



**THURBER** ENGINEERING LTD.

**FINAL**  
**FOUNDATION INVESTIGATION REPORT**  
**HIGHWAY 118 CULVERT STA. 18+245, OAKLEY TOWNSHIP**  
**ASSIGNMENT NO. 5017-E-0003**  
**G.W.P. 5287-14-00**

Geocres No.: 31E-398

Report to:

**McIntosh Perry Consulting Engineers Limited**

Latitude: 45.004772°  
Longitude: -79.033272°

August 2019  
Thurber File No.: 20244



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**PART 1. FACTUAL INFORMATION**

**1 INTRODUCTION**

This section of the report presents the factual findings obtained from a foundation investigation completed at a culvert at Sta. 18+245 on Highway 118. The culvert crossing is located approximately 0.4 km west of Bird Lake Road within Oakley Township in the District of Muskoka. Thurber Engineering Limited (Thurber) carried out the current field investigation as a sub-consultant to McIntosh Perry Consulting Engineers Ltd. (MPCE) under Assignment No. 5017-E-0003.

The purpose of this investigation was to explore the subsurface conditions at the site and, based on the data obtained, to provide a borehole location plan, records of boreholes, stratigraphic profile, laboratory test results and a written description of the subsurface conditions. A model of the subsurface conditions influencing design and construction was developed in the course of the current investigation.

No previous foundation investigation information was available for the subject culvert site within the online Geocres Library. A Project Assessment Report (PAR) and a historical base plan survey was provided by MPCE which documented the culvert stationing and size.

**2 SITE DESCRIPTION**

The existing culvert conveys (unnamed) creek flow from the north to the south under a high fill embankment supporting Highway 118. As shown on the base plan drawings provided by MPCE, the existing culvert is a non-structural corrugated steel plate (SPCSP) culvert with a diameter of 1.8 m. The length of the culvert is 36.6 m and the inverts of the culvert are shown at elevation 291.1 and 290.7 m at the inlet (north) and outlet (south), respectively. No signs of erosion or slope instability were noted on the existing highway embankments during the field investigation. The roadway surface over the culvert was generally in good condition with no dips or bumps noted during the field investigation. The existing culvert, as assessed by MPCE, showed minor signs of corrosion and had significant sediment deposits inside.

At the location of the culvert, Highway 118 is a two-lane highway with paved shoulders. The Highway 118 fill height above the culvert is approximately 4.5 m with the road surface at approximate elevation 297.2 m. The existing embankment slopes are inclined at approximately 2.4H:1V. Steel guidewires with wooden posts are present on both sides of the highway in the vicinity of the culvert. Open water is present on the inlet side of the highway. The land adjacent to the highway and creek alignment is densely vegetated with shrubs and predominantly coniferous trees. A single dwelling is located approximately 200 m east of the culvert. Bedrock outcrops and rock cuts are present within close proximity to the culvert site. Overhead utility lines run parallel to the highway immediately north of Highway 118. Traffic volumes on this section of Highway 118 are understood to be 1,600 AADT (2016).

Select photographs showing the existing conditions in the area of the culvert at the time of the field investigation are included in Appendix D for reference.

### **3 SITE INVESTIGATION AND FIELD TESTING**

The site investigation and field testing program was carried out on September 11<sup>th</sup> and 12<sup>th</sup>, 2018 for the on-road investigation and between September 12<sup>th</sup> to 15<sup>th</sup>, 2018 for the off-road investigation. The field investigation consisted of advancing four boreholes identified as 18-1 through 18-4. The drilling was carried out using portable equipment for off-road boreholes 18-1 and 18-4 and a truck mounted CME 75 drill rig for the on-road boreholes 18-2 and 18-3. Prior to commencement of drilling, utility clearances were obtained in the vicinity of the borehole locations.

The northing, easting and elevation of the boreholes are shown on the Borehole Location and Soil Strata Drawing No. 1 in Appendix A, the individual Record of Borehole sheets in Appendix B and in Table 3-1. The termination depth of each of the boreholes are also provided, below. The site is within MTM Zone 10. The borehole elevations were surveyed with a Nikon-AP-8 with an accuracy of +/- 1.5 mm. The survey referenced the top of the south end of the culvert, which has an elev. 292.544 m, as provided by MPCE. Horizontal locations were measured relative to existing site features.



**Table 3-1: Borehole Summary**

<b>Borehole No.</b>	<b>Drilled Location</b>	<b>Northing (m)</b>	<b>Easting (m)</b>	<b>Ground Surface Elevation (m)</b>	<b>Termination Depth * (m)</b>
18-1	Near Culvert Inlet	4 985 094.3	341 577.7	292.2	9.4
18-2	Westbound Lane HWY 118	4 985 082.9	341 593.1	297.2	18.7
18-3	Eastbound Lane HWY 118	4 985 077.0	341 589.2	297.3	16.2
18-4	Near Culvert Outlet	4 985 062.7	341 601.8	291.8	12.6

*Note: (\*) depths provided in table are from the ground surface*

Soil samples were obtained at select intervals using a split spoon sampler in conjunction with Standard Penetration Testing (SPT) following ASTM D1586. Boreholes 18-1 and 18-4, which were drilled with portable equipment, utilized a half-weight (32 kg) hammer for SPT testing. The N-values reported herein for the off-road boreholes have been corrected to an equivalent standard weight hammer (64 kg). The on-road boreholes utilized a standard weight hammer for SPT testing and no correction was necessary. Boreholes 18-1, 18-2 and 18-3 were advanced into bedrock with either NW or NWT casing in conjunction with coring techniques.

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

A 19 mm diameter standpipe piezometer was installed in Borehole 18-4 to allow for measurements of the groundwater level after completion of drilling. The piezometer installation details are illustrated on the respective Record of Borehole sheet provided in Appendix B. The boreholes were backfilled in accordance with MOE requirements (O.Reg. 903 as amended). Boreholes 18-2 and 18-3 were backfilled with granulars within the depth of pavement structure and capped with 150 mm of cold patch asphalt to reinstate the travelling surface.

#### **4 LABORATORY TESTING**

The recovered soil samples were subjected to visual identification and to natural moisture content determination. Selected samples were also subjected to gradation analysis (hydrometer and/or sieve) and Atterberg Limit testing. The results of these tests are summarized on the Record of Borehole sheets included in Appendix B. One sample of soil



recovered from within each of Boreholes 18-1 and 18-4 was selected for analytical testing of corrosivity parameters. All laboratory test results are provided in Appendix C.

## **5 DESCRIPTION OF SUBSURFACE CONDITIONS**

Details of the encountered soil stratigraphy are presented on the Record of Borehole sheets included in Appendix B and the Borehole Location and Soil Strata drawing included in Appendix A. 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 for interpretation of the site conditions. It must be recognized that the soil and groundwater conditions may vary between and beyond borehole locations.

In general terms, the site was found to be underlain by a pavement structure and granular fill overlying native deposits of silty sand, sand and silt over glacial till. Granite bedrock was encountered at varying elevations within the depth of investigation in Boreholes 18-1, 18-2 and 18-3.

### **5.1 Embankment**

#### **5.1.1 Asphalt**

Boreholes 18-2 and 18-3 were drilled through the existing Highway 118 embankment and encountered a layer of asphalt with a thickness of 75 and 100 mm, respectively.

#### **5.1.2 Fill: Sand with Silt and Gravel**

Below the asphalt in Boreholes 18-2 and 18-3 was a layer of fill consisting of sand with silt and gravel. The underside of this fill was 3.7 and 1.5 m below the existing roadway surface (elev. 293.5 and 295.8 m) in Boreholes 18-2 and 18-3, respectively.

The SPT tests conducted in the sand fill gave N-values ranging from 13 to 46 blows, indicating a relative density of compact to dense.

Recorded moisture contents ranged from 5 to 15%. The results of grain size analyses conducted on two samples of the sand fill are summarized below and are provided on the Record of Borehole sheets in Appendix B and illustrated on Figure C1 in Appendix C.

Soil Particle	Percentage (%)
Gravel	21 – 22
Sand	66 – 69
Silt	10 – 12
Clay	

### 5.1.3 Fill: Silty Sand with Gravel

A layer of fill consisting of silty sand with gravel was encountered below the upper sand fill in Boreholes 18-2 and 18-3. Occasional to frequent cobbles and boulders were noted within this fill. The silty sand fill was 1.6 to 4.7 m thick with an underside elevation of 291.9 and 291.1 m in Boreholes 18-2 and 18-3, respectively. Coring techniques were required to advance through cobbles and boulders below a depth of 3.7 m.

The SPT tests conducted in this fill gave N-values ranging from 6 to 52 blows indicating a relative density of loose to very dense.

Recorded moisture contents ranged from 13 to 22%. The results of a grain size analysis conducted on one sample of the silty sand fill indicated this material to consist of 18% gravel, 68% sand and 14% fines. These results are provided on the Record of Borehole sheet in Appendix B and are also illustrated on Figure C1 in Appendix C.

## 5.2 Silty Sand (SM)

A native silty sand deposit was encountered at ground surface in Borehole 18-1 and below the fill in Borehole 18-3 with thicknesses of 2.1 and 1.4 m, respectively. The underside of the silty sand ranged in elevation from 289.7 to 290.1 m. Traces of organics were encountered in the upper 0.6 m in Borehole 18-1 and throughout the layer in Borehole 18-3.

SPT tests conducted in the silty sand deposits gave N-values typically ranging from 1 to 14 blows indicating a relative density of very loose to compact. A single blow count of 37 was recorded at ground surface in Borehole 18-01.

Recorded moisture contents of the silty sand typically ranged from 23 to 35%. The results of grain size analyses conducted on two samples of the silty sand are summarized below and are illustrated on Figure C2 in Appendix C.

Soil Particle	Percentage (%)	
Gravel	0 – 4	
Sand	71 – 73	
Silt	25	25
Clay	2	

## 5.3 Sand (SP to SP-SM)

A native deposit of sand with varying amounts of silt and traces of gravel was encountered at surface in Borehole 18-4, below the silty sand deposit in Boreholes 18-1 and 18-3 and below the fill material in Borehole 18-2. The sand in Borehole 18-2 transitioned to silty sand with depth. Traces of organics were encountered in the upper 0.6 m of the sand deposit in Borehole 18-4 and organics with wood fragments were noted near the surface of the layer

in Borehole 18-2. Occasional to frequent cobbles and boulders were encountered within the sand deposit in Boreholes 18-2 and 18-3 below elevation 289.6 m. The thickness of the sand deposit ranged from 2.3 to 6.9 m with a bottom elevation of 287.8 to 283.6 m. Coring techniques were required to advance through cobbles and boulders where encountered in this material.

The SPT N-values conducted in this layer ranged from 2 to greater than 100 blows indicating a variable relative density of very loose to very dense.

The moisture content of the samples tested typically ranged from 10 to 40% with a single moisture content of 71% recorded in Borehole 18-4. The results of grain size analyses conducted on five samples of the sand are summarized below and are illustrated on Figure C3 in Appendix C.

Soil Particle	Percentage (%)
Gravel	2 – 10
Sand	81 – 95
Silt	1 – 13
Clay	

#### **5.4 Silt (ML)**

Borehole 18-4 encountered a deposit of silt with trace of sand below the sand deposit. The thickness of this layer was 4.6 m with a base elevation of 281.3 m.

The SPT tests conducted in this layer gave N-values ranging from 24 to 40 blows indicating a relative density of compact to dense.

Recorded moisture contents ranged from 22 to 27%. The results of a grain size analysis conducted on one sample of the silt indicated this material to consist of 0% gravel, 5% sand, 86% silt and 9% clay. These results are provided on the Record of Borehole sheet in Appendix B and are illustrated on Figure C4 in Appendix C.

An Atterberg Limit test was completed on one sample and the results indicated the silt to exhibit low plasticity (ML) with a liquid limit of 24, a plasticity limit of 22 and a plasticity index of 2. The results are illustrated on Figure C6 in Appendix C.

#### **5.5 Silty Sand (SM) with gravel – (Glacial Till)**

Below the deposits noted above was a deposit of glacial till consisting of silty sand with varying amounts of gravel within all boreholes. Frequent cobbles and boulders were encountered throughout the till deposit. Borehole 18-4 was terminated within the till at a depth of 12.6 m below existing ground surface (elev. 279.2). This layer was fully penetrated in the remaining three boreholes and the thickness of the deposit ranged from 1.8 to 2.1 m

with an underside elevation ranging from 281.7 to 285.9 m. Coring techniques were frequently required to advance through cobbles and boulders throughout this deposit.

SPT tests conducted in the till deposits gave N-values ranging typically from 45 to greater than 100 blows indicating a relative density of dense to very dense, but predominantly consisted of very dense material. A single SPT N-value of 10 blows was encountered near the surface of the till layer in Borehole 18-4.

Recorded moisture contents of the till typically ranged from 6 to 13%. The result of grain size analyses conducted on two samples of the till are summarized below and are provided on the Record of Borehole sheets in Appendix B and are illustrated on Figure C5 in Appendix C.

Soil Particle	Percentage (%)
Gravel	27 – 28
Sand	53 – 60
Silt	13 – 19
Clay	

## 5.6 Bedrock

Bedrock was proven by coring in Boreholes 18-1 and 18-2. Probable bedrock was also encountered in Borehole 18-3, however, insufficient depth of bedrock was cored to confirm. Information on the bedrock surface encountered in the boreholes is summarized in the following table.

**Table 5-1: Summary of Bedrock Elevations**

Borehole No.	Depth to Bedrock (m)	Bedrock Elevation (m)
18-1	6.3	285.9
18-2	14.3	282.9
18-3	15.5	281.7
18-4	N/A	Not encountered above 279.2 m

The bedrock core samples consisted of slightly weathered to fresh granite. The Total Core Recovery (TCR) from all core samples was 100%, the Solid Core Recovery (SCR) ranged from 56 to 100% and the Rock Quality Designation (RQD) ranged from 76 to 100%. Based on the measured RQD values, the bedrock is classified as good to excellent in quality (Table 3.10, Canadian Foundation and Engineering Manual 2006).

Photographs of the bedrock core are provided in Appendix C. The intact granite bedrock is predominantly medium to very strong. Photographs of the bedrock core are provided in Appendix C.

## 5.7 Groundwater

Accurate water levels could not be recorded in the open boreholes due to water being introduced as part of the rock coring operations. The groundwater level measured in the standpipe piezometer installed in Borehole 18-4 was recorded at a depth of 0.2 m below the ground surface (elev. 291.6 m) on September 29, 2018. It is expected that the groundwater level will likely reflect the fluctuating water level in the creek.

These observations are considered short term and it should be noted that the groundwater level at the time of construction may be different and seasonal fluctuations of the groundwater level are to be expected. In particular, the groundwater level may be at a higher elevation after periods of significant and/or prolonged precipitation.

## 5.8 Analytical Testing

Two samples of the native soils encountered at the site were submitted for analysis of pH, water soluble sulphate and chloride concentrations, and resistivity. The analysis results are summarized in the Table 5-2 and a copy of the test results is provided in Appendix C.

**Table 5-2: Results of Chemical Analysis**

Borehole (Sample)	Depth (mbgs)	Sulphate (µg/g)	pH ( - )	Resistivity (Ohm-cm)	Conductivity (uS/cm)	Chloride (µg/g)	Sulphide (%)
18-1 (SS3)	1.3 – 1.9	129	5.86	4,410	227	40	<0.02
18-4 (SS3)	1.2 – 1.8	62	5.11	4,110	243	104	<0.02

## 6 MISCELLANEOUS

Borehole locations were selected by Thurber relative to existing site features and the existing culvert location. The as-drilled location and ground surface elevation of the boreholes were measured by Thurber following completion of drilling. Elevation benchmarks were provided by MPCE.

George Downing Estate Drilling Ltd. and Forage M3 Drilling Services Inc., both of Hawksbury, Ontario, supplied and operated the drilling equipment to conduct the drilling, soil sampling, in-situ testing, standpipe installation and decommissioning of the boreholes. NC Traffic Management Inc. of Kirkland Lake, Ontario supplied the traffic control for lane and shoulder closures required for the field work. The field investigation was supervised on



a full-time basis by Miss Allison Chow, EIT and Mr. Sean O'Bryan, C.E.T. of Thurber. Overall supervision of the investigation was provided by Miss Katya Edney, P.Eng.

Routine geotechnical laboratory testing was completed by Thurber's laboratory in Ottawa, Ontario. Analytical testing was completed by Paracel Laboratories in Ottawa, Ontario. Interpretation of the factual data and preparation of this report were carried out by Miss Katya Edney P.Eng. and Mr. Stephen Peters P.Eng. The report was reviewed by Dr. Fred Griffiths, P.Eng and Dr. P.K. Chatterji, P.Eng. a Designated Principal Contact for MTO Foundation Projects.

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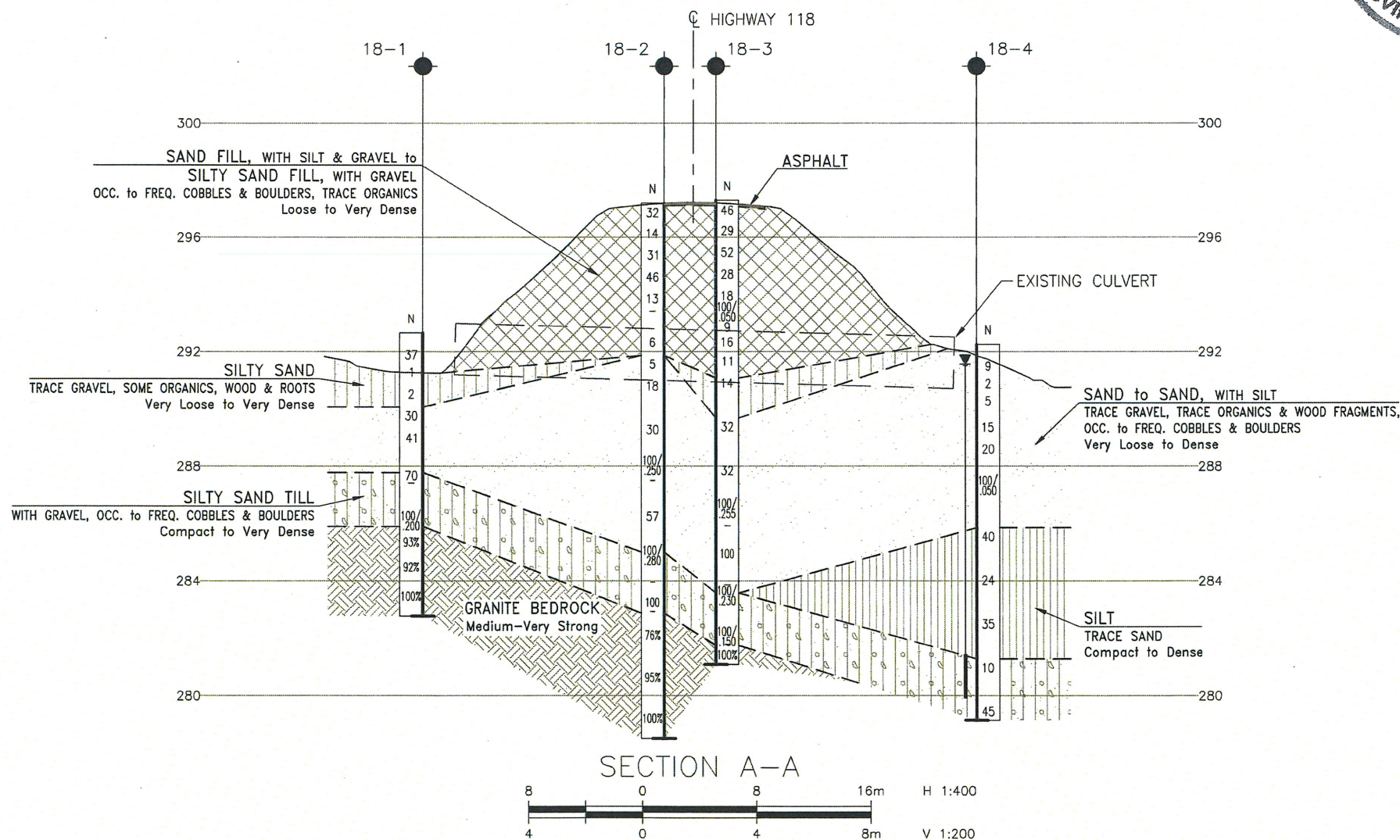
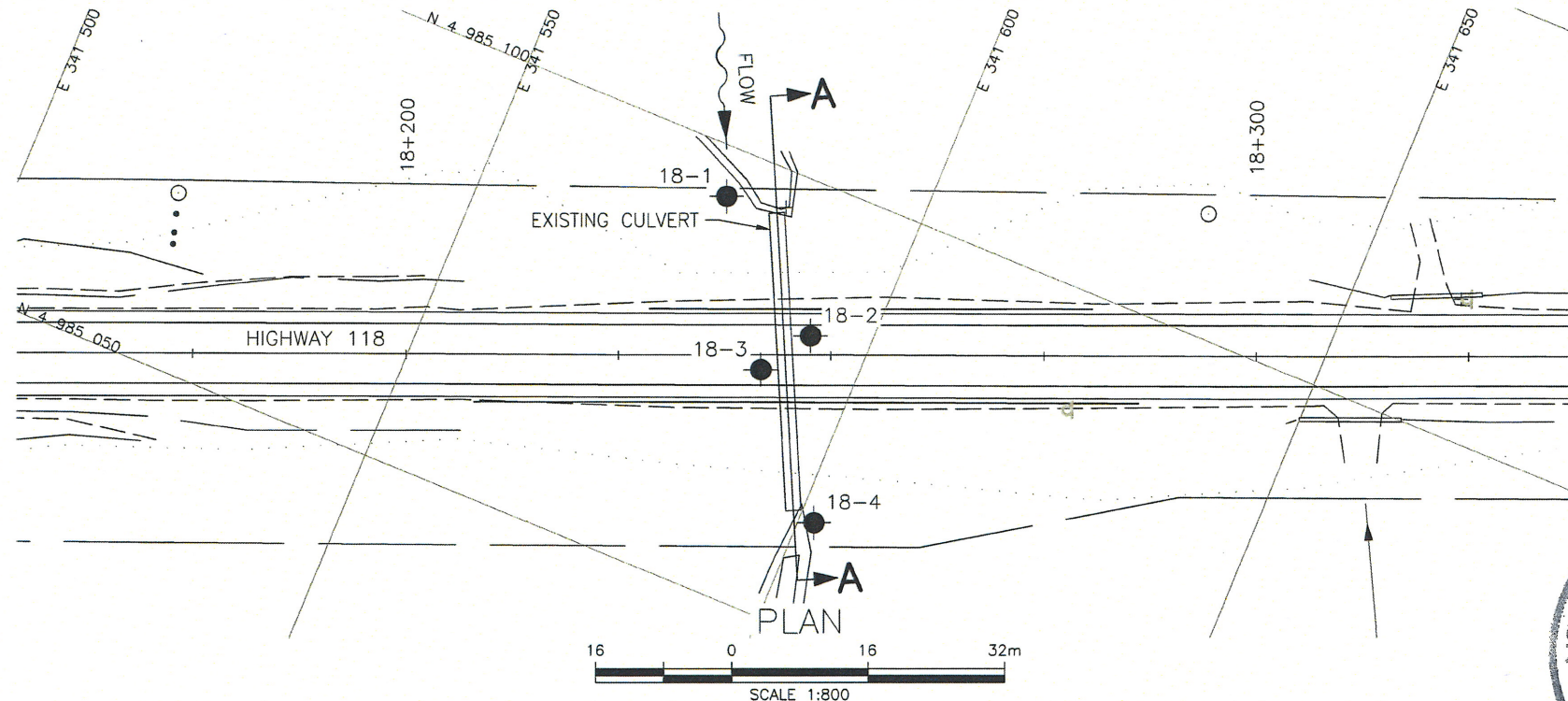
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## **Appendix A.**

### **Borehole Location Plan and Stratigraphic Drawing**





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



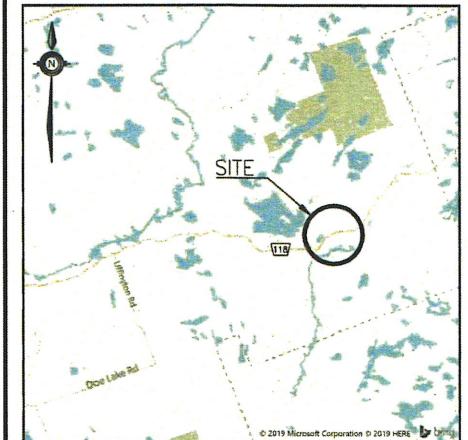
CONT No  
GWP No 5287-14-00

HIGHWAY 118  
STATION 18+245  
CULVERT REPLACEMENT  
BOREHOLE LOCATIONS AND SOIL STRATA

McINTOSH PERRY



THURBER ENGINEERING LTD.



KEYPLAN

LEGEND

●	Current Borehole by Thurber
⊕	Previous Borehole by Others (Approx.)
N	Blows /0.3m (Std Pen Test, 475J/blow)
CONE	Blows /0.3m (60° Cone, 475J/blow)
PH	Pressure, Hydraulic
W	Water Level
HA	Head Artesian Water
P	Piezometer
90%	Rock Quality Designation (RQD)
A/R	Auger Refusal

NO	ELEVATION	NORTHING	EASTING
18-1	292.2	4 985 094.3	341 577.7
18-2	297.2	4 985 082.9	341 593.1
18-3	297.3	4 985 077.0	341 589.2
18-4	291.8	4 985 062.7	341 601.8

-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 10.

GEOCRES No. 31E-398

REVISIONS	DATE	BY	DESCRIPTION
DESIGN	KE	CHK SP	CODE
DRAWN	MFA	CHK KE	SITE
			LOAD
			DATE APR 2019
			ISTRUCT
			DWG





## **Appendix B.**

### **Record of Borehole Sheets**



## SYMBOLS, ABBREVIATIONS AND TERMS USED ON TEST HOLE RECORDS

### TERMINOLOGY DESCRIBING COMMON SOIL GENESIS

Topsoil	mixture of soil and humus capable of supporting vegetative growth
Peat	mixture of fragments of decayed organic matter
Till	unstratified glacial deposit which may include particles ranging in sizes from clay to boulder
Fill	material below the surface identified as placed by humans (excluding buried services)

### TERMINOLOGY DESCRIBING SOIL STRUCTURE:

Desiccated	having visible signs of weathering by oxidization of clay materials, shrinkage cracks, etc.
Fissured	having cracks, and hence a blocky structure
Varved	composed of alternating layers of silt and clay
Stratified	composed of alternating successions of different soil types, e.g. silt and sand
Layer	> 75 mm in thickness
Seam	2 mm to 75 mm in thickness
Parting	< 2 mm in thickness

### RECOVERY:

For soil samples, the recovery is recorded as the length of the soil sample recovered.

### N-VALUE:

Numbers in this column are the field results of the Standard Penetration Test: the number of blows of a 63.5 kg hammer falling 0.76 m, required to drive a 50 mm O.D. split spoon sampler 0.3 m into undisturbed soil. For samples where insufficient penetration was achieved and N-value cannot be presented, the number of blows are reported over the sampler penetration in millimetres (e.g. 50/75).

### DYNAMIC CONE PENETRATION TEST (DCPT):

Dynamic cone penetration tests are performed using a standard 60 degree apex cone connected to an "A" size drill rods with the same standard fall height and weight as the Standard Penetration Test. The DCPT value is the number of blows of the hammer required to drive the cone 0.3 m into the soil. The DCPT is used as a probe to assess soil variability.



### STRATA PLOT:

Strata plots symbolize the soil and bedrock description. They are combinations of the following basic symbols. The dimensions within the strata symbols are not indicative of the particle size, layer thickness, etc.



Boulders  
Cobbles  
Gravel      Sand      Silt      Clay      Organics      Asphalt      Concrete      Fill      Bedrock

### TEXTURING CLASSIFICATION OF SOILS

Classification	Particle Size
Boulders	Greater than 200 mm
Cobbles	75 – 200 mm
Gravel	4.75 – 75 mm
Sand	0.075 – 4.75 mm
Silt	0.002 – 0.075 mm
Clay	Less than 0.002 mm

### TERMS DESCRIBING CONSISTENCY (COHESIVE SOILS ONLY)

Descriptive Term	Undrained Shear Strength (kPa)
Very Soft	12 or less
Soft	12 – 25
Firm	25 – 50
Stiff	50 – 100
Very Stiff	100 – 200
Hard	Greater than 200

NOTE: Clay sensitivity is defined as the ratio of the undisturbed strength over the remolded strength.

### SAMPLE TYPES

SS	Split spoon samples
ST	Shelby tube or thin wall tube
DP	Direct push sample
PS	Piston sample
BS	Bulk sample
WS	Wash sample
HQ, NQ, BQ etc.	Rock core sample obtained with the use of standard size diamond coring equipment

### TERMS DESCRIBING CONSISTENCY (COHESIONLESS SOILS ONLY)

Descriptive Term	SPT “N” Value
Very Loose	Less than 4
Loose	4 – 10
Compact	10 – 30
Dense	30 – 50
Very Dense	Greater than 50

### MODIFIED UNIFIED SOIL CLASSIFICATION

Major Divisions		Group Symbol	Typical Description
COARSE GRAINED SOIL	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	SILT AND CLAY SOILS $W_L < 35\%$	ML	Inorganic silts, 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.
		OL	Organic silts and organic silty-clays of low plasticity.
	SILT AND CLAY SOILS $35\% < W_L < 50\%$	MI	Inorganic compressible fine sandy silt with clay of medium plasticity, clayey silts.
		CI	Inorganic clays of medium plasticity, silty clays.
		OI	Organic silty clays of medium plasticity.
	SILT AND CLAY SOILS $W_L > 50\%$	MH	Inorganic silts, micaceous or diatomaceous fine sandy of silty soils, elastic silts.
		CH	Inorganic clays of high plasticity, fat clays.
		OH	Organic clays of high plasticity, organic silts.
HIGHLY ORGANIC SOILS		Pt	Peat and other organic soils.

Note -  $W_L$  = Liquid Limit



## EXPLANATION OF ROCK LOGGING TERMS

### ROCK WEATHERING CLASSIFICATION

Fresh (FR)	No visible signs of weathering.
Fresh Jointed (FJ)	Weathering limited to surface of major discontinuities.
Slightly Weathered (SW)	Penetrative weathering developed on open discontinuity surfaces, but only slight weathering of rock materials.
Moderately Weathered (MW)	Weathering extends throughout the rock mass, but the rock material is not friable.
Highly Weathered (HW)	Weathering extends throughout the rock mass and the rock is partly friable.
Completely Weathered (CW)	Rock is wholly decomposed and in a friable condition, but the rock texture and structures are preserved.

### TERMS

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

### DISCONTINUITY SPACING

Bedding	Bedding Plane Spacing
Very thickly bedded	Greater than 2 m
Thickly bedded	0.6 to 2 m
Medium bedded	0.2 to 0.6 m
Thinly bedded	60 mm to 0.2 m
Very thinly bedded	20 to 60 mm
Laminated	6 to 20 mm
Thinly laminated	Less than 6 mm

### STRENGTH CLASSIFICATION

Rock Strength	Approximate Uniaxial Compressive Strength (MPa)
Extremely Strong	Greater than 250
Very Strong	100 – 250
Strong	50 – 100
Medium Strong	25 – 50
Weak	5 – 25
Very Weak	1 – 5
Extremely Weak	0.25 – 1

# RECORD OF BOREHOLE No 18-1

1 OF 2

METRIC

GWP# 5287-14-00 LOCATION Lat: 45.004882°, Long: -79.033469° Sta. 18+245 N 4 985 094.3 E 341 577.7 ORIGINATED BY SOB  
 HWY 118 BOREHOLE TYPE Portable NWT Washboring COMPILED BY AC  
 DATUM Geodetic DATE 12.09.2018 - 13.09.2018 CHECKED BY KE

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				UNIT WEIGHT  $\gamma$  kN/m <sup>3</sup>	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					
292.7													
0.0	STAND												
292.2													
0.5	SILTY SAND (SM) trace organics dense brown		1	SS	37		292						
291.6													
1.1	SILTY SAND (SM) very loose brown		2	SS	1		291						
			3	SS	2								
290.1													
2.6	SAND (SP) trace gravel compact to dense brown		4	SS	30		290						
			5	SS	41		289						
287.8							288						
4.9	SILTY SAND with gravel TILL occasional to frequent cobbles and boulders very dense grey-brown		6	SS	70								
			7	NQ	-		287						
285.9			8	SS	100/		286						
6.8	BEDROCK GRANITE slightly weathered to fresh coarse grained medium strong to very strong red and grey		1	RUN	200 mm		285						
			2	RUN			284						
			3	RUN			283						
282.8													
9.9													

DOUBLE LINE ST 18+250.GPJ 2012TEMPLATE(MTO).GDT 23/8/19

Continued Next Page

+<sup>3</sup> ×<sup>3</sup>: Numbers refer to  
Sensitivity

20  
15  
10

(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 18-1

2 OF 2

METRIC

GWP# 5287-14-00 LOCATION Lat: 45.004882°, Long: -79.033469°  
Sta. 18+245 N 4 985 094.3 E 341 577.7 ORIGINATED BY SOB  
HWY 118 BOREHOLE TYPE Portable NWT Washboring COMPILED BY AC  
DATUM Geodetic DATE 12.09.2018 - 13.09.2018 CHECKED BY KE

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
	Continued From Previous Page																
	End of Borehole																
	A half-weight (32 kg) drop hammer was used to advance the split-spoon sampler. The N values presented have been adjusted to provide an equivalent N value that would have been obtained with a standard 64 kg hammer.																







# RECORD OF BOREHOLE No 18-2

1 OF 2

METRIC

GWP# 5287-14-00 LOCATION Lat: 45.004779°, Long: -79.033274° Sta. 18+245 N 4 985 082.9 E 341 593.1 ORIGINATED BY AC  
 HWY 118 BOREHOLE TYPE NW Washboring/NQ Coring COMPILED BY AC  
 DATUM Geodetic DATE 12.09.2018 - 12.09.2018 CHECKED BY KE

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT  $\gamma$  kN/m <sup>3</sup>	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								
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE								
							WATER CONTENT (%)									
							PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT w <sub>p</sub> w w <sub>L</sub>									
297.2																
0.0	ASPHALT (75 mm)  SAND with silt and gravel compact to dense red-brown to grey FILL		1	SS	32										22 66 12 (SI+CL)	
0.1																
			2	SS	14											
			3	SS	31											
			4	SS	46											
			5	SS	13											
293.5																
3.7	SILTY SAND with gravel occasional to frequent cobbles and boulders loose grey-brown boulder at 3.8 m FILL		6	NQ	-											
			7	SS	6											
291.9																
5.3	SAND (SP-SM) with silt trace gravel trace organics and wood loose to compact dark grey		8	SS	5											
			9	SS	18											
289.6																
7.6	SAND (SP-SM) with silt trace gravel trace wood fragments occasional to frequent cobbles and boulders dense red-brown to brown   boulder at 9.5 m		10	SS	30											
			11	SS	100/ 250 mm											
			12	NQ	-											

Continued Next Page

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to  
Sensitivity

20  
15  
10  
(%) STRAIN AT FAILURE

## METRIC

[illegible]

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to Sensitivity

# RECORD OF BOREHOLE No 18-3

1 OF 2

METRIC

GWP# 5287-14-00 LOCATION Lat: 45.004726°, Long: -79.033324° Sta. 18+245 N 4 985 077.0 E 341 589.2 ORIGINATED BY AC  
 HWY 118 BOREHOLE TYPE NW Washboring/NQ Coring COMPILED BY AC  
 DATUM Geodetic DATE 11.09.2018 - 11.09.2018 CHECKED BY KE

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 (%)							
								○ UNCONFINED      + FIELD VANE ● QUICK TRIAXIAL    × LAB VANE				w <sub>p</sub> w      w <sub>L</sub>							
297.3							20	40	60	80	100					GR	SA	SI	CL
0.0	ASPHALT (100 mm)																		
0.1	SAND with silt and gravel compact to dense brown FILL		1	SS	46								○				21	69	10 (SI+CL)
			2	SS	29								○						
295.8																			
1.5	SILTY SAND with gravel trace organics compact to very dense red-brown FILL		3	SS	52								○						
			4	SS	28								○						
			5	SS	18								○						
293.5			6	SS	100														
3.8	SILTY SAND with gravel loose to compact brown boulder at 3.9 m FILL		7	NQ	50 mm														
			8	SS	9								○						
			9	SS	16								○				18	68	14 (SI+CL)
			10	SS	11								○						
291.1													○						
6.2	SILTY SAND (SM) with organics, roots and wood fragments compact dark grey		11	SS	14									○				0	73 25 2 non-plastic
289.7																			
7.6	SAND (SP) trace gravel dense brown		12	SS	32								○						
			13	SS	32														
													○						

Continued Next Page

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

## METRIC

Lat: 45.004726°, Long: -79.033324°  
Sta. 18+245 N 4 985 077.0 E 341 589.2

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to Sensitivity

## METRIC

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	UNIT WEIGHT  γ  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)  GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	SHEAR STRENGTH kPa	W P W L	WATER CONTENT (%)			
292.3									○ UNCONFINED + FIELD VANE					
0.0	STAND								● QUICK TRIAXIAL × LAB VANE					
291.8														
0.5	SAND (SP) trace organics loose brown		1	SS	9									
291.2			2	SS	2									
1.1	SAND (SP) very loose to compact brown		3	SS	5									
			4	SS	15									
288.9														
3.4	SAND (SP) trace gravel occasional cobbles and boulders compact brown		5	SS	20									
			6	SS	100/ 50 mm									
285.9														
6.4	SILT (ML) trace sand compact to dense grey		7	SS	40									
			8	SS	24									
			9	SS	35									

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to Sensitivity

DOUBLE LINE ST 18+250.GPJ 2012TEMPLATE(MTO).GDT 23/8/19

# RECORD OF BOREHOLE No 18-4

2 OF 2

METRIC

GWP# 5287-14-00 LOCATION Lat: 45.004597°, Long: -79.033165° Sta. 18+245 N 4 985 062.7 E 341 601.8 ORIGINATED BY SOB  
 HWY 118 BOREHOLE TYPE Portable NWT Washboring COMPILED BY AC  
 DATUM Geodetic DATE 14.09.2018 - 15.09.2018 CHECKED BY KE

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT  $\gamma$ kN/m <sup>3</sup>	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							PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT W <sub>P</sub> W W <sub>L</sub> WATER CONTENT (%) 20 40 60						
281.3	<b>SILT (ML)</b> trace sand compact to dense grey						282							
11.0	<b>SILTY SAND</b> with gravel <b>TILL</b> occasional cobbles compact to dense brown		10	SS	10		281							
							280							
279.2			11	SS	45									
13.1	End of Borehole  A half-weight (32 kg) drop hammer was used to advance the split-spoon sampler. The N values presented have been adjusted to provide an equivalent N value that would have been obtained with a standard 64 kg hammer.  Water levels in 19 mm diameter standpipe: 15/9/2018 0.0 mbgs (elev. 291.8 m) 23/9/2018 0.2 mbgs (elev. 291.6 m) 29/9/2018 0.2 mbgs (elev. 291.6 m)													



**Appendix C.**  
**Laboratory Testing**

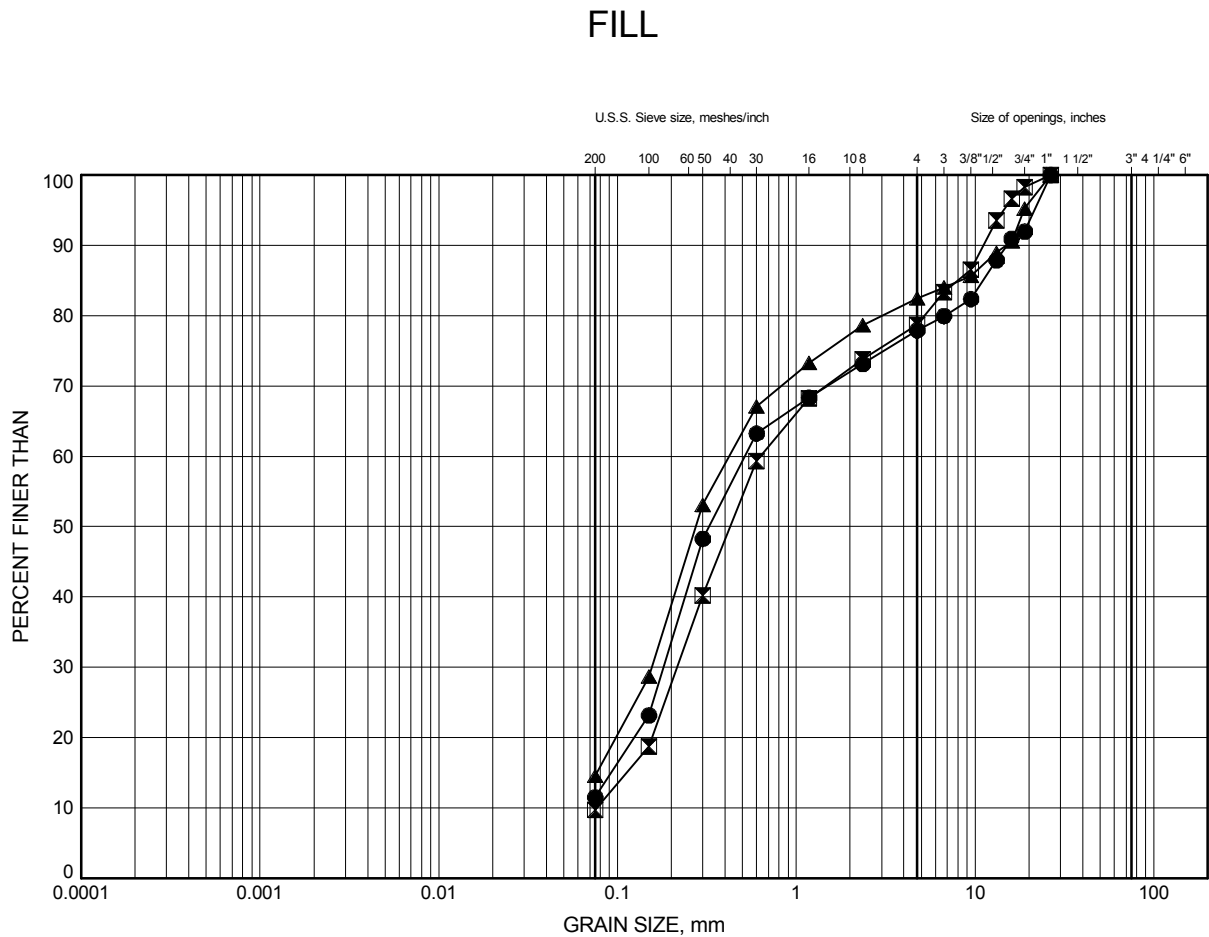


**Appendix C.1**  
**Particle Size Analysis Figures**



# HWY 118 Culverts Station 18+245 GRAIN SIZE DISTRIBUTION

FIGURE C1



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

## LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	18-2	2.6	294.6
⊠	18-3	0.4	296.9
▲	18-3	5.0	292.3

Date ..October 2018.....  
GWP# ..5287-14-00.....

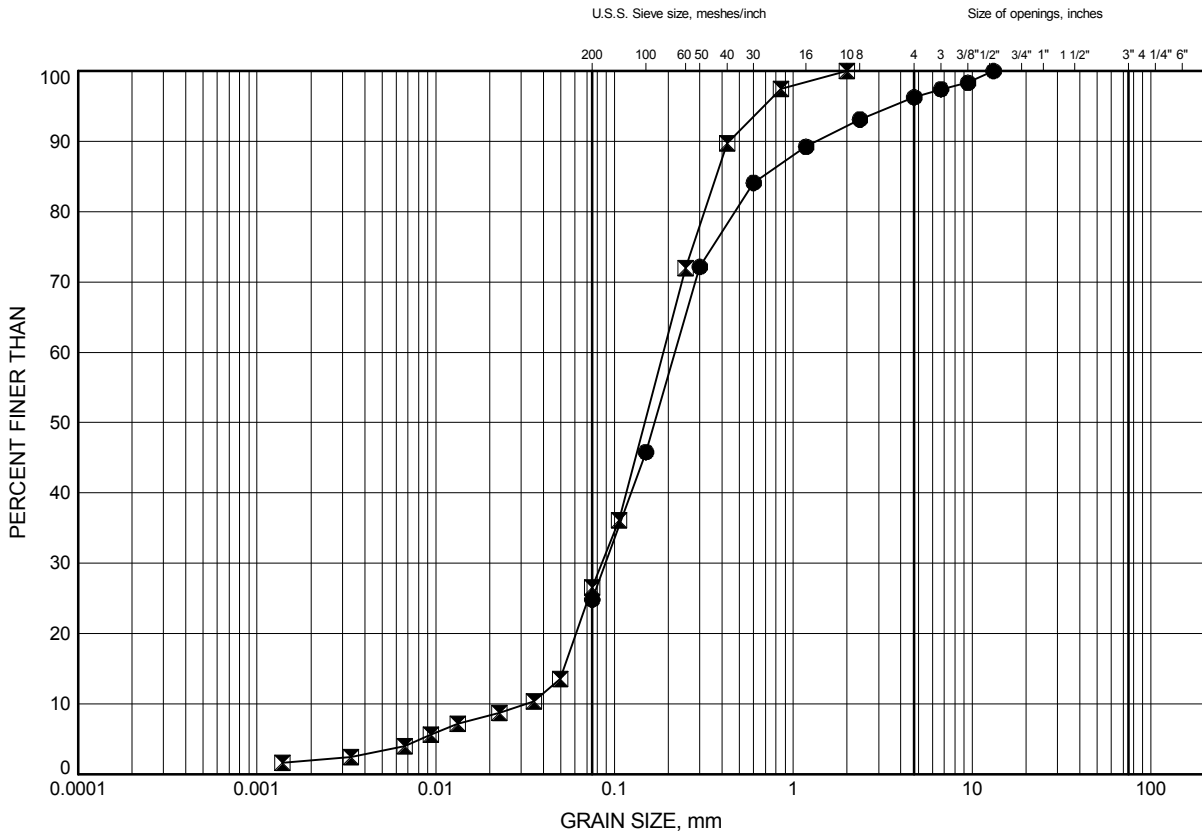


Prep'd .....AC.....  
Chkd. ....KE.....

# HWY 118 Culverts Station 18+245 GRAIN SIZE DISTRIBUTION

FIGURE C2

## SILTY SAND (SM)



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

## LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	18-1	0.9	291.3
⊠	18-3	6.5	290.8

Date ..October 2018.....

GWP# ..5287-14-00.....



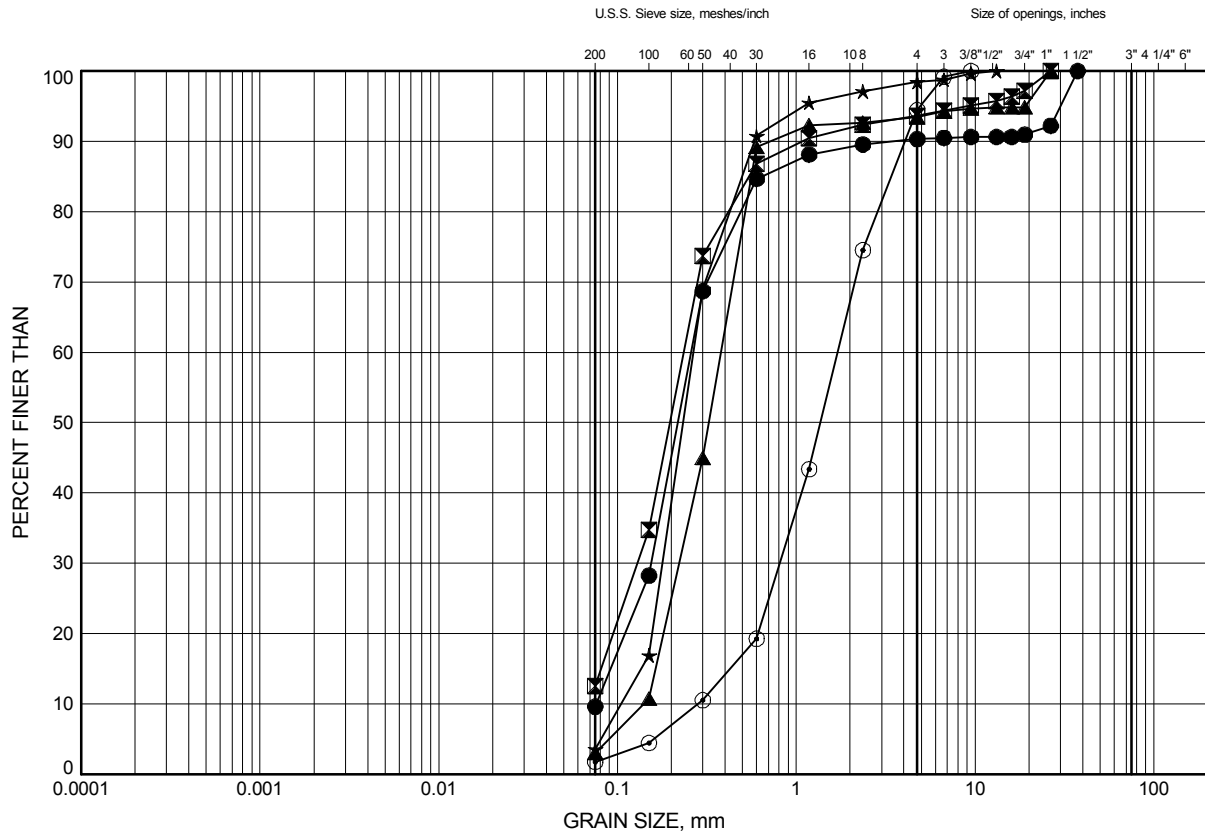
Prep'd .....AC.....

Chkd. ....KE.....

# HWY 118 Culverts Station 18+245 GRAIN SIZE DISTRIBUTION

FIGURE C3

### SAND (SP to SP-SM)



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

### LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	18-2	6.4	290.8
⊠	18-2	10.9	286.3
▲	18-3	12.3	284.9
★	18-4	2.4	289.4
⊙	18-4	4.5	287.3

Date ..October 2018.....

GWP# ..5287-14-00.....

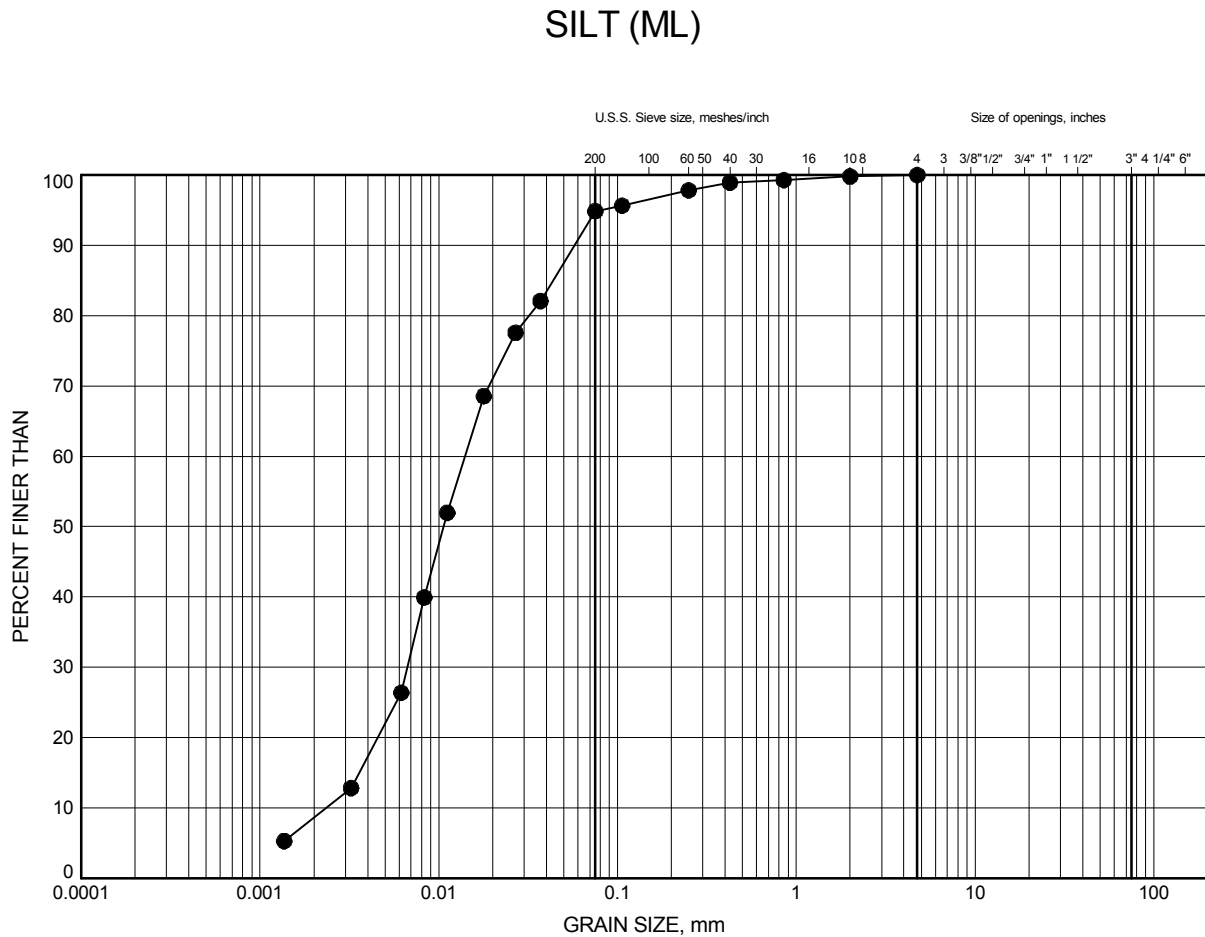


Prep'd .....AC.....

Chkd. ....KE.....

# HWY 118 Culverts Station 18+245 GRAIN SIZE DISTRIBUTION

FIGURE C4



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

## LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	18-4	9.3	282.5

Date ..October 2018.....  
GWP# ..5287-14-00.....

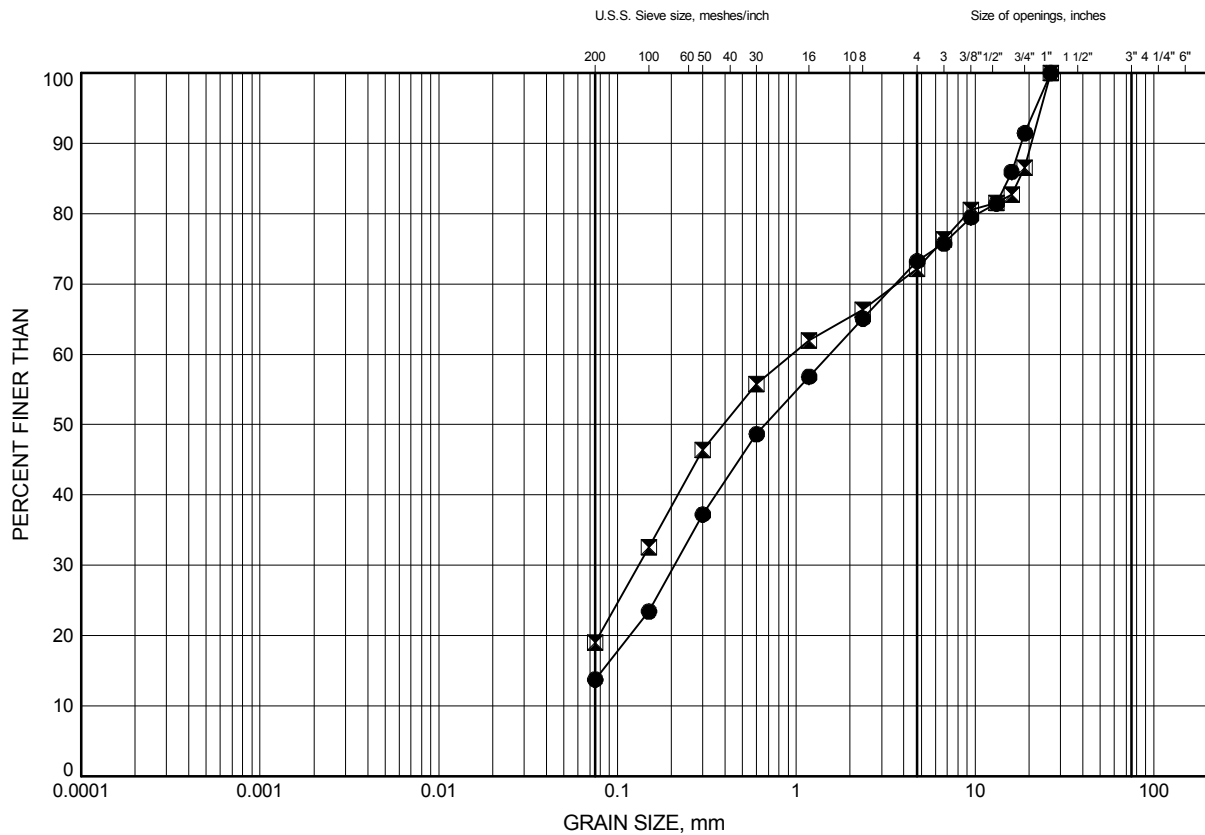


Prep'd .....AC.....  
Chkd. ....KE.....

# HWY 118 Culverts Station 18+245 GRAIN SIZE DISTRIBUTION

FIGURE C5

## SILTY SAND (SM) with gravel (GLACIAL TILL)



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

## LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	18-2	12.4	284.8
⊠	18-3	15.3	282.0

Date ..October 2018.....

GWP# ..5287-14-00.....



Prep'd .....AC.....

Chkd. ....KE.....

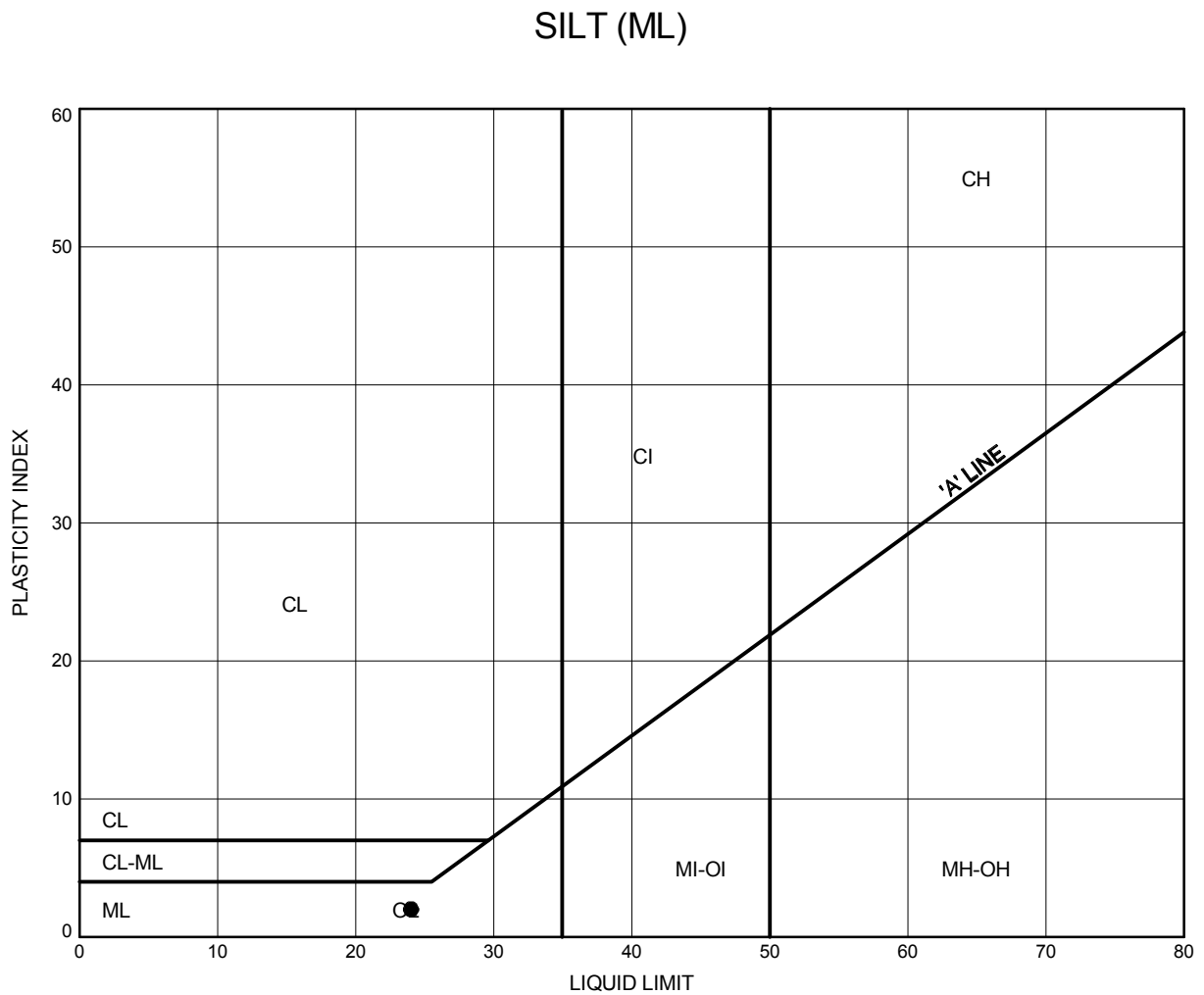


**Appendix C.2**  
**Atterberg Limit Testing Figure**

HWY 118 Culverts Station 18+245

# ATTERBERG LIMITS TEST RESULTS

FIGURE C6



## LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	18-4	9.3	282.5

Date ..October 2018.....  
 GWP# ..5287-14-00.....



Prep'd .....AC.....  
 Chkd. ....KE.....



**Appendix C.3**  
**Rock Core Photos**



**Borehole 18-1**  
**Run 1 to 3 (of 3)**  
**Elevation 285.9 m to 282.8 m**



**Borehole 18-2**  
**Run 1 to 3 (of 3)**  
**Elevation 282.8 m to 278.5 m**



**THURBER** ENGINEERING LTD.

**Foundation Investigation**  
**Hwy 118 Culverts St. 18+245**  
**Foundations**

**GWP: 5287-14-00**

**Project No.: 20244**

**Borehole 18-3**  
**Run 1 to 1 (of 1)**  
**Elevation 281.7 m to 281.1 m**



**THURBER** ENGINEERING LTD.

**Foundation Investigation**  
**Hwy 118 Culverts St. 18+245**  
**Foundations**

**GWP: 5287-14-00**

**Project No.: 20244**



## **Appendix C.4**

### **Analytical Testing Results**

## Certificate of Analysis

### Thurber Engineering Ltd.

2460 Lancaster Rd, Suite 104  
Ottawa, ON K1B 4S5  
Attn: Katya Edney

Client PO: 20244  
Project: Hwy 11+118  
Custody: 39862

Report Date: 28-Sep-2018  
Order Date: 24-Sep-2018

**Order #: 1839096**

This Certificate of Analysis contains analytical data applicable to the following samples as submitted:

Paracel ID	Client ID
1839096-01	18+250 18-1 SS3 6-8'
1839096-02	18+250 18-4 SS3 5'6"-7-6"
<del>1839096-03</del>	<del>18+875 18-2 SS8 17'6"-19'6"</del>
<del>1839096-04</del>	<del>11+490 18-01 SS3B 7-8'</del>

*Depths provided in results are measured from the top of the drilling platform which is not shown in the Record of Borehole Sheets. Platform height measured 0.5 m.*

Approved By:



Mark Foto, M.Sc.  
Lab Supervisor

Certificate of Analysis  
Client: Thurber Engineering Ltd.  
Client PO: 20244

Report Date: 28-Sep-2018  
Order Date: 24-Sep-2018  
Project Description: Hwy 11+118

### Analysis Summary Table

Analysis	Method Reference/Description	Extraction Date	Analysis Date
Anions	EPA 300.1 - IC, water extraction	26-Sep-18	26-Sep-18
Conductivity	MOE E3138 - probe @25 °C, water ext	27-Sep-18	27-Sep-18
pH, soil	EPA 150.1 - pH probe @ 25 °C, CaCl buffered ext.	27-Sep-18	27-Sep-18
Resistivity	EPA 120.1 - probe, water extraction	27-Sep-18	27-Sep-18
Solids, %	Gravimetric, calculation	27-Sep-18	27-Sep-18

Certificate of Analysis  
**Client: Thurber Engineering Ltd.**  
**Client PO: 20244**

Report Date: 28-Sep-2018

Order Date: 24-Sep-2018

**Project Description: Hwy 11+118**

<b>Client ID:</b>	18+250 18-1 SS3 6-8'	18+250 18-4 SS3 5'6"-7-6"	18+875 18-2 SS8 17'6"-19'6"	11+490 18-01 SS3B 7-8'
<b>Sample Date:</b>	09/12/2018 09:00	09/14/2018 09:00	09/19/2018 09:00	09/16/2018 09:00
<b>Sample ID:</b>	1839096-01	1839096-02	1839096-03	1839096-04
<b>MDL/Units</b>	Soil	Soil	Soil	Soil

#### Physical Characteristics

% Solids	0.1 % by Wt.	79.4	79.6	80.3	82.1
----------	--------------	------	------	------	------

#### General Inorganics

Conductivity	5 uS/cm	227	243	1340	383
pH	0.05 pH Units	5.86	5.11	4.82	5.32
Resistivity	0.10 Ohm.m	44.1	41.1	7.45	26.1

#### Anions

Chloride	5 ug/g dry	40	104	1260	236
Sulphate	5 ug/g dry	129	62	70	24



Certificate of Analysis  
**Client: Thurber Engineering Ltd.**  
**Client PO: 20244**

Report Date: 28-Sep-2018  
 Order Date: 24-Sep-2018  
**Project Description: Hwy 11+118**

**Method Quality Control: Blank**

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
<b>Anions</b>									
Chloride	ND	5	ug/g						
Sulphate	ND	5	ug/g						
<b>General Inorganics</b>									
Conductivity	ND	5	uS/cm						
Resistivity	ND	0.10	Ohm.m						



Certificate of Analysis  
Client: Thurber Engineering Ltd.  
Client PO: 20244

Report Date: 28-Sep-2018  
Order Date: 24-Sep-2018  
Project Description: Hwy 11+118

**Method Quality Control: Duplicate**

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
<b>Anions</b>									
Chloride	22.3	5	ug/g dry	23.2			4.1	20	
Sulphate	15.1	5	ug/g dry	15.6			3.3	20	
<b>General Inorganics</b>									
Conductivity	211	5	uS/cm	204			3.1	6.2	
pH	7.90	0.05	pH Units	7.93			0.4	10	
Resistivity	47.5	0.10	Ohm.m	48.9			3.1	20	
<b>Physical Characteristics</b>									
% Solids	79.2	0.1	% by Wt.	79.5			0.4	25	

Certificate of Analysis  
Client: Thurber Engineering Ltd.  
Client PO: 20244

Report Date: 28-Sep-2018  
Order Date: 24-Sep-2018  
Project Description: Hwy 11+118

### Method Quality Control: Spike

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
<b>Anions</b>									
Chloride	117	5	ug/g	23.2	93.8	78-113			
Sulphate	120	5	ug/g	15.6	104	78-111			

Certificate of Analysis  
Client: Thurber Engineering Ltd.  
Client PO: 20244

Report Date: 28-Sep-2018  
Order Date: 24-Sep-2018  
Project Description: Hwy 11+118

**Qualifier Notes:**

None

**Sample Data Revisions**

None

**Work Order Revisions / Comments:**

None

**Other Report Notes:**

n/a: not applicable  
ND: Not Detected  
MDL: Method Detection Limit  
Source Result: Data used as source for matrix and duplicate samples  
%REC: Percent recovery.  
RPD: Relative percent difference.

Soil results are reported on a dry weight basis when the units are denoted with 'dry'.  
Where %Solids is reported, moisture loss includes the loss of volatile hydrocarbons.

## Subcontracted Analysis

**Thurber Engineering Ltd.**2460 Lancaster Rd, Suite 104  
Ottawa, ON K1B 4S5  
Attn: Katya EdneyTel: (613) 247-2121  
Fax: (613) 247-2185Paracel Report No **1839096**Client Project(s): **Hwy 11+118**Client PO: **20244**Reference: **Standing Offer**CoC Number: **39862**Order Date: 24-Sep-18  
Report Date: 27-Sep-18

Sample(s) from this project were subcontracted for the listed parameters. A copy of the subcontractor's report is attached

Parcel ID	Client ID	Analysis
1839096-01	18+250 18-1 SS3 6-8'	Sulphide, solid
1839096-02	18+250 18-4 SS3 5'6"-7-6"	Sulphide, solid
<del>1839096-03</del>	<del>18+875 18-2 SS8 17'6"-19'6"</del>	<del>Sulphide, solid</del>
<del>1839096-04</del>	<del>11+490 18-01 SS3B 7-8'</del>	<del>Sulphide, solid</del>

**SGS Canada Inc.**

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

**Paracel Laboratories**

Attn : Dale Robertson

300-2319 St.Laurent Blvd.  
Ottawa, ON  
K1G 4K6, Canada

Phone: 613-731-9577  
Fax:613-731-9064

27-September-2018

**Date Rec. :** 25 September 2018  
**LR Report:** CA13421-SEP18  
**Reference:** Project#: 1839096

**Copy:** #1

## CERTIFICATE OF ANALYSIS

### Final Report

Sample ID	Sample Date & Time	Sulphide %
1: Analysis Start Date		27-Sep-18
2: Analysis Start Time		12:40
3: Analysis Completed Date		27-Sep-18
4: Analysis Completed Time		13:39
5: QC - Blank		< 0.02
6: QC - STD % Recovery		83%
7: QC - DUP % RPD		ND
8: RL		0.02
9: 18+250 18-1 SS3 6-8'	12-Sep-18	< 0.02
10: 18+250 18-4 SS3 5'6"-7-6"	14-Sep-18	< 0.02
11: 18+875 18-2 SS8 17'6-19'6"	19-Sep-18	< 0.02
12: 11+490 18-01 SS3B 7-8'	16-Sep-18	< 0.02

RL - SGS Reporting Limit  
ND - Not Detected

Kimberley Didsbury  
Project Specialist  
Environmental Services, Analytical



## **Appendix D.**

### **Site Photographs**



Photo 1. Looking North from Culvert 18+245 Inlet (2018/09/11)





Photo 2. Looking Southwest at Culvert 18+245 Inlet (2018/09/11)





**Photo 3. Looking East on HWY 118 (2018/09/13)**



**Photo 4. Looking West on HWY 118 (2018/09/13)**



**Photo 5. Looking west at Culvert 18+245 Outlet with Piezometer 18-4 (2018/09/15)**