



THURBER ENGINEERING LTD.

FINAL
FOUNDATION INVESTIGATION REPORT
HIGHWAY 11 UNDERPASS STRUCTURE
MUSKOKA RD 14/FRASERBURG RD, DISTRICT OF MUSKOKA
AGREEMENT NO. 5017-E-0003
Site No.: 42X-0189

G.W.P. 5138-13-00

Geocres No.: **31E-391**

Report to:

McIntosh Perry Consulting Engineers Limited

Latitude: 45.035188
Longitude: -79.292677

February 2019
Thurber File: 20244

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Geocres No.: 31E-391

PART 1. FACTUAL INFORMATION

1 INTRODUCTION

This section of the report presents the factual findings obtained from a foundation investigation completed at the Muskoka Road 14 (Fraserburg Road) crossing of Highway 11, located approximately 4.6 km north of Highway 118 within the District of Muskoka. Thurber Engineering Limited (Thurber) carried out the current field investigation as a sub-consultant to McIntosh Perry Consulting Engineers Ltd. (MPCE) under Assignment No. 5017-E-0003.

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. A model of the subsurface conditions influencing design and construction was developed in the course of the current investigation. The following historical foundation investigation report was obtained from the online Geocres library and reviewed in preparation of this report.

Ministry of Transportation and Communications (1986); Foundation Investigation and Design Report for Muskoka Road 14 Underpass (Fraserburg Road), Highway 11, Huntsville; Geocres No. 31E-101

2 SITE DESCRIPTION

The project assignment includes an underpass structure that is a two span cast in place post tensioned voided concrete slab bridge. The existing underpass conveys Muskoka Road 14 (Fraserburg Road) in a west – east alignment at an approximate skew of 29 degrees over Highway 11.

The underpass (Structure No.42X-0189) has two spans of 39 m each, a road width of 8.5 m and an overall width of 9.46 m. The clearance under the structure is approximately 5.2 m. The structure is understood to have been constructed in 1989 and has not yet been rehabilitated. The foundations are documented to consist of H-piles driven to bedrock at the west abutment and H-piles driven to refusal at the east abutment and pier. Wingwalls are present at the structure ends.

FINAL

At the location of the underpass structure, Highway 11 is a four-lane divided highway with a rural cross-section, paved shoulders and a grassed median. The approach fill height is approximately 5.3 to 7.1 m with the Muskoka Road 14 (Fraserburg Road) road surface at approximate elevation 260.2 m. The existing embankment slopes are inclined at approximately 2.4H:1V. Reinforced concrete barrier walls are situated on each side of the deck as guardrails.

The land adjacent to the highway is agricultural and vegetated with grasses, shrubs and trees. Traffic volumes on this section of Highway 11 are understood to be 14,800 AADT (2016).

Select photographs showing the existing conditions in the area of the underpass at the time of the field investigation are included in Appendix D for reference.

3 SITE INVESTIGATION AND FIELD TESTING

The site investigation and field testing program was carried out on April 29th, 2018. The field investigation consisted of advancing two boreholes identified as 18-1 and 18-2 near the abutments of the structure. The drilling was carried out using a truck mounted CME 55 drill rig. Prior to commencement of drilling, utility clearances were obtained in the vicinity of the borehole locations.

Soil samples were obtained at selected intervals using a split spoon sampler in conjunction with Standard Penetration Testing (SPT). A thin walled (Shelby) tube sample was attempted at a depth of 14.0 m in Borehole 18-2. The boreholes were sampled to depths of 17.1 and 19.5 m (elev. 243.9 and 239.9 m) below the existing ground surface in Boreholes 18-1 and 18-2, respectively.

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

The approximate borehole locations are shown on the Borehole Locations and Soil Strata Drawing included in Appendix A. The coordinates and elevations of the boreholes are provided on this drawing and on the individual Record of Borehole sheets. The northing and easting (MTM zone 10), elevation, and termination depth of the boreholes are summarized below in Table 3-1. The borehole elevations were surveyed relative to benchmark Pt. 301 (elev. 260.701 m), provided by MPCE, with a Nikon-AP-8 with an accuracy of +/- 1.5 mm. Horizontal locations were measured relative to existing site features.

Table 3-1: Borehole Summary

Borehole No.	Drilled Location	Northing (m)	Easting (m)	Ground Surface Elevation (m)	Termination Depth (m)
18-1	West of Structure, EB Lane	4 988 350.1	321 076.7	260.9	17.1
18-2	East of Structure, EB Lane	4 988 392.0	321 192.7	259.4	19.5

Following completion of the field investigation the boreholes were backfilled in accordance with MOE requirements (O.Reg. 903 as amended). All boreholes were backfilled with granulars within the depth of pavement structure and capped with 150 mm of cold patch asphalt to reinstate the traveling surface.

4 LABORATORY TESTING

The recovered soil samples were subjected to visual identification and to natural moisture content determination. Selected samples were also subjected to gradation analysis (hydrometer and/or sieve) and Atterberg Limit testing. The results of these tests are summarized on the Record of Borehole sheets included in Appendix B. One sample of soil recovered from within each Borehole was selected and submitted for analytical testing of corrosivity parameters. All laboratory test results from the field investigation are provided in Appendix C.

5 DESCRIPTION OF SUBSURFACE CONDITIONS

Details of the encountered soil stratigraphy are presented on the Record of Borehole sheets included in Appendix B and 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 paragraphs. However, the factual data presented on the Record of Borehole sheets takes precedence over this general description for interpretation of the site conditions. It must be recognized that the soil and groundwater conditions may vary between and beyond borehole locations.

In general terms, the site was found to be underlain by a pavement structure, sand fill overlying native silt which was underlain by a clay deposit and silt and silty sand layers. Bedrock was not encountered within the depth of the current investigation.

The historic 1986 boreholes from Geocres Report 31E-101 have also been included in Appendix B and their locations indicated on Drawing No. 608600-A in Appendix A. The locations and ground surface elevation for these boreholes are approximate. The 1986 borehole records indicate firm to stiff silty clay over very loose to compact silt over compact to very dense silty sand. Bedrock was proven by coring at elevation of 229.1 and 213.5 m near the west abutment and median pier, respectively. It is expected that conditions have changed as a result of the bridge and embankment construction since these holes were

drilled in 1986, therefore the historic documents have not been included in the following descriptions.

5.1 Embankment

5.1.1 Asphalt

Both boreholes were drilled through the existing Muskoka Road 14 (Fraserburg Road) approach embankments and encountered a layer of asphalt at the surface with a thickness of 50 to 125 mm.

5.1.2 Fill: Sand with gravel

Encountered below the asphalt was a layer of granular fill making up the pavement structure and consisting of sand with various amounts of gravel. The underside depth of the granular fill was at 1.5 m (elev. 257.9 to 259.4 m) below the existing roadway.

SPT tests conducted in this fill gave N-values ranging from 25 to 41 blows indicating a relative density of compact to dense.

Recorded moisture contents ranged from 2 to 6%.

5.1.3 Fill: Sand with silt

Below the pavement structure in both boreholes was a layer of fill consisting predominantly of sand to sand with silt. The sand fill was 4.6 to 7.2 m thick and the underside of the sand fill was at 6.1 and 8.7 m (elev. 254.8 and 250.8 m) below the existing roadway surface in Boreholes 18-1 and 18-2, respectively.

The SPT tests conducted in this fill gave N-values ranging from 12 to 66 blows indicating a relative density of compact to very dense.

Recorded moisture contents ranged from 3 to 14%. The results of grain size analyses conducted on two samples of the sand fill are summarized below and are illustrated on Figure C1 in Appendix C.

Soil Particle	Percentage (%)
Gravel	3 – 14
Sand	81 – 91
Silt & Clay	5 – 6

5.2 Silt (ML)

Below the embankment in both boreholes was a native silt with varying amounts of sand. Wood fragments were encountered near the base of this layer in Borehole 18-2. The thickness of this layer ranged from 0.8 to 3.0 m with a base elevation ranging from 254.1 to 247.7 m.

The SPT tests conducted in the silt layer gave N-values ranging from 5 to 7 indicating a relative density of loose.

Recorded moisture contents ranged from 18 to 25%. One moisture content as high as 137% was recorded in Borehole 18-2 within the sample containing wood fragments. Atterberg Limits testing on two samples indicated that this material was non-plastic. The results of grain size analyses conducted on two samples of the silt are summarized below and illustrated on Figure C2 in Appendix C.

Soil Particle	Percentage (%)
Gravel	0
Sand	11 – 23
Silt	64 – 82
Clay	7 – 13

5.3 Clay (CL to CH)

Both boreholes encountered a clay deposit below the silt layer. The thickness of this layer ranged from 3.1 to 5.3 m with a base elevation ranging from 244.7 to 248.7 m. Traces of wood fragments were noted in Borehole 18-2.

In-situ shear vane test results indicated undrained shear strength ranging from 45 to 75 kPa indicating a firm to stiff consistency. The results of the in-situ shear vane tests indicate that the clay exhibits sensitivity. SPT tests gave N-values ranging from 1 to 3 blows.

Recorded moisture contents ranged from 32 to 59%. The results of grain size analyses conducted on two samples of the clay are summarized below and illustrated on Figure C3 in Appendix C.

Soil Particle	Percentage (%)
Gravel	0
Sand	1 – 3
Silt	36 – 57
Clay	42 – 61

The results of Atterberg Limits testing completed on two samples of this material indicated a liquid limit ranging from 31 to 64, a plastic limit ranging from 17 to 27, and a plasticity index ranging from 14 to 37. The laboratory results indicate that the clay ranges from low to high plasticity (CL to CH). The results are summarized on the Record of Borehole sheets in Appendix B and the Atterberg Limits graph is included in Figure C5 of Appendix C.

5.4 Silty Sand (SM)

A deposit of silty sand was encountered below the clay in both boreholes. Traces of wood fibres were noted in Borehole 18-2. Borehole 18-2 was terminated within this layer at an elevation of 239.9 m. The thickness of this layer in Borehole 18-1 was 0.4 m with a base elevation of 248.3 m. A 0.6 m thick silt layer was encountered within this silty sand deposit in Borehole 18-2, see Section 5.5.

The SPT tests conducted in this silty sand layer gave N-values ranging from 6 to 38 blows indicating a relative density of loose to dense.

The recorded moisture contents ranged from 16 to 44%. The results of a grain size analysis conducted on one sample of the silty sand are summarized below and illustrated on Figure C4 in Appendix C.

Soil Particle	Percentage (%)
Gravel	0
Sand	71
Silt	26
Clay	3

5.5 Lower Silt (ML)

A lower deposit of silt with varying amounts of sand was encountered below the silty sand in Borehole 18-1 and within the silty sand layer in Borehole 18-2. Borehole 18-1 was terminated within this lower silt layer at an elevation of 243.9 m. The thickness of this lower silt deposit in Borehole 18-2 was 0.6 m with a base elevation of 240.6 m.

The SPT tests conducted in the lower silt layer gave N-values ranging from 9 to 22 indicating a relative density of loose to compact.

Recorded moisture contents ranged from 19 to 30%. Atterberg Limits testing on one sample indicated that this material was non-plastic. The results of a grain size analysis conducted on one sample of the lower silt are summarized below and illustrated on Figure C2 in Appendix C.

Soil Particle	Percentage (%)
Gravel	0
Sand	1
Silt	94
Clay	5

5.6 Bedrock

Bedrock was not encountered within the depth of the current investigation.

5.7 Groundwater

The groundwater level measured in both boreholes during drilling operations on April 29th, 2018 was recorded to be at an elevation of 251.3 and 252.4 m.

These observations are considered short term and it should be noted that the groundwater level at the time of construction could 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 events.

5.8 Analytical Testing

Two samples of soil 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 the table below:

Borehole (sample)	Depth (mbgs)	Sulphate (µg/g)	pH (-)	Resistivity (Ohm-cm)	Conductivity (uS/cm)	Chloride (µg/g)	Sulphide %
18-1 (SS10)	6.9 – 7.5	51	5.56	2,130	469	246	<0.02
18-2 (SS12A)	10.7 – 11.1	10	5.32	3,810	262	120	<0.02

6 MISCELLANEOUS

Borehole locations were selected by Thurber relative to the bridge abutments and other site features. The as-drilled locations and ground surface elevation of the boreholes were measured by Thurber following completion of the field program. Base plan drawings and survey benchmarks were provided by MPCE.

George Downing Estate Drilling Ltd. of Hawkesbury, Ontario supplied and operated the drilling equipment to conduct the drilling, soil sampling, in-situ testing and borehole decommissioning of the boreholes. The field investigation was supervised on a full time basis by Mr. Sean O'Bryan. of Thurber. Overall supervision of the field investigation program was provided by Mr. Stephen Peters, P.Eng.

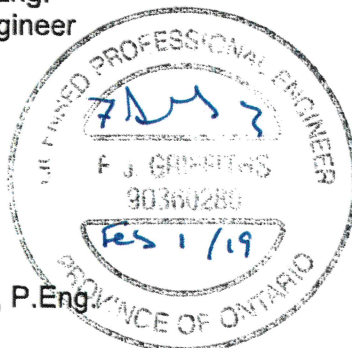
Routine geotechnical laboratory testing was completed by Thurber's laboratory in Ottawa, Ontario. Analytical testing was completed by Paracel Laboratories in Ottawa, Ontario. Interpretation of the factual data and preparation of this report were carried out by Miss Katya Edney, P.Eng. and Mr. Stephen Peters, P.Eng. The report was reviewed by Dr. Fred Griffiths, P.Eng and Dr. P.K. Chatterji, P.Eng. a Designated Principal Contact for MTO Foundation Projects.



Katya Edney, P.Eng.
Geotechnical Engineer



Stephen Peters, P.Eng.
Associate
Geotechnical Engineer



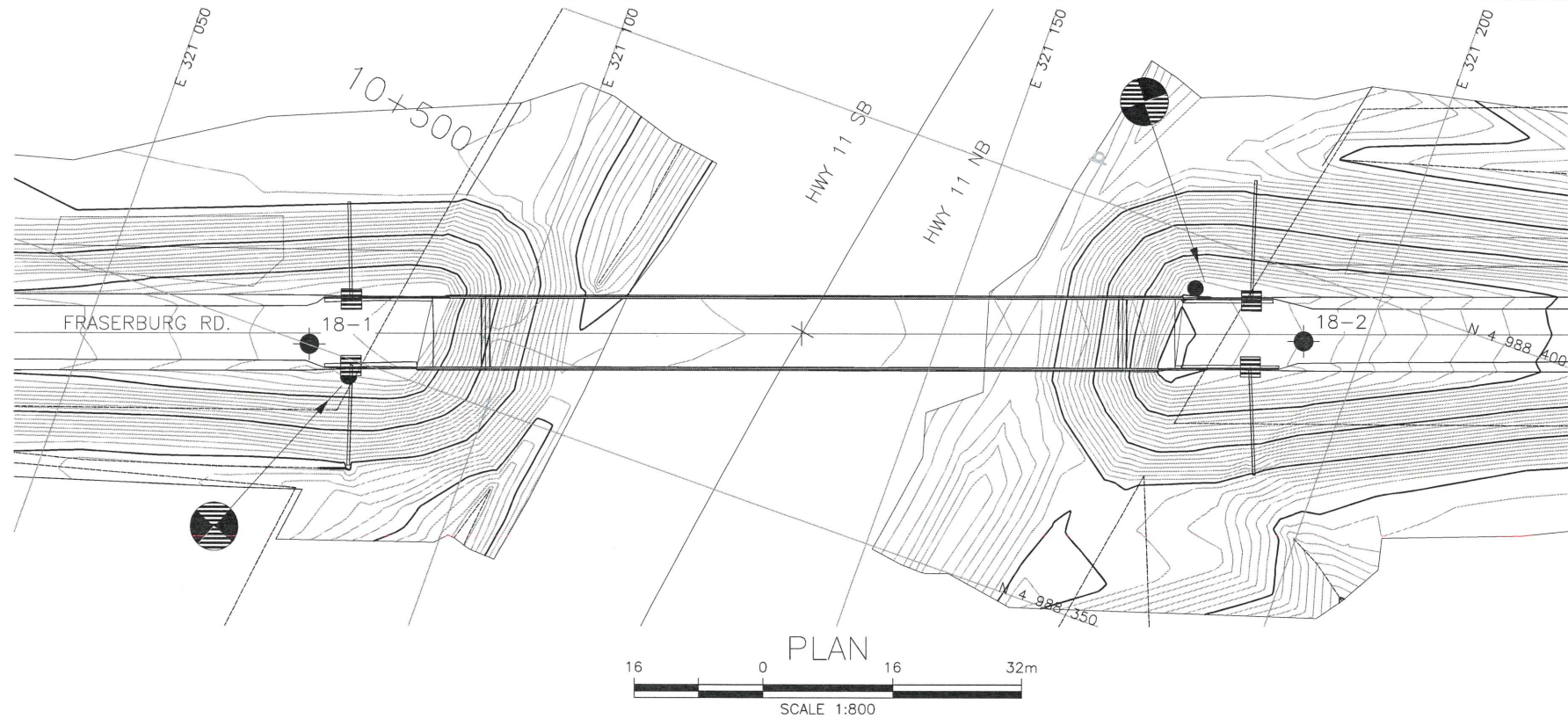
Dr. Fred Griffiths, P.Eng.
Senior Associate
Senior Geotechnical Engineer



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

Appendix A.

Borehole Location Plan and Stratigraphic Drawings



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



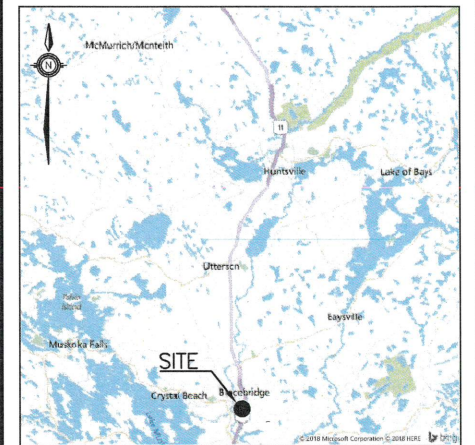
CONT No 2019-XXXX
WP No 5137-13-01

FRASERBURG ROAD
UNDERPASS
BOREHOLE LOCATIONS AND SOIL STRATA

McINTOSH PERRY



THURBER ENGINEERING LTD.



KEYPLAN LEGEND

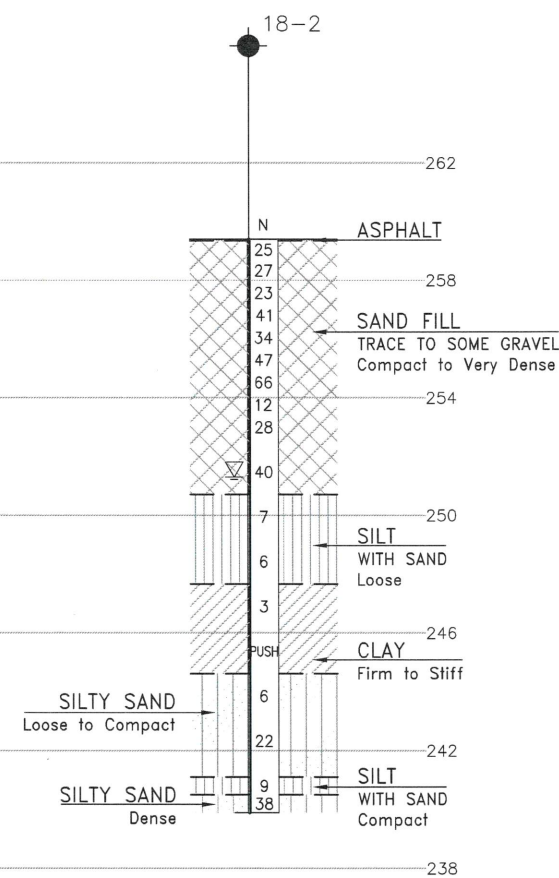
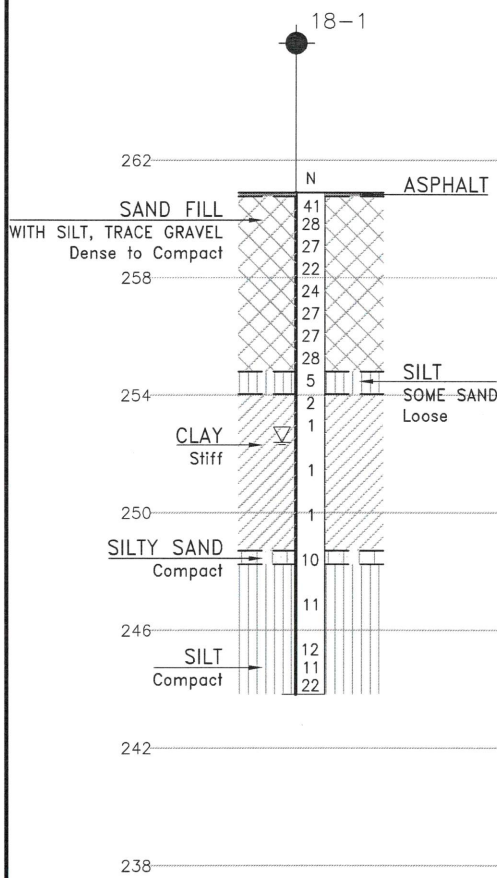
- Borehole
- Borehole & Cone
- N Blows /0.3m (Std Pen Test, 475J/blow)
- CONE Blows /0.3m (60° Cone, 475J/blow)
- PH Pressure, Hydraulic
- Water Level
- Head Artesian Water
- Piezometer
- 90% Rock Quality Designation (RQD)
- A/R Auger Refusal

NO	ELEVATION	NORTHING	EASTING
18-1	260.9	4 988 350.1	321 076.7
18-2	259.4	4 988 392.0	321 192.7

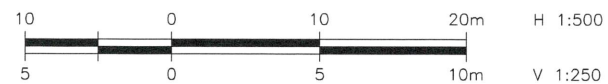
NOTES

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

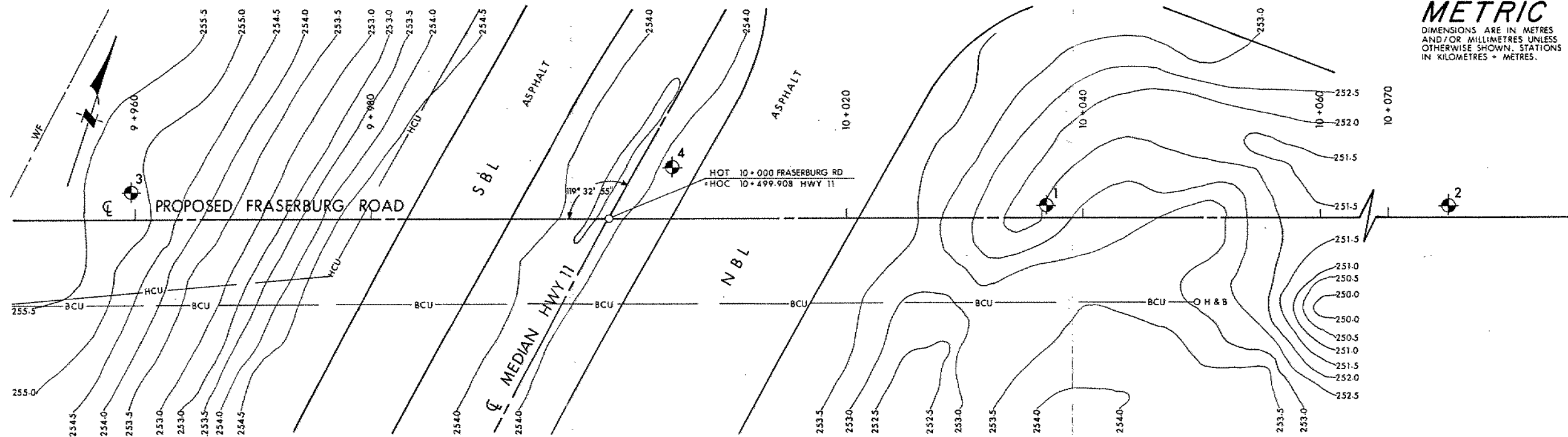
GEOCREs No. 31E-391



PROFILE ALONG Q FRASERBURG ROAD



DATE	BY	DESCRIPTION
DESIGN KE	CHK SP	CODE
DRAWN AN	CHK KE	SITE 42X-0189/BQ/STRUCT
		LOAD
		DATE FEB 2019
		DWG R2-02



METRIC
DIMENSIONS ARE IN METRES
AND/OR MILLIMETRES UNLESS
OTHERWISE SHOWN. STATIONS
IN KILOMETRES + METRES.

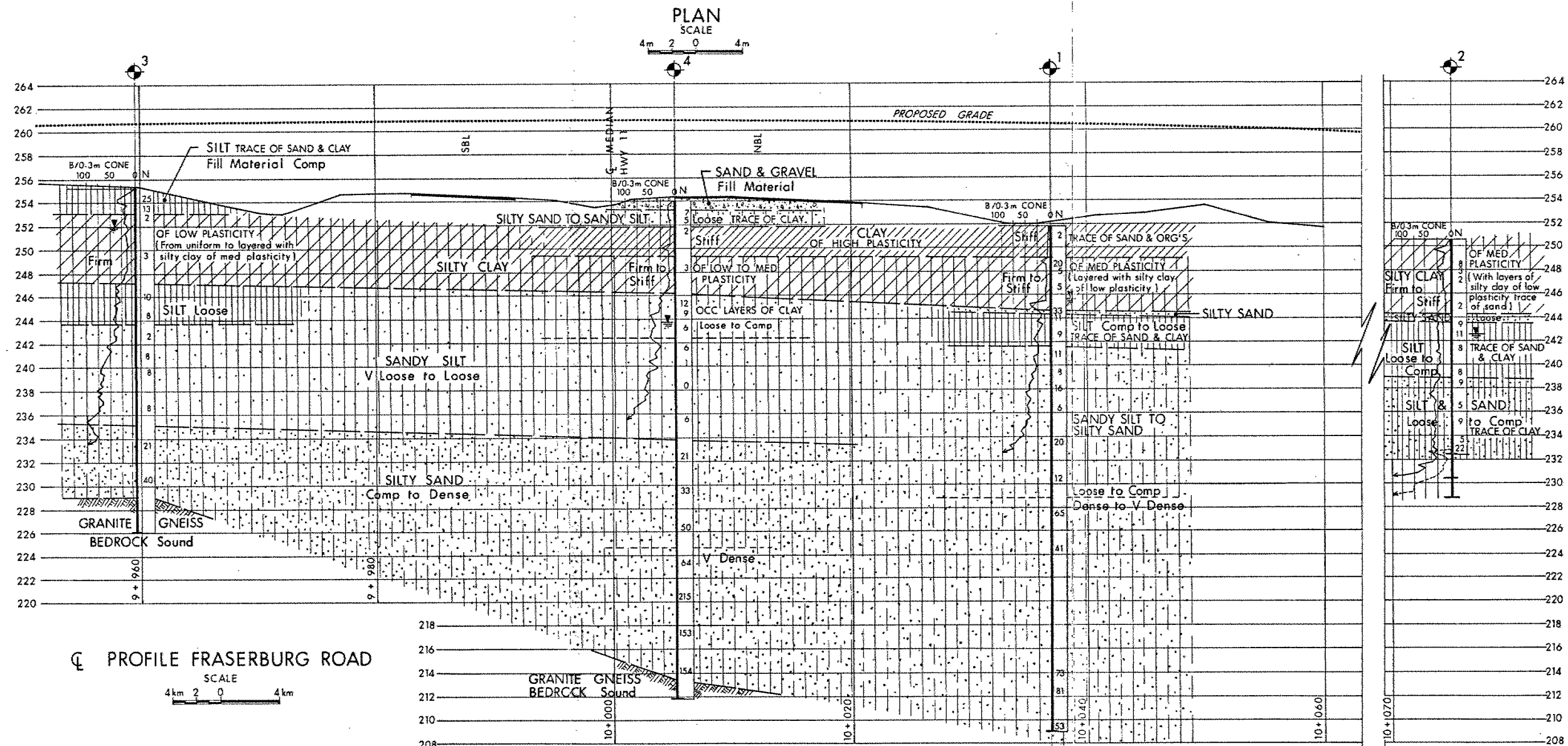
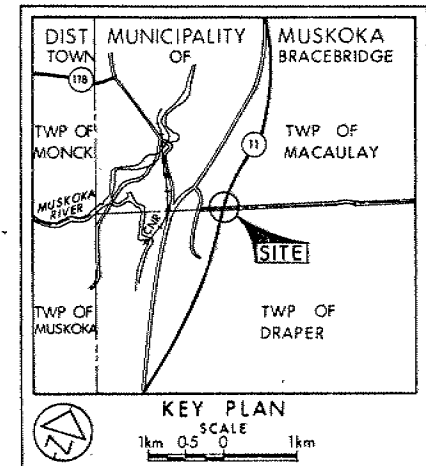
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FRASERBURG ROAD

BORE HOLE LOCATIONS & SOIL STRATA



SHEET



LEGEND

- Bore Hole
- ⊕ Dynamic Cone Penetration Test (Cone)
- ⊕ Bore Hole & Cone
- N Blows/0.3m (Std Pen Test, 475 J/blow)
- CONE Blows/0.3m (60° Cone, 475 J/blow)
- W/L at time of investigation 86 06

No	ELEVATION	STATION	OFFSET
1	251.9	10+037.0	1.0m Lt
2	250.6	10+075.0	1.0m Lt
3	255.3	9+959.8	2.3m Lt
4	254.0	10+005.4	4.2m Lt

NOTE
The boundaries between soil strata have been established only at Bore Hole locations. Between Bore Holes the boundaries are assumed from geological evidence.

NOTE: The complete foundation investigation and design report for this project and other related documents may be examined at the Engineering Materials Office, Downsview. Information contained in this report and related documents is specifically excluded in accordance with the conditions of Section 102-2 of Form 100.

REV.	DATE	BY	DESCRIPTION
Geocres No 31E-101			
HWY No 11			DIST 11
SUBMD PM [CHECKED]	DATE 1986 09 24		SITE
DRAWN DT [CHECKED]	APPROVED		DWG 608600-A

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).

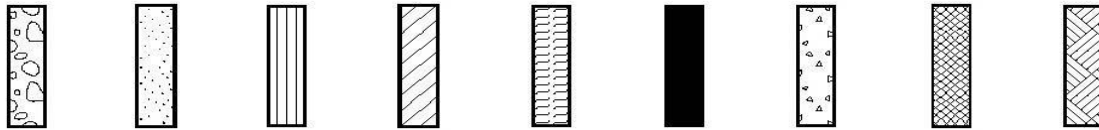
DYNAMIC CONE PENETRATION TEST (DCPT):

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 18-1

1 OF 2

METRIC

GWP# 5138-13-00 LOCATION Lat: 45.034948°, Long: -79.293419° HWY 11 UP at Fraserburg, MTM Zone 10: N 4 988 350.1 E 321 076.7 ORIGINATED BY SOB
 HWY 11 BOREHOLE TYPE CME55 Truck with HSA COMPILED BY KE
 DATUM Geodetic DATE 2018.04.29 - 2018.04.29 CHECKED BY SP

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				W P			W			W L				GR	SA	SI	CL	
260.9								20	40	60	80	100														
0.0	ASPHALT (125mm)																									
0.1	SAND trace gravel dense to compact, brown, moist FILL		1	SS	41																					
			2	SS	28																					
259.4																										
1.5	SAND with silt compact, brown-grey, moist FILL		3	SS	27																					
			4	SS	22																					
			5	SS	24																					
			6	SS	27																					
			7	SS	27																					
			8	SS	28																					
254.8																										
6.1	SILT (ML) some sand loose, brown with grey seams, wet		9	SS	5																					
254.1																										
6.9	CLAY (CH) stiff, brown with grey seams		10	SS	2																					
			11	SS	1																					
			12	SS	1																					

Continued Next Page

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

DOUBLE LINE 20244_FRASERBURG.GPJ 2012TEMPLATE(MTO).GDT 22/11/19

METRIC

[illegible]

+³, ×³: Numbers refer to Sensitivity

METRIC

[illegible]

+³, ×³: Numbers refer to Sensitivity

DOUBLE LINE 20244 FRASERBURG.GPJ 2012TEMPLATE(MTO).GDT 29/1/19

RECORD OF BOREHOLE No 18-2

2 OF 2

METRIC

GWP# 5138-13-00 LOCATION Lat: 45.035321°, Long: -79.291945°
HWY 11 BOREHOLE TYPE CME55 Truck with HSA / NW Casing ORIGINATED BY SOB
DATUM Geodetic DATE 2018.04.29 - 2018.04.29 COMPILED BY KE
CHECKED BY SP

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					
	Continued From Previous Page							20 40 60 80 100					
	SILT (ML) with sand loose, brown-grey, wet												
	- wood fragments below 10.8m		12	SS	6								
247.7													
11.7	CLAY (CL) firm to stiff, brown-grey trace wood fragments												
			13	SS	3								
244.7													
14.8	SILTY SAND (SM) loose to compact, grey, wet trace wood fibres												
			15	SS	6								
			16	SS	22								
241.2													
18.3	SILT (ML) with sand compact, grey, wet		17	SS	9								
240.6													
18.9	SILTY SAND (SM) dense, grey, wet		18	SS	38								
239.9													
19.5	End of Borehole Water level during drilling operations at 8.1 mbgs												

DOUBLE LINE 20244_FRASERBURG.GPJ 2012TEMPLATE(MTO).GDT 29/11/19

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



RECORD OF BOREHOLE No 1

METRIC

W P 60-86-00 LOCATION Sta. 10 + 037 O/S 1.0 m Lt. ORIGINATED BY PM
DIST 11 HWY 11 BOREHOLE TYPE Cont. Flight Auger (HS) Casing (BW) COMPILED BY
DATUM Geodetic DATE 86 06 05 - 86 06 11 CHECKED BY

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			20 40 60 80 100						
251.9	Ground Level								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE					
0.0	Clay of High Plasticity trace of sand trace of organics Stiff		1	SS	2		250	7					15.8	0 3 29 68
249.2			2	TW	PH									
2.7	Silty Clay of Medium Plasticity layered with Silty Clay of Low Plasticity Trace of Sand Firm to Stiff		3	SS	20		248	9						0 2 50 48
			4	SS	5									
			5	SS	5		246	5					17.6	0 79 20 1
			6	TW	PH			2						
244.7	Silty Sand Layer		7	SS	33		244							0 4 94 2
7.5	Silt, trace of sand, trace of clay Compact to Loose		8	SS	11									
			9	SS	9		242							0 11 81 8
241.6			10	SS	11		240							
10.3	Sandy Silt to Silty Sand trace of clay		11	SS	8		238							
			12	SS	16		236							
	Loose to Compact		13	SS	6		234							0 64 36 0
			14	SS	20		232							
			15	SS	12		230							
			16	SS	65		228							
			19	SS	41		224							
221.9	Dense to very Dense						222							

Continued

+3, x5: Numbers refer to Sensitivity

20 15 10 5 (%) STRAIN AT FAILURE

Continued



RECORD OF BOREHOLE No 1 Continued

METRIC

W P. 60-86-00 LOCATION Sta. 10 + 037, O/S 1.0 m Lt. ORIGINATED BY PM
DIST 11 HWY 11 BOREHOLE TYPE Continuous Flight Auger (HS) Casing (BW) COMPILED BY
DATUM Geodetic DATE 86 06 05 - 86 06 11 CHECKED BY

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 (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
221.9 30.0	Continued																
	Sandy Silt to						220										
	Silty Sand						218										
	trace of clay						216										
	Dense to						214										
	Very Dense		24	SS	73		212										
			25	SS	81		210										
209.0 42.9	End of Borehole		27	SS	53												

+³, x⁵: Numbers refer to
Sensitivity

20
15
10
5 (%) STRAIN AT FAILURE



RECORD OF BOREHOLE No 2

METRIC

W P 60-86-00 LOCATION Sta. 10 + 075, O/S 1.0 m Lt. ORIGINATED BY PM
DIST 11 HWY 11 BOREHOLE TYPE Cont. Flight Auger (HS) COMPILED BY
DATUM Geodetic DATE 86 06 12 - 86 06 13 CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			SHEAR STRENGTH kPa							WATER CONTENT (%)			
								20 40 60 80 100										
250.6	Ground Level							○ UNCONFINED	+ FIELD VANE									
								● QUICK TRIAXIAL	x LAB VANE									
								20 40 60 80 100										
0.0	Silty Clay of Medium Plasticity with layers of silty clay of Low Plasticity trace of sand Firm to Stiff		2	SS	8		250											
			3	SS	3		248							0 1 38 61				
			4	SS	2													
			5	TW	PH		246						17.8					
			6	SS	2													
244.3							244							0 1 64 35				
6.3	Silty Sand, trace of clay Loose		7	SS	9									0 66 29 5				
243.6			8	SS	11									0 5 90 5				
7.0	Silt Trace of Sand Trace of Clay Loose to Compact		9	SS	8		242											
			10	SS	8		240							0 12.84 4				
238.8			11	SS	9		238							0 40 59 1				
11.8	Silt and Sand Trace of Clay Loose to Compact		12	SS	5		236											
			13	SS	9		234											
			14	SS	5													
232.4			15	SS	22									0 58 40 2				
18.2	End of Borehole						232											
230.1																		
20.5	End of Cone Test						230											
228.6																		
22.0	End of Cone Test						228											

+3, x5: Numbers refer to 20
Sensitivity 15 5 (%) STRAIN AT FAILURE
10



RECORD OF BOREHOLE No 3

METRIC

W P 60-86-00 LOCATION Sta. 9 + 959.8, O/S 2.3 m Lt. ORIGINATED BY PM
DIST 11 HWY 11 BOREHOLE TYPE Cont. Flight Auger (HS), Casing (BW) COMPILED BY
DATUM Geodetic DATE 86 06 13 - 86 06 17 CHECKED BY

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			20 40 60 80 100	20 40 60 80 100					
255.3	Ground Level													
0.0	Silt, trace of sand		1	SS	25		254							0 9 83 8
253.2	trace of clay		2	SS	13		252							
2.1	Fill Material Compact		3	SS	2		250							
	Silty Clay of Low Plasticity (From Uniform to Layered with Silty Clay of Medium Plasticity)		4	TW	PH		248						16.3	
	Firm		5	SS	3		246							0 1 67 32
247.1			6	TW	PH		244						17.9	0 2 66 32
8.2	Silt		7	SS	10		242							
	Loose		8	SS	8		240							0 0 100 0
243.7			9	SS	2		238							
11.6	Sandy Silt		10	SS	8		236							
	Very Loose to Loose		11	SS	8		234							0 25 73 2
			12	SS	8		232							
235.2			13	SS	21		230							
20.1	Silty Sand		14	SS	40		228							0 91 9
	Compact to Dense		15	RC BX	REC 100%		226							
229.1			16	RC BX	REC 100%									
26.2	Granite Gneiss Sound Bedrock													
226.0														
29.3	End of Borehole													

+3, x5: Numbers refer to
Sensitivity

20
15 5 (%) STRAIN AT FAILURE
10



RECORD OF BOREHOLE No 4

METRIC

W P 60-86-00 LOCATION Sta. 10 + 005.4; O/S 4.2 m Lt. ORIGINATED BY PM
DIST 11 HWY 11 BOREHOLE TYPE Cont. Flight Auger (HS); Casing (BW) COMPILED BY
DATUM Geodetic DATE 86 06 18 - 86 06 20 CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100	20 40 60 80 100	W _p	W	W _L		
254.0	Shoulder Level													
0.0	Fill Material													
253.3	Sand and Gravel													
0.7	Silty Sand to Sandy Silt trace of clay		1	SS	7									0 16 76 8
251.9			2	SS	5									0 3 43 54
2.1	Clay of High Plasticity Stiff		3	SS	2									0 4 43 53
249.4			4	TW	PH									0 4 43 53
4.6	Silty Clay of Low to Medium Plasticity		5	SS	3									0 2 93 5
246.2	Firm to Stiff		6	TW	PH									0 18 78 4
7.8	Sandy Silt Occasional Layers of Clay		7	SS	12									0 27 70 3
242.3	Loose to Compact		8	SS	9									0 33 66 1
11.7			9	SS	6									
			10	SS	6									
			11	SS	1									
	Sandy Silt Very Loose to Loose		12	SS	0									
			13	SS	6									
233.9			14	SS	21									
20.1			15	SS	33									
	Silty Sand		16	SS	50									
	Compact to Dense													
224.0	Very Dense													
30.0														

Continued

+3, x5: Numbers refer to
Sensitivity

20
15 5 (%) STRAIN AT FAILURE
10

Continued

RECORD OF BOREHOLE No 4 Continued METRIC

W P 60-86-00 LOCATION Sta. 10 + 005.4; O/S 4.2 m Lt. ORIGINATED BY PM
 DIST 11 HWY 11 BOREHOLE TYPE Cont. Flight Auger (HS); Casing (BW) COMPILED BY _____
 DATUM Geodetic DATE 86 06 18 - 86 06 20 CHECKED BY /

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES		20	40	60	80	100	W _p	W	W _L		
224.0	Continued															
30.0			18	SS	64											
						222										
	Silty Sand		20	SS	215											
						220										
	Very Dense															
						218										
			22	SS	153											
						216										
			23	SS	154											
						214										
213.5																
40.5	Granite Gneiss Sound Bedrock		24	RC BX	REC 98%											
211.9						212										
42.1	End of Borehole															
						210										

Appendix C.

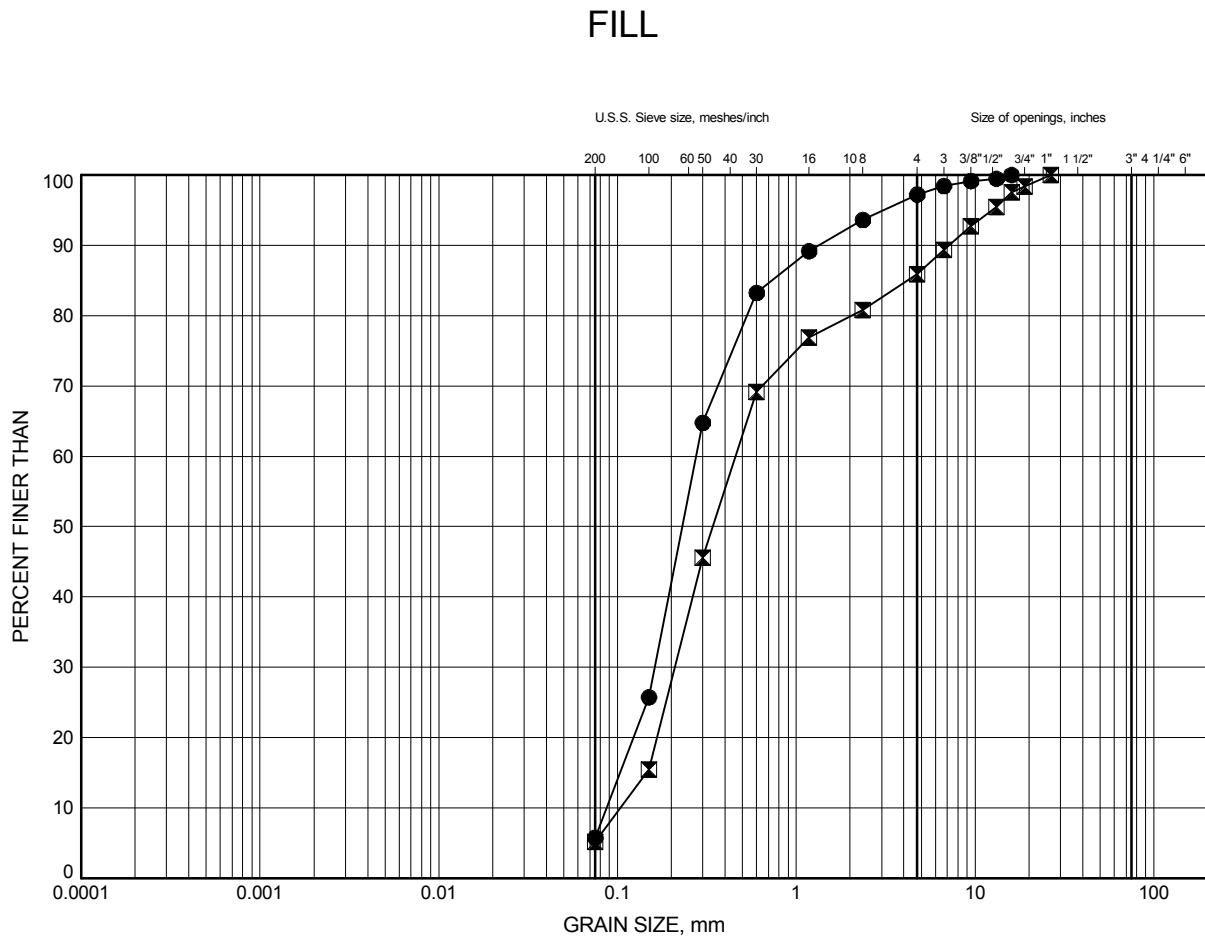
Laboratory Testing

Appendix C.1
Particle Size Analysis Figures

Hwy's 11 and 118 - Fraserburg

GRAIN SIZE DISTRIBUTION

FIGURE C1



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	18-1	2.6	258.3
◻	18-2	4.1	255.3

Date January 2019

GWP# 5138-13-00



Prep'd KE

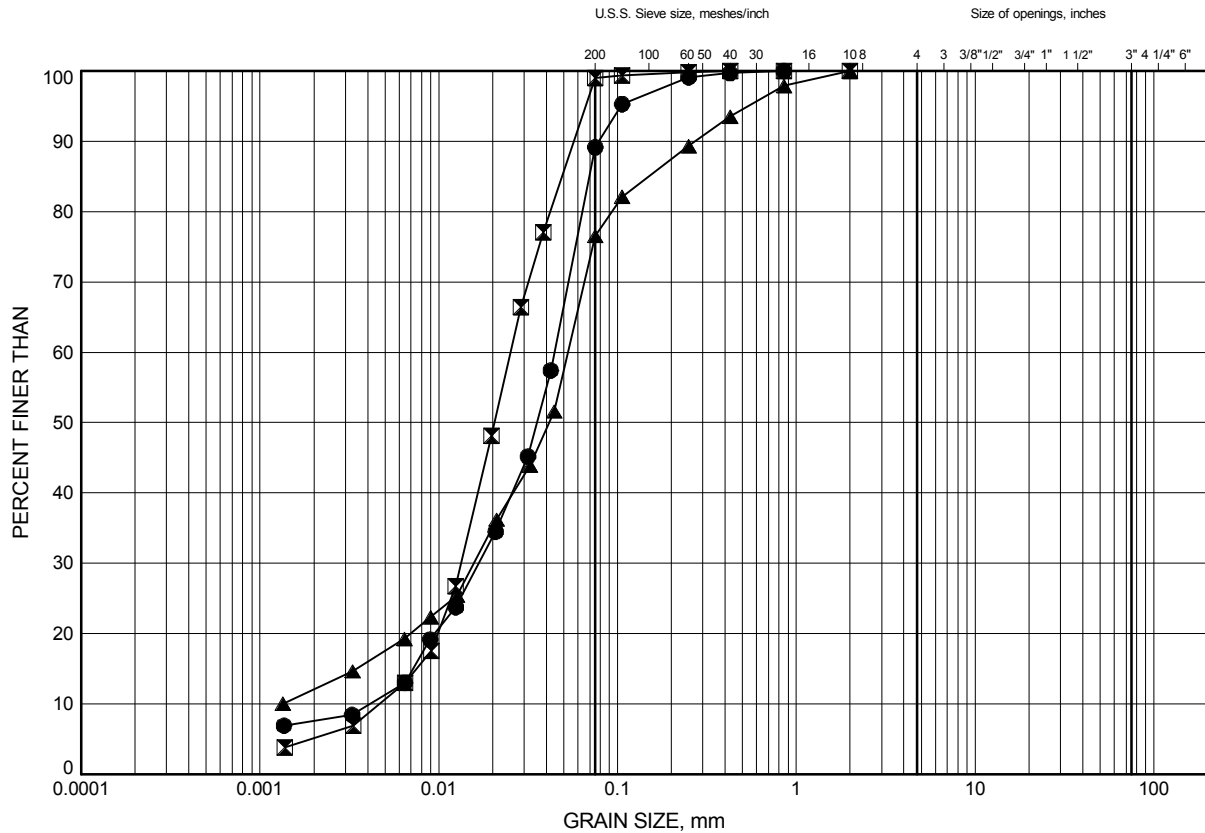
Chkd. SP

Hwy's 11 and 118 - Fraserburg

GRAIN SIZE DISTRIBUTION

FIGURE C2

SILT (ML) / LOWER SILT (ML)



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	18-1	6.4	254.5
⊠	18-1	14.0	246.9
▲	18-2	9.4	250.0

Date January 2019

GWP# 5138-13-00



Prep'd KE

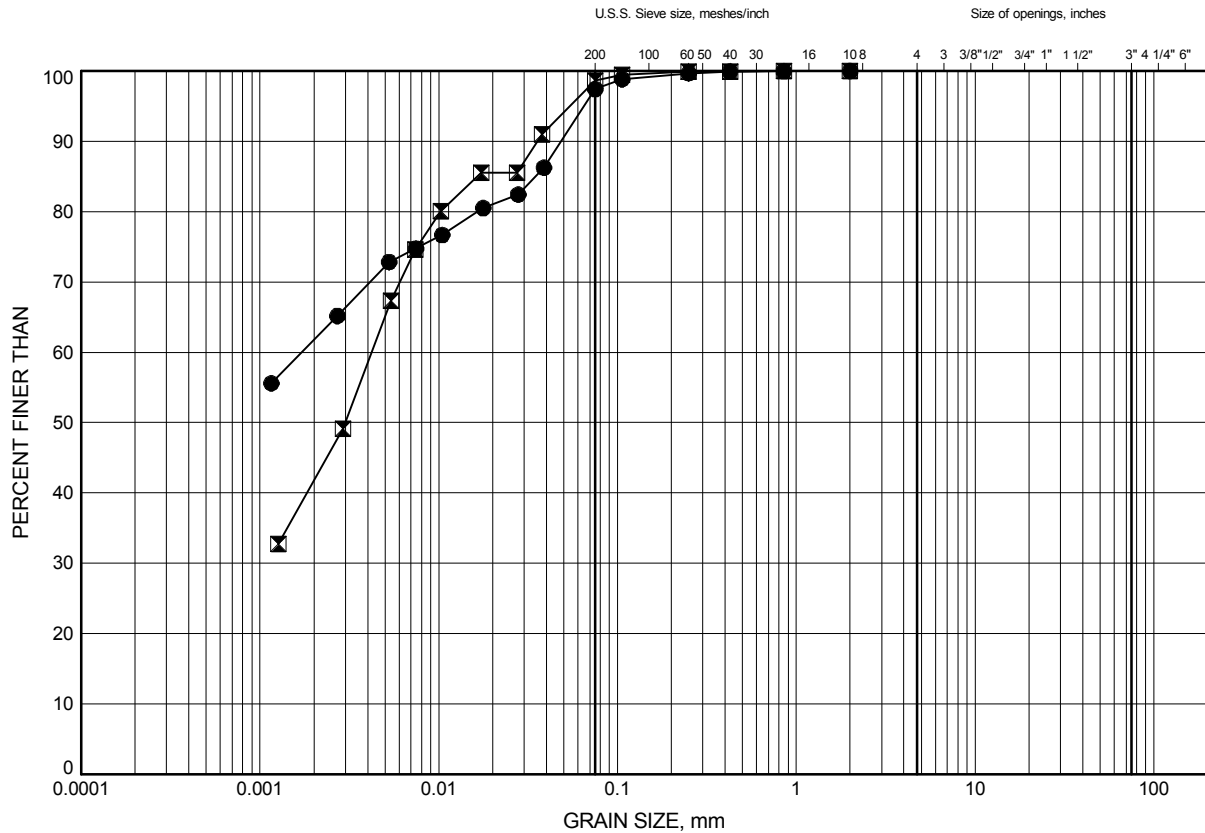
Chkd. SP

Hwy's 11 and 118 - Fraserburg

GRAIN SIZE DISTRIBUTION

FIGURE C3

CLAY (CL-CH)



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	18-1	7.9	253.0
⊠	18-2	12.5	247.0

Date January 2019
GWP# 5138-13-00



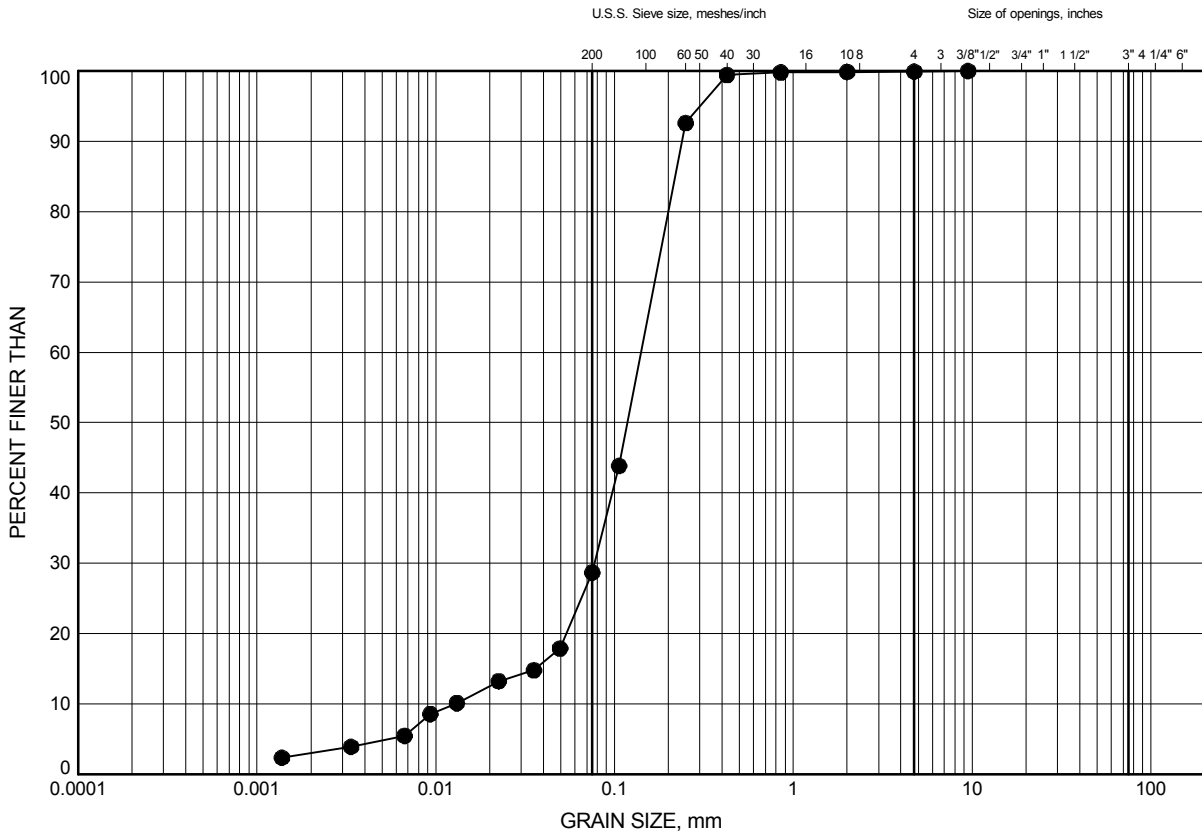
Prep'd KE
Chkd. SP

Hwy's 11 and 118 - Fraserburg

GRAIN SIZE DISTRIBUTION

FIGURE C4

SILTY SAND (SM)



Appendix C.2

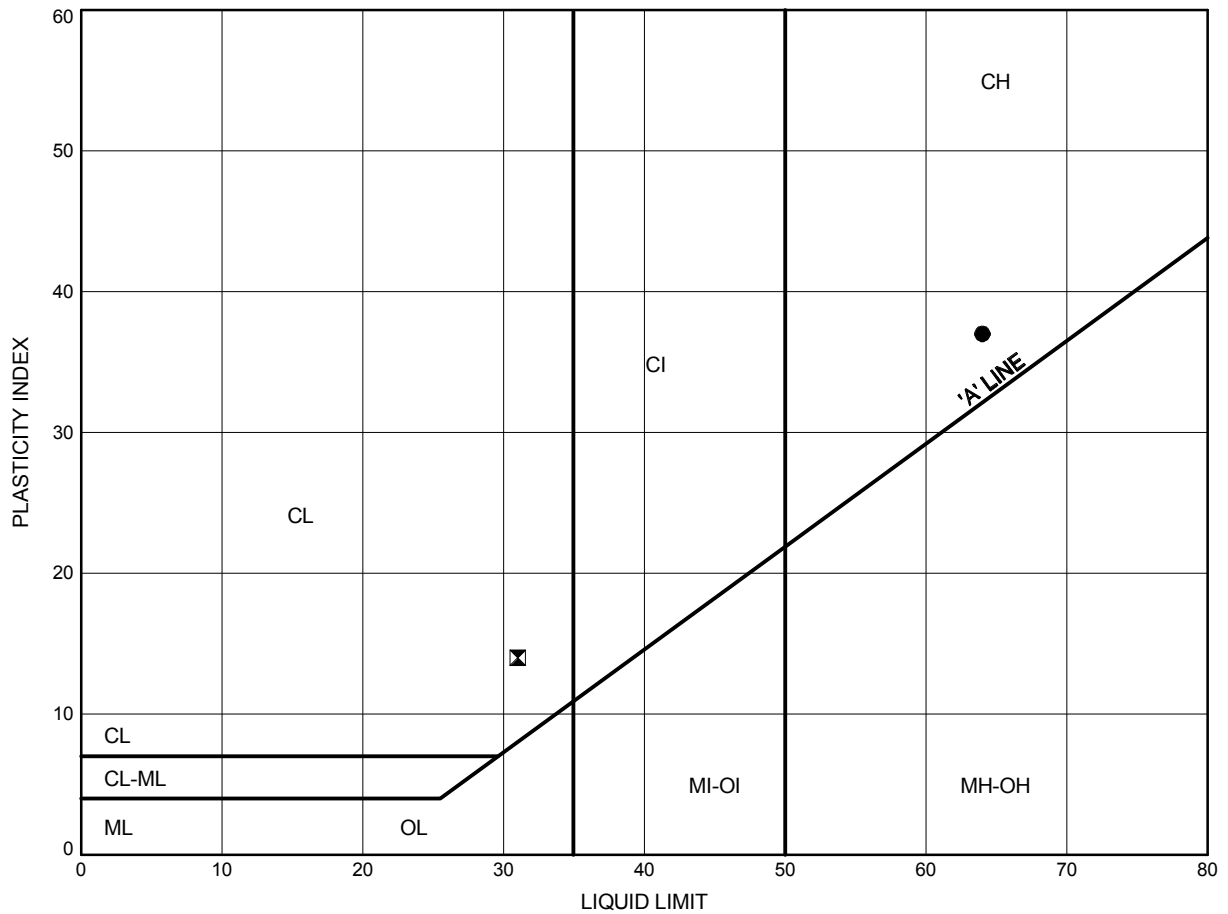
Atterberg Limits Figures

Hwy's 11 and 118 - Fraserburg

ATTERBERG LIMITS TEST RESULTS

FIGURE C5

CLAY (CL-CH)



LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	18-1	7.9	253.0
⊠	18-2	12.5	247.0

Date January 2019
GWP# 5138-13-00



Prep'd KE
Chkd. SP

Appendix C.3
Analytical Testing Results

Certificate of Analysis

Thurber Engineering Ltd.

2460 Lancaster Rd, Suite 104
Ottawa, ON K1B 4S5
Attn: Katya Edney

Client PO:
Project: HWY 11 + 118
Custody: 39845

Report Date: 10-May-2018
Order Date: 4-May-2018

Order #: 1818669

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

Parcel ID	Client ID
1818669-01	Road 117 18-1'ss13 40-42'
1818669-02	Road 117 18-2 'SS12 35-37'
1818669-03	Fraserburg '18-1SS10 22'6-24'6"
1818669-04	Fraserburg'18-2 SS12A 35-36'6"
1818669-05	Road 2 '18-1 SS9 20-22'
1818669-06	Road 2 '18-2 SS10 25-27'
1818669-07	Bullens '18-1 SS11 23'3"-25'3"
1818669-08	Road 3 18-1 SS10 25-27'
1818669-09	Road 3 18-2 SS10 25-27'
1818669-10	Siding 18-2SS5 10-12'
1818669-11	Siding 18-3 SS5 10-12'

Approved By:



Dale Robertson, BSc
Laboratory Director

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

Report Date: 10-May-2018

Order Date: 4-May-2018

Project Description: HWY 11 + 118

Analysis Summary Table

Analysis	Method Reference/Description	Extraction Date	Analysis Date
Anions	EPA 300.1 - IC, water extraction	8-May-18	8-May-18
Conductivity	MOE E3138 - probe @25 °C, water ext	8-May-18	9-May-18
pH, soil	EPA 150.1 - pH probe @ 25 °C, CaCl buffered ext.	7-May-18	7-May-18
Resistivity	EPA 120.1 - probe, water extraction	8-May-18	9-May-18
Solids, %	Gravimetric, calculation	7-May-18	7-May-18

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

Report Date: 10-May-2018

Order Date: 4-May-2018

Project Description: HWY 11 + 118

		Client ID:	Road 117 18-1'ss13 40-42'	Road 117 18-2 'SS12 35-37'	Fraserburg '18-1SS10 22'6-24'6"	Fraserburg'18-2 SS12A 35-36'6"
		Sample Date:	04/30/2018 09:00	04/30/2018 09:00	04/29/2018 09:00	04/29/2018 09:00
		Sample ID:	1818669-01	1818669-02	1818669-03	1818669-04
		MDL/Units	Soil	Soil	Soil	Soil
Physical Characteristics						
% Solids	0.1 % by Wt.		83.9	83.9	68.9	70.1
General Inorganics						
Conductivity	5 uS/cm		133	234	469	262
pH	0.05 pH Units		5.84	6.14	5.56	5.32
Resistivity	0.10 Ohm.m		75.0	42.7	21.3	38.1
Anions						
Chloride	5 ug/g dry		82	113	246	120
Sulphate	5 ug/g dry		12	9	51	10
		Client ID:	Road 2 '18-1 SS9 20-22'	Road 2 '18-2 SS10 25-27'	Bullens '18-1 SS11 23'3"-25'3"	Road 3 '18-1 SS10 25-27'
		Sample Date:	04/28/2018 09:00	05/01/2018 09:00	04/21/2018 09:00	04/27/2018 09:00
		Sample ID:	1818669-05	1818669-06	1818669-07	1818669-08
		MDL/Units	Soil	Soil	Soil	Soil
Physical Characteristics						
% Solids	0.1 % by Wt.		87.0	72.7	77.5	80.3
General Inorganics						
Conductivity	5 uS/cm		218	1780	400	61
pH	0.05 pH Units		6.41	5.76	7.44	6.39
Resistivity	0.10 Ohm.m		45.8	5.61	25.0	164
Anions						
Chloride	5 ug/g dry		124	1170	23	21
Sulphate	5 ug/g dry		7	10	200	11
		Client ID:	Road 3 18-2 SS10 25-27'	Siding 18-2SS5 10-12'	Siding 18-3 SS5 10-12'	-
		Sample Date:	04/27/2018 09:00	04/24/2018 09:00	04/23/2018 09:00	-
		Sample ID:	1818669-09	1818669-10	1818669-11	-
		MDL/Units	Soil	Soil	Soil	-
Physical Characteristics						
% Solids	0.1 % by Wt.		82.5	79.5	72.3	-
General Inorganics						
Conductivity	5 uS/cm		158	2120	428	-
pH	0.05 pH Units		6.44	6.34	6.13	-
Resistivity	0.10 Ohm.m		63.1	4.71	23.4	-
Anions						
Chloride	5 ug/g dry		83	1590	154	-
Sulphate	5 ug/g dry		9	19	76	-

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

Report Date: 10-May-2018

Order Date: 4-May-2018

Project Description: HWY 11 + 118

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-May-2018

Order Date: 4-May-2018

Project Description: HWY 11 + 118

Method Quality Control: Duplicate

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Anions									
Chloride	55.9	5	ug/g dry	55.6			0.7	20	
Sulphate	23.4	5	ug/g dry	22.9			2.1	20	
General Inorganics									
Conductivity	443	5	uS/cm	424			4.4	6.2	
pH	7.77	0.05	pH Units	7.77			0.0	10	
Resistivity	22.6	0.10	Ohm.m	23.6			4.4	20	
Physical Characteristics									
% Solids	98.2	0.1	% by Wt.	98.0			0.2	25	

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

Report Date: 10-May-2018

Order Date: 4-May-2018

Project Description: HWY 11 + 118

Method Quality Control: Spike

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Anions									
Chloride	149	5	ug/g	55.6	93.2	78-113			
Sulphate	119	5	ug/g	22.9	95.8	78-111			

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

Report Date: 10-May-2018
Order Date: 4-May-2018
Project Description: HWY 11 + 118

Qualifier Notes:

Login Qualifiers :

Container(s) - Bottle and COC sample ID don't match -

*Applies to samples: Road 117 18-1'ss13 40-42', Road 117 18-2 'SS12 35-37', Fraserburg '18-1SS10 22'6-24'6',
Bullens '18-1 SS11 23'3"-25'3"*

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 K1B 4S5
Attn: Katya Edney

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

Paracel Report No **1818669**
Client Project(s): **HWY 11 + 118**
Client PO:
Reference: **Standing Offer**
CoC Number: **39845**

Order Date: 04-May-18
Report Date: 15-May-18

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
1818669-01	Road 117 18-1'ss13 40-42'	Sulphide, solid
1818669-02	Road 117 18-2 'SS12 35-37'	Sulphide, solid
1818669-03	Fraserburg '18-1SS10 22'6-24'6"	Sulphide, solid
1818669-04	Fraserburg'18-2 SS12A 35-36'6"	Sulphide, solid
1818669-05	Road 2 '18-1 SS9 20-22'	Sulphide, solid
1818669-06	Road 2 '18-2 SS10 25-27'	Sulphide, solid
1818669-07	Bullens '18-1 SS11 23'3"-25'3"	Sulphide, solid
1818669-08	Road 3 18-1 SS10 25-27'	Sulphide, solid
1818669-09	Road 3 18-2 SS10 25-27'	Sulphide, solid
1818669-10	Siding 18-2SS5 10-12'	Sulphide, solid
1818669-11	Siding 18-3 SS5 10-12'	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,

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

15-May-2018

Date Rec. : 08 May 2018
LR Report: CA13203-MAY18
Reference: Project#: 1818669

Copy: #1

CERTIFICATE OF ANALYSIS

Final Report

Sample ID	Sample Date & Time	Sulphide %
1: Analysis Start Date		14-May-18
2: Analysis Start Time		13:09
3: Analysis Completed Date		14-May-18
4: Analysis Completed Time		14:54
5: QC - Blank		< 0.02
6: QC - STD % Recovery		101%
7: QC - DUP % RPD		ND
8: RL		0.02
9: Road 117 18-1'ss13 40-42'	30-Apr-18	< 0.02
10: Road 117 18-2 'SS12 35-37'	30-Apr-18	< 0.02
11: Fraserburg '18-1SS10 22'6-24'6"	29-Apr-18	< 0.02
12: Fraserburg '18-2 SS12A 35-36'6"	29-Apr-18	< 0.02
13: Road 2 '18-1 SS9 20-22'	28-Apr-18	< 0.02
14: Road 2 '18-2 SS10 25-27'	01-May-18	< 0.02
15: Bullens '18-1 SS11 23'3"-25'3"	21-Apr-18	0.40
16: Road 3 18-1 SS10 25-27'	27-Apr-18	< 0.02
17: Road 3 18-2 SS10 25-27'	27-Apr-18	< 0.02
18: Siding 18-2SS5 10-12'	24-Apr-18	< 0.02
19: Siding 18-3 SS5 10-12'	23-Apr-18	< 0.02

RL - SGS Reporting Limit

Carrie Greenlaw
Project Specialist
Environmental Services, Analytical

Appendix D.

Site Photographs

HIGHWAY 11 UNDERPASS STRUCTURE
MUSKOKA RD 14/FRASERBURG RD, DISTRICT OF MUSKOKA



Photo 1. Looking north along Highway 11 from West of Muskoka Road 14 Underpass Structure (April 29th, 2018)



Photo 2. Muskoka Road 14 (Fraserburg Road) Underpass Structure from west (April 29th, 2018)

HIGHWAY 11 UNDERPASS STRUCTURE
MUSKOKA RD 14/FRASERBURG RD, DISTRICT OF MUSKOKA



Photo 3. Looking east along Muskoka Road 14 (Fraserburg Road) (April 29th, 2018)



Photo 4. Looking west along Muskoka Road 14 (Fraserburg Road) (April 29th, 2018)