

**FOUNDATION INVESTIGATION REPORT
REPLACEMENT OF LITTLE GRASSY RIVER BRIDGE AT YONGEBERG
HIGHWAY 600
DISTRICT OF RAINY RIVER, ONTARIO**

G.W.P. 490-00-00, SITE NO: 45-11

Geocres Number: 52D-15

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

February 13, 2014
File: 19-1605-121

H:\19\1605\121 Bridge & Culvert Rehabs NWR\Reports &
Memos\Little Grassy Yongeberg\04 FINAL FIR\LITTLE
GRASSY YONGEBERG - FINAL FIR.doc

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	Asphalt.....	4
5.2	Embankment Fill	4
5.3	Silty Clay	5
5.4	Sand	5
5.5	Bedrock.....	6
5.6	Water Levels.....	6
6	MISCELLANEOUS.....	8

Appendices

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

FOUNDATION INVESTIGATION REPORT
REPLACEMENT OF LITTLE GRASSY RIVER BRIDGE AT YONGEBERG
HIGHWAY 600
DISTRICT OF RAINY RIVER, ONTARIO

G.W.P. 490-00-00, SITE NO: 45-11

Geocres Number: 52D-15

PART 1: FACTUAL INFORMATION

1 INTRODUCTION

This report presents the factual findings obtained from a foundation investigation conducted at the Little Grassy River Bridge on Highway 600 at Yongeberg, in the District of Rainy River, 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, a stratigraphic profile, laboratory test results and written descriptions 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 Little Grassy River Bridge at Yongeberg is located on Highway 600 approximately 1.4 km east of Highway 621, approximately 7 km southeast of Lake of the Woods and 25 km north of Highway 11. The existing bridge is a seven-span structure supported on timber pile foundations. The bridge is approximately 46.4 m long and 8.5 m wide. The east and west approach embankments are approximately 3.0 and 1.5 m high, respectively.

The section of the Little Grassy River at the bridge site comprises the east branch of the river, and flows northerly under the bridge before joining the main river flowing northwesterly towards Lake of the Woods. The surrounding lands are relatively flat and comprise farmland with occasional small trees, tree lots and dwellings.

Photographs in Appendix C show the general nature of the site and the existing structure.

The site lies within the physiographic region known as the Wabigoon Subprovince of the Superior Province of the Canadian Shield. The site is underlain by intermediate to felsic intrusive rocks. The bedrock is overlain by glaciolacustrine fine-grained deposits of silt and clay with minor sand. Modern alluvial deposits consisting of fine sand, silt and clay with detrital organic remains underlie the river channels.

3 SITE INVESTIGATION AND FIELD TESTING

The site investigation and field testing for this project were carried out between October 23 and 26, 2013 and comprised drilling and sampling six boreholes, identified as Boreholes LGY-1 to LGY-6. The approximate borehole locations are shown on the attached Borehole Locations and Soil Strata Drawing in Appendix D.

Boreholes LGY-2 to LGY-5 were drilled adjacent to the existing bridge abutments and were terminated in bedrock at depths of 15.8 to 19.5 m, including coring at least 3.0 m into bedrock. Boreholes LGY-1 and LGY-6 were drilled to 11.3 m depth at the east and west approaches, respectively.

The borehole locations were marked in the field and utility clearances were obtained prior to drilling. The coordinates and ground surface elevations for the boreholes were estimated from topographic plans provided by HMM.

A truck-mounted CME75 drill rig was used to advance the boreholes using a combination of hollow-stem augers, NW casing/wash-boring techniques and NQ coring. Soil samples were obtained at selected intervals using a split spoon sampler in conjunction with Standard Penetration Testing (SPT).

NQ coring techniques were used to recover 3.0 m long core samples from the bedrock in Boreholes LGY-2 to LGY-5. All rock cores were logged and the Total Core Recovery (TCR), Rock Quality Designation (RQD) and Fracture Indices (FI) were determined.

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 and rock core samples for transport to Thurber's laboratory for further examination and testing.

Groundwater conditions in the open boreholes were observed throughout the drilling operations. Groundwater conditions observed after completion of drilling were not representative of site conditions as water was introduced into the boreholes during coring and wash boring operations. Standpipe piezometers were installed in two boreholes to monitor the groundwater level after drilling. The piezometers were subsequently decommissioned and the boreholes without piezometers were backfilled in general accordance with MOE Regulation 903. Completion details of the piezometers and boreholes are summarized in Table 3.1.

Table 3.1 – Borehole Completion Details

Foundation Unit	Borehole	Piezometer Tip Depth/ Elevation (m)	Completion Details
East Approach	LGY-1	None installed	Borehole backfilled with bentonite holeplug to 0.3 m, concrete from 0.3 m to 0.1 m, then asphalt cold patch to surface.
East Abutment	LGY-2	None installed	Borehole backfilled with bentonite holeplug to 0.3 m, concrete from 0.3 m to 0.1 m, then asphalt cold patch to surface.
	LGY-3	16.2/ 312.4	Borehole backfilled with bentonite holeplug to 16.2m, sand from 16.2 m to 14.3 m, bentonite holeplug from 14.3 m to 0.3 m, concrete from 0.3m to 0.15 m, then asphalt cold patch and flush mount cover to surface.
West Abutment	LGY-4	13.1/ 315.7	Borehole backfilled with bentonite holeplug to 13.1 m, sand from 13.1 m to 11.3 m, bentonite holeplug from 11.3 m to 0.3 m, sand from 0.3m to 0.15 m, then asphalt cold patch and flush mount cover to surface.
	LGY-5	None installed	Borehole backfilled with bentonite holeplug to 0.1 m, then asphalt cold patch to surface.
West Approach	LGY-6	None installed	Borehole backfilled with bentonite holeplug to 0.3 m, concrete from 0.3 m to 0.1 m, then asphalt cold patch to surface.

4 LABORATORY TESTING

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

Bedrock core samples were subjected to geological logging. Point load tests were carried out on selected samples of intact bedrock in the laboratory to evaluate the unconfined compressive strength (UCS) of the bedrock. The UCS values of the rock assessed from the point load tests are reported on the borehole logs in Appendix A.

5 DESCRIPTION OF SUBSURFACE CONDITIONS

Reference is made to the Record of Borehole sheets included in Appendix A. Details of the encountered soil stratigraphy are presented in these sheets and on the “Borehole Locations and Soil

Strata” drawing included 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.

The site stratigraphy typically comprises granular and silty clay fill materials overlying a layer of native silty clay, underlain by a layer of sand, which in turn overlies bedrock. More detailed descriptions of the individual strata are presented below.

5.1 Asphalt

Asphalt was encountered on the roadway surface in all boreholes drilled. The asphalt was between 20mm and 25mm thick.

5.2 Embankment Fill

The existing embankment fill typically comprises brown sand to sand and gravel fill overlying brown silty clay fill. The granular fill was 0.7 to 1.1 m thick and was encountered below the asphalt in all boreholes. In Boreholes LGY-1 to LGY-3 drilled on the east approach embankment, the underlying clay fill layer was 1.9 to 3.0 m thick, with the lower boundary at depths of 3.0 m to 3.7 m (Elev. 325.6 to 324.9). On the west approach, clay fill was encountered only in Borehole LGY-4, and was 0.8 m thick with a lower boundary at 1.5 m depth (Elev. 327.3).

SPT N-values recorded within the granular fill ranged from 9 to 20 blows for 0.3 m penetration, indicating a typically compact relative density. SPT-values within the silty clay fill ranged from 8 to 12 blows per 0.3 m penetration, indicating a stiff consistency.

Moisture contents ranged from 4% to 17% in the granular fill and from 22% to 33% in the silty clay fill.

Five samples of granular fill and one sample of silty clay fill underwent laboratory grain size analysis testing, the results of which are summarized below. These results are also presented on the Record of Borehole sheets included in Appendix A. The grain size distribution curves for these samples are shown on Figures B1 and B2 of Appendix B.

Soil Particles	Sand to Sand & Gravel Fill (%)	Silty Clay Fill (%)
Gravel	8 to 35	0
Sand	57 to 91	27
Silt	1 to 8	36
Clay		37

5.3 Silty Clay

Brown to grey silty clay with trace to some sand was encountered beneath the fill in all boreholes. The clay layer is between 7.7 m and 10.5 m thick with a lower boundary at depths of 10.1 m to 11.7 m (Elev. 319.2 to 316.9).

In general, SPT N-values recorded in the silty clay ranged between 7 and 18 blows per 0.3 m penetration, indicating a firm to very stiff consistency, typically stiff. Higher N-values of 23 to 46 blows per 0.3 m were recorded near the base of this layer in three boreholes, indicating a very stiff to hard consistency. The moisture content of the clay ranged from 15% to 44%.

Selected samples of the silty clay underwent laboratory grain size analysis testing and Atterberg Limits tests. The grain size distribution curves for tested samples of silty clay are shown on Figures B3 and B4 of Appendix B. The results of the Atterberg Limits tests are presented in Figure B6, Appendix B. The results are summarized on the Record of Borehole sheets included in Appendix A, and in the following tables:

Soil Particles	Silty Clay (%)
Gravel	0 to 11
Sand	3 to 24
Silt	19 to 59
Clay	23 to 75

Liquid Limit	48 to 76
Plastic Limit	20 to 28

The above results indicate that the silty clay varies from intermediate to high plasticity with group symbols of CI and CH.

5.4 Sand

A sand layer was encountered below the silty clay in all boreholes. The gradation of this deposit varied from silty sand with some gravel to gravelly sand with some silt, as well as sand with trace silt and gravel. Occasional cobbles and possibly boulders were encountered in this layer. Boreholes LGY-1 and LGY-6 were terminated within this deposit at 11.3 m depth (Elev. 317.4 and 318.0). In Boreholes LGY-2 to LGY-5, the deposit was 1.5 m to 5.1 m thick, with a lower boundary on bedrock at depths of 12.8 m to 16.5 m (Elev. 316.0 to 312.1).

SPT N-values obtained in the sand ranged from 14 to 76 blows per 0.3 m penetration, indicating a compact to very dense condition. Two values of 50 blows for 0.125 m and 50 blows for no penetration are believed to have contacted cobbles or boulders. Moisture contents ranged from 4% to 19%.

The results of grain size distribution analyses conducted on five sand samples are shown on the Record Borehole sheets in Appendix A and in Figure B5 of Appendix B. The results are as summarised below.

Soil Particles	Silty to Gravelly Sand (%)
Gravel	7 to 26
Sand	39 to 86
Silt & Clay	7 to 48

5.5 Bedrock

Bedrock was encountered below the sand deposit in four boreholes and proven by recovery of 3.0 to 3.1 m long rock core samples. The depths and elevations of the bedrock surface are summarized in Table 5.1.

Table 5.1 – Depths and Elevations of Bedrock

Borehole	Top of Bedrock	
	Depth (m)	Elevation
LGY-2	16.5	312.1
LGY-3	16.2	312.4
LGY-4	13.1	315.7
LGY-5	12.8	316.0

The bedrock recovered in the core samples was described as black and white diorite. Core recovery in the bedrock was generally 100%, locally 95% in one run. The Rock Quality Designation (RQD) was between 74% and 100%, indicating typically good to excellent rock quality. The Fracture Index (FI) of the rock, expressed as fractures per 0.3 m core, was less than 3.

The unconfined compressive strength of the rock interpreted from point load tests conducted on the recovered cores ranged from 55 MPa to 174 MPa, indicating a strong to very strong rock.

5.6 Water Levels

Where possible, water levels were monitored in the open boreholes during drilling operations. Wash boring and rock coring methods were used to advance the boreholes and therefore water levels recorded during or upon completion of drilling may not reflect natural groundwater levels. Standpipe piezometers were installed in two boreholes to monitor the groundwater level after completion. The water levels observed in the open boreholes upon completion and measured in the piezometers are summarized in Table 5.2.

Table 5.2 – Water Level Measurements

Borehole	Date	Water Level		Comment
		Depth (m)	Elev. (m)	
LGY-1	October 23, 2013	10.7	318.0	In open borehole
LGY-2	October 25, 2013	1.8	326.8	In open borehole
LGY-3	October 26, 2013	4.3	324.3	In open borehole
	November 21, 2013	1.2	327.4	Piezometer
LGY-4	October 24, 2013	1.5	327.3	In open borehole
	November 21, 2013	1.3	327.5	Piezometer
LGY-5	October 24, 2013	4.9	323.9	In open borehole
LGY-6	October 23, 2013	11.3	318.0	In open borehole

The preliminary GA drawing provided by HMM indicates a water level at Elevation 324.6 in the Little Grassy River on September 8, 2013. In general, the groundwater level is expected to be at or slightly above the water level in the river. The higher water levels measured in the piezometers indicate an artesian condition in the sand underlying the clay deposit.

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

6 MISCELLANEOUS

Borehole locations were selected and established in the field by Thurber Engineering Ltd. The coordinates and the ground surface elevations for the boreholes were established based on topographic survey information provided by HMM.

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

Eastern Ontario Diamond Drilling of Hawkesbury, Ontario supplied a truck mounted CME75 drill rig and conducted the drilling, sampling and in-situ testing operations. The drilling operations were supervised by Mr. George Azzopardi.

Overall supervision of the field program was conducted by Mr. Mark Farrant, P.Eng. Interpretation of the data and preparation of the report were carried out by Ms. Mei Cheong, P.Eng.

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

Thurber Engineering Ltd



Mei Cheong, M.Phil.
Project Engineer



Murray R. Anderson, P.Eng., M.Eng
Senior Foundation 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

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


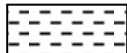



 Water Level
 Shear Strength Determination by Pocket Penetrometer

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

UNIFIED SOILS CLASSIFICATION

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

EXPLANATION OF ROCK LOGGING TERMS

<u>ROCK WEATHERING CLASSIFICATION</u>		<u>SYMBOLS</u>	
Fresh (FR)	No visible signs of weathering.		
Fresh Jointed (FJ)	Weathering limited to the surface of major discontinuities.		CLAYSTONE
Slightly Weathered (SW)	Penetrative weathering developed on open discontinuity surfaces, but only slight weathering of rock material.		SILTSTONE
Moderately Weathered (MW)	Weathering extends throughout the rock mass, but the rock material is not friable.		SANDSTONE
Highly Weathered (HW)	Weathering extends throughout the rock mass and the rock is partly friable.		COAL
Completely Weathered (CW)	Rock is wholly decomposed and in a friable condition, but the rock texture and structure are preserved.		Bedrock (general)

<u>DISCONTINUITY SPACING</u>		<u>STRENGTH CLASSIFICATION</u>			
Bedding	Bedding Plane Spacing	Rock Strength	Approximate Uniaxial Compressive Strength		Field Estimation of Hardness*
			(MPa)	(psi)	
Very thickly bedded	Greater than 2m	Extremely Strong	Greater than 250	Greater than 36,000	Specimen can only be chipped with a geological hammer
Thickly bedded	0.6 to 2m				
Medium bedded	0.2 to 0.6m	Very Strong	100-250	15,000 to 36,000	Requires many blows of geological hammer to break
Thinly bedded	60mm to 0.2m	Strong	50-100	7,500 to 15,000	Requires more than one blow of geological hammer to break
Very thinly bedded	20 to 60mm				
Laminated	6 to 20mm	Medium Strong	25.0 to 50.0	3,500 to 7,500	Breaks under single blow of geological hammer.
Thinly Laminated	Less than 6mm				

<u>TERMS</u>		Weak	5.0 to 25.0	750 to 3,500	Can be peeled by a pocket knife with difficulty
Total Core Recovery: (TCR)	Core recovered as a percentage of total core run length.				
Solid Core Recovery: (SCR)	Percent Ratio of solid core of full cylindrical shape recovered. Expressed with respect to the total length of core run.	Very Weak	1.0 to 5.0	150 to 750	Can be peeled by a pocket knife, crumbles under firm blows of geological pick.
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	Indented by thumbnail
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 LGY-1

1 OF 2

METRIC

WP# 490-00-01 LOCATION Little Grassy at Yongeberg N 5 423 614.2 E 204 628.1 ORIGINATED BY GA
 HWY 600 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2013.10.23 - 2013.10.23 CHECKED BY WM

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				W P W W L																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																															
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE				WATER CONTENT (%)																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																															
328.7							20	40	60	80	100																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																

Continued Next Page

+³, ×³: Numbers refer to
Sensitivity

20
15
10
(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No LGY-1

2 OF 2

METRIC

WP# 490-00-01 LOCATION Little Grassy at Yongeberg N 5 423 614.2 E 204 628.1 ORIGINATED BY GA
 HWY 600 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2013.10.23 - 2013.10.23 CHECKED BY WM

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	W _p	W	W _L			
	Continued From Previous Page																
318.0	Silty CLAY , trace sand, trace gravel Stiff Brown Damp																
10.7	SAND , some silt Compact Grey Wet		10	SS	14												
317.4																	
11.3	END OF BOREHOLE AT 11.3m. BOREHOLE OPEN TO 11.3m AND WATER LEVEL AT 10.7m. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO 0.3m, CONCRETE TO 0.1m, THEN ASPHALT TO SURFACE.																

RECORD OF BOREHOLE No LGY-2

1 OF 3

METRIC

WP# 490-00-01 LOCATION Little Grassy at Yongeberg N 5 423 614.6 E 204 613.1 ORIGINATED BY GA
 HWY 600 BOREHOLE TYPE NW Casing/NQ Coring COMPILED BY AN
 DATUM Geodetic DATE 2013.10.25 - 2013.10.25 CHECKED BY WM

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 (%)				GR	SA	SI	CL
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE	20	40	60	80	100	W _P		W	W _L		
328.6																			
0.0	ASPHALT: (25mm)																		
327.9	SAND, trace gravel, trace silt Compact Brown Wet (FILL)		1	SS	20								○					8	91
0.7																			1 (SI+CL)
	Silty CLAY, trace sand Stiff Brown Damp to Wet (FILL)		2	SS	11								○						
			3	SS	10								○						
			4	SS	12								○						
325.5																			
3.0	Silty CLAY, some sand Stiff Brown Damp		5	SS	12								○					0	17
																			27
																			56

Continued Next Page

+³, ×³: Numbers refer to
Sensitivity

20
15
10
(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No LGY-2

2 OF 3

METRIC

WP# 490-00-01 LOCATION Little Grassy at Yongeberg N 5 423 614.6 E 204 613.1 ORIGINATED BY GA
 HWY 600 BOREHOLE TYPE NW Casing/NQ Coring COMPILED BY AN
 DATUM Geodetic DATE 2013.10.25 - 2013.10.25 CHECKED BY WM

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa							WATER CONTENT (%)		
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE							W P W W L		
								20	40	60	80	100	20	40	60		
	Continued From Previous Page																
317.2	Silty CLAY , some sand Hard Brown Wet		10	SS	46		318						○				
11.4	SAND , trace to some gravel, trace silt, occasional cobbles Dense to Compact Grey Wet						317										
							316						○				
							315						○				
							314										
							313										
312.1	Start coring at 16.5m		13	SS	50/ 0.0												
16.5	BEDROCK , coarse grained, black/white: (DIORITE)						312										
	Trace mechanical breaks		1	RUN													
	Horizontal joint (25mm) at 16.5m, 16.6m, 16.7m, 16.9m, 17.0m, 18.9m		2	RUN			311										
309.1							310										
19.5	END OF BOREHOLE AT 19.5m. BOREHOLE OPEN TO 19.5m AND WATER LEVEL AT 1.8m.																

Continued Next Page

+³, ×³: Numbers refer to
Sensitivity

20
15
10

(%) STRAIN AT FAILURE

METRIC

[illegible]

RECORD OF BOREHOLE No LGY-3

1 OF 3

METRIC

WP# 490-00-01 LOCATION Little Grassy at Yongeberg N 5 423 618.3 E 204 613.2 ORIGINATED BY GA
 HWY 600 BOREHOLE TYPE NW Casing/NQ Coring COMPILED BY AN
 DATUM Geodetic DATE 2013.10.26 - 2013.10.26 CHECKED BY WM

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			SHEAR STRENGTH kPa				WATER CONTENT (%)				
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE	20 40 60 80 100	20 40 60	W _p W W _L					
328.6																
0.0	ASPHALT: (25mm)															
	Gravelly SAND Compact Brown Wet (FILL)		1	SS	18							○			21 77 2 (SI+CL)	
327.9							328									
0.7	Silty CLAY, trace sand Stiff Brown Damp to Wet (FILL)		2	SS	9							○				
							327					○				
			3	SS	12											
							326									
			4	SS	12							○				
							325									
324.9	Occasional wood fibres		5	SS	10											
							324					○				
3.7	Silty CLAY, some sand Stiff Brown Wet						323									
							322					○			0 10 27 63	
							321					○				
			8	SS	12		320									
							319					○				
			9	SS	15											

Continued Next Page

+³, ×³: Numbers refer to
Sensitivity

20
15
10
(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No LGY-3

2 OF 3

METRIC

WP# 490-00-01 LOCATION Little Grassy at Yongeberg N 5 423 618.3 E 204 613.2 ORIGINATED BY GA
 HWY 600 BOREHOLE TYPE NW Casing/NQ Coring COMPILED BY AN
 DATUM Geodetic DATE 2013.10.26 - 2013.10.26 CHECKED BY WM

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					
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE					
							PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT						
							W P W L						
							WATER CONTENT (%)						
							20 40 60						
	Continued From Previous Page												GR SA SI CL
316.9	Silty CLAY , some sand Very Stiff Brown Wet		10	SS	23		318						0 18 59 23
11.7	SAND , some silt, trace gravel, occasional cobbles Compact Grey Wet		11	SS	21		317						
315.5							316						
13.1	Silty SAND , trace clay, some gravel Dense to Very Dense Grey Wet		12	SS	50/ 0.125		315						13 39 42 6
							314						
			13	SS	76		313						
312.4	Start coring at 16.2m												
16.2	BEDROCK , coarse grained, strong, black/white: (DIORIITE) Trace mechanical breaks Horizontal joint (25mm) at 16.2m, 16.9m, 17.2m, 17.3m, 17.4m Sub-horizontal joint (25mm) at 16.8m, 17.5m, 18.7m Horizontal joint (25mm) at 17.8m, 18.4m, 18.9m, 19.1m		1	RUN			312						RUN #1 TCR=95% SCR=88% RQD=77% UCS=125MPa (Average)
							311						RUN #2 TCR=100% SCR=100% RQD=92% UCS=58MPa (Average)
309.4			2	RUN			310						
19.2	END OF BOREHOLE AT 19.2m. BOREHOLE OPEN TO 19.2m AND WATER LEVEL AT 4.3m. Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe												

Continued Next Page

+³, ×³: Numbers refer to
Sensitivity

20
15
10
(%) STRAIN AT FAILURE

METRIC

[illegible]

RECORD OF BOREHOLE No LGY-4

1 OF 2

METRIC

WP# 490-00-01 LOCATION Little Grassy at Yongeberg N 5 423 615.3 E 204 561.8 ORIGINATED BY GA
 HWY 600 BOREHOLE TYPE NW Casing/NQ Coring COMPILED BY AN
 DATUM Geodetic DATE 2013.10.24 - 2013.10.24 CHECKED BY WM

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 ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE						PLASTIC LIMIT W _P NATURAL MOISTURE CONTENT W LIQUID LIMIT W _L																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																												
328.8								20	40	60	80	100																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																														

Continued Next Page

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

RECORD OF BOREHOLE No LGY-4

2 OF 2

METRIC

WP# 490-00-01 LOCATION Little Grassy at Yongeberg N 5 423 615.3 E 204 561.8 ORIGINATED BY GA
 HWY 600 BOREHOLE TYPE NW Casing/NQ Coring COMPILED BY AN
 DATUM Geodetic DATE 2013.10.24 - 2013.10.24 CHECKED BY WM

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					
	Continued From Previous Page							<div>20406080100</div> <div>○ UNCONFINED + FIELD VANE</div> <div>● QUICK TRIAXIAL × LAB VANE</div>					
								<div>204060</div> <div>WATER CONTENT (%)</div> <div>PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT</div> <div>W_P W W_L</div>					
318.1	Silty CLAY , occasional sand Very Stiff Grey Wet												
10.7	Gravelly SAND , some silt Dense Grey Wet		10	SS	37		318						21 59 20 (SI+CL)
	Occasional cobbles and boulders						317						
315.7	Start coring at 13.1m						316					FI	RUN #1 TCR=100% SCR=100% RQD=93% UCS=164MPa (Average)
13.1	BEDROCK , coarse grained, strong, black/white: (DIORITE) Occasional mechanical breaks Horizontal joint (25mm) at 13.2m, 13.5m, 13.6m, 13.8m, 14.5m		1	RUN			315					2	
							314					1	RUN #2 TCR=100% SCR=100% RQD=92% UCS=174MPa (Average)
312.6	Horizontal joint (25mm) at 14.7m, 15.1m, 15.2m, 15.4m, 15.5m, 15.6m, 15.8m, 15.9m		2	RUN			313					1	
16.2	END OF BOREHOLE AT 16.2m. BOREHOLE OPEN TO 16.2m AND WATER LEVEL AT 1.5m. Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen. WATER LEVEL READINGS: DATE DEPTH (m) ELEV. (m) Nov. 21/13 1.3 327.5											2	

ONTMT4S 5121.GPJ 2012TEMPLATE(MTO).GDT 1/21/14

RECORD OF BOREHOLE No LGY-5

1 OF 2

METRIC

WP# 490-00-01 LOCATION Little Grassy at Yongeberg N 5 423 619.3 E 204 561.5 ORIGINATED BY GA
HWY 600 BOREHOLE TYPE NW Casing/NQ Coring COMPILED BY AN
DATUM Geodetic DATE 2013.10.24 - 2013.10.24 CHECKED BY WM

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						
328.8								20 40 60 80 100						
0.0	ASPHALT: (25mm)		1	SS	14									8 91 1 (SI+CL)
328.0	SAND, trace gravel, trace silt Compact Brown Wet (FILL)		2	SS	7		328							
0.8	Silty CLAY, trace sand Stiff to Very Stiff Brown Damp		3	SS	8		327							
			4	SS	14		326							4 24 38 34
			5	SS	15		325							
			6	SS	17		324							
	Grey		7	SS	15		323							
			8	SS	8		322							
			9	SS	19		321							4 10 44 42
							320							
							319							

Continued Next Page

+³, ×³: Numbers refer to
Sensitivity




20
15
10
(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No LGY-5

2 OF 2

METRIC

WP# 490-00-01 LOCATION Little Grassy at Yongeberg N 5 423 619.3 E 204 561.5 ORIGINATED BY GA
 HWY 600 BOREHOLE TYPE NW Casing/NQ Coring COMPILED BY AN
 DATUM Geodetic DATE 2013.10.24 - 2013.10.24 CHECKED BY WM

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 (%)					
								20 40 60 80 100				w _P w w _L					
Continued From Previous Page							○ UNCONFINED + FIELD VANE										
							● QUICK TRIAXIAL × LAB VANE										
317.5	Silty CLAY , trace sand, trace gravel Stiff to Hard Grey Wet		10	SS	35		318										
11.3	Gravelly SAND , some silt Dense Grey Wet						317						○				
316.0	Start coring at 12.8m		11	SS	37								○				
12.8	BEDROCK , coarse grained, strong, grey/black: (DIORITE) Occasional mechanical breaks Horizontal joint (25mm) at 12.9m, 13.7m Sub-horizontal joint (25mm) at 12.9m Horizontal joint (25mm) at 14.8m, 15.0m, 15.3m		1	RUN			316										
							315										
			2	RUN			314										
312.9																	
15.8	END OF BOREHOLE AT 15.8m. BOREHOLE OPEN TO 15.8m AND WATER LEVEL AT 4.9m. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO 0.1m, THEN ASPHALT PATCH TO SURFACE.																
											</						

+³, ×³: Numbers refer to
Sensitivity

20
15
10

(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No LGY-6

1 OF 2

METRIC

WP# 490-00-01 LOCATION Little Grassy at Yongeberg N 5 423 619.2 E 204 546.4 ORIGINATED BY GA
 HWY 600 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2013.10.23 - 2013.10.23 CHECKED BY WM

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						
329.3														
0.0	ASPHALT: (20mm)													
328.5	SAND and GRAVEL Compact Brown Damp (FILL)		1	SS	11		329							
0.8	Silty CLAY, trace to some sand, trace to some gravel Stiff Brown Damp		2	SS	10		328							
			3	SS	8		327							3 3 19 75
			4	SS	12		326							
			5	SS	13		325							
			6	SS	15		324							
	Grey		7	SS	8		323							
			8	SS	12		322							11 18 28 43
			9	SS	12		321							
							320							

Continued Next Page

+³, ×³: Numbers refer to
Sensitivity

20
15
10
(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No LGY-6

2 OF 2

METRIC

WP# 490-00-01 LOCATION Little Grassy at Yongeberg N 5 423 619.2 E 204 546.4 ORIGINATED BY GA
 HWY 600 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2013.10.23 - 2013.10.23 CHECKED BY WM

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																
319.2 10.1	Silty SAND , some gravel, trace clay Very Dense Grey Wet					319											
			10	SS	50											15 55 23 7	
318.0 11.3	END OF BOREHOLE AT 11.3m. BOREHOLE OPEN TO 11.3m AND WATER LEVEL AT 11.3m. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO 0.3m, CONCRETE TO 0.1m, THEN ASPHALT PATCH TO SURFACE.																

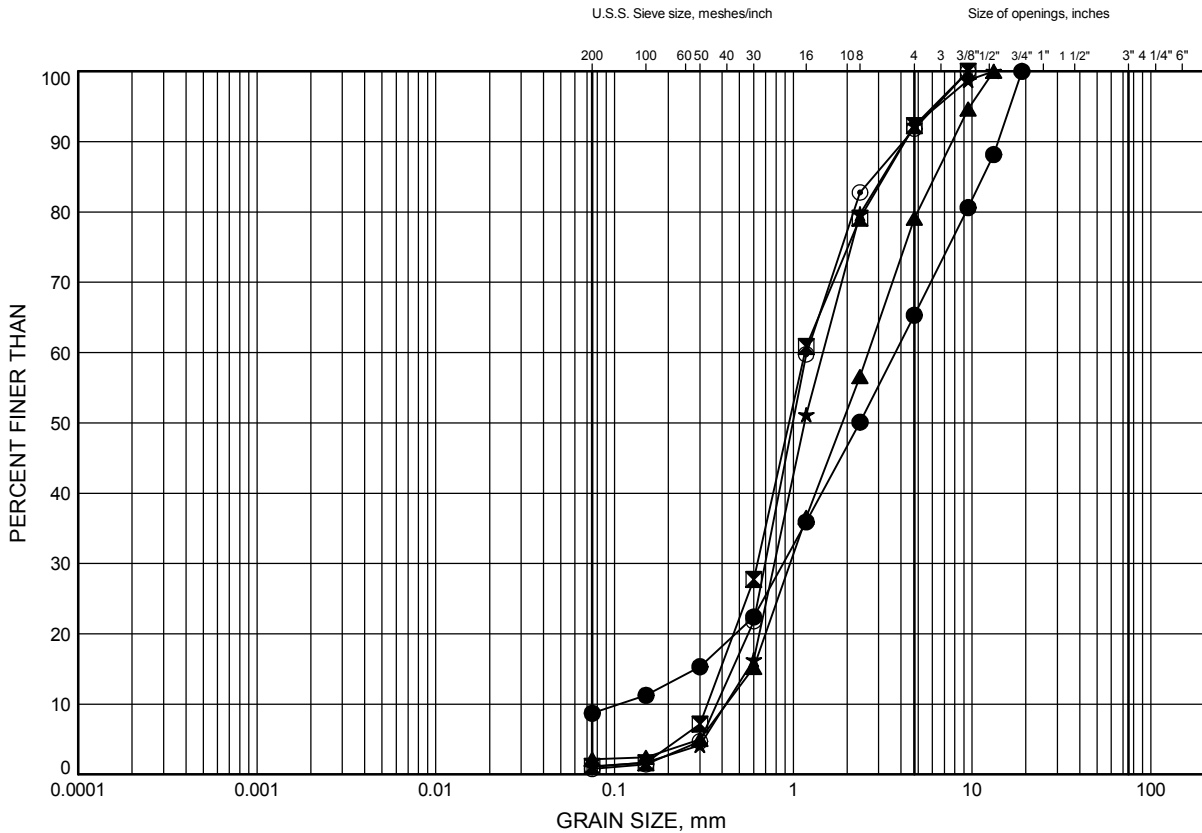
Appendix B

Laboratory Test Results

Little Grassy at Yongeberg
GRAIN SIZE DISTRIBUTION

FIGURE B1

SAND to SAND & GRAVEL FILL



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	LGY-1	0.38	328.32
⊠	LGY-2	0.38	328.22
▲	LGY-3	0.38	328.22
★	LGY-4	0.38	328.42
⊙	LGY-5	0.38	328.42

Date January 2014
WP# 490-00-01

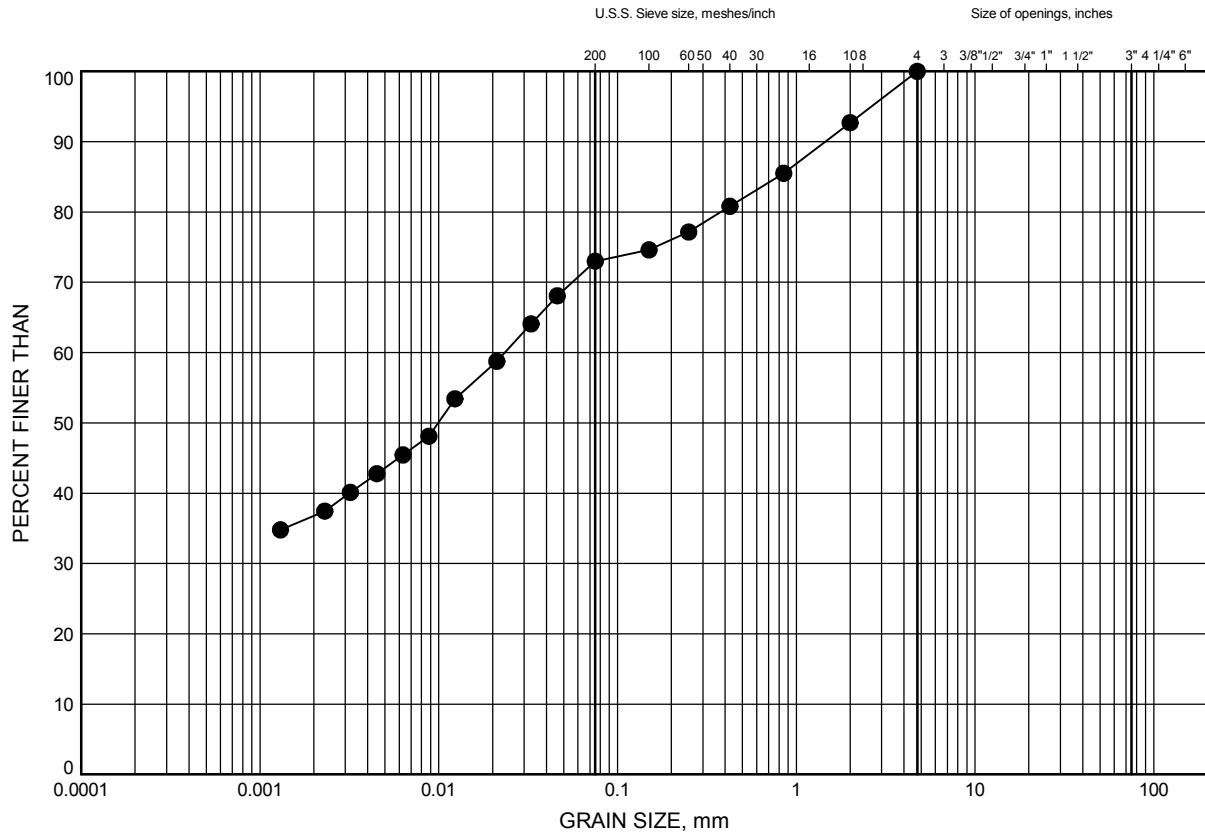


Prep'd MFA
Chkd. MC

Little Grassy at Yongeberg
GRAIN SIZE DISTRIBUTION

FIGURE B2

SILTY CLAY FILL



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	LGY-1	1.83	326.87

Date January 2014
WP# 490-00-01

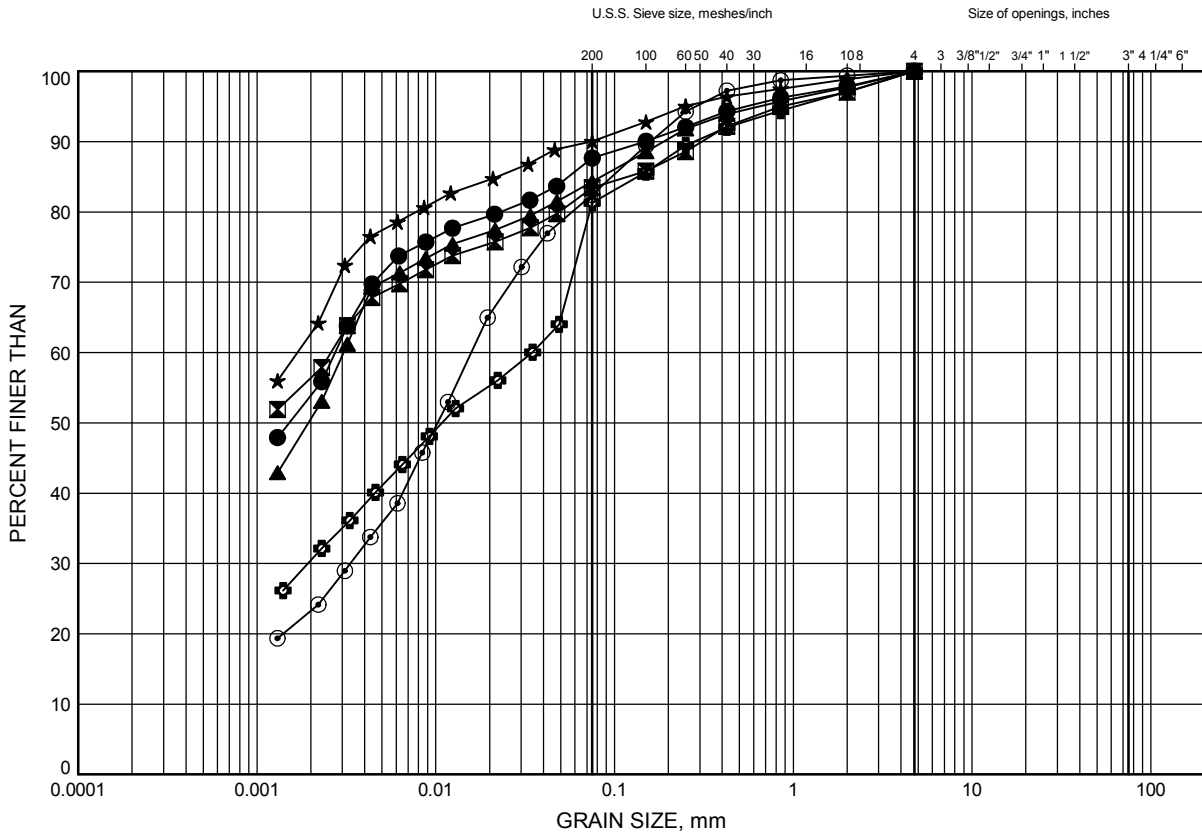


Prep'd MFA
Chkd. MC

Little Grassy at Yongeberg
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)
●	LGY-1	4.88	323.82
⊠	LGY-2	3.35	325.24
▲	LGY-2	7.92	320.67
★	LGY-3	6.40	322.20
⊙	LGY-3	10.97	317.62
⊕	LGY-4	4.88	323.92

Date January 2014
WP# 490-00-01

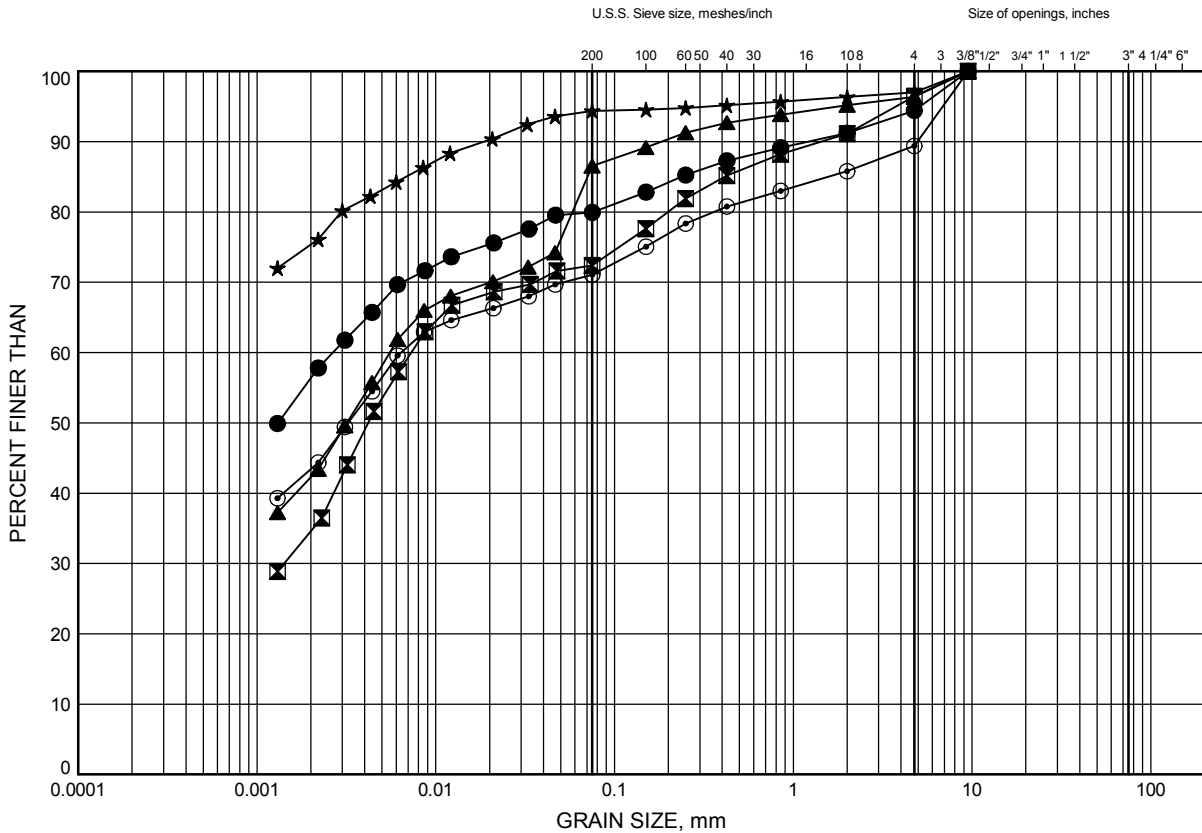


Prep'd MFA
Chkd. MC

Little Grassy at Yongeberg
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)
●	LGY-4	7.92	320.87
⊠	LGY-5	2.59	326.21
▲	LGY-5	6.40	322.40
★	LGY-6	1.83	327.47
⊙	LGY-6	7.92	321.37

Date January 2014
WP# 490-00-01

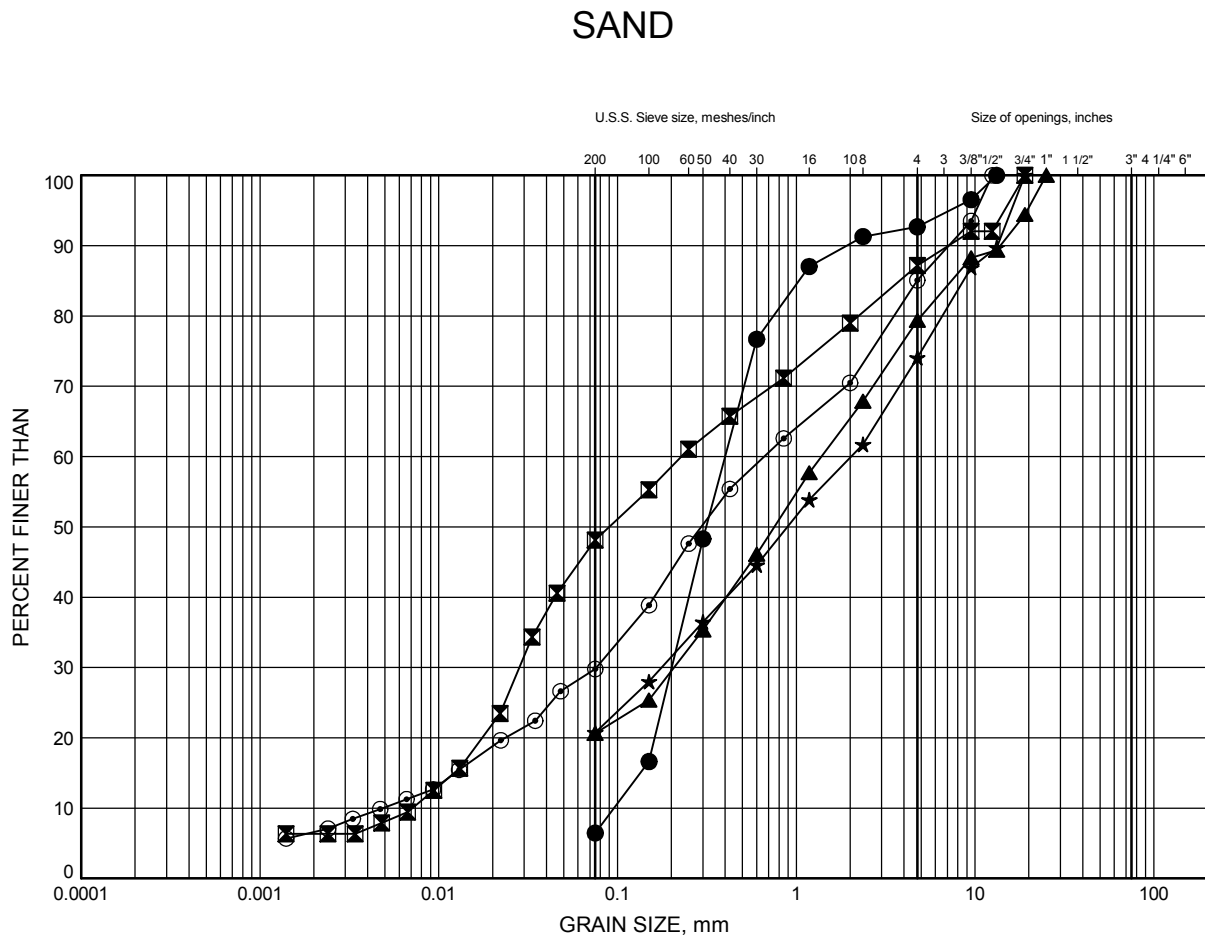


Prep'd MFA
Chkd. MC

Little Grassy at Yongeberg

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)
●	LGY-2	12.50	316.10
⊠	LGY-3	14.02	314.58
▲	LGY-4	10.97	317.82
★	LGY-5	12.50	316.30
⊙	LGY-6	10.97	318.32

Date January 2014
 WP# 490-00-01

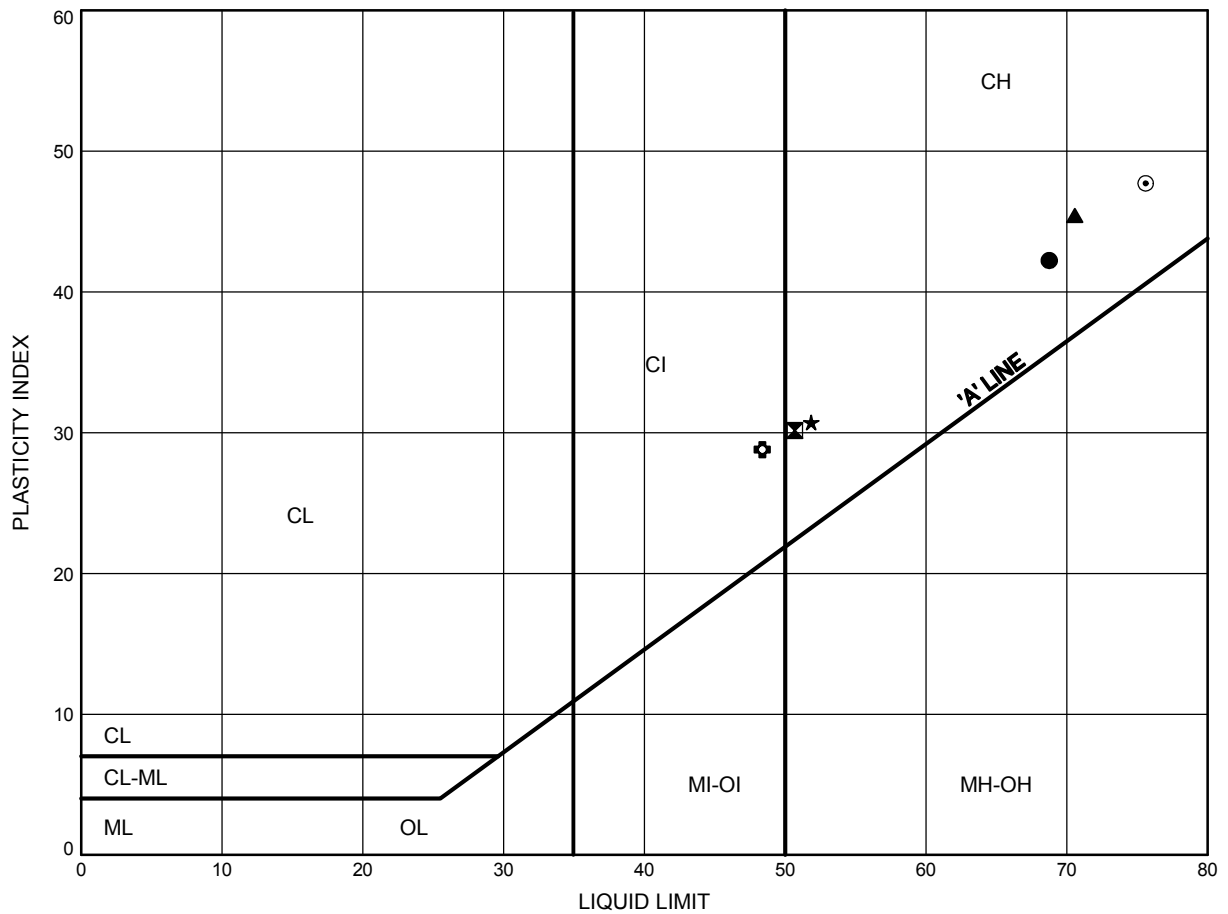


Prep'd MFA
 Chkd. MC

Little Grassy at Yongeberg
ATTERBERG LIMITS TEST RESULTS

FIGURE B6

SILTY CLAY



LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	LGY-1	4.88	323.82
⊠	LGY-2	7.92	320.67
▲	LGY-3	6.40	322.20
★	LGY-4	7.92	320.87
⊙	LGY-5	6.40	322.40
⊕	LGY-6	7.92	321.37

Date January 2014
 WP# 490-00-01



Prep'd MFA
 Chkd. MC

Appendix C

Site Photographs

Replacement Of Little Grassy River Bridge At Yongeberg
Highway 600, Site No: 45-11



Photograph 1 – South side of the bridge, looking east



Photograph 2 – North side of the bridge, looking east



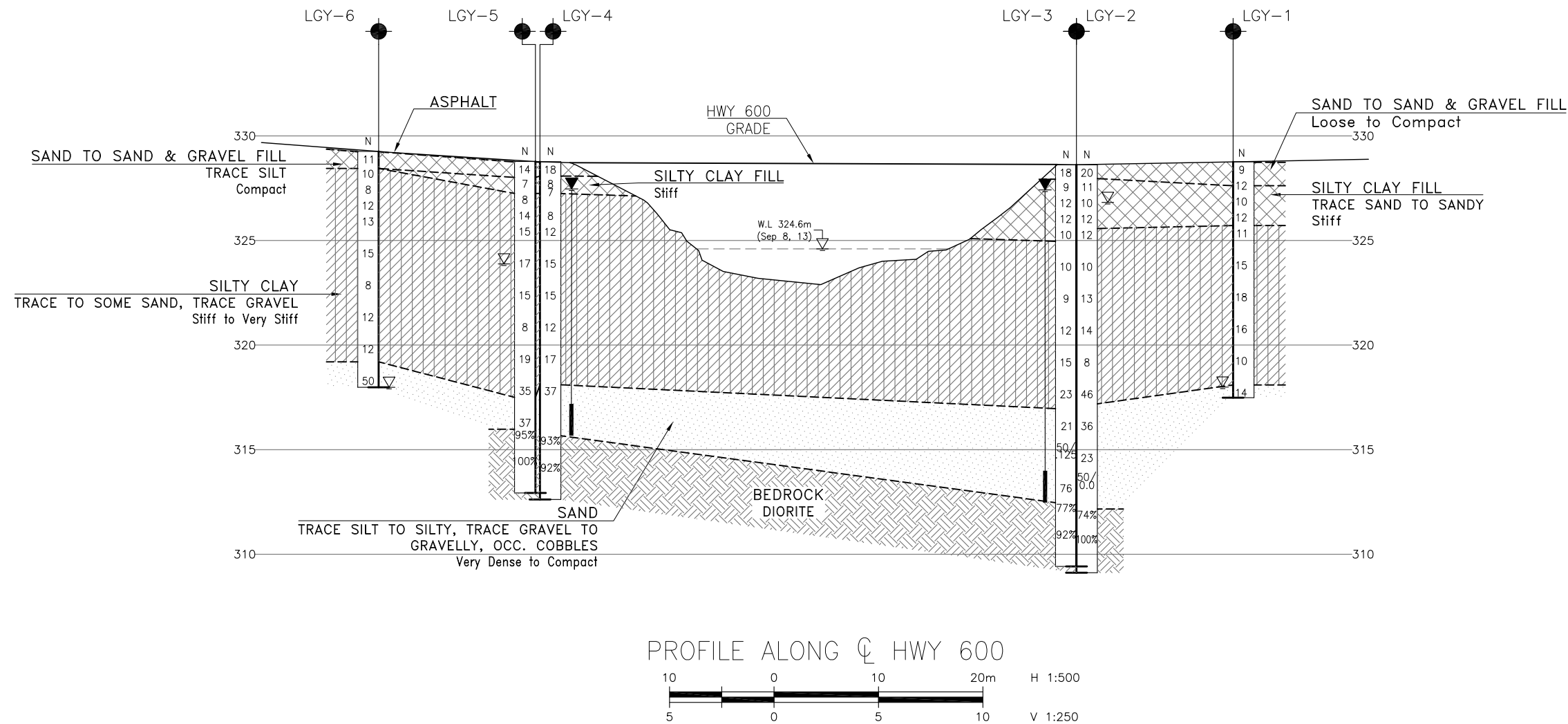
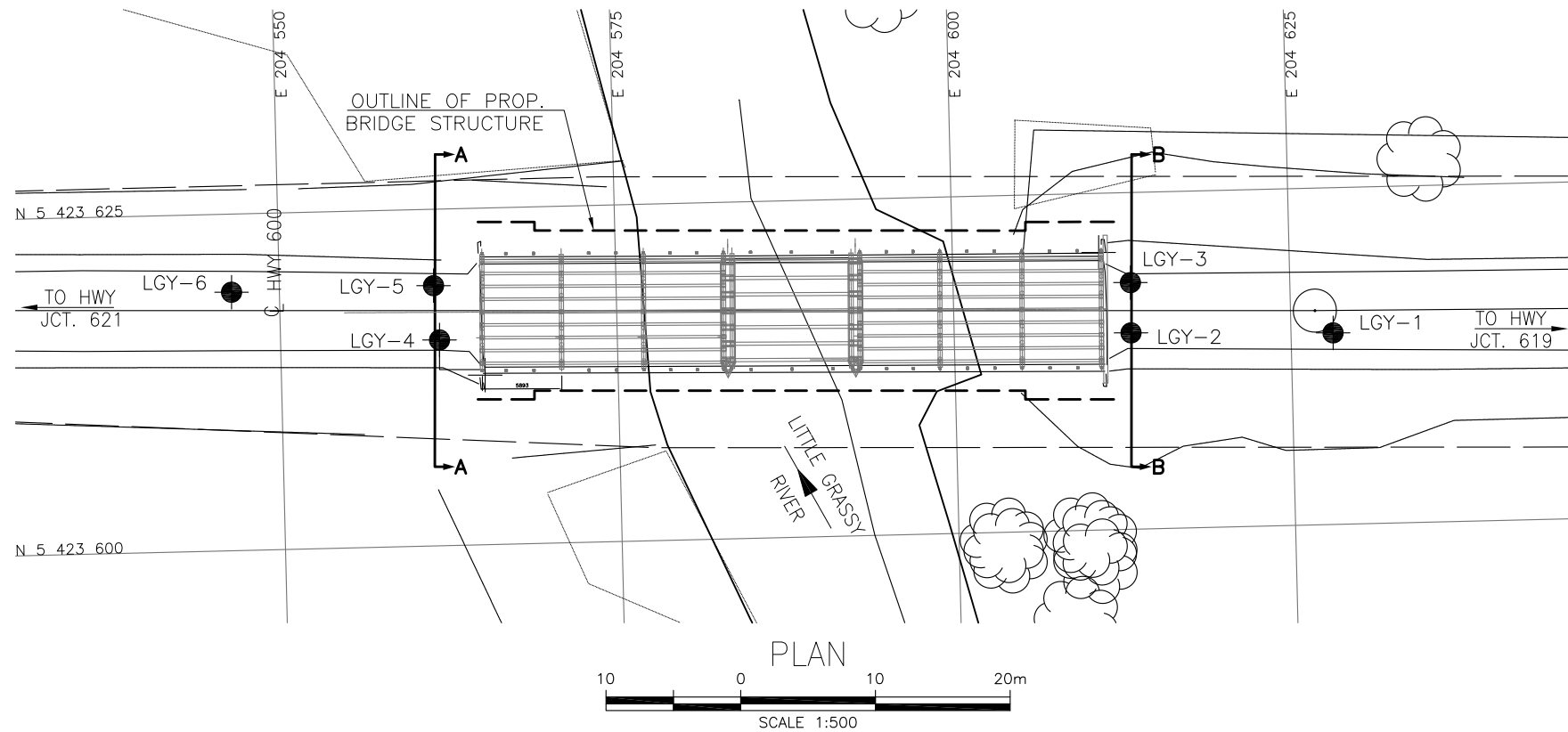
Photograph 3 – East piers, looking west



Photograph 4 – East abutment, looking northeast

Appendix D

Borehole Locations and Soil Strata Drawing



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



CONT No 2013-6025
WP No 490-00-01

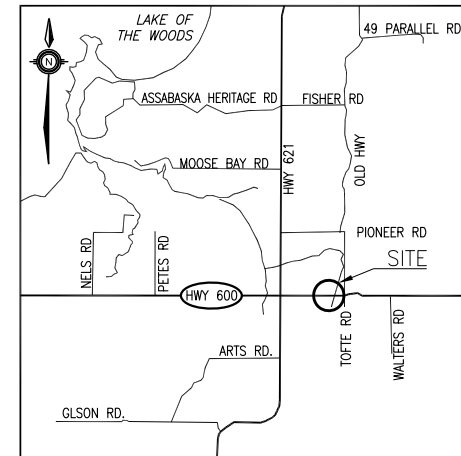
LITTLE GRASSY AT YONGEBERG
BOREHOLE LOCATIONS AND SOIL STRATA



SHEET
20



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
	Head Artesian Water
	Piezometer
90%	Rock Quality Designation (RQD)
A/R	Auger Refusal

NO	ELEVATION	NORTHING	EASTING
LGY-1	328.7	5 423 614.2	204 628.1
LGY-2	328.6	5 423 614.6	204 613.1
LGY-3	328.6	5 423 618.3	204 613.2
LGY-4	328.8	5 423 615.3	204 561.8
LGY-5	328.8	5 423 619.3	204 561.5
LGY-6	329.3	5 423 619.2	204 546.4

-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.

GEOCRIS No. 52D-15

REVISIONS	DATE	BY	DESCRIPTION
DESIGN	MC	CHK	MC
DRAWN	AN	CHK	
CODE CAN/CSA S6-06	LOAD CL-625-ONT	DATE	FEB 2014
SITE	45-011	STRUCT	DWG 2

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



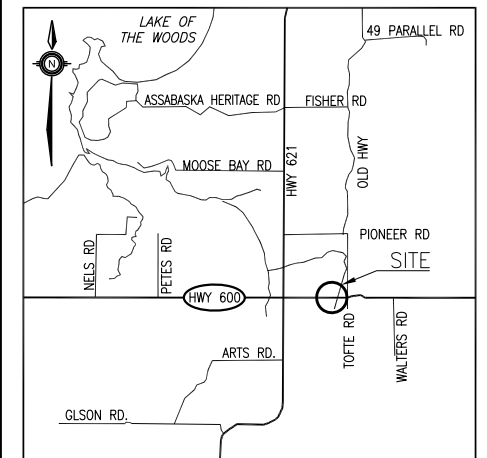
CONT No 2013-6025
WP No 490-00-01

LITTLE GRASSY AT YONGEBERG
BOREHOLE LOCATIONS AND SOIL STRATA

SHEET
21



THURBER ENGINEERING LTD.



KEYPLAN

LEGEND

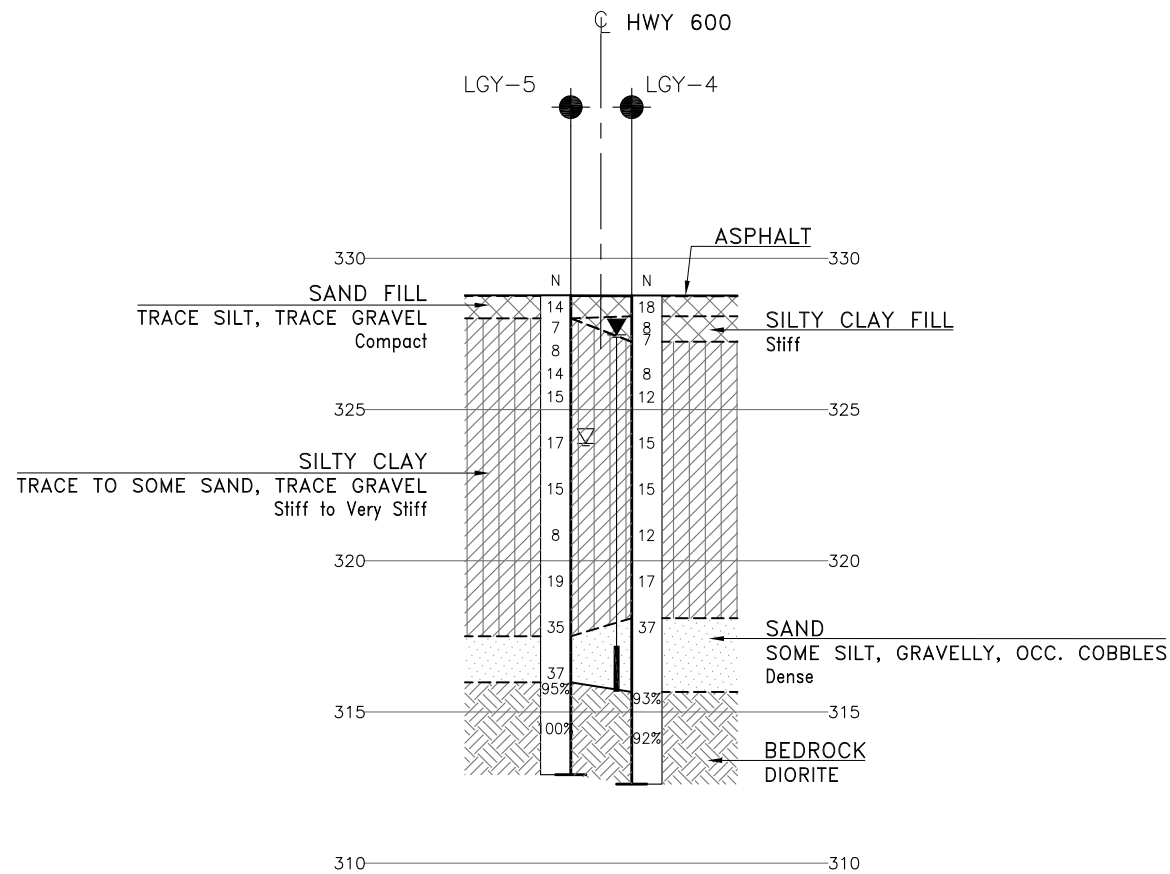
	Borehole
	Borehole and Cone
N	Blows /0.3m (Std Pen Test, 475J/blow)
CONE	Blows /0.3m (60' Cone, 475J/blow)
PH	Pressure, Hydraulic
	Water Level
	Head Artesian Water
	Piezometer
90%	Rock Quality Designation (RQD)
A/R	Auger Refusal

NO	ELEVATION	NORTHING	EASTING
LGY-1	328.7	5 423 614.2	204 628.1
LGY-2	328.6	5 423 614.6	204 613.1
LGY-3	328.6	5 423 618.3	204 613.2
LGY-4	328.8	5 423 615.3	204 561.8
LGY-5	328.8	5 423 619.3	204 561.5
LGY-6	329.3	5 423 619.2	204 546.4

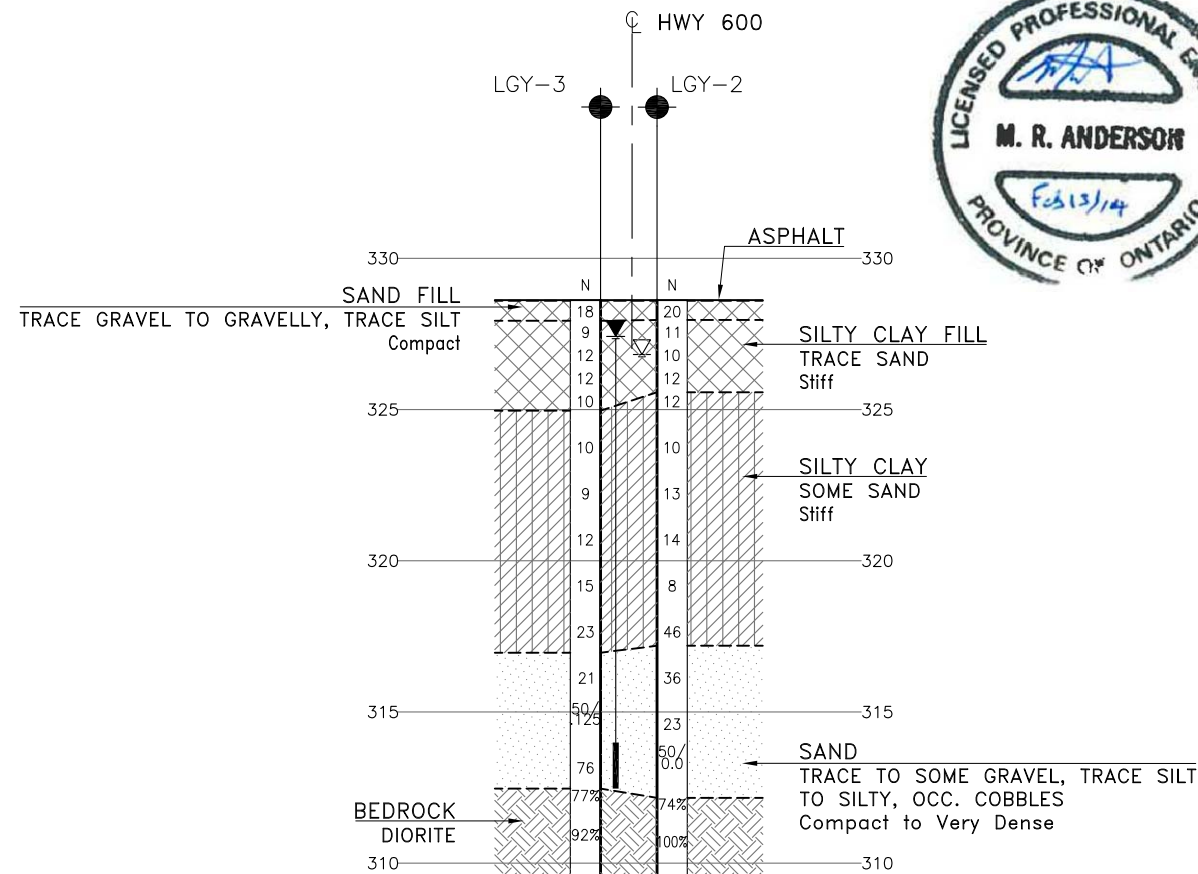
-NOTES-

- 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.

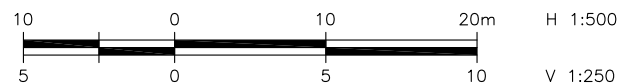
GEOCRES No. 52D-15



PROFILE ALONG A-A



PROFILE ALONG B-B



REVISIONS	DATE	BY	DESCRIPTION
DESIGN	MC	CHK	MC
DRAWN	AN	CHK	MC
CODE CAN/CSA	S6-06	LOAD CL-625-0NT	DATE FEB 2014
SITE	45-011	STRUCT	DWG 3