



THURBER ENGINEERING LTD.

**FOUNDATION INVESTIGATION REPORT
HIGHWAY 7 GRADE LOWERING FROM STN. 20+000 TO 20+450 AND
NEW STRUCTURAL CULVERT AT STN. 20+320, SITE NO. 32-097
MUNICIPALITY OF KAWARTHA LAKES
AGREEMENT 4016-E-0034, ASSIGNMENT 6
GWP 4094-17-00**

Geocres No.: 31D-746

Report to:

WSP Canada Group Ltd.

Latitude: 44.333587°
Longitude: -78.708828°

March 2020
Thurber File No.: 23770



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PART 1. FACTUAL INFORMATION

1 INTRODUCTION

This section of the report presents the factual findings obtained from a foundation investigation completed for the proposed grade lowering of Highway 7 from Station 20+000 to 20+450 and a new structural culvert at Station 20+320 (Site No. 32-097) where Highway 7 crosses the Victoria Rail Trail, located within the Municipality of Kawartha Lakes. The existing bridge crossing the Victoria Rail Trail is to be demolished as part of the project.

Thurber carried out the investigation as sub-consultant to WSP Canada Group Ltd. (WSP) under Ministry of Transportation (MTO) Retainer Agreement No. 4016-E-0034, Assignment No. 6, GWP 4094-17-00.

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 profiles, 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. A Preliminary Foundation Investigation and Design Report for this site dated September 2007 (Geocres 31D-424) was reviewed as part of the current assignment.

2 SITE DESCRIPTION

The intersection of Highway 7 and the Victoria Rail Trail is located approximately 300 m west of the Highway 7 and County Road 36 intersection. The Victoria Rail Trail is a former railway that has been converted to a multi-use recreational trail. Highway 7 at the location is oriented east-west and the trail is oriented northeast to southwest. For project purposes, the existing trail and the proposed culvert are herein described as oriented north-south.

Highway 7 in this area consists of a two-lane undivided highway with the end of a west-bound speed change lane and paved shoulders at the structure and a rural cross-section beyond the approach fills. The elevation of the road surface at the centreline ranges from about 260 m at Station 20+000 to 268 m at the Victoria Rail Trail overpass. The terrain is relatively flat and the land adjacent to the highway occupied by residential properties, a golf course, and agricultural fields. The elevation of the ground surface at the trail level is approximately 259 m. The approach



fills are sloped at approximately 2H:1V. No evidence of settlement, erosion or slope instability were noted at the approach fills at the time of the field investigation.

It is understood that the existing approximately 12 m, single-span structure is supported on spread footings. The approach fills in all four quadrants are partially supported by stepped retaining walls which are also supported on spread footings. An existing CSP was observed at the south end of the wing wall on the west side of the trail. It is understood that the twin 914 mm diameter CSP pipes convey flow from the south to the north beneath the existing bridge and have an invert elevation of approximately 258 m.

The two borehole records from Geocres 31D-424 indicate that the subsurface materials consist of fill over loose to very dense sandy silt over very dense silty sand till at elevation 253.7 m. Based on published geological information in *The Physiography of Southern Ontario* by Chapman and Putnam (1984), the culvert site lies within the physiographic region known as the Schomberg Clay Plains. The Schomberg Clay Plains generally consist of varved clays and silts underlain by till. The overburden is underlain by limestone bedrock.

Photographs showing the existing conditions at the site 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 between April 29 and May 16, 2019. The field investigation consisted of advancing seven boreholes (identified as Boreholes 19-1 through 19-7). Off-road Boreholes 19-1 and 19-2 were advanced at the Victoria Trail level at the proposed inlet and outlet of the structural culvert, and on-road Boreholes 19-3 through 19-7 were advanced through the Highway 7 embankment for the proposed grade lowering. Prior to commencement of drilling, utility clearances were obtained in the vicinity of the borehole locations.

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 10.

Table 3-1: Borehole Summary

Borehole No.	Drilled Location	Northing (m)	Easting (m)	Ground Surface Elevation (m)	Termination Depth Below Ground Surface (m)
19-1	Culvert	4 910 717.2	367 878.6	259.1	10.6
19-2	Culvert	4 910 689.7	367 905.8	259.1	10.3
19-3	Hwy 7	4 910 573.8	367 615.5	260.2	7.1
19-4	Hwy 7	4 910 626.8	367 702.0	263.5	11.2
19-5	Hwy 7	4 910 656.3	367 787.2	265.6	12.8
19-6	Hwy 7	4 910 712.9	367 915.2	267.6	12.8
19-7	Hwy 7	4 910 721.2	367 975.6	267.3	12.8



The off-road drilling was carried out using a track-mounted CME 55 drill rig and the on-road drilling was carried out using a truck-mounted CME 55 drill rig. Both rigs were equipped with hollow-stem augers and rotary diamond drilling equipment.

Soil samples were obtained at selected intervals using a split spoon sampler in conjunction with Standard Penetration Testing (SPT). Upon achieving auger refusal, Boreholes 19-1 and 19-2 were cored into the bedrock while collecting NQ sized bedrock core.

A 19 mm diameter standpipe piezometer was installed in Borehole 19-1 to allow for measurements of the groundwater level after completion of drilling. The piezometer installation details are illustrated on the Record of Borehole sheet provided in Appendix B. The boreholes were backfilled in accordance with MOE requirements (O.Reg. 903, as amended). The on-road boreholes were backfilled with granular material within the depth of pavement structure and topped with cold patch asphalt to reinstate the road surface. Upon completion of the groundwater measurements, the standpipe piezometer installed in Borehole 19-1 was decommissioned in accordance with O.Reg. 903 requirements.

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 total core recovery (TCR), solid core recovery (SCR) and rock quality designation (RQD) were measured. Chemical analysis for determination of pH, conductivity, resistivity, sulphide, sulphate and chloride concentrations was carried out on one soil sample.

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 is 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 as modified per current MTO soil practice for cohesive soils.



In general terms, the site was found to be underlain by embankment fill overlying a native deposit of till. The overburden soils are underlain by limestone bedrock.

5.1 Asphalt

Boreholes 19-4, 19-6 and 19-7 were advanced from the travelled lanes of Highway 7. The thickness of the asphalt at these locations ranged from 175 to 200 mm.

5.2 Topsoil

A layer of topsoil was encountered at the ground surface at off-road Boreholes 19-1 and 19-2. The thickness of the topsoil at these locations ranged from 40 to 50 mm.

5.3 Fill

5.3.1 Highway Embankment Fill

Heterogenous embankment fill consisting of a generally well-graded mixture of gravel, sand, silt, and clay was encountered from the ground surface in Boreholes 19-3 and 19-5, which were advanced from the shoulder of Highway 7, and below the asphalt in the remaining on-road boreholes. The grain size distribution of the fill is variable and the soils are described as ranging from sandy clay with gravel to silty gravel with sand. Organic silt was encountered at the base of the fill (7.9 m depth) in Borehole 19-5. Occasional cobbles and possible boulders were noted throughout the fill.

The underside of the fill was encountered at depths ranging from 2.8 to 10.7 m (elev. 256.9 to 259.5 m).

SPT tests conducted in this layer gave N-values ranging from 10 to 52 blows, indicating a compact to very dense relative density.

The results of grain size distribution testing carried out on nine samples of the fill are summarized in Table 5-1 below and are illustrated on Figures C1 and C2 in Appendix C.

Table 5-1: Summary of Grain Size Distribution Testing – Fill

Soil Particle	Percentage (%)	
Gravel	13 – 37	
Sand	25 – 39	
Silt	27 – 65	29 – 39
Clay		12 – 18

The results of Atterberg limit testing carried out on six samples of the fill are summarized in Table 5-2 below and are illustrated on Figures C6 and C7 in Appendix C. These results indicate that the fines within the fill are classified as clay of low plasticity (CL).

Table 5-2: Summary of Atterberg Limit Testing – Fill

Parameter	Value
Liquid Limit	18 – 24
Plastic Limit	10 – 12
Plasticity Index	8 – 12

Recorded moisture contents of the fill ranged from 2 to 19%.

5.3.2 Trail Embankment Fill

The trail embankment fill was observed in Boreholes 19-1 and 19-2 to consist of material ranging from clayey sand with gravel to sandy silt trace gravel. Trace organics were noted. The thickness of the fill was 1.4 m and 2.1 m with the underside of the unit at elevation 257.7 m and 257.0 m. SPT tests conducted in the fill yielded N-values of 7 to 12 indicating a loose to compact relative density.

The results of grain size distribution testing carried out on two samples of the fill are summarized in Table 5-3 below and are illustrated on Figure C1 in Appendix C.

Table 5-3: Summary of Grain Size Distribution Testing – Railway Fill

Soil Particle	Percentage (%)
Gravel	9 - 25
Sand	26 – 36
Silt	29 – 53
Clay	10 - 12

The results of Atterberg limit testing carried out on two samples of the fill are summarized in Table 5.4 below and are illustrated on Figure C6 in Appendix C. These results indicate that the fines within the fill are classified as silt (ML) to clay of low plasticity (CL).

Table 5-4: Summary of Atterberg Limit Testing – Railway Fill

Parameter	Value
Liquid Limit	18 – 27
Plastic Limit	15 – 17
Plasticity Index	3 - 10

Recorded moisture contents of the fill ranged from 10 to 19%.



5.4 Clay (CI)

A native deposit of clay with sand was encountered beneath the embankment fill in Boreholes 19-4 and 19-5. The thickness of the deposit ranged from 0.9 to 1.5 m with an underside depth ranging from 7.3 to 8.8 m below ground surface (elev. 256.2 to 256.8 m).

SPT tests conducted in the clay gave N-values of 8 to 12 blows, indicating a stiff consistency.

The results of grain size distribution testing carried out on one sample of the clay indicated this material to consist of 1% gravel, 15% sand, 45% silt, and 39% clay. These results are illustrated on Figure C3 in Appendix C. The results of Atterberg limit testing conducted on one sample of the clay are shown on Figure C8 in Appendix C and indicated this material to have a liquid limit of 42, a plastic limit of 18, and a plasticity index of 24. These results indicate that the soil is classified as clay of intermediate plasticity (CI).

Recorded moisture contents of the clay ranged from 19 to 21%.

5.5 Till

A native deposit of till consisting of a generally well-graded mixture clay, silt, sand, gravel, cobbles and boulders was encountered in all boreholes. The grain size distribution of the till is variable and the soils are described as ranging from silty clayey gravel to silty clay trace to some sand and gravel.

Where fully penetrated in Boreholes 19-1 and 19-2, the thickness of the till ranged from 4.8 to 6.1 m with an underside depth ranging from 6.9 to 7.5 m (elev. 251.6 to 252.2 m). The till was not fully penetrated in the other boreholes, but was proven to depths ranging from 7.1 to 12.8 m (elev. 252.3 to 254.8 m).

SPT tests conducted in this layer gave N-values ranging from 14 blows for 300 mm of penetration to 100 blows for 75 mm of penetration, indicating a very stiff to hard consistency for the cohesive till and a compact to very dense relative density for the non-cohesive till.

The results of grain size distribution testing carried out on 11 samples of the till are summarized in Table 5-5 below and are illustrated in Figures C4 and C5 in Appendix C.

Table 5-5: Summary of Grain Size Distribution Testing – Till

Soil Particle	Percentage (%)
Gravel	2 – 31
Sand	8 – 52
Silt	29 – 70
Clay	6 – 20



The results of Atterberg limit testing carried out on 10 samples of the till are summarized in Table 5-6 below and are illustrated on Figures C9 and C10 in Appendix C. These results indicate that the fines within the till are classified as silt (ML) to silty clay (CL-ML) to clay of low plasticity (CL). Testing on one sample from Borehole 19-3 (SS9) indicated that the soil was non-plastic.

Table 5-6: Summary of Atterberg Limit Testing – Till

Parameter	Value
Liquid Limit	14 – 21
Plastic Limit	11 – 14
Plasticity Index	3 – 9

Recorded moisture contents of the granular fill ranged from 3 to 26%.

5.6 Bedrock

Bedrock was encountered and proven by coring in Boreholes 19-1 and 19-2. A summary of the bedrock surface information is provided in Table 5- below:

Table 5-7: Summary of Bedrock Depth/Elevation

Borehole No.	Depth to Bedrock from Ground Surface (m)	Bedrock Surface Elevation (m)
19-1	7.5	251.6
19-2	6.9	252.2

The bedrock encountered in Boreholes 19-1 and 19-2 consisted of fresh, strong, horizontally bedded limestone with shale interbedding. The Total Core Recovery (TCR) measured on the recovered bedrock core was 100%, the Solid Core Recovery (SCR) ranged from 96 to 100%, and the Rock Quality Designation (RQD) ranged from 48 to 100% (but typically 86 to 100 %). Based on the measured RQD values, the bedrock is classified as poor to excellent (but typically good to excellent) quality. The bedrock is estimated to be strong. Photographs of the bedrock core are provided in Appendix C.

5.7 Groundwater

The groundwater water level measured in the standpipe piezometer installed in Borehole 19-1 at 2.2 m below the ground surface (elev. 256.9 m) on May 27, 2019 and at 1.5 m below the ground surface (elev. 257.6 m) on May 31, 2019. Water was noted in the ditch on April 22, 2019 in the southwest quadrant of the site at an approximate elevation of 258.3 m.

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.



5.8 Analytical Testing

One sample of the native soil was submitted for analysis of pH, water soluble sulphate, sulphide, chloride, conductivity and resistivity. The analysis results are provided in Appendix C and are summarized in Table 5-8 below.

Table 5-8: Results of Chemical Analysis

Borehole	19-1
Sample	SS3
Depth (m)	1.5 – 2.1
Chloride (µg/g)	70
Sulphate (µg/g)	8
Sulphide (%)	< 0.02
pH (-)	7.37
Resistivity (Ohm-cm)	4420
Conductivity (µS/cm)	226



6 MISCELLANEOUS

Borehole locations were selected by Thurber relative to existing site features and the existing Victoria Rail Trail bridge. 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 in reference to geodetic elevation benchmarks provided by the MTO.

Downing Drilling of Hawkesbury, Ontario supplied and operated the drilling equipment and carried out the drilling, soil sampling, in-situ testing, standpipe installation and borehole decommissioning. On Track Safety of Thornhill, Ontario supplied the traffic control signage and flag persons for the on-road drilling. The field investigation was supervised on a full-time basis by Mr. Richard Howarth of Thurber. Overall supervision of the investigation program was provided by Mr. Justin Gray, 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 Mr. Stephen Dunlop, P.Eng. The report was reviewed by Dr. Fred Griffiths, P.Eng., a Designated Principal Contact for MTO Foundation Projects.



Stephen Dunlop, M.A.Sc., P.Eng.
Senior Geotechnical Engineer

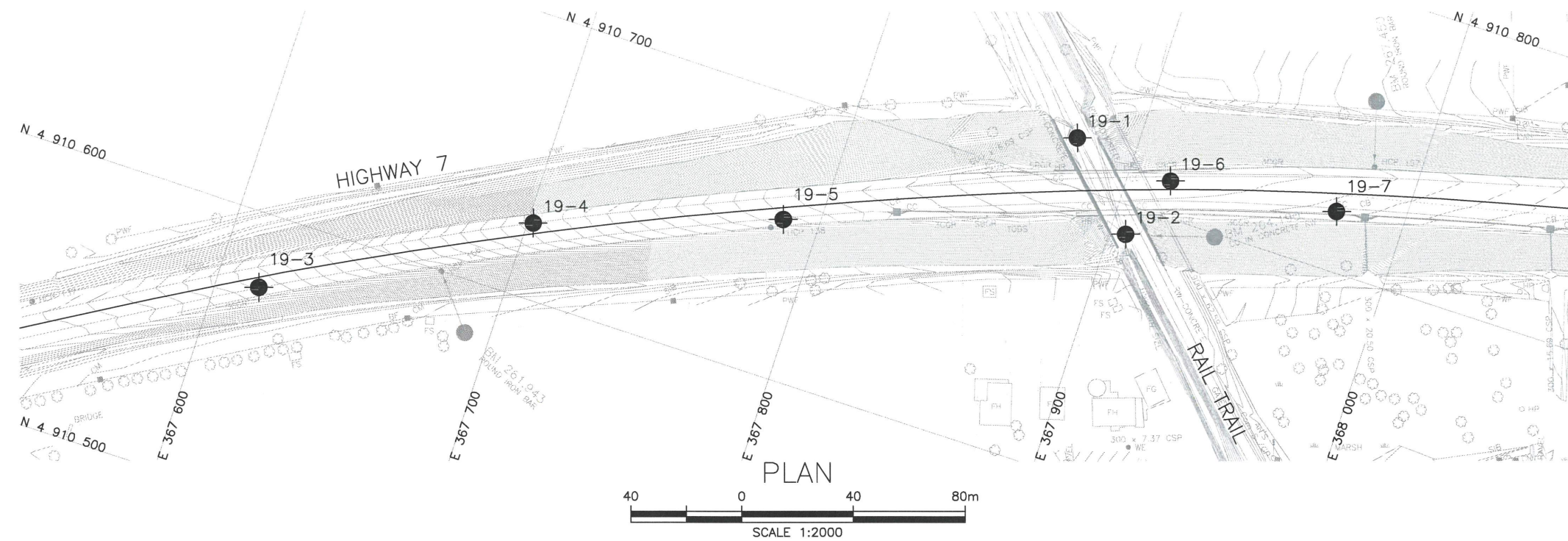


Fred Griffiths, Ph.D., P.Eng.
MTO Review Principal,
Senior Geotechnical Engineer



Appendix A.

Borehole Location Plan and Stratigraphic Drawings



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

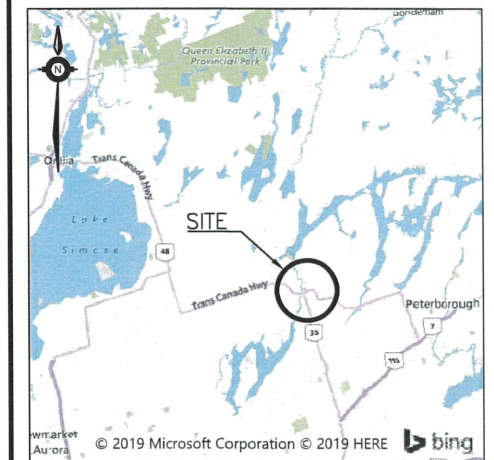


CONT No
WP No 4094-17-00

HIGHWAY 7
GRADE LOWERING
STATION 20+000 TO 20+450
BOREHOLE LOCATIONS AND SOIL STRATA



THURBER ENGINEERING LTD.



KEYPLAN

LEGEND

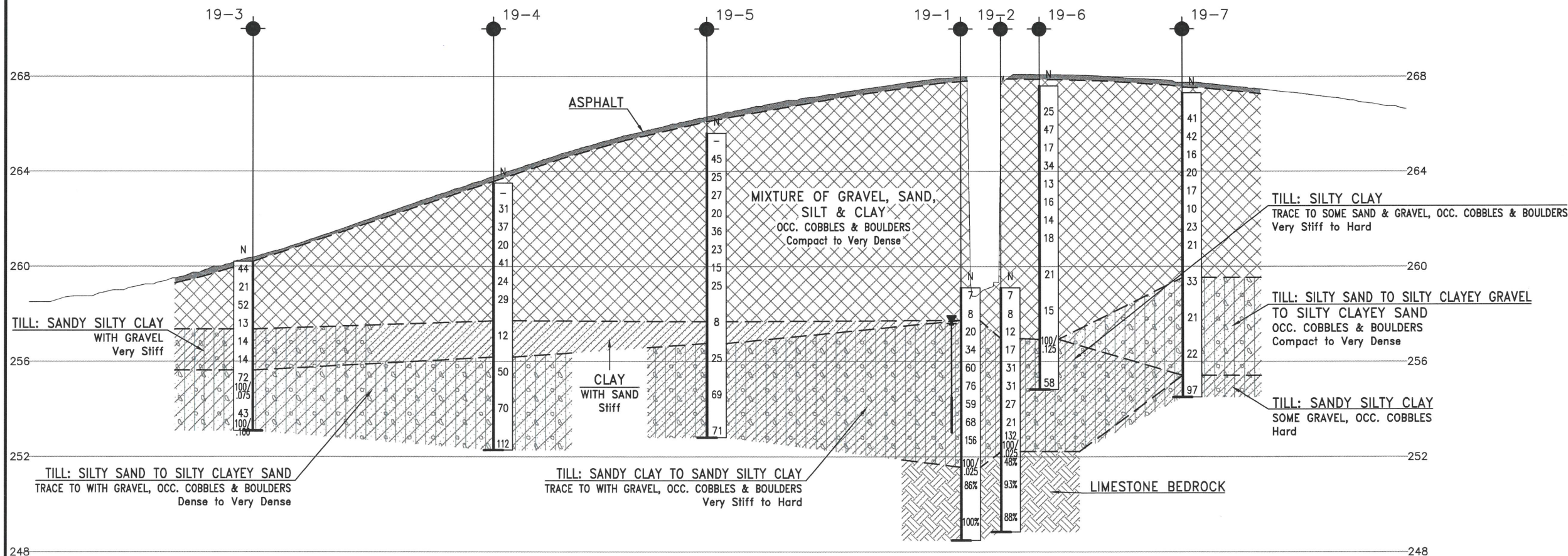
●	Borehole
◆	Borehole and Cone
N	Blows /0.3m (Std Pen Test, 475J/blow)
CONE	Blows /0.3m (60° Cone, 475J/blow)
PH	Pressure, Hydraulic
W	Water Level
↑	Head Artesian Water
—	Piezometer
90%	Rock Quality Designation (RQD)
A/R	Auger Refusal

NO	ELEVATION	NORTHING	EASTING
19-1	259.1	4 910 717.2	367 878.6
19-2	259.1	4 910 689.7	367 905.8
19-3	260.2	4 910 573.8	367 615.5
19-4	263.5	4 910 626.8	367 702.0
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19-6	267.6	4 910 712.9	367 915.2
19-7	267.3	4 910 721.2	367 975.6

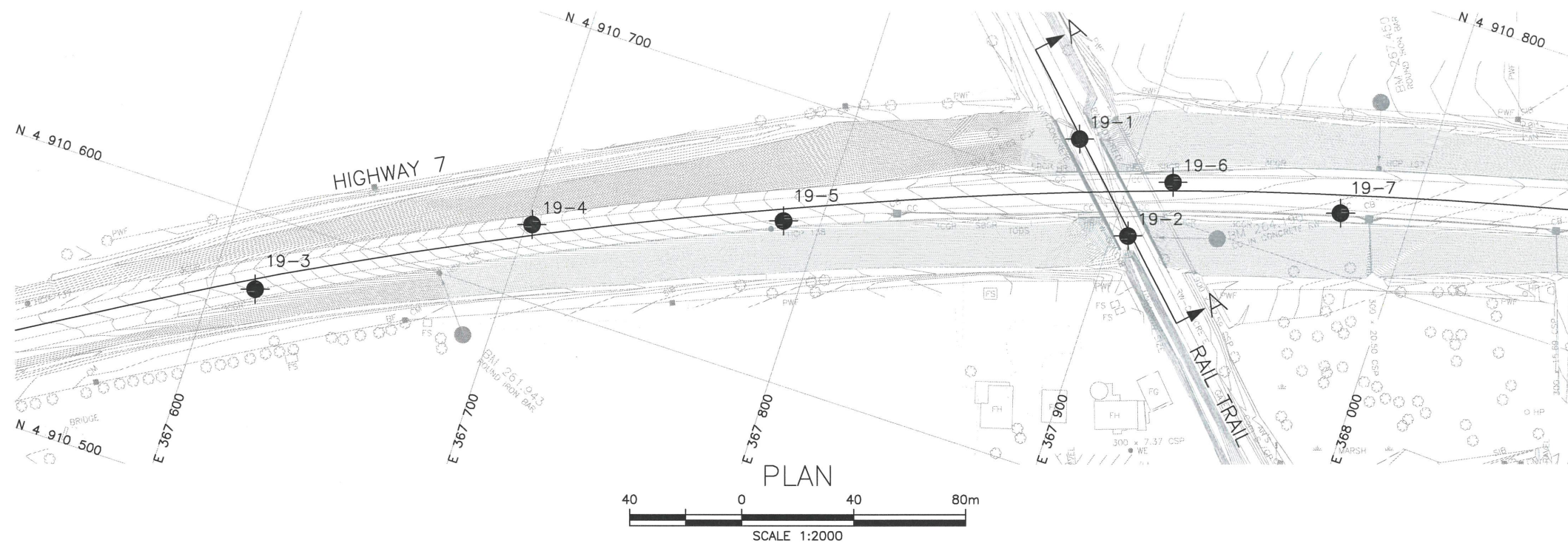
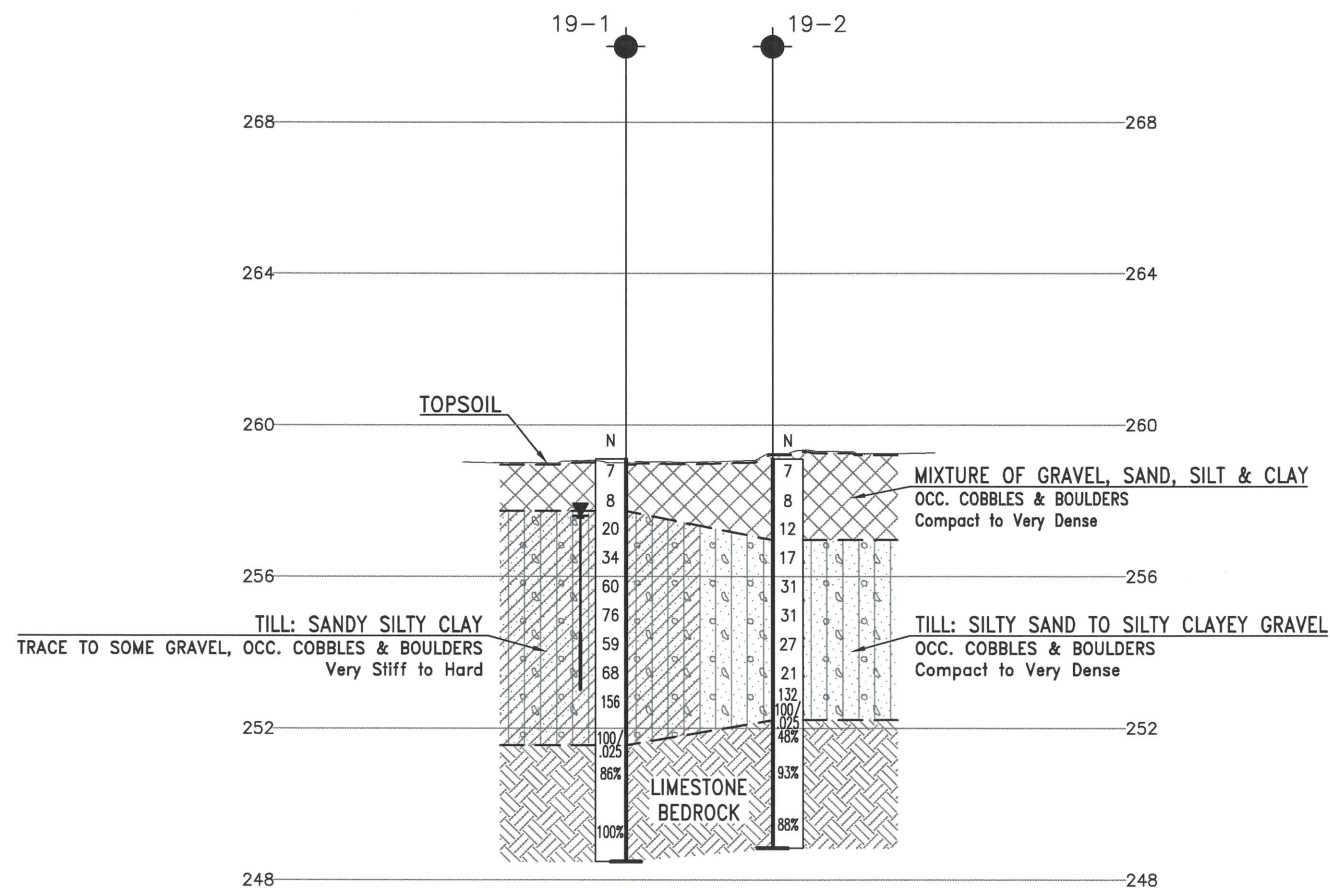
-NOTES-

- 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. 31D-746



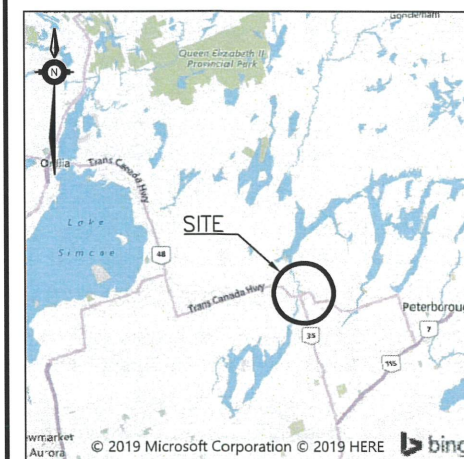
DATE	BY	DESCRIPTION
DESIGN	JG	CHK SD
DRAWN	MFA	CHK JG
CODE	LOAD	DATE
SITE	STRUCT	DWG 1

PLAN
SCALE 1:2000

SECTION A-A

H 1:2000
V 1:200METRIC
DIMENSIONS ARE IN METRES
AND/OR MILLIMETRES
UNLESS OTHERWISE SHOWNCONT No
WP No 4094-17-00HIGHWAY 7
STRUCTURAL CULVERT
AT STATION 20+300
BOREHOLE LOCATIONS AND SOIL STRATA

THURBER ENGINEERING LTD.



KEYPLAN

LEGEND

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

NO	ELEVATION	NORTHING	EASTING
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19-7	267.3	4 910 721.2	367 975.6

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GEOCRES No. 31D-746

REVISIONS	DATE	BY	DESCRIPTION
DESIGN	JG	CHK SD	CODE
DRAWN	MFA	CHK JG	SITE
			LOAD
			DATE
			MAR 2020
			STRUCT
			DWG 2



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 19-1

1 OF 2

METRIC

WP# 4094-17-00 LOCATION Lat: 44.333722° Long: -78.709021° ORIGINATED BY RH
 HWY 17 BOREHOLE TYPE HSA/NQ Coring COMPILED BY JG
 DATUM Geodetic DATE 2019.04.30 - 2019.04.30 CHECKED BY SD

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 W _L	20 40 60	GR SA SI CL		
259.1	Grass												
0.0	Topsoil (40 mm)		1	SS	7		259						25 36 29 10
	CLAYEY SAND with gravel trace organics loose brown FILL		2	SS	8		258						
257.7													
1.4	SANDY SILTY CLAY (CL-ML) trace to some gravel (TILL) occasional cobbles and boulders very stiff to hard brown to grey		3	SS	20		257						12 25 49 14
			4	SS	34		256						
			5	SS	60		255						
	- grey below 3.8 m		6	SS	76		254						2 24 58 16
			7	SS	59		253						
			8	SS	68		252						
			9	SS	156		251						RUN #1 TCR=100% SCR=100% RQD=86%
							250						RUN #2 TCR=100% SCR=100% RQD=100%
251.6			10	SS	100/25mm								
7.5	LIMESTONE BEDROCK with shale interbedding fresh strong horizontally bedded grey		1	RUN			251						
			2	RUN			250						

Continued Next Page

+³, ×³: Numbers refer to
Sensitivity

20
15
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(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 19-1

2 OF 2

METRIC

WP# 4094-17-00 LOCATION Lat: 44.333722° , Long: -78.709021°
MTM z10: N 4 910 717.2 E 367 878.6 ORIGINATED BY RH
HWY 17 BOREHOLE TYPE HSA/NQ Coring COMPILED BY JG
DATUM Geodetic DATE 2019.04.30 - 2019.04.30 CHECKED BY SD

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									
							20	40	60	80	100						
	Continued From Previous Page																
248.5	LIMESTONE BEDROCK with shale interbedding fresh						249										
10.6	strong horizontally bedded grey																
	End of Borehole WATER LEVEL READINGS: DATE DEPTH (m) ELEV. (m) 2019.05.27 2.2 256.9 2019.05.31 1.5 257.6																

DOUBLE LINE 23770 - HWY 7 VICTORIA RAIL TRAIL CULVERT AND GRADE LOWERING.GPJ 2012TEMPLATE(MTO).GDT 2/3/20

RECORD OF BOREHOLE No 19-2

1 OF 2

METRIC

WP# 4094-17-00 LOCATION Lat: 44.333472° Long: -78.708682°
MTM z10: N 4 910 689.7 E 367 905.8 ORIGINATED BY RH
HWY 17 BOREHOLE TYPE HSA/NQ Coring COMPILED BY JG
DATUM Geodetic DATE 2019.04.29 - 2019.04.29 CHECKED BY SD

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
								20 40 60 80 100						
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE						
							WATER CONTENT (%)							
							PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT w _p w w _L							
259.1	Grass													
0.0	Topsoil (50 mm)						259							
	Sandy SILT, trace gravel trace organics loose to compact brown FILL		1	SS	7							○		
			2	SS	8		258					H		9 26 53 12
			3	SS	12							○		
257.0							257							
2.1	SILTY SAND (SM) with gravel to SILTY CLAYEY GRAVEL (GC-GM) with sand (TILL) occasional cobbles and boulders compact to very dense brown		4	SS	17							○		
			5	SS	31		256					○H		26 31 34 9
	- grey below 3.8 m		6	SS	31		255					○		
			7	SS	27							○		
			8	SS	21		254					ΦH		31 30 29 10
			9	SS	132		253					○		
252.2			10	SS	100/							○		
6.9	LIMESTONE BEDROCK with shale interbedding fresh strong thinly bedded grey		1	RUN	25mm		252							RUN #1 TCR=100% SCR=96% RQD=48%
			2	RUN			251							RUN #2 TCR=100% SCR=100% RQD=93%
			3	RUN			250							RUN #3 TCR=100% SCR=100% RQD=88%

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+³, ×³: Numbers refer to
Sensitivity

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(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 19-2

2 OF 2

METRIC

WP# 4094-17-00 LOCATION Lat: 44.333472° , Long: -78.708682°
MTM z10: N 4 910 689.7 E 367 905.8 ORIGINATED BY RH
HWY 17 BOREHOLE TYPE HSA/NQ Coring COMPILED BY JG
DATUM Geodetic DATE 2019.04.29 - 2019.04.29 CHECKED BY SD

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 20 40 60 80 100					W P W W L 20 40 60					
248.8 10.3	Continued From Previous Page LIMESTONE BEDROCK with shale interbedding fresh strong thinly bedded grey End of Borehole						249										



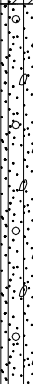
DOUBLE LINE 23770 - HWY 7 VICTORIA RAIL TRAIL CULVERT AND GRADE LOWERING.GPJ 2012TEMPLATE(MTO).GDT 2/3/20

RECORD OF BOREHOLE No 19-3

1 OF 1

METRIC

WP# 4094-17-00 LOCATION Lat: 44.332454°, Long: -78.712336°
MTM z10: N 4 910 573.8 E 367 615.5 ORIGINATED BY RH
HWY 17 BOREHOLE TYPE HSA COMPILED BY JG
DATUM Geodetic DATE 2019.05.14 - 2019.05.14 CHECKED BY SD

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 (%)					
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE					W P W W L					
260.2								20	40	60	80	100						
0.0	SILTY SAND with gravel occasional cobbles and possible boulders compact to very dense grey FILL		1	SS	44		260							○				
														○				
			2	SS	21		259							○				25 39 36 (SI+CL)
			3	SS	52									○				
							258											
			4	SS	13									○				
257.4															○			
2.8	SANDY SILTY CLAY (CL-ML) with gravel (TILL) very stiff brown		5	SS	14		257							○				17 32 36 15
														○				
			6	SS	14		256											
255.6																		
4.6	SILTY SAND (SM) trace to some gravel (TILL) occasional cobbles and boulders dense to very dense brown		7	SS	72									○				
			8	SS	100/ 75mm		255							○				
			9	SS	43		254							○				8 52 34 6 non-plastic
253.1			10	SS	100/ 100mm									○				
7.1	End of Borehole																	

DOUBLE LINE 23770 - HWY 7 VICTORIA RAIL TRAIL CULVERT AND GRADE LOWERING GPJ 2012TEMPLATE(MTO).GDT 2/3/20

RECORD OF BOREHOLE No 19-4

1 OF 2

METRIC

WP# 4094-17-00 LOCATION Lat: 44.332923°, Long: -78.711245° ORIGINATED BY RH
 HWY 17 BOREHOLE TYPE HSA MTM z10: N 4 910 626.8 E 367 702.0 COMPILED BY JG
 DATUM Geodetic DATE 2019.05.15 - 2019.05.15 CHECKED BY SD

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 W _L	WATER CONTENT (%)			20 40 60	GR		SA	SI	CL	
263.5																			
0.0	200mm Asphalt																		
0.2	SILTY SAND with gravel occasional cobbles and possible boulders compact to dense grey-brown to brown FILL		1	BS	-		263												
			2	SS	31														
			3	SS	37		262												
			4	SS	20		261												
			5	SS	41		260										19	32 49 (SI+CL)	
			6	SS	24		259												
			7	SS	29		258												
257.7																			
5.8	CLAY (CI) with sand stiff brown		8	SS	12		257										1	15 45 39	
256.2																			
7.3	SILTY CLAYEY SAND (SC-SM) with gravel (TILL) occasional cobbles and boulders dense to very dense brown		9	SS	50		256											21 34 35 10	
							255												
			10	SS	70		254												

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Sensitivity

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(%) STRAIN AT FAILURE


DOUBLE LINE 23770 - HWY 7 VICTORIA RAIL TRAIL CULVERT AND GRADE LOWERING GPJ 2012TEMPLATE(MTO).GDT 2/3/20

RECORD OF BOREHOLE No 19-4

2 OF 2

METRIC

WP# 4094-17-00 LOCATION Lat: 44.332923° , Long: -78.711245° ORIGINATED BY RH
 HWY 17 BOREHOLE TYPE HSA COMPILED BY JG
 DATUM Geodetic DATE 2019.05.15 - 2019.05.15 CHECKED BY SD

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										20 40 60		
	Continued From Previous Page																			
252.3	SILTY CLAYEY SAND (SC-SM) with gravel (TILL) occasional cobbles and boulders dense to very dense brown		11	SS	112		253													
11.2	End of Borehole																			



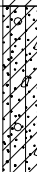
DOUBLE LINE 23770 - HWY 7 VICTORIA RAIL TRAIL CULVERT AND GRADE LOWERING.GPJ 2012TEMPLATE(MTO).GDT 2/3/20

RECORD OF BOREHOLE No 19-5

1 OF 2

METRIC

WP# 4094-17-00 LOCATION Lat: 44.333181°, Long: -78.710173° ORIGINATED BY RH
 HWY 17 BOREHOLE TYPE HSA COMPILED BY JG
 DATUM Geodetic DATE 2019.05.14 - 2019.05.14 CHECKED BY SD

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					w _p w w _L							
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE												
265.6																				
0.0			1	BS	-															
			2	SS	45															
264.2																				
1.4			3	SS	25															
			4	SS	27															
			5	SS	20															
			6	SS	36															
			7	SS	23															
			8	SS	15															
			9	SS	25															
257.7			10	SS	8															
7.9																				
256.8																				
8.8			11	SS	25															

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+³, ×³: Numbers refer to
Sensitivity

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(%) STRAIN AT FAILURE

DOUBLE LINE 23770 - HWY 7 VICTORIA RAIL TRAIL CULVERT AND GRADE LOWERING GPJ 2012TEMPLATE(MTO).GDT 2/3/20

RECORD OF BOREHOLE No 19-5

2 OF 2

METRIC

WP# 4094-17-00 LOCATION Lat: 44.333181°, Long: -78.710173°
MTM z10: N 4 910 656.3 E 367 787.2 ORIGINATED BY RH
HWY 17 BOREHOLE TYPE HSA COMPILED BY JG
DATUM Geodetic DATE 2019.05.14 - 2019.05.14 CHECKED BY SD

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									
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE									
	Continued From Previous Page						20	40	60	80	100						
	SANDY CLAY (CL) with gravel (TILL) occasional cobbles and boulders stiff to hard grey-brown																
			12	SS	69		255							○			
							254										
252.8				13	SS	71		253						●	●		22 25 38 15
12.8	End of Borehole																

DOUBLE LINE 23770 - HWY 7 VICTORIA RAIL TRAIL CULVERT AND GRADE LOWERING.GPJ 2012TEMPLATE(MTO).GDT 2/3/20

RECORD OF BOREHOLE No 19-6

1 OF 2

METRIC

WP# 4094-17-00 LOCATION Lat: 44.333681°, Long: -78.708561°
MTM z10: N 4 910 712.9 E 367 915.2 ORIGINATED BY RH
HWY 17 BOREHOLE TYPE HSA COMPILED BY JG
DATUM Geodetic DATE 2019.05.15 - 2019.05.15 CHECKED BY SD

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							
267.6																			
0.0	175 mm Asphalt																		
0.2	SILTY GRAVEL with sand occasional cobbles and possible boulders compact to dense grey FILL		1	BS			267												
			2	SS	25		266												
			3	SS	47		265												
			4	SS	17		264												
264.8			5	SS	34		263												
2.8	SAND with silt and gravel to SANDY SILT with gravel (FILL) dense brown		6	SS	13		262												
			7	SS	16		261												
			8	SS	14		260												
			9	SS	18		259												
			10	SS	21		258												
			11	SS	15														

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

DOUBLE LINE 23770 - HWY 7 VICTORIA RAIL TRAIL CULVERT AND GRADE LOWERING GPJ 2012TEMPLATE(MTO).GDT 2/3/20

RECORD OF BOREHOLE No 19-6

2 OF 2

METRIC

WP# 4094-17-00 LOCATION Lat: 44.333681°, Long: -78.708561°
MTM z10: N 4 910 712.9 E 367 915.2 ORIGINATED BY RH
HWY 17 BOREHOLE TYPE HSA COMPILED BY JG
DATUM Geodetic DATE 2019.05.15 - 2019.05.15 CHECKED BY SD

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 ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE								
	Continued From Previous Page						20	40	60	80	100					
256.9 10.7	SANDY CLAY some gravel to with gravel occasional cobbles and possible boulders compact brown FILL		12	SS	100/ 125mm											
	SILTY CLAY (CL-ML) trace to some sand and gravel (TILL) occasional cobbles and boulders very stiff to hard grey brown to grey															
254.8 12.8	End of Borehole		13	SS	58											2 8 70 20

DOUBLE LINE 23770 - HWY 7 VICTORIA RAIL TRAIL CULVERT AND GRADE LOWERING.GPJ 2012TEMPLATE(MTO).GDT 2/3/20

RECORD OF BOREHOLE No 19-7

1 OF 2

METRIC

WP# 4094-17-00 LOCATION Lat: 44.333749°, Long: -78.707802°
MTM z10: N 4 910 721.2 E 367 975.6 ORIGINATED BY RH
HWY 17 BOREHOLE TYPE HSA COMPILED BY JG
DATUM Geodetic DATE 2019.05.16 - 2019.05.16 CHECKED BY SD

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					
267.3													
0.0	200 mm Asphalt												
0.2	SAND with gravel dense brown-grey FILL		1	BS	-		267						
				1	SS	41							
265.9								266					
1.4	CLAYEY SAND with gravel to SANDY CLAY with gravel to CLAYEY GRAVEL with sand occasional cobbles and possible boulders compact to dense brown FILL			2	SS	42							
				3	SS	16		265					
				4	SS	20		264					
				5	SS	17							
				6	SS	10		263					
				7	SS	23		262					
				8	SS	21		261					
							260						
259.5	- trace organic silt at 7.8m		9	SS	33		259						
7.8	SILTY CLAYEY SAND (SC-SM) with gravel (TILL) occasional cobbles and boulders compact to dense brown						258						
				10	SS	21							

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+³, ×³: Numbers refer to
Sensitivity

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(%) STRAIN AT FAILURE

METRIC

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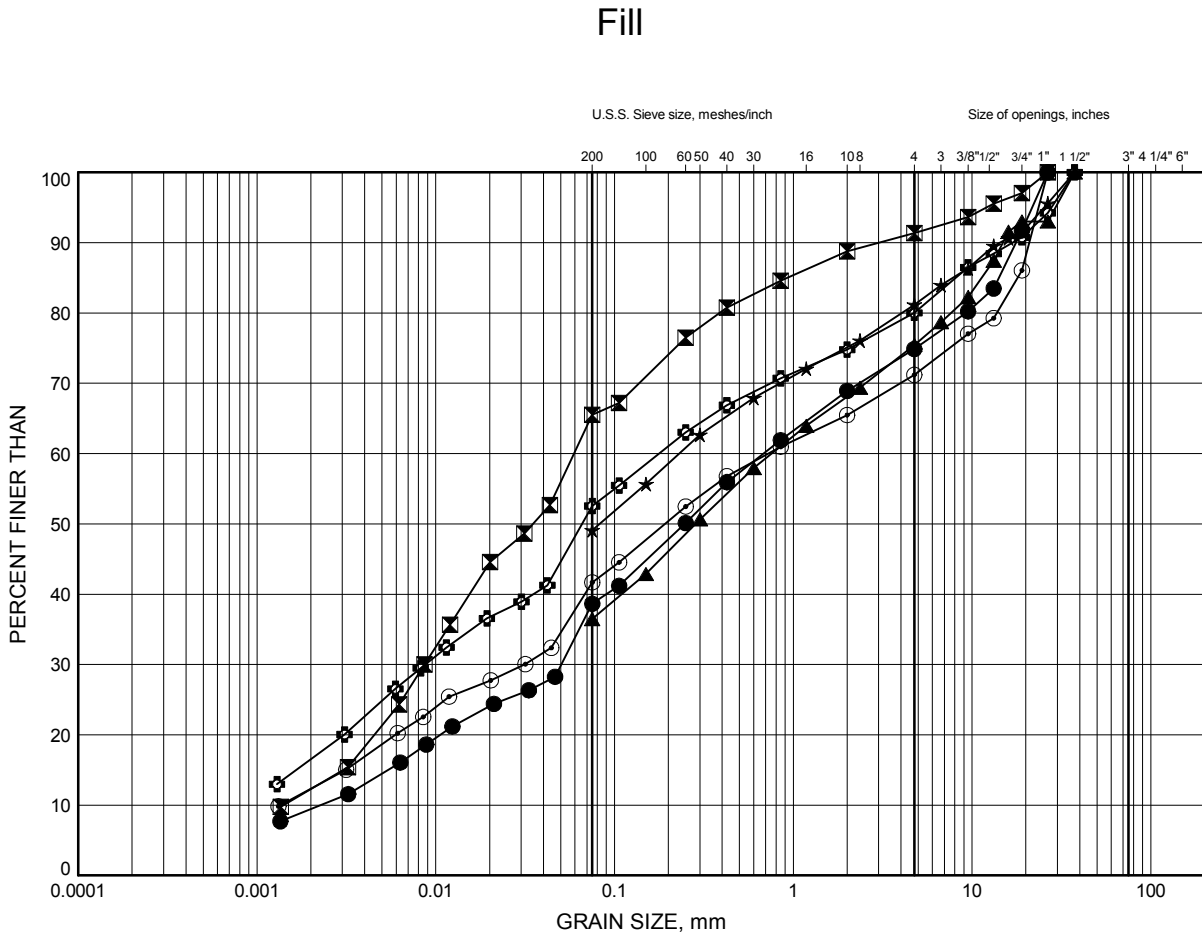
Appendix C.
Laboratory Testing



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

Hwy 7 Lindsay Rail Trail Culvert 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)
●	19-1	0.3	258.8
⊠	19-2	1.1	258.0
▲	19-3	1.1	259.1
★	19-4	3.4	260.1
⊙	19-5	2.6	263.0
⊕	19-5	6.4	259.2

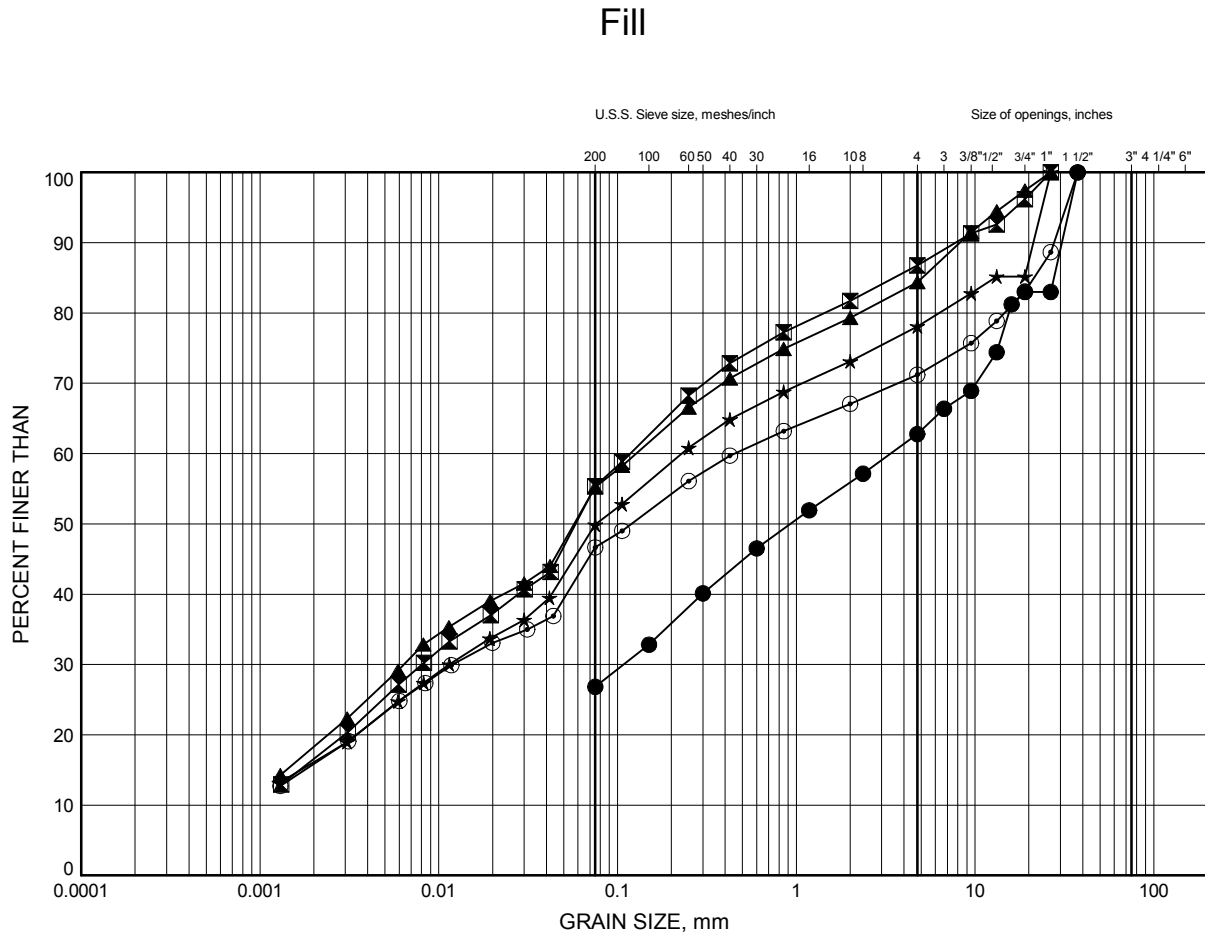
Date ..October 2019.....
WP# ..4094-17-00.....



Prep'dAC.....
Chkd.SD.....

Hwy 7 Lindsay Rail Trail Culvert GRAIN SIZE DISTRIBUTION

FIGURE C2



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	19-6	2.6	265.0
⊠	19-6	4.9	262.7
▲	19-6	7.9	259.7
★	19-7	3.4	263.9
⊙	19-7	6.4	260.9

Date ..October 2019.....
WP# ..4094-17-00.....

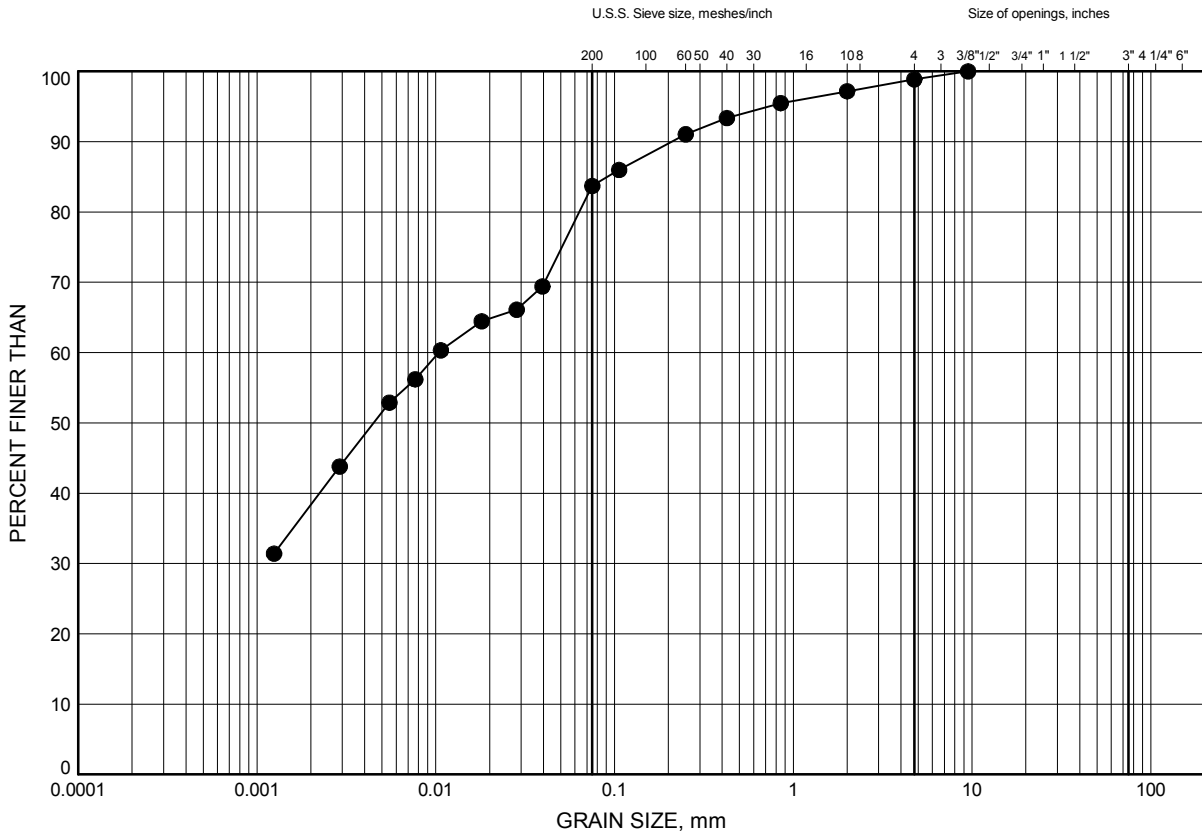


Prep'dAC.....
Chkd.SD.....

Hwy 7 Lindsay Rail Trail Culvert GRAIN SIZE DISTRIBUTION

FIGURE C3

Clay (CI) with sand



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	19-4	6.4	257.1

Date ..October 2019.....
WP# ..4094-17-00.....

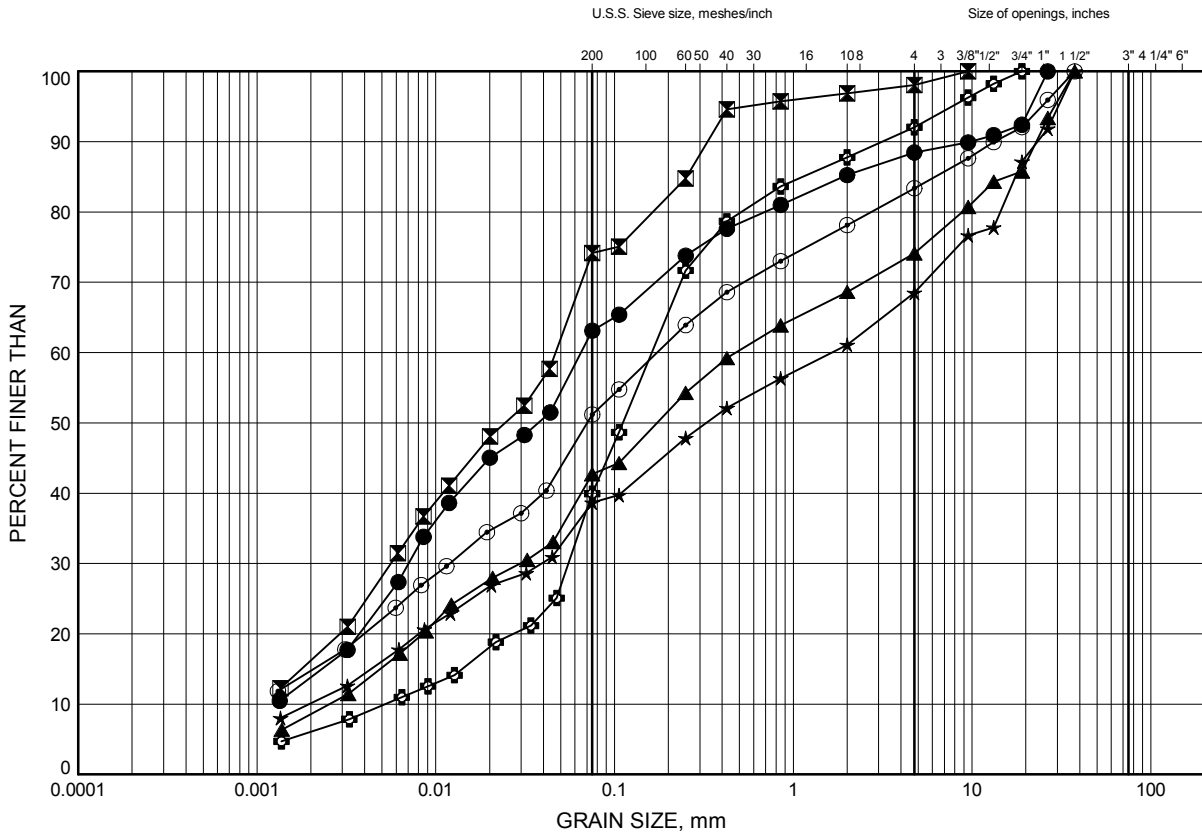


Prep'dAC.....
Chkd.SD.....

Hwy 7 Lindsay Rail Trail Culvert GRAIN SIZE DISTRIBUTION

FIGURE C4

Glacial Till



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	19-1	2.6	256.5
⊠	19-1	5.6	253.5
▲	19-2	3.4	255.7
★	19-2	5.6	253.5
⊙	19-3	3.4	256.8
⊕	19-3	6.4	253.8

Date ..October 2019.....
WP# ..4094-17-00.....

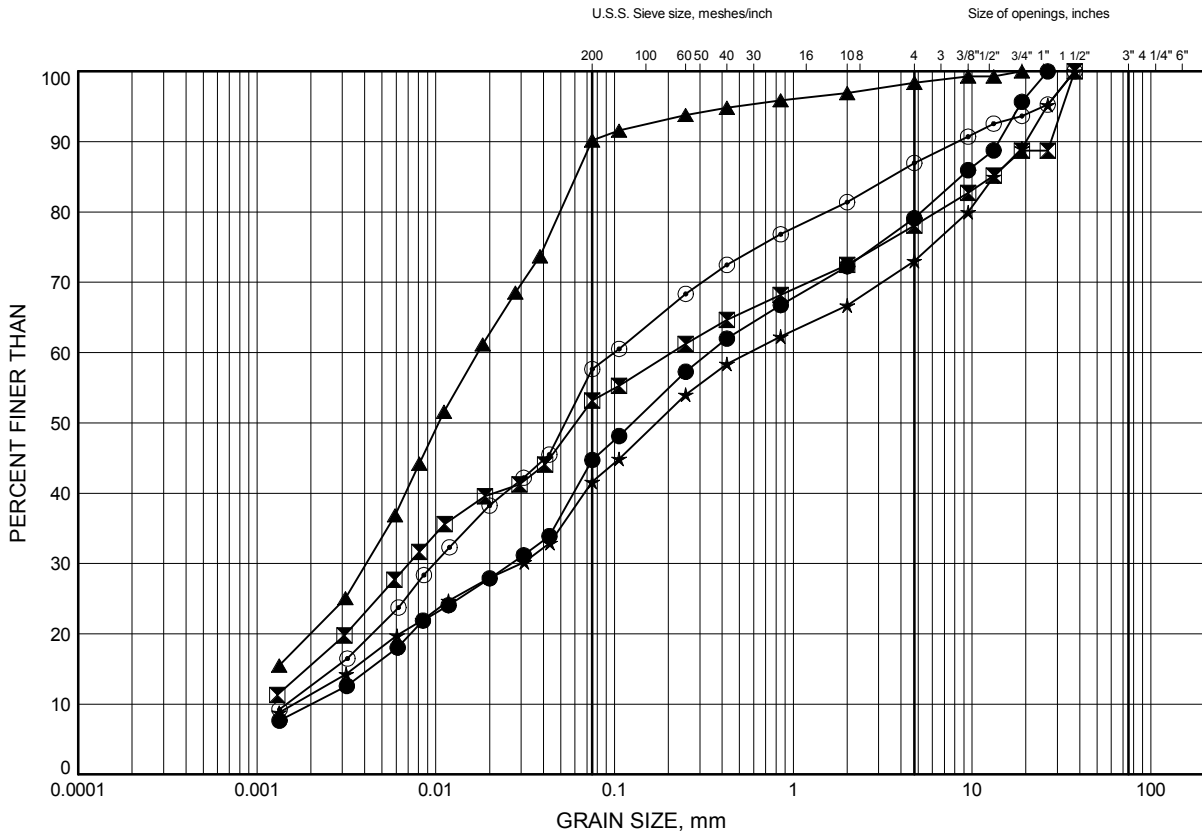


Prep'dAC.....
Chkd.SD.....

Hwy 7 Lindsay Rail Trail Culvert GRAIN SIZE DISTRIBUTION

FIGURE C5

Glacial Till



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	19-4	7.9	255.6
⊠	19-5	12.5	253.1
▲	19-6	12.5	255.1
★	19-7	11.0	256.3
⊙	19-7	12.5	254.8

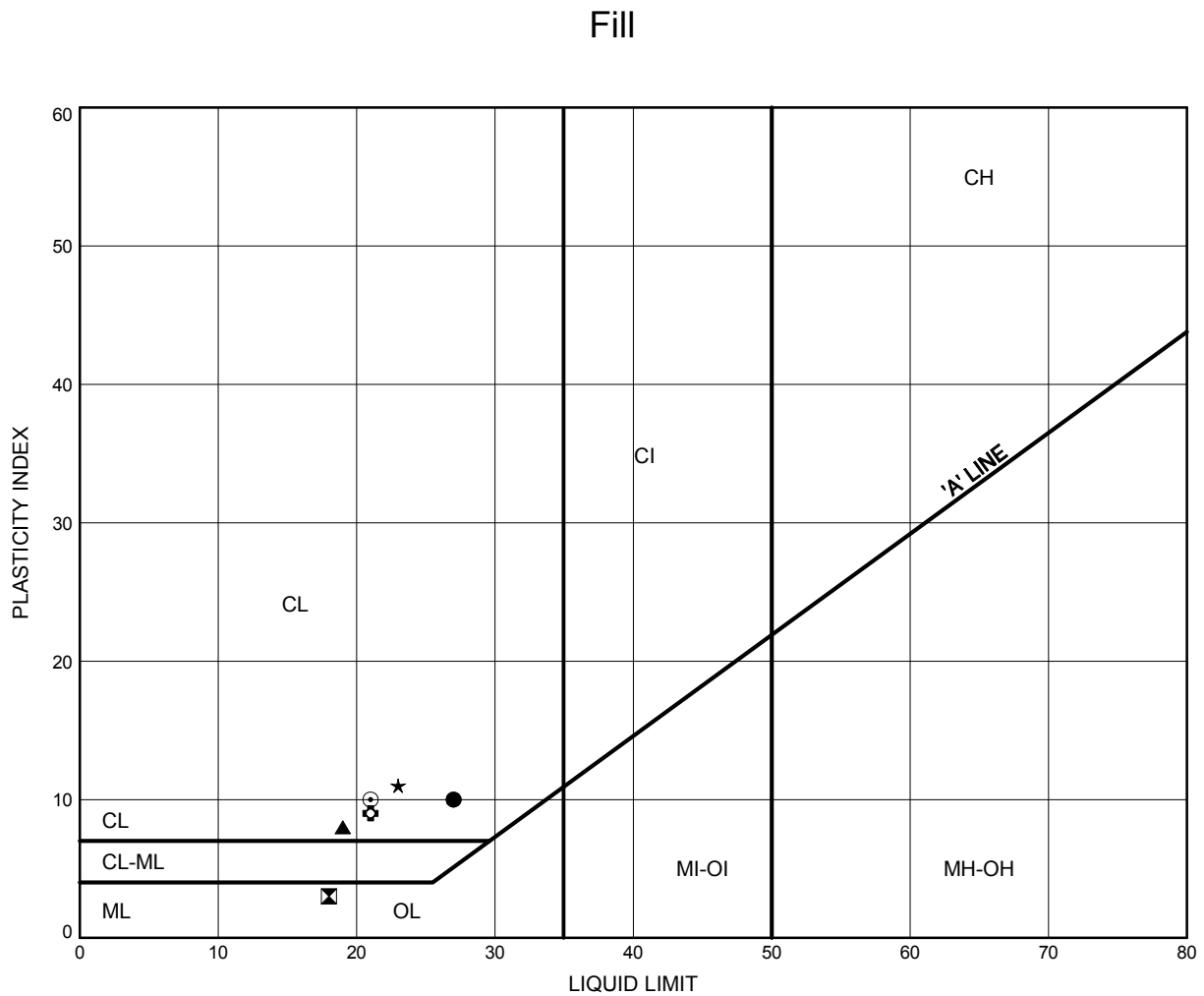
Date ..October 2019.....
WP# ..4094-17-00.....



Prep'dAC.....
Chkd.SD.....

Hwy 7 Lindsay Rail Trail Culvert ATTERBERG LIMITS TEST RESULTS

FIGURE C6



LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	19-1	0.3	258.8
⊠	19-2	1.1	258.0
▲	19-5	2.6	263.0
★	19-5	6.4	259.2
⊙	19-6	4.9	262.7
⊕	19-6	7.9	259.7

Date ..October 2019.....
WP# ..4094-17-00.....

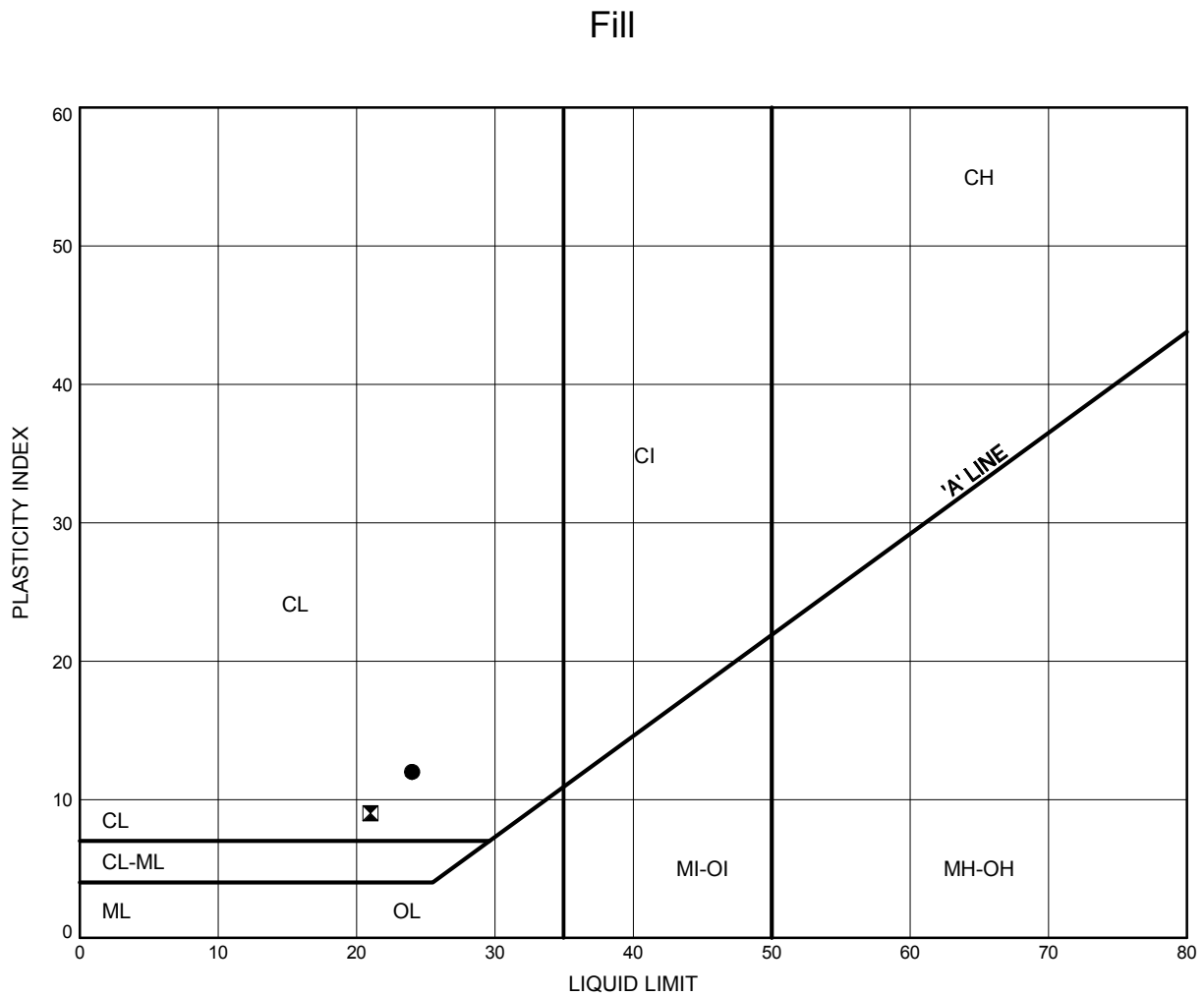


Prep'd ..AC.....
Chkd.SD.....

Hwy 7 Lindsay Rail Trail Culvert

ATTERBERG LIMITS TEST RESULTS

FIGURE C7



LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	19-7	3.4	263.9
⊠	19-7	6.4	260.9

Date ..October 2019.....
 WP# ..4094-17-00.....



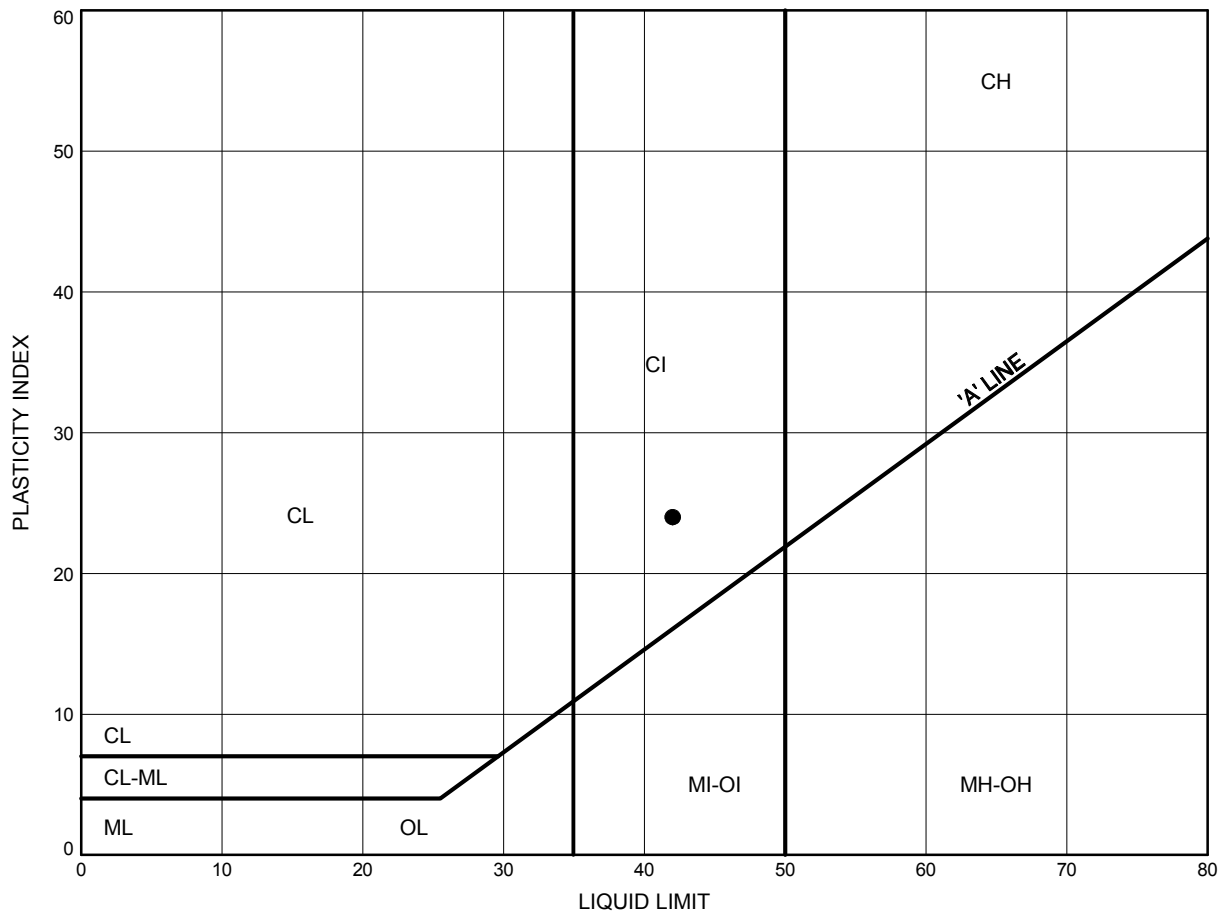
Prep'dAC.....
 Chkd.SD.....

Hwy 7 Lindsay Rail Trail Culvert

ATTERBERG LIMITS TEST RESULTS

FIGURE C8

Clay (CI) with sand



LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	19-4	6.4	257.1

Date ..October 2019.....
 WP# ..4094-17-00.....

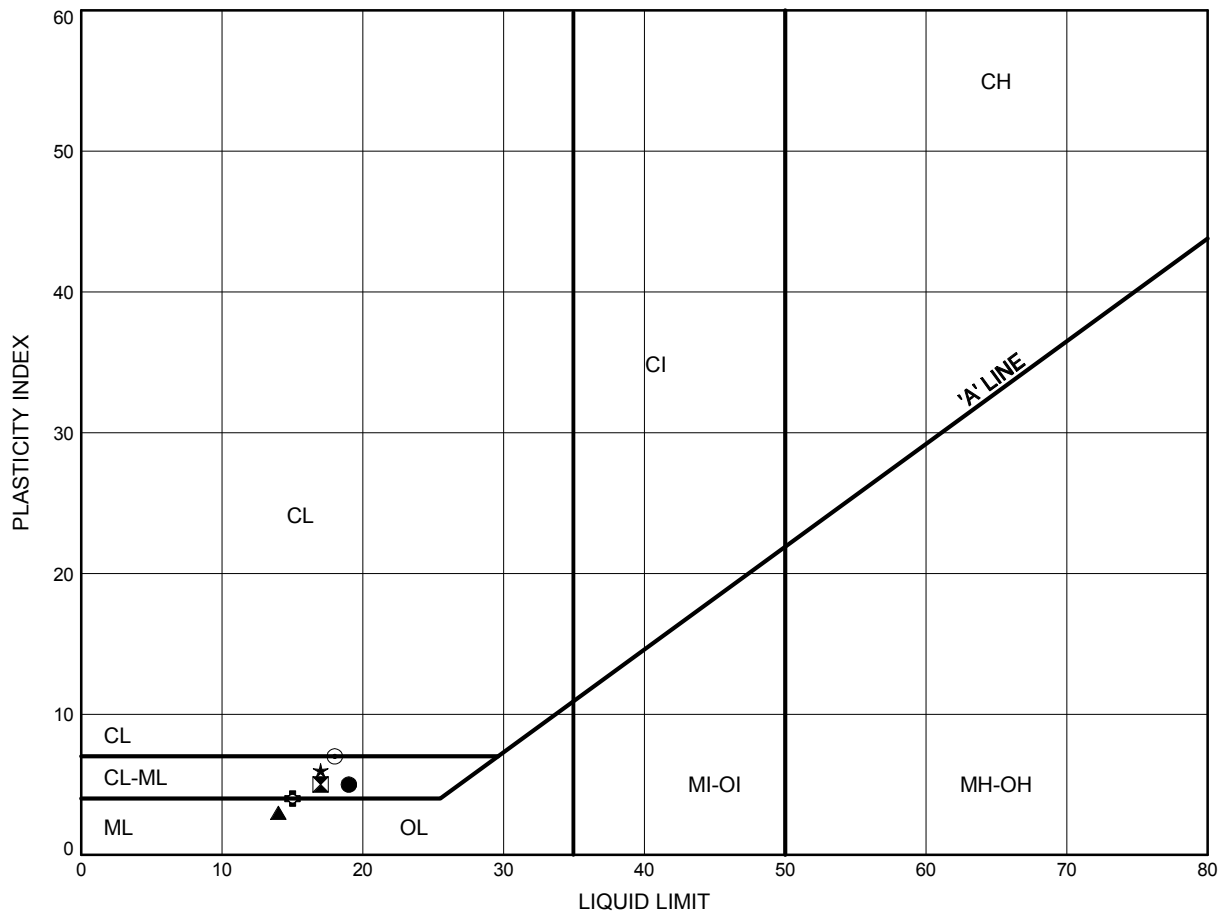


Prep'd ..AC.....
 Chkd.SD.....

Hwy 7 Lindsay Rail Trail Culvert ATTERBERG LIMITS TEST RESULTS

FIGURE C9

Glacial Till



LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	19-1	2.6	256.5
⊠	19-1	5.6	253.5
▲	19-2	3.4	255.7
★	19-2	5.6	253.5
⊙	19-3	3.4	256.8
⊕	19-4	7.9	255.6

Date ..October 2019.....
WP# ..4094-17-00.....

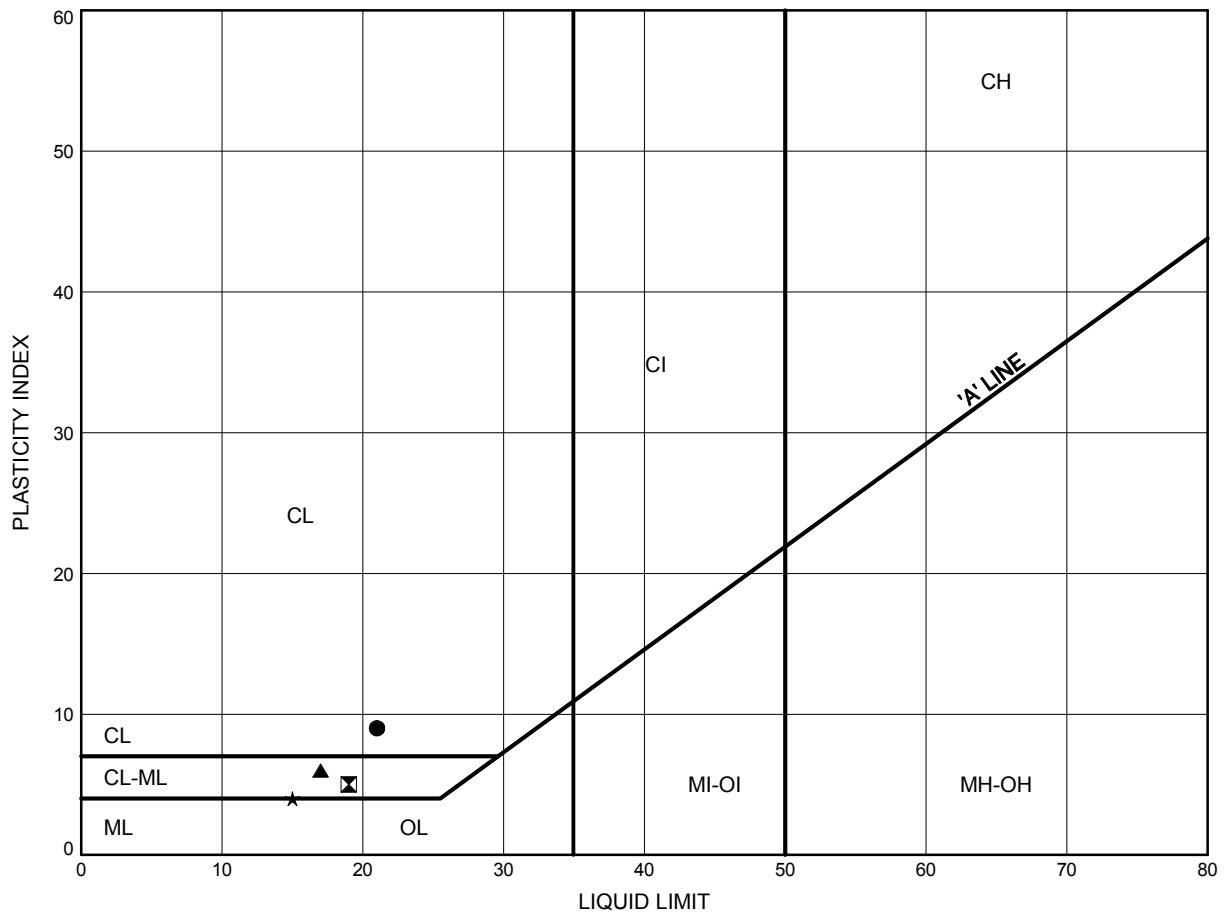


Prep'dAC.....
Chkd.SD.....

Hwy 7 Lindsay Rail Trail Culvert ATTERBERG LIMITS TEST RESULTS

FIGURE C10

Glacial Till



LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	19-5	12.5	253.1
⊠	19-6	12.5	255.1
▲	19-7	11.0	256.3
★	19-7	12.5	254.8

Date ..October 2019.....
WP# ..4094-17-00.....



Prep'dAC.....
Chkd.SD.....



Appendix C.2

Analytical Testing Results

Certificate of Analysis
Client: Thurber Engineering Ltd.
Client PO: 23770

Report Date: 22-May-2019

Order Date: 13-May-2019

Project Description: Hwy 7, Culvert 20+300

Client ID:	19-1, SS3, 5'-7'	-	-	-
Sample Date:	30-Apr-19 09:00	-	-	-
Sample ID:	1920149-01	-	-	-
MDL/Units	Soil	-	-	-

Physical Characteristics

% Solids	0.1 % by Wt.	88.2	-	-	-
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General Inorganics

Conductivity	5 uS/cm	226	-	-	-
pH	0.05 pH Units	7.37	-	-	-
Resistivity	0.10 Ohm.m	44.2	-	-	-

Anions

Chloride	5 ug/g dry	70	-	-	-
Sulphate	5 ug/g dry	8	-	-	-

**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-May-2019

Date Rec. : 15 May 2019
LR Report: CA12710-MAY19
Reference: Project#: 1920149

Copy: #1

CERTIFICATE OF ANALYSIS

Final Report

Sample ID	Sample Date & Time	Sulphide %
1: Analysis Start Date		22-May-19
2: Analysis Start Time		15:02
3: Analysis Completed Date		22-May-19
4: Analysis Completed Time		16:14
5: QC - Blank		< 0.02
6: QC - STD % Recovery		118%
7: QC - DUP % RPD		ND
8: RL		0.02
9: 19-1, SS3, 5'7	30-Apr-19 09:00	< 0.02

RL - SGS Reporting Limit

Note: Sample was past the 14 day holding time upon receipt; result may be unreliable.

Kimberley Didsbury
Project Specialist,
Environment, Health & Safety



Appendix C.3

Bedrock Core Photographs

Borehole 19-1
Run 1 to 2 (of 2)
Elevation 251.6 m to 248.5 m



Foundation Investigation
Highway 7 Lindsay – Culvert 23+000
Kawartha Lakes, Ontario

WP 4094-17-00
Project No.: 23770

Borehole 19-2
Run 1 to 3 (of 3)
Elevation 252.2 m to 248.8 m



Foundation Investigation
Highway 7 Lindsay – Culvert 22+039
Kawartha Lakes, Ontario

WP 4094-17-00
Project No.: 23770



Appendix D.

Site Photographs



Photo 1. Looking north towards Victoria Trail Bridge (2019/04/22)



Photo 2. Looking south towards Victoria Trail Bridge (2019/04/22)



Photo 3. Looking east along Hwy 7 from Victoria Trail Bridge (2019/04/22)



Photo 4. Looking west along Hwy 7 from Victoria Trail Bridge (2019/04/22)