

**FOUNDATION INVESTIGATION REPORT
BATCHAWANA RIVER BRIDGE REHABILITATION**

Highway 17, Site 38S-007

G.W.P. 5112-05-00

Township of Fisher

Geocres Number: 41K-88

Report to

McCormick Rankin Corporation

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August 15, 2011
File: 19-1351-185

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PART 1: FACTUAL INFORMATION

1. INTRODUCTION

This report presents the factual findings obtained from a foundation investigation conducted at the site of the Batchawana River Bridge, located on Highway 17 approximately 5 km south of Highway 563 in the Township of Fisher, Ontario. The investigation was undertaken for the proposed rehabilitation of the bridge at this location.

The purpose of the investigation was to explore the subsurface conditions at the site, and based on the data obtained, to provide a borehole location plan, records of boreholes, a stratigraphic profile, 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 McCormick Rankin Corporation, under the Ministry of Transportation Ontario (MTO) Agreement Number 5009-E-0032.

In the preparation of this report and in addition to the boreholes drilled under the current assignment, reference has been made to information on subsurface conditions contained in a previous foundation report. The title of this report is listed as follows:

- Foundation Investigation Report for Batchawana River Bridge Detour, W.P. 910-62-09, Str. Site 38S-7, Highway 17, District 18, Sault Ste. Marie, Dated December 4, 1987. (Reference 1).

2. SITE DESCRIPTION

The Batchawana River Bridge is located north of Sault Ste Marie on Highway 17 approximately 5 km south of Highway 563 in the Township of Fisher. At present, the highway crosses the Batchawana River on a five-span structure supported on concrete filled sheet pile cells.

The Batchawana River flows south and discharges into Batchawana Bay of Lake Superior. The river channel is approximately 85 m wide at the bridge location. The surrounding area is relatively flat within the bay area.

The area to the west of the bridge is heavily treed. A few residential and commercial dwellings are located along Highway 17 on the east side of the Batchawana River bridge. A boat launch area is located on the northwest side of the bridge. Overhead transmission lines cross the river on the north side of the existing bridge.

Photographs of the site included in Appendix D show the general nature of the surrounding land:

1. General view of the Batchawana River bridge
2. Existing conditions of bridge deck
3. Bridge approach embankment

Physiographically, the site lies within the Canadian Shield, characterized by Precambrian meta-volcanic and meta-sedimentary rocks intruded by later stage diabase dykes. In some areas the Precambrian rocks are covered by sedimentary rocks of the Huronian Supergroup. The bedrock is mantled by glaciolacustrine varved clays and sand and gravel deposits.

3. SITE INVESTIGATION AND FIELD TESTING

The present site investigation and field testing for this project was carried out between October 21 and November 1, 2010 and consisted of drilling and sampling a total of eight boreholes (numbered BW-01 to BW-08) at the foundation elements. Four boreholes were drilled near the existing bridge abutments and four near the pier locations through the bridge deck.

A Dynamic Cone Penetration Test (DCPT) was performed from the bottom of each borehole to depths ranging from 24.3 m to 50.9 m below the existing highway grade. An additional DCPT was performed adjacent to Borehole BW-07 from ground surface to a depth of 20.1 m.

The borehole locations and termination depths are indicated in Table 3.1.

Table 3.1 – Borehole locations and termination depths

Foundation Unit	Borehole	Borehole termination depth/ elevation⁽¹⁾ (m)	DCPT termination depth/elevation^(1,2) (m)
West Abutment	BW-01	12.8/173.5	24.3/162.0
	BW-02	43.3/143.1	43.8/142.6
Pier 1	BW-03	41.4/145.1	43.8/142.7
Pier 2	BW-04	41.7/144.9	44.4/142.1
Pier 3	BW-05	41.7/144.8	42.9/143.6
Pier 4	BW-06	41.6/144.9	44.9/141.6
East Abutment	BW-07	43.3/143.1	50.9/135.4
	BW-07D	-	20.1/166.2
	BW-08	12.8/173.5	25.0/161.3

⁽¹⁾ Depths/elevations for boreholes drilled at the pier locations were obtain from top of bridge deck.
 (Approx. distance from bridge deck to Batchawana River bed: 7.1 m – 7.4 m)

^(1,2) DCPTs were terminated upon cone refusal

The approximate locations of the boreholes are shown on the attached Borehole Locations and Soil Strata Drawing in Appendix E. Record of Sheets of Boreholes BW-01 to BW-08 drilled during the present investigation are attached in Appendix A.

The coordinates and elevations of Boreholes BW-01 to BW-08 are given on the drawing and on the individual Record of Borehole Sheets.

Records of Boreholes 1 to 8 drilled during the previous investigation, for a proposed detour structure at the Batchawana river bridge, (Reference 1) and their respective laboratory test results are enclosed in Appendix C.

Prior to commencement of drilling, utility clearances were obtained for all borehole locations. Road occupancy permits were obtained for boreholes drilled on the existing Highway 17 platform.

The drilling was carried out from the highway grade using a CME75 truck-mounted drill rig. A combination of hollow stem auger, casing and mud rotary drilling techniques were used to advance the boreholes. Samples were obtained at selected intervals using a split spoon sampler in conjunction with Standard Penetration Testing (SPT) in the overburden soils.

Groundwater conditions in the open boreholes were observed throughout the drilling operations. Two standpipe piezometers consisting of 19 mm PVC pipe with a slotted screen were installed in Boreholes BW-02 and BW-07. The locations and completion details of the boreholes and piezometers are shown in Table 3.2.

Table 3.2 – Borehole Completion Details

Location	Borehole	Details	
		Piezometer Tip Depth/ Elevation (m)	Completion Details
West Abutment	BW-01	None installed	Backfilled with bentonite holeplug to 9.1 m, cuttings from 9.1 m to 50 mm and asphalt to surface.
	BW-02	41.1/145.2	Piezometer with 1.5 m slotted screen installed with sand filter to 39.0 m, bentonite holeplug from 39.0 m to 29.0 m, drill cuttings from 29.0 m to 1.5 m, bentonite from 1.5 m to 0.15 m, sand from 0.15 m to 75 mm, and asphalt to surface. Flushmount cover installed.
Pier 1	BW-03	None installed	Borehole caved in below river bed depth. Borehole at bridge deck backfilled with 275 mm of concrete, then 25 mm of asphalt to surface.
Pier 2	BW-04	None installed	Borehole caved in below river bed depth. Borehole at bridge deck backfilled with 275 mm of concrete, then 25 mm of asphalt to surface.
Pier 3	BW-05	None installed	Borehole caved in below river bed depth. Borehole at bridge deck backfilled with 275 mm of concrete, then 25 mm of asphalt to surface.
Pier 4	BW-06	None installed	Borehole caved in below river bed depth. Borehole at bridge deck backfilled with 275 mm of concrete, then 25 mm of asphalt to surface.
East Abutment	BW-07	42.7/143.7	Piezometer with 3.0 m slotted screen installed with sand filter to 39.2 m, bentonite holeplug from 39.2 m to 36.9 m, drill cuttings from 36.9 m to 6.1 m, bentonite from 6.1 m to 80 mm, and asphalt to surface. Flushmount cover installed.
	BW-08	None installed	Backfilled with bentonite holeplug to 40 mm then asphalt to surface.

4. LABORATORY TESTING

The recovered soil samples were subjected to Visual Identification (VI) and to natural moisture content determination. Selected samples were also subjected to grain size distribution analyses (sieve and hydrometer) and Atterberg Limits testing where appropriate. 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 this appendix and on the “Borehole Locations and Soil Strata”

drawing in Appendix E. 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.

The stratigraphy encountered in the boreholes of the east and west abutments consisted of pavement structure over sand fill, overlying extensive deposits of native sand, silt and sandy silt. At the west abutment a deposit of silty clay was encountered underneath the silt deposit.

The stratigraphy encountered below the river bed (boreholes drilled through the bridge deck at each pier location) consisted of an extensive sand deposit overlying deposits of silt and sandy silt.

5.1 Pavement structure

Pavement structure consisting of approximately 50 mm of asphalt overlying granular (sand and gravel fill) road base was encountered in Boreholes BW-01, BW-02, BW-07 and BW-08 drilled through existing Highway 17 lanes at the east and west abutments. Boreholes BW-02 and BW-07 encountered 450 mm of concrete below the asphalt. The concrete is underlain by granular fill.

Boreholes BW-03 to BW-06 drilled through the bridge deck, in close proximity to the piers, revealed 25 mm of asphalt overlying 275 mm of concrete.

5.2 Fill

Fill was contacted below the pavement structure in Boreholes BW-01, BW-02, BW-07 and BW-08 drilled at the east and west abutments. The fill generally consists of brown sand containing trace to some gravel, trace to some silt and clay and occasional cobbles and boulders.

The thickness of the fill ranged from 1.8 m to 3.0 m.

The depth to the base of the fill varied from 2.3 m to 3.0 m (Elevations 183.3 to 184.1).

During the previous investigation for the detour bridge, granular fill was contacted at the east and west approaches in Boreholes 1, 4 and 5. The thickness of the fill ranged from 1.7 m to 1.8 m.

SPT 'N' values recorded in the cohesionless fill ranged from 42 to 3 blows per 0.3 m penetration indicating a dense to very loose relative density.

The moisture content of the fill ranged from 4% to 17%.

Grain size distribution curves for samples of sand fill tested are presented on the Record of Borehole sheet and on Figure B1 of Appendix B. The results of the laboratory test are summarized as follows:

Soil Particles	(%)
Gravel	0 to 2
Sand	77 to 96
Silt and Clay	2 to 22

5.3 Sand

An extensive deposit of native sand containing trace to some gravel, trace to some silt and clay and occasional cobbles was contacted below the fill at 2.3 m to 3.0 m depth (elevations 183.3 to 184.1) in boreholes drilled at the abutments (Boreholes BW-01, BW-02, BW-07 and BW-08). The native sand was contacted from the river bed level at elevations 179.1 to 179.4 in boreholes drilled at the pier locations (Boreholes BW-03 to BW-06). The sand was generally brown becoming grey with depth.

In Boreholes 1 to 8, previously drilled, the native sand was contacted at elevations ranging from 183.5 to 183.9 at the abutments and at elevations ranging from 178.8 to 179.8 at the piers.

Layers of gravelly sand and silty sand were encountered within the sand at various depths.

The thickness of the native sand ranged from 21.0 m to 28.0 m.

Boreholes BW-01 and BW-08 drilled at the west and east abutments were terminated within the native sand layer at 12.8 m depth (Elevation 173.5). The thickness of the sand is anticipated to be greater than 10.0 m at these locations.

The depth to the base of the sand was 30.5 m and 20.5 m (Elevations 155.9 and 157.9) below ground surfaces in Boreholes BW-02 and BW-07 drilled at the abutments.

The depth to the base of the sand varied from 21.1 m to 23.2 m (elevations 155.9 to 158.1) below the river bed in Boreholes BW-03 to BW-06 drilled at the piers.

SPT 'N' values recorded in the sand generally ranged from 1 to 43 blows per 0.3 m penetration indicating a very loose to dense relative density.

An SPT 'N' value of 58 blows per 0.3 m of penetration indicating a very dense relative density was measured with the gravelly sand layer near elevation 177.0 in Borehole BW-02.

The moisture content of the sand ranged from 8% to 30%. A high moisture content of 58% was measured near elevation 178.8 in Borehole BW-05.

Grain size distribution curves for samples of the sand deposit and silty sand and gravelly sand layers tested are presented on the Record of Borehole sheet and on Figure B2 to B8 of Appendix B. The results of the laboratory test are summarized as follows:

Soil Particles	Sand (%)	Silty sand (%)	Gravelly sand (%)
Gravel	0 to 18	0	23 to 37
Sand	79 to 97	34 to 76	59 to 75
Silt and Clay	1 to 21	24	2 to 4
Silt	-	29 to 61	-
Clay	-	2 to 5	-

5.4 Silt and sandy silt

Native grey silt containing trace gravel, trace to some sand and trace to some clay was contacted below the sand in Boreholes BW-02 to BW-07.

The thickness of the silt layer was 4.9 m and 6.7 m in Boreholes BW-02 and BW-03, respectively.

The depth to the base of the silt was 35.4 m and 29.8 m (elevations 151.0 and 149.4) in Boreholes BW-02 and BW-03, respectively.

Boreholes BW-04 to BW-06 were terminated within the silt layer at depths ranging from 34.2 m to 34.6 m (elevations 144.8 to 144.9), below the river bed.

In Boreholes BW-02 and BW-03, a layer of grey sandy silt containing trace clay was contacted at 41.3 m and 29.8 m depth (elevations 145.0 and 149.4), respectively. Both boreholes were terminated within the sandy silt at 43.3 m and 34.1 m depth (elevations 143.1 and 145.1), respectively.

SPT 'N' values recorded in the silt and sandy silt layers generally ranged from 19 to 78 blows for 0.3 m of penetration, indicating compact to very dense relative density. Low SPT 'N' values of 7 and 15 blows per 0.3 m of penetration were measured at elevation 157.5 in Boreholes BW-04 and BW-05.

The measured moisture contents in the silt and sandy silt range from 17% to 22%.

DCPTs were conducted below borehole termination depths and extended to cone refusal at depths presented in Table 3.1.

Grain size distribution curves for samples of silt and sandy silt tested are presented on the Record of Borehole sheets and on Figures B10 and B11 of Appendix B. The results of the laboratory test are summarized as follows:

Soil Particles	Silt (%)	Sandy silt (%)
Gravel	0 to 1	0
Sand	0 to 20	30 to 34
Silt	67 to 91	61 to 65
Clay	5 to 13	5

5.5 Silty Clay

A layer of reddish brown to grey silty clay containing trace sand was encountered underneath the silt layer at 35.4 m depth (elevation 151.0) in Borehole BW-02 drilled at the west abutment.

The thickness of the silty clay was 5.9 m.

The depth to the base of the silty clay was 41.3 m (elevation 145.0).

SPT 'N' values measured in the silty clay were 13 to 15 blows per 0.3 m of penetration, indicating a stiff consistency.

Moisture contents in the silty clay ranged from 19% to 39%.

Grain size distribution curves for two samples of silty clay tested are presented on the Record of Borehole sheet and on Figure B9. Atterberg Limits test results are presented on Figure B12 of Appendix B.

The results of the laboratory tests are summarized as follows:

Soil Particles	(%)
Gravel	0
Sand	1 to 3
Silt	20 to 24
Clay	73 to 79

Index Property	(%)
Liquid Limit	58 to 59
Plastic Limit	21 to 23

The above results show that the silty clay is typically of high plasticity with a group symbol of CH.

5.6 Water Levels

Water levels were observed in the boreholes during and upon completion of drilling. Two standpipe piezometers were installed in two boreholes to monitor water levels after

completion of drilling. The water levels measured in the piezometers are summarized in Table 5.1, along with the measurements in the boreholes upon completion of drilling.

Level Measurements

Foundation Unit	Borehole	Date	Water Level (m)		Comment
			Depth	Elevation	
West Abutment	BW-02	-	-	-	Unable to locate piezometer. It may have been destroyed after installation.
East Abutment	BW-07	November 28, 2010	3.4	183.0	In piezometer

During drilling operations, water levels measured at the Batchawana River were generally 3.2 m to 3.7 m below the bridge deck.

Reference 1 indicates that water level measured in the Batchawana River was at elevation 183.2 in June 1987. Piezometric reading indicates that water level is at elevation 183.0

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.

6. MISCELLANEOUS

Borehole locations were selected and established in the field by Thurber Engineering Ltd. Surveyors from MMM Group Limited obtained the co-ordinates and the ground surface elevations at each borehole.

Thurber obtained utility clearances for the borehole locations prior to drilling.

Eastern Ontario Diamond Drilling of Hawkesbury, Ontario supplied a truck-mounted CME75 drill rig and conducted the drilling, sampling and in-situ testing operations.

The drilling and sampling operations in the field were supervised on a full time basis by Ms. Eckie Siu of Thurber.

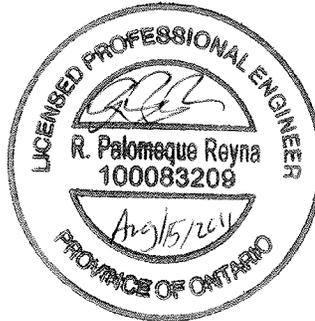
Routine laboratory testing was carried out by Thurber Engineering Ltd.

Overall supervision of the field program was conducted by Mr. Alastair E. Gorman, P.Eng. and Mr. Lukasz Gilarski, E.I.T. Interpretation of the data and preparation of the report were carried out by Mr. Alastair E. Gorman, P.Eng., Mr. Lukasz Gilarski, E.I.T. and Ms. R. Palomeque Reyna, P.Eng.

The report was reviewed by Dr. P.K. Chatterji, P.Eng. a Designated Principal Contact for MTO Foundations Projects.

THURBER ENGINEERING LTD.

Rocio Palomeque Reyna, P.Eng.
Geotechnical Engineer



P.K. Chatterji, P.Eng.,
Review Principal, Designated MTO Contact



Appendix A

**Record of Borehole Sheets
(present investigation)**

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

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

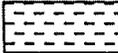
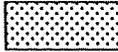
Water Level
 C_{pen} Shear Strength Determination by Pocket Penetrometer

- (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	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	Field Estimation of Hardness*
			(MPa) (psi)	
Very thickly bedded	Greater than 2m	Extremely Strong	Greater than 250 Greater than 36,000	Specimen can only be chipped with a geological hammer
Thickly bedded	0.6 to 2m			
Medium bedded	0.2 to 0.6m	Very Strong	100-250 15,000 to 36,000	Requires many blows of geological hammer to break
Thinly bedded	60mm to 0.2m			
Very thinly bedded	20 to 60mm	Strong	50-100 7,500 to 15,000	Requires more than one blow of geological hammer to break
Laminated	6 to 20mm			
Thinly Laminated	Less than 6mm	Medium Strong	25.0 to 50.0 3,500 to 7,500	Breaks under single blow of geological hammer.
<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 BW-01

1 OF 3

METRIC

W.P. 5198-06-00 LOCATION N 5 199 416.9 E 264 509.2 (Batchawana River Bridge) ORIGINATED BY ES
 HWY 17 BOREHOLE TYPE Hollow Stem Augers/HW/HQ Mud Rotary/DCPT COMPILED BY AN
 DATUM DATE 2010.10.21 - 2010.10.21 CHECKED BY JL

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	
186.3	ASPHALT: (50mm)																
0.0																	
0.1	SAND, some gravel, some silt and clay Dense Brown Moist (FILL) Becoming compact to loose	1	SS	42													
		2	SS	12									0	85	15		(SI+CL)
		3	SS	6													
	Occasional oxide staining	4	SS	7													
183.4																	
3.0	SAND, trace silt and clay, occasional cobbles Loose Brown Moist Becoming grey Wet	5	SS	7													
		6	SS	4													
		7	SS	5													
		8	SS	5													
	silty sand layer at 6.1m	9	SS	4													
		10	SS	22													
	Becoming compact	11	SS	28													
																	No Recovery

ONTMT4S 1185.GPJ 2/18/11

Continued Next Page

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

RECORD OF BOREHOLE No BW-01

3 OF 3

METRIC

W.P. 93-89-00 LOCATION N 5 199 416.9 E 264 509.2 (Batchawana River Bridge) ORIGINATED BY ES
 HWY 17 BOREHOLE TYPE Hollow Stem Augers/HW/HQ Mud Rotary/DCPT COMPILED BY AN
 DATUM Geodetic DATE 2010.10.21 - 2010.10.21 CHECKED BY JL

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						20 40 60 80 100 ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE						
162.0													
24.3	END OF BOREHOLE AT 24.3m UPON CONE REFUSAL. WATER LEVEL WAS NOT OBSERVED UPON COMPLETION OF DRILLING. BOREHOLE BACKFILLED WITH HOLEPLUG TO 9.1m, CUTTINGS TO 0.05m AND ASPHALT TO SURFACE.												

ONTMT4S 1185.GPJ 6/15/11

RECORD OF BOREHOLE No BW-02

1 OF 5

METRIC

W.P. 5198-06-00 LOCATION N 5 199 410.7 E 264 511.0 (Batchawana River Bridge) ORIGINATED BY ES
 HWY 17 BOREHOLE TYPE Hollow Stem Augers/HW Mud Rotary COMPILED BY AN
 DATUM _____ DATE 2010.10.24 - 2010.10.27 CHECKED BY JL

ELEV DEPTH	SOIL PROFILE DESCRIPTION	STRAT PLOT	SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
			NUMBER	TYPE	T _N VALUES			20	40					
186.3	ASPHALT: (50mm)													
185.8	CONCRETE													
0.5	GRAVEL, some sand, occasional cobbles Compact Brown Wet (FILL)		1	SS	12									
	occasional cobbles and boulders from 2.1m to 2.3m		2	SS	18									
184.1	SAND, trace gravel, trace silt and clay Very Loose to Loose Dark Brown Moist		3	SS	2									
2.3			4	SS	8									
			5	SS	6									
	Becoming wet		6	SS	3									
	Becoming grey		7	SS	4									
			8	SS	6									
			9	SS	28									14 83 3 (SI+CL)
	Some gravel Compact		10	SS	58									No Recovery
	Gravelly sand layer at 9.1m Cobbles Very Dense													

ONTMT4S 1185.GPJ 2/18/11

Continued Next Page

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

RECORD OF BOREHOLE No BW-02

2 OF 5

METRIC

W.P. 5198-06-00 LOCATION N 5 199 410.7 E 264 511.0 (Batchawana River Bridge) ORIGINATED BY ES
 HWY 17 BOREHOLE TYPE Hollow Stem Augers/HW Mud Rotary COMPILED BY AN
 DATUM _____ DATE 2010.10.24 - 2010.10.27 CHECKED BY JL

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT W _P	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL X LAB VANE							
	Continued From Previous Page													
	SAND, some gravel, trace silt and clay, occasional cobbles Compact Grey Wet					176								
		11	SS	22										
						175								
		12	SS	15										16 81 3 (SI+CL)
						174								
		13	SS	11										
						173								
						172								
		14	SS	16										
						171								
						170								
		15	SS	10										
						169								
						168								
		16	SS	15										
						167								

ONTMT4S 1185.GPJ 2/18/11

Continued Next Page

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

RECORD OF BOREHOLE No BW-02

3 OF 5

METRIC

W.P. 5198-06-00 LOCATION N 5 199 410.7 E 264 511.0 (Batchawana River Bridge) ORIGINATED BY ES
 HWY 17 BOREHOLE TYPE Hollow Stem Augers/HW Mud Rotary COMPILED BY AN
 DATUM _____ DATE 2010.10.24 - 2010.10.27 CHECKED BY JL

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	T _N VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL X LAB VANE						
	Continued From Previous Page		17	SS	20		166							
			18	SS	26		165							
			19	SS	31		162							0 57 39 4
	Silty sand layer, trace clay at 24.4m		20	SS	18		158							
							157							

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Continued Next Page

+³ X³: Numbers refer to Sensitivity 20 15 10 5 0 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No BW-02

4 OF 5

METRIC

W.P. 5198-06-00 LOCATION N 5 199 410.7 E 264 511.0 (Batchawana River Bridge) ORIGINATED BY ES
 HWY 17 BOREHOLE TYPE Hollow Stem Augers/HW Mud Rotary COMPILED BY AN
 DATUM DATE 2010.10.24 - 2010.10.27 CHECKED BY JL

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													
155.9	SAND, trace gravel, silt and clay Compact Grey Wet	[Strat Plot]	21	SS	38	[Ground Water]	[Elevation Scale]	[D.C.P. Plot]	[Plastic Limit]	[Natural Moisture Content]	[Liquid Limit]	[Unit Weight]	No Recovery
30.5													
	SILT, some clay, trace sand Dense Grey Moist												
			22	SS	40								0 5 84 11
151.0	Silty CLAY, trace sand Stiff Reddish Brown to Grey	[Strat Plot]	23	SS	15	[Ground Water]	[Elevation Scale]	[D.C.P. Plot]	[Plastic Limit]	[Natural Moisture Content]	[Liquid Limit]	[Unit Weight]	0 3 24 73
35.4													
			24	SS	15								
			25	SS	13								0 1 20 79

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Continued Next Page

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

RECORD OF BOREHOLE No BW-02

5 OF 5

METRIC

W.P. 5198-06-00 LOCATION N 5 199 410.7 E 264 511.0 (Batchawana River Bridge) ORIGINATED BY ES
 HWY 17 BOREHOLE TYPE Hollow Stem Augers/HW Mud Rotary COMPILED BY AN
 DATUM _____ DATE 2010.10.24 - 2010.10.27 CHECKED BY JL

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	T _N VALUES			20	40	60					
	Continued From Previous Page														
145.0	Silty CLAY, trace sand Stiff Grey														
41.3	Sandy SILT, trace clay Very Dense Grey Wet		26	SS	50										
143.1			27	SS	55										0 30 65 5
43.3	End of sampling at 43.3m and start DCPT														
142.6															
43.8	END OF BOREHOLE AT 43.8m UPON CONE REFUSAL. Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen. WATER LEVEL READINGS: DATE DEPTH (m) ELEV. (m) Piezometer was destroyed and it was not possible to locate.														

ONTMT4S 1185.GPJ 2/18/11

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



RECORD OF BOREHOLE No BW-03

1 OF 5

METRIC

W.P. 5198-06-00 LOCATION N 5 199 411.7 E 264 534.2 (Batchawana River Bridge) ORIGINATED BY ES
 HWY 17 BOREHOLE TYPE HQ/HW Mud Rotary COMPILED BY AN
 DATUM _____ DATE 2010.10.29 - 2010.10.31 CHECKED BY JL

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						
186.5 0.0 186.2 0.3	BRIDGE DECK 25mm of asphalt over 275mm of concrete													
183.3 3.2	RIVER SURFACE WATER													
179.3 7.3	RIVER BED SAND, some silt, trace clay, gravelly layer Very Loose to Compact Brown Wet		1 2 3 4	SS SS SS SS	2 14 23 21									
														0 87 13 (SI+CL)

ONTMT4S 1185.GPJ 2/18/11

Continued Next Page

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

RECORD OF BOREHOLE No BW-03

2 OF 5

METRIC

W.P. 5198-06-00 LOCATION N 5 199 411.7 E 264 534.2 (Batchawana River Bridge) ORIGINATED BY ES
 HWY 17 BOREHOLE TYPE HQ/HW Mud Rotary COMPILED BY AN
 DATUM DATE 2010.10.29 - 2010.10.31 CHECKED BY JL

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	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa				
						20 40 60 80 100	20 40 60				
	Continued From Previous Page										
	SAND, trace to some silt and clay Loose to Compact Grey Wet Cobble at 10.5m	5	SS	13		176					
		6	SS	18		175					
		7	SS	7		174					
		8	SS	16		173					0 88 12 (SI+CL)
		9	SS	10		172					
		10	SS	10		171					
	Gravelly sand layer at 16.4m	11	SS	11		170					23 75 2 (SI+CL)
		12	SS	13		169					
		13	SS	12		168					
						167					

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+ 3, X 3: Numbers refer to Sensitivity $\frac{20}{15} \cdot 5$ (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No BW-03

3 OF 5

METRIC

W.P. 5198-06-00 LOCATION N 5 199 411.7 E 264 534.2 (Batchawana River Bridge) ORIGINATED BY ES
 HWY 17 BOREHOLE TYPE HQ/HW Mud Rotary COMPILED BY AN
 DATUM _____ DATE 2010.10.29 - 2010.10.31 CHECKED BY JL

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL X LAB VANE							
	Continued From Previous Page													
	SAND, trace silt and clay Compact to Dense Grey Moist	14	SS	15										0 91 9 (SI+CL)
		15	SS	31										
		16	SS	30										
		17	SS	24										
		18	SS	21										0 66 29 5
		19	SS	21										
		Silty sand layer, trace clay at 27.1m												

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Continued Next Page

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

RECORD OF BOREHOLE No BW-03

4 OF 5

METRIC

W.P. 5198-06-00 LOCATION N 5 199 411.7 E 264 534.2 (Batchawana River Bridge) ORIGINATED BY ES
 HWY 17 BOREHOLE TYPE HQ/HW Mud Rotary COMPILED BY AN
 DATUM DATE 2010.10.29 - 2010.10.31 CHECKED BY JL

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					
156.1 30.4	Continued From Previous Page SAND, trace silt and clay Compact to Dense Grey Moist SILT, some sand, some clay, trace gravel Very Dense Grey Wet														
			20	SS	53									1 14 74 11	
			21	SS	68										
149.4 37.1	Sandy SILT, trace clay Very Dense to Dense Grey Wet														
			22	SS	68									0 34 61 5	

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Continued Next Page

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

RECORD OF BOREHOLE No BW-03

5 OF 5

METRIC

W.P. 93-89-00 LOCATION N 5 199 411.7 E 264 534.2 (Batchawana River Bridge) ORIGINATED BY ES
 HWY 17 BOREHOLE TYPE HQ/HW Mud Rotary COMPILED BY AN
 DATUM Geodetic DATE 2010.10.29 - 2010.10.31 CHECKED BY JL

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						
	Continued From Previous Page													
145.1	Sandy SILT, trace clay Dense Grey Wet		23	SS	40									
41.4	End of sampling at 41.4m and start DCPT													
142.7														
43.8	END OF BOREHOLE AT 43.8m ON CONE REFUSAL. WATER LEVEL WAS NOT OBSERVED UPON COMPLETION OF DRILLING. BOREHOLE CAVED TO 7.3m WHILE PULLING CASING, BOREHOLE BACKFILLED WITH 275mm OF CONCRETE AND 25mm OF ASPHALT AT BRIDGE DECK.													

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RECORD OF BOREHOLE No BW-04

2 OF 5

METRIC

W.P. 5198-06-00 LOCATION N 5 199 402.5 E 264 550.5 (Batchawana River Bridge) ORIGINATED BY ES
 HWY 17 BOREHOLE TYPE HQ/HW Mud Rotary COMPILED BY AN
 DATUM DATE 2010.10.31 - 2010.11.01 CHECKED BY JL

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						
	Continued From Previous Page												
	SAND, trace silt and clay Loose to Compact Grey Wet	4	SS	24		176							
		5	SS	10									
		6	S	8		175							
		7	SS	9		174							
		8	SS	9									
		9	SS	10		173							0 97 3 (SI+CL)
		10	SS	27		172							
	cobbles					171							
						170							
		11	SS	11									
						169							
						168							0 90 10 (SI+CL)
		12	SS	14		167							

ONTMT4S 1185.GPJ 2/18/11

Continued Next Page

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

RECORD OF BOREHOLE No BW-04

3 OF 5

METRIC

W.P. 5198-06-00 LOCATION N 5 199 402.5 E 264 550.5 (Batchawana River Bridge) ORIGINATED BY ES
 HWY 17 BOREHOLE TYPE HQ/HW Mud Rotary COMPILED BY AN
 DATUM DATE 2010.10.31 - 2010.11.01 CHECKED BY JL

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														
	SAND, trace silt and clay Compact Grey Wet		13	SS	18									
						166								
			14	SS	19									
						165								
						164								
			15	SS	24									
						163								
						162								
			16	SS	28									
						161								
	Dense		17	SS	39									
						160							0 88 12 (SI+CL)	
						159								
			18	SS	24									
						158								
	SILT, trace to some sand, trace clay Compact Grey Wet		19	SS	15								0 14 81 5	
						157								

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Continued Next Page

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

RECORD OF BOREHOLE No BW-04

4 OF 5

METRIC

W.P. 5198-06-00 LOCATION N 5 199 402.5 E 264 550.5 (Batchawana River Bridge) ORIGINATED BY ES
 HWY 17 BOREHOLE TYPE HQ/HW Mud Rotary COMPILED BY AN
 DATUM _____ DATE 2010.10.31 - 2010.11.01 CHECKED BY JL

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL X LAB VANE							
Continued From Previous Page														
	SILT, trace sand, trace clay Compact to Very Dense Grey Wet					156								
		20	SS	61		154								
		21	SS	49		151							0 7 87 6	
		22	SS	56		148								
						147								

ONTMT4S 1185.GPJ 2/18/11

Continued Next Page

+³, X³: Numbers refer to Sensitivity

20
15
10
5
0
(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No BW-04

5 OF 5

METRIC

W.P. 93-89-00 LOCATION N 5 199 402.5 E 264 550.5 (Batchawana River Bridge) ORIGINATED BY ES
 HWY 17 BOREHOLE TYPE HQ/HW Mud Rotary COMPILED BY AN
 DATUM Geodetic DATE 2010.10.31 - 2010.11.01 CHECKED BY JL

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												
144.9	SILT, trace sand, trace clay Very Dense Grey Wet		23	SS	59								
41.7	End of sampling at 41.7m and start DCPT												
142.1													
44.4	END OF BOREHOLE AT 44.4m ON CONE REFUSAL. WATER LEVEL WAS NOT OBSERVED UPON COMPLETION OF DRILLING. BOREHOLE CAVED TO 7.6m WHILE PULLING CASING, BOREHOLE BACKFILLED WITH 275mm OF CONCRETE AND 25mm OF ASPHALT AT BRIDGE DECK.												

ONTM14S 1185.GPJ 6/15/11

RECORD OF BOREHOLE No BW-05

2 OF 5

METRIC

W.P. 5198-06-00 LOCATION N 5 199 404.4 E 264 571.1 (Batchawana River Bridge) ORIGINATED BY ES
 HWY 17 BOREHOLE TYPE HQ/HW Mud Rotary COMPILED BY AN
 DATUM DATE 2010.10.28 - 2010.10.29 CHECKED BY JL

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT W _P	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa						
						○ UNCONFINED	+ FIELD VANE	● QUICK TRIAXIAL	× LAB VANE	WATER CONTENT (%)				
						20	40	60	80	100	20	40	60	
	Continued From Previous Page													
	SAND, trace gravel, trace silt and clay Loose to Compact Grey Wet		5	SS	8									
			6	SS	17									
			7	SS	15									
			8	SS	14									
			9	SS	8									
			10	SS	12									
			11	SS	17									
			12	SS	21									
			13	SS	18									18 81 1 (SI+CL)

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

RECORD OF BOREHOLE No BW-05 3 OF 5 METRIC

W.P. 5198-06-00 LOCATION N 5 199 404.4 E 264 571.1 (Batchawana River Bridge) ORIGINATED BY ES
 HWY 17 BOREHOLE TYPE HQ/HW Mud Rotary COMPILED BY AN
 DATUM _____ DATE 2010.10.28 - 2010.10.29 CHECKED BY JL

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						
	Continued From Previous Page													
	SAND, trace gravel, trace to some silt and clay Compact Grey Wet		14	SS	19		166							
							165							
			15	SS	25		164							
							163							1 88 11 (SI+CL)
			16	SS	29		162							
							161							
			17	SS	26		160							
							159							
			18	SS	24		158							
							157							
158.1 28.4	SILT, some sand, some clay Loose Grey Wet		19	SS	7									0 20 67 13

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Continued Next Page

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

RECORD OF BOREHOLE No BW-05

5 OF 5

METRIC

W.P. 93-89-00 LOCATION N 5 199 404.4 E 264 571.1 (Batchawana River Bridge) ORIGINATED BY ES
 HWY 17 BOREHOLE TYPE HQ/HW Mud Rotary COMPILED BY AN
 DATUM Geodetic DATE 2010.10.28 - 2010.10.29 CHECKED BY JL

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					
	Continued From Previous Page												
144.8	SILT, trace to some sand, trace clay Very Dense Grey Moist		23	SS	50								
41.7	End of sampling at 41.7m and start DCPT												
143.6													
42.9	END OF BOREHOLE AT 42.9m ON CONE REFUSAL. WATER LEVEL WAS NOT OBSERVED UPON COMPLETION OF DRILLING. BOREHOLE CAVED TO 7.6m WHILE PULLING CASING, BOREHOLE BACKFILLED WITH 275mm OF CONCRETE AND 25mm OF ASPHALT AT BRIDGE DECK.												

ONTM4S 1185.GPJ 6/15/11

RECORD OF BOREHOLE No BW-06

1 OF 5

METRIC

W.P. 5198-06-00 LOCATION N 5 199 395.2 E 264 587.3 (Batchawana River Bridge) ORIGINATED BY ES
 HWY 17 BOREHOLE TYPE HQ/HW Mud Rotary COMPILED BY AN
 DATUM _____ DATE 2010.11.01 - 2010.11.01 CHECKED BY JL

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	NATURAL MOISTURE CONTENT	LIQUID LIMIT		
							20 40 60 80 100	W _P	W	W _L		
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL X LAB VANE				
186.5 0.0 186.2 0.3	BRIDGE DECK 25mm of asphalt over 275mm of concrete											
182.9 3.6	RIVER SURFACE WATER											
179.1 7.4	RIVER BED SAND, some gravel, trace silt and clay Very Loose to Compact Brown Wet Gravelly sand layer at 7.9m		1	SS	3		179					
			2	SS	10		178					
			3	SS	10		177					

ONTMT4S 1185.GPJ 2/18/11

Continued Next Page

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

RECORD OF BOREHOLE No BW-06

2 OF 5

METRIC

W.P. 5198-06-00 LOCATION N 5 199 395.2 E 264 587.3 (Batchawana River Bridge) ORIGINATED BY ES
 HWY 17 BOREHOLE TYPE HQ/HW Mud Rotary COMPILED BY AN
 DATUM DATE 2010.11.01 - 2010.11.01 CHECKED BY JL

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT	UNIT WEIGHT 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				
						○ UNCONFINED + FIELD VANE					
						● QUICK TRIAXIAL × LAB VANE					
	Continued From Previous Page		4	SS	13						
	SAND, trace to some gravel, trace silt and clay Loose to Compact Brown Wet		5	SS	8						17 82 1 (SI+CL)
			6	SS	8						
			7	SS	10						
			8	SS	11						
			9	SS	11						7 91 2 (SI+CL)
			10	SS	12						
	Becoming grey										
			11	SS	13						26 71 3 (SI+CL)
	Gravelly sand layer at 16.5m										
			12	SS	14						
			13	SS	18						

ONTMT4S 1185.GPJ 2/18/11

Continued Next Page

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

RECORD OF BOREHOLE No BW-06

3 OF 5

METRIC

W.P. 5198-06-00 LOCATION N 5 199 395.2 E 264 587.3 (Batchawana River Bridge) ORIGINATED BY ES
 HWY 17 BOREHOLE TYPE HQ/HW Mud Rotary COMPILED BY AN
 DATUM DATE 2010.11.01 - 2010.11.01 CHECKED BY JL

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 X LAB VANE						
	Continued From Previous Page													
	SAND, trace to some silt and clay Compact Grey Moist		14	SS	25		166							0 86 14 (SI+CL)
			15	SS	18		164							
			16	SS	31		162							
			17	SS	20		161							
			18	SS	26		160							
	Silty sand, trace clay layer at 27.2m		19	SS	15		159							0 55 43 2
							158							
							157							

ONTMT4S 1185.GPJ 2/18/11

Continued Next Page

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

RECORD OF BOREHOLE No BW-06

5 OF 5

METRIC

W.P. 93-89-00 LOCATION N 5 199 395.2 E 264 587.3 (Batchawana River Bridge) ORIGINATED BY ES
 HWY 17 BOREHOLE TYPE HQ/HW Mud Rotary COMPILED BY AN
 DATUM Geodetic DATE 2010.11.01 - 2010.11.01 CHECKED BY JL

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	T _N VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE				
Continued From Previous Page												
144.9	SILT, trace clay Very Dense Grey Wet		23	SS	55							0 0 91 9
41.6	End of sampling at 41.5m and start DCPT											
141.6	END OF BOREHOLE AT 44.8m ON CONE REFUSAL. WATER LEVEL WAS NOT OBSERVED UPON COMPLETION OF DRILLING. BOREHOLE CAVED TO 7.4m WHILE PULLING CASING, BOREHOLE BACKFILLED WITH 275mm OF CONCRETE AND 25mm OF ASPHALT TO BRIDGE DECK.											

ONTMT4S 1185.GPJ 6/15/11

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

RECORD OF BOREHOLE No BW-07

1 OF 6

METRIC

W.P. 5198-06-00 LOCATION N 5 199 396.0 E 264 610.3 (Batchawana River Bridge) ORIGINATED BY ES
 HWY 17 BOREHOLE TYPE Hollow Stem Augers and HQ/HW Mud Rotary COMPILED BY AN
 DATUM DATE 2010.10.22 - 2010.10.23 CHECKED BY JL

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
186.4	ASPHALT: (50mm)																
185.8	CONCRETE: (150mm)																
0.5	SAND, trace gravel, some silt and clay, occasional cobbles Compact Brown Moist (FILL)		1	SS	26						o						
			2	SS	21						o						
			3	SS	11						o						1 77 22 (SI+CL)
183.3	SAND, coarse grained, trace gravel, trace silt and clay Loose to Compact Brown Moist		4	SS	18						o						
3.0			5	SS	9						o						
			6	SS	4						o						7 92 1 (SI+CL)
			7	SS	9						o						
	Silty sand layer at 6.0m Becoming grey Wet		8	SS	4						o						0 69 29 2
			9	SS	9						o						
			10	SS	8						o						

ONTMT4S 1185.GPJ 2/18/11

Continued Next Page

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

RECORD OF BOREHOLE No BW-07

2 OF 6

METRIC

W.P. 5198-06-00 LOCATION N 5 199 396.0 E 264 610.3 (Batchawana River Bridge) ORIGINATED BY ES
 HWY 17 BOREHOLE TYPE Hollow Stem Augers and HQ/HW Mud Rotary COMPILED BY AN
 DATUM DATE 2010.10.22 - 2010.10.23 CHECKED BY JL

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
Continued From Previous Page													
	SAND, trace gravel, trace silt and clay, occasional cobbles Compact Grey Wet					176							
		11	SS	25									
							175						
			12	SS	15								
							174						
							173						
			13	SS	15								
							172						
							171						3 95 2 (SI+CL)
						170							
		15	SS	23									
						169							
						168							
		16	SS	24									
						167							

ONTMT4S 1185.GPJ 2/18/11

Continued Next Page

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

RECORD OF BOREHOLE No BW-07

4 OF 6

METRIC

W.P. 5198-06-00 LOCATION N 5 199 396.0 E 264 610.3 (Batchawana River Bridge) ORIGINATED BY ES
 HWY 17 BOREHOLE TYPE Hollow Stem Augers and HQ/HW Mud Rotary COMPILED BY AN
 DATUM _____ DATE 2010.10.22 - 2010.10.23 CHECKED BY JL

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa								WATER CONTENT (%)
					20	40	60	80	100	20	40	60		GR SA SI CL	
	Continued From Previous Page														
	SILT, some sand, trace clay Compact to Very Dense Grey Wet	24	SS	57											
		25	SS	78											
		26	SS	47											
		27	SS	28											0 10 85 5
		28	SS	51											
			29	SS	41										0 1 88 11

ONTMT-4S 1185.GPJ 2/18/11

Continued Next Page

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

RECORD OF BOREHOLE No BW-07

6 OF 6

METRIC

W.P. 5198-06-00 LOCATION N 5 199 396.0 E 264 610.3 (Batchawana River Bridge) ORIGINATED BY ES
 HWY 17 BOREHOLE TYPE Hollow Stem Augers and HQ/HW Mud Rotary COMPILED BY AN
 DATUM _____ DATE 2010.10.22 - 2010.10.23 CHECKED BY JL

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							20	40	60	80	100				
135.4																
50.9	END OF BOREHOLE AT 50.9m ON CONE REFUSAL. Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen. WATER LEVEL READINGS: DATE DEPTH (m) ELEV. (m) 2010.11.28 3.4 183.0															

ONTMT4S 1185.GPJ 2/18/11

RECORD OF BOREHOLE No BW-07D

2 OF 3

METRIC

W.P. 5198-06-00 LOCATION N 5 199 396.0 E 264 610.3 (Batchawana River Bridge) ORIGINATED BY ES
 HWY 17 BOREHOLE TYPE Dynamic Cone Penetration Test COMPILED BY AN
 DATUM _____ DATE 2010.10.24 - 2010.10.24 CHECKED BY JL

SOIL PROFILE		SAMPLES				GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w		
	Continued From Previous Page						SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE WATER CONTENT (%) 20 40 60					
176												
175												
174												
173												
172												
171												
170												
169												
168												
167												

ONTMT4S 1185.GPJ 2/18/11

Continued Next Page

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

RECORD OF BOREHOLE No BW-07D

3 OF 3

METRIC

W.P. 5198-06-00 LOCATION N 5 199 396.0 E 264 610.3 (Batchawana River Bridge) ORIGINATED BY ES
 HWY 17 BOREHOLE TYPE Dynamic Cone Penetration Test COMPILED BY AN
 DATUM DATE 2010.10.24 - 2010.10.24 CHECKED BY JL

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _P	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa								
							20	40	60	80	100					
166.2	Continued From Previous Page															
20.1	END OF DCPT AT 20.1m UPON CONE REFUSAL. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO 0.1m THEN ASPHALT TO SURFACE.					166										

ONTMT4S 1185.GPJ 2/18/11

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

RECORD OF BOREHOLE No BW-08

1 OF 3

METRIC

W.P. 5198-06-00 LOCATION N 5 199 389.9 E 264 612.4 (Batchawana River Bridge) ORIGINATED BY ES
 HWY 17 BOREHOLE TYPE Hollow Stem Augers and HQ/HW Mud Rotary COMPILED BY AN
 DATUM _____ DATE 2010.10.21 - 2010.10.21 CHECKED BY JL

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
186.3	ASPHALT: (50mm)													
0.0	SAND, trace to some gravel, trace silt and clay Very Loose to Dense Brown Moist (FILL)		1	SS	36									
			2	SS	11									
			3	SS	4									2 96 2 (SI+CL)
			4	SS	3									
183.3	SAND, trace to some gravel, trace to some silt and clay Very Loose to Compact Brown Wet		5	SS	14									
3.0			6	SS	7									16 83 1 (SI+CL)
			7	SS	5									
			8	SS	3									
	Becoming grey		9	SS	3									
			10	SS	8									0 89 11 (SI+CL)
			11	SS	2									0 34 61 5
	Silty sand layer at 9.1m													

ONTMT4S 1185.GPJ 2/18/11

Continued Next Page

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

RECORD OF BOREHOLE No BW-08

3 OF 3

METRIC

W.P. 93-89-00 LOCATION N 5 199 389.9 E 264 612.4 (Batchawana River Bridge) ORIGINATED BY ES
 HWY 17 BOREHOLE TYPE Hollow Stem Augers and HQ/HW Mud Rotary COMPILED BY AN
 DATUM Geodetic DATE 2010.10.21 - 2010.10.21 CHECKED BY JL

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					
	Continued From Previous Page						20 40 60 80 100 ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE	20 40 60			kN/m ³		
161.3													
25.0	END OF BOREHOLE AT 25.0m UPON CONE REFUSAL. WATER LEVEL WAS NOT OBSERVED UPON COMPLETION OF DRILLING. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO 0.04m, THEN ASPHALT TO SURFACE.												

ONTMT4S 1185.GPJ 6/15/11

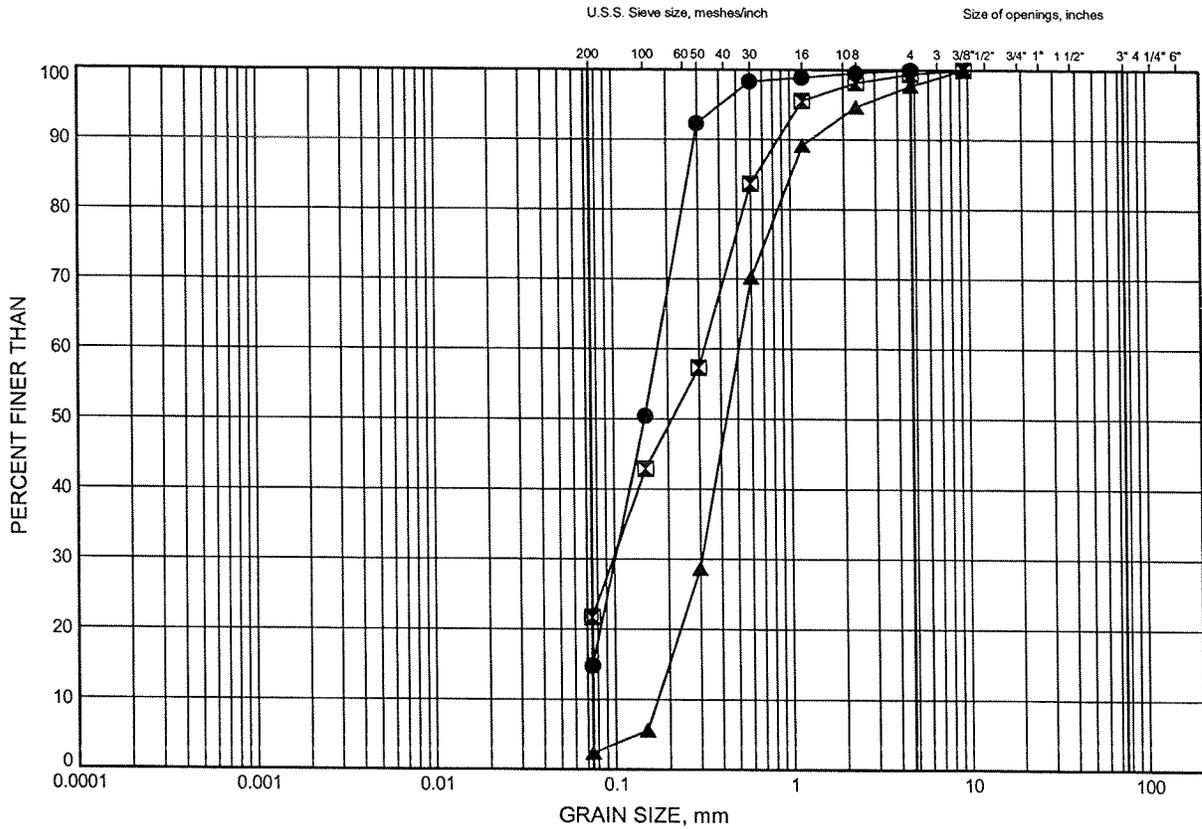
Appendix B

**Laboratory Test Results
(present investigation)**

Ten Bridge Rehabilitations and Two Bridge Replacements
GRAIN SIZE DISTRIBUTION

FIGURE B1

SAND FILL



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	BW-01	1.07	185.27
⊠	BW-07	2.59	183.76
▲	BW-08	1.83	184.50

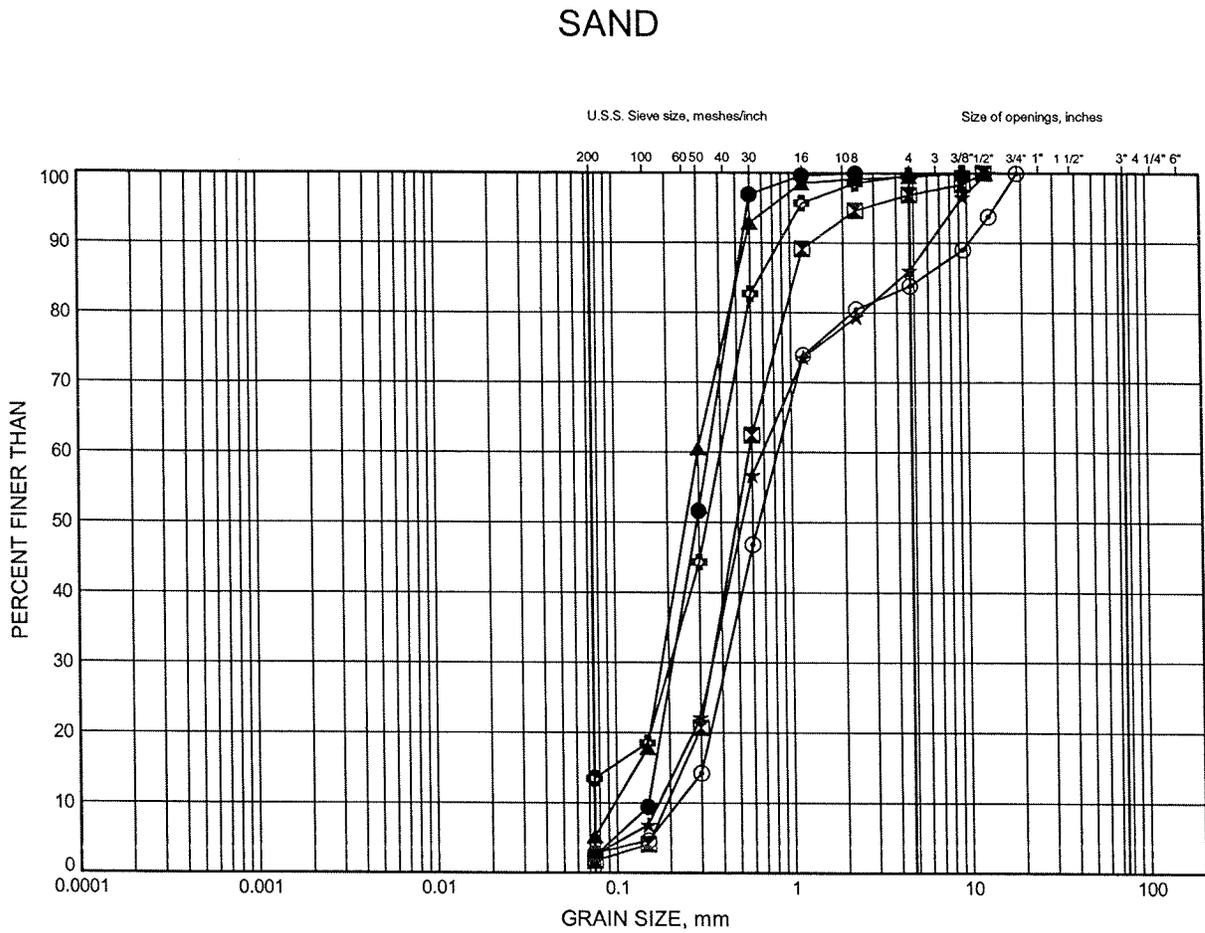
GRAIN SIZE DISTRIBUTION - THURBER 1185.GPJ 1/26/11

W.P.# .5198-06-00.....
 Prepared By .AN.....
 Checked By .RPR.....



Ten Bridge Rehabilitations and Two Bridge Replacements
GRAIN SIZE DISTRIBUTION

FIGURE B2



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	BW-01	3.35	182.98
⊠	BW-01	12.50	173.84
▲	BW-02	3.35	182.99
★	BW-02	7.92	178.42
⊙	BW-02	12.50	173.85
⊕	BW-03	9.09	177.42

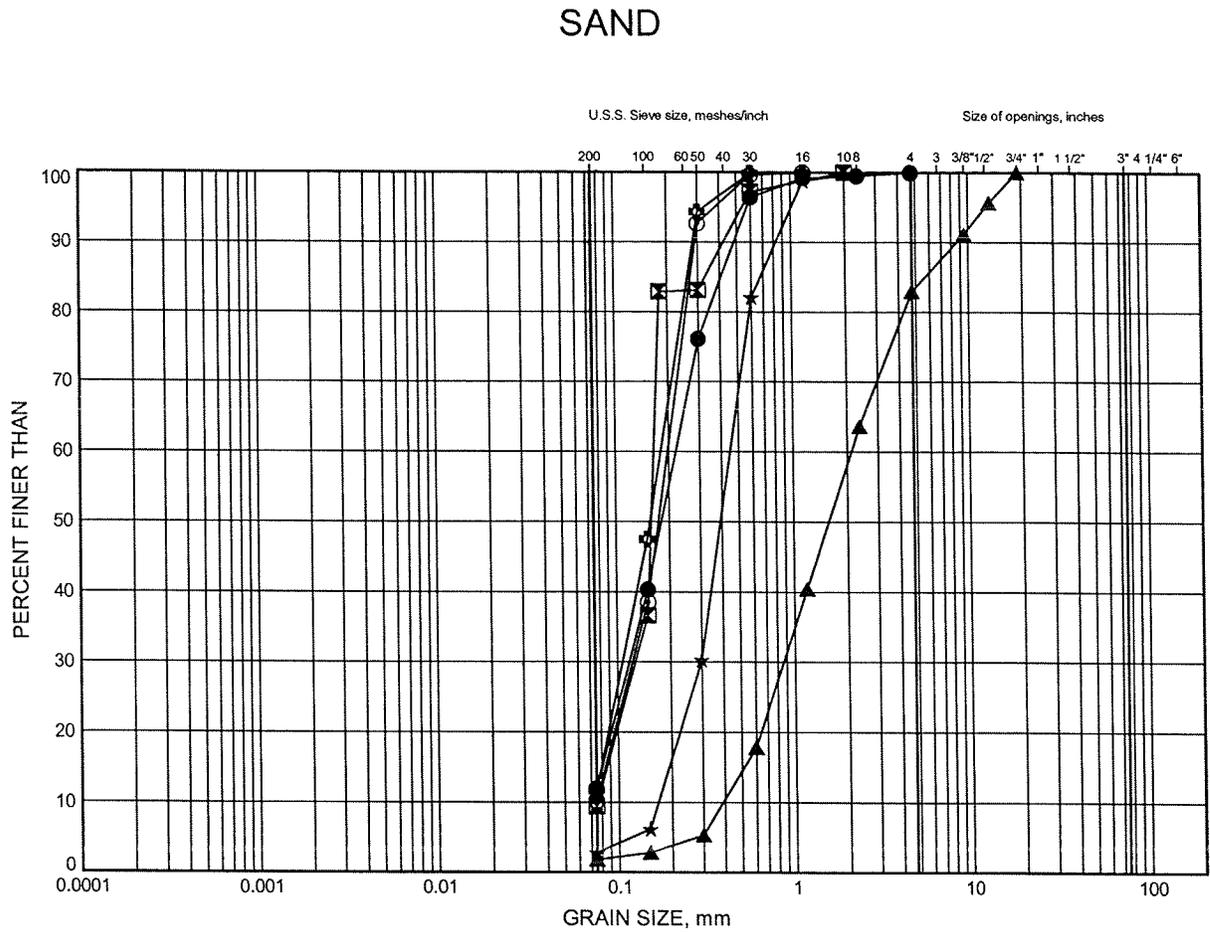
GRAIN SIZE DISTRIBUTION - THURBER 1185.GPJ 1/28/11

W.P.# .5198-06-00.....
 Prepared By .AN.....
 Checked By .RPR.....



Ten Bridge Rehabilitations and Two Bridge Replacements
GRAIN SIZE DISTRIBUTION

FIGURE B3



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	BW-03	12.90	173.61
⊠	BW-03	21.28	165.23
▲	BW-04	7.87	178.70
★	BW-04	13.97	172.61
⊙	BW-04	18.54	168.03
⊛	BW-04	26.16	160.41

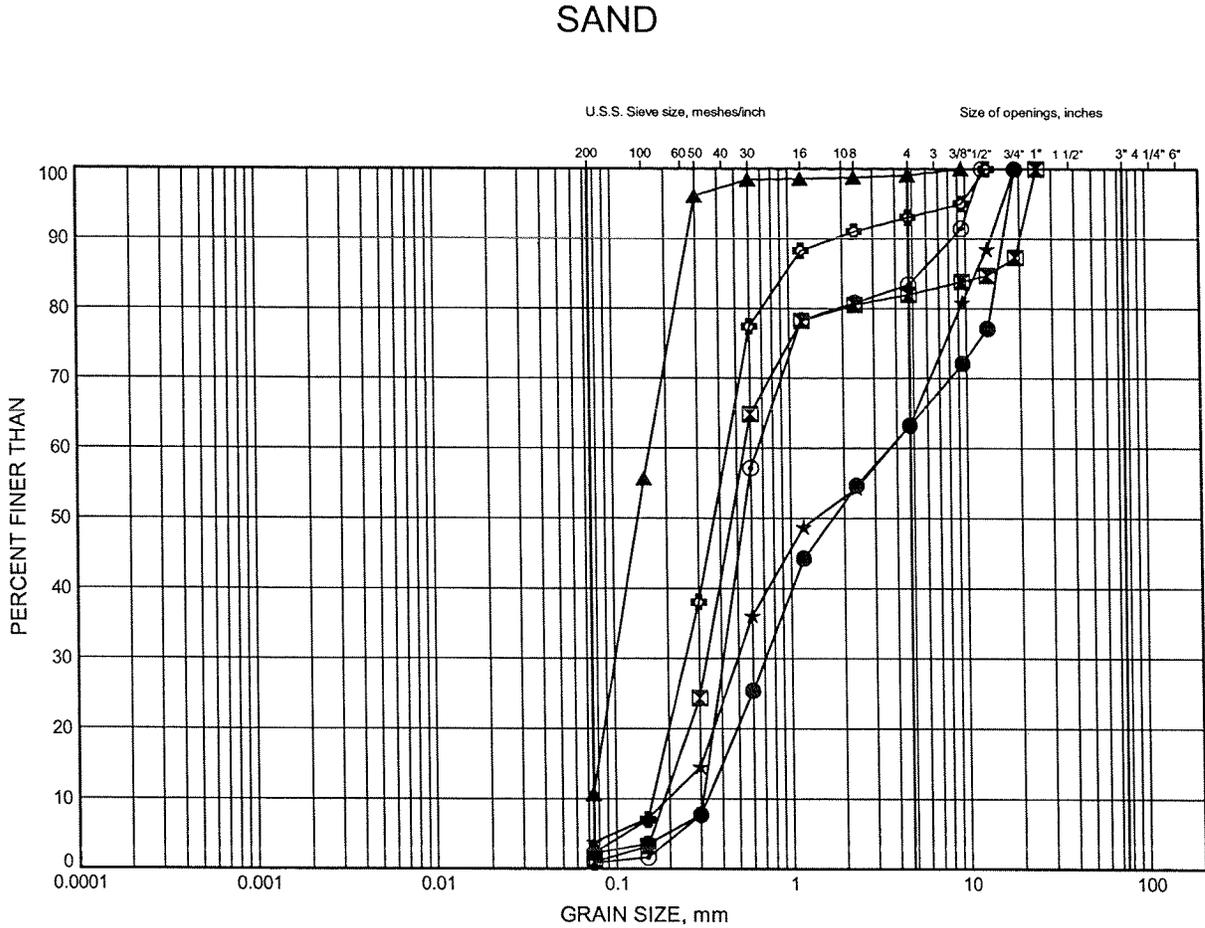
GRAIN SIZE DISTRIBUTION - THURBER 1185.GPJ 1/26/11

W.P.# .5198-06-00.....
 Prepared By .AN.....
 Checked By .RPR.....



Ten Bridge Rehabilitations and Two Bridge Replacements
GRAIN SIZE DISTRIBUTION

FIGURE B4



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	BW-05	9.70	176.84
⊠	BW-05	18.54	168.00
▲	BW-05	23.11	163.43
★	BW-06	8.48	178.00
⊙	BW-06	10.77	175.71
⊠	BW-06	13.82	172.66

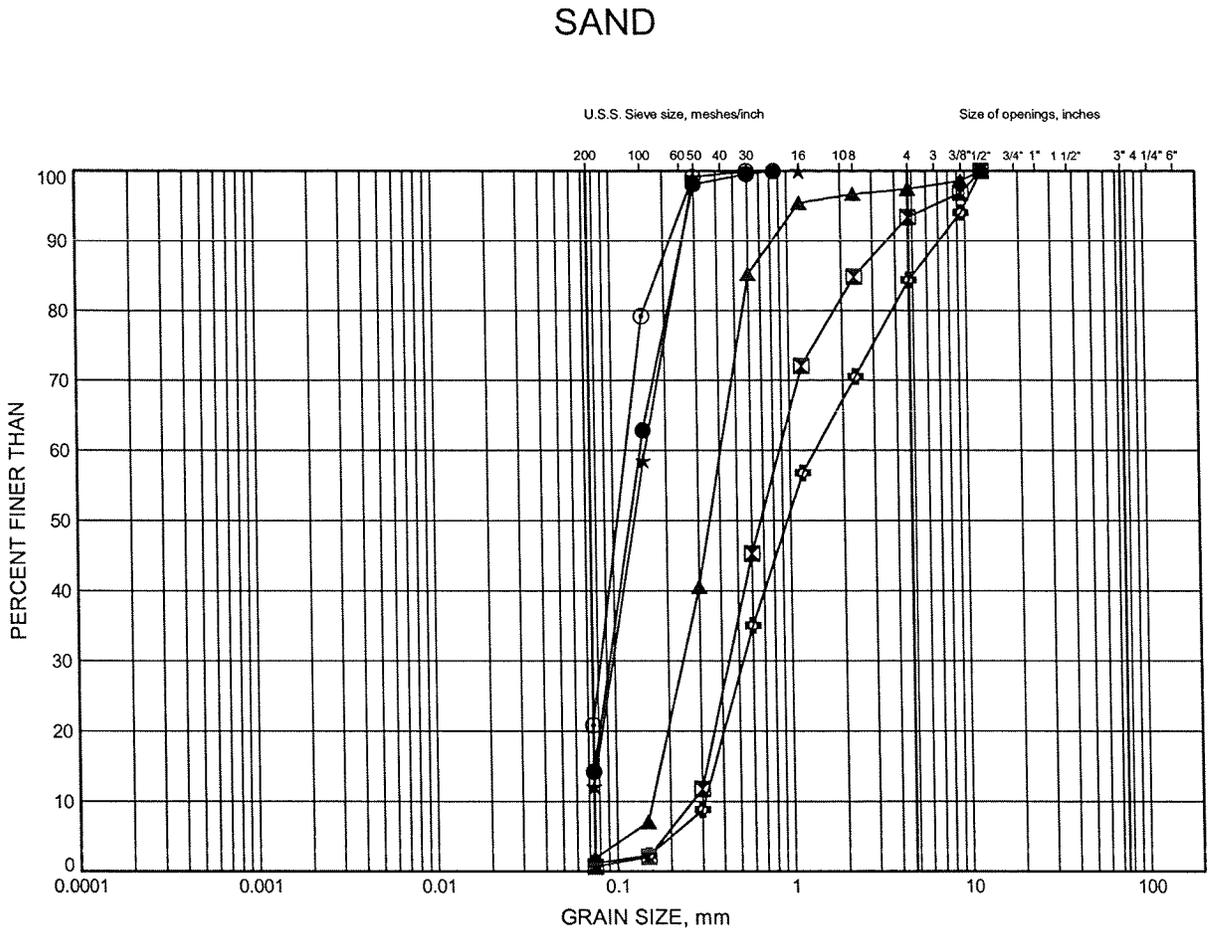
GRAIN SIZE DISTRIBUTION - THURBER 1185.GPJ 1/26/11

W.P.# .5198-06-00.....
 Prepared By .AN.....
 Checked By .RPR.....



Ten Bridge Rehabilitations and Two Bridge Replacements
GRAIN SIZE DISTRIBUTION

FIGURE B5



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	BW-06	21.44	165.04
⊠	BW-07	4.88	181.47
▲	BW-07	15.54	170.81
★	BW-07	21.64	164.71
⊙	BW-07	27.74	158.61
⊕	BW-08	4.11	182.21

GRAIN SIZE DISTRIBUTION - THURBER 1185.GPJ 1/26/11

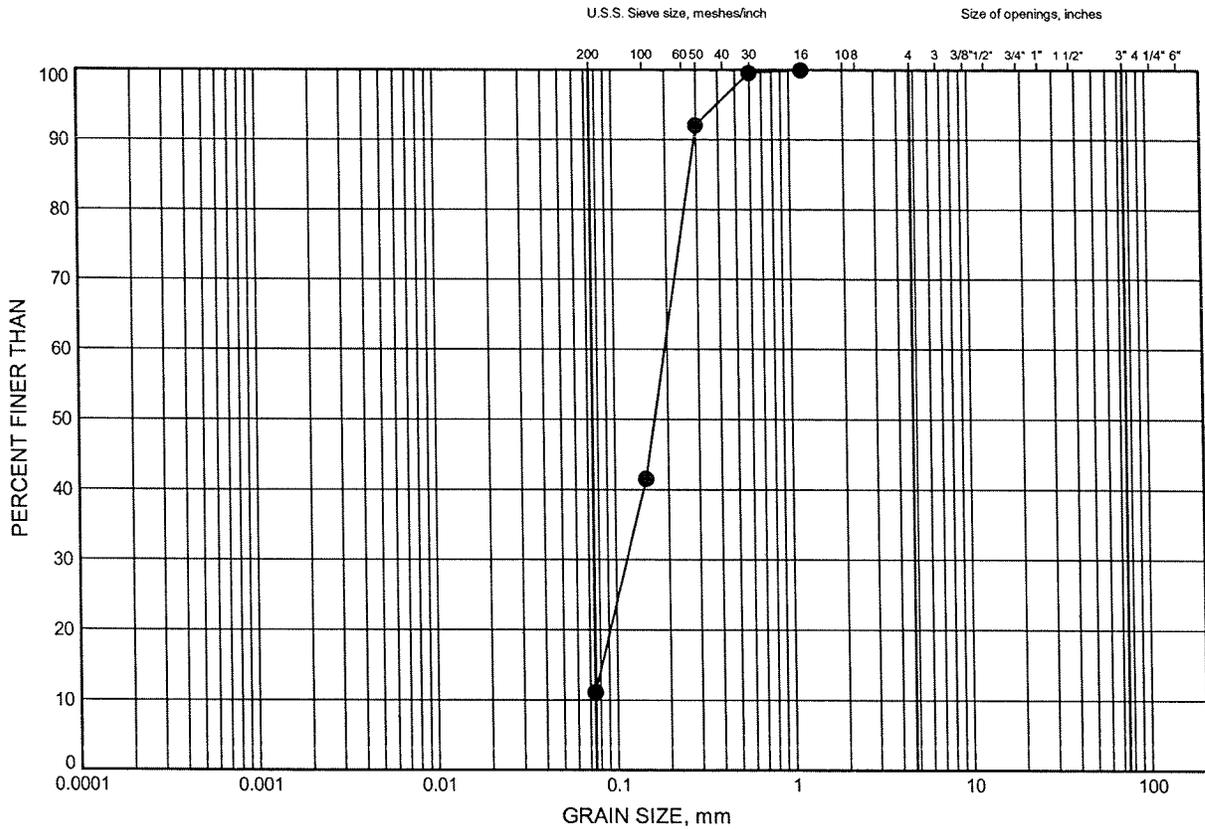
W.P.# .5198-06:00.....
 Prepared By .AN.....
 Checked By .RPR.....



Ten Bridge Rehabilitations and Two Bridge Replacements
GRAIN SIZE DISTRIBUTION

FIGURE B6

SAND



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	BW-08	7.92	178.40

GRAIN SIZE DISTRIBUTION - THURBER 1185.GPJ 1/26/11

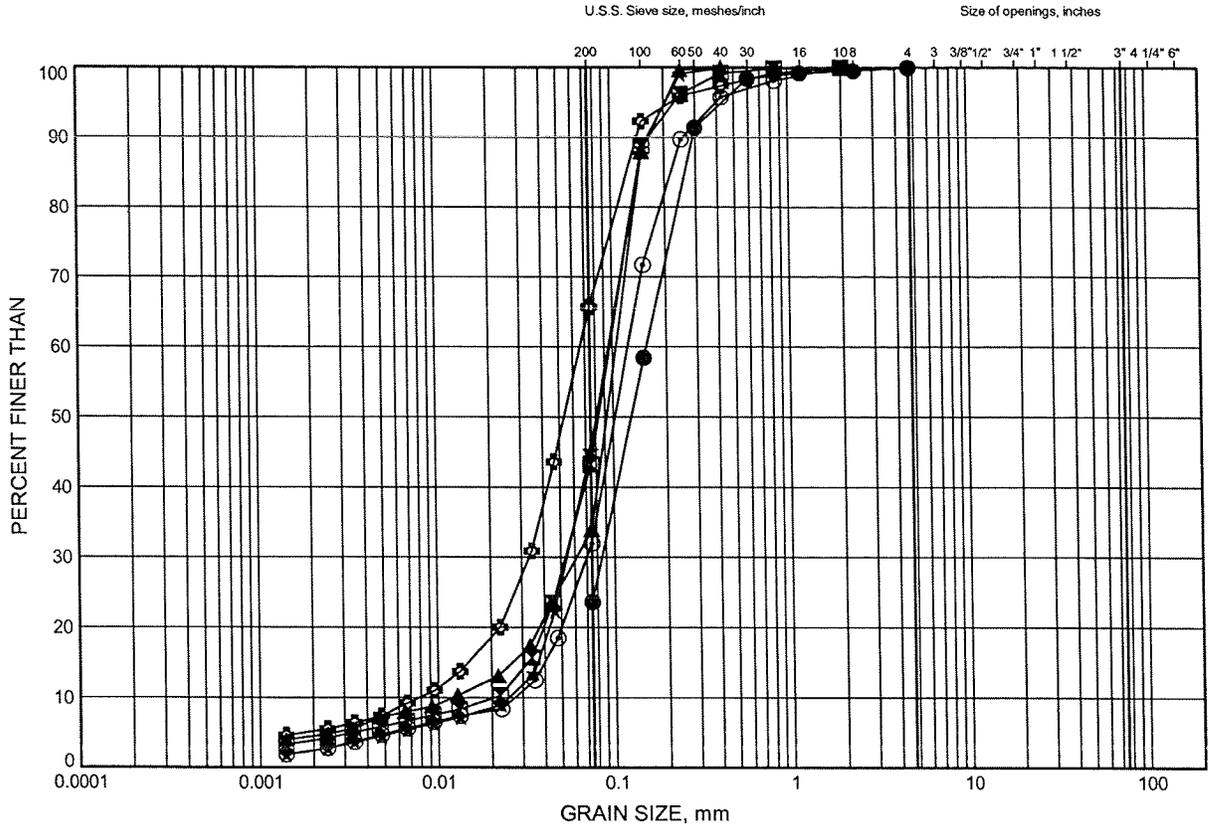
W.P.# .5198-06-00.....
 Prepared By .AN.....
 Checked By .RPR.....



Ten Bridge Rehabilitations and Two Bridge Replacements
GRAIN SIZE DISTRIBUTION

FIGURE B7

SILTY SAND



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	BW-01	6.40	179.94
⊠	BW-02	24.69	161.66
▲	BW-03	27.38	159.14
★	BW-06	27.53	158.95
⊙	BW-07	6.40	179.95
⊕	BW-08	9.45	176.88

GRAIN SIZE DISTRIBUTION - THURBER 1185.GPJ 1/26/11

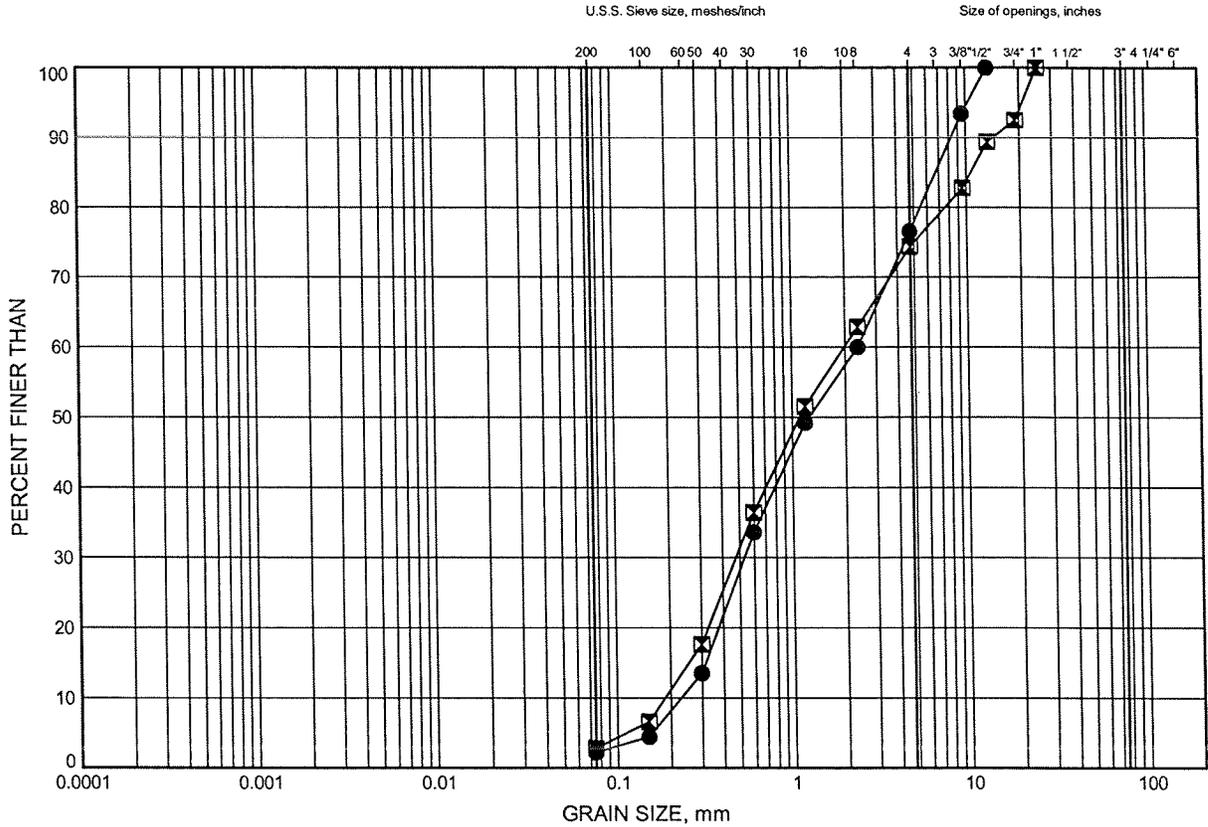
W.P.# .5198-06-00.....
 Prepared By .AN.....
 Checked By .RPR.....



Ten Bridge Rehabilitations and Two Bridge Replacements
GRAIN SIZE DISTRIBUTION

FIGURE B8

GRAVELLY SAND



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	BW-03	16.71	169.80
⊠	BW-06	16.86	169.62

GRAIN SIZE DISTRIBUTION - THURBER 1185.GPJ 1/26/11

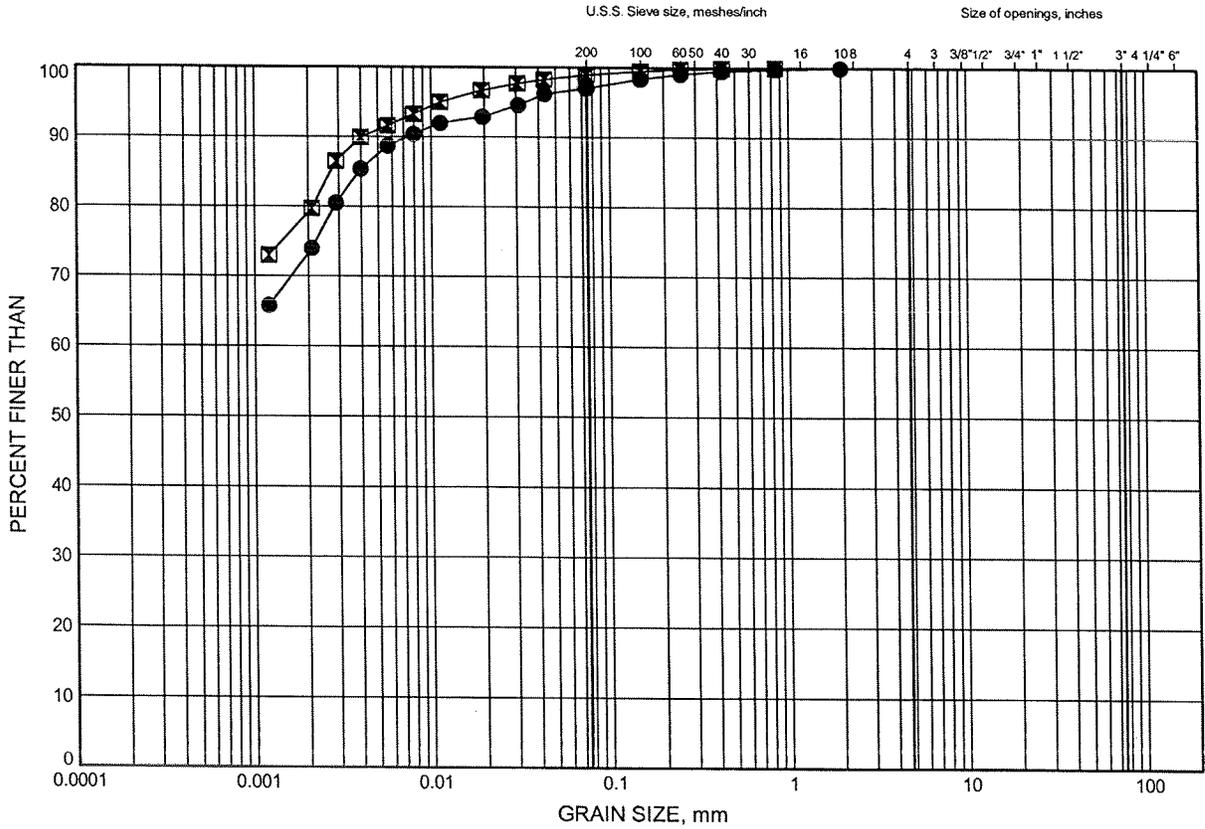
W.P.# .5198-06-00.....
 Prepared By .AN.....
 Checked By .RPR.....



Ten Bridge Rehabilitations and Two Bridge Replacements
GRAIN SIZE DISTRIBUTION

FIGURE B9

SILTY CLAY



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	BW-02	36.88	149.47
⊠	BW-02	39.93	146.42

GRAIN SIZE DISTRIBUTION - THURBER 1185.GPJ 1/26/11

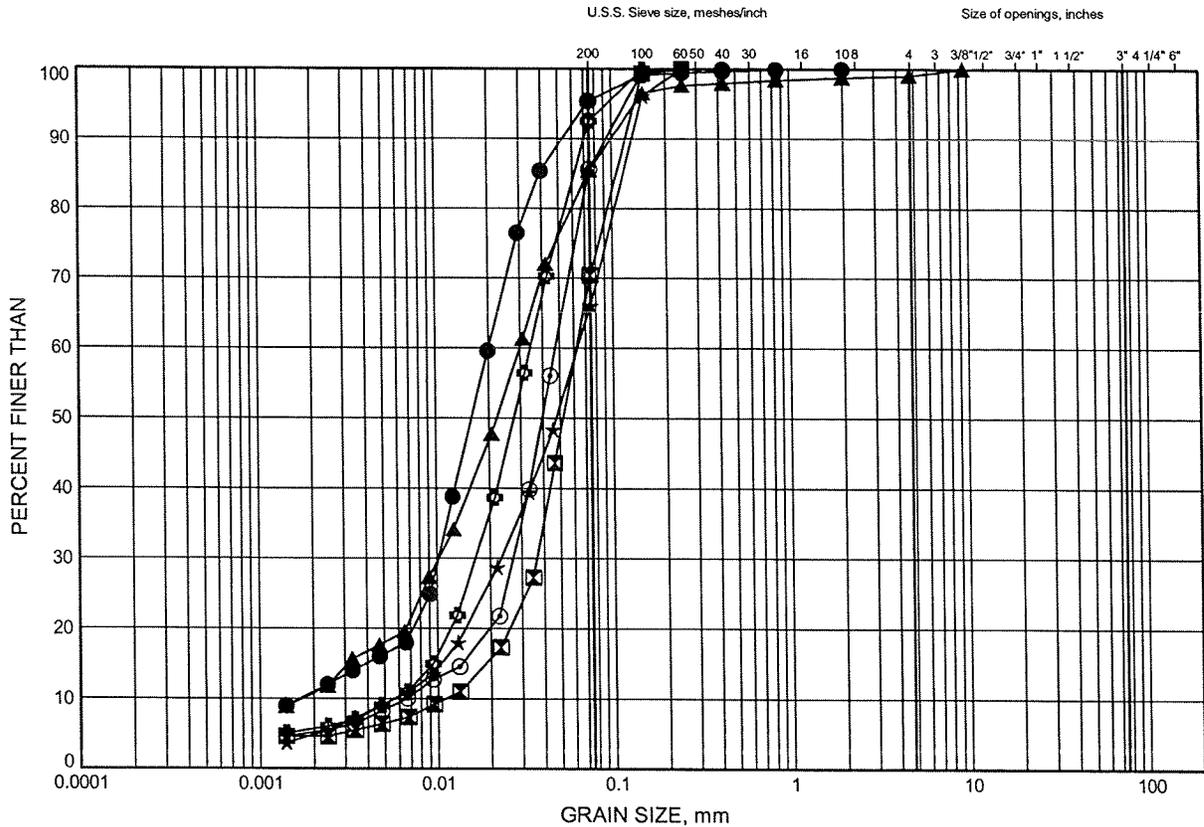
W.P.# .5198-06-00.....
 Prepared By .AN.....
 Checked By .RPR.....



Ten Bridge Rehabilitations and Two Bridge Replacements
GRAIN SIZE DISTRIBUTION

FIGURE B10

SILT/SANDY SILT



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	BW-02	33.83	152.51
⊠	BW-02	42.98	143.37
▲	BW-03	31.95	154.56
★	BW-03	38.05	148.47
⊙	BW-04	29.21	157.37
⊕	BW-04	35.30	151.27

GRAIN SIZE DISTRIBUTION - THURBER 1185.GPJ 1/26/11

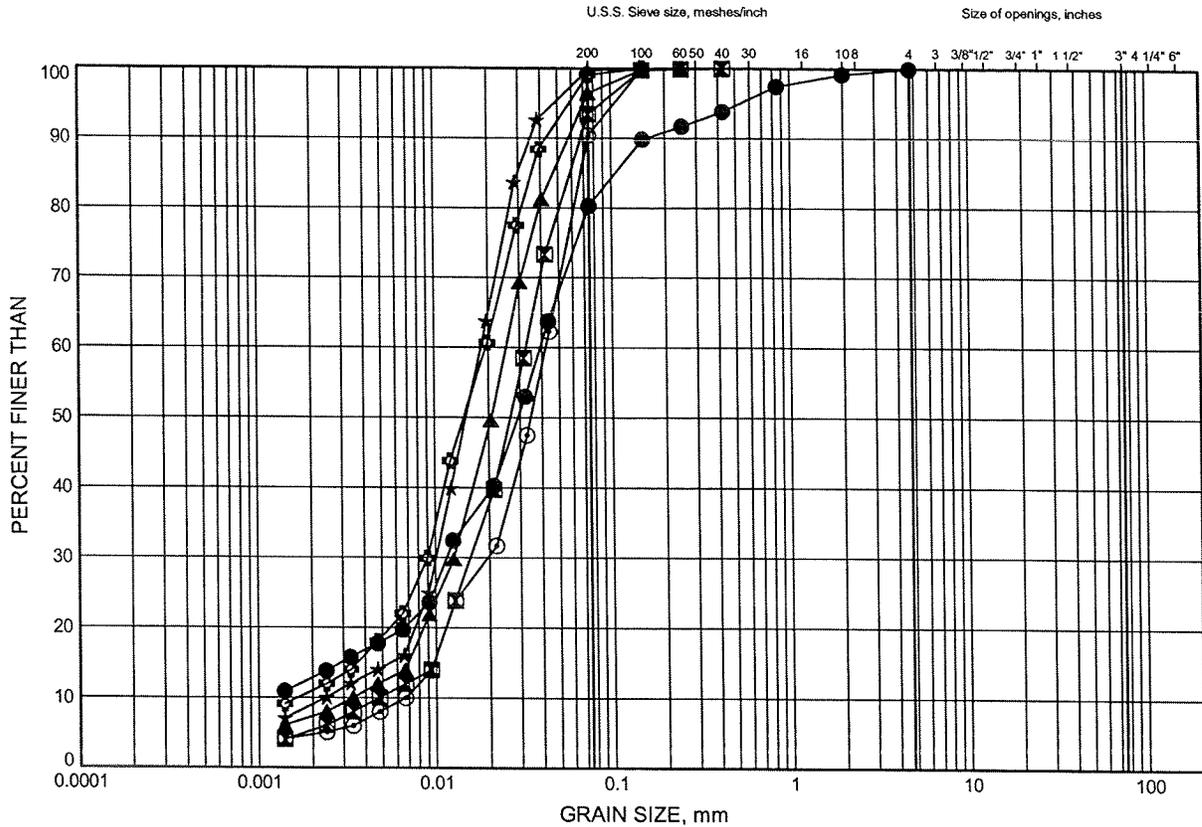
W.P.# .5198-06-00.....
 Prepared By .AN.....
 Checked By .RPR.....



Ten Bridge Rehabilitations and Two Bridge Replacements
GRAIN SIZE DISTRIBUTION

FIGURE B11

SILT/SANDY SILT



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	BW-05	29.21	157.33
⊠	BW-05	35.30	151.24
▲	BW-06	32.10	154.38
★	BW-06	41.25	145.23
⊙	BW-07	35.36	150.99
⊕	BW-07	39.93	146.42

GRAIN SIZE DISTRIBUTION - THURBER 1185.GPJ 1/26/11

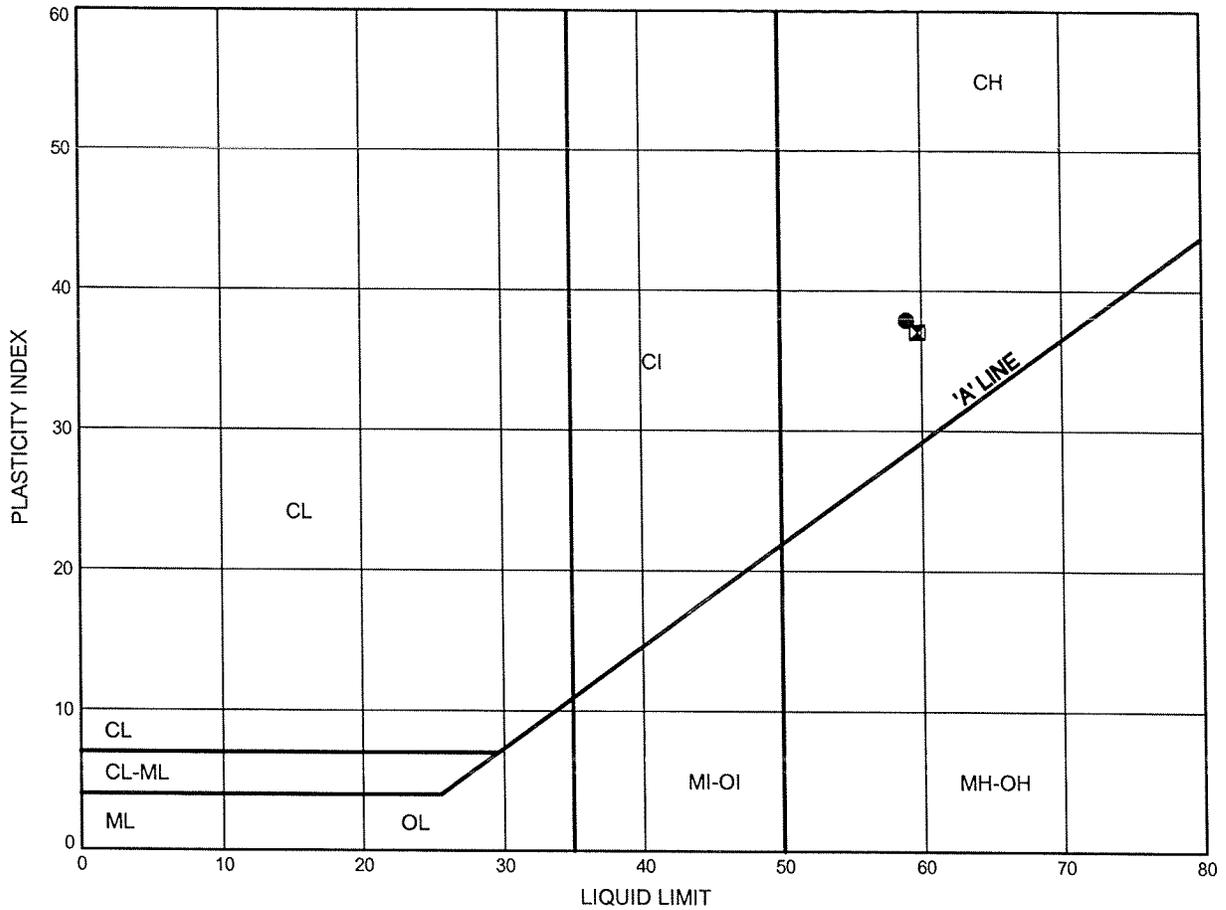
W.P.# .5198-06-00.....
 Prepared By .AN.....
 Checked By .RPR.....



Ten Bridge Rehabilitations and Two Bridge Replacements
ATTERBERG LIMITS TEST RESULTS

FIGURE B12

SILTY CLAY



SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	BW-02	36.88	149.47
⊠	BW-02	39.93	146.42

THURBALT 1185.GPJ 1/26/11

Date January 2011
 Project 5198-06-00



Prep'd AN
 Chkd. RPR

Appendix C

**Record of Borehole Sheets and Laboratory Results
(previous investigation)**

RECORD OF BOREHOLE No 1

METRIC

W P 910-62-09 LOCATION Sta. 16 + 837.0; 10.4 m Lt. of Hwy. 17 E ORIGINATED BY MLP
 DIST 18 HWY 17 BOREHOLE TYPE Cone Test, N-Casing COMPILED BY MLP
 DATUM Geodetic DATE 87 06 18 CHECKED BY DD

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80			100
185.6	Ground Surface													
0.0	Sand Some Silt trace gravel, trace clay Loose (Fill)	X	1	SS	7									4 83 11 2
183.9		X	2	SS	10									
1.7		X	3	SS	16									11 79 (10)
		X	4	SS	13									
	Occ. Cobbles	X	5	SS	13									72 28 (0)
	Sand Occasional Silt Zones Occasional Gravelly Zones Occasional Cobbles	X	6	SS	9									
		X	7	SS	10									1 90 8 1
	Loose to Dense (Lacustrine)	X	8	SS	7									23 32 43 2
		X	9	SS	37									
173.0		X	10	SS	25									
12.6	End of Borehole													
170.7														
14.9	End of Cone Test													

OFFICE REPORT ON SOIL EXPLORATION

+³, x⁵: Numbers refer to Sensitivity
 20
 15-0.5 (%) STRAIN AT FAILURE
 10

RECORD OF BOREHOLE No 2

METRIC

W P 910-62-09 LOCATION Sta. 16 + 800.0; 10.0 m Lt. of Hwy.17 E ORIGINATED BY MLP
 DIST 18 HWY 17 BOREHOLE TYPE Cone Test, N-Casing COMPILED BY MLP
 DATUM Geodetic DATE 87 06 15 CHECKED BY DD

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT Y	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	NUMBER	TYPE	'N' VALUES			20	40					
183.2	River Surface												
0.0	Water												
179.4	River Bed												
3.8	Occ. Cobbles	1	SS	15									
		2	SS	19									
		3	SS	15									
	Sand	4	SS	8									
	Occ. Silt Zones												
	Occ. Gravelly Zones												
	Occ. Cobbles	5	SS	9									
	Loose to Compact (Lacustrine)	6	SS	11									
	Occ. Cobbles	7	SS	11									
		8	SS	11									
		9	SS	12									
		10	SS	11									
		11	SS	11									
163.7		12	SS	15									
19.5	End of Borehole												
161.2													
22.0	End of Cone Test												

OFFICE REPORT ON SOIL EXPLORATION

+³, x⁵: Numbers refer to Sensitivity
 20
 15 - 5 (%) STRAIN AT FAILURE
 10

RECORD OF BOREHOLE No 3

METRIC

W P 910-62-09 LOCATION Sta. 16 + 770.0; 10.0 m Lt. of Hwy. 17 ORIGINATED BY MLP
 DIST 18 HWY 17 BOREHOLE TYPE Cone Test, N-Casing COMPILED BY MLP
 DATUM Geodetic DATE 87 06 13 CHECKED BY DD

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
183.2	River Surface													
0.0	Water													
179.8	River Bed													
3.4	Sand Occ. Silty Zones Occ. Gravelly Zones Occ. Cobbles Loose to Dense (Lacustrine)	1	SS	34									79 19 (2)	
		2	SS	41										56 44 (0)
		3	SS	21										15 84 (1)
		4	SS	16										
		5	SS	11										
		6	SS	10										
		7	SS	7										6 93 (1)
		8	SS	11										
		9	SS	14										
		10	SS	19										9 88 (3)
167.8	End of Borehole													
15.4	End of Cone Test													
166.8														
16.4														

OFFICE REPORT ON SOIL EXPLORATION

+³, x⁵: Numbers refer to Sensitivity
 20
 15 5 (%) STRAIN AT FAILURE
 10

RECORD OF BOREHOLE No 4

METRIC

W P 910-62-09 LOCATION Sta. 16 + 735.0; 10.0 m Lt. of Hwy. 17 ORIGINATED BY MLP
 DIST 18 HWY 17 BOREHOLE TYPE Cone Test, N-Casing COMPILED BY MLP
 DATUM Geodetic DATE 87 06 22-23 CHECKED BY DD

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 (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	NUMBER	TYPE	'N' VALUES			20	40					
185.3	Ground Surface												
0.0	Sand Some Silt trace gravel, trace clay Loose (Fill)	1	SS	9									
183.5		2	SS	9									
1.8		3	SS	6									
		4	SS	11									
	Sand Occ. Silt Zones Occ. Gravelly Zones Occ. Cobbles	5	SS	12									
		6	SS	46									
	Loose to Dense (Lacustrine)	7	SS	44									
		8	SS	14									
		9	SS	16									
172.7		10	SS	22									
12.6	End of Borehole												
168.2													
17.1	End of Cone Test												

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 5

METRIC

W P 910-62-09 LOCATION Sta. 16 + 735.0; 13.0 m Rt. of Hwy. 17 E ORIGINATED BY MLP
 DIST 18 HWY 17 BOREHOLE TYPE Cone Test, N-Casing COMPILED BY MLP
 DATUM Geodetic DATE 87 06 23 CHECKED BY DD

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					
185.6	Ground Surface													
0.0	Sand Some Silt trace gravel, trace clay Compact (Fill)	1	SS	14									1 83 15 1	
183.8		2	SS	13									0 81 19 0	
1.8		3	SS	16									11 75 13 1	
		4	SS	9										
		5	SS	10									1 46 52 1	
	Sand Occ. Silt Zones Occ. Gravelly Zones Occ. Cobbles	6	SS	9										
		7	SS	58										
	Loose to Very Dense (Lacustrine)	8	SS	57									24 76 (0)	
		9	SS	32										
173.0		10	SS	12										
12.6	End of Borehole													
167.9														
17.7	End of Cone Test													

OFFICE REPORT ON SOIL EXPLORATION

+³, x⁵: Numbers refer to Sensitivity 20
15 5 (%) STRAIN AT FAILURE
10

RECORD OF BOREHOLE No 6

METRIC

W P 910-62-09 LOCATION Sta. 16 + 770.0; 10.0 m Rt. of Hwy. 17 ORIGINATED BY MLP
 DIST 18 HWY 17 BOREHOLE TYPE Cone Test, N-Casing COMPILED BY MLP
 DATUM Geodetic DATE 87 06 10 - 13 CHECKED BY DD

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 (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			'N' VALUES	SHEAR STRENGTH					
183.2	River Surface												
0.0	Water												
179.2	River Bed												
4.0	Sand Occ. Silt Zones Occ. Gravelly Zones Occ. Cobbles Loose to Compact (Lacustrine)		1	SS	26								
			2	SS	23								
			3	SS	11								
			4	SS	8								
			5	SS	4								
			6	SS	10								
			7	SS	16								
			8	SS	12								
			9	SS	10								
			10	SS	18								
			11	SS	20								
			12	SS	11								
163.2	End of Borehole												
20.0													
159.9	End of Cone Test												
23.3													

OFFICE REPORT ON SOIL EXPLORATION

+³, x⁵: Numbers refer to Sensitivity
 20
 15
 10
 5 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 7

METRIC

W P 910-62-09 LOCATION Sta. 16 + 800.0; 10.0 m Rt. of Hwy. 17 E ORIGINATED BY MLP
 DIST 18 HWY 17 BOREHOLE TYPE Cone Test, N-Casing COMPILED BY MLP
 DATUM Geodetic DATE 87 06 09 CHECKED BY DD

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					
183.2	River Surface						20 40 60 80 100						GR SA SI CL
0.0	Water												
178.8	River Bed												
4.4	Sand Occ. Silt Zones Occ. Gravelly Zones Occ. Cobbles Very Loose to Compact (Lacustrine)		1	SS	2								
			2	SS	10								60 40 (0)
			3	SS	8								32 67 (1)
			4B	SS	8								
			5B	SS	17								0 73 26 1
			6	SS	7								0 99 (1)
			7	SS	10								
			8	SS	20								
168.3	End of Borehole												
14.9													
164.2	End of Cone Test												
19.0													

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 8

METRIC

W P 910-62-09 LOCATION Sta. 16 + 837.0; 13.0 m Rt. of Hwy. 17 E ORIGINATED BY MLP
 DIST 18 HWY 17 BOREHOLE TYPE Cone Test, N-Casing COMPILED BY MLP
 DATUM Geodetic DATE 87 06 19 CHECKED BY DD

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 (%) GR SA SI CL	
ELEV DEPTH	DESCRIPTION	NUMBER	TYPE	'N' VALUES			20	40						60
183.6	Ground Surface													
0.0	Sand Occ. Silt Zones Occ. Gravelly Zones Occ. Cobbles Loose to Compact (Lacustrine)	1	SS	11										
		2	SS	10										
		3	SS	10										
		4	SS	8										
		5	SS	10										
		6	SS	22										
		7	SS	11										
		8	SS	12										
		9	SS	6										
171.0		End of Borehole	10	SS	15									
12.6														
167.8	End of Cone Test													
15.8														

OFFICE REPORT ON SOIL EXPLORATION

+³, x⁵ : Numbers refer to
Sensitivity

20
15 ϕ 5 (%) STRAIN AT FAILURE
10

Appendix D
Site Photographs



Photograph 1 – General view of the Batchawana River bridge



Photograph 2 – Existing conditions of bridge deck



Photograph 3 – Bridge embankment

Appendix E

Drawing titled "Borehole Locations and Soil Strata"

