



THURBER ENGINEERING LTD.

**PRELIMINARY
FOUNDATION INVESTIGATION REPORT
HIGHWAY 17 TWINNING, RENFREW AREA
GOSHEN ROAD OVERPASSES, SITE NO. 29-410
WP 4068-09-00 / ASSIGNMENT NO. 4018-E-0009**

Geocres No.: 31F-225

Report to:

Ministry of Transportation Ontario

Latitude: 45.445730°
Longitude: -76.584160°

August 2022
Thurber File No.: 24726



TABLE OF CONTENTS

PART 1. FACTUAL INFORMATION

1	INTRODUCTION	1
2	SITE DESCRIPTION	1
2.1	General	1
2.2	Site Geology	2
3	SITE INVESTIGATION AND FIELD TESTING.....	2
4	LABORATORY TESTING.....	4
5	GENERAL DESCRIPTION OF SUBSURFACE CONDITIONS.....	4
5.1	Topsoil	5
5.2	Asphalt.....	5
5.3	Fill	5
5.4	Rock Fill	5
5.5	Sand to Silty Sand to Sandy Silt (SP, SM, ML).....	5
5.6	Clayey Silt to Sandy Silt (CL, ML).....	6
5.7	Clay (CI).....	7
5.8	Till: Sandy Clayey Silt to Silty Sand to Sand and Gravel (SM, SC-SM, SC, ML).....	7
5.9	Bedrock.....	8
5.10	Groundwater	9
5.11	Analytical Testing.....	11
6	MISCELLANEOUS	12

APPENDICES

Appendix A.	Borehole Location Plan and Stratigraphic Drawings
Appendix B.	Record of Borehole Sheets
Appendix C.	Laboratory Testing
Appendix D.	Site Photographs



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PART 1. FACTUAL INFORMATION

1 INTRODUCTION

Thurber Engineering Ltd. (Thurber) has been engaged by the Ministry of Transportation Ontario (MTO) under Assignment No. 4018-E-0009 to carry out Foundation Investigations to support the design of the Highway 17 Twinning Project which extends from Scheel Drive westerly to 3 km west of Bruce Street in the Renfrew area.

This section of the report presents the factual findings obtained from a foundation investigation completed at the future Eastbound and Westbound Overpass structures at Goshen Road and Highway 17. The existing Highway 17 alignment will become the future Highway 17 eastbound lanes. Thurber carried out the investigation under Ministry of Transportation (MTO) Assignment No. 4018-E-0009.

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

Previous foundation information from preliminary investigations completed in 2003/2004 for the currently proposed structures was available under Geocres 31F-134 and 31F-141.

It should be noted that the use of and reliance on Part 1 of the Report is governed by and limited to the terms and conditions set out in the Report and a reliance letter. The Preferred Proponent remains responsible to assess the need for additional investigations and to complete that work.

2 SITE DESCRIPTION

2.1 General

The site is located approximately 50 m east of the existing at grade intersection of Highway 17 and Goshen Road on Highway 17 in McNab/Braeside Township. It is proposed that Goshen Road will cross under Highway 17 at approximate Station 11+684 of the westbound (new) alignment and Station 11+799 of the eastbound (existing) alignment with a skew of approximately 36 degrees to the perpendicular of Highway 17. At the location of the proposed structures, Highway 17 is oriented east to west and Goshen Road is oriented roughly southeast to northwest.



For project purposes, the highway and sideroad are herein described as oriented east-west and north-south, respectively.

The land adjacent to the site consists of residential properties, agricultural fields, forests and wetter areas. The terrain generally slopes down to the south and west. Rock outcrops are visible in the existing ditch line north of existing Highway 17. Rock cuts are present 250 m east and 350 m west of the site on Highway 17. The existing highway in this area is an undivided rural highway with partially paved shoulders. In the westbound direction there is a single through lane and a right turn lane for Goshen Road. In the eastbound direction there are two through lanes and a right turn lane onto Goshen Road.

Goshen Road is a paved two lane roadway with gravel shoulders.

2.2 Site Geology

Based on published geological information in *The Physiography of Southern Ontario* by Chapman and Putnam (1984), the site lies within the physiographic region known as the Algonquin Highlands. The Algonquin Highlands are characterized primarily by rough rounded bedrock knobs and ridges. The bedrock is generally shallow, however the depth to bedrock can vary greatly over short distances. Base mapping by the Ontario Geological Survey indicates the bedrock in the area consists of gneisses and migmatites derived from early felsic plutonic rock such as granodiorite, tonalite, monzogranite, syenogranite. Mapping also suggests that multiple faults intersect at or near the site.

Photographs showing the existing conditions in the area of the site at the time of the field investigation are included in Appendix D for reference.

3 SITE INVESTIGATION AND FIELD TESTING

The current site investigation and field-testing program was carried out in two separate mobilizations. Truck accessible locations were drilled between August 29 and September 18, 2019. The off-road locations were drilled between July 6 and July 14, 2020. The field investigation consisted of advancing 13 boreholes identified as Boreholes GOS19-01 through GOS19-12 and GOS19-04W. Prior to commencement of drilling, utility clearances were obtained in the vicinity of the borehole locations. Traffic control was provided where required for lane closures to complete the on-road boreholes and access to the off-road boreholes.

Previously drilled Boreholes GOS-1 through GOS-4 were completed by Thurber in September and October 2003 as part of a preliminary investigation for the structures required for the twinning of Highway 17. Data from these boreholes has been fully incorporated into this report.

The locations of the 2019 and 2020 boreholes were surveyed by Thurber for both location and elevation with a Trimble Catalyst DA1 antenna with centimeter accuracy. The nearby benchmark, HCP 138 was checked as a reference during the surveys. The northing, easting and elevation of the boreholes are shown on the Borehole Location and Soil Strata Drawing No. 1 in Appendix A,



the individual Record of Borehole sheets in Appendix B, and in Table 3-1 below. The site is located within MTM Zone 9.

Table 3-1: Borehole Summary

Borehole No.	Drilled Location	Northing (Latitude)	Easting (Longitude)	Ground Surface Elevation (m)	Termination Depth (m)
GOS19-05	North Cut 9+900	5 034 069.5 (45.446525)	298 128.7 (-76.585284)	167.1	10.7
GOS19-06	North Cut 9+925	5 034 052.3 (45.446371)	298 146.7 (-76.585054)	167.0	9.2
GOS19-01	Westbound West Approach	5 034 031.8 (45.446186)	298 158.4 (-76.584904)	166.9	13.5
GOS19-11	Westbound West Approach	5 034 022.8 (45.446105)	298 163.3 (-76.584842)	166.8	7.6
GOS-2	Westbound West Approach	5 034 015.8 (45.446042)	298 171.4 (-76.584738)	166.8	6.8
GOS-1	Westbound East Approach	5 034 036.7 (45.446230)	298 171.9 (-76.584732)	169.0	15.9
GOS19-12	Westbound East Approach	5 034 030.3 (45.446172)	298 178.4 (-76.584649)	169.1	12.5
GOS19-02	Westbound East Approach	5 034 023.0 (45.446106)	298 183.7 (-76.584581)	169.2	14.9
GOS19-07	Median Cut 10+000	5 034 002.5 (45.445922)	298 201.8 (-76.584349)	169.2	9.9
GOS19-08	Median Cut 10+000	5 033 993.8 (45.445845)	298 192.5 (-76.584467)	168.5	6.5
GOS19-03	Eastbound West Approach	5 033 975.0 (45.445675)	298 209.0 (-76.584256)	167.4	4.5
GOS-4	Eastbound West Approach	5 033 957.6 (45.445519)	298 222.5 (-76.584084)	167.2	5.9
GOS-3	Eastbound East Approach	5 033 977.5 (45.445698)	298 222.0 (-76.584090)	167.5	4.7
GOS19-04	Eastbound East Approach	5 033 961.5 (45.445554)	298 235.8 (-76.583914)	168.0	9.6
GOS19-04W	Eastbound Structure	5 033 952.0 (45.445471)	298 228.6 (-76.584001)	167.0	6.4
GOS19-09	South Cut 10+075	5 033 940.0 (45.445361)	298 244.1 (-76.583801)	167.3	8.5
GOS19-10	South Cut 10+100	5 033 923.0 (45.445201)	298 262.4 (-76.583601)	166.5	7.7

The current investigation was carried out using truck-mounted CME 55 and track-mounted CME 75 drill rigs equipped with hollow-stem augers and/or rotary diamond drilling equipment.



Soil samples were obtained at selected intervals using a split spoon sampler in conjunction with Standard Penetration Testing (SPT). Select boreholes were advanced approximately 3.0 m to 7.2 m into bedrock, with NQ or HQ sized coring equipment.

Monitoring wells, approximately 50 mm in diameter, were installed in Boreholes GOS19-01, GOS19-02, GOS19-04W, GOS19-06, GOS19-07 and GOS19-09 of the current investigation and piezometers, approximately 19 mm in diameter, were installed in all historical boreholes (GOS-1 through GOS-4, inclusive). The installation details are illustrated on the respective Record of Borehole sheets provided in Appendix B. The boreholes were backfilled in accordance with MOE requirements (O.Reg 903, as amended). The monitoring wells will be decommissioned by Thurber, as outlined in the Hydrogeological Investigation and Design Report.

The drilling and sampling operations were supervised on a full-time basis by a member of Thurber's geotechnical staff. The drilling supervisor logged the boreholes and processed the recovered soil and bedrock samples for transport to Thurber's Ottawa geotechnical laboratory for further examination and testing.

4 LABORATORY TESTING

Geotechnical laboratory testing consisted of natural moisture content determination and visual identification of all retained soil samples. Testing for grain size distribution and Atterberg Limits was also carried out on selected samples to MTO and ASTM standards. All rock cores were photographed and their Fracture Index (FI), total core recovery (TCR), solid core recovery (SCR) and rock quality designation (RQD) were measured. Unconfined compressive strength (UCS) testing was completed on selected rock core samples. Chemical analysis for determination of pH, conductivity, resistivity, sulphide, sulphate and chloride was carried out on soil samples from Boreholes GOS19-01, GOS19-03, GOS19-02, GOS19-04W.

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.

5 GENERAL DESCRIPTION OF SUBSURFACE CONDITIONS

Details of the encountered soil stratigraphy are presented on the Record of Borehole sheets included in Appendix B and the Borehole Location and Soil Strata Drawing included in Appendix A. A general description of the stratigraphy based on the conditions encountered in the boreholes is given in the following sections. However, the factual data presented on the Borehole Records takes precedence over the Soil Strata Drawing and the general description. It must be recognized that the soil and groundwater conditions may vary between and beyond borehole locations. Soil classification is in accordance with ASTM D2487. Cohesive soils from the 2019 and 2020 boreholes are described per current MTO protocols.

In general terms, the site was found to have a surficial layer of topsoil, asphalt or fill overlying native deposits of interlayered silty sand, clayey silt, sandy clay and/or sandy silt, which are underlain by a deposit of glacial till over gneiss/granitic bedrock.



5.1 Topsoil

Topsoil was encountered at surface in Boreholes GOS19-02, GOS19-04W, GOS19-07 through GOS19-10, GOS-1 and GOS-2. The topsoil thickness was found to range between 25 mm and 250 mm. Topsoil thickness may vary between borehole locations and in other parts of the site and this limited data should not be used to estimate topsoil quantity.

5.2 Asphalt

Asphalt was encountered in Borehole GOS19-03 with a thickness of approximately 200 mm.

5.3 Fill

A granular fill layer consisting of silty sand to sand with silt to sand and varying amounts of gravel to sand and gravel was encountered below the asphalt in Borehole GOS19-03, below the topsoil in Borehole GOS19-07 and at surface in Boreholes GOS19-04, GOS19-05, GOS19-06, GOS-3 and GOS-4. The granular fill ranged in thickness from approximately 0.4 to 0.9 m with a base elevation ranging from 166.2 to 168.4 m.

SPT tests conducted in the fill gave N-values of 8 and greater than 100 for 125 mm of penetration, indicating a loose to very dense relative density.

The moisture content of the granular fill samples tested ranged from 3 to 7%. The results of grain size analyses on two sample of the fill material are summarized below and are illustrated on Figure C1 in Appendix C.

Summary of Grain Size Distribution Testing – Granular Fill

Soil Particle	Percentage (%)
Gravel	28 – 44
Sand	47 – 62
Silt and Clay	9 – 10

5.4 Rock Fill

Rock fill consisting of varying amounts of gravel, rock fragments, cobbles and boulders was encountered below the granular fill in Boreholes GOS19-04, GOS-3 and GOS-4. The rock fill ranged in thickness from approximately 1.1 to 1.5 m and extended to a base elevation ranging from approximately 165.6 to 165.8m. Penetration through this layer required the use of coring techniques. One moisture content of the rock fill was approximately 6%.

5.5 Sand to Silty Sand to Sandy Silt (SP, SM, ML)

A non-cohesive deposit consisting of sand to silty sand to sandy silt with varying amounts of gravel and cobbles was encountered at surface in Borehole GOS19-01, beneath the topsoil in Boreholes GOS-1, GOS-2, GOS19-02, GOS19-04W, GOS19-08, GOS19-09 and GOS19-10 and below the granular fill in Boreholes GOS19-05, GOS19-06 and GOS19-07. Coring was required in some

boreholes to advance through cobbles. The thickness of this unit ranged from 1.4 to 5.3 m and the underside of this layer ranged from elevation 160.9 to 166.9m. Trace amounts of organics were observed in this layer in Boreholes GOS 19-08 and GOS 19-10. Cobbles were noted in Borehole GOS 19-10. A layer of clayey silt was noted within this unit in Borehole GOS19-01 and a layer of sandy silt (ML) was noted in Borehole GOS-1.

SPT tests conducted in this layer gave N-values ranging from 4 to 73 blows for 50 mm of penetration, indicating a loose to very dense relative density, although typically compact to dense.

The moisture content of this unit ranged from 3 to 30%. The results of grain size distribution testing carried out on nine samples are summarized below and illustrated on Figures C2 to C3 in Appendix C.

Summary of Grain Size Distribution Testing – Sand to Silty Sand to Sandy Silt

Soil Particle	Percentage (%)
Gravel	0 – 35
Sand	50 – 92
Silt and Clay	7 - 42

5.6 Clayey Silt to Sandy Silt (CL, ML)

A native clayey silt to sandy silt deposit with varying amounts of clay and gravel was encountered within the silty sand in Borehole GOS19-01, below the sand to silty sand in Boreholes GOS19-02, GOS-1 and GOS-2, and beneath an unsampled interval in Borehole GOS 19-12. This layer ranged in thickness from 0.3 to 5.0 m with an underside elevation ranging from 161.8 to 165.1 m. A lower sand deposit was encountered in Borehole GOS-1 within the sandy silt layer and is included in Section 5.5 above.

SPT tests conducted within the clayey silt to sandy silt deposit gave N-values ranging from 12 to 41 indicating a compact to dense relative density.

The moisture content of the samples tested ranged from 14 to 40%. The results of four grain size analysis tests are summarized below and illustrated on Figure C4 in Appendix C.

Summary of Grain Size Distribution Testing – Clayey Silt to Sandy Silt

Soil Particle	Percentage (%)
Gravel	0 -2
Sand	25 – 43
Silt	48 – 63
Clay	7 - 12

The results of Atterberg Limits testing carried out on three samples indicated the deposit to be non-plastic.

5.7 Clay (Cl)

A cohesive unit clay was encountered beneath the silty sand in Borehole GOS 19-10. The thickness of the unit was 1.5 m and it extended to a base elevation of 162.7 m.

SPT tests conducted in this layer gave N-values ranging from 11 to 17, indicating a stiff to very stiff consistency.

The moisture content of this unit ranged from 27 to 28%. The results of grain size distribution testing carried out on one sample are summarized below and presented in Figure C5 in Appendix C.

Summary of Grain Size Distribution Testing – Clay

Soil Particle	Percentage (%)
Gravel	1
Sand	6
Silt	64
Clay	29

The results of Atterberg Limit Testing on one sample are summarized below and presented in Figure C9.

Summary of Atterberg Limit Testing – Sandy Clay to Clay

Parameter	Value
Liquid Limit	35
Plastic Limit	20
Plasticity Index	15

5.8 Till: Sandy Clayey Silt to Silty Sand to Sand and Gravel (SM, SC-SM, SC, ML)

A till deposit consisting of a heterogenous mixture of silt, sand, clay and gravel with occasional to frequent cobbles and boulders was encountered beneath the sandy silt in Boreholes GOS-1, GOS-2, GOS 19-02 and GOS19-12, beneath the clay in Borehole GOS19-10 and beneath the silty sand in Boreholes GOS 19-01, GOS 19-04W, GOS 19-05 through GOS 19-09. The drilling was terminated in this layer in Boreholes GOS19-05 and GOS19-06 at depths of 10.7 and 9.2 m (elev. 156.4 and 157.8m), respectively. Where fully penetrated, the thickness ranged from 0.1 to 6.2 m and the underside of this layer ranged from elevation 156.0 to 165.8 m.

The upper 2.6 m and 1.5 m of the till were observed to have increased clay content in Boreholes GOS 19-01 and GOS 19-05 respectively. A 1.2 m thick sand deposit was encountered within the till deposit in Borehole GOS-1 at a depth of 11.2 m (elev. 157.8m).

SPT tests conducted in the till gave N-values ranging from 7 to greater than 100 blows for 100 mm of penetration, indicating a loose to very dense relative density, although typically compact to dense. Refusals within this deposit are likely due to presence of cobbles and boulders. Penetration through this layer often required the use of coring techniques. Glacial tills inherently contain cobbles and boulders.

The moisture content of this unit ranged from 4 to 20%. The results of grain size distribution testing carried out on 13 samples of the till are summarized below and illustrated on Figures C6 to C8 in Appendix C.

Summary of Grain Size Distribution Testing – Glacial Till

Soil Particle	Percentage (%)	
Gravel	1 – 37	
Sand	37 – 76	
Silt	14 – 24	9 – 47
Clay		2 – 16

The results of Atterberg Limits testing carried out on the fines of five samples of this material are summarized below and are illustrated on Figure C10 in Appendix C. The laboratory results indicate that the fines are non plastic to low plastic (CL-ML to CL).

Summary of Atterberg Limit Testing – Glacial Till Fines

Parameter	Value
Liquid Limit	16 – 19
Plastic Limit	9 – 11
Plasticity Index	6 – 10

5.9 Bedrock

Bedrock was proven by coring in all boreholes except GOS19-05 and GOS19-06. The bedrock encountered consisted of slightly weathered to fresh, strong to extremely strong granite/gneiss that is predominantly grey and pink in colour. Bedrock logs are provided in Appendix B. Photographs of the bedrock cores are provided in Appendix C. The following table summarizes the rock core quality:

Summary of Rock Core Quality Parameter	Range	Average
Total Core Recovery (TCR), %	43 – 100	96
Solid Core Recovery (SCR), %	0 – 100	71
Rock Quality Designation (RQD), %	0 – 100	66
Fracture Index	0 – >10	3

Based on the average RQD value, the bedrock is classified as fair quality. Unconfined compressive strength (UCS) testing was carried out on 21 samples of the bedrock obtained from all current boreholes except GOS19-04W, GOS19-05 and GOS19-06 (see Appendix C for results)

and 12 samples from the past boreholes (Geocres 31F-134 and 31F-141). The UCS reported from the past boreholes were inferred from the results of Point Load Testing of bedrock core samples. The measured and inferred UCS values ranged from 88 MPa to 318 MPa with an average of 161 MPa. Based on the UCS values, the bedrock is strong to extremely strong. It is noted that within the rock cores a silt seam was present in GOS 19-02, voids were observed in GOS 19-09, and fractured zones and vertical and sub-vertical fractures were present in most boreholes.

A summary of the bedrock surface information is provided in Table 5-1 below:

Table 5-1: Summary of Bedrock Depth/Elevation

Borehole No.	Depth to Bedrock Surface (mbgs)	Bedrock Surface Elevation (m)
GOS-1	13.0	156.0
GOS-2	3.6	163.2
GOS-3	1.7	165.8
GOS-4	1.5	165.7
GOS19-01	10.0	156.9
GOS19-02	11.5	157.7
GOS19-03	0.8	166.6
GOS19-04	2.4	165.6
GOS19-04W	2.8	164.2
GOS19-07	4.2	165.0
GOS19-08	2.7	165.8
GOS19-09	3.1	164.2
GOS19-10	4.3	162.2
GOS19-11	4.2	162.6
GOS19-12	9.4	159.7

5.10 Groundwater

Standpipe piezometers and monitoring wells with diameters ranging from 19 mm to 50 mm were installed in six of the current boreholes and four previously drilled boreholes. Groundwater levels recorded in the piezometers are presented in Table 5-2 below:

Table 5-2: Summary of Groundwater Levels

Borehole No.	Bottom of Screen Elevation (m)	Screened Material	Depth (mbgs)	Groundwater Elevation (m)	Date of Measurement
GOS-1	153.4	Bedrock	5.7	163.3	Oct 22, 2003
			4.6	164.4	Dec 18, 2003
			4.8	164.2	Feb 5, 2004
GOS-2	160.7	Bedrock	2.5	164.3	Oct 22, 2003
			2.0	164.8	Dec 18, 2003
			2.1	164.7	Feb 5, 2004

Borehole No.	Bottom of Screen Elevation (m)	Screened Material	Depth (mbgs)	Groundwater Elevation (m)	Date of Measurement
GOS-3	162.8	Bedrock	2.9	164.6	Oct 22, 2003
			2.9	164.6	Dec 18, 2003
			-	Destroyed	Feb 5, 2004
GOS-4	161.3	Bedrock	2.8	164.4	Oct 22, 2003
			2.8	164.4	Dec 18, 2003
			-	Destroyed	Feb 5, 2004
GOS19-01	159.3	Till	0.6	166.3	21/04/20
			5.3	161.6	29/09/20
			3.7	163.2	Oct 18, 2021
			3.7	163.2	Oct 21, 2021
GOS19-02	160.0	Sandy Silt/Till	4.2	165.0	10/07/20
			4.7	164.5	22/07/20
			5.0	164.2	29/09/20
			4.9	164.3	16/12/20
			5.3	163.9	Sept 27, 2021
			5.3	163.9	Oct 02, 2021
			5.4	163.8	Oct 20, 2021
			5.4	163.8	Jan 20, 2022
GOS19-04W	160.6	Bedrock	5.7	161.3	22/07/20
			4.9	162.1	29/09/20
			4.1	162.9	16/12/20
			4.2	162.8	Sept 28, 2021
			4.5	162.5	Oct 02, 2021
			5.0	162.0	Jan 20, 2022
GOS19-06	157.8	Till	3.4	163.6	26/09/19
			0.6	166.4	21/04/20
			3.5	163.5	29/09/20
			3.7	163.3	Oct 22, 2021
GOS19-07	159.3	Bedrock	4.4	164.8	10/07/20
			4.5	164.7	22/07/20
			5.0	164.2	29/09/20
			4.7	164.5	15/12/20
			5.2	164.0	Sept 27, 2021
			5.2	164.0	Oct 02, 2021
			5.3	163.9	Jan 20, 2022

Borehole No.	Bottom of Screen Elevation (m)	Screened Material	Depth (mbgs)	Groundwater Elevation (m)	Date of Measurement
GOS19-09	158.8	Bedrock	6.1	161.2	15/07/20
			7.2	160.1	22/07/20
			7.4	159.9	29/09/20
			6.8	160.5	16/12/20
			7.5	159.8	Sept 28, 2021
			7.6	159.7	Oct 02, 2021
			7.3	160.0	Jan 20, 2022

These observations are considered short term and it should be noted that the groundwater level at the time of construction may be different and seasonal fluctuations of the groundwater level are to be expected. In particular, the groundwater level may be at a higher elevation after periods of significant and/or prolonged precipitation.

5.11 Analytical Testing

Four samples of the native soils were submitted to Paracel Laboratories in Ottawa, Ontario for analysis of pH, water soluble sulphate, sulphide and chloride concentrations, resistivity and conductivity. The analysis results are summarized in Table 5-3. Copies of the test results are provided in Appendix C.

Table 5-3: Results of Chemical Analysis

Borehole	GOS19-01	GOS19-02	GOS19-03	GOS19-04W
Sample	SS4	SS3	SS1	SS2
Depth (m)	2.3 – 2.5	1.5 – 2.1	0.2 – 0.7	0.8 – 1.4
Chloride (µg/g)	22	22	33	17
Sulphate (µg/g)	<5	<5	19	8
Sulphide (%)	0.03	<0.04	0.04	<0.04
pH (-)	7.50	8.10	7.80	8.12
Resistivity (Ohm-cm)	6,670	11,400	2,560	2,910
Conductivity (µS/cm)	150	87	391	343



6 MISCELLANEOUS

Borehole locations were selected by Thurber relative to existing site features. The as-drilled locations and ground surface elevation of the boreholes were surveyed by Thurber following completion of the field program. The elevation survey was carried out with reference to geodetic elevation benchmarks provided by the MTO.

Marathon Underground of Greely, Ontario and Eastern Ontario Diamond Drilling of Hawkesbury, Ontario supplied and operated the drilling equipment and carried out the drilling, soil sampling, in-situ testing, piezometer installation and borehole decommissioning. Traffic control services were provided by Beacon Lite of Ottawa, Ontario. Water supply for rock coring was provided by Bonnechere Excavating Inc., of Renfrew, Ontario. The field investigation was supervised on a full-time basis by Sean O'Bryan and Allison Chow of Thurber. Overall supervision of the investigation program was provided by Justin Gray, P.Eng.

Routine geotechnical laboratory testing was completed by Thurber's laboratory in Ottawa, Ontario. Unconfined Compressive Strength Testing of the bedrock was carried out by Stantec's laboratory in Ottawa. Analytical testing was completed by Paracel Laboratories in Ottawa.

Overall project management and direction of the field program was provided by Fred Griffiths, P.Eng. Interpretation of the factual data and preparation of this report were carried out by Katya Edney, P.Eng. and Fred Griffiths, P.Eng. The report was reviewed by P.K. Chatterji, P.Eng., a Designated Principal Contact for MTO Foundations Projects.

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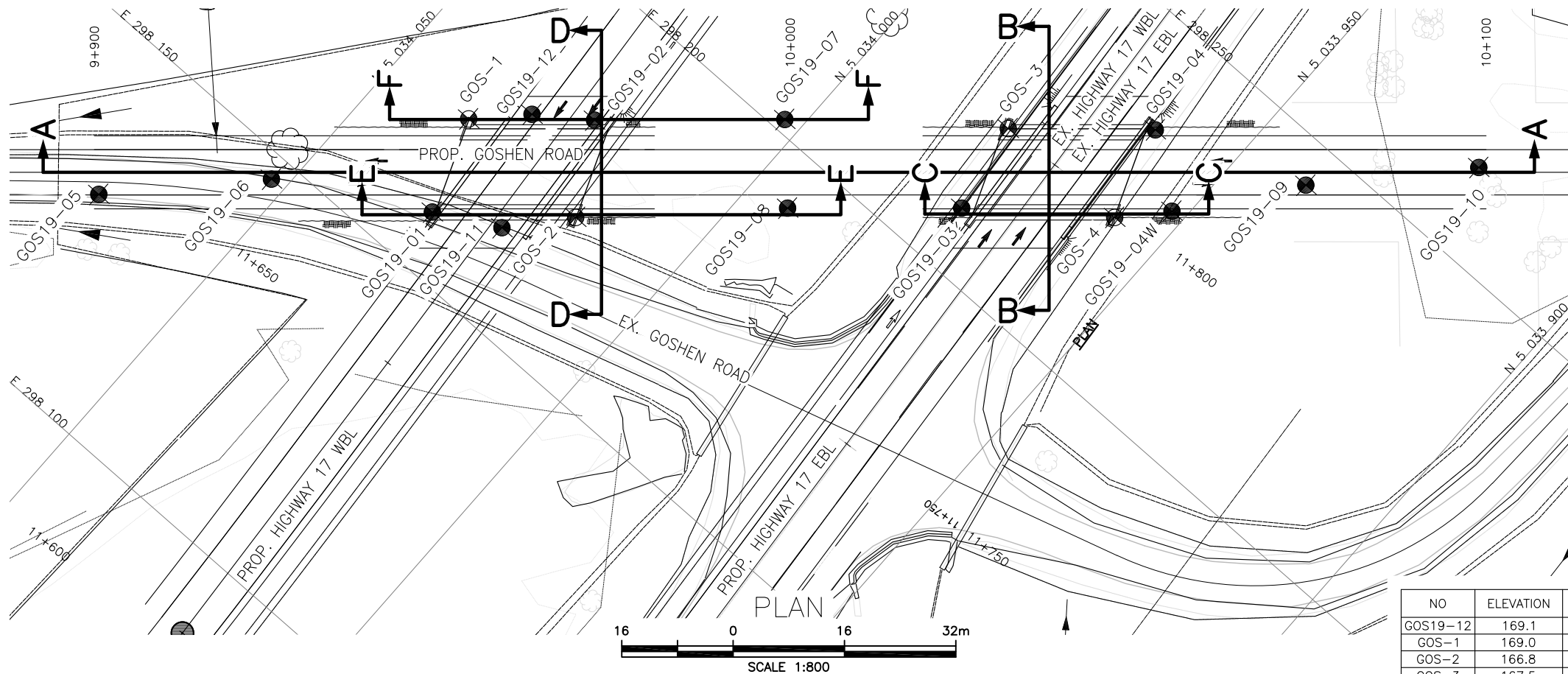


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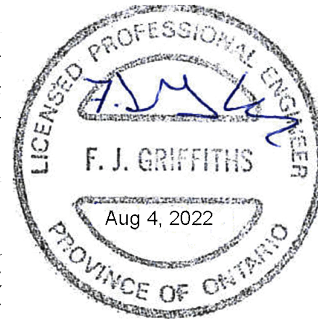


Appendix A.

Borehole Location Plan and Stratigraphic Drawings



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



NO	ELEVATION	NORTHING	EASTING
GOS19-12	169.1	5 034 030.3	298 178.4
GOS-1	169.0	5 034 036.7	298 171.9
GOS-2	166.8	5 034 015.8	298 171.4
GOS-3	167.5	5 033 977.5	298 222.0
GOS-4	167.2	5 033 957.6	298 222.5

CONT No
WP No 4068-09-00

HIGHWAY 17 TWINNING
GOSHEN ROAD
OVERPASS
BOREHOLE LOCATIONS AND SOIL STRATA

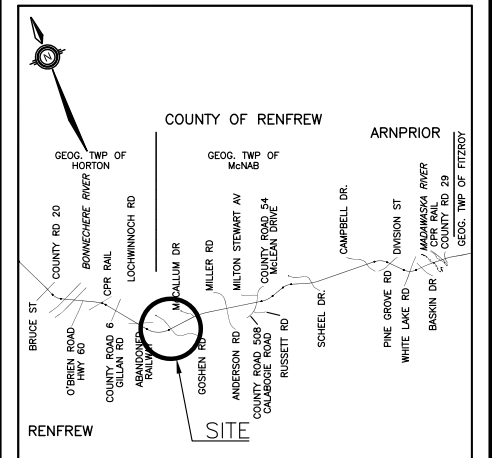


SHEET

Ontario



THURBER ENGINEERING LTD.



KEYPLAN

LEGEND

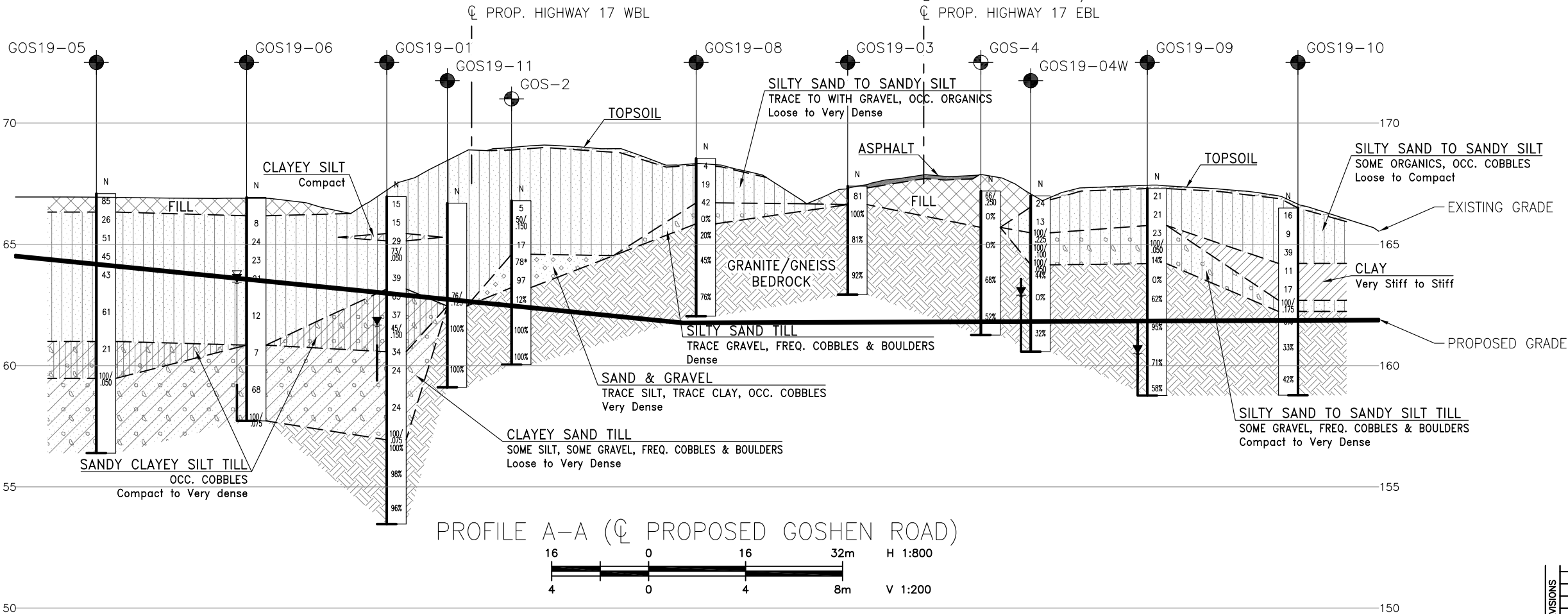
	Borehole (2020 Investigation)
	Borehole (2003 Investigation)
N	Blows /0.3m (Std Pen Test, 475J/blow)
CONE	Blows /0.3m (60' Cone, 475J/blow)
PH	Pressure, Hydraulic
	Water Level
	Head Artesian Water
	Piezometer
90%	Rock Quality Designation (RQD)
A/R	Auger Refusal

NO	ELEVATION	NORTHING	EASTING
GOS19-01	166.9	5 034 031.8	298 158.4
GOS19-02	169.2	5 034 023.0	298 183.7
GOS19-03	167.4	5 033 975.0	298 209.0
GOS19-04	168.0	5 033 961.5	298 235.8
GOS19-04W	167.0	5 033 952.0	298 228.6
GOS19-05	167.1	5 034 069.5	298 128.7
GOS19-06	167.0	5 034 052.3	298 146.7
GOS19-07	169.2	5 034 002.5	298 201.8
GOS19-08	168.5	5 033 993.8	298 192.5
GOS19-09	167.3	5 033 940.0	298 244.1
GOS19-10	166.5	5 033 923.0	298 262.4
GOS19-11	166.8	5 034 022.8	298 163.3

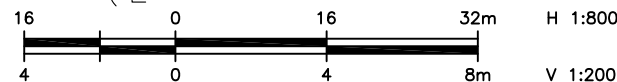
-NOTES-

- 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 9.

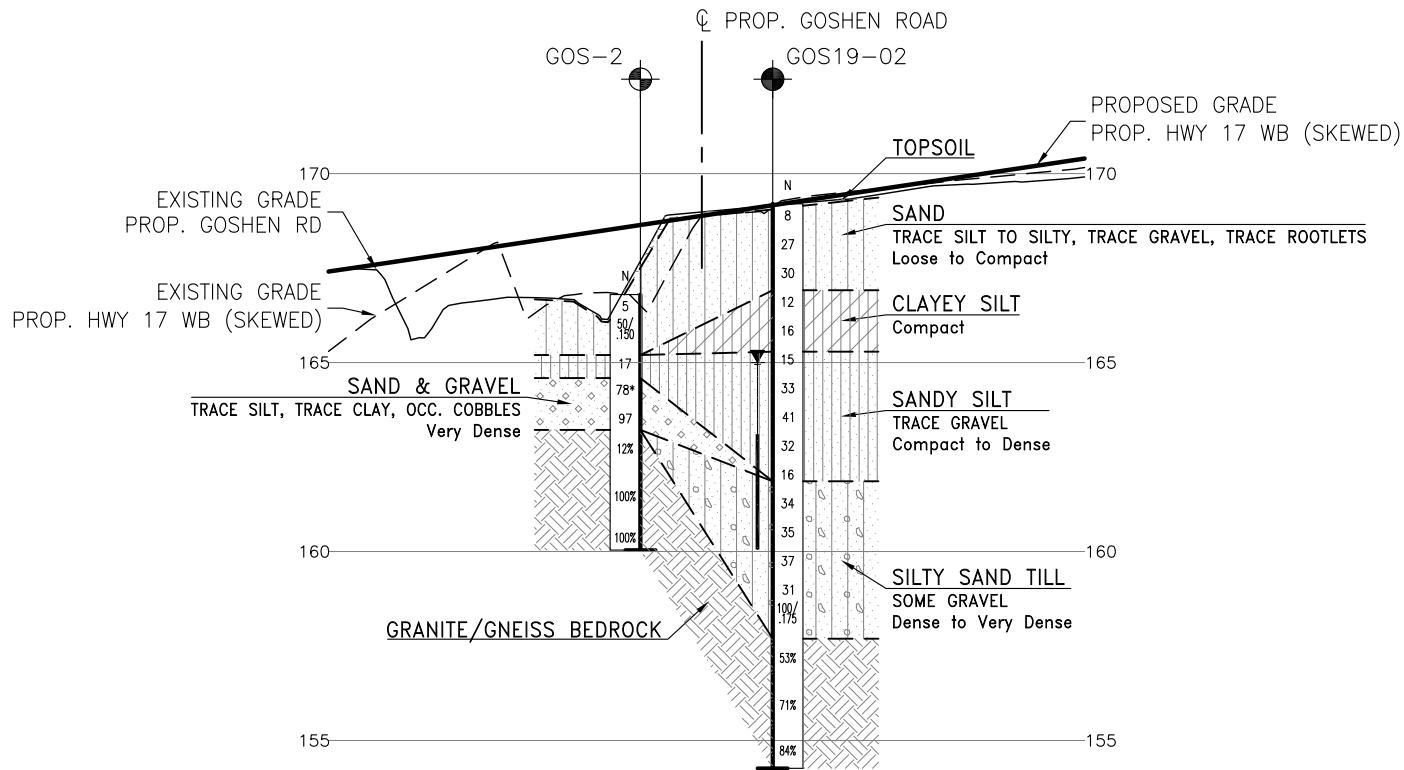
GEOCRES No. 31F-225



PROFILE A-A (along the proposed GOSHEN ROAD)



REVISIONS	DATE	BY	DESCRIPTION
DESIGN	JG	CHK FG	CODE
DRAWN	MFA	CHK JG	SITE 29-410
LOAD			
STRUCT			
DWG	1		
DATE	JUL 2022		



SECTION D-D

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



NO	ELEVATION	NORTHING	EASTING
GOS19-12	169.1	5 034 030.3	298 178.4
GOS-1	169.0	5 034 036.7	298 171.9
GOS-2	166.8	5 034 015.8	298 171.4
GOS-3	167.5	5 033 977.5	298 222.0
GOS-4	167.2	5 033 957.6	298 222.5

CONT No
WP No 4068-09-00

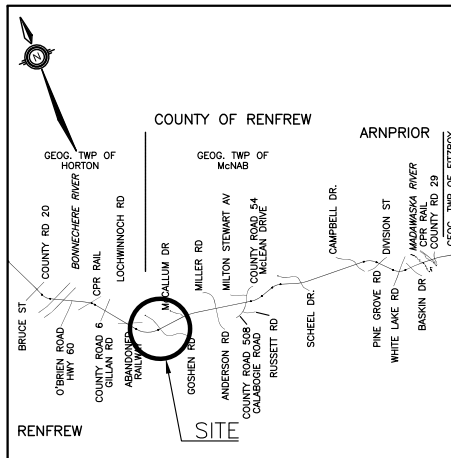
HIGHWAY 17 TWINNING
GOSHEN ROAD
OVERPASS
BOREHOLE LOCATIONS AND SOIL STRATA

SHEET

Ontario



THURBER ENGINEERING LTD.



KEYPLAN

LEGEND

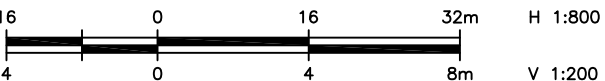
	Borehole (2020 Investigation)
	Borehole (2003 Investigation)
	N
	Blows /0.3m (Std Pen Test, 475J/blow)
	Blows /0.3m (60' Cone, 475J/blow)
	Pressure, Hydraulic
	Water Level
	Head Artesian Water
	Piezometer
	Rock Quality Designation (RQD)
	Auger Refusal

NO	ELEVATION	NORTHING	EASTING
GOS19-01	166.9	5 034 031.8	298 158.4
GOS19-02	169.2	5 034 023.0	298 183.7
GOS19-03	167.4	5 033 975.0	298 209.0
GOS19-04	168.0	5 033 961.5	298 235.8
GOS19-04W	167.0	5 033 952.0	298 228.6
GOS19-05	167.1	5 034 069.5	298 128.7
GOS19-06	167.0	5 034 052.3	298 146.7
GOS19-07	169.2	5 034 002.5	298 201.8
GOS19-08	168.5	5 033 993.8	298 192.5
GOS19-09	167.3	5 033 940.0	298 244.1
GOS19-10	166.5	5 033 923.0	298 262.4
GOS19-11	166.8	5 034 022.8	298 163.3

-NOTES-

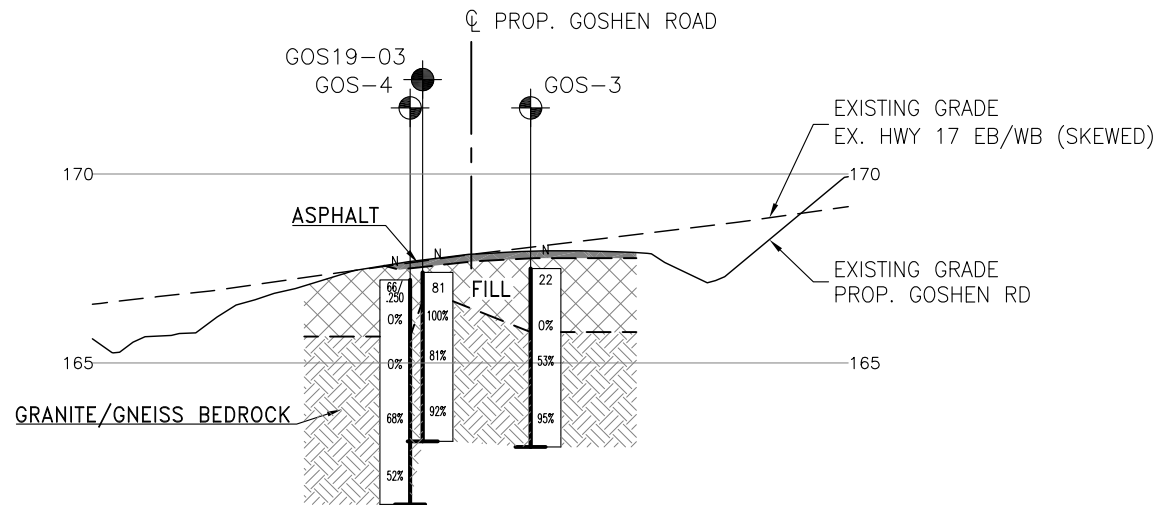
- The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.
- This drawing is for subsurface information only. Surface details and features are for conceptual illustration.
- Coordinate system is MTM NAD 83 Zone 9.

GEOCREs No. 31F-225

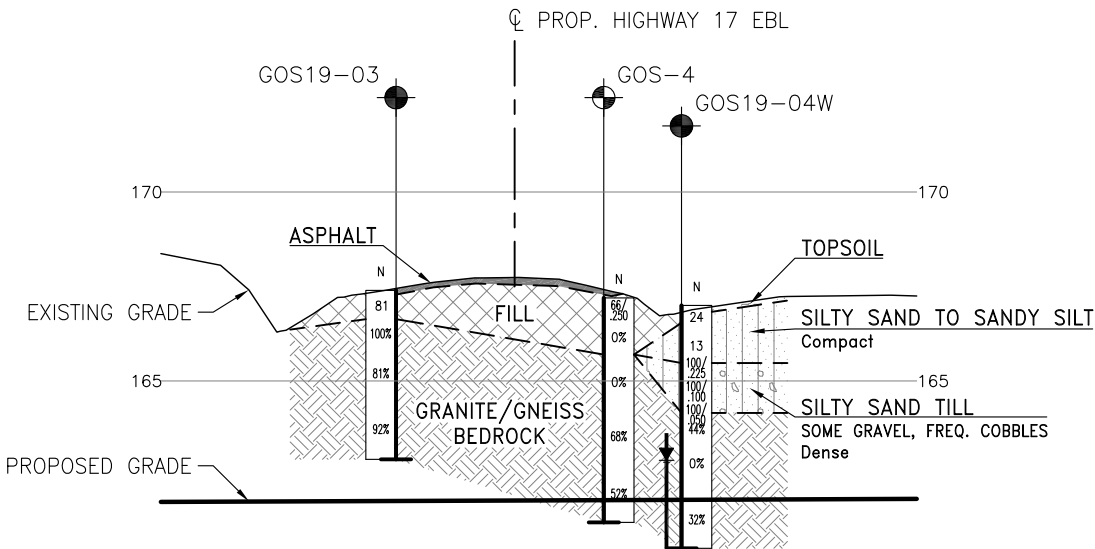


H 1:800

V 1:200

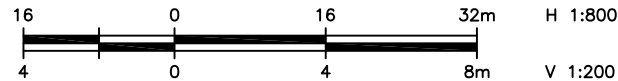
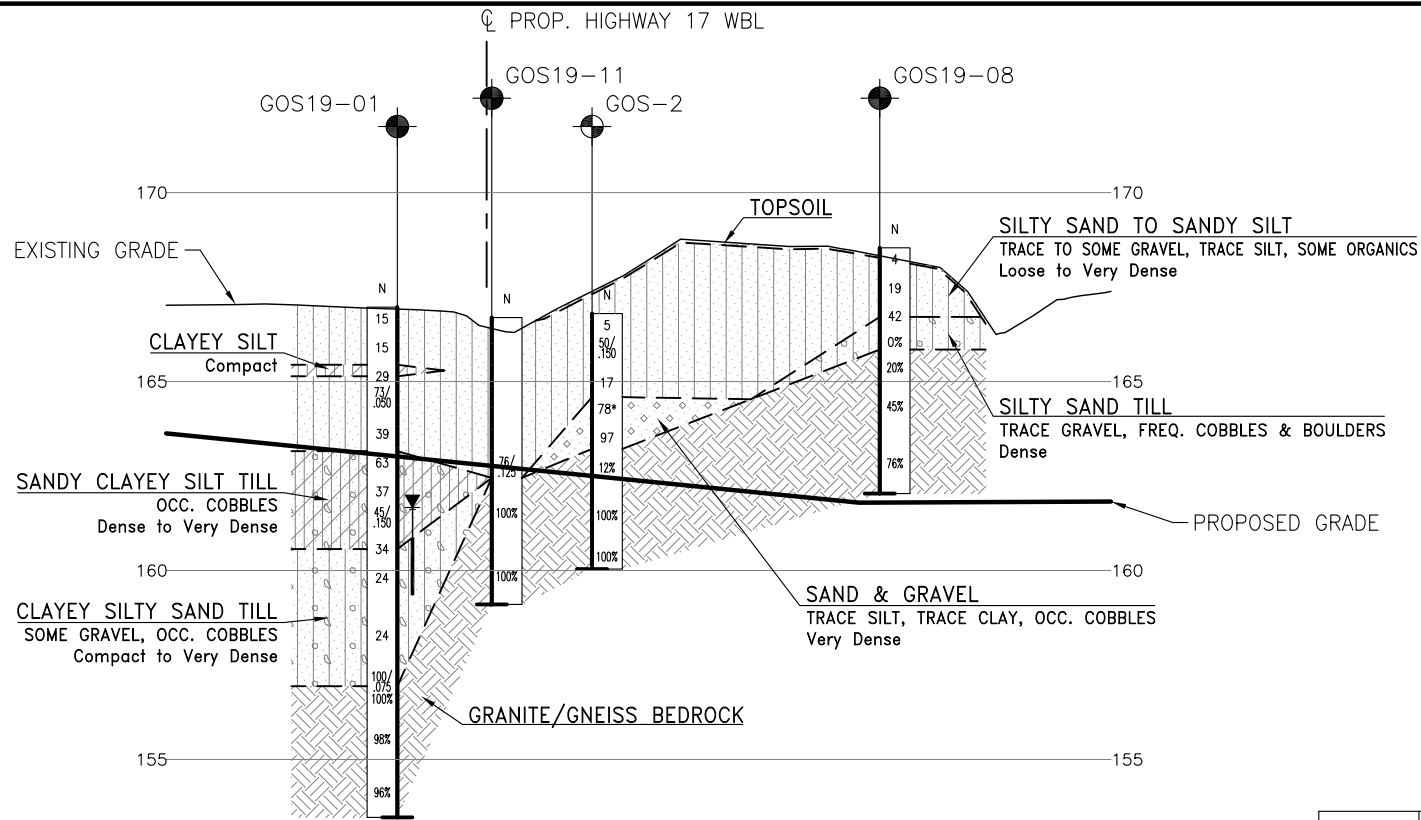


SECTION B-B

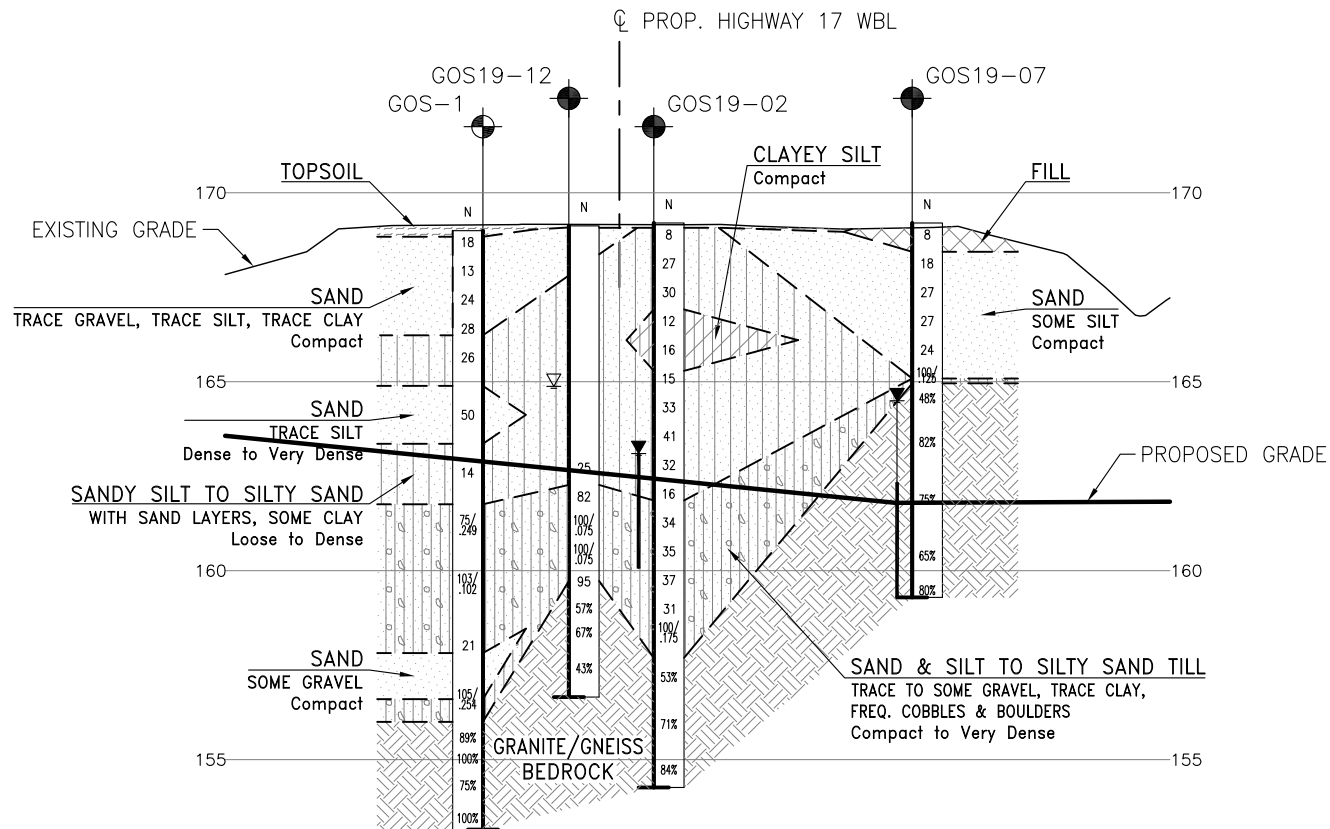


SECTION C-C

REVISIONS	DATE	BY	DESCRIPTION
DESIGN	JG	CHK FG	CODE
DRAWN	MFA	CHK JG	SITE 29-410
LOAD			DATE JUL 2022
STRUCT			DWG 2

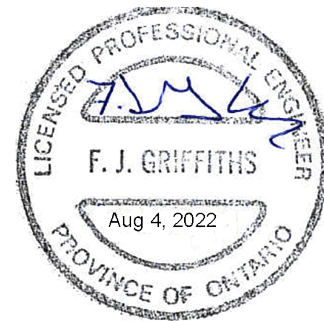


SECTION E-E



SECTION F-F

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



NO	ELEVATION	NORTHING	EASTING
GOS19-12	169.1	5 034 030.3	298 178.4
GOS-1	169.0	5 034 036.7	298 171.9
GOS-2	166.8	5 034 015.8	298 171.4
GOS-3	167.5	5 033 977.5	298 222.0
GOS-4	167.2	5 033 957.6	298 222.5

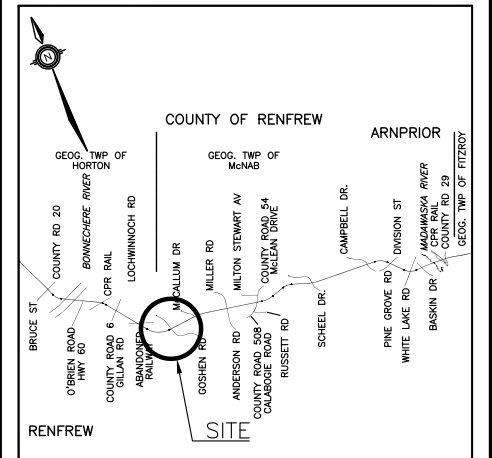
CONT No
WP No 4068-09-00

HIGHWAY 17 TWINNING
GOSHEN ROAD
OVERPASS
BOREHOLE LOCATIONS AND SOIL STRATA

SHEET

Ontario

THURBER ENGINEERING LTD.



KEYPLAN

LEGEND

- Borehole (2020 Investigation)
- Borehole (2003 Investigation)
- 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
GOS19-01	166.9	5 034 031.8	298 158.4
GOS19-02	169.2	5 034 023.0	298 183.7
GOS19-03	167.4	5 033 975.0	298 209.0
GOS19-04	168.0	5 033 961.5	298 235.8
GOS19-04W	167.0	5 033 952.0	298 228.6
GOS19-05	167.1	5 034 069.5	298 128.7
GOS19-06	167.0	5 034 052.3	298 146.7
GOS19-07	169.2	5 034 002.5	298 201.8
GOS19-08	168.5	5 033 993.8	298 192.5
GOS19-09	167.3	5 033 940.0	298 244.1
GOS19-10	166.5	5 033 923.0	298 262.4
GOS19-11	166.8	5 034 022.8	298 163.3

-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 9.

GEOCREs No. 31F-225

REVISIONS	DATE	BY	DESCRIPTION
DESIGN	JG	CHK FG	CODE
DRAWN	MFA	CHK JG	SITE 29-410
LOAD			
STRUCT			
DWG	3		
DATE	JUL 2022		



Appendix B.

Record of Borehole Sheets



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.



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

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



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

RECORD OF BOREHOLE No GOS19-01

1 OF 2

METRIC

WP# 4068-09-00 LOCATION Lat: 45.446186°, Long: -76.584904°
Goshen Road MTM Zone 9: N 5 034 031.8 E 298 158.4 ORIGINATED BY SOB
HWY 17 BOREHOLE TYPE CME 55 Truck, NW Casing/NQ Coring COMPILED BY MW
DATUM Geodetic DATE 2019.09.03 - 2019.09.03 CHECKED BY JG

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											
166.9	Ground Surface							20	40	60	80	100							
0.0	SILTY SAND (SM) Compact Brown		1	SS	15		166												
165.4			2	SS	15														
1.5	CLAYEY SILT Compact, Brown		3	SS	29		165												
165.1			4	SS	73/ 50mm		164												
1.8	SILTY SAND (SM) Compact to Dense Brown		5	SS	39														
163.1			6	SS	63		163												
3.8	SANDY CLAYEY SILT(CL) , occasional cobbles Dense to Very Dense Grey-Brown TILL		7	SS	37		162												
			8	SS	45/ 150mm		161												
160.5			9	SS	34		160												
6.4	CLAYEY SILTY SAND (SC-SM) , some gravel, occasional cobbles Compact to Very Dense Grey TILL		10	SS	24		159												
			11	SS	24		158												
156.9							157												

Continued Next Page

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

RECORD OF BOREHOLE No GOS19-01

2 OF 2

METRIC

WP# 4068-09-00 LOCATION Lat: 45.446186°, Long: -76.584904°
Goshen Road MTM Zone 9: N 5 034 031.8 E 298 158.4 ORIGINATED BY SOB
HWY 17 BOREHOLE TYPE CME 55 Truck, NW Casing/NQ Coring COMPILED BY MW
DATUM Geodetic DATE 2019.09.03 - 2019.09.03 CHECKED BY JG

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																													
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa										WATER CONTENT (%)			GR	SA	SI	CL																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																						
								20	40	60	80	100						20	40	60																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																										
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RECORD OF BOREHOLE No GOS19-02

1 OF 2

METRIC

WP# 4068-09-00 LOCATION Lat: 45.446106°, Long: -76.584581°
Goshen Road MTM Zone 9: N 5 034 023.0 E 298 183.7 ORIGINATED BY AC
HWY 17 BOREHOLE TYPE CME 75 Track, HW Casing/HQ Coring COMPILED BY MW
DATUM Geodetic DATE 2020.07.07 - 2020.07.07 CHECKED BY JG

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												
169.2	Ground Surface							20	40	60	80	100								
0.9	TOPSOIL (50 mm)							20	40	60	80	100								
	SAND (SP-SM) with silt Loose to compact Brown to grey-brown		1	SS	8		169													
			2	SS	27		168													10 81 9 (SI+CL)
			3	SS	30		167													
166.9	CLAYEY SILT Compact Grey-brown		4	SS	12		166													
			5	SS	16		165													
165.3	SANDY SILT (ML) Compact to dense Grey-brown		6	SS	15		164													0 32 56 12 non-plastic
			7	SS	33		163													2 43 48 7 non-plastic
			8	SS	41		162													
			9	SS	32		161													
161.9	SILTY SAND (SM) some gravel Dense to very dense Grey-brown to grey (TILL)		10	SS	16		160													15 69 16 (SI+CL)
7.3			11	SS	34															
			12	SS	35															
			13	SS	37															

Continued Next Page

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

DOUBLE LINE 24726 GOSHEN ROAD GINT.GPJ 2012TEMPLATE(MTO).GDT 22-7-26

2 OF 2

WP#	4068-09-00	LOCATION	Lat: 45.446106°, Long: -76.584581° Goshen Road MTM Zone 9: N 5 034 023.0 E 298 183.7	ORIGINATED BY	AC
HWY	17	BOREHOLE TYPE	CME 75 Track, HW Casing/HQ Coring	COMPILED BY	MW
DATUM	Geodetic	DATE	2020.07.07 - 2020.07.07	CHECKED BY	JG

[illegible]

DOUBLE LINE 24726 GOSHEN ROAD GINT.GPJ 2012TEMPLATE(MTO).GDT 22-7-26

+³, ×³: Numbers refer to Sensitivity

RECORD OF BOREHOLE No GOS19-03

1 OF 1

METRIC

WP# 4068-09-00 LOCATION Lat: 45.445675°, Long: -76.584256°
Goshen Road MTM Zone 9: N 5 033 975.0 E 298 209.0 ORIGINATED BY SOB
HWY 17 BOREHOLE TYPE CME 55 Truck, NW Casing/NQ Coring COMPILED BY JP
DATUM Geodetic DATE 2019.09.18 - 2019.09.18 CHECKED BY JG

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
								20 40 60 80 100						
								20 40 60 80 100						
167.4	Pavement Surface													
0.0	ASPHALT													
0.2	SILTY SAND with gravel FILL Very Dense Brown		1	SS	81		167							
166.6														
0.8	GRANITE/GNEISS BEDROCK Fresh, pink and grey, strong, coarse grained		1	RUN			166							
			2	RUN			165							
			3	RUN			164							
162.9							163							
4.5	End of Borehole													

DOUBLE LINE 24726 GOSHEN ROAD GINT.GPJ 2012TEMPLATE(MTO).GDT 22-7-26

RECORD OF DRILLHOLE GOS 19-03

PROJECT : Highway 17 Twinning
LOCATION : Goshen Road
STARTED : 2019 September 18
COMPLETED : 2019 September 18

INCLINATION: Vertical
AZIMUTH: Vertical
N 5 033 975.0 E 298 209.0

Project No. 4068-09-00

SHEET 1 OF 2
DATUM Geodetic

[illegible]

GROUNDWATER ELEVATIONS

 WATER LEVEL UPON COMPLETION

 WATER LEVEL IN WELL/PIEZOMETER

LOGGED : SOB

CHECKED :



RECORD OF DRILLHOLE GOS 19-03

PROJECT : Highway 17 Twinning
 LOCATION : Goshen Road
 STARTED : 2019 September 18
 COMPLETED : 2019 September 18

INCLINATION: Vertical
 AZIMUTH: Vertical
 N 5 033 975.0 E 298 209.0

Project No. 4068-09-00

SHEET 2 OF 2
 DATUM Geodetic

DEPTH SCALE (metres)	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV.	RUN No.	PENETRATION RATE (mm/min)	FLUSH	COLOUR % RETURN	FR-FRACTURE RU-ROUGH UNDULATING T-TIGHT, HARD CL-CLEAVAGE RP-ROUGH PLANAR SA-SLIGHTLY ALTERED, D-DIPPING J-JOINT SU-SMOOTH UNDULATING CLAY FREE D-DIPPING B-BEDDING SP-SMOOTH PLANAR SC-SWELLING, SOFT CLAY V-VERTICAL										Unconfined Compressive Strength (MPa)	FIELD/LABORATORY TESTING RESULTS ● Point Load Test Diametral ▲ Point Load Test Axial ■ Laboratory UCS Test																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																						
				DEPTH (m)					RECOVERY		R.Q.D. %	FRACT. INDEX PER .3 m	DISCONTINUITY DATA		HYDRAULIC CONDUCTIVITY k, cm/sec																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																											
									TOTAL CORE %	SOLID CORE %			DIP wrt Core Axis	TYPE AND SURFACE DESCRIPTION																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																												

GROUNDWATER ELEVATIONS

▽ WATER LEVEL UPON COMPLETION

▽ WATER LEVEL IN WELL/PIEZOMETER

LOGGED : SOB

CHECKED :



RECORD OF BOREHOLE No GOS19-04

1 OF 1

METRIC

WP# 4068-09-00 LOCATION Lat: 45.445554°, Long: -76.583914°
Goshen Road MTM Zone 9: N 5 033 961.5 E 298 235.8 ORIGINATED BY SOB
HWY 17 BOREHOLE TYPE CME 55 Truck, NW Casing/NQ Coring COMPILED BY JP
DATUM Geodetic DATE 2019.09.18 - 2019.09.18 CHECKED BY JG

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					
168.0	Shoulder							<div><div>20406080100</div><div>○ UNCONFINED + FIELD VANE</div><div>● QUICK TRIAXIAL × LAB VANE</div></div>					
0.0	SILTY SAND with gravel FILL Dense Brown		1	SS	41								44 47 9 (SI+CL)
167.1			2	SS	100/								
0.9	ROCK FILL -Gravel, cobbles and boulders				125mm		167						
			3	NQ			166						
165.6													
2.4	GRANITE/GNEISS BEDROCK Fresh, pink and grey, strong to very strong, coarse grained - Vertical Fracture from 3 m to 3.5 m		1	RUN			165						RUN #1 TCR=100% SCR=76% RQD=100% UCS=91MPa
							164						
			2	RUN			163						RUN #2 TCR=100% SCR=96% RQD=86% UCS=90MPa
							162						
			3	RUN			161						RUN #3 TCR=100% SCR=81% RQD=58% UCS=88MPa
							160						RUN #4 TCR=100% SCR=98% RQD=98% UCS=113MPa
158.4			5	RUN			159						RUN #5 TCR=100% SCR=100% RQD=96% UCS=123MPa
9.6	End of Borehole												

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

RECORD OF DRILLHOLE GOS 19-04

PROJECT : Highway 17 Twinning
LOCATION : Goshen Road
STARTED : 2019 September 18
COMPLETED : 2019 September 18

INCLINATION: Vertical
AZIMUTH: Vertical
N 5 033 961.5 E 298 235.8

Project No. 4068-09-00

SHEET 1 OF 3
DATUM Geodetic

[illegible]

GROUNDWATER ELEVATIONS

 WATER LEVEL UPON COMPLETION

 WATER LEVEL IN WELL/PIEZOMETER

LOGGED : SOB

CHECKED :



ROCKM2 24726 GOSHEN ROAD- ROCK.GPJ 22-7-25

RECORD OF DRILLHOLE GOS 19-04

PROJECT : Highway 17 Twinning
 LOCATION : Goshen Road
 STARTED : 2019 September 18
 COMPLETED : 2019 September 18

INCLINATION: Vertical
 AZIMUTH: Vertical
 N 5 033 961.5 E 298 235.8

Project No. 4068-09-00

SHEET 2 OF 3
 DATUM Geodetic

DEPTH SCALE (metres)	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	PENETRATION RATE (mm/min)	FLUSH	RECOVERY TOTAL CORE % SOLID CORE %	R.Q.D. %	FRACT. INDEX PER .3 m	DISCONTINUITY DATA DIP wrt Core Axis TYPE AND SURFACE DESCRIPTION	HYDRAULIC CONDUCTIVITY k, cm/sec	Unconfined Compressive Strength (MPa)	FIELD/LABORATORY TESTING RESULTS ● Point Load Test ▲ Diametral ▲ Point Load Test ■ Laboratory UCS Test
6	Rotary Drill NQ Core	GRANITE/GNEISS BEDROCK Fresh Pinkish White and Grey Phaneritic (Coarse grained) texture Massive structure Igneous formation Strong to very strong	+								J, SP, tight			
											J, SP, tight			
											J, SP, tight			
											J, SP, tight			
											J, SP, tight			
											J, SP, tight			
											J, SP, tight			
											J, SP, tight			
											J, SP, tight with non-softening clay			
											J, SP, oxidized			
											J, SP, tight			
7	Rotary Drill NQ Core		+		3						J, SP, oxidized			
											J, SP, tight			
											J, SP, tight			
											J, SP, tight			
											J, SP, tight			
											J, SP, tight, oxidized			
											J, SP			
											J, SP, tight, oxidized			
8	Rotary Drill NQ Core		+		4									

GROUNDWATER ELEVATIONS

▽ WATER LEVEL UPON COMPLETION

▽ WATER LEVEL IN WELL/PIEZOMETER

LOGGED : SOB

CHECKED :



RECORD OF DRILLHOLE GOS 19-04

PROJECT : Highway 17 Twinning
LOCATION : Goshen Road
STARTED : 2019 September 18
COMPLETED : 2019 September 18

INCLINATION: Vertical
AZIMUTH: Vertical
N 5 033 961.5 E 298 235.8

Project No. 4068-09-00

SHEET 3 OF 3
DATUM Geodetic

[illegible]

GROUNDWATER ELEVATIONS

 WATER LEVEL UPON COMPLETION

 WATER LEVEL IN WELL/PIEZOMETER

LOGGED : SOB

CHECKED :



RECORD OF BOREHOLE No GOS19-04W

1 OF 1

METRIC

WP# 4068-09-00 LOCATION Lat: 45.445471°, Long: -76.584001°
Goshen Road MTM Zone 9: N 5 033 952.0 E 298 228.6 ORIGINATED BY AC
HWY 17 BOREHOLE TYPE CME 75 Track, HW Casing/HQ Coring COMPILED BY MW
DATUM Geodetic DATE 2020.07.14 - 2020.07.14 CHECKED BY JG

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa								
167.0	Ground Surface															
0.0	TOPSOIL (100 mm)															
0.1	SILTY SAND to SANDY SILT Compact Moist to wet Brown		1	SS	24											
			2	SS	13		166									
165.5																
1.5	SILTY SAND (SM), some gravel Frequent cobbles Wet Dense Grey TILL		3	SS	100/ 225 mm		165									17 63 20 (SI+CL)
			4	SS	100/ 100 mm											
			5	NQ												
164.2			6	SS	100/ 50 mm		164									FI
2.8	GNEISS BEDROCK Slightly weathered to fresh Grey and pink Fine grained - Sub vertical fractures from 3.5 m to 5.7 m		1	RUN											2	RUN #1 TCR=100% SCR=44% RQD=44%
			2	RUN			163								>10	RUN #2 TCR=100% SCR=5% RQD=0%
							162								2	
			3	RUN			161								>10	RUN #3 TCR=100% SCR=35% RQD=32%
160.6															3	
6.4	End of Borehole Monitoring well consists of 50 mm diameter Schedule 40 PVC pipe with a 3 m slotted screen WATER LEVEL READINGS: Date Depth (m) Elev. (m) 2020.07.22 5.7 161.3 2020.09.29 4.9 162.1 2020.12.16 4.1 162.9 2021.09.28 4.2 162.8 2021.10.02 4.5 162.5 2022.01.20 5.0 162.0															

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

RECORD OF BOREHOLE No GOS19-05

1 OF 2

METRIC

WP# 4068-09-00 LOCATION Lat: 45.446525°, Long: -76.585284°
Goshen Road MTM Zone 9: N 5 034 069.5 E 298 128.7 ORIGINATED BY SOB
HWY 17 BOREHOLE TYPE CME 55 Truck, HSA/NW Casing COMPILED BY MW
DATUM Geodetic DATE 2019.08.29 - 2019.08.29 CHECKED BY JG

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
167.1	Shoulder							20 40 60 80 100						
0.0	SILTY SAND, some gravel FILL Very Dense Brown		1	SS	85		167							
166.3														
0.8	SILTY SAND (SM) Compact to Dense Brown		2	SS	26		166							
			3	SS	51		165							0 78 22 (SI+CL)
			4	SS	45		164							
			5	SS	43		163							
162.5														
4.6	SILTY SAND (SM) some gravel Very Dense Brown		6	SS	61		162							35 50 15 (SI+CL)
161.0							161							
6.1	SANDY CLAYEY SILT (CL) Compact Brownish Grey (TILL)		7	SS	21		160							2 47 37 14
159.5														
7.6	CLAYEY SAND (SC) , some gravel Frequent Cobbles and Boulders Very Dense Grey (TILL)		8	SS	100/ 50mm		159							
			9	NQ			158							
			10	NQ										14 41 32 13

Continued Next Page

+³, ×³: Numbers refer to
Sensitivity

20
15
10
(%) STRAIN AT FAILURE

DOUBLE LINE 24726 GOSHEN ROAD GINT GPJ 2012TEMPLATE(MTO) GDT 22-7-26

RECORD OF BOREHOLE No GOS19-05

2 OF 2

METRIC

WP# 4068-09-00 LOCATION Lat: 45.446525°, Long: -76.585284°
Goshen Road MTM Zone 9: N 5 034 069.5 E 298 128.7 ORIGINATED BY SOB
HWY 17 BOREHOLE TYPE CME 55 Truck, HSA/NW Casing COMPILED BY MW
DATUM Geodetic DATE 2019.08.29 - 2019.08.29 CHECKED BY JG

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 (%)				
								20 40 60 80 100	○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE			W _P W W _L					
	Continued From Previous Page						157										
156.4	CLAYEY SAND (SC), some gravel Frequent Cobbles and Boulders Very Dense, Grey (TILL)																
10.7	End of Borehole																
									</								

DOUBLE LINE 24726 GOSHEN ROAD GINT.GPJ 2012TEMPLATE(MTO).GDT 22-7-26

RECORD OF BOREHOLE No GOS19-06

1 OF 2

METRIC

WP# 4068-09-00 LOCATION Lat: 45.446371°, Long: -76.585054°
Goshen Road MTM Zone 9: N 5 034 052.3 E 298 146.7 ORIGINATED BY SOB
HWY 17 BOREHOLE TYPE CME 55 Truck, HSA/NW Casing COMPILED BY MW
DATUM Geodetic DATE 2019.08.29 - 2019.08.29 CHECKED BY JG

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
167.0	Shoulder							20 40 60 80 100						
0.0	SAND with silt and gravel FILL Compact Brown		1	GS				20 40 60 80 100						28 62 10 (SI+CL)
166.2														
0.8	SILTY SAND (SM) Loose to Compact Brown		2	SS	8		166							
			3	SS	24		165							
			4	SS	23		164							0 61 39 (SI+CL)
			5	SS	21		163							
			6	SS	12		162							
							161							
160.9														
6.1	CLAYEY SAND (SC), occasional cobble Loose to Very Dense Brown to Grey-Brown TILL		7	SS	7		160							
			8	NQ										
			9	SS	68		159							3 48 35 14
157.8							158							
9.2	End of Borehole		10	SS	100/75mm									
	Monitoring well consists of 46 mm diameter Schedule 40 PVC pipe with a 1.5 m slotted screen													

Continued Next Page

+³, ×³: Numbers refer to
Sensitivity

20
15
10
(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No GOS19-06

2 OF 2

METRIC

WP# 4068-09-00 LOCATION Lat: 45.446371°, Long: -76.585054°
Goshen Road MTM Zone 9: N 5 034 052.3 E 298 146.7 ORIGINATED BY SOB
HWY 17 BOREHOLE TYPE CME 55 Truck, HSA/NW Casing COMPILED BY MW
DATUM Geodetic DATE 2019.08.29 - 2019.08.29 CHECKED BY JG

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					
	WATER LEVEL READINGS: DATE DEPTH (m) ELEV. (m) 2019.09.26 3.4 163.6 2020.04.21 0.6 166.4 2020.09.29 3.5 163.5 2022.10.22 3.7 163.3																

DOUBLE LINE 24726 GOSHEN ROAD GINT.GPJ 2012TEMPLATE(MTO).GDT 22-7-26

RECORD OF BOREHOLE No GOS19-07

1 OF 2

METRIC

WP# 4068-09-00 LOCATION Lat: 45.445922°, Long: -76.584349°
Goshen Road MTM Zone 9: N 5 034 002.5 E 298 201.8 ORIGINATED BY AC
HWY 17 BOREHOLE TYPE CME 75 Track, HW Casing/HQ Coring COMPILED BY MW
DATUM Geodetic DATE 2020.07.08 - 2020.07.08 CHECKED BY JG

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					
169.2	Ground Surface							20 40 60 80 100					
0.0	TOPSOIL (25 mm)							20 40 60 80 100					
168.4	SILTY SAND FILL Loose Brown		1	SS	8		169						
0.8	SAND (SP-SM)some silt Compact Grey-brown		2	SS	18		168						2 88 10 (SI+CL)
			3	SS	27		167						
			4	SS	27		166						
			5	SS	24		165						
165.1			6	SS	100/		164						
164.0	SILTY SAND trace gravel Dense, Brown (TILL)		1	RUN	125 mm		163						RUN #1 TCR=100% SCR=52% RQD=48% UCS=178MPa
4.2	GRANITE/GNEISS BEDROCK Slightly weathered to fresh , pink to grey, very strong, fine grained - Subvertical fractures (4.4 m to 4.5 m, 4.7 m to 4.8 m, 7.2 m to 7.5 m, and 9.2 m to 9.9 m)		2	RUN			162						RUN #2 TCR=100% SCR=87% RQD=82% UCS=189MPa
			3	RUN			161						RUN #3 TCR=100% SCR=78% RQD=75% UCS=163MPa
			4	RUN			160						RUN #4 TCR=100% SCR=68% RQD=65% UCS=105MPa
159.3			5	RUN									RUN #5 TCR=100% SCR=80% RQD=80%

Continued Next Page

+³, ×³: Numbers refer to
Sensitivity

20
15
10

(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No GOS19-07

2 OF 2

METRIC

WP# 4068-09-00 LOCATION Lat: 45.445922°, Long: -76.584349°
Goshen Road MTM Zone 9: N 5 034 002.5 E 298 201.8 ORIGINATED BY AC
HWY 17 BOREHOLE TYPE CME 75 Track, HW Casing/HQ Coring COMPILED BY MW
DATUM Geodetic DATE 2020.07.08 - 2020.07.08 CHECKED BY JG

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									
	Continued From Previous Page							20	40	60	80	100					
9.9	End of Borehole Monitoring well consists of 50 mm diameter Schedule 40 PVC pipe with a 3.0 m slotted screen WATER LEVEL READINGS: DATE DEPTH (m) ELEV. (m) 2020.07.10 4.4 164.8 2020.07.22 4.5 164.7 2020.09.29 5.0 164.2 2020.12.15 4.7 164.5 2021.09.27 5.2 164.0 2021.10.20 5.2 164.0 2022.01.20 5.3 163.9																

DOUBLE LINE 24726 GOSHEN ROAD GINT.GPJ 2012TEMPLATE(MTO).GDT 22-7-26

RECORD OF BOREHOLE No GOS19-08

1 OF 1

METRIC

WP# 4068-09-00 LOCATION Lat: 45.445845°, Long: -76.584467°
Goshen Road MTM Zone 9: N 5 033 993.8 E 298 192.5 ORIGINATED BY AC
HWY 17 BOREHOLE TYPE CME 75 Track, HW Casing/HQ Coring COMPILED BY MW
DATUM Geodetic DATE 2020.07.09 - 2020.07.09 CHECKED BY JG

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 (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa				WATER CONTENT (%)								
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE				w _P w w _L								
168.5	Ground Surface							20	40	60	80	100								
0.0	TOPSOIL (50 mm)																			
	SILTY SAND (SM) to SANDY SILT (ML) Some organics Loose to compact Grey-brown		1	SS	4		168							○						
			2	SS	19		167							○						
166.7			3	SS	42		166							○						
1.8	SILTY SAND (SM) trace gravel Frequent cobbles and boulders Dense Grey-brown (TILL)		1	RUN			165												7 69 24 (SI+CL)	
165.8			2	RUN			164													
2.7	GRANITE/GNEISS BEDROCK Slightly weathered to fresh, pink to grey, very strong , fine to medium grained - Fractured from 4 m to 4.6 m - Subvertical fractures from 5.6 m to 5.8 m		3	RUN			163													
			4	RUN			162													
162.0	End of Borehole																			
6.5																				

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

RECORD OF BOREHOLE No GOS19-09

1 OF 2

METRIC

WP# 4068-09-00 LOCATION Lat: 45.445361°, Long: -76.583801°
Goshen Road MTM Zone 9: N 5 033 940.0 E 298 244.1 ORIGINATED BY AC
HWY 17 BOREHOLE TYPE CME 75 Track, HW Casing/HQ Coring COMPILED BY MW
DATUM Geodetic DATE 2020.07.13 - 2020.07.13 CHECKED BY JG

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
167.3	Ground Surface							20	40	60	80	100					
0.0	TOPSOIL (50 mm)							20	40	60	80	100					
	SILTY SAND (SM)trace gravel Compact Grey brown to grey Moist to wet		1	SS	21		167										8 67 25 (SI+CL)
			2	SS	21		166										
165.8																	
1.5	SILTY SAND compact to very dense brown wet (TILL)		3	SS	23		165										
	- Frequent cobbles and boulders 2.3 m to 3.1 m		4	SS	100/ 50 mm												
164.2			1	RUN			164									FI	RUN #1 TCR=100% SCR=50% RQD=42% UCS=109MPa
3.1	GRANITE/GNEISS BEDROCK Slightly weathered to fresh, pink and grey, very strong, fine to medium grained - Highly fractured from 3.4 m to 4.1 m		2	RUN			163									>10	RUN #2 TCR=61% SCR=0% RQD=0%
			3	RUN			162									2	RUN #3 TCR=100% SCR=65% RQD=62% UCS=159MPa
			4	RUN			161									1	RUN #4 TCR=100% SCR=95% RQD=95% UCS=118MPa
			5	RUN			160									0	RUN #5 TCR=100% SCR=76% RQD=71% UCS=121MPa
			6	RUN			159									5	RUN #6 TCR=100% SCR=71% RQD=58% UCS=123MPa
158.8																4	
8.5	End of Borehole Monitoring well consists of 51 mm diameter Schedule 40 PVC pipe with a 3 m slotted screen WATER LEVEL READINGS: Date Depth (m) Elev. (m) 2020.07.15 6.1 161.2 2020.07.22 7.2 160.1 2020.09.29 7.4 159.9 2020.12.16 6.8 160.5															3	

Continued Next Page

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

RECORD OF BOREHOLE No GOS19-09

2 OF 2

METRIC

WP# 4068-09-00 LOCATION Lat: 45.445361°, Long: -76.583801°
Goshen Road MTM Zone 9: N 5 033 940.0 E 298 244.1 ORIGINATED BY AC
HWY 17 BOREHOLE TYPE CME 75 Track, HW Casing/HQ Coring COMPILED BY MW
DATUM Geodetic DATE 2020.07.13 - 2020.07.13 CHECKED BY JG

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					
	WATER LEVEL READINGS: Date Depth (m) Elev. (m) 2021.09.28 7.5 159.8 2021.10.02 7.6 159.7 2021.01.20 7.3 160.0																

DOUBLE LINE 24726 GOSHEN ROAD GINT.GPJ 2012TEMPLATE(MTO).GDT 22-7-26

RECORD OF BOREHOLE No GOS19-10

1 OF 1

METRIC

WP# 4068-09-00 LOCATION Lat: 45.445201°, Long: -76.583601°
Goshen Road MTM Zone 9: N 5 033 923.0 E 298 262.4 ORIGINATED BY AC
HWY 17 BOREHOLE TYPE CME 75 Track, HW Casing/HQ Coring COMPILED BY MW
DATUM Geodetic DATE 2020.07.14 - 2020.07.14 CHECKED BY JG

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa								
166.5	Ground Surface															
0.0	TOPSOIL (100 mm)															
0.1	SILTY SAND, some organics, occasional cobbles Compact to loose Grey-brown to grey		1	SS	16											
			2	SS	9											
			3	SS	39											
164.2	CLAY (CI) Grey-brown Very stiff to stiff		4	SS	11											1 6 64 29
2.3			5	SS	17											
162.7	SANDY SILT (ML) some gravel Grey-brown, compact TILL		6	SS	100/ 175 mm											10 37 47 6
3.8	GRANITE/GNEISS BEDROCK Pink and grey Fine to medium grained Slightly weathered to fresh Frequent voids from 4.6 m to 4.9 m		1	RUN												RUN #1 TCR=47% SCR=0% RQD=0%
162.2	- Fractured zone at 5.1 m to 5.8 m		2	RUN												RUN #2 TCR=100% SCR=35% RQD=33% UCS=167MPa
4.3	- Fractured zone at 7.2 m to 7.3 m		3	RUN												RUN #3 TCR=100% SCR=50% RQD=42%
158.8	End of Borehole															
7.7																

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

RECORD OF BOREHOLE No GOS19-11

1 OF 1

METRIC

WP# 4068-09-00 LOCATION Lat: 45.446105°, Long: -76.584842°
Goshen Road MTM Zone 9: N 5 034 022.8 E 298 163.3 ORIGINATED BY SOB
HWY 17 BOREHOLE TYPE CME 55 Truck, NW Casing/NQ Coring COMPILED BY MW
DATUM Geodetic DATE 2019.09.03 - 2019.09.03 CHECKED BY JG

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC NATURAL LIQUID LIMIT MOISTURE LIMIT CONTENT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					W _P W W _L WATER CONTENT (%)							
166.8	Ground Surface							20	40	60	80	100								
0.0	Advanced casing directly to 3.8 m																			
163.0																				
3.8	SILTY SAND (SM) , some gravel		1	SS	76/															
162.6	Very Dense, Brown				125mm															
4.2	TILL																			
	GNEISS BEDROCK																			
	Fresh jointed, pink and grey , very strong, coarse grained, foliated																			
			1	RUN																
			2	RUN																
159.2																				
7.6	End of Borehole																			

DOUBLE LINE 24726 GOSHEN ROAD GINT.GPJ 2012TEMPLATE(MTO).GDT 22-7-26

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

RECORD OF DRILLHOLE GOS 19-11

PROJECT : Highway 17 Twinning
LOCATION : Goshen Road
STARTED : 2019 September 3
COMPLETED : 2019 September 3

INCLINATION: Vertical
AZIMUTH: Vertical
N 5 034 022.8 E 298 163.3

Project No. 4068-09-00

SHEET 1 OF 2
DATUM Geodetic

[illegible]

GROUNDWATER ELEVATIONS

 WATER LEVEL UPON COMPLETION

 WATER LEVEL IN WELL/PIEZOMETER

LOGGED : SOB

CHECKED :



RECORD OF DRILLHOLE GOS 19-11

PROJECT : Highway 17 Twinning
 LOCATION : Goshen Road
 STARTED : 2019 September 3
 COMPLETED : 2019 September 3

INCLINATION: Vertical
 AZIMUTH: Vertical
 N 5 034 022.8 E 298 163.3

Project No. 4068-09-00

SHEET 2 OF 2
 DATUM Geodetic

DEPTH SCALE (metres)	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	RUN No.	PENETRATION RATE (mm/min)	FLUSH	COLLOUR % RETURN	FR-FRACTURE		RU-ROUGH UNDULATING		T-TIGHT, HARD		HOR-HORIZONTAL		Unconfined Compressive Strength (MPa)	FIELD/LABORATORY TESTING RESULTS		
									CL-CLEAVAGE		RP-ROUGH PLANAR		SA-SLIGHTLY ALTERED, CLAY FREE		D-DIPPING					
									J-JOINT		SU-SMOOTH UNDULATING		SC-SWELLING, SOFT CLAY		V-VERTICAL					
									RECOVERY		R.Q.D. %	FRACT. INDEX PER .3 m	DISCONTINUITY DATA		HYDRAULIC CONDUCTIVITY k, cm/sec					
									TOTAL CORE %	SOLID CORE %			DIP wrt Core Axis	TYPE AND SURFACE DESCRIPTION	-6 -5 -4 -3 10 10 10 10					
	Rotary Drill	GRANITE/GNEISS BEDROCK Fresh Pinkish White and Grey Phaneritic (Coarse grained) texture Massive structure Igneous formation Strong to very strong	+																	
		End of Borehole	+	159.10 7.60										J, SP, oxidized						

GROUNDWATER ELEVATIONS



WATER LEVEL UPON COMPLETION



WATER LEVEL IN WELL/PIEZOMETER

LOGGED : SOB

CHECKED :



RECORD OF BOREHOLE No GOS19-12

1 OF 2

METRIC

WP# 4068-09-00 LOCATION Lat: 45.446172°, Long: -76.584649°
Goshen Road MTM Zone 9: N 5 034 030.3 E 298 178.4 ORIGINATED BY AC
HWY 17 BOREHOLE TYPE CME 75 Track, HW Casing/HQ Coring COMPILED BY MW
DATUM Geodetic DATE 2020.07.06 - 2020.07.06 CHECKED BY JG

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100		
169.1	Ground Surface													
0.0	Advanced casing directly to 6.1 m						169							
							168							
							167							
							166							
							165							
							164							
163.0							163							
6.1	SANDY SILT (ML) Compact to dense Grey-brown		1	SS	25									1 35 56 8 non-plastic
162.2														
6.9	SILTY SAND (SM) trace gravel Very dense Grey-brown (TILL) Frequent cobbles and boulders		2	SS	82		162							
			3	SS	100/ 75 mm		161							
			4	SS	100/ 75 mm									
							160							
159.7														
9.4	GNEISS BEDROCK Slightly weathered to fresh jointed, grey and pink, very strong, medium grained		5	SS	95								FI 3 3	8 72 20 (SI+CL)

Continued Next Page

+³, ×³: Numbers refer to
Sensitivity

20
15
10
(%) STRAIN AT FAILURE

METRIC

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 (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	20 40 60 80 100	W P W L	20 40 60				
	Continued From Previous Page						SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE		WATER CONTENT (%)					
156.6	GNEISS BEDROCK Slightly weathered to fresh jointed, grey and pink, very strong, medium grained -Sub-vertical fractures (9.9 m to 10.2 m and 10.9 m to 12 m)		1	RUN								4	RUN #1 TCR=100% SCR=57% RQD=57% UCS=122MPa	
			2	RUN									0	
			3	RUN									1	RUN #2 TCR=100% SCR=67% RQD=67%
12.5	End of Borehole											4	RUN #3 TCR=100% SCR=43% RQD=43%	

+³, ×³: Numbers refer to Sensitivity

RECORD OF DRILLHOLE GOS 19-12

PROJECT : Highway 17 Twinning
LOCATION : Goshen Road
STARTED : 2020 June 7
COMPLETED : 2020 June 7

INCLINATION: Vertical
AZIMUTH: Vertical
N 5 034 030.3 E 298 178.4

Project No. 4068-09-00

SHEET 1 OF 2
DATUM Geodetic

[illegible]

GROUNDWATER ELEVATIONS

 WATER LEVEL UPON COMPLETION

 WATER LEVEL IN WELL/PIEZOMETER

LOGGED : AC

CHECKED :



ROCKM2 24726 GOSHEN ROAD- ROCK.GPJ 22-7-25

RECORD OF DRILLHOLE GOS 19-12

PROJECT : Highway 17 Twinning
LOCATION : Goshen Road
STARTED : 2020 June 7
COMPLETED : 2020 June 7

Project No. 4068-09-00

INCLINATION: Vertical

AZIMUTH: Vertical

N 5 034 030.3 E 298 178.4

SHEET 2 OF 2
DATUM Geodetic

[illegible]

GROUNDWATER ELEVATIONS

 WATER LEVEL UPON COMPLETION

 WATER LEVEL IN WELL/PIEZOMETER

LOGGED : AC

CHECKED :



ROCKM2 24726 GOSHEN ROAD- ROCK.GPJ 22-7-25

METRIC

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		NATURAL MOISTURE CONTENT	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE	W P W L		
169.0 0.0 168.8	TOPSOIL (250mm)						169					
0.3	SAND, trace gravel, trace silt, trace clay Compact Brown Moist (SP)		1	SS	18		168					
			2	SS	13		167					1 92 5 2
			3	SS	24		166					0 25 63 12
			4	SS	28		165					
166.2 2.8	Sandy SILT, some clay Compact Brown Moist (ML-nonplastic)		5	SS	26		164					
164.9	SAND, trace silt Dense to Very Dense Brown Moist (SP)		6	SS	50		163					
163.4 5.6	Sandy SILT, with sand layers Compact Grey Wet (ML-nonplastic)		7	SS	14		162					
161.8 7.2	SAND and SILT, trace gravel, trace clay, occasional cobbles Very Dense to Compact Grey Wet (TILL) (ML-nonplastic)		8	SS	75/ 249		161					
	frequent cobbles		9	SS	103/ 102		160					1 48 43 7

(%) STRAIN AT FAILURE

ONTMT4 7450GOS.GPJ 18/06/04

METRIC

[illegible]

ONTMT4 7450GOS.GPJ 18/06/04

+³, ×³: Numbers refer to Sensitivity

RECORD OF BOREHOLE No GOS-2

1 OF 1

METRIC

G.W.P. 647-92-00 LOCATION N 5034015.8, E 298171.4 (Goshen Road WBL) ORIGINATED BY SL
 HWY HWY 17 BOREHOLE TYPE Hollow Stem Augers, NQ Coring COMPILED BY SS
 DATUM Geodetic DATE 23.09.03 - 23.09.03 CHECKED BY SKP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100		
166.8	TOPSOIL (50mm)													
166.8	SAND , trace gravel, trace silt, trace rootlets Loose Brown Moist (SP)		1	SS	5		166							
			2	SS	50/ .150									
165.2	Sandy SILT , trace gravel Compact Brown Moist		3	SS	17		165							
164.6	SAND and GRAVEL , trace silt, trace clay, occasional cobbles Very Dense Brown Wet		4	SS	78*		164							37 52 9 2
			5	SS	97 FI									
163.2	* Sampler bouncing, probable cobbles Auger refusal at 3.6m. GNEISS (BEDROCK) Fresh to slightly weathered, red with black dots, extremely strong Subvertical joint from 4.9m to 5.3m Multiple fractures zone from 3.6m to 4.3m		1	RUN	>5 >5 >5		163							RUN 1# TCR=100%, SCR=55%, RQD=12%, UCS=258MPa
3.6			2	RUN	0 2 0 0 1		162							RUN 2# TCR=100%, SCR=100%, RQD=100%, UCS=262MPa
			3	RUN	0 3		161							RUN 3# TCR=100%, SCR=100%, RQD=100%, UCS=238MPa
160.0	END OF BOREHOLE AT 6.76m. Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen.													
6.8														
WATER LEVEL READINGS: DATE ELEVATION (m) 22/10/03 164.3 18/12/03 164.8 05/02/04 164.7														

+³, ×³: Numbers refer to
Sensitivity

20
15
10





(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No GOS-3

1 OF 1

METRIC

G.W.P. 647-92-00 LOCATION N 5033977.5, E 298222.0 (Goshen Road EBL) ORIGINATED BY JL
 HWY HWY 17 BOREHOLE TYPE Hollow Stem Augers, NQ Coring COMPILED BY SS
 DATUM Geodetic DATE 16.10.03 - 16.10.03 CHECKED BY SKP

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								
167.5								20 40 60 80 100	PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L			
0.0	SAND and GRAVEL Compact Dark Brown to Black Moist (FILL)		1	SS	22									
166.9														
0.6	GRAVEL and ROCK FRAGMENTS probable cobbles and boulders (POSSIBLE ROCK FILL) Auger refusal at 1.32m.		1	GS	FI									
165.8			1	RUN	>5									
1.7	GNEISS BEDROCK Slightly weathered, pink with black and white subvertical banding, very strong to extremely strong Subvertical joints at 1.3m to 1.4m, 1.7m, 2.3m, 2.4m, 4.6m 50mm fractured zone at 3.6m.				4									
					>5									
				2	RUN		0							
							0							
							2							
					0									
					>5									
			3	RUN	2									
					1									
					1									
162.8														
4.7	END OF BOREHOLE AT 4.72m. Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen. WATER LEVEL READINGS: DATE ELEVATION (m) 22/10/03 164.6 18/12/03 164.6 05/02/04 Piezometer Destroyed													



Appendix C.
Laboratory Testing

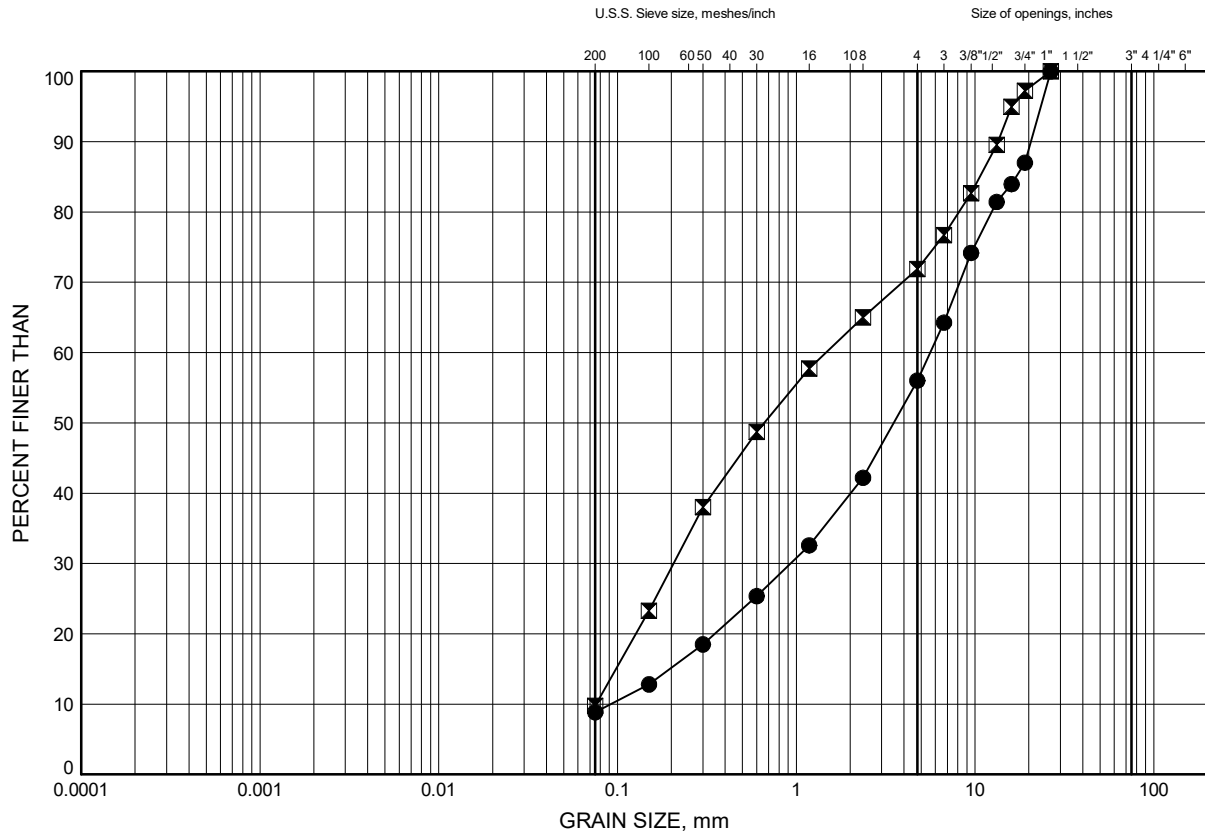


Appendix C.1
Particle Size Analysis Figures
Atterberg Limit Test Results

Highway 17 Twinning GRAIN SIZE DISTRIBUTION

FIGURE C1

Granular Fill



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	GOS19-04	0.3	167.7
◻	GOS19-06	0.3	166.7

Date March 2021
WP# 4068-09-00

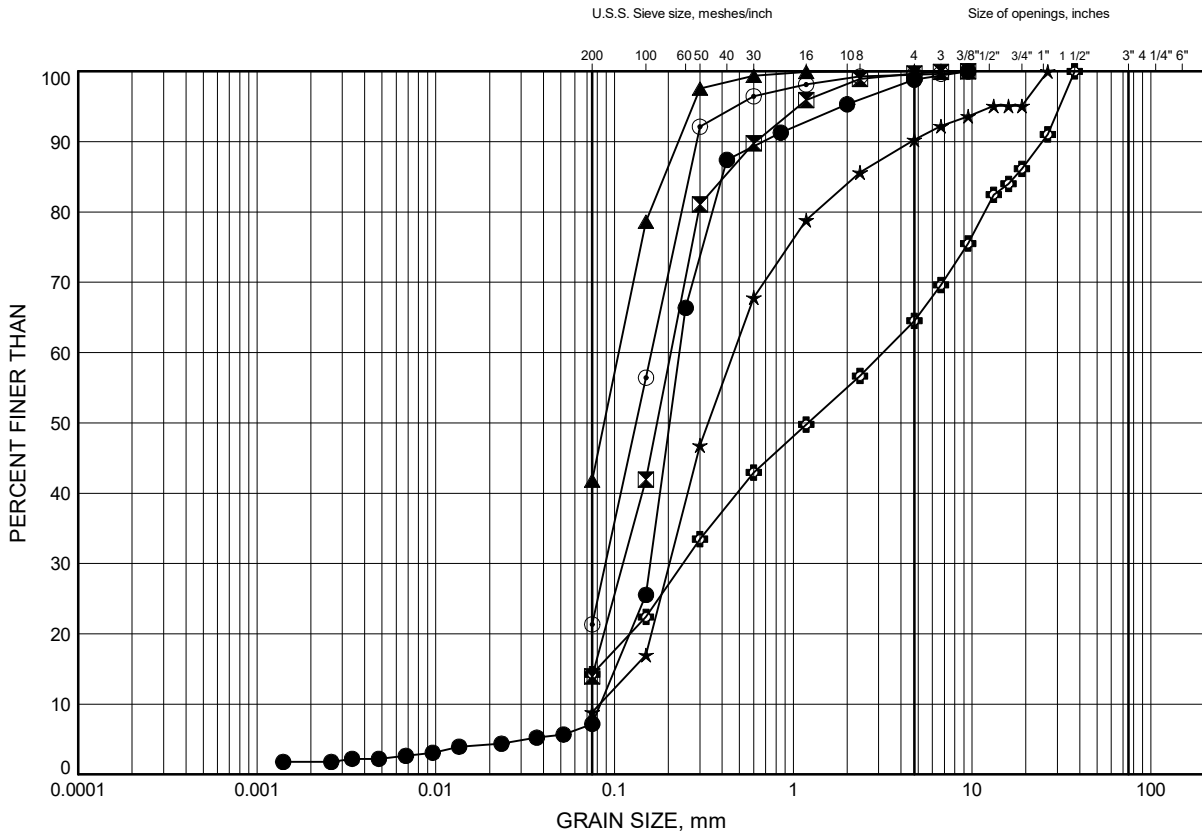


Prep'd KE
Chkd. FG

Highway 17 Twinning GRAIN SIZE DISTRIBUTION

FIGURE C2

Sand to Silty Sand (SP, SP-SM, SM)



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	GOS-1	1.8	167.2
⊠	GOS19-01	1.1	165.8
▲	GOS19-01	2.0	164.9
★	GOS19-02	1.1	168.1
⊙	GOS19-05	1.8	165.3
⊕	GOS19-05	4.9	162.2

Date March 2021
WP# 4068-09-00

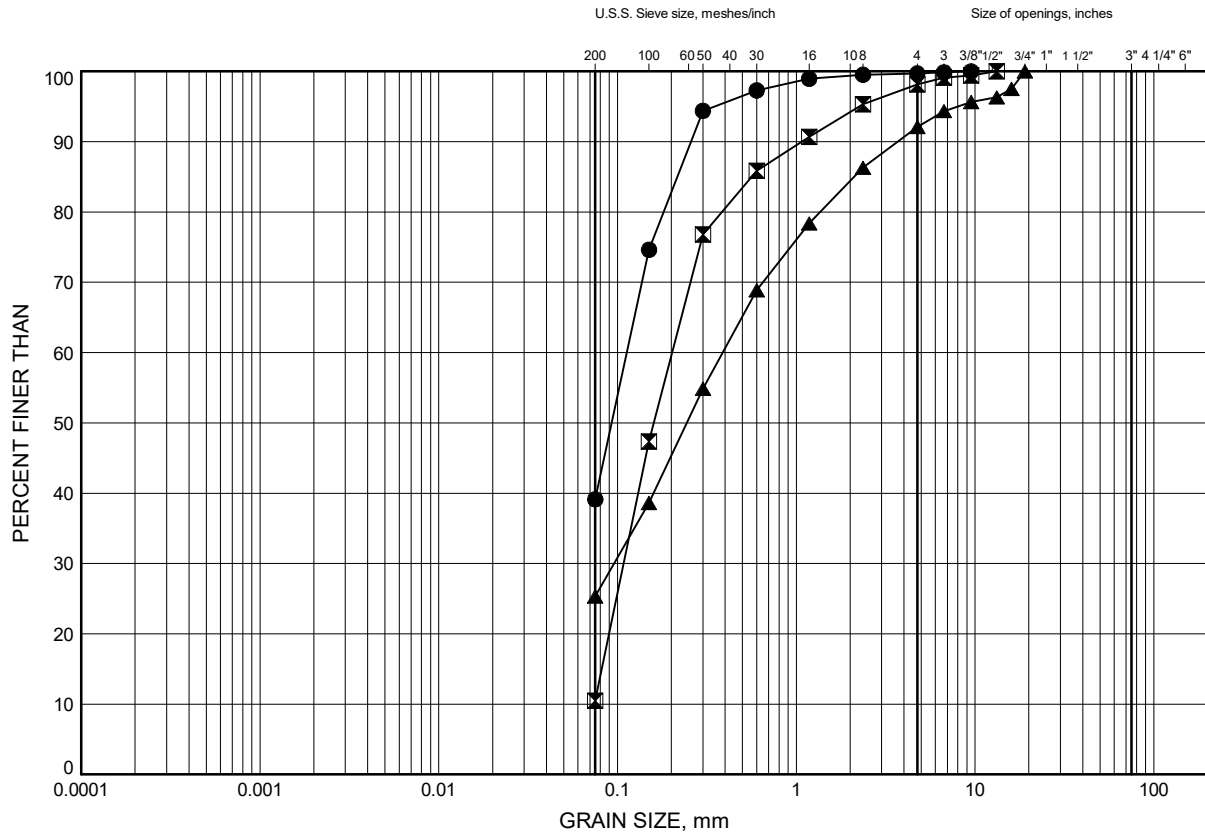


Prep'd KE
Chkd. FG

Highway 17 Twinning GRAIN SIZE DISTRIBUTION

FIGURE C3

Sand to Silty Sand (SP, SP-SM, SM)



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	GOS19-06	2.6	164.4
⊠	GOS19-07	1.1	168.1
▲	GOS19-09	1.0	166.3

Date March 2021
WP# 4068-09-00

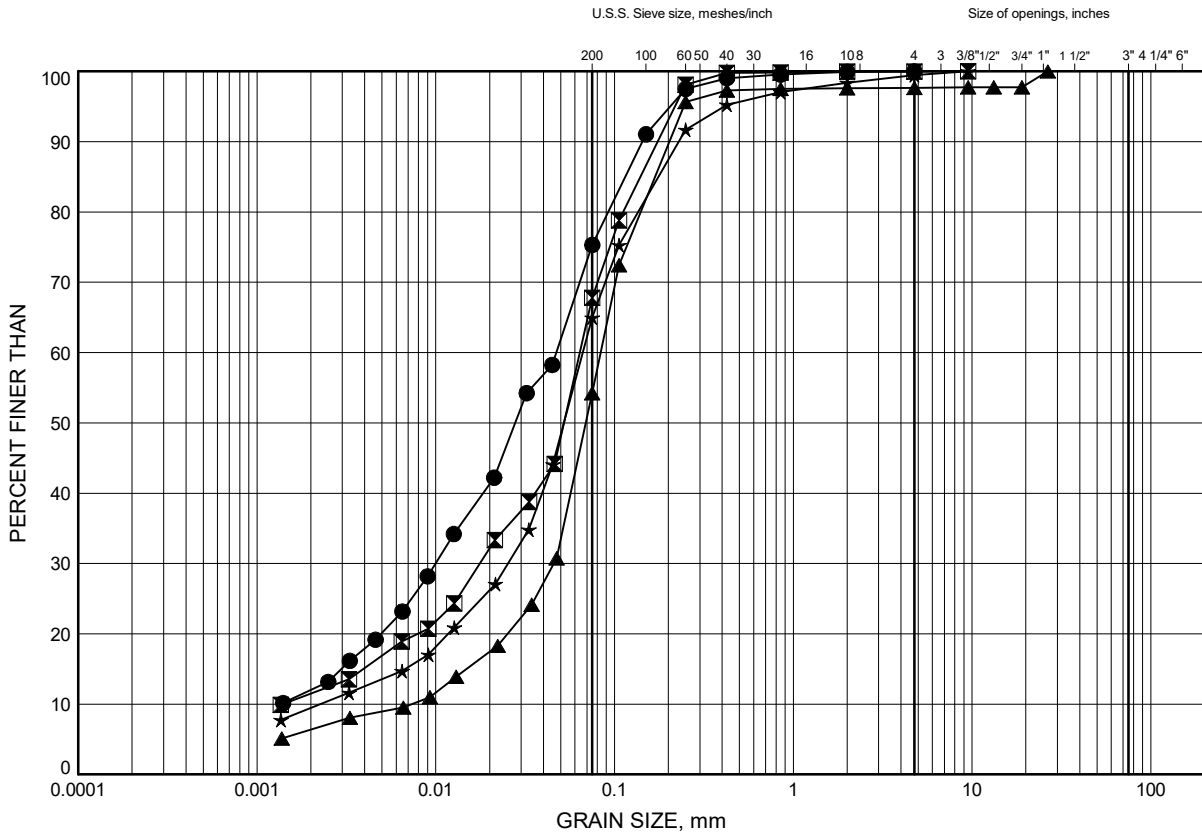


Prep'd KE
Chkd. FG

Highway 17 Twinning GRAIN SIZE DISTRIBUTION

FIGURE C4

Sandy Silt (ML)



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	GOS-1	3.4	165.6
⊠	GOS19-02	4.2	165.0
▲	GOS19-02	6.4	162.8
★	GOS19-12	6.4	162.7

Date March 2021
WP# 4068-09-00

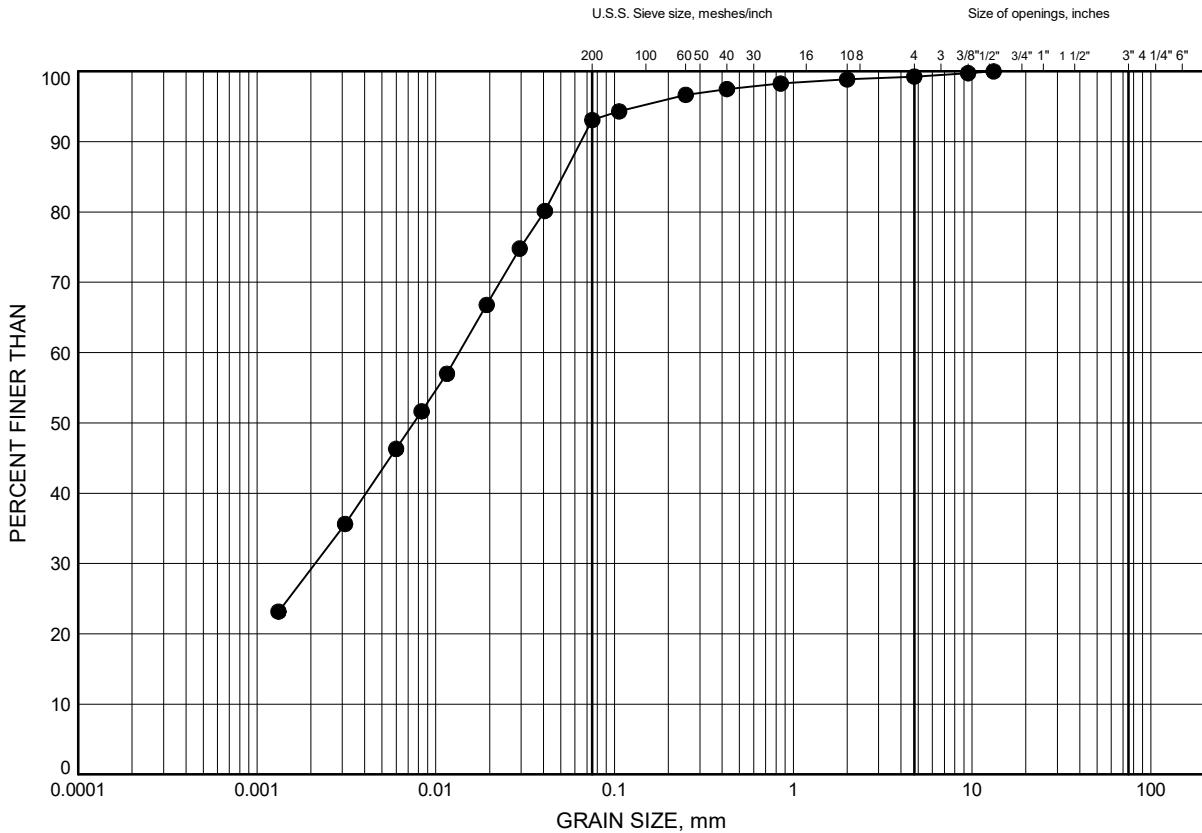


Prep'd KE
Chkd. FG

Highway 17 Twinning GRAIN SIZE DISTRIBUTION

FIGURE C5

Clay (CI)



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	GOS19-10	2.6	163.9

Date March 2021
WP# 4068-09-00

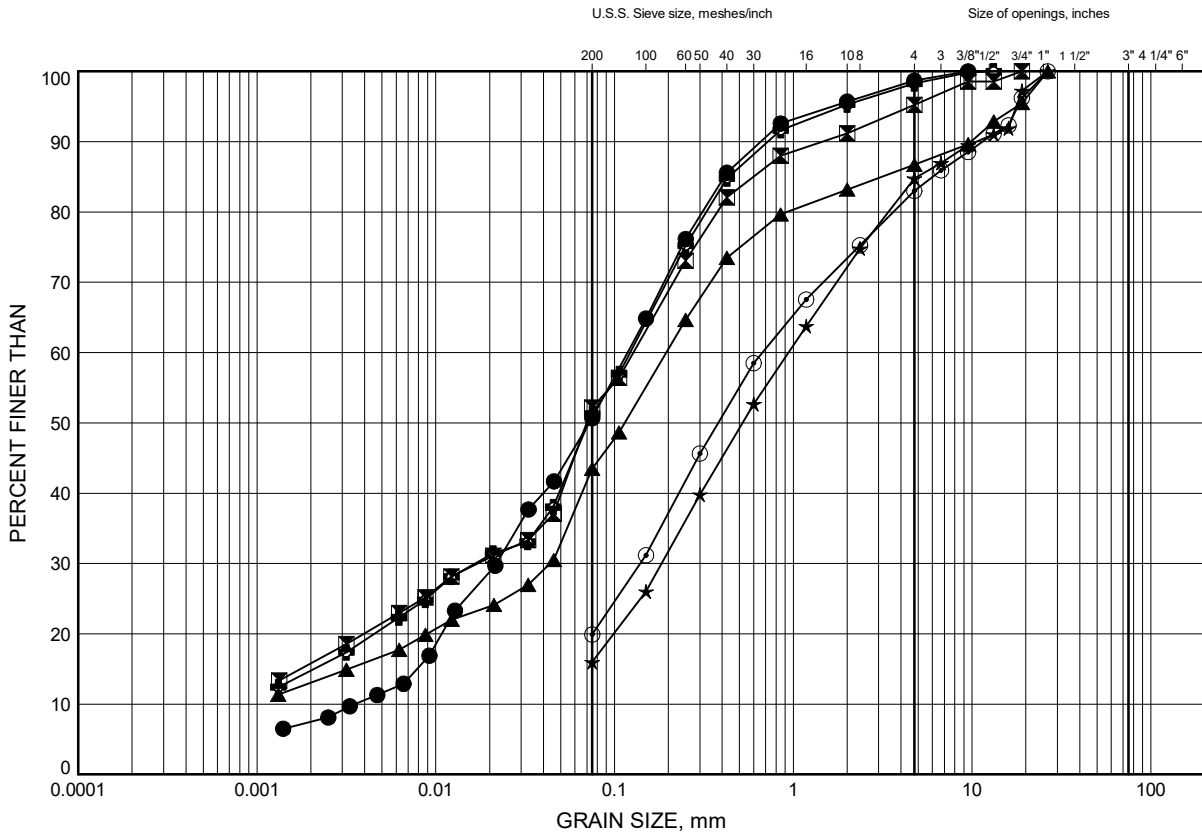


Prep'd KE
Chkd. FG

Highway 17 Twinning GRAIN SIZE DISTRIBUTION

FIGURE C6

Sandy Clayey Silt to Sandy Silt to Clayey Silty Sand to Silty Sand to Clayey Sand to Sand and Silt to Sand and Gravel (CL, ML, SC-SM, SM, SC) (TILL)



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	GOS-1	9.4	159.6
⊠	GOS19-01	4.9	162.0
▲	GOS19-01	8.7	158.2
★	GOS19-02	8.7	160.5
⊙	GOS19-04W	1.8	165.2
⊕	GOS19-05	6.4	160.7

Date March 2021
WP# 4068-09-00



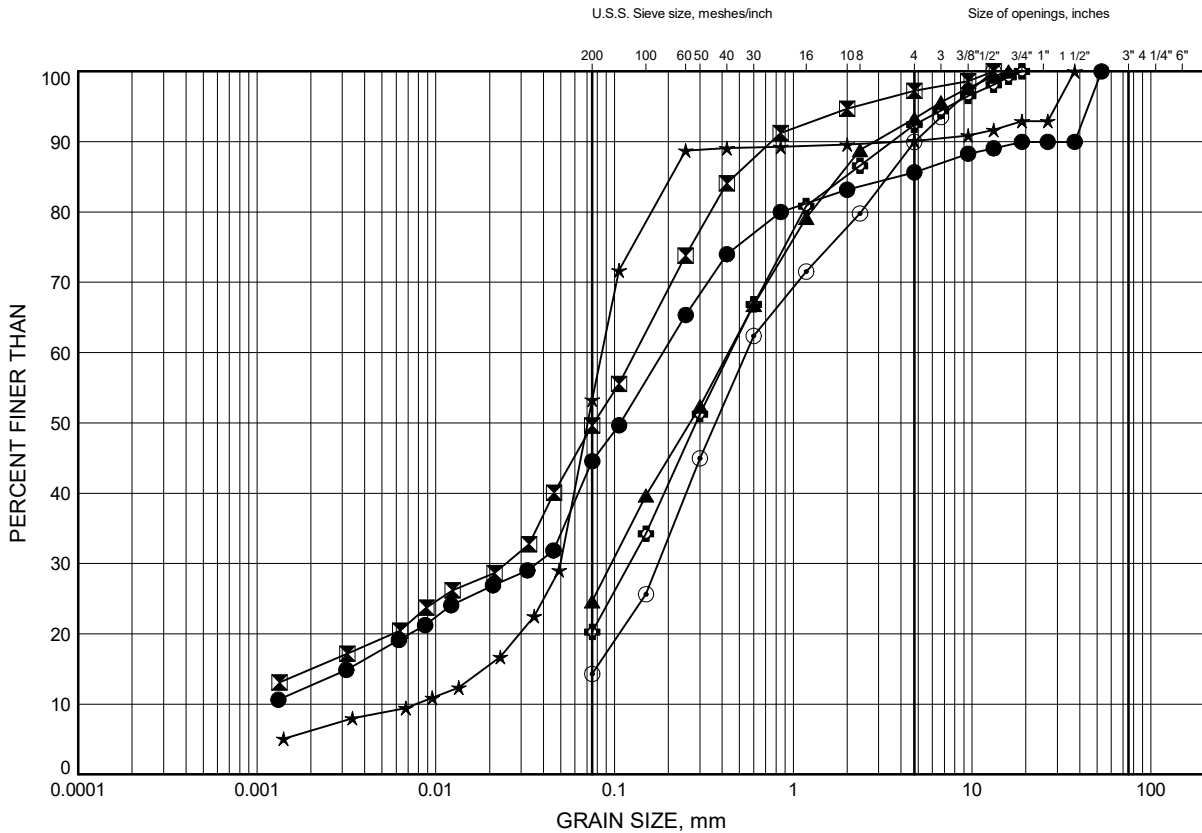
Prep'd KE
Chkd. FG

Highway 17 Twinning

GRAIN SIZE DISTRIBUTION

FIGURE C7

Sandy Clayey Silt to Sandy Silt to Clayey Silty Sand to Silty Sand to Clayey Sand to Sand and Silt to Sand and Gravel (CL, ML, SC-SM, SM, SC) (TILL)



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	GOS19-05	9.9	157.2
⊠	GOS19-06	7.9	159.1
▲	GOS19-08	2.0	166.5
★	GOS19-10	4.0	162.5
⊙	GOS19-11	4.0	162.8
⊕	GOS19-12	9.3	159.8

Date March 2021
 WP# 4068-09-00

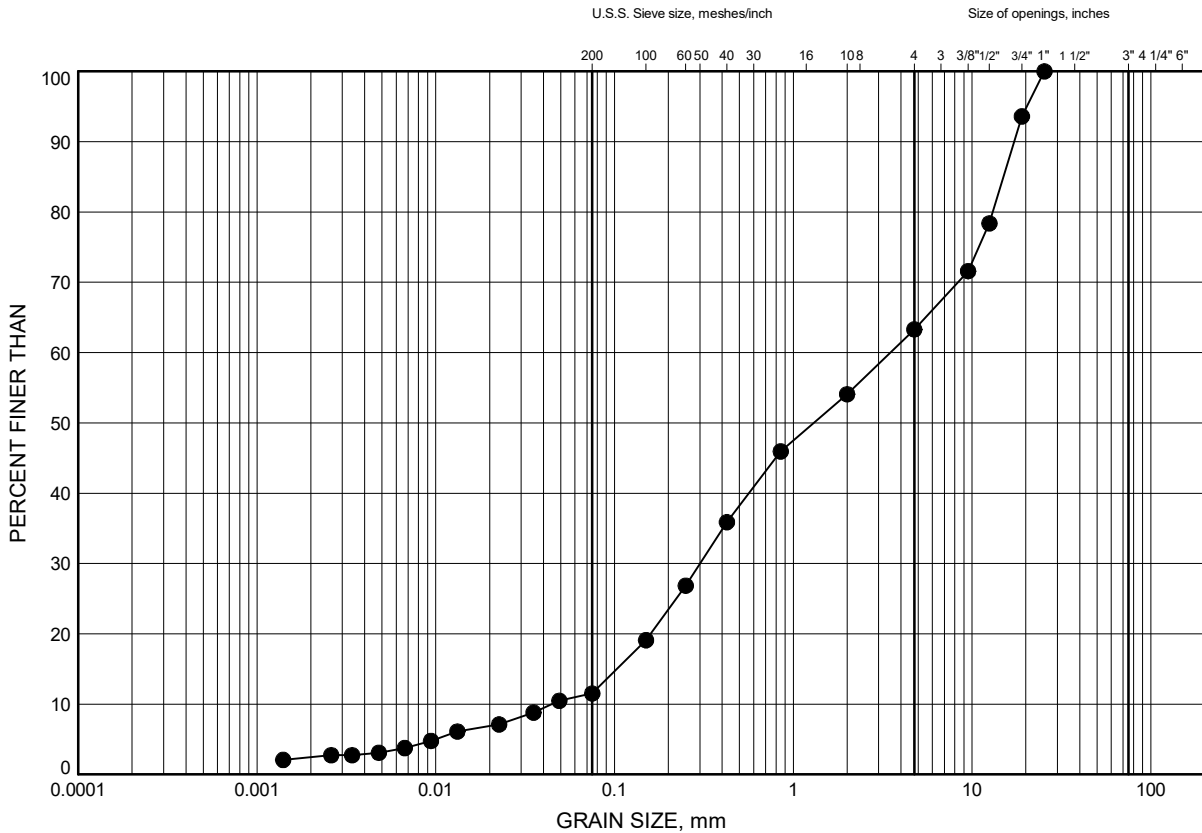


Prep'd KE
 Chkd. FG

Highway 17 Twinning GRAIN SIZE DISTRIBUTION

FIGURE C8

Sandy Clayey Silt to Sandy Silt to Clayey Silty Sand to Silty Sand to Clayey Sand to Sand and Silt to Sand and Gravel (CL, ML, SC-SM, SM, SC) (TILL)



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	GOS-2	2.5	164.3

Date March 2021
WP# 4068-09-00

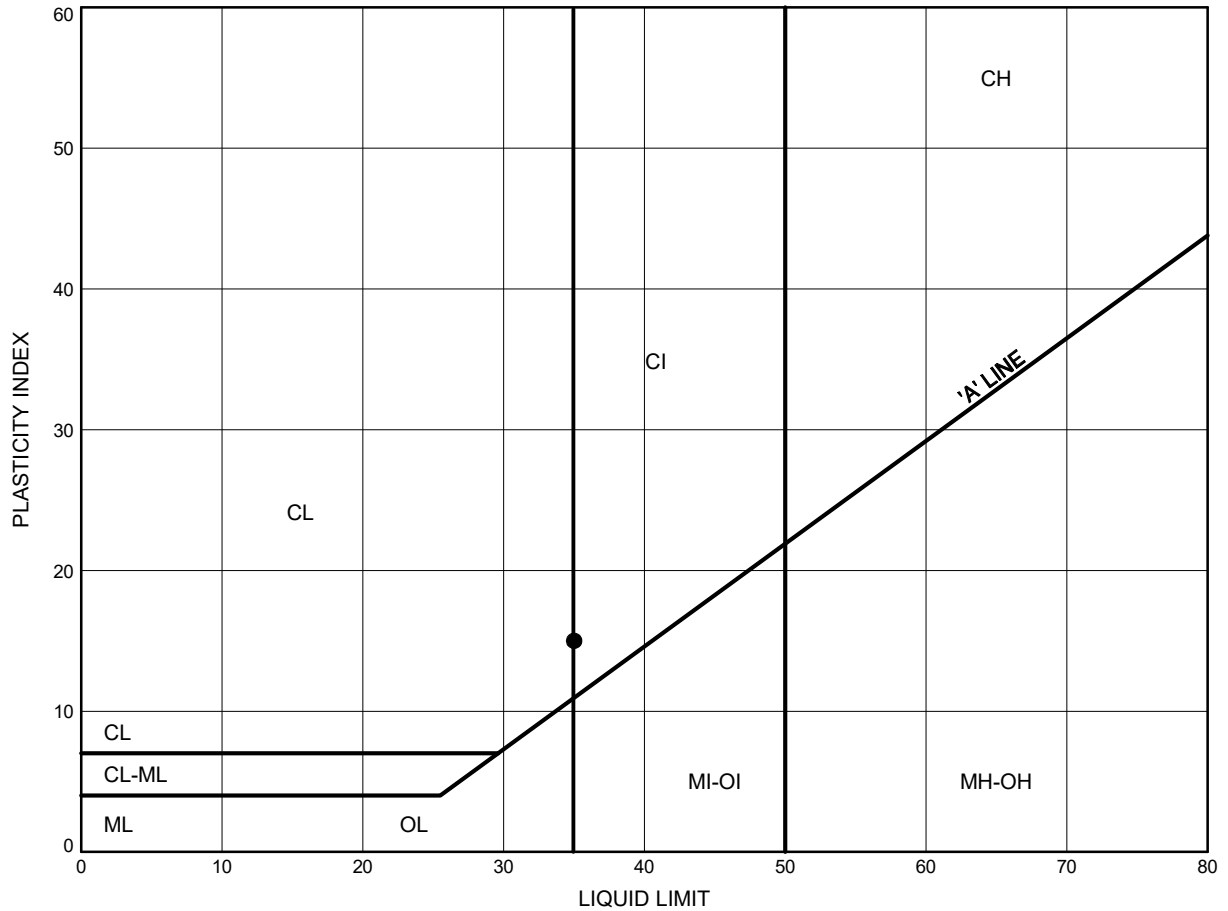


Prep'd KE
Chkd. FG

Highway 17 Twinning ATTERBERG LIMITS TEST RESULTS

FIGURE C9

Clay (CI)



LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	GOS19-10	2.6	163.9

Date March 2021
 WP# 4068-09-00

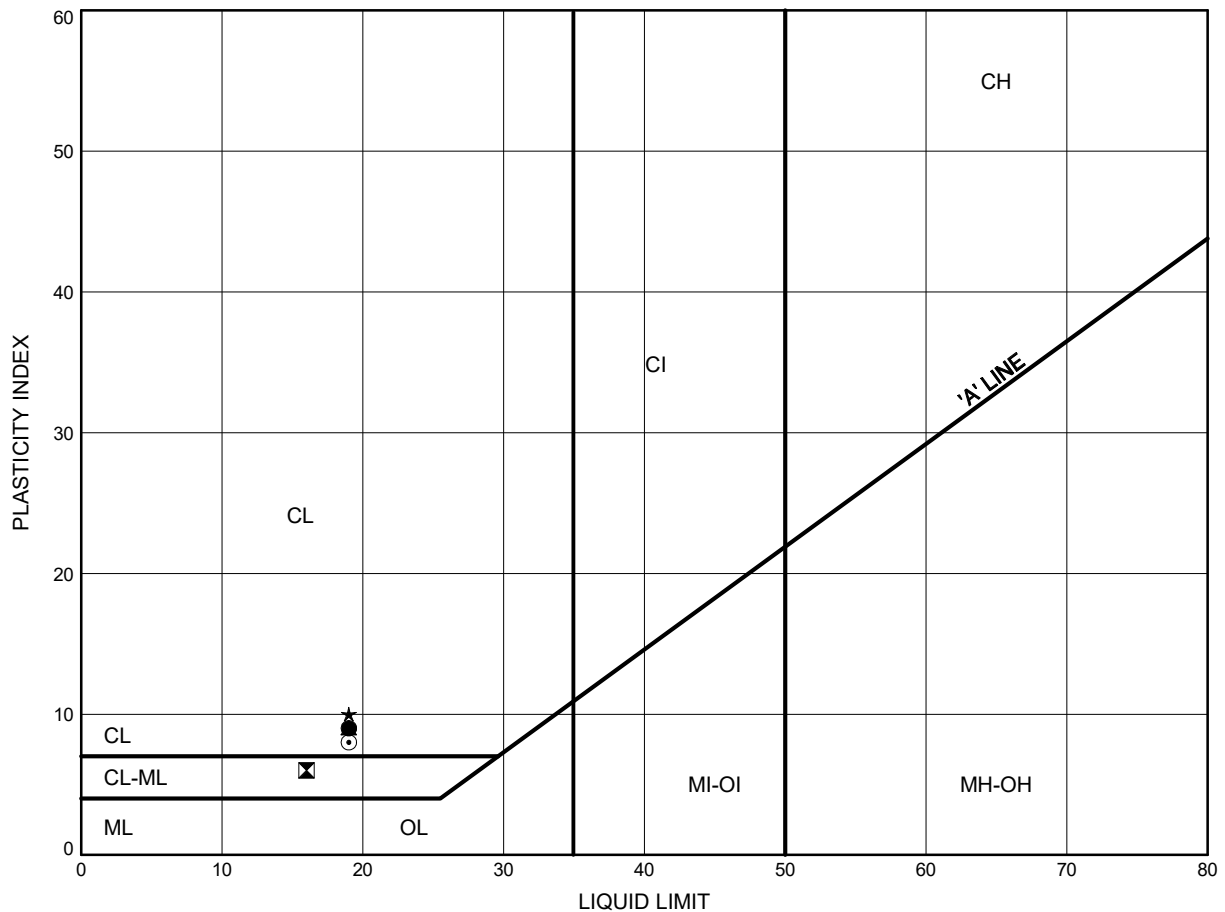


Prep'd KE
 Chkd. FG

Highway 17 Twinning ATTERBERG LIMITS TEST RESULTS

FIGURE C10

Sandy Clayey Silt to Clayey Silty Sand to Clayey Sand (CL, SC-SM, SC) (TILL)



LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	GOS19-01	4.9	162.0
⊠	GOS19-01	8.7	158.2
▲	GOS19-05	6.4	160.7
★	GOS19-05	9.9	157.2
⊙	GOS19-06	7.9	159.1

Date March 2021
 WP# 4068-09-00



Prep'd KE
 Chkd. FG



Appendix C.2

Analytical Testing Results

Certificate of Analysis

Thurber Engineering Ltd.

2460 Lancaster Rd, Suite 104
Ottawa, ON K1B 4S5
Attn: Justin Gray

Client PO:
Project: 24726 Task 200a.202
Custody:

Report Date: 28-Jul-2020
Order Date: 22-Jul-2020

Order #: 2030239

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

Paracel ID	Client ID
2030239-01	GOS 19-2, SS3, 5'-7'
2030239-02	GOS 19-4W, SS2, 2'6"-4'-6"

Approved By:



Dale Robertson, BSc
Laboratory Director

Certificate of Analysis

Report Date: 28-Jul-2020

Client: Thurber Engineering Ltd.

Order Date: 22-Jul-2020

Client PO:

Project Description: 24726 Task 200a.202

Analysis Summary Table

Analysis	Method Reference/Description	Extraction Date	Analysis Date
Anions	EPA 300.1 - IC, water extraction	28-Jul-20	28-Jul-20
Conductivity	MOE E3138 - probe @25 °C, water ext	27-Jul-20	27-Jul-20
pH, soil	EPA 150.1 - pH probe @ 25 °C, CaCl buffered ext.	22-Jul-20	23-Jul-20
Resistivity	EPA 120.1 - probe, water extraction	27-Jul-20	27-Jul-20
Solids, %	Gravimetric, calculation	28-Jul-20	28-Jul-20

Certificate of Analysis

Report Date: 28-Jul-2020

Client: Thurber Engineering Ltd.

Order Date: 22-Jul-2020

Client PO:

Project Description: 24726 Task 200a.202

Client ID:	GOS 19-2, SS3, 5'-7'	GOS 19-4W, SS2, 2'6"-4'-6"	-	-
Sample Date:	07-Jul-20 09:00	14-Jul-20 09:00	-	-
Sample ID:	2030239-01	2030239-02	-	-
MDL/Units	Soil	Soil	-	-

Physical Characteristics

% Solids	0.1 % by Wt.	87.8	85.5	-	-
----------	--------------	------	------	---	---

General Inorganics

Conductivity	5 uS/cm	87	343	-	-
pH	0.05 pH Units	8.10	8.12	-	-
Resistivity	0.10 Ohm.m	114	29.1	-	-

Anions

Chloride	5 ug/g dry	22	17	-	-
Sulphate	5 ug/g dry	<5	8	-	-

Certificate of Analysis

Report Date: 28-Jul-2020

Client: Thurber Engineering Ltd.

Order Date: 22-Jul-2020

Client PO:

Project Description: 24726 Task 200a.202

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						

Certificate of Analysis

Report Date: 28-Jul-2020

Client: Thurber Engineering Ltd.

Order Date: 22-Jul-2020

Client PO:

Project Description: 24726 Task 200a.202

Method Quality Control: Duplicate

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Anions									
Chloride	22.1	5	ug/g dry	21.8			1.4	20	
Sulphate	ND	5	ug/g dry	ND			NC	20	
General Inorganics									
Conductivity	230	5	uS/cm	227			1.3	5	
pH	11.46	0.05	pH Units	11.48			0.2	2.3	
Resistivity	43.6	0.10	Ohm.m	44.1			1.3	20	
Physical Characteristics									
% Solids	87.2	0.1	% by Wt.	87.8			0.6	25	

Certificate of Analysis

Report Date: 28-Jul-2020

Client: Thurber Engineering Ltd.

Order Date: 22-Jul-2020

Client PO:

Project Description: 24726 Task 200a.202

Method Quality Control: Spike

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Anions									
Chloride	119	5	ug/g	21.8	96.9	82-118			
Sulphate	104	5	ug/g	ND	104	80-120			

Certificate of Analysis

Report Date: 28-Jul-2020

Client: Thurber Engineering Ltd.

Order Date: 22-Jul-2020

Client PO:

Project Description: 24726 Task 200a.202

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.

NC: Not Calculated

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.

Subcontracted Analysis

Thurber Engineering Ltd.

2460 Lancaster Rd, Suite 104

Ottawa, ON K1B 4S5

Attn: Justin Gray

Tel: (613) 408-6795

Fax: (613) 247-2185

Paracel Report No. **2030239**

Client Project(s): **24726 Task 200a.202**

Client PO:

Reference: **Standing Offer**

Order Date: 22-Jul-20

Report Date: 31-Jul-20

CoC Number:

Sample(s) from this project were subcontracted for the listed parameters. A copy of the subcontractor's report is attached

Paracel ID	Client ID	Analysis
2030239-01	GOS 19-2, SS3, 5'-7'	Sulphide, solid
2030239-02	GOS 19-4W, SS2, 2'6"-4'-6"	Sulphide, solid

**SGS Canada Inc.**

P.O. Box 4300 - 185 Concession St.
Lakefield - Ontario - K0L 2H0
Phone: 705-652-2000 FAX: 705-652-6365

Paracel Laboratories

Attn : Dale Robertson

300-2319 St.Laurent Blvd.
Ottawa, ON
K1G 4K6, Canada

Phone: 613-731-9577
Fax: 613-731-9064

31-July-2020

Date Rec. : 23 July 2020
LR Report: CA15517-JUL20
Reference: Project#: 2030239

Copy: #1

CERTIFICATE OF ANALYSIS

Final Report

Sample ID	Sample Date & Time	Sulphide %
1: Analysis Start Date		31-Jul-20
2: Analysis Start Time		10:48
3: Analysis Completed Date		31-Jul-20
4: Analysis Completed Time		11:04
5: QC - Blank		< 0.04
6: QC - STD % Recovery		106%
7: QC - DUP % RPD		ND
8: RL		0.02
9: GOS 19-2, SS3, 5'-7'	07-Jul-20 09:00	< 0.04
10: GOS 19-4W, SS2, 2'6"-4'-6"	14-Jul-20 15:00	< 0.04

RL - SGS Reporting Limit
ND - Not Detected

Note: Sample GOS 19-2, SS3, 5' - 7' was already past the 14 day holding time for sulphide analysis when received. Processed as per client's instructions; result may be unreliable.

Kimberley Didsbury
Project Specialist,
Environment, Health & Safety

Certificate of Analysis

Thurber Engineering Ltd.

2460 Lancaster Rd, Suite 104
Ottawa, ON K1B4S5
Attn: Chris Murray

Client PO:
Project: 24726
Custody: 49169

Report Date: 20-Sep-2019
Order Date: 16-Sep-2019

Order #: 1938127

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

Paracel ID

1938127-01

Client ID

G05 19-01, SS4(7'6"-8'2")

Approved By:



Mark Foto, M.Sc.
Lab Supervisor

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

Report Date: 20-Sep-2019

Order Date: 16-Sep-2019

Project Description: 24726

Analysis Summary Table

Analysis	Method Reference/Description	Extraction Date	Analysis Date
Anions	EPA 300.1 - IC, water extraction	18-Sep-19	18-Sep-19
Conductivity	MOE E3138 - probe @25 °C, water ext	19-Sep-19	20-Sep-19
pH, soil	EPA 150.1 - pH probe @ 25 °C, CaCl buffered ext.	19-Sep-19	19-Sep-19
Resistivity	EPA 120.1 - probe, water extraction	19-Sep-19	20-Sep-19
Solids, %	Gravimetric, calculation	17-Sep-19	17-Sep-19

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

Report Date: 20-Sep-2019

Order Date: 16-Sep-2019

Project Description: 24726

Client ID:	G05 19-01, SS4(7'6"-8'2")	-	-	-
Sample Date:	03-Sep-19 09:00	-	-	-
Sample ID:	1938127-01	-	-	-
MDL/Units	Soil	-	-	-

Physical Characteristics

% Solids	0.1 % by Wt.	84.1	-	-	-
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General Inorganics

Conductivity	5 uS/cm	150	-	-	-
pH	0.05 pH Units	7.50	-	-	-
Resistivity	0.10 Ohm.m	66.7	-	-	-

Anions

Chloride	5 ug/g dry	22	-	-	-
Sulphate	5 ug/g dry	<5	-	-	-

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

Report Date: 20-Sep-2019

Order Date: 16-Sep-2019

Project Description: 24726

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						

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

Report Date: 20-Sep-2019

Order Date: 16-Sep-2019

Project Description: 24726

Method Quality Control: Duplicate

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Anions									
Chloride	21.0	5	ug/g dry	21.5			2.6	20	
Sulphate	ND	5	ug/g dry	ND			0.0	20	
General Inorganics									
Conductivity	97.4	5	uS/cm	101			3.2	5	
pH	7.39	0.05	pH Units	7.50			1.5	2.3	
Physical Characteristics									
% Solids	90.4	0.1	% by Wt.	90.3			0.1	25	

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

Report Date: 20-Sep-2019

Order Date: 16-Sep-2019

Project Description: 24726

Method Quality Control: Spike

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Anions									
Chloride	114	5	ug/g	21.5	92.9	82-118			
Sulphate	108	5	ug/g	ND	108	80-120			

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

Report Date: 20-Sep-2019

Order Date: 16-Sep-2019

Project Description: 24726

Qualifier Notes:

Login Qualifiers :

Received at temperature > 25C

Applies to samples: G05 19-01, SS4(7'6"-8'2")

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.

Subcontracted Analysis

Thurber Engineering Ltd.

2460 Lancaster Rd, Suite 104
Ottawa, ON K1B4S5
Attn: Chris Murray

Tel: (613) 247-2121
Fax: (613) 247-2185

Paracel Report No **1938127**

Client Project(s): **24726**

Client PO:

Reference: **Standing Offer**

CoC Number: **49169**

Order Date: 16-Sep-19
Report Date: 23-Sep-19

Sample(s) from this project were subcontracted for the listed parameters. A copy of the subcontractor's report is attached

Paracel ID	Client ID	Analysis
1938127-01	G05 19-01, SS4(7'6"-8'2")	Sulphide, solid

**SGS Canada Inc.**

P.O. Box 4300 - 185 Concession St.
Lakefield - Ontario - K0L 2H0
Phone: 705-652-2000 FAX: 705-652-6365

Paracel Laboratories

Attn : Dale Robertson

300-2319 St.Laurent Blvd.
Ottawa, ON
K1G 4K6, Canada

Phone: 613-731-9577
Fax:613-731-9064

23-September-2019

Date Rec. : 18 September 2019
LR Report: CA13701-SEP19
Reference: Project#: 1938127

Copy: #1

CERTIFICATE OF ANALYSIS

Final Report

Sample ID	Sample Date & Time	Sulphide %
1: Analysis Start Date		20-Sep-19
2: Analysis Start Time		12:49
3: Analysis Completed Date		20-Sep-19
4: Analysis Completed Time		14:35
5: QC - Blank		< 0.02
6: QC - STD % Recovery		113%
7: QC - DUP % RPD		3%
8: RL		0.02
9: G05 19-01, SS4 (7'6"-8'2")	03-Sep-19	0.03

RL - SGS Reporting Limit

Kimberley Didsbury
Project Specialist,
Environment, Health & Safety

Certificate of Analysis

Thurber Engineering Ltd.

2460 Lancaster Rd, Suite 104
Ottawa, ON K1B4S5
Attn: Chris Murray

Client PO:
Project: 24726
Custody: 49913

Report Date: 10-Oct-2019
Order Date: 4-Oct-2019

Order #: 1940637

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

Paracel ID
1940637-01

Client ID
GOS19-3, SS1 (6"-2'2")

Approved By:



Mark Foto, M.Sc.
Lab Supervisor

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

Report Date: 10-Oct-2019
Order Date: 4-Oct-2019
Project Description: 24726

Analysis Summary Table

Analysis	Method Reference/Description	Extraction Date	Analysis Date
Anions	EPA 300.1 - IC, water extraction	8-Oct-19	8-Oct-19
Conductivity	MOE E3138 - probe @25 °C, water ext	9-Oct-19	9-Oct-19
pH, soil	EPA 150.1 - pH probe @ 25 °C, CaCl buffered ext.	9-Oct-19	9-Oct-19
Resistivity	EPA 120.1 - probe, water extraction	9-Oct-19	9-Oct-19
Solids, %	Gravimetric, calculation	7-Oct-19	7-Oct-19

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

Report Date: 10-Oct-2019

Order Date: 4-Oct-2019

Project Description: 24726

Client ID:	GOS19-3, SS1 (6"-2'2")	-	-	-
Sample Date:	18-Sep-19 09:00	-	-	-
Sample ID:	1940637-01	-	-	-
MDL/Units	Soil	-	-	-

Physical Characteristics

% Solids	0.1 % by Wt.	94.9	-	-	-
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General Inorganics

Conductivity	5 uS/cm	391	-	-	-
pH	0.05 pH Units	7.80	-	-	-
Resistivity	0.10 Ohm.m	25.6	-	-	-

Anions

Chloride	5 ug/g dry	33	-	-	-
Sulphate	5 ug/g dry	19	-	-	-

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

Report Date: 10-Oct-2019

Order Date: 4-Oct-2019

Project Description: 24726

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						

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

Report Date: 10-Oct-2019
Order Date: 4-Oct-2019
Project Description: 24726

Method Quality Control: Duplicate

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Anions									
Chloride	502	5	ug/g dry	486			3.1	20	
Sulphate	123	5	ug/g dry	122			0.6	20	
General Inorganics									
pH	7.16	0.05	pH Units	7.13			0.4	2.3	
Resistivity	90.0	0.10	Ohm.m	89.9			0.2	20	
Physical Characteristics									
% Solids	94.3	0.1	% by Wt.	94.2			0.2	25	

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

Report Date: 10-Oct-2019

Order Date: 4-Oct-2019

Project Description: 24726

Method Quality Control: Spike

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Anions									
Chloride	576	5	ug/g	486	90.0	82-118			
Sulphate	229	5	ug/g	122	107	80-120			

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

Report Date: 10-Oct-2019
Order Date: 4-Oct-2019
Project Description: 24726

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.

Subcontracted Analysis

Thurber Engineering Ltd.

2460 Lancaster Rd, Suite 104
Ottawa, ON K1B4S5
Attn: Chris Murray

Tel: (613) 247-2121
Fax: (613) 247-2185

Paracel Report No **1940637**

Client Project(s): **24726**

Client PO:

Reference: **Standing Offer**

CoC Number: **49913**

Order Date: 04-Oct-19
Report Date: 10-Oct-19

Sample(s) from this project were subcontracted for the listed parameters. A copy of the subcontractor's report is attached

Paracel ID	Client ID	Analysis
1940637-01	GOS19-3, SS1 (6"-2'2")	Sulphide, solid

**SGS Canada Inc.**

P.O. Box 4300 - 185 Concession St.
Lakefield - Ontario - K0L 2H0
Phone: 705-652-2000 FAX: 705-652-6365

Paracel Laboratories

Attn : Dale Robertson

300-2319 St.Laurent Blvd.
Ottawa, ON
K1G 4K6, Canada

Phone: 613-731-9577
Fax:613-731-9064

10-October-2019

Date Rec. : 08 October 2019
LR Report: CA13305-OCT19
Reference: Project#: 1940637

Copy: #1

CERTIFICATE OF ANALYSIS

Final Report

Sample ID	Sample Date & Time	Sulphide %
1: Analysis Start Date		10-Oct-19
2: Analysis Start Time		14:36
3: Analysis Completed Date		10-Oct-19
4: Analysis Completed Time		14:53
5: QC - Blank		< 0.02
6: QC - STD % Recovery		115%
7: QC - DUP % RPD		16%
8: RL		0.02
9: GOS19-3, SS1 (6"-2'2")	18-Sep-19	0.04

RL - SGS Reporting Limit

Kimberley Didsbury
Project Specialist,
Environment, Health & Safety



Appendix C.3

UCS Test Results

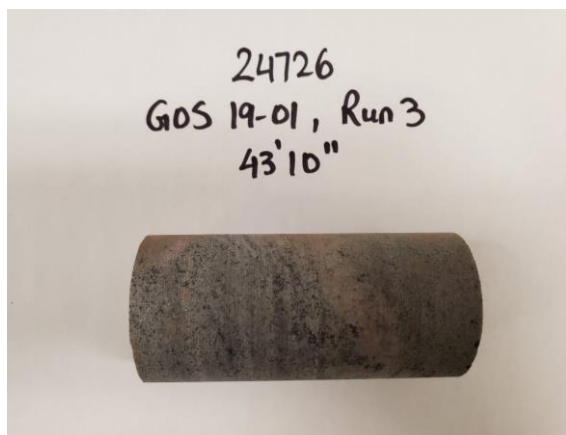
UNCONFINED COMPRESSION TEST REPORT

ASTM D7012-14

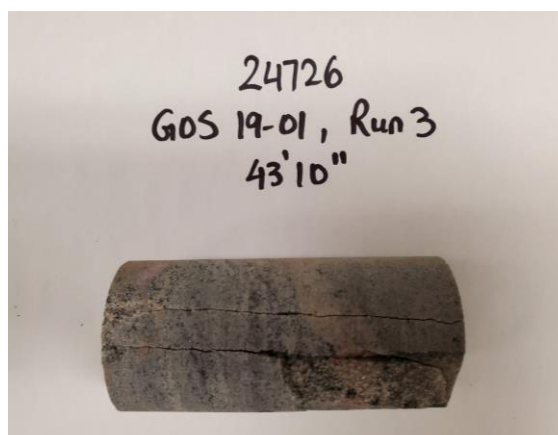
CLIENT:	Thurber Engineering (Ottawa)	FILE NUMBER:	24726
PROJECT NAME:	Highway 17 Twinning - Renfrew	REPORT DATE:	24-Mar-20
BOREHOLE No.:	GOS 19-01	TEST DATE:	12-Dec-19
SAMPLE No.:	NQ RUN 3		
SAMPLE DEPTH:	13.4m		
DESCRIPTION:	Gneiss		

Avg. Height (cm):	9.6	Weight (g):	465.1
Avg. Diameter (cm):	4.8	Wet Density (kg/m ³):	2,677
H. to Dia. Ratio**:	2:1	Dry Density (kg/m ³):	2,677
Cross Sectional Area (cm ²):	18.10	Moisture Content* (%):	N/A
Sample Volume (cm ³):	173.72		

ORIGINAL SPECIMEN



FRACTURED SPECIMEN



AVG. RATE OF STRAIN TO FAILURE:	1.6% / min
MAXIMUM COMPRESSIVE LOAD:	195.0 kN
UNCONFINED COMPRESSIVE STRENGTH:	107.8 MPa

Note: * Dimensions of Specimen conform to ASTM D 4543-04.

TEST DONE BY: BS
REVIEWED BY: WM

24726 - GOS 19-01 UCS Run 3, 43'10

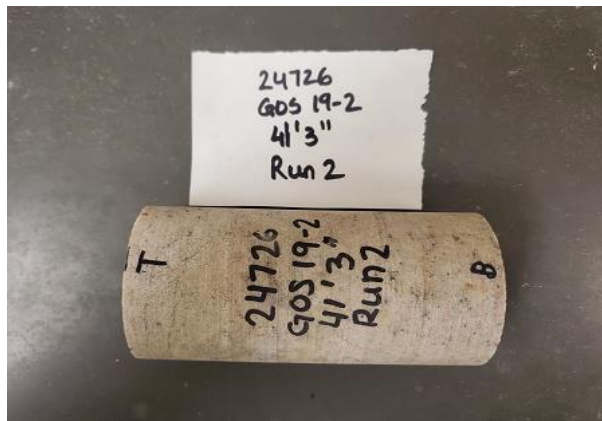
UNCONFINED COMPRESSION TEST REPORT

ASTM D7012-14

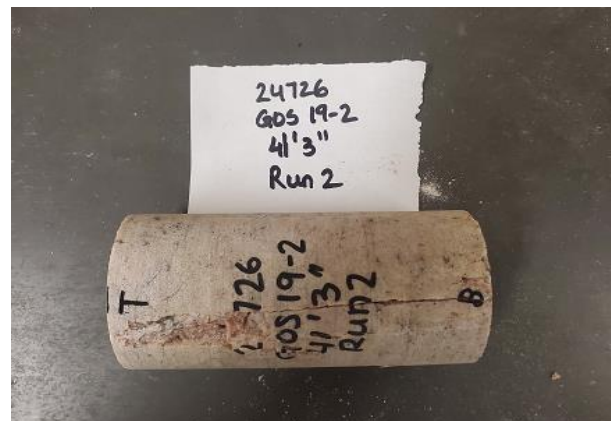
CLIENT:	Thurber Engineering Ltd. (Ottawa Office)	FILE NUMBER:	24726
PROJECT NAME:	Hwy 17 Twinning Renfrew to Haley Sta. Part 1B	REPORT DATE:	31-Aug-20
BOREHOLE No.:	GOS 19-02	TEST DATE:	27-Aug-20
SAMPLE No.:	Run 2		
SAMPLE DEPTH:	12.57 m		
DESCRIPTION:	Gneiss		

Avg. Height (cm):	12.5	Weight (g):	991.5
Avg. Diameter (cm):	6.2	Wet Density (kg/m ³):	2,627
H. to Dia. Ratio**:	2:1	Dry Density (kg/m ³):	2,627
Cross Sectional Area (cm ²):	30.19	Moisture Content* (%):	0.0
Sample Volume (cm ³):	377.38		

ORIGINAL SPECIMEN



FRACTURED SPECIMEN



AVG. RATE OF STRAIN TO FAILURE:	1.2% / min
MAXIMUM COMPRESSIVE LOAD:	350.6 kN
UNCONFINED COMPRESSIVE STRENGTH:	116.1 MPa

Note: * The moisture content was obtained before the test.
 ** Dimensions of Specimen conform to ASTM D 4543-04.

TEST DONE BY: BS
 REVIEWED BY: WM

GOS 19-02 Run 2

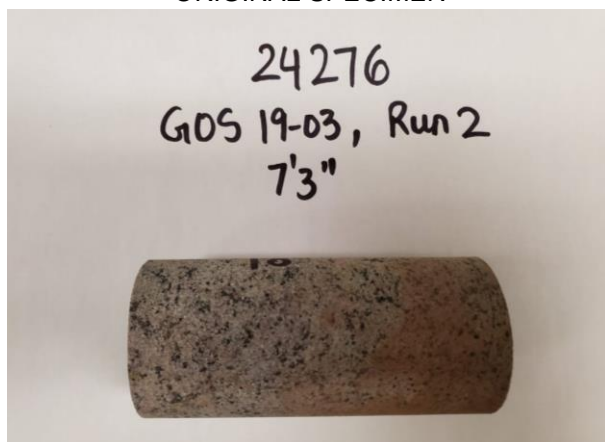
UNCONFINED COMPRESSION TEST REPORT

ASTM D7012-14

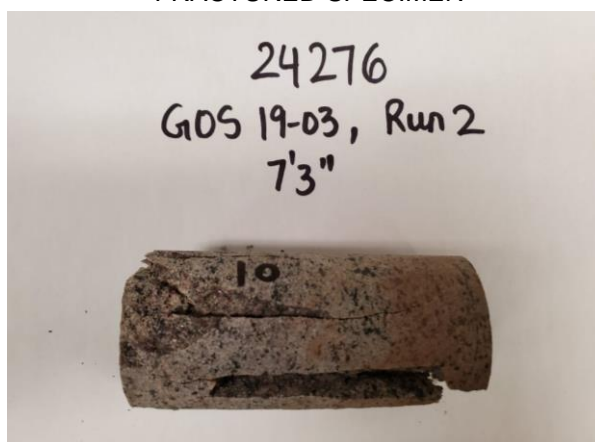
CLIENT:	Thurber Engineering (Ottawa)	FILE NUMBER:	24726
PROJECT NAME:	Highway 17 Twinning - Renfrew	REPORT DATE:	24-Mar-20
BOREHOLE No.:	GOS 19-03	TEST DATE:	12-Dec-19
SAMPLE No.:	NQ RUN 2		
SAMPLE DEPTH:	2.2m		
DESCRIPTION:	Gneiss		

Avg. Height (cm):	9.8	Weight (g):	476.9
Avg. Diameter (cm):	4.8	Wet Density (kg/m ³):	2,689
H. to Dia. Ratio**:	2:1	Dry Density (kg/m ³):	2,689
Cross Sectional Area (cm ²):	18.10	Moisture Content* (%):	N/A
Sample Volume (cm ³):	177.34		

ORIGINAL SPECIMEN



FRACTURED SPECIMEN



AVG. RATE OF STRAIN TO FAILURE:	1.5% / min
MAXIMUM COMPRESSIVE LOAD:	161.9 kN
UNCONFINED COMPRESSIVE STRENGTH:	89.5 MPa

Note: * Dimensions of Specimen conform to ASTM D 4543-04.

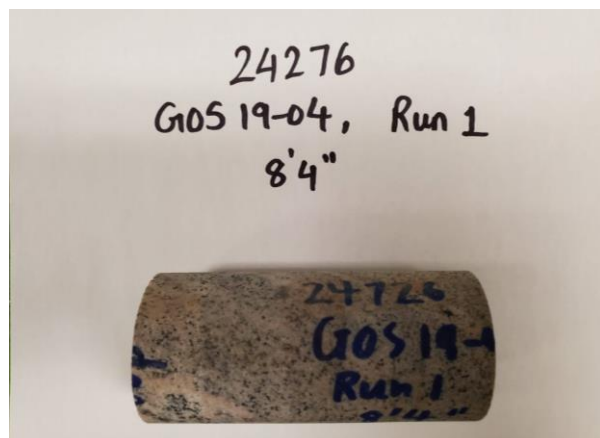
UNCONFINED COMPRESSION TEST REPORT

ASTM D7012-14

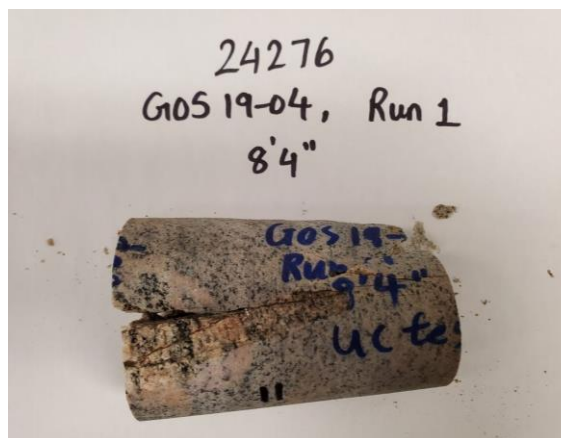
CLIENT:	Thurber Engineering (Ottawa)	FILE NUMBER:	24726
PROJECT NAME:	Highway 17 Twinning - Renfrew	REPORT DATE:	24-Mar-20
BOREHOLE No.:	GOS 19-04	TEST DATE:	12-Dec-19
SAMPLE No.:	NQ RUN 1		
SAMPLE DEPTH:	2.5m		
DESCRIPTION:	Gneiss		

Avg. Height (cm):	9.7	Weight (g):	464.4
Avg. Diameter (cm):	4.8	Wet Density (kg/m ³):	2,646
H. to Dia. Ratio**:	2:1	Dry Density (kg/m ³):	2,646
Cross Sectional Area (cm ²):	18.10	Moisture Content* (%):	N/A
Sample Volume (cm ³):	175.53		

ORIGINAL SPECIMEN



FRACTURED SPECIMEN



AVG. RATE OF STRAIN TO FAILURE:	1.5% / min
MAXIMUM COMPRESSIVE LOAD:	164.2 kN
UNCONFINED COMPRESSIVE STRENGTH:	90.7 MPa

Note: * Dimensions of Specimen conform to ASTM D 4543-04.

TEST DONE BY: BS
REVIEWED BY: WM

24726 - GOS 19-04 UCS Run 1, 8'4"

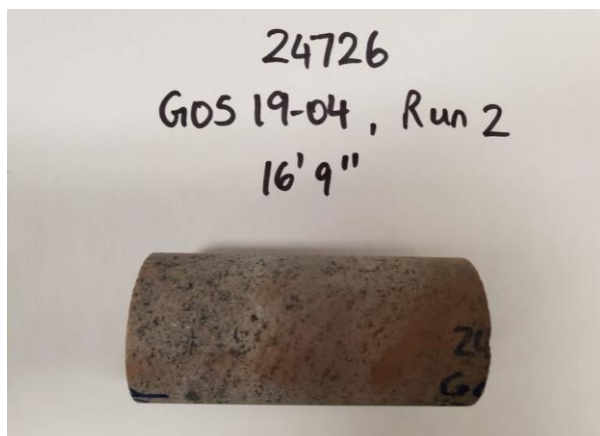
UNCONFINED COMPRESSION TEST REPORT

ASTM D7012-14

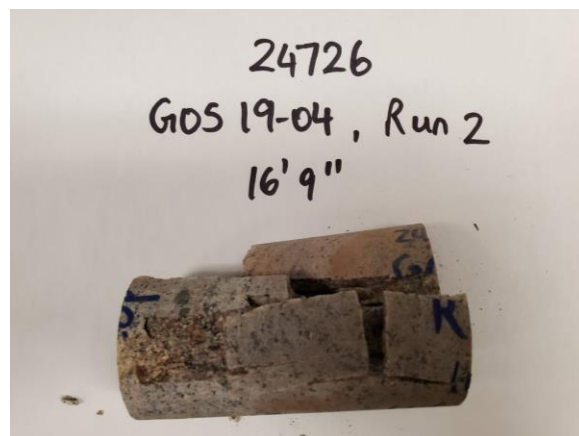
CLIENT:	Thurber Engineering (Ottawa)	FILE NUMBER:	24726
PROJECT NAME:	Highway 17 Twinning - Renfrew	REPORT DATE:	24-Mar-20
BOREHOLE No.:	GOS 19-04	TEST DATE:	12-Dec-19
SAMPLE No.:	NQ RUN 2		
SAMPLE DEPTH:	5.1m		
DESCRIPTION:	Gneiss		

Avg. Height (cm):	9.7	Weight (g):	468.6
Avg. Diameter (cm):	4.8	Wet Density (kg/m ³):	2,670
H. to Dia. Ratio**:	2:1	Dry Density (kg/m ³):	2,670
Cross Sectional Area (cm ²):	18.10	Moisture Content* (%):	N/A
Sample Volume (cm ³):	175.53		

ORIGINAL SPECIMEN



FRACTURED SPECIMEN



AVG. RATE OF STRAIN TO FAILURE:	1.5% / min
MAXIMUM COMPRESSIVE LOAD:	164.0 kN
UNCONFINED COMPRESSIVE STRENGTH:	90.6 MPa

Note: * Dimensions of Specimen conform to ASTM D 4543-04.

TEST DONE BY: BS
REVIEWED BY: WM

24726 - GOS 19-04 UCS Run 2, 16'9

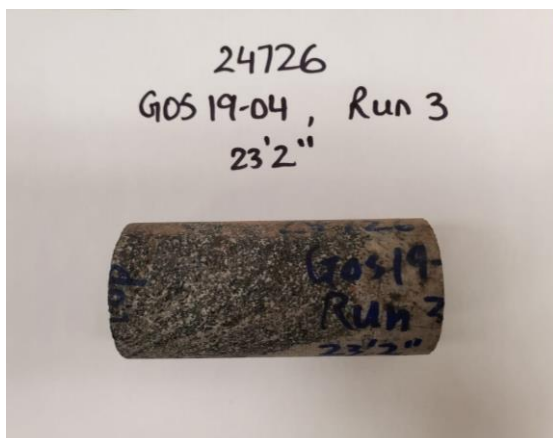
UNCONFINED COMPRESSION TEST REPORT

ASTM D7012-14

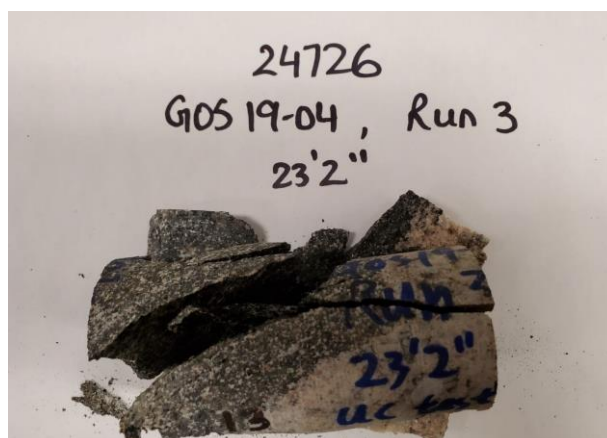
CLIENT:	Thurber Engineering (Ottawa)	FILE NUMBER:	24726
PROJECT NAME:	Highway 17 Twinning - Renfrew	REPORT DATE:	24-Mar-20
BOREHOLE No.:	GOS 19-04	TEST DATE:	12-Dec-19
SAMPLE No.:	NQ RUN 3		
SAMPLE DEPTH:	7.1m		
DESCRIPTION:	Gneiss		

Avg. Height (cm):	9.7	Weight (g):	493.8
Avg. Diameter (cm):	4.8	Wet Density (kg/m ³):	2,813
H. to Dia. Ratio**:	2:1	Dry Density (kg/m ³):	2,813
Cross Sectional Area (cm ²):	18.10	Moisture Content* (%):	N/A
Sample Volume (cm ³):	175.53		

ORIGINAL SPECIMEN



FRACTURED SPECIMEN



AVG. RATE OF STRAIN TO FAILURE:	1.5% / min
MAXIMUM COMPRESSIVE LOAD:	159.3 kN
UNCONFINED COMPRESSIVE STRENGTH:	88.0 MPa

Note: * Dimensions of Specimen conform to ASTM D 4543-04.

TEST DONE BY: BS
REVIEWED BY: WM

24726 - GOS 19-04 UCS Run 3, 23'2

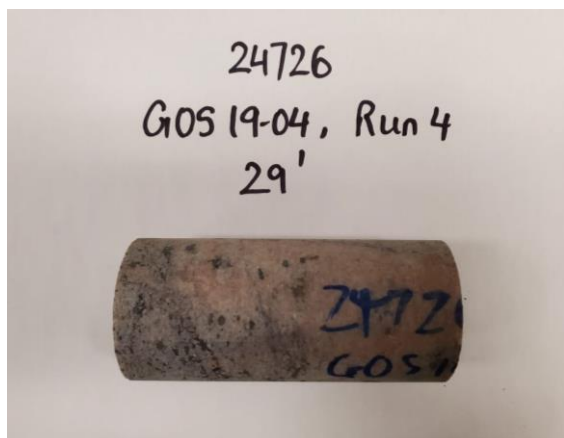
UNCONFINED COMPRESSION TEST REPORT

ASTM D7012-14

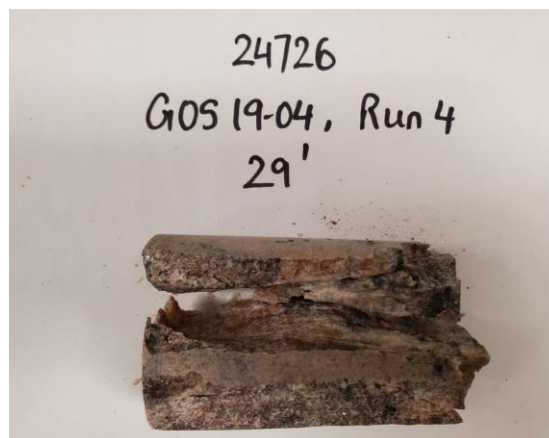
CLIENT:	Thurber Engineering (Ottawa)	FILE NUMBER:	24726
PROJECT NAME:	Highway 17 Twinning - Renfrew	REPORT DATE:	24-Mar-20
BOREHOLE No.:	GOS 19-04	TEST DATE:	12-Dec-19
SAMPLE No.:	NQ RUN 4		
SAMPLE DEPTH:	8.8m		
DESCRIPTION:	Gneiss		

Avg. Height (cm):	9.8	Weight (g):	467.9
Avg. Diameter (cm):	4.8	Wet Density (kg/m ³):	2,638
H. to Dia. Ratio**:	2:1	Dry Density (kg/m ³):	2,638
Cross Sectional Area (cm ²):	18.10	Moisture Content* (%):	N/A
Sample Volume (cm ³):	177.34		

ORIGINAL SPECIMEN



FRACTURED SPECIMEN



AVG. RATE OF STRAIN TO FAILURE:	1.5% / min
MAXIMUM COMPRESSIVE LOAD:	205.1 kN
UNCONFINED COMPRESSIVE STRENGTH:	113.3 MPa

Note: * Dimensions of Specimen conform to ASTM D 4543-04.

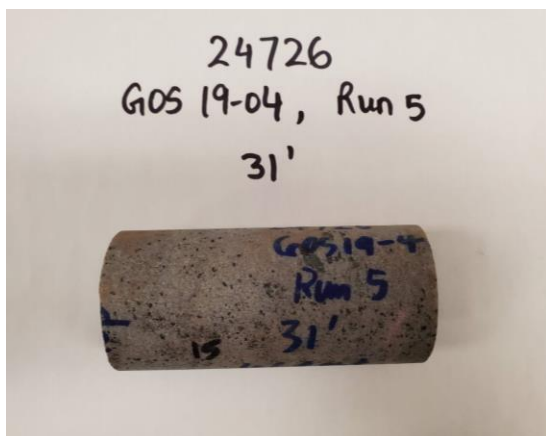
UNCONFINED COMPRESSION TEST REPORT

ASTM D7012-14

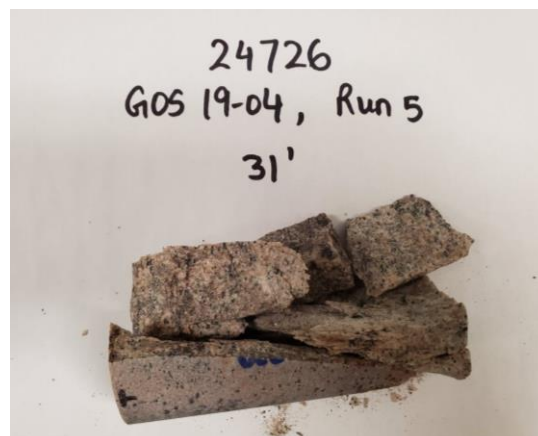
CLIENT:	Thurber Engineering (Ottawa)	FILE NUMBER:	24726
PROJECT NAME:	Highway 17 Twinning - Renfrew	REPORT DATE:	24-Mar-20
BOREHOLE No.:	GOS 19-04	TEST DATE:	12-Dec-19
SAMPLE No.:	NQ RUN 5		
SAMPLE DEPTH:	9.4m		
DESCRIPTION:	Gneiss		

Avg. Height (cm):	9.8	Weight (g):	471.2
Avg. Diameter (cm):	4.8	Wet Density (kg/m ³):	2,657
H. to Dia. Ratio**:	2:1	Dry Density (kg/m ³):	2,657
Cross Sectional Area (cm ²):	18.10	Moisture Content* (%):	N/A
Sample Volume (cm ³):	177.34		

ORIGINAL SPECIMEN



FRACTURED SPECIMEN



AVG. RATE OF STRAIN TO FAILURE:	1.5% / min
MAXIMUM COMPRESSIVE LOAD:	222.7 kN
UNCONFINED COMPRESSIVE STRENGTH:	123.1 MPa

Note: * Dimensions of Specimen conform to ASTM D 4543-04.

TEST DONE BY: BS
REVIEWED BY: WM

24726 - GOS 19-04 UCS Run 5, 31'0

UNCONFINED COMPRESSION TEST REPORT

ASTM D7012-14

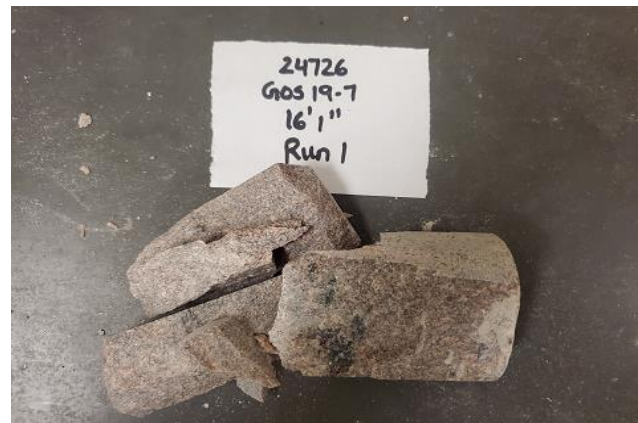
CLIENT:	Thurber Engineering Ltd. (Ottawa Office)	FILE NUMBER:	24726
PROJECT NAME:	Hwy 17 Twinning Renfrew to Haley Sta. Part 1B	REPORT DATE:	31-Aug-20
BOREHOLE No.:	GOS 19-07	TEST DATE:	27-Aug-20
SAMPLE No.:	Run 1		
SAMPLE DEPTH:	4.90 m		
DESCRIPTION:	Gneiss		

Avg. Height (cm):	13.0	Weight (g):	1112.9
Avg. Diameter (cm):	6.3	Wet Density (kg/m ³):	2,746
H. to Dia. Ratio**:	2.1:1	Dry Density (kg/m ³):	2,746
Cross Sectional Area (cm ²):	31.17	Moisture Content* (%):	0.0
Sample Volume (cm ³):	405.24		

ORIGINAL SPECIMEN



FRACTURED SPECIMEN



AVG. RATE OF STRAIN TO FAILURE:	1.2% / min
MAXIMUM COMPRESSIVE LOAD:	554.0 kN
UNCONFINED COMPRESSIVE STRENGTH:	177.7 MPa

Note: * The moisture content was obtained before the test.
 ** Dimensions of Specimen conform to ASTM D 4543-04.

TEST DONE BY: BS
 REVIEWED BY: WM

GOS 19-07 Run 1

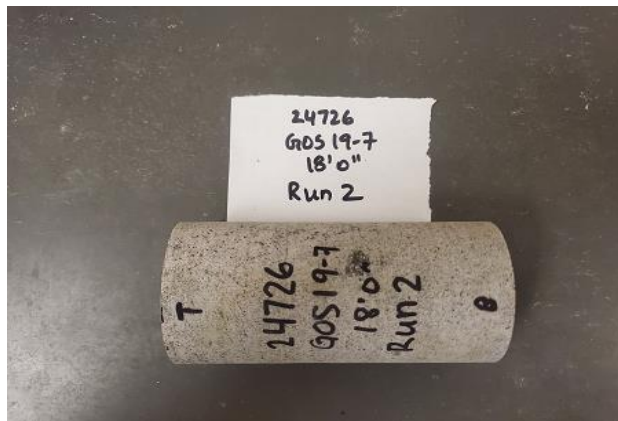
UNCONFINED COMPRESSION TEST REPORT

ASTM D7012-14

CLIENT:	Thurber Engineering Ltd. (Ottawa Office)	FILE NUMBER:	24726
PROJECT NAME:	Hwy 17 Twinning Renfrew to Haley Sta. Part 1B	REPORT DATE:	31-Aug-20
BOREHOLE No.:	GOS 19-07	TEST DATE:	27-Aug-20
SAMPLE No.:	Run 2		
SAMPLE DEPTH:	5.49 m		
DESCRIPTION:	Gneiss		

Avg. Height (cm):	12.8	Weight (g):	1106.4
Avg. Diameter (cm):	6.3	Wet Density (kg/m ³):	2,773
H. to Dia. Ratio**:	2:1	Dry Density (kg/m ³):	2,773
Cross Sectional Area (cm ²):	31.17	Moisture Content* (%):	0.0
Sample Volume (cm ³):	399.01		

ORIGINAL SPECIMEN



FRACTURED SPECIMEN



AVG. RATE OF STRAIN TO FAILURE:	1.2% / min
MAXIMUM COMPRESSIVE LOAD:	589.3 kN
UNCONFINED COMPRESSIVE STRENGTH:	189.0 MPa

Note: * The moisture content was obtained before the test.
 ** Dimensions of Specimen conform to ASTM D 4543-04.

TEST DONE BY: BS
 REVIEWED BY: WM

GOS 19-07 Run 2

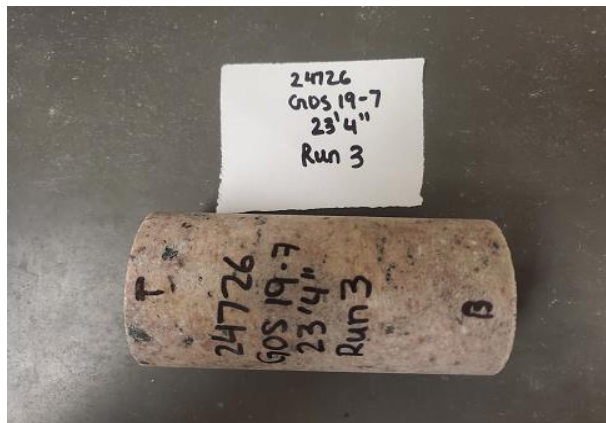
UNCONFINED COMPRESSION TEST REPORT

ASTM D7012-14

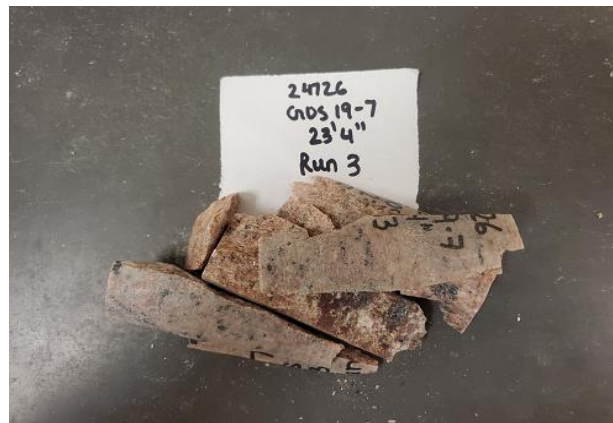
CLIENT:	Thurber Engineering Ltd. (Ottawa Office)	FILE NUMBER:	24726
PROJECT NAME:	Hwy 17 Twinning Renfrew to Haley Sta. Part 1B	REPORT DATE:	31-Aug-20
BOREHOLE No.:	GOS 19-07	TEST DATE:	27-Aug-20
SAMPLE No.:	Run 3		
SAMPLE DEPTH:	7.11 m		
DESCRIPTION:	Gneiss		

Avg. Height (cm):	12.7	Weight (g):	1045.3
Avg. Diameter (cm):	6.3	Wet Density (kg/m ³):	2,640
H. to Dia. Ratio**:	2:1	Dry Density (kg/m ³):	2,640
Cross Sectional Area (cm ²):	31.17	Moisture Content* (%):	0.0
Sample Volume (cm ³):	395.89		

ORIGINAL SPECIMEN



FRACTURED SPECIMEN



AVG. RATE OF STRAIN TO FAILURE:	1.2% / min
MAXIMUM COMPRESSIVE LOAD:	506.8 kN
UNCONFINED COMPRESSIVE STRENGTH:	162.6 MPa

Note: * The moisture content was obtained before the test.
** Dimensions of Specimen conform to ASTM D 4543-04.

TEST DONE BY: BS
REVIEWED BY: WM

GOS 19-07 Run 3

UNCONFINED COMPRESSION TEST REPORT

ASTM D7012-14

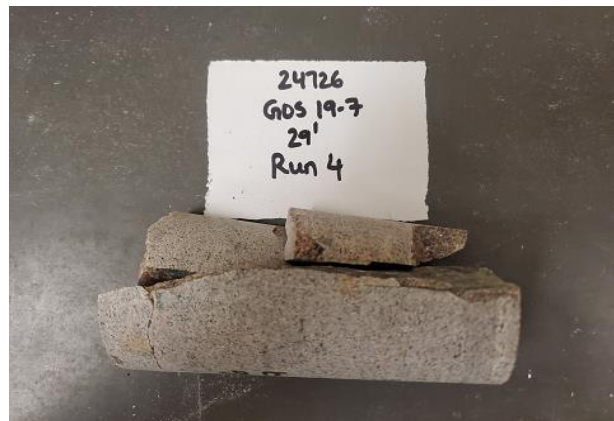
CLIENT:	Thurber Engineering Ltd. (Ottawa Office)	FILE NUMBER:	24726
PROJECT NAME:	Hwy 17 Twinning Renfrew to Haley Sta. Part 1B	REPORT DATE:	31-Aug-20
BOREHOLE No.:	GOS 19-07	TEST DATE:	27-Aug-20
SAMPLE No.:	Run 4		
SAMPLE DEPTH:	8.84 m		
DESCRIPTION:	Gneiss		

Avg. Height (cm):	12.8	Weight (g):	1089.1
Avg. Diameter (cm):	6.3	Wet Density (kg/m ³):	2,730
H. to Dia. Ratio**:	2:1	Dry Density (kg/m ³):	2,730
Cross Sectional Area (cm ²):	31.17	Moisture Content* (%):	0.0
Sample Volume (cm ³):	399.01		

ORIGINAL SPECIMEN



FRACTURED SPECIMEN



AVG. RATE OF STRAIN TO FAILURE:	1.2% / min
MAXIMUM COMPRESSIVE LOAD:	327.5 kN
UNCONFINED COMPRESSIVE STRENGTH:	105.1 MPa

Note: * The moisture content was obtained before the test.
 ** Dimensions of Specimen conform to ASTM D 4543-04.

TEST DONE BY: BS
 REVIEWED BY: WM

GOS 19-07 Run 4

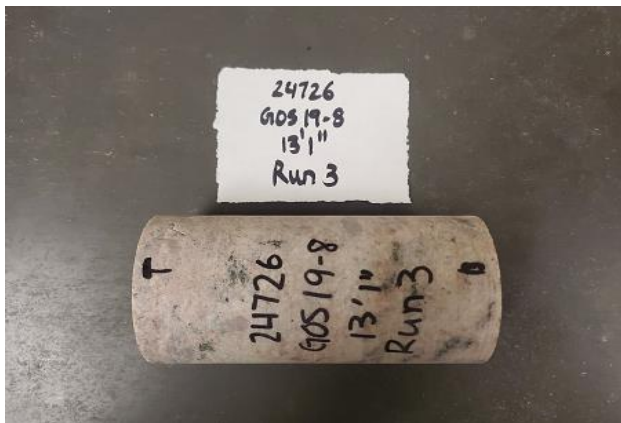
UNCONFINED COMPRESSION TEST REPORT

ASTM D7012-14

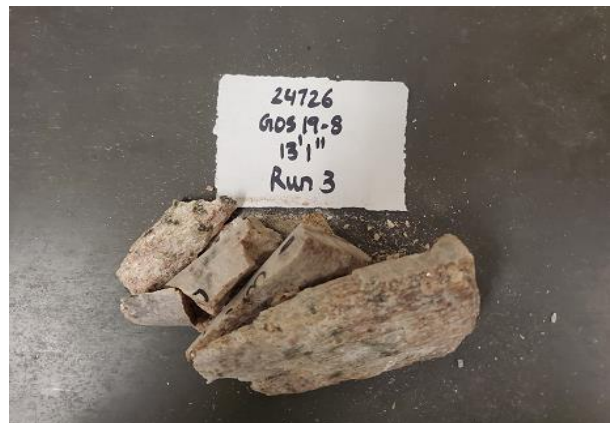
CLIENT:	Thurber Engineering Ltd. (Ottawa Office)	FILE NUMBER:	24726
PROJECT NAME:	Hwy 17 Twinning Renfrew to Haley Sta. Part 1B	REPORT DATE:	31-Aug-20
BOREHOLE No.:	GOS 19-08	TEST DATE:	27-Aug-20
SAMPLE No.:	Run 3		
SAMPLE DEPTH:	3.99 m		
DESCRIPTION:	Gneiss		

Avg. Height (cm):	12.8	Weight (g):	1049.2
Avg. Diameter (cm):	6.3	Wet Density (kg/m ³):	2,630
H. to Dia. Ratio**:	2:1	Dry Density (kg/m ³):	2,630
Cross Sectional Area (cm ²):	31.17	Moisture Content* (%):	0.0
Sample Volume (cm ³):	399.01		

ORIGINAL SPECIMEN



FRACTURED SPECIMEN



AVG. RATE OF STRAIN TO FAILURE:	1.2% / min
MAXIMUM COMPRESSIVE LOAD:	487.9 kN
UNCONFINED COMPRESSIVE STRENGTH:	156.5 MPa

Note: * The moisture content was obtained before the test.
 ** Dimensions of Specimen conform to ASTM D 4543-04.

TEST DONE BY: BS
 REVIEWED BY: WM

GOS 19-08 Run 3

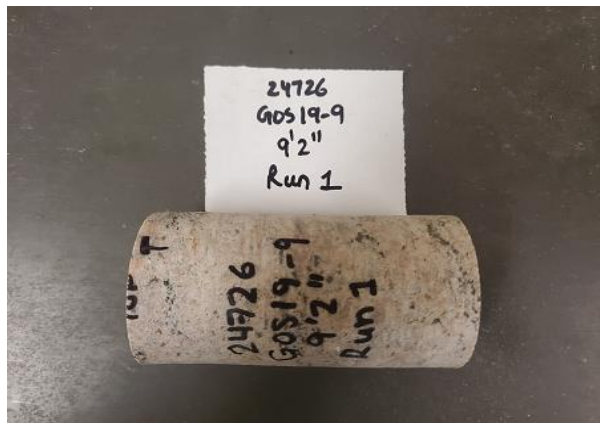
UNCONFINED COMPRESSION TEST REPORT

ASTM D7012-14

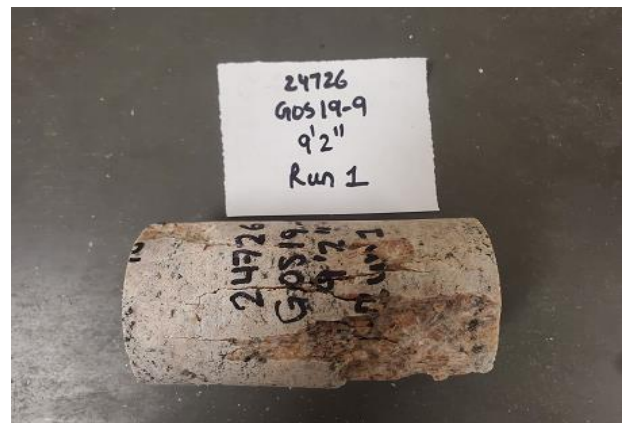
CLIENT:	Thurber Engineering Ltd. (Ottawa Office)	FILE NUMBER:	24726
PROJECT NAME:	Hwy 17 Twinning Renfrew to Haley Sta. Part 1B	REPORT DATE:	31-Aug-20
BOREHOLE No.:	GOS 19-09	TEST DATE:	27-Aug-20
SAMPLE No.:	Run 1		
SAMPLE DEPTH:	2.79 m		
DESCRIPTION:	Gneiss		

Avg. Height (cm):	11.6	Weight (g):	930.7
Avg. Diameter (cm):	6.2	Wet Density (kg/m ³):	2,658
H. to Dia. Ratio**:	1.9:1	Dry Density (kg/m ³):	2,658
Cross Sectional Area (cm ²):	30.19	Moisture Content* (%):	0.0
Sample Volume (cm ³):	350.21		

ORIGINAL SPECIMEN



FRACTURED SPECIMEN



AVG. RATE OF STRAIN TO FAILURE:	1.3% / min
MAXIMUM COMPRESSIVE LOAD:	330.2 kN
UNCONFINED COMPRESSIVE STRENGTH:	109.4 MPa

Note: * The moisture content was obtained before the test.
 ** Dimensions of Specimen do not conform to ASTM D 4543-04.

TEST DONE BY: BS
 REVIEWED BY: WM

GOS 19-09 Run 1

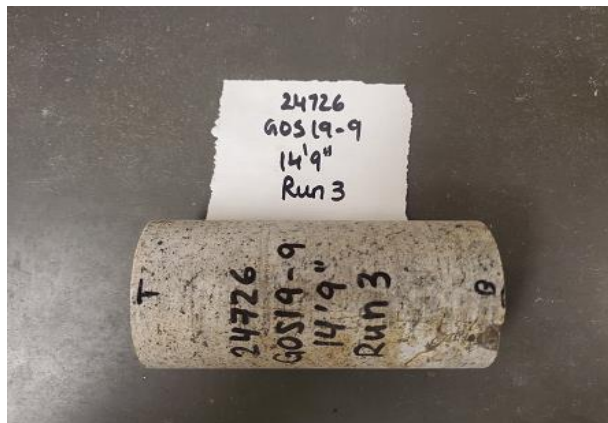
UNCONFINED COMPRESSION TEST REPORT

ASTM D7012-14

CLIENT:	Thurber Engineering Ltd. (Ottawa Office)	FILE NUMBER:	24726
PROJECT NAME:	Hwy 17 Twinning Renfrew to Haley Sta. Part 1B	REPORT DATE:	31-Aug-20
BOREHOLE No.:	GOS 19-09	TEST DATE:	27-Aug-20
SAMPLE No.:	Run 3		
SAMPLE DEPTH:	4.5 m		
DESCRIPTION:	Gneiss		

Avg. Height (cm):	12.9	Weight (g):	1067.3
Avg. Diameter (cm):	6.3	Wet Density (kg/m ³):	2,654
H. to Dia. Ratio**:	2:1	Dry Density (kg/m ³):	2,654
Cross Sectional Area (cm ²):	31.17	Moisture Content* (%):	0.0
Sample Volume (cm ³):	402.12		

ORIGINAL SPECIMEN



FRACTURED SPECIMEN



AVG. RATE OF STRAIN TO FAILURE:	1.2% / min
MAXIMUM COMPRESSIVE LOAD:	495.3 kN
UNCONFINED COMPRESSIVE STRENGTH:	158.9 MPa

Note: * The moisture content was obtained before the test.
** Dimensions of Specimen conform to ASTM D 4543-04.

TEST DONE BY: BS
REVIEWED BY: WM

GOS 19-09 Run 3

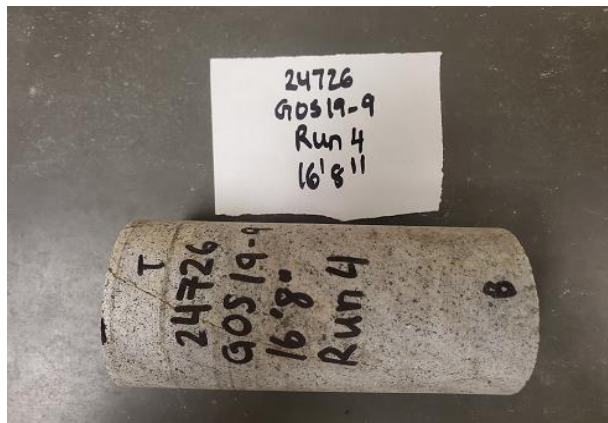
UNCONFINED COMPRESSION TEST REPORT

ASTM D7012-14

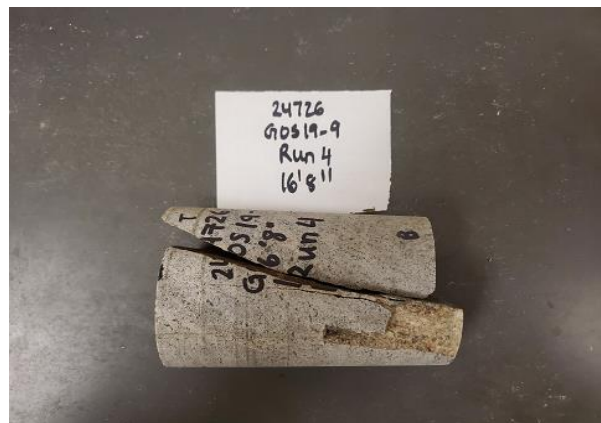
CLIENT:	Thurber Engineering Ltd. (Ottawa Office)	FILE NUMBER:	24726
PROJECT NAME:	Hwy 17 Twinning Renfrew to Haley Sta. Part 1B	REPORT DATE:	31-Aug-20
BOREHOLE No.:	GOS 19-09	TEST DATE:	27-Aug-20
SAMPLE No.:	Run 4		
SAMPLE DEPTH:	5.08 m		
DESCRIPTION:	Gneiss		

Avg. Height (cm):	13.0	Weight (g):	1095.8
Avg. Diameter (cm):	6.3	Wet Density (kg/m ³):	2,704
H. to Dia. Ratio**:	2.1:1	Dry Density (kg/m ³):	2,704
Cross Sectional Area (cm ²):	31.17	Moisture Content* (%):	0.0
Sample Volume (cm ³):	405.24		

ORIGINAL SPECIMEN



FRACTURED SPECIMEN



AVG. RATE OF STRAIN TO FAILURE:	1.2% / min
MAXIMUM COMPRESSIVE LOAD:	367.8 kN
UNCONFINED COMPRESSIVE STRENGTH:	118.0 MPa

Note: * The moisture content was obtained before the test.
 ** Dimensions of Specimen conform to ASTM D 4543-04.

TEST DONE BY: BS
REVIEWED BY: WM

GOS 19-09 Run 4

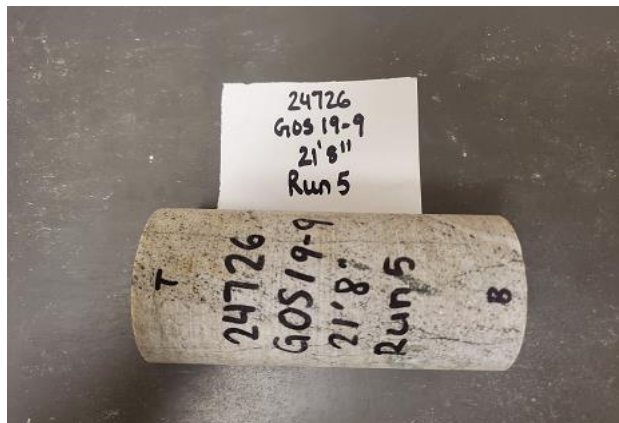
UNCONFINED COMPRESSION TEST REPORT

ASTM D7012-14

CLIENT:	Thurber Engineering Ltd. (Ottawa Office)	FILE NUMBER:	24726
PROJECT NAME:	Hwy 17 Twinning Renfrew to Haley Sta. Part 1B	REPORT DATE:	31-Aug-20
BOREHOLE No.:	GOS 19-09	TEST DATE:	27-Aug-20
SAMPLE No.:	Run 5		
SAMPLE DEPTH:	6.60 m		
DESCRIPTION:	Gneiss		

Avg. Height (cm):	12.9	Weight (g):	1069.1
Avg. Diameter (cm):	6.3	Wet Density (kg/m ³):	2,659
H. to Dia. Ratio**:	2:1	Dry Density (kg/m ³):	2,659
Cross Sectional Area (cm ²):	31.17	Moisture Content* (%):	0.0
Sample Volume (cm ³):	402.12		

ORIGINAL SPECIMEN



FRACTURED SPECIMEN



AVG. RATE OF STRAIN TO FAILURE:	1.2% / min
MAXIMUM COMPRESSIVE LOAD:	376.7 kN
UNCONFINED COMPRESSIVE STRENGTH:	120.8 MPa

Note: * The moisture content was obtained before the test.
 ** Dimensions of Specimen conform to ASTM D 4543-04.

TEST DONE BY: BS
 REVIEWED BY: WM

GOS 19-09 Run 5

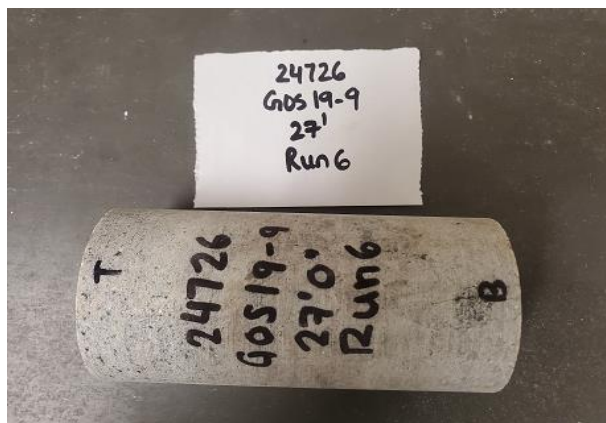
UNCONFINED COMPRESSION TEST REPORT

ASTM D7012-14

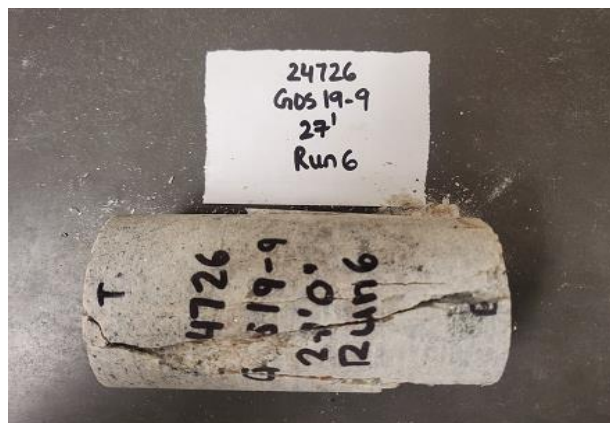
CLIENT:	Thurber Engineering Ltd. (Ottawa Office)	FILE NUMBER:	24726
PROJECT NAME:	Hwy 17 Twinning Renfrew to Haley Sta. Part 1B	REPORT DATE:	31-Aug-20
BOREHOLE No.:	GOS 19-09	TEST DATE:	27-Aug-20
SAMPLE No.:	Run 6		
SAMPLE DEPTH:	8.23 m		
DESCRIPTION:	Gneiss		

Avg. Height (cm):	12.8	Weight (g):	1044.2
Avg. Diameter (cm):	6.3	Wet Density (kg/m ³):	2,617
H. to Dia. Ratio**:	2:1	Dry Density (kg/m ³):	2,617
Cross Sectional Area (cm ²):	31.17	Moisture Content* (%):	0.0
Sample Volume (cm ³):	399.01		

ORIGINAL SPECIMEN



FRACTURED SPECIMEN



AVG. RATE OF STRAIN TO FAILURE:	1.2% / min
MAXIMUM COMPRESSIVE LOAD:	384.8 kN
UNCONFINED COMPRESSIVE STRENGTH:	123.4 MPa

Note: * The moisture content was obtained before the test.
 ** Dimensions of Specimen conform to ASTM D 4543-04.

TEST DONE BY: BS
 REVIEWED BY: WM

GOS 19-09 Run 6

UNCONFINED COMPRESSION TEST REPORT

ASTM D7012-14

CLIENT:	Thurber Engineering Ltd. (Ottawa Office)	FILE NUMBER:	24726
PROJECT NAME:	Hwy 17 Twinning Renfrew to Haley Sta. Part 1B	REPORT DATE:	31-Aug-20
BOREHOLE No.:	GOS 19-10	TEST DATE:	27-Aug-20
SAMPLE No.:	Run 2		
SAMPLE DEPTH:	6.25 m		
DESCRIPTION:	Gneiss		

Avg. Height (cm):	13.0	Weight (g):	1096.7
Avg. Diameter (cm):	6.3	Wet Density (kg/m ³):	2,706
H. to Dia. Ratio**:	2.1:1	Dry Density (kg/m ³):	2,706
Cross Sectional Area (cm ²):	31.17	Moisture Content* (%):	0.0
Sample Volume (cm ³):	405.24		

ORIGINAL SPECIMEN



FRACTURED SPECIMEN



AVG. RATE OF STRAIN TO FAILURE:	1.2% / min
MAXIMUM COMPRESSIVE LOAD:	521.4 kN
UNCONFINED COMPRESSIVE STRENGTH:	167.3 MPa

Note: * The moisture content was obtained before the test.
 ** Dimensions of Specimen conform to ASTM D 4543-04.

TEST DONE BY: BS
 REVIEWED BY: WM

GOS 19-10 Run 2

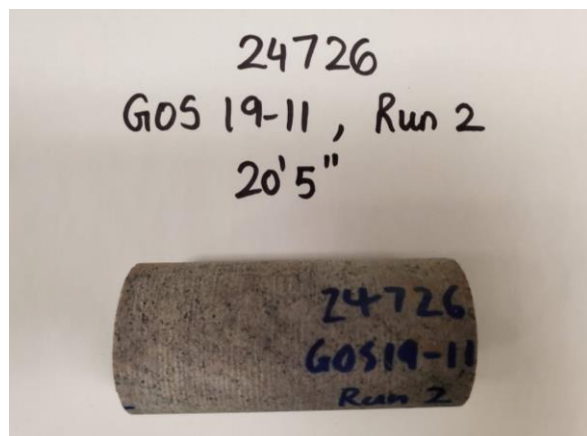
UNCONFINED COMPRESSION TEST REPORT

ASTM D7012-14

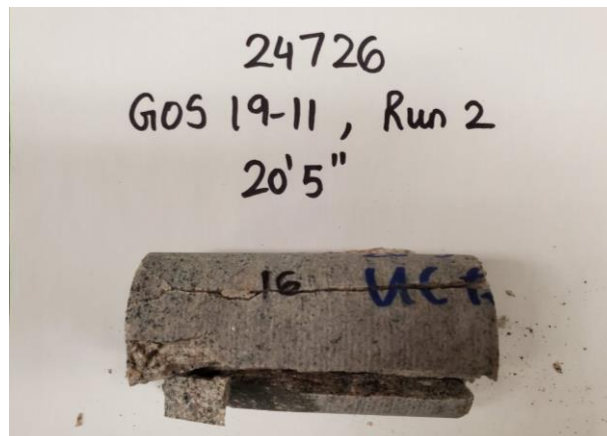
CLIENT:	Thurber Engineering (Ottawa)	FILE NUMBER:	24726
PROJECT NAME:	Highway 17 Twinning - Renfrew	REPORT DATE:	24-Mar-20
BOREHOLE No.:	GOS 19-11	TEST DATE:	12-Dec-19
SAMPLE No.:	NQ RUN 2		
SAMPLE DEPTH:	6.2m		
DESCRIPTION:	Gneiss		

Avg. Height (cm):	9.7	Weight (g):	464.7
Avg. Diameter (cm):	4.8	Wet Density (kg/m ³):	2,647
H. to Dia. Ratio**:	2:1	Dry Density (kg/m ³):	2,647
Cross Sectional Area (cm ²):	18.10	Moisture Content* (%):	N/A
Sample Volume (cm ³):	175.53		

ORIGINAL SPECIMEN



FRACTURED SPECIMEN



AVG. RATE OF STRAIN TO FAILURE:	1.5% / min
MAXIMUM COMPRESSIVE LOAD:	205.9 kN
UNCONFINED COMPRESSIVE STRENGTH:	113.8 MPa

Note: * Dimensions of Specimen conform to ASTM D 4543-04.

TEST DONE BY: BS
REVIEWED BY: WM

24726 - GOS 19-11 UCS Run 2, 20'5

UNCONFINED COMPRESSION TEST REPORT

ASTM D7012-14

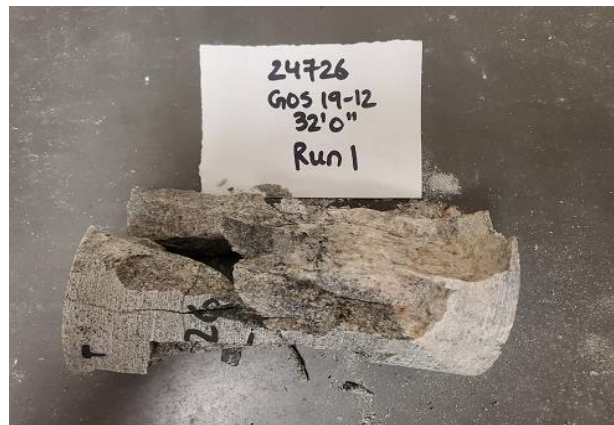
CLIENT:	Thurber Engineering Ltd. (Ottawa Office)	FILE NUMBER:	24726
PROJECT NAME:	Hwy 17 Twinning Renfrew to Haley Sta. Part 1B	REPORT DATE:	31-Aug-20
BOREHOLE No.:	GOS 19-12	TEST DATE:	27-Aug-20
SAMPLE No.:	Run 1		
SAMPLE DEPTH:	9.75 m		
DESCRIPTION:	Gneiss		

Avg. Height (cm):	12.8	Weight (g):	1051.4
Avg. Diameter (cm):	6.2	Wet Density (kg/m ³):	2,721
H. to Dia. Ratio**:	2.1:1	Dry Density (kg/m ³):	2,721
Cross Sectional Area (cm ²):	30.19	Moisture Content* (%):	0.0
Sample Volume (cm ³):	386.44		

ORIGINAL SPECIMEN



FRACTURED SPECIMEN



AVG. RATE OF STRAIN TO FAILURE:	1.2% / min
MAXIMUM COMPRESSIVE LOAD:	366.8 kN
UNCONFINED COMPRESSIVE STRENGTH:	121.5 MPa

Note: * The moisture content was obtained before the test.
 ** Dimensions of Specimen conform to ASTM D 4543-04.

TEST DONE BY: BS
 REVIEWED BY: WM

GOS 19-12 Run 1



Appendix C.4

Bedrock Core Photographs

Borehole GOS 19-01
Run 1 to 3 (of 3)
Elevation 156.9 m to 153.5 m

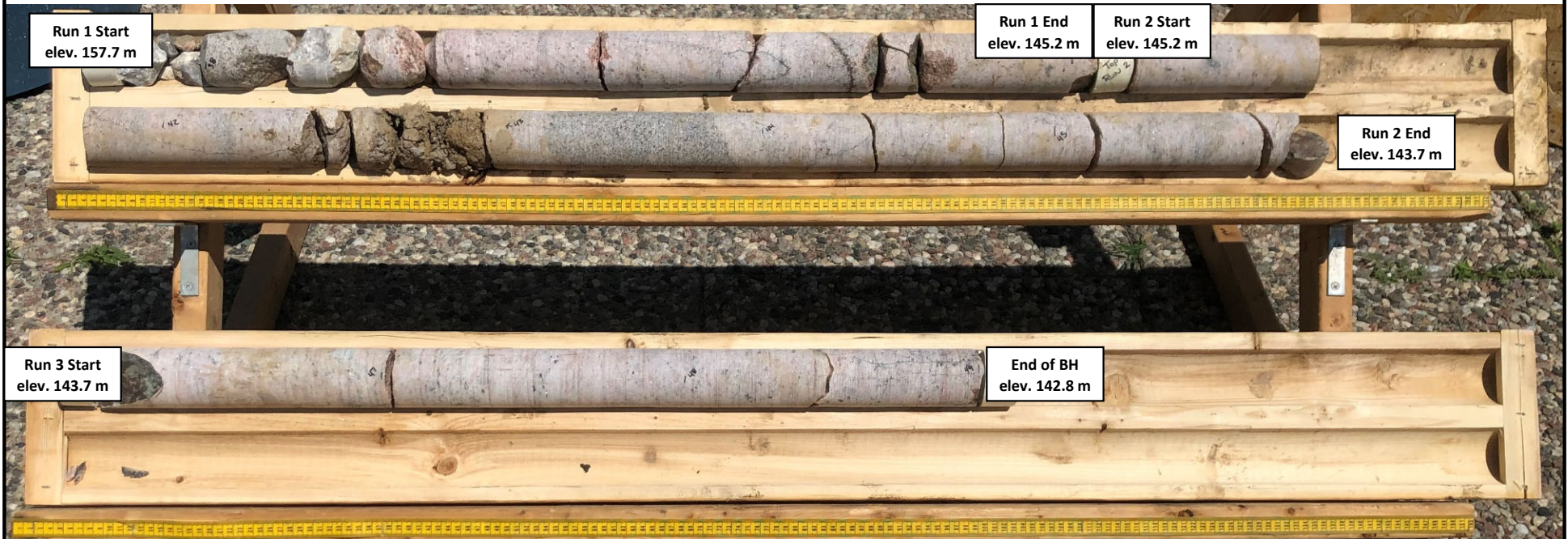


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Geotechnical Investigation
Goshen Road Overpasses
Renfrew, Ontario

W.P. 4068-09-00
Project No.: 24726

Borehole GOS 19-02
Run 1 to 3 (of 3)
Elevation 157.7 m to 154.3 m



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Borehole GOS 19-03
Run 1 to 3 (of 3)
Elevation 166.7 m to 163 m



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Borehole GOS 19-04
Run 1 to 2 (of 5)
Elevation 165.6 m to 162 m



Borehole GOS 19-04W

Run 1 to 3 (of 3)

Elevation 164.9 m to 160.6 m

NQ5 Start
elev. 164.9 m

NQ5 End
elev. 164.0 m

Run 1 Start
elev. 164.0 m

Run 1 End
elev. 163.5 m

Run 2 Start
elev. 163.5 m

Run 2 End
elev. 162.1 m

Run 3 Start
elev. 162.1 m

Run 3 End
elev. 160.6 m



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Borehole GOS 19-05
Run 3 to 5 (of 5)
Elevation 162 m to 158.4 m

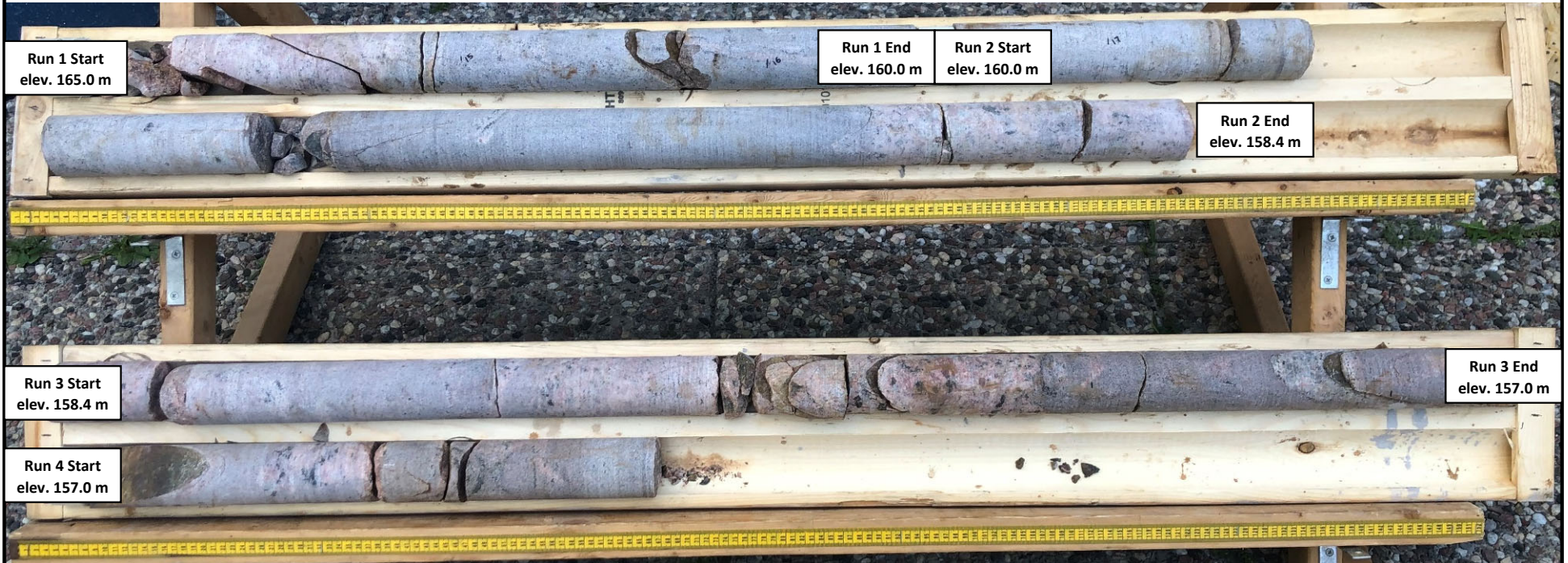


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Borehole GOS 19-7
Run 1 to 4 (of 5)
Elevation 165.0 m to 155.2 m



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Borehole GOS 19-7
Run 4 to 5 (of 5)
Elevation 165.0 m to 155.2 m



Borehole GOS 19-8
Run 1 to 4 (of 4)
Elevation 166.4 m to 159.9 m

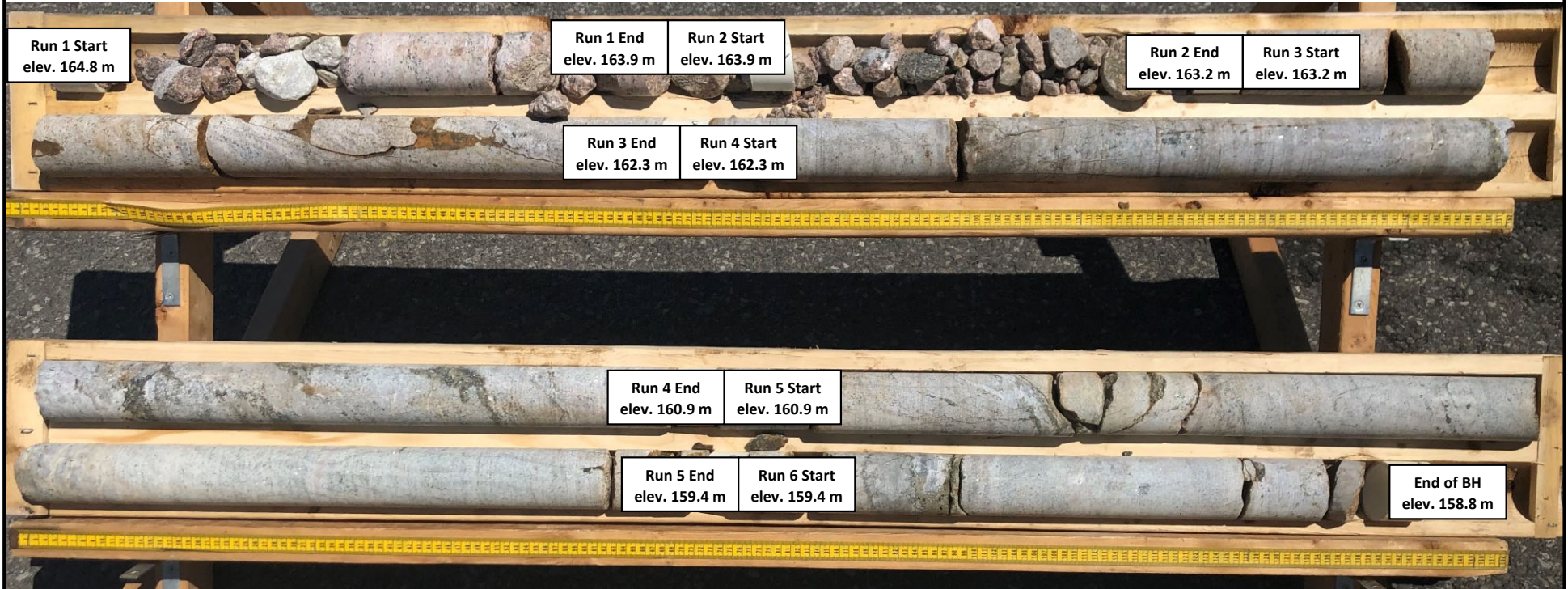


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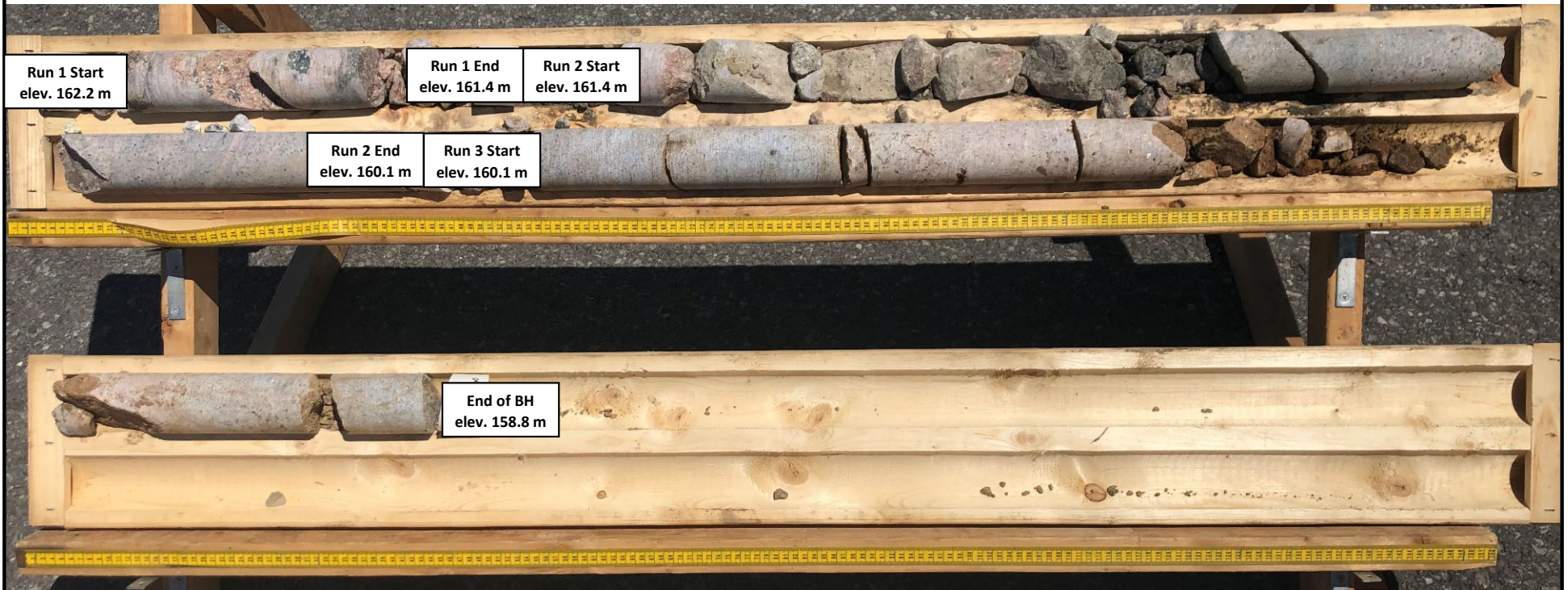
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Borehole GOS 19-9
Run 1 to 6 (of 6)
Elevation 164.8 m to 158.8 m



Borehole GOS 19-10
Run 1 to 3 (of 3)
Elevation 162.2 m to 158.8 m



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Borehole GOS 19-11
Run 1 to 2 (of 2)
Elevation 162.5 m to 159.2 m

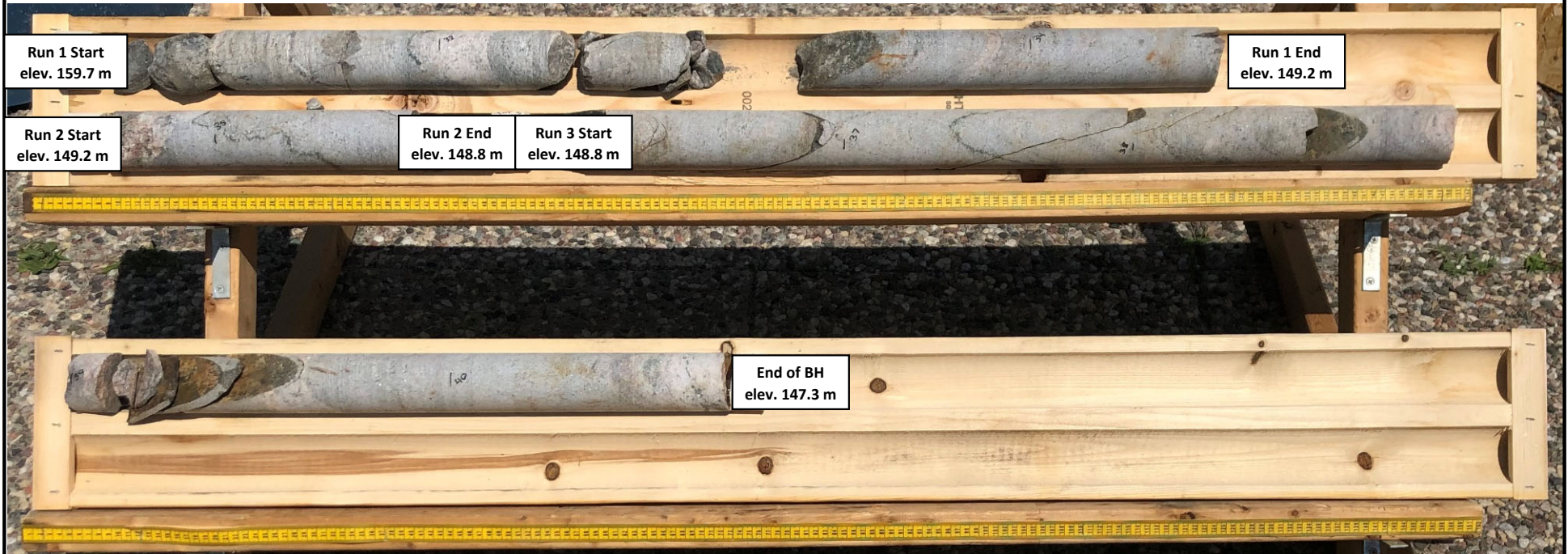


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Borehole GOS 19-12
Run 1 to 3 (of 3)
Elevation 159.7 m to 147.3 m



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Appendix D.
Site Photographs



Photo 1. Looking north from existing Highway 17 alignment at Goshen Rd (2020/07/08)



Photo 2. Looking south from existing Highway 17 alignment at Goshen Rd (2020/07/08)



Photo 3. Looking south towards existing Highway 17 from Goshen Road (2019/09/04)