



THURBER ENGINEERING LTD.

**FOUNDATION INVESTIGATION REPORT
BAKER CREEK CULVERT REHABILITATION OR REPLACEMENT
HIGHWAY 17, DISTRICT OF THUNDER BAY, ONTARIO
AGREEMENT 6019-E-0009, WORK ORDER 10
G.W.P. 6336-14-00, SITE NO. 48W-012/C
LATITUDE: 49.1366°, LONGITUDE: -90.7581°**

GEOCREs No.: 40P8-274

Report

to

HATCH

Date: February 24, 2021
File: 29181



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PART 1: FACTUAL INFORMATION

1. INTRODUCTION

This report presents the factual data obtained from a foundation investigation carried out by Thurber Engineering Ltd. (Thurber) for design of the proposed Baker Creek culvert rehabilitation or replacement. The Baker Creek culvert is located on Highway 17, west of Upsala, in the Trewartha Township, District of Thunder Bay, Ontario.

The purpose of this investigation was to explore the subsurface conditions at the culvert location 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 carried out the investigation as a sub-consultant to Hatch Corporation (Hatch), under the Ministry of Transportation Ontario (MTO) Retainer Agreement Number 6019-E-0009, Work Order 10.

Reference has been made to information on subsurface conditions contained in a previous foundation report prepared for this site. The title of the report is:

- Foundation Investigation and Design Report, Sisson Creek, English River Tributary and Baker Creek Culverts, Highway 17, G.W.P. 6336-14-00, W.P. 6338-14-01, W.P. 6337-14-01 & W.P. 6336-14-01, Geocres No. 52G-15, prepared by Golder, dated October 7, 2016. (Reference 1).

The records of borehole sheets and laboratory test results from the previous investigation are included in Appendix E for reference.

2. SITE DESCRIPTION

The site is located on Highway 17, approximately 76 km east of Highway 599, in the Township of Trewartha, District of Thunder Bay, Ontario. The existing culvert allows Baker Creek to flow in a



north to south direction under Highway 17. Highway 17 generally runs in an east-west direction at the culvert site.

The available base plan drawing provided by Hatch indicates that the existing structure is a closed box concrete culvert. The base plan indicates that the span of the structure is 6.0 m, the height is 2.5 m and the length of is 24.9 m. The estimated culvert invert is at approximate Elevation 466.1 m at both the inlet (north) and the outlet (south). The existing road grade at the culvert location is at approximate Elev. 469.7 m, which indicates approximately 1.1 m of fill above the culvert. The local creek water level was reportedly measured at Elev. 468.0 m in October 2014 and Elev. 467.7 m in April 2015. The site topography within the culvert area is generally flat, with low lying grassy land surrounding Baker Creek on both sides of Highway 17.

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

Based on Northern Ontario Engineering Geology Terrain Study (NOEGTS) mapping, the subsoils in the area of the Baker Creek culvert site consists of organic terrain and ground moraine deposits consisting of sand till. Based on the OGS Map MRD126 titled "Bedrock Geology of Ontario", dated 2011, the bedrock at site is identified as tonalite rock.

3. INVESTIGATION PROCEDURES

The current site investigation and field testing program for this project was carried out between August 10 and August 12, 2020, and consisted of drilling and sampling four (4) boreholes (20-01 to 20-04) to depths of 15.8 m below ground surface (Elevation 453.9 m to 453.5 m). Boreholes 20-01 and 20-04 were drilled through the paved portion of Highway 17 for possible roadway protection systems and stream diversion pipes. Boreholes 20-02 and 20-03 were drilled through the Highway 17 shoulders next to the existing culvert for the culvert replacement design. The approximate borehole locations are shown on the attached Borehole Locations and Soil Strata Drawing in Appendix D.

The previous site investigation, as drilled by Golder, consisted of drilling and sampling four (4) boreholes (BK-1 to BK-4) to depths of 9.8 m below the existing ground surface (Elevation 458.5 m to 458.0 m). Two of the boreholes were advanced near the inlet (north end) and two of the boreholes were advanced near the outlet (south end) of the culvert; near the locations of possible cofferdams.

The Record of Borehole sheets for the boreholes from the current investigation are included in Appendix A. The Record of Borehole sheets for the boreholes from the previous investigation by Golder are included in Appendix E. The approximate locations of the boreholes from both



investigations are shown on the Borehole Locations and Soil Strata Drawing included in Appendix D.

Utility clearances were obtained prior to the start of drilling. The northing, easting and ground surface elevations at the borehole locations were provided to Thurber by Hatch. The coordinate system MTM NAD 83, Zone 15 was used for the boreholes.

All boreholes were advanced using a truck-mounted CME 75 drill rig, using solid stem augers and NW casing with wash boring techniques. Soil samples were obtained in all boreholes at selected intervals using a split spoon sampler in conjunction with Standard Penetration Testing (SPT).

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.

Monitoring wells were installed in Boreholes 20-02 and 20-03. Both wells consisted of 50 mm Schedule 40 PVC pipe with a 1.5 m long slotted screen, enclosed in a column of filter sand to permit groundwater level monitoring. Piezometer installation details, groundwater level observations and water level readings are shown on the Record of Borehole sheets. A sample of the surface water and groundwater was obtained during the field investigation and submitted to a specialist analytical laboratory under chain of custody procedures for testing for a suite of parameters. Single well response tests ("slug") tests were carried out in the 50 mm diameter wells installed in both Boreholes 20-02 and 20-03. Upon collection of the final water level readings on August 21, 2020, the wells were decommissioned in accordance with MOE O.Reg. 903.

Details of the drilling program, including drilling depths, piezometer installation and completion details are summarized in Table 3.1 below.

Table 3.1: Borehole Completion Details

Borehole Number	Borehole Depth / Base Elevation (m)	Piezometer Tip Depth / Elevation (m)	Completion Details
20-01	15.8 / 453.9	None installed	Borehole backfilled with bentonite holeplug from 15.8 m to 0.3 m, sand from 0.3 m to 0.1 m and cold patch asphalt from 0.1 m to surface.



Borehole Number	Borehole Depth / Base Elevation (m)	Piezometer Tip Depth / Elevation (m)	Completion Details
20-02	15.8 / 453.5	6.2 / 463.1	Borehole caved in from 15.8 m to 6.4 m and was backfilled with filter sand from 6.4 m to 4.1 m, bentonite holeplug from 4.1 m to 0.6 m, sand from 0.6 m to 0.3 m and concrete with a flush mount cover from 0.3 m to ground surface.
20-03	15.8 / 453.8	6.2 / 463.4	Borehole caved in from 15.8 m to 6.4 m and was backfilled with filter sand from 6.4 m to 3.9 m, bentonite holeplug from 3.9 m to 0.6 m, sand from 0.6 m to 0.3 m and concrete with a flush mount cover from 0.3 m to ground surface.
20-04	15.8 / 453.8	None installed	Borehole backfilled with bentonite holeplug from 15.8 m to 0.3 m, sand from 0.3 m to 0.1 m and cold patch asphalt from 0.1 m to surface.

4. LABORATORY TESTING

All recovered soil samples were subjected to visual identification and natural moisture content determination. Selected samples were subjected to grain size distribution analyses (sieve and hydrometer), and the results of this testing program are summarized on the Record of Borehole sheets in Appendix A and are shown 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, a sample of the fill and a sample of the native soil were collected during the investigation and submitted to Bureau Veritas Canada (2019) Inc., a CALA accredited analytical laboratory in Mississauga, Ontario, for analytical testing of soil corrosivity parameters. In order to assess the quality of the groundwater for disposal purposes, a water sample was collected from the creek and the well installed in Borehole 20-02. The results of the analytical testing are summarized in this report and presented in Appendix B.

5. DESCRIPTION OF SUBSURFACE CONDITIONS

Reference is made to the Record of Borehole sheets for the current and previous investigations included in Appendix A and Appendix E, respectively. Details of the encountered soil stratigraphy are presented on the Record of Borehole sheets and on the Borehole Locations and Soil Strata



drawings 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 in the Record of Borehole sheets governs any interpretation of the site conditions. It must be recognized that soil conditions may vary between and beyond the borehole locations.

In general, the subsurface stratigraphy below the asphalt typically consists of sand to silty sand fill underlain by sand to silty sand, with lower deposits of sandy silt to sand and silt. Layers of organics and peat were encountered below the fill. More detailed descriptions of individual strata are presented below.

5.1 Asphalt

Boreholes 20-01 and 20-04 were drilled through the paved portion of Highway 17. The asphalt ranged in thickness from 125 to 150 mm at these locations.

5.2 Embankment Fill

Embankment fill ranging in composition from sand to gravelly sand to silty sand was encountered below the asphalt in Boreholes 20-01 and 20-04 and from ground surface in Borehole 20-02 and 20-03. The sand fill was brown in colour, and contained trace to some gravel, trace to some silt, trace clay and occasional cobbles. The gravelly sand fill contained trace silt and occasional cobbles. Hydrocarbon odour was observed in the sand fill in Borehole 20-02.

The embankment fill ranged in thickness from 1.7 m to 3.2 m, with an underside depth ranging from 1.9 m to 3.2 m below ground surface (Elevation 467.8 m to 466.1 m).

SPT 'N' values in the fill generally ranged from 5 blows to 24 blows, indicating a loose to compact relative density. A SPT 'N' Value of zero blows was encountered in the sand fill in Borehole 20-02, at an approximate depth of 2.6 m (Elevation 466.7 m), indicating a very loose relative density.

The measured moisture contents generally ranged from 2 to 20%. A moisture content of 41% was recorded in Borehole 20-02 at an approximate depth of 3.1 m (Elevation 466.2 m), possibly indicating the presence of organics.

The results of grain size analyses conducted on selected samples of sand and gravelly sand fill are provided on the Record of Borehole sheets in Appendix A and plotted in Figures B1 and B2 of Appendix B. The results are summarized as follows:



Soil Particle	Percentage (%)	
	Sand Fill	Gravelly Sand Fill
Gravel	5 to 17	30
Sand	64 to 88	64
Silt & Clay	6 to 11	6

5.3 Peat and Organics

A black amorphous peat layer was encountered at ground surface in Boreholes BK-3 and BK-4, with an underside depth of 1.4 m and 0.7 m (Elevation 466.8 m and 467.6 m), respectively. Black peat mixed with sand was also encountered below the fill in Borehole 20-04 with a thickness of 0.2 m and an underside depth of 2.6 m (Elevation 467.0 m).

A 0.2 m thick organic layer was encountered below the fill in Borehole 20-01, with an underside depth of 2.1 m (Elevation 467.6 m).

An SPT 'N' Value of 2 blows was recorded in the amorphous peat deposit, indicating a very soft consistency.

Recorded moisture contents of the peat and organics ranged from 150 percent to 222 percent.

5.4 Sand to Silty Sand

A deposit ranging in composition from sand to silty sand was encountered below the peat and organics in Boreholes 20-01, 20-04, BK-3 and BK-4, from ground surface in Boreholes BK-1 and BK-2, and below the embankment fill in Boreholes 20-02 and 20-03. The top 0.8 m of the sand to silty sand layer in Borehole BK-3 was noted to contain organics. The sand to silty sand was brown to grey in colour and was noted to contain trace gravel and trace clay in some locations.

Trace organics were observed in the silty sand in Borehole 20-01 and 20-04 at approximate depths of 2.1 m and 2.6 m (Elevation 467.6 m and 467.0 m), respectively. Trace organics were also observed in the sand to silty sand in Boreholes BK-1, BK-2 and BK-4.

Boreholes BK-1 to BK-4 were terminated in the sand to silty sand layer at a depth of 9.8 m (Elevation 458.5 m to 458.0 m). The thickness of the sand to silty sand layer where fully penetrated in Boreholes 20-01 to 20-04 ranged from 5.7 m to 9.1 m, with an underside depth ranging from 8.7 m to 11.7 m (Elevation 461.0 m to 457.9 m).



SPT 'N' Values in the sand to silty sand ranged from 1 blow to 20 blows, indicating a very loose to compact relative density; but typically loose.

Measured moisture contents generally ranged from 19 percent and 32 percent. A moisture content of 57 percent was recorded in the organic sand in Borehole BK-3. The results of grain size analyses conducted on samples of sand to silty sand deposit are provided on the Record of Borehole sheets in Appendix A and Appendix E, and plotted on Figures B3 and B4 of Appendix B and Figures C1 and C2 of Appendix E. The results are summarized as follows:

Soil Particle	Percentage (%)	
	Silty Sand	Sand
Gravel	0	0 to 1
Sand	64 to 77	77 to 99
Silt	22 to 35	1 to 23
Clay	1	

5.5 Sandy Silt to Sand and Silt

A sandy silt to sand and silt deposit was encountered below the sand to silty sand layer in Borehole 20-01, 20-02, 20-03 and 20-04. The sandy silt to sand and silt was grey in colour and contained trace clay.

Boreholes 20-01 to 20-04 were all terminated in the sandy silt to sand and silt deposit at a depth of 15.8 m below ground surface (Elevation 453.9 m to 453.5 m).

SPT 'N' Values in sandy silt to sand and silt ranged from 1 blow to 10 blows, indicating very loose to loose relative density.

Recorded moisture contents ranged from 19 percent and 28 percent. The results of grain size analyses conducted on samples of the sandy silt to sand and silt deposit are provided on the Record of Borehole sheets in Appendix A and plotted in Figure B5 of Appendix B. The results are summarized as follows:

Soil Particle	Percentage (%)
Gravel	0
Sand	31 to 65
Silt	34 to 67
Clay	1 to 2



5.6 Groundwater Conditions

Groundwater conditions were observed during drilling operations and groundwater levels were measured in the open boreholes upon completion of drilling, and in the monitoring wells installed in Boreholes 20-02 and 20-03. The measured groundwater levels are summarized in Table 5.1 below. The monitoring wells were decommissioned on August 21, 2020 following final water level readings and slug testing.

Table 5.1: Groundwater Measurements

Borehole	Date	Water Level (m)		Remark
		Depth	Elevation	
20-01	August 11, 2020	1.4	468.3	Open borehole
20-02	August 14, 2020	1.7	467.6	In monitoring well
	August 21, 2020	1.4	467.9	
20-03	August 12, 2020	2.0	467.6	In monitoring well
	August 21, 2020	1.7	467.9	
20-04	August 10, 2020	1.9	467.7	Open Borehole
BK-1	January 30, 2016	1.0	467.3	Open Borehole
BK-2	January 28, 2016	0.2	467.6	Open Borehole
BK-3	January 20, 2016	0.6	467.6	Open Borehole
BK-4	January 19, 2016	0.8	467.5	Open Borehole

The groundwater level is likely to reflect the local creek water level. The surface water level of Baker Creek upstream and downstream of the bridge was measured at Elevation 468.0 m upstream to 467.96 m downstream of the culvert in October 2014, as shown on the site plan in Appendix E. The creek level, at the time of base plan mapping in April 2015 was surveyed to be at Elevation 467.7 m.

It should also be noted that groundwater levels are short term observations 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 and spring snow melts.



6. CORROSIVITY AND SULPHATE TEST RESULTS

Samples of the gravelly sand fill and native sand from Boreholes 20-03 and 20-02, respectively, were submitted for analytical testing of corrosivity parameters and sulphate. A sample of creek water taken from Baker Creek during the previous investigation was tested for pH, sulphate, chloride, resistivity and conductivity. The laboratory certificates of analysis for the current investigation are presented in Appendix B and the analysis results from the previous investigation (creek water sample) are included in Reference 1. The results of the analytical tests are summarized below in Table 6.1.

Table 6.1: Analytical Test Results

Parameter	Units (Soil)	Units (Water)	Test Results		
			20-03, SS3 (5'-7') (1.5 – 2.1 m)	20-02, SS5B (10'6" – 12') (3.2 – 3.7 m)	Baker Creek
			(Gravelly Sand Fill)	(Native Sand)	(Creek Water)
Redox Potential	mV	N/A	210	317	N/A
Sulphide	mg/kg	N/A	<0.5	<0.5	N/A
pH	-	-	6.88	5.29	6.54
Chloride	µg/g	mg/L	280	190	3.45
Sulphate	µg/g	mg/L	<20	<20	0.86
Conductivity	uS/cm	µS/cm	448	269	68.1
Resistivity	ohm-cm	ohm-cm	2200	3700	14 700

7. WATER QUALITY

For assessment of the general groundwater quality in the project area, samples of the surface water from the creek and the groundwater from the monitoring well at Borehole 20-02 were collected on August 21, 2020. Due to a documentation error during transfer of the samples to the analytical laboratory, the water samples were combined prior to analysis. The combined water sample was analyzed for selected inorganic parameters included in the Ontario Provincial Water Quality Objectives (PWQO). The analytical test results are presented in Appendix B.



The analytical results of the water testing were compared to limits for the PWQO for surface water discharge. The concentrations of all parameters tested that did not meet the criteria established in the PWQO are listed below in Table 7.1.

Table 7.1 – Water Parameters Exceeding PWQO Criteria

Sample ID	Parameter	Criteria	Parameter Limit (mg/L)	Result (mg/L)
Baker Creek, 20-02	Sulphide	PWQO	0.02	0.0053
	Total Phosphorus	PWQO	0.01	0.18
	Total Sulphide	PWQO	0.002	0.005
	Dissolved Aluminum	PWQO	15	59
	Total Iron	PWQO	0.3	6.1

It should be noted that an oily sheen was observed in the creek water while obtaining water samples during the field investigation.

8. SINGLE WELL RESPONSE TEST RESULTS

8.1 Test Procedure

Single well response tests (SWRT) (“slug” tests) were carried out on the 50-mm diameter wells installed in Boreholes 20-02 and 20-03. The wells were screened in loose to compact sand to silty sand. The tests were completed using the following method:

- The static water level was measured and recorded, and a datalogger was inserted into the well below the water level. The datalogger was set to record water levels every 5 seconds, based on the anticipated rate of recovery of each well.
- A slug of groundwater was removed from the well with a dedicated bailer for each well to induce a change in hydraulic head (rising head test).
- Manual and electronic measurements were recorded until the water level in the well recovered sufficiently.
- Manual measurements were compared to electronic measurements for quality control of the data.

8.2 Hydraulic Conductivity

The two slug tests were completed and analyzed using the Hvorslev method. Plots of the slug test results are included in Appendix B. The hydraulic conductivity values calculated from the in-



situ slug tests are summarized in Table 8.1 below. The results from the two wells were very similar, ranging from 9.3×10^{-5} m/s to 1.0×10^{-4} m/s.

Table 8.1: Single Well Response Test Results

Monitoring Well	Hydraulic Conductivity (m/s)	Screened Formation
20-02	1.0×10^{-4}	Sand, some silt
20-03	9.3×10^{-5}	Silty sand to sand

From the grain size distribution curve of the sand at BH 20-03, the D_{10} value was approximately 0.106 mm. Using the Kozeny-Carman and Hazen correlations of grain size to hydraulic conductivity, the estimated hydraulic conductivity values are 3.4×10^{-5} m/s and 1.1×10^{-4} m/s, which are generally consistent with the SWRT results.

9. MISCELLANEOUS

Thurber obtained utility clearances for the borehole locations prior to drilling. Borehole locations were selected and established in the field by Thurber Engineering Ltd.

RPM Drilling of Thunder Bay, Ontario supplied a truck-mounted CME 75 drill rig and conducted the drilling, sampling and in-situ testing operations for the boreholes. Traffic control services conforming to Ontario Book 7 TL-20A lane closures and TL-6 shoulder closures were provided by Men at Worx Ltd. of Thunder Bay, Ontario.

Geotechnical laboratory testing was carried out in Thurber's geotechnical laboratory. Analytical testing was carried out by Bureau Veritas Canada (2019) Inc.

The field investigation was supervised on a full-time basis by Mr. Greg Stanhope of Thurber. Overall supervision of the field program was provided by Mr. Mark Farrant, P.Eng of Thurber and interpretation of the data was carried out by Ms. Judy Mei, E.I.T.

The report was prepared by Ms. Judy Mei, E.I.T. and Mr. Christopher Murray, P.Eng, and reviewed by Dr. P.K. Chatterji, P.Eng., a Designated Principal Contact for MTO Foundations Projects.



THURBER ENGINEERING LTD.

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Appendix A

Record of Borehole Sheets (Current Investigation)

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	TP Thin Wall Piston Sample	PH Sampler Advanced by Hydraulic Pressure	PM Sampler Advanced by Manual Pressure	RC Rock Core	SC Soil Core
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$$\text{Sensitivity} = \frac{\text{Undisturbed Shear Strength}}{\text{Remoulded Shear Strength}}$$

 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 20-01

1 OF 2

METRIC

W.P. 6336-14-00 LOCATION Baker Creek, MTM Zone 15, NAD 83: N 5 444 560.7 E 249 456.0 ORIGINATED BY GS
 DIST Thunder Bay HWY 17 BOREHOLE TYPE Solid Stem Augers/NW Casing with Wash Boring COMPILED BY AN
 DATUM Geodetic DATE 2020.08.11 - 2020.08.11 LATITUDE 49.136681 LONGITUDE -90.758514 CHECKED BY JM

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
469.7	GROUND SURFACE													
0.0	ASPHALT: (150mm)													
0.2	SAND, some gravel, some silt and clay, occasional cobbles Compact Brown Moist (FILL)		1	GS										12 77 11 (SI+CL)
468.3			2	SS	24									
1.4	SAND, trace silt, trace gravel Loose Brown Moist (FILL)		3	SS	7									
467.8														
1.9	Organics layer from 1.9m to 2.1m Black													
467.6														
2.1	Silty SAND, trace clay, trace gravel Very Loose to Compact Brown Wet Trace organics and bark from 2.1m to 3.0m		4	SS	7									
			5	SS	4									
			6	SS	17									0 77 22 1
			7	SS	3									
			8	SS	13									
	Becoming grey													
461.0	Sandy SILT to SAND and SILT, trace clay Very Loose to Loose Grey Wet		9	SS	5									
8.7														

ONTM14S2 MTO-29181.GPJ 2017TEMPLATE(MTO).GDT 11/18/20

Continued Next Page

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

RECORD OF BOREHOLE No 20-01

2 OF 2

METRIC

W.P. 6336-14-00 LOCATION Baker Creek, MTM Zone 15, NAD 83: N 5 444 560.7 E 249 456.0 ORIGINATED BY GS
 DIST Thunder Bay HWY 17 BOREHOLE TYPE Solid Stem Augers/NW Casing with Wash Boring COMPILED BY AN
 DATUM Geodetic DATE 2020.08.11 - 2020.08.11 LATITUDE 49.136681 LONGITUDE -90.758514 CHECKED BY JM

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa						
	Continued From Previous Page													
	Sandy SILT to SAND and SILT, trace clay Very Loose to Loose Grey Wet		10	SS	4	459							0 65 34 1	
			11	SS	2	457								
			12	SS	5	456								
			13	SS	6	455								
453.9						454								
15.8	END OF BOREHOLE AT 15.8m. BOREHOLE OPEN TO 3.5m AND WATER LEVEL AT 1.4m. BOREHOLE BACKFILLED WITH BENTONITE TO 0.3m, SAND TO 0.1m, THEN ASPHALT PATCH TO SURFACE.													

ONTM14S2 MTO-29181.GPJ 2017TEMPLATE(MTO).GDT 11/18/20

+³, ×³: Numbers refer to Sensitivity $\frac{20}{15} \pm 5$ (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 20-02

1 OF 2

METRIC

W.P. 6336-14-00 LOCATION Baker Creek, MTM Zone 15, NAD 83: N 5 444 548.7 E 249 458.2 ORIGINATED BY GS
 DIST Thunder Bay HWY 17 BOREHOLE TYPE Solid Stem Augers/NW Casing with Wash Boring COMPILED BY AN
 DATUM Geodetic DATE 2020.08.10 - 2020.08.12 LATITUDE 49.136574 LONGITUDE -90.758482 CHECKED BY JM

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			
469.3	GROUND SURFACE										
0.0	SAND , some gravel, trace silt Loose Brown Moist (FILL)		1	GS							
467.9			2	SS	6						17 77 6 (SI+CL)
1.4	SAND , trace gravel, trace silt, trace clay, with hydrocarbon odour Very Loose to Loose Brown Wet (FILL)		3	SS	5						
466.1			4	SS	0						
3.2	SAND , some silt, trace gravel Loose to Compact Brown Wet		5	SS	7						5 88 6 1
			6	SS	17						
	Becoming grey		7	SS	6						
			8	SS	9						
460.3	Sandy SILT , trace clay Very Loose Grey Wet		9	SS	1						

ONTMT4S2 MTO-29181.GPJ 2017TEMPLATE(MTO).GDT 11/18/20

Continued Next Page

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

RECORD OF BOREHOLE No 20-02

2 OF 2

METRIC

W.P. 6336-14-00 LOCATION Baker Creek, MTM Zone 15, NAD 83: N 5 444 548.7 E 249 458.2 ORIGINATED BY GS
 DIST Thunder Bay HWY 17 BOREHOLE TYPE Solid Stem Augers/NW Casing with Wash Boring COMPILED BY AN
 DATUM Geodetic DATE 2020.08.10 - 2020.08.12 LATITUDE 49.136574 LONGITUDE -90.758482 CHECKED BY JM

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						
	Continued From Previous Page													
	Sandy SILT, trace clay Very Loose to Loose Grey Wet		10	SS	3	459								
						458								
			11	SS	1	457							0 31 67 2	
						456								
			12	SS	2	455								
						454								
453.5			13	SS	5									
15.8	END OF BOREHOLE AT 15.8m. Well installation consists of 50mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen. WATER LEVEL READINGS DATE DEPTH(m) ELEV.(m) 2020.08.12 1.7 467.6 2020.08.21 1.4 467.9													

ONTM14S2 MTO-29181.GPJ 2017TEMPLATE(MTO).GDT 11/18/20

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

RECORD OF BOREHOLE No 20-03

1 OF 2

METRIC

W.P. 6336-14-00 LOCATION Baker Creek, MTM Zone 15, NAD 83: N 5 444 556.9 E 249 472.1 ORIGINATED BY GS
 DIST Thunder Bay HWY 17 BOREHOLE TYPE Solid Stem Augers/NW Casing with Wash Boring COMPILED BY AN
 DATUM Geodetic DATE 2020.08.11 - 2020.08.11 LATITUDE 49.136649 LONGITUDE -90.758292 CHECKED BY JM

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa							WATER CONTENT (%)			
						20	40	60	80	100	20	40	60	GR	SA	SI	CL	
469.6	GROUND SURFACE																	
0.0	Gravelly SAND, trace silt, occasional cobbles Loose to Compact Brown Moist (FILL)		1	GS														30 64 6 (SI+CL)
			2	SS	10													
			3	SS	13													
			4	SS	8													
466.6	Silty SAND, trace gravel, trace clay Loose to Compact Brown Wet		5	SS	4													
3.0			6	SS	20													
464.0	SAND, trace silt, trace clay Loose Grey Wet		7	SS	5													0 94 5 1
5.6			8	SS	4													
460.9	Sandy SILT, trace clay Very Loose to Loose Grey Wet		9	SS	4													
8.7																		

ONTMT4S2 MTO-29181.GPJ 2017TEMPLATE(MTO).GDT 11/18/20

Continued Next Page

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

RECORD OF BOREHOLE No 20-03

2 OF 2

METRIC

W.P. 6336-14-00 LOCATION Baker Creek, MTM Zone 15, NAD 83: N 5 444 556.9 E 249 472.1 ORIGINATED BY GS
 DIST Thunder Bay HWY 17 BOREHOLE TYPE Solid Stem Augers/NW Casing with Wash Boring COMPILED BY AN
 DATUM Geodetic DATE 2020.08.11 - 2020.08.11 LATITUDE 49.136649 LONGITUDE -90.758292 CHECKED BY JM

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa							WATER CONTENT (%)
	Continued From Previous Page					20 40 60 80 100	○ UNCONFINED	+ FIELD VANE		20 40 60					
459	Sandy SILT, trace clay Very Loose to Loose Grey Wet		10	SS	3										
458															
457			11	SS	3										
456			12	SS	10									0 31 67 2	
455															
454			13	SS	7										
15.8	END OF BOREHOLE AT 15.8m. Well installation consists of 50mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen. WATER LEVEL READINGS DATE DEPTH(m) ELEV.(m) 2020.08.12 2.0 467.6 2020.08.21 1.7 467.9														

ONTM14S2 MTO-29181.GPJ 2017TEMPLATE(MTO).GDT 11/18/20

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

RECORD OF BOREHOLE No 20-04

1 OF 2

METRIC

W.P. 6336-14-00 LOCATION Baker Creek, MTM Zone 15, NAD 83: N 5 444 548.1 E 249 475.3 ORIGINATED BY GS
 DIST Thunder Bay HWY 17 BOREHOLE TYPE Solid Stem Augers/NW Casing with Wash Boring COMPILED BY AN
 DATUM Geodetic DATE 2020.08.10 - 2020.08.10 LATITUDE 49.136570 LONGITUDE -90.758247 CHECKED BY JM

ELEV DEPTH	SOIL PROFILE DESCRIPTION	STRAT PLOT	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
			NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa							
469.6	GROUND SURFACE														
0.0	ASPHALT: (125mm)														
0.1	SAND, trace gravel, trace silt Compact Brown Moist (FILL)		1	GS											
468.2			2	SS	19									8 84 8 (SI+CL)	
1.4	Silty SAND Loose Brown with Grey pockets Wet (FILL)		3	SS	7	▽									
467.2			4	SS	8										
2.4 467.0	PEAT, mixed with sand Loose Black Wet														
2.6	Silty SAND, trace clay Very Loose to Loose Grey to Dark Grey Wet Trace organics from 2.6m to 2.9		5	SS	2									0 74 25 1	
			6	SS	8										
			7	SS	7										
			8	SS	7										
			9	SS	3									0 64 35 1	

ONTM14S2 MTO-29181.GPJ 2017TEMPLATE(MTO).GDT 11/18/20

Continued Next Page

+³, ×³: Numbers refer to Sensitivity $\frac{20}{15 \pm 5}$ 10 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 20-04

2 OF 2

METRIC

W.P. 6336-14-00 LOCATION Baker Creek, MTM Zone 15, NAD 83: N 5 444 548.1 E 249 475.3 ORIGINATED BY GS
 DIST Thunder Bay HWY 17 BOREHOLE TYPE Solid Stem Augers/NW Casing with Wash Boring COMPILED BY AN
 DATUM Geodetic DATE 2020.08.10 - 2020.08.10 LATITUDE 49.136570 LONGITUDE -90.758247 CHECKED BY JM

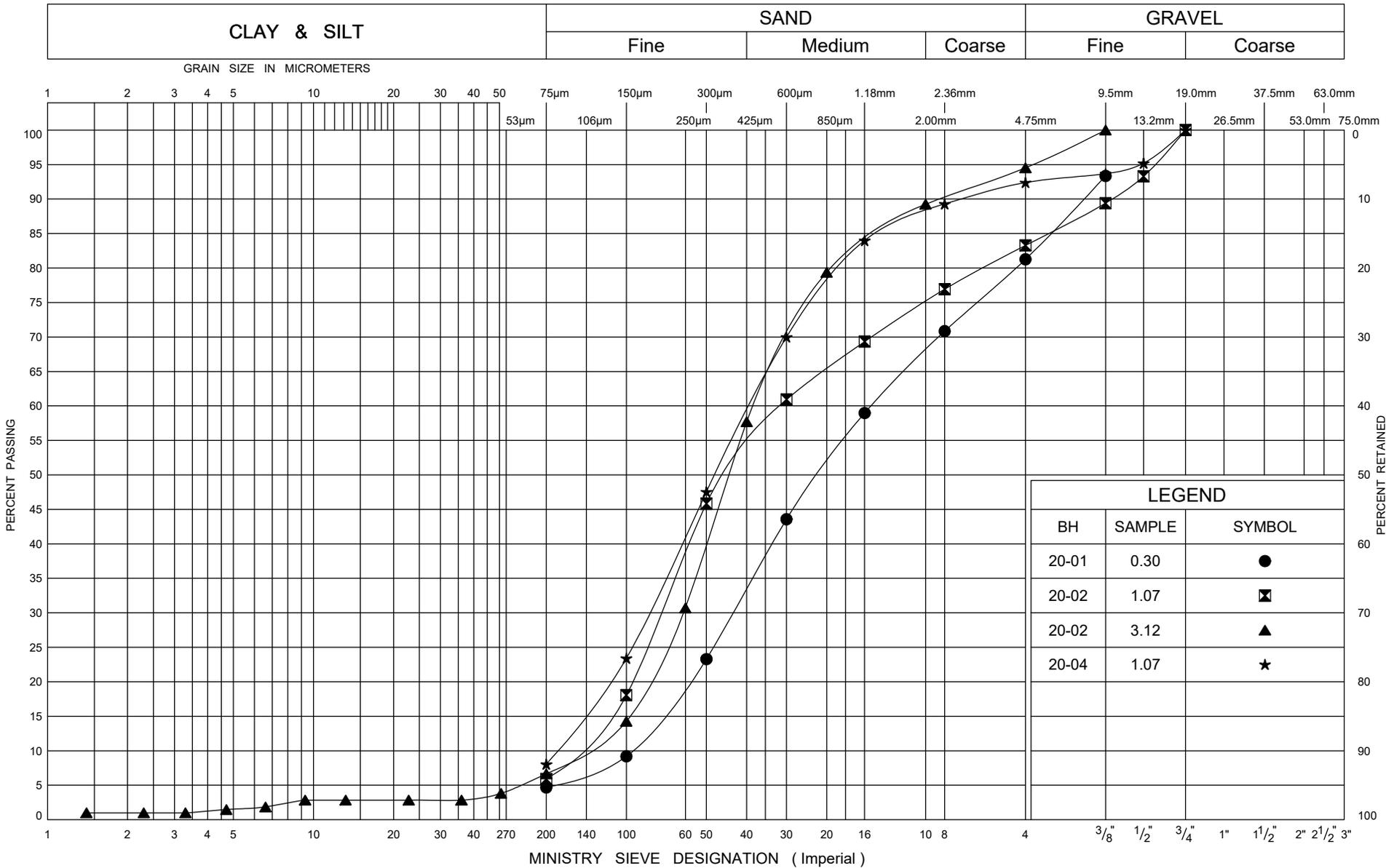
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60					
	Continued From Previous Page														
457.9	Silty SAND , trace clay Very Loose Grey Wet		10	SS	2										
11.7	Sandy SILT to SAND and SILT , trace clay Very Loose to Loose Grey Wet		11	SS	2									0 43 55 2	
			12	SS	9										
			13	SS	8										
453.8	END OF BOREHOLE AT 15.8m. BOREHOLE OPEN TO 3.0m AND WATER LEVEL AT 1.9m. BOREHOLE BACKFILLED WITH BENTONITE TO 0.3m, SAND TO 0.1m, THEN ASPHALT PATCH TO SURFACE.														

ONTM14S2 MTO-29181.GPJ 2017TEMPLATE(MTO).GDT 11/18/20



Appendix B

Laboratory Test Results (Current Investigation)



ONTARIO MOT GRAIN SIZE 2 MTO-29181.GPJ ONTARIO MOT.GDT 9/18/20

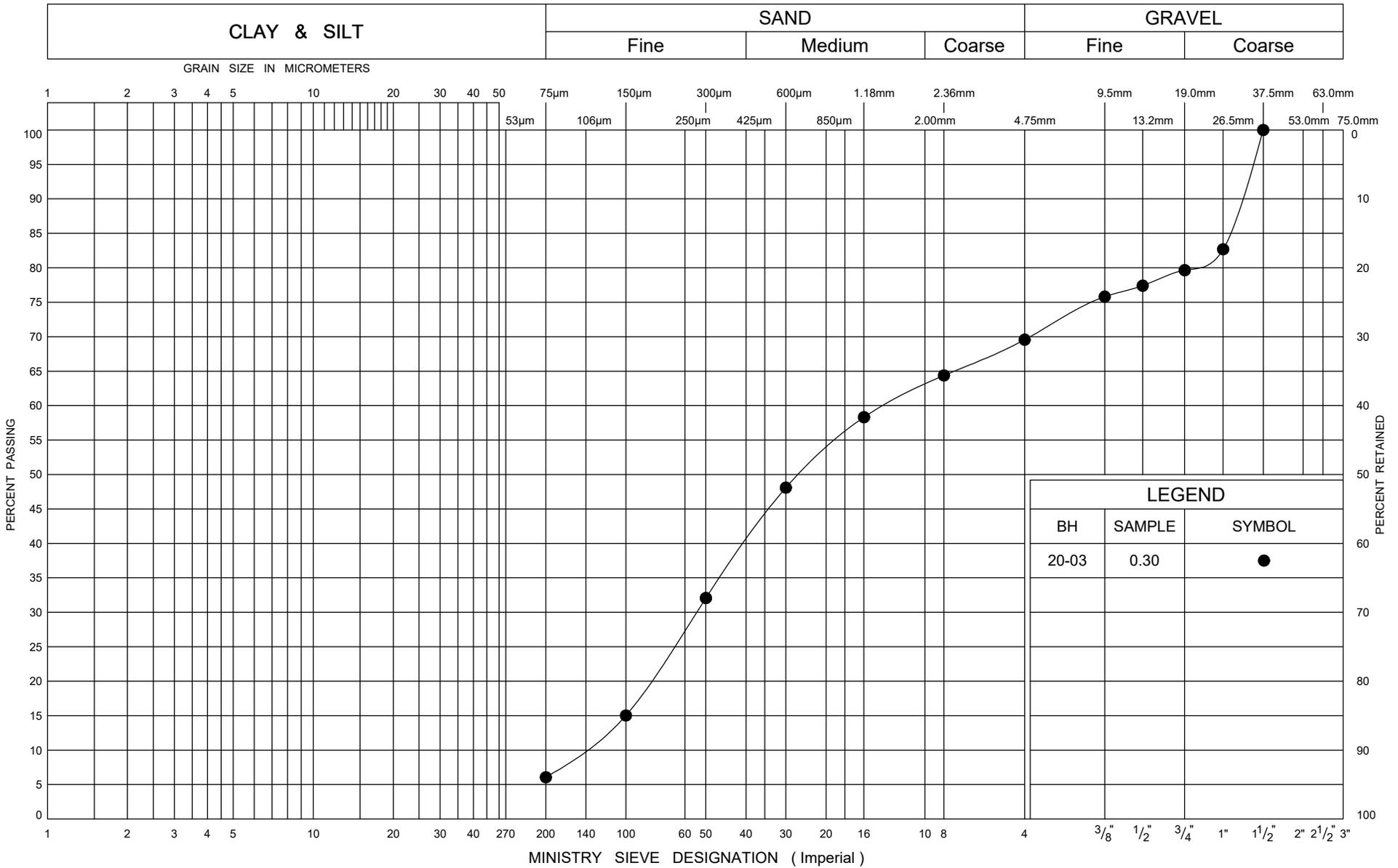


GRAIN SIZE DISTRIBUTION SAND FILL

FIG No B1

W P 6336-14-00

Baker Creek



LEGEND		
BH	SAMPLE	SYMBOL
20-03	0.30	●

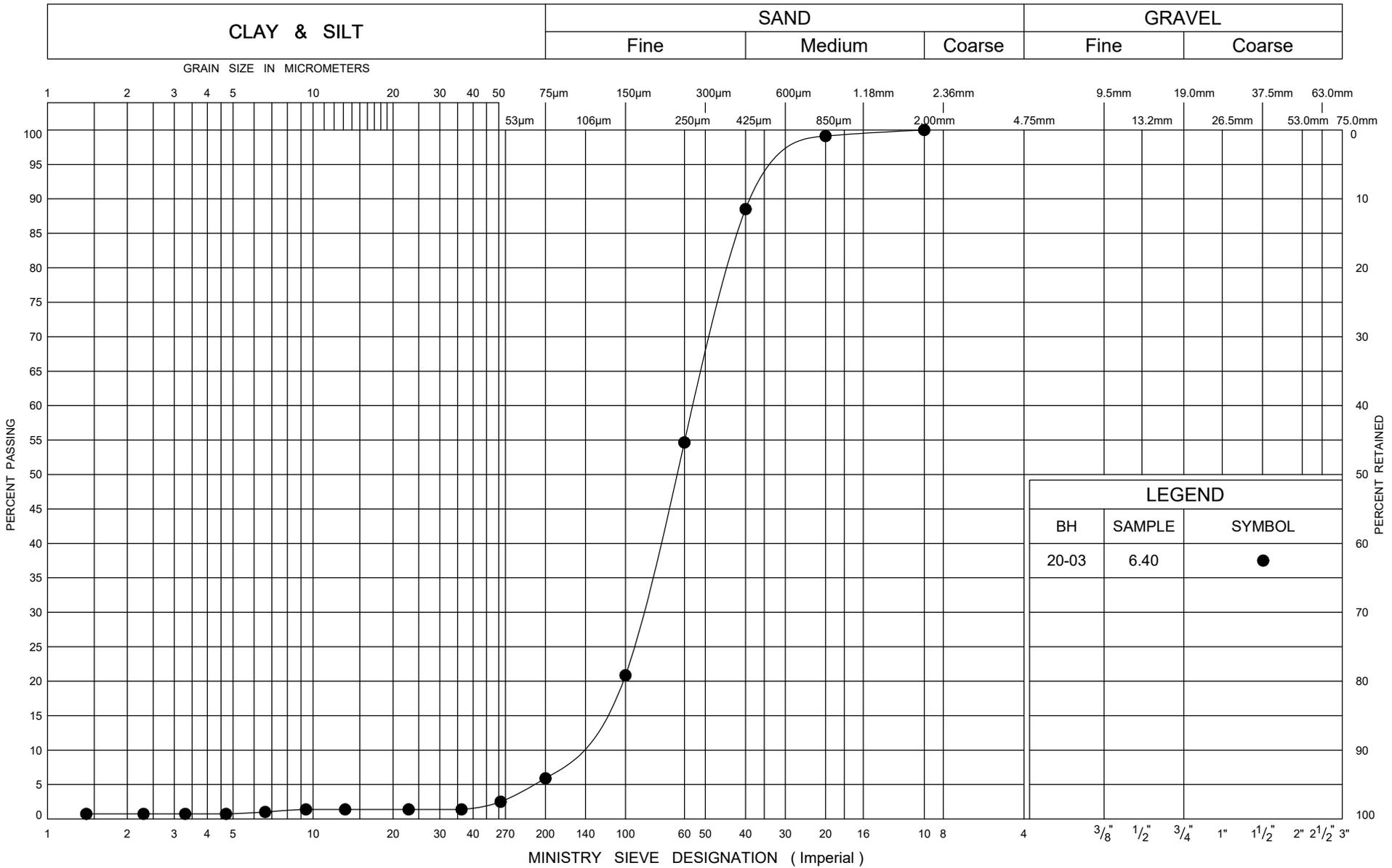
ONTARIO MOT GRAIN SIZE 2 MTO-29181.GPJ ONTARIO MOT.GDT 9/18/20

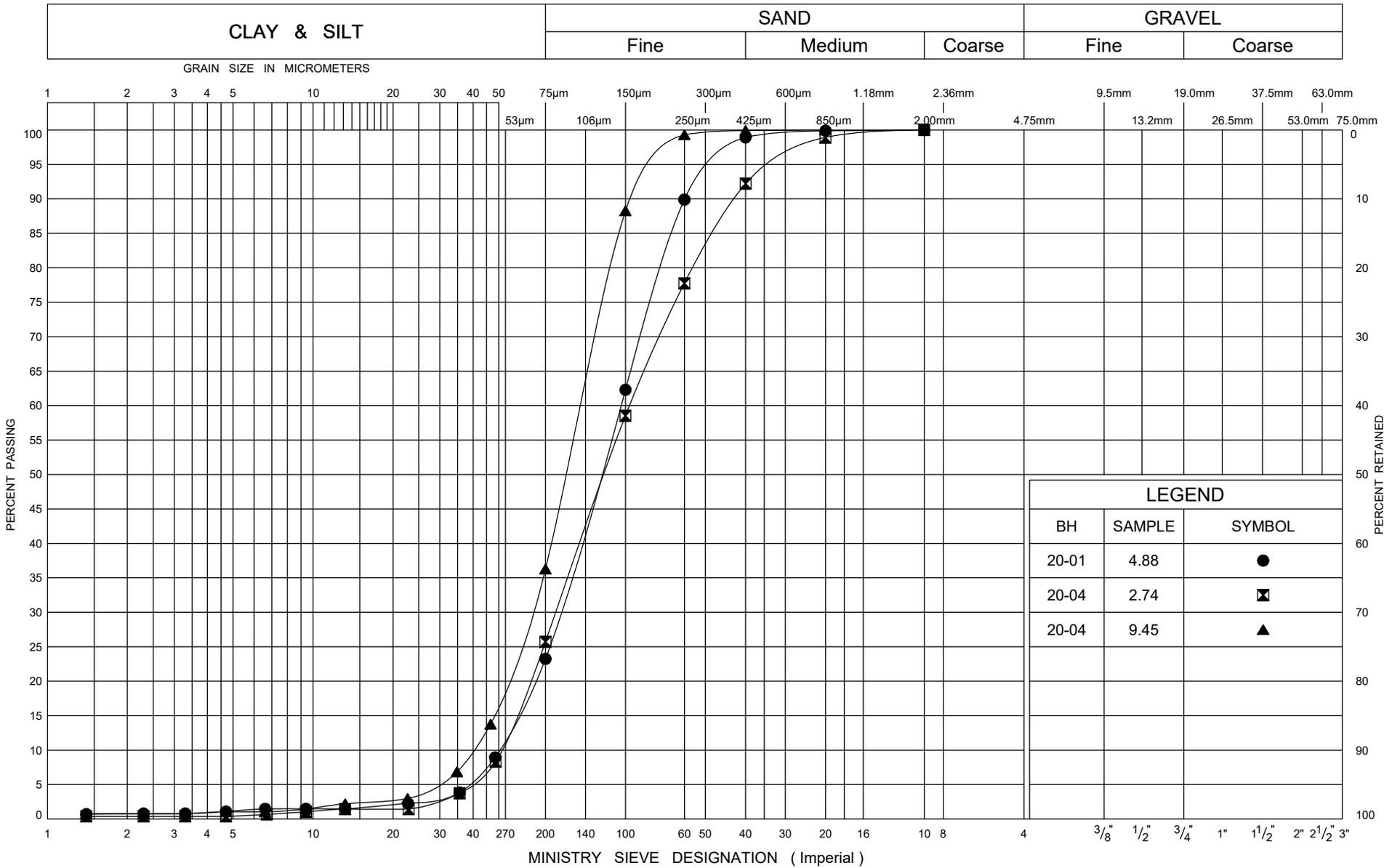


GRAIN SIZE DISTRIBUTION

Gravelly SAND FILL

FIG No B2
 W P 6336-14-00
 Baker Creek





ONTARIO MOT GRAIN SIZE 2 MTO-29181.GPJ ONTARIO MOT.GDT 9/18/20



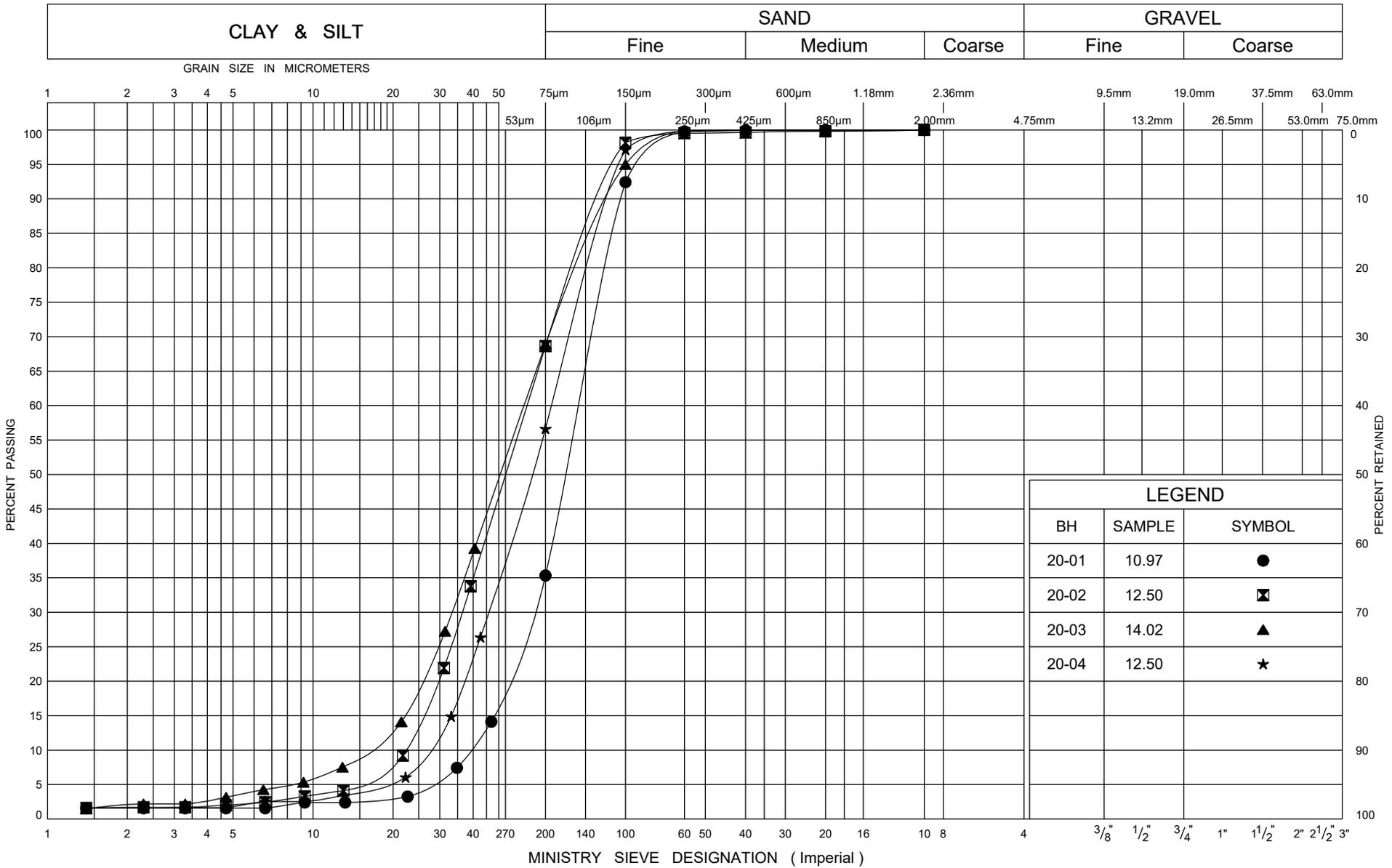
GRAIN SIZE DISTRIBUTION

Silty SAND

FIG No B4

W P 6336-14-00

Baker Creek



LEGEND		
BH	SAMPLE	SYMBOL
20-01	10.97	●
20-02	12.50	◻
20-03	14.02	▲
20-04	12.50	★

ONTARIO MOT GRAIN SIZE 2 MTO-29181.GPJ ONTARIO MOT.GDT 9/18/20



GRAIN SIZE DISTRIBUTION

Sandy SILT to SAND and SILT

FIG No B5
 W P 6336-14-00
 Baker Creek



Slug Test Analysis Report

Project: Baker Creek Culvert

Number: 29181

Client: Hatch

Location: Baker Creek Culvert

Slug Test: 20-02

Test Well: 20-02

Test Conducted by: GS

Test Date: 2020-08-21

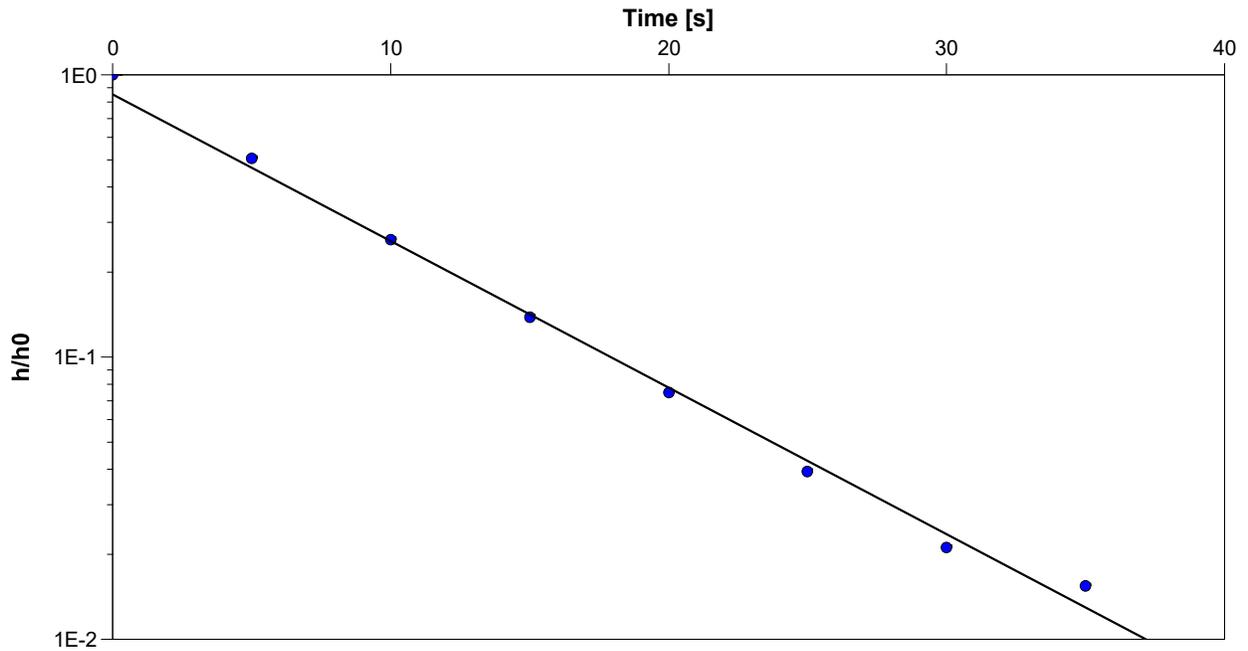
Analysis Performed by: PC

20-02 SWRT Analysis

Analysis Date: 2020-09-18

Aquifer Thickness:

Checked by: DH



Calculation using Hvorslev

Observation Well	Hydraulic Conductivity [m/s]	
20-02	1.0×10^{-4}	



THURBER ENGINEERING LTD.

Slug Test Analysis Report

Project: Baker Creek Culvert

Number: 29181

Client: Hatch

Location: Baker Creek Culvert

Slug Test: 20-03

Test Well: 20-03

Test Conducted by: GS

Test Date: 2020-08-12

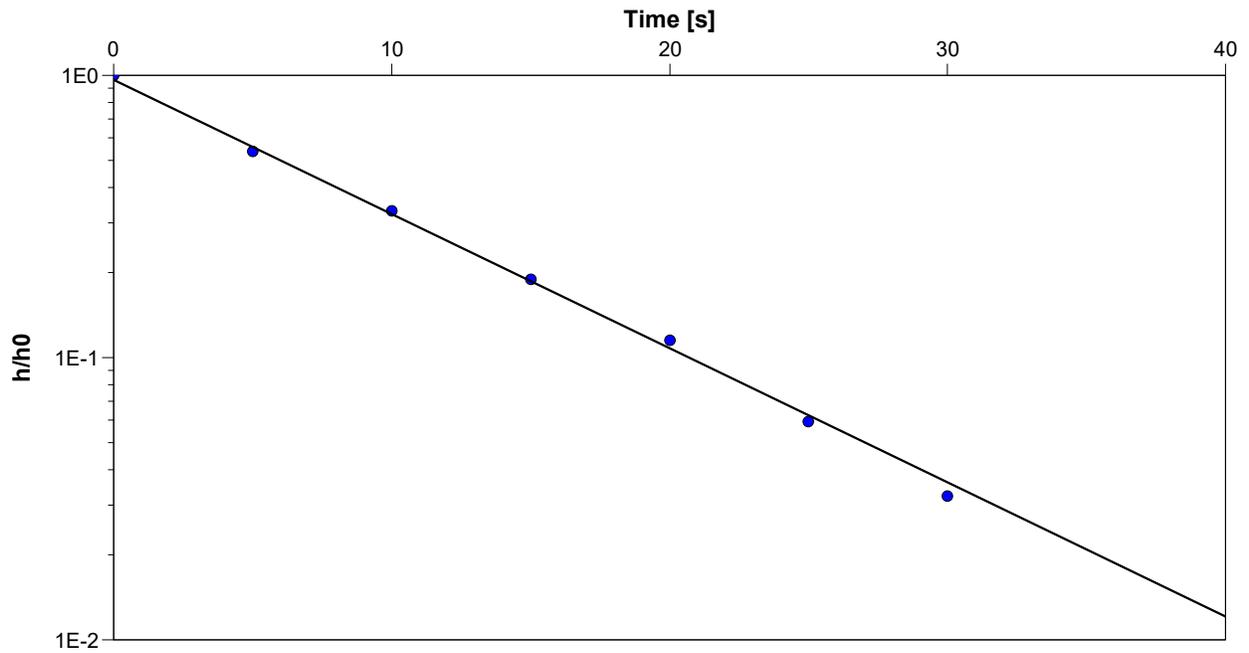
Analysis Performed by: PC

20-03 SWRT Analysis

Analysis Date: 2020-09-18

Aquifer Thickness:

Checked by: DH



Calculation using Hvorslev

Observation Well	Hydraulic Conductivity [m/s]	
20-03	9.3×10^{-5}	



Your Project #: 29181
 Site Location: BAKER CREEK CULVERT
 Your C.O.C. #: n/a

Attention: Judy Mei

Thurber Engineering Ltd
 2010 Winston Park Dr
 Suite 103
 Oakville, ON
 CANADA L6H 5R7

Report Date: 2020/09/11
 Report #: R6326370
 Version: 2 - Final

CERTIFICATE OF ANALYSIS

BV LABS JOB #: COM0935

Received: 2020/08/27, 14:35

Sample Matrix: Soil
 # Samples Received: 2

Analyses	Quantity	Date	Date	Laboratory Method	Analytical Method
		Extracted	Analyzed		
Chloride (20:1 extract)	2	2020/09/01	2020/09/01	CAM SOP-00463	SM 23 4500-CI E m
Conductivity	2	2020/09/01	2020/09/01	CAM SOP-00414	OMOE E3530 v1 m
Moisture (Subcontracted) (1, 3)	2	N/A	2020/09/02	AB SOP-00002	CCME PHC-CWS m
Sulphide in Soil (1)	2	N/A	2020/09/02	AB SOP-00080	EPA9030B/SM4500S2-DF
pH CaCl2 EXTRACT	2	2020/09/01	2020/09/01	CAM SOP-00413	EPA 9045 D m
Resistivity of Soil	2	2020/08/27	2020/09/01	CAM SOP-00414	SM 23 2510 m
Sulphate (20:1 Extract)	2	2020/09/01	2020/09/02	CAM SOP-00464	EPA 375.4 m
Redox Potential (2, 4)	2	N/A	N/A		

Remarks:

Bureau Veritas Laboratories are accredited to ISO/IEC 17025 for specific parameters on scopes of accreditation. Unless otherwise noted, procedures used by BV Labs are based upon recognized Provincial, Federal or US method compendia such as CCME, MELCC, EPA, APHA.

All work recorded herein has been done in accordance with procedures and practices ordinarily exercised by professionals in BV Labs profession using accepted testing methodologies, quality assurance and quality control procedures (except where otherwise agreed by the client and BV Labs in writing). All data is in statistical control and has met quality control and method performance criteria unless otherwise noted. All method blanks are reported; unless indicated otherwise, associated sample data are not blank corrected. Where applicable, unless otherwise noted, Measurement Uncertainty has not been accounted for when stating conformity to the referenced standard.

BV Labs liability is limited to the actual cost of the requested analyses, unless otherwise agreed in writing. There is no other warranty expressed or implied. BV Labs has been retained to provide analysis of samples provided by the Client using the testing methodology referenced in this report. Interpretation and use of test results are the sole responsibility of the Client and are not within the scope of services provided by BV Labs, unless otherwise agreed in writing. BV Labs is not responsible for the accuracy or any data impacts, that result from the information provided by the customer or their agent.

Solid sample results, except biota, are based on dry weight unless otherwise indicated. Organic analyses are not recovery corrected except for isotope dilution methods.

Results relate to samples tested. When sampling is not conducted by BV Labs, results relate to the supplied samples tested.

This Certificate shall not be reproduced except in full, without the written approval of the laboratory.

Reference Method suffix "m" indicates test methods incorporate validated modifications from specific reference methods to improve performance.

* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.

- (1) This test was performed by BVLabs Calgary via Mississauga
- (2) This test was performed by Sub from Campo to Env. Testing Canada (Eurofins)
- (3) Offsite analysis requires that subcontracted moisture be reported.



Your Project #: 29181
Site Location: BAKER CREEK CULVERT
Your C.O.C. #: n/a

Attention: Judy Mei

Thurber Engineering Ltd
2010 Winston Park Dr
Suite 103
Oakville, ON
CANADA L6H 5R7

Report Date: 2020/09/11
Report #: R6326370
Version: 2 - Final

CERTIFICATE OF ANALYSIS

BV LABS JOB #: COM0935

Received: 2020/08/27, 14:35

(4) Oxidation-Reduction Potential (ORP) values are determined using a Ag/AgCl reference electrode.

Encryption Key

Please direct all questions regarding this Certificate of Analysis to your Project Manager.

Antonella Brasil, Senior Project Manager

Email: Antonella.Brasil@bvlabs.com

Phone# (905)817-5817

=====

BV Labs has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per ISO/IEC 17025, signing the reports. For Service Group specific validation please refer to the Validation Signature Page.



SOIL CORROSIVITY PACKAGE (SOIL)

BV Labs ID		NME948	NME949		
Sampling Date		2020/08/26 15:00	2020/08/26 15:00		
COC Number		n/a	n/a		
	UNITS	20-03, SS3 (5' - 7')	20-02, SS5B (10'6" - 12")	RDL	QC Batch
Calculated Parameters					
Resistivity	ohm-cm	2200	3700	N/A	6914206
Inorganics					
Soluble (20:1) Chloride (Cl-)	ug/g	280	190	20	6921178
Conductivity	umho/cm	448	269	2	6920713
Available (CaCl2) pH	pH	6.88	5.29	N/A	6920644
Soluble (20:1) Sulphate (SO4)	ug/g	<20	<20	20	6921183
Sulphide	mg/kg	<0.5 (1)	<0.5 (1)	0.5	6924474
Physical Testing					
Moisture-Subcontracted	%	12	17	0.30	6928285
RDL = Reportable Detection Limit QC Batch = Quality Control Batch N/A = Not Applicable (1) Sample contained greater than 10% headspace at time of extraction.					



GENERAL COMMENTS

Each temperature is the average of up to three cooler temperatures taken at receipt

Package 1	9.0°C
-----------	-------

Sample NME948 [20-03, SS3 (5' - 7')] : Sample was analyzed past method specified hold time for Sulphide.

Sample NME949 [20-02, SS5B (10'6" - 12")] : Sample was analyzed past method specified hold time for Sulphide.

Results relate only to the items tested.



BUREAU
VERITAS

BV Labs Job #: COM0935
Report Date: 2020/09/11

Thurber Engineering Ltd
Client Project #: 29181
Site Location: BAKER CREEK CULVERT
Sampler Initials: JM

QUALITY ASSURANCE REPORT

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
6920644	NYS	Spiked Blank	Available (CaCl2) pH	2020/09/01		100	%	97 - 103
6920644	NYS	RPD	Available (CaCl2) pH	2020/09/01	1.3		%	N/A
6920713	NYS	Spiked Blank	Conductivity	2020/09/01		102	%	90 - 110
6920713	NYS	Method Blank	Conductivity	2020/09/01	<2		umho/cm	
6920713	NYS	RPD	Conductivity	2020/09/01	2.4		%	10
6921178	KAD	Matrix Spike	Soluble (20:1) Chloride (Cl-)	2020/09/01		111	%	70 - 130
6921178	KAD	Spiked Blank	Soluble (20:1) Chloride (Cl-)	2020/09/01		104	%	70 - 130
6921178	KAD	Method Blank	Soluble (20:1) Chloride (Cl-)	2020/09/01	<20		ug/g	
6921178	KAD	RPD	Soluble (20:1) Chloride (Cl-)	2020/09/01	NC		%	35
6921183	DRM	Matrix Spike	Soluble (20:1) Sulphate (SO4)	2020/09/02		119	%	70 - 130
6921183	DRM	Spiked Blank	Soluble (20:1) Sulphate (SO4)	2020/09/02		98	%	70 - 130
6921183	DRM	Method Blank	Soluble (20:1) Sulphate (SO4)	2020/09/02	<20		ug/g	
6921183	DRM	RPD	Soluble (20:1) Sulphate (SO4)	2020/09/02	NC		%	35
6924474	SLL	Matrix Spike	Sulphide	2020/09/02		83	%	75 - 125
6924474	SLL	Spiked Blank	Sulphide	2020/09/02		90	%	75 - 125
6924474	SLL	Method Blank	Sulphide	2020/09/02	<0.5		mg/kg	
6924474	SLL	RPD	Sulphide	2020/09/02	11		%	30
6928285	ETS	Method Blank	Moisture-Subcontracted	2020/09/02	<0.30		%	

N/A = Not Applicable

Duplicate: Paired analysis of a separate portion of the same sample. Used to evaluate the variance in the measurement.

Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate sample matrix interference.

Spiked Blank: A blank matrix sample to which a known amount of the analyte, usually from a second source, has been added. Used to evaluate method accuracy.

Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.

NC (Duplicate RPD): The duplicate RPD was not calculated. The concentration in the sample and/or duplicate was too low to permit a reliable RPD calculation (absolute difference <= 2x RDL).



BUREAU
VERITAS

BV Labs Job #: COM0935
Report Date: 2020/09/11

Thurber Engineering Ltd
Client Project #: 29181
Site Location: BAKER CREEK CULVERT
Sampler Initials: JM

VALIDATION SIGNATURE PAGE

The analytical data and all QC contained in this report were reviewed and validated by the following individual(s).

Ashton Gibson, Project Manager

Anastassia Hamanov, Scientific Specialist

Gita Pokhrel, Senior Analyst

Maria Magdalena Florescu, Ph.D., P.Chem., QP, Inorganics Manager

BV Labs has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per ISO/IEC 17025, signing the reports. For Service Group specific validation please refer to the Validation Signature Page.



6740 Campobello Road, Mississauga, Ontario L5N 2L8
 Phone: 905-817-5700 Fax: 905-817-5779 Toll Free: 800-563-6266
 CAM FCD-01191/6

CHAIN OF CUSTODY RECORD

Page ____ of ____

Invoice Information	Report Information (if differs from invoice)	Project Information (where applicable)	Turnaround Time (TAT) Required
Company Name: Thurber Engineering Ltd.	Company Name: _____	Quotation #: _____	<input checked="" type="checkbox"/> Regular TAT (5-7 days) Most analyses
Contact Name: Judy Mei/Mark Farrant	Contact Name: _____	P.O. #/ AFE#: _____	PLEASE PROVIDE ADVANCE NOTICE FOR RUSH PROJECTS
Address: 2010 Winston Park Dr #103, Oakville, ON L6H 5R7	Address: _____	Project #: 29181	Rush TAT (Surcharges will be applied)
Phone: (905) 829-8666 Fax: _____	Phone: _____ Fax: _____	Site Location: Baker Creek Culvert	<input type="checkbox"/> 1 Day <input type="checkbox"/> 2 Days <input type="checkbox"/> 3-4 Days
Email: jmei@thurber.ca, mfarrant@thurber.ca	Email: _____	Site #: _____	Date Required: _____
MOE REGULATED DRINKING WATER OR WATER INTENDED FOR HUMAN CONSUMPTION MUST BE SUBMITTED ON THE BUREAU VERITAS LABORATORIES DRINKING WATER CHAIN OF CUSTODY			Rush Confirmation #: _____
Sampled By: JM			LABORATORY USE ONLY

Regulation 153	Other Regulations	Analysis Requested
<input type="checkbox"/> Table 1 <input type="checkbox"/> Res/Park <input type="checkbox"/> Med/ Fine <input type="checkbox"/> Table 2 <input type="checkbox"/> Ind/Comm <input type="checkbox"/> Coarse <input type="checkbox"/> Table 3 <input type="checkbox"/> Agri/ Other <input type="checkbox"/> Table _____ FOR RSC (PLEASE CIRCLE) Y / N	<input type="checkbox"/> CCME <input type="checkbox"/> Sanitary Sewer Bylaw <input type="checkbox"/> MISA <input type="checkbox"/> Storm Sewer Bylaw <input type="checkbox"/> PWQO Region _____ <input type="checkbox"/> Other (Specify) _____ <input type="checkbox"/> REG 558 (MIN. 3 DAY TAT REQUIRED) <input type="checkbox"/> REG 406 Table _____	# OF CONTAINERS SUBMITTED FIELD FILTERED (CIRCLE) Metals / Hg / CVI BTEX/ PHE F1 PHCS P2 - F4 VOCs REG 153 METALS & INORGANICS REG 153 ICPMS METALS REG 153 METALS (Hg, Cr VI, ICPMS Metals, HWS - B) Soil Corrosivity HOLD- DO NOT ANALYZE

Include Criteria on Certificate of Analysis: Y / N

SAMPLES MUST BE KEPT COOL (< 10 °C) FROM TIME OF SAMPLING UNTIL DELIVERY TO BUREAU VERITAS

SAMPLE IDENTIFICATION	DATE SAMPLED (YYYY/MM/DD)	TIME SAMPLED (HH:MM)	MATRIX	# OF CONTAINERS SUBMITTED	FIELD FILTERED (CIRCLE) Metals / Hg / CVI	BTEX/ PHE F1	PHCS P2 - F4	VOCs	REG 153 METALS & INORGANICS	REG 153 ICPMS METALS	REG 153 METALS (Hg, Cr VI, ICPMS Metals, HWS - B)	Soil Corrosivity	HOLD- DO NOT ANALYZE
1 20-03, SS3 (5' - 7')	2020-08-26	15:00	Soil	2								X	
2 20-02, SS5B (10'6" - 12')	2020-08-26	15:00	Soil	2								X	
3													
4													
5													
6													
7													
8													
9													
10													

CUSTODY SEAL Y / N		COOLER TEMPERATURES
Present	Intact	
N	N	8/9/10
COOLING MEDIA PRESENT: <input checked="" type="checkbox"/> Y / <input type="checkbox"/> N		
COMMENTS		

RELINQUISHED BY: (Signature/Print)	DATE: (YYYY/MM/DD)	TIME: (HH:MM)	RECEIVED BY: (Signature/Print)	DATE: (YYYY/MM/DD)	TIME: (HH:MM)
<i>Judy Mei</i>	2020/08/27	13:40	<i>[Signature]</i>	2020/08/27	14:35
<i>Judy Mei</i>	2020/08/27	13:40	<i>[Signature]</i>	2020/08/27	14:35

27-Aug-20 14:35
 Antonella Brasil
COM0935
 KVG ENV-971

Client: Bureau Veritas Canada (2019) Inc.
6740 Campobello Road
Mississauga, ON
L5N 2L8
Attention: Antonella Brasil
PO#:
Invoice to: Bureau Veritas Canada (2019) Inc.

Report Number: 1937765
Date Submitted: 2020-09-01
Date Reported: 2020-09-09
Project: COM0935
COC #: 862181

Page 1 of 3

Dear Antonella Brasil:

Please find attached the analytical results for your samples. If you have any questions regarding this report, please do not hesitate to call (613-727-5692).

Report Comments:

APPROVAL: _____

Sarah Horner, Inorganics Technician

All analysis is completed at Eurofins Environment Testing Canada Inc. (Ottawa, Ontario) unless otherwise indicated.

Eurofins Environment Testing Canada Inc. (Ottawa, Ontario) is accredited by CALA, Canadian Association for Laboratory Accreditation to ISO/IEC 17025 for tests which appear on the scope of accreditation. The scope is available at: <http://www.cala.ca/scopes/2602.pdf>.

Eurofins Environment Testing Canada Inc. (Ottawa, Ontario) is licensed by the Ontario Ministry of the Environment, Conservation, and Parks (MECP) for specific tests in drinking water (license #2318). A copy of the license is available upon request.

Eurofins Environment Testing Canada Inc. (Ottawa, Ontario) is accredited by the Ontario Ministry of Agriculture, Food, and Rural Affairs for specific tests in agricultural soils.

Please note: Field data, where presented on the report, has been provided by the client and is presented for informational purposes only. Guideline values listed on this report are provided for ease of use (informational purposes) only. Eurofins recommends consulting the official provincial or federal guideline as required. Unless otherwise stated, measurement uncertainty is not taken into account when determining guideline or regulatory exceedances.

Certificate of Analysis

Client: Bureau Veritas Canada (2019) Inc.
 6740 Campobello Road
 Mississauga, ON
 L5N 2L8
 Attention: Antonella Brasil
 PO#:
 Invoice to: Bureau Veritas Canada (2019) Inc.

Report Number: 1937765
 Date Submitted: 2020-09-01
 Date Reported: 2020-09-09
 Project: COM0935
 COC #: 862181

Group	Analyte	MRL	Units	Guideline	Lab I.D.	Sample Matrix	Sample Type	Sampling Date	Sample I.D.					
Redox Potential	REDOX Potential		mV		1513958	Soil		2020-08-26	NME948-20-03 SS3 (5' - 7')	1513959	Soil		2020-08-26	NME949-20-02 SS5B (10'6" - 12")

Guideline = * = **Guideline Exceedence**

Results relate only to the parameters tested on the samples submitted.
 Methods references and/or additional QA/QC information available on request.

MRL = Method Reporting Limit, AO = Aesthetic Objective, OG = Operational Guideline, MAC = Maximum Acceptable Concentration, IMAC = Interim Maximum Acceptable Concentration, STD = Standard, PWQO = Provincial Water Quality Guideline, IPWQO = Interim Provincial Water Quality Objective, TDR = Typical Desired Range

Client: Bureau Veritas Canada (2019) Inc.
 6740 Campobello Road
 Mississauga, ON
 L5N 2L8
 Attention: Antonella Brasil
 PO#:
 Invoice to: Bureau Veritas Canada (2019) Inc.

Report Number: 1937765
 Date Submitted: 2020-09-01
 Date Reported: 2020-09-09
 Project: COM0935
 COC #: 862181

QC Summary

Analyte	Blank	QC % Rec	QC Limits
Run No 388927 Analysis/Extraction Date 2020-09-08 Analyst SKH Method C SM2580B			
REDOX Potential	212 mV	100	

Guideline = * = **Guideline Exceedence**

Results relate only to the parameters tested on the samples submitted.
 Methods references and/or additional QA/QC information available on request.

MRL = Method Reporting Limit, AO = Aesthetic Objective, OG = Operational Guideline, MAC = Maximum Acceptable Concentration, IMAC = Interim Maximum Acceptable Concentration, STD = Standard, PWQO = Provincial Water Quality Guideline, IPWQO = Interim Provincial Water Quality Objective, TDR = Typical Desired Range



Your Project #: 29181
 Site Location: BAKER CREEK CULVERT
 Your C.O.C. #: 782317-01-01

Attention: Mark Farrant

Thurber Engineering Ltd
 2010 Winston Park Dr
 Suite 103
 Oakville, ON
 CANADA L6H 5R7

Report Date: 2020/11/13
 Report #: R6409774
 Version: 2 - Revision

CERTIFICATE OF ANALYSIS – REVISED REPORT

BV LABS JOB #: C0L6330

Received: 2020/08/24, 10:40

Sample Matrix: Water
 # Samples Received: 1

Analyses	Quantity	Date	Date	Laboratory Method	Analytical Method
		Extracted	Analyzed		
Dissolved Aluminum (0.2 u, clay free)	1	N/A	2020/08/27	CAM SOP-00447	EPA 6020B m
Alkalinity	1	N/A	2020/08/26	CAM SOP-00448	SM 23 2320 B m
Chromium (VI) in Water	1	N/A	2020/08/27	CAM SOP-00436	EPA 7199 m
Free (WAD) Cyanide	1	N/A	2020/08/26	CAM SOP-00457	OMOE E3015 m
Dissolved Oxygen	1	2020/08/25	2020/08/25	CAM SOP-00427	SM 23 4500 O G m
Hardness (calculated as CaCO3)	1	N/A	2020/08/28	CAM SOP 00102/00408/00447	SM 2340 B
Mercury	1	2020/08/27	2020/08/27	CAM SOP-00453	EPA 7470A m
Dissolved Calcium and Magnesium	1	2020/08/26	2020/08/27	CAM SOP-00408	EPA 6010D m
Total Metals Analysis by ICPMS	1	N/A	2020/08/26	CAM SOP-00447	EPA 6020B m
Sulphide (as H2S) (1)	1	N/A	2020/08/27	AB WI-00065	Auto Calc.
Total Sulphide (1)	1	N/A	2020/08/27	AB SOP-00080	SM 23 4500 S2-A D Fm
Total Ammonia-N	1	N/A	2020/08/27	CAM SOP-00441	USGS I-2522-90 m
pH	1	2020/08/25	2020/08/26	CAM SOP-00413	SM 4500H+ B m
Phenols (4AAP)	1	N/A	2020/08/26	CAM SOP-00444	OMOE E3179 m
Total Phosphorus (Colourimetric)	1	2020/08/26	2020/08/28	CAM SOP-00407	SM 23 4500 P B H m
Turbidity	1	N/A	2020/08/26	CAM SOP-00417	SM 23 2130 B m

Remarks:

Bureau Veritas Laboratories are accredited to ISO/IEC 17025 for specific parameters on scopes of accreditation. Unless otherwise noted, procedures used by BV Labs are based upon recognized Provincial, Federal or US method compendia such as CCME, MELCC, EPA, APHA.

All work recorded herein has been done in accordance with procedures and practices ordinarily exercised by professionals in BV Labs profession using accepted testing methodologies, quality assurance and quality control procedures (except where otherwise agreed by the client and BV Labs in writing). All data is in statistical control and has met quality control and method performance criteria unless otherwise noted. All method blanks are reported; unless indicated otherwise, associated sample data are not blank corrected. Where applicable, unless otherwise noted, Measurement Uncertainty has not been accounted for when stating conformity to the referenced standard.

BV Labs liability is limited to the actual cost of the requested analyses, unless otherwise agreed in writing. There is no other warranty expressed or implied. BV Labs has retained to provide analysis of samples provided by the Client using the testing methodology referenced in this report. Interpretation and use of test results are the sole responsibility of the Client and are not within the scope of services provided by BV Labs, unless otherwise agreed in writing. BV Labs is not responsible for the accuracy or any data impacts, that result from the information provided by the customer or their agent.



Your Project #: 29181
Site Location: BAKER CREEK CULVERT
Your C.O.C. #: 782317-01-01

Attention: Mark Farrant

Thurber Engineering Ltd
2010 Winston Park Dr
Suite 103
Oakville, ON
CANADA L6H 5R7

Report Date: 2020/11/13
Report #: R6409774
Version: 2 - Revision

CERTIFICATE OF ANALYSIS – REVISED REPORT

BV LABS JOB #: C0L6330

Received: 2020/08/24, 10:40

Solid sample results, except biota, are based on dry weight unless otherwise indicated. Organic analyses are not recovery corrected except for isotope dilution methods.

Results relate to samples tested. When sampling is not conducted by BV Labs, results relate to the supplied samples tested.

This Certificate shall not be reproduced except in full, without the written approval of the laboratory.

Reference Method suffix "m" indicates test methods incorporate validated modifications from specific reference methods to improve performance.

* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.

(1) This test was performed by BVLabs Calgary via Mississauga

Encryption Key

Please direct all questions regarding this Certificate of Analysis to your Project Manager.

Antonella Brasil, Senior Project Manager

Email: Antonella.Brasil@bvlabs.com

Phone# (905)817-5817

=====

BV Labs has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per ISO/IEC 17025, signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

BUREAU
VERITASBV Labs Job #: COL6330
Report Date: 2020/11/13Thurber Engineering Ltd
Client Project #: 29181
Site Location: BAKER CREEK CULVERT**PWQO METALS AND INORGANICS (WATER)**

BV Labs ID			NLE502	NLE502		
Sampling Date			2020/08/21 13:30	2020/08/21 13:30		
COC Number			782317-01-01	782317-01-01		
	UNITS	Criteria	BAKER CREEK, 20-02	BAKER CREEK, 20-02 Lab-Dup	RDL	QC Batch
Calculated Parameters						
Hardness (CaCO ₃)	mg/L	-	83	N/A	1.0	6905748
Sulphide (as H ₂ S)	mg/L	0.002	0.0053	N/A	0.0020	6918194
Inorganics						
Total Ammonia-N	mg/L	-	13	N/A	0.050	6912563
Dissolved Oxygen	mg/L	-	0.820	0.800	N/A	6909534
pH	pH	6.5:8.5	6.73	N/A	N/A	6909103
Phenols-4AAP	mg/L	0.001	<0.0010	N/A	0.0010	6910166
Total Phosphorus	mg/L	0.01	0.18	N/A	0.02	6910791
Total Sulphide	mg/L	0.002	0.0050	N/A	0.0018	6918195
Turbidity	NTU	-	170	N/A	0.1	6909048
WAD Cyanide (Free)	ug/L	5	<1	<1	1	6910338
Alkalinity (Total as CaCO ₃)	mg/L	-	62	N/A	1.0	6909102
Metals						
Dissolved (0.2u) Aluminum (Al)	ug/L	15	59	N/A	5	6910907
Dissolved Calcium (Ca)	mg/L	-	24	N/A	0.050	6910917
Chromium (VI)	ug/L	1	<0.50	N/A	0.50	6910645
Dissolved Magnesium (Mg)	mg/L	-	5.6	N/A	0.050	6910917
Mercury (Hg)	ug/L	0.2	<0.10	N/A	0.10	6912601
Total Antimony (Sb)	ug/L	20	<0.50	N/A	0.50	6910169
Total Arsenic (As)	ug/L	100	<1.0	N/A	1.0	6910169
Total Beryllium (Be)	ug/L	11	<0.40	N/A	0.40	6910169
Total Boron (B)	ug/L	200	<10	N/A	10	6910169
Total Cadmium (Cd)	ug/L	0.2	<0.090	N/A	0.090	6910169
Total Chromium (Cr)	ug/L	-	<5.0	N/A	5.0	6910169
Total Cobalt (Co)	ug/L	0.9	<0.50	N/A	0.50	6910169
Total Copper (Cu)	ug/L	5	<0.90	N/A	0.90	6910169
Total Iron (Fe)	ug/L	300	6100	N/A	100	6910169
Total Lead (Pb)	ug/L	5	<0.50	N/A	0.50	6910169
Total Molybdenum (Mo)	ug/L	40	<0.50	N/A	0.50	6910169
Total Nickel (Ni)	ug/L	25	<1.0	N/A	1.0	6910169
RDL = Reportable Detection Limit QC Batch = Quality Control Batch Lab-Dup = Laboratory Initiated Duplicate Criteria: Ontario Provincial Water Quality Objectives Ref. to MOEE Water Management document dated Feb.1999 N/A = Not Applicable						



PWQO METALS AND INORGANICS (WATER)

BV Labs ID			NLE502	NLE502		
Sampling Date			2020/08/21 13:30	2020/08/21 13:30		
COC Number			782317-01-01	782317-01-01		
	UNITS	Criteria	BAKER CREEK, 20-02	BAKER CREEK, 20-02 Lab-Dup	RDL	QC Batch
Total Selenium (Se)	ug/L	100	<2.0	N/A	2.0	6910169
Total Silver (Ag)	ug/L	0.1	<0.090	N/A	0.090	6910169
Total Thallium (Tl)	ug/L	0.3	<0.050	N/A	0.050	6910169
Total Tungsten (W)	ug/L	30	<1.0	N/A	1.0	6910169
Total Uranium (U)	ug/L	5	<0.10	N/A	0.10	6910169
Total Vanadium (V)	ug/L	6	3.3	N/A	0.50	6910169
Total Zinc (Zn)	ug/L	30	5.0	N/A	5.0	6910169
Total Zirconium (Zr)	ug/L	4	<1.0	N/A	1.0	6910169
RDL = Reportable Detection Limit QC Batch = Quality Control Batch Lab-Dup = Laboratory Initiated Duplicate Criteria: Ontario Provincial Water Quality Objectives Ref. to MOEE Water Management document dated Feb.1999 N/A = Not Applicable						



BUREAU
VERITAS

BV Labs Job #: COL6330
Report Date: 2020/11/13

Thurber Engineering Ltd
Client Project #: 29181
Site Location: BAKER CREEK CULVERT

GENERAL COMMENTS

Each temperature is the average of up to three cooler temperatures taken at receipt

Package 1	10.7°C
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Revised Report (2020/11/13): PWQO Criteria included as per client request .

Results relate only to the items tested.



BUREAU
VERITAS

BV Labs Job #: COL6330
Report Date: 2020/11/13

Thurber Engineering Ltd
Client Project #: 29181
Site Location: BAKER CREEK CULVERT

QUALITY ASSURANCE REPORT

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
6909048	GTO	Spiked Blank	Turbidity	2020/08/26		109	%	85 - 115
6909048	GTO	Method Blank	Turbidity	2020/08/26	<0.1		NTU	
6909048	GTO	RPD	Turbidity	2020/08/26	NC		%	20
6909102	SAU	Spiked Blank	Alkalinity (Total as CaCO3)	2020/08/26		96	%	85 - 115
6909102	SAU	Method Blank	Alkalinity (Total as CaCO3)	2020/08/26	<1.0		mg/L	
6909102	SAU	RPD	Alkalinity (Total as CaCO3)	2020/08/26	0.17		%	20
6909103	SAU	Spiked Blank	pH	2020/08/26		101	%	98 - 103
6909103	SAU	RPD	pH	2020/08/26	0.12		%	N/A
6910166	BMO	Matrix Spike	Phenols-4AAP	2020/08/26		97	%	80 - 120
6910166	BMO	Spiked Blank	Phenols-4AAP	2020/08/26		98	%	80 - 120
6910166	BMO	Method Blank	Phenols-4AAP	2020/08/26	<0.0010		mg/L	
6910166	BMO	RPD	Phenols-4AAP	2020/08/26	NC		%	20
6910169	N_R	Matrix Spike	Total Antimony (Sb)	2020/08/26		103	%	80 - 120
			Total Arsenic (As)	2020/08/26		102	%	80 - 120
			Total Beryllium (Be)	2020/08/26		103	%	80 - 120
			Total Boron (B)	2020/08/26		99	%	80 - 120
			Total Cadmium (Cd)	2020/08/26		102	%	80 - 120
			Total Chromium (Cr)	2020/08/26		99	%	80 - 120
			Total Cobalt (Co)	2020/08/26		100	%	80 - 120
			Total Copper (Cu)	2020/08/26		101	%	80 - 120
			Total Iron (Fe)	2020/08/26		97	%	80 - 120
			Total Lead (Pb)	2020/08/26		99	%	80 - 120
			Total Molybdenum (Mo)	2020/08/26		101	%	80 - 120
			Total Nickel (Ni)	2020/08/26		95	%	80 - 120
			Total Selenium (Se)	2020/08/26		102	%	80 - 120
			Total Silver (Ag)	2020/08/26		95	%	80 - 120
			Total Thallium (Tl)	2020/08/26		98	%	80 - 120
			Total Tungsten (W)	2020/08/26		101	%	80 - 120
			Total Uranium (U)	2020/08/26		99	%	80 - 120
			Total Vanadium (V)	2020/08/26		101	%	80 - 120
			Total Zinc (Zn)	2020/08/26		100	%	80 - 120
			Total Zirconium (Zr)	2020/08/26		104	%	80 - 120
6910169	N_R	Spiked Blank	Total Antimony (Sb)	2020/08/26		100	%	80 - 120
			Total Arsenic (As)	2020/08/26		101	%	80 - 120
			Total Beryllium (Be)	2020/08/26		102	%	80 - 120
			Total Boron (B)	2020/08/26		98	%	80 - 120
			Total Cadmium (Cd)	2020/08/26		99	%	80 - 120
			Total Chromium (Cr)	2020/08/26		97	%	80 - 120
			Total Cobalt (Co)	2020/08/26		100	%	80 - 120
			Total Copper (Cu)	2020/08/26		101	%	80 - 120
			Total Iron (Fe)	2020/08/26		98	%	80 - 120
			Total Lead (Pb)	2020/08/26		98	%	80 - 120
			Total Molybdenum (Mo)	2020/08/26		98	%	80 - 120
			Total Nickel (Ni)	2020/08/26		98	%	80 - 120
			Total Selenium (Se)	2020/08/26		104	%	80 - 120
			Total Silver (Ag)	2020/08/26		95	%	80 - 120
			Total Thallium (Tl)	2020/08/26		97	%	80 - 120
			Total Tungsten (W)	2020/08/26		100	%	80 - 120
			Total Uranium (U)	2020/08/26		100	%	80 - 120
			Total Vanadium (V)	2020/08/26		100	%	80 - 120
			Total Zinc (Zn)	2020/08/26		105	%	80 - 120
			Total Zirconium (Zr)	2020/08/26		100	%	80 - 120



BUREAU
VERITAS

BV Labs Job #: COL6330
Report Date: 2020/11/13

Thurber Engineering Ltd
Client Project #: 29181
Site Location: BAKER CREEK CULVERT

QUALITY ASSURANCE REPORT(CONT'D)

QA/QC	Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
6910169	N_R	Method Blank	Total Antimony (Sb)	2020/08/26	<0.50		ug/L		
			Total Arsenic (As)	2020/08/26	<1.0		ug/L		
			Total Beryllium (Be)	2020/08/26	<0.40		ug/L		
			Total Boron (B)	2020/08/26	<10		ug/L		
			Total Cadmium (Cd)	2020/08/26	<0.090		ug/L		
			Total Chromium (Cr)	2020/08/26	<5.0		ug/L		
			Total Cobalt (Co)	2020/08/26	<0.50		ug/L		
			Total Copper (Cu)	2020/08/26	<0.90		ug/L		
			Total Iron (Fe)	2020/08/26	<100		ug/L		
			Total Lead (Pb)	2020/08/26	<0.50		ug/L		
			Total Molybdenum (Mo)	2020/08/26	<0.50		ug/L		
			Total Nickel (Ni)	2020/08/26	<1.0		ug/L		
			Total Selenium (Se)	2020/08/26	<2.0		ug/L		
			Total Silver (Ag)	2020/08/26	<0.090		ug/L		
			Total Thallium (Tl)	2020/08/26	<0.050		ug/L		
			Total Tungsten (W)	2020/08/26	<1.0		ug/L		
			Total Uranium (U)	2020/08/26	<0.10		ug/L		
			Total Vanadium (V)	2020/08/26	<0.50		ug/L		
			6910169	N_R	RPD	Total Zinc (Zn)	2020/08/26	<5.0	
Total Zirconium (Zr)	2020/08/26	<1.0					ug/L		
6910169	N_R	RPD	Total Iron (Fe)	2020/08/26	0.82		%	20	
6910338	LHA	Matrix Spike [NLE502-06]	WAD Cyanide (Free)	2020/08/26		102	%	80 - 120	
6910338	LHA	Spiked Blank	WAD Cyanide (Free)	2020/08/26		101	%	80 - 120	
6910338	LHA	Method Blank	WAD Cyanide (Free)	2020/08/26	<1		ug/L		
6910338	LHA	RPD [NLE502-06]	WAD Cyanide (Free)	2020/08/26	NC		%	20	
6910645	LLE	Matrix Spike	Chromium (VI)	2020/08/27		103	%	80 - 120	
6910645	LLE	Spiked Blank	Chromium (VI)	2020/08/27		103	%	80 - 120	
6910645	LLE	Method Blank	Chromium (VI)	2020/08/27	<0.50		ug/L		
6910645	LLE	RPD	Chromium (VI)	2020/08/27	NC		%	20	
6910791	SSV	Matrix Spike	Total Phosphorus	2020/08/27		95	%	80 - 120	
6910791	SSV	QC Standard	Total Phosphorus	2020/08/27		99	%	80 - 120	
6910791	SSV	Spiked Blank	Total Phosphorus	2020/08/27		97	%	80 - 120	
6910791	SSV	Method Blank	Total Phosphorus	2020/08/27	<0.004		mg/L		
6910791	SSV	RPD	Total Phosphorus	2020/08/27	NC		%	20	
6910907	ADA	Matrix Spike	Dissolved (0.2u) Aluminum (Al)	2020/08/27		103	%	80 - 120	
6910907	ADA	Spiked Blank	Dissolved (0.2u) Aluminum (Al)	2020/08/27		101	%	80 - 120	
6910907	ADA	Method Blank	Dissolved (0.2u) Aluminum (Al)	2020/08/27	<5		ug/L		
6910907	ADA	RPD	Dissolved (0.2u) Aluminum (Al)	2020/08/27	3.1		%	20	
6910917	SUK	Matrix Spike	Dissolved Calcium (Ca)	2020/08/27		NC	%	80 - 120	
			Dissolved Magnesium (Mg)	2020/08/27		95	%	80 - 120	
6910917	SUK	Spiked Blank	Dissolved Calcium (Ca)	2020/08/27		101	%	80 - 120	
			Dissolved Magnesium (Mg)	2020/08/27		97	%	80 - 120	
6910917	SUK	Method Blank	Dissolved Calcium (Ca)	2020/08/27	<0.050		mg/L		
			Dissolved Magnesium (Mg)	2020/08/27	<0.050		mg/L		
6912563	ASP	Matrix Spike	Total Ammonia-N	2020/08/27		100	%	75 - 125	
6912563	ASP	Spiked Blank	Total Ammonia-N	2020/08/27		101	%	80 - 120	
6912563	ASP	Method Blank	Total Ammonia-N	2020/08/27	<0.050		mg/L		
6912563	ASP	RPD	Total Ammonia-N	2020/08/27	1.0		%	20	
6912601	MPD	Matrix Spike	Mercury (Hg)	2020/08/27		92	%	75 - 125	
6912601	MPD	Spiked Blank	Mercury (Hg)	2020/08/27		92	%	80 - 120	
6912601	MPD	Method Blank	Mercury (Hg)	2020/08/27	<0.10		ug/L		
6912601	MPD	RPD	Mercury (Hg)	2020/08/27	NC		%	20	



BUREAU
VERITAS

BV Labs Job #: COL6330
Report Date: 2020/11/13

Thurber Engineering Ltd
Client Project #: 29181
Site Location: BAKER CREEK CULVERT

QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
6918195	éBS	Matrix Spike	Total Sulphide	2020/08/27		89	%	80 - 120
6918195	éBS	Spiked Blank	Total Sulphide	2020/08/27		83	%	80 - 120
6918195	éBS	Method Blank	Total Sulphide	2020/08/27	<0.0018		mg/L	
6918195	éBS	RPD	Total Sulphide	2020/08/27	NC		%	20

N/A = Not Applicable

Duplicate: Paired analysis of a separate portion of the same sample. Used to evaluate the variance in the measurement.

Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate sample matrix interference.

QC Standard: A sample of known concentration prepared by an external agency under stringent conditions. Used as an independent check of method accuracy.

Spiked Blank: A blank matrix sample to which a known amount of the analyte, usually from a second source, has been added. Used to evaluate method accuracy.

Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.

NC (Matrix Spike): The recovery in the matrix spike was not calculated. The relative difference between the concentration in the parent sample and the spike amount was too small to permit a reliable recovery calculation (matrix spike concentration was less than the native sample concentration)

NC (Duplicate RPD): The duplicate RPD was not calculated. The concentration in the sample and/or duplicate was too low to permit a reliable RPD calculation (absolute difference <= 2x RDL).



BUREAU
VERITAS

BV Labs Job #: COL6330
Report Date: 2020/11/13

Thurber Engineering Ltd
Client Project #: 29181
Site Location: BAKER CREEK CULVERT

VALIDATION SIGNATURE PAGE

The analytical data and all QC contained in this report were reviewed and validated by the following individual(s).

Anastassia Hamanov, Scientific Specialist

Maria Magdalena Florescu, Ph.D., P.Chem., QP, Inorganics Manager

BV Labs has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per ISO/IEC 17025, signing the reports. For Service Group specific validation please refer to the Validation Signature Page.



INVOICE TO:		REPORT TO:		PROJECT INFORMATION:		Laboratory Use Only:	
Company Name: #5843 Thurber Engineering Ltd	Company Name:	Quotation #: B90187	BV Labs Job #:	Bottle Order #:			
Attention: Mark Farrant	Attention: Same as Invoice	P.O. #:	782317				
Address: 2010 Winston Park Dr Suite 103 Oakville ON L6H 5R7	Address:	Project: 29181	COC #:	Project Manager:			
Tel: (905) 829-8666 Ext: 528 Fax: (905) 829-1166	Tel:	Project Name: Baker Creek Culvert	Antionella Brasil				
Email: mfarrant@thurber.ca	Email:	Site #: Greg Stanhope	C#782317-01-01				

MOE REGULATED DRINKING WATER OR WATER INTENDED FOR HUMAN CONSUMPTION MUST BE SUBMITTED ON THE BV LABS DRINKING WATER CHAIN OF CUSTODY						ANALYSIS REQUESTED (PLEASE BE SPECIFIC)										Turnaround Time (TAT) Required: Please provide advance notice for rush projects					
Regulation 153 (2011)			Other Regulations			Special Instructions	Field Filtered (please circle): Metals / Hg / Cr-VI	pH	Dissolved Al, Arsenic, Boron, Cadmium, Copper, Lead, Manganese, Mercury, Nickel, Selenium, Silver, Strontium, Vanadium, Zinc	Dissolved Oxygen	Free (unbound) cyanide	Total sulphide	Cr (VI) in water	Field Temp, total dissolved solids, unfiltered ammonia-N	Total ammonia-N	Total nitrogen analysis by IC/MS	Phenols (4AAP)	Regular (Standard) TAT: (will be applied if Rush TAT is not specified); Standard TAT = 5-7 Working days for most tests. Please note: Standard TAT for certain tests such as BOD and Dioxins/Furans are > 5 days - contact your Project Manager for details.		Job Specific Rush TAT (if applies to entire submission) Date Required: _____ Time Required: _____ Rush Confirmation Number: _____ (call lab for #)	
Table 1	Res/Park	Medium/Fine	CCME	Sanitary Sewer Bylaw														# of Bottles	Comments		
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>														4			
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>														2			
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>														2			
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>														2			
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>														2			
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>														2			
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<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>														2			
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>														2			

24-Aug-20 10:40
Antionella Brasil
COL6330
HGR ENV-1219

RELINQUISHED BY: (Signature/Print) Greg Stanhope	Date: (YY/MM/DD) Aug. 24, 2020	Time 10:30 AM	RECEIVED BY: (Signature/Print) [Signature]	Date: (YY/MM/DD) 20/08/24	Time 10:40	# jars used and not submitted	Laboratory Use Only			
Time Sensitive		Temperature (°C) on Receipt 10/11/11	Custody Seal Present Intact	Yes	No					

* UNLESS OTHERWISE AGREED TO IN WRITING, WORK SUBMITTED ON THIS CHAIN OF CUSTODY IS SUBJECT TO BV LABS' STANDARD TERMS AND CONDITIONS. SIGNING OF THIS CHAIN OF CUSTODY DOCUMENT IS ACKNOWLEDGMENT AND ACCEPTANCE OF OUR TERMS WHICH ARE AVAILABLE FOR VIEWING AT WWW.BVLABS.COM/TERMS-AND-CONDITIONS.
 ** SAMPLE CONTAINER, PRESERVATION, HOLD TIME AND PACKAGE INFORMATION CAN BE VIEWED AT WWW.BVLABS.COM/RESOURCES/CHAIN-OF-CUSTODY-FORMS.
 SAMPLES MUST BE KEPT COOL (< 10° C) FROM TIME OF SAMPLING UNTIL DELIVERY TO BV LABS
 White: BV Labs Yellow: Client



BUREAU
VERITAS

BV Labs Job #: COL6330
Report Date: 2020/11/13

Thurber Engineering Ltd
Client Project #: 29181
Site Location: BAKER CREEK CULVERT

Exceedance Summary Table – Prov. Water Quality Obj.

Result Exceedances

Sample ID	BV Labs ID	Parameter	Criteria	Result	DL	UNITS
BAKER CREEK, 20-02	NLE502-01	Dissolved (0.2u) Aluminum (Al)	15	59	5	ug/L
BAKER CREEK, 20-02	NLE502-02	Total Iron (Fe)	300	6100	100	ug/L
BAKER CREEK, 20-02	NLE502-08	Total Phosphorus	0.01	0.18	0.02	mg/L
BAKER CREEK, 20-02	NLE502-04	Total Sulphide	0.002	0.0050	0.0018	mg/L
BAKER CREEK, 20-02	NLE502-04	Sulphide (as H2S)	0.002	0.0053	0.0020	mg/L

The exceedance summary table is for information purposes only and should not be considered a comprehensive listing or statement of conformance to applicable regulatory guidelines.



Appendix C

Site Photographs



Figure 1: Looking east at east approach on Highway 17 (August 2020)



Figure 2: Looking west at west approach on Highway 17 (August 2020)



Figure 3: Upstream of Baker Creek from top of culvert inlet (August 2020)



Figure 3: Downstream of Baker Creek from top of culvert outlet (August 2020)



Figure 5: Looking northeast at culvert inlet (August 2020)



Figure 6: Looking east at culvert outlet (August 2020)



Figure 7: Looking east along north slope of Highway 17 embankment (August 2020)

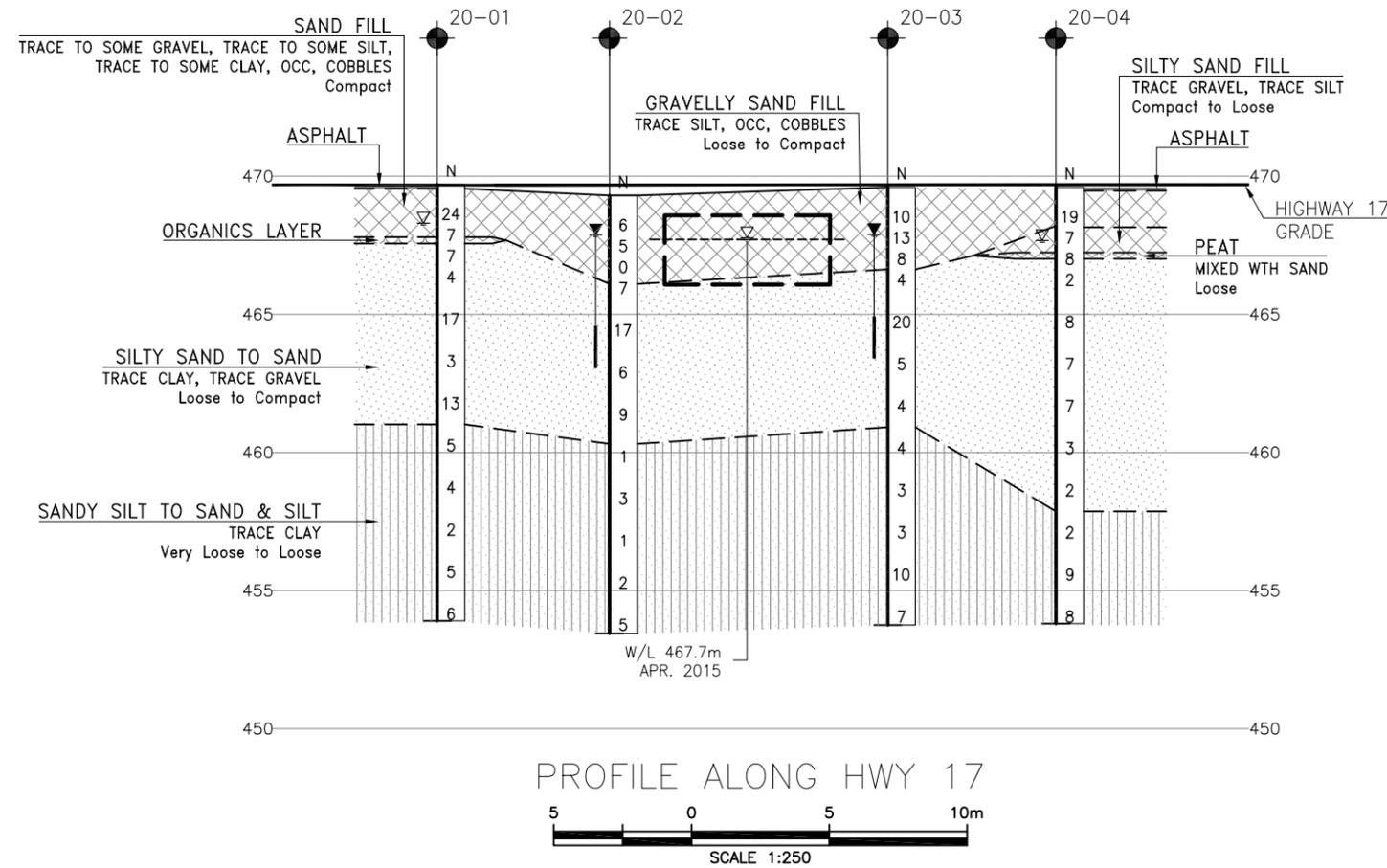
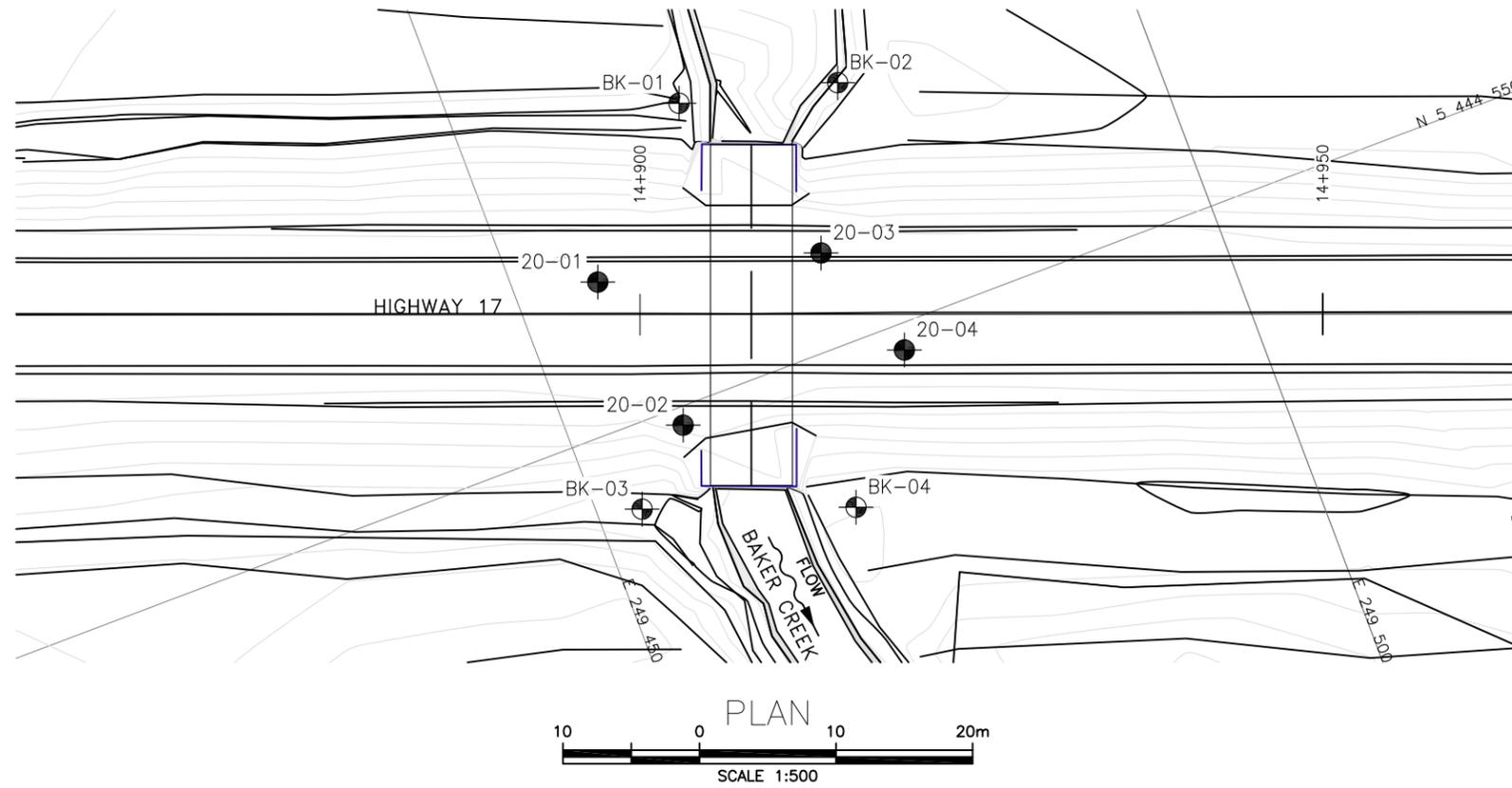


Figure 8: Looking east along south slope of Highway 17 embankment (August 2020)



Appendix D

Borehole Locations and Soil Strata Drawing



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



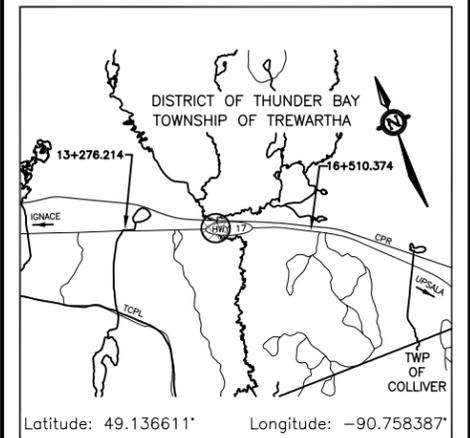
CONT No
WP No 6336-14-00

HIGHWAY 17
BAKER CREEK
CULVERT REPLACEMENT
BOREHOLE LOCATIONS AND SOIL STRATA



SHEET

HATCH



LEGEND

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

NO	ELEVATION	NORTHING	EASTING
20-01	469.7	5 444 560.7	249 456.0
20-02	469.3	5 444 548.7	249 458.2
20-03	469.6	5 444 556.9	249 472.1
20-04	469.6	5 444 548.1	249 475.3
BK-01	468.3	5 444 570.8	249 466.2
BK-02	467.8	5 444 568.1	249 477.6
BK-03	468.2	5 444 544.0	249 453.2
BK-04	468.3	5 444 538.6	249 467.9

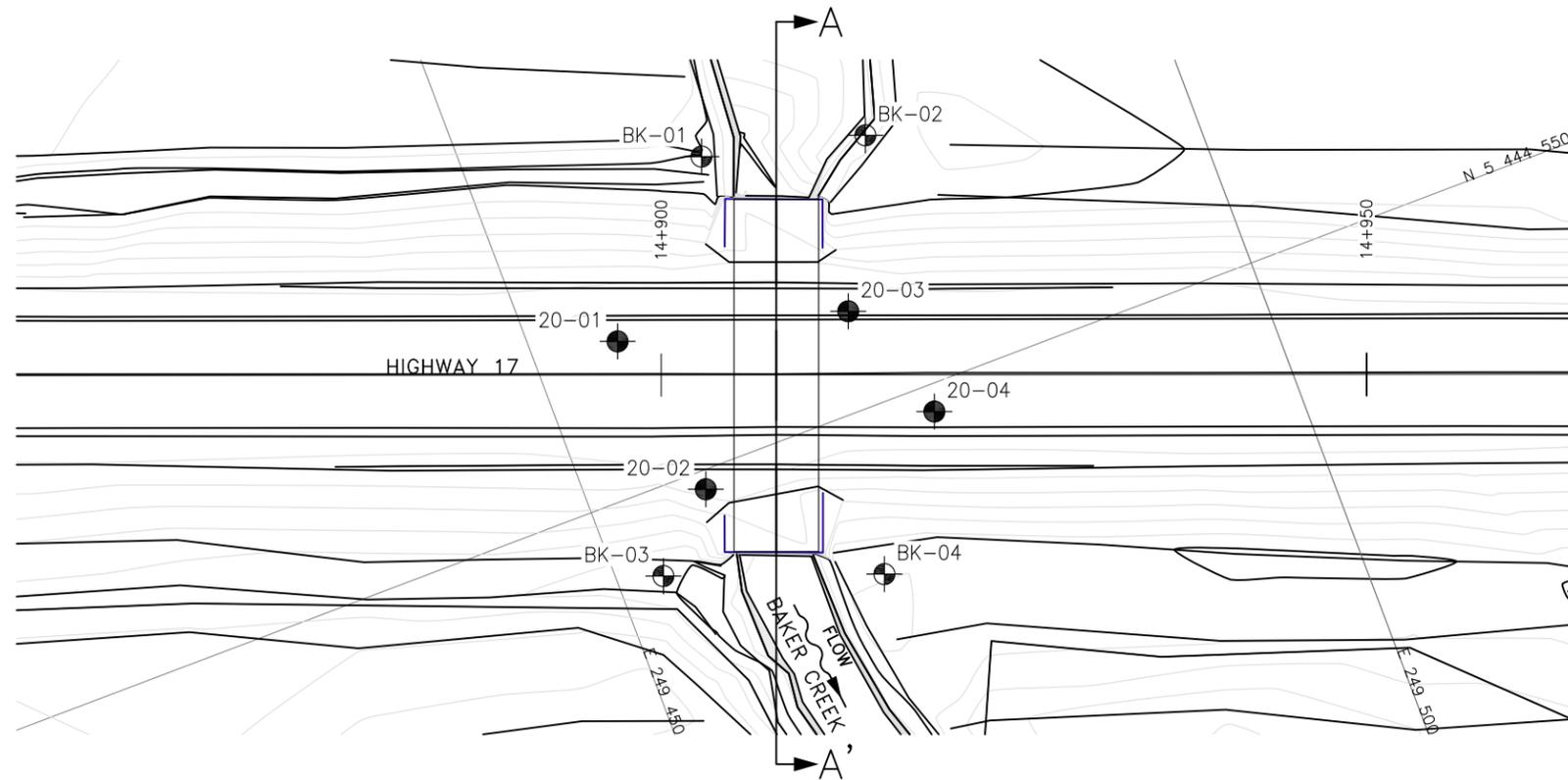
-NOTES-

- 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.

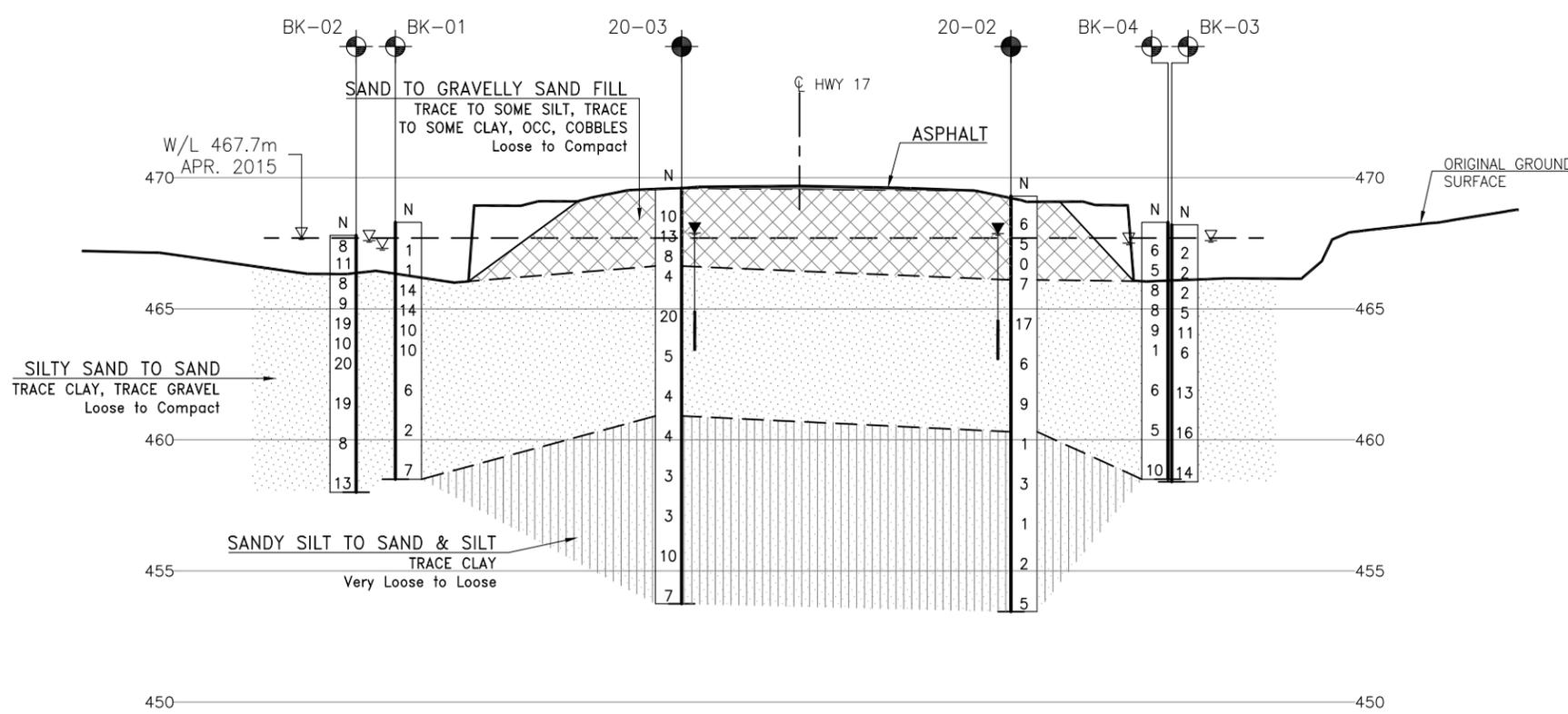
GEOCRES No. 40P8-274

REVISIONS	DATE	BY	DESCRIPTION

DESIGN	CHK	MEF	CODE	LOAD	DATE	FEB 2021
JM	AN	JK	SITE	STRUCT	DWG	1



PLAN
SCALE 1:500



PROFILE ALONG A-A'
SCALE 1:250

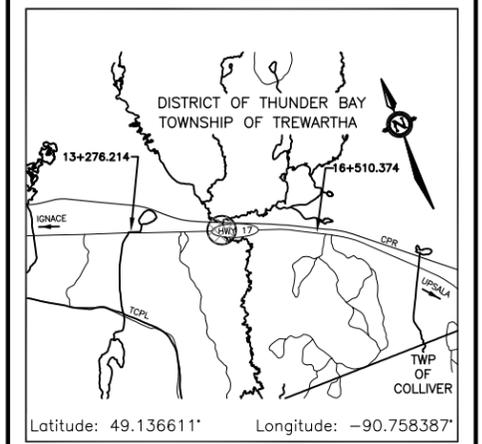
METRIC
DIMENSIONS ARE IN METRES
AND/OR MILLIMETRES
UNLESS OTHERWISE SHOWN



CONT No
WP No 6336-14-00

HIGHWAY 17
BAKER CREEK
CULVERT REPLACEMENT
BOREHOLE LOCATIONS AND SOIL STRATA

SHEET



KEYPLAN

LEGEND

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

NO	ELEVATION	NORTHING	EASTING
20-01	469.7	5 444 560.7	249 456.0
20-02	469.3	5 444 548.7	249 458.2
20-03	469.6	5 444 556.9	249 472.1
20-04	469.6	5 444 548.1	249 475.3
BK-01	468.3	5 444 570.8	249 466.2
BK-02	467.8	5 444 568.1	249 477.6
BK-03	468.2	5 444 544.0	249 453.2
BK-04	468.3	5 444 538.6	249 467.9

-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. 40P8-274

REVISIONS	DATE	BY	DESCRIPTION

DESIGN	CHK	MEF	CODE	LOAD	DATE	FEB 2021
JM	AN	JK	SITE	STRUCT	DWG 2	



Appendix E

Record of Borehole Sheets and Laboratory Test Results (Previous Investigation)

PROJECT <u>1533879</u>	RECORD OF BOREHOLE No BK-1	1 OF 1 METRIC
G.W.P. <u>6336-14-00</u>	LOCATION <u>N 5444570.8; E 249466.2</u>	ORIGINATED BY <u>SA</u>
DIST <u> </u> HWY <u>17</u>	BOREHOLE TYPE <u>NW Casing and Wash Boring</u>	COMPILED BY <u>AC</u>
DATUM <u>GEODETIC</u>	DATE <u>January 29 and 30, 2016</u>	CHECKED BY <u>DAM</u>

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC NATURAL LIQUID LIMIT			UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	NUMBER	TYPE	"N" VALUES			20	40	60	80	100	W _p	W	W _L		
468.3	GROUND SURFACE															
0.0	SNOW / ICE (500 mm)															
467.8																
0.5	SILT and SAND to SAND, some silt, trace clay Very loose to compact Brown to grey Wet Trace organics encountered in Sample 1.	1	SS	1	▽											
		2	SS	1												
		3	SS	14												
		4	SS	14												
		5	SS	10												
	Approximately 0.1 m of heave below 4.6 m depth.	6	SS	10												0 80 (20)
		7	SS	6												
		8	SS	2												
		9	SS	7												0 67 32 1
458.5	END OF BOREHOLE															
9.8	Note: 1. Water level at a depth of 1.0 m below ground surface (Elev. 467.3 m) upon completion of drilling.															

SUD-MTO 001 1533879.GPJ GAL=MISS.GDT 08/08/16 DATA INPUT:

+³, ×³: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

PROJECT <u>1533879</u>	RECORD OF BOREHOLE No BK-2		1 OF 1 METRIC
G.W.P. <u>6336-14-00</u>	LOCATION <u>N 5444568.1; E 249477.6</u>	ORIGINATED BY <u>SA</u>	
DIST <u> </u> HWY <u>17</u>	BOREHOLE TYPE <u>HW and NW Casing and Wash Boring</u>	COMPILED BY <u>AC</u>	
DATUM <u>GEODETIC</u>	DATE <u>January 28, 2016</u>	CHECKED BY <u>DAM</u>	

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	20	40	60	80					
467.8	GROUND SURFACE															
0.0	ICE (200 mm)															
0.2	SILTY SAND to SAND, trace gravel Loose to compact Brown to grey Wet Trace organics in Sample 1.		1	SS	8											
			2	SS	11											
			3	SS	8											0 99 (1)
			4	SS	9											
			5	SS	19											
			6	SS	10											1 86 (13)
			7	SS	20											
			8	SS	19											
	Approximately 0.2 m of heave at 6.1 m depth.		9	SS	8											0 77 (23)
			10	SS	13											
458.0	END OF BOREHOLE															
9.8	Note: 1. Water level at a depth of 0.2 m below ground surface (Elev. 467.6 m) upon completion of drilling.															

SUD-MTO 001 1533879.GPJ GAL=MISS.GDT 08/08/16 DATA INPUT:

+³, ×³: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

PROJECT <u>1533879</u>	RECORD OF BOREHOLE No BK-3	1 OF 1 METRIC
G.W.P. <u>6336-14-00</u>	LOCATION <u>N 5444544.0; E 249453.2</u>	ORIGINATED BY <u>MR</u>
DIST <u> </u> HWY <u>17</u>	BOREHOLE TYPE <u>108 mm I.D. Hollow Stem Augers</u>	COMPILED BY <u>AC</u>
DATUM <u>GEODETIC</u>	DATE <u>January 20, 2016</u>	CHECKED BY <u>DAM</u>

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								
						20 40 60 80 100	20 40 60 80 100	20 40 60								
468.2 0.0	GROUND SURFACE PEAT (Amorphous) Very soft Black Wet		1	AS	-											
466.8 1.4	ORGANIC SAND, trace to some silt, trace gravel, trace wood Very loose Dark brown to black Wet		2	SS	2											
466.0 2.2	SAND, trace to some silt Very loose to compact Grey Wet Approximately 0.6 m to 0.8 m of heave below 3.0 m depth.		3	SS	2											
			4	SS	2											
			5	SS	5											
			6	SS	11											
			7	SS	6											
			8	SS	13											
			9	SS	16											
			10	SS	14											
458.4 9.8	END OF BOREHOLE Note: 1. Water level at a depth of 0.6 m below ground surface (Elev. 467.6 m) upon completion of drilling.															

SUD-MTO 001 1533879.GPJ GAL=MISS.GDT 08/08/16 DATA INPUT:

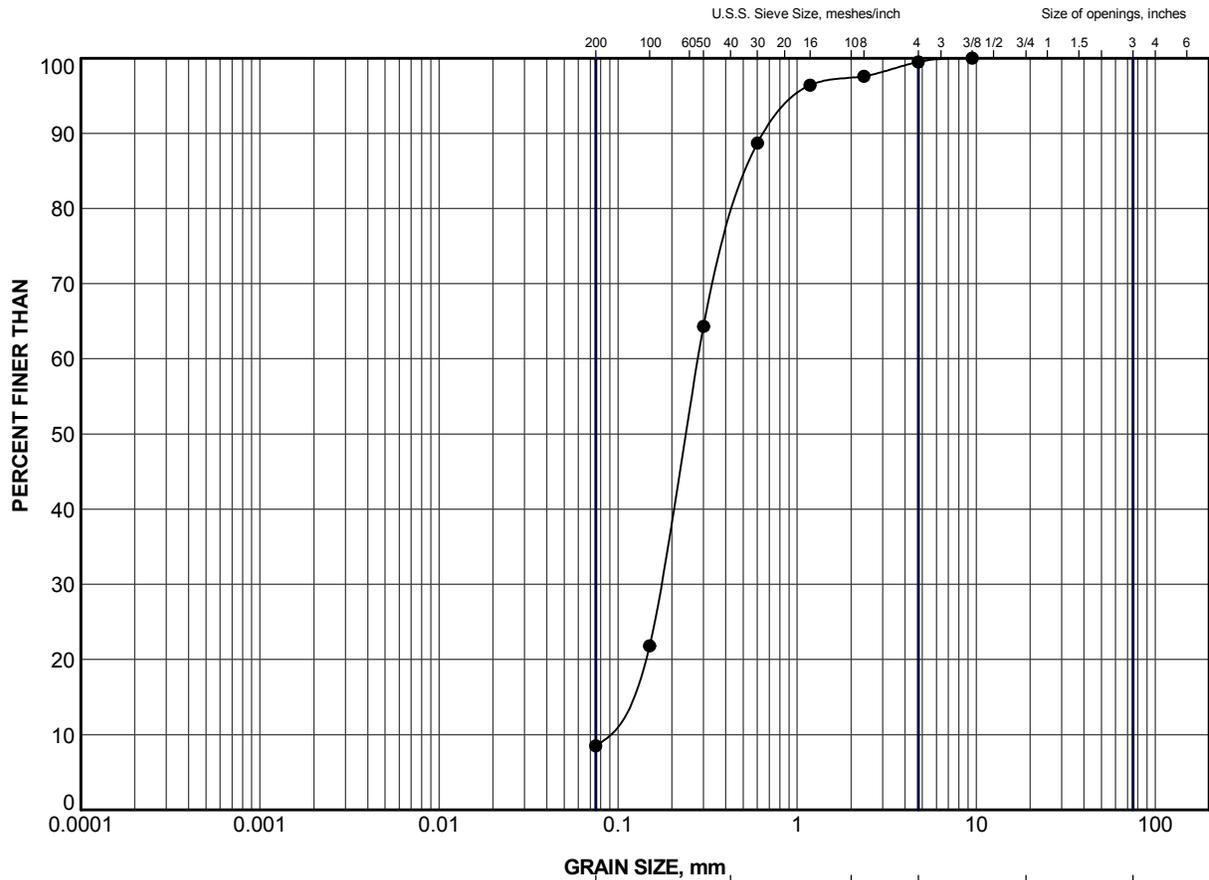
+³, X³: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

PROJECT <u>1533879</u>	RECORD OF BOREHOLE No BK-4	1 OF 1 METRIC
G.W.P. <u>6336-14-00</u>	LOCATION <u>N 5444538.6; E 249467.9</u>	ORIGINATED BY <u>MR</u>
DIST <u> </u> HWY <u>17</u>	BOREHOLE TYPE <u>108 mm I.D. Hollow Stem Augers</u>	COMPILED BY <u>AC</u>
DATUM <u>GEODETIC</u>	DATE <u>January 19, 2016</u>	CHECKED BY <u>DAM</u>

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC NATURAL LIQUID LIMIT MOISTURE LIMIT CONTENT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa					W _p	W			W _L	WATER CONTENT (%)	GR	SA
468.3	GROUND SURFACE																			
0.0	Sandy PEAT (Amorphous), some silt Brown Frozen*	[Pattern]	1	AS	-															
467.6	0.7					∇														
	SAND, trace to some silt, trace gravel Very loose to compact Brown to grey Wet	[Pattern]	2	SS	6								o							1 92 (7)
	Trace organics encountered in Sample 2.	[Pattern]	3	SS	5															
	Approximately 0.2 m to 1.4 m of heave below 2.3 m depth.	[Pattern]	4	SS	8															
		[Pattern]	5	SS	8								o							0 98 (2)
		[Pattern]	6	SS	9															
		[Pattern]	7	SS	1															
		[Pattern]	8	SS	6															
		[Pattern]	9	SS	5								o							0 94 (6)
		[Pattern]	10	SS	10															
458.5	9.8																			
	END OF BOREHOLE																			
	Note: 1. Water level at a depth of 0.8 m below ground surface (Elev. 467.5 m) upon completion of drilling.																			

SUD-MTO 001 1533879.GPJ GAL=MISS.GDT 08/08/16 DATA INPUT:

+³, ×³: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE



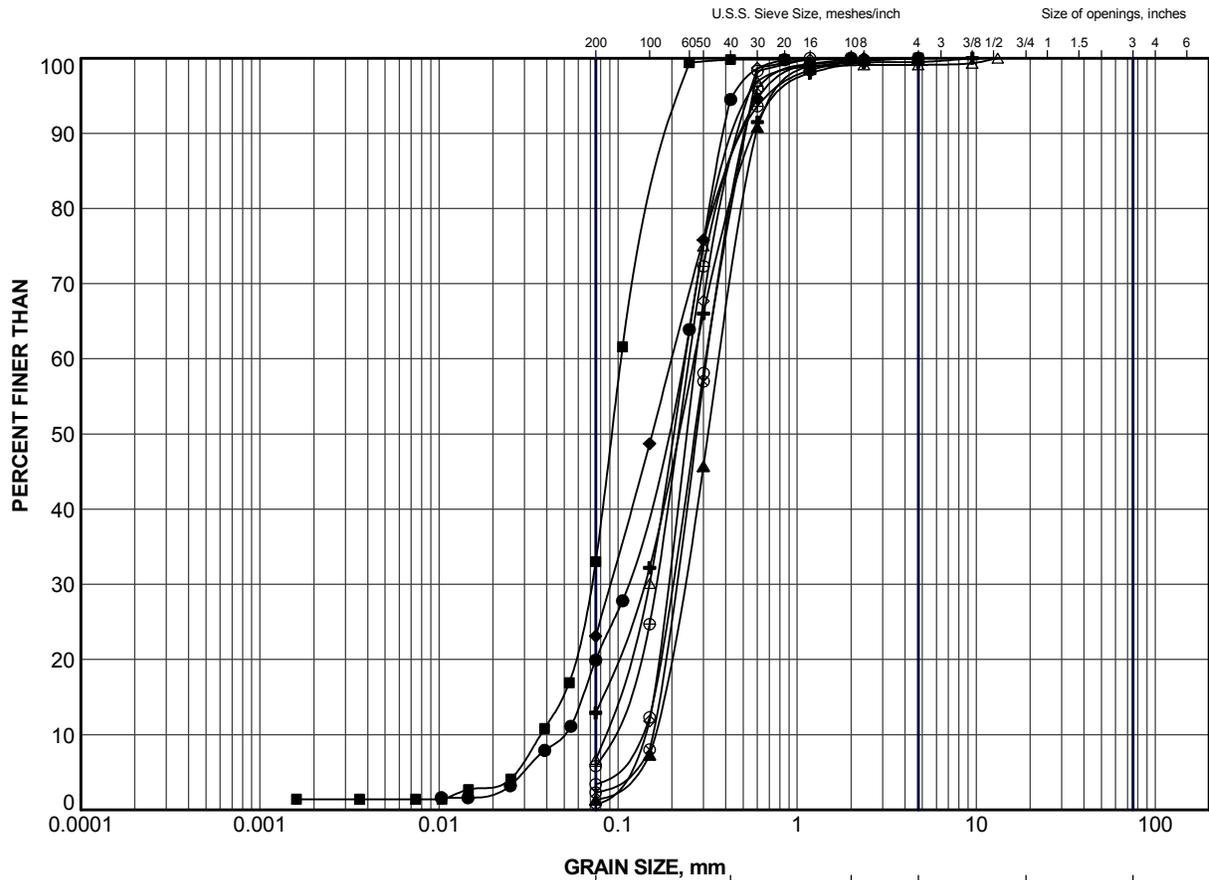
CLAY AND SILT	fine	medium	coarse	fine	coarse	Cobble Size
	SAND SIZE			GRAVEL SIZE		

LEGEND			
SYMBOL	BOREHOLE	SAMPLE	ELEV (m)
●	BK-3	3	466.4

PROJECT						HIGHWAY 17 BAKER CREEK CULVERT STA 14+907					
TITLE						GRAIN SIZE DISTRIBUTION SAND					
PROJECT No.			1533879			FILE No.			1533879.GPJ		
DRAWN	JJL	Aug 2016	SCALE	N/A	REV.	FIGURE C1					
CHECK	DAM	Aug 2016									
APPR	JMAC	Aug 2016									



SUD-MTO GSD (2016) GLDR_LDN.GDT



CLAY AND SILT	fine	medium	coarse	fine	coarse	Cobble Size
	SAND SIZE			GRAVEL SIZE		

LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEV (m)
●	BK-1	5	464.2
■	BK-1	9	458.8
▲	BK-2	3	466.0
+	BK-2	6	463.7
◆	BK-2	9	459.9
◇	BK-3	7	463.3
○	BK-3	9	460.3
△	BK-4	2	467.2
⊗	BK-4	5	464.9
⊕	BK-4	9	460.4

PROJECT HIGHWAY 17 BAKER CREEK CULVERT STA 14+907					
TITLE GRAIN SIZE DISTRIBUTION SILT and SAND to SAND					
PROJECT No.		1533879		FILE No.	1533879.GPJ
DRAWN	JJL	Aug 2016	SCALE	N/A	REV.
CHECK	DAM	Aug 2016	FIGURE C2		
APPR	JMAC	Aug 2016			



SUD-MTO GSD (2016) GLDR_LDN.GDT