



THURBER ENGINEERING LTD.

FINAL

FOUNDATION INVESTIGATION AND DESIGN REPORT

Culvert 24, Highway 69 – 5.8 km South of Highway 7182

Township of Shawanaga

Rehabilitation of Highway 69 and Shawanaga River Bridge

G.W.P. 5246-18-00

AGREEMENT NO: 5246-18-00

GEOCRES NO.: 41H09-001

Location: Lat: 45.510856°, Long: -80.228054°

Client Name: Egis Group

Date: June 4, 2024

File: 30351



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**FOUNDATION INVESTIGATION AND DESIGN REPORT
CULVERT 24, HIGHWAY 69 – 5.8 KM SOUTH OF HIGHWAY 7182
TOWNSHIP OF SHAWANAGA, ONTARIO
G.W.P. 5246-18-00
AGREEMENT NO.: 5020-E-0003**

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 24 which crosses Highway 69 approximately 5.8 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-24) is located on Highway 69, approximately 5.8 km south of the intersection of Highway 69 and Shebeshekong Road at approximately Station 11+449 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 an east to west 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 an 1800 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 32. The culvert invert is at approximate Elev. 210.0 m at the inlet (east end) and at approximate Elev. 209.6 m at the outlet (west end). Cover above the obvert of the culvert is approximately 4.5 m under the north and southbound lanes. The existing highway embankment at the culvert site is approximately 6 m to 6.5 m high and has side slopes inclined at approximately 1.4H:1V. Rock fill was noted on the embankment slopes around the culvert inlet and outlet.

The lands surrounding the site are generally flat to gently undulating, following the shallow bedrock surface. Bedrock is observed at ground surface both north and south of the culvert site and appears to dip towards the culvert and creek channel. The lands east and west of the culvert consist of swamp and some open water (observed seasonally). Photographs in Appendix E show the general nature of the site and the existing culvert.

2.2 Site Geology

Based on surficial geology mapping¹ prepared by the Ontario Geological Survey the culvert is located in an area mapped as Precambrian bedrock. Bedrock mapping² also prepared by the Ontario Geological Survey maps the local bedrock as migmatitic, tonalitic to granodioritic gneiss.

3. INVESTIGATION PROCEDURE

The foundation investigation and field-testing program for CL-24 was carried out in conjunction with several other culvert investigations reported under separate covers. The boreholes for this culvert investigation were advanced on August 10th and August 30th, 2023. The investigation consisted of two (2) boreholes, designated as 23-01 and 23-02, advanced to depths of 12.0 m and 6.3 m below ground surface (Elev. 198.0 m and 203.9 m), respectively. Boreholes 23-01 and 23-02 were drilled near the culvert inlet and outlet, respectively.

The Record of Borehole sheets 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 for Borehole 23-02 were provided by

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*.

Callon Dietz, Egis’ survey subconsultant. The survey was completed in the horizontal datum MTM Zone 10 CSRS CBNv6-2010.0 and the vertical datum CGVD 1928:1978 with a horizontal and vertical accuracy +/- 5 cm. Borehole 23-01 could not be located at the time of the survey. The coordinates and elevation of Borehole 23-01 are approximate and were determined by correlating field sketches and photographs with the topographic survey. The borehole coordinates and elevations are also 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) |
|-----------------|---------------------|--------------------|-------------------------------------|---|
| 23-01 | 5,041,481.7 | 247,923.4 | 210.0 | 12.0 |
| 23-02 | 5,041,455.2 | 247 904.4 | 210.1 | 6.3 |

Utility clearances were obtained prior to the start of drilling.

Boreholes 23-01 and 23-02 were drilled at the ends of the culvert using a track mounted CME-55 provided by Downing Drilling and a Diedrich D-50 drill rig provided by Walker Drilling Ltd, respectively. The boreholes were advanced through the overburden using hollow stem augers and wash boring methodologies. Soil samples were obtained at selected intervals using a split spoon sampler in conjunction with Standard Penetration Testing (SPT). HQ 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 3.05 m long slotted screen, enclosed in a column of filter sand was installed in Borehole 23-01 to permit groundwater level monitoring. A monitoring well consisting of 50 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 23-02. 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. The laboratory testing results are shown in Appendix C.

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 |
|------------------------|--------------------------------------|--|--|---|
| 23-01 | 210.0 | 12.0 / 198.0 | 4.6 / 205.4 | Borehole backfilled with bentonite holeplug from surface to 1.2 m, filter sand from 1.2 m to 4.9 m, bentonite holeplug from 4.9 m to 12.0 m. |
| 23-02 | 210.1 | 6.3/203.8 | 3.7 / 206.4 | Borehole backfilled with bentonite holeplug from ground surface to 1.2 m, peltonite from 1.2 m to 1.6 m, sand from 1.6 m to 4.2 m, and bentonite from 4.2 m to 6.3 m. |

The standpipe piezometer was decommissioned in general accordance with O.Reg. 903 upon collection of the final water level reading. The monitoring well 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. Atterberg Limits testing was not carried out as plastic soils were not encountered in either of the boreholes. 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 encountered stratigraphy consists of topsoil overlying native silt or sand overlying bedrock.

5.1 Topsoil

75 mm and 100 mm of topsoil were encountered at the ground surface in Boreholes 23-01 and 23-02, respectively. Natural moisture contents measured in the topsoil ranged from 40% to 130%. The topsoil thickness may vary between and beyond the boreholes.

5.2 Silt and Sand to Silt

A layer of silt and sand to silt was encountered in Borehole 23-02 at 0.1 m (Elev. 210.0 m) and extended to bedrock at 0.7 m depth (Elev. 209.4 m). The silt to sand and silt ranged in colour from brown to grey, and trace amounts of gravel and clay were observed within the layer.

One SPT N-value of 12 blows per 0.3 m of penetration was observed, indicating a compact relative density. A natural moisture content of 19% was recorded in the silt and sand to silt material.

5.3 Sand

A deposit of sand to silty sand was encountered below the topsoil in Borehole 23-01 at a depth of 75mm below ground surface. The base of the layer was encountered overlying bedrock at 8.2 m below ground surface (Elev. 201.8 m). The sand layer contained trace to some gravel and was generally described as containing trace silt and ranging in colour from brown to grey. Trace organics and a silty composition were noted below the topsoil and extending to 2.2 m (Elev. 207.8 m).

SPT “N” values ranging from 0 to 16 blows per 0.3 m of penetration indicating a relative density of very loose to compact were recorded. The natural moisture contents of the deposit varied from 14% to 36%.

Grain size analyses were performed on two selected samples of this deposit and the results are presented on the relevant Record of Borehole sheets and in Figure C1 in Appendix C. The test results are summarized below in Table 5-1.

Table 5-1: Grain size distribution of Sand

| Soil Particle | Percentage (%) |
|---------------|----------------|
| Gravel | 6 to 16 |
| Sand | 79 to 89 |
| Silt and Clay | 5 |

5.4 Bedrock

The overburden soils described above are underlain by gneiss bedrock. Bedrock was proven by coring in both boreholes. The bedrock is described as grey to pink in colour, highly weathered to fresh and weak to very strong. Photographs of the bedrock core are provided in Appendix D.

Table 5-2 summarizes the depths and elevations of the top of bedrock at the borehole locations.

Table 5-2: Depths and Elevations of Top of Bedrock

| Borehole | Top of Bedrock | |
|----------|----------------|---------------|
| | Depth (m) | Elevation (m) |
| 23-01 | 8.2 | 201.8 |
| 23-02 | 0.7 | 209.4 |

The rock core recovery measurements, rock quality designation and rock core laboratory testing results are summarized in Table 5-3 below.

Table 5-3 Bedrock Details

| Parameter | Range |
|--|-----------|
| Total Core Recovery (TCR), % | 87 to 100 |
| Solid Core Recovery (SCR), % | 62 to 100 |
| Rock Quality Designation (RQD), % | 41 to 100 |
| Fracture Index (fractures per 0.3 m) | 0 to 6 |
| Unconfined Compressive Strength Testing (MPa) | 91 to 117 |
| Unconfined Compressive Strength Testing (MPa) from Point Load Tests | 12 to 132 |

Based on the RQD, the bedrock quality ranged from poor to excellent, typically excellent (CFEM 5th Edition, 2023). The results of UCS and point load testing indicate that the tested samples of the bedrock are weak to very strong, typically strong to very strong (CFEM 5th Edition, 2023).

Locally in Run 1 of Borehole 23-01, the gneissic bedrock was described as moderately to highly weathered. UCS values as low as 12 MPa were measured from point load tests, indicating weak rock classification. RQD values of 41 to 47% were measured in 23-01 Runs 1 and 2, indicating the rock was poor quality.

The results of the UCS and point load testing are included in Appendix C.

5.5 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 the table below.

Table 5-4: Groundwater Measurements

| Borehole | Date | Water Level (m) | | Remark |
|----------|--------------------|-----------------|-----------|--------------------|
| | | Depth | Elevation | |
| 23-01 | September 21, 2023 | 0.0 | 210.0 | In piezometer |
| 23-02 | August 11, 2023 | 0.2 | 209.9 | In monitoring well |
| | September 21, 2023 | 0.5 | 209.7 | In monitoring well |
| | October 4, 2023 | 0.6 | 209.5 | In monitoring well |



It should be noted that the above value is considered a short-term reading and 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, no water was observed flowing through the culvert. Small pools/puddles of stagnant water were noted near each end of the culvert and the ground was generally wet.

6. CORROSIVITY AND SULPHATE TEST RESULTS

A sample of native silt from Borehole 23-02 was submitted for analytical testing of corrosivity parameters and sulphate. A sample of surface water taken from the surface water at 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 | |
|-----------------|-----------------|------------------|-----------------------------------|--|
| | | | 23-02 SS#1 CORR (0.0m – 0.61m) | Culvert Inlet Culvert 24 STA 11+449 |
| | | | (Silt and Sand to Silt) | (Surface Water) |
| Redox Potential | mV | mV | 287 | 143 |
| Sulphide | % | µg/L | <0.04 | < 6 |
| pH | - | - | 7.12 | 5.80 |
| Chloride | µg/g | mg/L | 130 | 210 |
| Sulphate | µg/g | mg/L | 17 | 12 |
| Conductivity | uS/cm | uS/cm | 267 | 657 |
| Resistivity | Ohms.cm | - | 3750 | --- |

7. MISCELLANEOUS

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

George Downing Estate Drilling (Downing) of Hawkesbury, Ontario and Walker Drilling of Utopia, Ontario supplied the drill rigs and conducted the drilling, sampling and in-situ testing operations.



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Traffic control services were provided by Beacon Lite of Ottawa, Ontario for access to the boreholes.

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, EIT and Mr. Matthew Boucher, P.Eng. of Thurber.

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

Thurber Engineering Ltd.

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**FOUNDATION INVESTIGATION AND DESIGN REPORT
CULVERT 24, HIGHWAY 69 – 5.8 KM SOUTH OF HIGHWAY 7182
TOWNSHIP OF SHAWANAGA, ONTARIO
G.W.P. 5246-18-00
AGREEMENT NO.: 5020-E-0003**

GEOCRES NO.: 41H09-001

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 24 which crosses Highway 69 approximately 5.8 km south of Highway 7182 (Shebeshekong Road) in the Township of Shawanaga, Ontario. The culvert crosses the highway at Station 11+449 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 an 1800 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 32 m. The culvert invert is at approximate Elev. 210.0 m at the inlet (east end) and at approximate Elev. 209.6 m at the outlet (west end). Cover above the obvert of the culvert is approximately 4.5 m under the north and southbound lanes. The existing highway embankment slopes at each end of the culvert are inclined at approximately 1.4H:1V . Rock fill was noted on the embankment slopes around the culvert inlet and outlet.

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 foundations 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 0.7 m and to 8.2 m of soil overlying bedrock at the culvert outlet and inlet, respectively. This soil consists of very loose to compact sand to silt with trace organics near the ground surface. 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 in Borehole 23-02 located near the outlet of the culvert due to shallow bedrock conditions. The use of a sandbag cofferdam is recommended from a foundation's perspective at the outlet of the culvert.

A sheet pile cofferdam may be feasible near the inlet of the culvert based on the ground conditions encountered in Borehole 23-01. However, it is possible that shallower bedrock will be encountered as a result of the sloped bedrock resulting in insufficient embedment depth. A sandbag cofferdam could also be considered from a foundation's perspective at the inlet of the culvert.

It is recommended that the work be carried out when the conditions at 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.

It should also be noted that the soils near the inlet of the culvert consist of silty sand and sand are relatively permeable. If a sandbag cofferdam is selected, surface water, if present at the time of construction, will tend to seep under the cofferdam, through the silty sand/sand and into the cofferdam enclosure. Additional pumps and/or higher capacity pumps may be required to keep the working area dry.

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.

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 concentration of water-soluble sulphate in soil and sulphate in 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 moderate based on the testing completed on a surface water sample and sample of silt to silt and sand, 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



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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. Rachel Bourassa, EIT and Mr. Matthew Boucher, P.Eng. The report was reviewed by Mr. Jason Lee, P.Eng., a Designated Principal Contact for MTO Foundations Projects.

Thurber Engineering Ltd.

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Designated MTO Principal Contact / Senior
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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.

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

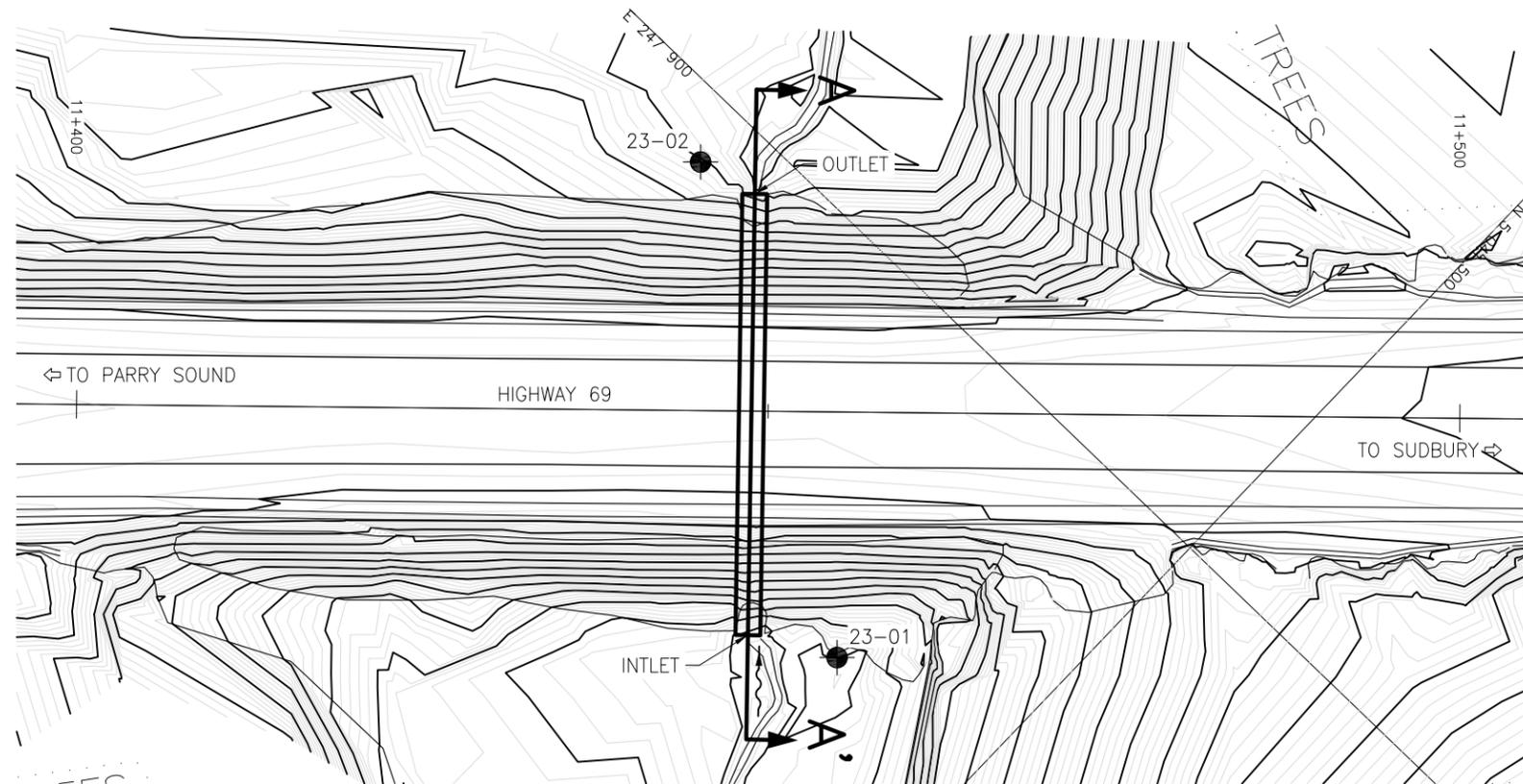
The information, interpretations and conclusions in the Report are based on Thurber's interpretation of conditions revealed through limited investigation conducted within a defined scope of services. Thurber does not accept responsibility for independent conclusions, interpretations, interpolations and/or 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.



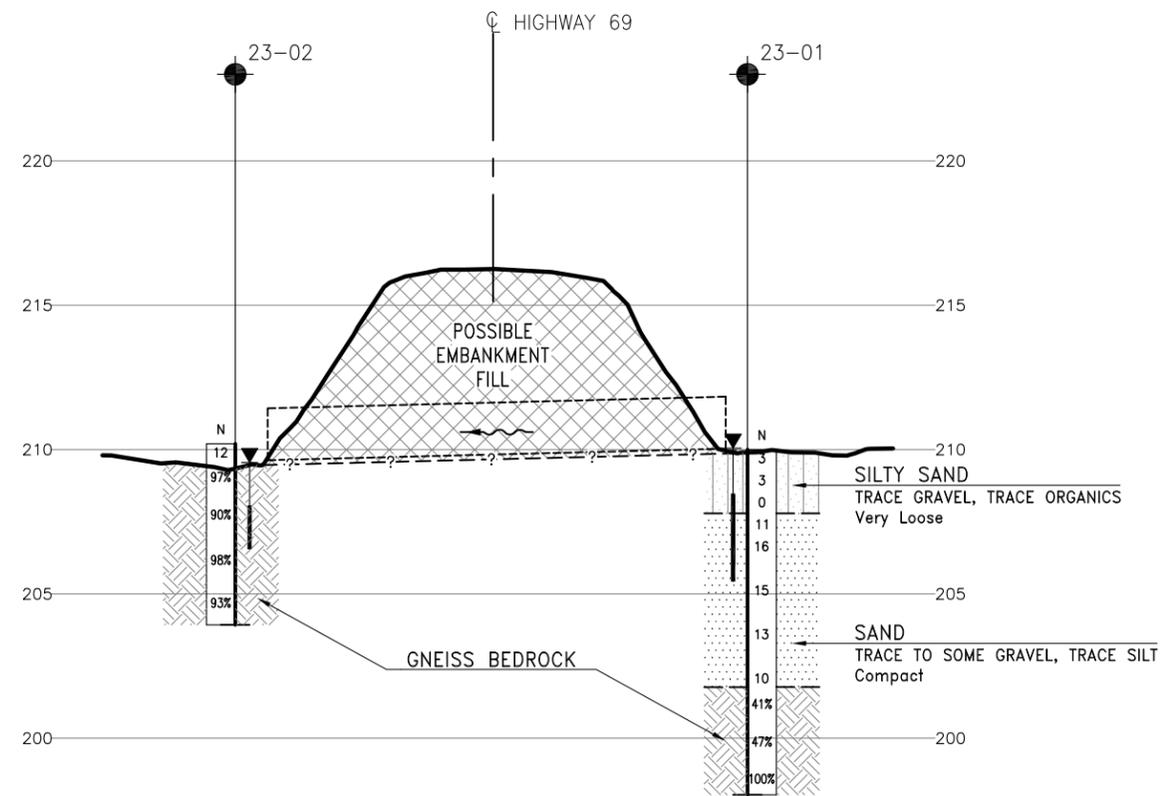
THURBER ENGINEERING LTD.

APPENDIX A

Borehole Locations and Strata Drawing



PLAN
SCALE 1:500

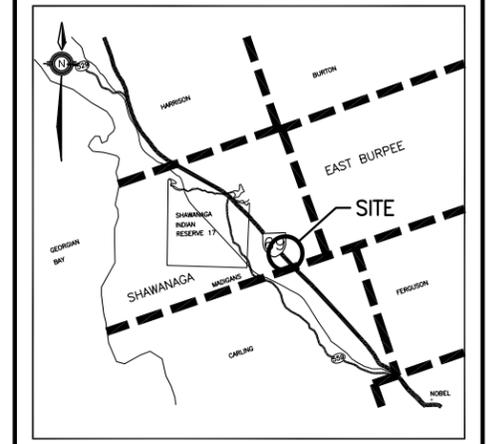


SECTION ALONG A-A'
H 1:500
V 1:250

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



| | |
|--|-------|
| CONT No GWP No 5246-18-00 | SHEET |
| HIGHWAY 69 SHAWANAGA RIVER BRIDGE CULVERT 24 BOREHOLE LOCATIONS AND SOIL STRATA | |



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 |
|-------|-----------|-------------|-----------|
| 23-01 | 210.0 | 5 041 487.1 | 247 923.4 |
| 23-02 | 210.1 | 5 041 455.2 | 247 904.4 |

-NOTES-

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

GEOCRES No. 41H09-001

| REVISIONS | DATE | BY | DESCRIPTION |
|-----------|------|----|-------------|
| | | | |
| | | | |

| | | | | | | | |
|--------|----|-----|-----|------|--------|------|----------|
| DESIGN | RB | CHK | MTB | CODE | LOAD | DATE | JUN 2024 |
| DRAWN | AN | CHK | RB | SITE | STRUCT | DWG | 1 |

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

| <u>ROCK WEATHERING CLASSIFICATION</u> | | <u>SYMBOLS</u> | | | |
|---------------------------------------|--|---|---|---------------------|--|
| Fresh (FR) | No visible signs of weathering. | | | | |
| Fresh Jointed (FJ) | Weathering limited to the surface of major discontinuities. |  | CLAYSTONE | | |
| Slightly Weathered (SW) | Penetrative weathering developed on open discontinuity surfaces, but only slight weathering of rock material. |  | SILTSTONE | | |
| Moderately Weathered (MW) | Weathering extends throughout the rock mass, but the rock material is not friable. |  | SANDSTONE | | |
| Highly Weathered (HW) | Weathering extends throughout the rock mass and the rock is partly friable. |  | COAL | | |
| Completely Weathered (CW) | Rock is wholly decomposed and in a friable condition, but the rock texture and structure are preserved. |  | Bedrock (general) | | |
| <u>DISCONTINUITY SPACING</u> | | <u>STRENGTH CLASSIFICATION</u> | | | |
| Bedding | Bedding Plane Spacing | Rock Strength | Approximate Uniaxial Compressive Strength | | Field Estimation of Hardness* |
| | | | (MPa) | (psi) | |
| Very thickly bedded | Greater than 2m | Extremely Strong | Greater than 250 | Greater than 36,000 | Specimen can only be chipped with a geological hammer |
| Thickly bedded | 0.6 to 2m | | | | |
| Medium bedded | 0.2 to 0.6m | Very Strong | 100-250 | 15,000 to 36,000 | Requires many blows of geological hammer to break |
| Thinly bedded | 60mm to 0.2m | | | | |
| Very thinly bedded | 20 to 60mm | Strong | 50-100 | 7,500 to 15,000 | Requires more than one blow of geological hammer to break |
| Laminated | 6 to 20mm | | | | |
| Thinly Laminated | Less than 6mm | Medium Strong | 25.0 to 50.0 | 3,500 to 7,500 | Breaks under single blow of geological hammer. |
| <u>TERMS</u> | | | | | |
| Total Core Recovery: (TCR) | Core recovered as a percentage of total core run length. | Weak | 5.0 to 25.0 | 750 to 3,500 | Can be peeled by a pocket knife with difficulty |
| Solid Core Recovery: (SCR) | Percent Ratio of solid core of full cylindrical shape recovered. Expressed with respect to the total length of core run. | Very Weak | 1.0 to 5.0 | 150 to 750 | Can be peeled by a pocket knife, crumbles under firm blows of geological pick. |
| 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. | Extremely Weak (Rock) | 0.25 to 1.0 | 35 to 150 | Indented by thumbnail |
| Uniaxial Compressive Strength (UCS) | Axial stress required to break the specimen | | | | |
| Fracture Index: (FI) | Frequency of natural fractures per 0.3m of core run. | | | | |

RECORD OF BOREHOLE No 23-01

2 OF 2

METRIC

GWP# 5246-18-00 LOCATION HWY 69 & Shawanaga River Bridge N 5 041 487.1 E 247 923.4 ORIGINATED BY JF
 DIST Parry Sound HWY 69 BOREHOLE TYPE Hollow Stem Auger and HQ Coring COMPILED BY AS
 DATUM Geodetic DATE 2023.08.30 - 2023.08.30 LATITUDE 45.510984 LONGITUDE -80.227927 CHECKED BY MB

| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | | | | PLASTIC LIMIT | NATURAL MOISTURE CONTENT | LIQUID LIMIT | UNIT WEIGHT γ kN/m ³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL | |
|---------------|--|------------|---------|------|------------|----------------------------|-----------------|--|----|----|----|-----|------------------|--------------------------------|-----------------|---|--|---|
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | "N" VALUES | | | SHEAR STRENGTH kPa | | | | | | | | | | WATER CONTENT (%) |
| | Continued From Previous Page | | | | | | | 20 | 40 | 60 | 80 | 100 | W P | W | W L | | | |
| | | | | | | | | O UNCONFINED + FIELD VANE ● QUICK TRIAXIAL X LAB VANE | | | | | | | | | | |
| 198.0 | Becoming slightly weathered to fresh, strong to very strong | | 2 | RUN | | | 199 | | | | | | | | | | | |
| | | | 3 | RUN | | | | | | | | | | | | | | RUN #3 TCR=100% SCR=100% RQD=100% UCS=115.0MPa (PLT) |
| 12.0 | END OF BOREHOLE AT 12.0m. 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 0.0 210.0 | | | | | | | | | | | | | | | | | |

ONTMT4S2_2020LIBRARY(MTO).GLB_MTO-30351.GPJ_4/26/24

RECORD OF BOREHOLE No 23-02

1 OF 1

METRIC

GWP# 5246-18-00 LOCATION HWY 69 & Shawanaga River Bridge N 5 041 455.2 E 247 904.4 ORIGINATED BY JF
 DIST Parry Sound HWY 69 BOREHOLE TYPE Wash Boring to 0.69m then HQ Coring COMPILED BY AS
 DATUM Geodetic DATE 2023.08.10 - 2023.08.10 LATITUDE 45.510696 LONGITUDE -80.228167 CHECKED BY MB

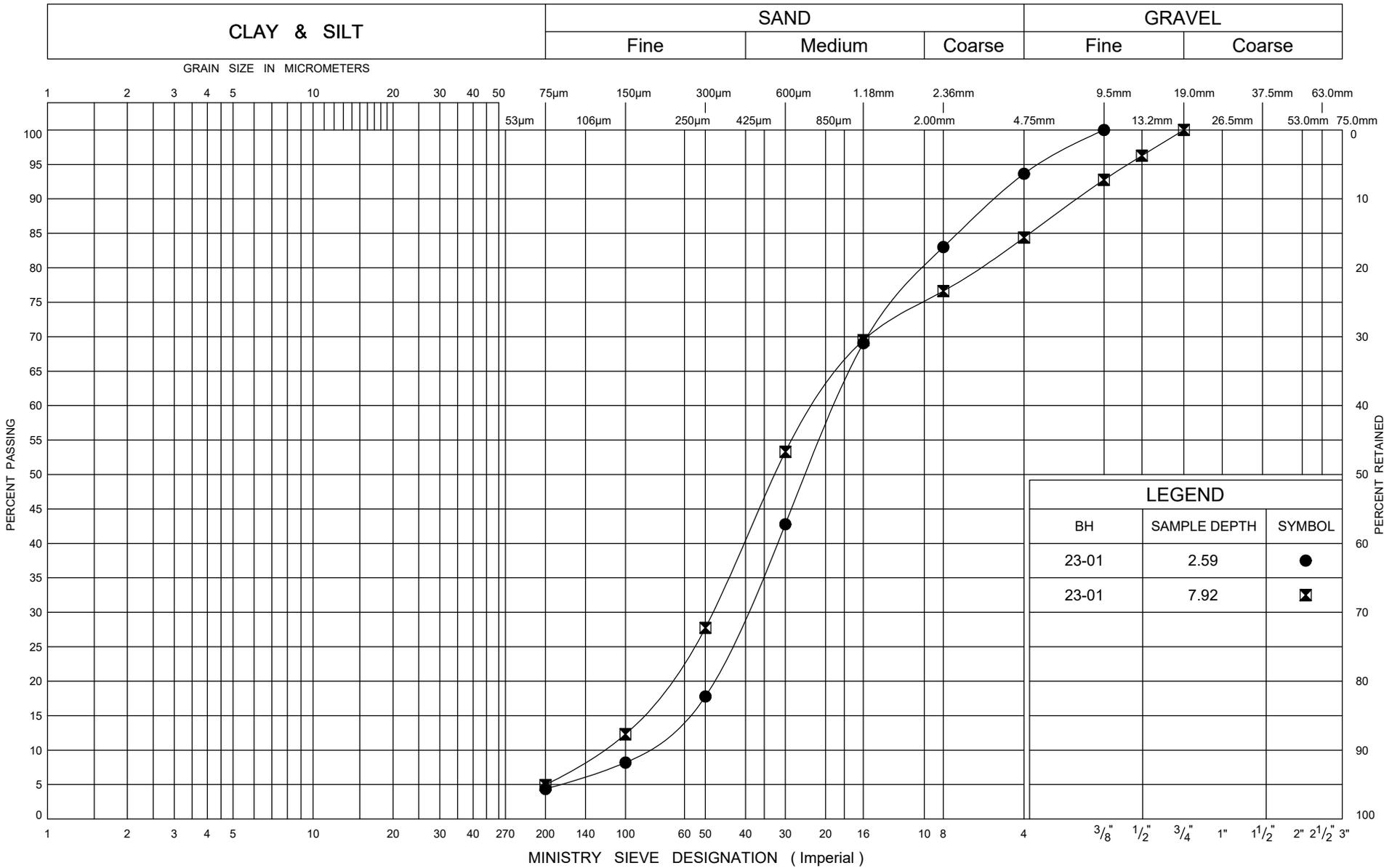
| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | | | | UNIT WEIGHT γ kN/m ³ | REMARKS & GRAIN SIZE DISTRIBUTION (%) |
|--------------|--|------------|---------|------|------------|--|-----------------|--|--|--|--|--|--|---------------------------------------|
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | "N" VALUES | | | SHEAR STRENGTH kPa | | | | | | |
| | | | | | | 20 40 60 80 100 ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE WATER CONTENT (%) 20 40 60 | | | | | | | | |
| 210.1 | GROUND SURFACE | | | | | | | | | | | | | |
| 0.0 | TOPSOIL: (100mm) | | | | | | | | | | | | | |
| 0.1 | SILT and SAND to SILT, some sand, trace gravel, trace clay Compact Brown to Grey Moist | | 1 | SS | 12 | | | | | | | | | |
| 209.4 | | | | | | | | | | | | | | |
| 0.7 | BEDROCK (GNEISS), slightly weathered to fresh, medium strong to very strong, grey and pink | | 1 | RUN | | | | | | | | | RUN #1 TCR=100% SCR=100% RQD=97% UCS=117.4MPa UCS=87MPa (PLT) | |
| | | | 2 | RUN | | | | | | | | | RUN #2 TCR=97% SCR=97% RQD=90% UCS=93.7MPa (PLT) | |
| | | | 3 | RUN | | | | | | | | | RUN #3 TCR=100% SCR=100% RQD=98% UCS=131.1MPa (PLT) | |
| | | | 4 | RUN | | | | | | | | | RUN #4 TCR=100% SCR=100% RQD=93% | |
| 203.8 | END OF BOREHOLE AT 6.3m. Well installation consists of 50mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen. | | | | | | | | | | | | | |
| 6.3 | WATER LEVEL READINGS DATE DEPTH(m) ELEV.(m) 2023.08.11 0.2 209.9 2023.09.21 0.5 209.7 2023.10.04 0.6 209.5 | | | | | | | | | | | | | |

ONTMT4S2_2020LIBRARY(MTO).GLB_MTO-30351.GPJ_4/26/24

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

APPENDIX C

Laboratory Test Results



| LEGEND | | |
|--------|--------------|--------|
| BH | SAMPLE DEPTH | SYMBOL |
| 23-01 | 2.59 | ● |
| 23-01 | 7.92 | ⊠ |

ONTARIO MOT GRAIN SIZE 3 MTO-30351.GPJ ONTARIO MOT.GDT 4/24/24



GRAIN SIZE DISTRIBUTION SAND

FIG No C1
 GWP# 5246-18-00
 HWY 69 & Shawanaga River Bridge



POINT LOAD TEST SHEET
ASTM D5731-08

Job No: 30351
Client: Egis
Project Name: Highway 69
Core Size: HQ BH No : 23-01

Date Drilled: 30-Aug-23
Date Tested: 14-Sep-23
Tester: AK
Reviewed by: RB

Table with 11 columns: Test No., Run No., Depth (m), Axial or Diametral, Gauge (MPa), Diameter (mm), Length (mm), Is(50) (MPa), UCS (MPa), Rock Type, Rock Strength (after Hoek & Brown, 1997). Rows 1-6 contain test data, rows 7-8 are blank, rows 9-11 show averages for runs 1, 2, and 3, and rows 12-35 are blank.

- * 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.



POINT LOAD TEST SHEET
ASTM D5731-08

Job No: 30351
Client: Egis
Project Name: Highway 69
Core Size: HQ BH No : 23-02

Date Drilled: 10-Aug-23
Date Tested: 06-Sep-23
Tester: AK
Reviewed by: RB

| 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 | 1.1 | D | 7.2 | 63.0 | 96.4 | 1.9 | 45.8 | Gneiss | Medium Strong |
| 2 | 1 | 1.2 | D | 20.2 | 63.0 | 121.4 | 5.3 | 128.2 | Gneiss | Very Strong |
| 3 | 2 | 1.6 | D | 10.0 | 63.0 | 122.9 | 2.7 | 63.7 | Gneiss | Strong |
| 4 | 2 | 2.5 | D | 19.4 | 63.0 | 115.3 | 5.2 | 123.7 | Gneiss | Very Strong |
| 5 | 3 | 3.3 | D | 20.6 | 63.0 | 101.1 | 5.5 | 130.9 | Gneiss | Very Strong |
| 6 | 3 | 3.9 | D | 20.7 | 63.0 | 89.3 | 5.5 | 131.7 | Gneiss | Very Strong |
| 7 | | | | | | | | | | |
| 8 | | | | | | | | | | |
| 9 | | | | | | | | Average Run 1 | 87.0 | Strong |
| 10 | | | | | | | | Average Run 2 | 93.7 | Strong |
| 11 | | | | | | | | Average Run 3 | 131.3 | Very Strong |
| 12 | | | | | | | | | | |
| 13 | | | | | | | | | | |
| 14 | | | | | | | | | | |
| 15 | | | | | | | | | | |
| 16 | | | | | | | | | | |
| 17 | | | | | | | | | | |
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| 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 $0.7 \times D$ on either side of test point.
- * Correlation factor to obtain UCS values is 24.

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

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 |
| Appendices | 3 |

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

Uniaxial Compression Test

| | | | |
|--|--------------------------|---|--|
| Client | Thurber Engineering Ltd. | Project | 30351 |
| Sample | BH23-01 | Depth | 32' 10" - 33' 10" |
| <u>Specimen parameters</u> | | Prior to testing | After testing |
| 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; | | | |
| Remarks: Loading Rate: 0.05mm/min. | | | |
| Performed by | SD | Date | 2023-11-08 |

Uniaxial Compression Test

| | | | |
|--|--------------------------|---|--|
| Client | Thurber Engineering Ltd. | Project | 30351 |
| Sample | BH23-02 | Depth | 2'3" - 3'2" |
| <u>Specimen parameters</u> | | <u>Prior to testing</u> | <u>After testing</u> |
| 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; | | | |
| Remarks: Loading Rate: 0.05mm/min. Specimen experienced pre-peak localized failure(s). | | | |
| Performed by | SD | Date | 2023-11-08 |

Uniaxial Compression Test

| | | | |
|---|--------------------------|---|--|
| Client | Thurber Engineering Ltd. | Project | 30351 |
| Sample | BH23-03 | Depth | 3'10" - 4'8" |
| <u>Specimen parameters</u> | | Prior to testing | After testing |
| 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; | | | |
| Remarks: Loading Rate: 0.05mm/min. | | | |
| Performed by | SD | Date | 2023-11-08 |

Uniaxial Compression Test

| | | | |
|--|--------------------------|---|--|
| Client | Thurber Engineering Ltd. | Project | 30351 |
| Sample | BH23-04 | Depth | 8'0" - 8'10" |
| <u>Specimen parameters</u> | | Prior to testing | After testing |
| 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; | | | |
| 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" |
| <u>Specimen parameters</u> | | Prior to testing | After testing |
| 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; | | | |
| Remarks: Loading Rate: 0.05mm/min. Specimen experienced 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" |
| <u>Specimen parameters</u> | | Prior to testing | After testing |
| 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; | | | |
| 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" | | | | | | | | | | | | | | |
| <table border="1"> <thead> <tr> <th colspan="2">Specimen parameters</th> </tr> </thead> <tbody> <tr> <td>Diameter (mm) ^a</td> <td>48.54</td> </tr> <tr> <td>Length (mm) ^a</td> <td>103.59</td> </tr> <tr> <td>Bulk density ρ (g/cm³)</td> <td>2.753</td> </tr> <tr> <td>UCS (MPa)</td> <td>113.8</td> </tr> <tr> <td>Lithology</td> <td>Granite gneiss</td> </tr> <tr> <td>Failure description ^b</td> <td>3, 5</td> </tr> </tbody> </table> | | 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 | <p>Prior to testing</p>  | <p>After testing</p>  |
| 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 | | | | | | | | | | | | | | | | |
| <p>^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;</p> | | | | | | | | | | | | | | | | | |
| <p>Remarks: Loading Rate: 0.05mm/min.</p> | | | | | | | | | | | | | | | | | |
| Performed by | SD | Date | 2023-11-08 | | | | | | | | | | | | | | |

Uniaxial Compression Test

| | | | |
|---|--------------------------|---|--|
| Client | Thurber Engineering Ltd. | Project | 30351 |
| Sample | BH23-10 | Depth | 27'6" - 28'5" |
| <u>Specimen parameters</u> | | <u>Prior to testing</u> | <u>After testing</u> |
| 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; | | | |
| Remarks: Loading Rate: 0.05mm/min. | | | |
| Performed by | SD | Date | 2023-11-08 |

Uniaxial Compression Test

| | | | |
|--|--------------------------|---|--|
| Client | Thurber Engineering Ltd. | Project | 30351 |
| Sample | BH23-12 | Depth | 21'5" - 22'4" |
| <u>Specimen parameters</u> | | Prior to testing | After testing |
| 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; | | | |
| 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" |
| <u>Specimen parameters</u> | | Prior to testing | After testing |
| 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; | | | |
| 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" |
| <u>Specimen parameters</u> | | Prior to testing | After testing |
| 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; | | | |
| Remarks: Loading Rate: 0.05mm/min. | | | |
| Performed by | SD | Date | 2023-11-08 |

Uniaxial Compression Test

| | | | |
|---|--------------------------|---|--|
| Client | Thurber Engineering Ltd. | Project | 30351 |
| Sample | BH23-16 | Depth | 7'3" - 7'11" |
| <u>Specimen parameters</u> | | Prior to testing | After testing |
| 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; | | | |
| Remarks: Loading Rate: 0.05mm/min. | | | |
| Performed by | SD | Date | 2023-11-08 |

Uniaxial Compression Test

| | | | |
|--|--------------------------|---|--|
| Client | Thurber Engineering Ltd. | Project | 30351 |
| Sample | BH23-17 | Depth | 12'6" - 13'5" |
| <u>Specimen parameters</u> | | Prior to testing | After testing |
| 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; | | | |
| Remarks: Loading Rate: 0.05mm/min. | | | |
| Performed by | SD | Date | 2023-11-08 |

Uniaxial Compression Test

| | | | |
|---|--------------------------|---|--|
| Client | Thurber Engineering Ltd. | Project | 30351 |
| Sample | BH23-18 | Depth | 28'7" - 29'7" |
| <u>Specimen parameters</u> | | Prior to testing | After testing |
| 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; | | | |
| Remarks: Loading Rate: 0.05mm/min. | | | |
| Performed by | SD | Date | 2023-11-08 |



FINAL REPORT

CA40126-AUG23 R

30351, Parry Sound (North)

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 **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 |
| 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 |
|------------------------------|---------|------|--------|--------|--------|--------|--------|--------|--------|
| 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-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 | 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-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 | EWL0270-AUG23 | uS/cm | 2 | < 2 | 0 | 20 | 100 | 90 | 110 | NA | | |



FINAL REPORT

CA40126-AUG23 R

QC SUMMARY

pH

Method: SM 4500 | 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 |
| 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 | Internal ref.: ME-CA-ENVISFA-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.

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This report supersedes all previous versions.

-- End of Analytical Report --

Request for Laboratory Services and CHAIN OF CUSTODY

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

Received By: Scott
 Received Date: 08/11/23 (mm/dd/yy)
 Received Time: 13:05 (hr : min)
 Cooling Agent Present: Yes No
 Temperature Upon Receipt (°C): 9ex3
 Type: ice
 Laboratory Information Section - Lab use only
 Quotation #: 30351
 Project #: 30351
 Site Location/ID: PARSEY SOUND(NORTH)
 P.O. #: _____
 TURNAROUND TIME (TAT) REQUIRED
 Regular TAT (5-7days)
 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

REPORT INFORMATION
 Company: THURBER ENGINEERING LAB
 Contact: MADISON CAWTO | MATTHEW BULLER
 Address: 2010 WINSTON PARK DR
 Phone: 905-829-8666
 Fax: _____
 Email: MCAWTO@THURBER.CA
 Invoice Information
 (same as Report Information)
 Company: _____
 Contact: _____
 Address: _____
 Phone: _____
 Email: ACCOUNTING@THURBER.CA

REGULATIONS
 0.Reg 153/04 0.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
 RECORD OF SITE CONDITION (RSC) YES NO
 Sewer By-Law:
 Sanitary
 Storm
 Municipality: _____
 Other Regulations:
 Reg 347/558 (3 Day min TAT)
 PWQO MMER
 CCME Other: _____
 MISA
 ODWS Not Reportable *See note

| SAMPLE IDENTIFICATION | DATE SAMPLED | TIME SAMPLED | # OF BOTTLES | MATRIX | ANALYSIS REQUESTED | | | | | | | | | | | COMMENTS: | | | | | | | | | | | |
|-------------------------|--------------|--------------|--------------|--------|---|--------------------------------|--|-----------|----------------------------------|-----------------------|------------------------|------------|----------------------------|------------|--|------------------------|--|---------------------------|---------------|--|--|--|--|--|--|--|--|
| | | | | | M & I | SVOC | PCB | PHC | VOC | Pest | Other (please specify) | SPLP TCLP | Water Characterization Pkg | Sewer Use: | Field Filtered (Y/N) | | | | | | | | | | | | |
| 1 CULVERT 24 STA 11+449 | 08/09/23 | 17:00 | 3 | WATER | Ind Cr, Ni, Hg, Pb, (B)(HWS), EC, SAR-soil (Cl, Na-water) | ICP Metals only (Cl, Na-water) | ICP Metals Suite (ICP metals plus B)(HWS-soil only) Hg, Cr, Ni, 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 | VOCs (all incl BTEX) | BTEX only | Pesticides (Organochlorine or specify other) | Other (please specify) | Water Characterization Pkg (General, Extended) | SPLP TCLP (Specify tests) | Specify tests | | | | | | | | |
| 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 47 STA 17+808 | 08/10/23 | 10:00 | 3 | WATER | | | | | | | | | | | | | | | | | | | | | | | |
| 8 | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 9 | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 10 | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 11 | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 12 | | | | | | | | | | | | | | | | | | | | | | | | | | | |

Observations/Comments/Special Instructions

Sampled By (NAME): JAKOB FLOOD
 Relinquished by (NAME): JAKOB FLOOD
 Signature: _____
 Signature: _____
 Date: 08/11/23 (mm/dd/yy)
 Date: 08/11/23 (mm/dd/yy)

Revision #: 1.7
 Date of Issue: 07 JUNE 2023
 Note: Submission of samples to SGS is acknowledgement that you have been provided direction on sample collection/handling and transportation of samples. (2) Submission of samples to SGS is considered authorization for completion of work. Signatures may appear on this form or be retained on file in the contract, or in an alternative format (e.g. shipping documents). (3) Results may be sent by email to an unlimited number of addresses for no additional cost. Fax is available upon request. This document is issued by the Company under its General Conditions of Service accessible at http://www.sgs.com/terms_and_conditions.htm. (Printed copies are available upon request.) Attention is drawn to the limitation of liability, indemnification and jurisdiction issues defined therein.



FINAL REPORT

CA40212-AUG23 R1

30351

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 | Madisan Chiarotto | Address | 185 Concession St., Lakefield ON, K0L 2H0 |
| Telephone | 647-548-8390 | Telephone | 2165 |
| Facsimile | | Facsimile | 705-652-6365 |
| Email | mchiarotto@thurber.ca | Email | jill.campbell@sgs.com |
| Project | 30351 | SGS Reference | CA40212-AUG23 |
| Order Number | | Received | 08/22/2023 |
| Samples | Soil (6) | Approved | 08/29/2023 |
| | | Report Number | CA40212-AUG23 R1 |
| | | Date Reported | 08/29/2023 |

COMMENTS

Temperature of Sample upon Receipt: 8 degrees C

Cooling Agent Present: Yes

Custody Seal Present: Yes

Chain of Custody Number: 036623

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

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| QC Summary..... | 5-6 |
| Legend..... | 7 |
| Annexes..... | 8 |



FINAL REPORT

CA40212-AUG23 R1

Client: Thurber Engineering Ltd.

Project: 30351

Project Manager: Madisan Chiarotto

Samplers: Madisan Chiarotto

MATRIX: SOIL

| Sample Number | 5 | 6 | 7 | 8 | 9 | 10 |
|----------------------|------------|------------|-------------|------------|-------------|------------|
| Sample Name | 23-02 SS#1 | 23-04 SS#2 | 23-05 SS#5B | 23-12 SS#7 | 23-16 SS#2B | 23-17 SS#3 |
| | CORR | CORR | CORR | CORR | CORR | CORR |
| Sample Matrix | Soil | Soil | Soil | Soil | Soil | Soil |
| Sample Date | 10/08/2023 | 09/08/2023 | 26/07/2023 | 02/08/2023 | 02/08/2023 | 04/08/2023 |

| Parameter | Units | RL | Result | Result | Result | Result | Result | Result |
|---|----------|-------|--------|--------|--------|--------|--------|--------|
| Corrosivity Index | | | | | | | | |
| Corrosivity Index | none | 1 | 1 | 1 | 3 | 1 | 1 | 1 |
| Soil Redox Potential | mV | no | 287 | 304 | 295 | 249 | 453 | 368 |
| Sulphide (Na ₂ CO ₃) | % | 0.04 | < 0.04 | < 0.04 | < 0.04 | < 0.04 | < 0.04 | < 0.04 |
| pH | pH Units | 0.05 | 7.12 | 6.09 | 6.47 | 6.54 | 5.90 | 7.02 |
| Resistivity (calculated) | ohms.cm | -9999 | 3750 | 3890 | 2260 | 5920 | 26300 | 22200 |
| General Chemistry | | | | | | | | |
| Conductivity | uS/cm | 2 | 267 | 257 | 443 | 169 | 38 | 45 |
| Metals and Inorganics | | | | | | | | |
| Moisture Content | % | 0.1 | 13.7 | 18.4 | 15.4 | 19.8 | 11.6 | 22.4 |
| Sulphate | µg/g | 0.4 | 17 | 16 | 15 | 10 | 7.9 | 9.0 |
| Other (ORP) | | | | | | | | |
| Chloride | µg/g | 0.4 | 130 | 170 | 170 | 77 | 7.1 | 25 |

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 | DIO0693-AUG23 | µg/g | 0.4 | <0.4 | 3 | 35 | 101 | 80 | 120 | 100 | 75 | 125 |
| Sulphate | DIO0693-AUG23 | µg/g | 0.4 | <0.4 | 22 | 35 | 99 | 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 (Na ₂ CO ₃) | ECS0120-AUG23 | % | 0.04 | < 0.04 | 5 | 20 | 106 | 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 | EWL0460-AUG23 | uS/cm | 2 | < 2 | 0 | 20 | 100 | 90 | 110 | NA | | |



FINAL REPORT

CA40212-AUG23 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 | EWL0460-AUG23 | 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.

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This report supersedes all previous versions.

-- End of Analytical Report --

Request for Laboratory Services and CHAIN OF CUSTODY

Industries & Environment - Lakeland, 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

Received By: ED
 Received Date: 8 Oct 08 (mm/dd/yy)
 Received Time: 11:00 (hr : min)
 Cooling Agent Present: Yes No
 Custody Seal Present: Yes No
 Custody Seal Intact: Yes No
 Temperature Upon Receipt (°C): 8.3
 Type: ICCS
 LAB LIMS #: CA40212-AUG 23

REPORT INFORMATION
 Company: Thurber Engineering Ltd
 Contact: Madisen Chiroto
 Address: 2010 Winsion Bldg Dr
Unit 105, Oakville ON, L6H5R7
 Phone: (905) 829-8666
 Fax: mchiroto@thurber.ca
m.bouchon@thurber.ca
 Email: accounting@thurber.ca

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

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

REGULATIONS
 RECORD OF SITE CONDITION (RSC) YES NO
 O.Reg 153/04 Res/Park Soil Texture: Coarse Medium/Fine
 Table 1 Ind/Com Agri/Other Appx.
 Table 2 Table 3
 Soil Volume: <350m3 >350m3
 Other Regulations: Reg 347/568 (3 Day min TAT) PWQO MMER Other:
 CCME MISA ODWS Not Reportable *See note
 Sewer By-Law: Sanitary Storm Municipality:

ANALYSIS REQUESTED
 Field Filtered (Y/N)
 Metals & Inorganics (Cl, Na-water) (Cl, CN, Hg, Pb, (B)HWS, EC, SAR, soil)
 Full Metals Suite (ICP metals plus B(HWS)-soil only) Hg, Cr, V, Ni, Cu, Pb, Mo, Ni, Se, Ag, Mn, U, V, Zn
 ICP Metals only (Sb, As, Ba, Be, B, Cd, Cr, Co, Cu, Pb, Mo, Ni, Se, Ag, Mn, U, V, Zn)
 SVOCs (all incl PAHs, ABNs, CPs)
 PAHs only
 PCBs (Total) Aroclor
 PHC
 VOCs (all incl BTEX no BTEX)
 BTEX only
 Pesticides
 Organochlorine or specify other
 Pest
 Other (please specify) Corrosivity Pkg
 Water Characterization Pkg General Extended
 Specify Pkg: _____
 Sewer Use: _____
 SPLP tests Metals VOC 1,4-Dioxin OCP ABN
 TCLP tests Metals VOC PCB Bile/P ABN Ignit

| SAMPLE IDENTIFICATION | DATE SAMPLED | TIME SAMPLED | # OF BOTTLES | MATRIX |
|-----------------------|--------------|--------------|--------------|--------|
| 1 23-02 55#1 CORR | 08/10/23 | | 1 | Soil |
| 2 23-04 55#2 CORR | 08/09/23 | | 1 | Soil |
| 3 23-05 55#5B CORR | 07/26/23 | | 1 | Soil |
| 4 23-12 55#7 CORR | 08/10/23 | | 1 | Soil |
| 5 23-16 55#8 CORR | 08/10/23 | | 1 | Soil |
| 6 23-17 55#3 CORR | 08/04/23 | | 1 | Soil |
| 7 | | | | |
| 8 | | | | |
| 9 | | | | |
| 10 | | | | |
| 11 | | | | |
| 12 | | | | |

Observations/Comments/Special Instructions
 Sampled By (NAME): Madisen Chiroto
 Relinquished by (NAME): Madisen Chiroto
 Signature: _____
 Signature: _____
 Date: 08.12.23 (mm/dd/yy)
 Date: 08.12.23 (mm/dd/yy)
 Pink Copy - Client
 Yellow & White Copy - SGS
 Note: Submission of samples to SGS is acknowledgement that you have been provided direction on sample collection/handling and transportation of samples. (2) Submission of samples to SGS is considered authorization for completion of work. Signatures may appear on this form or be retained on file in the contract, or in an alternative format (e.g. shipping documents). (3) Results may be sent by email to an unlimited number of addresses for no additional cost. Fax is available upon request. This document is issued by the Company under its General Conditions of Service accessible at http://www.sgs.com/terms_and_conditions.htm. (Printed copies are available upon request.) Attention is drawn to the limitation of liability, indemnification and jurisdiction issues defined therein.



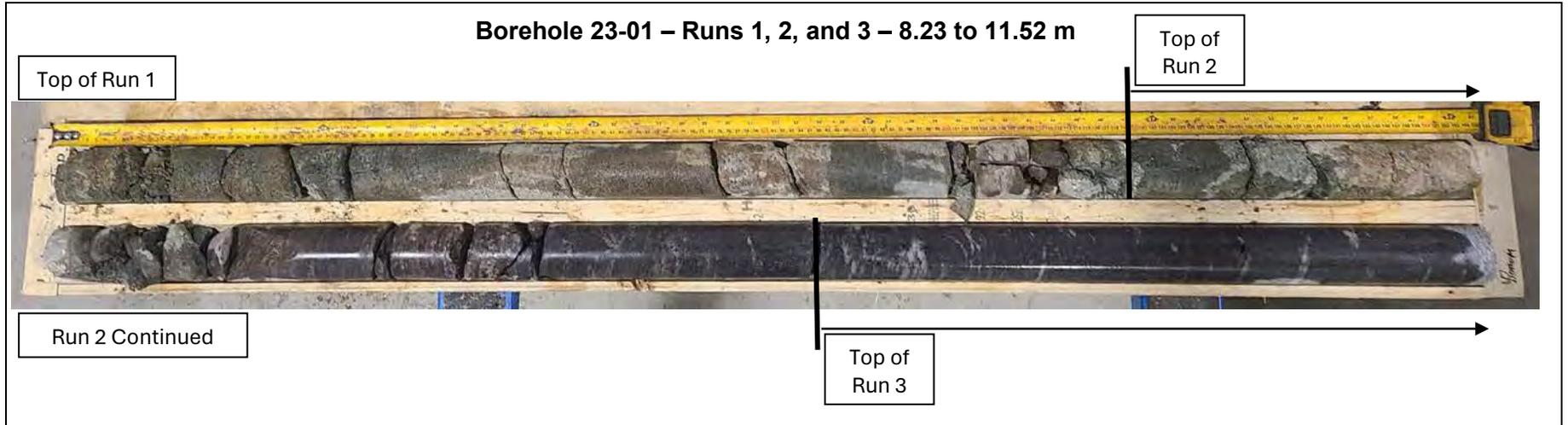
APPENDIX D

Bedrock Core Photographs



THURBER ENGINEERING LTD.

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





THURBER ENGINEERING LTD.

HIGHWAY 69 AND REHABILITATION OF SHAWANAGA RIVER BRIDGE

Photographs of Rock Core

Borehole 23-02 – Runs 1 and 2 – 0.69 to 3.28 m



Run 2 Continued

Borehole 23-02 – Runs 3 and 4 – 3.28 to 6.27 m



Top of Run 3

Top of Run 4



APPENDIX E

Site Photographs



THURBER ENGINEERING LTD.



Photograph 1: Drilling Borehole 23-01 Looking Southeast



THURBER ENGINEERING LTD.



Photograph 2: Borehole 23-01 after piezometer installation, looking southwest towards Culvert Inlet



THURBER ENGINEERING LTD.



Photograph 3: Culvert Inlet with Piezometer at Borehole 23-01



THURBER ENGINEERING LTD.



Photograph 4: Looking north towards the Borehole 23-02 site



THURBER ENGINEERING LTD.



Photograph 5: Borehole 23-02 after well installation, looking north towards Culvert outlet