



**THURBER** ENGINEERING LTD.

**FOUNDATION INVESTIGATION REPORT  
HIGHWAY 7-NEW EBL AND WBL OVERPASSES  
AT WOODLAWN ROAD  
HIGHWAY 7-NEW, KITCHENER TO GUELPH  
SITE 35-608/2  
G.W.P. 408-88-00**

**GEOCRES No. 40P9-63**

**Latitude 43.549859 ° , Longitude -80.298268 °**

**Report**

to

**WSP**

Date: June 25, 2021  
File: 11375



## TABLE OF CONTENTS

### PART 1: FACTUAL INFORMATION

1.	INTRODUCTION .....	1
2.	SITE DESCRIPTION .....	2
3.	SITE INVESTIGATION AND FIELD TESTING.....	2
4.	LABORATORY TESTING .....	5
5.	DESCRIPTION OF SUBSURFACE CONDITIONS .....	5
5.1	Topsoil.....	6
5.2	Asphalt .....	6
5.3	Fill.....	6
5.4	Silty Sand to Sand .....	7
5.5	Gravelly Sand to Sand and Gravel.....	8
5.6	Sand and Silt to Sandy Silt Till.....	9
5.7	Dolostone Bedrock .....	9
5.8	Groundwater Conditions .....	11
6.	CORROSIVITY AND SULPHATE TEST RESULTS.....	12
7.	MISCELLANEOUS .....	13

### APPENDICES

Appendix A	Record of Borehole Sheets (Present investigation) Geotechnical and Analytical Test Results (Present investigation) <ul style="list-style-type: none"><li>• Grain size analysis and Atterberg Limit Tests</li><li>• UCS Test Results</li><li>• Point Load Test Results</li><li>• Analytical Tests Results</li></ul>
Appendix B	Record of Borehole Sheets (Previous investigation) Geotechnical Test Results (Previous investigation)
Appendix C	Rock Core Photographs
Appendix D	Borehole location and Soil Strata Drawing



**FOUNDATION INVESTIGATION REPORT  
HIGHWAY 7-NEW EBL AND WBL OVERPASSES  
AT WOODLAWN ROAD  
HIGHWAY 7-NEW, KITCHENER TO GUELPH  
SITE 35-608/2  
G.W.P. 408-88-00**

**GEOCRES No. 40P9-63**

**PART 1: FACTUAL INFORMATION**

**1. INTRODUCTION**

This report presents the factual findings obtained from a foundation investigation conducted at the site of the proposed overpass structures to carry the EBL and WBL of Highway 7-New over Woodlawn Road in the City of Guelph, Ontario. The proposed Woodlawn overpass structures are part of the Highway 7-New Project.

The purpose of the 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, a stratigraphic profile, cross sections, laboratory test results and a written description of the subsurface conditions. A model of the subsurface conditions under the potential foundation footprints was developed from the data obtained in the course of the investigation.

Thurber was retained by WSP to carry out the site investigation under the Ministry of Transportation Ontario (MTO) Agreement Order Number 3014-E-0013.

Reference has been made to information on subsurface conditions contained in a previous foundation report prepared for this site during the preliminary design phase. The title of the report is:

- Preliminary, Foundation Investigation and Design Report, Proposed Highway 7 Bridge Over Woodlawn Road, Highway 7-New, Kitchener to Guelph, G.W.P. 408-88-00, Geocres No. 40P9-46, Report to Ministry of Transportation Ontario Southwestern Region, File: 15-64-17, dated October 8, 2008. (Reference 1).

Client: WSP  
File No.: 11375

Date: June 25, 2021  
Page: 1 of 14

E file: H:\10000+11375 Hwy 7 New PD and DD Foundations\Reports & Memos\Woodlawn Rd\Bridge\FIR\ 11375-Woodlawn Road Bridge FINAL FIR



## **2. SITE DESCRIPTION**

The proposed Woodlawn Road overpass structures are located approximately 4.5 km northwest of the city centre of the City of Guelph at the intersection of Highway 7 and Woodlawn Road. . The existing highway corridor south of Woodlawn Road is surrounded primarily by commercial and industrial properties and there is a vacant lot north of the intersection of Highway 7 and Woodlawn Road which extends northerly to Curtis Drive. The existing topography in the vicinity of the site is generally flat.

Based on the Ontario Geological Survey Special Volume 2, The Physiography of Southern Ontario, Third Edition by Chapman and Putnam, the site lies within an area referred to as the Guelph Drumlin Field, an area of drumlinized till plain, also mapped as containing eskers. The till is described as stony and the occurrence of surface boulders is noted. Chapman and Putnam give a typical gradation of the till as being 50% sand, 35% silt and 15% clay. Swampy valleys are reported to occur between the drumlins and associated gravel terraces.

## **3. SITE INVESTIGATION AND FIELD TESTING**

The foundation investigation was completed in two phases. An initial investigation was completed at the site in June 2008, at which time four (4) boreholes (i.e. 08-236 to 08-239) were drilled at the west and east abutments of the proposed overpass structures. Subsequently, in April 2021, an additional nine (9) boreholes (i.e. WL16-01 to WL16-08 and WL16-04B) were advanced at the site near the foundation units and the approach embankments of the structures. The approximate locations of the boreholes are shown on the Borehole Location and Soil Strata Drawings included in Appendix D. The Records of Boreholes sheets from the initial and recent investigations are provided in Appendices A and B, respectively.

The ground surface elevations and coordinates of the recent as-drilled boreholes were surveyed by Thurber using a Trimble R10.

Prior to commencing the site investigation, utility clearances were obtained for all borehole locations. A field work notification was also submitted to the MTO Western Region.

During the current investigation, track-mounted B57 and truck-mounted B60 drill rigs were used in conjunction with hollow-stem augers to advance the boreholes in the overburden soils. In general, soil samples were obtained at selected intervals using a 50mm diameter split spoon sampler in conjunction with the Standard Penetration Testing (SPT). HQ coring methods were



used to advance Boreholes WL16-03 to WL16-06, 0.9 to 4.3 m into bedrock. All remaining boreholes were advanced to auger refusal on probable bedrock and refusal density soils as defined by SPT 'N' values of greater than 100 blows per 0.3 m of penetration.

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

Groundwater conditions in the open boreholes were observed throughout the drilling operations. Standpipe piezometers were installed in selected boreholes (WL16-04B, WL16-06, WL16-07, 08-237 and 08-238). Each piezometer consisted of either a 50 mm (WL16-04B, WL16-06 and WL16-07) or 25 mm (08-237 and 08-238) Schedule 40 PVC pipe with a 1.5m to 3.0 m long slotted screen enclosed in a column of filter sand to permit groundwater level monitoring. Piezometer installation details, groundwater level observations and water level readings are shown on the Record of Borehole sheets. Upon completion of the drilling operations, the boreholes without piezometers were abandoned in general accordance with Ontario Regulation 903 (as amended by O. Reg. 372/07). The details of standpipe piezometer installation and borehole completion are provided on the Record of Borehole Sheets in Appendix A and B. The piezometer installations were decommissioned as per O.Reg. 903.

**Table 3.1 – Borehole Completion Details**

Foundation Unit		Borehole	Borehole Depth / Base Elevation (m)	Piezometer Tip Depth / Elevation (m)	Completion Details
Hwy 7-New EBL	West abutment	WL16-01	6.1 / 334.2	None Installed	Backfilled with bentonite.
		WL16-03	8.9 / 331.2	None Installed	Backfilled with bentonite.
		08-238	5.3 / 335.7	5.0 / 336.0	Piezometer with 1.5 m slotted screen installed with sand filter from 5.0 m to 3.2 m, bentonite holeplug from 3.2 m to 0.3

Foundation Unit		Borehole	Borehole Depth / Base Elevation (m)	Piezometer Tip Depth / Elevation (m)	Completion Details
					m, concrete to surface.
	East abutment	WL16-07	4.4 / 335.9	4.3 / 336.0	Bentonite holeplug from 4.4 m to 4.3 m, Piezometer with 3.0 m slotted screen installed with sand filter from 4.3 m to 0.9 m, bentonite holeplug from 0.9 m to 0.3 m, concrete from 0.3 m to 0.1, then sand to surface.
		08-239	8.5 / 331.5	None Installed	Backfilled with bentonite.
Hwy 7-New WBL	West abutment	WL16-04	6.2 / 334.7	None Installed	Backfilled with bentonite.
		WL16-02	4.4 / 336.8	None Installed	Backfilled with bentonite.
		08-236	7.8 / 333.7	None Installed	Backfilled with bentonite to 0.6m, grout to surface
	East abutment	WL16-05	7.6 / 333.0	None Installed	Backfilled with bentonite to 0.3 m, sand and gravel to surface.
		WL16-06	7.0 / 333.4	4.0 / 336.4	Bentonite holeplug from 7.0 m to 4.0 m, Piezometer with 1.5 m slotted screen installed with sand filter from 4.0 m to 2.1 m, bentonite holeplug from 2.1 m to 0.5 m, concrete from 0.5 m to 0.1, then sand to surface.

Foundation Unit		Borehole	Borehole Depth / Base Elevation (m)	Piezometer Tip Depth / Elevation (m)	Completion Details
		WL16-08	4.3 / 336.1	None Installed	Backfilled with bentonite to 0.45m, concrete 0.45m to 0.15m, then asphalt to surface.
		08-237	5.3 / 335.7	5.0 / 336.0	Piezometer with 1.5 m slotted screen installed with sand filter from 3.7 m to 1.5 m, bentonite holeplug from 1.5 m to 0.5 m, concrete to surface.

#### 4. LABORATORY TESTING

The recovered soil samples were subjected to Visual Identification (VI) and to natural moisture content determination. Selected samples were also subjected to grain size analysis and Atterberg Limits testing. All the laboratory tests were carried out in accordance with MTO and/or ASTM Standards, as appropriate. The results of the laboratory testing of current and previous investigations are summarized on the Record of Borehole sheets in Appendices A and B, and are also presented on the figures included in Appendices A and B.

In order to assess the potential for sulphate attack on concrete foundations, as well as the potential for corrosion associated with the structure, samples of the gravelly sand fill, native gravelly sand, sand and silt till, and silty sand were collected. The samples were submitted to SGS Canada Inc., a CALA accredited analytical laboratory in Lakefield, Ontario, for analytical testing of corrosivity parameters and sulphate content. The results of the analytical testing are summarized in Section 6 and are presented in Appendix A.

#### 5. DESCRIPTION OF SUBSURFACE CONDITIONS

Details of the encountered soil stratigraphy are presented on the Record of Borehole sheets included in Appendices A and B. 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 and must be used for interpretation of the site conditions. It should be recognized and expected that soil conditions may vary between and beyond the borehole locations.

In general, the subsurface conditions encountered at the site consist of topsoil and asphalt overlying fill above native layers of silty sand to sand, gravelly sand to sand and gravel, and sand and silt to sandy silt till. The overburden materials are underlain by dolostone bedrock. Descriptions of the individual strata are presented below.

### **5.1 Topsoil**

Topsoil was identified at the ground surface in Boreholes WL16-02 to WL16-04, WL16-06 and WL16-07. The topsoil thickness ranged from 75 mm to 175 mm.

The topsoil thickness may vary between and beyond the borehole locations, and the limited data presented in this report should not be used for quantity estimation purposes.

### **5.2 Asphalt**

Asphalt was encountered at the ground surface in Borehole WL16-08 which was advanced through the pavement. The asphalt thickness was measured as 125 mm.

### **5.3 Fill**

Fill consisting of gravelly sand to sand and gravel, containing some to trace amounts of silt and clay, and clayey silt to silt, trace to with sand, trace gravel, was encountered in all boreholes at ground surface or underlying the topsoil and asphalt layers. Silty sand fill containing trace gravel and clay was also encountered below the clayey silt fill in Borehole WL16-03 at a depth of 0.7 m (Elev. 339.4 m). Cobbles and/or dolostone fragments were noted in the gravelly sand to sand and gravel fill in WL16-04, 08-236, 08-237, and 08-238, and possible boulders were noted in 08-237. Organics and rootlets were observed within the clayey silt to silt fill in all boreholes. A gas odour was noted in Boreholes 08-237 and 08-239.

The thickness of the fill ranged from 1.1 m to 3.7 m and the lower boundary was encountered between Elevation 339.3 and 335.8 .





SPT N-values in the gravelly sand to sand and gravel fill ranged from 10 blows per 0.3 m penetration to 50 blows per 0.100 m per penetration, indicating a compact to very dense relative density. It is noted that the higher N-values are likely due to the presence of cobbles within the fill and that the majority of the N-values were in the order of 10 to 30 blows. SPT N-values in the clayey silt to fill ranged from 2 to 19 blows per 0.3 m penetration, indicating a soft to very stiff consistency. An SPT N-value of 16 blows per 0.3 m penetration was recorded in the silty sand fill, indicating a compact relative density.

Moisture contents within the gravelly sand fill ranged from 3 to 16 percent. Moisture contents within the clayey silt to silt fill ranged from 6 to 27 percent with an average value of about 20 percent. A moisture content of 10 percent was recorded in the silty sand fill.

The gradation analysis completed on samples of the fill are illustrated on Figures A1 to A3 in Appendix A and Figure B1 in Appendix B. The results of the tests are summarized below and are presented on the corresponding Record of Borehole sheets in Appendices A and B.

	<b>Clayey Silt to Silt Fill</b>	<b>Silty Sand Fill</b>	<b>Gravelly Sand to Sand and Gravel Fill</b>
<b>Soil Particle</b>	<b>Percentage (%)</b>	<b>Percentage (%)</b>	<b>Percentage (%)</b>
Gravel	0 to 2	5	25 to 43
Sand	32 to 50	62	42 to 53
Silt	36 to 43	29	-
Clay	9 to 14	4	-
Silt + Clay	68	-	13 to 27

## 5.4 Silty Sand to Sand

Brown silty sand to sand, trace gravel, trace to some clay, was encountered underlying the fill in WL16-05 to WL16-08 and 08-239. Dolostone fragments were noted within this deposit in Boreholes WL16-05 and WL16-08 and a gas odour was noted in Borehole 08-239. The thickness of the silty sand to sand ranged from 0.6 m to 2.2 m and the lower boundary of the deposit was encountered at depths between 2.1 m and 4.6 m (Elev. 337.8 and 335.9).



SPT N-values in the silty sand to sand ranged from 10 to 26 blows per 0.3 m penetration indicating a compact relative density. Moisture contents measured within the silty sand to sand ranged from 9 to 19 percent.

The gradation analysis completed on samples of the silty sand to sand are illustrated on Figure A4 in Appendix A and Figure B2 in Appendix B. The results of the tests are summarized below and are presented on the corresponding Record of Borehole sheets in Appendices A and B.

Soil Particle	Percentage (%)
Gravel	1
Sand	49 to 61
Silt	35 to 39
Clay	3 to 11

## 5.5 Gravelly Sand to Sand and Gravel

Brown gravelly sand to sand and gravel, trace silt to some silt, trace clay, was encountered underlying the fill in Boreholes WL16-01 and WL16-03, and underlying the silty sand in 08-239. Occasional cobbles were noted within this deposit in Borehole WL16-03 and numerous cobbles were noted in this deposit in Borehole 08-239. The thickness of the gravelly sand to sand and gravel ranged from 1.3 m to 1.9 m and the lower boundary of the deposit was encountered at depths between 3.0 m and 3.7 m (Elev. 337.3 and 336.3).

SPT N-values in the silty sand to sand ranged from 19 to 43 blows per 0.3 m penetration indicating a compact to dense relative density. Moisture contents measured on samples ranged from 6 to 30 percent.

The gradation analysis completed on samples of the gravelly sand to sand and gravel are illustrated on Figure A5 in Appendix A and Figure B3 in Appendix B. The results of the tests are summarized below and are presented on the corresponding Record of Borehole sheets in Appendices A and B.



Soil Particle	Percentage (%)
Gravel	20 to 21
Sand	58
Silt + Clay	21 to 22

### 5.6 Sand and Silt to Sandy Silt Till

Brown sand and silt to sandy silt till, trace gravel to gravelly, trace to some clay, was encountered underlying the gravelly sand to sand and gravel in Boreholes WL16-01 and WL16-03, and underlying fill in WL16-02, WL16-04, 08-236, 08-238, and 08-239. Cobbles were noted within the deposit. The thickness of the till ranged from 1.6 m to 2.7 m and extended to depths ranging from 4.4 m to 5.3 m (Elev. 336.8 to 334.6). Glacial tills inherently contain cobbles and boulders.

SPT N-values in the till ranged from 25 blows per 0.3 m penetration to 103 blows per 0.125 m penetration, indicating a compact to very dense relative density (typically dense to very dense). Moisture contents measured on samples ranged from 7 to 15 percent.

The gradation analysis completed on samples of the sand and silt to sandy silt till are illustrated on Figure A6 in Appendix A and Figure B4 in Appendix B. The results of the tests are summarized below and are presented on the corresponding Record of Borehole sheets in Appendices A and B.

Soil Particle	Percentage (%)
Gravel	0 to 13
Sand	31 to 45
Silt	38 to 55
Clay	4 to 11

### 5.7 Dolostone Bedrock

The overburden soils described above are underlain by highly to moderately weathered dolostone bedrock, which was encountered at depths ranging from 4.0 m to 5.5 m (Elev. 336.8 to 334.6) in all boreholes, and proven by coring 3.0 to 4.2 m into the rock in five boreholes. The bedrock was described as light grey/white in colour. Rock core photos are presented in Appendix C.



Depths and elevations of the top of bedrock encountered in the present and previous investigations are shown in Table 5.1.

**Table 5.1 – Depth and Elevation of Top of Bedrock**

Foundation Unit		Borehole	Depth to Bedrock (m)	Top of Bedrock Elevation (m)
Hwy 7-New EBL	West abutment	WL16-01	5.3	335.0
		WL16-03 <sup>(1)</sup>	4.6	335.5
		08-238	5.3	335.7
	East abutment	WL16-07	4.4	335.9
		08-239	5.3	334.6
Hwy 7-New WBL	West abutment	WL16-04 <sup>(1)</sup>	5.3	335.6
		WL16-04B <sup>(1)(2)</sup>	5.5	335.4
		WL16-02	4.4	336.8
		08-236 <sup>(1)</sup>	4.5	336.8
	East abutment	WL16-05 <sup>(1)</sup>	4.6	336.0
		WL16-06 <sup>(1)</sup>	4.0	336.4
		WL16-08	4.3	336.1

(1) Proven by coring.

(2) WL16-04B was completed beside WL16-04 due to difficulties achieving 3m rock core in WL16-04

Total Core Recovery (TCR) in the bedrock ranged from 83% and 100% with Solid Core Recovery (SCR) of 83% and 100% (except Borehole WL16-04 ranging between 22% and 83%). The Rock



Quality Designation (RQD) determined from the recovered cores was 0% to 87%, indicating very poor to good rock quality.

The Fracture Index (FI) of the rock, expressed as fractures per 0.3 m of core, ranged from 0 to 8.

Unconfined compressive strength (UCS) and Point Load Tests (PLT) were conducted in rock cores. Unconfined compressive strengths (UCS) interpreted from point load tests conducted on selected rock cores typically varied from 31.4 MPa to 157.3 MPa. The UCS of the rock, determined from four laboratory unconfined compression tests, ranged from 25.1 MPa to 129.0 MPa. The results indicate a medium strong to very strong rock.

Results of UCS tests and point load tests conducted on the rock core samples are included in Appendix A.

## 5.8 Groundwater Conditions

Groundwater conditions were observed during drilling operations, and groundwater levels were measured in the open boreholes upon completion of drilling. Standpipe piezometers were installed in Boreholes 08-237, 08-238, WL16-04B, WL16-06 and WL16-07 to monitor the groundwater level at the site. The groundwater levels measured in the open boreholes and standpipe piezometers are summarized in Table 5.2.

**Table 5.2 – Water Level Measurements**

Borehole	Date	Water Level (m)		Remark
		Depth	Elevation	
08-236	June 18, 2008	4.0	337.4	Open Borehole
08-238	June 20, 2008	2.7	338.3	Open Borehole
	July 15, 2008	2.9	338.1	Piezometer
WL16-01	April 8, 2021	2.3	338.0	Inferred
WL16-02	April 7, 2021	4.3	336.9	Open Borehole
		2.5	338.7	Inferred
WL16-03	April 8, 2021	Dry	-	Open Borehole
		2.3	337.8	Inferred
WL16-04	April 9, 2021	Dry	-	Open Borehole
		4.1	336.8	Inferred
WL16-04B	April 14, 2021	4.4	336.5	Piezometer



Borehole	Date	Water Level (m)		Remark
		Depth	Elevation	
	April 16, 2021	2.9	338.0	Piezometer
WL16-05	April 8, 2021	2.2	338.4	Open borehole
WL16-06	April 6, 2021	2.7	337.7	Open borehole
	April 16, 2021	2.7	337.7	Piezometer
08-237	June 20, 2008	2.4	337.1	Open Borehole
	July 15, 2008	2.3	337.2	Piezometer
08-239	June 19, 2008	2.1	337.8	Open Borehole
WL16-07	April 16, 2021	2.5	337.9	Piezometer
WL16-08	April 7, 2021	3.4	337.0	Open Borehole

The groundwater levels above are short-term readings, and seasonal fluctuations of the groundwater levels are to be expected. The groundwater levels may be at a higher elevation after periods of significant or prolonged precipitation.

## 6. CORROSIVITY AND SULPHATE TEST RESULTS

Four (4) samples selected from Boreholes WL16-03 to WL16-06 were submitted for analytical testing of corrosivity parameters and sulphate. The results of the analytical tests are shown in Table 6.1. The laboratory certificates of analysis are presented in Appendix A.

**Table 6.1 – Analytical Test Results**

Parameter	Units (Soil)	Test Results			
		WL16-03 SS 3B Depth 1.5 m	WL16-04 SS 6 Depth 4.6 m	WL16-05 SS 5 Depth 3.0 m	WL16-06 SS 2 Depth 0.8 m
		(Native Gravelly Sand)	(Native Sand and Silt Till)	(Native Silty Sand)	(Sand Fill)
Sulphide	%	<0.04	<0.04	<0.04	<0.04
Chloride	µg/g	88	60	190	350
Sulphate	µg/g	4.8	8.7	7.6	11
pH	No unit	9.27	9.32	9.48	8.78
Electrical Conductivity	µS/cm	148	95	436	814
Resistivity	Ohms.cm	6760	10500	2290	1230

Client: WSP  
File No.: 11375

Date: June 25, 2021  
Page: 12 of 14

E file: H:\10000-11375 Hwy 7 New PD and DD Foundations\Reports & Memos\Woodlawn Rd\Bridge\FIR\ 11375-Woodlawn Road Bridge FINAL FIR



Parameter	Units (Soil)	Test Results			
		WL16-03 SS 3B Depth 1.5 m	WL16-04 SS 6 Depth 4.6 m	WL16-05 SS 5 Depth 3.0 m	WL16-06 SS 2 Depth 0.8 m
		(Native Gravelly Sand)	(Native Sand and Silt Till)	(Native Silty Sand)	(Sand Fill)
Redox Potential	mV	112	230	192	284

## 7. MISCELLANEOUS

Landshark Group of Brantford, Ontario supplied a track-mounted B57 drill rig and a truck-mounted B60 drill rig and conducted the drilling, sampling and in-situ testing operations for the present investigation.

The coordinates and elevations for the boreholes were obtained with GPS equipment by Thurber.

The drilling and sampling operations in the field for the current investigation were supervised on a full-time basis by Thurber field technicians.

Geotechnical laboratory testing was carried out at Thurber's geotechnical laboratory. Analytical laboratory testing was carried out by SGS Canada Inc.

Details of the previous investigation, conducted in 2008, are presented in Reference 1.

Overall supervision of the field program for the present investigation was conducted by Mr. Geoff Lay, P.Eng.. Interpretation of the data and preparation of the current report was carried out by Mr. Joshua Alexander, E.I.T. and Mr. Geoff Lay, P.Eng., Mr. Jason Lee, P.Eng., a Designated Principal Contact for MTO Foundations projects, reviewed the report.



Thurber Engineering Ltd.

Joshua Alexander, E.I.T.



Geoff Lay, P.Eng.  
Geotechnical Engineer



Jason Lee, P.Eng..  
Principal/Senior Geotechnical Engineer





## **Appendix A**

### **Record of Borehole Sheets (Present investigation) Geotechnical and Analytical Test Results (Present investigation)**

- Grain size analysis and Atterberg Limit Tests
- UCS Test Results
- Point Load Test Results
- Analytical Tests Results

## SYMBOLS, ABBREVIATIONS AND TERMS USED ON RECORDS OF BOREHOLES

### 1. TEXTURAL CLASSIFICATION OF SOILS

CLASSIFICATION	PARTICLE SIZE	VISUAL IDENTIFICATION
Boulders	Greater than 200mm	same
Cobbles	75 to 200mm	same
Gravel	4.75 to 75mm	5 to 75mm
Sand	0.075 to 4.75mm	Not visible particles to 5mm
Silt	0.002 to 0.075mm	Non-plastic particles, not visible to the naked eye
Clay	Less than 0.002mm	Plastic particles, not visible to the naked eye

### 2. COARSE GRAIN SOIL DESCRIPTION (50% greater than 0.075mm)

TERMINOLOGY	PROPORTION
Trace or Occasional	Less than 10%
Some	10 to 20%
Adjective (e.g. silty or sandy)	20 to 35%
And (e.g. sand and gravel)	35 to 50%

### 3. TERMS DESCRIBING CONSISTENCY (COHESIVE SOILS ONLY)

DESCRIPTIVE TERM	UNDRAINED SHEAR STRENGTH (kPa)	APPROXIMATE SPT <sup>(1)</sup> 'N' VALUE
Very Soft	12 or less	Less than 2
Soft	12 to 25	2 to 4
Firm	25 to 50	4 to 8
Stiff	50 to 100	8 to 15
Very Stiff	100 to 200	15 to 30
Hard	Greater than 200	Greater than 30

NOTE: Hierarchy of Soil Strength Prediction

- 1) Laboratory Triaxial Testing
- 2) Field Insitu Vane Testing
- 3) Laboratory Vane Testing
- 4) SPT value
- 5) Pocket Penetrometer

### 4. TERMS DESCRIBING DENSITY (COHESIONLESS SOILS ONLY)

DESCRIPTIVE TERM	SPT "N" VALUE
Very Loose	Less than 4
Loose	4 to 10
Compact	10 to 30
Dense	30 to 50
Very Dense	Greater than 50

### 5. LEGEND FOR RECORDS OF BOREHOLES

SYMBOLS AND ABBREVIATIONS FOR SAMPLE TYPE	SS Split Spoon Sample	WS Wash Sample	AS Auger (Grab) Sample
	TW Thin Wall Shelby Tube Sample	TP Thin Wall Piston Sample	
	PH Sampler Advanced by Hydraulic Pressure	PM Sampler Advanced by Manual Pressure	
	WH Sampler Advanced by Self Static Weight	RC Rock Core	SC Soil Core

$$\text{Sensitivity} = \frac{\text{Undisturbed Shear Strength}}{\text{Remoulded Shear Strength}}$$

 Water Level


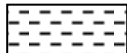



$C_{pen}$  Shear Strength Determination by Pocket Penetrometer

- (1) SPT 'N' Value      Standard Penetration Test 'N' Value – refers to the number of blows from a 63.5kg hammer free falling a height of 0.76m to advance a standard 50 mm outside diameter split spoon sampler for 0.3 m depth into undisturbed ground.
- (2) DCPT      Dynamic Cone Penetration Test – Continuous penetration of a 50 mm outside diameter, 60° conical steel point attached to "A" size rods driven by a 63.5 kg hammer free falling a height of 0.76 m. The resistance to cone penetration is the number of hammer blows required for each 0.3 m advance of the conical point into undisturbed ground.

# UNIFIED SOILS CLASSIFICATION

MAJOR DIVISIONS		GROUP SYMBOL	TYPICAL DESCRIPTION
COARSE GRAINED SOILS	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	SILTS AND CLAYS $W_L < 50\%$	ML	Inorganic silts and 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. ( $W_L < 30\%$ ).
		CI	Inorganic clays of medium plasticity, silty clays. ( $30\% < W_L < 50\%$ ).
		OL	Organic silts and organic silty-clays of low plasticity.
	SILTS AND CLAYS $W_L > 50\%$	MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts.
		CH	Inorganic clays of high plasticity, fat clays.
		OH	Organic clays of medium to high plasticity, organic silts.
HIGHLY ORGANIC SOILS		Pt	Peat and other highly organic soils.
CLAY SHALE			
SANDSTONE			
SILTSTONE			
CLAYSTONE			
COAL			

## EXPLANATION OF ROCK LOGGING TERMS

<u>ROCK WEATHERING CLASSIFICATION</u>		<u>SYMBOLS</u>	
<b>Fresh (FR)</b>	No visible signs of weathering.		
<b>Fresh Jointed (FJ)</b>	Weathering limited to the surface of major discontinuities.		CLAYSTONE
<b>Slightly Weathered (SW)</b>	Penetrative weathering developed on open discontinuity surfaces, but only slight weathering of rock material.		SILTSTONE
<b>Moderately Weathered (MW)</b>	Weathering extends throughout the rock mass, but the rock material is not friable.		SANDSTONE
<b>Highly Weathered (HW)</b>	Weathering extends throughout the rock mass and the rock is partly friable.		COAL
<b>Completely Weathered (CW)</b>	Rock is wholly decomposed and in a friable condition, but the rock texture and structure are preserved.		Bedrock (general)

<u>DISCONTINUITY SPACING</u>		<u>STRENGTH CLASSIFICATION</u>			
Bedding	Bedding Plane Spacing	Rock Strength	Approximate Uniaxial Compressive Strength		Field Estimation of Hardness*
			(MPa)	(psi)	
Very thickly bedded	Greater than 2m	Extremely Strong	Greater than 250	Greater than 36,000	Specimen can only be chipped with a geological hammer
Thickly bedded	0.6 to 2m				
Medium bedded	0.2 to 0.6m	Very Strong	100-250	15,000 to 36,000	Requires many blows of geological hammer to break
Thinly bedded	60mm to 0.2m	Strong	50-100	7,500 to 15,000	Requires more than one blow of geological hammer to break
Very thinly bedded	20 to 60mm				
Laminated	6 to 20mm	Medium Strong	25.0 to 50.0	3,500 to 7,500	Breaks under single blow of geological hammer.
Thinly Laminated	Less than 6mm				

<u>TERMS</u>					
Total Core Recovery: (TCR)	Core recovered as a percentage of total core run length.	Weak	5.0 to 25.0	750 to 3,500	Can be peeled by a pocket knife with difficulty
Solid Core Recovery: (SCR)	Percent Ratio of solid core of full cylindrical shape recovered. Expressed with respect to the total length of core run.	Very Weak	1.0 to 5.0	150 to 750	Can be peeled by a pocket knife, crumbles under firm blows of geological pick.
Rock Quality Designation: (RQD)	Total length of sound core recovered in pieces 0.1m in length or larger as a percentage of total core run length.	Extremely Weak (Rock)	0.25 to 1.0	35 to 150	Indented by thumbnail
Uniaxial Compressive Strength (UCS)	Axial stress required to break the specimen				
Fracture Index: (FI)	Frequency of natural fractures per 0.3m of core run.				

# RECORD OF BOREHOLE No WL16-01

1 OF 1

METRIC

GWP# 408-88-00 LOCATION EBL North Approach, MTM NAD 83 Zone 10: N 4 823 669.7 E 240 284.5 ORIGINATED BY MC  
DIST Southwest HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY BH  
DATUM Geodetic DATE 2021.04.08 - 2021.04.08 LATITUDE 43.550167 LONGITUDE -80.298442 CHECKED BY JA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100		
340.3	GROUND SURFACE													
0.0	<b>GRAVEL</b> (FILL)													
0.1	<b>SAND and GRAVEL</b> Compact Brown Moist (FILL)		1	SS	10		340							
339.7														
0.7														
339.3			2	SS	19									
1.1	Clayey <b>SILT</b> , with sand, occasional organics Very Stiff Brown Moist (FILL)						339							0 46 43 11
	<b>SAND and GRAVEL</b> , some silt Compact to Dense Brown Moist		3	SS	42									
							338							
			4	SS	41									
337.3														
3.0	<b>SAND and SILT</b> , some gravel, trace clay Dense to Very Dense Brown Wet (TILL)		5	SS	37		337							13 45 38 4
							336							
	Dolostone fragments		6	SS	55/ 0.075									
335.0														
5.3	<b>DOLOSTONE</b> , slightly to moderately weathered, grey		8	SS	50/ 0.025		335							
334.2														
6.1	END OF BOREHOLE AT 6.1m. INFERRED GROUNDWATER LEVEL AT 2.3m. BOREHOLE DRY UPON COMPLETION OF DRILLING. BOREHOLE BACKFILLED WITH HOLEPLUG.		9	SS	50/ 0.00									

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to  
Sensitivity

20  
15  
10

(%) STRAIN AT FAILURE

ONTMT4S2 MTO-11375(GINTDATA).GPJ 2017TEMPLATE(MTO).GDT 6/25/21

# RECORD OF BOREHOLE No WL16-02

1 OF 1

METRIC

GWP# 408-88-00 LOCATION WBL North Approach, MTM NAD 83 Zone 10: N 4 823 686.7 E 240 305.0 ORIGINATED BY MC  
DIST Southwest HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY BH  
DATUM Geodetic DATE 2021.04.07 - 2021.04.07 LATITUDE 43.550321 LONGITUDE -80.298190 CHECKED BY JA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT W <sub>P</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT  γ  kN/m <sup>3</sup>	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								WATER CONTENT (%)
341.2	GROUND SURFACE							20	40	60	80	100				
0.0	TOPSOIL: (175mm)							20	40	60	80	100				
0.2	Clayey <b>SILT</b> , some sand, trace gravel, occasional rootlets Soft to Firm Brown Moist (FILL)		1	SS	4		341									
			2	SS	8		340									
339.8																
1.4	Gravelly <b>SAND</b> , some silt, trace clay Compact to Dense Brown Moist (FILL)		3	SS	25		339									
338.7			4	SS	32		338									
2.5	<b>SAND</b> and <b>SILT</b> , some gravel to gravelly, trace clay, occasional cobbles Dense to Very Dense Brown Wet (TILL)															
			5	SS	103/ 0.275		337									
336.8																
4.4	END OF BOREHOLE AT 4.4m UPON AUGER REFUSAL ON PROBABLE BEDROCK. INFERRED GROUNDWATER LEVEL AT 2.5m. BOREHOLE OPEN AND WATER LEVEL AT 4.3m UPON COMPLETION OF DRILLING. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO 0.2m, THEN AUGER CUTTINGS TO SURFACE.		6	SS	100/ 0.025											

ONTMT4S2 MTO-11375(GINTDATA).GPJ 2017TEMPLATE(MTO).GDT 6/25/21

# RECORD OF BOREHOLE No WL16-03

1 OF 2

METRIC

GWP# 408-88-00 LOCATION EBL North Approach, MTM NAD 83 Zone 10: N 4 823 658.6 E 240 294.3 ORIGINATED BY MC  
DIST Southwest HWY 7 BOREHOLE TYPE Hollow Stem Augers/NQ Coring COMPILED BY BH  
DATUM Geodetic DATE 2021.04.08 - 2021.04.08 LATITUDE 43.550068 LONGITUDE -80.298319 CHECKED BY JA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					
								20 40 60 80 100					
340.1	GROUND SURFACE												
0.0	TOPSOIL: (125mm)												
0.1	Clayey <b>SILT</b> , trace sand, trace gravel Firm Dark Brown		1	SS	6		340						
339.4	Moist (FILL)												
0.7	Silty <b>SAND</b> , trace gravel, trace clay, occasional organics Compact Brown		2	SS	16		339						5 62 29 4
338.4	Moist (FILL)												
1.7	Gravelly <b>SAND</b> , some silt, occasional cobbles Compact to Dense Brown Wet		3	SS	39		338						21 58 21 (SI+CL)
337.1			4	SS	27								
3.0	<b>SAND</b> and <b>SILT</b> , some gravel, trace clay, occasional cobbles Dense Brown Wet (TILL)		5	SS	45		337						
335.5	Coring started at 4.6m		6	SS	60/		336						
4.6	<b>DOLOSTONE</b> , moderately weathered, very thinly laminated, brown				0.125								
	Horizontal fracture at 5.2m, 5.3m, 5.4m, 5.5m, 5.6m, 5.7m, 5.9m, 6.0m, 6.1m, and 6.2m		1	RUN			335					FI	RUN #1 TCR=93% SCR=89% RQD=43%
	Horizontal fracture 6.4m, 6.5m, 6.7m, 6.8m, 7.0m, 7.1m, 7.2m, and 7.5m Vertical fracture (75mm) at 6.7m		2	RUN			334					3	
	Horizontal fracture at 7.7m, 7.8m, 8.0m, 8.1m 8.4m, 8.6m, 8.7m, and 8.8m		3	RUN			333					3	RUN #2 TCR=100% SCR=90% RQD=60% UCS=66.6MPa
331.2												2	
8.9	END OF BOREHOLE AT 8.9m. INFERRED GROUNDWATER LEVEL AT 2.3m. BOREHOLE DRY BEFORE SWITCHING TO CORING. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO 0.1m,						332					2	RUN #3 TCR=100% SCR=92% RQD=63%
												1	
												3	
												1	

Continued Next Page

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to  
Sensitivity

20  
15  
10

(%) STRAIN AT FAILURE

ONTMT4S2 MTO-11375(GINTDATA).GPJ 2017TEMPLATE(MTO).GDT 6/25/21

RECORD OF BOREHOLE No WL16-03

2 OF 2

METRIC

GWP# 408-88-00 LOCATION EBL North Approach, MTM NAD 83 Zone 10: N 4 823 658.6 E 240 294.3 ORIGINATED BY MC  
DIST Southwest HWY 7 BOREHOLE TYPE Hollow Stem Augers/NQ Coring COMPILED BY BH  
DATUM Geodetic DATE 2021.04.08 - 2021.04.08 LATITUDE 43.550068 LONGITUDE -80.298319 CHECKED BY JA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100	W <sub>p</sub>	W	W <sub>L</sub>		
	Continued From Previous Page THEN AUGER CUTTINGS TO SURFACE.																

ONTMT4S2 MTO-11375(GINTDATA).GPJ 2017TEMPLATE(MTO).GDT 6/25/21

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to  
Sensitivity

20  
15 5  
10 (%) STRAIN AT FAILURE



# RECORD OF BOREHOLE No WL16-04

1 OF 1

METRIC

GWP# 408-88-00 LOCATION WBL North Approach, MTM NAD 83 Zone 10: N 4 823 676.2 E 240 302.2 ORIGINATED BY MC  
DIST Southwest HWY 7 BOREHOLE TYPE Hollow Stem Augers/NQ Coring COMPILED BY BH  
DATUM Geodetic DATE 2021.04.09 - 2021.04.09 LATITUDE 43.550227 LONGITUDE -80.298224 CHECKED BY JA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT W <sub>P</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT  γ  kN/m <sup>3</sup>	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									
340.9	GROUND SURFACE																	
0.0 0.1	<b>TOPSOIL:</b> (75mm)  Clayey <b>SILT</b> , with sand, trace gravel, mixed with organics Firm Dark Brown Moist (FILL)		1	SS	7		340								2 46 43 9			
			2	SS	7													
339.2			3	SS	28		339											
1.7	<b>SAND</b> and <b>GRAVEL</b> , some silt, trace clay Compact Brown Moist to Wet (FILL)		4	SS	27										37 42 21 (SI+CL)			
337.9	Occasional dolostone fragments						338											
3.0	<b>SAND</b> and <b>SILT</b> , trace to some gravel, trace clay Compact to Very Dense Brown Moist to Wet (TILL)		5	SS	25		337								9 42 45 4			
			6	SS	76		336											
335.6														FI	RUN #1 TCR=89% SCR=22% RQD=22%			
5.3	<b>DOLOSTONE</b> , moderately weathered, very thinly laminated Vertical fracture (50mm) at 5.5m Sub-horizontal fracture (125mm) at 5.6m		1	RUN			335							0	RUN #2 TCR=83% SCR=83% RQD=83%			
			2	RUN										1	RQD=83% RUN #3			
334.7	Horizontal fracture at 5.8m Horizontal fracture at 5.9m Horizontal fracture at 6.1m		3	RUN										1	TCR=100% SCR=50% RQD=0%			
6.2	END OF BOREHOLE AT 6.2m. INFERRED GROUNDWATER LEVEL AT 4.1m. BOREHOLE DRY BEFORE SWITCHING TO CORING. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO 0.1m, THEN AUGER CUTTINGS TO SURFACE.																	

ONTMT4S2 MTO-11375(GINTDATA).GPJ 2017TEMPLATE(MTO).GDT 6/25/21

# RECORD OF BOREHOLE No WL16-04B

1 OF 2

METRIC

GWP# 408-88-00 LOCATION WBL North Approach, MTM NAD 83 Zone 10: N 4 823 676.2 E 240 302.2 ORIGINATED BY MC  
DIST Southwest HWY 7 BOREHOLE TYPE Hollow Stem Augers/NQ Coring COMPILED BY BH  
DATUM Geodetic DATE 2021.04.14 - 2021.04.14 LATITUDE 43.550227 LONGITUDE -80.298224 CHECKED BY JA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	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						
340.9	GROUND SURFACE																
0.0	Borehole augered to 5.5m depth below ground surface for rock coring and monitoring well installation. No soil samples were collected.																
335.4	Coring started at 5.5m																
5.5	<b>DOLOSTONE</b> , highly to moderately weathered, beige to brown		1	RUN													
	Horizontal fractures at 5.5m, 5.6m, 5.8m, 5.9m, and 6.0m																
	Sub-horizontal fracture at 5.7m and 6.0m																
	Horizontal fracture at 6.3m, 6.8m, 7.1m, 7.3m, 7.4m, 7.5m, 7.6m, and 7.7m		2	RUN													
	Sub-horizontal fracture (200mm) at 7.5m																
	Vertical fracture (75mm) at 7.6m																
	Horizontal fracture at 8.0m, 8.3m, 8.7m, 8.8m, 9.1m																
	Highly fracture zone at 8.5m																
	Vertical fracture (75mm) at 8.7m		3	RUN													
331.7	END OF BOREHOLE AT 9.2m. Monitoring Well installation consists of 50mm diameter Schedule 40 PVC pipe with a 3.05m slotted screen.																
9.2																	

Continued Next Page

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to Sensitivity

20  
15  
10  
(%) STRAIN AT FAILURE

ONTMT4S2 MTO-11375(GINTDATA).GPJ 2017TEMPLATE(MTO).GDT 6/25/21

## 2 OF 2

METRIC

GWP#	408-88-00	LOCATION	WBL North Approach, MTM NAD 83 Zone 10: N 4 823 676.2 E 240 302.2			ORIGINATED BY	MC		
DIST	Southwest	HWY	7	BOREHOLE TYPE	Hollow Stem Augers/NQ Coring			COMPILED BY	BH
DATUM	Geodetic	DATE	2021.04.14 - 2021.04.14	LATITUDE	43.550227	LONGITUDE	-80.298224	CHECKED BY	JA

[illegible]

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to Sensitivity

# RECORD OF BOREHOLE No WL16-05

1 OF 1

METRIC

GWP# 408-88-00 LOCATION EBL South Abutment, MTM NAD 83 Zone 10: N 4 823 638.1 E 240 342.8 ORIGINATED BY GA  
DIST Southwest HWY 7 BOREHOLE TYPE Hollow Stem Augers/NQ Coring COMPILED BY BH  
DATUM Geodetic DATE 2021.04.08 - 2021.04.08 LATITUDE 43.549887 LONGITUDE -80.297717 CHECKED BY JA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT  γ  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																									
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED      + FIELD VANE ● QUICK TRIAXIAL    × LAB VANE							WATER CONTENT (%) w <sub>p</sub> w      w <sub>L</sub>																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																								
340.6	GROUND SURFACE							20	40	60	80	100																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																											</

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

ONTMT4S2 MTO-11375(GINTDATA).GPJ 2017TEMPLATE(MTO).GDT 6/25/21

# RECORD OF BOREHOLE No WL16-06

1 OF 1

METRIC

GWP# 408-88-00 LOCATION WBL South Abutment, MTM NAD 83 Zone 10: N 4 823 651.4 E 240 354.8 ORIGINATED BY GA  
DIST Southwest HWY 7 BOREHOLE TYPE Hollow Stem Augers/NQ Coring COMPILED BY BH  
DATUM Geodetic DATE 2021.04.06 - 2021.04.06 LATITUDE 43.550008 LONGITUDE -80.297570 CHECKED BY JA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100		
340.3	GROUND SURFACE													
0.0 0.1	<b>TOPSOIL:</b> (75mm)  Gravelly <b>SAND</b> , some silt and clay Compact Brown Moist (FILL)		1	SS	16		340							27 53 20 (SI+CL)
			2	SS	22		339							
			3	SS	19		338							
			4	SS	18		337							
337.4														
3.0	Silty <b>SAND</b> , trace gravel, trace clay Compact Brown Wet		5	SS	10		336							1 61 35 3
336.4	Coring started at 4.0m		6	SS	50/									
4.0	<b>DOLOSTONE</b> , moderately weathered, bedded, beige to grey  Horizontal fractures at 4.1m, 4.4m, 4.5m, 4.6m, 4.7m, 4.9m, and 5.0m          Horizontal joints 5.2m, 5.7m, and 6.9m		1	RUN	0.0		335							RUN #1 TCR=100% SCR=100% RQD=81% UCS=25.1MPa
			2	RUN			334							RUN #2 TCR=100% SCR=98% RQD=87%
333.4														
7.0	END OF BOREHOLE AT 7.0m. BOREHOLE OPEN AND WATER LEVEL AT 2.7m UPON COMPLETION Monitoring Well installation consists of 50mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen.  WATER LEVEL READINGS DATE DEPTH(m) ELEV.(m) 2021.04.16 2.7 337.6													

ONTMT4S2 MTO-11375(GINTDATA).GPJ 2017TEMPLATE(MTO).GDT 6/25/21

# RECORD OF BOREHOLE No WL16-07

1 OF 1

METRIC

GWP# 408-88-00 LOCATION EBL South Approach, MTM NAD 83 Zone 10: N 4 823 610.7 E 240 330.5 ORIGINATED BY GA  
DIST Southwest HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY BH  
DATUM Geodetic DATE 2021.04.07 - 2021.04.07 LATITUDE 43.549639 LONGITUDE -80.297866 CHECKED BY JA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100		
340.3	GROUND SURFACE													
0.0 0.1	TOPSOIL: (75mm) Gravelly SAND, trace silt to silty Compact Brown Moist (FILL)		1	SS	19		340							
			2	SS	14		339							
338.9	Clayey SILT, with sand, trace gravel Stiff Brown Moist (FILL)		3	SS	9		338							
338.1			4	SS	18		337							
			5	SS	18		336							
335.9	Silty SAND, trace gravel, trace clay Compact Brown Wet		6	SS	24									
4.4	END OF BOREHOLE AT 4.4m UPON AUGER REFUSAL ON PROBABLE BEDROCK. Monitoring Well installation consists of 50mm diameter Schedule 40 PVC pipe with a 3.05m slotted screen.  WATER LEVEL READINGS DATE DEPTH(m) ELEV.(m) 2021.04.16 2.5 337.9													

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to  
Sensitivity

20  
15  
10



(%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No WL16-08

1 OF 1

METRIC

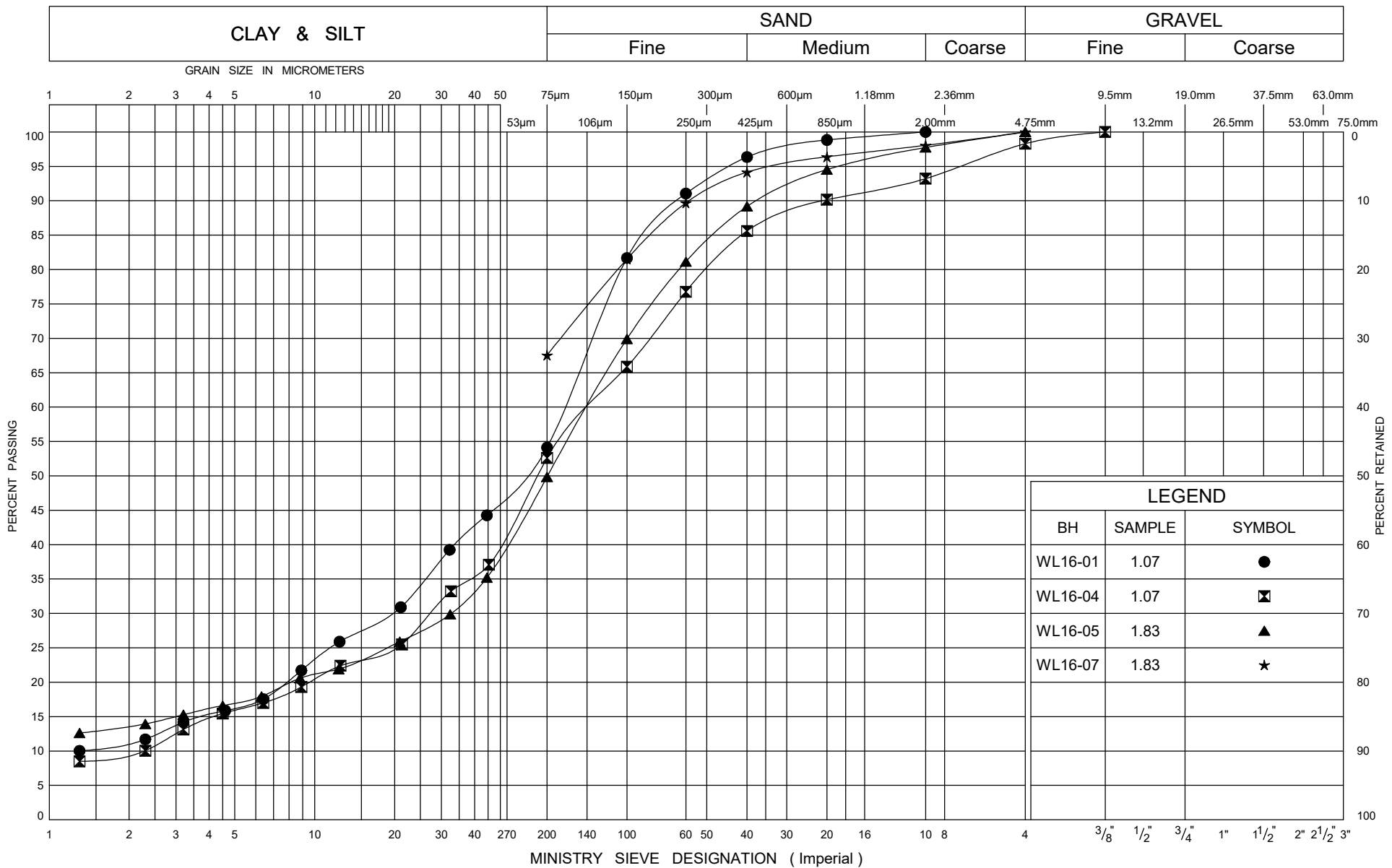
GWP# 408-88-00 LOCATION WBL South Approach, MTM NAD 83 Zone 10: N 4 823 638.7 E 240 352.2 ORIGINATED BY GA  
DIST Southwest HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY BH  
DATUM Geodetic DATE 2021.04.07 - 2021.04.07 LATITUDE 43.549894 LONGITUDE -80.297601 CHECKED BY JA

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 <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)					
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa				WATER CONTENT (%)									
								○ UNCONFINED      + FIELD VANE ● QUICK TRIAXIAL      × LAB VANE				w <sub>p</sub> w      w <sub>L</sub>									
340.4	GROUND SURFACE							20	40	60	80	100		20	40	60		GR	SA	SI	CL
0.0	ASPHALT: (125mm)																				
0.1	Gravelly <b>SAND</b> , some silt and clay Compact Brown Moist (FILL)		1	SS	21		340														
			2	SS	19																
								339													
			3	SS	20																
			4	SS	17		338														
337.4	<b>SAND</b> , trace silt, frequent dolostone fragments Compact Brown Wet		5	SS	15		337														
336.1																					
4.3	END OF BOREHOLE AT 4.3m UPON AUGER REFUSAL ON PROBABLE BEDROCK. WATER LEVEL AT 3.4m UPON COMPLETION OF DRILLING. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO 0.5m, CONCRETE TO 0.2m, THEN ASPHALT TO SURFACE.																				

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to  
Sensitivity

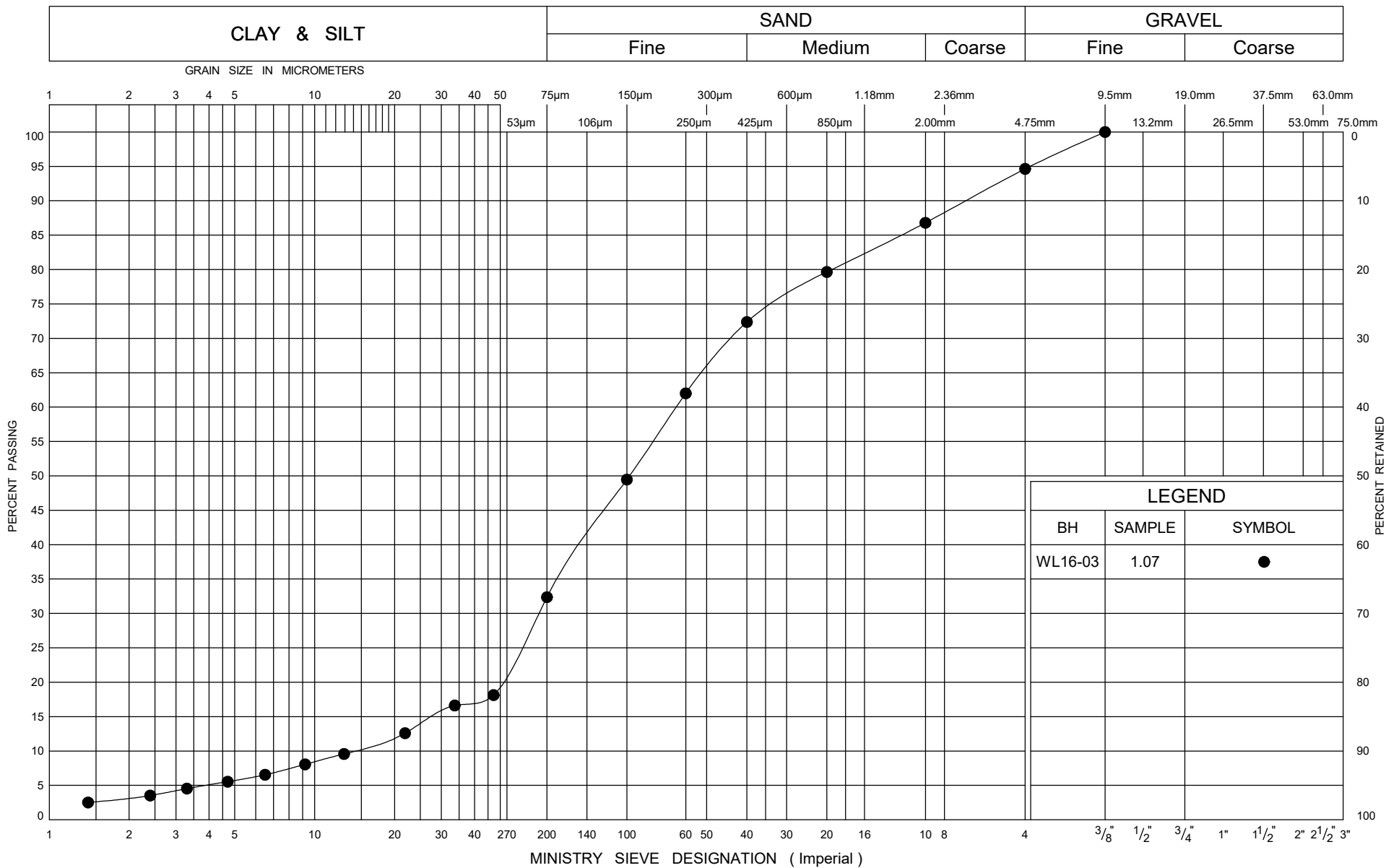
20  
15  
10

(%) STRAIN AT FAILURE





ONTARIO MOT GRAIN SIZE 2 MTO-11375(GINTDATA)\GPJ\_ONTARIO MOT.GDT 6/17/21



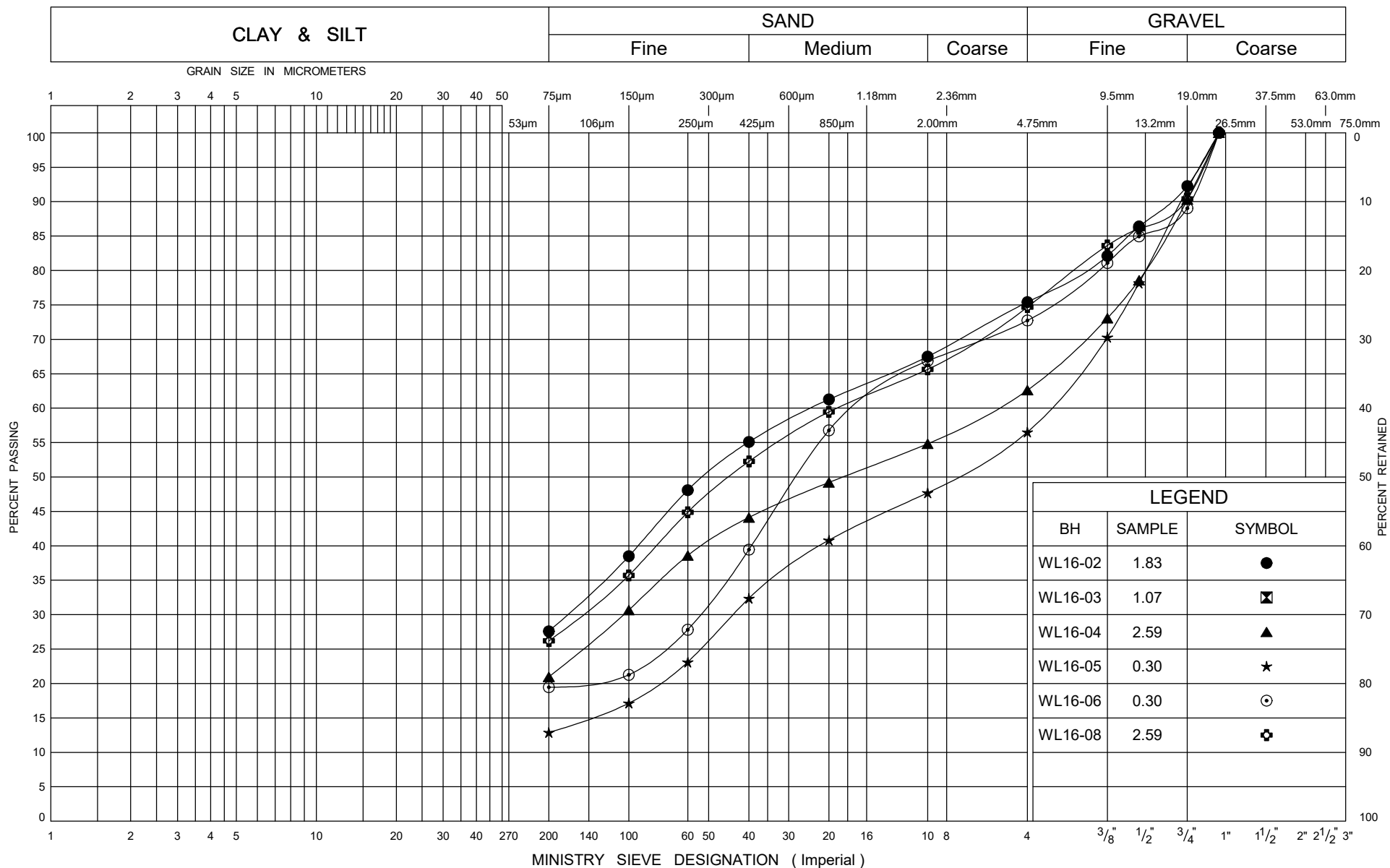
# GRAIN SIZE DISTRIBUTION

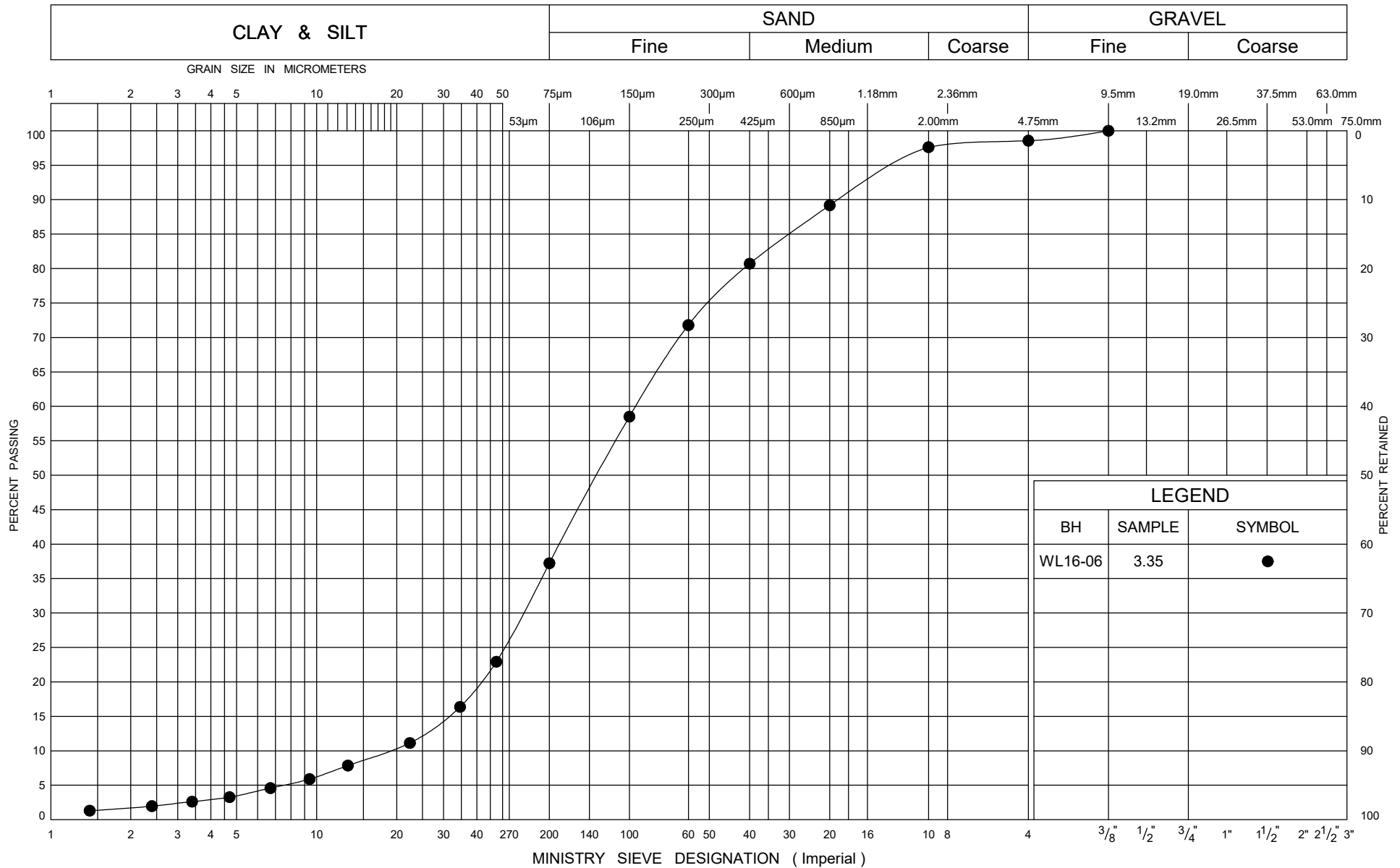
## Silty SAND FILL

FIG No A2

W P 408-88-00

Woodlawn Road Overpass





Ministry of  
Transportation

## GRAIN SIZE DISTRIBUTION

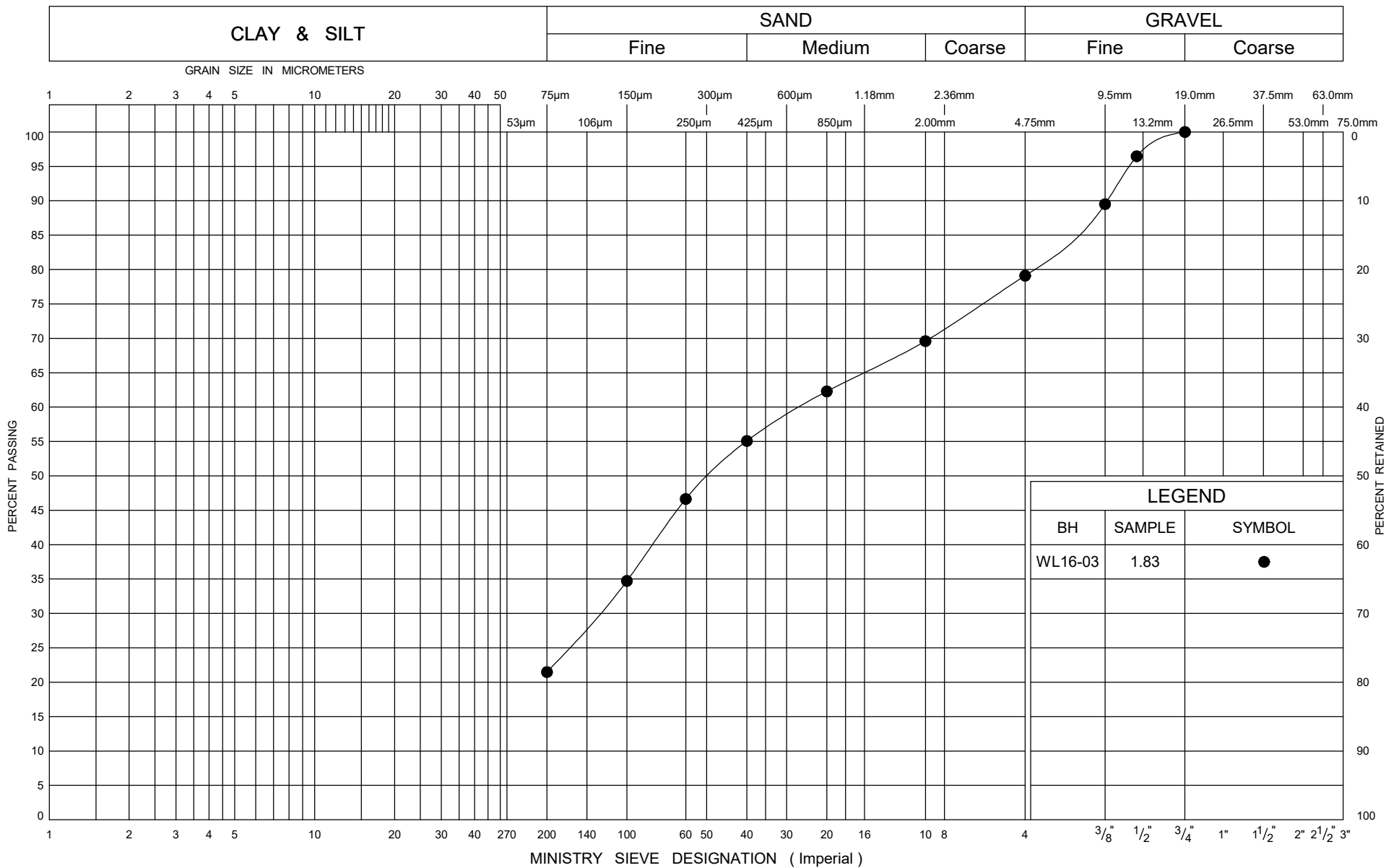
Silty SAND to SAND

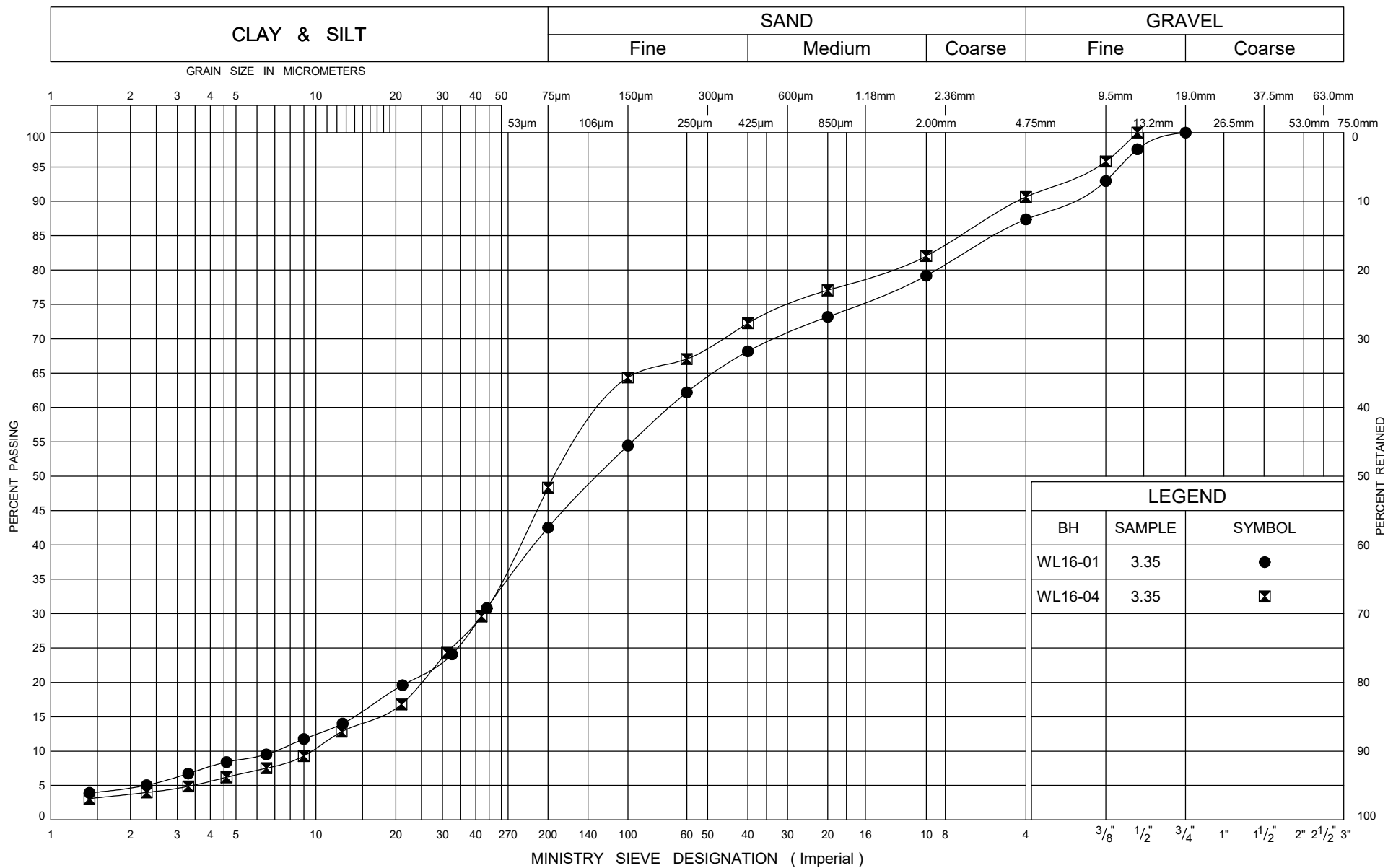
FIG No A4

W P 408-88-00

Woodlawn Road Overpass

ONTARIO MOT GRAIN SIZE 2 MTO-11375(GINTDATA)\GPJ\_ONTARIO MOT.GDT 6/17/21





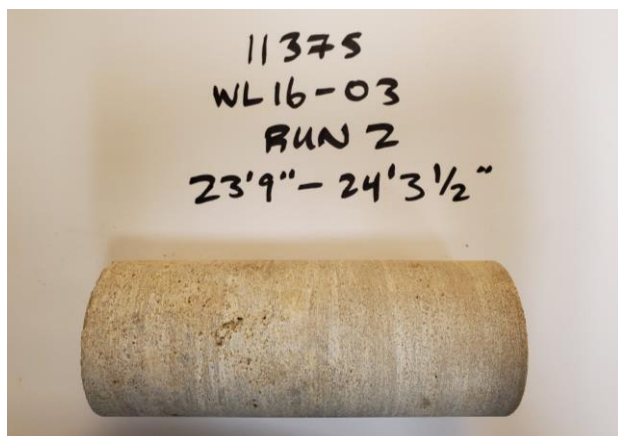
# UNCONFINED COMPRESSION TEST REPORT

## ASTM D7012-14

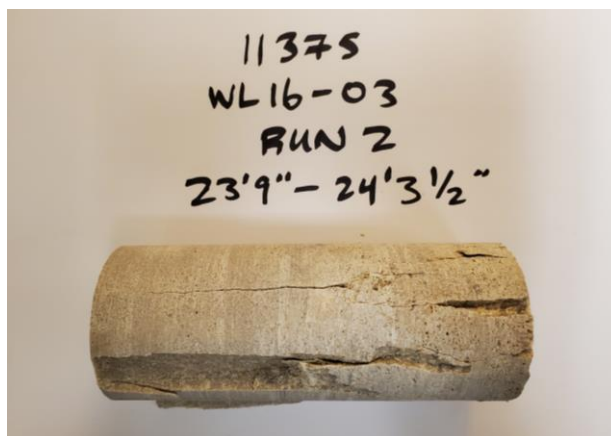
CLIENT:	WSP Canada Group Ltd.	FILE NUMBER:	11375
PROJECT NAME:	Hwy 7 New PD and DD Foundations	REPORT DATE:	5-May-21
BOREHOLE No.:	WL16-03	TEST DATE:	4-May-21
SAMPLE No.:	HQ Run 2		
SAMPLE DEPTH:	23'9" - 24'3.5"		
DESCRIPTION:	Dolostone		

Avg. Height (cm):	14.5	Weight (g):	1205.9
Avg. Diameter (cm):	6.3	Wet Density (kg/m <sup>3</sup> ):	2,668
H. to Dia. Ratio**:	2.3:1	Dry Density (kg/m <sup>3</sup> ):	2,668
Cross Sectional Area (cm <sup>2</sup> ):	31.17	Moisture Content* (%):	N/A
Sample Volume (cm <sup>3</sup> ):	452.00		

ORIGINAL SPECIMEN



FRACTURED SPECIMEN



AVG. RATE OF STRAIN TO FAILURE:	1.0% / min
MAXIMUM COMPRESSIVE LOAD:	207.7 kN
UNCONFINED COMPRESSIVE STRENGTH:	66.6 MPa

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

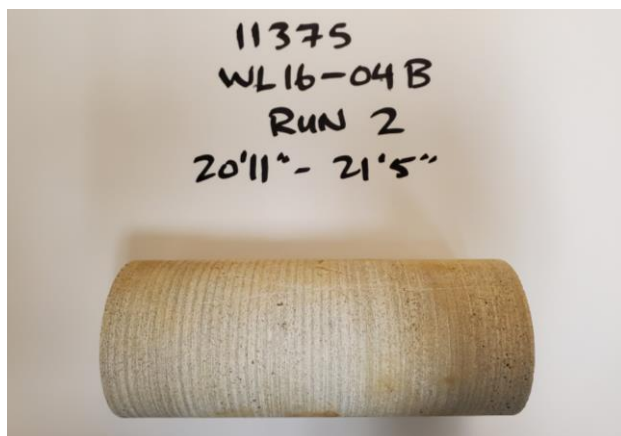
# UNCONFINED COMPRESSION TEST REPORT

## ASTM D7012-14

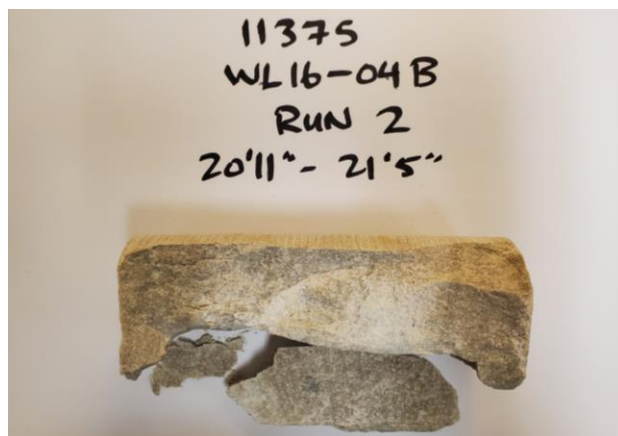
CLIENT:	WSP Canada Group Ltd.	FILE NUMBER:	11375
PROJECT NAME:	Hwy 7 New PD and DD Foundations	REPORT DATE:	5-May-21
BOREHOLE No.:	WL16-04B	TEST DATE:	4-May-21
SAMPLE No.:	HQ Run 2		
SAMPLE DEPTH:	20'11" - 21'5"		
DESCRIPTION:	Dolostone		

Avg. Height (cm):	14.0	Weight (g):	1181.6
Avg. Diameter (cm):	6.3	Wet Density (kg/m <sup>3</sup> ):	2,708
H. to Dia. Ratio**:	2.2:1	Dry Density (kg/m <sup>3</sup> ):	2,708
Cross Sectional Area (cm <sup>2</sup> ):	31.17	Moisture Content* (%):	N/A
Sample Volume (cm <sup>3</sup> ):	436.41		

ORIGINAL SPECIMEN



FRACTURED SPECIMEN



AVG. RATE OF STRAIN TO FAILURE:	1.1% / min
MAXIMUM COMPRESSIVE LOAD:	361.4 kN
UNCONFINED COMPRESSIVE STRENGTH:	115.9 MPa

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

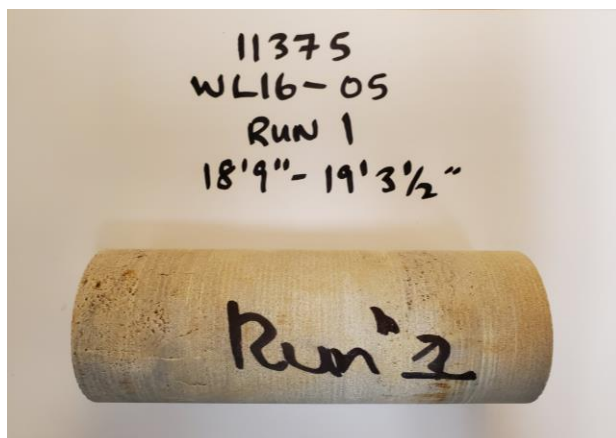
# UNCONFINED COMPRESSION TEST REPORT

## ASTM D7012-14

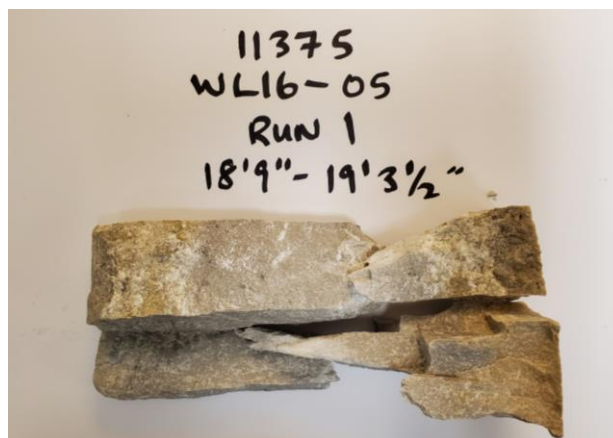
CLIENT:	WSP Canada Group Ltd.	FILE NUMBER:	11375
PROJECT NAME:	Hwy 7 New PD and DD Foundations	REPORT DATE:	5-May-21
BOREHOLE No.:	WL16-05	TEST DATE:	4-May-21
SAMPLE No.:	HQ Run 1		
SAMPLE DEPTH:	18'9" - 19'3.5"		
DESCRIPTION:	Dolostone		

Avg. Height (cm):	16.0	Weight (g):	1367.2
Avg. Diameter (cm):	6.3	Wet Density (kg/m <sup>3</sup> ):	2,741
H. to Dia. Ratio**:	2.5:1	Dry Density (kg/m <sup>3</sup> ):	2,741
Cross Sectional Area (cm <sup>2</sup> ):	31.17	Moisture Content* (%):	N/A
Sample Volume (cm <sup>3</sup> ):	498.76		

ORIGINAL SPECIMEN



FRACTURED SPECIMEN



AVG. RATE OF STRAIN TO FAILURE:	0.9% / min
MAXIMUM COMPRESSIVE LOAD:	402.2 kN
UNCONFINED COMPRESSIVE STRENGTH:	129.0 MPa

Note: \* Dimensions of Specimen do not conform to ASTM D 4543-04.

TEST DONE BY: BS  
REVIEWED BY: WM

11375 WL16-05 Run 1 - UCS TEMP



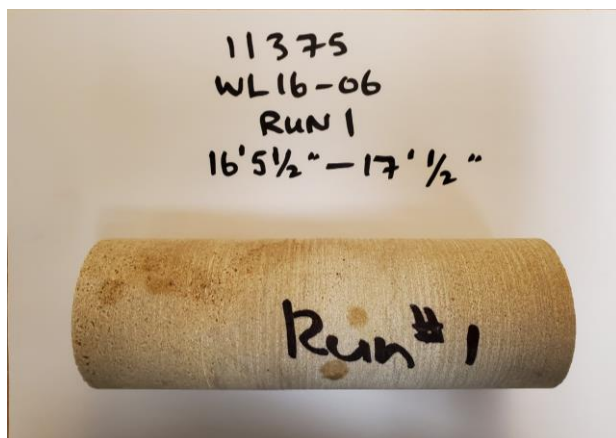
## UNCONFINED COMPRESSION TEST REPORT

### ASTM D7012-14

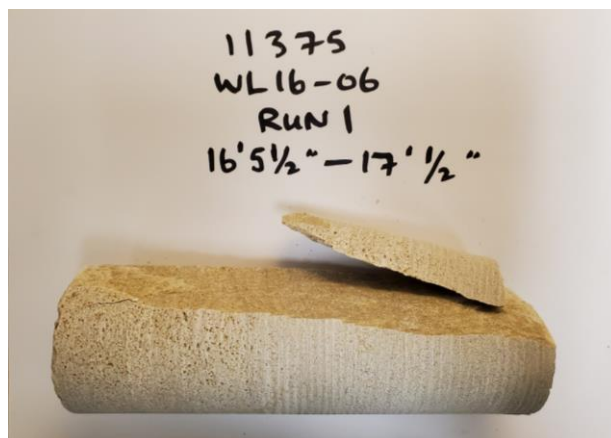
CLIENT: WSP Canada Group Ltd. FILE NUMBER: 11375  
PROJECT NAME: Hwy 7 New PD and DD Foundations REPORT DATE: 5-May-21  
BOREHOLE No.: WL16-06 TEST DATE: 4-May-21  
SAMPLE No.: HQ Run 1  
SAMPLE DEPTH: 16'5.5" - 17'0.5"  
DESCRIPTION: Dolostone

Avg. Height (cm):	17.0	Weight (g):	1367.7
Avg. Diameter (cm):	6.3	Wet Density (kg/m <sup>3</sup> ):	2,581
H. to Dia. Ratio**:	2.7:1	Dry Density (kg/m <sup>3</sup> ):	2,581
Cross Sectional Area (cm <sup>2</sup> ):	31.17	Moisture Content* (%):	N/A
Sample Volume (cm <sup>3</sup> ):	529.93		

ORIGINAL SPECIMEN



FRACTURED SPECIMEN



AVG. RATE OF STRAIN TO FAILURE:	0.9% / min
MAXIMUM COMPRESSIVE LOAD:	78.2 kN
UNCONFINED COMPRESSIVE STRENGTH:	25.1 MPa

Note: \* Dimensions of Specimen do not conform to ASTM D 4543-04.

**THURBER ENGINEERING LTD.****POINT LOAD TEST SHEET**

Job No : 11375 Client : WSP  
Date Drilled : 08-Apr-20  
Project Name : Woodlawn Road Interchange Project Date Tested : 21-Apr-20  
Core Size : HQ BH No : WL 16-03 Tester : GP

Test No.	Run No.	Depth (m)	Axial or Diametral	Gauge (MPa)	Diameter (mm)	Length (mm)	UCS (MPa)	Rock Type	Notes
1	1	5.1	D	22.0	63.2	139.1	139.5	Dolostone	Very Strong
2	1	5.8	A	8.2	63.1	62.6	43.5	Dolostone	Medium Strong
3	1	6.3	A	6.3	63.2	67.8	31.4	Dolostone	Medium Strong
4	2	6.5	A	20.2	63.2	61.1	108.7	Dolostone	Very Strong
5	2	7.0	D	17.4	63.3	130.0	109.8	Dolostone	Very Strong
6	2	7.5	A	18.4	63.3	72.8	86.6	Dolostone	Strong
7	3	7.7	A	8.8	63.3	60.1	47.7	Dolostone	Medium Strong
8	3	8.3	D	7.3	63.2	123.3	46.4	Dolostone	Medium Strong
9	3	8.8	A	21.4	63.3	67.8	106.2	Dolostone	Very Strong
10									
11									
12									
13									
14									
15									
16									
17									
18									
19									
20									
21									
22									
23									
24									
25									
26									
27									
28									
29									
30									
31									
32									
33									
34									
35									

\* It is ideal to perform axial test on core specimens with D/L ratio of  $1.1 \pm 0.1$

Long pieces of core can be tested diametrically to produce suitable lengths for axial testing

\* Diametral Test should have  $0.7 \times D$  on either side of test point.

**THURBER ENGINEERING LTD.****POINT LOAD TEST SHEET**

**Job No :** 11375 **Client :** WSP  
**Date Drilled :** 14-Apr-20  
**Project Name :** Woodlawn Road Interchange Project **Date Tested :** 21-Apr-20  
**Core Size :** HQ **BH No :** WL 16-04B **Tester :** GP

Test No.	Run No.	Depth (m)	Axial or Diametral	Gauge (MPa)	Diameter (mm)	Length (mm)	UCS (MPa)	Rock Type	Notes
1	1	5.7	A	17.3	63.2	67.8	85.9	Dolostone	Strong
2	1	6.2	D	19.2	63.3	135.2	121.6	Dolostone	Very Strong
3	2	6.7	A	17.3	63.3	67.3	86.6	Dolostone	Strong
4	2	6.8	D	8.2	63.3	140.1	51.9	Dolostone	Strong
5	2	7.5	A	6.2	63.3	62.8	32.7	Dolostone	Medium Strong
6	3	8.0	D	5.7	63.3	142.4	36.0	Dolostone	Medium Strong
7	3	8.6	A	8.1	63.3	72.5	38.0	Dolostone	Medium Strong
8	3	9.1	A	6.2	63.3	66.1	31.4	Dolostone	Medium Strong
9									
10									
11									
12									
13									
14									
15									
16									
17									
18									
19									
20									
21									
22									
23									
24									
25									
26									
27									
28									
29									
30									
31									
32									
33									
34									
35									

\* It is ideal to perform axial test on core specimens with D/L ratio of  $1.1 \pm 0.1$

Long pieces of core can be tested diametrically to produce suitable lengths for axial testing

\* Diametral Test should have  $0.7 \times D$  on either side of test point.



**THURBER** ENGINEERING LTD.

**POINT LOAD TEST SHEET**

Job No : 11375 Client : WSP  
Date Drilled : 08-Apr-20  
Project Name : Woodlawn Road Interchange Project Date Tested : 21-Apr-20  
Core Size : HQ BH No : WL 16-05 Tester : GP

Test No.	Run No.	Depth (m)	Axial or Diametral	Gauge (MPa)	Diameter (mm)	Length (mm)	UCS (MPa)	Rock Type	Notes
1	1	4.9	A	16.4	63.3	70.6	78.9	Dolostone	Strong
2	1	5.3	D	24.3	63.3	113.5	153.5	Dolostone	Very Strong
3	1	6.0	A	20.0	63.3	61.1	107.9	Dolostone	Very Strong
4	2	6.3	D	23.9	63.2	121.0	151.2	Dolostone	Very Strong
5	2	6.9	A	13.8	63.3	63.9	71.9	Dolostone	Strong
6	2	7.5	D	11.9	63.3	104.6	75.3	Dolostone	Strong
7									
8									
9									
10									
11									
12									
13									
14									
15									
16									
17									
18									
19									
20									
21									
22									
23									
24									
25									
26									
27									
28									
29									
30									
31									
32									
33									
34									
35									

\* It is ideal to perform axial test on core specimens with D/L ratio of  $1.1 \pm 0.1$

Long pieces of core can be tested diametrically to produce suitable lengths for axial testing

\* Diametral Test should have  $0.7 \times D$  on either side of test point.

**THURBER ENGINEERING LTD.****POINT LOAD TEST SHEET**

Job No : 11375 Client : WSP  
Date Drilled : 06-Apr-20  
Project Name : Woodlawn Road Interchange Project Date Tested : 21-Apr-20  
Core Size : HQ BH No : WL 16-06 Tester : GP

Test No.	Run No.	Depth (m)	Axial or Diametral	Gauge (MPa)	Diameter (mm)	Length (mm)	UCS (MPa)	Rock Type	Notes
1	1	4.1	A	13.44	47.6	64.7	86.4	Dolostone	Strong
2	1	4.8	D	14.40	47.6	111.8	141.5	Dolostone	Very Strong
3	1	5.4	A	15.58	47.3	71.6	92.9	Dolostone	Strong
4	2	5.7	D	13.06	47.1	104.5	130.4	Dolostone	Very Strong
5	2	6.4	A	24.46	47.4	64.8	157.3	Dolostone	Very Strong
6	2	6.8	D	6.21	47.4	101.6	61.4	Dolostone	Strong
7									
8									
9									
10									
11									
12									
13									
14									
15									
16									
17									
18									
19									
20									
21									
22									
23									
24									
25									
26									
27									
28									
29									
30									
31									
32									
33									
34									
35									

\* It is ideal to perform axial test on core specimens with D/L ratio of  $1.1 \pm 0.1$

Long pieces of core can be tested diametrically to produce suitable lengths for axial testing

\* Diametral Test should have  $0.7 \times D$  on either side of test point.



## FINAL REPORT

CA14856-APR21 R1

11375,, Woodlawn Rd

Prepared for

**Thurber Engineering Ltd.**

## First Page

### CLIENT DETAILS

Client Thurber Engineering Ltd.

Address 103, 2010 Winston Park Drive  
Oakville, ON  
L6H 5R7, Canada

Contact Joshua Alexander

Telephone 613-606-7303

Facsimile

Email jalexander@thurber.ca

Project 11375., Woodlawn Rd

Order Number

Samples Soil (6)

### LABORATORY DETAILS

Project Specialist Jill Campbell, B.Sc.,GISAS

Laboratory SGS Canada Inc.

Address 185 Concession St., Lakefield ON, K0L 2H0

Telephone 2165

Facsimile 705-652-6365

Email jill.campbell@sgs.com

SGS Reference CA14856-APR21

Received 04/19/2021

Approved 04/26/2021

Report Number CA14856-APR21 R1

Date Reported 04/26/2021

### COMMENTS

Temperature of Sample upon Receipt: 9 degrees C

Cooling Agent Present:Yes

Custody Seal Present:Yes

Chain of Custody Number:007526

Corrosivity Index is based on the American Water Works Corrosivity Scale according to AWWA C-105. An index greater than 10 indicates the soil matrix may be corrosive to cast iron alloys.

### SIGNATORIES

Jill Campbell, B.Sc.,GISAS









TABLE OF CONTENTS

---

First Page..... 1-2

Index..... 3

Results..... 4-5

QC Summary..... 6-7

Legend..... 8

Annexes..... 9



# FINAL REPORT

CA14856-APR21 R1

**Client:** Thurber Engineering Ltd.

**Project:** 11375,, Woodlawn Rd

**Project Manager:** Joshua Alexander

**Samplers:** Joshua Alexander

## PACKAGE: - Corrosivity Index (SOIL)

Sample Number	5	6	7	8	9	10
Sample Name	RW 20-01, SS4	WL 16-05, SS5	RW 20-04, SS3	WL 16-03, SS3B	WL 16-06, SS2	WL 16-04, SS6
Sample Matrix	Soil	Soil	Soil	Soil	Soil	Soil
Sample Date	15/04/2021	08/04/2021	13/04/2021	08/04/2021	06/04/2021	08/04/2021

Parameter	Units	RL	Result	Result	Result	Result	Result	Result
-----------	-------	----	--------	--------	--------	--------	--------	--------

### Corrosivity Index

Corrosivity Index	none	1	3	5	13	3	13	3
Soil Redox Potential	mV	-	198	192	163	112	284	230
Sulphide (Na2CO3)	%	0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04
pH	pH Units	0.05	9.26	9.48	8.87	9.27	8.78	9.32
Resistivity (calculated)	ohms.cm	-9999	5850	2290	245	6760	1230	10500

## PACKAGE: - General Chemistry (SOIL)

Sample Number	5	6	7	8	9	10
Sample Name	RW 20-01, SS4	WL 16-05, SS5	RW 20-04, SS3	WL 16-03, SS3B	WL 16-06, SS2	WL 16-04, SS6
Sample Matrix	Soil	Soil	Soil	Soil	Soil	Soil
Sample Date	15/04/2021	08/04/2021	13/04/2021	08/04/2021	06/04/2021	08/04/2021

Parameter	Units	RL	Result	Result	Result	Result	Result	Result
-----------	-------	----	--------	--------	--------	--------	--------	--------

### General Chemistry

Conductivity	uS/cm	2	171	436	4080	148	814	95
--------------	-------	---	-----	-----	------	-----	-----	----

## PACKAGE: - Metals and Inorganics (SOIL)

Sample Number	5	6	7	8	9	10
Sample Name	RW 20-01, SS4	WL 16-05, SS5	RW 20-04, SS3	WL 16-03, SS3B	WL 16-06, SS2	WL 16-04, SS6
Sample Matrix	Soil	Soil	Soil	Soil	Soil	Soil
Sample Date	15/04/2021	08/04/2021	13/04/2021	08/04/2021	06/04/2021	08/04/2021

Parameter	Units	RL	Result	Result	Result	Result	Result	Result
-----------	-------	----	--------	--------	--------	--------	--------	--------

### Metals and Inorganics

Moisture Content	%	0.1	0.3	0.4	0.6	0.4	1.2	0.4
Sulphate	µg/g	0.4	4.8	7.6	20	4.8	11	8.7



FINAL REPORT

CA14856-APR21 R1

**Client:** Thurber Engineering Ltd.  
**Project:** 11375,, Woodlawn Rd  
**Project Manager:** Joshua Alexander  
**Samplers:** Joshua Alexander

PACKAGE: - Other (ORP) (SOIL)

			Sample Number	5	6	7	8	9	10
			Sample Name	RW 20-01, SS4	WL 16-05, SS5	RW 20-04, SS3	WL 16-03, SS3B	WL 16-06, SS2	WL 16-04, SS6
			Sample Matrix	Soil	Soil	Soil	Soil	Soil	Soil
			Sample Date	15/04/2021	08/04/2021	13/04/2021	08/04/2021	06/04/2021	08/04/2021
Parameter	Units	RL							
			Result	Result	Result	Result	Result	Result	Result
Other (ORP)									
Chloride	µg/g	0.4		48	190	1400	88	350	60

PACKAGE: - UNDEFINED (SOIL)

			Sample Number	5	6	7	8	9	10
			Sample Name	RW 20-01, SS4	WL 16-05, SS5	RW 20-04, SS3	WL 16-03, SS3B	WL 16-06, SS2	WL 16-04, SS6
			Sample Matrix	Soil	Soil	Soil	Soil	Soil	Soil
			Sample Date	15/04/2021	08/04/2021	13/04/2021	08/04/2021	06/04/2021	08/04/2021
Parameter	Units	RL							
			Result	Result	Result	Result	Result	Result	Result
UNDEFINED									
	-	-		1	1	1	1	1	1



FINAL REPORT

CA14856-APR21 R1

QC SUMMARY

Anions by IC  
Method: EPA300/MA300-Ions1.3 | Internal ref.: ME-CA-IENVIIC-LAK-AN-001

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Chloride	DIO0375-APR21	µg/g	0.4	<0.4	2	20	97	80	120	109	75	125
Sulphate	DIO0375-APR21	µg/g	0.4	<0.4	2	20	97	80	120	95	75	125

Carbon/Sulphur  
Method: ASTM E1915-07A | Internal ref.: ME-CA-IENVIARD-LAK-AN-020

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Sulphide (Na2CO3)	ECS0054-APR21	%	0.04	< 0.04	ND	20	112	80	120			

Conductivity  
Method: SM 2510 | Internal ref.: ME-CA-IENVIEWL-LAK-AN-006

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Conductivity	EWL0405-APR21	uS/cm	2	< 2	0	20	100	90	110	NA		



QC SUMMARY

pH  
Method: SM 4500 | Internal ref.: ME-CA-IENVIEWL-LAK-AN-001

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
pH	EWL0405-APR21	pH Units	0.05	NA	0		101			NA		

Method Blank: a blank matrix that is carried through the entire analytical procedure. Used to assess laboratory contamination.

Duplicate: Paired analysis of a separate portion of the same sample that is carried through the entire analytical procedure. Used to evaluate measurement precision.

LCS/Spike Blank: Laboratory control sample or spike blank refer to a blank matrix to which a known amount of analyte has been added. Used to evaluate analyte recovery and laboratory accuracy without sample matrix effects.

Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate laboratory accuracy with sample matrix effects.

Reference Material: a material or substance matrix matched to the samples that contains a known amount of the analyte of interest. A reference material may be used in place of a matrix spike.

RL: Reporting limit

RPD: Relative percent difference

AC: Acceptance criteria

**Multielement Scan Qualifier:** as the number of analytes in a scan increases, so does the chance of a limit exceedance by random chance as opposed to a real method problem. Thus, in multielement scans, for the LCS and matrix spike, up to 10% of the analytes may exceed the quoted limits by up to 10% absolute and the spike is considered acceptable.

**Duplicate Qualifier:** for duplicates as the measured result approaches the RL, the uncertainty associated with the value increases dramatically, thus duplicate acceptance limits apply only where the average of the two duplicates is greater than five times the RL.

**Matrix Spike Qualifier:** for matrix spikes, as the concentration of the native analyte increases, the uncertainty of the matrix spike recovery increases. Thus, the matrix spike acceptance limits apply only when the concentration of the matrix spike is greater than or equal to the concentration of the native analyte.

## LEGEND

### FOOTNOTES

**NSS** Insufficient sample for analysis.

**RL** Reporting Limit.

↑ Reporting limit raised.

↓ Reporting limit lowered.

**NA** The sample was not analysed for this analyte

**ND** Non Detect

Samples analysed as received. Solid samples expressed on a dry weight basis. "Temperature Upon Receipt" is representative of the whole shipment and may not reflect the temperature of individual samples.

Analysis conducted on samples submitted pursuant to or as part of Reg. 153/04, are in accordance to the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act" published by the Ministry and dated March 9, 2004 as amended.

SGS provides criteria information (such as regulatory or guideline limits and summary of limit exceedances) as a service. Every attempt is made to ensure the criteria information in this report is accurate and current, however, it is not guaranteed. Comparison to the most current criteria is the responsibility of the client and SGS assumes no responsibility for the accuracy of the criteria levels indicated. This document is issued, on the Client's behalf, by the Company under its General Conditions of Service available on request and accessible at [http://www.sgs.com/terms\\_and\\_conditions.htm](http://www.sgs.com/terms_and_conditions.htm). The Client's attention is drawn to the limitation of liability, indemnification and jurisdiction issues defined therein. Any other holder of this document is advised that information contained hereon reflects the Company's findings at the time of its intervention only and within the limits of Client's instructions, if any. The Company's sole responsibility is to its Client and this document does not exonerate parties to a transaction from exercising all their rights and obligations under the transaction documents.

This report must not be reproduced, except in full. This report supersedes all previous versions.

-- End of Analytical Report --





## **Appendix B**

**Record of Borehole Sheets (Previous investigation)**  
**Geotechnical Test Results (Previous investigation)**



## SYMBOLS, ABBREVIATIONS AND TERMS USED ON RECORDS OF BOREHOLES

### 1. TEXTURAL CLASSIFICATION OF SOILS

CLASSIFICATION	PARTICLE SIZE	VISUAL IDENTIFICATION
Boulders	Greater than 200mm	same
Cobbles	75 to 200mm	same
Gravel	4.75 to 75mm	5 to 75mm
Sand	0.075 to 4.75mm	Not visible particles to 5mm
Silt	0.002 to 0.075mm	Non-plastic particles, not visible to the naked eye
Clay	Less than 0.002mm	Plastic particles, not visible to the naked eye

### 2. COARSE GRAIN SOIL DESCRIPTION (50% greater than 0.075mm)

TERMINOLOGY	PROPORTION
Trace or Occasional	Less than 10%
Some	10 to 20%
Adjective (e.g. silty or sandy)	20 to 35%
And (e.g. sand and gravel)	35 to 50%

### 3. TERMS DESCRIBING CONSISTENCY (COHESIVE SOILS ONLY)

DESCRIPTIVE TERM	UNDRAINED SHEAR STRENGTH (kPa)	APPROXIMATE SPT <sup>(1)</sup> 'N' VALUE
Very Soft	12 or less	Less than 2
Soft	12 to 25	2 to 4
Firm	25 to 50	4 to 8
Stiff	50 to 100	8 to 15
Very Stiff	100 to 200	15 to 30
Hard	Greater than 200	Greater than 30

NOTE: Hierarchy of Soil Strength Prediction

- 1) Laboratory Triaxial Testing
- 2) Field Insitu Vane Testing
- 3) Laboratory Vane Testing
- 4) SPT value
- 5) Pocket Penetrometer



### 4. TERMS DESCRIBING DENSITY (COHESIONLESS SOILS ONLY)

DESCRIPTIVE TERM	SPT "N" VALUE
Very Loose	Less than 4
Loose	4 to 10
Compact	10 to 30
Dense	30 to 50
Very Dense	Greater than 50

### 5. LEGEND FOR RECORDS OF BOREHOLES

SYMBOLS AND ABBREVIATIONS FOR SAMPLE TYPE	SS Split Spoon Sample	WS Wash Sample	AS Auger (Grab) Sample
	TW Thin Wall Shelby Tube Sample	TP Thin Wall Piston Sample	
	PH Sampler Advanced by Hydraulic Pressure	PM Sampler Advanced by Manual Pressure	
	WH Sampler Advanced by Self Static Weight	RC Rock Core	SC Soil Core

$$\text{Sensitivity} = \frac{\text{Undisturbed Shear Strength}}{\text{Remoulded Shear Strength}}$$






 Water Level  
 Shear Strength Determination by Pocket Penetrometer

- (1) SPT 'N' Value Standard Penetration Test 'N' Value – refers to the number of blows from a 63.5kg hammer free falling a height of 0.76m to advance a standard 50 mm outside diameter split spoon sampler for 0.3 m depth into undisturbed ground.
- (2) DCPT Dynamic Cone Penetration Test – Continuous penetration of a 50 mm outside diameter, 60° conical steel point attached to "A" size rods driven by a 63.5 kg hammer free falling a height of 0.76 m. The resistance to cone penetration is the number of hammer blows required for each 0.3 m advance of the conical point into undisturbed ground.

# UNIFIED SOILS CLASSIFICATION

MAJOR DIVISIONS		GROUP SYMBOL	TYPICAL DESCRIPTION
COARSE GRAINED SOILS	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	SILTS AND CLAYS $W_L < 50\%$	ML	Inorganic silts and 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. ( $W_L < 30\%$ ).
		CI	Inorganic clays of medium plasticity, silty clays. ( $30\% < W_L < 50\%$ ).
		OL	Organic silts and organic silty-clays of low plasticity.
	SILTS AND CLAYS $W_L > 50\%$	MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts.
		CH	Inorganic clays of high plasticity, fat clays.
		OH	Organic clays of medium to high plasticity, organic silts.
HIGHLY ORGANIC SOILS		Pt	Peat and other highly organic soils.
CLAY SHALE			
SANDSTONE			
SILTSTONE			
CLAYSTONE			
COAL			

## EXPLANATION OF ROCK LOGGING TERMS

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

DISCONTINUITY SPACING		STRENGTH CLASSIFICATION		
Bedding	Bedding Plane Spacing	Rock Strength	Approximate Uniaxial Compressive Strength (MPa) (psi)	Field Estimation of Hardness*
Very thickly bedded	Greater than 2m	Extremely Strong	Greater than 250 Greater than 36,000	Specimen can only be chipped with a geological hammer
Thickly bedded	0.6 to 2m			
Medium bedded	0.2 to 0.6m	Very Strong	100-250 15,000 to 36,000	Requires many blows of geological hammer to break
Thinly bedded	60mm to 0.2m			
Very thinly bedded	20 to 60mm	Strong	50-100 7,500 to 15,000	Requires more than one blow of geological hammer to break
Laminated	6 to 20mm			
Thinly Laminated	Less than 6mm	Medium Strong	25.0 to 50.0 3,500 to 7,500	Breaks under single blow of geological hammer.
		Weak	5.0 to 25.0 750 to 3,500	Can be peeled by a pocket knife with difficulty
		Very Weak	1.0 to 5.0 150 to 750	Can be peeled by a pocket knife, crumbles under firm blows of geological pick.
		Extremely Weak (Rock)	0.25 to 1.0 35 to 150	Indented by thumbnail

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 0.1m in length or larger as a percentage of total core run length.
Uniaxial Compressive Strength (UCS)	Axial stress required to break the specimen
Fracture Index: (FI)	Frequency of natural fractures per 0.3m of core run.

# RECORD OF BOREHOLE No 08-236

1 OF 1

METRIC

G.W.P. 408-88-00 LOCATION N 4 823 685.76 E 240 320.65 ORIGINATED BY SA  
 HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY ES  
 DATUM Geodetic DATE 2008.06.18 - 2008.06.18 CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100		
341.4														
0.0	SILT, mixed with topsoil, occasional roots Loose Dark brown Moist (FILL)		1	SS	2		341							
340.6														
0.8	SAND and GRAVEL, some silt, trace clay Compact to very dense Brown Moist (FILL) Cobbles  Auger grinding, split spoon bouncing		2	SS	25		340							
			3	SS	53		339							33 43 24 (SI+CL)
			4	SS	75		338							
338.4														
3.0	Sandy SILT, numerous cobbles Very dense Grey Moist (TILL)		5	SS	88		337							0 45 48 7
336.8														
4.6	Coring started at 4.62m  DOLOSTONE Slightly to moderately weathered White		2	RUN			336							RUN 1# TCR=100%, SCR=100%, RQD=33%
			3	RUN			335							RUN 2# TCR=100%, SCR=100%, RQD=45%
			4	RUN			334							RUN 3# TCR=86%, SCR=86%, RQD=26%, UCS=130MPa RUN 4# TCR=100%, SCR=100%, RQD=90%, UCS=130MPa
333.7														
7.8	END OF BOREHOLE AT 7.8m. WATER OBSERVED AT 4.0m DURING DRILLING. BOREHOLE BACKFILLED WITH HOLEPLUG TO 4.6m THEN BENTONITE SEAL TO 0.6m THEN GROUT TO SURFACE.													

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

# RECORD OF BOREHOLE No 08-237

1 OF 1

METRIC

G.W.P. 408-88-00 LOCATION N 4 823 653.07 E 240 355.32 ORIGINATED BY SA  
 HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY ES  
 DATUM Geodetic DATE 2008.06.20 - 2008.06.20 CHECKED BY RPR

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT Y kN/m <sup>3</sup>	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 <sub>p</sub>	W	W <sub>L</sub>			
339.5																
0.0	SAND and GRAVEL, silty, trace clay, numerous cobbles Dense to very dense Brown Moist (FILL) Possible boulders  Wet, gas odour		1	SS	50/											
					100											
			2	SS	37										32 43 25 (SI+CL)	
			3	SS	63											
			4	SS	57										38 43 19 (SI+CL)	
335.8																
3.7	END OF BOREHOLE AT 3.66m UPON AUGER REFUSAL ON POSSIBLE BEDROCK. WATER OBSERVED AT 2.4m DURING DRILLING. Piezometer installation consists of 25mm diameter schedule 40 PVC pipe with a 1.52m slotted screen. WATER LEVEL READINGS: DATE DEPTH (m) ELEV. (m) 2008.07.15 2.3 337.2															

# RECORD OF BOREHOLE No 08-238

1 OF 1

METRIC

G.W.P. 408-88-00 LOCATION N 4 823 655.45 E 240 290.22 ORIGINATED BY SA  
 HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY ES  
 DATUM Geodetic DATE 2008.06.18 - 2008.06.20 CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			UNIT WEIGHT  $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa				
341.0								20 40 60 80 100				
0.0	SILT, some gravel, trace sand, mixed with topsoil Dark brown Moist (FILL)		1	AS								
340.2												
0.8	SAND and GRAVEL, some silt, trace clay, numerous cobbles Compact to very dense Brown Moist (FILL)		1	SS	23							
			2	SS	92							
338.4	Possible boulder at 2.5m											
338.4			3	SS	50							
2.6	Sandy SILT, trace gravel, some clay Very dense Brown Moist to wet (TILL)											

+<sup>3</sup> ×<sup>3</sup>: Numbers refer to  
Sensitivity

20  
15 5  
10 (%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No 08-239

1 OF 1

METRIC

G.W.P. 408-88-00 LOCATION N 4 823 617.26 E 240 315.41  
 HWY 7 BOREHOLE TYPE Hollow Stem Augers  
 DATUM Geodetic DATE 2008.06.19 - 2008.06.19  
 ORIGINATED BY SLL  
 COMPILED BY ES  
 CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			UNIT WEIGHT  $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa				
								WATER CONTENT (%)				
339.9							20 40 60 80 100	PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT		
0.0							0 20 40 60 80 100	W <sub>P</sub>	W	W <sub>L</sub>		
0.1	SILT, mixed with topsoil, roots Dark brown Moist (FILL)		1	SS	35							
	SAND and GRAVEL, trace silt Dense Brown Moist (FILL)		2	SS	46							
338.4	Silty, organic, gas odour Dark brown											
1.5	Silty SAND, trace gravel, some clay, gas odour Compact		3	SS	13							1 49 39 11
337.8	Brown Moist											
2.1	SAND, fine grained, some gravel, trace silt, trace clay, numerous cobbles Dense Brown Wet		4	SS	42							
			5	SS	43							20 58 22 (SI+CL)
336.3												
3.7	Sandy SILT, trace gravel, trace clay Very dense Brown Wet (TILL)											
			6	SS	58							3 34 54 9
334.6												
5.3	DOLOSTONE Coring started at 5.3m Slightly to moderately weathered White		1	RUN							FI	RUN 1# TCR=100%, SCR=100%, RQD=100%
			2	RUN							2	
											10	
			3	RUN							10	RUN 2# TCR=100%, SCR=100%, RQD=80%, UCS=140MPa
											2	
											10	
											10	RUN 3# TCR=100%, SCR=100%, RQD=69%, UCS=130MPa
			4	RUN							2	
											>10	
											>10	RUN 4# TCR=100%, SCR=100%, RQD=25%, UCS=105MPa
331.5											5	
8.5	END OF BOREHOLE AT 8.46m. WATER OBSERVED AT 2.1m DURING DRILLING. BOREHOLE BACKFILLED WITH HOLEPLUG TO 5.2m, BENTONITE BENSEAL TO 0.6m THAN HOLEPLUG TO SURFACE.										4	

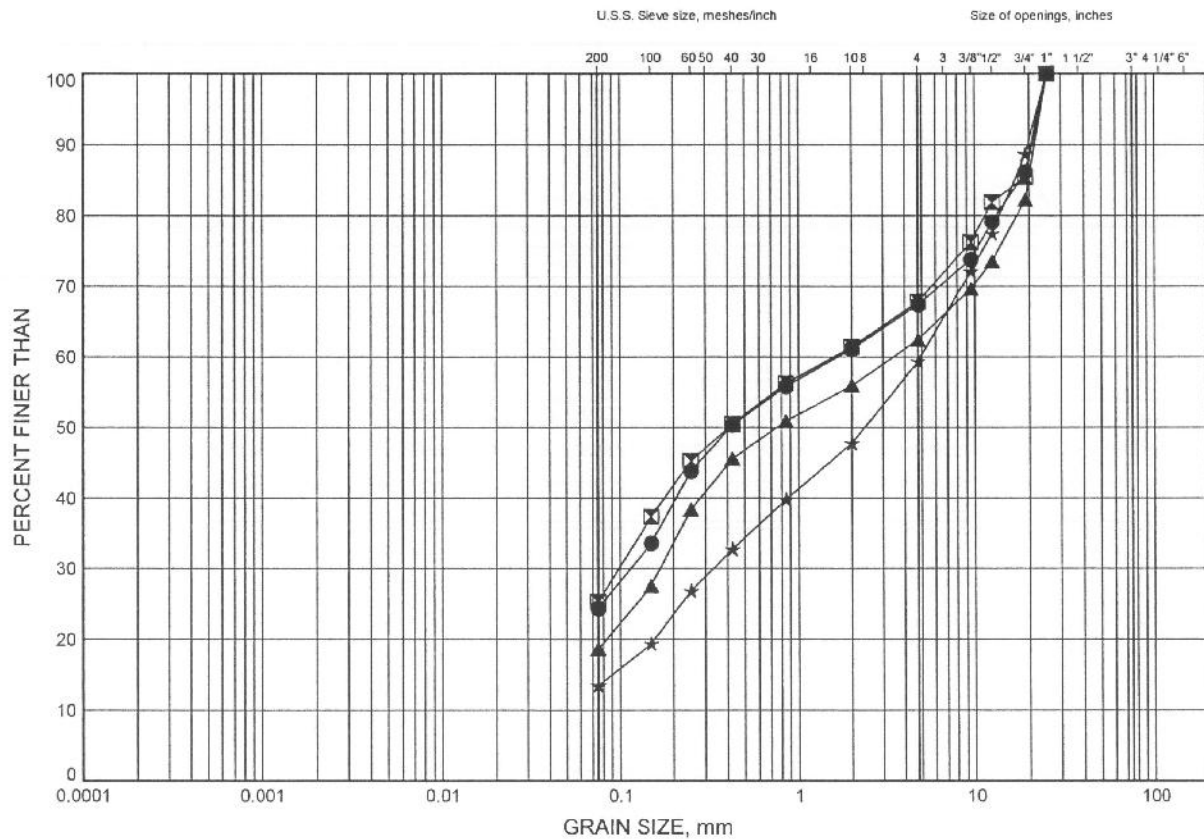
+ 3, x 3 Numbers refer to  
Sensitivity 20  
15 10 5  
(%) STRAIN AT FAILURE



# Highway 7 - New GRAIN SIZE DISTRIBUTION

FIGURE B1

## Sand and Gravel Fill



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

### LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	08-236	1.83	339.61
⊠	08-237	1.83	357.71
▲	08-237	3.35	356.19
☆	08-238	1.83	339.21



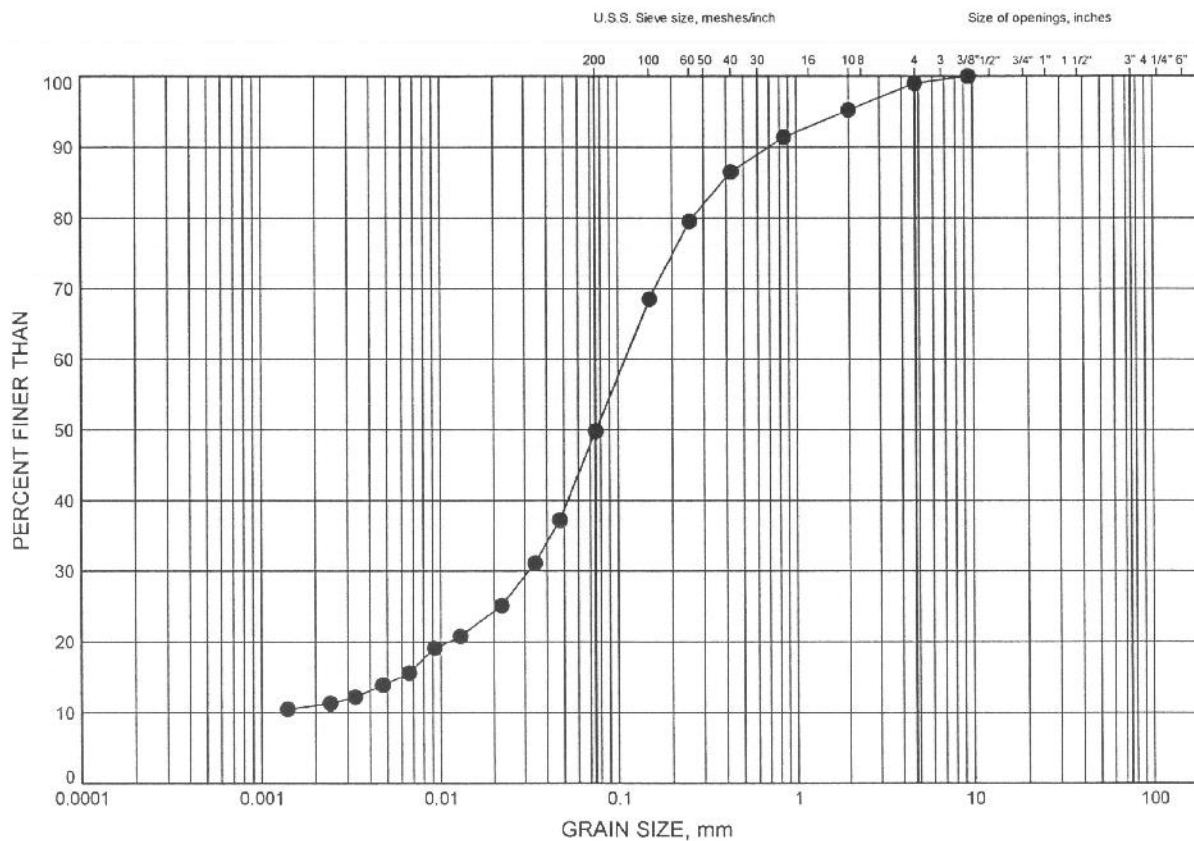
W.P.# 408-88-00  
Prepared By SA  
Checked By RPR



# Highway 7 - New GRAIN SIZE DISTRIBUTION

FIGURE B2

Silty Sand



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

## LEGEND

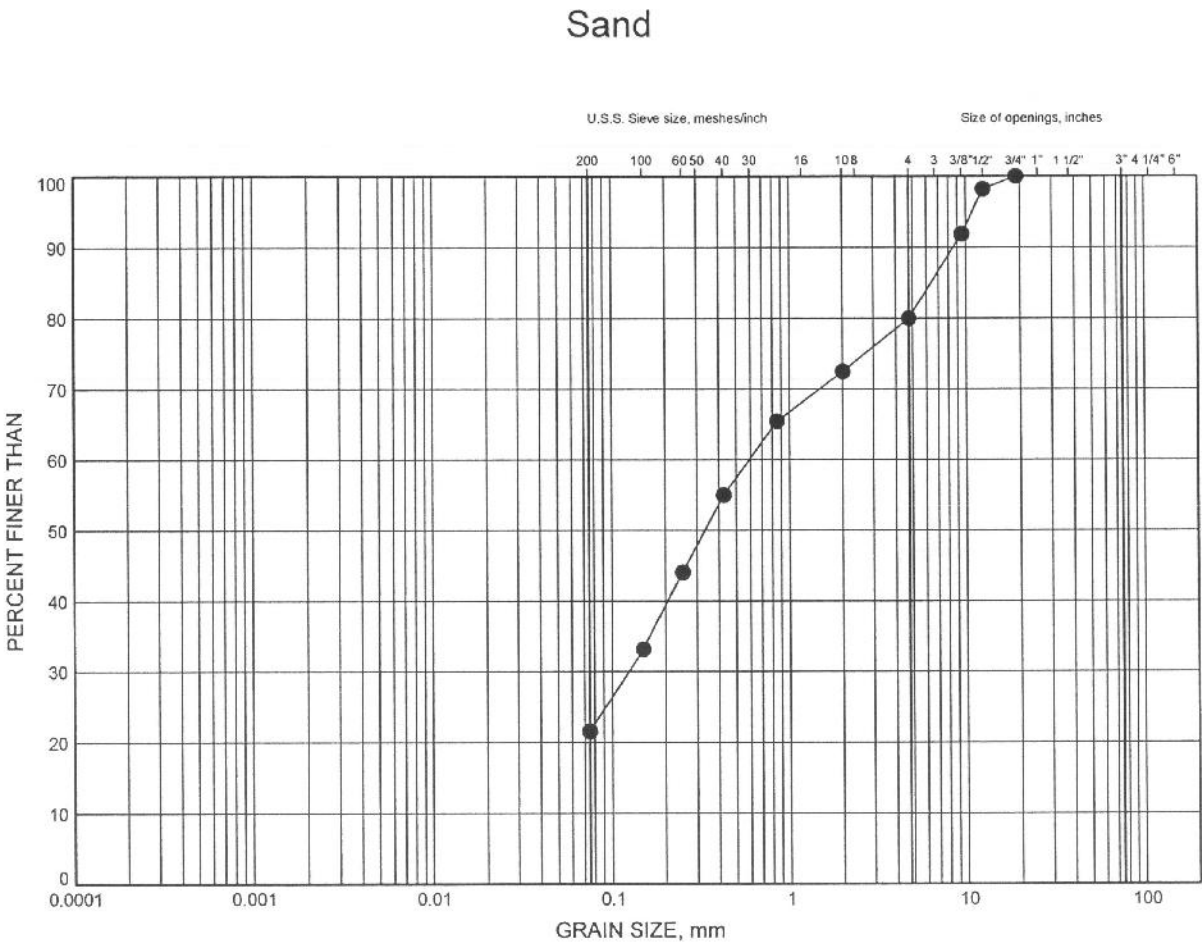
SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	08-239	1.83	338.09



W.P.# 408-88-00  
Prepared By SA  
Checked By RPR

Highway 7 - New  
GRAIN SIZE DISTRIBUTION

FIGURE B3



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	08-239	3.35	336.57



THURBER

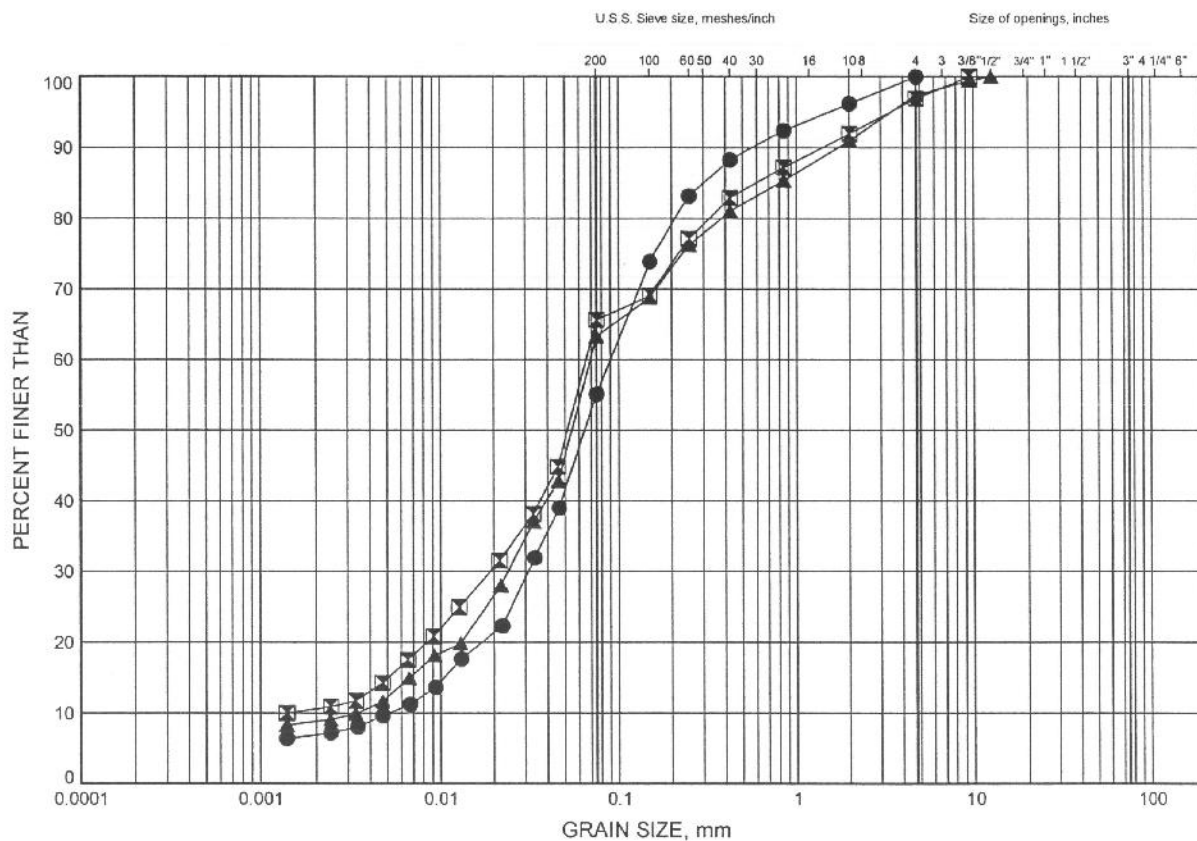
GRAIN SIZE DISTRIBUTION - THURBER 6417R.GPJ 7/23/08

W.P.# 408-88-00  
Prepared By SA  
Checked By RPR

# Highway 7 - New GRAIN SIZE DISTRIBUTION

FIGURE B4

## Sandy Silt Till



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

### LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	08-236	3.16	338.27
⊠	08-238	2.51	338.52
▲	08-239	4.88	335.04



W.P.# 408-88-00  
Prepared By SA  
Checked By RPR



## **Appendix C**

### **Rock Core Photographs**

PHOTOGRAPHS OF ROCK CORES – BOREHOLE WL16-03 (Dry)

BOTTOM

RUNS 1-3

Run 1

Run 2

Run 3



Run #	Depth (ft)	Depth (m)
1	16'6" – 21'0"	5.03 – 6.40
2	21'0" – 25'0"	6.40 – 7.62
3	25'0" – 29'4"	7.62 – 8.93

TOP



PHOTOGRAPHS OF ROCK CORES – BOREHOLE WL16-04B (Dry)

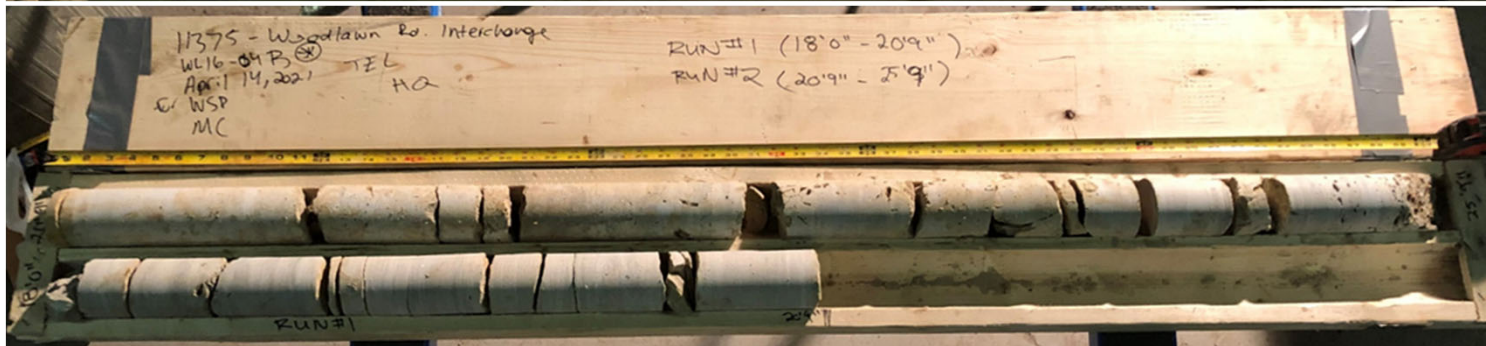
TOP

RUNS 1-3

Run 3



Run 2



Run 1

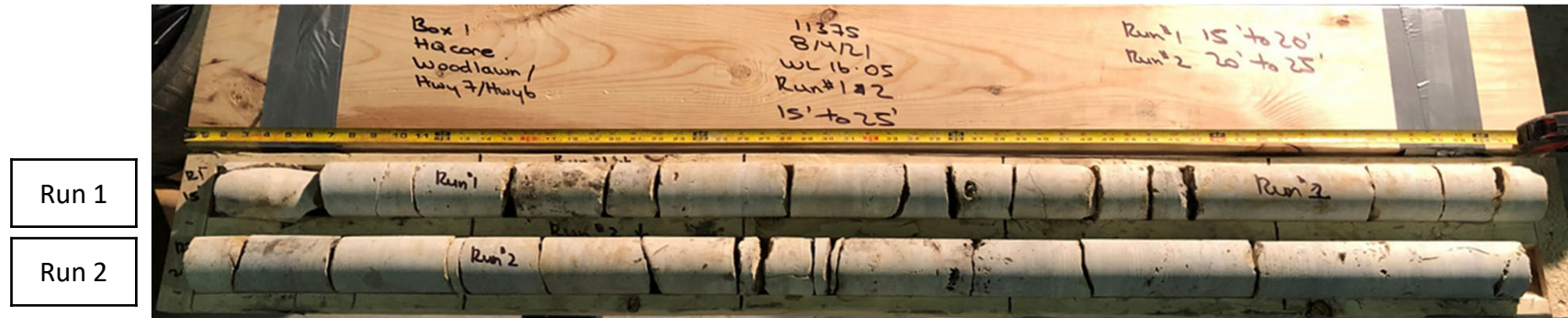
Run #	Depth (ft)	Depth (m)
1	18'0" – 20'9"	5.49 – 6.17
2	20'9" – 25'9"	6.17 – 7.01
3	25'9" – 30'3"	7.85 – 9.22

BOTTOM



TOP

RUNS 1-2



Date Drilled: April 8, 2021

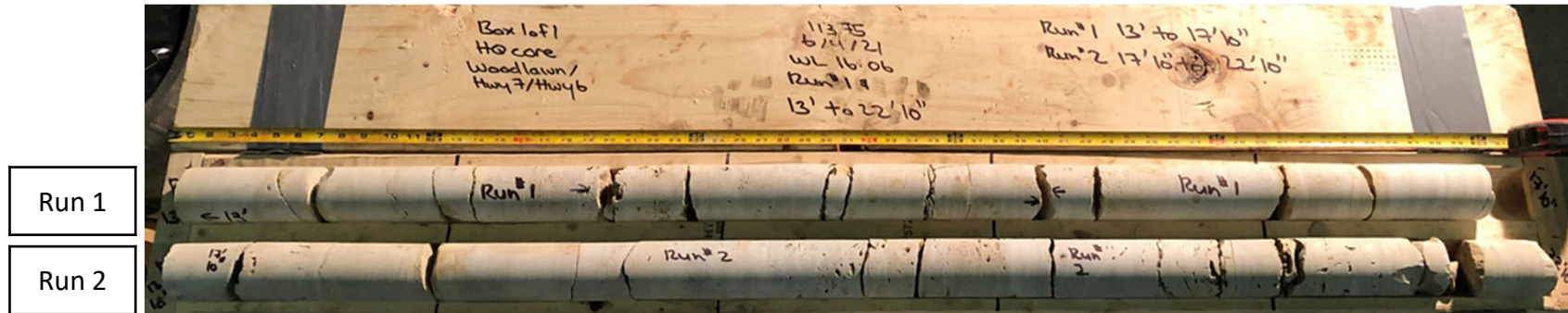
BOTTOM

Run #	Depth (ft)	Depth (m)
1	15'0" – 20'0"	4.57 – 6.09
2	20'0" – 25'0"	6.09 – 7.62



TOP

RUNS 1-2



BOTTOM

Date Drilled: April 6, 2021

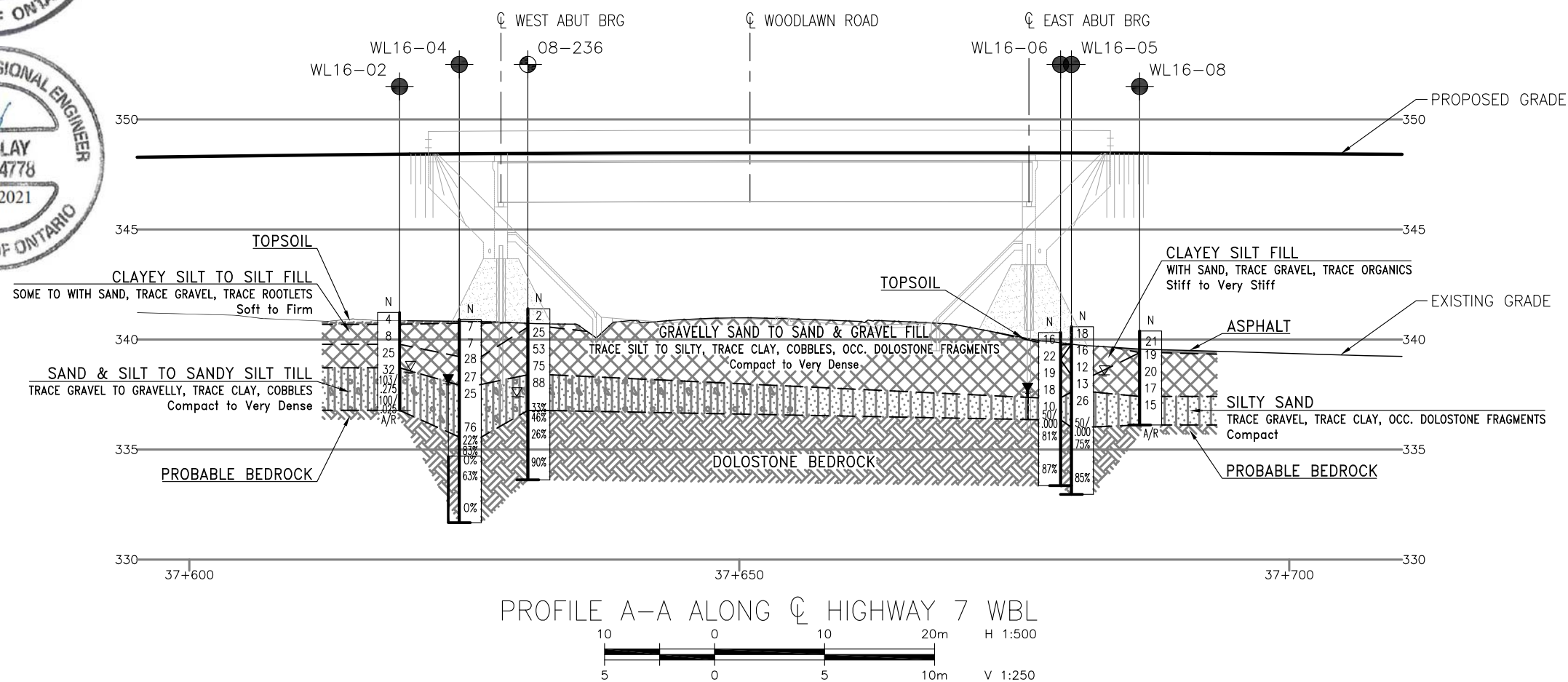
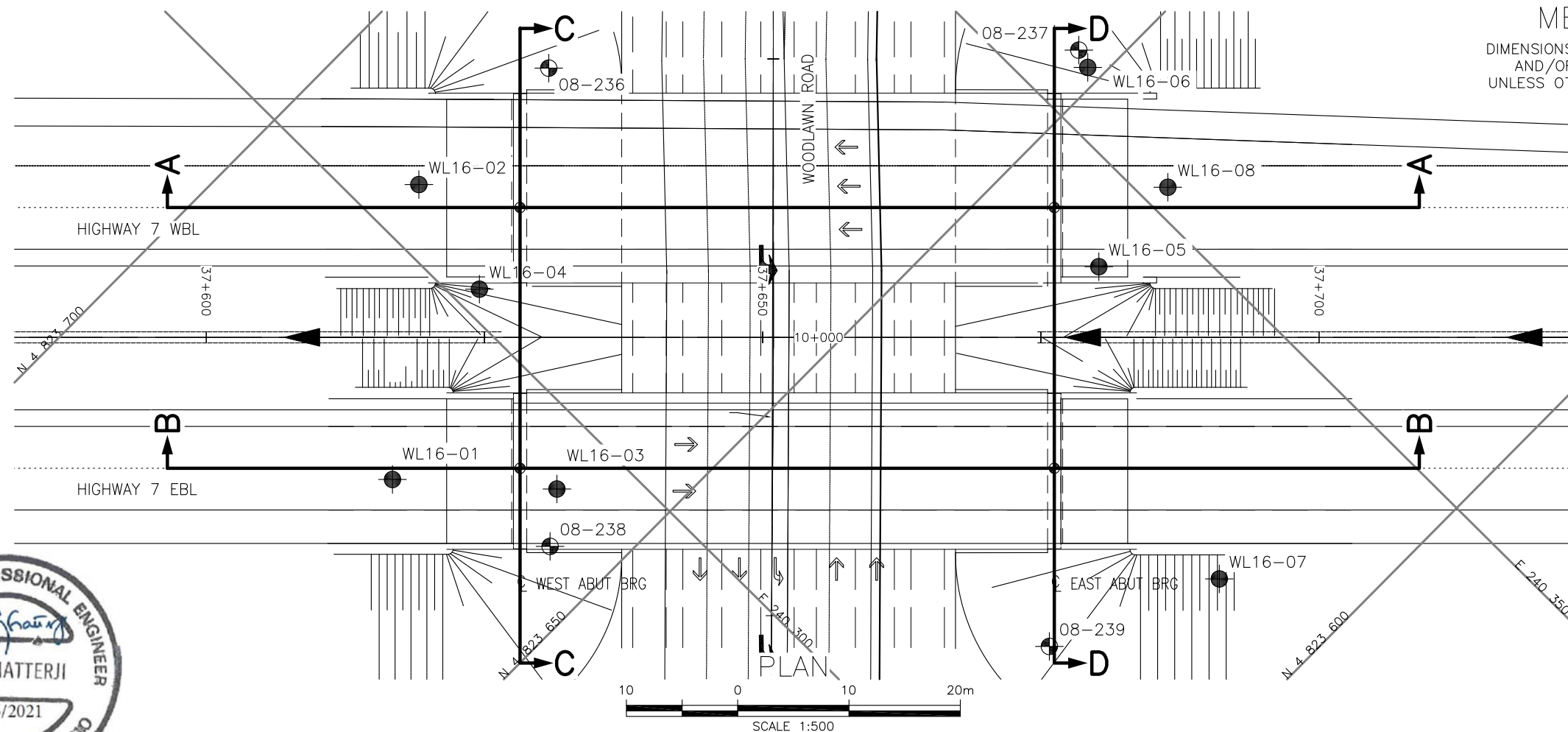
Run #	Depth (ft)	Depth (m)
1	13'0" – 17'6"	3.96 – 5.33
2	17'6" – 22'10"	5.33 – 6.96





## **Appendix D**

### **Borehole location and Soil Strata Drawing**

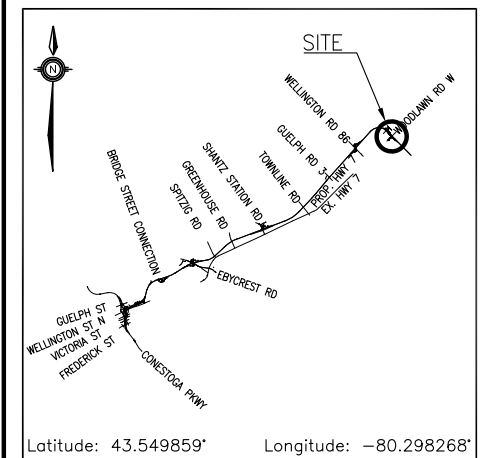


METRIC  
DIMENSIONS ARE IN METRES  
AND/OR MILLIMETRES  
UNLESS OTHERWISE SHOWN

CONT No  
GWP No 408-88-00






HIGHWAY 7  
WOODLAWN ROAD  
PROPOSED EBL & WBL OVERPASSES  
BOREHOLE LOCATIONS AND SOIL STRATA

SHEET



## KEYPLAN

## LEGEND

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

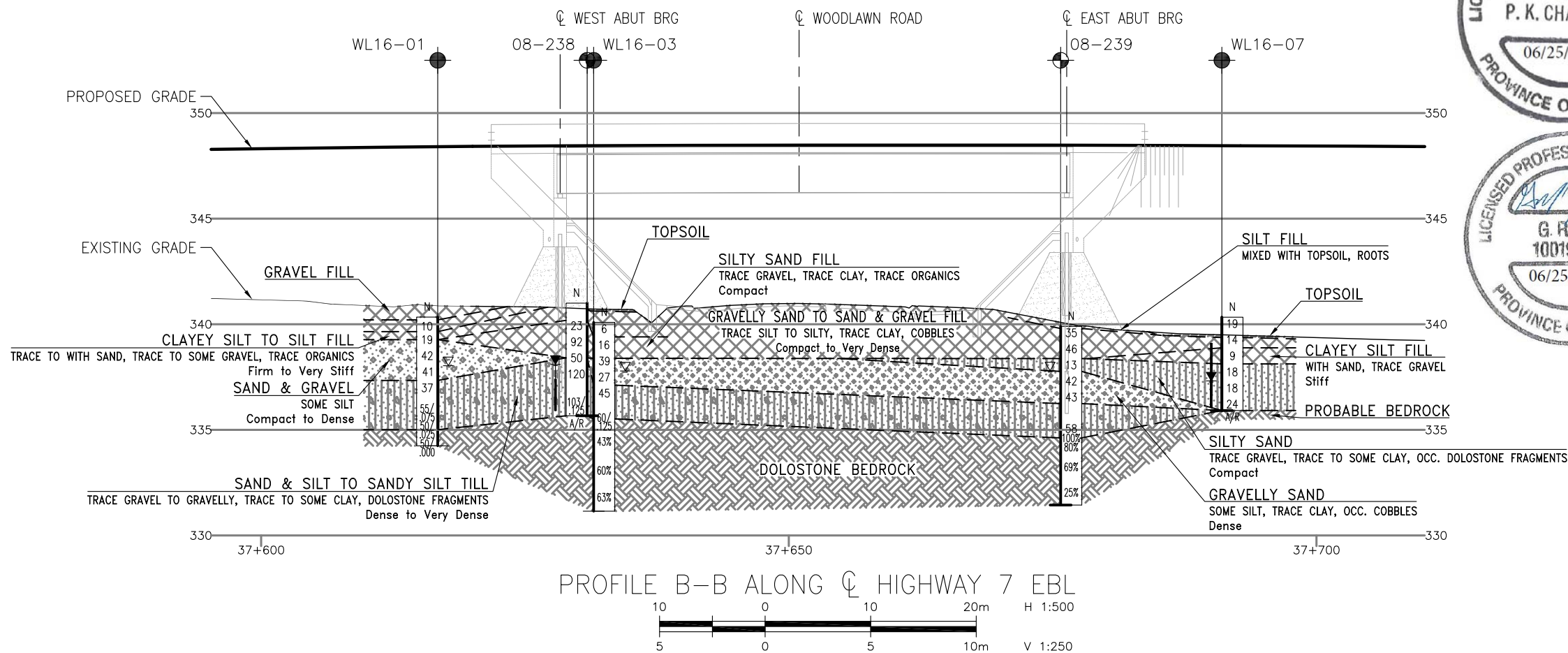
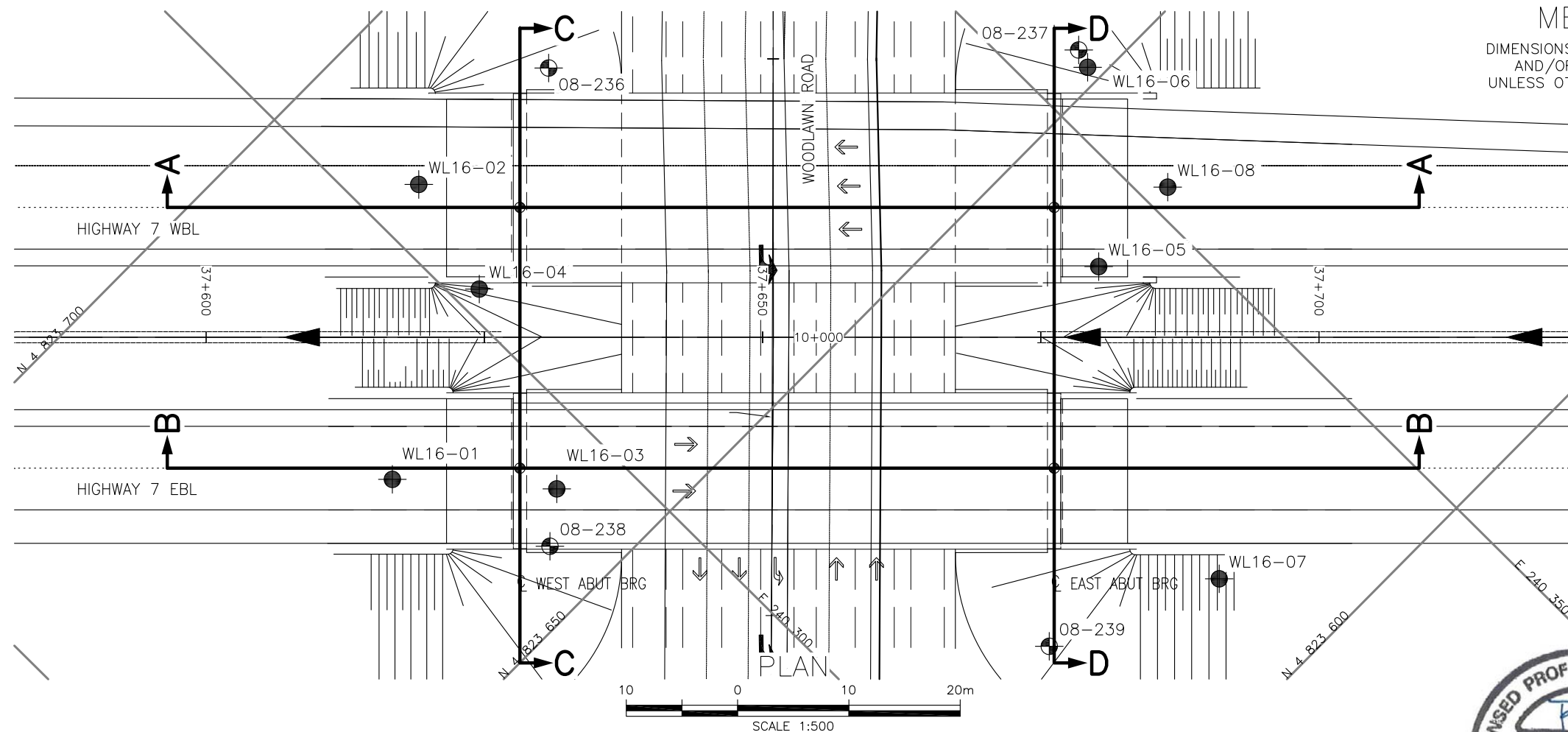
NO	ELEVATION	NORTHING	EASTING
WL16-01	340.3	4 823 669.7	240 284.5
WL16-02	341.2	4 823 686.7	240 305.0
WL16-03	340.1	4 823 658.6	240 294.3
WL16-04	340.9	4 823 676.2	240 302.2
WL16-05	340.6	4 823 638.1	240 342.8
WL16-06	340.3	4 823 651.4	240 354.8
WL16-07	340.3	4 823 610.7	240 330.5
WL16-08	340.4	4 823 638.7	240 352.2
08-236	341.4	4 823 685.8	240 320.6
08-237	339.5	4 823 653.1	240 355.3
08-238	341.0	4 823 655.5	240 290.2
08-239	339.9	4 823 617.3	240 315.4

-NOTES-

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

GEOCRES No.

REVISIONS									
	DATE	BY	DESCRIPTION						
DESIGN	GL	CHK	PKC	CODE	LOAD	DATE	JUN 2021		
DRAWN	MFA	CHK	GL	SITE 35-608/2		INSTRUCT	DWG	1	



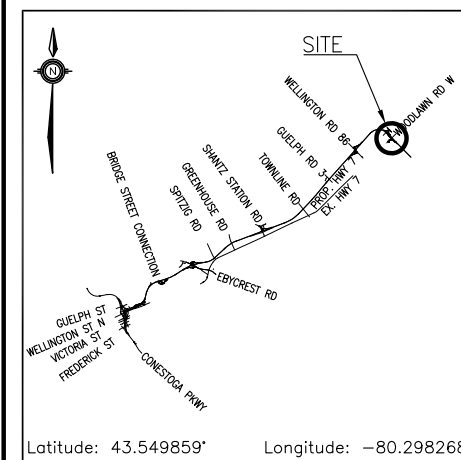
METRIC  
DIMENSIONS ARE IN METRES  
AND/OR MILLIMETRES  
UNLESS OTHERWISE SHOWN

CONT No  
GWP No 408-88-00

HIGHWAY 7  
WOODLAWN ROAD  
PROPOSED EBL & WBL OVERPASSES  
BOREHOLE LOCATIONS AND SOIL STRATA








**THURBER** ENGINEERING LTD.



## KEYPLAN

## LEGEND

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

NO	ELEVATION	NORTHING	EASTING
WL16-01	340.3	4 823 669.7	240 284.5
WL16-02	341.2	4 823 686.7	240 305.0
WL16-03	340.1	4 823 658.6	240 294.3
WL16-04	340.9	4 823 676.2	240 302.2
WL16-05	340.6	4 823 638.1	240 342.8
WL16-06	340.3	4 823 651.4	240 354.8
WL16-07	340.3	4 823 610.7	240 330.5
WL16-08	340.4	4 823 638.7	240 352.2
08-236	341.4	4 823 685.8	240 320.6
08-237	339.5	4 823 653.1	240 355.3
08-238	341.0	4 823 655.5	240 290.2
08-239	339.9	4 823 617.3	240 315.4

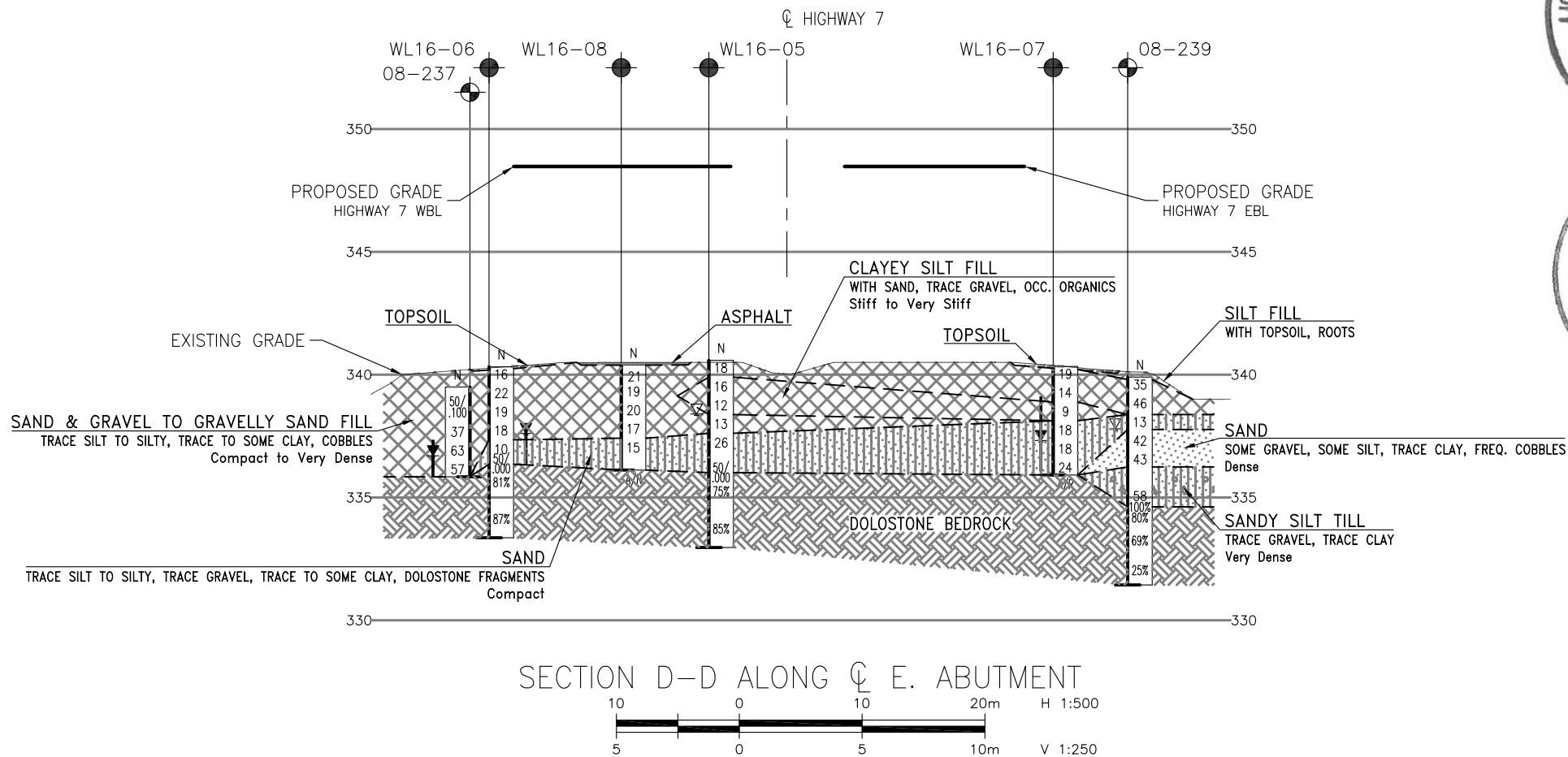
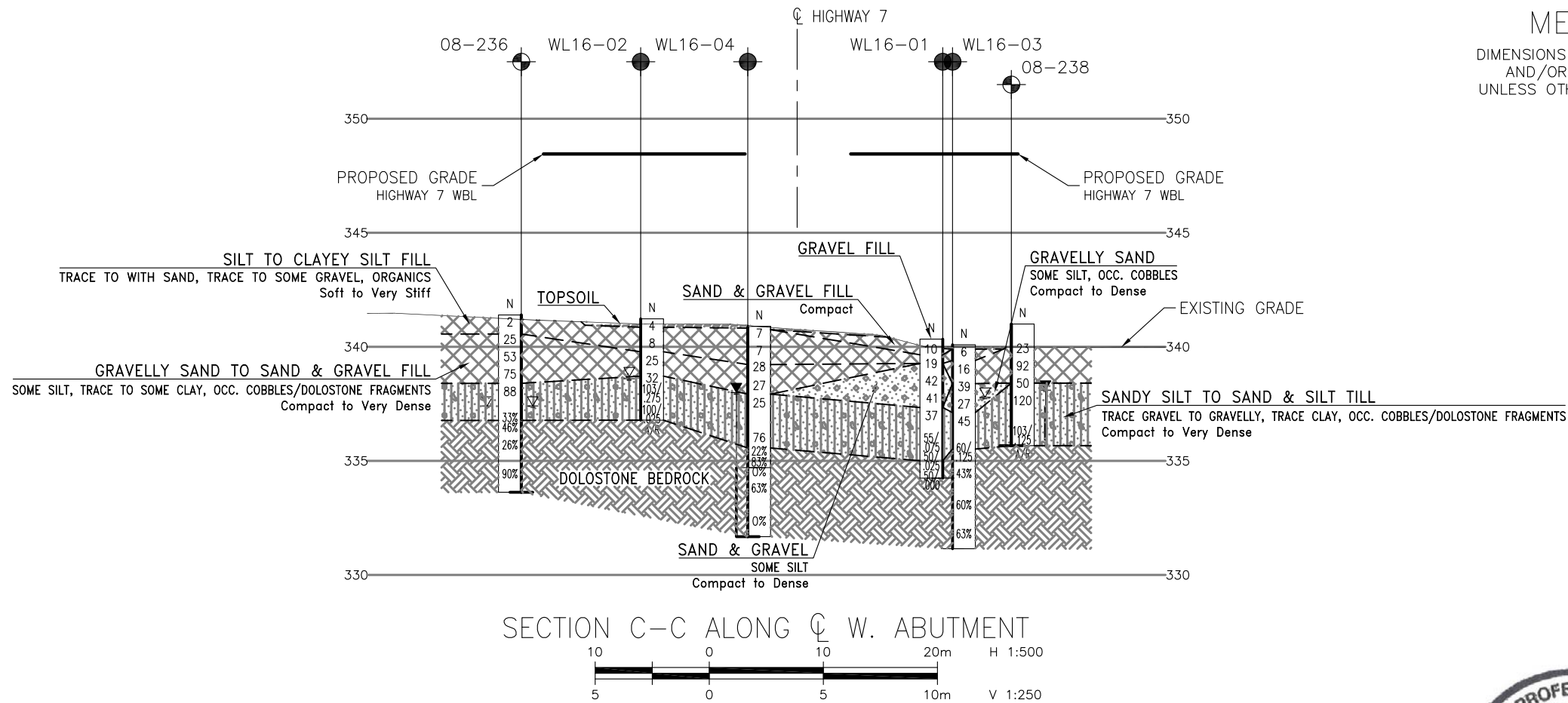
-NOTES-

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

GEOCRES No.

REVISIONS									
	DATE	BY	DESCRIPTION						
DESIGN	GL	CHK	PKC	CODE	LOAD	DATE JUN 2021			
DRAWN	MFA	CHK	GL	SITE 35-608/2	STRUCT	DWG 2			



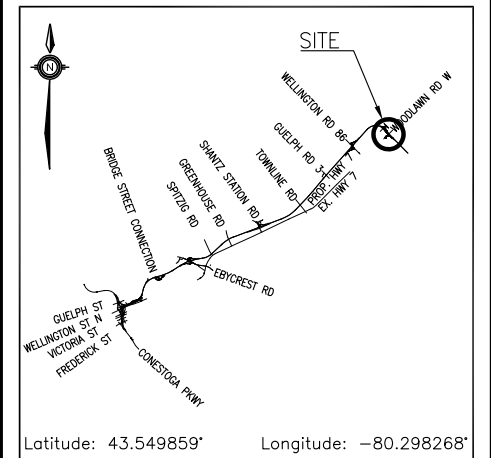


CONT No  
GWP No 408-88-00

HIGHWAY 7  
WOODLAWN ROAD  
PROPOSED EBL & WBL OVERPASSES  
BOREHOLE LOCATIONS AND SOIL STRATA



THURBER ENGINEERING LTD.



### KEYPLAN LEGEND

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

NO	ELEVATION	NORTHING	EASTING
WL16-01	340.3	4 823 669.7	240 284.5
WL16-02	341.2	4 823 686.7	240 305.0
WL16-03	340.1	4 823 658.6	240 294.3
WL16-04	340.9	4 823 676.2	240 302.2
WL16-05	340.6	4 823 638.1	240 342.8
WL16-06	340.3	4 823 651.4	240 354.8
WL16-07	340.3	4 823 610.7	240 330.5
WL16-08	340.4	4 823 638.7	240 352.2
08-236	341.4	4 823 685.8	240 320.6
08-237	339.5	4 823 653.1	240 355.3
08-238	341.0	4 823 655.5	240 290.2
08-239	339.9	4 823 617.3	240 315.4

### -NOTES-

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

GEOCRES No.

REVISIONS																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																														</
-----------	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	----