

**FOUNDATION INVESTIGATION REPORT
RETAINING WALL NORTH OF GRAND RIVER
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: 40P8-152

Report to

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HighFillRWWall FINAL FIR.doc

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PART 1: FACTUAL INFORMATION

1 INTRODUCTION

This report presents the factual findings obtained from a foundation investigation conducted for a proposed retaining wall to be constructed in connection with 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 require widening of an existing deep cut between Stations 13+400 and 13+650 located north of the Grand River.

A foundation investigation was previously carried out for the deep cut, and the results were documented in a report dated June 27, 2007 (Geocres No. 40P8-148). Since that time, the design has evolved to include a retaining wall within the cut section. This report presents information obtained from boreholes drilled along the proposed retaining wall alignment as well as data from the previous deep cut investigation.

The purpose of this investigation was to explore the subsurface conditions along the retaining wall alignment and, based on the data obtained, to provide a borehole location plan, records of boreholes, stratigraphic profiles, 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. In the project area, Highway 8 rises in a northerly direction from near elevation 295 m at the Grand River bridge to near elevation 303 m at the north limit of the deep cut section. The existing cut section is approximately 250 m in length 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 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.

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 current study (retaining wall) were carried out between May 16 and 22, 2008 and consisted of drilling and sampling six boreholes (Nos. 08-04 to 08-09) to depths of 6.7 to 20.1 m. The site investigation for the previous (deep cut) study was 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 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 Drawings 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.

In general terms, the site was found to be underlain by a unit of sand to silt, 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 Topsoil

A 100 to 275 mm thick layer of topsoil was encountered at the ground surface in all boreholes. 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 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%.

5.3 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.

SPT N-values in the sand/silt 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 N-values of less than 10 blows (loose) were relatively isolated, and that N-values greater than 50 may reflect the presence of cobbles or boulders.

Moisture contents in this material varied significantly from 1 to 22%.

Grain size distribution results for the sand to silt and sand are presented on the Record of Borehole sheets and Figures B1, B2 and B9 of Appendix B. The results of laboratory tests carried out on 12 samples were as follows:

Gravel %	0 to 26
Sand %	13 to 95
Silt %	44 to 81 (where hydrometer was conducted)
Clay %	3 to 14 (where hydrometer was conducted)
Silt & Clay %	5 to 24 (sieve analysis only)

The lower boundary of the sand/silt material was encountered at depths of 1.4 to 6.3 m, generally increasing towards the south (elevation 301.7 to 306.1 m, highest near Station 13+500).

5.4 Silty Clay Till

The upper sand/silt 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 1.4 to 9.2 m (elevation 298.8 to 306.1 m). The lower boundary was encountered at depths of 10.7 to 16.0 m (elevation 294.0 to 296.7 m). Boreholes 08-04 and 08-05 were terminated in the clay till at 6.7 and 9.8 m depth.

In five boreholes, a 0.5 to 2.8 m thick layer of sand and gravel to gravelly sand was encountered within the clay till, typically within 0.7 to 1.5 m of the upper boundary of this unit. At two locations (boreholes 06-33 and 08-05), the sand and gravel was encountered between the upper sand deposit and the clay till. Zones of sandy silt to silty sand till, 1.3 to 3.5 m thick, were also encountered in or above the clay till in three boreholes (boreholes 06-31, 06-32 and 08-08).

Standard Penetration Tests conducted in the clay till yielded N-values ranging from 25 blows/0.3 m penetration to 50 blows/0.075 m, indicating a very stiff to hard consistency. The higher N-values may reflect the presence of cobbles in the till. In borehole 08-04, N-values of 7 to 24 were obtained, indicating a firm to very stiff consistency.

Moisture contents generally ranged from 10 to 20%, with localized values as low as 3% likely resulting from the presence of gravel particles in the sample tested.

The results of grain size analyses carried out on 17 samples are tabulated below. One other sample from near 3.4 m depth in borehole 08-06 indicated a coarser gradation, with 13% gravel and 26% sand.

Gravel %	0 to 3
Sand %	1 to 15
Silt %	33 to 51
Clay %	36 to 65

Liquid Limit	28 to 51
Plastic Limit	14 to 21

The Atterberg Limits indicate that the silt clay till varies from a CL to marginal CH classification (low to high plasticity).

The grain size distribution curves for the samples tested are shown in Figures B4, B5, B11 and B12, Appendix B. The Atterberg Limits are plotted on Figures B7, B8, B14 and B15.

Glacial till is known to contain cobbles and boulders.

5.5 Sand and Gravel to Gravelly Sand

Localized deposits of sand and gravel to gravelly sand were encountered within or above the silty clay till stratum in seven boreholes. The sand and gravel deposits were 0.5 to 2.8 m thick, with an upper boundary contacted at depths of 2.1 to 9.2 m (elevation 299.8 to 304.6 m).

SPT N-values in the sand and gravel layers ranged from 22 to 88 blows/0.3 m, indicating a compact to very dense condition. Moisture contents ranged from 5 to 20%. The results of grain size analyses conducted on five samples of this material (Figures B3 and B10) were as follows:

Gravel %	33 to 56
Sand %	37 to 56
Silt & Clay %	6 to 13

5.6 Interbedded Sandy Silt to Silty Sand Till

Zones of sandy silt to silty sand till were encountered within or above the clay till locally in boreholes 06-31, 06-32 and 08-08. 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 6 to 12%. The results of grain size analyses conducted on two samples of this material are included on Figures B6 and B13.

5.7 Sandy Silt to Silty Sand Till

Very dense, grey sandy silt to silty sand till was encountered below the clay till in all boreholes except boreholes 08-04 and 08-05. The upper boundary of this till was encountered at depths of 10.7 to 16.0 m (elevation 294.0 to 296.7 m). Drilling was terminated in the till at depths of 11.0 to 20.1 m (elevation 288.0 to 296.4 m).

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. Moisture contents from this deposit ranged from 4 to 12%, with one value of 19% obtained locally.

The results of the grain size distribution analyses conducted on nine samples are presented on Figures B6 and B13. The results are summarized below. Glacial till is known to contain cobbles and boulders.

Gravel %	2 to 24 (typically 2 to 6)
Sand %	27 to 48
Silt %	28 to 53
Clay %	11 to 16

5.8 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 eight of the boreholes. 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 selected boreholes to monitor water levels after 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
08-05	22-May-2008	4.3	302.3
	19-Aug-2008	Destroyed	-
08-07	22-May-2008	16.5	291.9
	19-Aug-2008	14.0 (damaged)	294.4
08-09	22-May-2008	17.4	291.6
	19-Aug-2008	17.3	291.7

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.

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 and Mr. Keli Shi.

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.

Thurber Engineering Ltd.
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Appendix A

Record of Borehole Sheets

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	TP Thin Wall Piston Sample	PH Sampler Advanced by Hydraulic Pressure	PM Sampler Advanced by Manual Pressure	RC Rock Core	SC Soil Core

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

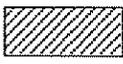
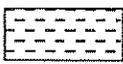
 Water Level
 Shear Strength Determination by Pocket Penetrometer

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

UNIFIED SOILS CLASSIFICATION

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

EXPLANATION OF ROCK LOGGING TERMS

<u>ROCK WEATHERING CLASSIFICATION</u>		<u>SYMBOLS</u>			
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)		
<u>DISCONTINUITY SPACING</u>		<u>STRENGTH CLASSIFICATION</u>			
Bedding	Bedding Plane Spacing	Rock Strength	Approximate Uniaxial Compressive Strength (MPa)	Uniaxial Compressive Strength (psi)	Field Estimation of Hardness*
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.
<u>TERMS</u>		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 06-28

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 2006-09-19 - 2006-09-19 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	LIQUID LIMIT w _L	
307.1														
0.0 306.8	TOPSOIL: (250mm), black													
0.3	SILT and SAND, some clay, trace gravel Compact Brown Moist: (TILL)		1	SS	11						○			
			2	SS	22						○			0 36 48 14
304.8	SAND, trace silt, trace gravel Very dense Brown Moist to wet		3	SS	63						○			
303.9	Silty CLAY, trace sand Hard Brown (TILL)		4	SS	71						○			
302.9	Gravelly SAND, some silt Compact to Dense Brown Wet		5	SS	27						○			33 54 13 (SI+CL)
	Occasional cobbles		6	SS	38						○			
300.1	Silty CLAY, trace sand, trace gravel Hard Grey (TILL)(CH)		7	SS	56						○			
			8	SS	72						○			0 2 35 63

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+³ X³: Numbers refer to Sensitivity
 20
 15 ⊕ 5
 10 (%) 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 2006-09-19 - 2006-09-19 CHECKED BY MEF

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT NUMBER	TYPE	"N" VALUES			20	40	60	80	100						20
Continued From Previous Page																	
295.5			9	SS	76/ 275												
11.6	Sandy SILT, some clay, trace gravel Very Dense Grey (TILL)																
294.6			10	SS	50/ 150												
12.5	END OF BOREHOLE AT 12.50m. Piezometer installation consists of 25mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen. WATER LEVEL READINGS: 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																

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+³. X³: 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 2006-09-19 - 2006-09-20 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
Continued From Previous Page																
296.3			9	SS	44											0 2 37 61
11.9	SILT and SAND, trace clay, trace gravel Very dense Grey Moist: (TILL)		10	SS	50/ .125											
			11	SS	50/ .125											2 41 41 16
			12	SS	50/ .125											
			13	SS	50/ .025											
			14	SS	50/ .125											
288.3			15	SS	50/ .125											

ONTMTAS 7938.GPJ 11/26/08

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+³.X³: Numbers refer to Sensitivity
 20
 15-5
 10 (%) 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 4 809 460.35 E 230 275.72 ORIGINATED BY SLL
 HWY 8 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MFA
 DATUM Geodetic DATE 2006-09-19 - 2006-09-20 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					
19.9	Continued From Previous Page 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 11/26/08

+³, X³: Numbers refer to Sensitivity
 20
 15 10 5
 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 06-30

1 OF 3

METRIC

G.W.P. 277-97-00 LOCATION Hwy 8 Widening, Grand River to Sportsworld Dr. N 4 809 440.12 E 230 337.88 ORIGINATED BY SLL
 HWY 8 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MFA
 DATUM Geodetic DATE 2006-09-20 - 2006-09-20 CHECKED BY MEF

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			FLASTIC 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	20 40 60						
310.5														
0.0	TOPSOIL: (250mm), black													
310.3														
0.3	SILT and SAND, trace gravel, trace clay Loose to Compact Brown Moist		1	SS	8									
			2	SS	11								1 39 52 8	
308.5														
2.0	SAND, trace silt Compact Brown Moist		3	SS	28									
			4	SS	24								0 95 5 (SI+CL)	
306.5														
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									

ONTMT4S 7938.GPJ 11/26/08

Continued Next Page

+³. X³: Numbers refer to Sensitivity 20
15 10 5 (% STRAIN AT FAILURE)

RECORD OF BOREHOLE No 06-30

2 OF 3

METRIC

G.W.P. 277-97-00 LOCATION Hwy 8 Widening, Grand River to Sportsworld Dr. N 4 809 440.12 E 230 337.88 ORIGINATED BY SLL
 HWY 8 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MFA
 DATUM Geodetic DATE 2006-09-20 - 2006-09-20 CHECKED BY MEF

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	NUMBER	TYPE	"N" VALUES			20	40	60					
Continued From Previous Page														
		9	SS	66										
		10	SS	40										0 2 33 65
		11	SS	50/ .125										
295.7		12	SS	50/ .150										
14.8	SILT and SAND, some clay, trace gravel, occasional cobbles Very dense Grey Moist: (TILL)	13	SS	50/ .125										5 40 39 16
		14	SS	50/ .125										
		15	SS	50/ .125										
290.6														

ONTMT4S 7938.GPJ 11/26/08

Continued Next Page

+³ × 3³: Numbers refer to Sensitivity
 20
 15 ⊕ 5
 10 (%) 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 2006-09-20 - 2006-09-20 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								
19.9	<p>Continued From Previous Page</p> <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											

ONTMT4S 7938.GPJ 11/26/08

+³. X³: Numbers refer to Sensitivity 20
15 5
10 (%) STRAIN AT FAILURE

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 2006-09-21 - 2006-09-21 CHECKED BY MEF

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa							WATER CONTENT (%)		
						20	40	60	80	100	20	40	60	GR	SA	SI	CL
310.0																	
0.0																	
0.1	TOPSOIL: (100mm), black																
	SAND, trace silt, trace gravel Dense to Compact Brown Moist		1	SS	44												
			2	SS	32												
			3	SS	27												
307.0																	
2.9	SILT, some sand to sandy, trace clay Compact Brown Moist to wet		4	SS	23									0	13	81	6
			5	SS	13												
304.8																	
5.1	Sandy SILT, some clay, trace gravel Compact Grey Moist: (TILL)		6	SS	25									8	28	48	16
			7	SS	71												
302.3																	
7.6	Silty CLAY, trace sand, occasional cobbles Hard Grey (TILL)		8	SS	64												

ONTMT#S 7938.GPJ 11/26/08

Continued Next Page

+³. ×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 2006-09-21 - 2006-09-21 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
Continued From Previous Page																
299.6	Sandy SILT, some clay, trace gravel, occasional cobbles Very dense Grey Moist: (TILL)		9	SS	50/ .125											
10.4																
298.2																
11.7	Silty CLAY, trace sand, occasional cobbles Hard Grey (TILL)(CH)		10	SS	90										0 1 36 63	
297																
296																
295			11	SS	50/ .125											
294			12	SS	50/ .125											
294.0	Silty SAND, some gravel, occasional cobbles Very Dense Grey Moist: (TILL)		13	SS	50/ .125											
16.0																
293																
292			14	SS	50/ .125										24 48 28 (SI+CL)	
291			15	SS	50/ .125											
290.0																

ONTMT4S 7938.GPJ 11/26/08

Continued Next Page

+³ × 3³: Numbers refer to Sensitivity
 20
 15-φ-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 2006-09-21 - 2006-09-21 CHECKED BY MEF

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	20	40	60	80					
19.9	<p>Continued From Previous Page</p> <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 19.66 290.28 22/09/06 14.48 295.48 29/09/06 16.28 293.68</p>				.125											

ONTMT4S 7938.GPJ 11/26/06

+³. X³: Numbers refer to
Sensitivity

20
15-5
10 (% STRAIN AT FAILURE

RECORD OF BOREHOLE No 06-32

1 OF 3

METRIC

G.W.P. 277-97-00 LOCATION Hwy 8 Widening, Grand River to Sportsworld Dr. N 4 809 393.01 E 230 412.34 ORIGINATED BY SLL
 HWY 8 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MFA
 DATUM Geodetic DATE 2008-09-22 - 2006-09-25 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								WATER CONTENT (%)	
					20	40	60	80	100	20	40	60	GR	SA	SI	CL
0.0	TOPSOIL: (275mm), black															
0.3	SAND, trace silt, trace gravel Compact Brown Moist	1	SS	10												
308.9		2	SS	12												
307.0	SAND, some silt to silty, trace gravel Dense to Compact Brown Moist	3	SS	33												
		4	SS	17												
		5	SS	37												
303.6	Silty CLAY, trace sand, trace gravel Hard Grey (TILL)	6	SS	47												
		7	SS	50/ .100												
302.0	Sandy SILT, some clay, trace gravel Very dense Grey Moist: (TILL)	8	SS	50/ .100												

ONTMT4S 7938.GPJ 11/26/08

Continued Next Page

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

RECORD OF BOREHOLE No 06-32

2 OF 3

METRIC

G.W.P. 277-97-00 LOCATION Hwy 8 Widening, Grand River to Sportsworld Dr. N 4 809 393.01 E 230 412.34 ORIGINATED BY SLL
 HWY 8 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MFA
 DATUM Geodetic DATE 2006-09-22 - 2006-09-25 CHECKED BY MEF

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)				
ELEV DEPTH	DESCRIPTION	NUMBER	TYPE	"N" VALUES			20	40	60						80	100	20	40
Continued From Previous Page																		
298.5	Silty CLAY, trace sand Hard Grey (TILL)(CI)	9	SS	60/ .100														
		10	SS	92/ 250										0	1	35	64	
		11	SS	50/ .075														
		12	SS	50/ .100														
		13	SS	50/ .075														
294.3	Sandy SILT, some clay, trace gravel Very dense Grey Moist: (TILL)	14	SS	50/ .125														
291		15	SS	50/ .125										6	27	53	14	
289.3																		

ONTMT-4S 7938.GPJ 11/26/08

Continued Next Page

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

RECORD OF BOREHOLE No 06-32

3 OF 3

METRIC

G.W.P. 277-97-00 LOCATION Hwy 8 Widening, Grand River to Sportsworld Dr. N 4 809 393.01 E 230 412.34 ORIGINATED BY SLL
 HWY 8 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MFA
 DATUM Geodetic DATE 2006-08-22 - 2006-09-25 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	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100					
19.9	Continued From Previous Page END OF BOREHOLE AT 19.91m. Piezometer installation consists of 25mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen. WATER LEVEL READINGS: DATE DEPTH(m) ELEV.(m) 29/09/06 17.49 291.72				.100											GR SA SI CL	

ONTMT4S 7938.GPJ 11/26/08

+³. ×³: Numbers refer to Sensitivity

20
15 5
10 (%) STRAIN AT FAILURE

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 2006-09-21 - 2006-09-22 CHECKED BY MEF

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa						
						20	40	60	80	100	20	40	60	GR SA SI CL
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									16 76 8 (SI+CL)
	Occasional cobbles													
301.7			6	SS	50/ .125									
6.3	SAND and GRAVEL , trace silt Very dense Grey Wet		7	SS	67									56 37 7 (SI+CL)
298.8			8	SS	67									
9.2	Silty CLAY , trace sand Hard Grey (TILL)													

ONTMT4S 7938.GPJ 11/26/08

Continued Next Page

+³ X³: Numbers refer to Sensitivity
 20
 15-Φ⁵
 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 2006-09-21 - 2006-09-22 CHECKED BY MEF

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	NUMBER	TYPE	"N" VALUES			20	40	60					
Continued From Previous Page														
	Occasional cobbles	9	SS	80										0 2 40 58
294.5		10	SS	50/ .125										
13.5	SILT and SAND, some clay, trace gravel, occasional cobbles, occasional sand layers Very dense Grey Moist: (TILL)	11	SS	50/ .100										
		12	SS	50/ .125										4 38 43 15
		13	SS	50/ .125										
		14	SS	50/ .125										
		15	SS	50/ .125										

Continued Next Page

+³ X³: Numbers refer to Sensitivity
 20
 15 5
 10 (%) STRAIN AT FAILURE

ONTM/T4S 7936.GPJ 11/26/08

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 2006-09-21 - 2006-09-22 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	W _p					
288.0	Continued From Previous Page																
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 11/26/08

+³, X³: Numbers refer to Sensitivity
 20
 15 ϕ 5
 10 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 08-04

1 OF 1

METRIC

G.W.P. 277-97-00 LOCATION Hwy 8 Widening, Grand River to Sportsworld Dr. N 4 809 531.23 E 230 211.92 ORIGINATED BY KS
 HWY 8 BOREHOLE TYPE Hollow Stem Augers COMPILED BY WM
 DATUM Geodetic DATE 2008-05-22 - 2008-05-22 CHECKED BY MRA

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	W.P.	W	W.L.
304.6																		
0.0	TOPSOIL: (150mm)																	
0.2	SAND and SILT, trace clay, trace gravel Compact Brown Moist		1	SS	11													
			2	SS	17													
303.2																		
1.4	Silty CLAY, some sand, trace gravel Stiff Brown Moist to Wet (TILL)		3	SS	12													
302.5																		
2.1	SAND and GRAVEL, trace silt, with sand layers Compact Brown Wet		4	SS	22													40 53 7 (SI+CL)
301.4																		
3.3	Silty CLAY, trace sand Firm to Very Stiff Grey to Brown Moist (TILL)		5	SS	7													0 7 49 44
			6	SS	16													
			7	SS	16													
			8	SS	24													0 4 36 60
297.9																		
6.7	END OF BOREHOLE AT 6.7m. BOREHOLE BACKFILLED WITH BENTONITE TO SURFACE.																	

ONTMT4S_7938.GPJ 8/27/08

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

RECORD OF BOREHOLE No 08-05

1 OF 2

METRIC

G.W.P. 277-97-00 LOCATION Hwy 8 Widening, Grand River to Sportsworld Dr. N 4 809 507.61 E 230 250.18 ORIGINATED BY KS
 HWY 8 BOREHOLE TYPE Hollow Stem Augers COMPILED BY WM
 DATUM Geodetic DATE 2008-05-21 - 2008-05-22 CHECKED BY MRA

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa						
						20	40	60	80	100	20	40	60	GR SA SI CL
306.6														
0.0	TOPSOIL: (225mm)													
0.2	SAND, some gravel, trace silt to silty Compact Brown Moist		1	SS	7									
			2	SS	20									
			3	SS	27									26 56 18 (SI+CL)
			4	SS	30									
303.5	SAND and GRAVEL, trace silt Compact to Dense Grey/Brown Moist to Wet		5	SS	27									
3.0			6	SS	35									56 38 6 (SI+CL)
301.8	Silty CLAY, trace sand Very Stiff to Hard Brown to Grey Moist (TILL)		7	SS	34									0 7 49 44
4.8			8	SS	25									
			9	SS	33									0 4 39 57
			10	SS	32									
296.8														
9.8	END OF BOREHOLE AT 9.8m.													

ONTMT4S 7938.GPJ 8/27/08

Continued Next Page

+³, x³ Numbers refer to Sensitivity 20 15 10 5 0 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 08-06

1 OF 2

METRIC

G.W.P. 277-97-00 LOCATION Hwy 8 Widening, Grand River to Sportsworld Dr. N 4 809 479.70 E 230 295.23 ORIGINATED BY KS
 HWY 8 BOREHOLE TYPE Hollow Stem Augers COMPILED BY WM
 DATUM Geodetic DATE 2008-05-21 - 2008-05-21 CHECKED BY MRA

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							
307.4															
0.0	TOPSOIL: (200mm)														
0.2	SAND and SILT, trace to some clay, trace to some gravel Loose to Compact Brown Moist		1	SS	10		307								
			2	SS	9										
306.0															
1.4	Sandy, silty CLAY, some gravel, occasional cobbles, occasional sand seams Firm to Hard Brown Moist (TILL)		3	SS	7		306								
			4	SS	19		305								
			5	SS	27		304						13	26 36 25	
			6	SS	42										
302.8															
4.6	Silty CLAY, trace sand, trace gravel Very Stiff to Hard Grey Moist (TILL)		7	SS	56		303								
			8	SS	29		301						0	8 48 44	
			9	SS	29		300								
			10	SS	31		299								
							298								

ONTM14S 7938.GPJ 8/27/08

Continued Next Page

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

RECORD OF BOREHOLE No 08-06

2 OF 2

METRIC

G.W.P. 277-97-00 LOCATION Hwy 8 Widening, Grand River to Sportsworld Dr. N 4 809 479.70 E 230 295.23 ORIGINATED BY KS
 HWY 8 BOREHOLE TYPE Hollow Stem Augers COMPILED BY WM
 DATUM Geodetic DATE 2008-05-21 - 2008-05-21 CHECKED BY MRA

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa								
							20	40	60	80	100	W _p	W	W _L		GR SA SI CL
	Continued From Previous Page															
296.7	Silty CLAY, trace sand, trace gravel Very Stiff to Hard Grey Moist (TILL)					297										
10.7																
296.4	SILT and SAND, trace to some clay, trace gravel Very Dense Grey Moist (TILL)		11	SS	61/							o				4 39 43 14
11.0	END OF BOREHOLE AT 11.0m. BOREHOLE BACKFILLED WITH BENTONITE TO SURFACE.															

ONTMT-4S 7938.GPJ 8/27/08

+³, x³: Numbers refer to Sensitivity 20
15
10 5 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 08-07

1 OF 2

METRIC

G.W.P. 277-97-00 LOCATION Hwy 8 Widening, Grand River to Sportsworld Dr. N 4 809 458.92 E 230 327.35 ORIGINATED BY KS
 HWY 8 BOREHOLE TYPE Hollow Stem Augers COMPILED BY WM
 DATUM Geodetic DATE 2008-05-21 - 2008-05-21 CHECKED BY MRA

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa							WATER CONTENT (%)		
						20	40	60	80	100	20	40	60	GR	SA	SI	CL
308.4																	
0.0	TOPSOIL: (100mm)																
0.1	SAND, trace to some silt Loose to Compact Light Brown Moist		1	SS	9						o						
			2	SS	18						o						
			3	SS	9						o			0	89	11	(SI+CL)
306.1																	
2.3	Silty CLAY, trace to some sand, trace gravel, with sand lenses Stiff Brown to Grey Moist (TILL)		4	SS	8						o						
			5	SS	12						o	—		3	15	46	36
304.6																	
3.8	SAND and GRAVEL, trace silt Dense Brown Moist		6	SS	34						o						
303.9																	
4.6	Silty CLAY, some sand, trace gravel, occasional sand and gravel layers Hard Grey Moist (TILL)		7	SS	32						o						
			8	SS	50						o						
			9	SS	36						o						
			10	SS	44						o	—		0	3	44	53

ONTMT4S-7938.GPJ 8/27/08

Continued Next Page

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

RECORD OF BOREHOLE No 08-07

2 OF 2

METRIC

G.W.P. 277-97-00 LOCATION Hwy 8 Widening, Grand River to Sportsworld Dr. N 4 809 458.92 E 230 327.35 ORIGINATED BY KS
 HWY 8 BOREHOLE TYPE Hollow Stem Augers COMPILED BY WM
 DATUM Geodetic DATE 2008-05-21 - 2008-05-21 CHECKED BY MRA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)							
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60				80	100	W _p	W	W _L	GR	SA
Continued From Previous Page																				
296.1	Silty CLAY, some sand, trace gravel, occasional sand and gravel layers Hard Grey Moist (TILL)	[Strat Plot]	11	SS	35															
12.3	Sandy SILT, trace to some clay, trace to some gravel, occasional cobbles Very Dense Grey Moist (TILL)	[Strat Plot]	12	SS	96/ 250															
			13	SS	50/ .100												6	28	52	14
			14	SS	50/ .150															
291.6	END OF BOREHOLE AT 16.9m. Piezometer installation consists of 25.4mm diameter Schedule 40 PVC pipe with a 3.05m slotted screen.		15	SS	70/ .100															
16.9																				
WATER LEVEL READINGS: DATE DEPTH(m) ELEV.(m) 2008-05-22 16.5 291.9 2008-08-19* 14.0 294.4 *Damaged																				

ONTMT4S 7938.GPJ 8/27/08

+³.x³: Numbers refer to Sensitivity 20
15
10 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 08-08

1 OF 3

METRIC

G.W.P. 277-97-00 LOCATION Hwy 8 Widening, Grand River to Sportsworld Dr. N 4 809 430.57 E 230 370.41 ORIGINATED BY KS
 HWY 8 BOREHOLE TYPE Solid Stem Augers / Hollow Stem Augers COMPILED BY WM
 DATUM Geodetic DATE 2008-05-16 - 2008-05-16 CHECKED BY MRA

ELEV DEPTH	SOIL PROFILE DESCRIPTION	STRAT PLOT	SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
			NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa							
							20 40 60 80 100	○ UNCONFINED	+ FIELD VANE						
								● QUICK TRIAXIAL	× LAB VANE	WATER CONTENT (%)					
								20 40 60 80 100		20 40 60					
308.3 0.0	TOPSOIL: (225mm)														
0.2	SAND, trace to some gravel, trace to some silt Compact Light Brown Moist		1	SS	10		308								
			2	SS	13		307								
			3	SS	16										
			4	SS	13		306							2 78 20 (SI+CL)	
			5	SS	18		305								
304.1 4.1	SILT, some clay, trace sand Dense to Very Dense Brown Moist to Wet		6	SS	35		304							0 9 77 14	
303.2 5.0	Silty CLAY, some sand Hard Grey Moist (TILL)		7	SS	59		303								
301.9 6.4	Silty SAND, some gravel Very Dense Grey Moist to Wet (TILL) occasional cobbles		8	SS	115		302								
			9	SS	93/ 150		301							14 37 33 16	
299.4 8.8	Silty CLAY, trace sand Hard Grey Moist (TILL)		10	SS	32		299								

ONTMT4S 7938.GPJ 8/27/08

Continued Next Page

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

RECORD OF BOREHOLE No 08-08

2 OF 3

METRIC

G.W.P. 277-97-00 LOCATION Hwy 8 Widening, Grand River to Sportsworld Dr. N 4 809 430.57 E 230 370.41 ORIGINATED BY KS
 HWY 8 BOREHOLE TYPE Solid Stem Augers / Hollow Stem Augers COMPILED BY WM
 DATUM Geodetic DATE 2008-05-16 - 2008-05-16 CHECKED BY MRA

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						
Continued From Previous Page														
296.1	Silty CLAY, trace sand Hard Grey Moist (TILL)		11	SS	64								0 4 35 61	
12.2	Sandy SILT, trace to some gravel, occasional sand layers, occasional cobbles Very Dense Grey Moist to Wet (TILL)		12	SS	50/ .075									
			13	SS	50/ .100									
			14	SS	60/ .150								4 35 46 15	
			15	SS	86/ .150									
			16	SS	100/ .150									
			17	SS	50/									

ONTMT4S 7938.GPJ 8/27/08

Continued Next Page

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

RECORD OF BOREHOLE No 08-08

3 OF 3

METRIC

G.W.P. 277-97-00 LOCATION Hwy 8 Widening, Grand River to Sportsworld Dr. N 4 809 430.57 E 230 370.41 ORIGINATED BY KS
 HWY 8 BOREHOLE TYPE Solid Stem Augers / Hollow Stem Augers COMPILED BY WM
 DATUM Geodetic DATE 2008-05-16 - 2008-05-16 CHECKED BY MRA

SOIL PROFILE		SAMPLES				GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	UNIT WEIGHT	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa							
288.2	Continued From Previous Page														
20.1	END OF BOREHOLE AT 20.1m. BOREHOLE BACKFILLED WITH BENTONITE TO SURFACE.						288								

ONTMT4S 7936.GPJ 8/27/08

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

RECORD OF BOREHOLE No 08-09

1 OF 3

METRIC

G.W.P. 277-97-00 LOCATION Hwy 8 Widening, Grand River to Sportsworld Dr. N 4 809 402.11 E 230 413.11 ORIGINATED BY KS
 HWY 8 BOREHOLE TYPE Hollow Stem Augers COMPILED BY WM
 DATUM Geodetic DATE 2008-05-20 - 2008-05-20 CHECKED BY MRA

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa						
						20	40	60	80	100	20	40	60	GR SA SI CL
309.0														
0.0	TOPSOIL: (150mm)													
0.2	SAND, some gravel, trace silt Compact Light Brown Moist to Dry		1	SS	7									
			2	SS	15									
307.5														
1.5	SAND and SILT, occasional cobbles Compact Brown Moist to Wet		3	SS	24									
			4	SS	21									0 53 44 3
			5	SS	22									
			6	SS	28									
			7	SS	15									
	Grinding at 5.2m, probable cobbles.													
303.5														
5.5	Silty CLAY, trace sand, occasional sand pockets, occasional cobbles Hard Grey Moist (TILL)		8	SS	52									
			9	SS	51									0 6 49 45
	Grinding at 7.9m, probable gravel or cobbles.													
299.8														
9.2	SAND and GRAVEL, trace to some silt Dense Grey Moist		10	SS	42									

ONTMT-4S 7938.GPJ 8/27/08

Continued Next Page

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

RECORD OF BOREHOLE No 08-09

2 OF 3

METRIC

G.W.P. 277-97-00 LOCATION Hwy 8 Widening, Grand River to Sportsworld Dr. N 4 809 402.11 E 230 413.11 ORIGINATED BY KS
 HWY 8 BOREHOLE TYPE Hollow Stem Augers COMPILED BY WM
 DATUM Geodetic DATE 2008-05-20 - 2008-05-20 CHECKED BY MRA

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	SHEAR STRENGTH kPa			
						20 40 60 80 100	PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L		
						○ UNCONFINED + FIELD VANE	WATER CONTENT (%)				
						● QUICK TRIAXIAL × LAB VANE	20 40 60				GR SA SI CL
298.9 10.1	Continued From Previous Page Silty CLAY, trace sand, occasional cobbles and boulders Hard Grey Moist (TILL)		11	SS	54			○			
	Grinding at 12.2m.		12	SS	41			○	—		1 9 38 52
	Grinding at 12.8m to 13.1m, probable boulder.										
295.2 13.8	Grinding at 13.7m to 14.0m, probable cobble. Silty SAND, trace to some clay, trace to some gravel Very Dense Grey Moist (TILL)		13	SS	100/ .150			○			
	Grinding at 14.9m to 15.2m.		14	SS	50/ .100			○			6 49 34 11
			15	SS	50/ .125			○			
			16	SS	50/ .075			○			
			17	SS	100/			○			

ONTM145 7936 GPJ 8/28/08

Continued Next Page

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

RECORD OF BOREHOLE No 08-09

3 OF 3

METRIC

G.W.P. 277-97-00 LOCATION Hwy 8 Widening, Grand River to Sportsworld Dr. N 4 809 402.11 E 230 413.11 ORIGINATED BY KS
 HWY 8 BOREHOLE TYPE Hollow Stem Augers COMPILED BY WM
 DATUM Geodetic DATE 2008-05-20 - 2008-05-20 CHECKED BY MRA

SOIL PROFILE		SAMPLES				GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60					
288.9	Continued From Previous Page														
20.1	END OF BOREHOLE AT 20.1m. Piezometer installation consists of 25.4mm diameter Schedule 40 PVC pipe with a 3.05m slotted screen. WATER LEVEL READINGS: DATE DEPTH(m) ELEV.(m) 2008-05-22 17.4 291.6 2008-08-19 17.3 291.7														

ONTMT-4S 7938.GPJ 8/27/08

+³, X³: Numbers refer to Sensitivity
 20
 15 5
 10 (%) STRAIN AT FAILURE

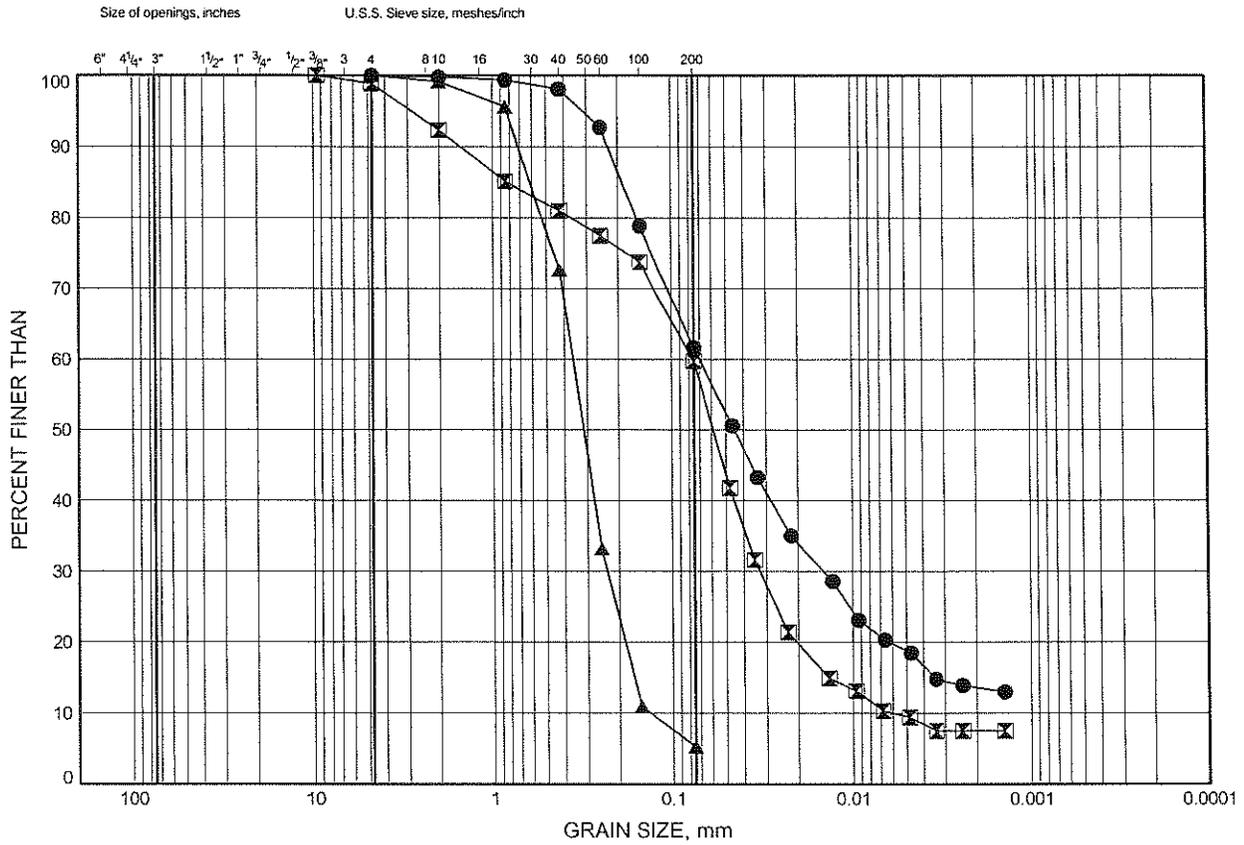
Appendix B

Laboratory Test Results

Highway 8 Widening Over Grand River GRAIN SIZE DISTRIBUTION

FIGURE B1

SAND TO SILT AND SAND



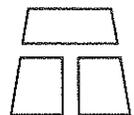
COBBLE SIZE	COARSE	FINE	COARSE	MEDIUM	FINE	SILT and CLAY
	GRAVEL		SAND			FINE GRAINED

SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	06-28	1.83	305.25
⊠	06-30	1.83	308.68
▲	06-30	3.35	307.16

THURBGSD 7938.GPJ 17/01/07

Date January 2007

Project 277-97-00



THURBER

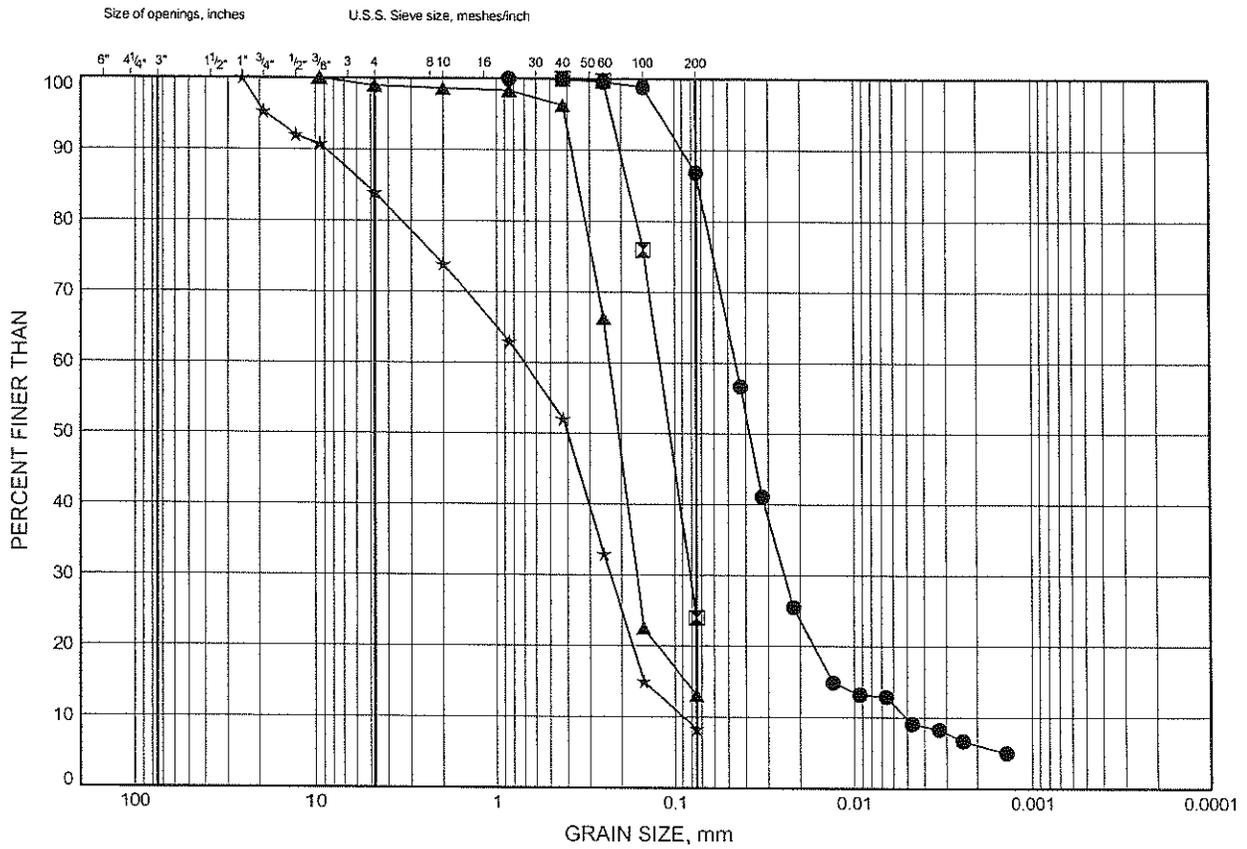
Prep'd MFA

Chkd. MRA

Highway 8 Widening Over Grand River GRAIN SIZE DISTRIBUTION

FIGURE B2

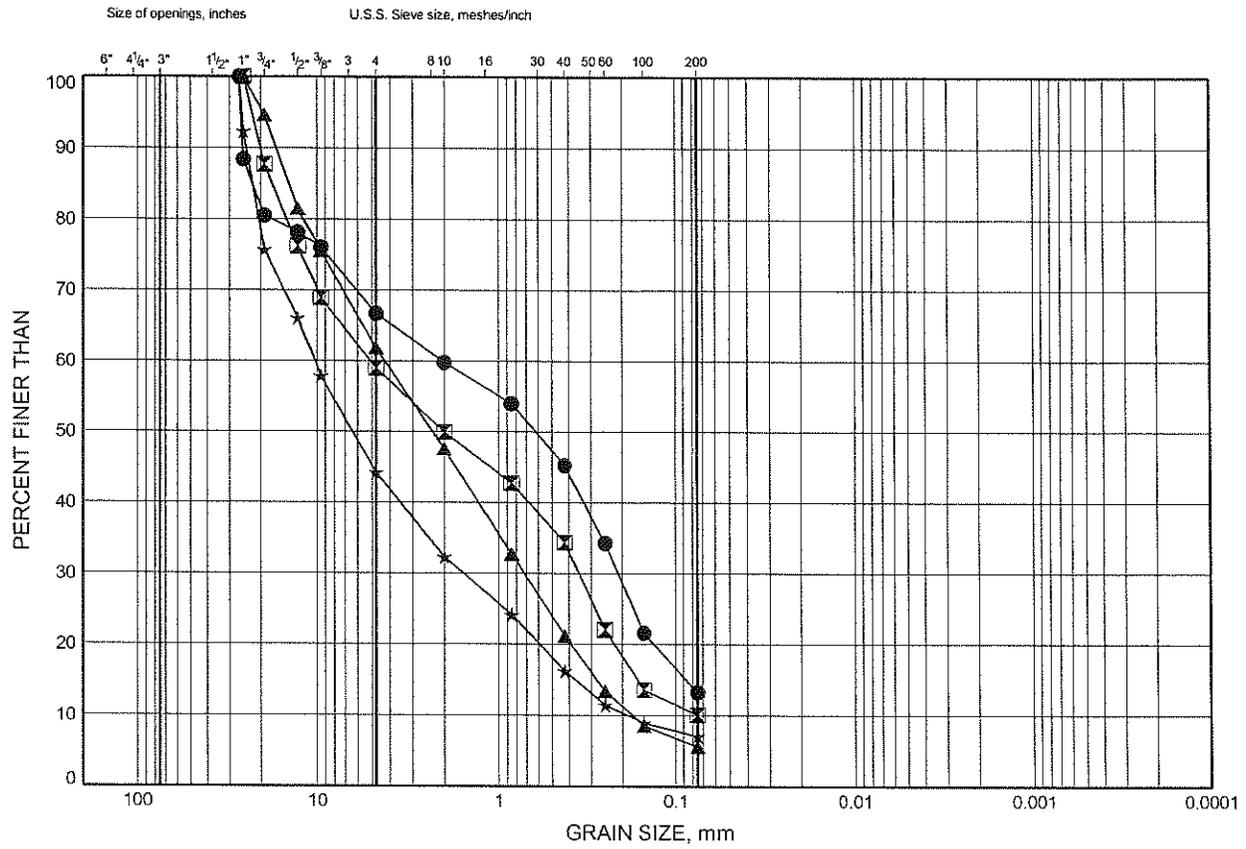
SAND TO SILT AND SAND



Highway 8 Widening Over Grand River GRAIN SIZE DISTRIBUTION

FIGURE B3

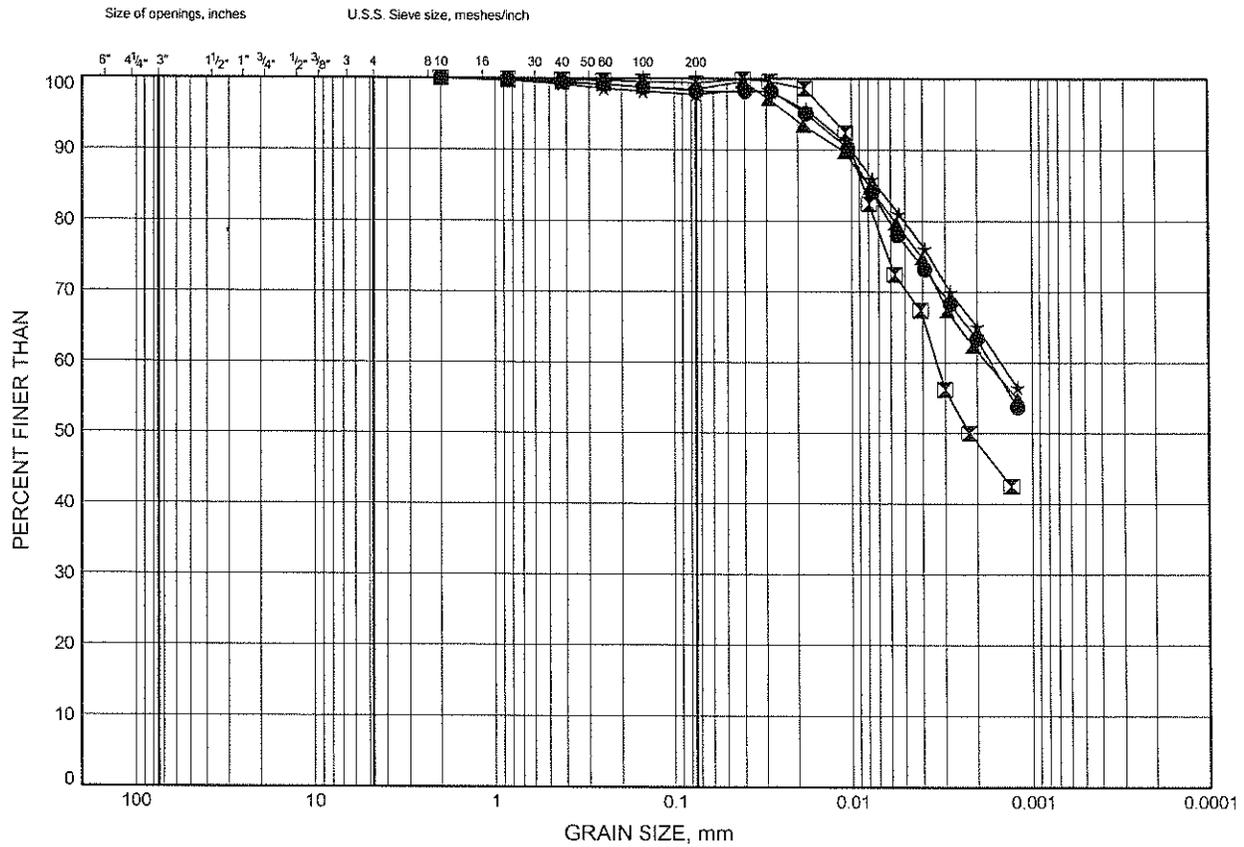
SAND AND GRAVEL TO GRAVELLY SAND



Highway 8 Widening Over Grand River GRAIN SIZE DISTRIBUTION

FIGURE B4

SILTY CLAY TILL



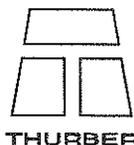
COBBLE SIZE	COARSE	FINE	COARSE	MEDIUM	FINE	SILT and CLAY
	GRAVEL		SAND			FINE GRAINED

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

THURBGSD 7898.GPJ 17/01/07

Date January 2007

Project 277-97-00



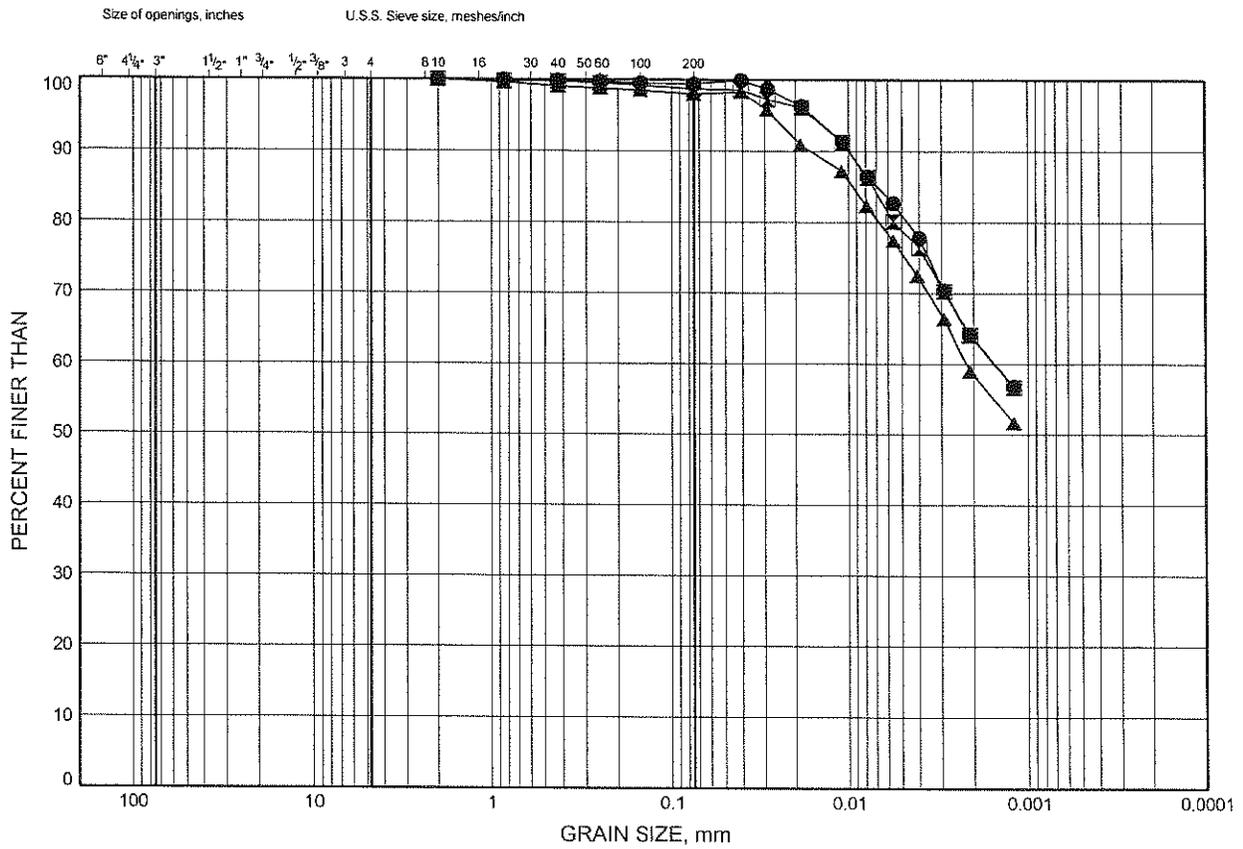
Prep'd MFA

Chkd. MRA

Highway 8 Widening Over Grand River GRAIN SIZE DISTRIBUTION

FIGURE B5

SILTY CLAY TILL

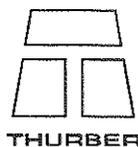


COBBLE SIZE	COARSE	FINE	COARSE	MEDIUM	FINE	SILT and CLAY
	GRAVEL		SAND			FINE GRAINED

SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	06-31	12.42	297.53
◻	06-32	12.40	296.81
▲	06-33	10.90	297.13

THURBGSD 7938.GPJ 17/01/07

Date January 2007
Project 277-97-00

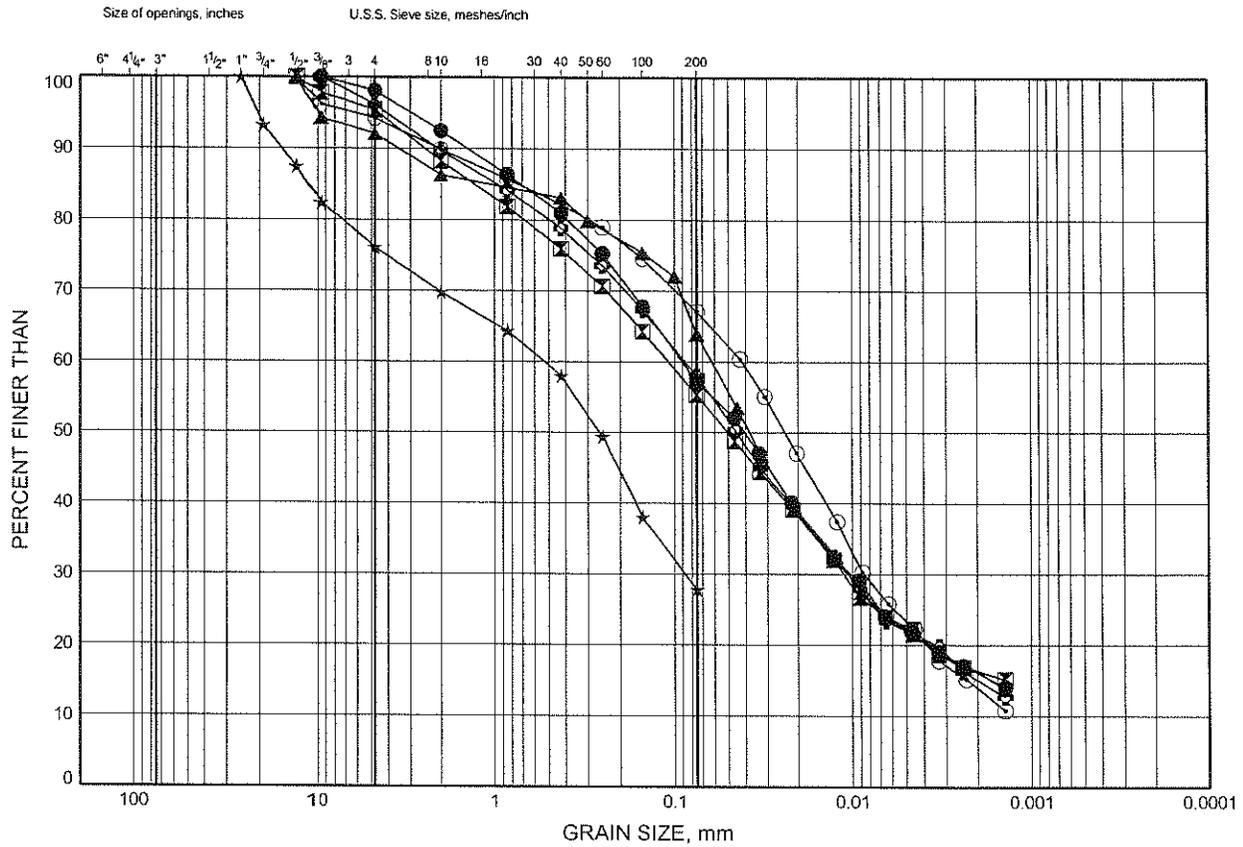


Prep'd MFA
Chkd. MRA

Highway 8 Widening Over Grand River GRAIN SIZE DISTRIBUTION

FIGURE B6

SANDY SILT TO SILTY SAND TILL

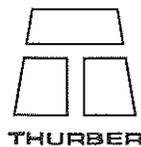


COBBLE SIZE	COARSE	FINE	COARSE	MEDIUM	FINE	SILT and CLAY
	GRAVEL		SAND			FINE GRAINED

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

THURBGS 7938.GPJ 17/01/07

Date January 2007
Project 277-97-00

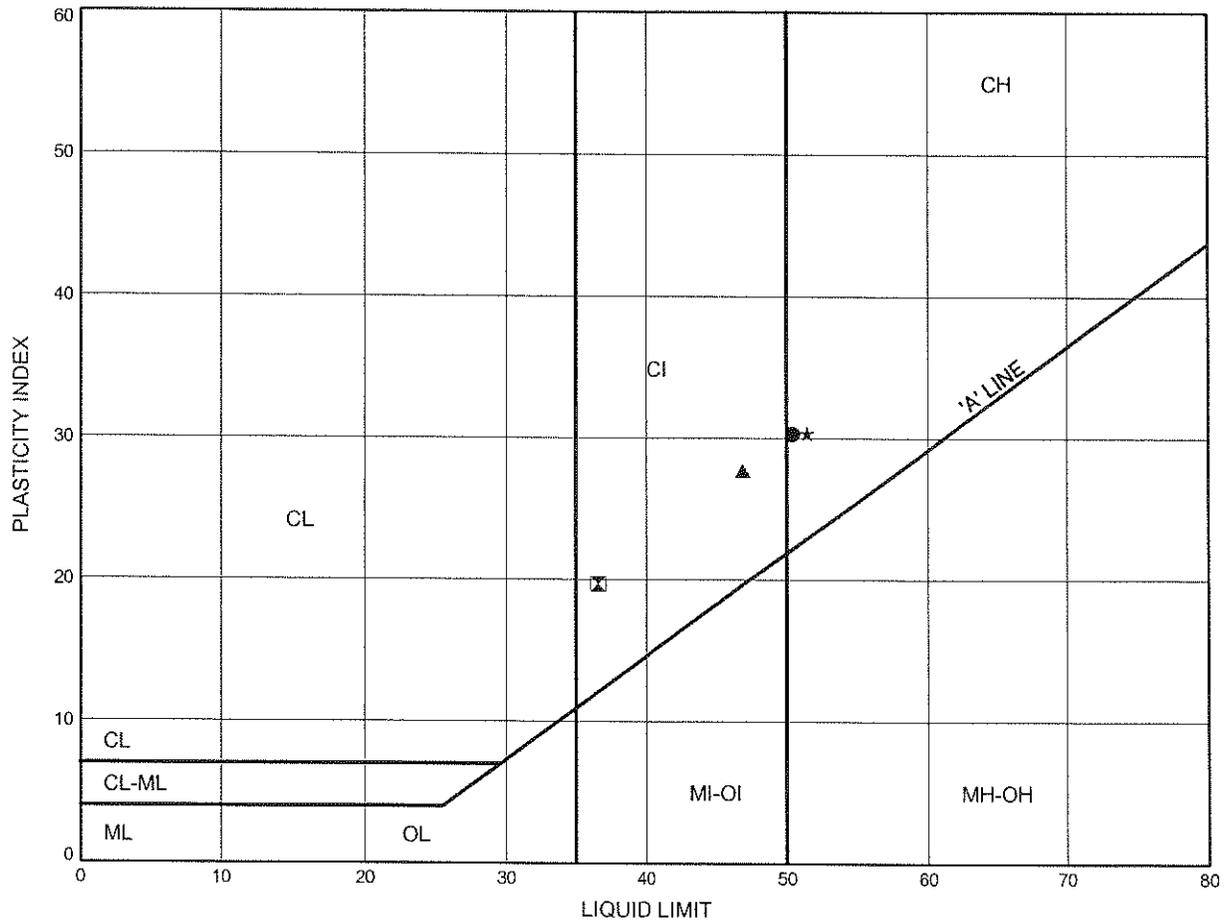


Prep'd MFA
Chkd. MRA

Highway 8 Widening Over Grand River
ATTERBERG LIMITS TEST RESULTS

FIGURE B7

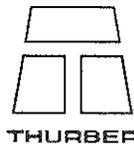
SILTY CLAY TILL



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

THURBALT 7938.GPJ 17/01/07

Date January 2007
 Project 277-97-00

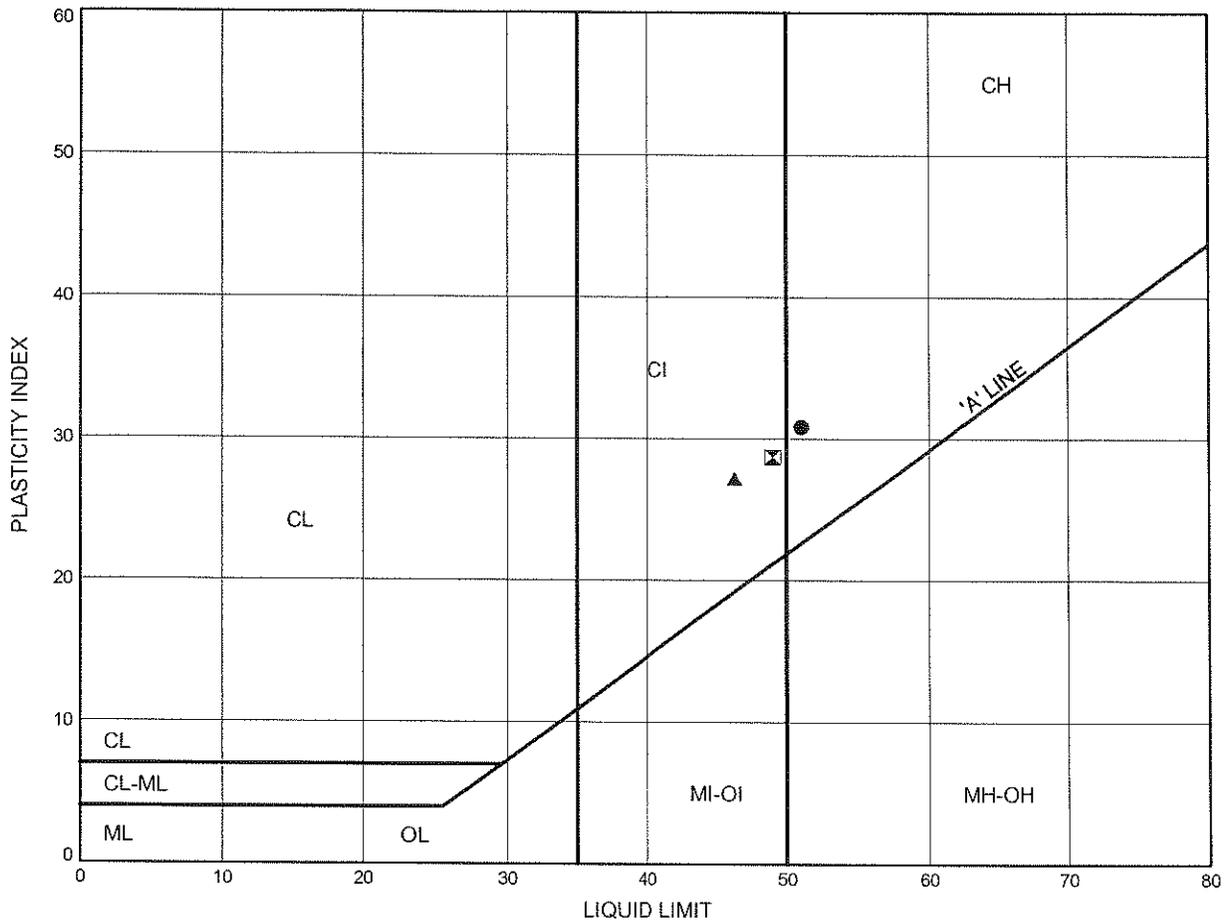


Prep'd MFA
 Chkd. MRA

Highway 8 Widening Over Grand River
ATTERBERG LIMITS TEST RESULTS

FIGURE B8

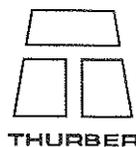
SILTY CLAY TILL



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

THURBALT 793B.GPJ 17/01/07

Date January 2007
 Project 277-97-00

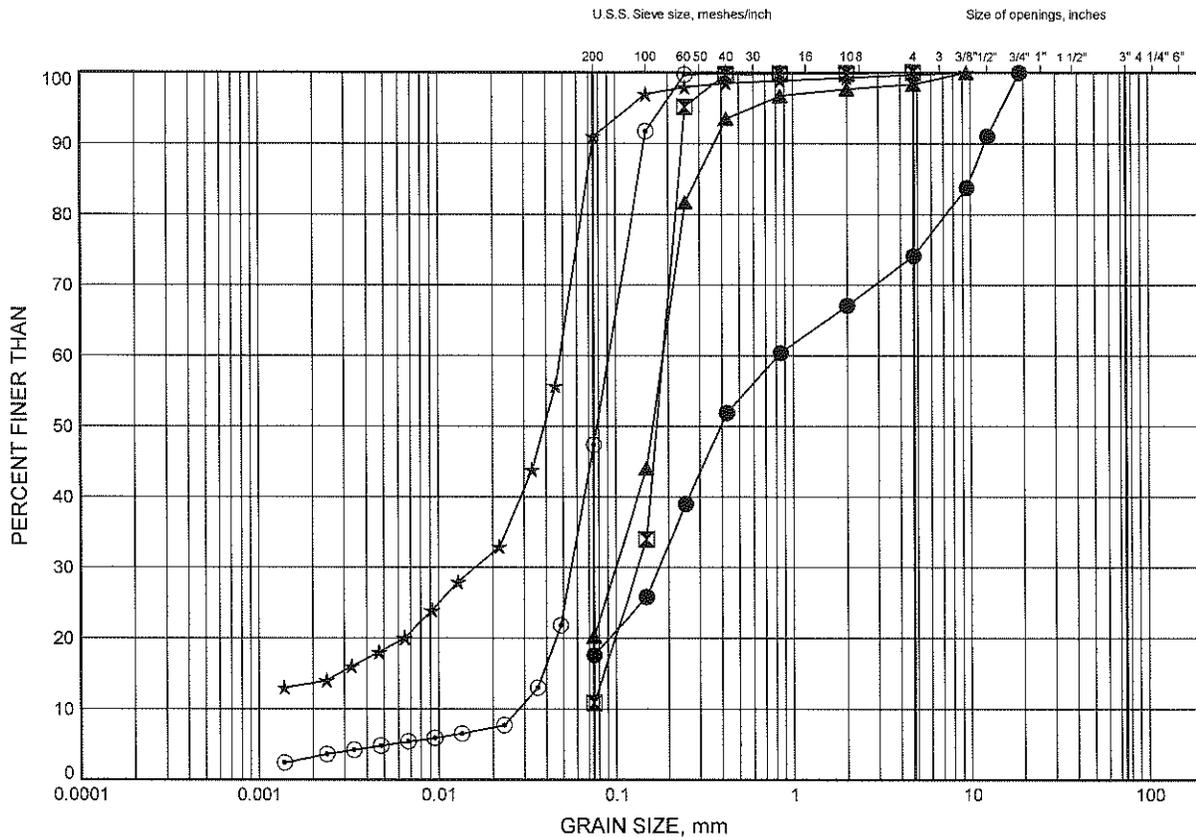


Prep'd MFA
 Chkd. MRA

Highway 8 Widening Over Grand River GRAIN SIZE DISTRIBUTION

FIGURE B9

SAND TO SILT



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	08-05	1.83	304.77
⊠	08-07	1.83	306.59
▲	08-08	2.59	305.67
☆	08-08	4.11	304.14
⊙	08-09	2.59	306.39

GRAIN SIZE DISTRIBUTION - THURBER 7938.CPJ 8/27/08

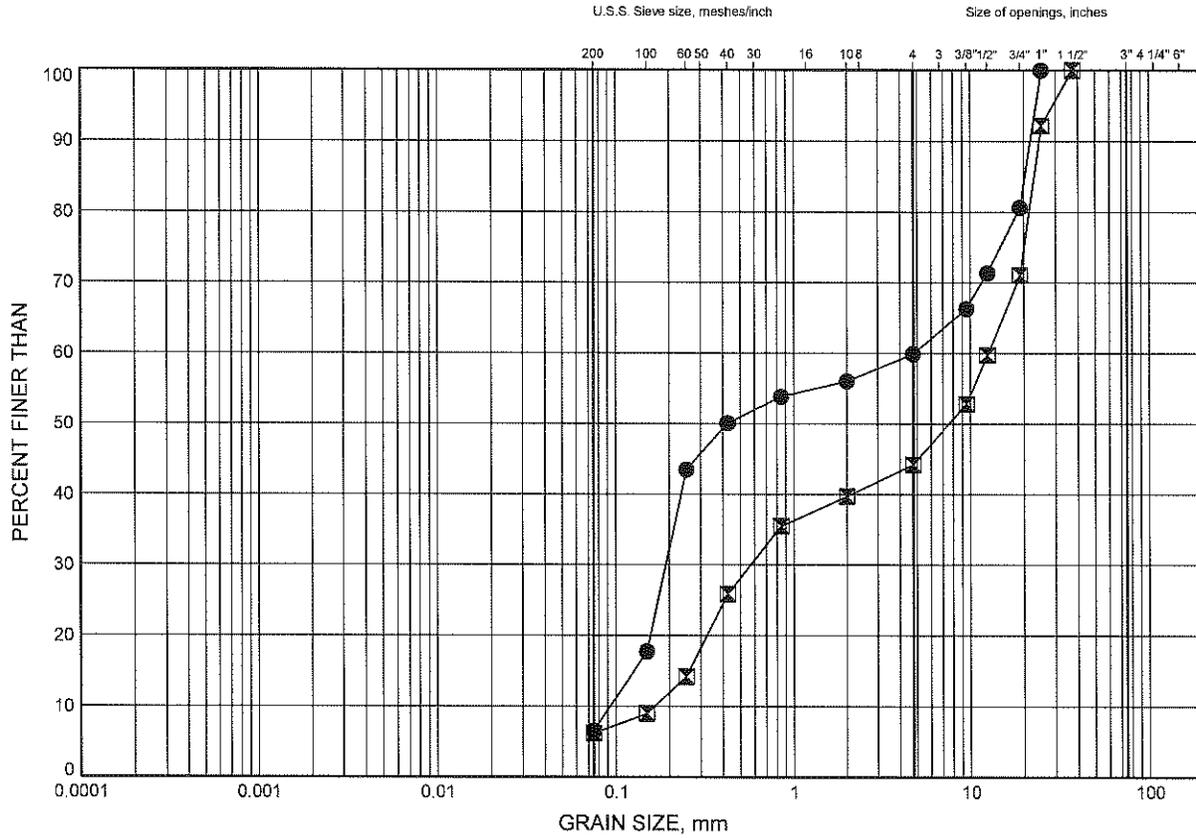
W.P.# 277-97-00.....
 Prepared By MFA.....
 Checked By MRA.....



Highway 8 Widening Over Grand River GRAIN SIZE DISTRIBUTION

FIGURE B10

SAND AND GRAVEL



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	08-04	2.59	302.02
⊠	08-05	4.11	302.48

GRAIN SIZE DISTRIBUTION - THURBER 7938 GPJ 8/27/08

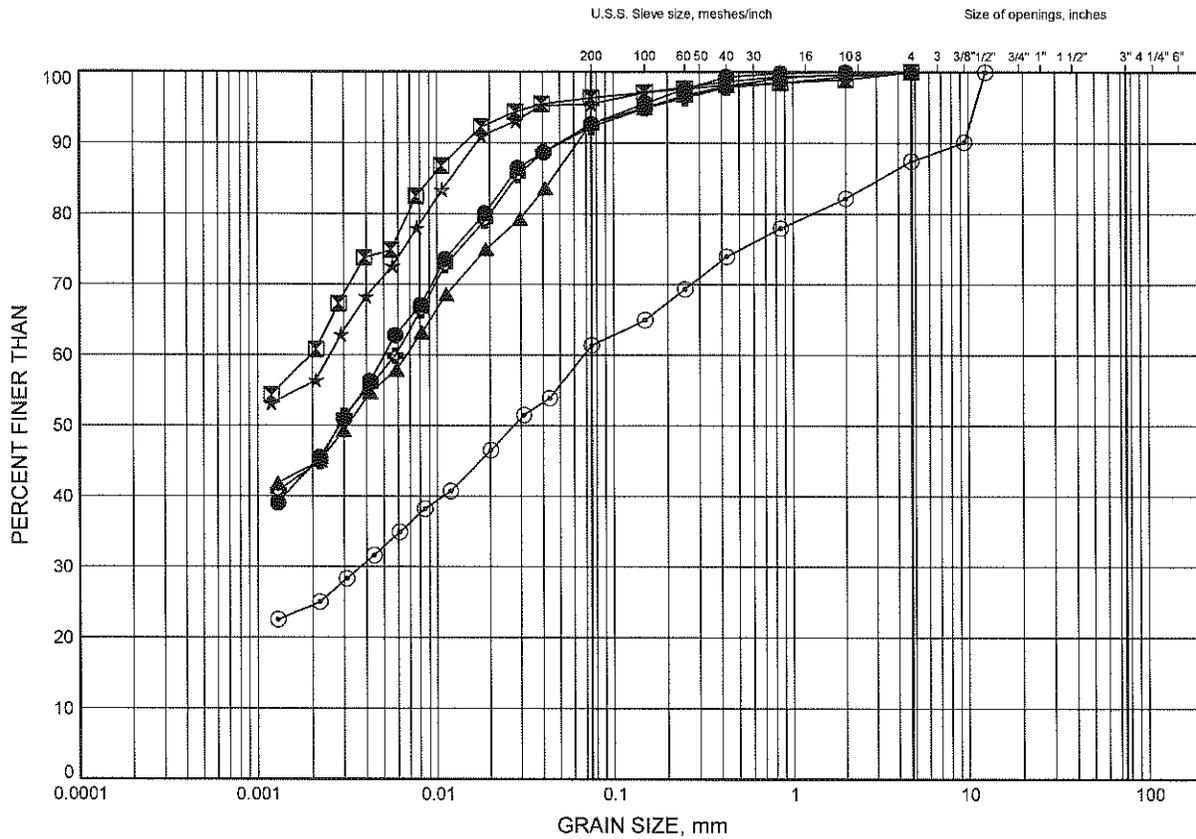
W.P.# 277-97-00
 Prepared By MFA
 Checked By MRA



Highway 8 Widening Over Grand River GRAIN SIZE DISTRIBUTION

FIGURE B11

SILTY CLAY TILL



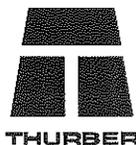
SILT and CLAY		FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
FINE GRAINED		SAND			GRAVEL		

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	08-04	3.35	301.25
☒	08-04	6.40	298.21
▲	08-05	4.88	301.72
☆	08-05	7.92	298.67
⊙	08-06	3.35	304.00
⊗	08-06	6.40	300.95

GRAIN SIZE DISTRIBUTION - THURBER 7938.GPJ 8/27/08

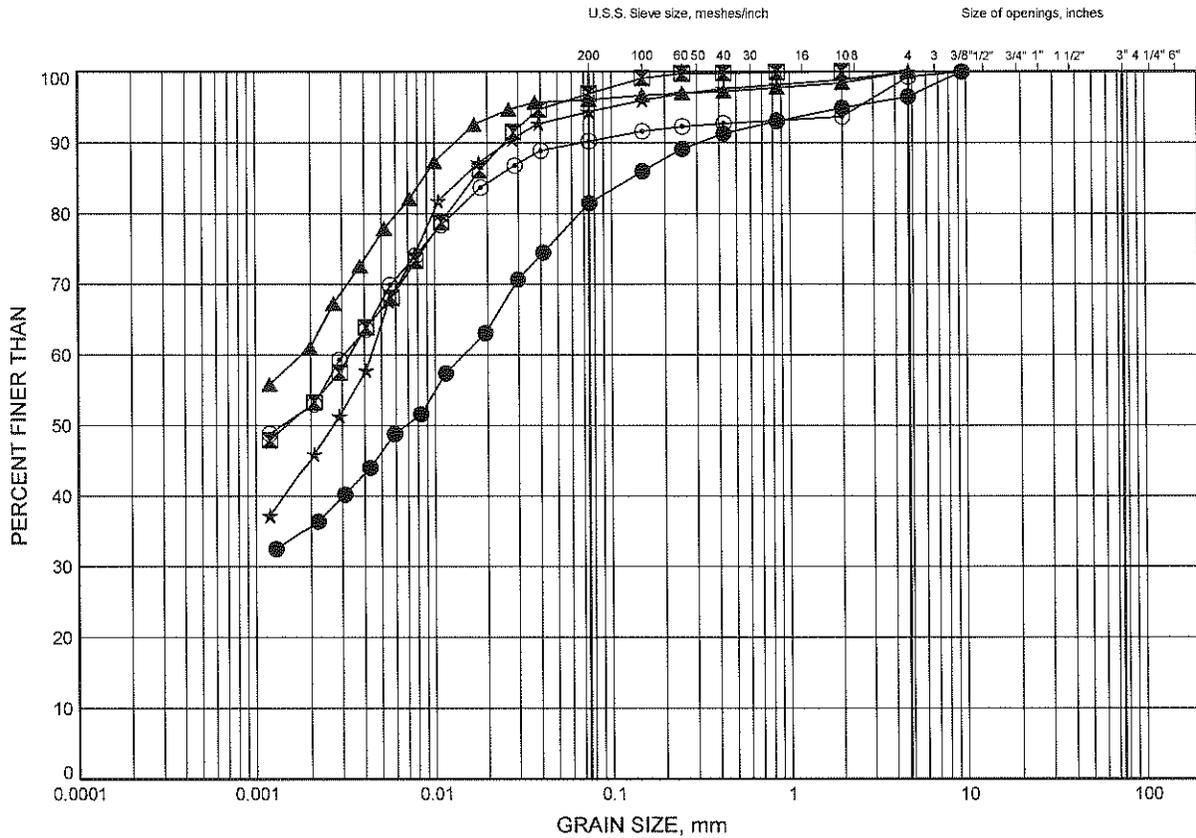
W.P.# 277-97-00
 Prepared By MFA
 Checked By MRA



Highway 8 Widening Over Grand River GRAIN SIZE DISTRIBUTION

FIGURE B12

SILTY CLAY TILL



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	08-07	3.35	305.07
⊠	08-07	9.45	298.97
▲	08-08	10.97	297.28
☆	08-09	7.92	301.06
⊙	08-09	12.50	296.49

GRAIN SIZE DISTRIBUTION - THURBER, 7938.GPJ, 8/27/08

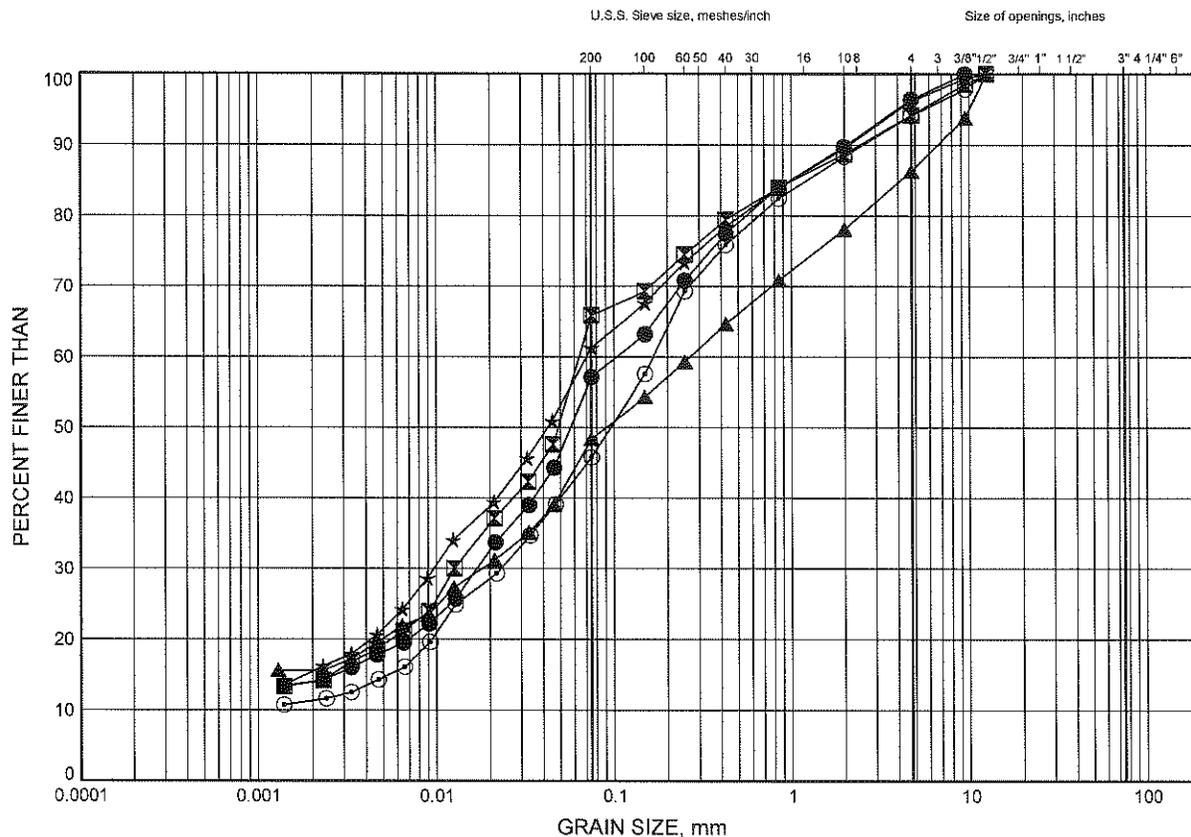
W.P.# : 277-97-00
 Prepared By : MFA
 Checked By : MRA



Highway 8 Widening Over Grand River GRAIN SIZE DISTRIBUTION

FIGURE B13

SANDY SILT TO SILTY SAND TILL



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	08-06	10.82	296.53
⊠	08-07	13.84	294.58
▲	08-08	7.77	300.48
☆	08-08	15.39	292.86
⊙	08-09	15.37	293.62

GRAIN SIZE DISTRIBUTION - THURBER 7938.GPJ 8/27/08

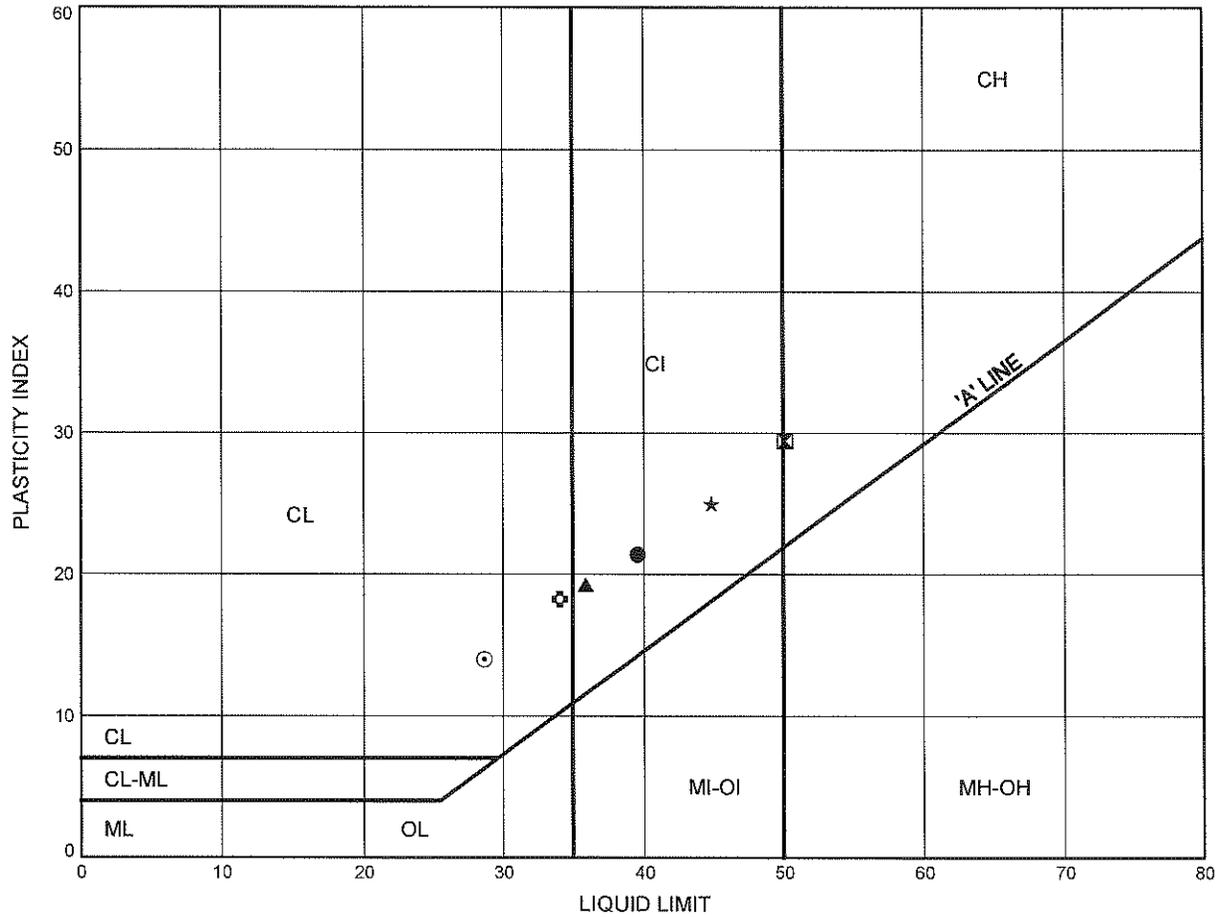
W.P.# 277-97-00
 Prepared By MFA
 Checked By MRA



Highway 8 Widening Over Grand River
ATTERBERG LIMITS TEST RESULTS

FIGURE B14

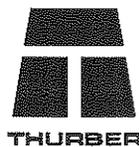
SILTY CLAY TILL



SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	08-04	3.35	301.25
⊠	08-04	6.40	298.21
▲	08-05	4.88	301.72
★	08-05	7.92	298.67
⊙	08-06	3.35	304.00
⊕	08-06	6.40	300.95

THURBALT 7938.GPJ 8/27/08

Date August 2008
 Project 277-97-00

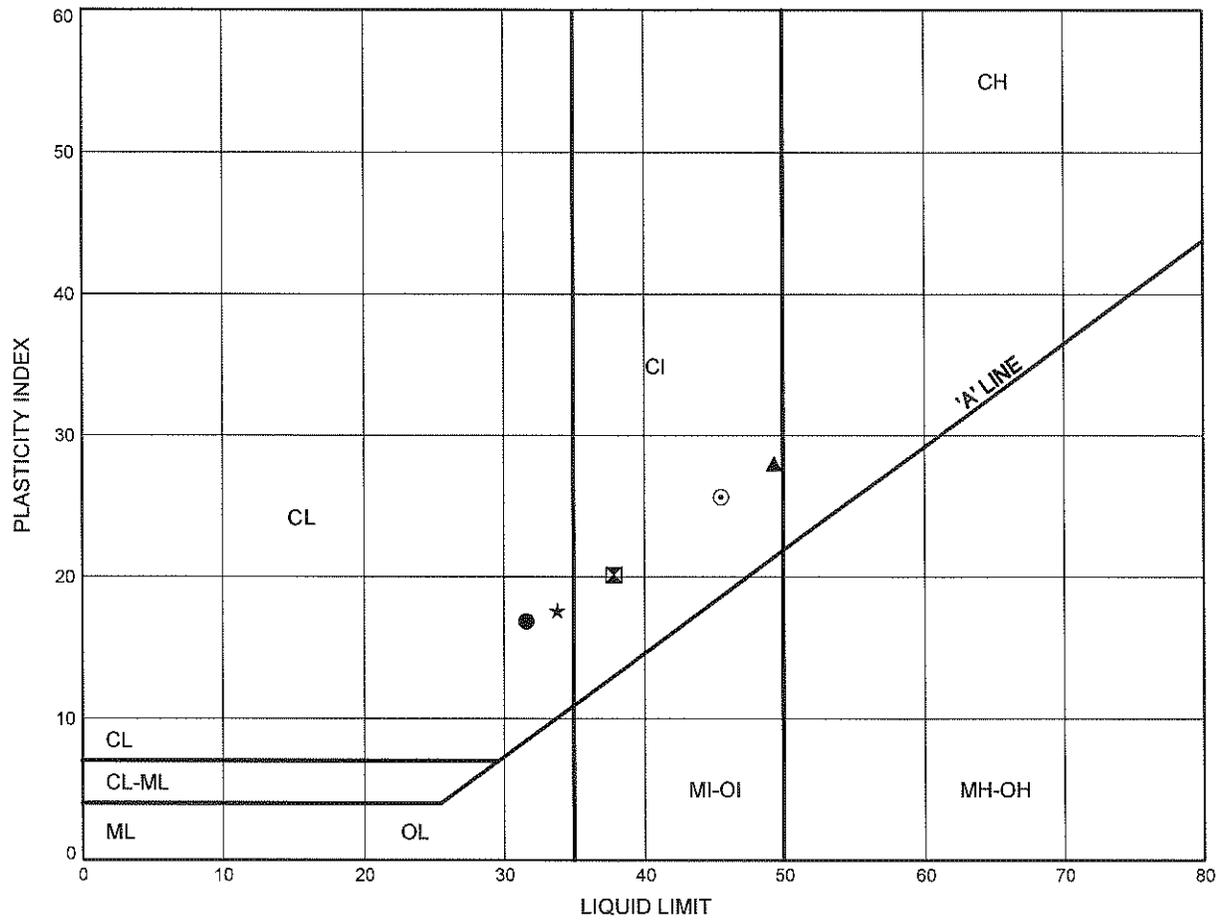


Prep'd MFA
 Chkd. MRA

Highway 8 Widening Over Grand River
ATTERBERG LIMITS TEST RESULTS

FIGURE B15

SILTY CLAY TILL



SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	08-07	3.35	305.07
⊠	08-07	9.45	298.97
▲	08-08	10.97	297.28
★	08-09	7.92	301.06
⊙	08-09	12.50	296.49

THURBALT 7938.GPJ 8/27/08

Date August 2008
 Project 277-97-00



Prep'd MFA
 Chkd. MRA

Appendix C

Tables and Figures

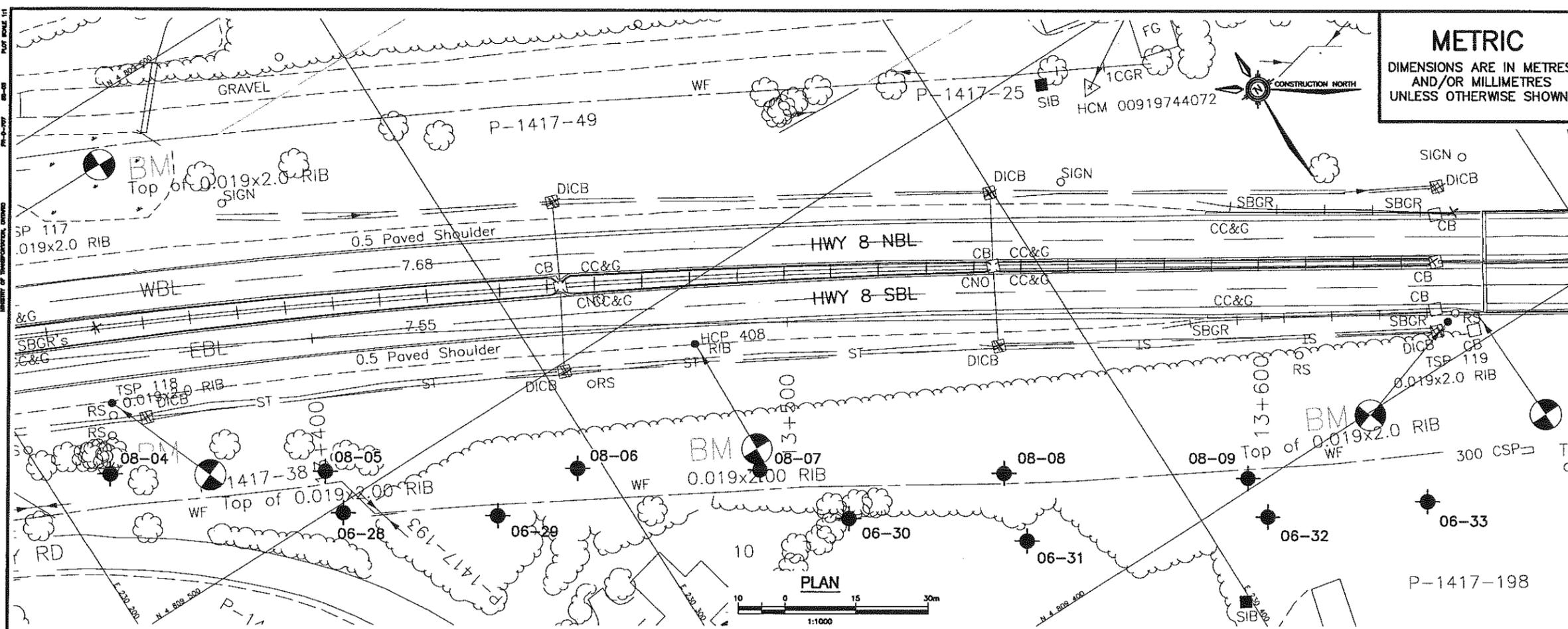
TABLE C1 – BOREHOLE COMPLETION DETAILS

Borehole	Piezometer Tip (Sand Filter) Details			Backfill
	Depth	Elevation	Stratum	
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
08-04	-	-	-	Bentonite grout to ground surface
08-05	9.1 - 5.6	297.5 – 301.0	Silty clay till	Bentonite seal to 5.0 m, grout to surface
08-06	-	-	-	Bentonite grout to ground surface
08-07	16.8 – 13.3	291.6 – 295.1	Sandy silt till	Bentonite seal to 12.8 m, grout to surface
08-08	-	-	-	Bentonite grout to ground surface
08-09	19.8 – 16.3	289.2 – 292.7	Silty sand till	Bentonite grout to 2.4 m, cuttings to surface

Appendix D

Drawings

Borehole Locations and Soil Strata



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

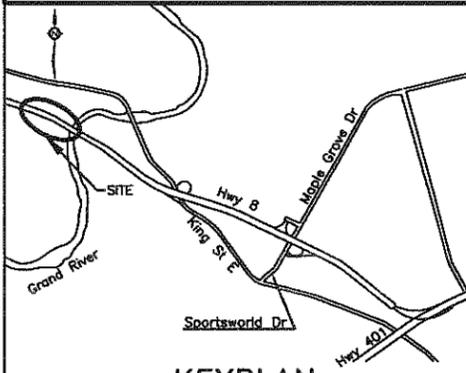
CONT No
GWP No.277-97-00

DEEP CUT
HWY 8 WIDENING
KITCHENER
BOREHOLE LOCATIONS AND SOIL STRATA

SHEET

**MORRISON
HERSHFIELD**

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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

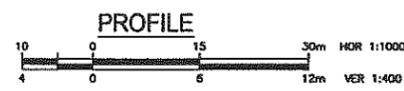
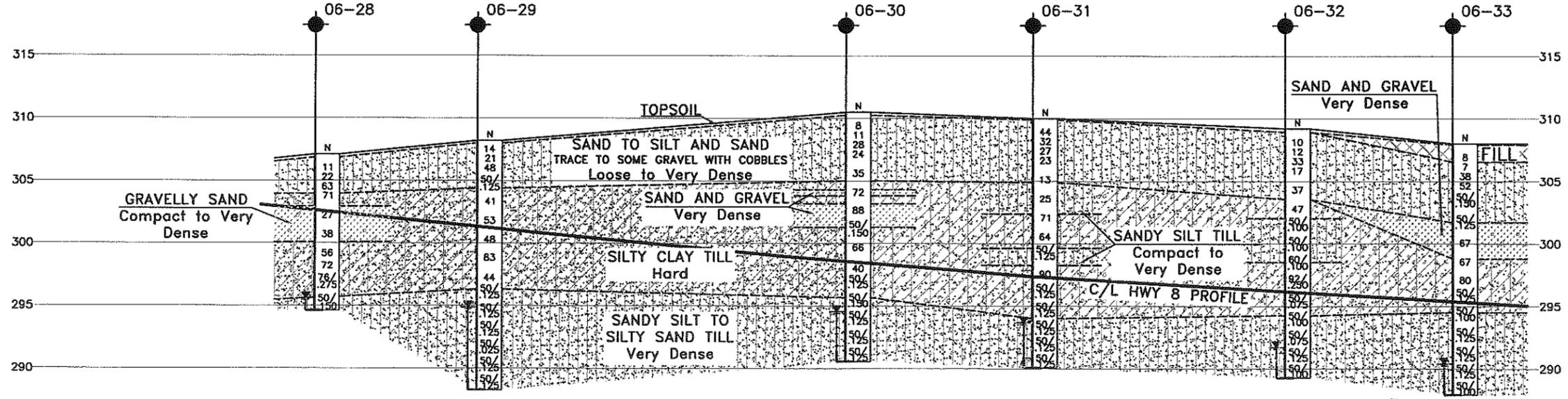
NO	ELEVATION	NORTHING	EASTING
06-28	307.1	4 809 498.2	230 248.8
06-29	308.2	4 809 480.4	230 275.7
06-30	310.5	4 809 440.1	230 337.9
06-31	310.0	4 809 416.0	230 366.9
06-32	309.2	4 809 393.0	230 412.3
06-33	308.0	4 809 377.7	230 442.3
08-04	304.6	4 809 531.2	230 211.9
08-05	306.6	4 809 507.6	230 250.2
08-06	307.4	4 809 479.7	230 295.2
08-07	308.4	4 809 458.9	230 327.4
08-08	308.3	4 809 430.6	230 370.4
08-09	309.0	4 809 402.1	230 413.1

-NOTES-

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

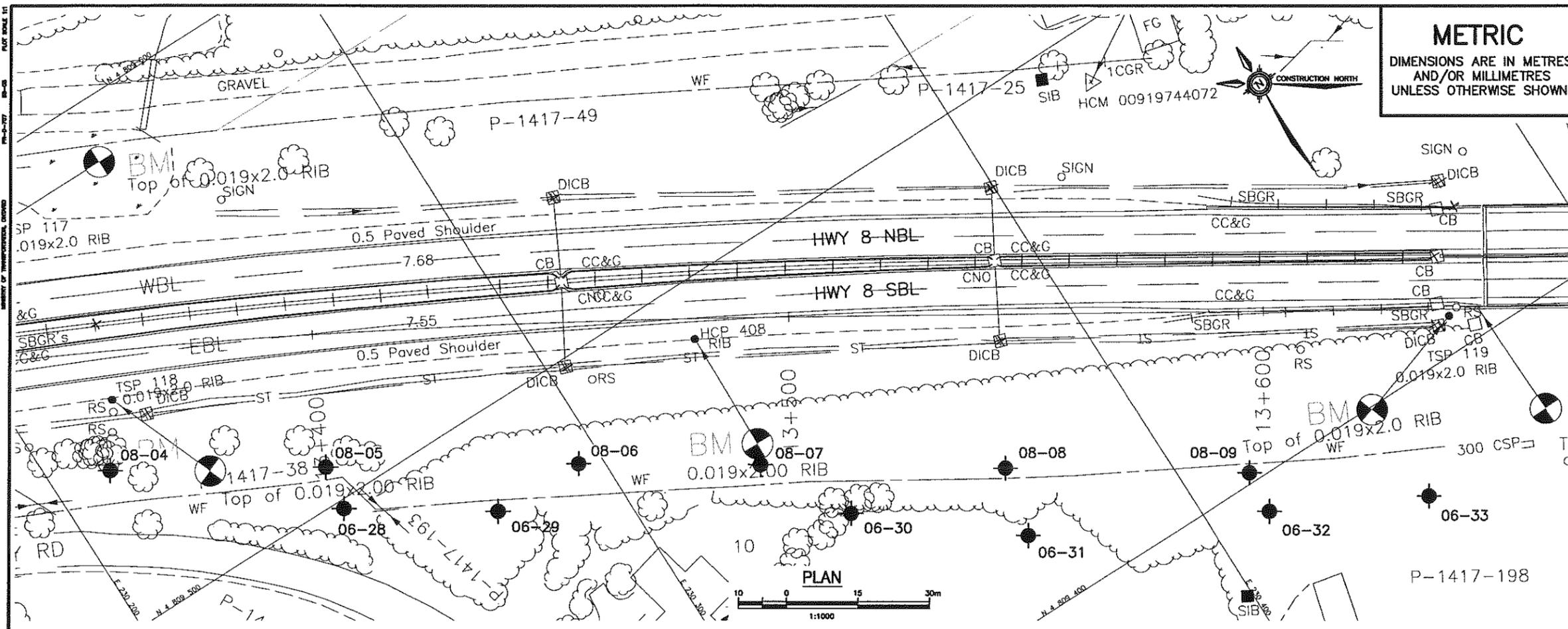
2) This drawing is for subsurface information only. Surface details and features are for conceptual illustration.

GEOCRES No. 40P8-152



DRAWING NOT TO BE SCALED
100 mm ON ORIGINAL DRAWING

REVISIONS	DATE	BY	DESCRIPTION



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

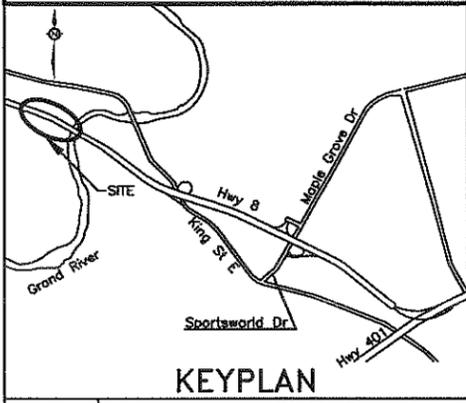
CONT No
GWP No.277-97-00

DEEP CUT
HWY 8 WIDENING
KITCHENER
BOREHOLE LOCATIONS AND SOIL STRATA

SHEET

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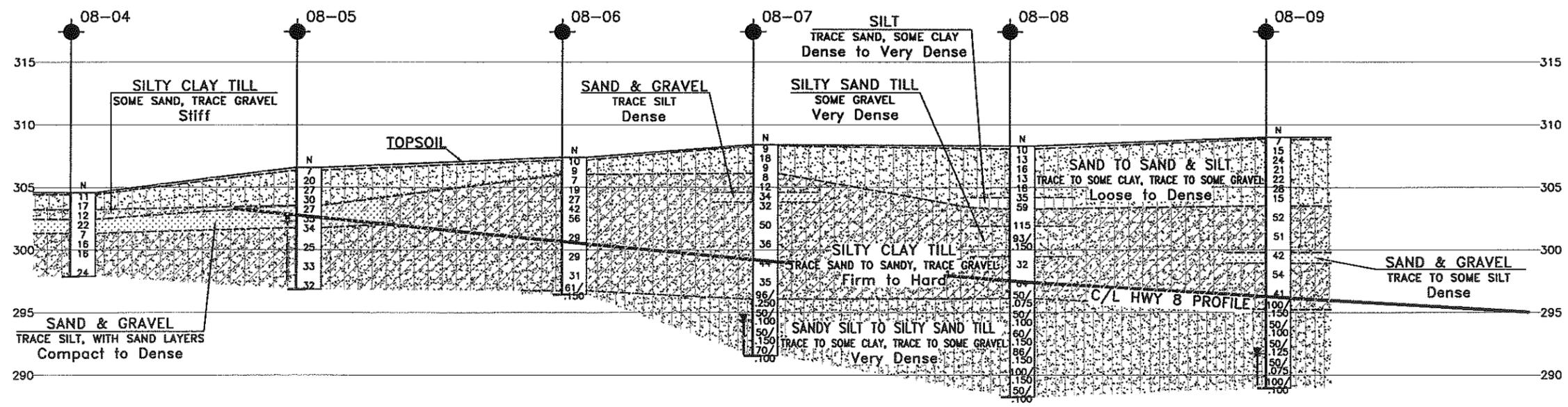
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KEYPLAN

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



NO	ELEVATION	NORTHING	EASTING
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06-30	310.5	4 809 440.1	230 337.9
06-31	310.0	4 809 416.0	230 366.9
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08-05	306.6	4 809 507.6	230 250.2
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08-07	308.4	4 809 458.9	230 327.4
08-08	308.3	4 809 430.6	230 370.4
08-09	309.0	4 809 402.1	230 413.1

-NOTES-

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

GEOCRES No. 40P8-152



DRAWING NOT TO BE SCALED
100 mm ON ORIGINAL DRAWING

DATE	BY	DESCRIPTION
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CREATED: JAN 07
MODIFIED:

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