



THURBER ENGINEERING LTD.

**FOUNDATION INVESTIGATION AND DESIGN REPORT
OVERHEAD SIGN SUPPORT STRUCTURES
HIGHWAY 400, 401, 427, AND 404
CENTRAL REGION
BOWMANVILLE TO TORONTO, ONTARIO
CONTRACT NUMBER: DB 2017-2029**

GEOCRES No. 30M14-479

Report

to

Brennan Paving & Construction Ltd.

Date: February 7, 2019
File: 21892



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PART 1: FACTUAL INFORMATION

1. INTRODUCTION

This report presents the factual data obtained from a foundation investigation carried out by Thurber Engineering Ltd. (Thurber) for the detailed design of Overhead Sign Supports (OSS) at various locations along Highway 401, 400, 404, and 427. Thurber carried out this investigation as foundation consultant to Brennan Paving & Construction Ltd. (BPC) for the Ministry of Transportation Ontario (MTO) Design Build Contract Number 2017-2029.

The purpose of this investigation was to explore the subsurface conditions at the proposed locations of the overhead and cantilevered sign supports and, based on this data, to provide borehole locations plans, records of boreholes, laboratory test results and a written description of the subsurface conditions.

2. SITE DESCRIPTION

The overhead and cantilevered signs are to be located at locations from Cobble Dick Road to Weston Road along Highway 401, on Highway 427 just north of Bloor Street West, on Highway 400 just north of Sheppard Avenue West to Maple Leaf Drive, and on Highway 404 just north of John Street, in Toronto, Ajax, Oshawa, and Bowmanville, Ontario.

The signs were located at sites numbered 1 to 27. Sites 8 to 16, and 18 to 25 were located along Highway 401 in Ajax, Oshawa, and Bowmanville. Sites 1 and 17 were located along Highway 400, Site 26 was located on Highway 427, and Sites 5 and 27 were located along Highway 401, in Toronto, Ontario. An investigation was not conducted at Site 2 as an existing sign support foundation is planned on being re-used at that site.

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At Sites 8 to 16, and 18 to 25, the project area is generally located within the physiographic region known as the Iroquois Plain which consists of low lying area adjacent to Lake Ontario formerly inundated by glacial Lake Iroquois. The surficial geology generally consists of sandy silt till (Newmarket Till) locally overlain by fine-grained glaciolacustrine deposits of clay, silt and sand. Based on published geologic maps, the underlying bedrock in the area is expected to comprise limestone and shale.

At the remaining, more westerly located sites, the project area is generally located within the physiographic regions known as the South Slope and Peel Plain. The South Slope is comprised predominantly of the Halton drift (till). The Halton Till is an interbedded complex of clayey silt till and sand. This deposit comprises a slightly hummocky till plain, into which the surface watercourses have eroded to 10 to 15 m deep gullies. Relatively recent fluvial sediments have been deposited in the gullies. The Peel Plain is generally comprised of fine textured deposits of silt and clay associated with localized ice-contact lake environments. These deposits are generally encountered over-lying the Halton Till. Based on published geologic maps, the underlying bedrock in the area is expected to comprise limestone and shale.

3. INVESTIGATION PROCEDURES

The field investigation for this project was carried out between June 13 and December 8, 2018, and consisted of drilling and sampling twenty three (26) boreholes, designated as Boreholes 18-01, and 18-03 to 18-27, near the locations of proposed overhead signs, to depths of between 7.7 m and 11.1 m. All of the boreholes were located on the shoulder of either the north bound or south bound lanes of Highway 401, 400, 404, and 427, with the exception of Borehole 18-05 which was located on the shoulder of the on-ramp to Highway 401 westbound from the southbound lanes of Weston Road. The approximate locations of the boreholes covered in the report are shown on the Borehole Location Plans (1 to 7) in Appendix C.

Utility clearances at the borehole locations were obtained prior to the start of drilling. The ground surface elevations for the boreholes were estimated from topographic drawings provided to Thurber by BPC. The boreholes were drilled using a truck-mounted drill rig using solid and hollow stem augers. Samples of the overburden soils were obtained from the boreholes at selected intervals using a split spoon sampler in conjunction with Standard Penetration testing (SPT).

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

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Groundwater conditions were observed in the open boreholes throughout the drilling operations. Upon completion of drilling, the boreholes were backfilled in general accordance with Ontario Regulation 903, as amended. Completion details of the boreholes are summarized in Table 3.1 below.

Table 3.1 – Borehole Completion Details

Borehole Number	Borehole Depth / Base Elevation (m)	Completion Details
18-01	8.2 / 114.1	Borehole backfilled with bentonite holeplug to 7.0 m, cuttings to 0.8 m, bentonite holeplug to 0.2 m, then asphalt to surface.
18-03	9.8 / 166.3	Borehole backfilled with bentonite holeplug and cuttings to surface.
18-04	8.2 / 157.0	Boreholes backfilled with gravel to 1.2 m then concrete and asphalt to surface.
18-05	8.2 / 132.8	Borehole backfilled with cuttings to 0.1 m then asphalt to surface.
18-06	8.8 / 164.8	Boreholes backfilled with gravel to 1.2 m then concrete and asphalt to surface.
18-07	8.2 / 164.6	Borehole caved to 7.0 m then backfilled with bentonite holeplug to 5.8 m, cuttings to 0.7 m, bentonite holeplug to 0.1 m, then asphalt to surface.
18-08	7.9 / 81.1	Borehole caved to 7.0 m then backfilled with bentonite holeplug and cuttings to 0.2 m, then asphalt to surface.
18-09	7.7 / 103.6	Borehole backfilled with bentonite holeplug and cuttings to 0.2 m then asphalt to surface.
18-10	9.8 / 86.4	Borehole caved to 8.2 m then backfilled with bentonite holeplug and cuttings to 0.2 m, then asphalt to surface.
18-11	7.8 / 91.8	Borehole caved to 4.9 m then backfilled with bentonite holeplug and cuttings to 0.2 m, then asphalt to surface.
18-12	9.8 / 72.2	Borehole backfilled with bentonite holeplug and cuttings to 0.2 m then asphalt to surface.
18-13	7.7 / 90.0	Borehole backfilled with bentonite holeplug and cuttings to 0.2 m then asphalt to surface.



Borehole Number	Borehole Depth / Base Elevation (m)	Completion Details
18-14	8.2 / 83.3	Borehole backfilled with bentonite holeplug and cuttings to 0.2 m then asphalt to surface.
18-15	8.2 / 85.8	Borehole backfilled with bentonite holeplug and cuttings to 0.2 m then asphalt to surface.
18-16	7.9 / 97.9	Borehole backfilled with bentonite holeplug and cuttings to 0.2 m then asphalt to surface.
18-17	8.2 / 137.8	Borehole caved to 7.2 m, then backfilled with bentonite holeplug to 5.9 m, cuttings to 0.8 m, bentonite holeplug to 0.2 m, then asphalt to surface.
18-18	7.7 / 77.3	Borehole backfilled with bentonite holeplug and cuttings to 0.2 m then asphalt to surface.
18-19	8.2 / 74.1	Borehole backfilled with bentonite holeplug and cuttings to 0.2 m then asphalt to surface.
18-20	7.9 / 73.0	Borehole backfilled with bentonite holeplug and cuttings to 0.2 m then asphalt to surface.
18-21	8.2 / 74.2	Borehole backfilled with bentonite holeplug and cuttings to 0.2 m then asphalt to surface.
18-22	7.7 / 77.8	Borehole caved to 7.3 m then backfilled with bentonite holeplug to and cuttings to 0.1 m, then asphalt to surface.
18-23	8.2 / 74.9	Borehole backfilled with bentonite holeplug and cuttings to 0.2 m then asphalt to surface.
18-24	8.2 / 82.1	Borehole backfilled with bentonite holeplug and cuttings to 0.2 m then asphalt to surface.
18-25B	7.7 / 92.9	Borehole caved to 5.2 m then backfilled with bentonite holeplug to and cuttings to 0.2 m, then asphalt to surface.
18-26	7.8 / 122.8	Borehole backfilled with bentonite holeplug and cuttings to 0.2 m then asphalt to surface.
18-27	11.1 / 163.5	Borehole caved to 9.4 m then backfilled with bentonite holeplug to and cuttings to 0.1 m, then asphalt to surface.

4. LABORATORY TESTING

The recovered soil samples were subjected to Visual Identification (VI) and to natural moisture content determination. Selected samples were also subjected to grain size distribution analyses

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(hydrometer and/or sieve) and Atterberg Limits testing, where appropriate. Laboratory testing results are summarized on the Record of Borehole sheets included in Appendix A and are presented on the figures included in Appendix B.

5. DESCRIPTION OF SUBSURFACE CONDITIONS

Details of the encountered soil stratigraphy are presented on the Record of Borehole sheets included in Appendix A. A general description of the stratigraphy, based on the conditions encountered in the boreholes, is given in the following paragraphs. However, the factual data presented on the Record of Borehole sheets takes precedence over this general description and must be used for interpretation of the site conditions. It should be recognized and expected that soil conditions may vary between and beyond borehole locations.

5.1 Bowmanville Area (Sites 14 to 16, and 18 to 25)

In general, in the Bowmanville area, which included the sites along Highway 401 from Cobbledick Road to Holt Road, the subsurface conditions encountered consisted of asphalt overlying sand to sand and gravel fill which is in turn underlain by clayey silt fill. The native soils beneath the fill material generally consisted of clayey silt to silty clay overlying silty sand to sandy silt till. Sand layers were also encountered at various depths. Bedrock was not encountered in any borehole. Descriptions of the individual strata are presented below.

5.1.1 Asphalt

All boreholes were drilled through the paved shoulder of Highway 401 and encountered approximately 75 mm to 200 mm of asphalt.

5.1.2 Sand to Gravelly Sand Fill

Sand to gravelly sand fill, containing trace to some silt was encountered beneath the asphalt in all boreholes. The sand to sand and gravel fill was approximately 0.7 m to 2.1 m thick and extended to depths of approximately 0.8 m to 2.3 m.

SPT 'N' values within the sand to sand and gravel fill ranged from 11 to 23 blows per 0.3 m of penetration, indicating a compact condition. Moisture contents between 2 percent and 21 percent were measured in the fill.

The results of a grain size distribution analyses carried out on a selected sample of the gravelly

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sand fill is presented on the Record of Borehole sheets included in Appendix A and on Figure B1 of Appendix B. The results of the grain size distribution analyses are summarized below:

Soil Particle	Percentage (%)
Gravel	32
Sand	54
Silt and Clay	14

5.1.3 Clayey Silt to Silty Clay Fill

Clayey silt to silty clay fill, with sand to some sand, and trace gravel, was encountered in Boreholes 18-14 to 18-16, 18-19, 18-20, and 18-23 to 18-25B beneath the sand to gravelly sand fill. The clayey silt was approximately 0.7 m to 5.6 m thick and extended to depths of between 1.5 m and 7.2 m.

SPT 'N' values within the clayey silt fill ranged from 5 to 29 blows per 0.3 m of penetration, indicating a firm to very stiff consistency. Measure moisture contents between 9 percent and 27 percent were measured in the clayey silt fill.

The results of grain size distribution analyses carried out on selected samples of the clayey silt fill are presented on the Record of Borehole sheets included in Appendix A and on Figure B2 of Appendix B. The results of the grain size distribution analyses are summarized below:

Soil Particle	Percentage (%)
Gravel	0 to 5
Sand	11 to 45
Silt	28 to 46
Clay	25 to 44

5.1.4 Clayey Silt to Silty Clay

Clayey silt to silty clay, with sand to some sand, and trace gravel, was encountered in Boreholes 18-14, 18-21, 18-20, 18-22, 18-23, and 18-25B. The clayey silt to silty clay where fully penetrated was approximately 0.8 m to 4.3 m thick and extended to depths of between 2.7 m and 6.9 m. Borehole 18-14 was terminated within the clayey silt at a depth of 8.2 m below existing ground surface.



SPT 'N' values within the silty clay to clayey silt ranged from 8 to 26 blows per 0.3 m penetration indicating a stiff to very stiff consistency. Measured moisture contents between 7 to 32 percent were measured in the clayey silt to silty clay.

The results of grain size distribution analyses and Atterberg Limits carried out on selected samples of the clayey silt to silty clay are presented on the Record of Borehole sheets included in Appendix A and on Figures B3 and B10 of Appendix B. The results of the grain size distribution analyses are summarized below:

Soil Particle	Percentage (%)
Gravel	0 to 2
Sand	0 to 11
Silt	34 to 58
Clay	33 to 61

The results of Atterberg Limits testing are summarized below:

Index Property	Percentage (%)
Plastic Limit	14 to 19
Liquid Limit	27 to 44
Plasticity Index	13 to 26

The results of the Atterberg Limits testing indicate the layer to be of low to medium plasticity with group symbol CL to CI.

5.1.5 Till

Till, consisting of clayey silt with sand to silty sand, and sand to sandy silt, with trace to some gravel, was encountered in Boreholes 18-15, 18-16, 18-18, 18-20 and 18-22 to 18-25B at depths of between 2.2 m and 6.9 m. Where fully penetrated, in Boreholes 18-15 and 18-16, the till was approximately 4.2 m to 5.8 m thick and extended to a depth of approximately 7.3 m and 7.2 m. Boreholes 18-18 and 18-20 to 18-25B were terminated within the till layer at depths between 7.7 m to 8.2 m.

SPT 'N' values within the till typically ranged from 31 blows for 0.3 m penetration to 100 blows for 0.1 m penetration indicating a hard consistency in the cohesive till and a dense to very dense condition in the cohesionless till. 'N' values of greater than 100 blows may also indicate the presence of cobbles and boulders. Measure moisture contents in the till ranged from 4 to 24 percent.



The results of grain size distribution analyses and Atterberg Limits carried out on selected samples of the till are presented on the Record of Borehole sheets included in Appendix A and on Figures B6 and B11 of Appendix B. The results of the grain size distribution analyses are summarized below:

Soil Particle	Percentage (%)
Gravel	2 to 15
Sand	26 to 67
Silt	17 to 40
Clay	7 to 36

The results of Atterberg Limits testing are summarized below:

Index Property	Percentage (%)
Plastic Limit	10
Liquid Limit	14
Plasticity Index	4

The results of the Atterberg Limits testing indicate the layer to be of slight plasticity with group symbol CL - ML.

Glacial tills inherently contain cobbles and boulders.

5.1.6 Sand to Sand and Gravel

Sand to sand and gravel, containing some silt, trace gravel, and trace clay, was encountered in Boreholes 18-15, 18-16, 18-19, 18-20, and 18-23 at depths of between 4.1 m and 7.3 m. Where fully penetrated in Boreholes 18-20 and 18-23, the sand to sand and gravel layers were approximately 0.6 m to 1.5 m thick. Boreholes 18-15, 18-16, and 18-19 were terminated in the sand layer at depths of between 7.9 m and 8.2 m.

SPT 'N' values in the sand to sand and gravel ranged from 17 blows for 0.3 m penetration to 50 blows for 0.1 m penetration, indicating a compact to very dense condition. Measured moisture contents in the sand to sand and gravel ranged from 6 to 18 percent.

The results of grain size distribution analyses carried out on selected samples of the sand to sand and gravel are presented on the Record of Borehole sheets included in Appendix A and on Figure B8 of Appendix B. The results of the grain size distribution analyses are summarized below:



Soil Particle	Percentage (%)
Gravel	2 to 44
Sand	51 to 79
Silt	10 to 27
Clay	4 to 10
Silt and Clay	5

5.2 Ajax and Oshawa Area (Sites 8 to 12)

In general, in the Ajax and Oshawa Area, which included the sites along Highway 401 from Salem Road South to Courtice Road, the subsurface conditions encountered consisted of asphalt overlying sand fill then clayey silt fill. Beneath the fill material the native soils generally consisted of clayey silt till to silty sand till. Bedrock was not encountered in any of the boreholes. Descriptions of the individual strata are presented below.

5.2.1 Asphalt

All boreholes were drilled through the paved shoulder of Highway 401 and encountered approximately 125 mm to 450 mm of asphalt.

5.2.2 Sand to Silty Sand Fill

Sand fill, containing trace to some gravel, trace silt to silty, and trace clay was encountered in all boreholes beneath the pavement structure. The sand fill was approximately 0.7 m to 4.9 m thick and extended to depths of between 0.9 m to 5.2 m below ground surface.

SPT 'N' values within the sand fill ranged from 14 to 50 blows per 0.3 m of penetration, indicating a compact condition. Moisture contents between 1 to 18 percent were measured in the sand fill.

The results of a grain size distribution analyses carried out on selected samples of the sand to silty sand fill are presented on the Record of Borehole sheets included in Appendix A and on Figure B1 of Appendix B. The results of the grain size distribution analyses are summarized below:



Soil Particle	Percentage (%)
Gravel	4
Sand	55 to 67
Silt	23 to 32
Clay	6 to 9

5.2.3 Silty Clay Fill

Silty clay fill with sand to some sand, and trace gravel was encountered in Boreholes 18-10 and 18-12 at depths of between 1.2 m and 1.4 m. The silty clay fill was approximately 0.3 m to 5.8 m thick and extended to depths of between 1.5 m to 7.2 m below ground surface.

SPT 'N' values within the silty clay fill ranged from 7 to 20 blows per 0.3 m of penetration, indicating a firm to very stiff condition. Moisture contents between 8 to 38 percent were measured in the clayey silt fill.

The results of grain size distribution analyses and Atterberg Limits carried out on selected samples of the silty clay fill are presented on the Record of Borehole sheets included in Appendix A and on Figures B2 and B9 of Appendix B. The results of the grain size distribution analyses are summarized below:

Soil Particle	Percentage (%)
Gravel	5 to 8
Sand	28 to 31
Silt	27 to 29
Clay	35 to 37

The results of Atterberg Limits testing are summarized below:

Index Property	Percentage (%)
Plastic Limit	16
Liquid Limit	31 to 32
Plasticity Index	15 to 16

The results of the Atterberg Limits testing indicate this fill to be of low plasticity with group symbol CL.

5.2.4 Till

Silty sand till with some clay and clayey silt till was encountered in Boreholes 18-08, 18-11, 18-12, and 18-13 at depths of between 0.9 m to 9.1 m. Where fully penetrated in Borehole 18-08,



the till was approximately 1.7 m thick and extended to a depth of 7.3 m below ground surface. Boreholes 18-09, 18-11, 18-12, and 18-13 were terminated within the till layer at a depth of between approximately 7.7 m to 9.8 m.

SPT 'N' values within the till typically ranged from 27 blows for 0.3 m penetration to 100 blows for 0.1 m penetration indicating a very stiff to hard consistency in the cohesive till and a compact to very dense condition in the cohesionless till. 'N' values of greater than 100 blows may also indicate the presence of cobbles and boulders. Measure moisture contents in the till ranged from 6 to 15 percent.

The results of grain size distribution analyses carried out on selected samples of the till are presented on the Record of Borehole sheets included in Appendix A and on Figures B4 of Appendix B. The results of the grain size distribution analyses are summarized below:

Soil Particle	Percentage (%)
Gravel	2 to 15
Sand	26 to 67
Silt	17 to 40
Clay	7 to 36

Glacial tills inherently contain cobbles and boulders

5.2.5 Sandy Silt to Sand

Sandy silt, trace clay, to sand containing some gravel, some silt, and trace clay was encountered in Borehole 18-08 at a depth of approximately 1.5 m. The sandy silt to sand was approximately 4.1 m thick and extended do a depth of approximately 5.6 m.

SPT 'N' values in the sandy silt to sand ranged from 43 to 53 blows for 0.3 m penetration, indicating a dense to very dense condition. Measured moisture contents in the sandy silt to sand ranged from 16 to 20 percent.

The results of grain size distribution analyses carried out on selected samples of the sandy silt to sand are presented on the Record of Borehole sheets included in Appendix A and on Figure B7 of Appendix B. The results of the grain size distribution analyses are summarized below:



Soil Particle	Percentage (%)
Gravel	0 to 14
Sand	35 to 71
Silt	12 to 58
Clay	3 to 7

5.3 Toronto Area (Sites 1, 3, 4, 5, 6, 7, 17, 26, and 27)

In general, in the Toronto area, which includes the sites along Highway 401 from Markham Road to Weston Road, as well as the sites on Highway 400, 427, and 404, the subsurface conditions encountered consisted of asphalt overlying sand to sand and gravel fill which was in turn underlain by clayey silt to silty sand fill. The native soils beneath the embankment fill generally consisted of silt clay, sandy silt and clayey silt to silty sand till. Bedrock was not encountered in any borehole. Descriptions of the individual strata are presented below.

5.3.1 Asphalt

All boreholes were drilled through the paved shoulder of the Highway and encountered approximately 100 mm to 200 mm of asphalt.

5.3.2 Sand to Sand and Gravel Fill

Sand and gravel fill, to sand fill with trace to some gravel was encountered in all boreholes beneath the pavement structure. The sand to sand and gravel fill was approximately 0.4 m to 1.7m thick and extended to depths of between 0.6 m to 1.8 m below ground surface.

A SPT 'N' value within the sand to sand and gravel fill ranged from 4 to 20 blows per 0.3 m of penetration, indicating a loose to compact condition. Moisture contents between 2 to 12 percent were measured in the sand to sand and gravel fill.

The results of a grain size distribution analyses carried out on select samples of the sand to sand and gravel fill are presented on the Record of Borehole sheets included in Appendix A and on Figure B1 of Appendix B. The results of the grain size distribution analyses are summarized below:

Soil Particle	Percentage (%)
Gravel	20
Sand	64
Silt and Clay	16



5.3.3 Clayey Silt Fill

Clayey silt fill, containing trace to some sand, and trace gravel, was encountered in Boreholes 18-03, 18-05, 18-06, 18-26, and 18-27. The clayey silt fill was approximately 0.4 m to 4.0 m thick and extended to depths of approximately 1.1 m to 4.6 m below ground surface.

SPT 'N' values within the clayey silt fill ranged from 7 to 22 blows for 0.3 m penetration, indicating a firm to very stiff consistency. Measured moisture contents in the clayey silt fill ranged from 7 to 22 percent.

The results of a grain size distribution analysis carried out on a select sample of the clayey silt fill is presented on the Record of Borehole sheets included in Appendix A and on Figure B2 of Appendix B. The results of the grain size distribution analyses are summarized below:

Soil Particle	Percentage (%)
Gravel	0
Sand	27
Silt	45
Clay	28

5.3.4 Silty Sand to Sandy Silt Fill

Silty sand to sandy silt fill, containing trace to some clay, and trace to some gravel was encountered in Boreholes 18-04, 18-07, 18-17 and 18-26. The silty sand to sandy silt fill was approximately 0.8 m to 1.7 m thick and extended to depths of approximately 1.5 m to 2.2 m below ground surface.

SPT 'N' values in the silty sand to sandy silt fill ranged from 8 to 21 blows for 0.3 m penetration, indicating a loose to compact condition. Measured moisture contents in the silty sand to sandy silt fill ranged from 2 to 18 percent.

The results of grain size distribution analysis carried out on select samples of the silty sand fill is presented on the Record of Borehole sheets included in Appendix A and on Figure B1 of Appendix B. The results of the grain size distribution analyses are summarized below:



Soil Particle	Percentage (%)
Gravel	5 to 17
Sand	47 to 48
Silt	22 to 28
Clay	13 to 20

5.3.5 Silty Clay to Clayey Silt Till

Silty clay to clayey silt till with sand and trace gravel was encountered in Boreholes 18-01, 18-03 to 18-07, 18-17, and 18-26 at depths of between 0.6 m to 4.6 m below ground surface elevation. The silty clay to clayey silt till, where fully penetrated, was approximately 2.2 m to 2.6 m thick and extended to depths of between 4.1 m to 5.6 m. Boreholes 18-01, 18-03, 18-04, 18-05, 18-06 and 18-07 were terminated in the silty clay to clayey silt till at depths of between 8.2 m to 9.8 m below ground surface.

SPT 'N' values in the silty clay to clayey silt till ranged from 8 to 50 blows for 0.3 m penetration, indicating a stiff to hard consistency. Measured moisture contents in the silty clay to clayey silt till ranged from 9 to 23 percent.

The results of a grain size distribution analyses and Atterberg Limit Tests carried out on select samples of the silty clay to clayey silt till are presented on the Record of Borehole sheets included in Appendix A and on Figures B4, B5, and B11 of Appendix B. The results of the grain size distribution analyses are summarized below:

Soil Particle	Percentage (%)
Gravel	0 to 4
Sand	10 to 40
Silt	31 to 49
Clay	26 to 51

The results of Atterberg Limits testing are summarized below:

Index Property	Percentage (%)
Plastic Limit	10 to 15
Liquid Limit	14 to 30
Plasticity Index	4 to 17

The results of the Atterberg Limits testing indicate the layer to be of slight plasticity with group symbol CL – ML to CL.



Glacial tills inherently contain cobbles and boulders

5.3.6 Silty Clay

Silty clay, containing trace to some sand, was encountered in Borehole 18-17 and 18-27 at depths of approximately 2.3 m and 4.1 m below ground surface. Where fully penetrated in Borehole 18-27 the silty clay was approximately 3.3 m thick and extended to a depth of approximately 5.6 m below ground surface. Borehole 18-17 was terminated within the silty clay a depth of 8.2 m below ground surface.

SPT 'N' values in the silty clay ranged from 4 to 40 blows for 0.3 m penetration, indicating a firm to hard consistency. Measured moisture contents in the silty clay ranged from 13 to 35 percent.

The results of grain size distribution analyses carried out on selected samples of the silty clay are presented on the Record of Borehole sheets included in Appendix A and on Figure B3 of Appendix B. The results of the grain size distribution analyses are summarized below:

Soil Particle	Percentage (%)
Gravel	0
Sand	3 to 11
Silt	41 to 62
Clay	35 to 48

5.3.7 Sandy Silt to Sand

Sandy silt to sand, containing trace to some clay and gravel was encountered in Boreholes 18-04 and 18-27 at a depth of 1.5 m and 5.6 m below ground surface, respectively. Where fully penetrated in Borehole 18-04 this layer was approximately 1.5 m thick and extended to a depth of 3.0 m. Borehole 18-27 was terminated in the sandy silt to sand at a depth of approximately 11.1 m below ground surface.

SPT 'N' values in the sandy silt to sand ranged from 4 blows for 0.3 m penetration to 50 blows for 0.15 m penetration, indicating a loose to very dense condition. Measure moisture contents ranged from 10 to 34 percent.

The results of a grain size distribution analysis carried out on a select sample of the sand is presented on the Record of Borehole sheets included in Appendix A and on Figure B8 of Appendix B. The results of the grain size distribution analyses are summarized below:



Soil Particle	Percentage (%)
Gravel	0
Sand	88
Silt	9
Clay	3

5.4 Groundwater Conditions

Groundwater conditions were observed during drilling operations and groundwater levels were measured in the open boreholes upon completion of drilling. Several of the boreholes were dry upon completion. The groundwater levels measured in the open boreholes are summarized below.



Borehole	Date	Water Level (m)		Remark
		Depth	Elevation	
18-01	July 12, 2018	Dry	-	Open borehole
18-03	November 25, 2018	7.2	168.9	Open borehole
18-04	December 8, 2018	5.2	160.0	Open borehole
18-05	July 12, 2018	Dry	-	Open borehole
18-06	December 8, 2018	8.8	164.8	Open borehole
18-07	July 11, 2018	4.6	168.2	Borehole caved to 7.0 m
18-08	June 21, 2018	3.7	85.3	Borehole caved to 7.0 m
18-09	June 20, 2018	Dry	-	Open borehole
18-10	June 20, 2018	7.0	89.2	Borehole caved to 8.2 m
18-11	June 20, 2018	Dry	-	Borehole caved to 4.9 m
18-12	June 20, 2018	3.4	78.6	Open borehole
18-13	June 20, 2018	3.7	94.0	Open borehole
18-14	June 13, 2018	6.2	85.3	Open borehole
18-15	June 13, 2018	5.6	88.4	Open borehole
18-16	June 19, 2018	5.0	100.8	Open borehole
18-17	July 12, 2018	Dry	-	Borehole caved to 7.2 m
18-18	June 21, 2018	Dry	-	Open borehole
18-19	June 14, 2018	7.0	75.3	Open borehole
18-20	June 19, 2018	4.0	76.9	Open borehole
18-21	June 21, 2018	Dry	-	Open borehole
18-22	June 14, 2018	Dry	-	Borehole caved to 7.3 m
18-23	June 14, 2018	6.9	76.2	Open borehole
18-24	June 19, 2018	7.1	83.2	Open borehole
18-25B	August 26, 2018	5.1	95.5	Borehole caved to 5.2 m
18-26	June 18, 2018	Dry	-	Open borehole
18-27	June 17, 2018	5.3	169.3	Borehole caved to 9.4 m

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

6. MISCELLANEOUS

Thurber obtained subsurface utility clearances at the borehole locations prior to drilling. Thurber estimated the northing and easting coordinates and ground surface elevations from measurements taken in the field relative to the topographic drawings provided by BPC.



Drill Tech Drilling Ltd. Of Newmarket, Ontario, and Malone's Soil Samples Co. Ltd. of Fenelon Falls, 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 Ms. Eckie Sui, Mr. Amir Fereidouni, Ms. Judy Mei, and Mr. Bryan Lui of Thurber. Overall supervision of the field program was provided by Mr. Cory Zanatta, P.Eng. of Thurber.

Geotechnical laboratory testing was carried out at Thurber's geotechnical laboratory. Analytical laboratory testing was carried out by SGS Canada Inc. Interpretation of the field data and preparation of this report was carried out by Mr. Cory Zanatta, P.Eng., and Dr. Sydney Pang, P.Eng. The report was reviewed by Dr. P.K. Chatterji, P.Eng., a Designated Principal Contact for MTO Foundations Projects.



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**FOUNDATION INVESTIGATION AND DESIGN REPORT
OVERHEAD SIGN SUPPORT STRUCTURES
HIGHWAY 400, 401, 427, AND 404
CENTRAL REGION
BOWMANVILLE TO TORONTO, ONTARIO
CONTRACT NUMBER: 2017-2029**

GEOCRES No. 30M14-479

PART 2: ENGINEERING DISCUSSION AND RECOMMENDATIONS

7. GENERAL

This section of the report presents foundation recommendations for the design of the proposed Overhead and Cantilevered Sign (OH & CS) supports.

This foundation investigation and design report with the interpretation and recommendations are intended for the use of the Brennan Paving & Construction Ltd. (BPC), and shall not be used or relied upon for any other purposes or by any other parties. Where comments are made on construction, they are provided only in order to highlight those aspects which could affect the design of the project. BPC and its subcontractors must make their own interpretation of the factual information provided as it may affect equipment selection, proposed construction methods and scheduling.

The project includes a total of twenty seven (27) overhead and cantilevered signs. The signs were numbered 1 to 27. Sign 2 will be utilizing an existing sign support foundation and therefore no borehole was drilled at that location.

Information on the proposed locations of the signs was provided to Thurber by BPC. Based on the proposed design layout, one borehole was drilled near the location of each proposed sign location. The Record of Borehole sheets for these boreholes are presented in Appendix A.

8. FOUNDATION DESIGN PARAMETERS

Design of the sign support foundations should be carried out in accordance with the following document.

- Ministry of Transportation, Ontario (2015) "Sign Support Manual", Highway Standards

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Branch, Bridge Office (Reference 1).

Reference should also be made to the following documents.

- Ministry of Transportation, Ontario (2004) “Guidelines for the Design of High Mast Pole Foundations”, Fourth Edition, BRO-009, Engineering Standards Branch, Bridge Office (Reference 2).
- Canadian Highway Bridge Design Code and Commentary (2014). CAN/CSA-S6-00 and S6.1-00 (Reference 3).

It is understood that a typical cantilevered sign support foundation consists of a single conventional augered caisson (drilled shaft), and a typical overhead or tri-chord sign support foundation consists of two conventional augered caissons, one at either end of the sign. Table 1 following the text of this report presents the recommended foundation design parameters for the design of such caissons. For the overhead signs with two supports, both caissons should be designed using the same set of foundation parameters as recommended in Table 1.

MTO’s standard designs for the various sign types and other relevant foundation design recommendations in Reference 1 may be used as a basis for the sign support designs. The foundation design parameters in Table 1 should be used in conjunction with Reference 2 to confirm that the standard designs are adequate.

In order to take into account frost action and surficial disturbance, the ultimate lateral passive resistance in front of a caisson within the upper 1.4 m below final grade should be neglected in the foundation design. It is recommended that all topsoil and organics be neglected in determining lateral resistance.

Where downward sloping fill or native soil exists in front of a caisson, reduction of lateral passive resistance should be taken into consideration during design. For foundation design of the caissons, it should be assumed that full lateral resistance can only be mobilized where the width of the soil in front of or behind the caisson is equal to or greater than approximately four (4) times the diameter of the caissons. For sloping ground in front of a caisson, the magnitude of the mobilized passive resistance can be estimated by interpolating between zero passive resistance at the level where the slope face intersects the pile, and full passive resistance at the level where the slope face is at a horizontal distance equal to or greater than four (4) times the diameter of the caisson.

Where an unconfined compressive strength, q_u , ($q_u = 2 \times C_u$, undrained shear strength) is

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provided for a cohesive soil (clayey silt to silty clay fill, clayey silt to silty clay, silty clay till or clayey silt till), the ultimate lateral passive resistance should be calculated in conjunction with the total soil unit weight. When designing for portions of the caissons below the groundwater level in cohesionless sands and silts, the submerged soil unit weight, γ' , should be used. The required depth of the drilled shaft will be governed by lateral loads, including wind loads, acting on the sign. The length of the caisson should also be sufficient to counteract frost jacking (upward) forces.

An equivalent caisson width equal to 2 times the caisson diameter may be assumed for lateral resistance calculations. Appropriate load and resistance factors should be applied for caisson design.

9. CAISSON INSTALLATION

Caisson installation should generally be carried out in accordance with OPSS.PROV 903.

Caisson installation equipment must be able to dislodge, handle, remove cobbles and boulders, to penetrate obstructions within the fill and to drill through hard or very dense layers, where encountered.

The short-term groundwater levels were measured to be between 3 m and 8 m depths below existing ground surface. The stabilized groundwater levels are anticipated to be higher. Soil sloughing and water seepage may occur in unsupported holes especially in sands and silts below the groundwater level. Temporary liners must be available to support the caisson sidewalls and to provide seepage cut-off where required. At locations where water bearing sands and silts are present, a balancing water head may be required inside the liner to minimize the potential of basal heave and disturbance. Any accumulated water may have to be pumped out from the hole prior to placing concrete. Should it prove to be impractical to remove the accumulated water inside the hole, it is recommended that the concrete be placed by the tremie method.

10. CONSTRUCTION CONCERNS

Concerns during caisson construction mainly involve the handling and removal of cobbles or boulders, or other obstructions in the fill and till, drilling through hard/very dense soils, soil sloughing and water seepage from caisson sidewalls, and basal instability. Recommendations on how to address these issues have been outlined in the previous sections.



11. CONSTRUCTION INSPECTION AND TESTING

Caisson construction should be monitored by qualified geotechnical personnel (as per OPSS.PROV 903) to verify the soil conditions and to confirm that those conditions are consistent with the design assumptions in this report.

12. CLOSURE

Engineering assessment and preparation of this report was carried out by Mr. Cory Zanatta, P.Eng, and Mr. Sydney Pang, P.Eng. The report was reviewed by Mr. P.K. Chatterji, P.Eng., a Designated Principal Contact for MTO Foundations Projects.



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**FOUNDATION DESIGN PARAMETERS
OVERHEAD SIGN SUPPORT
HIGHWAYS 400, 401, 404 and 427**

Site Number	Borehole Number	Reference Simplified Subsurface Stratigraphy for Design	Depth Below Existing Grade (m)	Geotechnical Design Parameters						Groundwater Depth (m) below ground surface
				q_u (kPa)	ϕ' (deg.)	γ (kN/m ³)	γ' (kN/m ³)	n_h (MN/m ³)	K_p	
1	BH 18-01	Silty Clay (Till)	0.6 to 8.2	150	-	19	-	-	-	2
3	BH 18-03	Silty Clay (Fill)	0.7 to 1.5	90	-	18	-	-	-	4
		Silty Clay (Till)	1.5 to 9.8	180	-	19	-	-	-	
4	BH 18-04	Silty Sand (Fill)	0.6 to 1.5	-	29	19	-	2.5	2.9	4
		Sandy Silt to Silty Sand	1.5 to 3.0	-	30	20	10	3	3.0	
		Clayey Silt to Silty Clay (Till)	3.0 to 8.2	200	-	19	-	-	-	
5	BH 18-05	Clayey Silt (Fill)	0.7 to 1.1	80	-	18	-	-	-	1
		Silty Clay (Till)	1.1 to 8.2	200	-	20	-	-	-	
6	BH 18-06	Clayey Silt (Fill)	0.6 to 4.6	120	-	18	-	-	-	4
		Clayey Silt (Till)	4.6 to 8.8	120	-	18	-	-	-	
7	BH 18-07	Silty Sand (Fill)	0.1 to 1.8	-	30	19	-	3	3.0	2
		Sand and Silt (Till)	1.8 to 4.1	-	32	20	10	4	3.2	
		Silty Clay (Till)	4.1 to 8.2	150	-	19	-	-	-	
8	BH 18-08	Sand to Gravelly Sand (Fill)	0.5 to 1.5	-	30	20	-	3	3.0	3
		Sandy Silt to Sand	1.5 to 5.6	-	34	21	11	5.5	3.5	
		Silty Sand (Till)	5.6 to 7.9	-	35	21	11	7	3.7	
9	BH 18-09	Sand (Fill)	0.3 to 2.3	-	30	19	-	3	3.0	2
		Clayey Silt to Silty Clay (Till)	2.3 to 7.7	200	-	20	-	-	-	
10	BH 18-10	Sand (Fill)	0.3 to 1.4	-	30	19	-	3	3.0	2
		Silty Clay (Fill)	1.4 to 7.2	80	-	18	-	-	-	
		Silty Clay	7.2 to 9.8	80	-	18	-	-	-	
11	BH 18-11	Sand to Silty Sand (Fill)	0.3 to 5.2	-	30	19	9	3	3.0	3
		Clayey Silt (Till)	5.2 to 7.8	200	-	20	-	-	-	
12	BH 18-12	Sand (Fill)	0.1 to 1.4	-	30	19	-	3	3.0	2
		Silty Clay (Fill)	1.4 to 4.9	120	-	18	-	-	-	
		Clayey Silt to Silty Clay	4.9 to 9.1	70	-	18	-	-	-	
		Clayey Silt Till	9.1 to 9.8	180	-	19	-	-	-	

Notes 1: In order to take into account frost action and surficial disturbances, the ultimate passive resistance in front of the caisson within the upper 1.4 m below final grade should be neglected.

**FOUNDATION DESIGN PARAMETERS
OVERHEAD SIGN SUPPORT
HIGHWAYS 400, 401, 404 and 427**

Site Number	Borehole Number	Reference Simplified Subsurface Stratigraphy for Design	Depth Below Existing Grade (m)	Geotechnical Design Parameters						
				q _u (kPa)	φ' (deg.)	γ (kN/m ³)	γ' (kN/m ³)	n _h (MN/m ³)	K _p	Groundwater Depth (m) below ground surface
13	BH 18-13	Silty Sand (Till)	0.9 to 7.7	-	35	21	11	7	3.7	3
14	BH 18-14	Clayey Silt (Fill)	1.1 to 2.2	75	-	18	-	-	-	5
		Silty Clay	2.2 to 7.2	120	-	18	-	-	-	
15	BH 18-15	Clayey Silt (Fill)	0.8 to 1.5	100	-	18	-	-	-	5
		Sand and Silt (Till)	1.5 to 5.6	-	35	21	11	7	3.7	
		Clayey Silt (Till)	5.6 to 7.3	200	-	20	-	-	-	
		Silty Sand	7.3 to 8.2	-	35	21	11	7	3.7	
16	BH 18-16	Clayey Silt (Fill)	0.9 to 3.0	120	-	18	-	-	-	5
		Sand to Sandy Silt (Till)	3.0 to 7.9	-	35	21	11	7	3.7	
17	BH 18-17	Silty Sand to Sandy Silt (Fill)	0.6 to 1.9	-	29	19	-	2.5	2.9	4
		Silty Clay (Till)	1.9 to 4.1	170	-	19	-	-	-	
		Silty Clay	4.1 to 6.7	150	-	19	-	-	-	
		Silty Clay	6.7 to 8.2	50	-	17	-	-	-	
18	BH 18-18	Sand (Fill)	0.2 to 2.3	-	30	19	9	3	3.0	4
		Silty Sand (Till)	2.3 to 4.6	-	28	18	8	2	2.8	
		Silty Sand(Till)	4.6 to 7.7	-	34	21	11	6	3.5	
19	BH 18-19	Sand to Sandy Silt (Fill)	0.2 to 1.6	-	30	19	-	3	3.0	4
		Clayey Silt to Silty Clay (Fill)	1.6 to 7.2	75	-	18	-	-	-	
		Sand	7.2 to 8.2	-	32	20	10	3.5	3.2	
20	BH 18-20	Sand (Fill)	0.2 to 2.0	-	30	19	9	3	3.0	4
		Silty Clay (Fill)	2.0 to 4.1	100	-	18	-	-	-	
		Sand and Gravel	4.1 to 5.6	-	32	20	10	3.5	3.2	
		Clayey Silt	5.6 to 6.9	160	-	19	-	-	-	
		Sandy Silt (Till)	6.9 to 7.9	-	35	21	11	7	3.7	
21	BH 18-21	Sand (Fill)	0.2 to 1.5	-	30	19	-	3	3.0	4
		Silty Clay to Clayey Silt	1.5 to 5.6	100	-	18	-	-	-	
		Clayey Silt (Till)	5.6 to 7.2	50	-	17	-	-	-	
		Clayey Silt (Till)	7.2 to 8.2	200	-	20	-	-	-	
22	BH 18-22	Sand (Fill)	0.1 to 1.3	-	30	-	9	3	3.0	2
		Silty Clay	1.3 to 2.7	100	-	18	-	-	-	
		Silty Sand (Till)	2.7 to 7.7	-	35	21	11	7	3.7	
23	BH 18-23	Sand (Fill)	0.1 to 1.0	-	30	19	9	3	3.0	4
		Silty Clay (Fill)	1.0 to 5.0	100	-	18	-	-	-	
		Clayey Silt	5.0 to 5.8	100	-	18	-	-	-	
		Sand to Sandy Silt (Till)	5.8 to 8.2	-	35	21	11	7	3.7	
24	BH 18-24	Sand (Fill)	0.1 to 1.2	-	30	19	9	3	3.0	4
		Clayey Silt (Fill)	1.2 to 2.3	75	-	18	-	-	-	
		Silty Clay (Till)	2.3 to 5.6	180	-	19	-	-	-	
		Sand and Silt (Till)	5.6 to 8.2	-	35	21	11	7	3.7	

Notes 1: In order to take into account frost action and surficial disturbances, the ultimate passive resistance in front of the caisson within the upper 1.4 m below final grade should be neglected.

**FOUNDATION DESIGN PARAMETERS
OVERHEAD SIGN SUPPORT
HIGHWAYS 400, 401, 404 and 427**

Site Number	Borehole Number	Reference Simplified Subsurface Stratigraphy for Design	Depth Below Existing Grade (m)	Geotechnical Design Parameters						Groundwater Depth (m) below ground surface
				q_u (kPa)	ϕ' (deg.)	γ (kN/m ³)	γ' (kN/m ³)	n_h (MN/m ³)	K_p	
25 (Revised location)	BH 18-25B	Gravelly Sand to Sand (Fill)	0.2 to 1.3	-	30	19	-	3	3.0	4
		Clayey Silt	1.3 to 5.6	120	-	18	-	-	-	
		Sandy Silt (Till)	5.6 to 7.7	-	35	21	11	7	3.7	
26	BH 18-26	Clayey Silt (Fill)	0.2 to 3.0	100	-	18	-	-	-	4
		Silty Clay (Till)	3.0 to 5.6	180	-	19	-	-	-	
		Sandy Silt (Till)	5.6 to 7.8	-	35	21	11	7	3.7	
27	BH 18-27	Sand (Fill)	0.2 to 1.1	-	30	19	-	3	3.0	4
		Clayey Silt (Fill)	1.1 to 2.3	100	-	18	-	-	-	
		Silty Clay	2.3 to 5.6	200	-	20	-	-	-	
		Sandy Silt	5.6 to 8.7	-	32	20	10	3.5	3.2	
		Sand	8.7 to 11.1	-	28	18	8	2	2.8	

Notes 1: In order to take into account frost action and surficial disturbances, the ultimate passive resistance in front of the caisson within the upper 1.4 m below final grade should be neglected.

LEGEND

q_u	=	Unconfined Compressive Strength (=2 x C_u , undrained shear strength) (kPa)
ϕ'	=	Angle of Internal Friction (degrees)
n_h	=	Coefficient Related to Soil Density (MN/m ³) or X 10 ³ kN/m ³)
K_p	=	Coefficient of Passive Earth Pressure
γ	=	Soil Unit Weight (kN/m ³)
γ'	=	Submerged Soil Unit Weight (kN/m ³) - to be used for cohesionless soils below the groundwater table



Appendix A

Record of Borehole Sheets

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			

RECORD OF BOREHOLE No 18-01

1 OF 1

METRIC

LOCATION MTM NAD 83 Zone 10: N 4 841 094.6 E 304 728.5 ORIGINATED BY BL
 HWY 400 BOREHOLE TYPE Solid Stem Augers COMPILED BY MP
 DATUM Geodetic DATE 2018.07.12 - 2018.07.12 LATITUDE _____ LONGITUDE _____ CHECKED BY CZ

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa						
122.3	GROUND SURFACE													
0.0	ASPHALT: (150mm)													
0.2	SAND and GRAVEL (FILL)		1	GS										
121.7														
0.6	Silty CLAY, some sand, trace gravel Stiff to Very Stiff Brown Moist (TILL)		1	SS	15									
			2	SS	30								0 15 34 51	
	grey below 2.2m		3	SS	10									
			4	SS	14									
			5	SS	20								1 21 34 44	
			6	SS	19									
			7	SS	22									
114.1														
8.2	END OF BOREHOLE AT 8.2m. BOREHOLE OPEN AND DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO 7.0m, CUTTINGS TO 0.8m AND HOLEPLUG TO 0.2m, THEN ASPHALT COLD PATCH TO SURFACE.													

ONT/MT452_MTO-21892.GPJ_2017TEMPLATE(MTO).GDT_2/7/19

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

RECORD OF BOREHOLE No 18-03

1 OF 2

METRIC

LOCATION MTM NAD 83 Zone 10: N 4 847 643.9 E 318 593.7 ORIGINATED BY AF
 HWY 401 BOREHOLE TYPE Solid Stem Augers COMPILED BY MP
 DATUM Geodetic DATE 2018.11.25 - 2018.11.25 LATITUDE _____ LONGITUDE _____ CHECKED BY CZ

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60			80	100
176.1	GROUND SURFACE													
0.0	ASPHALT: (200mm)													
0.2	SAND, some silt, some gravel Brown Moist (FILL)		1	GS							o			20 64 16 (SI+CL)
175.4														
0.7	Silty CLAY, some sand, trace gravel Firm Brown Moist (FILL)		2	SS	7						o			
174.6														
1.5	Silty CLAY, with sand and gravel Very Stiff Brown Moist (TILL)		3	SS	16						o			
174.6														
			4	SS	16						o			0 23 41 36
			5	SS	26						o			
172.0														
4.1	Hard		6	SS	31						o			
170.5														
5.6			7	SS	19						o			
			8	SS	16						o			4 17 30 49
			9	SS	15						o			
166.3														
9.8	END OF BOREHOLE AT 9.8m.													

ONTMT452_MTO-21892.GPJ_2017TEMPLATE(MTO).GDT_2/7/19

Continued Next Page

+³, x³: Numbers refer to Sensitivity
 20
 15
 10
 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 18-03

2 OF 2

METRIC

LOCATION MTM NAD 83 Zone 10: N 4 847 643.9 E 318 593.7 ORIGINATED BY AF
 HWY 401 BOREHOLE TYPE Solid Stem Augers COMPILED BY MP
 DATUM Geodetic DATE 2018.11.25 - 2018.11.25 LATITUDE _____ LONGITUDE _____ CHECKED BY CZ

SOIL PROFILE			SAMPLES				GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	PLASTIC LIMIT			NATURAL MOISTURE CONTENT	LIQUID LIMIT	W _p	W	W _L		
	Continued From Previous Page WATER LEVEL AT 7.2m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND CUTTINGS TO SURFACE.														

ONTMT4S2_MTO-21892.GPJ_2017TEMPLATE(MTO).GDT_2/7/19

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

RECORD OF BOREHOLE No 18-05

1 OF 1

METRIC

LOCATION MTM NAD 83 Zone 10: N 4 841 635.8 E 301 834.7 ORIGINATED BY BL
 HWY 401 BOREHOLE TYPE Solid Stem Augers COMPILED BY MP
 DATUM Geodetic DATE 2018.12.07 - 2018.12.07 LATITUDE _____ LONGITUDE _____ CHECKED BY CZ

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa		WATER CONTENT (%)		
141.0	GROUND SURFACE											
0.0	ASPHALT: (100mm)											
0.1	SAND and GRAVEL (FILL)		1	GS								
140.3	Clayey SILT, trace sand, trace gravel											
0.7	Brown Moist (FILL)		1	SS	7							
139.9	Silty CLAY, with sand to some sand, trace gravel											
1.1	Very Stiff to Hard Grey Moist (TILL)		2	SS	34							
			3	SS	28							1 17 40 42
			4	SS	51							
			5	SS	46							
	occasional cobbles at 6.1m		6	SS	32							2 26 39 33
			7	SS	25							
132.8	END OF BOREHOLE AT 8.2m. BOREHOLE OPEN AND DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH CUTTINGS TO 0.1m, THEN ASPHALT COLD PATCH TO SURFACE.											

ONT/MT452, MTO-21892.GPJ 2017TEMPLATE(MTO).GDT 2/7/19

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

RECORD OF BOREHOLE No 18-06

1 OF 1

METRIC

LOCATION MTM NAD 83 Zone 10: N 4 848 458.3 E 322 593.2 ORIGINATED BY JM
 HWY 401 BOREHOLE TYPE Solid Stem Augers COMPILED BY MP
 DATUM Geodetic DATE 2018.12.07 - 2018.12.07 LATITUDE _____ LONGITUDE _____ CHECKED BY CZ

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80			100	PLASTIC LIMIT W _p
173.6	GROUND SURFACE														
0.0	SAND , some gravel, trace silt Compact Brown Moist (FILL) Clayey SILT , trace gravel, trace sand Stiff Brown Moist (FILL)		1	SS	20						○				
173.0			173												
0.6			172												
			171												
			170												
169.0	Clayey SILT , some clay to clayey, trace sand to sandy, trace gravel Stiff to Hard Grey Moist (TILL)		6	SS	8						○				
4.6			169												
			168												
			7	SS	14						○				
			8	SS	39						○				
164.8	END OF BOREHOLE AT 8.8m. WATER LEVEL AT BOTTOM OF BOREHOLE UPON COMPLETION. BOREHOLE BACKFILLED WITH WELL GRAVEL TO 1.2m, THEN DRY CEMENT AND COLD PATCH ASPHALT TO SURFACE.														
8.8			165												

ONT/MT452, MTO-21892.GPJ 2017TEMPLATE(MTO).GDT 2/7/19

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

RECORD OF BOREHOLE No 18-07

1 OF 1

METRIC

LOCATION MTM NAD 83 Zone 10: N 4 854 107.1 E 315 761.6 ORIGINATED BY BL
 HWY 401 BOREHOLE TYPE Solid Stem Augers COMPILED BY MP
 DATUM Geodetic DATE 2018.07.11 - 2018.07.11 LATITUDE _____ LONGITUDE _____ CHECKED BY CZ

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60			80	100
172.8	GROUND SURFACE													
0.0	ASPHALT: (100mm)													
0.1	Silty SAND, trace gravel Compact Brown Moist (FILL)		1	GS							o			
			1	SS	16						o			
171.0			2	SS	20						o			
1.8	SAND and SILT, some clay, trace gravel Compact Grey Moist (TILL)		3	SS	11						o			
			4	SS	21						o			
168.7														
4.1	Silty CLAY, with sand, trace gravel Very Stiff to Stiff Grey Moist (TILL)		5	SS	22						o			
			6	SS	14						o			
166.6			7	SS	12						o			
8.2	END OF BOREHOLE AT 8.2m. BOREHOLE CAVED TO 7.0m AND WATER LEVEL AT 4.6m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO 5.8m, CUTTINGS TO 0.7m AND HOLEPLUG TO 0.1m, THEN ASPHALT COLD PATCH TO SURFACE.													

ONT/MT/452_MTO-21892.GPJ_2017TEMPLATE(MTO).GDT_2/7/19

+³, x³: Numbers refer to Sensitivity 20
15 5 10 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 18-08

1 OF 1

METRIC

LOCATION MTM NAD 83 Zone 10: N 4 857 655.8 E 344 868.4 ORIGINATED BY ES
 HWY 401 BOREHOLE TYPE Solid Stem Augers COMPILED BY MP
 DATUM Geodetic DATE 2018.06.21 - 2018.06.21 LATITUDE _____ LONGITUDE _____ CHECKED BY CZ

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa		WATER CONTENT (%)		
89.0	GROUND SURFACE											
0.0	ASPHALT: (450mm)											
88.5												
0.5	SAND, some gravel to gravelly Dense Brown Moist (FILL)		1	GS								
87.8			1	SS	39							
1.2	Clayey SILT, with sand, trace gravel											
87.5	Brown Moist (FILL)											
1.5	Sandy SILT, trace clay Dense to Very Dense Brown Moist		2	SS	43							
			3	SS	47							0 35 58 7
			4	SS	53							
84.9												
4.1	SAND, some gravel, some silt, trace clay Dense Brown Wet		5	SS	47							14 71 12 3
83.4												
5.6	Silty SAND, trace gravel Very Dense Grey Moist (TILL)		6	SS	100/ 0.250							
			7	SS	100/							
81.1												
7.9	END OF BOREHOLE AT 7.9m. BOREHOLE OPEN TO 7.0 AND WATER LEVEL AT 3.7m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND CUTTINGS TO 0.2m, THEN ASPHALT TO SURFACE.				0.275							

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

RECORD OF BOREHOLE No 18-09

1 OF 1

METRIC

LOCATION MTM NAD 83 Zone 10: N 4 860 147.1 E 355 903.8 ORIGINATED BY AF
 HWY 401 BOREHOLE TYPE Solid Stem Augers COMPILED BY MP
 DATUM Geodetic DATE 2018.06.20 - 2018.06.20 LATITUDE _____ LONGITUDE _____ CHECKED BY CZ

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa						
111.3	GROUND SURFACE													
0.0	ASPHALT: (275mm)													
111.0														
0.3	Silty SAND, trace gravel, trace clay Compact Brown Moist (FILL)		1	GS										
			1	SS	15								4 67 23 6	
			2	SS	14									
109.0														
2.3	Silty SAND, some clay, trace gravel Very Dense Grey Moist (TILL)		3	SS	50/ 0.125									
108.3			4	SS	50/ 0.125									
3.0	Clayey SILT to Silty CLAY, with sand to some sand, trace gravel Hard Grey Moist (TILL)		4	SS	50/ 0.125									
			5	SS	50/ 0.075								4 38 32 26	
			6	SS	50/ 0.075									
	Auger grinding from 7.0 to 7.5m													
103.6														
7.7	END OF BOREHOLE AT 7.7m. BOREHOLE OPEN AND DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND CUTTINGS TO SURFACE.		7	SS	50/ 0.100									

ONT/MT/4S2_MTO-21892.GPJ_2017TEMPLATE(MTO).GDT_2/7/19

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

RECORD OF BOREHOLE No 18-10

1 OF 2

METRIC

LOCATION MTM NAD 83 Zone 10: N 4 860 330.8 E 356 465.9 ORIGINATED BY AF
 HWY 401 BOREHOLE TYPE Solid Stem Augers COMPILED BY MP
 DATUM Geodetic DATE 2018.06.20 - 2018.06.20 LATITUDE _____ LONGITUDE _____ CHECKED BY CZ

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	20	40			60	80	100	PLASTIC LIMIT W _p
96.2	GROUND SURFACE														
0.0 95.9	ASPHALT: (250mm)														
0.3	SAND, some silt, trace gravel Compact Brown Moist (FILL)		1	GS											
95.9			1	SS	17										
94.8	Silty CLAY, with sand to some sand, trace gravel Stiff to Firm Grey Moist (FILL) trace rootlets, trace organics		2	SS	11										
1.4			3	SS	6										
			4	SS	7										
			5	SS	7										
			6	SS	7										
			7	SS	3										
89.0	Silty CLAY, some sand, trace gravel Soft to Stiff Grey Wet		7	SS	3										
7.2			8	SS	14										
86.4	END OF BOREHOLE AT 9.8m.														
9.8															

ONTMT4S2_MTO-21892.GPJ_2017TEMPLATE(MTO).GDT_2/7/19

Continued Next Page

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

RECORD OF BOREHOLE No 18-10

2 OF 2

METRIC

LOCATION MTM NAD 83 Zone 10: N 4 860 330.8 E 356 465.9 ORIGINATED BY AF
 HWY 401 BOREHOLE TYPE Solid Stem Augers COMPILED BY MP
 DATUM Geodetic DATE 2018.06.20 - 2018.06.20 LATITUDE _____ LONGITUDE _____ CHECKED BY CZ

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa								WATER CONTENT (%)
							20	40	60	80	100	W _p	W	W _L		
	Continued From Previous Page BOREHOLE OPEN TO 8.2 AND WATER LEVEL AT 7.0m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND CUTTINGS TO SURFACE.															

ONTMT4S2_MTO-21892.GPJ_2017TEMPLATE(MTO).GDT_2/7/19

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

RECORD OF BOREHOLE No 18-11

1 OF 1

METRIC

LOCATION MTM NAD 83 Zone 10: N 4 866 722.1 E 357 667.7 ORIGINATED BY AF
 HWY 401 BOREHOLE TYPE Solid Stem Augers COMPILED BY MP
 DATUM Geodetic DATE 2018.06.20 - 2018.06.20 LATITUDE _____ LONGITUDE _____ CHECKED BY CZ

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa							
						20	40	60	80	100	PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L		
99.6	GROUND SURFACE														
0.0	ASPHALT: (250mm)														
0.3	SAND, some silt to silty, trace gravel, trace clay Compact to Dense Brown Moist (FILL)		1	GS											
99			1	SS	26										4 55 32 9
98			2	SS	50										
97			3	SS	22										
96			4	SS	15										
94.4	Clayey SILT, with sand, trace gravel Hard Grey Moist (TILL)		5	SS	34										
94			6	SS	100/ 0.100										
91.8	END OF BOREHOLE AT 7.8m. BOREHOLE OPEN TO 4.9 AND DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND CUTTINGS TO SURFACE.		7	SS	100/ 0.150									3 44 36 17	
7.8															

ONTMT4S2_MTO-21892.GPJ_2017TEMPLATE(MTO).GDT_2/7/19

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

RECORD OF BOREHOLE No 18-12

1 OF 2

METRIC

LOCATION MTM NAD 83 Zone 10: N 4 860 923.0 E 359 592.7 ORIGINATED BY AF
 HWY 401 BOREHOLE TYPE Solid Stem Augers COMPILED BY MP
 DATUM Geodetic DATE 2018.06.20 - 2018.06.20 LATITUDE _____ LONGITUDE _____ CHECKED BY CZ

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)						
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa								WATER CONTENT (%)					
							20	40	60	80	100	20	40	60	GR	SA	SI	CL			
82.0	GROUND SURFACE																				
0.0	ASPHALT: (125mm)																				
0.1	SAND, some to trace gravel, trace silt Compact Brown Moist (FILL)	[Hatched]	1	GS																	
			1	SS	24																
80.6	Silty CLAY, with sand, trace gravel Stiff to Very Stiff Brown Moist (FILL)	[Hatched]	2	SS	14																
1.4			3	SS	11																
			4	SS	20																
			5	SS	10																
77.9	Silty SAND, trace gravel Compact Brown Wet (FILL)	[Hatched]																			
4.1			6	SS	7																
77.1	Silty CLAY, with sand, trace gravel Firm to Soft Brown Moist	[Hatched]																			
4.9			7	SS	2																
			8	SS	27																
72.9	Clayey SILT, some sand, trace gravel Very Stiff Grey Moist (TILL)	[Hatched]																			
9.1			3	SS	3																
72.2			4	SS	5																
9.8	END OF BOREHOLE AT 9.8m																				

ONTMT452, MTO-21892.GPJ 2017TEMPLATE(MTO).GDT 2/7/19

Continued Next Page

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

RECORD OF BOREHOLE No 18-12

2 OF 2

METRIC

LOCATION MTM NAD 83 Zone 10: N 4 860 923.0 E 359 592.7 ORIGINATED BY AF
 HWY 401 BOREHOLE TYPE Solid Stem Augers COMPILED BY MP
 DATUM Geodetic DATE 2018.06.20 - 2018.06.20 LATITUDE _____ LONGITUDE _____ CHECKED BY CZ

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa							
	Continued From Previous Page BOREHOLE OPEN AND WATER LEVEL AT 3.4m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND CUTTINGS TO 0.2m, THEN ASPHALT TO SURFACE.														

ONTMT4S2_MTO-21892.GPJ_2017TEMPLATE(MTO).GDT_2/7/19

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

RECORD OF BOREHOLE No 18-13

1 OF 1

METRIC

LOCATION MTM NAD 83 Zone 10: N 4 860 793.3 E 357 790.8 ORIGINATED BY ES
 HWY 401 BOREHOLE TYPE Solid Stem Augers COMPILED BY MP
 DATUM Geodetic DATE 2018.06.20 - 2018.06.20 LATITUDE _____ LONGITUDE _____ CHECKED BY CZ

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa							
						20 40 60 80 100 ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE WATER CONTENT (%) 20 40 60									
97.7	GROUND SURFACE														
0.0	ASPHALT: (150mm)														
0.2	SAND, some gravel Compact Brown Moist (FILL)	[Strat Plot: 0.2-0.9m]	1	GS											
97															
96.8															
0.9			Silty SAND, some clay, trace gravel Dense to Very Dense Brown to Grey Moist (TILL)	[Strat Plot: 0.9-7.7m]	1	SS	34							3 57 29 11	
					2	SS	50/	0.075							
					3	SS	50/	0.125							
					4	SS	50/	0.100							
	5	SS			50/	0.100									
	6	SS			50/	0.075									
90.0	END OF BOREHOLE AT 7.7m. BOREHOLE OPEN AND WATER LEVEL AT 3.7m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND CUTTINGS TO 0.2m, THEN ASPHALT TO SURFACE.	[Strat Plot: 7.7-90.0m]	7	SS	50/	0.075									
7.7															

ONTMT4S2_MTO-21892.GPJ_2017TEMPLATE(MTO).GDT_2/7/19

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

RECORD OF BOREHOLE No 18-14

1 OF 1

METRIC

LOCATION MTM NAD 83 Zone 10: N 4 863 141.9 E 375 919.5 ORIGINATED BY ES
 HWY 401 BOREHOLE TYPE Solid Stem Augers COMPILED BY MP
 DATUM Geodetic DATE 2018.06.13 - 2018.06.13 LATITUDE _____ LONGITUDE _____ CHECKED BY CZ

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					
						20 40 60 80 100 ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE WATER CONTENT (%) 20 40 60							
91.5	GROUND SURFACE												
0.0	ASPHALT: (100mm)												
0.1	Gravelly SAND, some silt Loose Brown Moist (FILL)		1	GS	-								
90.4			1	SS	8							32	54 14 (SI+CL)
1.1	Clayey SILT, some sand Stiff Brown Moist (FILL)		2	SS	8								
89.6													
1.9	ORGANICS Loose												
89.3	Dark Brown Moist												
2.2	Silty CLAY, some sand, trace gravel Very Stiff to Stiff Brown Moist		3	SS	16								
			4	SS	19								
			5	SS	12								
			6	SS	9								0 11 48 41
			7	SS	26								
83.3													
8.2	END OF BOREHOLE AT 8.2m. BOREHOLE OPEN AND WATER LEVEL AT 6.2m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND CUTTINGS TO 0.2m, THEN ASPHALT TO SURFACE.												

ONT/MT452_MTO-21892.GPJ_2017TEMPLATE(MTO).GDT_2/7/19

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

RECORD OF BOREHOLE No 18-15

1 OF 1

METRIC

LOCATION MTM NAD 83 Zone 10: N 486 298.8 E 375 312.7 ORIGINATED BY ES
 HWY 401 BOREHOLE TYPE Solid Stem Augers COMPILED BY MP
 DATUM Geodetic DATE 2018.06.13 - 2018.06.13 LATITUDE _____ LONGITUDE _____ CHECKED BY CZ

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa		WATER CONTENT (%)		
94.0	GROUND SURFACE											
0.0	ASPHALT: (100mm)											
0.1	SAND, some gravel Loose Brown Moist		1	GS								
93.2	(FILL)											
0.8	Clayey SILT, some sand, trace gravel Stiff Brown Moist		1	SS	9							
92.5	(FILL)											
1.5	SAND and SILT, trace gravel, trace to some clay Dense to Very Dense Brown Moist		2	SS	46							3 43 36 18
	(TILL)		3	SS	93/ 0.275							
			4	SS	90							
			5	SS	50/ 0.125							
88.4	Clayey SILT, some sand, trace gravel Hard Grey Moist		6	SS	87							
5.6	(TILL)											
86.7	Silty SAND, trace clay, trace gravel Very Dense Brown Wet		7	SS	56							2 67 27 4
7.3												
85.8	END OF BOREHOLE AT 8.2m. BOREHOLE OPEN AND WATER LEVEL AT 5.6m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND CUTTINGS TO 0.2m, THEN ASPHALT TO SURFACE.											
8.2												

ONTMT4S2_MTO-21892.GPJ_2017TEMPLATE(MTO).GDT_2/7/19

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

RECORD OF BOREHOLE No 18-16

1 OF 1

METRIC

LOCATION MTM NAD 83 Zone 10: N 4 862 765.1 E 373 842.2 ORIGINATED BY ES
 HWY 401 BOREHOLE TYPE Solid Stem Augers COMPILED BY MP
 DATUM Geodetic DATE 2018.06.19 - 2018.06.19 LATITUDE _____ LONGITUDE _____ CHECKED BY CZ

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa					
105.8	GROUND SURFACE												
0.0	ASPHALT: (150mm)												
0.2	SAND, some gravel Compact Brown Moist (FILL)		1	GS									
104.9			1	SS	29								
0.9			2	SS	10								2 45 28 25
	Clayey SILT, with sand, trace gravel Very Stiff to Stiff Brown Moist (FILL)		3	SS	14								
102.8			4	SS	50/ 0.125								9 67 17 7
3.0			5	SS	50/ 0.075								
	SAND, some silt, trace gravel, trace clay Very Dense Brown Moist (TILL)		6	SS	50/ 0.125								
100.2			7	SS	50/ 0.100								
5.6	Sandy SILT, trace gravel Very Dense Grey Moist (TILL)												
98.6	SAND, trace gravel Very Dense Brown Wet												
7.2													
97.9	END OF BOREHOLE AT 7.9m. BOREHOLE OPEN AND WATER LEVEL AT 5.0m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND CUTTINGS TO 0.2m, THEN ASPHALT TO SURFACE.												

ONTMT4S2_MTO-21892.GPJ_2017TEMPLATE(MTO).GDT_2/7/19

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

RECORD OF BOREHOLE No 18-17

1 OF 1

METRIC

LOCATION MTM NAD 83 Zone 10: N 4 844 308.9 E 302 601.9 ORIGINATED BY BL
 HWY 401 BOREHOLE TYPE Solid Stem Augers COMPILED BY MP
 DATUM Geodetic DATE 2018.07.12 - 2018.07.12 LATITUDE _____ LONGITUDE _____ CHECKED BY CZ

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					
						20 40 60 80 100 ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE WATER CONTENT (%) 20 40 60							
146.0	GROUND SURFACE												
0.0	ASPHALT: (150mm)												
0.2	SAND and GRAVEL (FILL)		1	GS									
145.4													
0.6	Sandy SILT to Silty SAND, trace clay, trace gravel		1	SS	8								
	Loose Brown Moist (FILL)												
144.1			2	SS	6								
1.9	Silty CLAY, with sand, trace gravel		3	SS	17								1 28 35 36
	Very Stiff to Hard Brown Moist (TILL)		4	SS	32								
141.9			5	SS	20								0 3 62 35
4.1	Silty CLAY, trace sand		6	SS	12								
	Very Stiff to Firm Grey Moist		7	SS	4								
137.8													
8.2	END OF BOREHOLE AT 8.2m. BOREHOLE CAVED TO 7.2m AND DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO 5.9m, CUTTINGS TO 0.8m AND HOLEPLUG TO 0.2m, THEN ASPHALT COLD PATCH TO SURFACE.												

ONT/MT452_MTO-21892.GPJ_2017TEMPLATE(MTO).GDT_2/7/19

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

RECORD OF BOREHOLE No 18-18

1 OF 1

METRIC

LOCATION MTM NAD 83 Zone 10: N 4 861 431.5 E 369 196.6 ORIGINATED BY AF
 HWY 401 BOREHOLE TYPE Solid Stem Augers COMPILED BY MP
 DATUM Geodetic DATE 2018.06.21 - 2018.06.21 LATITUDE _____ LONGITUDE _____ CHECKED BY CZ

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa						
85.0	GROUND SURFACE													
0.0	ASPHALT: (200mm)													
0.2	SAND, some silt to silty, trace gravel Compact Brown Moist (FILL)		1	GS										
			1	SS	13									
			2	SS	12									
82.7														
2.3	Silty SAND, some clay, trace to some gravel Loose Brown Moist (TILL)		3	SS	3									15 44 27 14
			4	SS	4									
	Dense to Very Dense													
			5	SS	31									6 50 31 13
			6	SS	66									
77.3			7	SS	50/									
7.7	END OF BOREHOLE AT 7.7m. BOREHOLE OPWN AND DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND CUTTINGS TO SURFACE.				0.100									

ONTMT4S2_MTO-21892.GPJ_2017TEMPLATE(MTO).GDT_2/7/19

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

RECORD OF BOREHOLE No 18-20

1 OF 1

METRIC

LOCATION MTM NAD 83 Zone 10: N 4 862 139.9 E 370 347.9 ORIGINATED BY ES
 HWY 401 BOREHOLE TYPE Solid Stem Augers COMPILED BY MP
 DATUM Geodetic DATE 2018.06.19 - 2018.06.19 LATITUDE _____ LONGITUDE _____ CHECKED BY CZ

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60			80	100	W _p
80.9	GROUND SURFACE														
0.0	ASPHALT: (150mm)														
0.2	SAND, some gravel Compact Brown Moist (FILL)		1	GS											
			1	SS	23										
			2	SS	11										
78.9	Silty CLAY, some sand, trace gravel Stiff Brown Moist (FILL)														
			3	SS	8										
			4	SS	9										
76.8	SAND and GRAVEL, trace silt Compact Brown Wet														
			5	SS	17										
75.3	Clayey SILT, some sand, trace gravel Very Stiff Grey Moist														
			6	SS	20										
74.0	Sandy SILT, trace to some gravel Very Dense Grey Wet (TILL)														
			7	SS	50/										
73.0	END OF BOREHOLE AT 7.9m. BOREHOLE OPEN AND WATER LEVEL AT 4.0m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND CUTTINGS TO 0.2m, THEN ASPHALT TO SURFACE.				0.150										

ONT/MT452_MTO-21892.GPJ_2017TEMPLATE(MTO).GDT_2/7/19

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

RECORD OF BOREHOLE No 18-21

1 OF 1

METRIC

LOCATION MTM NAD 83 Zone 10: N 4 862 321.1 E 370 827.8 ORIGINATED BY AF
 HWY 401 BOREHOLE TYPE Solid Stem Augers COMPILED BY MP
 DATUM Geodetic DATE 2018.06.21 - 2018.06.21 LATITUDE _____ LONGITUDE _____ CHECKED BY CZ

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa		WATER CONTENT (%)		
82.4	GROUND SURFACE											
0.0	ASPHALT: (200mm)											
0.2	SAND, some silt, trace gravel Compact Brown Moist (FILL)		1	GS								
			1	SS	18							
80.9	Silty CLAY to Clayey SILT, trace sand, trace gravel Stiff Brown Moist		2	SS	10							0 9 58 33
			3	SS	9							
			4	SS	8							
			5	SS	9							
76.8	Clayey SILT, with sand, trace gravel Firm Brown Moist (TILL) with sand		6	SS	4							3 36 36 25
			7	SS	54							
74.2	Hard											
8.2	END OF BOREHOLE AT 8.2m. BOREHOLE DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND CUTTINGS TO SURFACE.											

ONTMT4S2_MTO-21892.GPJ_2017TEMPLATE(MTO).GDT_2/7/19

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

RECORD OF BOREHOLE No 18-22

1 OF 1

METRIC

LOCATION MTM NAD 83 Zone 10: N 4 862 573.1 E 371 745.4 ORIGINATED BY ES
 HWY 401 BOREHOLE TYPE Solid Stem Augers COMPILED BY MP
 DATUM Geodetic DATE 2018.06.14 - 2018.06.14 LATITUDE _____ LONGITUDE _____ CHECKED BY CZ

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa						
85.5	GROUND SURFACE													
0.0	ASPHALT: (125mm)													
0.1	SAND, some to trace gravel Compact Brown Moist (FILL)	[Hatched Pattern]	1	GS										
84.2			1	SS	13									
1.3	Silty CLAY Stiff to Very Stiff Brown Moist	[Diagonal Pattern]	2	SS	8								0 0 39 61	
82.8			3	SS	21									
2.7	Silty SAND, trace gravel, trace clay Very Dense Grey Moist (TILL)	[Dotted Pattern]	4	SS	105									
			5	SS	50/ 0.100									
			6	SS	50/ 0.100									5 54 33 8
			7	SS	50/ 0.100									
77.8	END OF BOREHOLE AT 7.9m. BOREHOLE OPEN TO 7.3m AND DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND CUTTINGS TO 0.1m, THEN ASPHALT TO SURFACE.													

ONTMT4S2_MTO-21892.GPJ_2017TEMPLATE(MTO).GDT_2/7/19

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

RECORD OF BOREHOLE No 18-24

1 OF 1

METRIC

LOCATION MTM NAD 83 Zone 10: N 4 862 666.6 E 372 925.6 ORIGINATED BY ES
 HWY 401 BOREHOLE TYPE Solid Stem Augers COMPILED BY MP
 DATUM Geodetic DATE 2018.06.19 - 2018.06.19 LATITUDE _____ LONGITUDE _____ CHECKED BY CZ

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa						
						20	40	60	80	100	20	40	60	GR SA SI CL
90.3	GROUND SURFACE													
0.0	ASPHALT: (125mm)													
0.1	SAND, some gravel Compact Brown Moist (FILL)	[Hatched Pattern]	1	GS										
89.1			1	SS	20									
1.2	Clayey SILT, some sand, trace gravel Firm Brown Moist (FILL)	[Hatched Pattern]	2	SS	7									
88.0			3	SS	27									
2.3	Silty CLAY, trace sand, trace gravel Very Stiff Brown Moist (TILL)	[Hatched Pattern]	4	SS	18									2 8 34 56
87.0			5	SS	29									
84.7			6	SS	21									
5.6	SAND and SILT, some clay, trace gravel Compact to Very Dense Grey Wet (TILL)	[Hatched Pattern]	7	SS	63									
82.1														
8.2	END OF BOREHOLE AT 8.2m. BOREHOLE OPEN AND WATER LEVEL AT 7.1m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND CUTTINGS TO 0.2m, THEN ASPHALT TO SURFACE.													

ONTMT4S2_MTO-21892.GPJ_2017TEMPLATE(MTO).GDT_2/7/19

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

RECORD OF BOREHOLE No 18-25B

1 OF 1

METRIC

LOCATION MTM NAD 83 Zone 10: N 4 862 827.6 E 874 068.3 ORIGINATED BY KK
 HWY 401 BOREHOLE TYPE Solid Stem Augers COMPILED BY MP
 DATUM Geodetic DATE 2018.08.26 - 2018.08.26 LATITUDE _____ LONGITUDE _____ CHECKED BY CZ

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa								
						20 40 60 80 100 ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE WATER CONTENT (%) 20 40 60										
100.6	GROUND SURFACE															
0.0	ASPHALT: (150mm)															
0.2	Gravelly SAND to SAND, trace to some silt Compact Brown Moist (FILL)		1	GS												
99.3			1	SS	18											
1.3			Clayey SILT, with sand, trace gravel Stiff Grey Moist		2	SS	14									
					3	SS	10									
					4	SS	12									
	5	SS			15											
95.0	Sandy SILT, trace clay, trace gravel Very Dense Grey Moist		6	SS	100/ 0.075											
92.9			7	SS	100/ 0.050											
7.7	END OF BOREHOLE AT 7.7m. BOREHOLE CAVED TO 3.0m AND WATER LEVEL AT 5.1m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND CUTTINGS TO 0.2m, THEN ASPHALT COLD PATCH TO SURFACE.															

ONT/MT/4S2_MTO-21892.GPJ_2017TEMPLATE(MTO).GDT_2/7/19

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

RECORD OF BOREHOLE No 18-26

1 OF 1

METRIC

LOCATION MTM NAD 83 Zone 10: N 4 833 128.7 E 299 977.5 ORIGINATED BY ES
 HWY 427 BOREHOLE TYPE Solid Stem Augers COMPILED BY MP
 DATUM Geodetic DATE 2018.06.18 - 2018.06.18 LATITUDE _____ LONGITUDE _____ CHECKED BY CZ

ELEV DEPTH	SOIL PROFILE DESCRIPTION	STRAT PLOT	SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
			NUMBER	TYPE	"N" VALUES			20	40	60			80
130.6	GROUND SURFACE												
0.0	ASPHALT: (150mm)												
0.2	SAND, some gravel Dark Brown Moist (FILL)		1	GS									
129.7													
0.9	Clayey SILT, some sand, trace gravel Stiff Brown Moist (FILL)		1	SS	14								
129.2													
1.4	Silty SAND, some clay, some gravel Compact Brown Moist (FILL)		2	SS	21								17 48 22 13
128.4													
2.2	Clayey SILT, some sand, trace gravel Stiff Brown Moist (FILL)		3	SS	10								
127.8													
2.8 127.6	ORGANICS, trace rootlets Compact Brown Moist		4	SS	23								1 22 44 33
3.0	Silty CLAY, with sand, trace gravel Very Stiff to Hard Brown Moist (TILL)		5	SS	50								
125.0													
5.6	Sandy SILT, some clay, trace gravel Very Dense Brown Moist (TILL)		6	SS	69								
122.8													
7.8	END OF BOREHOLE AT 7.8m. BOREHOLE OPEN AND DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND CUTTINGS TO 0.2m, THEN ASPHALT TO SURFACE.		7	SS	50/ 0.150								

ONT/MT/4S2_MTO-21892.GPJ_2017TEMPLATE(MTO).GDT_2/7/19

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

RECORD OF BOREHOLE No 18-27

1 OF 2

METRIC

LOCATION MTM NAD 83 Zone 10: N 4 847 095.6 E 314 161.8 ORIGINATED BY ES
 HWY 401 BOREHOLE TYPE Solid Stem Augers COMPILED BY MP
 DATUM Geodetic DATE 2018.06.17 - 2018.06.17 LATITUDE _____ LONGITUDE _____ CHECKED BY CZ

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60						80
174.6	GROUND SURFACE															
0.0	ASPHALT: (150mm)															
0.2	SAND, some to trace gravel Compact Brown Moist (FILL)		1	GS												
173.5			1	SS	22											
1.1	Clayey SILT, some sand, trace gravel Very Stiff to Stiff Brown Moist (FILL)		2	SS	10											
172.3			2	SS	10											
2.3	Silty CLAY, some sand Very Stiff to Hard Brown Moist		3	SS	26											
172.3			4	SS	34											
171			5	SS	40											
170			5	SS	40											
169.0	Sandy SILT, trace gravel Compact Brown Wet		6	SS	10											
168			7	SS	15											
167			7	SS	15											
165.9	SAND, trace silt, trace clay Loose Brown Wet		8	SS	4											
165			8	SS	4											

ONTMT452_MTO-21892.GPJ_2017TEMPLATE(MTO).GDT_2/7/19

Continued Next Page

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

RECORD OF BOREHOLE No 18-27

2 OF 2

METRIC

LOCATION MTM NAD 83 Zone 10: N 4 847 095.6 E 314 161.8 ORIGINATED BY ES
 HWY 401 BOREHOLE TYPE Solid Stem Augers COMPILED BY MP
 DATUM Geodetic DATE 2018.06.17 - 2018.06.17 LATITUDE _____ LONGITUDE _____ CHECKED BY CZ

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80						100	20
163.5	Continued From Previous Page SAND , trace silt, trace clay Very Dense Brown Wet		9	SS	50/ 0.150		164											0 88 9 3
11.1	END OF BOREHOLE AT 7.9m. BOREHOLE OPEN TO 9.4m AND WATER LEVEL AT 5.3m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND CUTTINGS TO 0.1m, THEN ASPHALT TO SURFACE.																	

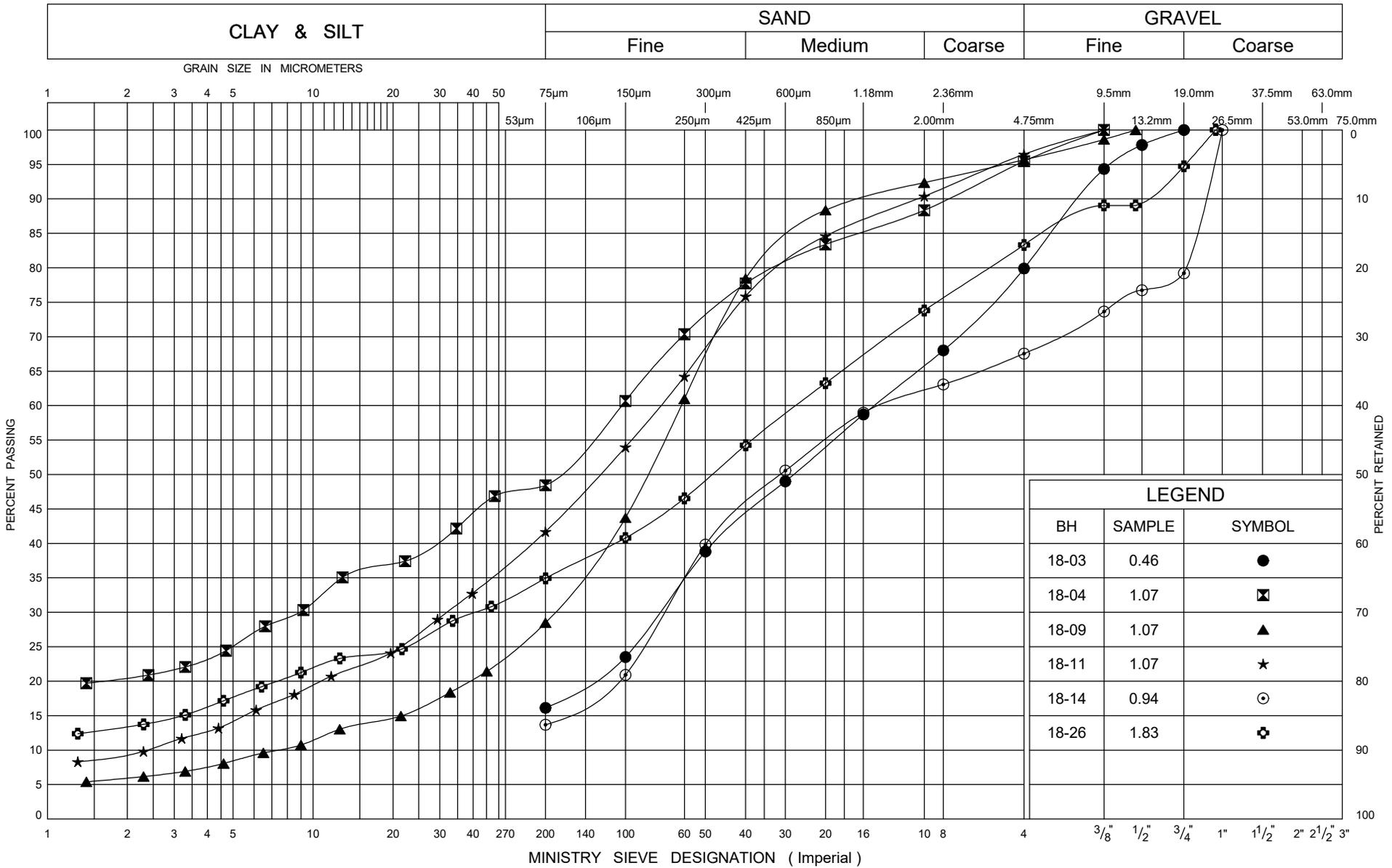
ONTMT4S2_MTO-21892.GPJ_2017TEMPLATE(MTO).GDT_2/7/19

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



Appendix B

Laboratory Test Results

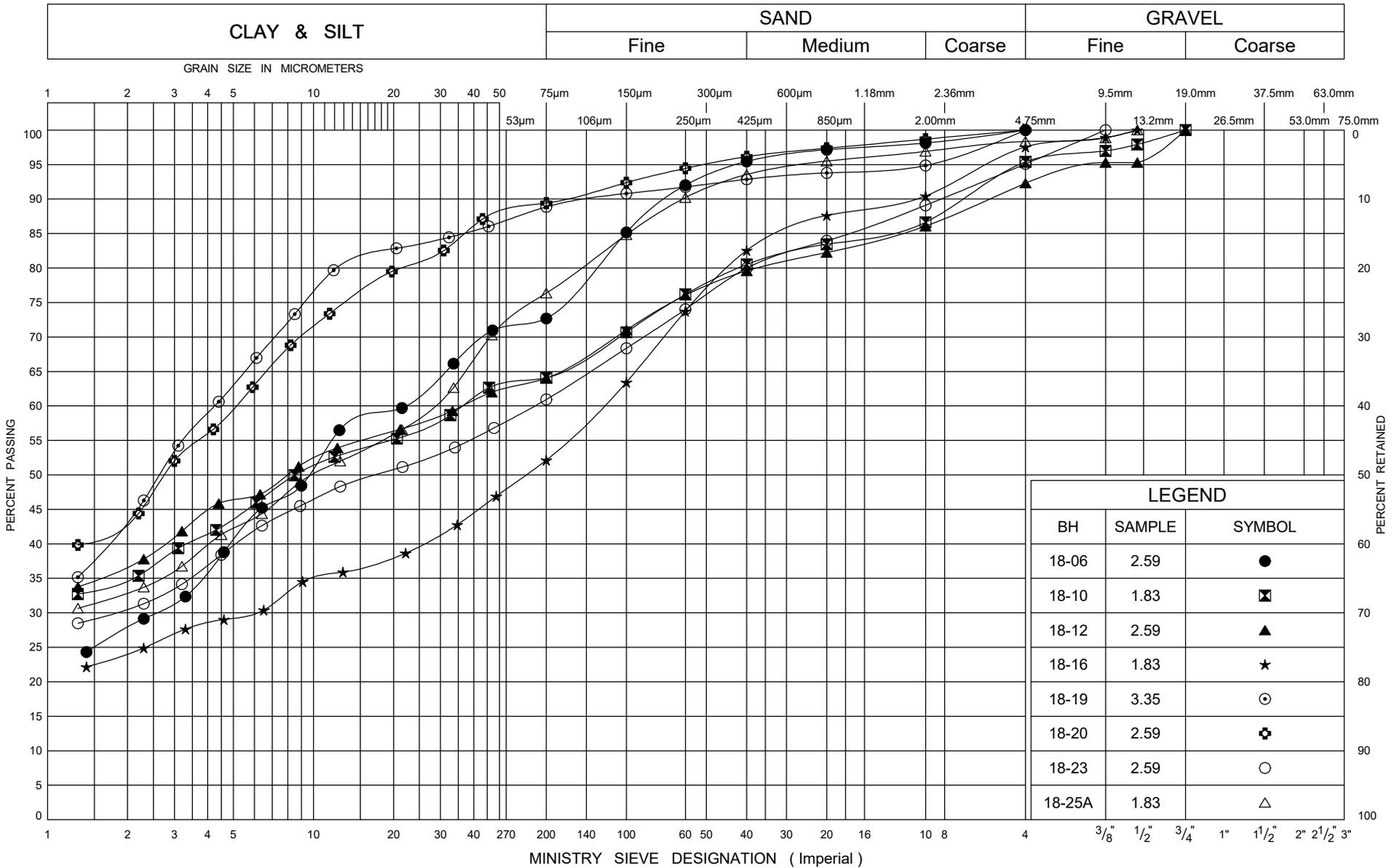


ONTARIO MOT GRAIN SIZE 2 MTO-21892.GPJ ONTARIO MOT.GDT 1/25/19



GRAIN SIZE DISTRIBUTION
SAND, Silty SAND to Gravelly SAND FILL

FIG No B1
 W P



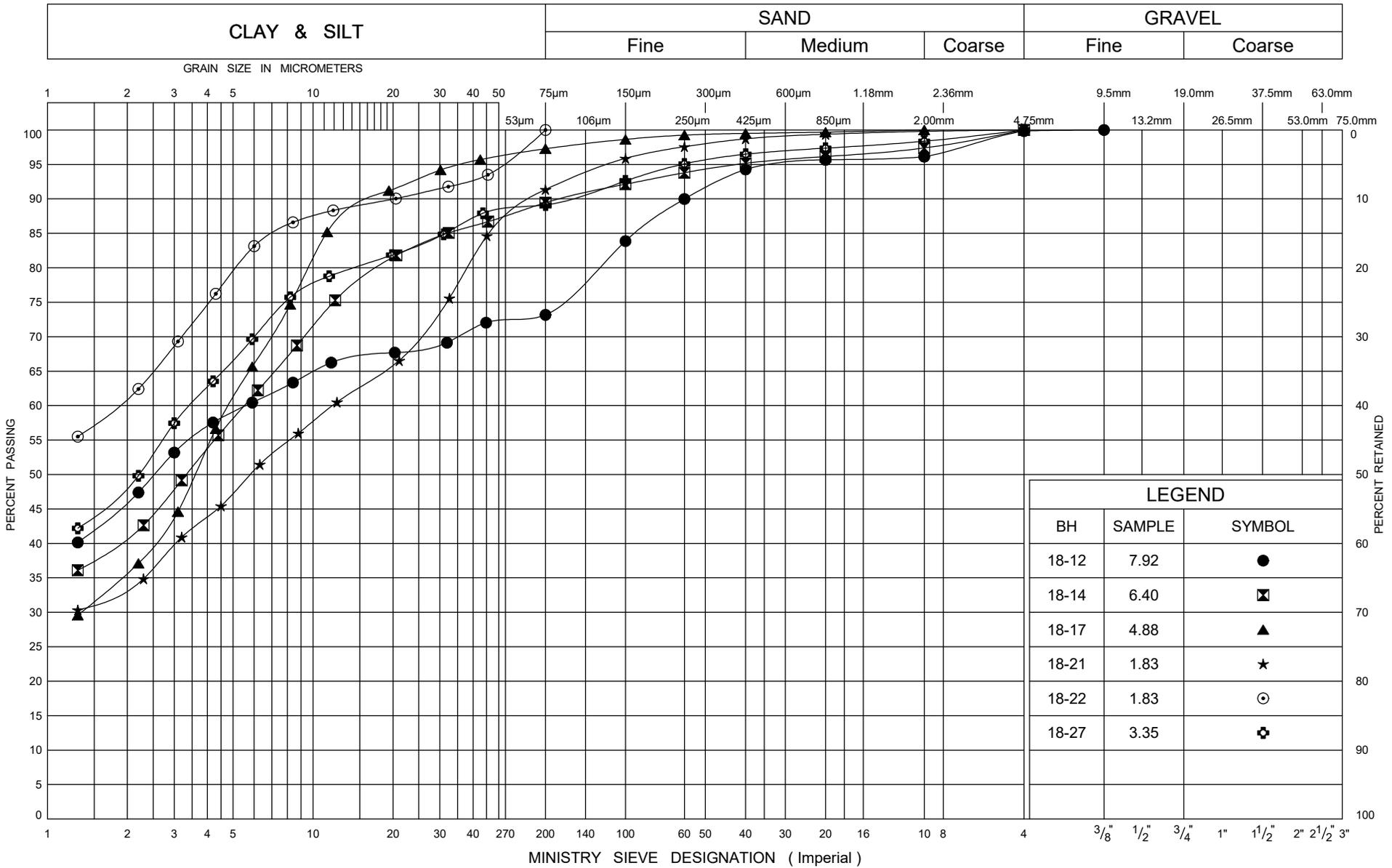
ONTARIO MOT GRAIN SIZE 2 MTO-21892.GPJ ONTARIO MOT.GDT 1/25/19



GRAIN SIZE DISTRIBUTION

Clayey SILT to Silty CLAY FILL

FIG No B2
W P



LEGEND		
BH	SAMPLE	SYMBOL
18-12	7.92	●
18-14	6.40	⊠
18-17	4.88	▲
18-21	1.83	★
18-22	1.83	⊙
18-27	3.35	⊕

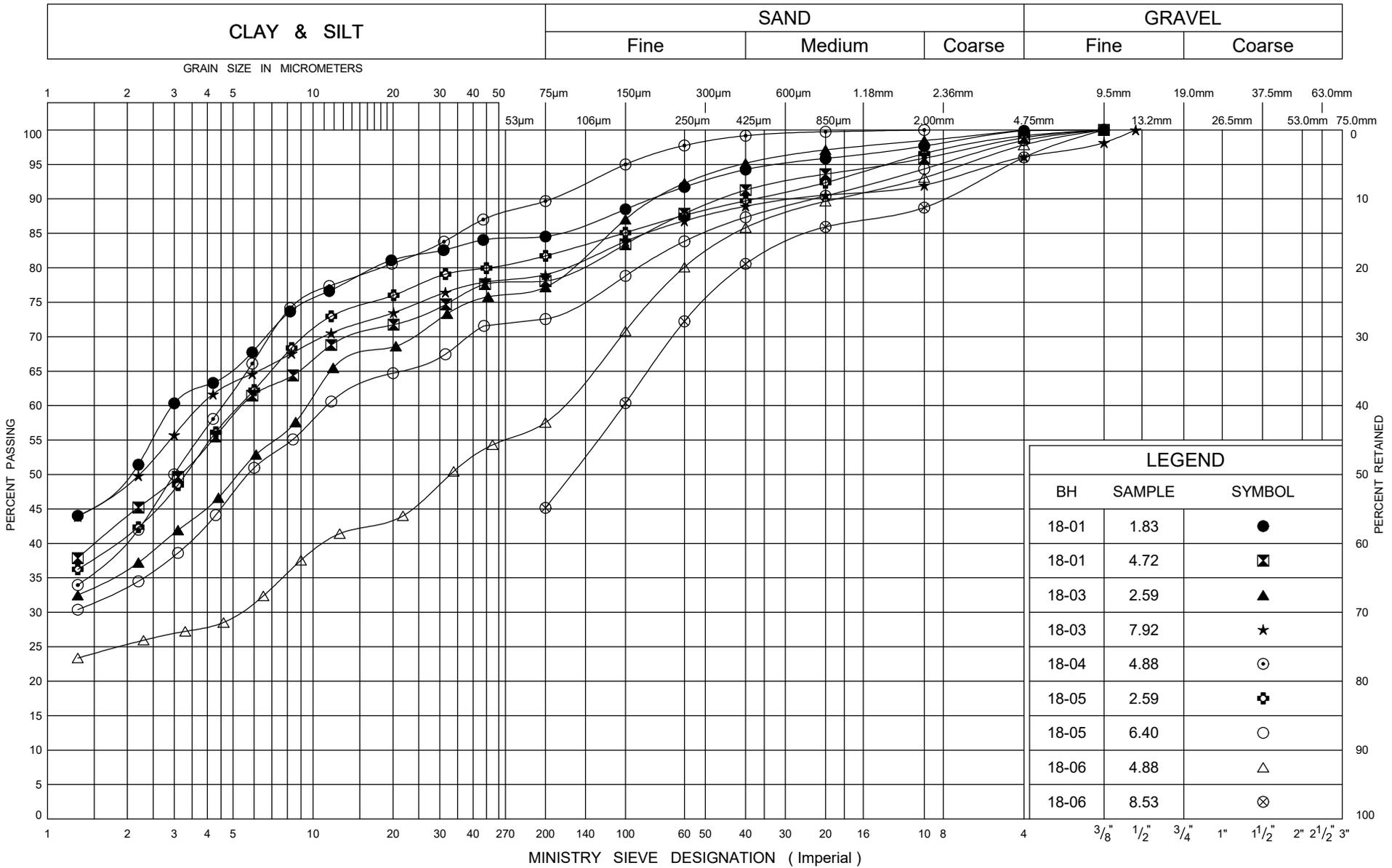
ONTARIO MOT GRAIN SIZE 2 MTO-21892.GPJ ONTARIO MOT.GDT 1/25/19



GRAIN SIZE DISTRIBUTION

Clayey SILT to Silty CLAY

FIG No B3
W P



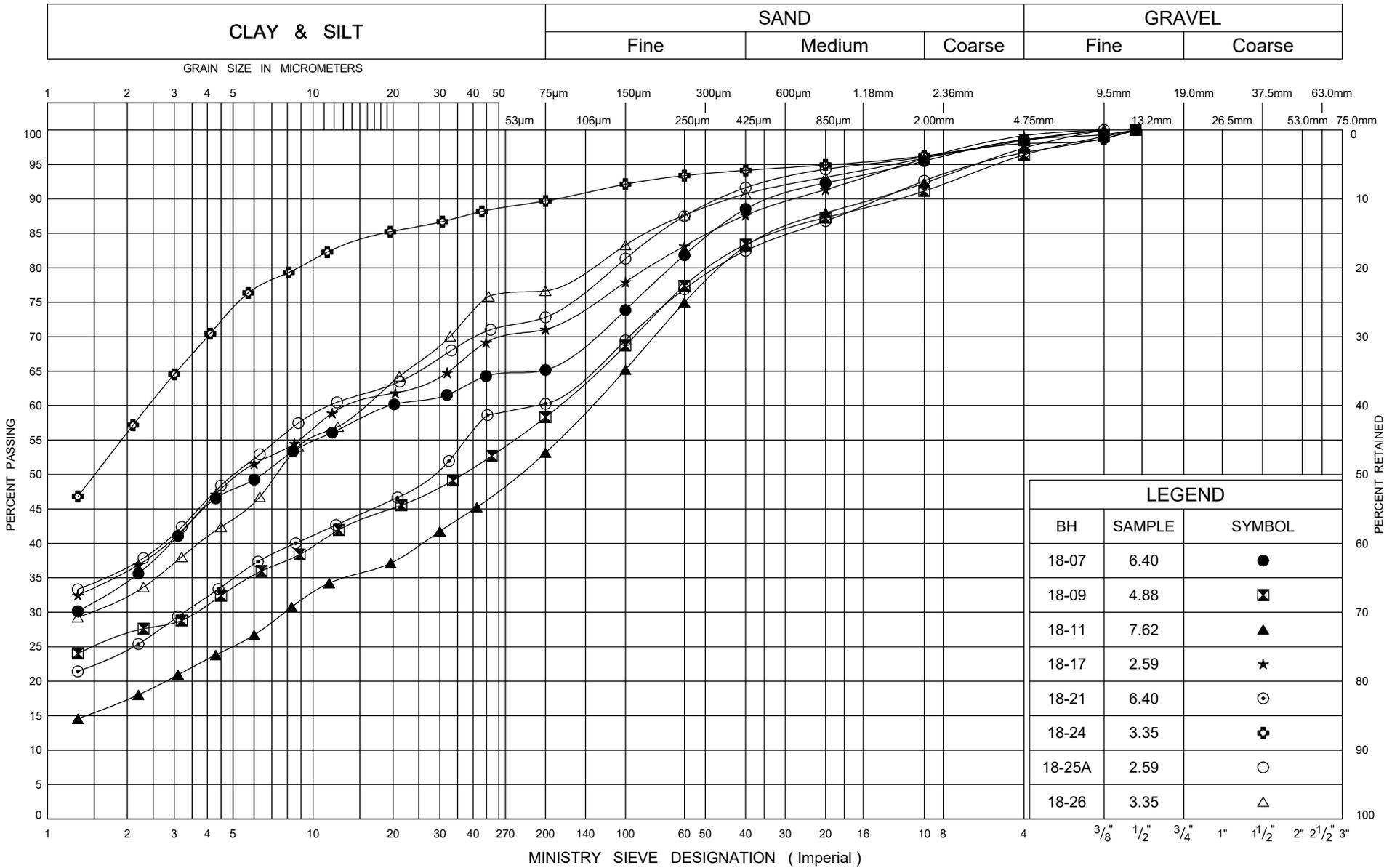
ONTARIO MOT GRAIN SIZE 2X_MTO-21892.GPJ_ONTARIO MOT.GDT_2/7/19



GRAIN SIZE DISTRIBUTION

Silty CLAY to Clayey SILT TILL

FIG No B4
W P



LEGEND		
BH	SAMPLE	SYMBOL
18-07	6.40	●
18-09	4.88	⊠
18-11	7.62	▲
18-17	2.59	★
18-21	6.40	⊙
18-24	3.35	⊕
18-25A	2.59	○
18-26	3.35	△

ONTARIO MOT GRAIN SIZE 2 MTO-21892.GPJ ONTARIO MOT.GDT 1/25/19

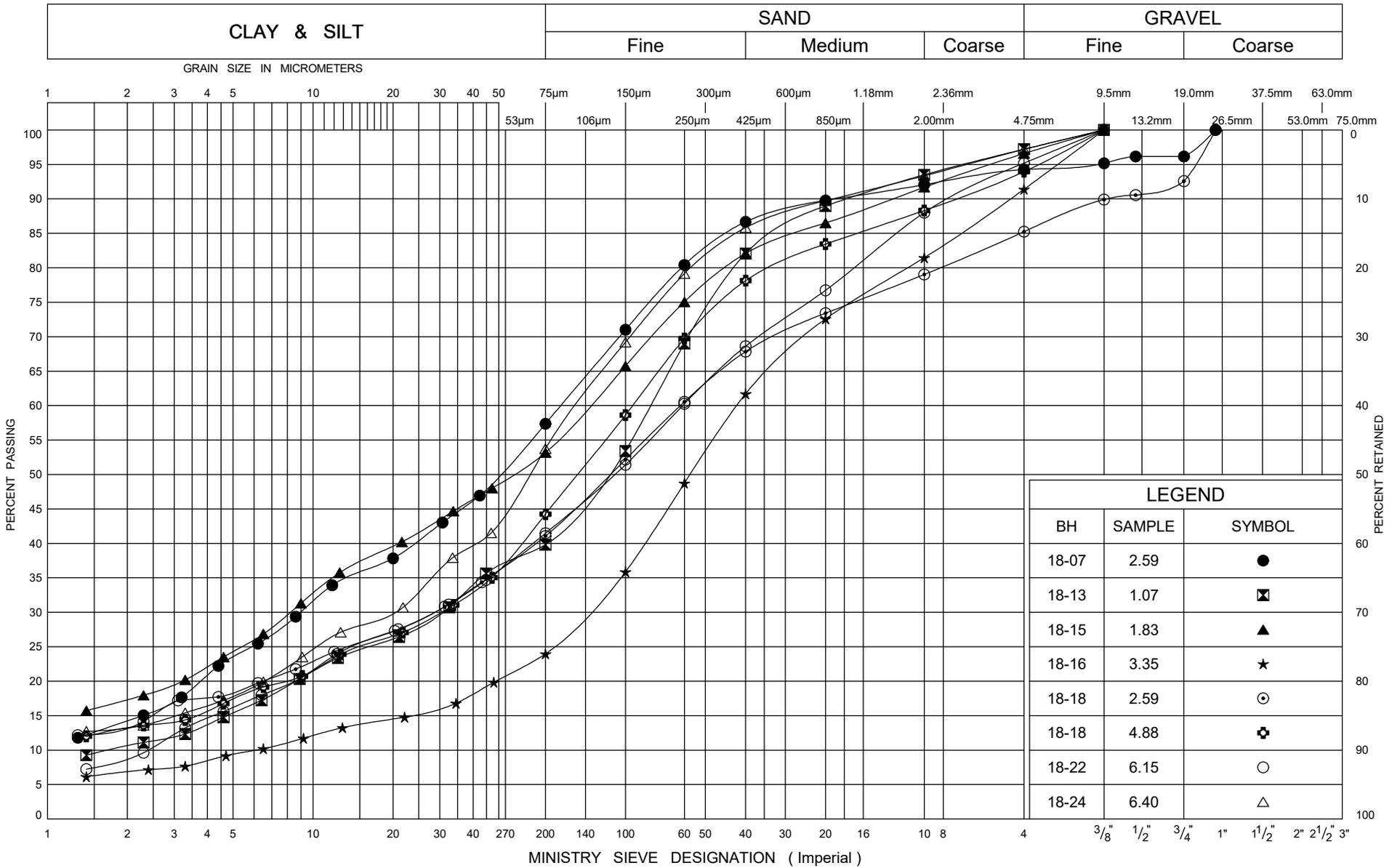


GRAIN SIZE DISTRIBUTION

Silty CLAY to Clayey SILT TILL

FIG No B5

W P



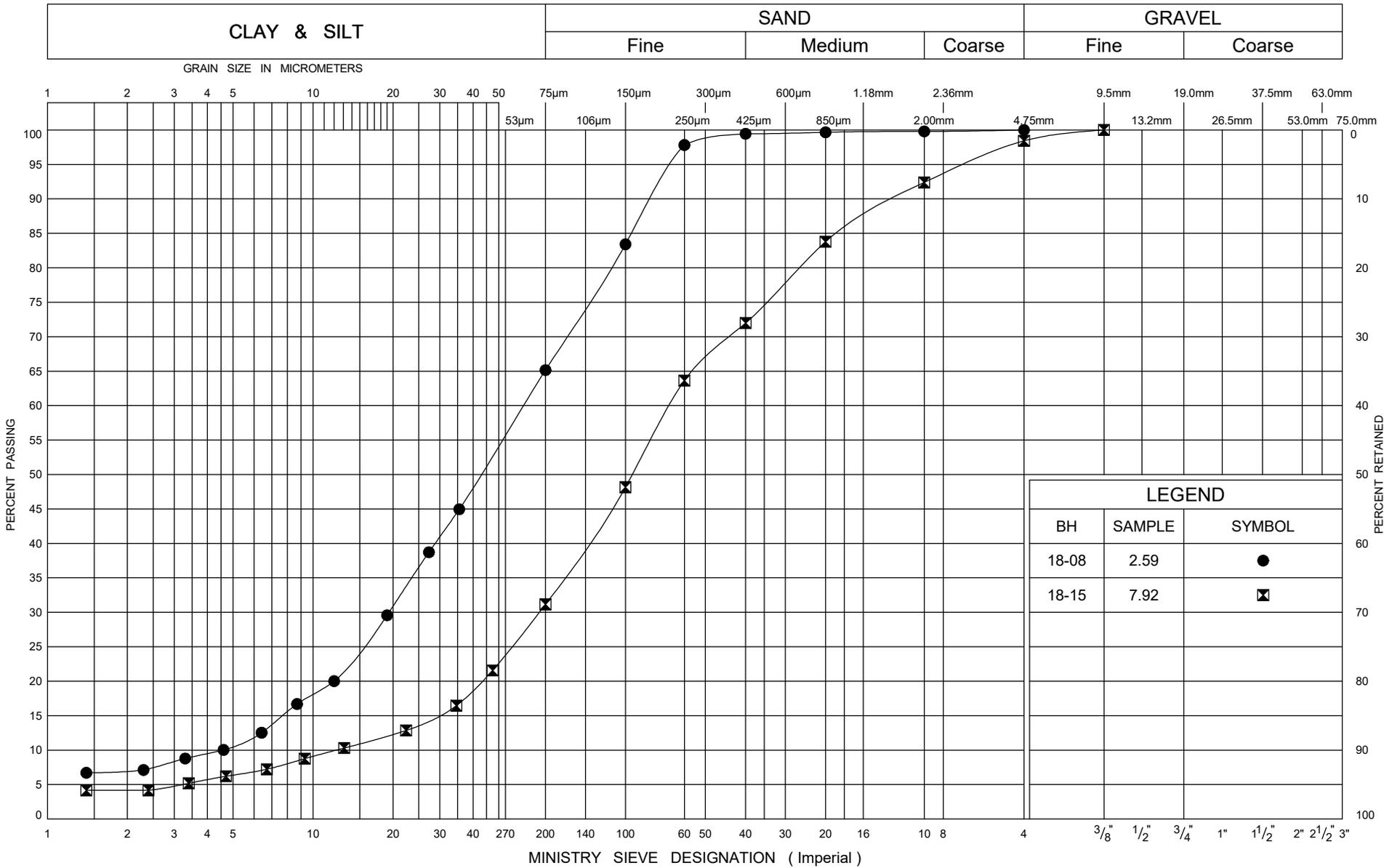
ONTARIO MOT GRAIN SIZE 2 MTO-21892.GPJ ONTARIO MOT.GDT 1/25/19



GRAIN SIZE DISTRIBUTION

Silty SAND to Sandy SILT TILL

FIG No B6
W P

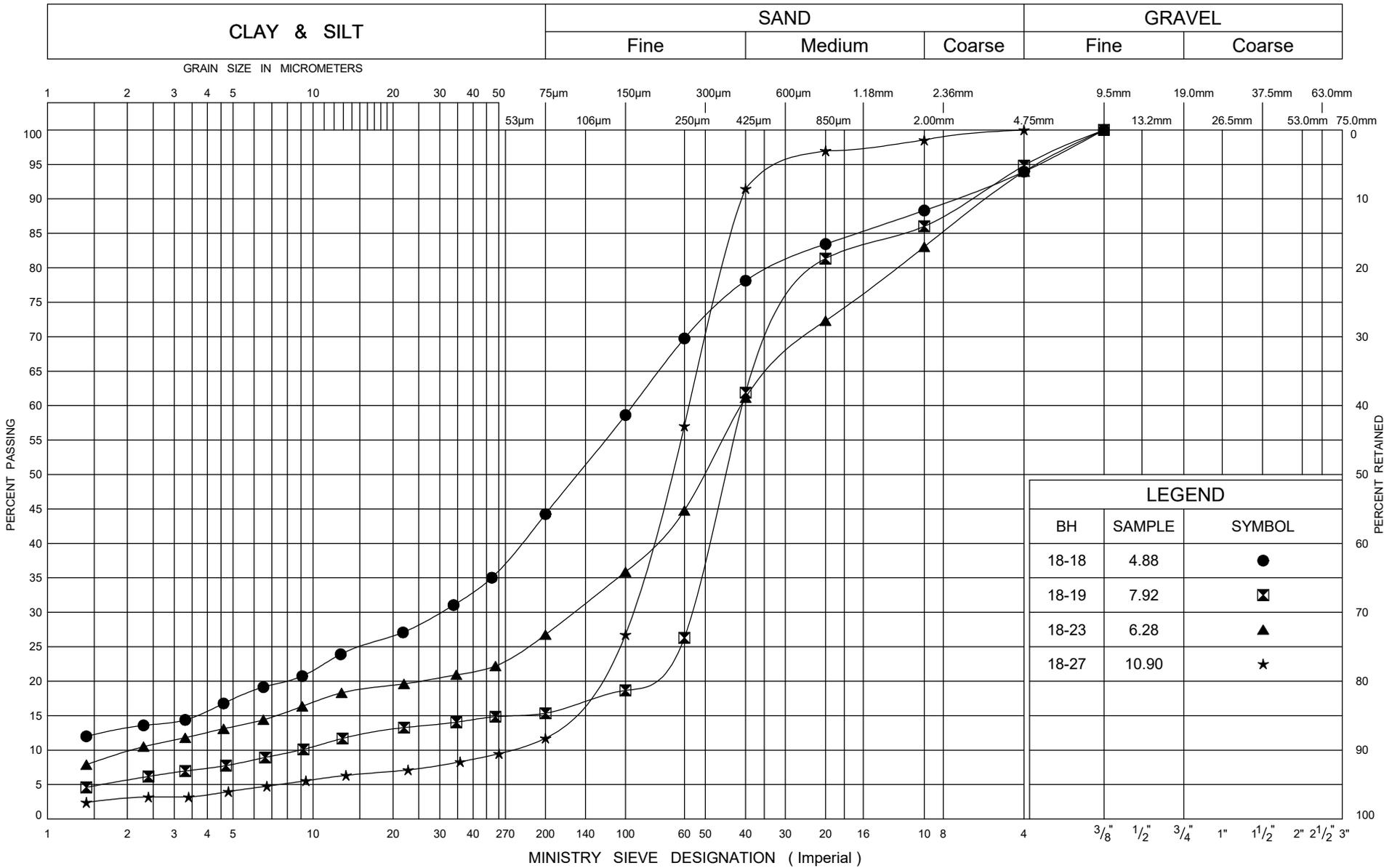


ONTARIO MOT GRAIN SIZE 2 MTO-21892.GPJ ONTARIO MOT.GDT 1/25/19



GRAIN SIZE DISTRIBUTION
Sandy SILT to SAND

FIG No B7
W P



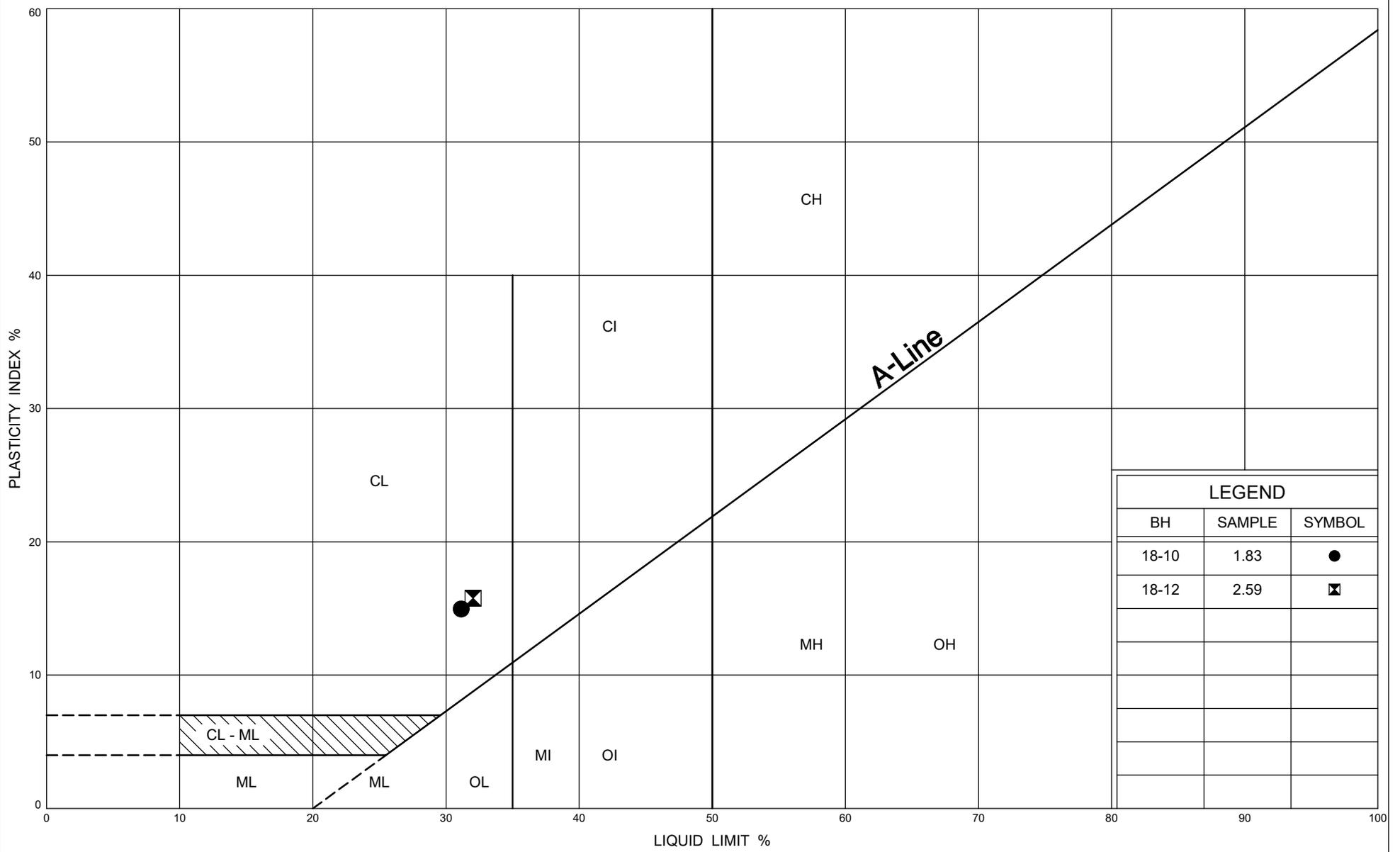
LEGEND		
BH	SAMPLE	SYMBOL
18-18	4.88	●
18-19	7.92	⊠
18-23	6.28	▲
18-27	10.90	★

ONTARIO MOT GRAIN SIZE 2 MTO-21892.GPJ ONTARIO MOT.GDT 1/25/19



GRAIN SIZE DISTRIBUTION SAND to SAND and GRAVEL

FIG No B8
W P



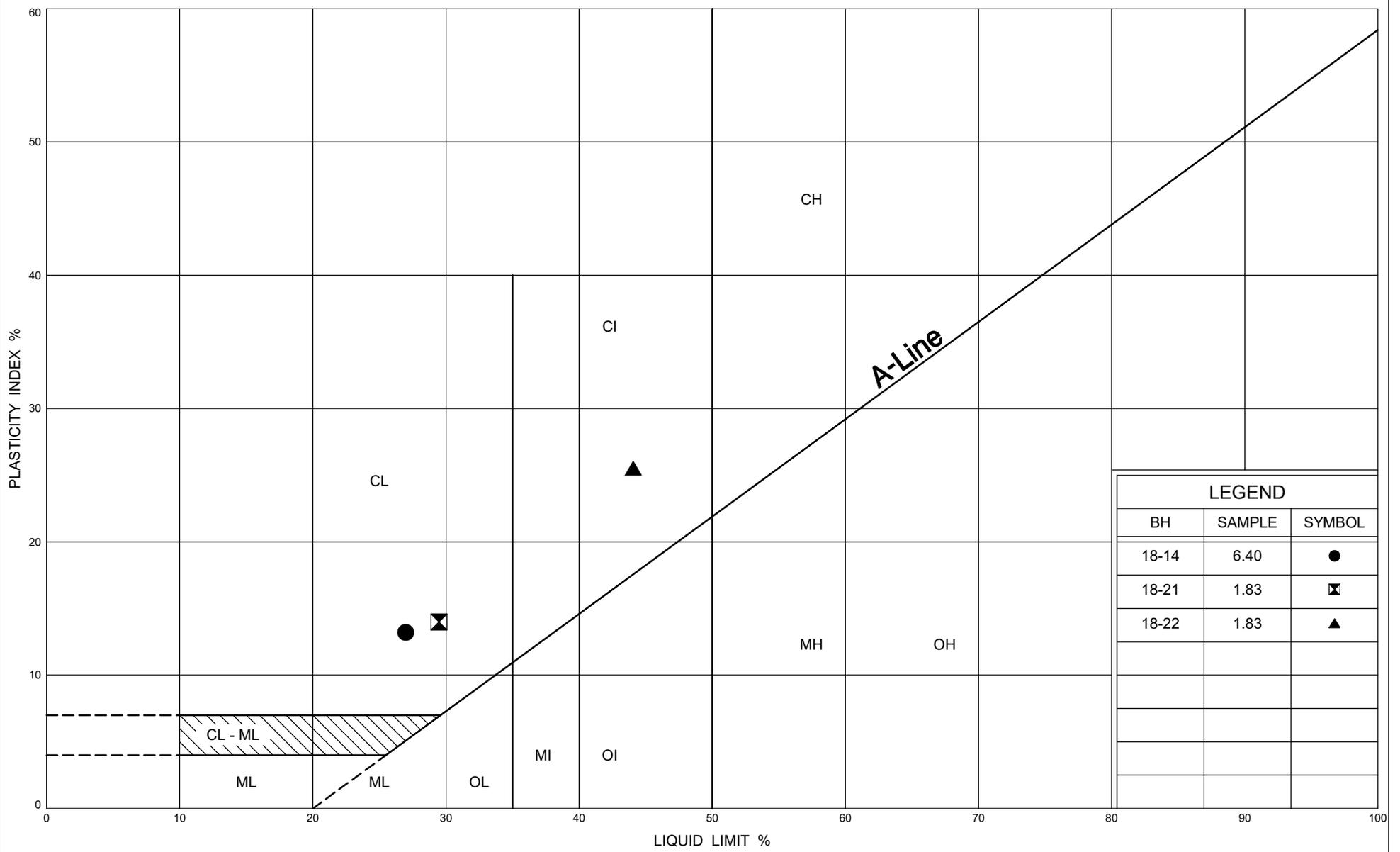
LEGEND		
BH	SAMPLE	SYMBOL
18-10	1.83	●
18-12	2.59	⊠

ONTARIO MOT PLASTICITY CHART MTO-21892.GPJ ONTARIO MOT.GDT 1/25/19



PLASTICITY CHART
Silty CLAY to Clayey SILT FILL

FIG No B9
W P



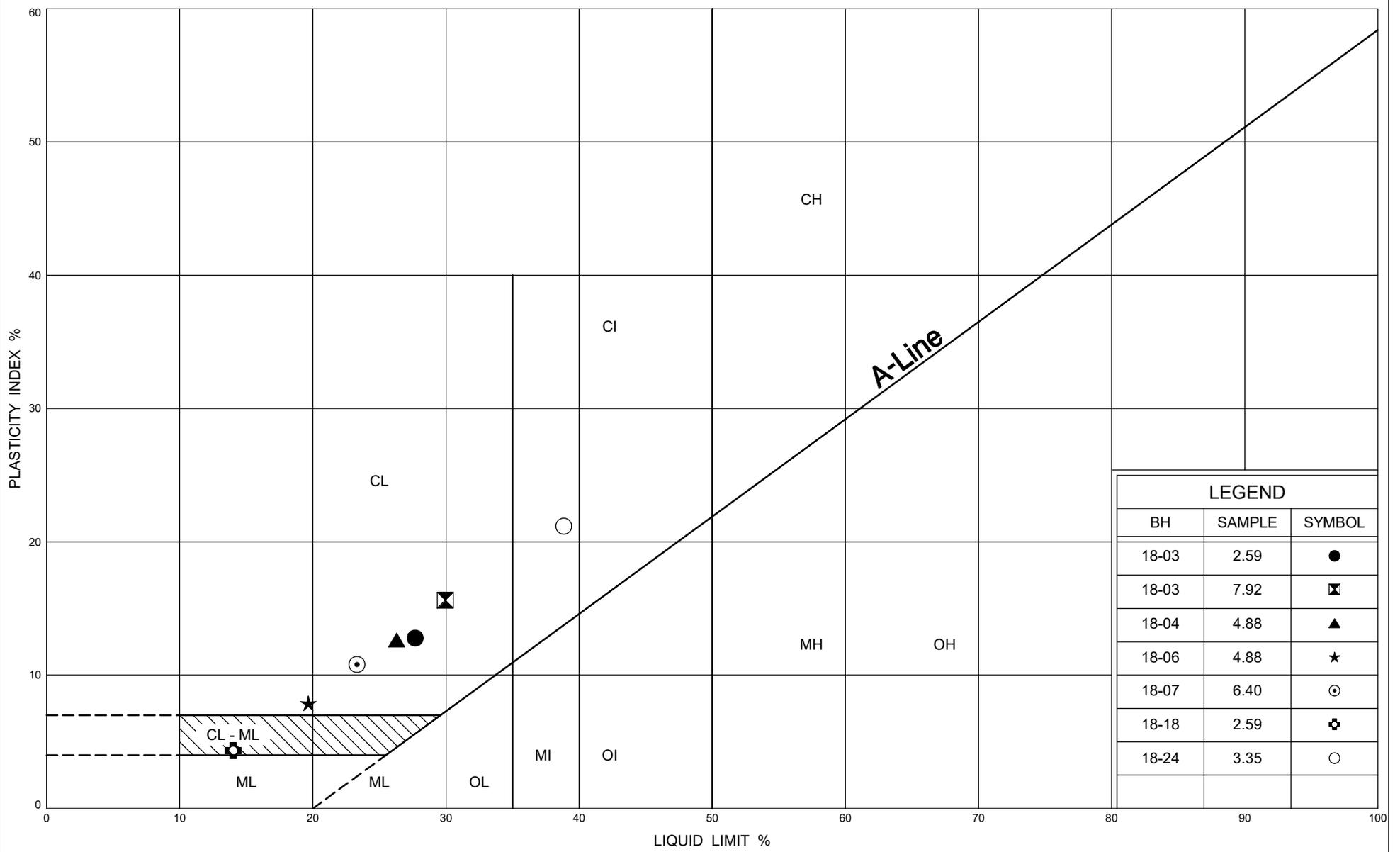
LEGEND		
BH	SAMPLE	SYMBOL
18-14	6.40	●
18-21	1.83	⊠
18-22	1.83	▲

ONTARIO MOT PLASTICITY CHART MTO-21892.GPJ ONTARIO MOT.GDT 1/25/19



PLASTICITY CHART
Clayey SILT to Silty CLAY

FIG No B10
W P



LEGEND		
BH	SAMPLE	SYMBOL
18-03	2.59	●
18-03	7.92	⊠
18-04	4.88	▲
18-06	4.88	★
18-07	6.40	⊙
18-18	2.59	⊕
18-24	3.35	○

ONTARIO MOT PLASTICITY CHART MTO-21892.GPJ ONTARIO MOT.GDT 2/7/19



PLASTICITY CHART

Silty CLAY to Clayey SILT TILL

FIG No B11

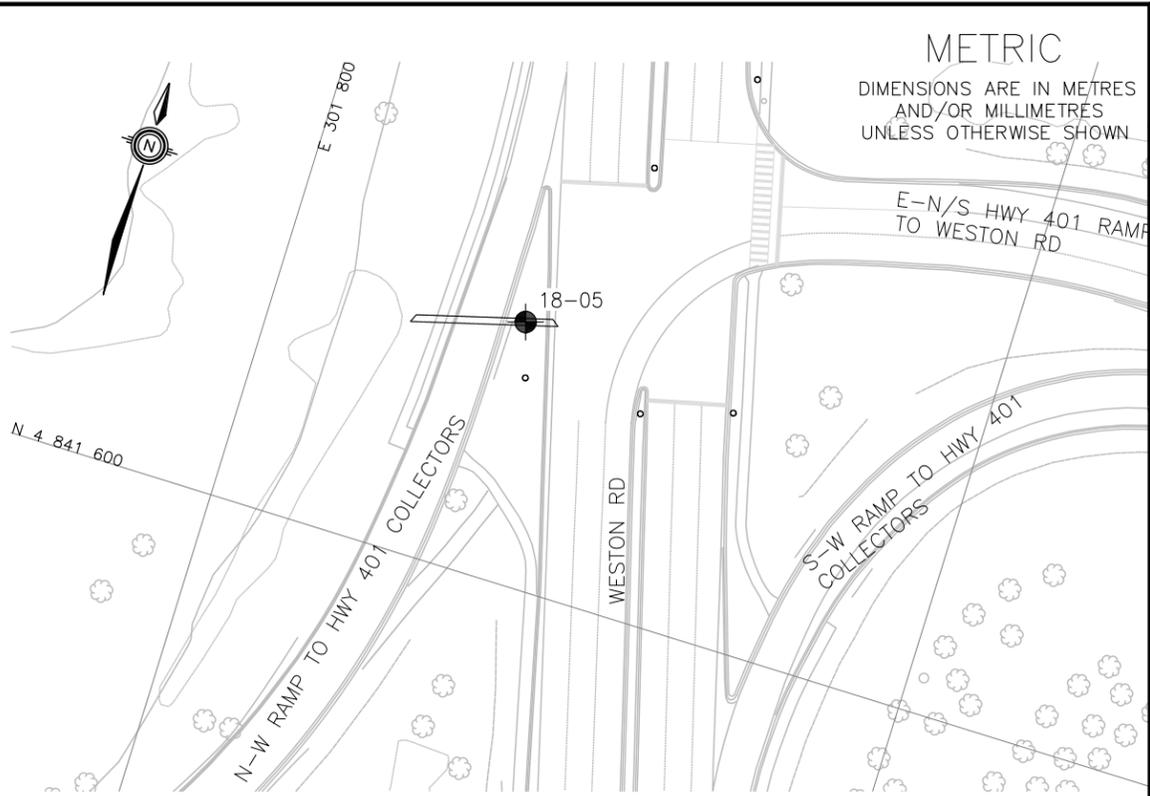
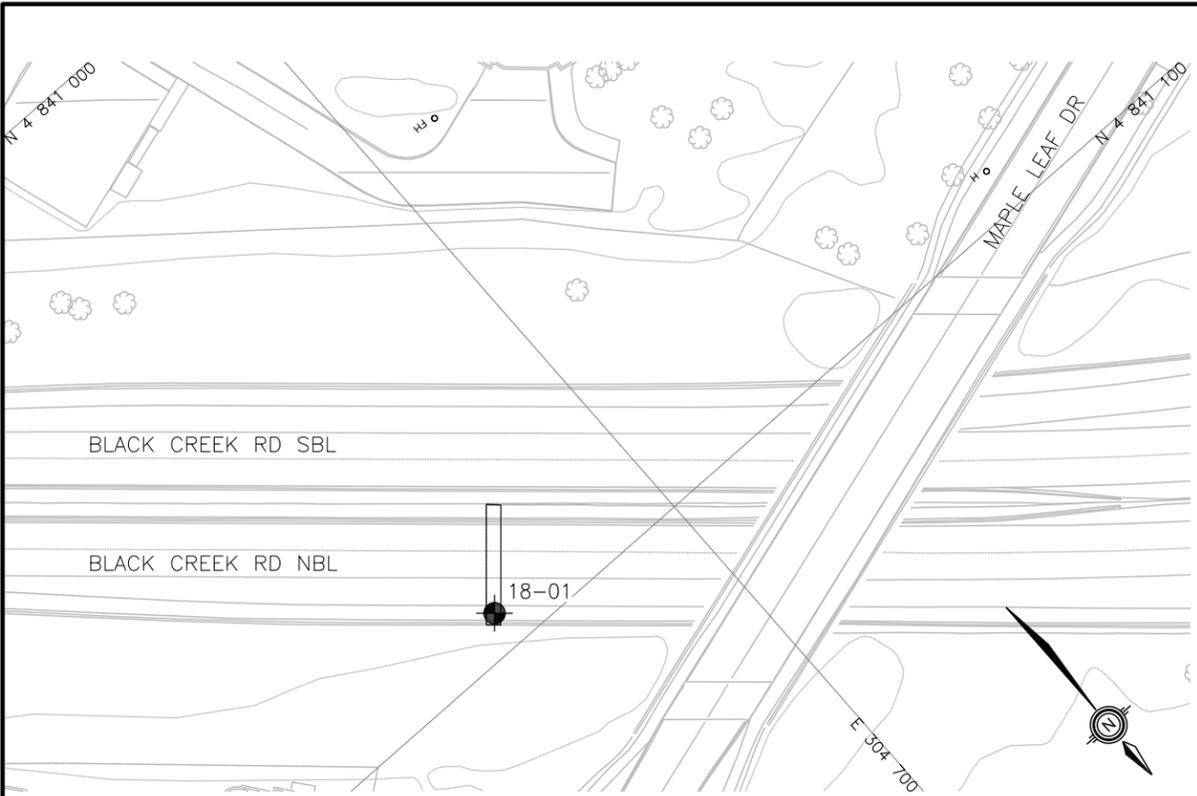
W P



Appendix C

Borehole Locations and Soil Strata Drawing

MINISTRY OF TRANSPORTATION, ONTARIO

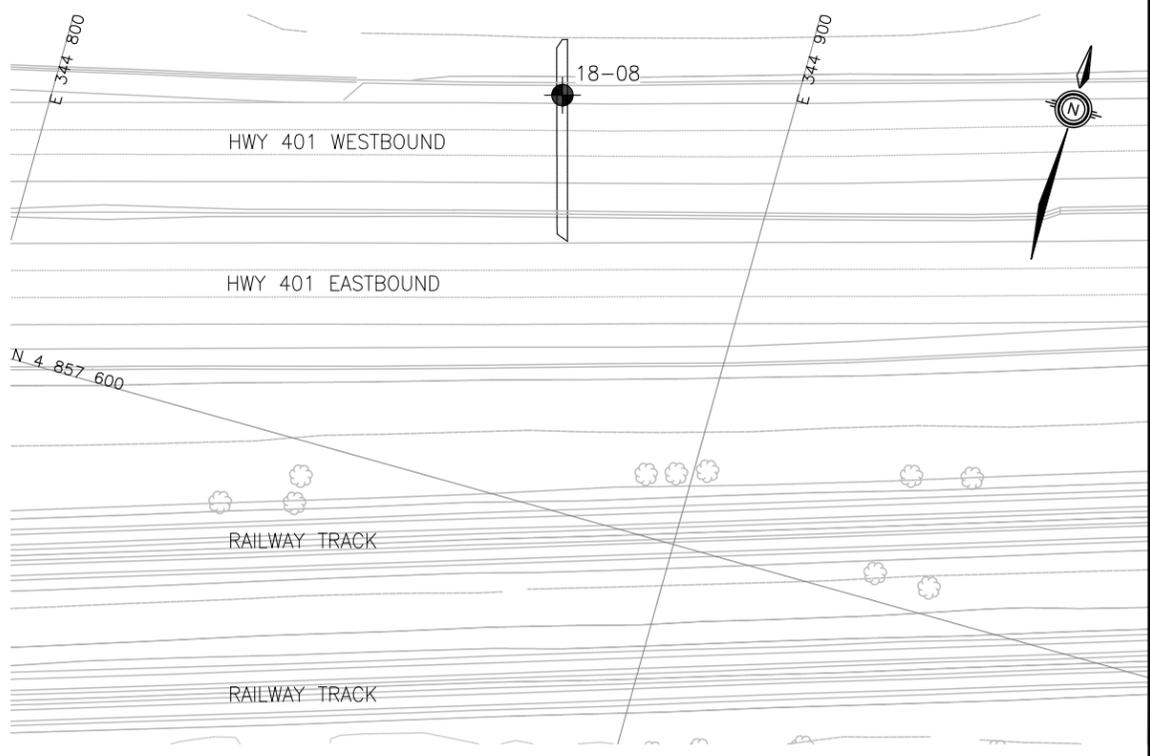
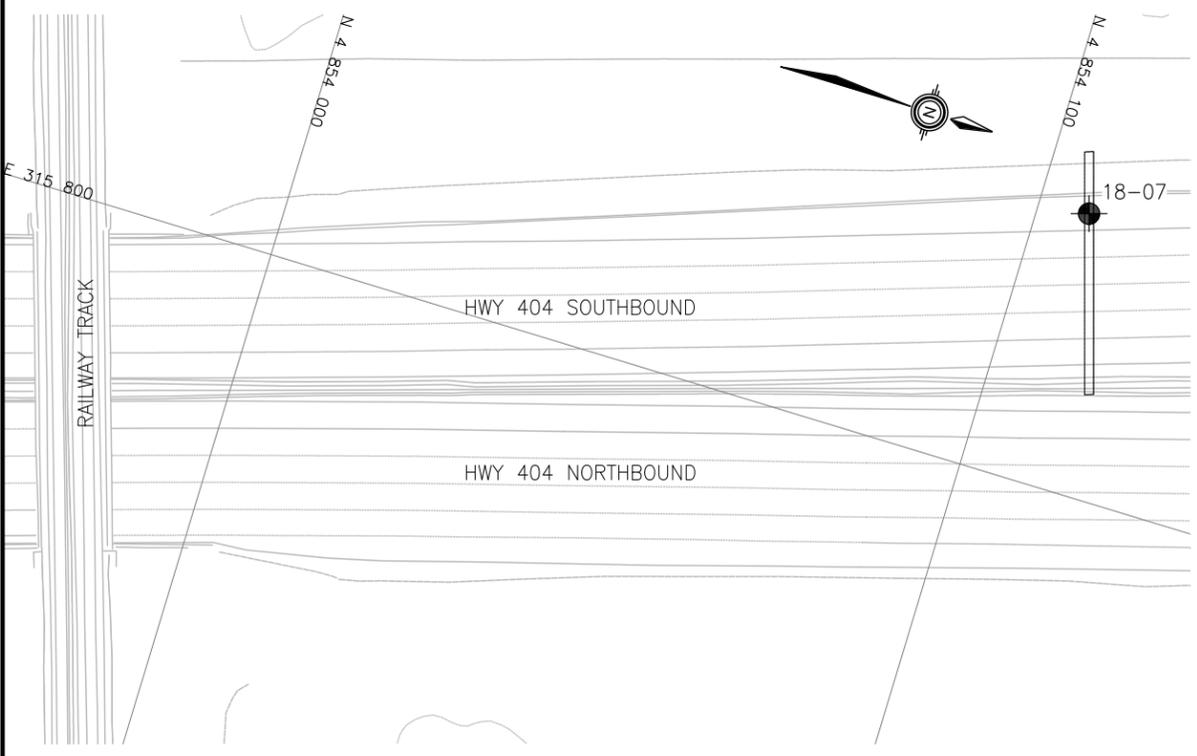


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CONT No	
WP No	
HIGHWAY 401 OVERHEAD SIGNS TORONTO AREA BOREHOLE LOCATIONS PLAN	SHEET



KEYPLAN



LEGEND

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

NO	ELEVATION	NORTHING	EASTING
18-01	122.3	4 841 094.6	304 728.5
18-05	141.0	4 841 635.8	301 834.7
18-07	172.8	4 854 107.1	315 761.6
18-08	89.0	4 857 655.8	344 868.4

-NOTES-

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- 3) Coordinate system is MTM NAD 83 Zone 10.

GEOCREs No. 30M14-479

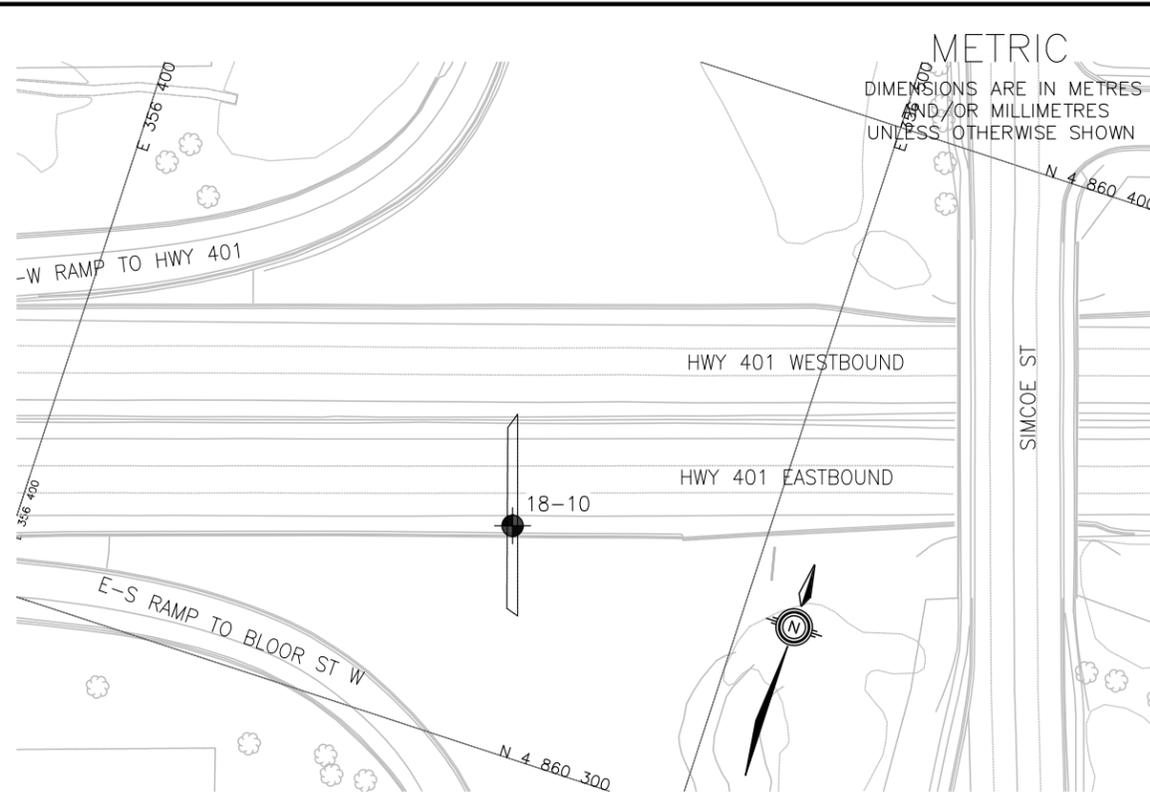
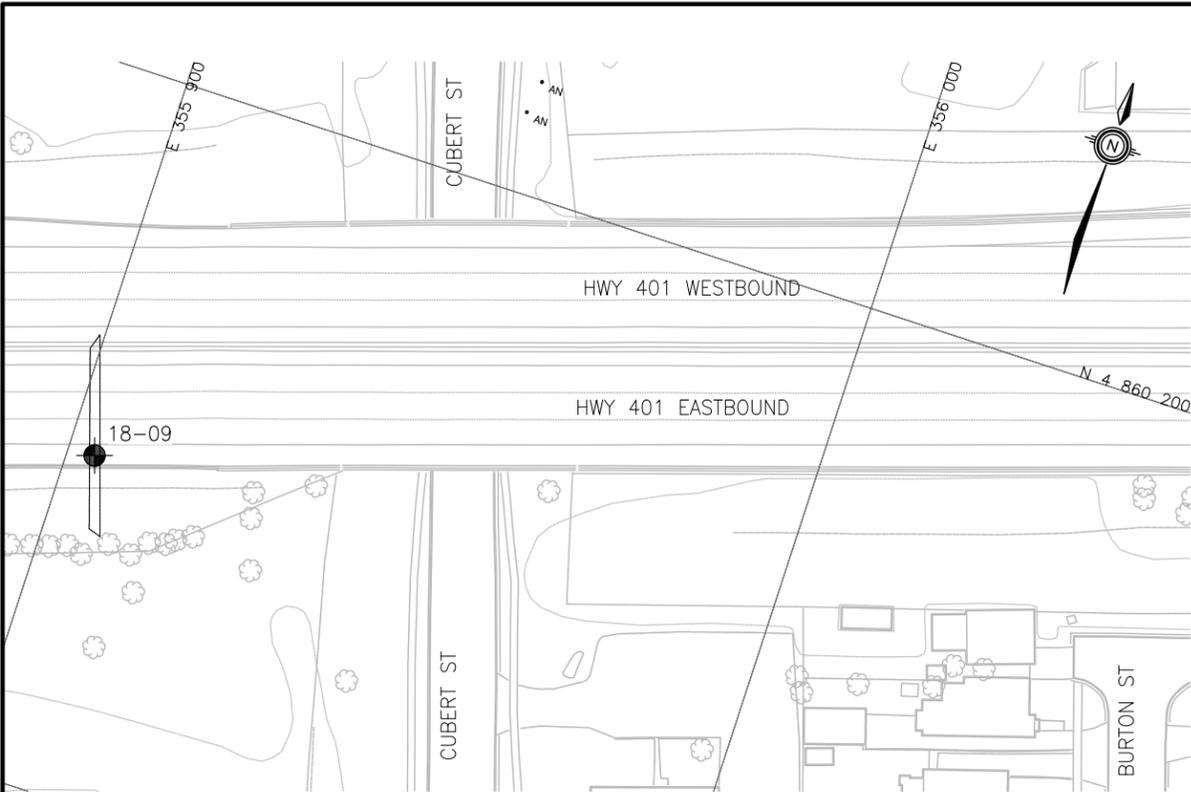


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MINISTRY OF TRANSPORTATION, ONTARIO

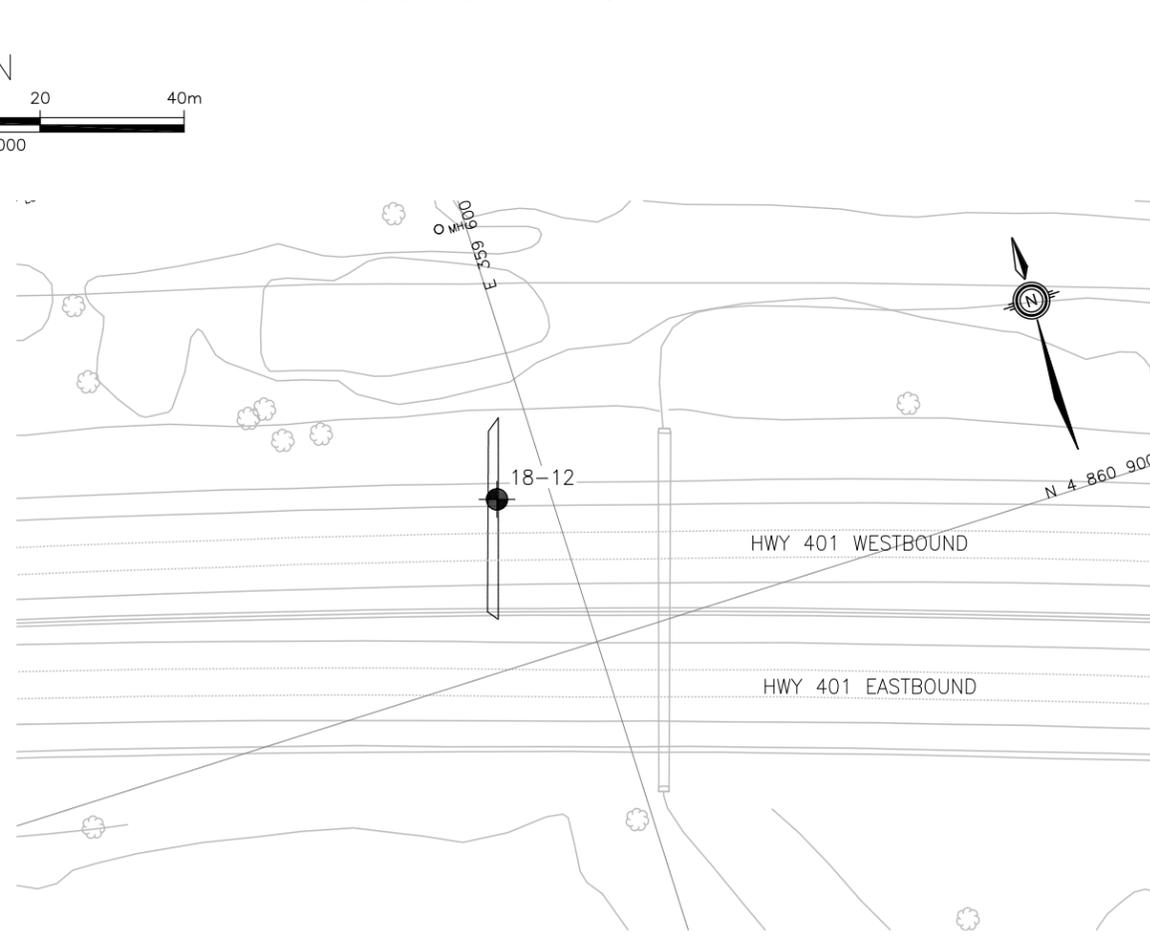
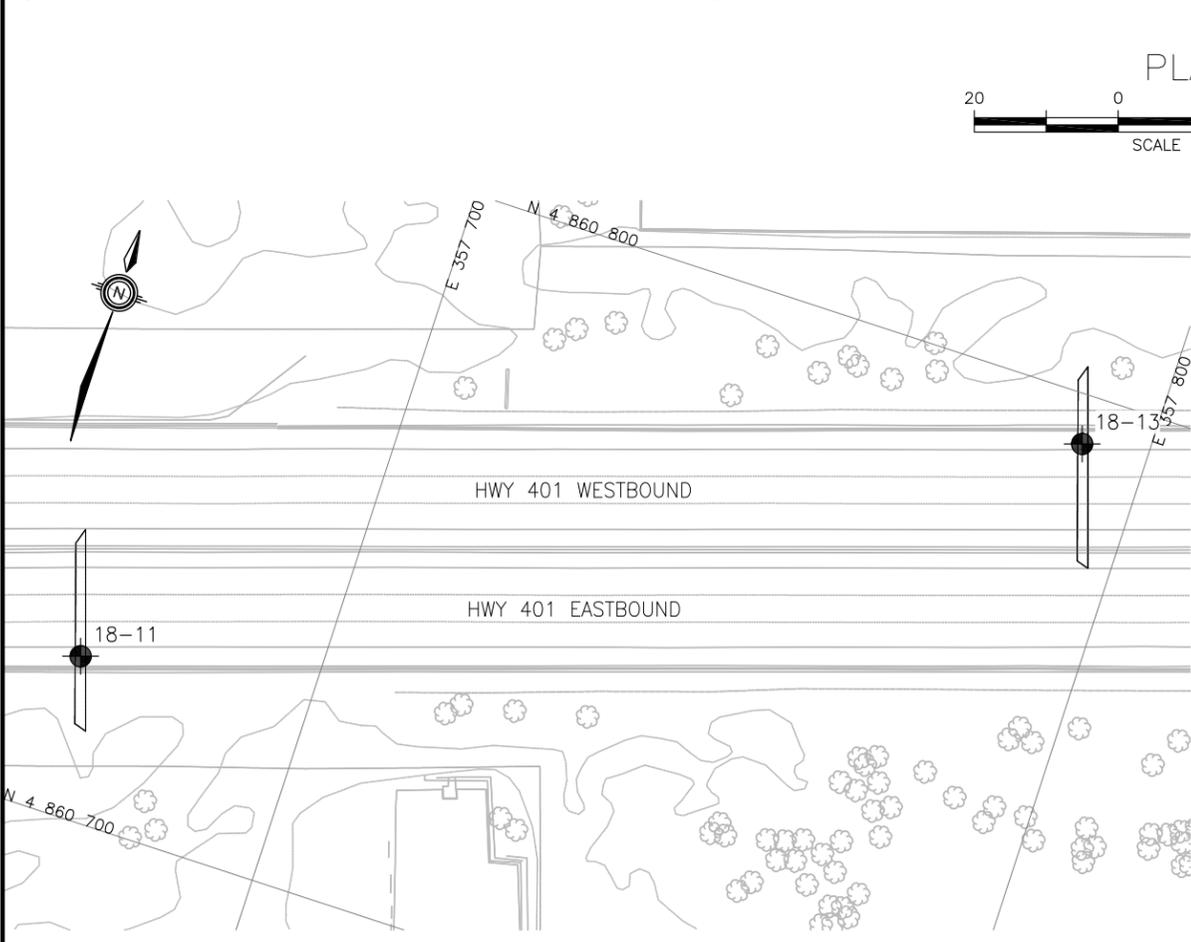


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CONT No	
WP No	
HIGHWAY 401 OVERHEAD SIGNS TORONTO AREA BOREHOLE LOCATIONS PLAN	SHEET



KEYPLAN



LEGEND

- Borehole
- Borehole and Cone
- Blows /0.3m (Std Pen Test, 475J/blow)
- Blows /0.3m (60' Cone, 475J/blow)
- Pressure, Hydraulic
- Water Level
- Head Artesian Water
- Piezometer
- Rock Quality Designation (RQD)
- Auger Refusal

NO	ELEVATION	NORTHING	EASTING
18-09	111.3	4 860 147.1	355 903.8
18-10	96.2	4 860 330.8	356 465.9
18-11	99.6	4 860 722.1	357 667.7
18-12	82.0	4 860 923.0	359 592.7
18-13	97.7	4 860 793.3	357 790.8

- NOTES-**
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GEOCRES No. 30M14-479

REVISIONS	DATE	BY	DESCRIPTION

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CONT No
WP No

HIGHWAY 401
OVERHEAD SIGNS
TORONTO AREA
BOREHOLE LOCATIONS PLAN

SHEET



KEYPLAN

LEGEND

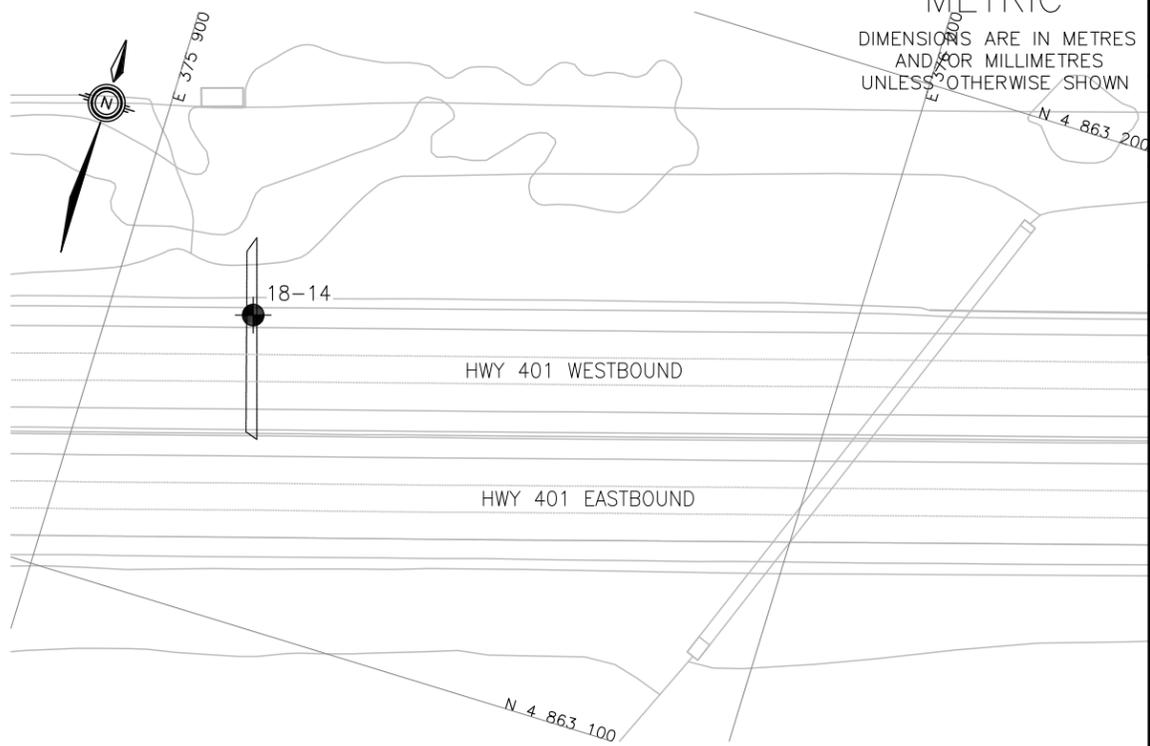
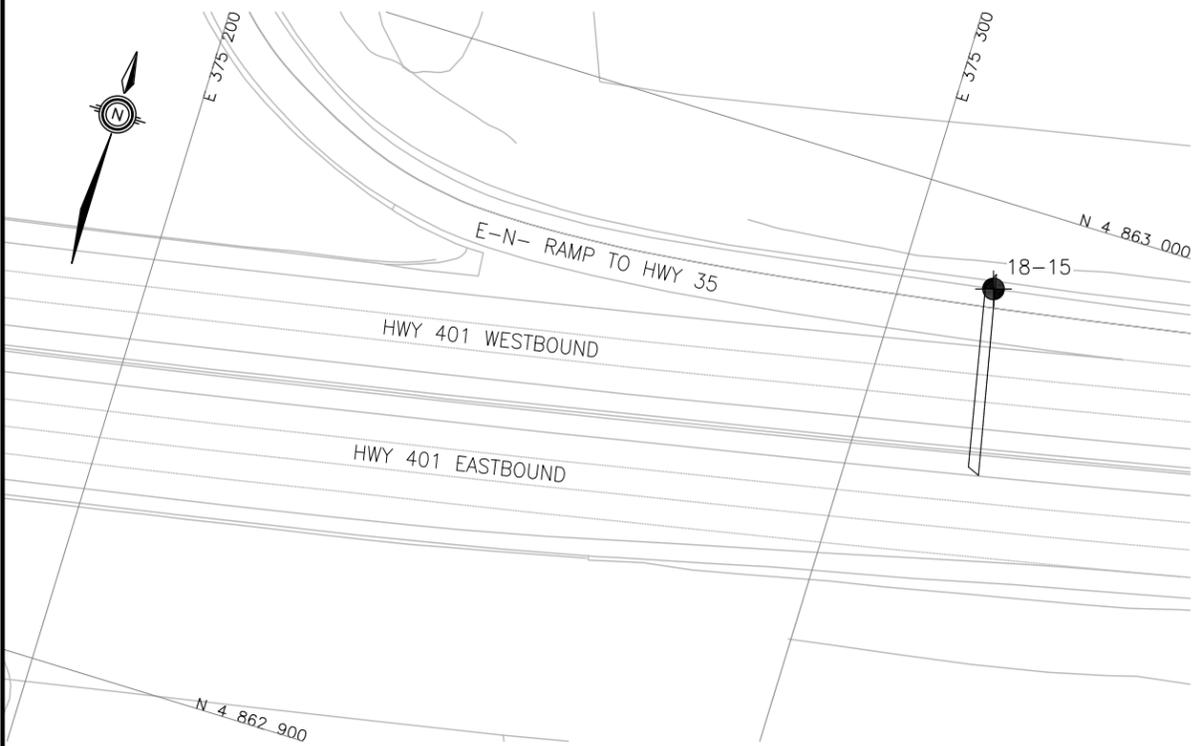
- Borehole
- Borehole and Cone
- N Blows /0.3m (Std Pen Test, 475J/blow)
- CONE Blows /0.3m (60' Cone, 475J/blow)
- PH Pressure, Hydraulic
- Water Level
- Head Artesian Water
- Piezometer
- 90% Rock Quality Designation (RQD)
- A/R Auger Refusal

NO	ELEVATION	NORTHING	EASTING
18-14	91.5	4 863 141.9	375 919.5
18-15	94.0	4 862 988.0	375 312.7
18-16	105.8	4 862 765.1	373 842.2
18-25B	102.6	4 862 827.9	374 068.9

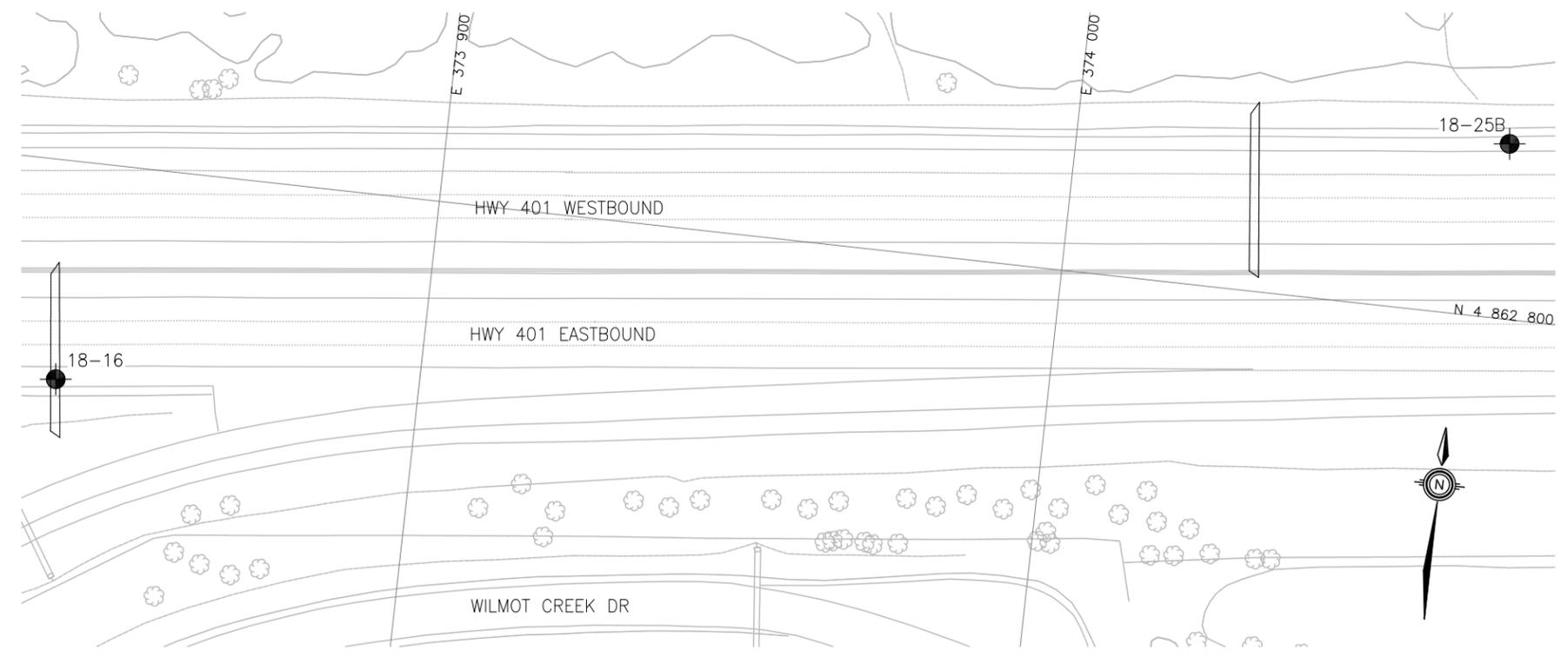
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PLAN
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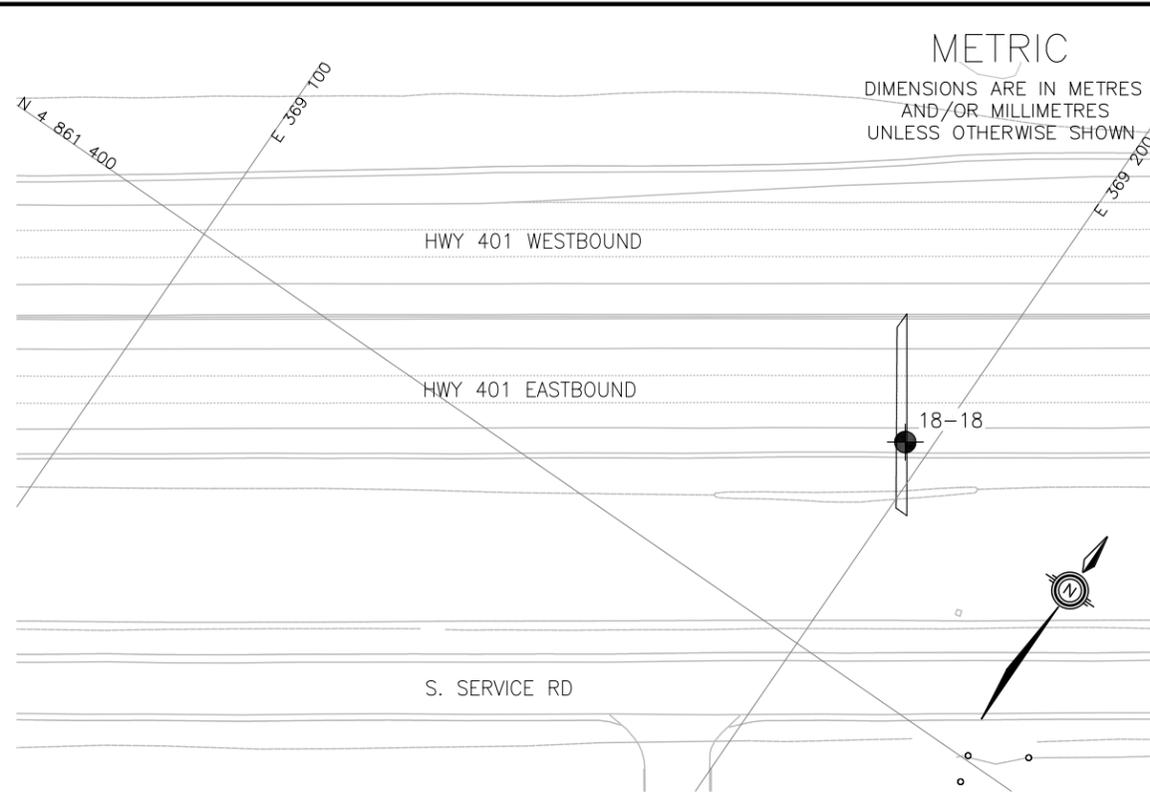
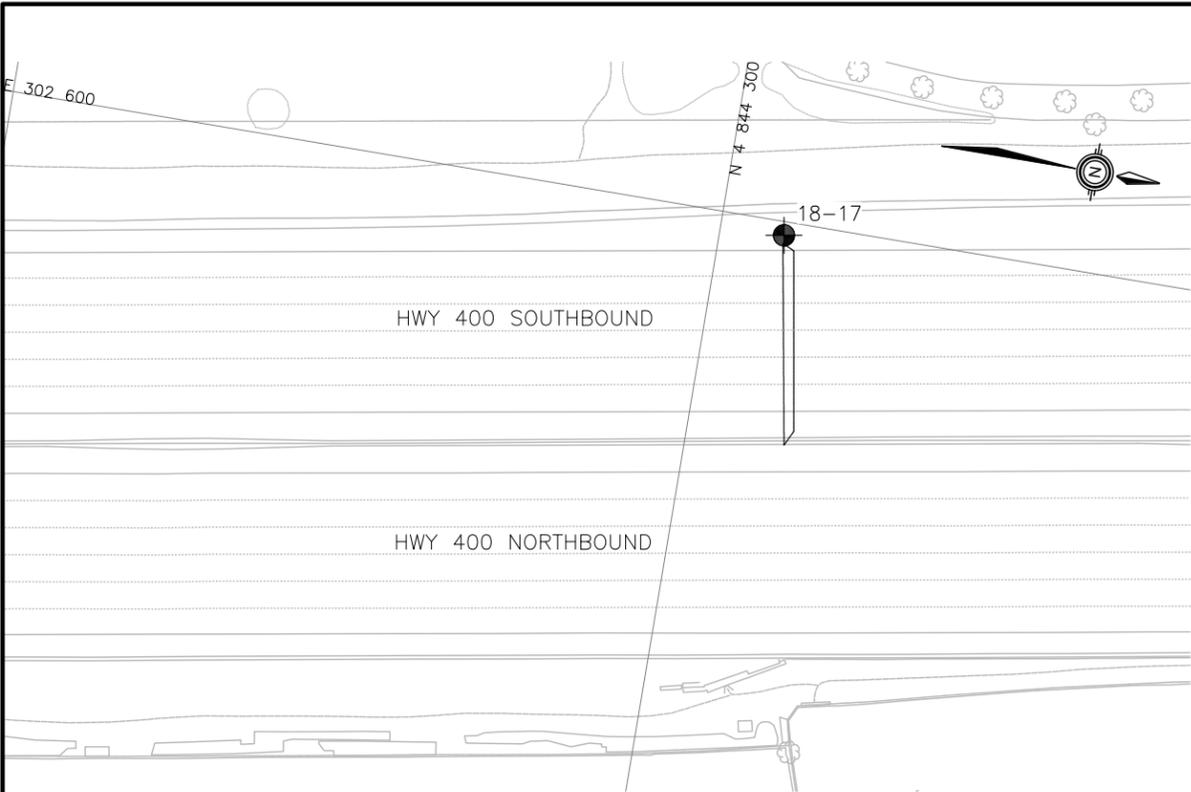


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MINISTRY OF TRANSPORTATION, ONTARIO



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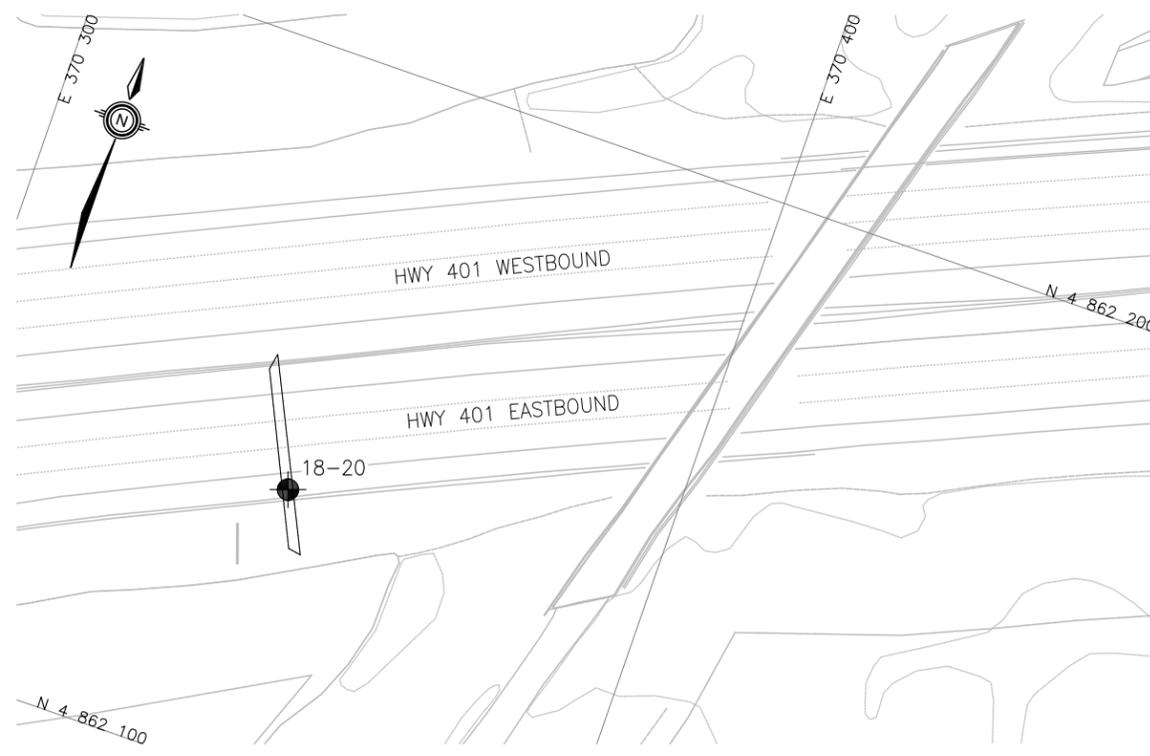
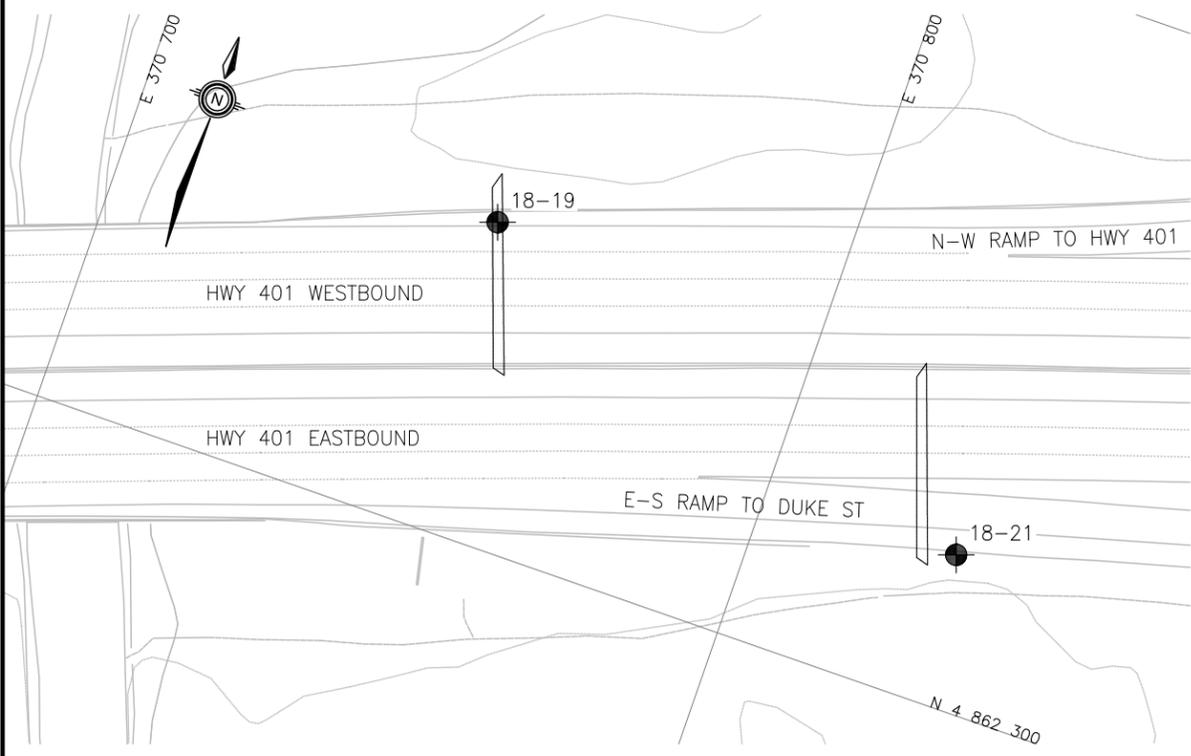
CONT No	
WP No	
HIGHWAY 400 & HIGHWAY 401 OVERHEAD SIGNS TORONTO AREA BOREHOLE LOCATIONS PLAN	SHEET



THURBER ENGINEERING LTD.



KEYPLAN



LEGEND

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

NO	ELEVATION	NORTHING	EASTING
18-17	146.0	4 844 308.9	302 601.9
18-18	85.0	4 861 431.5	369 196.6
18-19	82.3	4 862 343.7	370 752.5
18-20	80.9	4 862 139.9	370 347.9
18-21	82.4	4 862 321.1	370 827.8

-NOTES-

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- Coordinate system is MTM NAD 83 Zone 10.

GEOCRES No. 30M14-479



REVISIONS	DATE	BY	DESCRIPTION

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CONT No	
WP No	
HIGHWAY 400 & HIGHWAY 401 OVERHEAD SIGNS TORONTO AREA BOREHOLE LOCATIONS PLAN	SHEET



KEYPLAN

LEGEND

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

NO	ELEVATION	NORTHING	EASTING
18-22	85.5	4 862 573.1	371 745.4
18-23	83.1	4 862 453.3	371 102.3
18-24	90.3	4 862 666.6	372 925.6

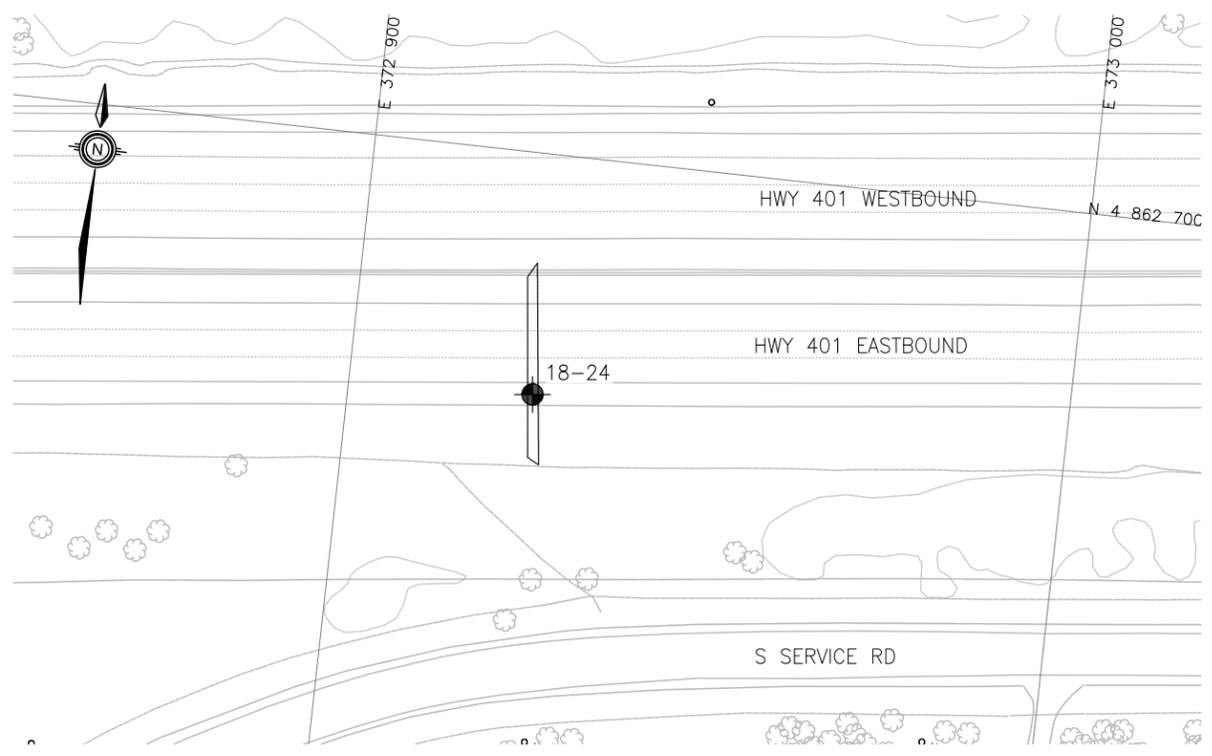
-NOTES-

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- Coordinate system is MTM NAD 83 Zone 10.

GEOCRES No. 30M14-479



PLAN



PLAN



REVISIONS	DATE	BY	DESCRIPTION

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METRIC

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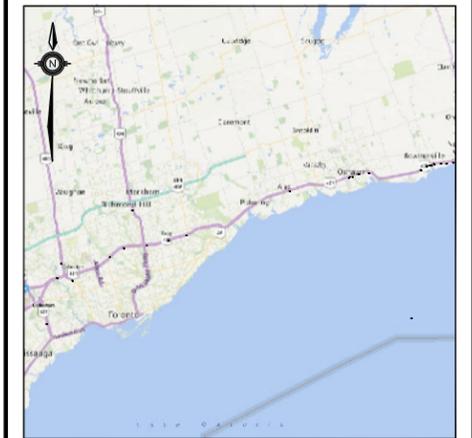
CONT No
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HIGHWAY 427 & HIGHWAY 401
OVERHEAD SIGNS
TORONTO AREA
BOREHOLE LOCATIONS PLAN

SHEET



THURBER ENGINEERING LTD.



KEYPLAN

LEGEND

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

NO	ELEVATION	NORTHING	EASTING
18-26	130.6	4 833 128.7	299 977.5
18-27	174.6	4 847 095.6	314 161.8

-NOTES-

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- Coordinate system is MTM NAD 83 Zone 10.

GEOCRES No. 30M14-479



REVISIONS	DATE	BY	DESCRIPTION

DESIGN	CZ	CHK	SKP	CODE	LOAD	DATE	AUG 2018
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CONT No	
WP No	
HIGHWAY 401 OVERHEAD SIGNS TORONTO AREA BOREHOLE LOCATIONS PLAN	SHEET



KEYPLAN

LEGEND

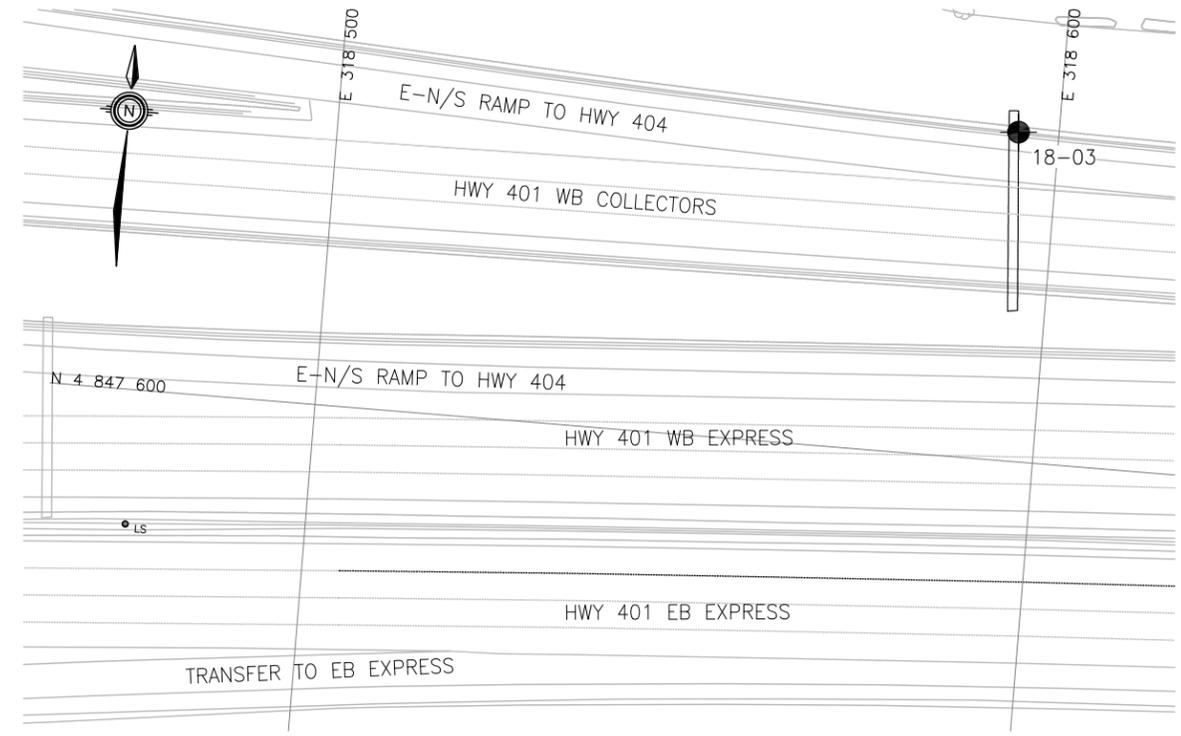
- Borehole
- Borehole and Cone
- N Blows /0.3m (Std Pen Test, 475J/blow)
- CONE Blows /0.3m (60° Cone, 475J/blow)
- PH Pressure, Hydraulic
- Water Level
- Head Artesian Water
- Piezometer
- 90% Rock Quality Designation (RQD)
- A/R Auger Refusal

NO	ELEVATION	NORTHING	EASTING
18-03	0.0	4 847 645.6	318 594.4
18-04	0.0	4 849 357.8	325 736.5
18-06	0.0	4 848 459.1	322 592.2

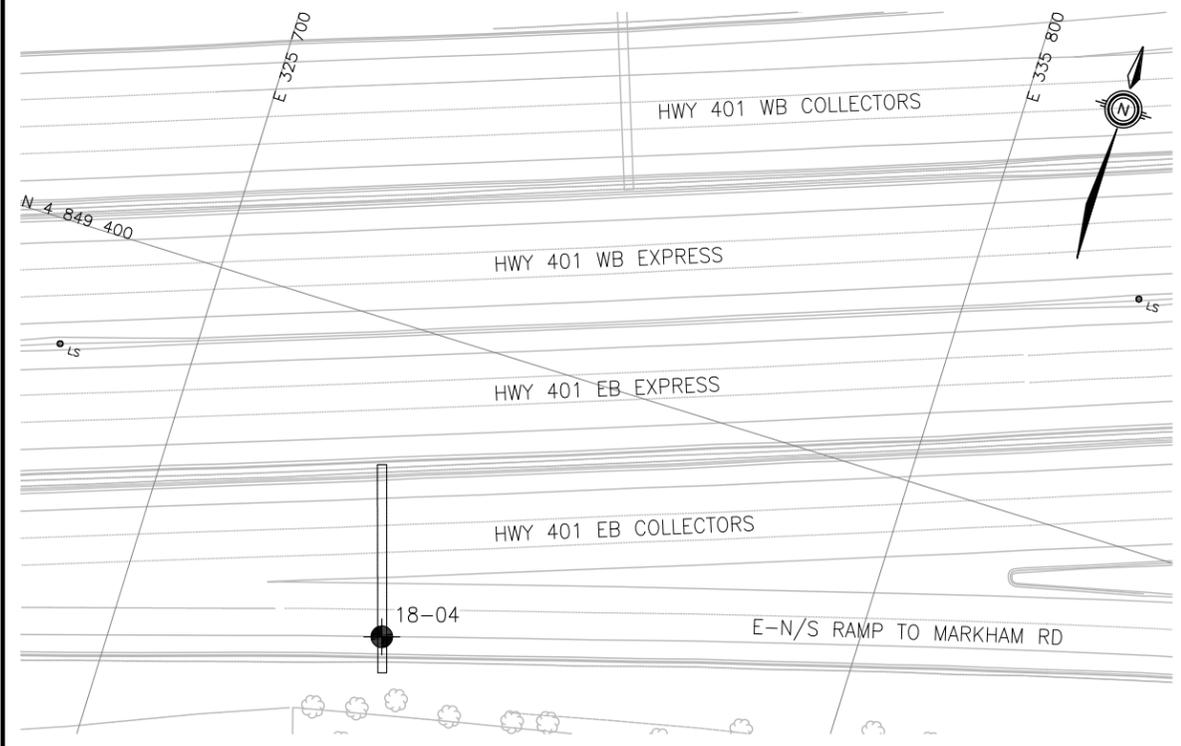
-NOTES-

- 1) The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.
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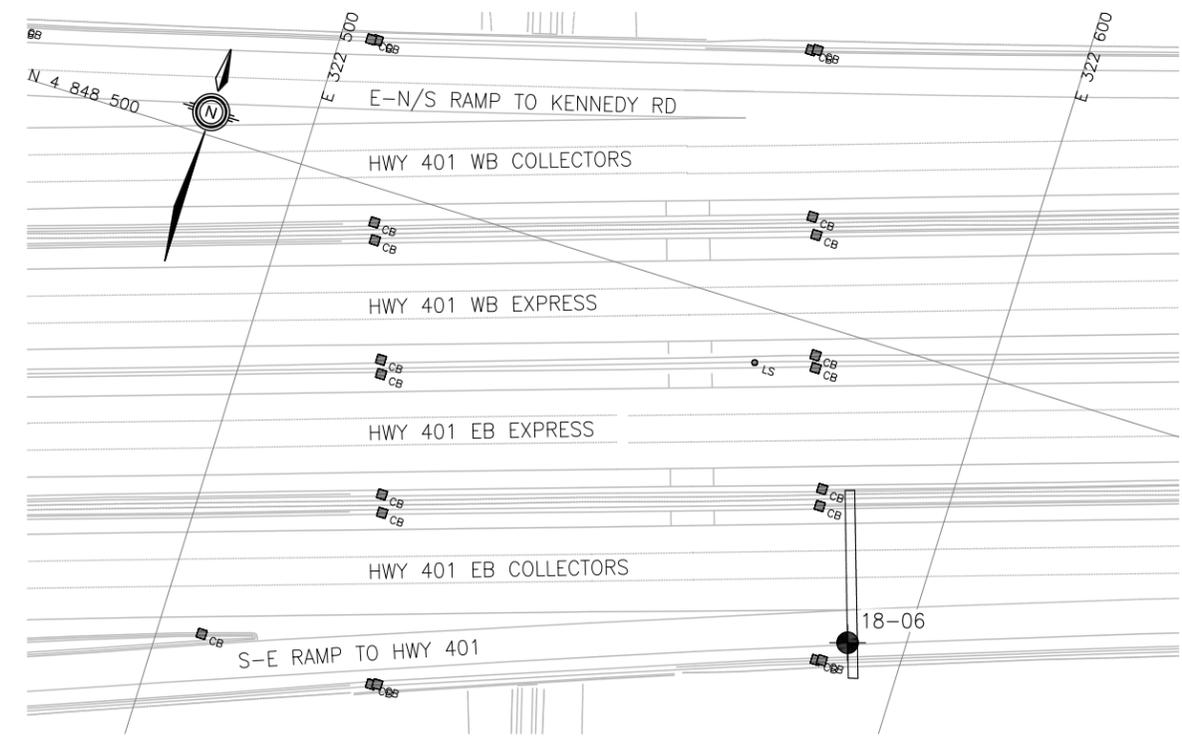
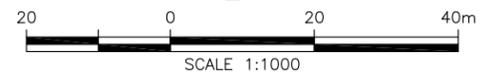
GEOCRES No. 30M14-479



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REVISIONS	DATE	BY	DESCRIPTION

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