

**FOUNDATION INVESTIGATION REPORT
ENGLISH RIVER BRIDGE REPLACEMENT
EAST OF IGNACE, ONTARIO
HIGHWAY 17 IN THE NORTHWEST REGION**

W.P. 468-00-00, SITE No. 41S-73

Geocres Number: 52G-8

Report to

Hatch Mott MacDonald

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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 a proposed replacement of the existing bridge structure which carries Highway 17 over English River, east of The Town of Ignace, Ontario.

The purpose of this 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, stratigraphic profile and cross-sections, laboratory test results and a written description of the subsurface conditions. A model of the subsurface conditions was developed from the data obtained in the course of the investigation.

Thurber carried out the investigation as a sub-consultant to Hatch Mott MacDonald, under the Ministry of Transportation Ontario (MTO) Agreement Number 6010-E-0010.

2 SITE DESCRIPTION

The English River Bridge is located on Highway 17 approximately 50 km east of The Town of Ignace, Ontario (Kenora County).

At present, the highway crosses the English River on a six-span structure supported on timber piles. The English River bridge spans approximately 36.0 m across the river channel. The width of the bridge is approximately 10.0 m. The English River flows to the north.

The surrounding area near the site is relatively flat. The areas to the east and west of the site are heavily treed.

Photographs in Appendix C show the general nature of the site.

The site lies within the physiographic region known as the Wabigoon Terrane subprovince of the Superior Province of the Canadian Shield. The region is 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 site investigation and field testing for this project was carried out from March 9 to 17, 2011 and consisted of drilling and sampling six boreholes (numbered ERB11-01 to ERB11-06) in the area of the existing west and east approaches and abutments. Boreholes ERB11-01 and ERB11-06 drilled at the west and east approaches were terminated at 9.8 m and 7.6 m depth (elevations 452.8 and 454.8), respectively. Boreholes ERB11-02 to ERB11-4 drilled at the abutments were terminated at depths ranging from 26.8 m to 31.6 m (elevations 431.0 to 435.7). Boreholes ERB11-02 to ERB11-05 were supplemented by dynamic cone penetration testing (DCPT) conducted adjacent to each borehole. The depths to the DCPT ranged from 12.8 m to 20.1 m (elevations 442.4 to 449.7). DCPT was conducted from the base of Boreholes ERB11-01 and ERB11-06 to 16.8 m and 15.8 m depth, respectively (elevations 445.8 and 446.6).

The approximate locations of the boreholes are shown on the attached Borehole Locations and Soil Strata Drawing in Appendix D.

The borehole locations were marked in the field and utility clearances were obtained prior to drilling. 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 drilling techniques and coring methods were used to advance the boreholes. The coring methods were used at various depths in the boreholes where boulders were encountered. Overburden samples were obtained at selected intervals using a split spoon sampler in conjunction with Standard Penetration Testing (SPT).

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

Groundwater conditions in the open boreholes were observed throughout the drilling operations. Upon completion of drilling, boreholes caved in and they were subsequently backfilled with sand and/or auger cuttings to 0.3 m or 0.6 m, concrete to 0.1 m and then asphalt to surface.

4 LABORATORY TESTING

All recovered soil samples were subjected to Visual Identification (VI) and moisture content determinations. Selected samples were also subjected to grain size distribution analyses (sieve and hydrometer). The results of this testing program are summarized on the Record of Borehole sheets in Appendix A and on the figures presented in Appendix B.

5 DESCRIPTION OF SUBSURFACE CONDITIONS

Reference is made to the Record of Borehole sheets in Appendix A. Details of the encountered soil stratigraphy are presented in these sheets and on the “Borehole Locations and Soil Strata” drawing in Appendix D. An overall description of the stratigraphy is given in the following paragraphs. However, the factual data presented in the Record of Borehole Sheets governs any interpretation of the site conditions.

In general terms, the stratigraphy encountered at this site consist of pavement structure overlying granular fill and peat. Extensive deposits of sand containing cobbles and boulders were contacted below the peat. Layers of sandy silt and clayey silt were also encountered in the boreholes at various depths. Bedrock was not encountered within the depth explored.

More detailed descriptions of the individual strata are presented below.

5.1 Pavement structure

Pavement structure was encountered in all the boreholes drilled at this site. The boreholes were drilled through the existing Highway 17 lanes. The pavement structure consists of approximately 90 mm to 150 mm of asphalt overlying granular fill.

5.2 Fill

Fill was contacted below the pavement structure in all the boreholes. The fill generally consists of brown to grey gravelly sand, sand and gravel and sand containing trace to some silt and clay and occasional cobbles and boulders. The lower part of the fill in Borehole ERB11-01 contained organics and wood fibres.

The thickness of the fill ranged from 3.6 m to 5.1 m.

The depth to the base of the fill varied from 3.7 m to 5.2 m (elevations 457.3 to 458.9).

SPT ‘N’ values recorded in the cohesionless fill ranged from 14 blows per 0.3 m of penetration to 166 blows per 0.1 m of penetration, indicating a compact to very dense relative density. Lower SPT ‘N’ values ranging from 3 to 7 blows per 0.3 m of penetration, indicating a very loose to loose relative density, were measured below 2.3 m depth in Boreholes ERB11-01 and ERB11-06 drilled at the approaches.

The moisture content of the fill ranged from 3% to 20%.

Grain size distribution curves for samples of the 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	13 to 80
Sand	18 to 74
Silt	13
Clay	1
Silt and Clay	2 to 19

5.3 Peat

Dark brown to black silty peat containing some sand was contacted below the fill in all the boreholes at depths ranging from 3.7 m to 5.2 m (elevations 457.3 to 458.9).

The thickness of the peat ranged from 0.1 m to 1.5 m.

The depth to the base of the peat ranged from 4.1 m to 6.1 m (elevations 456.3 to 458.5).

SPT 'N' values recorded in the peat were 3 and 4 blows per 0.3 m penetration indicating a soft consistency.

The moisture contents of the peat ranged from 32 % to 68%.

5.4 Sand

Native brown to grey sand containing trace gravel, trace to some silt, trace clay and some cobbles and boulders was contacted at depths and elevations indicated in Table 5.1. The Table 5.1 also indicates the depths and elevations to the base of the sand.

Table 5.1 – Depths and Elevations of Top and Base of Sand Stratum

Foundation Unit	Borehole	Top and Base Depths below existing ground surface (m)	Elevation of top and base of sand stratum (m)	Thickness (m)
West Approach	ERB11-01	4.6 to 9.8 ⁽¹⁾	458.0 to 452.8	5.2
West Abutment	ERB11-02	4.7 to 20.4	457.8 to 442.1	15.7
		24.4 to 30.5 ^(1,2)	438.1 to 432.0	6.1
	ERB11-03	6.1 to 13.3 14.8 to 20.9 24.4 to 26.8 ^(1,2)	456.4 to 449.2 447.7 to 441.6 438.1 to 435.7	7.2 6.1 2.4
East Abutment	ERB11-04	4.6 to 17.8 19.3 to 23.8	458.0 to 444.8 443.3 to 438.8	13.2 4.5
		25.9 to 27.9	436.7 to 434.7	2.0
	ERB11-05	4.9 to 18.3 20 to 27.4 ^(1,2)	457.6 to 444.2 442.5 to 435.1	13.4 7.4
East Approach	ERB11-06	6.1 to 7.6 ⁽¹⁾	456.3 to 454.8	1.5

⁽¹⁾Borehole termination depth

⁽²⁾Coring through boulders

The cobbles and boulders were generally encountered in the sand deposit below elevations 434 to 438.

At some locations coring through boulders was required to advance the boreholes.

A layer of gravel was contacted at 23.8 m depth (elevation 438.8) in Borehole ERB11-04 drilled at the east abutment. The thickness of the gravel layer was 2.1 m.

In Borehole ERB11-04, cobbles and boulders were encountered below the sand at 27.9 m depth (elevation 434.7). Borehole ERB11-04 was terminated within the cobbles and boulders at 31.6 m depth (elevation 431.0).

Standard Penetration tests in the sand layer gave SPT 'N' values generally in the range of 4 to 44 blows per 0.3 m of penetration, indicating a loose to dense relative density. An SPT 'N' value of 65 blows per 0.3 m of penetration was measured near elevation 436.5 in Borehole ERB11-05 drilled at the east abutment. The sand layer is generally in a compact state.

The moisture contents of samples from the sand generally vary between 8% and 28%.

Grain size distribution curves for the sand samples tested are presented in Figures B2 to B4 in Appendix B. The results of the laboratory test are summarized as follows:

Soil Particles	(%)
Gravel	0 to 22
Sand	37 to 98
Silt	16 to 60
Clay	1 to 3
Silt and Clay	2 to 27

5.5 Sandy Silt

Brown to grey sandy silt containing trace gravel and trace to some clay was contacted at depths and elevations indicated in Table 5.2.

Table 5.2 – Depths and Elevations of Top and Base of Sandy Silt Layer

Foundati on Unit	Borehole	Top and Base Depths below existing ground surface (m)	Elevation of top and base of silt layer (m)	Thickness (m)
West Approach	ERB11-01	4.1 to 4.6	458.5 to 458.0	0.5
West Abutment	ERB11-03	13.3 to 14.8	449.2 to 447.7	1.5
East Abutment	ERB11-04	17.8 to 19.3	444.8 to 443.3	1.5
	ERB11-05	18.3 to 19.3	444.2 to 443.2	1.0

Standard Penetration tests in the sandy silt layer gave SPT ‘N’ values generally in the range of 11 to 23 blows per 0.3 m of penetration, indicating a compact relative density.

The moisture contents of samples from the sandy silt layer generally vary between 20% and 41%.

Grain size distribution curves for the sandy silt samples tested are presented in Figure B4 of Appendix B. The results of the laboratory test are summarized as follows:

Soil Particles	(%)
Gravel	0
Sand	19 to 31
Silt	68 to 74
Clay	1 to 11

5.6 Clayey Silt

Brown to grey clayey silt containing trace sand was contacted below the sand and silty sand at 20.4, 20.9 and 19.3 m depth (elevations 442.1, 441.6 and 443.2) in Boreholes ERB11-02, ERB11-03 and ERB11-05, respectively.

The thickness of the clayey silt was 4.0 m, 3.5 m and 0.7 m at the three boreholes.

The depth to the base of the clayey silt was at 24.4 m (elevation 438.1) in Boreholes ERB11-02 and ERB11-03 and 20.0 m depth (elevation 442.5) in Borehole ERB11-05.

Standard Penetration tests in the clayey silt layer gave SPT 'N' values of 15 and 18 blows per 0.3 m of penetration, indicating a very stiff consistency.

The moisture contents of samples from the clayey silt layer were 32% and 58%.

A grain size distribution curve for one clayey silt sample tested is presented in Appendix B, Figure B5. The results of the laboratory test are summarized as follows:

Soil Particles	(%)
Gravel	0
Sand	2
Silt	86
Clay	12

5.7 Water Levels

Water levels were observed in the boreholes during and upon completion of drilling. In Boreholes ERB11-01, ERB11-05 and ERB11-06, water levels were observed at 2.7 m, 2.5 m and 2.6 m depth (elevations 459.9, 460.0 and 459.8).

In the remaining boreholes, it was not possible to obtain water levels at the completion of drilling, as the boreholes caved in. The boreholes cave in to depths shown in Table 5.3.

Table 5.3 – Depths of boreholes cave-in

Foundation Unit	Borehole	Depth below existing ground surface (m)
West Abutment	ERB11-02	2.7
	ERB11-02	2.7
	ERB11-03	2.4
East Abutment	ERB11-04	1.5
	ERB11-05	4.3

Preliminary GA drawing indicates that water level in the English River was at Elevation 460.0 on April 13, 2011.

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 Engineering Northwest Ltd. provided data and drawings to obtain the co-ordinates and the ground surface elevations.

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

Eastern Ontario Diamond Drilling Ltd. from Hawkesbury, Ontario supplied a truck mounted CME 75 drill rig and conducted the drilling, sampling and in-situ testing operations.

The field program was supervised by Mr. Ryan Kromer of Thurber.

Routine laboratory testing was carried out by Thurber Engineering Ltd.

Overall planning and supervision of the field program was conducted by Mr. Tony Harte, M.Sc. Interpretation of the data and preparation of the report were carried out by 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



Appendix A

Record of Borehole Sheets

SYMBOLS, ABBREVIATIONS AND TERMS USED ON RECORDS OF BOREHOLES

1. TEXTURAL CLASSIFICATION OF SOILS

CLASSIFICATION	PARTICLE SIZE	VISUAL IDENTIFICATION
Boulders	Greater than 200mm	same
Cobbles	75 to 200mm	same
Gravel	4.75 to 75mm	5 to 75mm
Sand	0.075 to 4.75mm	Not visible particles to 5mm
Silt	0.002 to 0.075mm	Non-plastic particles, not visible to the naked eye
Clay	Less than 0.002mm	Plastic particles, not visible to the naked eye

2. COARSE GRAIN SOIL DESCRIPTION (50% greater than 0.075mm)

TERMINOLOGY	PROPORTION
Trace or Occasional	Less than 10%
Some	10 to 20%
Adjective (e.g. silty or sandy)	20 to 35%
And (e.g. sand and gravel)	35 to 50%

3. TERMS DESCRIBING CONSISTENCY (COHESIVE SOILS ONLY)

DESCRIPTIVE TERM	UNDRAINED SHEAR STRENGTH (kPa)	APPROXIMATE SPT ⁽¹⁾ 'N' VALUE
Very Soft	12 or less	Less than 2
Soft	12 to 25	2 to 4
Firm	25 to 50	4 to 8
Stiff	50 to 100	8 to 15
Very Stiff	100 to 200	15 to 30
Hard	Greater than 200	Greater than 30

NOTE: Hierarchy of Soil Strength Prediction

- 1) Laboratory Triaxial Testing
- 2) Field Insitu Vane Testing
- 3) Laboratory Vane Testing
- 4) SPT value
- 5) Pocket Penetrometer

4. TERMS DESCRIBING DENSITY (COHESIONLESS SOILS ONLY)

DESCRIPTIVE TERM	SPT "N" VALUE
Very Loose	Less than 4
Loose	4 to 10
Compact	10 to 30
Dense	30 to 50
Very Dense	Greater than 50

5. LEGEND FOR RECORDS OF BOREHOLES

SYMBOLS AND ABBREVIATIONS FOR SAMPLE TYPE	SS Split Spoon Sample	WS Wash Sample	AS Auger (Grab) Sample
	TW Thin Wall Shelby Tube Sample	TP Thin Wall Piston Sample	
	PH Sampler Advanced by Hydraulic Pressure	PM Sampler Advanced by Manual Pressure	
	WH Sampler Advanced by Self Static Weight	RC Rock Core	SC Soil Core

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



Water Level

C_{pen}

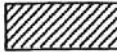
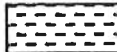



Shear Strength Determination by Pocket Penetrometer

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

UNIFIED SOILS CLASSIFICATION

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

EXPLANATION OF ROCK LOGGING TERMS

ROCK WEATHERING CLASSIFICATION		SYMBOLS			
Fresh (FR)	No visible signs of weathering.				
Fresh Jointed (FJ)	Weathering limited to the surface of major discontinuities.		CLAYSTONE		
Slightly Weathered (SW)	Penetrative weathering developed on open discontinuity surfaces, but only slight weathering of rock material.		SILTSTONE		
Moderately Weathered (MW)	Weathering extends throughout the rock mass, but the rock material is not friable.		SANDSTONE		
Highly Weathered (HW)	Weathering extends throughout the rock mass and the rock is partly friable.		COAL		
Completely Weathered (CW)	Rock is wholly decomposed and in a friable condition, but the rock texture and structure are preserved.		Bedrock (general)		
DISCONTINUITY SPACING		STRENGTH CLASSIFICATION			
Bedding	Bedding Plane Spacing	Rock Strength	Approximate Uniaxial Compressive Strength		Field Estimation of Hardness*
			(MPa)	(psi)	
Very thickly bedded	Greater than 2m	Extremely Strong	Greater than 250	Greater than 36,000	Specimen can only be chipped with a geological hammer
Thickly bedded	0.6 to 2m				
Medium bedded	0.2 to 0.6m	Very Strong	100-250	15,000 to 36,000	Requires many blows of geological hammer to break
Thinly bedded	60mm to 0.2m				
Very thinly bedded	20 to 60mm	Strong	50-100	7,500 to 15,000	Requires more than one blow of geological hammer to break
Laminated	6 to 20mm				
Thinly Laminated	Less than 6mm	Medium Strong	25.0 to 50.0	3,500 to 7,500	Breaks under single blow of geological hammer.
TERMS		Weak	5.0 to 25.0	750 to 3,500	Can be peeled by a pocket knife with difficulty
Total Core Recovery: (TCR)	Core recovered as a percentage of total core run length.	Very Weak	1.0 to 5.0	150 to 750	Can be peeled by a pocket knife, crumbles under firm blows of geological pick.
Solid Core Recovery: (SCR)	Percent Ratio of solid core of full cylindrical shape recovered. Expressed with respect to the total length of core run.				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.	Extremely Weak (Rock)	0.25 to 1.0	35 to 150	
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 ERB11-01

1 of 2

METRIC

W.P. 468-00-00 LOCATION N 5 455 520.0 E 234 084.1 English River Bridge ORIGINATED BY RK
HWY 11 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
DATUM Geodetic DATE 2011.03.14 - 2011.03.14 CHECKED BY RPR

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							WATER CONTENT (%)	
								○ UNCONFINED ● QUICK TRIAXIAL	+ FIELD VANE × LAB VANE							
462.6								20 40 60 80 100	20 40 60							
0.0	ASPHALT: (150mm)															
0.2	Gravelly SAND, occasional cobbles and boulders Dense to Very Dense Brown Moist (FILL)		1	AS			462									
			1	SS	45/ 0.275											
			2	SS	30		461									
460.3																
2.3	SAND, medium grained, some gravel, some silt, trace clay, occasional organics and wood fibres Loose to Very Loose Brown to Dark Brown Moist (FILL)		3	SS	7		460						13 73 13 1			
			4	SS	3											
458.9																
3.7	PEAT, silty Soft Dark Brown to Black Wet		5	SS	11		459									
458.5																
4.1	Sandy SILT Compact Greyish Brown Moist		6	SS	4		458						3 89 8 (SI+CL)			
458.0																
4.6	SAND, medium to coarse grained, trace gravel, trace silt and clay Very Loose to Compact Grey Wet															
			7	SS	20		457									
							456									
			8	SS	7		455						0 73 26 1			
	Silty															
							454									
			9	SS	17											
452.8							453									
9.8	DCPT start at 9.8m.															

Continued Next Page

+³ ×³: Numbers refer to
Sensitivity

20
15 5
10 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No ERB11-01

2 OF 2

METRIC

W.P. 468-00-00 LOCATION N 5 455 520.0 E 234 084.1 English River Bridge ORIGINATED BY RK
HWY 11 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
DATUM Geodetic DATE 2011.03.14 - 2011.03.14 CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x 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
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES						
	Continued From Previous Page										
445.8							452				
							451				
							450				
							449				
							448				
							447				
16.8	END OF BOREHOLE AT 16.8m. DCPT TERMINATED UPON REFUSAL AT 16.8m. WATER LEVEL AT 2.7m. BOREHOLE CAVED TO 2.7m. BOREHOLE BACKFILLED WITH AUGER CUTTINGS TO 0.6m, CONCRETE TO 0.1m, THEN ASPHALT TO SURFACE.						446				

ONTMT4S 5121.GPJ 9/13/11

RECORD OF BOREHOLE No ERB11-02

1 OF 4

METRIC

W.P. 468-00-00 LOCATION N 5 455 521.9 E 234 094.2 English River Bridge ORIGINATED BY RK
 HWY 11 BOREHOLE TYPE Casing COMPILED BY AN
 DATUM Geodetic DATE 2011.03.11 - 2011.03.11 CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa				WATER CONTENT (%)
								○ UNCONFINED ● QUICK TRIAXIAL	+ FIELD VANE x LAB VANE			
462.5 0.0 0.1	ASPHALT: (100mm) SAND and GRAVEL, occasional cobbles Very Dense to Compact Brown to Grey Wet (FILL)											
			1	SS	57							
			2	SS	166/ 0.100							
			3	SS	35							
			4	SS	30							
457.9 457.8 4.7	PEAT, silty, some sand Brown Wet (100mm) SAND, medium to coarse, trace gravel, trace silt and clay Compact to Dense Gray Wet		5	SS	14							
			6	SS	31							
			7	SS	22							
			8	SS	14							

Continued Next Page

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

RECORD OF BOREHOLE No ERB11-02

2 OF 4

METRIC

W.P. 468-00-00 LOCATION N 5 455 521.9 E 234 094.2 English River Bridge ORIGINATED BY RK
HWY 11 BOREHOLE TYPE Casing COMPILED BY AN
DATUM Geodetic DATE 2011.03.11 - 2011.03.11 CHECKED BY RPR

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							WATER CONTENT (%)
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE							
	Continued From Previous Page							20 40 60 80 100	20 40 60						
	SAND, fine, some silt to silty, trace clay Loose to Compact Greyish Brown Wet		9	SS	6		452							0 70 28 2	
							451								
			10	SS	11		450								
			11	SS	18		449								
							448								
			12	SS	16		447							0 83 16 1	
							446								
			13	SS	16		445								
							444								
			14	SS	21		443								

Continued Next Page

+³, ×³: Numbers refer to
Sensitivity

20
15
10

(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No ERB11-02

3 OF 4

METRIC

W.P. 468-00-00 LOCATION N 5 455 521.9 E 234 094.2 English River Bridge ORIGINATED BY RK
HWY 11 BOREHOLE TYPE Casing COMPILED BY AN
DATUM Geodetic DATE 2011.03.11 - 2011.03.11 CHECKED BY RPR

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		
	Continued From Previous Page							SHEAR STRENGTH kPa						
								○ UNCONFINED + FIELD VANE						
								● QUICK TRIAXIAL × LAB VANE						
								WATER CONTENT (%)						
								PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT						
								w _p w w _L						
								20 40 60 80 100						
442.1	SAND, some silt, trace clay		15	SS	35		442							0 83 16 1
20.4	Dense Greyish Brown Wet													
	Clayey SILT, sand layers													
	Very Stiff													
	Grey													
			16	SS	18		441							
							440							
							439							
438.1							438							
24.4	SAND, some gravel, some silt and		17	SS	37									22 51 27
	clay, occasional cobbles and boulders													(Si+CL)
	Dense													
	Grey													
	Wet													
							437							
							436							
							435							
			18	SS	41									
							434							
							433							
	Boulders from 29.2m to 29.9m													

Continued Next Page

+³ × 3³: Numbers refer to
Sensitivity

20
15
10

(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No ERB11-02

4 OF 4

METRIC

W.P. 468-00-00 LOCATION N 5 455 521.9 E 234 094.2 English River Bridge ORIGINATED BY RK
HWY 11 BOREHOLE TYPE Casing COMPILED BY AN
DATUM Geodetic DATE 2011.03.11 - 2011.03.11 CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE					W _P	W	W _L		
	Continued From Previous Page							20	40	60	80	100					
432.0	SAND, some silt and clay, boulders Dense Grey																
30.5	Wet END OF BOREHOLE AT 30.5m. BOREHOLE CAVED TO 2.7m. BOREHOLE BACKFILLED WITH AUGER CUTTINGS TO 0.6m, CONCRETE TO 0.07m, THEN ASPHALT TO SURFACE.						432										

RECORD OF BOREHOLE No ERB11-03

2 OF 3

METRIC

W.P. 468-00-00 LOCATION N 5 455 517.5 E 234 093.1 English River Bridge ORIGINATED BY RK
HWY 11 BOREHOLE TYPE Casing COMPILED BY MFA
DATUM Geodetic DATE 2011.03.14 - 2011.03.15 CHECKED BY RPR

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							WATER CONTENT (%)	
								○ UNCONFINED ● QUICK TRIAXIAL	+ FIELD VANE x LAB VANE							
Continued From Previous Page								20 40 60 80 100								
449.2	SAND, some silt to silty Loose Brown to Grey Wet		10	SS	7		452									
							451									
			11	SS	5		450									
13.3	Sandy SILT, trace clay Compact Brown to Grey Wet		12	SS	15		449							0 31 68 1		
447.7							448									
14.8	SAND, some silt to silty Compact to Dense Brown to Grey Wet		13	SS	12		447									
							446							0 81 18 1		
							445									
			15	SS	31		444									
							443									

Continued Next Page

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

RECORD OF BOREHOLE No ERB11-03

3 OF 3

METRIC


W.P. 468-00-00 LOCATION N 5 455 517.5 E 234 093.1 English River Bridge ORIGINATED BY RK
HWY 11 BOREHOLE TYPE Casing COMPILED BY MFA
DATUM Geodetic DATE 2011.03.14 - 2011.03.15 CHECKED BY RPR

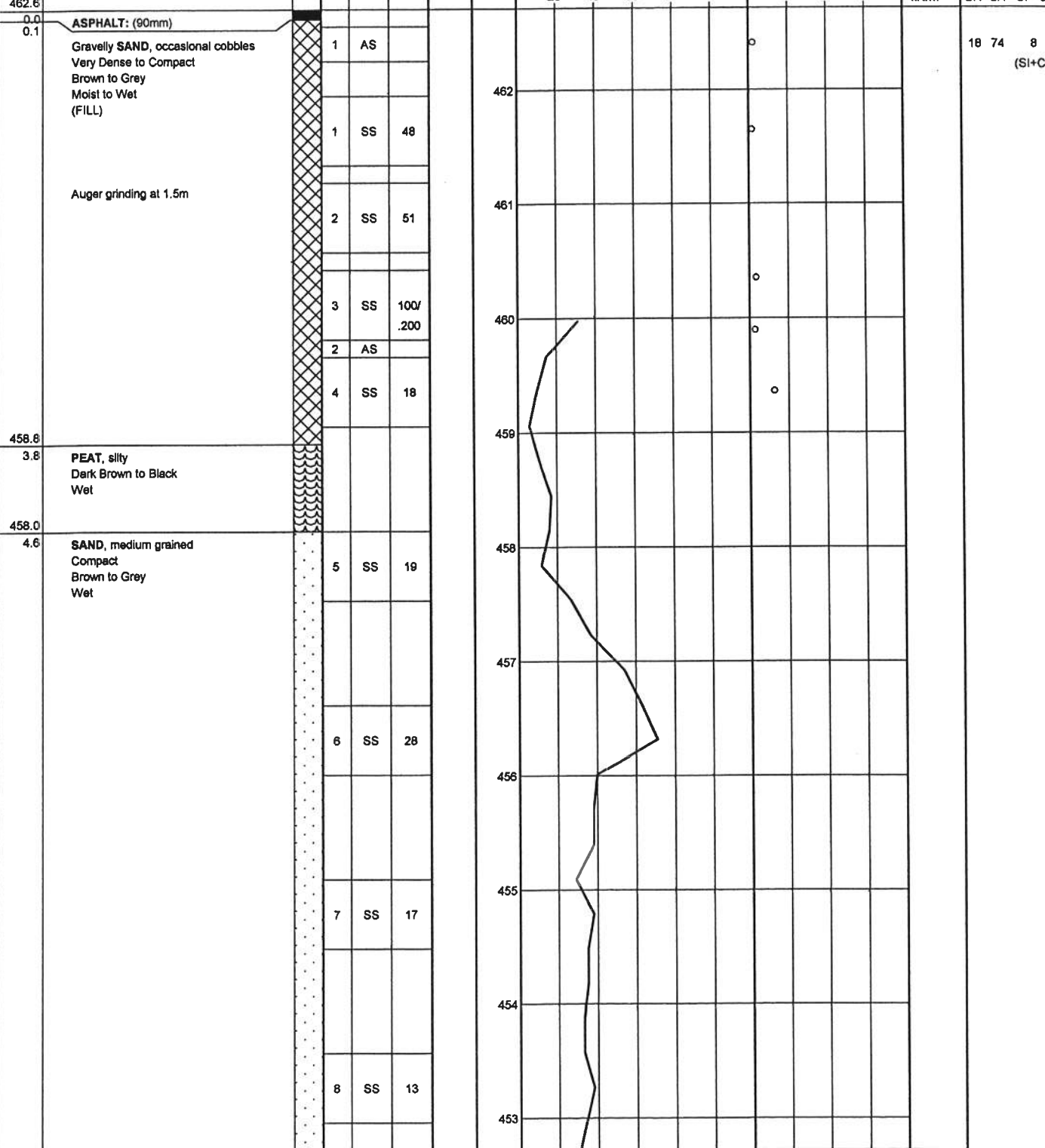
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)							
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa											
								20 40 60 80 100					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT						
								20 40 60 80 100					w _p w w _L						
							○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE					WATER CONTENT (%)			GR SA SI CL				
Continued From Previous Page																			
441.6	SAND, some silt to silty Compact Brown to Grey Wet		16	SS	24		442												
20.9	Clayey SILT, trace sand Very Stiff Grey		17	SS	15		441												
							440												
438.1							439												
24.4	SAND, fine grained, gravelly layers, occasional cobbles and boulders Dense Grey Wet Coring through boulders from 25.3m to 26.8m		18	SS	31		438												
							437												
435.7							436												
26.8	END OF BOREHOLE AT 26.8m. BOREHOLE CAVED TO 2.4m. BOREHOLE BACKFILLED WITH SAND AND AUGER CUTTINGS TO 0.3m, CONCRETE TO 0.1m, THEN ASPHALT TO SURFACE.																		

+³, ×³: Numbers refer to
Sensitivity

20
15 5
10 (%) STRAIN AT FAILURE

METRIC

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT	PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES				W _p	W	W _L		
102.5							SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100				20 40 60		GR SA SI



(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No ERB11-04

2 OF 4

METRIC

W.P. 468-00-00 LOCATION N 5 455 510.1 E 234 132.4 English River Bridge ORIGINATED BY RK
HWY 11 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MFA
DATUM Geodetic DATE 2011.03.09 - 2011.03.10 CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _P	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa							WATER CONTENT (%)
								○ UNCONFINED ● QUICK TRIAXIAL	+ FIELD VANE × LAB VANE						
	Continued From Previous Page							20 40 60 80 100	20 40 60						
	SAND, some silt to silty, trace clay Compact Brown to Grey Wet														
			9	SS	20		452								
							451								
	Layer of sandy silt		10	SS	15		450						0 37 60 3		
							449								
			11	SS	28		448						0 63 36 1		
							447								
			12	SS	17		446								
							445								
			13	SS	16		444						0 70 29 1		
444.8							443								
17.8	Sandy SILT, some clay Compact Grey Wet		14	SS	23		442						0 19 70 11		
443.3							441								
19.3	SAND, some silt to silty, trace clay Compact Brown to Grey Wet						440								

ONTMT4S 5121.GPJ 9/13/11

Continued Next Page

+³ ×³: Numbers refer to
Sensitivity

20
15
10

(%) STRAIN AT FAILURE

METRIC

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	W _p W W _L	WATER CONTENT (%)		
	Continued from Previous Page						SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100					

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT NATURAL MOISTURE LIQUID CONTENT LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	W _p W W _L	20 40 60					
								SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE			WATER CONTENT (%)				
	Continued From Previous Page		15	SS	39										
							442								
							441								
							440								
			16	SS	27										
							439								
438.8	SAND, some silt to silty, trace clay Compact to Dense Grey Wet						438								
23.8	GRAVEL, some sand Grey Wet						437								
	occasional cobbles and boulders						436								
436.7							435								
25.9	SAND, some gravel to gravelly, some silt and clay Compact Grey Wet		17	SS	17										
							434								
434.7							433								
27.9	Coring through cobbles and boulders: (GRANITE, pink and grey)		1	RUN											
			2A	RUN			434								
			2B	RUN			433								

+³, ×³: Numbers refer to Sensitivity

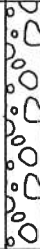
ONTMT4S 5121.GPJ 9/13/11

RECORD OF BOREHOLE No ERB11-04

4 OF 4

METRIC

W.P. 468-00-00 LOCATION N 5 455 510.1 E 234 132.4 English River Bridge ORIGINATED BY RK
HWY 11 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MFA
DATUM Geodetic DATE 2011.03.09 - 2011.03.10 CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT Y kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100	W _P	W	W _L		
	Continued From Previous Page																
431.0	Coring through boulders: (GRANITE, pink and grey)		3	RUN		432											
31.6	END OF BOREHOLE AT 31.6m. BOREHOLE CAVED TO 1.5m, BACKFILLED WITH SAND TO 0.6m, CONCRETE TO 0.1m, THEN ASPHALT TO SURFACE.																

RECORD OF BOREHOLE No ERB11-05

1 OF 3

METRIC

W.P. 468-00-00 LOCATION N 5 455 505.9 E 234 129.7 English River Bridge ORIGINATED BY RK
 HWY 11 BOREHOLE TYPE Casing COMPILED BY MFA
 DATUM Geodetic DATE 2011.03.16 - 2011.03.16 CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT		UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE	WATER CONTENT (%)	W _p	W		
462.5	ASPHALT: (100mm)												
0.0	SAND and GRAVEL Very Dense to Compact Brown Wet (FILL) Cobbles becoming Grey		1	SS	44								
0.1			2	SS	19								
			3	SS	50								
			4	SS	22								
458.8	PEAT, silty Soft Black Wet		5	SS	4								
457.6	SAND, medium grained, trace silt and clay Dense to Compact Brown Wet		6	SS	15								
4.9			7	SS	32								
			8	SS	15								
			9	SS	15								

Continued Next Page

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

RECORD OF BOREHOLE No ERB11-05

2 OF 3

METRIC

W.P. 468-00-00 LOCATION N 5 455 505.9 E 234 129.7 English River Bridge ORIGINATED BY RK
 HWY 11 BOREHOLE TYPE Casing COMPILED BY MFA
 DATUM Geodetic DATE 2011.03.16 - 2011.03.16 CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
	Continued From Previous Page							○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE						
	SAND, trace silt to silty, trace clay Loose to Compact Brown to Grey Wet		10	SS	7		452							
							451							
			11	SS	11		450							
							449							
			12	SS	10		448							0 57 42 1
							447							
			13	SS	13		446							
							445							
			14	SS	12		444							
							443							
444.2														
18.3	Sandy SILT Compact Brown to Grey Wet		15	SS	19		444							0 22 74 4
443.2														
19.3	Clayey SILT Reddish Brown to Grey Wet													
442.5														

Continued Next Page

+³ ×³: Numbers refer to
Sensitivity

20
15
10

(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No ERB11-05

3 OF 3

METRIC

W.P. 468-00-00 LOCATION N 5 455 505.9 E 234 129.7 English River Bridge ORIGINATED BY RK
 HWY 11 BOREHOLE TYPE Casing COMPILED BY MFA
 DATUM Geodetic DATE 2011.03.16 - 2011.03.16 CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					
								○ UNCONFINED + FIELD VANE					
								● QUICK TRIAXIAL × LAB VANE					
Continued From Previous Page			16	SS	32								
20.0	SAND, some silt to silty Dense Brown to Grey Wet												
			17	SS	38								

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

RECORD OF BOREHOLE No ERB11-06

1 OF 2

METRIC

W.P. 468-00-00 LOCATION N 5 455 507.6 E 234 140.2 English River Bridge ORIGINATED BY RK
 HWY 11 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MFA
 DATUM Geodetic DATE 2011.03.09 - 2011.03.09 CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa				
								20 40 60 80 100				
								20 40 60 80 100				
462.4												
0.0	ASPHALT: (90mm)											
0.1	SAND, some gravel to gravelly, trace to some silt, trace clay Very Dense to Loose Brown Moist (FILL)		1	AS								
			1	SS	81							18 63 19 (SI+CL)
			2	SS	26							
	Moist to Wet		3	SS	6							21 70 9 (SI+CL)
	Brown to Grey		4	SS	5							28 58 14 (SI+CL)
457.8												
4.6	PEAT, silty, some sand Soft Dark Brown Wet		5	SS	3							
456.3												
6.1	SAND, medium grained, trace clay Compact Grey Wet		6	SS	10							0 98 2 (SI+CL)
454.8												
7.6	END OF BOREHOLE AT 7.6m. WATER LEVEL AT 2.8m UPON COMPLETION OF DRILLING. BOREHOLE BACKFILLED WITH AUGER CUTTINGS TO 0.6m, CONCRETE TO 0.1m, THEN ASPHALT TO SURFACE. Start DCPT at 7.6m.											

Continued Next Page

+³ ×³: Numbers refer to
Sensitivity

20
15 5
10 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No ERB11-06

2 OF 2

METRIC

W.P. 468-00-00 LOCATION N 5 455 507.6 E 234 140.2 English River Bridge ORIGINATED BY RK
 HWY 11 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MFA
 DATUM Geodetic DATE 2011.03.09 - 2011.03.09 CHECKED BY RPR

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	LIQUID LIMIT w _L		
	Continued From Previous Page							SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE	WATER CONTENT (%) 20 40 60				
446.6							452						
							451						
							450						
							449						
							448						
15.8	END OF DCPT AT 15.8m.						447						

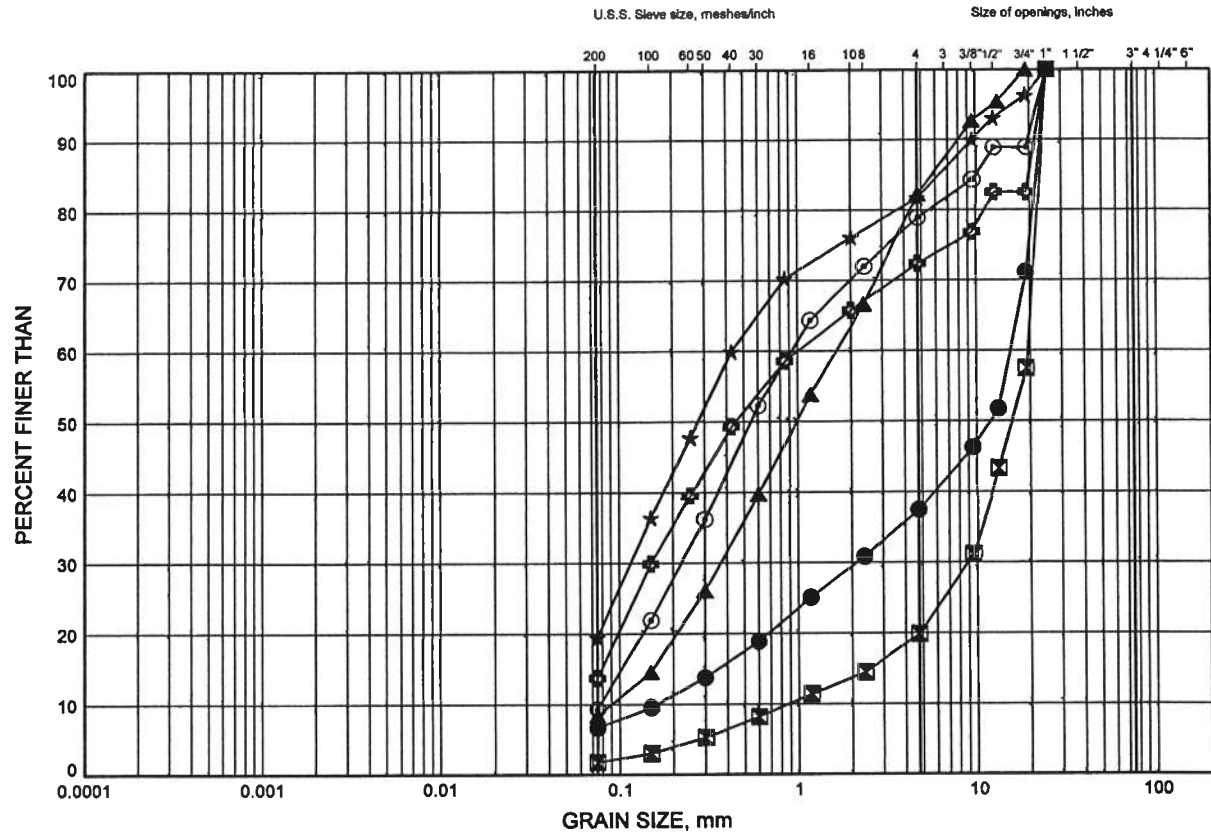
Appendix B

Laboratory Test Results

6010-E-0010 Bridge and Culvert Rehabs NWR
GRAIN SIZE DISTRIBUTION

FIGURE B1

GRAVELLY SAND/SAND & GRAVEL FILL



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

LEGEND

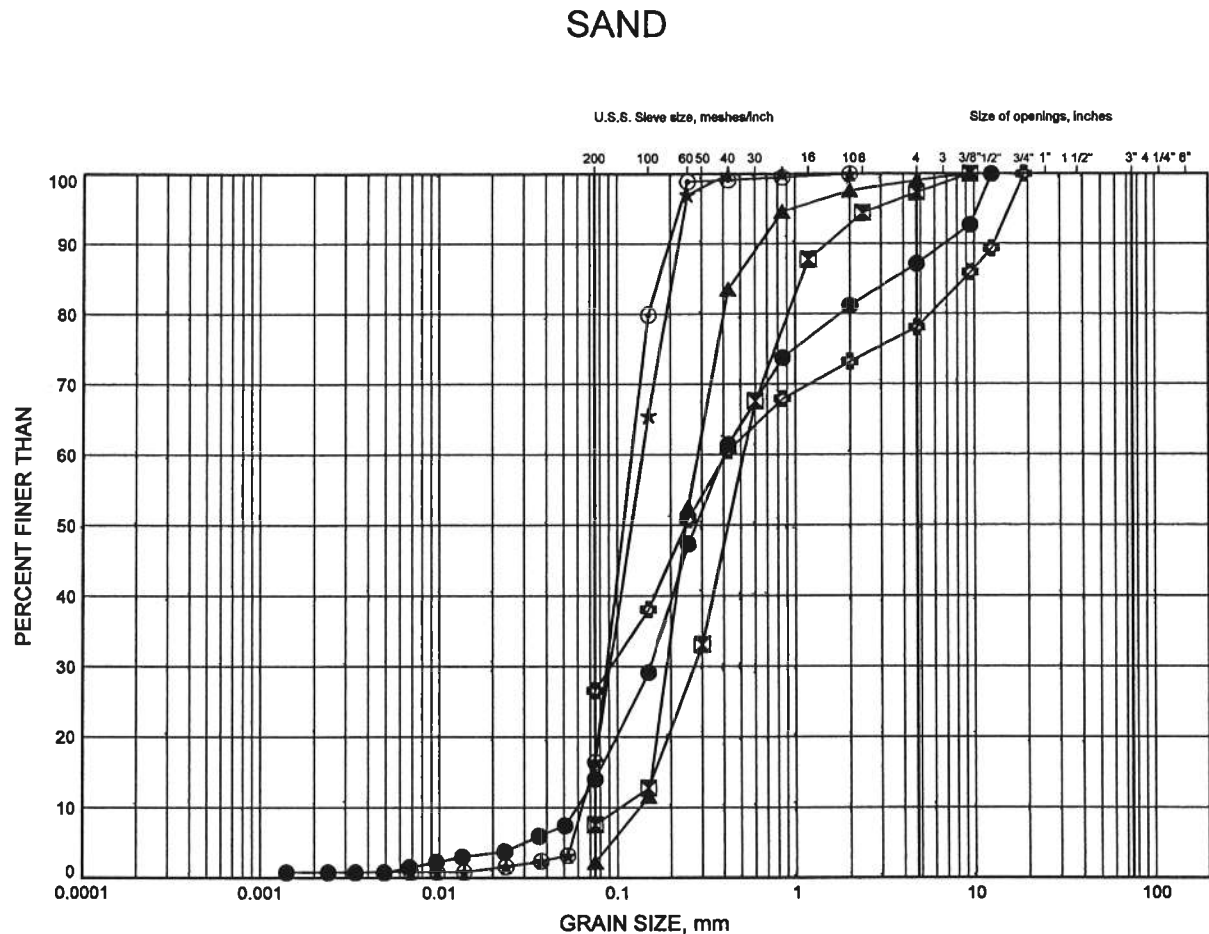
SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	ERB11-02	2.59	459.91
⊠	ERB11-03	2.59	459.91
▲	ERB11-04	0.30	462.30
★	ERB11-06	1.07	461.33
⊙	ERB11-06	2.59	459.81
⊕	ERB11-06	3.35	459.05



W.P.# .468-00-00.....
Prepared By .AN.....
Checked By .RPR.....

6010-E-0010 Bridge and Culvert Rehabs NWR
GRAIN SIZE DISTRIBUTION

FIGURE B2



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

LEGEND

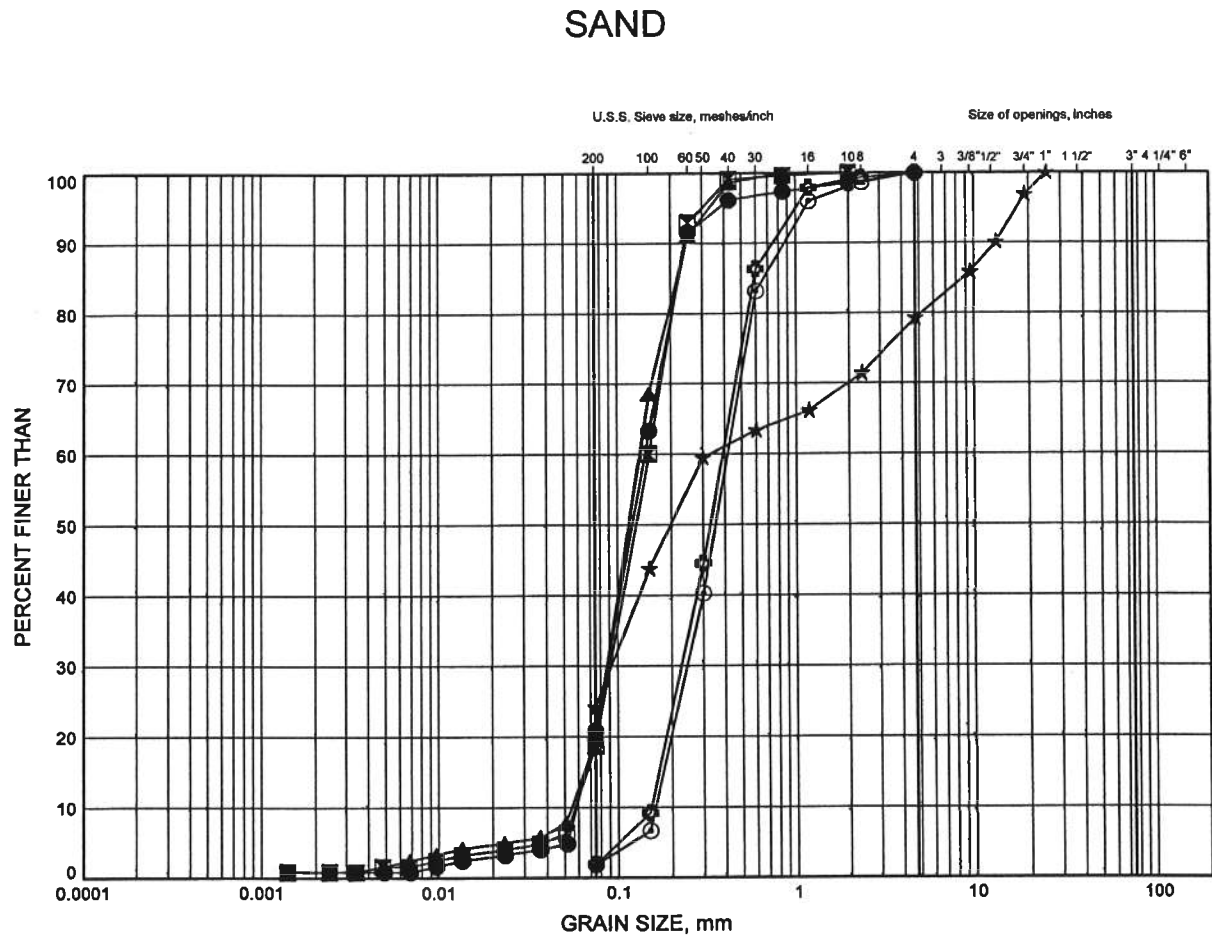
SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	ERB11-01	2.59	460.01
⊠	ERB11-01	4.88	457.72
▲	ERB11-02	6.40	456.10
★	ERB11-02	15.54	446.96
⊙	ERB11-02	20.12	442.38
⊕	ERB11-02	24.69	437.81



W.P.# 468-00-00
Prepared By AN
Checked By RPR

6010-E-0010 Bridge and Culvert Rehabs NWR
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)
●	ERB11-03	9.45	453.05
⊠	ERB11-03	17.07	445.43
▲	ERB11-04	23.16	439.44
★	ERB11-04	26.21	436.39
⊙	ERB11-05	7.92	454.58
⊕	ERB11-06	6.40	456.00

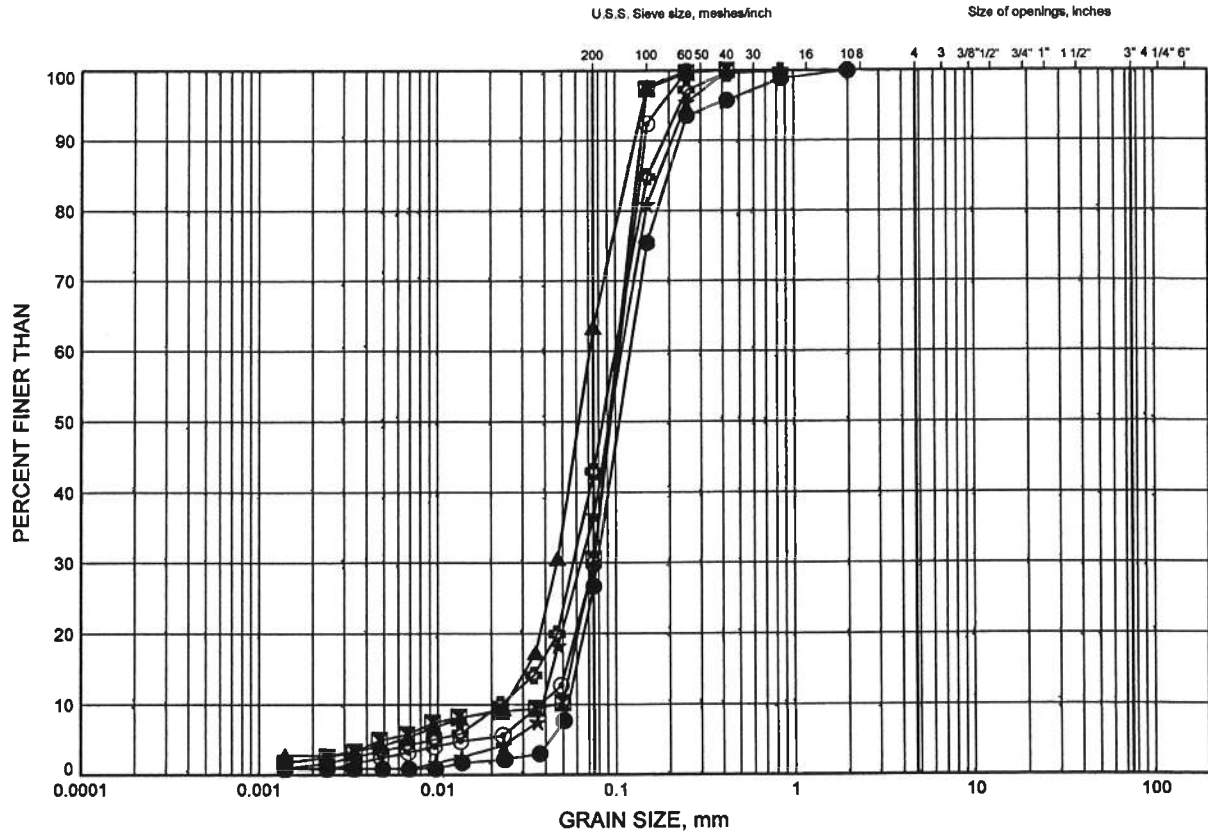


W.P.# .468-00-00.....
Prepared By .AN.....
Checked By .RPR.....

6010-E-0010 Bridge and Culvert Rehabs NWR
GRAIN SIZE DISTRIBUTION

FIGURE B4

SAND (SILTY)



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

LEGEND

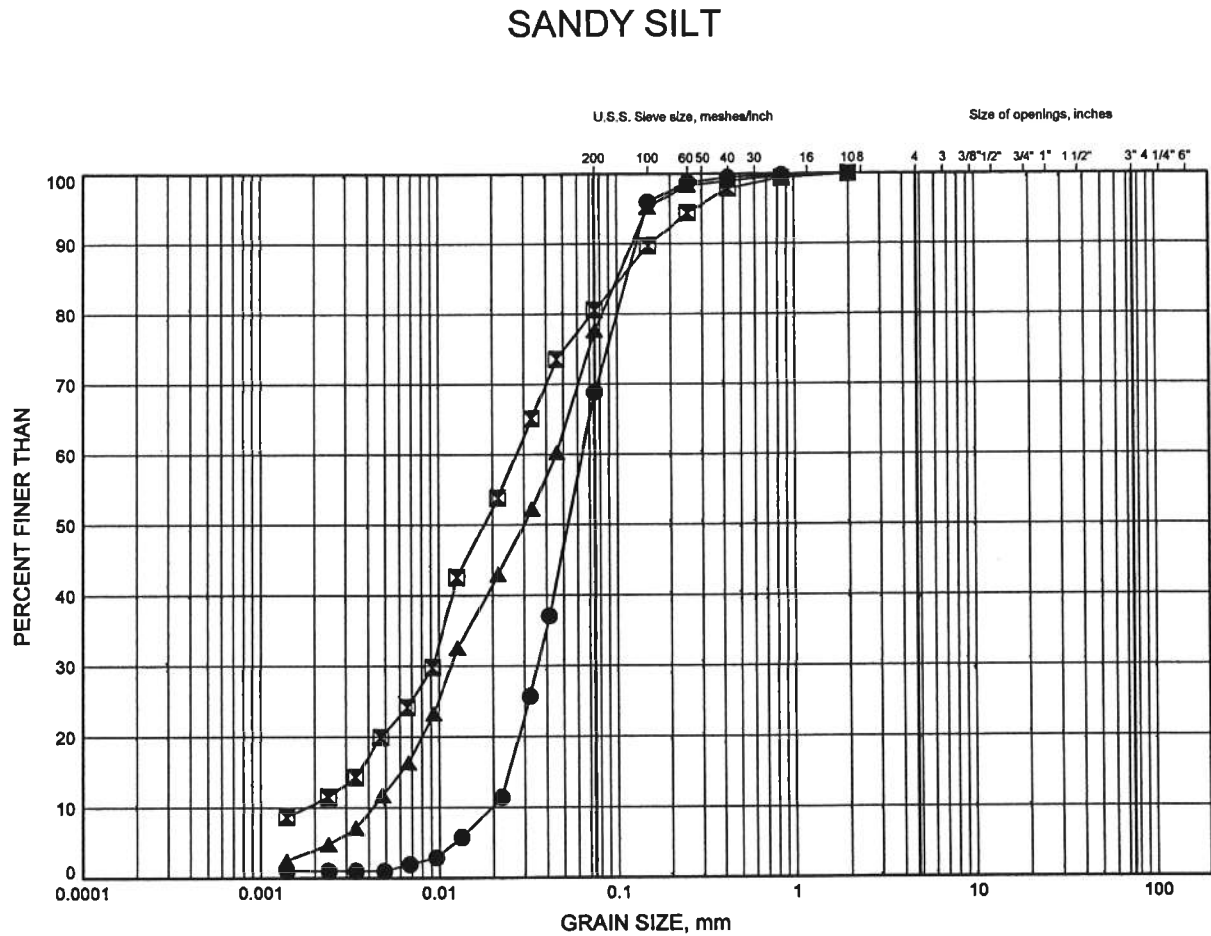
SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	ERB11-01	7.92	454.68
⊠	ERB11-02	10.97	451.53
▲	ERB11-04	12.50	450.10
★	ERB11-04	14.02	448.58
⊙	ERB11-04	17.07	445.53
⊕	ERB11-05	14.02	448.48



W.P.# .468-00-00.....
Prepared By .AN.....
Checked By .RPR.....

6010-E-0010 Bridge and Culvert Rehabs NWR
GRAIN SIZE DISTRIBUTION

FIGURE B5



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

LEGEND

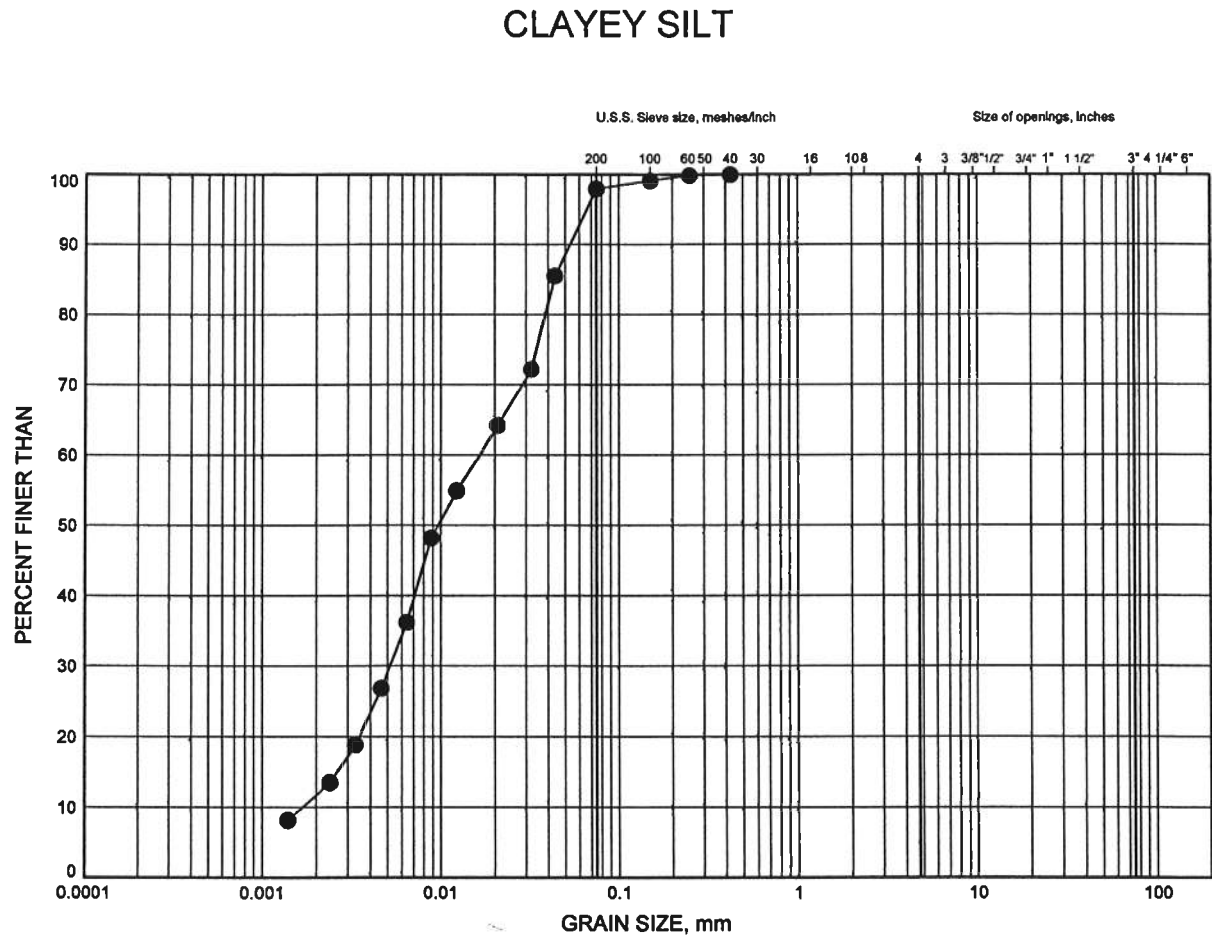
SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	ERB11-03	14.02	448.48
⊠	ERB11-04	18.59	444.01
▲	ERB11-05	18.59	443.91



W.P.# .468-00-00.....
Prepared By .AN.....
Checked By .RPR.....

6010-E-0010 Bridge and Culvert Rehabs NWR
GRAIN SIZE DISTRIBUTION

FIGURE B6



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	ERB11-03	21.64	440.86



W.P.# 468-00-00.....
Prepared By .AN.....
Checked By .RPR.....

**FOUNDATION INVESTIGATION REPORT
ENGLISH RIVER BRIDGE REPLACEMENT
EAST OF IGNACE, ONTARIO
HIGHWAY 17 IN THE NORTHWEST REGION**

W.P. 468-00-00, SITE No. 41S-73

Geocres Number: 52G-8

Report to

Hatch Mott MacDonald

Thurber Engineering Ltd.
2010 Winston Park Drive, Suite 103
Oakville, Ontario
L6H 5R7
Phone: (905) 829 8666
Fax: (905) 829 1166

March 14, 2012
File: 19-1605-121

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Memos\English River\191605121 English River-FIR-
Final.doc

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Appendices

Appendix A	Record of Borehole Sheets
Appendix B	Laboratory Test Results
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**FOUNDATION INVESTIGATION REPORT
ENGLISH RIVER BRIDGE REPLACEMENT
EAST OF IGNACE, ONTARIO
HIGHWAY 17 IN THE NORTHWEST REGION**

W.P. 468-00-00, SITE No. 41S-73

Geocres Number: 52G-8

PART 1: FACTUAL INFORMATION

1 INTRODUCTION

This report presents the factual findings obtained from a foundation investigation conducted at the site of a proposed replacement of the existing bridge structure which carries Highway 17 over English River, east of The Town of Ignace, Ontario.

The purpose of this 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, stratigraphic profile and cross-sections, laboratory test results and a written description of the subsurface conditions. A model of the subsurface conditions was developed from the data obtained in the course of the investigation.

Thurber carried out the investigation as a sub-consultant to Hatch Mott MacDonald, under the Ministry of Transportation Ontario (MTO) Agreement Number 6010-E-0010.

2 SITE DESCRIPTION

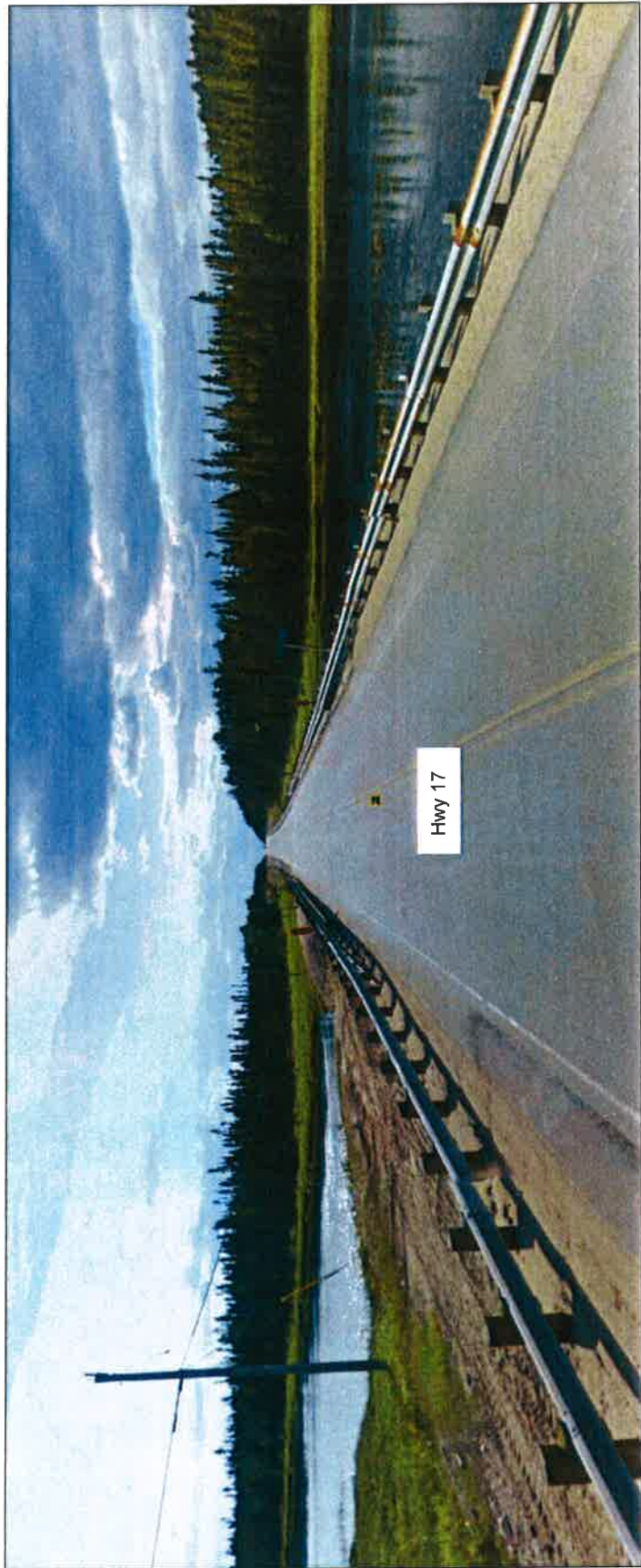
The English River Bridge is located on Highway 17 approximately 50 km east of The Town of Ignace, Ontario (Kenora County).

At present, the highway crosses the English River on a six-span structure supported on timber piles. The English River bridge spans approximately 36.0 m across the river channel. The width of the bridge is approximately 10.0 m. The English River flows to the north.

The surrounding area near the site is relatively flat. The areas to the east and west of the site are heavily treed.

Appendix C

Site Photographs



Photograph 1 – Existing English River Bridge & Highway 17



Photograph 2– English River Bridge



Photograph 3 – North side of the English River Bridge

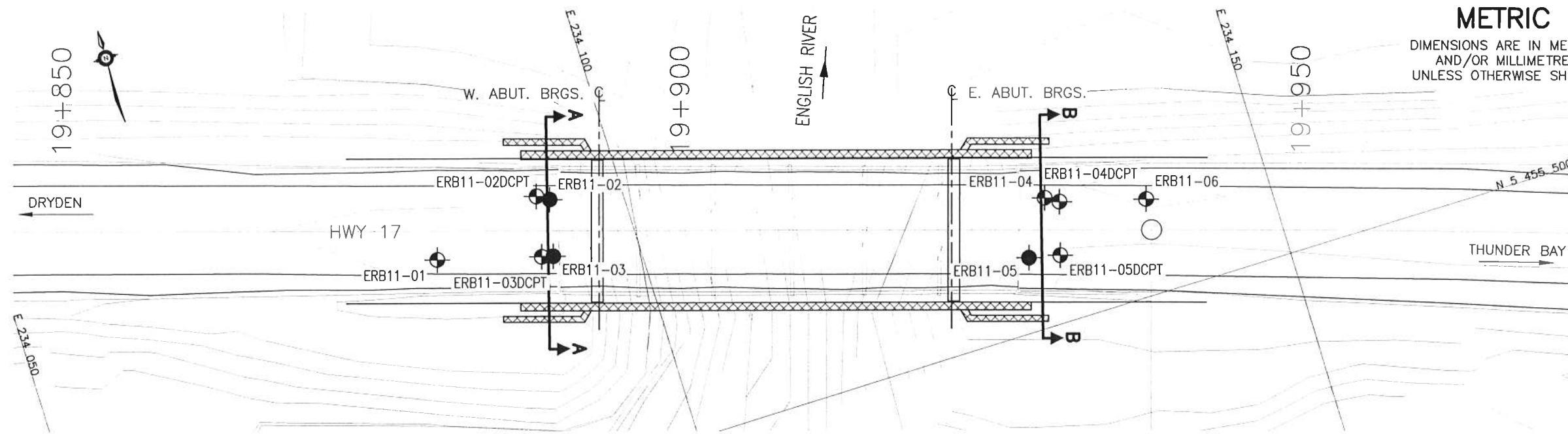


Photograph 4 – South side of the English River Bridge

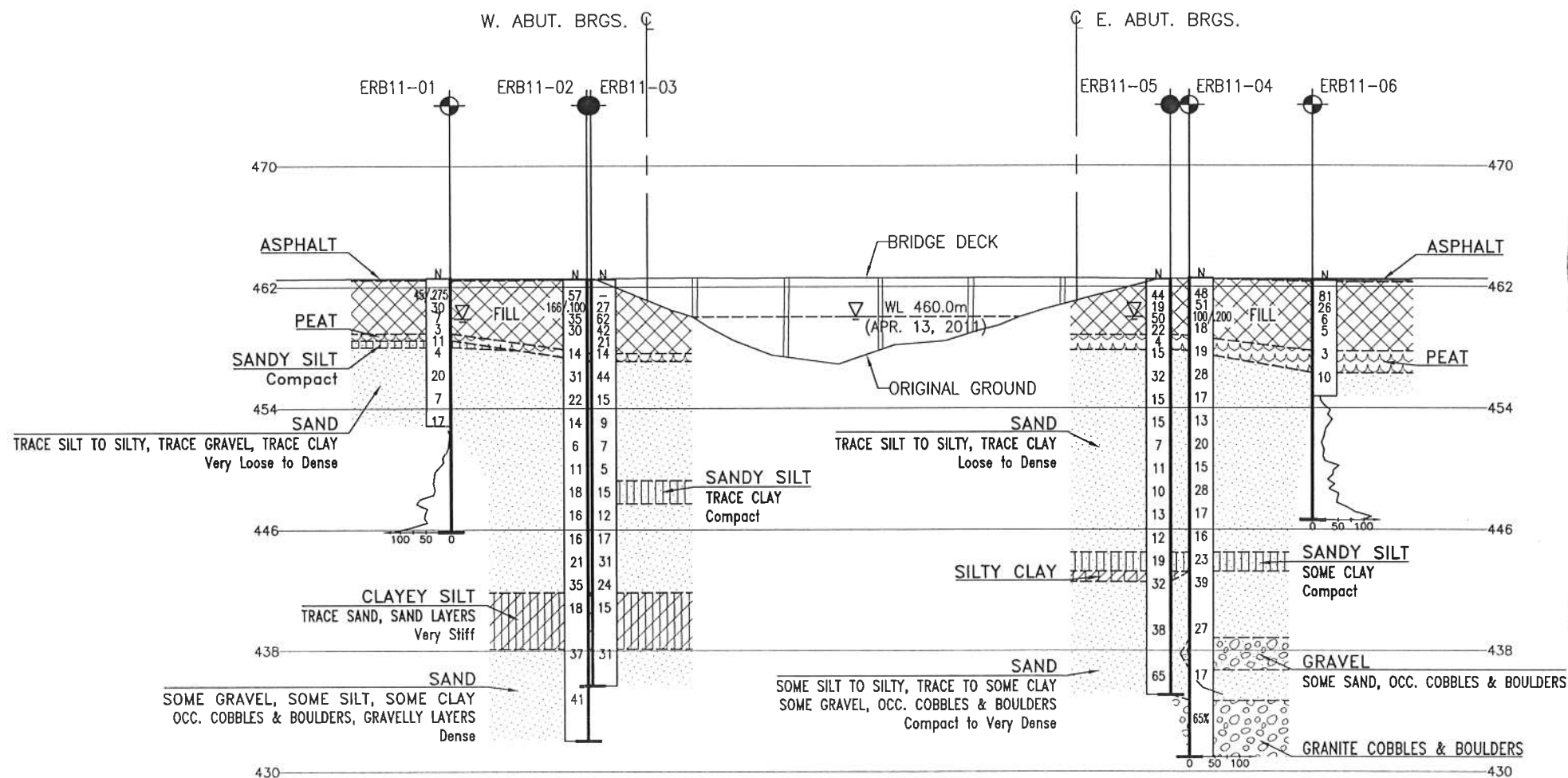
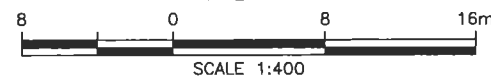
Appendix D

Drawing

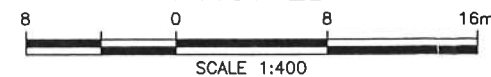
Borehole Locations and Soil Strata



PLAN



PROFILE



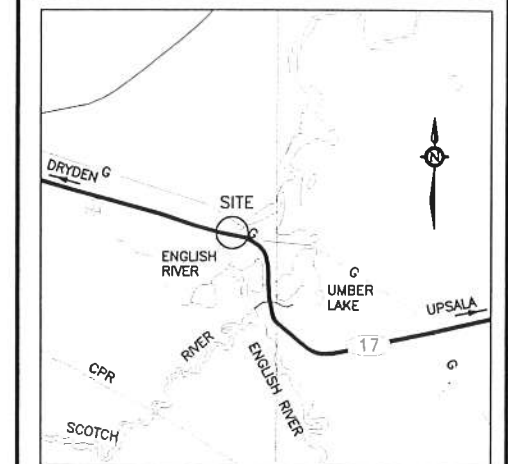
METRIC
DIMENSIONS ARE IN METRES
AND/OR MILLIMETRES
UNLESS OTHERWISE SHOWN

CONT No
WP No 468-00-00

HIGHWAY 17
BRIDGE AND CULVERT REHABS NWR
ENGLISH RIVER BRIDGE
BOREHOLE LOCATIONS AND SOIL STRATA

Hatch Mott MacDonald

THURBER ENGINEERING LTD.
GEOTECHNICAL • ENVIRONMENTAL • MATERIALS



KEYPLAN

LEGEND

◆	Borehole
◆	Borehole and Cone / Cone
N	Blows /0.3m (Std Pen Test, 475J/blow)
CONE	Blows /0.3m (60' Cone, 475J/blow)
PH	Pressure, Hydraulic
W	Water Level
↑	Head Artesian Water
↑	Piezometer
90%	Rock Quality Designation (RQD)
A/R	Auger Refusal

NO	ELEVATION	NORTHING	EASTING
ERB11-01	462.6	5 455 520.0	234 084.1
ERB11-02	462.5	5 455 521.9	234 094.2
ERB11-02DCPT	462.5	5 455 522.5	234 093.3
ERB11-03	462.5	5 455 517.5	234 093.1
ERB11-03DCPT	462.5	5 455 517.7	234 092.2
ERB11-04	462.6	5 455 510.1	234 132.4
ERB11-04DCPT	462.6	5 455 509.5	234 133.4
ERB11-05	462.5	5 455 505.9	234 129.7
ERB11-05DCPT	462.5	5 455 505.3	234 132.2
ERB11-06	462.4	5 455 507.6	234 140.2

-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. 52G-8



DATE	BY	DESCRIPTION
DESIGN	RPR	CHK PKC
DRAWN	MFA	CHK RPR
LOAD	DATE	JAN. 2012
STRUCT	DWG	1

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

CONT No
WP No 468-00-00

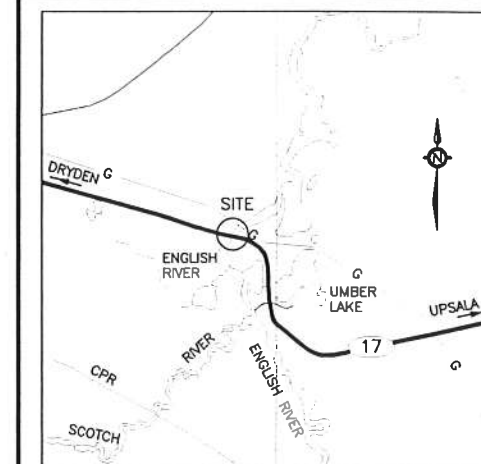


HIGHWAY 17
BRIDGE AND CULVERT REHABS NWR
ENGLISH RIVER BRIDGE
BOREHOLE LOCATIONS AND SOIL STRATA

SHEET

**Hatch Mott
MacDonald**

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**KEYPLAN
LEGEND**

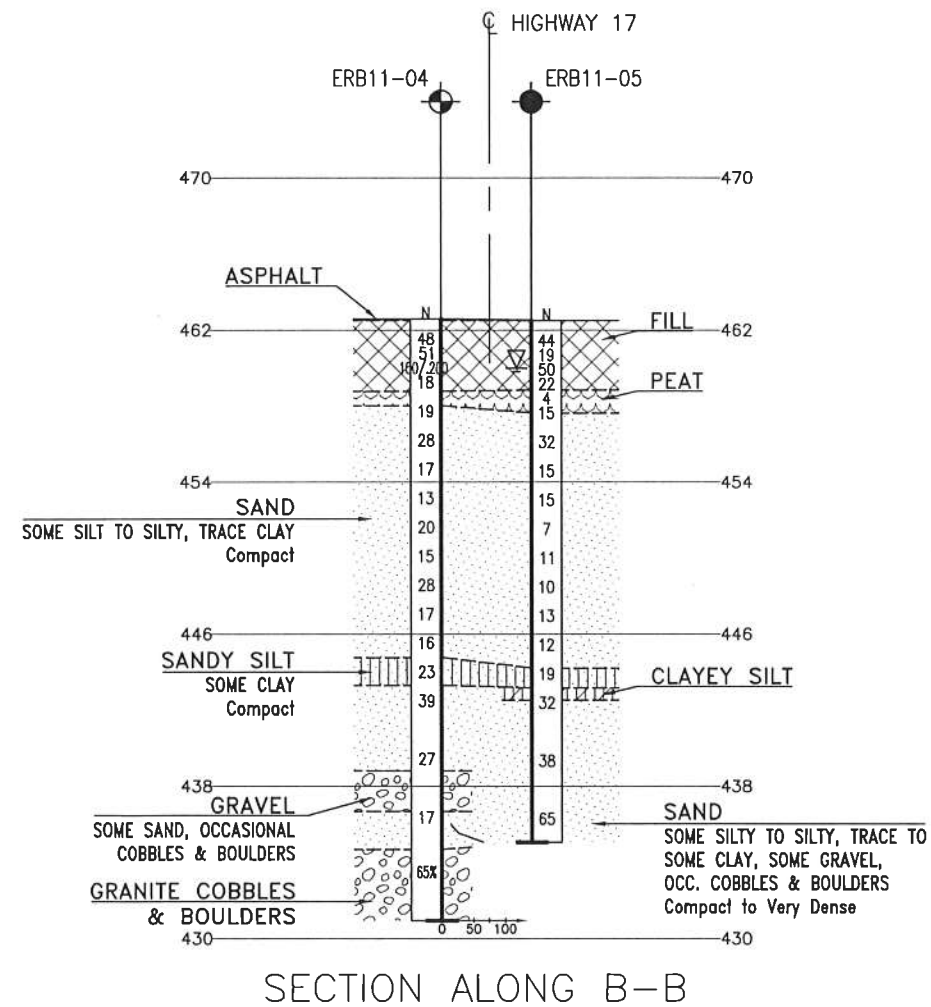
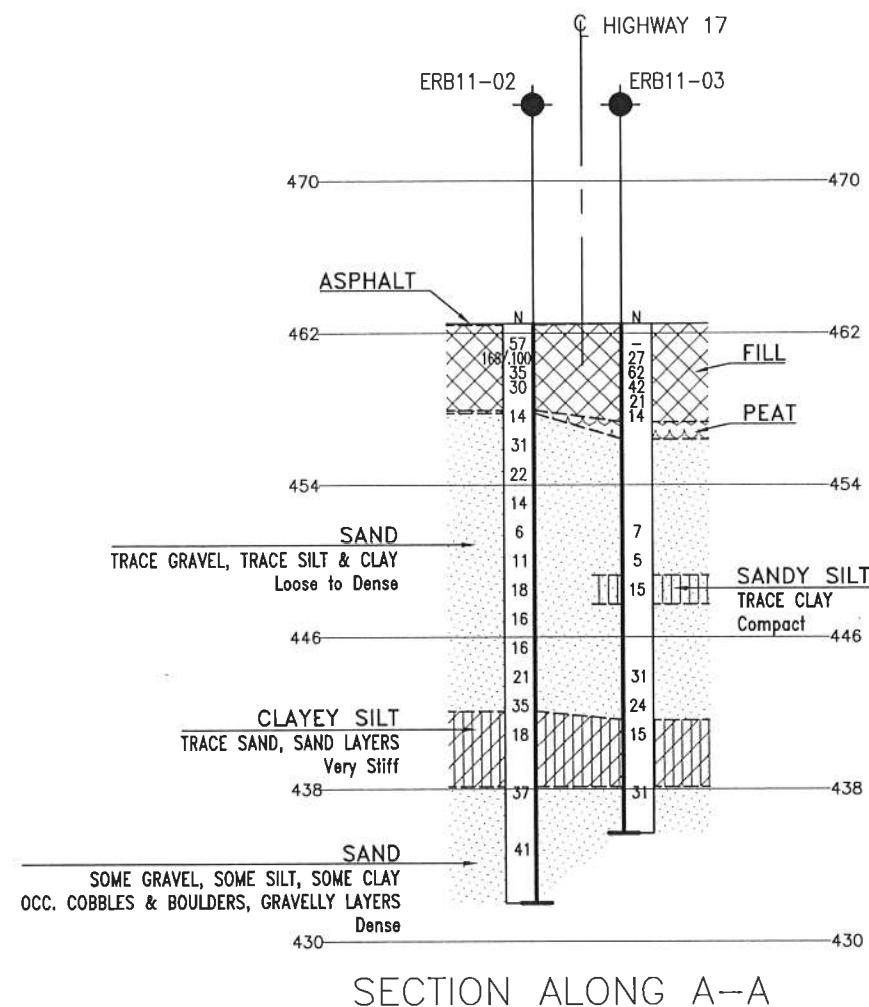
	Borehole
	Borehole and Cone / Cone
N	Blows /0.3m (Std Pen Test, 475J/blow)
CONE	Blows /0.3m (60' Cone, 475J/blow)
PH	Pressure, Hydraulic
	Water Level
	Head Artesian Water
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90%	Rock Quality Designation (RQD)
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NO	ELEVATION	NORTHING	EASTING
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ERB11-03DCPT	462.5	5 455 517.7	234 092.2
ERB11-04	462.6	5 455 510.1	234 132.4
ERB11-04DCPT	462.6	5 455 509.5	234 133.4
ERB11-05	462.5	5 455 505.9	234 129.7
ERB11-05DCPT	462.5	5 455 505.3	234 132.2
ERB11-06	462.4	5 455 507.6	234 140.2

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GEOCRES No. 52G-8



REVISIONS	DATE	BY	DESCRIPTION
DESIGN	RPR	CHK PKC	CODE
DRAWN	MFA	CHK RPR	SITE
			LOAD
			STRUCT
			DWG 2
			DATE JAN. 2012