



THURBER ENGINEERING LTD.

**DETAILED FOUNDATION INVESTIGATION REPORT
ROSSMERE CREEK CULVERT REPLACEMENT
HIGHWAY 11, HAGEY TOWNSHIP
DISTRICT OF THUNDER BAY, ONTARIO
G.W.P. No. 6804-14-00, W.P. No. 6804-14-01
SITE No. 48W-192/C
LATITUDE: 48.635823°, LONGITUDE: -90.185649°**

GEOCRES Number: 52B-36

Report

to

WSP Canada Inc.

Date: October 31, 2018
File: 22155



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1. INTRODUCTION

This report presents the factual data obtained from a foundation investigation carried out by Thurber Engineering Ltd. (Thurber) for the detailed design of the proposed Rossmere Creek Culvert replacement. The Rossmere Creek culvert is located on Highway 11, west of Shebandowan, in Hagey Township, District of Thunder Bay, Ontario. Thurber previously conducted a preliminary foundation investigation at the culvert site in 2017.

The purpose of this investigation was to explore the subsurface conditions at the culvert site and, based on the data obtained, to provide a borehole location plan, stratigraphic profile, records of boreholes, laboratory test results, and a written description of the subsurface conditions.

Thurber was retained by WSP Canada Inc. (WSP) to carry out this detailed foundation investigation under the Ministry of Transportation Ontario (MTO) Agreement Number 6015-E-0035.

The preliminary investigation previously conducted by Thurber is described in the following report:

- Preliminary Foundation Investigation and Design Report, Rossmere Creek Culvert Replacement, Highway 11, Site No. 48W-192/C, Hagey Township, District of Thunder Bay Ontario, GEOCRES Number 52B-32, dated October 2, 2017, prepared by Thurber Engineering Ltd.

The Borehole Logs from the preliminary investigation are included in this report.

2. SITE DESCRIPTION

The site is located on Highway 11, approximately 2.9 km west of the intersection of Highway 586

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and Highway 11 in Hagey Township, District of Thunder Bay, Ontario. The key plan showing the general location of the culvert site is presented on the Borehole Location and soil Strata Drawings in Appendix D.

Highway 11 runs in a general east-west direction with the culvert perpendicular to the centreline of the highway. The culvert allows Rossmere Creek to flow in a southerly direction and drain into Rossmere Bay, part of Middle Shebandowan Lake.

The Ontario Structural Inspection Manual (Inspection Form) prepared by MTO on December 16 2015 indicates that the existing structure is a 25 m long, three span (1.4 m, 1.4 m, 1.0 m) open footing, timber structure culvert with an unknown construction date. The culvert invert is at approximately Elevation 449.3 m at the inlet (north end) and 449.2 m at the outlet (south end), and the culvert height is approximately 1.2 m. The existing road grade of Highway 11 at the culvert location is approximately Elev. 452.2 m, which indicates approximately 1.8 m of fill above the culvert. The Rossmere water level (ice level) was measured by Thurber at Elevation 450.2 m on March 27, 2017, and was measured by others at 450.0 m in August, 2015. At the time of the field investigations the culvert was flowing mostly full, with the top of the ice elevation just below the crest of the culvert. No information is available to indicate whether the culvert is founded on footings or timber piles.

The lands surrounding Rossmere Creek and the culvert at the site predominantly consist of heavily forested areas with occasional marsh lands and lakes. Local topography is generally of low relief and consists of organic terrain. Photographs of the culvert and surrounding area are presented in Appendix C.

Based on published geological information, the subsurface soils at the site generally consist of organic deposits of peat with nearby ground moraine deposits of silty to sand till. Bedrock in the area has been identified as mafic to intermediate metavolcanic bedrock, comprised of basaltic and andesitic flows.

3. INVESTIGATION PROCEDURES

The current investigation and field testing program was carried out between March 7 and April 23, 2018, and consisted of drilling and sampling six (6) boreholes, designated as Boreholes 18-01 to 18-06, to depths ranging from 9.8 m to 15.5 m below the existing ground surface. Boreholes 18-01 to 18-04 were drilled near the inlet and outlet of the existing culverts near the locations of the the proposed cofferdams, and Boreholes 18-05 and 18-06 were drilled through the paved section



of Highway 11 for the proposed roadway protection systems and diversion pipe.

The previous preliminary investigation was carried out between March 25 and 27, 2017 and consisted of drilling and sampling a total of seven (7) boreholes, designated as Boreholes 17-15 to 17-21, to depths ranging from 3.7 m to 15.3 m below the existing ground surface.

The Record of Borehole sheets for the boreholes from the current and previous investigations are included in Appendix A. The approximate locations of the boreholes from both investigations are shown on the Borehole Locations and Soil Strata Drawings included in Appendix D.

Utility clearances were obtained prior to the start of drilling. The ground surface elevations for the boreholes were estimated from cross sections and topographic drawings provided to Thurber by WSP. The boreholes from the current investigation were drilled using a truck mounted drill rig with hollow stem augers and wash boring techniques for Boreholes 18-05 and 18-06, and a portable Hilti drill and tripod equipment using wash boring techniques for Boreholes 18-01 to 18-04. Samples of the overburden soils were obtained from the boreholes at selected intervals using a split spoon sampler in conjunction with Standard Penetration Testing (SPT). A Dynamic Cone Penetration Test (DCPT) was carried out at Boreholes 18-05 and 18-06 adjacent to the original borehole to cone refusal depth of approximately 14.1 m and 15.5 m, respectively.

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

Piezometers were installed as part of the current investigation in Boreholes 18-02, 18-03 and 18-06, and water level readings were taken throughout the investigation. The piezometers were decommissioned at the completion of the field investigation. The boreholes were backfilled in general accordance with Ontario Regulation 903, as amended. A piezometer was also installed in Borehole 17-18 drilled during the preliminary investigation. Caving was noted in a number of boreholes in the silt and silty sand soils.

Completion details of the boreholes are summarized in Table 3.1.

Table 3.1 – Borehole Completion Details

Borehole Number	Borehole Depth / Base Elevation (m)	Piezometer Tip Depth / Elevation (m)	Completion Details
18-01	9.8 / 440.3	None installed	Borehole caved to 5.2 m then backfilled with bentonite holeplug and cuttings to surface.
18-02	9.9 / 440.1	3.7 / 446.3	Borehole caved to 3.7 m, then backfilled with sand to 1.5 m, then bentonite holeplug to surface
18-03	9.8 / 440.2	5.8 / 444.2	Borehole caved to 5.8 m, then backfilled with sand to 3.4 m, then bentonite holeplug to surface
18-04	9.8 / 440.3	None installed	Borehole caved to 5.4 m then backfilled with bentonite holeplug and cuttings to surface.
18-05	15.2 / 436.9	None installed	Borehole caved to 10.4 m then backfilled with bentonite holeplug and cuttings to 0.6 m, concrete to 0.3 m, then asphalt to surface.
18-06	15.5 / 436.7	15.2 / 437.0	Sand from 15.5 m to 11.6 m, bentonite holeplug to 11 m, bentonite holeplug and cuttings to 0.6 m, concrete to 0.3 m, then asphalt to surface.
17-15	12.8 / 437.6	None installed	Borehole backfilled with bentonite holeplug and cuttings to surface.
17-16	15.3 / 436.9	None installed	Borehole backfilled with bentonite holeplug cuttings and concrete to surface.
17-17	15.3 / 436.8	None installed	Borehole backfilled with bentonite holeplug cuttings and concrete to surface.
17-18	12.8 / 437.4	12.2 / 438	Sand from 12.8 m to 10.7 m, and bentonite holeplug cuttings and concrete to surface.

Borehole Number	Borehole Depth / Base Elevation (m)	Piezometer Tip Depth / Elevation (m)	Completion Details
17-19	3.7 / 448.4	None installed	Borehole backfilled with bentonite holeplug and concrete to surface.
17-20	3.7 / 448.4	None installed	Borehole backfilled with bentonite holeplug and concrete to surface.
17-21	3.7 / 448.4	None installed	Borehole backfilled with bentonite holeplug and concrete to surface.

4. LABORATORY TESTING

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

In order to assess the potential for sulphate attack on concrete foundations, as well as the potential for corrosion associated with the structure, during the previous investigation, two samples of the existing native soil, and a sample of the surface water from the creek upstream of the existing culvert were collected. The samples were submitted to SGS Canada Inc., a CALA accredited analytical laboratory in Lakefield, Ontario, for analytical testing of corrosivity parameters and sulphate content. The results of the analytical testing are summarized in Section 6 and are presented in Appendix B.

5. DESCRIPTION OF SUBSURFACE CONDITIONS

Reference is made to the Record of Borehole sheets included in Appendix A and the soil stratigraphy drawings included in Appendix D. A general description of the stratigraphy, based on the conditions encountered in the boreholes, is given in the following paragraphs. However, the factual data presented on the Record of Borehole sheets takes precedence over this general description and should be used for interpretation of site conditions. It must be recognized and expected that soil conditions may vary between and beyond the borehole locations.

In general, the subsurface conditions encountered in the boreholes below the existing



embankment fill typically consist of peat, underlain by silty clay, and deposits of silt and sand. Auger refusal and cone refusal occurred in Boreholes 17-17 and 17-16 beneath the sand deposits on probable bedrock at Elevations 437.6 m and 436.9 m. DCPT refusals were also encountered in Boreholes 18-05 and 18-06 at Elevations ranging from 438.0 m to 436.7 m. Descriptions of the individual strata are presented below.

5.1 Asphalt

The boreholes that were drilled through the paved portion of Highway 11 (Boreholes 18-05, 18-06, 17-16, 17-17, 17-19, 17-20, and 17-21) encountered approximately 75 mm to 350 mm of asphalt at the ground surface, which extended to Elevation 451.7 m to 452.1 m.

5.2 Embankment Fill

Embankment fill was encountered in all boreholes drilled on Highway 11 (Boreholes 18-05, 18-06, 17-16, 17-17, 17-19, 17-20, and 17-21) beneath the asphalt. The fill consisted of sand, gravelly, sand, and silty sand and contained trace to some silt, trace to some gravel, and occasional cobbles and boulders, particularly in the upper portions of the fill. The embankment fill typically extended to depths of approximately 2.1 m to 3.1 m below existing road surface elevation (Elevation 449.1 m to 450.0 m).

SPT 'N' values in the fill ranged from 5 to 46 blows for 0.3 m penetration, indicating a loose to very dense relative density. Higher blow counts of more than 50 blows for 0.05 m were also recorded in the embankment fill, however these high blow counts are likely a result of cobbles or boulders within the fill as well as frozen material. Measured moisture contents ranged from 2 to 22%.

The results of grain size distribution analyses conducted on samples of the fill are presented on the Record of Borehole sheets included in Appendix A and are summarized in the following table. The results are also presented on Figure B1 in Appendix B.

Soil Particle	Percentage
Gravel	0 to 25
Sand	60 to 70
Silt and Clay	10 to 40



5.3 Peat

Peat was encountered beneath the embankment fill in all boreholes on Highway 11 and at the ground surface in the boreholes at the inlet and outlet of the existing culvert. The peat is described as black to dark brown in colour and contains trace to some silt and sand, and some roots and rootlets.

The peat ranged in thickness from 0.4 m to 2.4 m where fully penetrated. Beneath the road embankment, the peat, where fully penetrated, extended to depths of between 3.5 m and 4.3 m below existing road surface (Elevations 447.8 m to 448.7 m). At the inlet and outlet, the peat extended to depths of between 1.4 m and 2.4 m below existing ground surface (Elevations 447.7 m and 448.8 m). In Boreholes 17-19 to 17-21 the peat extended to the maximum depth drilled of 3.7 m below existing road surface (Elevation 448.4 m).

SPT 'N' values recorded in the peat ranged between 1 to 6 blows for 0.3 m penetration, indicating a very soft to firm consistency. The blow counts in the peat under the highway embankment are higher than the blow counts in the peat beyond the toe of the embankment. Higher blow counts of 16 and 40 were recorded near the ground surface in the peat but were likely a result of frozen material. Measured moisture contents in the peat ranged from 61% to 617%. The uncompressed peat beyond the toe of the embankment generally has a higher water content.

5.4 Silty Clay to Clay

Silty clay changing to clay, with some silt, trace to some sand and brown in colour was encountered beneath the peat deposits in all boreholes where the peat was fully penetrated. The silty clay to clay, where fully penetrated, was approximately 1.4 m to 5.6 m thick and extended to depths of between 3.5 m and 8.1 m below the existing ground surface (Elevations 446.6 m and 443.1 m).

A lower layer of silty clay to clay was encountered in Boreholes 18-03 and 18-05 at a depth of 7.5 m and 11.0 m (Elevation 442.5 m and 441.1 m), respectively. The lower silty clay to clay was approximately 1.6 m and 1.2 m thick, extending to depths of approximately 9.1 m and 12.2 m (Elevations 440.9 m and 439.9 m), respectively.

SPT 'N' values recorded in the silty clay to clay ranged from 0 to 19 blows for 0.3 m penetration. In-situ vane shear tests were conducted in the silty clay to clay and measured undrained shear strengths of between 57 kPa and 106 kPa. The results of the SPTs and vane shear tests indicate



the silty clay is soft to very stiff. The sensitivity of the silty clay to clay was measured to range between 2 and 6, indicating low sensitivity to sensitive. Measured moisture contents in the silty clay ranged from 23% to 84%.

The results of grain size analyses conducted on samples of the silty clay are provided on the Record of Borehole sheets in Appendix A, and illustrated in Figure B2 and B3 of Appendix B. The results are summarized as follows:

Soil Particle	Percentage
Gravel	0
Sand	0 to 20
Silt	14 to 35
Clay	45 to 83

The results of Atterberg Limits tests conducted on samples of the silty clay are provided on the Record of Borehole sheets in Appendix A and illustrated in Figure B7 of Appendix B. The results are summarized as follows:

Soil Property	Percentage
Liquid Limit	41 to 79
Plastic Limit	18 to 30
Plasticity Index	23 to 52

The results of the Atterberg Limits testing indicate that the silty clay has an intermediate to high plasticity with group symbol CI to CH.

5.5 Silt

Silt, containing trace sand and clay, was encountered in Boreholes 17-15 to 17-18, 18-01, 18-04 and 18-06 at depths of between 5.6 m and 8.7 m (Elevations 446.6 m to 441.5 m). Where fully penetrated the silt layer was approximately 1.5 m to 6.1 m thick and extended to depths of between 10.2 m and 11.9 m (Elevations 441.9 m and 438.7 m). Boreholes 18-01 and 18-04 were terminated within the silt layer at depths of 9.8 m (Elevation 440.3 m).

SPT 'N' values recorded in the silt ranged from 6 to 71 blows for 0.3 m penetration, indicating a loose to very dense relative density. Measure moisture contents in the silt ranged from 10% to 34%.



The results of grain size analyses conducted on samples of the silt are provided on the Record of Borehole sheets in Appendix A, and illustrated in Figure B4 of Appendix B. The results are summarized as follows:

Soil Particle	Percentage
Gravel	0
Sand	0 to 5
Silt	89 to 94
Clay	4 to 7

5.6 Silty Sand to Sandy Silt

Silty sand to sandy silt, containing trace to some gravel, trace to some silt, trace clay and brown to grey in colour, was encountered in Boreholes 17-15, 17-18, and 18-01 to 18-05 at depths of between 4.7 m and 11.7 m (Elevations 445.3 m and 438.7 m). Where fully penetrated the silty sand to sandy silt was approximately 1.8 m to 2.9 m thick and extended to depths of between 7.6 m and 11.0 m (Elevations 442.5 m and 441.1 m). Boreholes 17-15, 17-18, 18-02, and 18-03 were terminated in the silty sand to sandy silt layers at depths of between 9.8 m and 12.8 m (Elevations 440.2 m and 437.4 m).

SPT 'N' values recorded in the silty sand to sandy silt ranged from 8 to 66 blows for 0.3 m penetration, indicating a loose to very dense relative density. Measure moisture contents ranged from 9 to 27 percent.

The results of grain size analyses conducted on samples of the silty sand to sandy silt are provided on the Record of Borehole sheets in Appendix A, and illustrated in Figure B5 of Appendix B. The results are summarized as follows:

Soil Particle	Percentage
Gravel	0 to 18
Sand	28 to 68
Silt	21 to 67
Clay	2 to 5

5.7 Sand

Sand, containing trace to some gravel, trace to some silt, trace clay, and occasional cobbles was encountered in Boreholes 17-16, 17-17, 18-05, and 18-06 at depths of between 10.2 m and 12.2



m (Elevations 441.9m and 439.9 m). These boreholes were terminated within the sand layer at depths of between 15.2 m and 15.5 m (Elevations 436.9 m and 436.7 m). A separate sand layer was encountered in Borehole 18-02 at a depth of approximately 3.5 m (Elevation 446.5 m) and was approximately 1.2 m thick, extending to a depth of 4.7 m (Elevation 445.3 m).

SPT 'N' values recorded in the sand ranged from 17 to 36 blows for 0.3 m penetration, indicating a compact to dense relative density. Measure moisture contents ranged from 2 to 21 percent.

The results of grain size analyses conducted on samples of the sand are provided on the Record of Borehole sheets in Appendix A, and illustrated in Figure B6 of Appendix B. The results are summarized as follows:

Soil Particle	Percentage
Gravel	0 to 18
Sand	58 to 98
Silt	14 to 19
Clay	2 to 5
Silt and Clay	2

5.8 Auger Refusal

Auger and/or split spoon refusal was encountered at a depth of 15.3 m (Elev 436.8 to 436.9 m) in Boreholes 17-16 and 17-17.

5.9 Groundwater Conditions

Groundwater conditions were observed during drilling and in the open boreholes upon completion, and piezometers were installed in Boreholes 17-18, 18-02, 18-03, and 18-06. The groundwater levels are high measured in the open boreholes and the piezometers are summarized in Table 5.1 below. The piezometers were decommissioned and sealed at the end of the field investigation.

Table 5.1 – Groundwater Measurements

Borehole	Date	Water Level (m)		Remark
		Depth	Elevation	
18-01	April 21, 2018	-	-	Borehole caved to 5 m depth
18-02	April 23, 2018	-0.1	450.1	In piezometer/artesian condition in sand



Borehole	Date	Water Level (m)		Remark
		Depth	Elevation	
18-03	April 21, 2018	-1.4	451.4	In piezometer/artesian condition in silty sand
	April 22, 2018	-1.4	451.4	
	April 23, 2018	-1.4	451.4	
18-04	April 17, 2018	0.0	450.1	Borehole caved to 5.4 m.
18-05	March 8, 2018	1.7	450.4	Borehole caved to 10.4 m.
18-06	March 9, 2018	1.7	450.5	In piezometer
17-15	March 27, 2017	0.2	450.2	Open borehole
17-16	March 27, 2017	3.0	449.2	Open borehole
17-17	March 26, 2017	3.0	449.1	Open borehole
17-18	March 27, 2017	0.2	450.0	In piezometer
17-19	March 25, 2017	3.0	449.1	Open borehole
17-20	March 25, 2017	3.0	449.1	Open borehole
17-21	March 25, 2017	3.0	449.1	Open borehole

During the previous investigation, the creek was frozen at the time and the top of ice level was recorded by Thurber at Elev. 450.2 m. The water level in the creek was also recorded by others, as shown on the topographic survey provided by WSP, and was 450.0 m in August, 2015. The groundwater level should be assumed to reflect the local creek water level. Artesian groundwater conditions were noted in Boreholes 18-02 and 18-03.

The above groundwater levels are short-term readings and seasonal fluctuations of the groundwater levels are to be expected. In particular, the groundwater levels may be at a higher elevation after periods of significant or prolonged precipitation.

6. CORROSIVITY AND SULPHATE TEST RESULTS

Two samples of the native silty clay from Boreholes 17-16 and 17-17, and a sample of the creek water 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		
			17-16 SS#5, 4.6 m – 5.2 m	17-17 SS#5, 4.6 m – 5.2 m	Rossmere Creek
			(Silty Clay)	(Silty Clay)	(Creek Water)
Sulphide	%	mg/L	<0.02	<0.02	0.014
Chloride	µg/g	mg/L	16	30	24
Sulphate	µg/g	mg/L	150	22	1.1
pH	No unit	No unit	8.98	8.64	6.35
Electrical Conductivity	µS/cm	µS/cm	127	160	115
Resistivity	Ohms.cm	Ohms.cm	7870	6250	8700
Redox Potential	mV	mV	286	210	197

7. MISCELLANEOUS

Thurber obtained subsurface utility clearances prior to drilling. Thurber estimated the northing and easting coordinates and ground surface elevations from measurements taken in the field relative to the topographic plans provided by WSP.

OGS Inc. of Almonte, Ontario supplied and operated the drilling, sampling and in-situ testing equipment for the current field investigation. The field investigation was supervised on a full time basis by Mr. Amir Fereidouni and Jilesh Patel of Thurber. Overall supervision of the field program was provided by Mr. Mark Farrant, P.Eng. of Thurber.

Geotechnical laboratory testing was carried out at Thurber's geotechnical laboratory. Analytical laboratory testing was carried out by SGS Canada Inc. Interpretation of the field data and preparation of this report was carried out by Mr. Cory Zanatta, P.Eng. 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.



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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 18-01

1 OF 2

METRIC

W.P. 6804-14-01 LOCATION Rossmere Creek Culvert, MTM NAD 83-15 N 5 388 623.3 E 291 123.5 ORIGINATED BY JP
DIST Thunder Bay HWY 11 BOREHOLE TYPE Wash Boring COMPILED BY MP
DATUM Geodetic DATE 2018.04.20 - 2018.04.21 LATITUDE 48.63597332 LONGITUDE -90.18558004 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	○ UNCONFINED + FIELD VANE	● QUICK TRIAXIAL × LAB VANE	W _P W W _L				
450.1	GROUND SURFACE														
0.0	PEAT , some silty sand, trace roots and rootlets Very Soft Dark Brown Wet		1	SS	2		450							240	
			2	SS	2		449								
			3	SS	2		448								617
447.7			4	SS	4		447								520
2.4	Silty CLAY , some sand Soft to Stiff Brown Wet to Moist (CI)		5	SS	6		447		4.0 +						
			6	SS	13		446								
							445								
444.3			7	SS	18		444								
5.8	Silty SAND , trace clay Compact Grey Wet						443								
442.5			8	SS	16		442								
7.6	SILT , trace sand and clay Compact Grey Wet						441								
440.3			9	SS	14										
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 18-01

2 OF 2

METRIC

W.P. 6804-14-01 LOCATION Rossmere Creek Culvert, MTM NAD 83-15 N 5 388 623.3 E 291 123.5 ORIGINATED BY JP
 DIST Thunder Bay HWY 11 BOREHOLE TYPE Wash Boring COMPILED BY MP
 DATUM Geodetic DATE 2018.04.20 - 2018.04.21 LATITUDE 48.63597332 LONGITUDE -90.18558004 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			20 40 60 80 100	20 40 60 80 100	W P W W L	20 40 60			
	Continued From Previous Page BOREHOLE CAVED TO 5.2m. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND CUTTINGS TO SURFACE.													

RECORD OF BOREHOLE No 18-02

1 OF 2

METRIC

W.P. 6804-14-01 LOCATION Rossmere Creek Culvert, MTM NAD 83-15 N 5 388 620.2 E 291 114.1 ORIGINATED BY JP
DIST Thunder Bay HWY 11 BOREHOLE TYPE Wash Boring COMPILED BY MP
DATUM Geodetic DATE 2018.04.22 - 2018.04.23 LATITUDE 48.63594544 LONGITUDE -90.18570664 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 (%)				
450.0	GROUND SURFACE							20 40 60 80 100	20 40 60					
0.0	PEAT , some silt and sand, trace roots and rootlets Very Soft Dark Brown Wet		1	SS	2							219		
			2	SS	2							186		
447.9			3	SS	2							452		
2.1	Silty CLAY , some sand Firm to Stiff Brown Moist (CH)		4	SS	6								0 17 21 62	
446.5									6.0					
3.5	SAND , trace silt and clay Compact Grey Wet		5	SS	26								0 98 2 (SI+CL)	
445.3														
4.7	Sandy SILT , trace clay Loose to Compact Grey Wet		6	SS	8									
					7	SS	17							
			8	SS	14								0 28 67 5	
			9	SS	13									
440.1														

Continued Next Page

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

RECORD OF BOREHOLE No 18-02

2 OF 2

METRIC

W.P. 6804-14-01 LOCATION Rossmere Creek Culvert, MTM NAD 83-15 N 5 388 620.2 E 291 114.1 ORIGINATED BY JP
 DIST Thunder Bay HWY 11 BOREHOLE TYPE Wash Boring COMPILED BY MP
 DATUM Geodetic DATE 2018.04.22 - 2018.04.23 LATITUDE 48.63594544 LONGITUDE -90.18570664 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 (%)					
9.9	<p>Continued From Previous Page</p> <p>END OF BOREHOLE AT 9.9m. BOREHOLE CAVED TO 3.7m. Well installation consists of 25mm diameter Schedule 40 PVC pipe with a 1.5m slotted screen.</p> <p>WATER LEVEL READINGS DATE DEPTH(m) ELEV.(m) 2018.04.23 -0.1 450.1</p>													

RECORD OF BOREHOLE No 18-03

1 OF 2

METRIC

W.P. 6804-14-01 LOCATION Rossmere Creek Culvert, MTM NAD 83-15 N 5 388 588.6 E 291 126.3 ORIGINATED BY JP
 DIST Thunder Bay HWY 11 BOREHOLE TYPE Wash Boring COMPILED BY MP
 DATUM Geodetic DATE 2018.04.19 - 2018.04.20 LATITUDE 48.63566145 LONGITUDE -90.18554083 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			SHEAR STRENGTH kPa							
								○ UNCONFINED	+ FIELD VANE	● QUICK TRIAXIAL × LAB VANE					
450.0	GROUND SURFACE						20	40	60	80	100				
0.0	PEAT , some sand and silt, trace roots and rootlets Very Stiff to Soft Dark Brown Wet		1	SS	16								286	0 0 23 77	
			2	SS	2								273		
													496		
448.2		3	SS	2											
1.8	Silty CLAY Very Stiff to Firm Brown Moist (CH)														
			4	SS	19										
			5	SS	7										
			6	SS	8										
444.8															
5.2	Silty SAND , trace gravel Very Dense Grey Moist														
			7	SS	66										
442.5															
7.5	CLAY , some silt Stiff Grey Wet		8	SS	13									0 0 17 83	
440.9															
9.1	Silty SAND , some gravel, trace clay Very Dense Grey Wet		9	SS	66										
440.2															
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 18-03

2 OF 2

METRIC

W.P. 6804-14-01 LOCATION Rossmere Creek Culvert, MTM NAD 83-15 N 5 388 588.6 E 291 126.3 ORIGINATED BY JP
 DIST Thunder Bay HWY 11 BOREHOLE TYPE Wash Boring COMPILED BY MP
 DATUM Geodetic DATE 2018.04.19 - 2018.04.20 LATITUDE 48.63566145 LONGITUDE -90.18554083 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 (%)																			
	<p>Continued From Previous Page</p> <p>BOREHOLE CAVED TO 5.8m. Well installation consists of 25mm diameter Schedule 40 PVC pipe with a 1.5m slotted screen.</p> <p>WATER LEVEL READINGS</p> <table border="1"> <thead> <tr> <th>DATE</th> <th>DEPTH(m)</th> <th>ELEV.(m)</th> </tr> </thead> <tbody> <tr> <td>2018.04.20</td> <td>-1.0</td> <td>451.0</td> </tr> <tr> <td>2018.04.21</td> <td>-1.4</td> <td>451.4</td> </tr> <tr> <td>2018.04.22</td> <td>-1.4</td> <td>451.4</td> </tr> <tr> <td>2018.04.23</td> <td>-1.4</td> <td>451.4</td> </tr> </tbody> </table>	DATE	DEPTH(m)	ELEV.(m)	2018.04.20	-1.0	451.0	2018.04.21	-1.4	451.4	2018.04.22	-1.4	451.4	2018.04.23	-1.4	451.4												
DATE	DEPTH(m)	ELEV.(m)																										
2018.04.20	-1.0	451.0																										
2018.04.21	-1.4	451.4																										
2018.04.22	-1.4	451.4																										
2018.04.23	-1.4	451.4																										

RECORD OF BOREHOLE No 18-04

1 OF 2

METRIC

W.P. 6804-14-01 LOCATION Rossmere Creek Culvert, MTM NAD 83-15 N 5 388 588.5 E 291 114.4 ORIGINATED BY JP
DIST Thunder Bay HWY 11 BOREHOLE TYPE Wash Boring COMPILED BY MP
DATUM Geodetic DATE 2018.04.17 - 2018.04.17 LATITUDE 48.6356603 LONGITUDE -90.18570202 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								
								20	40	60						80
450.1	GROUND SURFACE															
0.0	PEAT, some silt and sand, trace roots and rootlets Firm to Soft Brown Wet		1	SS	40											
			2	SS	5											
			3	SS	2											
448.1																
2.0	Silty CLAY, trace sand Soft to Stiff Brown Moist (CH)		4	SS	3											
			5	SS	11											
			6	SS	6											
444.8																
5.3	SILT and SAND, some gravel, trace clay Compact Grey Wet															
			7	SS	21											
442.5																
7.6	SILT, trace clay Very Dense to Compact Grey Wet		8	SS	71											
			9	SS	16											
440.3																
9.8	END OF BOREHOLE AT 9.8m.															

Continued Next Page

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

RECORD OF BOREHOLE No 18-04

2 OF 2

METRIC

W.P. 6804-14-01 LOCATION Rossmere Creek Culvert, MTM NAD 83-15 N 5 388 588.5 E 291 114.4 ORIGINATED BY JP
 DIST Thunder Bay HWY 11 BOREHOLE TYPE Wash Boring COMPILED BY MP
 DATUM Geodetic DATE 2018.04.17 - 2018.04.17 LATITUDE 48.6356603 LONGITUDE -90.18570202 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 (%)					
	Continued From Previous Page													
	BOREHOLE CAVED TO 5.4m AND WATER LEVEL AT SURFACE. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND CUTTINGS TO SURFACE.													

RECORD OF BOREHOLE No 18-05

1 OF 2

METRIC

W.P. 6804-14-01 LOCATION Rossmere Creek Culvert, MTM NAD 83-15 N 5 388 606.2 E 291 134.1 ORIGINATED BY JP
DIST Thunder Bay HWY 11 BOREHOLE TYPE Hollow Stem Augers/Dynamic Cone Penetration Test COMPILED BY MP
DATUM Geodetic DATE 2018.03.07 - 2018.03.08 LATITUDE 48.63581993 LONGITUDE -90.18543484 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			20 40 60 80 100	W _P W W _L	20 40 60	GR SA SI CL			
452.1	GROUND SURFACE													
0.0	ASPHALT: (350mm)													
451.7														
0.4	Silty SAND , trace to some gravel, trace clay, trace cobbles Very Dense Grey Frozen (FILL)		1	SS	50/ 0.050									
			2	SS	52/ 0.075									
			3	SS	5									
449.1														
3.0	PEAT , with silty sand, trace gravel Loose Brown Wet		4	SS	5									
448.4														
3.7	CLAY , some silt, trace sand Stiff to Soft Brown Moist (CH)		5	SS	8									
			6	SS	10									
			7	SS	4									
444.0														
8.1	Silty SAND , trace clay Grey Wet		8	SS	24									

Continued Next Page

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

RECORD OF BOREHOLE No 18-05

2 OF 2

METRIC

W.P. 6804-14-01 LOCATION Rossmere Creek Culvert, MTM NAD 83-15 N 5 388 606.2 E 291 134.1 ORIGINATED BY JP
DIST Thunder Bay HWY 11 BOREHOLE TYPE Hollow Stem Augers/Dynamic Cone Penetration Test COMPILED BY MP
DATUM Geodetic DATE 2018.03.07 - 2018.03.08 LATITUDE 48.63581993 LONGITUDE -90.18543484 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 (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa				
								20 40 60 80 100				
Continued From Previous Page								<div><div><div></div><div></div><div></div></div><div><div></div><div></div><div></div></div></div> <div><div><div></div><div></div><div></div></div><div><div></div><div></div><div></div></div></div> <div><div><div></div><div></div><div></div></div><div><div></div><div></div><div></div></div></div> <div><div><div></div><div></div><div></div></div><div><div></div><div></div><div></div></div></div> <div><div><div></div><div></div><div></div></div><div><div></div><div></div><div></div></div></div> <div><div><div></div><div></div><div></div></div><div><div></div><div></div><div></div></div></div> <div><div><div></div><div></div><div></div></div><div><div></div><div></div><div></div></div></div> <div><div><div></div><div></div><div></div></div><div><div></div><div></div><div></div></div></div> <div><div><div></div><div></div><div></div></div><div><div></div><div></div><div></div></div></div> 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+³, ×³: Numbers refer to Sensitivity
20
15
10
(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 18-06

1 OF 2

METRIC

W.P. 6804-14-01 LOCATION Rossmere Creek Culvert, MTM NAD 83-15 N 5 388 603.0 E 291 113.3 ORIGINATED BY JP
 DIST Thunder Bay HWY 11 BOREHOLE TYPE Hollow Stem Augers/Wash Boring/Dynamic Cone Penetration Test COMPILED BY MP
 DATUM Geodetic DATE 2018.03.09 - 2018.03.09 LATITUDE 48.63579073 LONGITUDE -90.1857177 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			20 40 60 80 100	PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	
452.2	GROUND SURFACE											
0.0	ASPHALT: (300mm)											
451.9							452					
0.3	SAND, some gravel, some silt and clay Very Dense Brown Moist (FILL)		1	SS	90		451					17 67 16 (SI+CL)
451.1	Silty SAND, trace gravel Very Dense to Compact Grey Frozen (FILL)		2	SS	51		450					
1.1			3	SS	19		449					
449.1			4	SS	6		448					
3.1	PEAT, with silty sand, trace gravel Loose Brown Wet		5	SS	4		447					0 4 24 72
448.7	Silty CLAY, trace sand Soft Brown Wet		6	SS	5		446					
3.5			7	SS	9		445					0 3 91 6
444.9			8	SS	13		444					
7.3							443					

Continued Next Page

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

RECORD OF BOREHOLE No 18-06

2 OF 2

METRIC

W.P. 6804-14-01 LOCATION Rossmere Creek Culvert, MTM NAD 83-15 N 5 388 603.0 E 291 113.3 ORIGINATED BY JP
 DIST Thunder Bay HWY 11 BOREHOLE TYPE Hollow Stem Augers/Wash Boring/Dynamic Cone Penetration Test COMPILED BY MP
 DATUM Geodetic DATE 2018.03.09 - 2018.03.09 LATITUDE 48.63579073 LONGITUDE -90.1857177 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 (%) GR SA SI CL			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					WATER CONTENT (%)		
								○ UNCONFINED	+	FIELD VANE			● QUICK TRIAXIAL	×	LAB VANE
	Continued From Previous Page						20 40 60 80 100	20 40 60 80 100	PLASTIC LIMIT W _P	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L				
440.3	SAND, with cobbles, trace silt Compact to Dense Grey Wet		9	SS	20								0 0 94 6		
11.9			10	SS	25										
			11	SS	36										
			12	SS	29										
436.7															
15.5	END OF BOREHOLE AT 15.5m. Well installation consists of 25mm diameter Schedule 40 PVC pipe with a 3.0m slotted screen.														
	WATER LEVEL READINGS DATE DEPTH(m) ELEV.(m) 2018.03.09 1.7 450.5														





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

RECORD OF BOREHOLE No 17-15

1 OF 2

METRIC

W.P. 6804-14-01 LOCATION Rossmere Creek Culvert, MTM NAD 83 Zone 15 N 5 388 618.3 E 291 128.0 ORIGINATED BY AHF
 HWY 11/17 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2017.03.27 - 2017.03.27 CHECKED BY CZ

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa			WATER CONTENT (%)								
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE	W _P	W	W _L								
450.4	GROUND SURFACE							20	40	60	80	100							
0.0	PEAT , trace roots and rootlets Very Soft Dark Brown Wet		1	GS			450										163		
			1	SS	1		449												
448.7																			
1.7	Silty CLAY , some sand Very Soft to Stiff Brown Wet (CI)		2	SS	1		448												
			3	SS	4														
			4	SS	3														
			5	SS	10														
			6	SS	0														
443.1																			
7.3	SILT , trace sand and clay Loose Grey Wet		7	SS	10		443												
							442												
			8	SS	9		441												

Continued Next Page

+³, ×³: Numbers refer to
Sensitivity

20
15
10
(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 17-15

2 OF 2

METRIC

W.P. 6804-14-01 LOCATION Rossmere Creek Culvert, MTM NAD 83 Zone 15 N 5 388 618.3 E 291 128.0 ORIGINATED BY AHF
 HWY 11/17 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2017.03.27 - 2017.03.27 CHECKED BY CZ

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE					
	Continued From Previous Page							20 40 60 80 100					
438.7			9	SS	6		440						
11.7	SAND and SILT, trace clay, trace gravel Very Dense Grey Wet						439						
437.6			10	SS	60		438						8 36 52 4
12.8	END OF BOREHOLE AT 12.8m. WATER LEVEL IN OPEN BOREHOLE AT APPROX. 0.2m. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND CUTTINGS TO SURFACE.												

ONTMT4S MTO-15593.GPJ 2017TEMPLATE(MTO).GDT 10/3/17

RECORD OF BOREHOLE No 17-16

1 OF 2

METRIC

W.P. 6804-14-01 LOCATION Rossmere Creek Culvert, MTM NAD 83 Zone 15 N 5 388 606.7 E 291 118.7 ORIGINATED BY AHF
 HWY 11/17 BOREHOLE TYPE Hollow Stem Augers/Dynamic Cone Penetration Test COMPILED BY AN
 DATUM Geodetic DATE 2017.03.27 - 2017.03.27 CHECKED BY CZ

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				
452.2	GROUND SURFACE							20 40 60 80 100	PLASTIC LIMIT W _P	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	
0.0 0.1	ASPHALT: (75mm)							20 40 60 80 100	WATER CONTENT (%)			
	SAND, some silt, trace gravel, occasional cobbles and boulders Compact Brown Moist (FILL)		1	GS					○ UNCONFINED	+ FIELD VANE		
			1	SS	100/				● QUICK TRIAXIAL	× LAB VANE		
			2	GS	0.025							
450.7												
1.5	SAND and SILT, trace clay Compact Brown Moist (FILL)		2	SS	14							
			3	SS	11							
449.2												
3.0	PEAT, trace sand, roots and rootlets Soft Dark Brown Wet		4	SS	4							
448.1												
4.1	Silty CLAY, trace sand Very Soft Brown Wet		5	SS	2							
446.6												
5.6	SILT, trace sand and clay Loose to Compact Grey Wet		6	SS	7							
			7	SS	11							
			8	SS	10							

Continued Next Page

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

RECORD OF BOREHOLE No 17-16

2 OF 2

METRIC

W.P. 6804-14-01 LOCATION Rossmere Creek Culvert, MTM NAD 83 Zone 15 N 5 388 606.7 E 291 118.7 ORIGINATED BY AHF
 HWY 11/17 BOREHOLE TYPE Hollow Stem Augers/Dynamic Cone Penetration Test COMPILED BY AN
 DATUM Geodetic DATE 2017.03.27 - 2017.03.27 CHECKED BY CZ

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				
								20 40 60 80 100				
	Continued From Previous Page							<div><div>20 40 60 80 100</div><div>○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE</div></div>				
	Becoming dense		9	SS	34		442	<div><div>20 40 60 80 100</div><div>○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE</div></div>				14 84 2 (SI+CL)
440.5							441					
11.7	SAND , some gravel, trace silt Dense to Compact Grey Wet		10	SS	36		440	<div><div>20 40 60 80 100</div><div>○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE</div></div>				
							439					
			11	SS	27		438	<div><div>20 40 60 80 100</div><div>○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE</div></div>				
436.9			12	SS	100		437	<div><div>20 40 60 80 100</div><div>○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE</div></div>				
15.3	END OF BOREHOLE AT 15.3m ON AUGER REFUSAL. WATER LEVEL IN OPEN BOREHOLE AT APPROX. 3.0m. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG, CUTTINGS AND CONCRETE TO SURFACE. DYNAMIC CONE PENETRATION TEST CONDUCTED ADJACENT TO BOREHOLE.				0.025							

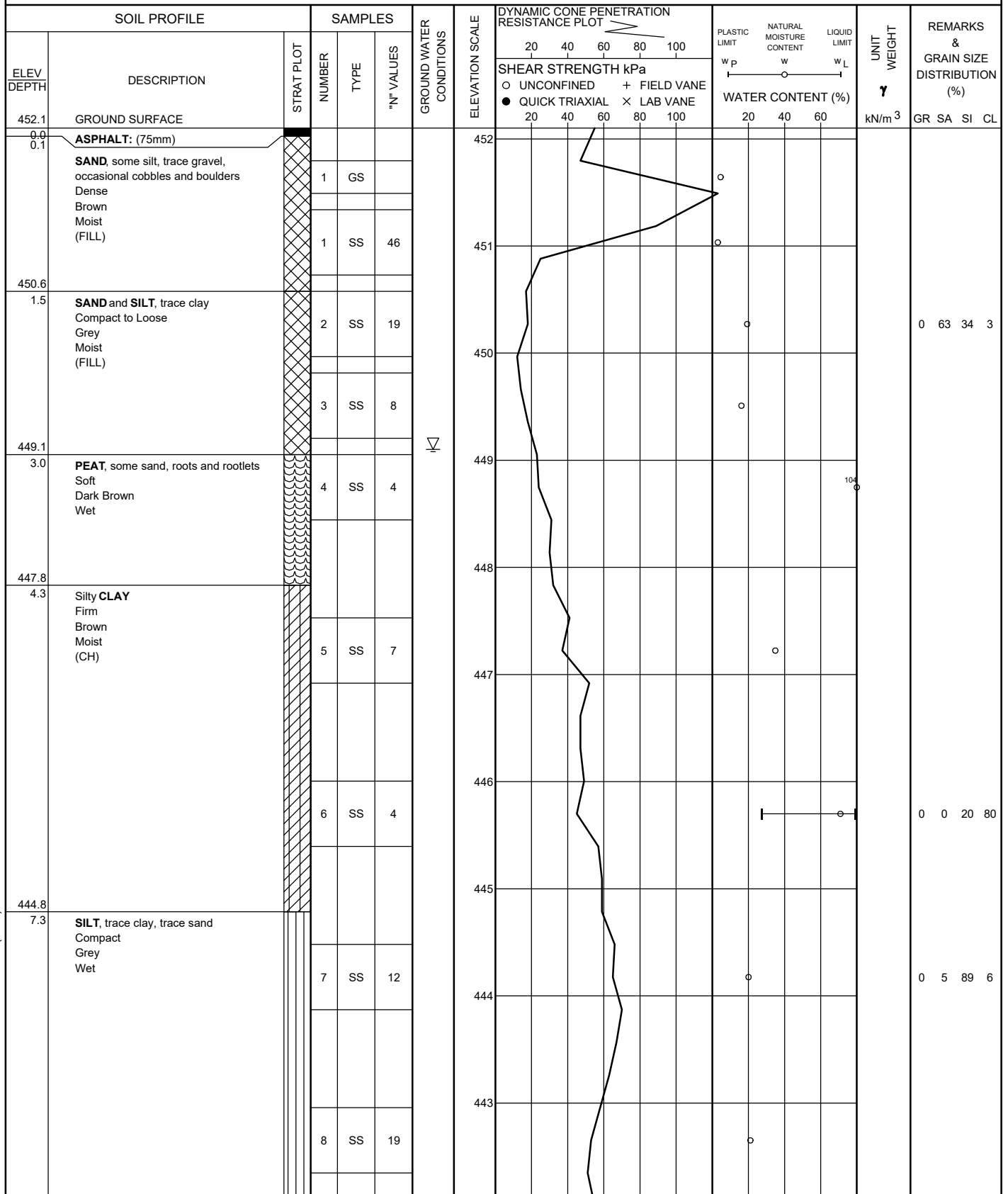
+³, ×³: Numbers refer to Sensitivity
 20
 15 10 5 10
 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 17-17

1 OF 2

METRIC

W.P. 6804-14-01 LOCATION Rossmere Creek Culvert, MTM NAD 83 Zone 15 N 5 388 602.7 E 291 128.2 ORIGINATED BY AHF
 HWY 11/17 BOREHOLE TYPE Hollow Stem Augers/Dynamic Cone Penetration Test COMPILED BY AN
 DATUM Geodetic DATE 2017.03.25 - 2017.03.26 CHECKED BY CZ



Continued Next Page

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

RECORD OF BOREHOLE No 17-17

2 OF 2

METRIC

W.P. 6804-14-01 LOCATION Rossmere Creek Culvert, MTM NAD 83 Zone 15 N 5 388 602.7 E 291 128.2 ORIGINATED BY AHF
 HWY 11/17 BOREHOLE TYPE Hollow Stem Augers/Dynamic Cone Penetration Test COMPILED BY AN
 DATUM Geodetic DATE 2017.03.25 - 2017.03.26 CHECKED BY CZ

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								
441.9	Continued From Previous Page						442									
10.2	SAND, some silt, some gravel, trace clay Compact Grey Wet		9	SS	17		441									
							440									
			10	SS	29		439									
							438									
			11	SS	20		437									
436.8	END OF BOREHOLE AT 15.3m ON SPLIT SPOON REFUSAL WATER LEVEL IN OPEN BOREHOLE AT APPROX. 3.0m. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG, CUTTINGS AND CONCRETE TO SURFACE. DYNAMIC CONE PENETRATION TEST CONDUCTED ADJACENT TO BOREHOLE.		12	SS	100/ 0.025											
15.3																

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

RECORD OF BOREHOLE No 17-18

1 OF 2

METRIC

W.P. 6804-14-01 LOCATION Rossmere Creek Culvert, MTM NAD 83 Zone 15 N 5 388 592.6 E 291 119.4 ORIGINATED BY AHF
 HWY 11/17 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2017.03.25 - 2017.03.25 CHECKED BY CZ

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																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																
450.2	GROUND SURFACE							20	40	60	80	100																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																												

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

RECORD OF BOREHOLE No 17-18

2 OF 2

METRIC

W.P. 6804-14-01 LOCATION Rossmere Creek Culvert, MTM NAD 83 Zone 15 N 5 388 592.6 E 291 119.4 ORIGINATED BY AHF
 HWY 11/17 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2017.03.25 - 2017.03.25 CHECKED BY CZ

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				
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE								
Continued From Previous Page																
440.0							440									
10.2	Silty SAND , trace gravel Compact Grey Wet		9	SS	17											
							439									
							438									
437.4			10	SS	17											
12.8	END OF BOREHOLE AT 12.8m. WATER LEVEL IN OPEN BOREHOLE AT 0.2m. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND CUTTINGS TO SURFACE. Well installation consists of 19mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen. WATER LEVEL READINGS DATE DEPTH(m) ELEV.(m) 2017.03.27 0.2 450.0 Decommissioned															

RECORD OF BOREHOLE No 17-19

1 OF 1

METRIC

W.P. 6804-14-01 LOCATION Rossmere Creek Culvert, MTM NAD 83 Zone 15 N 5 388 605.8 E 291 136.1 ORIGINATED BY AHF
 HWY 11/17 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2107.03.25 - 2017.03.25 CHECKED BY CZ

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 ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE		WATER CONTENT (%) w _P w w _L			
452.1	GROUND SURFACE							20 40 60 80 100					
0.0 0.1	ASPHALT: (75mm)						452						
	Gravelly SAND , some silt Brown Moist (FILL)		1	GS			451						25 65 10 (SI+CL)
450.0							450						
2.1	PEAT , some sand, trace roots and rootlets Soft Dark Brown Wet		2	GS			449					232	
448.4			1	SS	3							235	
3.7	END OF BOREHOLE AT 3.7m. WATER LEVEL IN OPEN BOREHOLE AT APPROX. 3.0m. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND CONCRETE TO SURFACE.												

+³, ×³: Numbers refer to
Sensitivity




20
15
10
(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 17-20

1 OF 1

METRIC

W.P. 6804-14-01 LOCATION Rossmere Creek Culvert, MTM NAD 83 Zone 15 N 5 388 605.5 E 291 146.1 ORIGINATED BY AHF
 HWY 11/17 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2017.03.25 - 2017.03.25 CHECKED BY CZ

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						
452.1	GROUND SURFACE							20 40 60 80 100		PLASTIC LIMIT W _P	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L		
0.0	ASPHALT: (75mm) SAND , some silt, trace gravel Brown Moist (FILL)													
0.1			1	GS			452							
								451						
450.0	PEAT , some sand, trace roots and rootlets Soft Dark Brown Wet		2	GS										
2.1						450						275		
						449						195		
448.4			1	SS	3									
3.7	END OF BOREHOLE AT 3.7m. WATER LEVEL IN OPEN BOREHOLE AT APPROX. 3.0m. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND CONCRETE TO SURFACE.													

+³, ×³: Numbers refer to
Sensitivity

20
15
10

(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 17-21

1 OF 1

METRIC

W.P. 6804-14-01 LOCATION Rossmere Creek Culvert, MTM NAD 83 Zone 15 N 5 388 605.1 E 291 156.1 ORIGINATED BY AHF
 HWY 11/17 BOREHOLE TYPE Solid Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2017.03.25 - 2017.03.25 CHECKED BY CZ

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				
452.1	GROUND SURFACE							20 40 60 80 100				
0.0 0.1	ASPHALT: (75mm)						452					
	SAND, some silt, some gravel Brown Moist (FILL)		1	GS								15 68 17 (SI+CL)
							451					
							450					
449.7												
2.4	PEAT, some roots and rootlets, trace sand Dark Brown Wet Firm		2	GS								
							449					
448.4			1	SS	5							
3.7	END OF BOREHOLE AT 3.7m. WATER LEVEL IN OPEN BOREHOLE AT APPROX. 3.0m. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND CONCRETE TO SURFACE.											

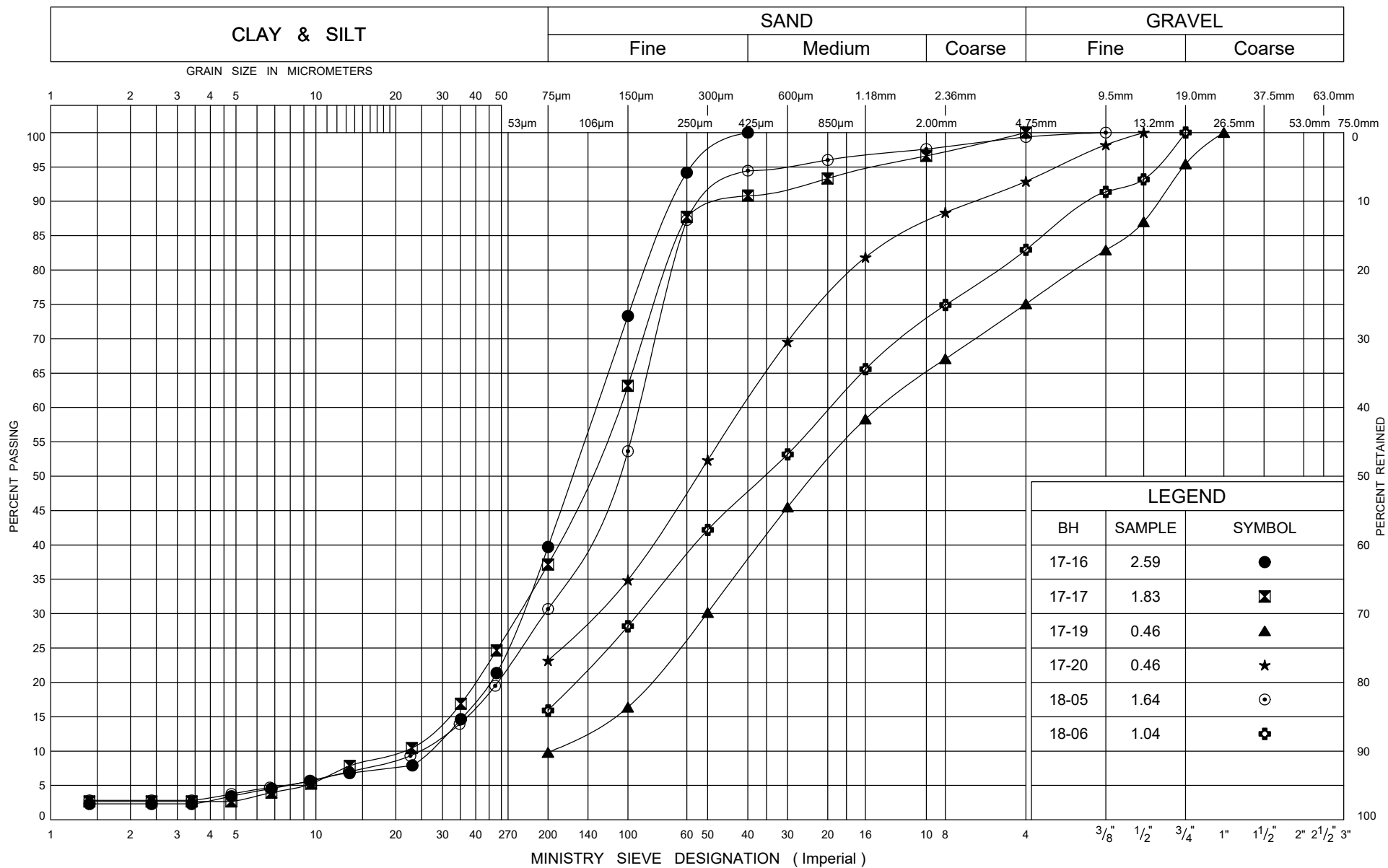
+³, ×³: Numbers refer to
Sensitivity

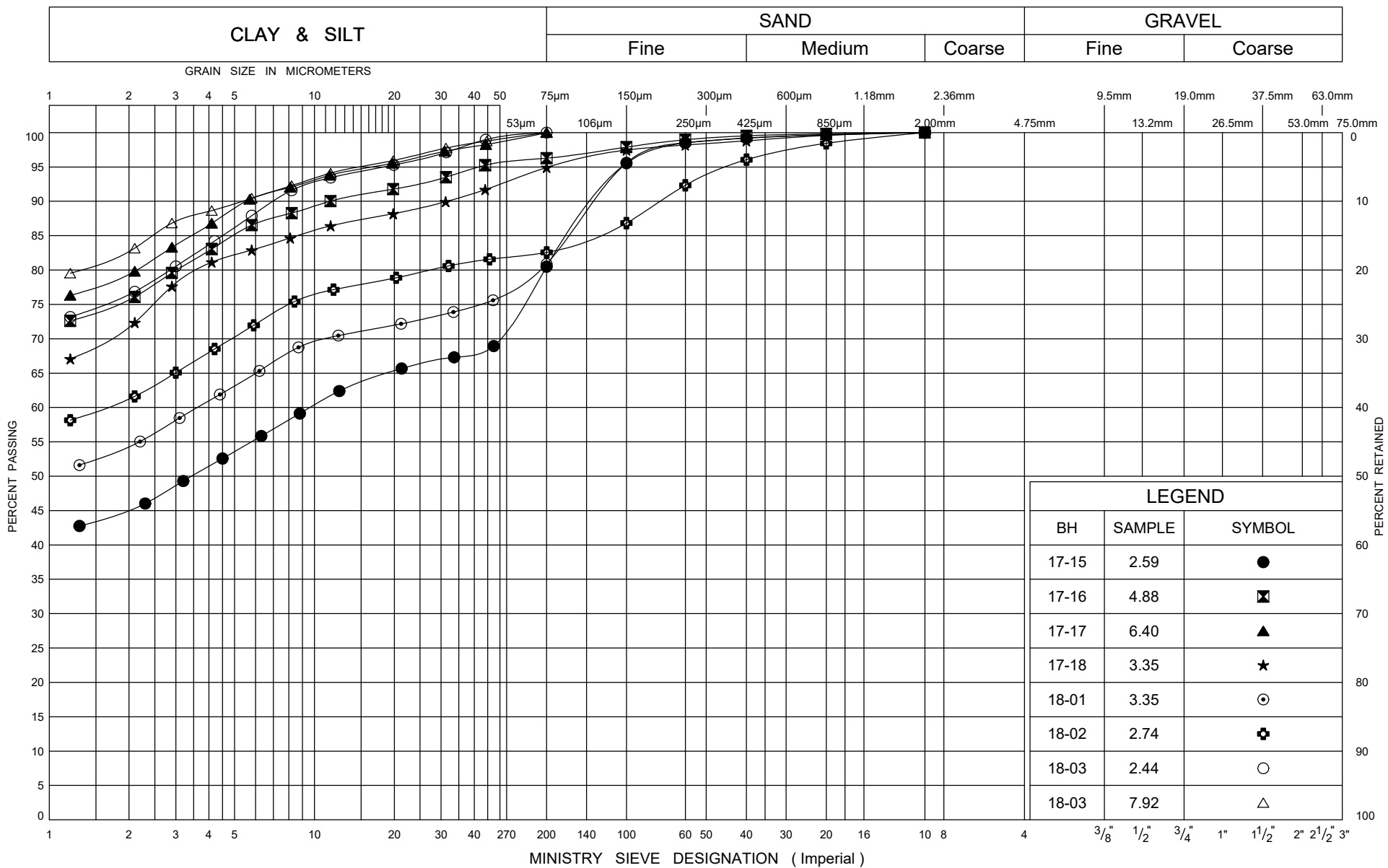
20
15
10
(%) STRAIN AT FAILURE

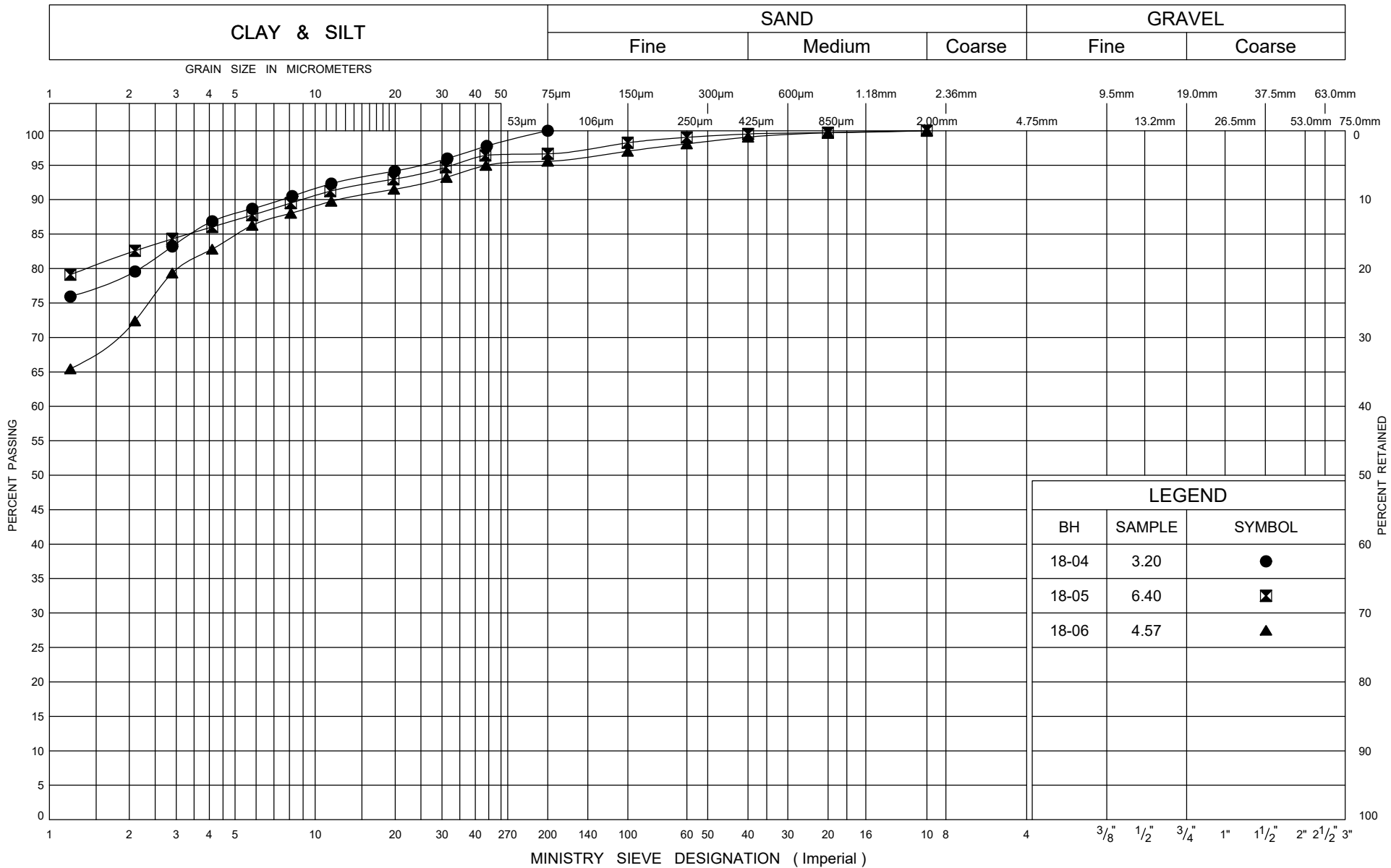


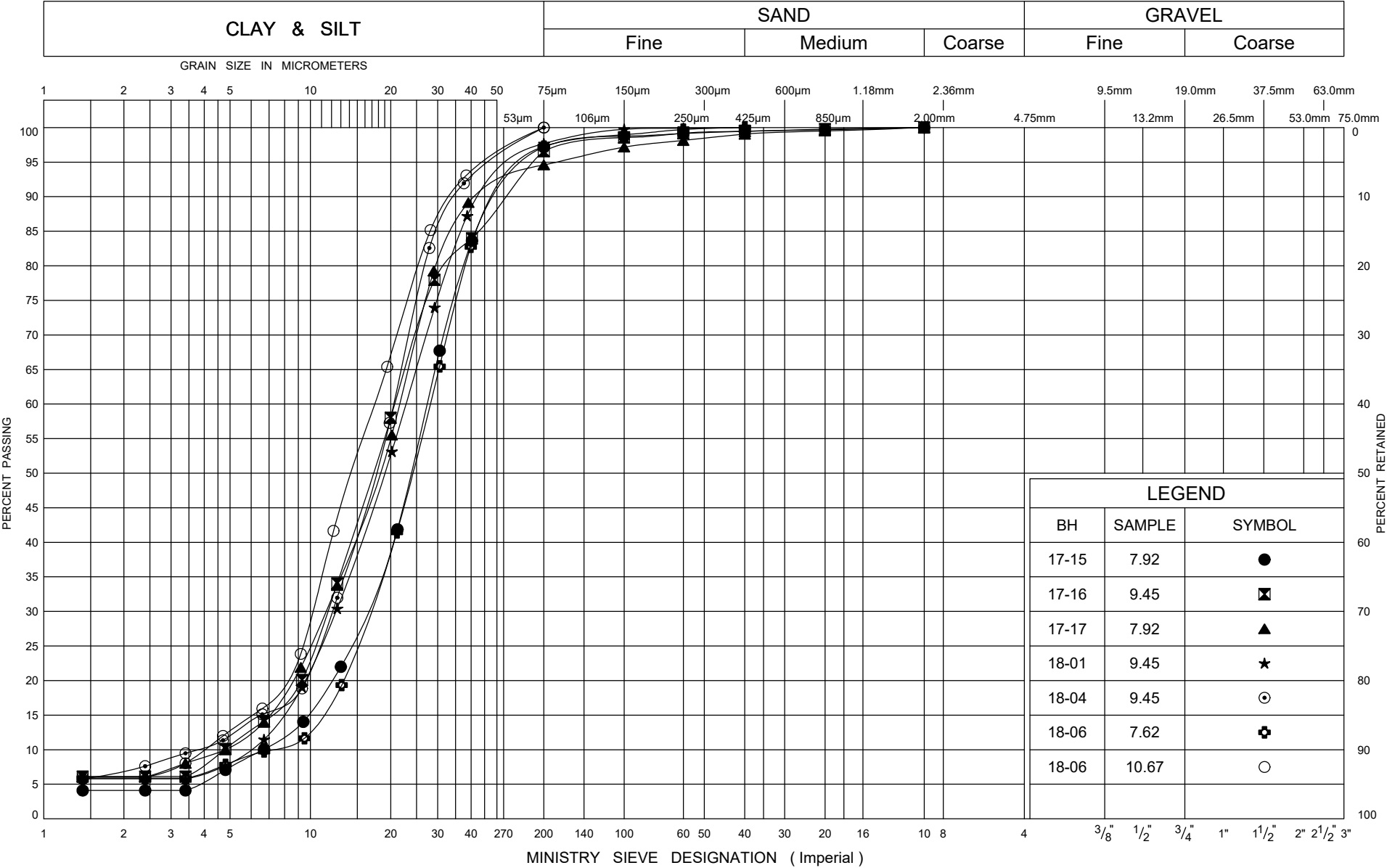
Appendix B

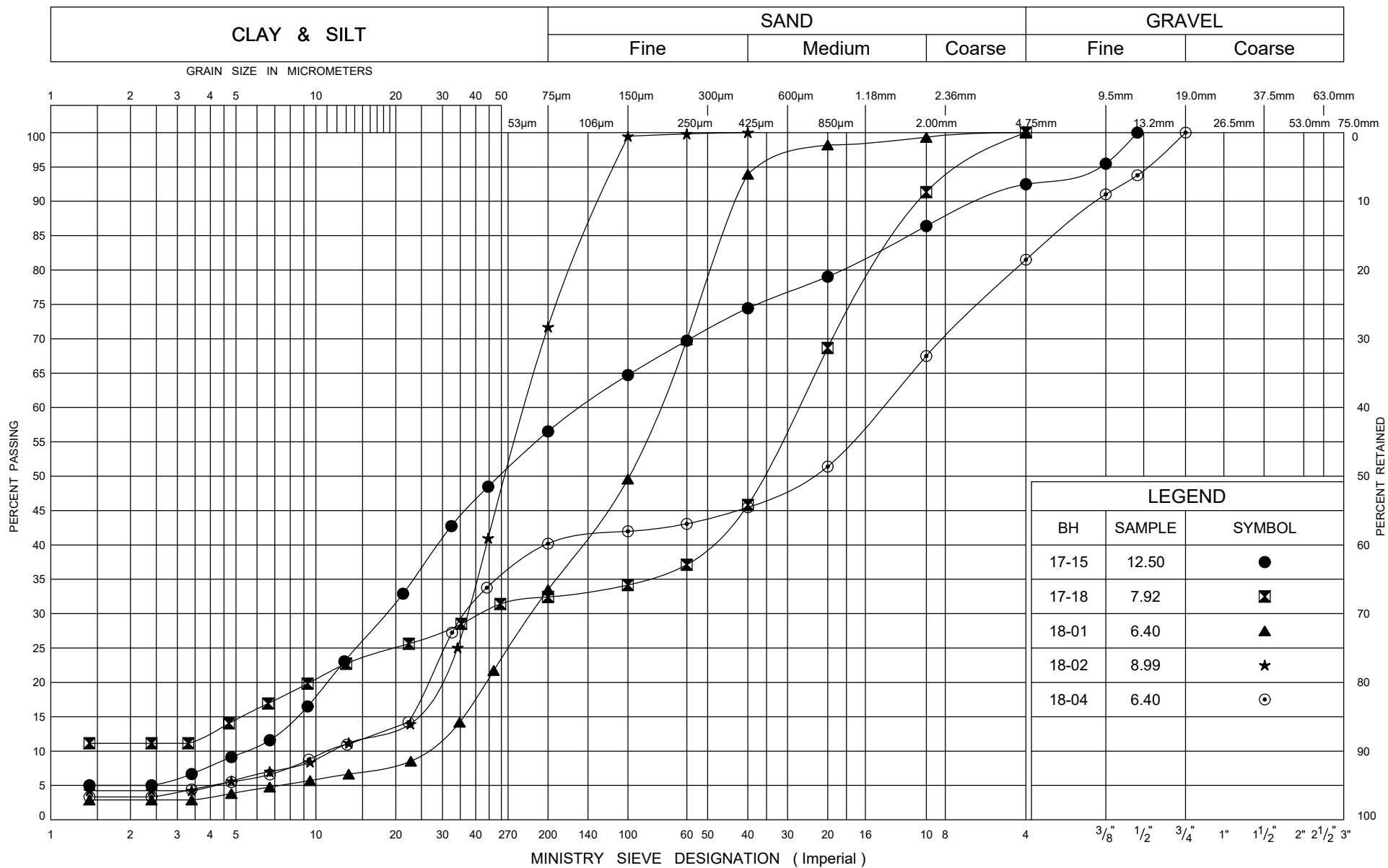
Geotechnical and Analytical Laboratory Test Results

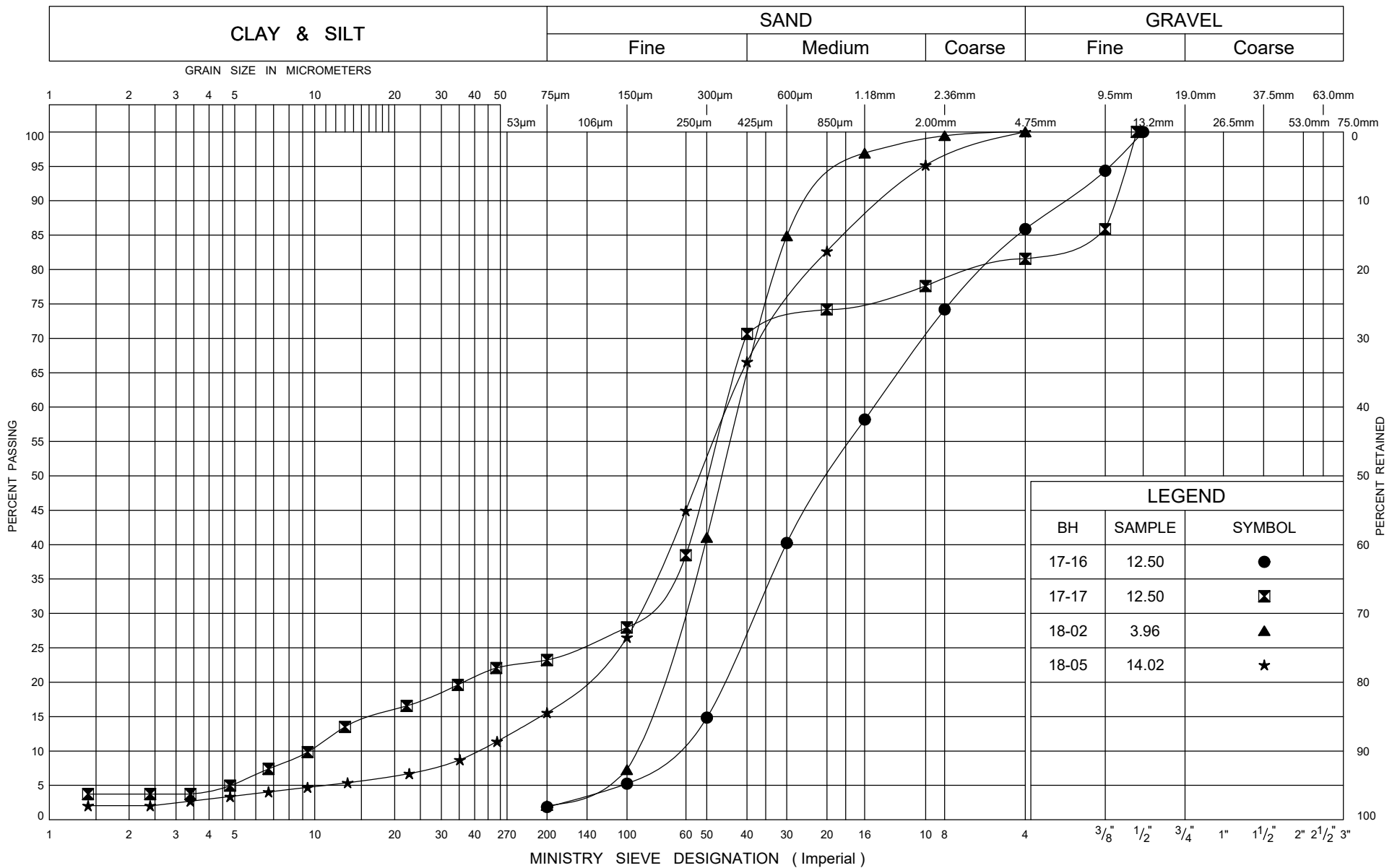


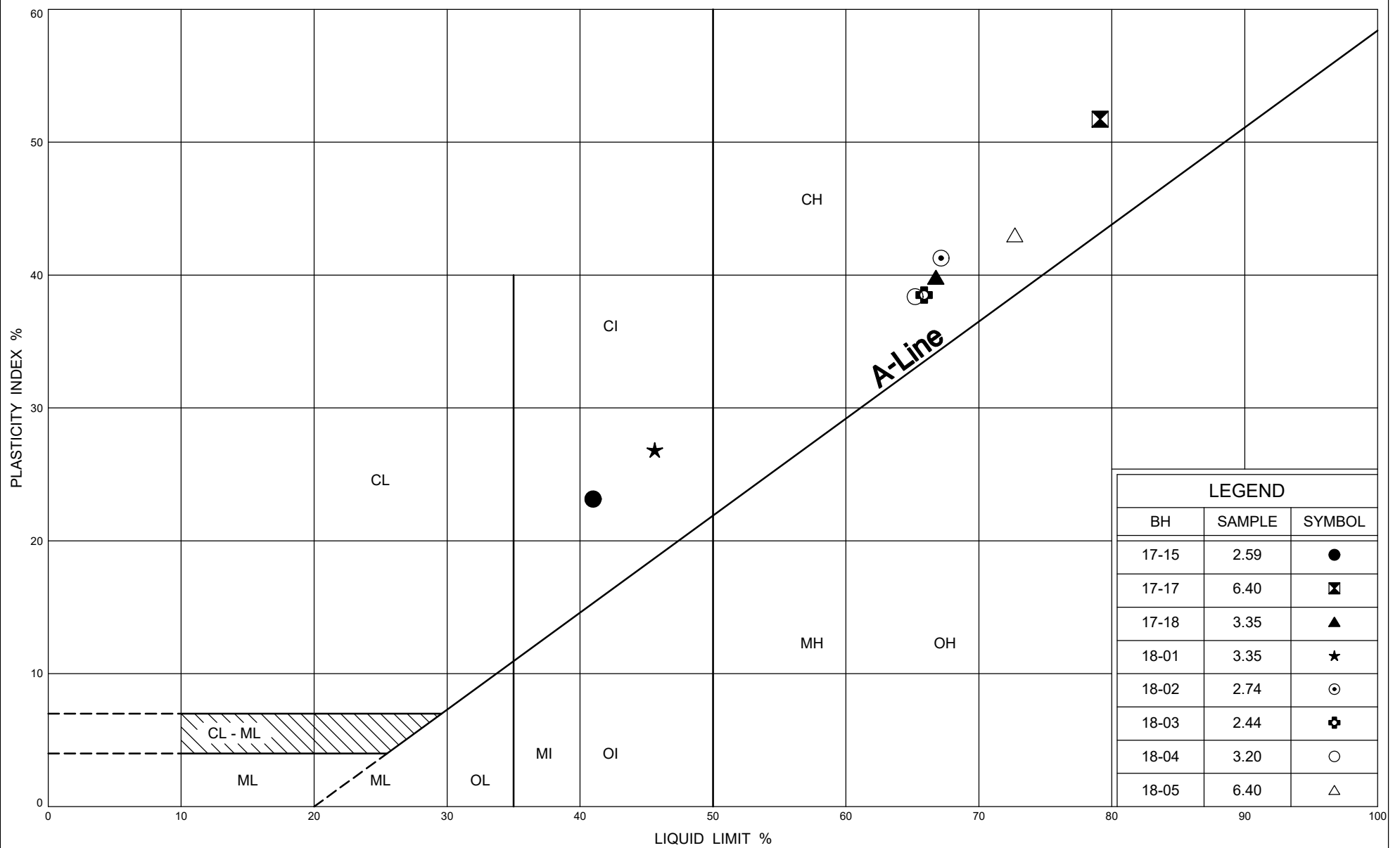












Ministry of
Transportation

PLASTICITY CHART

Silty CLAY

FIG No B7

W P 6804-14-01

Rossmere Creek Culvert



SGS Canada Inc.

P.O. Box 4300 - 185 Concession St.
Lakefield - Ontario - K0L 2H0
Phone: 705-652-2000 FAX: 705-652-6365

Thurber Engineering Ltd

Attn : Cory Zanatta

2010 Winston Park Dr
Oakville, ON
L6H 5R7,

Phone: 905-829-8666 x 240

Fax:

Project : 17840/17792

02-June-2017

Date Rec. : 10 May 2017

LR Report: CA14294-MAY17

Reference: 17840/17792 Cory Zanatta

Copy: #2

CERTIFICATE OF ANALYSIS

Final Report - Reissue

Analysis	1: Analysis Start Date	2: Analysis Start Time	3: Analysis Approval Date	4: Analysis Approval Time	5: MDL	6: Rossmere Creek
Sample Date & Time						25-Apr-17
Temperature Upon Receipt [°C]	---	---	--	--	---	9.0
pH [no unit]	11-May-17	10:30	15-May-17	10:54	0.05	6.35
Conductivity [µS/cm]	11-May-17	10:41	15-May-17	10:51	2	115
Resistivity (calculated) [ohms.cm]	---	---	---	---	---	8700
Redox Potential [mV]	11-May-17	13:57	15-May-17	10:32	---	197
Chloride [mg/L]	15-May-17	18:20	16-May-17	13:24	0.04	24
Sulphate [mg/L]	15-May-17	18:20	16-May-17	13:24	0.04	1.1
Sulphide [mg/L]	11-May-17	12:10	12-May-17	16:01	0.006	0.014



SGS Canada Inc.

P.O. Box 4300 - 185 Concession St.

Lakefield - Ontario - KOL 2H0

Phone: 705-652-2000 FAX: 705-652-6365

Project : 17840/17792

LR Report : CA14294-MAY17

Temperature of Sample upon Receipt: 9 degrees C

Cooling Agent Present: yes

Custody Seal Present: no

Deanna Edwards, B.Sc, C.Chem

Project Specialist

Environmental Services, Analytical



SGS Canada Inc.

P.O. Box 4300 - 185 Concession St.
Lakefield - Ontario - K0L 2H0
Phone: 705-652-2000 FAX: 705-652-6365

Project : 17840/17792

LR Report : CA14294-MAY17

Method Descriptions

Parameter	SGS Method Code	Reference Method Code
Anions by IC	ME-CA-[ENV]IC-LAK-AN-001	EPA300/MA300-Ions1.3
Conductivity	ME-CA-[ENV]EWL-LAK-AN-006	SM 2510
pH	ME-CA-[ENV]EWL-LAK-AN-006	SM 4500
Redox Potential		SM 2580
Sulphide by SFA	ME-CA-[ENV]SFA-LAK-AN-008	SM 4500



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Project : 17840/17792

LR Report : CA14294-MAY17

Quality Control Report

Inorganic Analysis												
Parameter	Reporting Limit	Unit	Method Blank		RPD		LCS / Spike Blank			Matrix Spike / Reference Material		
					RPD	Acceptance Criteria	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
						%		Low	High		Low	High
Anions by IC - QCBatchID: DIO0256-MAY17												
Chloride	0.04	mg/L	<0.04		2	20	97	80	120	100	75	125
Sulphate	0.04	mg/L	<0.04		0	20	96	80	120	89	75	125
Anions by IC - QCBatchID: DIO0269-MAY17												
Chloride	0.04	mg/L	<0.04		0	20	100	80	120	119	75	125
Sulphate	0.04	mg/L	<0.04		0	20	97	80	120	102	75	125
Conductivity - QCBatchID: EWL0183-MAY17												
Conductivity	2	µS/cm	< 2		0	10	99	90	110	NA		
pH - QCBatchID: EWL0182-MAY17												
pH	0.05	no unit	NA		1		100			NA		
Redox Potential - QCBatchID: EWL0192-MAY17												
Redox Potential	no	mV	NA		0	20	103	80	120	NA		
Sulphide by SFA - QCBatchID: SKA0095-MAY17												
Sulphide	0.006	mg/L	<0.006		ND	20	80	80	120	NV	75	125
Sulphide by SFA - QCBatchID: SKA0105-MAY17												
Sulphide	0.006	mg/L	0.009		ND	20	96	80	120	125	75	125



SGS Canada Inc.

P.O. Box 4300 - 185 Concession St.
Lakefield - Ontario - K0L 2H0
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Thurber Engineering Ltd

Attn : Cory Zanatta

2010 Winston Park Dr
Oakville, ON
L6H 5R7,

Phone: 905-829-8666 x 240

Fax:

Project : 15593

08-May-2017

Date Rec. : 02 May 2017

LR Report: CA14060-MAY17

Reference: 15593 Cory Zanatta

Copy: #1

CERTIFICATE OF ANALYSIS

Final Report

Analysis	1: Analysis Start Date	2: Analysis Start Time	3: Analysis Approval Date	4: Analysis Approval Time	9: 17-16 SS5	10: 17-17 SS5
Sample Date & Time					26-Mar-17	26-Mar-17
Temperature Upon Receipt [°C]	---	---	---	---	6.0	6.0
Corrosivity Index [none]	08-May-17	14:35	08-May-17	14:35	5.0	5.0
Soil Redox Potential [mV]	03-May-17	16:33	04-May-17	14:12	286	210
Sulphide [%]	05-May-17	13:47	05-May-17	15:54	< 0.02	< 0.02
% Moisture (wet wt) [%]	04-May-17	13:57	04-May-17	14:37	31.6	30.3
pH [no unit]	03-May-17	15:41	05-May-17	09:17	8.98	8.64
Chloride [µg/g]	05-May-17	17:42	08-May-17	14:40	16	30
Sulphate [µg/g]	05-May-17	17:42	08-May-17	14:40	150	22
Conductivity [uS/cm]	03-May-17	15:41	05-May-17	09:17	127	160
Resistivity (calculated) [Ohms.cm]	03-May-17	15:41	08-May-17	14:21	7870	6250

Temperature of Sample upon Receipt: 12 degrees C

Cooling Agent Present: Yes

Custody Seal Present: No

Corrosivity Index is based on the American Water Works Corrosivity Scale according to AWWA C-105. An index greater than 10 indicates the soil matrix may be corrosive to cast iron alloys.



SGS Canada Inc.

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Lakefield - Ontario - K0L 2H0

Phone: 705-652-2000 FAX: 705-652-6365

Project : 15593

LR Report : CA14060-MAY17

Method Descriptions

Parameter	SGS Method Code
Anions by IC	ME-CA-[ENV]IC-LAK-AN-001
Carbon/Sulphur	ME-CA-[ENV]ARD-LAK-AN-020
Conductivity	ME-CA-[ENV]EWL-LAK-AN-006
Metals Prep	ME-CA-[ENV]ARD-LAK-AN-013
pH	ME-CA-[ENV]EWL-LAK-AN-001

Deanna Edwards, B.Sc, C.Chem

Project Specialist

Environmental Services, Analytical



SGS Canada Inc.

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Lakefield - Ontario - KOL 2H0

Phone: 705-652-2000 FAX: 705-652-6365

Project : 15593

LR Report : CA14060-MAY17

Quality Control Report

Inorganic Analysis												
Parameter	Reporting Limit	Unit	Method Blank				LCS / Spike Blank			Matrix Spike / Reference Material		
					RPD	Acceptance Criteria	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
						%		Low	High		Low	High
Anions by IC - QCBatchID: DIO0108-MAY17												
Chloride	0.4	µg/g	<0.4		3	20	101	80	120	105	75	125
Sulphate	0.4	µg/g	<0.4		2	20	97	80	120	87	75	125
Carbon/Sulphur - QCBatchID: ECS0006-MAY17												
Sulphide	0.02	%	<0.02		ND	20	113	80	120			
Conductivity - QCBatchID: EWL0047-MAY17												
Conductivity	2	uS/cm	< 2		2	10	93	90	110	NA		
pH - QCBatchID: EWL0047-MAY17												
pH	0.05	no unit	NA		0		100			NA		



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2010 Winston Park Dr
Oakville, ON
L6H 5R7,

Phone: 905-829-8666 x 240

Fax:

Project : 17840/17792

02-June-2017

Date Rec. : 10 May 2017

LR Report: CA14294-MAY17

Reference: 17840/17792 Cory Zanatta

Copy: #2

CERTIFICATE OF ANALYSIS

Final Report - Reissue

Analysis	1: Analysis Start Date	2: Analysis Start Time	3: Analysis Approval Date	4: Analysis Approval Time	5: MDL	6: Rossmere Creek
Sample Date & Time						25-Apr-17
Temperature Upon Receipt [°C]	---	---	--	--	---	9.0
pH [no unit]	11-May-17	10:30	15-May-17	10:54	0.05	6.35
Conductivity [µS/cm]	11-May-17	10:41	15-May-17	10:51	2	115
Resistivity (calculated) [ohms.cm]	---	---	---	---	---	8700
Redox Potential [mV]	11-May-17	13:57	15-May-17	10:32	---	197
Chloride [mg/L]	15-May-17	18:20	16-May-17	13:24	0.04	24
Sulphate [mg/L]	15-May-17	18:20	16-May-17	13:24	0.04	1.1
Sulphide [mg/L]	11-May-17	12:10	12-May-17	16:01	0.006	0.014



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Project : 17840/17792

LR Report : CA14294-MAY17

Temperature of Sample upon Receipt: 9 degrees C

Cooling Agent Present: yes

Custody Seal Present: no

Deanna Edwards, B.Sc, C.Chem

Project Specialist

Environmental Services, Analytical



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Lakefield - Ontario - K0L 2H0

Phone: 705-652-2000 FAX: 705-652-6365

Project : 17840/17792

LR Report : CA14294-MAY17

Method Descriptions

Parameter	SGS Method Code	Reference Method Code
Anions by IC	ME-CA-[ENV]IC-LAK-AN-001	EPA300/MA300-Ions1.3
Conductivity	ME-CA-[ENV]EWL-LAK-AN-006	SM 2510
pH	ME-CA-[ENV]EWL-LAK-AN-006	SM 4500
Redox Potential		SM 2580
Sulphide by SFA	ME-CA-[ENV]SFA-LAK-AN-008	SM 4500



SGS Canada Inc.

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Lakefield - Ontario - K0L 2H0
Phone: 705-652-2000 FAX: 705-652-6365

Project : 17840/17792

LR Report : CA14294-MAY17

Quality Control Report

Inorganic Analysis												
Parameter	Reporting Limit	Unit	Method Blank		RPD		LCS / Spike Blank			Matrix Spike / Reference Material		
					RPD	Acceptance Criteria	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
						%		Low	High		Low	High
Anions by IC - QCBatchID: DIO0256-MAY17												
Chloride	0.04	mg/L	<0.04		2	20	97	80	120	100	75	125
Sulphate	0.04	mg/L	<0.04		0	20	96	80	120	89	75	125
Anions by IC - QCBatchID: DIO0269-MAY17												
Chloride	0.04	mg/L	<0.04		0	20	100	80	120	119	75	125
Sulphate	0.04	mg/L	<0.04		0	20	97	80	120	102	75	125
Conductivity - QCBatchID: EWL0183-MAY17												
Conductivity	2	µS/cm	< 2		0	10	99	90	110	NA		
pH - QCBatchID: EWL0182-MAY17												
pH	0.05	no unit	NA		1		100			NA		
Redox Potential - QCBatchID: EWL0192-MAY17												
Redox Potential	no	mV	NA		0	20	103	80	120	NA		
Sulphide by SFA - QCBatchID: SKA0095-MAY17												
Sulphide	0.006	mg/L	<0.006		ND	20	80	80	120	NV	75	125
Sulphide by SFA - QCBatchID: SKA0105-MAY17												
Sulphide	0.006	mg/L	0.009		ND	20	96	80	120	125	75	125



Appendix C

Selected Site Photographs



Photo 1: View looking east along the south embankment of Highway 11



Photo 2: View looking west along Highway 11



Photo 3: South Side of Rossmere Creek Culvert



Photo 4: North Side of Rossmere Creek Culvert



Photo 5: Rossmere Creek Culvert Upstream



Photo 5: Rossmere Creek Culvert Downstream



Photo 6: Rossmere Creek looking south downstream.

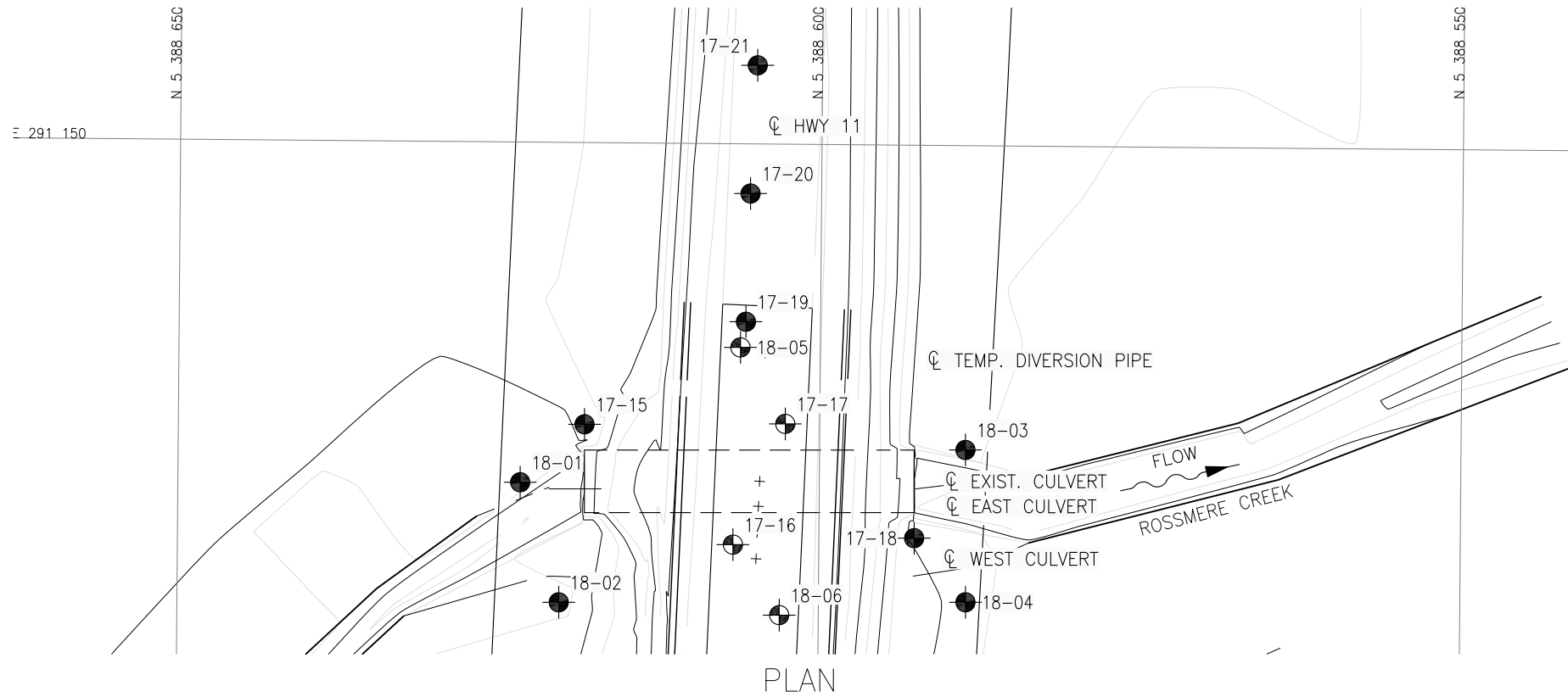


Photo 6: Rossmere Creek looking north west upstream.



Appendix D

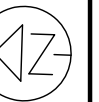
Borehole Locations and Soil Strata Drawing



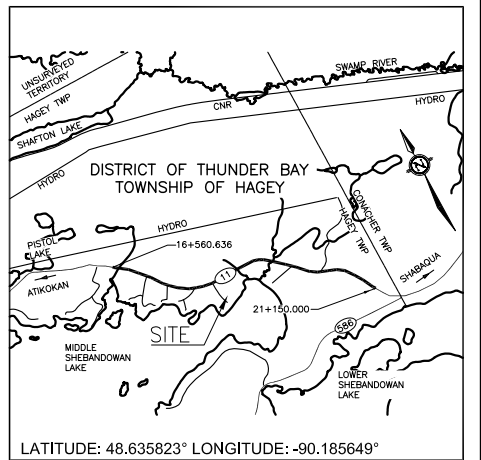
METRIC
DIMENSIONS ARE IN METRES
AND/OR MILLIMETRES
UNLESS OTHERWISE SHOWN

CONT No 6016-E-0012
WP No 6804-14-01

HIGHWAY 11
ROSSMERE CREEK
CULVERT REPLACEMENT
BOREHOLE LOCATIONS AND SOIL STRATA



SHEET
9



KEYPLAN

LEGEND

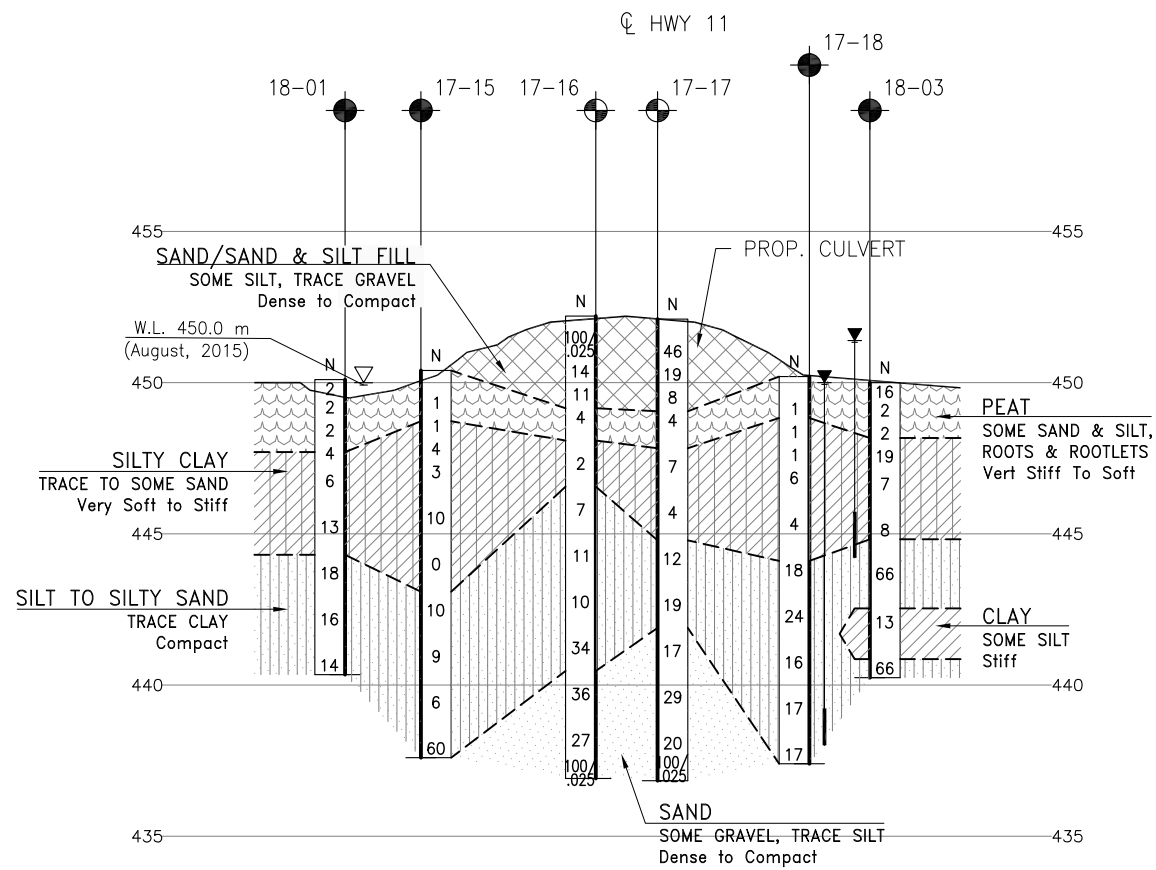
	Borehole
	Borehole and Cone
N	Blows /0.3m (Std Pen Test, 475J/blow)
CONE	Blows /0.3m (60° Cone, 475J/blow)
PH	Pressure, Hydraulic
	Water Level
	Head Artesian Water
	Piezometer
A/R	Auger Refusal

NO	ELEVATION	NORTHING	EASTING
17-15	450.4	5 388 618.3	291 128.0
17-16	452.2	5 388 606.7	291 118.7
17-17	452.1	5 388 602.7	291 128.2
17-18	450.2	5 388 592.6	291 119.4
17-19	452.1	5 388 605.8	291 136.1
17-20	452.1	5 388 605.5	291 146.1
17-21	452.1	5 388 605.1	291 156.1
18-01	450.1	5 388 623.3	291 123.5
18-02	450.0	5 388 620.2	291 114.1
18-03	450.0	5 388 588.6	291 126.3
18-04	450.1	5 388 588.5	291 114.4
18-05	452.1	5 388 606.2	291 134.1
18-06	452.2	5 388 603.0	291 113.3

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.
- Coordinate system is MTM NAD 83 Zone 15

GEOCRES No. 52B-36



PROFILE ALONG CULVERT

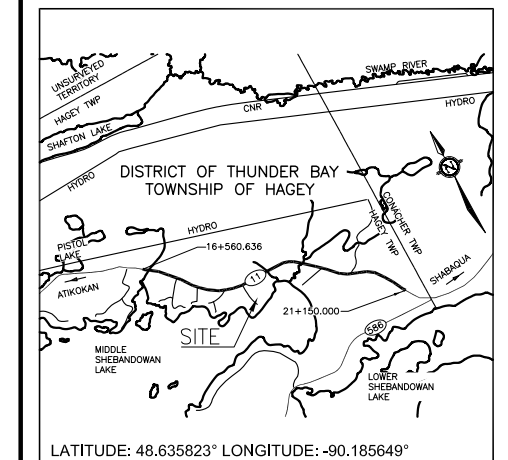


REVISIONS	DATE	BY	DESCRIPTION
DESIGN	CZ	CHK MEF	CODE LOAD DATE MAY 2018
DRAWN	AN	CHK CZ	SITE 48W-192/C/STRUCT DWG 1

CONT No 6016-E-0012
WP No 6804-14-01






HIGHWAY 11
ROSSMERE CREEK
CULVERT REPLACEMENT
BOREHOLE LOCATIONS AND SOIL STRATA

SHEET
10



KEYPLAN

LEGEND

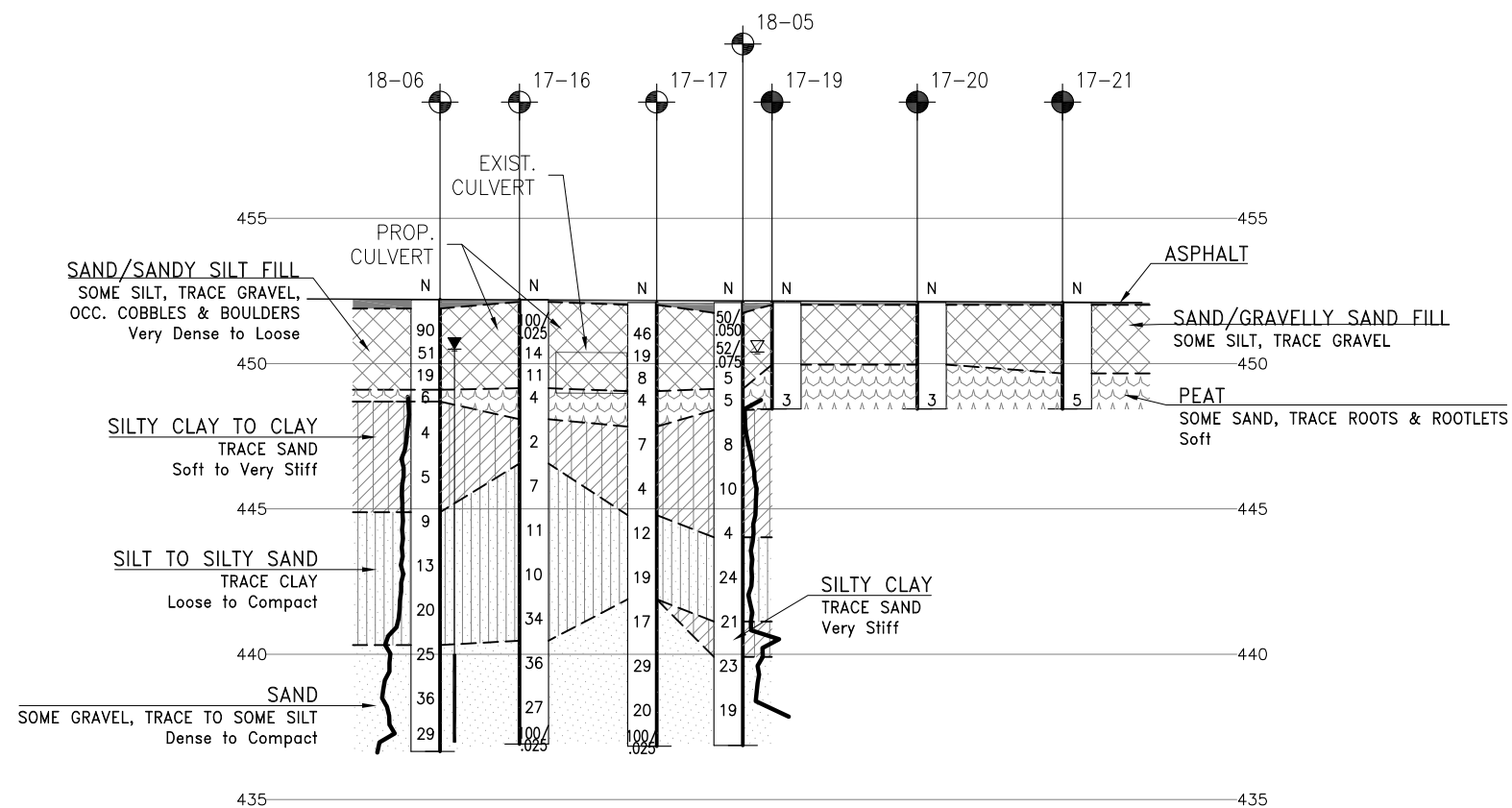
	Borehole
	Borehole and Cone
N	Blows /0.3m (Std Pen Test, 475J/blow)
CONE	Blows /0.3m (60° Cone, 475J/blow)
PH	Pressure, Hydraulic
	Water Level
	Head Artesian Water
	Piezometer
A/R	Auger Refusal

NO	ELEVATION	NORTHING	EASTING
17-15	450.4	5 388 618.3	291 128.0
17-16	452.2	5 388 606.7	291 118.7
17-17	452.1	5 388 602.7	291 128.2
17-18	450.2	5 388 592.6	291 119.4
17-19	452.1	5 388 605.8	291 136.1
17-20	452.1	5 388 605.5	291 146.1
17-21	452.1	5 388 605.1	291 156.1
18-01	450.1	5 388 623.3	291 123.5
18-02	450.0	5 388 620.2	291 114.1
18-03	450.0	5 388 588.6	291 126.3
18-04	450.1	5 388 588.5	291 114.4
18-05	452.1	5 388 606.2	291 134.1
18-06	452.2	5 388 603.0	291 113.3

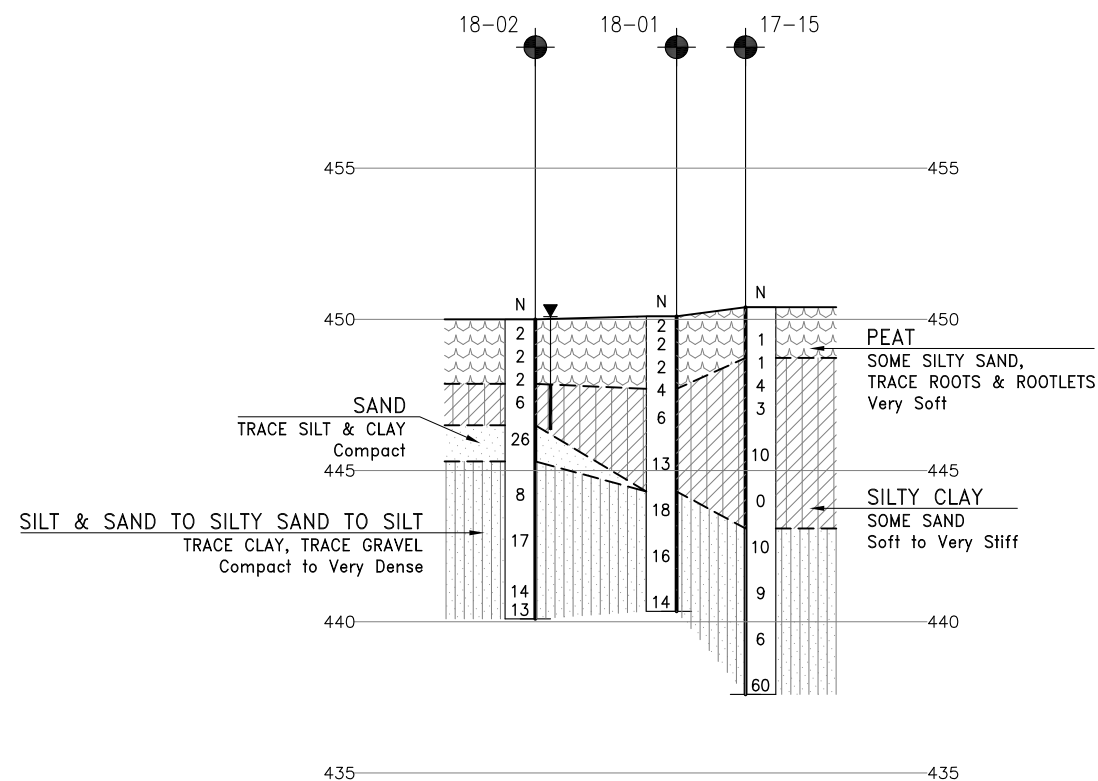
-NOTES-

- 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.
- 3) Coordinate system is MTM NAD 83 Zone 15

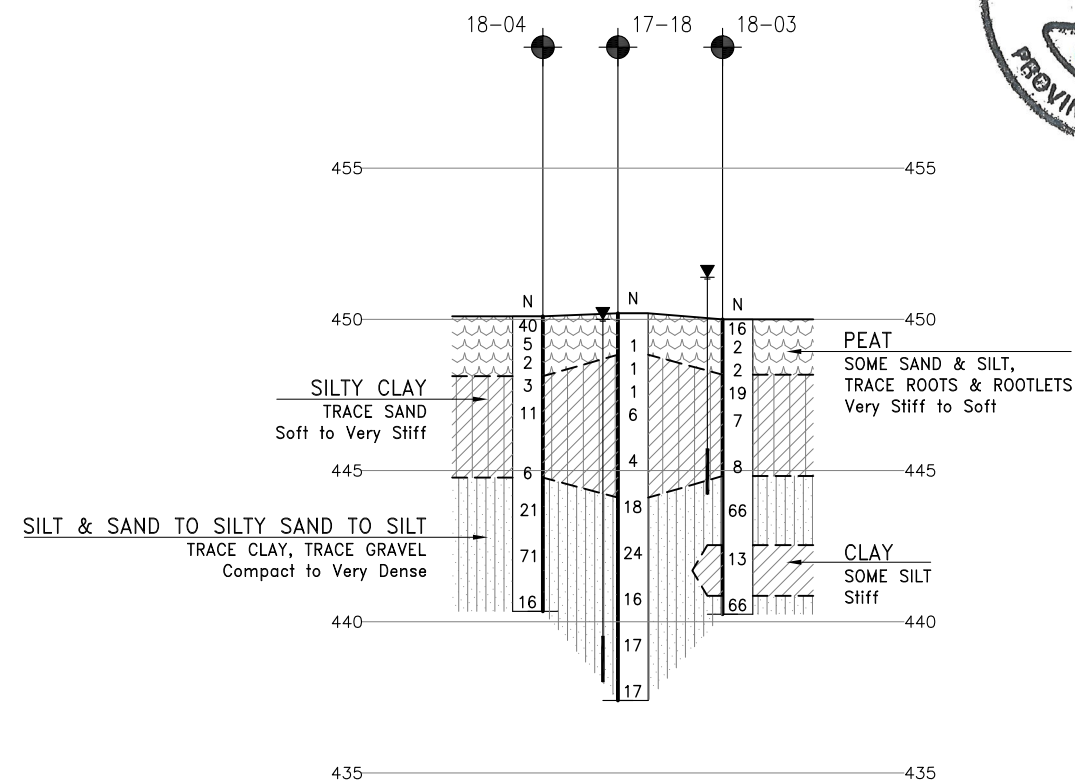
GEOCRES No. 52B-36



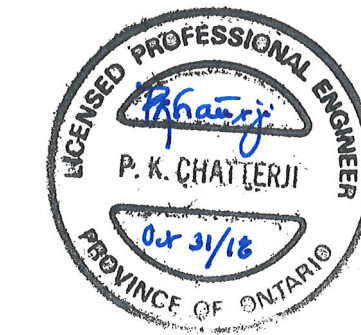
PROFILE ALONG \mathbb{Q} HWY 11



SECTION A-A'



SECTION B-B'



REVISIONS									
	DATE	BY	DESCRIPTION						
DESIGN	CZ	CHK	MEF	CODE	LOAD		DATE	MAY 2018	
DRAWN	AN	CHK	CZ	SITE	STRUCT	DWG	2		