FOUNDATION INVESTIGATION REPORT
CHIPPEWA RIVER BRIDGE REHABILITATION
Highway 17, Site 38S-008
G.W.P. 5141-08-00
Township of Tilley

Geocres Number: 41K-89

Report to

McCormick Rankin Corporation

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November 3, 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 Chippewa River bridge located on Highway 17 in the Township of Tilley, Ontario. This investigation was completed for the proposed rehabilitation of the bridge.

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 (MRC), under the Ministry of Transportation Ontario (MTO) Agreement Number 5009-E-0032.

2. SITE DESCRIPTION

The Chippewa River Bridge is located on Highway 17 in the Township of Tilley, Ontario, approximately 42.3 km north of Sault Ste. Marie.

At present, the highway crosses the Chippewa River on a reinforced concrete arch. The concrete arch is covered with granular fill from the top of concrete arch to the base of the asphalt. A concrete pedestrian sidewalk and an observation deck are located on the upstream edge of the bridge. The total length of the bridge is 47.5 m. The widths of the bridge and the pedestrian sidewalk are is approximately 11.4 m and 2.0 m, respectively.

The Chippewa River flows south and discharges near Batchawana Bay of Lake Superior.

The Chippewa Falls are located and visible on the north side of Highway 17. At this location, the Chippewa River descends about 20 m over several sets of waterfalls. The river is up to 32 m wide near the bridge.

The lands on the south side of the bridge are relatively flat and heavily treed. A low-rise building is located on the southeast side of the bridge. A picnic/rest area occupies the northeast side of the bridge.

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

- 1 and 2 - General view of the south side of the Chippewa River Bridge (downstream)
- 3 and 4 - Existing conditions of west and east slopes/approaches on the south side of the bridge
- 5 and 6 - General view of the north side of the Chippewa River Bridge (upstream)
- 7 and 8 - Upstream and downstream of the Chippewa River

Physiographically, the site lies within the Canadian Shield which is characterized by Pre-Cambrian igneous and metamorphic bedrock. Locally, the bedrock is mantled by deposits of sand and gravel.

3. SITE INVESTIGATION AND FIELD TESTING

The site investigation and field testing for this project was carried on October 19 and 20, 2010, and consisted of drilling and sampling four boreholes numbered CHIP-1 to CHIP-4. The boreholes were drilled on the existing Highway 17 lanes near each foundation element.

Boreholes CHIP-1 and CHIP-4 were drilled near the west and east abutments, respectively. Both boreholes were initially advanced through overburden soils to 8.6 m and 7.4 m depth, and then further advanced into the bedrock by coring to 12.0 m and 10.6 m.

Boreholes CHIP-2 and CHIP-3 were drilled near the existing buttresses and were terminated at 3.7 m depth.

Eight Dynamic Cone Penetration Tests (DCPTs) were also performed in close proximity of the four boreholes. DCPTs extended to depths ranging from 4.4 m to 8.5 below the existing highway grade.

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

Table 3.1 – Borehole and DCPTs locations and termination depths

Location relative to the existing bridge	Borehole	DCPT	Borehole/ DCPT termination depth (m)	Borehole/ DCPT termination elevation (m)
West abutment	CHIP-1	-	12.0	179.7[(1)]
	-	1A	8.5	183.1
	-	1B	8.2	183.4
West buttress/ end of arch	CHIP-2	-	3.7	187.9
	-	2A	4.6	187.0
	-	2B	6.1	185.5
East buttress/ end of arch	CHIP-3	-	3.7	187.8
	-	3A	5.5	186.0
	-	3B	4.6	186.9
East abutment	CHIP-4	-	10.6	180.8[(1)]
	-	4A	7.3	184.2
	-	4B	4.4	187.1

(1) Depth and elevation include coring into bedrock.

The approximate locations of the four boreholes and eight DCPTs are shown on the attached Borehole Locations and Soil Strata Drawing in Appendix E. The coordinates and elevations of the boreholes are given on these drawings and on the individual Record of Borehole Sheets in Appendix A.

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

Hollow stem augers were used to advance the boreholes in the overburden. Samples were obtained at selected intervals using a split spoon sampler in conjunction with Standard Penetration Testing (SPT). NQ rock coring equipment was used to recover core samples of the underlying bedrock in selected boreholes. A minimum 3.0 m of rock cores were recovered from Boreholes CHIP-1 and CHIP-4.

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

All rock cores were logged, and the Total Core Recovery (TCR), Rock Quality Designation (RQD) and the Fracture Index (FI) were determined.

Groundwater conditions in the open boreholes were observed throughout the drilling operations. Two standpipe piezometers consisting of 19 mm PVC pipes with slotted screens were installed in Boreholes CHIP-1 and CHIP-4 to permit monitoring of groundwater levels. Details of the piezometer installations and other borehole completion details are as shown in Table 3.2.

Table 3.2 – Borehole Completion Details

Location relative to the existing bridge	Borehole	Details	
		Piezometer Tip Depth/ Elevation (m)	Completion Details
West abutment	CHIP-1	11.8/179.8	Piezometer with 1.5 m slotted screen installed with sand filter to 8.7 m, bentonite from 8.7 m to 5.8 m, cuttings from 5.8 m to 0.5 m, bentonite from 0.5 m to 0.15 m, sand from 0.15 m to 0.08 m, and asphalt to surface. Flushmount cover installed.
West buttress	CHIP-2	None installed	Backfilled with cuttings to 0.05 m, then asphalt to surface.
East buttress	CHIP-3	None installed	Backfilled with cuttings to 0.1 m, then asphalt to surface.
East abutment	CHIP-4	7.3/184.2	Piezometer with 1.5 m slotted screen installed with sand filter to 5.4 m, bentonite from 5.4 m to 2.4 m, cuttings from 2.4 m to 0.3 m, bentonite from 0.3 m to 0.08 m, and asphalt to surface. Flushmount cover installed.

4. GEOTECHNICAL LABORATORY TESTING

All recovered soil and rock samples were subjected to Visual Identification (VI) and geological logging. Moisture content determinations were carried out on all soil samples. At least 25% of the recovered samples of soil were also subjected to grain size distribution analyses (sieve and hydrometer). 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.

Point load tests were carried out on selected samples of intact bedrock upon arrival at the laboratory to assist in evaluation of the compressive strength of the bedrock. Results of point load tests on the selected rock core samples are shown in Point Load Test Sheets included in Appendix B and on the Record of Borehole sheets in Appendix A.

5. CHLORIDE CONTENT TESTING

Selected soil samples from the boreholes were submitted to a qualified, CAEAL accredited laboratory (AGAT Laboratories Limited) in Mississauga, Ontario for analytical testing to assess for presence of chloride content.

The results of analytical analyses are presented on Appendix C, 'Certificate of Analysis'.

6. DESCRIPTION OF SUBSURFACE CONDITIONS

Reference is made to the Record of Borehole sheets in Appendix A. Details of the encountered soil and rock 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.

In general terms, the soil stratigraphy encountered at this site consists of pavement structure overlying fill which is underlain by native deposits of sand, silty sand and gravelly sand. Granitic bedrock was contacted below the native cohesionless deposits. More detailed descriptions of the individual strata are presented below.

6.1 Pavement Structure

Pavement structure consisting of approximately 50 mm to 75 mm of asphalt overlying granular (sand and gravel) fill was encountered in all the boreholes drilled on existing Highway 17 lanes.

6.2 Fill

Granular fill was contacted below the asphalt in all the boreholes. The fill generally consists of brown sand containing trace gravel to gravelly, trace silt and clay and occasional cobbles.

The thickness of the fill was about 3.6 m at the west and east buttress locations (Boreholes CHIP-2 and CHIP-3). At the west and east abutments, the thickness of the fill was 1.2 m and 1.7 m, respectively.

The depths to the base of the fill at the east and west abutments are 1.3 m and 1.8 m (elevations 190.4 and 189.6), respectively.

Boreholes CHIP-2 and CHIP-3 were terminated on top of the concrete arch contacted below the fill at 3.7 m depth (elevations 187.9 and 187.8).

Within the upper 1.5 m of the cohesionless fill layer, the SPT 'N' values ranged from 24 to 143 blows per 0.3 m of penetration, indicating a compact to very dense relative density. Below elevation 190.4, the measured SPT 'N' values ranged from 3 to 19 blows per 0.3 m of penetration, indicating a very loose to compact relative density.

The moisture content of the fill ranged from 2% to 8%.

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

Soil Particles	Sand fill (%)	Gravelly sand fill (%)
Gravel	17	27 to 34
Sand	77	56 to 66
Silt & Clay	6	5 to 12

Based on the grain size distribution curves, the coefficient of permeability of the sand, gravelly sand fill is estimated to range from 2.0×10^{-2} cm/sec to 6.0×10^{-3} cm/sec.

6.3 Sand

Native sand was contacted below the fill at 1.3 m depth (elevation 190.4) in Borehole CHIP-1. The sand was brown in colour and contained trace to some gravel, trace silt and trace clay.

The thickness of the sand was 7.3 m.

The depth to the base of the sand was 8.6 m (elevation 183.1).

SPT 'N' values measured in the sand ranged from 2 to 17 blows for per 0.3 m penetration, indicating a very loose to compact relative density.

The natural moisture contents of samples recovered from the sand layer ranged from 2% to 21%.

Grain size distribution curves for samples of sand tested are presented on the Record of Borehole sheets and on Figure B2 of Appendix B. The results of the laboratory test are summarized as follows:

Soil Particles	Sand fill (%)
Gravel	5 to 12
Sand	82 to 90
Silt & Clay	3 to 8

Based on the grain size distribution curves, the coefficient of permeability of the sand, gravelly sand fill is estimated be 2.0×10^{-2} cm/sec.

6.4 Silty Sand

Native brown silty sand containing trace gravel and clay was contacted below the fill at 1.8 m depth (elevation 189.6) in Borehole CHIP-4, drilled at the east abutment.

The thickness of the silty sand was 3.1 m.

The depth to the base of the silty sand was 4.9 m (elevation 186.6).

SPT 'N' values measured in the silty sand ranged from 3 to 8 blows for per 0.3 m penetration, indicating a very loose to loose relative density.

The natural moisture contents of samples recovered from the silty sand layer ranged from 17% to 19%.

Grain size distribution curves for samples of silty sand tested are presented on the Record of Borehole sheets and on Figure B3 of Appendix B. The results of the laboratory test are summarized as follows:

Soil Particles	Silty sand (%)
Gravel	1 to 5
Sand	63 to 65
Silt	28 to 34
Clay	2

Based on the grain size distribution curves, the coefficient of permeability of the sand, gravelly sand fill is estimated to be 3.0×10^{-4} cm/sec.

6.5 Gravelly Sand

A layer of gravelly sand with trace silt and clay and occasional cobbles was encountered below the silty sand at 4.9 m depth (elevation 186.6) in Borehole CHIP-4.

The thickness of the gravelly sand was 2.5 m.

The depth to the base of the gravelly sand was 7.4 m (elevation 184.1).

SPT 'N' values measured in the gravelly sand ranged from 5 to 10 blows per 0.3 m of penetration indicating a loose to compact relative density.

The natural moisture content in the gravelly sand ranged from 7% to 22%.

Grain size distribution curve for a sample of gravelly sand tested is presented on the Record of Borehole sheets and on Figure B4 of Appendix B. The results of the laboratory test are summarized as follows:

Soil Particles	Gravelly sand (%)
Gravel	24
Sand	70
Silt & Clay	6

6.6 Bedrock

The soils described in Boreholes CHIP-1 and CHIP-4 were found to be underlain by granitic bedrock. The bedrock encountered in the boreholes is generally described as moderately weathered. The bedrock in Borehole CHIP-1 was generally grey with occasional pink and white bands visible in most cores. In Borehole CHIP-4, the bedrock was red with grey bands. Occasional mechanical breaks and sub-vertical fractures were observed in the rock cores.

Table 5.1 summarizes depths and elevations to the top of bedrock in the boreholes and DCPTs. Where coring was not carried out, bedrock was inferred from cone refusal in DCPTs.

Table 5.1 – Depth and Elevation of Top of Bedrock

Location relative to the existing bridge	Borehole/DCPT	Depth to Bedrock (m)	Top of Bedrock Elevation (m)
West abutment	CHIP-1	8.6[2]	183.1
	1A[1]	8.5	183.1
	1B[1]	8.2	183.4
East abutment	CHIP-4*	7.4[2]	184.1
	4A[1]	7.3	184.2
	4B[1]	4.4	187.1

[1] DCPT
[2] Proved by coring below augered depth

Total core recovery (TCR) in the bedrock ranged from 90% to 100% in all boreholes, except in Borehole CHIP-1 Run 1 where a TCR of 50% was observed.

Rock quality designation (RQD) values of 54% and 57% were recorded in Borehole CHIP-4 Runs 1 and 2, indicating a fair rock quality. Higher RQD values ranging from

83% to 90%, indicating a good rock quality, were obtained in Borehole CHIP-1 Runs 2 and 3 and Borehole CHIP-4 Run 3.

RQD value of 0% was noted in Borehole CHIP-1 Run 1.

The Fracture Index (FI) of the rock, expressed as fractures per 0.3 m of core, generally ranged from 1 to greater than 10 in most of the cores.

The estimated uniaxial compressive strength of the rock cores generally ranges from 57 MPa to 219 MPa, indicating a strong to very strong rock. Low values of unconfined compressive strength, 6.2 MPa and 31 MPa, were measured in Borehole CHIP-1 Run 2. These low values indicate a weak to medium strong rock. These estimated rock strength values are interpreted from point load tests that were conducted on rock cores recovered from the boreholes. A summary of the Point Load Test Results is presented in Point Load Test Sheets included in Appendix B.

6.7 Water Levels

Water levels were monitored in the boreholes during and upon completion of drilling. A standpipe piezometer was installed in boreholes drilled at the east and west abutments to monitor water levels after completion of drilling. The water levels measured in the piezometers are summarized in Table 5.2.

Table 5.2 – Water Level Measurements

Location relative to the existing bridge	Borehole	Date	Water Level (m)	
			Depth	Elevation
West abutment	CHIP-1	November 28, 2010	6.9	184.7
East abutment	CHIP-4	November 28, 2010	7.1	184.4

Piezometric reading indicates that water level is near elevations 184.4 to 184.7.

Preliminary GA drawing indicates that water level in the Chippewa River is near Elevation 183.5.

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.

6.8 Chloride Content Results

Chloride analyses were conducted on four soil samples (fill and native soils). Table 5.3 shows the chemical testing results. The results are presented on the attached Certificate of Analysis in Appendix C.

Table 5.3 – Results of Chloride Testing

Borehole	Sample	Depth (m)	Elevation	Soil	Chloride concentration (µg/g)
CHIP-1	SS1	0.15	191.4	Sand, some gravel, FILL	169
CHIP-2	SS3	1.2	190.4	Sand, some gravel, trace silt and clay, FILL	657
CHIP-3	SS4	1.8	189.7	Gravelly SAND, trace to some silt and clay, FILL	329
CHIP-4	SS5	2.4	189.1	Silty SAND, trace gravel and clay	2270

7. MISCELLANEOUS

Borehole locations were selected and established in the field by Thurber Engineering Ltd. Surveyors from McCormick Rankin Corporation 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. 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.

Rocío Palomeque Reyna, P.Eng.
Geotechnical Engineer

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

Appendix A

Record of Borehole Sheets

Ministry of Transportation
Ontario

RECORD OF BOREHOLE No CHIP-1 1 OF 2 METRIC

W.P. 93-89-00 LOCATION N 5 198 839.4 E 272 311.5 (Chippewa River Bridge) ORIGINATED BY ES
HWY 17 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
DATUM Geodetic DATE 2010.10.19 - 2010.10.19 CHECKED BY JL

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (O UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
191.6								20 40 60 80 100	20 40 60		
0.0 / 0.1	**ASPHALT:** (63mm)										
	SAND, some gravel Very Dense to Dense Brown Moist (FILL)		1	SS	93		191				
			2	SS	38						
190.4 / 1.3	**SAND**, trace to some gravel, trace silt, trace clay Compact to Loose Brown Moist		3	SS	10		190				5 87 8 (SI+CL)
			4	SS	4						
			5	SS	6		189				
	Wet		6	SS	6						11 86 3 (SI+CL)
			7	SS	4		188				
			8	SS	4						
			9	SS	4		187				12 82 6 (SI+CL)
			10	SS	9						
			11	SS	17		186				
			12	SS	6	▼					
	Very Loose to Loose		13	SS	2		185				5 90 5 (SI+CL)
			14	SS	4						
183.1 / 8.6	**BEDROCK**, granitic, moderately weathered, grey, with red bands, mechanical breaks Coring started at 8.6m 75mm sub-vertical fractures at 8.7m, 8.8m Sub-horizontal fractures at 8.8m Sub-vertical fractures between 25mm to 100mm at 9.5m, 10.1m 300mm at 8.9m		1	RUN			184			FI >5 7 2 2 2	RUN #1 TCR=50% SCR=50% RQD=0% UCS=188MPa (Average) RUN #2 TCR=100% SCR=97% RQD=83% UCS=93MPa
			2	RUN			183				
							182				

Continued Next Page

+³, ×³: Numbers refer to Sensitivity

20 / 15 ⊕ 5 / 10 (%) STRAIN AT FAILURE

ONTMT4S 1185.GPJ 7/20/11

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No CHIP-1 2 OF 2 METRIC

W.P. 93-89-00 LOCATION N 5 198 839.4 E 272 311.5 (Chippewa River Bridge) ORIGINATED BY ES

HWY 17 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN

DATUM Geodetic DATE 2010.10.19 - 2010.10.19 CHECKED BY JL

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	Continued From Previous Page							20 40 60 80 100	20 40 60		
	BEDROCK, granitic, moderately weathered, grey, red bands, mechanical breaks 50mm soft zone at 10.3m									>5	(Average)
							181			0	RUN #3 TCR=90% SCR=90% RQD=90% UCS=93MPa (Average)
	Sub-vertical fractures between 25mm to 75mm at 10.6m, 11.2m, 11.3m, 11.5m		3	RUN						1 2	
	Quartz vein at 10.5m, 11.1m						180			2 1	
179.7											
12.0	END OF BOREHOLE AT 12.0m. 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 6.9 184.7										

+³, ×³: Numbers refer to Sensitivity

15 20 10 5 (%) STRAIN AT FAILURE

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Ontario

RECORD OF BOREHOLE No CHIP-2 1 OF 1 METRIC

W.P. 93-89-00 LOCATION N 5 198 836.2 E 272 327.3 (Chippewa River Bridge) ORIGINATED BY ES
HWY 17 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
DATUM Geodetic DATE 2010.10.19 - 2010.10.19 CHECKED BY JL

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa: ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
191.6											
0.0	**ASPHALT:** (75mm)										
0.1	**SAND**, some gravel, trace silt and clay Very Dense to Compact Brown Moist (FILL)		1	SS	143		191	○	○		
			2	SS	24			○	○		17 77 6 (SI+CL)
			3	SS	19		190	○	○		
	Becoming gravelly		4	SS	11			○	○		32 63 5 (SI+CL)
			5	SS	22		189	○	○		
	Loose		6	SS	5			○	○		
187.9							188				
3.7	END OF BOREHOLE AT 3.7m. BOREHOLE BACKFILLED WITH CUTTINGS TO 0.05m, THEN ASPHALT TO SURFACE.										

$+^3$, $\times^3$: Numbers refer to Sensitivity

$15 \oplus^{20}_{10} 5$ (%) STRAIN AT FAILURE

ONTMT4S 1185.GPJ 7/20/11

Ministry of Transportation
Ontario

RECORD OF BOREHOLE No CHIP-3 1 OF 1 METRIC

W.P. 93-89-00 LOCATION N 5 198 815.4 E 272 353.4 (Chippewa River Bridge) ORIGINATED BY ES

HWY 17 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN

DATUM Geodetic DATE 2010.10.20 - 2010.10.20 CHECKED BY JL

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa: ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
191.5											
0.0	**ASPHALT:** (50mm)										
	Gravelly **SAND**, trace to some silt and clay, occasional cobbles Very Dense to Compact Brown Moist (FILL)		1	SS	141		191		○		27 61 12 (SI+CL)
			2	SS	44				○		34 56 10 (SI+CL)
			3	SS	10		190		○		
	Loose		4	SS	5				○		
			5	SS	9		189		○		
187.8	Very Loose		6	SS	3		188		○		29 66 5 (SI+CL)
3.7	END OF BOREHOLE AT 3.7m. BOREHOLE BACKFILLED WITH CUTTINGS TO 0.1m, THEN ASPHALT TO SURFACE.										

ONTMT4S 1185.GPJ 7/20/11

$+^3$, $\times^3$: Numbers refer to Sensitivity

$15 \oplus^{20}_{10} 5$ (%) STRAIN AT FAILURE

Ministry of Transportation
Ontario

THUNDER

RECORD OF BOREHOLE No CHIP-4 1 OF 2 METRIC

W.P. 93-89-00 LOCATION N 5 198 815.6 E 272 363.8 (Chippewa River Bridge) ORIGINATED BY ES

HWY 17 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN

DATUM Geodetic DATE 2010.10.19 - 2010.10.19 CHECKED BY JL

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
191.5											
0.0 / 0.1	**ASPHALT:** (63mm)										
	SAND, some gravel, occasional cobbles Very Dense Brown Moist (FILL)		1	SS	121		191		o		
			2	SS	59				o		
	Compact		3	SS	14		190		o		
189.6											
1.8	Silty **SAND**, trace gravel, trace clay Very Loose to Loose Brown Moist		4	SS	8				o		1 63 34 2
			5	SS	6		189		o		
			6	SS	4				o		5 65 28 2
			7	SS	3		188		o		
			8	SS	8				o		
186.6							187		o		
4.9	Gravelly **SAND**, trace silt and clay, occasional cobbles Loose Brown Moist		9	SS	5				o		
			10	SS	9		186		o		24 70 6 (SI+CL)
			11	SS	5				o		
	Compact		12	SS	10		185		o		
184.1			13	SS	50/0.025					FI	
7.4	**BEDROCK**, granitic, moderately weathered, red, with grey bands, mechanical breaks Coring started at 7.4m		1	RUN			184			>5 >5	RUN #1 TCR=100% SCR=100% RQD=54% UCS=196MPa (Average)
	Sub-vertical fractures between 25mm to 50mm at 7.7m, 7.9m, 8.0m, 8.1m		2	RUN			183			1 >5 >10	
	Highly weathered Sub-vertical fractures between 25mm to 50mm at 8.9m, 9.2 175mm at 8.7m 150mm at 9.0m						182			>10 >10 1	RUN #2 TCR=100% SCR=70% RQD=57% UCS=127MPa (Average)

Continued Next Page

+³, ×³: Numbers refer to Sensitivity

20 / 15 ⊕ 5 / 10 (%) STRAIN AT FAILURE

ONTMT4S 1185.GPJ 7/20/11

Ministry of Transportation
Ontario

RECORD OF BOREHOLE No CHIP-4 2 OF 2 METRIC

W.P. 93-89-00 LOCATION N 5 198 815.6 E 272 363.8 (Chippewa River Bridge) ORIGINATED BY ES

HWY 17 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN

DATUM Geodetic DATE 2010.10.19 - 2010.10.19 CHECKED BY JL

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (20 40 60 80 100): O UNCONFINED, + FIELD VANE, ● QUICK TRIAXIAL, × LAB VANE	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	Continued From Previous Page										
180.8	Sub-vertical fractures between 25mm to 50mm at 9.9m, 10.3m, 10.5m		3	RUN			181			4 >5	RUN #3 TCR=100% SCR=100% RQD=89% UCS=206MPa (Average)
10.6	END OF BOREHOLE AT 10.6m. 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	7.10	184.4

$+^3$, $\times^3$: Numbers refer to Sensitivity

20 / 15 ⊕ 5 / 10 (%) STRAIN AT FAILURE

ONTMT4S 1185.GPJ 7/20/11

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No DCPT-1A 1 OF 1 METRIC

W.P. 5198-06-00 LOCATION N 5 198 839.1 E 272 311.9 (Chippewa River Bridge) ORIGINATED BY ES

HWY 17 BOREHOLE TYPE Dynamic Cone Penetration Test COMPILED BY AN

DATUM DATE 2010.10.20 - 2010.10.20 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	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100 SHEAR STRENGTH kPa: O UNCONFINED, + FIELD VANE, ● QUICK TRIAXIAL, × LAB VANE; 20 40 60 80 100	w_P w w_L WATER CONTENT (%) 20 40 60	γ kN/m³	GR SA SI CL
191.6											
0.0	Auger to 1.0m, then start DCPT						191 190 189 188 187 186 185 184				
183.1											
8.5	END OF DCPT AT 8.5m UPON CONE REFUSAL. BOREHOLE BACKFILLED WITH HOLEPLUG TO 0.1m THEN ASPHALT TO SURFACE.										

+ 3 , × 3 : Numbers refer to Sensitivity

20 15 5 10 (%) STRAIN AT FAILURE

ONTMT4S 1185.GPJ 3/23/11

Ministry of Transportation
Ontario

RECORD OF BOREHOLE No DCPT-1B 1 OF 1 METRIC

W.P. 5198-06-00 LOCATION N 5 198 841.6 E 272 312.7 (Chippewa River Bridge) ORIGINATED BY ES
HWY 17 BOREHOLE TYPE Dynamic Cone Penetration Test COMPILED BY AN
DATUM DATE 2010.10.20 - 2010.10.20 CHECKED BY JL

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	GROUND WATER CONDITIONS	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
191.6								
0.0	Auger to 1.0m, then start DCPT							
183.4								
8.2	END OF DCPT AT 8.2m UPON CONE REFUSAL. BOREHOLE BACKFILLED WITH HOLEPLUG TO 0.1m THEN ASPHALT TO SURFACE.							

ELEVATION SCALE: 191, 190, 189, 188, 187, 186, 185, 184

DYNAMIC CONE PENETRATION RESISTANCE PLOT
20 40 60 80 100

SHEAR STRENGTH kPa
○ UNCONFINED + FIELD VANE
● QUICK TRIAXIAL × LAB VANE
20 40 60 80 100

PLASTIC LIMIT w_P NATURAL MOISTURE CONTENT w LIQUID LIMIT w_L
WATER CONTENT (%)
20 40 60

+ ³, × ³: Numbers refer to Sensitivity

15 (20/10) 5 (%) STRAIN AT FAILURE

ONTMT4S 1185.GPJ 3/23/11

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No DCPT-2A 1 OF 1 METRIC

W.P. 93-89-00 LOCATION N 5 198 836.4 E 272 326.9 (Chippewa River Bridge) ORIGINATED BY ES

HWY 17 BOREHOLE TYPE Dynamic Cone Penetration Test COMPILED BY AN

DATUM Geodetic DATE 2010.10.20 - 2010.10.20 CHECKED BY JL

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
191.6								20 40 60 80 100	20 40 60		
0.0	Auger to 1.0m, then start DCPT						191				
							190				
							189				
							188				
187.0											
4.6	END OF DCPT AT 4.6m. BOREHOLE BACKFILLED WITH HOLEPLUG TO 0.1m THEN ASPHALT TO SURFACE.										

$+^3, \times^3$: Numbers refer to Sensitivity

$\frac{20}{15 \oplus 5}$ (%) STRAIN AT FAILURE

ONTMT4S 1185.GPJ 7/21/11

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No DCPT-2B 1 OF 1 METRIC

W.P. 93-89-00 LOCATION N 5 198 834.5 E 272 326.3 (Chippewa River Bridge) ORIGINATED BY ES

HWY 17 BOREHOLE TYPE Dynamic Cone Penetration Test COMPILED BY AN

DATUM Geodetic DATE 2010.10.20 - 2010.10.20 CHECKED BY JL

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa: ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
191.6											
0.0	Auger to 1.0m, then start DCPT						191				
							190				
							189				
							188				
							187				
							186				
185.5											
6.1	END OF DCPT AT 6.1m. BOREHOLE BACKFILLED WITH HOLEPLUG TO 0.1m THEN ASPHALT TO SURFACE.										

$+^3$, $\times^3$: Numbers refer to Sensitivity

20 / 15 ⊕ 5 / 10 (%) STRAIN AT FAILURE

ONTMT4S 1185.GPJ 7/21/11

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No DCPT-3A 1 OF 1 METRIC

W.P. 5198-06-00 LOCATION N 5 198 815.1 E 272 353.9 (Chippewa River Bridge) ORIGINATED BY ES

HWY 17 BOREHOLE TYPE Dynamic Cone Penetration Test COMPILED BY AN

DATUM DATE 2010.10.20 - 2010.10.20 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	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa: ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE	w_P w w_L WATER CONTENT (%)	γ kN/m^3	GR SA SI CL
191.5								20 40 60 80 100	20 40 60		
0.0	Auger to 1.0m, then start DCPT						191				
							190				
							189				
							188				
							187				
186.0											
5.5	END OF DCPT AT 5.5m ON CONCRETE ARCH. BOREHOLE BACKFILLED WITH HOLEPLUG TO 0.1m THEN ASPHALT TO SURFACE.										

$+^3$, $\times^3$: Numbers refer to Sensitivity

$\frac{20}{15 \oplus 5}$ (%) STRAIN AT FAILURE
10

ONTMT4S 1185.GPJ 3/23/11

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No DCPT-3B 1 OF 1 METRIC

W.P. 5198-06-00 LOCATION N 5 198 817.1 E 272 354.4 (Chippewa River Bridge) ORIGINATED BY ES

HWY 17 BOREHOLE TYPE Dynamic Cone Penetration Test COMPILED BY AN

DATUM DATE 2010.10.20 - 2010.10.20 CHECKED BY JL

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
191.5											
0.0	Auger to 1.0m, then start DCPT						191				
							190				
							189				
							188				
186.9							187				
4.6	END OF DCPT AT 4.6m ON CONCRETE ARCH. BOREHOLE BACKFILLED WITH HOLEPLUG TO 0.1m THEN ASPHALT TO SURFACE.										

+ ^{3}, × ^{3}: Numbers refer to Sensitivity

20 / 15 5 / 10 (%) STRAIN AT FAILURE

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Ontario

RECORD OF BOREHOLE No DCPT-4A 1 OF 1 METRIC

W.P. 5198-06-00 LOCATION N 5 198 814.6 E 272 365.5 (Chippewa River Bridge) ORIGINATED BY ES

HWY 17 BOREHOLE TYPE Dynamic Cone Penetration Test COMPILED BY AN

DATUM DATE 2010.10.20 - 2010.10.20 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	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa: ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE	w_P w w_L WATER CONTENT (%)	γ kN/m^3	GR SA SI CL
191.5								20 40 60 80 100	20 40 60		
0.0	Auger to 1.0m, then start DCPT						191				
							190				
							189				
							188				
							187				
							186				
184.2							185				
7.3	END OF DCPT AT 7.3m UPON CONE REFUSAL. BOREHOLE BACKFILLED WITH HOLEPLUG TO 0.1m THEN ASPHALT TO SURFACE.										

+^{3}, ×^{3}: Numbers refer to Sensitivity

$\frac{20}{15 \oplus 5}$ (%) STRAIN AT FAILURE

ONTMT4S 1185.GPJ 3/23/11

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No DCPT-4B 1 OF 1 METRIC

W.P. 5198-06-00 LOCATION N 5 198 814.3 E 272 363.1 (Chippewa River Bridge) ORIGINATED BY ES

HWY 17 BOREHOLE TYPE Dynamic Cone Penetration Test COMPILED BY AN

DATUM DATE 2010.10.20 - 2010.10.20 CHECKED BY JL

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
191.5											
0.0	Auger to 1.0m, then start DCPT						191				
							190				
							189				
							188				
187.1											
4.4	END OF DCPT AT 4.4m UPON REFUSAL. BOREHOLE BACKFILLED WITH HOLEPLUG TO 0.1m THEN ASPHALT TO SURFACE.										

$+^3$, $\times^3$: Numbers refer to Sensitivity

20 / 15 ⊕ 5 / 10 (%) STRAIN AT FAILURE

ONTMT4S 1185.GPJ 3/23/11

Appendix B

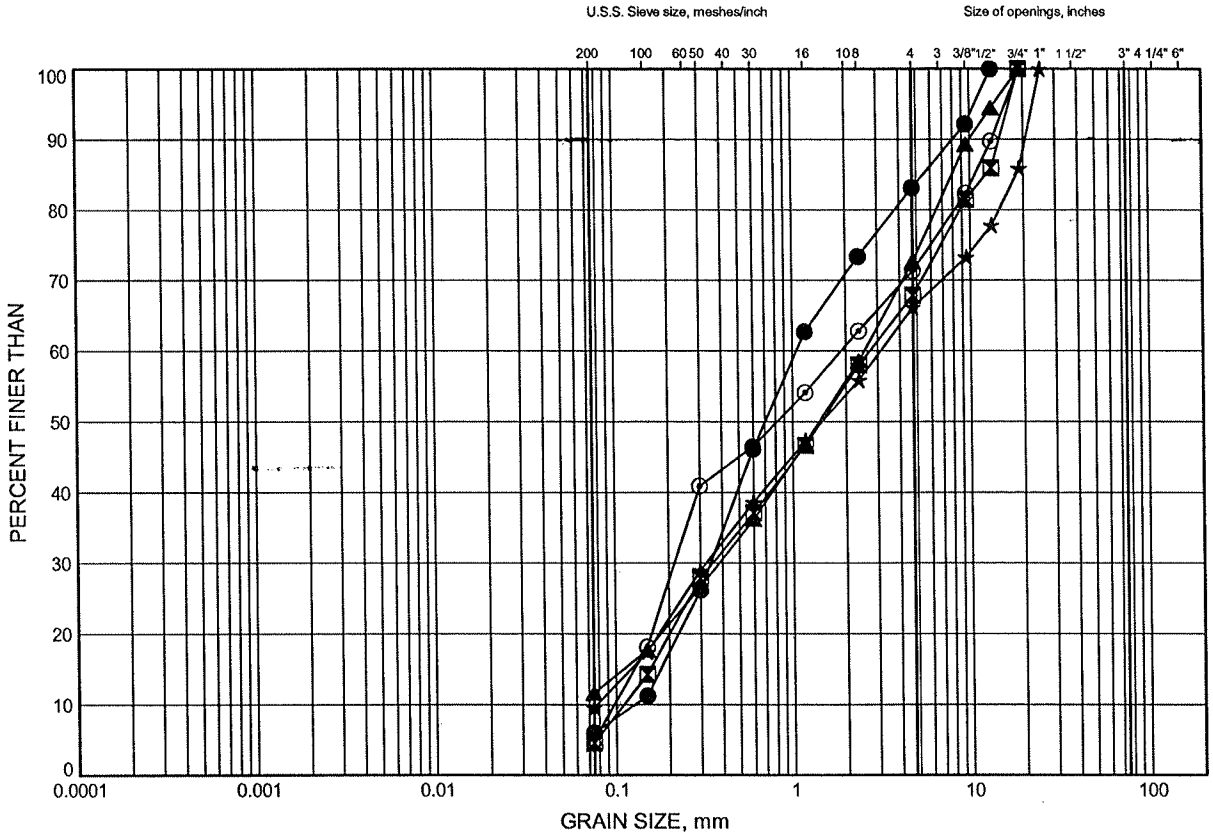
Laboratory Test Results

Ten Bridge Rehabilitations and Two Bridge Replacements

GRAIN SIZE DISTRIBUTION

FIGURE B1

FILL (SAND, GRAVELLY SAND)



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	CHIP-02	0.91	190.65
⊠	CHIP-02	2.13	189.43
▲	CHIP-03	0.38	191.12
★	CHIP-03	0.91	190.59
⊙	CHIP-03	3.35	188.15

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

THURBER

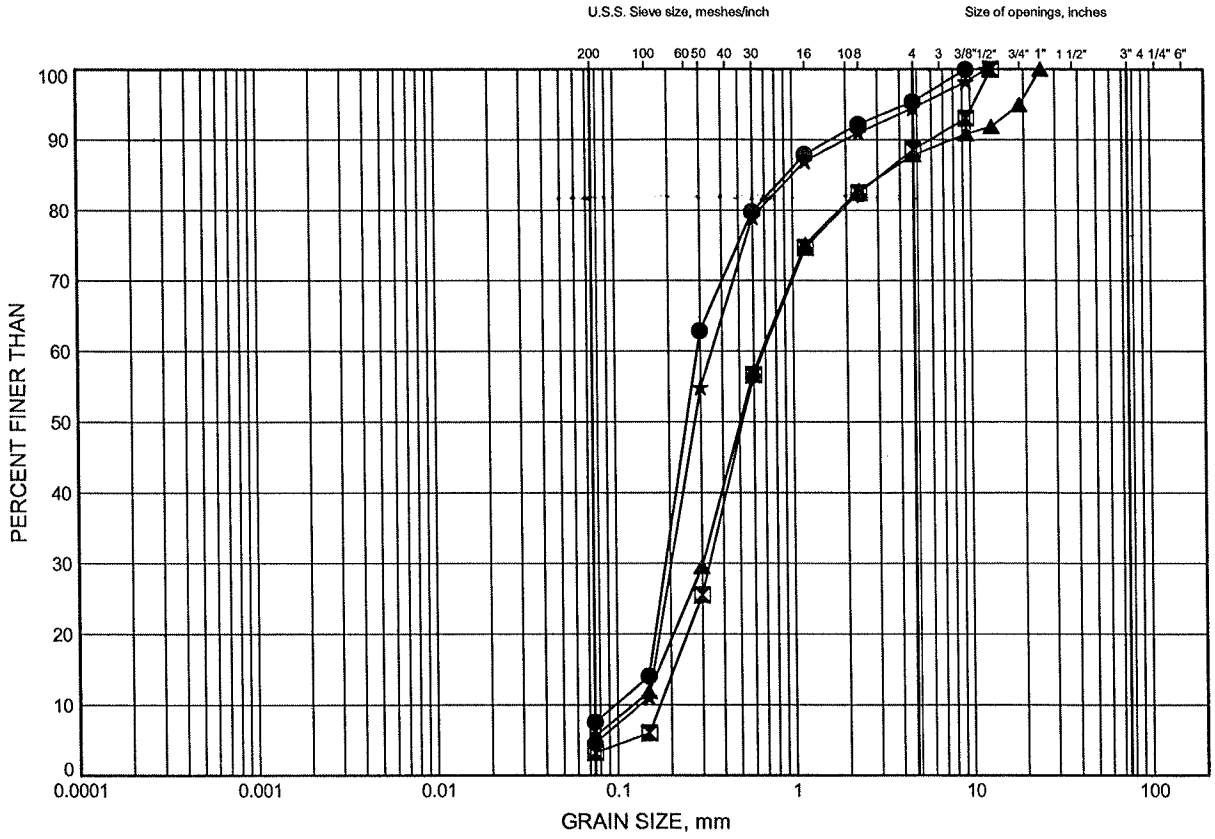
GRAIN SIZE DISTRIBUTION - THURBER 1185.GPJ 2/25/11

Ten Bridge Rehabilitations and Two Bridge Replacements

GRAIN SIZE DISTRIBUTION

FIGURE B2

SAND



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	CHIP-01	1.52	190.11
⊠	CHIP-01	3.35	188.29
▲	CHIP-01	5.18	186.46
★	CHIP-01	7.62	184.02

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

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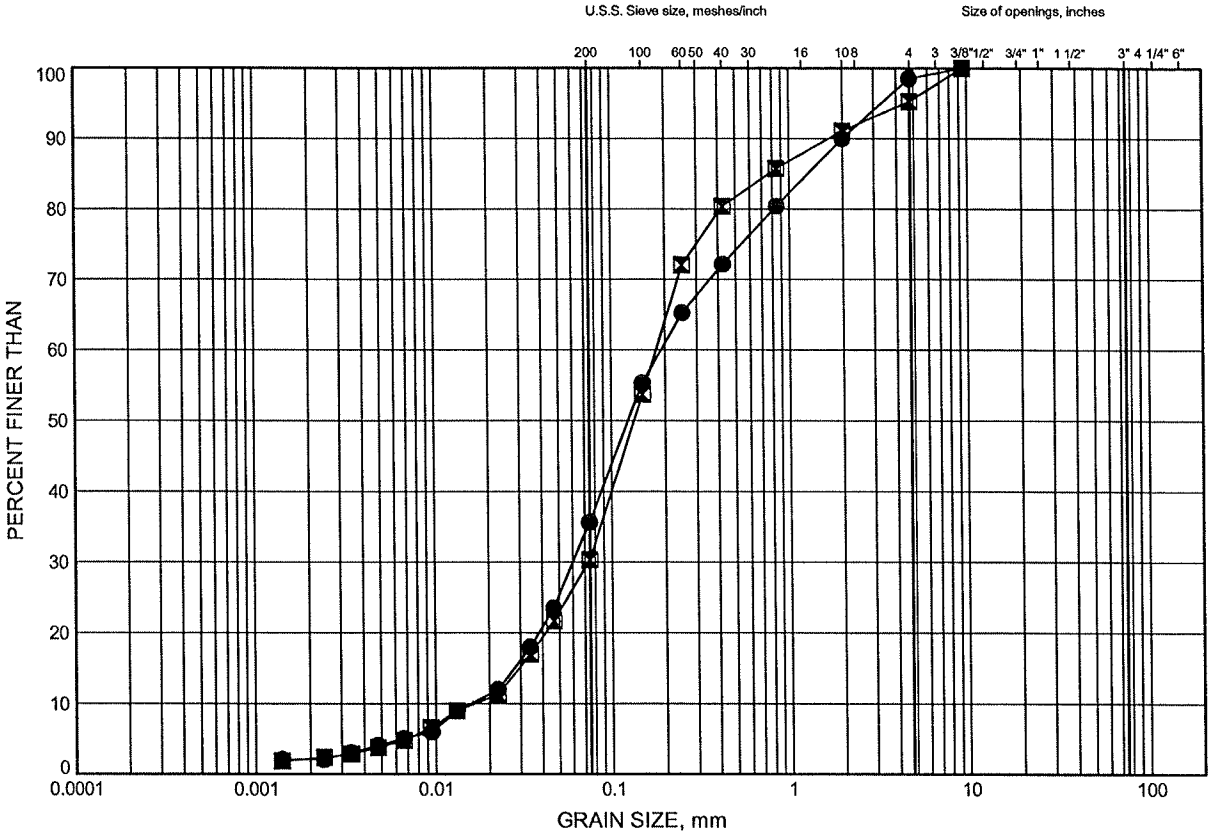
GRAIN SIZE DISTRIBUTION - THURBER 1185.GPJ 2/25/11

Ten Bridge Rehabilitations and Two Bridge Replacements

GRAIN SIZE DISTRIBUTION

FIGURE B3

SILTY SAND



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	CHIP-04	2.13	189.34
⊠	CHIP-04	3.35	188.12

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

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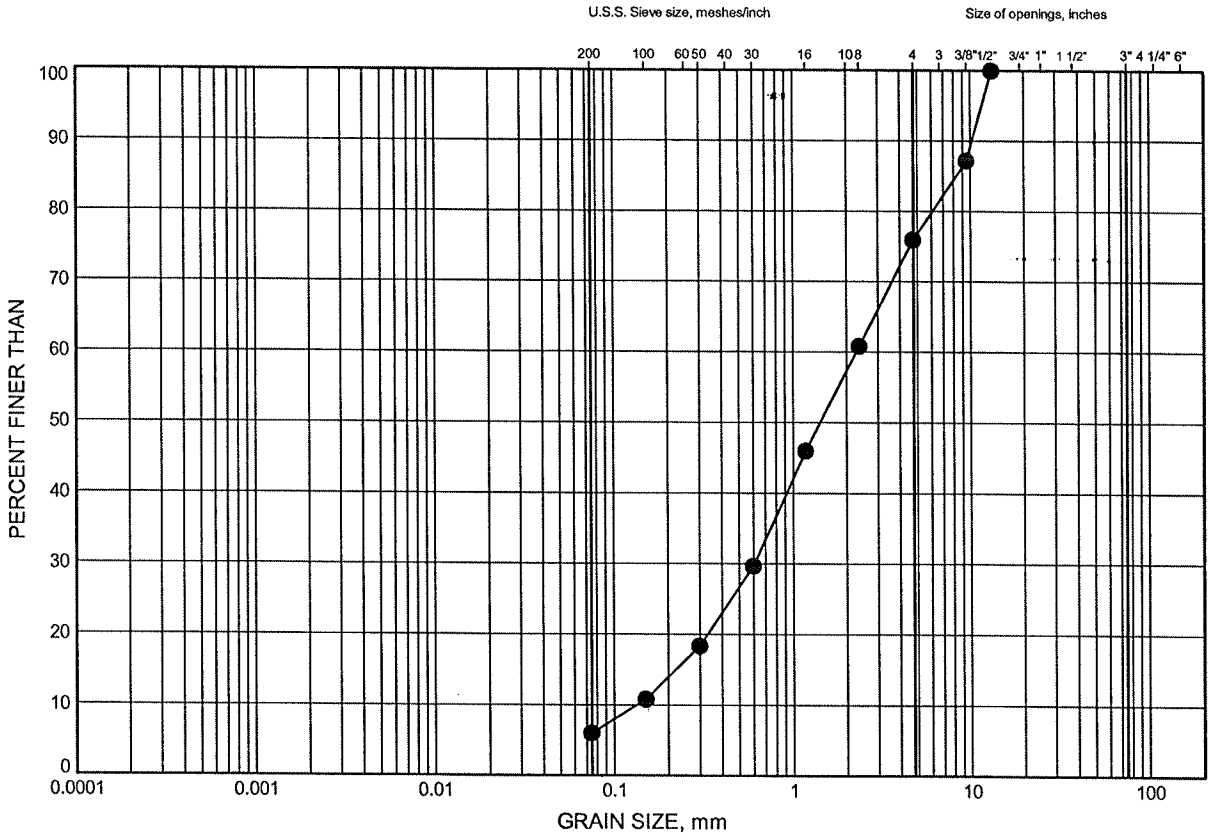
GRAIN SIZE DISTRIBUTION - THURBER 1185.GPJ 2/25/11

Ten Bridge Rehabilitations and Two Bridge Replacements

GRAIN SIZE DISTRIBUTION

FIGURE B4

GRAVELLY SAND



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	CHIP-04	5.79	185.68

W.P.# 5198-06-00

Prepared By AN

Checked By RPR

THURBER

GRAIN SIZE DISTRIBUTION - THURBER 1185.GPJ 2/25/11

THURBER ENGINEERING LTD.
GEOTECHNICAL • ENVIRONMENTAL • MATERIALS

POINT LOAD TEST SHEET

Job No :	19-1351-185	**Client :**	McCormick Rankin Corporation
Project Name :	Ten Bridge Rehabilitations and Two Bridge Replacements	**Date Drilled :**	19/10/2010
		Date Tested :	27/10/2010
Core Size :	NQ **BH No :** CHIP-01	**Tester :**	SLL

Test No.	Run No.	Depth (m)	Axial or Diametral	Force (kN)	Diameter (mm)	Length (mm)	UCS (MPa)	Rock Type	Notes
1	1	8.6	D	18.2	47.6	103.5	188.6	GRANITE	Very Strong
2	2	9.1	D	10.8	47.6	112.4	111.9	GRANITE	Very Strong
3	2	9.3	D	14.8	47.6	126.6	153.3	GRANITE	Very Strong
4	2	9.8	D	15.5	47.6	18.6	160.6	GRANITE	Very Strong
5	2	10.0	D	0.6	47.6	109.4	6.2	GRANITE	Weak
6	2	10.2	D	3.0	47.6	106.4	31.1	GRANITE	Medium Strong
7	3	10.6	D	5.5	47.6	120.9	57.0	GRANITE	Strong
8	3	10.9	D	10.1	47.6	118.7	104.6	GRANITE	Very Strong
9	3	11.2	D	9.4	47.6	126.0	97.4	GRANITE	Strong
10	3	11.6	D	16.0	47.6	123.6	165.8	GRANITE	Very Strong
11	3	11.7	D	21.2	47.6	109.4	219.6	GRANITE	Very Strong
12									
13									
14									
15									
16									
17									
18									
19									
20									
21									
22									
23									
24									
25									
26									
27									
28									
29									
30									

* It is ideal to perform axial test on core specimens with D/L ratio of 1.1 ± 0.1
Long pieces of core can be tested diametrically to produce suitable lengths for axial testing

* Diametral Test should have 0.7 x D on either side of test point.

THURBER ENGINEERING LTD.
GEOTECHNICAL • ENVIRONMENTAL • MATERIALS

POINT LOAD TEST SHEET

Job No :	19-1351-185	**Client :**	McCormick Rankin Corporation
Project Name :	Ten Bridge Rehabilitations and Two Bridge Replacements	**Date Drilled :**	19/10/2010
		Date Tested :	27/10/2010
Core Size :	NQ **BH No :** CHIP-04	**Tester :**	SLL

Test No.	Run No.	Depth (m)	Axial or Diametral	Force (kN)	Diameter (mm)	Length (mm)	UCS (MPa)	Rock Type	Notes
1	1	7.9	D	19.0	47.6	131.5	196.9	GRANITE	Very Strong
2	2	8.3	D	13.8	47.6	107.7	143.0	GRANITE	Very Strong
3	2	8.7	D	6.8	47.6	134.4	70.5	GRANITE	Strong
4	2	9.4	D	16.4	47.6	93.8	169.9	GRANITE	Very Strong
5	3	9.9	D	18.8	47.6	120.4	194.8	GRANITE	Very Strong
6	3	10.3	D	21.1	47.6	89.4	218.6	GRANITE	Very Strong
7									
8									
9									
10									
11									
12									
13									
14									
15									
16									
17									
18									
19									
20									
21									
22									
23									
24									
25									
26									
27									
28									
29									
30									

* It is ideal to perform axial test on core specimens with D/L ratio of 1.1 ± 0.1
Long pieces of core can be tested diametrically to produce suitable lengths for axial testing
* Diametral Test should have 0.7 x D on either side of test point.

Appendix C

Certificate of Analysis

AGAT Laboratories

5835 COOPERS AVENUE
MISSISSAUGA, ONTARIO
CANADA L4Z 1Y2
TEL (905)712-5100
FAX (905)712-5122
http://www.agatlabs.com

Certificate of Analysis

AGAT WORK ORDER: 11T477330

PROJECT NO: 19-1351-185

CLIENT NAME: THURBER ENGINEERING LTD

ATTENTION TO: Rocio Palomeque Reyna

Chloride (Soil)

DATE SAMPLED: Oct 19, 2010 | **DATE RECEIVED: Mar 09, 2011** | **DATE REPORTED: Mar 17, 2011** | **SAMPLE TYPE: Soil**

Parameter	Unit	G / S	RDL	CHIP-02,SS3 2293519	CHIP-03,SS4 2293520	CHIP-04,SS5 2293521	CHIP-01,SS1 2293522
Chloride (2:1)	µg/g		2	657	329	2270	169

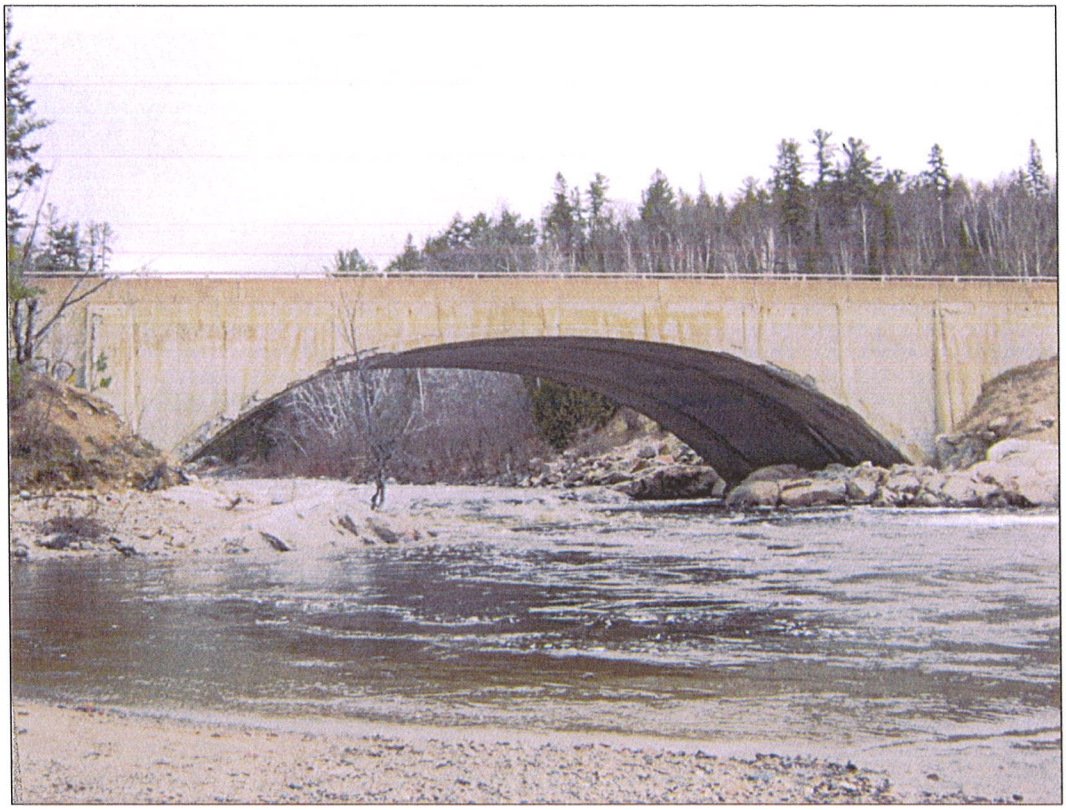
Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard

2293519-2293522 Chloride was determined on the extract obtained from the 2:1 leaching procedure (2 parts DI water:1 part soil).

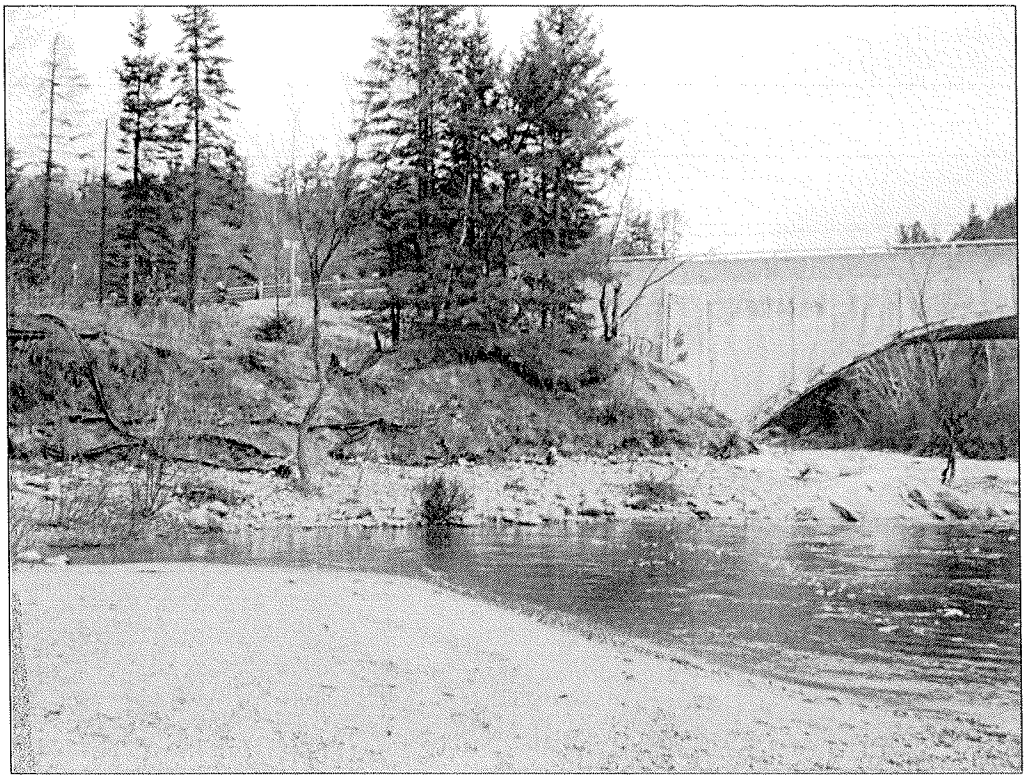
Certified By: Elizabeth Rolakowska

Appendix D

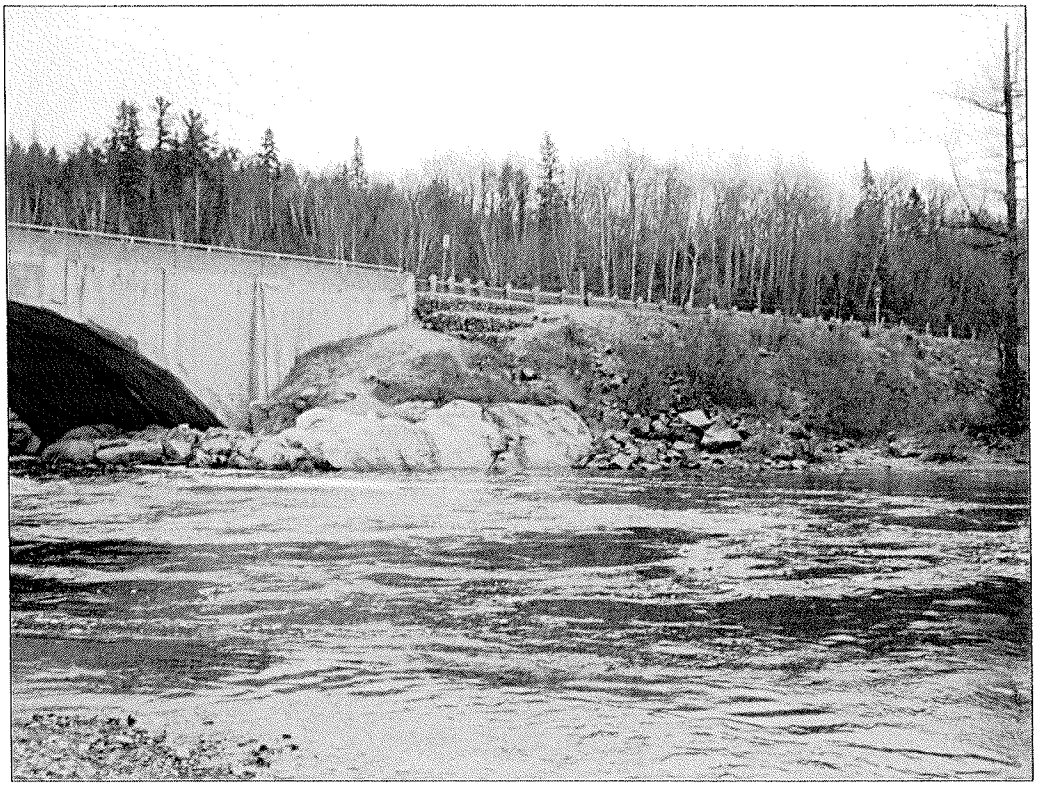
Site Photographs



Photographs 1 and 2 – General view of the south side of the Chippewa River Bridge (downstream)



Photograph 3 - Existing conditions of the west slopes/approaches on the south side of the bridge



Photograph 4 - Existing conditions of east slopes/approaches on the south side of the bridge

Photographs 5 and 6- General view of the north side of the Chippewa River Bridge (upstream)

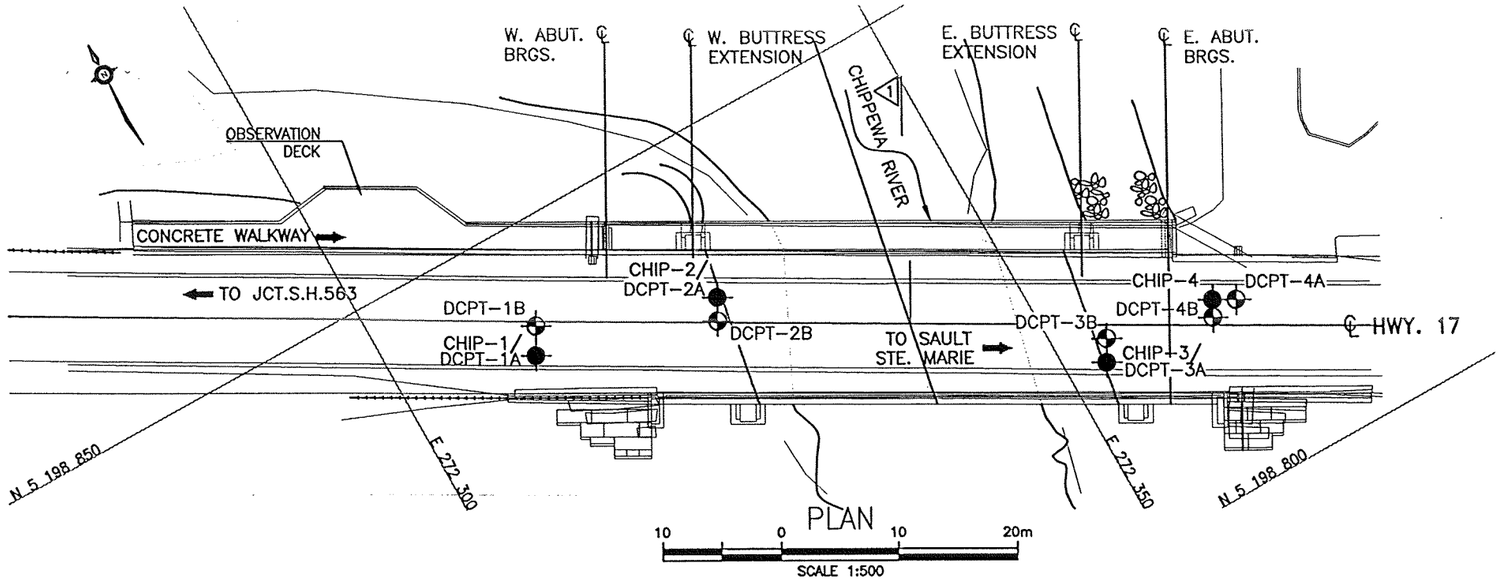
Photograph 7- South side of the Chippewa River Bridge (downstream)

Photograph 8- North side of the Chippewa River Bridge (upstream)

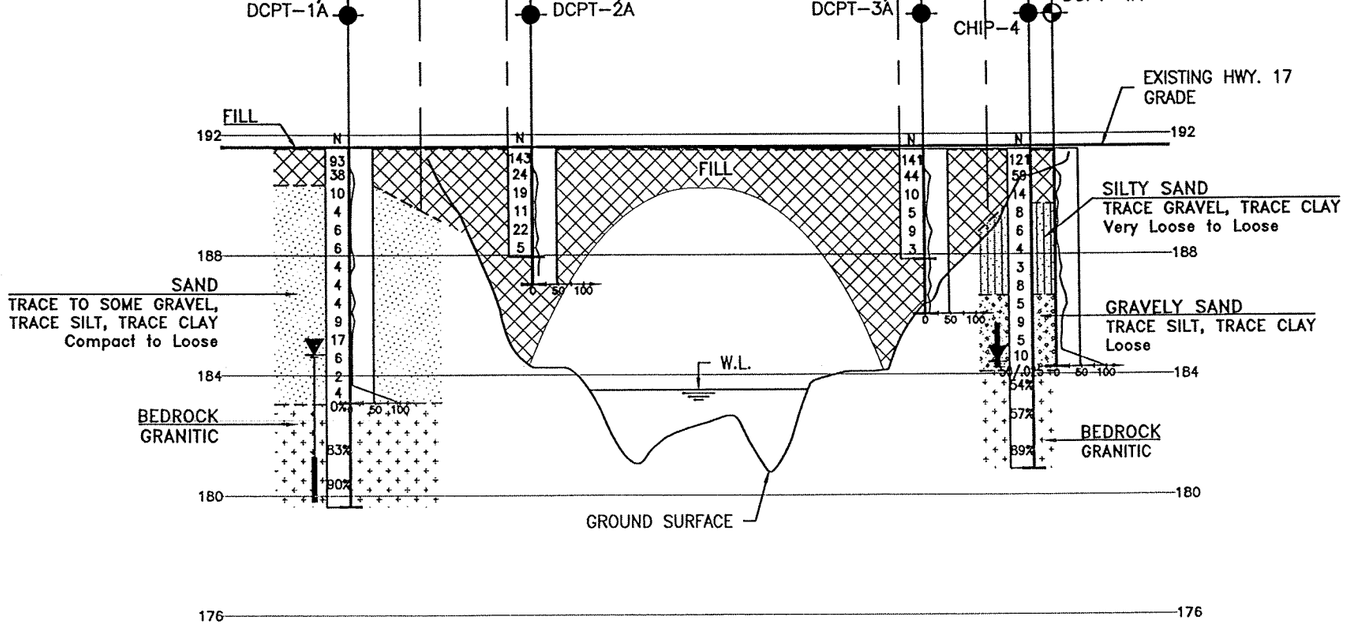
Appendix E

Drawing titled "Borehole Locations and Soil Strata"

MINISTRY OF TRANSPORTATION, ONTARIO



PLAN



PROFILE ALONG HWY 17

10 0 10 20m H 1:500

4 0 4 8 V 1:200

METRIC

DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN

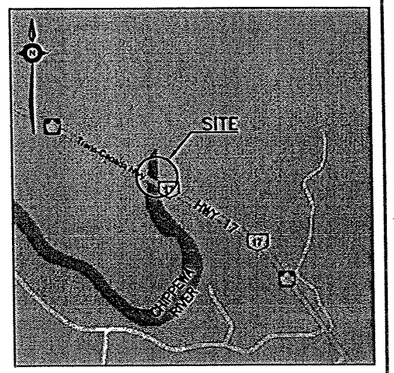
CONT No
WP No 5141-08-00

CHIPPEWA RIVER BRIDGE REHABILITATION HWY 17

BOREHOLE LOCATIONS AND SOIL STRATA

SHEET

THURBER ENGINEERING LTD.
GEOTECHNICAL • ENVIRONMENTAL • MATERIALS



KEYPLAN

LICENSED PROFESSIONAL ENGINEER
R. Palomeque Reyna
100083209
Nov 3/2011
PROVINCE OF ONTARIO

LICENSED PROFESSIONAL ENGINEER
P. K. CHATTERJI
Nov 3/2011
PROVINCE OF ONTARIO

LEGEND

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

NO	ELEVATION	NORTHING	EASTING
CHIP-1	191.6	5 198 839.4	272 311.5
CHIP-2	191.6	5 198 836.2	272 327.3
CHIP-3	191.5	5 198 815.4	272 353.4
CHIP-4	191.5	5 198 815.6	272 363.8
DCPT-1A	191.6	5 198 839.1	272 311.9
DCPT-1B	191.6	5 198 841.6	272 312.7
DCPT-2A	191.6	5 198 836.4	272 326.9
DCPT-2B	191.6	5 198 834.5	272 326.3
DCPT-3A	191.5	5 198 815.1	272 353.9
DCPT-3B	191.5	5 198 817.1	272 354.4
DCPT-4A	191.5	5 198 814.6	272 365.5
DCPT-4B	191.5	5 198 814.3	272 363.1

-NOTES-

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

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

GEOCRES No. 41K-89

REVISIONS		
DATE	BY	DESCRIPTION

DESIGN	RPR	CHK	CODE	LOAD	DATE NOV. 2011
DRAWN	AN	CHK RPR	SITE	STRUCT	DWG 1

FILENAME: H:\Drafting\191\1351\1851\bd1185-BoreholePlan&Profile(CHIPPEWA).dwg
PLOTDATE: 11/3/2011 1:27 PM