



THURBER ENGINEERING LTD.

**FOUNDATION INVESTIGATION AND DESIGN REPORT
HIGH FILL EMBANKMENTS
AT WOODLAWN ROAD INTERCHANGE
HIGHWAY 7-NEW, KITCHENER TO GUELPH
SITE 35-608/2
G.W.P. 3003-20-00**

GEOCRES No. 40P9-64

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Report

to

WSP

Date: August 10, 2021
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APPENDIX A HWY 7 NEW MAINLINE STA. 37+450 TO 37+600 (08-230, 08-231, 08-232, ML16 37+450, ML16 37+550)

APPENDIX B HWY 7 NEW MAINLINE STA. 37+700 TO 38+150 (08-233, 08-234, 08-235, 08-240, ML16 37+950, ML16 38+000, ML16 38+050, ML16 38+100, ML16 38+150)

APPENDIX C WOODLAWN E-S RAMP STA. 37+900 TO 38+100 (WL16 E-S01 TO WL16 E-S04)

APPENDIX D WOODLAWN E-S RAMP STA. 38+100 TO 38+300 (RW20-01 TO RW20-05)

Appendices A through D include:

- Record of Borehole Sheets
- Geotechnical and Analytical Laboratory Test Results
- Borehole Location and Soil Strata Drawings
- Slope Stability Analysis Results



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PART 1: FACTUAL INFORMATION

1 INTRODUCTION

This section of the report presents the factual findings obtained from a foundation investigation completed for proposed high fill embankments of 4.5 m or greater in height at Woodlawn Road interchange in the City of Guelph, Ontario. Thurber Engineering Limited (Thurber) carried out the current field investigation as a sub-consultant to WSP under Assignment No. 3014-E-0013.

The proposed Woodlawn Road interchange will include construction of a new Highway 7 mainline embankment, interim loop ramp, N-E/W ramp, W-S ramp, E-S ramp, S-E ramp, and E-N ramp. The interim loop ramp will be located north of Woodlawn Road and will be in place until the permanent Highway 7 is constructed. Overpass structures are proposed to carry the EBL and WBL of Highway 7-New over Woodlawn Road. A foundation investigation was carried out and a separate Foundation Investigation and Design Report was prepared for the proposed Woodlawn Road Overpass structures. A retaining wall was originally proposed to be constructed along the Woodlawn E-S ramp, however this retaining wall was eliminated after the alignment of the E-S ramp was changed.

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

Reference has been made to the following foundation reports that were prepared by Thurber during the preliminary design phase:

- Preliminary, Foundation Investigation and Design Report, High Fills and Deep Cuts, From East of Townline Road to Hanlon Expressway, Highway 7-New, Kitchener to Guelph, G.W.P. 3003-20-00, Geocres No. 40P9-48, Report to Ministry of Transportation Ontario Southwestern Region, File: 15-64-17, dated September 10, 2009. (Reference 1).



2 SITE DESCRIPTION

The site is located approximately 4.5 km northwest of the city centre of the City of Guelph in the vicinity of the intersection of Hanlon Parkway and Woodlawn Road. The existing Hanlon Parkway within the project limits is a four-lane divided highway with a grass median. At-grade intersections are present at Woodlawn Road, Guelph Junction Railway (GJR) North Spur, South Rail Spur, and Speedvale Avenue.

The existing highway corridor south of Woodlawn Road is surrounded primarily by commercial and industrial properties. A vacant lot is present to the north of the intersection of Hanlon Parkway 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 INVESTIGATIONS AND FIELD TESTING

The foundation investigation was completed in two phases. An initial investigation was completed at the site in May and June 2008, at which time seven (7) boreholes were drilled along the proposed Highway 7 mainline alignment (i.e. 08-230 to 08-235 and 08-240). Subsequently, in April 2021, an additional seven (7) boreholes (i.e. ML16 37+450, ML16 37+550, ML16 37+950, ML16 38+000, ML16 38+050, ML16 38+100, and ML16 38+150) were drilled along the proposed Highway 7 mainline alignment, and four (4) boreholes (i.e. WL16 E-S01 to WL16 E-S04) were drilled along the proposed Woodlawn E-S ramp. Five (5) boreholes (RW20-01 to RW20-05) were also completed for the retaining wall proposed along the Woodlawn E-S ramp which was ultimately removed from the scope of work. The fills along this section are up to about 5 m high.

Based on the profile drawings and cross-sections provided by WSP, there are three high fill sections proposed for the Woodlawn Road interchange, ranging in length from approximately 200 m to 450 m. Two of the high fill sections are located along the new Highway 7 mainline alignment, north and south of Woodlawn Road, while the third high fill section is located along the Woodlawn E-S Ramp.



A summary of the boreholes completed for the high fill sections is provided in Table 3.1 below. The approximate locations of the boreholes is shown on the Borehole Location and Soil Strata Drawings included in Appendices A through C. The Records of Boreholes sheets for the high fill sections are also included in Appendices A through C. The Record of Borehole sheets for the proposed Woodlawn E-S ramp retaining wall which was eliminated from the scope are included in Appendix D.

Table 3.1 – Summary of Boreholes

Location of Investigation	Approximate Chainage	Approximate Length (m)	Foundation Boreholes	
			2021 Investigation	2008 Investigation
Mainline North of Woodlawn Road	37+350 to 37+600	250	ML16 37+450 & ML16 37+550	08-230 to 08-232
Mainline South of Woodlawn Road	37+700 to 38+150	450	ML16 37+950, ML16 38+000, ML16 38+050, ML16 38+100, ML16 38+150	08-233, 08-234, 08-235 08-240
Woodlawn E-S Ramp	37+900 to 38+100	200	WL16 E-S01 to WL16 E-S04	None
Woodlawn E-S Ramp (*)	38+100 to 38+300	200	RW20-01 to RW20-05	None

(*) For the retaining wall proposed along the Woodlawn E-S ramp which was ultimately removed from the scope of work

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, a track-mounted B57 and a 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). All boreholes were advanced to auger/spoon refusal.

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 (ML16 37+450, ML16 38+000 and ML16 38+100). Each piezometer consisted of a 50 mm 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 Appendices A through C. The piezometer installations were decommissioned as per O.Reg. 903.

Table 3.2 – Borehole Completion Details

Fill Location	Borehole Number	Borehole Depth / Base Elevation (m)	Piezometer Tip Depth / Elevation (m)	Completion Details
North of Woodlawn Road (Sta. 37+350 to 37+600)	ML16 37+450	6.1 / 335.5	6.0 / 335.6	Cave in from 6.1 m to 5.9 m, Piezometer with 3.0 m slotted screen installed with sand filter from 5.9 m to 2.1 m, bentonite holeplug from 2.1 m to 0.1 m, sand to surface.
	ML16 37+550	5.3 / 336.3	None Installed	Backfilled with bentonite holeplug to 0.15 m, cuttings to surface.
South of Woodlawn Road (Sta. 37+700 to 38+150)	ML16 37+950	3.6 / 335.3	None Installed	Backfilled with bentonite holeplug to 0.6 m, sand to 0.3 m, asphalt to surface.
	ML16 38+000	3.8 / 334.7	3.7 / 334.8	Cave in from 3.8 m to 3.7 m, Piezometer with 1.5 m slotted screen installed with sand filter from 3.7 m to 1.8 m, bentonite holeplug from 1.8 m to 0.6 m, sand from 0.6 m to 0.3 m, concrete from 0.3 m to 0.1 m, sand to surface.
	ML16 38+050	3.7 / 334.6	None Installed	Backfilled with bentonite holeplug to 0.6 m, sand to 0.3 m, asphalt to surface.



Fill Location	Borehole Number	Borehole Depth / Base Elevation (m)	Piezometer Tip Depth / Elevation (m)	Completion Details
	ML16 38+100	4.1 / 334.1	4.0 / 334.2	Cave in from 4.1 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 0.3 m, sand from 0.3 m to 0.1 m, concrete to surface.
	ML16 38+150	4.0 / 334.1	None Installed	Backfilled with bentonite holeplug to 0.6 m, sand to 0.3 m, asphalt to surface.
Woodlawn E-S Ramp (Sta. 37+900 to 38+100)	WL16 E-S01	5.5 / 333.4	None Installed	Backfilled with bentonite holeplug to 0.6 m, then topsoil to surface.
	WL16 E-S02	5.2 / 334.0	None Installed	Backfilled with bentonite holeplug to 0.6 m, then topsoil to surface.
	WL16 E-S03	4.4 / 334.3	None Installed	Backfilled with bentonite holeplug to surface.
	WL16 E-S04	4.8 / 334.0	None Installed	Backfilled with bentonite holeplug to 0.6 m, then topsoil to surface.
Woodlawn E-S Ramp (Sta. 38+100 to 38+300)	RW20-01	6.3 / 332.2	6.3 / 332.2	Piezometer with 3 m slotted screen installed with sand filter from 6.3 m to 2.9 m, then bentonite holeplug to surface.
	RW20-02	7.0 / 330.8	None Installed	Backfilled with bentonite holeplug to 0.6 m, cement to 0.3 m, sand and gravel to surface.
	RW20-03	7.0 / 330.9	None Installed	Backfilled with bentonite holeplug to 0.3 m, sand and gravel to surface.
	RW20-04	7.2 / 331.0	4.1 / 334.0	Piezometer with 3 m slotted screen installed with sand filter from 4.1 m to 0.8 m, bentonite holeplug to 0.3 m, sand to 0.15 m, then cement to surface.
	RW20-05	8.5 / 329.8	None Installed	Backfilled with bentonite holeplug to 0.6 m, cement to 0.3 m, sand and gravel to surface.

4 LABORATORY TESTING

The recovered soil samples were subjected to visual identification and to natural moisture content determination. Selected samples were also subjected to gradation analysis (hydrometer and/or

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sieve). The results of these tests are summarized on the Record of Borehole sheets included in Appendices A through D. All laboratory test results from the field investigation are provided in Appendices A through D.

5 DESCRIPTION OF SUBSURFACE CONDITIONS

Details of the encountered soil stratigraphy are presented on the Record of Borehole sheets and the Borehole Location and Soil Strata drawings included in Appendices A through D. A general description of the stratigraphy, based on the conditions encountered in the boreholes, is given in the following paragraphs. However, the factual data presented on the Record of Borehole sheets takes precedence over this general description for interpretation of the site conditions. It must be recognized that the soil and groundwater conditions will vary between and beyond borehole locations.

5.1 Hwy 7 New Mainline Station 37+350 to 37+600 (BH 08-230, 08-231, 08-232, ML16 37+450, ML16 37+550)

5.1.1 Topsoil

Topsoil was encountered at the ground surface in all the boreholes advanced at this site. The thickness of the topsoil ranged from 75 mm to 300 mm. The topsoil thickness may vary between the boreholes and in other areas of the site. This limited topsoil thickness is not sufficient for estimating topsoil stripping quantity.

5.1.2 Clayey Silt

Brown clayey silt containing some organics was encountered below the topsoil in boreholes ML16 37+450 and ML16 37+550. The clayey silt was 0.6 m thick and the underside was encountered at depths of 0.7 m and 0.8 m below ground surface (Elev. 340.9).

SPT N-values in the organic silt ranged from 3 to 5 blows per 0.3 m indicating a soft to firm consistency. Moisture contents measured on samples of the clayey silt ranged from 20 to 35 percent.

5.1.3 Gravelly Sand to Sand and Gravel

Brown gravelly sand to sand and gravel, trace silt to silty, was encountered underlying topsoil or clayey silt in all of the boreholes with the exception of Borehole ML16 37+550. Occasional cobbles and dolostone fragments were noted within this deposit. The thickness of this deposit ranged from 1.8 m to 2.9 m and the lower boundary of the deposit was encountered at depths between 2.1 m and 3.2 m (Elev. 338.6 and 337.7).



SPT N-values in the gravelly sand to sand and gravel ranged from 18 to 54 blows per 0.3 m indicating a compact to very dense relative density.

Recorded moisture contents ranged from 6 percent to 18 percent. The results of gradation analyses completed on selected samples of the gravelly sand to sand and gravel are illustrated on Figure A2 of Appendix A. The results of the tests are summarized below and are presented on the corresponding Record of Borehole sheets in Appendix A.

Soil Particle	Percentage (%)
Gravel	22 to 33
Sand	34 to 49
Silt + Clay	28 to 33

5.1.4 Sand and Silt to Sandy Silt Till

Brown sand and silt to sandy silt till, trace to some clay, trace gravel, was encountered underlying the gravelly sand to sand and gravel in Boreholes ML16 37+450, and 08-230 to 08-232, and underlying the clayey silt in Borehole ML16 37+550. Occasional cobbles and dolostone fragments were noted in the till. All of the boreholes were terminated in this deposit upon auger refusal at depths ranging from 4.3 m to 6.7 m (Elev. 336.7 to 334.2).

SPT N-values in the sandy silt till ranged from 31 blows per 0.3 m penetration to 52 per 0.05 m penetration, indicating a dense to very dense relative density.

Recorded moisture contents ranged from 6 percent to 12 percent. The results of gradation analyses completed on selected samples of the sand and silt to sandy silt till are illustrated on Figures A1 and A3 of Appendix A. The results of the tests are summarized below and are presented on the corresponding Record of Borehole sheets in Appendix A.

Soil Particle	Percentage (%)
Gravel	1 to 10
Sand	24 to 43
Silt	42 to 55
Clay	6 to 16

Glacial tills inherently contain cobbles and boulders.



5.1.5 Groundwater Conditions

Piezometers were installed in select boreholes to monitor groundwater levels after completion of drilling. The measured groundwater levels are summarized in the table below. It is noted that borehole ML16 37+550 was dry upon completion of drilling. It is anticipated that this is due to groundwater drawdown during borehole drilling and is not believed to represent the actual water level condition. The inferred water level depth / elevation is provided in this regard.

Borehole	Date	Depth / Elevation (m) / (m)	Remark
08-230	February 19, 2009	1.4 / 339.5	Piezometer
08-231	August 8, 2008	2.6 / 338.1	Open Borehole
08-232	August 6, 2008	2.4 / 338.6	Open Borehole
ML16 37+450	April 16, 2021	1.0 / 340.6	Piezometer
ML16 37+550	April 7, 2021	Dry 3.8 / 337.8	Open Borehole Inferred

The above water levels are short term observations and the groundwater level at the time of construction may be different. Seasonal fluctuations of the groundwater level are to be expected. In particular, the groundwater level may be at a higher elevation after periods of significant and/or prolonged precipitation and spring snow melts.

5.2 Hwy 7 New Mainline Station 37+700 to 38+150 (BH 08-233, 08-234, 08-235, 08-240, ML16 37+950, ML16 38+000, ML16 38+050, ML16 38+100, ML16 38+150)

5.2.1 Topsoil

Topsoil was encountered at the ground surface in the boreholes advanced through the grass median (i.e. Boreholes 08-233, 08-234, 08-235 and 08-240). The thickness ranged from 150 mm to 300 mm. The topsoil thickness may vary between the boreholes and in other areas of the site. This limited topsoil thickness is not sufficient for estimating topsoil stripping quantity.

5.2.2 Asphalt

Asphalt with a thickness of 100 mm and 125 mm was encountered at ground surface in Boreholes ML16 37+950 and ML16 38+100, respectively.



5.2.3 Fill

Fill was encountered at ground surface or below asphalt or topsoil in all boreholes. The fill was comprised primarily of sand and gravel, with localized layers of gravel and sand, and a localized sandy silt fill layer in Borehole 08-234. Occasional cobbles were observed within the granular fill in Boreholes 08-233 and 08-235 and dolostone fragments were noted within the fill in Borehole ML16 38+150. The thickness of the fill ranged from 0.9 m to 3.6 m and the lower boundary of the fill was encountered at depths ranging from 1.2 m to 3.7 m (Elev. 337.2 to 334.4).

SPT N-values recorded in the sand and gravel/gravel/sand fill ranged from 13 blows per 300 mm to 70 blows per 0.3 m penetration indicating a compact to very dense relative density. The N-values recorded in the sandy silt fill ranged from 13 to 18 blows per 0.3 m penetration indicating a compact relative density.

Recorded moisture contents in the fill ranged from 3 percent to 18 percent. The results of gradation analyses completed on selected samples of the sand and gravel fill are illustrated on Figures B1 and B3 of Appendix B. The results of a gradation analysis conducted on a sample of the sandy silt fill are provided on Figure B4 of Appendix B. The results of the tests are summarized below and are presented on the corresponding Record of Borehole sheets in Appendix B.

Soil Particle	Sand and Gravel Fill	Sandy Silt Fill
	Percentage (%)	Percentage (%)
Gravel	33 to 43	0
Sand	42 to 51	58
Silt	-	33
Clay	-	9
Silt + Clay	9 to 17	-

5.2.4 Clayey Silt Till

Brown to grey clayey silt till was encountered below the fill in Boreholes 08-234 and 08-240. The clayey silt till had a thickness of 0.3 m and the lower boundary was at 1.5 m to 2.1 m (Elev. 336.7 to 336.6).

SPT N-values in the clayey silt till ranged from 18 to 22 blows per 0.3 m indicating a very stiff consistency.

Recorded moisture contents ranged from 12 percent to 15 percent.



5.2.5 Sandy Silt Till

Grey sandy silt till was encountered below fill and clayey silt till in Boreholes 08-233 and Borehole 08-240, respectively. The till contained trace some gravel and trace to some clay and occasional cobbles and dolostone fragments. These boreholes were terminated within this layer upon auger refusal at depths of 3.5 m to 4.7 m (Elev. 335.7 and 333.5).

SPT N-values in the sandy silt till ranged from 35 blows per 0.3m penetration to over 50 blows per 0.125 m penetration indicating a dense to very dense relative density.

Recorded moisture contents ranged from 8 percent to 15 percent. The results of gradation analyses completed on selected samples of the sandy silt till are illustrated on Figure B5 of Appendix B. The results of the tests are summarized below and are presented on the corresponding Record of Borehole sheets in Appendix B.

Soil Particle	Percentage (%)
Gravel	7 to 11
Sand	36 to 49
Silt	35 to 41
Clay	5 to 16

Glacial tills inherently contain cobbles and boulders.

5.2.6 Sand and Gravel

Brown sand and gravel, trace to some silt, trace to some clay, was encountered underlying the granular fill in Boreholes ML16 37+950 to ML16 38+150 and 08-234. These boreholes were terminated in the sand and gravel at depths ranging from 3.4 m to 4.1 m (Elev. 335.3 to 334.1).

SPT N-values in the sand and gravel ranged from 20 blows per 0.3 m penetration to 50 blows per 0.15 m indicating compact to very dense relative density.

Recorded moisture contents ranged from 5 percent to 15 percent. The results of gradation analyses completed on selected samples of the sand and gravel is illustrated on Figure B2 and B6 of Appendix B. The results of the tests are summarized below and are presented on the corresponding Record of Borehole sheets in Appendix B.



Soil Particle	Percentage (%)
Gravel	32 to 50
Sand	33 to 58
Silt + Clay	10 to 22

5.2.7 Groundwater Conditions

Piezometers were installed in Boreholes 08-234, 08-235, ML16 38+000 and ML16 38+100 to monitor groundwater levels after completion of drilling. The measured groundwater levels are summarized in the table below.

Borehole	Date	Depth / Elevation (m) / (m)	Remark
08-233	August 5, 2008	2.1 / 337.1	Open Borehole
08-234	August 20, 2008 February 9, 2009	1.6 / 337.1 2.0 / 336.7	Piezometer
08-235	August 20, 2008 February 9, 2009	1.5 / 336.6 2.3 / 335.8	Piezometer
08-240	August 5, 2008	3.0 / 335.2	Open Borehole
ML16 37+950	April 9, 2021	2.5 / 336.4	Open Borehole
ML16 38+000	April 16, 2021	2.3 / 336.3	Piezometer
ML16 38+050	April 9, 2021	2.4 / 335.9	Open Borehole
ML16 38+100	April 9, 2021	2.2 / 336.0	Piezometer
ML16 28+150	April 12, 2021	3.0 / 335.1	Open Borehole

The above water levels are short term observations and the groundwater level at the time of construction may be different. Seasonal fluctuations of the groundwater level are to be expected. In particular, the groundwater level may be at a higher elevation after periods of significant and/or prolonged precipitation and spring snow melts.

5.3 Woodlawn E-S Ramp Station 37+900 to 38+100 (BH WL16 E-S01 to WL16 E-S04)

5.3.1 Topsoil

Topsoil was encountered at the ground surface in all boreholes. The thickness of the topsoil ranged from 25 mm to 150 mm. The topsoil thickness may vary between the boreholes and in other areas of the site. This limited topsoil thickness is not sufficient for estimating topsoil stripping quantity.



5.3.2 Fill

Gravelly sand fill containing some silt, trace organics, trace asphalt fragments, was encountered below the topsoil in Boreholes WL16 E-S02 and WL16 E-S03. The thickness of the gravelly sand fill ranged from 1.2 m to 2.1 m and the lower boundary of the fill was encountered at depths of 1.4 m to of 2.2 m (Elevation 337.2 to 337.0).

Sandy silt to silt fill was encountered below the topsoil in Borehole WL16E-S04. This fill extended to a depth of 2.2 m below ground surface (Elev. 336.7).

SPT N-values recorded in the gravelly sand fill ranged from 26 to 54 blows per 0.3 m indicating a compact to very dense relative density. The N-values in the sandy silt to silt fill ranged from 6 to 25 blows per 0.3 m penetration indicating a loose to compact density.

Moisture contents measured on samples of the gravelly sand fill were generally between 5 and 8 percent. Moisture contents on the silt fill ranged from 6 to 13 percent.

The results of gradation analyses completed on selected samples of the gravelly sand fill are illustrated on Figure C1 of Appendix C. The results of the tests are summarized below and are presented on the corresponding Record of Borehole sheets in Appendix C.

Soil Particle	Percentage (%)
Gravel	21 to 35
Sand	50 to 62
Silt + Clay	15 to 17

5.3.3 Silty Sand

Brown silty sand containing trace gravel and clay was encountered below the topsoil in Borehole WL16 E-S01. The silty sand was 2.6 m thick and the lower boundary was encountered at a depth of 2.6 m (Elev. 336.3).

SPT N-values recorded in the silty sand ranged from 9 to 27 blows per 0.3 m penetration indicating a loose to compact relative density.

Recorded moisture contents ranged from 10 percent to 20 percent. The results of a gradation analysis completed on a sample of the silty sand is illustrated on Figure C2 of Appendix C. The



results of the test are summarized below and are presented on the corresponding Record of Borehole sheets in Appendix C.

Soil Particle	Percentage (%)
Gravel	6
Sand	67
Silt	21
Clay	6

5.3.4 Silt

Dark grey silt was encountered below the gravelly sand fill in Borehole WL16 E-S03. The silt layer had a thickness of 0.8 m and the underside of the silt was located at a depth of 2.2 m (Elevation 336.5).

An SPT N-value of 14 blows per 0.3 m penetration was recorded in the silt, indicating a stiff relative density.

A moisture content of 14 percent was measured on a sample of the silt.

5.3.5 Sandy Gravel to Gravelly Sand

A deposit of brown sandy gravel to gravelly sand was encountered below the silty sand in Borehole WL16 E-S01, below the silt in Borehole WL16 E-S03 and below the fill in Boreholes WL16 E-S02 and WL16 E-S04. All of the boreholes were terminated upon auger refusal in this deposit at depths ranging from 4.4 m to 5.5 m (Elevation 334.3 m to 333.4m).

SPT N-values in the sandy gravel to gravelly sand ranged from 22 blows per 0.3 m to 50 blows per 0.075 m penetration indicating a compact to very dense relative density (typically very dense).

Recorded moisture contents ranged from 6 to 15 percent. The results of a gradation analyses completed on selected samples of the sandy gravel to gravelly sand are illustrated on Figure C3 of Appendix C. The results of the tests are summarized below and are presented on the corresponding Record of Borehole sheets in Appendix C.



Soil Particle	Percentage (%)
Gravel	23 to 57
Sand	31 to 64
Silt + Clay	12 to 15

5.3.6 Groundwater Conditions

No piezometers were installed in the east-south ramp boreholes to monitor groundwater levels after completion of drilling. However, the groundwater levels were measured in the open boreholes upon completion and inferred from ground conditions. The measured and inferred groundwater levels are summarized below.

Borehole	Date	Depth / Elevation (m) / (m)	Remark
WL16 E-S01	April 13, 2021	Dry / - 0.8 / 338.1	Open Borehole Inferred
WL16 E-S02	April 13, 2021	Dry / - 2.3 / 336.9	Open Borehole Inferred
WL16 E-S03	April 15, 2021	Dry / - 1.5 / 337.2	Open Borehole Inferred
WL16 E-S04	April 15, 2021	Dry / - 1.5 / 337.4	Open Borehole Inferred

The above water levels are short term observations and the groundwater level at the time of construction may be different. Seasonal fluctuations of the groundwater level are to be expected. In particular, the groundwater level may be at a higher elevation after periods of significant and/or prolonged precipitation and spring snow melts.

5.4 Woodlawn E-S Ramp Sta. 38+100 to 38+300 (RW20-01 to RW20-05)

5.4.1 Topsoil

Topsoil was encountered at the ground surface in Borehole RW20-01. The thickness of the topsoil was 100 mm. The topsoil thickness may vary between the boreholes and in other areas of the site. This limited topsoil thickness is not sufficient for estimating topsoil stripping quantity.

5.4.2 Granular Fill

Grey to brown granular fill consisting of sandy gravel to gravelly sand, some silt and trace to some clay, was encountered at the ground surface in the boreholes advanced through the shoulder of Hanlon Parkway (i.e. RW20-02 to RW20-05).



The lower boundary of the fill was encountered at depths ranging from 1.4 m to 2.4 m (Elevation 336.4 m to 335.9 m).

SPT N-values recorded in the granular fill ranged from 14 blows per 0.3 m penetration to 50 blows per 0.150 m penetration, indicating a compact to very dense relative density.

The moisture content of samples of the granular fill generally ranged from 3 percent to 13 percent.

The results of gradation analyses completed on selected samples of the granular fill are illustrated on Figure D1 of Appendix D. The results of the tests are summarized below and are presented on the corresponding Record of Borehole sheets in Appendix D.

Soil Particle	Percentage (%)
Gravel	21 to 60
Sand	30 to 53
Silt + Clay	10 to 26

5.4.3 Silty Sand to Sand and Silt

Greyish brown to brown silty sand to sand and silt containing trace gravel and trace to some clay was encountered below the topsoil and granular fill in Boreholes RW20-01 and RW20-05, respectively. The thickness of this layer ranged from 1.7 m to 2.1 m and the lower boundary of this layer was encountered at depths between 2.2 and 4.1 m (Elevation 336.2 m to 334.2 m).

SPT N-values recorded in the silty sand ranged from 9 to 21 blows per 0.3 m penetration, indicating a loose to compact relative density.

The moisture content of samples of the silty sand generally ranged from 5 percent to 17 percent.

The results of gradation analyses completed on selected samples of the silty sand are illustrated on Figure D2 of Appendix D. The results of the tests are summarized below and are presented on the corresponding Record of Borehole sheets in Appendix D.



Soil Particle	Percentage (%)
Gravel	0 to 3
Sand	48 to 68
Silt	25 to 45
Clay	4 to 7

5.4.4 Gravelly Silty Sand Till

Brown gravelly silty sand till containing trace clay and occasional dolostone fragments was encountered underlying the silty sand to sand and silt layer in Boreholes RW20-01 and RW20-05, and below the granular fill in Boreholes RW20-02 to RW20-04.

The thickness of the till ranged from 1.0 to 2.6 m and the lower boundary of the till was encountered at depths ranging from 3.2 m to 5.5 m (Elevation 335.2 m to 332.8 m).

SPT N-values recorded in the gravelly silty sand till ranged from 14 blows per 0.3 m penetration to 50 blows per 0.075 m penetration, indicating a compact to very dense relative density. Recorded moisture contents on samples of the till generally ranged from 6 percent to 12 percent.

The results of a gradation analysis completed on a sample of the gravelly silty sand till are illustrated on Figure D3 of Appendix D. The results of the tests are summarized below and are presented on the corresponding Record of Borehole sheets in Appendix D.

Soil Particle	Percentage (%)
Gravel	25
Sand	50
Silt	22
Clay	3

Glacial tills inherently contain cobbles and boulders.

5.4.5 Bedrock

Dolostone bedrock was encountered underlying the overburden soils described above. The top of bedrock was encountered at depths ranging from 3.2 m to 5.5 m (Elevation 335.2 m to 332.8 m) and was proven by coring 3.0 m to 3.1 m into the rock.



Total Core Recovery (TCR) in all of the recovered bedrock cores were measured to be 100% with Solid Core Recovery (SCR) of between 32% and 100%. Rock Quality Designation (RQD) values measured on the recovered bedrock samples varied from 0% to 90%, indicating very poor to good rock quality.

The Fracture Index (FI) of the rock, expressed as fractures per 0.3 m of the core, ranged from 0 to more than 5.

Two unconfined compression tests and 30 point load tests were performed on the recovered rock cores. The unconfined compressive strength (UCS) of the dolostone rock cores measured from the unconfined compressive strength tests were approximately 44 MPa and 50 MPa, indicating medium strong rock.

The UCS values interpreted from the point load tests ranged from approximately 19 MPa to 179 MPa, indicating the rock is weak to very strong. The majority of the interpreted UCS values were between 30 MPa and 100 MPa (medium strong to strong).

5.4.6 Groundwater Conditions

Water levels were observed in the boreholes during and upon completion of drilling. Two standpipe piezometers were installed at this site in Boreholes RW20-01 and RW20-04 to monitor water levels after completion of drilling. The water levels measured in the piezometers are summarized below, along with the measurements in the open boreholes upon completion of drilling.

Borehole	Date	Depth / Elevation (m) / (m)	Remark
RW20-01	April 15, 2021	2.5 / 335.9	Open borehole
	April 16, 2021	1.8 / 336.6	Piezometer
RW20-02	April 13, 2021	1.9 / 335.9	Open borehole
RW20-03	April 8, 2021	2.1 / 335.8	Open borehole
RW20-04	April 13, 2021	2.2 / 335.9	Open Borehole
	April 16, 2021	2.3 / 335.8	Piezometer
RW20-05	April 14, 2021	2.2 / 336.1	Open borehole



The above values are short-term readings, and seasonal fluctuations of the groundwater level 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

Samples of the native and fill sand from Boreholes RW20-01, SS4 (depth of 2.3 m) and RW20-04, SS6 (depth of 1.5 m) 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 provided in Appendix D.

Table 6.1 – Analytical Test Results

Parameter	Units (Soil)	Test Results	
		RW20-01 SS4	RW20-04 SS3
		Native Gravelly Silty Sand Till	Granular Fill
Corrosivity Index	none	3	13
Soil Redox Potential	mV	198	163
Sulphide	%	< 0.04	< 0.04
Moisture Content	%	0.3	0.6
pH	pH Units	9.3	8.9
Chloride	µg/g	48	1400
Sulphate	µg/g	4.8	20
Conductivity	uS/cm	171	4080
Resistivity (calculated)	ohms.cm	5850	245

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., and Dr. P.K. Chatterji, a Designated Principal Contact for MTO Foundations projects, reviewed the report.

Thurber Engineering Ltd.

A handwritten signature in blue ink that reads 'Josh Alexander'.

Joshua Alexander, E.I.T.



Geoff Lay, P.Eng.
Geotechnical Engineer



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



P.K. Chatterji, P.Eng.
Review Principal, Designated MTO Contact



**FOUNDATION INVESTIGATION AND DESIGN REPORT
HIGH FILL EMBANKMENTS
AT WOODLAWN ROAD INTERCHANGE
HIGHWAY 7-NEW, KITCHENER TO GUELPH
SITE 35-608/2
G.W.P. 3003-20-00**

GEOCRES No. 40P9-64

PART 2: ENGINEERING DISCUSSION AND RECOMMENDATIONS

8 GENERAL

This section of the report provides an interpretation of the factual data from Part 1 of this report and presents foundation design recommendations to assist the project team in the design of the proposed high fill embankments at Woodlawn Road interchange in the City of Guelph, Ontario. The discussion and recommendations presented in this report are based on the information provided by WSP and on the factual data obtained during the course of the investigation. Thurber Engineering Limited (Thurber) carried out the current geotechnical investigation as a sub-consultant to WSP under Assignment No. 3014-E-0013.

This foundation investigation and design report with the interpretation and recommendations are intended for the use of the Ministry of Transportation and shall not be used or relied upon for any other purposes or by any other parties including the construction or design-build contractor. The construction or design-build contractor must make their own interpretation based on the factual data in Part 1 of the report. Where comments are made on construction, they are provided only in order to highlight those aspects which could affect the design of the project. Contractors must make their own interpretation of the factual information provided as it may affect equipment selection, proposed construction methods and scheduling.

The proposed Woodlawn Road interchange will include construction of a new Highway 7 mainline embankment, interim loop ramp, N-E/W ramp, W-S ramp, E-S ramp, S-E ramp, and E-N ramp. The interim loop ramp will be located north of Woodlawn Road and will be in place until the permanent Highway 7 is constructed. Overpass structures are proposed to carry the EBL and WBL of Highway 7-New over Woodlawn Road. Foundation recommendations for the overpass structures are provided in a separate report. A retaining wall was originally proposed to be constructed along the Woodlawn E-S ramp, however this retaining wall was removed from the scope of work.



Fill sections with maximum fill height in excess of 4.5 m are summarized in Table 8.1 below. Based on the profile drawings and cross-sections provided by WSP, there are no deep cut sections proposed for the Woodlawn Road interchange.

Table 8.1 – Summary of High Fill Sections

Location	Approximate Chainage	Approx. Length (m)	Approx. Max Fill Height (m)	Anticipated Foundation Soils
Mainline North of Woodlawn Road	37+350 to 37+600	250	8.5	Compact to Very Dense Gravelly Sand to Sand and Gravel
Mainline South of Woodlawn Road	37+700 to 38+150	450	8.5	Compact to Very Dense Sand and Gravel Fill
Woodlawn E-S Ramp	37+900 to 38+100	200	6.5	Compact to Very Dense Gravelly Sand Fill / Silt Fill / Silty Sand

The foundation stability and settlements, their impact on the construction schedule and long-term performance of the proposed embankments have been analyzed for the high fill sections, i.e. fill height greater than 4.5 m, and are addressed in the following sections of the report.

It is noted that foundation recommendations for the Woodlawn Road Overpass structures are provided in a separate report.

8.1 Applicable Codes and Design Considerations

The geotechnical assessment presented below has been prepared based on the available data regarding the proposed high fill embankments and existing ground conditions and in accordance with the Canadian Highway Bridge Design Code (CHBDC), version CSA S6-19.

As per Section 6.5.1 of the CHBDC (2019), the degree of site prediction model understanding is considered to be Typical based on the current information.

9 ENGINEERING AND ANALYSIS METHODOLOGY

9.1 General

The subsurface conditions were investigated to assess the stability of the proposed high fill embankments, potential settlement issues under the embankments, and anticipated construction concerns. Analyses were carried out for critical sections based on embankment height and



existing subsurface conditions which were selected for critical and unfavourable foundation soil conditions.

Geotechnical factors governing design of high fill embankments include the following:

- Thickness, extent and engineering properties of the foundation soils, with consideration to the extent and thickness of peat, topsoil, organic deposits, compressible and/or excessively soft/loose soils
- Depth of bedrock or refusal materials
- Embankment material type (i.e. SSM, granular fill, or earth fill)
- Embankment geometry including height, side slope angle and requirements for stabilizing berms
- Construction and post-construction settlement of embankments
- Construction procedures

For the purpose of preparing geotechnical design recommendations, a number of assumptions have been made that are consistent with MTO's standard highway design practices:

- Peat, topsoil, organic deposits and other deleterious materials will be stripped from the subgrade prior to constructing embankments (OPSS.PROV 206)
- Where new fill is placed against an existing embankment slope or on a sloping ground surface steeper than 3H:1V, the existing slope will be benched (OPSD 208.010)
- The embankments will be constructed using earth fill or granular fill, such as OPSS Select Subgrade Material (SSM), OPSS Granular B Type I or Type II
- Embankments will be constructed with side slopes not steeper than 2H:1V
- Earth fill embankments at or greater than 8 m in height will be provided with a 2 m wide mid-height berm

9.2 Global Stability

Stability analyses were carried out to assess the global stability of the high fills at the critical embankment sections along the proposed mainline and ramp alignments. The assessed embankment height ranged from about 7 m to 8.5 m. The stability analyses were carried out utilizing the commercially available slope stability program Slope/W (Version 10) of the GeoStudio software package developed by GEOSLOPE International Ltd using Morgenstern Price method of slices.



For the purposes of analysis, it was assumed that the embankments would be constructed with either SSM, Granular B Type I or Type II, or Earth Fill. It was also assumed that the embankments would be constructed with side slopes inclined to 2H:1V. It is noted that there is a small section along the east side of the mainline embankment south of Woodlawn Road between approximately Station 37+900 and 37+950 where slopes steeper than 2H:1V are required not to encroach on a small stream (Marden Drain).

In light of the predominantly cohesionless soils present at the site, a Factor of Safety (F.S.) of 1.3 is considered appropriate for embankments for the long-term (drained) condition. A F.S. of 1.0 is considered appropriate for the seismic loading condition.

The analyses under seismic loading were performed using a pseudo- static slope stability analysis. Horizontal seismic coefficient, k_h of 0.0395 g (one-half of the corresponding site peak ground acceleration in accordance with Section 6.14.9.1 of CHBDC (2019), for a site Class C) was taken for the seismic stability analysis.

The results of the stability analyses are presented on the stability figures included in Appendices A through C. The computed F.S. are summarized in Table 9.1 below.

Table 9.1 – Computed Factors of Safety

Location	Approximate Chainage	Slope Inclination	Condition	Factor of Safety	Figure
Mainline North of Woodlawn Road	37+600	2H:1V	Long Term (Drained)	1.5	A4
		2H:1V	Pseudo Static	1.4	A5
Mainline South of Woodlawn Road	37+925	1.75H:1V	Long Term (Drained)	1.1	B7
		1.75H:1V	Pseudo Static	1.0	B8
		RSS 1H:1V	Long Term (Drained)	1.5	B9
		RSS 1H:1V	Pseudo Static	1.4	B10
		RSS Wall	Long Term (Drained)	1.7	B11
		RSS Wall	Pseudo Static	1.6	B12
Woodlawn E-S Ramp	38+000	2H:1V	Long Term (Drained)	1.3	C4
		2H:1V	Long Term (Drained)	1.5	C5
		2H:1V	Pseudo Static	1.3	C6

The above table indicates that for embankments constructed with SSM, Granular B Type I or Type II, or Earth Fill to a 2H:1V slope inclination, the F.S. are in excess of 1.3 for the long term (drained) and 1.0 for the seismic conditions (i.e. Figures A4, A5, C4 to C6). For the steep embankment



section close to Marden Drain (Station 37+900 and 37+950), a F.S. of 1.1 was computed for an embankment constructed to 1.75H:1V for the long term (drained) condition, which is less than the minimum F.S. of 1.3 adopted for this site. Therefore, a retaining wall or reinforced earth slope should be considered within this section.

For planning purposes, preliminary stability analyses were conducted for potential RSS wall and reinforced earth slope configurations. The results are presented in Figures B9 to B12 in Appendix B. The analysis results indicate that a reinforced earth slope constructed to a 1H:1V inclination with minimum reinforcing strip length of 1.0 times wall height would achieve F.S. greater than 1.5 and 1.0 for the long-term and seismic conditions, respectively (Figures B9 and B10). Alternatively, consideration could be given to using an RSS wall within this section. For an RSS wall up to 7 m high with a minimum reinforcing strip length of 0.7 times the wall height, F.S. of 1.7 and 1.6 were computed for the long-term and seismic conditions, respectively (Figure B11 and B12). If an RSS wall located within the floodplain of the Marden Drain is not acceptable, consideration could be given to using a concrete cantilevered wall.

The design, construction and performance of the RSS wall and reinforced earth slope are ultimately the responsibilities of the Contractor.. The proprietary product should be an approved product in the MTO DSM list. If a RSS or retaining wall is used, a stability and settlement analysis should be carried out by the Contractor's Engineer to confirm that the wall satisfies the minimum factors of safety against instability and that any settlements are within tolerable limits. The wall must be checked for the various modes of failure including sliding and overturning. The Contractor must also design the wall for highest water level in the Marden Drain and establish a minimum retaining wall setback distance from the creek that is acceptable to the regulatory authorities. RSS wall design should be in accordance with Section 6.19 of the CHBDC (2019) and MTO RSS SP 599S22

Lastly, it is noted that no boreholes have been completed for the retaining wall within this section. It is recommended that additional borehole investigation be completed in this area to support detailed design of retaining wall or earth slope, whichever is selected.

9.3 Settlement

In accordance with MTO's Embankment Settlement Criteria for Design (July 2, 2010), the maximum permissible post-construction total settlement for new embankments is 100 mm or less within 20 years following paving.



Based on the soil conditions at this site, foundation settlements under the proposed 4.5 m to 8.5 m high fill embankments are estimated to be in the order of 30 to 60 mm and are expected to be essentially complete at the end of fill placement.

Self compression of the compacted fill is estimated to be approximately 0.5% of the fill height (i.e. 22 mm to 43 mm). Post-construction settlement due to fill compression has been estimated at 0.25% of the embankment height (i.e. 11 mm to 22 mm).

There is an existing culvert located approximately 250 m south of Woodlawn Road which crosses Hanlon Parkway just north of GJR North Spur. Placement of new fill has the potential to cause settlement of existing buried culverts. An assessment of the impact of fill placement on any existing culverts must be carried out by the DBR Contractor's Engineer.

9.4 Seismic Considerations

In accordance with the CHBDC (2019), the selection of the seismic site classification is based on the averaged soil conditions encountered in the upper 30 m of the stratigraphy. In general, the site is primarily underlain by layers of compact to very dense sand and gravel and dense to very dense sand/silt till. The overburden soils are underlain by dolostone bedrock.

This would correspond to a Seismic Site Class C in accordance with Table 4.1, Clause 4.4.3.2 of the CHBDC (2019). The peak ground acceleration, PGA, for a 2% in 50-year probability of exceedance at this site is 0.079 g as per the National Building Code of Canada (NBCC).

10 DESIGN AND CONSTRUCTION CONSIDERATIONS

10.1 Fill Embankment

Prior to fill placement, the subgrade must be adequately prepared to receive the new fill. All vegetation, topsoil, organics, soft/loosened or wet soils should be sub-excavated. All subgrade surfaces should be inspected and any soft spots sub-excavated and replaced with suitable compacted granular materials prior to placing the new embankment fill. The subgrade preparation and placement and compaction of the earth fill must be carried out in the dry.

Embankment construction should be carried out in accordance with OPSS.PROV 206 and OPSS.PROV 501 requirements. New fill shall consist of OPSS Select Subgrade Material (SSM), OPSS Granular B Type I or Type II, or clean earth fill (i.e., unfrozen soils free of organics, deleterious materials and debris). Intermediate to high plastic clay soils must not be used for



embankment construction. The water content of the earth fill must be +/- 2 percent of its optimum water content so that it is properly compactible.

To prevent surface runoff from eroding and gulying the embankment side slopes, consideration should be given to installing an asphalt barrier curb in accordance with OPSD 601.010.

It is recommended that all exposed slope surfaces be vegetated and seeded in accordance with current MTO practice with reference to OPSS.PROV 804. Surface runoff and precipitation must be prevented from flowing perpendicularly down any slope surface. Erosion protection measures must be provided for all of the slopes.

Where newly placed embankment fill is placed against existing embankment slopes or on a sloping ground surface steeper than 3H:1V, benching of the existing slope should be carried out in accordance with OPSD 208.010. To reduce erosion of the embankment side slopes due to surface water runoff, erosion protection should be provided in accordance with OPSS 804.

Mid-height berms comprising 2 m wide benches should be incorporated along the length of embankments with heights at or exceeding 8 m in height.

11 CONSTRUCTION CONCERNS

Potential construction concerns include, but are not necessarily limited to:

- No boreholes have been completed for the retaining wall or reinforced earth slope which is expected to be required along the east side of the mainline embankment south of Woodlawn Road between approximately Station 37+900 and 37+950 adjacent to the existing Marden Drain. It is recommended that additional borehole investigation be completed in this area to support detailed design of retaining wall or earth slope, whichever is selected.
- Placement of new fill has the potential to cause settlement of existing buried culverts. An assessment of the impact of fill placement of the existing culverts must be carried out by the DBR Contractor's Engineer.
- All topsoil, peat or other deleterious materials must be stripped from the footprint of the proposed embankments.

The successful performance of the project will depend largely upon good workmanship and quality control during construction. Subgrade examination and field density testing should be carried out by qualified geotechnical personnel during construction in accordance with SP109S12 to confirm that foundation recommendations are correctly implemented, and material specifications are met.



12 CLOSURE

Engineering analysis and preparation of this report were carried out by Mr. Geoff Lay, P.Eng.. The report was reviewed by Mr. Jason Lee, P.Eng., and Dr. P.K. Chatterji, P.Eng., the Designated Principal Contact for MTO Foundation Projects.

Thurber Engineering Ltd.
Report Prepared By:



Geoff Lay, P.Eng.
Geotechnical Engineer



Jason Lee, P.Eng.
Principal
Senior Geotechnical Engineer

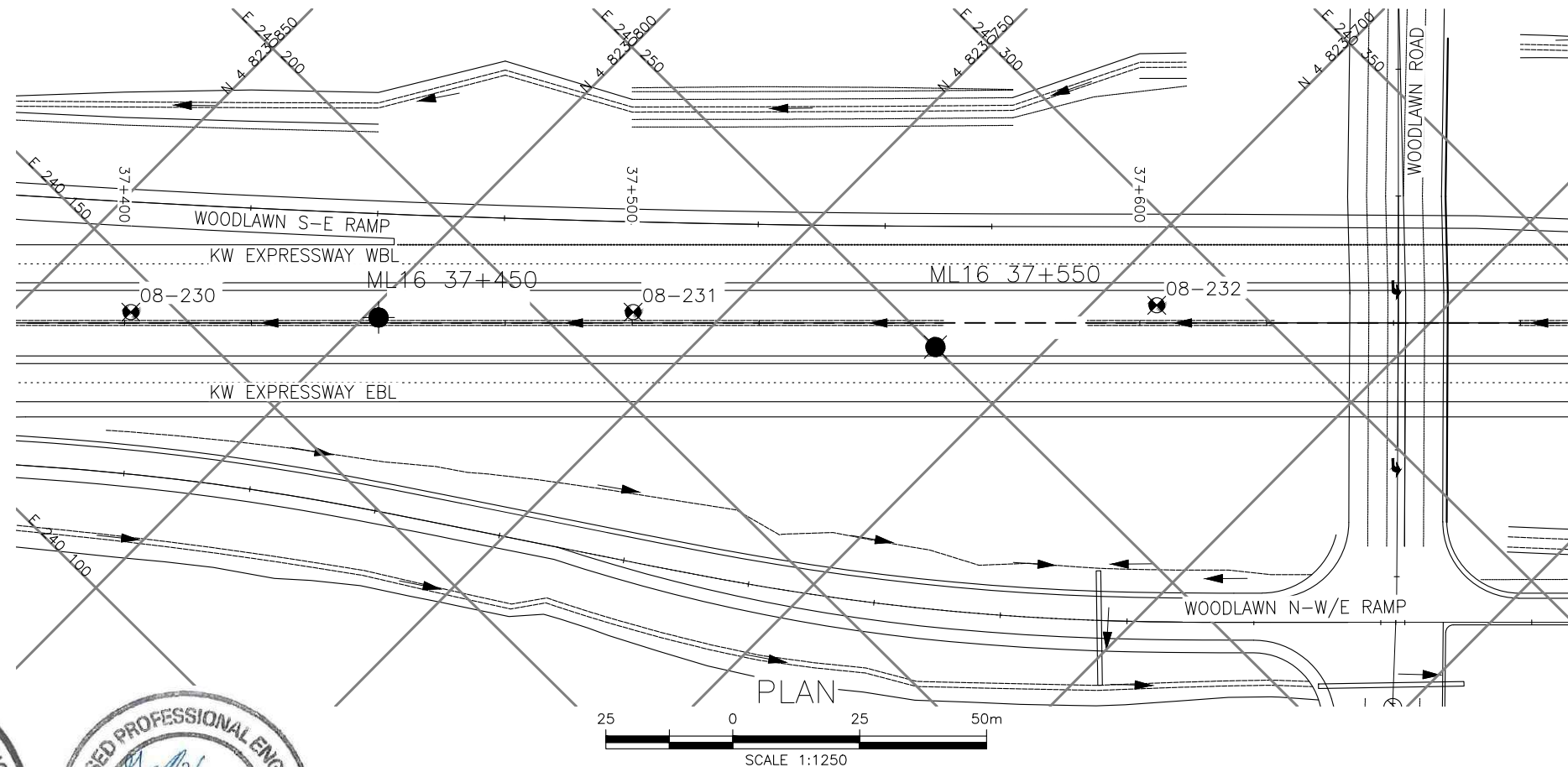


P.K. Chatterji, P.Eng., Ph.D.
Review Principal
Senior Geotechnical Engineer



Appendix A

**Hwy 7 New Mainline Sta. 37+450 to 37+600 (08-230, 08-231, 08-232, ML16 37+450,
ML16 37+550)**

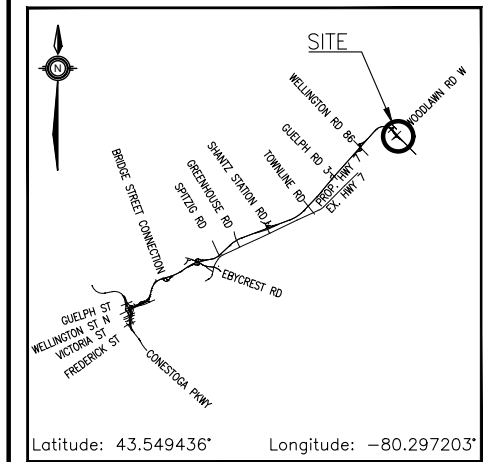


METRIC
DIMENSIONS ARE IN METRES
AND/OR MILLIMETRES
UNLESS OTHERWISE SHOWN

CONT No
GWP No 3003-20-00



HIGHWAY 7
MAINLINE
AT WOODLAWN ROAD I/C
BOREHOLE LOCATIONS AND SOIL STRATA



KEYPLAN

LEGEND

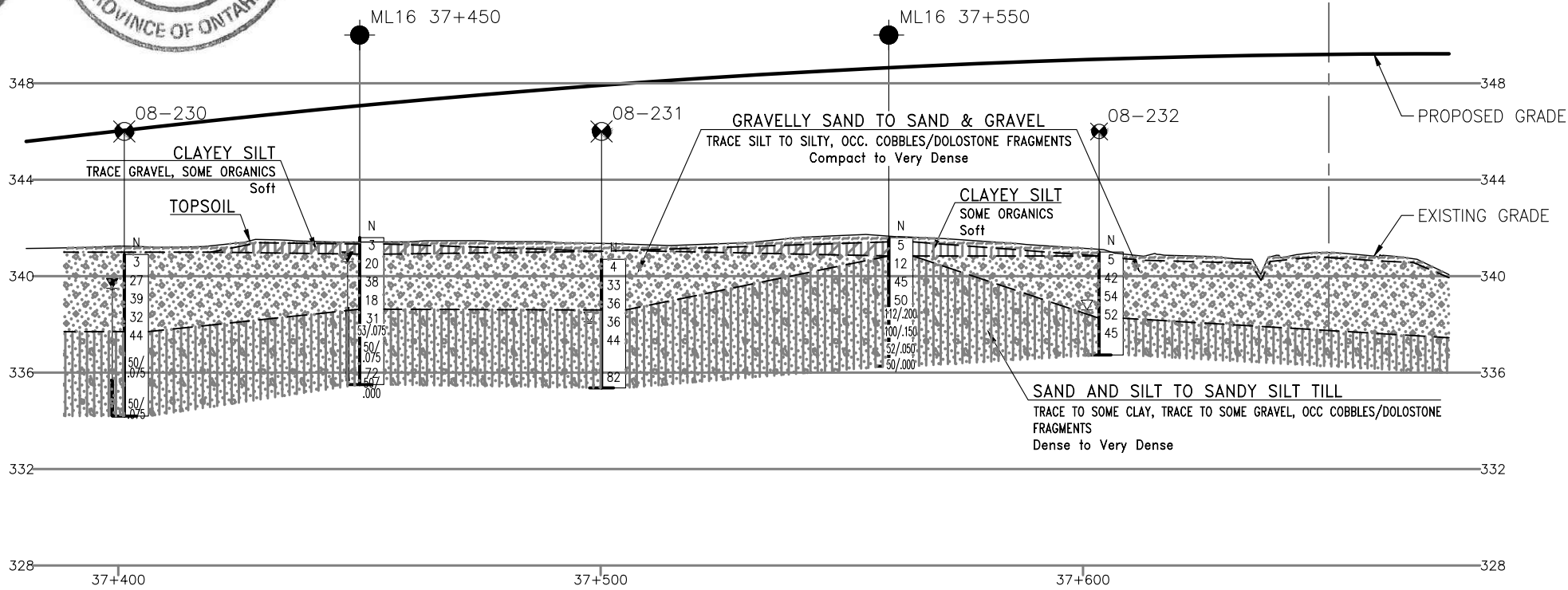
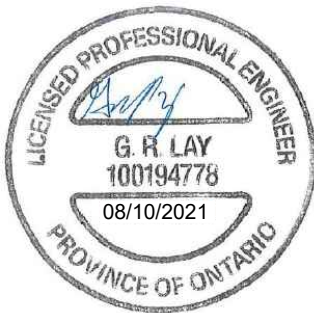
- Borehole (Current Investigation)
- Borehole (Previous Investigation)
- N Blows /0.3m (Std Pen Test, 475J/blow)
- CONE Blows /0.3m (60° Cone, 475J/blow)
- PH Pressure, Hydraulic
- Water Level
- Head Artesian Water
- Piezometer
- 90% Rock Quality Designation (RQD)
- A/R Auger Refusal

NO	ELEVATION	NORTHING	EASTING
ML16 37+450	341.6	4 823 797.9	240 177.0
ML16 37+550	341.6	4 823 715.9	240 250.1
08-230	340.9	4 823 833.3	240 143.4
08-231	340.7	4 823 763.0	240 213.1
08-232	341.0	4 823 690.7	240 286.6

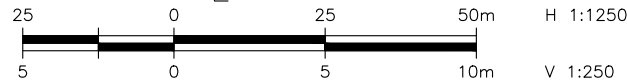
-NOTES-

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

GEOCRES No. 40P9-64



PROFILE ALONG HIGHWAY 7 MEDIAN





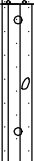
REVISIONS	DATE	BY	DESCRIPTION
DESIGN	JA	CHK	PKC
DRAWN	MFA	CHK	JA
LOAD	DATE	JUN	2021
STRUCT	DWG	1	

RECORD OF BOREHOLE No ML16 37+450

1 OF 1

METRIC

GWP# 408-88-00 LOCATION , MTM NAD 83 Zone 10: N 4 823 797.9 E 240 177.0 ORIGINATED BY MC
DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY BH
DATUM Geodetic DATE 2021.04.07 - 2021.04.07 LATITUDE 43.551311 LONGITUDE -80.299787 CHECKED BY JA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL						
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa												
341.6	GROUND SURFACE							20	40	60	80	100								
0.0 0.1	TOPSOIL: (75mm)		1	SS	3		341													
340.9	Clayey SILT, trace gravel, some organics																			
0.7	Soft Brown Moist		2	SS	20		340													
	Gravelly SAND, trace silt																			
	Compact to Very Dense																			
	Brown Moist to Wet		3	SS	38															
			4	SS	18		339													
338.6																				
3.0	SAND and SILT to Sandy SILT, trace to some clay, trace gravel, occasional dolostone fragments		5	SS	31		338										8	43	43	6
	Dense to Very Dense																			
	Brown Wet (TILL)		6	SS	53/ 0.075															
			7	SS	50/ 0.075		337													
			8	SS	72		336										5	24	55	16
335.5			9	SS	50/ 0.00															
6.1	END OF BOREHOLE AT 6.1m UPON AUGER REFUSAL. Monitoring Well installation consists of 19mm diameter Schedule 40 PVC pipe with a 3.05m slotted screen. WATER LEVEL READINGS DATE DEPTH(m) ELEV.(m) 2021.04.16 1.0 340.6																			




ONTMT4S2 MTO-11375(GINTDATA)\GPJ 2017TEMPLATE(MTO)_GDT 6/29/21

RECORD OF BOREHOLE No ML16 37+550

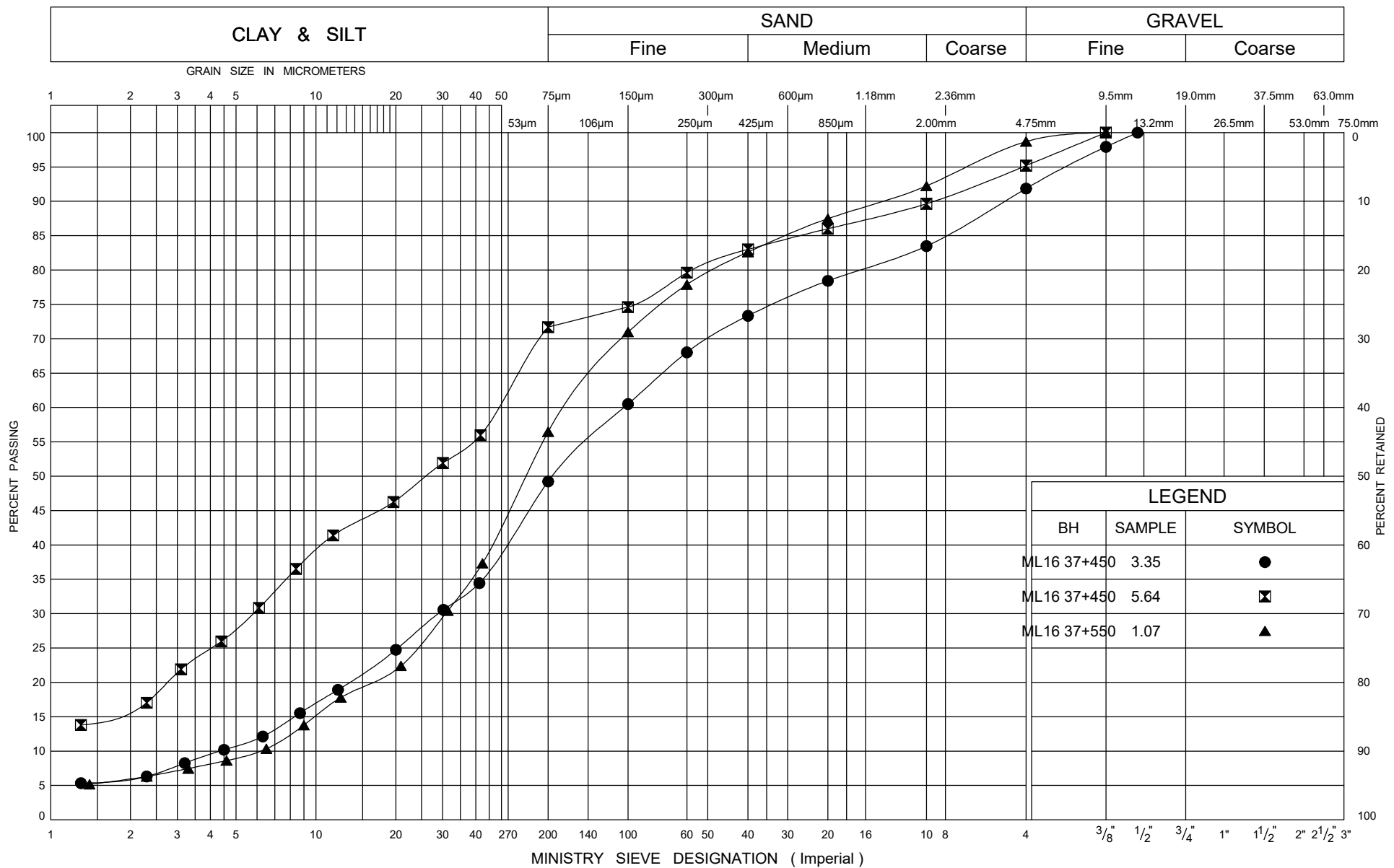
1 OF 1

METRIC

GWP# 408-88-00 LOCATION , MTM NAD 83 Zone 10: N 4 823 715.9 E 240 250.1 ORIGINATED BY MC
DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY BH
DATUM Geodetic DATE 2021.04.07 - 2021.04.07 LATITUDE 43.550579 LONGITUDE -80.298873 CHECKED BY JA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
341.6	GROUND SURFACE													
0.0	TOPSOIL: (175mm)													
0.2	Clayey SILT , some organics Soft Brown Moist		1	SS	5									
340.9														
0.8	SAND and SILT to Sandy SILT , trace to some clay, trace gravel, occasional dolostone fragments Very Dense Brown Moist to Wet (TILL)		2	SS	12									
			3	SS	45									
			4	SS	50									
			5	SS	112/ 0.200									
			6	SS	100/ 0.150									
			7	SS	52/ 0.050									
336.3			8	SS	50/ 0.00									
5.3	END OF BOREHOLE AT 5.3m UPON AUGER REFUSAL. BOREHOLE BACKFILLED WITH HOLEPLUG TO 0.15m, THEN TOPSOIL TO SURFACE.													

ONTMT4S2 MTO-11375(GINTDATA)\GPJ 2017TEMPLATE(MTO)_GDT 6/29/21



RECORD OF BOREHOLE No 08-230

1 OF 1

METRIC

GWP# 408-88-00 LOCATION N 4 823 833.32 E 240 143.44 N 4 823 833.3 E 240 143.4 ORIGINATED BY SA
DIST HWY 77 - New BOREHOLE TYPE Solid Stem Augers COMPILED BY LG
DATUM Geodetic DATE 2008.08.06 - 2008.08.06 LATITUDE LONGITUDE 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 γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa		WATER CONTENT (%)				
340.9	GROUND SURFACE							20 40 60 80 100	○ UNCONFINED + FIELD VANE	W P W W L				
0.0	TOPSOIL, occasional roots: (300mm)							20 40 60 80 100	● QUICK TRIAXIAL × LAB VANE					
340.6			1	SS	3		340							
0.3	Gravelly SAND, silty Compact to Dense Brown Moist to Wet													
	Occasional cobbles		2	SS	27									
			3	SS	39		339							
			4	SS	32		338							
337.7														
3.2	Sandy SILT, trace to some clay, trace gravel, occasional cobbles Dense to Very Dense Brown Moist (TILL)		5	SS	44		337							
			6	SS	50/ 0.075		336							
							335							
334.2			7	SS	50/ 0.075									
6.7	END OF BOREHOLE AT 6.7m UPON AUGER REFUSAL. BOREHOLE BACKFILLED WITH BENTONITE GROUT TO 0.6m AND AUGER CUTTINGS AND HOLEPLUG TO SURFACE. Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen. WATER LEVEL READINGS: ELEV. (m) DATE DEPTH (m) 2009.02.19 1.4 339.5													

ONTMT4S2 MTO-11375(GINTDATA)\GPJ_2017\TEMPLATE(MTO).GDT 6/29/21

RECORD OF BOREHOLE No 08-231

1 OF 1

METRIC

GWP# 408-88-00 LOCATION N 4 823 763.02 E 240 213.07 N 4 823 763.0 E 240 213.1 ORIGINATED BY SA
DIST HWY 77 - New BOREHOLE TYPE Solid Stem Augers COMPILED BY LG
DATUM Geodetic DATE 2008.08.06 - 2008.08.06 LATITUDE LONGITUDE CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100		
340.7	GROUND SURFACE													
0.0	TOPSOIL, occasional roots: (300mm)													
340.4			1	SS	4									
0.3	SAND and GRAVEL, silty, occasional cobbles Dense Brown Moist													
			2	SS	33									
			3	SS	36									
338.6														
2.1	Sandy SILT, trace to some clay, some gravel, occasional cobbles Dense to Very Dense Brown Moist to Wet (TILL) Occasional dolostone fragments													
			4	SS	36									
			5	SS	44									
			6	SS	82									
335.4	Auger grinding at 5.2m.													
5.3	END OF BOREHOLE AT 5.3m UPON AUGER REFUSAL. WATER LEVEL OBSERVED AT 2.6m DURING DRILLING. BOREHOLE BACKFILLED WITH HOLEPLUG AND AUGER CUTTINGS MIXED TO SURFACE.													

ONTMT4S2 MTO-11375(GINTDATA)\GPJ 2017\TEMPLATE(MTO)\GDT 6/29/21

RECORD OF BOREHOLE No 08-232

1 OF 1

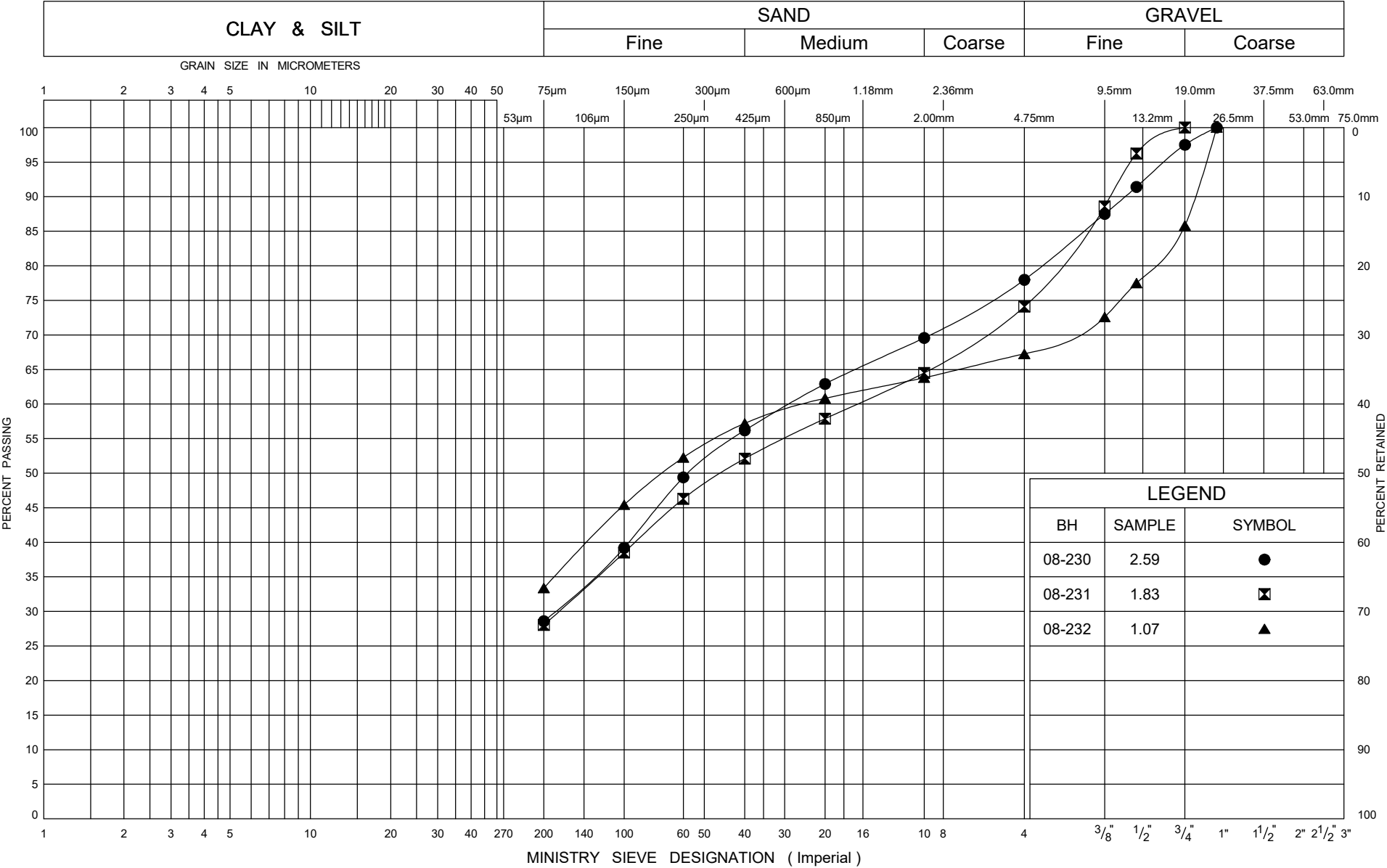
METRIC

GWP# 408-88-00 LOCATION N 4 823 690.69 E 240 286.62 N 4 823 690.7 E 240 286.6 ORIGINATED BY SA
DIST HWY 77 - New BOREHOLE TYPE Solid Stem Augers COMPILED BY LG
DATUM Geodetic DATE 2008.08.06 - 2008.08.06 LATITUDE LONGITUDE CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100		
341.0	GROUND SURFACE													
0.0	TOPSOIL, occasional roots													
340.7	Dark Brown		1	SS	5									
0.3	(300mm)													
	SAND and GRAVEL, silty, occasional dolostone fragments													
	Dense to Very Dense		2	SS	42		340							33 34 33
	Brown													(SI+CL)
	Moist													
			3	SS	54		339							
338.3			4	SS	52									
2.7	Sandy SILT, trace to some clay, trace gravel, occasional cobbles, dolostone fragments						338							
	Dense		5	SS	45									7 43 44 6
	Brown													
	Wet													
	(TILL)													
336.7	Auger grinding at 4.2m						337							
4.3	END OF BOREHOLE AT 4.3m UPON AUGER REFUSAL.													
	WATER LEVEL OBSERVED AT 2.4m DURING DRILLING.													
	BOREHOLE BACKFILLED WITH HOLEPLUG AND AUGER CUTTINGS MIXED TO SURFACE.													

ONTMT4S2 MTO-11375(GINTDATA)\GPJ 2017TEMPLATE(MTO)_GDT 6/29/21

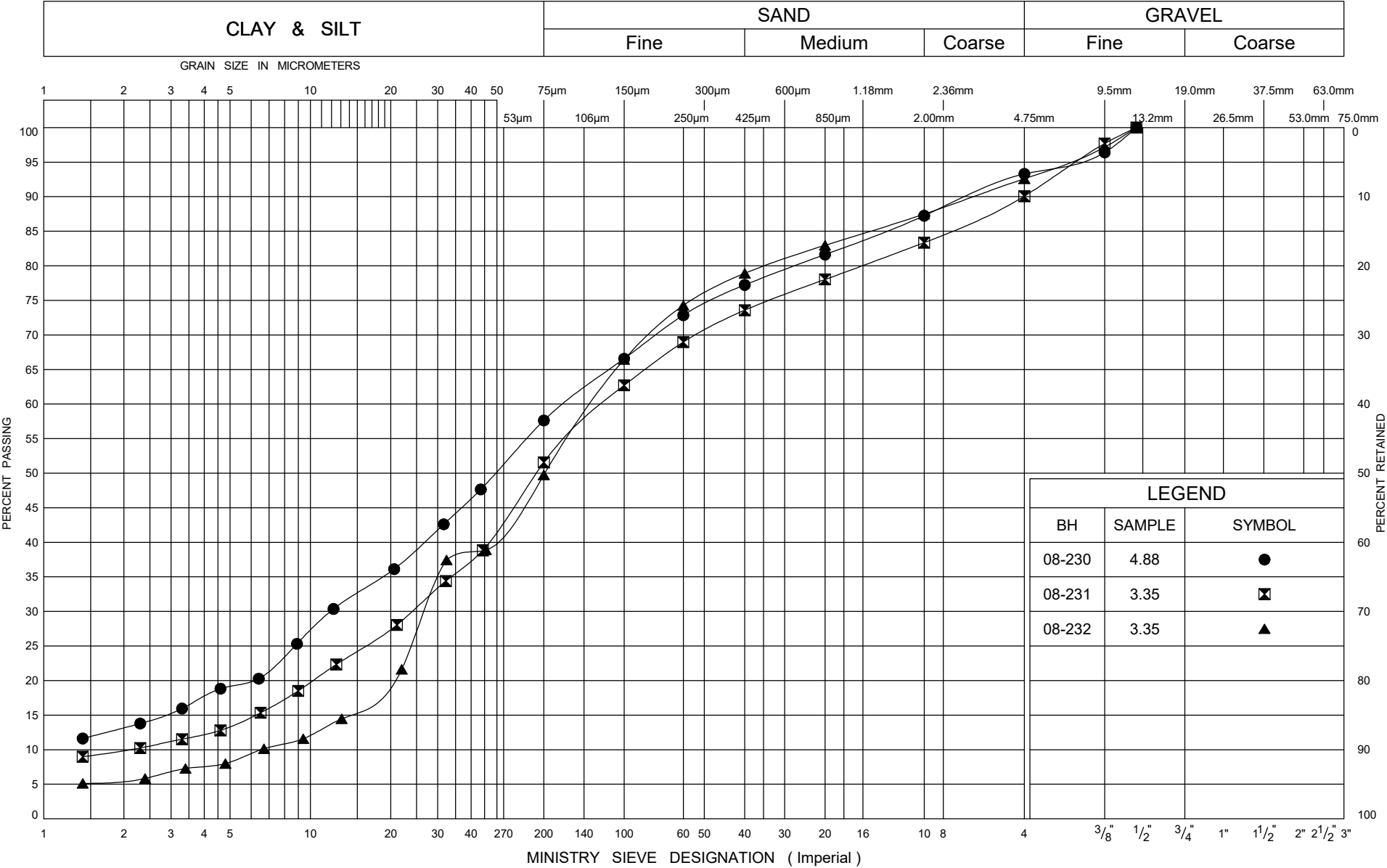
ONTARIO MOT GRAIN SIZE 2 MTO-11375(GINTDATA)\GPJ_ONTARIO MOT.GDT 6/29/21






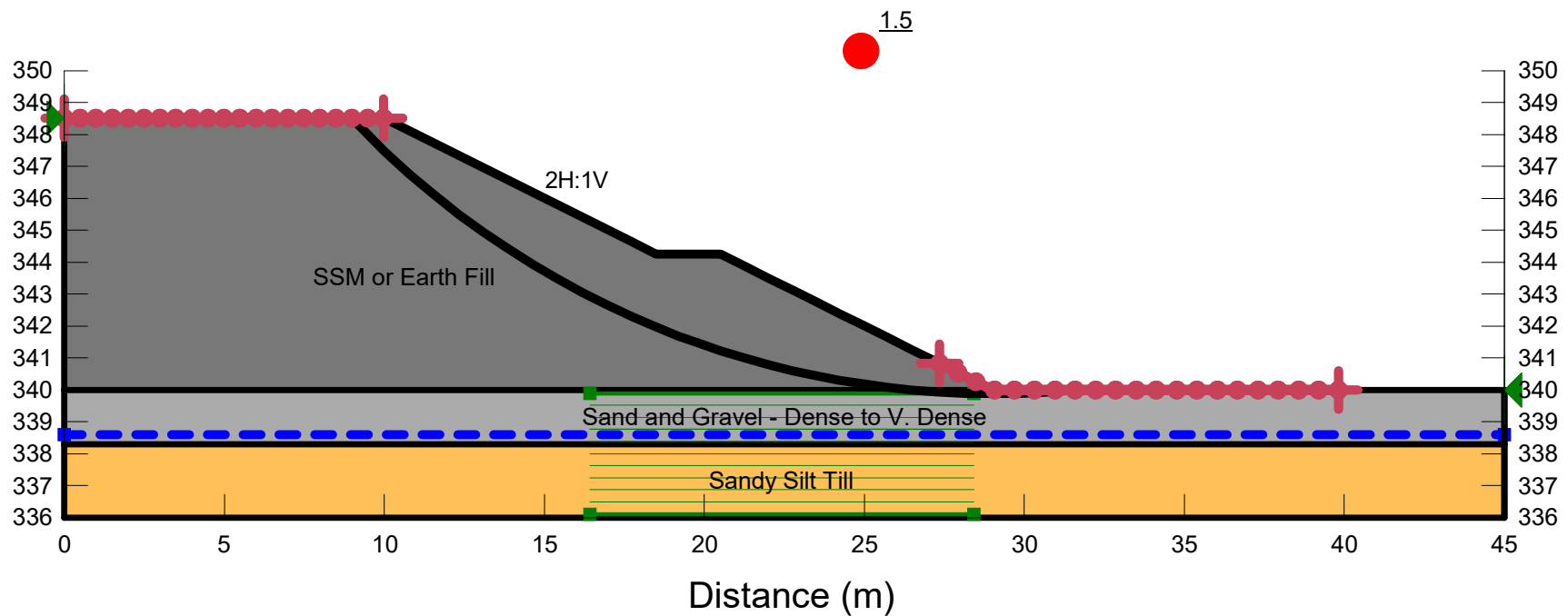
GRAIN SIZE DISTRIBUTION
Gravelly SAND to SAND and GRAVEL




FIG No A2
W P 408-88-00
-

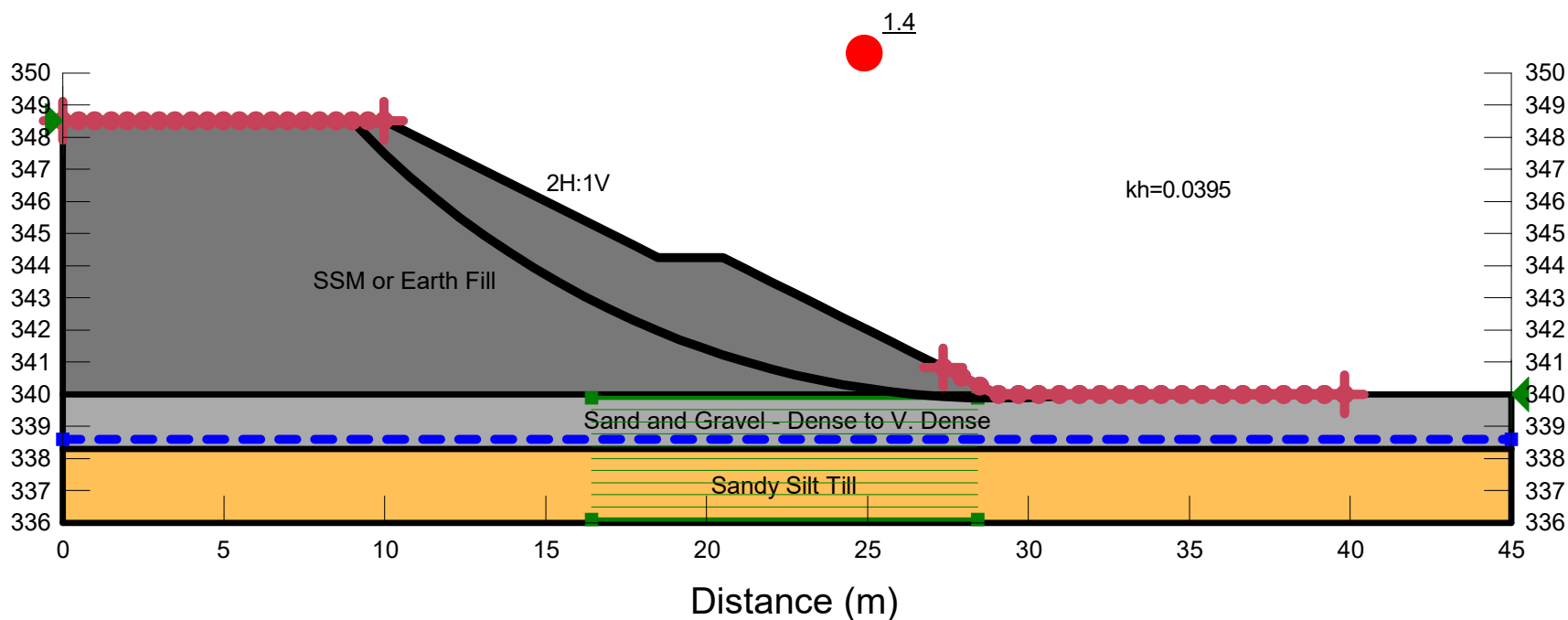
ONTARIO MOT GRAIN SIZE 2 MTO-11375(GINTDATA)\GPJ_ONTARIO MOT.GDT 6/29/21



Color	Name	Material Model	Unit Weight (kN/m³)	Effective Cohesion (kPa)	Effective Friction Angle (°)
	Sand and Gravel - Dense to V. Dense	Mohr-Coulomb	21	0	32
	Sandy Silt Till	Mohr-Coulomb	21	0	31
	SSM or Earth Fill	Mohr-Coulomb	21.5	0	30



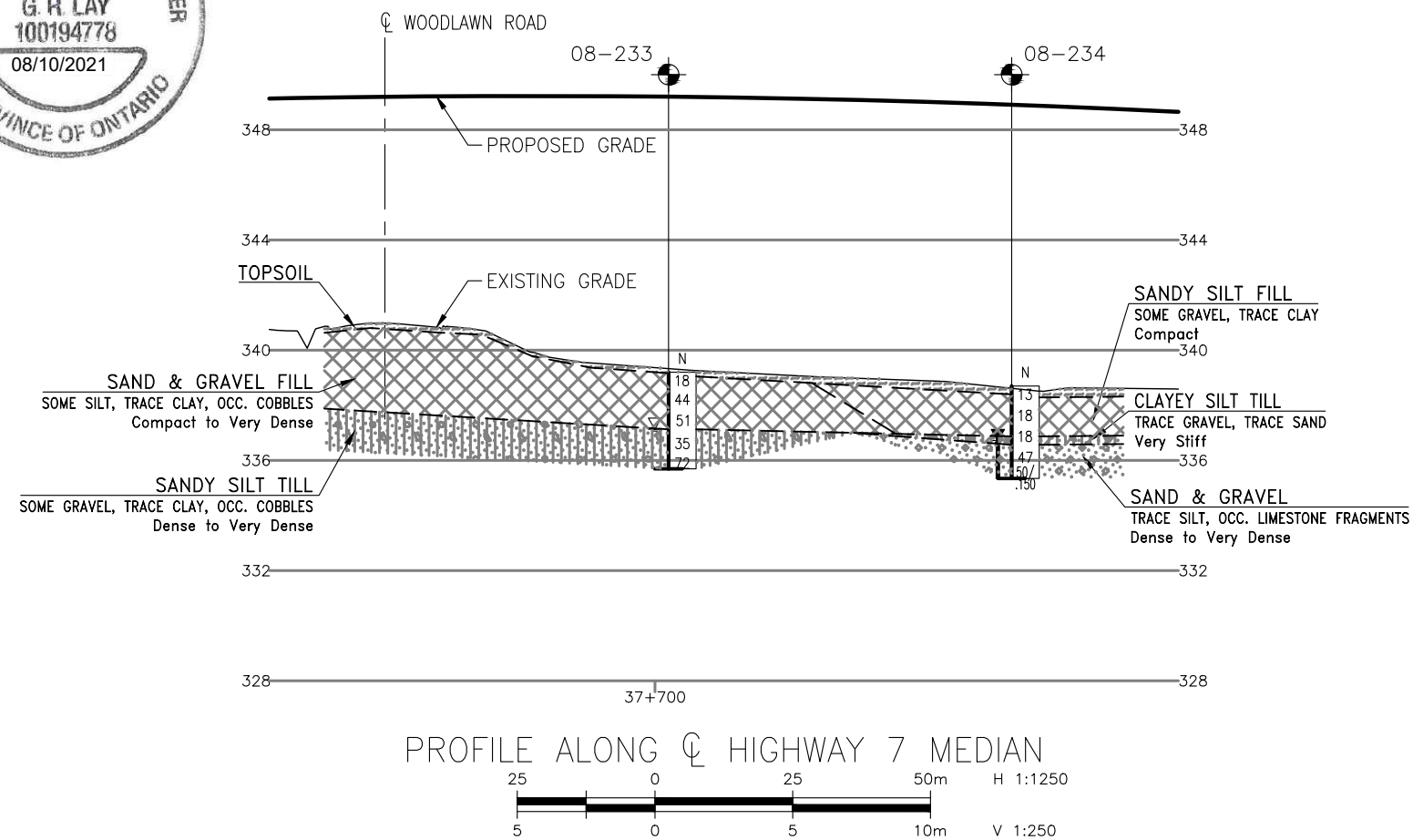
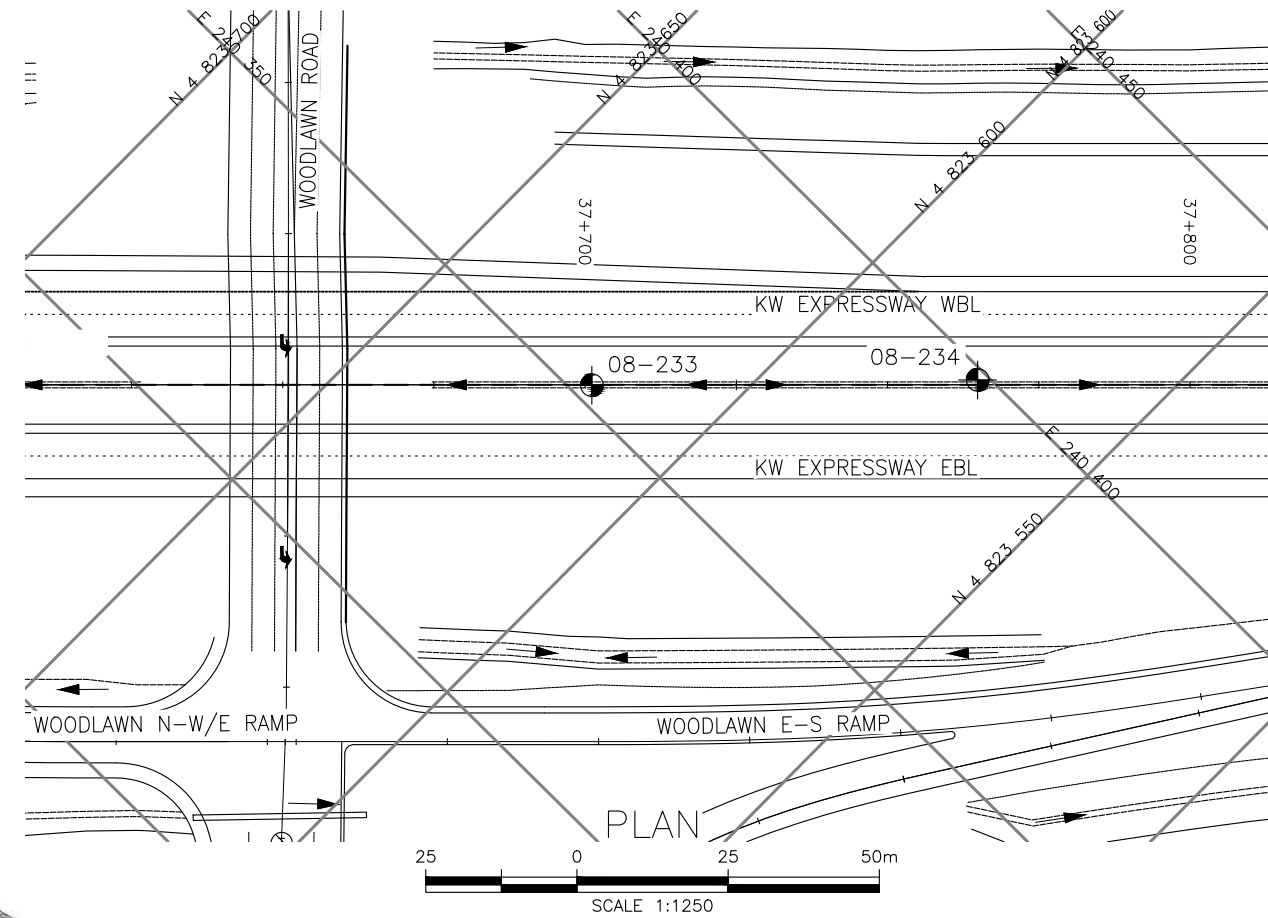
Color	Name	Material Model	Unit Weight (kN/m³)	Effective Cohesion (kPa)	Effective Friction Angle (°)
	Sand and Gravel - Dense to V. Dense	Mohr-Coulomb	21	0	32
	Sandy Silt Till	Mohr-Coulomb	21	0	31
	SSM or Earth Fill	Mohr-Coulomb	21.5	0	30





Appendix B

**Hwy 7 New Mainline Sta. 37+700 to 38+150 (08-233, 08-234, 08-235, 08-240,
ML16 37+950, ML16 38+000, ML16 38+050, ML16 38+100, ML16 38+150)**



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

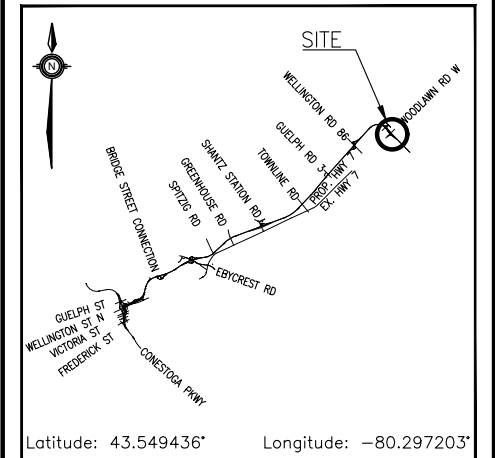
CONT No	(
GWP No 3003-20-00	



SHEET








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

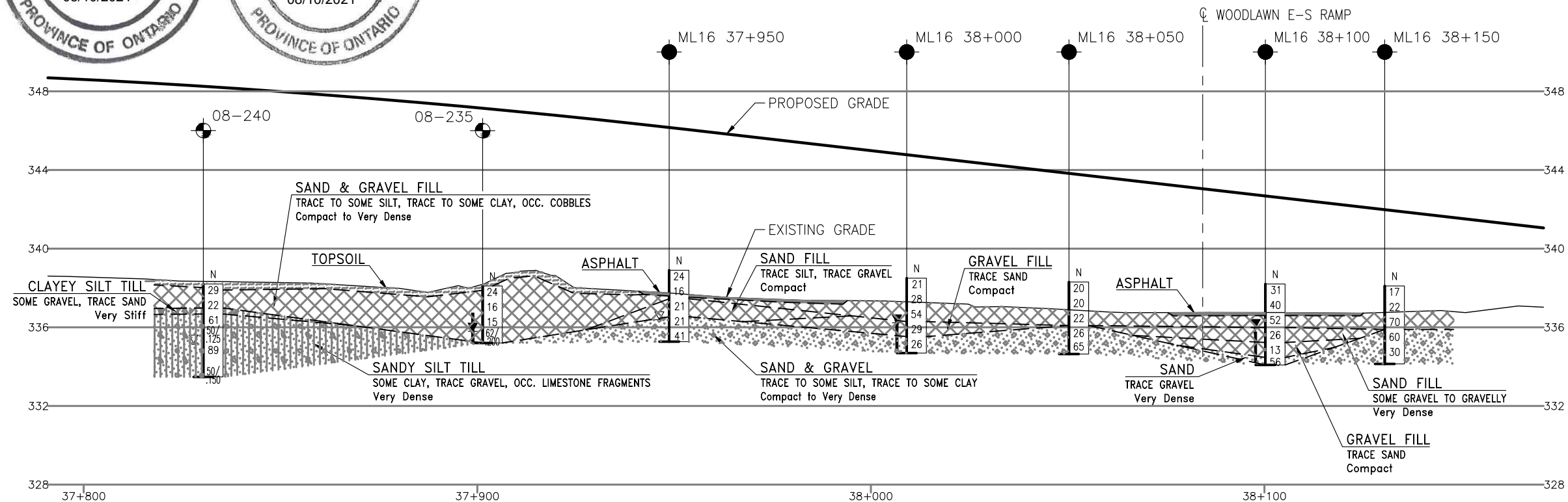
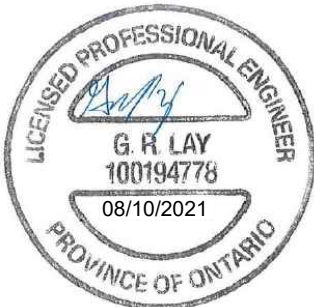
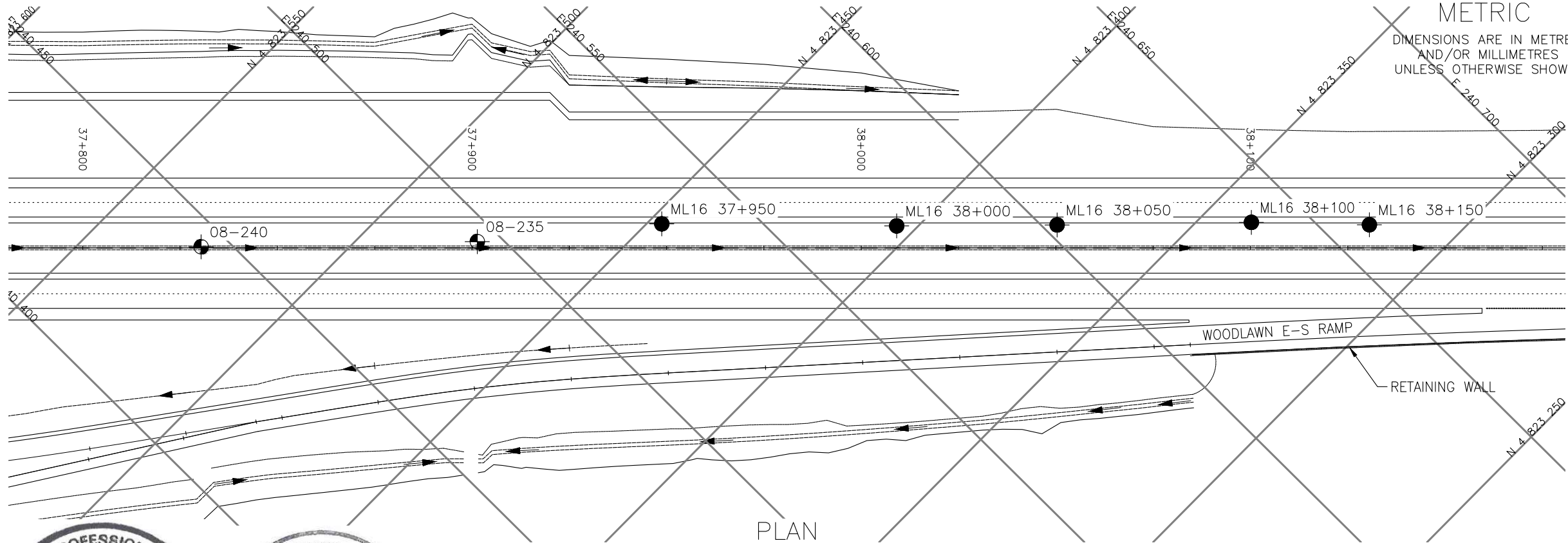
NO	ELEVATION	NORTHING	EASTING
08-233	339.2	4 823 618.7	240 352.9
08-234	338.7	4 823 574.1	240 398.4

-NOTES-

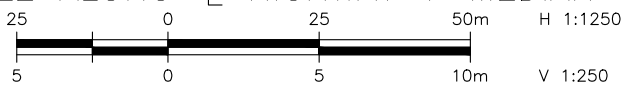
- 1) The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.
- 2) This drawing is for subsurface information only. Surface details and features are for conceptual illustration.
- 3) Coordinate system is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

GEOCRES No. 40P9-64

REVISIONS									
	DATE	BY	DESCRIPTION						
DESIGN	JA	CHK	PKC	CODE	LOAD	DATE JUN 2021			
DRAWN	MFA	CHK	JA	SITE	STRUCT	DWG 2			



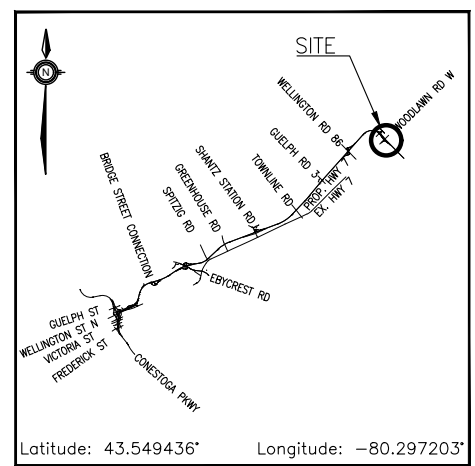
PROFILE ALONG ϕ HIGHWAY 7 MEDIAN



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

CONT No
GWP No 3003-20-00

HIGHWAY 7
MAINLINE
AT WOODLAWN ROAD I/C
BOREHOLE LOCATIONS AND SOIL STRATA



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
ML16 37+950	338.9	4 823 447.2	240 531.6
ML16 38+000	338.5	4 823 404.0	240 573.7
ML16 38+050	338.3	4 823 374.8	240 602.9
ML16 38+100	338.2	4 823 339.9	240 638.5
ML16 38+150	338.1	4 823 317.9	240 659.4
08-235	338.1	4 823 477.7	240 495.0
08-240	338.2	4 823 527.1	240 444.2

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. 40P9-64

REVISIONS	DATE	BY	DESCRIPTION
DESIGN	JA	CHK PKC	CODE
DRAWN	MFA	CHK JA	SITE
LOAD	DATE	JUN 2021	
STRUCT	DWG	3	

RECORD OF BOREHOLE No ML16 37+950

1 OF 1

METRIC

GWP# 408-88-00 LOCATION , MTM NAD 83 Zone 10: N 4 823 447.2 E 240 531.6 ORIGINATED BY MC
DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY BH
DATUM Geodetic DATE 2021.04.09 - 2021.04.09 LATITUDE 43.548185 LONGITUDE -80.295357 CHECKED BY JA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100		
338.9	GROUND SURFACE													
0.0	ASPHALT: (100mm)													
0.1	SAND and GRAVEL, trace to some silt, trace to some clay Compact Brown Dry (FILL)		1	SS	24		338							
			2	SS	16									
337.5														
1.4	SAND, trace silt, trace gravel Compact Brown Moist (FILL)		3	SS	21		337							
336.5														
2.4	SAND and GRAVEL, trace to some silt, trace to some clay Compact to Dense Brown Wet		4	SS	21		336							
			5	SS	41									
335.3														36 45 19 (SI+CL)
3.6	END OF BOREHOLE AT 3.6m UPON AUGER REFUSAL. WATER LEVEL AT 2.5m UPON COMPLETION. BOREHOLE BACKFILLED WITH HOLEPLUG TO 0.6m, SAND TO 0.3m, CONCRETE TO 0.15m, THEN ASPHALT TO SURFACE.													

ONTMT4S2 MTO-11375(GINTDATA)\GPJ 2017TEMPLATE(MTO)_GDT 6/29/21

RECORD OF BOREHOLE No ML16 38+000

1 OF 1

METRIC

GWP# 408-88-00 LOCATION , MTM NAD 83 Zone 10: N 4 823 404.0 E 240 573.7 ORIGINATED BY MC
DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY BH
DATUM Geodetic DATE 2021.04.14 - 2021.04.14 LATITUDE 43.547800 LONGITUDE -80.294831 CHECKED BY JA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100		
338.5	GROUND SURFACE													
0.0	SAND and GRAVEL , trace to some silt, trace to some clay Compact Brown Dry (FILL)		1	SS	21		338							43 48 9 (SI+CL)
			2	SS	28									
			3	SS	54		337							
336.3														
2.2	GRAVEL , trace sand Compact Brown Wet (FILL)		4	SS	29		336							
335.6														
3.0	SAND and GRAVEL , trace to some silt, trace to some clay Compact Brown Wet		5	SS	20		335							42 36 22 (SI+CL)
334.7														
3.8	END OF BOREHOLE AT 3.8m UPON AUGER REFUSAL. 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 2.3 336.3													

ONTMT4S2 MTO-11375(GINTDATA).GPJ 2017TEMPLATE(MTO).GDT 6/29/21

RECORD OF BOREHOLE No ML16 38+050

1 OF 1

METRIC

GWP# 408-88-00 LOCATION , MTM NAD 83 Zone 10: N 4 823 374.8 E 240 602.9 ORIGINATED BY MC
DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY BH
DATUM Geodetic DATE 2021.04.09 - 2021.04.09 LATITUDE 43.547540 LONGITUDE -80.294467 CHECKED BY JA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100		
338.3	GROUND SURFACE													
0.0	SAND and GRAVEL , trace to some silt, trace to some clay Compact Brown Dry to Wet (FILL)		1	SS	20		338							
			2	SS	20		337							
			3	SS	22									
336.1														
2.2	SAND and GRAVEL , trace to some silt, trace to some clay Compact to Very Dense Brown Moist		4	SS	26		336							39 44 17 (SI+CL)
			5	SS	65		335							32 58 10 (SI+CL)
334.6														
3.7	END OF BOREHOLE AT 3.7m UPON AUGER REFUSAL. BOREHOLE OPEN AND WATER LEVEL AT 2.4m UPON COMPLETION. BOREHOLE BACKFILLED WITH HOLEPLUG TO 0.6m, SAND TO 0.3m, THEN SAND AND GRAVEL TO SURFACE.													

ONTMT4S2 MTO-11375(GINTDATA)\GPJ 2017TEMPLATE(MTO)_GDT 6/29/21

RECORD OF BOREHOLE No ML16 38+100

1 OF 1

METRIC

GWP# 408-88-00 LOCATION , MTM NAD 83 Zone 10: N 4 823 339.9 E 240 638.5 ORIGINATED BY MC
DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY BH
DATUM Geodetic DATE 2021.04.09 - 2021.04.09 LATITUDE 43.547228 LONGITUDE -80.294022 CHECKED BY JA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100		
338.2	GROUND SURFACE													
0.0	ASPHALT: (125mm)													
0.1	SAND and GRAVEL, trace to some silt, trace to some clay Dense to Very Dense Brown Dry (FILL)		1	SS	31		338							
			2	SS	40		337							
			3	SS	52									
336.0							336							
2.2	SAND, some gravel to gravelly Very Dense Brown Moist (FILL)		4	SS	26									
335.2														
3.0	GRAVEL, trace sand Compact Brown Moist (FILL)		5	SS	13		335							
334.4														
3.7	SAND, trace gravel Very Dense Brown Wet		6	SS	56									
334.1														
4.1	END OF BOREHOLE AT 4.1m UPON AUGER REFUSAL. 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 2.2 336.0													

ONTMT4S2 MTO-11375(GINTDATA).GPJ 2017TEMPLATE(MTO).GDT 6/29/21

RECORD OF BOREHOLE No ML16 38+150

1 OF 1

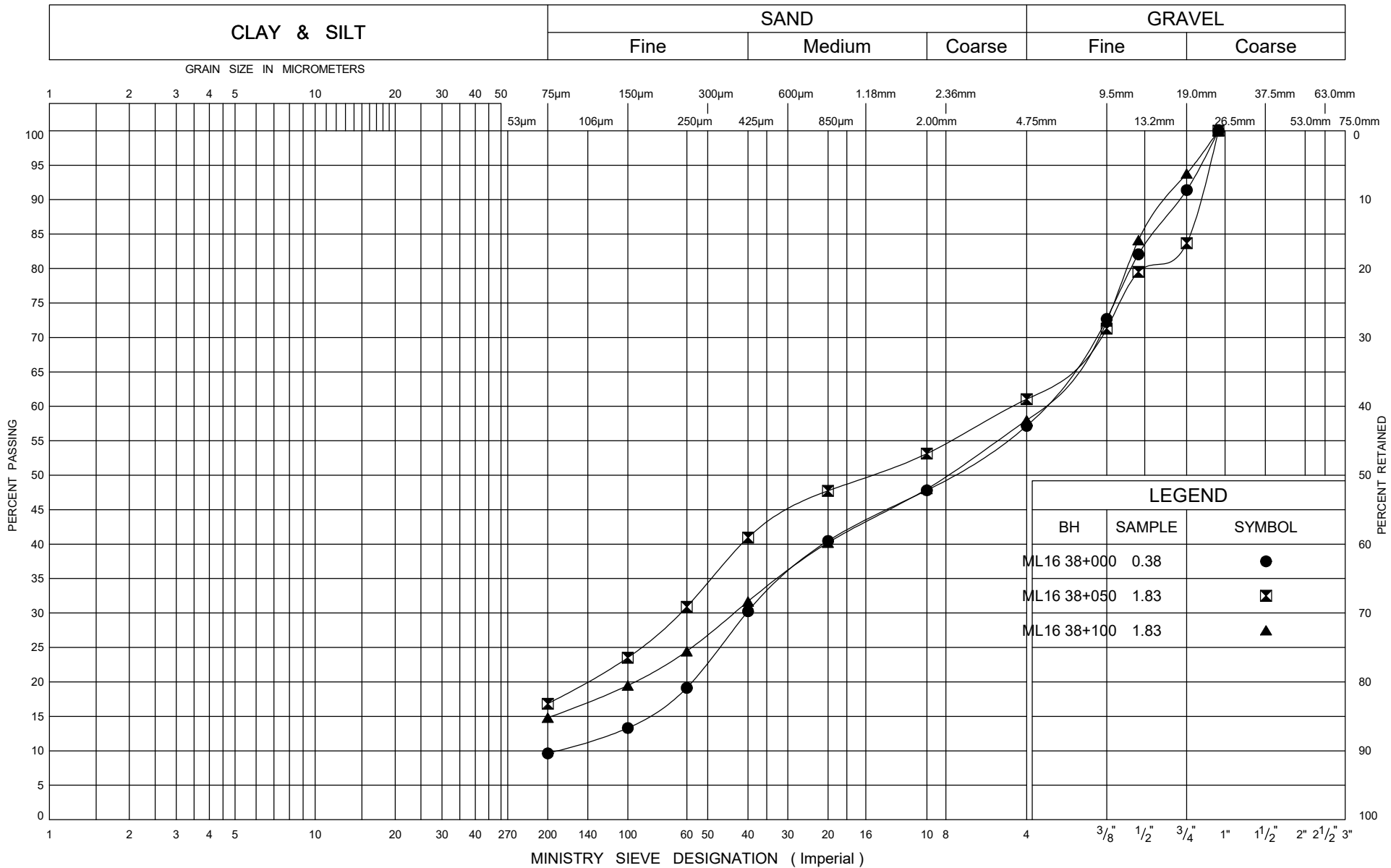
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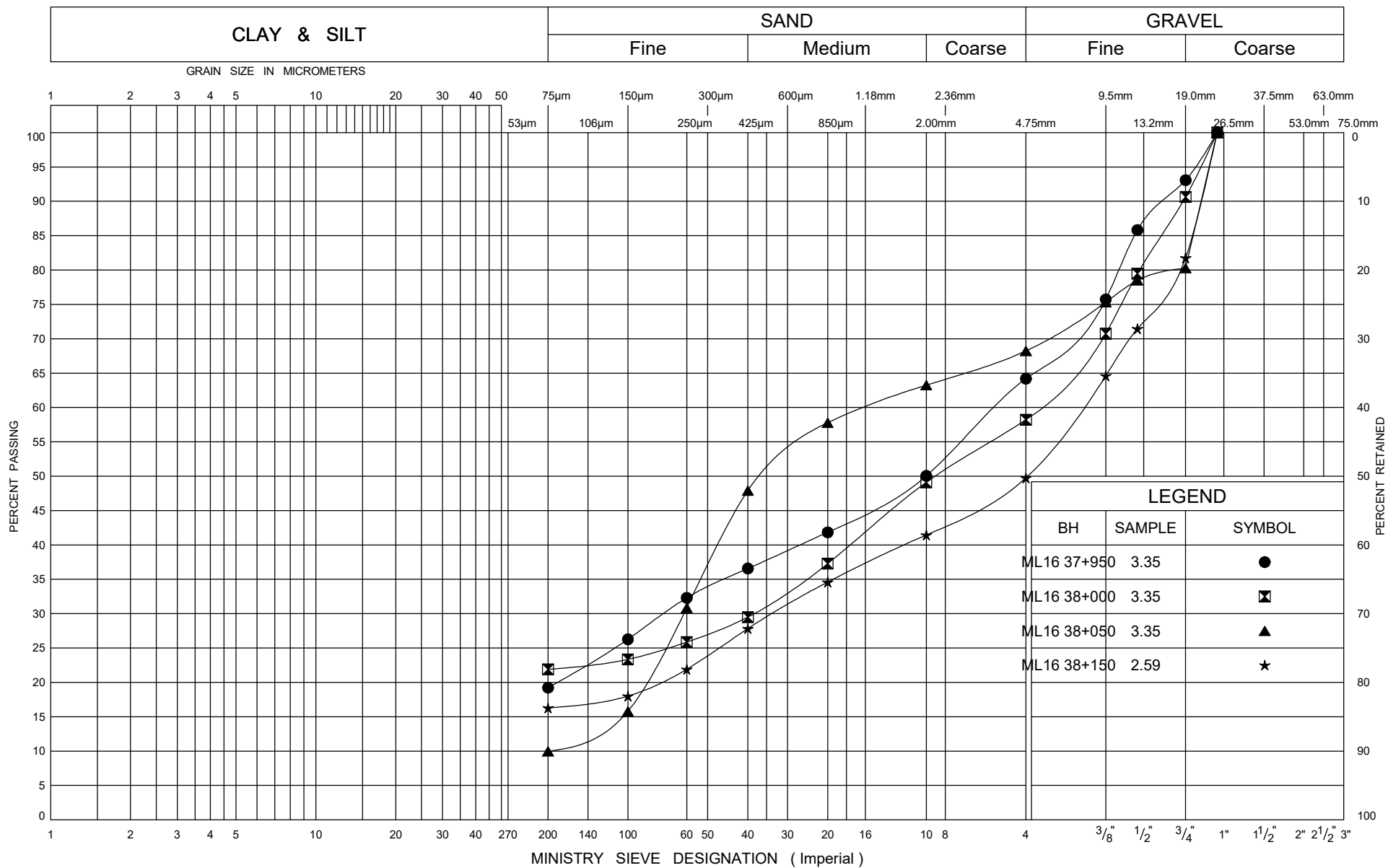
GWP# 408-88-00 LOCATION , MTM NAD 83 Zone 10: N 4 823 317.9 E 240 659.4 ORIGINATED BY MC
DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY BH
DATUM Geodetic DATE 2021.04.12 - 2021.04.12 LATITUDE 43.547032 LONGITUDE -80.293761 CHECKED BY JA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100		
338.1	GROUND SURFACE													
0.0	SAND and GRAVEL , trace to some silt, trace to some clay, occasional dolostone fragments Compact to Very Dense Brown Dry (FILL)		1	SS	17		338							
			2	SS	22		337							
			3	SS	70		336							
335.9														
2.2	SAND and GRAVEL , trace to some silt, trace to some clay, occasional dolostone fragments Very Dense to Dense Brown Moist to Wet		4	SS	60		335							50 33 17 (SI+CL)
			5	SS	30									
334.1														
4.0	END OF BOREHOLE AT 4.0m UPON AUGER REFUSAL. BOREHOLE OPEN AND WATER LEVEL AT 3.0m UPON COMPLETION. BOREHOLE BACKFILLED WITH HOLEPLUG TO 0.6m, SAND TO 0.3m, THEN SAND AND GRAVEL TO SURFACE.													

ONTMT4S2 MTO-11375(GINTDATA).GPJ 2017TEMPLATE(MTO).GDT 6/29/21

ONTARIO MOT GRAIN SIZE 2 MTO-11375(GINTDATA)\GPJ_ONTARIO MOT.GDT 6/29/21




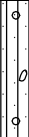


RECORD OF BOREHOLE No 08-233

1 OF 1

METRIC

W.P. 408-88-00 LOCATION N 4 823 618.73 E 240 352.94 N 4 823 618.7 E 240 352.9 ORIGINATED BY SA
 HWY 7 - New BOREHOLE TYPE Solid Stem Augers COMPILED BY LG
 DATUM Geodetic DATE 2008.08.05 - 2008.08.05 CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE						
339.2	GROUND SURFACE													
0.0	TOPSOIL, occasional roots: (150mm)													
0.2	SAND and GRAVEL, some silt, trace clay, occasional cobbles Compact to Very Dense Brown to Grey Moist (FILL)		1	SS	18									
			2	SS	44									
			3	SS	51									
337.2														
2.1	Sandy SILT, some gravel, trace clay, occasional cobbles Dense to Very Dense Grey Wet (TILL) Occasional limestone shale fragments		4	SS	35									
			5	SS	72									
335.7														
3.5	END OF BOREHOLE AT 3.5m UPON AUGER REFUSAL. WATER LEVEL OBSERVED AT 2.1m DURING DRILLING. BOREHOLE BACKFILLED WITH AUGER CUTTINGS TO 0.3m, THEN HOLEPLUG TO SURFACE.													

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

RECORD OF BOREHOLE No 08-234

1 OF 1

METRIC

W.P. 408-88-00 LOCATION N 4 823 574.05 E 240 398.43 N 4 823 574.1 E 240 398.4 ORIGINATED BY SA
 HWY 7 - New BOREHOLE TYPE Solid Stem Augers COMPILED BY LG
 DATUM Geodetic DATE 2008.08.05 - 2008.08.05 CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _P	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
338.7	GROUND SURFACE							20	40	60	80	100					
0.0	TOPSOIL, occasional roots: (300mm)																
338.4			1	SS	13												
0.3	Sandy SILT , some gravel, trace clay Compact Dark Brown to Grey Moist (FILL)																
			2	SS	18												0 58 33 9
336.9			3	SS	18												
1.8	Clayey SILT , trace gravel, trace sand Very Stiff Brown to Grey (TILL)																
336.6																	
2.1	SAND and GRAVEL , trace silt, occasional limestone fragments Dense to Very Dense Grey Wet		4	SS	47												50 39 11 (SI+CL)
335.3			5	SS	50/												
3.4	END OF BOREHOLE AT 3.4m UPON AUGER REFUSAL. Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen. WATER LEVEL READINGS: DATE DEPTH (m) ELEV. (m) 2008.08.20 1.6 337.1 2009.02.09 2.0 336.7																

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

RECORD OF BOREHOLE No 08-235

1 OF 1

METRIC

W.P. 408-88-00 LOCATION N 4 823 477.67 E 240 495.04 N 4 823 477.7 E 240 495.0 ORIGINATED BY SA
 HWY 7 - New BOREHOLE TYPE Solid Stem Augers COMPILED BY LG
 DATUM Geodetic DATE 2008.08.05 - 2008.08.05 CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE							PLASTIC LIMIT W _P NATURAL MOISTURE CONTENT W LIQUID LIMIT W _L		
338.1	GROUND SURFACE							20	40	60	80	100					
0.0	TOPSOIL, occasional roots: (300mm)						338										
337.8			1	SS	24												
0.3	SAND and GRAVEL, some silt, trace clay, occasional cobbles Compact to Very Dense Brown to Grey Wet (FILL)																
			2	SS	16		337										
			3	SS	15												
							336										
			4	SS	62/ 200												
335.2	Occasional limestone shale fragments Auger grinding at 2.9m																
2.9	END OF BOREHOLE AT 2.9m UPON AUGER REFUSAL. Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen. WATER LEVEL READINGS: DATE DEPTH (m) ELEV. (m) 2008.08.20 1.5 336.6 2009.02.09 2.3 335.8																

+³, ×³: Numbers refer to
Sensitivity

20
15
10
(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 08-240

1 OF 1

METRIC

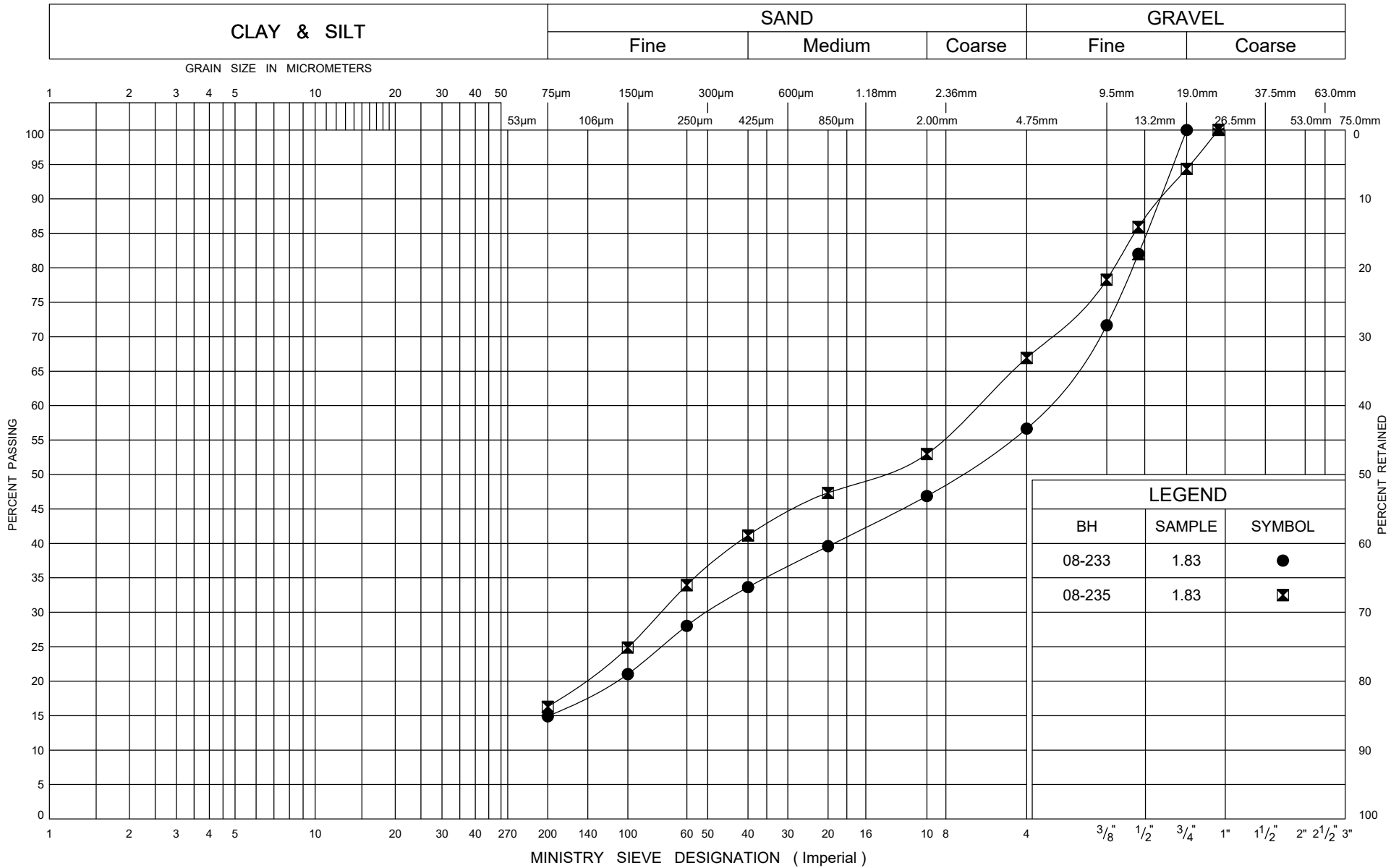
W.P. 408-88-00 LOCATION N 4 823 527.12 E 240 444.16 N 4 823 527.1 E 240 444.2 ORIGINATED BY SA
 HWY 7 - New BOREHOLE TYPE Solid Stem Augers COMPILED BY LG
 DATUM Geodetic DATE 2008.08.05 - 2008.08.05 CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
338.2	GROUND SURFACE							20 40 60 80 100						
0.0	TOPSOIL, occasional roots: (300mm)							20 40 60 80 100						
337.9			1	SS	29		338							
0.3	SAND and GRAVEL, trace silt Compact Brown to Grey Moist (FILL)							20 40 60 80 100						
337.0			2	SS	22		337							
1.2	Clayey SILT, some gravel, trace sand Very Stiff Brown to Grey (TILL)							20 40 60 80 100						
336.7								20 40 60 80 100						
1.5	Sandy SILT, some clay, trace gravel, occasional limestone fragments Very Dense Grey Moist (TILL)		3	SS	61		336							
								20 40 60 80 100						
			4	SS	50/ .125		335							
								20 40 60 80 100						
	Moist to Wet		5	SS	89		334							
								20 40 60 80 100						
333.5	Occasional limestone shale fragments		6	SS	50/ .150									7 36 41 16
4.7	END OF BOREHOLE AT 4.7m UPON AUGER REFUSAL. WATER LEVEL OBSERVED AT 3.0m DURING DRILLING. BOREHOLE BACKFILLED WITH AUGER CUTTINGS TO 0.3m, THEN HOLEPLUG TO SURFACE.													7 42 41 10

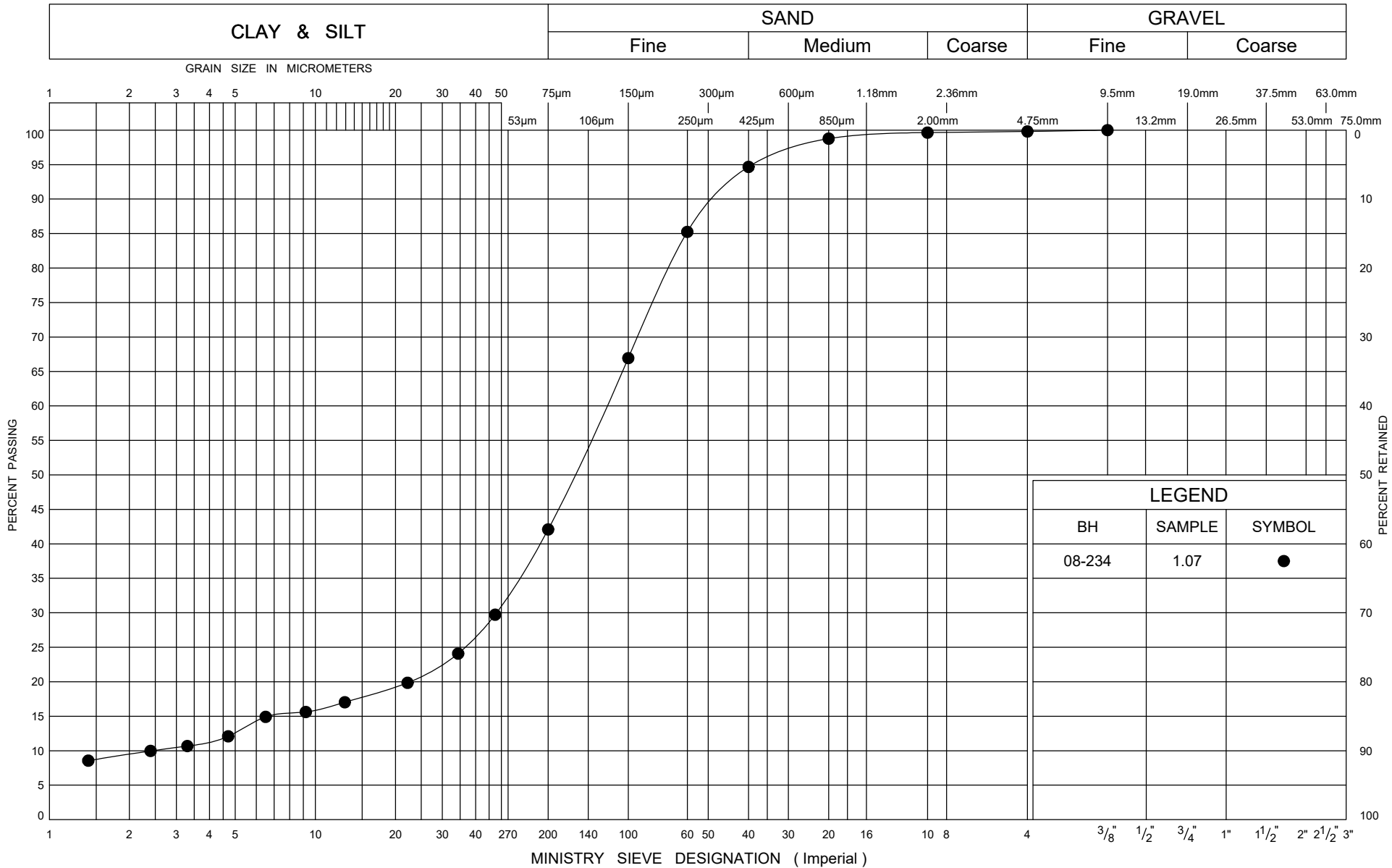
+³, ×³: Numbers refer to
Sensitivity

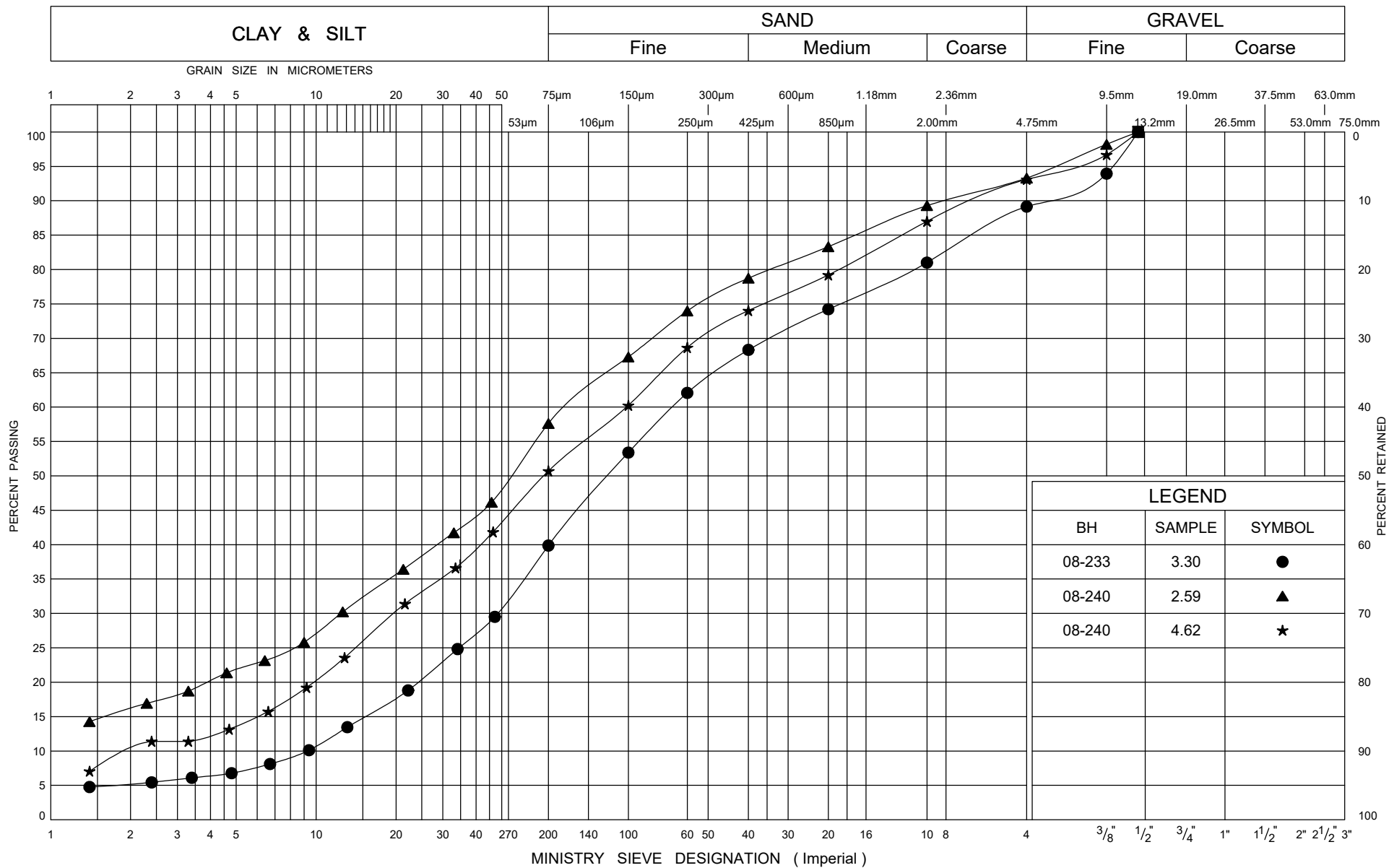
20
15
10
(%) STRAIN AT FAILURE

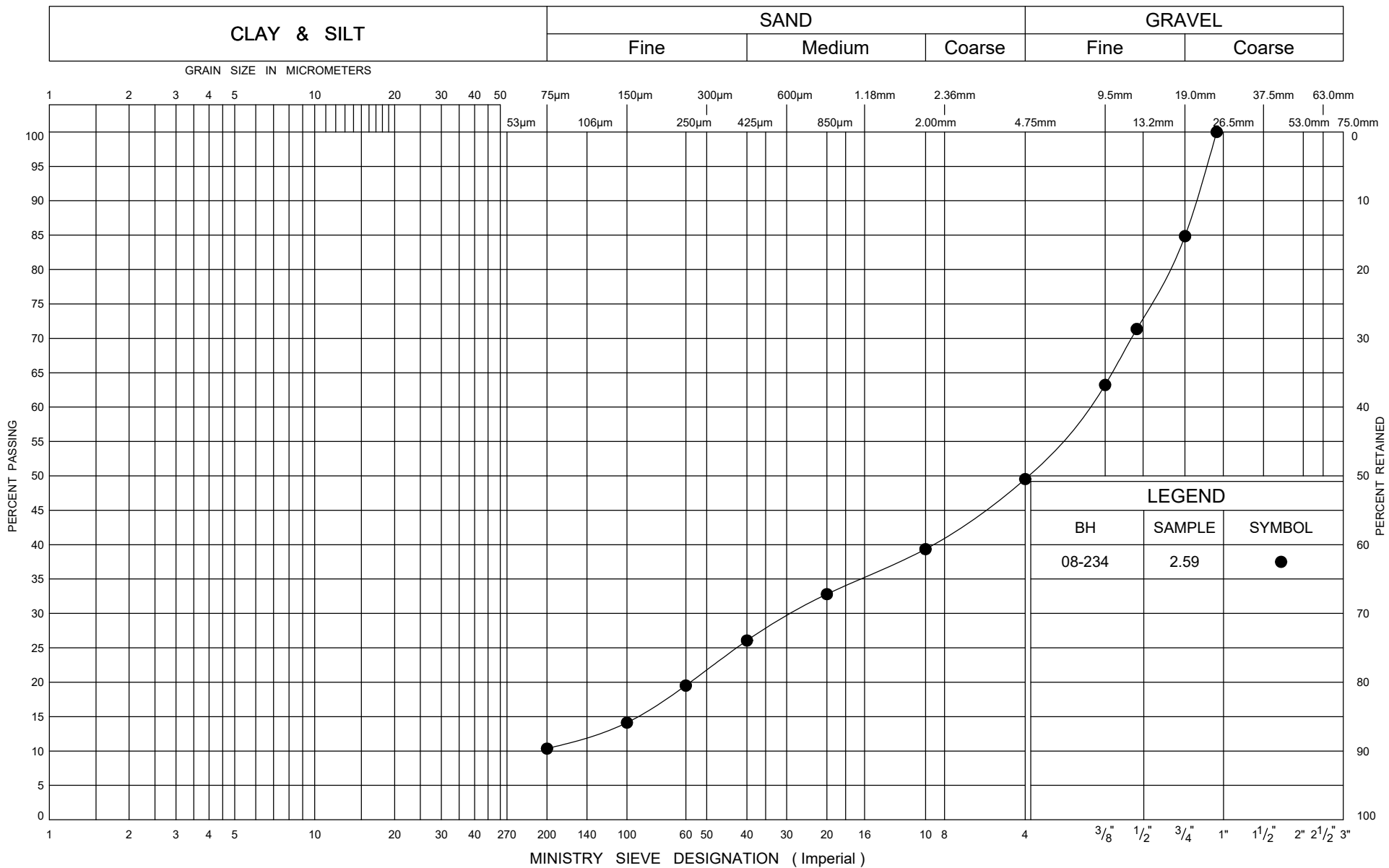
ONTARIO MOT GRAIN SIZE 3 MTO-11375(GINTDATA)\GPJ_ONTARIO MOT.GDT 3/24/20








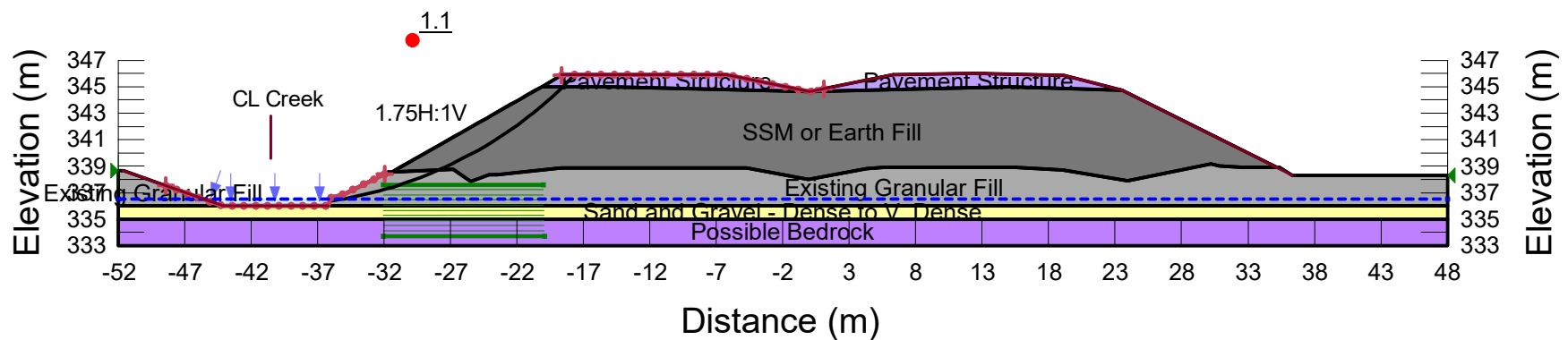
ONTARIO MOT GRAIN SIZE 3 MTO-11375(GINTDATA)\GPJ_ONTARIO MOT.GDT 3/24/20








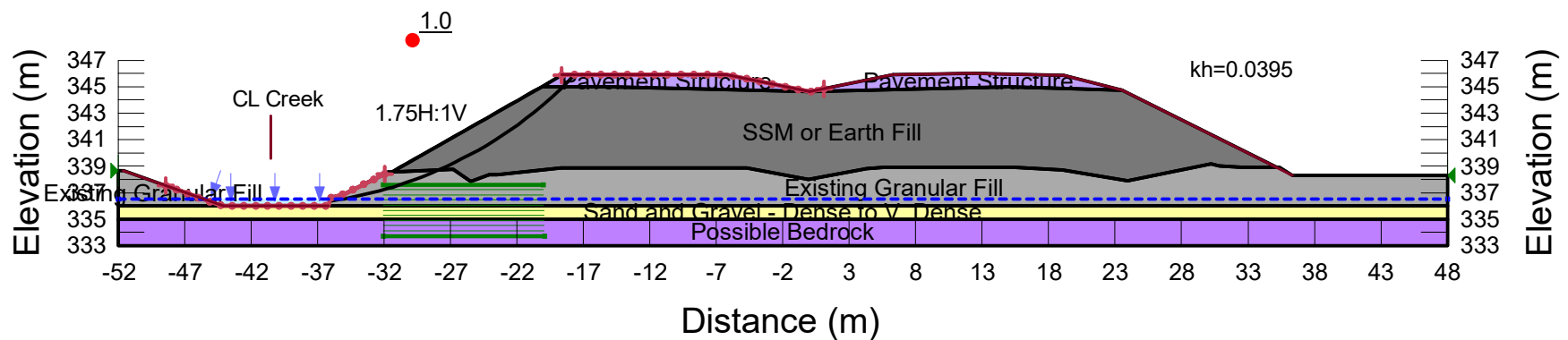










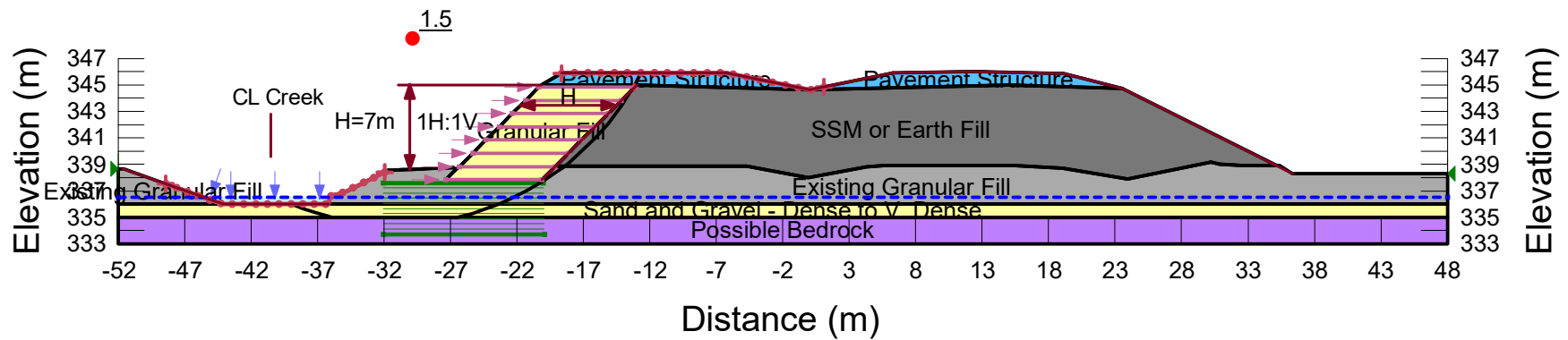
Color	Name	Material Model	Unit Weight (kN/m ³)	Effective Cohesion (kPa)	Effective Friction Angle (°)
	Existing Granular Fill	Mohr-Coulomb	21	0	31
	Pavement Structure	Mohr-Coulomb	22	0	35
	Possible Bedrock	Bedrock (Impenetrable)			
	Sand and Gravel - Dense to V. Dense	Mohr-Coulomb	22	0	33
	SSM or Earth Fill	Mohr-Coulomb	21.5	0	30









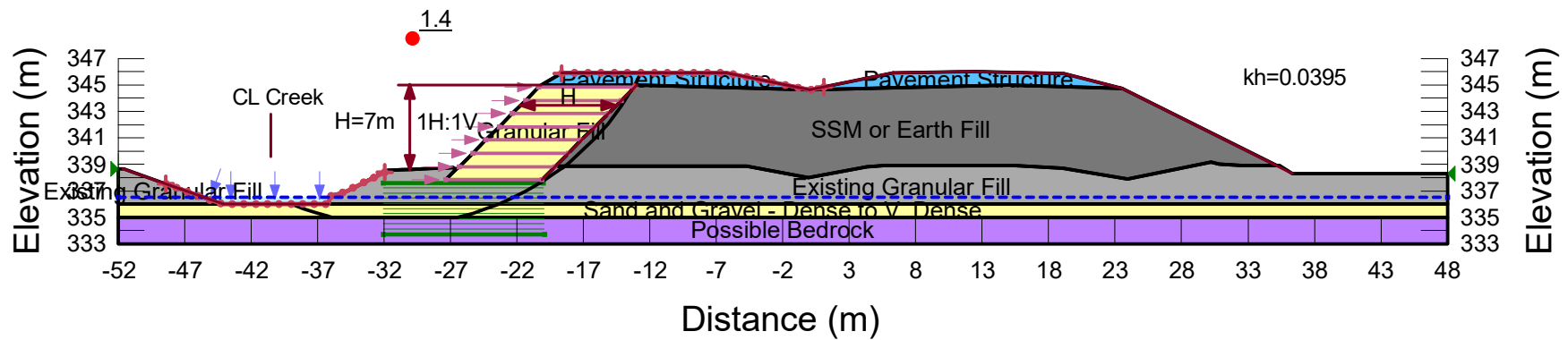
Color	Name	Material Model	Unit Weight (kN/m ³)	Effective Cohesion (kPa)	Effective Friction Angle (°)
	Existing Granular Fill	Mohr-Coulomb	21	0	31
	Pavement Structure	Mohr-Coulomb	22	0	35
	Possible Bedrock	Bedrock (Impenetrable)			
	Sand and Gravel - Dense to V. Dense	Mohr-Coulomb	22	0	33
	SSM or Earth Fill	Mohr-Coulomb	21.5	0	30










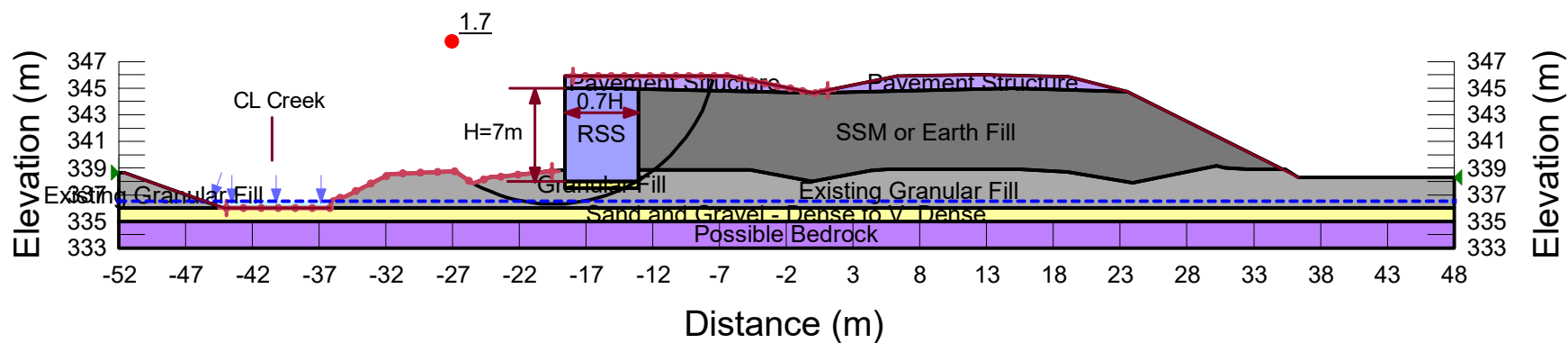
Color	Name	Material Model	Unit Weight (kN/m³)	Effective Cohesion (kPa)	Effective Friction Angle (°)
	Existing Granular Fill	Mohr-Coulomb	21	0	31
	Granular Fill	Mohr-Coulomb	22	0	35
	Pavement Structure	Mohr-Coulomb	22	0	35
	Possible Bedrock	Bedrock (Impenetrable)			
	Sand and Gravel - Dense to V. Dense	Mohr-Coulomb	22	0	33
	SSM or Earth Fill	Mohr-Coulomb	21.5	0	30










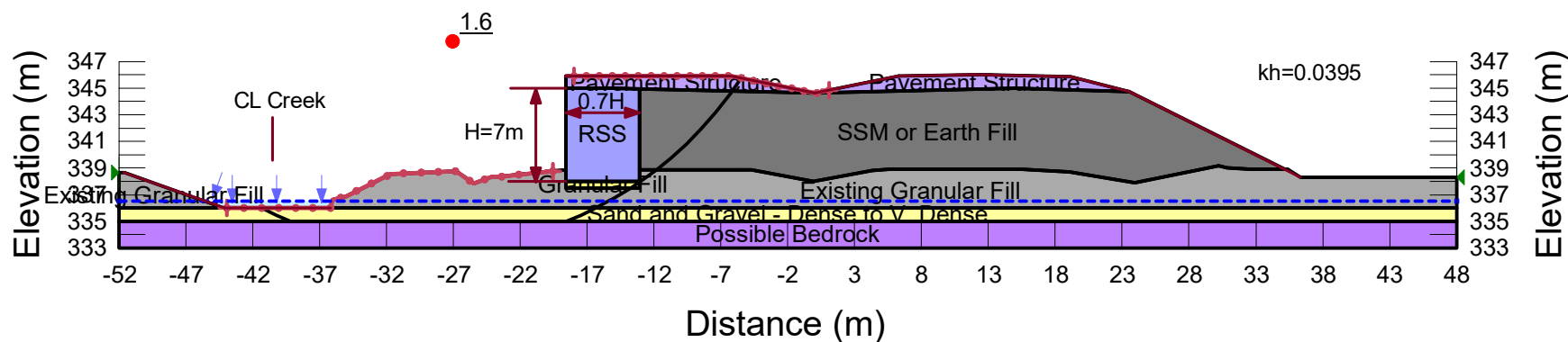
Color	Name	Material Model	Unit Weight (kN/m³)	Effective Cohesion (kPa)	Effective Friction Angle (°)
	Existing Granular Fill	Mohr-Coulomb	21	0	31
	Granular Fill	Mohr-Coulomb	22	0	35
	Pavement Structure	Mohr-Coulomb	22	0	35
	Possible Bedrock	Bedrock (Impenetrable)			
	Sand and Gravel - Dense to V. Dense	Mohr-Coulomb	22	0	33
	SSM or Earth Fill	Mohr-Coulomb	21.5	0	30



Color	Name	Material Model	Unit Weight (kN/m³)	Effective Cohesion (kPa)	Effective Friction Angle (°)
	Existing Granular Fill	Mohr-Coulomb	21	0	31
	Granular Fill	Mohr-Coulomb	22	0	35
	Pavement Structure	Mohr-Coulomb	22	0	35
	Possible Bedrock	Bedrock (Impenetrable)			
	RSS	Mohr-Coulomb	22	200	34
	Sand and Gravel - Dense to V. Dense	Mohr-Coulomb	22	0	33
	SSM or Earth Fill	Mohr-Coulomb	21.5	0	30



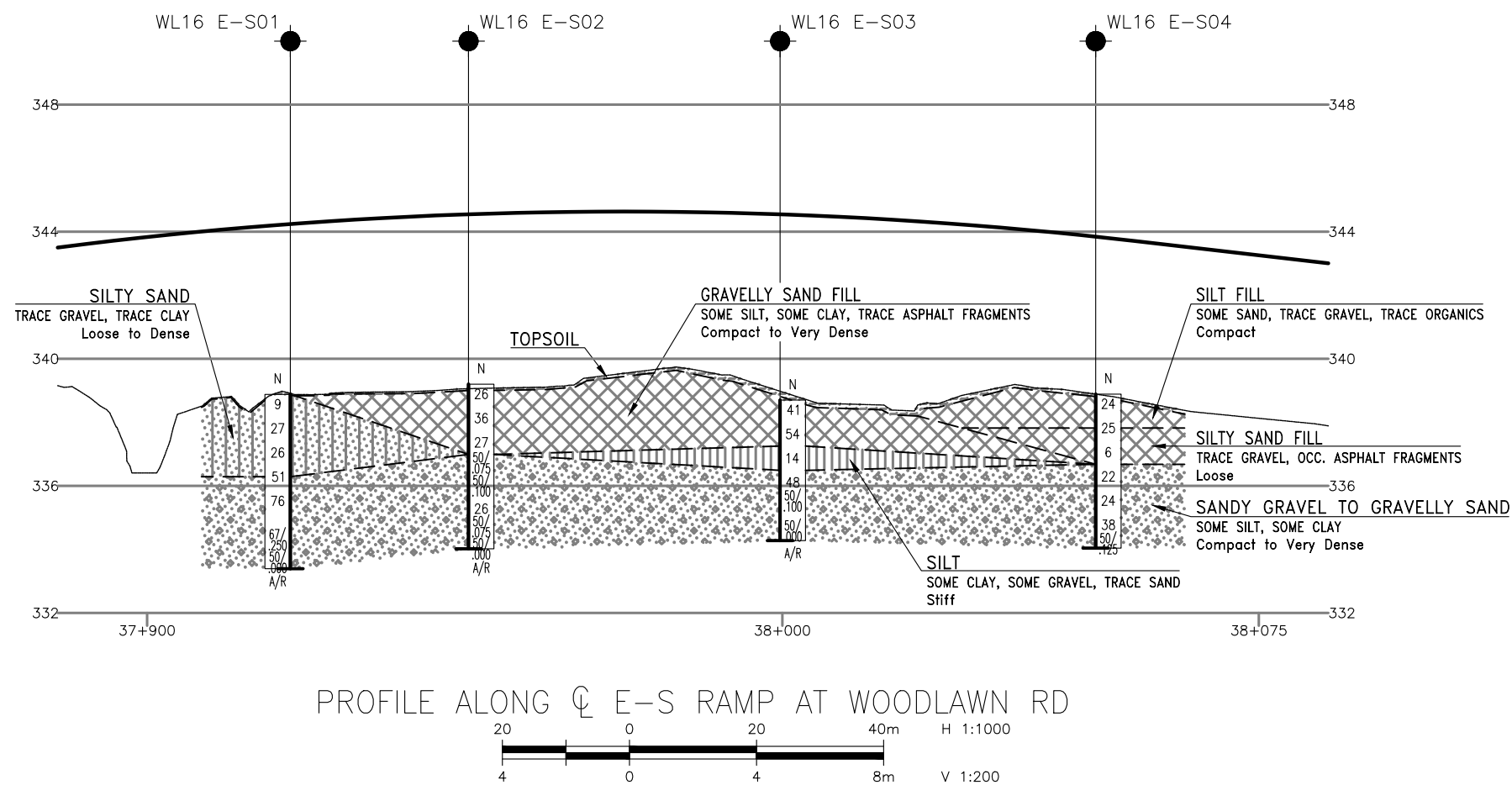
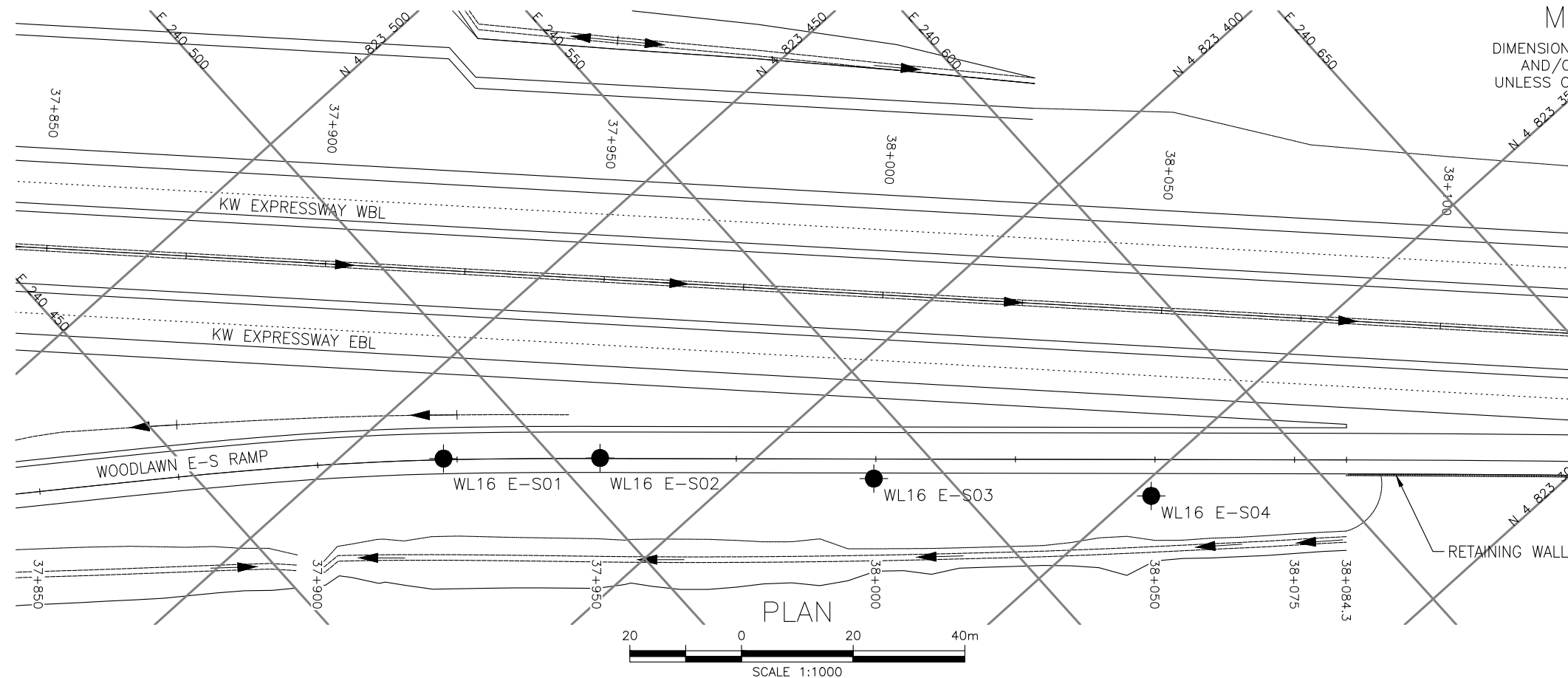
Color	Name	Material Model	Unit Weight (kN/m³)	Effective Cohesion (kPa)	Effective Friction Angle (°)
	Existing Granular Fill	Mohr-Coulomb	21	0	31
	Granular Fill	Mohr-Coulomb	22	0	35
	Pavement Structure	Mohr-Coulomb	22	0	35
	Possible Bedrock	Bedrock (Impenetrable)			
	RSS	Mohr-Coulomb	22	200	34
	Sand and Gravel - Dense to V. Dense	Mohr-Coulomb	22	0	33
	SSM or Earth Fill	Mohr-Coulomb	21.5	0	30





Appendix C

Woodlawn E-S Ramp Sta. 37+900 to 38+100 (WL16 E-S01 to WL16 E-S04)



08/10/2021

A circular professional engineer seal for the Province of Ontario. The outer ring contains the text "LICENSED PROFESSIONAL ENGINEER" at the top and "PROVINCE OF ONTARIO" at the bottom. The center of the seal features a signature, the name "G. R. LAY", the license number "100194778", and the date "08/10/2021".

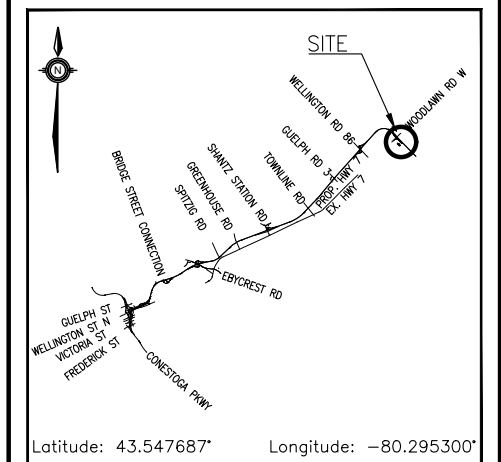
METRIC
DIMENSIONS ARE IN METRES
AND/OR MILLIMETRES
UNLESS OTHERWISE SHOWN

CONT No
GWP No 408-88-00

HIGHWAY 7
PROPOSED E-S RAMP
AT WOODLAWN ROAD
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 |

[illegible]

-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. 40P9-64

REVISIONS									
	DATE	BY				DESCRIPTION			
DESIGN	JA	CHK	PKC			LOAD		DATE	AUG 2021
DRAWN	MFA	CHK	JA			SITE		STRUCT	DWG 4

RECORD OF BOREHOLE No WL16 E-S01

1 OF 1

METRIC

GWP# 408-88-00 LOCATION , MTM NAD 83 Zone 10: N 4 823 437.4 E 240 485.3 ORIGINATED BY MC
DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY BH
DATUM Geodetic DATE 2021.04.13 - 2021.04.13 LATITUDE 43.548093 LONGITUDE -80.295930 CHECKED BY JA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100		
338.9	GROUND SURFACE													
0.0	TOPSOIL: (25mm) Silty SAND, trace gravel, trace clay Loose to Dense Brown Moist		1	SS	9		338							6 67 21 6
			2	SS	27									
			3	SS	26		337							
336.3			4	SS	51		336							
2.6	SAND and GRAVEL, some silt Very Dense Brown Wet		5	SS	76		335							41 47 12 (SI+CL)
			6	SS	67/ 0.250		334							
333.4			7	SS	50/ 0.0									
5.5	END OF BOREHOLE UPON AUGER REFUSAL. INFERRED GROUNDWATER LEVEL AT 0.8m. BOREHOLE DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE TO 0.6m, THEN TOPSOIL TO SURFACE.													

ONTMT4S2 MTO-11375(GINTDATA)\GPJ 2017\TEMPLATE(MTO)_GDT 6/29/21

RECORD OF BOREHOLE No WL16 E-S02

1 OF 1

METRIC

GWP# 408-88-00 LOCATION , MTM NAD 83 Zone 10: N 4 823 418.7 E 240 506.2 ORIGINATED BY MC
DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY BH
DATUM Geodetic DATE 2021.04.13 - 2021.04.13 LATITUDE 43.547927 LONGITUDE -80.295669 CHECKED BY JA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100		
339.2	GROUND SURFACE													
0.0	TOPSOIL: (50mm)													
0.1	Gravelly SAND, some silt, trace asphalt fragments Compact to Dense Brown Moist (FILL)		1	SS	26		339							
			2	SS	36		338							
			3	SS	27									
337.0							337							
2.2	Sandy GRAVEL to Gravelly SAND, some silt, some clay Compact to Very Dense Brown Wet		4	SS	50/ 0.075									
			5	SS	50/ 0.100		336							
			6	SS	26		335							
			7	SS	50/ 0.075									
334.0			8	SS	50/ 0.00									
5.2	END OF BOREHOLE AT 5.2m UPON AUGER REFUSAL. INFERRED GROUNDWATER LEVEL AT 2.3m. BOREHOLE DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE TO 0.6m, THEN TOPSOIL TO SURFACE.													

ONTMT4S2 MTO-11375(GINTDATA)\GPJ 2017TEMPLATE(MTO)_GDT 6/29/21

RECORD OF BOREHOLE No WL16 E-S03

1 OF 1

METRIC

GWP# 408-88-00 LOCATION , MTM NAD 83 Zone 10: N 4 823 383.1 E 240 540.1 ORIGINATED BY MC
 DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY BH
 DATUM Geodetic DATE 2021.04.15 - 2021.04.15 LATITUDE 43.547609 LONGITUDE -80.295245 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	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa				WATER CONTENT (%)				
338.7	GROUND SURFACE					▽	338	20 40 60 80 100				w _p w w _L			kN/m ³	GR SA SI CL
0.0	TOPSOIL: (150mm)							○ UNCONFINED + FIELD VANE								
0.2	Gravelly SAND , some silt, trace asphalt fragments Dense to Very Dense Brown Dry to Moist (FILL)		1	SS	41			● QUICK TRIAXIAL × LAB VANE								
			2	SS	54											
337.2								337	336							
1.4	SILT , some clay, some gravel, trace sand Stiff Dark Grey Moist		3	SS	14											
336.5	Sandy GRAVEL to Gravelly SAND , some silt Dense to Very Dense Brown Moist		4	SS	48								57 31 12 (SI+CL)			
2.2																
			5	SS	50/ 0.100											
334.3						335										
4.4	BOREHOLE ENDS AT 4.4m UPON AUGER REFUSAL.INFERRED GROUNDWATER LEVEL AT 1.5m. BOREHOLE DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH HOLEPLUG.		6	SS	50/ 0.00											





ONTMT4S2 MTO-11375(GINTDATA)\GPJ 2017TEMPLATE(MTO)_GDT 6/29/21

RECORD OF BOREHOLE No WL16 E-S04

1 OF 1

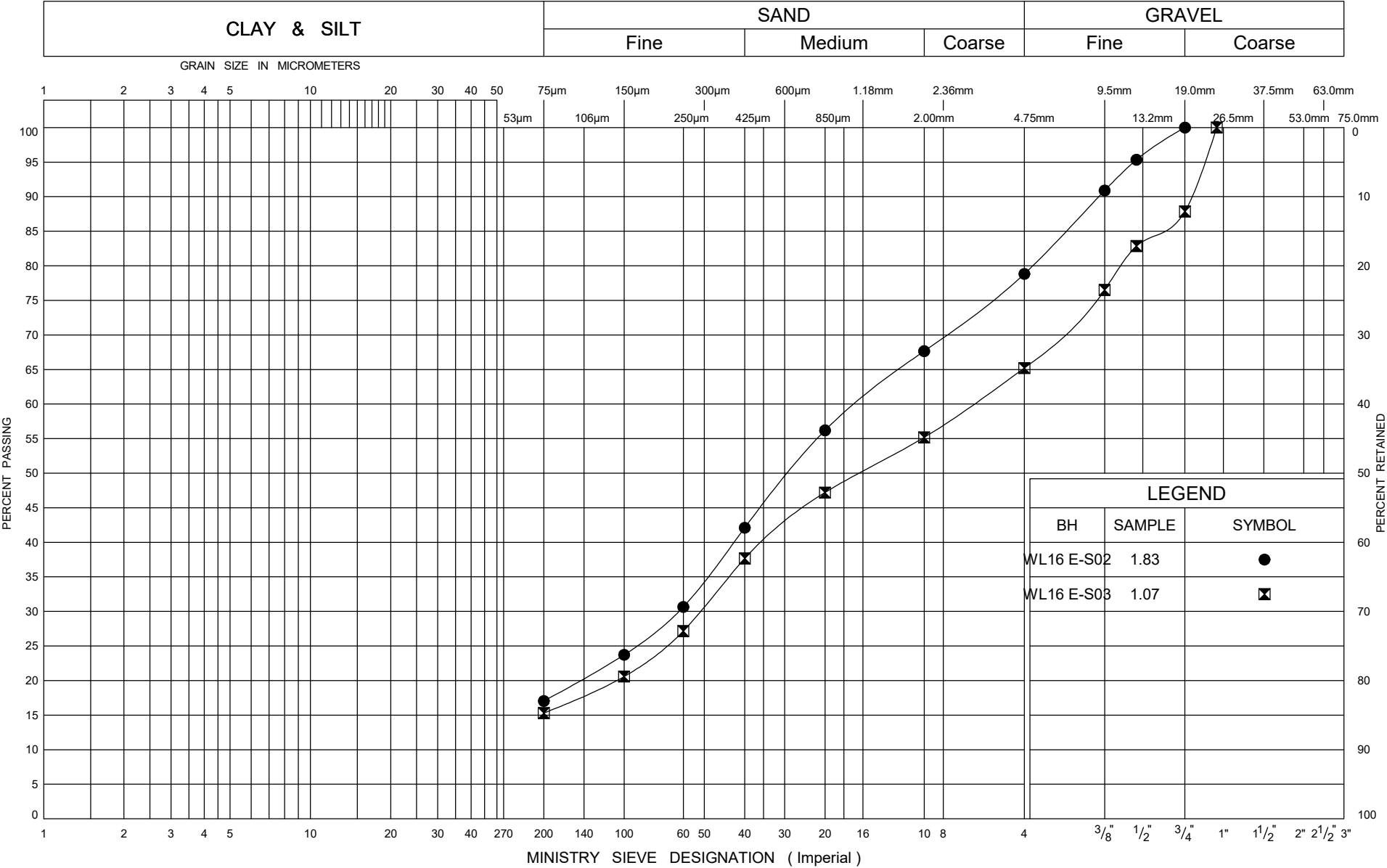
METRIC

GWP# 408-88-00 LOCATION , MTM NAD 83 Zone 10: N 4 823 347.5 E 240 574.9 ORIGINATED BY MC
DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY BH
DATUM Geodetic DATE 2021.04.13 - 2021.04.13 LATITUDE 43.547292 LONGITUDE -80.294811 CHECKED BY JA

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT NATURAL LIMIT MOISTURE LIQUID CONTENT LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE				WATER CONTENT (%) w _P w w _L					
338.9	GROUND SURFACE							20	40	60	80	100					
0.0 0.1	TOPSOIL: (75mm)		1	SS	24	▽	338							○			
337.8	SILT, some sand, trace gravel, trace organics Compact Brown Wet (FILL)																
1.1	Silty SAND, trace gravel, occasional asphalt fragments Loose Brown Wet (FILL)		2	SS	25												
																○	
336.7																	
2.2	Sandy GRAVEL to Gravelly SAND, some silt Compact to Very Dense Brown Wet		4	SS	22											○	
			5	SS	24												
			6	SS	38		335										
334.0			7	SS	50/												
4.8	END OF BOREHOLE AT 4.8m UPON AUGER REFUSAL. INFERRED GROUNDWATER LEVEL AT 1.5m. BOREHOLE DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH HOLEPLUG TO 0.6m, THEN TOPSOIL TO SURFACE.				0.125												

ONTMT4S2 MTO-11375(GINTDATA).GPJ 2017TEMPLATE(MTO).GDT 6/29/21

ONTARIO MOT GRAIN SIZE 2 MTO-11375(GINTDATA)\GPJ_ONTARIO MOT.GDT 6/29/21



GRAIN SIZE DISTRIBUTION

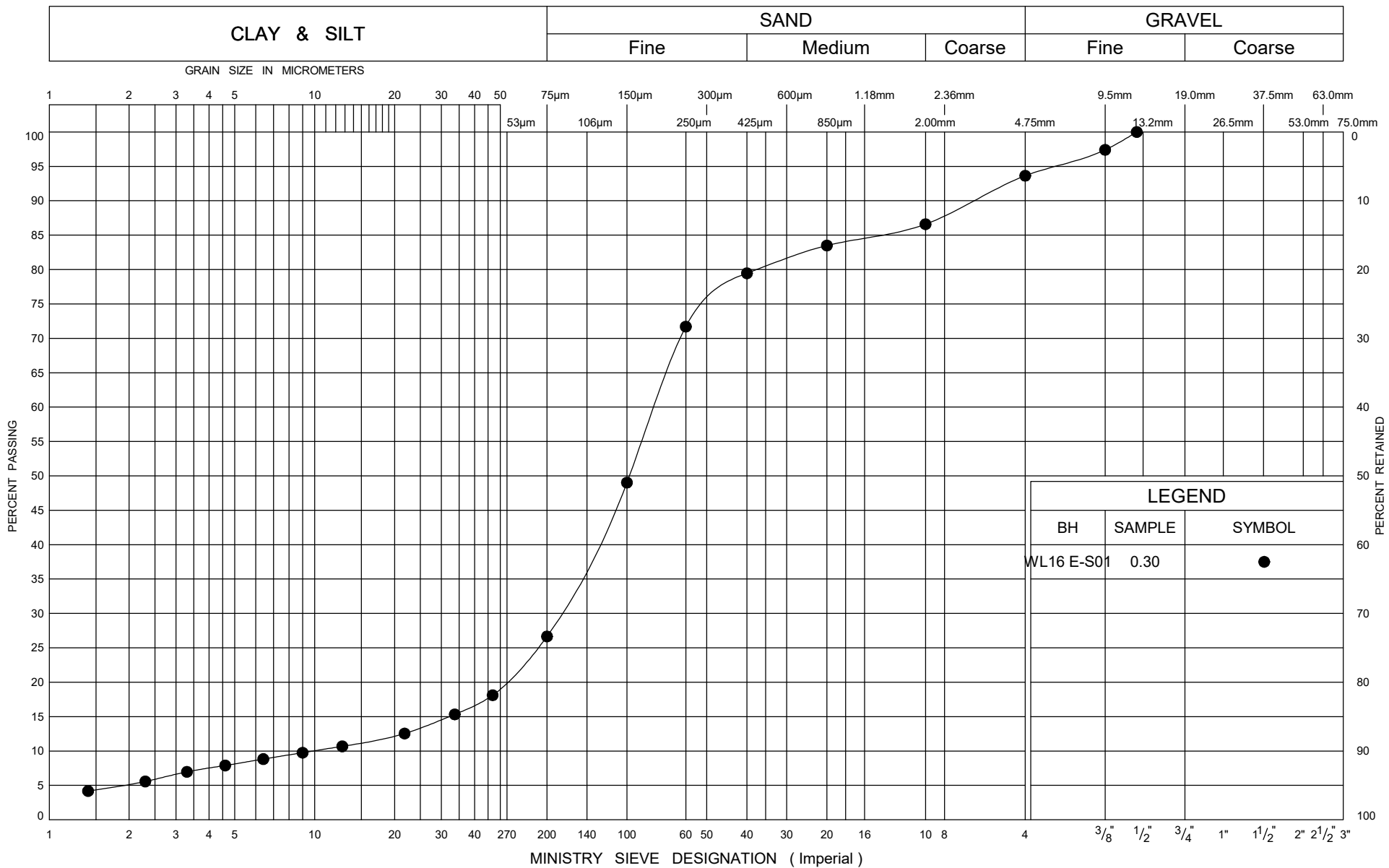
Gravelly SAND FILL

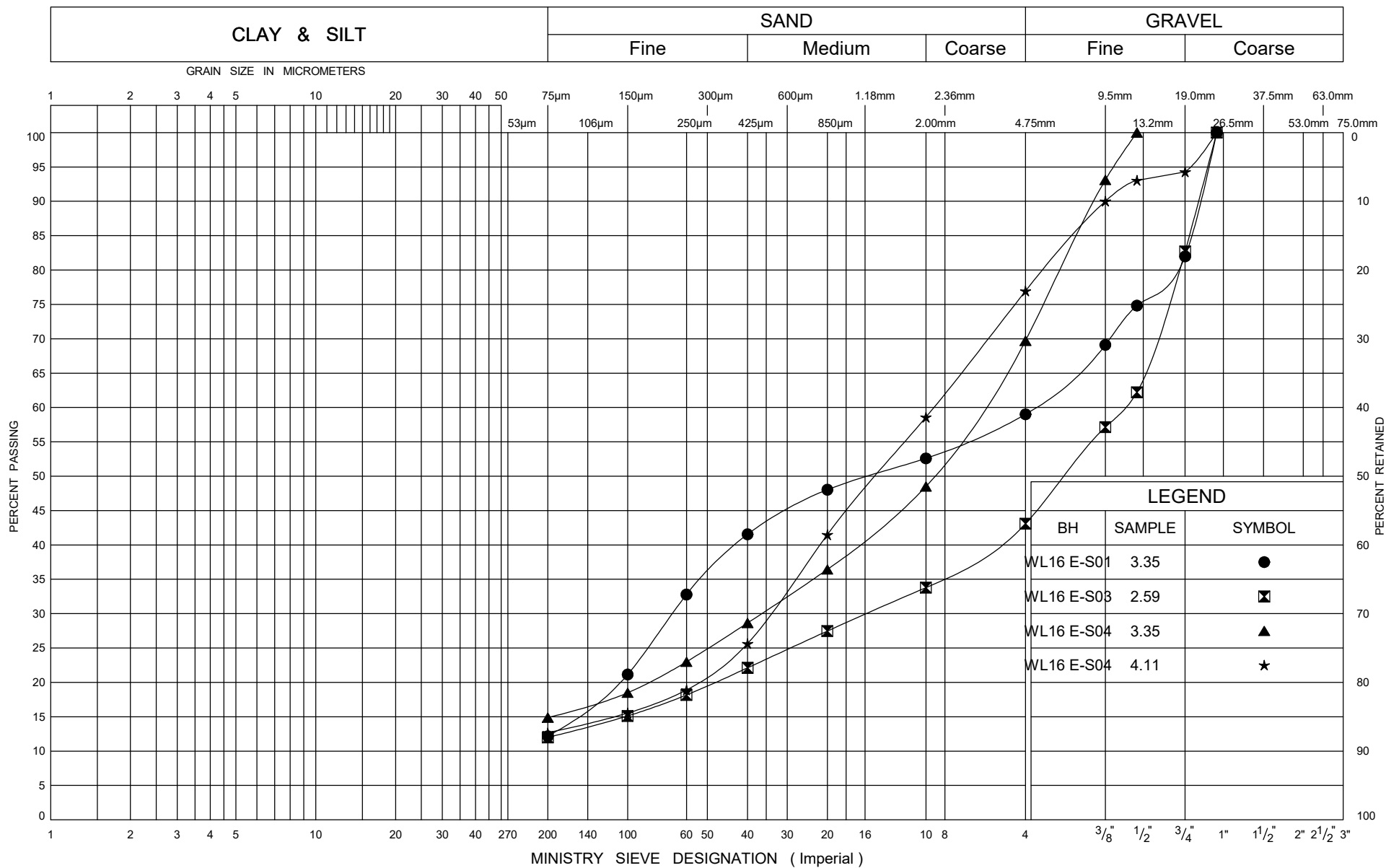
FIG No C1





W P 408-88-00

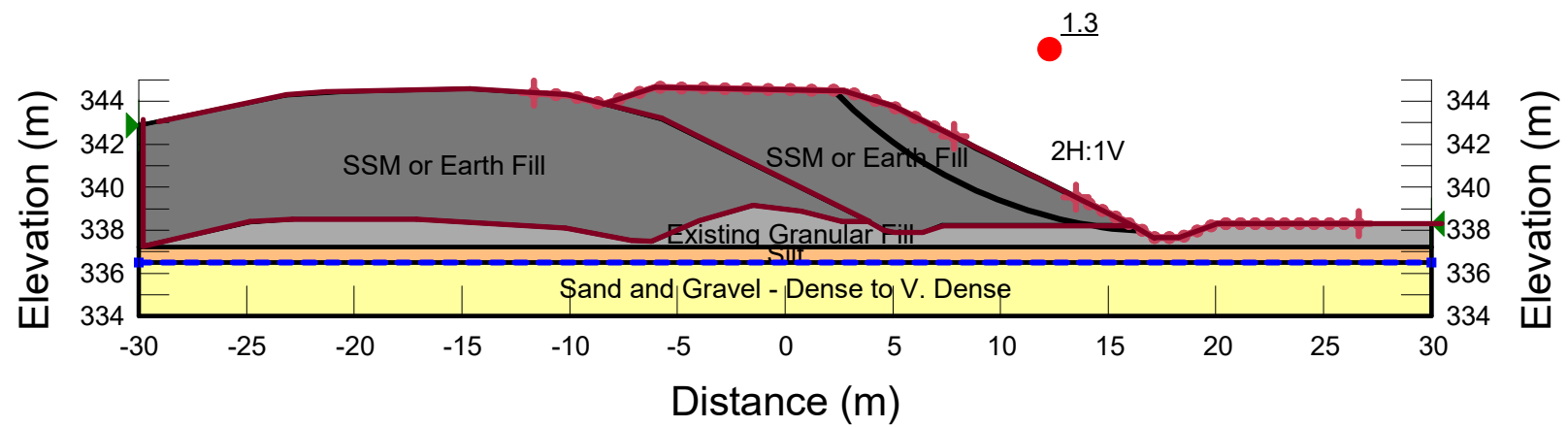
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

ONTARIO MOT GRAIN SIZE 2 MTO-11375(GINTDATA)\GPJ_ONTARIO MOT.GDT 6/29/21

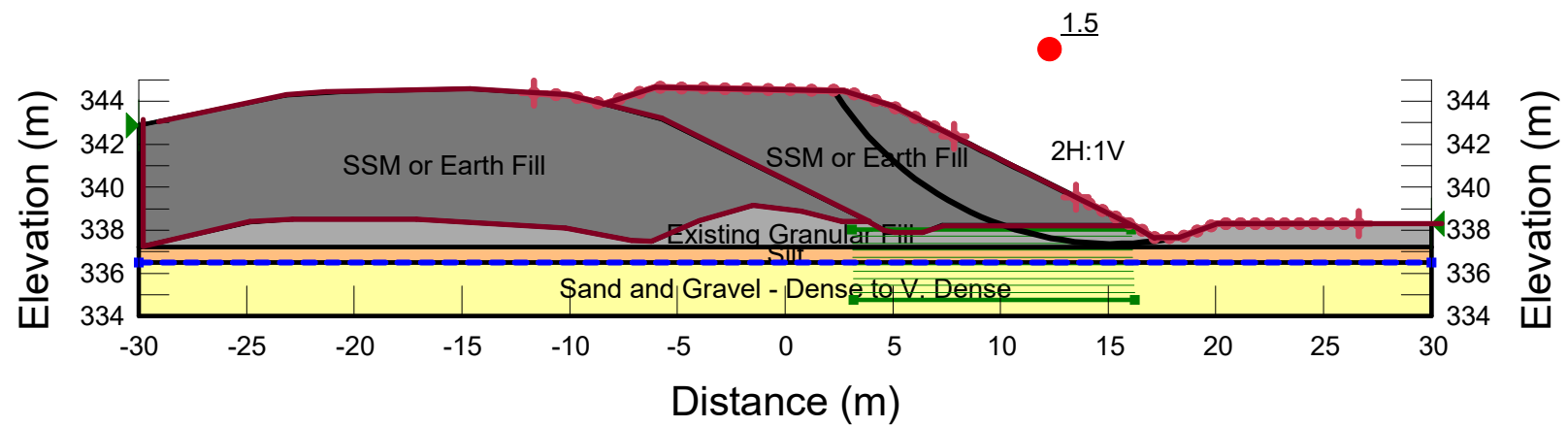








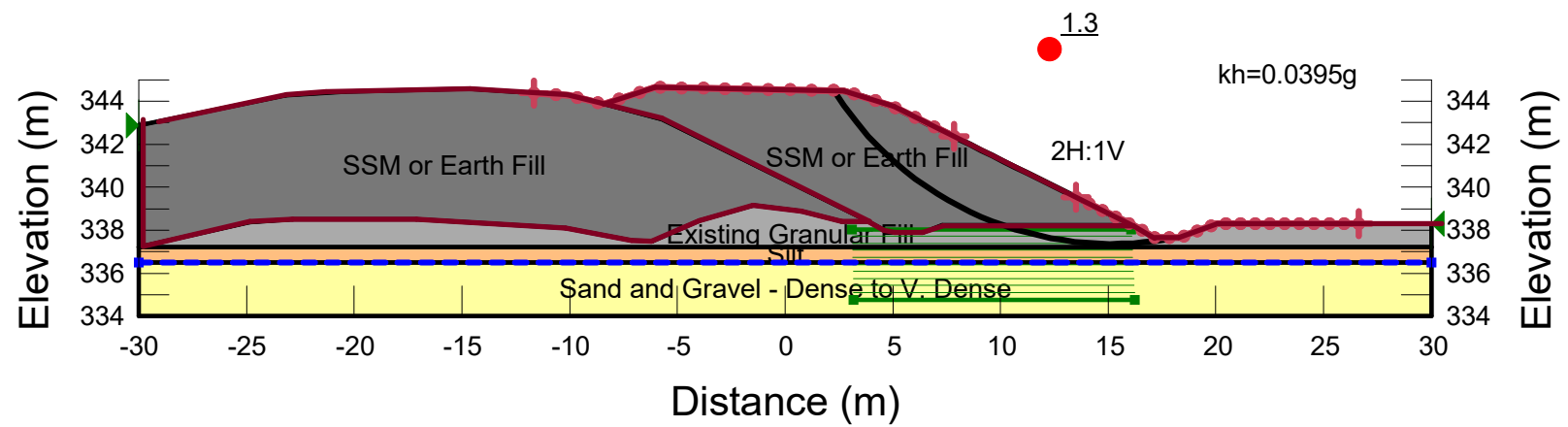
Color	Name	Unit Weight (kN/m ³)	Effective Cohesion (kPa)	Effective Friction Angle (°)
	Existing Granular Fill	21	0	31
	Sand and Gravel - Dense to V. Dense	22	0	33
	Silt	20	0	28
	SSM or Earth Fill	21.5	0	30



Color	Name	Unit Weight (kN/m ³)	Effective Cohesion (kPa)	Effective Friction Angle (°)
	Existing Granular Fill	21	0	31
	Sand and Gravel - Dense to V. Dense	22	0	33
	Silt	20	0	28
	SSM or Earth Fill	21.5	0	30



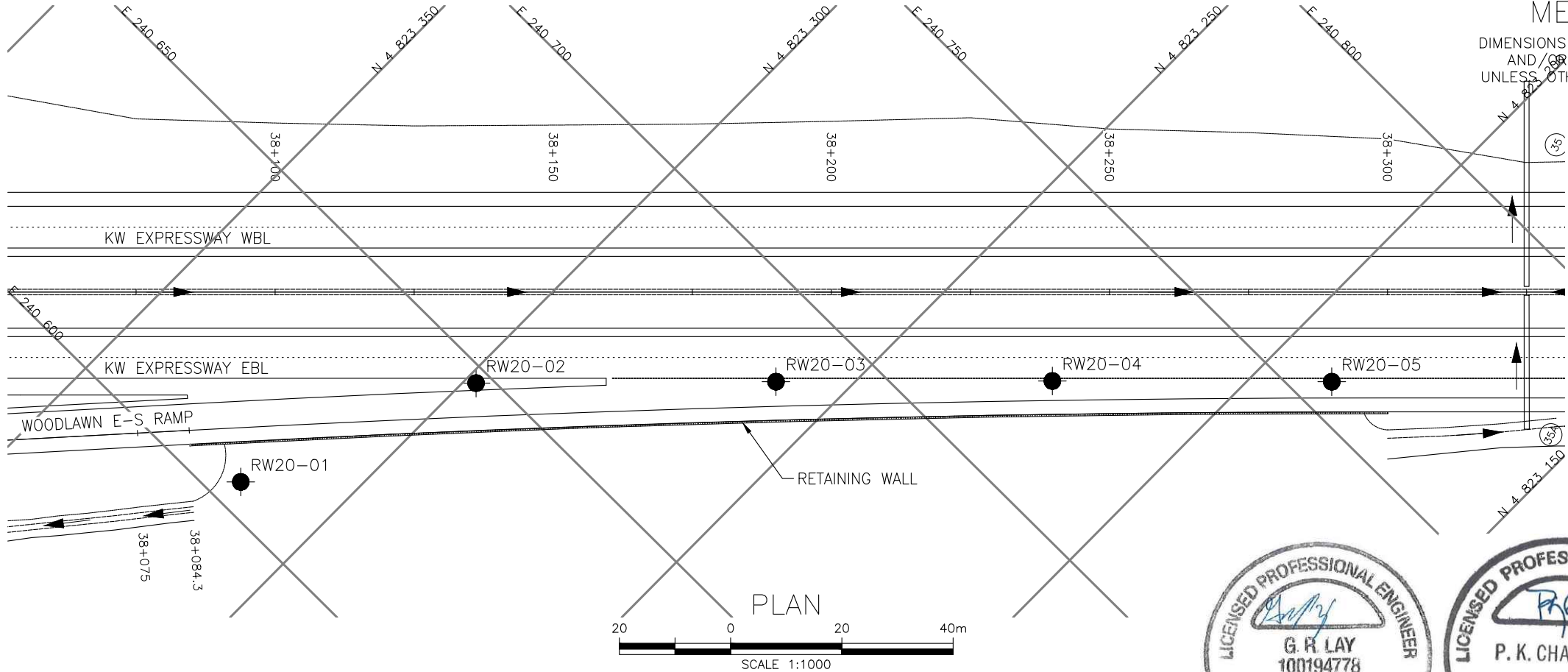
Color	Name	Unit Weight (kN/m ³)	Effective Cohesion (kPa)	Effective Friction Angle (°)
	Existing Granular Fill	21	0	31
	Sand and Gravel - Dense to V. Dense	22	0	33
	Silt	20	0	28
	SSM or Earth Fill	21.5	0	30





Appendix D

Woodlawn E-S Ramp Sta. 38+100 to 38+300 (RW20-01 to RW20-05)



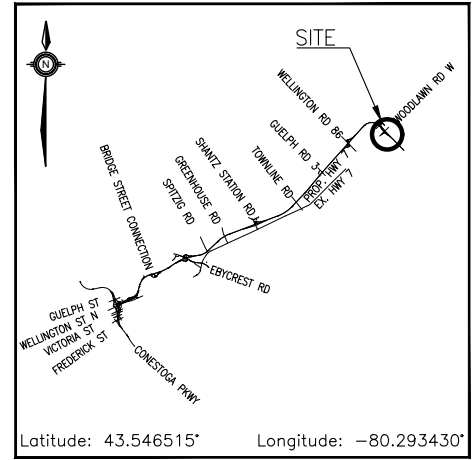
METRIC
DIMENSIONS ARE IN METRES
AND / OR MILLIMETRES
UNLESS OTHERWISE SHOWN

CONT No
GWP No 408-88-00

HIGHWAY 7
E-S RAMP WOODLAWN ROAD
PROPOSED RETAINING WALL
BOREHOLE LOCATIONS AND SOIL STRATA



THURBER ENGINEERING LTD.



KEYPLAN

LEGEND

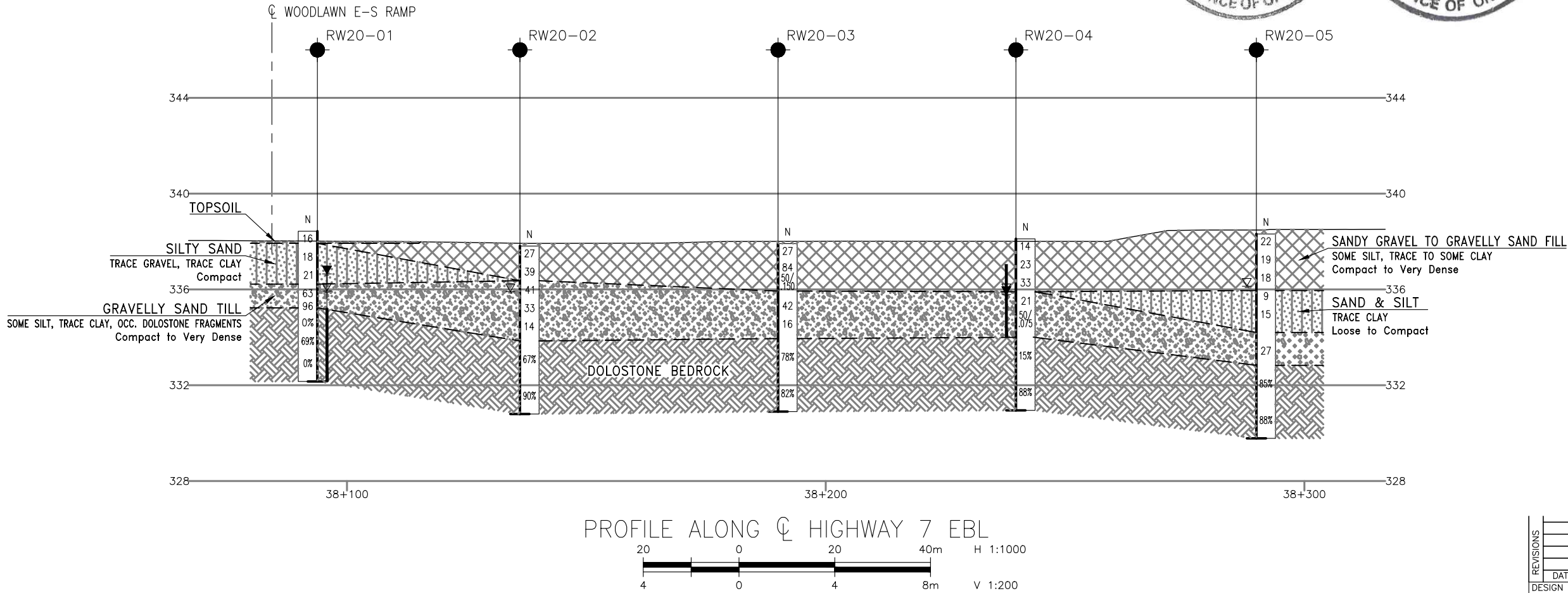
- Borehole (Current Investigation)
- Borehole (Previous Investigation)
- N Blows /0.3m (Std Pen Test, 475J/blow)
- CONE Blows /0.3m (60° Cone, 475J/blow)
- PH Pressure, Hydraulic
- ▽ Water Level
- ▽ Head Artesian Water
- ▽ Piezometer
- 90% Rock Quality Designation (RQD)
- A/R Auger Refusal

NO	ELEVATION	NORTHING	EASTING
RW20-01	338.4	4 823 315.8	240 605.1
RW20-02	337.8	4 823 298.2	240 647.5
RW20-03	337.9	4 823 260.1	240 685.6
RW20-04	338.1	4 823 224.9	240 720.7
RW20-05	338.3	4 823 189.1	240 756.0

-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. 40P9-64



REVISIONS	DATE	BY	DESCRIPTION
DESIGN	JA	CHK	PKC
DRAWN	MFA	CHK	JA
LOAD	DATE	AUG	2021
STRUCT	DWG	1	

RECORD OF BOREHOLE No RW20-01

1 OF 1

METRIC

GWP# 408-88-00 LOCATION Woodlawn Rd. Interchange RW, MTM NAD 83 Zone 10: N 4 823 315.8 E 240 605.1 ORIGINATED BY MC
DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers/NQ Coring COMPILED BY BH
DATUM Geodetic DATE 2021.04.15 - 2021.04.15 LATITUDE 43.547009 LONGITUDE -80.294433 CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100		
338.4	GROUND SURFACE													
0.0	TOPSOIL: (100mm)													
0.1	Silty SAND , trace gravel, trace clay Compact Brown Moist		1	SS	16		338							
			2	SS	18		337							3 68 25 4
			3	SS	21		336							
336.2	Gravelly, silty SAND , trace clay Very Dense Brown Wet (TILL)		4	SS	63		335							
			5	SS	96		334							
335.2	DOLOSTONE , slightly weathered, very thinly laminated						333							
3.2	Horizontal fracture at 3.3m, 3.4m, 3.8m, 3.9m, 4.1m, 4.2m, and 4.3m Vertical fracture (50mm) at 3.3m, (100mm) at 3.6m and (75mm) at 4.1m Sub-horizontal fracture at 3.9m Horizontal fracture (75mm) at 4.6m		1	RUN										RUN #1 TCR=100% SCR=42% RQD=0%
			2	RUN										RUN #2 TCR=100% SCR=100% RQD=69%
			3	RUN										RUN #3 TCR=100% SCR=50% RQD=0%
332.2	END OF BOREHOLE AT 6.3m. WATER LEVEL AT 2.5m UPON COMPLETION OF DRILLING. Monitoring Well installation consists of 50mm diameter Schedule 40 PVC pipe with a 3.05m slotted screen.													
6.3	WATER LEVEL READINGS DATE DEPTH(m) ELEV.(m) 2021.04.16 1.8 336.6													

ONTMT4S2 MTO-11375(GINTDATA)\GPJ 2017TEMPLATE(MTO)_GDT 8/4/21

RECORD OF BOREHOLE No RW20-02

1 OF 1

METRIC

GWP# 408-88-00 LOCATION Woodlawn Rd. Interchange RW, MTM NAD 83 Zone 10: N 4 823 298.2 E 240 647.5 ORIGINATED BY GA
DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers/NQ Coring COMPILED BY BH
DATUM Geodetic DATE 2021.04.13 - 2021.04.13 LATITUDE 43.546855 LONGITUDE -80.293906 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 γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa				WATER CONTENT (%)						
337.8	GROUND SURFACE							20	40	60	80	100	W _P	W	W _L			
0.0	Sandy GRAVEL to Gravelly SAND , some silt, trace clay Compact to Dense Grey to Brown Dry (FILL)		1	SS	27		337										60 30 10 (SI+CL)	
			2	SS	39		337											
336.4							336											
1.4	Gravelly, silty SAND , trace clay Dense to Compact Brown Wet (TILL)		3	SS	41		336											
			4	SS	33		335											
			5	SS	14		335											
							334											
333.8							334											FI
4.0	DOLOSTONE , fresh, bedded. grey to beige Horizontal fracture at 4.2m, 4.4m, 4.5m, 4.8m, 5.1m, 5.2m, and 5.4m Highly broken zone (175mm) at 4.9m Horizontal fracture at 5.6m, 5.7m, 5.8m, and 6.0m Sandstone layer (900mm) at 5.9m		1	RUN			333											1 3 1 1 2 3 2 0 0 0
								333										
							332											
							332											
330.8							331											
7.0	END OF BOREHOLE AT 7.0m BOREHOLE CAVED IN AT 3.8m AND WATER LEVEL AT 1.9m.																	

ONTMT4S2 MTO-11375(GINTDATA)\GPJ 2017TEMPLATE(MTO)_GDT 8/4/21

RECORD OF BOREHOLE No RW20-03

1 OF 1

METRIC

GWP# 408-88-00 LOCATION Woodlawn Rd. Interchange RW, MTM NAD 83 Zone 10: N 4 823 260.1 E 240 685.6 ORIGINATED BY GA
DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers/NQ Coring COMPILED BY BH
DATUM Geodetic DATE 2021.04.08 - 2021.04.08 LATITUDE 43.546515 LONGITUDE -80.293430 CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100		
337.9 0.0	GROUND SURFACE													
	Sandy GRAVEL to Gravelly SAND , some silt, some clay Compact to Very Dense Brown Dry (FILL)		1	SS	27		337							42 44 14 (SI+CL)
			2	SS	84									
			3	SS	50/ 0.150									
335.9 2.0	Gravelly, silty SAND , trace clay, occasional dolostone fragments Dense to Compact Brown Wet (TILL)		4	SS	42		336							
			5	SS	16		335							
333.9 4.0	DOLOSTONE , fresh, bedded, beige Horizontal joints at 4.1m, 4.2m, 4.5m, 4.7m, 4.8m, 4.9m, and 5.0m Highly broken zone (50mm) at 4.7m and 4.9m Horizontal joints at 5.7m, and 6.1m Highly broken zone (125mm) at 5.8m		1	RUN			334							RUN #1 TCR=100% SCR=92% RQD=78%
				SS			333							RUN # TCR=100% SCR=92% RQD=82%
332														
331														
330.9 7.0	END OF BOREHOLE AT 7.0m. BOREHOLE OPEN AND WATER LEVEL AT 2.1m UPON COMPLETION. BOREHOLE BACKFILLED WITH HOLEPLUG TO 0.3m, THEN SAND AND GRAVEL TO SURFACE.													

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RECORD OF BOREHOLE No RW20-04

1 OF 1

METRIC

GWP# 408-88-00 LOCATION Woodlawn Rd. Interchange RW, MTM NAD 83 Zone 10: N 4 823 224.9 E 240 720.7 ORIGINATED BY GA
DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers/NQ Coring COMPILED BY BH
DATUM Geodetic DATE 2021.04.13 - 2021.04.13 LATITUDE 43.546201 LONGITUDE -80.292992 CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100		
338.1	GROUND SURFACE													
0.0	Sandy GRAVEL to Gravelly SAND , some silt, some clay Compact to Dense Brown Dry (FILL)		1	SS	14		338							
			2	SS	23		337							
			3	SS	33		336							
335.9														
2.2	Gravelly, silty SAND , trace clay Compact to Very Dense Brown Wet (TILL)		4	SS	21		335							
			5	SS	50/ 0.075		334							
334.0														
4.1	DOLOSTONE , fresh, beige Horizontal fracture at 4.2m, 4.3m, 4.4m, 4.5m, 4.7m, 4.9m, 5.0m, 5.1m, 5.2m, 5.3m, and 5.6m Vertical joints (100mm) at 4.3m, (175mm) at 4.5m, (425mm) at 4.9m, and (75mm) at 5.6m Horizontal joint at 5.9m, 6.0m, 6.1m, 6.7m and 6.8m		1	RUN			333							
			2	RUN			332							
331.0														
7.2	END OF BOREHOLE AT 7.2m. BOREHOLE OPEN AND WATER LEVEL AT 2.2m. Monitoring Well 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 2.3 335.8						331							

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RECORD OF BOREHOLE No RW20-05

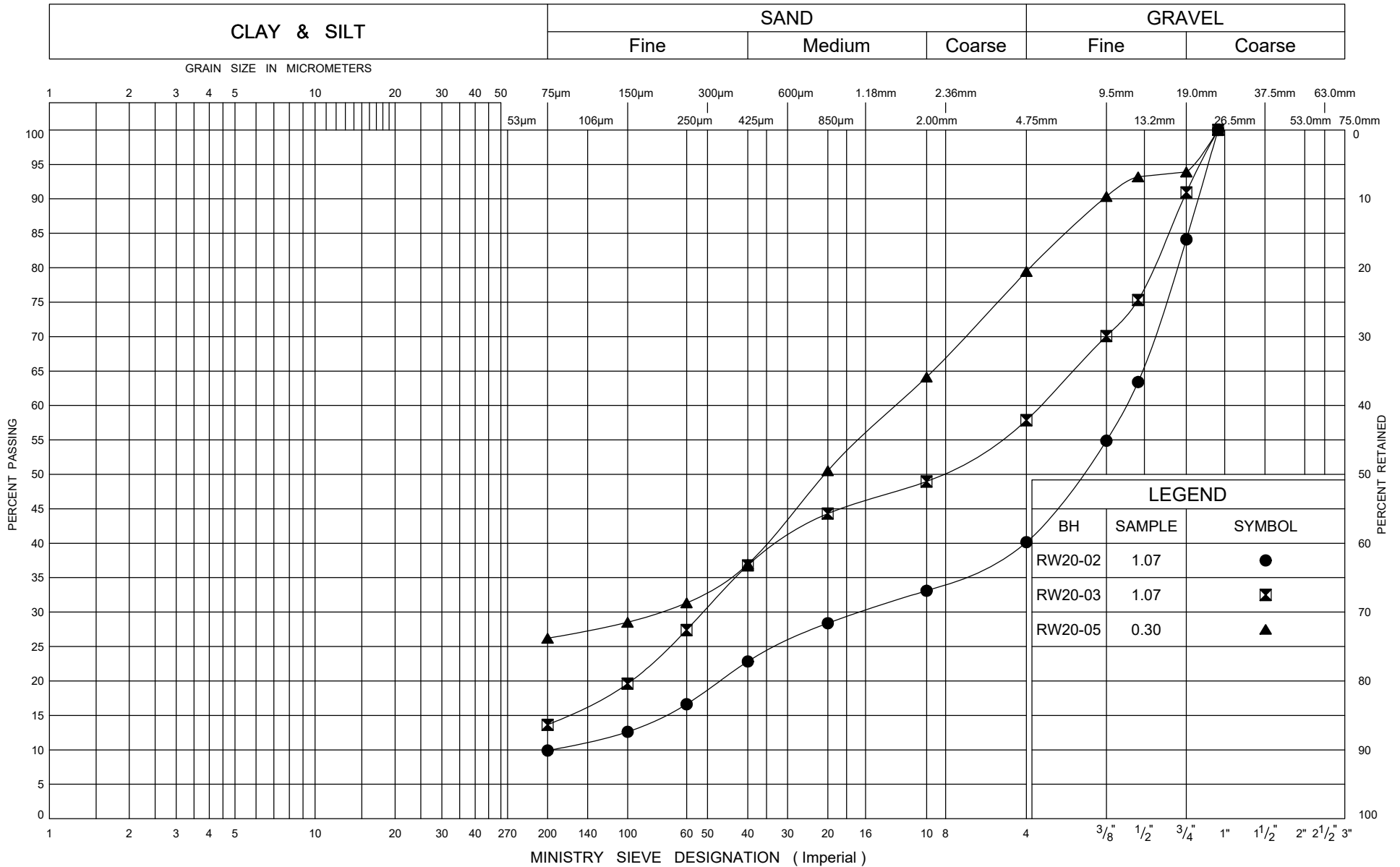
1 OF 1

METRIC

GWP# 408-88-00 LOCATION Woodlawn Rd. Interchange RW, MTM NAD 83 Zone 10: N 4 823 189.1 E 240 756.0 ORIGINATED BY GA
 DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers/NQ Coring COMPILED BY BH
 DATUM Geodetic DATE 2021.04.14 - 2021.04.14 LATITUDE 43.545882 LONGITUDE -80.292551 CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100		
338.3 0.0	GROUND SURFACE													
	Sandy GRAVEL to Gravelly SAND , some silt, trace clay Compact Brown Dry (FILL)		1	SS	22		338							21 53 26 (SI+CL)
			2	SS	19		337							
			3	SS	18		336							
336.0 2.4	SAND and SILT , some clay Loose to Compact Greyish Brown Wet		4	SS	9		335							0 48 45 7
			5	SS	15		334							
334.2 4.1	Gravelly, silty SAND , trace clay, occasional dolostone fragments Compact Wet (TILL)		6	SS	27		333							
332.8 5.5	DOLOSTONE , fresh, bedded, beige Horizontal joints at 5.5m, 5.6m, 6.3m, 6.5m, and 6.6m		1	RUN			332							RUN #1 TCR=100% SCR=100% RQD=85%
			2	RUN			331							RUN #2 TCR=100% SCR=100% RQD=88%
329.8 8.5	END OF BOREHOLE AT 8.5m. BOREHOLE OPEN AND WATER LEVEL AT 2.2m UPON COMPLETION.						330							

ONTMT4S2 MTO-11375(GINTDATA)\GPJ 2017TEMPLATE(MTO)_GDT 8/4/21



Ministry of
Transportation

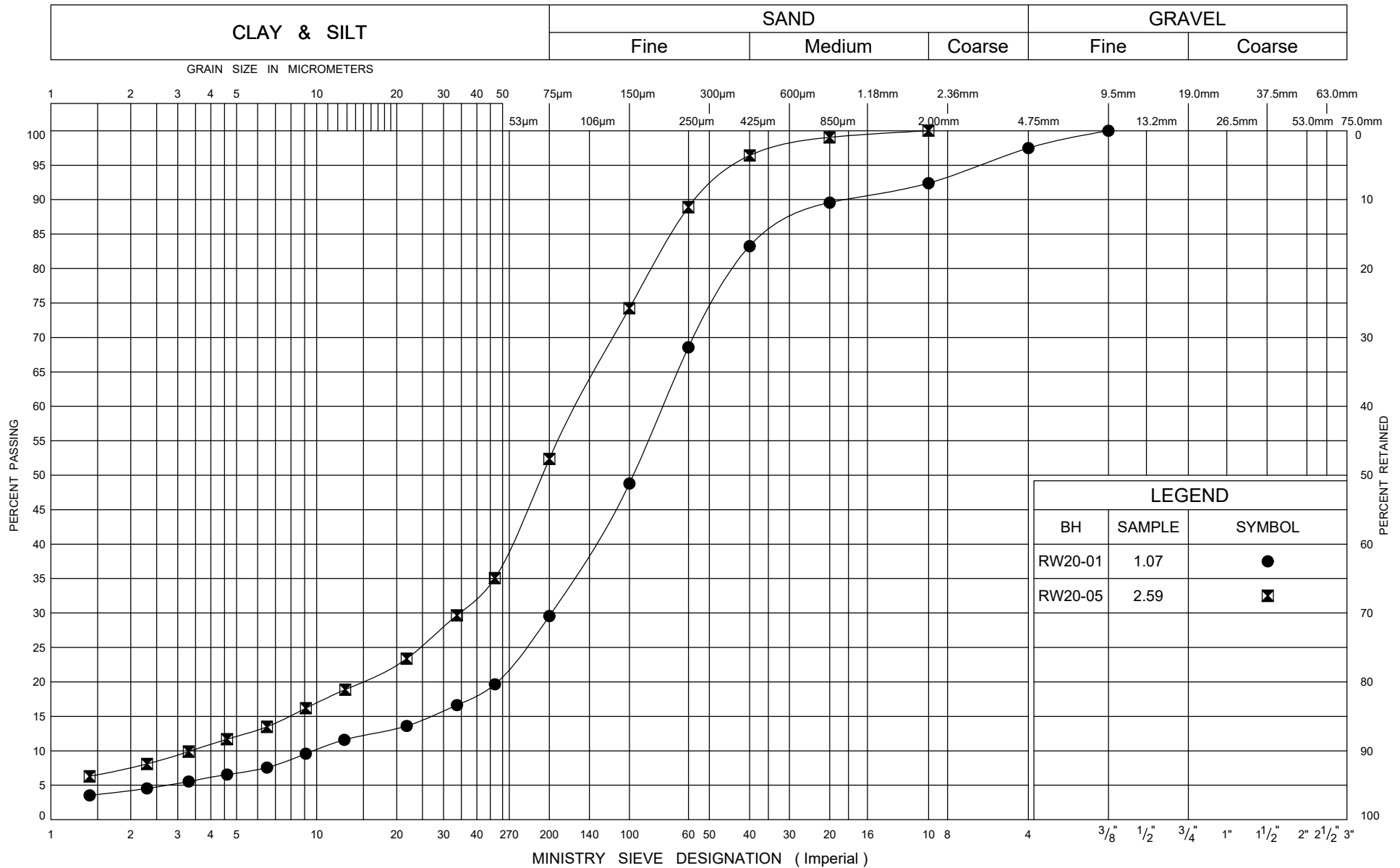
GRAIN SIZE DISTRIBUTION

Granular FILL

FIG No D1

W P 408-88-00

Woodlawn Rd. Interchange RW



Ministry of
Transportation

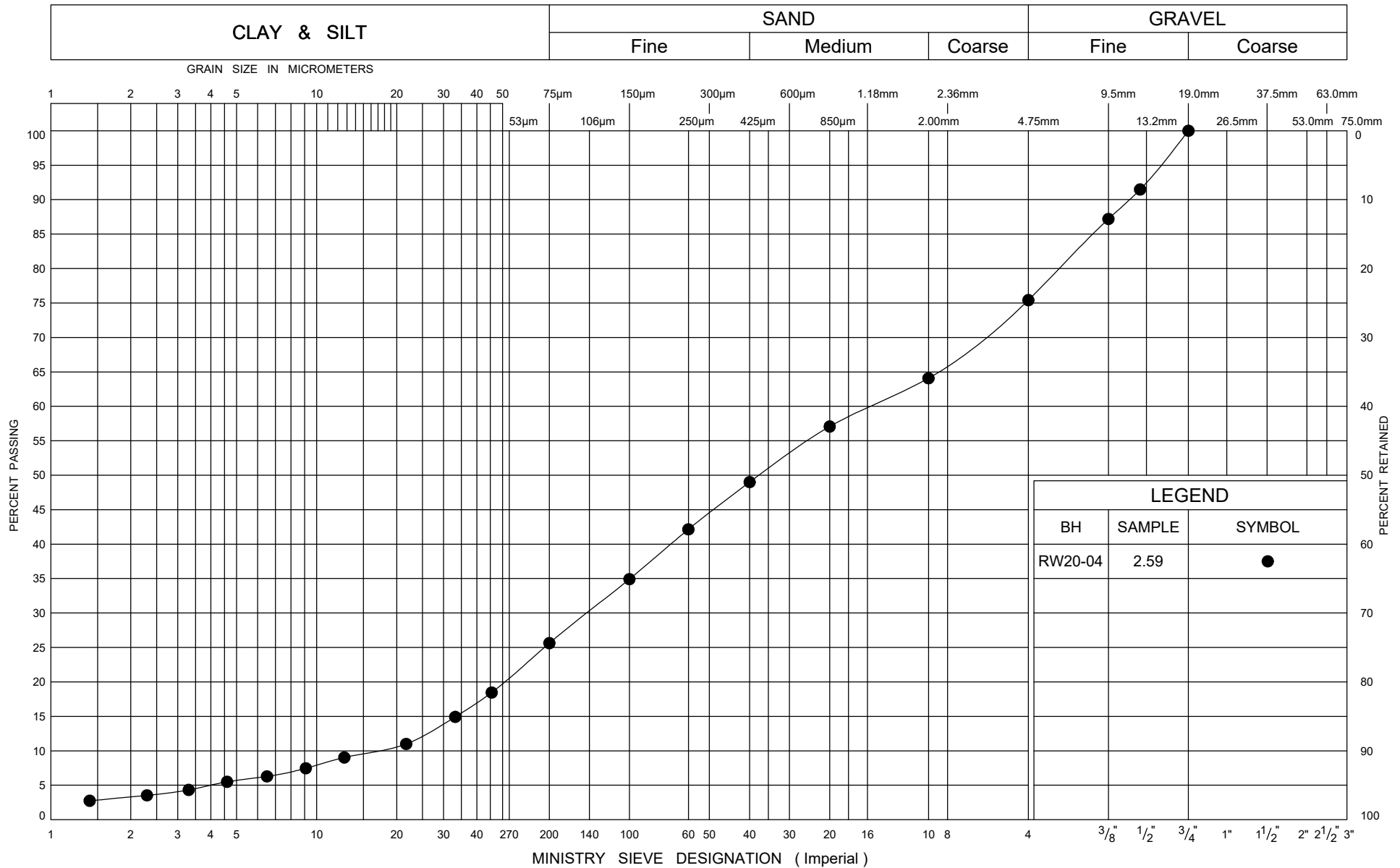
GRAIN SIZE DISTRIBUTION

Silty SAND

FIG No D2

W P 408-88-00

Woodlawn Rd. Interchange RW



Ministry of
Transportation

GRAIN SIZE DISTRIBUTION

Gravelly Silty SAND TILL

FIG No D3

W P 408-88-00

Woodlawn Rd. Interchange RW

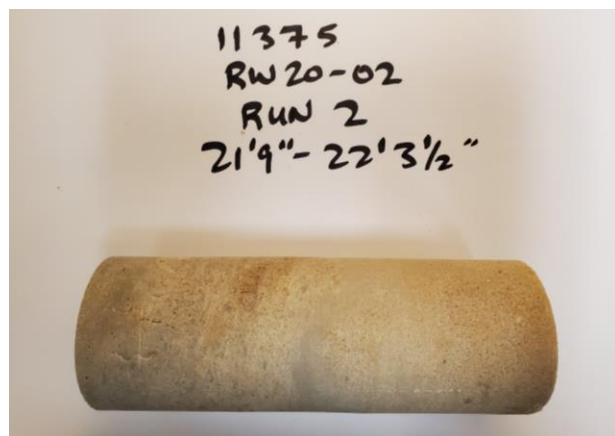
UNCONFINED COMPRESSION TEST REPORT

ASTM D7012-14

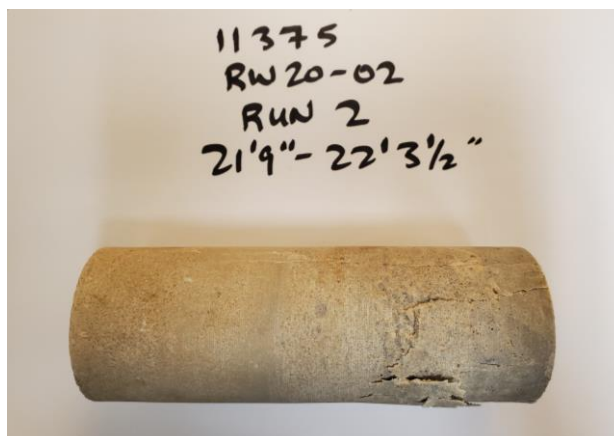
CLIENT:	WSP Canada Group Ltd.	FILE NUMBER:	11375
PROJECT NAME:	Hwy 7 New PD and DD Foundations	REPORT DATE:	5-May-21
BOREHOLE No.:	RW20-02	TEST DATE:	4-May-21
SAMPLE No.:	HQ Run 2		
SAMPLE DEPTH:	21'9" - 22'3.5"		
DESCRIPTION:	Dolostone		

Avg. Height (cm):	16.0	Weight (g):	1257.6
Avg. Diameter (cm):	6.3	Wet Density (kg/m ³):	2,521
H. to Dia. Ratio**:	2.5:1	Dry Density (kg/m ³):	2,521
Cross Sectional Area (cm ²):	31.17	Moisture Content* (%):	N/A
Sample Volume (cm ³):	498.76		

ORIGINAL SPECIMEN



FRACTURED SPECIMEN



AVG. RATE OF STRAIN TO FAILURE:	0.9% / min
MAXIMUM COMPRESSIVE LOAD:	137.7 kN
UNCONFINED COMPRESSIVE STRENGTH:	44.2 MPa

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

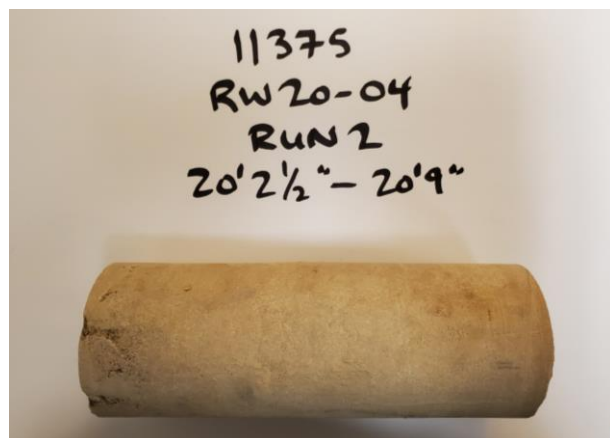
UNCONFINED COMPRESSION TEST REPORT

ASTM D7012-14

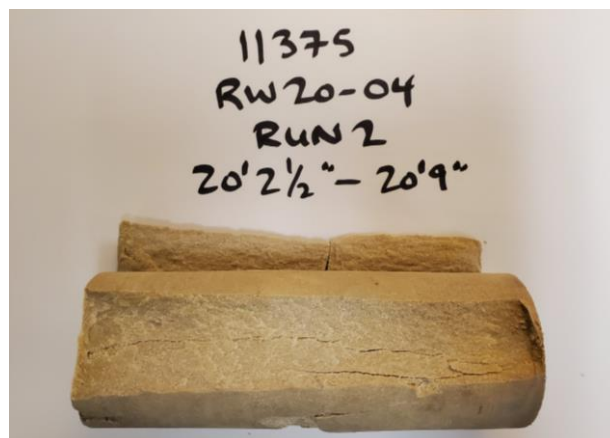
CLIENT:	WSP Canada Group Ltd.	FILE NUMBER:	11375
PROJECT NAME:	Hwy 7 New PD and DD Foundations	REPORT DATE:	5-May-21
BOREHOLE No.:	RW20-04	TEST DATE:	4-May-21
SAMPLE No.:	HQ Run 2		
SAMPLE DEPTH:	20'2.5" - 20'9"		
DESCRIPTION:	Dolostone		

Avg. Height (cm):	15.7	Weight (g):	1202.2
Avg. Diameter (cm):	6.3	Wet Density (kg/m ³):	2,456
H. to Dia. Ratio**:	2.5:1	Dry Density (kg/m ³):	2,456
Cross Sectional Area (cm ²):	31.17	Moisture Content* (%):	N/A
Sample Volume (cm ³):	489.41		

ORIGINAL SPECIMEN



FRACTURED SPECIMEN



AVG. RATE OF STRAIN TO FAILURE:	1.0% / min
MAXIMUM COMPRESSIVE LOAD:	154.6 kN
UNCONFINED COMPRESSIVE STRENGTH:	49.6 MPa

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

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

Job No : 11375 Client : WSP
Date Drilled : 15-Apr-20
Project Name : Woodlawn Road Interchange Project Date Tested : 21-Apr-20
Core Size : HQ BH No : RW 20-01 Tester : GP

Test No.	Run No.	Depth (m)	Axial or Diametral	Gauge (MPa)	Diameter (mm)	Length (mm)	UCS (MPa)	Rock Type	Notes
1	1	3.4	A	21.0	63.4	65.6	106.9	Dolostone	Very Strong
2	1	3.8	D	14.4	63.4	109.9	90.9	Dolostone	Strong
3	1	4.3	D	28.5	63.4	91.4	179.4	Dolostone	Very Strong
4	2	4.5	A	16.4	63.3	66.1	83.2	Dolostone	Strong
5	3	4.8	A	21.8	63.4	73.5	101.6	Dolostone	Very Strong
6	3	5.4	D	14.5	63.3	111.8	91.6	Dolostone	Strong
7									
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33									
34									
35									

* It is ideal to perform axial test on core specimens with D/L ratio of 1.1 ± 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 : 13-Apr-20
Project Name : Woodlawn Road Interchange Project Date Tested : 21-Apr-20
Core Size : HQ BH No : RW 20-02 Tester : GP

Test No.	Run No.	Depth (m)	Axial or Diametral	Gauge (MPa)	Diameter (mm)	Length (mm)	UCS (MPa)	Rock Type	Notes
1	1	4.0	A	3.8	63.1	67.6	18.7	Dolostone	Weak
2	1	5.1	D	15.2	63.2	120.7	96.6	Dolostone	Strong
3	1	5.2	A	27.3	63.2	59.8	149.8	Dolostone	Very Strong
4	2	5.8	D	18.6	63.3	104.2	117.3	Dolostone	Very Strong
5	2	6.3	A	6.7	63.2	58.5	37.2	Dolostone	Medium Strong
6	2	6.9	D	5.0	63.2	116.6	31.9	Dolostone	Medium Strong
7									
8									
9									
10									
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35									

* It is ideal to perform axial test on core specimens with D/L ratio of 1.1 ± 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.

Last Modified: August 15, 2013



THURBER ENGINEERING LTD.

POINT LOAD TEST SHEET

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

Test No.	Run No.	Depth (m)	Axial or Diametral	Gauge (MPa)	Diameter (mm)	Length (mm)	UCS (MPa)	Rock Type	Notes
1	1	4.2	A	24.3	63.3	65.2	124.6	Dolostone	Very Strong
2	1	4.9	D	15.9	63.3	130.3	100.6	Dolostone	Very Strong
3	1	5.2	A	9.2	63.3	60.6	49.7	Dolostone	Medium Strong
4	2	5.6	D	16.3	63.3	116.2	103.3	Dolostone	Very Strong
5	2	6.1	A	14.2	63.3	63.0	74.6	Dolostone	Strong
6	2	7.0	D	8.1	63.2	97.9	51.5	Dolostone	Strong
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* It is ideal to perform axial test on core specimens with D/L ratio of 1.1 ± 0.1
Long pieces of core can be tested diametrically to produce suitable lengths for axial testing
* Diametral Test should have 0.7 x D on either side of test point.

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

Job No : 11375 Client : WSP
Date Drilled : 13-Apr-20
Project Name : Woodlawn Road Interchange Project Date Tested : 21-Apr-20
Core Size : HQ BH No : RW 20-04 Tester : GP

Test No.	Run No.	Depth (m)	Axial or Diametral	Gauge (MPa)	Diameter (mm)	Length (mm)	UCS (MPa)	Rock Type	Notes
1	1	4.2	A	9.6	63.2	61.0	52.0	Dolostone	Strong
2	1	4.7	A	14.0	63.2	72.2	66.4	Dolostone	Strong
3	1	5.5	D	5.2	63.3	131.2	33.1	Dolostone	Medium Strong
4	2	6.1	A	8.5	63.3	74.0	39.5	Dolostone	Medium Strong
5	2	6.6	D	14.2	63.3	131.0	89.5	Dolostone	Strong
6	2	6.8	D	15.6	63.3	106.4	98.3	Dolostone	Strong
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* It is ideal to perform axial test on core specimens with D/L ratio of 1.1 ± 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.

Last Modified: August 15, 2013

**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 : RW 20-05 Tester : GP

Test No.	Run No.	Depth (m)	Axial or Diametral	Gauge (MPa)	Diameter (mm)	Length (mm)	UCS (MPa)	Rock Type	Notes
1	1	5.7	A	7.9	63.1	63.0	41.6	Dolostone	Medium Strong
2	1	6.1	D	8.5	63.2	122.4	53.8	Dolostone	Strong
3	1	6.7	D	13.3	63.2	155.6	84.4	Dolostone	Strong
4	2	7.3	A	4.4	63.3	62.3	23.5	Dolostone	Weak
5	2	7.8	D	15.0	63.3	114.1	94.8	Dolostone	Strong
6	2	8.5	A	15.2	63.4	58.1	85.1	Dolostone	Strong
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* It is ideal to perform axial test on core specimens with D/L ratio of 1.1 ± 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





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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
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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
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General Chemistry

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

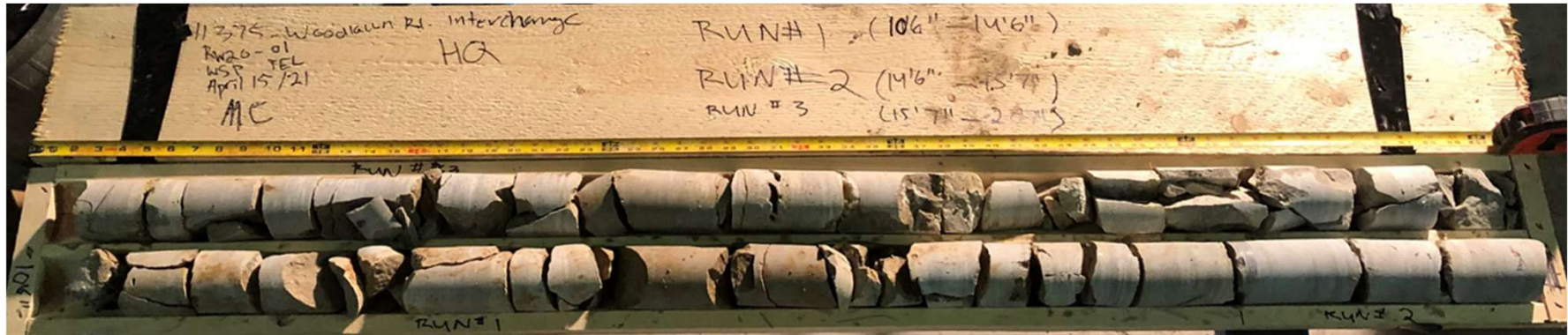
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-- End of Analytical Report --

PHOTOGRAPHS OF ROCK CORES – BOREHOLE RW20-01 (Dry)

BOTTOM

RUNS 1-3



Date Drilled: April 15, 2021

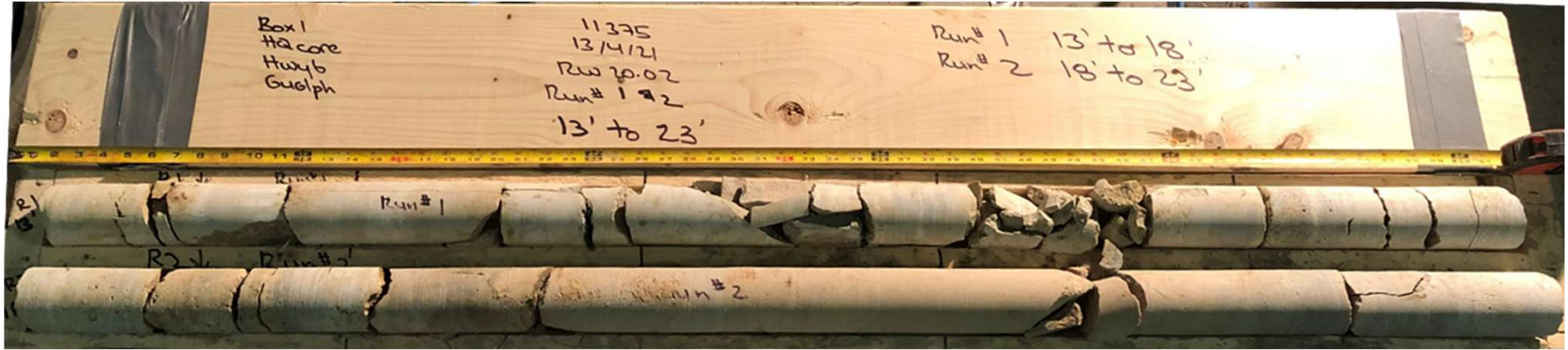
TOP

Run #	Depth (ft)	Depth (m)
1	10'6" – 14'6"	3.20 – 4.41
2	14'6" – 15'2"	4.41 – 4.62
3	15'2" – 20'7"	4.62 – 6.27

PHOTOGRAPHS OF ROCK CORES – BOREHOLE RW20-02 (Dry)

TOP

RUNS 1-2



Date Drilled: April 13, 2021

BOTTOM

Run #	Depth (ft)	Depth (m)
1	13'0" – 18'0"	3.96 – 5.49
2	18'0" – 23'0"	5.49 – 7.01

PHOTOGRAPHS OF ROCK CORES – BOREHOLE RW20-03 (Dry)

TOP

RUNS 1-2



Date Drilled: April 8, 2021

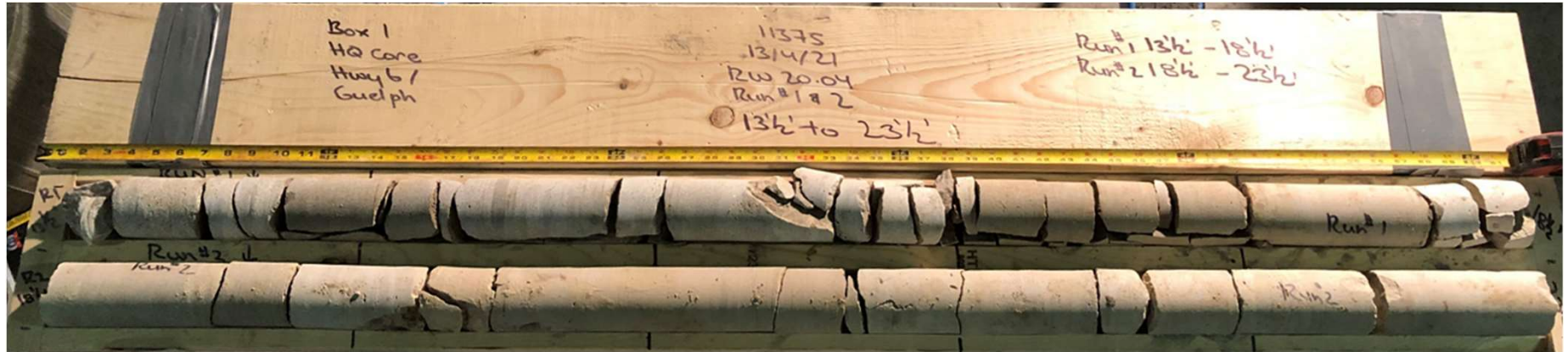
BOTTOM

Run #	Depth (ft)	Depth (m)
1	13'0" – 18'0"	3.96 – 5.49
2	18'0" – 23'0"	5.49 – 7.01

PHOTOGRAPHS OF ROCK CORES – BOREHOLE RW20-04 (Dry)

TOP

RUNS 1-2



Date Drilled: April 13, 2021

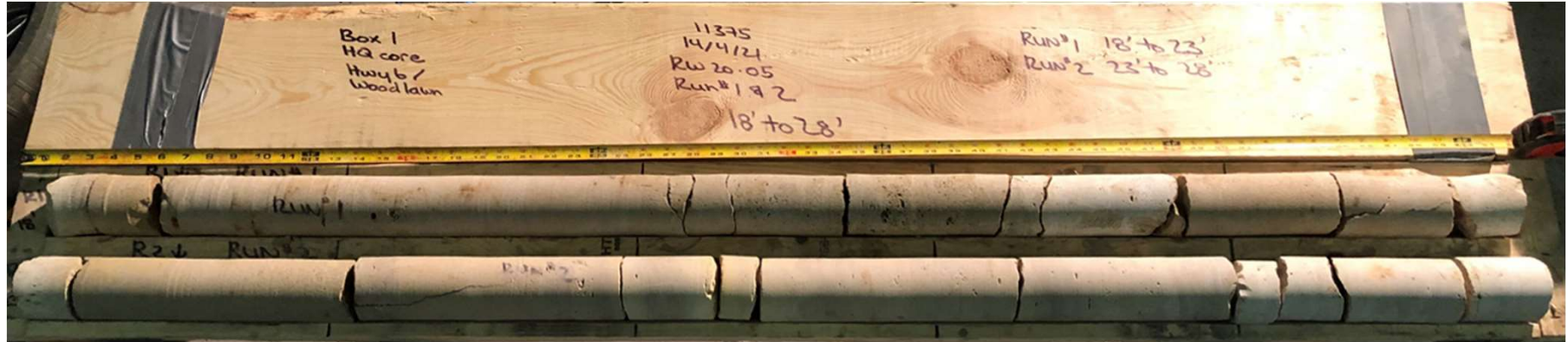
BOTTOM

Run #	Depth (ft)	Depth (m)
1	13'6" – 18'6"	4.11 – 5.64
2	18'6" – 23'6"	5.64 – 7.16

PHOTOGRAPHS OF ROCK CORES – BOREHOLE RW20-05 (Dry)

TOP

RUNS 1-2



Date Drilled: April 14, 2021

BOTTOM

Run #	Depth (ft)	Depth (m)
1	18'0" – 23'0"	5.49 – 7.01
2	23'0" – 28'0"	7.01 – 8.53



Photo 1 – Looking at RW20-02 towards South on HWY-7



Photo 2 – Looking at RW20-02 towards North on HWY-7



Photo 3 – Looking at RW20-05 towards North on HWY-7