THURBER ENGINEERING LTD.

FINAL
FOUNDATION INVESTIGATION REPORT
REHABILITATION OF BRIDGE STRUCTURE No. 40-024
HIGHWAY 35 GULL RIVER SOUTH BRIDGE
LUTTERWORTH TOWNSHIP
G.W.P. 5087-11-00
AGREEMENT NO.: 5015-E-0043

GEOCRES NUMBER: 31D-692

SUBMITTED TO

MCINTOSH PERRY CONSULTING ENGINEERS

Location:
Latitude: 44.806067°
Longitude: -78.803566°

June 2018
Thurber File: 16284

104, 2460 Lancaster Road, Ottawa ON K1B 4S5 T. 613 247 2121 F. 613 247 2185
thurber.ca

Table of Contents

PART 1: FACTUAL INFORMATION

APPENDICES

FINAL
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PART 1: FACTUAL INFORMATION

1 INTRODUCTION

This report presents the factual data obtained from a foundation investigation conducted by Thurber Engineering Ltd. (Thurber) for the proposed rehabilitation of the Gull River South Bridge located on Highway 35, within Lutterworth Township. Thurber carried out the investigation as a subconsultant to McIntosh Perry Consulting Engineers (MPCE) as part of Agreement No. 5015-E-0043.

The purpose of this investigation was to explore the subsurface conditions at the site and, based on this data, provide a borehole location plan, record of boreholes, a stratigraphic profile, laboratory test results and a written description of the subsurface conditions. A base plan survey drawing was provided by MPCE for the preparation of this report.

An earlier foundation investigation report that has been obtained from the online Geocres Library in preparation of this report is as follows:

> Foundation Investigation Report for New Structure at Gull River & Hwy. #35, Moore's Falls, District #11 (Huntsville), W.J. 67-F-56 - W.P. 425-65 & 106-65 (Geocres 31D00-128), dated August 1967.

The boreholes from this historic report were drilled off the current alignment of Highway 35 and therefore may not reflect conditions at the existing bridge foundations. Furthermore, the position of the boreholes from the historical report relative to the boreholes completed as part of the current investigation are not known. For these reasons the historic boreholes have not been included in the description of the subsurface conditions within this report.

2 SITE DESCRIPTION

The existing structure (No. 40-024) is located on Highway 35, approximately 0.35 km north of Haliburton Road 2 (Deep Bay Rd) near Miner's Bay, Ontario. It is noted that for project orientation purposes, Highway 35 within the project limits, will be described with a north-south alignment. The location of the bridge is shown on the inset Key Plan on Drawing No. 1 in Appendix A.

Within the project limits, Highway 35 is a two-lane highway. Based on the September 2017 drawing provided by MPCE, the roadway cross-section consists of two, 3.75 m wide lanes, and paved shoulders with a width of 1.5 m and 1.3 m on the SBL and NBL respectively. There is a 1.5 m wide sidewalk just outside the shoulder on the south bound side. Steel guide rails are located on both sides of the highway for a short distance from the bridge.

The existing bridge is a 20 m single span concrete bridge. The bridge is noted in the RFP to be constructed in 1968 with abutments founded on spread footings on bedrock.

The embankment slopes located adjacent to the north abutment are inclined at approximately 2H:1V with the surface consisting of granular fill. The southwest embankment slope was also inclined at approximately 2H:1V with granular fill noted at the surface but the southeast embankment slope was found to be inclined at approximately 1.5H:1V and rockfill with some granular infill was noted at the surface. Based on the drawing provided by MPCE, the elevation of the center line of roadway was reported to be approximately 273.0 m and 272.9 m at the north and south abutments, respectively.

Water within Gull River flows from the west to the east. Water control dams are located in close proximity on the upstream side of the bridge. Since the Gull River Bridge is located downstream of the water control structures, it is expected that relatively quick changes in water levels may be encountered. The topography adjacent to the river at the site is rolling forested lands with frequent bedrock outcrops. The land in the vicinity of the bridge is occupied mainly by single-family dwellings and cottages with the exception of a restaurant which is present southwest of the bridge site. Traffic volumes are understood to be 3150 AADT (2013).

Site photographs showing the general conditions at the site during the time of the field investigation are presented in Appendix D.

3 SITE INVESTIGATION AND FIELD TESTING

Thurber contacted Ontario One Call in advance of the field investigation to obtain utility locate clearances in the vicinity of the proposed boreholes.

The field investigation for this site included advancing two boreholes drilled on May 10th and 11th, 2017. The northing, easting and elevation of the boreholes are shown on the Borehole Location and Soil Strata Drawing No. 1 in Appendix A and are summarized in Table 3-1. The site is within MTM Zone 10.

Table 3-1: Borehole Summary

Borehole No.	Drilled Location	Northing (m)	Easting (m)	Ground Surface Elevation (m)	Borehole Termination Depth Below Existing Ground Surface (m)
17-1	North Abutment – southbound lane	4 963 116.8	359 915.1	273.1	7.3
17-2	South Abutment – northbound lane	4 963 136.5	359 877.2	272.9	7.3

Both boreholes were advanced through the roadway embankment with a truck mounted CME 75 drill rig equipped with HW/NW casing. The subsurface stratigraphy encountered in the boreholes was recorded in the field by Thurber personnel. Split spoon samples were collected at regular depth intervals in the boreholes via the completion of Standard Penetration Tests (SPT), following the methods described in ASTM Standard D1586. Rock was cored and collected using NQ coring

equipment. All soil and rock core samples recovered from the boreholes were transported to Thurber's Ottawa geotechnical laboratory for further examination and testing.

The boreholes were backfilled with a low-permeability mixture of auger cuttings and bentonite pellets in accordance with Ontario MOE Regulation 903. Boreholes advanced within paved areas were capped with cuttings followed by 150 mm of cold patch asphalt to reinstate the travelling surface.

The as-drilled locations and ground surface elevation of the boreholes were surveyed by MPCE in July 2017.

3.1 Laboratory Testing

Geotechnical laboratory testing consisted of natural moisture content determination and visual identification of all retained soil samples in accordance with the current MTO standards. Grain size distribution analyses testing was also carried out on selected samples to MTO and ASTM standards. All rock cores were photographed and their total core recovery (TCR), solid core recover (SCR) and rock quality designation (RQD) were determined. Chemical analysis for determination of pH, conductivity, resistivity, soluble sulphate and chloride concentrations was carried out on two soil samples.

The results of the geotechnical tests are summarized on the Record of Borehole sheets included in Appendix B and all laboratory results are presented on the figures included in Appendix C.

4 DESCRIPTION OF SUBSURFACE CONDITIONS

4.1 Overview / General

Reference is made to the Record of Borehole sheets in Appendix B for details of the soil stratigraphy encountered in the boreholes. A stratigraphic profile is presented on Drawing No. 1 in Appendix A for illustrative purposes. An overall description of the stratigraphy is given in the following paragraphs; however, the factual data presented in the Record of Boreholes governs any interpretation of the site conditions. It must be recognized that soil and groundwater conditions may vary between and beyond sampled locations.

The stratigraphy encountered in the boreholes through the embankment near the abutment is generally characterized by the asphalt pavement structure underlain by granular fill and rockfill embankments overlying bedrock.

4.2 Asphalt

Both boreholes were advanced through the Highway 35 pavement structure and encountered asphalt ranging from 225 mm to 400 mm in thickness.

4.3 Fill

4.3.1 Granular Fill

A granular fill layer consisting predominantly of sand with silt and gravel to silty sand with gravel was encountered below the asphalt in both boreholes. This layer has a thickness ranging from 1.3 m to 3.3 m (bottom elevation of 269.4 m to 271.4 m). Cobbles and boulders were observed

in this unit within Borehole 17-1. The SPT 'N' values ranged from 6 to 42 blows; indicating a loose to dense condition.

The moisture content of the granular fill samples tested ranged from 9% to 20%. The results of three grain size analyses conducted on samples of granular fill are summarized in Table 4-1 and illustrated on Figure C1 in Appendix C.

Table 4-1: Gradation Results for Granular Fill

Soil Particle	%
Gravel	4 to 26
Sand	61 to 91
Silt and Clay	5 to 13

4.3.2 Rock Fill

A layer consisting predominantly of rock fill was encountered beneath the granular fill in Borehole 17-2. This layer has a top elevation of 271.4 m, and a thickness of 3.2 m. The borehole was advanced through the rockfill using casing and coring techniques. Sampling was attempted, however due to the nature of this material sample recovery was poor or not feasible. A single SPT 'N' value of 100 blows for 75 mm of penetration was obtained within this layer; indicating a very dense condition.

Rockfill pieces were cored and indicated particles with diameters up to 575 mm. Boulders estimated as large as 1 m in diameter were observed on the side slopes of the embankment adjacent to Borehole 17-2.

4.4 Bedrock

The fill was underlain by granite bedrock in both boreholes and was proven with coring techniques. The bedrock surface ranges from elevation 268.2 to 269.4 m and is summarized in the table below:

Table 4-2 Summary of Bedrock Elevation

Location	Borehole No.	Depth Below Existing Ground Surface (m)	Top of Bedrock Elevation (m)
North Abutment	17-1	3.7	269.4
South Abutment	17-2	4.7	268.2

The Total Core Recovery (TCR) ranged from 87 to 100%, the Solid Core Recovery (SCR) ranged from 87 to 100% and the Rock Quality Designation (RQD) typically ranged from 53 to 98%. The diamond core barrel wore out near the beginning of Run 3 on Borehole 17-2 and no further penetration was achievable. This resulted in a core recovery for Run 3 of less than 100 mm and an insufficient length of core to calculate an RQD for that run. Based on the RQD values the bedrock is classified as fair to excellent quality.

4.5 Groundwater

No water levels were obtained during drilling due to the introduction of water into the casing by the drilling method used in Borehole 17-1 and 17-2. The hydrology report should be referenced for water levels in the Gull River.

Due to the permeable nature of the granular fill and the open nature of the rockfill and approach embankments located within close proximity to upstream water control structures, it is expected that the groundwater level will respond rapidly to the water level changes in Gull River.

4.6 Results of Analytical Tests

Two samples of soil recovered from within the boreholes were selected and submitted for analytical testing including pH, conductivity, resistivity, chloride and sulphate. The results are summarized below and presented in the Certificate of Analysis included in Appendix C.

Table 4-3: Analytical Results Summary

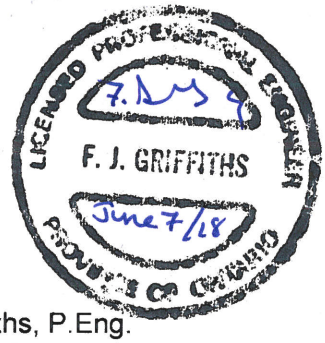
Borehole	Sample	Depth (m)	pH	Conductivity (uS/cm)	Resistivity (Ohm-cm)	Chloride (µg/g)	Sulphate (µg/g)
17-1	SS4	2.8	7.2	1530	654	681	299
17-2	SS2	1.1	7.6	2980	336	1890	18

5 MISCELLANEOUS

Thurber obtained utility clearances prior to drilling and the borehole locations were positioned relative to existing site features and proposed works. MPCE surveyed the borehole locations and ground surface elevations. George Downing Estate Drilling Ltd. of Hawkesbury, Ontario supplied and operated the drilling equipment to carry out the drilling, sampling, in-situ testing and borehole decommissioning. The drilling, and sampling operations in the field were supervised on a full-time basis by Mr. Jeffery Morrison, E.I.T. of Thurber. Laboratory testing was carried out in Thurber's MTO-approved laboratory in Ottawa.

Overall project management and direction of the field program was provided by Mr. Stephen Peters, P.Eng. Interpretation of the field data and preparation of this report was completed by Mr. Christopher Murray, M.Sc., P.Eng.. The report was reviewed by Dr. Fred Griffiths, P.Eng. and Dr. P.K. Chatterji, P.Eng., the Designated Principal Contact for MTO Foundations Projects.

Christopher Murray, M.Sc., P.Eng.
Geotechnical Engineer

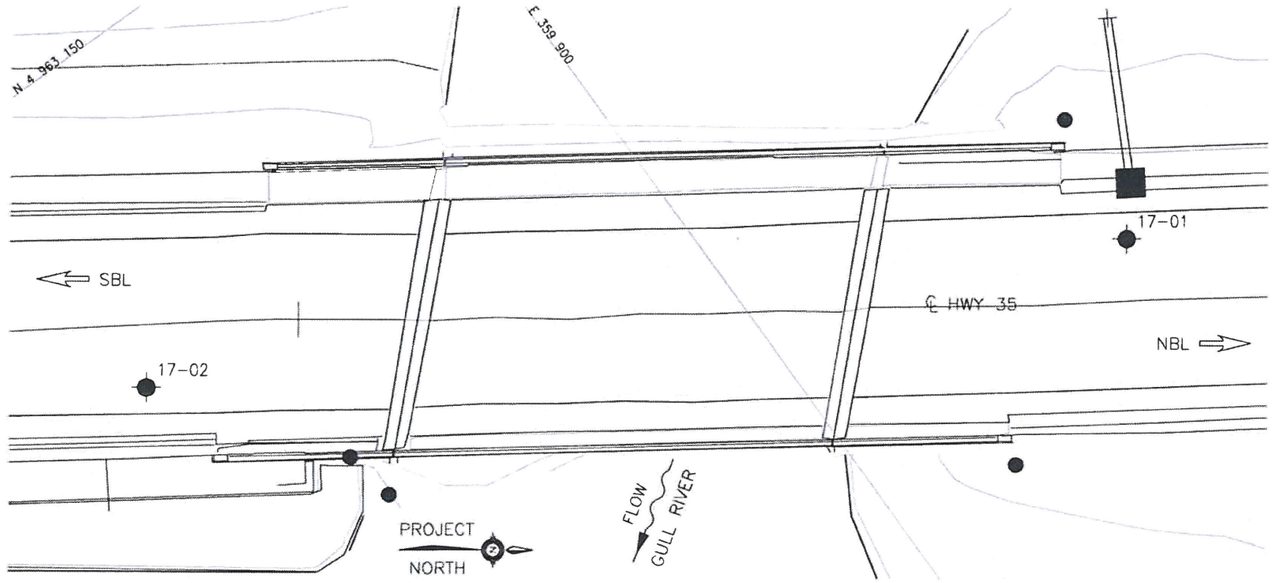


Dr. Fred Griffiths, P.Eng.
Senior Associate
Senior Geotechnical Engineer

Dr. P.K. Chatterji, P.Eng.
MTO Review Principal
Senior Geotechnical Engineer

APPENDIX A

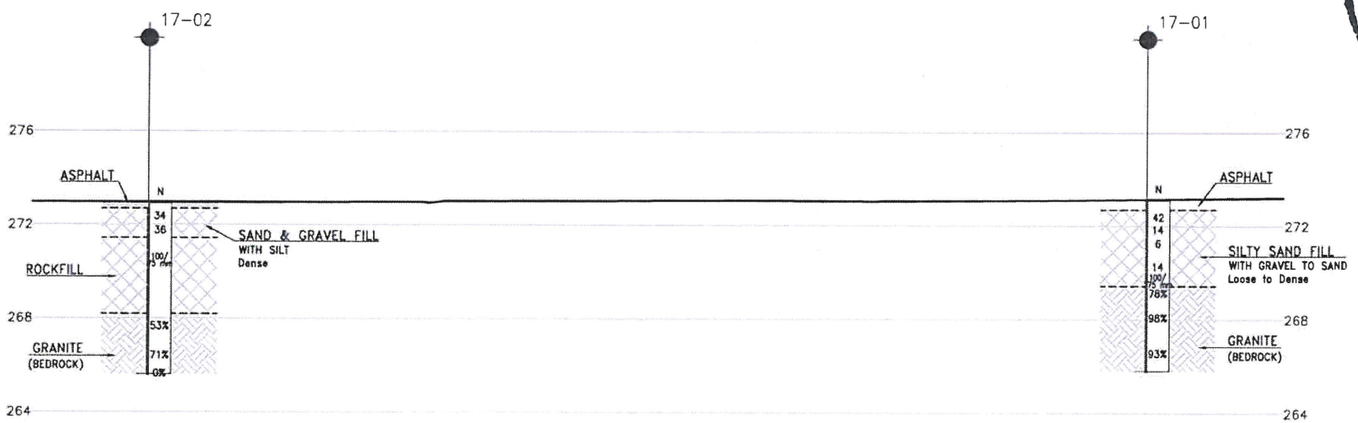
BOREHOLE LOCATION AND SOIL STRATA DRAWINGS



PLAN

5 0 5 10m

SCALE 1:250



PLAN ALONG ℄ HWY 35

5 0 5 10m

SCALE 1:250

METRIC

DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN

LICENSED PROFESSIONAL ENGINEER
P. K. CHATTERJI
June 7/18
PROVINCE OF ONTARIO

LICENSED PROFESSIONAL ENGINEER
F. J. GRIFFITHS
June 7/18
PROVINCE OF ONTARIO

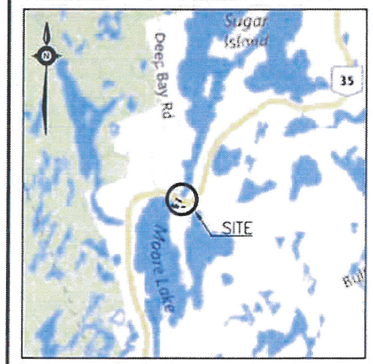
CONT No
GWP No 5087-11-00

SHEET

HIGHWAY 35
GULL RIVER SOUTH
BRIDGE REHABILITATION
BOREHOLE LOCATIONS AND SOIL STRATA

McINTOSH PERRY

THURBER ENGINEERING LTD.



KEYPLAN

LEGEND

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

NO	ELEVATION	NORTHING	EASTING
17-01	273.1	4 963 116.8	359 915.1
17-02	272.9	4 963 136.5	359 877.2

-NOTES-

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

GEOCRES No. 31D-692

REVISIONS		
DATE	BY	DESCRIPTION

DESIGN CM	CHK	CODE	LOAD	DATE	MAR 2018
DRAWN AN	CHK CM	SITE	STRUCT	DWG 1	

FILENAME H:\Drafting\16000\16284\TED-16284-BHPP-GR.dwg
PLOTDATE 5/30/2018 8:41 AM

APPENDIX B

RECORD OF BOREHOLE SHEETS

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SYMBOLS, ABBREVIATIONS AND TERMS USED ON TEST HOLE RECORDS

TERMINOLOGY DESCRIBING COMMON SOIL GENESIS

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

TERMINOLOGY DESCRIBING SOIL STRUCTURE:

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

RECOVERY:

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

N-VALUE:

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

DYNAMIC CONE PENETRATION TEST (DCPT):

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

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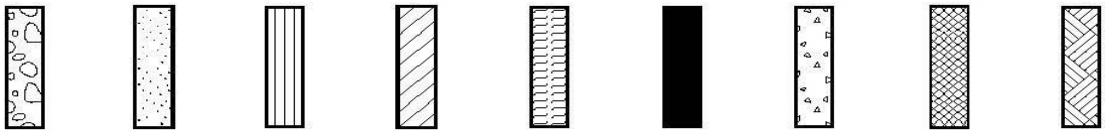
STRATA PLOT:
Strata plots symbolize the soil and bedrock description. They are combinations of the following basic symbols. The dimensions within the strata symbols are not indicative of the particle size, layer thickness, etc.



Boulders
Cobbles
Gravel
Sand
Silt
Clay
Organics
Asphalt
Concrete
Fill
Bedrock

TEXTURING CLASSIFICATION OF SOILS

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

TERMS DESCRIBING CONSISTENCY (COHESIVE SOILS ONLY)

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

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

SAMPLE TYPES

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

TERMS DESCRIBING CONSISTENCY (COHESIONLESS SOILS ONLY)

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

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MODIFIED UNIFIED SOIL CLASSIFICATION

Major Divisions		Group Symbol	Typical Description
COARSE GRAINED SOIL	GRAVEL AND GRAVELLY SOILS	GW	Well-graded gravels or gravel-sand mixtures, little or no fines.
		GP	Poorly-graded gravels or gravel-sand mixtures, little or no fines.
		GM	Silty gravels, gravel-sand-silt mixtures.
		GC	Clayey gravels, gravel-sand-clay mixtures.
	SAND AND SANDY SOILS	SW	Well-graded sands or gravelly sands, little or no fines.
		SP	Poorly-graded sands or gravelly sands, little or no fines.
		SM	Silty sands, sand-silt mixtures.
		SC	Clayey sands, sand-clay mixtures.
FINE GRAINED SOILS	SILT AND CLAY SOILS $W_L < 35\%$	ML	Inorganic silts, very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity.
		CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays.
		OL	Organic silts and organic silty-clays of low plasticity.
	SILT AND CLAY SOILS $35\% < W_L < 50\%$	MI	Inorganic compressible fine sandy silt with clay of medium plasticity, clayey silts.
		CI	Inorganic clays of medium plasticity, silty clays.
		OI	Organic silty clays of medium plasticity.
	SILT AND CLAY SOILS $W_L > 50\%$	MH	Inorganic silts, micaceous or diatomaceous fine sandy of silty soils, elastic silts.
		CH	Inorganic clays of high plasticity, fat clays.
		OH	Organic clays of high plasticity, organic silts.
HIGHLY ORGANIC SOILS		Pt	Peat and other organic soils.

Note - W_L= Liquid Limit

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EXPLANATION OF ROCK LOGGING TERMS

ROCK WEATHERING CLASSIFICATION

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

TERMS

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

DISCONTINUITY SPACING

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

STRENGTH CLASSIFICATION

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

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No 17-1 1 OF 1 METRIC

GWP# 5087-11-00 LOCATION Gull River South Bridge, MTM z10: N 4 963 116.8 E 359 915.1 ORIGINATED BY JM

HWY 35 BOREHOLE TYPE NW Casing / NQ Coring COMPILED BY JM

DATUM Geodetic DATE 2017.05.11 - 2017.05.11 CHECKED BY CM

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
273.1								20 40 60 80 100	20 40 60		
0.0 / 272.7	**400 mm ASPHALT**						273				
0.4	Silty SAND with Gravel to SAND Loose to Dense Brown **FILL**		1	SS	42				○		26 61 13 (SI+CL)
			2	SS	14		272		○		
			3	SS	6				○		4 91 5 (SI+CL)
	- 250 mm Boulder at 2.3 m						271				
			4	SS	14				○		
	- Frequent Cobbles below 3.1 m						270		○		
269.4			5	SS	100/ 275 mm						
3.7	**GRANITE BEDROCK**, occasional Chlorite and Quartz seams Slightly Weathered to Fresh Medium Bedded Grey		1	RUN			269				RUN #1 TCR=87% SCR=87% RQD=78%
			2	RUN			268				RUN #2 TCR=100% SCR=100% RQD=98%
			3	RUN			267				RUN #3 TCR=100% SCR=100% RQD=93%
265.8							266				
7.3	End of Borehole										

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

(%) STRAIN AT FAILURE

ONTMT4S 16284 GULL RIVER BRIDGE SOUTH.GPJ 2012TEMPLATE(MTO).GDT 16/3/18

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THURBER

RECORD OF BOREHOLE No 17-2 1 OF 1 METRIC

GWP# 5087-11-00 LOCATION Gull River South Bridge, MTM z10: N 4 963 136.5 E 359 877.2 ORIGINATED BY JM

HWY 35 BOREHOLE TYPE NW Casing / NQ Coring COMPILED BY JM

DATUM Geodetic DATE 2017.05.10 - 2017.05.10 CHECKED BY CM

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
272.9								20 40 60 80 100	20 40 60		
0.0	**225 mm ASPHALT**										
0.2	SAND with Silt and Gravel Dense Brown **FILL**		1	SS	34				○		15 76 9 (SI+CL)
			2	SS	36		272		○		
271.4											
1.5	**ROCK FILL** - 150 mm Boulder at 1.5 m - 200 mm Boulder at 1.7 m - 575 mm Boulder at 1.9 m						271				
			3	SS	100/ 75 mm						
	- Frequent Cobbles below 2.5 m						270				
268.2							269				
4.7	**GRANITE BEDROCK** Slightly Weathered Thinly Bedded Grey and Pink		1	RUN			268				RUN #1 TCR=100% SCR=100% RQD=53%
			2	RUN			267				RUN #2 TCR=100% SCR=100% RQD=71%
265.6			3	RUN			266				RUN #3 TCR=100%
7.3	End of Borehole										SCR=100% RQD=0%

+ ^{3}, × ^{3}: Numbers refer to Sensitivity

20
15 ⊕ 5
10
(%) STRAIN AT FAILURE

ONTMT4S 16284 GULL RIVER BRIDGE SOUTH.GPJ 2012TEMPLATE(MTO).GDT 16/3/18

APPENDIX C

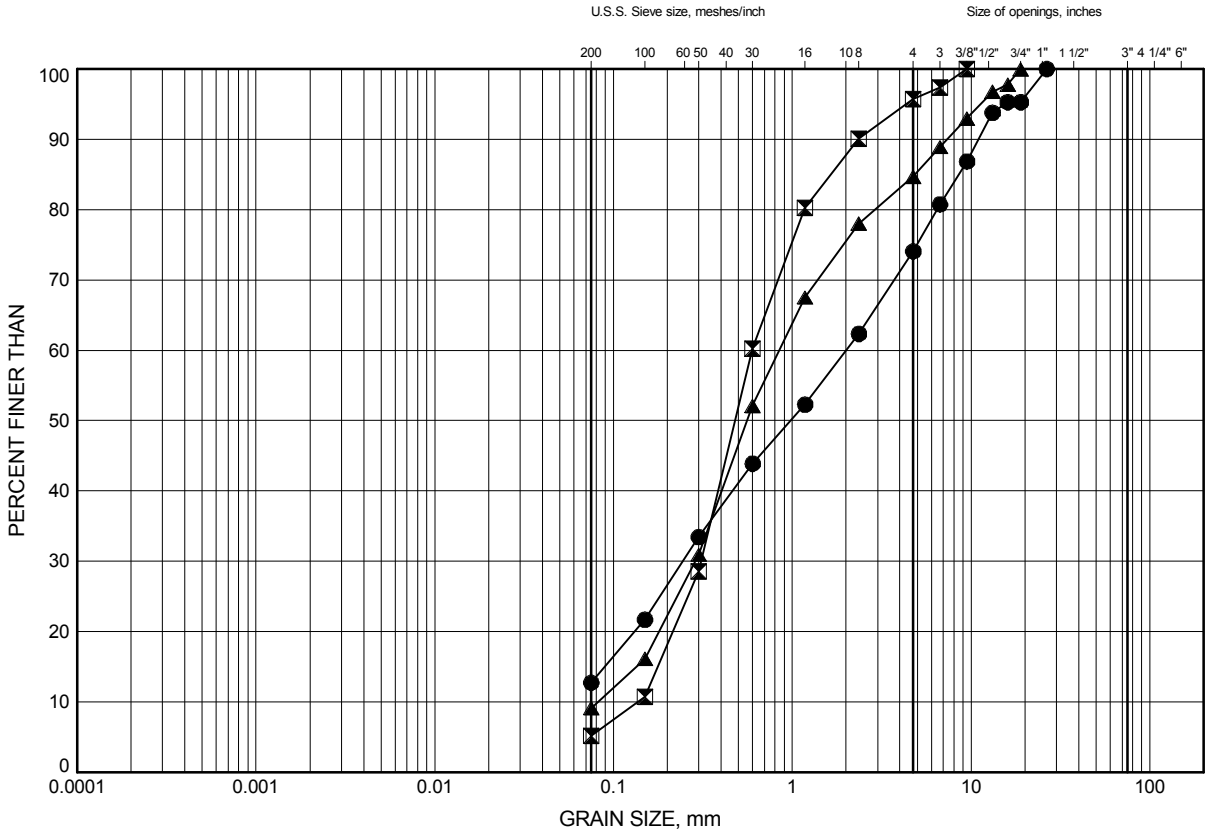
LABORATORY TEST RESULTS

Gull River South Bridge

GRAIN SIZE DISTRIBUTION

FIGURE C1

Fill



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	17-1	0.71	
⊠	17-1	1.83	
▲	17-2	0.53	

Date July 2017

GWP# 5087-11-00

THURBER

Prep'd CM

Chkd. SP

GRAIN SIZE DISTRIBUTION - THURBER 16284 GULL RIVER BRIDGE SOUTH.GPJ 20/7/17

Borehole 17-1

Runs 1 and 2 (of 3)

Elevation 269.4 m to 267.3 m

THURBER ENGINEERING LTD.

Foundation Investigation
Gull River South Bridge
Lutterworth Township, Ontario

GWP: 5274-14-00

Project No.: 16284

Borehole 17-1

Run 3 (of 3)

Elevation 267.3 m to 265.8 m

THURBER ENGINEERING LTD.

Foundation Investigation
Gull River South Bridge
Lutterworth Township, Ontario

GWP: 5274-14-00

Project No.: 16284

Borehole 17-2

Runs 1 and 2 (of 3)

Elevation 268.2 m to 266.3 m

THURBER ENGINEERING LTD.

Foundation Investigation
Gull River South Bridge
Lutterworth Township, Ontario

GWP: 5274-14-00

Project No.: 16284

Borehole 17-2

Run 2 and 3 (of 3)

Elevation 266.3 m to 265.6 m

THURBER ENGINEERING LTD.

Foundation Investigation
Gull River South Bridge
Lutterworth Township, Ontario

GWP: 5274-14-00

Project No.: 16284

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Certificate of Analysis

Thurber Engineering Ltd.

2460 Lancaster Rd, Suite 104
Ottawa, ON K1B4S5
Attn: Stephen Peters

Client PO: 16284
Project: South Gull River Bridge
Custody: 14056

Report Date: 1-Jun-2017
Order Date: 26-May-2017

Order #: 1721506

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

Paracel ID	Client ID
1721506-01	BH17-1, SS4, 8'3"-10'3"
1721506-02	BH17-2, SS2, 2'9"-4'9"

Approved By:

Dale Robertson, BSc
Laboratory Director

Certificate of Analysis
Client: Thurber Engineering Ltd.
Client PO: 16284

Report Date: 01-Jun-2017
Order Date: 26-May-2017
Project Description: South Gull River Bridge

Analysis Summary Table

Analysis	Method Reference/Description	Extraction Date	Analysis Date
Anions	EPA 300.1 - IC, water extraction	29-May-17	29-May-17
Conductivity	MOE E3138 - probe @25 °C, water ext	1-Jun-17	1-Jun-17
pH, soil	EPA 150.1 - pH probe @ 25 °C, CaCl buffered ext.	28-May-17	28-May-17
Resistivity	EPA 120.1 - probe, water extraction	1-Jun-17	1-Jun-17
Solids, %	Gravimetric, calculation	28-May-17	28-May-17

Certificate of Analysis
Client: Thurber Engineering Ltd.
Client PO: 16284

Report Date: 01-Jun-2017
Order Date: 26-May-2017
Project Description: South Gull River Bridge

	Client ID:	BH17-1, SS4, 8'3"-10'3"	BH17-2, SS2, 2'9"-4'9"	-	-
	Sample Date:	11-May-17	10-May-17	-	-
	Sample ID:	1721506-01	1721506-02	-	-
	MDL/Units	Soil	Soil	-	-
Physical Characteristics					
% Solids	0.1 % by Wt.	84.3	86.3	-	-
General Inorganics					
Conductivity	5 uS/cm	1530	2980	-	-
pH	0.05 pH Units	7.23	7.63	-	-
Resistivity	0.10 Ohm.m	6.54	3.36	-	-
Anions					
Chloride	5 ug/g dry	681	1890	-	-
Sulphate	5 ug/g dry	299	18	-	-

Certificate of Analysis
Client: Thurber Engineering Ltd.
Client PO: 16284

Report Date: 01-Jun-2017
Order Date: 26-May-2017
Project Description: South Gull River Bridge

Method Quality Control: Blank

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

Method Quality Control: Duplicate

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Anions									
Chloride	153	5	ug/g dry	151			1.5	20	
Sulphate	890	5	ug/g dry	884			0.7	20	
General Inorganics									
Conductivity	735	5	uS/cm	758			3.1	6.2	
pH	7.88	0.05	pH Units	7.85			0.4	10	
Resistivity	13.6	0.10	Ohm.m	13.2			3.1	20	
Physical Characteristics									
% Solids	85.6	0.1	% by Wt.	85.9			0.3	25	

Certificate of Analysis
Client: Thurber Engineering Ltd.
Client PO: 16284

Report Date: 01-Jun-2017
Order Date: 26-May-2017
Project Description: South Gull River Bridge

Method Quality Control: Spike

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Anions									
Chloride	256	5	ug/g	151	105	78-113			
Sulphate	972	5	ug/g	884	88.7	78-111			

Qualifier Notes:

None

Sample Data Revisions

None

Work Order Revisions / Comments:

None

Other Report Notes:

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

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

APPENDIX D

SELECTED PHOTOGRAPHS

Figure 1: Roadway Platform at Bridge 40-024 looking South (05/11/2017)

Figure 2: Roadway Platform at Bridge 40-024 looking North (05/10/2017)

Figure 3: West Side of Bridge Looking South from North Abutment (05/10/2017)

Figure 4: East Side of Bridge Looking South from North Abutment (05/10/2017)