

**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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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

C_{pen}


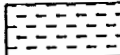


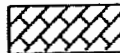
Shear Strength Determination by Pocket Penetrometer

- (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
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*
			(MPa)	(psi)	
Very thickly bedded	Greater than 2m	Extremely Strong	Greater than 250	Greater than 36,000	Specimen can only be chipped with a geological hammer
Thickly bedded	0.6 to 2m				
Medium bedded	0.2 to 0.6m	Very Strong	100-250	15,000 to 36,000	Requires many blows of geological hammer to break
Thinly bedded	60mm to 0.2m				
Very thinly bedded	20 to 60mm	Strong	50-100	7,500 to 15,000	Requires more than one blow of geological hammer to break
Laminated	6 to 20mm				
Thinly Laminated	Less than 6mm	Medium Strong	25.0 to 50.0	3,500 to 7,500	Breaks under single blow of geological hammer.

TERMS		Weak	5.0 to 25.0	750 to 3,500	Can be peeled by a pocket knife with difficulty
Total Core Recovery: (TCR)	Core recovered as a percentage of total core run length.	Very Weak	1.0 to 5.0	150 to 750	Can be peeled by a pocket knife, crumbles under firm blows of geological pick.
Solid Core Recovery: (SCR)	Percent Ratio of solid core of full cylindrical shape recovered. Expressed with respect to the total length of core run.	Extremely Weak (Rock)	0.25 to 1.0	35 to 150	Indented by thumbnail
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				UNIT WEIGHT Y kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
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		
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												
0.6	(FILL)												
	TOPSOIL: (75 mm)												
	SAND and GRAVEL, trace silt, occasional cobbles		2	SS	14								
	Compact to Dense												
	Brown												
	Moist												
			3	SS	30								
			4	SS	45								
			5	SS	39								
280.9													
3.6	SILT and SAND, some clay, trace gravel												
	Very Dense												
	Brown												
	Moist												
	(TILL)												
			6	SS	71								
278.9													
5.6	SAND, trace to some silt, some gravel		7	SS	90/ 275								
	Very dense												
	Grey												
	Moist to wet												
			8	SS	88/ 275								
275.9													
8.6	Silty CLAY, trace sand		9	SS	50/ .050								
	Hard												
	Grey												
	(TILL)												
275.1													
9.4	Gravelly SAND, trace silt												
	Very Dense												
	Grey												

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 kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	20 40 60 80 100					
	Wet													
			10	SS	50/ .075		274							
							273							
			11	SS	70/ 275		272							
							271							
270.5			12	SS	50/ .050									0 93 2 (SI+CL)
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													

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			SHEAR STRENGTH kPa									WATER CONTENT (%)		
								20 40 60 80 100									20 40 60		
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE											
284.2																GR SA SI CL			
0.0	TOPSOIL: (100 mm)																		
0.1	SAND, some silt, trace clay, trace gravel, topsoil stained, trace roots		1	SS	13		284												
283.5	Compact																		
0.7	Dark brown																		
	Moist																		
	(FILL)																		
	SAND AND GRAVEL, some silt		2	SS	21		283												
	Compact to Very Dense																		
	Brown																		
	Moist																		
	Occasional cobbles, wet		3	SS	61		282												
			4	SS	50/ .125		281									47 41 12 (SI+CL)			
			5	SS	40		280												
280.6	Sandy SILT, some clay, trace gravel, occasional cobbles																		
3.6	Very Dense																		
	Grey		6	SS	74		279												
	Moist (TILL)																		
			7	SS	50/ .100		278									3 32 55 11			
			8	SS	50/ .125		277												
			9	SS	50/ .100		276												
							275												

Continued Next Page

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

METRIC

[illegible]

+ 3, × 3: Numbers refer to Sensitivity

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			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL LIMIT MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE		WATER CONTENT (%) w _p w w _L				
284.3							20 40 60 80 100							
0.0	TOPSOIL: (50 mm)													
0.0	GRAVEL: (FILL)													
0.1	TOPSOIL: (75 mm)		1	SS	25									
0.2	SAND and GRAVEL, trace silt Compact to Very Dense Brown Moist													
			2	SS	34									
			3	SS	100/ .275									
			4	SS	61									
281.0			5	SS	30									
3.4	SILT and SAND, some clay, trace gravel, occasional cobbles Dense to Very Dense Grey Moist (TILL)													38 55 8 (SI+CL)
			6	SS	36									
278.0			7	SS	50/ .075									
6.3	END OF BOREHOLE AT 6.33 m. BOREHOLE GROUTED WITH BENTONITE TO SURFACE.													

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			UNIT WEIGHT γ KN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
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	
307.1								SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE				
0.0	TOPSOIL: (250mm), black						307					
306.8												
0.3	SILT and SAND, some clay, trace gravel Compact Brown Moist: (TILL)		1	SS	11		306		○			
			2	SS	22		305		○			0 38 48 14
304.8												
2.3	SAND, trace silt, trace gravel Very dense Brown Moist to wet		3	SS	63		305		○			
303.9												
3.1	Silty CLAY, trace sand Hard Brown (TILL)		4	SS	71		304		○			
									○			
302.9							303					
4.2	Gravelly SAND, some silt Compact to Dense Brown Wet		5	SS	27		302		○			33 53 13 (SI+CL)
	Occasional cobbles		6	SS	38		301		○			
300.1												
7.0	Silty CLAY, trace sand, trace gravel Hard Grey (TILL)(CH)		7	SS	56		300		○			
							299					
			8	SS	72		298		○			0 2 35 63

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+ 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			PLASTIC LIMIT W _P	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL																		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	20 40 60 80 100	20 40 60 80 100																							
295.5	11.6		9	SS	76/ 275		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																															

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			SHEAR STRENGTH kPa								WATER CONTENT (%)		
								20 40 60 80 100										
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE										
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													
			3	SS	48													
	becoming sand and gravel		4	SS	50/ .125													
304.4																		
3.8	Silly CLAY, trace sand Hard Grey (TILL)(CI)		5	SS	41													
			6	SS	53													
			7	SS	48													
			8	SS	83													

Continued Next Page

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

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 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 80 100	20 40 60 80 100					
298			9	SS	44									0 2 37 62
296.3														
11.9	SILT and SAND, trace clay, trace gravel Very dense Grey Moist: (TILL)		10	SS	50/ .125									
295			11	SS	50/ .125									2 41 41 16
294														
293			12	SS	50/ .125									
292														
291			13	SS	50/ .025									
290			14	SS	50/ .125									
289														
288.3			15	SS	50/									

Continued Next Page

+ 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	NATURAL MOISTURE CONTENT	LIQUID LIMIT	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa	WATER CONTENT (%)					
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

METRIC

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 CONTENT (%)		
								SHEAR STRENGTH kPa							
								SHEAR STRENGTH kPa							
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										
308.5			2	SS	11							1 39 52 8			
2.0	SAND, trace silt Compact Brown Moist		3	SS	28										
306.5			4	SS	24							0 95 5 (SI+CL)			
4.0	SILT and SAND, trace gravel, trace clay Dense Brown Wet		5	SS	35										
305.0															
5.5	Silty CLAY, trace sand, trace gravel Grey (TILL)														
304.3															
6.2	SAND and GRAVEL, trace silt Very dense Grey Wet		6	SS	72										
303.8															
6.7	Silty CLAY, trace sand, trace gravel Grey (TILL)														
303.2															
7.3	SAND and GRAVEL, trace silt Very dense Grey Wet		7	SS	88							38 56 6 (SI+CL)			
301.3															
9.2	Silty CLAY, trace sand, trace gravel Hard Grey (TILL)(CH)		8	SS	50/ .150										

+ 3, × 3: Numbers refer to Sensitivity

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 (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	20 40 60 80 100					
295.7	SILT and SAND, some clay, trace gravel, occasional cobbles Very dense Grey Moist: (TILL)		9	SS	66									
			10	SS	40									
			11	SS	50/ .125									
			12	SS	50/ .150									
294.8			13	SS	50/ .125									
			14	SS	50/ .125									
290.6			15	SS	50/ .125									

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 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					
19.9	<p>END OF BOREHOLE AT 19.94m. Piezometer installation consists of 25mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen.</p> <p>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</p>				.125									

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 (%)
ELEV. DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	20 40 60 80 100	20 40 60 80 100					
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
302.3															
7.6	Silty CLAY, trace sand, occasional cobbles Hard Grey (TILL)		7	SS	71										
			8	SS	64										

Continued Next Page

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

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 Y kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60					
299.6	Sandy SILT, some clay, trace gravel, occasional cobbles Very dense Grey Moist: (TILL)		9	SS	50/ .125										
10.4															
298.2	Silty CLAY, trace sand, occasional cobbles Hard Grey (TILL)(CH)		10	SS	90										
11.7															
294.0	Silty SAND, some gravel, occasional cobbles Very Dense Grey Moist: (TILL)		11	SS	50/ .125										
16.0															
294.0			12	SS	50/ .125										
294.0			13	SS	50/ .125										
294.0			14	SS	50/ .125										
294.0			15	SS	50/ .125										
290.0															

Continued Next Page

+³, x³: 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 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	WATER CONTENT (%)					
19.9	<p>END OF BOREHOLE AT 19.94m. Piezometer installation consists of 25mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen.</p> <p>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</p>				.125									

ONTMT4S 7938.GPJ 20/03/07

METRIC

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	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 CONTENT (%)	
							20 40 60 80 100 ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE							
309.2 0.0 308.9 0.3	TOPSOIL: (275mm), black 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									
			4	SS	17									
			5	SS	37									
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									

+ 3, × 3: Numbers refer to Sensitivity

CONTMT4S 7938.GPJ 20/03/07

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 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			20 40 60 80 100	20 40 60 80 100	W _P W W _L	20 40 60			
298.5	Silty CLAY, trace sand Hard Grey (TILL)(CI)		9	SS	60/ .100									
			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									6 27 53 14
289.3			15	SS	50/									

Continued Next Page

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

METRIC

[illegible]

RECORD OF BOREHOLE No 06-33

1 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 (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa							
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE							
								20 40 60 80 100 20 40 60 80 100							
308.0															
0.0	TOPSOIL: (100mm), black														
0.1	SAND, trace gravel, trace wood fragments Loose Brown Moist: (FILL)		1	SS	8										
306.6															
1.4	SAND, some gravel, trace silt Loose to Very Dense Brown Moist		2	SS	7										
			3	SS	38										
			4	SS	52										
			5	SS	50/ .150										
	Occasional cobbles														

Continued Next Page

+ 3 × 3: Numbers refer to
Sensitivity 20
15 5
10 (%) 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 (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE	20 40 60 80 100	20 40 60					
298	Occasional cobbles		9	SS	80									0 2 40 58	
297															
296			10	SS	50/ .125										
294.5	SILT and SAND, some clay, trace gravel, occasional cobbles, occasional sand layers Very dense Grey Moist: (TILL)		11	SS	50/ .100										
294															
293			12	SS	50/ .125									4 38 43 15	
292															
291			13	SS	50/ .125										
290			14	SS	50/ .125										
289			15	SS	50/ .125										

Continued Next Page

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

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 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 (%)	
288.0						100	288	20	40	60	80	100	20	40	60	kN/m ³	GR SA SI CL
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																

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					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE						
284.5								20	40	60	80	100		
0.0	TOPSOIL: (100 mm)													
0.1	SAND, some gravel Compact Brown Moist		1	SS	17		284						○	
283.7														
0.8	SAND and GRAVEL, some silt Very Dense Brown Moist		2	SS	56		283						○	
			3	SS	72								○	
			4	SS	100		282						○	
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.													

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 NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa		WATER CONTENT (%)				
284.4								20 40 60 80 100						
0.0	TOPSOIL: (125 mm)							20 40 60 80 100						
0.1	SAND, some silt Loose Dark Brown Wet		1	SS	4		284							
283.5														
0.9	SAND and GRAVEL, trace silt, occasional cobbles Loose to Compact Brown Moist		2	SS	8		283							
			3	SS	12									
	Becoming Very Dense occasional boulders		4	SS	63		282							
	Becoming Grey		5	SS	74		281							49 43 8 (SI+CL)
280.1														
4.3	Silty SAND, some gravel Loose Grey Wet		6	SS	8		280							
278.8							279							
5.6	Silty SAND, some gravel Very Dense Grey Wet													
278.2	(TILL)		7	SS	50/									
6.2	END OF BOREHOLE AT 6.20 m. BOREHOLE GROUTED WITH BENTONITE TO SURFACE.				.100									

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				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					
284.8								20 40 60 80 100					
0.0	TOPSOIL: (125 mm)							○ UNCONFINED + FIELD VANE					
0.1	Clayey SILT, trace organics Firm Brown to Dark Brown		1	SS	8		284	● QUICK TRIAXIAL × LAB VANE					
			2	SS	6								
283.0			3	SS	20		283						
1.8	SAND and GRAVEL, some silt, occasional cobbles Compact to Very Dense Brown Wet		4	SS	34		282						
			5	SS	56								
280.9							281						47 38 15 (SI+CL)
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.												

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

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	20 40 60 80 100	20 40 60 80 100		
284.9							285					
0.0	TOPSOIL: (125 mm)											
0.1	SAND, some gravel, trace silt, trace organics Loose to Compact Brown to Dark Brown Moist		1	SS	4							
			2	SS	8		284					
			3	SS	14		283					
282.7												
2.2	SAND and GRAVEL, some silt, occasional cobbles Dense Brown Wet		4	SS	46		282					59 30 11 (SI+CL)
			5	SS	44							
281.4												
3.5	Sandy SILT, trace clay, trace gravel Compact Brown Moist (TILL)		6	SS	22		281					
							280					
279.3												
5.6	Sandy, Silty CLAY Hard Grey (TILL)(CL)		7	SS	44		279					0 31 47 20
							278					
277.8												
7.2	Sandy SILT, trace clay, trace gravel, occasional cobbles Very dense Grey Moist (TILL)		8	SS	76/ 275		277					
276.9												
8.1	END OF BOREHOLE AT 8.05 m. BOREHOLE GROUTED WITH BENTONITE TO SURFACE.											

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			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
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	
285.2 0.0	TOPSOIL: (125mm)											
0.1	SAND, trace silt and gravel Compact Brown Moist		1	SS	12		285					
284.4 0.8	(FILL) TOPSOIL, mixed with clayey silt Stiff Dark Brown		2	SS	9		284					
283.7 1.4	Sandy SILT, some topsoil Loose to Compact Brown Moist		3	SS	5		283					
			4	SS	22							
282.1 3.0	SAND and GRAVEL, trace silt Dense Brown Moist		5	SS	34		282					
281.4 3.8	SILT AND SAND, trace clay, trace gravel, occasional cobbles Dense to Very Dense Grey Moist (TILL)		6	SS	47		281					
			7	SS	34		280					
							279					
							278					
277.3 7.9	END OF BOREHOLE AT 7.90 m BOREHOLE GROUTED WITH BENTONITE TO SURFACE		8	SS	50/ .125							

+ ³ , × ³ : Numbers refer to Sensitivity 20 15 10 5 (%) 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			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE				
284.9							20 40 60 80 100	20 40 60				
0.0	TOPSOIL, some roots Loose Black Moist		1	SS	7							
284.1												
0.8	Sandy SILT Loose Dark Brown Moist		2	SS	4		284					
283.5												
1.4	SAND and GRAVEL, some silt, occasional cobbles Very Dense to Compact Brown Wet		3	SS	82		283					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		282					
							281					
			6	SS	68		280					3 32 53 7
			7	SS	85/ 225		279					
278.4												
6.5	END OF BOREHOLE AT 6.48 m. BOREHOLE GROUTED WITH BENTONITE TO SURFACE.											

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			SHEAR STRENGTH kPa						
287.2							20 40 60 80 100						
0.0	TOPSOIL: (75 mm)						○ UNCONFINED + FIELD VANE						
0.1	SAND, some silt, trace gravel Compact to Loose Brown Moist (FILL)	1	SS	18		287	● QUICK TRIAXIAL × LAB VANE						
	Occasional cobbles	2	SS	18		286							
		3	SS	23		285							
		4	SS	9									
284.2													
3.0	SAND and GRAVEL, trace silt, occasional cobbles Very dense Brown Moist to wet	5	SS	82		284							
		6	SS	92/ 275		283							42 49 9 (SI+CL)
						282							
281.4													
5.8	Sandy SILT, trace gravel Compact Grey Moist (TILL)	7	SS	28		281							
						280							
279.9													
7.3	Clayey SILT, some sand, trace gravel Hard Grey Moist (TILL)	8	SS	91/ 250									0 18 64 16
279.2													
8.0	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

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			SHEAR STRENGTH kPa								
								20 40 60 80 100								
								20 40 60 80 100								
287.5																
0.0 0.1	TOPSOIL: (50 mm) SAND, trace silt Compact Brown Moist (FILL)		1	SS	16											
	trace gravel		2	SS	28											
	occasional cobbles		3	SS	23											
285.3																
2.2	SAND, some gravel, some silt, occasional cobbles Compact Brown Moist		4	SS	14											
			5	SS	17											
282.9																
4.6	SAND and GRAVEL, some silt, occasional cobbles Very Dense Grey Moist		6	SS	83										42 41 17 (SI+CL)	
282.1																
5.4	Sandy, Silty CLAY Hard Grey (TILL)(CL)		7	SS	35										1 31 48 20	
	occasional cobbles		8	SS	95/ 250											
279.4																
8.0	END OF BOREHOLE AT 8.03 m. BOREHOLE GROUTED WITH BENTONITE TO SURFACE.															

+ 3, x 3: Numbers refer to
Sensitivity 20
15 5
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					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100		
288.4														
0.0	TOPSOIL: (75 mm)													
0.1	Gravelly SAND, some silt Dense to Compact Brown Moist (FILL)		1	SS	31		288							
			2	SS	20		287							
			3	SS	44		286							32 51 17 (SI+CL)
			4	SS	35		285							
285.4														
3.0	Silty SAND, some gravel Compact to Dense Brown Moist to wet		5	SS	12		284							
			6	SS	30		283							21 55 24 (SI+CL)
							282							
			7	SS	24		281							
282.1														
6.3	Sandy SILT, trace gravel Compact to Very Dense Grey Moist (TILL)													
			8	SS	50/									
280.5														
7.9	END OF BOREHOLE AT 7.90 m. BOREHOLE GROUTED WITH BENTONITE TO SURFACE.				.125									

+ ³, × ³: 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 w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE								
289.9								20	40	60	80	100				
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											
			5	SS	22											
286.1																
3.8	Silty SAND , some gravel, occasional cobbles Very dense Brown to grey Moist		6	SS	69											
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															

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				UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						WATER CONTENT (%)		
291.7																
0.0 0.1	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			6	SS	31											
4.6	Sandy SILT, trace gravel, trace clay, occasional cobbles Dense Grey Moist (FILL)															
285.7			7	SS	47											
5.9	Silty SAND, some gravel Dense to Very Dense Brown with topsoil staining Moist															
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

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 NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					WATER CONTENT (%)				
								○ UNCONFINED + FIELD VANE					w _p w w _L				
								● QUICK TRIAXIAL × LAB VANE									
293.1							20	40	60	80	100	20	40	60			
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									○			
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									P-H			
283.4																	
9.7	END OF BOREHOLE AT 9.68 m. BOREHOLE GROUTED WITH																

ONTMT4S 7938.GPJ 2003/07

Continued Next Page

+³ ×³: Numbers refer to
Sensitivity

20
15 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 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	20 40 60 80 100	W _P W W _L	20 40 60						
	BENTONITE TO SURFACE.																

ONTMT4S 7938 GPJ 20/03/07

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	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa								WATER CONTENT (%)		
								20 40 60 80 100	○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE							W P W W L		
295.3	TOPSOIL: (25 mm)							20 40 60 80 100										
0.0	SAND, trace silt Compact Brown Moist (FILL)		1	SS	14		295											
0.2	Silty CLAY, trace sand Very stiff Brown (CH)		2	SS	15		294											
			3	SS	20										0 2 35 64			
	Becoming Grey		4	SS	19		293											
292.4							292											
3.0	Sandy, Silty CLAY, trace gravel, occasional cobbles Hard Grey (TILL)		5	SS	50		291											
290.6																		
4.7																		
290.4	Silty SAND, some gravel, occasional cobbles Very dense Grey Moist (TILL)		6	SS	80/ 225										17 54 28			
5.0															(SI+CL)			
	END OF BOREHOLE AT 4.95 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 4.28 291.04																	



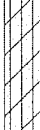

+ 3 . × 3 : Numbers refer to
Sensitivity 20
15 5
10 (%) STRAIN AT FAILURE

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 NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa		WATER CONTENT (%)				
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE	W _P W W _L					
284.6								20 40 60 80 100						
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									
			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									
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.		9	SS	50/ .050									

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 06-64

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					PLASTIC NATURAL LIQUID LIMIT MOISTURE LIMIT CONTENT			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	20 40 60 80 100	W _P W W _L	20 40 60																							
<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>11.08.06</td> <td>1.34</td> <td>283.24</td> </tr> <tr> <td>14.08.06</td> <td>1.47</td> <td>283.11</td> </tr> <tr> <td>15.08.06</td> <td>1.48</td> <td>283.10</td> </tr> <tr> <td>16.08.06</td> <td>1.49</td> <td>283.09</td> </tr> <tr> <td>29.09.06</td> <td>1.39</td> <td>283.19</td> </tr> </tbody> </table>																	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
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

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			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	PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w		
285.1												
0.0	TOPSOIL: (150 mm)											
0.1	SAND, trace organics		1	SS	3		285					
	Very Loose											
284.4	Dark Brown											
	Moist											
0.7	Clayey SILT, some sand, trace organics		2	SS	4		284					
	Soft											
	Dark Brown											
	Becoming Very Stiff		3	SS	3		283					
			4	SS	17							
282.2							282					
3.0	SAND and GRAVEL, some silt, occasional cobbles		5	SS	18							
	Compact											
	Brown											
	Wet											
281.2							281					
4.0	SILT and SAND, trace clay, trace gravel											
	Dense to Very Dense											
	Brown to Grey		6	SS	31		280					
	Moist (TILL)											
278.7			7	SS	50/		279					
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.				.125							
	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 7938.GPJ 20/03/07

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 B1

SAND TO SILT AND SAND

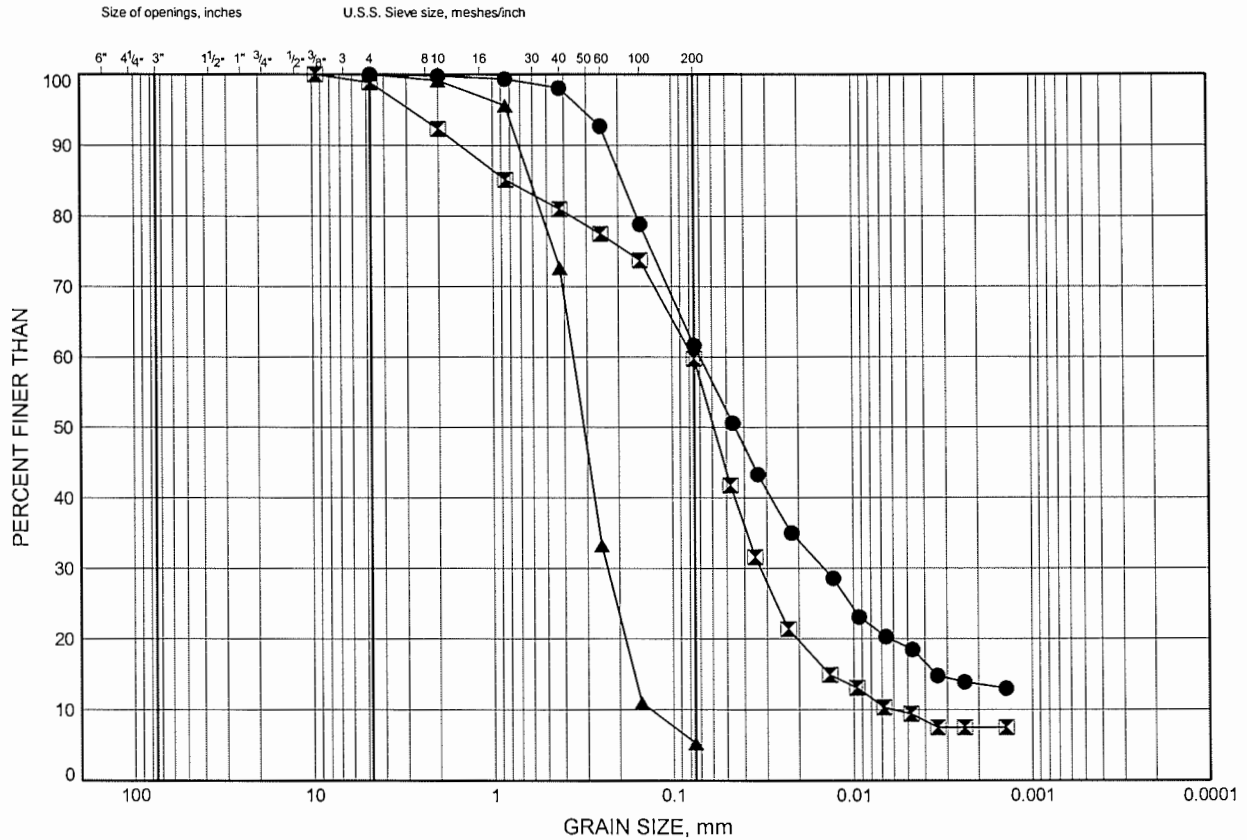


FIGURE B2

Size of openings, inches

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

PERCENT FINER THAN

GRAIN SIZE, mm

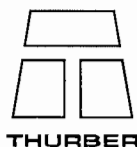
Grain Size (mm)	Percent Finer (%) - Curve 1 (Circles)	Percent Finer (%) - Curve 2 (Triangles)	Percent Finer (%) - Curve 3 (Squares)	Percent Finer (%) - Curve 4 (Crosses)
100	100	100	100	100
10	100	100	100	91
1	100	100	100	63
0.5	100	100	100	52
0.25	100	66	100	33
0.15	100	23	76	15
0.1	99	13	24	8
0.075	87	-	-	-
0.06	57	-	-	-
0.045	41	-	-	-
0.03	25	-	-	-
0.02	15	-	-	-
0.015	13	-	-	-
0.012	13	-	-	-
0.01	9	-	-	-
0.0075	8	-	-	-
0.006	6	-	-	-
0.0045	4	-	-	-

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

SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	06-31	3.35	306.60
☒	06-32	2.59	306.62
▲	06-32	4.88	304.33
★	06-33	3.35	304.67

Date January 2007.....
Project 277-97-00.....

Prep'd MFA
Chkd. MRA

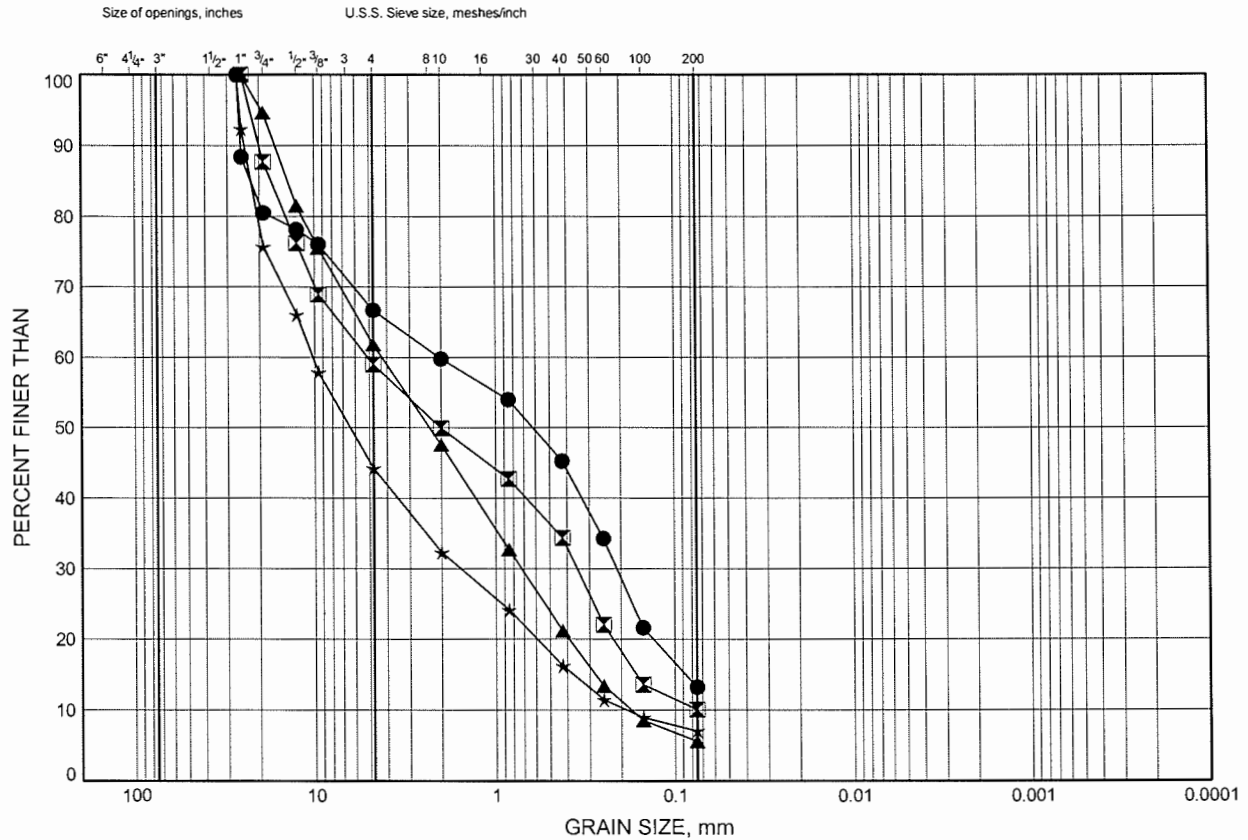


Highway 8 Widening Over Grand River

GRAIN SIZE DISTRIBUTION

FIGURE B3

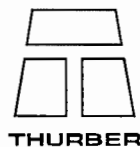
SAND AND GRAVEL TO GRAVELLY SAND



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

SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	06-28	4.88	302.21
⊠	06-29	2.59	305.60
▲	06-30	7.85	302.66
★	06-33	7.92	300.10

Date January 2007
Project 277-97-00

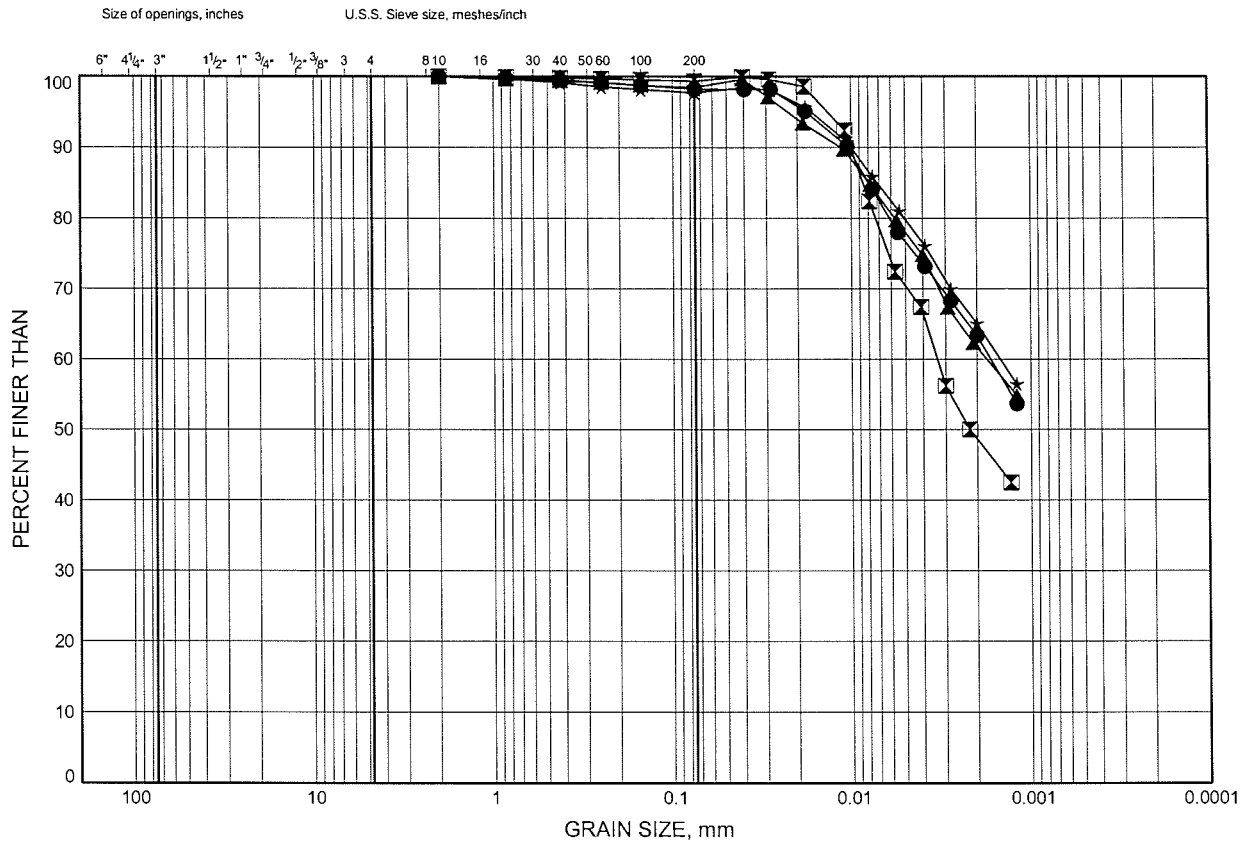


Prep'd MFA
Chkd. MRA

Highway 8 Widening Over Grand River GRAIN SIZE DISTRIBUTION

FIGURE B4

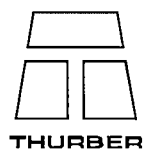
SILTY CLAY TILL



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

Date January 2007
Project 277-97-00



Prep'd MFA
Chkd. MRA

Highway 8 Widening Over Grand River GRAIN SIZE DISTRIBUTION

FIGURE B5

SILTY CLAY TILL

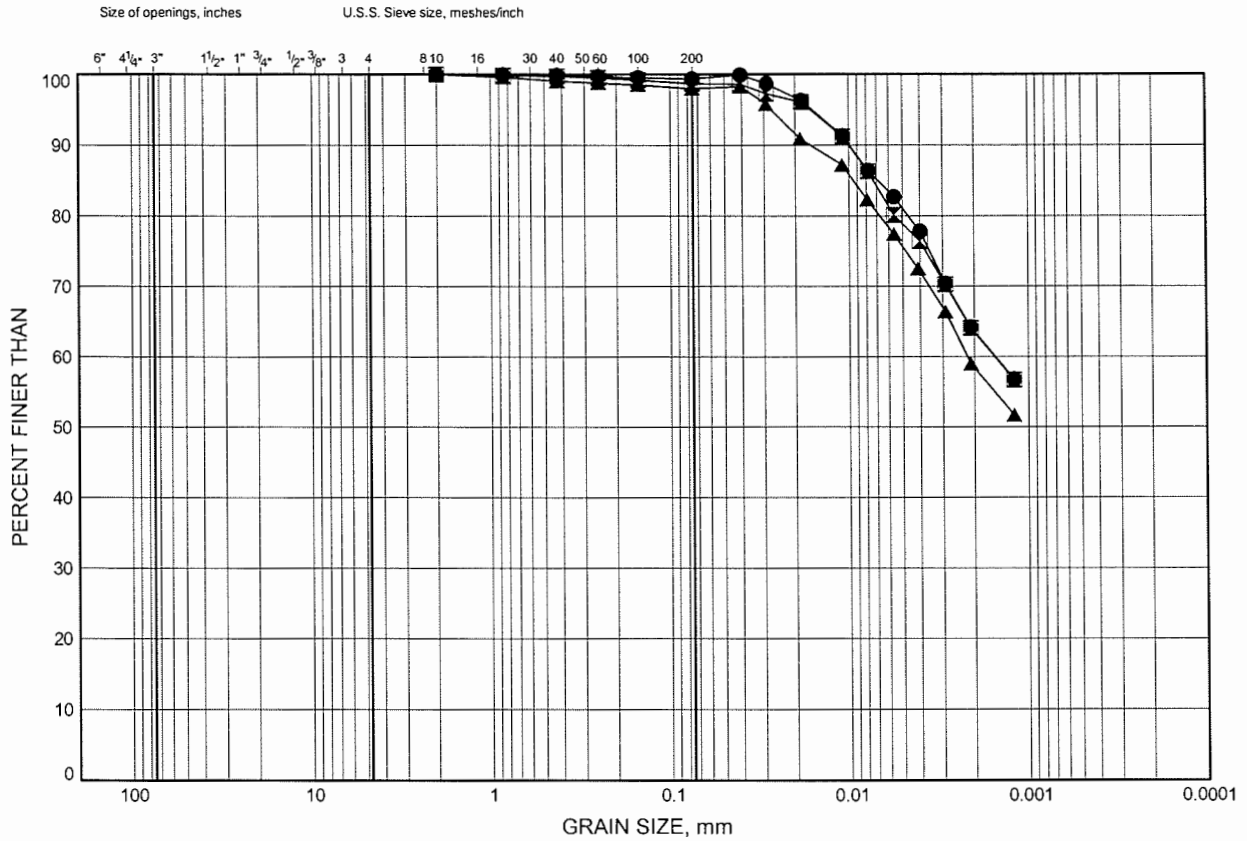


FIGURE B6

Figure 1 is a graph showing the relationship between Grain Size (mm) on the x-axis and Percent Finer Than on the y-axis. The x-axis is logarithmic, ranging from 100 mm to 0.001 mm. The y-axis is linear, ranging from 0 to 100. The graph includes multiple curves representing different sieve sizes, plotted on a semi-logarithmic scale. The curves show that as grain size decreases, the percent finer than increases, approaching 100% for very fine grains.

The x-axis is labeled "GRAIN SIZE, mm" and has major ticks at 100, 10, 1, 0.1, 0.01, 0.001, and 0.0001. The y-axis is labeled "PERCENT FINER THAN" and has major ticks at 0, 10, 20, 30, 40, 50, 60, 70, 80, 90, and 100.

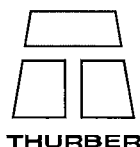
The graph includes multiple curves representing different sieve sizes, plotted on a semi-logarithmic scale. The curves show that as grain size decreases, the percent finer than increases, approaching 100% for very fine grains.

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

Date January 2007
Project 277-97-00

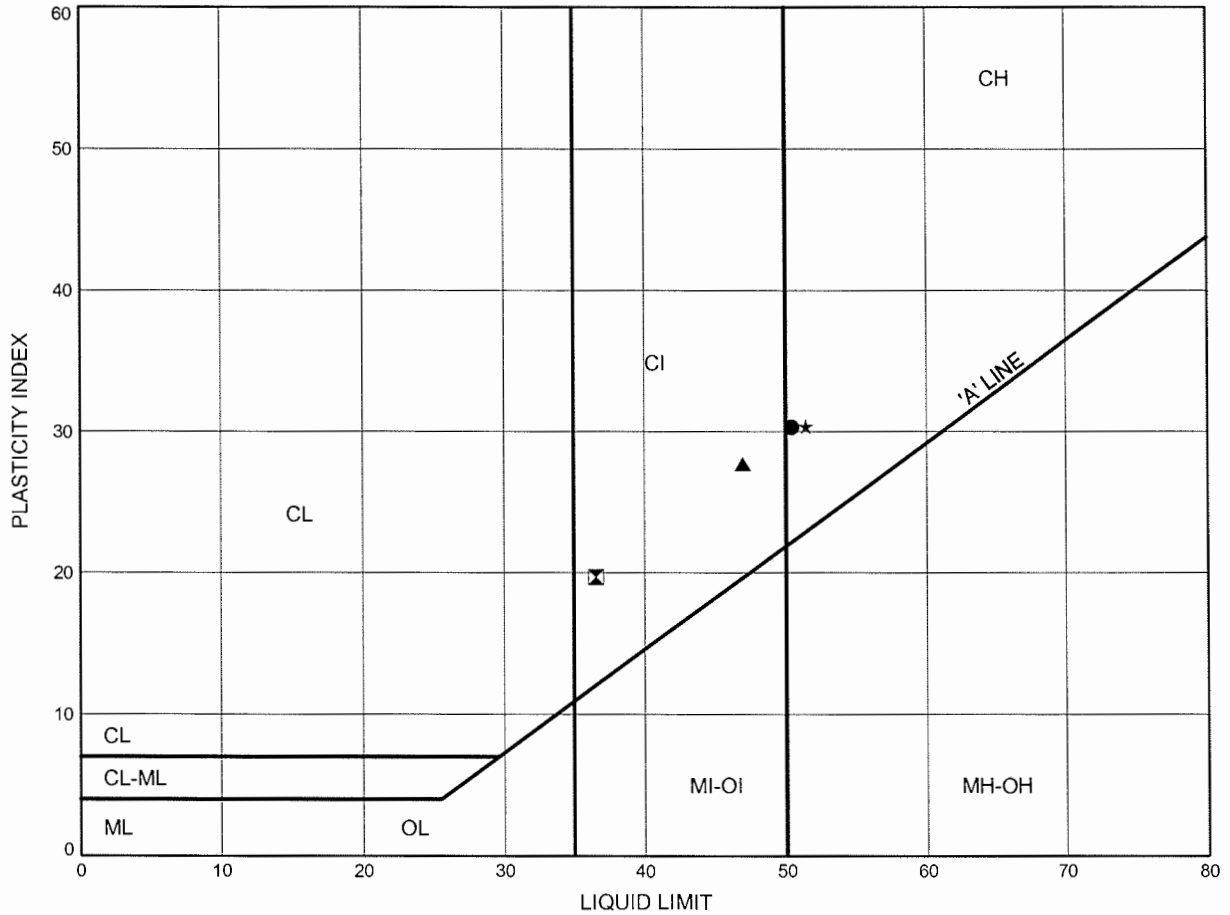
Prep'd MFA
Chkd. MRA



Highway 8 Widening Over Grand River ATTERBERG LIMITS TEST RESULTS

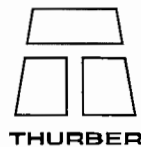
FIGURE B7

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

Date January 2007
Project 277-97-00

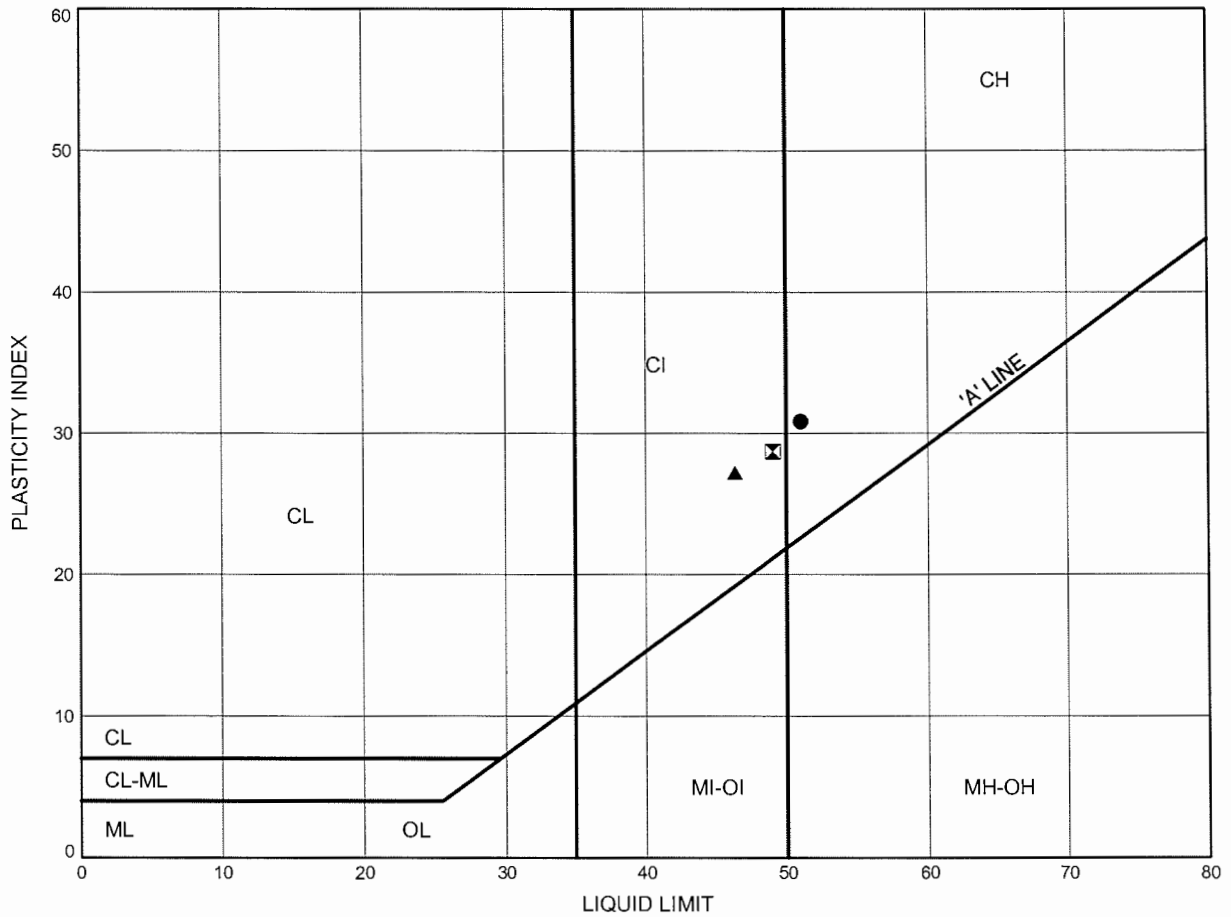


Prep'd MFA
Chkd. MRA

Highway 8 Widening Over Grand River ATTERBERG LIMITS TEST RESULTS

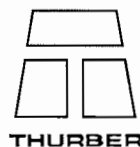
FIGURE B8

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

Date January 2007
 Project 277-97-00



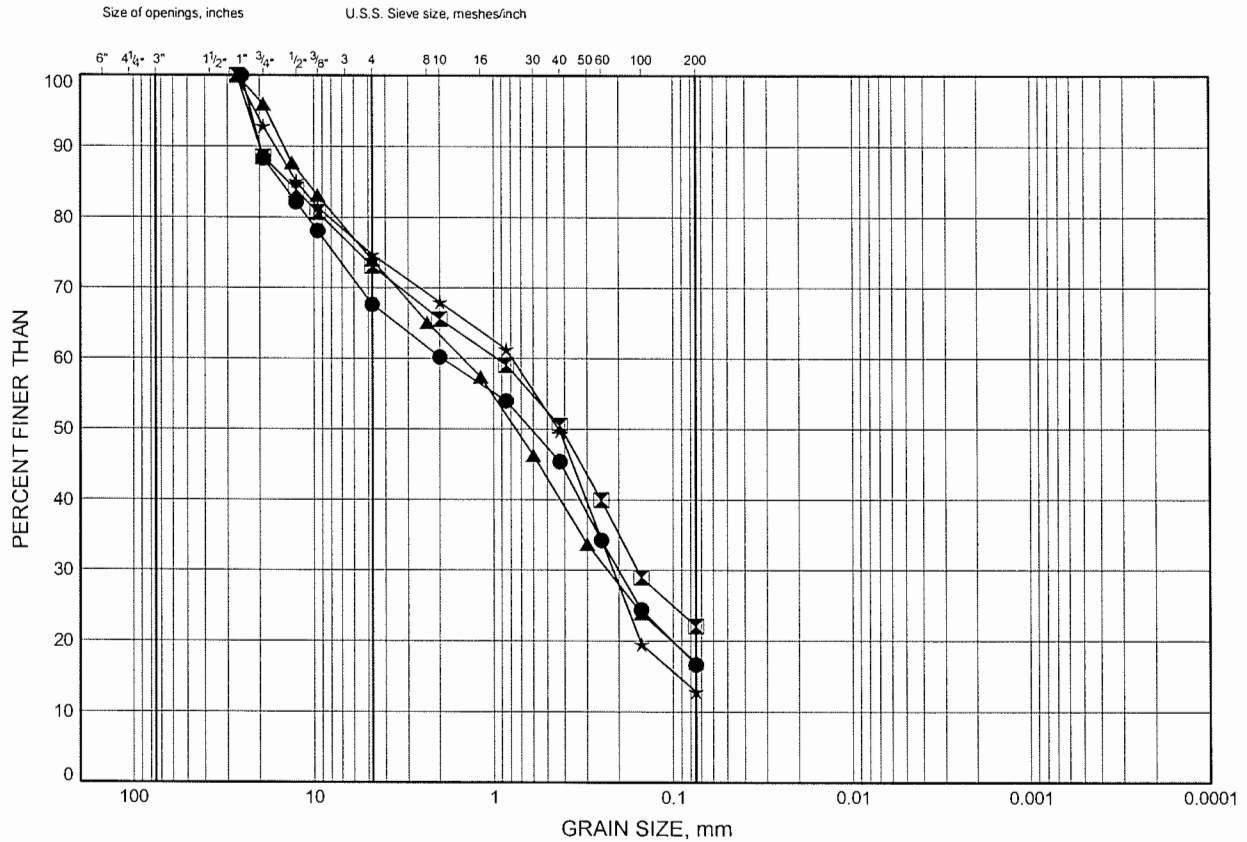
Prep'd MFA
 Chkd. MRA

Highway 8 Widening Over Grand River

GRAIN SIZE DISTRIBUTION

FIGURE B9

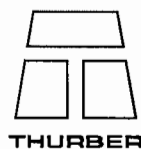
SAND FILL



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

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Project 277-97-00



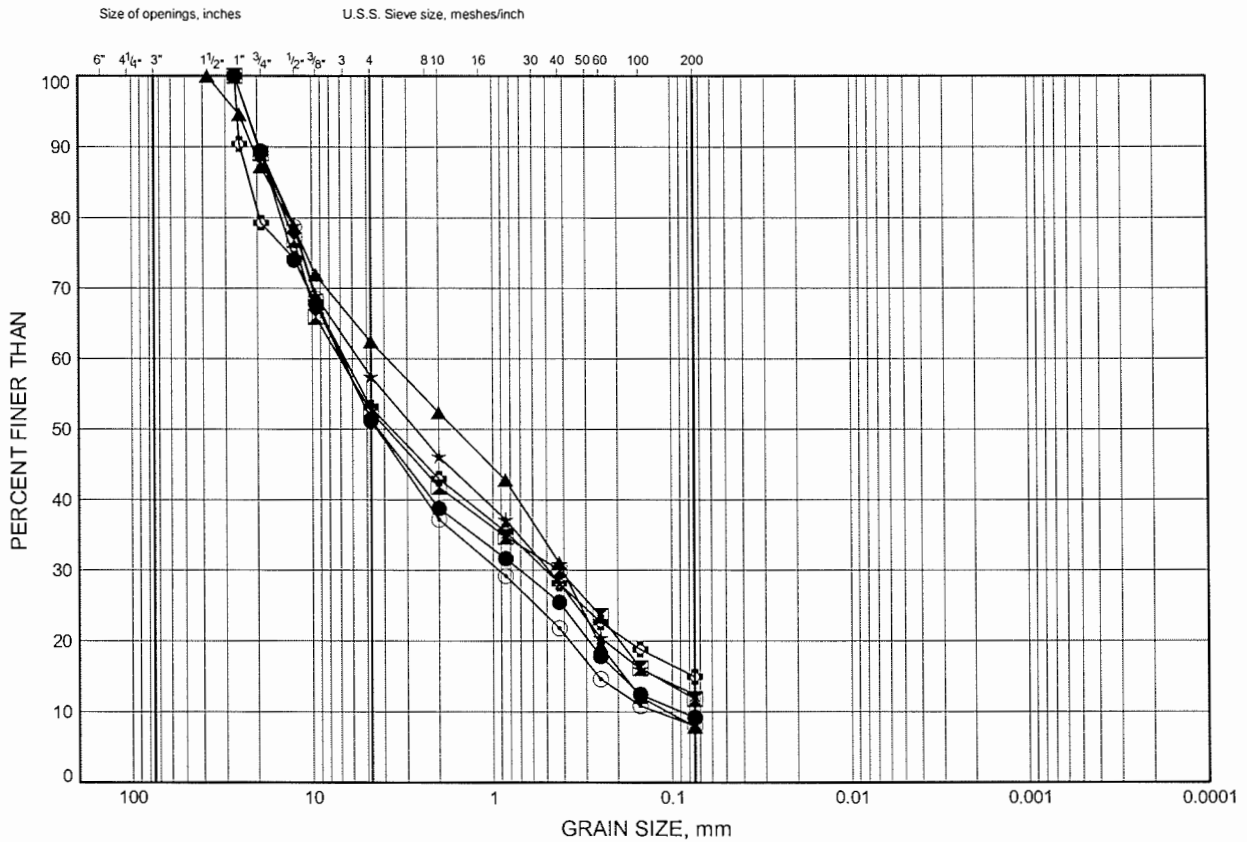
Prep'd JHL
Chkd. MRA

Highway 8 Widening Over Grand River

GRAIN SIZE DISTRIBUTION

FIGURE B10

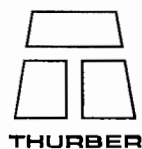
SAND AND GRAVEL



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

Date February 2007
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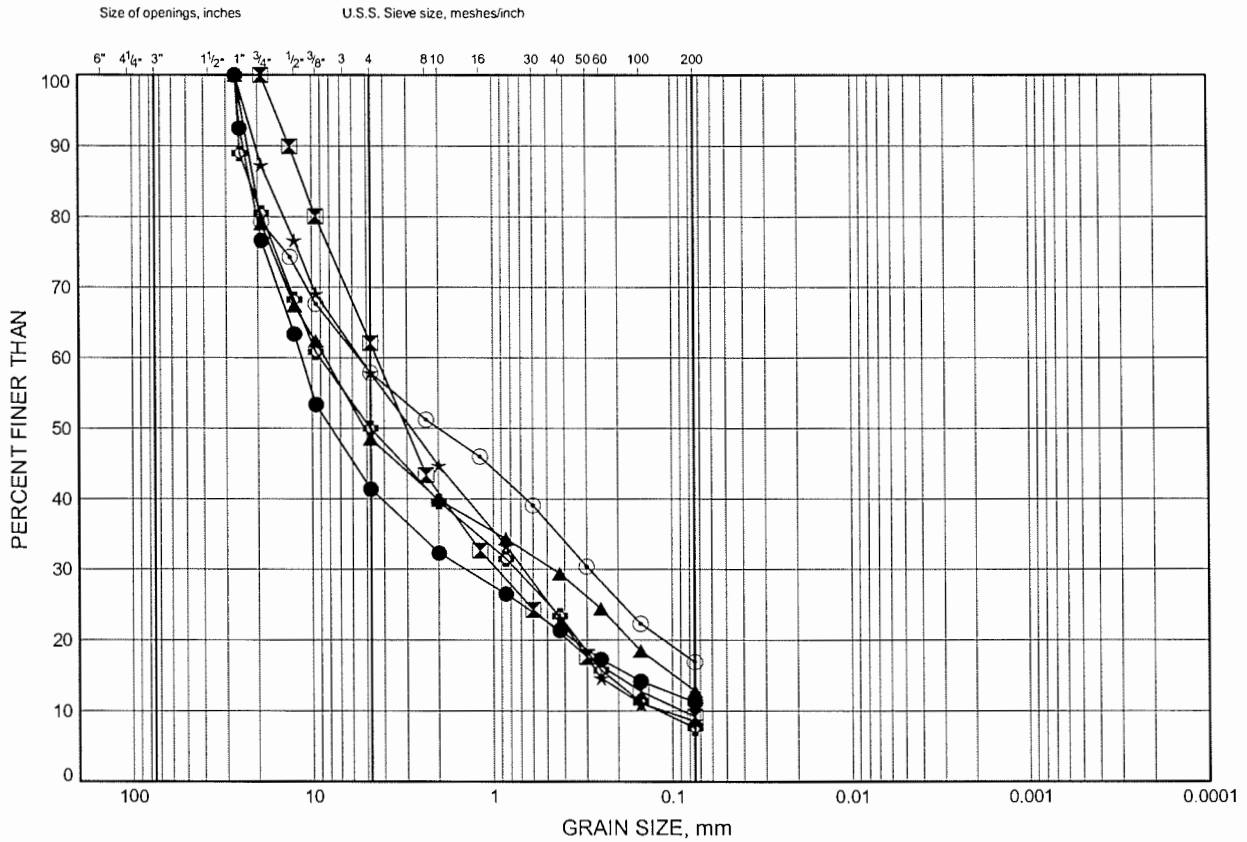
Prep'd JHL
Chkd. MRA

Highway 8 Widening Over Grand River

GRAIN SIZE DISTRIBUTION

FIGURE B11

SAND AND GRAVEL

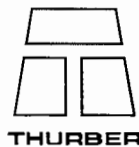


COBBLE SIZE	COARSE	FINE	COARSE	MEDIUM	FINE	SILT and CLAY
	GRAVEL		SAND			FINE GRAINED

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

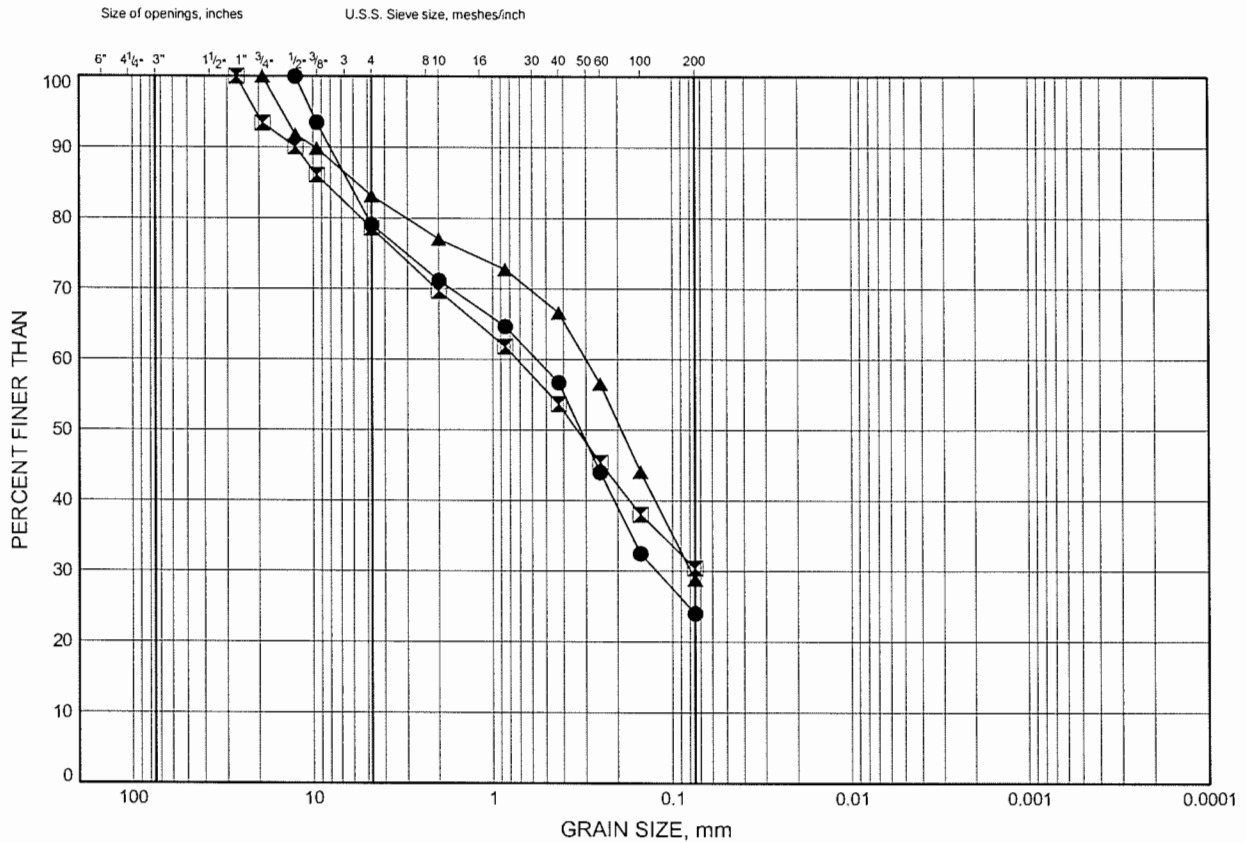
Chkd. MRA

Highway 8 Widening Over Grand River

GRAIN SIZE DISTRIBUTION

FIGURE B12

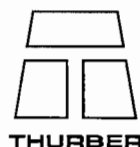
SAND TO SILTY SAND



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

SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	06-42	4.80	283.59
⊠	06-43	4.88	285.01
▲	06-44	6.32	285.36

Date February 2007
Project 277-97-00

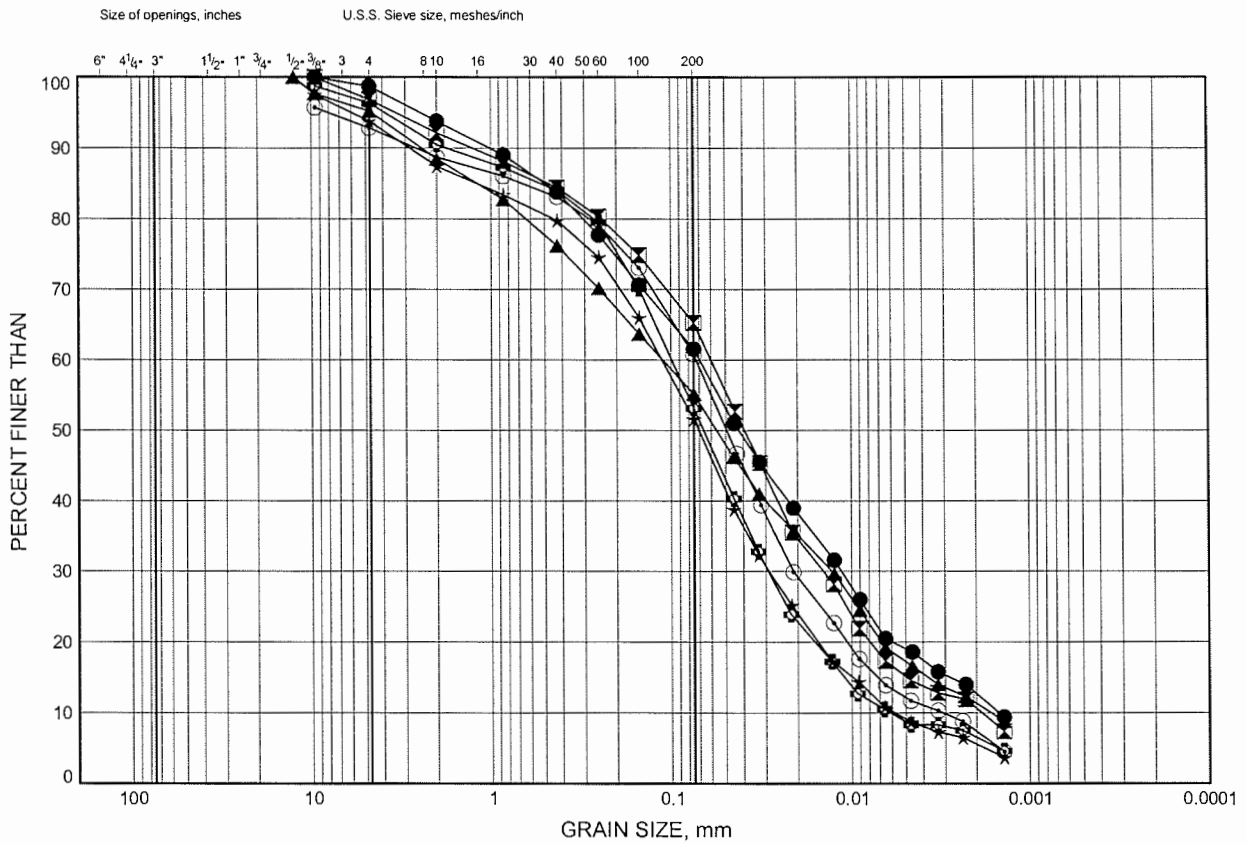


Prep'd JHL
Chkd. MRA

Highway 8 Widening Over Grand River GRAIN SIZE DISTRIBUTION

FIGURE B13

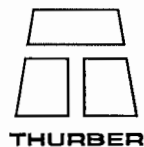
SILTY SAND TO SANDY SILT TILL



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

SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	06-11	4.88	279.63
⊠	06-12	6.22	277.97
▲	06-13	4.88	279.43
★	06-38	6.40	278.77
⊙	06-39	4.88	280.04
⊗	06-73	4.88	280.25

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Project 277-97-00



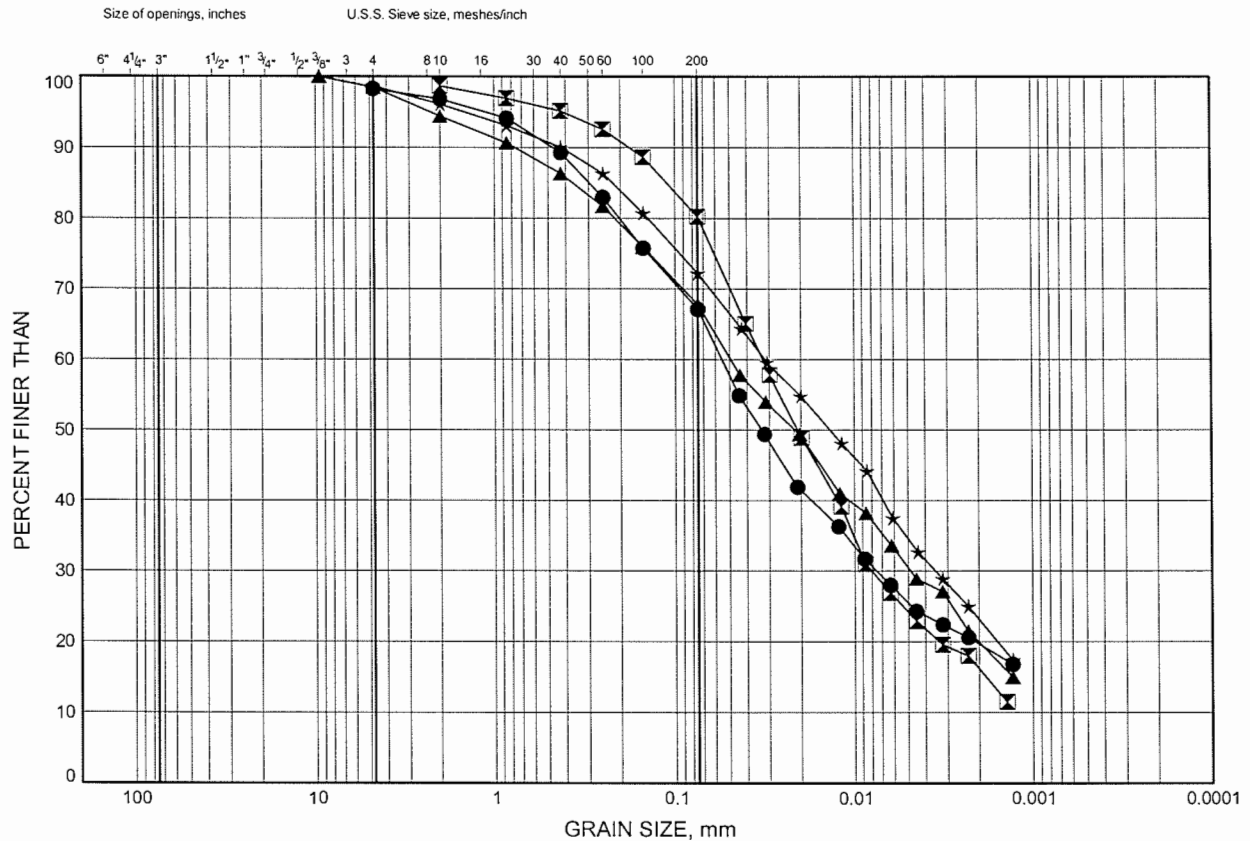
Prep'd JHL
Chkd. MRA

Highway 8 Widening Over Grand River

GRAIN SIZE DISTRIBUTION

FIGURE B14

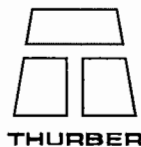
CLAYEY SILT TO SANDY CLAY TILL



COBBLE SIZE	COARSE	FINE	COARSE	MEDIUM	FINE	SILT and CLAY
	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

Date February 2007
Project 277-97-00



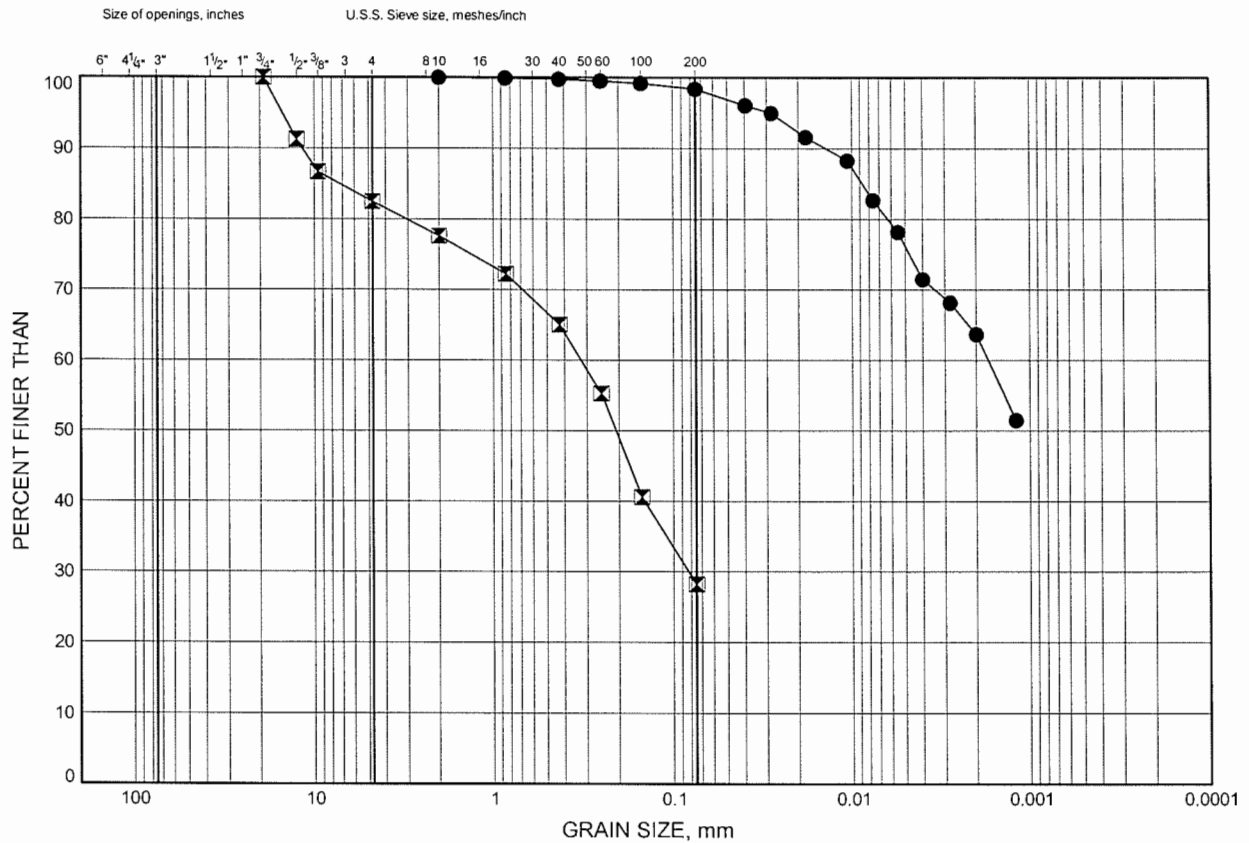
Prep'd JHL
Chkd. MRA

Highway 8 Widening Over Grand River

GRAIN SIZE DISTRIBUTION

FIGURE B15

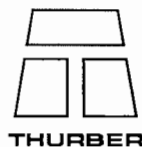
SILTY CLAY, SILTY SAND TILL



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

SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	06-46	1.83	293.49
⊠	06-46	4.83	290.49

Date February 2007
Project 277-97-00

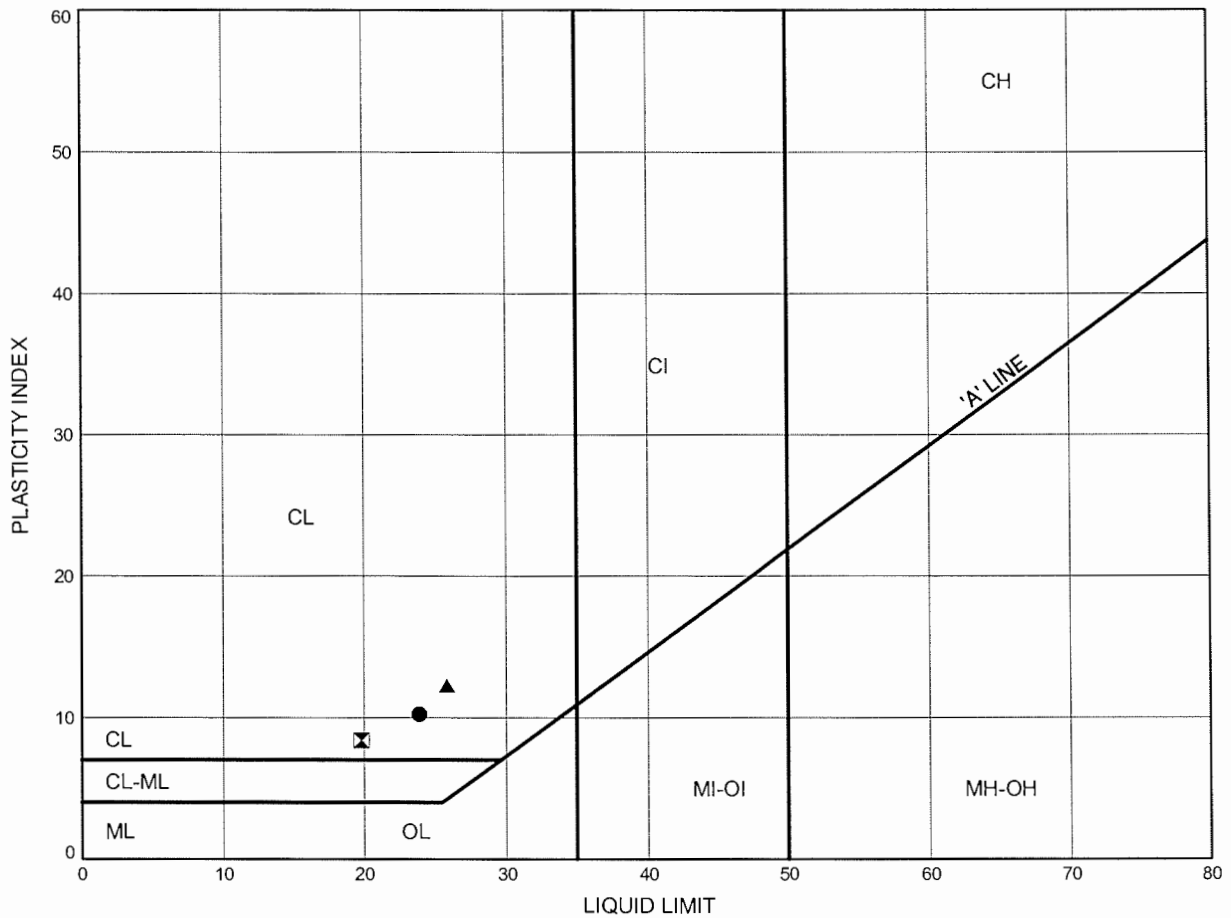


Prep'd JHL
Chkd. MRA

Highway 8 Widening Over Grand River
ATTERBERG LIMITS TEST RESULTS

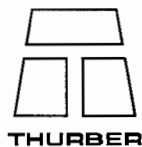
FIGURE B16

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

Date February 2007
 Project 277-97-00

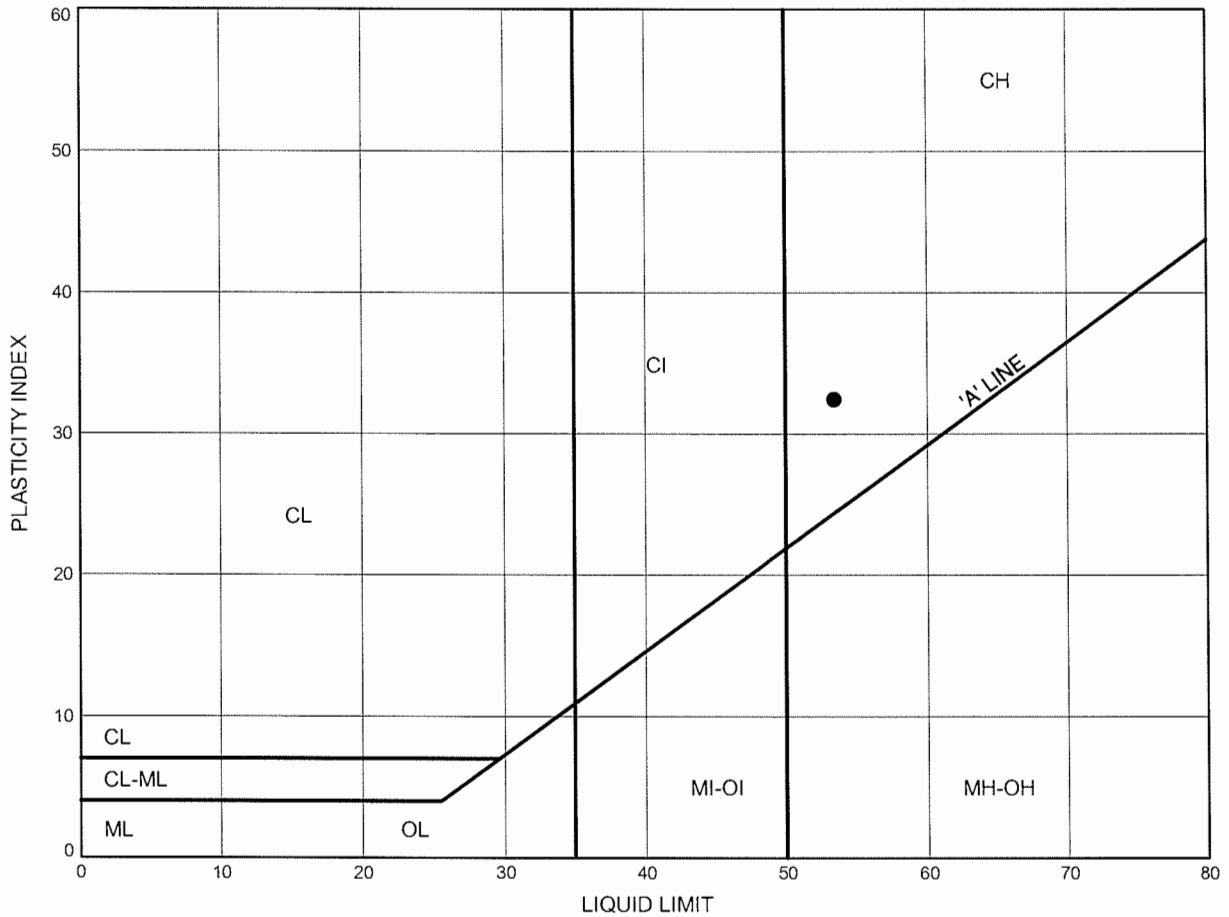


Prep'd JHL
 Chkd. MRA

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

Date February 2007
 Project 277-97-00



Prep'd JHL
 Chkd. MRA

Appendix C

Tables

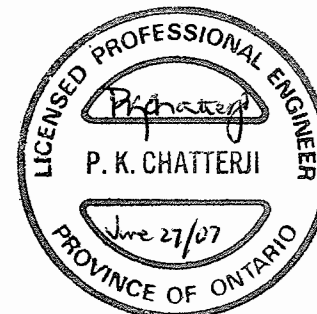
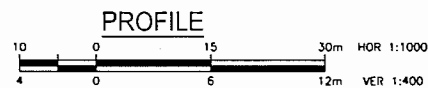
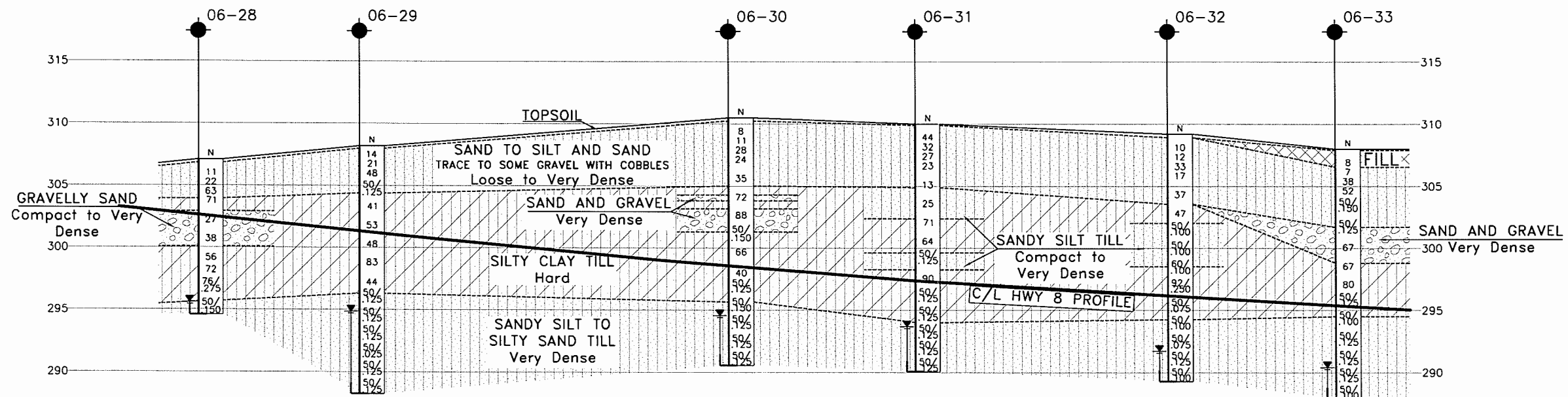
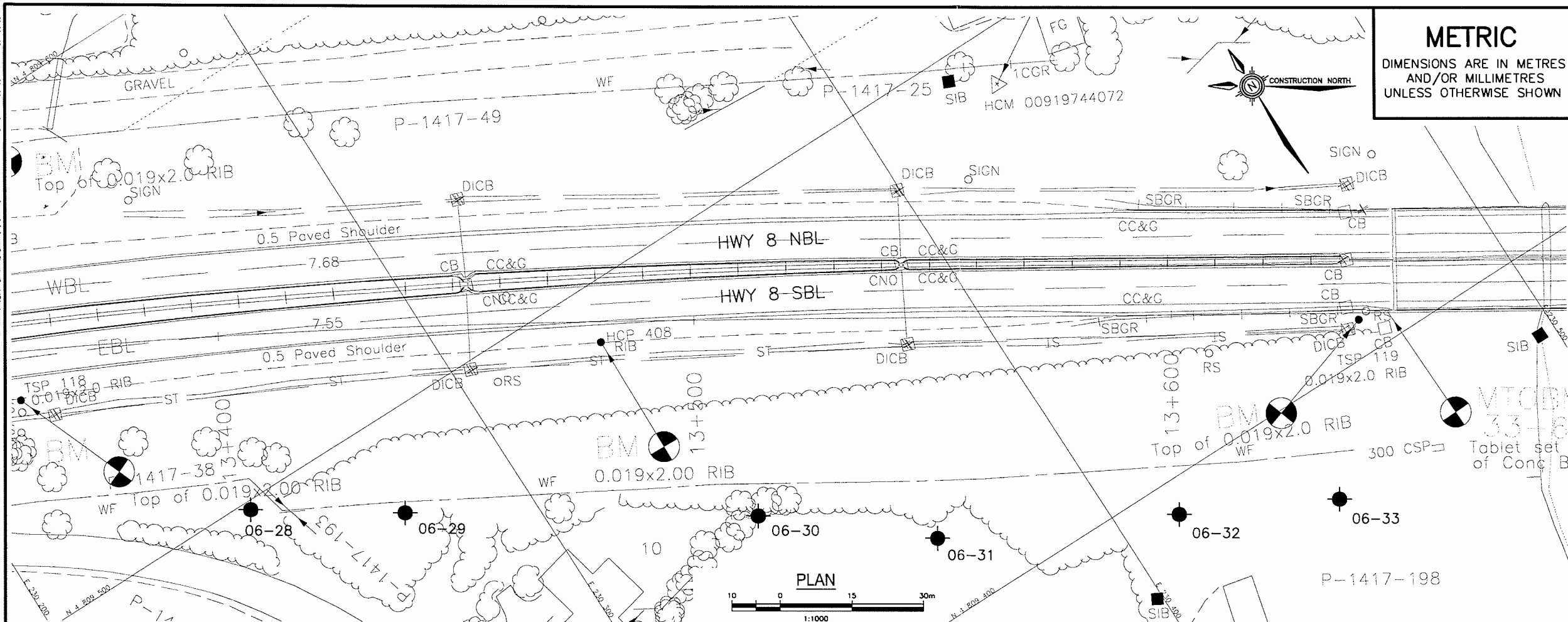
TABLE C1 – BOREHOLE COMPLETION DETAILS

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



DRAWING NOT TO BE SCALED
100 mm ON ORIGINAL DRAWING

METRIC

DIMENSIONS ARE IN METRES
AND/OR MILLIMETRES
UNLESS OTHERWISE SHOWN

CONT No
GWP No.277-97-00

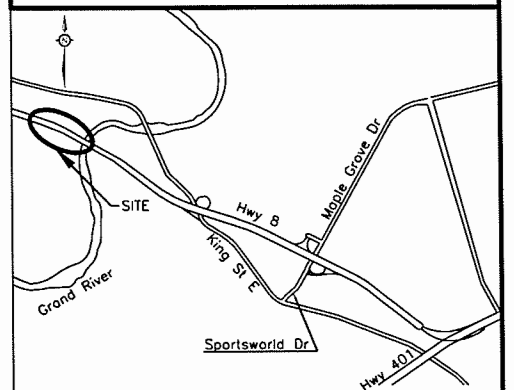
DEEP CUT
HWY 8 WIDENING
KITCHENER
BOREHOLE LOCATIONS AND SOIL STRATA

SHEET

M O R R I S O N
H E R S H F I E L D








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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 |

[illegible]

-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.

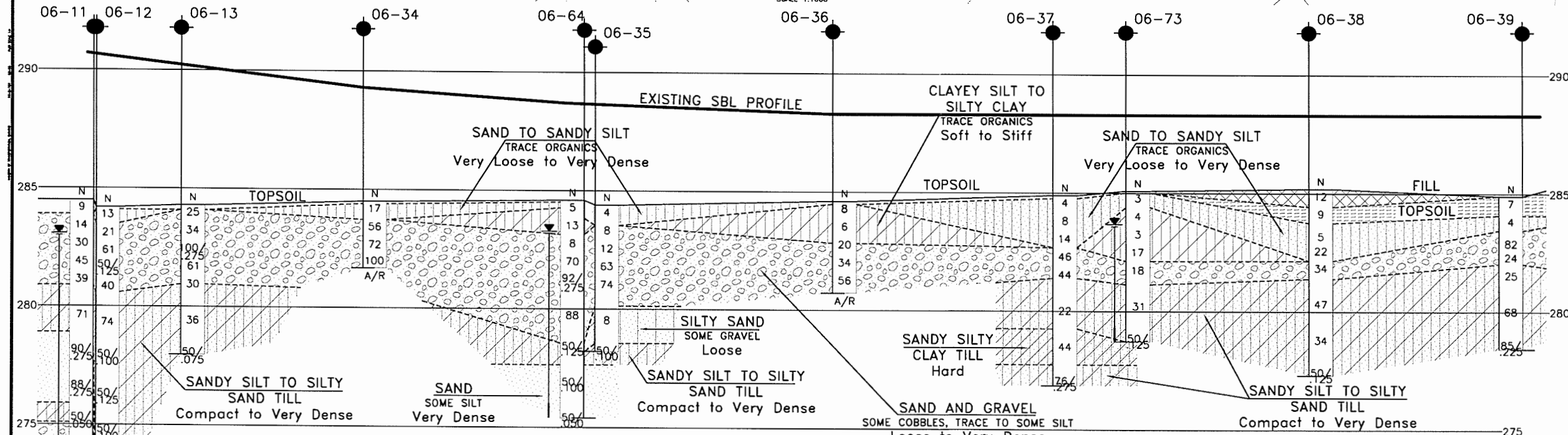
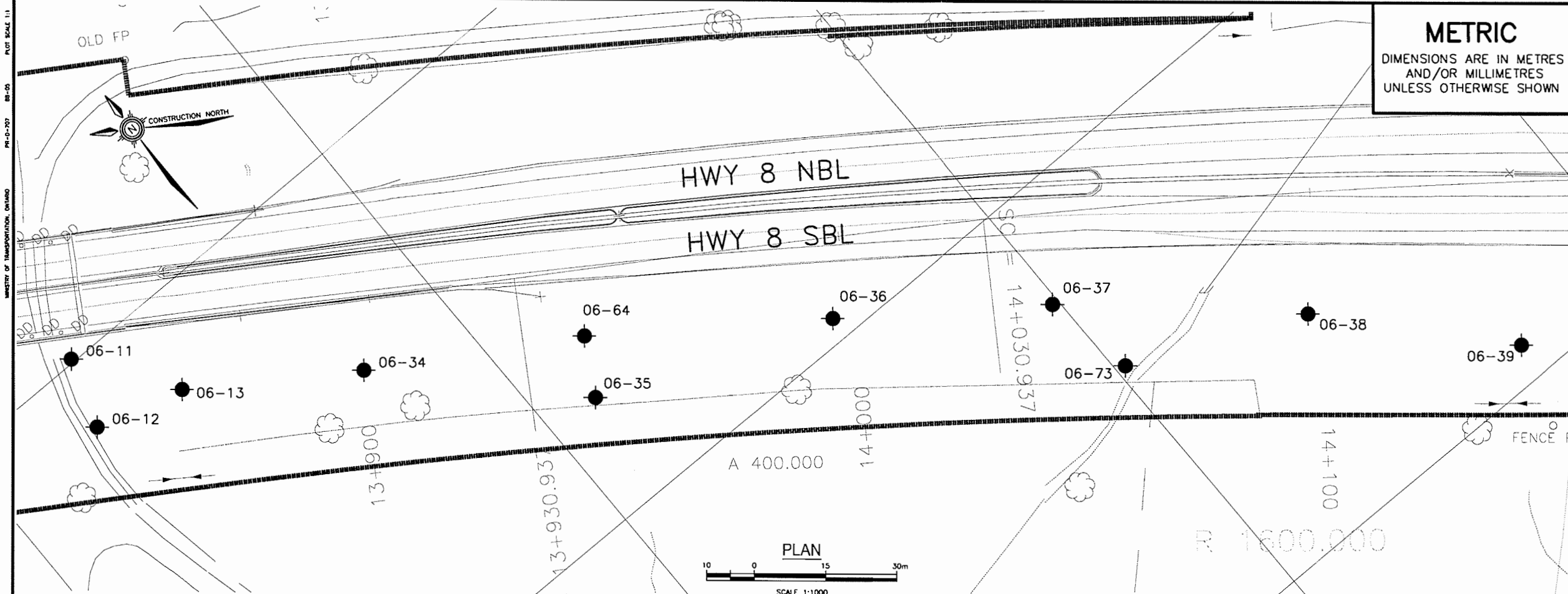
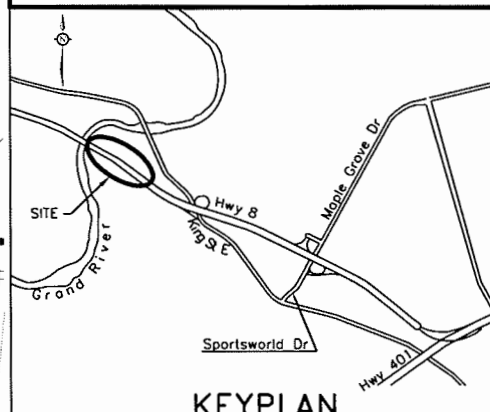
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REVISIONS									
	DATE	BY	DESCRIPTION						
DESIGN	MRA	CHK PKC	CODE	LOAD	DATE				JAN 2007
DRAWN	MFA	CHK PKC	SITE	STRUCT	DWG				1

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

CONT No
 GWP No 277-97-00
 HIGH FILL
 HWY 8 WIDENING
 STA. 13+859 TO 14+150
 BOREHOLE LOCATIONS AND SOIL STRATA

**MORRISON
 HERSHFELD**
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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-

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

LICENSED PROFESSIONAL ENGINEER
 M. R. ANDERSON
 PROVINCE OF ONTARIO
 June 27/07

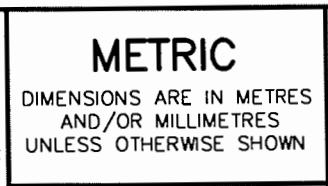
LICENSED PROFESSIONAL ENGINEER
 P. K. CHATTERJI
 PROVINCE OF ONTARIO
 June 27/07

REVISIONS

DATE	BY	DESCRIPTION
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DRAWN	JHL	CHK PKC SITE

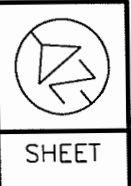
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 STRUCT DWG 2

DRAWING NOT TO BE SCALED
 100 mm ON ORIGINAL DRAWING



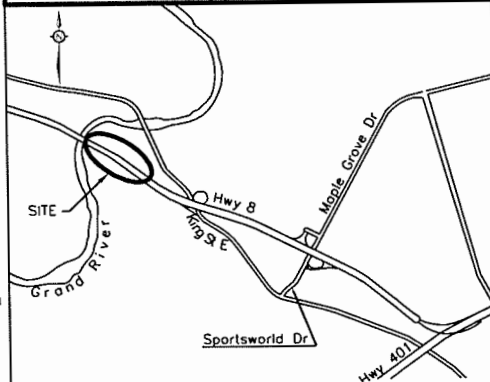
CONT No
GWP No 277-97-00

HIGH FILL
HWY 8 WIDENING
STA. 14+150 TO 14+500
BOREHOLE LOCATIONS AND SOIL STRATA



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KEYPLAN
LEGEND

[illegible]

-NOTES-

- 2) 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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