

**FOUNDATION INVESTIGATION REPORT
WOOD'S ROAD CULVERT REPLACEMENT
NEW LISKEARD DISTRICT, ONTARIO**

G.W.P. No. 5030-14-00, SITE NO. 47-331

Geocres Number: 41P-65

Report to

MMM GROUP LIMITED

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PART 1: FACTUAL INFORMATION

1 INTRODUCTION

This report presents the factual data obtained from a foundation investigation conducted by Thurber Engineering Ltd. (Thurber) at the culverts on Wood's Road over an unnamed creek, located in the Township of Marquis, New Liskeard District, Ontario.

The purpose of this investigation was to obtain subsurface information at the twin culvert location and, based on the data obtained, to provide borehole location plans, stratigraphic profiles, records of boreholes, laboratory test results, and a written description of the subsurface conditions.

Thurber was retained by MMM Group Limited to carry out this foundation investigation under the MTO Assignment Number 5014-E-0024.

2 SITE DESCRIPTION

The culvert site is located on Wood's Road, 9.4 km west of Highway 573 in the Township of Marquis, New Liskeard District, Ontario. This culvert allows an unnamed creek to flow, from west to east, under Wood's Road.

Based on the terms of reference, the existing culvert consists of twin corrugated steel pipe (CSP) culverts with 3.0 and 4.8 m diameters, with approximately 1 m of fill above the culverts. The culverts were constructed in 1970. It is understood that the culverts are in poor condition with deterioration and deformation of the steel barrels, corrosion and perforations at a few locations, cracks at bolt locations, and breakdown of coating. The twin culvert is proposed for full replacement.

Wood's Road is a 2-lane gravel road with a grade level at the existing culverts at approximate Elevation 286 m. The creek level was measured to range between 281.8 and 281.3 m in May 2015.

The site is located approximately 20 km northwest of Englehart with residential properties to the north of the culverts. Naturally elevated areas slope downwards towards the creek with vegetation

consisting of tall grass and shrubs with frequent trees. The local topography is of low relief with no visible bedrock outcrops.

Evidence of slope erosion was observed at the north bank of the creek on the downstream (east) side of the culvert. A timber retaining structure with rock fill is present on the west side of the road embankment adjacent to the inlet of the north culvert barrel.

Based on published geological information, the general area of the project is covered by glaciolacustrine sediments of clays and silts deposited during the Pleisocene period. These deposits are mostly varved clays, but massive clays are also present in some areas. Due to the different rates of seasonal deposition during various periods of glaciation, the lower zones of the deposits display much thicker varves than in the upper zones. Below the varved clays are glacial outwash deposits of silts, sands and gravel underlain by Precambrian massive to foliated granodiorite to granite.

Selected photographs of the culvert area are included in Appendix D for reference.

3 SITE INVESTIGATION AND FIELD TESTING

This borehole investigation and field testing program was carried out in two stages. The first was between May 26 and May 27, 2015 and the second between June 3 and June 5, 2015. The program consisted of drilling and sampling 6 boreholes (numbered HL-1 to HL-06) to depths ranging from 9.8 to 14.3 m, and extending 1 borehole to 27.4 m by conducting a Dynamic Cone Penetration Test (DCPT). Of these boreholes, two were located near the culvert inlet (HL-01 and HL-02), two were located near the culvert outlet (HL-05 and HL-06), and two were located on the shoulders of the road embankment (HL-03 and HL-04).

Prior to the start of drilling, the borehole locations were marked/staked in the field and utility clearances were obtained. The coordinates and ground surface elevations for the boreholes were derived from topographic plans provided to Thurber by MMM Group Limited. The approximate borehole locations are shown on the Borehole Locations and Soil Strata drawing included in Appendix C.

A track-mounted CME 45 hi-torque drill rig was used to advance Boreholes HL-01, HL-03, and HL-04 to the target depth using NW casing/wash boring techniques. A portable tripod drill rig was used to advance Boreholes HL-02, HL-05, and HL-06 to the target depth due to difficult access for a conventional drill rig beyond the road embankment. Soil samples were obtained at selected intervals using a 50 mm diameter split spoon sampler in conjunction with Standard Penetration Testing (SPT). Field vane shear tests using an MTO "N" size vane were carried out in very soft to soft cohesive soils. Groundwater conditions in the open boreholes were observed throughout the drilling operations. The details regarding borehole completion are summarized in Table 3.1.

Table 3.1 - Borehole Completion and Backfilling Details

Borehole	Borehole Depth/ Elevation (m)	Borehole Backfilling Details
HL-01	9.8 / 275.8	Bentonite holeplug and cuttings from 9.8 m to 0.2 m and granular to ground surface
HL-02	11.3 / 270.7	Bentonite holeplug from 11.3 m to ground surface
HL-03	14.3 / 271.4	Bentonite holeplug and cuttings from 14.3 m to 0.2 m and granular to ground surface
HL-04	14.3 / 271.3	Bentonite holeplug and cuttings from 14.3 m to 0.2 m and granular to ground surface
HL-05	11.3 / 272.9	Bentonite holeplug from 11.3 m to ground surface
HL-06	11.3 / 272.8	Bentonite holeplug from 11.3 m to ground surface

The results of the field drilling and sampling are presented on the Record of Borehole sheets in Appendix A.

A member of Thurber's technical staff supervised the drilling and sampling operations on a full time basis. The supervisor logged the boreholes, secured the recovered soil samples in labelled containers, and transported the samples to Thurber's laboratory for further examination and testing.

4 LABORATORY TESTING

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

In order to assess the potential for sulphate attack on concrete foundations, as well as the potential for corrosion on metal associated with the structure, a sample of the existing native soil, and a sample of surface water from the creek upstream of the bridge were collected. The samples were submitted to AGAT Laboratories in Mississauga, Ontario for analytical testing of corrosivity parameters and sulphate. The results of the analytical testing are summarized in Section 6 below and are presented in Appendix B.

5 DESCRIPTION OF SUBSURFACE CONDITIONS

5.1 General

Reference is made to the Record of Borehole sheets in Appendix A for details of the soil stratigraphy encountered in the boreholes. A stratigraphic profile and selected cross-sections for this culvert site are presented on the Borehole Locations and Soil Strata Drawing in Appendix C for illustrative purposes. An overall description of the stratigraphy is given in the following paragraphs; however, the factual data presented in the records of boreholes governs any interpretation of the site conditions.

In general, the subsurface conditions encountered in the boreholes located on the road shoulder consist of granular fill overlying a deposit of silty clay with silt interbeds. Near the culvert inlet and outlet, the silty clay underlies a layer of sand to sandy silt with surficial topsoil. Groundwater levels are generally in the order of 1.1 to 2.1 m below original ground surface. More detailed descriptions of the individual stratum are presented below.

5.2 Topsoil

A 50 mm thick layer of topsoil with some roots and rootlets was encountered at the ground surface in Borehole HL-05 located near the culvert outlet area. The topsoil thickness may vary between and beyond the borehole locations, and the limited data is not suitable for estimating topsoil quantities.

5.3 Fill

Embankment fill was encountered in Boreholes HL-01, HL-03, and HL-04. This fill typically consists of brown sand to gravelly sand with some inferred cobbles and boulders. The fill in Boreholes HL-03 and HL-04 were overlain by a thin veneer of silt with some clay and organic inclusions and rootlets at shallow depths. Where encountered, the thickness of the embankment fill ranged from 3.1 to 6.1 m with a lower boundary at depths of 3.2 to 6.1 m (base Elevations 282.5 to 279.5 m). A 0.8 m thick concrete layer was encountered in Borehole HL-01 extending to a depth of 6.1 m (base Elevation 279.5). At the same depth and elevation, a 0.8 m diameter boulder was encountered in Borehole HL-04.

SPT N-values measured in the cohesionless fill ranged from 1 to 49 blows per 0.3 m penetration, but mostly between 6 and 20 blows per 0.3 m penetration indicating a typically loose to compact state. The high 'N' values may be attributed to the presence of cobbles or boulders. Measured moisture contents of the recovered fill samples ranged between 6% and 20%. Grain size analyses conducted on samples of the sand to gravelly sand fill are presented in Figure B1 in Appendix B. These results are summarized in the following table.

Soil Particles	%
Gravel	7 to 36
Sand	58 to 89
Silt and Clay	5 to 16

5.4 Surficial Sand and Silt/Sandy Silt

A layer of non-cohesive deposit of sand and silt to sandy silt was encountered at the ground surface in Boreholes HL-02 and HL-06, and beneath the topsoil in Borehole HL-05. The material comprises some clay and organics (roots and rootlets) and its thickness ranges from 0.6 m to 1.4 m with the base at Elevations from 283.5 to 281.4 m.

SPT N-values measured in the deposit ranged from 4 to 9 blows per 0.3 m penetration indicating a loose relative density. Measured moisture contents of the samples ranged from 3% to 39%, with most values ranging from 19% to 33%. Grain size analyses conducted on selected samples are presented on Figure B2 in Appendix B. These results are summarized in the following table.

Soil Particles	%
<u>Sand</u>	
Gravel	3
Sand	91
Silt and Clay	6
<u>Sandy Silt</u>	
Gravel	0
Sand	24
Silt	62
Clay	14

5.5 Silt

A silt layer 3.0 m in thickness was encountered in Borehole HL-03 beneath the embankment fill. This grey silt typically contained some clay and trace sand. The thickness of the silt layer is approximately 3.0 m with a lower boundary at a depth of 6.2 m (base Elevation of 279.5 m).

SPT N-values measured in the silt ranged from 9 to 20 blows per 0.3 m penetration indicating a loose to compact state. Measured moisture contents of the recovered silt samples ranged

between 21% and 35%. The grain size analysis conducted on sample of silt is presented in Figure B3 in Appendix B. The results are summarized in the following table.

Soil Particles	%
Gravel	0
Sand	8
Silt	77
Clay	15

5.6 Silty Clay

Silty clay was encountered in all six boreholes drilled at the site. This grey soil typically contained trace sand and trace gravel. All boreholes were terminated within the silty clay at depths of 9.8 to 14.3 m (base Elevations from 275.8 to 270.7 m).

The weathered crust of the silty clay deposit is approximately 1.6 to 3 m thick (base elevations between 281.1 and 279.7 m). It contains trace sand and gravel, and is typically brown in colour. Within the crust, the SPT N-values typically ranged between 7 and 39 blows per 0.3 m penetration, with most values lying between 7 and 17 blows which indicates a typically firm consistency with occasional soft and very stiff zones. Below the crust, the silty clay becomes grey with measured N-values ranging between 0 and 14 blows per 0.3 m penetration with N-values increasing with depth. In conjunction with measured field vane shear strengths ranging from 18 to 69 kPa, the lower portion of the silty clay was found to have a typically firm to stiff consistency with occasional soft zones.

The measured water contents of samples recovered of the clay typically ranged from 19% to 50%. Values of between 19% and 30% were observed at shallow depths in the weathered crust. Grain size analyses conducted on samples of the silty clay are presented in Figures B4, B5 and B6, and Atterberg Limits test results are presented in Figure B7 and Figure B8 in Appendix B. The results are summarized in the following table.

Soil Particles	%
Gravel	0 to 7
Sand	0 to 8
Silt	43 to 75
Clay	25 to 57
Soil Property	%
Liquid Limit	33 to 50
Plasticity Index	14 to 25

The results of the Atterberg Limits tests indicate that the silty clay is typically of low plasticity (CL) to intermediate plasticity (CI).

Below the sampled depth in Borehole HL-04, a DCPT was carried out within the silty clay to a depth of 27.4 m (base Elevation 258.2 m). No practical refusal was encountered (100 blows per 0.3 m penetration).

5.7 Groundwater Conditions

Free water was observed in most of the boreholes upon completion of drilling and are presented below.

Table 5.1 – Water Level Measurements in Open Boreholes

Borehole	Date of Reading	Water Level	
		Depth (m)	Elevation (m)
HL-01	May 27, 2015	2.1	283.5
HL-02	June 05, 2015	1.2	280.8
HL -03	May 27, 2015	1.6	284.1
HL -05	June 03, 2015	1.3	282.9
HL -06	June 04, 2015	1.1	283.0

The groundwater level should be assumed to coincide with the local creek water level. The creek level was measured to range between 281.8 and 281.3 m in May 2015. The groundwater levels are expected to vary seasonally and are subject to severe weather events such as rainstorms.

6 CORROSIVITY AND SULPHATE TEST RESULTS

A sample of the native soil and a sample of the surface water from the creek were submitted for analytical testing of corrosivity parameters and sulphate. The results of the analytical tests are shown in Table 6.1. The laboratory certificates of analysis are presented in Appendix B.

Table 6.1 – Analytical Test Results

Parameter	Units (Soil)	Units (Water)	Test Results	
			HL-3 SS#7B, 20'5"-22'	Wood's Road Culvert
			(Soil, 6.2-6.7 m deep)	(Creek Water)
Sulphide	%	mg/L	0.02	<0.05
Chloride	µg/g	mg/L	2	2.51
Sulphate	µg/g	mg/L	2	0.88

pH	pH Units	pH Units	8.2	7.01
Electrical Conductivity	mS/cm	µS/cm	0.101	55
Resistivity	ohm.cm	ohm.cm	9900	18200
Redox Potential	mV	mV	286	339
Langlier Index	-	-	-	-1.96
Total Hardness (as CaCO ₃)	-	mg/L	-	27.5
Total Dissolved Solids	-	mg/L	-	66
Alkalinity (as CaCO ₃)	-	mg/L	-	23

7 MISCELLANEOUS

Thurber staked and/or marked the borehole locations in the field and obtained utility clearances prior to drilling. Thurber obtained the northing and easting coordinates and ground surface elevations from measurements taken in the field relative to the topographic plans provided by MMM Group Limited.

Eastern Ontario Diamond Drilling of Hawkesbury, Ontario supplied and operated a track-mounted CME-45 hi-torque drill rig to carry out the drilling, sampling and in-situ testing operations for two boreholes on the embankment shoulders and one borehole at the north culvert inlet. Walker Drilling Limited of Utopia, Ontario supplied and operated a portable tripod drill rig to carry out the drilling, sampling and in-situ testing operations for one borehole at the culvert inlet and two boreholes at the culvert outlet. The drilling and sampling operations in the field were supervised on a full time basis by Ms. Deanna Pizycki and Ms. Eckie Siu of Thurber. Geotechnical laboratory testing was carried out by Thurber in its MTO-approved laboratory.

A sample of creek water and a sample of native soil were submitted to AGAT Laboratories in Mississauga, Ontario for testing against selected corrosivity parameters.

Overall supervision of the field program, interpretation of the data, and preparation of the report were carried out by Mr. Stephane Loranger, CET, Ms. Deanna Pizycki, EIT and Mr. Mark Farrant P.Eng. The report was reviewed by Dr. P.K. Chatterji, P.Eng., a Designated Principal Contact for MTO Foundations Projects.

THURBER ENGINEERING LTD.

Deanna Pizycki
22 OCT, 2015

Deanna Pizycki, EIT
Geotechnical Engineer-in-Training



Mark Farrant, M.Eng., P.Eng.
Geotechnical Engineer



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

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




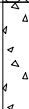

MAJOR DIVISIONS		GROUP SYMBOL	TYPICAL DESCRIPTION
COARSE GRAINED SOILS	GRAVEL AND GRAVELLY SOILS	GW	Well-graded gravels or gravel-sand mixtures, little or no fines.
		GP	Poorly-graded gravels or gravel-sand mixtures, little or no fines.
		GM	Silty gravels, gravel-sand-silt mixtures.
		GC	Clayey gravels, 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			

RECORD OF BOREHOLE No HL-01

1 OF 2

METRIC

GWP# 5030-14-00 LOCATION Wood's Road Culvert N 5 312 410.0 E 371 718.4 ORIGINATED BY DJP
 HWY BOREHOLE TYPE Hollow Stem Augers/NW Casing COMPILED BY MFA
 DATUM Geodetic DATE 2015.05.27 - 2015.05.27 CHECKED BY MEF

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										PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L				
SHEAR STRENGTH kPa								WATER CONTENT (%)													
○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE																					
285.6	GROUND SURFACE						20	40	60	80	100	20	40	60	GR	SA	SI	CL			
0.0	Gravelly SAND , some silt, trace clay, occasional cobbles Compact to Loose Brown Moist (FILL) Cored to dislodge cobbles from 0.8m to 1.4m becoming trace silt		1	SS	14														26	58	16 (SI+CL)
			2	SS	9																
			3	SS	17																
			4	SS	9																
			5	SS	6																
280.3																					
5.3	CONCRETE																				
279.5																					
6.1	Silty CLAY , frequent silt interbeds (3mm) Firm Grey becoming occasional silt interbeds (3mm) Very Soft		6	SS	8																
			7	SS	2																
			8	SS	2																
275.8																					
9.8	END OF BOREHOLE AT 9.8m.																				

Continued Next Page

+³, ×³: Numbers refer to
Sensitivity

20
15
10
(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No HL-01

2 OF 2

METRIC

GWP# 5030-14-00 LOCATION Wood's Road Culvert N 5 312 410.0 E 371 718.4 ORIGINATED BY DJP
 HWY BOREHOLE TYPE Hollow Stem Augers/NW Casing COMPILED BY MFA
 DATUM Geodetic DATE 2015.05.27 - 2015.05.27 CHECKED BY MEF

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100					
	Continued From Previous Page																
	WATER LEVEL AT 2.1m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND CUTTINGS TO 0.2m AND GRANULAR TO SURFACE.																

RECORD OF BOREHOLE No HL-02

1 OF 2

METRIC

GWP# 5030-14-00 LOCATION Wood's Road Culvert N 5 312 396.0 E 371 708.2 ORIGINATED BY ES
 HWY BOREHOLE TYPE Tripod COMPILED BY MFA
 DATUM Geodetic DATE 2015.06.05 - 2015.06.05 CHECKED BY MEF

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa				WATER CONTENT (%)						
								20 40 60 80 100	W _P W W _L									
282.0	GROUND SURFACE																	
0.0	SILT, trace sand, some clay, some organics (roots and rootlets) Loose Dark Brown Moist		1	SS	6	▽									kN/m ³	GR SA SI CL		
281.4																		
0.6	Silty CLAY, trace sand Firm to Stiff Brown																	
	Occasional oxide staining becoming Grey		2	SS	11													
			3	SS	7													
			4	SS	4													
			5	SS	4													
			6	SS	4													
			7	SS	3													
			8	SS	4													
			9	SS	8													

Continued Next Page

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

RECORD OF BOREHOLE No HL-02

2 OF 2

METRIC

GWP# 5030-14-00 LOCATION Wood's Road Culvert N 5 312 396.0 E 371 708.2 ORIGINATED BY ES
 HWY BOREHOLE TYPE Tripod COMPILED BY MFA
 DATUM Geodetic DATE 2015.06.05 - 2015.06.05 CHECKED BY MEF

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE									
	Continued From Previous Page																
270.7			10	SS	14		271									0 0 68 32	
11.3	END OF BOREHOLE AT 11.3m. WATER LEVEL AT 1.2m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO SURFACE.																

RECORD OF BOREHOLE No HL-03

1 OF 2

METRIC

GWP# 5030-14-00 LOCATION Wood's Road Culvert N 5 312 391.4 E 371 718.6 ORIGINATED BY DJP
 HWY BOREHOLE TYPE NW Casing COMPILED BY MFA
 DATUM Geodetic DATE 2015.05.27 - 2015.05.27 CHECKED BY MEF

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w _P	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa												
285.7	GROUND SURFACE							20	40	60	80	100								
0.0	SILT , some clay, some sand, trace gravel, trace organics Soft Brown Moist (FILL)		1	SS	4		285													
	SAND , trace gravel, trace silt, trace clay, trace cobbles Loose Brown Moist (FILL)	2	SS	6																
	Becoming gravelly Dense		4	SS	49		283													
	Cobble or boulder from 2.9 to 3.0m																			
282.5	SILT , some clay, trace sand Compact to Loose Grey Moist		5	SS	20		282													
3.2																				
	Becoming some clay to clayey		6	SS	9		281													
							280													
279.5	Silty CLAY , occasional silt seams (2mm) Firm Brown to Grey		7	SS	13		279													
6.2																				
							278													
			8	SS	0															
							277													
			9	SS	0		276													

Continued Next Page

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

RECORD OF BOREHOLE No HL-03

2 OF 2

METRIC

GWP# 5030-14-00 LOCATION Wood's Road Culvert N 5 312 391.4 E 371 718.6 ORIGINATED BY DJP
 HWY BOREHOLE TYPE NW Casing COMPILED BY MFA
 DATUM Geodetic DATE 2015.05.27 - 2015.05.27 CHECKED BY MEF

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														
	Continued From Previous Page							20	40	60	80	100		W _p	W	W _L						
	Silt and clay interbeds (25mm)						275															
		10	SS	0			274															
		11	SS	3			273															
271.4			12	SS	5		272													0 0 71 29		
14.3	END OF BOREHOLE AT 14.3m. WATER LEVEL AT 1.6m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND CUTTINGS TO 0.2m AND GRANULAR TO SURFACE.																					


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

RECORD OF BOREHOLE No HL-04

1 OF 3

METRIC

GWP# 5030-14-00 LOCATION Wood's Road Culvert N 5 312 407.4 E 371 725.4 ORIGINATED BY DJP
 HWY BOREHOLE TYPE Casing/Dynamic Cone Penetration Test COMPILED BY MFA
 DATUM Geodetic DATE 2015.05.26 - 2015.05.26 CHECKED BY MEF

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		
285.6	GROUND SURFACE							20	40	60	80	100										
0.0	SILT , some sand, some clay, trace gravel, trace organics (roots) Very Soft Brown Moist (FILL) SAND , some gravel, trace silt, occasional cobbles and boulders Loose to Compact Brown Moist (FILL) Cobble (150mm) at 2.9m Loose Becoming Grey and Wet Boulder (400mm) at 4.3m		1	SS	1																	
0.1																						
			2	SS	7																	
			3	SS	10																	
			4	SS	15																	
			5	SS	9																	
</																						

Continued Next Page

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

RECORD OF BOREHOLE No HL-04

2 OF 3

METRIC

GWP# 5030-14-00 LOCATION Wood's Road Culvert N 5 312 407.4 E 371 725.4 ORIGINATED BY DJP
 HWY BOREHOLE TYPE Casing/Dynamic Cone Penetration Test COMPILED BY MFA
 DATUM Geodetic DATE 2015.05.26 - 2015.05.26 CHECKED BY MEF

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE								
	Continued From Previous Page															
	becoming Firm		10	SS	7		275									
							274									
	Some silt and clay seams (25mm)		11	SS	4		273									
							272									
			12	SS	6											
271.3							271									
14.3	End of sampling at 14.3m and start of DCPT.						270									
							269									
							268									
							267									
							266									

Continued Next Page

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

RECORD OF BOREHOLE No HL-04

3 OF 3

METRIC

GWP# 5030-14-00 LOCATION Wood's Road Culvert N 5 312 407.4 E 371 725.4 ORIGINATED BY DJP
 HWY BOREHOLE TYPE Casing/Dynamic Cone Penetration Test COMPILED BY MFA
 DATUM Geodetic DATE 2015.05.26 - 2015.05.26 CHECKED BY MEF

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE									
	Continued From Previous Page																
							265										
							264										
							263										
							262										
							261										
							260										
							259										
258.2 27.4	END OF BOREHOLE AND DCPT AT 27.4m. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND CUTTINGS TO 0.2m AND GRANULAR TO SURFACE.																

ONTMT4S 19-5161-252.GPJ 2015TEMPLATE(MTO).GDT 10/22/15

RECORD OF BOREHOLE No HL-05

1 OF 2

METRIC

GWP# 5030-14-00 LOCATION Wood's Road Culvert N 5 312 378.6 E 371 729.2 ORIGINATED BY ES
 HWY BOREHOLE TYPE Tripod COMPILED BY MFA
 DATUM Geodetic DATE 2015.06.03 - 2015.06.03 CHECKED BY MEF

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W _P	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)							
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa								WATER CONTENT (%)				GR	SA	SI	CL
								○ UNCONFINED	+ FIELD VANE	● QUICK TRIAXIAL	× LAB VANE												
284.2	GROUND SURFACE																						
0.0	TOPSOIL , some roots and rootlets: (50mm) SAND , trace silt and clay, trace gravel, trace roots Loose Brown Damp		1	SS	9												3	91	6 (SI+CL)				
0.1																							
283.5			2	SS	13																		
0.7	Silty CLAY , trace sand, trace gravel Stiff Dark Brown to Brown Very Stiff Brown																						
	occasional sand seams		3	SS	17																		
			4	SS	9												0	0	64 36				
			5	SS	9																		
			6	SS	8																		
	becoming Firm		7	SS	5																		
	trace gravel becoming Soft		8	SS	3												0	0	48 52				
			9	SS	0																		
			10	SS	2																		

Continued Next Page

+³, ×³: Numbers refer to
Sensitivity

20
15
10

(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No HL-05

2 OF 2

METRIC

GWP# 5030-14-00 LOCATION Wood's Road Culvert N 5 312 378.6 E 371 729.2 ORIGINATED BY ES
 HWY BOREHOLE TYPE Tripod COMPILED BY MFA
 DATUM Geodetic DATE 2015.06.03 - 2015.06.03 CHECKED BY MEF

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE									
	Continued From Previous Page							20	40	60	80	100					
272.9	Firm		11	SS	6		274										0 0 75 25
11.3	END OF BOREHOLE AT 11.3m. WATER LEVEL AT 1.3m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO SURFACE.						273										

RECORD OF BOREHOLE No HL-06

1 OF 2

METRIC

GWP# 5030-14-00 LOCATION Wood's Road Culvert N 5 312 407.8 E 371 728.5 ORIGINATED BY ES
 HWY BOREHOLE TYPE Tripod COMPILED BY MFA
 DATUM Geodetic DATE 2015.06.04 - 2015.06.04 CHECKED BY MEF

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)						
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									WATER CONTENT (%)			GR	SA	SI	CL
								○ UNCONFINED	+ FIELD VANE	● QUICK TRIAXIAL	× LAB VANE												
284.1	GROUND SURFACE																						
0.0	SILT , trace sand to sandy, some clay, trace organics (roots and rootlets) Loose Dark Brown Moist to Wet		1	SS	4																		
			2	SS	6																		
282.7																							
1.4	Silty CLAY , trace sand, trace gravel Stiff to Hard Brown to Grey Wet		3	SS	8																		
			4	SS	39																		
	becoming Firm		5	SS	7																		
			6	SS	2																		
			7	SS	1																		
			8	SS	3																		
			9	SS	8																		

Continued Next Page

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

RECORD OF BOREHOLE No HL-06

2 OF 2

METRIC

GWP# 5030-14-00 LOCATION Wood's Road Culvert N 5 312 407.8 E 371 728.5 ORIGINATED BY ES
 HWY _____ BOREHOLE TYPE Tripod COMPILED BY MFA
 DATUM Geodetic DATE 2015.06.04 - 2015.06.04 CHECKED BY MEF

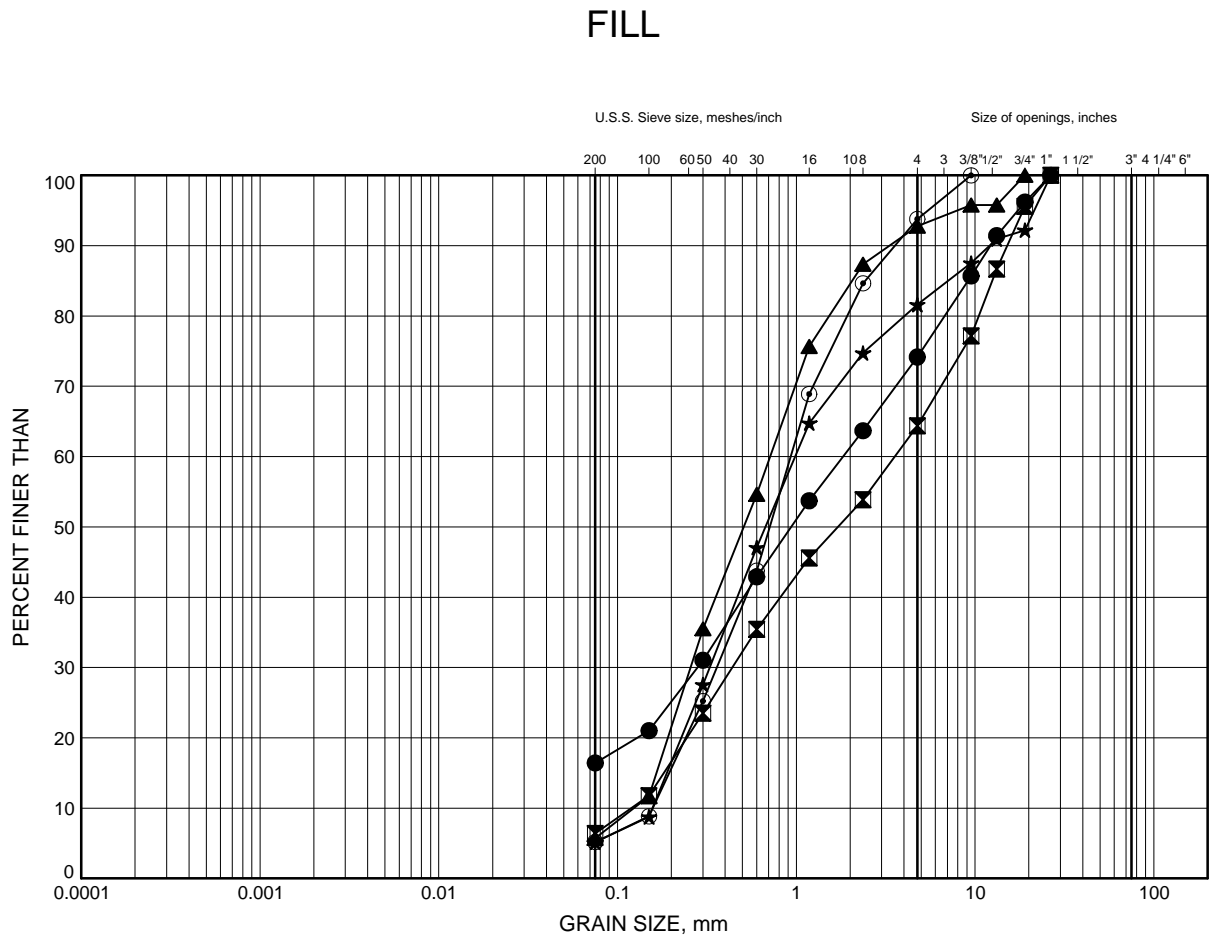
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa	WATER CONTENT (%)								
	Continued From Previous Page							20	40	60	80	100					
	Stiff						274										
			10	SS	9		273										
272.8																	
11.3	END OF BOREHOLE AT 11.3m. WATER LEVEL AT 1.1m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO SURFACE.																

Appendix B

Geotechnical and Analytical Laboratory Test Results

Wood's Road Culvert GRAIN SIZE DISTRIBUTION

FIGURE B1



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	HL-01	0.30	285.30
⊠	HL-01	4.88	280.72
▲	HL-03	1.83	283.87
★	HL-04	1.07	284.53
⊙	HL-04	4.78	280.82

Date ..October 2015.....

GWP# ..5030-14-00.....



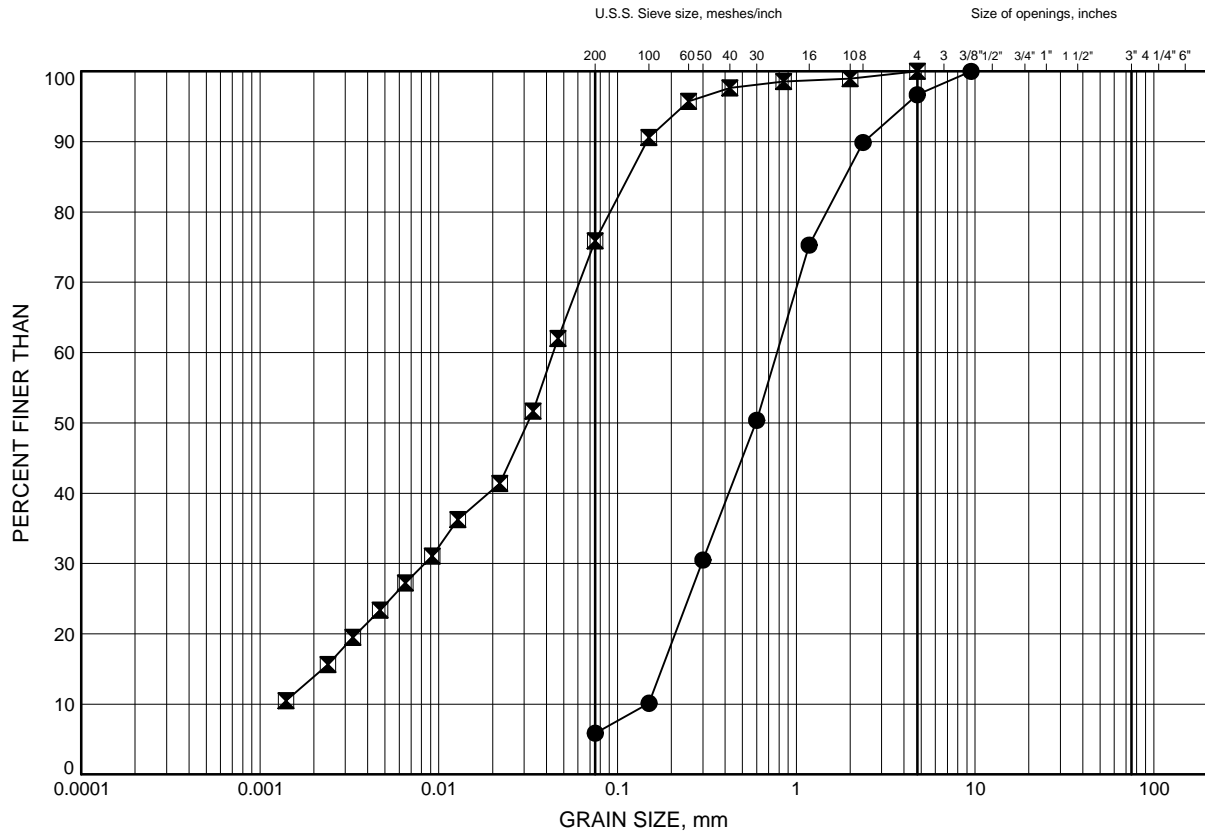
Prep'dAN.....

Chkd.AMP.....

Wood's Road Culvert GRAIN SIZE DISTRIBUTION

FIGURE B2

SAND to Sandy SILT



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	HL-05	0.33	283.87
⊠	HL-06	1.07	283.03

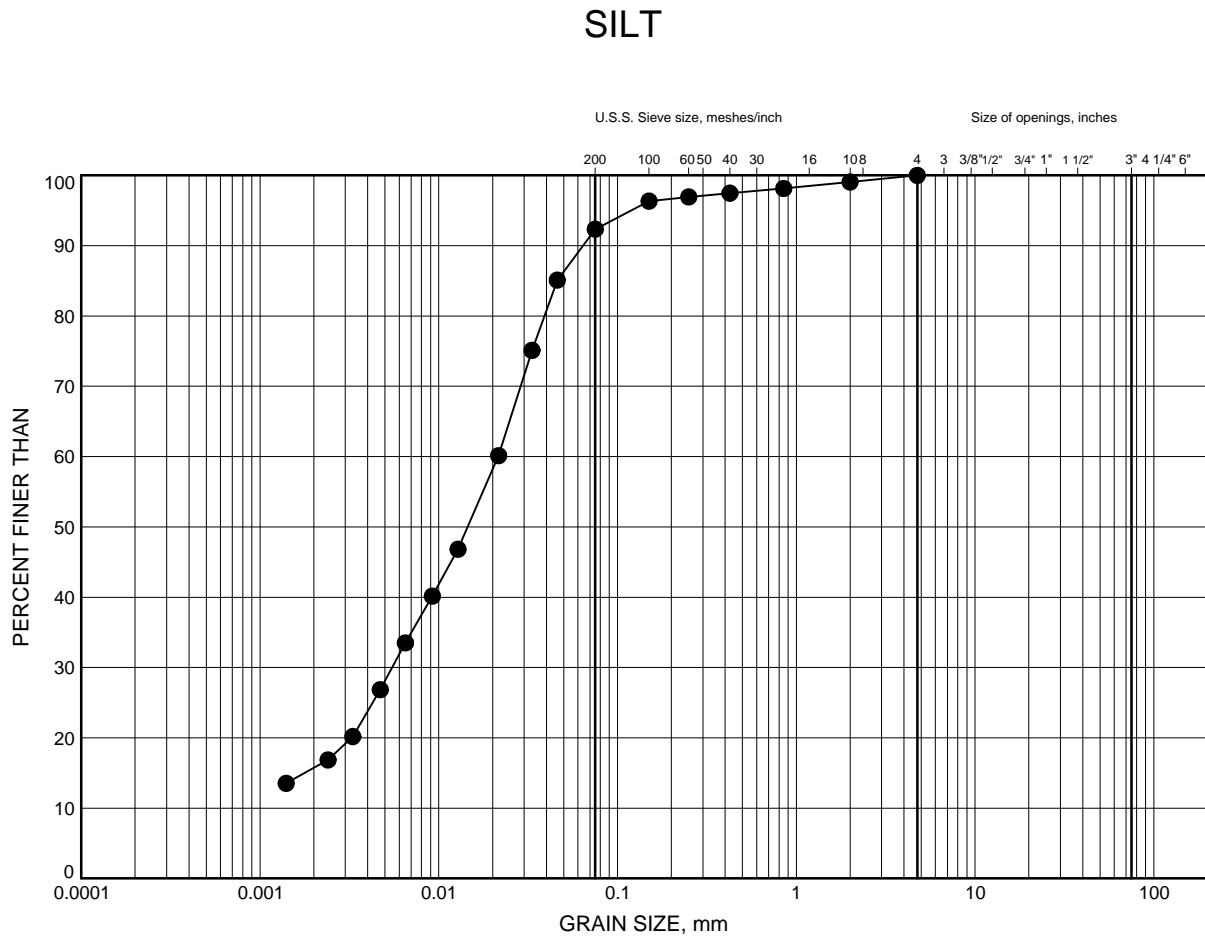
Date October 2015
GWP# 5030-14-00



Prep'd AN
Chkd. AMP

Wood's Road Culvert GRAIN SIZE DISTRIBUTION

FIGURE B3



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	HL-03	3.42	282.28

Date October 2015
GWP# 5030-14-00

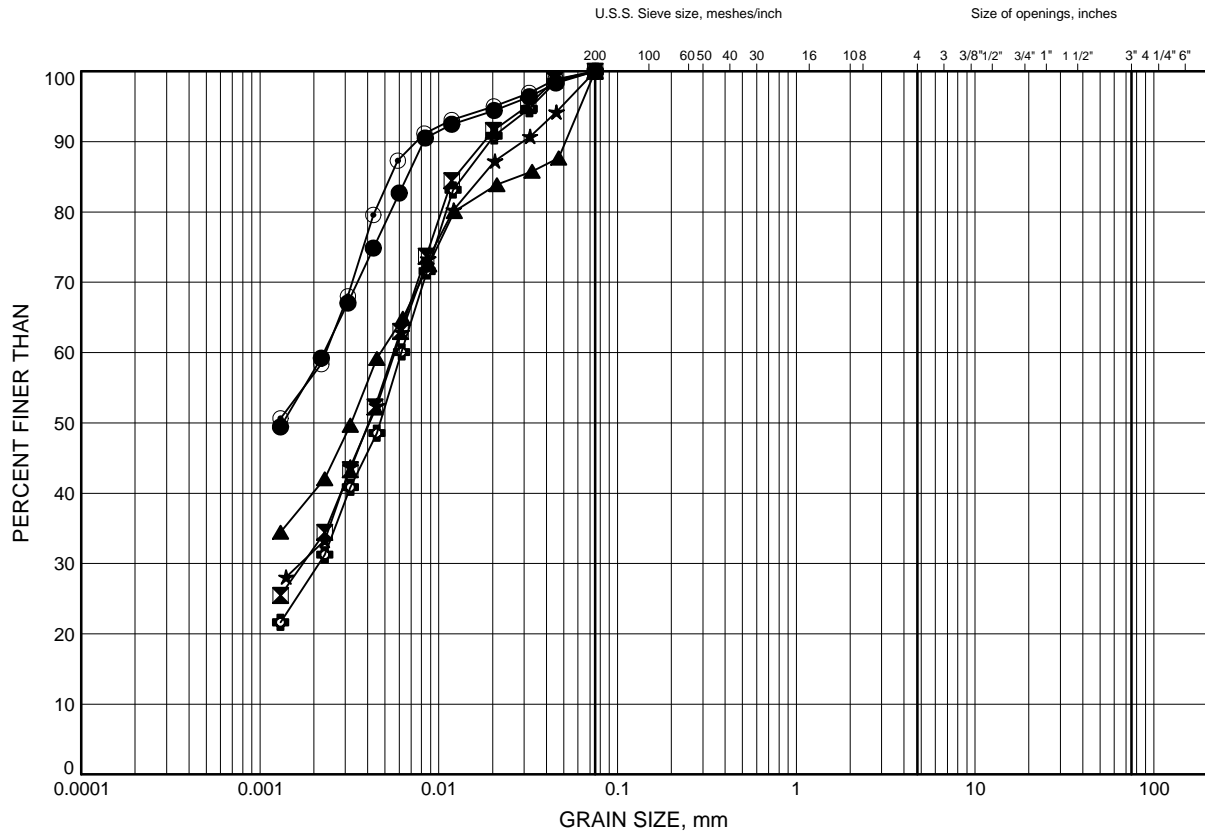


Prep'd AN
Chkd. AMP

Wood's Road Culvert 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)
●	HL-01	7.92	277.68
⊠	HL-02	1.83	280.17
▲	HL-02	6.40	275.60
★	HL-02	10.97	271.03
⊙	HL-03	9.45	276.25
⊕	HL-03	14.02	271.68

Date ..October 2015.....

GWP# ..5030-14-00.....

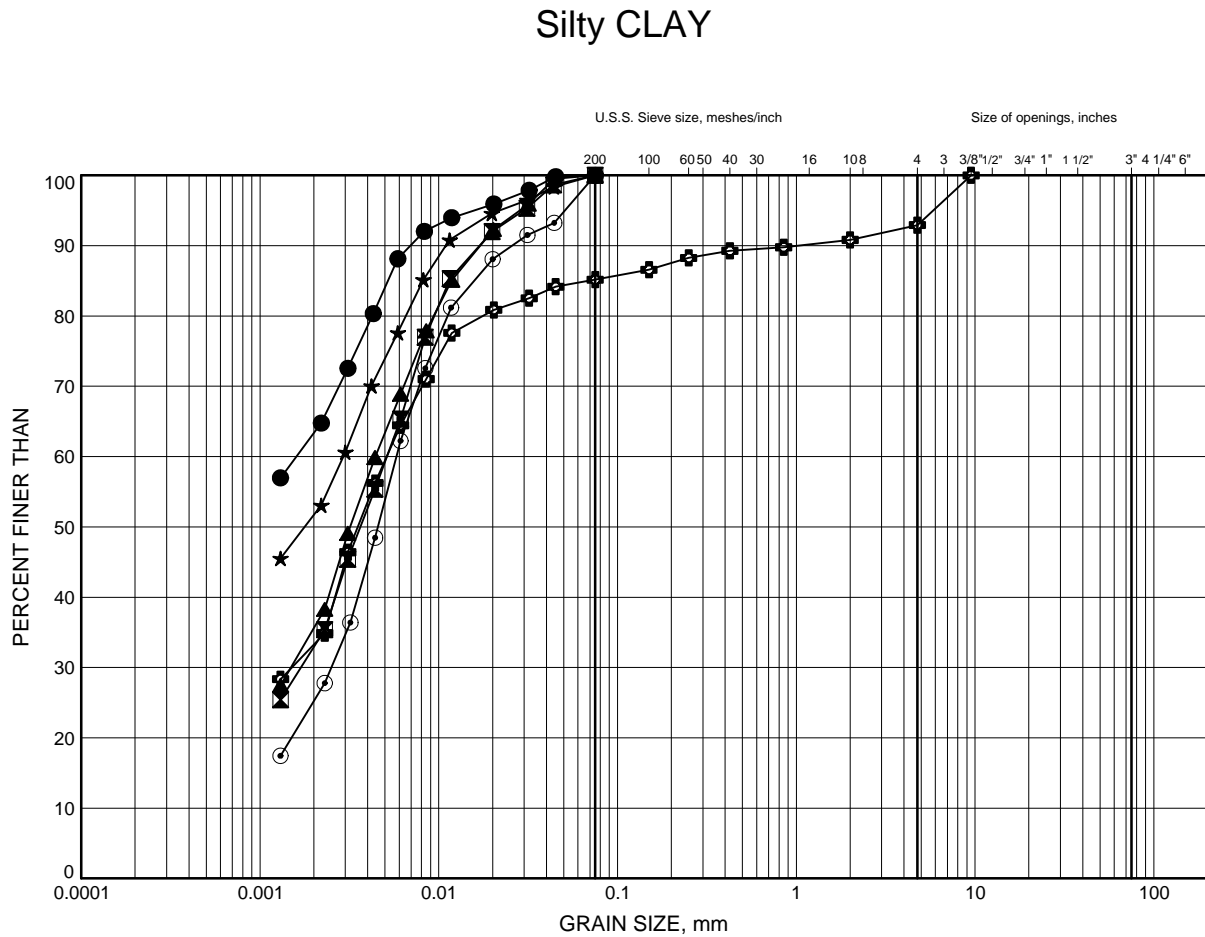


Prep'dAN.....

Chkd.AMP.....

Wood's Road Culvert 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)
●	HL-04	9.45	276.15
⊠	HL-04	14.02	271.58
▲	HL-05	2.59	281.61
★	HL-05	6.40	277.80
⊙	HL-05	10.97	273.23
⊕	HL-06	2.59	281.51

Date ..October 2015.....

GWP# ..5030-14-00.....



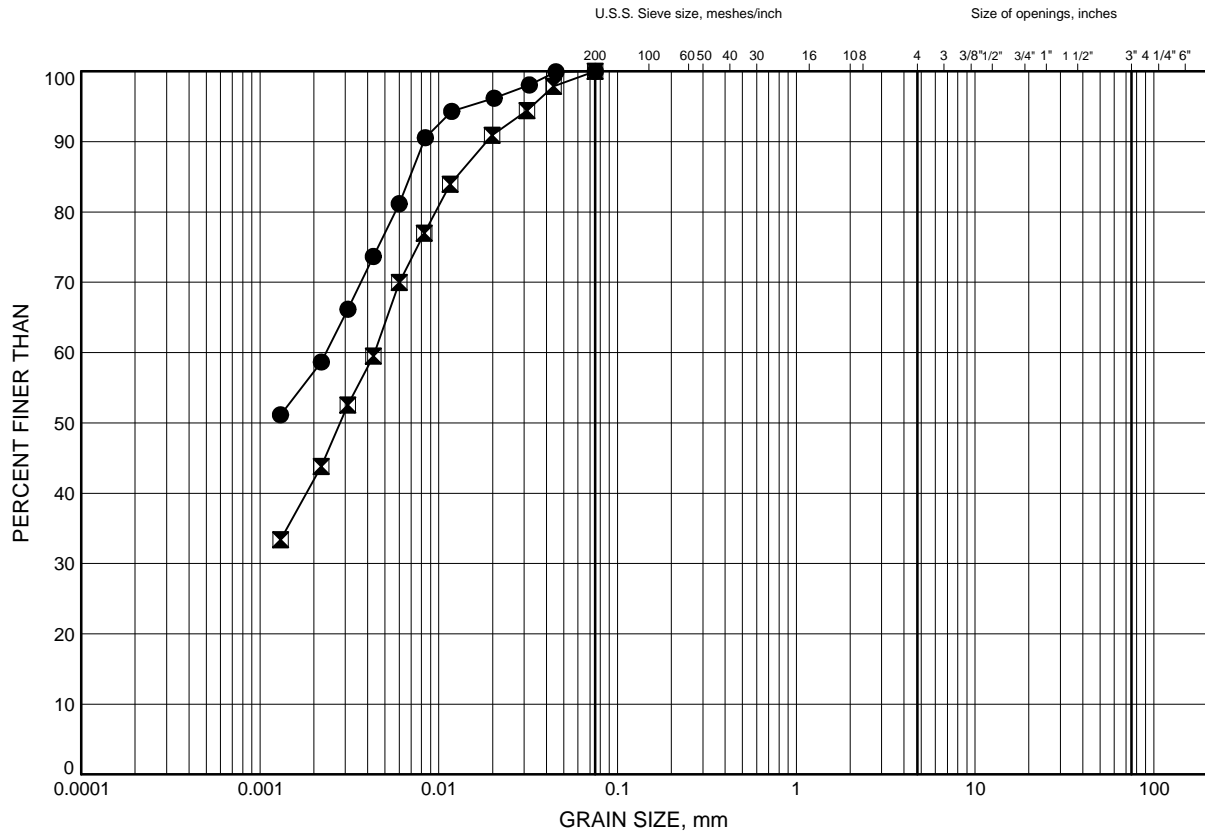
Prep'dAN.....

Chkd.AMP.....

Wood's Road Culvert GRAIN SIZE DISTRIBUTION

FIGURE B6

Silty CLAY



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	HL-06	6.40	277.70
⊠	HL-06	9.45	274.65

Date October 2015
GWP# 5030-14-00

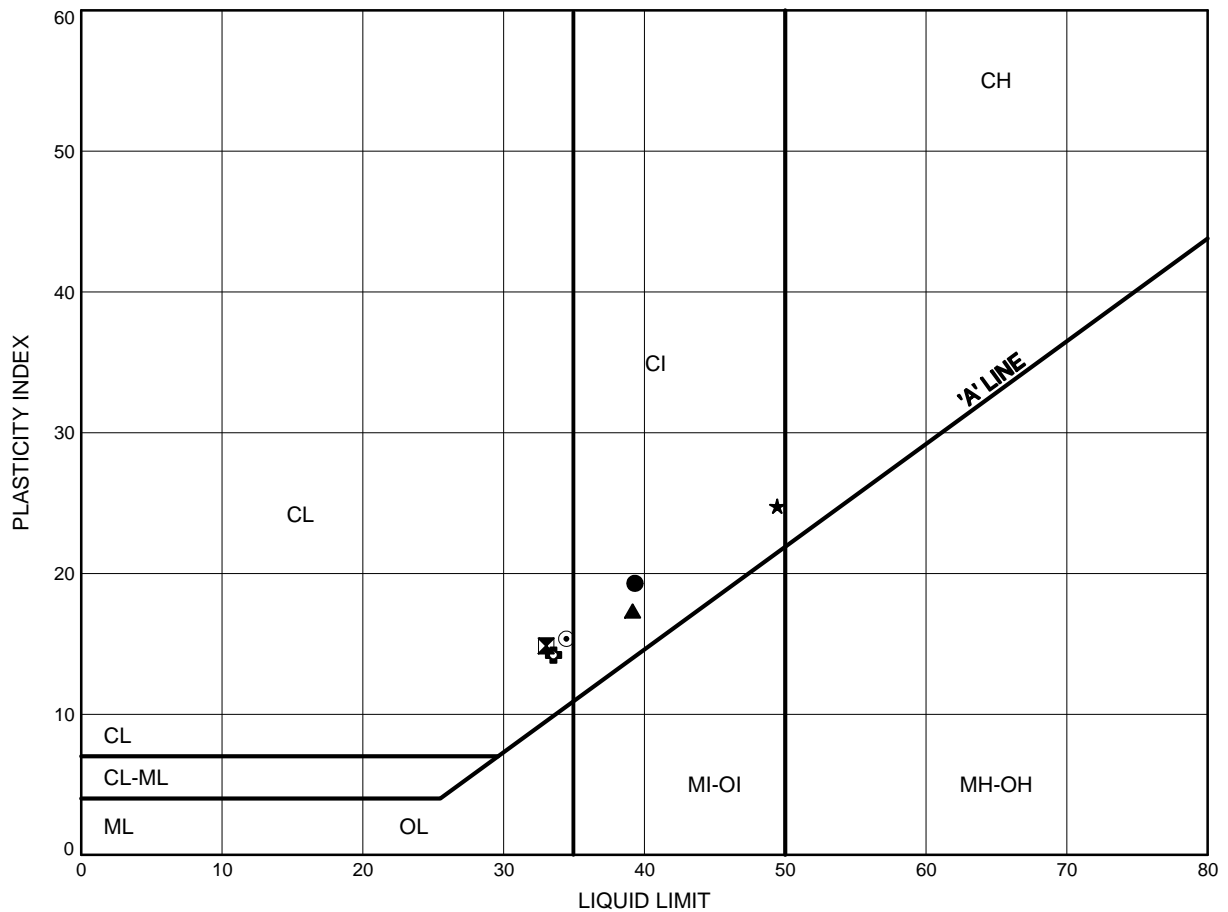


Prep'd AN
Chkd. AMP

Wood's Road Culvert
ATTERBERG LIMITS TEST RESULTS

FIGURE B7

Silty CLAY



LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	HL-01	7.92	277.68
⊠	HL-02	6.40	275.60
▲	HL-03	9.45	276.25
★	HL-04	9.45	276.15
⊙	HL-05	2.59	281.61
⊕	HL-05	6.40	277.80

Date ..October 2015.....
 GWP# ..5030-14-00.....

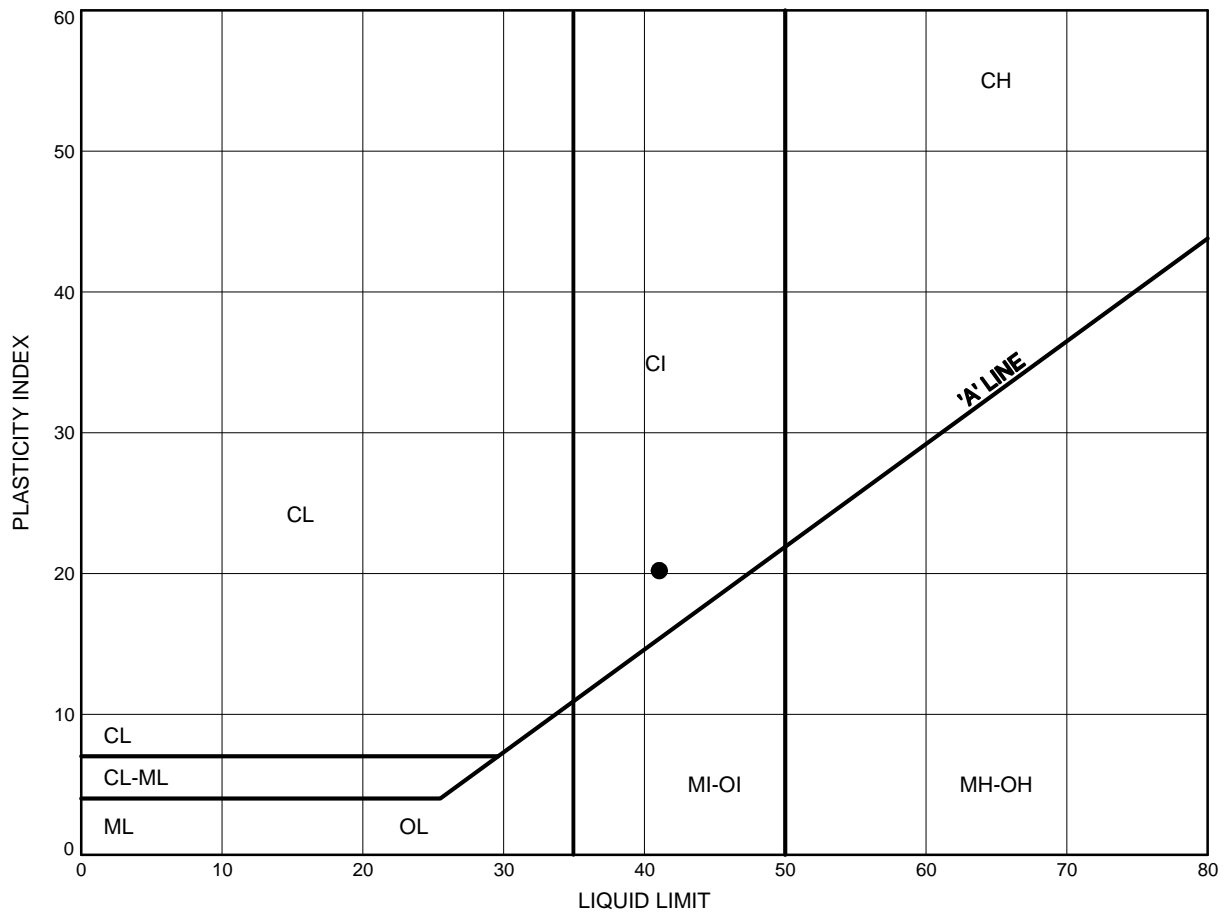


Prep'dAN.....
 Chkd.AMP.....

Wood's Road Culvert
ATTERBERG LIMITS TEST RESULTS

FIGURE B8

Silty CLAY



LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	HL-06	6.40	277.70

Date October 2015
 GWP# 5030-14-00



Prep'd AN
 Chkd. AMP

Certificate of Analysis

CLIENT NAME: THURBER ENGINEERING LTD

PROJECT: 19-5161-252

SAMPLING SITE:

AGAT WORK ORDER: 15T980955

ATTENTION TO: MARK FARRANT

SAMPLED BY:

Corrosivity Package							
SAMPLE TYPE: Soil		SAMPLE ID: 6615976			DATE RECEIVED: Jun 04, 2015		
DATE SAMPLED: May 23, 2015				DATE REPORTED: Jun 09, 2015			
SAMPLE DESCRIPTION: HL-3 SS7B 20'5"-22'							
PARAMETER	UNIT	RESULT	G / S	RDL	DATE ANALYZED	INITIAL	DATE PREPARED
Sulfide	%	0.02		0.01	Jun 09, 2015	FM	Jun 08, 2015
Chloride (2:1)	µg/g	2		2	Jun 09, 2015	WZ	Jun 09, 2015
Sulphate (2:1)	µg/g	2		2	Jun 09, 2015	WZ	Jun 09, 2015
pH (2:1)	pH Units	8.20		NA		BG	Jun 09, 2015
Electrical Conductivity (2:1)	mS/cm	0.101		0.005	Jun 09, 2015	TM	Jun 09, 2015
Resistivity (2:1)	ohm.cm	9900		1	Jun 09, 2015	SYS	Jun 09, 2015
Redox Potential (2:1)	mV	286		5	Jun 09, 2015	TM	Jun 09, 2015

COMMENTS:

RDL - Reported Detection Limit; G / S - Guideline / Standard
* Sulphide analysis was performed at AGAT Laboratories Vancouver.

EC/Resistivity, pH, Chloride, Sulphate and Redox Potential were determined on the extract obtained from the 2:1 leaching procedure (2 parts DI water: 1 part soil).

Certified By:



Certificate of Analysis

CLIENT NAME: THURBER ENGINEERING LTD

PROJECT: 19-5161-252

SAMPLING SITE:

AGAT WORK ORDER: 15T981461

ATTENTION TO: MARK FARRANT

SAMPLED BY: DP

Inorganic Chemistry (Water)							
SAMPLE TYPE: Water		SAMPLE ID: 6621886			DATE RECEIVED: Jun 05, 2015		
DATE SAMPLED: Jun 03, 2015				DATE REPORTED: Jun 10, 2015			
SAMPLE DESCRIPTION: Wood’s Road Culvert							
PARAMETER	UNIT	RESULT	G / S	RDL	DATE ANALYZED	INITIAL	DATE PREPARED
Electrical Conductivity	uS/cm	55		2	Jun 08, 2015	JC	Jun 08, 2015
pH	pH Units	7.01		NA	Jun 08, 2015	JC	Jun 08, 2015
Langelier Index		-1.96			Jun 09, 2015	SYS	Jun 09, 2015
Total Hardness (as CaCO3)	mg/L	27.5		0.5	Jun 09, 2015	SYS	Jun 09, 2015
Total Dissolved Solids	mg/L	66		20	Jun 08, 2015	BP	Jun 08, 2015
Alkalinity (as CaCO3)	mg/L	23		5	Jun 08, 2015	JC	Jun 08, 2015
Resistivity	ohms.cm	18200			Jun 08, 2015	SYS	Jun 08, 2015
Redox Potential	mV	339		5	Jun 10, 2015	TM	Jun 10, 2015
Chloride	mg/L	2.51		0.10	Jun 08, 2015	WZ	Jun 08, 2015
Sulphate	mg/L	0.88		0.10	Jun 08, 2015	WZ	Jun 08, 2015
Sulphide	mg/L	<0.05		0.05	Jun 10, 2015	SN	Jun 10, 2015

COMMENTS:

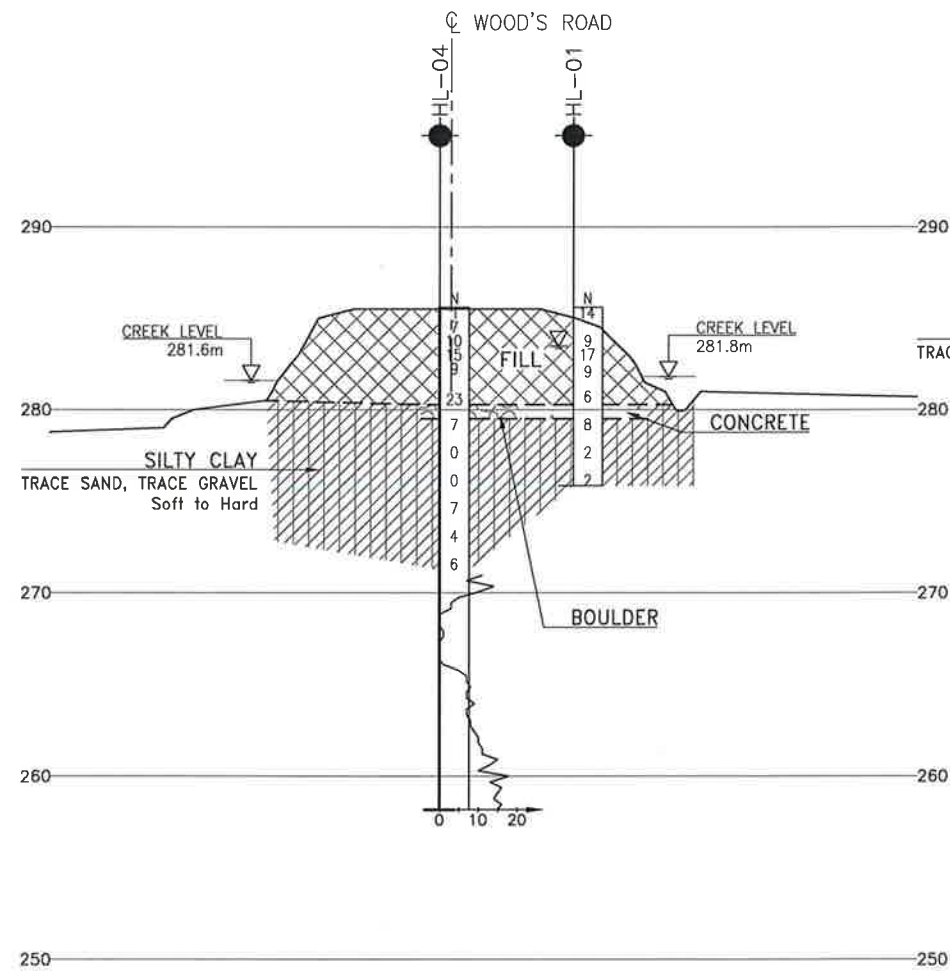
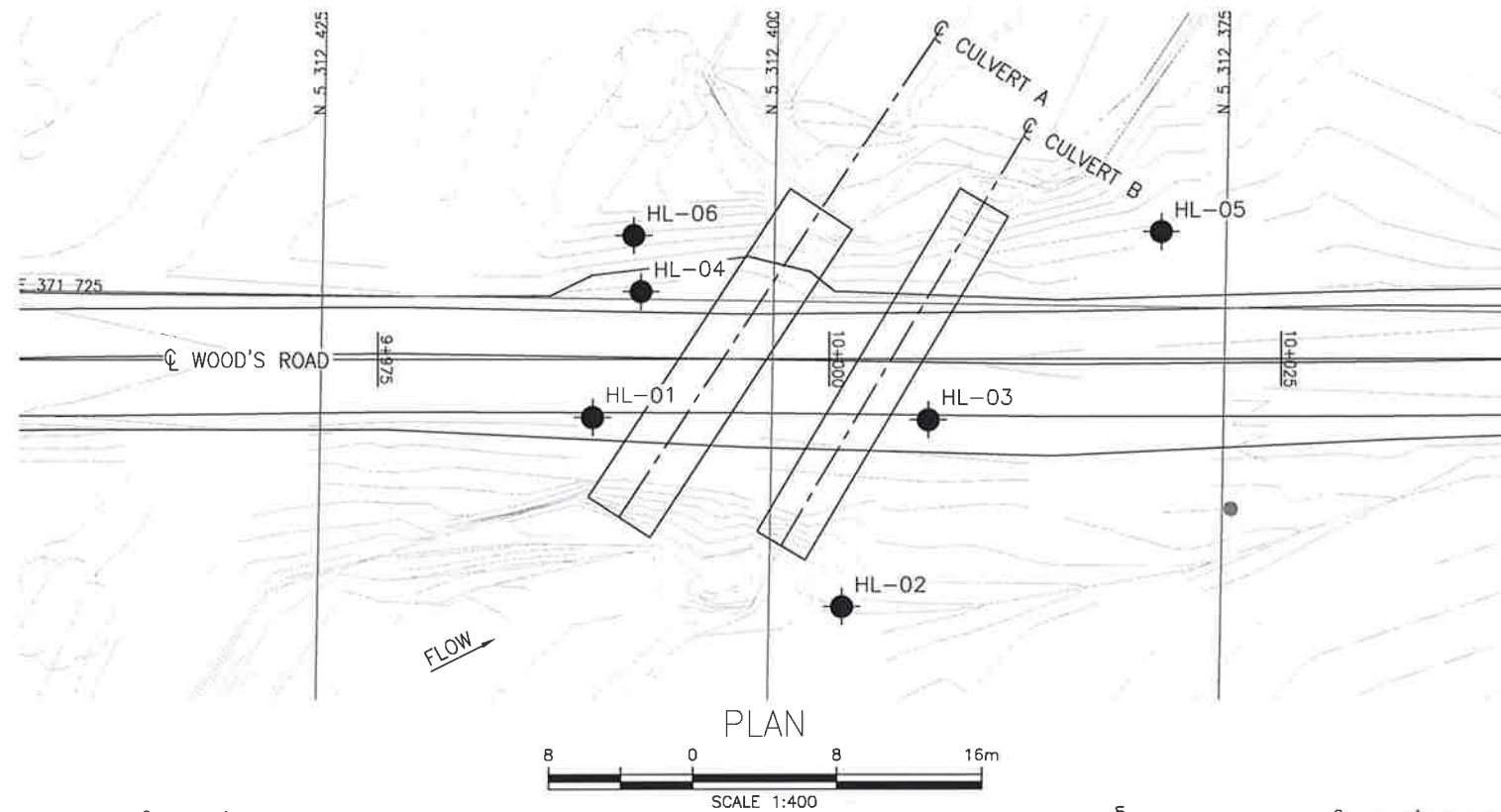
RDL - Reported Detection Limit; G / S - Guideline / Standard

Certified By:

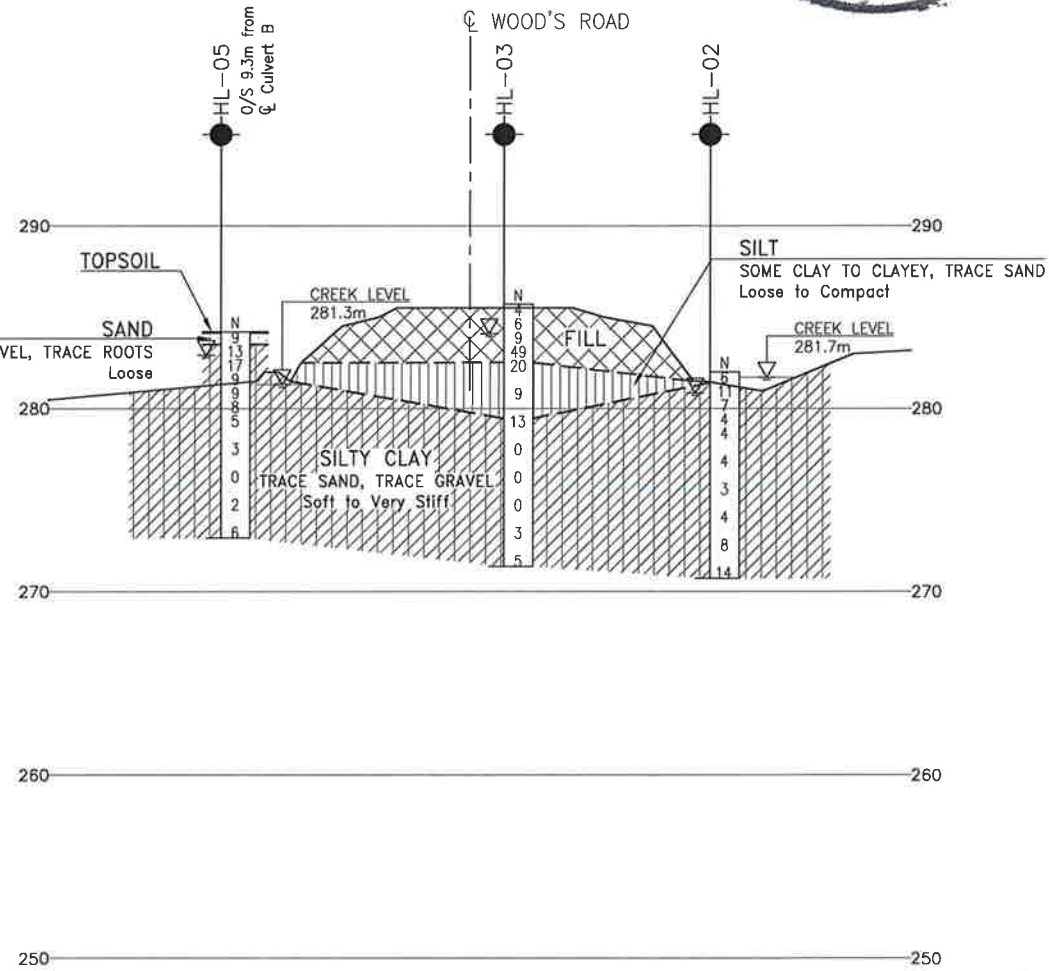


Appendix C

Borehole Locations and Soil Strata Drawings



SECTION ALONG CULVERT A



SECTION ALONG CULVERT B

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

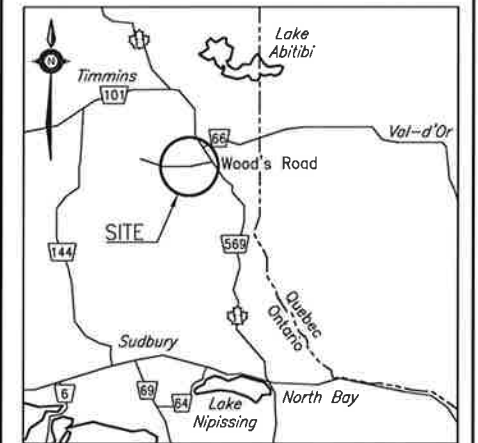


CONT No
GWP No 5030-14-00

WOOD'S ROAD
CULVERT
REPLACEMENT
BOREHOLE LOCATIONS AND SOIL STRATA



SHEET



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

NO	ELEVATION	NORTHING	EASTING
HL-01	285.6	5 312 410.0	371 718.4
HL-02	282.0	5 312 396.0	371 708.2
HL-03	285.7	5 312 391.4	371 718.6
HL-04	285.6	5 312 407.4	371 725.4
HL-05	284.2	5 312 378.6	371 729.2
HL-06	284.1	5 312 407.8	371 728.5

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. 41P-65

REVISIONS	DATE	BY	DESCRIPTION
DESIGN	DJP	CHK MEF	CODE
DRAWN	MFA	CHK DJP	SITE 47-331/C/STRUCT
			LOAD
			DATE OCT 2015
			DWG 1

Appendix D

Selected Photograph of Culvert Location

Wood's Road Culvert Replacement
Wood's Road, Site No. 47-331



Photo 1: Wood's Road Culvert Inlet Looking East



Photo 2: Wood's Road Culvert Outlet Looking Southwest

Wood's Road Culvert Replacement
Wood's Road, Site No. 47-331



**Photo 3: Looking east from Culvert North Barrel Outlet.
Slope erosion visible on north bank of creek**



**Photo 4: Looking East towards Culvert North Barrel Inlet. Retaining Structure with Rock Fill
noted along road embankment.**