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FINAL
FOUNDATION INVESTIGATION AND DESIGN REPORT
Culvert 38 Rehabilitation, Highway 69 – 2.0 km South of Highway 7182
Township of Shawanaga
Rehabilitation of Highway 69 and Shawanaga River Bridge
G.W.P. 5246-18-00
ASSIGNMENT NO.: 5020-E-0003
GEOCRES NO.: 41H09-004

Location: Lat: 45.53555°, Long: -80.26169°

Client Name: Egis Group
Date: August 9, 2024
File: 30351

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FINAL
FOUNDATION INVESTIGATION AND DESIGN REPORT
CULVERT 38, HIGHWAY 69 – 2.0 KM SOUTH OF HIGHWAY 7182
TOWNSHIP OF SHAWANAGA, ONTARIO
G.W.P. 5246-18-00
ASSIGNMENT NO.: 5020-E-0003

GEOCRES NO.: 41H09-004

PART 1. FACTUAL INFORMATION

1. INTRODUCTION

This section of the report presents the factual findings obtained from a foundation investigation conducted by Thurber Engineering Ltd. (Thurber) for the rehabilitation of Culvert 38 which crosses Highway 69 approximately 2.0 km south of Highway 7182 (Shebeshekong Road) in the Township of Shawanaga, Ontario. Thurber carried out the assignment as a sub-consultant to Egis Group (Egis) under Assignment No. 5020-E-0003.

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

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

2.1 General

The deep fill embankment culvert (CL-38) is located on Highway 69, Station 15+250, approximately 2 km south of the intersection of Highway 69 and Shebeshekong Road in the Township of Shawanaga, Ontario. For project orientation and reporting purposes, Highway 69 is herein described as orientated north-south and the culvert is described as oriented east-west. The existing culvert allows surface water to flow in a west to east direction under the highway.

At the location of the culvert, Highway 69 is a two-lane, undivided highway with a posted speed limit of 90 km/hr. The culvert crosses under the north and southbound lanes.

The base plan provided by Egis indicates that the existing culvert is a 900 mm diameter corrugated steel pipe (CSP). Field observations confirmed that the culvert is a CSP. The plan indicates the length of the culvert is approximately 30 m. The culvert invert is at approximate Elev. 211.1 m at the inlet (west end) and at approximate Elev. 210.8 m at the outlet (east end). Cover above the obvert of the culvert is approximately 4 m under the north and southbound lanes. The existing highway embankment at the culvert location is approximately 4.5 m high and the embankment slopes are inclined at approximately 1.75H:1V on both the east and west side.

The lands surrounding the site are generally low-lying and flat with bedrock outcrops noted nearby. The land on the west side of the highway near the culvert inlet were dryer and treed. Rockfill was noted around the culvert inlet. The lands on the east side of the highway near the culvert outlet are low lying with some wet swampy terrain immediately surrounding the outlet. Photographs in Appendix E show the general nature of the site and the existing culvert.

2.2 Site Geology

Based on surficial geology mapping prepared by the Ontario Geological Survey[1] the culvert is located in an area mapped as bedrock-drift complex in Precambrian terrain. Bedrock mapping[2] also prepared by the Ontario Geological Survey maps the local bedrock as intermediate to felsic intrusive rocks consisting of weakly foliated to gneissic granodiorite.

3. INVESTIGATION PROCEDURE

The foundation investigation and field-testing program for CL-38 was carried out in conjunction with several other culvert investigations reported under separate cover. The boreholes for this culvert investigation were advanced between September 15 to 25, 2023. The investigation consisted of two (2) boreholes, designated as 23-09 and 23-10, advanced to depths of 5.1 m to 11.1 m below ground surface, respectively (Elev. 207.1 m and 200.2 m). Boreholes 23-09 and 23-10 were drilled near the culvert inlet and outlet, respectively.

The Record of Borehole sheets for the boreholes are included in Appendix B. The approximate borehole locations are shown on the attached Borehole Locations and Soil Strata Drawing in Appendix A. A summary of the borehole coordinates, elevations, and termination depths is provided in Table 3.1. The as-drilled borehole elevations and coordinates were provided by Callon Dietz, Egis' survey subconsultant. The survey was completed in the horizontal datum MTM Zone

[1] *Ontario Geological Survey 2010. Surficial geology of Southern Ontario; Ontario Geological Survey, Miscellaneous Release – Data 128_REV.*
[2] *Culshaw, N.G., Corrigan, D., Ketchum, J.W.F., Wallace, P. and Wodicka, N. 2004. Precambrian geology, Naiscoot area; Ontario Geological Survey, Preliminary Map P.3549, scale 1:50 000.*

10 CSRS CBNv6-2010.0 and the vertical datum CGVD 1928:1978 with horizontal and vertical accuracies of +/- 5 cm. The borehole coordinates and elevations are shown on the Borehole Location and Soil Strata drawing included in Appendix A and on the individual Record of Borehole sheet included in Appendix B.

Table 3-1 Borehole Summary

Borehole	Northing (m)	Easting (m)	Ground Surface Elevation (m)	Termination Depth Below Ground Surface (m)
23-09	5,044, 231.0	245,296.8	212.2	5.1
23-10	5,044,251.2	245,328.4	211.3	11.1

Utility clearances were obtained prior to the start of drilling.

Boreholes 23-09 and 23-10 were drilled at the ends of the culvert using portable drilling equipment due to access limitations. Soil samples were obtained using a split spoon sampler in conjunction with Standard Penetration Testing (SPT). NQ coring methods were used to advance the two boreholes into bedrock.

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 and rock core samples for transport to Thurber's laboratory for further examination and testing.

The rock cores were logged, and the Total Core Recovery (TCR), Solid Core Recovery (SCR), Rock Quality Designation (RQD) and Fracture Index (FI) were determined.

Due to water being introduced during drilling and coring operations groundwater conditions were not observed in the open boreholes. A standpipe piezometer consisting of a 25 mm diameter PVC pipe with a 3.0 m long slotted screen, enclosed in a column of filter sand was installed in Borehole 23-10 to permit groundwater level monitoring. A monitoring well consisting of 32 mm diameter Schedule 40 PVC pipe with a 1.5 m long slotted screen, enclosed in a column of filter sand was installed in Borehole 23-09. The monitoring well was installed as per Egis' request to allow for well testing to be carried out by Egis to support a potential Permit to Take Water Application or registration on the Environmental Activity and Sector Registry. Well installation details, groundwater level observations and water level readings are shown on the Record of Borehole sheets in Appendix B. A surface water sample at the culvert inlet was obtained during the field investigation and submitted to a specialist analytical laboratory under chain of custody procedures for testing for a corrosivity related parameters.

Details of the drilling program, including drilling depths, monitoring well/ piezometer installation and completion details are summarized in Table 3.2 below.

Table 3-2: Borehole Completion Details

Borehole Number	Top of Borehole Elevation (m)	Borehole Depth / Base Elevation (m)	Monitoring Well/ Piezometer Depth / Elevation (m)	Completion Details
23-09	212.2	5.1 / 207.1	3.7 / 208.5	Borehole was backfilled with bentonite holeplug from 5.1 m to 3.9 m, filter sand from 3.9 m to 1.8 m, bentonite holeplug from 1.8 m to ground surface
23-10	211.3	11.1 / 200.2	6.1 / 205.2	Borehole was backfilled with bentonite holeplug from 11.1 m to 6.1 m, filter sand from 6.1 m to 1.8 m, bentonite holeplug from 1.8 m to ground surface.

The standpipe piezometer was decommissioned in general accordance with O.Reg. 903 upon collection of the final water level reading. The monitoring well in Borehole 23-09 was left in place and will be decommissioned as part of the construction contract under Egis' direction.

4. LABORATORY TESTING

Laboratory testing was selected in general accordance with the current MTO Guideline for Foundation Engineering Services, Section 5. Geotechnical laboratory testing consisted of natural moisture content determination and visual identification of all retained soil samples and grain size distribution analysis and Atterberg Limits testing (where applicable) on selected soil samples. The rock cores were photographed, and the total core recovery (TCR), solid core recovery (SCR), and rock quality designation (RQD) were measured. Unconfined compressive strength (UCS) and point load testing was carried out on select intact bedrock cores to assess the unconfined compressive strength (UCS) of the bedrock. The results of this testing program are summarized on the Record of Borehole sheets in Appendix B and are shown on the figures included in Appendix C.

In order to assess the potential for sulphate attack on buried concrete structures, as well as the potential for corrosion associated with buried steel elements of the structures, a sample of the

native soil from the boreholes, as well as a surface water sample from the upstream end of the culvert were collected during the investigation. The samples were submitted to SGS, a CALA accredited analytical laboratory in Mississauga, Ontario, for analytical testing of corrosivity parameters and sulphate content. The results of the analytical testing are summarized in this report and presented in Appendix C.

5. DESCRIPTION OF SUBSURFACE CONDITIONS

Details of the encountered soil stratigraphy are presented on the Record of Borehole sheets included in Appendix B and on the Borehole Locations and Soil Strata drawing in Appendix A. A general description of the stratigraphy, based on the conditions encountered in the boreholes, is given in the following paragraphs. However, the factual data presented 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 boreholes drilled at the ends of the culvert encountered a layer of organic soil overlying native soils overlying bedrock.

5.1 Organic Soils

Boreholes 23-09 and 23-10 drilled near the culvert inlet and outlet, respectively, encountered 75 mm of topsoil at the ground surface. One moisture content of 148% was measured in the topsoil.

Borehole 23-10 drilled near the culvert outlet encountered approximately 1.1 m of peat beneath the topsoil. Two SPT-N values of 1 and 2 blows for 0.3 m of penetration were recorded in this material indicating a very loose/very soft relative density/consistency. One moisture content of 284% was measured in the peat layer.

Topsoil and peat thicknesses are expected to vary between and beyond borehole locations.

5.2 Sand to Silty Sand

A layer of sand was encountered in Boreholes 23-09 and 23-10, below the organic soils. This material was encountered at depths ranging of 0.1 m and 1.2 m (Elev. 212.1 m and 210.1 m), respectively. The layer had a thickness of 1.9 m and 0.1 m, respectively in Boreholes 23-09 and 23-10 (base Elev. 210.2 m and 210.0 m). This material was described as light brown to grey in colour and also contained some silt, trace clay, trace gravel and trace organic material. Within the sand layer in Borehole 23-09, trace organic material was observed in the upper 0.6 m and a thin layer of silty clay (100 mm thick) was noted at a depth of 1.7m.

In Borehole 23-10 a second lower layer of sand containing some silt to silty was encountered at a depth of 5.5 m (Elev. 205.8 m). This layer was 2.1 m thick and extended to the top of bedrock.

SPT N-values of 3 to 60 blows per 0.3 m of penetration to were recorded in the upper sand layer, indicating a very loose to very dense relative density. A single value of 100 blows per 0.025 m was recorded in this layer just above the bedrock. The refusal blow count is likely due to encountering the top of bedrock.

One SPT N-value of 138 per 0.3 m of penetration was recorded in the lower sand layer in Borehole 23-10, indicating a very dense relative density.

Moisture contents measured in this material ranged from 17% to 48%. The higher value of 48% was measured in a sample from the top of the sand layer in Borehole 23-09 which contained organic material. The results of grain size distribution analyses carried out on a sample of this material are provided on Figure C1 in Appendix C. The results are also summarized in Table 5-1 and on the Record of Borehole sheets in Appendix B.

Table 5-1: Grain Size Distribution on Sand

Soil Particle	Percentage (%)
Gravel	0
Sand	82
Silt	15
Clay	3

5.3 Silty Clay

A layer of silty clay was encountered below the sand layer in Borehole 23-10 at a depth of 1.3 m (Elev. 210.0 m). The silty clay was described to contain trace sand to sandy and was grey in colour. The thickness of the silty clay layer was 2.2 m (base Elev. 207.8 m).

SPT N-values of 2 to 5 blows per 0.3 m of penetration were recorded in the silty clay, indicating a soft to firm consistency.

Moisture contents ranging from 22% to 68% were recorded in the silty clay. The results of gradation analyses completed on selected samples of the silty clay are illustrated on Figure C2 of Appendix C. The results of the tests are also summarized in the table below and on the Record of Borehole sheet in Appendix B.

Table 5-2: Grain Size Distribution on Silty Clay

Soil Particle	Percentage (%)
Gravel	0
Sand	4 to 24
Silt	33 to 52
Clay	24 to 63

The results of two Atterberg Limits tests completed on selected samples of the silty clay are illustrated on Figure C4 in Appendix C. The results of the tests are also summarized in Table 5-3 and on the Record of Borehole sheets in Appendix A. The results indicate that this soil exhibits low to high plasticity (CL-CH) and plots above the A-Line on the plasticity chart.

Table 5-3: Atterberg Limits Testing Results on Silty Clay

Parameter	Value (%)
Liquid Limit	25 to 66
Plastic Limit	15 to 31
Plasticity Index	10 to 35

5.4 Sandy Silt

A layer of sandy silt was encountered below the silty clay in Borehole 23-10 at a depth of 3.5 m (Elev. 207.8 m). The layer had a thickness of 2.0 m with an underside depth of 5.5 m (base Elev. 205.8 m). SPT N-values of 32 and 41 blows per 0.3 m of penetration were recorded in the sandy silt, indicating a dense relative density.

Moisture contents ranging from 15% to 18% were recorded in the sandy silt layer. The results of one gradation analysis completed on a selected sample of the sandy silt are illustrated on Figure C3 of Appendix C. The results of the test are also summarized in Table 5.4 and on the Record of Borehole sheets in Appendix B.

Table 5-4: Grain Size Distribution on Sandy Silt

Soil Particle	Percentage (%)
Gravel	1
Sand	29
Silt	62
Clay	8

5.5 Bedrock

The soils described above are underlain by gneiss bedrock. Bedrock was proven by coring in both boreholes. The bedrock encountered consisted of slightly weathered to fresh, grey and pink, strong to very strong rock. Photographs of the bedrock core are provided in Appendix D.

Table 5-5 summarizes the depths and elevations of the top of bedrock at the borehole locations.

Table 5-5: Depths and Elevations of Top of Bedrock

Borehole	Top of Bedrock	
	Depth (m)	Elevation (m)
23-09	2.0	210.2
23-10	7.6	203.7

The rock core recovery measurements, rock quality designation and rock core laboratory testing results are summarized in Table 5-6 below.

Table 5-6: Bedrock Details

Parameter	Range
Total Core Recovery (TCR), %	100*
Solid Core Recovery (SCR), %	85 – 100*
Rock Quality Designation (RQD), %	79 – 100*
Fracture Index (fractures per 0.3 m)	0 – 3*
Unconfined Compressive Strength from UCS Tests (MPa)	114 – 129
Unconfined Compressive Strength Estimated from Point Load Tests (MPa)	99 – 199

**Borehole 23-09 Run 3 was not included in assessment due to damage caused to the core while trying to remove it from the core barrel; TCR = 82%, SCR = 75%, RQD = N/A, FI = 3, 4*

Based on the RQD, the bedrock quality is described as good to excellent (CFEM 5th Edition, 2023). The results of UCS and point load testing indicate that the tested samples of the bedrock are strong to very strong (CFEM 5th Edition, 2023). The results of the UCS and point load testing are included in Appendix C.

5.6 Groundwater Level

Water levels were not observed upon completion of the boreholes as water was introduced into the borehole for bedrock coring and levels may not be representative. The measured groundwater levels observed in piezometer / monitoring well installations are summarized in Table 5.7.

Table 5-7: Groundwater Measurements

Borehole	Date	Water Level (m)		Remark
		Depth	Elevation	
23-09	October 4, 2023	0.7	211.5	In monitoring well
23-10	September 21, 2023	0.1	211.2	In piezometer

It should be noted that the above values are considered to be short-term readings and they may not reflect the groundwater level at the time of construction. 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 events.

At the time of the investigation, flowing surface water was not observed at either end of CL-38. Stagnant water was observed in the culvert and around the swampy area surrounding the culvert. The surface water sample was collected from water upstream of the inlet of CL-38.

6. CORROSIVITY AND SULPHATE TEST RESULTS

A sample of native sand from Borehole 21-09 was submitted for analytical testing of corrosivity parameters and sulphate. A sample of surface water taken from water upstream from the inlet of the culvert was also submitted for analytical testing of pH, sulphate, chloride, resistivity, and conductivity. The laboratory certificates of analysis for the current investigation are presented in Appendix C. The results of the analytical tests are summarized below in Table 6-1.

Table 6-1: Analytical Corrosivity Test Results

Parameter	Units (Soil)	Units (Water)	Test Results	
			23-09 SS#1B CORR (0.1m –0.6m)	Culvert Inlet Culvert 38 STA 15+250
			(Sand)	(Surface Water)
Redox Potential	mV	mV	341	127
Sulphide	%	µg/L	<0.01	7.0
pH	-	-	5.38	6.32
Chloride	µg/g	mg/L	18	380
Sulphate	µg/g	mg/L	5.9	28
Conductivity	uS/cm	uS/cm	108	1120
Resistivity	Ohms.cm	Ohms.cm	9260	--

7. MISCELLANEOUS

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

Ohlmann Geotechnical Services (OGS) Inc. of Almonte, Ontario supplied the drill rigs and conducted the drilling, sampling and in-situ testing operations for Boreholes 23-09 and 23-10. Traffic Control services were provided by Ramudden Services of Hamilton, Ontario for Boreholes 23-09 and 23-10.

All geotechnical laboratory testing of soil samples and point load testing of bedrock core samples were carried out in Thurber's geotechnical laboratory. Uniaxial compressive strength tests were carried out by Geomechanica Inc. Analytical testing of soil and water samples was carried out by SGS Canada Inc.

The field investigation was supervised on a full-time basis by Mr. Jakob Flood of Thurber. The overall supervision of the field program was conducted by Ms. Madisan Chiarotto, P.Eng. and Mr. Matthew Boucher, P.Eng. of Thurber.

Interpretation of the field data and preparation of this report was carried out by Ms. Madisan Chiarotto, P.Eng. and Mr. Matthew Boucher, P.Eng. The report was reviewed by Mr. Jason Lee, P.Eng., a Designated Principal Contact for MTO Foundations Projects.

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PART 2. ENGINEERING DISCUSSION AND RECOMMENDATIONS

8. GENERAL

This section of the report provides an interpretation of the factual data from Part 1 of the report and presents foundation design recommendations for the proposed rehabilitation of Culvert 38 which crosses Highway 69 approximately 2.0 km north of Highway 7182 (Shebeshekong Road) in the Township of Shawanaga, Ontario. The culvert crosses the highway at Station 15+250 of Highway 69.

This foundation investigation and design report with the interpretation and recommendations are intended for the use of Egis and the Ministry of Transportation and shall not be used or relied upon for any other purposes or by any other parties including the construction or design-build contractor. The Contractors must make their own interpretation based on the factual data in Part 1 of the report. Where comments are made on construction, they are provided only to highlight those aspects which could affect the design of the project. Contractors must make their own interpretation of the information provided in Part 1 of this report as it may affect equipment selection, proposed construction methods and scheduling.

The base plan provided by Egis indicates that the existing culvert is a 900 mm diameter corrugated steel pipe (CSP). Field observations confirmed that the culvert is a CSP. The plan indicates the length of the culvert is approximately 30 m. The culvert invert is at approximate Elev. 211.1 m at the inlet (west end) and at approximate Elev. 210.8 m at the outlet (east end). Cover above the obvert of the culvert is approximately 4 m under the north and southbound lanes. The existing highway embankment at the culvert location is approximately 4.5 m high and the embankment slopes are inclined at approximately 1.75H:1V on both the east and west side.

Based on preliminary discussions with Egis, it is understood that the culvert will be rehabilitated by lining the inside of the existing culvert using trenchless techniques. It is understood that no

changes to the existing Highway 69 embankment and no excavations are planned during the rehabilitation work. No wingwalls / headwalls are present at the existing culvert or planned as part of the culvert design.

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.

9. PROPOSED CULVERT REHABILITATION

9.1 Culvert Lining

We understand that the existing culvert is expected to be rehabilitated by adding a lining to the inside of the existing culvert using trenchless techniques. From a foundation's perspective, this method is suitable and poses very little risk to the highway pavement or to the stability of the embankment. However, we recommend that the existing culvert be inspected and surveyed before rehabilitation work begins to ensure it has not deformed or sagged and is able to accommodate the lining.

10. COFFERDAM DESIGN

Construction of cofferdams may be required to divert surface water flow and to facilitate rehabilitation of the culvert in the dry.

The boreholes advanced indicate there is 2.0 m and to 7.6 m of soil overlying bedrock at the culvert inlet and outlet, respectively. Overburden at Borehole 23-10 at the outlet generally consisted of peat overlying soft to firm silty clay and dense to very dense sandy silt and silty sand. Overburden at Borehole 23-09 at the inlet consisted of very loose to very dense sand. It is important to note that the ground conditions may vary beyond the borehole locations, and it is expected that the top of bedrock elevation will vary.

Typical options for cofferdams include interlocking sheet piles or sandbags. Installation of sheet piles is not feasible in the ground conditions encountered at Borehole 23-09, at the culvert inlet, due to shallow bedrock conditions. The use of a sandbag cofferdam is recommended from a foundation's perspective at the inlet of the culvert.

Installation of sheet piles may be feasible in the ground conditions encountered at Borehole 23-10. However, it is possible that shallower bedrock will be encountered as a result of the sloped bedrock resulting in insufficient embedment depth. The use of a sandbag cofferdam is recommended from a foundation's perspective at the inlet of the culvert.

It is recommended that the work be carried out when the conditions are the culvert are relatively dry as they were at the time of the investigation. This may eliminate the need for cofferdams or reduce the amount of surface water that needs to be diverted.

The Contractor should be aware that regardless of the cofferdam type selected, pumping from sumps installed within the cofferdams will be required to maintain a dry working area. Due to the sand layer extending to 2 m below ground surface at the inlet and peat layer extending to 1.2 m below ground surface which are relatively permeable, it should be expected that water will tend to seep under the sandbag cofferdams, through these soils and up into the cofferdam enclosure. Additional pumps or large capacity pumps may be required to maintain a dry working area within the cofferdams.

The design and selection of the cofferdam system is the responsibility of the Contractor. The Contractor should consider the ground conditions in selecting the type of cofferdam for this site.

11. CORROSION AND SULPHATE ATTACK POTENTIAL

Analytical tests on soil and surface water were completed to determine the potential for degradation of concrete in the presence of soluble sulphates and the potential for corrosion of exposed steel used in buried infrastructure. The results of the analytical tests are summarized in Section 6.

The water-soluble sulphate concentration measured in the soil sample and the sulphate concentration in the water provide an indication of the degree of sulphate attack that is expected for concrete in contact with soil and water. The water-soluble sulphate concentration measured in the soil sample and the sulphate concentration in the water sample indicate that a negligible degree of sulphate attack is expected for concrete in contact with soil and water at this site.

The potential for soil corrosion on buried steel or other metal objects is considered to be mild to high based on the testing completed on a sample of sand and a sample of surface water, respectively. The corrosive effects of road de-icing salts should also be considered.

12. CONSTRUCTION CONCERNS

Potential construction concerns include, but are not necessarily limited to:

- The bedrock surface elevation varied in the boreholes drilled as part of the investigation. The bedrock surface may fluctuate above and below that shown on the drawing in Appendix A.

- Based on the relatively permeable surficial soils encountered in BH23-09 near the culvert inlet (sand) water may seep through the soil and into the cofferdam enclosure. Additional sumps and pumps or higher capacity pumps may be required to maintain a dry working area.

The successful performance of the project will depend largely upon good workmanship and quality control during construction.

13. CLOSURE

Interpretation of the preparation of this report was carried out by Ms. Madisan Chiarotto, P.Eng. and Mr. Matthew Boucher, P.Eng. The report was reviewed by Mr. Jason Lee, P.Eng., a Designated Principal Contact for MTO Foundations Projects.

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THURBER

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.

3. BASIS OF REPORT

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

The information and opinions expressed in the Report, or any document forming part of the Report, are for the sole benefit of the Client. NO OTHER PARTY MAY USE OR RELY UPON THE REPORT OR ANY PORTION THEREOF WITHOUT THURBER'S WRITTEN CONSENT AND SUCH USE SHALL BE ON SUCH TERMS AND CONDITIONS AS THURBER MAY EXPRESSLY APPROVE. Ownership in and copyright for the contents of the Report belong to Thurber. Any use which a third party makes of the Report, is the sole responsibility of such third party. Thurber accepts no responsibility whatsoever for damages suffered by any third party resulting from use of the Report without Thurber's express written permission.

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.

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APPENDIX A

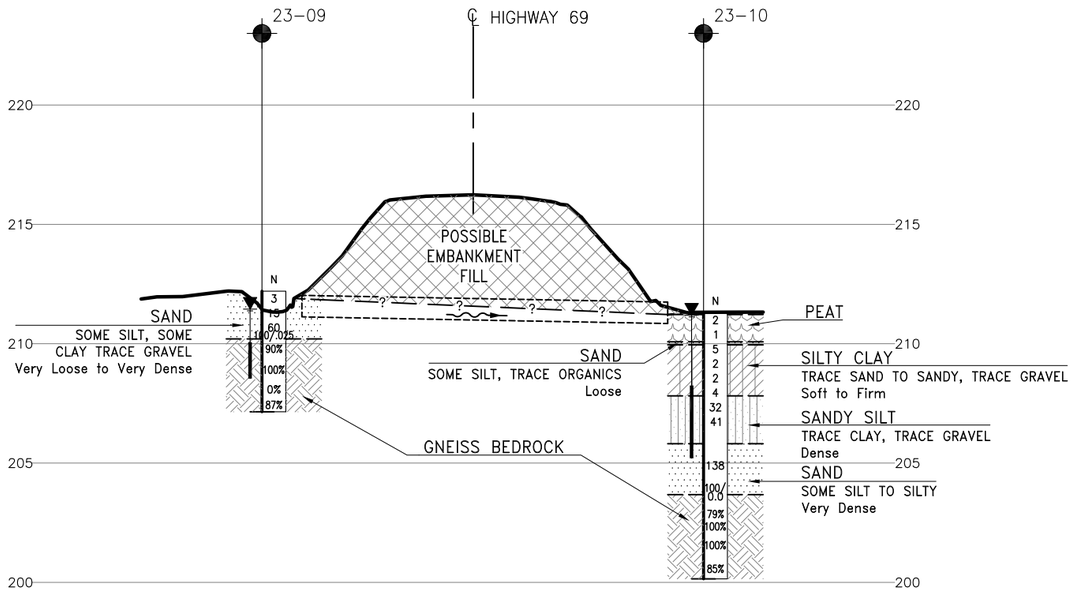
Borehole Locations and Strata Drawing

MINISTRY OF TRANSPORTATION, ONTARIO

PLAN

10 0 10 20m

SCALE 1:500



SECTION ALONG A–A'

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

LICENSED PROFESSIONAL ENGINEER
M. T. BOUCHER
100181961
2024/08/09
PROVINCE OF ONTARIO

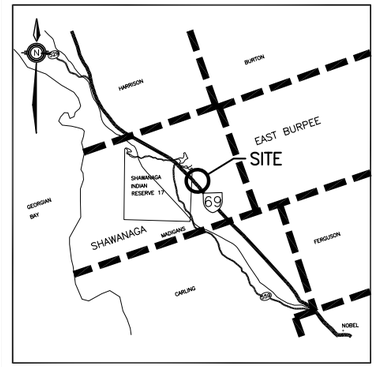
LICENSED PROFESSIONAL ENGINEER
J. P. K. LEE
100086735
2024/08/09
PROVINCE OF ONTARIO

CONT No
GWP No 5246-18-00

SHEET

HIGHWAY 69
SHAWANAGA RIVER BRIDGE
CULVERT 38
BOREHOLE LOCATIONS AND SOIL STRATA

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 Upon Completion of Drilling
▼	Water Level in Monitoring Well/Piezometer
▮	Monitoring Well/Piezometer Screen
90%	Rock Quality Designation (RQD)
A/R	Auger Refusal

NO	ELEVATION	NORTHING	EASTING
23-09	212.2	5 044 231.0	245 296.8
23-10	211.3	5 044 251.2	245 328.4

-NOTES-

1) The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.
2) This drawing is for subsurface information only. Surface details and features are for conceptual illustration.
3) Coordinate system is MTM NAD 83 Zone 10.

GEOCRES No. 41H09-004

REVISIONS		
DATE	BY	DESCRIPTION

DESIGN	MC	CHK	MTB	CODE	LOAD
DRAWN	AN	CHK	MC	SITE	STRUCT

DATE JUN 2024
DWG 1

FILENAME: H:\Drafting\30000\30351\TES-30351-PLPR.dwg
PLOTDATE: 6/3/2024 5:29 PM

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APPENDIX B

Record of Boreholes Sheet

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

C_{pen} 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.

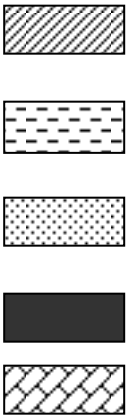
(2) DCPT Dynamic Cone Penetration Test – Continuous penetration of a 50 mm outside diameter, 60° conical steel point attached to "A" size rods driven by a 63.5 kg hammer free falling a height of 0.76 m. The resistance to cone penetration is the number of hammer blows required for each 0.3 m advance of the conical point into undisturbed ground.

EXPLANATION OF ROCK LOGGING TERMS

ROCK WEATHERING CLASSIFICATION

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

SYMBOLS



CLAYSTONE

SILTSTONE

SANDSTONE

COAL

Bedrock (general)

DISCONTINUITY SPACING

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

TERMS

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

STRENGTH CLASSIFICATION

Rock Strength	Approximate Uniaxial Compressive Strength (MPa)	(psi)	Field Estimation of Hardness*
Extremely Strong	Greater than 250	Greater than 36,000	Specimen can only be chipped with a geological hammer
Very Strong	100-250	15,000 to 36,000	Requires many blows of geological hammer to break
Strong	50-100	7,500 to 15,000	Requires more than one blow of geological hammer to break
Medium Strong	25.0 to 50.0	3,500 to 7,500	Breaks under single blow of geological hammer.
Weak	5.0 to 25.0	750 to 3,500	Can be peeled by a pocket knife with difficulty
Very Weak	1.0 to 5.0	150 to 750	Can be peeled by a pocket knife, crumbles under firm blows of geological pick.
Extremely Weak (Rock)	0.25 to 1.0	35 to 150	Indented by thumbnail

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Ontario

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RECORD OF BOREHOLE No 23-09 1 OF 1 METRIC

GWP# 5246-18-00 LOCATION HWY 69 & Shawanaga River Bridge N 5 044 231.0 E 245 296.8 ORIGINATED BY JF

DIST Parry Sound HWY 69 BOREHOLE TYPE Tripod remote access with continuous SS and NQ Coring COMPILED BY AS

DATUM Geodetic DATE 2023.09.20 - 2023.09.25 LATITUDE 45.535454 LONGITUDE -80.261873 CHECKED BY MB

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
212.2	GROUND SURFACE								
0.0	**TOPSOIL:** (75mm)								
0.1	**SAND**, some silt, trace clay, trace gravel trace organics to 0.6m Very Loose to Very Dense Light Brown to Grey Moist to Wet		1	SS	3		212		
			2	SS	15				0 82 15 3
			3	SS	60		211		
	Silty clay layer 100mm thick at 1.7m								
210.2	No recovery in SS4		4	SS	100/			FI	RUN #1 TCR=100% SCR=100% RQD=90% UCS=113.8MPa UCS=113.8MPa (PLT)
2.0	**BEDROCK (GNEISS),** slightly weathered to fresh, strong to very strong, grey		1	RUN	0.025		210	1 2 0	
			2	RUN			209	1 1 1	RUN #2 TCR=100% SCR=100% RQD=100% UCS=149.7MPa (PLT)
	Core from Run 3 was jammed in core barrel, some core lost or damaged		3	RUN			208	3 4	RUN #3 TCR=82% SCR=75% RQD=N/A UCS=167.7MPa (PLT)
207.1			4	RUN				1 2	RUN #4 TCR=100% SCR=100% RQD=87% UCS=188.1MPa
5.1	END OF BOREHOLE AT 5.1m. Well installation consists of 32mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen. WATER LEVEL READINGS DATE DEPTH(m) ELEV.(m) 2023.10.04 0.7 211.5								(PLT)

DYNAMIC CONE PENETRATION RESISTANCE PLOT: 20 40 60 80 100

SHEAR STRENGTH kPa: ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE; 20 40 60 80 100

PLASTIC LIMIT w_P NATURAL MOISTURE CONTENT w LIQUID LIMIT w_L

WATER CONTENT (%): 20 40 60 148

+ ³, × ³: Numbers refer to Sensitivity

20 15 10 5 (%) STRAIN AT FAILURE

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Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No 23-10 1 OF 2 METRIC

GWP# 5246-18-00 LOCATION HWY 69 & Shawanaga River Bridge N 5 044 251.2 E 245 328.4 ORIGINATED BY JF

DIST Parry Sound HWY 69 BOREHOLE TYPE Tripod remote access with continuous SS and NQ Coring COMPILED BY AS

DATUM Geodetic DATE 2023.09.15 - 2023.09.19 LATITUDE 45.535638 LONGITUDE -80.261471 CHECKED BY MB

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
211.3	GROUND SURFACE										
0.0 / 0.1	**TOPSOIL:** (75mm)										
	PEAT Very Loose/Very Soft Dark Brown Wet		1	SS	2		211				
			2	SS	1				284		
210.1											
1.2 / 1.3	**SAND**, some silt, trace organics Loose Grey Moist		3	SS	5		210				
	Silty, **CLAY**, trace sand Soft to Firm Grey Moist to Wet		4	SS	2		209				0 4 33 63
			5	SS	2						
	Becoming sandy		6	SS	4		208				0 24 52 24
207.8											
3.5	Sandy **SILT**, trace clay, trace gravel Dense Grey Moist		7	SS	32		207				
			8	SS	41						1 29 62 8
205.8							206				
5.5	**SAND**, some silt to silty Very Dense Grey Moist		9	SS	138		205				
203.7	No recovery in SS10		10	SS	100/0.00		204				
7.6	**BEDROCK (GNEISS),** slightly weathered to fresh, very strong, gey and pink		1	RUN			203			FI 3 1	RUN #1 TCR=100% SCR=95% RQD=79% UCS=129.2MPa
			2	RUN						1 0	UCS=166.8MPa (PLT) RUN #2 TCR=100% SCR=100% RQD=100%
			3	RUN			202			0 2 2	UCS=150.3MPa (PLT) RUN #3 TCR=100% SCR=100% RQD=100%

Continued Next Page

+ ³, × ³: Numbers refer to Sensitivity

20 / 15 5 / 10 (%) STRAIN AT FAILURE

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Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No 23-10 2 OF 2 METRIC

GWP# 5246-18-00 LOCATION HWY 69 & Shawanaga River Bridge N 5 044 251.2 E 245 328.4 ORIGINATED BY JF

DIST Parry Sound HWY 69 BOREHOLE TYPE Tripod remote access with continuous SS and NQ Coring COMPILED BY AS

DATUM Geodetic DATE 2023.09.15 - 2023.09.19 LATITUDE 45.535638 LONGITUDE -80.261471 CHECKED BY MB

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (20 40 60 80 100): ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	Continued From Previous Page						201			0	UCS=160.6MPa (PLT)
			4	RUN						1	RUN #4 TCR=100% SCR=85% RQD=85% UCS=157.3MPa (PLT)
200.2										1	
										2	
11.1	END OF BOREHOLE AT 11.1m. Well installation consists of 25mm diameter Schedule 40 PVC pipe with a 3.05m slotted screen.										

WATER LEVEL READINGS

DATE	DEPTH(m)	ELEV.(m)
2023.09.21	0.1	211.2

$+^3$, $\times^3$: Numbers refer to Sensitivity

$\frac{20}{15 \oplus 5}$ (%) STRAIN AT FAILURE
10

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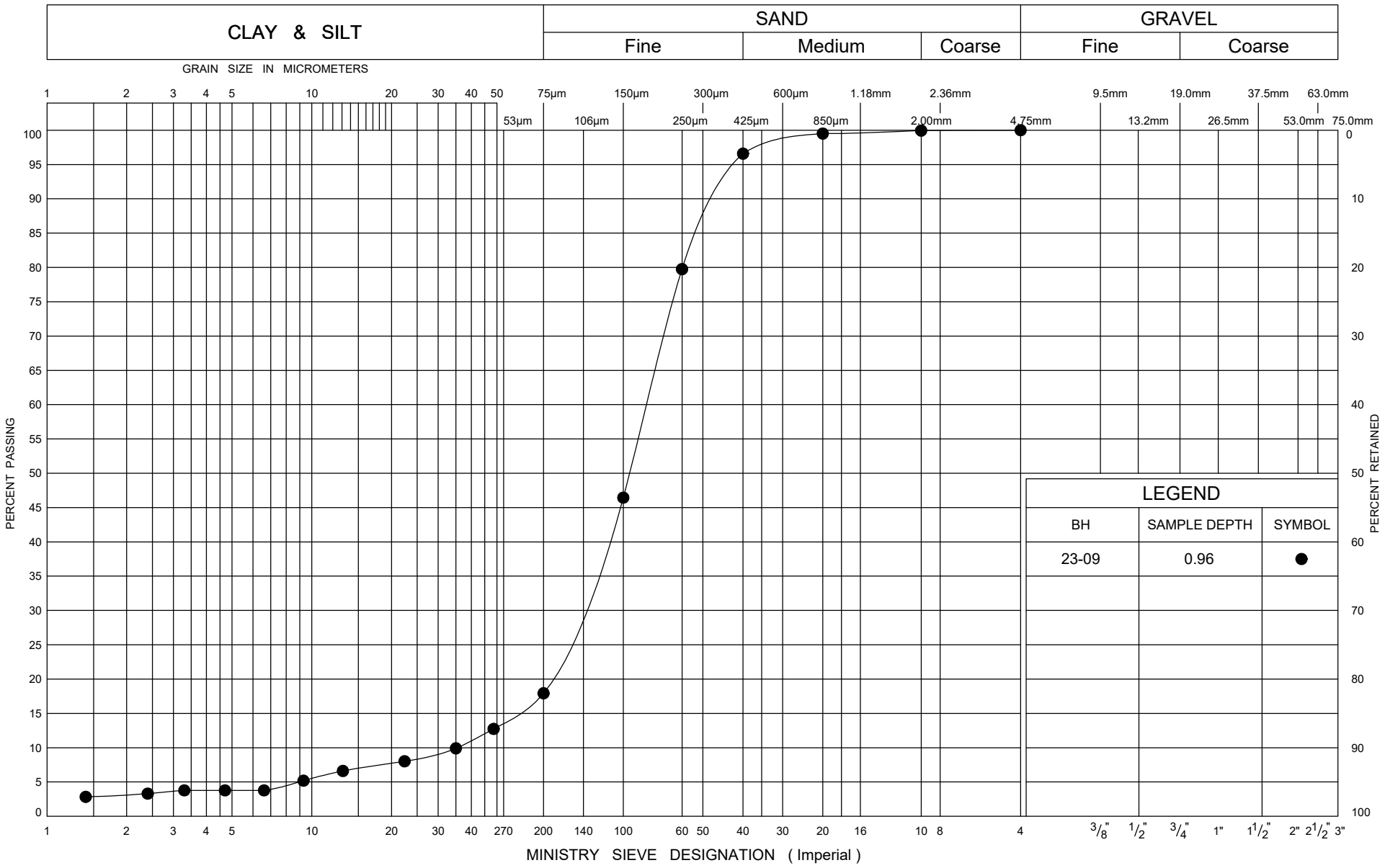
APPENDIX C

Laboratory Test Results



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GRAIN SIZE DISTRIBUTION

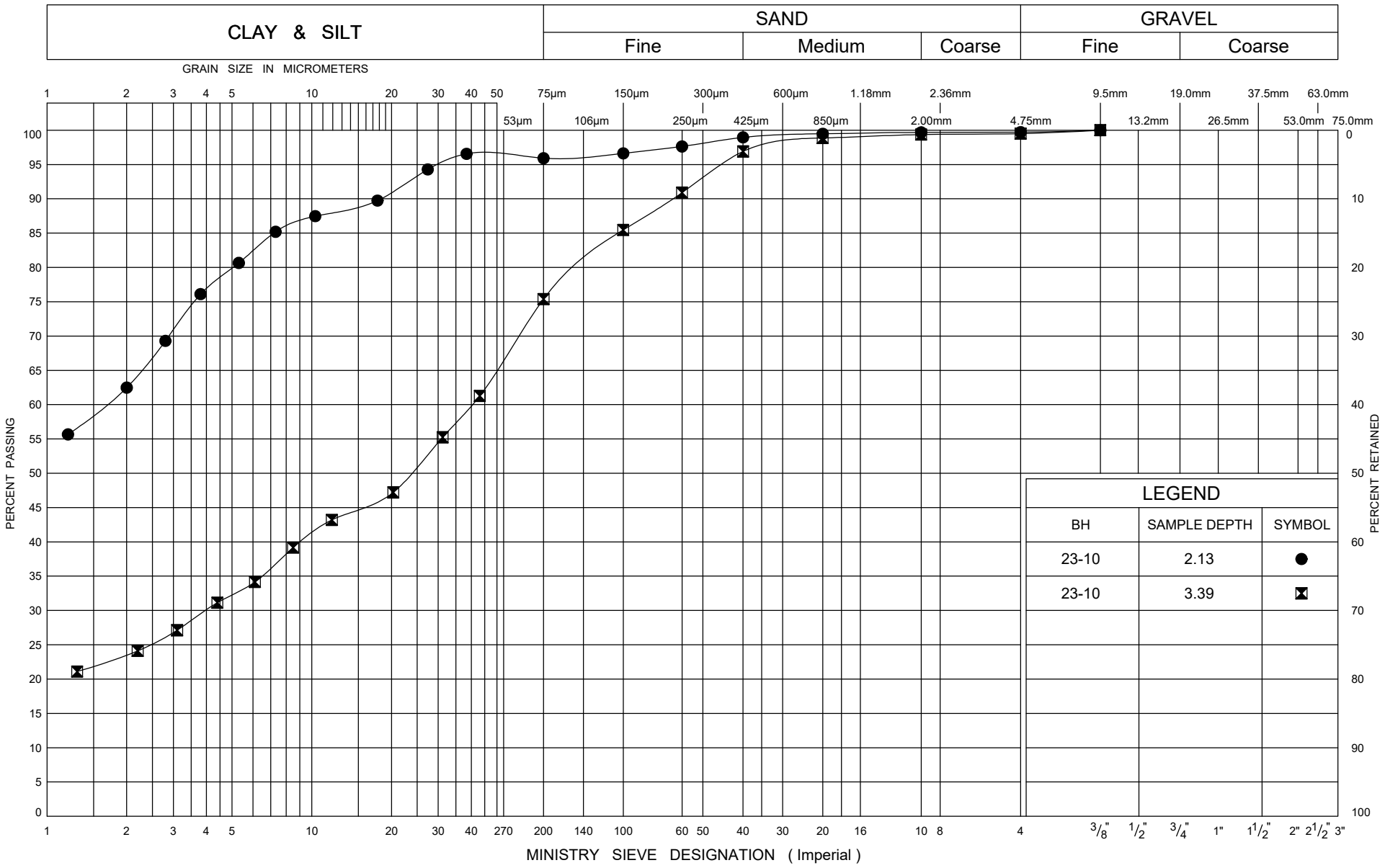
SAND to Silty SAND

FIG No C1

GWP# 5246-18-00

HWY 69 & Shawanaga River Bridge

ONTARIO MOT GRAIN SIZE 3 MTO-30351.GPJ ONTARIO MOT.GDT 6/3/24



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GRAIN SIZE DISTRIBUTION

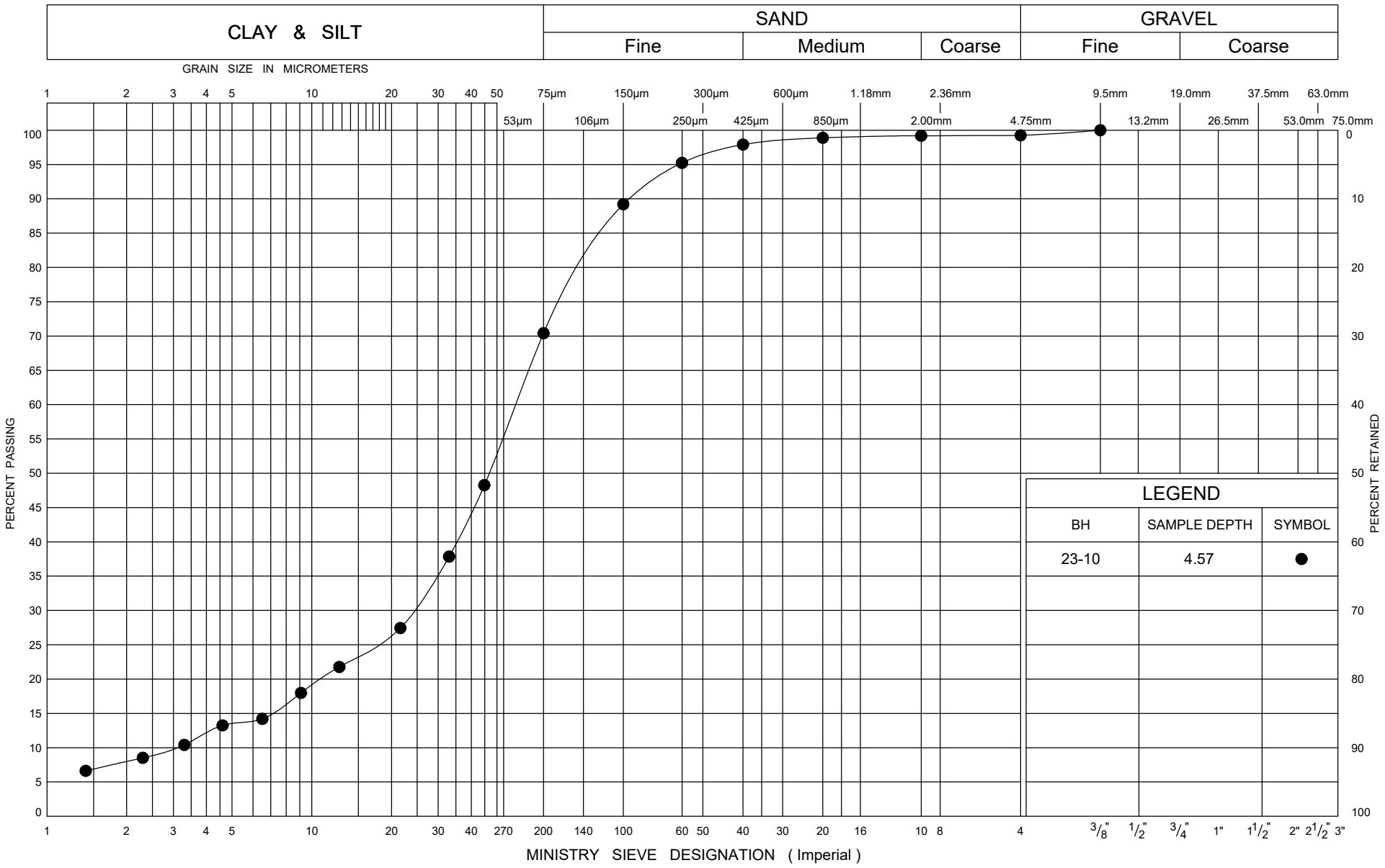
Silty CLAY

FIG No C2

GWP# 5246-18-00

HWY 69 & Shawanaga River Bridge

ONTARIO MOT GRAIN SIZE 3 MTO-30351.GPJ ONTARIO MOT.GDT 6/3/24



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GRAIN SIZE DISTRIBUTION

Sandy SILT

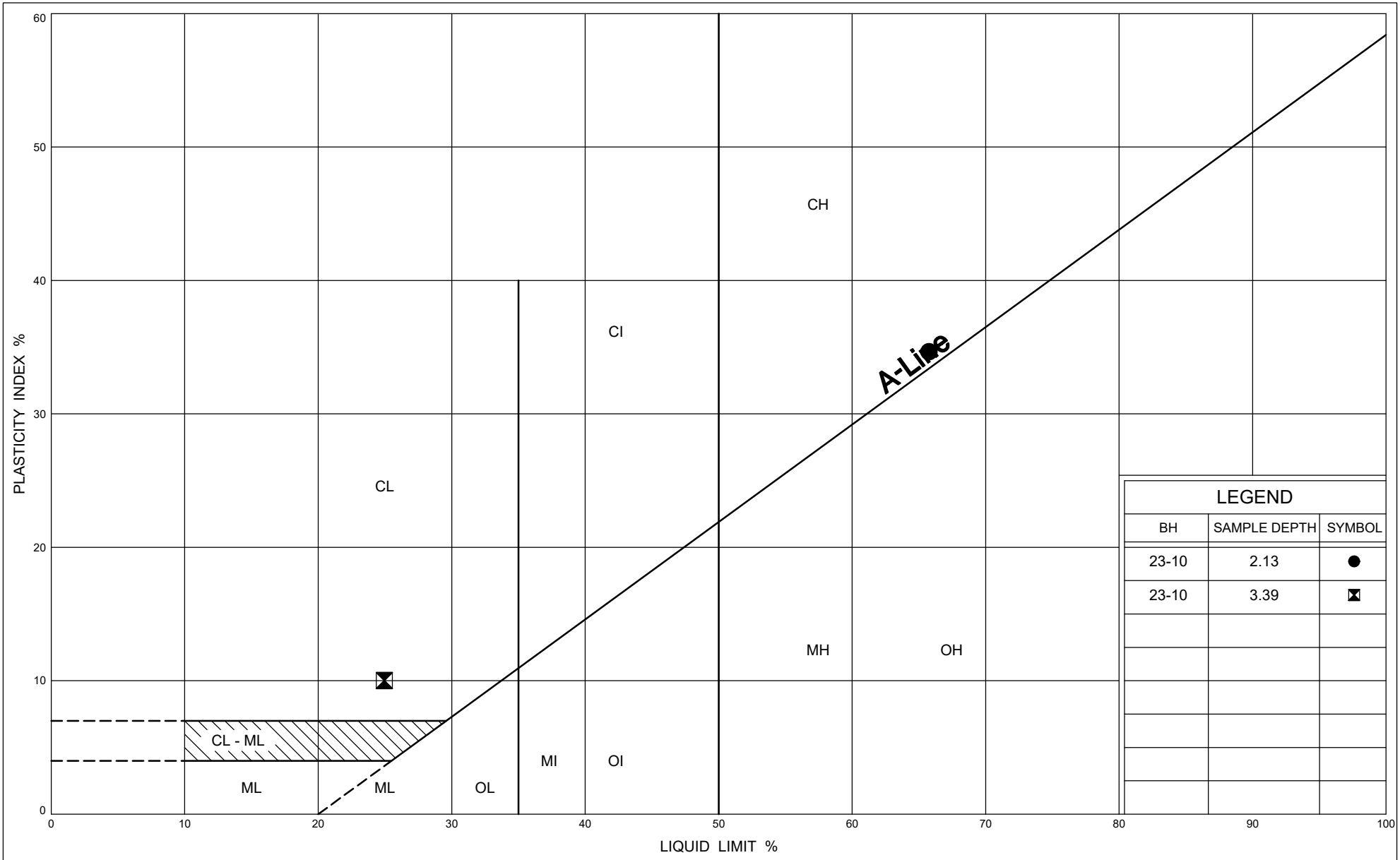
FIG No C3

GWP# 5246-18-00

HWY 69 & Shawanaga River Bridge

ONTARIO MOT GRAIN SIZE 3 MTO-30351.GPJ ONTARIO MOT.GDT 6/3/24

Oct 75, FF - S - 21



ONTARIO MOT PLASTICITY CHART 2 MTO-30351.GPJ ONTARIO MOT.GDT 6/3/24

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PLASTICITY CHART

Silty CLAY

FIG No C4

GWP# 5246-18-00

HWY 69 & Shawanaga River Bridge

THURBER ENGINEERING LTD.

POINT LOAD TEST SHEET

ASTM D5731-08

Job No:	30351	**Date Drilled:**	19-Sep-23
Client:	Egis	**Date Tested:**	12-Oct-23
Project Name:	Highway 69 and Shawanaga River Bridge Rehab	**Tester:**	AK
Core Size:	NQ **BH No :** 23-09	**Reviewed by:**	MC

Test No.	Run No.	Depth (m)	Axial or Diametral	Gauge (MPa)	Diameter (mm)	Length (mm)	$I_{s(50)}$ (MPa)	UCS (MPa)	Rock Type	Rock Strength (after Hoek & Brown, 1997)
1	1	2.0	D	14.6	47.7	83.6	6.0	143.1	Gneiss	Very Strong
2	1	2.1	D	10.1	47.7	86.3	4.1	98.5	Gneiss	Strong
3	1	2.2	D	10.2	47.7	107.3	4.2	99.9	Gneiss	Strong
4	2	2.8	D	15.2	47.7	86.6	6.2	148.6	Gneiss	Very Strong
5	2	2.9	D	15.4	47.7	84.0	6.3	150.8	Gneiss	Very Strong
6	3	3.8	D	15.9	47.7	82.6	6.5	155.3	Gneiss	Very Strong
7	3	3.9	D	18.4	47.7	96.7	7.5	180.1	Gneiss	Very Strong
8	4	4.5	D	20.3	47.7	100.7	8.3	198.9	Gneiss	Very Strong
9	4	4.6	D	18.1	47.7	98.7	7.4	177.2	Gneiss	Very Strong
10										
11					**Average Run 1**			113.8		
12					**Average Run 2**			149.7		
13					**Average Run 3**			167.7		
14					**Average Run 4**			188.1		
15										
16										
17										
18										
19										
20										
21										
22										
23										
24										
25										
26										
27										
28										
29										
30										
31										
32										
33										
34										
35										

* It is ideal to perform axial test on core specimens with D/L ratio of 1.1 ± 0.1
Long pieces of core can be tested diametrically to produce suitable lengths for axial testing

* Diametral Test should have 0.7 x D on either side of test point.

* Correlation factor to obtain UCS values is 24.

Last Modified: September 14, 2016

THURBER ENGINEERING LTD.

POINT LOAD TEST SHEET

ASTM D5731-08

Job No:	30351	**Date Drilled:**	09-Sep-23
Client:	Egis	**Date Tested:**	04-Oct-23
Project Name:	Highway 69 and Shawanaga River Bridge Rehab	**Tester:**	AK
Core Size:	NQ **BH No :** 23-10	**Reviewed by:**	MC

Test No.	Run No.	Depth (m)	Axial or Diametral	Gauge (MPa)	Diameter (mm)	Length (mm)	$I_{s(50)}$ (MPa)	UCS (MPa)	Rock Type	Rock Strength (after Hoek & Brown, 1997)
1	1	8.3	D	20.6	50.0	97.1	7.8	187.8	Gneiss	Very Strong
2	1	8.4	D	16.0	50.0	99.4	6.1	145.8	Gneiss	Very Strong
3	2	8.7	D	16.7	50.0	104.6	6.3	152.2	Gneiss	Very Strong
4	2	8.8	D	15.5	50.0	85.5	5.9	140.9	Gneiss	Very Strong
5	2	9.0	D	17.3	50.0	81.1	6.6	157.8	Gneiss	Very Strong
6	3	9.2	D	21.7	50.0	88.2	8.2	197.5	Gneiss	Very Strong
7	3	9.6	D	13.3	50.0	103.5	5.1	121.2	Gneiss	Very Strong
8	3	9.9	D	17.9	50.0	105.9	6.8	163.1	Gneiss	Very Strong
9	4	10.8	D	17.2	50.0	91.3	6.5	156.2	Gneiss	Very Strong
10	4	10.9	D	17.5	50.0	72.3	6.6	159.4	Gneiss	Very Strong
11	4	11.0	D	17.2	50.0	78.3	6.5	156.2	Gneiss	Very Strong
12										
13										
14					**Average Run 1**			166.8		
15					**Average Run 2**			150.3		
16					**Average Run 3**			160.6		
17					**Average Run 4**			157.3		
18										
19										
20										
21										
22										
23										
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28										
29										
30										
31										
32										
33										
34										
35										

* It is ideal to perform axial test on core specimens with D/L ratio of 1.1 ± 0.1
Long pieces of core can be tested diametrically to produce suitable lengths for axial testing

* Diametral Test should have 0.7 x D on either side of test point.

* Correlation factor to obtain UCS values is 24.

Last Modified: September 14, 2016

Geomechanica Inc.
Unit 14 – 1240 Speers Rd.
Oakville Ontario
Canada L6L 2X4

November 9, 2023

Madisan Chiarotto
Thurber Engineering Ltd.
103, 2010 Winston Park Drive
Oakville ON
L6H 5R7

Re: UCS testing (Thurber Project No. 30551)

Dear Madisan:

On October 20th, 2023, fourteen (14) rock core samples (HQ and NQ sized) were received by Geomechanica Inc. via drop-off by Thurber personnel. These samples were identified as being from Thurber project 30551 (Highway 69 and Shawanaga River Bridge Rehabilitation). From these samples, fourteen (14) UCS tests were completed.

Details regarding the steps of specimen preparation and testing are presented in the accompanying laboratory report and summary spreadsheet.

Sincerely,

Bryan Tatone Ph.D., P. Eng.

Geomechanica Inc.
Tel: (647) 478-9767
Email: bryan.tatone@geomechanica.com

GEOMECHANICA

Rock Laboratory Testing Results

A report submitted to:

Madisan Chiarotto
Thurber Engineering Ltd.
103, 2010 Winston Park Drive
Oakville, Ontario
Canada L6H 5R7

Prepared by:

Bryan Tatone, PhD, PEng

Omid Mahabadi, PhD, PEng
Geomechanica Inc.
#14-1240 Speers Rd.
Oakville ON
L6L 2X4 Canada
Tel: +1-647-478-9767
lab@geomechanica.com

November 9, 2023
Project number: 30351

Abstract

This document summarizes the results of laboratory testing, including 14 Uniaxial Compressive Strength (UCS) tests. The UCS values along with photographs of specimens before and after testing are presented herein.

In this document:

1 Uniaxial Compressive Strength Tests

1.1 Overview

This section summarizes the results of uniaxial compressive strength (UCS) testing. The testing was performed in Geomechanica's rock testing laboratory using a 150 ton (1.3 MN) Forney loading frame equipped with pressure-compensated control valve to maintain an axial displacement rate of approximately 0.05 mm/min (Figure 1). The preparation and testing procedure for each specimen included the following:

1. Unwrapping the core sample and inspecting it for damage.
2. Diamond cutting the core sample to obtain a cylindrical specimen with an appropriate length (length:diameter = 2:1) and nearly parallel end faces.
3. Diamond grinding the specimen to obtain flat (within ± 0.025 mm) and parallel end faces (within 0.25°).
4. Placing the specimen into the loading frame and axially loading the specimen to rupture while continuously recording axial force and axial deformation to determine the peak strength (UCS).

Figure 1: Forney loading frame setup for UCS testing.

Using a precision V-block mounted on the magnetic chuck of the surface grinder, test specimens met the end flatness, end parallelism, and perpendicularity criteria set out in ASTM D4543-19. The side straightness criteria, as checked with a feeler gauge, and the minimum length:diameter criteria were met for all specimens unless noted otherwise in Table 1. Testing of the specimens followed ASTM D7012-14 Method C.

1.2 Results

The results of UCS testing are summarized in Table 1. Additional specimens and testing details are included in the summary spreadsheet that accompanies this report.

Table 1: Summary of Uniaxial Compression test results.

Sample	Depth (m)	Bulk density ρ (g/cm^3)	UCS (MPa)	Lithology	Failure description
BH23-01	32'10" - 33'10"	2.769	90.5	Granite gneiss	1, 2
BH23-02	2'3" - 3'2"	2.770	117.4	Granite gneiss	1
BH23-03	3'10" - 4'8"	2.792	118.4	Granite gneiss	3
BH23-04	8'0" - 8'10"	2.753	101.2	Granite gneiss	1
BH23-05	21'0" - 22'11"	2.646	117.3	Pegmatite	4
BH23-07	13'5" - 14'4"	2.746	90.2	Granite gneiss	3
BH23-09	7'10" - 8'5"	2.753	113.8	Granite gneiss	3, 5
BH23-10	27'6" - 28'5"	2.661	129.2	Granite gneiss	3
BH23-12	21'5" - 22'4"	2.775	86.7	Granite gneiss	1
BH23-13	6'6" - 7'2"	2.674	129.4	Granite gneiss	6
BH23-15	17'2" - 17'10"	2.416	98.6	Granite gneiss	3, 5
BH23-16	7'3" - 7'11"	2.648	147.0	Granite gneiss	3, 2
BH23-17	12'6" - 13'5"	2.751	75.9	Granite gneiss	1, 5
BH23-18	28'7" - 29'7"	2.707	68.2	Granite gneiss	3, 5

[1] Inclined shear failure
[2] Partial hourglass failure
[3] Inclined shear fracture and axial splitting failure
[4] Axial splitting failure
[5] Failure partly along pre-existing structure
[6] Hourglass failure

1.3 Specimen photographs

Photographs of the specimens before and after testing are presented in the Appendix of this report.

Appendices

Specimen sheets

- BH23-01
- BH23-02
- BH23-03
- BH23-04
- BH23-05
- BH23-07
- BH23-09
- BH23-10
- BH23-12
- BH23-13
- BH23-15
- BH23-16
- BH23-17
- BH23-18

GEOMECHANICA

Uniaxial Compression Test

Client	Thurber Engineering Ltd.	**Project**	30351
Sample	BH23-01	**Depth**	32'10" - 33'10"

Specimen parameters	
Diameter (mm) [a]	60.80
Length (mm) [a]	129.90
Bulk density ρ (g/cm^3)	2.769
UCS (MPa)	90.5
Lithology	Granite gneiss
Failure description [b]	1, 2

[a] Additional specimen measurement/details provided in accompanying summary spreadsheet.
[b] Failure description: [1] Inclined shear failure; [2] Partial hourglass failure;

Prior to testing

After testing

Remarks: Loading Rate: 0.05mm/min.

Performed by	SD	**Date**	2023-11-08

GEOMECHANICA

Uniaxial Compression Test

Client	Thurber Engineering Ltd.	**Project**	30351
Sample	BH23-02	**Depth**	2'3" - 3'2"

Specimen parameters	
Diameter (mm) [a]	62.92
Length (mm) [a]	129.18
Bulk density ρ (g/cm^3)	2.770
UCS (MPa)	117.4
Lithology	Granite gneiss
Failure description [b]	1

[a] Additional specimen measurement/details provided in accompanying summary spreadsheet.
[b] Failure description: [1] Inclined shear failure;

Prior to testing

After testing

Remarks: Loading Rate: 0.05mm/min. Specimen expereinced pre-peak localized failure(s).

Performed by	SD	**Date**	2023-11-08

GEOMECHANICA

Uniaxial Compression Test

Client	Thurber Engineering Ltd.	**Project**	30351
Sample	BH23-03	**Depth**	3’10” - 4’8”

Specimen parameters	
Diameter (mm) [a]	60.75
Length (mm) [a]	129.54
Bulk density ρ (g/cm^3)	2.792
UCS (MPa)	118.4
Lithology	Granite gneiss
Failure description [b]	3

[a] Additional specimen measurement/details provided in accompanying summary spreadsheet.
[b] Failure description: [3] Inclined shear fracture and axial splitting failure;

Prior to testing

After testing

Remarks: Loading Rate: 0.05mm/min.

Performed by	SD	**Date**	2023-11-08

GEOMECHANICA

Uniaxial Compression Test

Client	Thurber Engineering Ltd.	**Project**	30351
Sample	BH23-04	**Depth**	8'0" - 8'10"

Specimen parameters	
Diameter (mm) [a]	61.85
Length (mm) [a]	129.19
Bulk density ρ (g/cm^3)	2.753
UCS (MPa)	101.2
Lithology	Granite gneiss
Failure description [b]	1

[a] Additional specimen measurement/details provided in accompanying summary spreadsheet.
[b] Failure description: [1] Inclined shear failure;

Prior to testing

After testing

Remarks: Loading Rate: 0.05mm/min.

Performed by	SD	**Date**	2023-11-08

Uniaxial Compression Test

Client	Thurber Engineering Ltd.	**Project**	30351
Sample	BH23-05	**Depth**	21'0" - 22'11"

Specimen parameters	
Diameter (mm) [a]	47.52
Length (mm) [a]	102.95
Bulk density ρ (g/cm^3)	2.646
UCS (MPa)	117.3
Lithology	Pegmatite
Failure description [b]	4

[a] Additional specimen measurement/details provided in accompanying summary spreadsheet.
[b] Failure description: [4] Axial splitting failure;

Prior to testing

After testing

Remarks: Loading Rate: 0.05mm/min. Specimen expereinced pre-peak localized failure(s).

Performed by	SD	**Date**	2023-11-08

Uniaxial Compression Test

Client	Thurber Engineering Ltd.	**Project**	30351
Sample	BH23-07	**Depth**	13’5” - 14’4”

Specimen parameters	
Diameter (mm) [a]	46.74
Length (mm) [a]	103.86
Bulk density ρ (g/cm^3)	2.746
UCS (MPa)	90.2
Lithology	Granite gneiss
Failure description [b]	3

[a] Additional specimen measurement/details provided in accompanying summary spreadsheet.
[b] Failure description: [3] Inclined shear fracture and axial splitting failure;

Prior to testing

After testing

Remarks: Loading Rate: 0.05mm/min.

Performed by	SD	**Date**	2023-11-08

Uniaxial Compression Test

Client	Thurber Engineering Ltd.	**Project**	30351
Sample	BH23-09	**Depth**	7’10” - 8’5”

Specimen parameters	
Diameter (mm) [a]	48.54
Length (mm) [a]	103.59
Bulk density ρ (g/cm^3)	2.753
UCS (MPa)	113.8
Lithology	Granite gneiss
Failure description [b]	3, 5

[a] Additional specimen measurement/details provided in accompanying summary spreadsheet.
[b] Failure description: [3] Inclined shear fracture and axial splitting failure; [5] Failure partly along pre-existing structure;

Prior to testing

After testing

Remarks: Loading Rate: 0.05mm/min.

Performed by	SD	**Date**	2023-11-08

GEOMECHANICA

Uniaxial Compression Test

Client	Thurber Engineering Ltd.	**Project**	30351
Sample	BH23-10	**Depth**	27'6" - 28'5"

Specimen parameters	
Diameter (mm) [a]	50.08
Length (mm) [a]	103.01
Bulk density ρ (g/cm^3)	2.661
UCS (MPa)	129.2
Lithology	Granite gneiss
Failure description [b]	3

[a] Additional specimen measurement/details provided in accompanying summary spreadsheet.
[b] Failure description: [3] Inclined shear fracture and axial splitting failure;

Prior to testing

After testing

Remarks: Loading Rate: 0.05mm/min.

Performed by	SD	**Date**	2023-11-08

GEOMECHANICA

Uniaxial Compression Test

Client	Thurber Engineering Ltd.	**Project**	30351
Sample	BH23-12	**Depth**	21’5” - 22’4”

Specimen parameters	
Diameter (mm) [a]	46.99
Length (mm) [a]	103.61
Bulk density ρ (g/cm^3)	2.775
UCS (MPa)	86.7
Lithology	Granite gneiss
Failure description [b]	1

[a] Additional specimen measurement/details provided in accompanying summary spreadsheet.
[b] Failure description: [1] Inclined shear failure;

Prior to testing

After testing

Remarks: Loading Rate: 0.05mm/min.

Performed by	SD	**Date**	2023-11-08

Uniaxial Compression Test

Client	Thurber Engineering Ltd.	**Project**	30351
Sample	BH23-13	**Depth**	6'6" - 7'2"

Specimen parameters	
Diameter (mm) [a]	48.89
Length (mm) [a]	103.89
Bulk density ρ (g/cm^3)	2.674
UCS (MPa)	129.4
Lithology	Granite gneiss
Failure description [b]	6

[a] Additional specimen measurement/details provided in accompanying summary spreadsheet.
[b] Failure description: [6] Hourglass failure;

Prior to testing

After testing

Remarks: Loading Rate: 0.05mm/min.

Performed by	SD	**Date**	2023-11-08

Uniaxial Compression Test

Client	Thurber Engineering Ltd.	**Project**	30351
Sample	BH23-15	**Depth**	17’2” - 17’10”

Specimen parameters	
Diameter (mm) [a]	49.61
Length (mm) [a]	103.77
Bulk density ρ (g/cm^3)	2.416
UCS (MPa)	98.6
Lithology	Granite gneiss
Failure description [b]	3, 5

[a] Additional specimen measurement/details provided in accompanying summary spreadsheet.
[b] Failure description: [3] Inclined shear fracture and axial splitting failure; [5] Failure partly along pre-existing structure;

Prior to testing

After testing

Remarks: Loading Rate: 0.05mm/min.

Performed by	SD	**Date**	2023-11-08

GEOMECHANICA

Uniaxial Compression Test

Client	Thurber Engineering Ltd.	**Project**	30351
Sample	BH23-16	**Depth**	7'3" - 7'11"

Specimen parameters	
Diameter (mm) [a]	47.11
Length (mm) [a]	103.57
Bulk density ρ (g/cm^3)	2.648
UCS (MPa)	147.0
Lithology	Granite gneiss
Failure description [b]	3, 2

[a] Additional specimen measurement/details provided in accompanying summary spreadsheet.
[b] Failure description: [3] Inclined shear fracture and axial splitting failure; [2] Partial hourglass failure;

Prior to testing

After testing

Remarks: Loading Rate: 0.05mm/min.

Performed by	SD	**Date**	2023-11-08

GEOMECHANICA

Uniaxial Compression Test

Client	Thurber Engineering Ltd.	**Project**	30351
Sample	BH23-17	**Depth**	12’6” - 13’5”

Specimen parameters	
Diameter (mm) [a]	46.83
Length (mm) [a]	102.54
Bulk density ρ (g/cm^3)	2.751
UCS (MPa)	75.9
Lithology	Granite gneiss
Failure description [b]	1, 5

[a] Additional specimen measurement/details provided in accompanying summary spreadsheet.
[b] Failure description: [1] Inclined shear failure; [5] Failure partly along pre-existing structure;

Prior to testing

After testing

Remarks: Loading Rate: 0.05mm/min.

Performed by	SD	**Date**	2023-11-08

GEOMECHANICA

Uniaxial Compression Test

Client	Thurber Engineering Ltd.	**Project**	30351
Sample	BH23-18	**Depth**	28’7” - 29’7”

Specimen parameters	
Diameter (mm) [a]	62.81
Length (mm) [a]	129.38
Bulk density ρ (g/cm^3)	2.707
UCS (MPa)	68.2
Lithology	Granite gneiss
Failure description [b]	3, 5

[a] Additional specimen measurement/details provided in accompanying summary spreadsheet.
[b] Failure description: [3] Inclined shear fracture and axial splitting failure; [5] Failure partly along pre-existing structure;

Prior to testing

After testing

Remarks: Loading Rate: 0.05mm/min.

Performed by	SD	**Date**	2023-11-08

FINAL REPORT

CA40011-OCT23 R1

30351, Parry Sound

Prepared for

Thurber Engineering Ltd.

FINAL REPORT

First Page

CLIENT DETAILS		LABORATORY DETAILS	
Client	Thurber Engineering Ltd.	Project Specialist	Jill Campbell, B.Sc.,GISAS
		Laboratory	SGS Canada Inc.
Address	103, 2010 Winston Park Drive Oakville, ON L6H 5R7. Canada	Address	185 Concession St., Lakefield ON, K0L 2H0
Contact	Madisan Chiarotto	Telephone	2165
Telephone	647-548-8390	Facsimile	705-652-6365
Facsimile		Email	jill.campbell@sgs.com
Email	mchiarotto@thurber.ca	SGS Reference	CA40011-OCT23
Project	30351, Parry Sound	Received	10/03/2023
Order Number		Approved	10/12/2023
Samples	Soil (1)	Report Number	CA40011-OCT23 R1
		Date Reported	10/12/2023

COMMENTS

Temperature of Sample upon Receipt: 8 degrees C
Cooling Agent Present: Yes
Custody Seal Present: Yes

Chain of Custody Number: n/a

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

TABLE OF CONTENTS

Client: Thurber Engineering Ltd.
Project: 30351, Parry Sound
Project Manager: Madisan Chiarotto
Samplers: Madison Chiarotto

MATRIX: SOIL

Sample Number	5
Sample Name	23-09 SS1B Corr
Sample Matrix	Soil
Sample Date	20/09/2023

Parameter	Units	RL		Result
Corrosivity Index				
Corrosivity Index	none	1		2
Soil Redox Potential	mV	no		341
Sulphide (Na2CO3)	%	0.01		< 0.01
pH	pH Units	0.05		5.38
Resistivity (calculated)	ohms.cm	-9999		9260
General Chemistry				
Conductivity	uS/cm	2		108
Metals and Inorganics				
Moisture Content	%	0.1		35.1
Sulphate	µg/g	0.4		5.9
Other (ORP)				
Chloride	µg/g	0.4		18

QC SUMMARY

Anions by IC

Method: EPA300/MA300-Ions1.3 | Internal ref.: ME-CA-[ENV]IC-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	DIO0178-OCT23	µg/g	0.4	<0.4	18	35	102	80	120	106	75	125
Sulphate	DIO0178-OCT23	µg/g	0.4	<0.4	5	35	95	80	120	93	75	125

Carbon/Sulphur

Method: ASTM E1915-07A | Internal ref.: ME-CA-[ENV]ARD-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)	ECS0032-OCT23	%	0.01	< 0.01	ND	20	114	80	120			

Conductivity

Method: SM 2510 | Internal ref.: ME-CA-[ENV]EWL-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	EWL0149-OCT23	uS/cm	2	2	1	20	100	90	110	NA		

QC SUMMARY

pH

Method: SM 4500 I Internal ref.: ME-CA-[ENV]EWL-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	EWL0149-OCT23	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.

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 report supersedes all previous versions.

-- End of Analytical Report --

Request for Laboratory Services and CHAIN OF CUSTODY

SGS 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:

Page 1 of 1

Laboratory Information Section - Lab use only

Received By: ED
Received Date: 10/3/23 (mm/dd/yy)
Received Time: 11:15 (hr:min)
Received By (signature):
Custody Seal Present: Yes ☑ No ☐
Custody Seal Intact: Yes ☐ No ☐
Cooling Agent Present: Yes ☐ No ☑ Type: ICE
Temperature Upon Receipt (°C): 8.4 x 3
LAB LIMS #: CA-40011-Oct23

REPORT INFORMATION	INVOICE INFORMATION
Company: Thurber Engineering Ltd	☑ (same as Report Information)
Contact: Madisan Chiarotto	Company:
Address: 2010 Winston Park Drive, Suite 103	Contact:
	Address:
Phone: 905-829-8666	
Fax:	Phone:
Email: mchiarotto@thurber.ca and mboucher@thurber.ca	Email: accountingON@thurber.ca

Quotation #:
P.O. #: 30351
Project #: 30351
Site Location/ID: Parry Sound

TURNAROUND TIME (TAT) REQUIRED

☑ Regular TAT (5-7days)

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:

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

REGULATIONS

☐ O.Reg 153/04 ☑ O.Reg 406/19
☐ Table 1 ☐ Res/Park Soil Texture:
☐ Table 2 ☐ Ind/Com ☑ Coarse
☐ Table 3 ☐ Agri/Other ☐ Medium/Fine
☑ Table 2 1
Soil Volume: ☐ 50m3 ☑ >350m3

Other Regulations:
☐ Reg 347/558 (3 Day min TAT)
☐ PWQO ☐ MER
☐ CCME ☑ Other
☐ MISA
☐ PDWS Not Reportable *See note

Sewer By-Law:
☐ Sanitary
☐ Storm
Municipality:

RECORD OF SITE CONDITION (RSC) ☐ YES ☑ NO

ANALYSIS REQUESTED

	SAMPLE IDENTIFICATION	DATE SAMPLED	TIME SAMPLED	# OF BOTTLES	MATRIX
1	23-09 SS1B CORR	20-Sep-23		1	SOIL
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					

	M & I				SVOC		PCB	PHC		VOC		Pest	Other (please specify)							TCLP	
	Field Filtered (Y/N)	Metals & Inorganics incl CrVI, CN, Hg pH (B(HWS),EC,SAR-soil) (Cl, Na-water)	Full Metals Suite (ICP metals plus B(HWS-soil only), Hg, CrVI	ICP Metals only Sb,As,Ba,Be,B,Cd,Cr,Co,Cu,Pb,Mo,Ni,	PAHs only	SVOCs all incl PAHs, ABNs, CPs	PCBs Total ☐ Aroclor ☐	F1-F4 + BTEX	F1-F4 only no BTEX	VOCs all incl BTEX	BTEX only	Pesticides Organochlorine or specify other		Corrosivity Package			Appendix 2: 406/19 Leachate Screening Levels Table:	Sewer Use: Specify pkg	Water Characterization Pkg General / Extended	Specify TCLP tests ☐ M&I ☐ VOC ☐ PCB ☐ B(a)P ☐ ABN ☐ Ignit.	COMMENTS:
1														x							
2																					
3																					
4																					
5																					
6																					
7																					
8																					
9																					
10																					
11																					
12																					

Observations/Comments/Special Instructions

Sampled By (NAME): Madisan Chiarotto
Signature:
Date: 16/03/23 (mm/dd/yy)

Relinquished by (NAME): Madisan Chiarotto
Signature:
Date: 10/03/23 (mm/dd/yy)

Pink Copy - Client
Yellow & White Copy - SGS

Revision # 1.4
Date of Issue: 22 May 2020

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FINAL REPORT

CA40126-AUG23 R

30351, Parry Sound (North)

Prepared for

Thurber Engineering Ltd.

FINAL REPORT

CA40126-AUG23 R

First Page

CLIENT DETAILS

Client	Thurber Engineering Ltd.
Address	103, 2010 Winston Park Drive Oakville, ON L6H 5R7. Canada
Contact	Madisan Chiarotto
Telephone	647-548-8390
Facsimile	
Email	mchiarotto@thurber.ca
Project	30351, Parry Sound (North)
Order Number	
Samples	Solution (7)

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	CA40126-AUG23
Received	08/11/2023
Approved	08/17/2023
Report Number	CA40126-AUG23 R
Date Reported	08/17/2023

COMMENTS

Temperature of Sample upon Receipt: 9 degrees C
Cooling Agent Present: Yes
Custody Seal Present: Yes

Chain of Custody Number: 036865

SIGNATORIES

Jill Campbell, B.Sc.,GISAS

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FINAL REPORT

CA40126-AUG23 R

Client: Thurber Engineering Ltd.
Project: 30351, Parry Sound (North)
Project Manager: Madisan Chiarotto
Samplers: Jakob Flood

MATRIX: WATER

	Sample Number	6	7	8	9	10	11	12
	Sample Name	Culvert 24 STA 11+449	Culvert 25 STA 11+680	Culvert 35 STA 14+631	Culvert 38 STA 15+250	Culvert 43 STA 16+534	Culvert 44 STA 16+764	Culvert 47 STA 17+808
	Sample Matrix	Solution	Solution	Solution	Solution	Solution	Solution	Solution
	Sample Date	09/08/2023	09/08/2023	09/08/2023	11/08/2023	11/08/2023	11/08/2023	08/08/2023
Parameter	**Units**	**RL**		**Result**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**
General Chemistry								
Conductivity	uS/cm	2		657	171	76	1120	80	66	1180
Redox Potential	mV	no		143	152	117	127	136	240	152
Sulphide	µg/L	6		< 6	< 6	16	7.0	23	41	< 6
Metals and Inorganics								
Sulphate	mg/L	0.04		12	8.1	3.0	28	0.74	5.8	16
Other (ORP)								
pH	No unit	0.05		5.80	6.28	5.68	6.32	5.98	5.77	6.41
Chloride	mg/L	0.04		210	38	17	380	14	10	380

QC SUMMARY

Anions by IC

Method: EPA300/MA300-Ions1.3 | Internal ref.: ME-CA-[ENVIIC-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	DIO0332-AUG23	mg/L	0.04	<0.04	6	20	102	90	110	108	75	125
Sulphate	DIO0332-AUG23	mg/L	0.04	<0.04	ND	20	97	90	110	92	75	125
Sulphate	DIO0393-AUG23	mg/L	0.04	<0.04	3	20	97	90	110	91	75	125

Conductivity

Method: SM 2510 | 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
Conductivity	EWL0270-AUG23	uS/cm	2	< 2	0	20	100	90	110	NA		

QC SUMMARY

pH

Method: SM 4500 I Internal ref.: ME-CA-[ENV]EWL-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	EWL0265-AUG23	No unit	0.05	NA	0		100			NA		
pH	EWL0277-AUG23	No unit	0.05	NA	0		100			NA		

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	EWL0243-AUG23	mV	no	NA	2	20	104	80	120	NA		

Sulphide by SFA

Method: SM 4500 I Internal ref.: ME-CA-[ENV]SFA-LAK-AN-008

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	SKA0140-AUG23	ug/L	6	<0.006	ND	20	110	80	120	NA	75	125

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 report supersedes all previous versions.

-- End of Analytical Report --

SGS

Request for Laboratory Services and CHAIN OF CUSTODY

No: 036865

Industries & Environment - 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

Laboratory Information Section - Lab use only

Received By: Scott
Received Date: 08/11/2023 (mm/dd/yy)
Received Time: 13:05 (hr : min)
Received By (signature): Scott
Custody Seal Present: Yes ☐ No ☐
Custody Seal Intact: Yes ☐ No ☐
Cooling Agent Present: Yes ☑ No ☐ Type: ice
Temperature Upon Receipt (°C): 9 ICE 3
LAB LIMS #: CA40126-AUG23

REPORT INFORMATION

Company: THURBER ENGINEERING LTD
Contact: MADISAN CHIAROTTO | MATTHEW BOUCHER
Address: 2010 WINSTON PARK DR
Phone: 905-829-8666
Fax:
Email: MBOUCHER@THURBER.CA MCHIAROTTO@THURBER.CA

INVOICE INFORMATION

☐ (same as Report Information)
Company:
Contact:
Address:
Phone:
Email: ACCOUNTINGON@THURBER.CA

Quotation #:
P.O. #:
Project #: 30351
Site Location/ID: PARRY SOUND (NORTH)

TURNAROUND TIME (TAT) REQUIRED

☐ Regular TAT (5-7days)

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:

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

REGULATIONS

☐ O.Reg 153/04 ☐ O.Reg 406/19

☐ Table 1 ☐ Res/Park Soil Texture:
☐ Table 2 ☐ Ind/Com ☐ Coarse
☐ Table 3 ☐ Agri/Other ☐ Medium/Fine
☐ Table _____ Appx. _____
Soil Volume ☐ <350m3 ☐ >350m3

Other Regulations:
☐ Reg 347/558 (3 Day min TAT)
☐ PWQO ☐ MMER
☐ CCME ☐ Other:
☐ MISA _____
☐ ODWS Not Reportable *See note

Sewer By-Law:
☐ Sanitary
☐ Storm
Municipality:

RECORD OF SITE CONDITION (RSC) ☐ YES ☐ NO

ANALYSIS REQUESTED

	SAMPLE IDENTIFICATION	DATE SAMPLED	TIME SAMPLED	# OF BOTTLES	MATRIX
1	CULVERT 24 STA 11+449	08/09/23	17:00	3	WATER
2	CULVERT 25 STA 11+680	08/09/23	16:45	3	WATER
3	CULVERT 35 STA 14+631	08/09/23	9:30	3	WATER
4	CULVERT 38 STA 15+250	08/11/23	9:10	3	WATER
5	CULVERT 43 STA 16+534	08/11/23	9:05	3	WATER
6	CULVERT 44 STA 16+764	08/11/23	9:00	3	WATER
7	CULVERT 97 STA 17+808	08/08/23	10:00	3	WATER
8					
9					
10					
11					
12					

M & I: Field Filtered (Y/N); Metals & Inorganics incl CrVI, CN,Hg pH,(B(HWS),EC,SAR–soil) (CL Na-Water); Full Metals Suite ICP metals plus B(HWS-soil only) Hg, CrVI; ICP Metals only Sb,As,Ba,Be,B,Cd, Cr,Co,Cu,Pb,Mo,Ni,Se,Ag,Tl,U,V,Zn; PAHs only; SVOCs all incl PAHs, ABNs, CPs; PCBs Total ☐ Aroclor ☐; F1-F4 + BTEX; F1-F4 only no BTEX; VOCs all incl BTEX; BTEX only; Pesticides Organochlorine or specify other

Other (please specify): CORROSIVITY PACKAGE FOR WATER SAMPLES INCLUDING CHLORIDES; Sewer Use: Specify pkg:; Water Characterization Pkg ☐ General ☐ Extended

	Corrosivity Package for Water Samples including Chlorides	Sewer Use: Specify pkg:	Water Characterization Pkg General ☐ Extended ☐
1	X		
2	X		
3	X		
4	X		
5	X		
6	X		
7	X		

SPLP: Specify tests ☐ Metals ☐ VOC ☐ 1,4-Dioxane ☐ OCP ☐ ABN
TCLP: Specify tests ☐ M&I ☐ VOC ☐ PCB ☐ B(a)P ☐ ABN ☐ Ignit.

COMMENTS:

Observations/Comments/Special Instructions

Sampled By (NAME): JAKOB FLOOD	Signature:	Date: 08/11/23 (mm/dd/yy)	Pink Copy - Client
Relinquished by (NAME): JAKOB FLOOD	Signature:	Date: 08/11/23 (mm/dd/yy)	Yellow & White Copy - SGS

THURBER ENGINEERING LTD.

APPENDIX D

Bedrock Core Photos

HIGHWAY 69 AND REHABILITATION OF SHAWANAGA RIVER BRIDGE

Photographs of Rock Core

Borehole 23-09 – Runs 1, 2, 3 and 4 – 2.01 – 5.05 m

Top of Run 1

Run 1 Continues

Run 2 Continues

Top of Run 3

Top of Run 4

HIGHWAY 69 AND REHABILITATION OF SHAWANAGA RIVER BRIDGE
Photographs of Rock Core

Borehole 23-10 – Runs 1, 2 and 3 – 8.13 – 10.31 m

Top of Run 1

Top of Run 2

Top of Run 3

Run 3 Continues

HIGHWAY 69 AND REHABILITATION OF SHAWANAGA RIVER BRIDGE
Photographs of Rock Core

Borehole 23-10 – Run 4 – 10.31 – 11.15 m

Top of Run 4

Run 4 Continues

THURBER ENGINEERING LTD.

APPENDIX E

Site Photographs

Photograph 1: East Shoulder of Highway Over Culvert 38 Looking South

Photograph 2: Culvert Outlet, Looking East

Photograph 3: Culvert Outlet, East Embankment Slope Looking South

Photograph 4: Culvert Inlet, West Embankment Looking North

Photograph 5: Borehole 23-09 After Completion

Photograph 6: Borehole 23-10 After Completion