



THURBER ENGINEERING LTD.

**FOUNDATION INVESTIGATION REPORT
CAMERON CREEK CULVERT REPLACEMENT
HIGHWAY 11, DISTRICT OF RAINY RIVER, ONTARIO
AGREEMENT 6019-E-0009, WORK ORDER 35
G.W.P. 6120-17-00, SITE NO. 45X-0160/C0
LATITUDE: 48.678411°, LONGITUDE: -94.140064°**

GEOCRES No.: 52D-37

Report

to

HATCH

Date: January 18, 2023
File: 33309



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1. INTRODUCTION

This report presents the factual data obtained from a foundation investigation carried out by Thurber Engineering Ltd. for the design of the proposed Cameron Creek Culvert replacement. The Cameron Creek Culvert is located on Highway 11, within the Morley Township, District of Rainy River, Ontario. The site is approximately 1.7 km east of Highway 617 in Stratton, 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, under the Ministry of Transportation Ontario (MTO) Retainer Agreement Number 6019-E-0009, Work Order 35.

It is a condition of this report that Thurber's performance of its professional services is subject to the attached Statement of Limitations and Conditions.

2. SITE DESCRIPTION

The Cameron Creek Culvert is located on Highway 11, between Sharp Road and Oster Road, near Stratton, Ontario. The existing culvert allows Cameron Creek to flow in a north to south direction under Highway 11. Highway 11 generally runs in an east-west direction at the culvert site.

The General Arrangement drawings provided by Hatch indicate that the existing structure is a closed bottom, concrete box culvert, with a span of 6.1 m, opening height of 1.8 m, and length 19.7 m. The estimated culvert invert (bottom of pipe) is at approximate Elev. 334.8 m at the inlet (north) and 334.7 m at the outlet (south). The existing road grade at the culvert location is at



approximate Elev. 338.31 m, which indicates approximately 1.3 m of fill above the top slab of the culvert. The local creek water level was reportedly measured at Elev. 334.9 m on July 17, 2018.

The site topography near the culvert area is generally flat along Highway 11 on both sides of Cameron Creek. The existing highway embankment side slopes are inclined at approximately 1H:1V or steeper at the ends of the culvert, and 2H:1V or flatter beyond the culvert.

The lands surrounding the site predominantly consist of agricultural areas with some residences near Highway 11 with localized, partially forested terrain along the creek. A railway corridor running in a general east-west direction exists approximately 130 m north of the culvert site. Photographs in Appendix C show the general nature of the site and the existing culvert.

Based on published geological information, the culvert lies within an area consisting of Glaciolacustrine deposits of silt and clay with minor sand, overlying Precambrian bedrock. Based on the OGS Map MRD126-REV1 titled "Bedrock Geology of Ontario", dated 2011, the bedrock at site is identified as a metamorphosed tonalite to granodiorite, and mafic to intermediate metavolcanic rocks.

3. INVESTIGATION PROCEDURES

The site investigation and field-testing program for this project was carried out in two phases, from May 3 to 5, 2022 and from August 26 to 28, 2022. The investigation consisted of drilling and sampling five (5) boreholes (22-01 to 22-05) to depths of 12.8 to 16.3 m below ground surface (Elev. 321.9 m to 323.9 m). Boreholes 22-03 to 22-05 were drilled through the paved portion of Highway 11. Boreholes 22-01 and 22-02 were drilled off road, near the culvert inlet and outlet.

The Record of Borehole sheets are included in Appendix A. The approximate locations of the boreholes are shown on the Borehole Locations and Soil Strata Drawings included in Appendix D.

Utility clearances were obtained prior to the start of drilling. The ground surface elevations for the boreholes were estimated from field measurements relative to existing site features and the topographic drawings provided to Thurber by Hatch. The coordinate system MTM NAD 83, Zone 16 was used for the boreholes.

Boreholes 22-01 and 22-02 were advanced using a Simco Track mounted, limited access drill rig, using solid stem augers. Boreholes 22-03 to 22-05 were advanced using a rubber-tired CME 750 drill rig, using solid stem augers and NW casing / Tricone 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). Field vane shear testing, typically using an MTO “N” sized shear vane was carried out in the cohesive soils.

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.

A monitoring well was installed in Borehole 22-01. The well consisted of 50 mm Schedule 40 PVC pipe with a 3.0 m long slotted screen, enclosed in a column of filter sand to permit groundwater level monitoring. Well installation details, groundwater level observations and water level readings are shown on the Record of Borehole sheets.

A sample of the groundwater was obtained from the well during the field investigation and submitted to a specialist analytical laboratory under chain of custody procedures for testing for a suite of water quality parameters. A single well response test (“slug test”) was also carried out in the well. Upon collection of the final water level readings on August 28, 2022, the well was decommissioned in general accordance with MECP O.Reg. 903.

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

Table 3.1: Borehole Completion Details

Borehole Number	Borehole Depth / Base Elevation (m)	Monitoring Well Tip Depth / Elevation (m)	Completion Details
22-01	12.8 / 323.5	12.0 / 324.2	50mm diameter Schedule 40 PVC pipe with a 3.05m slotted screen monitoring well installed at 12.0 m depth. Filter sand from 12.8 m to 7.8 m, bentonite to surface with 0.17 m stick up. Monitoring well removed August 28, 2022, borehole backfilled with bentonite to surface.
22-02	12.8 / 323.9	None installed	Borehole was backfilled with bentonite holeplug from 12.8 m to surface.

Borehole Number	Borehole Depth / Base Elevation (m)	Monitoring Well Tip Depth / Elevation (m)	Completion Details
22-03	16.3 / 322.0	None installed	Borehole backfilled with bentonite holeplug from 16.3 to 1.2 m, concrete from 1.2 m to 0.2 m, and asphalt to surface.
22-04	16.3 / 321.9	None installed	Borehole backfilled with bentonite holeplug from 16.3 to 1.2 m, concrete from 1.2 m to 0.2 m, and asphalt to surface.
22-05	15.8 / 322.5	None installed	Borehole backfilled with bentonite holeplug from 15.8 to 1.2 m, concrete from 1.2 m to 0.2 m, and asphalt 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) for 25% of the collected samples. 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, two (2) samples of the soil and one sample of surface water were collected during the investigation and submitted to SGS, a CALA accredited analytical laboratory in Lakefield, Ontario, for analytical testing of soil corrosivity parameters. In order to assess the quality of the groundwater for disposal purposes, a groundwater sample from Borehole 22-01 and a surface water sample from the creek were collected. 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 included in Appendix A. 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 gravelly sand to gravel and sand fill, overlying silty clay fill. The fill is underlain by native sandy, silty clay. More detailed descriptions of individual strata are presented below.

5.1 Asphalt

Boreholes 22-03, 22-04, and 22-05 were drilled through the paved portion of Highway 11. The asphalt thickness was 150 mm in all three boreholes.

5.2 Granular Fill

Granular embankment fill was encountered below the pavement in Boreholes 22-03, 22-04, and 22-05. The fill was described as brown and ranged in composition from gravelly sand to sand and gravel with some silt. The granular fill was encountered from the bottom of asphalt at 0.15 m depth and extended to depths ranging from 1.8 to 3.2 m (Elev. 336.5 to 335.1 m) across all road boreholes. The approximate thickness of the granular fill ranged from 1.6 to 3.0 m.

SPT 'N' values in the granular fill ranged from 8 to 88 blows per 0.3 m of penetration, indicating a loose to very dense relative density; typically compact to very dense. The measured moisture content for the granular fill ranged from 2 to 15%.

The results of grain size analyses conducted on three selected samples of the granular fill are provided on the Record of Borehole sheets in Appendix A and plotted in Figure B1 of Appendix B. The results are summarized in Table 3.1 below.

Table 5.1: Granular Fill Grain Size Analysis

Soil Particle	Percentage (%)
Gravel	27 to 42
Sand	44 to 61
Silt and Clay	12 to 15



5.3 Silty Clay Fill

Silty clay fill was encountered below the granular fill in Boreholes 22-03 and 22-05 at depths of 3.2 and 1.8 m (Elev. 335.1 and 336.5 m) respectively. The silty clay fill extended to depths of 4.1 m in both boreholes (Elev. 334.2 m). The thickness of the silty clay fill ranged from 0.9 to 2.3 m. The silty clay was described as grey and contained trace sand and gravel.

SPT 'N' values in the silty clay fill ranged from 4 to 11 blows per 0.3 m of penetration, indicating a soft to stiff relative density. Measured moisture contents ranged from 28 to 50%.

One grain size analysis and one Atterberg limit test was conducted the silty clay fill. The results of the grain size analysis indicate the soil was composed of 0% gravel, 1% sand, 34% silt, and 65% clay sized particles. The results of the Atterberg Limits test indicates the Liquid Limit is 80%, the Plastic Limit is 28%, and the Plastic Index is 52%, indicating a soil type of high plasticity (CH). The results of the grain size analysis and the Atterberg Limit analysis are provided on the Record of Borehole sheets in Appendix A and plotted in Figure B2 and B5 of Appendix B, respectively.

5.4 Topsoil

Topsoil was observed at the ground surface in Boreholes 22-01 and 22-02. Topsoil thicknesses were 225 mm and 50 mm respectively. The soil was described as black and moist. The topsoil thickness may vary in other areas of the site.

5.5 Silty Clay

Silty clay was encountered below the fill or topsoil in all boreholes. The silty clay was encountered below the topsoil at the off-road boreholes (22-01 and 22-02) at depths from 0.05 to 0.2 m (Elev. 336.7 to 336.1 m). In the on-road boreholes (22-03, 22-04, and 22-05) the silty clay was encountered below the granular or silty clay fill at depths ranging from 3.0 to 4.1 m (Elev. 335.2 to 334.2 m). All boreholes were terminated within the silty clay. The termination depths ranged from 12.8 m to 16.3 m (Elevation 323.9 to 321.9 m)

The silty clay was generally sandy, contained trace gravel and ranged in colour from brown to grey. In Borehole 22-01, the upper 0.5 m of the silty clay was observed to include occasional organics. SPT 'N' Values in the silty clay ranged from 3 to 21 per 0.3 m penetration, and field vane shear tests measured undrained shear strengths ranging from 64 to 105 kPa. The SPT 'N' values and undrained shear strength values indicate that the clay has a soft to very stiff consistency (typically stiff to very stiff).



Recorded moisture contents in the silty clay typically ranged from 18 to 32%, with localized moisture content measurements ranging from 12% to 48% in Borehole 22-04. The results of grain size analyses conducted on 11 samples of the silty clay deposit are provided on the Record of Borehole sheets in Appendix A and plotted in Figures B3 and B4 of Appendix B. The results are summarized in Table 5.2 below.

Table 5.2: Silty Clay Grain Size Analysis

Soil Particle	Percentage (%)
Gravel	0 to 6
Sand	15 to 33
Silt	34 to 45
Clay	24 to 51

The results of Atterberg Limits tests conducted on nine samples of the silty clay deposit are provided on the Record of Borehole sheets in Appendix A and plotted in Figures B6 and B7 of Appendix B. the results are summarized in Table 5.3 below.

Table 5.3: Silty Clay Atterberg Limits Test Results

Parameter	Result
Liquid Limit	26 to 48
Plastic Limit	13 to 18
Plasticity Index	13 to 30

The results indicate that the silty clay has low to intermediate plasticity, with group symbols of CL to CI.

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 well installed in Borehole 22-01. The measured groundwater levels are summarized in Table 5.4 below. The monitoring well was decommissioned on August 28, 2022 following final water level readings and slug testing.

Table 5.4: Groundwater Measurements

Borehole	Date	Water Level (m)		Remark
		Depth	Elevation	
22-01	August 27, 2022	11.6	324.7	In monitoring well.
	August 27, 2022	11.3	324.9	
	August 27, 2022	11.1	325.2	
	August 28, 2022	10.7	325.6	
22-02	August 28, 2022	11.0	325.7	Open borehole.
22-03	May 3, 2022	5.1	333.2	Open borehole.
22-04	May 4, 2022	1.8	336.4	Open borehole (inside drill casing).
22-05	May 4, 2022	1.7	336.6	Open borehole (inside drill casing).

Due to the short duration of the field investigation, it is anticipated that sufficient time was not available for infiltration of groundwater into the open boreholes and monitoring well, given the presence of relatively low permeability silty clay subsurface soils. Therefore, the water level measurements recorded may not represent the stabilized groundwater level.

The groundwater level is likely to reflect the local river water level. The surface water level of Cameron Creek was reportedly measured at Elev. 334.9 m in July 2018.

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 native silty clay and the gravelly sand fill from Boreholes 22-02 and 22-03 and a sample of surface water taken from the Cameron Creek were submitted for analytical testing of corrosivity parameters and sulphate. The laboratory certificates of analysis for the current investigation are presented in Appendix B. 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		
			22-02 SS1 (0' – 2')	22-03 SS4 (7'6" – 9'6")	Cameron Creek
			Native Silty Clay	Gravelly Sand Fill	Surface Water
Redox Potential	mV	mV	279	230	214
Sulphide	%	N/A	< 0.04	< 0.04	---
pH	-	-	8.28	8.88	7.98
Chloride	µg/g	mg/L	< 10↑	99	2.0
Sulphate	µg/g	mg/L	30	24	1.3
Conductivity	µS/cm	µS/cm	150	278	433
Resistivity	ohm-cm	ohm-cm	6670	3600	2309*

↑ Indicates that standard reporting limit was raised by laboratory

* Calculated by Thurber based on conductivity result

7. WATER QUALITY

For assessment of the general groundwater quality at the site, a sample of the groundwater from the monitoring well at Borehole 22-01, and a surface water sample from the creek were collected on August 28, 2022. The water samples were analyzed for selected inorganic parameters included in the Ontario Provincial Water Quality Objectives (PWQO), as well as Total Suspended Solids. Filtered sub-samples of the groundwater and surface water were also tested for dissolved metal parameters for comparison purposes. 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. All parameters shown in Table 7.1 are from the unfiltered sample, representing total concentrations. No dissolved parameter concentrations (filtered sub-samples) exceeded the PWQO criteria. The Total Suspended Solids concentration for surface water was 4 mg/L and was 23,100 mg/L for the unfiltered water taken from the monitoring well at 22-01 (no assigned PWQO criteria).

Table 7.1 – Water Parameters Exceeding PWQO Criteria

Sample ID	Parameter	Criteria	Parameter Limit (mg/L)	Result (mg/L)
22-01 (Groundwater)	Mercury (total)	PWQO	0.0002	0.00108
	Arsenic (total)	Interim PWQO PWQO	0.005 0.100	0.0264
	Boron (total)	Interim PWQO	0.0002	0.434
	Cadmium (total)	Interim PWQO ¹ PWQO	0.0005 0.0002	0.00731
	Cobalt (total)	Interim PWQO	0.0009	0.0733
	Iron (total)	PWQO	0.3	6.68
	Nickel (total)	PWQO	0.025	0.141
	Phosphorus (total)	Interim PWQO ²	0.01	3.11
	Thallium (total)	Interim PWQO	0.0003	0.000380
	Zinc (total)	Interim PWQO PWQO	0.02 0.03	0.175
Cameron Creek (Surface Water)	Cobalt (total)	PWQO	0.0009	0.00102
	Iron (total)	PWQO	0.3	0.556
	Phosphorus (total)	Interim PWQO ²	0.01	0.059

¹ Cadmium interim PWQO follows a scale based on measured hardness as CaCO₃. The interim PWQO of 0.0001 mg/L is set for water with less than 100 mg/L hardness as CaCO₃. The interim PWQO of 0.0005 mg/L is set for water with greater than 100 mg/L hardness as CaCO₃. All water samples taken have measured hardness as CaCO₃ greater than 100 mg/L. See Appendix B for testing results.

² Total Phosphorous Interim PWQO follows site specific guidelines. The interim PWQO of 0.01 mg/L is set as a high level of protection against aesthetic deterioration, the interim PWQO of 0.02 mg/L to avoid nuisance concentrations of algae in lakes, and the interim PWQO of 0.03 mg/L to avoid excessive plant growth in rivers and streams

8. SINGLE WELL RESPONSE TEST RESULTS

8.1 Test Procedure

A Single Well Response Test (SWRT), or “slug” test, was carried out in the 50-mm diameter well installed in Borehole 22-01. The well was screened across silty clay. The test was completed using the following method:

- Following installation of the monitoring well, the well was initially dry.
- A datalogger was inserted into the well after installation to monitor the initial water level recovery in the well. The datalogger was set to record water levels every 10 seconds, based on the anticipated rate of recovery of the well.



- 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 slug test was analyzed using the Hvorslev method. The plot of the slug test result is included in Appendix B. The hydraulic conductivity value calculated from the in-situ slug test is summarized in Table 8.1 below.

Table 8.1: Single Well Response Test Result

Monitoring Well	Hydraulic Conductivity (m/s)	Screened Formation
22-01	1.6×10^{-8}	Silty Clay

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 rubber-tired CME 750 drill rig and a Simco Limited Access drill rig, and conducted the drilling, sampling and in-situ testing operations for the boreholes. Traffic control services were provided by ML Judson Trucking Ltd. of Emo, Ontario.

Geotechnical laboratory testing was carried out in Thurber's geotechnical laboratory. Analytical testing was carried out by SGS.

The field investigation was supervised on a full-time basis by Mr. Gregory Stanhope and Mr. Matthew MacAskill of Thurber. The overall supervision of the field program was conducted by Ms. Rachel Bourassa, EIT and Mr. Mark Farrant, P.Eng. of Thurber.

Interpretation of the field data and preparation of this report was carried out by Ms. Rachel Bourassa, E.I.T. and Mr. Mark Farrant, P.Eng. The report was reviewed by Dr. P.K. Chatterji, P.Eng., a Designated Principal Contact for MTO Foundations Projects.



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STATEMENT OF LIMITATIONS AND CONDITIONS

1. STANDARD OF CARE

This Report has been prepared in accordance with generally accepted engineering or environmental consulting practices in the applicable jurisdiction. No other warranty, expressed or implied, is intended or made.

2. COMPLETE REPORT

All documents, records, data and files, whether electronic or otherwise, generated as part of this assignment are a part of the Report, which is of a summary nature and is not intended to stand alone without reference to the instructions given to Thurber by the Client, communications between Thurber and the Client, and any other reports, proposals or documents prepared by Thurber for the Client relative to the specific site described herein, all of which together constitute the Report.

IN ORDER TO PROPERLY UNDERSTAND THE SUGGESTIONS, RECOMMENDATIONS AND OPINIONS EXPRESSED HEREIN, REFERENCE MUST BE MADE TO THE WHOLE OF THE REPORT. THURBER IS NOT RESPONSIBLE FOR USE BY ANY PARTY OF PORTIONS OF THE REPORT WITHOUT REFERENCE TO THE WHOLE REPORT.

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The Report has been prepared for the specific site, development, design objectives and purposes that were described to Thurber by the Client. The applicability and reliability of any of the findings, recommendations, suggestions, or opinions expressed in the Report, subject to the limitations provided herein, are only valid to the extent that the Report expressly addresses proposed development, design objectives and purposes, and then only to the extent that there has been no material alteration to or variation from any of the said descriptions provided to Thurber, unless Thurber is specifically requested by the Client to review and revise the Report in light of such alteration or variation.

4. USE OF THE REPORT

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5. INTERPRETATION OF THE REPORT

- a) Nature and Exactness of Soil and Contaminant Description: Classification and identification of soils, rocks, geological units, contaminant materials and quantities have been based on investigations performed in accordance with the standards set out in Paragraph 1. Classification and identification of these factors are judgmental in nature. Comprehensive sampling and testing programs implemented with the appropriate equipment by experienced personnel may fail to locate some conditions. All investigations utilizing the standards of Paragraph 1 will involve an inherent risk that some conditions will not be detected and all documents or records summarizing such investigations will be based on assumptions of what exists between the actual points sampled. Actual conditions may vary significantly between the points investigated and the Client and all other persons making use of such documents or records with our express written consent should be aware of this risk and the Report is delivered subject to the express condition that such risk is accepted by the Client and such other persons. Some conditions are subject to change over time and those making use of the Report should be aware of this possibility and understand that the Report only presents the conditions at the sampled points at the time of sampling. If special concerns exist, or the Client has special considerations or requirements, the Client should disclose them so that additional or special investigations may be undertaken which would not otherwise be within the scope of investigations made for the purposes of the Report.
- b) Reliance on Provided Information: The evaluation and conclusions contained in the Report have been prepared on the basis of conditions in evidence at the time of site inspections and on the basis of information provided to Thurber. Thurber has relied in good faith upon representations, information and instructions provided by the Client and others concerning the site. Accordingly, Thurber does not accept responsibility for any deficiency, misstatement or inaccuracy contained in the Report as a result of misstatements, omissions, misrepresentations, or fraudulent acts of the Client or other persons providing information relied on by Thurber. Thurber is entitled to rely on such representations, information and instructions and is not required to carry out investigations to determine the truth or accuracy of such representations, information and instructions.
- c) Design Services: The Report may form part of design and construction documents for information purposes even though it may have been issued prior to final design being completed. Thurber should be retained to review final design, project plans and related documents prior to construction to confirm that they are consistent with the intent of the Report. Any differences that may exist between the Report's recommendations and the final design detailed in the contract documents should be reported to Thurber immediately so that Thurber can address potential conflicts.
- d) Construction Services: During construction Thurber should be retained to provide field reviews. Field reviews consist of performing sufficient and timely observations of encountered conditions in order to confirm and document that the site conditions do not materially differ from those interpreted conditions considered in the preparation of the report. Adequate field reviews are necessary for Thurber to provide letters of assurance, in accordance with the requirements of many regulatory authorities.

6. RELEASE OF POLLUTANTS OR HAZARDOUS SUBSTANCES

Geotechnical engineering and environmental consulting projects often have the potential to encounter pollutants or hazardous substances and the potential to cause the escape, release or dispersal of those substances. Thurber shall have no liability to the Client under any circumstances, for the escape, release or dispersal of pollutants or hazardous substances, unless such pollutants or hazardous substances have been specifically and accurately identified to Thurber by the Client prior to the commencement of Thurber's professional services.

7. INDEPENDENT JUDGEMENTS OF CLIENT

The information, interpretations and conclusions in the Report are based on Thurber's interpretation of conditions revealed through limited investigation conducted within a defined scope of services. Thurber does not accept responsibility for independent conclusions, interpretations, interpolations and/or decisions of the Client, or others who may come into possession of the Report, or any part thereof, which may be based on information contained in the Report. This restriction of liability includes but is not limited to decisions made to develop, purchase or sell land.



Appendix A

Record of Borehole Sheets

SYMBOLS, ABBREVIATIONS AND TERMS USED ON RECORDS OF BOREHOLES

1. TEXTURAL CLASSIFICATION OF SOILS

CLASSIFICATION	PARTICLE SIZE	VISUAL IDENTIFICATION
Boulders	Greater than 200mm	same
Cobbles	75 to 200mm	same
Gravel	4.75 to 75mm	5 to 75mm
Sand	0.075 to 4.75mm	Not visible particles to 5mm
Silt	0.002 to 0.075mm	Non-plastic particles, not visible to the naked eye
Clay	Less than 0.002mm	Plastic particles, not visible to the naked eye

2. COARSE GRAIN SOIL DESCRIPTION (50% greater than 0.075mm)

TERMINOLOGY	PROPORTION
Trace or Occasional	Less than 10%
Some	10 to 20%
Adjective (e.g. silty or sandy)	20 to 35%
And (e.g. sand and gravel)	35 to 50%

3. TERMS DESCRIBING CONSISTENCY (COHESIVE SOILS ONLY)

DESCRIPTIVE TERM	UNDRAINED SHEAR STRENGTH (kPa)	APPROXIMATE SPT ⁽¹⁾ 'N' VALUE
Very Soft	12 or less	Less than 2
Soft	12 to 25	2 to 4
Firm	25 to 50	4 to 8
Stiff	50 to 100	8 to 15
Very Stiff	100 to 200	15 to 30
Hard	Greater than 200	Greater than 30

NOTE: Hierarchy of Soil Strength Prediction

- 1) Laboratory Triaxial Testing
- 2) Field Insitu Vane Testing
- 3) Laboratory Vane Testing
- 4) SPT value
- 5) Pocket Penetrometer


4. TERMS DESCRIBING DENSITY (COHESIONLESS SOILS ONLY)

DESCRIPTIVE TERM	SPT "N" VALUE
Very Loose	Less than 4
Loose	4 to 10
Compact	10 to 30
Dense	30 to 50
Very Dense	Greater than 50

5. LEGEND FOR RECORDS OF BOREHOLES

SYMBOLS AND ABBREVIATIONS FOR SAMPLE TYPE	SS Split Spoon Sample	WS Wash Sample	AS Auger (Grab) Sample
	TW Thin Wall Shelby Tube Sample	TP Thin Wall Piston Sample	
	PH Sampler Advanced by Hydraulic Pressure	PM Sampler Advanced by Manual Pressure	
	WH Sampler Advanced by Self Static Weight	RC Rock Core	SC Soil Core

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

 Water Level
 Shear Strength Determination by Pocket Penetrometer

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

UNIFIED SOILS CLASSIFICATION

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

RECORD OF BOREHOLE No 22-01

1 OF 2

METRIC

GWP# 6120-17-00 LOCATION Cameron Creek Culvert; MTM NAD 83-16: N 5 393 966.3 E 220 848.6 ORIGINATED BY GS
 DIST Rainy River HWY 11 BOREHOLE TYPE Solid Stem Augers COMPILED BY MC
 DATUM Geodetic DATE 2022.08.26 - 2022.08.27 LATITUDE 48.678533 LONGITUDE -94.140124 CHECKED BY RB

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						
336.3	GROUND SURFACE							20	40	60	80	100		
0.0	TOPSOIL													
0.2	Black Moist		1	SS	6		336						○	
335.6	Silty CLAY , occasional organics													
0.7	Brown Moist													
	Silty CLAY , sandy, trace gravel		2	SS	5								○	6 26 44 24
	Firm						335							
	Grey													
	Moist (CL)		3	SS	6								○	
							334							
			1	TW										
							333							
	Becoming Very Stiff									+				
			4	SS	5		332						○	2 29 43 26
							331							
			5	SS	15		330						○	
			6	SS	17		329						○	
							328							
			7	SS	20								○	1 30 40 29
							327							

Continued Next Page

+³, ×³: Numbers refer to
Sensitivity

20
15
10
(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 22-01

2 OF 2

METRIC

GWP# 6120-17-00 LOCATION Cameron Creek Culvert; MTM NAD 83-16: N 5 393 966.3 E 220 848.6 ORIGINATED BY GS
 DIST Rainy River HWY 11 BOREHOLE TYPE Solid Stem Augers COMPILED BY MC
 DATUM Geodetic DATE 2022.08.26 - 2022.08.27 LATITUDE 48.678533 LONGITUDE -94.140124 CHECKED BY RB

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																
	Silty CLAY , sandy, trace gravel Very Stiff Grey Wet (CL)		8	SS	20												
			9	SS	21												
			10	SS	19												
323.5																	
12.8	END OF BOREHOLE AT 12.8m. Monitoring Well installation consists of 50mm diameter Schedule 40 PVC pipe with a 3.05m slotted screen. WATER LEVEL READINGS DATE DEPTH(m) ELEV.(m) 2022.08.27 11.1 325.2 2022.08.28 10.7 325.6 Water level taken on August 28, 2022, was unstabilized.																

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RECORD OF BOREHOLE No 22-02

1 OF 2

METRIC

GWP# 6120-17-00 LOCATION Cameron Creek Culvert; MTM NAD 83-16: N 5 393 935.9 E 220 850.1 ORIGINATED BY GS
 DIST Rainy River HWY 11 BOREHOLE TYPE Solid Stem Augers COMPILED BY MC
 DATUM Geodetic DATE 2022.08.27 - 2022.08.28 LATITUDE 48.678260 LONGITUDE -94.140098 CHECKED BY RB

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	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
336.7	GROUND SURFACE															
0.0	TOPSOIL Black Moist		1	SS	20											
	Silty CLAY , some sand, trace gravel Stiff to Very Stiff Grey Moist to Wet (CI-CL)		2	SS	12									0 15 34 51		
			3	SS	12											
	Becoming sandy		4	SS	11											
			5	SS	8									1 33 40 26		
			1	TW												
			6	SS	14											
			7	SS	12											

Continued Next Page

+³, ×³: Numbers refer to
Sensitivity

20
15
10
(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 22-02

2 OF 2

METRIC

GWP# 6120-17-00 LOCATION Cameron Creek Culvert; MTM NAD 83-16: N 5 393 935.9 E 220 850.1 ORIGINATED BY GS
 DIST Rainy River HWY 11 BOREHOLE TYPE Solid Stem Augers COMPILED BY MC
 DATUM Geodetic DATE 2022.08.27 - 2022.08.28 LATITUDE 48.678260 LONGITUDE -94.140098 CHECKED BY RB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT							UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																							
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa												WATER CONTENT (%)																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																			
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE												W P W W L																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																			
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RECORD OF BOREHOLE No 22-03

1 OF 2

METRIC

GWP# 6120-17-00 LOCATION Cameron Creek Culvert; MTM NAD 83-16: N 5 393 954.9 E 220 859.1 ORIGINATED BY MM
DIST Rainy River HWY 11 BOREHOLE TYPE Solid Stem Augers/Wash Boring COMPILED BY AA
DATUM Geodetic DATE 2022.03.05 - 2022.03.05 LATITUDE 48.678432 LONGITUDE -94.139979 CHECKED BY RB

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																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																
338.3	GROUND SURFACE							20 40 60 80 100																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																
0.0	ASPHALT: (150mm)							20 40 60 80 100																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																
0.2	Gravelly SAND , some silt Very Dense to Compact Brown Moist (FILL)		1	SS	49		338																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																	

Continued Next Page

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

METRIC

[illegible]



+³, ×³: Numbers refer to Sensitivity

RECORD OF BOREHOLE No 22-04

1 OF 2

METRIC

GWP# 6120-17-00 LOCATION Cameron Creek Culvert; MTM NAD 83-16: N 5 393 949.6 E 220 838.2 ORIGINATED BY MM
DIST Rainy River HWY 11 BOREHOLE TYPE Solid Stem Augers/Wash Boring COMPILED BY AA
DATUM Geodetic DATE 2022.03.05 - 2022.03.05 LATITUDE 48.678381 LONGITUDE -94.140262 CHECKED BY RB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa				WATER CONTENT (%)								
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE				w _P w w _L								
338.2	GROUND SURFACE					▽	20	40	60	80	100									
0.0	ASPHALT: (150mm)						20	40	60	80	100									
0.2	Gravelly SAND , some silt Very Dense to Loose Brown Dry to Moist (FILL)		1	SS	62															
			2	SS	18															
			3	SS	32															
			4	SS	8															
335.2	Silty CLAY , sandy, trace gravel Firm Grey Wet (CL-CI)		5	SS	5															
3.0	Becoming Stiff to Very Stiff		6	SS	5															
			7	SS	6															
			8	SS	12															
			9	SS	17															

Continued Next Page

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

METRIC

SOIL PROFILE					
ELEV DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES	GROUND WATER CONDITIONS	DYNAMIC CONE PENETRATION RESISTANCE PLOT
			NUMBER TYPE "N" VALUES		<div><div>20406080100</div><div>○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE</div><div>20406080100</div></div> <div><div>PLASTIC LIMIT W_P</div><div>NATURAL MOISTURE CONTENT W</div><div>LIQUID LIMIT W_L</div><div>WATER CONTENT (%)</div></div>
	Continued From Previous Page				
	Silty CLAY , sandy, trace gravel Very Stiff to Stiff Grey Wet (CL-CI)		10 SS 15		
			11 SS 12		
			12 SS 13		
			1 ST		
321.9 16.3	END OF BOREHOLE AT 16.3m BOREHOLE OPEN TO 16.3m AND WATER LEVEL AT 1.8m* (INSIDE CASING) COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO 1.2m, CONCRETE TO 0.2m, AND ASPHALT TO SURFACE.				
	* UNSTABILIZED WATER LEVEL				

+³, ×³: Numbers refer to Sensitivity

RECORD OF BOREHOLE No 22-05

1 OF 2

METRIC

GWP# 6120-17-00 LOCATION Cameron Creek Culvert; MTM NAD 83-16: N 5 393 949.2 E 220 864.8 ORIGINATED BY MM
DIST Rainy River HWY 11 BOREHOLE TYPE Solid Stem Augers/Wash Boring COMPILED BY AA
DATUM Geodetic DATE 2022.04.05 - 2022.04.05 LATITUDE 48.678381 LONGITUDE -94.139901 CHECKED BY RB

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	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa								WATER CONTENT (%)
338.3	GROUND SURFACE					▽									GR SA SI CL	
0.0	ASPHALT: (150mm)															
0.2	SAND and GRAVEL, some silt Very Dense to Compact Brown Dry to Moist (FILL)		1	SS	66											
			2	SS	11											
336.5			3	SS	7											
1.8	Silty CLAY, trace sand, trace gravel Firm Brown Wet (FILL-CH)		4	SS	5											
			5	SS	4											
334.2																
4.1	Silty CLAY, sandy, trace gravel Soft Grey Wet (CI) Becoming Stiff		6	SS	3											
			7	SS	6											
			1	ST												
			8	SS	9											

Continued Next Page

+³, ×³: Numbers refer to
Sensitivity

20
15
10
(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 22-05

2 OF 2

METRIC

GWP# 6120-17-00 LOCATION Cameron Creek Culvert; MTM NAD 83-16: N 5 393 949.2 E 220 864.8 ORIGINATED BY MM
DIST Rainy River HWY 11 BOREHOLE TYPE Solid Stem Augers/Wash Boring COMPILED BY AA
DATUM Geodetic DATE 2022.04.05 - 2022.04.05 LATITUDE 48.678381 LONGITUDE -94.139901 CHECKED BY RB

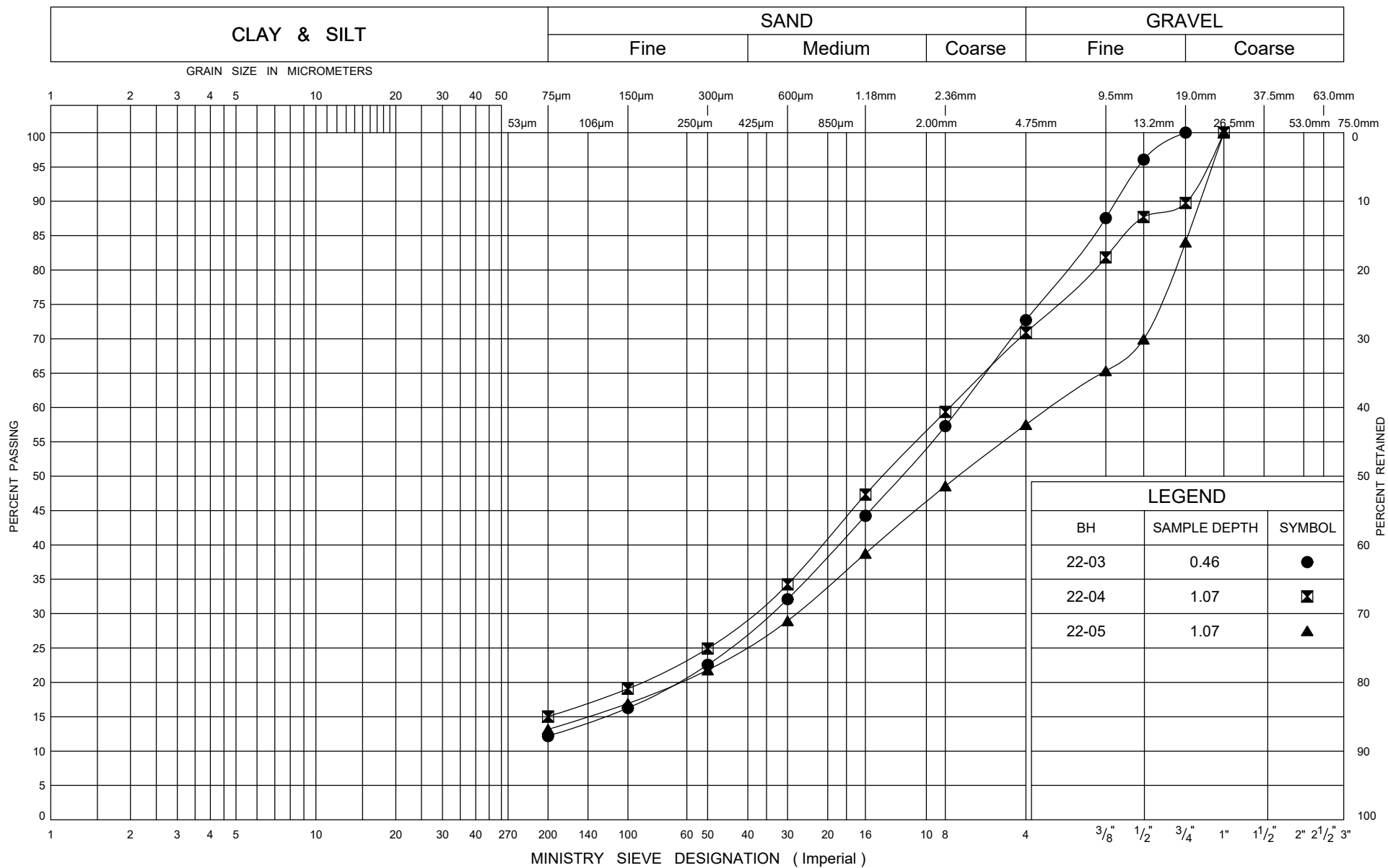
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT NATURAL MOISTURE LIQUID CONTENT LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa				WATER CONTENT (%)				
								○ UNCONFINED + FIELD VANE				W _P W W _L				
Continued From Previous Page						● QUICK TRIAXIAL × LAB VANE										
	Silty CLAY , sandy, trace gravel Stiff Grey Wet (CI)						20	40	60	80	100	20	40	60		
										1.6						
			9	SS	9								○			
										1.3						
			10	SS	11								○			
										1.5						
			11	SS	9								○			
										1.4						
			12	SS	13								○			
322.5																
15.8	END OF BOREHOLE AT 15.8m. BOREHOLE OPEN TO 15.8m AND WATER LEVEL AT 1.7m* (INSIDE CASING) COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO 1.2m, CONCRETE TO 0.2m, AND ASPHALT TO SURFACE. * UNSTABILIZED WATER LEVEL															

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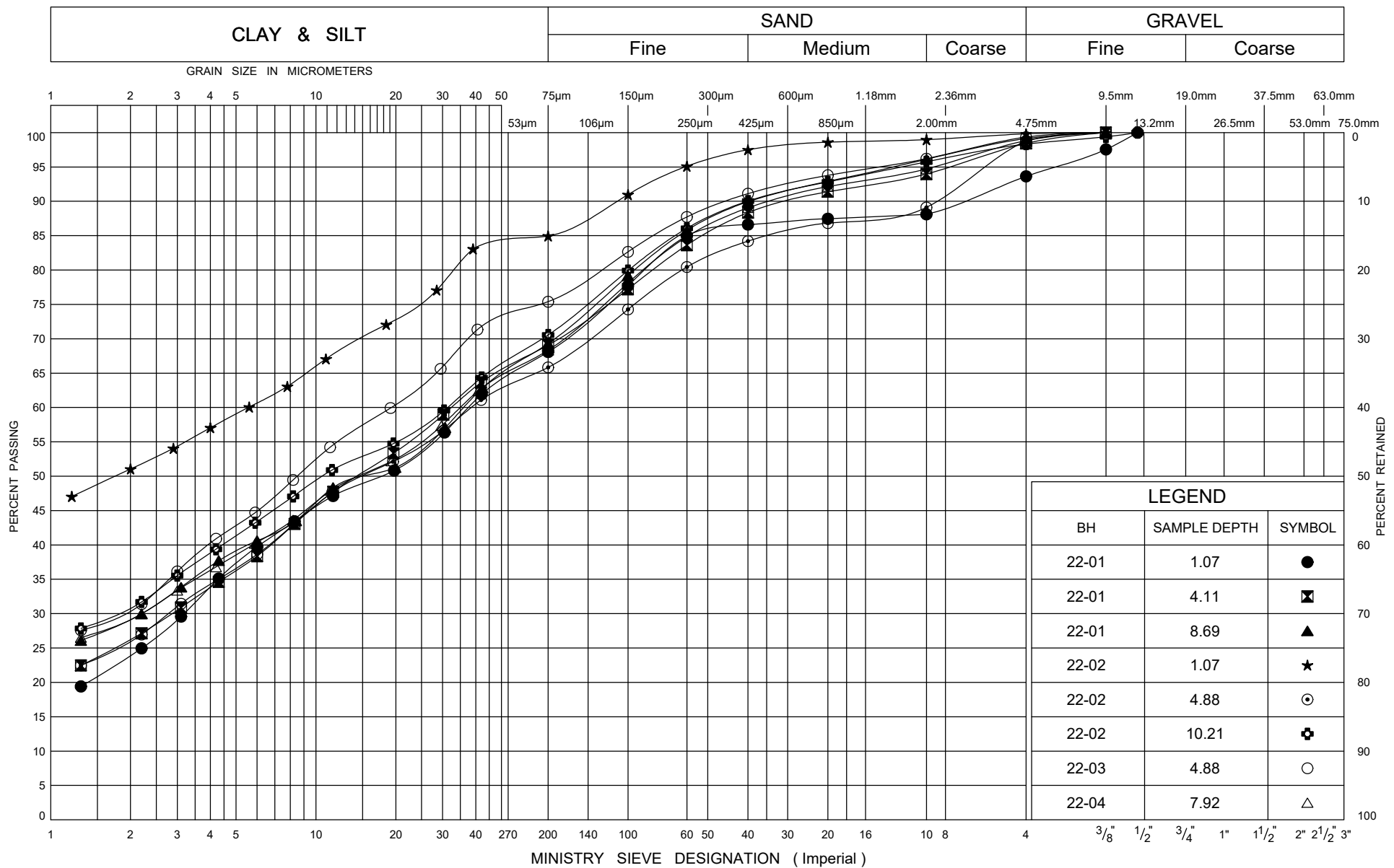
Appendix B

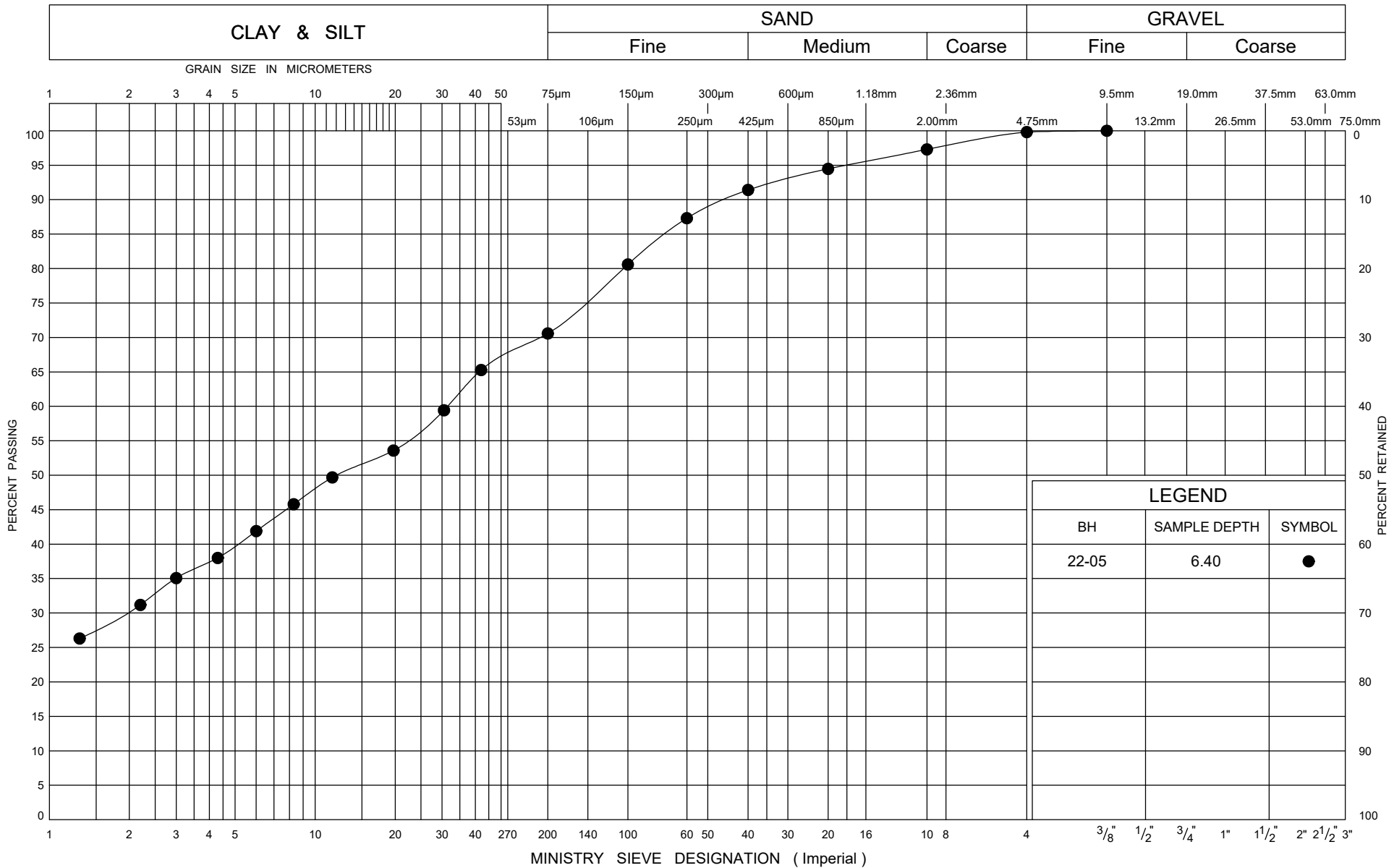
Laboratory and Well Test Results





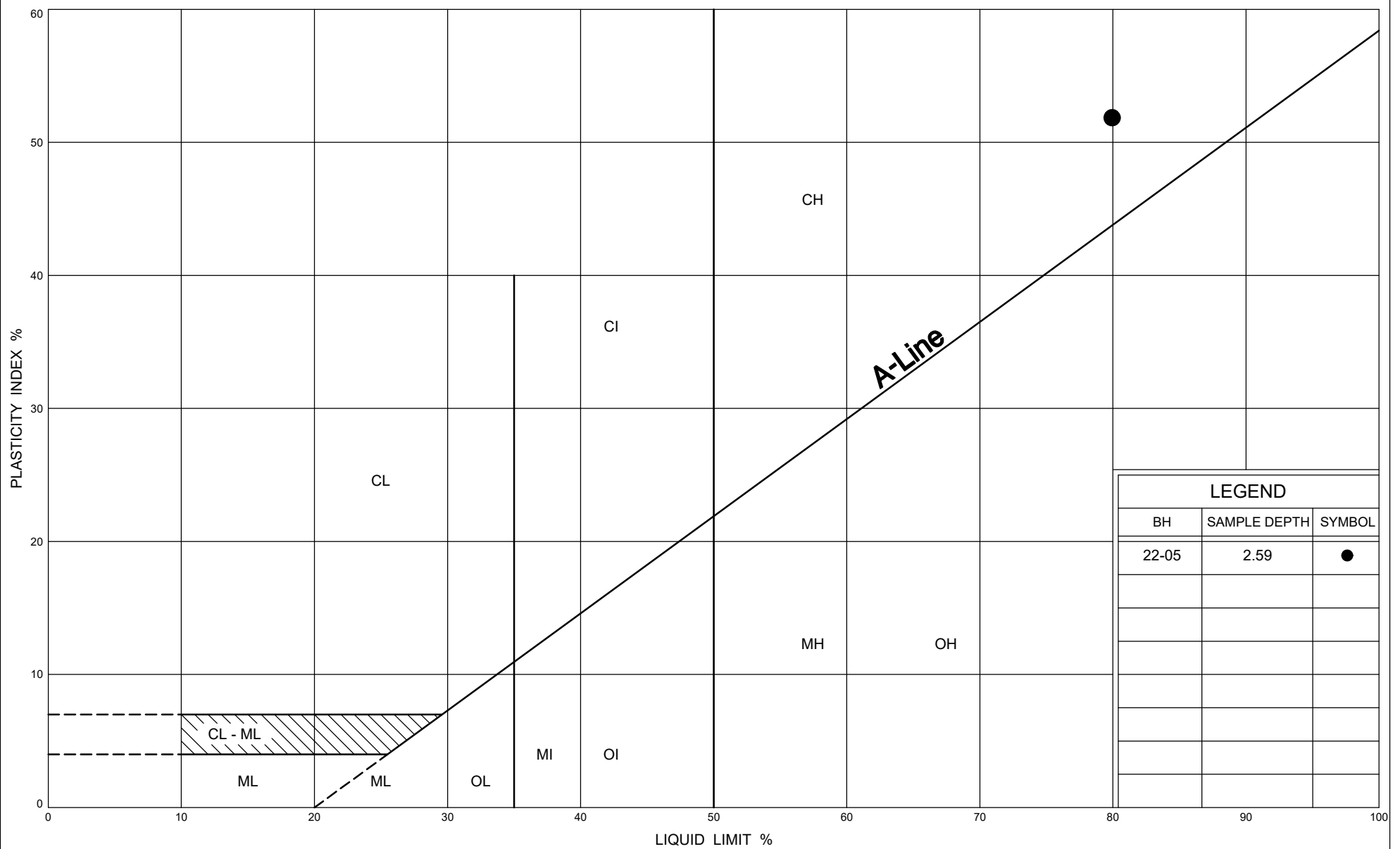
Cameron Creek Culvert





GRAIN SIZE DISTRIBUTION
Sandy Silty CLAY

FIG No B4
W.P.
Cameron Creek Culvert



Ministry of
Transportation

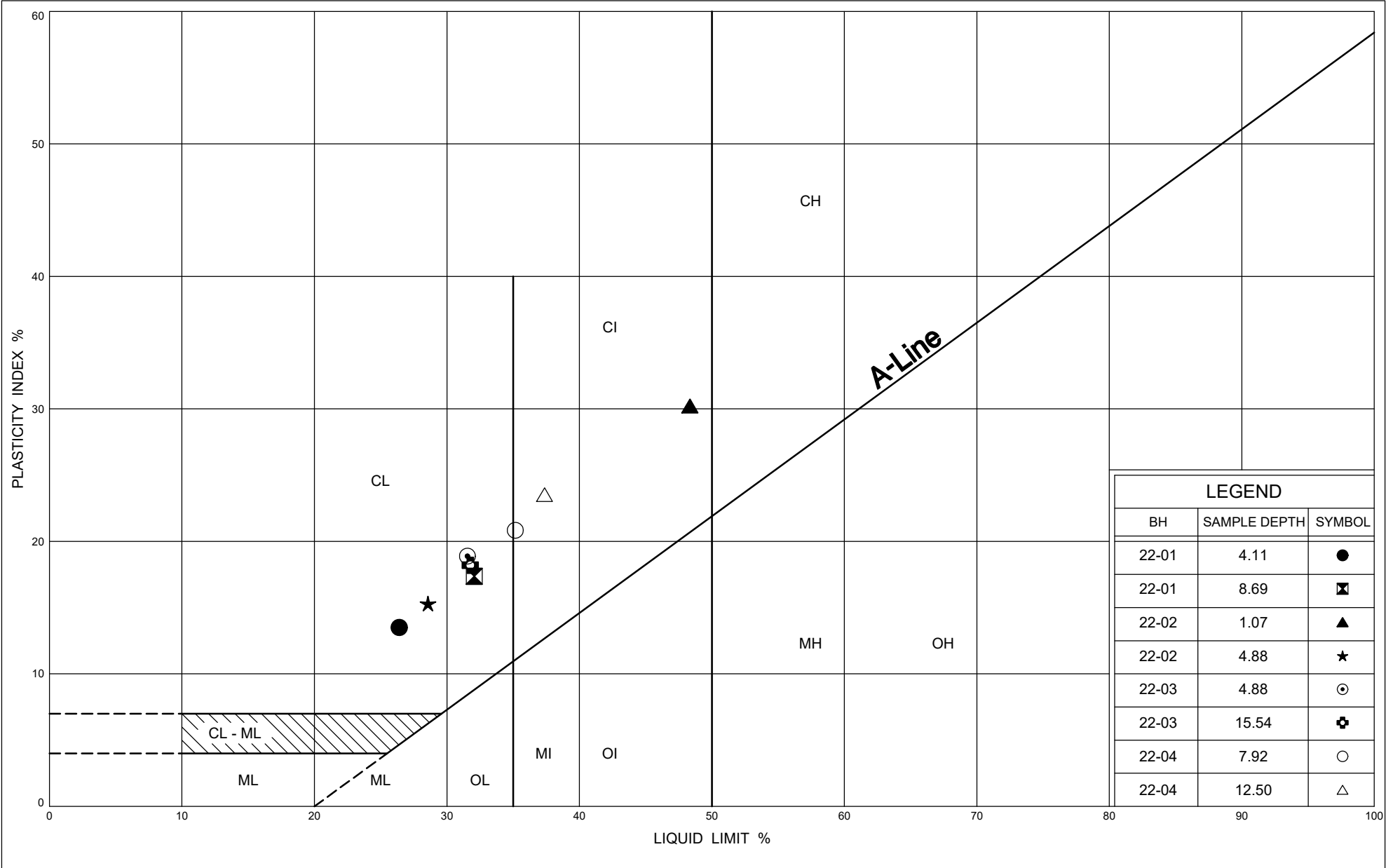
PLASTICITY CHART

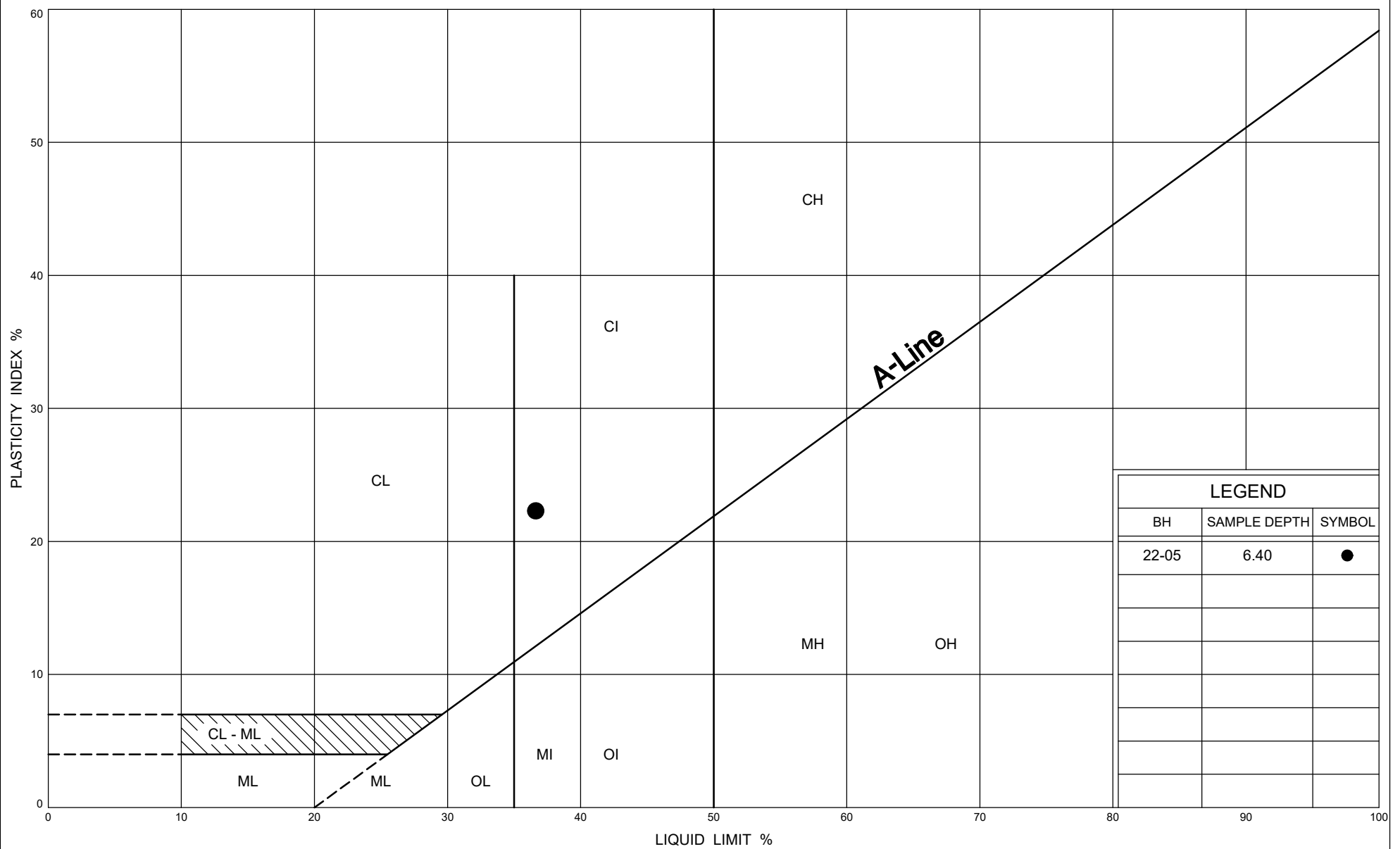
Silty CLAY FILL

FIG No B5

W.P.

Cameron Creek Culvert





Ministry of
Transportation

PLASTICITY CHART

Sandy Silty CLAY

FIG No B7

W.P.

Cameron Creek Culvert



THURBER ENGINEERING LTD.

Slug Test Analysis Report

Project: Cameron Creek Culvert Replacement

Number: 33309

Client: MTO

Location: District of Rainey River

Slug Test: 22-01

Test Well: 22-01

Test Conducted by: GS

Test Date: 2022-08-27

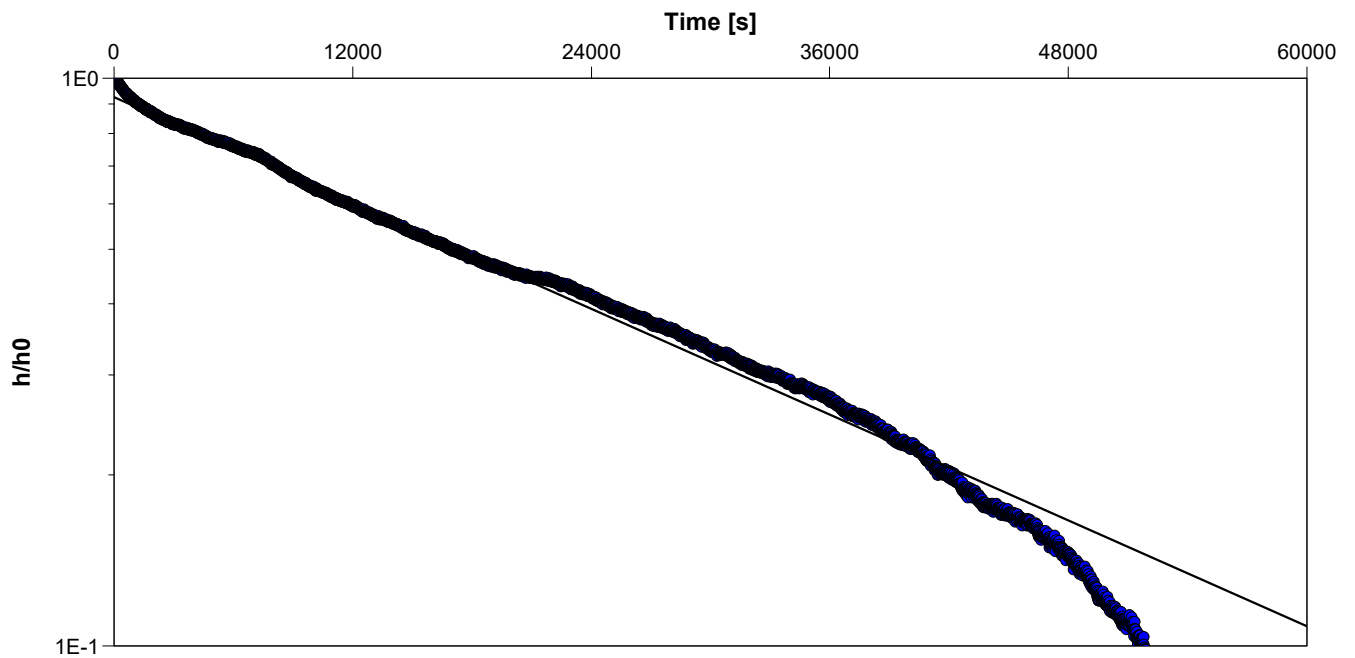
Analysis Performed by: JR

22-01 SWRT Analysis

Analysis Date: 2022-10-27

Aquifer Thickness:

Checked by: PC



Calculation using Hvorslev

Observation Well	Hydraulic Conductivity [m/s]
------------------	---------------------------------

22-01	1.6×10^{-8}
-------	----------------------



FINAL REPORT

CA40191-OCT22 R1

33309, C.ameron and Lyon Creek Culvert

Prepared for

Thurber Engineering Ltd.

First Page

CLIENT DETAILS

Client Thurber Engineering Ltd.

Address 103, 2010 Winston Park Drive
Oakville, ON
L6H 5R7, Canada

Contact Rachel Bourassa

Telephone 905-829-8666 x 263

Facsimile

Email rbourassa@thurber.ca

Project 33309, C.ameron and Lyon Creek Culvert

Order Number

Samples Soil (1)

LABORATORY DETAILS

Project Specialist Jill Campbell, B.Sc.,GISAS

Laboratory SGS Canada Inc.

Address 185 Concession St., Lakefield ON, K0L 2H0

Telephone 2165

Facsimile 705-652-6365

Email jill.campbell@sgs.com

SGS Reference CA40191-OCT22

Received 10/26/2022

Approved 11/04/2022

Report Number CA40191-OCT22 R1

Date Reported 11/08/2022

COMMENTS

Temperature of Sample upon Receipt: 9 degrees C

Cooling Agent Present: Yes

Custody Seal Present: Yes

Chain of Custody Number: No.1

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

SIGNATORIES

Jill Campbell, B.Sc.,GISAS





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FINAL REPORT

CA40191-OCT22 R1

Client: Thurber Engineering Ltd.

Project: 33309, C.ameron and Lyon Creek Culvert

Project Manager: Rachel Bourassa

Samplers: Rachel Bourassa

MATRIX: SOIL

Sample Number 6

Sample Name 22-02 SS1 (0'-2')

Sample Matrix Soil

Sample Date 27/10/2022

Parameter	Units	RL	Result
Corrosivity Index			
Corrosivity Index	none	1	1
Soil Redox Potential	mV	no	279
Sulphide (Na ₂ CO ₃)	%	0.04	< 0.04
pH	pH Units	0.05	8.28
Resistivity (calculated)	ohms.cm	-9999	6670
General Chemistry			
Conductivity	uS/cm	2	150
Metals and Inorganics			
Moisture Content	%	0.1	18.5
Sulphate	µg/g	0.4	30
Other (ORP)			
Chloride	µg/g	0.4	< 10†



FINAL REPORT

CA40191-OCT22 R1

QC SUMMARY

Anions by IC
Method: EPA300/MA300-Ions1.3 | Internal ref.: ME-CA-IENVIIC-LAK-AN-001

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Chloride	DIO0587-OCT22	µg/g	0.4	<0.4	1	35	98	80	120	92	75	125
Sulphate	DIO0587-OCT22	µg/g	0.4	<0.4	3	35	99	80	120	107	75	125

Carbon/Sulphur
Method: ASTM E1915-07A | Internal ref.: ME-CA-IENVIARD-LAK-AN-020

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Sulphide (Na2CO3)	ECS0088-OCT22	%	0.04	< 0.04	ND	20	117	80	120			

Conductivity
Method: SM 2510 | Internal ref.: ME-CA-IENVIEWL-LAK-AN-006

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Conductivity	EWL0670-OCT22	uS/cm	2	< 2	0	20	99	90	110	NA		



FINAL REPORT

CA40191-OCT22 R1

QC SUMMARY

pH
Method: SM 4500 | Internal ref.: ME-CA-|ENVIEWL-LAK-AN-001

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
pH	EWL0670-OCT22	pH Units	0.05	NA	0		100			NA		

Method Blank: a blank matrix that is carried through the entire analytical procedure. Used to assess laboratory contamination.

Duplicate: Paired analysis of a separate portion of the same sample that is carried through the entire analytical procedure. Used to evaluate measurement precision.

LCS/Spike Blank: Laboratory control sample or spike blank refer to a blank matrix to which a known amount of analyte has been added. Used to evaluate analyte recovery and laboratory accuracy without sample matrix effects.

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

Reference Material: a material or substance matrix matched to the samples that contains a known amount of the analyte of interest. A reference material may be used in place of a matrix spike.

RL: Reporting limit

RPD: Relative percent difference

AC: Acceptance criteria

Multielement Scan Qualifier: as the number of analytes in a scan increases, so does the chance of a limit exceedance by random chance as opposed to a real method problem. Thus, in multielement scans, for the LCS and matrix spike, up to 10% of the analytes may exceed the quoted limits by up to 10% absolute and the spike is considered acceptable.

Duplicate Qualifier: for duplicates as the measured result approaches the RL, the uncertainty associated with the value increases dramatically, thus duplicate acceptance limits apply only where the average of the two duplicates is greater than five times the RL.

Matrix Spike Qualifier: for matrix spikes, as the concentration of the native analyte increases, the uncertainty of the matrix spike recovery increases. Thus, the matrix spike acceptance limits apply only when the concentration of the matrix spike is greater than or equal to the concentration of the native analyte.

LEGEND

FOOTNOTES

NSS Insufficient sample for analysis.

RL Reporting Limit.

↑ Reporting limit raised.

↓ Reporting limit lowered.

NA The sample was not analysed for this analyte

ND Non Detect

Results relate only to the sample tested.

Data reported represent the sample as submitted to SGS. Solid samples expressed on a dry weight basis.

"Temperature Upon Receipt" is representative of the whole shipment and may not reflect the temperature of individual samples.

Analysis conducted on samples submitted pursuant to or as part of Reg. 153/04, are in accordance to the "Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act and Excess Soil Quality" published by the Ministry and dated March 9, 2004 as amended.

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This report supersedes all previous versions.

-- End of Analytical Report --



Request for Laboratory Services and CHAIN OF CUSTODY

Environment, Health & Safety - Lakefield: 185 Concession St., Lakefield, ON K0L 2H0 Phone: 705-652-2000 Fax: 705-652-6365 Web: www.sgs.com/environment
- London: 657 Consortium Court, London, ON, N6E 2S8 Phone: 519-672-4500 Toll Free: 877-848-8060 Fax: 519-672-0361

No: 1

Page 1 of 1

Received By: ED

Received Date (mm/dd/yy): 10-26-22

Received Time: 11:50

Received By (signature): [Signature]

Custody Seal Present: ☒

Custody Seal Intact: ☒

REPORT INFORMATION

Company: Thurber Engineering Ltd.
Contact: Rachel Bourassa
Address: 103-2010 Winsion Park Drive
Oakville, Ontario
Phone: 416-523-1015
Email: rbourassa@thurber.ca
Email:

INVOICE INFORMATION

☒ (same as Report Information)
Company: _____
Contact: _____
Address: _____
Phone: _____
Email: _____

PROJECT INFORMATION

Quotation #: _____ P.O. #: _____
Project #: 33309 Site Location/ID: Cameron and Lyon Creek Culvert
☒ Regular TAT (5-7days) **TURNAROUND TIME (TAT) REQUIRED**
TAT's are quoted in business days (exclude statutory holidays & weekends).
Samples received after 6pm or on weekends: TAT begins next business day
RUSH TAT (Additional Charges May Apply): ☐ 1 Day ☐ 2 Days ☐ 3 Days ☐ 4 Days
PLEASE CONFIRM RUSH FEASIBILITY WITH SGS REPRESENTATIVE PRIOR TO SUBMISSION
Specify Due Date: _____ Rush Confirmation ID: _____

REGULATIONS

Regulation 153/04:

Table 1 ☐ R/P/I
Table 2 ☐ J/C/C
Table 3 ☐ A/O
Table ☐ _____
Soil Texture: ☐ Coarse ☐ Medium ☐ Fine

Other Regulations:

Reg 347/558 (3 Day min TAT)
☐ PWQO ☐ MMER ☐ Other:
☐ CCME ☒ MISA

Sewer By-Law:

☐ Sanitary ☐ Storm
☐ Municipality:

RECORD OF SITE CONDITION (RSC)

☐ YES ☐ NO

SAMPLE IDENTIFICATION

MATRIX

TIME SAMPLED

OF BOTTLES

DATE SAMPLED

1	22-07 SS3B (8'6" - 9'6")	8/23/22	1	Soil	
2	22-02 SS1 (0'-2')	8/27/22	1	Soil	
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					

ANALYSIS REQUESTED

Field Filtered (Y/N) ☐
Metals & Inorganics ☐
PAH ☐ ABN ☐ SVOC(all) ☐
PCB Total ☐ Aroclor ☐
PHC F1-F4 ☐ VOC ☐
BTEX ☐ BTEX/F1 ☐ F2-F4 ☐
VOC ☐ BTEX ☐ THM ☐
Pesticides OC ☐ OP ☐
TCP M&I ☐ VOC ☐ PCB ☐
B(a)P ☐ ABN ☐ Ignit. ☐
Water Pkg ☐ Gan. ☐ Ext. ☐
Sewer Use: ☐
Corrosivity/Resistivity ☐

COMMENTS:

NOTE: DRINKING (POTABLE) WATER SAMPLES FOR HUMAN CONSUMPTION MUST BE SUBMITTED WITH SGS DRINKING WATER CHAIN OF CUSTODY

Observations/Comments/Special Instructions

*Corrosivity should include Substrate

Sampled By (NAME): Rachel Bourassa / GS
Relinquished by (NAME): Rachel Bourassa

Signature: [Signature]
Signature: [Signature]

Date: 8/27/22
Date: 10/26/22

(mm/dd/yy)
(mm/dd/yy)

Pink Copy - Client

Yellow & White Copy - SGS

Revision # 1.1

Date of Issue 04 April, 2018



FINAL REPORT

CA40152-JUN22 R1

33309, C.ameron and Lyon Creek Culvert

Prepared for

Thurber Engineering Ltd.

First Page

CLIENT DETAILS

Client Thurber Engineering Ltd.

Address 103, 2010 Winston Park Drive
Oakville, ON
L6H 5R7, Canada

Contact Rachel Bourassa

Telephone 905-829-8666 x 263

Facsimile

Email rbourassa@thurber.ca

Project 33309, C.ameron and Lyon Creek Culvert

Order Number

Samples Soil (1)

LABORATORY DETAILS

Project Specialist Jill Campbell, B.Sc.,GISAS

Laboratory SGS Canada Inc.

Address 185 Concession St., Lakefield ON, K0L 2H0

Telephone 2165

Facsimile 705-652-6365

Email jill.campbell@sgs.com

SGS Reference CA40152-JUN22

Received 06/09/2022

Approved 06/26/2022

Report Number CA40152-JUN22 R1

Date Reported 11/08/2022

COMMENTS

Temperature of Sample upon Receipt: 8 degrees C

Cooling Agent Present: Yes

Custody Seal Present: Yes

Chain of Custody Number:1

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

SIGNATORIES

Jill Campbell, B.Sc.,GISAS





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FINAL REPORT

CA40152-JUN22 R1

Client: Thurber Engineering Ltd.

Project: 33309, C.ameron and Lyon Creek Culvert

Project Manager: Rachel Bourassa

Samplers: Rachel Bourassa

MATRIX: SOIL

Sample Number 5
Sample Name 22-03 SS4
(7'6"-9'6")
Sample Matrix Soil
Sample Date 03/05/2022

Parameter	Units	RL	Result
Corrosivity Index			
Corrosivity Index	none	1	4
Soil Redox Potential	mV	no	230
Sulphide (Na ₂ CO ₃)	%	0.04	< 0.04
pH	pH Units	0.05	8.88
Resistivity (calculated)	ohms.cm	-9999	3600
General Chemistry			
Conductivity	uS/cm	2	278
Metals and Inorganics			
Moisture Content	%	0.1	13.9
Sulphate	µg/g	0.4	24
Other (ORP)			
Chloride	µg/g	0.4	99



FINAL REPORT

CA40152-JUN22 R1

QC SUMMARY

Anions by IC
Method: EPA300/MA300-Ions1.3 | Internal ref.: ME-CA-IENVIIC-LAK-AN-001

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Chloride	DIO0242-JUN22	µg/g	0.4	<0.4	3	35	97	80	120	99	75	125
Sulphate	DIO0242-JUN22	µg/g	0.4	<0.4	5	35	96	80	120	96	75	125

Carbon/Sulphur
Method: ASTM E1915-07A | Internal ref.: ME-CA-IENVIARD-LAK-AN-020

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Sulphide (Na2CO3)	ECS0029-JUN22	%	0.04	< 0.04								

Conductivity
Method: SM 2510 | Internal ref.: ME-CA-IENVIEWL-LAK-AN-006

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Conductivity	EWL0245-JUN22	uS/cm	2	2	0	20	101	90	110	NA		



QC SUMMARY

pH
Method: SM 4500 | Internal ref.: ME-CA-|ENVIEWL-LAK-AN-001

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
pH	EWL0245-JUN22	pH Units	0.05	NA	0		99			NA		

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RPD: Relative percent difference

AC: Acceptance criteria

Multielement Scan Qualifier: as the number of analytes in a scan increases, so does the chance of a limit exceedance by random chance as opposed to a real method problem. Thus, in multielement scans, for the LCS and matrix spike, up to 10% of the analytes may exceed the quoted limits by up to 10% absolute and the spike is considered acceptable.

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LEGEND

FOOTNOTES

NSS Insufficient sample for analysis.

RL Reporting Limit.

↑ Reporting limit raised.

↓ Reporting limit lowered.

NA The sample was not analysed for this analyte

ND Non Detect

Results relate only to the sample tested.

Data reported represent the sample as submitted to SGS. Solid samples expressed on a dry weight basis.

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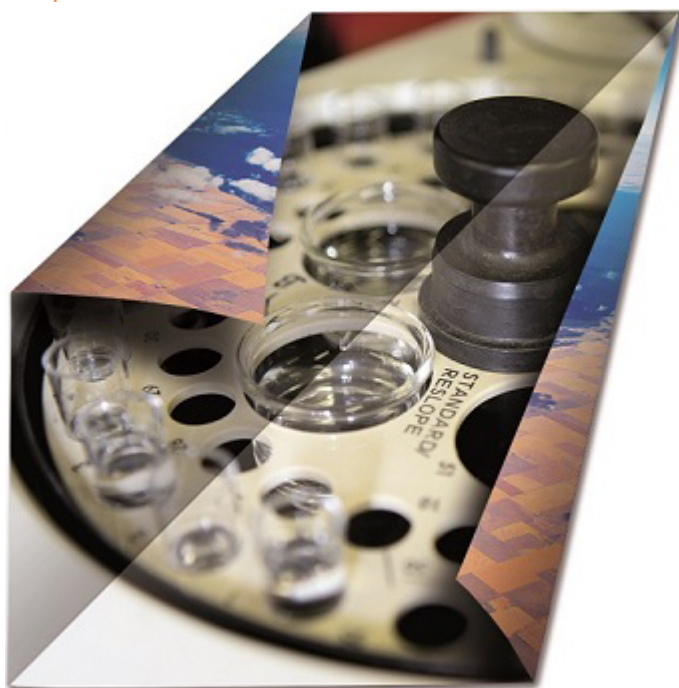
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This report supersedes all previous versions.

-- End of Analytical Report --

Revision #: 1.1



FINAL REPORT

CA40016-SEP22 R

33309, Emo, ON

Prepared for

Thurber Engineering Ltd.

First Page

CLIENT DETAILS

Client **Thurber Engineering Ltd.**

Address **103, 2010 Winston Park Drive
Oakville, ON
L6H 5R7, Canada**

Contact **Rachel Bourassa**

Telephone **905-829-8666 x 263**

Facsimile

Email **rbourassa@thurber.ca**

Project **33309, Emo, ON**

Order Number

Samples **Surface Water (1)**

LABORATORY DETAILS

Project Specialist **Brad Moore Hon. B.Sc**

Laboratory **SGS Canada Inc.**

Address **185 Concession St., Lakefield ON, K0L 2H0**

Telephone **705-652-2143**

Facsimile **705-652-6365**

Email **brad.moore@sgs.com**

SGS Reference **CA40016-SEP22**

Received **09/01/2022**

Approved **09/07/2022**

Report Number **CA40016-SEP22 R**

Date Reported **09/07/2022**

COMMENTS

Temperature of Sample upon Receipt: 9 degrees C

Cooling Agent Present: Yes

Custody Seal Present: Yes

Chain of Custody Number: 010115

SIGNATORIES

Brad Moore Hon. B.Sc

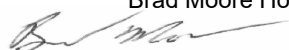




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FINAL REPORT

CA40016-SEP22 R

Client: Thurber Engineering Ltd.
Project: 33309, Emo, ON
Project Manager: Rachel Bourassa
Samplers: Greg Stanhope

MATRIX: WATER

Sample Number 6
Sample Name Cameron Creek
SW
Sample Matrix Surface Water
Sample Date 28/08/2022

L1 = PWQQ_L / WATER / - - Table 2 - General - July 1999 PIBS 3303E

Parameter	Units	RL	L1	Result
General Chemistry				
Conductivity	uS/cm	2		433
Redox Potential	mV	no		214
Metals and Inorganics				
Sulphate	mg/L	0.04		1.3
Other (ORP)				
pH	No unit	0.05	8.6	7.98
Chloride	mg/L	0.04		2.0

EXCEEDANCE SUMMARY

No exceedances are present above the regulatory limit(s) indicated



FINAL REPORT

CA40016-SEP22 R

QC SUMMARY

Anions by IC
Method: EPA300/MA300-Ions1.3 | Internal ref.: ME-CA-IENVIIC-LAK-AN-001

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Chloride	DIO0073-SEP22	mg/L	0.04	<0.04	4	20	97	90	110	96	75	125
Sulphate	DIO0115-SEP22	mg/L	0.04	<0.04	0	20	97	90	110	94	75	125

Conductivity
Method: SM 2510 | Internal ref.: ME-CA-IENVIEWL-LAK-AN-006

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Conductivity	EWL0055-SEP22	uS/cm	2	< 2	0	20	99	90	110	NA		

pH
Method: SM 4500 | Internal ref.: ME-CA-IENVIEWL-LAK-AN-006

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
pH	EWL0055-SEP22	No unit	0.05	NA	1		100			NA		



QC SUMMARY

Redox Potential
Method: SM 2580 I

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Redox Potential	EWL0057-SEP22	mV	no	NA	0	20	103	80	120	NA		

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LCS/Spike Blank: Laboratory control sample or spike blank refer to a blank matrix to which a known amount of analyte has been added. Used to evaluate analyte recovery and laboratory accuracy without sample matrix effects.

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RL: Reporting limit

RPD: Relative percent difference

AC: Acceptance criteria

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Matrix Spike Qualifier: for matrix spikes, as the concentration of the native analyte increases, the uncertainty of the matrix spike recovery increases. Thus, the matrix spike acceptance limits apply only when the concentration of the matrix spike is greater than or equal to the concentration of the native analyte.

LEGEND

FOOTNOTES

NSS Insufficient sample for analysis.

RL Reporting Limit.

↑ Reporting limit raised.

↓ Reporting limit lowered.

NA The sample was not analysed for this analyte

ND Non Detect

Results relate only to the sample tested.

Data reported represent the sample as submitted to SGS. Solid samples expressed on a dry weight basis.

"Temperature Upon Receipt" is representative of the whole shipment and may not reflect the temperature of individual samples.

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This report supersedes all previous versions.

-- End of Analytical Report --



Request for Laboratory Services and CHAIN OF CUSTODY

Laboratory Information Section - Lab use only

Received By: Scott R
Received Date (mm/dd/yyyy): 09/01/2022 (mm/dd/yyyy)
Received Time: 11:30

Received By (signature): [Signature]
Custody Seal Present: ☒
Custody Seal Intact: ☒

Cooling Agent Present: ☒
Temperature Upon Receipt (°C): 12.2
9.2 x 3

LAB LIMS #: SRPT-40015-16

REPORT INFORMATION	INVOICE INFORMATION	PROJECT INFORMATION
Company: <u>Thurber Eng LTD</u>	<input checked="" type="checkbox"/> (same as Report Information)	Quotation #: _____ P.O. #: _____
Contact: <u>Rachel Bourassa</u>	Company: _____	Project #: <u>33309</u> Site Location/ID: <u>EMO, ON</u>
Address: <u>2010 Winston Park Dr</u>	Contact: _____	TURNAROUND TIME (TAT) REQUIRED <input checked="" type="checkbox"/> Regular TAT (5-7 days) TAT's are quoted in business days (exclude statutory holidays & weekends). Samples received after 6pm or on weekends: TAT begins next business day
# <u>103 Oakville ON L6M 5R7</u>	Address: _____	
Phone: <u>416 523 1015</u>	Phone: _____	RUSH TAT (Additional Charges May Apply): <input type="checkbox"/> 1 Day <input type="checkbox"/> 2 Days <input type="checkbox"/> 3 Days <input type="checkbox"/> 4 Days PLEASE CONFIRM RUSH FEASIBILITY WITH SGS REPRESENTATIVE PRIOR TO SUBMISSION
Email: <u>r.bourassa@thurber.ca</u>	Email: _____	Specify Due Date: _____ Rush Confirmation ID: _____

REGULATIONS

Regulation 153/04: ☐ Table 1 ☐ R/P/I ☐ Soil Texture: ☐ Coarse ☐ Medium ☐ Fine

Other Regulations: ☐ Reg 347/558 (3 Day min TAT) ☒ PWQO ☐ MMER ☐ CCME ☐ Other: ☐ MISA

Sewer By-Law: ☐ Sanitary ☐ Storm Municipality: _____

NOTE: DRINKING (POTABLE) WATER SAMPLES FOR HUMAN CONSUMPTION MUST BE SUBMITTED WITH SGS DRINKING WATER CHAIN OF CUSTODY

Regulation 153/04:			Other Regulations:		Sewer By-Law:		ANALYSIS REQUESTED															COMMENTS:	
<input type="checkbox"/> Table 1	<input type="checkbox"/> R/P/I	Soil Texture:	<input type="checkbox"/> Reg 347/558 (3 Day min TAT)	<input type="checkbox"/> Sanitary	Municipality:																		
<input type="checkbox"/> Table 2	<input type="checkbox"/> I/C/C	<input type="checkbox"/> Coarse	<input checked="" type="checkbox"/> PWQO	<input type="checkbox"/> MMER			<input type="checkbox"/> Storm	Field Filtered (Y/N)	Metals & Inorganics	PAH <input type="checkbox"/> ABN <input type="checkbox"/> SVOC (all) <input type="checkbox"/>	PCB Total <input type="checkbox"/> Aroclor <input type="checkbox"/>	PHC F1-F4 <input type="checkbox"/> VOC <input type="checkbox"/>	BTEX <input type="checkbox"/> BTEX/F1 <input type="checkbox"/> F2-F4 <input type="checkbox"/>	VOC <input type="checkbox"/> BTEX <input type="checkbox"/> THM <input type="checkbox"/>	Pesticides OC <input type="checkbox"/> OP <input type="checkbox"/>	TCLP M&I <input type="checkbox"/> VOC <input type="checkbox"/> PCB <input type="checkbox"/>	B(a)P <input type="checkbox"/> ABN <input type="checkbox"/> Ignit. <input type="checkbox"/>	Water Pkg Gen. <input type="checkbox"/> Ext. <input type="checkbox"/>	Sewer Use:	TSS	Lab Filtered Metals	Corrosivity	General Water Characterization
<input type="checkbox"/> Table 3	<input type="checkbox"/> A/O	<input type="checkbox"/> Medium	<input type="checkbox"/> CCME	<input type="checkbox"/> Other:																			
<input type="checkbox"/> Table		<input type="checkbox"/> Fine	<input type="checkbox"/> MISA																				
RECORD OF SITE CONDITION (RSC)						<input type="checkbox"/> YES	<input type="checkbox"/> NO																
SAMPLE IDENTIFICATION		DATE SAMPLED	TIME SAMPLED	# OF BOTTLES	MATRIX																		
1	Cameron Creek SW	Aug 28/22		15	Water														✓	✓	✓	✓	
2	22-01	Aug 28/22		14	Water														✓	✓	✓	✓	
3																							
4																							
5																							
6																							
7																							
8																							
9																							
10																							
11																							
12																							

Observations/Comments/Special Instructions: Corrosivity Includes PH, Soluble Sulphate, Chloride, Resistivity, Electrical Conductivity

Sampled By (NAME): <u>Greg Stanhope</u>	Signature: <u>[Signature]</u>	Date: <u>Aug 1 28 1 2022</u> (mm/dd/yy)	Pink Copy - Client
Relinquished by (NAME): <u>Rachel Bourassa</u>	Signature: <u>[Signature]</u>	Date: <u>Aug 1 31 1 2022</u> (mm/dd/yy)	Yellow & White Copy - SGS



FINAL REPORT

CA40015-SEP22 R1

33309, Emo, ON.

Prepared for

Thurber Engineering Ltd.

First Page

CLIENT DETAILS		LABORATORY DETAILS	
Client	Thurber Engineering Ltd.	Project Specialist	Jill Campbell, B.Sc.,GISAS
Address	103, 2010 Winston Park Drive Oakville, ON L6H 5R7, Canada	Laboratory	SGS Canada Inc.
Contact	Rachel Bourassa	Address	185 Concession St., Lakefield ON, K0L 2H0
Telephone	905-829-8666 x 263	Telephone	2165
Facsimile		Facsimile	705-652-6365
Email	rbourassa@thurber.ca	Email	jill.campbell@sgs.com
Project	33309, Emo, ON.	SGS Reference	CA40015-SEP22
Order Number		Received	09/01/2022
Samples	Ground Water (1)	Approved	09/14/2022
		Report Number	CA40015-SEP22 R1
		Date Reported	11/11/2022

COMMENTS

MAC - Maximum Acceptable Concentration

AO/OG - Aesthetic Objective / Operational Guideline

NR - Not reportable under applicable Provincial drinking water regulations as per client.

Temperature of Sample upon Receipt: 9 degrees C

Cooling Agent Present: YES

Custody Seal Present: YES

Chain of Custody Number: 010115

SIGNATORIES

Jill Campbell, B.Sc.,GISAS





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FINAL REPORT

CA40015-SEP22 R1

Client: Thurber Engineering Ltd.

Project: 33309, Emo, ON.

Project Manager: Rachel Bourassa

Samplers: Greg Stanhope

MATRIX: WATER

Sample Number 8
Sample Name 22-01
Sample Matrix Ground Water
Sample Date 28/08/2022

L1 = PWQQ_L / WATER / - - Table 2 - General - July 1999 PIBS 3303E

Parameter	Units	RL	L1	Result
General Chemistry				
Total Suspended Solids	mg/L	2		23100
Alkalinity	mg/L as CaCO3	2		407
Bicarbonate	mg/L as CaCO3	2		407
Carbonate	mg/L as CaCO3	2		< 2
OH	mg/L as CaCO3	2		< 2
Colour	TCU	3		17
Conductivity	uS/cm	2		1030
Turbidity	NTU	0.10		>4000
Ammonia+Ammonium (N)	as N mg/L	0.1		0.9
Phosphorus (total reactive)	mg/L	0.03		0.19
Total Organic Carbon	mg/L	1		8
Ion Ratio	-	-9999		28.04
Total Dissolved Solids (calculated)	mg/L	-9999		6469
Conductivity (calculated)	uS/cm	-9999		17434
Langeliers Index 4° C	@ 4° C	-9999		2.22
Saturation pH 4°C	pHs @ 4°C	-9999		5.79



FINAL REPORT

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MATRIX: WATER

Sample Number 8
Sample Name 22-01
Sample Matrix Ground Water
Sample Date 28/08/2022

L1 = PWQO_L / WATER / - - Table 2 - General - July 1999 PIBS 3303E

Parameter	Units	RL	L1	Result
Metals and Inorganics				
Fluoride	mg/L	0.06		0.35
Bromide	mg/L	0.3		< 0.3
Nitrite (as N)	as N mg/L	0.03		0.24
Nitrate (as N)	as N mg/L	0.06		0.43
Sulphate	mg/L	0.2		140
Hardness (dissolved)	mg/L as CaCO ₃	0.05		424
Aluminum (dissolved)	mg/L	0.001	0.075	0.069
Aluminum (0.2µm)	mg/L	0.001	0.075	0.006
Arsenic (dissolved)	mg/L	0.0002		0.0027
Boron (dissolved)	mg/L	0.002		0.179
Barium (dissolved)	mg/L	0.00008		0.0493
Beryllium (dissolved)	mg/L	0.000007		0.000013
Cobalt (dissolved)	mg/L	0.000004		0.00491
Calcium (dissolved)	mg/L	0.01		95.3
Cadmium (dissolved)	mg/L	0.000003		0.000342
Copper (dissolved)	mg/L	0.0002		0.0084
Chromium (dissolved)	mg/L	0.00008		< 0.00008
Iron (dissolved)	mg/L	0.007		0.050
Potassium (dissolved)	mg/L	0.009		7.20
Magnesium (dissolved)	mg/L	0.001		45.3
Manganese (dissolved)	mg/L	0.00001		0.0961
Molybdenum (dissolved)	mg/L	0.00004		0.03848



FINAL REPORT

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MATRIX: WATER

Sample Number 8
Sample Name 22-01
Sample Matrix Ground Water
Sample Date 28/08/2022

L1 = PWQO_L / WATER / - - Table 2 - General - July 1999 PIBS 3303E

Parameter	Units	RL	L1	Result
Metals and Inorganics (continued)				
Nickel (dissolved)	mg/L	0.0001		0.0041
Sodium (dissolved)	mg/L	0.01		55.9
Phosphorus (dissolved)	mg/L	0.003		0.032
Lead (dissolved)	mg/L	0.00009		0.00107
Silicon (dissolved)	mg/L	0.02		5.84
Silver (dissolved)	mg/L	0.00005		< 0.00005
Strontium (dissolved)	mg/L	0.00008		0.448
Thallium (dissolved)	mg/L	0.000005		0.000035
Tin (dissolved)	mg/L	0.00006		0.00026
Titanium (dissolved)	mg/L	0.00005		0.00506
Antimony (dissolved)	mg/L	0.0009		0.0013
Selenium (dissolved)	mg/L	0.00004		0.00213
Uranium (dissolved)	mg/L	0.000002		0.0199
Vanadium (dissolved)	mg/L	0.00001		0.00234
Zinc (dissolved)	mg/L	0.002		0.055
Hardness	mg/L as CaCO3	0.05		16500
Aluminum (total)	mg/L	0.001		0.333
Arsenic (total)	mg/L	0.0002	0.005	0.0264
Boron (total)	mg/L	0.002	0.2	0.434
Barium (total)	mg/L	0.00008		1.48
Beryllium (total)	mg/L	0.000007	1.1	0.000220
Cobalt (total)	mg/L	0.000004	0.0009	0.0733



FINAL REPORT

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MATRIX: WATER

Sample Number 8
Sample Name 22-01
Sample Matrix Ground Water
Sample Date 28/08/2022

L1 = PWQO_L / WATER / - - Table 2 - General - July 1999 PIBS 3303E

Parameter	Units	RL	L1	Result
Metals and Inorganics (continued)				
Calcium (total)	mg/L	0.01		4910
Cadmium (total)	mg/L	0.000003	0.0005	0.00731
Copper (total)	mg/L	0.0002	0.005	0.0022
Chromium (total)	mg/L	0.00008	0.1	< 0.00008
Iron (total)	mg/L	0.007	0.3	6.68
Potassium (total)	mg/L	0.009		30.5
Magnesium (total)	mg/L	0.001		1040
Manganese (total)	mg/L	0.00001		23.6
Molybdenum (total)	mg/L	0.00004	0.04	0.0278
Nickel (total)	mg/L	0.0001	0.025	0.141
Sodium (total)	mg/L	0.01		66.1
Phosphorus (total)	mg/L	0.003	0.01	3.11
Lead (total)	mg/L	0.00009	0.025	< 0.00009
Silicon (total)	mg/L	0.02		24.8
Silver (total)	mg/L	0.00005	0.0001	< 0.00005
Strontium (total)	mg/L	0.00008		4.72
Thallium (total)	mg/L	0.000005	0.0003	0.000380
Tin (total)	mg/L	0.00006		< 0.00006
Titanium (total)	mg/L	0.00005		0.00054
Antimony (total)	mg/L	0.0009	0.02	< 0.0009
Selenium (total)	mg/L	0.00004	0.1	0.00101
Uranium (total)	mg/L	0.000002	0.005	0.000080



FINAL REPORT

CA40015-SEP22 R1

Client: Thurber Engineering Ltd.

Project: 33309, Emo, ON.

Project Manager: Rachel Bourassa

Samplers: Greg Stanhope

MATRIX: WATER

Sample Number 8
Sample Name 22-01
Sample Matrix Ground Water
Sample Date 28/08/2022

L1 = PWQQ_L / WATER / - - Table 2 - General - July 1999 PIBS 3303E

Parameter	Units	RL	L1	Result
Metals and Inorganics (continued)				
Vanadium (total)	mg/L	0.00001	0.006	0.00445
Zinc (total)	mg/L	0.002	0.02	0.175
Cation sum	meq/L	-9999		336.68
Anion Sum	meq/L	-9999		12.01
Anion-Cation Balance	% difference	-9999		93.11
Other (ORP)				
pH	No unit	0.05	8.6	8.01
Chloride	mg/L	0.2		30
Mercury (total)	mg/L	0.00001	0.0002	0.00108
Mercury (dissolved)	mg/L	0.00001	0.0002	0.00007

EXCEEDANCE SUMMARY

				PWQO_L / WATER / - - Table 2 - General - July 1999 PIBS 3303E L1
Parameter	Method	Units	Result	

22-01

Mercury	EPA 7471A/SM 3112B	mg/L	0.00108	0.0002
Arsenic	SM 3030/EPA 200.8	mg/L	0.0264	0.005
Boron	SM 3030/EPA 200.8	mg/L	0.434	0.2
Cadmium	SM 3030/EPA 200.8	mg/L	0.00731	0.0005
Cobalt	SM 3030/EPA 200.8	mg/L	0.0733	0.0009
Iron	SM 3030/EPA 200.8	mg/L	6.68	0.3
Nickel	SM 3030/EPA 200.8	mg/L	0.141	0.025
Phosphorus	SM 3030/EPA 200.8	mg/L	3.11	0.01
Thallium	SM 3030/EPA 200.8	mg/L	0.000380	0.0003
Zinc	SM 3030/EPA 200.8	mg/L	0.175	0.02



FINAL REPORT

CA40015-SEP22 R1

QC SUMMARY

Alkalinity

Method: SM 2320 | Internal ref.: ME-CA-1ENVIEWL-LAK-AN-006

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Alkalinity	EWL0055-SEP22	mg/L as CaCO3	2	< 2	0	20	100	80	120	NA		

Ammonia by SFA

Method: SM 4500 | Internal ref.: ME-CA-1ENVISFA-LAK-AN-007

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Ammonia+Ammonium (N)	SKA0060-SEP22	as N mg/L	0.1	<0.1	ND	10	101	90	110	102	75	125
Ammonia+Ammonium (N)	SKA0069-SEP22	as N mg/L	0.1	<0.1	2	10	102	90	110	99	75	125



FINAL REPORT

CA40015-SEP22 R1

QC SUMMARY

Anions by IC

Method: EPA300/MA300-Ions1.3 | Internal ref.: ME-CA-IENVIIC-LAK-AN-001

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Bromide	DIO0070-SEP22	mg/L	0.3	<0.3	ND	20	99	90	110	102	75	125
Nitrite (as N)	DIO0070-SEP22	mg/L	0.03	<0.03	ND	20	99	90	110	102	75	125
Nitrate (as N)	DIO0070-SEP22	mg/L	0.06	<0.06	ND	20	100	90	110	103	75	125
Chloride	DIO0136-SEP22	mg/L	0.2	<0.2	2	20	100	90	110	100	75	125
Sulphate	DIO0136-SEP22	mg/L	0.2	<0.2	2	20	100	90	110	97	75	125
Chloride	DIO0178-SEP22	mg/L	0.2	<0.2	16	20	103	90	110	106	75	125
Sulphate	DIO0178-SEP22	mg/L	0.2	<0.2	2	20	97	90	110	NV	75	125

Carbon by SFA

Method: SM 5310 | Internal ref.: ME-CA-IENVISFA-LAK-AN-009

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Total Organic Carbon	SKA5019-SEP22	mg/L	1	<1	0	20	100	90	110	96	75	125



FINAL REPORT

CA40015-SEP22 R1

QC SUMMARY

Carbonate/Bicarbonate

Method: SM 2320 | Internal ref.: ME-CA-ENVIEWL-LAK-AN-006

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Carbonate	EWL0055-SEP22	mg/L as CaCO3	2	< 2	ND	10	NA	90	110	NA		
Bicarbonate	EWL0055-SEP22	mg/L as CaCO3	2	< 2	0	10	NA	90	110	NA		
OH	EWL0055-SEP22	mg/L as CaCO3	2	< 2	ND	10	NA	90	110	NA		

Colour

Method: SM 2120 | Internal ref.: ME-CA-ENVIEWL-LAK-AN-002

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Colour	EWL0075-SEP22	TCU	3	< 3	ND	10	100	80	120	NA		



FINAL REPORT

CA40015-SEP22 R1

QC SUMMARY

Conductivity
Method: SM 2510 | Internal ref.: ME-CA-IENVIEWL-LAK-AN-006

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Conductivity	EWL0055-SEP22	uS/cm	2	< 2	0	20	99	90	110	NA		

Fluoride by Specific Ion Electrode
Method: SM 4500 | Internal ref.: ME-CA-IENVIEWL-LAK-AN-014

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Fluoride	EWL0070-SEP22	mg/L	0.06	<0.06	ND	10	103	90	110	97	75	125
Fluoride	EWL0083-SEP22	mg/L	0.06	<0.06	0	10	102	90	110	99	75	125

Mercury by CVAAS
Method: EPA 7471A/SM 3112B | Internal ref.: ME-CA-IENVISPE-LAK-AN-004

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Mercury (total)	EHG0005-SEP22	mg/L	0.00001	< 0.00001	18	20	105	80	120	101	70	130



FINAL REPORT

CA40015-SEP22 R1

QC SUMMARY

Metals in aqueous samples - ICP-MS
Method: SM 3030/EPA 200.8 | Internal ref.: ME-CA-ENVISPE-LAK-AN-006

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Silver (total)	EMS0061-SEP22	mg/L	0.00005	<0.00005	ND	20	107	90	110	99	70	130
Aluminum (total)	EMS0061-SEP22	mg/L	0.001	<0.001	3	20	100	90	110	99	70	130
Aluminum (0.2µm)	EMS0061-SEP22	mg/L	0.001	<0.001	3	20	100	90	110	99	70	130
Arsenic (total)	EMS0061-SEP22	mg/L	0.0002	<0.0002	2	20	102	90	110	91	70	130
Barium (total)	EMS0061-SEP22	mg/L	0.00008	<0.00002	10	20	106	90	110	108	70	130
Beryllium (total)	EMS0061-SEP22	mg/L	0.000007	<0.000007	ND	20	96	90	110	88	70	130
Boron (total)	EMS0061-SEP22	mg/L	0.002	<0.002	12	20	101	90	110	99	70	130
Calcium (total)	EMS0061-SEP22	mg/L	0.01	<0.01	3	20	101	90	110	102	70	130
Cadmium (total)	EMS0061-SEP22	mg/L	0.000003	<0.000003	ND	20	104	90	110	104	70	130
Cobalt (total)	EMS0061-SEP22	mg/L	0.000004	<0.000004	10	20	105	90	110	107	70	130
Chromium (total)	EMS0061-SEP22	mg/L	0.00008	<0.00008	1	20	99	90	110	92	70	130
Copper (total)	EMS0061-SEP22	mg/L	0.0002	<0.0002	ND	20	103	90	110	119	70	130
Iron (total)	EMS0061-SEP22	mg/L	0.007	<0.007	ND	20	97	90	110	125	70	130
Potassium (total)	EMS0061-SEP22	mg/L	0.009	<0.009	1	20	96	90	110	114	70	130
Magnesium (total)	EMS0061-SEP22	mg/L	0.001	<0.001	0	20	95	90	110	109	70	130
Manganese (total)	EMS0061-SEP22	mg/L	0.00001	<0.00001	9	20	101	90	110	91	70	130
Molybdenum (total)	EMS0061-SEP22	mg/L	0.00004	<0.00004	3	20	102	90	110	108	70	130
Sodium (total)	EMS0061-SEP22	mg/L	0.01	<0.01	3	20	98	90	110	110	70	130
Nickel (total)	EMS0061-SEP22	mg/L	0.0001	<0.0001	4	20	99	90	110	104	70	130
Lead (total)	EMS0061-SEP22	mg/L	0.00009	<0.00001	0	20	106	90	110	111	70	130



FINAL REPORT

CA40015-SEP22 R1

QC SUMMARY

Metals in aqueous samples - ICP-MS (continued)
Method: SM 3030/EPA 200.8 | Internal ref.: ME-CA-~~I~~ENVISPE-LAK-AN-006

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Phosphorus (total)	EMS0061-SEP22	mg/L	0.003	<0.003	13	20	96	90	110	NV	70	130
Antimony (total)	EMS0061-SEP22	mg/L	0.0009	<0.0009	ND	20	98	90	110	128	70	130
Selenium (total)	EMS0061-SEP22	mg/L	0.00004	<0.00004	ND	20	102	90	110	89	70	130
Silicon (total)	EMS0061-SEP22	mg/L	0.02	<0.02	13	20	93	90	110	NV	70	130
Tin (total)	EMS0061-SEP22	mg/L	0.00006	<0.00006	ND	20	108	90	110	NV	70	130
Strontium (total)	EMS0061-SEP22	mg/L	0.00008	<0.00002	0	20	104	90	110	105	70	130
Titanium (total)	EMS0061-SEP22	mg/L	0.00005	<0.00005	6	20	101	90	110	NV	70	130
Thallium (total)	EMS0061-SEP22	mg/L	0.000005	<0.000005	ND	20	96	90	110	99	70	130
Uranium (total)	EMS0061-SEP22	mg/L	0.000002	<0.000002	1	20	108	90	110	118	70	130
Vanadium (total)	EMS0061-SEP22	mg/L	0.00001	<0.00001	3	20	99	90	110	102	70	130
Zinc (total)	EMS0061-SEP22	mg/L	0.002	<0.002	2	20	101	90	110	110	70	130

pH
Method: SM 4500 | Internal ref.: ME-CA-~~I~~ENVIEWL-LAK-AN-006

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
pH	EWL0055-SEP22	No unit	0.05	NA	1		100			NA		



FINAL REPORT

CA40015-SEP22 R1

QC SUMMARY

Reactive Phosphorus by SFA
Method: SM 4500-P F | Internal ref.: ME-CA-IENVISFA-LAK-AN-004

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Phosphorus (total reactive)	SKA0035-SEP22	mg/L	0.03	<0.03	ND	10	104	90	110	93	75	125
Phosphorus (total reactive)	SKA0048-SEP22	mg/L	0.03	<0.03	6	10	108	90	110	NV	75	125

Suspended Solids
Method: SM 2540D | Internal ref.: ME-CA-IENVIEWL-LAK-AN-004

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Total Suspended Solids	EWL0066-SEP22	mg/L	2	< 2	1	10	99	90	110	NA		

Turbidity
Method: SM 2130 | Internal ref.: ME-CA-IENVIEWL-LAK-AN-003

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Turbidity	EWL0064-SEP22	NTU	0.10	< 0.10	4	10	100	90	110	NA		



QC SUMMARY

Method Blank: a blank matrix that is carried through the entire analytical procedure. Used to assess laboratory contamination.

Duplicate: Paired analysis of a separate portion of the same sample that is carried through the entire analytical procedure. Used to evaluate measurement precision.

LCS/Spike Blank: Laboratory control sample or spike blank refer to a blank matrix to which a known amount of analyte has been added. Used to evaluate analyte recovery and laboratory accuracy without sample matrix effects.

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

Reference Material: a material or substance matrix matched to the samples that contains a known amount of the analyte of interest. A reference material may be used in place of a matrix spike.

RL: Reporting limit

RPD: Relative percent difference

AC: Acceptance criteria

Multielement Scan Qualifier: as the number of analytes in a scan increases, so does the chance of a limit exceedance by random chance as opposed to a real method problem. Thus, in multielement scans, for the LCS and matrix spike, up to 10% of the analytes may exceed the quoted limits by up to 10% absolute and the spike is considered acceptable.

Duplicate Qualifier: for duplicates as the measured result approaches the RL, the uncertainty associated with the value increases dramatically, thus duplicate acceptance limits apply only where the average of the two duplicates is greater than five times the RL.

Matrix Spike Qualifier: for matrix spikes, as the concentration of the native analyte increases, the uncertainty of the matrix spike recovery increases. Thus, the matrix spike acceptance limits apply only when the concentration of the matrix spike is greater than or equal to the concentration of the native analyte.

LEGEND

FOOTNOTES

NSS Insufficient sample for analysis.

RL Reporting Limit.

↑ Reporting limit raised.

↓ Reporting limit lowered.

NA The sample was not analysed for this analyte

ND Non Detect

Results relate only to the sample tested.

Data reported represent the sample as submitted to SGS. Solid samples expressed on a dry weight basis.

"Temperature Upon Receipt" is representative of the whole shipment and may not reflect the temperature of individual samples.

Analysis conducted on samples submitted pursuant to or as part of Reg. 153/04, are in accordance to the "Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act and Excess Soil Quality" published by the Ministry and dated March 9, 2004 as amended.

SGS provides criteria information (such as regulatory or guideline limits and summary of limit exceedances) as a service. Every attempt is made to ensure the criteria information in this report is accurate and current, however, it is not guaranteed. Comparison to the most current criteria is the responsibility of the client and SGS assumes no responsibility for the accuracy of the criteria levels indicated.

SGS Canada Inc. statement of conformity decision rule does not consider uncertainty when analytical results are compared to a specified standard or regulation.

This document is issued, on the Client's behalf, by the Company under its General Conditions of Service available on request and accessible at http://www.sgs.com/terms_and_conditions.htm.

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This report supersedes all previous versions.

-- End of Analytical Report --



Environment, Health & Safety

Request for Laboratory Services and CHAIN OF CUSTODY

- Lakefield: 185 Concession St., Lakefield, ON K0L 2H0 Phone: 705-652-2000 Fax: 705-652-6365 Web: www.sgs.com/environment
 - London: 657 Consortium Court, London, ON, N6E 2S8 Phone: 519-672-4500 Toll Free: 877-848-8060 Fax: 519-672-0361

No: 010115

Page 1 of 1

Laboratory Information Section - Lab use only

Received By: Scott R
 Received Date (mm/dd/yyyy): 09/01/2022 (mm/dd/yyyy)
 Received Time: 11:30

Received By (signature): SCustody Seal Present: ☒Custody Seal Intact: ☒Cooling Agent Present: ☒Temperature Upon Receipt (°C): 12.2
9.2 x 3

LAB LIMS #:

SRPT-40015-16

REPORT INFORMATION	INVOICE INFORMATION	PROJECT INFORMATION
Company: <u>Thurber Eng LTD</u>	<input checked="" type="checkbox"/> (same as Report Information)	Quotation #: _____ P.O. #: _____
Contact: <u>Rachel Bourassa</u>	Company: _____	Project #: <u>33309</u> Site Location/ID: <u>EMO, ON</u>
Address: <u>2010 Winston Park Dr</u>	Contact: _____	TURNAROUND TIME (TAT) REQUIRED
# <u>103 Oakville ON L6M 5R7</u>	Address: _____	<input checked="" type="checkbox"/> Regular TAT (5-7 days) TAT's are quoted in business days (exclude statutory holidays & weekends). Samples received after 6pm or on weekends: TAT begins next business day
Phone: <u>416 523 1015</u>	Phone: _____	RUSH TAT (Additional Charges May Apply): <input type="checkbox"/> 1 Day <input type="checkbox"/> 2 Days <input type="checkbox"/> 3 Days <input type="checkbox"/> 4 Days
Email: <u>r.bourassa@thurber.ca</u>	Email: _____	PLEASE CONFIRM RUSH FEASIBILITY WITH SGS REPRESENTATIVE PRIOR TO SUBMISSION
		Specify Due Date: _____ Rush Confirmation ID: _____

REGULATIONS					NOTE: DRINKING (POTABLE) WATER SAMPLES FOR HUMAN CONSUMPTION MUST BE SUBMITTED WITH SGS DRINKING WATER CHAIN OF CUSTODY															COMMENTS:																	
Regulation 153/04:			Other Regulations:			Sewer By-Law:			ANALYSIS REQUESTED																												
<input type="checkbox"/> Table 1	<input type="checkbox"/> R/P/I	Soil Texture:	<input type="checkbox"/> Reg 347/558 (3 Day min TAT)	<input type="checkbox"/> PWQO	<input type="checkbox"/> MMR	<input type="checkbox"/> Sanitary	<input type="checkbox"/> PAH	<input type="checkbox"/> ABN	<input type="checkbox"/> SVOC(all)	<input type="checkbox"/> PCB Total	<input type="checkbox"/> Aroclor	<input type="checkbox"/> VOC	<input type="checkbox"/> BTEX	<input type="checkbox"/> F1-F4	<input type="checkbox"/> F2-F4	<input type="checkbox"/> VOC	<input type="checkbox"/> BTEX	<input type="checkbox"/> THM	<input type="checkbox"/> OP		<input type="checkbox"/> Pesticides	<input type="checkbox"/> OC	<input type="checkbox"/> PCB	<input type="checkbox"/> TCLP M&I	<input type="checkbox"/> VOC	<input type="checkbox"/> B(a)P	<input type="checkbox"/> ABN	<input type="checkbox"/> Ignit.	<input type="checkbox"/> Water Pkg	<input type="checkbox"/> Gen.	<input type="checkbox"/> Ext.	<input type="checkbox"/> Sewer Use:	<input type="checkbox"/> TSS	<input type="checkbox"/> Lab Filtered Metals	<input type="checkbox"/> Corrosivity	<input type="checkbox"/> General Water Characterization	<input type="checkbox"/> Package
<input type="checkbox"/> Table 2	<input type="checkbox"/> I/C/C	<input type="checkbox"/> Coarse	<input type="checkbox"/> CCME	<input type="checkbox"/> Other:	<input type="checkbox"/> Storm	<input type="checkbox"/> Field Filtered (Y/N)	<input type="checkbox"/> Metals & Inorganics	<input type="checkbox"/> PAH	<input type="checkbox"/> ABN	<input type="checkbox"/> SVOC(all)	<input type="checkbox"/> PCB Total	<input type="checkbox"/> Aroclor	<input type="checkbox"/> VOC	<input type="checkbox"/> BTEX	<input type="checkbox"/> F1-F4	<input type="checkbox"/> F2-F4	<input type="checkbox"/> VOC	<input type="checkbox"/> BTEX	<input type="checkbox"/> THM	<input type="checkbox"/> OP	<input type="checkbox"/> Pesticides	<input type="checkbox"/> OC	<input type="checkbox"/> PCB	<input type="checkbox"/> TCLP M&I	<input type="checkbox"/> VOC	<input type="checkbox"/> B(a)P	<input type="checkbox"/> ABN	<input type="checkbox"/> Ignit.	<input type="checkbox"/> Water Pkg	<input type="checkbox"/> Gen.	<input type="checkbox"/> Ext.	<input type="checkbox"/> Sewer Use:	<input type="checkbox"/> TSS	<input type="checkbox"/> Lab Filtered Metals	<input type="checkbox"/> Corrosivity	<input type="checkbox"/> General Water Characterization	<input type="checkbox"/> Package
<input type="checkbox"/> Table 3	<input type="checkbox"/> A/O	<input type="checkbox"/> Medium	<input type="checkbox"/> MISA																																		
<input type="checkbox"/> Table		<input type="checkbox"/> Fine																																			

RECORD OF SITE CONDITION (RSC) <input type="checkbox"/> YES <input type="checkbox"/> NO				ANALYSIS REQUESTED															COMMENTS:																		
SAMPLE IDENTIFICATION	DATE SAMPLED	TIME SAMPLED	# OF BOTTLES	MATRIX	Field Filtered (Y/N)	Metals & Inorganics	PAH	ABN	SVOC(all)	PCB Total	Aroclor	VOC	BTEX	F1-F4	F2-F4	VOC	BTEX	THM		OP	Pesticides	OC	PCB	TCLP M&I	VOC	B(a)P	ABN	Ignit.	Water Pkg	Gen.	Ext.	Sewer Use:	TSS	Lab Filtered Metals	Corrosivity	General Water Characterization	Package
1 Cameron Creek SW	Aug 28/22		15	Water																																	
2 22-01	Aug 28/22		14	Water																																	
3																																					
4																																					
5																																					
6																																					
7																																					
8																																					
9																																					
10																																					
11																																					
12																																					

Observations/Comments/Special Instructions

Corrosivity Includes PM, Soluble Sulphate, Chloride, Resistivity, Electrical ConductivitySampled By (NAME): Greg StanhopeSignature: GSDate: Aug 1 28 1 2022

(mm/dd/yy)

Pink Copy - Client

Relinquished by (NAME): Rachel BourassaSignature: Rachel BourassaDate: Aug 1 31 1 2022

(mm/dd/yy)

Yellow & White Copy - SGS

Revision #: 1.1

Date of Issue: 04 April, 2018



FINAL REPORT

CA40015-SEP22 R1

33309, Emo, ON.

Prepared for

Thurber Engineering Ltd.

First Page

CLIENT DETAILS

Client Thurber Engineering Ltd.

Address 103, 2010 Winston Park Drive
Oakville, ON
L6H 5R7, Canada

Contact Rachel Bourassa

Telephone 905-829-8666 x 263

Facsimile

Email rbourassa@thurber.ca

Project 33309, Emo, ON.

Order Number

Samples Surface Water (1)

LABORATORY DETAILS

Project Specialist Jill Campbell, B.Sc.,GISAS

Laboratory SGS Canada Inc.

Address 185 Concession St., Lakefield ON, K0L 2H0

Telephone 2165

Facsimile 705-652-6365

Email jill.campbell@sgs.com

SGS Reference CA40015-SEP22

Received 09/01/2022

Approved 09/14/2022

Report Number CA40015-SEP22 R1

Date Reported 11/11/2022

COMMENTS

MAC - Maximum Acceptable Concentration

AO/OG - Aesthetic Objective / Operational Guideline

NR - Not reportable under applicable Provincial drinking water regulations as per client.

Temperature of Sample upon Receipt: 9 degrees C

Cooling Agent Present: YES

Custody Seal Present: YES

Chain of Custody Number: 010115

SIGNATORIES

Jill Campbell, B.Sc.,GISAS





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FINAL REPORT

CA40015-SEP22 R1

Client: Thurber Engineering Ltd.

Project: 33309, Emo, ON.

Project Manager: Rachel Bourassa

Samplers: Greg Stanhope

MATRIX: WATER

Sample Number 7

Sample Name Cameron Creek
SW

Sample Matrix Surface Water

Sample Date 28/08/2022

L1 = PWQQ_L / WATER / - - Table 2 - General - July 1999 PIBS 3303E

Parameter	Units	RL	L1	Result
General Chemistry				
Total Suspended Solids	mg/L	2		4
Alkalinity	mg/L as CaCO ₃	2		226
Bicarbonate	mg/L as CaCO ₃	2		226
Carbonate	mg/L as CaCO ₃	2		< 2
OH	mg/L as CaCO ₃	2		< 2
Colour	TCU	3		144
Conductivity	uS/cm	2		436
Turbidity	NTU	0.10		4.1
Ammonia+Ammonium (N)	as N mg/L	0.1		< 0.1
Phosphorus (total reactive)	mg/L	0.03		0.03
Total Organic Carbon	mg/L	1		38
Ion Ratio	-	-9999		1.03
Total Dissolved Solids (calculated)	mg/L	-9999		222
Conductivity (calculated)	uS/cm	-9999		470
Langeliers Index 4° C	@ 4° C	-9999		0.18
Saturation pH 4°C	pHs @ 4°C	-9999		7.84



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CA40015-SEP22 R1

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MATRIX: WATER

Sample Number 7

Sample Name Cameron Creek
SW

Sample Matrix Surface Water

Sample Date 28/08/2022

L1 = PWQQ_L / WATER / - - Table 2 - General - July 1999 PIBS 3303E

Parameter	Units	RL	L1	Result
Metals and Inorganics				
Fluoride	mg/L	0.06		0.11
Bromide	mg/L	0.3		< 0.3
Nitrite (as N)	as N mg/L	0.03		< 0.03
Nitrate (as N)	as N mg/L	0.06		< 0.06
Sulphate	mg/L	0.2		1.0
Hardness (dissolved)	mg/L as CaCO ₃	0.05		236
Aluminum (dissolved)	mg/L	0.001	0.075	0.006
Aluminum (0.2µm)	mg/L	0.001	0.075	0.007
Arsenic (dissolved)	mg/L	0.0002		0.0033
Boron (dissolved)	mg/L	0.002		0.021
Barium (dissolved)	mg/L	0.00008		0.0195
Beryllium (dissolved)	mg/L	0.000007		0.000018
Cobalt (dissolved)	mg/L	0.000004		0.000562
Calcium (dissolved)	mg/L	0.01		60.9
Cadmium (dissolved)	mg/L	0.000003		< 0.000003
Copper (dissolved)	mg/L	0.0002		0.0007
Chromium (dissolved)	mg/L	0.00008		< 0.00008
Iron (dissolved)	mg/L	0.007		0.240
Potassium (dissolved)	mg/L	0.009		2.05
Magnesium (dissolved)	mg/L	0.001		20.5
Manganese (dissolved)	mg/L	0.00001		0.153



FINAL REPORT

CA40015-SEP22 R1

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MATRIX: WATER

Sample Number 7

Sample Name Cameron Creek
SW

Sample Matrix Surface Water

Sample Date 28/08/2022

L1 = PWQQ_L / WATER / - - Table 2 - General - July 1999 PIBS 3303E

Parameter	Units	RL	L1	Result
Metals and Inorganics (continued)				
Molybdenum (dissolved)	mg/L	0.00004		0.00117
Nickel (dissolved)	mg/L	0.0001		0.0032
Sodium (dissolved)	mg/L	0.01		2.83
Phosphorus (dissolved)	mg/L	0.003		0.045
Lead (dissolved)	mg/L	0.00009		< 0.00009
Silicon (dissolved)	mg/L	0.02		9.30
Silver (dissolved)	mg/L	0.00005		< 0.00005
Strontium (dissolved)	mg/L	0.00008		0.114
Thallium (dissolved)	mg/L	0.000005		< 0.000005
Tin (dissolved)	mg/L	0.00006		< 0.00006
Titanium (dissolved)	mg/L	0.00005		0.00062
Antimony (dissolved)	mg/L	0.0009		< 0.0009
Selenium (dissolved)	mg/L	0.00004		0.00022
Uranium (dissolved)	mg/L	0.000002		0.000365
Vanadium (dissolved)	mg/L	0.00001		0.00078
Zinc (dissolved)	mg/L	0.002		< 0.002
Hardness	mg/L as CaCO ₃	0.05		226
Aluminum (total)	mg/L	0.001		0.106
Arsenic (total)	mg/L	0.0002	0.005	0.0034
Boron (total)	mg/L	0.002	0.2	0.018
Barium (total)	mg/L	0.00008		0.0223



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Samplers: Greg Stanhope

MATRIX: WATER

Sample Number 7

Sample Name Cameron Creek
SW

Sample Matrix Surface Water

Sample Date 28/08/2022

L1 = PWQO_L / WATER / - - Table 2 - General - July 1999 PIBS 3303E

Parameter	Units	RL	L1	Result
Metals and Inorganics (continued)				
Beryllium (total)	mg/L	0.000007	1.1	0.000012
Cobalt (total)	mg/L	0.000004	0.0009	0.00102
Calcium (total)	mg/L	0.01		56.3
Cadmium (total)	mg/L	0.000003	0.0005	< 0.000003
Copper (total)	mg/L	0.0002	0.005	0.0008
Chromium (total)	mg/L	0.00008	0.1	0.00031
Iron (total)	mg/L	0.007	0.3	0.556
Potassium (total)	mg/L	0.009		2.11
Magnesium (total)	mg/L	0.001		20.7
Manganese (total)	mg/L	0.00001		0.475
Molybdenum (total)	mg/L	0.00004	0.04	0.00135
Nickel (total)	mg/L	0.0001	0.025	0.0035
Sodium (total)	mg/L	0.01		2.92
Phosphorus (total)	mg/L	0.003	0.01	0.059
Lead (total)	mg/L	0.00009	0.025	0.00011
Silicon (total)	mg/L	0.02		8.10
Silver (total)	mg/L	0.00005	0.0001	< 0.00005
Strontium (total)	mg/L	0.00008		0.117
Thallium (total)	mg/L	0.000005	0.0003	< 0.000005
Tin (total)	mg/L	0.00006		< 0.00006
Titanium (total)	mg/L	0.00005		0.00438



FINAL REPORT

CA40015-SEP22 R1

Client: Thurber Engineering Ltd.

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Project Manager: Rachel Bourassa

Samplers: Greg Stanhope

MATRIX: WATER

Sample Number 7

Sample Name Cameron Creek
SW

Sample Matrix Surface Water

Sample Date 28/08/2022

L1 = PWQQ_L / WATER / - - Table 2 - General - July 1999 PIBS 3303E

Parameter	Units	RL	L1	Result
Metals and Inorganics (continued)				
Antimony (total)	mg/L	0.0009	0.02	< 0.0009
Selenium (total)	mg/L	0.00004	0.1	0.00016
Uranium (total)	mg/L	0.000002	0.005	0.000375
Vanadium (total)	mg/L	0.00001	0.006	0.00115
Zinc (total)	mg/L	0.002	0.02	< 0.002
Cation sum	meq/L	-9999		4.78
Anion Sum	meq/L	-9999		4.62
Anion-Cation Balance	% difference	-9999		1.70

Other (ORP)

pH	No unit	0.05	8.6	8.02
Chloride	mg/L	0.2		2.8
Mercury (total)	mg/L	0.00001	0.0002	< 0.00001
Mercury (dissolved)	mg/L	0.00001	0.0002	< 0.00001



EXCEEDANCE SUMMARY

				PWQO_L / WATER
				/ - - Table 2 -
				General - July 1999
				PIBS 3303E
Parameter	Method	Units	Result	L1

Cameron Creek SW

Cobalt	SM 3030/EPA 200.8	mg/L	0.00102	0.0009
Iron	SM 3030/EPA 200.8	mg/L	0.556	0.3
Phosphorus	SM 3030/EPA 200.8	mg/L	0.059	0.01



FINAL REPORT

CA40015-SEP22 R1

QC SUMMARY

Alkalinity

Method: SM 2320 | Internal ref.: ME-CA-1ENVIEWL-LAK-AN-006

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Alkalinity	EWL0055-SEP22	mg/L as CaCO3	2	< 2	0	20	100	80	120	NA		

Ammonia by SFA

Method: SM 4500 | Internal ref.: ME-CA-1ENVISFA-LAK-AN-007

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Ammonia+Ammonium (N)	SKA0060-SEP22	as N mg/L	0.1	<0.1	ND	10	101	90	110	102	75	125
Ammonia+Ammonium (N)	SKA0069-SEP22	as N mg/L	0.1	<0.1	2	10	102	90	110	99	75	125



FINAL REPORT

CA40015-SEP22 R1

QC SUMMARY

Anions by IC
Method: EPA300/MA300-Ions1.3 | Internal ref.: ME-CA-IENVIIC-LAK-AN-001

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Bromide	DIO0070-SEP22	mg/L	0.3	<0.3	ND	20	99	90	110	102	75	125
Nitrite (as N)	DIO0070-SEP22	mg/L	0.03	<0.03	ND	20	99	90	110	102	75	125
Nitrate (as N)	DIO0070-SEP22	mg/L	0.06	<0.06	ND	20	100	90	110	103	75	125
Chloride	DIO0136-SEP22	mg/L	0.2	<0.2	2	20	100	90	110	100	75	125
Sulphate	DIO0136-SEP22	mg/L	0.2	<0.2	2	20	100	90	110	97	75	125
Chloride	DIO0178-SEP22	mg/L	0.2	<0.2	16	20	103	90	110	106	75	125
Sulphate	DIO0178-SEP22	mg/L	0.2	<0.2	2	20	97	90	110	NV	75	125

Carbon by SFA
Method: SM 5310 | Internal ref.: ME-CA-IENVISFA-LAK-AN-009

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Total Organic Carbon	SKA5019-SEP22	mg/L	1	<1	0	20	100	90	110	96	75	125



FINAL REPORT

CA40015-SEP22 R1

QC SUMMARY

Carbonate/Bicarbonate

Method: SM 2320 | Internal ref.: ME-CA-ENVIEWWL-LAK-AN-006

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Carbonate	EWL0055-SEP22	mg/L as CaCO3	2	< 2	ND	10	NA	90	110	NA		
Bicarbonate	EWL0055-SEP22	mg/L as CaCO3	2	< 2	0	10	NA	90	110	NA		
OH	EWL0055-SEP22	mg/L as CaCO3	2	< 2	ND	10	NA	90	110	NA		

Colour

Method: SM 2120 | Internal ref.: ME-CA-ENVIEWWL-LAK-AN-002

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Colour	EWL0075-SEP22	TCU	3	< 3	ND	10	100	80	120	NA		



FINAL REPORT

CA40015-SEP22 R1

QC SUMMARY

Conductivity
Method: SM 2510 | Internal ref.: ME-CA-IENVIEWL-LAK-AN-006

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Conductivity	EWL0055-SEP22	uS/cm	2	< 2	0	20	99	90	110	NA		

Fluoride by Specific Ion Electrode
Method: SM 4500 | Internal ref.: ME-CA-IENVIEWL-LAK-AN-014

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Fluoride	EWL0070-SEP22	mg/L	0.06	<0.06	ND	10	103	90	110	97	75	125
Fluoride	EWL0083-SEP22	mg/L	0.06	<0.06	0	10	102	90	110	99	75	125

Mercury by CVAAS
Method: EPA 7471A/SM 3112B | Internal ref.: ME-CA-IENVISPE-LAK-AN-004

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Mercury (total)	EHG0005-SEP22	mg/L	0.00001	< 0.00001	18	20	105	80	120	101	70	130



FINAL REPORT

CA40015-SEP22 R1

QC SUMMARY

Metals in aqueous samples - ICP-MS
Method: SM 3030/EPA 200.8 | Internal ref.: ME-CA-ENVISPE-LAK-AN-006

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Silver (total)	EMS0061-SEP22	mg/L	0.00005	<0.00005	ND	20	107	90	110	99	70	130
Aluminum (total)	EMS0061-SEP22	mg/L	0.001	<0.001	3	20	100	90	110	99	70	130
Aluminum (0.2µm)	EMS0061-SEP22	mg/L	0.001	<0.001	3	20	100	90	110	99	70	130
Arsenic (total)	EMS0061-SEP22	mg/L	0.0002	<0.0002	2	20	102	90	110	91	70	130
Barium (total)	EMS0061-SEP22	mg/L	0.00008	<0.00002	10	20	106	90	110	108	70	130
Beryllium (total)	EMS0061-SEP22	mg/L	0.000007	<0.000007	ND	20	96	90	110	88	70	130
Boron (total)	EMS0061-SEP22	mg/L	0.002	<0.002	12	20	101	90	110	99	70	130
Calcium (total)	EMS0061-SEP22	mg/L	0.01	<0.01	3	20	101	90	110	102	70	130
Cadmium (total)	EMS0061-SEP22	mg/L	0.000003	<0.000003	ND	20	104	90	110	104	70	130
Cobalt (total)	EMS0061-SEP22	mg/L	0.000004	<0.000004	10	20	105	90	110	107	70	130
Chromium (total)	EMS0061-SEP22	mg/L	0.00008	<0.00008	1	20	99	90	110	92	70	130
Copper (total)	EMS0061-SEP22	mg/L	0.0002	<0.0002	ND	20	103	90	110	119	70	130
Iron (total)	EMS0061-SEP22	mg/L	0.007	<0.007	ND	20	97	90	110	125	70	130
Potassium (total)	EMS0061-SEP22	mg/L	0.009	<0.009	1	20	96	90	110	114	70	130
Magnesium (total)	EMS0061-SEP22	mg/L	0.001	<0.001	0	20	95	90	110	109	70	130
Manganese (total)	EMS0061-SEP22	mg/L	0.00001	<0.00001	9	20	101	90	110	91	70	130
Molybdenum (total)	EMS0061-SEP22	mg/L	0.00004	<0.00004	3	20	102	90	110	108	70	130
Sodium (total)	EMS0061-SEP22	mg/L	0.01	<0.01	3	20	98	90	110	110	70	130
Nickel (total)	EMS0061-SEP22	mg/L	0.0001	<0.0001	4	20	99	90	110	104	70	130
Lead (total)	EMS0061-SEP22	mg/L	0.00009	<0.00001	0	20	106	90	110	111	70	130



FINAL REPORT

CA40015-SEP22 R1

QC SUMMARY

Metals in aqueous samples - ICP-MS (continued)
Method: SM 3030/EPA 200.8 | Internal ref.: ME-CA-IENVISPE-LAK-AN-006

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Phosphorus (total)	EMS0061-SEP22	mg/L	0.003	<0.003	13	20	96	90	110	NV	70	130
Antimony (total)	EMS0061-SEP22	mg/L	0.0009	<0.0009	ND	20	98	90	110	128	70	130
Selenium (total)	EMS0061-SEP22	mg/L	0.00004	<0.00004	ND	20	102	90	110	89	70	130
Silicon (total)	EMS0061-SEP22	mg/L	0.02	<0.02	13	20	93	90	110	NV	70	130
Tin (total)	EMS0061-SEP22	mg/L	0.00006	<0.00006	ND	20	108	90	110	NV	70	130
Strontium (total)	EMS0061-SEP22	mg/L	0.00008	<0.00002	0	20	104	90	110	105	70	130
Titanium (total)	EMS0061-SEP22	mg/L	0.00005	<0.00005	6	20	101	90	110	NV	70	130
Thallium (total)	EMS0061-SEP22	mg/L	0.000005	<0.000005	ND	20	96	90	110	99	70	130
Uranium (total)	EMS0061-SEP22	mg/L	0.000002	<0.000002	1	20	108	90	110	118	70	130
Vanadium (total)	EMS0061-SEP22	mg/L	0.00001	<0.00001	3	20	99	90	110	102	70	130
Zinc (total)	EMS0061-SEP22	mg/L	0.002	<0.002	2	20	101	90	110	110	70	130

pH
Method: SM 4500 | Internal ref.: ME-CA-IENVIEWL-LAK-AN-006

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
pH	EWL0055-SEP22	No unit	0.05	NA	1		100			NA		



FINAL REPORT

CA40015-SEP22 R1

QC SUMMARY

Reactive Phosphorus by SFA
Method: SM 4500-P F | Internal ref.: ME-CA-IENVISFA-LAK-AN-004

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Phosphorus (total reactive)	SKA0035-SEP22	mg/L	0.03	<0.03	ND	10	104	90	110	93	75	125
Phosphorus (total reactive)	SKA0048-SEP22	mg/L	0.03	<0.03	6	10	108	90	110	NV	75	125

Suspended Solids
Method: SM 2540D | Internal ref.: ME-CA-IENVIEWL-LAK-AN-004

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Total Suspended Solids	EWL0066-SEP22	mg/L	2	< 2	1	10	99	90	110	NA		

Turbidity
Method: SM 2130 | Internal ref.: ME-CA-IENVIEWL-LAK-AN-003

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Turbidity	EWL0064-SEP22	NTU	0.10	< 0.10	4	10	100	90	110	NA		



QC SUMMARY

Method Blank: a blank matrix that is carried through the entire analytical procedure. Used to assess laboratory contamination.

Duplicate: Paired analysis of a separate portion of the same sample that is carried through the entire analytical procedure. Used to evaluate measurement precision.

LCS/Spike Blank: Laboratory control sample or spike blank refer to a blank matrix to which a known amount of analyte has been added. Used to evaluate analyte recovery and laboratory accuracy without sample matrix effects.

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

Reference Material: a material or substance matrix matched to the samples that contains a known amount of the analyte of interest. A reference material may be used in place of a matrix spike.

RL: Reporting limit

RPD: Relative percent difference

AC: Acceptance criteria

Multielement Scan Qualifier: as the number of analytes in a scan increases, so does the chance of a limit exceedance by random chance as opposed to a real method problem. Thus, in multielement scans, for the LCS and matrix spike, up to 10% of the analytes may exceed the quoted limits by up to 10% absolute and the spike is considered acceptable.

Duplicate Qualifier: for duplicates as the measured result approaches the RL, the uncertainty associated with the value increases dramatically, thus duplicate acceptance limits apply only where the average of the two duplicates is greater than five times the RL.

Matrix Spike Qualifier: for matrix spikes, as the concentration of the native analyte increases, the uncertainty of the matrix spike recovery increases. Thus, the matrix spike acceptance limits apply only when the concentration of the matrix spike is greater than or equal to the concentration of the native analyte.

LEGEND

FOOTNOTES

NSS Insufficient sample for analysis.

RL Reporting Limit.

↑ Reporting limit raised.

↓ Reporting limit lowered.

NA The sample was not analysed for this analyte

ND Non Detect

Results relate only to the sample tested.

Data reported represent the sample as submitted to SGS. Solid samples expressed on a dry weight basis.

"Temperature Upon Receipt" is representative of the whole shipment and may not reflect the temperature of individual samples.

Analysis conducted on samples submitted pursuant to or as part of Reg. 153/04, are in accordance to the "Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act and Excess Soil Quality" published by the Ministry and dated March 9, 2004 as amended.

SGS provides criteria information (such as regulatory or guideline limits and summary of limit exceedances) as a service. Every attempt is made to ensure the criteria information in this report is accurate and current, however, it is not guaranteed. Comparison to the most current criteria is the responsibility of the client and SGS assumes no responsibility for the accuracy of the criteria levels indicated.

SGS Canada Inc. statement of conformity decision rule does not consider uncertainty when analytical results are compared to a specified standard or regulation.

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This report supersedes all previous versions.

-- End of Analytical Report --



Environment, Health & Safety

Request for Laboratory Services and CHAIN OF CUSTODY

- Lakefield: 185 Concession St., Lakefield, ON K0L 2H0 Phone: 705-652-2000 Fax: 705-652-6365 Web: www.sgs.com/environment
- London: 657 Consortium Court, London, ON, N6E 2S8 Phone: 519-672-4500 Toll Free: 877-848-8060 Fax: 519-672-0361

No: 010115

Page 1 of 1

Laboratory Information Section - Lab use only

Received By: Scott R
Received Date (mm/dd/yyyy): 09/01/2022 (mm/dd/yyyy)
Received Time: 11:30

Received By (signature): S
Custody Seal Present: ☒
Custody Seal Intact: ☒

Cooling Agent Present: ☒ Ice
Temperature Upon Receipt (°C): 9.2 x 3

LAB LIMS #: SRPT-40015-16

REPORT INFORMATION	INVOICE INFORMATION	PROJECT INFORMATION
Company: <u>Thurber Eng LTD</u>	<input checked="" type="checkbox"/> (same as Report Information)	Quotation #: _____ P.O. #: _____
Contact: <u>Rachel Bourassa</u>	Company: _____	Project #: <u>33309</u> Site Location/ID: <u>EMO, ON</u>
Address: <u>2010 Winston Park Dr</u>	Contact: _____	TURNAROUND TIME (TAT) REQUIRED <input checked="" type="checkbox"/> Regular TAT (5-7 days) TAT's are quoted in business days (exclude statutory holidays & weekends). Samples received after 6pm or on weekends: TAT begins next business day RUSH TAT (Additional Charges May Apply): <input type="checkbox"/> 1 Day <input type="checkbox"/> 2 Days <input type="checkbox"/> 3 Days <input type="checkbox"/> 4 Days PLEASE CONFIRM RUSH FEASIBILITY WITH SGS REPRESENTATIVE PRIOR TO SUBMISSION Specify Due Date: _____ Rush Confirmation ID: _____
# <u>103 Oakville ON L6M 5R7</u>	Address: _____	
Phone: <u>416 523 1015</u>	Phone: _____	
Email: <u>r.bourassa@thurber.ca</u>	Email: _____	

REGULATIONS					ANALYSIS REQUESTED															COMMENTS:	
Regulation 153/04:			Other Regulations:			Sewer By-Law:															
<input type="checkbox"/> Table 1	<input type="checkbox"/> R/P/I	Soil Texture:	<input type="checkbox"/> Reg 347/558 (3 Day min TAT)	<input type="checkbox"/> Sanitary																	
<input type="checkbox"/> Table 2	<input type="checkbox"/> I/C/C	<input type="checkbox"/> Coarse	<input checked="" type="checkbox"/> PWQO	<input type="checkbox"/> MMR																	
<input type="checkbox"/> Table 3	<input type="checkbox"/> A/O	<input type="checkbox"/> Medium	<input type="checkbox"/> CCME	<input type="checkbox"/> Other:																	
<input type="checkbox"/> Table		<input type="checkbox"/> Fine	<input type="checkbox"/> MISA	Municipality:																	
RECORD OF SITE CONDITION (RSC) <input type="checkbox"/> YES <input type="checkbox"/> NO																					
SAMPLE IDENTIFICATION	DATE SAMPLED	TIME SAMPLED	# OF BOTTLES	MATRIX	Field Filtered (Y/N)	Metals & Inorganics	PAH <input type="checkbox"/> ABN <input type="checkbox"/> SVOC(all) <input type="checkbox"/>	PCB Total <input type="checkbox"/> Aroclor <input type="checkbox"/>	PHC F1-F4 <input type="checkbox"/> VOC <input type="checkbox"/>	BTEX <input type="checkbox"/> BTEX/F1 <input type="checkbox"/> F2-F4 <input type="checkbox"/>	VOC <input type="checkbox"/> BTEX <input type="checkbox"/> THM <input type="checkbox"/>	Pesticides OC <input type="checkbox"/> OP <input type="checkbox"/>	TCPL M&I <input type="checkbox"/> VOC <input type="checkbox"/> PCB <input type="checkbox"/>	B(a)P <input type="checkbox"/> ABN <input type="checkbox"/> Ignit. <input type="checkbox"/>	Water Pkg Gen. <input type="checkbox"/> Ext. <input type="checkbox"/>	Sewer Use: <input type="checkbox"/>	TSS	Lab Filtered Metals	Corrosivity	General Water Characterization	Package
1 <u>Cameron Creek SW</u>	<u>Aug 28/22</u>		<u>15</u>	<u>Water</u>													<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
2 <u>22-01</u>	<u>Aug 28/22</u>		<u>14</u>	<u>Water</u>													<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
3																					
4																					
5																					
6																					
7																					
8																					
9																					
10																					
11																					
12																					

Observations/Comments/Special Instructions

Corrosivity Includes PM, Soluble Sulphate, Chloride, Resistivity, Electrical Conductivity

Sampled By (NAME): Greg Stanhope

Signature: GS

Date: Aug 1 28 1 2022 (mm/dd/yyyy)

Pink Copy - Client

Relinquished by (NAME): Rachel Bourassa

Signature: Rachel Bourassa

Date: Aug 1 31 1 2022 (mm/dd/yyyy)

Yellow & White Copy - SGS

Revision #: 1.1

Date of Issue: 04 April, 2018



Appendix C

Site Photographs



Photo 1: Looking south at culvert inlet (August 2022)



Photo 2: Looking east along north embankment near culvert inlet (April 2022)



Date & Time: Mon, Aug 22, 2022, 15:41:58 CDT
Position: 15 N 416106 5392338 ($\pm 6.0\text{m}$)
Altitude: 338m ($\pm 3.2\text{m}$)
Datum: WGS-84
Azimuth/Bearing: 304° N56°W 5404mils True ($\pm 12^\circ$)
Elevation Angle: -07.5°
Horizon Angle: -01.7°
Zoom: 1.0X



Photo 3: Looking west along north embankment near culvert inlet (August 2022)



Photo 4: Looking north at culvert outlet (May 2022)



Photo 5: Looking west along south embankment near culvert outlet (August 2022)



Photo 6: Looking east along south embankment near culvert outlet (August 2022)



Photo 7: Looking east along Highway 11 near culvert outlet (taken by Hatch)

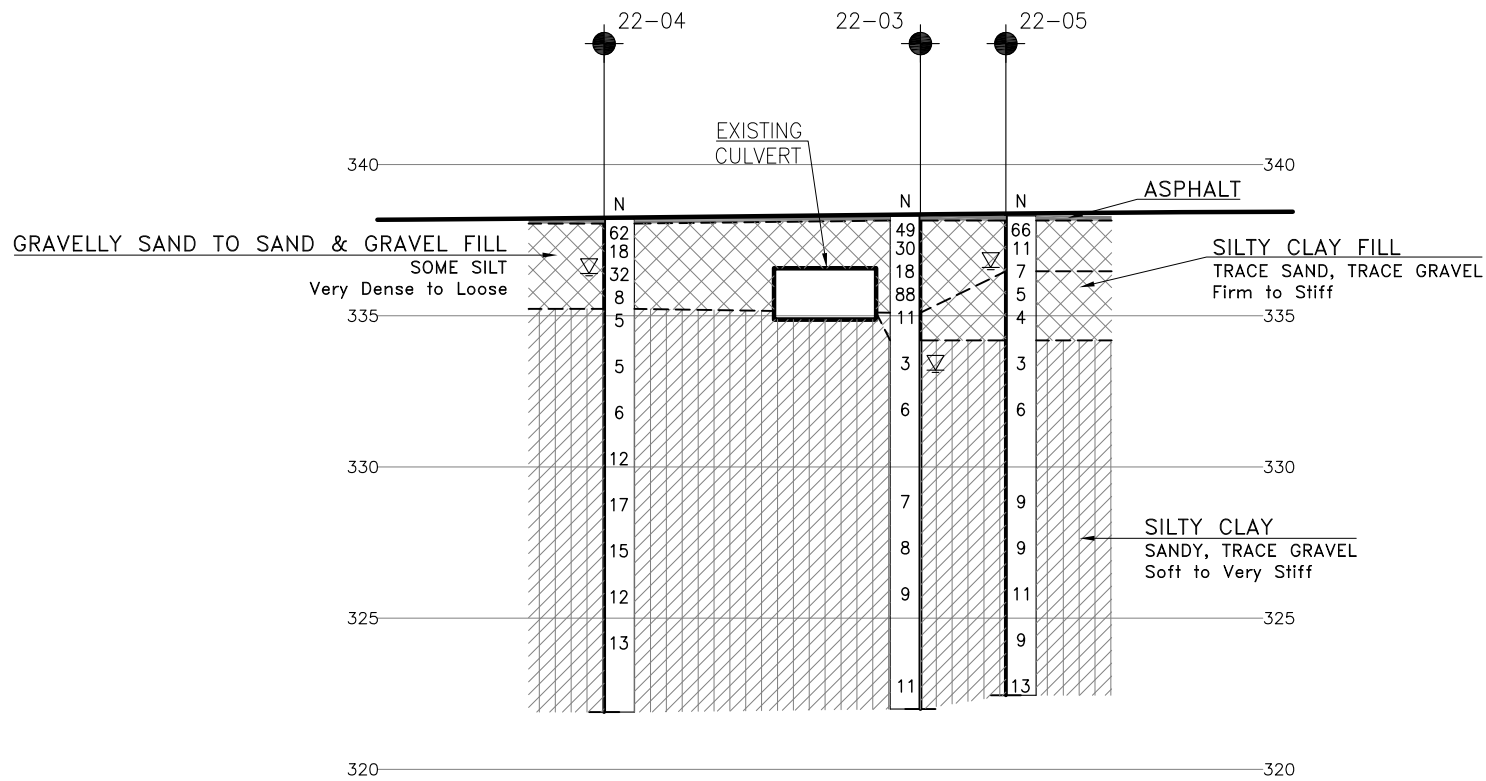
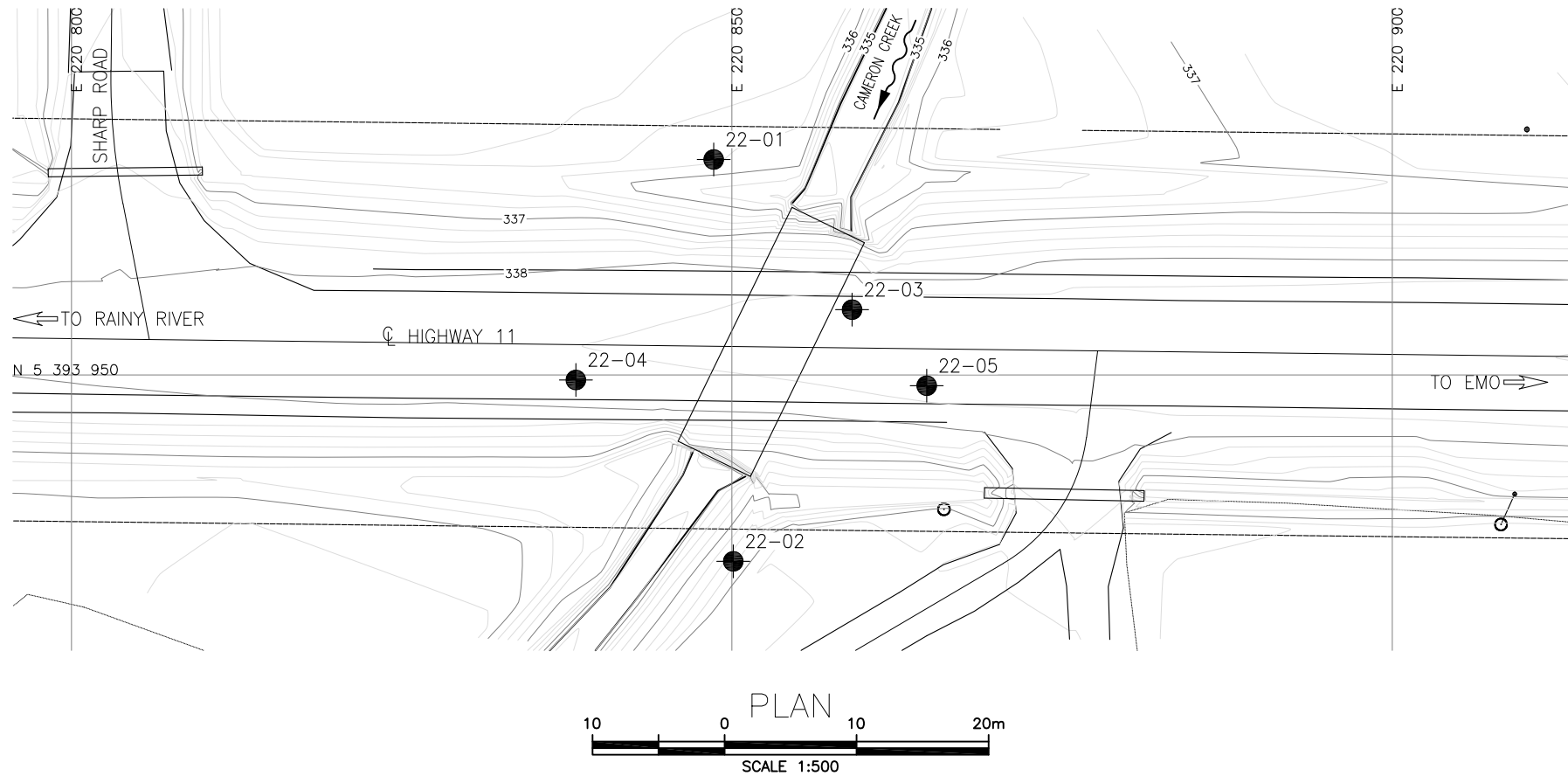


Photo 8: Looking west along Highway 11 near culvert inlet (taken by Hatch)



Appendix D

Borehole Locations and Soil Strata Drawings



PROFILE ALONG ϕ HIGHWAY 11

10 0 10 20m H 1:500

5 0 5 10m V 1:250

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

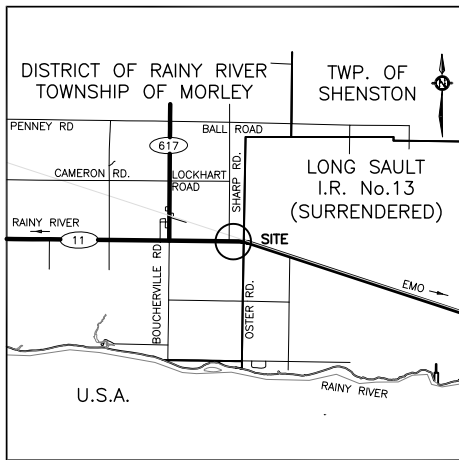


CONT No
GWP No 6120-17-00

HIGHWAY 11
CROSSING AT
CAMERON CREEK
BOREHOLE LOCATIONS AND SOIL STRATA



SHEET



KEYPLAN

LEGEND

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

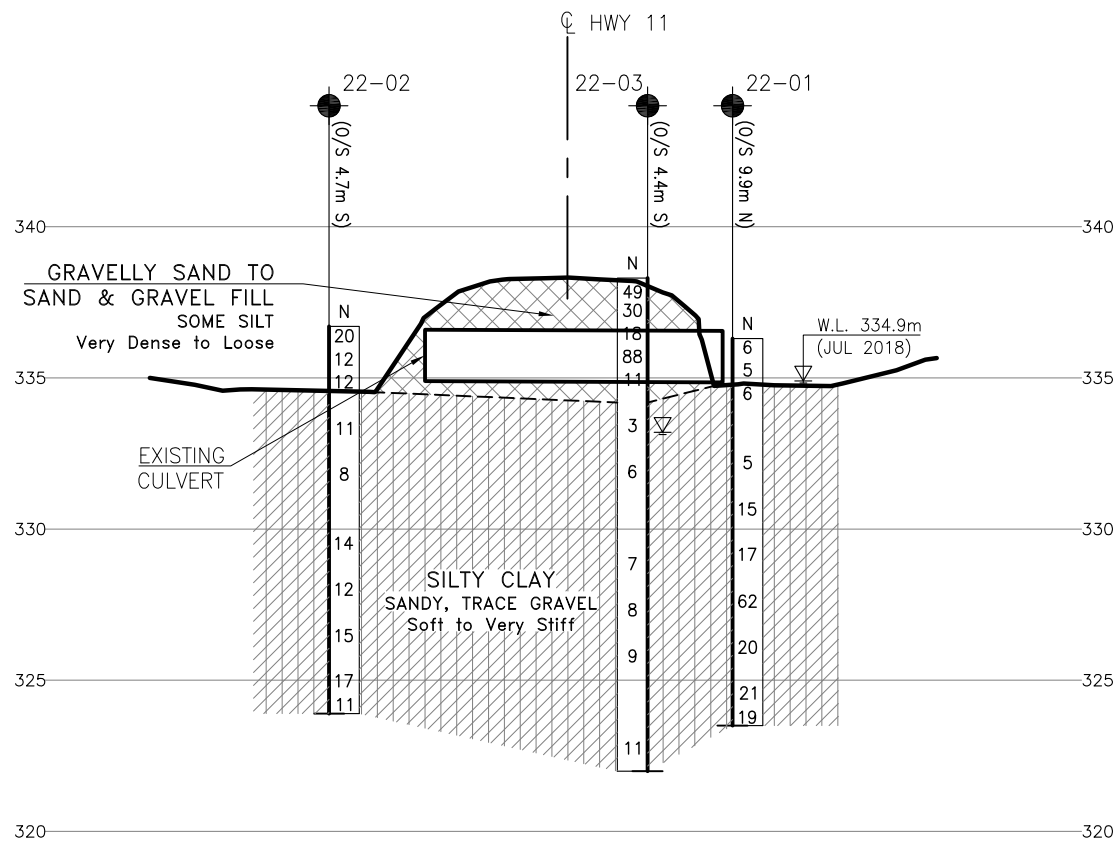
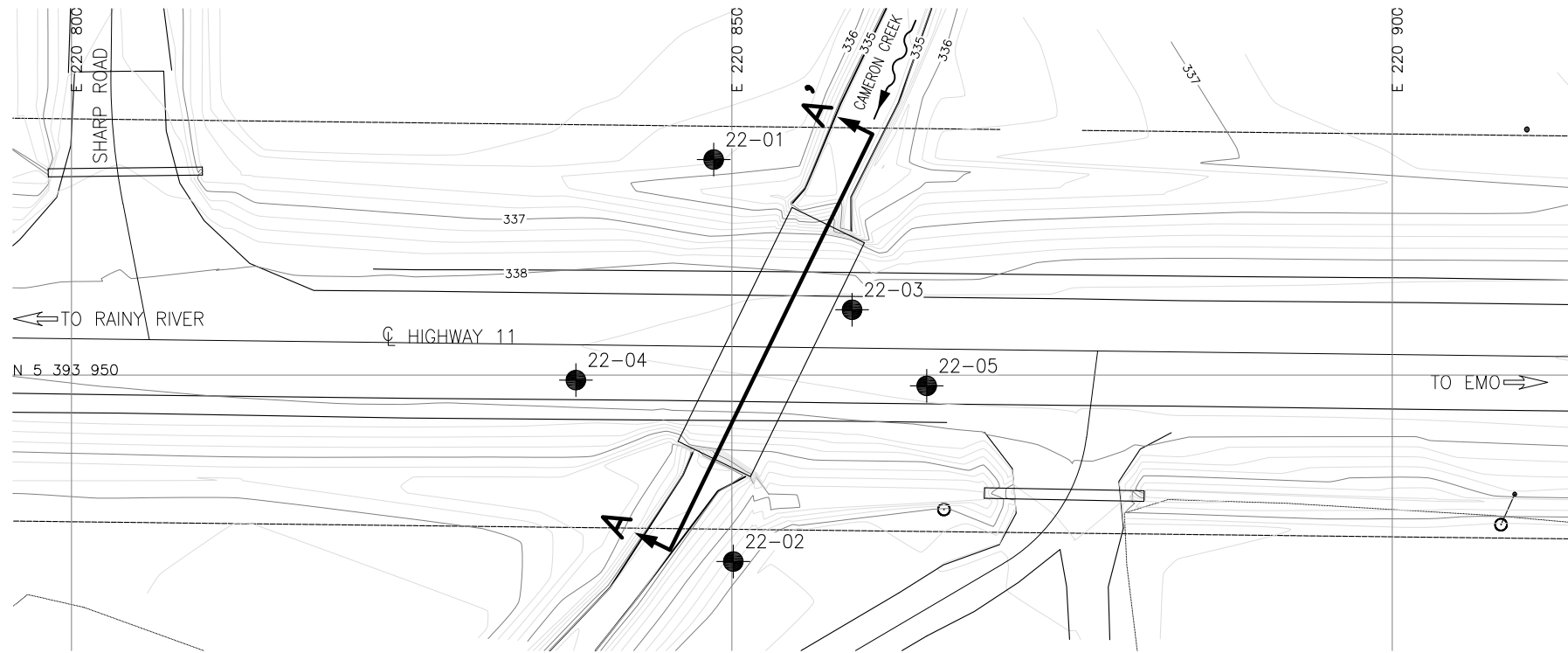
NO	ELEVATION	NORTHING	EASTING
22-01	336.3	5 393 966.3	220 848.6
22-02	336.7	5 393 935.9	220 850.1
22-03	338.3	5 393 954.9	220 859.1
22-04	338.2	5 393 949.6	220 838.2
22-05	338.3	5 393 949.2	220 864.8

-NOTES-

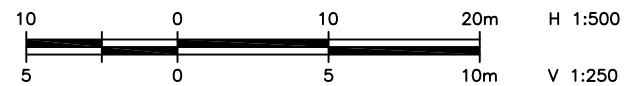
- The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.
- This drawing is for subsurface information only. Surface details and features are for conceptual illustration.
- Coordinate system is MTM NAD 83 Zone 16.

GEOCRES No. 52D-37

REVISIONS	DATE	BY	DESCRIPTION
DESIGN	RB	CHK	MEF
DRAWN	AN	CHK	RB
CODE	LOAD	DATE	JAN 2023
SITE	45X-0160/CO	STRUCT	DWG 1



PROFILE ALONG A-A'



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



CONT No
GWP No 6120-17-00

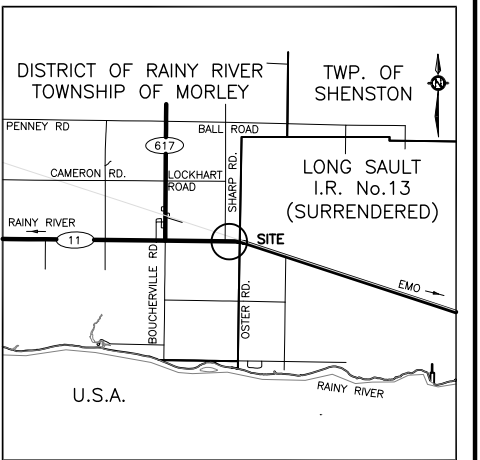
HIGHWAY 11
CROSSING AT
CAMERON CREEK
BOREHOLE LOCATIONS AND SOIL STRATA



SHEET



THURBER ENGINEERING LTD.



KEYPLAN

LEGEND

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

NO	ELEVATION	NORTHING	EASTING
22-01	336.3	5 393 966.3	220 848.6
22-02	336.7	5 393 935.9	220 850.1
22-03	338.3	5 393 954.9	220 859.1
22-04	338.2	5 393 949.6	220 838.2
22-05	338.3	5 393 949.2	220 864.8

-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 16.

GEOCRES No. 52D-37

REVISIONS	DATE	BY	DESCRIPTION
DESIGN	RB	CHK MEF	CODE
DRAWN	AN	CHK RB	SITE 45X-0160/CO
			LOAD
			DATE JAN 2023
			DWG 1