

FOUNDATION INVESTIGATION REPORT
CULVERTS
HIGHWAY 11/17 FOUR-LANING FROM 1.0 KM WEST OF
HODDER AVENUE/COPENHAGEN ROAD EASTERLY FOR 5.8 KM
W.P. 334-94-00

Geocres Number: 52A-144

Report to

McCormick Rankin Corporation

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PART 1: FACTUAL INFORMATION

1 INTRODUCTION

This report presents the factual findings obtained from a foundation investigation conducted for three culverts to be installed in connection with the proposed widening of Highway 11/17 in Thunder Bay, Ontario.

Highway 11/17 will be widened from a two-lane undivided highway to a four-lane divided section from 1.0 km west of Hodder Avenue/Copenhagen Road easterly for 5.8 km. The project will include realignment of Copenhagen Road north of the highway. The Savigny Creek culvert under Copenhagen Road and the Catbert Creek and Ishkibibble Creek culverts crossing Highway 11/17 will be replaced.

The purpose of the investigation was to explore the subsurface conditions at the proposed culvert locations and, based on the data obtained, to provide borehole logs, borehole location plans, stratigraphic profiles, and written descriptions of the subsurface conditions.

Thurber carried out the investigation as a sub-consultant to McCormick Rankin Corporation, under the Ministry of Transportation Ontario (MTO) Agreement Number 6008-E-0005.

2 SITE DESCRIPTION

The project site lies at the northeast limit of the City of Thunder Bay. The Savigny Creek culvert under Copenhagen Road and the Catbert Creek and Ishkibibble Creek culverts crossing Highway 11/17 will be replaced with larger and longer culverts. The culvert locations are as follows:

Table 2.1 – Culvert Locations

Culvert Name	Roadway	Station
Savigny Creek	Copenhagen Road	9+572
Catbert Creek	Highway 11/17	27+525
Ishkibibble Creek	Highway 11/17	29+956

The lands surrounding the culvert sites are generally forested with low marshy areas adjacent to the creeks. The ground surface rises sharply north of the culverts on Highway 11/17. Photographs of the culvert sites are included in Appendix C.

Geologically, the site area is located within the physiographic region known as the Canadian Shield, characterized by Pre-Cambrian bedrock typically occurring as rounded knobs and ridges where exposed. At this site, the bedrock consists of the Gunflint Formation, a sequence of limestone, graphitic shale, tuff, taconite, chert-carbonite and chert. Intrusions/sills of diorite are present locally. The bedrock is overlain by a discontinuous layer of glacial till comprising a heterogeneous mixture of clayey silt, silt, sand and gravel.

3 SITE INVESTIGATION AND FIELD TESTING

The site investigation was carried out in two stages with an initial three boreholes drilled at the Savigny Creek site on July 13 and 14, 2009 and the remainder of the boreholes drilled between January 22 and 31, 2010. The boreholes were terminated upon auger refusal at depths of 0.7 to 7.2 m. One borehole location (borehole 10-107) could not be accessed by drilling equipment and therefore a hand-shovel was used to confirm bedrock at the surface at this location. A supplementary borehole (borehole 10-107A) was advanced nearby.

The approximate locations of the boreholes are shown on the attached Borehole Locations and Soil Strata Drawings in Appendix D. The borehole elevations, locations and depths are summarized in Table 3.1.

Table 3.1 – Borehole Summary

Culvert	Borehole	Ground Surface Elevation (m)	Location		Total Depth (m)
			Northing	Easting	
Savigny Creek	09-62A	256.2	5 372 403.2	365 250.9	1.5
	09-62B	256.8	5 372 421.6	365 255.9	1.7
	10-62C	256.0	5 372 404.5	365 240.7	2.4
	09-63	256.3	5 372 405.5	365 261.0	1.5
	10-63B	256.5	5 372 428.0	365 280.1	5.4
Catbert Creek	10-100	238.7	5 372 611.3	367 259.0	7.2
	10-101	238.2	5 372 585.6	367 277.1	1.5
	10-101A	238.1	5 372 589.9	367 274.1	4.4
	10-102	240.5	5 372 568.2	367 283.8	7.2
	10-103	237.9	5 372 538.1	367 298.2	3.3
Ishkibibble Creek	10-104	251.7	5 373 948.9	369 222.6	1.4
	10-105	259.9	5 373 970.8	369 208.2	4.2
	10-106	255.8	5 374 013.8	369 231.2	0.7
	10-107	263.6	5 374 060.7	369 235.9	0.0
	10-107A	260.5	5 374 044.2	369 228.7	0.8

Prior to commencing the site investigation, clearance was obtained from utility companies having plant in the area.

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

The drilling and sampling operations were supervised on a full time basis by a member of Thurber's technical staff. The supervisor logged the boreholes and processed the recovered soil samples for transport to Thurber's laboratory for further examination and testing.

Groundwater conditions in the open boreholes were observed throughout the drilling operations. In boreholes 10-100 and 10-103, standpipe piezometers consisting of 19 mm PVC pipe with a slotted screen were installed and enclosed in filter sand to permit longer term groundwater level monitoring. The completion details of the piezometers are shown in Table 3.2. Following the final water level reading, the piezometers were decommissioned in accordance with MOE Regulation 903.

The boreholes in which no piezometers were installed were backfilled with bentonite and cuttings. The borehole completion details are shown in Table 3.2.

Table 3.2 – Borehole Completion Details

Borehole	Piezometer Tip		Completion Details
	Depth (m)	Elevation (m)	
09-62A	-	-	Borehole backfilled with cuttings to surface
09-62B	-	-	Borehole backfilled with cuttings to surface
10-62C	-	-	Borehole backfilled with cuttings to 1.2 m, then bentonite to surface
09-63	-	-	Borehole backfilled with cuttings to surface
10-63B	-	-	Borehole backfilled with cuttings to 2.1 m, then bentonite to surface
10-100	7.0	231.7	Piezometer with 1.5 m slotted screen installed with sand filter to 4.9 m, bentonite seal from 4.9 m to ground surface
10-101	-	-	Borehole backfilled with cuttings to surface
10-101A	-	-	Borehole backfilled with sand to 0.9 m, then bentonite to surface
10-102	-	-	Borehole backfilled with sand to 3.9 m, then bentonite from 3.9 to 0.2 m, then asphalt to surface
10-103	3.3	234.5	Piezometer with 1.5 m slotted screen installed with sand filter to 1.8 m, bentonite seal from 1.8 m to ground surface
10-104	-	-	Borehole backfilled with cuttings to surface
10-105	-	-	Borehole backfilled with sand to 2.4 m, then bentonite from 2.4 to 0.2 m, then asphalt to surface
10-106	-	-	Borehole backfilled with cuttings to surface
10-107A	-	-	Borehole backfilled with cuttings to surface

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.

Selected samples were also subjected to gradation analysis 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

Reference is made to the Record of Borehole sheets in Appendix A. Details of the encountered soil stratigraphy are presented in these appendices 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.

5.1 Savigny Creek Culvert

Boreholes 09-62A, 09-62B, 10-62C, 09-63 and 10-63B

The stratigraphy encountered in the boreholes drilled at Savigny Creek consisted of a layer of peat, organics or topsoil of varying thickness, overlying discontinuous deposits of silt, silty clay and silty sand, underlain by silty sand to sand and silt till.

Peat, Organics and Topsoil

The surficial organic layer encountered in the boreholes varied from a 200 mm thick topsoil layer in borehole 09-62A, to a 300 mm thick layer of black organics in boreholes 09-62B and 09-63, to a dark brown peat deposit extending to depths of 1.5 and 2.0 m in boreholes 10-62C and 10-63B. The base of the peat layer is at elevation 254.4 to 254.5 m.

Standard Penetration Test ‘N’ values of 0 to 3 blows/0.3 m were recorded in the peat layer. Moisture contents ranged from 87 to 155%.

Silt

A 2.3 m thick layer of grey silt, some clay, trace sand was encountered below the peat in borehole 10-63B. The lower boundary of the silt was at 4.3 m depth (elevation 252.3 m).

SPT ‘N’ values of 16 and 8 blows/0.3 m were obtained in the silt, indicating a compact to loose condition. Moisture contents ranged from about 23 to 28%.

The results of a laboratory grain size distribution test carried out on a sample of the silt (Figure B1, Appendix B) were as follows:

Gravel (%)	0
Sand (%)	1
Silt (%)	88
Clay (%)	11

Silty Clay

A discontinuous silty clay layer was encountered below the organic layer in borehole 09-62B and below the silt deposit in borehole 10-63B. The clay was described as dark brown with topsoil staining (organics) in borehole 09-62B and grey in borehole 10-63B. The clay layer was 1.1 and 0.6 m thick in the respective boreholes, with a lower boundary at elevation 255.4 and 251.7 m.

SPT 'N' values of 4 and 8 blows/0.3 m were obtained in the clay, indicating a soft to firm consistency. Moisture contents of 70% (borehole 09-62B) and 17% (borehole 10-63B) were determined.

The results of a laboratory grain size distribution test and Atterberg Limits test carried out on a sample of the clay were as follows:

Gravel (%)	5
Sand (%)	19
Silt (%)	57
Clay (%)	19
Liquid Limit	28
Plastic Limit	19

The grains size and Atterberg Limits test results are plotted on Figures B2 and B6 of Appendix B, respectively. The Atterberg Limits indicate that the clay is low plastic (CL).

Silty Sand

A 0.5 m thick layer of loose to compact, grey silty sand was encountered below the clay in borehole 10-63B. Auger refusal was met in this deposit at 5.4 m depth (elevation 251.1 m). A moisture content of 12% was determined.

Silty Sand to Sand and Silt Till

A till deposit consisting of silty sand to sand and silt was encountered below the organic deposits in boreholes 09-62A, 10-62C and 09-63, and below the clay layer in borehole 09-62B. The upper boundary of this unit was encountered at depths of 0.2 to 1.5 m (elevation 254.4 to 256.0 m). Auger refusal was met at depths of 1.5 to 2.4 m in/below the till. Till soils often contain cobbles and boulders.

SPT 'N' values recorded in three of the boreholes ranged from 4 to 17 blows/0.3 m, indicating a loose to compact condition. 'N' values of 50 blows/0.075 m and 100 blows/0.1 m were obtained in two boreholes, reflecting the presence of cobbles or possible bedrock. The moisture content of samples from this deposit ranged from about 10 to 15%, locally 32% in borehole 09-62A.

The results of laboratory grain size distribution tests carried out on samples of the till are shown in Figure B3, Appendix B. The results were as follows:

Gravel (%)	4 to 12
Sand (%)	48 to 57
Silt (%)	23 to 38
Clay (%)	4 to 10

Auger Refusal

Auger refusal was encountered on possible bedrock or boulders at depths of 1.5 to 5.4 m in all boreholes. The depths to auger refusal are summarized in Table 5.1.

Table 5.1 – Depth to Auger Refusal

Borehole	Depth to Refusal (m)	Refusal Elevation (m)
09-62A	1.5	254.6
09-62B	1.7	255.1
10-62C	2.4	253.6
09-63	1.5	254.7
10-63B	5.4	251.1

Groundwater

The groundwater depths and elevations observed in the boreholes upon completion of drilling are summarized in Table 5.2.

Table 5.2 – Groundwater Depths and Elevations

Borehole	Date	Water Level (m)	
		Depth	Elevation
09-62A	13-Jul-09	0.8	255.4
09-62B	14-Jul-09	Dry	-
10-62C	31-Jan-10	1.4	254.6
09-63	13-Jul-09	1.4	254.9
10-63B	31-Jan-10	0.7	255.7

The above water levels reflect the unstabilized conditions in the boreholes upon completion of drilling. The measurements are short-term observations and seasonal fluctuations of the groundwater level are to be expected.

5.2 Catbert Creek Culvert

Boreholes 10-100 to 10-103

The subsurface stratigraphy encountered in the boreholes drilled at Catbert Creek consisted of a peat layer or existing highway embankment fill overlying sandy silt to silty sand. Auger refusal was met below the sands and silts at depths of 1.5 to 7.2 m.

Fill

Borehole 10-102 was drilled on the north side of the existing Highway 11/17 embankment and encountered a 75 mm thick asphalt layer overlying sand and gravel fill to 1.5 m depth (elevation 239.0 m), followed by a 0.8 m thick layer of silt and sand fill. The lower boundary of the fill was encountered at a depth of 2.3 m (elevation 238.2 m).

The sand and gravel fill was described as brown, and the sand and silt fill was dark brown.

A Standard Penetration Test 'N' value of 50 blows/0.125 m was obtained in the sand and gravel, reflecting a frozen or very dense condition. An 'N' value of 32 blows/0.3 was recorded in the sand and silt fill, indicating a dense condition.

Moisture contents were approximately 6 and 9 % in the sand and gravel fill, and 12% in the sand and silt fill.

Peat

A 0.6 to 0.9 m thick layer of peat was encountered in boreholes 10-100, 10-101A and 10-103. The lower boundary of the peat was at elevation 236.9 to 238.1 m, rising to the north. The moisture content of the peat ranged from 34 to 204%.

Sandy Silt to Silty Sand

A relatively thick deposit of sands and silts, ranging from sandy silt to silty sand, was encountered at the ground surface in borehole 10-101 and below the peat and fill in the remaining boreholes. The sand/silt was described most often as grey, however it was brown in borehole 10-101, dark brown with organics in the upper 0.7 m of this unit in borehole 10-101A, and brown to dark brown to about 5 m depth in borehole 10-102.

Auger refusal was encountered within or below the sand/silt at depths of 1.5 to 7.2 m.

The results of laboratory grain size distribution tests carried out on samples of the sands and silts are illustrated in Figure B4, Appendix B. The results were as follows:

Gravel (%)	1 to 8
Sand (%)	29 to 55
Silt (%)	37 to 65
Clay (%)	4 to 5

SPT 'N' values obtained in the sands and silts were variable. In the upper 0.7 to 1.5 m of this deposit in boreholes 10-101 to 10-103, 'N' values ranged from 1 to 7 blows/0.3 m,

indicating a loose to very loose condition. Below this zone (elevation 235.6 to 236.6 m) and below the peat in borehole 10-100 (elevation 238.1 m), 'N' values ranged from 16 to 100 blows/0.3 m, indicating a variable compact to very dense condition.

The moisture content of samples from this deposit ranged from about 10 to 25%.

Auger Refusal

Auger refusal was encountered on possible bedrock or boulders at depths of 1.5 to 7.2 m in all boreholes. The depths to auger refusal are summarized in Table 5.3.

Table 5.3 – Depth to Auger Refusal

Borehole	Depth to Refusal (m)	Refusal Elevation (m)
10-100	7.2	231.6
10-101	1.5	236.7
10-101A	4.4	233.7
10-102	7.2	233.3
10-103	3.3	234.5

Groundwater

The groundwater depths and elevations observed in the boreholes upon completion of drilling and subsequently in the piezometers installed in two boreholes are summarized in Table 5.4.

Table 5.4 – Groundwater Depths and Elevations

Borehole	Date	Water Level (m)		Event
		Depth	Elevation	
10-100	29-Jan-10	2.4	236.3	Upon completion
	31-Jan-10	0.5	238.2	In piezometer
	01-Mar-10	0.9	237.8	In piezometer
10-101	24-Jan-10	1.4	236.8	Upon completion
10-101A	31-Jan-10	0.8	237.3	Upon completion
10-102	26-Jan-10	2.2	238.3	Upon completion
10-103	23-Jan-10	0.0	237.9	Upon completion
	31-Jan-10	0.6	237.3	In piezometer
	01-Mar-10	0.7	237.2	In piezometer

The above water levels reflect the unstabilized conditions in the boreholes upon completion of drilling or the piezometric head at the level of the piezometer tips at the time of the readings. The measurements are short-term observations and seasonal fluctuations of the groundwater level are to be expected.

5.3 Ishkibibble Creek Culvert Boreholes 104 to 107A

The subsurface stratigraphy encountered in the boreholes drilled at Ishkibibble Creek consisted of existing embankment fill overlying a relatively thin layer of silty sand. Auger refusal was met at depths of 0.7 to 4.2 m, and bedrock was exposed at the north end of the culvert alignment.

Fill

Borehole 10-105 was drilled on the north side of the existing Highway 11/17 embankment and encountered a 75 mm thick asphalt layer overlying sand and gravel fill to 1.5 m depth, followed by sand fill to 3.0 m depth (elevation 256.9 m). Borehole 10-104, drilled near the south toe of the highway embankment, encountered 0.8 m of sand and gravel fill.

The sand and gravel fill was described as brown in borehole 10-105, and brown to dark brown in borehole 10-104. The underlying sand fill in borehole 10-105 was dark brown.

Standard Penetration Test 'N' values of 47 and 55 blows/0.3 m were obtained in the sand fill, indicating a dense to very dense condition.

Moisture contents in the fill were approximately 7 to 11 % in borehole 10-105, and 30% in borehole 10-104.

The results of a laboratory grain size distribution test carried out on a sample of the sand fill are shown on Figure B5 in Appendix B and were as follows:

Gravel (%)	20
Sand (%)	60
Silt and Clay (%)	20

Silty Sand

A thin layer of silty sand was encountered below the fill in boreholes 10-104 and 10-105 and at the ground surface in boreholes 10-106 and 10-107A. The silty sand was described brown to dark brown with occasional roots or organics. Auger refusal was encountered at depths of 0.7 to 4.2 m, indicating a layer thickness of 0.6 to 1.2 m.

SPT 'N' values obtained in the silty sand ranged from 17 to 52 blows/0.3 m, indicating a compact to very dense condition.

Moisture contents of 8 and 20% were determined in this deposit.

Auger Refusal

Auger refusal was encountered on possible bedrock or boulders at depths of up to 4.2 m in all boreholes. The depths to auger refusal are summarized in Table 5.5.

Table 5.5 – Depth to Auger Refusal

Borehole	Depth to Refusal (m)	Refusal Elevation (m)
10-104	1.4	250.3
10-105	4.2	255.7
10-106	0.7	255.1
10-107A	0.8	259.8
10-107	0.0	263.6

Groundwater

Groundwater was not observed in the boreholes during or upon completion of drilling. The water level observations are short-term and seasonal fluctuations of the groundwater level are to be expected.

6 MISCELLANEOUS

J.D. Barnes Limited determined the co-ordinates and ground elevations at the boreholes following completion of the site investigation.

TBT Engineering Consulting Group of Thunder Bay, Ontario supplied and operated the drilling and sampling equipment for the field program. Full time supervision of the field activities, including obtaining utility clearances, was carried out by Mr. Stephane Loranger and Mr. Jason Mei of Thurber.

Supervision of the field program, interpretation of the field data, and preparation of the report was performed by Mr. Tony Harte and Mr. Murray Anderson, 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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Review Principal



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
	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			

RECORD OF BOREHOLE No 09-062A

1 OF 1

METRIC

G.W.P. 334-94-00 LOCATION N 5 372 403.2 E 365 250.9 ORIGINATED BY SLL
 HWY 11/17 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2009.07.13 - 2009.07.13 CHECKED BY TH

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		
256.2														
0.0	TOPSOIL, with roots and rootlets													
0.2	Silty SAND, some gravel, trace clay Loose Brown Wet (TILL)		1	SS	4									
254.6														
1.5	END OF BOREHOLE AT 1.5m UPON AUGER REFUSAL ON PROBABLE BEDROCK. BOREHOLE OPEN TO 1.1m AND WATER LEVEL AT 0.8m UPON COMPLETION. BOREHOLE BACKFILLED WITH CUTTINGS TO SURFACE.													

RECORD OF BOREHOLE No 09-062B

1 OF 1

METRIC

G.W.P. 334-94-00 LOCATION N 5 372 421.6 E 365 255.9 ORIGINATED BY SLL
 HWY 11/17 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2009.07.14 - 2009.07.14 CHECKED BY TH

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									
256.8							20	40	60	80	100	20	40	60			
0.0	ORGANICS, with roots and rootlets Black																
256.5																	
0.3	Silty CLAY, topsoil stained, trace roots and rootlets Soft to Firm Dark Brown		1	SS	4										○		
255.4																	
1.4	Silty SAND		2	SS	50										○		
255.1	Very Dense Brown (TILL)																
1.7	END OF BOREHOLE AT 1.7m UPON AUGER REFUSAL ON PROBABLE BEDROCK. BOREHOLE OPEN AND DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH CUTTINGS TO SURFACE.				0.75												

+³ . X³ : Numbers refer to
Sensitivity

20
15 10 5
10 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 10-062C

1 OF 1

METRIC

G.W.P. 334-94-00 LOCATION N 5 372 404.5 E 365 240.7 ORIGINATED BY JM
 HWY 11/17 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2010.01.31 - 2010.01.31 CHECKED BY TH

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						
256.0								20 40 60 80 100						
0.0	PEAT, trace roots Dark Brown Frozen		1	AS		▽	256	○ UNCONFINED + FIELD VANE						
			1	SS	3		255	● QUICK TRIAXIAL × LAB VANE						
254.4														
1.5	SAND and SILT, some gravel Compact Grey Moist (TILL)		2	SS	15		254							10 48 38 4
253.6			3	SS	100/									
2.4	END OF BOREHOLE AT 2.4m UPON AUGER REFUSAL ON PROBABLE BEDROCK. BOREHOLE OPEN TO 1.7m, AND WATER LEVEL AT 1.4m UPON COMPLETION. BOREHOLE BACKFILLED WITH CUTTINGS TO 1.2m, THEN BENTONITE TO SURFACE.				0.100									

+³ ×³: Numbers refer to
Sensitivity

20
15
10

(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 09-063

1 OF 1

METRIC

G.W.P. 334-94-00 LOCATION N 5 372 405.5 E 365 261.0 ORIGINATED BY SLL
 HWY 11/17 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2009.07.13 - 2009.07.13 CHECKED BY TH

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						
256.3								SHEAR STRENGTH kPa						
0.0	ORGANICS, peat		1	AS				○ UNCONFINED + FIELD VANE						
256.0	Black							● QUICK TRIAXIAL × LAB VANE						
0.3	SAND and SILT, some clay, trace gravel Compact Grey Wet (TILL)		1	SS	17		256	WATER CONTENT (%)						GR SA SI CL
254.7							255							4 48 38 10
1.5	END OF BOREHOLE AT 1.5m UPON AUGER REFUSAL ON PROBABLE BEDROCK. BOREHOLE OPEN AND WATER LEVEL AT 1.4m UPON COMPLETION. BOREHOLE BACKFILLED WITH CUTTINGS TO SURFACE.													

RECORD OF BOREHOLE No 10-063B

1 OF 1

METRIC

G.W.P. 334-94-00 LOCATION N 5 372 428.0 E 365 280.1 ORIGINATED BY JM
 HWY 11/17 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2010.01.31 - 2010.01.31 CHECKED BY TH

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 (%)			
								○ UNCONFINED		+ FIELD VANE		● QUICK TRIAXIAL				x LAB VANE		
256.5							20	40	60	80	100	PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L				
0.0	PEAT, trace roots Dark Brown Frozen to Moist		1	AS		▽												
	Occasional silt Very Loose		1	SS	0													
			2	SS	0													
254.5																		
2.0	SILT, some clay, trace sand Loose to Compact Grey Moist		3	SS	16													
			4	SS	8													
252.3																		
4.3	Silty CLAY, some sand, trace gravel Firm Grey Moist		5	SS	8													
251.7																		
4.9	Silty SAND, trace gravel Loose to Compact Grey Moist																	
251.1																		
5.4	END OF BOREHOLE AT 5.4m UPON AUGER REFUSAL ON PROBABLE BEDROCK. BOREHOLE OPEN TO 3.7m, AND WATER LEVEL AT 0.7m UPON COMPLETION. BOREHOLE BACKFILLED WITH CUTTINGS TO 2.1m, THEN BENTONITE TO SURFACE.																	

+³ . x³ : Numbers refer to
Sensitivity

20
15
10

(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 10-100

1 OF 1

METRIC

G.W.P. 334-94-00 LOCATION N 5 372 611.3 E 367 259.0 ORIGINATED BY JM
HWY 11/17 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
DATUM Geodetic DATE 2010.01.29 - 2010.01.29 CHECKED BY TH

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa								WATER CONTENT (%)		
								○ UNCONFINED	+ FIELD VANE	● QUICK TRIAXIAL						× LAB VANE		
238.7																		
0.0	PEAT, some roots Dark Brown Frozen to Wet		1	AS														
238.1																		
0.6	SAND and SILT, trace clay, trace gravel Compact to Very Dense Grey Moist to Wet																	
			1	SS	16													
			2	SS	21													
			3	SS	100/ 300													
			4	SS	48													
			5	SS	38													
			6	SS	57													
231.6																		
7.2	END OF BOREHOLE AT 7.2m UPON AUGER REFUSAL ON PROBABLE BEDROCK. BOREHOLE OPEN TO 7.2m, AND WATER LEVEL AT 2.4m UPON COMPLETION. Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen. WATER LEVEL READINGS: DATE DEPTH (m) ELEV. (m) 2010.01.31 0.5 238.2 2010.03.01 0.9 237.8																	

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



ONTMT4S 1156.GPJ 3/10/10

RECORD OF BOREHOLE No 10-101

1 OF 1

METRIC

G.W.P. 334-94-00 LOCATION N 5 372 585.6 E 367 277.1 ORIGINATED BY JM
 HWY 11/17 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2010.01.24 - 2010.01.24 CHECKED BY TH

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	UNIT WEIGHT Y	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
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
238.2	Sandy SILT, trace gravel, with organics Moist (FILL)		1	SS	11		238											
0.0																		
236.7			2	SS	3		237											
1.5	END OF BOREHOLE AT 1.5m UPON AUGER REFUSAL ON PROBABLE BEDROCK OR BOULDERS. BOREHOLE OPEN TO 1.5m, AND WATER LEVEL AT 1.4m UPON COMPLETION. BOREHOLE BACKFILLED WITH CUTTINGS TO SURFACE.		3	SS	50													
					025													

RECORD OF BOREHOLE No 10-101A

1 OF 1

METRIC

G.W.P. 334-94-00 LOCATION N 5 372 589.9 E 367 274.1 ORIGINATED BY JM
 HWY 11/17 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2010.01.31 - 2010.01.31 CHECKED BY TH

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		
238.1														
0.0	PEAT, some roots Dark Brown Frozen to Wet		1	AS			238							
237.3														
0.8	Sandy SILT, trace gravel, mixed with organics Loose Dark Brown Wet		1	SS	7		237							
236.6														
1.5	SAND and SILT, occasional gravel Compact Grey Wet to Moist		2	SS	19		236							
			3	SS	24									
			4	SS	78		235							
233.7							234							
4.4	END OF BOREHOLE AT 4.4m UPON AUGER REFUSAL ON PROBABLE BEDROCK. BOREHOLE OPEN TO 1.7m, AND WATER LEVEL AT 0.8m UPON COMPLETION. BOREHOLE BACKFILLED WITH SAND TO 0.9m, THEN BENTONITE TO SURFACE.													

+³, X³: Numbers refer to
Sensitivity

20
15
10

(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 10-102

1 OF 1

METRIC

G.W.P. 334-94-00 LOCATION N 5 372 568.2 E 367 283.8 ORIGINATED BY JM
 HWY 11/17 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2010.01.26 - 2010.01.26 CHECKED BY TH

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						
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE						
							WATER CONTENT (%)							
							20 40 60							
240.5														
0.0	ASPHALT: (75mm)													
0.1	SAND and GRAVEL Very Dense Brown Frozen to Moist (FILL)		1	AS										
			1	SS	50/ .125									
239.0														
1.5	SILT and SAND, trace gravel Dense Dark Brown Moist (FILL)		2	SS	32									
238.2														
2.3	SAND and SILT, trace gravel, occasional roots Very Loose Brown to Dark Brown Wet		3	SS	4								2 48 45 5	
			4	SS	1									
	Becoming dense, grey		5	SS	31									
			6	SS	28								1 29 65 5	
233.3														
7.2	END OF BOREHOLE AT 7.2m UPON AUGER REFUSAL ON PROBABLE BEDROCK. BOREHOLE OPEN TO 7.0m AND WATER LEVEL AT 2.2m UPON COMPLETION. BOREHOLE BACKFILLED WITH SAND TO 3.9m, THEN BENTONITE TO 0.2m, THEN ASPHALT TO SURFACE.													

+³, ×³: Numbers refer to
Sensitivity

20
15
10

(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 10-103

1 OF 1

METRIC

G.W.P. 334-94-00 LOCATION N 5 372 538.1 E 367 298.2 ORIGINATED BY JM
 HWY 11/17 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2010.01.23 - 2010.01.23 CHECKED BY TH



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			WATER CONTENT (%)		
237.9							20	40	60	80	100	PLASTIC LIMIT w _P	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L		
0.0	PEAT Dark Brown Wet		1	AS											65	
236.9															20	
0.9	Silty SAND, trace gravel Loose Grey wet		1	SS	6								○			
236.3																
1.5	SAND and SILT, trace clay, trace gravel Loose to Dense Grey Moist		2	SS	7								○			
			3	SS	17								○			2 40 53 5
234.5			4	SS	50/								○			
3.3	END OF BOREHOLE AT 3.3m UPON AUGER REFUSAL ON PROBABLE BEDROCK. WATER LEVEL AT SURFACE UPON COMPLETION. Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 0.91m slotted screen. WATER LEVEL READINGS: DATE DEPTH (m) ELEV. (m) 2010.01.31 0.6 237.3 2010.03.01 0.7 237.2				125											

RECORD OF BOREHOLE No 10-104

1 OF 1

METRIC

G.W.P. 334-94-00 LOCATION N 5 373 948.9 E 369 222.6 ORIGINATED BY JM
HWY 11/17 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
DATUM Geodetic DATE 2010.01.29 - 2010.01.29 CHECKED BY TH

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE LIQUID CONTENT			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				
251.7							20	40	60	80	100						
0.0	SAND and GRAVEL , occasional cobbles, trace organics Dark Brown to Brown Frozen to Moist (FILL)		1	AS		251									○		
250.9																	
0.8	Silty SAND , trace to some gravel, occasional cobbles, occasional roots Compact		1	SS	17											○	
250.3	Brown																
1.4	END OF BOREHOLE AT 1.4m UPON AUGER REFUSAL ON PROBABLE BEDROCK. BOREHOLE OPEN TO 1.4m, AND DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH CUTTINGS TO SURFACE.																

RECORD OF BOREHOLE No 10-105

1 OF 1

METRIC

G.W.P. 334-94-00 LOCATION N 5 373 970.8 E 369 208.2 ORIGINATED BY JM
 HWY 11/17 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2010.01.27 - 2010.01.27 CHECKED BY TH

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									
259.9								20	40	60	80	100					
0.0	ASPHALT: (75mm)																
0.1	SAND and GRAVEL Brown Frozen to Moist (FILL)		1	AS													
			2	AS													
258.4																	
1.5	SAND, some gravel, some silt Dense to Very Dense Dark Brown Moist (FILL)		1	SS	47												
			2	SS	55												
256.9																	
3.0	Silty SAND, some gravel Very Dense Dark Brown to Brown Moist		3	SS	42												
255.7																	
4.2	END OF BOREHOLE AT 4.2m UPON AUGER REFUSAL ON PROBABLE BEDROCK OR BOULDERS. BOREHOLE OPEN AND DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH SAND TO 2.4m, THEN BENTONITE TO 0.2m, THEN ASPHALT TO SURFACE.																

+³. x³: Numbers refer to
Sensitivity

20
15 5
10 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 10-106

1 OF 1

METRIC

G.W.P. 334-94-00 LOCATION N 5 374 013.8 E 369 231.2 ORIGINATED BY JM
 HWY 11/17 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2010.01.22 - 2010.01.22 CHECKED BY TH

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					
255.8																	
0.0	Silty SAND, some gravel, trace organics Very Dense Dark Brown Frozen		1	SS	52												
255.1																	
0.7	END OF BOREHOLE AT 0.7m UPON AUGER REFUSAL ON PROBABLE BEDROCK. BOREHOLE OPEN AND DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH CUTTINGS TO SURFACE.						255										

RECORD OF BOREHOLE No 10-107

1 OF 1

METRIC

G.W.P. 334-94-00 LOCATION N 5 374 060.7 E 369 235.9 ORIGINATED BY JM
 HWY 11/17 BOREHOLE TYPE Hand Shovel COMPILED BY AN
 DATUM Geodetic DATE 2010.01.23 - 2010.01.23 CHECKED BY TH

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					
						20	40	60	80	100	20	40	60			
263.6 0.0	BEDROCK AT SURFACE.															

RECORD OF BOREHOLE No 10-107A

1 OF 1

METRIC

G.W.P. 334-94-00 LOCATION N 5 374 044.2 E 369 228.7 ORIGINATED BY JM
 HWY 11/17 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2010.01.23 - 2010.01.23 CHECKED BY TH

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE					WATER CONTENT (%) w _p w w _L				
260.5							20	40	60	80	100	20	40	60			
0.0	Silty SAND, some gravel, occasional roots Compact Brown Frozen		1	SS	17												
259.8						260											
0.8	END OF BOREHOLE AT 0.8m UPON AUGER REFUSAL ON PROBABLE BEDROCK. BOREHOLE OPEN AND DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH CUTTINGS TO SURFACE.																

ONTMT4S 1156.GPJ 3/10/10

+³ . x³ : Numbers refer to
Sensitivity

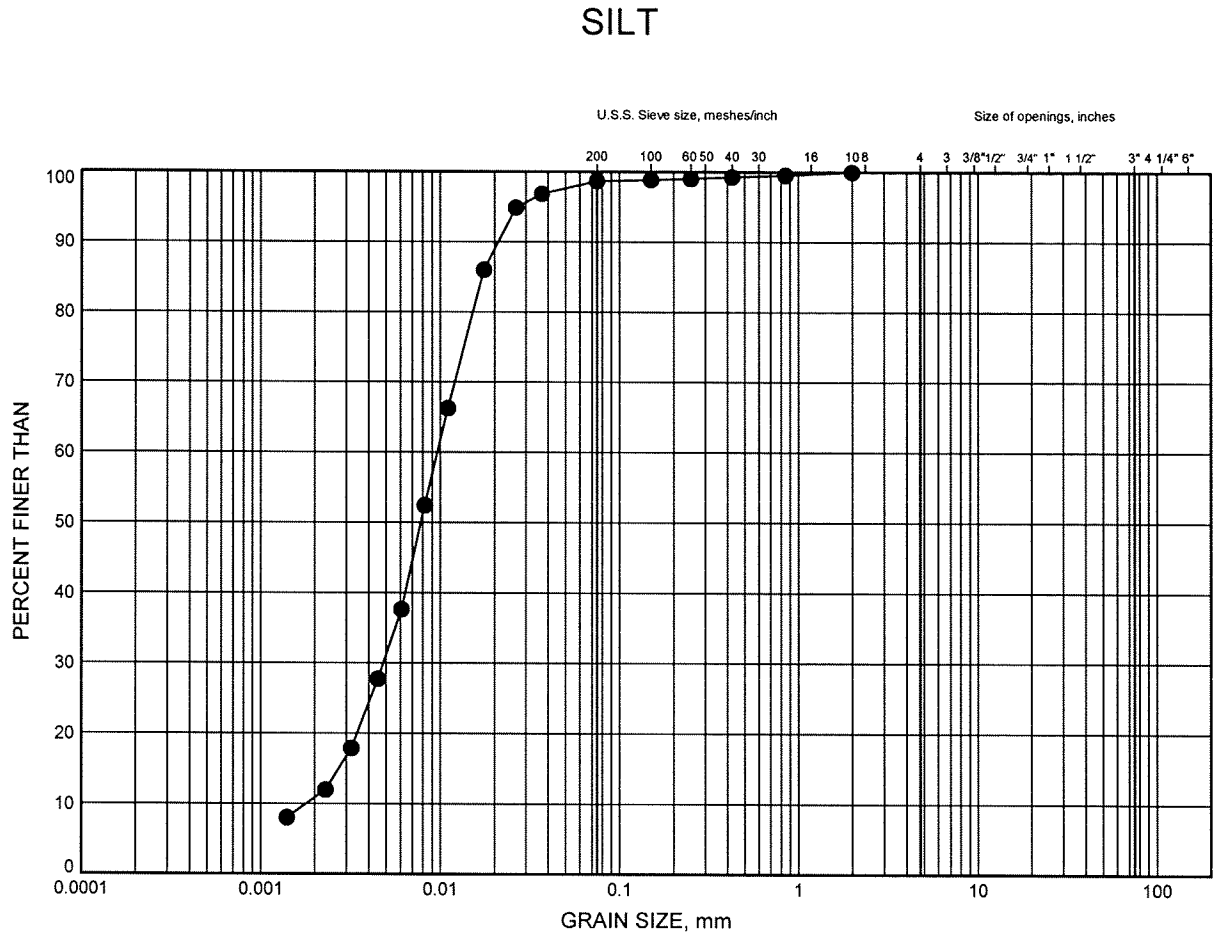
20
15 5
10 (%) STRAIN AT FAILURE

Appendix B

Laboratory Test Results

Hwy 11/17 Hodder Avenue GRAIN SIZE DISTRIBUTION

FIGURE B1



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	10-063B	2.59	253.94

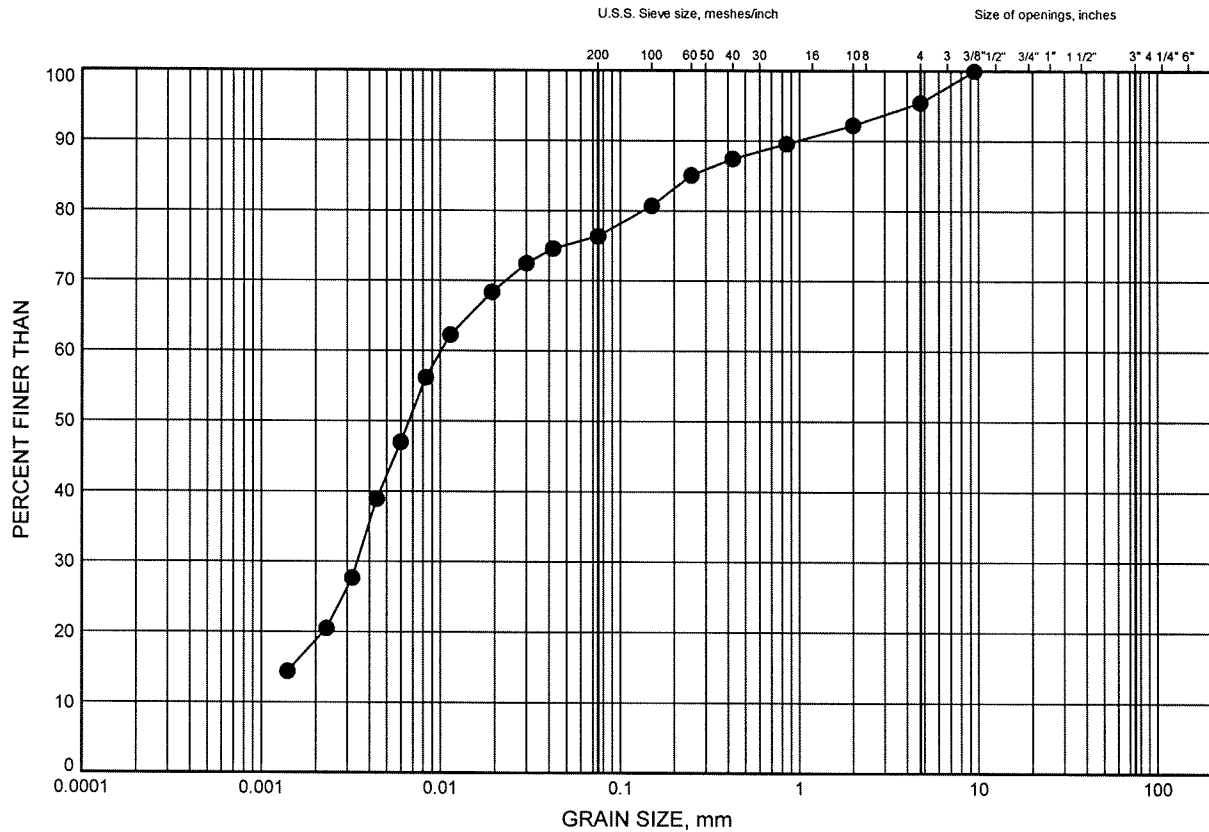


W.P.# 334-94-00
Prepared By AN
Checked By MRA

Hwy 11/17 Hodder Avenue
GRAIN SIZE DISTRIBUTION

FIGURE B2

SILTY CLAY



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	10-063B	4.80	251.73

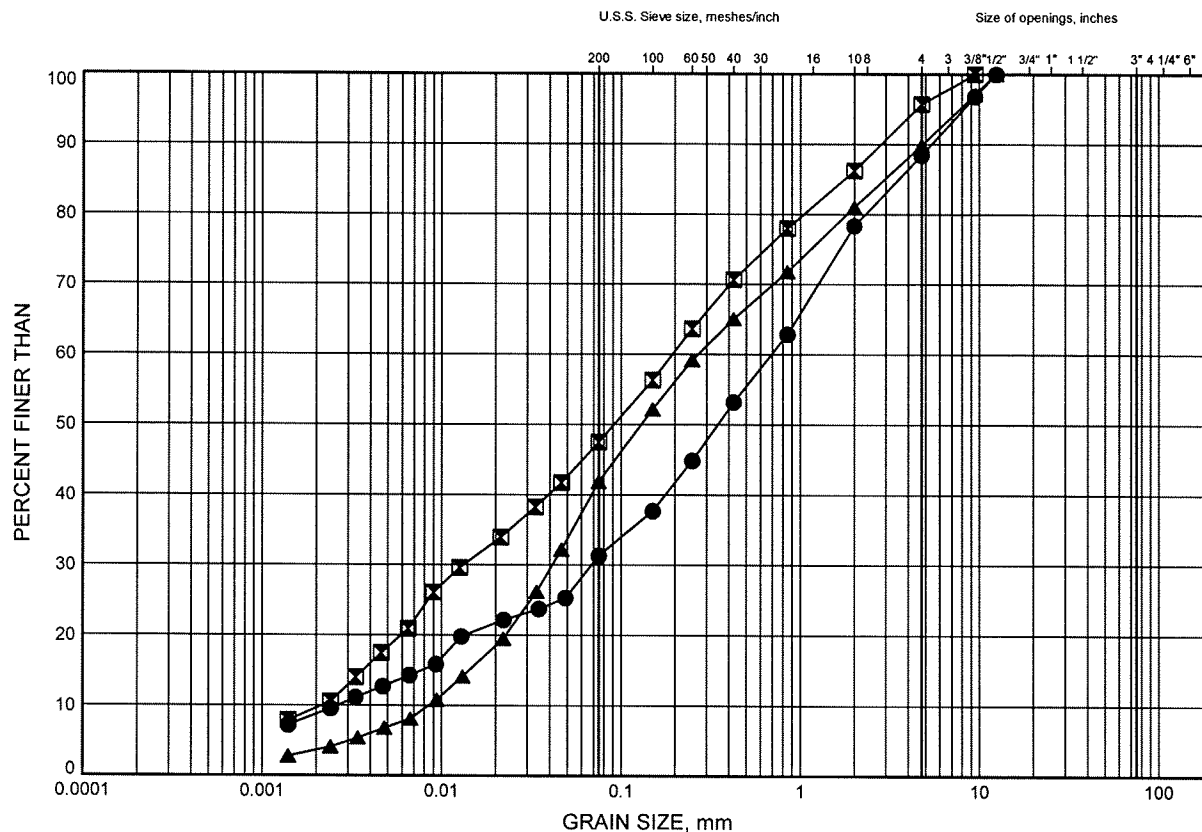


W.P.# .334-94-00.....
Prepared By .AN.....
Checked By .MRA.....

Hwy 11/17 Hodder Avenue
GRAIN SIZE DISTRIBUTION

FIGURE B3

SILTY SAND to SAND & SILT TILL



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	09-062A	1.07	255.11
⊠	09-063	1.07	255.21
▲	10-062C	1.83	254.14

GRAIN SIZE DISTRIBUTION - THURBER 1156.GPJ 3/19/10

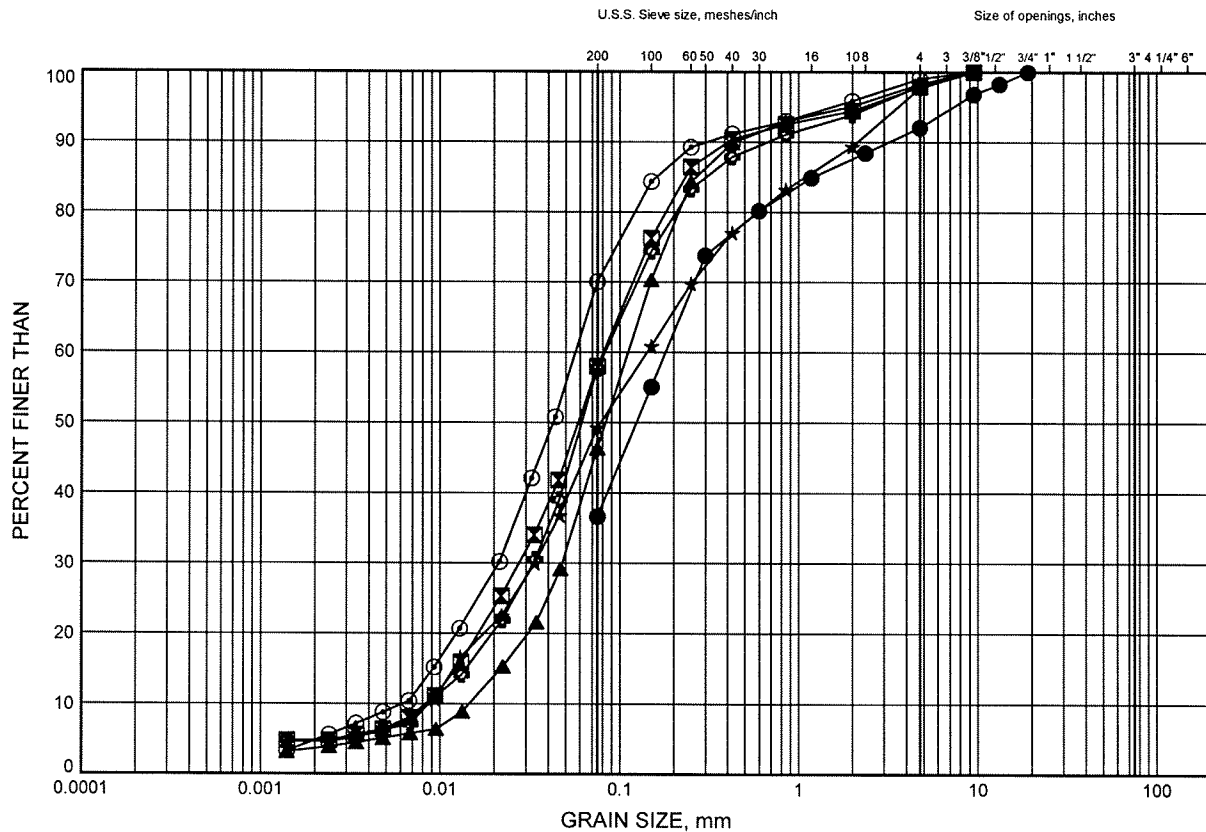
W.P.# 334-94-00
Prepared By AN
Checked By MRA



Hwy 11/17 Hodder Avenue GRAIN SIZE DISTRIBUTION

FIGURE B4

SILTY SAND to SANDY SILT



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	10-100	3.35	235.38
■	10-100	6.40	232.33
▲	10-101A	2.59	235.51
★	10-102	2.59	237.94
○	10-102	6.40	234.13
⊕	10-103	2.59	235.26

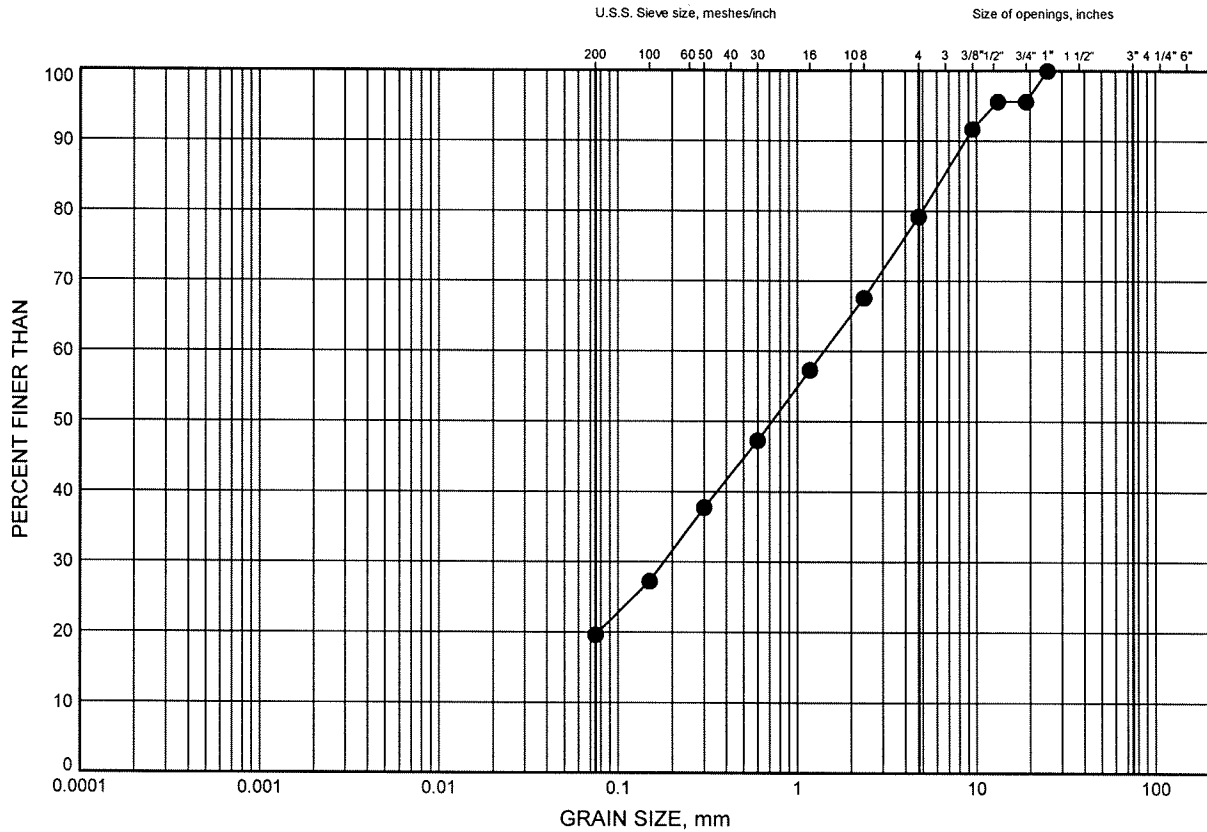


W.P.# 334-94-00.....
Prepared By AN.....
Checked By MRA.....

Hwy 11/17 Hodder Avenue
GRAIN SIZE DISTRIBUTION

FIGURE B5

SAND FILL



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	10-105	2.59	258.71

GRAIN SIZE DISTRIBUTION - THURBER 1156.GPJ 3/19/10

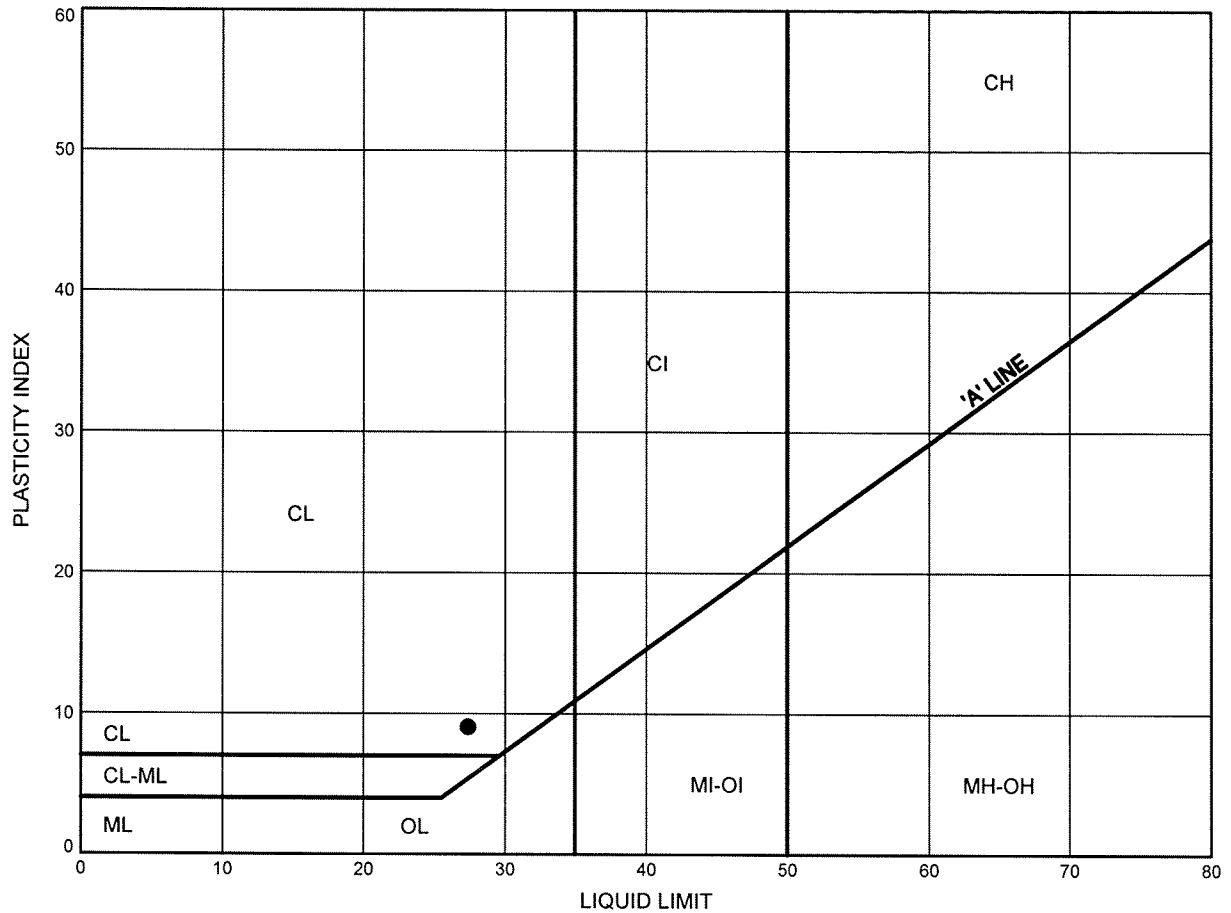
W.P.# 334-94-00
 Prepared By AN
 Checked By MRA



Hwy 11/17 Hodder Avenue
ATTERBERG LIMITS TEST RESULTS

FIGURE B6

SILTY CLAY



SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	10-063B	4.80	251.73

Date March 2010
 Project 334-94-00



Prep'd AN
 Chkd. MRA

Appendix C

Site Photographs

Culverts
Highway 11/17 Four-Laning Thunder Bay



Photo 1 – West end of existing culvert at Copenhagen Road



Photo 2 – East end of existing culvert at Copenhagen Road



Photo 3 – North end of Culvert at Hwy 11/17 Sta. 27+525



Photo 4 – South end of culvert at Hwy 11/17 Sta. 27+525



Photo 5 – South end of culvert at Hwy 11/17 Sta. 29+950

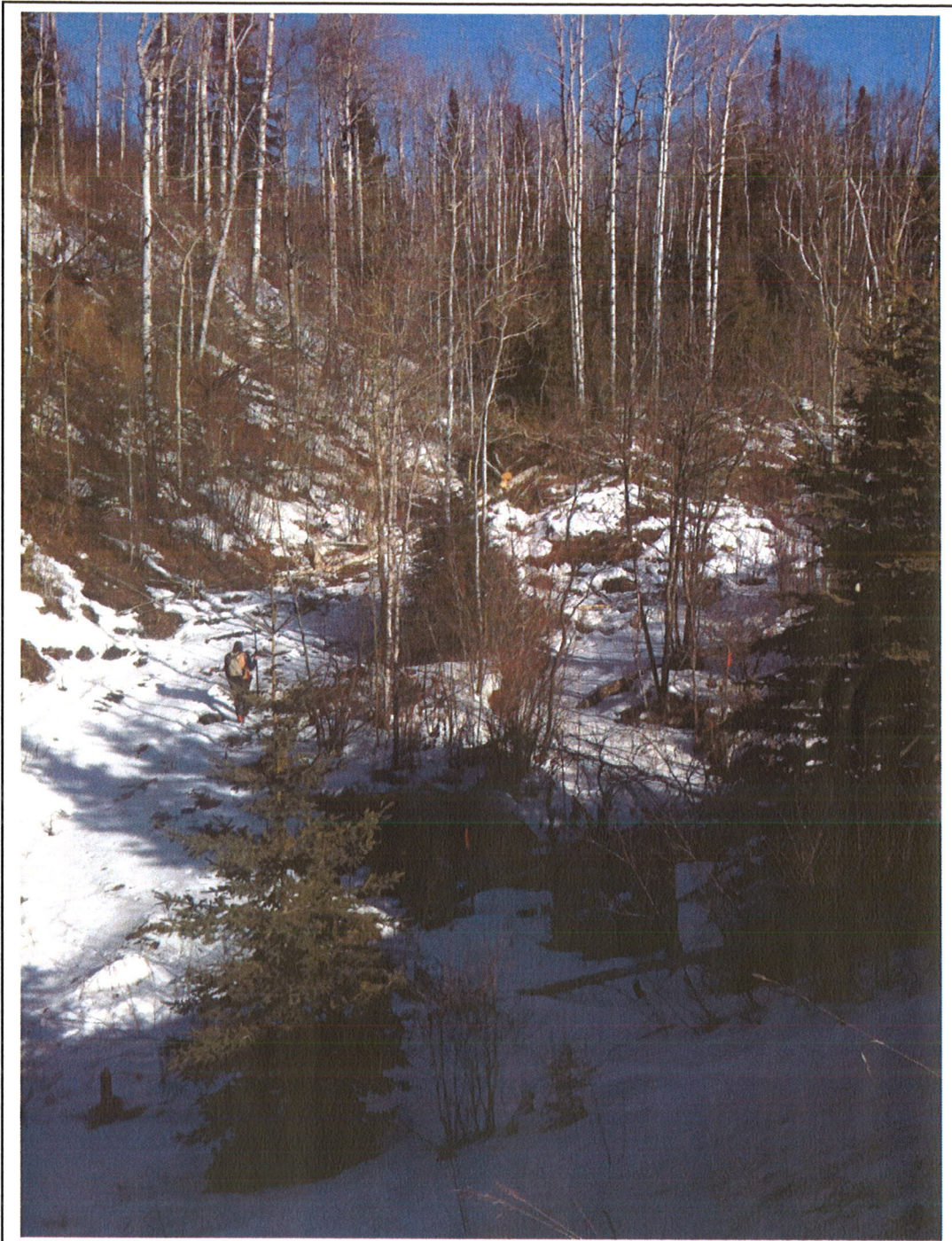
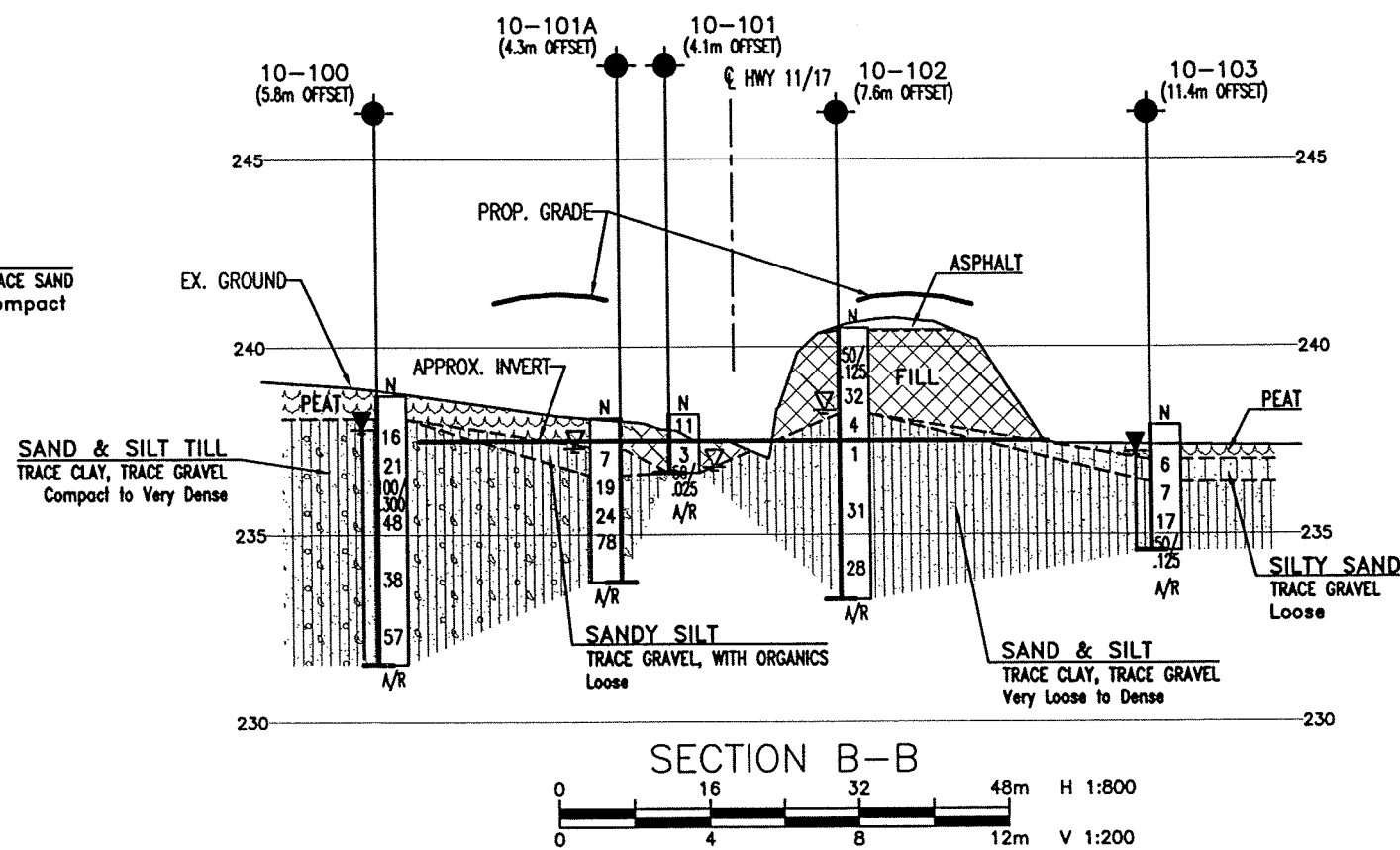
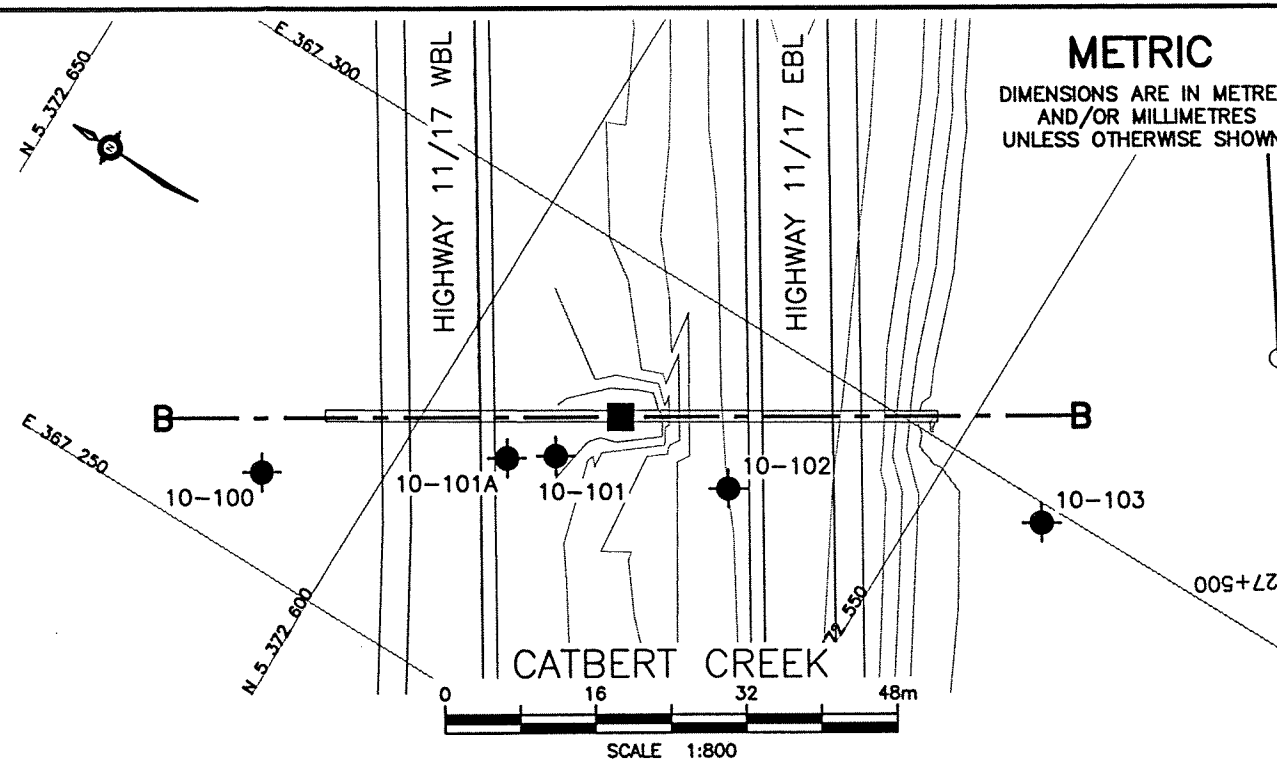


Photo 6 – North end of culvert at Hwy 11/17 Sta. 29+950

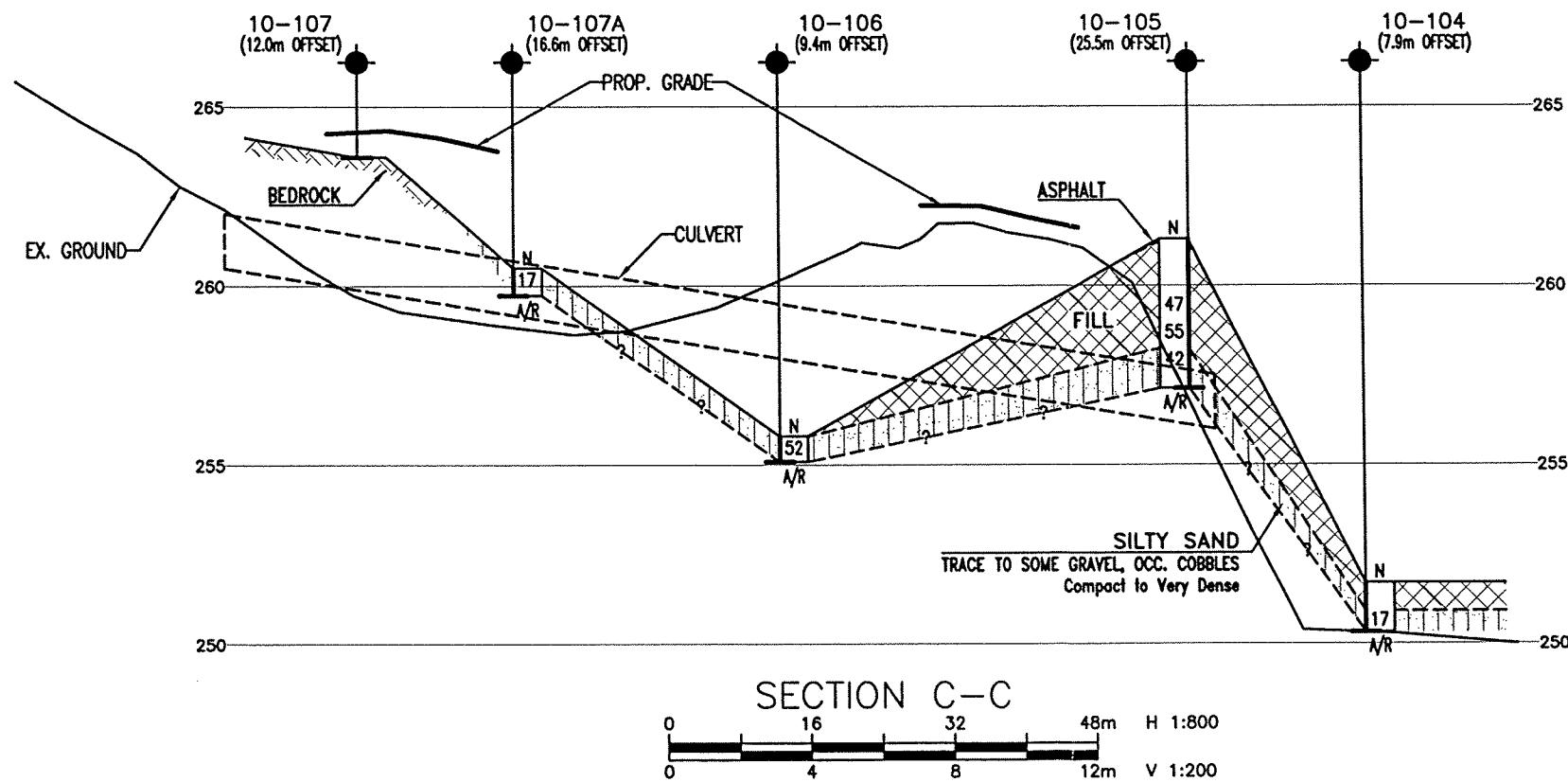
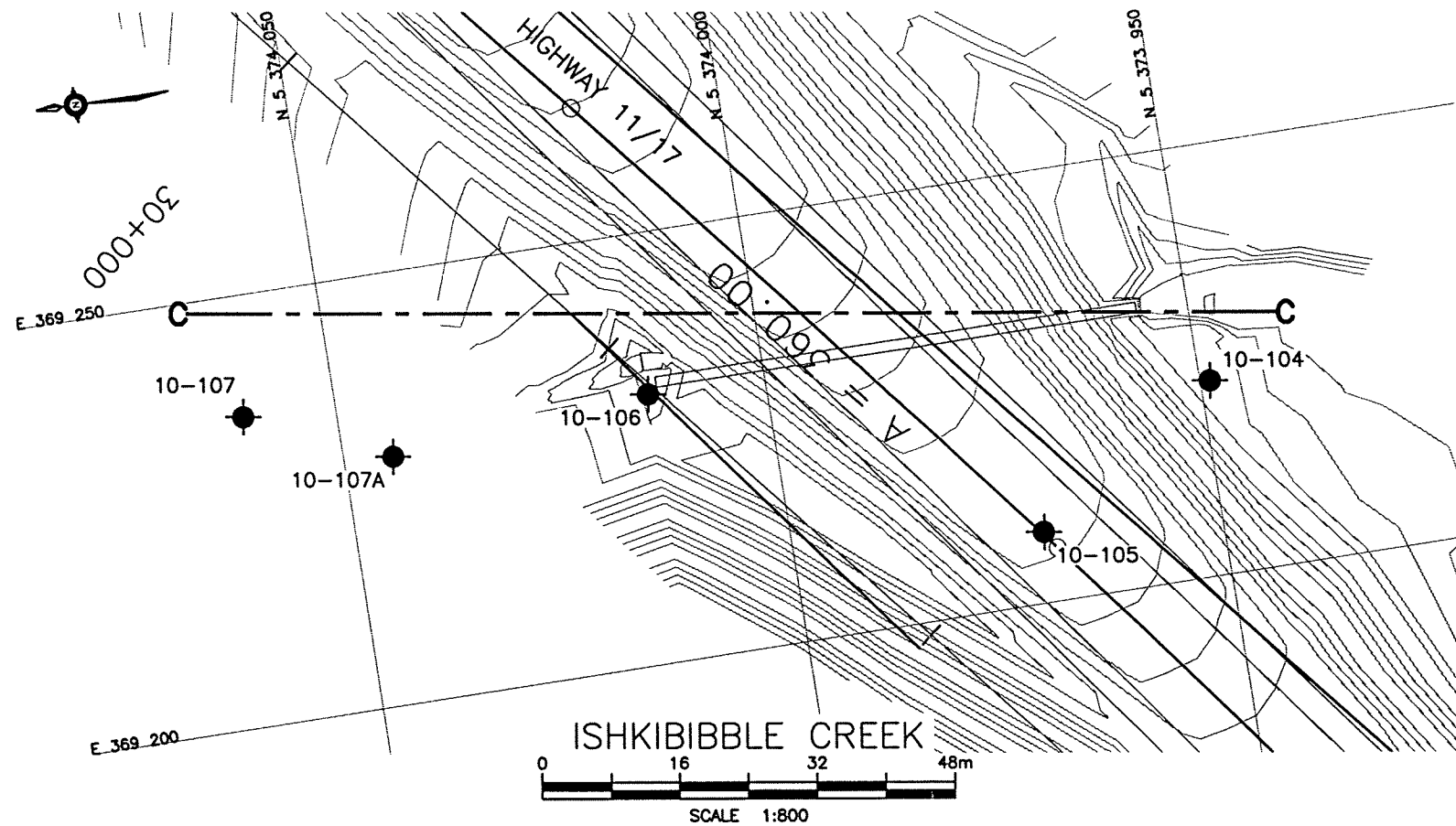
Appendix D

Borehole Locations and Soil Strata Drawings



LICENSED PROFESSIONAL ENGINEER
P. K. Chatterji
 P. K. CHATTERJI
 10000
 June 3/10
 PROVINCE OF ONTARIO

[illegible]



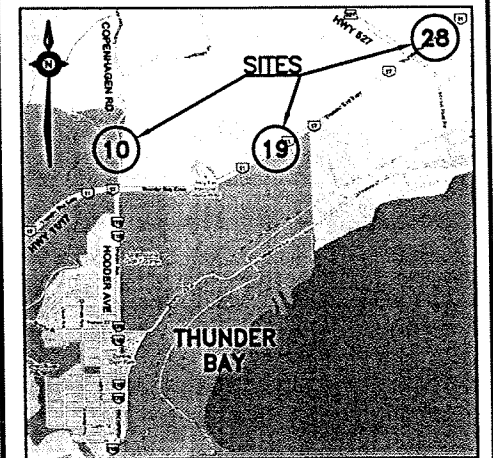
METRIC
DIMENSIONS ARE IN METRES
AND/OR MILLIMETRES
UNLESS OTHERWISE SHOWN

CONT No
WP No 334-94-00
HIGHWAY 11/17
HODDER AVENUE TO HWY 527
CULVERTS
BOREHOLE LOCATIONS AND SOIL STRATA

SHEET

MRC McCORMICK RANKIN
CORPORATION

THURBER ENGINEERING LTD.
GEOTECHNICAL • ENVIRONMENTAL • MATERIALS



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
- W Water Level
- HA Head Artesian Water
- PZ Piezometer
- 90% Rock Quality Designation (RQD)
- A/R Auger Refusal

NO	ELEVATION	NORTHING	EASTING
10-104	251.7	5 373 948.9	369 222.6
10-105	259.9	5 373 970.8	369 208.2
10-106	255.8	5 374 013.8	369 231.2
10-107	263.6	5 374 060.7	369 235.9
10-107A	260.5	5 374 044.2	369 228.7

-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. 52A-144



REVISIONS	DATE	BY	DESCRIPTION
DESIGN	MRA	CHK AEG	CODE
DRAWN	MFA	CHK PKC	SITE
			STRUCT
			DWG 2