

**FOUNDATION INVESTIGATION REPORT
BEAVER CREEK BRIDGE REPLACEMENT
HIGHWAY 594, DISTRICT OF KENORA
G.W.P. 6047-08-00, STRUCTURE NO. 41S-56**

Geocres Number: 52F-35

**Report to
McCormick Rankin Corporation**

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TABLE OF CONTENTS

PART 1 FACTUAL INFORMATION

1	INTRODUCTION	1
2	SITE DESCRIPTION	1
3	SITE INVESTIGATION AND FIELD TESTING	2
4	LABORATORY TESTING	3
5	DESCRIPTION OF SUBSURFACE CONDITIONS	3
5.1	Pavement Structure	3
5.2	Silty Clay Fill.....	4
5.3	Silty Clay	4
5.4	Sand to Gravelly Sand	5
5.5	Silt.....	5
5.6	Bedrock.....	6
5.7	Water Levels	6
6	MISCELLANEOUS	7

Appendices

Appendix A	Record of Borehole Sheets
Appendix B	Laboratory Test Results
Appendix C	Photographs
Appendix D	Drawing titled “Borehole Locations and Soil Strata”

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PART 1: FACTUAL INFORMATION

1 INTRODUCTION

This report presents the factual findings obtained from a geotechnical investigation conducted at the location of the bridge carrying Highway 594 over Beaver Creek in the District of Kenora, Ontario.

The purpose of the investigation was to explore the subsurface conditions at the bridge location and, based on the data obtained, to provide a borehole location plan, borehole logs, stratigraphic profile, cross-sections, laboratory test results and a written description of the subsurface conditions.

Thurber carried out the investigation as a sub-consultant to McCormick Rankin Corporation under the Ministry of Transportation Ontario (MTO) Agreement Number 6010-E-0011.

2 SITE DESCRIPTION

The site is located on Highway 594 approximately 75 m east of Griffith Road and 15 km west of Dryden in the Geographic Township of Aubrey, District of Kenora, Ontario.

Highway 594 at the bridge location is a two-lane surface treated roadway. The existing Beaver Creek Bridge has a total span of 18.9 m and is supported on four timber pile bents. Archive drawings indicate that the timber piles have lengths of 9 to 15 m. The approach embankments are in the order of 2.5 m high. Photographs of the site are presented in Appendix C.

The surrounding lands consist of a mix of grass and brush covered floodplain adjacent to the creek, heavily wooded areas, and occasional agricultural fields. The ground surface has a flat to gently undulating topography.

The site lies within the Canadian Shield, characterized by low, rounded hills of Pre-Cambrian bedrock mantled by varying thicknesses of overburden. At this site, the overburden primarily consists of glaciolacustrine silts and clays. The thickness of this geologic stratum is in the order of 30 m. The bedrock comprises a metasedimentary granitic complex of the Ghost Lake Batholith.

3 SITE INVESTIGATION AND FIELD TESTING

The site investigation and field testing for this project were carried out during the period June 1 to 24, 2011. Six sampled boreholes were drilled at the site: four boreholes (BCB-2 to BCB-5) were advanced adjacent to the existing bridge abutments to depths of 27.3 to 32.2 m (bedrock/probable bedrock), and two boreholes (BCB-1 and BCB-6) were drilled in the approaches 20 m from the abutments to a depth of 11.9 m. Two of the abutment boreholes were advanced a further 3.1 to 3.4 m into bedrock by rock coring.

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

Hollow stem augers and wash-boring with casing were used to advance the boreholes. Samples were obtained at selected intervals using a 50 mm diameter split spoon sampler in conjunction with Standard Penetration Testing (SPT). In situ vane shear testing was carried out using an MTO 'N' vane to evaluate the undrained shear strength of the cohesive deposits.

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.

Groundwater conditions in the open boreholes were observed throughout the drilling operations. Where artesian conditions were encountered, drill casing was extended above the ground surface to measure the pressure head. Standpipe piezometers were not installed due to the artesian conditions and the locations of the boreholes within the roadway. The boreholes were backfilled with bentonite, cement and auger cuttings upon completion. The borehole completion details are shown in Table 3.1.

Table 3.1 – Borehole Decommissioning Details

Borehole	Completion Details
BCB-1	Portland cement from 11.9 to 0.1m, then cold patch asphalt to surface.
BCB-2	Bentonite from 35.3 to 24.3m, sand from 24.3 to 21.3m, auger cuttings from 21.3 to 9.1m, bentonite from 9.1 to 0.1m, then cold patch asphalt to surface.
BCB-3	Peltonite from 32.2 to 30.5m, cement from 30.5 to 25.2m, auger cuttings from 25.2 to 9.1m, bentonite from 9.1 to 6.0m, cement from 6.0 to 1.5m, sand and gravel from 1.5 to 0.2m, then cold patch asphalt surface.
BCB-4	Cement from 28.0 to 24.1m, bentonite from 24.1 to 19.2m, auger cuttings from 19.2 to 9.4m, bentonite from 9.4 to 4.3m, sand and gravel from 4.3 to 0.2m, then cold patch asphalt to surface.
BCB-5	Bentonite from 30.7 to 24.3m, auger cuttings from 24.3 to 6.1m, bentonite from 6.1 to 0.1m, then cold patch asphalt to surface.
BCB-6	Portland cement from 11.9 to 0.1m, then cold patch asphalt to surface.

4 LABORATORY TESTING

The recovered soil samples were subjected to Visual Identification (VI) and to natural moisture content determination. Selected samples were also subjected to grain size distribution analyses (sieve and hydrometer) and Atterberg Limits testing where appropriate. The results of this testing program are shown on the Record of Borehole sheets in Appendix A and on the figures contained in Appendix B.

Point load testing was conducted on rock core samples retrieved from the boreholes. The results of the point load tests are shown on the borehole logs in Appendix A.

5 DESCRIPTION OF SUBSURFACE CONDITIONS

Reference is made to the Record of Borehole sheets in Appendix A for details of the encountered soil stratigraphy. A stratigraphic profile is presented on the Borehole Locations and Soil Strata Drawing in Appendix D, for illustrative purposes. Overall descriptions of the stratigraphy are given in the following paragraphs. However, the factual data presented in the Record of Borehole Sheets governs any interpretation of the site conditions. It must be recognized that soil conditions may vary between and beyond borehole locations.

The soil stratigraphy encountered at the borehole locations typically consists of a roadway pavement structure overlying silty clay fill (embankment fill), underlain by a deep deposit of silty clay. The silty clay is underlain by a discontinuous sand/gravel/silt layer and bedrock.

More detailed descriptions of the individual strata are presented below.

5.1 Pavement Structure

A pavement structure consisting of 13 to 25 mm of asphaltic surface treatment over sand to sand and gravel fill was encountered in all boreholes. The sand/gravel extended to depths of 1.0 to 1.3 m (Elev. 346.8 to 347.3 m).

SPT 'N' values obtained in the lower portion of the sand/gravel fill ranged from 8 to 16 blows/0.3 m penetration, indicating a loose to compact condition. Moisture contents typically varied from 2 to 5%, with one value of 19% from Borehole BCB-1.

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

Gravel %	20 to 38
Sand %	52 to 65
Silt & Clay %	10 to 15

5.2 Silty Clay Fill

A layer of silty clay fill was encountered below the pavement structure in all boreholes except Borehole BCB-1. The fill was variously described as brown, dark brown and blackish brown, and contained wood fibres and organics. In Borehole BCB-3, a 200 mm thick layer of organics was encountered at the base of the fill.

The thickness of the silty clay fill was 0.4 to 2.0 m. The depth to the base of the silty clay fill ranged from 1.6 to 3.1 m (Elev. 345.3 to 346.7 m).

The consistency of the cohesive fill was firm to stiff, based on SPT 'N' values ranging from 6 to 12 blows/0.3 m. The moisture content varied from 23 to 35%. A moisture content of 4% was obtained in a sample with mixed sand and gravel in Borehole BCB-3.

5.3 Silty Clay

Native silty clay was encountered below the pavement structure in Borehole BCB-1 and below the clay fill in the remaining boreholes. The upper 0.7 to 2.3 m of the clay typically contained wood fibres, rootlets and other organic material, and the colour varied between grey, dark grey, dark brown and brown. Below this depth, the clay was grey, with a reddish brown zone between approximate depths of 14.7 and 17.8 m.

The thickness of the silty clay deposit ranged from 21.9 to 26.6 m. The lower boundary was at depths of 25.0 to 28.9 m (Elev. 319.4 to 323.4 m). Boreholes BCB-1 and BCB-6 were terminated in the silty clay at 11.9 m depth (Elev. 336.1 to 336.4 m).

SPT 'N' values obtained in the silty clay generally decreased with depth in the upper 1.0 to 4.0 m of this deposit, ranging from 14 blows/0.3 m to 1 blow/0.3 m, indicating a stiff to very soft consistency. Below approximately 5.5 m depth (4.0 m in Borehole BCB-5), the sampling equipment generally sank under self-weight, resulting in 'N' values of zero.

The undrained shear strength determined by in situ vane testing typically ranged from 18 to 46 kPa, indicating a soft to firm consistency. Shear strengths of 60 to 90 kPa (stiff) were measured below about 15 m depth in Boreholes BCB-2 and BCB-5 and at about 27 m depth in Borehole BCB-3. The apparent increase in shear strength with depth measured by vane testing in Boreholes BCB-2 and BCB-5 is not consistent with the recorded 'N' values and tactile descriptions.

Moisture contents in the silty clay ranged from 25 to 44% in samples obtained from within 3 to 5 m below the ground surface. Below this depth, the moisture contents ranged from 50 to 89%. A single value of 18% was measured at 26.2 m depth in Borehole BCB-3.

The results of grain size distribution analyses conducted on samples of the silty clay are presented on the Record of Borehole sheets and on Figures B2 to B5 of Appendix B. The results of Atterberg Limits testing are plotted on the logs and on Figures B8 to B10. A summary follows:

	<u>In upper 0.7 to 2.3 m</u>	<u>Remainder</u>
Gravel %	0	0
Sand %	4 to 10	0 to 1
Silt %	35 to 42	16 to 38
Clay %	48 to 61	61 to 84
Liquid Limit	56	44 to 70
Plastic Limit	29	21 to 26

The results of the laboratory testing indicate that the silty clay is typically of high plasticity with a designation of CH. Two tested samples from Borehole BCB-5 indicated medium plasticity (CI).

5.4 Sand to Gravelly Sand

A layer of sand to gravelly sand was encountered below the silty clay in Boreholes BCB-2, BCB-3 and BCB-5 at depths of 25.0 to 28.9 m (Elev. 319.4 to 323.4 m). The sand layer was 2.1 to 3.4 m thick with a lower boundary at depths of 27.1 to 32.2 m (Elev. 316.0 to 321.3 m). In Borehole BCB-5, a 200 mm thick layer of cobbles and gravel was encountered at the base of the sand layer.

SPT 'N' values in the sand ranged from 15 to 20 blows/0.3 m, indicating a compact relative density. 'N' values of 50 blows for 50 to 125 mm of penetration were obtained at the surface of the underlying bedrock in Boreholes BCB-2 and BCB-3. The moisture contents varied from 12 to 21%.

Grain size distribution curves for the sand are presented on the Record of Borehole sheets and on Figure B6 of Appendix B. The results of the laboratory tests are summarized as follows:

Gravel %	3 to 28
Sand %	53 to 84
Silt & Clay %	13 to 19

5.5 Silt

A layer of silt was encountered below the silty clay in Borehole BCB-4 at 26.3 m depth (Elev. 322.1 m). The silt layer was 1.7 m thick with a lower boundary at 28.0 m depth (Elev. 320.4 m).

An SPT 'N' value of 9 blows/0.3 m was obtained at the upper boundary of the silt, indicating a loose condition. A moisture content of 22% was measured.

A grain size distribution curve for the silt is presented on the Record of Borehole sheet and on Figure B7 of Appendix B. The results of the laboratory tests are summarized as follows:

Gravel %	0
Sand %	6
Silt %	82
Clay %	12

5.6 Bedrock

Bedrock and probable bedrock were encountered below the sand and silt layers in Boreholes BCB-2 to BCB-5. The depths to bedrock proved by coring or inferred by auger refusal are summarized in Table 5.1.

Table 5.1 – Depth to Bedrock at Borehole Locations

Location	BH Number	Depth to Bedrock (m)	Top of Bedrock Elevation (m)	Cored/ Inferred
West Abutment	BCB-2	32.2	316.0	Cored
	BCB-3	32.2	316.1	Inferred
East Abutment	BCB-4	28.0	320.4	Inferred
	BCB-5	27.3	321.1	Cored

The bedrock recovered in the cores was described as dark grey granite. Core recovery was between 88 and 100%. RQD values ranged from 77 to 100% indicating good to excellent rock quality. The Fracture Index (FI) of the rock, expressed as fractures per 0.3 m of core, was generally less than 3.

The unconfined compressive strength of the rock, estimated from the results of point load tests conducted on the rock core samples, ranged between 78 and 134 MPa, indicating a strong to very strong intact rock. The point load test results are included on the borehole logs in Appendix A.

5.7 Water Levels

Groundwater was measured at 3.9 and 4.4 m depth in Boreholes BCB-1 and BCB-6 upon completion of drilling. An artesian groundwater condition was encountered in the sand, gravelly sand and silt layer underlying the silty clay deposit in Boreholes BCB-2 to BCB-5. The water levels measured in the open boreholes, referenced to the ground surface, are summarized in Table 5.2.

It is noted that in Borehole BCB-5, artesian water continued to flow from augers extended 1.8 m above the ground surface, and the full artesian head was not determined.

The water level in Beaver Creek was at Elev. 346.2 m in July 2011.

Table 5.2 – Water Level Measurements

Borehole	Date	Water Level (m)		Comment
		Depth	Elevation	
BCB-1	June 24, 2011	3.9	344.1	In open borehole
BCB-2	June 3, 2011	-3.1*	351.3*	In drill casing
BCB-3	June 21, 2011	-3.0*	351.3*	In drill casing
BCB-4	June 22, 2011	-2.7*	351.1*	In augers
BCB-5	June 2, 2011	-1.8*	>350.2*	Flowing from augers
BCB-6	June 24, 2011	4.4	343.9	In open borehole

*Indicates water level above ground surface, artesian conditions.

The above values are short-term readings and fluctuations of the groundwater level are to be expected subject to seasonal conditions and the water level in the creek. In particular, the groundwater level may be at a higher elevation after the spring snowmelt or after periods of heavy rainfall.

6 MISCELLANEOUS

The borehole locations were established in the field by Thurber Engineering. The coordinates and ground surface elevations at the boreholes were subsequently determined by MMM Group Limited survey personnel.

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

Eastern Ontario Diamond Drilling Ltd. supplied truck-mounted drilling equipment and conducted the drilling, sampling and in-situ testing operations for the boreholes drilled.

The field program was supervised on a full time basis by Ms. Eckie Siu of Thurber Engineering Ltd. Overall supervision of the field program was provided by Mr. Alastair E. Gorman, P.Eng. and Ms. Lindsey Blaine, E.I.T.

Interpretation of the data and preparation of the report was carried out by Mr. Murray R. Anderson, P.Eng. The report was reviewed by Dr. P.K. Chatterji, P.Eng. a Designated Principal Contact for MTO Foundations Projects.

Thurber Engineering Ltd.

Murray R. Anderson, P.Eng., M.Eng.
Senior Foundations Engineer



P.K. Chatterji, P.Eng., Ph.D.
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
 Shear Strength Determination by Pocket Penetrometer

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

UNIFIED SOILS CLASSIFICATION

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

EXPLANATION OF ROCK LOGGING TERMS

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.
		Weak	5.0 to 25.0	750 to 3,500	Can be peeled by a pocket knife with difficulty
		Very Weak	1.0 to 5.0	150 to 750	Can be peeled by a pocket knife, crumbles under firm blows of geological pick.
		Extremely Weak (Rock)	0.25 to 1.0	35 to 150	Indented by thumbnail

TERMS	
Total Core Recovery: (TCR)	Core recovered as a percentage of total core run length.
Solid Core Recovery: (SCR)	Percent Ratio of solid core of full cylindrical shape recovered. Expressed with respect to the total length of core run.
Rock Quality Designation: (RQD)	Total length of sound core recovered in pieces 0.1m in length or larger as a percentage of total core run length.
Uniaxial Compressive Strength (UCS)	Axial stress required to break the specimen
Fracture Index: (FI)	Frequency of natural fractures per 0.3m of core run.

RECORD OF BOREHOLE No BCB-1

1 OF 2

METRIC

W.P. 6047-08-00 LOCATION Beaver Creek Bridge N 5 516 406.4 E 301 298.6 ORIGINATED BY ES
 HWY 594 BOREHOLE TYPE Hollow Stem Augers/Casing COMPILED BY AN
 DATUM Geodetic DATE 2011.06.24 - 2011.06.24 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	20 40 60 80 100	PLASTIC LIMIT W _P	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	
348.0	ASPHALT: (25mm)		1	GS			348						
346.8	SAND and GRAVEL Brown Damp (FILL)		1	SS	12		347						
1.2	Silty CLAY, trace sand, organics, occasional wood fibres Stiff to Soft Brown to Dark Brown		2	SS	8		346						
	Dark Brown to Grey		3	SS	6		345						0 7 38 55
344.5			4	SS	2		344						
3.5	Silty CLAY, trace sand Very Soft Grey		5	SS	1		343						0 1 38 61
			6	SS	0		342						
			7	SS	0		341						
			8	SS	0		340						0 0 23 77
							339						

Continued Next Page

+³, X³: Numbers refer to
Sensitivity

20
15
10

(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No BCB-1

2 OF 2

METRIC

W.P. 6047-08-00 LOCATION Beaver Creek Bridge N 5 516 406.4 E 301 298.6 ORIGINATED BY ES
HWY 594 BOREHOLE TYPE Hollow Stem Augers/Casing COMPILED BY AN
DATUM Geodetic DATE 2011.06.24 - 2011.06.24 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		
	Continued From Previous Page						SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL X LAB VANE						
							WATER CONTENT (%) 20 40 60 80 100						
							PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT W _P W W _L						
336.1			9	SS	0	338							
11.9	END OF BOREHOLE AT 11.9m. WATER LEVEL AT 3.9m UPON COMPLETION. BOREHOLE BACKFILLED WITH PORTLAND CEMENT TO 0.07m, THEN ASPHALT TO SURFACE.					337							

+ 3, X 3: Numbers refer to
Sensitivity

20
15
10

(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No BCB-2

1 OF 4

METRIC

W.P. 6048-08-00 LOCATION Beaver Creek Bridge N 5 516 407.8 E 301 307.0 ORIGINATED BY ES
 HWY 11 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2011.06.02 - 2011.06.03 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	PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	
348.2	ASPHALT: (25mm)											
347.2	SAND and GRAVEL, trace silt Brown Moist (FILL)		1	GS			348					GR SA SI CL
1.0	Silty CLAY, some sand, trace gravel, trace rootlets Firm Brown (FILL)		1	SS	8		347					38 52 10 (SI+CL)
345.7			2	SS	6		346					
2.5	Silty CLAY, trace sand, occasional wood fibres, trace peat Firm to Soft Dark Grey		3	SS	6		345					0 10 42 48
343.6			4	SS	5		344					
4.6	Silty CLAY, trace sand Very Soft Grey		5	SS	2		343					
			6	SS	0		342					0 0 20 80
			7	SS	0		341					
			8	SS	0		340					
							339					

Continued Next Page

+³, ×³: Numbers refer to
Sensitivity

20
15
10

(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No BCB-2

2 OF 4

METRIC

W.P. 6047-08-00 LOCATION Beaver Creek Bridge N 5 516 407.8 E 301 307.0 ORIGINATED BY ES
HWY 594 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
DATUM Geodetic DATE 2011.06.02 - 2011.06.03 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 (%)				
	Continued From Previous Page											
	Silty CLAY Very Soft Grey		9	SS	0		338					
							337					
			1	TW			336					
			10	SS	0		335					
							334					
333.5 14.7			11	SS	0		333					
	Reddish Brown						332					
			12	SS	0		331					
330.5 17.8							330					
			13	SS	0		329					

Continued Next Page



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

RECORD OF BOREHOLE No BCB-2

3 OF 4

METRIC

W.P. 6047-08-00 LOCATION Beaver Creek Bridge N 5 516 407.8 E 301 307.0 ORIGINATED BY ES
 HWY 594 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2011.06.02 - 2011.06.03 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			WATER CONTENT (%)				
								○ UNCONFINED	+ FIELD VANE	● QUICK TRIAXIAL	x LAB VANE	w _p	w		
								20 40 60 80 100							
Continued From Previous Page															
	Silty CLAY Very Soft Grey		14	SS	0		328								
							327								
							326								
			15	SS	0		325								
							324								
							323								
			16	SS	0		322								
							321								
							320								
319.4							319								
28.8	SAND , trace gravel, some silt Compact Grey Wet		17	SS	15										

Continued Next Page

+³, ×³: Numbers refer to
Sensitivity

20
15
10

(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No BCB-2

4 OF 4

METRIC

W.P. 6047-08-00 LOCATION Beaver Creek Bridge N 5 516 407.8 E 301 307.0 ORIGINATED BY ES
HWY 594 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
DATUM Geodetic DATE 2011.06.02 - 2011.06.03 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			WATER CONTENT (%)				
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE			w _p w w _L				
								20 40 60 80 100	20 40 60						
	Continued From Previous Page														
316.0			18	SS	50/										
32.2	GRANITE, occasional quartz, strong, dark grey Sub-vertical fractures at 32.4m, 33.2m and 33.5m		1	RUN	0.125										
			2	RUN											
312.9															
35.3	END OF BOREHOLE AT 35.3m. ARTESIAN GROUND WATER WITH HEAD AT 3.1m ABOVE GROUND SURFACE AT THE COMPLETION OF BOREHOLE. BOREHOLE BACKFILLED WITH BENTONITE TO 24.3m, SAND TO 21.3m, CLAY CUTTINGS TO 9.1m, BENTONITE TO 0.04m, THEN ASPHALT TO SURFACE.														

RECORD OF BOREHOLE No BCB-3

1 OF 4

METRIC

W.P. 6048-08-00 LOCATION Beaver Creek Bridge N 5 516 402.6 E 301 306.8 ORIGINATED BY ES
 HWY 11 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2011.06.21 - 2011.06.21 CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			UNIT WEIGHT kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100				
								SHEAR STRENGTH kPa				
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE				
						WATER CONTENT (%)						
						PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT w _p w w _L						
348.3												
0.8	ASPHALT: (25mm)											
	SAND, some gravel Damp Brown (FILL)		1	GS			348					
347.1			1	SS	9							
1.1	Silty CLAY, some sand, trace gravel Stiff Brown (FILL)						347					
	With sand and gravel		2	SS	9							
346.1												
346.0	ORGANICS						346					
2.3	Dark Brown Damp		3	SS	6							
	Silty CLAY, trace sand, occasional wood fibres Firm Grey Damp											
			4	SS	7		345					
344.8												
3.5	Silty CLAY, trace sand Soft to Very Soft Grey						344					
			5	SS	2							
							343					
			6	SS	0		342					
							341					
			7	SS	0							
							340					
			8	SS	0		339					

Continued Next Page

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

RECORD OF BOREHOLE No BCB-3

3 OF 4

METRIC

W.P. 6047-08-00 LOCATION Beaver Creek Bridge N 5 516 402.6 E 301 306.8 ORIGINATED BY ES
HWY 594 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
DATUM Geodetic DATE 2011.06.21 - 2011.06.21 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	PLASTIC LIMIT W _P	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	
	Continued From Previous Page							SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE	WATER CONTENT (%) 20 40 60			
	Silty CLAY, trace sand Very Soft Grey		14	SS	0		328					
							327					
							326					
			15	SS	0		325					0 0 26 74
							324					
							323					
			16	SS	1		322					
							321					
							320					
319.4 28.9	Gravelly SAND, some silt Compact Grey Wet		17	SS	20		319					28 53 19 (SI+CL)

Continued Next Page

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

RECORD OF BOREHOLE No BCB-3

4 OF 4

METRIC

W.P. 6047-08-00 LOCATION Beaver Creek Bridge N 5 516 402.6 E 301 306.8 ORIGINATED BY ES
 HWY 594 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2011.06.21 - 2011.06.21 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					WATER CONTENT (%)				
							20	40	60	80	100	W _p	W	W _L			
	Continued From Previous Page																
317.8							318										
30.5	SAND, coarse grained, trace gravel Very Dense Brown Wet						317										
316.1			18	SS	50/							○					
32.2	END OF BOREHOLE AT 32.2m UPON REFUSAL TO AUGER ON PROBABLE BEDROCK. ARTESIAN GROUND WATER WITH HEAD AT 3.0m ABOVE GROUND SURFACE UPON COMPLETION. BOREHOLE BACKFILLED WITH PELTONITE FROM 32.2m TO 30.5m, CEMENT FROM 30.5m TO 25.2m, CUTTINGS FROM 25.2m TO 9.1m, HOLEPLUG FROM 9.1m TO 6.0m, CEMENT FROM 6.0m TO 1.5m, SAND AND GRAVEL FROM 1.5m TO 0.2m, THEN ASPHALT TO SURFACE.				0.050												

RECORD OF BOREHOLE No BCB-4

1 OF 3

METRIC

W.P. 6048-08-00 LOCATION Beaver Creek Bridge N 5 516 407.1 E 301 331.2 ORIGINATED BY ES
 HWY 11 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2011.06.22 - 2011.06.22 CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				UNIT WEIGHT Y kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																							
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																												
								20	40	60	80			100																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																						
348.4	ASPHALT: (25mm) SAND, some gravel, some silt Brown Damp (FILL)		1	GS																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																</

Continued Next Page

+³, ×³: Numbers refer to
Sensitivity

20
15 5
10 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No BCB-4

2 OF 3

METRIC

W.P. 6047-08-00 LOCATION Beaver Creek Bridge N 5 516 407.1 E 301 331.2 ORIGINATED BY ES
HWY 594 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
DATUM Geodetic DATE 2011.06.22 - 2011.06.22 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						
	Continued From Previous Page													
	Silty CLAY, trace sand Very Soft Grey		9	SS	0									
			10	SS	0									
			11	SS	0									
333.6 14.8														
	Reddish Brown		12	SS	0									
			13	SS	0									
330.6 17.8														
			14	SS	0									

Continued Next Page

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

RECORD OF BOREHOLE No BCB-4

3 OF 3

METRIC

W.P. 6047-08-00 LOCATION Beaver Creek Bridge N 5 516 407.1 E 301 331.2 ORIGINATED BY ES
 HWY 594 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2011.06.22 - 2011.06.22 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													
	Silty CLAY Very Soft Grey Wet		1	TW			328							
			15	SS	0		325							
322.1			16	SS	9									
26.3	SILT, some clay, trace sand Loose Grey Wet						322							
320.4														
28.0	END OF BOREHOLE AT 28.0m UPON REFUSAL TO AUGER ON PROBABLE BEDROCK. ARTESIAN GROUND WATER WITH HEAD AT 2.7m ABOVE GROUND SURFACE UPON COMPLETION. BOREHOLE BACKFILLED WITH CEMENT FROM 28.0m TO 24.1m, BENTONITE FROM 24.1m TO 19.2m, CUTTINGS FROM 19.2m TO 9.4m, BENTONITE FROM 9.4m TO 4.3m, SAND AND GRAVEL FROM 4.3m TO 0.15m, THEN ASPHALT TO SURFACE.													

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

RECORD OF BOREHOLE No BCB-5

1 OF 4

METRIC

W.P. 6048-08-00 LOCATION Beaver Creek Bridge N 5 516 402.7 E 301 330.8 ORIGINATED BY ES
 HWY 11 BOREHOLE TYPE Hollow Stem Augers/Casing COMPILED BY AN
 DATUM Geodetic DATE 2011.06.01 - 2011.06.02 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 (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa			WATER CONTENT (%)				
								○ UNCONFINED ● QUICK TRIAXIAL	+ FIELD VANE × LAB VANE						
348.4							20 40 60 80 100				20 40 60				GR SA SI CL
0.8	ASPHALT: (13mm)		1	GS											* Flowing from casing extended 1.8m above ground surface.
	SAND, some gravel, trace silt Brown Moist (FILL)														
347.3			1	SS	9										
1.1	Silty CLAY, trace sand, trace gravel, occasional burnt wood fibres Stiff to Firm Blackish Brown (FILL)		2	SS	12										
			3	SS	6										
345.3			4	SS	3										
3.1	Silty CLAY, trace sand Soft to Very Soft Grey		5	SS	0										0 1 26 73
			6	SS	0										
			1	TW											
			2	TW											
								</							

Continued Next Page

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

METRIC

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 C		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	SHEAR STRENGTH kPa			PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT	WATER CONTENT (%)
								UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE	P W P W L				
Continued From Previous Page													
	Silty CLAY Very Soft Grey Wet		7	SS	0						0 0 24 76		
			8	SS	0								
			9	SS	0								
333.7 14.7	Reddish Brown		10	SS	0								
			11	SS	0								
330.6 17.8			12	SS	0								

+³, ×³: Numbers refer to Sensitivity

ONTMT4S 1197.GPJ 8/30/11

METRIC

[illegible]

+ ³ × ³: Numbers refer to Sensitivity

ONTMT4S 1197.GPJ 9/9/11

RECORD OF BOREHOLE No BCB-5

4 OF 4

METRIC

W.P. 6047-08-00 LOCATION Beaver Creek Bridge N 5 516 402.7 E 301 330.8 ORIGINATED BY ES
HWY 594 BOREHOLE TYPE Hollow Stem Augers/Casing COMPILED BY AN
DATUM Geodetic DATE 2011.06.01 - 2011.06.02 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		3	RUN			318							
317.7														
30.7	END OF BOREHOLE AT 30.7m. ARTESIAN GROUND WATER CONDITION WITH HEAD GREATER THAN 1.8m ABOVE GROUND SURFACE UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE TO 24.3m, CUTTINGS TO 6.1m, BENTONITE TO 0.04m, THEN ASPHALT TO SURFACE.													

+³, X³: Numbers refer to
Sensitivity

20
15
10

(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No BCB-6

1 OF 2

METRIC

W.P. 6047-08-00 LOCATION Beaver Creek Bridge N 5 516 406.0 E 301 338.9 ORIGINATED BY ES
 HWY 594 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2011.06.24 - 2011.06.24 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	PLASTIC LIMIT W _P	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L		
348.3	ASPHALT: (25mm)												
347.1	SAND, some gravel Brown Damp (FILL)		1	GS			348						
1.2	Silty CLAY, some sand, trace gravel Stiff		1	SS	16		347						
346.7	Brown (FILL)												
1.6	Silty CLAY, some sand, trace rootlets Stiff		2	SS	14		346						
346.0	Grey												
2.3	Silty CLAY, trace sand Stiff to Very Soft Grey		3	SS	10		345						
			4	SS	4		344						
			5	SS	5		343						
			6	SS	0		342						
			7	SS	0		341						
			8	SS	0		340						
							339						


Continued Next Page

+ ³ , × ³ : Numbers refer to
Sensitivity

20
15
10
(%) STRAIN AT FAILURE

METRIC

W.P.	6047-08-00	LOCATION	Beaver Creek Bridge N 5 516 406.0 E 301 338.9	ORIGINATED BY	ES
HWY	594	BOREHOLE TYPE	Hollow Stem Augers	COMPILED BY	AN
DATUM	Geodetic	DATE	2011.06.24 - 2011.06.24	CHECKED BY	RPR

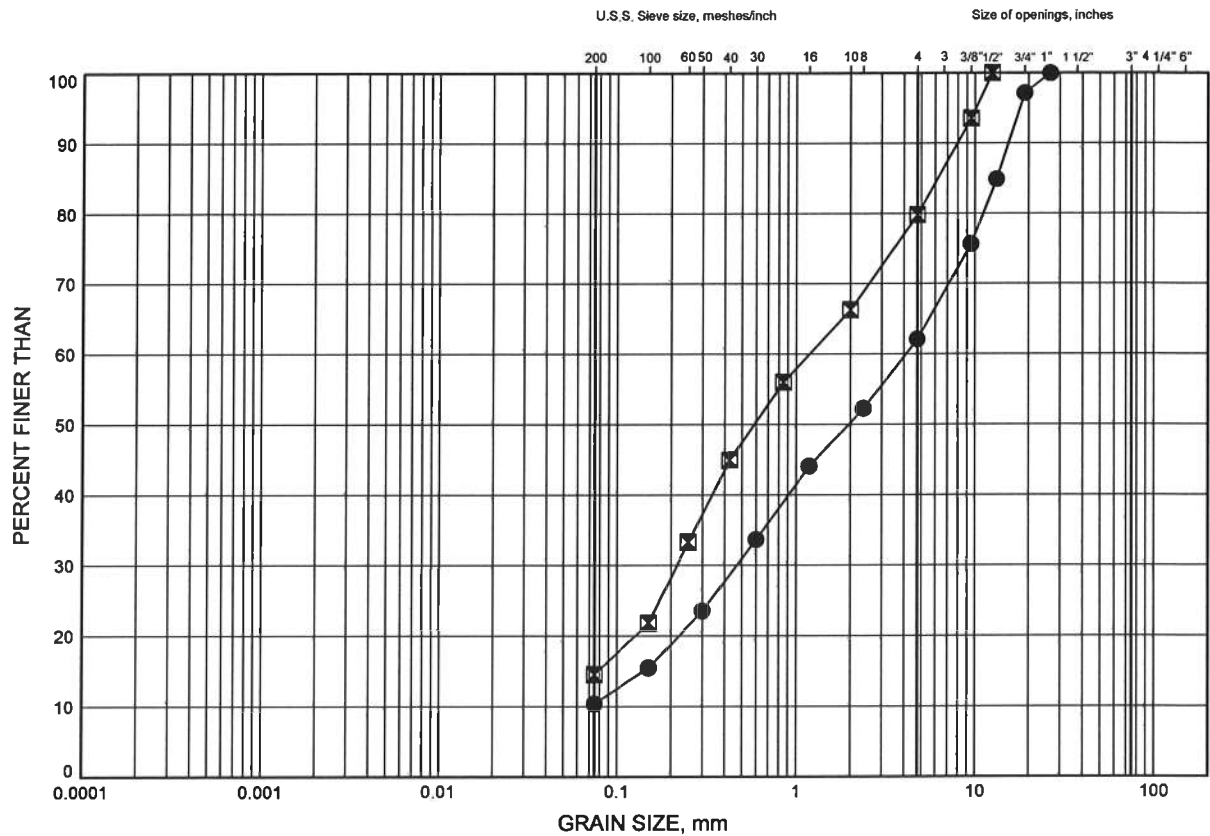
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa			WATER CONTENT (%)				
								20 40 60 80 100	20 40 60 80 100	20 40 60					
	Continued From Previous Page														
336.4	Silty CLAY , trace sand Very Soft Grey		9	SS	0		336								0 0 18 82
11.9	END OF BOREHOLE AT 11.9m. WATER LEVEL AT 4.4m UPON COMPLETION. BOREHOLE BACKFILLED WITH PORTLAND CEMENT TO 0.1m, THEN ASPHALT TO SURFACE.						337								

Appendix B
Laboratory Test Results

NWR 32 Rehab GRAIN SIZE DISTRIBUTION

FIGURE B1

SAND and GRAVEL FILL



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	BCB-2	0.46	347.76
⊠	BCB-4	1.07	347.35

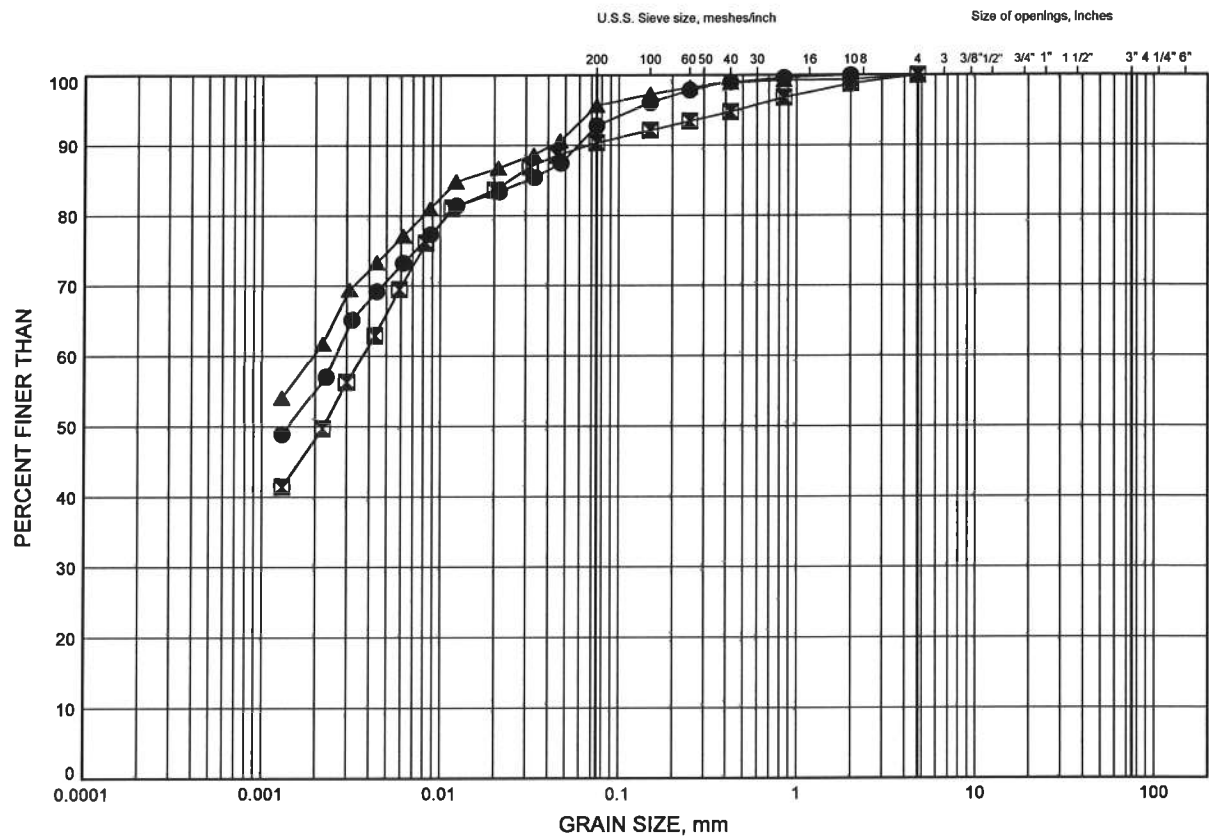


W.P.# 6047-08-00
Prepared By AN
Checked By MRA

NWR 32 Rehas GRAIN SIZE DISTRIBUTION

FIGURE B2

SILTY CLAY



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	BCB-1	2.59	345.39
⊠	BCB-2	2.51	345.71
▲	BCB-3	2.59	345.67

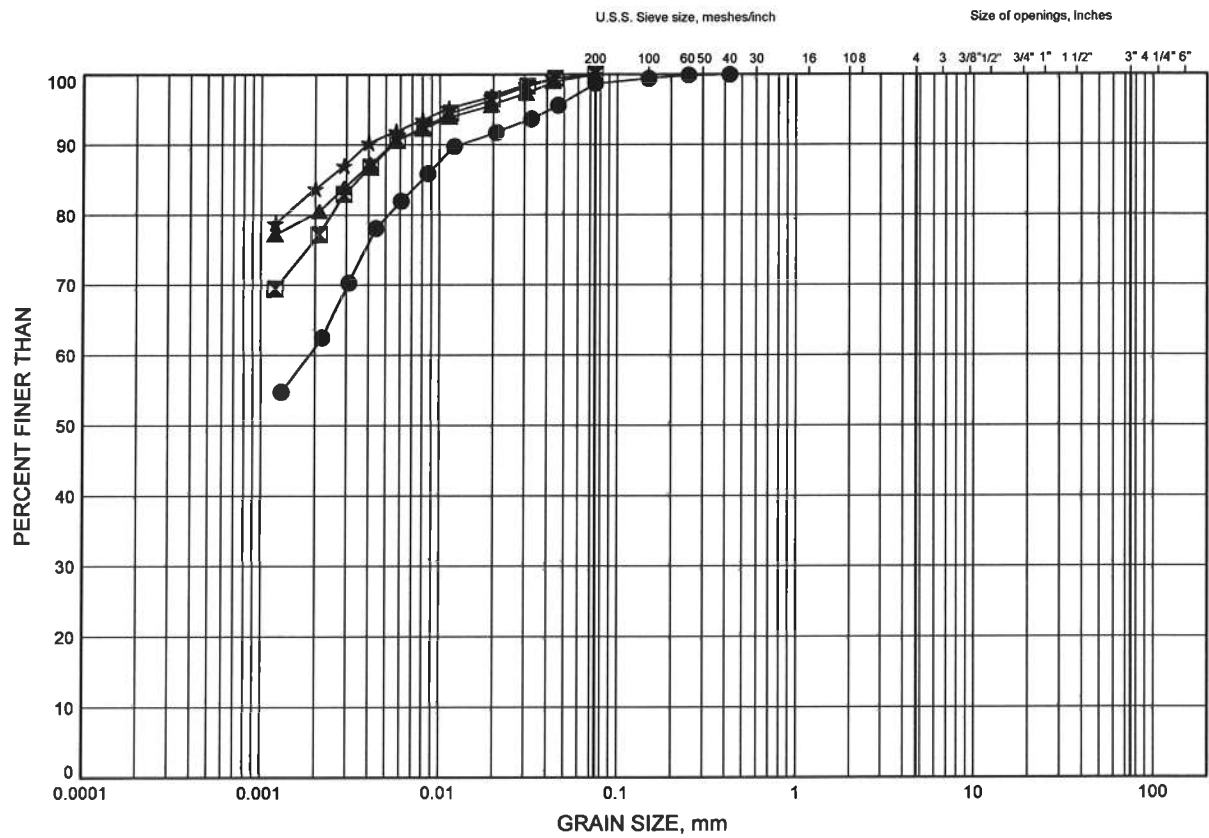


W.P.# 6047-08-00
Prepared By AN
Checked By MRA

NWR 32 Rehabs GRAIN SIZE DISTRIBUTION

FIGURE B3

SILTY CLAY



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	BCB-1	4.88	343.11
⊠	BCB-1	7.92	340.06
▲	BCB-2	6.32	341.90
★	BCB-2	16.99	331.23

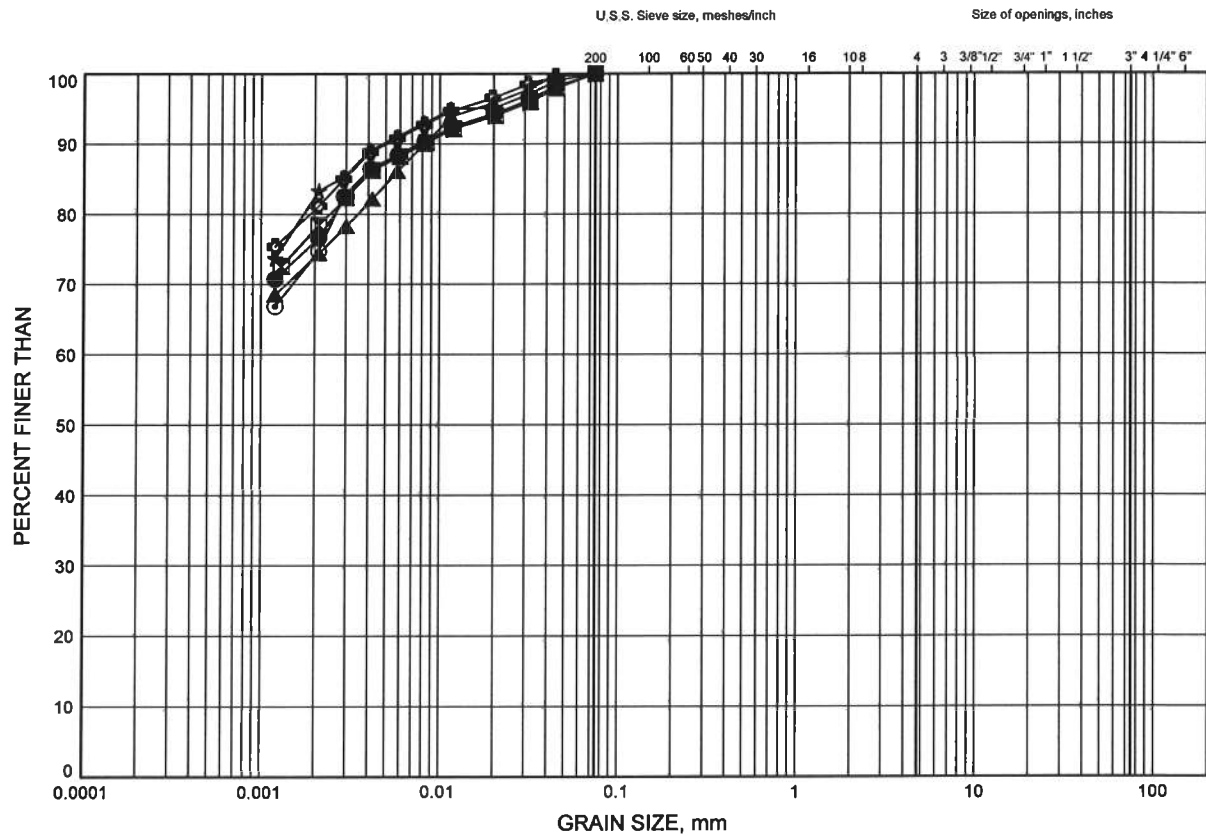


W.P.# 6047-08-00
Prepared By AN
Checked By MRA

NWR 32 Rehas GRAIN SIZE DISTRIBUTION

FIGURE B4

SILTY CLAY



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	BCB-3	12.50	335.76
⊠	BCB-3	15.54	332.71
▲	BCB-3	23.16	325.09
★	BCB-4	6.40	342.02
⊙	BCB-4	14.02	334.40
⊕	BCB-4	18.59	329.82



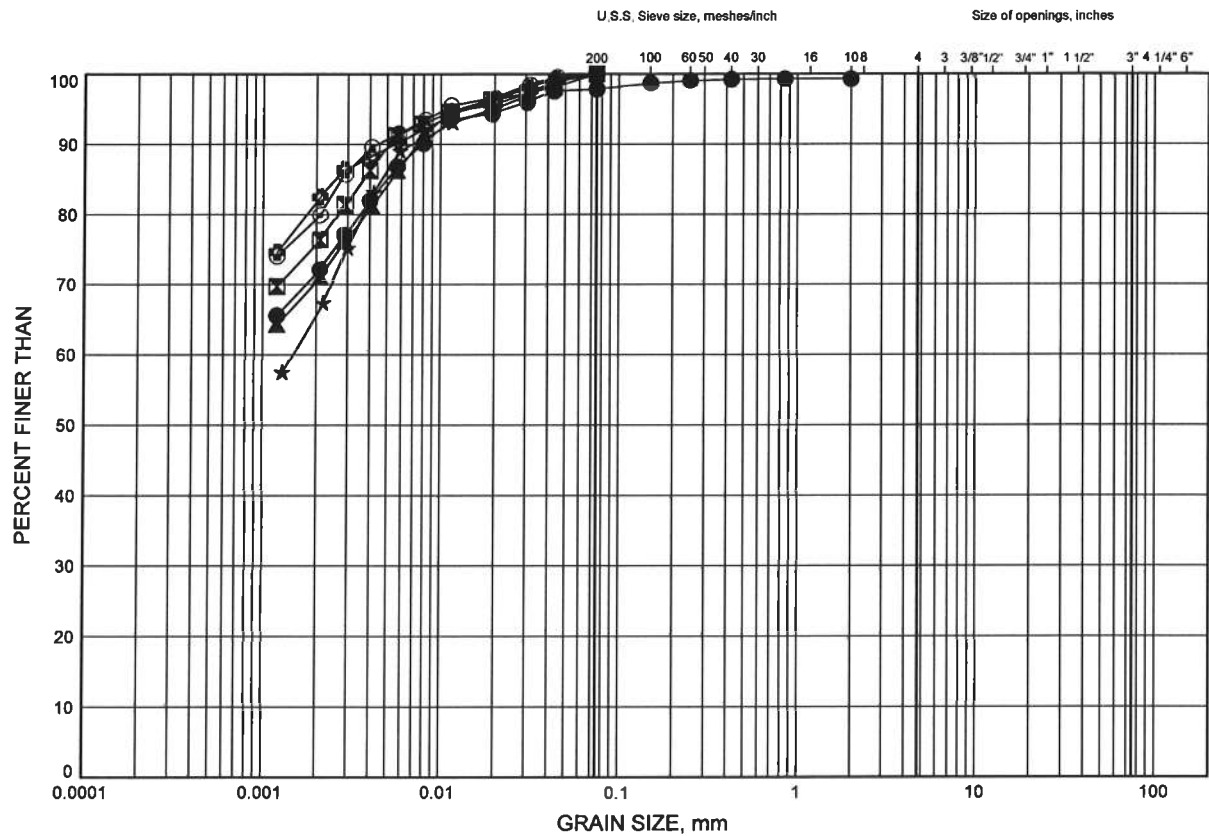
W.P.# 6047-08-00
Prepared By AN
Checked By MRA

NWR 32 Rehas

GRAIN SIZE DISTRIBUTION

FIGURE B5

SILTY CLAY



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	BCB-5	3.28	345.13
⊠	BCB-5	10.97	337.43
▲	BCB-5	20.04	328.36
★	BCB-6	2.59	345.73
⊙	BCB-6	6.40	341.92
⊕	BCB-6	10.97	337.34



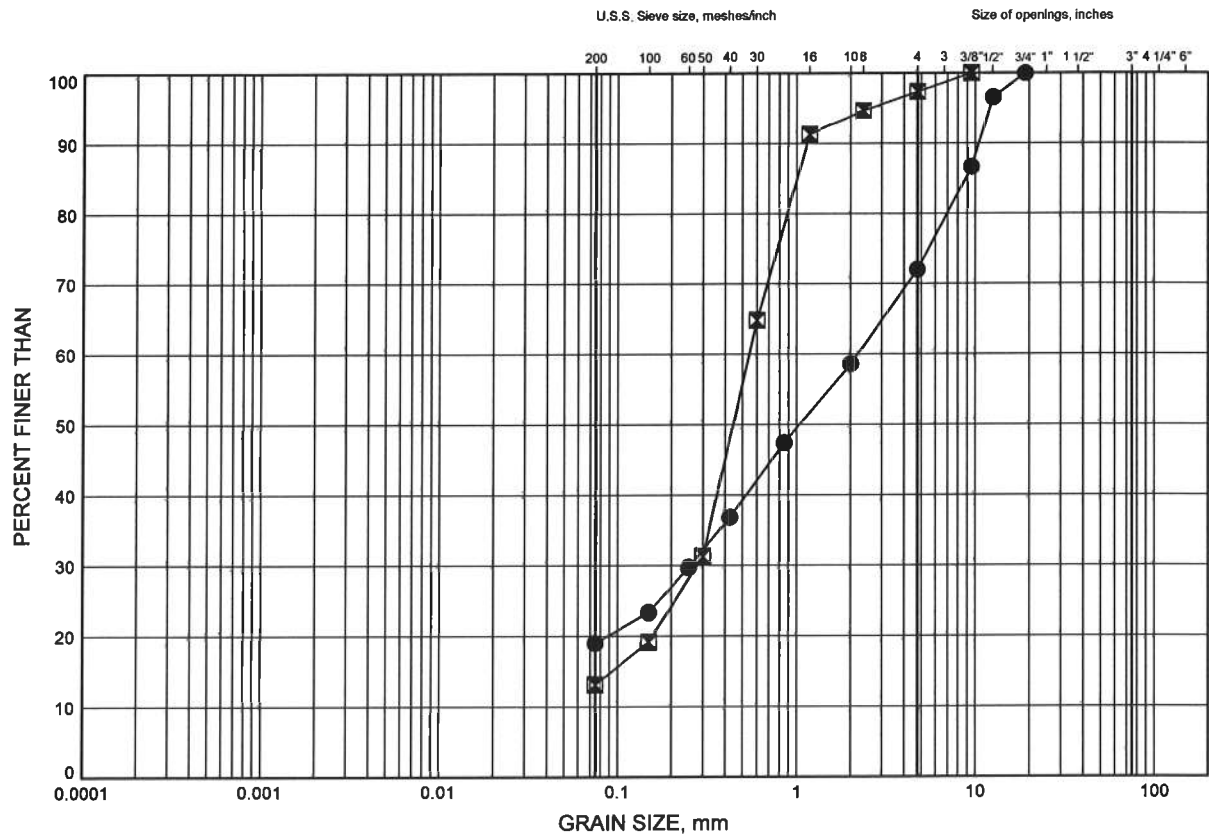
W.P.# 6047-08-00
 Prepared By AN
 Checked By MRA

NWR 32 Rehas

GRAIN SIZE DISTRIBUTION

FIGURE B6

SAND to GRAVELLY SAND



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	BCB-3	29.26	319.00
⊠	BCB-5	26.75	321.66

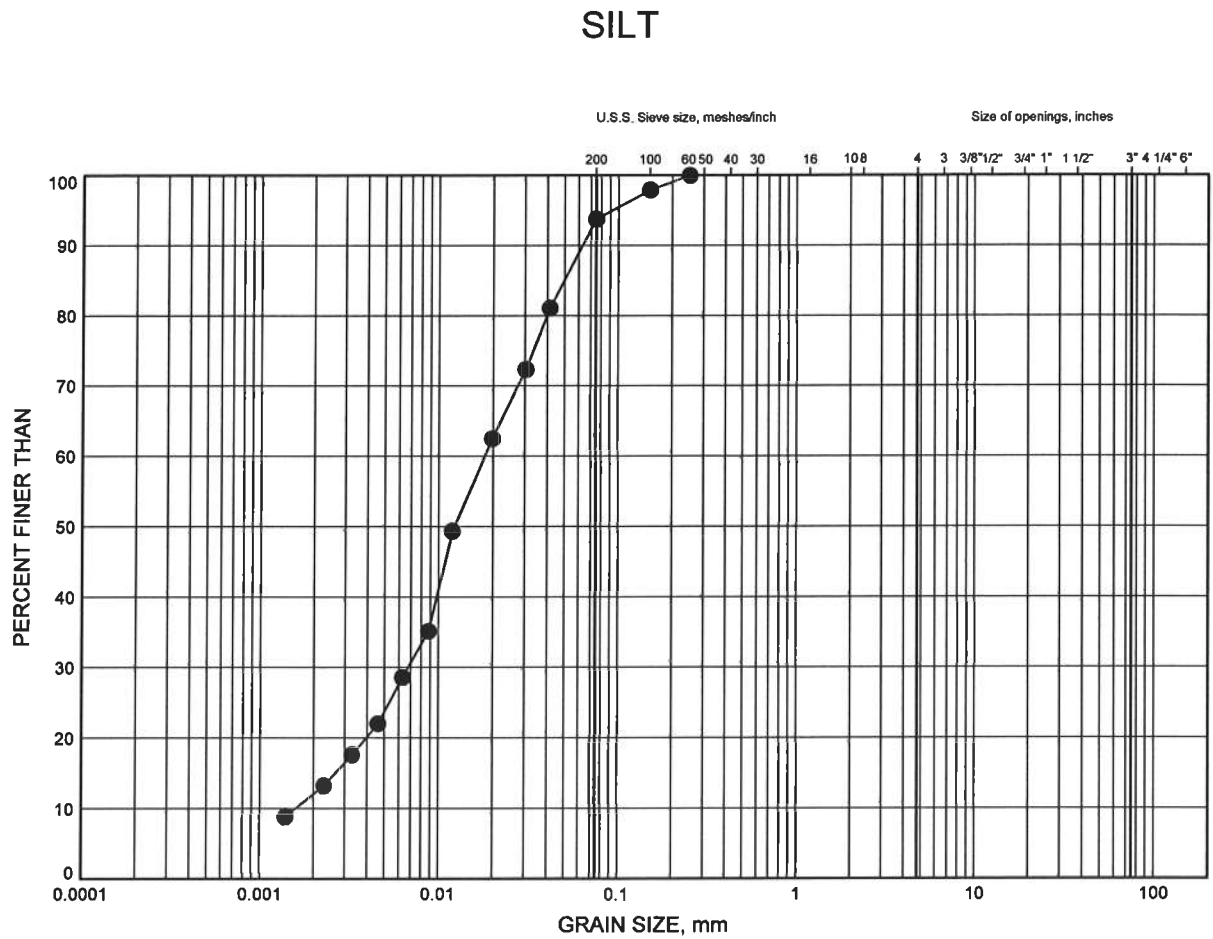


W.P.# 6047-08-00
 Prepared By AN
 Checked By MRA

NWR 32 Rehas

GRAIN SIZE DISTRIBUTION

FIGURE B7



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	BCB-4	26.21	322.20

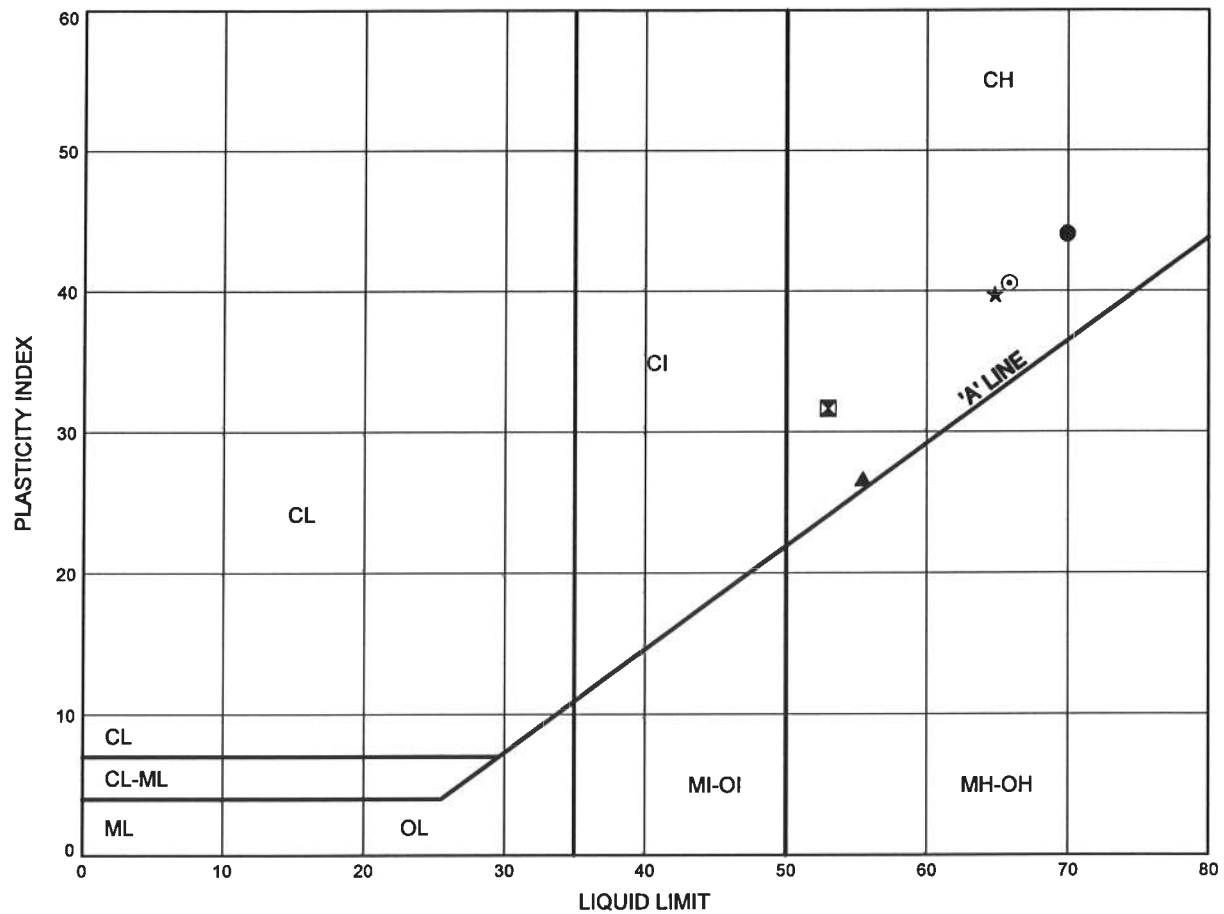


W.P.# 6047-08-00
 Prepared By AN
 Checked By MRA

NWR 32 Rehabs
ATTERBERG LIMITS TEST RESULTS

FIGURE B8

SILTY CLAY



SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	BCB-1	4.88	343.11
⊠	BCB-1	7.92	340.06
▲	BCB-2	2.51	345.71
★	BCB-2	6.32	341.90
⊙	BCB-2	16.99	331.23

Date September 2011
 Project 6047-08-00

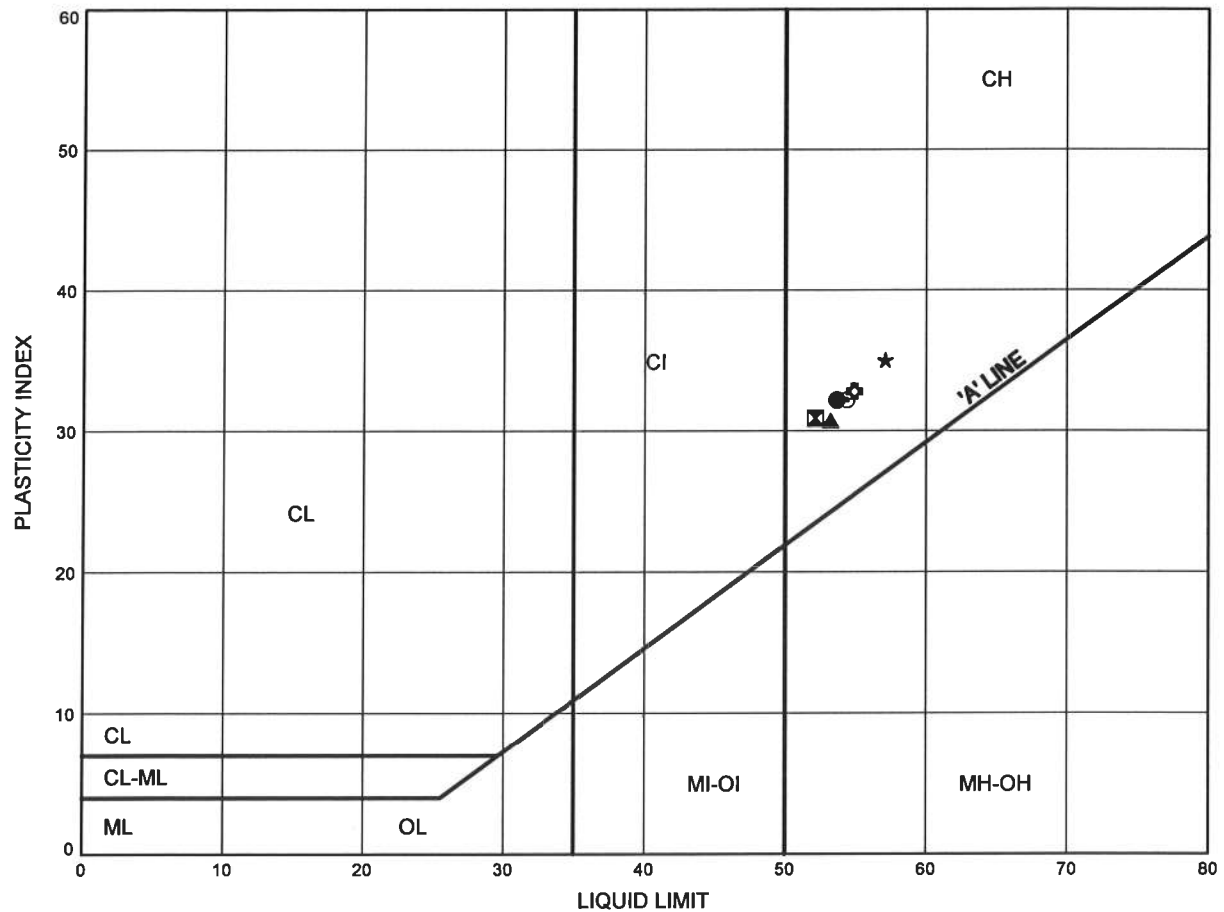


Prep'd AN
 Chkd. MRA

NWR 32 Rehabs
ATTERBERG LIMITS TEST RESULTS

FIGURE B9

SILTY CLAY



SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	BCB-3	12.50	335.76
⊠	BCB-3	15.54	332.71
▲	BCB-3	23.16	325.09
★	BCB-4	6.40	342.02
⊙	BCB-4	14.02	334.40
⊕	BCB-4	18.59	329.82

Date September 2011
 Project 6047-08-00

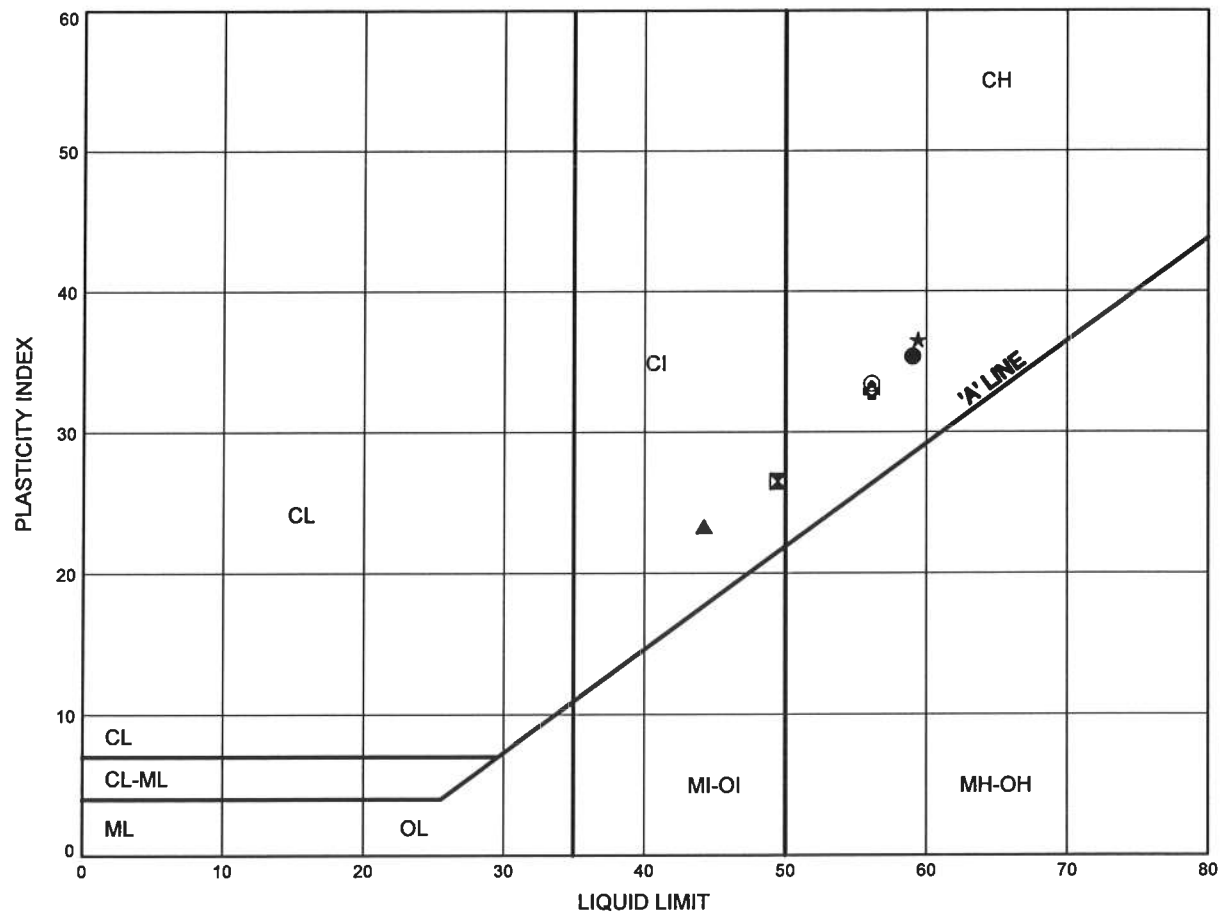


Prep'd AN
 Chkd. MRA

NWR 32 Rehabs
ATTERBERG LIMITS TEST RESULTS

FIGURE B10

SILTY CLAY



SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	BCB-5	3.28	345.13
⊠	BCB-5	10.97	337.43
▲	BCB-5	20.04	328.36
★	BCB-6	2.59	345.73
⊙	BCB-6	6.40	341.92
⊕	BCB-6	10.97	337.34

Date September 2011
 Project 6047-08-00



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 Chkd. MRA

Appendix C
Photographs



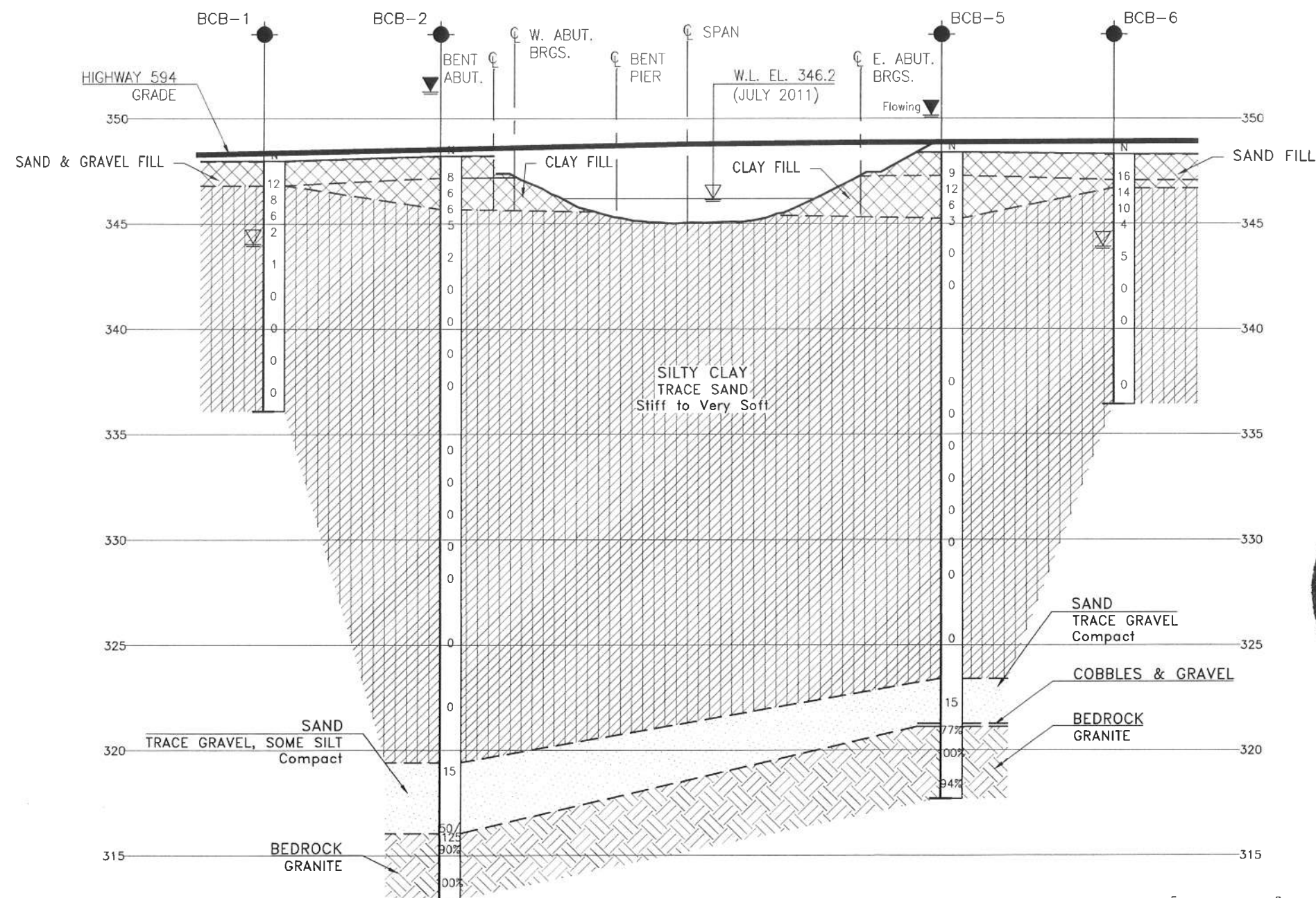
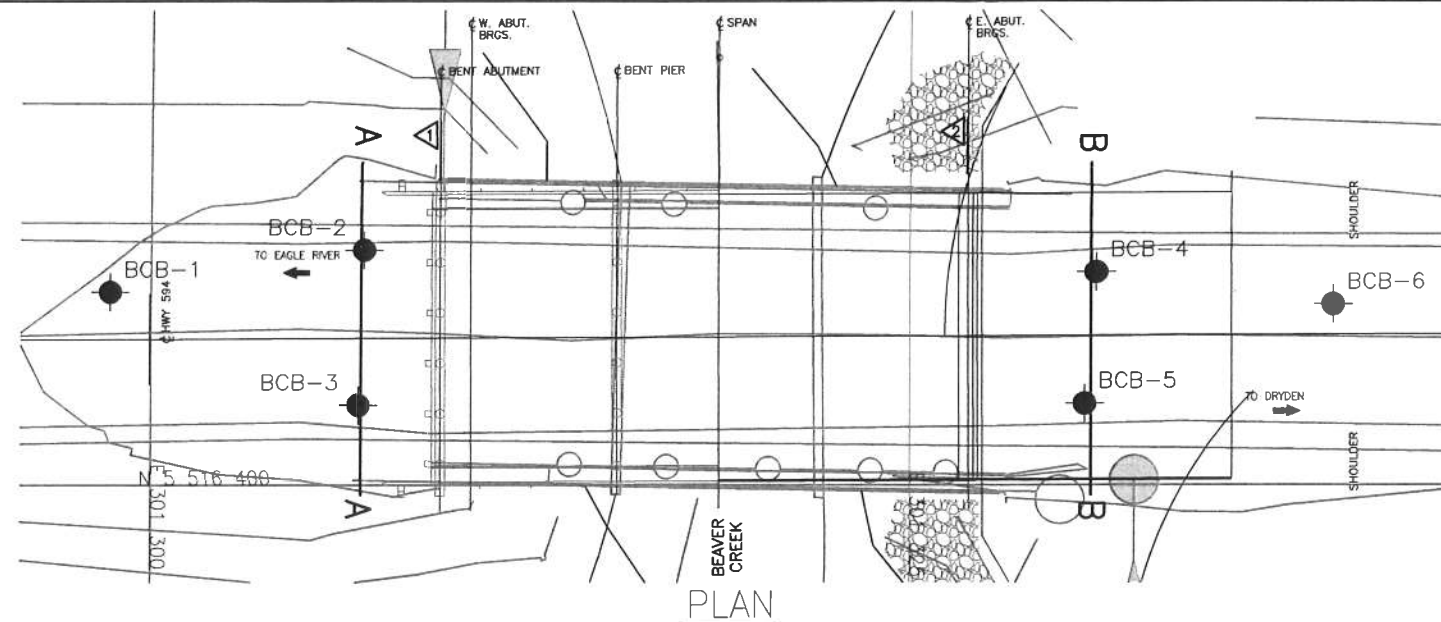
Photograph 1: Beaver Creek Bridge looking east.



Photograph 2: South side of Beaver Creek Bridge.

Appendix D

Drawing titled “Borehole Locations and Soil Strata”



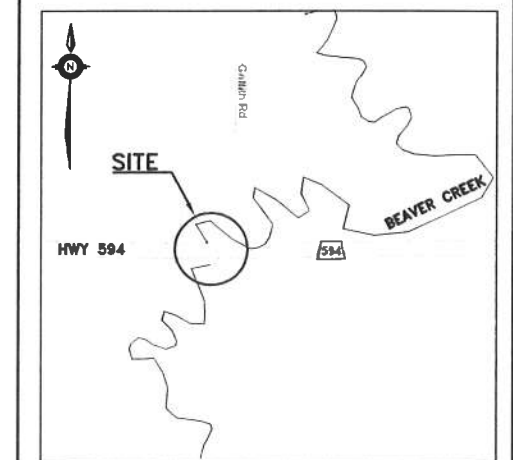
METRIC
DIMENSIONS ARE IN METRES
AND/OR MILLIMETRES
UNLESS OTHERWISE SHOWN

CONT No
WP No 6047-08-00

BEAVER CREEK BRIDGE
REPLACEMENT HWY 594
BOREHOLE LOCATIONS AND SOIL STRATA

MRC McCORMICK RANKIN
CORPORATION

THURBER ENGINEERING LTD.



LEGEND

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

NO	ELEVATION	NORTHING	EASTING
BCB-1	348.0	5 516 406.4	301 298.6
BCB-2	348.2	5 516 407.8	301 307.0
BCB-3	348.3	5 516 402.6	301 306.8
BCB-4	348.4	5 516 407.1	301 331.2
BCB-5	348.4	5 516 402.7	301 330.8
BCB-6	348.3	5 516 406.0	301 338.9

NOTES

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

GEOCRES No. 52F-35



REVISIONS	DATE	BY	DESCRIPTION
DESIGN	MRA	CHK	MRA
DRAWN	AN	CHK	SITE
LOAD	DATE	FEB. 2012	
STRUCT	DWG	1	



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

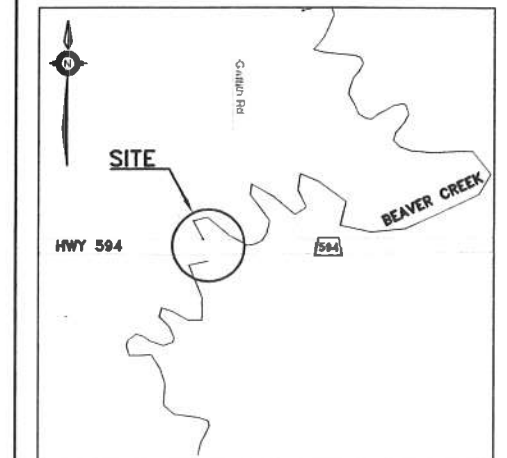
CONT No
WP No 6047-08-00

BEAVER CREEK BRIDGE
REPLACEMENT HWY 594
BOREHOLE LOCATIONS AND SOIL STRATA

SHEET

MRC McCORMICK RANKIN
CORPORATION

THURBER ENGINEERING LTD.



KEYPLAN LEGEND

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

NO	ELEVATION	NORTHING	EASTING
BCB-1	348.0	5 516 406.4	301 298.6
BCB-2	348.2	5 516 407.8	301 307.0
BCB-3	348.3	5 516 402.6	301 306.8
BCB-4	348.4	5 516 407.1	301 331.2
BCB-5	348.4	5 516 402.7	301 330.8
BCB-6	348.3	5 516 406.0	301 338.9

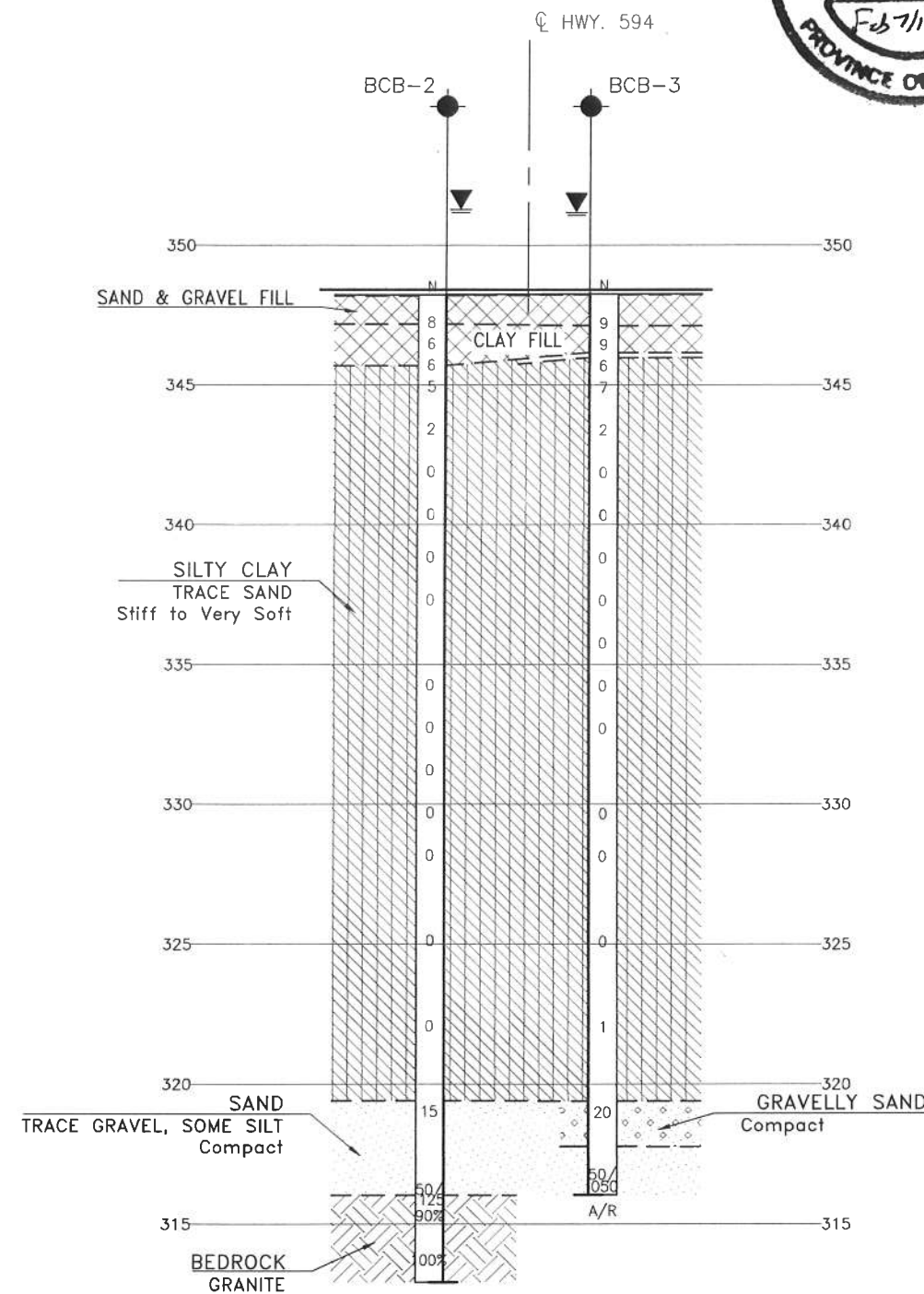
-NOTES-

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

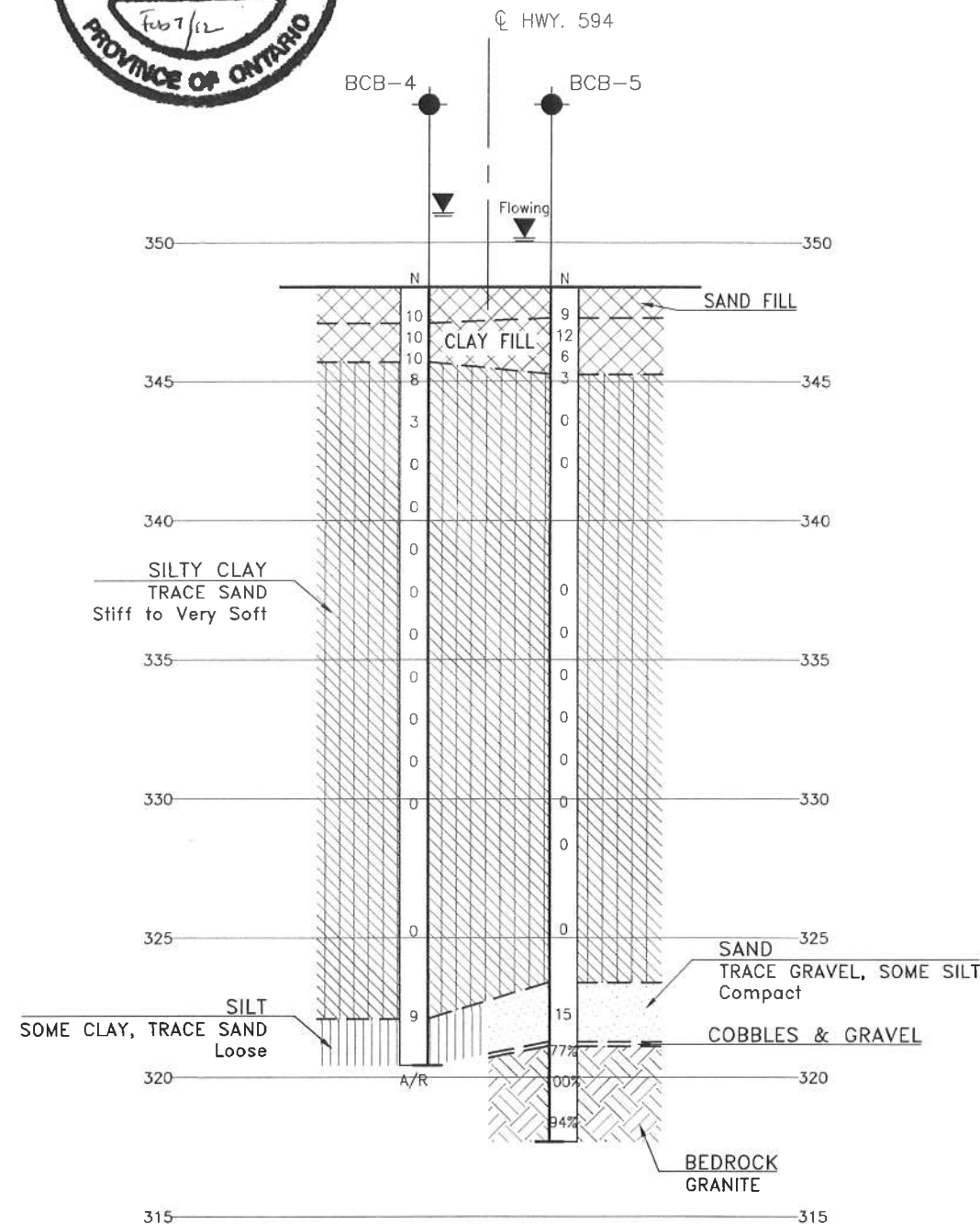
GEOCRES No. 52F-35

REVISIONS	DATE	BY	DESCRIPTION
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DRAWN	AN	CHK	SITE
LOAD			
STRUCT			
DWG	2		
DATE	FEB.	2012	

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SECTION A-A



SECTION B-B