPJ 20/03/07

RECORD OF BOREHOLE No 06-64

1 OF 2

METRIC

G.W.P. 277-97-00 LOCATION Hwy 8 Widening, Grand River to Sportsworld Dr. N 4 809 235.31 E 230 718.37 ORIGINATED BY SLL
 HWY 8 BOREHOLE TYPE Hollow Stem Augers COMPILED BY JHL
 DATUM Geodetic DATE 10.08.06 - 10.08.06 CHECKED BY MEF

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	NUMBER	TYPE	"N" VALUES			20	40	60	80						100	20
284.6																	
0.0 0.1	TOPSOIL: (150 mm) Silty CLAY, trace sand, topsoil stained Firm to Stiff Dark Brown	1	SS	5													
		2	SS	13													
283.1																	
1.4	SAND and GRAVEL, trace silt, occasional cobbles Loose Brown Moist Becoming Very Dense occasional cobbles and boulders	3	SS	8													
		4	SS	70													
		5	SS	92/ 275													50 42 8 (SI+CL)
		6	SS	88													
278.5																	
6.0	Sandy SILT, trace gravel, occasional cobbles Very Dense Grey Moist to Wet (TILL)	7	SS	50/ 125													
277.6																	
7.0	SAND, some silt, trace gravel, occasional cobbles Very Dense Grey Wet	8	SS	50/ 100													
		9	SS	50/ 050													
275.4																	
9.2	END OF BOREHOLE AT 9.19 m. Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen.																

Continued Next Page

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

ONTMT4S 7938.GPJ 20/03/07

RECORD OF BOREHOLE No 06-64

2 OF 2

METRIC

G.W.P. 277-97-00 LOCATION Hwy 8 Widening, Grand River to Sportsworld Dr. N 4 809 235.31 E 230 718.37 ORIGINATED BY SLL
 HWY 8 BOREHOLE TYPE Hollow Stem Augers COMPILED BY JHL
 DATUM Geodetic DATE 10.08.06 - 10.08.06 CHECKED BY MEF

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa					
	WATER LEVEL READINGS: DATE DEPTH(m) ELEV.(m) 11.08.06 1.34 283.24 14.08.06 1.47 283.11 15.08.06 1.48 283.10 16.08.06 1.49 283.09 29.09.06 1.39 283.19												

ONTMT4S 7938.GPJ 20/03/07

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

RECORD OF BOREHOLE No 06-73

1 OF 1

METRIC

G.W.P. 277-97-00 LOCATION Hwy 8 Widening, Grand River to Sportsworld Dr. N 4 809 157.57 E 230 802.08 ORIGINATED BY SLL
 HWY 8 BOREHOLE TYPE Hollow Stem Augers COMPILED BY JHL
 DATUM Geodetic DATE 09.08.06 - 09.08.06 CHECKED BY MEF

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 kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa					
285.1						20 40 60 80 100							
0.0 0.1	TOPSOIL: (150 mm) SAND, trace organics Very Loose Dark Brown		1	SS	3								
284.4	Moist												
0.7	Clayey SILT, some sand, trace organics Soft Dark Brown		2	SS	4								
			3	SS	3								
	Becoming Very Stiff		4	SS	17								
282.2													
3.0	SAND and GRAVEL, some silt, occasional cobbles Compact Brown Wet		5	SS	18								
281.2													
4.0	SILT and SAND, trace clay, trace gravel Dense to Very Dense Brown to Grey Moist (TILL)		6	SS	31							2 43 47 7	
278.7			7	SS	50/125								
6.4	END OF BOREHOLE AT 6.37 m. Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen. WATER LEVEL READINGS: DATE DEPTH(m) ELEV.(m) 10.08.06 1.95 283.18 11.08.06 1.92 283.21 14.08.06 2.02 283.11 15.08.06 2.00 283.13 16.08.06 2.00 283.13 29.09.06 1.52 283.61												

ONTMT4S 793B.GPJ 20/03/07

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

Appendix B

Laboratory Test Results

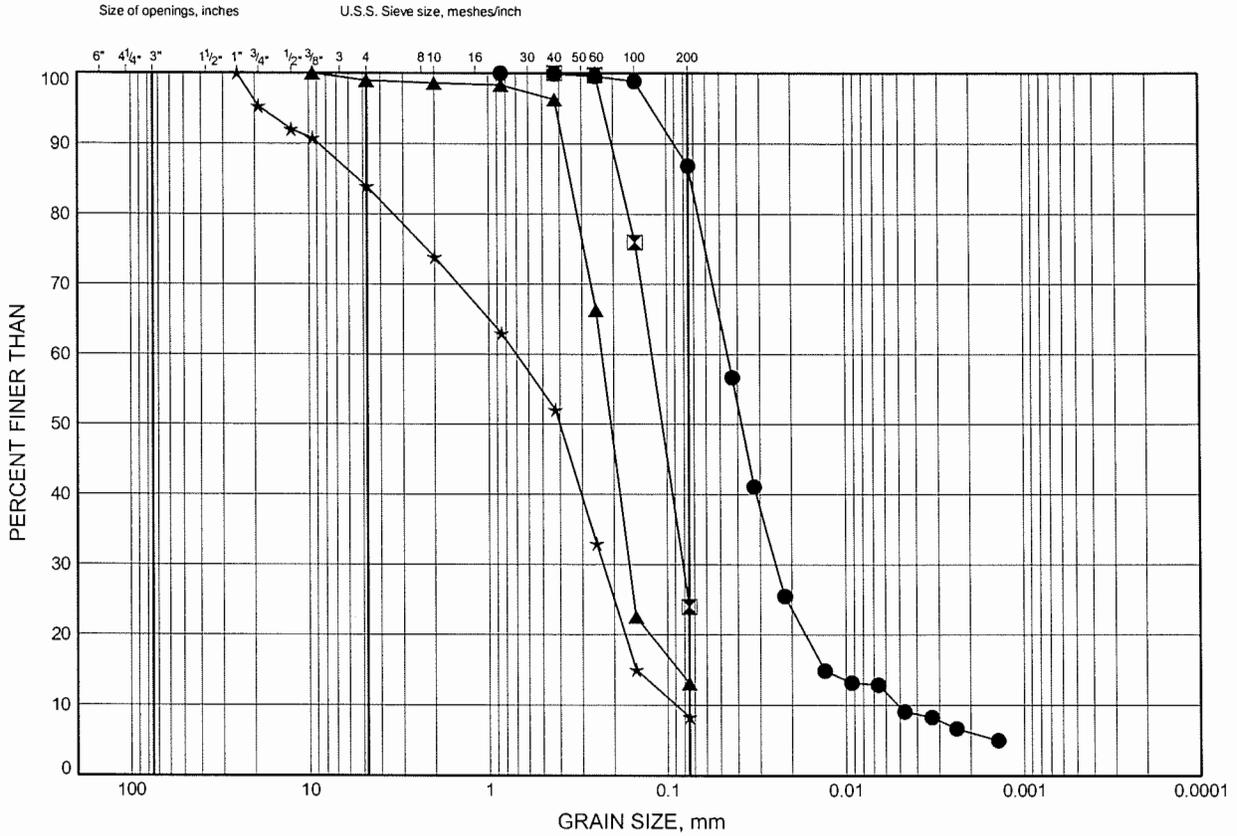
Deep Cut – Figures B1 to B8

High Fill – Figures B9 to B17

Highway 8 Widening Over Grand River GRAIN SIZE DISTRIBUTION

FIGURE B2

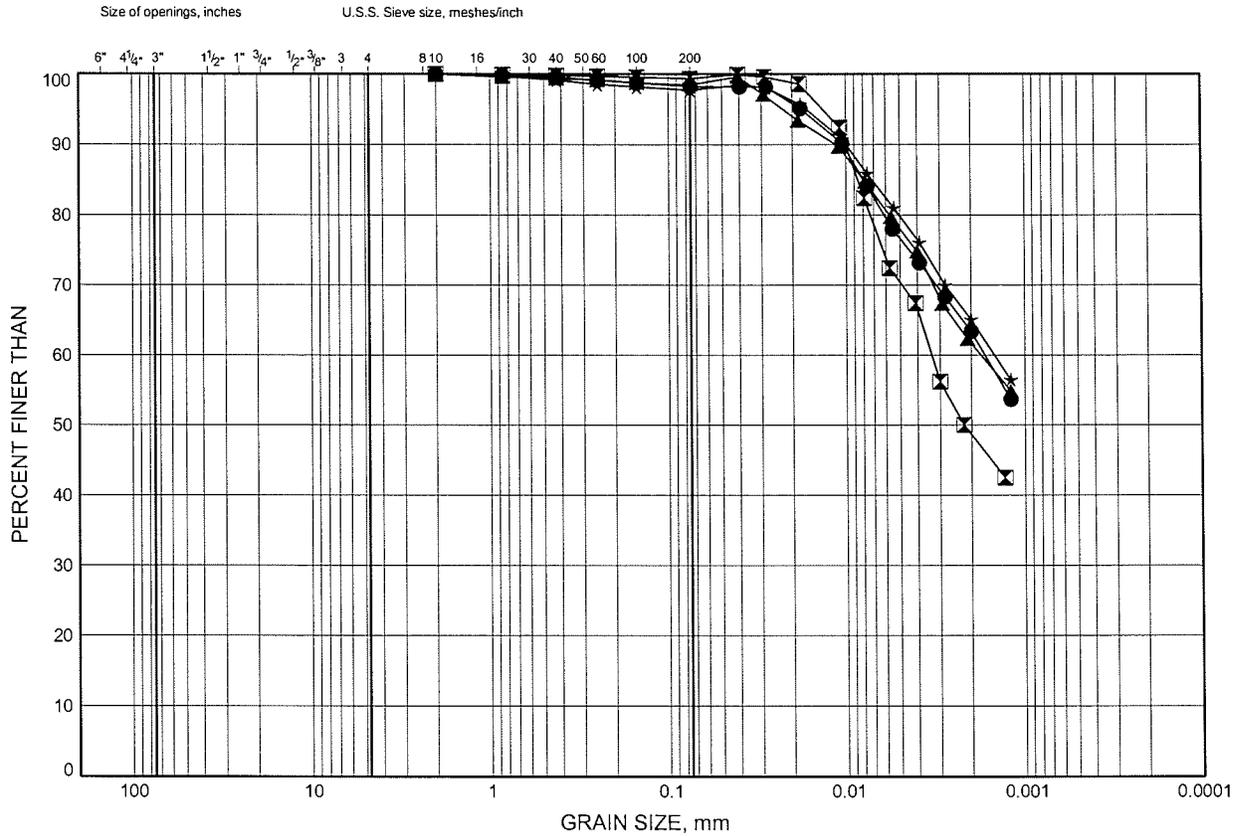
SAND TO SILT AND SAND



Highway 8 Widening Over Grand River GRAIN SIZE DISTRIBUTION

FIGURE B4

SILTY CLAY TILL

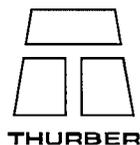


COBBLE SIZE	COARSE	FINE	COARSE	MEDIUM	FINE	SILT and CLAY
	GRAVEL		SAND			FINE GRAINED

SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	06-28	9.35	297.73
⊠	06-29	6.40	301.79
▲	06-29	10.97	297.22
★	06-30	12.50	298.01

THURBGSD 7938.GPJ 17/01/07

Date January 2007
Project 277-97-00

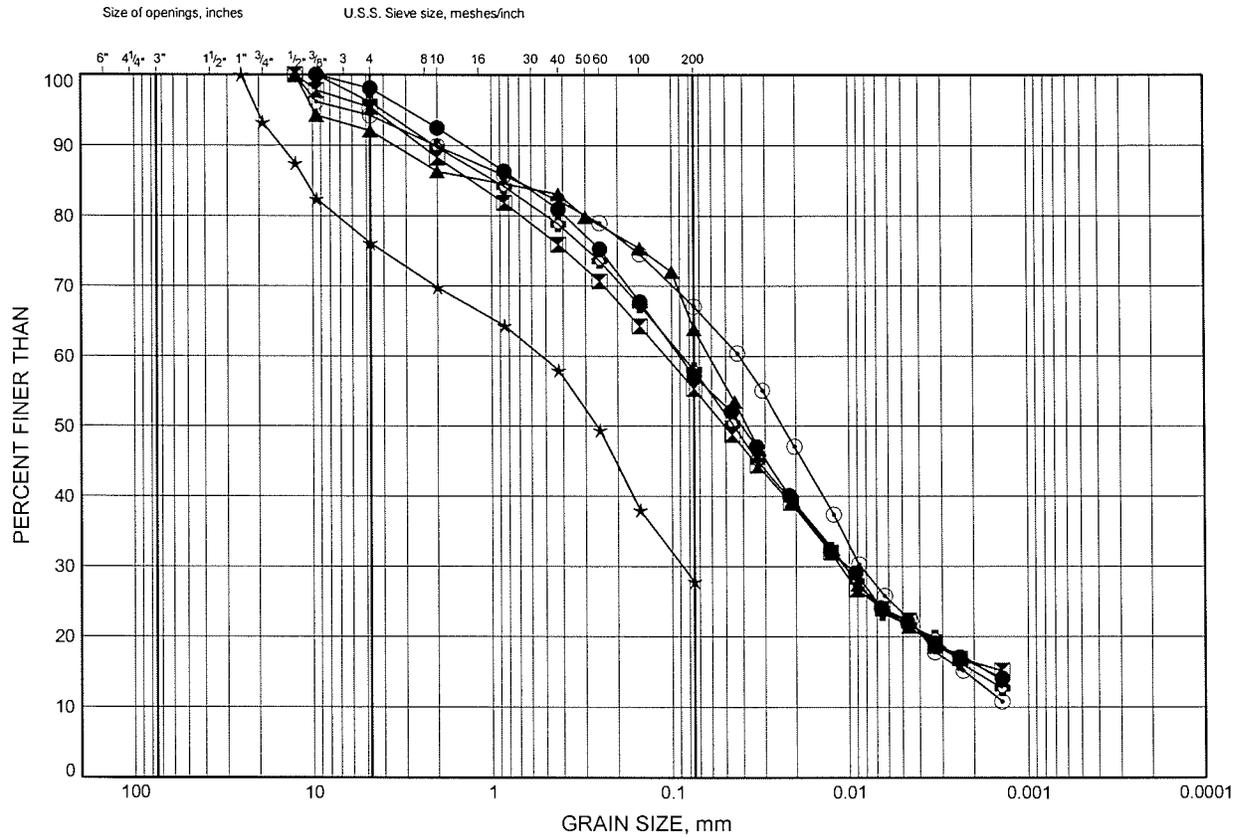


Prep'd MFA
Chkd. MRA

Highway 8 Widening Over Grand River GRAIN SIZE DISTRIBUTION

FIGURE B6

SANDY SILT TO SILTY SAND TILL

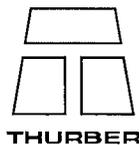


COBBLE SIZE	COARSE	FINE	COARSE	MEDIUM	FINE	SILT and CLAY
	GRAVEL		SAND			FINE GRAINED

SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	06-29	13.78	294.41
⊠	06-30	16.90	293.60
▲	06-31	6.40	303.55
★	06-31	18.58	291.37
⊙	06-32	18.34	290.87
⊕	06-33	15.38	292.65

THURBGSD 7938.GPJ 17/01/07

Date January 2007
Project 277-97-00

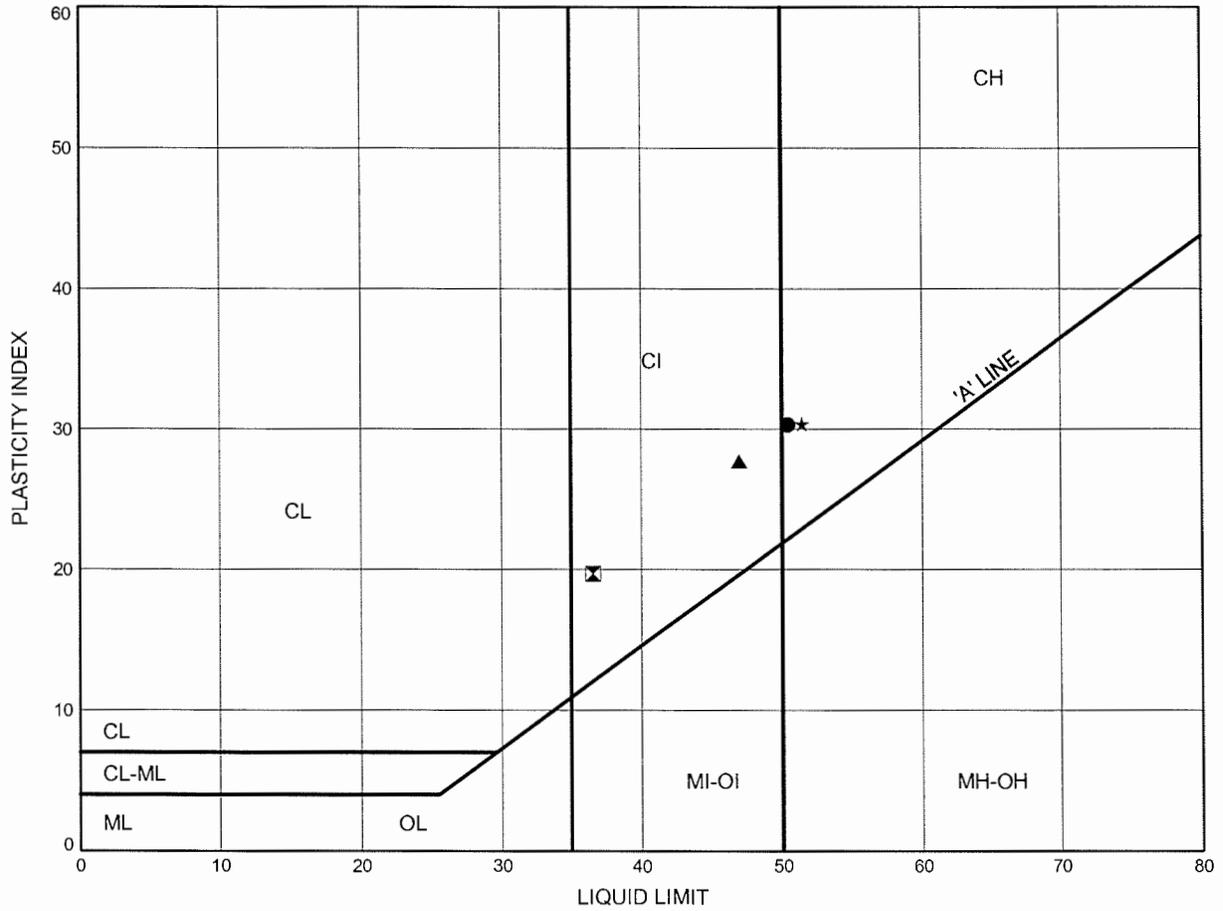


Prep'd MFA
Chkd. MRA

Highway 8 Widening Over Grand River
ATTERBERG LIMITS TEST RESULTS

FIGURE B7

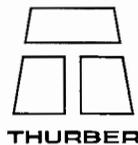
SILTY CLAY TILL



SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	06-28	9.35	297.73
⊠	06-29	6.40	301.79
▲	06-29	10.97	297.22
★	06-30	12.50	298.01

THURBALT 7938.GPJ 17/01/07

Date January 2007
 Project 277-97-00

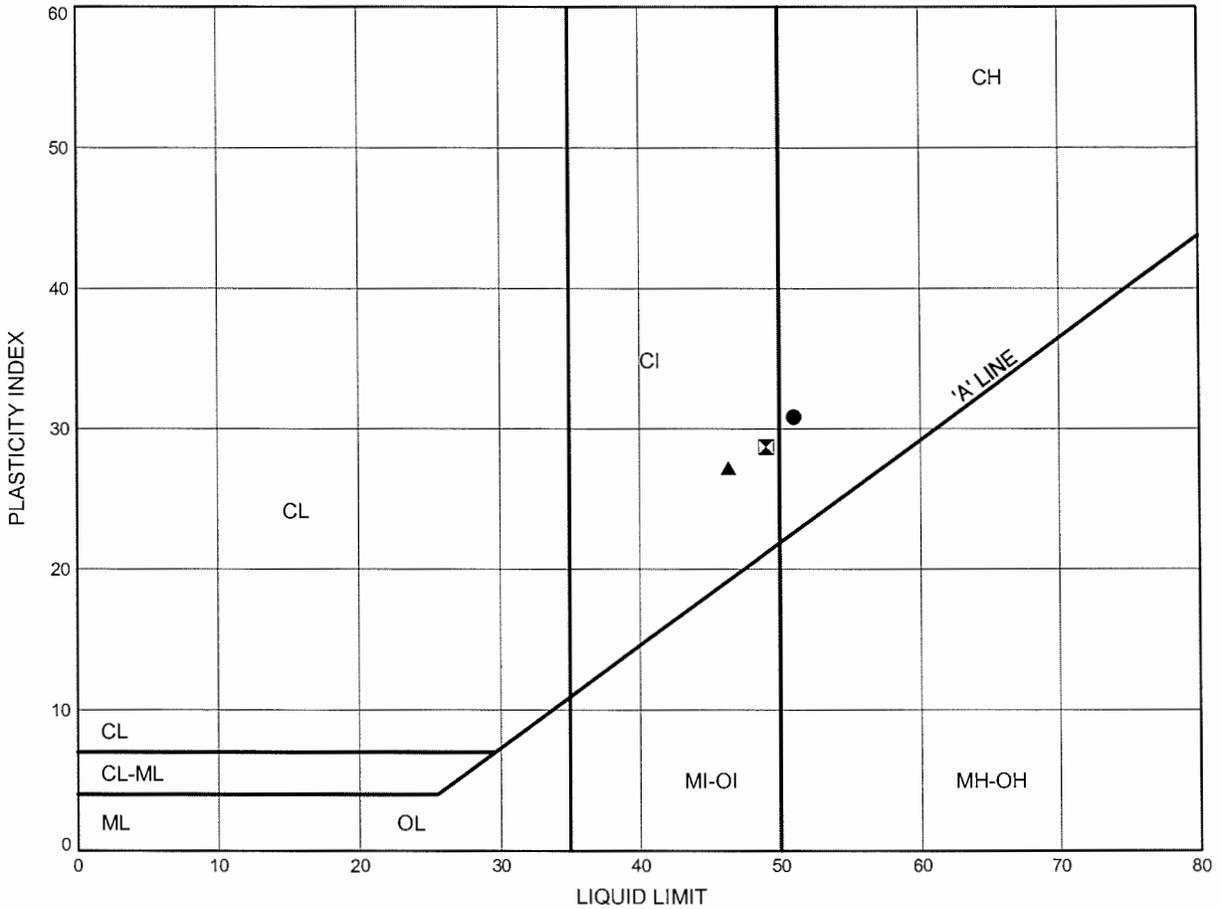


Prep'd MFA
 Chkd. MRA

Highway 8 Widening Over Grand River
ATTERBERG LIMITS TEST RESULTS

FIGURE B8

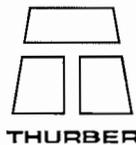
SILTY CLAY TILL



SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	06-31	12.42	297.53
⊠	06-32	12.40	296.81
▲	06-33	10.72	297.31

THURBALT 7938.GPJ 17/01/07

Date January 2007
 Project 277-97-00

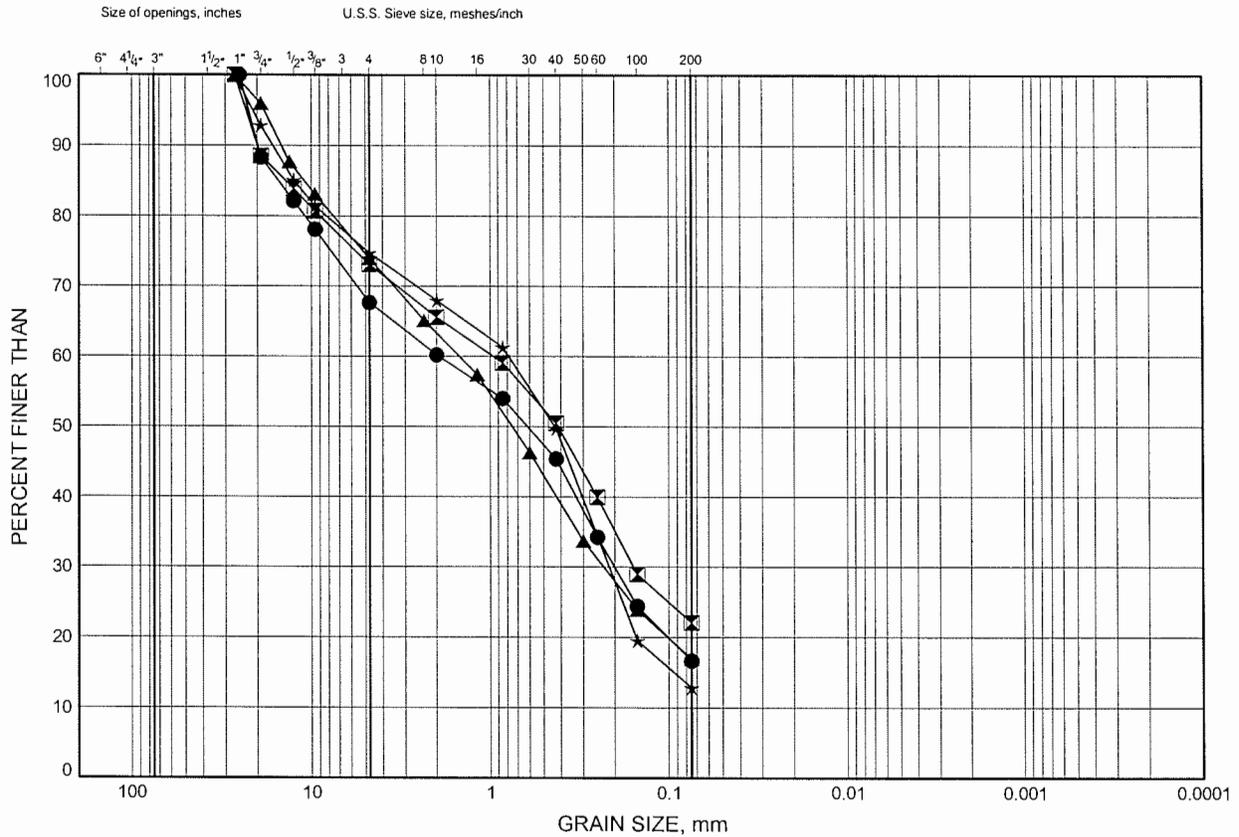


Prep'd MFA
 Chkd. MRA

Highway 8 Widening Over Grand River GRAIN SIZE DISTRIBUTION

FIGURE B9

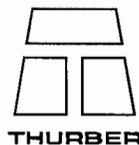
SAND FILL



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

SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	06-42	1.83	286.57
⊠	06-43	2.59	287.30
▲	06-44	2.59	289.09
★	06-45	3.35	289.70

Date February 2007
Project 277-97-00

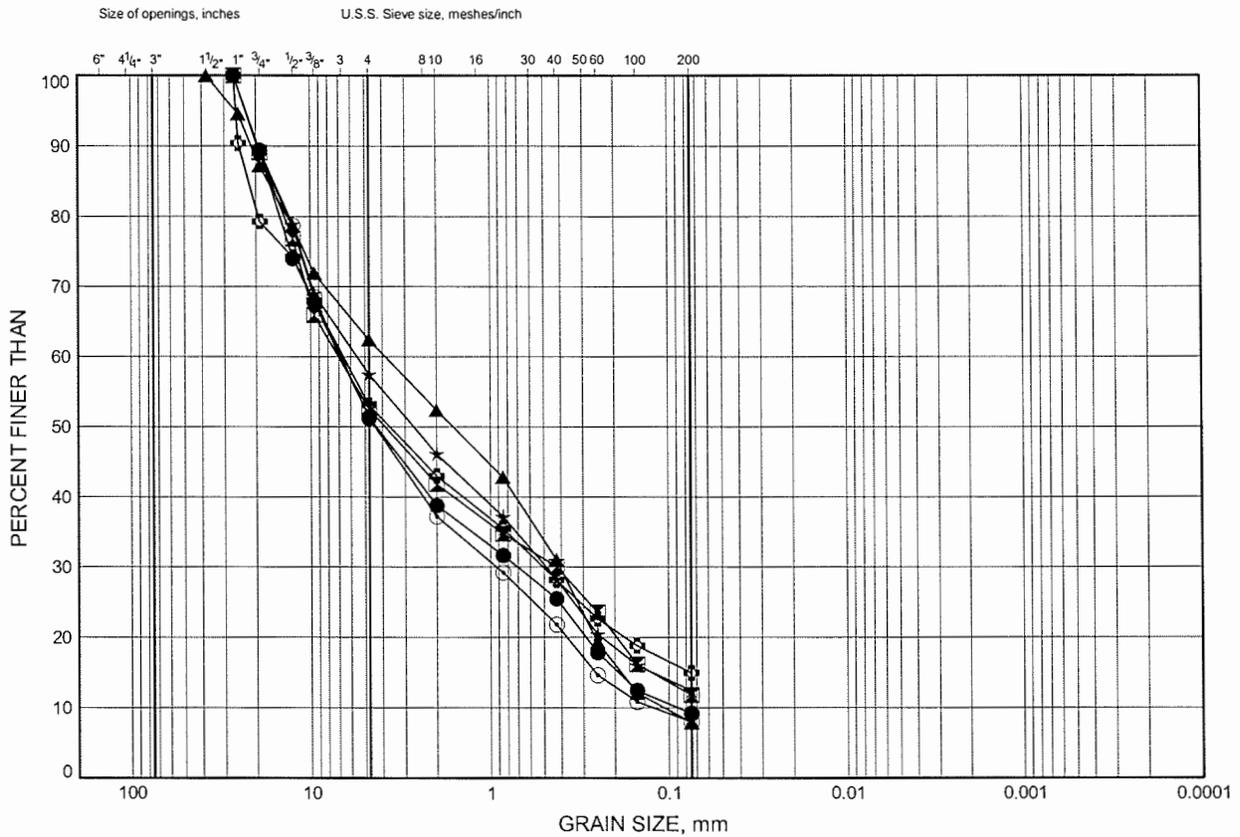


Prep'd JHL
Chkd. MRA

Highway 8 Widening Over Grand River GRAIN SIZE DISTRIBUTION

FIGURE B10

SAND AND GRAVEL

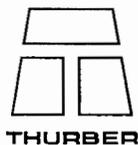


COBBLE SIZE	COARSE	FINE	COARSE	MEDIUM	FINE	SILT and CLAY
	GRAVEL		SAND			FINE GRAINED

SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	06-11	3.35	281.15
⊠	06-12	3.18	281.02
▲	06-13	2.51	281.80
★	06-34	1.83	282.63
⊙	06-35	3.28	281.13
⊗	06-36	3.35	281.42

THURBGSD 7938.GPJ 06/02/07

Date February 2007
Project 277-97-00

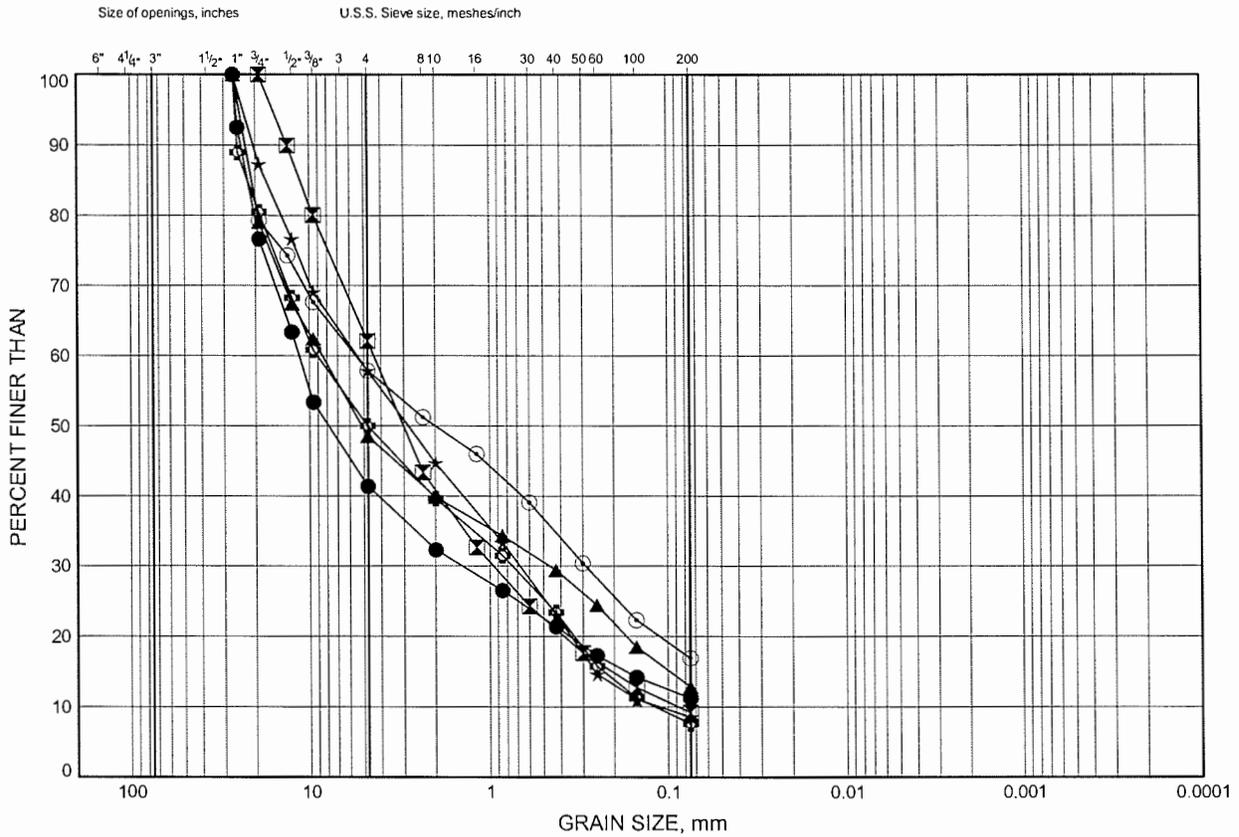


Prep'd JHL
Chkd. MRA

Highway 8 Widening Over Grand River GRAIN SIZE DISTRIBUTION

FIGURE B11

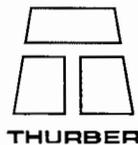
SAND AND GRAVEL



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

SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	06-37	2.59	282.36
⊠	06-38	3.35	281.82
▲	06-39	1.83	283.09
★	06-40	4.80	282.38
⊙	06-41	4.88	282.59
⊠	06-64	3.25	281.33

Date February 2007
Project 277-97-00

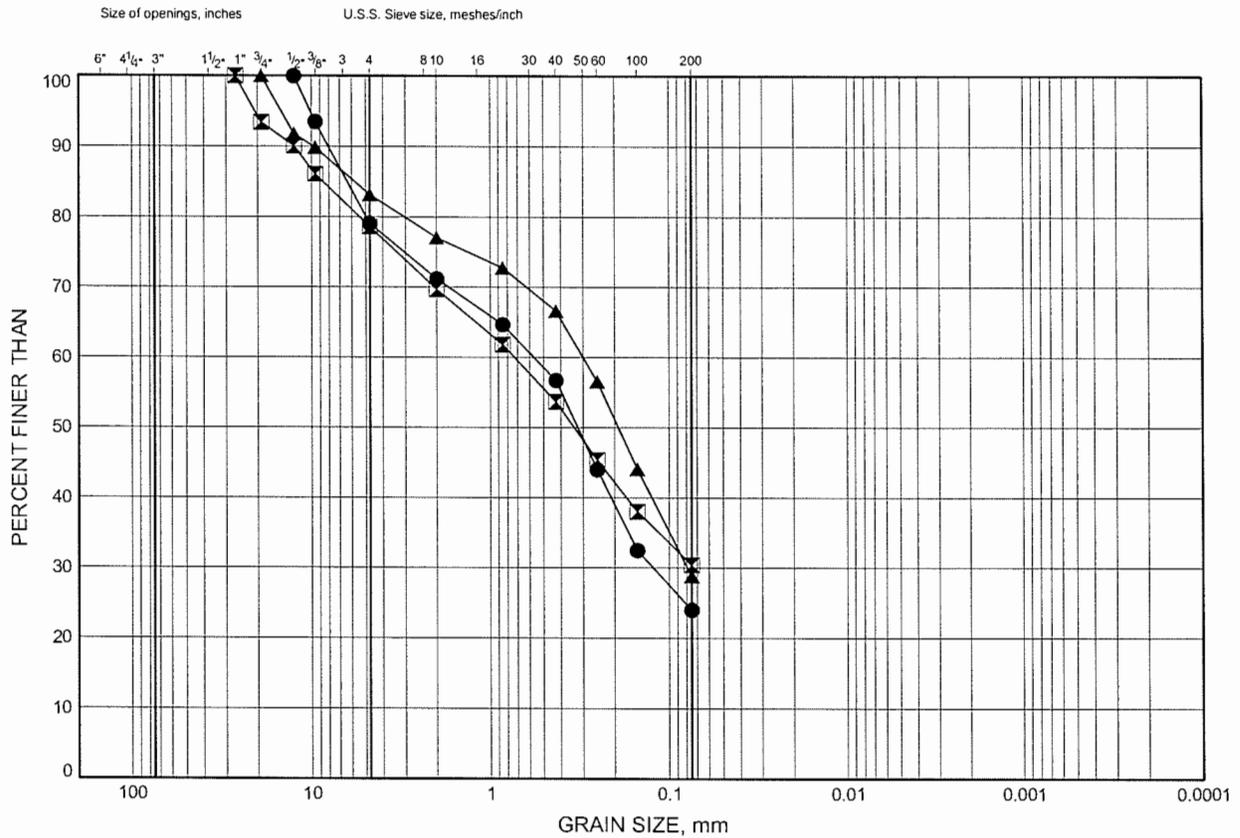


Prep'd JHL
Chkd. MRA

Highway 8 Widening Over Grand River GRAIN SIZE DISTRIBUTION

FIGURE B12

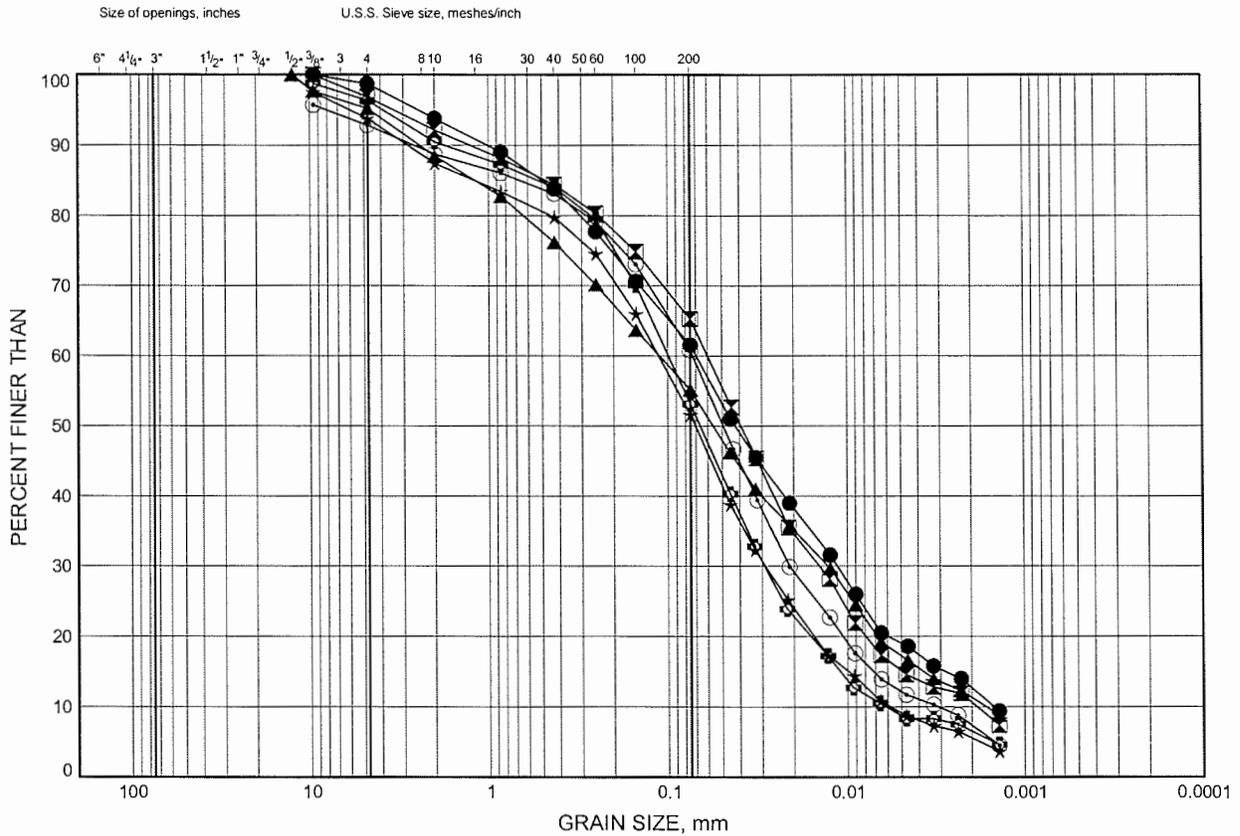
SAND TO SILTY SAND



Highway 8 Widening Over Grand River
GRAIN SIZE DISTRIBUTION

FIGURE B13

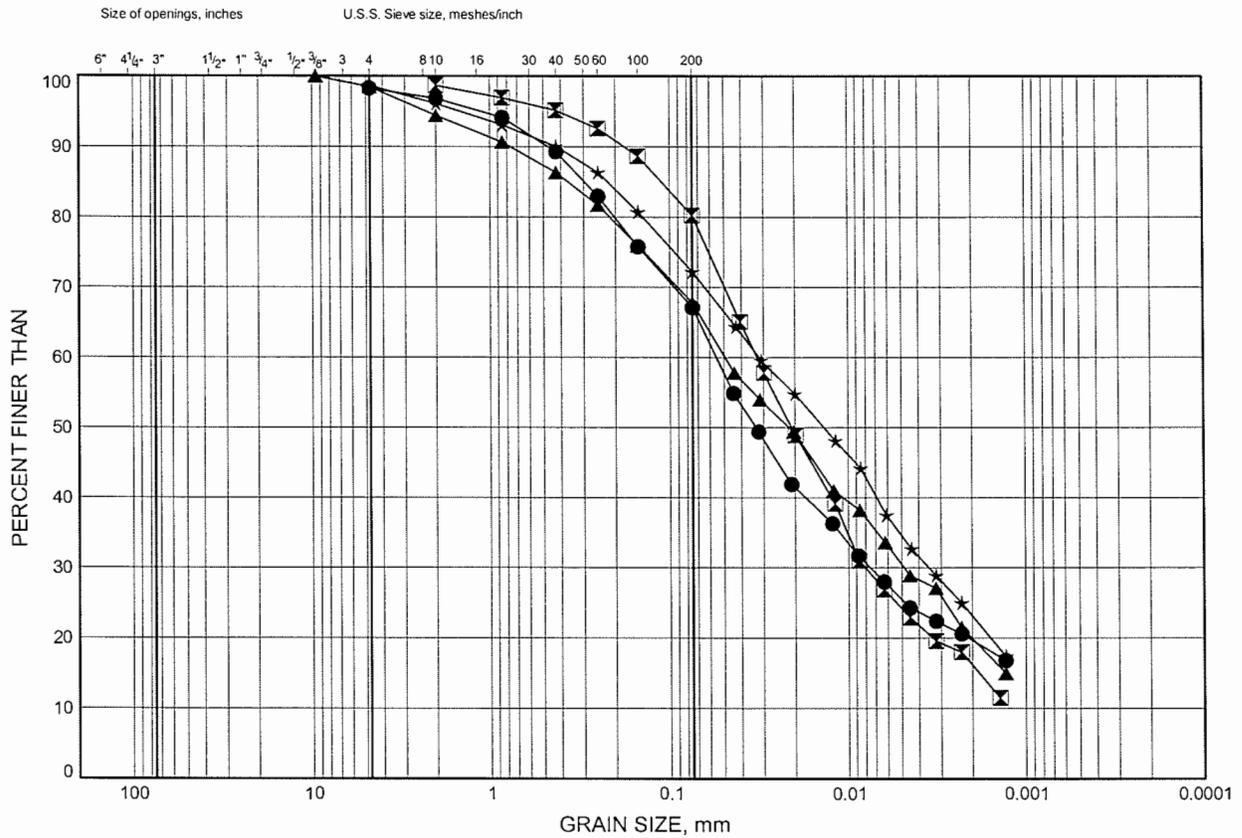
SILTY SAND TO SANDY SILT TILL



Highway 8 Widening Over Grand River GRAIN SIZE DISTRIBUTION

FIGURE B14

CLAYEY SILT TO SANDY CLAY TILL

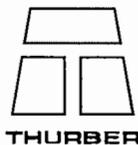


	COARSE	FINE	COARSE	MEDIUM	FINE	SILT and CLAY
COBBLE SIZE	GRAVEL		SAND			FINE GRAINED

SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	06-37	6.40	278.55
⊠	06-40	7.82	279.35
▲	06-41	6.40	281.07
★	06-45	9.41	283.65

THURBGSD 7938.GPJ 09/02/07

Date February 2007
Project 277-97-00

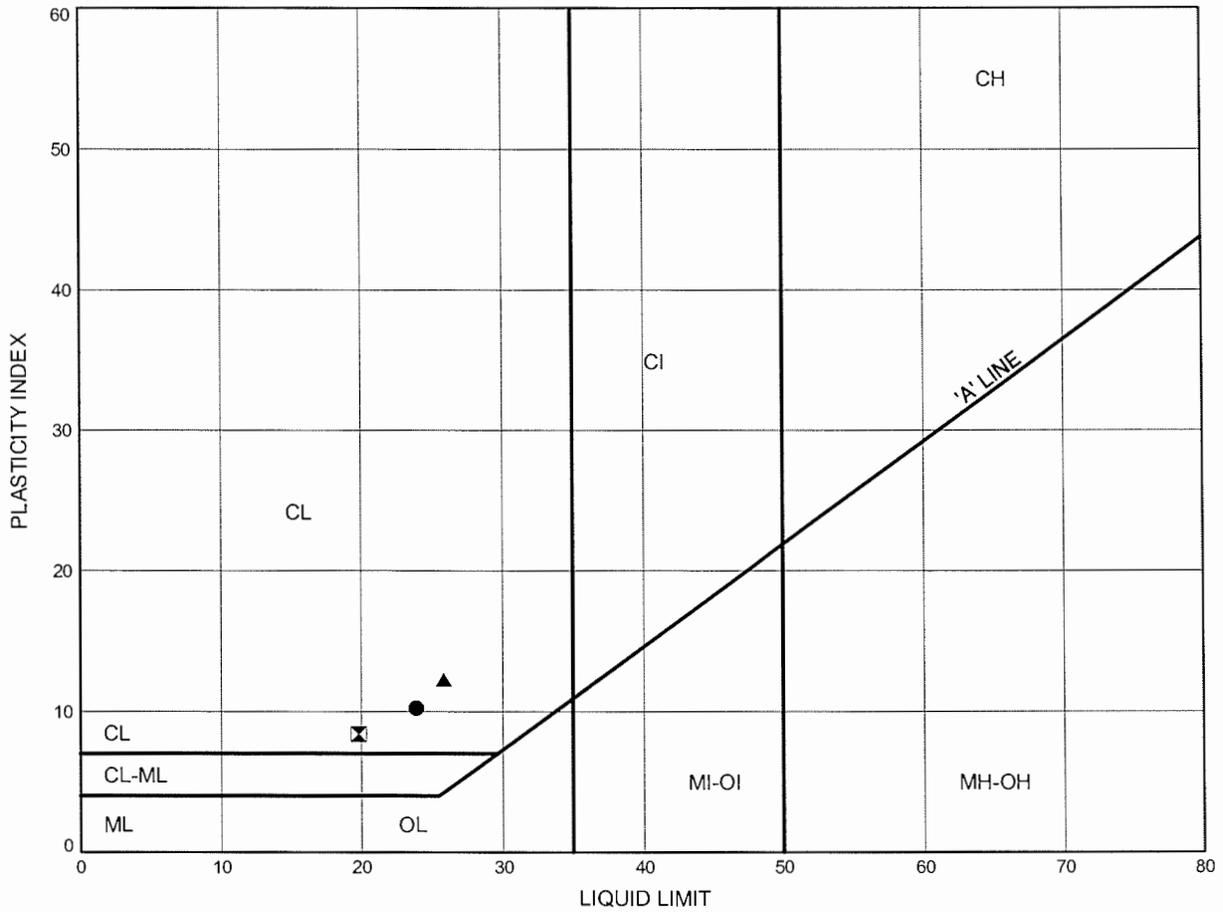


Prep'd JHL
Chkd. MRA

Highway 8 Widening Over Grand River
ATTERBERG LIMITS TEST RESULTS

FIGURE B16

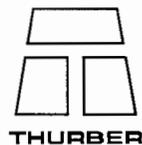
SANDY SILTY CLAY TILL



SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	06-37	6.40	278.55
⊠	06-41	6.40	281.07
▲	06-45	9.41	283.65

THURBALT 7938.GPJ 08/02/07

Date February 2007
 Project 277-97-00

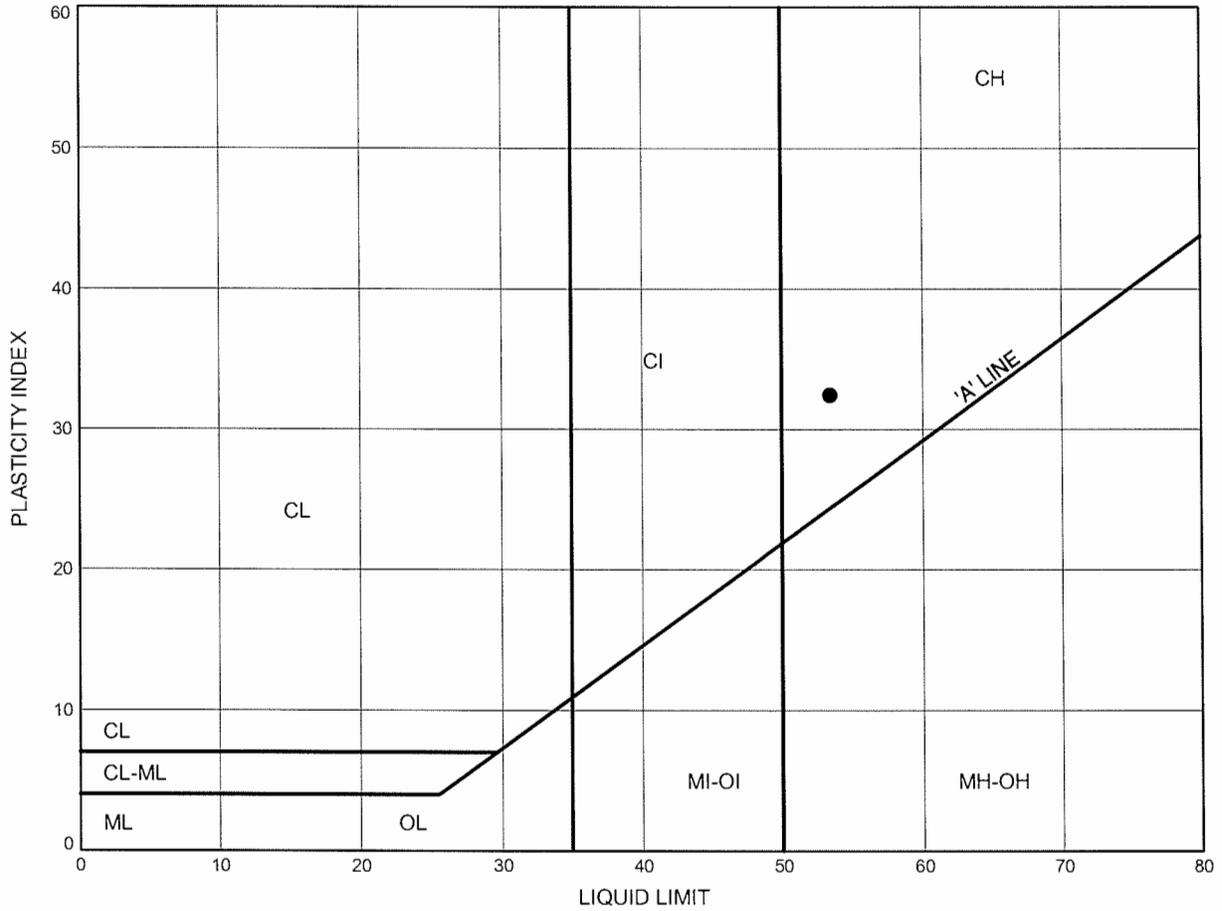


Prep'd JHL
 Chkd. MRA

Highway 8 Widening Over Grand River
ATTERBERG LIMITS TEST RESULTS

FIGURE B17

SILTY CLAY



SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	06-46	1.83	293.49

THURBALT 7938.GPJ 23/02/07

Date February 2007
 Project 277-97-00



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Appendix C

Tables

TABLE C1 – BOREHOLE COMPLETION DETAILS

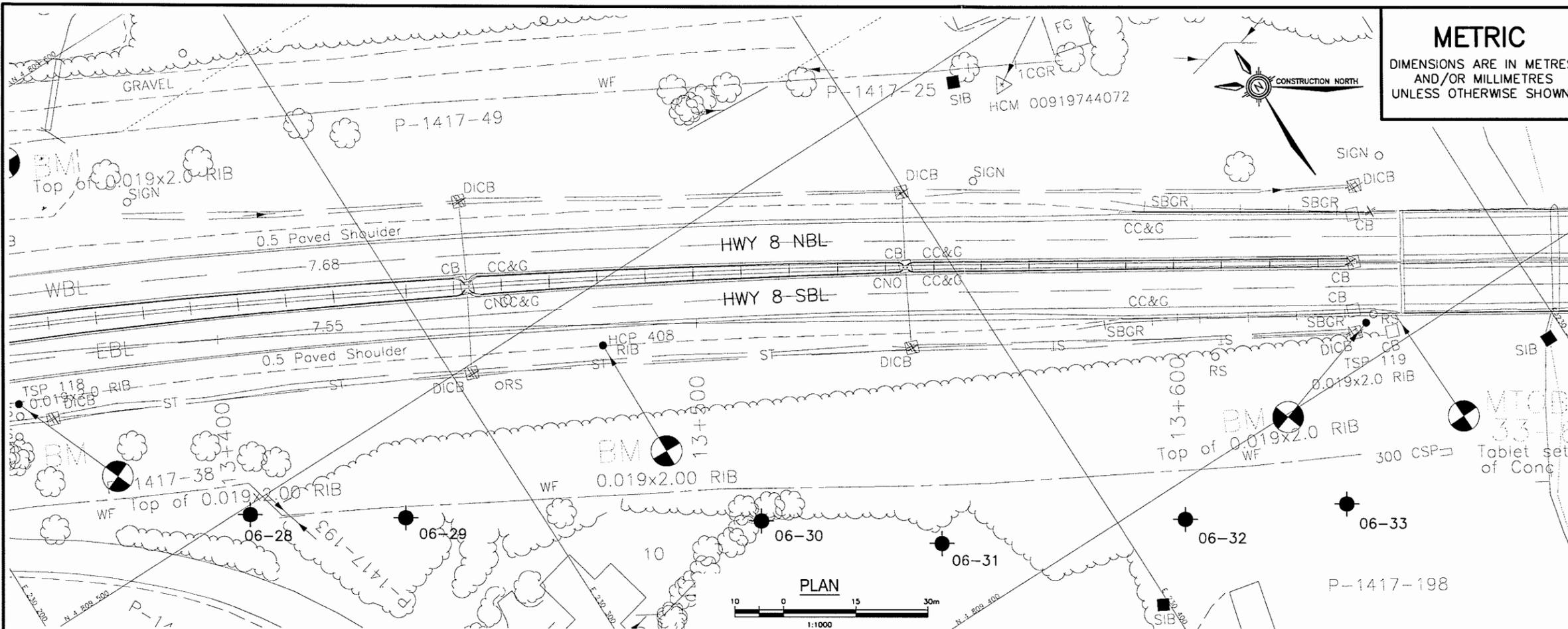
Borehole	Piezometer Tip (Sand Filter) Details			Backfill
	Depth	Elevation	Stratum	
06-11	14.0 – 12.2	270.5 - 272.3	Gravelly sand	Bentonite seal to 11.6 m, grout to surface
06-12	-	-	-	Bentonite grout to ground surface
06-13	-	-	-	Bentonite grout to ground surface
06-28	12.0 – 9.6	295.1 – 297.5	Silty clay till, sandy silt till	Bentonite seal to 8.9 m, grout to 1.2 m, cuttings to surface
06-29	19.9 – 17.7	288.3 – 290.5	Silt and sand till	Bentonite seal to 17.2 m, grout to 1.2 m, cuttings to surface
06-30	19.8 – 18.0	290.7 – 292.5	Silt and sand till	Bentonite seal to 17.2 m, grout to surface
06-31	19.9 – 17.8	290.1 – 292.2	Silty sand till	Bentonite seal to 17.3 m, grout to 0.9 m, cuttings to 0.6 m, bentonite to surface
06-32	19.9 – 17.8	289.3 – 291.4	Sandy silt till	Bentonite seal to 17.1 m, grout to 0.9 m, bentonite to 0.3 m, cuttings to surface
06-33	20.1 – 18.1	287.9 – 289.9	Silt and sand till	Bentonite seal to 17.0 m, grout to 0.9 m, cuttings to surface
06-34	-	-	-	Bentonite seal to 2.1 m, cuttings to surface
06-35	-	-	-	Bentonite grout to ground surface
06-36	-	-	-	Bentonite grout to ground surface
06-37	-	-	-	Bentonite grout to ground surface
06-38	-	-	-	Bentonite grout to 0.3 m, bentonite seal to surface
06-39	-	-	-	Bentonite grout to 0.3 m, bentonite seal to surface
06-40	7.9 – 6.0	279.3 – 281.2	Sandy silt till, clayey silt till	Bentonite seal to 5.3 m, grout to 0.3 m, bentonite to surface
06-41	-	-	-	Bentonite grout to 0.3 m, bentonite seal to surface
06-42	-	-	-	Bentonite grout to 0.3 m, bentonite seal to surface
06-43	5.7 – 4.0	284.2 - 285.9	Silty sand	Bentonite seal to 3.7 m, grout to 0.3 m, bentonite to surface
06-44	-	-	-	Bentonite grout to 0.3 m, bentonite seal to surface
06-45	-	-	-	Bentonite grout to 0.3 m, bentonite seal to surface
06-46	5.0 – 2.7	290.3 - 292.6	Sandy silty clay till, silty sand till	Bentonite seal to 2.1 m, grout to surface
06-64	9.1 – 7.0	275.5 – 277.6	Sand	Bentonite seal to 6.6 m, grout to 0.3 m, bentonite to surface
06-73	5.9 – 3.8	279.2 – 281.3	Silt and sand till	Bentonite grout to ground surface

Appendix D

Drawings

Borehole Locations and Soil Strata

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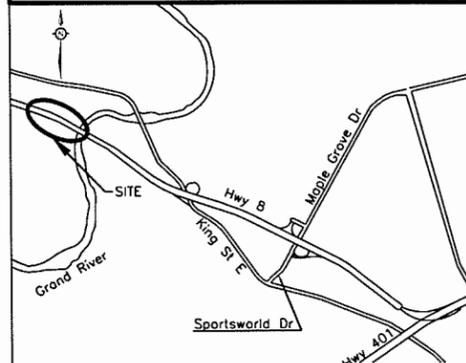


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CONT No
 GWP No.277-97-00

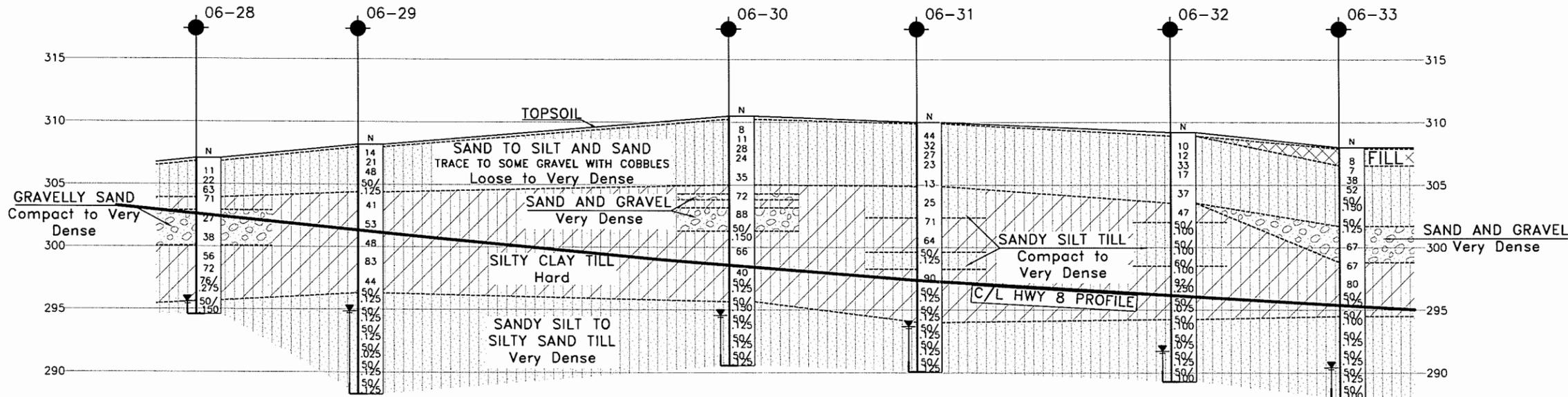
DEEP CUT
 HWY 8 WIDENING
 KITCHENER
 BOREHOLE LOCATIONS AND SOIL STRATA

SHEET



**KEYPLAN
 LEGEND**

- Borehole
- ⊙ Borehole and Cone
- N Blows /0.3m (Std Pen Test, 475J/blow)
- CONE Blows /0.3m (60' Cone, 475J/blow)
- PH Pressure, Hydraulic
- ⊕ Water Level
- ⊕ Head Artesian Water
- ⊕ Piezometer
- 90% Rock Quality Designation (RQD)
- A/R Auger Refusal



NO	ELEVATION	NORTHING	EASTING
06-28	307.1	4 809 498.2	230 248.8
06-29	308.2	4 809 480.4	230 275.7
06-30	310.5	4 809 440.1	230 337.9
06-31	310.0	4 809 416.0	230 366.9
06-32	309.2	4 809 393.0	230 412.3
06-33	308.0	4 809 377.7	230 442.3

-NOTES-

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

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

GEOCREs No. 40P8-148



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 DATE: JUN 26, 2007
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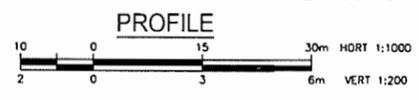
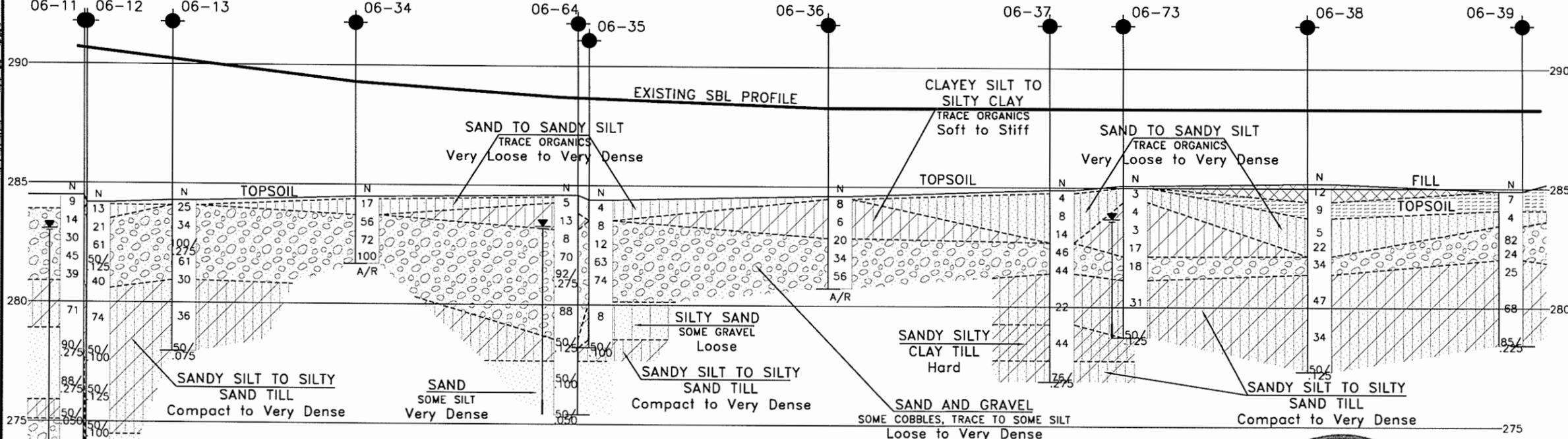
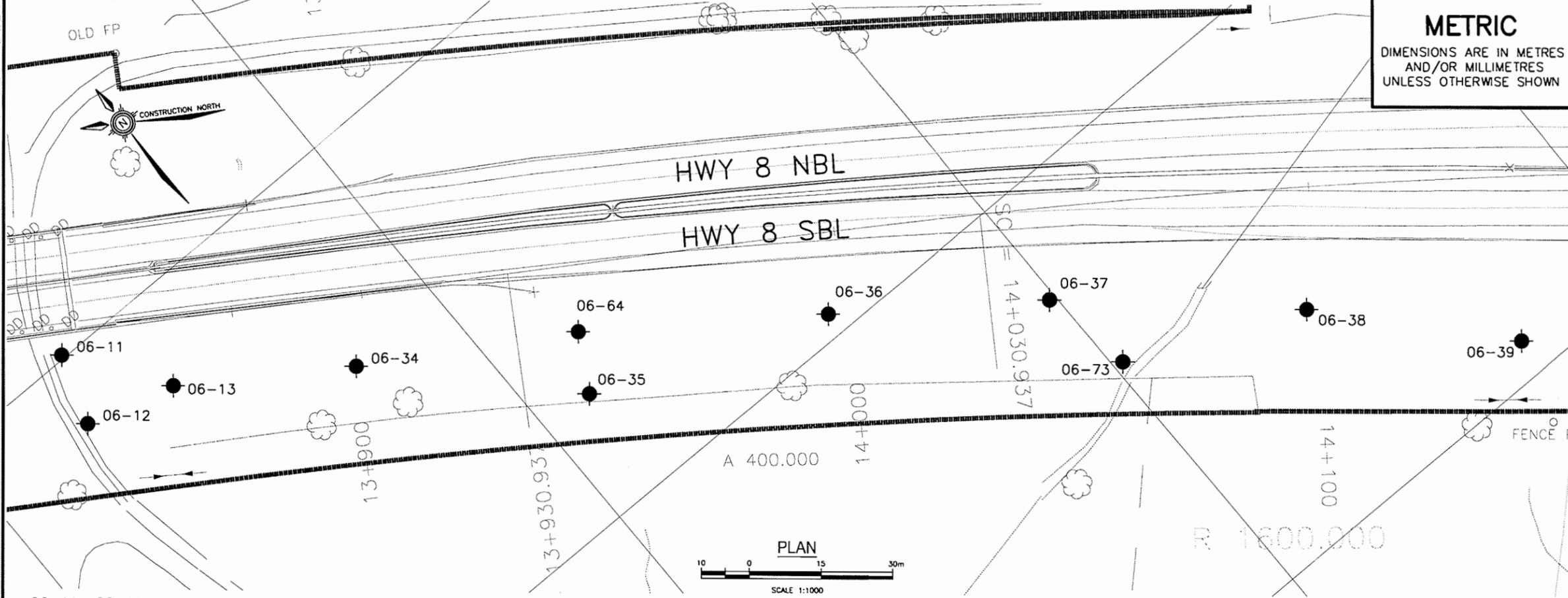
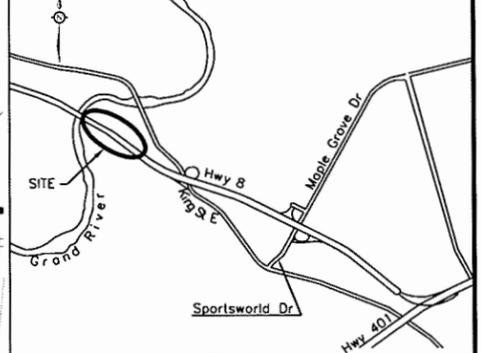
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 GWP No 277-97-00
 HIGH FILL
 HWY 8 WIDENING
 STA. 13+859 TO 14+150
 BOREHOLE LOCATIONS AND SOIL STRATA



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LEGEND

- BoreHole
- ⊕ BoreHole and Cone
- ⊗ BoreHole from Previous Investigation (Approximate)
- N Blows /0.3m (Std Pen Test, 475J/blow)
- CONE Blows /0.3m (60' Cone, 475J/blow)
- PH Pressure, Hydraulic
- ↕ Water Level
- ↕ Head Artesian Water
- ↕ Piezometer
- 90% Rock Quality Designation (RQD)
- A/R Auger Refusal

NO	ELEVATION	NORTHING	EASTING
06-11	284.5	4 809 300.8	230 631.3
06-12	284.2	4 809 286.2	230 626.4
06-13	284.3	4 809 280.9	230 645.4
06-34	284.5	4 809 259.4	230 677.7
06-35	284.4	4 809 223.9	230 711.7
06-36	284.8	4 809 204.8	230 761.0
06-37	284.9	4 809 177.3	230 798.6
06-38	285.2	4 809 141.3	230 838.7
06-39	284.9	4 809 107.5	230 869.0
06-64	284.6	4 809 235.3	230 718.4
06-73	285.1	4 809 157.6	230 802.1

-NOTES-

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

GEOCREs No. 40P8-148



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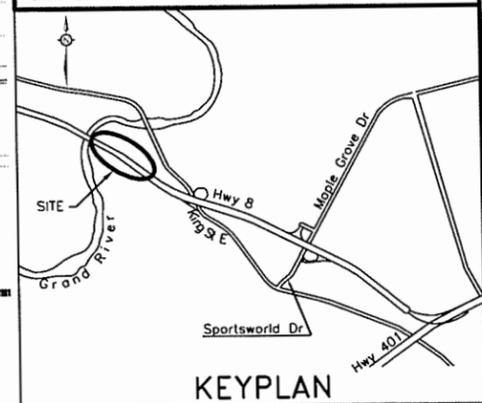
CONT No
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HIGH FILL
 HWY 8 WIDENING
 STA. 14+150 TO 14+500
 BOREHOLE LOCATIONS AND SOIL STRATA

SHEET

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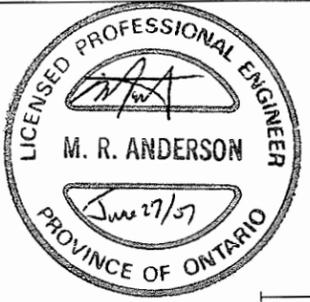
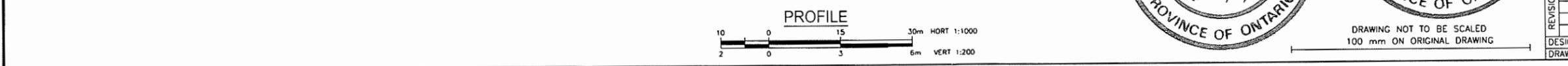
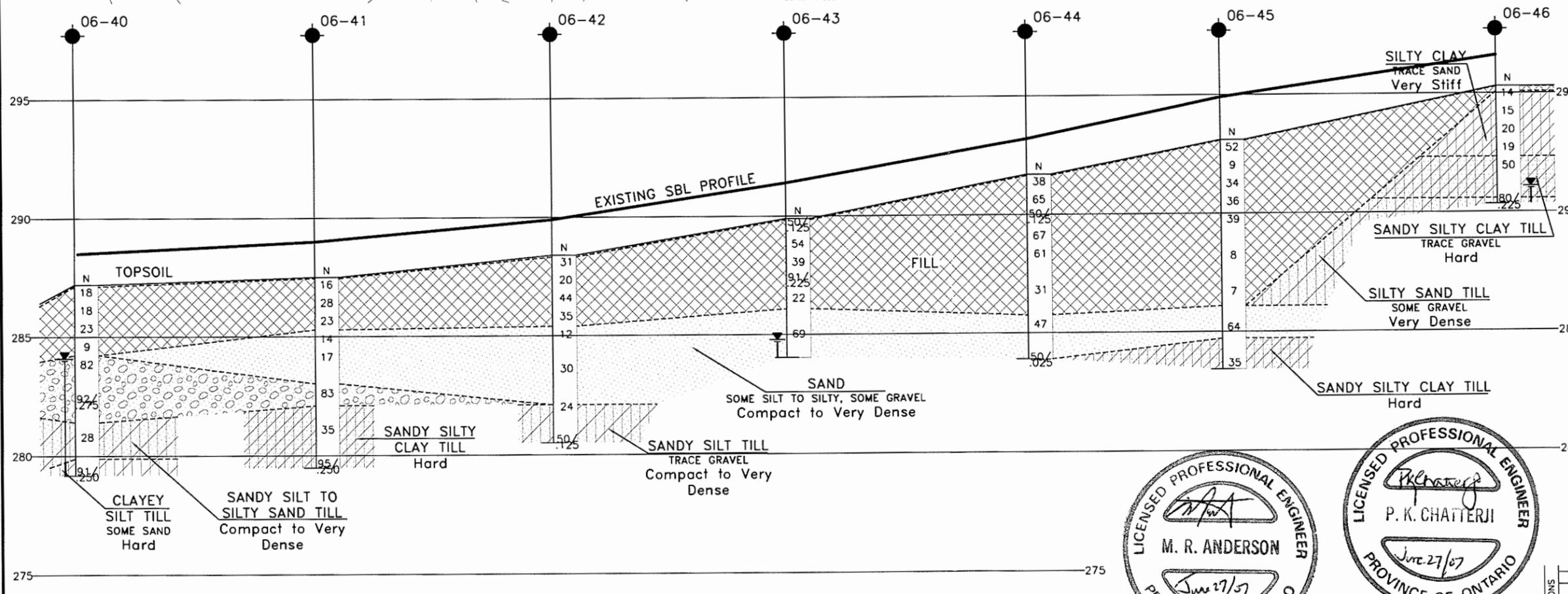
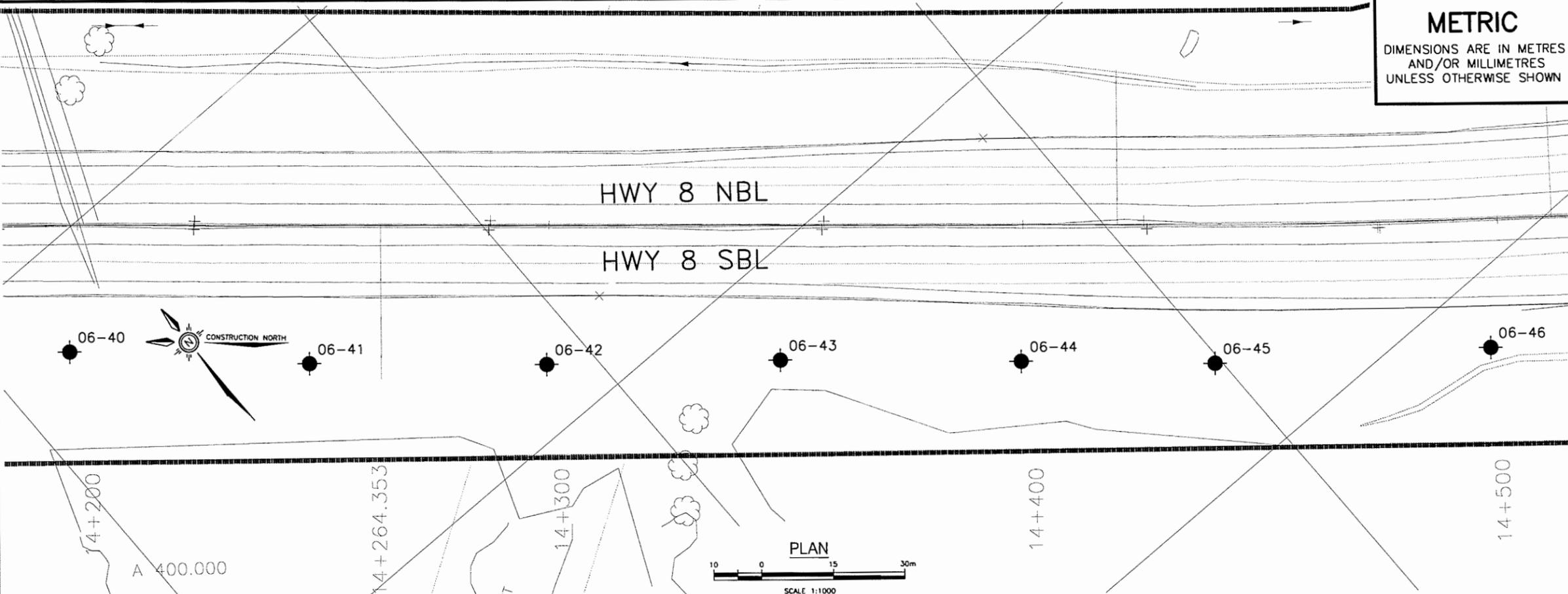
**KEYPLAN
 LEGEND**

- BoreHole
- ⊕ BoreHole and Cone
- ⊖ BoreHole from Previous Investigation (Approximate)
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- ⊖ Piezometer
- 90% Rock Quality Designation (RQD)
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NO	ELEVATION	NORTHING	EASTING
06-40	287.2	4 809 080.1	230 915.9
06-41	287.5	4 809 045.3	230 953.1
06-42	288.4	4 809 012.8	230 991.3
06-43	289.9	4 808 981.6	231 029.5
06-44	291.7	4 808 948.5	231 068.1
06-45	293.1	4 808 921.4	231 098.8
06-46	295.3	4 808 886.6	231 145.2

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

GEOCRES No. 40P8-148



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