



THURBER ENGINEERING LTD.

**FOUNDATION INVESTIGATION REPORT
PROPOSED RETAINING WALLS
HIGHWAY 7-NEW, KITCHENER TO GUELPH
G.W.P. 408-88-00**

Geocres Number: 40P9-58

Report

To

WSP

Date: May 6, 2020
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PART 1: FACTUAL INFORMATION

1.0 INTRODUCTION

This report presents the factual findings obtained from a foundation investigation conducted at seven (7) proposed standalone retaining wall sites along the proposed Highway 7-New mainline alignment and the existing Kitchener-Guelph Expressway (KWE - Highway 85) corridor in the City of Kitchener, Ontario.

The purpose of the investigations was to explore the subsurface conditions at the proposed retaining wall sites and, based on the data obtained, to provide borehole location plans, records of boreholes, stratigraphic profiles, laboratory test results and written descriptions of the subsurface conditions. Models of the subsurface conditions under the proposed retaining walls were developed from the data obtained in the course of the current and previous investigations.

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

- Foundation investigation and design report for Northeast Corner Retaining Wall, Frederick Street Underpass, Site No. 33-234, G.W.P. 3110-09-00, City of Kitchener, Ontario, prepared by Peto MacCallum Ltd., PML Ref. 10KF079C, Geocres No. 40P8-199, dated May 31, 2012 (Reference 1).

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

2.0 SITE DESCRIPTION

The retaining wall sites addressed in this report are located within the existing Highway 7/Highway 85 interchange from north of Guelph Street to South of Frederick Street. A total of



seven (7) retaining walls were identified within this section of the proposed Highway 7-New mainline.

The area is surrounded by industrial and commercial lands and is generally flat.

The designations and approximate locations of the proposed retaining walls are as follows:

Retaining Wall No.	Location	Approx. Chainage (From)	Approx. Chainage (To)	Approx. Length (m)	Maximum Height (m)
RW01	Frederick St - S/E - Becker Street Retaining Wall	20+910	21+250	340.0	6.0
RW02	Frederick St - N/E - Ann Street Retaining Wall	21+270	21+455	185.00	7.2
RW10	E-S Ramp Hwy 85 Overpass - N/E	19+830	20+075	245.0	4.5
RW12	S-E Ramp-Wellington St Overpass - S/E	19+867	20+150	283.0	7.6
RW16	Highway 85 SB/E-S Ramp - North of Frederick Street	18+800	18+880	80.0	5.5
RW24	E-N Ramp over Guelph Street - North Abutment	19+412	19+500	88.0	3.5
RW28	Dumfries Avenue	21+030	21+120	90.0	2.8

Based on the Ontario Geological Survey Special Volume 2, The Physiography of Southern Ontario, Third Edition by Chapman and Putnam, the site lies within the physiographic region known as the Waterloo Hills, characterized by ridges of sandy till kames or kame moraines, with outwash sands occupying the intervening hollows.

3.0 SITE INVESTIGATION AND FIELD TESTING

A detailed site investigation was carried out for the seven proposed retaining walls. Thirty one boreholes were drilled by Thurber Engineering between October 20, 2016 and September 24, 2019. Four boreholes were drilled by Peto MacCallum Ltd. between April 8, 2011 and July 20, 2011.

A summary of the borehole locations, designations, borehole termination depths and termination elevations for each retaining wall is provided in Table 3.1. The coordinates and elevations of



the boreholes are given on the drawings and on the individual Record of Borehole Sheets. Record of Borehole Sheets for each retaining wall are included in Appendices A to G.

Table 3.1 – Borehole Designations

Retaining Wall	Approx. Chainage (From)	Approx. Chainage (To)	Borehole	Borehole Termination Depth (m)	Borehole Termination Elevation (m)	Appendix
RW01	20+910	21+250	RW01-01 to RW01-07	11.1 m to 14.3 m	313.8 to 305.7	A
RW02	21+270	21+455	RW02-02 to RW02-04, (RW1 to RW4) ¹	9.8 m to 17.4 m	309.9 to 301.7	B
RW10	19+830	20+075	RW09-02, RW10-02 to RW10-06	9.6 m to 13.5 m	313.2 to 305.1	C
RW12	19+867	20+150	RW12-01 to RW12-06	15.6 m to 20.1 m	322.8 m to 325.3 m	D
RW16	18+800	18+880	RW16-01 to RW16-03	11.3 m to 12.5 m	310.0 to 307.4	E
RW24	19+412	19+500	RW24-01 to RW24-03	11.3 m to 12.8 m	307.4 to 305.3	F
RW28	21+030	21+120	RW28-01 to RW28-03	9.8 m to 11.3 m	325.3 to 323.6	G

¹ Boreholes RW1 to RW4 were drilled in a previous investigation conducted by Peto MacCallium, as detailed in Reference 1.

Three to seven boreholes were drilled at each retaining wall site. The boreholes were drilled along the retaining wall alignments, with one borehole at each end and an approximate 50 m spacing in between boreholes.

The approximate locations of the boreholes are shown on the drawings included in Appendices A through G.

Prior to commencing the site investigation, utility clearances were obtained for all borehole locations. All of the boreholes were drilled on MTO property and did not require Permission to Enter (PTE) to be obtained.

The boreholes were drilled using a track-mounted drill rig and the boreholes were advanced with a combination of hollow stem augers and mud rotary drilling. Samples were obtained at



selected depth intervals using a split spoon sampler in conjunction with Standard Penetration Testing (SPT) in the native soils.

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 samples for transport to Thurber’s laboratory for further examination and testing. Results of field drilling and sampling of the investigation are presented on the Record of Borehole sheets in Appendices A to G.

Groundwater conditions in the open boreholes were observed during the drilling operations. Five piezometers were installed at boreholes RW01-04, RW10-03, RW12-03, RW12-04 and RW12-05 to permit for longer term monitoring of groundwater levels. The piezometers consisted of 25 mm diameter PVC pipe with a slotted screen enclosed in filter sand. The locations and completion details of the piezometers are summarized in Table 3.2 along with the borehole completion details. The completion of the boreholes and the standpipe piezometers were carried out in accordance with the requirements of O. Reg. 903 (as amended by O. Reg. 372/07).

Table 3.2 – Borehole Completion Details

Retaining Wall	Borehole	Borehole Depth / Base Elevation (m)	Piezometer Tip Depth / Elevation (m)	Completion Details
RW01	RW01-01	14.3	-	Borehole backfilled with grout to 4.3 m, bentonite holeplug to 0.2 m, then asphalt to surface.
	RW01-02	11.1	-	Borehole backfilled with grout to 3.7 m, bentonite holeplug to 0.1 m, then asphalt to surface.
	RW01-03	14.1	-	Borehole backfilled with bentonite holeplug to surface.
	RW01-04	14.0	13.7/313.1	Piezometer with 3.0 m slotted screen installed with sand filter from 14.0 m to 9.7 m, bentonite holeplug from 9.7 m to ground surface.
	RW01-05	14.3	-	Borehole backfilled with bentonite holeplug and asphalt patch to surface.
	RW01-06	14.3	-	Borehole backfilled with bentonite holeplug and asphalt patch to surface.
	RW01-07	14.3	-	Borehole backfilled with bentonite holeplug and asphalt patch to surface.
RW02	RW02-02	13.3	-	Borehole backfilled with bentonite holeplug



Retaining Wall	Borehole	Borehole Depth / Base Elevation (m)	Piezometer Tip Depth / Elevation (m)	Completion Details
				and asphalt patch to surface.
	RW02-03	15.8	-	Borehole backfilled with bentonite holeplug and asphalt patch to surface.
	RW02-04	17.4	-	Borehole backfilled with bentonite holeplug to 0.6 m, sand to 0.2 m, then asphalt to surface.
RW10	RW09-02	9.6	-	Borehole backfilled with bentonite holeplug and grout to surface.
	RW10-02	9.4	-	Borehole backfilled with bentonite holeplug to 0.3 m and cuttings to surface.
	RW10-03	9.8	9.1/.319.3	Piezometer with 3.0 m slotted screen installed with sand filter from 9.1 m to 5.5 m, bentonite holeplug from 5.5 m to 0.3 m, then well gravel to ground surface.
	RW10-04	9.5	-	Borehole backfilled with bentonite holeplug to 0.15 m and cuttings to surface.
	RW10-05	8.1	-	Borehole backfilled with bentonite holeplug and auger cuttings to surface.
	RW10-06	13.5	-	Borehole backfilled with bentonite holeplug and auger cuttings to surface.
RW12	RW12-01	15.8	-	Borehole backfilled with bentonite holeplug to 0.3 m and auger cuttings to surface.
	RW12-02	15.8	-	Borehole backfilled with bentonite holeplug to surface.
	RW12-03	15.8	13.7/311.6	Piezometer with 3.0 m slotted screen installed with sand filter from 14.3 m to 10.1 m, then bentonite holeplug from 10.1 m to ground surface.
	RW12-04	15.8	4.5/320.6	Piezometer with 1.5 m slotted screen installed with sand filter from 4.8 m to 2.7 m, bentonite holeplug from 2.7 m to 0.9 m, then cuttings to ground surface.
	RW12-05	15.6	15.2/308.2	Piezometer with 3.0 m slotted screen installed with sand filter from 15.2 m to 11.6 m, bentonite holeplug from 11.6 m to 0.3 m, then well gravel to ground surface.
	RW12-06	20.1	-	Borehole backfilled with bentonite holeplug and auger cuttings to surface.
RW16	RW16-01	11.3	-	Borehole backfilled with bentonite holeplug and asphalt patch to surface.
	RW16-02	11.3	-	Borehole backfilled with bentonite holeplug



Retaining Wall	Borehole	Borehole Depth / Base Elevation (m)	Piezometer Tip Depth / Elevation (m)	Completion Details
				and asphalt patch to surface.
	RW16-03	12.5	-	Borehole backfilled with bentonite holeplug and asphalt patch to surface.
RW24	RW24-01	12.8	-	Borehole backfilled with bentonite holeplug and auger cuttings, then asphalt to surface.
	RW24-02	12.8	-	Borehole backfilled with bentonite holeplug and auger cuttings and asphalt to surface.
	RW24-03	11.3	-	Borehole backfilled with bentonite holeplug and auger cuttings and asphalt to surface.
RW28	RW28-01	9.8	-	Borehole backfilled with bentonite holeplug and auger cuttings and asphalt to surface.
	RW28-02	9.8	-	Borehole backfilled with bentonite holeplug and auger cuttings and asphalt to surface.
	RW28-03	11.3	-	Borehole backfilled with bentonite holeplug and auger cuttings and asphalt to surface.

4.0 LABORATORY TESTING

The recovered soil samples were subjected to Visual Identification (VI) and to natural moisture content determination. Selected samples were also subjected to gradation analysis (sieve and hydrometer) and Atterberg Limits testing, where appropriate. The results of this testing program are summarized on the Record of Borehole sheets and figures included in Appendix A through G.

In order to assess the potential for sulphate attack on concrete foundations, as well as the potential for corrosion associated with the structure, a sample of the native soil from the retaining walls was collected and submitted to SGS Canada Inc., a CALA accredited analytical laboratory in Lakefield, Ontario, for analytical testing of corrosivity parameters. The results of the analytical testing are summarized in this report and presented in Appendix H.

5.0 DESCRIPTION OF SUBSURFACE CONDITIONS

Details of the encountered soil stratigraphy are presented on the Record of Borehole sheets included in Appendices A to G and depicted on the “Borehole Locations and Soil Strata” drawings for each retaining wall alignments in these appendices. An overall description of the stratigraphy at each retaining wall site is given in the following paragraphs. However, the



factual data presented in the Record of Borehole Sheets governs any interpretation of the site conditions. It should be recognized and expected that soil conditions may vary between and beyond borehole locations.

5.1 Retaining Wall RW01 - Frederick St - S/E - Becker Street (Station 20+910 to 21+250 - Appendix A)

In general, the soil stratigraphy at this site consisted of surficial topsoil or asphalt overlying a granular fill layer, a layer of native sand, silty clay, and a layer of sandy silt to silty sand.

5.1.1 Topsoil

A layer of topsoil was encountered surficially in two boreholes drilled at this site, RW01-03 and RW01-04. It was generally dark brown in colour. The thickness of the topsoil layer ranged from 0.15 m to 0.2 m. The topsoil thickness may vary between the borehole locations and in other areas of the site.

5.1.2 Asphalt

Asphalt with a thickness of 100 mm was encountered at Boreholes RW01-01, RW01-02 and RW01-05. Asphalt with a thickness of 75 mm was encountered at Boreholes RW01-06 and RW01-07.

5.1.3 Granular Fill

Granular fill was encountered immediately below the asphalt at five boreholes at this site, Boreholes RW01-01, RW01-02 and RW01-05 to RW01-07. Granular fill was encountered immediately below the topsoil at Boreholes RW01-03 and RW01-04.

The granular fill consisted of sand to sand and gravel, generally brown in colour, with trace silt to silty and trace clay. Occasional organics were encountered in the granular fill in Borehole RW01-04. A layer of silt to clayey silt fill was also encountered below the sand fill in Boreholes RW01-02 and RW01-03, with trace to some sand and trace clay to clayey.

The thickness of the granular fill ranged from 0.6 m to 3.0 m, with the lower boundary of this layer encountered at depths of 0.7 m to 3.2 m (Elevation 324.6 to 319.4).

SPT N-values recorded in the granular fill ranged from 4 to 36 blows for 0.3 m penetration, indicating a loose to dense relative density.



Moisture content of samples of the granular fill generally ranged from 3 percent to 27 percent.

Three samples of the granular fill underwent laboratory gradation analysis, and one sample of the clayey silt fill underwent Atterberg limits testing. These results are summarized on the Record of Borehole sheets included in Appendix A and the grain size distribution curves for these samples are plotted on Figure A1 of Appendix A. The results of the Atterberg Limits tests are plotted on Figure A5. The results of this testing are summarized as follows:

Soil Particles	Granular Fill (%)
Gravel	0 to 32
Sand	0 to 46
Silt	22 to 76
Clay	5 to 27

Index Property	
Liquid Limit	20
Plastic Limit	13
Plasticity Index	7

The above results indicate that the clayey silt fill is of low plasticity with a group symbol of CL-ML.

5.1.4 Sand

A native sand layer was encountered below the granular fill in all boreholes at this site, Boreholes RW01-01 to RW01-07. The sand layer was encountered at depths ranging from 0.7 m to 3.2 m (Elevation 324.6 to 319.4).

The sand layer was brown in colour and contained some silt to silty, trace clay and trace gravel.

The thickness of the sand ranged from 0.6 m to 4.0 m, with the lower boundary of the sand layer encountered at depths ranging from 1.3 m to 7.2 m (Elevation 321.2 to 317.7).

SPT N-values recorded in the sand ranged from 5 to 37 blows for 0.3 m penetration, indicating a loose to dense relative density.



Moisture content of samples of the sand generally ranged from 4 percent to 23 percent.

Three samples of the sand underwent laboratory gradation analysis. These results are summarized on the Record of Borehole sheets included in Appendix A and the grain size distribution curves for these samples are plotted on Figure A2. The results of this testing are summarized as follows:

Soil Particles	Sand (%)
Gravel	0 to 3
Sand	76 to 81
Silt	16 to 19
Clay	2 to 5

5.1.5 Silty Clay

Silty clay was encountered below the sand layer in all boreholes, RW01-01 to RW01-07, at depths ranging from 1.3 m to 7.2 m (Elevation 321.2 to 317.7).

A 4.0 to 5.3 m thick silty sand to sandy silt layer was encountered within the silty clay in Boreholes RW01-05 and RW01-06.

The silty clay was brown to grey and contained some trace to some sand and trace gravel.

The thickness of the silty clay layer where fully penetrated ranged from 1.3 m to 10.4 m, with the lower boundary of the silty clay encountered at depths ranging 5.6 m to 11.7 m (Elevation 319.3 to 308.3). Boreholes RW01-05 and RW01-06 were terminated in the silty clay layer at a depth of 14.3 m for both boreholes (Elevation 307.1 and 306.2).

SPT N-values recorded in the silty clay ranged from 7 blows for 0.3 m penetration to 100 blows for 0.2 m penetration, indicating a firm to hard consistency (typically very stiff to hard).

The natural moisture content of samples of the silty clay ranged from 11 percent to 28 percent.

Six samples of the silty clay underwent laboratory gradation analysis and Atterberg Limits testing, the results of which are summarized below. These results are also presented on the Record of Borehole sheets in Appendix A and the grain size



distribution curves for these samples are plotted on Figure A3 of Appendix A. The results of the Atterberg Limits tests are plotted on Figure A6.

Soil Particles	Silty Clay (%)
Gravel	0 to 2
Sand	1 to 10
Silt	39 to 50
Clay	41 to 59

Index Property	
Liquid Limit	28 to 49
Plastic Limit	13 to 23
Plasticity Index	15 to 27

The above results indicate that the silty clay is of low to intermediate plasticity with a group symbol of CL or CI.

5.1.6 Sandy Silt to Silty Sand

A deposit of sandy silt to silty sand was encountered below the silty clay layer in Boreholes RW01-01 to RW01-04 at depths ranging from 5.6 m to 10.0 m (Elevation 319.3 to 316.8), and within the larger silty clay layer in Boreholes RW01-05 and RW01-06, at depths of 6.3 m and 7.2 m (Elevation 315.1 and 313.4), respectively.

Sandy silt to silty sand was also encountered below the silty clay layer in Borehole RW01-07 at a depth of 11.7 m (Elevation 308.3).

The sandy silt to silty sand was grey in colour and contained trace to some clay and trace gravel.

Boreholes RW01-01, to RW01-04 were terminated in the sandy silt to silty sand layer at depths ranging from 11.1 to 14.3 m (Elevation 313.8 to 311.7). Borehole RW01-07 was terminated in the sandy silt to silty sand at a depth of 14.3 m (Elevation 305.7).

The thickness of the sandy silt to silty sand encountered within the silty clay, in Boreholes RW01-05 and RW01-06 where the layer was fully penetrated, was 4.0 to 5.4



m, with the lower boundary of the sandy silt to silty sand encountered at depths from 11.2 to 11.7 m (Elevation 309.7 to 309.4).

SPT N-values recorded in the sandy silt to silty sand ranged from 30 blows for 0.3 m penetration to 100 blows for 0.2 m penetration, indicating a dense to very dense relative density.

Moisture content of samples of the sandy silt to silty sand generally ranged from 10 percent to 22 percent.

Seven samples of the sandy silt to silty sand underwent laboratory gradation analysis, and one sample underwent Atterberg limits testing. The results are summarized on the Record of Borehole sheets included in Appendix A and the grain size distribution curves for these samples are plotted on Figure A5 of Appendix A. The results of the Atterberg Limits tests are plotted on Figure A7. The results of this testing are summarized as follows:

Soil Particles	Sandy Silt to Silty Sand (%)
Gravel	0
Sand	22 to 72
Silt	26 to 68
Clay	1 to 19

Index Property	
Liquid Limit	17
Plastic Limit	12
Plasticity Index	5

The above results indicate one sample of the silty sand to sandy silt of low plasticity with a group symbol of CL-ML, indicating the possibility of silt or clay lenses within the silty sand to sandy silt.

5.1.7 Groundwater Conditions

Water levels were observed in the boreholes during and upon completion of drilling. One standpipe piezometer was installed at this site, in Borehole RW01-04, to monitor water levels after completion of drilling. The water levels measured in the piezometer



are summarized in Table 5.1.1, along with the measurements in the open boreholes upon completion of drilling.

Table 5.1.1 – Water Level Measurements

Borehole	Date	Water Level (m)		Comment
		Depth	Elevation	
RW01-01	Sept 24, 2019	2.2	323.8	Open borehole
RW01-02	Sept 24, 2019	3.2	321.7	Open borehole
RW01-03	June 05, 2018	5.0	322.8	Open borehole
RW01-04	June 25, 2018	4.9	321.9	Piezometer
RW01-05	Aug 12, 2019	4.1	317.3	Open borehole
RW01-06	Aug 13, 2019	2.3	318.3	Open borehole
RW01-07	Aug 14, 2019	4.1	315.9	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.

Upon completion of drilling, Borehole RW01-05 caved-in at 7.9 m, and Borehole RW01-07 caved-in at 8.2 m.

5.2 Retaining Wall RW02 - Frederick St - N/E - Ann Street (Station 21+270 to 21+455 – Appendix B)

In general the soil stratigraphy at this site consisted of asphalt and granular fill overlying a layer of silty clay, a layer of silt and sand, and a layer of sand. A layer of upper sand was encountered in Boreholes RW-03 and RW-04.

It should be noted that Borehole RW-03 and RW-04 were drilled behind the retaining wall and on the embankment, and not shown within the stratigraphy profiles. Due to the difference in elevations and location, the encountered soil depths and elevations will be discussed separately to Boreholes RW02-02 to 02-04, RW-01 and RW-02.



5.2.1 Asphalt

Asphalt with thicknesses ranging from 112 mm to 200 mm was encountered surficially at Boreholes RW02-02 to RW02-04. Asphalt was also encountered surficially at Boreholes RW-01 and RW-02.

5.2.2 Granular Fill

Granular fill consisting of sand was encountered immediately below the asphalt at Boreholes RW02-02 to RW02-04, RW-01 and RW-02.

The granular fill below the asphalt consisted of sand generally brown in colour with gravel, trace silt to silty and trace clay.

The thickness of the granular fill ranged from 0.6 m to 1.4 m, with the lower boundary of this layer encountered at depths of 0.8 m to 1.4 m (Elevation 318.8 to 318.3).

Additionally, granular fill was encountered surficially in Boreholes RW-03 and RW-04 behind the retaining wall, in a previous investigation by others.

The granular fill in Boreholes RW-03 and RW-04 consisted of silty sand, silt, gravelly sand and contained clayey silt fill layers, generally brown in colour. The thickness of the fill layer was 2.3 m in both boreholes, with the lower boundary encountered at the depth of 2.3 m (Elevation 320.2 and 321.1).

SPT N-values recorded in the granular fill ranged from 3 to 27 blows for 0.3 m penetration, indicating a very loose to compact relative density.

Moisture content of samples of the granular fill generally ranged from 3 percent to 16 percent.

Six samples of the granular fill underwent laboratory gradation analysis. These results are summarized on the Record of Borehole sheets included in Appendix B and the grain size distribution curves for these samples are plotted on Figures RW-GS-1 to RW-GS-4 from previous investigations. The results of this testing are summarized as follows:

Soil Particles	Granular Fill (%)
Gravel	3 to 23
Sand	20 to 68
Silt	11 to 54
Clay	4 to 18



It should be noted that cohesive clayey silt fill layers were observed within the granular fill in Boreholes RW-03 and RW-04.

5.2.3 Upper Sand

An upper native sand layer was encountered below the granular fill layer in Boreholes RW02-02 to RW02-04, at depths ranging from 0.6 m to 0.8 m (Elevation 318.8 to 318.5).

The sand was generally brown in colour, with some silt to silty, trace clay and trace gravel.

The thickness of the upper sand layer in Boreholes RW02-02 to RW02-04 ranged from 3.3 to 4.2 m, with the lower boundary encountered at a depth ranging from 4.1 to 5.0 m (Elevation 315.4 to 314.3).

Additionally, an upper native sand layer was encountered beneath the fill layer in Boreholes RW-03 and RW-04 behind the retaining wall, at the depth of 2.3 m (Elevation 320.2 and 321.1).

The sand was generally brown in colour, with trace to with gravel, trace to some silt and trace clay. The sand encountered in Borehole RW-04 below Elevation 319.7 was gravelly to with gravel.

The thickness of the upper sand layer in Boreholes RW-03 and RW-04 was 2.1 m and 3.6 m, with the lower boundary encountered at the depth of 4.4 m and 5.9 m (Elevation 317.6 and 317.9), respectively.

SPT N-values recorded in the upper sand generally ranged from 9 blows to 34 blows for 0.3 m penetration, indicating a generally compact to dense relative density with local loose layers.

Moisture content of samples of the upper sand generally ranged from 3 percent to 24 percent.

Ten samples of the upper sand underwent laboratory gradation analysis. These results are summarized on the Record of Borehole sheets included in Appendix B and the grain size distribution curves for these samples are plotted on Figure B1 and Figure RW-GS-6. The results of this testing are summarized as follows:

Soil Particles	Upper Sand (%)
Gravel	0 to 38
Sand	43 to 94



Silt	3 to 31
Clay	0 to 6

It should be noted that soil descriptions in the “Borehole Locations and Soil Strata” drawing in Appendix B do not include information from Boreholes RW-03 and RW-04.

5.2.4 Silty Clay

Silty clay was encountered below the granular fill in Boreholes RW02-02 to 02-04, RW-01 and RW-02 at depths ranging from 1.4 m to 5.0 m (Elevation 318.3 to 314.3).

The silty clay was generally brown to grey in colour and contained trace to with sand and trace gravel.

Borehole RW02-04 was terminated within the silty clay layer at a depth of 17.4 m (Elevation 301.7). Boreholes RW-01 and RW-02 were both terminated within the silty clay layer at a depth of 9.8 m (Elevation 309.9).

The thickness of the silty clay layer was 1.5 m and 8.7 m in Boreholes RW02-02 and RW02-03, respectively, with the lower boundary of the silty clay encountered at depths of 5.6 and 13.7 m (Elevation 313.9 and 305.8).

Additionally, silty clay was encountered in Boreholes RW-03 and RW-04 below the upper sand layer at depths of 4.4 m and 5.9 m (Elevation 317.9 and 316.5), respectively. The silty clay was generally brown to grey in colour and contained trace sand, trace gravel and occasional cobbles.

Boreholes RW-03 and RW-04 were terminated in the silty clay at depths of 6.4 m and 7.0 m (Elevation 315.9 and 316.5), respectively.

SPT N-values recorded in the silty clay generally ranged from 6 blows for 0.3 m penetration to 70 blows for 0.15 m penetration, indicating a firm to hard consistency.

The natural moisture content of samples of the silty clay ranged from 9 percent to 41 percent.

Nine samples of the silty clay underwent laboratory gradation analysis and seven samples underwent Atterberg Limits testing, the results of which are summarized below. These results are also presented on the Record of Borehole sheets in Appendix B and the grain size distribution curves for these samples are plotted on Figure B2 and Figure



RW-GS-7 of Appendix B. The results of the Atterberg Limits tests are plotted on Figure B5 and Figure RW-PC-2.

Soil Particles	Silty Clay (%)
Gravel	0 to 7
Sand	0 to 37
Silt	30 to 50
Clay	24 to 69

Index Property	
Liquid Limit	35 to 46
Plastic Limit	17 to 23
Plasticity Index	18 to 27

The above results indicate that the silty clay is of low to intermediate plasticity with a group symbol of CL or CI.

5.2.5 Silt and Sand

A silt and sand layer was encountered below the silty sand till in RW02-02. The silt and sand was grey in colour and contained trace clay and trace gravel.

Borehole RW02-02 was terminated within the silt and sand layer at a depth of 12.8 m (Elevation 306.8).

SPT N-values recorded in the silt and sand ranged from 83 to 98 blows for 0.3 m penetration, indicating a very dense relative density.

Moisture content of samples of the silt and sand generally ranged from 16 percent to 19 percent.

One sample of the silt and sand underwent laboratory gradation analysis. The results are summarized on the Record of Borehole sheets included in Appendix B and the grain size distribution curves for these samples are plotted on Figure B3 of Appendix B. The results of this testing are summarized as follows:

Soil Particles	Silt and Sand (%)
Gravel	0
Sand	43



Silt	56
Clay	1

5.2.6 Lower Sand

A lower sand layer was encountered below the silty clay in RW02-03. The sand was grey in colour and contained trace to some silt and trace clay.

Borehole RW02-03 was terminated within the lower sand layer at the depth of 15.8 m (Elevation 303.6).

SPT N-values recorded in the lower sand ranged from 43 to 75 blows for 0.3 m penetration, indicating a dense to very dense relative density.

Moisture content of samples of the lower sand ranged from 17 percent to 18 percent.

One sample of the sand underwent laboratory gradation analysis. The results are summarized on the Record of Borehole sheets included in Appendix B and the grain size distribution curves for these samples are plotted on Figure B4 of Appendix B. The results of this testing are summarized as follows:

Soil Particles	Lower Sand (%)
Gravel	0
Sand	87
Silt	10
Clay	3

5.2.7 Groundwater Conditions

Water levels were observed in the boreholes during and upon completion of drilling. Two standpipe piezometers were installed at this site for previous investigations by others, in Boreholes RW-01 and RW-03. The water levels measured in the open boreholes upon completion of drilling are summarized in Table 5.2.1.

Table 5.2.1 – Water Level Measurements

Borehole	Date	Water Level (m)		Comment
		Depth	Elevation	
RW02-02	Aug 22, 2019	N/A	N/A	Water level in open borehole not available. Cave-in



				observed at 4.6 m.
RW02-03	Sept 24, 2019	N/A	N/A	Water level in open borehole not available. Cave-in observed at 4.6 m
RW02-04	June 05, 2018	1.5	317.6	Open borehole
RW-01	April 8, 2011	2.9	316.8	Piezometer
RW-02	April 8, 2011	7.3	312.4	Open borehole
RW-03	July 19, 2011 Sept 23, 2011 Oct 8, 2011	Dry 3.3 3.3	Dry 319.0 319.0	Piezometer
RW-04	July 20, 2011	N/A	N/A	Water level in open borehole N/A. Cave-in observed at 5 m.

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.

Upon completion of drilling, Borehole RW02-02 caved-in at 4.6 m, Borehole RW02-03 caved-in at 4.6 m, Borehole RW02-04 caved-in at 8.7 m, Borehole RW-02 caved-in at 8.7 m and Borehole RW-04 caved-in at 5.0 m.

5.3 Retaining Wall RW10 - E-S Ramp Hwy 85 Overpass - N/E (Station 19+830 to 20+075 – Appendix C)

In general the soil stratigraphy at this site consisted of topsoil or granular fill overlying an upper layer of native sand, silty clay, a layer of sand and silt, and a lower layer of sand to silty sand.

5.3.1 Topsoil

A layer of topsoil was encountered surficially in three boreholes drilled at this site, RW10-04, RW10-05 and RW10-06. It was generally dark brown in colour.

The thickness of the topsoil layer ranged from 0.2 m to 0.5 m. The topsoil thickness may vary between the borehole locations and in other areas of the site.

Moisture content of samples of the topsoil generally ranged from 25 percent to 50 percent.



5.3.2 Granular Fill

Granular fill consisting of sand to sand and gravel was encountered surficially at three boreholes at this site, Boreholes RW10-02 and RW10-03. Granular fill was encountered immediately below the topsoil at Borehole RW10-04.

The granular fill consisted of sand generally brown in colour, with trace silt to silty, trace to some clay and trace to no gravel, or consisted of sand and gravel.

The thickness of the granular fill ranged from 2.7 m to 3.2 m, with the lower boundary of this layer encountered at depths of 3.0 m to 3.7 m (Elevation 325.3 to 323.9).

SPT N-values recorded in the granular fill ranged from 2 to 20 blows for 0.3 m penetration, indicating a loose to compact relative density.

Moisture content of samples of the granular fill generally ranged from 6 percent to 14 percent.

Three samples of the granular fill underwent laboratory gradation analysis. These results are summarized on the Record of Borehole sheets included in Appendix C and the grain size distribution curves for these samples are plotted on Figure C1 of Appendix C. The results of this testing are summarized as follows:

Soil Particles	Granular Fill (%)
Gravel	0 to 13
Sand	64 to 87
Silt	10 to 25
Clay	3 to 11

5.3.3 Upper Sand

An upper native sand layer was encountered at ground surface in RW09-02, below the granular fill in RW10-02, RW10-03 and RW-04 and immediately below the topsoil in Borehole RW10-05.

The sand was brown in colour and contained trace silt to silty, trace to some clay, trace gravel, with occasional cobbles.



The thickness of the upper sand layer ranged from 1.7 m to 3.4 m with the lower boundary of the sand layer encountered at depths ranging from 2.2 to 7.1 (Elevation 322.5 to 320.4).

SPT N-values recorded in the upper sand layer ranged from 6 to 32 blows for 0.3 m penetration, indicating a loose to compact relative density.

Moisture content of samples of the upper sand layer generally ranged from 1 percent to 14 percent.

Three samples of the sand underwent laboratory gradation analysis. These results are summarized on the Record of Borehole sheets included in Appendix C and the grain size distribution curves for these samples are plotted on Figure C2 of Appendix C. The results of this testing are summarized as follows:

Soil Particles	Granular Fill (%)
Gravel	0 to 4
Sand	79 to 89
Silt and Clay	7 to 19

5.3.4 Silty Clay

Silty clay was encountered below the granular fill in Boreholes RW09-02, RW10-02 and RW10-04, at depths ranging from 2.4 m to 7.1 m (Elevation 322.1 to 320.4).

Silty clay was also encountered below the upper native sand layer at 7.0 m depth (Elevation 321.4) in Borehole RW10-03, and 2.2 m depth (Elevation 322.5) in Borehole RW10-05, and immediately below the topsoil in Borehole RW10-06.

The silty clay was brown to grey and contained trace to with sand and trace gravel.

Boreholes RW10-02, RW10-03 and RW10-04 were terminated within the silty clay at a depth of 9.4 m, 9.8 m and 9.5 m, respectively (Elevation 319.6, 318.6 and 317.3).

The thickness of the silty clay layer was 2.3 m, 3.4 m and 2.9 m for Boreholes RW09-02, RW10-05 and RW10-06, respectively, with the lower boundary of the silty clay encountered at depths of 9.4 m, 5.6 m and 3.4 m (Elevation 318.7, 319.1 and 315.2).

SPT N-values recorded in the silty clay ranged from 12 blows for 0.3 m penetration to 100 blows for 0.2 m penetration, indicating a stiff to hard consistency.



The natural moisture content of samples of the silty clay ranged from 6 percent to 23 percent.

Six samples of the silty clay underwent laboratory gradation analysis and five samples underwent Atterberg Limits testing, the results of which are summarized below. These results are also presented on the Record of Borehole sheets in Appendix C and the grain size distribution curves for these samples are plotted on Figure C3 of Appendix C. The results of the Atterberg Limits tests are plotted on Figure C6.

Soil Particles	Silty Clay (%)
Gravel	0
Sand	0 to 38
Silt	39 to 49
Clay	19 to 53

Index Property	
Liquid Limit	29 to 37
Plastic Limit	14 to 16
Plasticity Index	15 to 21

The above results indicate that the silty clay is of low to intermediate plasticity with a group symbol of CL or CI.

5.3.5 Sand and Silt

Sand and silt was encountered below the silty clay at the depth of 4.1 m (Elevation 318.7) in Borehole RW09-02 and 5.6 m (Elevation 319.1) in Borehole RW10-05.

The sand and silt was grey in colour and contained trace to some clay.

Borehole RW09-02 was terminated in the sand and silt at the depth of 9.6 m (Elevation 313.2) and Borehole RW10-05 was terminated in the sand and silt at the depth of 8.1 m (Elevation 316.6).

SPT N-values recorded in the sand and silt ranged from 41 to 109 blows for 0.3 m penetration, indicating a dense to very dense relative density.

Moisture content of samples of the sand and silt generally ranged from 2 percent to 19 percent.



Two samples of the sand and silt underwent laboratory gradation analysis. The results are summarized on the Record of Borehole sheets included in Appendix C and the grain size distribution curves for these samples are plotted on Figure C4 of Appendix C. The results of this testing are summarized as follows:

Soil Particles	Sand and Silt (%)
Gravel	0
Sand	49 to 52
Silt	38 to 41
Clay	10

5.3.6 Lower Sand to Silty Sand

A lower sand to silty sand layer was encountered below the silty clay in RW10-06 at the depth of 3.4 m (Elevation 315.2).

The sand to silty sand was generally grey in colour and contained trace clay.

Borehole RW10-06 was terminated in the lower sand to silty sand layer at the depth of 13.5 m (Elevation 305.1).

SPT N-values recorded in the sand to silty sand ranged from 5 to 72 blows for 0.3 m penetration, indicating a loose to very dense relative density.

Moisture content of samples of the sand to silty sand generally ranged from 14 percent to 20 percent.

Two samples of the sand to silty sand underwent laboratory gradation analysis. The results are summarized on the Record of Borehole sheets included in Appendix C and the grain size distribution curves for these samples are plotted on Figure C5 of Appendix B. The results of this testing are summarized as follows:

Soil Particles	Lower Sand to Sandy Silt (%)
Gravel	0
Sand	71 to 87
Silt	13 to 25
Clay	0 to 4



5.3.7 Groundwater Conditions

Water levels were observed in the boreholes during and upon completion of drilling. One standpipe piezometer was installed at this site, in Borehole RW10-03, to monitor water levels after completion of drilling. The water levels measured in the piezometer are summarized in Table 5.3.1, along with the measurements in the open boreholes upon completion of drilling.

Table 5.3.1 – Water Level Measurements

Borehole	Date	Water Level (m)		Comment
		Depth	Elevation	
RW09-02	April 11, 2018	7.1	315.7	Open borehole
RW10-02	April 19, 2018	Dry	-	Open borehole
RW10-03	April 27, 2018	6.2	322.2	Piezometer
	May 16, 2018	6.1	322.3	
	May 31, 2018	6.0	322.4	
	June 25, 2018	5.7	322.6	
RW10-04	April 18, 2019	4.9	322.0	Open borehole
RW10-05	Oct 26, 2016	Dry	-	Open borehole
RW10-06	Oct 24, 2016	4.6	314.0	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.

Upon completion of drilling, Borehole RW10-04 caved-in at 4.6 m and Borehole RW10-04 caved-in at 5.3 m.

5.4 Retaining Wall RW12 - S-E Ramp-Wellington St Overpass - S/E (Station 19+867 to 20+150 – Appendix D)

In general the soil stratigraphy at this site consisted of granular fill overlying a layer of upper native sand, an upper layer of silty clay or silty clay till, a lower sand or silt layer, and a lower layer of silty clay.



5.4.1 Topsoil

A layer of topsoil was encountered surficially at one borehole drilled at this site, RW12-03. It was generally dark brown in colour. The thickness of the topsoil layer 0.3 m. The topsoil thickness may vary between the borehole locations and in other areas of the site.

The moisture content of samples of the topsoil was 15 percent.

5.4.2 Granular Fill

Granular fill was encountered surficially at five boreholes at this site, Boreholes RW-12-01, RW12-02, RW12-04, RW12-05 and RW12-06. Granular fill was encountered immediately below the topsoil layer in Borehole RW12-03.

The granular fill was brown to grey in colour and consisted of sand, with trace silt to silty, trace to some gravel and trace clay, or sand and silt. Occasional organics were observed at Boreholes RW12-01 and RW12-04.

The thickness of the granular fill ranged from 0.7 m to 3.0 m, with the lower boundary of this layer encountered at depths of 0.7 m to 3.0 m (Elevation 320.5 to 323.7).

SPT N-values recorded in the granular fill ranged from 3 to 38 blows for 0.3 m penetration, indicating a very loose to dense relative density.

Moisture content of samples of the granular fill generally ranged from 3 percent to 26 percent.

Four samples of the granular fill underwent laboratory gradation analysis. These results are summarized on the Record of Borehole sheets included in Appendix D and the grain size distribution curves for these samples are plotted on Figure D1 of Appendix D. The results of this testing are summarized as follows:

Soil Particles	Granular Fill (%)
Gravel	0 to 15
Sand	35 to 86
Silt	5 to 60
Clay	0 to 8



5.4.3 Upper Sand

An upper native sand layer was encountered immediately below the granular fill in five boreholes at this site, Boreholes RW12-01 to RW12-05, at depths ranging from 1.4 m to 3.0 m (Elevation 323.7 m to 321.3 m).

The upper native sand layer was brown to grey in colour and contained trace silt, trace clay and trace gravel.

The thickness of the upper sand ranged from 0.6 m to 1.9 m, with the lower boundary of the sand layer encountered at depths ranging from 2.0 m to 4.1 m (Elevation 323.1 to 320.5).

SPT N-values recorded in the upper sand ranged from 4 to 26 blows for 0.3 m penetration, indicating a loose to compact relative density.

Moisture content of samples of the upper sand generally ranged from 15 percent to 39 percent.

One sample of the upper sand underwent laboratory gradation analysis. These results are summarized on the Record of Borehole sheets included in Appendix D and the grain size distribution curves for these samples are plotted on Figure D2 of Appendix D. The results of this testing are summarized as follows:

Soil Particles	Upper Sand (%)
Gravel	0
Sand	93
Silt	7
Clay	0

5.4.4 Silty Clay Till

A silty clay till layer was encountered below the upper native sand layer at a depth of 4.1 m in Boreholes RW12-01, RW12-02 and RW12-03 (Elevation 320.4, 321.0, 321.2).

The silty clay till was brown to grey and contained some to with sand, trace gravel and occasional cobbles.

The thickness of the silty clay till layer ranged from 1.5 m to 4.6 m in Boreholes RW12-01 to RW12-03, with the lower boundary of the silty clay till encountered at depths ranging from 5.6 m to 8.7 m (Elevation 315.9 to 319.6).



SPT N-values recorded in the silty clay till ranged from 19 to 34 blows for 0.3 m penetration, indicating a very stiff to hard consistency.

The natural moisture content of samples of the silty clay till ranged from 8 percent to 30 percent.

Two samples of the silty clay till underwent laboratory gradation analysis and Atterberg Limits testing, the results of which are summarized below. These results are also presented on the Record of Borehole sheets in Appendix D and the grain size distribution curve for this sample is plotted on Figure D3 of Appendix D. The results of the Atterberg Limits tests are plotted on Figure D7.

Soil Particles	Silty Clay Till (%)
Gravel	3 to 7
Sand	19 to 24
Silt	39 to 50
Clay	23 to 35

Index Property	
Liquid Limit	24 to 27
Plastic Limit	14 to 15
Plasticity Index	10 to 12

The above results indicate that the silty clay till is low plasticity with a group symbol of CL.

It should be noted that glacial tills are known to contain cobbles and boulders.

5.4.5 Upper Silty Clay

An upper silty clay layer was encountered immediately below the granular fill in Borehole RW12-06 at a depth of 0.7 m (Elevation 320.5 m) and below the upper sand layer in Boreholes RW12-04 and RW12-05 at a depth of 2.0 m and 2.9 m, respectively (Elevation 323.1 and 320.5).

Silty clay was also encountered below the silty clay till layer at Borehole RW12-03 at a depth of 5.6 m (Elevation 319.6), and below the lower sand layer at Boreholes RW12-01 and RW12-02 at depths of 12.3 m and 12.2 m (Elevation 312.2 and 312.9), respectively.



The upper silty clay was brown to grey and contained trace to with sand.

Boreholes RW12-01 and RW12-02 were terminated in the silty clay layer at the depth of 15.8 m for both boreholes (Elevation 308.7 and 309.2).

In Boreholes RW12-03, RW12-04 and RW12-06, the thickness of the silty clay layer was 5.4 m, 5.2 m and 9.8 m, with the lower boundary of the silty clay encountered at a depth of 11.0 m, 7.2 m and 10.5 m (Elevation 314.3, 317.9 and 310.7), respectively.

SPT N-values recorded in the upper silty clay ranged from 15 to 100 blows for 0.3 m penetration, indicating a stiff to hard consistency.

The natural moisture content of samples of the upper silty clay ranged from 12 percent to 43 percent.

Eight samples of the upper silty clay underwent laboratory gradation analysis and Atterberg Limits testing, the results of which are summarized below. These results are also presented on the Record of Borehole sheets in Appendix D and the grain size distribution curve for this sample is plotted on Figure D4 of Appendix D. The results of the Atterberg Limits tests are plotted on Figure D8.

Soil Particles	Upper Silty Clay (%)
Gravel	0 to 3
Sand	0 to 39
Silt	35 to 57
Clay	19 to 61

Index Property	
Liquid Limit	17 to 42
Plastic Limit	9 to 18
Plasticity Index	8 to 24

The above results indicate that the upper silty clay is low to intermediate plasticity with a group symbol of CL or CI.

5.4.6 Lower Sand to Sand and Silt

A lower sand to sand and silt layer was encountered below the silty clay till at Boreholes RW12-01 and RW12-02 at a depth of 8.7 m and 7.2 m, respectively (Elevation 315.9



and 317.9). A lower sand to sand and silt layer was also encountered below the silty clay at Boreholes RW12-03 to RW12-06, at depths ranging from 7.2 m to 11.0 m (Elevation 315.1 to 310.7).

The lower sand to sand and silt layer was generally brown to grey in colour, and contained trace gravel and trace clay, with occasional cobbles.

The thickness of the lower sand to sand and silt layer ranged from 1.3 m to 4.8 m, with the lower boundary of the sand encountered at depths ranging from 10.0 m to 15.2 m (Elevation 315.1 to 308.6).

And additional sand layer was encountered in Borehole RW12-06 below the lower silty clay, at a depth of 17.8 m (Elevation 303.4). Borehole RW12-06 was terminated in this second sand layer at a depth of 20.1 m (Elevation 301.1).

SPT N-values recorded in the lower sand ranged from 11 to 130 blows for 0.3 m penetration, indicating a compact to very dense relative density.

Moisture content of samples of the lower sand generally ranged from 9 percent to 25 percent.

Six samples of the lower sand underwent laboratory gradation analysis. These results are summarized on the Record of Borehole sheets included in Appendix D and the grain size distribution curves for these samples are plotted on Figure D5 of Appendix D. The results of this testing are summarized as follows:

Soil Particles	Lower Sand (%)
Gravel	0 to 7
Sand	40 to 94
Silt	6 to 53
Clay	0 to 9

5.4.7 Lower Silty Clay

A lower silty clay layer was encountered below the lower sand to sand and silt layer in Boreholes RW12-03 to RW12-06, at depths ranging from 11.7 m to 15.2 m (Elevation 313.3 to 308.6).

The lower silty clay was grey and contained trace to some sand.



Boreholes RW12-03, RW12-04 and RW12-05 were terminated in the lower silty clay layer at a depth of 15.8, 15.8 m and 15.6 m (Elevation 309.4, 309.2 and 307.8), respectively.

In Borehole RW12-06, the thickness of the lower silty clay layer was 5.2 m, with the lower boundary of the silty clay encountered at a depth of 17.8 m (Elevation 303.4).

SPT N-values recorded in the lower silty clay ranged from 26 to 100 blows for 0.3 m penetration, indicating a very stiff to hard consistency.

The natural moisture content of samples of the lower silty clay ranged from 14 percent to 26 percent.

Four samples of the lower silty clay underwent laboratory gradation analysis and two samples underwent Atterberg Limits testing, the results of which are summarized below. These results are also presented on the Record of Borehole sheets in Appendix D and the grain size distribution curve for this sample is plotted on Figure D6 of Appendix D. The results of the Atterberg Limits tests are plotted on Figure D9.

Soil Particles	Lower Silty Clay (%)
Gravel	0
Sand	0 to 14
Silt	29 to 69
Clay	17 to 59

Index Property	
Liquid Limit	37 to 38
Plastic Limit	16 to 18
Plasticity Index	20

The above results indicate that the lower silty clay is of intermediate plasticity with a group symbol of CI.

5.4.8 Groundwater Conditions

Water levels were observed in the boreholes during and upon completion of drilling. Three standpipe piezometers were installed at this site, in Boreholes RW12-03, RW12-



04 and RW12-05 to monitor water levels after completion of drilling. The water levels measured in the piezometer are summarized in Table 5.4.1, along with the measurements in the open boreholes upon completion of drilling.

Table 5.4.1 – Water Level Measurements

Borehole	Date	Water Level (m)		Comment
		Depth	Elevation	
RW12-01	N/A	N/A	N/A	Water level in open borehole not available. No cave-in observed.
RW12-02	N/A	N/A	N/A	Water level in open borehole not available. No cave-in observed.
RW12-03	May 16, 2018	8.3	316.9	Piezometer
	May 31, 2018	8.2	317.1	
	June 25, 2018	7.9	317.3	
RW12-04	April 19, 2018	13.4	311.7	Open borehole (Water reading N/A as piezometer was destroyed)
RW12-05	April 27, 2018	5.9	317.5	Piezometer
	May 16, 2018	6.0	317.5	
	May 31, 2018	5.9	317.5	
	June 25, 2018	5.6	317.8	
RW12-06	Oct 20, 2016	10.7	310.5	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.

5.5 Retaining Wall RW16 - Highway 85 SB/E-S Ramp (Station 18+800 to 18+880 – Appendix E)

In general the soil stratigraphy at this site consisted of asphalt and granular fill overlying a layer of native sand or clayey silt, a layer of silty clay and a lower layer of silty sand to sandy silt.



5.5.1 Asphalt

Asphalt with a thickness of 150 mm was encountered at all boreholes at this site, Boreholes RW16-01, RW16-02 and RW16-03.

5.5.2 Granular Fill

Granular fill consisting of sand and gravel was encountered immediately beneath the asphalt layers for boreholes RW16-02 and RW16-03, and sandy silt fill for Borehole RW16-01.

The granular fill consisted of sand and gravel or sandy silt with gravel and was generally brown in colour.

The thickness of the granular fill ranged from 0.5 m to 0.6 m, with the lower boundary of this layer encountered at depths of 0.7 m to 0.8 m (Elevation 320.5 to 319.3).

Moisture content of samples of the granular fill generally ranged from 1 percent to 3 percent.

5.5.3 Sand

Native sand was encountered immediately beneath the asphalt layer in Boreholes RW16-01 and RW16-02.

The sand was brown in colour and contained some silt to silty, trace to some clay, trace gravel, with occasional cobbles.

The thickness of the sand layer was 1.5 m and 0.7 m, with the lower boundary of the sand encountered at a depth of 2.3 m and 1.4 m, at Boreholes RW16-01 and RW16-02, respectively (Elevation 319.0 and 319.0).

SPT N-values within the sand varied from 8 to 26 blows for 0.3 m penetration, indicating loose to compact relative density.

Measured moisture contents within the sand were 14% to 18%.

The result of grain size distribution analysis carried out on one sample of the native sand is presented on the Record of Borehole Sheets included in Appendix E and on Figure E1 of Appendix E. The result of the grain size distribution analysis is summarized below:



Soil Particle	Sand (%)
Gravel	2
Sand	78
Silt	16
Clay	4

5.5.4 Clayey Silt

A layer of clayey silt was encountered immediately below the granular fill at 0.7 m depth (Elevation 319.3) in Borehole RW16-03.

The clayey silt was grey in colour and contained some sand and gravel.

The thickness of the clayey silt was 0.7 m, with the lower boundary of the layer encountered at a depth of 1.4 m (Elevation 318.5).

The SPT N-value recorded in the clayey silt was 39 blows for 0.3 m penetration, indicating a hard consistency.

The moisture content of the sample of the clayey silt was 21 percent.

5.5.5 Silty Clay

A layer of silty clay was encountered below the upper sand layer in Boreholes RW16-01 and RW16-02, and below the clayey silt in Borehole RW16-03, at 2.3 m, 1.4 m and 1.4 m depth, respectively (Elevation 319.0, 319.0 and 318.5).

The silty clay was brown to grey in colour and contained trace to some sand, trace gravel and trace shale.

Borehole RW16-02 was terminated in the silty clay layer at a depth of 11.3 m (Elevation 309.1).

The thickness of the silty clay was 6.5 m and 7.3 m at Boreholes RW16-01 and RW16-03, respectively, with the lower boundary of the layer encountered at depths of 8.8 m and 8.7 m (Elevation 312.5 and 311.3).

SPT N-values recorded in the silty clay ranged from 15 to 58 blows for 0.3 m penetration, indicating a very stiff to hard consistency.

Moisture content of samples of the silty clay generally ranged from 10 percent to 33 percent.



Four samples of the silty clay underwent laboratory gradation analysis and Atterberg Limits testing, the results of which are summarized below. These results are also presented on the Record of Borehole sheets in Appendix E and the grain size distribution curves for these samples are plotted on Figure E2 of Appendix E. The results of the Atterberg Limits tests are plotted on Figure E4.

Soil Particles	Silty Clay (%)
Gravel	0
Sand	1 to 5
Silt	32 to 53
Clay	42 to 67

Index Property	
Liquid Limit	36 to 46
Plastic Limit	18 to 21
Plasticity Index	17 to 26

The above results indicate that the silty clay is of intermediate plasticity with a group symbol of CI.

Audible grinding of the auger during drilling in Borehole RW16-03 was noted between depths of 3.6 m and 9.1 m (Elevation 316.3 and 310.8), indicating the possibility of occasional cobbles within the silty clay layer.

5.5.6 Silty Sand to Sandy Silt

A silty sand to sandy silt layer was encountered immediately below the silty clay in Boreholes RW16-01 and RW16-03, at depths of 8.8 m and 8.7 m, respectively (Elevation 312.5 and 311.3).

The silty sand to sandy silt was grey in colour and contained trace clay.

Boreholes RW16-01 and RW16-03 were both terminated in the silty sand to sandy silt layer at a depth of 11.3 m (Elevation 310.0 and 308.7).

SPT N-values within the silty sand to sandy silt varied from 18 to 42 blows for 0.3 m penetration, indicating compact to dense relative density.



Measured moisture contents within the silty sand to sandy silt were 12 percent to 20 percent.

The result of grain size distribution analysis carried out on one sample of the silty sand to sandy silt is presented on the Record of Borehole Sheets included in Appendix E and on E3 of Appendix E. The result of the grain size distribution analysis is summarized below:

Soil Particle	Silty Sand to Sandy Silt (%)
Gravel	0
Sand	24
Silt	70
Clay	6

5.5.7 Groundwater Conditions

Water levels were observed in the boreholes during and upon completion of drilling. No standpipe piezometers were installed at this site. The water levels measured in the open boreholes upon completion of drilling are summarized in Table 5.5.1.

Table 5.5.1 – Water Level Measurements

Borehole	Date	Water Level (m)		Comment
		Depth	Elevation	
RW16-01	Aug 19, 2019	N/A	N/A	Water level in open borehole not available. Cave-in observed at 0.2 m.
RW16-02	Aug 19, 2019	3.7	316.7	Open borehole
RW16-03	Aug 15, 2019	8.8	311.1	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.

Upon completion of drilling, Boreholes RW16-01 caved-in at 0.2 m, RW16-02 caved-in at 10.4 m and RW16-03 caved-in at 9.1 m.



5.6 Retaining Wall RW24 - E-N Ramp over Guelph Street (Station 19+412 to 19+500 – Appendix F)

In general the soil stratigraphy at this site consisted of asphalt and granular fill overlying a layer of cohesive fill or native sand, sand and silt and silty clay.

5.6.1 Asphalt

Asphalt with thicknesses ranging from 125 mm to 200 mm was encountered at all boreholes at this site, Boreholes RW24-01 to RW24-03.

5.6.2 Granular Fill

Granular fill consisting of sand to sand and gravel fill was encountered immediately below the asphalt in all three boreholes at this site, Boreholes RW24-01 to RW24-03. A lower granular fill layer consisting of sand/silt fill was encountered below the sand and gravel fill.

The upper granular fill consisted of sand and gravel generally brown in colour, with some silt and clay. The lower granular fill consisted of sand or silt fill generally brown in colour, with trace to some clay and trace gravel.

The thickness of the granular fill ranged from 3.2 m to 3.9 m, with the lower boundary of this layer encountered at depths of 3.3 m to 4.1 m (Elevation 314.7 to 314.4).

SPT N-values recorded in the granular fill ranged from 11 to 49 blows for 0.3 m penetration, indicating a compact to dense relative density.

Moisture content of samples of the granular fill generally ranged from 3 percent to 11 percent.

Four samples of the granular fill underwent laboratory gradation analysis. These results are summarized on the Record of Borehole sheets included in Appendix F and the grain size distribution curves for these samples are plotted on Figure F1 of Appendix F. The results of this testing are summarized as follows:

Soil Particles	Granular Fill (%)
Gravel	2 to 42
Sand	35 to 80
Silt	12 to 42
Clay	1 to 11



5.6.3 Cohesive Fill

A layer of cohesive fill was encountered below the granular fill in Boreholes RW24-01 and RW24-02, at depths of 3.3 m and 3.4 m (Elevation 314.4 and 314.7), respectively.

The cohesive fill consisted of silty clay generally brown to grey in colour and contained some sand to sandy and trace gravel.

The thickness of the cohesive fill ranged from 0.7 m to 2.3 m, with the lower boundary of the layer encountered at a depth of 4.1 m to 5.6 m (Elevation 312.0 and 314.0).

The SPT N-value recorded in the cohesive fill ranged from 16 to 27 blows for 0.3 m penetration, indicating a very stiff consistency.

The moisture content of the samples of cohesive fill ranged from 12 percent to 16 percent.

One sample of the cohesive fill underwent laboratory gradation analysis and Atterberg Limits testing, the results of which are summarized below. These results are also presented on the Record of Borehole sheets in Appendix F and the grain size distribution curves for these samples are plotted on Figure F2 of Appendix F. The results of the Atterberg Limits tests are plotted on Figure F6.

Soil Particles	Cohesive Fill (%)
Gravel	3
Sand	26
Silt	51
Clay	20

Index Property	
Liquid Limit	20
Plastic Limit	11
Plasticity Index	9

The above results indicate that the cohesive fill is low plasticity with a group symbol of CL.



5.6.4 Sand

A layer of native sand was encountered below the cohesive fill in Borehole RW24-02 and below the granular fill in Borehole RW24-03, at depths of 4.1 m for both boreholes (Elevation 314.0 and 314.5).

The sand was generally brown in colour and contained some silt to silty, trace to some gravel, with occasional cobbles.

The thickness of the sand layer was 3.1 m for both boreholes, with the lower boundary of the sand encountered at a depth of 7.2 m for both boreholes (Elevation 310.9 and 311.5) for Boreholes RW24-02 and RW24-03, respectively).

SPT N-values within the sand varied from 23 to 57 blows for 0.3 m penetration, indicating compact to very dense relative density.

Measured moisture contents within the sand were 7 percent to 20 percent.

The result of grain size distribution analysis carried out on one sample of the sand is presented on the Record of Borehole Sheets included in Appendix F and on Figure F3 of Appendix F. The result of the grain size distribution analysis is summarized below:

Soil Particle	Sand (%)
Gravel	5
Sand	78
Silt	14
Clay	3

5.6.5 Sand and Silt

A layer of sand and silt to sandy silt was encountered below the cohesive fill in Borehole RW24-01, and below the sand layer in Boreholes RW24-02 and RW24-03. The sand and silt to sandy silt was generally brown in colour and contained trace to some clay and trace to some gravel.

The sand and silt layer was encountered at depths of 5.6 m, 7.2 m and 7.2 m (Elevation 312.0, 310.9 and 311.5) in Boreholes RW24-01, RW24-02 and RW24-03, respectively.

Borehole RW24-03 was terminated within the sand and silt layer at a depth of 11.3 m (Elevation 307.4).



The thickness of the sand and silt layer was 1.6 m and 3.0 m thick, with the lower boundary of this layer encountered at depths of 7.2 m and 10.2 m (Elevation 310.5 and 307.9) for Boreholes RW24-01 and RW24-02, respectively.

SPT N-values recorded in the sand and silt layer ranged from 3 to 69 blows for 0.3 m penetration, indicating a loose to very dense relative density.

Moisture content of samples of the sand and silt layer generally ranged from 10 percent to 28 percent.

One sample of the sand and silt underwent laboratory gradation analysis. The results are summarized on the Record of Borehole sheets included in Appendix F and the grain size distribution curves for these samples are plotted on Figure F4 of Appendix F. The results of this testing are summarized as follows:

Soil Particles	Sand and Silt (%)
Gravel	3
Sand	56
Silt	36
Clay	5

5.6.6 Silty Clay

A layer of silty clay was encountered below the sand and silt layer in Boreholes RW24-01 and RW24-02 at the depth of 7.2 m and 10.2 m, respectively (Elevation 310.5 and 307.9).

The silty clay was brown to grey in colour and contained trace sand to with sand and trace gravel.

Boreholes RW24-01 and RW24-02 were terminated within the silty clay layer at a depth of 12.8 m for both boreholes (Elevation 304.9 and 305.3, respectively).

SPT N-values recorded in the silty clay ranged from 11 to 32 blows for 0.3 m penetration, indicating a stiff to hard consistency.

Moisture content of samples of the silty clay generally ranged from 15 percent to 27 percent.

Two samples of the silty clay underwent laboratory gradation analysis and Atterberg Limits testing, the results of which are summarized below. These results are also presented on the Record of Borehole sheets in Appendix F and the grain size



distribution curves for these samples are plotted on Figure F5 of Appendix F. The results of the Atterberg Limits tests are plotted on F7.

Soil Particles	Silty Clay (%)
Gravel	0 to 1
Sand	1 to 31
Silt	43 to 46
Clay	22 to 56

Index Property	
Liquid Limit	22 to 37
Plastic Limit	12 to 17
Plasticity Index	10 to 20

The above results indicate that the silty clay is of low to intermediate plasticity with a group symbol of CL or CI.

5.6.7 Groundwater Conditions

Water levels were observed in the boreholes during and upon completion of drilling. No standpipe piezometers were installed at this site. The water levels measured in the open boreholes upon completion of drilling are summarized in Table 5.6.1.

Table 5.6.1 – Water Level Measurements

Borehole	Date	Water Level (m)		Comment
		Depth	Elevation	
RW24-01	Sept 6, 2019	10.1	307.6	Open borehole
RW24-02	Sept 6, 2019	10.1	308.0	Open borehole
RW24-03	Sept 6, 2019	10.2	308.4	Open borehole

The above values are short-term readings and seasonal fluctuations of the groundwater level are to be expected. In particular, the groundwater level may be at a higher elevation after the spring snowmelt or after periods of heavy rainfall.



Upon completion of drilling, Boreholes RW24-01 caved-in at 9.4 m, RW24-02 caved-in at 7.0 m and RW24-03 caved-in at 7.5 m.

5.7 Retaining Wall RW28 - Dumfries Ave (Station 21+030 to 21+120 – Appendix G)

In general the soil stratigraphy at this site consisted of asphalt and granular fill overlying a layer of native sand, a layer of silty clay to clayey silt and sand and silt.

5.7.1 Asphalt

Asphalt with thicknesses ranging from 100 mm to 125 mm was encountered at all boreholes at this site, Boreholes RW28-01 to RW28-03.

5.7.2 Granular Fill

Granular fill consisting of sand and gravel was encountered immediately below the asphalt at all three boreholes at this site, Boreholes RW28-01 to RW28-03.

The granular fill consisted of sand and gravel, generally brown in colour, with some silt and clay.

The thickness of the granular fill was 0.6 m, with the lower boundary of the layer encountered at depths of 0.7 m (Elevation 324.6 to 322.9) for all boreholes.

Moisture content of samples of the granular fill generally ranged from 2 percent to 4 percent.

One sample of the granular fill underwent laboratory gradation analysis. The results are summarized on the Record of Borehole sheets included in Appendix G and the grain size distribution curves for these samples are plotted on Figure G1 of Appendix G. The results of this testing are summarized as follows:

Soil Particles	Granular Fill (%)
Gravel	44
Sand	44
Silt and Clay	12

5.7.3 Sand

Native sand was encountered below the granular fill layer at a depth of 0.7 m in all three boreholes at this site, Boreholes RW28-01 to RW28-03 (Elevation 324.6, to 322.9).



The sand was brown in colour and contained trace silt to silty, trace clay, trace gravel, with occasional cobbles.

The thickness of the sand layer ranged from 2.6 m to 3.5 m with the lower boundary of the sand encountered at a depth ranging from 3.3 m to 4.2 m (Elevation 321.1 to 320.4)

SPT N-values within the sand varied from 7 to 34 blows for 0.3 m penetration, indicating loose to dense relative density.

Measured moisture contents within the sand were 3% to 25%.

The result of grain size distribution analysis carried out on two samples of the sand is presented on the Record of Borehole Sheets included in Appendix G and on Figure G2 of Appendix G. The result of the grain size distribution analysis is summarized below:

Soil Particle	Sand (%)
Gravel	0 to 2
Sand	87 to 92
Silt	7 to 9
Clay	1 to 2

5.7.4 Silty Clay to Clayey Silt

A layer of silty clay to clayey silt was encountered below the native sand layer in all boreholes at this site, at depths ranging from 3.3 to 4.2 m (Elevation 321.1 to 320.4).

The silty clay to clayey silt was brown to grey in colour and contained some sand to with sand and trace gravel.

The thickness of the silty clay to clayey silt ranged from 3.6 m to 5.3 m, with the lower boundary of the layer encountered at depths ranging from 7.2 m to 8.6 m (Elevation 319.5 to 315.8)

SPT N-values recorded in the silty clay to clayey silt ranged from 13 to 100 blows for 0.3 m penetration, indicating a stiff to hard consistency.

Moisture content of samples of the silty clay to clayey silt generally ranged from 11 percent to 22 percent.

Two samples. of the silty clay to clayey silt underwent laboratory gradation analysis and Atterberg Limits testing, the results of which are summarized below. These results are also presented on the Record of Borehole sheets in Appendix G and the grain size



distribution curves for these samples are plotted on Figure G3 of Appendix G. The results of the Atterberg Limits tests are plotted on Figure G5.

Soil Particles	Silty Clay to Clayey Silt (%)
Gravel	0 to 5
Sand	18 to 46
Silt	32 to 60
Clay	17 to 22

Index Property	
Liquid Limit	17 to 19
Plastic Limit	10 to 12
Plasticity Index	5 to 8

The above results indicate that the silty clay to clayey silt is of low plasticity with a group symbol of CL-ML or CL.

It should be noted that high sand contents observed in the silty clay to clayey silt layer indicate the possibility of sand lenses or pockets within the silty clay to clayey silt.

5.7.5 Sand and Silt

A layer of sand and silt was encountered below the silty clay in all boreholes at this site, at depths ranging from 7.2 m to 8.6 m (Elevation 317.4 to 315.8).

The sand and silt was brown to grey in colour and contained trace to some clay and trace gravel.

All three boreholes were terminated in the sand and silt layer at depths of 9.8 m, 9.8 m and 11.3 m (Elevation 315.5, 314.6 and 316.5) for Boreholes RW28-01, RW28-02 and RW28-03, respectively.

SPT N-values recorded in the sand and silt ranged from 18 blows for 0.3 m penetration to 100 blows for 0.2 m penetration, indicating a compact to very dense relative density.

Moisture content of samples of the sand and silt generally ranged from 12 percent to 18 percent.

Three samples of the sand and silt underwent laboratory gradation analysis, and one sample of the silty sand underwent Atterberg limits testing. The results are summarized



on the Record of Borehole sheets included in Appendix G and the grain size distribution curves for these samples are plotted on Figure G4 of Appendix G. The results of this testing are summarized as follows:

Soil Particles	Sand and Silt (%)
Gravel	0 to 5
Sand	37 to 62
Silt	32 to 59
Clay	1 to 17

5.7.6 Groundwater Conditions

Water levels were observed in the boreholes during and upon completion of drilling. No standpipe piezometers were installed at this site. The water levels measured in the open boreholes upon completion of drilling are summarized in Table 5.7.1.

Table 5.7.1 – Water Level Measurements

Borehole	Date	Water Level (m)		Comment
		Depth	Elevation	
RW28-01	Aug 11, 2019	2.7	322.5	Open borehole
RW28-02	Aug 11, 2019	2.4	322.0	Open borehole
RW28-03	Sept 6, 2019	2.4	321.2	Open borehole

The above values are short-term readings and seasonal fluctuations of the groundwater level are to be expected. In particular, the groundwater level may be at a higher elevation after the spring snowmelt or after periods of heavy rainfall.

Upon completion of drilling, Boreholes RW28-01 caved-in at 4.9 m, RW28-02 caved-in at 7.9 m and RW28-03 caved-in at 2.4 m.

6.0 CORROSIVITY AND SULPHATE TEST RESULTS

Samples of the sand from Boreholes RW01-02, SS4 (depth of 2.3 m) and RW16-01, SS2 (depth of 0.8 m), sand fill from Boreholes RW02-04, SS3 (depth of 1.5 m), RW09-02, SS3 (depth of 1.5 m), RW10-04, SS4 (depth of 2.3 m), sandy silt from Borehole RW12-05, SS3 (depth of 1.5 m) and silty sand from Borehole RW24-02, SS4 (depth of



3.0 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 presented in Appendix H.

Table 6.1 – Analytical Test Results

Parameter	Units (Soil)	Test Results						
		RW01-02 SS4 2.3 m	RW02-04 SS3 1.5 m	RW09-02 SS3 1.5 m	RW10-04 SS4 2.3 m	RW12-05 SS3 1.5 m	RW16-01 SS2 0.8 m	RW24-02 SS4 3.0 m
		(Soil Sample)						
Corrosivity Index	none	9	5	4	3	4	4	11
Soil Redox Potential	mV	309	218	274	182	230	309	263
Sulphide	%	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Moisture Content	%	17.2	17.5	11.3	4.4	9.3	13.8	13.1
pH	pH Units	8.79	8.97	9.04	9.11	8.67	8.95	8.18
Chloride	µg/g	190	100	53	3.2	70	140	760
Sulphate	µg/g	13	5.8	13	1.1	15	12	31
Conductivity	uS/cm	543	356	150	59	217	117	1280
Resistivity (calculated)	ohms.cm	1840	2810	6670	17100	4610	8550	780

7.0 MISCELLANEOUS

Landshark Drilling of Brantford, Ontario supplied a rubber track mounted B-57 drill rig and conducted the drilling, sampling and in-situ testing operations for the investigation.

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

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

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

Overall supervision of the field program for the investigation was conducted by Dr. Nancy Berg, P.Eng. Interpretation of the data and preparation of the report was carried out by Ms. Judy Mei, EIT, and Dr. Nancy Berg, P.Eng.



Thurber Engineering Ltd.



Judy Mei, EIT
Geotechnical EIT



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



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Review Principal, Designated MTO Contact



Appendix A

Record of Borehole Sheets, Laboratory Test Results, Borehole Locations and Soil Strata Drawing

Retaining Wall 1 (RW01-01 to RW01-07)

SYMBOLS, ABBREVIATIONS AND TERMS USED ON RECORDS OF BOREHOLES

1. TEXTURAL CLASSIFICATION OF SOILS

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

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

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

3. TERMS DESCRIBING CONSISTENCY (COHESIVE SOILS ONLY)

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

NOTE: Hierarchy of Soil Strength Prediction

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

4. TERMS DESCRIBING DENSITY (COHESIONLESS SOILS ONLY)

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

5. LEGEND FOR RECORDS OF BOREHOLES

SYMBOLS AND ABBREVIATIONS FOR SAMPLE TYPE	SS Split Spoon Sample	WS Wash Sample	AS Auger (Grab) Sample	TP Thin Wall Piston Sample	PH Sampler Advanced by Hydraulic Pressure	PM Sampler Advanced by Manual Pressure	RC Rock Core	SC Soil Core
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$$\text{Sensitivity} = \frac{\text{Undisturbed Shear Strength}}{\text{Remoulded Shear Strength}}$$

 Water Level
 Shear Strength Determination by Pocket Penetrometer

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

UNIFIED SOILS CLASSIFICATION

MAJOR DIVISIONS		GROUP SYMBOL	TYPICAL DESCRIPTION
COARSE GRAINED SOILS	GRAVEL AND GRAVELLY SOILS	GW	Well-graded gravels or gravel-sand mixtures, little or no fines.
		GP	Poorly-graded gravels or gravel-sand mixtures, little or no fines.
		GM	Silty gravels, gravel-sand-silt mixtures.
		GC	Clayey gravels, gravel-sand-clay mixtures.
	SAND AND SANDY SOILS	SW	Well-graded sands or gravelly sands, little or no fines.
		SP	Poorly-graded sands or gravelly sands, little or no fines.
		SM	Silty sands, sand-silt mixtures.
		SC	Clayey sands, sand-clay mixtures.
FINE GRAINED SOILS	SILTS AND CLAYS $W_L < 50\%$	ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity.
		CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays. ($W_L < 30\%$).
		CI	Inorganic clays of medium plasticity, silty clays. ($30\% < W_L < 50\%$).
		OL	Organic silts and organic silty-clays of low plasticity.
	SILTS AND CLAYS $W_L > 50\%$	MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts.
		CH	Inorganic clays of high plasticity, fat clays.
		OH	Organic clays of medium to high plasticity, organic silts.
HIGHLY ORGANIC SOILS	Pt	Peat and other highly organic soils.	
CLAY SHALE			
SANDSTONE			
SILTSTONE			
CLAYSTONE			
COAL			

EXPLANATION OF ROCK LOGGING TERMS

<u>ROCK WEATHERING CLASSIFICATION</u>		<u>SYMBOLS</u>			
Fresh (FR)	No visible signs of weathering.				
Fresh Jointed (FJ)	Weathering limited to the surface of major discontinuities.				CLAYSTONE
Slightly Weathered (SW)	Penetrative weathering developed on open discontinuity surfaces, but only slight weathering of rock material.				SILTSTONE
Moderately Weathered (MW)	Weathering extends throughout the rock mass, but the rock material is not friable.				SANDSTONE
Highly Weathered (HW)	Weathering extends throughout the rock mass and the rock is partly friable.				COAL
Completely Weathered (CW)	Rock is wholly decomposed and in a friable condition, but the rock texture and structure are preserved.				Bedrock (general)
<u>DISCONTINUITY SPACING</u>		<u>STRENGTH CLASSIFICATION</u>			
Bedding	Bedding Plane Spacing	Rock Strength	Approximate Uniaxial Compressive Strength		Field Estimation of Hardness*
			(MPa)	(psi)	
Very thickly bedded	Greater than 2m	Extremely Strong	Greater than 250	Greater than 36,000	Specimen can only be chipped with a geological hammer
Thickly bedded	0.6 to 2m				
Medium bedded	0.2 to 0.6m	Very Strong	100-250	15,000 to 36,000	Requires many blows of geological hammer to break
Thinly bedded	60mm to 0.2m				
Very thinly bedded	20 to 60mm	Strong	50-100	7,500 to 15,000	Requires more than one blow of geological hammer to break
Laminated	6 to 20mm				
Thinly Laminated	Less than 6mm	Medium Strong	25.0 to 50.0	3,500 to 7,500	Breaks under single blow of geological hammer.
<u>TERMS</u>					
Total Core Recovery: (TCR)	Core recovered as a percentage of total core run length.	Weak	5.0 to 25.0	750 to 3,500	Can be peeled by a pocket knife with difficulty
Solid Core Recovery: (SCR)	Percent Ratio of solid core of full cylindrical shape recovered. Expressed with respect to the total length of core run.	Very Weak	1.0 to 5.0	150 to 750	Can be peeled by a pocket knife, crumbles under firm blows of geological pick.
Rock Quality Designation: (RQD)	Total length of sound core recovered in pieces 0.1m in length or larger as a percentage of total core run length.	Extremely Weak (Rock)	0.25 to 1.0	35 to 150	Indented by thumbnail
Uniaxial Compressive Strength (UCS)	Axial stress required to break the specimen				
Fracture Index: (FI)	Frequency of natural fractures per 0.3m of core run.				

RECORD OF BOREHOLE No RW01-01 1 OF 2 METRIC

GWP# 408-88-00 LOCATION Retaining Wall 1, MTM NAD 83 Zone 10: N 4 813 375.5 E 226 297.0 ORIGINATED BY ES
 DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers/Tricone COMPILED BY AN
 DATUM Geodetic DATE 2019.09.24 - 2019.09.24 LATITUDE 43.455902 LONGITUDE -80.469603 CHECKED BY NB

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						
326.0	GROUND SURFACE													
0.0	ASPHALT: (100mm)													
0.1	SAND, some to trace gravel Compact Brown Moist (FILL) clayey silt layer at 1.4m (500mm)		1	GS										
			2	SS	12									
			3	SS	22									
324.1	SAND, some silt to silty, trace gravel, trace clay Compact to Dense Brown Wet		4	SS	34									
1.9			5	SS	27									
			6	SS	37									
			7	SS	21									
320.4	Silty CLAY, trace sand Very Stiff Grey Moist		8	SS	17									
5.6			9	SS	37									
316.9	Silty SAND, trace gravel Dense to Very Dense Grey Moist													
9.1														
316.0														

ONTMT4S2, MTO-11375.GPJ 2017TEMPLATE(MTO).GDT 12/10/19

Continued Next Page

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

RECORD OF BOREHOLE No RW01-01 2 OF 2 METRIC

GWP# 408-88-00 LOCATION Retaining Wall 1, MTM NAD 83 Zone 10: N 4 813 375.5 E 226 297.0 ORIGINATED BY ES
 DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers/Tricone COMPILED BY AN
 DATUM Geodetic DATE 2019.09.24 - 2019.09.24 LATITUDE 43.455902 LONGITUDE -80.469603 CHECKED BY NB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
							20 40 60 80 100	PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	W _p W W _L			
								WATER CONTENT (%)						
								20 40 60						
10.0	Silty SAND, trace gravel Dense to Very Dense Grey Moist		10	SS	71		315							
	silt layer at 12.0m (600mm)						314							
313.4			11	SS	70									
12.6	Silty SAND, trace clay Very Dense Grey Wet						313							
311.7			12	SS	74		312						0 72 26 2	
14.3	END OF BOREHOLE AT 14.3m. WATER LEVEL AT 2.2m UPON COMPLETION. BOREHOLE BACKFILLED WITH GROUT TO 4.3m, BENTONITE HOLEPLUG TO 0.2m, THEN ASPHALT TO SURFACE.													

ONT/MT452_MTO-11375.GPJ 2017TEMPLATE(MTO).GDT 12/10/19

RECORD OF BOREHOLE No RW01-02 2 OF 2 METRIC

GWP# 408-88-00 LOCATION Retaining Wall 1, MTM NAD 83 Zone 10: N 4 813 419.6 E 226 272.7 ORIGINATED BY ES
 DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers/Tricone COMPILED BY AN
 DATUM Geodetic DATE 2019.09.24 - 2019.09.24 LATITUDE 43.456484 LONGITUDE -80.470036 CHECKED BY NB

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									
	Continued From Previous Page							20	40	60	80	100	W _p	W	W _L		GR SA SI CL
314.7																	
10.2	Silty SAND, trace gravel Very Dense Grey Wet																
313.8			10	SS	105		314										
11.1	END OF BOREHOLE AT 11.1m. WATER LEVEL AT 3.2m UPON COMPLETION. BOREHOLE BACKFILLED WITH GROUT TO 3.7m, HOLEPLUG TO 0.1m, THEN ASPHALT TO SURFACE.																

ONTMT4S2_MTO-11375.GPJ_2017TEMPLATE(MTO).GDT_12/10/19

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

RECORD OF BOREHOLE No RW01-03 1 OF 2 METRIC

GWP# 408-88-00 LOCATION Retaining Wall 1, MTM NAD 83 Zone 10: N 4 813 475.3 E 226 263.8 ORIGINATED BY AF
 DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MP
 DATUM Geodetic DATE 2018.06.05 - 2018.06.05 LATITUDE 43.457067 LONGITUDE -80.470499 CHECKED BY NB

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV. DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa 20 40 60 80 100							WATER CONTENT (%) 20 40 60
327.8	GROUND SURFACE														
0.0	TOPSOIL (150mm)														
0.2	SAND and GRAVEL, some silt to silty, trace asphalt Compact Brown Moist (FILL)		1	SS	13										
			2	SS	20										
325.5															
2.3	SILT, some clay, trace sand Compact Brown Moist (FILL)		3	SS	19								0 0 73 27		
324.6															
3.2	SAND, some silt to silty, trace clay, trace gravel Compact Brown Wet		4	SS	25										
					5	SS	15								
					6	SS	19								
320.6	Silty CLAY, trace to some sand, trace gravel Very Stiff to Hard Grey Moist		7	SS	27										
7.2															
					8	SS	100/ 0.175								
317.8															

ONTMT452_MTO-11375.GPJ 2017TEMPLATE(MTO).GDT 12/10/19

Continued Next Page

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

RECORD OF BOREHOLE No RW01-03 2 OF 2 METRIC

GWP# 408-88-00 LOCATION Retaining Wall 1, MTM NAD 83 Zone 10: N 4 813 475.3 E 226 263.8 ORIGINATED BY AF
 DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MP
 DATUM Geodetic DATE 2018.06.05 - 2018.06.05 LATITUDE 43.457067 LONGITUDE -80.470499 CHECKED BY NB

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa								
	Continued From Previous Page					20 40 60 80 100										
10.0	SILT, some sand to sandy, some clay Dense to Very Dense Grey Moist		9	SS	47											
			10	SS	100/ 0.250										0 19 62 19	
			11	SS	100/ 0.200											
313.7 14.1	END OF BOREHOLE AT 14.1m. WATER LEVEL AT 5.0m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO SURFACE.															

ONT/MT4S2_MTO-11375.GPJ_2017TEMPLATE(MTO).GDT_12/10/19

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

RECORD OF BOREHOLE No RW01-04 1 OF 2 METRIC

GWP# 408-88-00 LOCATION Retaining Wall 1, MTM NAD 83 Zone 10: N 4 813 519.0 E 226 257.8 ORIGINATED BY JB
 DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MFA
 DATUM Geodetic DATE 2018.05.06 - 2018.05.06 LATITUDE 43.457461 LONGITUDE -80.470575 CHECKED BY NB

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									
						20	40	60	80	100							
326.8	GROUND SURFACE																
0.0	TOPSOIL(200mm)																
0.2	SAND, some silt to silty, trace to some gravel, occasional organics Loose to Compact Brown Moist (FILL)		1	SS	4												
			2	SS	6												
324.5	SAND, some silt to silty, trace clay Compact Brown Moist		3	SS	20												
			4	SS	21												
			5	SS	24												
			6	SS	7												
321.2	Silty CLAY, trace sand, trace gravel Very Stiff to Hard Grey Wet		7	SS	17												
			8	SS	39												
316.8																	

ONT\MT452_MTO-11375.GPJ_2017TEMPLATE(MTO).GDT_12/10/19

Continued Next Page

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

RECORD OF BOREHOLE No RW01-04 2 OF 2 METRIC

GWP# 408-88-00 LOCATION Retaining Wall 1, MTM NAD 83 Zone 10: N 4 813 519.0 E 226 257.8 ORIGINATED BY JB
 DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MFA
 DATUM Geodetic DATE 2018.05.06 - 2018.05.06 LATITUDE 43.457461 LONGITUDE -80.470575 CHECKED BY NB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV. DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE									
10.0	Continued From Previous Page Sandy SILT, some clay, trace gravel Very Dense Grey Moist		9	SS	64		316										
			10	SS	90		315										
			11	SS	100/		314										
312.8							313										
14.0	END OF BOREHOLE AT 14.0m. Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 3.0m slotted screen. WATER LEVEL READINGS DATE DEPTH(m) ELEV.(m) 2018.06.25 4.9 321.9				0.150											0 22 59 19	

ONT/MT/4S2_MTO-11375.GPJ_2017TEMPLATE(MTO).GDT_12/10/19

RECORD OF BOREHOLE No RW01-05 1 OF 2 METRIC

GWP# 408-88-00 LOCATION Retaining Wall 1, MTM NAD 83 Zone 10: N 4 813 571.9 E 226 227.3 ORIGINATED BY BL
 DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2019.08.12 - 2019.08.13 LATITUDE 43.457951 LONGITUDE -80.470715 CHECKED BY NB

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV. DEPTH	DESCRIPTION	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa								
					○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE				20	40	60				
321.4	GROUND SURFACE														
0.0	ASPHALT: (100mm)														
0.1	SAND and GRAVEL Brown Dry (FILL)	1	GS												
320.7		2	SS	16											
0.7		3	SS	16											
319.2	Silty SAND, trace gravel Compact Brown Moist														
2.2		4	SS	11											
		5	SS	23											
	Silty CLAY, trace sand Stiff to Hard Grey Moist														
318		6	SS	36											0 3 39 58
	Silty SAND to Sandy SILT, trace clay Dense to Very Dense Grey Moist														
315.1		7	SS	42											
6.3		8	SS	67											
		9	SS	32											
311.4															

ONT/MT452_MTO-11375.GPJ_2017TEMPLATE(MTO).GDT_12/10/19

Continued Next Page

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

RECORD OF BOREHOLE No RW01-05 2 OF 2 METRIC

GWP# 408-88-00 LOCATION Retaining Wall 1, MTM NAD 83 Zone 10: N 4 813 571.9 E 226 227.3 ORIGINATED BY BL
 DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2019.08.12 - 2019.08.13 LATITUDE 43.457951 LONGITUDE -80.470715 CHECKED BY NB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE							
10.0	Silty SAND, trace clay Dense Grey Moist		10	SS	45		311							0 71 28 1	
309.7							310								
11.7	Silty CLAY, trace sand Hard Grey Moist			11	SS	32		309							
307.1			12	SS	42		308						0 2 39 59		
14.3	END OF BOREHOLE AT 14.3m. BOREHOLE CAVED TO 7.9m AND WATER LEVEL AT 4.1m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND ASPHALT PATCH TO SURFACE.														

ONTMT4S2_MTO-11375.GPJ_2017TEMPLATE(MTO).GDT_12/10/19

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

RECORD OF BOREHOLE No RW01-06 1 OF 2 METRIC

GWP# 408-88-00 LOCATION Retaining Wall 1, MTM NAD 83 Zone 10: N 4 813 618.5 E 226 222.2 ORIGINATED BY BL
 DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2019.08.13 - 2019.08.13 LATITUDE 43.458395 LONGITUDE -80.470785 CHECKED BY NB

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV. DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa					
						20 40 60 80 100 ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE WATER CONTENT (%) 20 40 60							
320.5	GROUND SURFACE												
0.0 0.1	ASPHALT: (75mm)												
319.9 0.7	SAND and GRAVEL, trace silt, trace clay Brown Dry (FILL)		1	GS									
	SAND, some silt, trace clay, trace gravel Loose to Dense Brown Moist to Wet		2	SS	15								
			3	SS	5								3 76 16 5
			4	SS	34								
317.7 2.8	Silty CLAY, trace sand Very Stiff to Hard Grey Moist		5	SS	34								
			6	SS	30								
			7	SS	29								
313.4 7.2	Sandy SILT to SILT and SAND, trace to some clay, trace gravel Compact to Dense Grey Moist to Wet		8	SS	30								0 38 49 13
			9	SS	32								

ONT\MT452_MTO-11375.GPJ 2017TEMPLATE(MTO).GDT 12/10/19

Continued Next Page

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

RECORD OF BOREHOLE No RW01-06 2 OF 2 METRIC

GWP# 408-88-00 LOCATION Retaining Wall 1, MTM NAD 83 Zone 10: N 4 813 618.5 E 226 222.2 ORIGINATED BY BL
 DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2019.08.13 - 2019.08.13 LATITUDE 43.458395 LONGITUDE -80.470785 CHECKED BY NB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE							
309.4	Continued From Previous Page		10	SS	30										
11.2	Silty CLAY , trace to some sand Hard Grey Moist														
308			11	SS	33									0 10 45 45	
307															
306.2			12	SS	33										
14.3	END OF BOREHOLE AT 14.3m. BOREHOLE CAVED TO 4.4m AND WATER LEVEL AT 2.3m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND ASPHALT PATCH TO SURFACE.														

ONTMT4S2_MTO-11375.GPJ_2017TEMPLATE(MTO).GDT_12/10/19

RECORD OF BOREHOLE No RW01-07 1 OF 2 METRIC

GWP# 408-88-00 LOCATION Retaining Wall 1, MTM NAD 83 Zone 10: N 4 813 661.7 E 226 221.5 ORIGINATED BY BL
 DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2019.08.14 - 2019.08.14 LATITUDE 43.458833 LONGITUDE -80.471043 CHECKED BY NB

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	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa							
320.0	GROUND SURFACE													
0.0	ASPHALT: (75mm)													
0.1	SAND and GRAVEL , some silt, trace clay Brown Dry (FILL)	1	GS										32 46 22 (SI+CL)	
319.4														
0.7														
318.8	Silty SAND , trace gravel Dense Brown Moist	2	SS	32										
1.3														
	Silty CLAY , trace to some sand, trace gravel Very Stiff to Hard Grey Moist	3	SS	32										
		4	SS	32										
		5	SS	35										
		6	SS	34									2 7 50 41	
		7	SS	28										
		8	SS	24										
		9	SS	23										

ONTMT452_MTO-11375.GPJ_2017TEMPLATE(MTO).GDT_12/10/19

Continued Next Page

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

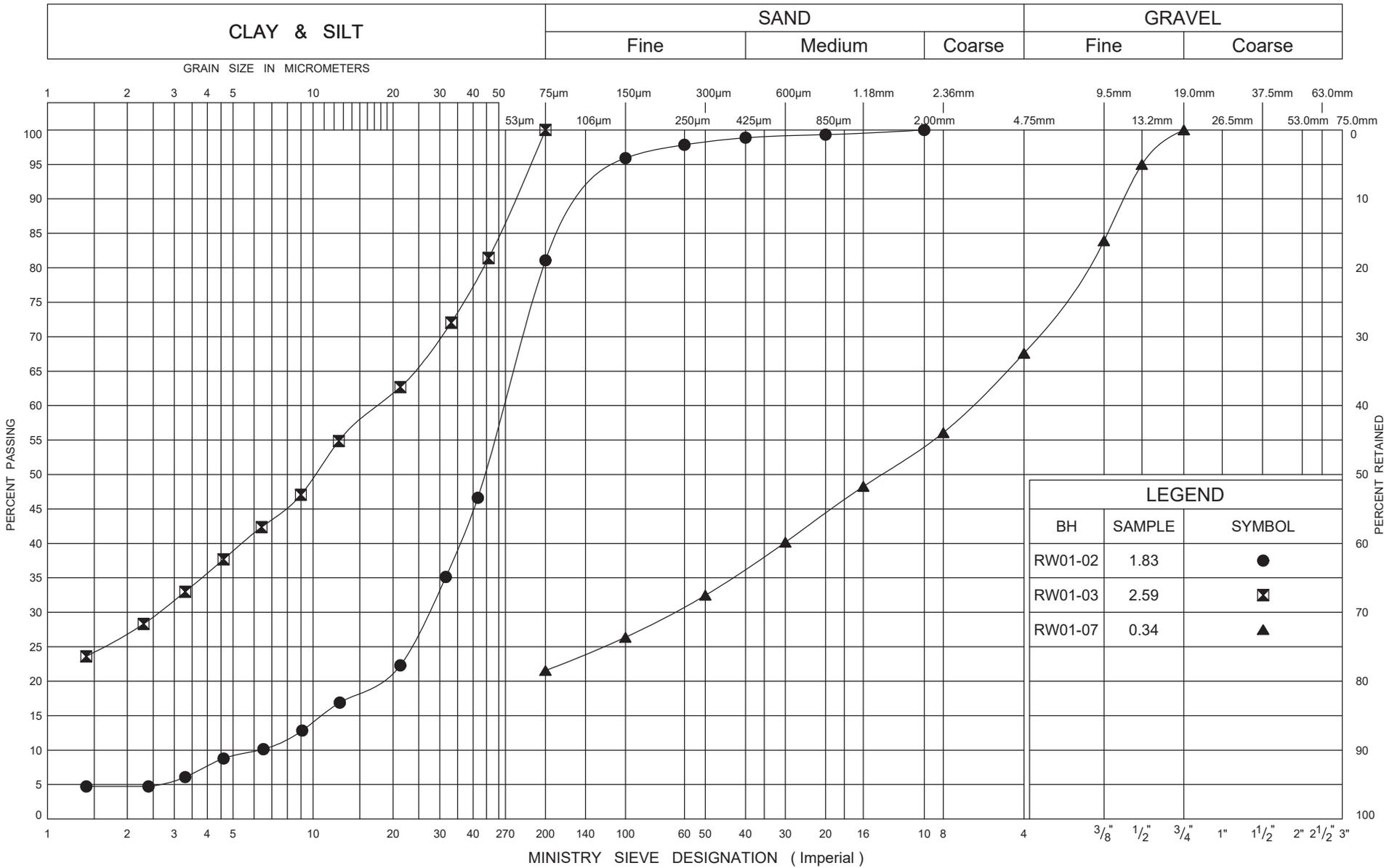
RECORD OF BOREHOLE No RW01-07 2 OF 2 METRIC

GWP# 408-88-00 LOCATION Retaining Wall 1, MTM NAD 83 Zone 10: N 4 813 661.7 E 226 221.5 ORIGINATED BY BL
 DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2019.08.14 - 2019.08.14 LATITUDE 43.458833 LONGITUDE -80.471043 CHECKED BY NB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE									
308.3	Continued From Previous Page Silty CLAY , trace to some sand, trace gravel Very Stiff to Hard Grey Moist		10	SS	19		310										
11.7	Sandy SILT , trace clay Dense to Very Dense Grey Moist		11	SS	31		308										
305.7			12	SS	55		306									0 25 68 7	
14.3	END OF BOREHOLE AT 14.3m. BOREHOLE CAVED TO 8.2m AND WATER LEVEL AT 4.1m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND ASPHALT TO SURFACE.																

ONT/MT452_MTO-11375.GPJ_2017TEMPLATE(MTO).GDT_12/10/19

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



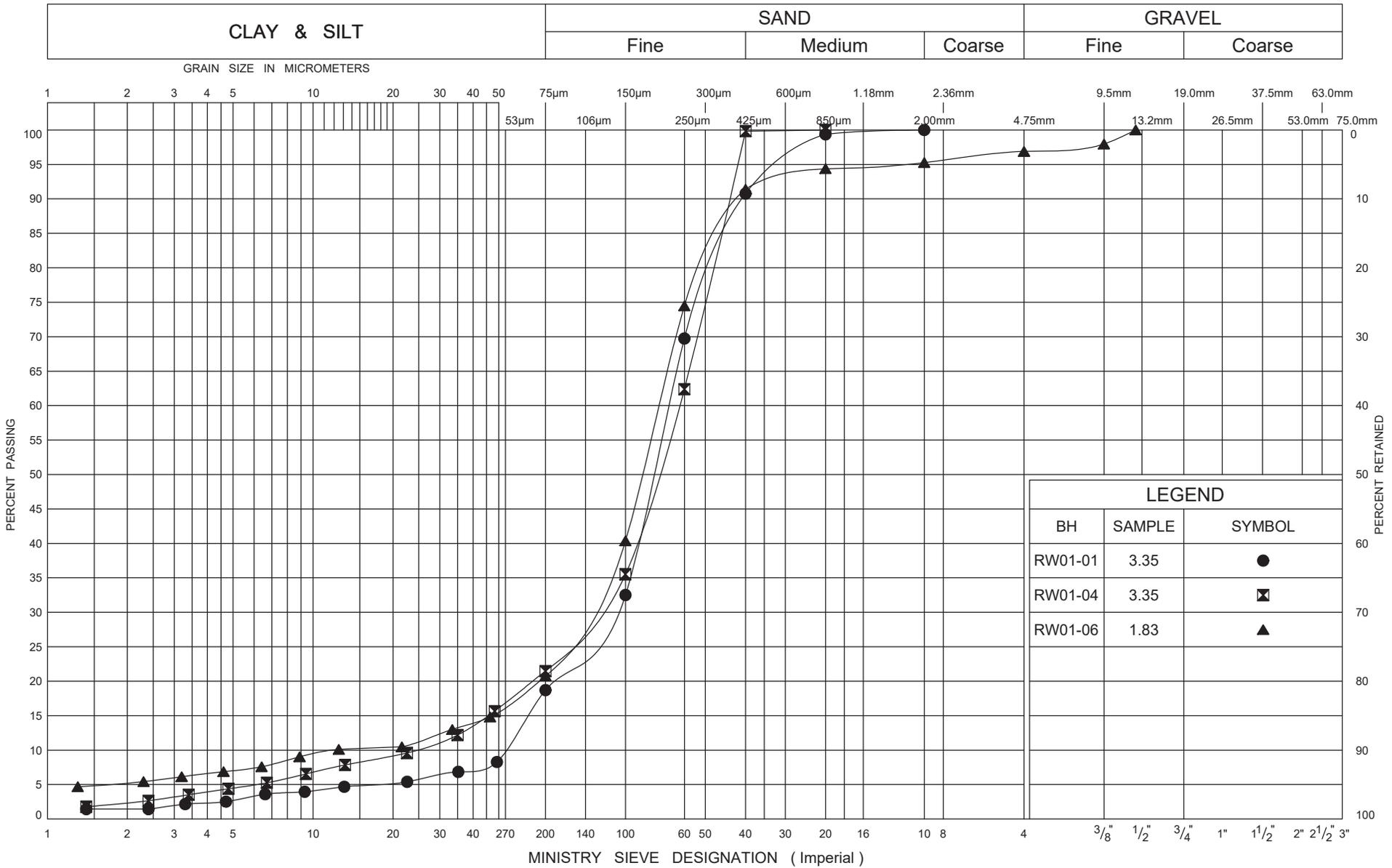
ONTARIO MOT GRAIN SIZE 2 MTO-11375.GPJ ONTARIO MOT.GDT 12/10/19



GRAIN SIZE DISTRIBUTION

Granular FILL

FIG No A1
 W P 408-88-00
 Retaining Wall 1

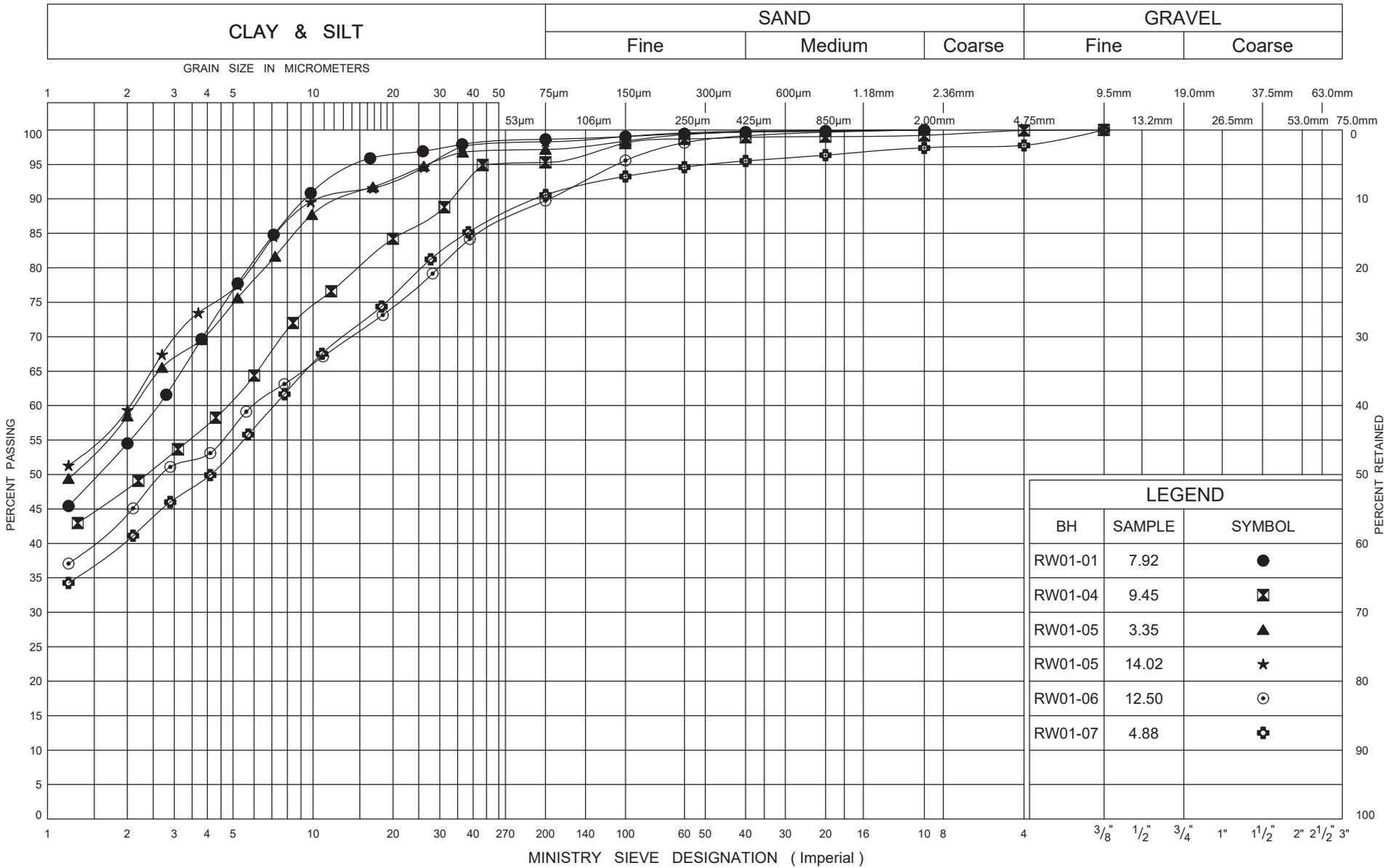


ONTARIO MOT GRAIN SIZE 2 MTO-11375.GPJ ONTARIO MOT.GDT 12/10/19



GRAIN SIZE DISTRIBUTION SAND

FIG No A2
 W P 408-88-00
 Retaining Wall 1



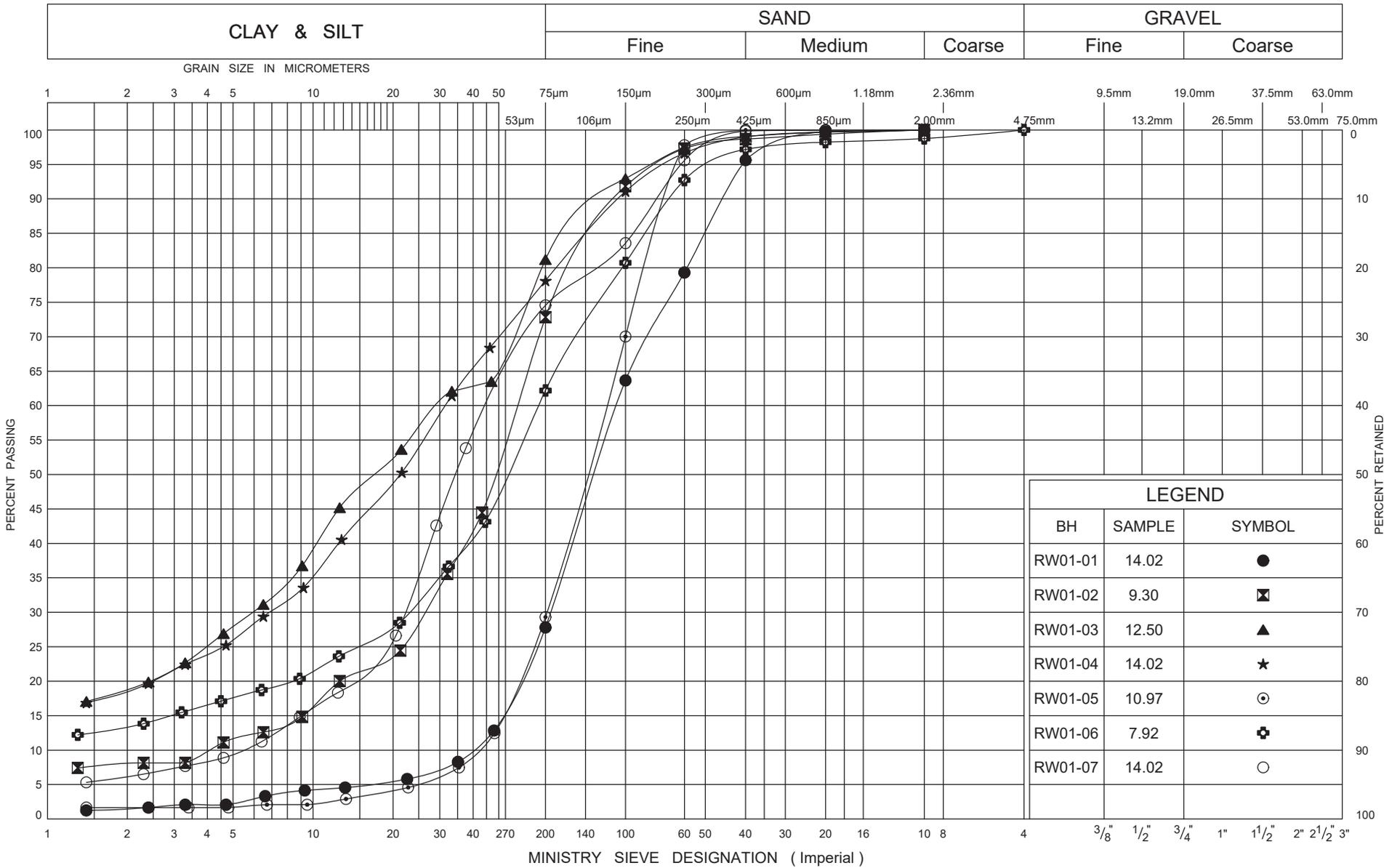
ONTARIO MOT GRAIN SIZE 2 MTO-11375.GPJ ONTARIO MOT.GDT 12/10/19



GRAIN SIZE DISTRIBUTION

Silty CLAY

FIG No A3
W P 408-88-00
Retaining Wall 1



LEGEND		
BH	SAMPLE	SYMBOL
RW01-01	14.02	●
RW01-02	9.30	⊠
RW01-03	12.50	▲
RW01-04	14.02	★
RW01-05	10.97	⊙
RW01-06	7.92	⊕
RW01-07	14.02	○

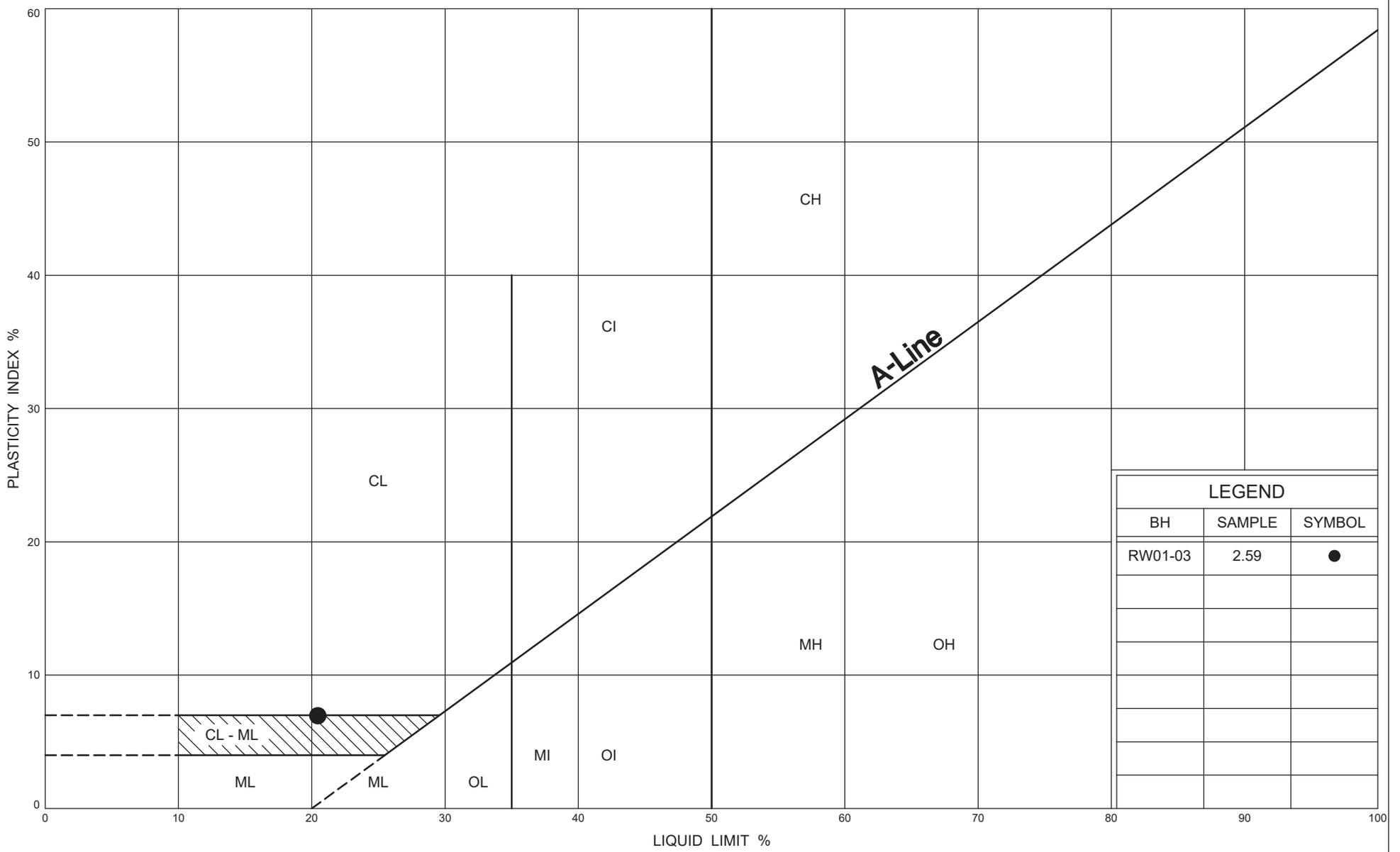
ONTARIO MOT GRAIN SIZE 2 MTO-11375.GPJ ONTARIO MOT.GDT 12/10/19



GRAIN SIZE DISTRIBUTION

Sandy SILT / Silty SAND

FIG No A4
 W P 408-88-00
 Retaining Wall 1



LEGEND		
BH	SAMPLE	SYMBOL
RW01-03	2.59	●

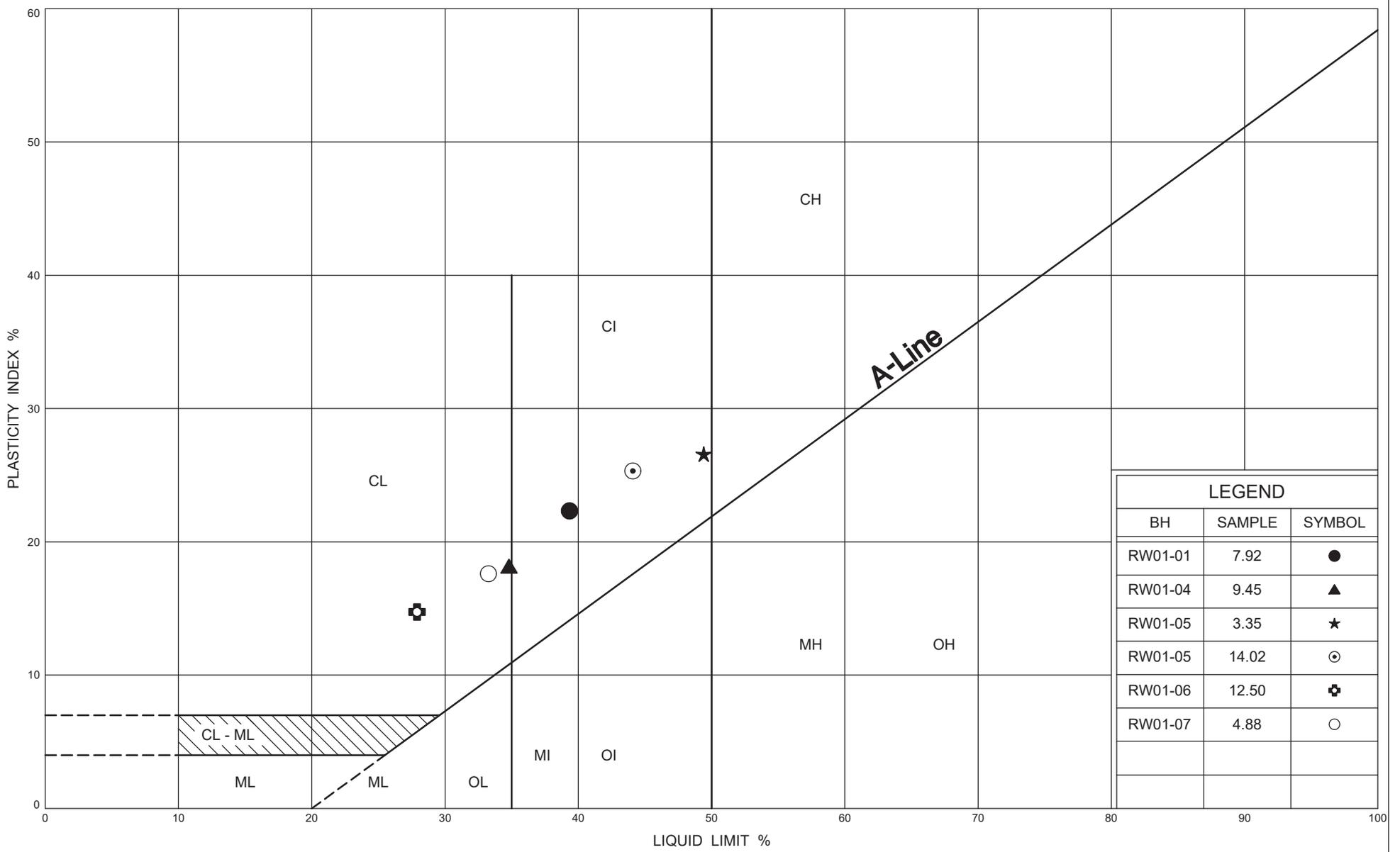
ONTARIO MOT PLASTICITY CHART MTO-11375.GPJ ONTARIO MOT.GDT 12/10/19



PLASTICITY CHART

Granular (Silt) FILL

FIG No A5
 W P 408-88-00
 Retaining Wall 1



LEGEND		
BH	SAMPLE	SYMBOL
RW01-01	7.92	●
RW01-04	9.45	▲
RW01-05	3.35	★
RW01-05	14.02	⊙
RW01-06	12.50	⊕
RW01-07	4.88	○

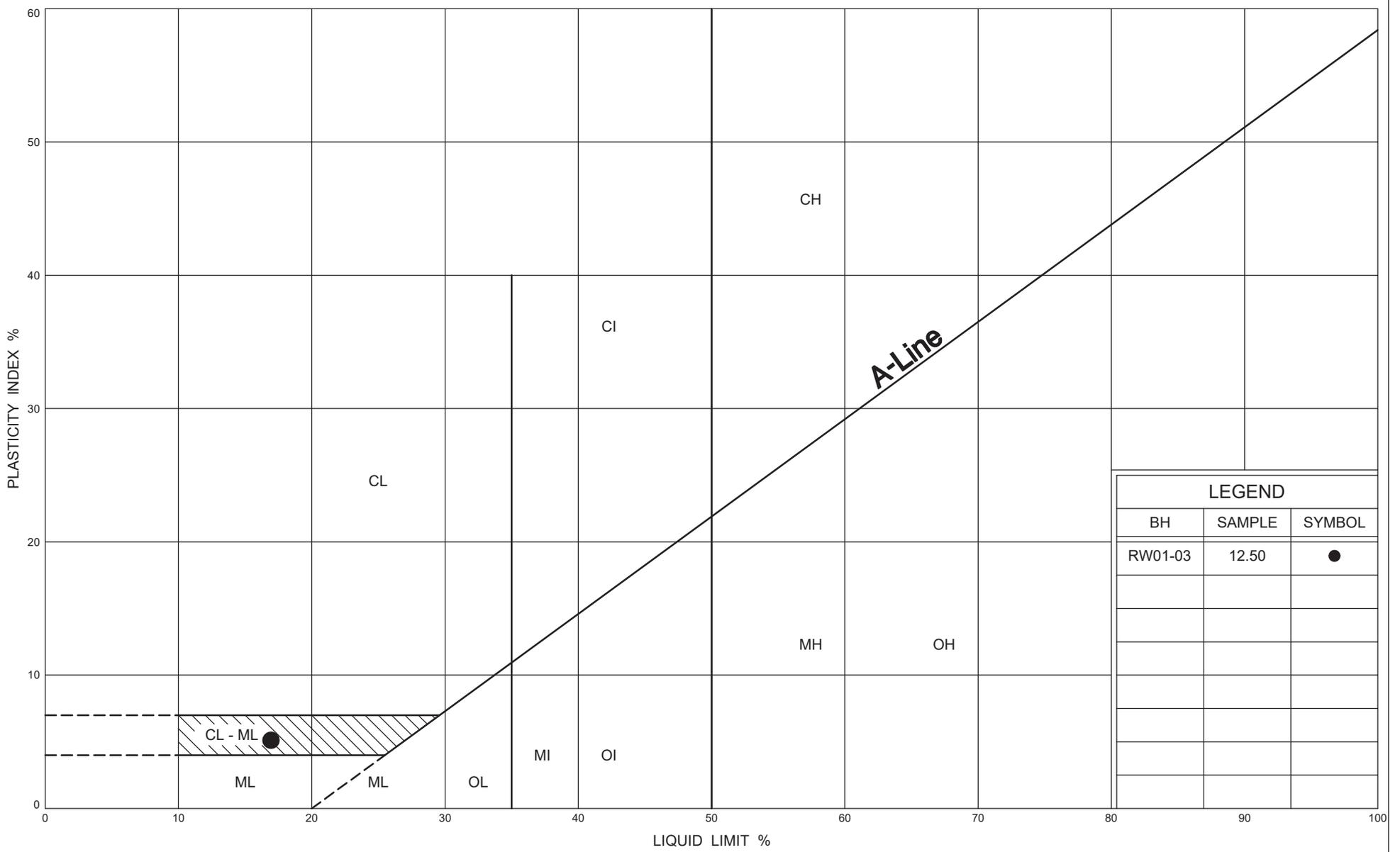
ONTARIO MOT PLASTICITY CHART MTO-11375.GPJ ONTARIO MOT.GDT 12/10/19



PLASTICITY CHART

Silty CLAY

FIG No A6
 W P 408-88-00
 Retaining Wall 1



LEGEND		
BH	SAMPLE	SYMBOL
RW01-03	12.50	●

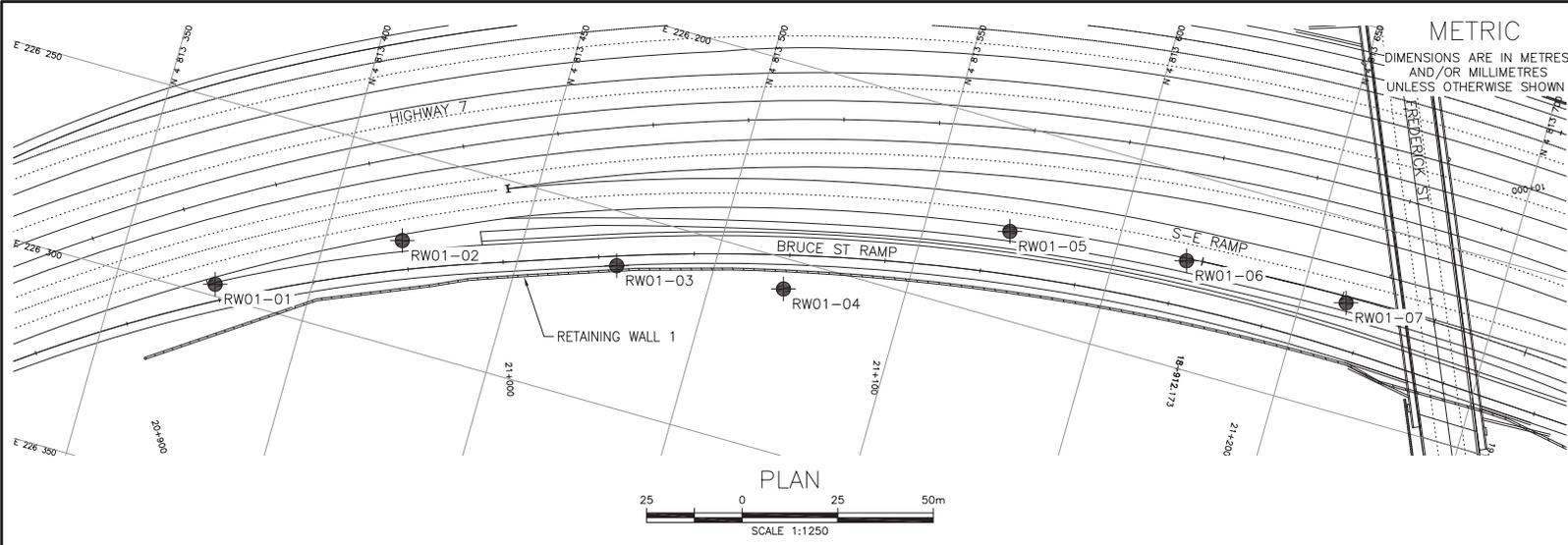
ONTARIO MOT PLASTICITY CHART MTO-11375.GPJ ONTARIO MOT.GDT 12/10/19



PLASTICITY CHART
Sandy SILT / Silty SAND

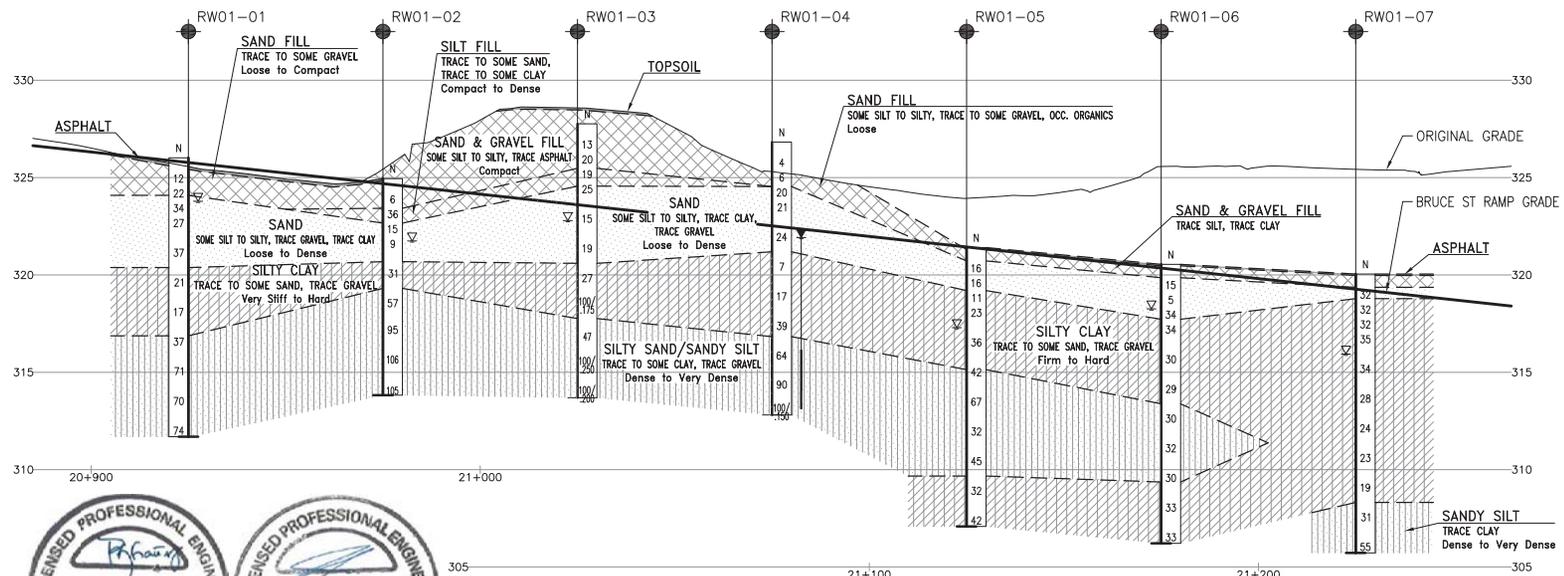
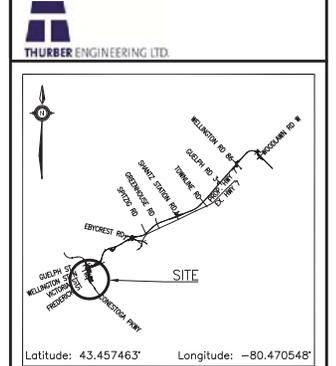
FIG No A7
W P 408-88-00
Retaining Wall 1

MINISTRY OF TRANSPORTATION, ONTARIO



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

CONT No GWP No 408-88-00		SHEET
HIGHWAY 7 FREDERICK ST.-S/E-BECKER ST. RETAINING WALL 1 BOREHOLE LOCATIONS AND SOIL STRATA		



KEYPLAN

LEGEND

- ◆ Borehole (Current Investigation)
- ◇ Borehole (by Others)
- 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 (ROD)
- A/R Auger Refusal

NO	ELEVATION	NORTHING	EASTING
RW01-01	326.0	4 813 375.5	226 297.0
RW01-02	324.9	4 813 419.6	226 272.7
RW01-03	327.8	4 813 475.3	226 263.9
RW01-04	326.8	4 813 519.0	226 257.8
RW01-05	321.4	4 813 571.9	226 227.3
RW01-06	320.5	4 813 618.5	226 222.2
RW01-07	320.0	4 813 661.7	226 221.5

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. 40P9-58



PROFILE ALONG BRUCE STREET RAMP
FREDERICK STREET-S/E-BECKER STREET

REVISIONS	DATE	BY	DESCRIPTION

DESIGN	CHK	PKC	CODE	LOAD	DATE	MAY 2020

DRAWN	MFA	CHK	NB	SITE	STRUCT	DWG	1

FILENAME: H:\Spatial\11000\11375\11375-TBD-11375-BRP-RW01.dwg PLOTDATE: 5/6/2020 4:15 PM



Appendix B

**Record of Borehole Sheets, Laboratory Test Results and Borehole Locations,
and Soil Strata Drawing**

**Retaining Wall 2
(RW-01 to RW-04 and RW02-02 to RW02-04)**



Record of Borehole Sheets, Laboratory Test Results and Borehole Locations
and Soil Strata Drawing for Current Investigation
(RW02-02 to RW02-04)

RECORD OF BOREHOLE No RW02-02 1 OF 2 METRIC

GWP# 408-88-00 LOCATION Retaining Wall 2, MTM NAD 83 Zone 10: N 4 813 757.0 E 226 227.0 ORIGINATED BY JP
 DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2019.08.22 - 2019.08.22 LATITUDE 43.459602 LONGITUDE -80.470929 CHECKED BY NB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV. DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE							
319.6	GROUND SURFACE														
0.0	ASPHALT: (200mm)														
0.2	Silty SAND, with gravel Brown Dry (FILL)		1	GS			319								
318.8															
0.8	Silty SAND, trace clay, trace gravel Dense to Compact Brown Moist		2	SS	30		318								
			3	SS	34		317								
			4	SS	24		316								
			5	SS	21		315							1 63 31 5	
315.4	Silty CLAY, some to with sand, trace gravel Stiff to Hard Grey Moist		6	SS	14		314								
			7	SS	35		313							7 37 32 24	
			8	SS	89		312								
311.6	SILT and SAND, trace clay, trace gravel Very Dense Grey Wet		9	SS	89		311								
7.9							310								

ONT\MT452_MTO-11375.GPJ 2017TEMPLATE(MTO).GDT 12/13/19

Continued Next Page

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

RECORD OF BOREHOLE No RW02-02 2 OF 2 METRIC

GWP# 408-88-00 LOCATION Retaining Wall 2, MTM NAD 83 Zone 10: N 4 813 757.0 E 226 227.0 ORIGINATED BY JP
 DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2019.08.22 - 2019.08.22 LATITUDE 43.459602 LONGITUDE -80.470929 CHECKED BY NB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE							
	Continued From Previous Page														
306.8	SILT and SAND, trace clay Very Dense Grey Wet		10	SS	83										
			11	SS	98									0 43 56 1	
12.8	End of sampling and start DCPT														
306.2															
13.3	END OF BOREHOLE AT 13.3m UPON DCPT REFUSAL. BOREHOLE CAVED TO 4.6m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND ASPHALT PATCH TO SURFACE.														

ONT\MT452_MTO-11375.GPJ_2017TEMPLATE(MTO).GDT_12/13/19

RECORD OF BOREHOLE No RW02-03 1 OF 2 METRIC

GWP# 408-88-00 LOCATION Retaining Wall 2, MTM NAD 83 Zone 10: N 4 813 807.5 E 226 232.5 ORIGINATED BY JP
 DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2019.08.21 - 2019.08.21 LATITUDE 43.460057 LONGITUDE -80.470870 CHECKED BY NB

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							
						20 40 60 80 100 ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE			WATER CONTENT (%) 20 40 60				GR SA SI CL		
319.5	GROUND SURFACE														
0.0	ASPHALT: (200mm)														
0.2	Silty SAND, with gravel Brown Dry (FILL)		1	GS											
318.7															
0.8	SAND, trace to some silt, trace clay Compact Brown Wet		2	SS	26									0 91 8 1	
			3	SS	22										
			4	SS	16										
			5	SS	11										
			6	SS	27										
314.5	Silty CLAY, trace sand Very Stiff Grey Moist														
5.0															
	Firm		7	SS	6									Switch to tricone	
			8	SS	29										
			9	SS	15									0 1 38 61	
309.5															

ONTMT452_MTO-11375.GPJ 2017TEMPLATE(MTO).GDT 12/13/19

Continued Next Page

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

RECORD OF BOREHOLE No RW02-04 1 OF 2 METRIC

GWP# 408-88-00 LOCATION Retaining Wall 2, MTM NAD 83 Zone 10: N 4 813 856.9 E 226 242.2 ORIGINATED BY ES
 DIST _____ HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MFA
 DATUM Geodetic DATE 2019.09.23 - 2019.09.23 LATITUDE 43.460514 LONGITUDE -80.470774 CHECKED BY NB

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV. DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa						
319.1	GROUND SURFACE													
0.0	ASPHALT:(112mm)					319								
0.1	SAND, with gravel Brown Moist (FILL)		1	GS										
318.5	SAND, trace silt and clay, trace gravel Compact to Dense Brown Wet		2	SS	26	318								
0.6			3	SS	32	317								
			4	SS	21	316								1 94 5 (SI+CL)
			5	SS	34	315								
314.3	Silty CLAY, some sand to sandy, trace gravel Very Stiff Grey Moist		6	SS	17	314								
4.8			7	SS	16	313								0 21 45 34
			8	SS	26	312								
			9	SS	17	311								
	Wet					310								

ONTMT452_MTO-11375.GPJ 2017TEMPLATE(MTO).GDT 12/13/19

Continued Next Page

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

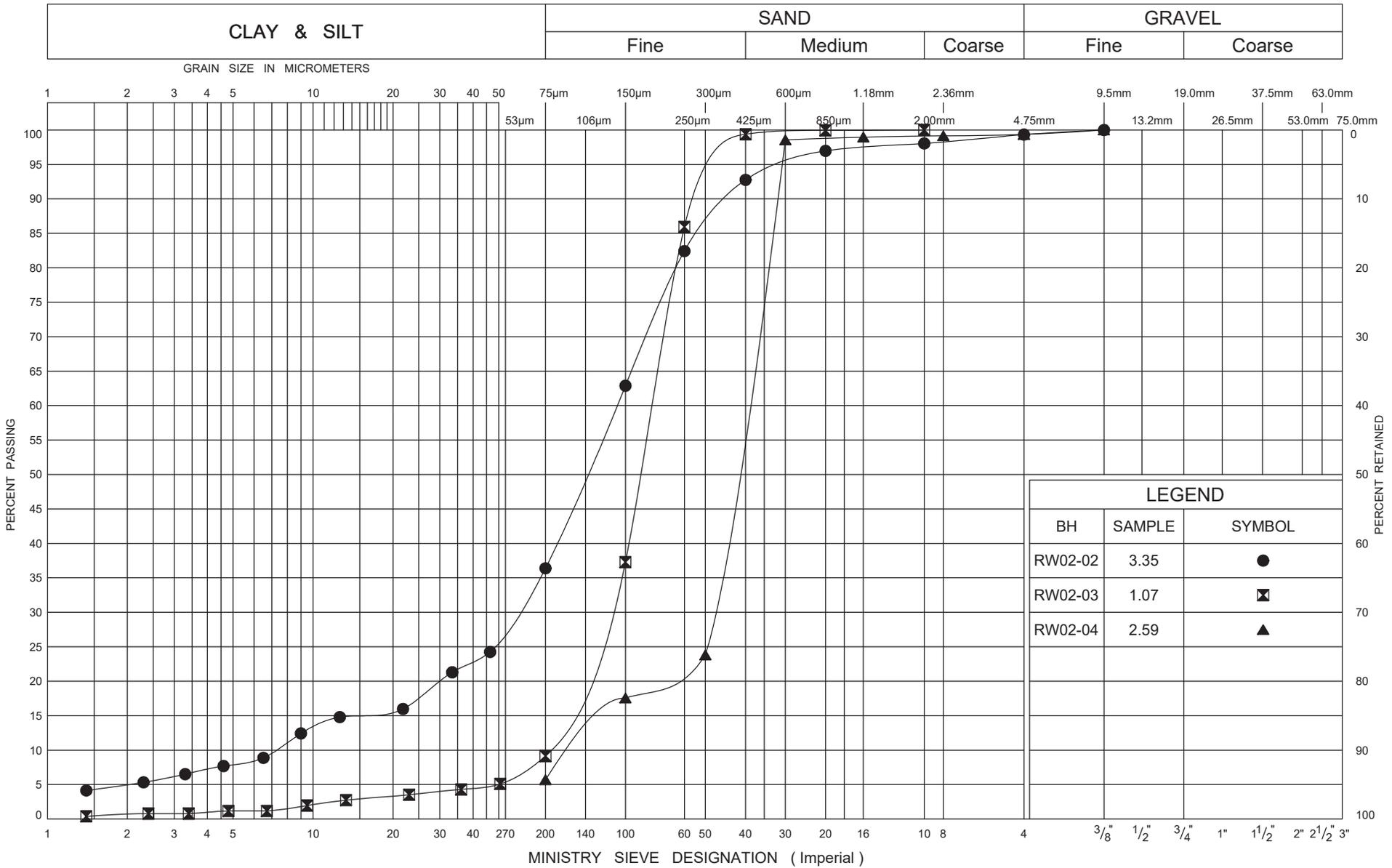
RECORD OF BOREHOLE No RW02-04 2 OF 2 METRIC

GWP# 408-88-00 LOCATION Retaining Wall 2, MTM NAD 83 Zone 10: N 4 813 856.9 E 226 242.2 ORIGINATED BY ES
 DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MFA
 DATUM Geodetic DATE 2019.09.23 - 2019.09.23 LATITUDE 43.460514 LONGITUDE -80.470774 CHECKED BY NB

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							
306.9	Continued From Previous Page Silty CLAY , some sand to sandy, trace gravel Very Stiff Grey Moist Hard		10	SS	37										
12.2	Silty CLAY , trace sand Stiff Grey Wet		11	SS	9									0 1 30 69	
			12	SS	12										
			13	SS	12										
	silty sand layer at 15.8m (80mm)														
301.7			14	SS	37									0 2 39 59	
17.4	END OF BOREHOLE AT 17.4m. WATER LEVEL AT 1.5m UPON COMPLETION. BOREHOLE BACKFILLED WITH HOLEPLUG TO 0.6m, SAND TO 0.2m, THEN ASPHALT TO SURFACE.														

ONTMT4S2_MTO-11375.GPJ 2017TEMPLATE(MTO).GDT 12/13/19

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



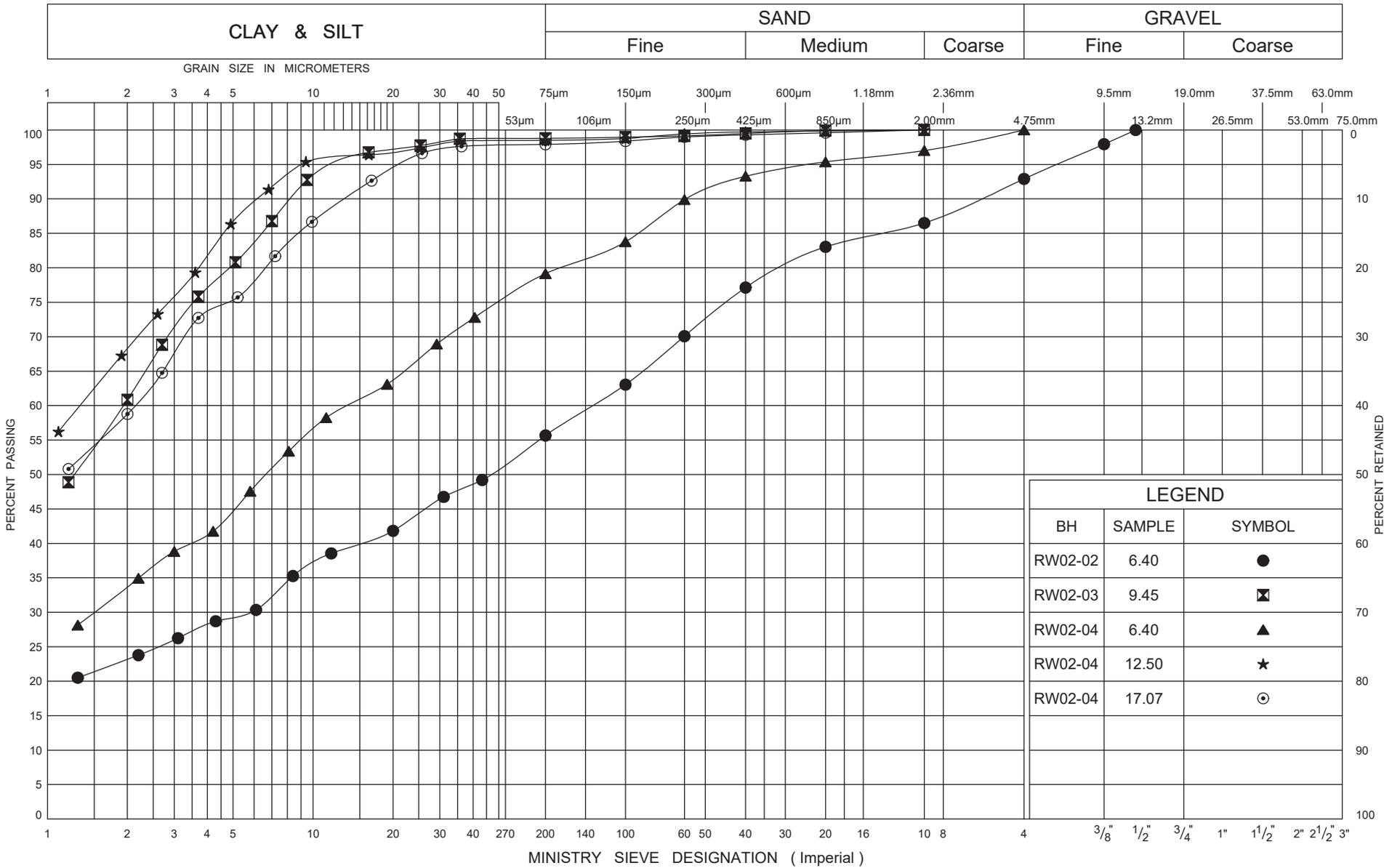
ONTARIO MOT GRAIN SIZE 2 MTO-11375.GPJ ONTARIO MOT.GDT 12/10/19



GRAIN SIZE DISTRIBUTION

Upper SAND

FIG No B1
 W P 408-88-00
 Retaining Wall 2



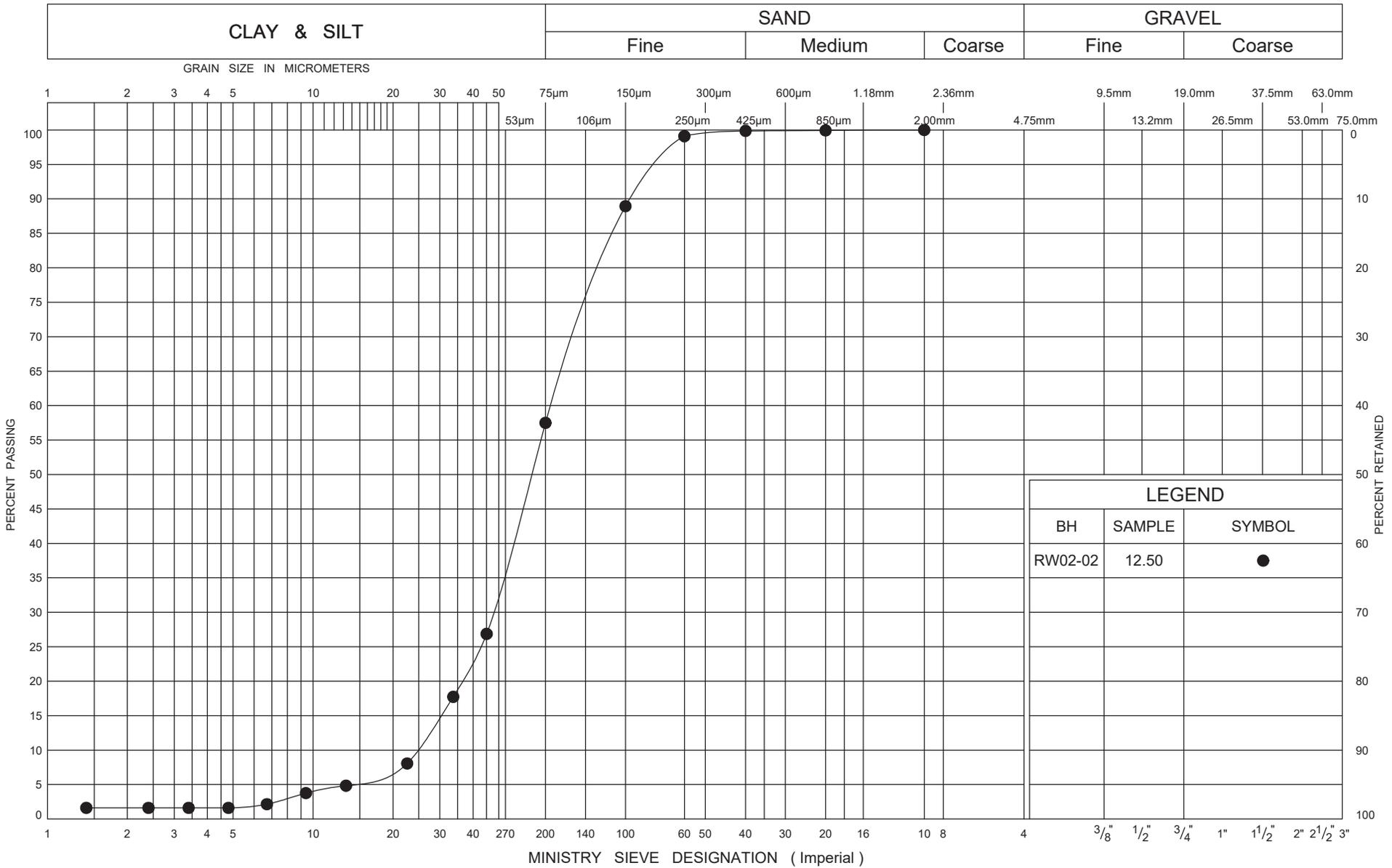
ONTARIO MOT GRAIN SIZE 2 MTO-11375.GPJ ONTARIO MOT.GDT 12/10/19



GRAIN SIZE DISTRIBUTION

Silty CLAY

FIG No B2
 W P 408-88-00
 Retaining Wall 2

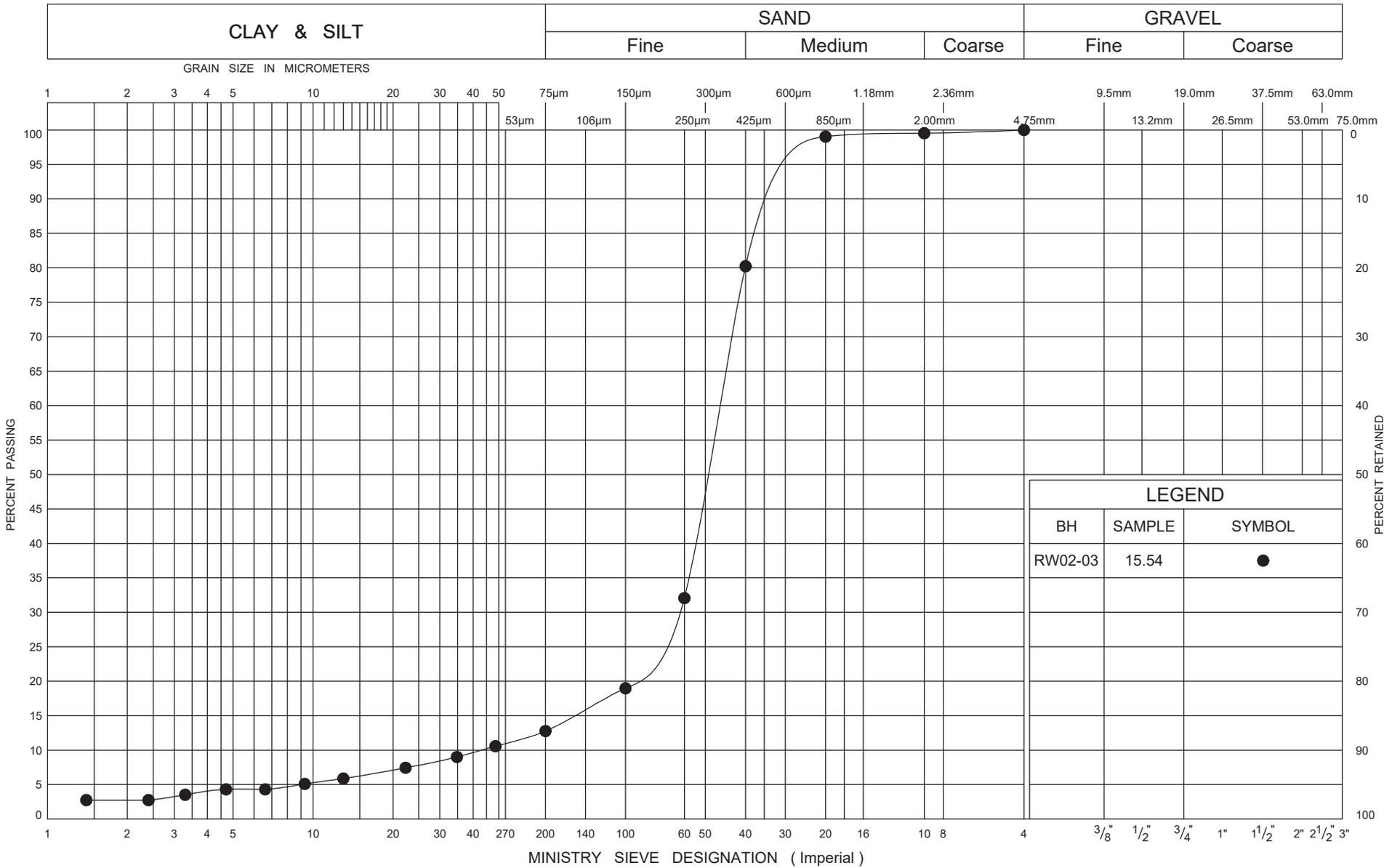


ONTARIO MOT GRAIN SIZE 2 MTO-11375.GPJ ONTARIO MOT.GDT 12/10/19



GRAIN SIZE DISTRIBUTION SILT and SAND

FIG No B3
W P 408-88-00
Retaining Wall 2



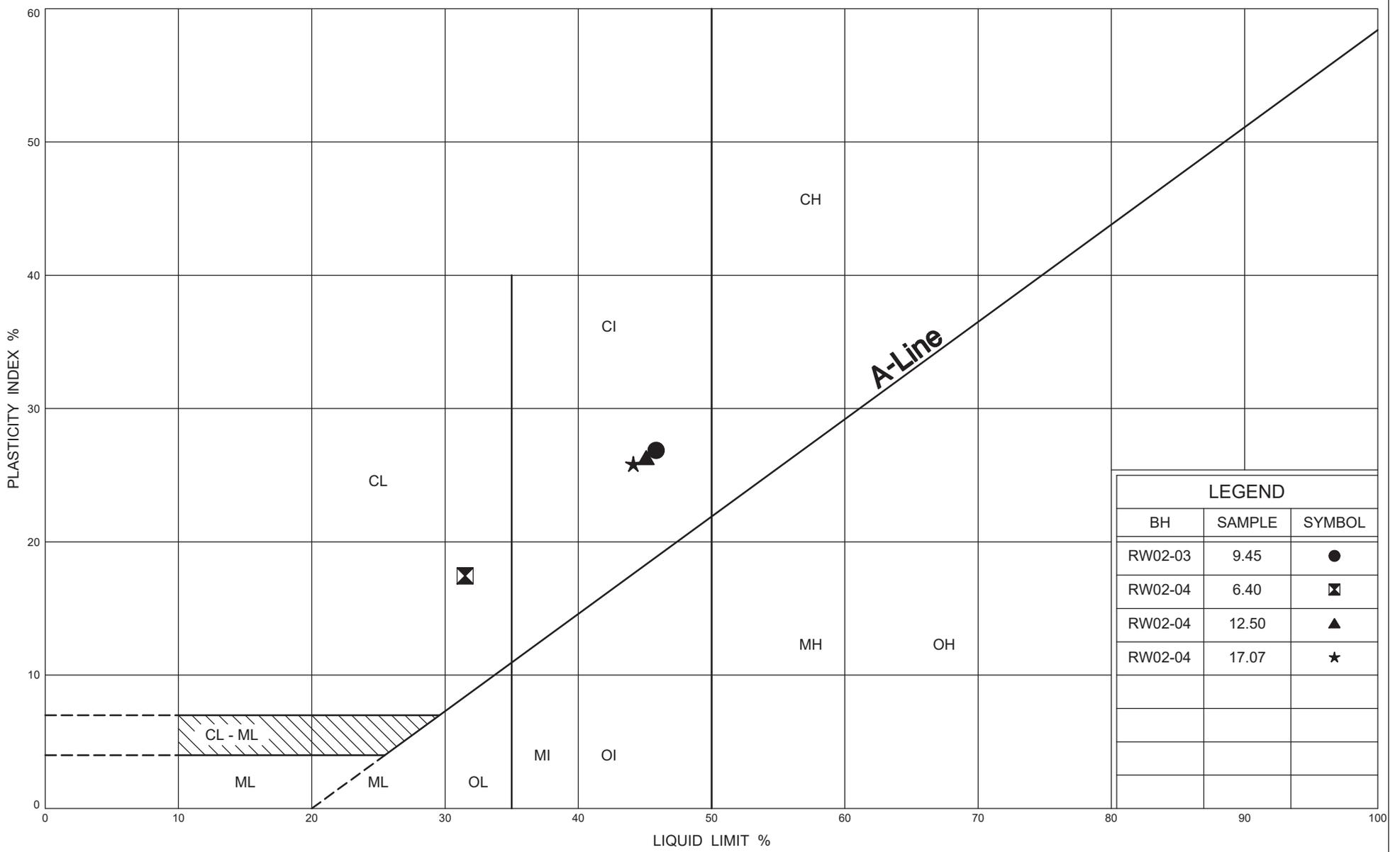
ONTARIO MOT GRAIN SIZE 2 MTO-11375.GPJ ONTARIO MOT.GDT 12/10/19



GRAIN SIZE DISTRIBUTION

Lower SAND

FIG No B4
 W P 408-88-00
 Retaining Wall 2



LEGEND		
BH	SAMPLE	SYMBOL
RW02-03	9.45	●
RW02-04	6.40	⊠
RW02-04	12.50	▲
RW02-04	17.07	★

ONTARIO MOT PLASTICITY CHART MTO-11375.GPJ ONTARIO MOT.GDT 12/10/19



PLASTICITY CHART
Silty CLAY

FIG No B5
W P 408-88-00
Retaining Wall 2



Record of Borehole Sheets and Laboratory Test Results for Previous
Investigation (Geocres No. 40P8-199 - Reference 1)

(RW-01 to RW-04)

Foundation investigation and design report for Northeast Corner Retaining Wall, Frederick Street Underpass, Site No. 33-234, G.W.P. 3110-09-00, City of Kitchener, Ontario, prepared by Peto MacCallum Ltd., PML Ref. 10KF079C, Geocres No. 4098-199, dated May 31, 2012

EXPLANATION OF TERMS USED IN REPORT

N VALUE: THE STANDARD PENETRATION TEST (SPT) N VALUE IS THE NUMBER OF BLOWS REQUIRED TO CAUSE A STANDARD 51mm O.D. SPLIT BARREL SAMPLER TO PENETRATE 0.3m INTO UNDISTURBED GROUND IN A BOREHOLE WHEN DRIVEN BY A HAMMER WITH A MASS OF 63.5kg, FALLING FREELY A DISTANCE OF 0.76m. FOR PENETRATIONS OF LESS THAN 0.3m N VALUES ARE INDICATED AS THE NUMBER OF BLOWS FOR THE PENETRATION ACHIEVED. AVERAGE N VALUE IS DENOTED THUS \bar{N} .

DYNAMIC CONE PENETRATION TEST: CONTINUOUS PENETRATION OF A CONICAL STEEL POINT (51mm O.D. 60° CONE ANGLE) DRIVEN BY 475 J IMPACT ENERGY ON 'A' SIZE DRILL RODS. THE RESISTANCE TO CONE PENETRATION IS MEASURED AS THE NUMBER OF BLOWS FOR EACH 0.3m ADVANCE OF THE CONICAL POINT INTO THE UNDISTURBED GROUND.

SOILS ARE DESCRIBED BY THEIR COMPOSITION AND CONSISTENCY OR DENSENESS.

COMPOSITION: SECONDARY SOIL COMPONENTS ARE DESCRIBED ON THE BASIS OF PERCENTAGE BY MASS OF THE WHOLE SAMPLE AS FOLLOWS:

PERCENT BY MASS	0 - 10	10 - 20	20 - 30	30 - 40	> 40
	TRACE	SOME	WITH	ADJECTIVE (SILTY)	AND (AND SILTY)

CONSISTENCY: COHESIVE SOILS ARE DESCRIBED ON THE BASIS OF THEIR UNDRAINED SHEAR STRENGTH (c_u) AS FOLLOWS:

c_u (kPa)	0 - 12	12 - 25	25 - 50	50 - 100	100 - 200	> 200
	VERY SOFT	SOFT	FIRM	STIFF	VERY STIFF	HARD

DENSENESS: COHESIONLESS SOILS ARE DESCRIBED ON THE BASIS OF DENSENESS AS INDICATED BY SPT N VALUES AS FOLLOWS:

N (BLOWS / 0.3m)	0 - 5	5 - 10	10 - 30	30 - 50	> 50
	VERY LOOSE	LOOSE	COMPACT	DENSE	VERY DENSE

ROCKS ARE DESCRIBED BY THEIR COMPOSITION AND STRUCTURAL FEATURES AND / OR STRENGTH.

RECOVERY: SUM OF ALL RECOVERED ROCK CORE PIECES FROM A CORING RUN EXPRESSED AS A PERCENT OF THE TOTAL LENGTH OF THE CORING RUN.

MODIFIED RECOVERY: SUM OF THOSE INTACT CORE PIECES, 100mm² IN LENGTH EXPRESSED AS A PERCENT OF THE LENGTH OF THE CORING RUN. THE ROCK QUALITY DESIGNATION (R Q D), FOR MODIFIED RECOVERY, IS:

R Q D (%)	0 - 25	25 - 50	50 - 75	75 - 90	90 - 100
	VERY POOR	POOR	FAIR	GOOD	EXCELLENT

JOINTING AND BEDDING:

SPACING	50mm	50 - 300mm	0.3m - 1m	1m - 3m	> 3m
JOINTING	VERY CLOSE	CLOSE	MOD. CLOSE	WIDE	VERY WIDE
BEDDING	VERY THIN	THIN	MEDIUM	THICK	VERY THICK

ABBREVIATIONS AND SYMBOLS

FIELD SAMPLING

S S	SPLIT SPOON	T P	THINWALL PISTON
W S	WASH SAMPLE	O S	OSTERBERG SAMPLE
S T	SLOTTED TUBE SAMPLE	R C	ROCK CORE
B S	BLOCK SAMPLE	P H	T W ADVANCED HYDRAULICALLY
C S	CHUNK SAMPLE	P M	T W ADVANCED MANUALLY
T W	THINWALL OPEN	F S	FOIL SAMPLE
F V	FIELD VANE		

STRESS AND STRAIN

u_w	kPa	PORE WATER PRESSURE
u	l	PORE PRESSURE RATIO
σ	kPa	TOTAL NORMAL STRESS
σ'	kPa	EFFECTIVE NORMAL STRESS
τ	kPa	SHEAR STRESS
$\sigma_1, \sigma_2, \sigma_3$	kPa	PRINCIPAL STRESSES
ϵ	%	LINEAR STRAIN
$\epsilon_1, \epsilon_2, \epsilon_3$	%	PRINCIPAL STRAINS
E	kPa	MODULUS OF LINEAR DEFORMATION
G	kPa	MODULUS OF SHEAR DEFORMATION
μ	l	COEFFICIENT OF FRICTION

MECHANICAL PROPERTIES OF SOIL

m_v	kPa ⁻¹	COEFFICIENT OF VOLUME CHANGE
C_c	l	COMPRESSION INDEX
C_s	l	SWELLING INDEX
C_α	l	RATE OF SECONDARY CONSOLIDATION
C_v	m ² /s	COEFFICIENT OF CONSOLIDATION
H	m	DRAINAGE PATH
T_v	l	TIME FACTOR
U	%	DEGREE OF CONSOLIDATION
σ'_{VD}	kPa	EFFECTIVE OVERBURDEN PRESSURE
σ'_p	kPa	PRECONSOLIDATION PRESSURE
τ_f	kPa	SHEAR STRENGTH
c'	kPa	EFFECTIVE COHESION INTERCEPT
ϕ'	-°	EFFECTIVE ANGLE OF INTERNAL FRICTION
c_u	kPa	APPARENT COHESION INTERCEPT
ϕ_u	-°	APPARENT ANGLE OF INTERNAL FRICTION
τ_R	kPa	RESIDUAL SHEAR STRENGTH
τ_r	kPa	REMOULDED SHEAR STRENGTH
S_f	l	SENSITIVITY = $\frac{c_u}{\tau_r}$

PHYSICAL PROPERTIES OF SOIL

ρ_s	kg/m ³	DENSITY OF SOLID PARTICLES	n	l, %	POROSITY	e_{max}	l, %	VOID RATIO IN LOOSEST STATE
γ_s	kN/m ³	UNIT WEIGHT OF SOLID PARTICLES	w	l, %	WATER CONTENT	e_{min}	l, %	VOID RATIO IN DENSEST STATE
ρ_w	kg/m ³	DENSITY OF WATER	s_r	%	DEGREE OF SATURATION	I_D	l	DENSITY INDEX = $\frac{e_{max} - e}{e_{max} - e_{min}}$
γ_w	kN/m ³	UNIT WEIGHT OF WATER	w_L	%	LIQUID LIMIT	D	mm	GRAIN DIAMETER
ρ	kg/m ³	DENSITY OF SOIL	w_p	%	PLASTIC LIMIT	D_n	mm	n PERCENT - DIAMETER
γ	kN/m ³	UNIT WEIGHT OF SOIL	w_s	%	SHRINKAGE LIMIT	C_u	l	UNIFORMITY COEFFICIENT
ρ_d	kg/m ³	DENSITY OF DRY SOIL	I_p	%	PLASTICITY INDEX = $w_L - w_p$	h	m	HYDRAULIC HEAD OR POTENTIAL
γ_d	kN/m ³	UNIT WEIGHT OF DRY SOIL	I_L	l	LIQUIDITY INDEX = $\frac{w - w_p}{I_p}$	q	m ³ /s	RATE OF DISCHARGE
ρ_{sat}	kg/m ³	DENSITY OF SATURATED SOIL	I_C	l	CONSISTENCY INDEX = $\frac{w_L - w}{I_p}$	v	m/s	DISCHARGE VELOCITY
γ_{sat}	kN/m ³	UNIT WEIGHT OF SATURATED SOIL	DTPL		DRIER THAN PLASTIC LIMIT	i	l	HYDRAULIC GRADIENT
ρ'	kg/m ³	DENSITY OF SUBMERGED SOIL	APT		ABOUT PLASTIC LIMIT	k	m/s	HYDRAULIC CONDUCTIVITY
γ'	kN/m ³	UNIT WEIGHT OF SUBMERGED SOIL	WTP		WETTER THAN PLASTIC LIMIT	j	kN/m ²	SEEPAGE FORCE
e	l, %	VOID RATIO						

RECORD OF BOREHOLE No RW-1

1 of 1

METRIC

G.W.P. 3110-09-00 **LOCATION** Coords: 4 813 701.9 N; 226 222.6 E **ORIGINATED BY** R.B.
DIST London **HWY** 7/ 85 **BOREHOLE TYPE** C.F.H.S.A. and Dynamic Cone Penetration Test **COMPILED BY** N.S.B.
DATUM Geodetic **DATE** April 08, 2011 **CHECKED BY** B.R.G.

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa								
						20	40	60	80	100						
319.7	Ground Surface															
0.0	Asphalt over sand some silt, some gravel Very loose Brown Wet (FILL)		1	AS	-											
318.3			2	SS	3											
1.4	Silty clay, trace sand Very stiff Brown Moist sand layers to 4.9m Hard to Greyish very stiff brown		3	SS	17						225				(**)	
			4	SS	34						225					
			5	SS	25						225					
			6	SS	28						225					
	Hard		7	SS	37						225					
			8	SS	31						225					
			9	SS	33						225					
			10	SS	39						225					
309.9	End of borehole															
9.8	* Borehole dry (**) Base of footing -El.318.2 Note: Borehole cave-in at 8.5m C.F.H.S.A. denotes Continuous Flight Hollow Stem Augers <u>Water Level Readings:</u> Date Depth Elev. Apr. 08, '11 2.9 316.8 <u>Piezometer Legend:</u> Bentonite seal Filter sand 19mm dia. PVC screen Bentonite grout															

RECORD OF BOREHOLE No RW-2

1 of 1

METRIC

G.W.P. 3110-09-00 **LOCATION** Coords: 4 813 710.4 N; 226 223.0 E **ORIGINATED BY** R.B.
DIST London **HWY** 7/ 85 **BOREHOLE TYPE** Continuous Flight Hollow Stem Augers **COMPILED BY** N.S.B.
DATUM Geodetic **DATE** April 08, 2011 **CHECKED BY** B.R.G.

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE		"N" VALUES	20	40	60	80						100	20	40
319.7	Ground Surface																	
0.0	Asphalt over sand and crushed gravel, trace silt Compact Brown Moist (FILL)		1	AS	-													
318.3			2	SS	11													
1.4	Silty clay, trace gravel sand layers Stiff Dark Moist brown		3	SS	9						225							(**)
	sand layers to 3.7m Hard Greyish brown		4	SS	31						225							
			5	SS	23						225							0 2 45 53
			6	SS	44						225							
			7	SS	43						225							0 0 32 68
			8	SS	35						225							
			9	SS	29						225							
309.9	End of borehole																	

* 2011 04 08

Water level measured after drilling

 (**) Base of footing
-El.318.2

Note: Borehole cave-in at 8.7m

RECORD OF BOREHOLE No RW-3

1 of 1

METRIC

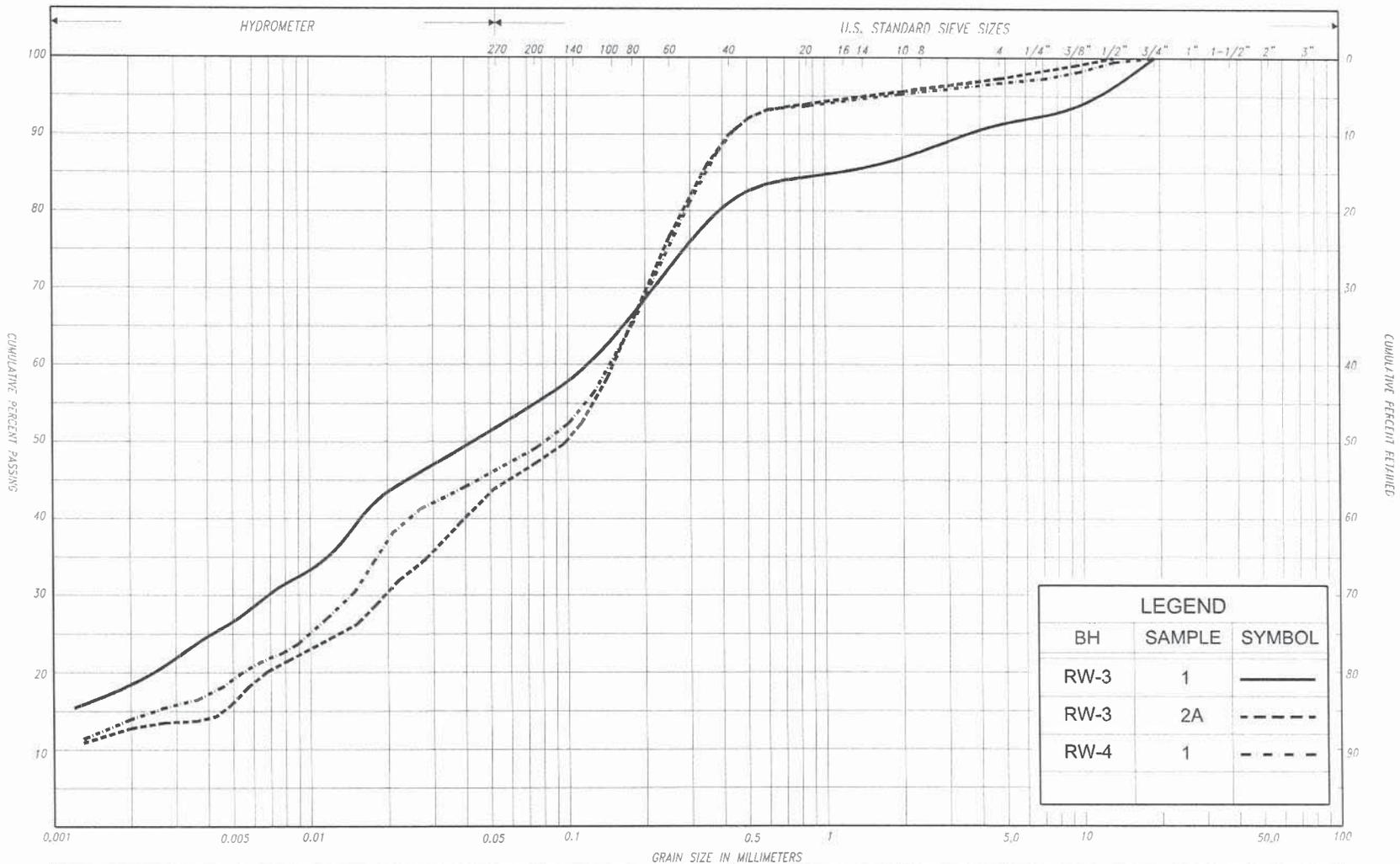
G.W.P. 3110-09-00 **LOCATION** Coords: 4 813 719.3 N; 226 229.5 E **ORIGINATED BY** F.P.
DIST London **HWY** 7/ 85 **BOREHOLE TYPE** Dynamic Ram Sounder **COMPILED BY** N.S.B.
DATUM Geodetic **DATE** July 19, 2011 **CHECKED BY** B.R.G.

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	20	40	60	80						100	20
322.3	Ground Surface																	
0.0	Silty sand some clay, trace gravel organic inclusions		1	SS	14													8 37 37 18
	Compact Grey Moist (FILL)		2	SS	27													3 50 34 13
	clayey silt layers																	4 26 45 25
	gravelly sand																	23 39 27 11
320.0	Compact Brown Damp clayey silt layers		3	SS	20													4 25 42 29
2.3	Sand trace to some gravel trace clay		4	SS	21													15 76 6 3
	Compact Brown Moist to wet		5	SS	18													10 76 10 4
			6	SS	14													(1#) 73 12 4
317.9	Silty clay trace sand, trace gravel silty sand and gravelly sand layers, cobbles		7	SS	36													3 23 50 24
	Hard Grey Moist		8	SS	67													
315.9	End of borehole		9	SS	70/15cm													
6.4	Sample 9: Sampler bouncing																	
	* 2011 07 19																	
	∇ Water level observed during drilling																	
	(**) Base of footing -El.318.2																	
	Water Level Readings:																	
	Date Depth Elev.																	
	July 19, '11 (m) Dry ----																	
	Sept. 23, '11 3.3 319.0																	
	Oct. 08, '11 3.3 319.0																	
	Piezometer Legend:																	
	Bentonite seal																	
	Filter sand																	
	30mm dia. PVC screen																	
	Filter bed																	



TABLE A-1
LIST OF ATTERBERG LIMITS RESULTS

SOIL TYPE	BOREHOLE NO.	SAMPLE NO.	DEPTH / ELEVATION (m)	MOISTURE CONTENT (W %)	LIQUID LIMIT (LL)	PLASTIC LIMIT (PL)	PLASTICITY INDEX (PI)
Clayey Silt Fill	RW-3	3B	2.1 / 320.2	-	22	12	10
Silty Clay	RW-2	3	1.9 / 317.8	19	36	18	18
	RW-2	5	3.3 / 316.3	19	35	17	18
	RW-2	7	6.3 / 313.4	21	45	23	22

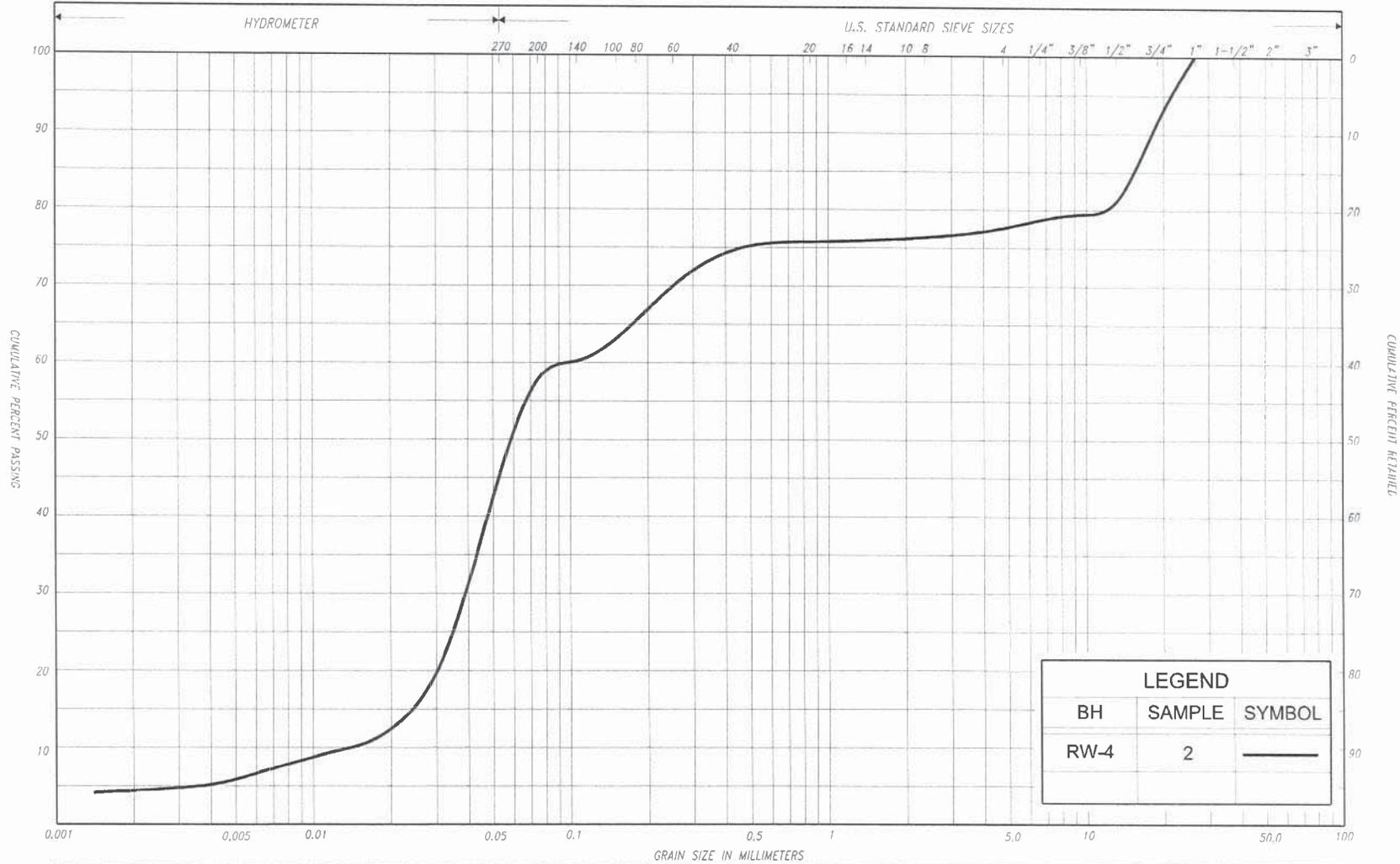


SILT & CLAY				FINE SAND			MEDIUM SAND		COARSE SAND		GRAVEL		COR. R.F.S.	UNIFIED
CLAY	FINE SILT		COARSE SILT	FINE SAND		MEDIUM SAND		COARSE SAND		GRAVEL		CORRI.F.S.	M.I.T.	
CLAY		SILT		V. FINE SAND	FINE SAND	MED. SAND	COARSE SAND		GRAVEL		U.S. BUREAU			

GRAIN SIZE DISTRIBUTION
 SILTY SAND, some clay, trace gravel
 (FILL)

FIG No. RW-GS-1
 HWY: 7 / 85
 G.W.P. No. 3110-09-00





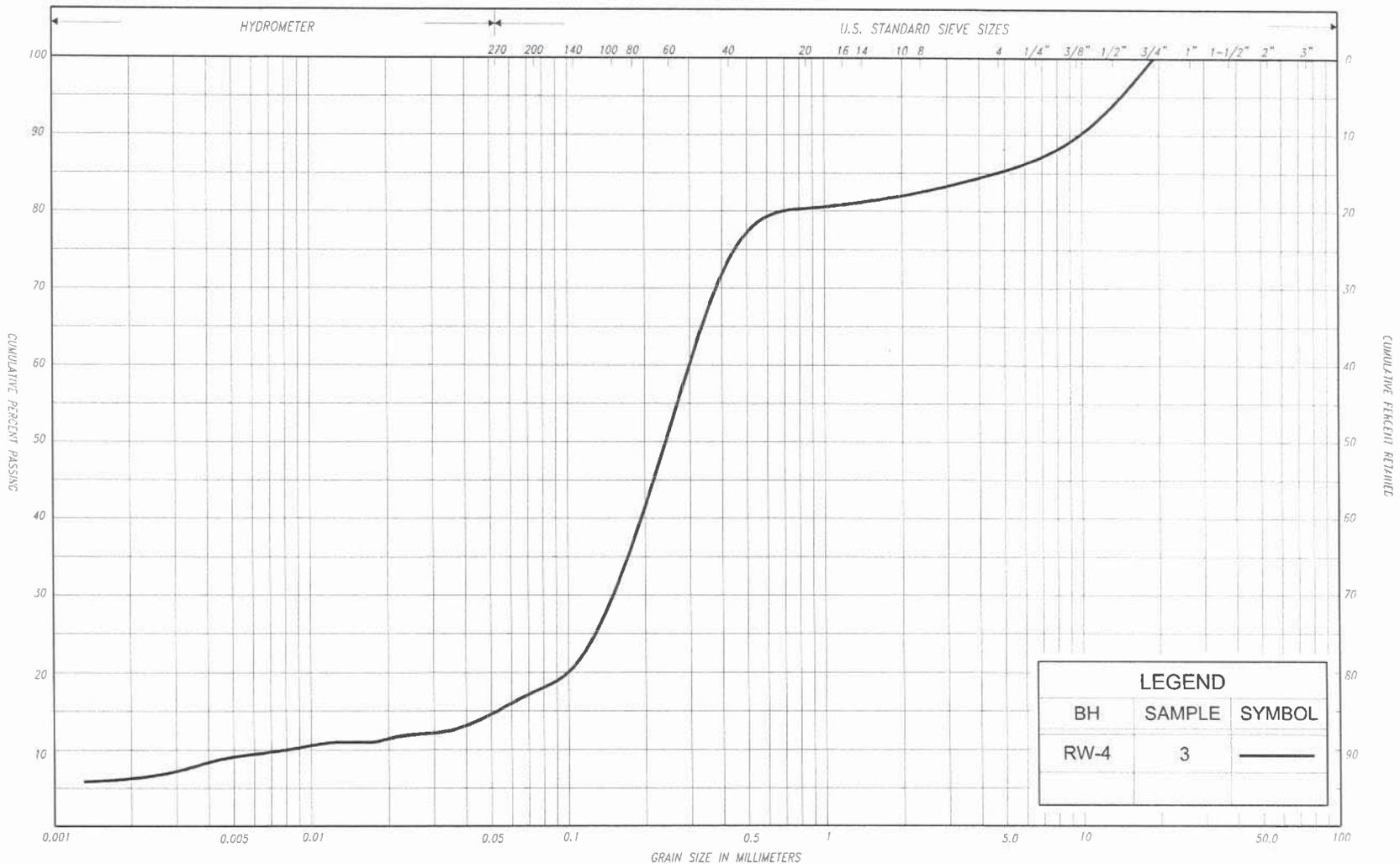
LEGEND		
BH	SAMPLE	SYMBOL
RW-4	2	—

SILT & CLAY			FINE SAND			MEDIUM SAND		COARSE SAND		GRAVEL		COR. BLES	UNIFIED
CLAY	FINE	MEDIUM SILT	COARSE	FINE	MEDIUM SAND	COARSE	GRAVEL			CORBLES	M.I.T.		
CLAY	SILT		V. FINE	FINE SAND	MED.	COARSE	GRAVEL					U.S. BUREAU	

GRAIN SIZE DISTRIBUTION
 SILT, some sand, some gravel, trace clay
 (FILL)

FIG No. RW-GS-2
 HWY: 7 / 85
 G.W.P. No. 3110-09-00





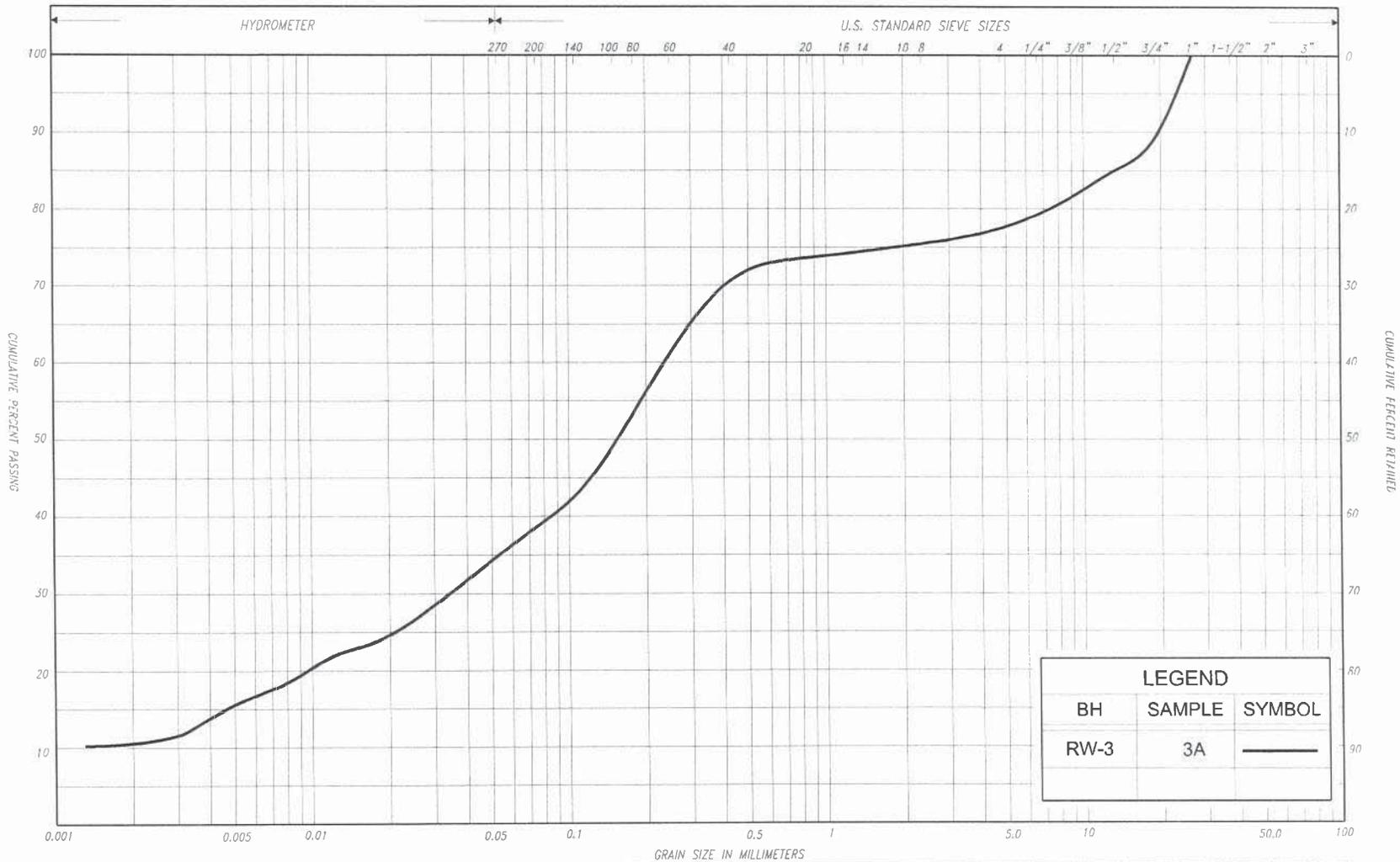
LEGEND		
BH	SAMPLE	SYMBOL
RW-4	3	—

SILT & CLAY				FINE SAND			MEDIUM SAND			COARSE SAND			GRAVEL			COR. BLES	UNIFIED				
CLAY	FINE SILT		MEDIUM SILT		COARSE SILT			FINE SAND			MEDIUM SAND			COARSE SAND			GRAVEL			CORRI FS	M.I.T.
CLAY		SILT				V. FINE SAND		FINE SAND		MED. SAND		COARSE SAND		GRAVEL						U.S. BUREAU	

GRAIN SIZE DISTRIBUTION
 SAND, some silt, some gravel, trace clay
 (FILL)

FIG No. RW-GS-3
 HWY: 7 / 85
 G.W.P. No. 3110-09-00





LEGEND		
BH	SAMPLE	SYMBOL
RW-3	3A	—

SILT & CLAY			FINE SAND			MEDIUM SAND			COARSE SAND			GRAVEL			COBBLES	UNIFIED
CLAY	FINE SILT	MEDIUM SILT	COARSE SILT	FINE SAND	MED. SAND	COARSE SAND	GRAVEL			GRAVEL			COBBLES	M.I.T.		
CLAY	SILT			Y. FINE SAND	FINE SAND	MED. SAND	COARSE SAND	GRAVEL			GRAVEL			COBBLES	U.S. AIRFAU	

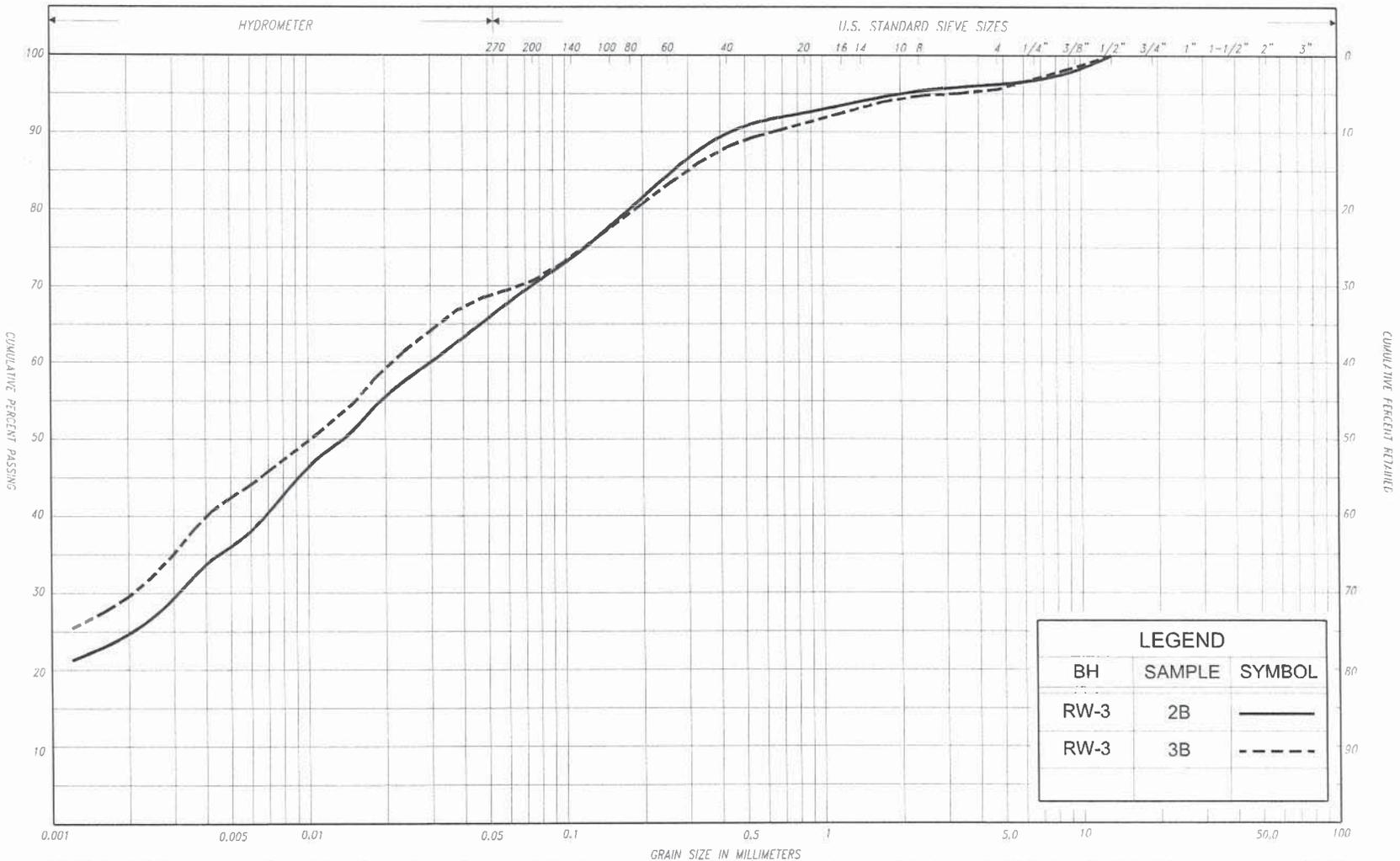


GRAIN SIZE DISTRIBUTION
GRAVELLY SAND, with silt, some clay
(FILL)

FIG No. RW-GS-4

HWY: 7 / 85

G.W.P. No. 3110-09-00



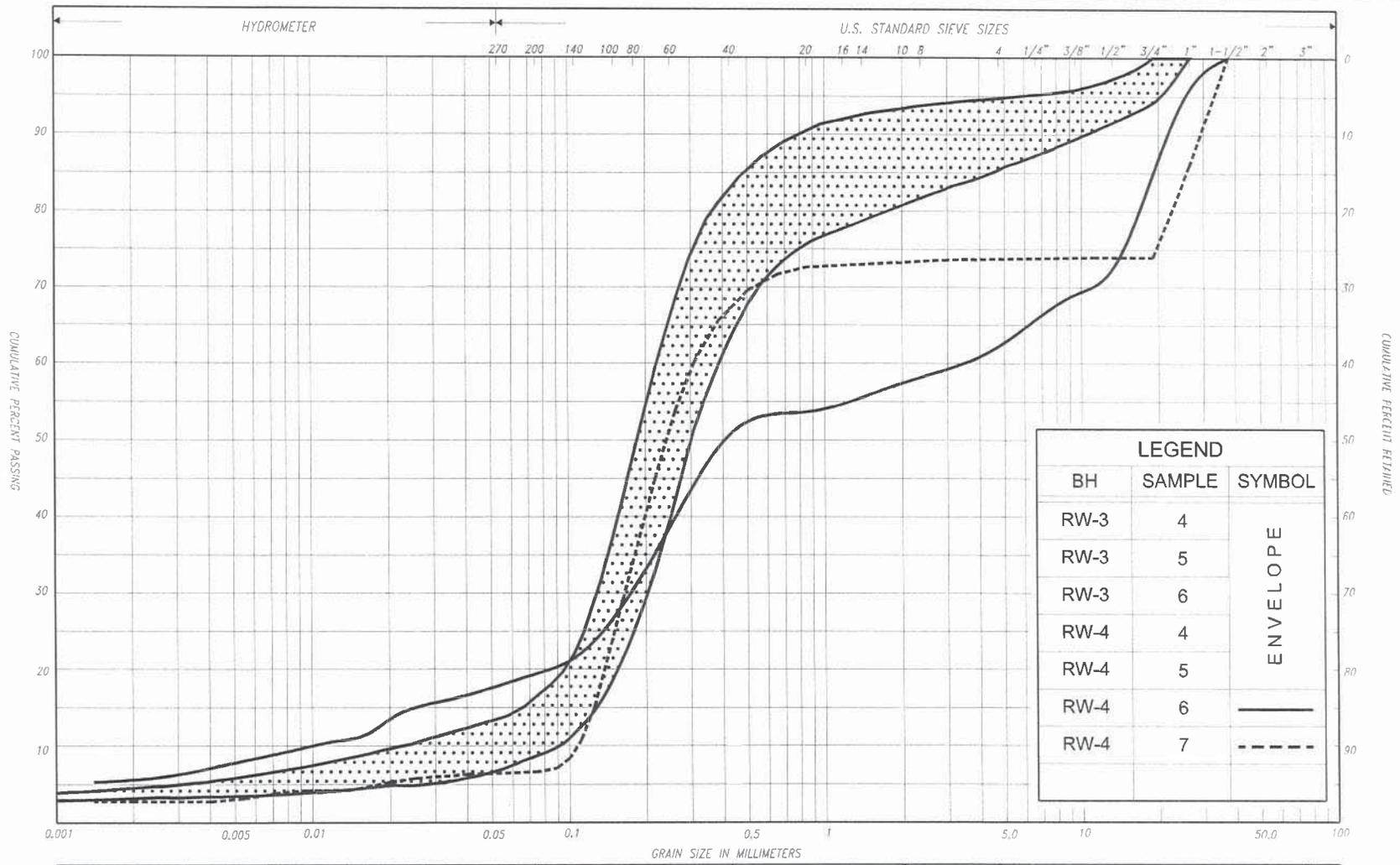
LEGEND		
BH	SAMPLE	SYMBOL
RW-3	2B	—
RW-3	3B	- - -

SILT & CLAY				FINE SAND			MEDIUM SAND		COARSE SAND		GRAVEL		COB BLES	UNIFIED
CLAY	FINE SILT		COARSE SILT	FINE SAND		MEDIUM SAND		COARSE SAND		GRAVEL		COB BLES	M.I.T.	
CLAY		SILT		Y. FINE SAND	FINE SAND	MED. SAND	COARSE SAND		GRAVEL				U.S. BUREAU	

GRAIN SIZE DISTRIBUTION
CLAYEY SILT, with sand, trace gravel (CI)
(FILL)

FIG No. RW-GS-5
 HWY: 7 / 85
 G.W.P. No. 3110-09-00





LEGEND		
BH	SAMPLE	SYMBOL
RW-3	4	ENVELOPE
RW-3	5	
RW-3	6	
RW-4	4	
RW-4	5	
RW-4	6	
RW-4	7	

SILT & CLAY				FINE SAND			MEDIUM SAND			COARSE SAND			GRAVEL			CORRIELES	UNIFIED
CLAY	FINE SILT		MEDIUM SILT		COARSE SILT	FINE SAND		MEDIUM SAND		COARSE SAND		GRAVEL			CORRIELES	M.I.T.	
CLAY		SILT			V. FINE SAND	FINE SAND	MED. SAND	COARSE SAND		GRAVEL							U.S. BUREAU

GRAIN SIZE DISTRIBUTION

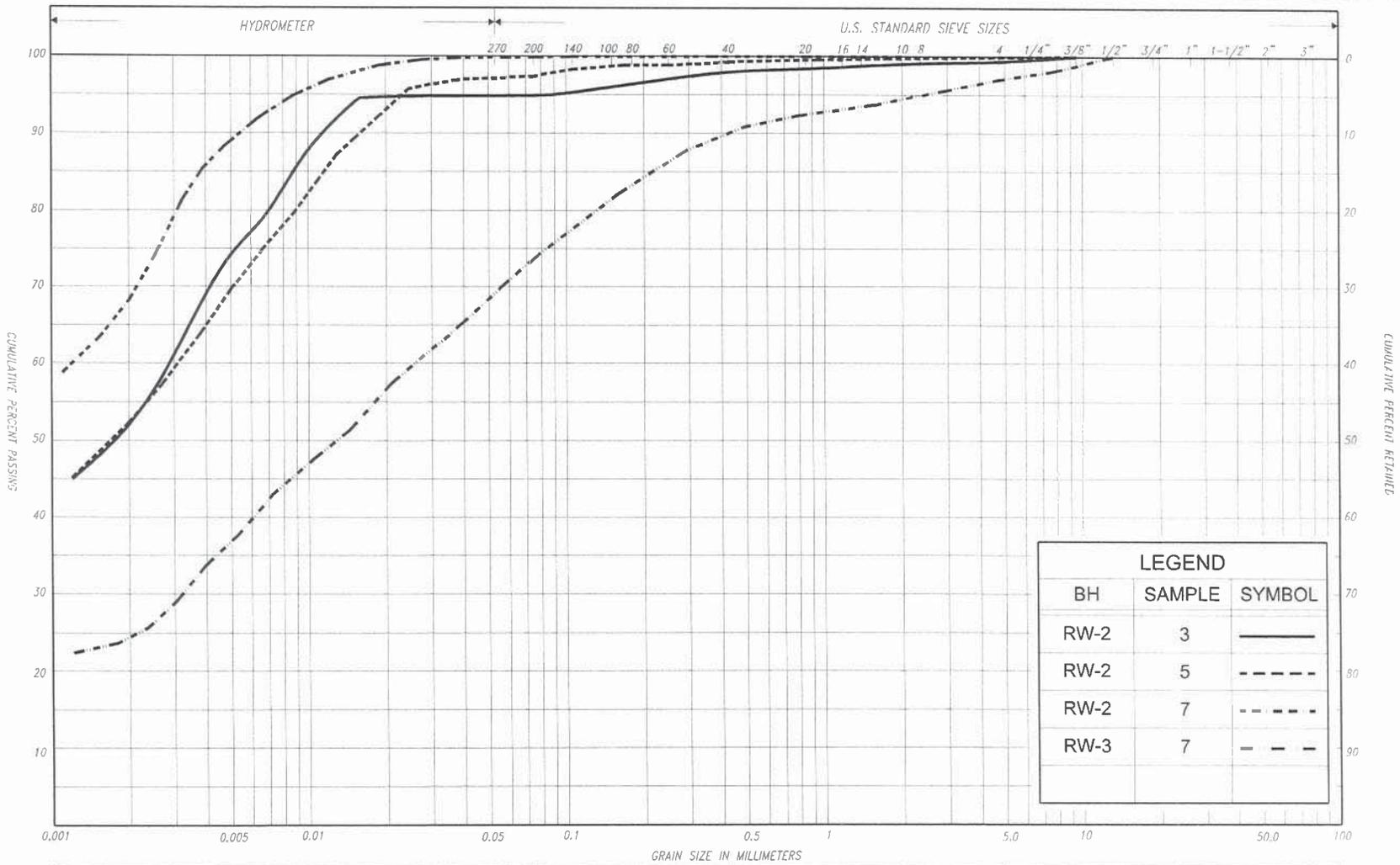
SAND, trace gravel to gravelly, trace to some silt, trace clay

FIG No. RW-GS-6

HWY: 7 / 85

G.W.P. No. 3110-09-00





SILT & CLAY				FINE SAND			MEDIUM SAND		COARSE SAND		GRAVEL		COB BLFS	UNIFIED
CLAY	FINE SILT		COARSE SILT	FINE SAND		MEDIUM SAND		COARSE SAND		GRAVEL		COARLES	M.I.T.	
CLAY		SILT		V. FINE SAND	FINE SAND	MED. SAND	COARSE SAND		GRAVEL				U.S. BUREAU	

GRAIN SIZE DISTRIBUTION

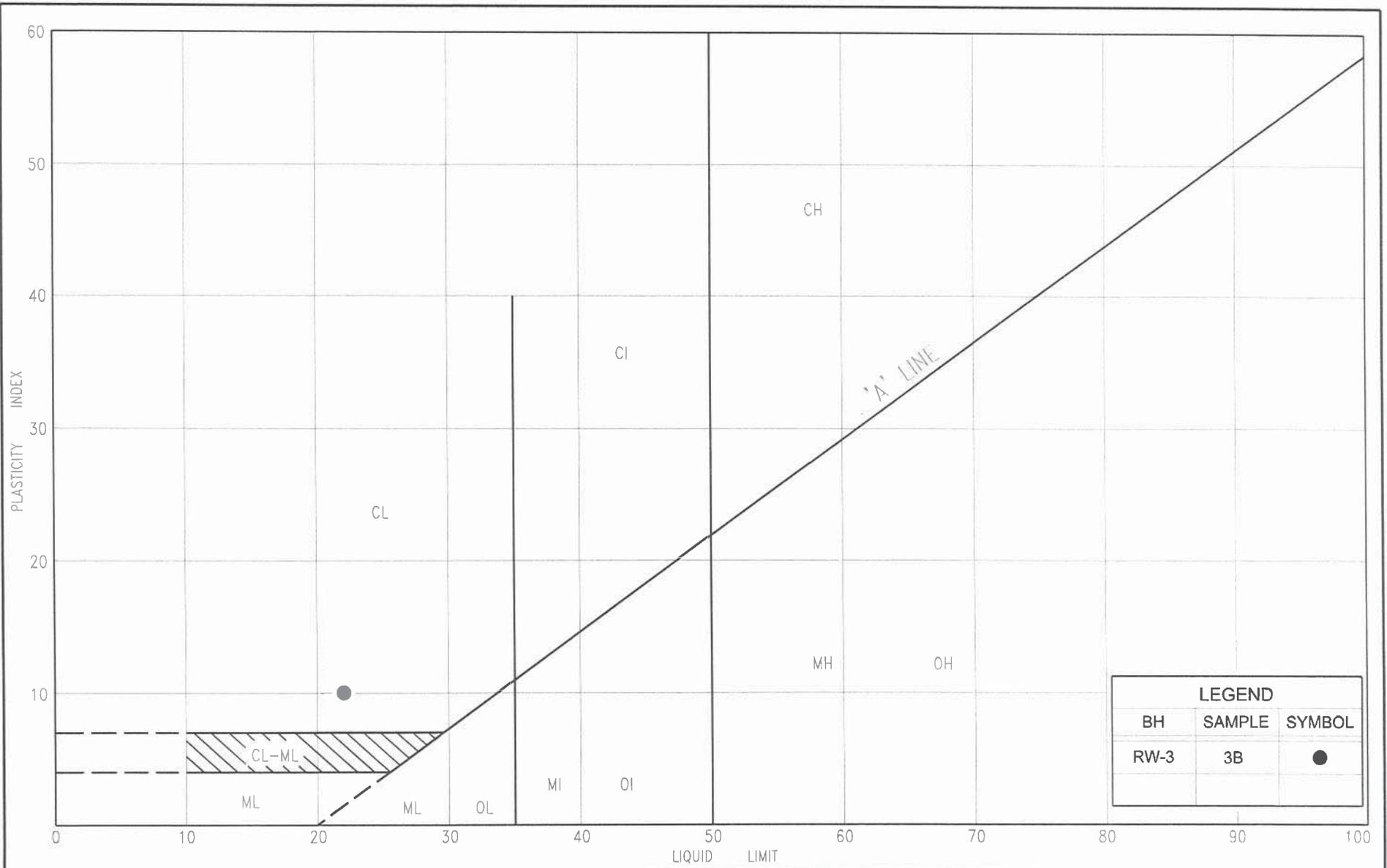
SILTY CLAY, trace to with sand, trace gravel (CI)

FIG No. RW-GS-7

HWY: 7 / 85

G.W.P. No. 3110-09-00





PLASTICITY CHART

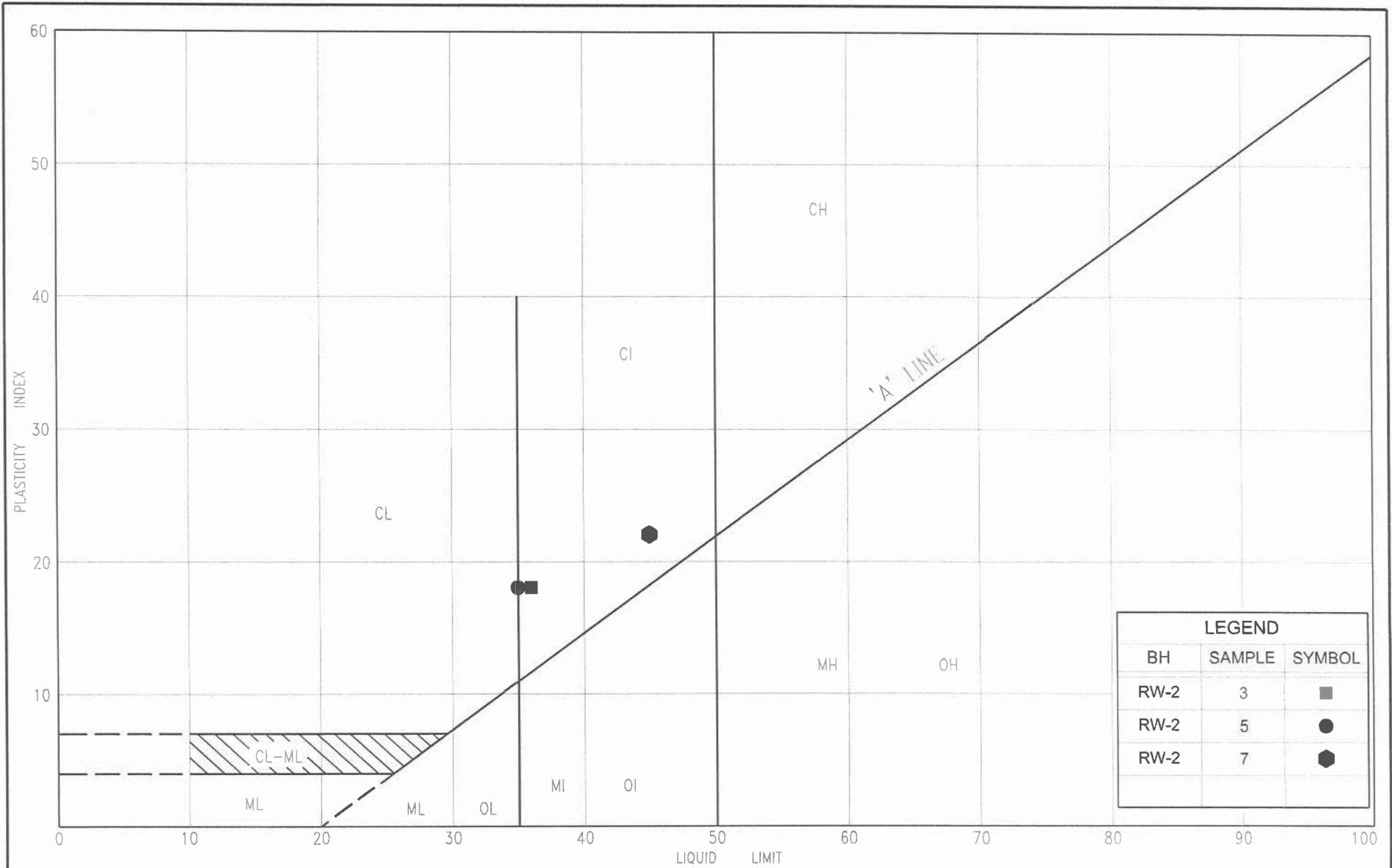
CLAYEY SILT, with sand, trace gravel (CL)
(FILL)

FIG No. RW-PC-1

HWY: 7 / 85

G.W.P. No. 3110-09-00





PLASTICITY CHART

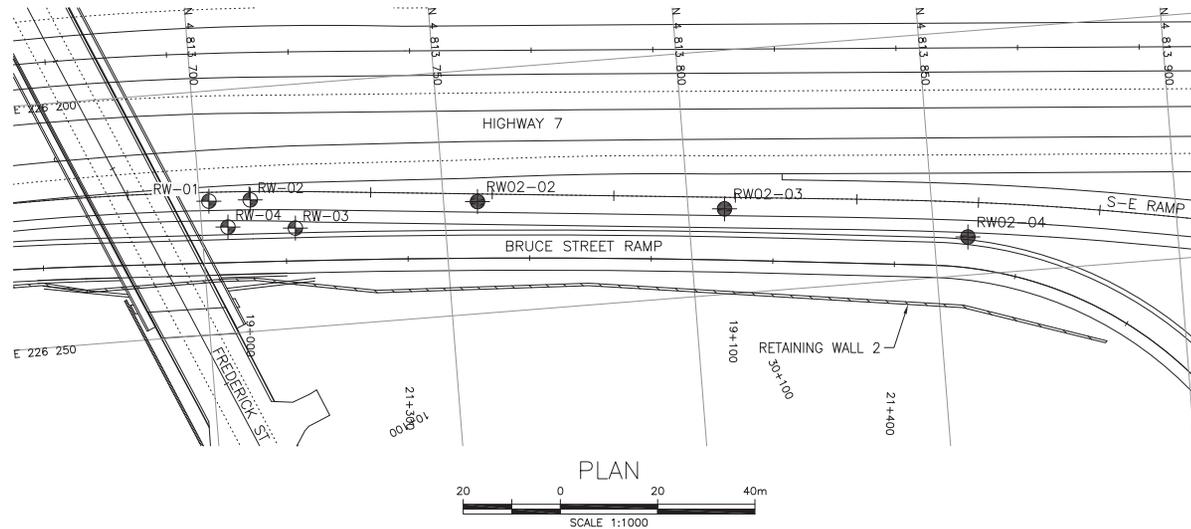
SILTY CLAY, trace to with sand, trace gravel (CI)

FIG No. RW-PC-2

HWY: 7 / 85

G.W.P. No. 3110-09-00

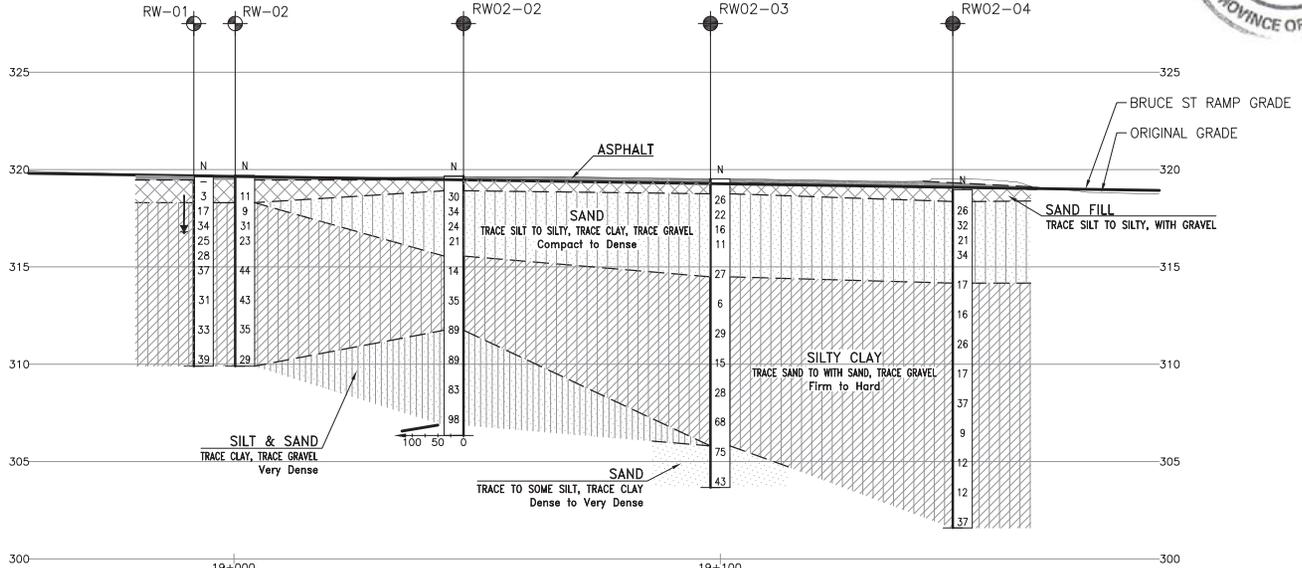
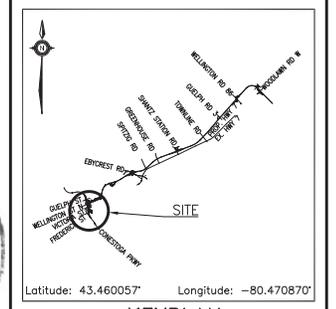




METRIC
DIMENSIONS ARE IN METRES
AND/OR MILLIMETRES
UNLESS OTHERWISE SHOWN



CONT No GWP No 408-88-00	 SHEET
HIGHWAY 7 FREDERICK ST.-N/E-ANN ST. RETAINING WALL 2 BOREHOLE LOCATIONS AND SOIL STRATA	



PROFILE ALONG BRUCE STREET RAMP
FREDERICK STREET-N/E-ANN STREET

KEYPLAN
LEGEND

- ◆ Borehole (Current Investigation)
- ◊ Borehole (by Others)
- 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 (ROD)
- A/R Auger Refusal

NO	ELEVATION	NORTHING	EASTING
RW02-02	319.6	4 813 757.0	226 227.0
RW02-03	319.5	4 813 807.5	226 232.5
RW02-04	319.1	4 813 856.9	226 242.2
RW-01	319.7	4 813 710.9	226 222.6
RW-02	319.7	4 813 710.4	226 233.0
RW-03	322.3	4 813 719.2	226 229.5
RW-04	323.5	4 813 705.4	226 228.2

- 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. 40P9-58

REVISIONS	DATE	BY	DESCRIPTION

DESIGN	NB	CHK	PKC	CODE	LOAD	DATE	MAY 2020
DRAWN	MFA	CHK	NB	SITE	STRUCT	DWG	1



Appendix C

Record of Borehole Sheets, Laboratory Test Results, Borehole Locations and Soil Strata Drawing

**Retaining Wall 10
(RW09-02, RW10-02 to RW10-06)**

RECORD OF BOREHOLE No RW09-02

1 OF 2

METRIC

GWP# 408-88-00 LOCATION Retaining Wall 9, MTM NAD 83 Zone 10: N 4 814 582.8 E 226 319.4 ORIGINATED BY GA
 DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MP
 DATUM Geodetic DATE 2018.04.11 - 2018.04.11 LATITUDE 43.467045 LONGITUDE -80.469941 CHECKED BY NB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60					
322.8	GROUND SURFACE														
0.0	SAND , some silt, trace clay, trace gravel Loose to Compact Brown Moist		1	SS	8										
			2	SS	11									2 79 14 5	
			3	SS	6										
320.4	Silty CLAY , trace sand, trace gravel Very Stiff to Hard Brown Wet		4	SS	20									0 9 49 42	
			5	SS	33										
318.7	SAND and SILT , trace to some clay Very Dense Grey Wet		6	SS	109										
			7	SS	104									0 52 38 10	
			8	SS	102										
			9	SS	103										
313.2	END OF BOREHOLE AT 9.6m. BOREHOLE OPEN TO 9.6m AND														

ONTMT4S2_MTO-11375.GPJ_2017TEMPLATE(MTO).GDT_12/16/19

Continued Next Page

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

RECORD OF BOREHOLE No RW09-02

2 OF 2

METRIC

GWP# 408-88-00 LOCATION Retaining Wall 9, MTM NAD 83 Zone 10: N 4 814 582.8 E 226 319.4 ORIGINATED BY GA
 DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MP
 DATUM Geodetic DATE 2018.04.11 - 2018.04.11 LATITUDE 43.467045 LONGITUDE -80.469941 CHECKED BY NB

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa						
	Continued From Previous Page WATER LEVEL AT 7.1m. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND GROUT TO SURFACE.													

ONTMT4S2_MTO-11375.GPJ_2017TEMPLATE(MTO).GDT_12/16/19

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

RECORD OF BOREHOLE No RW10-02

1 OF 2

METRIC

GWP# 408-88-00 LOCATION Retaining Wall 10, MTM NAD 83 Zone 10: N 4 814 587.1 E 226 370.2 ORIGINATED BY MB
 DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MP
 DATUM Geodetic DATE 2018.04.19 - 2018.04.19 LATITUDE 43.467088 LONGITUDE -80.469313 CHECKED BY NB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE							
329.1	GROUND SURFACE														
0.0	SAND and GRAVEL Compact Brown Moist (FILL) Silty SAND , trace to some clay Very Loose to Compact Brown Moist (FILL)		1	SS	16										
328.4			2	SS	3										
0.6			3	SS	5										0 64 25 11
			4	SS	20										
			5	SS	13										
325.3	SAND , trace gravel, trace silt and clay Compact to Dense Brown Moist		6	SS	27										
3.7			7	SS	29										4 89 7 (SI+CL)
			8	SS	32										
			9	SS	29										
321.9	Silty CLAY , with sand Very Stiff to Hard Brown Moist														
7.1															
319.6	END OF BOREHOLE AT 9.4m. BOREHOLE OPEN TO 9.4m AND DRY UPON COMPLETION.		10	SS	100/									0 38 43 19	
9.4						0.200									

ONTM1452_MTO-11375.GPJ 2017TEMPLATE(MTO).GDT 12/16/19

Continued Next Page

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

RECORD OF BOREHOLE No RW10-02

2 OF 2

METRIC

GWP# 408-88-00 LOCATION Retaining Wall 10, MTM NAD 83 Zone 10: N 4 814 587.1 E 226 370.2 ORIGINATED BY MB
 DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MP
 DATUM Geodetic DATE 2018.04.19 - 2018.04.19 LATITUDE 43.467088 LONGITUDE -80.469313 CHECKED BY NB

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa								WATER CONTENT (%)		
							20	40	60	80	100	W _p	W	W _L				
							○ UNCONFINED	+	FIELD VANE									
							● QUICK TRIAXIAL	×	LAB VANE									
							20	40	60	80	100	20	40	60				
	Continued From Previous Page BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO 0.3m AND CUTTINGS TO SURFACE.																	

ONTMT4S2_MTO-11375.GPJ_2017TEMPLATE(MTO).GDT_12/16/19

RECORD OF BOREHOLE No RW10-03

1 OF 2

METRIC

GWP# 408-88-00 LOCATION Retaining Wall 10, MTM NAD 83 Zone 10: N 4 814 591.8 E 226 418.6 ORIGINATED BY MB
 DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MP
 DATUM Geodetic DATE 2018.04.18 - 2018.04.18 LATITUDE 43.467136 LONGITUDE -80.468717 CHECKED BY NB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa							
							20 40 60 80 100				20 40 60				
328.4	GROUND SURFACE														
0.0	SAND and GRAVEL Compact Brown Moist (FILL)		1	SS	11										13 64 17 6
327.8															
0.5	SAND , trace silt and clay, trace gravel Loose to Compact Brown Moist (FILL)		2	SS	6										
			3	SS	8										
			4	SS	13										
			5	SS	11										
324.6															
3.7	SAND , trace silt, trace gravel Compact Brown Moist		6	SS	25										1 89 10 (SI+CL)
			7	SS	28										
			8	SS	28										
321.4															
7.0	Silty CLAY , trace to some sand Hard Brown Wet to Moist		9	SS	30										
			10	SS	73										0 10 39 51
318.6															
9.8	END OF BOREHOLE AT 9.8m.														

ONT/MT452_MTO-11375.GPJ 2017TEMPLATE(MTO).GDT 12/16/19

Continued Next Page

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

RECORD OF BOREHOLE No RW10-03

2 OF 2

METRIC

GWP# 408-88-00 LOCATION Retaining Wall 10, MTM NAD 83 Zone 10: N 4 814 591.8 E 226 418.6 ORIGINATED BY MB
 DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MP
 DATUM Geodetic DATE 2018.04.18 - 2018.04.18 LATITUDE 43.467136 LONGITUDE -80.468717 CHECKED BY NB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa 20 40 60 80 100							
	Continued From Previous Page WATER LEVEL AT 6.2m UPON COMPLETION. Piezometer installation consists of 25mm diameter Schedule 40 PVC pipe with a 3.0m slotted screen. WATER LEVEL READINGS DATE DEPTH(m) ELEV.(m) 2018.04.27 6.2 322.2 2018.05.16 6.1 322.3 2018.05.31 6.0 322.4 2018.06.25 5.7 322.6														

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RECORD OF BOREHOLE No RW10-04

1 OF 2

METRIC

GWP# 408-88-00 LOCATION Retaining Wall 10, MTM NAD 83 Zone 10: N 4 814 601.3 E 226 470.5 ORIGINATED BY MB
 DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MP
 DATUM Geodetic DATE 2018.04.18 - 2018.04.18 LATITUDE 43.467227 LONGITUDE -80.468076 CHECKED BY NB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE							
326.8	GROUND SURFACE														
0.0 326.6	TOPSOIL (200mm)														
0.3	SAND, trace to some silt, trace clay Very Loose to Loose Brown Moist (FILL)		1	SS	4										
			2	SS	2										
			3	SS	2										
			4	SS	5									0 87 10 3	
323.9	SAND, trace silt, trace gravel Compact to Dense Brown Moist		5	SS	15										
			6	SS	31										
322.1	Silty CLAY, trace sand Very Stiff Brown Moist		7	SS	30	▽									
			8	SS	17									0 9 48 43	
			9	SS	48										
	Hard														
317.3	END OF BOREHOLE AT 9.5m. BOREHOLE OPEN TO 5.3m AND WATER LEVEL AT 4.9m UPON		10	SS	72										

ONT\MT452_MTO-11375.GPJ 2017TEMPLATE(MTO).GDT 12/16/19

Continued Next Page

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

RECORD OF BOREHOLE No RW10-04

2 OF 2

METRIC

GWP# 408-88-00 LOCATION Retaining Wall 10, MTM NAD 83 Zone 10: N 4 814 601.3 E 226 470.5 ORIGINATED BY MB
 DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MP
 DATUM Geodetic DATE 2018.04.18 - 2018.04.18 LATITUDE 43.467227 LONGITUDE -80.468076 CHECKED BY NB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa								
	Continued From Previous Page							20 40 60 80 100								
	COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO 0.15m AND CUTTINGS TO SURFACE.															

ONTMT4S2_MTO-11375.GPJ_2017TEMPLATE(MTO).GDT_12/16/19

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

RECORD OF BOREHOLE No RW10-05

1 OF 1

METRIC

GWP# 408-88-00 LOCATION Retaining Wall 1, MTM NAD 83 Zone 10: N 4 814 614.5 E 226 513.4 ORIGINATED BY JB
 DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MFA
 DATUM Geodetic DATE 2016.10.26 - 2016.10.26 LATITUDE 43.467350 LONGITUDE -80.467548 CHECKED BY NB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE							
324.7	GROUND SURFACE														
0.0	TOPSOIL (400mm)		1	SS	8										
324.3	SAND, some silt to silty Compact to Loose Brown Moist Clayey silt layer at 1.10m (400mm)		2	SS	23										
0.4			3	SS	9										
322.5			4	SS	27										
2.2	Silty CLAY Very Stiff Grey Moist		5	SS	25										
322.5			6	SS	18										
321			7	SS	41										
319.1	SAND and SILT, trace to some clay Dense to Very Dense Grey Wet		8	SS	61										
5.6															
316.6	END OF BOREHOLE AT 8.1m. BOREHOLE DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE AND AUGER CUTTINGS TO SURFACE.														

ONTMT4S2_MTO-11375.GPJ 2017TEMPLATE(MTO).GDT 12/16/19

RECORD OF BOREHOLE No RW10-06

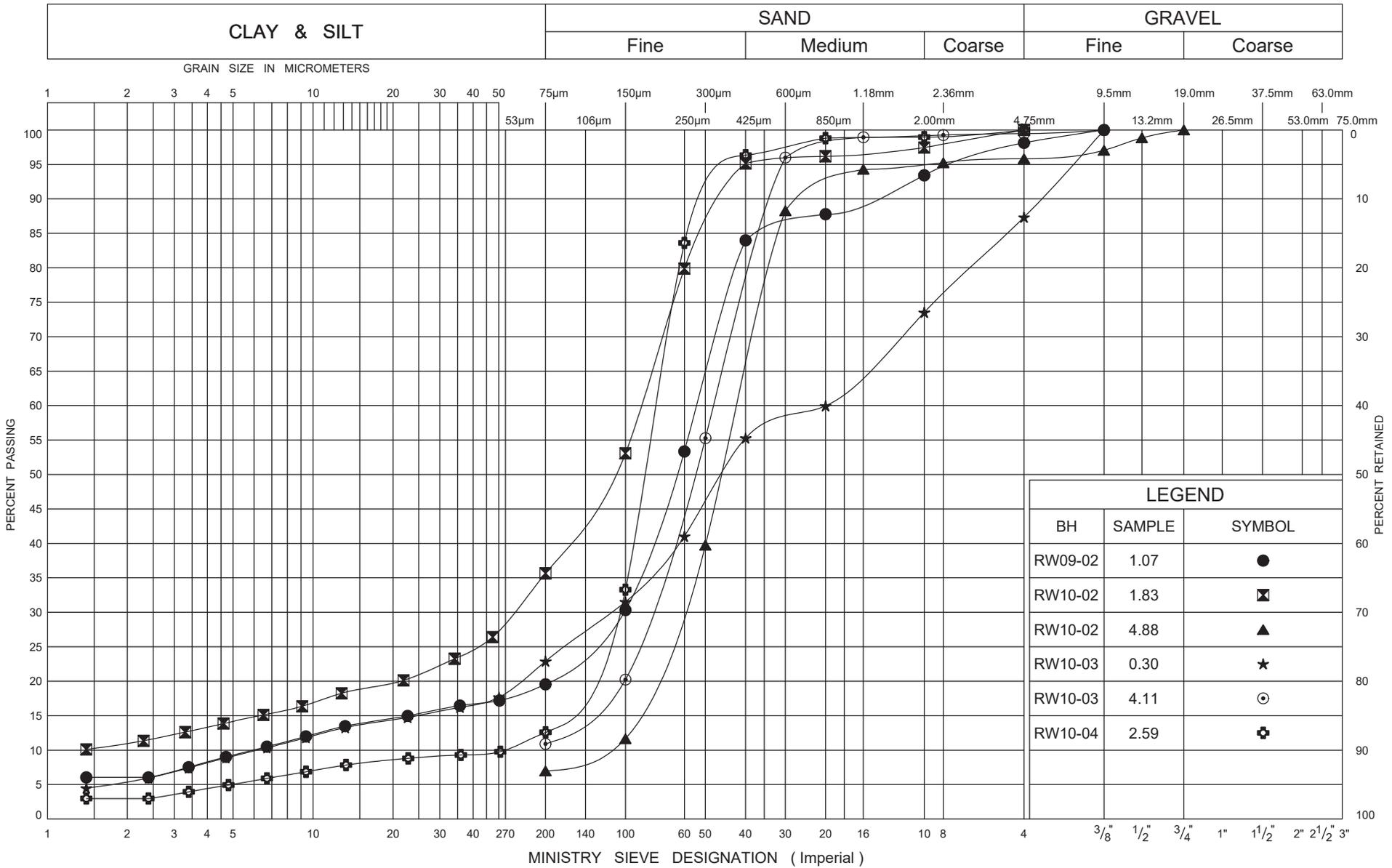
2 OF 2

METRIC

GWP# 408-88-00 LOCATION Retaining Wall 1, MTM NAD 83 Zone 10: N 4 814 638.7 E 226 573.6 ORIGINATED BY JB
 DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MFA
 DATUM Geodetic DATE 2016.10.24 - 2016.10.25 LATITUDE 43.467574 LONGITUDE -80.466808 CHECKED BY NB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa	WATER CONTENT (%)						
	Continued From Previous Page														
			10	SS	72		308								
	Loose						307								
	DCPT from 12.9m to 13.5m		11	SS	9		306								
305.1															
13.5	END OF BOREHOLE AT 13.5m UPON DCPT REFUSAL. WATER LEVEL AT 4.6m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE AND AUGER CUTTINGS TO SURFACE.														

ONTMT4S2_MTO-11375.GPJ_2017TEMPLATE(MTO).GDT_12/16/19



LEGEND		
BH	SAMPLE	SYMBOL
RW09-02	1.07	●
RW10-02	1.83	⊠
RW10-02	4.88	▲
RW10-03	0.30	★
RW10-03	4.11	⊙
RW10-04	2.59	⊕

ONTARIO MOT GRAIN SIZE 2 MTO-11375.GPJ ONTARIO MOT.GDT 12/10/19



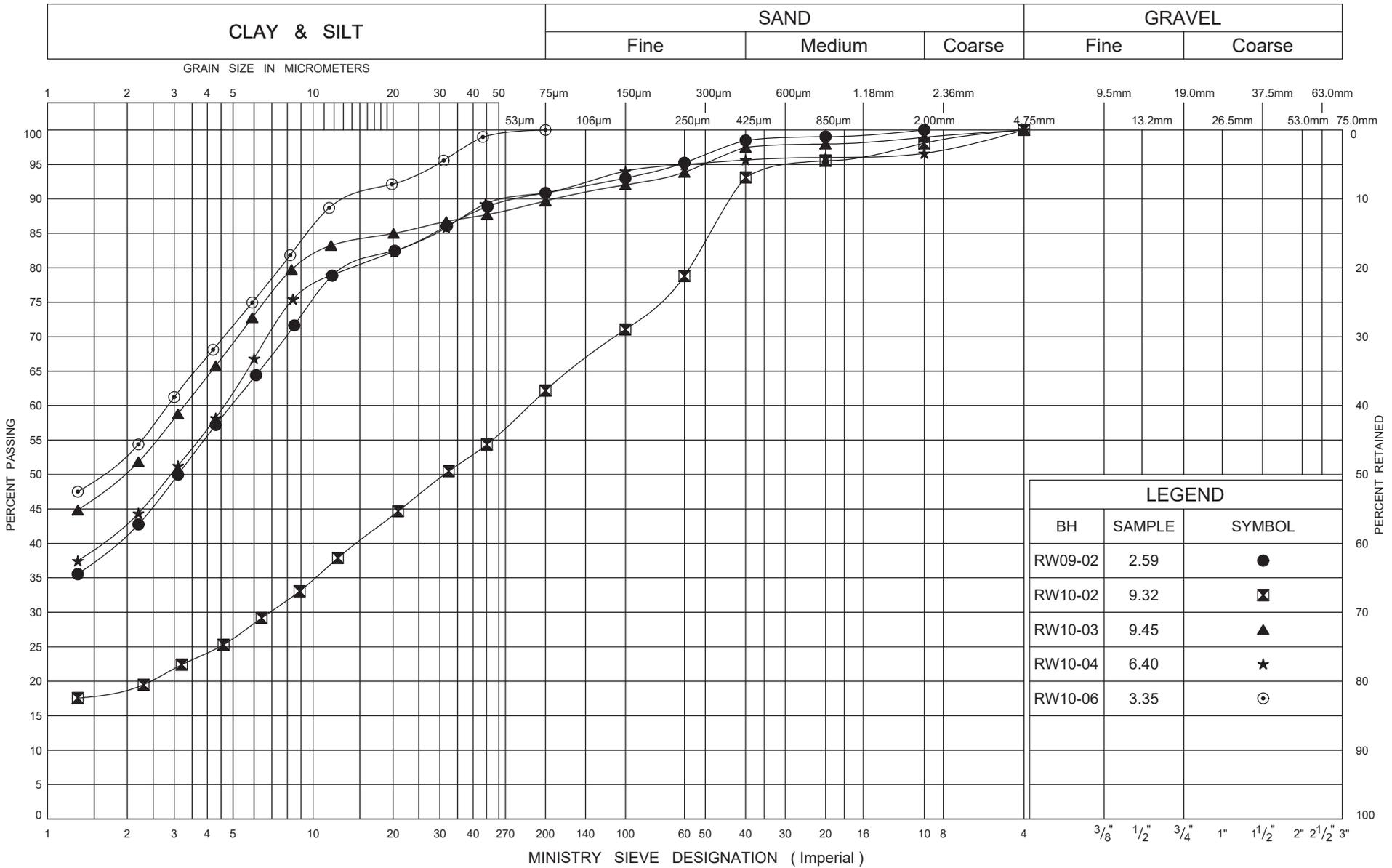
GRAIN SIZE DISTRIBUTION

Granular FILL

FIG No C1

W P 408-88-00

Retaining Wall 10



ONTARIO MOT GRAIN SIZE 2 MTO-11375.GPJ ONTARIO MOT.GDT 12/10/19



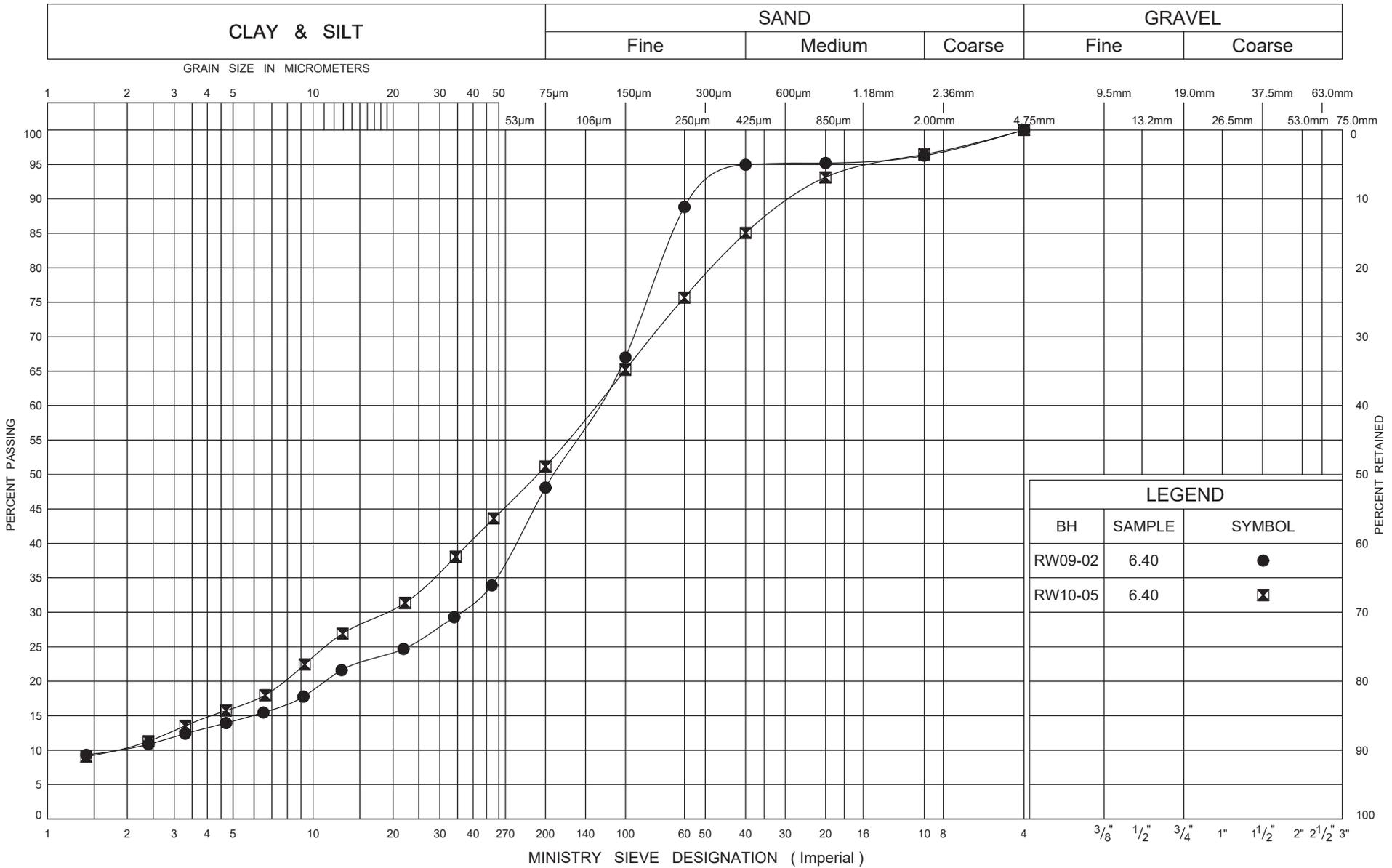
GRAIN SIZE DISTRIBUTION

Silty CLAY

FIG No C2

W P 408-88-00

Retaining Wall 10



ONTARIO MOT GRAIN SIZE 2 MTO-11375.GPJ ONTARIO MOT.GDT 12/10/19

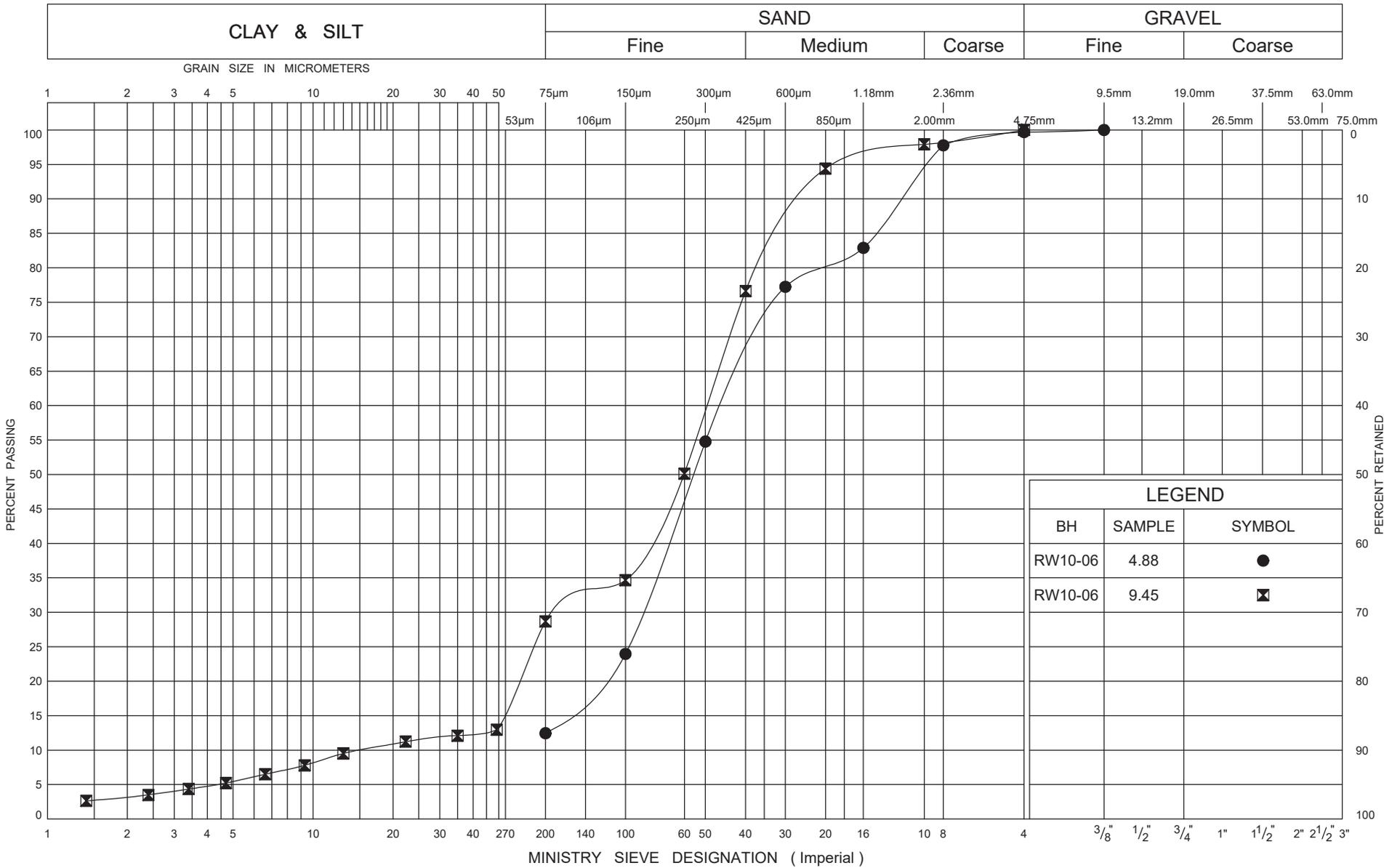


GRAIN SIZE DISTRIBUTION SAND and SILT

FIG No C3

W P 408-88-00

Retaining Wall 10



LEGEND		
BH	SAMPLE	SYMBOL
RW10-06	4.88	●
RW10-06	9.45	⊠

ONTARIO MOT GRAIN SIZE 2 MTO-11375.GPJ ONTARIO MOT.GDT 12/10/19



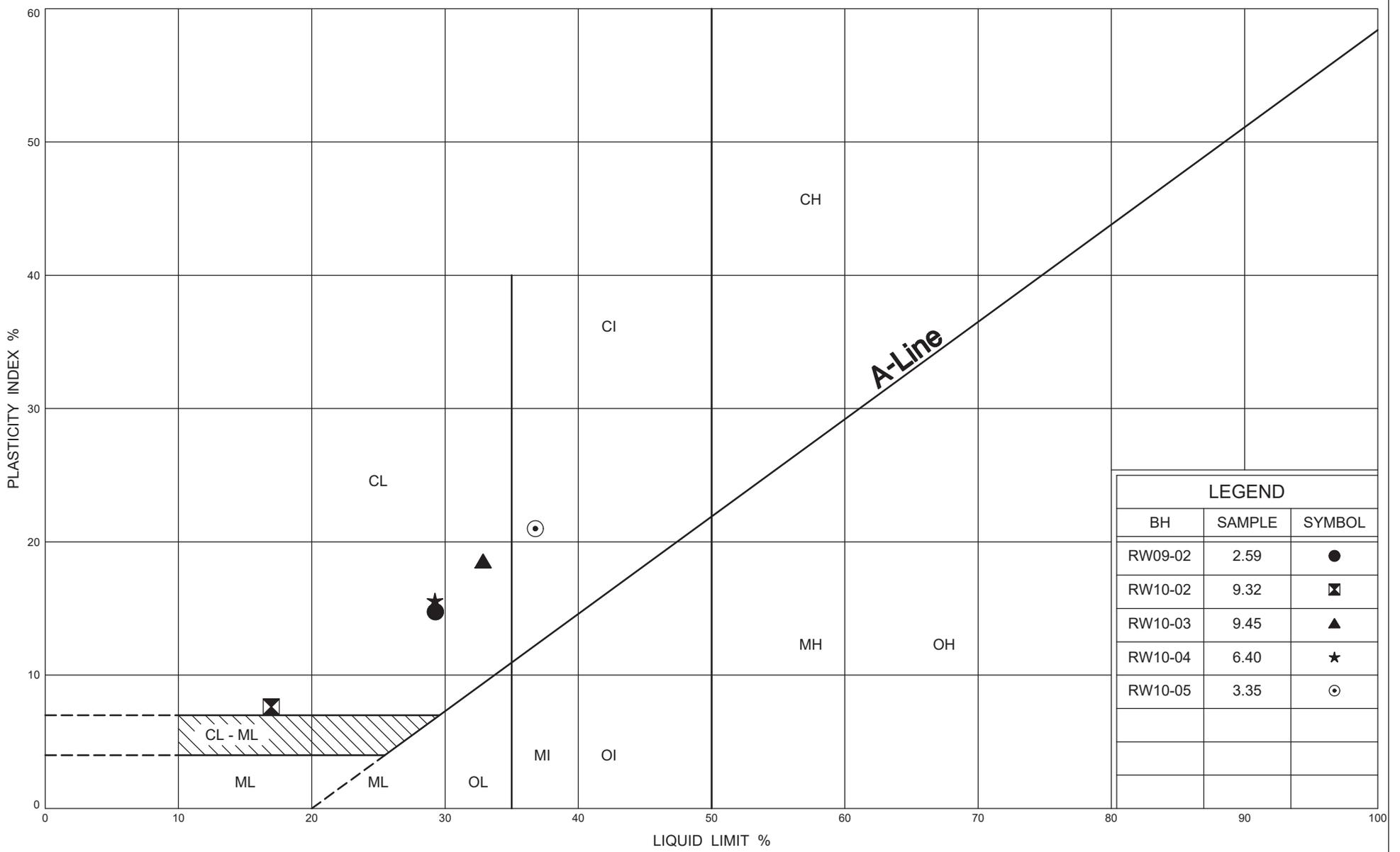
GRAIN SIZE DISTRIBUTION

Lower SAND to Silty Sand

FIG No C4

W P 408-88-00

Retaining Wall 10



LEGEND		
BH	SAMPLE	SYMBOL
RW09-02	2.59	●
RW10-02	9.32	⊠
RW10-03	9.45	▲
RW10-04	6.40	★
RW10-05	3.35	⊙

ONTARIO MOT PLASTICITY CHART MTO-11375.GPJ ONTARIO MOT.GDT 12/10/19



PLASTICITY CHART

Silty CLAY

FIG No C5
 W P 408-88-00
 Retaining Wall 10



Appendix D

**Record of Borehole Sheets, Laboratory Test Results, Borehole Locations
and Soil Strata Drawing**

**Retaining Wall 12
(RW12-01 to RW12-06)**

RECORD OF BOREHOLE No RW12-01 1 OF 2 METRIC

GWP# 408-88-00 LOCATION Retaining Wall 12, MTM NAD 83 Zone 10: N 4 814 519.7 E 226 387.0 ORIGINATED BY MB
 DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MP
 DATUM Geodetic DATE 2018.05.04 - 2018.05.04 LATITUDE 43.466492 LONGITUDE -80.469093 CHECKED BY NB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV. DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60					
324.6	GROUND SURFACE														
0.0	SAND , some gravel, trace silt and clay, occasional organics Compact Brown Moist (FILL)		1	SS	12										
			2	SS	20										15 80 5 (SI+CL)
			3	SS	15										
322.3	SAND , trace silt, trace clay, trace gravel Compact to Loose Brown Moist		4	SS	19										
2.2			5	SS	4										
320.4	Silty CLAY , some sand, trace gravel Very Stiff Brown Moist (TILL)		6	SS	21										
4.1			7	SS	19									7 19 39 35	
			8	SS	19										
315.9	SAND , trace gravel, trace silt, trace clay Dense to Very Dense Brown Moist		9	SS	38										
8.7															
314.6															

ONT/MT452, MTO-11375.GPJ 2017TEMPLATE(MTO).GDT 12/10/19

Continued Next Page

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

RECORD OF BOREHOLE No RW12-02 1 OF 2 METRIC

GWP# 408-88-00 LOCATION Retaining Wall 12, MTM NAD 83 Zone 10: N 4 814 541.0 E 226 436.3 ORIGINATED BY JP
 DIST _____ HWY 7 BOREHOLE TYPE Casing Advance COMPILED BY MP
 DATUM Geodetic DATE 2018.05.07 - 2018.05.07 LATITUDE 43.466678 LONGITUDE -80.468481 CHECKED BY NB

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								
						20 40 60 80 100 ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE				WATER CONTENT (%)						
						20 40 60 80 100				20	40	60				
325.1	GROUND SURFACE															
0.0	SAND , trace silt and clay, trace gravel Compact Brown Moist (FILL)		1	SS	18											
			2	SS	18											
			3	SS	15										5 86 9 (SI+CL)	
			4	SS	18											
322.1	SAND , trace silt, trace gravel Compact Brown Wet		5	SS	14										Switch to casing advancer	
321.0	Silty CLAY , some sand to sandy, trace gravel Hard Brown to Grey Moist (TILL)		6	SS	30										3 24 50 23	
			7	SS	34											
317.9	SAND , trace to some silt, trace clay Very Dense Grey to Brown Wet		8	SS	64											
7.2			9	SS	72										0 89 7 4	
315.1																

ONTMT4S2_MTO-11375.GPJ 2017TEMPLATE(MTO).GDT 12/10/19

Continued Next Page

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

RECORD OF BOREHOLE No RW12-02 2 OF 2 METRIC

GWP# 408-88-00 LOCATION Retaining Wall 12, MTM NAD 83 Zone 10: N 4 814 541.0 E 226 436.3 ORIGINATED BY JP
 DIST HWY 7 BOREHOLE TYPE Casing Advance COMPILED BY MP
 DATUM Geodetic DATE 2018.05.07 - 2018.05.07 LATITUDE 43.466678 LONGITUDE -80.468481 CHECKED BY NB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV. DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE							
10.0	Continued From Previous Page SAND , trace to some silt, trace clay Very Dense Grey Wet		10	SS	80		315								
							314								
312.9							313								
12.2	Silty CLAY , trace sand Hard Grey Moist		11	SS	90		312								
							311								
							310								
309.2			13	SS	31									0 7 35 58	
15.8	END OF BOREHOLE AT 15.8m. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO SURFACE.														

ONTMT4S2_MTO-11375.GPJ_2017TEMPLATE(MTO).GDT_12/10/19

RECORD OF BOREHOLE No RW12-03 1 OF 2 METRIC

GWP# 408-88-00 LOCATION Retaining Wall 12, MTM NAD 83 Zone 10: N 4 814 557.8 E 226 482.0 ORIGINATED BY JP
 DIST _____ HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MP
 DATUM Geodetic DATE 2018.05.07 - 2018.05.07 LATITUDE 43.466834 LONGITUDE -80.467923 CHECKED BY NB

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							
						20	40	60	80	100					
325.3	GROUND SURFACE														
0.0	TOPSOIL(300mm)														
325.0															
0.3	SAND, trace to some silt, trace clay Compact Brown Moist (FILL)		1	SS	15										
			2	SS	22										
			3	SS	12										
323.1															
2.2	SAND, trace silt and clay, trace gravel Compact Brown Moist		4	SS	17									0 93 7 (SI+CL)	
			5	SS	11										
321.2															
4.1	Silty CLAY, some sand, trace gravel, with cobble Very Stiff Grey Moist (TILL)		6	SS	22										
319.6															
5.6	Silty CLAY, trace to some sand Very Stiff Grey Moist		7	SS	17										
			8	SS	19										
			9	SS	15									0 14 44 42	
315.3															

ONT/MT452_MTO-11375.GPJ 2017TEMPLATE(MTO).GDT 12/10/19

Continued Next Page

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

RECORD OF BOREHOLE No RW12-03 2 OF 2 METRIC

GWP# 408-88-00 LOCATION Retaining Wall 12, MTM NAD 83 Zone 10: N 4 814 557.8 E 226 482.0 ORIGINATED BY JP
 DIST _____ HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MP
 DATUM Geodetic DATE 2018.05.07 - 2018.05.07 LATITUDE 43.466834 LONGITUDE -80.467923 CHECKED BY NB

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								
						20 40 60 80 100 ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE				WATER CONTENT (%)						
						20 40 60 80 100				20 40 60						
10.0	Silty CLAY , trace to some sand Very Stiff Grey Moist															
314.3			10	SS	44											
11.0	SAND and SILT , trace gravel, trace clay Dense to Very Dense Grey Wet															
			11	SS	54/ 0.125										0 46 50 4	
			12	SS	73/ 0.125											
310.0																
15.2	Silty CLAY Hard Grey Moist		13	SS	55										0 0 41 59	
309.4																
15.8	END OF BOREHOLE AT 15.8m. Piezometer installation consists of 25mm diameter Schedule 40 PVC pipe with a 3.0m slotted screen.															
	WATER LEVEL READINGS DATE DEPTH(m) ELEV.(m) 2018.05.16 8.3 316.9 2018.05.31 8.2 317.1 2018.06.25 7.9 317.3															

ONTMT4S2_MTO-11375.GPJ_2017TEMPLATE(MTO).GDT_12/10/19

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

RECORD OF BOREHOLE No RW12-04 1 OF 2 METRIC

GWP# 408-88-00 LOCATION Retaining Wall 12, MTM NAD 83 Zone 10: N 4 814 584.9 E 226 524.5 ORIGINATED BY MB
 DIST _____ HWY 7 BOREHOLE TYPE Hollow Stem Augers/DCPT COMPILED BY MP
 DATUM Geodetic DATE 2018.04.19 - 2018.04.19 LATITUDE 43.467045 LONGITUDE -80.467331 CHECKED BY NB

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	PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W		
325.1	GROUND SURFACE											
0.0	Silty SAND, trace gravel, trace clay, occasional organics Dense to Compact Brown Moist (FILL)		1	SS	38							
			2	SS	15							0 64 28 8
323.7												
1.4	SAND, trace silt Compact Brown Moist		3	SS	16							
323.1												
2.0	Silty CLAY, trace to some sand Very Stiff Grey Moist		4	SS	23							
			5	SS	26							0 10 43 47
	layer of silty sand at 4.6m (100mm)		6	SS	28							
			7	SS	30							0 0 39 61
317.9												
7.2	SAND and SILT, trace clay Very Dense Brown Moist occasional cobbles		8	SS	61							
			9	SS	100/ 0.250							0 40 53 7
315.1												

ONTMT4S2_MTO-11375.GPJ 2017TEMPLATE(MTO).GDT 12/10/19

Continued Next Page

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

RECORD OF BOREHOLE No RW12-05 2 OF 2 METRIC

GWP# 408-88-00 LOCATION Retaining Wall 12, MTM NAD 83 Zone 10: N 4 814 607.0 E 226 600.3 ORIGINATED BY MB
 DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers/DCPT COMPILED BY MP
 DATUM Geodetic DATE 2018.04.20 - 2018.04.20 LATITUDE 43.467165 LONGITUDE -80.466762 CHECKED BY NB

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									WATER CONTENT (%)														
						20	40	60	80	100	20	40	60																		
10.0	Continued From Previous Page SAND , trace silt and clay, trace gravel Compact to Dense Brown Moist		10	SS	40																										
	Very Dense		11	SS	100/ 0.275											0 94 6 (SI+CL)															
			12	SS	76																										
308.6	14.8 Silty CLAY , some sand Hard Brown Moist		13	SS	100/ 0.250											0 14 69 17															
307.8	15.6 END OF BOREHOLE AT 15.6m. WATER LEVEL AT 6.05m UPON COMPLETION. Piezometer installation consists of 25mm diameter Schedule 40 PVC pipe with a 3.0m slotted screen. DCPT FROM GROUND SURFACE TO 4.6m.																														
	WATER LEVEL READINGS <table border="1" style="margin-left: 20px;"> <thead> <tr> <th>DATE</th> <th>DEPTH(m)</th> <th>ELEV.(m)</th> </tr> </thead> <tbody> <tr> <td>2018.04.27</td> <td>5.9</td> <td>317.5</td> </tr> <tr> <td>2018.05.16</td> <td>6.0</td> <td>317.5</td> </tr> <tr> <td>2018.05.31</td> <td>5.9</td> <td>317.5</td> </tr> <tr> <td>2018.06.25</td> <td>5.6</td> <td>317.8</td> </tr> </tbody> </table>	DATE	DEPTH(m)	ELEV.(m)	2018.04.27	5.9	317.5	2018.05.16	6.0	317.5	2018.05.31	5.9	317.5	2018.06.25	5.6	317.8															
DATE	DEPTH(m)	ELEV.(m)																													
2018.04.27	5.9	317.5																													
2018.05.16	6.0	317.5																													
2018.05.31	5.9	317.5																													
2018.06.25	5.6	317.8																													

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RECORD OF BOREHOLE No RW12-06 1 OF 3 METRIC

GWP# 408-88-00 LOCATION Retaining Wall 12, MTM NAD 83 Zone 10: N 4 814 632.6 E 226 676.8 ORIGINATED BY JB
 DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MFA
 DATUM Geodetic DATE 2016.10.20 - 2016.10.20 LATITUDE 43.467360 LONGITUDE -80.466142 CHECKED BY NB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					
						20 40 60 80 100 ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE WATER CONTENT (%) 20 40 60							
321.2	GROUND SURFACE												
0.0	Silty SAND, occasional organics Very Loose Brown Moist (FILL)		1	SS	3								
320.5													
0.7	Silty CLAY Stiff to Very Stiff Brown Moist		2	SS	11								
			3	SS	21								0 0 57 43
			4	SS	26								
	Grey		5	SS	21								
			6	SS	23								
			7	SS	21								
			8	SS	18								0 0 44 56
	Hard		9	SS	38								
311.2													

ONTMT4S2_MTO-11375.GPJ 2017TEMPLATE(MTO).GDT 12/10/19

Continued Next Page

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

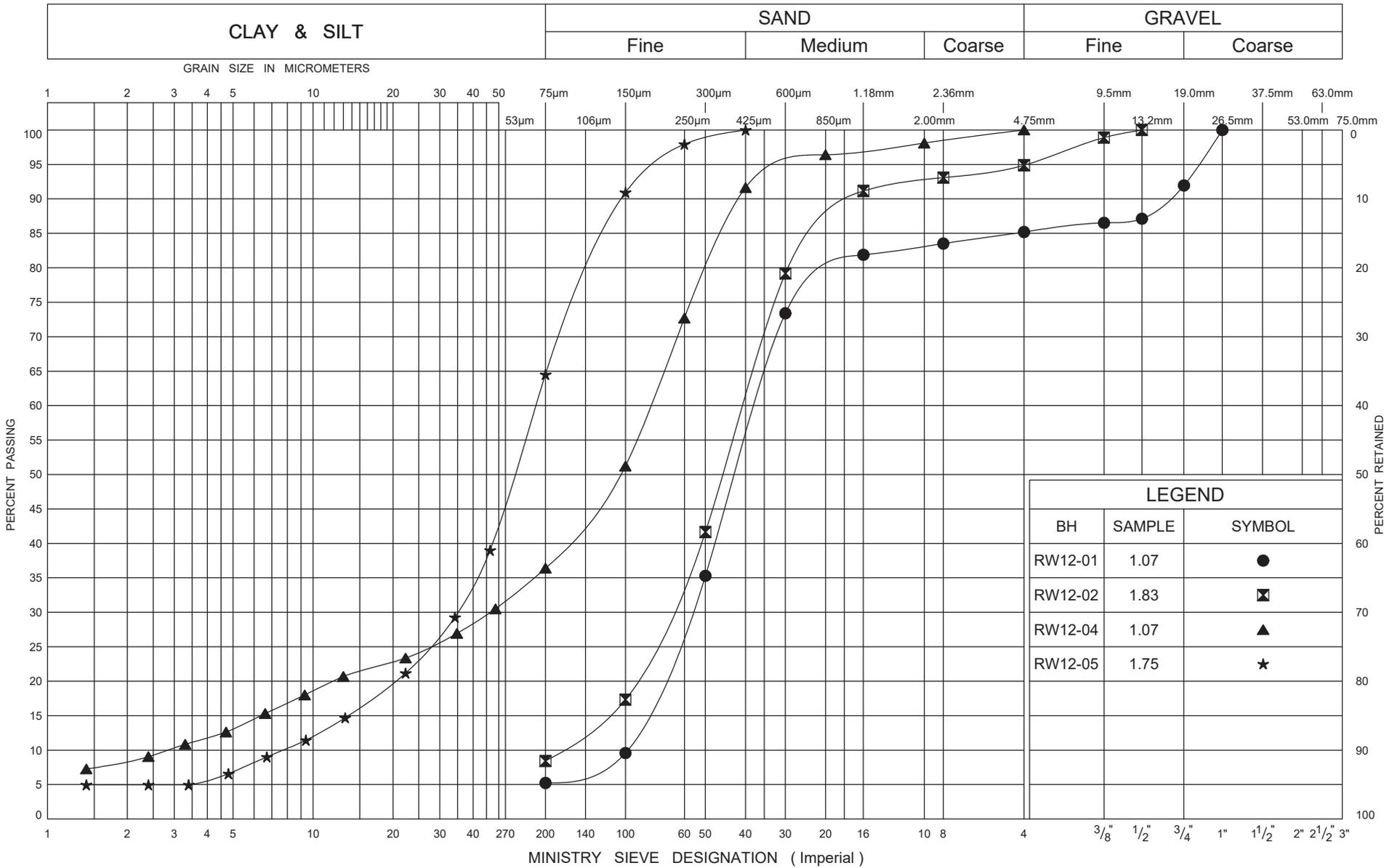
RECORD OF BOREHOLE No RW12-06 3 OF 3 METRIC

GWP# 408-88-00 LOCATION Retaining Wall 12, MTM NAD 83 Zone 10: N 4 814 632.6 E 226 676.8 ORIGINATED BY JB
 DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MFA
 DATUM Geodetic DATE 2016.10.20 - 2016.10.20 LATITUDE 43.467360 LONGITUDE -80.466142 CHECKED BY NB

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								
							20	40	60	80	100	W _p	W	W _L		
301.1	Continued From Previous Page		16	SS	130											
20.1	END OF BOREHOLE AT 20.1m. WATER LEVEL AT 10.7m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE AND AUGER CUTTINGS TO SURFACE.															

ONTMT4S2_MTO-11375.GPJ_2017TEMPLATE(MTO).GDT_12/10/19

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



ONTARIO MOT GRAIN SIZE 2 MTO-11375.GPJ ONTARIO MOT.GDT 12/10/19

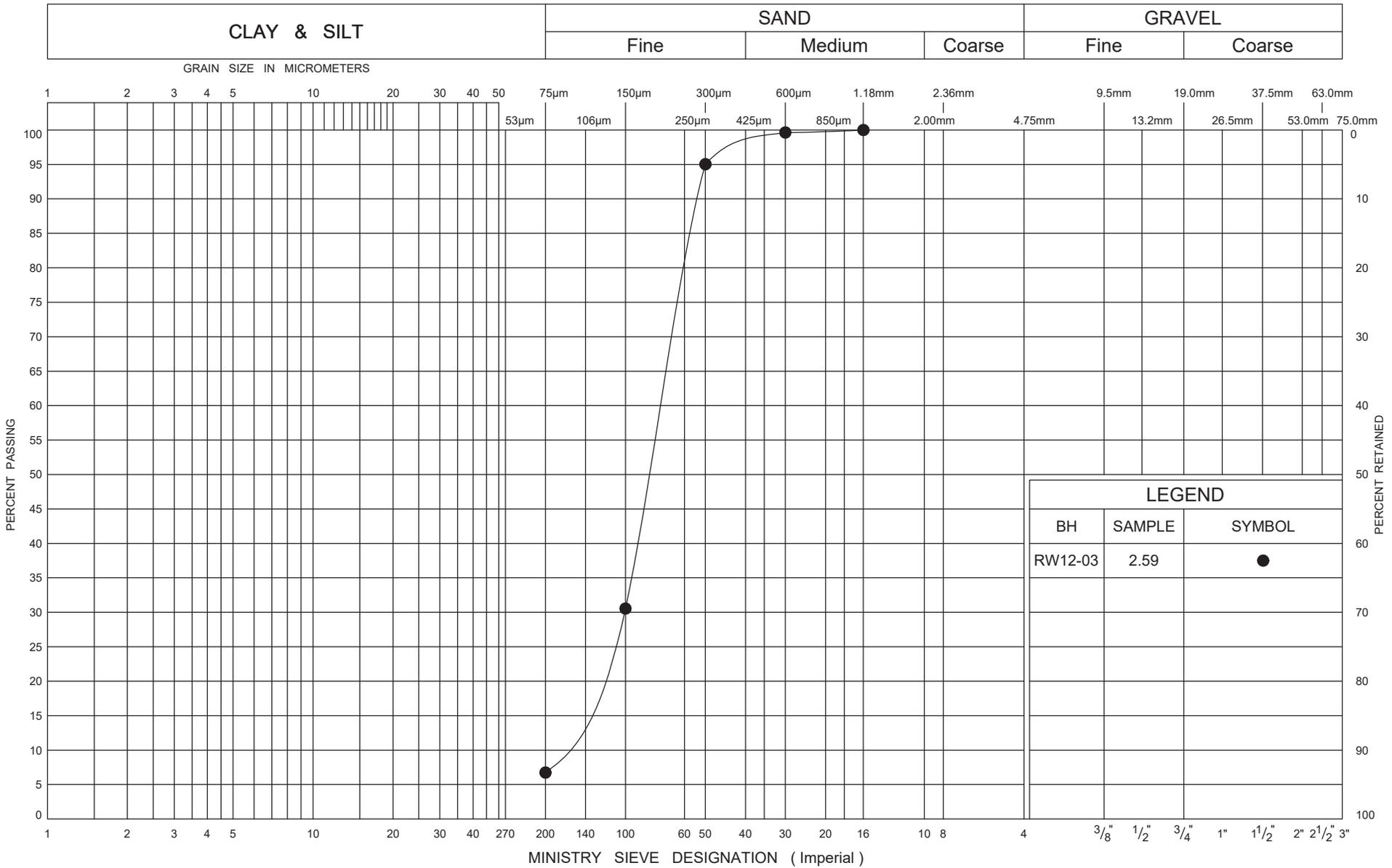


GRAIN SIZE DISTRIBUTION
Granular FILL

FIG No D1

W P 408-88-00

Retaining Wall 12



ONTARIO MOT GRAIN SIZE 2 MTO-11375.GPJ ONTARIO MOT.GDT 12/10/19



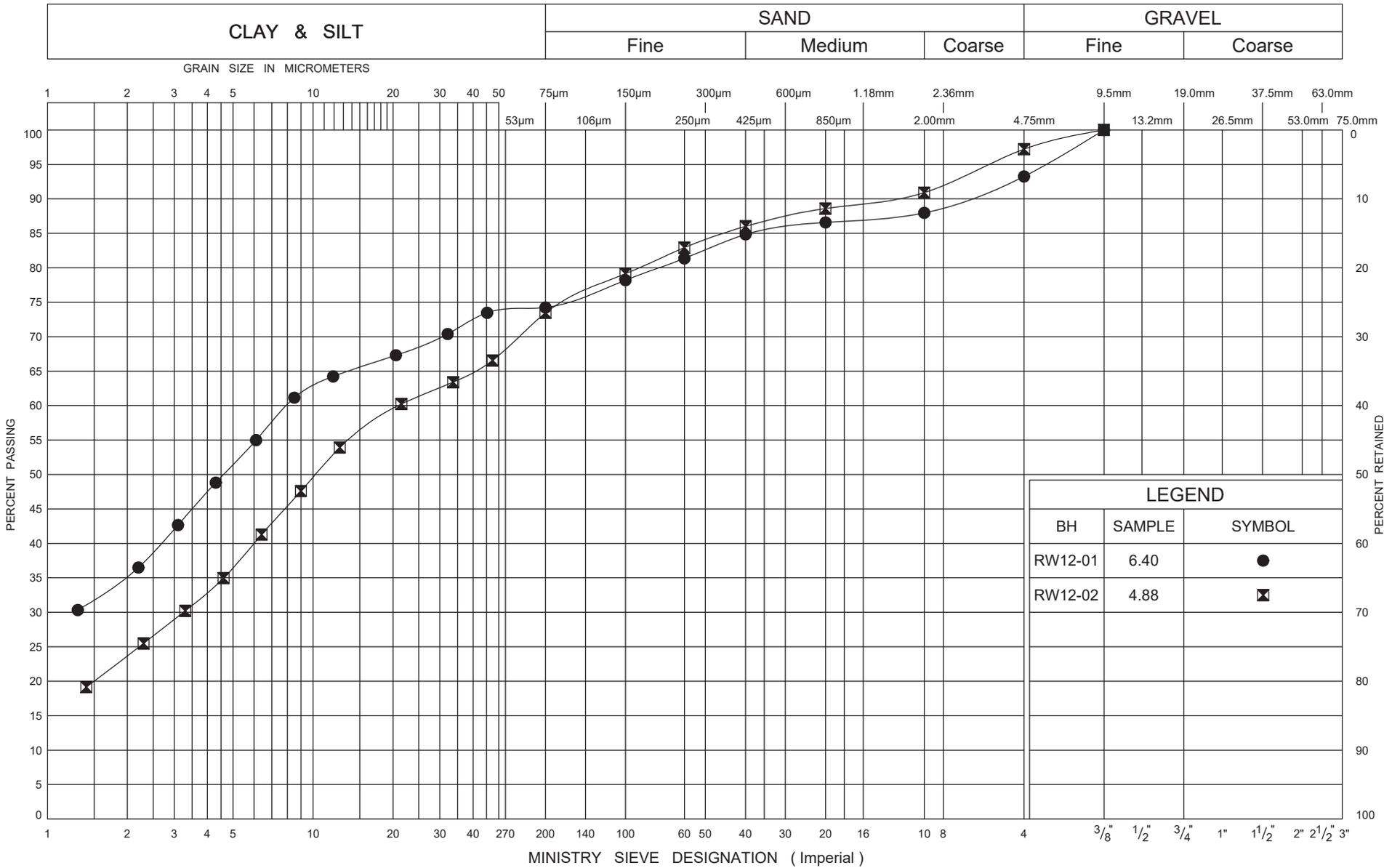
GRAIN SIZE DISTRIBUTION

Upper SAND

FIG No D2

W P 408-88-00

Retaining Wall 12



ONTARIO MOT GRAIN SIZE 2 MTO-11375.GPJ ONTARIO MOT.GDT 12/10/19



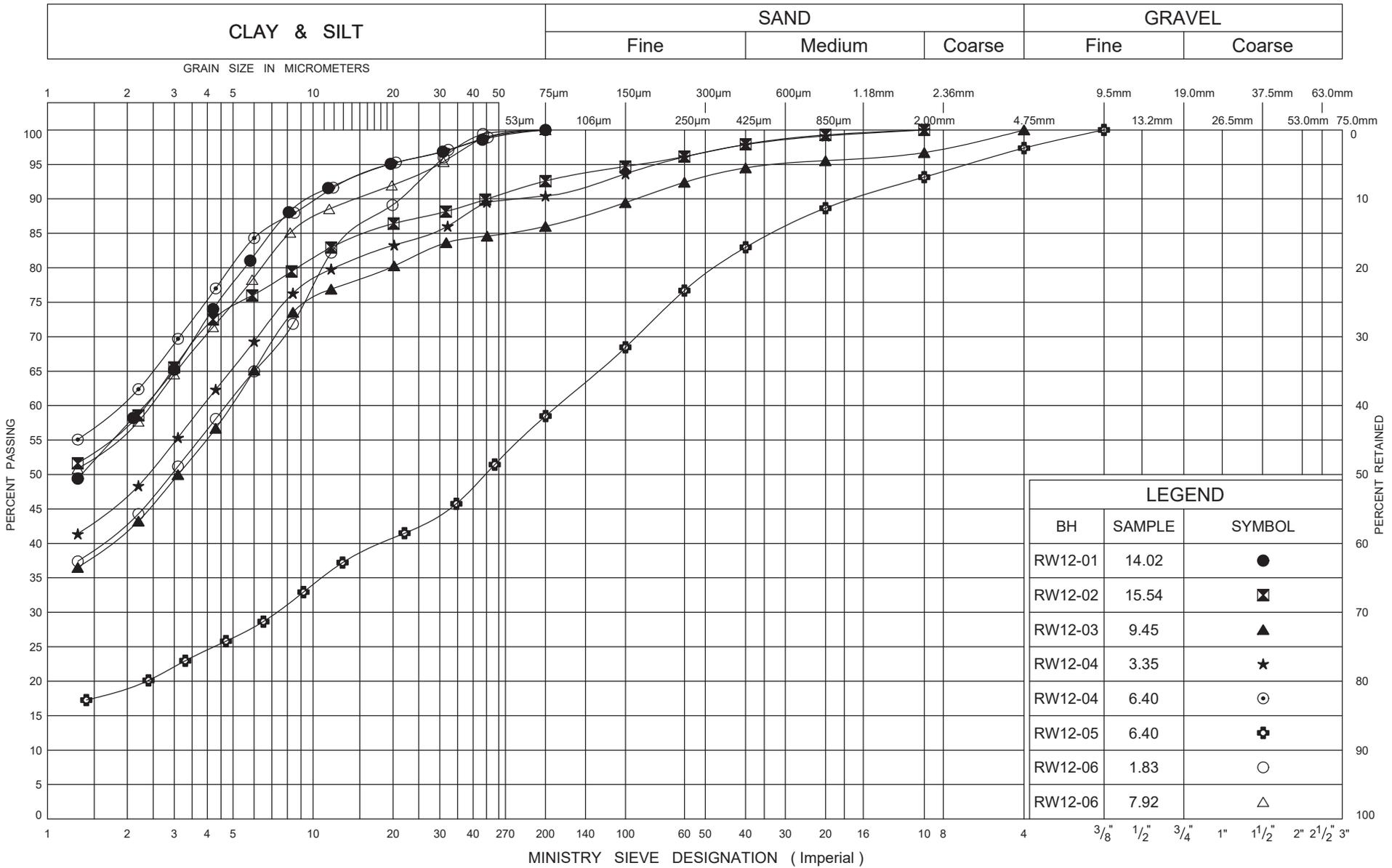
GRAIN SIZE DISTRIBUTION

Silty CLAY TILL

FIG No D3

W P 408-88-00

Retaining Wall 12



ONTARIO MOT GRAIN SIZE 2 MTO-11375.GPJ ONTARIO MOT.GDT 12/10/19



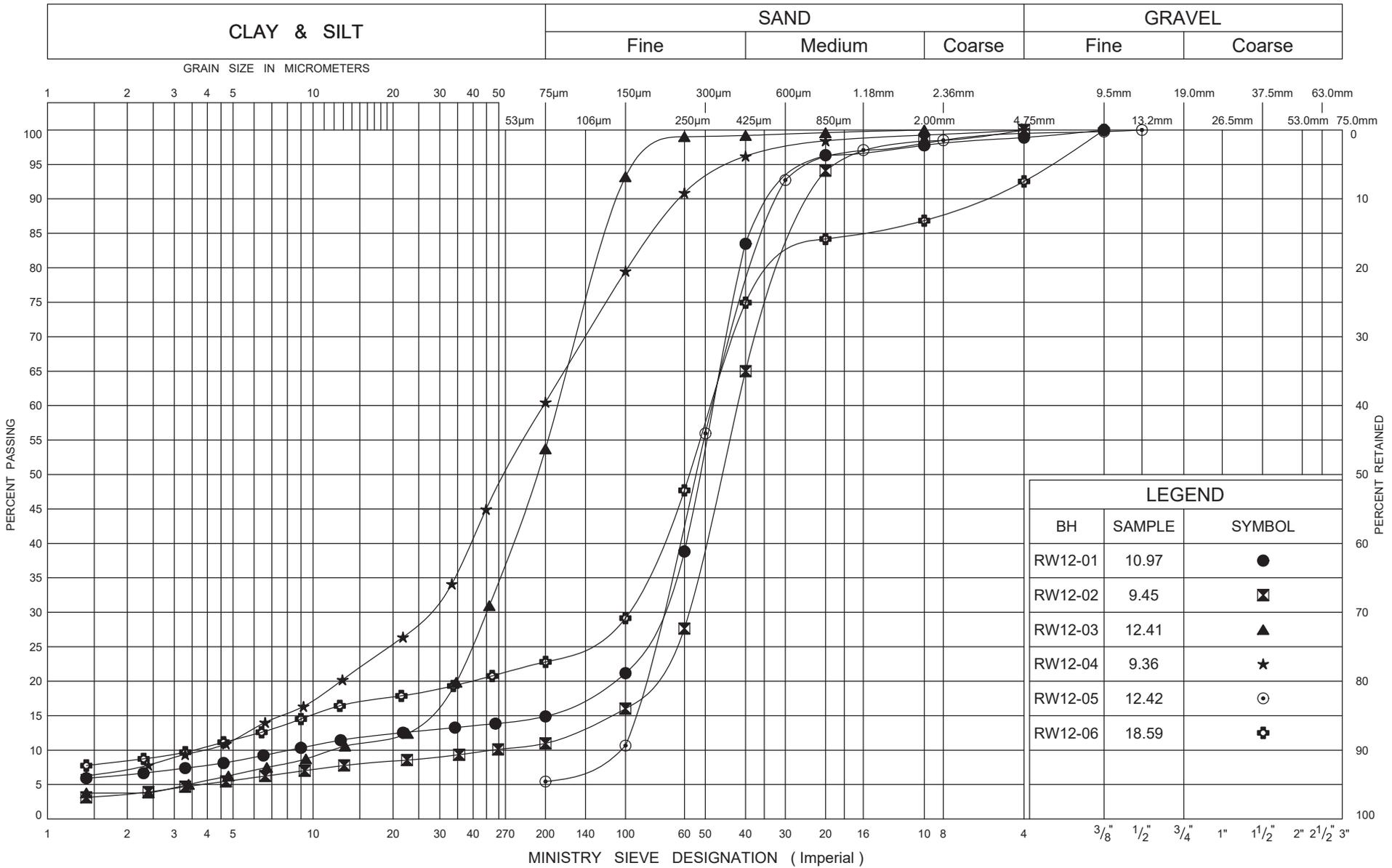
GRAIN SIZE DISTRIBUTION

Upper Silty CLAY

FIG No D4

W P 408-88-00

Retaining Wall 12



LEGEND		
BH	SAMPLE	SYMBOL
RW12-01	10.97	●
RW12-02	9.45	⊠
RW12-03	12.41	▲
RW12-04	9.36	★
RW12-05	12.42	⊙
RW12-06	18.59	⊕

ONTARIO MOT GRAIN SIZE 2 MTO-11375.GPJ ONTARIO MOT.GDT 12/10/19



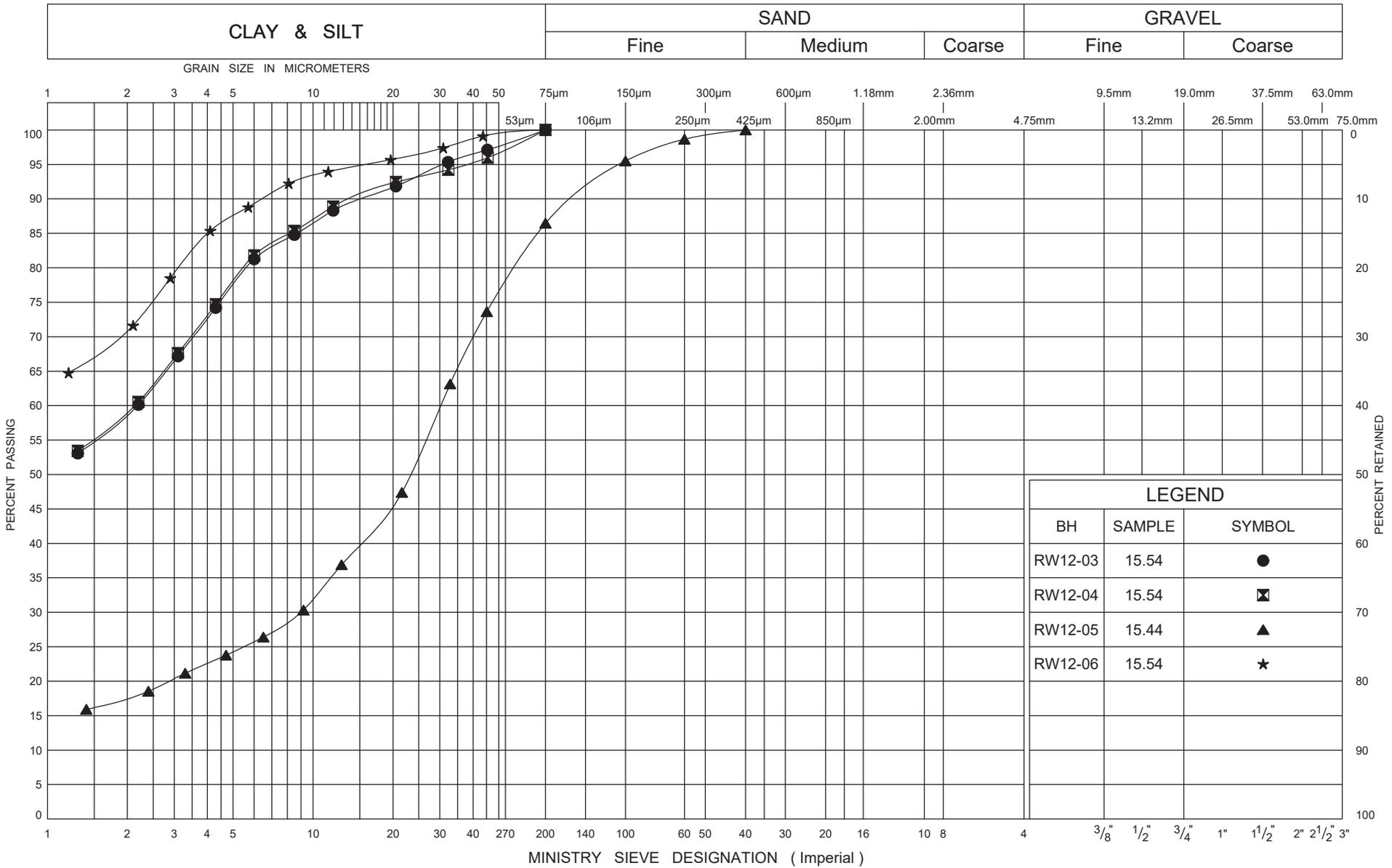
GRAIN SIZE DISTRIBUTION

Lower SAND / SILT

FIG No D5

W P 408-88-00

Retaining Wall 12



LEGEND		
BH	SAMPLE	SYMBOL
RW12-03	15.54	●
RW12-04	15.54	⊠
RW12-05	15.44	▲
RW12-06	15.54	★

ONTARIO MOT GRAIN SIZE 2 MTO-11375.GPJ ONTARIO MOT.GDT 12/10/19



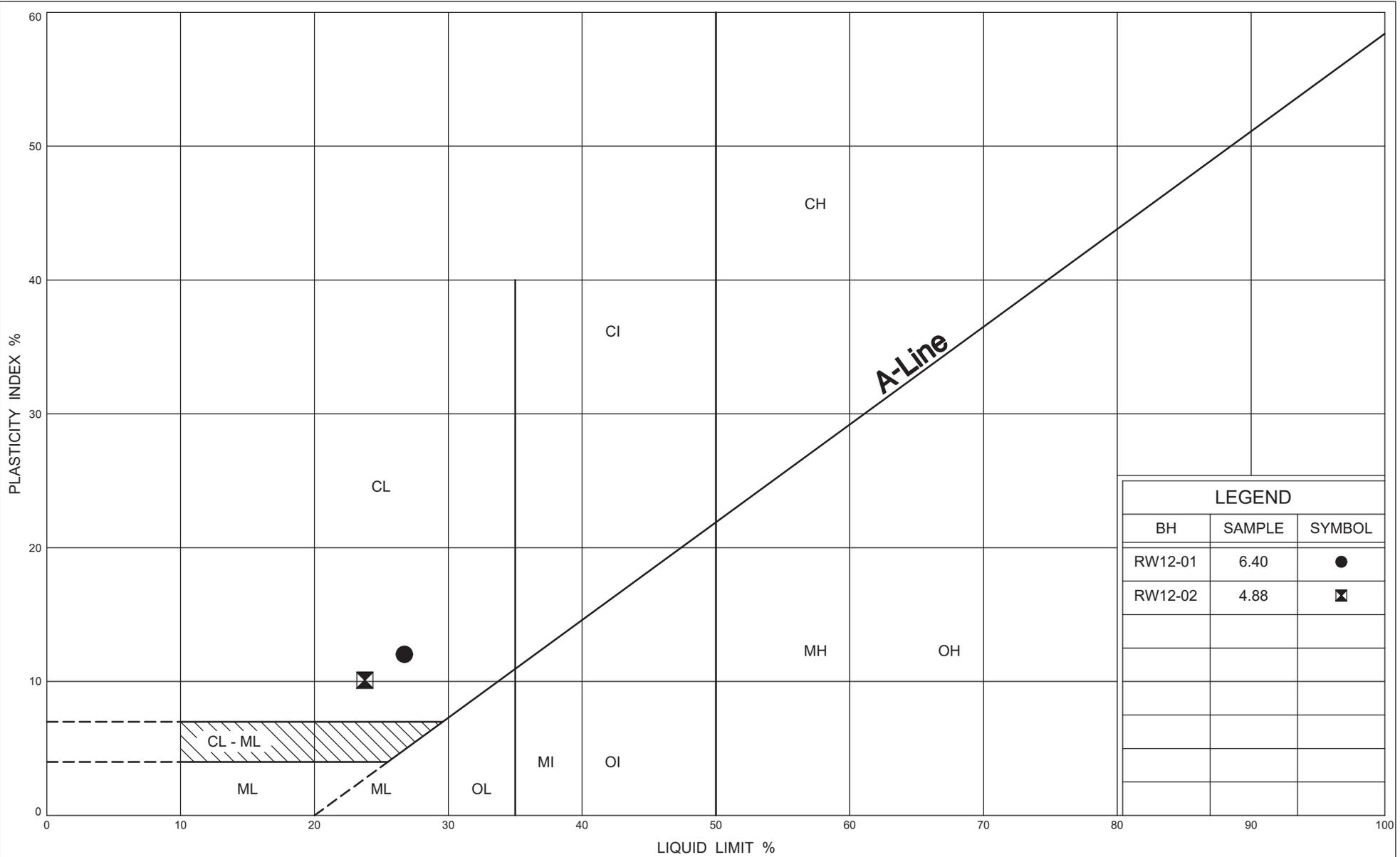
GRAIN SIZE DISTRIBUTION

Lower Silty CLAY

FIG No D6

W P 408-88-00

Retaining Wall 12

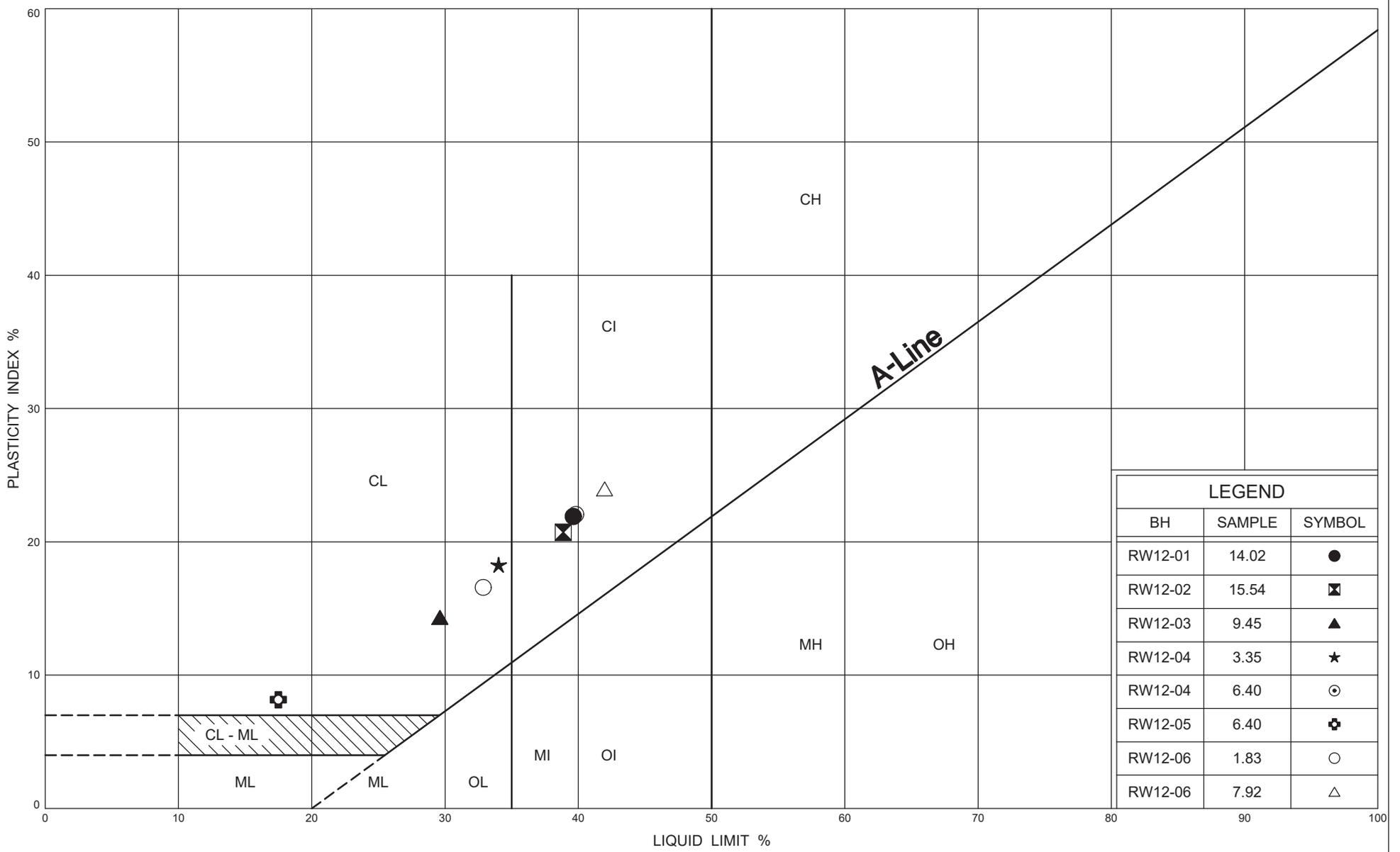


PLASTICITY CHART
Silty CLAY TILL

FIG No D7

W P 408-88-00

Retaining Wall 12



LEGEND		
BH	SAMPLE	SYMBOL
RW12-01	14.02	●
RW12-02	15.54	⊠
RW12-03	9.45	▲
RW12-04	3.35	★
RW12-04	6.40	⊙
RW12-05	6.40	⊕
RW12-06	1.83	○
RW12-06	7.92	△

ONTARIO MOT PLASTICITY CHART MTO-11375.GPJ ONTARIO MOT.GDT 12/10/19

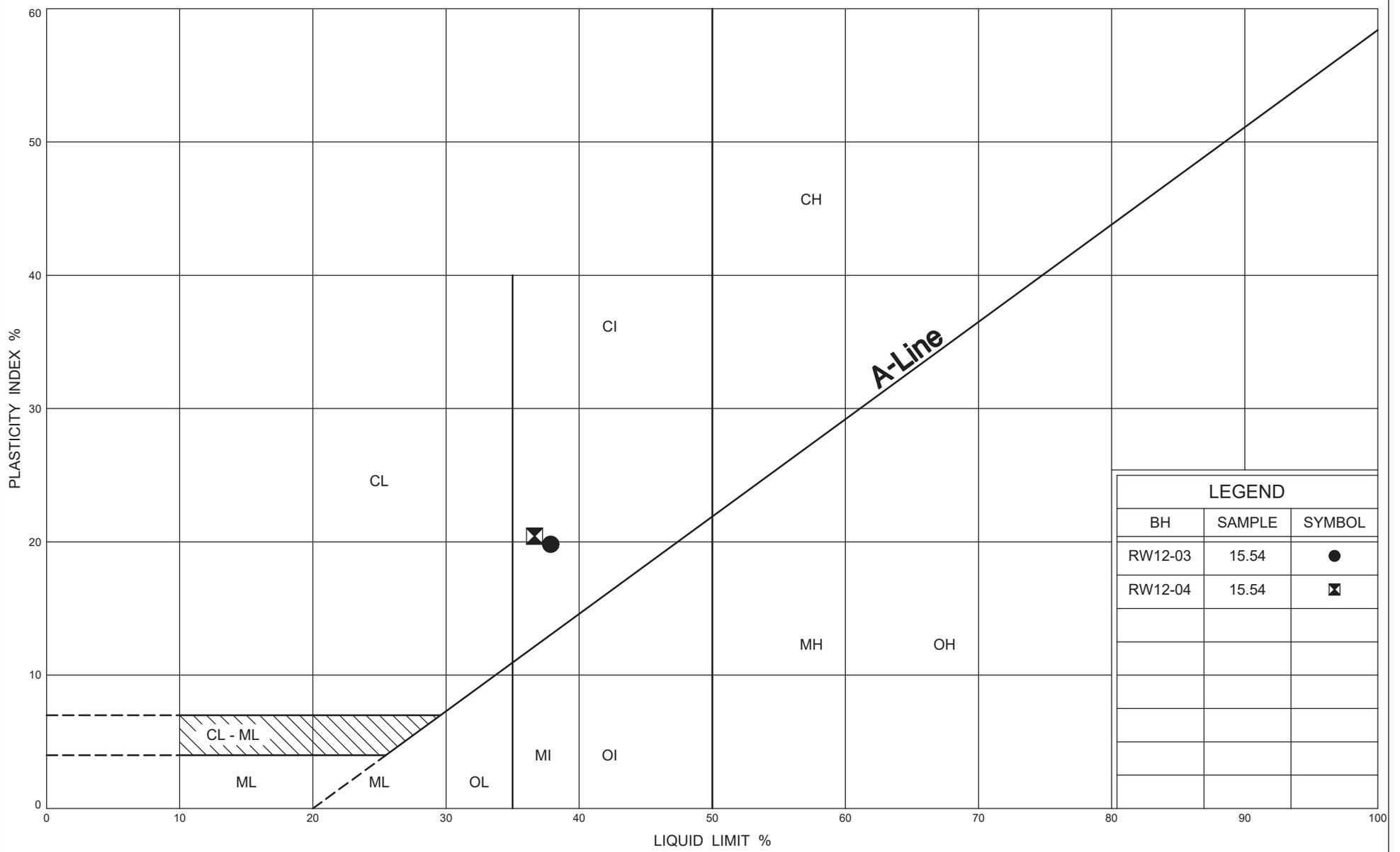


PLASTICITY CHART
Upper Silty CLAY

FIG No D8

W P 408-88-00

Retaining Wall 12



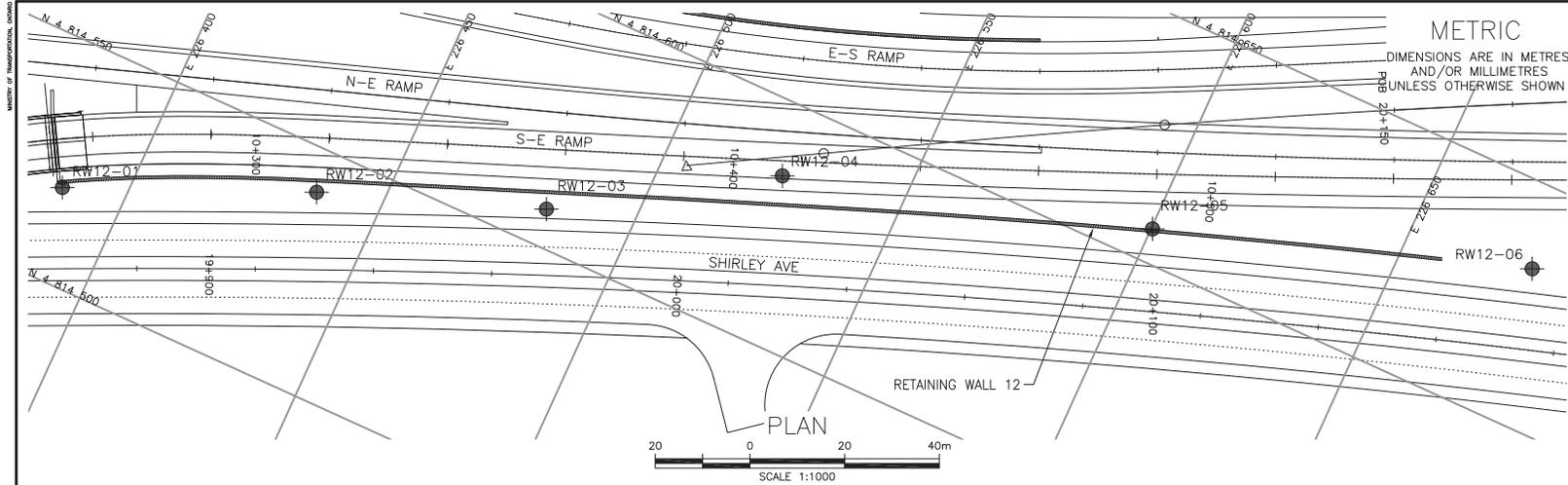
LEGEND		
BH	SAMPLE	SYMBOL
RW12-03	15.54	●
RW12-04	15.54	⊠

ONTARIO MOT PLASTICITY CHART MTO-11375.GPJ ONTARIO MOT.GDT 12/10/19



PLASTICITY CHART
Lower Silty CLAY

FIG No D9
W P 408-88-00
Retaining Wall 12



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

CONT No
GWP No 408-88-00

HIGHWAY 7
S-E RAMP-WELLINGTON ST. OVERPASS-S/E
RETAINING WALL 12
BOREHOLE LOCATIONS AND SOIL STRATA

wsp

THURBER ENGINEERING LTD

SHEET

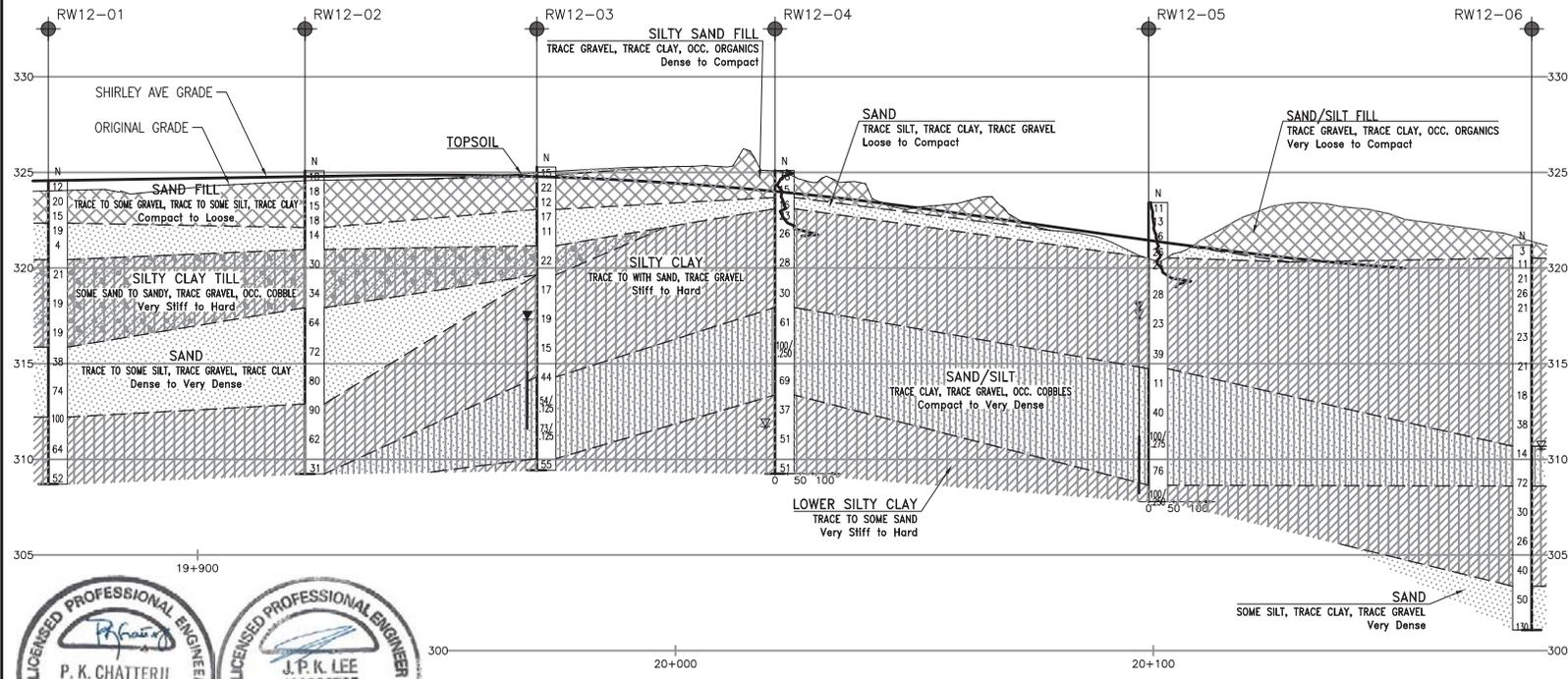
Latitude: 43.466941° Longitude: -80.467629°

KEYPLAN

LEGEND

- ◆ Borehole (Current Investigation)
- ⊕ Borehole (by Others)
- 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 (ROD)
- A/R Auger Refusal

NO	ELEVATION	NORTHING	EASTING
RW12-01	324.6	4 814 519.7	226 387.0
RW12-02	325.1	4 814 541.0	226 436.3
RW12-03	325.3	4 814 557.8	226 482.0
RW12-04	325.1	4 814 584.9	226 524.5
RW12-05	323.4	4 814 607.0	226 600.3
RW12-06	321.2	4 814 632.6	226 676.8



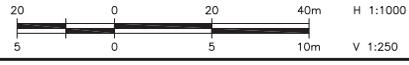
NOTES-

- 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. 40P9-58



PROFILE ALONG S-E RAMP-WELLINGTON ST. OVERPASS-S/E



REVISIONS

DATE	BY	DESCRIPTION
DESIGN	NB	CHK PKC CODE
DRAWN	MFA	CHK NB SITE

LOAD DATE MAY 2020
STRUCT DWS 1

FILENAME: H:\Projects\11000\11370\11370-TD-11370-BMP-RW12.dwg
PLOTDATE: 5/6/2020 4:21 PM



Appendix E

Record of Borehole Sheets, Laboratory Test Results, Borehole Locations and Soil Strata Drawing

**Retaining Wall 16
(RW16-01 to RW16-03)**

RECORD OF BOREHOLE No RW16-01 1 OF 2 METRIC

GWP# 408-88-00 LOCATION Retaining Wall 16, MTM NAD 83 Zone 10: N 4 813 677.3 E 226 163.6 ORIGINATED BY JP
 DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2019.08.19 - 2019.08.19 LATITUDE 43.458863 LONGITUDE -80.471748 CHECKED BY NB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE							
321.3	GROUND SURFACE														
0.0	ASPHALT: (150mm)														
0.2	Sandy SILT, with gravel Brown Dry (FILL)		1	GS			321								
320.5	SAND, some silt to silty, trace clay, trace gravel Compact Brown Wet		2	SS	25		320								
0.8			3	SS	26		320							2 78 16 4	
			4	SS	25		319								
319.0	Silty CLAY, trace sand, trace gravel Very Stiff Grey Moist		5	SS	22		318								
2.3			6	SS	21		317								
			7	SS	28		315							0 1 32 67	
			8	SS	58		313								
312.5	Hard						314								
							312								
8.8	Sandy SILT, trace clay Dense Grey Wet		9	SS	42		312								

ONTMT452_MTO-11375.GPJ 2017TEMPLATE(MTO).GDT 12/10/19

Continued Next Page

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

RECORD OF BOREHOLE No RW16-01 2 OF 2 METRIC

GWP# 408-88-00 LOCATION Retaining Wall 16, MTM NAD 83 Zone 10: N 4 813 677.3 E 226 163.6 ORIGINATED BY JP
 DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2019.08.19 - 2019.08.19 LATITUDE 43.458863 LONGITUDE -80.471748 CHECKED BY NB

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								
	Continued From Previous Page															
310.0			10	SS	45		311								0 24 70 6	
11.3	END OF BOREHOLE AT 11.3m. BOREHOLE CAVED TO 0.2m AND WATER LEVEL NOT OBSERVED. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND ASPHALT PATCH TO SURFACE.															

ONTMT4S2_MTO-11375.GPJ_2017TEMPLATE(MTO).GDT_12/10/19

RECORD OF BOREHOLE No RW16-02 1 OF 2 METRIC

GWP# 408-88-00 LOCATION Retaining Wall 16, MTM NAD 83 Zone 10: N 4 813 716.6 E 226 163.9 ORIGINATED BY BL
 DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2019.08.15 - 2019.08.19 LATITUDE 43.459222 LONGITUDE -80.471733 CHECKED BY NB

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						
320.4	GROUND SURFACE													
0.0	ASPHALT: (150mm)													
0.2	SAND and GRAVEL, granular Brown Dry		1	GS										
319.7	(FILL)													
0.7	Silty SAND, some clay, occasional cobbles Loose		2	SS	8									
319.0	Brown Moist													
1.4	Silty CLAY, trace sand, trace shale Very Stiff to Hard Brown Dry to Moist		3	SS	25									
	Grey		4	SS	35								0 5 53 42	
			5	SS	39									
			6	SS	38									
			7	SS	21									
			8	SS	32									
			9	SS	41								0 1 45 54	
310.4														

ONT\MT452_MTO-11375.GPJ_2017TEMPLATE(MTO).GDT_12/10/19

Continued Next Page

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

RECORD OF BOREHOLE No RW16-02 2 OF 2 METRIC

GWP# 408-88-00 LOCATION Retaining Wall 16, MTM NAD 83 Zone 10: N 4 813 716.6 E 226 163.9 ORIGINATED BY BL
 DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2019.08.15 - 2019.08.19 LATITUDE 43.459222 LONGITUDE -80.471733 CHECKED BY NB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa							
							20	40	60	80	100	PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	
							○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE					WATER CONTENT (%)			
							20	40	60	80	100	20	40	60	
10.0	Continued From Previous Page Silty CLAY , trace sand, trace shale Very Stiff to Hard Brown Dry to Moist		10	SS	21		310								
309.1															
11.3	END OF BOREHOLE AT 11.3m. BOREHOLE CAVED TO 10.4m AND WATER LEVEL AT 3.7m. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND ASPHALT PATCH TO SURFACE.														

ONTMT4S2_MTO-11375.GPJ_2017TEMPLATE(MTO).GDT_12/10/19

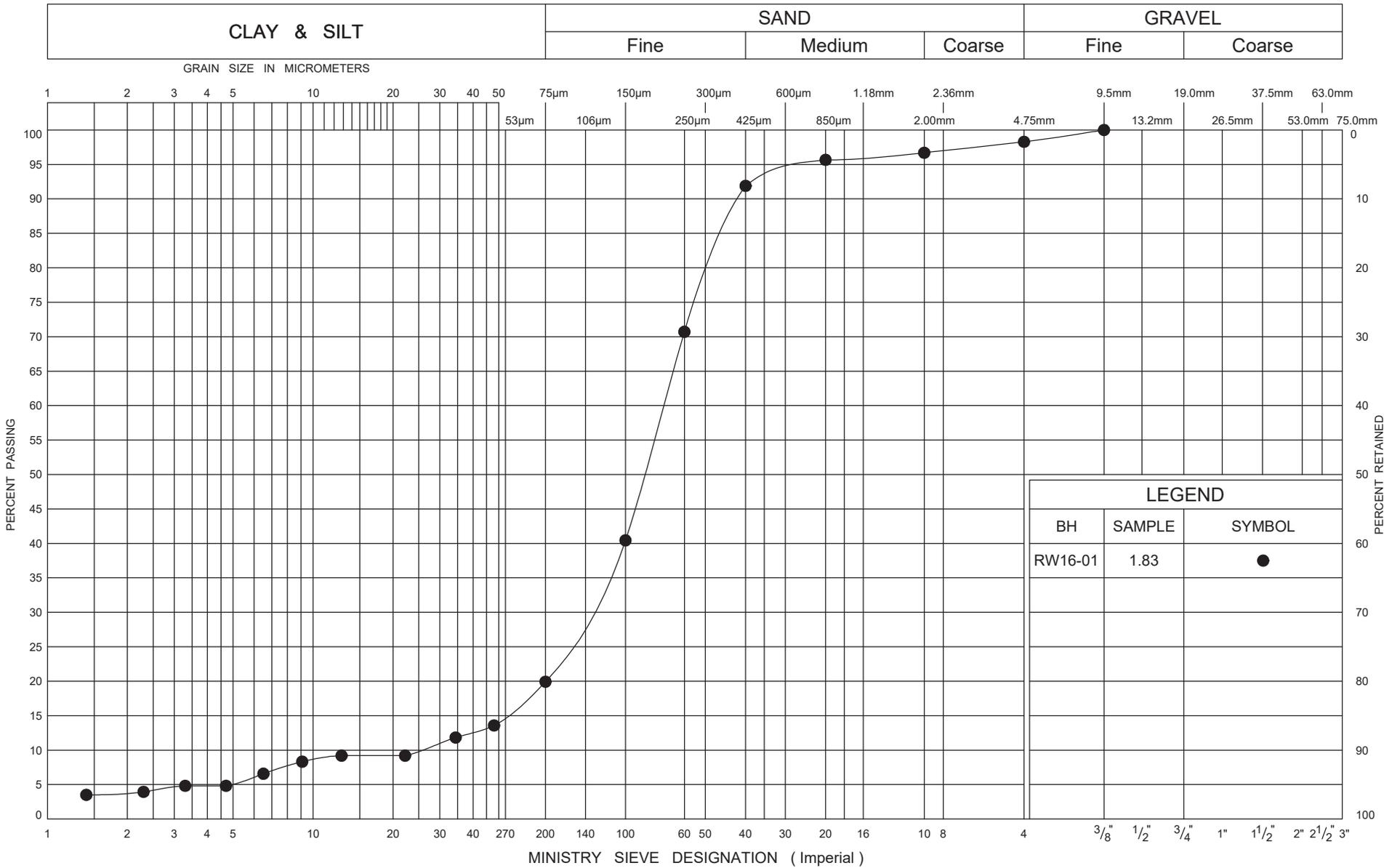
+³, ×³: Numbers refer to Sensitivity 20
15 10 5 0 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No RW16-03 2 OF 2 METRIC

GWP# 408-88-00 LOCATION Retaining Wall 16, MTM NAD 83 Zone 10: N 4 813 755.4 E 226 164.5 ORIGINATED BY BL
 DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2019.08.15 - 2019.08.15 LATITUDE 43.459582 LONGITUDE -80.471709 CHECKED BY NB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE							
	Continued From Previous Page														
308.7	Sandy SILT to Silty SAND Compact Grey Wet		10	SS	27									Auger grinding	
11.3	End of sampling DCPT from 11.3m to 12.5m														
307.4															
12.5	END OF BOREHOLE AT 12.5m. BOREHOLE CAVED TO 9.1m AND WATER LEVEL AT 8.8m UPON DRILLING. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND ASPHALT PATCH TO SURFACE.														

ONT/MT4S2_MTO-11375.GPJ 2017TEMPLATE(MTO).GDT 12/10/19

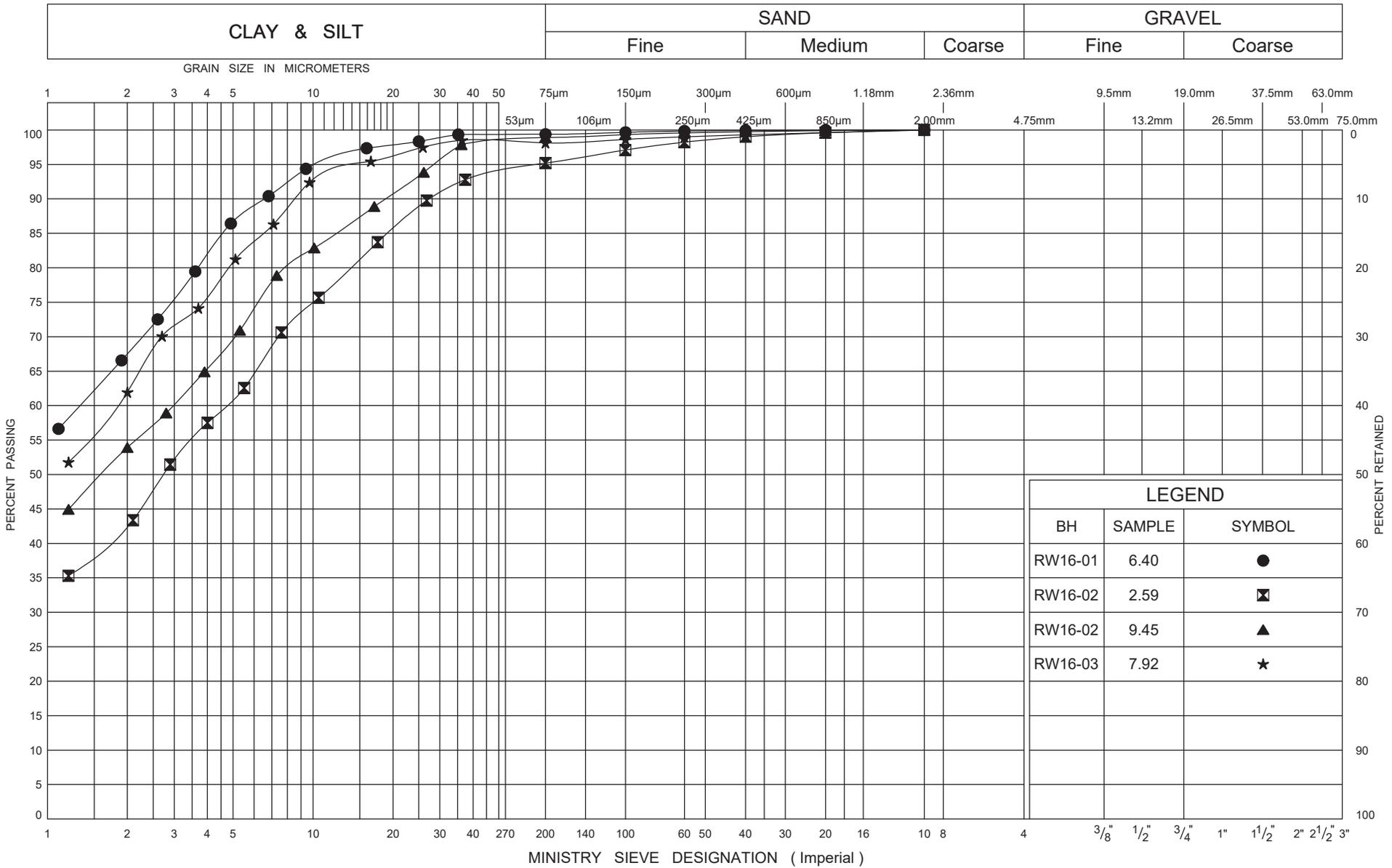


ONTARIO MOT GRAIN SIZE 2 MTO-11375.GPJ ONTARIO MOT.GDT 12/10/19



GRAIN SIZE DISTRIBUTION SAND

FIG No E1
W P 408-88-00
Retaining Wall 16



ONTARIO MOT GRAIN SIZE 2 MTO-11375.GPJ ONTARIO MOT.GDT 12/10/19



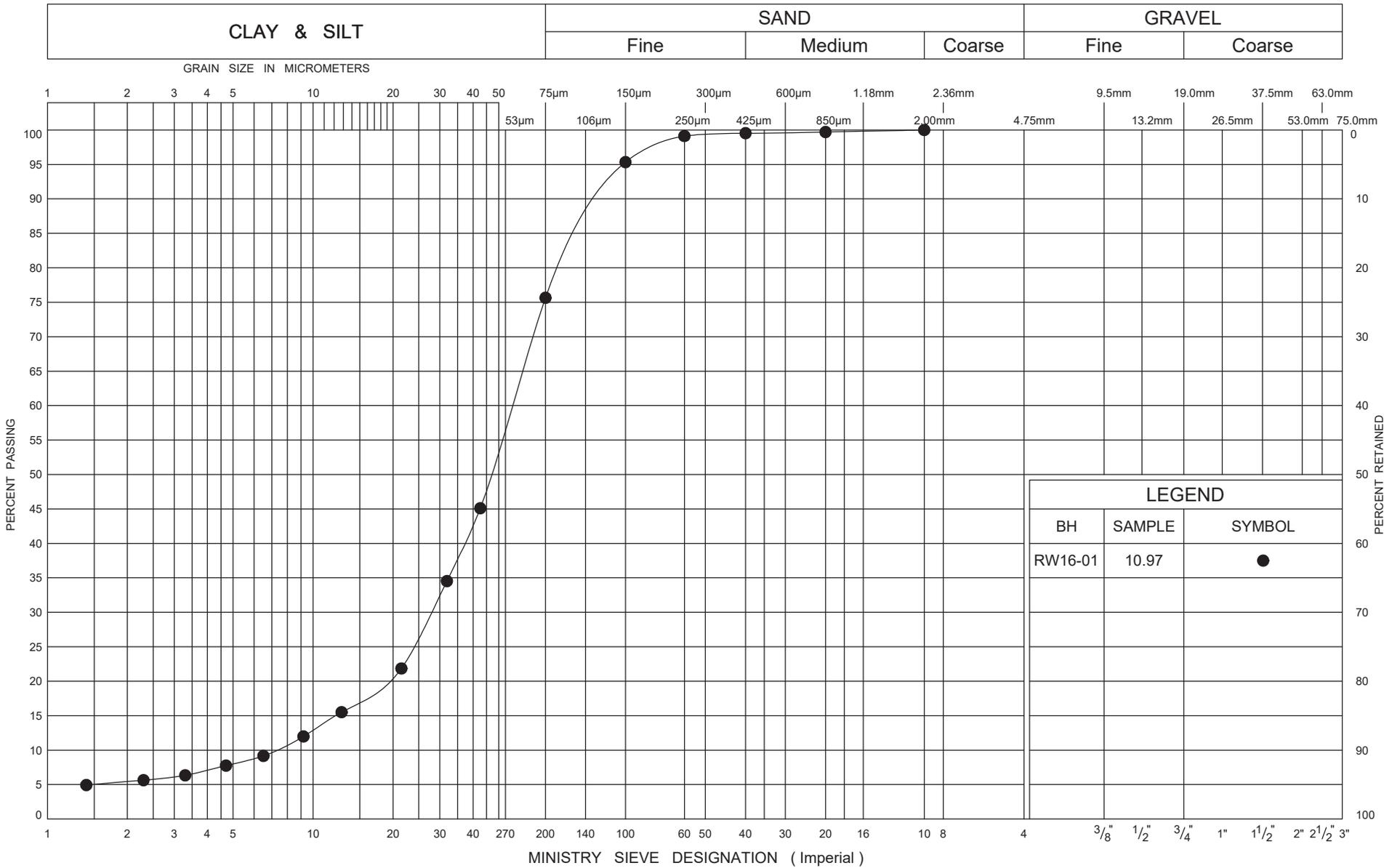
GRAIN SIZE DISTRIBUTION

Silty CLAY

FIG No E2

W P 408-88-00

Retaining Wall 16



ONTARIO MOT GRAIN SIZE 2 MTO-11375.GPJ ONTARIO MOT.GDT 12/10/19

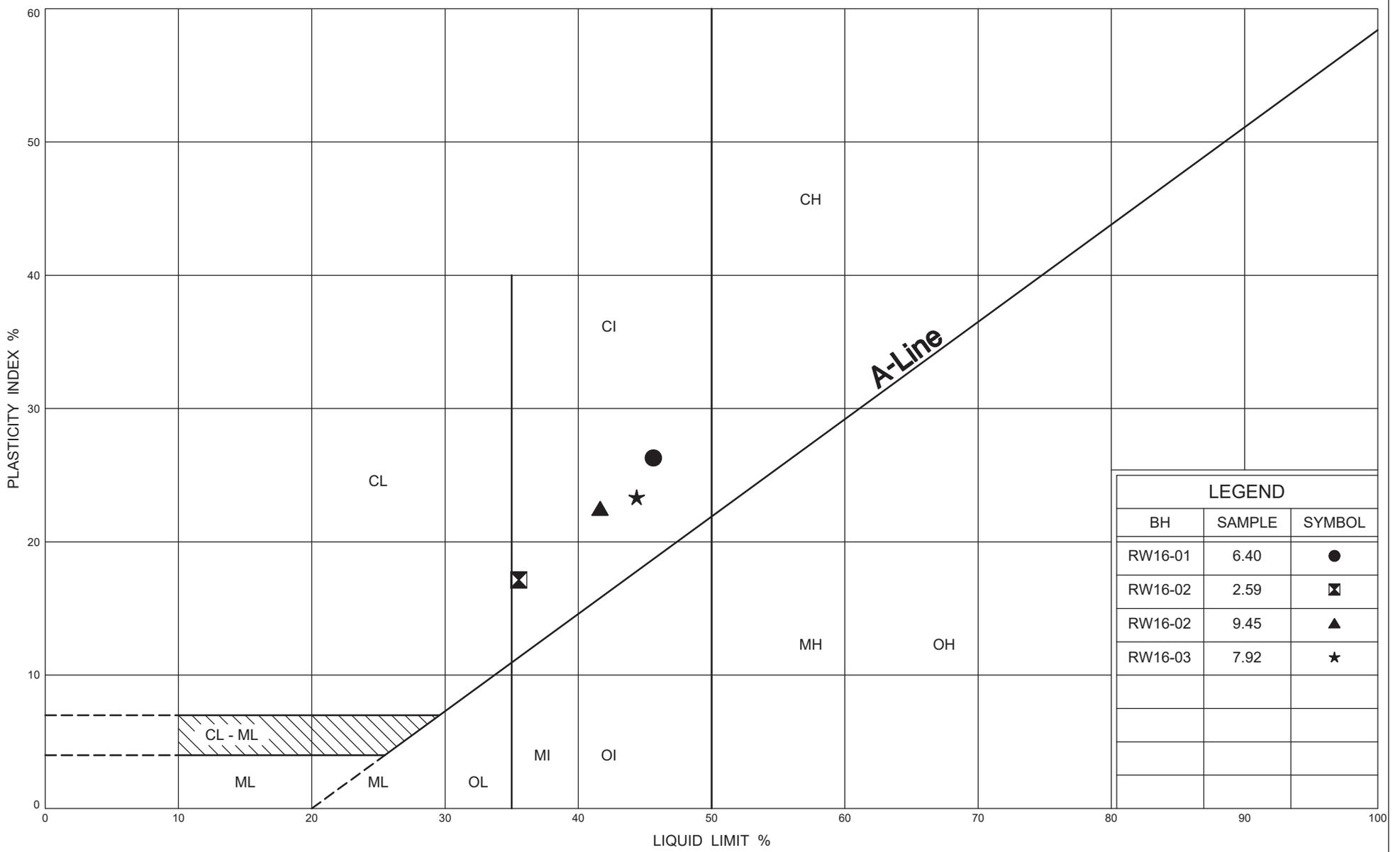


GRAIN SIZE DISTRIBUTION
Silty SAND to Sandy SILT

FIG No E3

W P 408-88-00

Retaining Wall 16



LEGEND		
BH	SAMPLE	SYMBOL
RW16-01	6.40	●
RW16-02	2.59	⊠
RW16-02	9.45	▲
RW16-03	7.92	★

ONTARIO MOT PLASTICITY CHART MTO-11375.GPJ ONTARIO MOT.GDT 12/10/19



PLASTICITY CHART

Silty CLAY

FIG No E4
 W P 408-88-00
 Retaining Wall 16



Appendix F

Record of Borehole Sheets, Laboratory Test Results, Borehole Locations and Soil Strata Drawing

**Retaining Wall 24
(RW24-01 to RW24-03)**

RECORD OF BOREHOLE No RW24-01 2 OF 2 METRIC

GWP# 408-88-00 LOCATION Retaining Wall 24, MTM NAD 83 Zone 10: N 4 814 847.4 E 226 015.2 ORIGINATED BY BL
 DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY BH
 DATUM Geodetic DATE 2019.09.06 - 2019.09.06 LATITUDE 43.469400 LONGITUDE -80.473725 CHECKED BY NB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE							
304.9	Continued From Previous Page Silty CLAY , trace sand Very Stiff to Hard Grey Moist		10	SS	19		307								
							306								
12.8	END OF BOREHOLE AT 12.8m. BOREHOLE OPEN TO 9.4m AND WATER LEVEL AT 10.1m UPON COMPLETION. BOREHOLE BACKFILLED WITH HOLEPLUG AND CUTTINGS, THEN ASPHALT TO SURFACE.		11	SS	30		305								

ONTMT4S2_MTO-11375.GPJ_2017TEMPLATE(MTO).GDT_12/10/19

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

RECORD OF BOREHOLE No RW24-02 2 OF 2 METRIC

GWP# 408-88-00 LOCATION Retaining Wall 24, MTM NAD 83 Zone 10: N 4 814 806.8 E 226 031.5 ORIGINATED BY BL
 DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY BH
 DATUM Geodetic DATE 2019.09.06 - 2019.09.06 LATITUDE 43.469038 LONGITUDE -80.473502 CHECKED BY NB

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							
Continued From Previous Page							20	40	60	80	100				
307.9	Silty CLAY , trace sand Very Stiff to Hard Grey Moist		10	SS	19										
10.2															
305.3			11	SS	32									0 1 43 56	
12.8	END OF BOREHOLE AT 12.8m. BOREHOLE OPEN TO 7.0m AND WATER LEVEL AT 10.1m UPON COMPLETION. BOREHOLE BACKFILLED WITH HOLEPLUG AND CUTTINGS, THEN ASPHALT TO SURFACE.														

ONT/MT452_MTO-11375.GPJ_2017TEMPLATE(MTO).GDT_12/10/19

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

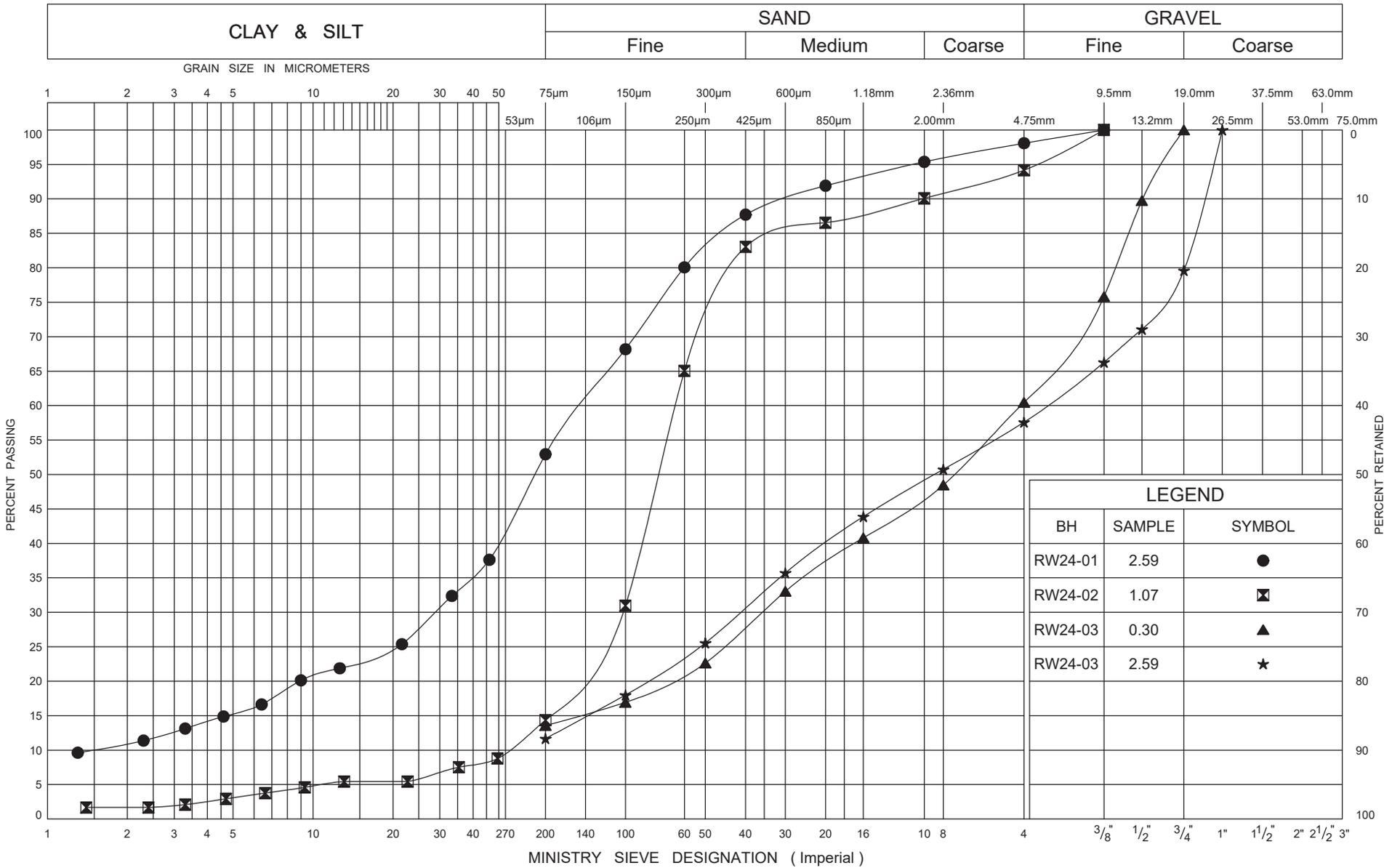
RECORD OF BOREHOLE No RW24-03 2 OF 2 METRIC

GWP# 408-88-00 LOCATION Retaining Wall 24, MTM NAD 83 Zone 10: N 4 814 766.3 E 226 047.4 ORIGINATED BY BL
 DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY BH
 DATUM Geodetic DATE 2019.09.06 - 2019.09.06 LATITUDE 43.468679 LONGITUDE -80.473272 CHECKED BY NB

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									
307.4	Continued From Previous Page		10	SS	38		308										
11.3	END OF BOREHOLE AT 11.3m. BOREHOLE OPEN TO 7.5m AND WATER LEVEL AT 10.2m UPON COMPLETION. BOREHOLE BACKFILLED WITH HOLEPLUG AND CUTTINGS, THEN ASPHALT TO SURFACE.																

ONTMT4S2_MTO-11375.GPJ_2017TEMPLATE(MTO).GDT_12/10/19

+³, ×³: Numbers refer to Sensitivity $\frac{20}{15 \pm 5}{10}$ (%) STRAIN AT FAILURE



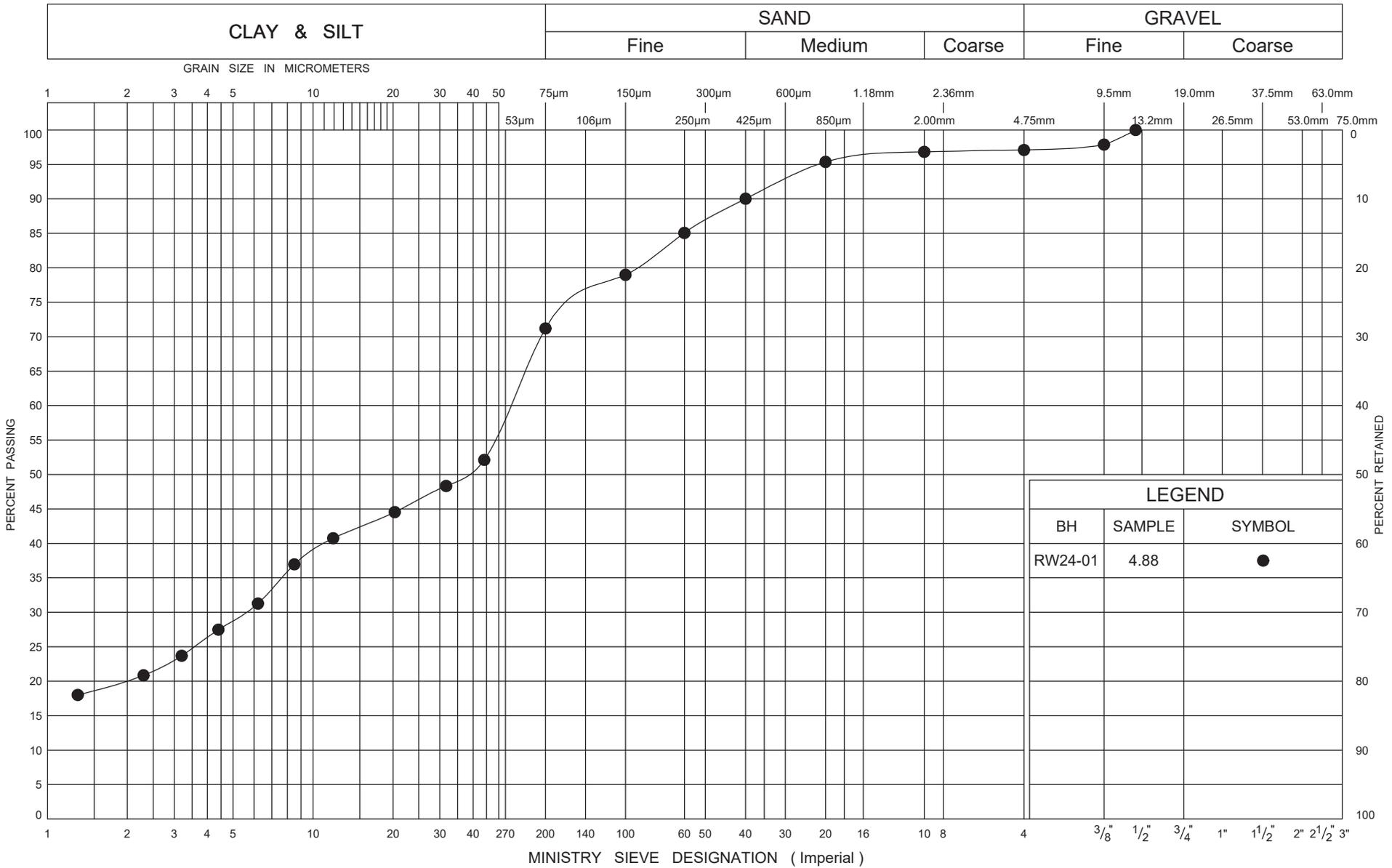
ONTARIO MOT GRAIN SIZE 2 MTO-11375.GPJ ONTARIO MOT.GDT 12/10/19



GRAIN SIZE DISTRIBUTION

Granular FILL

FIG No F1
 W P 408-88-00
 Retaining Wall 24



ONTARIO MOT GRAIN SIZE 2 MTO-11375.GPJ ONTARIO MOT.GDT 12/10/19



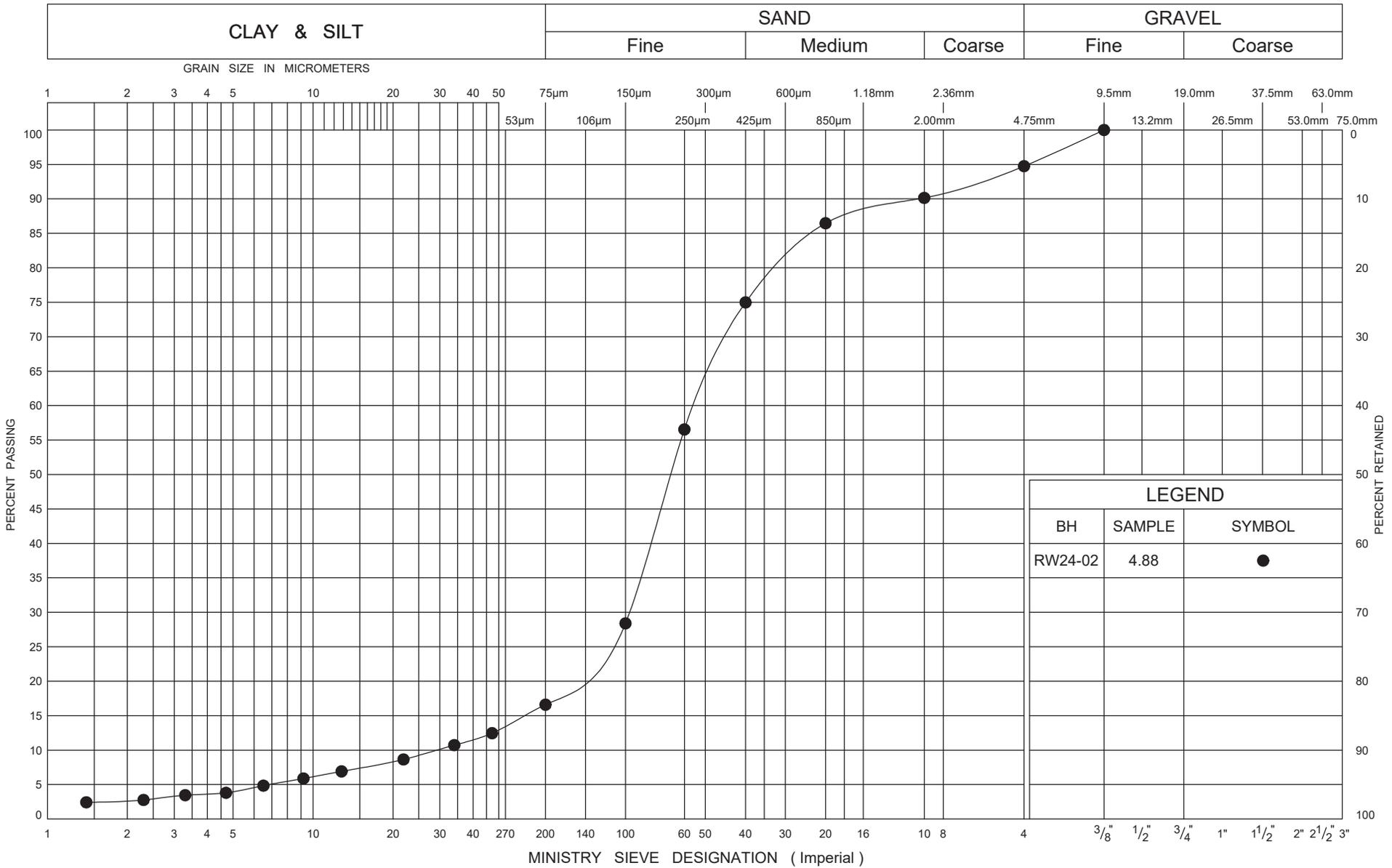
GRAIN SIZE DISTRIBUTION

Cohesive FILL

FIG No F2

W P 408-88-00

Retaining Wall 24



ONTARIO MOT GRAIN SIZE 2 MTO-11375.GPJ ONTARIO MOT.GDT 12/10/19

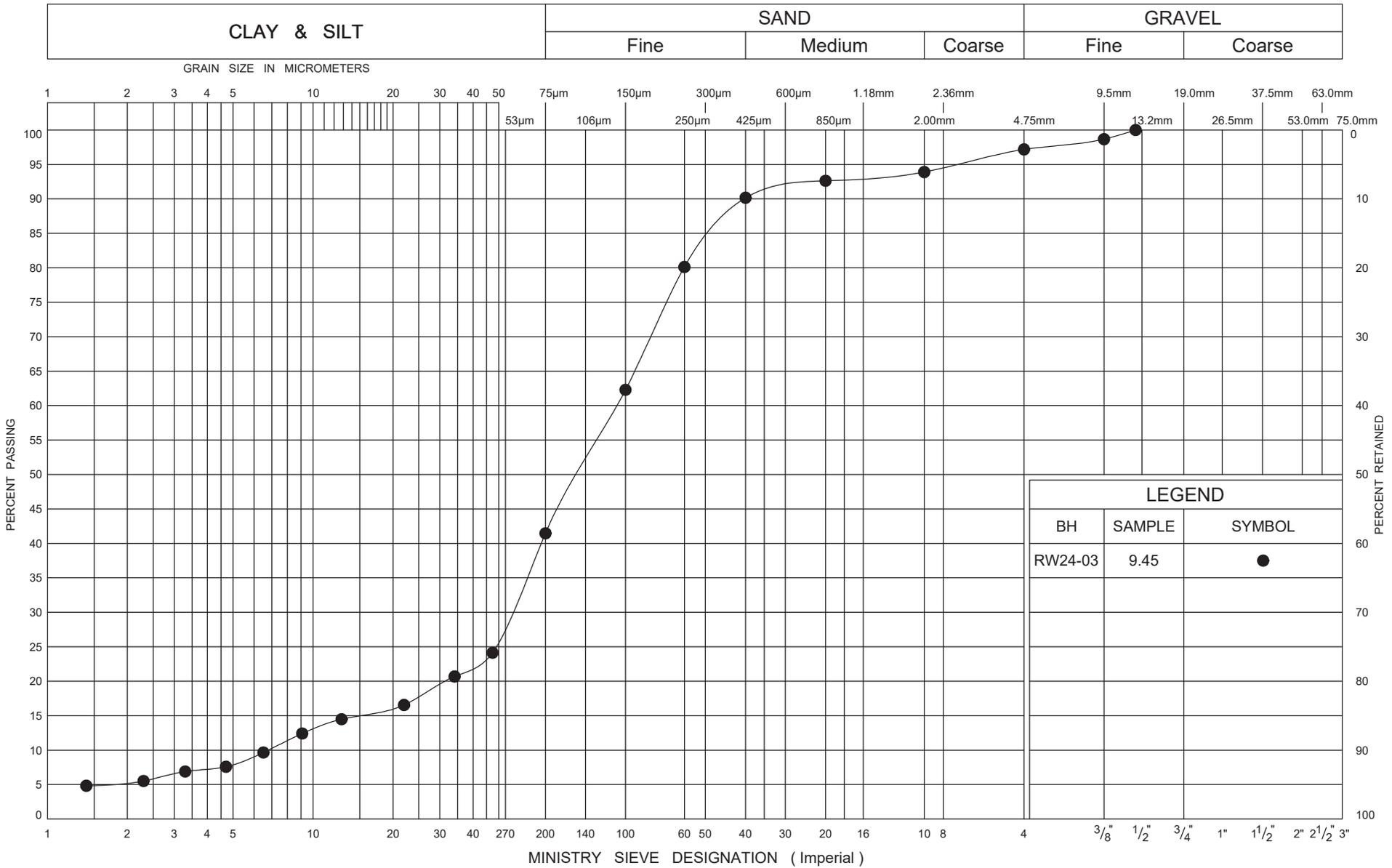


GRAIN SIZE DISTRIBUTION SAND

FIG No F3

W P 408-88-00

Retaining Wall 24



ONTARIO MOT GRAIN SIZE 2 MTO-11375.GPJ ONTARIO MOT.GDT 12/10/19

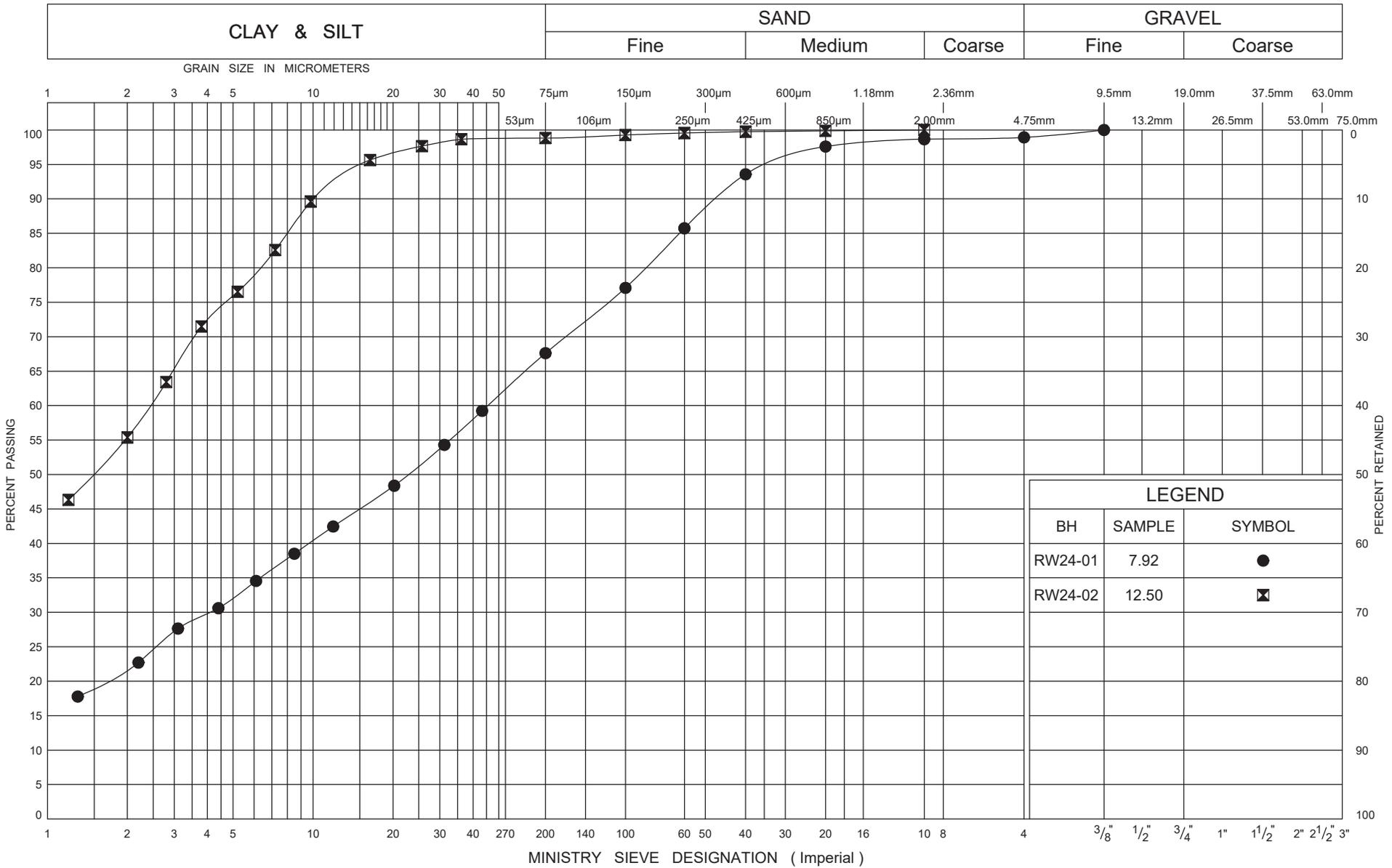


GRAIN SIZE DISTRIBUTION SAND and SILT

FIG No F4

W P 408-88-00

Retaining Wall 24



LEGEND		
BH	SAMPLE	SYMBOL
RW24-01	7.92	●
RW24-02	12.50	⊠

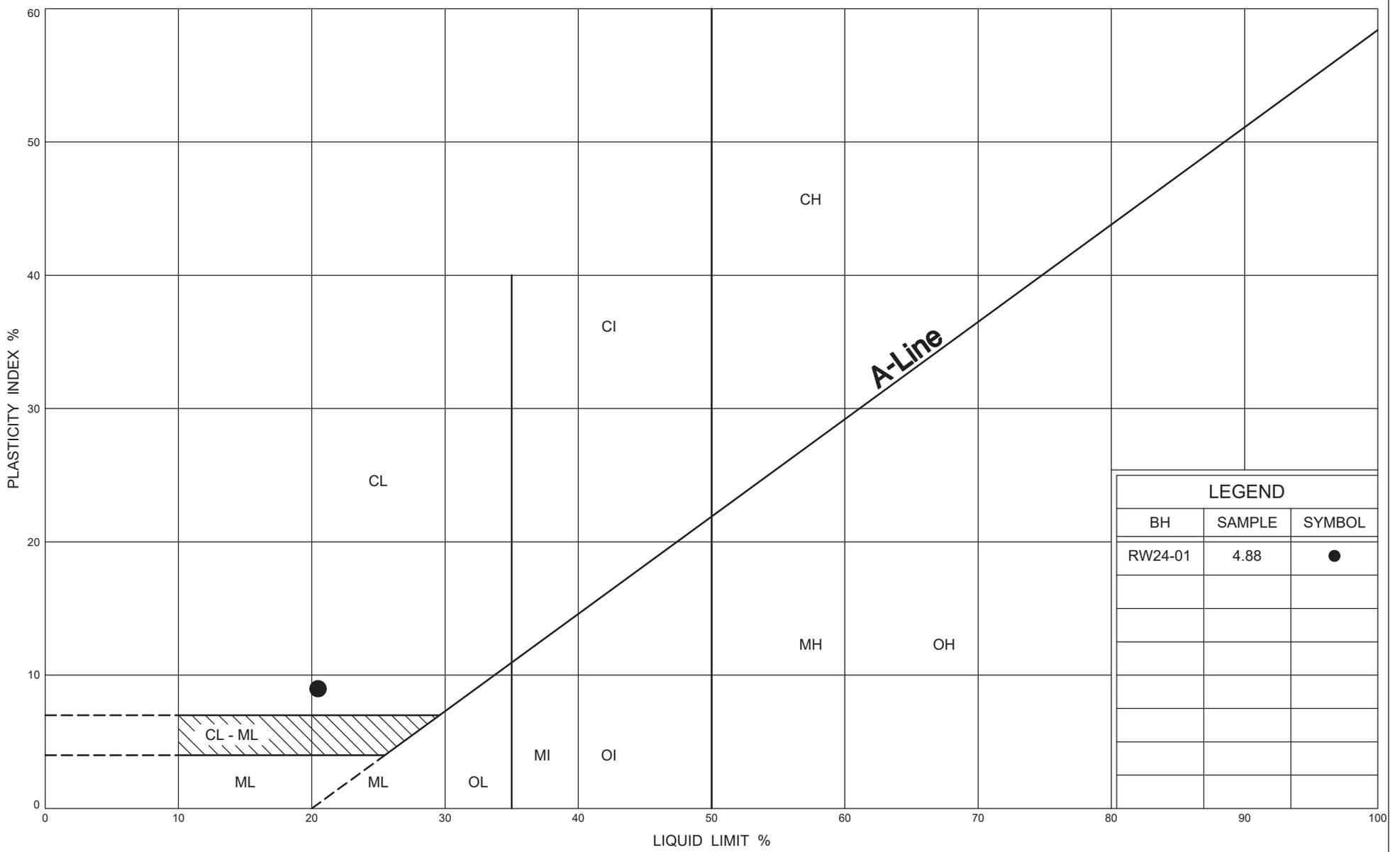
ONTARIO MOT GRAIN SIZE 2 MTO-11375.GPJ ONTARIO MOT.GDT 12/10/19



GRAIN SIZE DISTRIBUTION

Silty CLAY

FIG No F5
 W P 408-88-00
 Retaining Wall 24



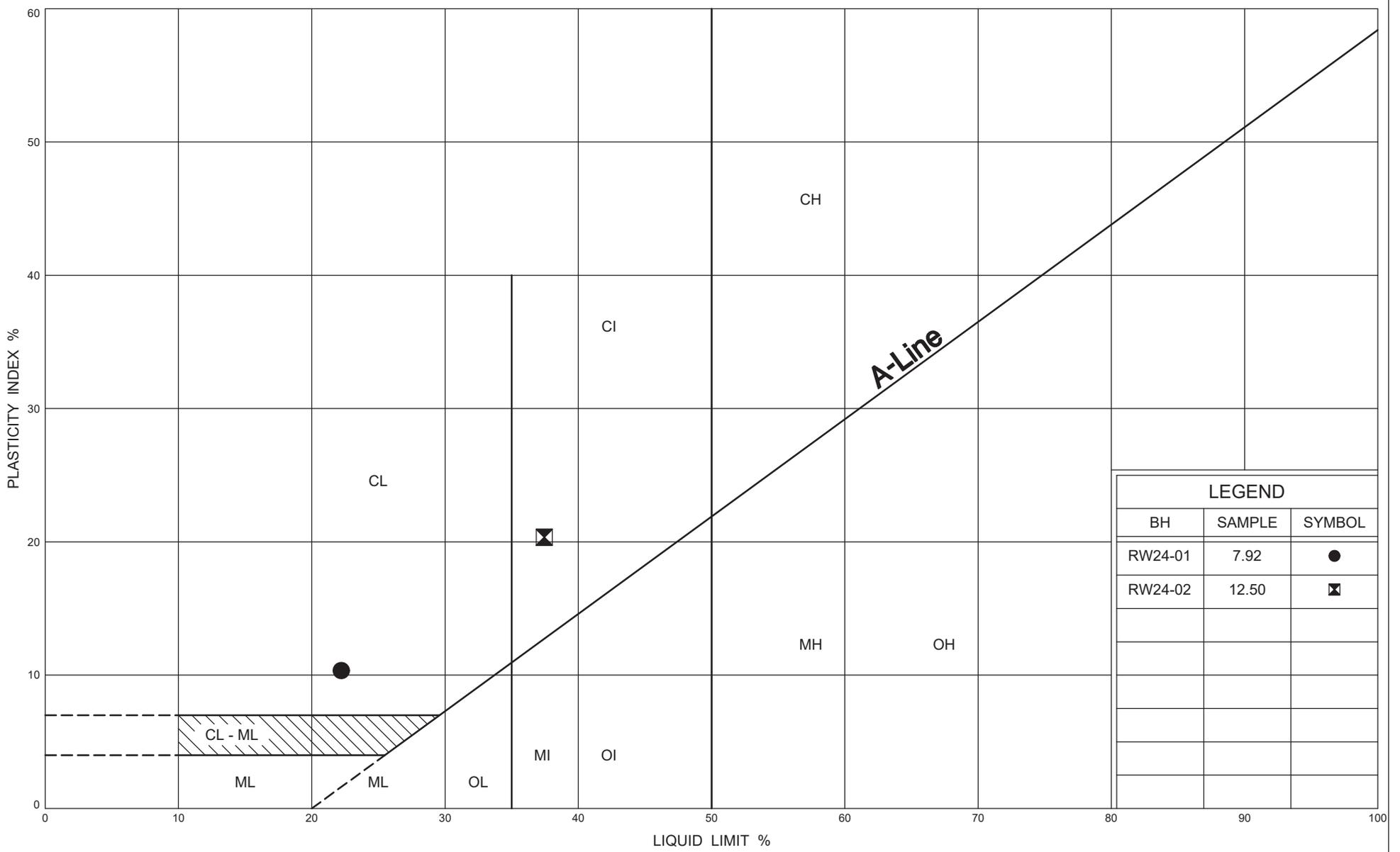
LEGEND		
BH	SAMPLE	SYMBOL
RW24-01	4.88	●

ONTARIO MOT PLASTICITY CHART MTO-11375.GPJ ONTARIO MOT.GDT 12/10/19



PLASTICITY CHART
Cohesive FILL

FIG No F6
W P 408-88-00
Retaining Wall 24



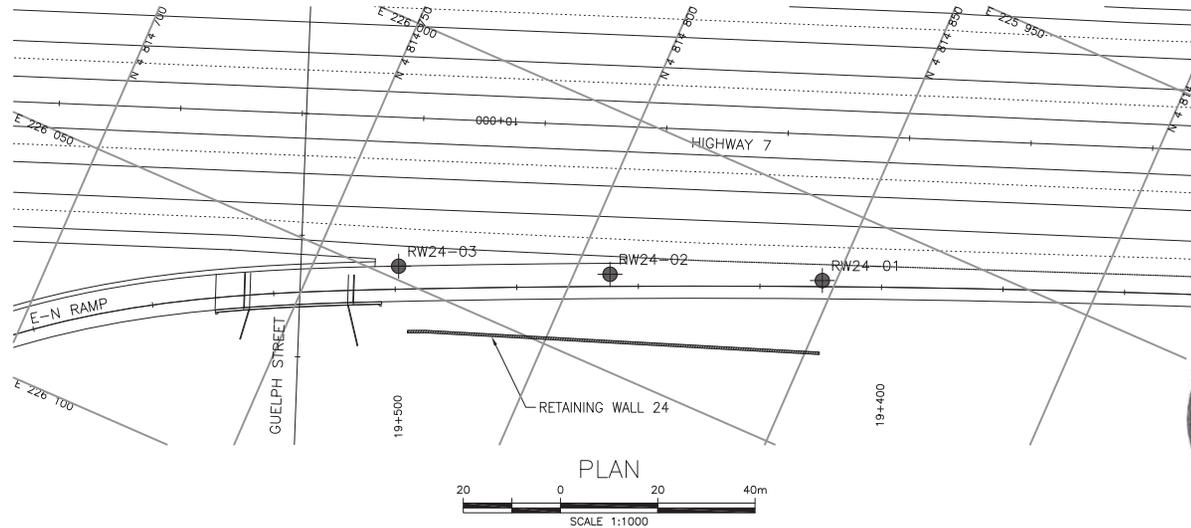
LEGEND		
BH	SAMPLE	SYMBOL
RW24-01	7.92	●
RW24-02	12.50	⊠

ONTARIO MOT PLASTICITY CHART MTO-11375.GPJ ONTARIO MOT.GDT 12/10/19



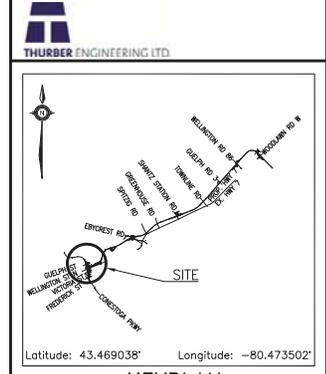
PLASTICITY CHART
Silty CLAY

FIG No F7
W P 408-88-00
Retaining Wall 24



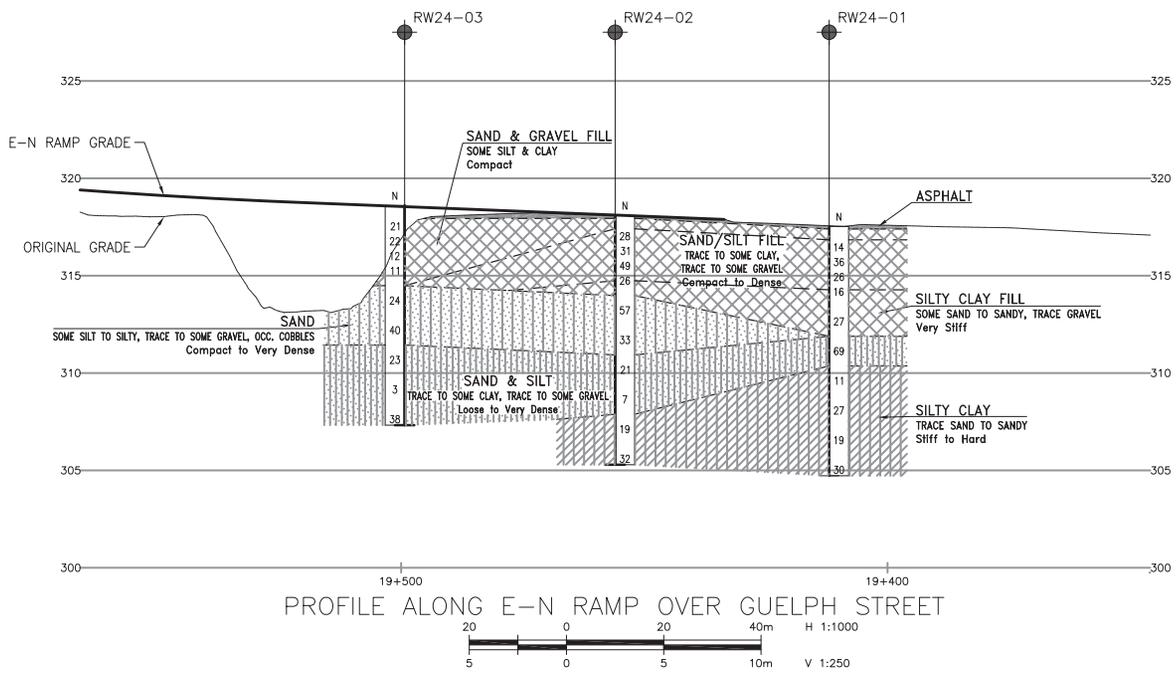
METRIC
DIMENSIONS ARE IN METRES
AND/OR MILLIMETRES
UNLESS OTHERWISE SHOWN

CONT No GWP No 408-88-00	
HIGHWAY 7 E-N RAMP OVER GUELPH ST. RETAINING WALL 24 BOREHOLE LOCATIONS AND SOIL STRATA	



LICENSED PROFESSIONAL ENGINEER
P. K. CHATTERJI
05/06/2020
PROVINCE OF ONTARIO

LICENSED PROFESSIONAL ENGINEER
J. P. K. LEE
100086735
05/06/2020
PROVINCE OF ONTARIO



KEYPLAN

LEGEND

	Borehole (Current Investigation)
	Borehole (by Others)
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 (ROD)
A/R	Auger Refusal

NO	ELEVATION	NORTHING	EASTING
RW24-01	317.7	4 814 847.4	226 015.2
RW24-02	318.1	4 814 808.6	226 031.5
RW24-03	318.6	4 814 766.3	226 047.4

NOTES-

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

GEOCRIS No. 40P9-58

REVISIONS	DATE	BY	DESCRIPTION

DESIGN	NB	CHK	PKC	CODE	LOAD	DATE	MAY 2020
DRAWN	MFA	CHK	NB	SITE	STRUCT	DWG	1



Appendix G

Record of Borehole Sheets, Laboratory Test Results, Borehole Locations and Soil Strata Drawing

**Retaining Wall 28
(RW28-01 to RW28-03)**

RECORD OF BOREHOLE No RW28-01 1 OF 2 METRIC

GWP# 408-88-00 LOCATION Retaining Wall 28, MTM NAD 83 Zone 10: N 4 813 453.3 E 226 205.0 ORIGINATED BY BL
 DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2019.08.11 - 2019.08.11 LATITUDE 43.456836 LONGITUDE -80.471249 CHECKED BY NB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV. DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa							
							20	40	60	80	100	20	40	60	GR SA SI CL
325.3	GROUND SURFACE														
0.0	ASPHALT: (125mm)														
0.1	SAND and GRAVEL Brown Dry (FILL) SAND, trace to some silt, trace clay Compact Brown Dry to Moist Loose Wet		1	GS											
324.6			2	SS	22										
0.7			3	SS	21										
			4	SS	22										
			5	SS	7										0 92 7 1
321.1	Silty CLAY to Clayey SILT, some sand to sandy, trace gravel Hard Grey Moist		6	SS	47										
4.2			7	SS	61										
			8	SS	65										
317.4	SAND and SILT, trace clay Very Dense Grey Moist		9	SS	65										0 37 59 4
7.8															
315.5	END OF BOREHOLE AT 9.8m.														
9.8															

ONT\MT452_MTO-11375.GPJ_2017TEMPLATE(MTO).GDT_12/10/19

Continued Next Page

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

RECORD OF BOREHOLE No RW28-01 2 OF 2 METRIC

GWP# 408-88-00 LOCATION Retaining Wall 28, MTM NAD 83 Zone 10: N 4 813 453.3 E 226 205.0 ORIGINATED BY BL
 DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2019.08.11 - 2019.08.11 LATITUDE 43.456836 LONGITUDE -80.471249 CHECKED BY NB

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa								
	Continued From Previous Page															
	BOREHOLE OPEN TO 4.9m. WATER LEVEL AT 2.7M UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND ASPHALT PATCH TO SURFACE.															

ONTMT4S2_MTO-11375.GPJ_2017TEMPLATE(MTO).GDT_12/10/19

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

RECORD OF BOREHOLE No RW28-02 1 OF 2 METRIC

GWP# 408-88-00 LOCATION Retaining Wall 28, MTM NAD 83 Zone 10: N 4 813 494.5 E 226 191.0 ORIGINATED BY BL
 DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2019.08.11 - 2019.08.11 LATITUDE 43.457223 LONGITUDE -80.471445 CHECKED BY NB

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV. DEPTH	DESCRIPTION	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa							
					○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE							GR SA SI CL		
324.4	GROUND SURFACE													
0.0	ASPHALT: (100mm)													
0.1	SAND and GRAVEL Brown Dry (FILL)	1	GS											
323.7														
0.7	SAND, trace to some silt, trace gravel, trace clay Compact Brown Dry to Wet	2	SS	23									2	87 9 2
		3	SS	17										
		4	SS	10										
	Occasional cobbles													
321.1														
3.3	Silty CLAY to Clayey SILT, with sand, trace gravel Very Stiff to Hard Brown/Grey Moist	5	SS	18										
		6	SS	47									5	46 32 17
	Grey													
		7	SS	46										
	Some sand													
		8	SS	100/ 0.275									0	18 60 22
315.8														
8.6	SAND and SILT, trace gravel Very Dense Brown Wet	9	SS	100/ 0.275										
314.6														
9.8														

ONTMT452_MTO-11375.GPJ 2017TEMPLATE(MTO).GDT 12/12/19

Continued Next Page

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

RECORD OF BOREHOLE No RW28-02 2 OF 2 METRIC

GWP# 408-88-00 LOCATION Retaining Wall 28, MTM NAD 83 Zone 10: N 4 813 494.5 E 226 191.0 ORIGINATED BY BL
 DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2019.08.11 - 2019.08.11 LATITUDE 43.457223 LONGITUDE -80.471445 CHECKED BY NB

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV. DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa								
	Continued From Previous Page															
	END OF BOREHOLE AT 9.8m. BOREHOLE CAVED TO 7.9m AND WATER LEVEL AT 2.4m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND ASPHALT PATCH TO SURFACE.															

ONTMT4S2_MTO-11375.GPJ_2017TEMPLATE(MTO).GDT_12/12/19

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

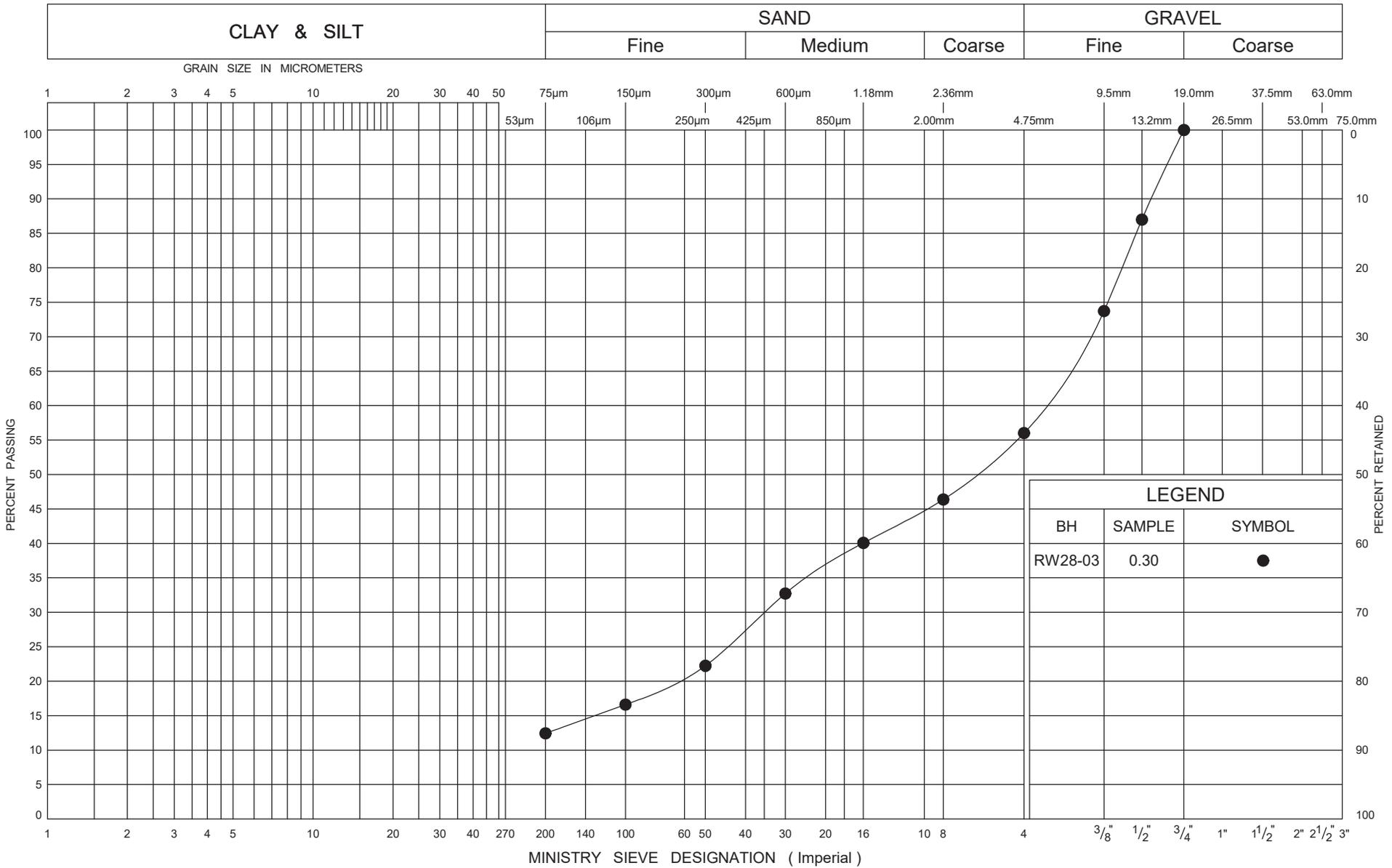
RECORD OF BOREHOLE No RW28-03 2 OF 2 METRIC

GWP# 408-88-00 LOCATION Retaining Wall 28, MTM NAD 83 Zone 10: N 4 813 538.7 E 226 177.8 ORIGINATED BY BL
 DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2019.08.11 - 2019.08.11 LATITUDE 43.457615 LONGITUDE -80.471620 CHECKED BY NB

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			20	40	60	80	100			PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W
312.4	Continued From Previous Page SAND and SILT , trace clay Dense Brown Moist		10	SS	31		313									0 62 37 1
11.3	END OF BOREHOLE AT 11.3m. BOREHOLE CAVED TO 2.4m AND WATER LEVEL AT 2.4m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND ASPHALT PATCH TO SURFACE.															

ONTMT4S2_MTO-11375.GPJ_2017TEMPLATE(MTO).GDT_12/10/19

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



ONTARIO MOT GRAIN SIZE 2 MTO-11375.GPJ ONTARIO MOT.GDT 11/28/19



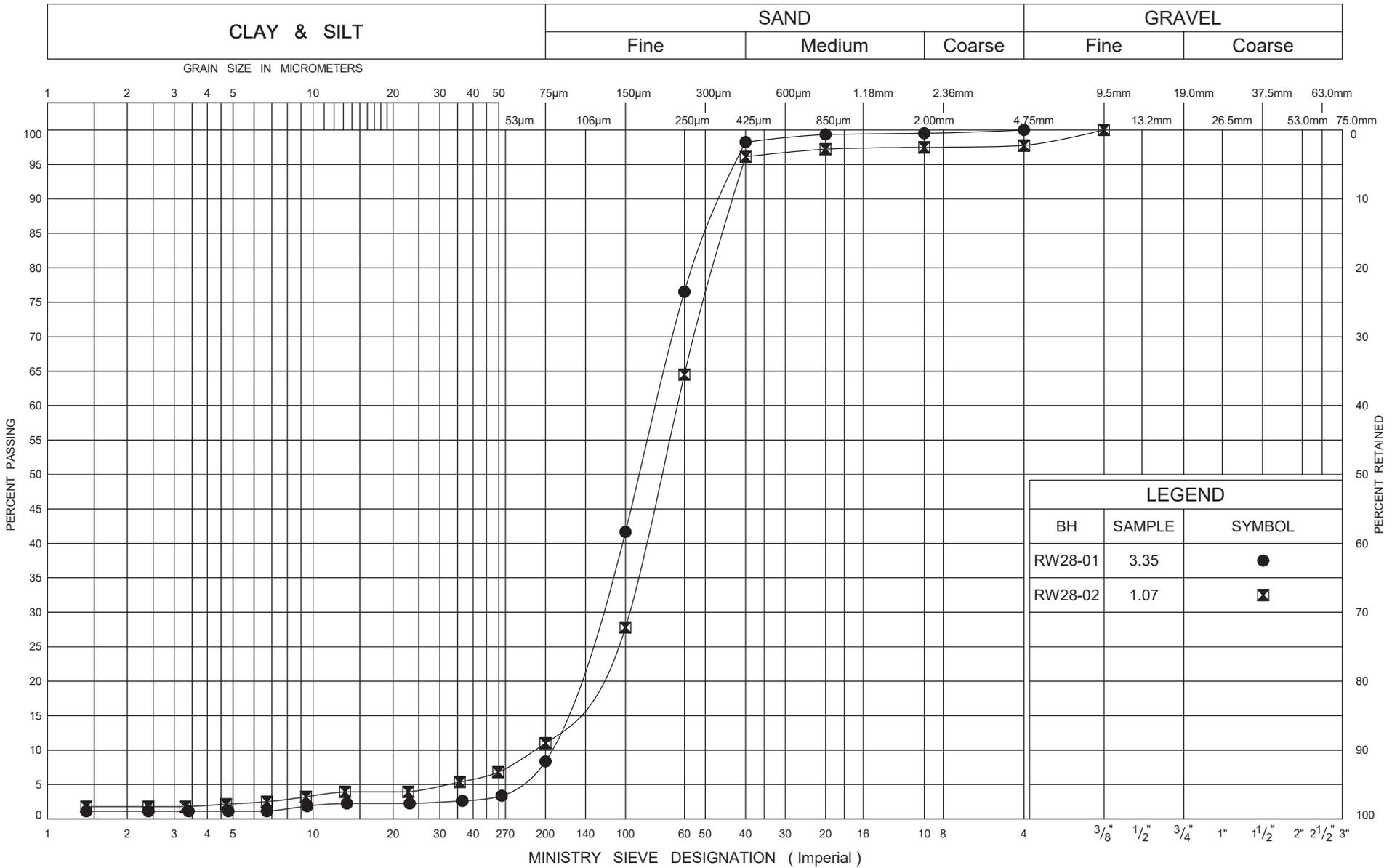
GRAIN SIZE DISTRIBUTION

Granular FILL

FIG No G1

W P 408-88-00

Retaining Wall 28



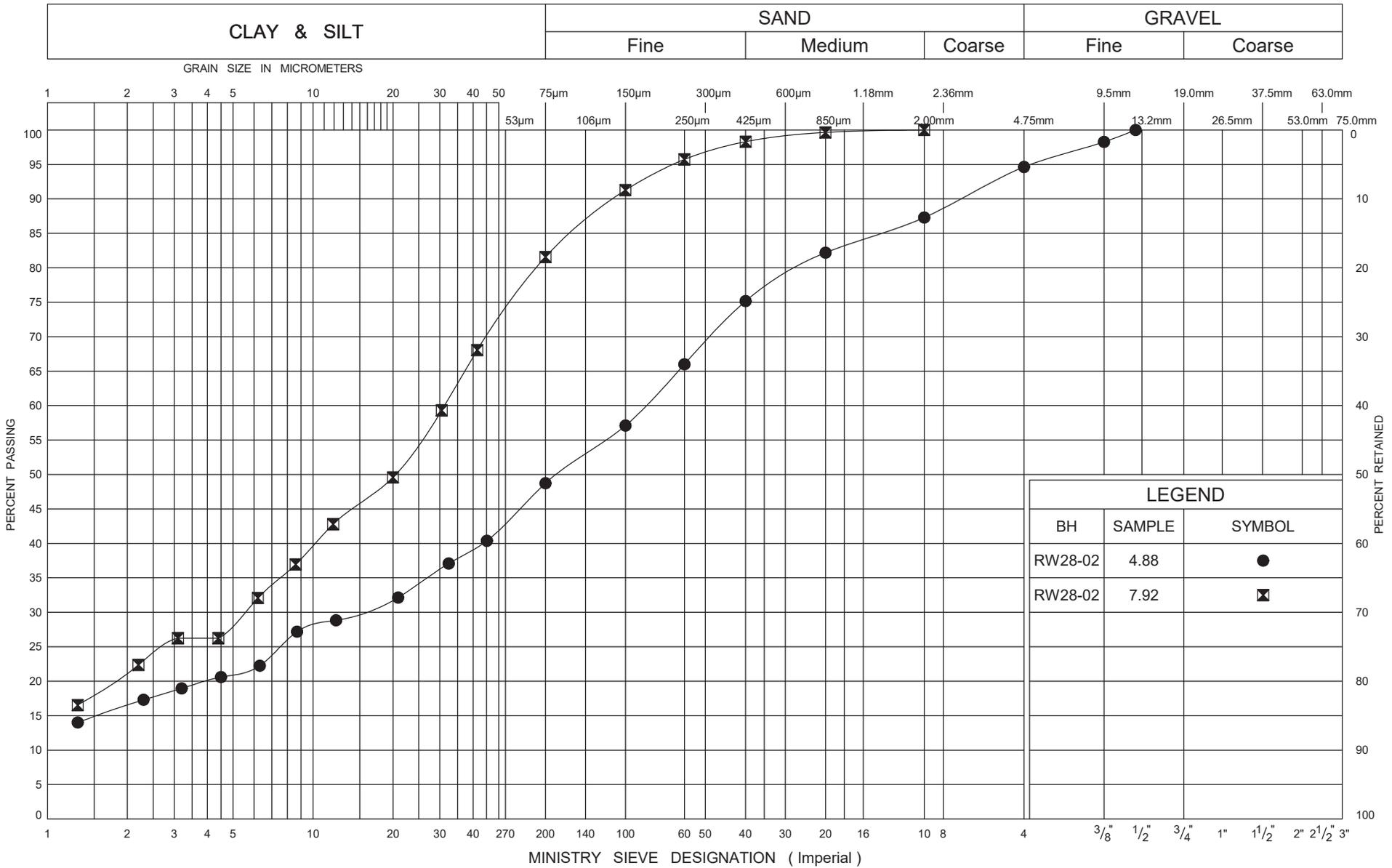
LEGEND		
BH	SAMPLE	SYMBOL
RW28-01	3.35	●
RW28-02	1.07	⊠

ONTARIO MOT GRAIN SIZE 2 MTO-11375.GPJ ONTARIO MOT.GDT 11/28/19



GRAIN SIZE DISTRIBUTION SAND

FIG No G2
W P 408-88-00
Retaining Wall 28



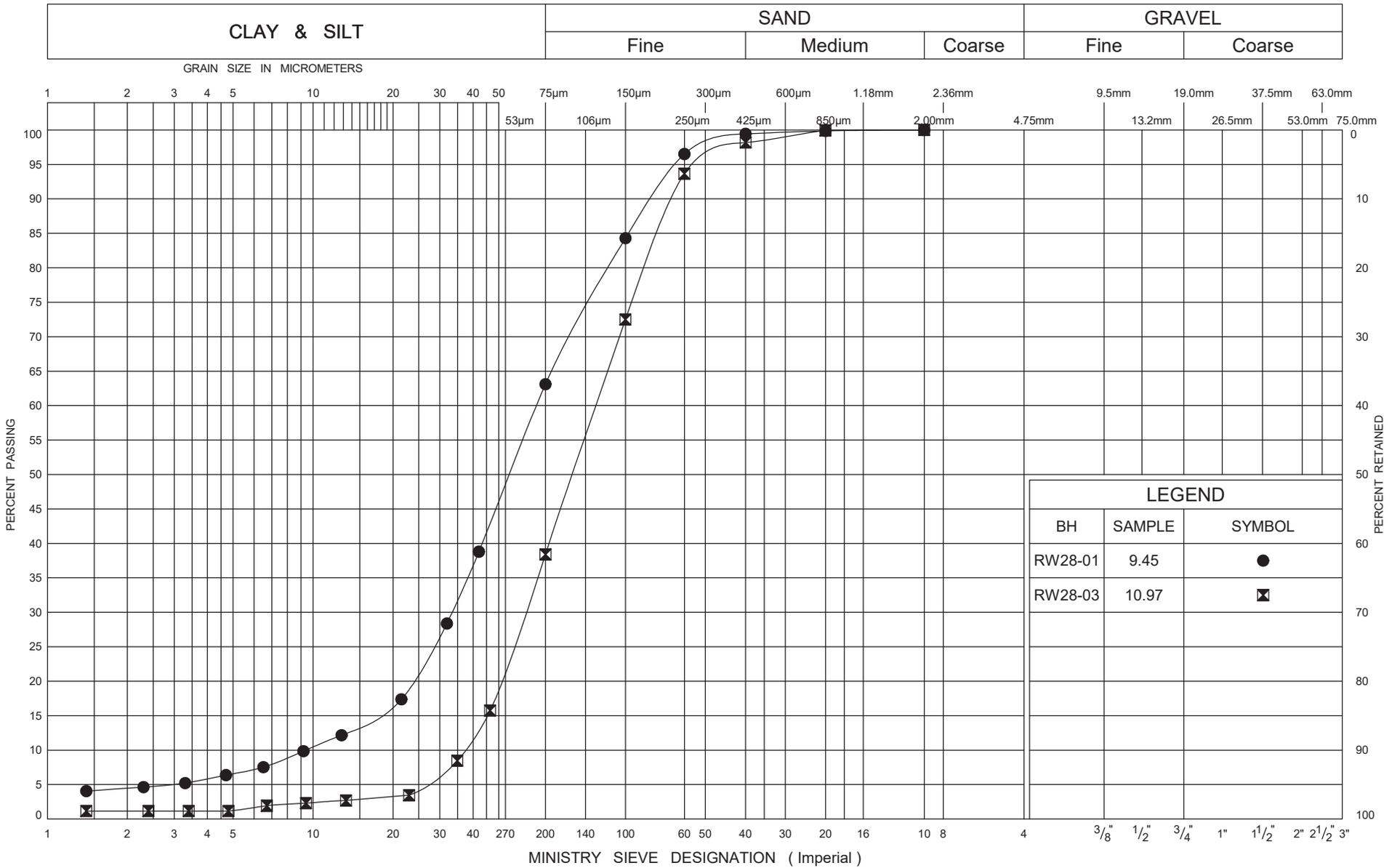
LEGEND		
BH	SAMPLE	SYMBOL
RW28-02	4.88	●
RW28-02	7.92	⊠

ONTARIO MOT GRAIN SIZE 2 MTO-11375.GPJ ONTARIO MOT.GDT 11/28/19



GRAIN SIZE DISTRIBUTION
Silty CLAY to Clayey SILT

FIG No G3
W P 408-88-00
Retaining Wall 28



ONTARIO MOT GRAIN SIZE 2 MTO-11375.GPJ ONTARIO MOT.GDT 11/28/19

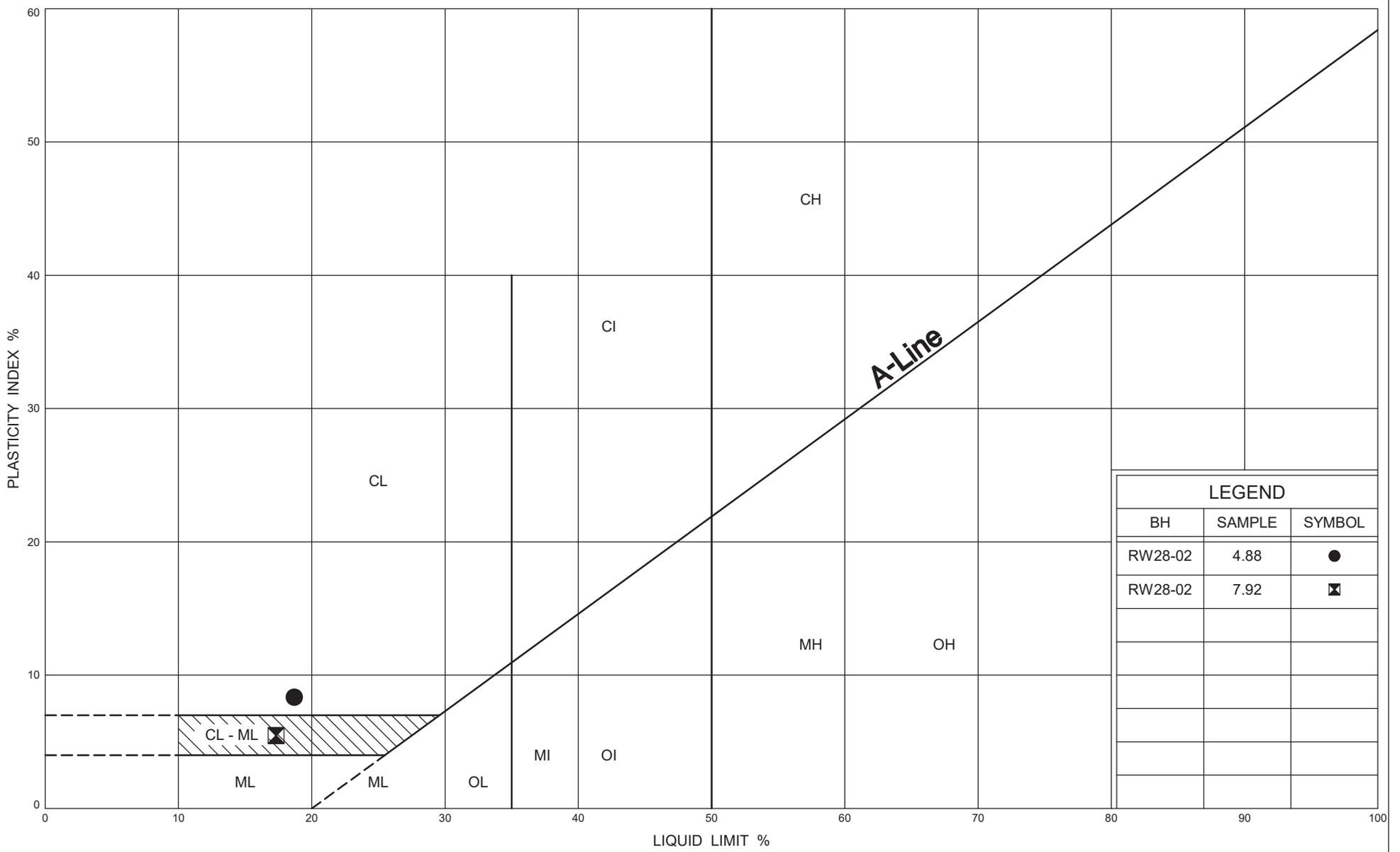


GRAIN SIZE DISTRIBUTION SAND and SILT

FIG No G4

W P 408-88-00

Retaining Wall 28



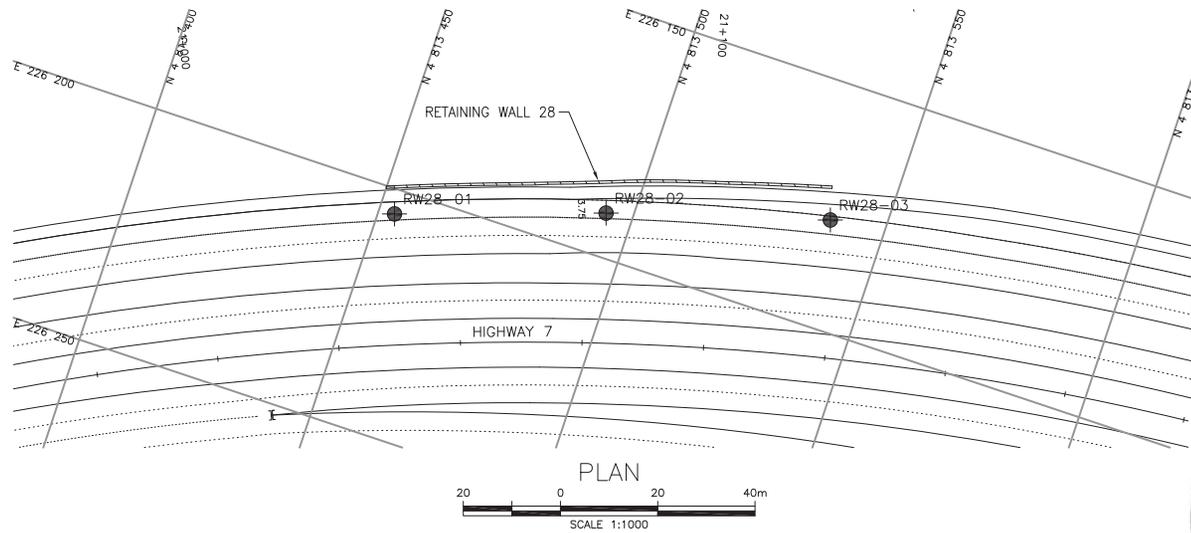
LEGEND		
BH	SAMPLE	SYMBOL
RW28-02	4.88	●
RW28-02	7.92	⊠

ONTARIO MOT PLASTICITY CHART MTO-11375.GPJ ONTARIO MOT.GDT 11/28/19



PLASTICITY CHART
Silty CLAY to Clayey SILT

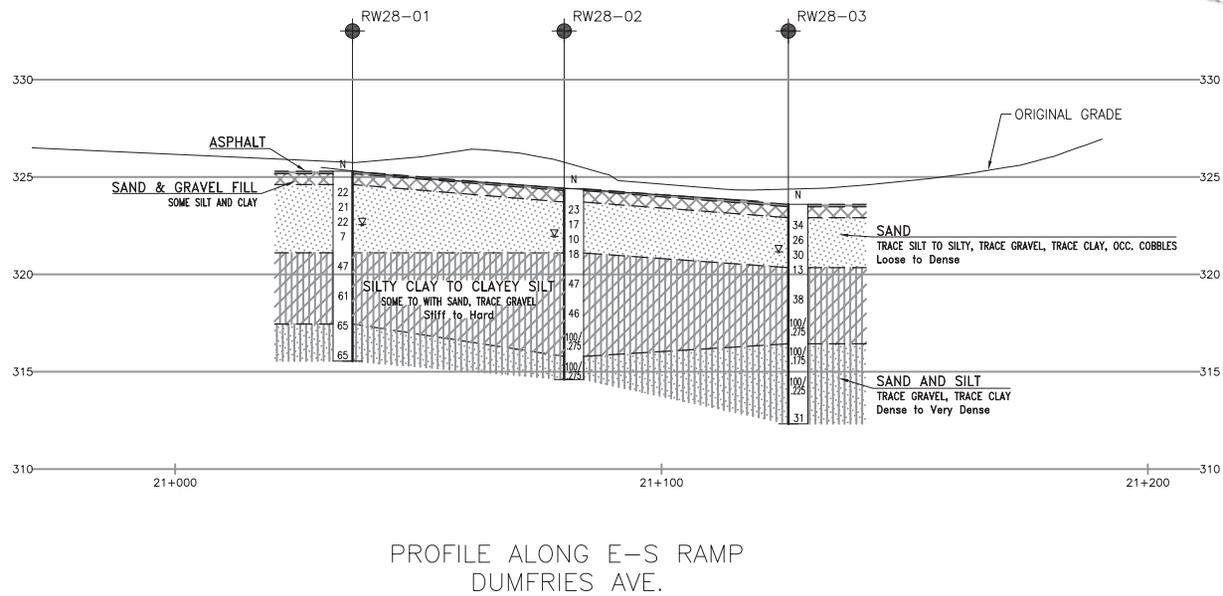
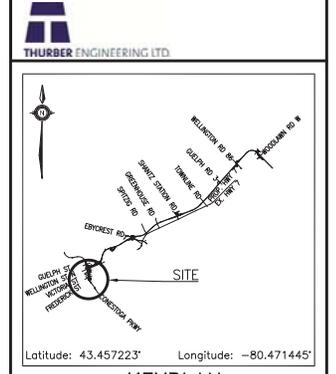
FIG No G5
W P 408-88-00
Retaining Wall 28



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



CONT No GWP No 408-88-00	
HIGHWAY 7 DUMFRIES AVENUE RETAINING WALL 28 BOREHOLE LOCATIONS AND SOIL STRATA	
	SHEET



PROFILE ALONG E-S RAMP
DUMFRIES AVE.

KEYPLAN

LEGEND

- ◆ Borehole (Current Investigation)
- ◇ Borehole (by Others)
- 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 (ROD)
- A/R Auger Refusal

NO	ELEVATION	NORTHING	EASTING
RW28-01	325.3	4 813 453.3	226 205.0
RW28-02	324.4	4 813 494.5	226 185.0
RW28-03	323.6	4 813 538.7	226 177.8

- 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.

GEOCRIS No. 40P9-58

REVISIONS	DATE	BY	DESCRIPTION

DESIGN NB	CHK PKC	CODE	LOAD	DATE	MAY 2020
DRAWN MFA	CHK NB	SITE	ISTRUCT	DWG 1	