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FOUNDATION INVESTIGATION AND DESIGN REPORT
FREDERICK STREET UNDERPASS

HIGHWAY 7 / 85, KITCHENER, ONTARIO
Assignment No. 3020-E-0016
G.W.P. 3025-20-00
GEOCRES NO. 40P08-300

Client Name: MTO
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FOUNDATION INVESTIGATION REPORT
FREDERICK STREET UNDERPASS
HIGHWAY 7-NEW, KITCHENER TO GUELPH
G.W.P. 3025-20-00
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PART A: FACTUAL INFORMATION

1. INTRODUCTION

Thurber Engineering (Thurber) has been retained by the Ministry of Transportation, Ontario (MTO) to provide foundation engineering services for the Frederick Street Underpass replacement over the Conestoga Parkway (Highway 7/85) in the Regional Municipality of Waterloo, Ontario. This report addresses the proposed replacement of the existing Frederick Street Underpass (MTO Structure Site No. 33X-0234/B0) and associated retaining walls at the location shown on the Key Plan in Drawing 1 to 3.

The purpose of the investigation was to explore the subsurface conditions at the site and, based on the data obtained, to provide a borehole location plan, records of boreholes, a stratigraphic profile, cross sections, laboratory test results and a written description of the subsurface conditions. A model of the subsurface conditions was developed from the data obtained in the course of the investigation.

The Terms of Reference (TOR) for the foundation engineering services are outlined in MTO's Request for Proposals (RFP) for Retainer Assignment No. 2 under Agreement No. 3020-E-0016, dated September 19, 2022.

It is a condition of this report that Thurber's performance of its professional services is subject to the attached Statement of Limitations and Conditions.

2. SITE DESCRIPTION

The site is located in the City of Kitchener, approximately 350 m south of the Highway 7/85 and Victoria Street interchange. At this location, an underpass structure carries Frederick Street over the northbound and southbound lanes (NBL and SBL) of Highway 7/85 and existing ramps (E-S and S-E). The existing Frederick Street Underpass at Highway 7/85 was constructed in 1968 and is a four-span structure supported on two abutments and three piers. The original 1959 GA

drawing for the structure indicates that the existing abutments and piers are supported on spread footings.

The existing grade on Frederick Street is at about Elev. 327.5 m and 325.0 m adjacent to the west and east abutments, respectively. Locally, Highway 7/85 has been constructed in a cut up to about 6.5 m deep and the existing highway grade ranges from about Elev. 321 m to 320 m, decreasing towards the east. The site is primarily surrounded by industrial and commercial lands and is relatively flat.

Photographs of the site are included in Appendix A.

3. INVESTIGATION PROCEDURES

3.1 Previous Investigations

Previous investigations have been conducted at the Frederick Street Underpass site, the titles of which are summarized below:

- Foundation Investigation Report for Frederick Street Underpass, Kitchener-Waterloo Expressway, District #4 (Hamilton), W.J. 66-F-53, W.P. 634-64, GEOCRES No. 40P8-48, prepared by DHO (Department of Highways Ontario), dated July 21, 1966.
- Foundation Investigation Report for Northeast Corner Retaining Wall – Frederick Street Underpass, Site No. 33-234, G.W.P. 3110-09-00, City of Kitchener, Ontario, GEOCRES No. 40P8-199, prepared by Peto MacCallum Ltd., dated May 31, 2012.
- Foundation Investigation and Design Report – Frederick Street Underpass, Highway 7 New – Kitchener to Guelph, GWP 408-88-00, GEOCRES No. 40P8-285, prepared by Thurber Engineering Ltd., dated February 9, 2023.

In August 2020, Thurber carried out a preliminary foundation investigation at the site, during which time two boreholes (designated as Boreholes 20-01 and 20-02) were advanced at the west abutment and east abutment of the existing underpass, respectively, as shown on Drawing 1. The results of the investigation are presented in Thurber's report titled *"Foundation Investigation Report, Frederick Street Underpass, Highway 7 – New, Kitchener to Guelph, G.W.P. 408-88-00*", dated February 9, 2021 (GEOCRES 40P8-285).

The borehole locations are provided on the borehole records in Appendix B and shown on Drawing 1. The locations are positioned relative to MTM NAD 83 (Zone 10) northing and easting coordinates and the ground surface elevations are referenced to Geodetic datum. The borehole locations, ground surface elevations, and borehole depths are summarized below.

Borehole	MTM NAD83 Northing (m)	MTM NAD83 Easting (m)	Ground Surface Elevation (m)	Borehole Depth (m)
20-01	4,813,653.3	226,144.0	327.5	38.3
20-02	4,813,695.8	226,245.9	325.0	38.4

Borehole records for BH 20-01 and 20-02 are included in Appendix B.

3.2 Current Investigation (2023)

The current investigation was completed in April and May 2023 and involved the completion of six boreholes designated as FS23-01 to FS23-06. These boreholes were advanced to depths ranging from 38.3 to 41.5 m. Two shallower boreholes designated as SS23-01 and SS23-02 were also advanced to depths of 8.2 m in the northwest quadrant of the site, along the area of the proposed northwest retaining wall and a sanitary sewer re-alignment. The approximate locations of the boreholes are shown on the attached Borehole Location and Soil Strata Drawings following the text of this report.

The Record of Borehole Sheets for the boreholes are included in Appendix C.

Utility clearances and Permits to Enter (PTE) were obtained prior to mobilization to the site. The ground surface elevations at the as-drilled borehole locations were obtained in the field by Thurber using a Trimble R10 survey unit. The coordinate system MTM NAD 83, Zone 10 was used for the boreholes.

During the current investigation, a truck-mounted CME 75 drill rig was used in conjunction with hollow-stem augers and tricone (mud rotary) to advance the boreholes. In the shallower boreholes, SS23-01 and SS23-02, only hollow stem augers were used. Borehole FS23-06 was hydroexcavated for the upper 6 m due to the presence of congested underground utilities at the location. In general, soil samples were obtained at selected intervals using a 50 mm diameter split spoon sampler in conjunction with Standard Penetration Testing (SPT).

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 current investigation are presented on the Record of Borehole sheets in Appendix C.

Groundwater conditions observed in open boreholes are not considered stabilized due to the introduction of water throughout the drilling operations. Groundwater level readings observed upon completion of drilling are shown on the Record of Borehole sheets. Piezometer installation details are provided on the borehole logs. Where piezometer was not installed in the FS-series boreholes, the borehole was grouted to 0.3 m below surface and then backfilled with sand and cold patch asphalt to surface (if advanced through pavement). Where a piezometer was not installed in SS23-02, the borehole was backfilled with holeplug.

A summary of the borehole elevations, termination depths and elevations, and piezometer tip details are in the table below.

Foundation Unit	Borehole	Ground Surface Elevation (m)	Borehole Depth (m) / Borehole Termination Elevation (m)	Piezometer Tip Depth (m) / Elevation (m)
West Abutment	FS23-01	327.7	41.2 / 286.5	7.6 / 320.1
	FS23-02	327.3	40.4 / 286.9	-
Centre Pier	FS23-03	320.5	41.4 / 279.1	7.6 / 312.9
	FS23-04	320.8	38.3 / 282.5	-
East Abutment	FS23-05	325.3	41.5 / 283.8	-
	FS23-06	325.4	41.5 / 283.9	-
Northwest Retaining Wall/Sewer Realignment	SS23-01	324.7	8.2 / 316.5	7.6 / 317.1
	SS23-02	327.4	8.2 / 319.2	-

3.3 Laboratory Testing

The recovered soil samples were subjected to Visual Identification (VI) and to natural moisture content determination. Selected samples were also subjected to grain size analysis and Atterberg Limits testing. The results of the laboratory testing are summarized on the Record of Borehole sheets in Appendix C and are shown on figures in Appendix D.

Testing was carried out on samples of the native soils to assess the potential for sulphate attack on buried concrete structures, as well as the potential for corrosion associated with buried steel

elements of the structures. The results of the analytical testing are summarized in this report and presented in Appendix D.

4. SITE GEOLOGY AND SUBSURFACE CONDITIONS

4.1 Regional Geology

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 and kames or kame moraines, with outwash sands occupying the intervening hollows.

4.2 Subsurface Conditions

Details of the encountered soil stratigraphy are presented on the Record of Borehole sheets included in Appendix C and interpreted stratigraphic profile and section are presented on the Borehole Locations and Soil Strata Drawings. A general description of the stratigraphy, based on the conditions encountered in the boreholes from the current investigation, is given in the following sections. However, the factual data presented on the Record of Borehole sheets takes precedence over this general description for interpretation of the site conditions. Classification and descriptions of coarse- and fine-grained soils are made in general accordance with ASTM D2487, and MTO's Soil Classification Manual (as amended), respectively.

The boundaries between soil deposits on the record of boreholes have been inferred from non-continuous sampling, observation of the progress of drilling, and the results of Standard Penetration Testing. Therefore, the boundaries represent the transitions between soil deposits rather than exact planes of geological change. Variation on the stratigraphic boundaries between and beyond boreholes will exist and is to be expected.

In general, the subsurface conditions at the site consist of a pavement structure and layers of a non-homogeneous fill overlying a silty clay to clay above a deposit of silty sand to silt. The sandy silt to silt is underlain by a lower silty clay to clay deposit, which is in turn underlain by a deposit of clayey sand to sandy silty clay till within the depths of borehole investigation.

4.3 Asphalt

Borehole FS23-01 was advanced through Frederick Street and the thickness of the asphalt was measured to be 50 mm thick. Boreholes FS23-03 and FS23-04 were advanced through Highway 7/85, near the median between the northbound and southbound express lanes of the

highway. The pavement thickness was measured to be 330 mm and 300 mm thick in Boreholes FS23-03 and FS23-04, respectively. Borehole SS23-02 was advanced through the parking lot at 460 Frederick Street and the asphalt was measured to be 50 mm thick.

4.4 Topsoil

A 100 mm to 150 mm thick layer of topsoil was encountered at ground surface at Boreholes FS23-02, FS23-05 and SS23-01. The topsoil thickness may vary in other areas of the site.

4.5 Fill

An approximately 1.1 m to 5.6 m thick layer of non-homogenous fill was encountered at the ground surface in Borehole FS23-06, underlying the asphalt (Frederick Street, Highway 7/85, and parking lot of 460 Frederick Street) in Boreholes FS23-01, FS23-03, FS23-04, and SS23-02, and below the topsoil in Borehole FS23-02. The top of the fill was encountered at ground surface to a depth of 0.3 m below ground surface (between Elevations 327.7 m and 320.1 m) and extends to depths ranging from 1.4 m to 5.6 m below ground surface (between Elevations 325.5 m and 318.6 m).

In general, SPT 'N' values recorded in the non-cohesive fill generally ranged from 10 blows to 41 blows per 0.3 m penetration, indicating a compact to dense condition. However, SPT 'N' values of 0 blows (i.e. weight of hammer) and 5 blows per 0.3 m of penetration were also recorded near the bottom of the fill layer in Borehole FS23-01, indicating the fill is very loose to loose in places. Where cohesive fill was encountered in Boreholes FS23-02 to FS23-04, and SS23-02, the SPT 'N'-values ranged from 6 to 30, suggesting a generally firm to very stiff consistency. The measured moisture contents generally ranged from 2 per cent to 19 per cent.

The results of grain size analyses carried out on the fill samples are shown on the Record of Borehole sheets in Appendix C and presented in Figure D1 of Appendix D. The results are summarized as follows:

Soil Particle	Non-cohesive Fill Percentage (%)	Cohesive Fill Percentage (%)
Gravel	5 to 38	0 to 27
Sand	49 to 79	10 to 47
Silt	11 to 24	29 to 55
Clay	2 to 7	10 to 35
Silt and Clay	12 to 16	-

The results of the Atterberg Limits tests carried out on samples of the cohesive fill are shown on the Record of Borehole logs in Appendix C and presented in Figure D2 of Appendix D. The results are summarized as follows:

Index Property	Percentage (%)
Liquid Limit	17 to 27
Plastic Limit	12 to 14
Plastic Index	5 to 14

The results of the Atterberg Limits testing indicate the material is clayey silt to silty clay of low plasticity (CL-ML to CL).

4.6 Upper Sand to Silty Sand to Silt

An approximately 3.2 m to 7.1 m thick deposit, varying in composition from sand, some gravel to silty sand to silt, some sand, trace gravel, was encountered underlying the topsoil in Borehole FS23-05 and SS23-01, and underlying the fill in Boreholes FS23-01, FS23-02, and SS23-02. The top of the sand to silt deposit was encountered at depths ranging from 0.1 m to 3.7 m below ground surface (between Elevations 325.5 m and 324.0 m) and it extends to depths ranging from 3.4 m to 7.2 m below ground surface (Elevations 321.8 m to 318.1 m).

The SPT “N”-values measured within the sand to silt deposit range generally from 3 to 28 blows per 0.3 m of penetration, indicating a loose to compact relative density. One SPT “N”-value in Borehole SS23-02 measured weight of hammer (WH) in this deposit. The measured moisture contents generally ranged from 4 per cent to 23 per cent.

The results of grain size analyses carried out on samples of the sand to silt are shown on the Record of Borehole sheets in Appendix C and presented in Figure D3 of Appendix D. The results are summarized as follows:

Soil Particle	Percentage (%)
Gravel	0 to 15
Sand	54 to 83
Silt	11 to 37
Clay	1 to 9

4.7 Upper Sandy Silty Clay to Clayey Silt Till

An approximately 1.1 m to 3.5 m thick deposit, varying in composition from Sandy Silty Clay to Sandy Clayey Silt to Clayey Silt, trace to some gravel, was encountered underlying the fill in Borehole FS23-03 and FS23-06, and underlying the sand in Borehole FS23-05, SS23-01 and SS23-02. Borehole SS23-02 was terminated within this layer. The top of the cohesive till deposit was encountered at depths ranging from 1.4 m to 7.2 m below ground surface (between Elevations 321.8 m and 318.1 m) and it extends to depths ranging from 4.5 m to 10.7 m below ground surface (Elevations 320.2 m to 314.6 m).

The SPT “N”-values measured within the upper cohesive till deposit range generally from 7 to 65 blows per 0.3 m of penetration, indicating a firm to hard consistency. The measured moisture contents generally ranged from 11 per cent to 25 per cent.

The results of grain size analyses carried out on samples of the upper cohesive till are shown on the Record of Borehole sheets in Appendix C and presented in Figures D4A and D4B of Appendix D. The results for the cohesive till are summarized as follows:

Soil Particle	Percentage (%)
Gravel	0 to 21
Sand	4 to 32
Silt	33 to 50
Clay	11 to 46

The results of the Atterberg Limits tests carried out on samples of the upper cohesive till are shown on the Record of Borehole logs in Appendix C and presented in Figure D5A and D5B of Appendix D. The results are summarized as follows:

Index Property	Percentage (%)
Liquid Limit	17 to 26
Plastic Limit	9 to 11
Plastic Index	7 to 15

The results of the Atterberg Limits testing indicate the material is clayey silt of low plasticity to silty clay of intermediate plasticity (CL-ML to CI), shown on Figure D6A and Figure D6B, respectively.

Glacial tills inherently contain cobbles and boulders.

4.8 Silty Sand

An approximately 1.2 m thick layer of silty sand was encountered underlying the upper cohesive till in Borehole FS23-06. The top of the silty sand layer was encountered at a depth of 9.0 m below ground surface (Elevation 316.4 m) and it extends to a depth of 10.2 m below ground surface (Elevation 315.2 m).

The SPT “N”-value measured within the silty sand layer was 78 blows per 0.3 m of penetration, indicating a very dense relative density. The measured moisture content was 19 per cent.

The results of grain size analyses carried out on a sample of the silty sand is shown on the Record of Borehole sheets in Appendix C and presented in Figure D6 of Appendix D. The results are summarized as follows:

Soil Particle	Percentage (%)
Gravel	0
Sand	78
Silt and Clay	22

4.9 Upper Silty Clay to Clay

An approximately 4.1 m to 8.0 m thick deposit, varying in composition from silty clay to clay, trace sand, trace gravel was encountered underlying the sand to silty sand in Boreholes FS23-01, FS23-02 and FS23-06, underlying the cohesive till in Boreholes SS23-01, FS23-03 and FS23-05, and underlying the fill in Borehole FS23-04. The top of the upper silty clay to clay deposit was encountered at depths ranging from 2.2 m to 10.7 m below ground surface (between Elevations 320.9 m and 314.6 m) and it extends to depths ranging from 8.2 m to 17.8 m below ground surface (Elevations 316.5 m to 307.6 m). Borehole SS23-01 was terminated in this deposit.

The SPT “N”-values measured within the upper plastic till deposit range generally from 13 to 84 blows per 0.3 m of penetration, indicating a stiff to hard consistency. The measured moisture contents generally ranged from 10 per cent to 38 per cent.

The results of grain size analyses carried out on samples of the upper silty clay to clay are shown on the Record of Borehole sheets in Appendix C and presented in Figure D7 of Appendix D. The results are summarized as follows:

Soil Particle	Percentage (%)
Gravel	0 to 1
Sand	0 to 10
Silt	29 to 56
Clay	38 to 71

The results of the Atterberg Limits tests carried out on samples of the upper silty clay to clay are shown on the Record of Borehole logs in Appendix C and presented in Figure D8 of Appendix D. The results are summarized as follows:

Index Property	Percentage (%)
Liquid Limit	33 to 57
Plastic Limit	13 to 22
Plastic Index	18 to 36

The results of the Atterberg Limits testing indicate the material is silty clay of low plasticity to a clay of high plasticity (CL to CH).

4.10 Silty Sand to Silt

An approximately 2.2 m to 5.9 m thick deposit, varying in composition from silty sand to sandy silt to silt, some sand was encountered underlying the upper silty clay to clay Boreholes FS23-01 to FS23-04 and FS23-06. The top of the silty sand to silt deposit was encountered at depths ranging from 10.2 m to 17.8 m below ground surface (between Elevations 314.0 m and 307.6 m) and it extends to depths ranging from 12.4 m to 21.6 m below ground surface (Elevations 309.5 m to 303.8 m).

The SPT “N”-values measured within the silty sand to silt deposit range generally from 40 to 134 blows per 0.3 m of penetration, indicating a dense to very dense relative density. Other SPT “N”-values measured in this deposit include 110 blows and 120 blows for 0.28 m of penetration. The measured moisture contents generally ranged from 12 per cent to 33 per cent.

The results of grain size analyses carried out on samples of the silty sand to silt are shown on the Record of Borehole sheets in Appendix C and presented in Figure D9 of Appendix D. The results are summarized as follows:

Soil Particle	Percentage (%)
Gravel	0 to 1
Sand	18 to 59
Silt	39 to 74
Clay	2 to 8

The results of the Atterberg Limits tests attempts carried out on samples of the silty sand to silt suggested the fines portion of the material is non-plastic.

4.11 Clayey Silt

An approximately 4.5 m thick deposit of clayey silt, some sand was encountered underlying the upper silty clay in Borehole FS23-05. The top of the silty clay deposit was encountered at a depth of 14.8 m below ground surface (Elevation 310.5 m) and it extends to a depth of 19.3 m below ground surface (Elevation 306.0 m).

The SPT “N”-values measured within the clayey silt deposit range generally from 67 to 113 blows per 0.3 m of penetration, indicating a hard consistency. The measured moisture contents generally ranged from 13 per cent to 20 per cent.

The results of grain size analyses carried out on samples of the silty clay are shown on the Record of Borehole sheets in Appendix C and presented in Figure D10 of Appendix D. The results are summarized as follows:

Soil Particle	Percentage (%)
Gravel	0
Sand	16

Silt	67
Clay	17

The results of the Atterberg Limits tests carried out on a sample of the silty clay are shown on the Record of Borehole logs in Appendix C and presented in Figure D11 of Appendix D. The results are summarized as follows:

Index Property	Percentage (%)
Liquid Limit	19
Plastic Limit	11
Plastic Index	8

The results of the Atterberg Limits testing indicate the material is silty clay of low plasticity (CL).

4.12 Lower Silty Clay to Clay

An approximately 9.2 m to 16.0 m thick deposit, varying in composition from silty clay to clay, trace sand was encountered underlying the silty sand to silt in Boreholes FS23-01 to FS23-04 and FS23-06, and underlying the clayey silt in Borehole FS23-05. The top of the lower silty clay to clay deposit was encountered at depths ranging from 12.4 m to 21.6 m below ground surface (between Elevations 309.5 m and 303.8 m) and it extends to depths ranging from 27.7 m to 35.4 m below ground surface (Elevations 294.6 m to 292.3 m).

The SPT “N”-values measured within the lower cohesive deposit range generally from 25 to 64 blows per 0.3 m of penetration, indicating a stiff to hard consistency. The measured moisture contents generally ranged from 17 per cent to 30 per cent.

The results of grain size analyses carried out on samples of the lower silty clay to clay are shown on the Record of Borehole sheets in Appendix C and presented in Figure D12 of Appendix D. The results are summarized as follows:

Soil Particle	Percentage (%)
Gravel	0
Sand	0 to 3
Silt	20 to 40
Clay	57 to 80

The results of the Atterberg Limits tests carried out on samples of the lower silty clay to clay are shown on the Record of Borehole logs in Appendix C and presented in Figure D13 of Appendix D. The results are summarized as follows:

Index Property	Percentage (%)
Liquid Limit	42 to 56
Plastic Limit	15 to 21
Plastic Index	25 to 35

The results of the Atterberg Limits testing indicate the material is silty clay of intermediate to high plasticity (CI to CH).

4.13 Lower Sand to Sandy Silt

An approximately 3.1 m thick deposit, varying in composition from sand, some silt to silty sand to sandy silt was encountered underlying the lower silty clay to clay in Boreholes FS23-03 to FS23-05. The top of the sand to sandy silt deposit was encountered at depths ranging from 27.7 m to 32.3 m below ground surface (between Elevations 293.1 m and 292.7 m) and it extends to depths ranging from 30.8 m to 35.4 m below ground surface (Elevations 290.1 m to 289.7 m).

The SPT “N”-values measured within the sand to sandy silt deposit range from 22 to 99 blows per 0.3 m of penetration, indicating a compact to very dense relative density. The measured moisture contents generally ranged from 12 per cent to 26 per cent.

The results of grain size analyses carried out on samples of the silty sand to silt are shown on the Record of Borehole sheets in Appendix C and presented in Figure D14 of Appendix D. The results are summarized as follows:

Soil Particle	Percentage (%)
Gravel	0
Sand	30 to 84
Silt	62
Clay	8
Silt and Clay	16 to 20

4.14 Gravel and Sand

An approximately 1.7 m thick layer of gravel and sand, trace fines was encountered underlying the lower silt till in Borehole FS23-06. The top of the gravel and sand layer was encountered at a depth of 33.8 m below ground surface (Elevation 291.6 m) and it extends to a depth of 35.5 m below ground surface (Elevation 289.9 m).

A SPT “N”-value measured within the gravel and sand deposit was 52 blows per 0.3 m of penetration, indicating a very dense relative density. The measured moisture was 10 per cent.

The results of grain size analyses carried out on a sample of the gravel and sand are shown on the Record of Borehole sheets in Appendix C and presented in Figure D15 of Appendix D. The results are summarized as follows:

Soil Particle	Percentage (%)
Gravel	52
Sand	41
Silt and Clay	7

4.15 Lower Silt to Clayey Silt Till

A deposit at least 5.0 m to 10.6 m thick, varying in composition from sandy silt to clayey sand to sandy clayey silt to sandy silty clay, trace gravel till was encountered underlying the lower silty clay to clay deposit in Boreholes FS23-01 and FS23-02, underlying the lower sand to sandy silt in Boreholes FS23-03 to FS23-05, and underlying the gravel and sand in Borehole FS23-06. An approximately 3.0 m thick layer of silt till, trace sand was encountered underlying the lower silty clay to clay Borehole FS23-06. The top of the lower cohesive till deposit was encountered at depths ranging from 30.8 m to 35.5 m below ground surface (between Elevations 293.5 m and 289.7 m). Boreholes FS23-01 to FS23-06 were terminated in this till deposit.

The SPT “N”-values measured within the lower cohesive till deposit range generally from 102 to greater than 100 blows per 0.3 m of penetration, indicating a hard consistency. SPT “N”-values that did not achieve full penetration ranged from 100 blows for 0.08 m of penetration to 109 blows for 0.28 m of penetration. A SPT “N”-value measured within the lower non-plastic till deposit was 102 blows per 0.3 m of penetration, indicating a very dense relative density. The measured moisture contents generally ranged from 5 per cent to 28 per cent.

The results of grain size analyses carried out on samples of the lower non-plastic and plastic till deposit are shown on the Record of Borehole sheets in Appendix C and presented in Figure D16A and D16B of Appendix D. The results are summarized as follows:

Soil Particle	Plastic Till Percentage (%)	Non-Plastic Till Percentage (%)
Gravel	2 to 8	0
Sand	26 to 60	7
Silt	28 to 53	66
Clay	7 to 20	27

The results of the Atterberg Limits tests carried out on the fines portion of samples of the lower plastic till deposit are shown on the Record of Borehole logs in Appendix C and presented in Figure D17 of Appendix D. The results are summarized as follows:

Index Property	Percentage (%)
Liquid Limit	15 to 19
Plastic Limit	9 to 10
Plastic Index	5 to 10

The results of the Atterberg Limits testing indicate the material is clayey silt to silty clay of low plasticity (CL-ML to CL).

Glacial tills inherently contain cobbles and boulders.

4.16 Groundwater Conditions

Details of the water level observed in the boreholes upon completion of drilling and in piezometers are presented on the record of boreholes and summarized below.

Borehole	Date of Measurement	Groundwater Level (m)		Remark
		Depth[1]	Elevation	
FS23-01	June 1, 2023	5.9	321.8	In monitoring well.
	August 29, 2023	5.7	322.0	In monitoring well.
FS23-03	April 19, 2023	2.1	318.4	In monitoring well.

Borehole	Date of Measurement	Groundwater Level (m)		Remark
		Depth[1]	Elevation	
FS23-04	April 21, 2023	-1.6	322.4	Artesian pressure encountered when at a depth of 38.1 m below ground surface. Water level measurement in rods when tricone at a depth of 29.4 m below ground surface.[2]
SS23-01	June 1, 2023	4.9	319.8	In monitoring well.
	August 29, 2023	5.1	319.6	In monitoring well.

Notes:
1. *Positive and negative depth values are used to represent water levels that are measured either below or above the ground surface, respectively.*
2. *Water level measured in open borehole / hollow stem augers.*

The water levels measured in the borehole upon completion of drilling and piezometers are short-term observations and subject to seasonal fluctuations. In particular, the water levels may be at a higher elevation during spring and after periods of significant or prolonged precipitation.

4.17 Single Well Response Test Results – Hydraulic Conductivity

The SWRT results were analyzed using the Hvorslev method. The SWRT analysis plots are included in Appendix C. The hydraulic conductivity values calculated from the in-situ SWRTs are summarized in the following table:

Monitoring Well	Screen Interval (m bgs)	Screened Geology	Hydraulic Conductivity (m/s)
SS23-01	4.5 – 7.6	Silty Clay	1.3×10^{-8}
FS23-01	4.5 – 7.6	Silty Sand / Silty Clay	6.8×10^{-8}
FS23-03	4.5 – 7.6	Clay	7.8×10^{-8}

Hydraulic conductivities from the slug tests at this site are in the range of 10^{-8} m/s, however, the silty sand that FS23-01 is screened in may have a hydraulic conductivity up to 1.6×10^{-5} m/s based on the grain size analysis.

5. ANALYTICAL LABORATORY TESTING

Three samples from select borehole locations were submitted for analytical testing for corrosivity analysis and sulphide content. The analytical test results for the soil are presented in Appendix D and are summarized below.

Borehole	FS23-02	FS23-04	FS23-05
Sample	SS7	SS5	SS12
Depth (m)	4.6 – 5.2	3.0 – 3.7	10.7 – 11.3
Elevation (m)	322.7 – 322.1	317.8 – 317.1	314.6 – 314.0
Sulphide (Na_2CO_3) %	<0.04	0.04	0.04
Chloride (µg/g)	23	98	11
Sulphate (µg/g)	17	350	260
pH	8.38	8.43	9.23
Conductivity (µS/cm)	642	430	144
Resistivity (Ohm-cm)	1560	2330	6940

6. MISCELLANEOUS

Aardvark Drilling Ltd. of Guelph, Ontario supplied and operated the drilling, sampling, and in-situ testing equipment for the field investigation. The field investigation was supervised on a full-time basis by Mr. Hayden Clarke, Mr. Jaimin Patel, Mr. Liam Scalena, EIT, and Mr. Kenneth Omenogor, EIT. The overall management of the field program was conducted by Ms. Alysha Kobylinski, P.Eng.

Geotechnical laboratory testing on soil samples was carried out in Thurber's geotechnical laboratory. Corrosivity testing on the organic silt deposit was carried out by SGS Canada Inc., a CALA accredited analytical laboratory in Guelph, Ontario.

Interpretation of the field data and preparation of this report was carried out by Ms. Alysha Kobylinski, P.Eng. The report was reviewed by Mr. Keli Shi, M.Eng., P.Eng., a Senior Geotechnical Engineer, and Dr. P.K. Chatterji, Ph.D., P.Eng., a Designated Principal Contact for MTO Foundations Projects at Thurber.

THURBER ENGINEERING LTD.

Thurber Engineering Ltd.

Alysha Kobylinski, P. Eng.
Geotechnical Engineer

Keli Shi, M.Eng., P. Eng.
Senior Geotechnical Engineer

Date: ***February 9, 2024***
File: ***35708***

P.K. Chatterji, Ph.D., P. Eng.
Designated MTO Contact

THURBER

STATEMENT OF LIMITATIONS AND CONDITIONS

1. STANDARD OF CARE

This Report has been prepared in accordance with generally accepted engineering or environmental consulting practices in the applicable jurisdiction. No other warranty, expressed or implied, is intended or made.

2. COMPLETE REPORT

All documents, records, data and files, whether electronic or otherwise, generated as part of this assignment are a part of the Report, which is of a summary nature and is not intended to stand alone without reference to the instructions given to Thurber by the Client, communications between Thurber and the Client, and any other reports, proposals or documents prepared by Thurber for the Client relative to the specific site described herein, all of which together constitute the Report.

IN ORDER TO PROPERLY UNDERSTAND THE SUGGESTIONS, RECOMMENDATIONS AND OPINIONS EXPRESSED HEREIN, REFERENCE MUST BE MADE TO THE WHOLE OF THE REPORT. THURBER IS NOT RESPONSIBLE FOR USE BY ANY PARTY OF PORTIONS OF THE REPORT WITHOUT REFERENCE TO THE WHOLE REPORT.

3. BASIS OF REPORT

The Report has been prepared for the specific site, development, design objectives and purposes that were described to Thurber by the Client. The applicability and reliability of any of the findings, recommendations, suggestions, or opinions expressed in the Report, subject to the limitations provided herein, are only valid to the extent that the Report expressly addresses proposed development, design objectives and purposes, and then only to the extent that there has been no material alteration to or variation from any of the said descriptions provided to Thurber, unless Thurber is specifically requested by the Client to review and revise the Report in light of such alteration or variation.

4. USE OF THE REPORT

The information and opinions expressed in the Report, or any document forming part of the Report, are for the sole benefit of the Client. NO OTHER PARTY MAY USE OR RELY UPON THE REPORT OR ANY PORTION THEREOF WITHOUT THURBER'S WRITTEN CONSENT AND SUCH USE SHALL BE ON SUCH TERMS AND CONDITIONS AS THURBER MAY EXPRESSLY APPROVE. Ownership in and copyright for the contents of the Report belong to Thurber. Any use which a third party makes of the Report, is the sole responsibility of such third party. Thurber accepts no responsibility whatsoever for damages suffered by any third party resulting from use of the Report without Thurber's express written permission.

5. INTERPRETATION OF THE REPORT

a) Nature and Exactness of Soil and Contaminant Description: Classification and identification of soils, rocks, geological units, contaminant materials and quantities have been based on investigations performed in accordance with the standards set out in Paragraph 1. Classification and identification of these factors are judgmental in nature. Comprehensive sampling and testing programs implemented with the appropriate equipment by experienced personnel may fail to locate some conditions. All investigations utilizing the standards of Paragraph 1 will involve an inherent risk that some conditions will not be detected and all documents or records summarizing such investigations will be based on assumptions of what exists between the actual points sampled. Actual conditions may vary significantly between the points investigated and the Client and all other persons making use of such documents or records with our express written consent should be aware of this risk and the Report is delivered subject to the express condition that such risk is accepted by the Client and such other persons. Some conditions are subject to change over time and those making use of the Report should be aware of this possibility and understand that the Report only presents the conditions at the sampled points at the time of sampling. If special concerns exist, or the Client has special considerations or requirements, the Client should disclose them so that additional or special investigations may be undertaken which would not otherwise be within the scope of investigations made for the purposes of the Report.

b) Reliance on Provided Information: The evaluation and conclusions contained in the Report have been prepared on the basis of conditions in evidence at the time of site inspections and on the basis of information provided to Thurber. Thurber has relied in good faith upon representations, information and instructions provided by the Client and others concerning the site. Accordingly, Thurber does not accept responsibility for any deficiency, misstatement or inaccuracy contained in the Report as a result of misstatements, omissions, misrepresentations, or fraudulent acts of the Client or other persons providing information relied on by Thurber. Thurber is entitled to rely on such representations, information and instructions and is not required to carry out investigations to determine the truth or accuracy of such representations, information and instructions.

c) Design Services: The Report may form part of design and construction documents for information purposes even though it may have been issued prior to final design being completed. Thurber should be retained to review final design, project plans and related documents prior to construction to confirm that they are consistent with the intent of the Report. Any differences that may exist between the Report's recommendations and the final design detailed in the contract documents should be reported to Thurber immediately so that Thurber can address potential conflicts.

d) Construction Services: During construction Thurber should be retained to provide field reviews. Field reviews consist of performing sufficient and timely observations of encountered conditions in order to confirm and document that the site conditions do not materially differ from those interpreted conditions considered in the preparation of the report. Adequate field reviews are necessary for Thurber to provide letters of assurance, in accordance with the requirements of many regulatory authorities.

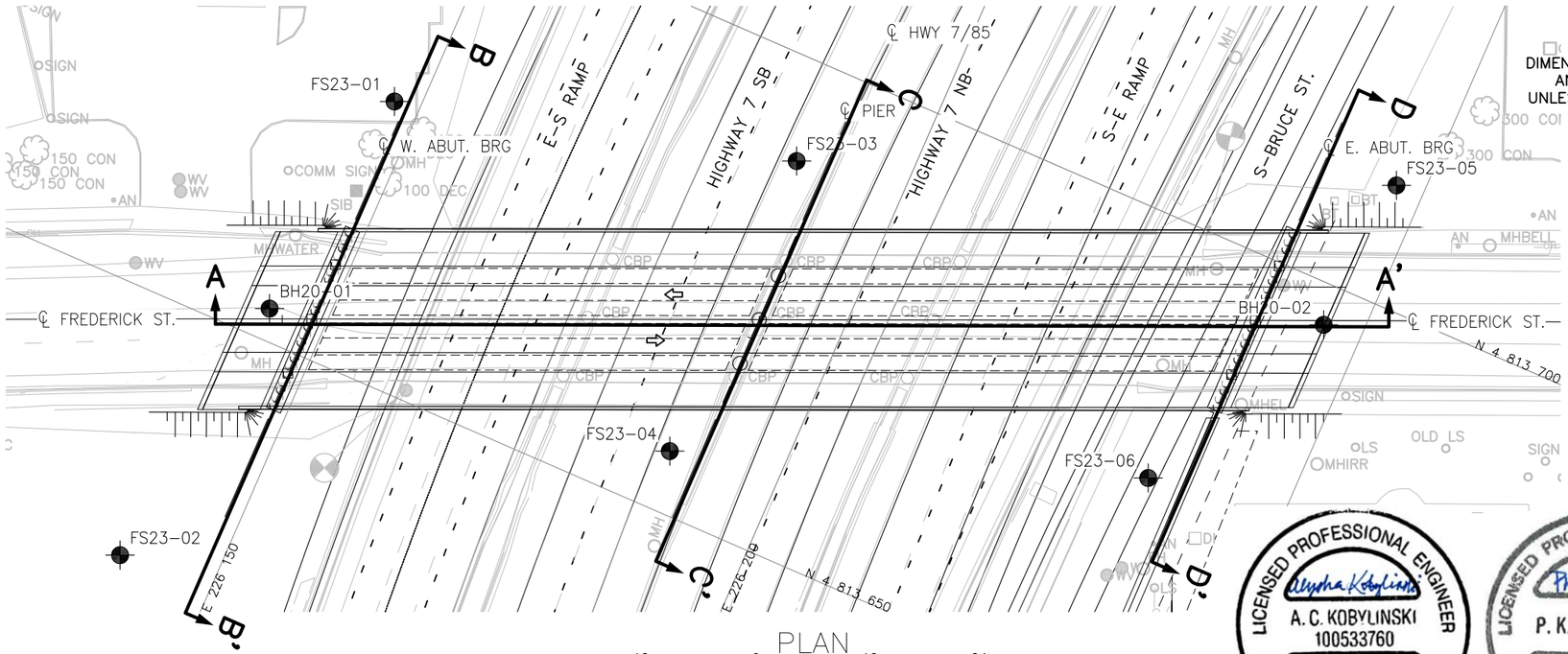
6. RELEASE OF POLLUTANTS OR HAZARDOUS SUBSTANCES

Geotechnical engineering and environmental consulting projects often have the potential to encounter pollutants or hazardous substances and the potential to cause the escape, release or dispersal of those substances. Thurber shall have no liability to the Client under any circumstances, for the escape, release or dispersal of pollutants or hazardous substances, unless such pollutants or hazardous substances have been specifically and accurately identified to Thurber by the Client prior to the commencement of Thurber's professional services.

7. INDEPENDENT JUDGEMENTS OF CLIENT

The information, interpretations and conclusions in the Report are based on Thurber's interpretation of conditions revealed through limited investigation conducted within a defined scope of services. Thurber does not accept responsibility for independent conclusions, interpretations, interpolations and/or decisions of the Client, or others who may come into possession of the Report, or any part thereof, which may be based on information contained in the Report. This restriction of liability includes but is not limited to decisions made to develop, purchase or sell land.

MINISTRY OF TRANSPORTATION, ONTARIO



PLAN

12 0 12 24m

SCALE 1:600

METRIC

DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN

CONT No
WP No

HIGHWAY 7/85
FREDERICK STREET BRIDGE
UNDERPASS REPLACEMENT
BOREHOLE LOCATIONS AND SOIL STRATA

SHEET

Ontario

THURBER ENGINEERING LTD.

LICENSED PROFESSIONAL ENGINEER
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P. K. CHATTERJI
FEB. 9, 2024
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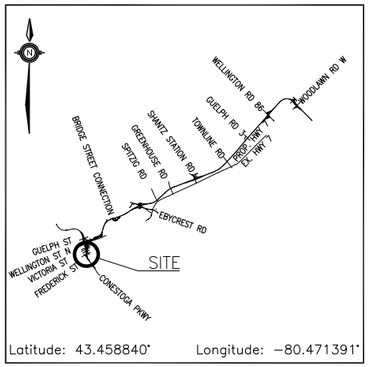

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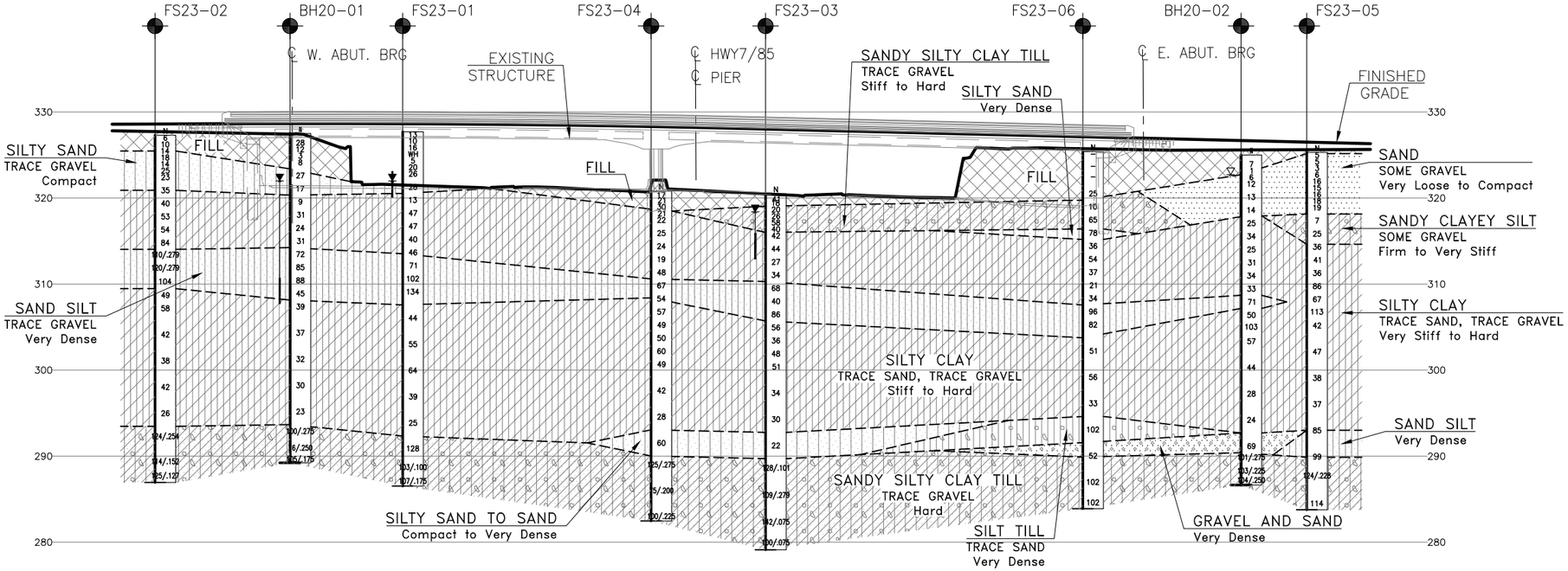
KEYPLAN



PROFILE ALONG ℄ FREDERICK ST. (A–A')

12 0 12 24m

SCALE 1:600

LEGEND

●	Borehole
⊕	Borehole and Cone
N	Blows /0.3m (Std Pen Test, 475J/blow)
CONE	Blows /0.3m (60° Cone, 475J/blow)
PH	Pressure, Hydraulic
▽	Water Level Upon Completion of Drilling
▼	Water Level in Monitoring Well/Piezometer
	Monitoring Well/Piezometer Screen
90%	Rock Quality Designation (RQD)
A/R	Auger Refusal

NO	ELEVATION	NORTHING	EASTING
BH20-01	327.5	4 813 653.3	226 144.0
BH20-02	325.0	4 813 695.8	226 245.9
FS23-01	327.7	4 813 678.4	226 147.3
FS23-02	327.3	4 813 623.3	226 139.9
FS23-03	320.5	4 813 689.5	226 188.4
FS23-04	320.8	4 813 656.3	226 188.4
FS23-05	325.3	4 813 712.3	226 247.1
FS23-06	325.4	4 813 673.8	226 235.5

-NOTES-

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

GEOCRES No. 40P08-300

REVISIONS		
DATE	BY	DESCRIPTION

DESIGN	AK	CHK	KS	CODE	LOAD
DRAWN	AN	CHK	AK	SITE	STRUCT

DATE FEB 2024
DWG 1

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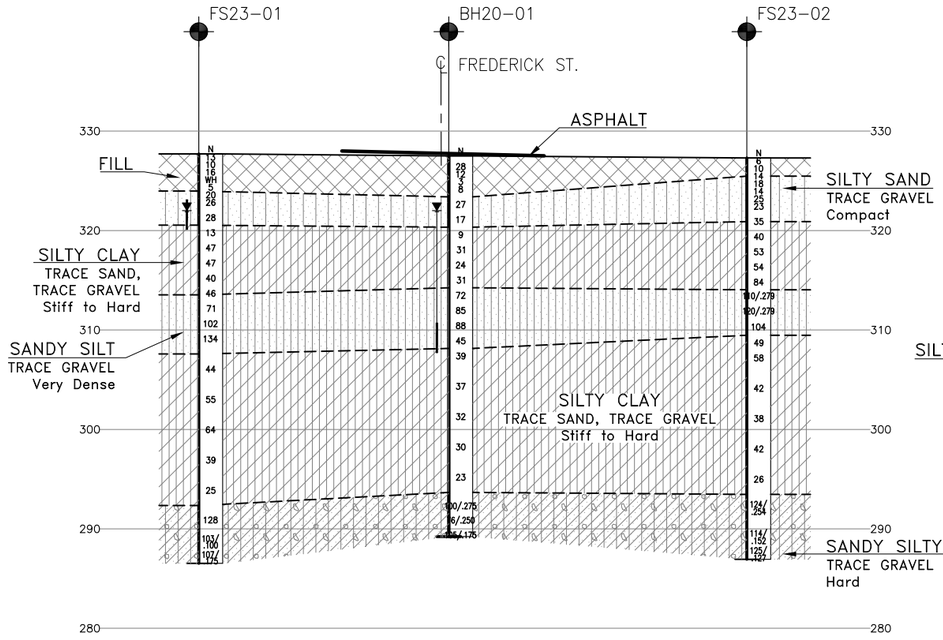
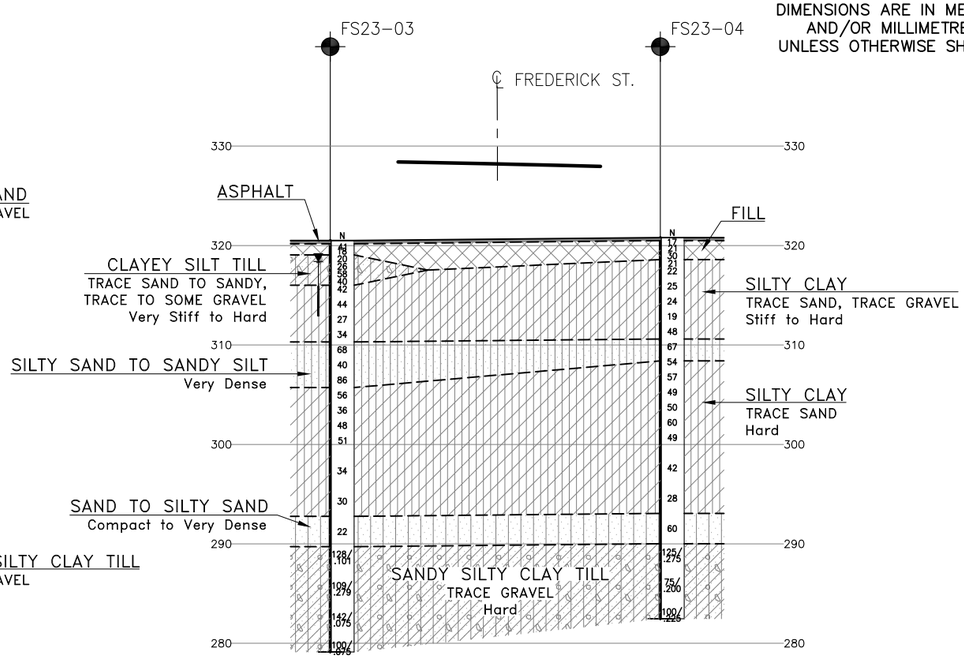
MINISTRY OF TRANSPORTATION, ONTARIO

METRIC

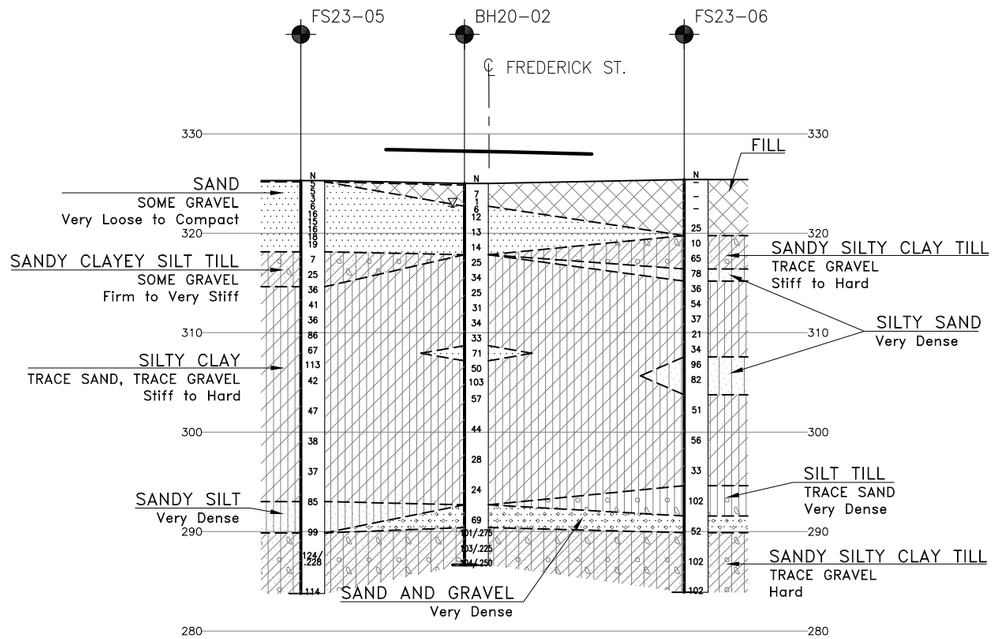
DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN



SECTION ALONG W. ABUT. BRG (B–B')



SECTION ALONG PIER (C–C')



SECTION ALONG E. ABUT. BRG (D–D')

12 0 12 24m

SCALE 1:600

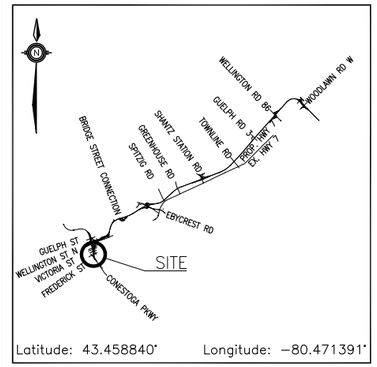
CONT No
WP No

HIGHWAY 7/85
FREDERICK STREET BRIDGE
UNDERPASS REPLACEMENT
BOREHOLE LOCATIONS AND SOIL STRATA

SHEET

Ontario

THURBER ENGINEERING LTD.



KEYPLAN

	LEGEND
⊕	Borehole
⊕	Borehole and Cone
N	Blows /0.3m (Std Pen Test, 475J/blow)
CONE	Blows /0.3m (60° Cone, 475J/blow)
PH	Pressure, Hydraulic
▽	Water Level Upon Completion of Drilling
▼	Water Level in Monitoring Well/Piezometer
▮	Monitoring Well/Piezometer Screen
90%	Rock Quality Designation (RQD)
A/R	Auger Refusal

NO	ELEVATION	NORTHING	EASTING
BH20–01	327.5	4 813 653.3	226 144.0
BH20–02	325.0	4 813 695.8	226 245.9
FS23–01	327.7	4 813 678.4	226 147.3
FS23–02	327.3	4 813 623.3	226 139.9
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FS23–04	320.8	4 813 656.3	226 188.4
FS23–05	325.3	4 813 712.3	226 247.1
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-NOTES-

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

GEOCRES No. 40P08-300

REVISIONS		
DATE	BY	DESCRIPTION

DESIGN	AK	CHK	KS	CODE	LOAD
DRAWN	AN	CHK	AK	SITE	STRUCT

DATE FEB 2024
DWG 2

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APPENDIX A

Site Photographs

Photograph #1 – Frederick Street near west abutment, facing east. (Google Earth)

Photograph #2 – Frederick Street near east abutment, facing west. (Google Earth)

Photograph #3 – Highway 7/85, south of the Frederick Street bridge, facing north. (Google Earth)

Photograph #4 – Highway 7/85, north of the Frederick Street bridge, facing south. (Google Earth)

Photograph #5 – Borehole advancement at FS23-05, facing north. (May 2023)

Photograph #6 – Hydroexcavation at Borehole FS23-06, facing north. (May 2023)

Photograph #7 – Pieces of concrete and debris (metal cooking pot) encountered in Fill at FS23-06 hydroexcavated interval. (May 2023)

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APPENDIX B

Previous Investigation: Record of Borehole Logs and Laboratory Test Results

SYMBOLS, ABBREVIATIONS AND TERMS USED ON RECORDS OF BOREHOLES

1. TEXTURAL CLASSIFICATION OF SOILS

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

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

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

3. TERMS DESCRIBING CONSISTENCY (COHESIVE SOILS ONLY)

DESCRIPTIVE TERM	UNDRAINED SHEAR STRENGTH (kPa)	APPROXIMATE SPT[(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
	TW Thin Wall Shelby Tube Sample		TP Thin Wall Piston Sample
	PH Sampler Advanced by Hydraulic Pressure		PM Sampler Advanced by Manual Pressure
	WH Sampler Advanced by Self Static Weight	RC Rock Core	SC Soil Core

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

▼ Water Level

C_{pen} Shear Strength Determination by Pocket Penetrometer

(1) SPT 'N' Value Standard Penetration Test 'N' Value – refers to the number of blows from a 63.5kg hammer free falling a height of 0.76m to advance a standard 50 mm outside diameter split spoon sampler for 0.3 m depth into undisturbed ground.

(2) DCPT Dynamic Cone Penetration Test – Continuous penetration of a 50 mm outside diameter, 60° conical steel point attached to "A" size rods driven by a 63.5 kg hammer free falling a height of 0.76 m. The resistance to cone penetration is the number of hammer blows required for each 0.3 m advance of the conical point into undisturbed ground.

UNIFIED SOILS CLASSIFICATION

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

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RECORD OF BOREHOLE No BH20-01 1 OF 4 METRIC

GWP# 408-88-00 LOCATION , MTM NAD 83 Zone 10: N 4 813 653.3 E 226 144.0 ORIGINATED BY MC

DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers/Tricone COMPILED BY AN

DATUM Geodetic DATE 2020.08.17 - 2020.08.19 LATITUDE 43.458660 LONGITUDE -80.471975 CHECKED BY GRL

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%)	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
327.5	GROUND SURFACE										
0.0	**ASPHALT:** (200mm)										
0.2 / 326.7	**SAND** and **GRAVEL** Brown Dry (FILL)						327				
0.8 / 325.3	**SAND**, some silt, some gravel Compact Brown Dry (FILL)		1	SS	28				○		
			2	SS	12		326		○		
2.2 / 323.4	**SAND**, trace silt Very Loose to Loose Brown Dry (FILL)		3	SS	3		325		○		
			4	SS	8		324		○		0 89 11 (SI+CL)
4.1 / 320.3	**SAND**, trace silt Compact Brown Wet		5	SS	27	▼	323		○		
			6	SS	17		322		○		
7.2 / 318.8	Clayey **SILT**, trace sand, trace gravel Stiff Brown Wet		7	SS	9		321		○		1 7 78 14
8.7	Silty **CLAY**, trace sand Very Stiff to Hard Grey Wet		8	SS	31		320		○		
							319				
							318				

Continued Next Page

+ ^{3}, × ^{3}: Numbers refer to Sensitivity

(%) STRAIN AT FAILURE

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No BH20-01 2 OF 4 METRIC

GWP# 408-88-00 LOCATION , MTM NAD 83 Zone 10: N 4 813 653.3 E 226 144.0 ORIGINATED BY MC

DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers/Tricone COMPILED BY AN

DATUM Geodetic DATE 2020.08.17 - 2020.08.19 LATITUDE 43.458660 LONGITUDE -80.471975 CHECKED BY GRL

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	Continued From Previous Page										
			9	SS	24		317				0 0 30 70
							316				
			10	SS	31		315				
314.2											
13.3	Silty **SAND** to Sandy **SILT**, trace clay Very Dense to Dense Grey Wet		11	SS	72		314				
							313				
			12	SS	85		312				
			13	SS	88		311				0 28 66 6
							310				
			14	SS	45		309				
308.1											
19.4	Silty **CLAY**, trace sand Hard Grey Wet						308				

Continued Next Page

+ ^{3}, × ^{3}: Numbers refer to Sensitivity

(%) STRAIN AT FAILURE

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No BH20-01 3 OF 4 METRIC

GWP# 408-88-00 LOCATION , MTM NAD 83 Zone 10: N 4 813 653.3 E 226 144.0 ORIGINATED BY MC

DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers/Tricone COMPILED BY AN

DATUM Geodetic DATE 2020.08.17 - 2020.08.19 LATITUDE 43.458660 LONGITUDE -80.471975 CHECKED BY GRL

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa	PLASTIC LIMIT / NATURAL MOISTURE CONTENT / LIQUID LIMIT / WATER CONTENT (%)	UNIT WEIGHT	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	20 40 60	γ kN/m³	GR SA SI CL
	Continued From Previous Page		15	SS	39		307				
			16	SS	37		306				
			17	SS	32		305				
			18	SS	30		304				0 4 36 60
							303				
							302				
							301				
							300				
							299				
							298				

Continued Next Page

+ ³, × ³: Numbers refer to Sensitivity

(%) STRAIN AT FAILURE

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No BH20-01 4 OF 4 METRIC

GWP# 408-88-00 LOCATION , MTM NAD 83 Zone 10: N 4 813 653.3 E 226 144.0 ORIGINATED BY MC

DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers/Tricone COMPILED BY AN

DATUM Geodetic DATE 2020.08.17 - 2020.08.19 LATITUDE 43.458660 LONGITUDE -80.471975 CHECKED BY GRL

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	Continued From Previous Page						297				
							296				
	Very Stiff		19	SS	23		295		○		
293.7							294				
33.8	Silty **CLAY**, sandy, trace gravel Hard Grey Wet (TILL)						293				
			20	SS	100/ 0.275		292				
			21	SS	76/ 0.250		291		○		3 31 51 15
289.2			22	SS	105/		290		○		
38.3	END OF BOREHOLE AT 38.3m. Well installation consists of 50mm diameter Schedule 40 PVC pipe with a 3.05m slotted screen. WATER LEVEL READINGS DATE DEPTH(m) ELEV.(m) 2020.08.24 5.5 322.0				0.175						

+ ^{3}, × ^{3}: Numbers refer to Sensitivity

(%) STRAIN AT FAILURE

ONTMT4S2 MTO-11375(GINTDATA).GPJ 2017TEMPLATE(MTO).GDT 2/9/21

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Ontario

THURBER

RECORD OF BOREHOLE No BH20-02 1 OF 4 METRIC

GWP# 408-88-00 LOCATION , MTM NAD 83 Zone 10: N 4 813 695.8 E 226 245.9 ORIGINATED BY MC

DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers/Tricone COMPILED BY AN

DATUM Geodetic DATE 2020.08.20 - 2020.08.21 LATITUDE 43.459054 LONGITUDE -80.470721 CHECKED BY GRL

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE
325.0	GROUND SURFACE						
0.0	**ASPHALT:** (163mm)						
0.2	**SAND** and **GRAVEL** Brown Dry						
324.3	(FILL)						
0.7	**SAND**, gravelly to some gravel Loose to Very Loose Brown Dry (FILL)		1	SS	7		324
			2	SS	1		323
322.7						▽	
2.3	**SAND**, trace silt Loose to Compact Brown Dry		3	SS	6		322
			4	SS	12		321
	Wet		5	SS	13		320
			6	SS	14		319
317.8							318
7.2	Silty **CLAY**, trace sand Very Stiff to Hard Grey Wet		7	SS	25		317
			8	SS	34		316
							315

DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100

SHEAR STRENGTH kPa
○ UNCONFINED + FIELD VANE
● QUICK TRIAXIAL × LAB VANE
20 40 60 80 100

PLASTIC LIMIT w_P | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w_L
WATER CONTENT (%)
20 40 60

UNIT WEIGHT γ kN/m^3

REMARKS & GRAIN SIZE DISTRIBUTION (%)
GR SA SI CL

Continued Next Page

$+^3$, $\times^3$: Numbers refer to Sensitivity

(%) STRAIN AT FAILURE

ONTMT4S2 MTO-11375(GINTDATA).GPJ 2017TEMPLATE(MTO).GDT 2/9/21

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No BH20-02 2 OF 4 METRIC

GWP# 408-88-00 LOCATION , MTM NAD 83 Zone 10: N 4 813 695.8 E 226 245.9 ORIGINATED BY MC

DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers/Tricone COMPILED BY AN

DATUM Geodetic DATE 2020.08.20 - 2020.08.21 LATITUDE 43.459054 LONGITUDE -80.470721 CHECKED BY GRL

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	Continued From Previous Page							20 40 60 80 100	20 40 60		
			9	SS	25		314				
			10	SS	31		313				0 0 34 66
310.9			11	SS	34		312				
14.1	**SAND** Dense Brown Wet						311				
310.2											
14.8			12	SS	33		310				
308.7							309				
16.3	**SAND** Very Dense Brown Wet		13	SS	71		308				
307.2							307				
17.8	Silty **CLAY**, trace sand Hard Grey Wet		14	SS	50		306				0 1 43 56
							305				

Continued Next Page

+ ^{3}, × ^{3}: Numbers refer to Sensitivity

(%) STRAIN AT FAILURE

ONTMT4S2 MTO-11375(GINTDATA).GPJ 2017TEMPLATE(MTO).GDT 2/9/21

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No BH20-02 3 OF 4 METRIC

GWP# 408-88-00 LOCATION , MTM NAD 83 Zone 10: N 4 813 695.8 E 226 245.9 ORIGINATED BY MC

DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers/Tricone COMPILED BY AN

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	Continued From Previous Page		15	SS	103						
			16	SS	57		304		○		
							303				
							302				
							301				
			17	SS	44		300		⊢○⊣		0 2 37 61
							299				
							298				
	Very Stiff		18	SS	28		297		○		
							296				
							295				

Continued Next Page

+ ^{3}, × ^{3}: Numbers refer to Sensitivity

20 / 15 5 / 10 (%) STRAIN AT FAILURE

ONTMT4S2 MTO-11375(GINTDATA).GPJ 2017TEMPLATE(MTO).GDT 2/9/21

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No BH20-02 4 OF 4 METRIC

GWP# 408-88-00 LOCATION , MTM NAD 83 Zone 10: N 4 813 695.8 E 226 245.9 ORIGINATED BY MC

DIST HWY 7 BOREHOLE TYPE Hollow Stem Augers/Tricone COMPILED BY AN

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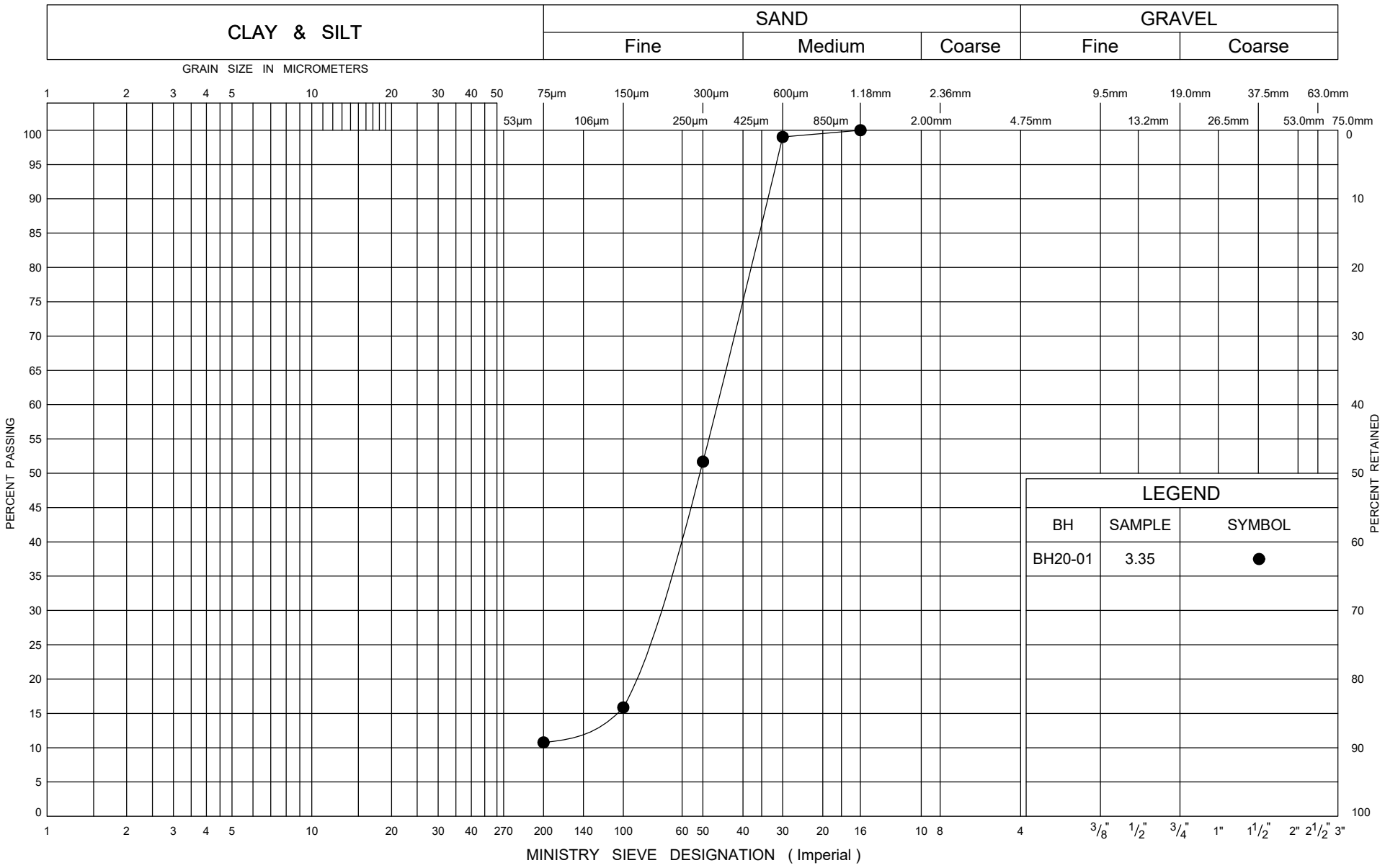
	Continued From Previous Page							20 40 60 80 100	20 40 60		
			19	SS	24		294		○		
292.7							293				
32.3	**SAND**, with gravel, trace silt Very Dense Grey Wet		20	SS	69		292		○		
290.4							291				
34.6	Silty **CLAY**, with sand, gravelly Hard Grey Wet (TILL)		21	SS	101/0.275		290		○		21 36 28 15
			22	SS	103/0.225		289		○		
286.6			23	SS	104/0.250		288				
38.4	END OF BOREHOLE AT 38.35m. WATER LEVEL AT 2.3m. BOREHOLE BACKFILLED WITH BENTONITE CUTTINGS AND ASPHALT COLD PATCH TO SURFACE.						287		○		

+ ^{3}, × ^{3}: Numbers refer to Sensitivity

20 / 15 5 / 10 (%) STRAIN AT FAILURE

ONTMT4S2 MTO-11375(GINTDATA).GPJ 2017TEMPLATE(MTO).GDT 2/9/21



ONTARIO MOT GRAIN SIZE 2 MTO-11375(GINTDATA).GPJ ONTARIO MOT.GDT 11/26/20

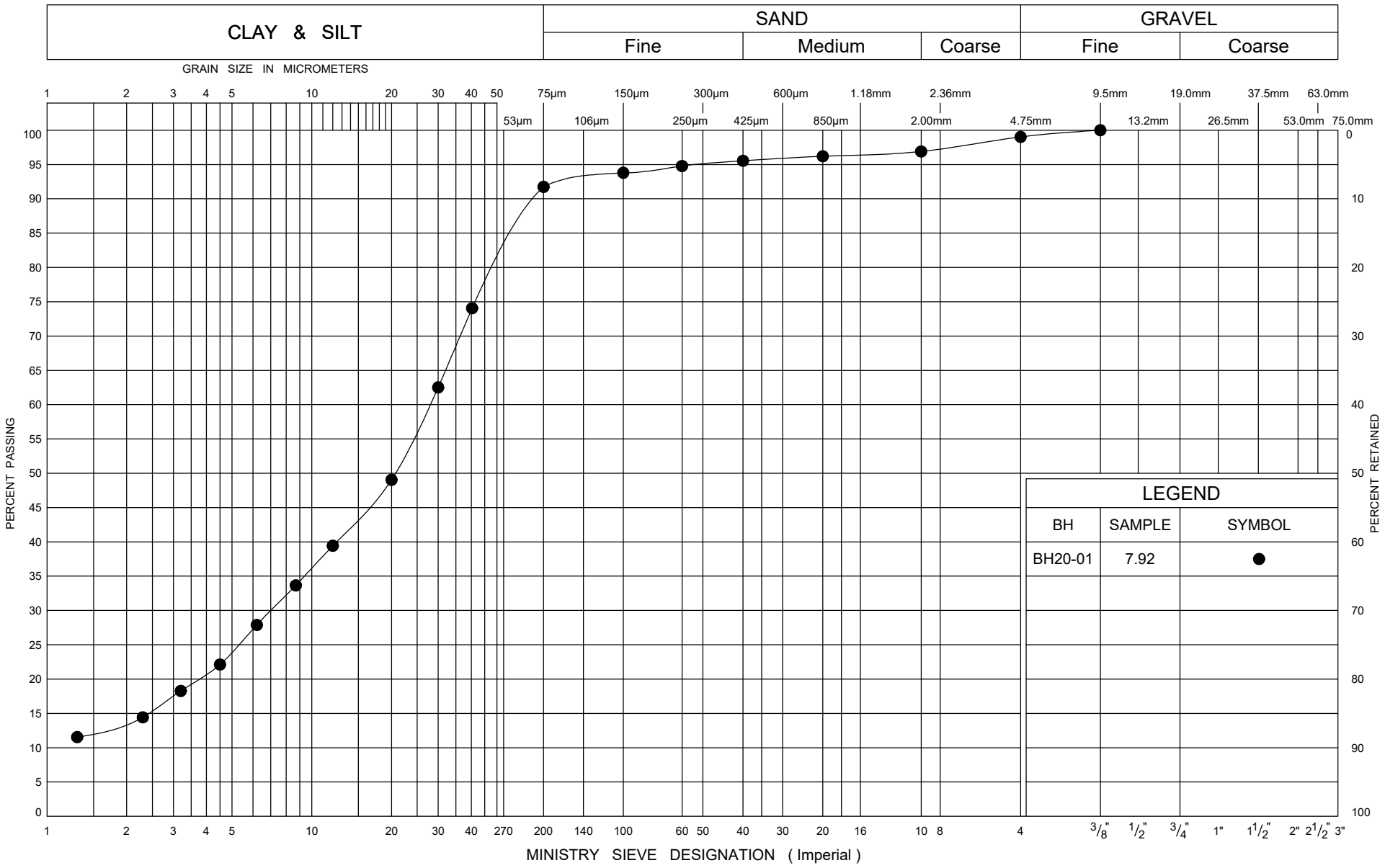
Ministry of Transportation
Ontario

GRAIN SIZE DISTRIBUTION

SAND (FILL)

FIG No A1

W P 408-88-00



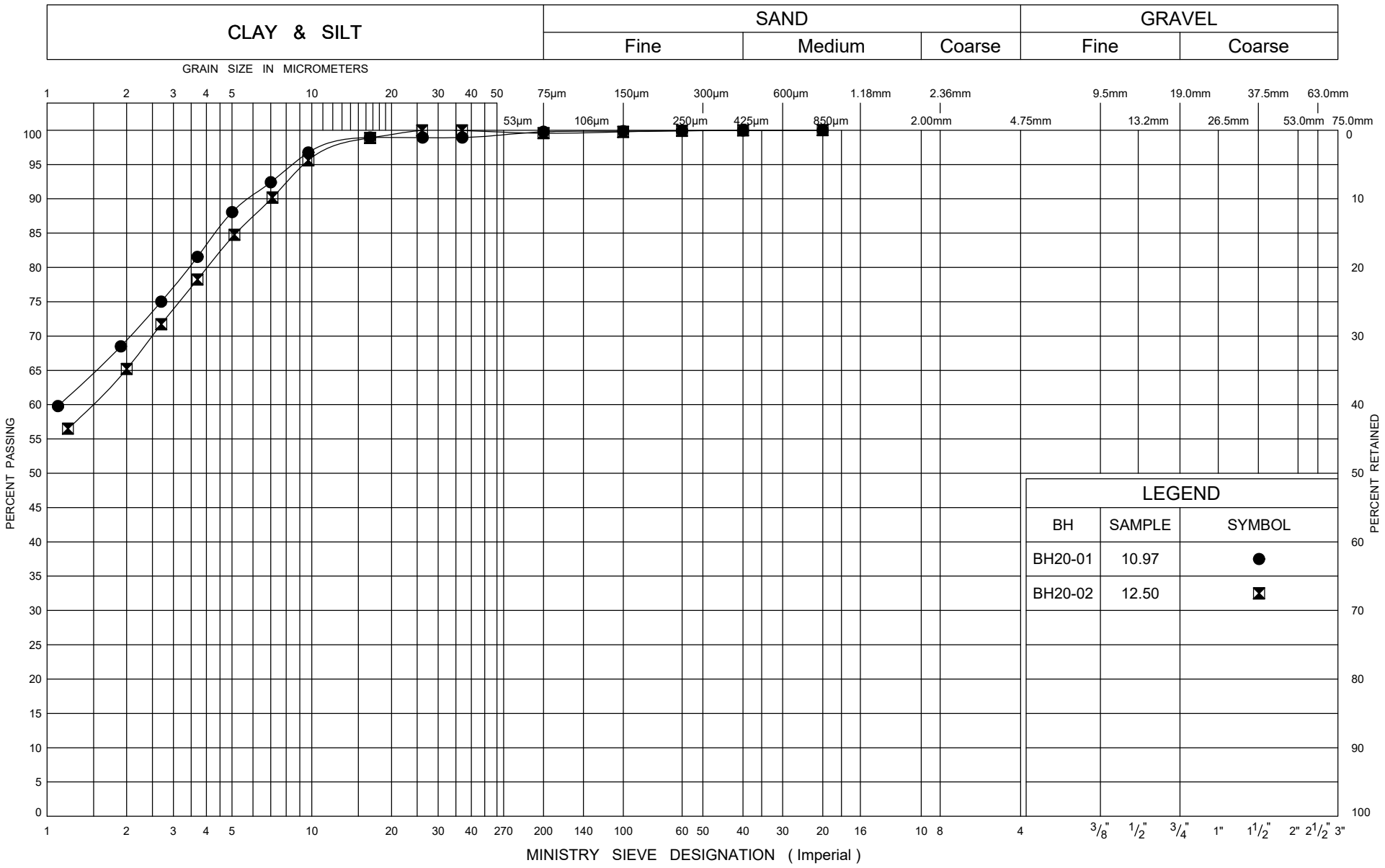
Ministry of Transportation
Ontario

GRAIN SIZE DISTRIBUTION

Clayey SILT

FIG No A2

W P 408-88-00



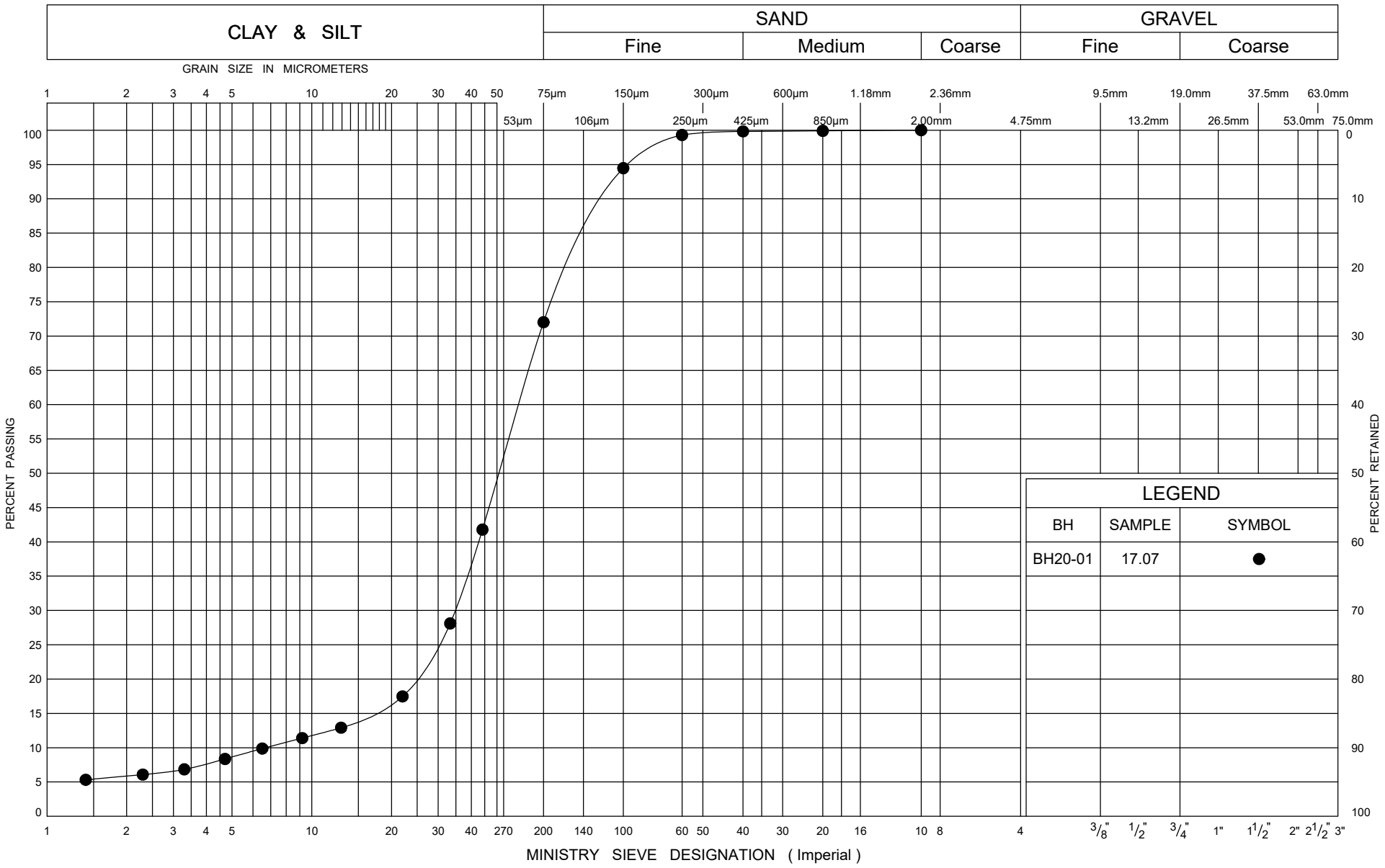
Ministry of Transportation
Ontario

GRAIN SIZE DISTRIBUTION

Upper Silty CLAY

FIG No A3

W P 408-88-00



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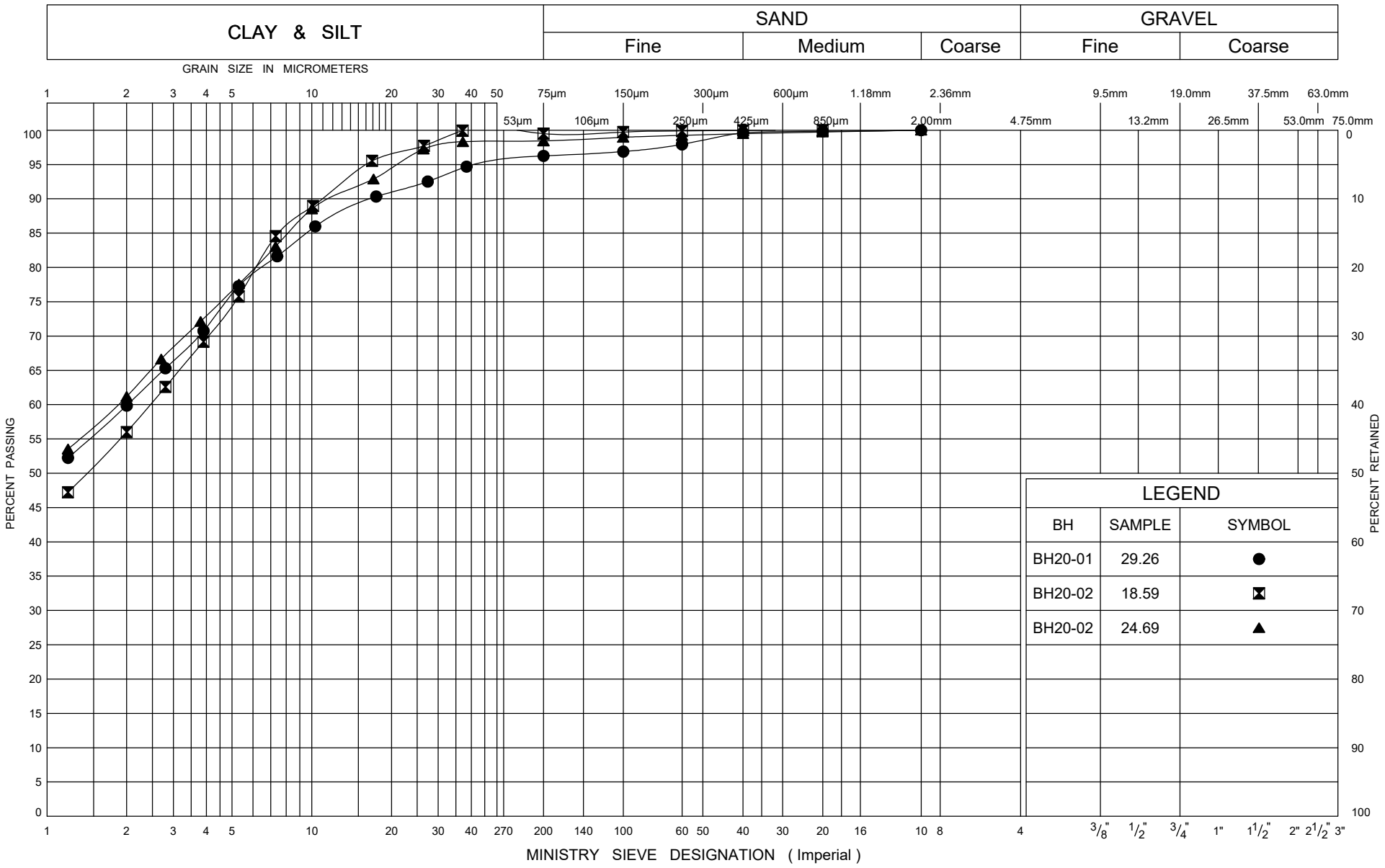
Ontario

GRAIN SIZE DISTRIBUTION

Sandy SILT to Silty SAND

FIG No A4

W P 408-88-00



ONTARIO MOT GRAIN SIZE 2 MTO-11375(GINTDATA).GPJ ONTARIO MOT.GDT 11/26/20

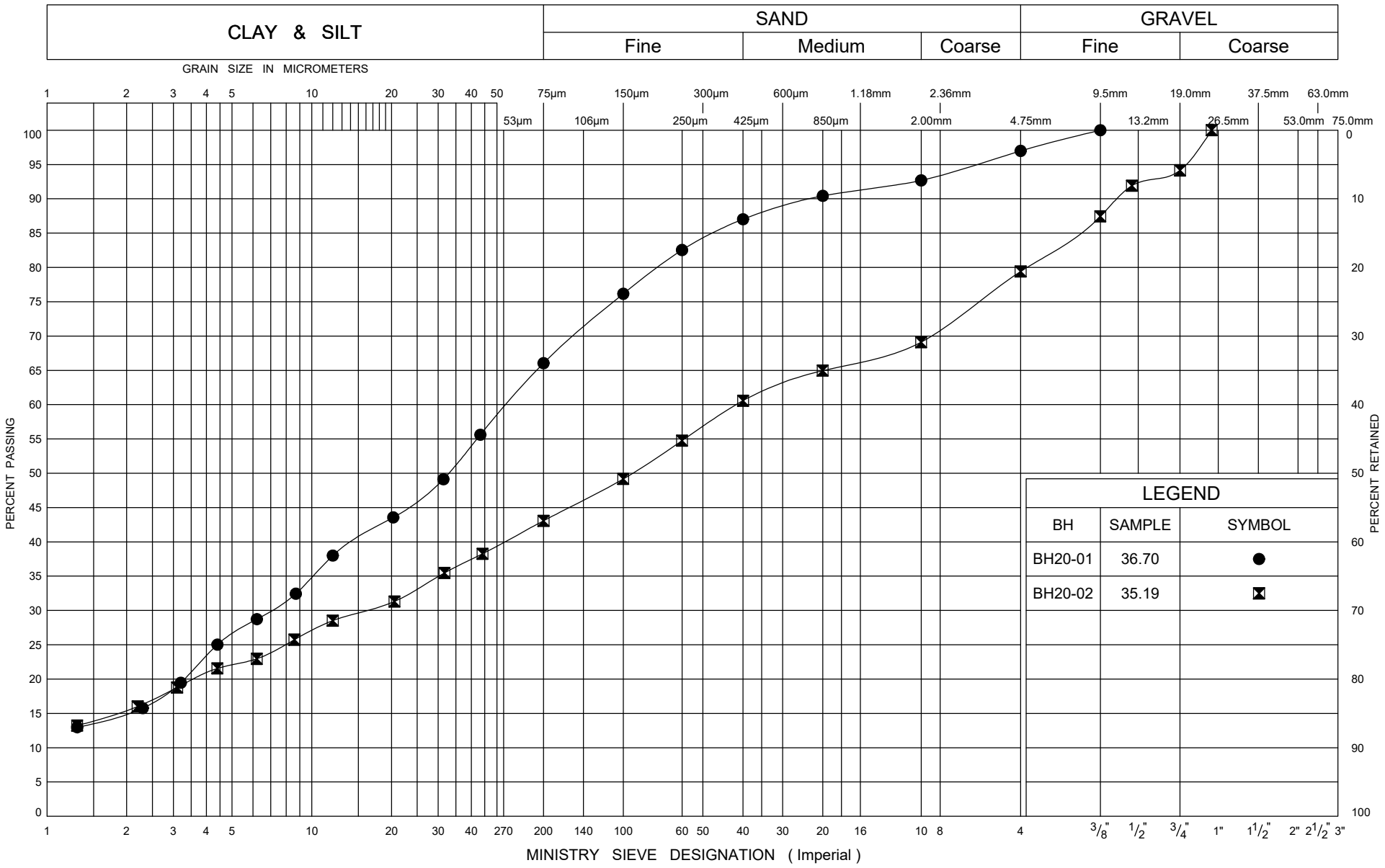
Ministry of Transportation
Ontario

GRAIN SIZE DISTRIBUTION

Lower Silty CLAY

FIG No A5

W P 408-88-00



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Ontario

GRAIN SIZE DISTRIBUTION

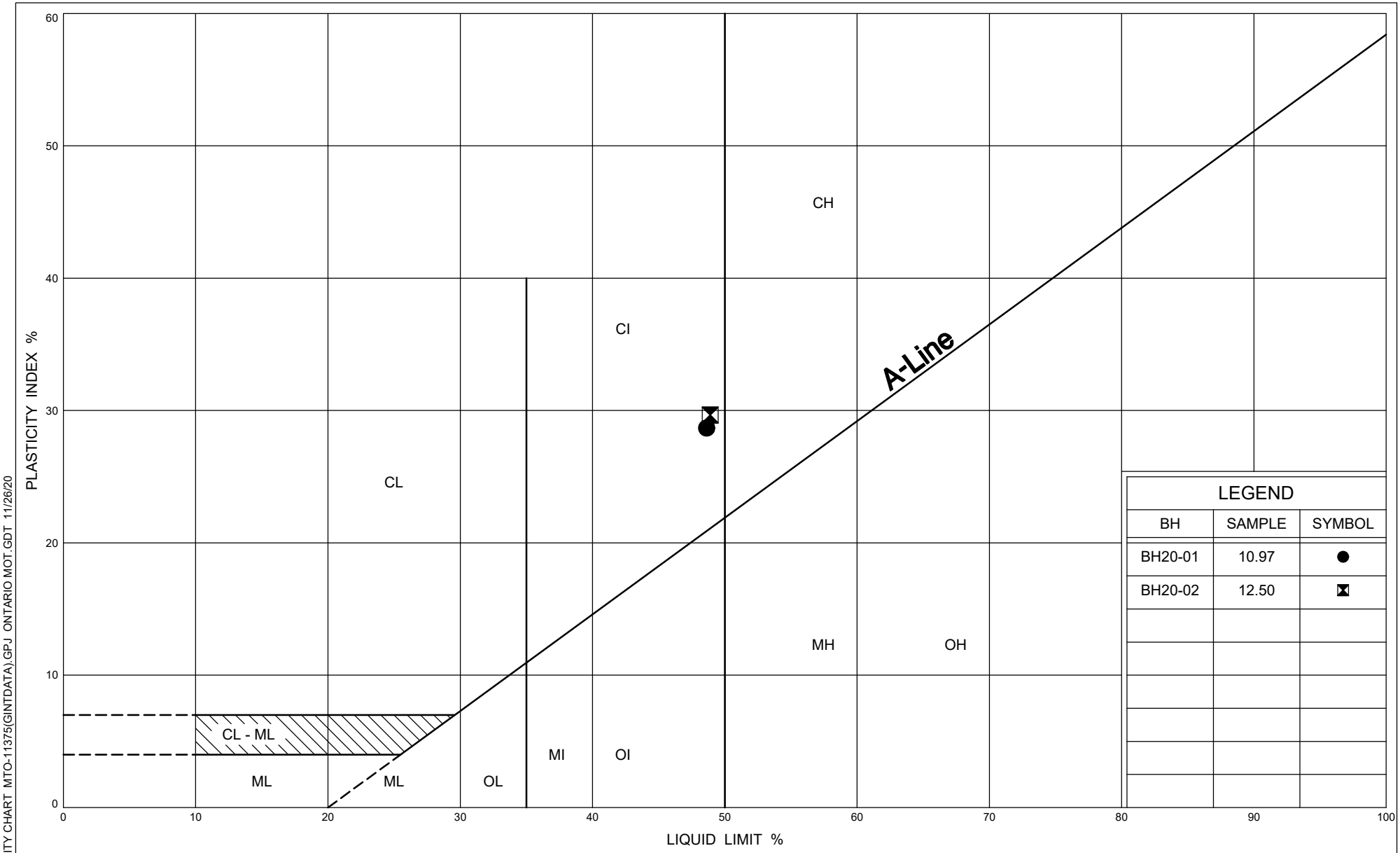
Silty CLAY TILL

FIG No A6

W P 408-88-00

ONTARIO MOT GRAIN SIZE 2 MTO-11375(GINTDATA).GPJ ONTARIO MOT.GDT 11/26/20

Oct 75, FF - S - 21



ONTARIO MOT PLASTICITY CHART MTO-11375(GINTDATA).GPJ ONTARIO MOT.GDT 11/26/20

Ministry of Transportation
Ontario

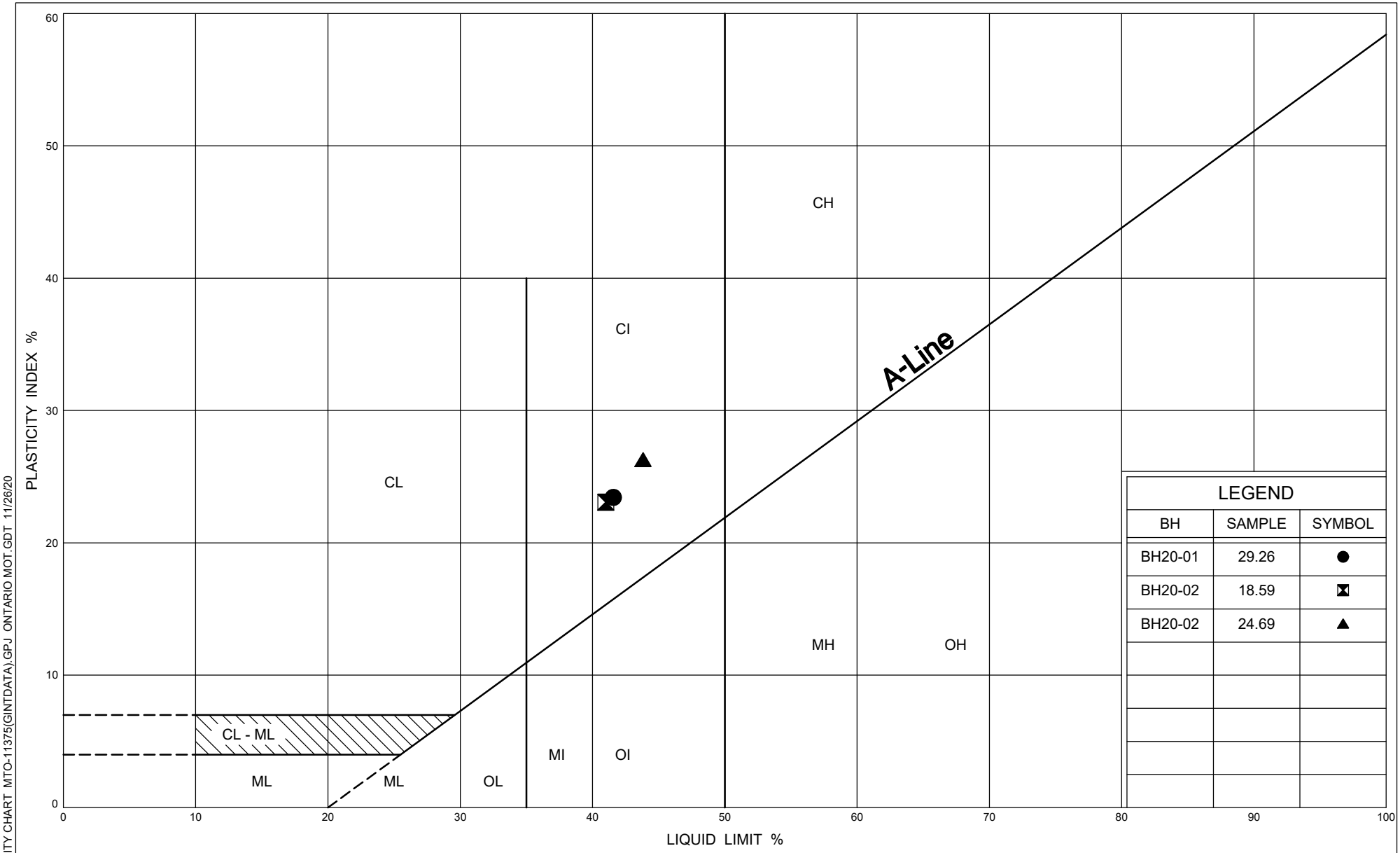
PLASTICITY CHART

Upper Silty CLAY

FIG No A7

W P 408-88-00

Oct 75, FF - S - 21



ONTARIO MOT PLASTICITY CHART MTO-11375(GINTDATA).GPJ ONTARIO MOT.GDT 11/26/20

Ministry of Transportation
Ontario

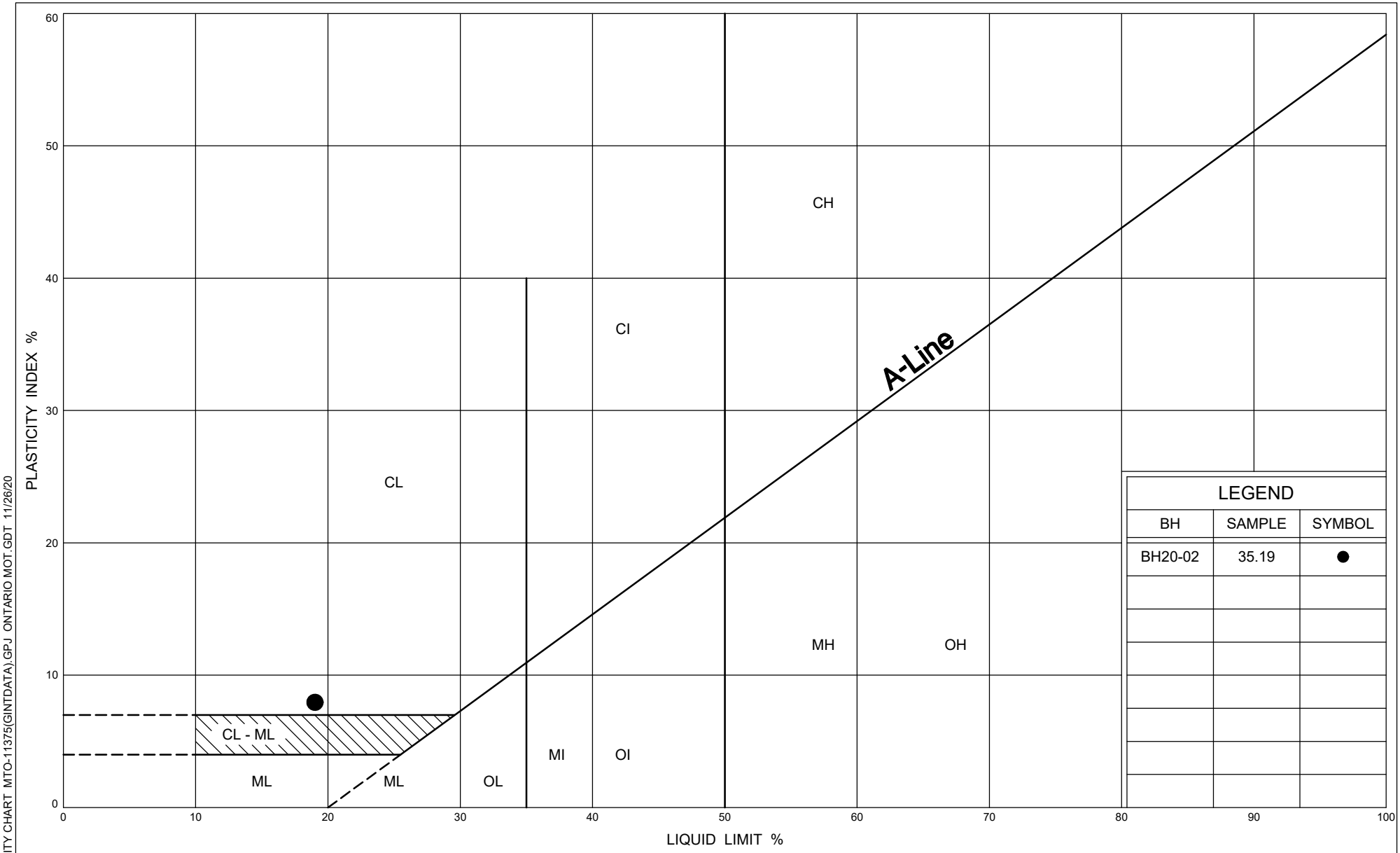
PLASTICITY CHART

Lower Silty CLAY

FIG No A8

W P 408-88-00

Oct 75, FF - S - 21



ONTARIO MOT PLASTICITY CHART MTO-11375(GINTDATA).GPJ ONTARIO MOT.GDT 11/26/20

Ministry of Transportation
Ontario

PLASTICITY CHART

Silty CLAY TILL

FIG No A9

W P 408-88-00

FINAL REPORT

CA14882-AUG20 R1

1375 Frederick St.

Prepared for

Thurber Engineering Ltd.

FINAL REPORT

CA14882-AUG20 R1

First Page

CLIENT DETAILS		LABORATORY DETAILS	
Client	Thurber Engineering Ltd.	Project Specialist	Jill Campbell, B.Sc.,GISAS
		Laboratory	SGS Canada Inc.
Address	103, 2010 Winston Park Drive Oakville, ON L6H 5R7. Canada	Address	185 Concession St., Lakefield ON, K0L 2H0
Contact	Geoff Lay	Telephone	2165
Telephone	905-829-8666	Facsimile	705-652-6365
Facsimile		Email	jill.campbell@sgs.com
Email	glay@thurber.ca	SGS Reference	CA14882-AUG20
Project	1375 Frederick St.	Received	08/28/2020
Order Number		Approved	09/03/2020
Samples	Soil (2)	Report Number	CA14882-AUG20 R1
		Date Reported	09/03/2020

COMMENTS

Temperature of Sample upon Receipt:7 degrees C
Cooling Agent Present:YES
Custody Seal Present:YES

Chain of Custody Number:NA

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

SIGNATORIES

Jill Campbell, B.Sc.,GISAS

TABLE OF CONTENTS

Client: Thurber Engineering Ltd.
Project: 1375 Frederick St.
Project Manager: Geoff Lay
Samplers: Brett Thomas

PACKAGE: **- Corrosivity Index** (SOIL)

Sample Number	5	6
Sample Name	BH20-01 SS#4	BH20-02 SS#3
Sample Matrix	Soil	Soil
Sample Date	17/08/2020	20/08/2020

Parameter	Units	RL		Result	Result
Corrosivity Index					
Corrosivity Index	none	1		8	13
Soil Redox Potential	mV	-		287	285
Sulphide	%	0.04		< 0.04	< 0.04
pH	pH Units	0.05		9.66	9.37
Resistivity (calculated)	ohms.cm	-9999		1830	892

PACKAGE: **- General Chemistry** (SOIL)

Sample Number	5	6
Sample Name	BH20-01 SS#4	BH20-02 SS#3
Sample Matrix	Soil	Soil
Sample Date	17/08/2020	20/08/2020

Parameter	Units	RL		Result	Result
General Chemistry					
Conductivity	uS/cm	2		547	1120

PACKAGE: **- Metals and Inorganics** (SOIL)

Sample Number	5	6
Sample Name	BH20-01 SS#4	BH20-02 SS#3
Sample Matrix	Soil	Soil
Sample Date	17/08/2020	20/08/2020

Parameter	Units	RL		Result	Result
Metals and Inorganics					
Moisture Content	%	0.1		3.8	4.4
Sulphate	µg/g	0.4		8.3	21

FINAL REPORT

CA14882-AUG20 R1

Client: Thurber Engineering Ltd.
Project: 1375 Frederick St.
Project Manager: Geoff Lay
Samplers: Brett Thomas

PACKAGE: **- Other (ORP)** (SOIL)

Sample Number	5	6
Sample Name	BH20-01 SS#4	BH20-02 SS#3
Sample Matrix	Soil	Soil
Sample Date	17/08/2020	20/08/2020

Parameter	Units	RL		Result	Result
Other (ORP)					
Chloride	µg/g	0.4		210	750

QC SUMMARY

Anions by IC

Method: EPA300/MA300-Ions1.3 | Internal ref.: ME-CA-[ENV]IC-LAK-AN-001

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Chloride	DIO0461-AUG20	µg/g	0.4	<0.4	2	20	96	80	120	103	75	125
Sulphate	DIO0461-AUG20	µg/g	0.4	<0.4	8	20	98	80	120	95	75	125

Carbon/Sulphur

Method: ASTM E1915-07A | Internal ref.: ME-CA-[ENV]ARD-LAK-AN-020

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Sulphide	ECS0001-SEP20	%	0.04	< 0.04	ND	20	100	80	120			

Conductivity

Method: SM 2510 | Internal ref.: ME-CA-[ENV]EWL-LAK-AN-006

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Conductivity	EWL0414-AUG20	uS/cm	2	< 0.002	1	20	99	90	110	NA		

QC SUMMARY

pH

Method: SM 4500 I Internal ref.: ME-CA-[ENV]EWL-LAK-AN-001

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
pH	EWL0414-AUG20	pH Units	0.05	NA	1		100			NA		

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

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

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

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

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

RL: Reporting limit

RPD: Relative percent difference

AC: Acceptance criteria

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

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

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

LEGEND

FOOTNOTES

NSS	Insufficient sample for analysis.
RL	Reporting Limit.
↑	Reporting limit raised.
↓	Reporting limit lowered.
NA	The sample was not analysed for this analyte
ND	Non Detect

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

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

-- End of Analytical Report --

SGS

Environment, Health & Safety - Lakefield: 185 Concession St., Lakefield, ON K0L 2H0 Phone: 705-652-2000 Fax: 705-652-6365 Web: www.sgs.com/environment
- London: 657 Consortium Court, London, ON, N6E 2S8 Phone: 519-672-4500 Toll Free: 877-848-8060 Fax: 519-672-0361

Request for Laboratory Services and CHAIN OF CUSTODY

No:

Laboratory Information Section - Lab use only

Received By: Scott R

Received Date: 08/28/2020 (mm/dd/yy)

Received Time: 16:20 (hr : min)

Received By (signature): [signature]

Custody Seal Present: Yes ☑ No ☐

Custody Seal Intact: Yes ☑ No ☐

Cooling Agent Present: Yes ☑ No ☐ Type: Ice

Temperature Upon Receipt (°C): 12 2 2°C

LAB LIMS #: 14882

REPORT INFORMATION	INVOICE INFORMATION
Company: Thurber Engineering Ltd.	☑ (same as Report Information)
Contact: Geoff Lay	Company:
Address: 2010 Winston Park Drive #103, Oakville, ON L6H 5R7	Contact:
	Address:
Phone: (905) 829-8666	
Fax:	Phone:
Email: glay@thurber.ca	Email:

Quotation #:

P.O. #:

Project #: 11375

Site Location/ID: Frederick St

TURNAROUND TIME (TAT) REQUIRED

☑ Regular TAT (5-7days)

TAT's are quoted in business days (exclude statutory holidays & weekends). Samples received after 6pm or on weekends: TAT begins next business day

RUSH TAT (Additional Charges May Apply): ☐ 1 Day ☐ 2 Days ☐ 3 Days ☐ 4 Days

PLEASE CONFIRM RUSH FEASIBILITY WITH SGS REPRESENTATIVE PRIOR TO SUBMISSION

Specify Due Date:

NOTE: DRINKING (POTABLE) WATER SAMPLES FOR HUMAN CONSUMPTION MUST BE SUBMITTED WITH SGS DRINKING WATER CHAIN OF CUSTODY

REGULATIONS

Regulation 153/04: ☐ Table 1 ☑ Table 2 ☐ Table 3 ☐ Table ____ ; ☑ Res/Park ☐ Ind/Com ☐ Agri/Other ; Soil Texture: ☑ Coarse ☐ Medium/Fine

Other Regulations: ☐ Reg 347/558 (3 Day min TAT) ☐ PWQO ☐ MMER ☐ CCME ☐ Other ☐ MISA

Sewer By-Law: ☐ Sanitary ☐ Storm Municipality:

RECORD OF SITE CONDITION (RSC) ☐ YES ☐ NO

ANALYSIS REQUESTED

#	SAMPLE IDENTIFICATION	DATE SAMPLED	TIME SAMPLED	# OF BOTTLES	MATRIX	Field Filtered (Y/N)	Metals & Inorganics	Full Metals Suite	ICP Metals only	PAHs only	SVOCs	PCBs (Total ☐ Aroclor ☐)	F1-F4 + BTEX	F1-F4 only (no BTEX)	VOCs	BTEX only	Pesticides	Corrosivity	Other	Other	Other	Other	Sewer Use	Water Characterization Pkg	TCLP	COMMENTS
1	BH20-01 SS #4	Aug.17/2020	9 AM	2	Soil													✓								4 day Soil
2	BH20-02 SS #3	Aug. 20/2020	9 AM	2	Soil													✓								
3																										
4																										
5																										
6																										
7																										
8																										
9																										
10																										
11																										
12																										

Observations/Comments/Special Instructions

Sampled By (NAME): Brett Thomas Signature: [signature] Date: 08/28/2020 (mm/dd/yy)

Relinquished by (NAME): Brett Thomas Signature: [signature] Date: 08/28/2020 (mm/dd/yy)

Pink Copy - Client

Yellow & White Copy - SGS

Revision # 1.5 Date of Issue: 12 Oct, 2018

THURBER ENGINEERING LTD.

APPENDIX C

Current Investigation: Record of Borehole Logs

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
	TW Thin Wall Shelby Tube Sample		TP Thin Wall Piston Sample
	PH Sampler Advanced by Hydraulic Pressure		PM Sampler Advanced by Manual Pressure
	WH Sampler Advanced by Self Static Weight	RC Rock Core	SC Soil Core

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

▼ Water Level

C_{pen} Shear Strength Determination by Pocket Penetrometer

(1) SPT 'N' Value Standard Penetration Test 'N' Value – refers to the number of blows from a 63.5kg hammer free falling a height of 0.76m to advance a standard 50 mm outside diameter split spoon sampler for 0.3 m depth into undisturbed ground.

(2) DCPT Dynamic Cone Penetration Test – Continuous penetration of a 50 mm outside diameter, 60° conical steel point attached to "A" size rods driven by a 63.5 kg hammer free falling a height of 0.76 m. The resistance to cone penetration is the number of hammer blows required for each 0.3 m advance of the conical point into undisturbed ground.

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No FS23-01 1 OF 5 METRIC

GWP# 3025-20-00 LOCATION N 4 813 678.4 E 226 147.3 ORIGINATED BY HC

DIST Western HWY 7/85 BOREHOLE TYPE 205 mm I.D. Hollow Stem Auger, 125 mm diameter tricone (Mud Rotary) COMPILED BY AK

DATUM Geodetic DATE 2023.04.26 - 2023.05.03 LATITUDE 43.458887 LONGITUDE -80.471937 CHECKED BY KS

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
327.7	GROUND SURFACE										
0.0 / 0.0	**ASPHALT:** (50 mm)										
	SAND, some gravel Compact Brown Moist (FILL)		1	SS	13						
327.0 / 0.7	Silty **SAND**, trace gravel Compact Brown Moist (FILL)		2	SS	10		327				
			3	SS	16		326				9 60 24 7
325.5 / 2.2	Sandy **SILT**, some clay, trace gravel Very Loose to Loose Brown Moist (FILL)		4	SS	WH		325				
			5	SS	5						
324.0 / 3.7	Silty **SAND**, trace gravel Compact Brown Wet		6	SS	20		324				
			7	SS	26		323				6 80 11 3
			8	SS	28		322				
320.5 / 7.2	Silty **CLAY**, trace to sand, trace gravel Stiff to Hard Grey Moist to Wet		9	SS	13		321				
			10	SS	47		320				
							319				
							318				0 10 52 38

Continued Next Page

$+^3$, $\times^3$: Numbers refer to Sensitivity

20 / 15 / 10 / 5 (%) STRAIN AT FAILURE

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Ontario

THURBER

RECORD OF BOREHOLE No FS23-01 2 OF 5 METRIC

GWP# 3025-20-00 LOCATION N 4 813 678.4 E 226 147.3 ORIGINATED BY HC

DIST Western HWY 7/85 BOREHOLE TYPE 205 mm I.D. Hollow Stem Auger, 125 mm diameter tricone (Mud Rotary) COMPILED BY AK

DATUM Geodetic DATE 2023.04.26 - 2023.05.03 LATITUDE 43.458887 LONGITUDE -80.471937 CHECKED BY KS

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	Continued From Previous Page										
	Silty **CLAY**, trace to sand, trace gravel Stiff to Hard Grey Moist to Wet										
	300 mm silty sand at a depth of 11.0 m		11	SS	47		317				
							316				
			12	SS	40		315				
313.5			13	SS	46		314				
14.2	Sandy **SILT**, trace gravel Very Dense Grey Wet						313				
			14	SS	71		312				
			15	SS	102		311				0 32 63 5
							310				
			16	SS	134		309				
							308				

Continued Next Page

$+^3$, $\times^3$: Numbers refer to Sensitivity

20 / 15 / 10 / 5 (%) STRAIN AT FAILURE

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THURBER

RECORD OF BOREHOLE No FS23-01 3 OF 5 METRIC

GWP# 3025-20-00 LOCATION N 4 813 678.4 E 226 147.3 ORIGINATED BY HC

DIST Western HWY 7/85 BOREHOLE TYPE 205 mm I.D. Hollow Stem Auger, 125 mm diameter tricone (Mud Rotary) COMPILED BY AK

DATUM Geodetic DATE 2023.04.26 - 2023.05.03 LATITUDE 43.458887 LONGITUDE -80.471937 CHECKED BY KS

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
307.6	Continued From Previous Page										
20.1	Silty **CLAY**, trace sand Very Stiff to Hard Grey Wet						307				
			17	SS	44		306		○		
							305				
							304				
			18	SS	55		303				0 2 38 60
							302				
							301				
			19	SS	64		300		○		
							299				
							298				

Continued Next Page

+ ^{3}, × ^{3}: Numbers refer to Sensitivity

15 (20/10) 5 (%) STRAIN AT FAILURE

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RECORD OF BOREHOLE No FS23-01 4 OF 5 METRIC

GWP# 3025-20-00 LOCATION N 4 813 678.4 E 226 147.3 ORIGINATED BY HC

DIST Western HWY 7/85 BOREHOLE TYPE 205 mm I.D. Hollow Stem Auger, 125 mm diameter tricone (Mud Rotary) COMPILED BY AK

DATUM Geodetic DATE 2023.04.26 - 2023.05.03 LATITUDE 43.458887 LONGITUDE -80.471937 CHECKED BY KS

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (20 40 60 80 100): ○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	Continued From Previous Page										
	Silty **CLAY**, trace sand Very Stiff to Hard Grey Wet										
			20	SS	39		297		○		
							296				
							295				
			21	SS	25		294		○		
292.3							293				
35.4	Sandy Silty **CLAY**, trace gravel Hard Grey Wet (TILL)						292				
			22	SS	128		291		○		6 26 51 17
							290				
							289				
			23	SS	103/ 0.100		288		○		

Continued Next Page

$+^3$, $\times^3$: Numbers refer to Sensitivity

20 / 15 ⊕ 5 / 10 (%) STRAIN AT FAILURE

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RECORD OF BOREHOLE No FS23-01 5 OF 5 METRIC

GWP# 3025-20-00 LOCATION N 4 813 678.4 E 226 147.3 ORIGINATED BY HC

DIST Western HWY 7/85 BOREHOLE TYPE 205 mm I.D. Hollow Stem Auger, 125 mm diameter tricone (Mud Rotary) COMPILED BY AK

DATUM Geodetic DATE 2023.04.26 - 2023.05.03 LATITUDE 43.458887 LONGITUDE -80.471937 CHECKED BY KS

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	Continued From Previous Page										
286.5	Sandy Silty **CLAY**, trace gravel Hard Grey Wet (TILL)		24	SS	107/ 0.175		287				3 27 53 17
41.2	END OF BOREHOLE AT 41.2 m.										

NOTE:

1. WATER LEVEL NOT MEASURED UPON COMPLETION OF DRILLING DUE TO INTRODUCTION OF DRILLING MUD.

Well installation consists of 25 mm diameter Schedule 40 PVC pipe with a 3.05 m slotted screen.

WATER LEVEL READINGS

DATE	DEPTH(m)	ELEV.(m)
2023.06.01	5.9	321.8
2023.08.09	5.7	322.0

$+^3$, $\times^3$: Numbers refer to Sensitivity

(%) STRAIN AT FAILURE

Ministry of Transportation
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RECORD OF BOREHOLE No FS23-02 1 OF 5 METRIC

GWP# 3025-20-00 LOCATION N 4 813 623.3 E 226 139.9 ORIGINATED BY HC

DIST Western HWY 7/85 BOREHOLE TYPE 205 mm I.D. Hollow Stem Auger, 125 mm diameter tricone (Mud Rotary) COMPILED BY AK

DATUM Geodetic DATE 2023.05.04 - 2023.05.10 LATITUDE 43.458390 LONGITUDE -80.472020 CHECKED BY KS

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa: ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
327.3	GROUND SURFACE						327				
0.0	**TOPSOIL:** (100 mm)										
0.1	Clayey **SAND**, trace gravel, containing rootlets		1	SS	6						6 47 37 10
326.6	Firm										
0.7	Dark Brown										
	Wet		2	SS	10		326				
	(FILL)										
	Clayey **SILT**, some sand, trace gravel										
	Compact										
	Light Brown		3	SS	14						
325.5	Moist										
1.8	(FILL)						325				
	Silty **SAND**										
	Compact										
	Light Brown		4	SS	18						
	Moist to Wet										
			5	SS	14		324				0 83 14 3
	Wet		6	SS	25		323				
			7	SS	23		322				
320.9			8	SS	35		321				
6.4	Silty **CLAY**, trace sand										
	Hard										
	Grey						320				
	Moist to Wet										
			9	SS	40		319				0 2 52 46
			10	SS	53		318				

Continued Next Page

$+^3$, $\times^3$: Numbers refer to Sensitivity

$\frac{20}{15}\oplus\frac{5}{10}$ (%) STRAIN AT FAILURE

Ministry of Transportation
Ontario

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RECORD OF BOREHOLE No FS23-02 2 OF 5 METRIC

GWP# 3025-20-00 LOCATION N 4 813 623.3 E 226 139.9 ORIGINATED BY HC

DIST Western HWY 7/85 BOREHOLE TYPE 205 mm I.D. Hollow Stem Auger, 125 mm diameter tricone (Mud Rotary) COMPILED BY AK

DATUM Geodetic DATE 2023.05.04 - 2023.05.10 LATITUDE 43.458390 LONGITUDE -80.472020 CHECKED BY KS

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (20 40 60 80 100): ○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	Continued From Previous Page										
	Silty **CLAY**, trace sand Hard Grey Moist to Wet						317				
			11	SS	54				○		
							316				
			12	SS	84		315		○		
314.0											
13.3	**SILT** and **SAND** Very Dense Grey Wet						314				
			13	SS	110/ 0.279				○		0 41 54 5 Non-Plastic
							313				
			14	SS	120/ 0.279		312		○		
							311				
			15	SS	104				○		
309.5							310				
17.8	Silty **CLAY**, trace sand, trace gravel Very Stiff to Hard Grey Wet										
			16	SS	49		309		○		
							308				

Continued Next Page

$+^3$, $\times^3$: Numbers refer to Sensitivity

$\frac{20}{15}\oplus\frac{5}{10}$ (%) STRAIN AT FAILURE

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RECORD OF BOREHOLE No FS23-02 3 OF 5 METRIC

GWP# 3025-20-00 LOCATION N 4 813 623.3 E 226 139.9 ORIGINATED BY HC

DIST Western HWY 7/85 BOREHOLE TYPE 205 mm I.D. Hollow Stem Auger, 125 mm diameter tricone (Mud Rotary) COMPILED BY AK

DATUM Geodetic DATE 2023.05.04 - 2023.05.10 LATITUDE 43.458390 LONGITUDE -80.472020 CHECKED BY KS

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa: ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	Continued From Previous Page									
	Silty **CLAY**, trace sand, trace gravel Very Stiff to Hard Grey Wet		17	SS	58		307	○	○	
							306			
							305			
			18	SS	42		304		○	
							303			
							302			
			19	SS	38		301		○	
							300			
							299			
			20	SS	42		298		○	0 1 36 63

Continued Next Page

$+^3$, $\times^3$: Numbers refer to Sensitivity

(%) STRAIN AT FAILURE

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RECORD OF BOREHOLE No FS23-02 4 OF 5 METRIC

GWP# 3025-20-00 LOCATION N 4 813 623.3 E 226 139.9 ORIGINATED BY HC

DIST Western HWY 7/85 BOREHOLE TYPE 205 mm I.D. Hollow Stem Auger, 125 mm diameter tricone (Mud Rotary) COMPILED BY AK

DATUM Geodetic DATE 2023.05.04 - 2023.05.10 LATITUDE 43.458390 LONGITUDE -80.472020 CHECKED BY KS

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa 20 40 60 80 100 (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES						GR SA SI CL
	Continued From Previous Page										
	Silty **CLAY**, trace sand, trace gravel Very Stiff to Hard Grey Wet						297				
							296				
			21	SS	26		295		○		
293.5							294				
33.8	Sandy **SILT**, some clay Very Dense Grey Wet (TILL)						293				
291.9			22	SS	124/ 0.254		292		○ ○		
35.4	Clayey **SILT**, some sand, trace gravel Hard Grey Wet (TILL)						291				
							290				
			23	SS	114/ 0.152		289		○		
							288				

Continued Next Page

$+^3$, $\times^3$: Numbers refer to Sensitivity

$\frac{20}{15 \oplus 5}$ (%) STRAIN AT FAILURE

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RECORD OF BOREHOLE No FS23-02 5 OF 5 METRIC

GWP# 3025-20-00 LOCATION N 4 813 623.3 E 226 139.9 ORIGINATED BY HC

DIST Western HWY 7/85 BOREHOLE TYPE 205 mm I.D. Hollow Stem Auger, 125 mm diameter tricone (Mud Rotary) COMPILED BY AK

DATUM Geodetic DATE 2023.05.04 - 2023.05.10 LATITUDE 43.458390 LONGITUDE -80.472020 CHECKED BY KS

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (20 40 60 80 100) O UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	Continued From Previous Page									
286.9			24	SS	125/		287			
40.4	END OF BOREHOLE AT 40.4 m.				0.127					
	NOTES:									
	1. WATER LEVEL NOT MEASURED UPON COMPLETION OF DRILLING DUE TO INTRODUCTION OF DRILLING MUD.									

$+^3$, $\times^3$: Numbers refer to Sensitivity

20 / 15 5 / 10 (%) STRAIN AT FAILURE

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Ministry of Transportation
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THURBER

RECORD OF BOREHOLE No FS23-03 1 OF 5 METRIC

GWP# 3025-20-00 LOCATION N 4 813 689.5 E 226 188.4 ORIGINATED BY HC

DIST Western HWY 7/85 BOREHOLE TYPE 205 mm I.D. Hollow Stem Auger, 125 mm diameter tricone (Mud Rotary) COMPILED BY AK

DATUM Geodetic DATE 2023.03.29 - 2023.04.10 LATITUDE 43.458991 LONGITUDE -80.471431 CHECKED BY KS

ELEV / DEPTH	DESCRIPTION	NUMBER	TYPE	"N" VALUES	GR	SA	SI	CL
320.5	GROUND SURFACE							
0.0 / 320.1	**ASPHALT:** (330 mm)							
0.3 / 319.5	Gravelly Silty **SAND** Dense Brown Moist (FILL)	1	SS	41				
0.9 / 319.4		2	SS	18				
1.1 / 319.0	Clayey **SILT**, trace gravel Very Stiff Brown Moist (FILL)							
1.4	Silty **SAND**, trace gravel Compact Brown Moist (FILL)	3	SS	20	0	4	50	46
	Clayey **SILT**, trace sand to sandy, trace to some gravel Very Stiff to Hard Brown Moist (TILL)	4	SS	26				
		5	SS	58				
316.0		6	SS	40	16	32	33	19
4.5	**CLAY** Very Stiff to Hard Brown Moist	7	SS	42				
		8	SS	44				
		9	SS	27	0	0	29	71
		10	SS	34				

ELEVATION SCALE: 320, 319, 318, 317, 316, 315, 314, 313, 312, 311

DYNAMIC CONE PENETRATION RESISTANCE PLOT: 20 40 60 80 100

SHEAR STRENGTH kPa: ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE; 20 40 60 80 100

PLASTIC LIMIT w_P NATURAL MOISTURE CONTENT w LIQUID LIMIT w_L

WATER CONTENT (%): 20 40 60

UNIT WEIGHT γ kN/m^3

REMARKS & GRAIN SIZE DISTRIBUTION (%)

GROUND WATER CONDITIONS

Continued Next Page

$+^3$, $\times^3$: Numbers refer to Sensitivity

(%) STRAIN AT FAILURE

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No FS23-03 2 OF 5 METRIC

GWP# 3025-20-00 LOCATION N 4 813 689.5 E 226 188.4 ORIGINATED BY HC

DIST Western HWY 7/85 BOREHOLE TYPE 205 mm I.D. Hollow Stem Auger, 125 mm diameter tricone (Mud Rotary) COMPILED BY AK

DATUM Geodetic DATE 2023.03.29 - 2023.04.10 LATITUDE 43.458991 LONGITUDE -80.471431 CHECKED BY KS

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	Continued From Previous Page										
310.3											
10.2	Silty **SAND** to Sandy **SILT** Very Dense Brown to Grey Moist		11	SS	68		310				0 19 73 8
							309				
			12	SS	40		308				
			13	SS	86		307				0 59 39 2
305.7							306				
14.8	Silty **CLAY**, trace sand Hard Brown Moist		14	SS	56		305				
			15	SS	36		304				
			16	SS	48		303				
							302				0 3 40 57
							301				

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$+^3$, $\times^3$: Numbers refer to Sensitivity

(%) STRAIN AT FAILURE

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RECORD OF BOREHOLE No FS23-03 3 OF 5 METRIC

GWP# 3025-20-00 LOCATION N 4 813 689.5 E 226 188.4 ORIGINATED BY HC

DIST Western HWY 7/85 BOREHOLE TYPE 205 mm I.D. Hollow Stem Auger, 125 mm diameter tricone (Mud Rotary) COMPILED BY AK

DATUM Geodetic DATE 2023.03.29 - 2023.04.10 LATITUDE 43.458991 LONGITUDE -80.471431 CHECKED BY KS

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%)	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	Continued From Previous Page							20 40 60 80 100	20 40 60		
	Silty **CLAY**, trace sand Hard Brown Moist		17	SS	51		300		○		
							299				
							298				
			18	SS	34				○		
							297				
							296				
							295				
			19	SS	30				○		
292.7							294				
27.7	**SAND**, some non-plastic fines Compact Brown Wet						293				
							292				
			20	SS	22				○		0 80 20 (SI+CL)
							291				

Continued Next Page

$+^3$, $\times^3$: Numbers refer to Sensitivity

$\frac{20}{15}\oplus\frac{5}{10}$ (%) STRAIN AT FAILURE

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Ontario

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RECORD OF BOREHOLE No FS23-03 4 OF 5 METRIC

GWP# 3025-20-00 LOCATION N 4 813 689.5 E 226 188.4 ORIGINATED BY HC

DIST Western HWY 7/85 BOREHOLE TYPE 205 mm I.D. Hollow Stem Auger, 125 mm diameter tricone (Mud Rotary) COMPILED BY AK

DATUM Geodetic DATE 2023.03.29 - 2023.04.10 LATITUDE 43.458991 LONGITUDE -80.471431 CHECKED BY KS

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%): GR SA SI CL
	Continued From Previous Page								
289.7	**SAND**, some non-plastic fines Compact Brown Wet						290		
30.8	Sandy Clayey **SILT**, trace gravel Hard Grey Wet (TILL)						289		
			21	SS	128/ 0.101		288		
							287		
							286		
			22	SS	109/ 0.279		285		3 26 51 20
							284		
							283		
			23	SS	142/ 0.075		282		
							281		

DYNAMIC CONE PENETRATION RESISTANCE PLOT: 20 40 60 80 100

SHEAR STRENGTH kPa: ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE (20 40 60 80 100)

PLASTIC LIMIT w_P | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w_L

WATER CONTENT (%): 20 40 60

Continued Next Page

+ ³, × ³: Numbers refer to Sensitivity

15 20 10 5 (%) STRAIN AT FAILURE

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RECORD OF BOREHOLE No FS23-03 5 OF 5 METRIC

GWP# 3025-20-00 LOCATION N 4 813 689.5 E 226 188.4 ORIGINATED BY HC

DIST Western HWY 7/85 BOREHOLE TYPE 205 mm I.D. Hollow Stem Auger, 125 mm diameter tricone (Mud Rotary) COMPILED BY AK

DATUM Geodetic DATE 2023.03.29 - 2023.04.10 LATITUDE 43.458991 LONGITUDE -80.471431 CHECKED BY KS

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa: O UNCONFINED, + FIELD VANE, ● QUICK TRIAXIAL, × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	Continued From Previous Page									
	Sandy Clayey **SILT**, trace gravel Hard Grey Wet (TILL)						280			
279.1			24	SS	100/ 0.075					
41.4	END OF BOREHOLE AT 41.4 m.									
	NOTE:									
	1. WATER LEVEL NOT MEASURED UPON COMPLETION OF DRILLING DUE TO INTRODUCTION OF DRILLING MUD									
	Well installation consists of 25 mm diameter Schedule 40 PVC pipe with a 3.05 m slotted screen.									
	WATER LEVEL READINGS DATE DEPTH(m) ELEV.(m) 2023.04.19 2.1 318.4									

$+^3$, $\times^3$: Numbers refer to Sensitivity

20 / 15 5 / 10 (%) STRAIN AT FAILURE

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RECORD OF BOREHOLE No FS23-04 1 OF 5 METRIC

GWP# 3025-20-00 LOCATION N 4 813 656.3 E 226 188.4 ORIGINATED BY HC

DIST Western HWY 7/85 BOREHOLE TYPE 205 mm I.D. Hollow Stem Auger, 125 mm diameter tricone (Mud Rotary) COMPILED BY JW

DATUM Geodetic DATE 2023.04.11 - 2023.04.21 LATITUDE 43.458692 LONGITUDE -80.471426 CHECKED BY AK

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (20 40 60 80 100) o UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
320.8	GROUND SURFACE									
0.0 / 320.5	**ASPHALT:** (300 mm)									
0.3	Gravelly **SAND** Compact to Dense Brown Moist (FILL)		1	SS	17					35 53 12 (SI+CL)
319.6			2	SS	21		320			
1.2	Clayey **SILT**, some sand Hard Brown Moist (FILL)		3	SS	30		319			0 10 55 35
319.0 / 1.8										
318.6 / 2.2	**SAND**, trace silt, trace gravel Dense Brown Moist (FILL)		4	SS	21		318			0 4 45 51
	Silty **CLAY**, trace sand Very Stiff to Hard Brown to Grey Moist to Wet		5	SS	22		317			
			7	SS	25		316			
			8	SS	24		315			
			9	SS	19		314			
			10	SS	48		313			
							312			
							311			

Continued Next Page

$+^3$, $\times^3$: Numbers refer to Sensitivity

20 / 15 5 / 10 (%) STRAIN AT FAILURE

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No FS23-04 2 OF 5 METRIC

GWP# 3025-20-00 LOCATION N 4 813 656.3 E 226 188.4 ORIGINATED BY HC

DIST Western HWY 7/85 BOREHOLE TYPE 205 mm I.D. Hollow Stem Auger, 125 mm diameter tricone (Mud Rotary) COMPILED BY JW

DATUM Geodetic DATE 2023.04.11 - 2023.04.21 LATITUDE 43.458692 LONGITUDE -80.471426 CHECKED BY AK

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (20 40 60 80 100) ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	Continued From Previous Page										
310.6											
10.2	**SILT**, some sand Very Dense Grey Wet		11	SS	67		310				0 18 74 8
							309				
308.4			12	SS	54		308				
12.4	Silty **CLAY**, trace sand Very Stiff Grey Moist										
			13	SS	57		307				0 2 39 59
			14	SS	49		306				
			15	SS	50		305				
			16	SS	60		304				
							303				
							302				
							301				

Continued Next Page

$+^3$, $\times^3$: Numbers refer to Sensitivity

$\frac{20}{15}\oplus\frac{5}{10}$ (%) STRAIN AT FAILURE

Ministry of Transportation
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THURBER

RECORD OF BOREHOLE No FS23-04 3 OF 5 METRIC

GWP# 3025-20-00 LOCATION N 4 813 656.3 E 226 188.4 ORIGINATED BY HC

DIST Western HWY 7/85 BOREHOLE TYPE 205 mm I.D. Hollow Stem Auger, 125 mm diameter tricone (Mud Rotary) COMPILED BY JW

DATUM Geodetic DATE 2023.04.11 - 2023.04.21 LATITUDE 43.458692 LONGITUDE -80.471426 CHECKED BY AK

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (20 40 60 80 100): ○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	Continued From Previous Page										
	Silty **CLAY**, trace sand Very Stiff Grey Moist		17	SS	49		300		○		
							299				
			18	SS	42		298		○		
							297				
							296				
							295				
			19	SS	28		294		○		
293.1											
27.7	Silty **SAND** Very Dense Brown Wet						293				
							292				
			20	SS	60				○		0 84 16 (SI+CL)
							291				

Continued Next Page

$+^3$, $\times^3$: Numbers refer to Sensitivity

$\frac{20}{15}\oplus\frac{5}{10}$ (%) STRAIN AT FAILURE

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RECORD OF BOREHOLE No FS23-04 4 OF 5 METRIC

GWP# 3025-20-00 LOCATION N 4 813 656.3 E 226 188.4 ORIGINATED BY HC

DIST Western HWY 7/85 BOREHOLE TYPE 205 mm I.D. Hollow Stem Auger, 125 mm diameter tricone (Mud Rotary) COMPILED BY JW

DATUM Geodetic DATE 2023.04.11 - 2023.04.21 LATITUDE 43.458692 LONGITUDE -80.471426 CHECKED BY AK

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (20 40 60 80 100): O UNCONFINED, + FIELD VANE, ● QUICK TRIAXIAL, × LAB VANE	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	Continued From Previous Page										
290.1											
30.8	Clayey **SILT**, trace sand to sandy Hard Grey Wet (TILL)						290				
							289				
			21	SS	125/ 0.275						8 34 47 11
							288				
							287				
							286				
			22	SS	75/ 0.200						5 60 28 7
							285				
							284				
							283				
282.5			23	SS	100/ 0.225						
38.3	END OF BOREHOLE AT 38.3 m. NOTE: 1. ARTESIAN CONDITIONS ENCOUNTERED WHEN AT A DEPTH OF 38.1 m. WATER LEVEL MEASURED AT 1.6 m ABOVE GROUND SURFACE IN RODS WHEN END OF TRICONE AT A DEPTH OF 29.4 m BELOW										

Continued Next Page

+ ^{3}, × ^{3}: Numbers refer to Sensitivity

15 20 10 5 (%) STRAIN AT FAILURE

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RECORD OF BOREHOLE No FS23-04 5 OF 5 METRIC

GWP# 3025-20-00 LOCATION N 4 813 656.3 E 226 188.4 ORIGINATED BY HC

DIST Western HWY 7/85 BOREHOLE TYPE 205 mm I.D. Hollow Stem Auger, 125 mm diameter tricone (Mud Rotary) COMPILED BY JW

DATUM Geodetic DATE 2023.04.11 - 2023.04.21 LATITUDE 43.458692 LONGITUDE -80.471426 CHECKED BY AK

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa: O UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES						GR SA SI CL
	Continued From Previous Page										
	GROUND SURFACE. BOREHOLE DECOMMISSIONED WITH CEMENTITIOUS GROUT.										

$+^3$, $\times^3$: Numbers refer to Sensitivity

20 / 15 5 / 10 (%) STRAIN AT FAILURE

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RECORD OF BOREHOLE No FS23-05 1 OF 5 METRIC

GWP# 3025-20-00 LOCATION N 4 813 712.3 E 226 247.1 ORIGINATED BY HC/KO

DIST Western HWY 7/85 BOREHOLE TYPE 205 mm O.D. Hollow Stem Augers; 125 mm diameter tricone mud rotary COMPILED BY AK

DATUM Geodetic DATE 2023.05.11 - 2023.05.18 LATITUDE 43.459202 LONGITUDE -80.470709 CHECKED BY KS

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa: ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
325.3	GROUND SURFACE										
0.0	**TOPSOIL:** (125 mm)										
0.1	**SAND**, some gravel Very Loose to Compact Brown Moist to Wet		1	SS	5		325		○		
			2	SS	5				○		
							324				
			3	SS	3				○		
							323				
			4	SS	6				○		
							322				
			5	SS	16				○		
			6	SS	15		321		○		15 73 11 1
			7	SS	16				○		
							320				
	Wet below a depth of 3.0 m		8	SS	18				○		
			9	SS	19		319		○		
318.1											
7.2	Sandy Clayey **SILT**, some gravel Firm to Very Stiff Grey Moist to Wet (TILL)						318				
			10	SS	7				⊢○		12 30 45 13
							317				
			11	SS	25		316		○		

Continued Next Page

$+^3$, $\times^3$: Numbers refer to Sensitivity

$\frac{20}{15}$ 5 $\frac{}{10}$ (%) STRAIN AT FAILURE

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RECORD OF BOREHOLE No FS23-05 2 OF 5 METRIC

GWP# 3025-20-00 LOCATION N 4 813 712.3 E 226 247.1 ORIGINATED BY HC/KO

DIST Western HWY 7/85 BOREHOLE TYPE 205 mm O.D. Hollow Stem Augers; 125 mm diameter tricone mud rotary COMPILED BY AK

DATUM Geodetic DATE 2023.05.11 - 2023.05.18 LATITUDE 43.459202 LONGITUDE -80.470709 CHECKED BY KS

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (20 40 60 80 100) O UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	Continued From Previous Page									
314.6	Sandy Clayey **SILT**, some gravel Firm to Very Stiff Grey Moist to Wet (TILL)						315			
10.7	Silty **CLAY**, trace sand Hard Grey Moist		12	SS	36		314			
			13	SS	41		313			
			14	SS	36		312			0 1 35 64
310.5							311			
14.8	Clayey **SILT**, some sand Hard Grey Wet		15	SS	86		310			0 16 67 17
			16	SS	67		309			
							308			
			17	SS	113		307			
306.0							306			
19.3	Silty **CLAY** to **CLAY** Hard Grey Wet									

Continued Next Page

$+^3$, $\times^3$: Numbers refer to Sensitivity

20 / 15 5 / 10 (%) STRAIN AT FAILURE

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RECORD OF BOREHOLE No FS23-05 3 OF 5 METRIC

GWP# 3025-20-00 LOCATION N 4 813 712.3 E 226 247.1 ORIGINATED BY HC/KO

DIST Western HWY 7/85 BOREHOLE TYPE 205 mm O.D. Hollow Stem Augers; 125 mm diameter tricone mud rotary COMPILED BY AK

DATUM Geodetic DATE 2023.05.11 - 2023.05.18 LATITUDE 43.459202 LONGITUDE -80.470709 CHECKED BY KS

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (20 40 60 80 100) o UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES						GR SA SI CL
	Continued From Previous Page										
	Silty **CLAY** to **CLAY** Hard Grey Wet		18	SS	42		305		o		
							304				
							303				
			19	SS	47		302		o		
							301				
							300				
			20	SS	38		299		o—|		
							298				
							297				
			21	SS	37		296		o—|		0 0 20 80

Continued Next Page

$+^3$, $\times^3$: Numbers refer to Sensitivity

20 / 15 ⊕ 5 / 10 (%) STRAIN AT FAILURE

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RECORD OF BOREHOLE No FS23-05 4 OF 5 METRIC

GWP# 3025-20-00 LOCATION N 4 813 712.3 E 226 247.1 ORIGINATED BY HC/KO

DIST Western HWY 7/85 BOREHOLE TYPE 205 mm O.D. Hollow Stem Augers; 125 mm diameter tricone mud rotary COMPILED BY AK

DATUM Geodetic DATE 2023.05.11 - 2023.05.18 LATITUDE 43.459202 LONGITUDE -80.470709 CHECKED BY KS

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (20 40 60 80 100): ○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	Continued From Previous Page										
	Silty **CLAY** to **CLAY** Hard Grey Wet						295 294				
293.0			22	SS	85		293		○		
32.3	Sandy **SILT** Very Dense Grey Wet						292 291		○		0 30 62 8
289.9			23	SS	99		290		○		
35.4	Sandy Silty **CLAY**, trace gravel Hard Grey Wet (TILL)						289 288		○		
			24	SS	124/ ~~0.228~~		287 286		○		2 28 51 19

Continued Next Page

$+^3$, $\times^3$: Numbers refer to Sensitivity

$\frac{20}{15 \oplus 5}$ (%) STRAIN AT FAILURE

Ministry of Transportation
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THURBER

RECORD OF BOREHOLE No FS23-05 5 OF 5 METRIC

GWP# 3025-20-00 LOCATION N 4 813 712.3 E 226 247.1 ORIGINATED BY HC/KO

DIST Western HWY 7/85 BOREHOLE TYPE 205 mm O.D. Hollow Stem Augers; 125 mm diameter tricone mud rotary COMPILED BY AK

DATUM Geodetic DATE 2023.05.11 - 2023.05.18 LATITUDE 43.459202 LONGITUDE -80.470709 CHECKED BY KS

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (20 40 60 80 100): O UNCONFINED, + FIELD VANE, ● QUICK TRIAXIAL, × LAB VANE	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES						GR SA SI CL
	Continued From Previous Page										
	Sandy Silty **CLAY**, trace gravel Hard Grey Wet (TILL)						285				
283.8			25	SS	114		284				
41.5	END OF BOREHOLE AT 41.5 m. NOTE: 1. WATER LEVEL NOT MEASURED UPON COMPLETION OF DRILLING DUE TO INTRODUCTION OF MUD FOR TRICONE MUD ROTARY.										

$+^3$, $\times^3$: Numbers refer to Sensitivity

20 / 15 5 / 10 (%) STRAIN AT FAILURE

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RECORD OF BOREHOLE No FS23-06 1 OF 5 METRIC

GWP# 3025-20-00 LOCATION N 4 813 673.8 E 226 235.5 ORIGINATED BY LS/HC

DIST Western HWY 7/85 BOREHOLE TYPE Hydroexcavation; 205 mm O.D. Hollow Stem Augers; 125 mm diameter tricone mud rotary COMPILED BY AK

DATUM Geodetic DATE 2023.05.19 - 2023.05.26 LATITUDE 43.458854 LONGITUDE -80.470847 CHECKED BY KS

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
325.4	GROUND SURFACE										
0.0	Silty **SAND**, trace gravel Brown Moist (FILL) Contains asphalt fragments and rootlets		1	GS	-		325		○		
			2	GS	-		324		○		
							323				
			3	GS	-				○		5 79 16 (SI+CL)
321.6							322				
3.8	**SAND** Compact Brown Moist (FILL)		4	SS	25		321		○		
319.8							320				
5.6	Sandy Silty **CLAY**, trace gravel Stiff to Hard Brown Moist (TILL)		5	SS	10		319		○		
			6	SS	65		318		⊖		5 28 43 24
316.4							317				
9.0	Silty **SAND** Very Dense Brownish Grey Wet		7	SS	78		316		○		0 78 22 (SI+CL)

Continued Next Page

$+^3$, $\times^3$: Numbers refer to Sensitivity

$\frac{20}{15 \oplus 5}$ (%) STRAIN AT FAILURE
10

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THURBER

RECORD OF BOREHOLE No FS23-06 2 OF 5 METRIC

GWP# 3025-20-00 LOCATION N 4 813 673.8 E 226 235.5 ORIGINATED BY LS/HC

DIST Western HWY 7/85 BOREHOLE TYPE Hydroexcavation; 205 mm O.D. Hollow Stem Augers; 125 mm diameter tricone mud rotary COMPILED BY AK

DATUM Geodetic DATE 2023.05.19 - 2023.05.26 LATITUDE 43.458854 LONGITUDE -80.470847 CHECKED BY KS

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (O UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	Continued From Previous Page							20 40 60 80 100	20 40 60		
315.2											
10.2	Silty **CLAY** Very Stiff to Hard Grey Moist		8	SS	36		315		o		
							314				
			9	SS	54		313		o		
							312				
			10	SS	37		311				
			11	SS	21		310		o		0 0 29 71
							309				
			12	SS	34				o		
307.6							308				
17.8	Silty **SAND** Very Dense Grey Wet		13	SS	96		307		o		
							306				

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$+^3$, $\times^3$: Numbers refer to Sensitivity

$\frac{20}{15}$ 5 $\frac{}{10}$ (%) STRAIN AT FAILURE

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RECORD OF BOREHOLE No FS23-06 3 OF 5 METRIC

GWP# 3025-20-00 LOCATION N 4 813 673.8 E 226 235.5 ORIGINATED BY LS/HC

DIST Western HWY 7/85 BOREHOLE TYPE Hydroexcavation; 205 mm O.D. Hollow Stem Augers; 125 mm diameter tricone mud rotary COMPILED BY AK

DATUM Geodetic DATE 2023.05.19 - 2023.05.26 LATITUDE 43.458854 LONGITUDE -80.470847 CHECKED BY KS

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	Continued From Previous Page										
	Silty **SAND** Very Dense Grey Wet		14	SS	82		305		○		
303.8							304				
21.6	Silty **CLAY** Hard Grey Wet		15	SS	51		303		○		
							302				
							301				
							300				
			16	SS	56		299		○		
							298				
							297				
			17	SS	33		296		○		

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$+^3$, $\times^3$: Numbers refer to Sensitivity

$\frac{20}{15}\oplus\frac{5}{10}$ (%) STRAIN AT FAILURE

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THURBER

RECORD OF BOREHOLE No FS23-06 4 OF 5 METRIC

GWP# 3025-20-00 LOCATION N 4 813 673.8 E 226 235.5 ORIGINATED BY LS/HC

DIST Western HWY 7/85 BOREHOLE TYPE Hydroexcavation; 205 mm O.D. Hollow Stem Augers; 125 mm diameter tricone mud rotary COMPILED BY AK

DATUM Geodetic DATE 2023.05.19 - 2023.05.26 LATITUDE 43.458854 LONGITUDE -80.470847 CHECKED BY KS

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	Continued From Previous Page										
294.6	Silty **CLAY** Hard Grey Wet						295				
30.8	**SILT**, trace sand Very Dense Grey Wet (TILL)						294				
			18	SS	102		293				0 7 66 27
291.6							292				
33.8	**GRAVEL** and **SAND**, trace non-plastic fines Very Dense Grey Wet						291				
289.9			19	SS	52		290				52 41 7 (SI+CL)
35.5	Sandy Clayey **SILT**, trace gravel Hard Grey Wet (TILL)						289				
							288				
			20	SS	102		287				
							286				

Continued Next Page

$+^3$, $\times^3$: Numbers refer to Sensitivity

$\frac{20}{15}$ $\frac{5}{10}$ (%) STRAIN AT FAILURE

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Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No FS23-06 5 OF 5 METRIC

GWP# 3025-20-00 LOCATION N 4 813 673.8 E 226 235.5 ORIGINATED BY LS/HC

DIST Western HWY 7/85 BOREHOLE TYPE Hydroexcavation; 205 mm O.D. Hollow Stem Augers; 125 mm diameter tricone mud rotary COMPILED BY AK

DATUM Geodetic DATE 2023.05.19 - 2023.05.26 LATITUDE 43.458854 LONGITUDE -80.470847 CHECKED BY KS

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	Continued From Previous Page										
	Sandy Clayey **SILT**, trace gravel Hard Grey Wet (TILL)						285				
283.9			21	SS	102		284		o		
41.5	END OF BOREHOLE AT 41.5 m. NOTE: 1. WATER LEVEL NOT MEASURED UPON COMPLETION OF DRILLING DUE TO INTRODUCTION OF DRILLING MUD FOR TRICONE ADVANCEMENT.										

$+^3$, $\times^3$: Numbers refer to Sensitivity

(%) STRAIN AT FAILURE

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Ontario

THURBER

RECORD OF BOREHOLE No SS23-01 1 OF 2 METRIC

GWP# 3025-20-00 LOCATION N 4 813 767.4 E 226 134.9 ORIGINATED BY HC

DIST Western HWY 7/85 BOREHOLE TYPE 205 mm O.D. Hollow Stem Augers COMPILED BY AK

DATUM Geodetic DATE 2023.05.03 - 2023.05.04 LATITUDE 43.459686 LONGITUDE -80.472103 CHECKED BY AK

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa: ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
324.7	GROUND SURFACE										
0.0	**TOPSOIL:** (150 mm)										
0.2	**SILT**, some sand, trace gravel, containing organics Loose to Compact Brown Moist		1	SS	6		324		○		
			2	SS	18				○		
322.6			3	SS	15		323		○ ○		
2.1	**SAND** Compact Brown Moist		4	SS	17		322		○ ○		
321.3			5	SS	11				○ ○		21 26 42 11
3.4	Silty **CLAY**, trace sand to sandy, trace gravel Stiff to Hard Brown to Grey Moist to Wet (TILL)		6	SS	15		321		○ ○		
320.2	200 mm sand layer at a depth of 3.7 m										
4.5	Silty **CLAY**, trace gravel, trace sand Stiff to Hard Grey Moist		7	SS	20		320		○		
			8	SS	19		319		⊢○⊣		1 4 56 39
316.5			9	SS	47		318		○		
8.2	END OF BOREHOLE AT 8.2 m. NOTE: 1. WATER LEVEL MEASURED AT A DEPTH OF 4.2 m BELOW GROUND SURFACE UPON COMPLETION OF DRILLING. Well installation consists of 25 mm diameter Schedule 40 PVC pipe with						317				

Continued Next Page

+ ^{3}, × ^{3}: Numbers refer to Sensitivity

20 / 15 5 / 10 (%) STRAIN AT FAILURE

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No SS23-01 2 OF 2 METRIC

GWP# 3025-20-00 LOCATION N 4 813 767.4 E 226 134.9 ORIGINATED BY HC

DIST Western HWY 7/85 BOREHOLE TYPE 205 mm O.D. Hollow Stem Augers COMPILED BY AK

DATUM Geodetic DATE 2023.05.03 - 2023.05.04 LATITUDE 43.459686 LONGITUDE -80.472103 CHECKED BY AK

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa: O UNCONFINED, + FIELD VANE, ● QUICK TRIAXIAL, × LAB VANE (20 40 60 80 100)	PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L / WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES						GR SA SI CL
	Continued From Previous Page										
	a 3.05 m slotted screen. WATER LEVEL READINGS DATE DEPTH(m) ELEV.(m) 2023.06.01 4.9 319.8 2023.08.09 5.1 319.6										

$+^3$, $\times^3$: Numbers refer to Sensitivity

20 / 15 / 10 / 5 (%) STRAIN AT FAILURE

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THURBER

RECORD OF BOREHOLE No SS23-02 1 OF 1 METRIC

GWP# 3025-20-00 LOCATION N 4 813 724.3 E 226 141.6 ORIGINATED BY HC

DIST Western HWY 7/85 BOREHOLE TYPE 205 mm I.D. Hollow Stem Auger COMPILED BY AK

DATUM Geodetic DATE 2023.04.24 - 2023.04.24 LATITUDE 43.459299 LONGITUDE -80.472014 CHECKED BY AK

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa: UNCONFINED, QUICK TRIAXIAL, FIELD VANE, LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
327.4	GROUND SURFACE										
0.0 / 0.0	**ASPHALT:** (50 mm)										
	Silty **SAND** and **GRAVEL** Dense Brown Moist		1	SS	33		327		o		38 49 11 2
326.6 / 0.8	(FILL)										
	Gravelly Clayey **SAND** Stiff Brown Moist (FILL)		2	SS	10				o		27 34 29 10
			3	SS	14		326		o o		
325.2 / 2.2	Silty **SAND** to **SAND** Very Loose to Compact Brown Moist to Wet		4	SS	3		325		o		0 54 37 9
			5	SS	WH		324		o		
			6	SS	17				o o		
							323				
			7	SS	20				o		
321.8 / 5.6	Sandy Clayey **SILT**, trace gravel Stiff to Very Stiff Brown to Grey Moist to Wet (TILL) 150 mm silty sand interlayer at a depth of 6.6 m						322				
			8	SS	10		321		o o		
	Grey below a depth of 7.6 m						320				
319.2			9	SS	17				o		7 28 49 16
8.2	END OF BOREHOLE AT 8.2 m. NOTE: WATER LEVEL NOT MEASURED UPON COMPLETION OF DRILLING										

$+^3$, $\times^3$: Numbers refer to Sensitivity

$\frac{20}{15}\oplus\frac{5}{10}$ (%) STRAIN AT FAILURE

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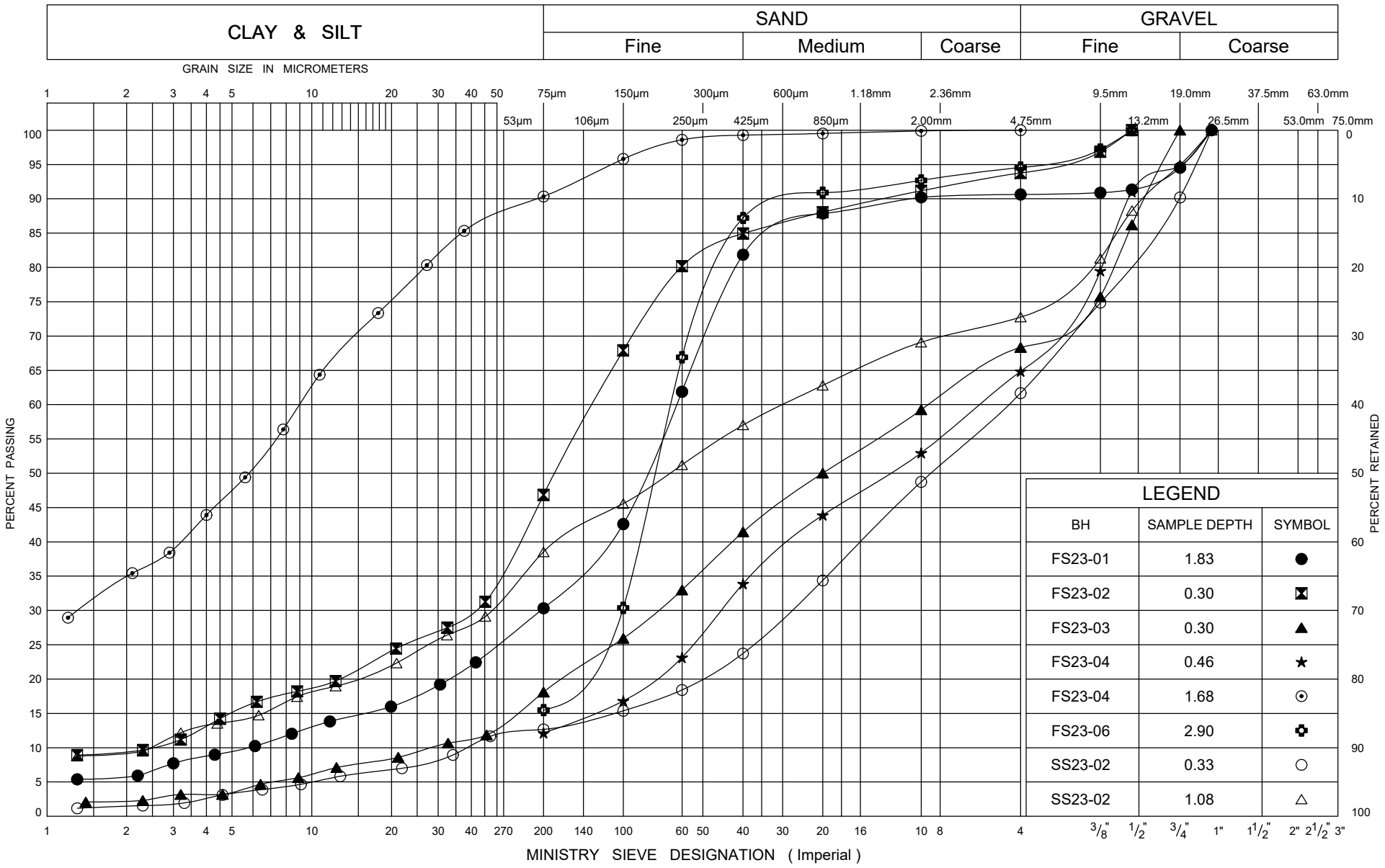
THURBER ENGINEERING LTD.

APPENDIX D

Current Investigation: Laboratory Test Results



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GRAIN SIZE DISTRIBUTION

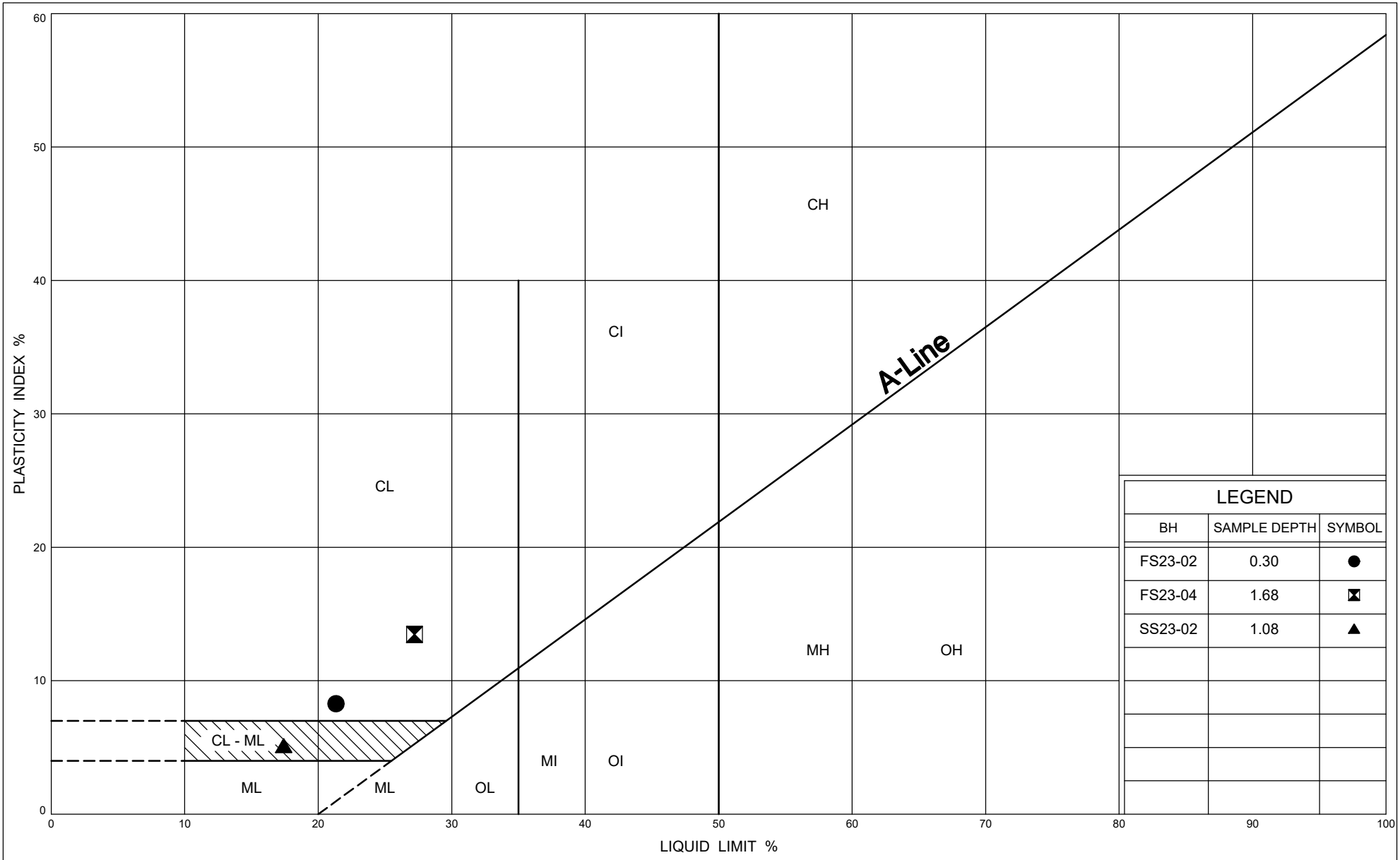
Fill (Plastic and Non-Plastic)

FIG No D1

W.P.

ONTARIO MOT GRAIN SIZE 3 MTO-35708.GPJ ONTARIO MOT.GDT 8/28/23

Oct 75, FF - S - 21



LEGEND		
BH	SAMPLE DEPTH	SYMBOL
FS23-02	0.30	●
FS23-04	1.68	⊠
SS23-02	1.08	▲

ONTARIO MOT PLASTICITY CHART 2 MTO-35708.GPJ ONTARIO MOT.GDT 8/28/23

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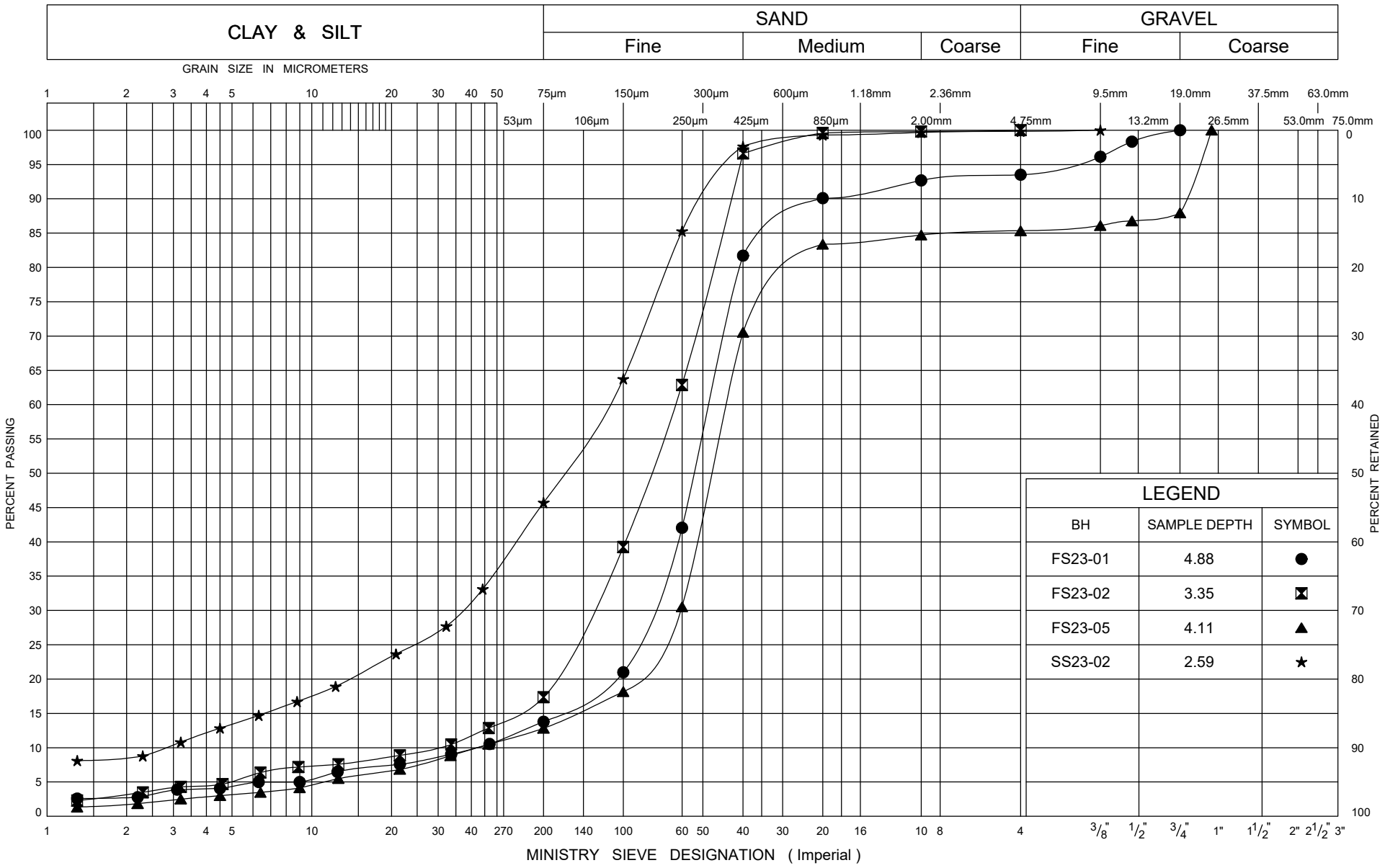
PLASTICITY CHART

Fill (Plastic)

FIG No D2

W.P.



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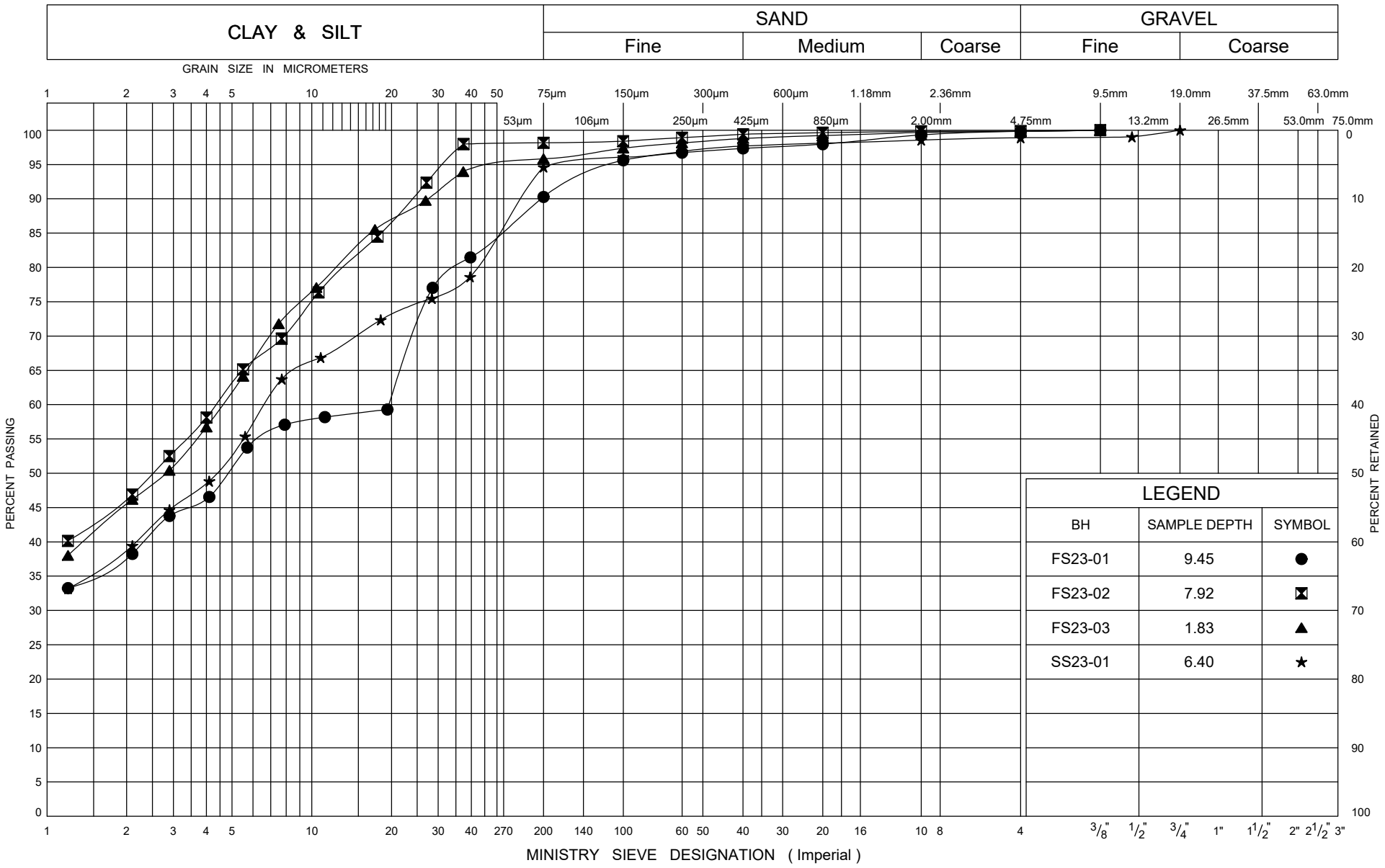
GRAIN SIZE DISTRIBUTION

Upper SAND to SILTY SAND to SILT

FIG No D3

W.P.

ONTARIO MOT GRAIN SIZE 3 MTO-35708.GPJ ONTARIO MOT.GDT 8/28/23



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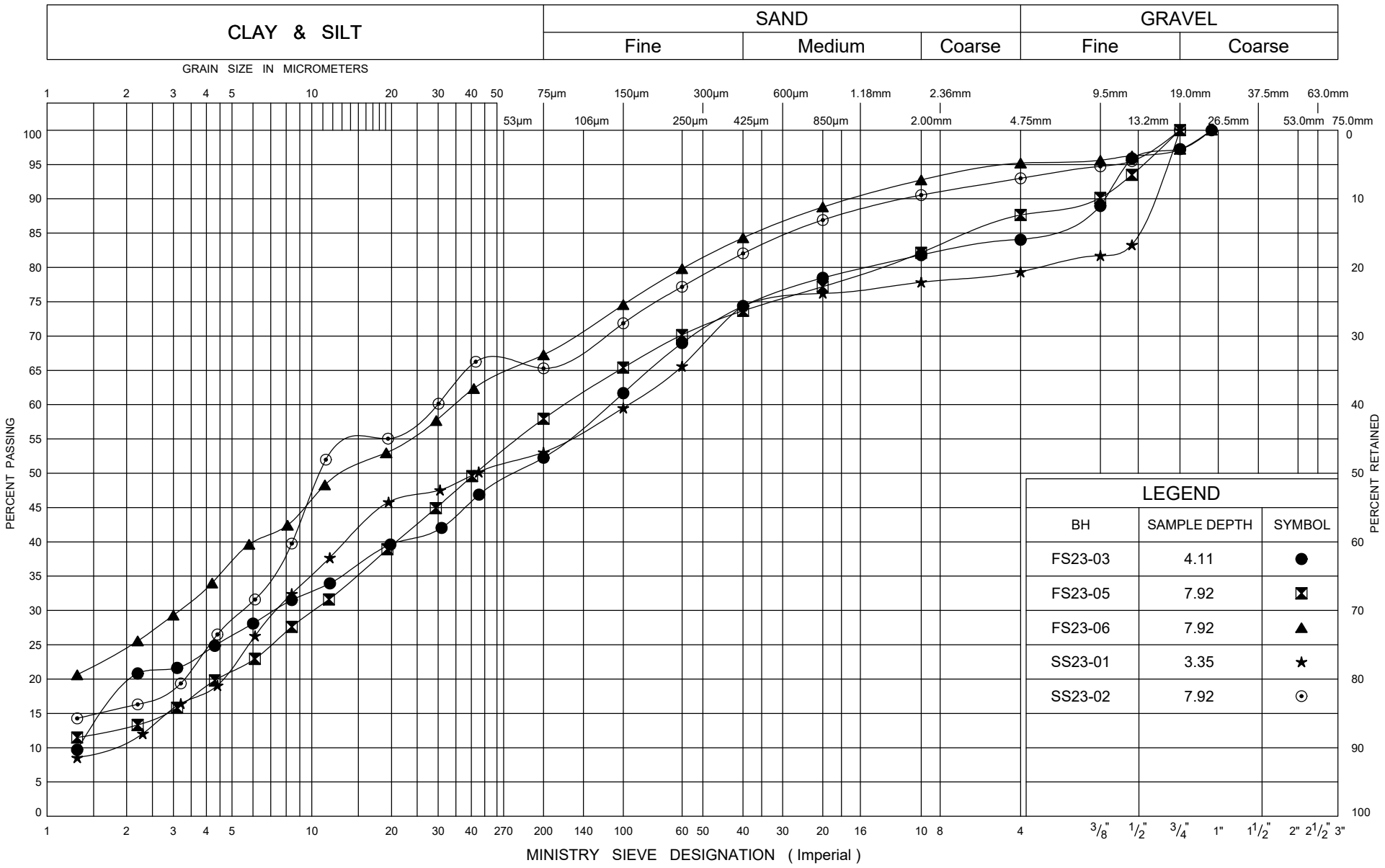
GRAIN SIZE DISTRIBUTION

SILTY CLAY to CLAYEY SILT TILL

FIG No D4A

W.P.



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GRAIN SIZE DISTRIBUTION

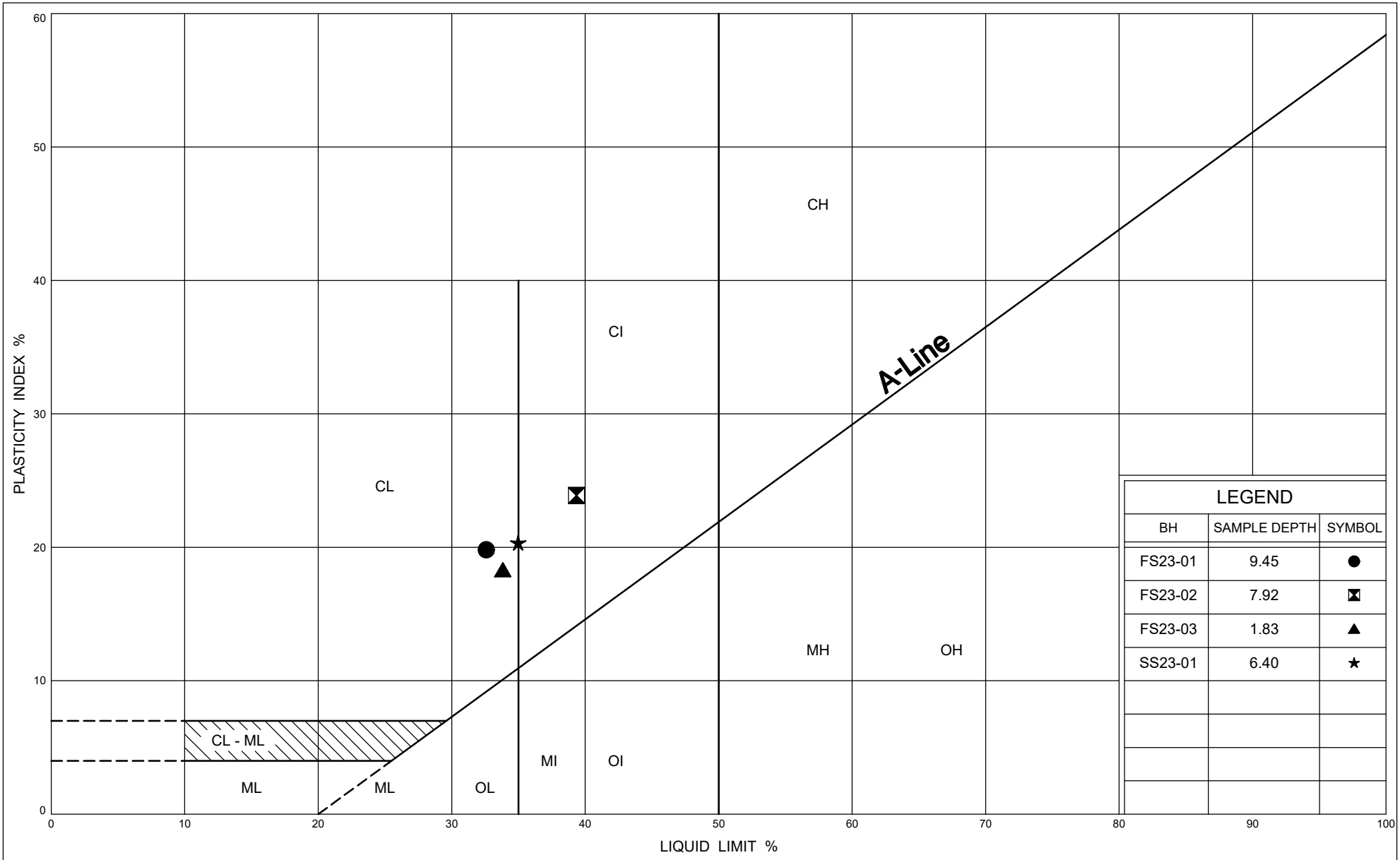
Sandy SILTY CLAY to CLAYEY SILT TILL

FIG No D4B

W.P.

ONTARIO MOT GRAIN SIZE 3 MTO-35708.GPJ ONTARIO MOT.GDT 8/28/23

Oct 75, FF - S - 21



ONTARIO MOT PLASTICITY CHART 2 MTO-35708.GPJ ONTARIO MOT.GDT 8/28/23

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PLASTICITY CHART

SILTY CLAY to CLAYEY SILT TILL

FIG No D5A

W.P.

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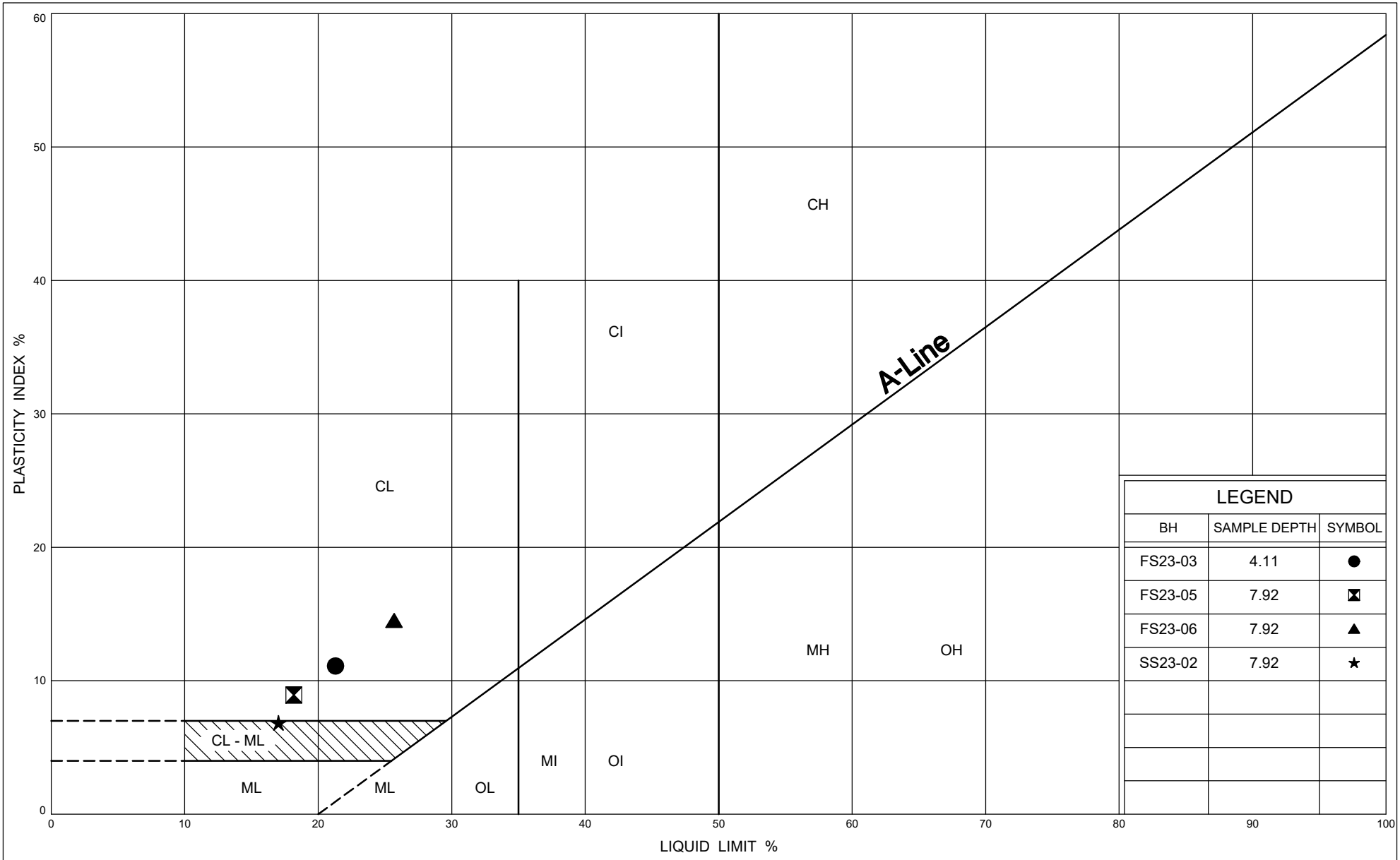

ONTARIO MOT PLASTICITY CHART 2 MTO-35708.GPJ ONTARIO MOT.GDT 8/28/23

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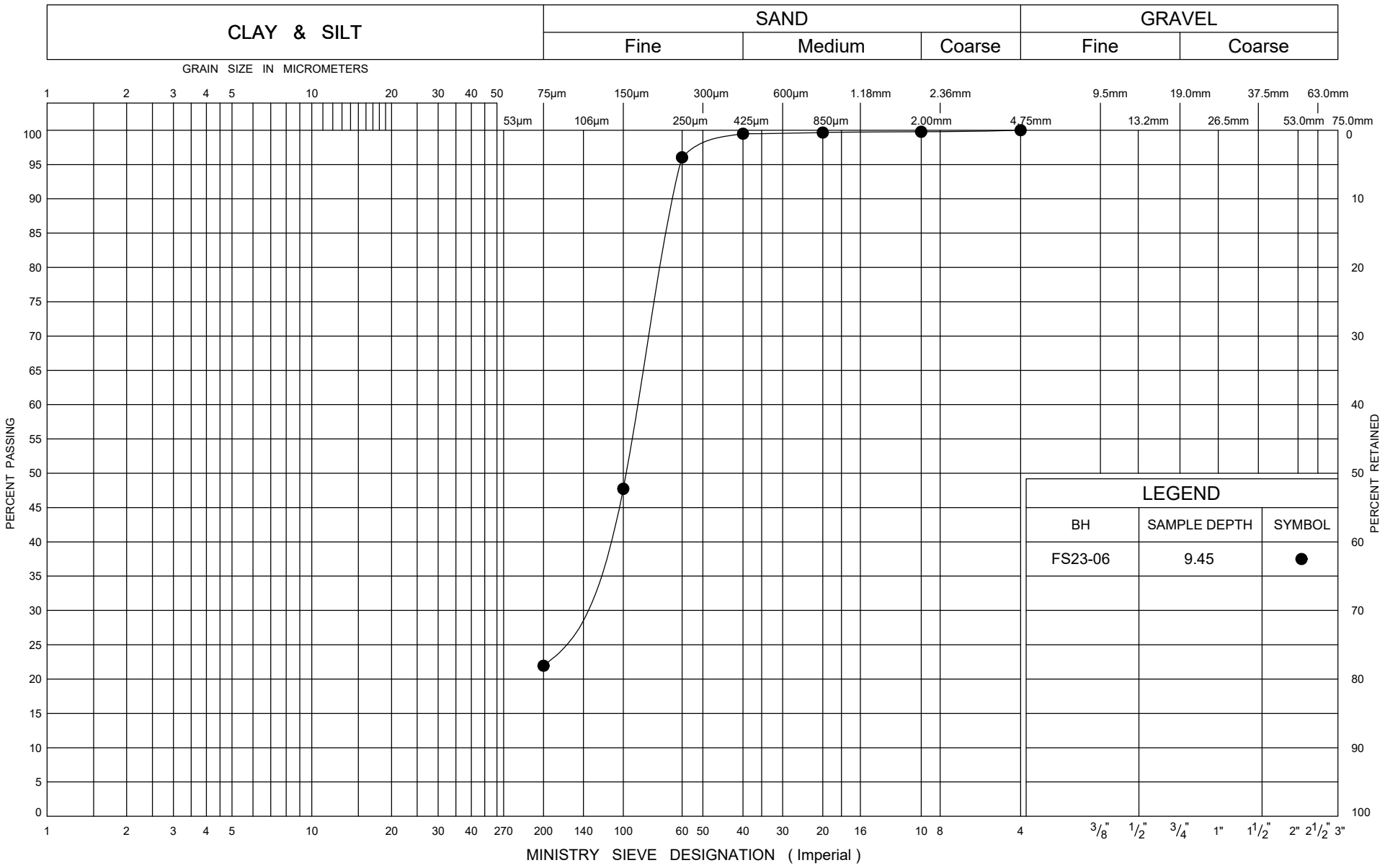
PLASTICITY CHART

Sandy SILTY CLAY to CLAYEY SILT TILL

FIG No D5B

W.P.



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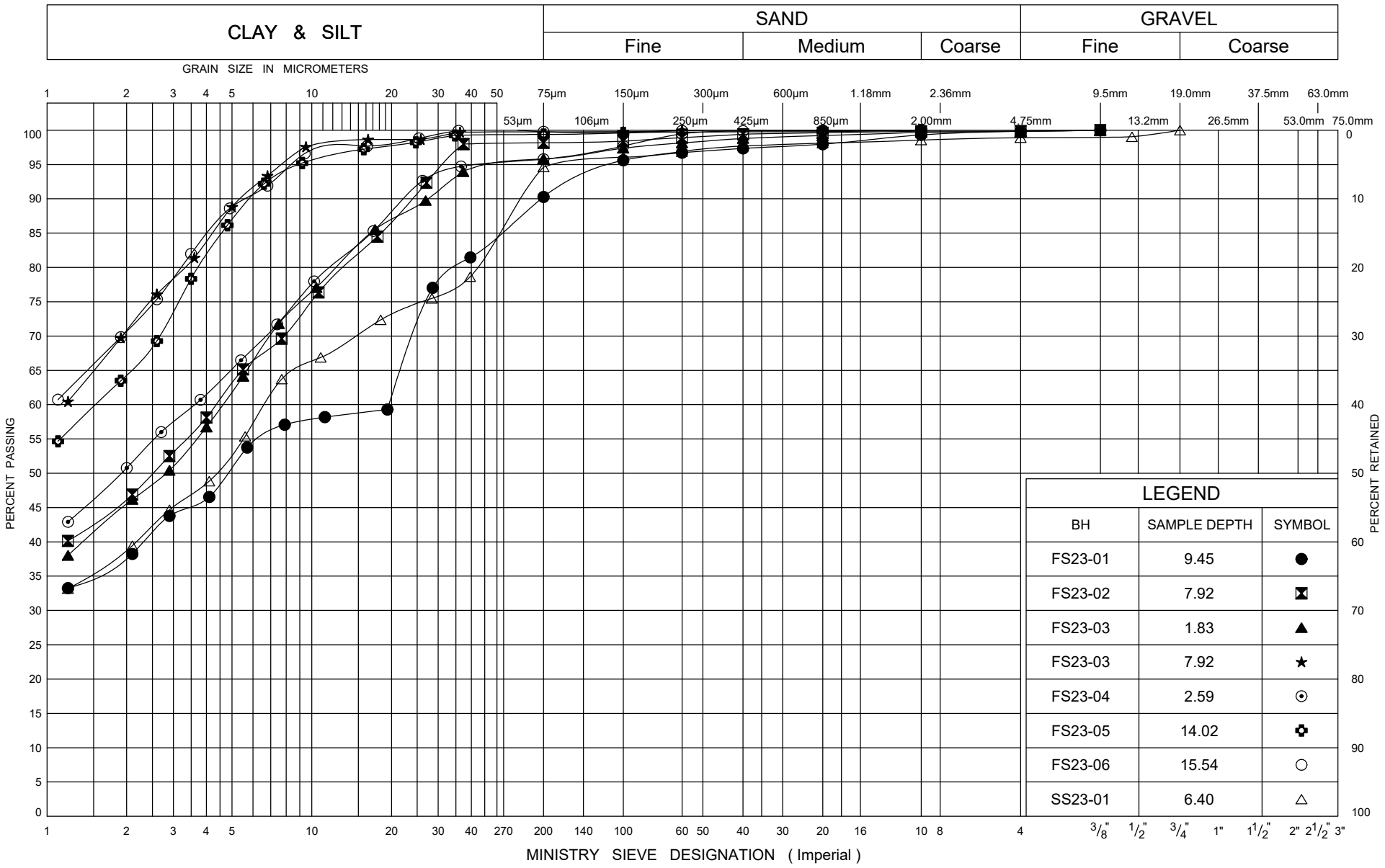
GRAIN SIZE DISTRIBUTION

SILTY SAND

FIG No D6

W.P.

ONTARIO MOT GRAIN SIZE 3 MTO-35708.GPJ ONTARIO MOT.GDT 8/28/23



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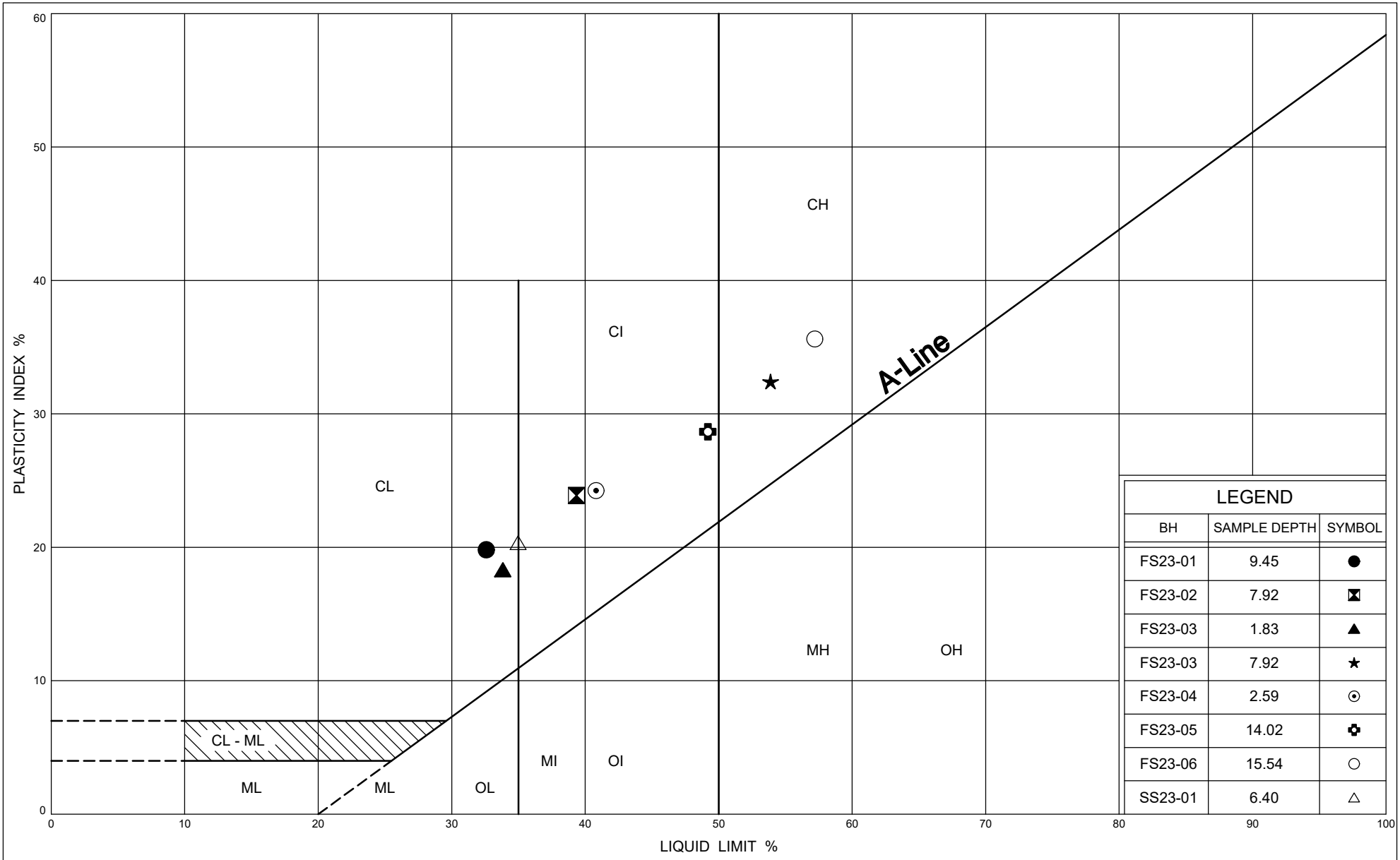
GRAIN SIZE DISTRIBUTION

Upper SILTY CLAY to CLAY

FIG No D7

W.P.

Oct 75, FF - S - 21



ONTARIO MOT PLASTICITY CHART 2 MTO-35708.GPJ ONTARIO MOT.GDT 8/28/23

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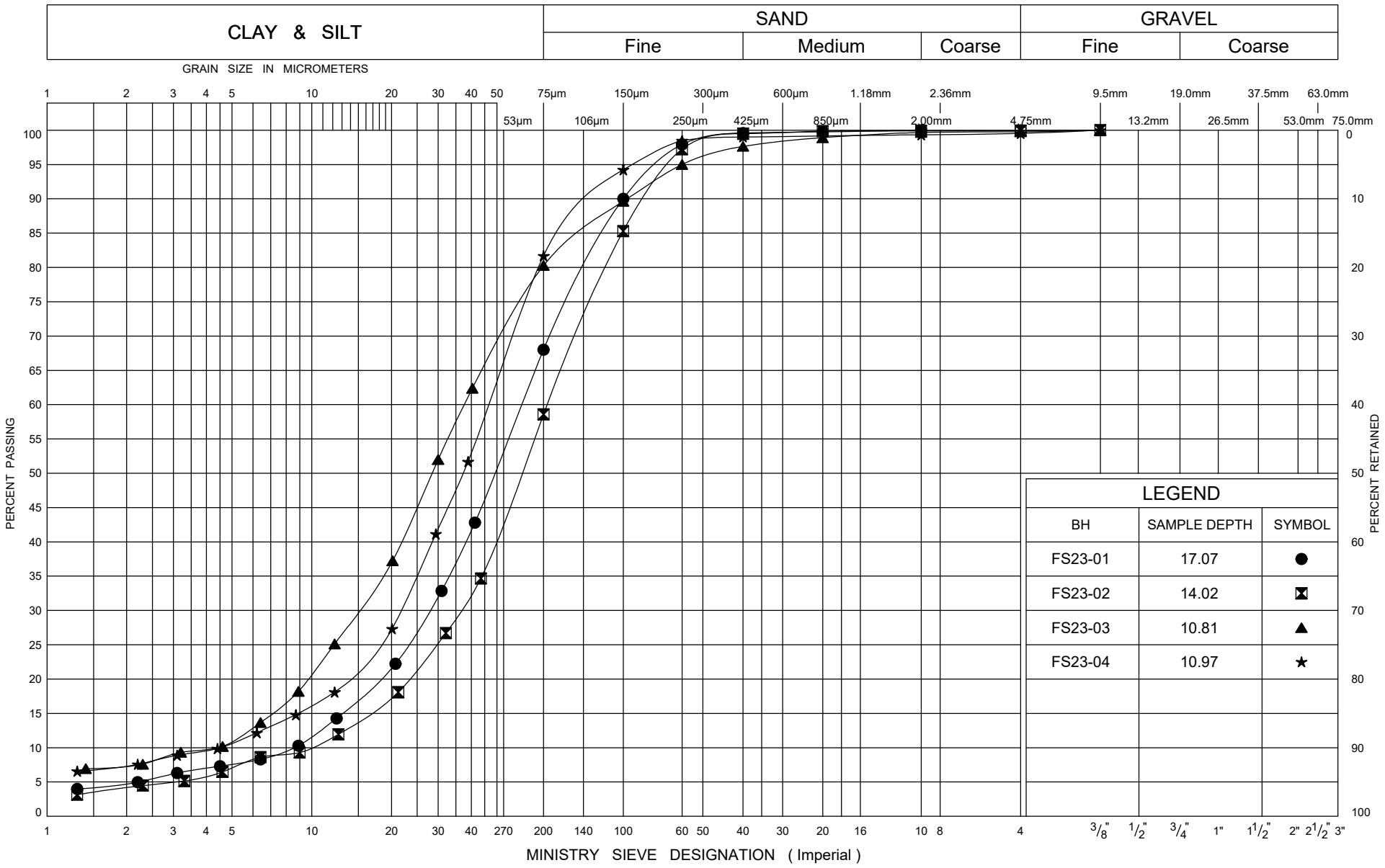
PLASTICITY CHART

Upper SILTY CLAY to CLAY

FIG No D8

W.P.



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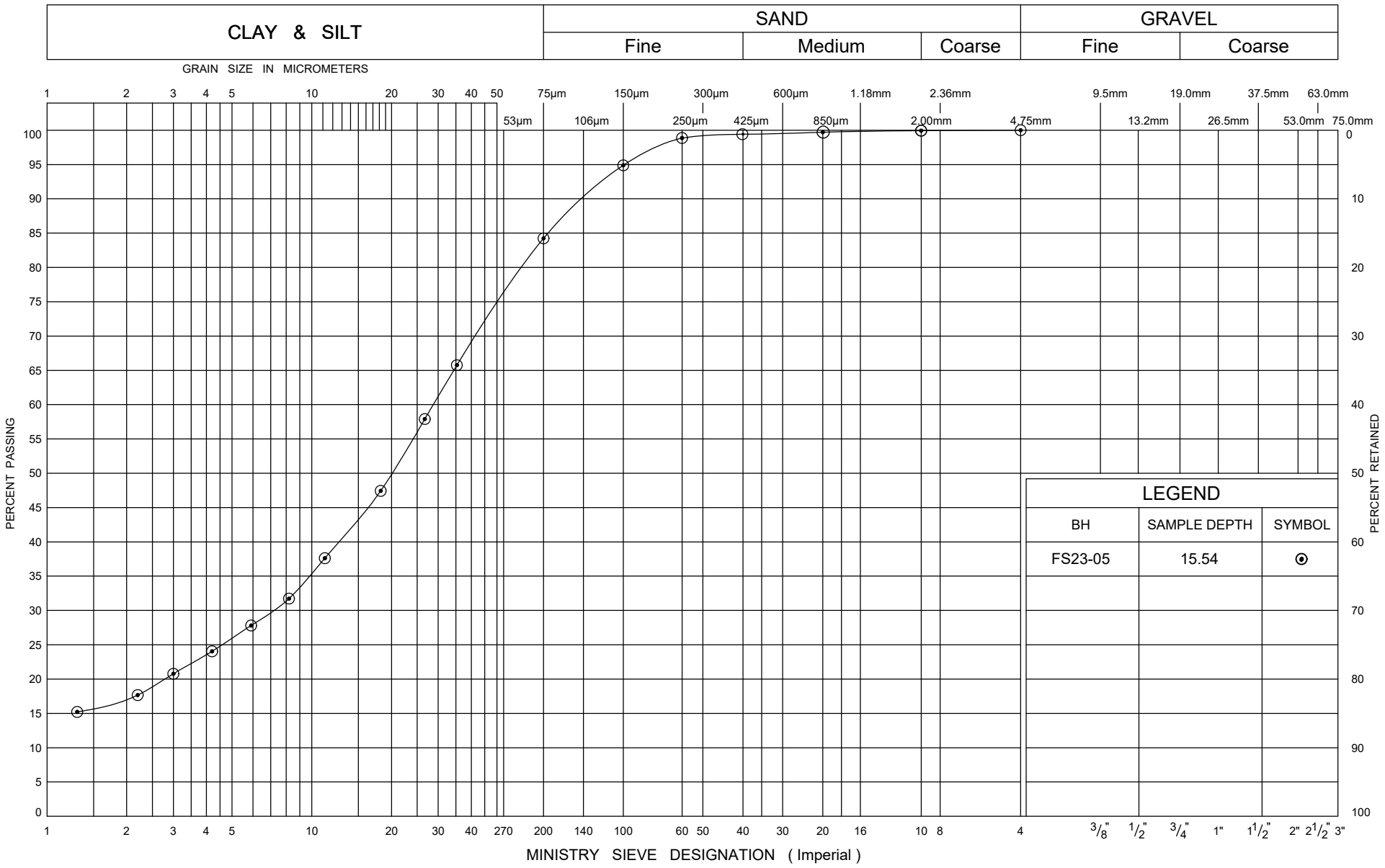
GRAIN SIZE DISTRIBUTION

SILTY SAND to SILT

FIG No D9

W.P.

ONTARIO MOT GRAIN SIZE 3 MTO-35708.GPJ ONTARIO MOT.GDT 8/28/23



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GRAIN SIZE DISTRIBUTION

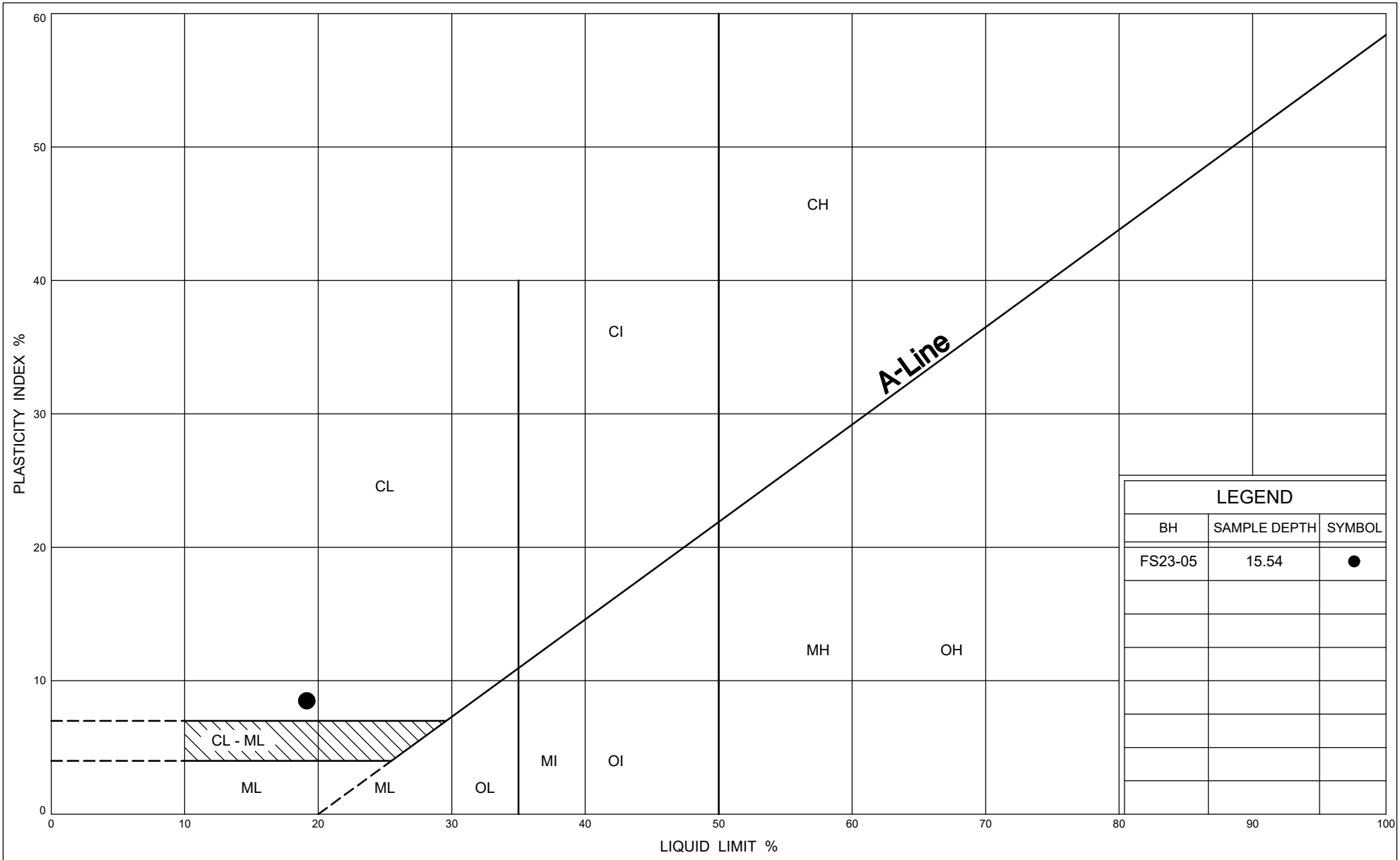
SILTY CLAY

FIG No D10

W.P.

ONTARIO MOT GRAIN SIZE 3 MTO-35708.GPJ ONTARIO MOT.GDT 8/28/23

Oct 75, FF - S - 21



ONTARIO MOT PLASTICITY CHART 2 MTO-35708.GPJ ONTARIO MOT.GDT 8/28/23

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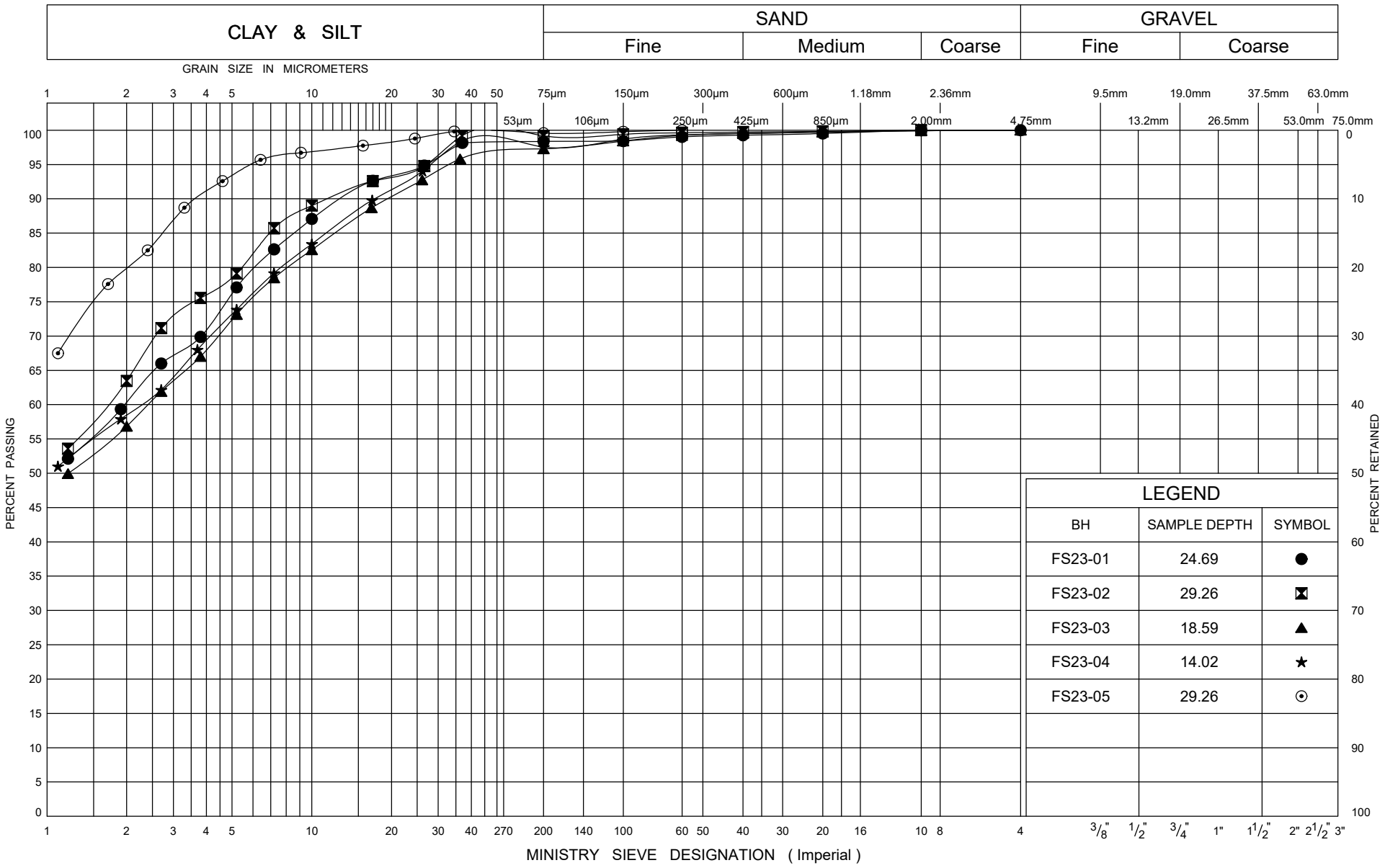
PLASTICITY CHART

SILTY CLAY

FIG No D11

W.P.



ONTARIO MOT GRAIN SIZE 3 MTO-35708.GPJ ONTARIO MOT.GDT 8/28/23

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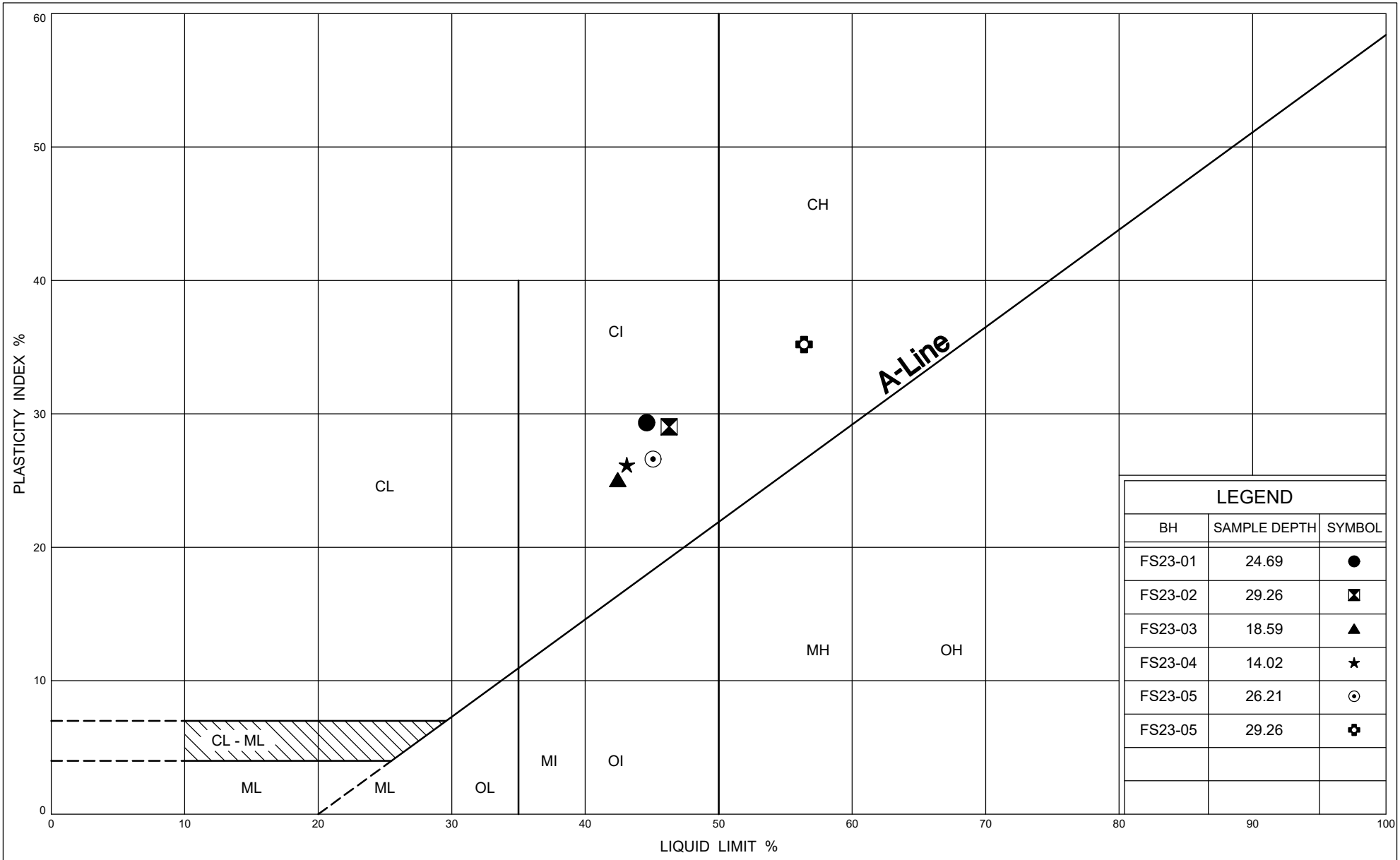
GRAIN SIZE DISTRIBUTION

Lower SILTY CLAY to CLAY

FIG No D12

W.P.

Oct 75, FF - S - 21



ONTARIO MOT PLASTICITY CHART 2 MTO-35708.GPJ ONTARIO MOT.GDT 8/28/23

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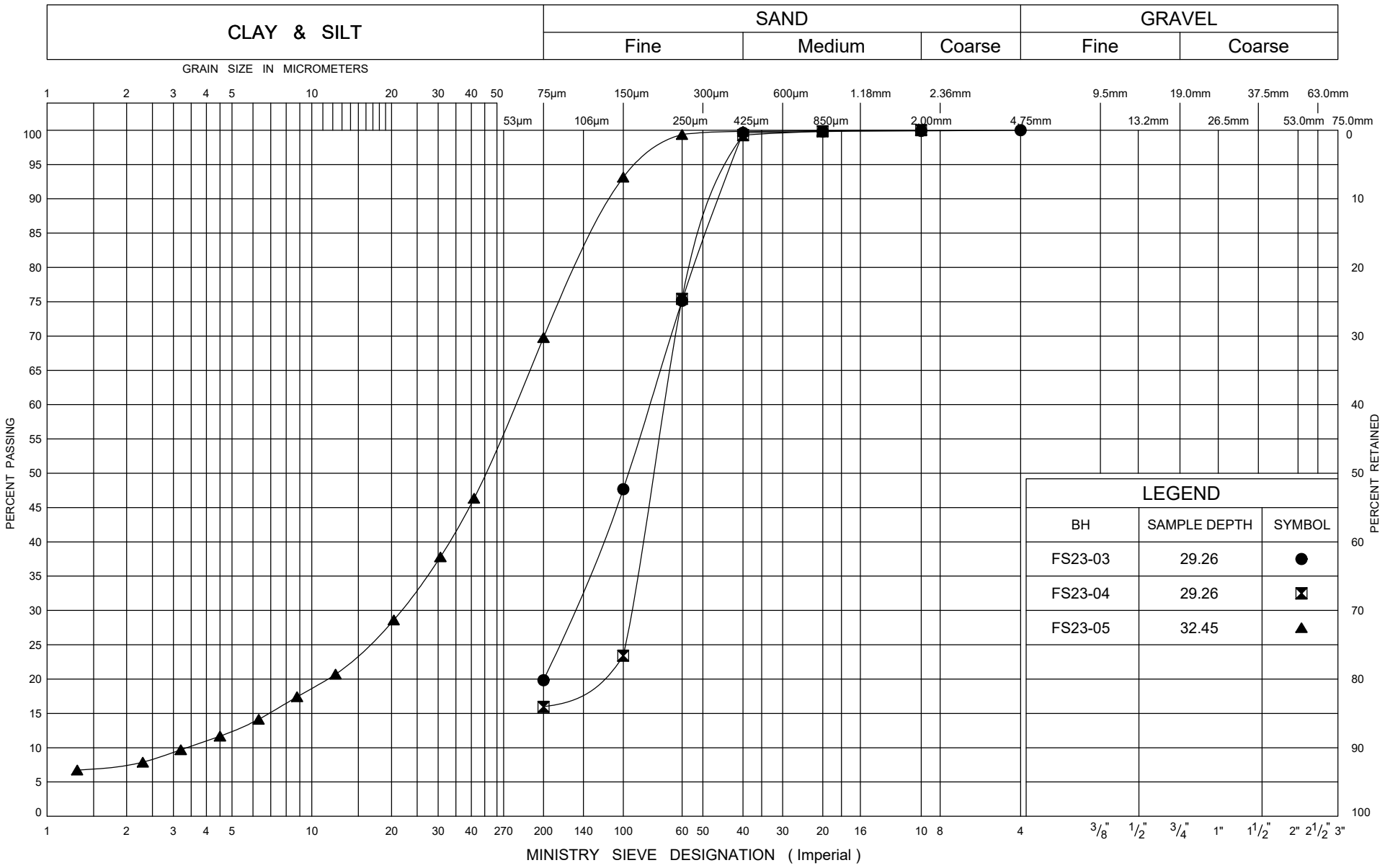
Ontario

PLASTICITY CHART

Lower SILTY CLAY to CLAY

FIG No D13

W.P.



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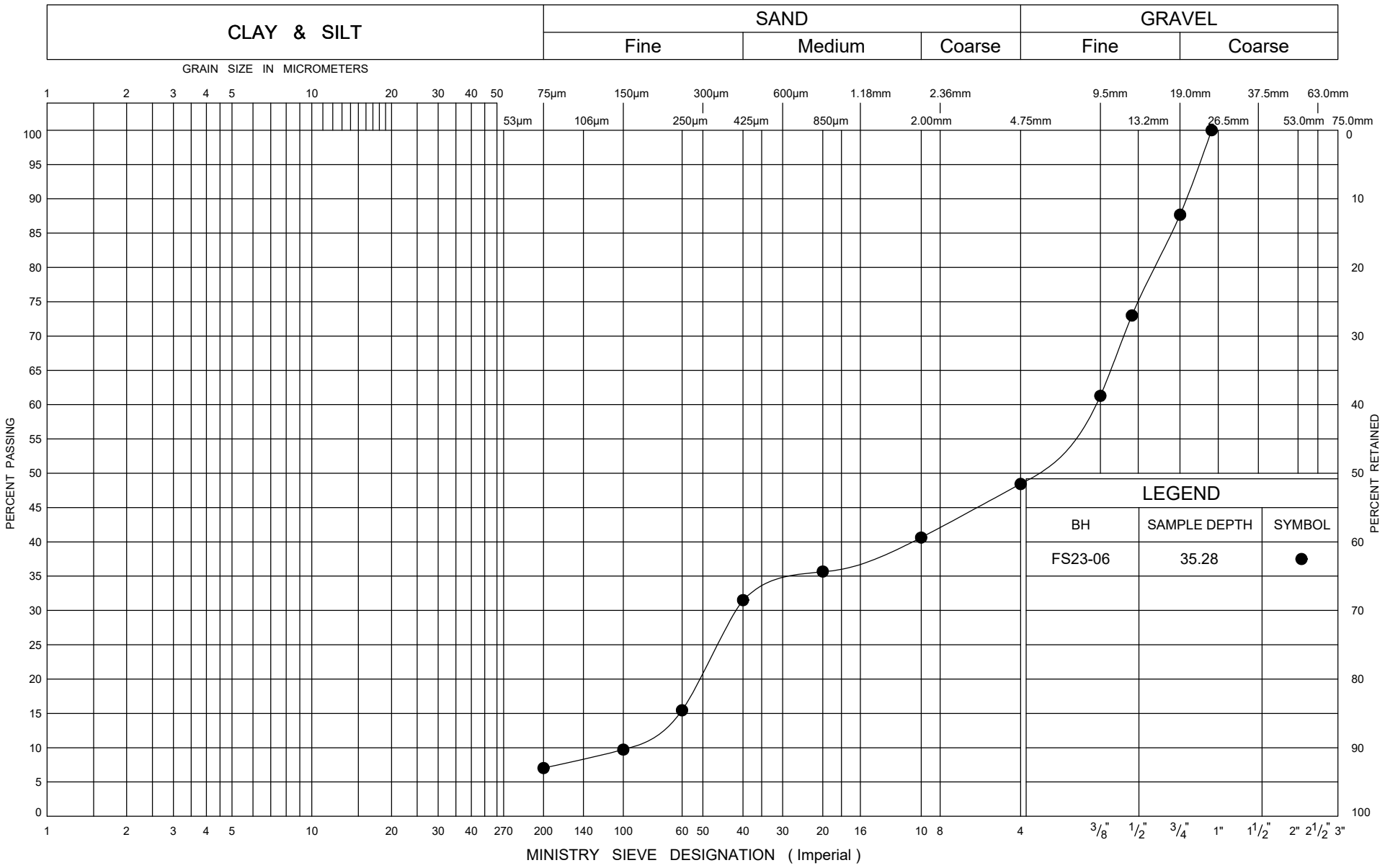
GRAIN SIZE DISTRIBUTION

Lower SAND to Sandy SILT

FIG No D14

W.P.

ONTARIO MOT GRAIN SIZE 3 MTO-35708.GPJ ONTARIO MOT.GDT 8/28/23



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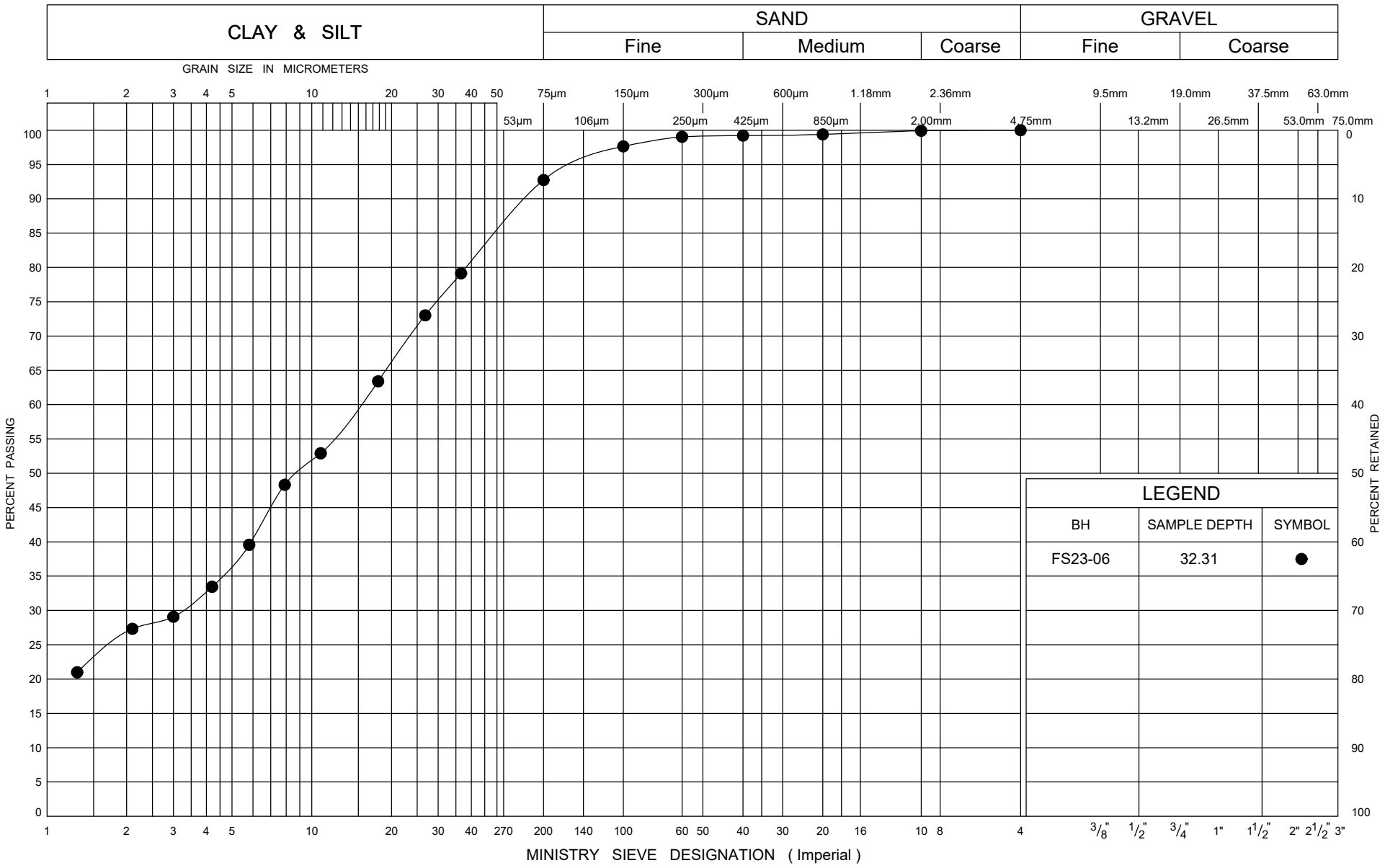
GRAIN SIZE DISTRIBUTION

GRAVEL and Sand

FIG No D15

W.P.

ONTARIO MOT GRAIN SIZE 3 MTO-35708.GPJ ONTARIO MOT.GDT 8/28/23



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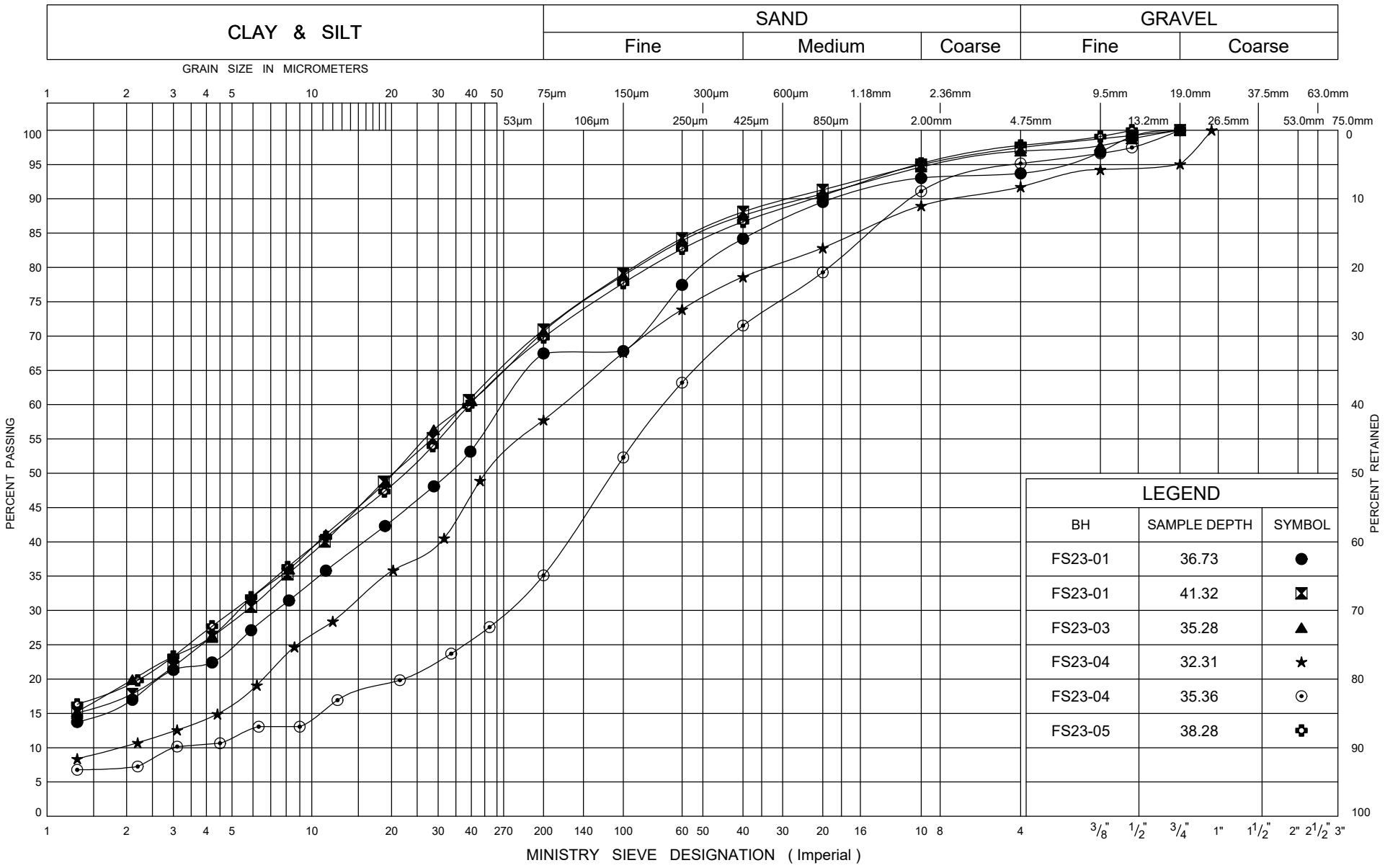
GRAIN SIZE DISTRIBUTION

Lower SILT TILL

FIG No D16A

W.P.

ONTARIO MOT GRAIN SIZE 3 MTO-35708.GPJ ONTARIO MOT.GDT 8/28/23



ONTARIO MOT GRAIN SIZE 3 MTO-35708.GPJ ONTARIO MOT.GDT 8/28/23

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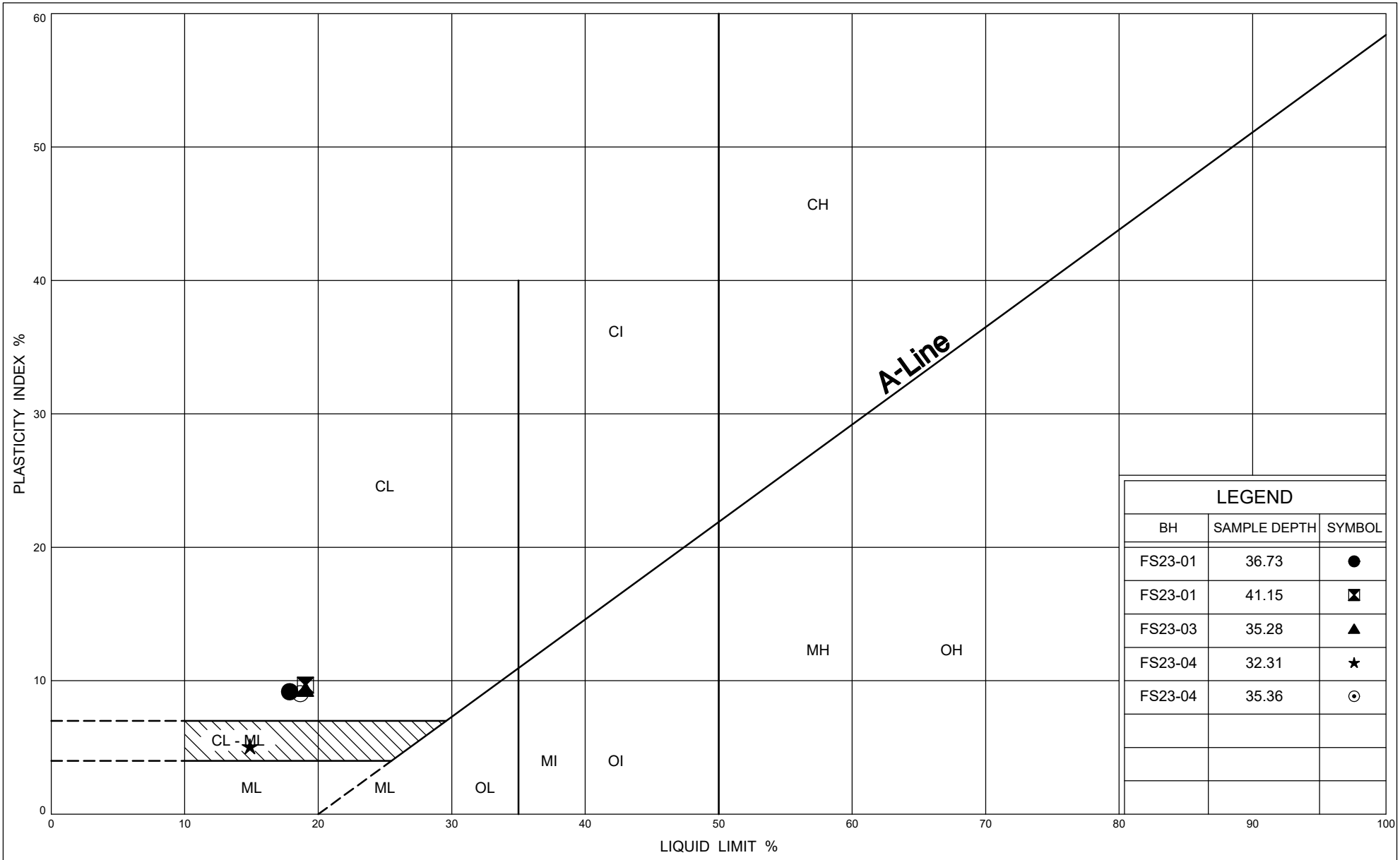
GRAIN SIZE DISTRIBUTION

Lower CLAYEY SAND to Sandy CLAYEY SILT to Sandy SILTY CLAY TILL

FIG No D16B

W.P.

Oct 75, FF - S - 21



ONTARIO MOT PLASTICITY CHART 2 MTO-35708.GPJ ONTARIO MOT.GDT 8/28/23

Ministry of Transportation
Ontario

PLASTICITY CHART

Lower CLAYEY SAND to Sandy CLAYEY SILT to Sandy SILTY CLAY TILL

FIG No D17

W.P.

FINAL REPORT

CA40281-AUG23 R1

35708, Kitchener

Prepared for

Thurber Engineering Ltd.

FINAL REPORT

First Page

CLIENT DETAILS

Client	Thurber Engineering Ltd.
Address	250 Thompson Drive, Unit 3 Cambridge, ON N1T 2H9. Canada
Contact	Alysha Kobylinski
Telephone	226-748-9593
Facsimile	
Email	akobylinski@thurber.ca
Project	35708, Kitchener
Order Number	
Samples	Soil (3)

LABORATORY DETAILS

Project Specialist	Brad Moore Hon. B.Sc
Laboratory	SGS Canada Inc.
Address	185 Concession St., Lakefield ON, K0L 2H0
Telephone	705-652-2143
Facsimile	705-652-6365
Email	brad.moore@sgs.com
SGS Reference	CA40281-AUG23
Received	08/28/2023
Approved	09/06/2023
Report Number	CA40281-AUG23 R1
Date Reported	09/06/2023

COMMENTS

Temperature of Sample upon Receipt: 7 degrees C
Cooling Agent Present: Yes
Custody Seal Present: Yes

Chain of Custody Number: 031835

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

SIGNATORIES

Brad Moore Hon. B.Sc

TABLE OF CONTENTS

FINAL REPORT

CA40281-AUG23 R1

Client: Thurber Engineering Ltd.
Project: 35708, Kitchener
Project Manager: Alysha Kobylinski
Samplers: HC

MATRIX: SOIL

Sample Number	5	6	7
Sample Name	FS23-02 SS7	FS23-04 SS5	FS23-05 SS12
Sample Matrix	Soil	Soil	Soil
Sample Date	04/05/2023	13/04/2023	12/05/2023

Parameter	Units	RL		Result	Result	Result
Corrosivity Index						
Corrosivity Index	none	1		9	6	8
Soil Redox Potential	mV	no		197	283	190
Sulphide (Na2CO3)	%	0.04		< 0.04	0.04	0.04
pH	pH Units	0.05		8.38	8.43	9.23
Resistivity (calculated)	ohms.cm	-9999		1560	2330	6940
General Chemistry						
Conductivity	uS/cm	2		642	430	144
Metals and Inorganics						
Moisture Content	%	0.1		13.6	18.2	16.1
Sulphate	µg/g	0.4		17	350	260
Other (ORP)						
Chloride	µg/g	0.4		23	98	11

QC SUMMARY

Anions by IC

Method: EPA300/MA300-Ions1.3 | Internal ref.: ME-CA-[ENV]IC-LAK-AN-001

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Chloride	DIO0758-AUG23	µg/g	0.4	<0.4	5	35	102	80	120	104	75	125
Sulphate	DIO0758-AUG23	µg/g	0.4	<0.4	1	35	97	80	120	92	75	125

Carbon/Sulphur

Method: ASTM E1915-07A | Internal ref.: ME-CA-[ENV]ARD-LAK-AN-020

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Sulphide (Na2CO3)	ECS0011-SEP23	%	0.04	< 0.04	ND	20	115	80	120			

Conductivity

Method: SM 2510 | Internal ref.: ME-CA-[ENV]EWL-LAK-AN-006

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Conductivity	EWL0580-AUG23	uS/cm	2	< 2	1	20	99	90	110	NA		

QC SUMMARY

pH

Method: SM 4500 I Internal ref.: ME-CA-[ENV]EWL-LAK-AN-001

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
pH	EWL0580-AUG23	pH Units	0.05	NA	1		100			NA		

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

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

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

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

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

RL: Reporting limit

RPD: Relative percent difference

AC: Acceptance criteria

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

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

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

LEGEND

FOOTNOTES

NSS	Insufficient sample for analysis.
RL	Reporting Limit.
↑	Reporting limit raised.
↓	Reporting limit lowered.
NA	The sample was not analysed for this analyte
ND	Non Detect

Results relate only to the sample tested.
Data reported represent the sample as submitted to SGS. Solid samples expressed on a dry weight basis.
"Temperature Upon Receipt" is representative of the whole shipment and may not reflect the temperature of individual samples.
Analysis conducted on samples submitted pursuant to or as part of Reg. 153/04, are in accordance to the "Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act and Excess Soil Quality" published by the Ministry and dated March 9, 2004 as amended.

SGS provides criteria information (such as regulatory or guideline limits and summary of limit exceedances) as a service. Every attempt is made to ensure the criteria information in this report is accurate and current, however, it is not guaranteed. Comparison to the most current criteria is the responsibility of the client and SGS assumes no responsibility for the accuracy of the criteria levels indicated.

SGS Canada Inc. statement of conformity decision rule does not consider uncertainty when analytical results are compared to a specified standard or regulation.

This report supersedes all previous versions.

-- End of Analytical Report --

Request for Laboratory Services and CHAIN OF CUSTODY

SGS Industries & Environment - Lakefield: 185 Concession St., Lakefield, ON K0L 2H0 Phone: 705-652-2000 Fax: 705-652-6365 Web: www.sgs.com/environment
- London: 657 Consortium Court, London, ON, N6E 2S8 Phone: 519-672-4500 Toll Free: 877-848-8060 Fax: 519-672-0361

No: 031835 Page _____ of _____

Laboratory Information Section - Lab use only

Received By: ED
Received Date: 8/25/23 (mm/dd/yy)
Received Time: 12:30 (hr : min)
Received By (signature): [signature]
Custody Seal Present: Yes ☑ No ☐
Custody Seal Intact: Yes ☐ No ☐
Cooling Agent Present: Yes ☑ No ☐ Type: ICE
Temperature Upon Receipt (°C) 7.2 & 5.
LAB LIMS #: CA-40281-AUG23 SR.

REPORT INFORMATION
Company: Thurber Engineering Ltd
Contact: Alysha Kobylinski
Address: Unit 3, 250 Thompson Drive
Cambridge, ON
Phone: 226-748-9593
Fax:
Email: akobylinski@thurber.ca

INVOICE INFORMATION
☑ (same as Report Information)
Company:
Contact:
Address:
Phone:
Email:

Quotation #: Thurber
Project #: 35708
P.O. #: 35708
Site Location/ID: Kitchener

TURNAROUND TIME (TAT) REQUIRED
☑ Regular TAT (5-7days)
TAT's are quoted in business days (exclude statutory holidays & weekends). Samples received after 6pm or on weekends: TAT begins next business day
RUSH TAT (Additional Charges May Apply): ☐ 1 Day ☐ 2 Days ☐ 3 Days ☐ 4 Days
PLEASE CONFIRM RUSH FEASIBILITY WITH SGS REPRESENTATIVE PRIOR TO SUBMISSION
Specify Due Date:
*NOTE: DRINKING (POTABLE) WATER SAMPLES FOR HUMAN CONSUMPTION MUST BE SUBMITTED WITH SGS DRINKING WATER CHAIN OF CUSTODY

REGULATIONS
☐ O.Reg 153/04 ☐ O.Reg 406/19
☐ Table 1 ☐ Res/Park Soil Texture: ☐ Coarse
☐ Table 2 ☐ Ind/Com ☐ Medium/Fine
☐ Table 3 ☐ Agri/Other
☐ Table _____ Appx. _____
Soil Volume ☐ <350m3 ☐ >350m3

Other Regulations:
☐ Reg 347/558 (3 Day min TAT)
☐ PWQO ☐ MMER
☐ CCME ☐ Other:
☐ MISA
☐ ODWS Not Reportable *See note

Sewer By-Law:
☐ Sanitary
☐ Storm
Municipality:

RECORD OF SITE CONDITION (RSC) ☐ YES ☐ NO

ANALYSIS REQUESTED

	SAMPLE IDENTIFICATION	DATE SAMPLED	TIME SAMPLED	# OF BOTTLES	MATRIX	Field Filtered (Y/N)	M&I: Metals & Inorganics (incl CrVI, CN, Hg pH,(B(HWS),EC,SAR–soil) (Cl, Na–water)	M&I: Full Metals Suite (ICP metals plus B(HWS–soil only) Hg, CrVI	M&I: ICP Metals only Sb,As,Ba,Be,B,Cd, Cr,Co,Cu,Pb,Mo,Ni,Se,Ag,Tl,U,V,Zn	SVOC: PAHs only	SVOC: SVOCs all incl PAHs, ABNs, CPs	PCB: PCBs Total ☐ Aroclor ☐	PHC: F1-F4 + BTEX	PHC: F1-F4 only no BTEX	VOC: VOCs all incl BTEX	VOC: BTEX only	Pest: Pesticides Organochlorine or specify other	Other: Corrosivity Pkg	Other: + Sulphide	Other	Other	Other: Sewer Use: Specify pkg:	Other: Water Characterization Pkg General ☐ Extended ☐	SPLP Specify tests: ☐ Metals ☐ VOC ☐ 1,4-Dioxane ☐ OCP ☐ ABN	TCLP Specify tests: ☐ M&I ☐ VOC ☐ PCB ☐ B(a)P ☐ ABN ☐ Ignit.	COMMENTS:
1	FS23-02 SS7	2023/05/04	PM	2	SOIL													X	X						2 jars
2	FS23-04 SS5	2023/04/13	PM	2	SOIL													X	X						2 jars
3	FS23-05 SS12	2023/05/12	PM	2	SOIL													X	X						2 jars.
4																									
5																									
6																									
7																									
8																									
9																									
10																									
11																									
12																									

Observations/Comments/Special Instructions

Sampled By (NAME): HC
Signature:
Date: ____/____/____ (mm/dd/yy)
Pink Copy - Client

Relinquished by (NAME): Alysha Kobylinski
Signature: Alysha Kobylinski
Date: 23/08/28 (mm/dd/yy)
Yellow & White Copy - SGS

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Date of Issue: 02 May 2022