



THURBER ENGINEERING LTD.

**FOUNDATION INVESTIGATION AND DESIGN REPORT
MEDIAN SEWER
HIGHWAY 404 HOV LANE EXPANSION AND REHABILITATION
CONTRACT 2
FROM HIGHWAY 407 TO MAJOR MACKENZIE DRIVE
MARKHAM, ONTARIO
G.W.P. 2930-17-00**

GEOCRES NO. 30M14-497

**Latitude 43.869380
Longitude -79.376417**

Report

to

WSP Canada Inc.

Date: January 30, 2019
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- Record of Borehole Sheets
- Laboratory Test Results
- Drawing titled “Borehole Locations and Soil Strata”



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PART 1: FACTUAL INFORMATION

1. INTRODUCTION

This report presents the factual findings obtained from a foundation investigation conducted for the proposed median sewer (Contract 2) along Highway 404 north of Highway 407 to Major Mackenzie Drive in the City of Markham, Ontario.

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

Thurber was retained by WSP Canada Inc. (WSP) to carry out this foundation investigation under the MTO Assignment Number 2016-E-0014.

Reference has been made to information on subsurface conditions contained in previous foundation reports prepared for this site. The titles of these reports are:

- Draft Foundation Investigation and Design Report for Highway 404 16th Avenue Overpass, Replacement and Widening, Highway 404 HOV Lane Expansion and Rehabilitation, Contract 2, Markham, Ontario, Site 37-666, G.W.P. 2930-17-00, prepared by Thurber Engineering, dated October 2018 (Reference 1).
- Draft Foundation Investigation and Design Report for Rouge River NBL and SBL Bridges, Replacement and Widening, Highway 404 HOV Lane Expansion and Rehabilitation,

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Contract 2, Markham, Ontario, Sites 37-347/1 and 34-347/2, G.W.P. 2930-17-00, prepared by Thurber Engineering, dated August 14, 2018. (Reference 2).

- Draft Foundation Investigation and Design Report for Overhead, High Occupancy Toll, High Occupancy Message, Emergency Detour Route, Highway 407 ETR and Toll Station Sign Supports, 404 HOV Lane Expansion and Rehabilitation, Contract 2, Markham, Ontario, Sites 37-347/1 and 34-347/2, G.W.P. 2930-17-00, prepared by Thurber Engineering, dated August 14, 2018. (Reference 2).

2. PROJECT AND SITE DESCRIPTION

The median sewer alignment covered in this report extends along Highway 404 from north of Highway 7 to south of Major Mackenzie Drive. The general locations of the proposed works are shown on the key plan and on the Borehole Locations and Soil Strata Drawings in Appendices A to C.

The land use adjacent to the east side of this section of Highway 404 is largely rural and agricultural. Along the west side of this section of Highway 404, the land use is generally commercial. The vegetation cover beyond the paved areas of the highway comprises grass, shrubs and stands of trees.

The project alignment is located within the physiographic region known as the Peel Plain. The topography is flat and gently undulating. The soil cover in the region typically comprises silty clay glacial tills with sand and silt layers. Shale bedrock of the Georgian Bay Formation is anticipated at an approximate depth of 50 m.

3. SITE INVESTIGATION AND FIELD TESTING

Site investigation and field testing for the proposed median sewer consisted of drilling and sampling a total of 42 boreholes to depth ranging from 6.4 m to 12.8 m (Elevations 202.3 to 177.0) below highway grade. Deeper boreholes drilled for previous investigations in the area (References 1 and 2), varied from 24.7 m to 39.5 m (Elevations 177.9 to 156.2). All boreholes were drilled within the period of May 22 to August 9, 2018. Some of the boreholes addressing the median sewer are also used for addressing other aspects of the works.

The boreholes used to address the proposed median sewer on the Highway 404 embankment, were drilled during approved lane closure times at night on the left (fast) lanes and the median



shoulders of the northbound and southbound lanes, respectively. Lane closures and traffic control were planned for drilling each borehole. Prior to commencement of drilling, utility clearances were obtained for all borehole locations.

The approximate borehole locations are shown on the Borehole Locations and Soil Strata Drawings in Appendices A to C. Northing and easting coordinates at the borehole locations were obtained by Thurber using a Trimble GPS Pathfinder ProXRT, and the corresponding ground surface elevations were provided by WSP based on the project DTM survey. The coordinates and elevations of the boreholes are given on these drawings and on the individual Record of Borehole Sheets in Appendices A to C.

The boreholes were advanced using truck-mounted drill rigs. Hollow and solid stem augers were used to advance the boreholes. Soil samples were obtained at selected intervals using a 50 mm diameter split spoon sampler in conjunction with the Standard Penetration Test (SPT).

Members of Thurber's geotechnical staff supervised the drilling and sampling operations on a full time basis. The supervisors logged the boreholes, visually examined the recovered soil samples, and transported them to Thurber's laboratory for further examination and testing.

Groundwater conditions in the open boreholes were observed throughout the drilling operations. Standpipe piezometers were installed at selected locations to permit monitoring of groundwater levels. The piezometers consisted of 19 mm or 25 mm diameter PVC pipes with slotted screens. The locations and completion details of the piezometers are shown in Table 1 immediately following the text of this report.

Upon completion, the boreholes were abandoned in general accordance with Ontario Regulation 903 amended by Ontario Reg. 372 (O.Reg. 903). Once the final water level readings are taken, the piezometers will be decommissioned in general accordance with O.Reg. 903.

4. LABORATORY TESTING

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



5. DESCRIPTION OF SUBSURFACE CONDITIONS

This section presents a generalized summary of the subsurface conditions encountered at the boreholes used for addressing the proposed median sewer. Borehole location plans and stratigraphic profiles for selected sections along Highway 404 are presented on the Borehole Locations and Soil Strata Drawings in Appendices A to C. These profiles are identified by sections and station numbers in Table 5.1 below. Records of Borehole sheets and laboratory testing data relevant to each section are also included in the appendices.

The soil strata drawings presented in this report are based on the stratigraphy at selected sections along the Highway 404 alignment. The factual data presented in the Record of Borehole Sheets governs any interpretation of the site conditions. It must be recognized that soil conditions will vary between and beyond the borehole locations.

In general, the soil stratigraphy encountered along the proposed median sewer alignment typically consists of pavement structure (asphalt on granular) and fill overlying native soils which typically comprised stiff to hard silty clay till with interbedded layers of sands and silts. Deposits of dense to very dense sand and silt till were also encountered below the silty clay till at some locations. Groundwater levels measured in installed standpipe piezometers typically ranged between approximately 2 m to greater than 10 m depth below existing grade. It is noted that these observations are short term and subject to seasonal fluctuations, and therefore do not necessarily represent the stabilized groundwater conditions.

Table 5.1- Proposed Median Sewer (Sections)

Location	Approximate Hwy. 404 Station No.	Highway Section	Reference Boreholes	Appendix
Section 1	15+140 to 16+200	From 1 km north of Highway 7 to south of 16 th Avenue	MS2-21 to MS2-32 TS2-02, 16TH-08 ⁽¹⁾ 16TH-09 ⁽¹⁾	A
Section 2	16+250 to 17+200	From north of 16 th Avenue to south of Rouge River	MS2-10 to MS2-20 TS2-02, 16TH-01 ⁽¹⁾ 16TH-02 ⁽¹⁾ , 16TH-04 ⁽¹⁾ HMP2-01, R-07 ⁽¹⁾	B
Section 3	17+270 to 18+190	From north of Rouge River to south of Major Mackenzie	MS2-01 to MS2-09 TS2-01, R-04 ⁽¹⁾	C

⁽¹⁾ Borehole drilled during other investigations (References 1 and 2)

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More detailed descriptions of the stratigraphy within these sections are presented below.

5.1 Section 1 - From 1 km north of Highway 7 to south of 16th Avenue (Stations 15+140 to 16+200)

5.1.1 Topsoil

A 100 mm thick layer of topsoil was encountered surficially in Borehole 16TH-08.

The topsoil thickness may vary between and beyond the borehole locations, and the data is not intended for the purpose of estimating quantities.

5.1.2 Asphalt

Boreholes MS2-21 to MS2-32 and TS2-02 were drilled through asphalt of approximately 125 mm to 175 mm in thickness.

5.1.3 Sand and Gravel Fill, Silty Clay Fill and Silty Sand Fill

Pavement granular fill consisting of brown sand and gravel, trace silt and trace clay was contacted below the asphalt in Boreholes MS2-21 to MS2-32 and TS2-02. The thickness of the sand and gravel ranged from 0.5 m to 1.2 m.

A 700 mm thick layer of brown silty clay fill containing trace sand and trace gravel was encountered below the sand and gravel fill in Borehole MS2-28.

Brown to grey silty sand fill, trace gravel and trace clay was contacted below the sand and gravel fill in Borehole MS2-30, below the topsoil in Borehole 16TH-08 and surficially in Borehole 16TH-09. The thickness of the silty sand fill ranged from 0.4 m to 1.4 m. The depth to base of fill ranged from 0.7 m to 1.4 m (Elevations 194.5 to 188.1).

SPT 'N' values within the cohesionless fill ranged from 12 blows to 27 blows per 0.3 m of penetration indicating a compact condition. An SPT 'N' value measured in the silty clay fill was 8 blows per 0.3 m of penetration, indicating a firm to stiff consistency. The measured moisture contents of the fill samples varied between 2 percent and 24 percent.

5.1.4 Silty Clay Till

A deposit of brown to grey silty clay till, trace sand to with sand and trace gravel were encountered in all boreholes used to address the median sewer within this section at



depths ranging from 0.7 m to 1.4 m, except for Borehole MS2-28 where this till was encountered at 7.0 m depth. Interbedded layers of sands and silts were encountered within the silty clay till deposit.

Where fully penetrated in Boreholes MS2-25, MS2-28, MS2-30, MS2-31 and 16TH-09, the thickness of the silty clay till ranged from 1.5 m to 7.4 m. The depths to base of the till ranged from 2.5 m to 8.8 m (Elevations 188.9 to 181.7).

Boreholes MS2-21 to MS2-24, MS2-26, MS2-27, MS2-29, MS2-32, TS2-02 and 16TH-08 were terminated within the silty clay till at depths ranging from 6.7 m to 12.8 m (Elevations 186.3 to 177.0).

SPT 'N' values recorded in the silty clay till typically ranged from 6 to 83 blows per 0.3 m of penetration, indicating a firm to hard consistency. Occasional 'N' values greater than 100 blows for less than 0.3 m of penetration were also measured in some boreholes, indicating the possible presence of cobbles and boulders. The measured moisture contents of selected samples of the silty clay till varied between 3 percent and 31 percent. A sample of the silty clay till containing organics from Borehole MS2-32 revealed a moisture content of 64 percent.

The results of grain size distribution analyses carried out on selected samples of the silty clay till are presented on the Record of Borehole sheets included in Appendix A. Grain size distribution curves of the silty clay till samples tested are presented in Figures A1 to A3 of Appendix A. The results of the grain size distribution analyses are summarized below:

Soil Particle	Silty clay till (percent)
Gravel	0 to 3
Sand	9 to 36
Silt	24 to 51
Clay	22 to 67

The results of Atterberg Limits tests conducted during the present investigation, on samples of the silty clay till are provided on the Record of Borehole sheets in Appendix A, and illustrated in Figures A7 and A8 of Appendix A. The results are summarized as follows:



Index Property	Percentage (%)
Liquid Limit	20 to 39
Plasticity Index	8 to 22

The results of the Atterberg Limits testing indicate that the silty clay till is low to medium plastic with group symbols CL and CI.

Glacial tills inherently contain cobbles and boulders.

5.1.5 Sands and Silts

Interbedded layers of grey silty sand, sandy silt, silt to sand and silt containing trace gravel and trace clay were encountered within the silty clay till deposit at depths ranging from 1.4 m to 5.6 m in Boreholes MS2-21 to MS2-24, MS2-26 to MS2-28, and MS2-30 to MS2-32, and at 8.5 m and 8.8 m depth in Boreholes 16TH-08 and 16TH-09, respectively. The thickness of these cohesionless layers varied from 1.0 m to 5.6 m. The depth to the base of the sand and silt layers varied from 3.0 m to 11.0 m (Elevations 190.1 to 179.5). Borehole 16TH-09 was terminated within the sand and silt at 9.8 m depth (Elevation 185.4).

SPT 'N' values recorded in the sands and silts ranged from 7 to 41 blows per 0.3 m penetration indicating a loose to dense state. SPT 'N' values of 100 blows per 0.2 m of penetration and 76 blows per 0.3 m of penetration in Borehole MS2-28 indicated a very dense condition. The measured moisture contents of samples of these cohesionless layers varied between 7 percent and 29 percent.

The results of grain size distribution analyses carried out on selected samples of the sands and silts are presented on Record of Borehole Sheets included in Appendix A, and on Figures A4 and A5 of Appendix A. The results of laboratory gradation tests are summarized as follows:

Soil Particles	(Percent)
Gravel	0 to 5
Sand	0 to 70
Silt	20 to 91
Clay	4 to 15



5.1.6 Sand and Silt to Sandy Silt Till

Grey sand and silt to sandy silt till containing trace to some clay and trace gravel was contacted in Boreholes MS2-24, MS2-25, MS2-28, MS2-30 to MS2-31 and TS2-02 at depths ranging from 2.5 m to 8.5 m. The thickness of the sand and silt till was 2.9 m and 3.0 m in Boreholes MS2-24 and TS2-02. The depth to the base of the sand and silt till/silt till varied from 8.5 m to 11.7 m (Elevations 184.0 to 179.5) in Boreholes MS2-24 and TS2-02. Boreholes MS2-25, MS2-28, MS2-30 and MS2-31 were terminated within the sand and silt till at depths ranging from 8.2 m to 12.8 m (183.2 m to 177.2).

SPT 'N' values recorded in the sand and silt to sandy silt till ranged from 14 blows per 0.3m penetration to greater than 100 blows for less than 0.3 m penetration, indicating compact to very dense conditions. SPT 'N' values greater than 100 blows measured in Boreholes MS2-30 and TS2-02 indicated the possible presence of cobbles and boulders. The measured moisture contents of selected samples of the cohesionless till deposits varied between 7 percent and 22 percent.

Grain size distribution results for sand and silt to sandy silt till samples are presented on the Record of Borehole sheets and on Figure A6 of Appendix A. The results of laboratory gradation tests are summarized as follows:

Soil Particles	Percent
Gravel	1 to 12
Sand	20 to 45
Silt	36 to 61
Clay	7 to 18

Glacial tills inherently contain cobbles and boulders.

5.1.7 Water Levels

Standpipe piezometers were installed in Boreholes MS2-22, MS2-29, MS2-32 and 16TH-09 to permit monitoring of groundwater levels. Water levels measured in the four installed standpipes and open boreholes are presented in Table 5.2 below.



Table 5.2- Measured Groundwater Levels

Borehole	Date	Water Level (m)		Comments
		Depth	Elevation	
MS2-21	July 24, 21018	3.6	190.4	Open borehole
MS 2-22	September 30, 2018	2.6	190.4	Piezometer
	November 22, 2018	1.9	191.1	
MS 2-23	July 30, 2018	4.4	188.4	Open borehole
MS 2-24	July 25, 2018	4.6	188.0	Open borehole
MS 2-25	July 25, 2018	4.6	186.8	Open borehole
MS 2-26	August 1, 2018	2.3	189.0	Open borehole
MS 2-28	August 2, 2018	3.4	186.8	Open borehole
MS 2-29	July 26, 2018	4.6	185.1	Open borehole
	September 30, 2018	2.4	187.3	Piezometer
	November 23, 2018	2.2	187.5	
MS 2-30	July 24, 2018	3.4	186.1	Open borehole
MS 2-31	August 2, 2018	3.4	186.0	Open borehole
MS 2-32	September 30, 2018	2.2	187.3	Piezometer
	November 22, 2018	2.9	186.6	
TS2-02	July 30, 2018	4.6	190.7	Open borehole
16TH-08	May 31, 2018	8.5	186.7	Open borehole
16TH-09	May 31, 2018	8.4	186.8	Open borehole
	August 22, 2018	6.0	189.2	Piezometer
	November 23, 2018	4.8	190.4	

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

5.2 Section 2 – From north of 16th Avenue to south of Rouge River (Stations 16+250 to 17+200)

5.2.1 Topsoil

A layer of topsoil was encountered surficially in Boreholes 16TH-01, 16TH-02 and 16TH-04. The thickness of the topsoil varied from 50 mm to 125 mm.



The topsoil thickness may vary between and beyond the borehole locations, and the data is not intended for the purpose of estimating quantities.

5.2.2 Asphalt

Boreholes MS2-10 to MS2-20 and HMP2-01 were drilled through surficial asphalt ranging from 75 mm to 200 mm in thickness.

5.2.3 Sand and Gravel Fill, Silty Sand Fill and Silty Clay Fill

Pavement granular fill consisting of sand and gravel to sand, some silt was encountered below the asphalt in Boreholes MS2-10 to MS2-20 and HMP2-01, and below the topsoil in Boreholes 16TH-01, 16TH-02 and 16TH-04. The thickness of the sand and gravel fill at the boreholes ranged between 0.2 m and 1.1 m.

Layers of sand, silty sand, sandy silt and silt fill were encountered below the sand and gravel fill in Boreholes MS2-10 to MS2-12, MS2-14, MS2-16, MS2-17, MS2-19 and MS2-20. The thickness of these cohesionless layers varied from 0.3 m to 1.7 m. In Boreholes R-07, a 6.1 m thick layer of silt fill containing some sand, trace gravel, trace clay and occasional organics, was encountered surficially. In HMP2-01, a 9.9 m thick sand and silt fill was encountered below the asphalt and granular.

Silty clay fill was encountered at 0.6 m and 6.1 m in Boreholes 16TH-04 and R-07, respectively.

The depth to the base of the fill varied from 0.6 m to 2.6 m (Elevations 201.3 to 193.7) in all but Boreholes R-07 and HMP2-01 where the depth to the base of the fill was at 9.2 m and 10.2 m depths (Elevations 193.4 to 193.0), respectively.

SPT 'N' values within the cohesionless fill typically ranged from 11 to 52 blows per 0.3 m penetration indicating compact to very dense conditions. An 'N' value of 8 was measured at the surface of Borehole R-07 indicating a loose zone. An SPT 'N' value of 100 blows for less than 0.3 m of penetration, indicating a very dense state, was measured in Borehole R-07 near Elevation 198.0. The measured moisture contents of samples of the cohesionless fill varied between 1 percent and 21 percent.

SPT 'N' values in the silty clay fill ranged from 11 to 32 blows per 0.3 m of penetration, indicating a stiff to hard consistency. The measured moisture contents of samples of the cohesive fill varied between 11 percent and 12 percent.



The results of grain size distribution analyses carried out on representative samples of the fill are presented on the Record of Borehole Sheets included in Appendix B and on Figures B1 to B3 of Appendix B. The results of the gradation testing from all the relevant boreholes are summarized below:

Soil Particles	Sand and Silt Fill (percent)	Sand and Gravel Fill (percent)	Silty Clay Fill (percent)
Gravel	0 to 1	26 to 29	2
Sand	16 to 42	60 to 67	36
Silt	52 to 75	-	39
Clay	3 to 9	-	23
Silt and Clay	-	7 to 11	-

The results of Atterberg Limits tests conducted on a sample of the silty clay fill are provided on the Record of Borehole sheets in Appendix B, and illustrated in Figure B10 of Appendix B. The results are summarized as follows:

Index Property	Percentage (%)
Liquid Limit	19
Plasticity Index	9

The results of the Atterberg Limits testing indicate that the silty clay fill is low plastic with a group symbol CL.

5.2.4 Silty Clay Till

A deposit of brown to grey native silty clay till, with sand and trace gravel, was encountered in all the boreholes, except Borehole HMP2-01 at depths ranging from 0.6 m to 6.1 m. In Borehole R-07, the silty clay till was contacted at 18.9 m depth. In Boreholes 16TH-04 and MS2-20, the silty clay till was found interbedded with sands and silt at various depths and elevations.

Boreholes MS2-10 to MS2-18, MS2-20, 16TH-01 and 16TH-02 were terminated in the silty clay till at depths ranging from 6.5 m to 12.8 m (Elevations 194.9 to 184.1). Boreholes R-07 and 16TH-04 were terminated at 24.7 m and 39.5 m depth (Elevations 177.9 and 156.2). Near the bottom of Borehole 16TH-04, this deposit grades into a clayey silt till. The thickness of the silty clay till was 1.5 m in Borehole MS2-19.



SPT 'N' values recorded in the silty clay till typically ranged from 9 blows per 0.3 m penetration to greater than 100 blows for less than 0.3 m of penetration, indicating a stiff to hard consistency. Occasional 'N' values of 4 and 6 were measured at the shallower portion of this till in Borehole 16TH-04 indicating a firm zone. The measured moisture contents of selected samples of the silty clay till varied between 6 percent and 31 percent.

The results of grain size distribution analyses carried out on selected samples of the silty clay till and one sample of the clayey silt till are presented on the Record of Borehole sheets included in Appendix B. Grain size distribution curves of the cohesive till samples tested are presented in Figures B4 to B7 of Appendix B. The results of the grain size distribution analyses are summarized below:

Soil Particle	Silty Clay Till (percent)	Clayey Silt Till (percent)
Gravel	0 to 5	0
Sand	0 to 38	0
Silt	31 to 63	83
Clay	23 to 57	17

The results of Atterberg Limits tests conducted during the present investigation, on samples of the silty clay till are provided on the Record of Borehole sheets in Appendix B, and illustrated in Figures B11 to B13 of Appendix B. The results are summarized as follows:

Index Property	Percentage (%)
Liquid Limit	18 to 42
Plasticity Index	7 to 24

The results of the Atterberg Limits testing indicate that the silty clay till is low to medium plastic with group symbols CL and CI, and the clayey silt till has slight to low plasticity with group symbols of CL-ML and CL.

Glacial tills inherently contain cobbles and boulders.

5.2.5 Sands and Silts

Layers of brown to grey sand, sand and silt, silty sand, sandy silt and silt were encountered at depths ranging from 0.4 m to 10.2 m in Boreholes MS2-10, MS2-11, MS2-15, MS2-17, MS2-19, MS2-20, HMP2-01, 16TH-01, 16TH-02, 16TH-04 and R-07. In Boreholes 16TH-



01, 16TH-02, 16TH-04 and HMP2-01, these sands and silts were contacted at depths of 1.0 m, 1.6 m, 2.0 m, 3.7 m, 5.8 m and 6.7 m and at lower depths of 8.8 m and 10.2 m. The thickness of these cohesionless layers typically ranged from 0.4 m to 4.7 m, but is up to 7.1 m in Boreholes R-07. Borehole HMP2-01 encountered sand, trace gravel at 10.2m depths until the end of the borehole.

The depth to the base of the sands and silts varied from 2.2 m to 7.2 m (Elevations 200.1 to 190.0) in Boreholes MS2-10, MS2-11, MS2-15, MS2-17, MS2-19 and MS2-20. In the deeper Boreholes 16TH-01, 16TH-02, 16TH-04 and R-07, the depth to the base of the cohesionless layers ranged from 7.7 m to 16.3 m (Elevations 187.7 to 186.3).

Borehole MS2-19 was terminated within the silt at 6.7 m (Elevation 190.6). Borehole HMP2-01 was terminated within the sand at 12.8 m depth (Elevation 190.4).

SPT 'N' values recorded in these sand and silt layers typically ranged from 11 to 28 blows per 0.3 m penetration indicating compact conditions. In Boreholes MS2-11, MS2-17, 16TH-02 and 16TH-04, SPT 'N' values of 4 to 9 blows per 0.3 m penetration indicated the presence of loose zones. In Boreholes HMP2-01 and R-07, 'N' values of 31 blows per 0.3m penetration to greater than 100 blows for less than 0.3 m penetration indicated dense to very dense condition, and possible presence of cobbles and boulders. The measured moisture contents of selected samples of the cohesionless till layer varied between 8 percent and 25 percent.

Grain size distribution results for the samples of these cohesionless soils tested are presented on the Record of Borehole sheets in Appendix B and on Figure B8 of Appendix B. The results of laboratory gradation tests are summarized as follows:

Soil Particles	Percentage (%)
Gravel	0 to 2
Sand	5 to 91
Silt	31 to 82
Clay	3 to 11

5.2.6 Sandy Silt Till and Silty Sand Till

Deposits of brown to grey sandy silt till and silty sand till containing trace to some clay and trace gravel, were encountered at 16.3 m depth in Borehole R-07 and at 15.5 m depth in Borehole 16TH-04. A lower layer of silty sand till was contacted at 36.8 m depth in



Borehole 16TH-04. The thickness of these cohesionless tills ranged between 1.6 m and 3.1 m.

The depth to the base of the cohesionless till was at 18.6 m and 18.9 m (Elevations 177.1 to 183.7) in Boreholes 16TH-04 and R-07, respectively. The depth to the base of the lower silty sand till in Borehole 16TH-04 was at 38.4 m (Elevation 157.3).

SPT 'N' values recorded in the cohesionless till ranged from 11 to 17 blows per 0.3 m penetration indicating a compact condition in the upper portion of Borehole 16TH-04. Elsewhere, 'N' values of 100 blows for less than 0.3 m of penetration were measured indicating a very dense state. In conjunction with resistance to augering at some locations, these high values may indicate the presence of cobbles and boulders. The measured moisture contents of samples of the cohesionless till varied between 10 percent and 20 percent.

Grain size distribution test results for a cohesionless glacial till sample are presented on the Record of Borehole sheets and on Figure B9 of Appendix B. The results of the laboratory gradation test are summarized as follows:

Soil Particles	Percentage (%)
Gravel	0
Sand	26
Silt	59
Clay	15

Glacial tills inherently contain cobbles and boulders.

5.2.7 Water Levels

Standpipe piezometers were installed in Boreholes MS2-12, MS2-16, R-07, 16TH-01 and 16TH-04 to permit monitoring of groundwater levels. Water levels measured in the five installed standpipes and open boreholes are presented in Table 5.3 below.



Table 5.3 - Measured Groundwater Levels

Borehole	Date	Water Level (m)		Comments
		Depth	Elevation	
MS 2-10	July 18, 2018	Dry	-	Open borehole
MS 2-11	July 23, 2018	Dry	-	Open borehole
MS 2-12	July 19, 2018	8.5	193.5	Open borehole
	September 30, 2018	8.1	193.9	Piezometer
	November 23, 2018	8.1	193.9	
MS 2-13	July 10, 2018	4.6	196.8	Open borehole
MS 2-14	July 17, 2018	6.1	194.8	Open borehole
MS 2-15	July 25, 2018	-	-	Open borehole
MS 2-16	July 16, 2018	2.3	197.3	Open borehole
	September 30, 2018	1.7	197.9	Piezometer
	November 23, 2018	1.7	197.9	
MS 2-17	July 24, 2018	2.1	196.9	Open borehole
MS 2-18	July 10, 2018	3.0	195.2	Open borehole
MS 2-19	July 9, 2018	4.6	192.7	Open borehole
MS 2-20	July 9, 2018	4.6	192.6	Open borehole
HMP 2-01	July 23, 2018	10.7	192.5	Open borehole
16TH-01	June 4, 2018	4.6	190.9	Open borehole
	August 22, 2018	5.7	189.8	Piezometer
	November 23, 2018	4.8	190.7	
16TH-02	June 1, 2018	6.1	189.3	Open borehole
16TH-04	August 22, 2018	6.7	189.0	Piezometer
R-07	June 22, 2018	9.3	193.3	Piezometer
	November 22, 2018	9.2	193.4	

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



5.3 Section 3 – North of Rouge River to south of Major Mackenzie Drive (Stations 17+270 to 18+190)

5.3.1 Asphalt

Asphalt of approximately 150 mm to 200 mm in thickness was encountered surficially in Boreholes MS2-1 to MS2-09 and TS2-01.

5.3.2 Sand and Gravel Fill, Silty Sand Fill, Silty Clay Fill

Pavement granular fill consisting of sand and gravel, trace silt and trace clay, was contacted below the asphalt in Boreholes MS2-01 to MS2-09 and TS2-01. The thickness of the sand and gravel fill ranged from 0.4 m to 0.9 m.

A 2.3 m thick layer of brown silty sand fill containing some gravel and trace clay was contacted at 0.7 m depth in Borehole MS2-09.

Brown to grey silty clay fill containing some sand to with sand, trace gravel and occasional organics, was contacted at 1.0 m and 0.9 m depths in Boreholes MS2-05 and MS2-07, respectively, and surficially in Borehole R-04. The thickness of the silty clay fill was 0.4 m and 1.3 m in Boreholes MS2-05 and MS2-07, respectively, and 9.6 m in Borehole R-04. The base of fill layers were found to range from 0.6 m to 3.0 m depths (Elevations 208.6 to 201.0) in all but Borehole R-04 where the base of fill was at 9.6 m depth (Elevation 193.3).

SPT 'N' values within the cohesionless fill ranged from 19 to 45 blows per 0.3 m of penetration indicating compact to dense conditions. SPT 'N' values measured in the silty clay fill ranged from 6 to 35 blows per 0.3 m of penetration indicating a stiff to hard consistency. The measured moisture contents of selected cohesionless fill samples varied from 2 percent to 13 percent. The moisture content of the silty clay fill ranged from 2 percent to 24 percent.

The results of grain size distribution analyses carried out on a silty clay fill sample are presented on the Record of Borehole Sheets included in Appendix C and on Figure C1 of Appendix C. The results of the gradation testing are summarized below:



Soil Particles	Silty Clay Fill (percent)
Gravel	3
Sand	33
Silt	27
Clay	37

5.3.3 Organics

A 400 mm thick layer of dark brown organics was contacted below the silty clay fill, at 9.6 m depth, in Borehole R-04.

5.3.4 Silty Clay Till

A deposit of brown to grey native silty clay till, trace sand to with sand and trace gravel, was encountered at depths ranging from 0.6 m to 5.6 m in all but Borehole R-04 where the silty clay till was encountered at 16.6 m depth. The thickness of the silty clay till was 2.9 m in Borehole MS2-09. The other boreholes were typically terminated within the silty clay till at depths ranging from 6.4 m to 8.2 m (Elevations 202.3 to 196.0), except for Borehole R-04 which was terminated within the silty clay till at 25.0m depth (Elevation 177.9).

SPT 'N' values recorded in the silty clay till ranged from 11 to 87 blows per 0.3 m penetration indicating stiff to hard consistency. A number of 'N' values were greater than 100 blows for less than 0.3 m of penetration indicating a hard consistency or the presence of cobbles and boulders. The measured moisture contents of selected samples of the silty clay till varied between 6 percent and 26 percent.

The results of grain size distribution analyses carried out on selected samples of the silty clay till are presented on the Record of Borehole sheets included in Appendix C. Grain size distribution curves of silty clay till samples are presented in Figures C2 and C3 of Appendix C. The results of the grain size distribution analyses are summarized below:



Soil Particle	Silty clay till (percent)
Gravel	0 to 5
Sand	0 to 41
Silt	32 to 48
Clay	19 to 65

The results of Atterberg Limits tests conducted during the present investigation, on samples of the silty clay till are provided on the Record of Borehole sheets in Appendix C, and illustrated in Figures C6 and C7 of Appendix C. The results are summarized as follows:

Index Property	Percentage (%)
Liquid Limit	43 to 17
Plasticity Index	6 to 24

The results of the Atterberg Limits testing indicate that the silty clay till is typically low to medium plastic with group symbols CL and CI, except for a medium plastic zone with a group symbol of CI.

Glacial tills inherently contain cobbles and boulders.

5.3.5 Sands and Silts

A 2.6 m thick layer of brown silt containing some clay, was contacted at 3.0 m depth in Borehole MS2-09.

A 4.5 m thick layer of brown sand containing trace silt, trace to some gravel and clay pockets was contacted in Borehole R-04 at 10.0 m depth.

The depth to the base of the silt and sand layers was at 5.6 m and 14.5 m in Boreholes MS2-09 and R-04 (Elevations 198.3 and 188.4), respectively.

SPT 'N' values recorded in the sands and silts ranged from 12 to 78 blows per 0.3 m penetration indicating a compact to very dense state. The measured moisture contents of samples of these cohesionless layers varied between 9 percent and 36 percent.

The results of grain size distribution analyses carried out on selected samples of the sand and silt, are presented on Record of Borehole Sheets included in Appendix C and on Figure C4 of Appendix C. The results of laboratory gradation tests are summarized as follows:

Soil Particles	Sand (percent)	Silt (percent)
Gravel	11	0
Sand	81	0
Silt	8	88
Clay		12

5.3.6 Gravelly Sand

A layer of grey gravelly sand containing trace silt, trace clay and occasional cobbles was contacted at 14.5 m in Borehole R-04. The thickness of the gravelly sand is 2.1 m. The depth to the base of the gravelly sand was at 16.6 m (Elevation 186.3).

An SPT 'N' value recorded in the gravelly sand was 100 blows for less than 0.3 m of penetration, indicating a very dense state. The measured moisture content of a gravelly sand sample was 13 percent.

The results of grain size distribution analyses carried out on a sample of the gravelly sand are presented on Record of Borehole Sheets included in Appendix C and on Figure C5 of Appendix C. The results of laboratory gradation tests are summarized as follows:

Soil Particles	Gravelly Sand (Percent)
Gravel	28
Sand	60
Silt and Clay	12

5.3.7 Sand and Silt Till

A deposit of brown sand and silt till containing trace clay and trace gravel was contacted in Borehole MS2-09 at 8.5 m depth.

Borehole MS2-09 was terminated within the sand and silt till at 12.8 m depth (Elevation 191.2).

SPT 'N' values recorded in the sand and silt till ranged from 56 to 89 blows per 0.3 m penetration indicating a very dense condition. The measured moisture contents of selected samples of the cohesionless till varied between 10 percent and 17 percent.



Glacial tills inherently contain cobbles and boulders.

5.3.8 Water Levels

Standpipe piezometers were installed in Boreholes MS2-02, MS2-05 and R-04 to permit monitoring of groundwater levels. Water levels measured in the three installed standpipes and open boreholes are presented in Table 5.4 below.

Table 5.4- Measured Groundwater Levels

Borehole	Date	Water Level (m)		Comments
		Depth	Elevation	
MS 2-01	August 2, 2018	Dry	-	Open borehole
MS 2-02	July 25, 2018	Dry	-	Open borehole
	September 30, 2018	5.5	202.1	Piezometer
MS 2-03	July 25, 2018	Dry	-	Open borehole
MS 2-04	July 20, 2018	Dry	-	Open borehole
MS 2-05	July 20, 2018	6.4	199.5	Open borehole
	September 30, 2018	2.3	203.6	Piezometer
	November 23, 2018	2.3	203.6	
MS 2-06	July 29, 2018	Dry	-	Open borehole
MS 2-07	July 20, 2018	Dry	-	Open borehole
MS 2-08	July 19, 2018	7.3	196.9	Open borehole
MS 2-09	July 29, 2018	10.7	193.3	Open borehole
TS 2-01	August 2, 2018	Dry	-	Open borehole
R-04	May 25, 2018	11.6	191.3	Open borehole
	June 22, 2018	9.5	193.4	Piezometer
	September 30, 2018	9.5	193.4	
	November 23, 2018	12.3	190.6	

6. MISCELLANEOUS

Thurber staked and/or marked the borehole locations in the field and obtained utility clearances prior to drilling. WSP provided the northing and easting coordinates and ground surface elevations.



Altech Drilling of Cambridge, Ontario, and Walker Drilling of Utopia, Ontario, supplied and operated a truck-mounted D-120 and a truck mounted CME-75 drill rigs, respectively, to carry out the drilling, sampling and in-situ testing operations in the boreholes.

The drilling and sampling operations in the field were supervised on a full time basis by Mr. Stephen Jones, Mr. Kevin Kweon, Mr. Bryan Lui, and Mr. Saeed Bastan of Thurber. Geotechnical laboratory testing was carried out by Thurber in its MTO-approved laboratory. Overall supervision of the field program was carried out by Mr. Stephane Loranger, CET.

Overall project management was provided by Dr. Sydney Pang, P.Eng. Interpretation of the field data and preparation of this report was completed by Ms. Rocío Palomeque Reyna, P.Eng. The report was reviewed by Dr. Sydney Pang, P.Eng. and Dr. P.K. Chatterji, P.Eng., a Designated Principal Contact for MTO Foundations Projects.



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**FOUNDATION INVESTIGATION AND DESIGN REPORT
MEDIAN SEWER
HIGHWAY 404 HOV LANE EXPANSION AND REHABILITATION
CONTRACT 2
FROM HIGHWAY 407 TO MAJOR MACKENZIE DRIVE
MARKHAM, ONTARIO
G.W.P. 2930-17-00**

GEOCRES NO. 30M14-497

PART 2: ENGINEERING DISCUSSION AND RECOMMENDATIONS

7. GENERAL

This section of the report presents foundation recommendations and comments for the design and installation of a median sewer along Highway 404 from Highway 407 to Major Mackenzie Drive (Contract 2) in Markham, Ontario. Proposed invert depths and elevations of the new sewer are provided in a Storm Sewer Characteristics Table (sewer table) and drawings prepared by WSP.

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

The discussion and recommendations presented in this report are based on the information provided by WSP and on the factual data obtained during the course of this investigation.



8. MEDIAN SEWER

Based on information from WSP, the diameter of the pipes typically range from 300 to 825 mm and the invert depths vary from 1.5 m to 2.5 m below ground surface. The new median sewer would consist of concrete, PVC/PP or HDPE pipes. It is understood that there is no existing median sewer along the majority of this stretch of Highway 404, except for sections adjacent to the existing bridges. The existing pipes will be removed and replaced with new pipes.

It is anticipated that installation of the median sewer is to be carried out by trenching. In general, shallow, vertically sided excavations not exceeding 2.5 m in depth may be carried out within temporary protection (shoring) systems or steel trench boxes where applicable. For deeper excavations, or where water seepage is a concern, or where adjacent ground movement is to be minimized, temporary shoring such as interlocking sheetpiles or soldier piles and lagging may be considered. Sloped open cuts may be possible in some cases if there is sufficient available space adjacent to the trench. Water control in the form of sump pumping will generally be required in conjunction with various forms of earth support and excavation outlined above. In areas where water-bearing sands and silts are present at or above the trench invert, dewatering in the form of localized groundwater lowering using well points and/or eductors may be required.

Prior to placement of the pipe bedding, the base of the trench excavation must be properly dewatered and dry, and free of disturbed or loose soil. In order to confirm uniformity along the alignment, the exposed subgrade should be inspected and approved prior to placing and compacting the bedding. Any identified disturbed/wet soils should be sub-excavated and replaced with compacted granular materials or clear crushed stone as per OPSS.PROV 1004. It is critical that the pipe be supported on well prepared bedding overlying a competent and uniform subgrade in order to minimize the potential for differential settlement.

It is recommended that sewer pipe installation, trenching, backfilling and compacting be carried out in accordance with OPSS.PROV 401, OPSS.PROV 410, OPSS 492 and OPSD 802.030, OPSD 802.031, OPSD 802.032 as appropriate. Care must be exercised when compacting the fill immediately above the crown of the pipe in order not to damage the pipe. Reference should also be made to OPSS.PROV 501 and OPSS.PROV 1010.

8.1 Excavation and Groundwater Control

The following outlines the subsurface conditions that are likely to be encountered at the trench sidewalls and subgrade for the median sewer.



Approximate Stations 15+140 to 16+200 (Excavation approximately 1.2 m to 2.5 m deep, and 3.0 m near Station 15+140)

The subsurface along this section generally consists of pavement structure (asphalt over granular base) overlying layers of silty clay fill and sand and silt fill, which are underlain by stiff to hard silty clay till with interbedded sand and silt layers. Typically dense to very dense sand and silt to sandy silt till was contacted below the silty clay till at some locations. The groundwater levels measured in the piezometers ranged from about 2 m to 5 m below ground surface, which are up to the order of 0.5 m to 1 m above the proposed pipe invert level. It is anticipated that the pipe subgrade would typically consist of firm to very stiff silty clay till with exposed loose to compact silt between approximate Stations 15+450 to 15+700.

Approximate Stations 16+250 to 17+200 (Excavation approximately 1.0 m to 2.0 m deep)

The subsurface along this section generally consists of pavement structure (asphalt over granular base) overlying layers of silty clay fill and sandy silt/silty sand fill, which are underlain by stiff to hard silty clay till. Layers of compact sands and silts were encountered within this section below the fill and/or interbedded with the silty clay till. The groundwater levels measured in the piezometers ranged from about 2 m to 9 m below ground surface, which is slightly above or below the proposed pipe invert level. It is anticipated that the pipe subgrade would vary between compact to very dense sand/silt fill, stiff to very stiff silty clay fill, compact sands and silts, and very stiff to hard silty clay till.

Approximate Stations 17+270 to 18+190 (Excavation approximately 1.0 m to 1.5 m deep)

The subsurface along this section generally consists pavement structure (asphalt over granular base) overlying layers of stiff to hard silty clay fill and compact to dense sandy silt/silty sand fill, which are underlain by very stiff to hard silty clay till. Layers of compact to dense sands and silts were also encountered below the fill near Station 17+350 (Borehole MS2-09) and near the Rouge River at lower depths. The groundwater levels measured in the piezometers ranged from about 2 m to 5.5 m depths below ground surface, which are up to the order of 0.5 m to 3 m below the proposed pipe invert level. It is anticipated that the pipe subgrade would vary between firm silty clay fill, compact to dense silty sand fill, compact to dense sands and silts, and very stiff to hard silty clay till.



In general, for excavations through surficial fill overlying silty clay till with interbedded layers of sands and silts, trench box with conventional sump pumping may be considered for sewer installation. It is noted that a trench box is primarily used to enhance the safety of workers inside trenches and is not effective in minimizing water seepage or limiting adjacent ground movements.

Some movement of the adjacent ground should be expected where trench boxes or timber sheathings are used. If this becomes a concern, consideration may be given to limiting the length of an excavation such that the pipe within the excavated section can be laid and the trench properly backfilled during the course of the same day.

Regardless of whether open cutting, trench box or other types of ground support is used, ground movement adjacent to trenches must be subjected to the criterion associated with Performance Level 2 as per Clause 539.04.01.01 in OPSS.PROV 539 (also see Section 8.2 Temporary Protection System). It is recommended that a new NSSP or additional statements to an existing NSSP be included in the contract documents. Suggested wording of such statements is included in Appendix D.

If excavations are primarily through surficial fill and cohesionless sands and silts, sloughing of the trench sidewalls should be expected, especially in cases where the groundwater level is above the trench base. At these locations, trench box in conjunction with localized effective dewatering (e.g. well points, eductors) or sheetpile cutoff may need to be used.

The contractor should be alerted that it is their responsibility to carry out groundwater control during excavation. Water seepage should be expected from the sands and silts that are likely to be exposed at and above the base of the trenches, water-bearing seams/layers within the silty clay till and perched water within the existing surficial fill. Sump pumping will be required in all cases to maintain reasonably dry excavations. Surface runoff and precipitation should be diverted away from all trench excavations where practicable.

Dewatering and unwatering should be carried out in accordance with OPSS.PROV 517, SP 517F01 Amendment to OPSS 517, November 2016 (issued July 2017). There is no pre-construction condition survey and dewatering design engineer requirements.

It is noted that cobbles or boulders should be expected in the tills. Excavation of these obstructions and hard/very dense zones within the till is anticipated to be laboured and difficult. The contractor's excavating equipment must be capable of dislodging, handling and removing the obstructions, and penetrating the hard/very dense zones to reach the desired depths.



All excavations should conform to the requirements of the latest edition of the Ontario Occupational Health & Safety Act (OHSA), its regulations and other applicable local regulations. For the purpose of OHSA, the fill and native soils above the groundwater level may be classified as Type 3 soils, and cohesionless soils below the groundwater level as Type 4 soils.

Where space permits and at the ends of the trenches, slopes of temporarily unsupported cuts conforming with the requirements of the OHSA may be formed, but should not be steeper than 1H : 1V above the groundwater level. Flatter slopes may be required at locations where water seepage or sloughing occurs during excavation.

Where excavation for pipe installation is located in close proximity to existing buried utilities and where temporary protection is otherwise required, consideration may be given to using interlocking sheetpile walls, or soldier pile and timber lagging walls. Design of a temporary protection system is the responsibility of the contractor (see Section 8.2 below).

Furthermore, should sloughing or caving occur at depths below the water table or at any other location, the contractor must immediately modify the excavating and shoring methods, and construction sequence in order to prevent further sloughing from occurring, and full support must be provided to the trench walls. It is always a good practice to excavate from areas of low trench invert elevations to areas of higher elevation (i.e. uphill) so that the previously placed sewer backfill may act as a drain to the subsequent sections of the trench.

Decisions regarding shoring methods and sequencing should be made by the contractor. Any required shoring system must be designed by a licensed Professional Engineer experienced in such designs. Any dewatering system must be designed by specialists experienced in such designs.

The sewer design should take into account any protective measures that may be required for crossing below any existing gas lines, hydro lines, watermains, structures and any other buried facilities that may exist in the vicinity of the work areas. This may require discussions with relevant owners of these facilities and design of temporary protection and support of the particular utility. During construction, some authorities may require that their representative(s) be on site on a full-time basis.



8.2 Temporary Protection System

Temporary protection (shoring) may be required at some locations as discussed above. An item titled "Protection System" as per OPSS.PROV 539 should be included in the contract documents. It is recommended that Performance Level 2 as per Clause 539.04.01.01 be used.

The design of roadway protection is the responsibility of the Contractor. However, soldier pile and wood lagging walls or interlocking steel sheetpile walls may be considered as temporary shoring at this site. It is anticipated that the protection system will extend predominantly through the existing pavement granulars, silty clay to sand/silt embankment fill into the underlying stiff to hard silty clay till with interbedded layers of compact to dense sands and silts to develop the required toe resistance. Installation of temporary protection should consider that the existing embankment fill may contain obstructions.

A temporary shoring wall may be designed using the parameters given below:

Soil Bulk Unit Weight	γ	=	20 kN/m ³
Soil Submerged Unit Weight (below gwl)	γ'	=	10 kN/m ³
Coefficient of Active Pressure	K_a	=	0.33 (embankment fill)
		=	0.33 (sands and silts)
		=	0.31 (silty clay till)
Coefficient of Passive Pressure	K_p	=	3.0 (fill)
		=	3.0 (sands and silts)
		=	3.2 (silty clay till)

It is recommended that lateral earth pressures acting on the wall be computed in accordance with the CHBDC 2014. The surcharge should include soil loadings above the retained soil and other loadings adjacent to the wall. A properly designed and constructed soldier pile and lagging wall will be permeable and therefore water pressure acting on the retained height may be set to zero. Full groundwater pressure will have to be taken into account for a sheetpile wall design. The actual pressure distribution acting on the shoring system is a function of the construction sequence and the relative flexibility of the wall and these factors must be considered when designing the roadway protection system.

The designer of the roadway protection system should check whether the depth of embedment is sufficient to provide base fixity.

All roadway protection systems should be designed by a Professional Engineer experienced in such designs.



8.3 Sewer Bedding

Prior to placement of the pipe bedding, the base of the trench excavation must be dewatered and in a reasonably dry condition. Where loose and wet materials are exposed at subgrade level, sub-excavation of these disturbed materials will be required. Backfill to replace the over-excavation should consist of OPSS Granular A placed in 150 mm thick loose lifts and compacted to a minimum 95% of its Standard Proctor Maximum Dry Density (SPMDD). If a reasonably dry trench base cannot be maintained, the Granular A backfill may be substituted with 19 mm clear stones as specified in OPSS.PROV 1004.05.02. The clear stone should be continuously wrapped in non-woven, Class II (heavy duty) geotextile filter cloth with an apparent opening size of 0.212mm, such as a Terrafix 360R. It is critical that the pipe be supported on uniform competent subgrade and well compacted bedding in order to minimize the potential of differential settlement. At locations where less competent subgrade is encountered, the bedding thickness may be locally increased.

It is recommended that pipe bedding and cover should be in accordance with current MTO practice. It is recommended that the bedding materials meet the gradation requirements for OPSS Granular A materials, and should be placed in loose lifts not thicker than 150 mm and be compacted to 100% of its Standard Proctor Maximum Dry Density (SPMDD) within 2 percent of its optimum moisture content (OMC). Placement and compaction of granular bedding and granular fill should be in accordance with OPSS.PROV 401 and OPSS.PROV 501 requirements. The bedding thickness depends on the pipe diameter D , typically equal to $0.15D$, but should be a minimum 150 mm and should extend to at least 300 mm above the crown of the pipe to provide a granular surround. Care must be exercised when compacting the fill immediately above the crown of the pipe in order not to damage the pipe. Reference should be made to OPSD 802.030, 802.031 and 802.032, where applicable.

8.4 Trench Backfill

It is anticipated that the excavated materials will generally consist of sand and gravel fill, silty clay fill, silty sand/sandy silt fill and native silty clay till with interbedded layers of sands and silts.



Excavated soils including sand and gravel and sand/silt fill and native sands/silts above the groundwater level would generally be considered suitable as trench backfill for the median sewer, provided the environmental requirements are met. However, the backfill soils must be unfrozen, free of organics, debris and other deleterious materials, and are at a moisture content suitable for compaction. Such fill should be placed in loose lifts of not more than 200 mm in thickness and compacted to a minimum 98 percent of the SPMDD within ± 2 percent of its OMC.

Other excavated soils including sands and silts under the groundwater level and the silty clay till should not be used as backfill. The water-bearing sands and silts are likely to be too wet for adequate compaction, and it is difficult to achieve adequate compaction of the clay till within a narrow trench. Instead, granular materials meeting the gradation requirements of OPSS Granular B, Type I or Select Subgrade Material (SSM) may be used as trench backfill. The backfill materials should be placed in loose lifts not exceeding 200 mm and be compacted to at least 98 percent of its SPMDD within ± 2 percent of its OMC.

Trenching, backfilling and compacting must be carried out as per OPSS.PROV 401 and OPSS.PROV 501 requirements.

Excess excavated materials may be disposed of off site or reused as general fill for landscaping purposes elsewhere within the project.

9. CONSTRUCTION CONCERNS

Potential construction concerns that have been identified for this project include the following:

9.1 Loss of Ground

Trenching along the median for sewer replacement will result in some adjacent ground movements depending on the soil and groundwater conditions. Although the risk of causing pavement distress is lower than trenchless methods, the Contractor must recognize that construction sequencing including the implementation of temporary protection (shoring) and groundwater control will be critical to limiting ground movements to within tolerable limits.

9.2 Groundwater Control

Groundwater control will be required for installation of the median sewer. Sump pumping will be required at all locations. Localized dewatering by means of vacuum well points and/or eductors may need to be implemented as required. Partial groundwater cutoff using interlocking sheetpile



walls may be required at some locations. Surface runoff and precipitation should be diverted away from excavations at all times.

9.3 Obstructions

Glacial tills inherently contain cobbles and boulders, and the existing highway fill may contain similar and other obstructions. The Contractor's equipment and methodology must be selected to handle such obstructions and successfully remove them without jeopardizing the highway. The impact of such obstructions on the pipe alignments should be assessed.

It is recommended that the Contractor be alerted to the following points, either by a Non-Standard Special Provision (NSSP) or otherwise by inclusion in the Contract Documents.

- The fill materials and glacial till deposits may contain cobbles and boulders. The Contractor must be equipped to dislodge, remove and otherwise handle such obstructions during excavation.

Suggested wording of a NSSP for the above is included in Appendix E.

9.4 Buried Utilities

The Contractor must accurately establish, in three dimensions, the locations of all buried utilities crossing or closely paralleling the median sewer alignment. Any discrepancy from the Contract Drawings must be reported to the Contract Administrator.

10. CLOSURE

Engineering analysis and report preparation was carried out by Ms. Rocío Palomeque Reyna, P.Eng.

Messrs. Sydney Pang, P.Eng. and P.K. Chatterji, P.Eng., a Designated Principal Contact for MTO Foundations Projects, reviewed the report.



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Review Principal, Designated MTO Contact



Table 1 – Completion Details for Piezometer Installations

Borehole No.	Borehole Depth/ Base Elevation (m)	Piezometer Tip Depth / Elevation (m)	Completion Details
Section 1 - From Highway 407 to south of 16th Avenue, (Stations 15+140 to 16+200)			
MS 2-22	6.7/186.3	6.1/186.96	Piezometer with 3.0 m slotted screen installed with sand filter from 6.7 m to 2.4 m, bentonite holeplug from 2.4 m to 1.5 m, auger cuttings from 1.5 m to 0.2 m, then concrete to ground surface.
MS 2-29	7.9/181.9	6.1/183.6	Piezometer with 3.0 m slotted screen installed with sand filter from 7.9 m to 2.4 m, bentonite holeplug from 2.4 m to 0.9 m, auger cuttings from 0.9 m to 0.15 m, then asphalt to ground surface.
MS 2-32	12.5/177.0	6.2/183.3	Piezometer with 3.0 m slotted screen installed with auger cuttings from 12.5 m to 6.6 m, sand filter from 6.6 m to 2.4 m, bentonite holeplug from 2.4 m to 0.15 m, then auger cuttings to ground surface.
16TH-09	9.8/185.4	9.1/180.8	Piezometer with 3.0 m slotted screen installed with sand filter from 9.8 m to 5.5 m, bentonite holeplug from 5.5 m to 3.0 m, then auger cuttings from 3.0 m to ground surface.
Section 2 - From north of 16th Avenue to south of Rouge River, (Stations 16+250 to 17+200)			
MS 2-12	12.3/189.7	11.0/191.0	Borehole caved to 11.0 m. Piezometer with 3.0 m slotted screen installed with sand filter from 11.0 m to 6.7 m, bentonite holeplug from 6.7 m to 0.2 m, then auger cuttings from 0.2 m to ground surface.
MS 2-16	12.8/86.7	6.7/192.8	Auger cuttings from 12.8 m to 6.7 m. Piezometer with 3.0 m slotted screen installed with sand filter from 6.7 m to 2.4 m, bentonite holeplug from 2.4 m to 0.3 m, then auger cuttings from 0.3 m to ground surface.
16TH-01	11.3/184.2	7.6/187.9	Piezometer with 3.0 m slotted screen installed with sand filter from 11.3 m to 4.3 m, bentonite holeplug from 4.3 m to 2.4 m, bentonite mixed with auger cuttings from 2.4 m to ground surface.

Borehole No.	Borehole Depth/ Base Elevation (m)	Piezometer Tip Depth / Elevation (m)	Completion Details
16TH-04	39.5/156.2	39.5/156.2	Piezometer with 3.0 m slotted screen installed with sand filter from 39.5 m to 32.2 m, bentonite holeplug from 32.2 m to 25.8 m, bentonite mixed with auger cuttings from 25.8 m to ground surface.
R-07	24.7/177.9	24.4/178.2	Piezometer with 3.0 m slotted screen installed with sand filter from 24.7 m to 20.7 m, bentonite holeplug from 20.7 m to 12.2 m, bentonite mixed with auger cuttings from 12.2 m to ground surface.
Section 3 - From south of Rouge River to Major Mackenzie Drive, (Stations 17+270 to 18+190)			
MS 2-02	6.7/200.9	6.1/201.5	Piezometer with 3.0 m slotted screen installed with sand filter from 6.7 m to 2.4 m, bentonite holeplug from 2.4 m to 1.5 m, auger cuttings from 1.5 m to 0.15 m, concrete from 0.15 m to ground surface
MS 2-05	8.2/197.7	7.5/198.7	Piezometer with 3.0 m slotted screen installed with sand filter from 8.2 m to 3.4 m, bentonite holeplug from 3.4 m to ground surface.
R-04	25.0/177.9	15.2/187.7	Borehole caved to 15.2 m. Piezometer with 3.0 m slotted screen installed with sand filter from 15.2 m to 10.9 m, bentonite from 10.9 m to 6.1 m, bentonite mixed with auger cuttings from 6.1 m to ground surface.

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

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


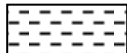



 Water Level
 Shear Strength Determination by Pocket Penetrometer

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

UNIFIED SOILS CLASSIFICATION

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

EXPLANATION OF ROCK LOGGING TERMS

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



Appendix A

Section 1

**From 1 km north of Highway 7 to south of 16th Avenue
(Stations 15+140 to 16+200)**

RECORD OF BOREHOLE No 16TH-08

1 OF 2

METRIC

O&V.P. 2930-FI-00 LOCATION 16th Ave. Overpass, MTM NAD 83 Zone10: N 4 858 338.4 E 314 812.1 ORIGINATED BY SB
 HWY 404 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2018.05.31 - 2018.05.31 LATITUDE 43.864949 LONGITUDE -79.375440 CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					
195.2	GROUND SURFACE												
0.0	TOPSOIL: (100mm)												
0.1	Silty SAND , trace clay and gravel, occasional organics Compact Brown Moist (FILL)		1	SS	14		195						
			2	SS	21		194						
193.8													
1.4	Silty CLAY , with sand, trace gravel Firm to Stiff Grey Moist (TILL)		3	SS	6		193						
			4	SS	7								
			5	SS	9		192						
			6	SS	6		191						
			7	SS	8		190						
			8	SS	10		189						
							188						
							187						
186.7													
8.5	SAND and SILT , trace clay, trace gravel Compact to Very Loose Grey Wet		9	SS	11								0 0 85 15
			10	SS	0*		186						0 40 56 4 * Disturbed due to drilling

Continued Next Page

$+^3, \times^3$: Numbers refer to Sensitivity
 20
15
10
5
0
(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 16TH-08

2 OF 2

METRIC

ÖB.V.P. 2930-FI-00 LOCATION 16th Ave. Overpass, MTM NAD 83 Zone10: N 4 858 338.4 E 314 812.1 ORIGINATED BY SB
 HWY 404 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2018.05.31 - 2018.05.31 LATITUDE 43.864949 LONGITUDE -79.375440 CHECKED BY RPR


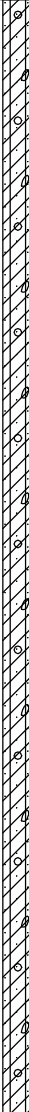

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W _P	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE								
	Continued From Previous Page							20	40	60	80	100				
184.2	SAND and SILT , trace clay Compact Grey Wet						185									
11.0	Silty CLAY , some sand, trace gravel		11	SS	14		184									
183.9	Stiff Grey															
11.3	Wet (TILL)															
	END OF BOREHOLE AT 11.3m. WATER LEVEL AT 8.5m AND BOREHOLE CAVED TO 9.1m DEPTH UPON COMPLETION. BACKFILLED WITH BENTONITE HOLEPLUG AND AUGER CUTTINGS TO SURFACE.															

RECORD OF BOREHOLE No 16TH-09

1 OF 2

METRIC

O&V.P. 2930-FI-00 LOCATION 16th Ave. Overpass, MTM NAD 83 Zone10: N 4 858 344.4 E 314 828.2 ORIGINATED BY SB
 HWY 404 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2018.05.31 - 2018.05.31 LATITUDE 43.865003 LONGITUDE -79.375240 CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					
								20 40 60 80 100					
195.2	GROUND SURFACE												
0.0	Silty SAND , some gravel, trace clay, occasional organics Compact Brown to Grey Moist (FILL) black silt seams		1	SS	13								
			2	SS	12								
193.8													
1.4	Silty CLAY , with sand, trace gravel Stiff Grey Moist (TILL)		3	SS	11								
			4	SS	9								
			5	SS	14								
			6	SS	10								
			7	SS	8								
			8	SS	15								
186.4													
8.8	SAND and SILT , trace to some clay Compact Grey Wet		9	SS	15								
185.4													
9.8	END OF BOREHOLE AT 9.8m.												

Continued Next Page

$+^3, \times^3$: Numbers refer to
Sensitivity
 20
15
10
 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 16TH-09

2 OF 2

METRIC

ÖB.V.P. 2930-FI-00 LOCATION 16th Ave. Overpass, MTM NAD 83 Zone10: N 4 858 344.4 E 314 828.2 ORIGINATED BY SB
 HWY 404 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2018.05.31 - 2018.05.31 LATITUDE 43.865003 LONGITUDE -79.375240 CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
	Continued From Previous Page																
	WATER LEVEL AT 8.4m UPON COMPLETION. Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 3.05m slotted screen. WATER LEVEL READINGS DATE DEPTH(m) ELEV.(m) 2018.08.22 6.0 189.2 2018.11.23 4.8 190.4																

RECORD OF BOREHOLE No MS 2-21

1 OF 2

METRIC

O.B.P. 2930-FI-00 LOCATION N 4 858 137.9 E 314 846.0 ORIGINATED BY KK
 HWY 404 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MP
 DATUM Geodetic DATE 2018.07.24 - 2018.07.24 LATITUDE 43.863144 LONGITUDE -79.375022 CHECKED BY RD

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 (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa				WATER CONTENT (%)					
194.0	GROUND SURFACE							20	40	60	80	100					
0.0	ASPHALT (150mm)							20	40	60	80	100					
0.2	SAND and GRAVEL, trace clay, trace silt Compact Brown Moist (FILL)		1	SS	13		193										
192.6			2	SS	14												
1.4	Silty CLAY, trace sand, trace gravel Very Stiff Brown Moist (TILL)		3	SS	16		192										
			4	SS	15		191										0 9 24 67
			5	SS	18												
189.9	Silty SAND, trace gravel, trace clay Compact Grey Moist		6	SS	16		190										5 70 20 5
4.1							189										
			7	SS	18		188										
186.9	Silty CLAY , with sand, trace gravel Very Stiff Grey Moist (TILL)		8	SS	22		187										
7.2							186										
			9	SS	16		185										

Continued Next Page


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

RECORD OF BOREHOLE No MS 2-21

2 OF 2

METRIC

O&M.P. 2930-FI-00 LOCATION N 4 858 137.9 E 314 846.0 ORIGINATED BY KK
 HWY 404 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MP
 DATUM Geodetic DATE 2018.07.24 - 2018.07.24 LATITUDE 43.863144 LONGITUDE -79.375022 CHECKED BY RD

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT NATURAL MOISTURE LIQUID CONTENT LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)					
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE				W _P W W _L WATER CONTENT (%)				GR	SA	SI	CL		
	Continued From Previous Page							20	40	60	80	100									
181.2	Silty CLAY , with sand, trace gravel Hard Grey Moist (TILL)		10	SS	34		183											2	22	41	35
							182														
12.8	END OF BOREHOLE AT 12.8m. WATER LEVEL AT 3.6m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND AUGER CUTTINGS TO 0.2m, THEN COLD PATCH ASPHALT TO SURFACE.																				

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

RECORD OF BOREHOLE No MS 2-22

1 OF 1

METRIC

ÖB.V.P. 2930-FI-00 LOCATION N 4 858 038.5 E 314 866.2 ORIGINATED BY KK
 HWY 404 BOREHOLE TYPE Solid Stem Augers COMPILED BY MP
 DATUM Geodetic DATE 2018.07.24 - 2018.07.24 LATITUDE 43.862249 LONGITUDE -79.374772 CHECKED BY RD

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					
193.0	GROUND SURFACE							20 40 60 80 100					
0.0	ASPHALT (175mm)						193	20 40 60 80 100					
0.2	SAND and GRAVEL, trace silt, trace clay Compact Brown Moist (FILL)		1	SS	18		193	20 40 60 80 100					
192.2								20 40 60 80 100					
0.8	Silty CLAY, some sand, trace gravel Stiff to Very Stiff Brown to Grey Moist (TILL)		2	SS	13		192	20 40 60 80 100					
								20 40 60 80 100					
			3	SS	16		191	20 40 60 80 100					
								20 40 60 80 100					
			4	SS	16		190	20 40 60 80 100				0 15 46 39	
190.1								20 40 60 80 100					
3.0	Silty SAND, trace gravel, trace clay Compact Grey Moist		5	SS	15		189	20 40 60 80 100					
188.9								20 40 60 80 100					
4.1	Silty CLAY, with sand, trace gravel Very Stiff Grey Moist (TILL)		6	SS	16		188	20 40 60 80 100				2 28 48 22	
								20 40 60 80 100					
							187	20 40 60 80 100					
			7	SS	29			20 40 60 80 100					
186.3								20 40 60 80 100					
6.7	END OF BOREHOLE AT 6.7m. Piezometer installation consists of 25mm diameter Schedule 40 PVC pipe with a 3.0m slotted screen. WATER LEVEL READINGS DATE DEPTH(m) ELEV.(m) 2018.09.30 2.6 190.4 2018.11.22 1.9 191.1												

ONTMT452 MTO-15786.GPJ 2017TEMPLATE(MTO).GDT 12/3/18

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

RECORD OF BOREHOLE No MS 2-23

1 OF 1

METRIC

ŌNV.P. 2930-FI-00 LOCATION N 4 857 998.4 E 314 871.5 ORIGINATED BY KK
 HWY 404 BOREHOLE TYPE Solid Stem Augers COMPILED BY MP
 DATUM Geodetic DATE 2018.07.30 - 2018.07.30 LATITUDE 43.861888 LONGITUDE -79.374707 CHECKED BY RD

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					
192.8	GROUND SURFACE												
0.0	ASPHALT (150mm)												
0.2	SAND and GRAVEL, trace silt, trace clay Brown Moist (FILL)		1	GS									
192.1													
0.7	Silty CLAY, trace gravel, trace sand Stiff Brown Moist (TILL)		2	SS	13								
			3	SS	12								
190.8													
2.0	SILT, some sand, trace clay Compact Grey Wet		4	SS	13								
189.8													
3.0	Silty CLAY, with sand, trace gravel Stiff to Hard Grey Moist (TILL)		5	SS	10								
			6	SS	16								
			7	SS	27								
			8	SS	43								
184.6													
8.2	END OF BOREHOLE AT 8.2m. WATER LEVEL AT 4.4m DEPTH UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO 1.5m, AUGER CUTTINGS TO 0.2m, THEN COLD PATCH ASPHALT TO SURFACE.												

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

RECORD OF BOREHOLE No MS 2-24

1 OF 2

METRIC

O&P. 2930-FI-00 LOCATION N 4 857 978.0 E 314 894.1 ORIGINATED BY KK
 HWY 404 BOREHOLE TYPE Solid Stem Augers COMPILED BY MP
 DATUM Geodetic DATE 2018.07.25 - 2018.07.25 LATITUDE 43.861704 LONGITUDE -79.374426 CHECKED BY RD

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 (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE				WATER CONTENT (%) w _p w w _L				GR	SA	SI	CL
192.6	GROUND SURFACE							20	40	60	80	100							
0.0	ASPHALT (125mm)																		
	SAND and GRAVEL Compact Brown Moist (FILL)		1	SS	17		192						○						
191.5			2	SS	20								○						
1.1	Silty CLAY, trace sand, trace gravel Hard to Stiff Brown Moist (TILL)						191							○					
			3	SS	31									○					
189.9			4	SS	12		190						○						
2.7	SILT, some clay, trace sand, trace gravel Compact Grey Moist to wet												○						
			5	SS	18		189							○					
							188												
	Loose		6	SS	8									○					
							187												
187.0																			
5.6	SAND and SILT, trace gravel, trace clay Dense to Very Dense Grey Moist (TILL)						186							○					
			7	SS	48														
							185												
			8	SS	57									○					
							184												
184.0																			
8.5	Silty CLAY, with sand, trace gravel Hard Grey Moist (TILL)						183							○					
			9	SS	83														

Continued Next Page


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

RECORD OF BOREHOLE No MS 2-24

2 OF 2

METRIC

O&V.P. 2930-FI-00 LOCATION N 4 857 978.0 E 314 894.1 ORIGINATED BY KK
 HWY 404 BOREHOLE TYPE Solid Stem Augers COMPILED BY MP
 DATUM Geodetic DATE 2018.07.25 - 2018.07.25 LATITUDE 43.861704 LONGITUDE -79.374426 CHECKED BY RD

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W _P	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE								
	Continued From Previous Page						20	40	60	80	100					
	Silty CLAY , with sand, trace gravel Hard Grey Moist (TILL)		10	SS	75											2 23 45 30
179.8			11	SS	58											
12.8	END OF BOREHOLE AT 12.8m. WATER LEVEL AT 4.6m DEPTH BEFORE BOREHOLE CAVING TO 3.0m DEPTH UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO 0.1m, THEN COLD PATCH ASPHALT TO SURFACE.															

$+^3, \times^3$: Numbers refer to Sensitivity
 20
15
10
5
0
 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No MS 2-25

1 OF 1

METRIC

O&V.P. 2930-FI-00 LOCATION N 4 857 856.6 E 314 914.9 ORIGINATED BY BL
 HWY 404 BOREHOLE TYPE Solid Stem Augers COMPILED BY MP
 DATUM Geodetic DATE 2018.07.25 - 2018.07.25 LATITUDE 43.860611 LONGITUDE -79.374170 CHECKED BY RD

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					
191.4	GROUND SURFACE												
0.0	ASPHALT (125mm)												
0.1	SAND and GRAVEL Compact Brown Moist (FILL)		1	SS	17		191						
190.6													
0.8	Silty CLAY, trace sand, trace gravel Very Stiff Brown Moist (TILL)		2	SS	19		190						
			3	SS	21								
188.9			4	SS	14		189						
2.5	Sandy SILT, trace to some clay, trace gravel Compact to Dense Grey Moist (TILL)												
			5	SS	19		188						1 20 61 18
			6	SS	23		187						
			7	SS	33		185						
	Becoming SAND and SILT		8	SS	20		184						5 37 43 15
183.2													
8.2	END OF BOREHOLE AT 8.2m. WATER LEVEL AT 4.6m DEPTH BEFORE BOREHOLE CAVING TO 3.0m DEPTH UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO 0.1m, THEN COLD PATCH ASPHALT TO SURFACE.												

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

RECORD OF BOREHOLE No MS 2-26

1 OF 2

METRIC

O&V.P. 2930-FI-00 LOCATION N 4 857 811.8 E 314 902.1 ORIGINATED BY BL
 HWY 404 BOREHOLE TYPE Solid Stem Augers COMPILED BY MP
 DATUM Geodetic DATE 2018.08.01 - 2018.08.01 LATITUDE 43.860208 LONGITUDE -79.374330 CHECKED BY RD

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE				WATER CONTENT (%) W _P W W _L					γ
191.3	GROUND SURFACE							20	40	60	80	100					
0.0	ASPHALT (150mm)							20	40	60	80	100					
0.2	SAND and GRAVEL, trace silt, trace clay Compact Brown Moist (FILL)		1	SS	27		191							○			
190.3														○			
1.0	Silty CLAY, some sand, trace gravel Stiff to Very Stiff Brown Moist (TILL)		2	SS	12		190							○			
														○			
			3	SS	17									○			
189.1							189								○		
2.2	SILT, trace to some clay, trace sand Compact Grey Wet		4	SS	20										○		
			5	SS	18		188							○			
187.2							187								○		
4.1	Silty CLAY, with sand, trace gravel Very Stiff to Hard Grey Moist (TILL)		6	SS	29										○		
							186								○		
			7	SS	100/ 0.150		185								○		
							184								○		
			8	SS	100/ 0.200										○		
							183										
			9	SS	82		182								○		

Continued Next Page

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

RECORD OF BOREHOLE No MS 2-26

2 OF 2

METRIC

O&M.P. 2930-FI-00 LOCATION N 4 857 811.8 E 314 902.1 ORIGINATED BY BL
 HWY 404 BOREHOLE TYPE Solid Stem Augers COMPILED BY MP
 DATUM Geodetic DATE 2018.08.01 - 2018.08.01 LATITUDE 43.860208 LONGITUDE -79.374330 CHECKED BY RD

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W _P	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100 SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE								
	Continued From Previous Page															
	Silty CLAY , with sand, trace gravel Hard Grey Moist (TILL)		10	SS	77		181									
							180									
178.7			11	SS	100/ 0.275		179									
12.6	END OF BOREHOLE AT 12.6m. BOREHOLE CAVED TO 2.4m AND WATER LEVEL AT 2.3m DEPTH UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO 0.2m, THEN COLD PATCH ASPHALT TO SURFACE.															

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

RECORD OF BOREHOLE No MS 2-27

1 OF 1

METRIC

ŌNV.P. 2930-FI-00 LOCATION N 4 857 704.3 E 314 924.2 ORIGINATED BY KK
 HWY 404 BOREHOLE TYPE Solid Stem Augers COMPILED BY MP
 DATUM Geodetic DATE 2018.08.01 - 2018.08.01 LATITUDE 43.859240 LONGITUDE -79.374058 CHECKED BY RD

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					
190.5	GROUND SURFACE												
0.0	ASPHALT (150mm)												
0.2	SAND and GRAVEL, trace silt, trace clay (FILL)		1	GS			190						
189.8													
0.7	Silty CLAY, some sand, trace gravel Stiff Brown Moist (TILL)		2	SS	12		189						1 14 27 58
189.0													
1.4	SILT, trace to some clay, trace sand, trace gravel Compact to Loose Grey Moist		3	SS	13		189						0 9 84 7
			4	SS	12		188						
			5	SS	9		187						0 10 78 12
186.3													
4.1	Silty CLAY, with sand, trace gravel Hard Grey Moist (TILL)		6	SS	58		186						1 36 41 22
							185						
			7	SS	100/ 0-200		184						
							183						
			8	SS	31								
182.2													
8.2	END OF BOREHOLE AT 8.2m. BOREHOLE CAVED TO 3.1m DEPTH UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO 1.5m, AUGER CUTTINGS TO 0.2m, THEN COLD PATCH ASPHALT TO SURFACE.												

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

RECORD OF BOREHOLE No MS 2-28

1 OF 2

METRIC

ŌBV.P. 2930-FI-00 LOCATION N 4 857 651.2 E 314 931.2 ORIGINATED BY BL
 HWY 404 BOREHOLE TYPE Solid Stem Augers COMPILED BY MP
 DATUM Geodetic DATE 2018.08.02 - 2018.08.02 LATITUDE 43.858762 LONGITUDE -79.373971 CHECKED BY RD

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						
190.2	GROUND SURFACE							20	40	60	80	100		
0.0	ASPHALT (150mm)													
0.2	SAND and GRAVEL Brown Moist (FILL)		1	GS			190							
189.5														
0.7	Silty CLAY, trace sand, trace gravel Firm to Stiff Brown Moist (FILL)		2	SS	8		189							
188.7														
1.4	SILT, some sand, trace clay Loose to Compact Grey Moist		3	SS	7		188							
			4	SS	10									0 16 78 6
			5	SS	15		187							
186.1							186							
4.1	Very Dense		6	SS	76									
							185							
			7	SS	100/ 0.200		184							
183.2	Silty CLAY, with sand, trace gravel Hard Grey Moist (TILL)		8	SS	31		183							
7.0														
							182							
181.7	SAND and SILT, some gravel, trace clay Very Dense Grey Moist (TILL)		9	SS	87		181							12 45 36 7
8.5														

Continued Next Page

$+^3, \times^3$: Numbers refer to Sensitivity
 20
15
10
 (%) STRAIN AT FAILURE

METRIC

[illegible]

+³, ×³: Numbers refer to Sensitivity

RECORD OF BOREHOLE No MS 2-29

1 OF 1

METRIC

O&P. 2930-FI-00 LOCATION N 4 857 556.4 E 314 971.5 ORIGINATED BY BL
 HWY 404 BOREHOLE TYPE Solid Stem Augers COMPILED BY MP
 DATUM Geodetic DATE 2018.07.26 - 2018.07.26 LATITUDE 43.857909 LONGITUDE -79.373472 CHECKED BY RD

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							
189.7	GROUND SURFACE							20	40	60	80	100			
0.0	ASPHALT (150mm)							20	40	60	80	100			
0.2	SAND and GRAVEL Compact Brown Moist (FILL)		1	SS	20		189								
188.7			2	SS	19										
1.1	Silty CLAY, some sand to with sand, trace gravel Very Stiff to Stiff Brown Wet (TILL)		3	SS	19		188								
187.5															
2.2	Firm		4	SS	4		187								
186.8															
3.0			5	SS	11		186								
	Grey Moist		6	SS	23		185								
184.1															
5.6	Hard		7	SS	70		184								
							183								
181.9			8	SS	100/		182								
7.9	END OF BOREHOLE AT 7.9m. WATER LEVEL AT 4.6m DEPTH BEFORE BOREHOLE CAVING TO 6.1m DEPTH UPON COMPLETION. Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 3.0m slotted screen.				0.200										
	WATER LEVEL READINGS DATE DEPTH(m) ELEV.(m) 2018.09.30 2.4 187.3 2018.11.23 2.2 187.5														

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

RECORD OF BOREHOLE No MS 2-30

1 OF 2

METRIC

O&P. 2930-FI-00 LOCATION N 4 857 490.3 E 314 981.3 ORIGINATED BY BL
 HWY 404 BOREHOLE TYPE Solid Stem Augers COMPILED BY MP
 DATUM Geodetic DATE 2018.07.24 - 2018.07.24 LATITUDE 43.857313 LONGITUDE -79.373351 CHECKED BY RD

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					
189.5	GROUND SURFACE							20 40 60 80 100					
0.0	ASPHALT (125mm)							○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE					
0.1	SAND and GRAVEL, trace silt, trace clay Compact Brown Moist (FILL)		1	SS	25		189						
188.6													
1.0	Silty SAND, trace gravel, trace clay Compact Brown Moist (FILL)		2	SS	18								
188.1													
1.4	Silty CLAY, some sand Very Stiff to Stiff Brown Moist (TILL)		3	SS	28		188						
			4	SS	11		187						
186.3													
3.2	SAND and SILT, trace clay Compact Brown to Grey Moist		5	SS	30		186						
			6	SS	12								
185.0													
4.5	SAND and SILT, trace gravel, trace clay Very Dense Grey Moist to Wet (TILL)		7	SS	67		185						
			8	SS	100/ 0.275		183						
							182						
							181						
			9	SS	100/ 0.125		180						

Continued Next Page

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

RECORD OF BOREHOLE No MS 2-30

2 OF 2

METRIC

O&P. 2930-FI-00 LOCATION N 4 857 490.3 E 314 981.3 ORIGINATED BY BL
 HWY 404 BOREHOLE TYPE Solid Stem Augers COMPILED BY MP
 DATUM Geodetic DATE 2018.07.24 - 2018.07.24 LATITUDE 43.857313 LONGITUDE -79.373351 CHECKED BY RD

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						
	Continued From Previous Page							○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE						
								20 40 60 80 100						
								WATER CONTENT (%)						
								PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT W _P W W _L						
	SAND and SILT , some gravel, trace clay Very Dense Brown Moist to Wet (TILL)		10	SS	100/ 0.150		179							10 40 43 7
							178							
177.2			11	SS	100/ 0.150									
12.3	END OF BOREHOLE AT 12.3m. BOREHOLE CAVED TO 3.4m AND WATER LEVEL AT 3.4m DEPTH UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO 0.1m, THEN COLD PATCH ASPHALT TO SURFACE.				0.150									

RECORD OF BOREHOLE No MS 2-31

1 OF 1

METRIC

O&P. 2930-FI-00 LOCATION N 4 857 433.4 E 314 973.3 ORIGINATED BY BL
 HWY 404 BOREHOLE TYPE Solid Stem Augers COMPILED BY MP
 DATUM Geodetic DATE 2018.08.02 - 2018.08.02 LATITUDE 43.856801 LONGITUDE -79.373452 CHECKED BY RD

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					
189.4	GROUND SURFACE												
0.0	ASPHALT (150mm)												
0.2	SAND and GRAVEL Grey Moist (FILL)			GS			189						
188.7			1	SS	13		188						
0.7	Silty CLAY, some sand, trace gravel Stiff to Very Stiff Brown Moist (TILL)		2	SS	15		187						
			3	SS	14		186						1 20 37 42
			4	SS	11		185						
			5	SS	23		184						
183.8			6	SS	31		183						0 36 59 5
5.6	SAND and SILT, trace clay Dense Grey Moist		7	SS	65		182						
182.3													
7.2	SAND and SILT, trace clay Very Dense Grey Moist (TILL)												
181.2													
8.2	END OF BOREHOLE AT 8.2m. WATER LEVEL AT 3.4m DEPTH UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO 0.1m, THEN COLD PATCH ASPHALT TO SURFACE.												

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

RECORD OF BOREHOLE No MS 2-32

1 OF 2

METRIC

O&P. 2930-FI-00 LOCATION N 4 857 318.0 E 314 994.2 ORIGINATED BY BL
 HWY 404 BOREHOLE TYPE Hollow Stem Augers/Solid Stem Augers COMPILED BY MP
 DATUM Geodetic DATE 2018.08.09 - 2018.08.09 LATITUDE 43.855762 LONGITUDE -79.373194 CHECKED BY RD

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										
189.5	GROUND SURFACE							20	40	60	80	100						
0.0	ASPHALT (150mm)							20	40	60	80	100						
0.2	SAND and GRAVEL, trace silt, trace clay Compact Brown Moist (FILL)		1	SS	12		189											
			2	SS	18													
188.1	Silty CLAY, some sand, trace gravel Very Stiff to Stiff Brown Moist (TILL)		3	SS	28		188											
1.4	occasional organics at 2.4m		4	SS	8		187											
			5	SS	8		186											
185.4	Sandy SILT, trace to some clay Compact Grey Wet		6	SS	10		185											
4.1							184											
			7	SS	25		183											
	trace gravel		8	SS	21		182											
							181											
			9	SS	41		180											
179.5																		

Borehole was initially terminated at 6.7m and piezometer installed. Another adjacent borehole was advanced without sampling to 6.7m below which sampling was continued.

Borehole was initially terminated at 6.7m and piezometer installed. Another adjacent borehole was advanced without sampling to 6.7m below which sampling was continued.

Continued Next Page

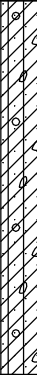



+³, ×³: Numbers refer to Sensitivity 20 15 10 5 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No MS 2-32

2 OF 2

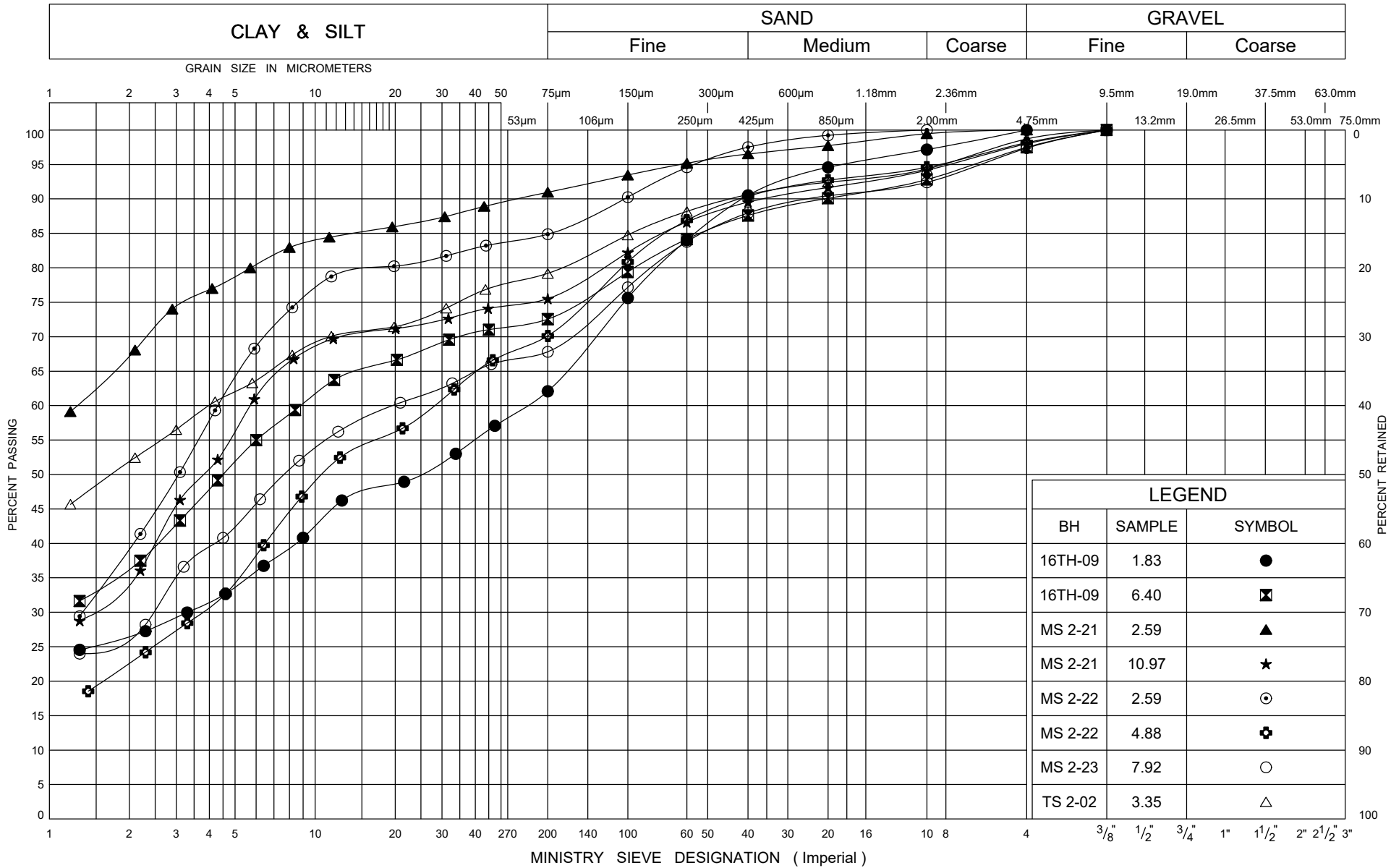
METRIC

O&P. 2930-FI-00 LOCATION N 4 857 318.0 E 314 994.2 ORIGINATED BY BL
 HWY 404 BOREHOLE TYPE Hollow Stem Augers/Solid Stem Augers COMPILED BY MP
 DATUM Geodetic DATE 2018.08.09 - 2018.08.09 LATITUDE 43.855762 LONGITUDE -79.373194 CHECKED BY RD

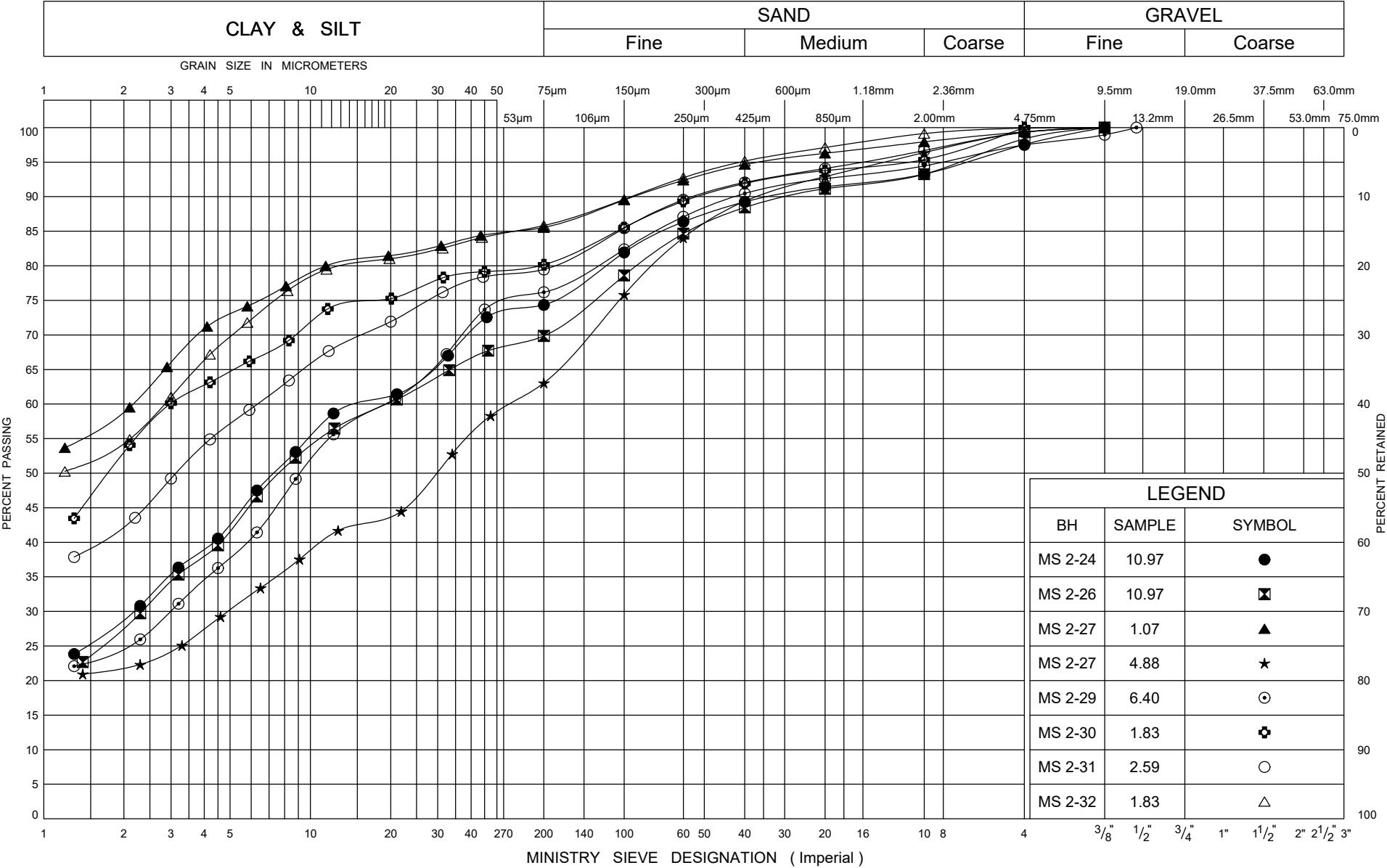
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa								
								20	40	60	80					
Continued From Previous Page																
10.0	Silty CLAY , some sand, trace gravel Hard Grey Moist (TILL)		10	SS	62		179									
							178									
177.0			11	SS	100/											
12.5	END OF BOREHOLE AT 12.5m. WATER LEVEL AT 2.0m DEPTH BEFORE BOREHOLE CAVING TO 1.5m UPON COMPLETION. Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 3.0m slotted screen. WATER LEVEL READINGS DATE DEPTH(m) ELEV.(m) 2018.09.30 2.2 187.3 2018.11.22 2.9 186.6				0.250											

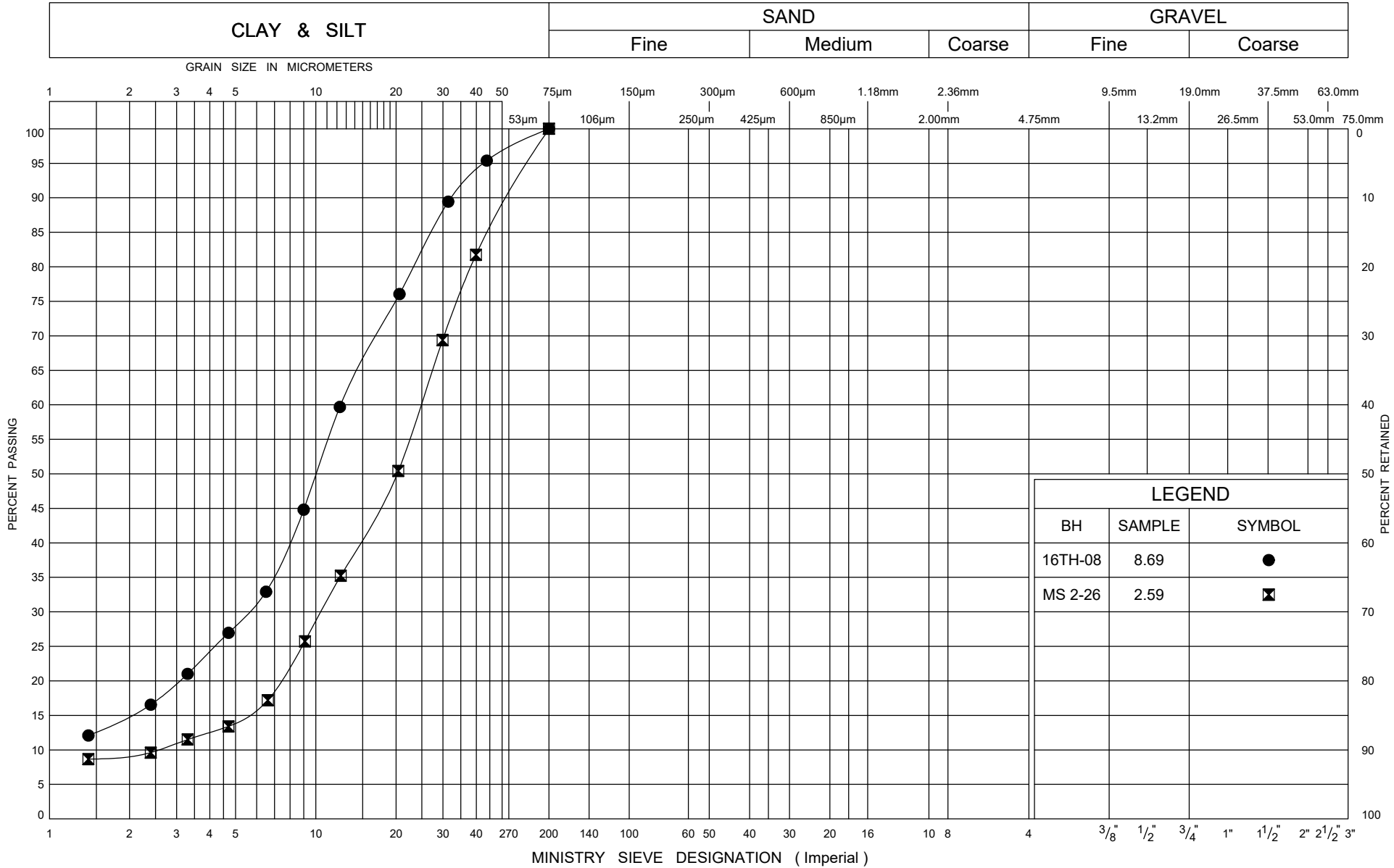
METRIC

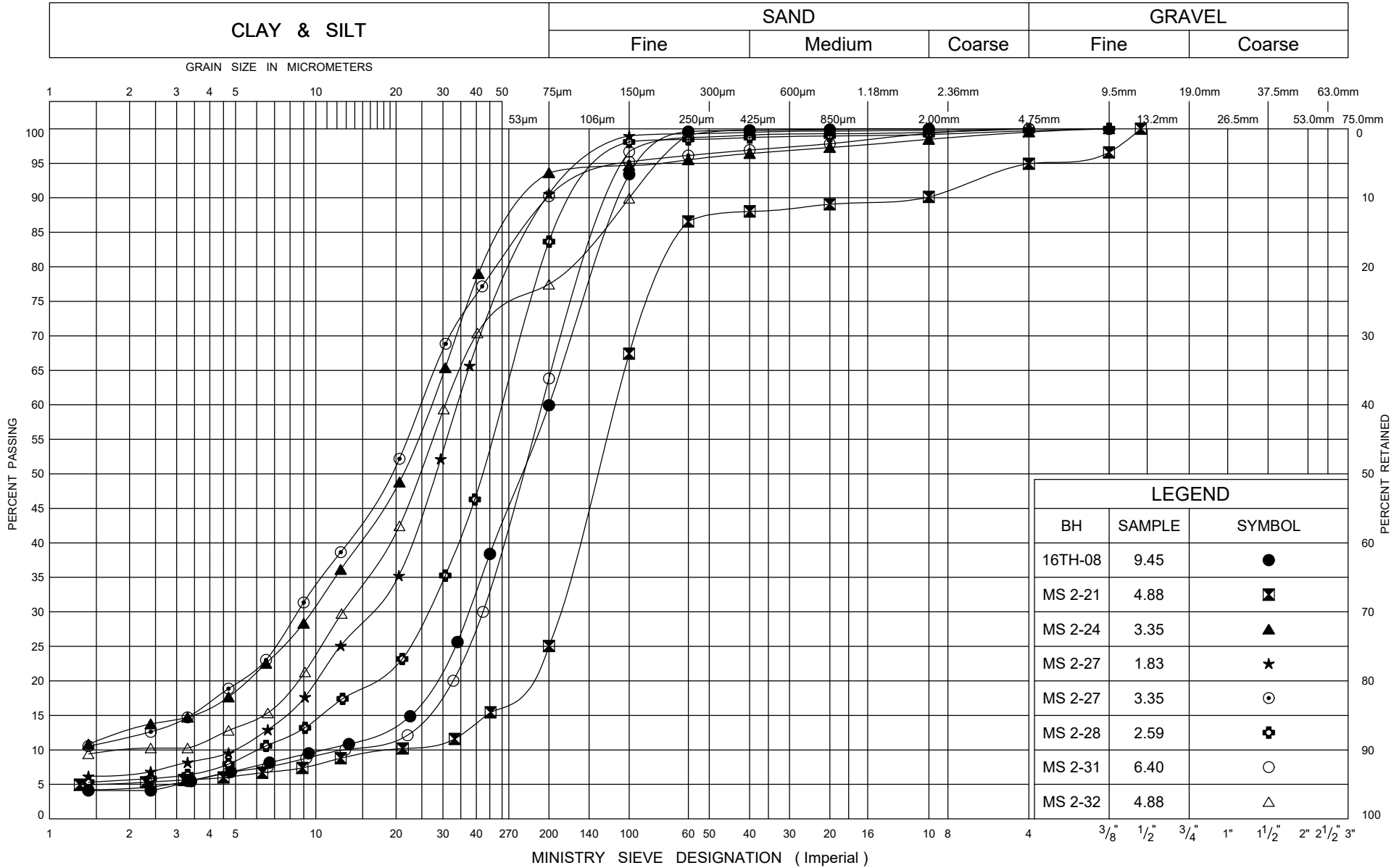
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT		UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE		WATER CONTENT (%) w _p w w _L			
	Continued From Previous Page												
183.5	SAND and SILT , trace clay Very Dense Grey Wet (TILL)		10	SS	100/ 0.300								
184													
182.5	Silty CLAY , with sand, trace gravel Hard Grey Moist (TILL)		11	SS	54								
183													
12.8	END OF BOREHOLE AT 12.8m. BOREHOLE CAVED TO 4.6m AND WATER LEVEL AT 4.6m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO 0.2m, THEN COLD PATCH ASPHALT TO SURFACE.												

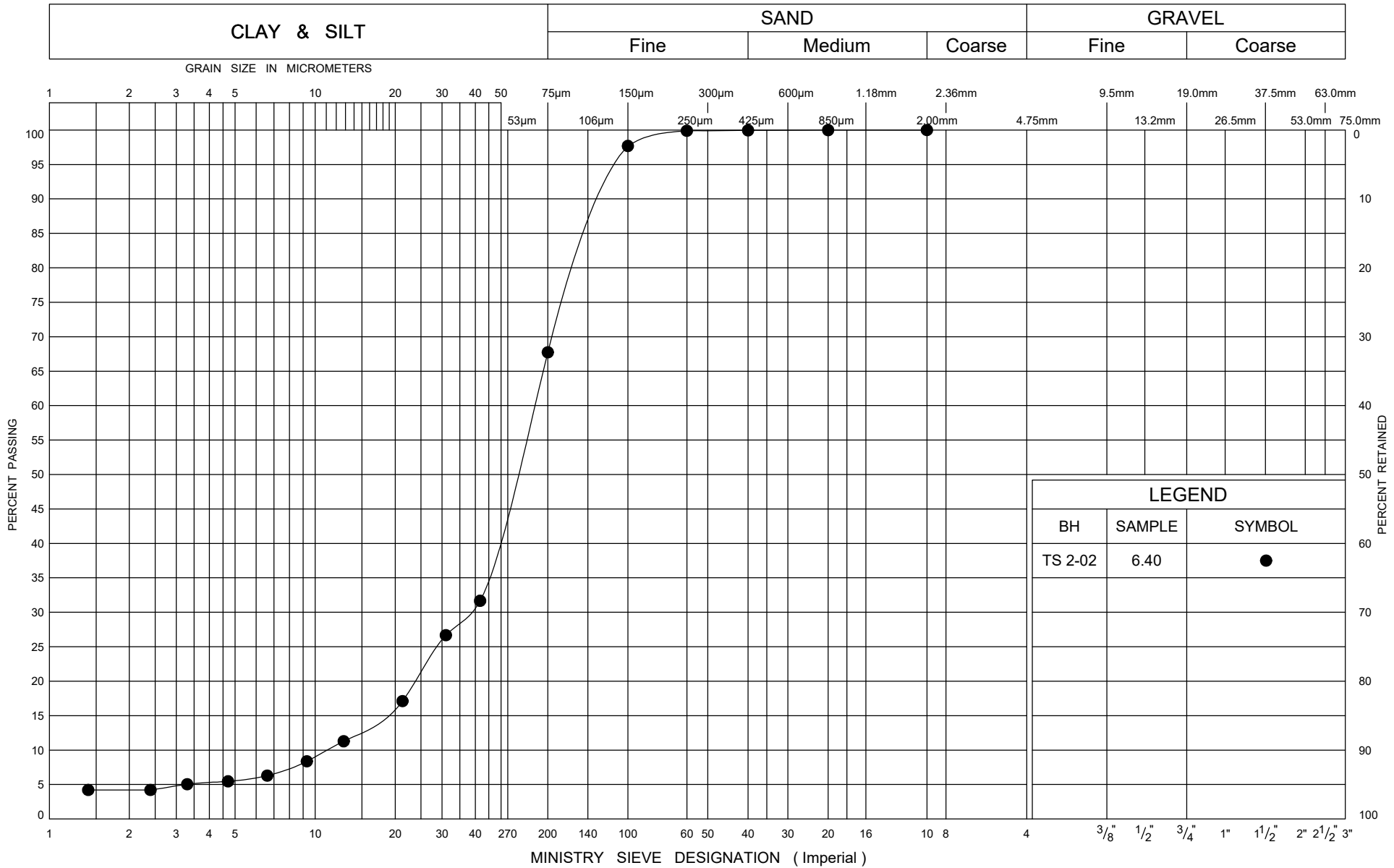


UNIFIED SOIL CLASSIFICATION SYSTEM





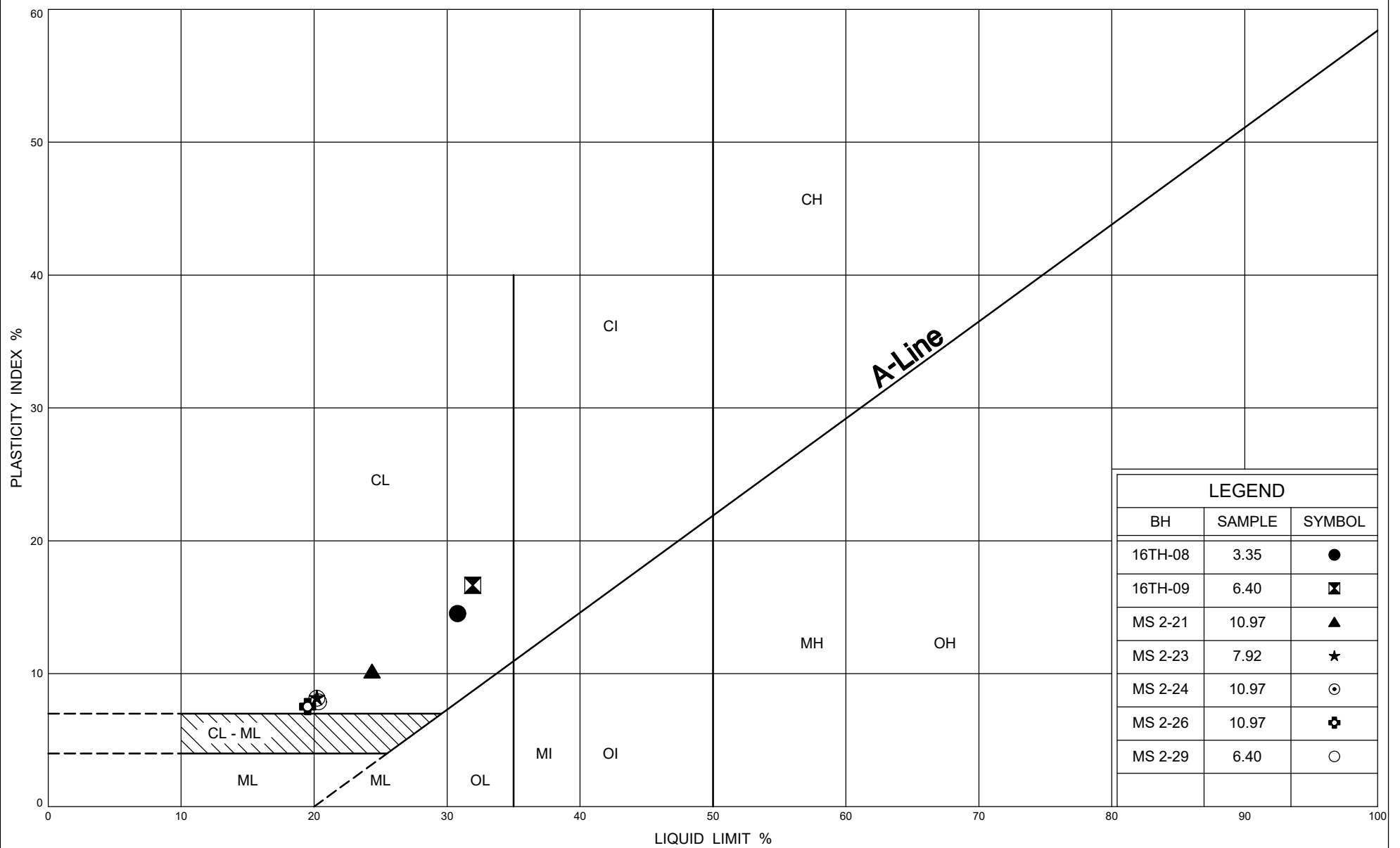


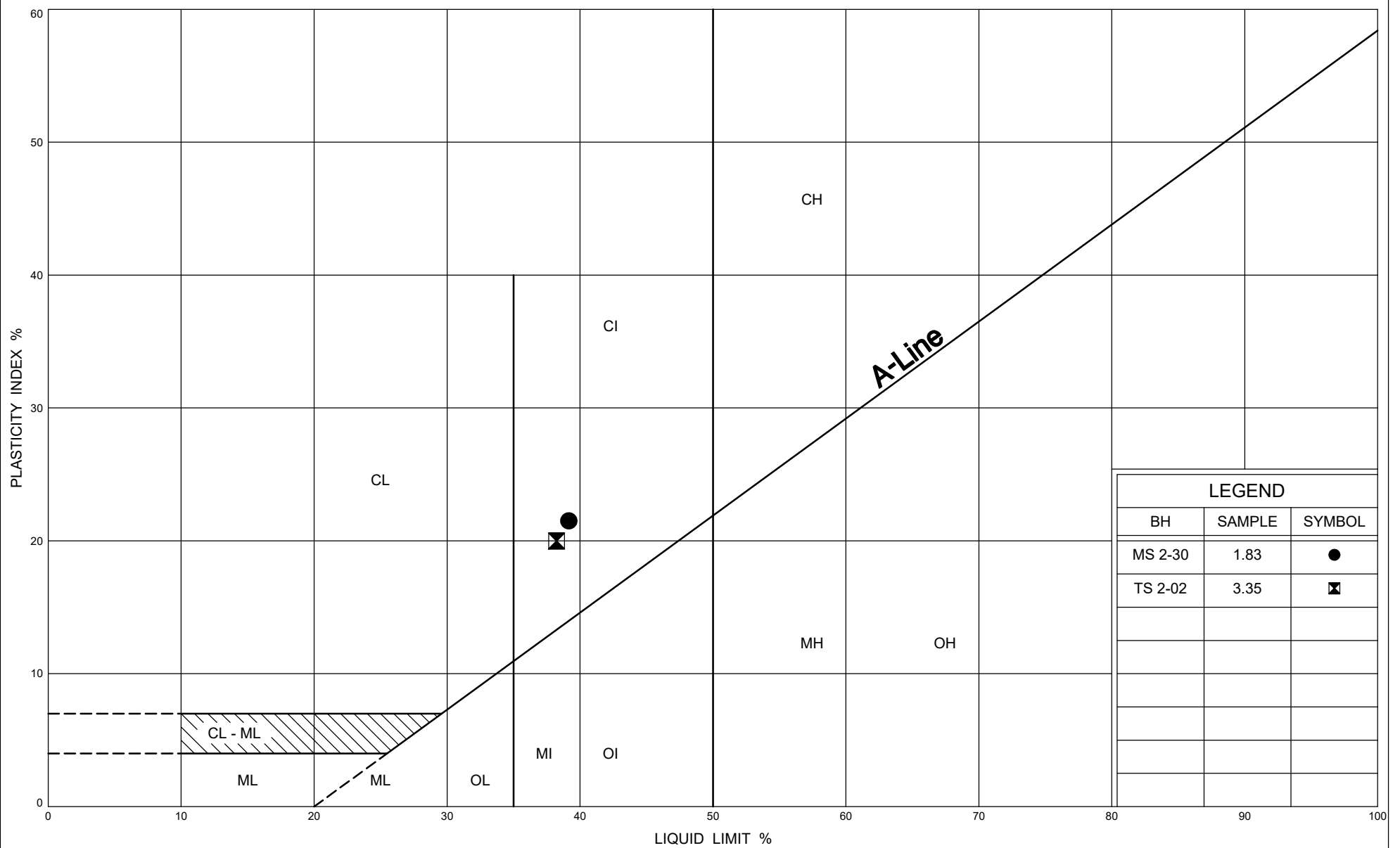




GRAIN SIZE DISTRIBUTION

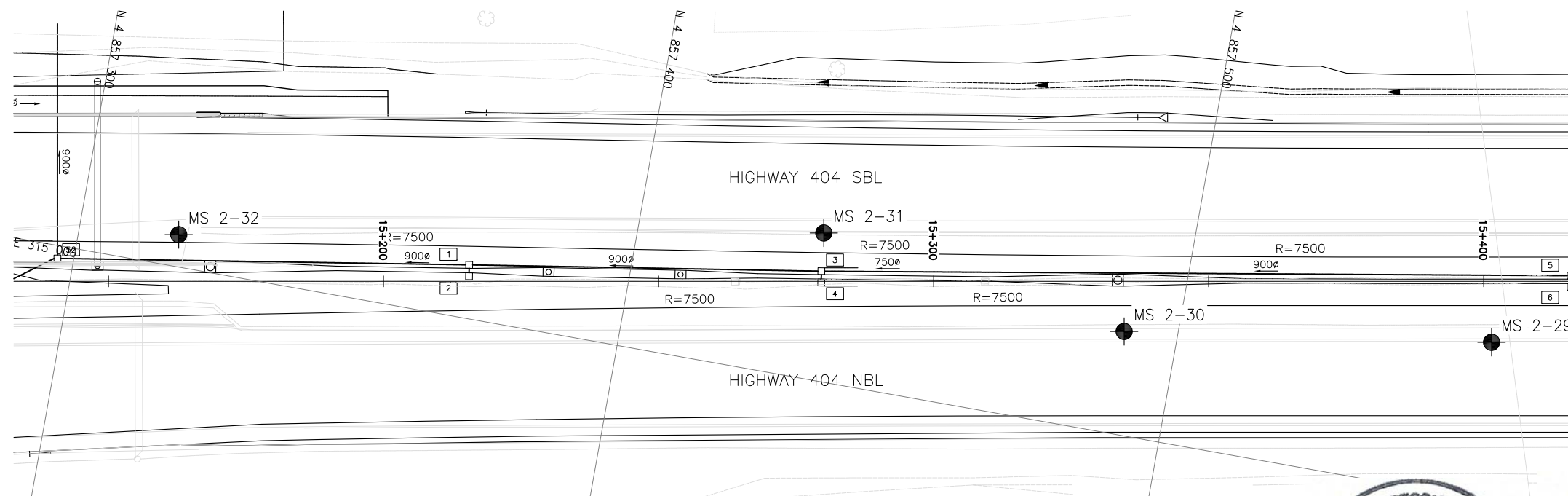
G W P 2930-17-00





LEGEND		
BH	SAMPLE	SYMBOL
MS 2-30	1.83	●
TS 2-02	3.35	⊠

ONTARIO MOT PLASTICITY CHART MTO-15786.GPJ ONTARIO MOT.GDT 12/3/18



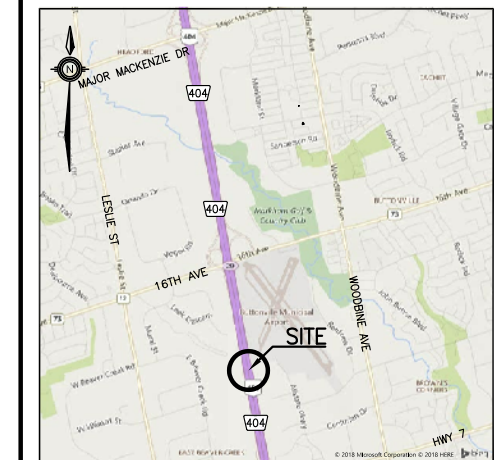
METRIC
DIMENSIONS ARE IN METRES
AND/OR MILLIMETRES
UNLESS OTHERWISE SHOWN

CONT No	(
GWP No 2930-17-00	

HIGHWAY 404 WIDENING MEDIAN SEWER STA 15+150 TO STA 15+400 BOREHOLE LOCATIONS AND SOIL STRATA	
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




THURBER ENGINEERING LTD.



KEYPLAN

LEGEND

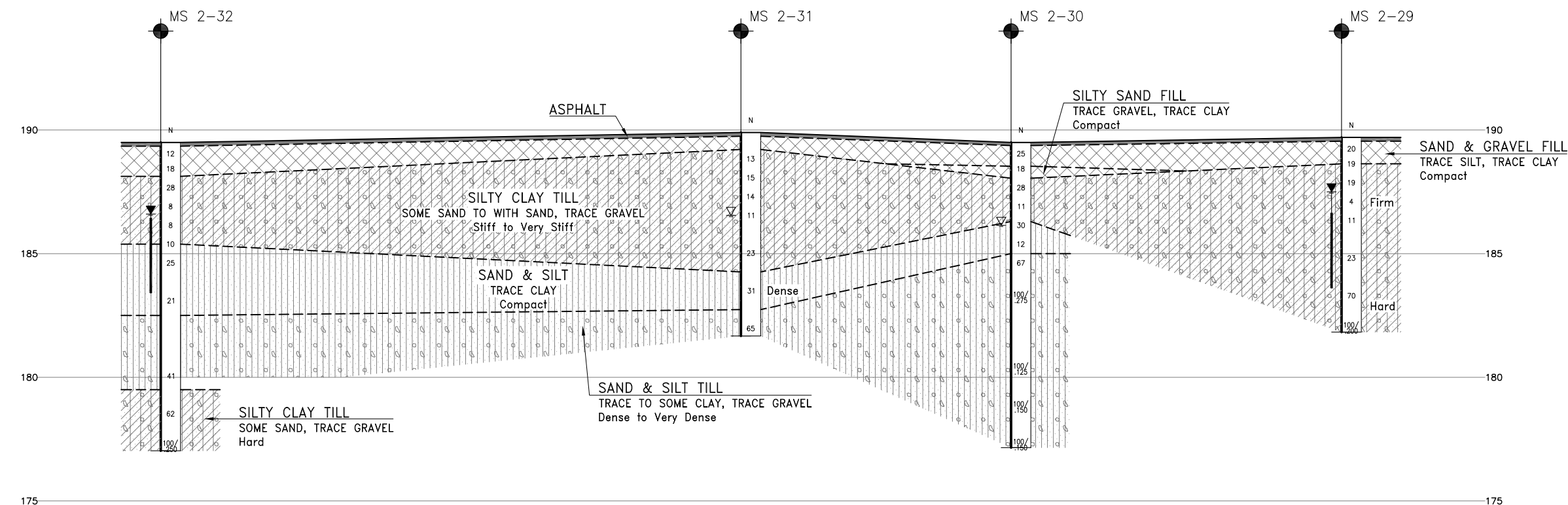
	Borehole
	Borehole and Cone
N	Blows /0.3m (Std Pen Test, 475J/blow)
CONE	Blows /0.3m (60° Cone, 475J/blow)
PH	Pressure, Hydraulic
	Water Level
	Head Artesian Water
	Piezometer
90%	Rock Quality Designation (RQD)
A/R	Auger Refusal

[illegible]

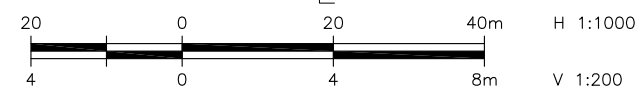
-NOTES-

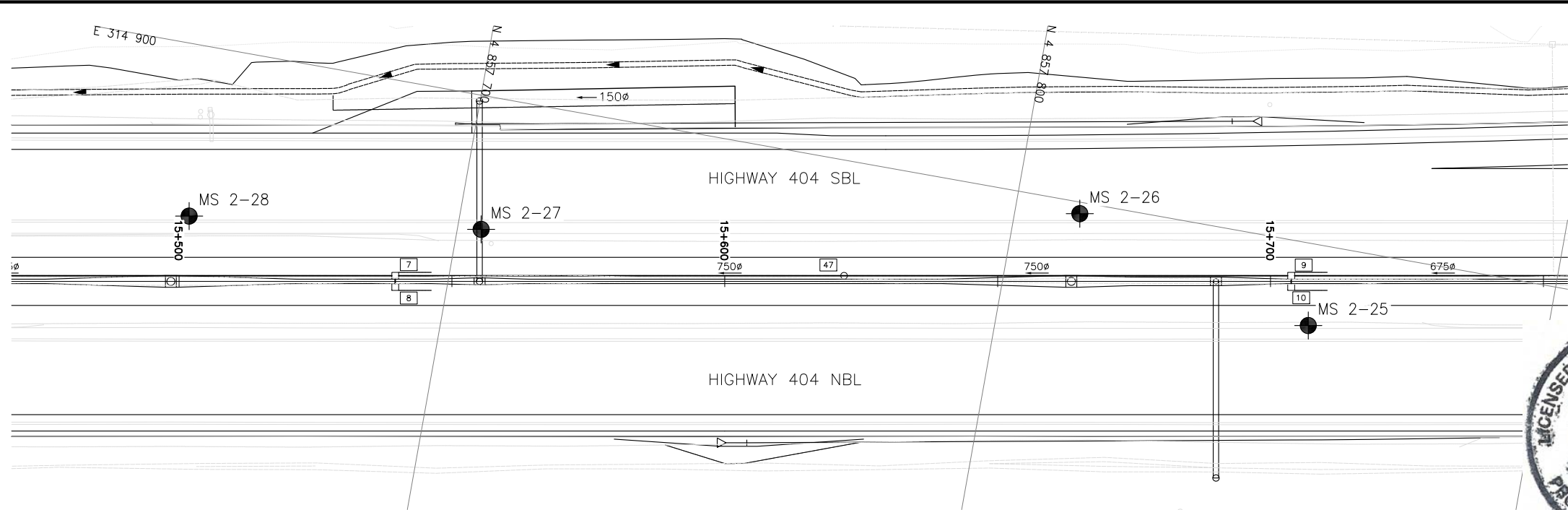
- 1) The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.
- 2) This drawing is for subsurface information only. Surface details and features are for conceptual illustration.
- 3) Coordinate system is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

GEOCRES No. 30M14-497

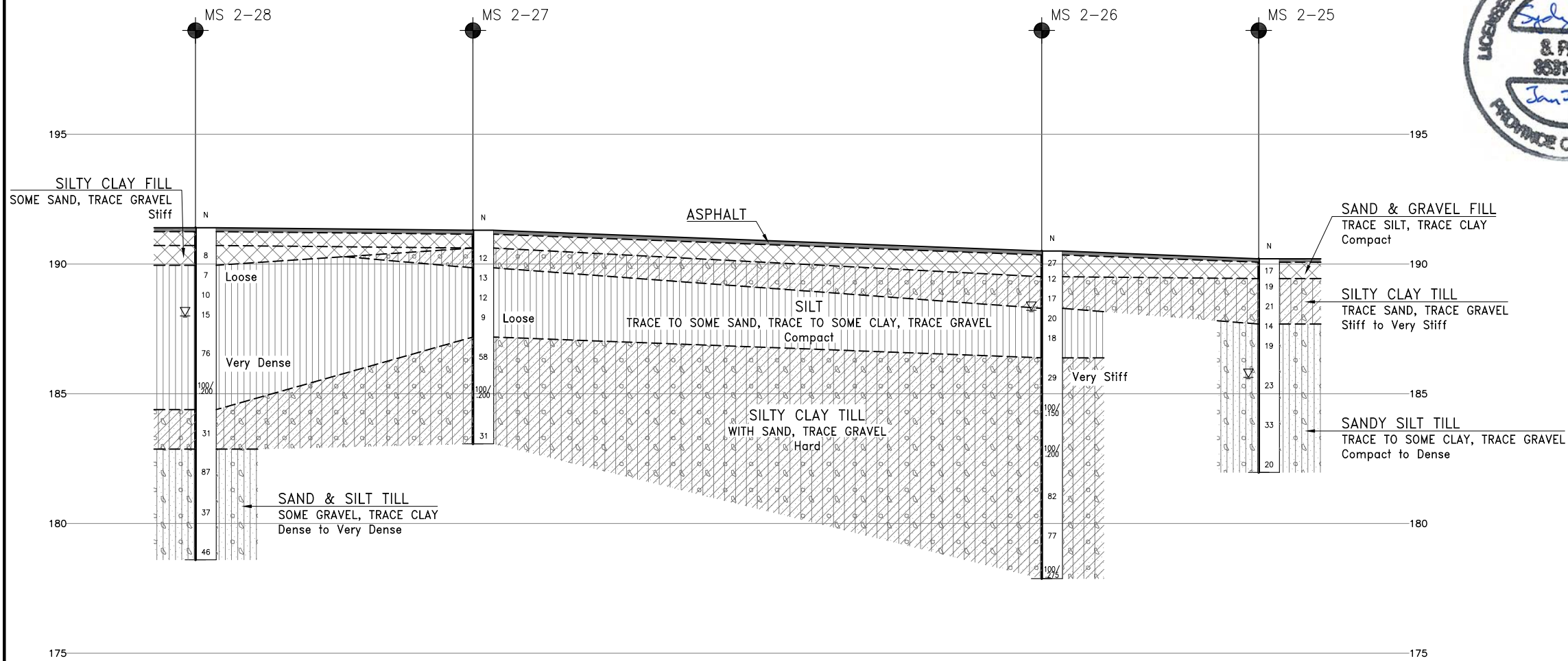
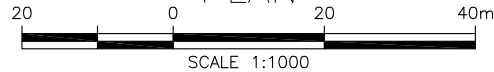


PROFILE ALONG C HWY 404

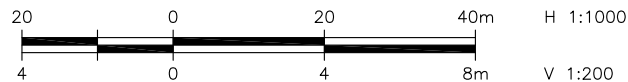
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PLAN



PROFILE ALONG CL HWY 404



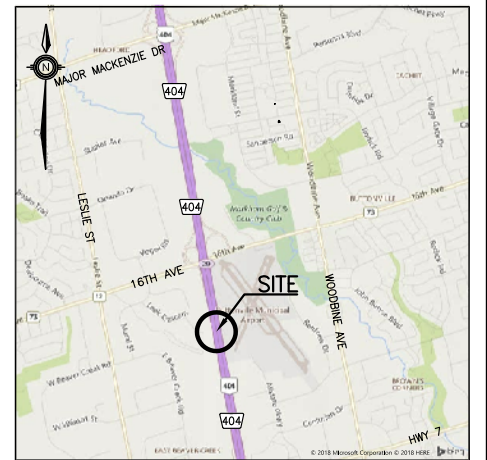
METRIC

DIMENSIONS ARE IN METRES
AND/OR MILLIMETRES
UNLESS OTHERWISE SHOWN



CONT No
GWP No 2930-17-00

HIGHWAY 404 WIDENING
MEDIAN SEWER
STA 15+500 TO STA 15+750
BOREHOLE LOCATIONS AND SOIL STRATA



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

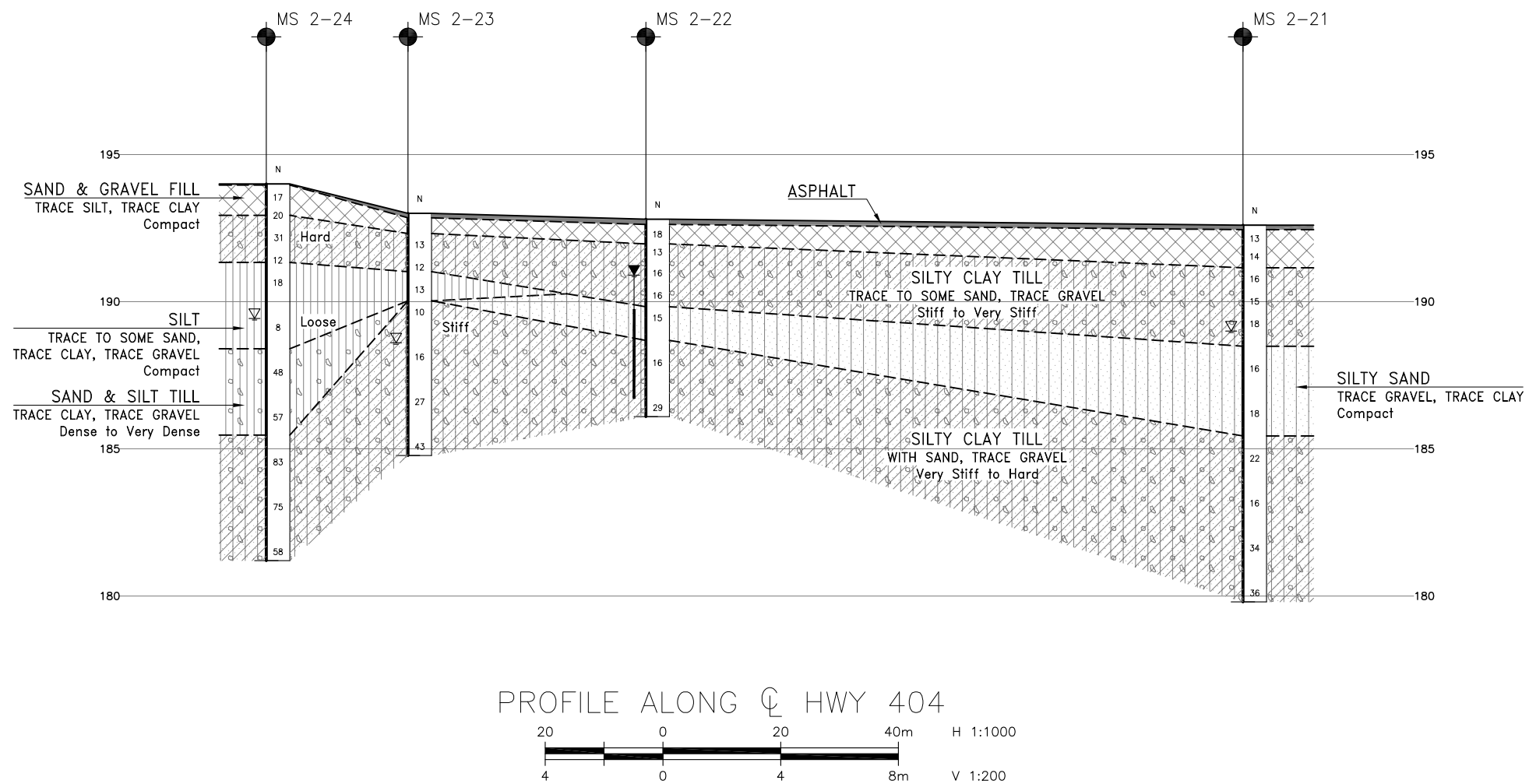
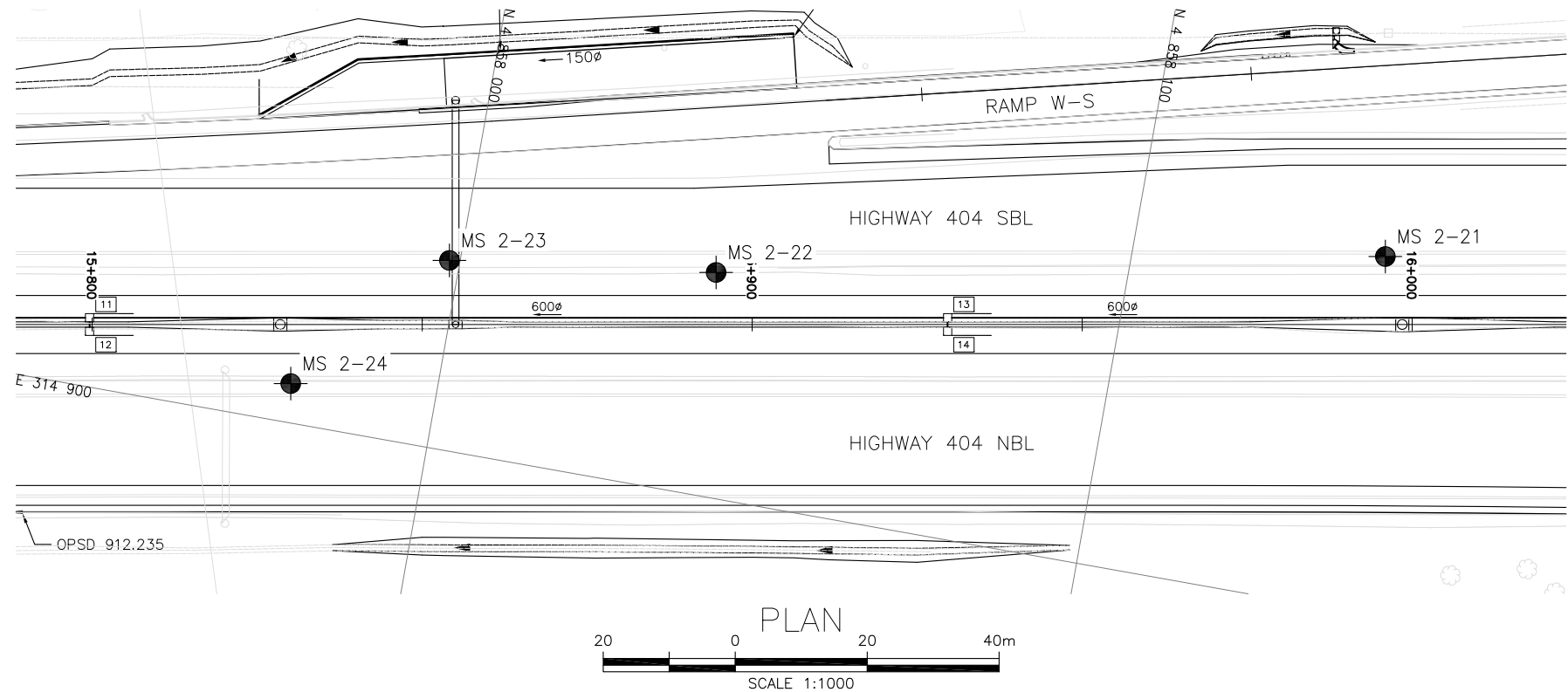
NO	ELEVATION	NORTHING	EASTING
MS 2-25	191.4	4 857 856.6	314 914.9
MS 2-26	191.3	4 857 811.8	314 902.1
MS 2-27	190.5	4 857 704.3	314 924.2
MS 2-28	190.2	4 857 651.2	314 931.2

-NOTES-

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

GEOCRES No. 30M14-497

REVISIONS	DATE	BY	DESCRIPTION
DESIGN	RPR	CHK SKP	CODE
DRAWN	AN	CHK RPR	SITE
			LOAD
			DATE
			JAN 2019
			STRUCT
			DWG A2



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



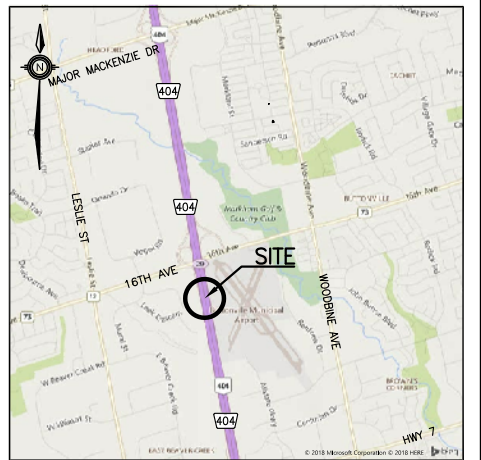
CONT No
GWP No 2930-17-00

HIGHWAY 404 WIDENING
MEDIAN SEWER
STA 15+800 TO STA 16+000
BOREHOLE LOCATIONS AND SOIL STRATA

WSP



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

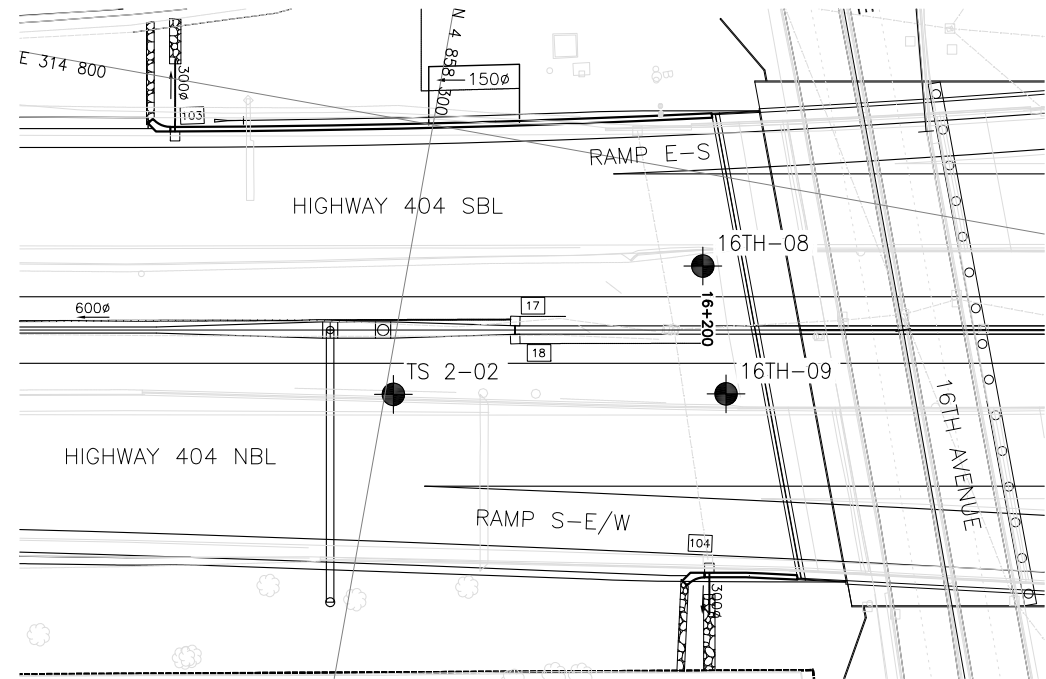
NO	ELEVATION	NORTHING	EASTING
MS 2-21	194.0	4 858 137.9	314 846.0
MS 2-22	193.0	4 858 038.5	314 866.2
MS 2-23	192.8	4 857 998.4	314 871.5
MS 2-24	192.6	4 857 978.0	314 894.1

-NOTES-

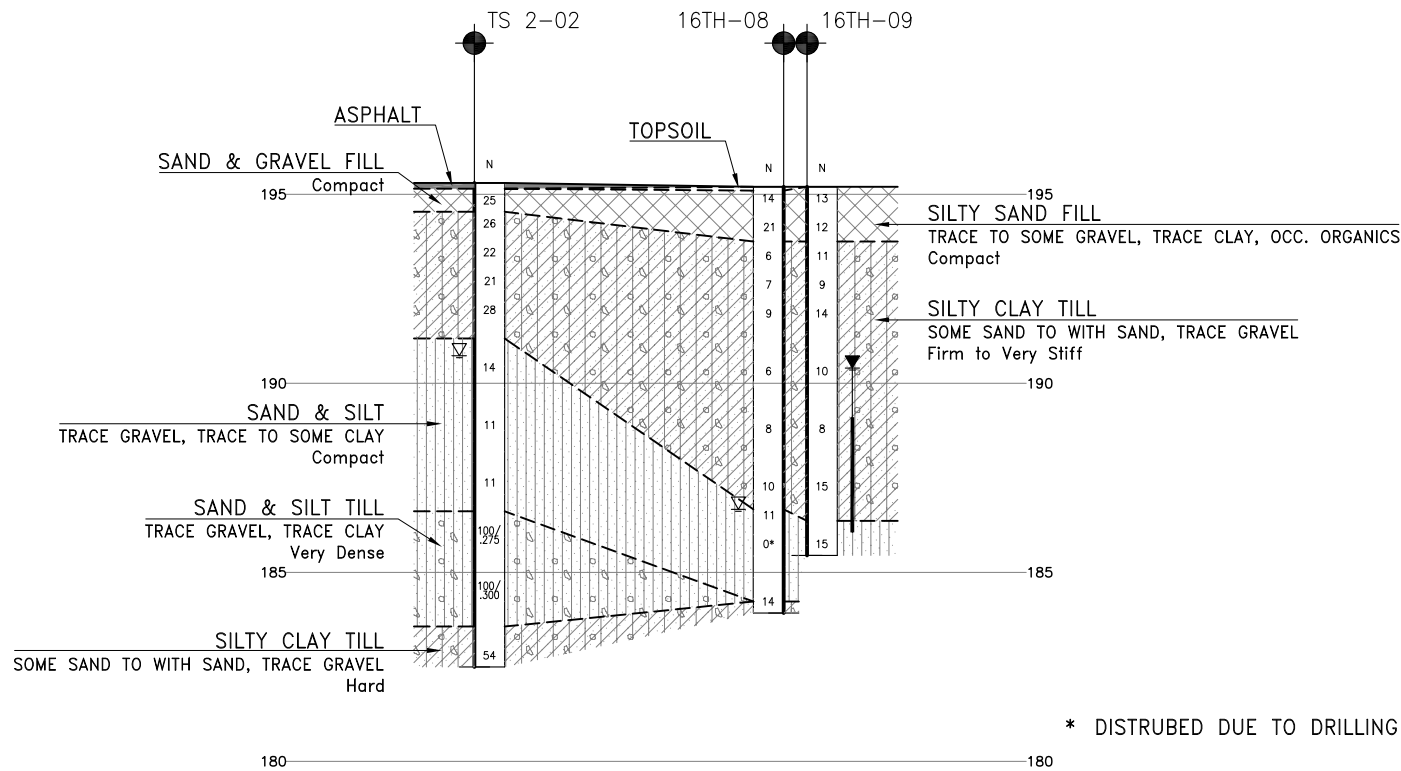
- The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.
- This drawing is for subsurface information only. Surface details and features are for conceptual illustration.
- Coordinate system is MTM NAD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

GEOCRES No. 30M14-497

REVISIONS	DATE	BY	DESCRIPTION
DESIGN	RPR	CHK	SKP
DRAWN	AN	CHK	RPR
CODE	LOAD	DATE	JAN 2019
SITE	STRUCT	DWG	A3



PLAN
SCALE 1:1000



PROFILE ALONG CL HWY 404

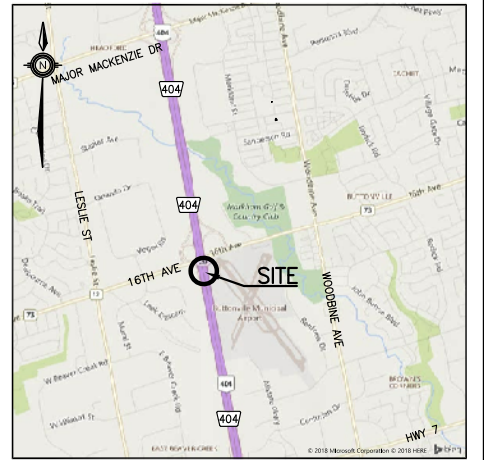
H 1:1000
V 1:200

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



CONT No
GWP No 2930-17-00

HIGHWAY 404 WIDENING
MEDIAN SEWER
STA 16+150 TO STA 16+200
BOREHOLE LOCATIONS AND SOIL STRATA



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
16TH-08	195.2	4 858 338.4	314 812.1
16TH-09	195.2	4 858 344.4	314 828.2
TS 2-02	195.3	4 858 301.1	314 836.0

-NOTES-

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

GEOCRES No. 30M14-497

REVISIONS	DATE	BY	DESCRIPTION



Appendix B

Section 2

**From north of 16th Avenue to south of Rouge River
(Stations 16+250 to 17+200)**

RECORD OF BOREHOLE No 16TH-01

1 OF 2

METRIC

G.W.P. 2930-17-00 LOCATION 16th Ave. Overpass, MTM NAD 83 Zone10: N 4 858 407.9 E 314 803.6 ORIGINATED BY SB
 HWY 404 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2018.06.01 - 2018.06.04 LATITUDE 43.865575 LONGITUDE -79.375544 CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa										
195.5	GROUND SURFACE							20	40	60	80	100						
0.0	TOPSOIL: (125mm)																	
0.1	SAND, trace silt, trace gravel Compact Brown		1	SS	19		195											
194.7	Moist (FILL)																	
0.8	Silty CLAY, with sand, trace gravel Very Stiff Brown		2	SS	18		194											
193.9	Moist (TILL)																	
1.6	SAND, some silt Compact Brown		3	SS	14		193											
193.2	Moist																	
2.3	Silty CLAY, with sand, trace gravel Stiff to Very Stiff Brown to Grey Moist (TILL)		4	SS	10		192											
191.8			5	SS	17		191											
3.7	SAND, some silt, occasional cobbles Compact Grey Wet						190											
			6	SS	11		189											
189.4							188											
6.1	Silty CLAY, with sand, trace gravel Stiff Grey Wet (TILL)		7	SS	12		187											
			8	SS	15		186											
186.7																		
8.8	SAND, some silt Grey Wet																	
186.3																		
9.2	Hard		9	SS	59													

Continued Next Page

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

RECORD OF BOREHOLE No 16TH-01 2 OF 2 METRIC

G.W.P. 2930-17-00 LOCATION 16th Ave. Overpass, MTM NAD 83 Zone10: N 4 858 407.9 E 314 803.6 ORIGINATED BY SB
 HWY 404 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2018.06.01 - 2018.06.04 LATITUDE 43.865575 LONGITUDE -79.375544 CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE									
184.2	Silty CLAY , with sand, trace gravel Hard Grey Wet (TILL)		10	SS	50		185										
11.3	END OF BOREHOLE AT 11.3m. WATER LEVEL AT 4.6m UPON COMPLETION. Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 3.05m slotted screen. WATER LEVEL READINGS DATE DEPTH(m) ELEV.(m) 2018.08.22 5.7 189.8 2018.11.23 4.8 190.7																

RECORD OF BOREHOLE No 16TH-02

1 OF 2

METRIC

G.W.P. 2930-17-00 LOCATION 16th Ave. Overpass, MTM NAD 83 Zone10: N 4 858 407.4 E 314 812.8 ORIGINATED BY SB
 HWY 404 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2018.06.01 - 2018.06.01 LATITUDE 43.865570 LONGITUDE -79.375430 CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa										
195.4	GROUND SURFACE							20	40	60	80	100						
0.0	TOPSOIL: (125mm)							20	40	60	80	100						
0.1	SAND, some gravel, trace silt		1	SS	11		195											
194.8	Compact																	
0.6	Brown																	
194.4	Moist (FILL)																	
1.0	Silty CLAY, with sand, trace gravel		2	SS	20		194											
	Stiff																	
	Brown																	
	Moist (TILL)																	
	SAND, some clay, trace gravel, trace silt		3	SS	19													
193.2	Compact																	
2.2	Brown						193											
	Moist																	
	Silty CLAY, with sand, trace gravel		4	SS	13													
	Stiff																	
	Brown to Grey																	
	Moist (TILL)																	
			5	SS	15		192											
							191											
			6	SS	9		190											
189.6																		
5.8	SAND, some silt, trace gravel		7	SS	4		189											
	Loose																	
	Grey																	
	Wet																	
							188											
187.7	Silty CLAY, with sand, trace gravel		8	SS	11													
	Stiff to Hard																	
	Grey																	
	Wet (TILL)						187											
			9	SS	45		186											

Continued Next Page

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

RECORD OF BOREHOLE No 16TH-02 2 OF 2 METRIC

G.W.P. 2930-17-00 LOCATION 16th Ave. Overpass, MTM NAD 83 Zone10: N 4 858 407.4 E 314 812.8 ORIGINATED BY SB
 HWY 404 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2018.06.01 - 2018.06.01 LATITUDE 43.865570 LONGITUDE -79.375430 CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE									
184.1	Continued From Previous Page Silty CLAY , with sand, trace gravel Very Stiff Grey Moist (TILL)		10	SS	25		185										
11.3	END OF BOREHOLE AT 11.3m. WATER LEVEL AT 6.1m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND AUGER CUTTINGS TO SURFACE.																

RECORD OF BOREHOLE No 16TH-04

1 OF 5

METRIC

G.W.P. 2930-17-00 LOCATION 16th Ave. Overpass, MTM NAD 83 Zone10: N 4 858 397.5 E 314 804.7 ORIGINATED BY SB
 HWY 404 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2018.06.06 - 2018.06.12 LATITUDE 43.865481 LONGITUDE -79.375532 CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa										
195.7	GROUND SURFACE							20	40	60	80	100						
0.0	TOPSOIL: (50mm)																	
195.1	SAND , some silt, trace clay and gravel, occasional organics Compact Brown Moist (FILL)		1	SS	15		195											
0.6	Silty CLAY , some sand, trace gravel Very Stiff to Stiff Brown Moist (FILL)		2	SS	17													
193.7			3	SS	11		194											
2.0	SAND , some silt Compact to Loose Brown Moist		4	SS	18		193											
			5	SS	8													
192.2	Silty CLAY , trace sand Firm Grey Moist (TILL)		6	SS	4		192											
3.5			7	SS	6		191											
189.0	SAND and SILT , trace clay Compact Grey Wet		8	SS	12		189											
6.7			9	SS	20		188											
186.6	Silty CLAY , some sand to sandy, trace gravel Very Stiff Grey Wet (TILL)						187											
9.1							186											

Continued Next Page

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

RECORD OF BOREHOLE No 16TH-04

2 OF 5

METRIC

G.W.P. 2930-17-00 LOCATION 16th Ave. Overpass, MTM NAD 83 Zone10: N 4 858 397.5 E 314 804.7 ORIGINATED BY SB
 HWY 404 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2018.06.06 - 2018.06.12 LATITUDE 43.865481 LONGITUDE -79.375532 CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					
	Continued From Previous Page							20 40 60 80 100					
	Silty CLAY , some sand, trace gravel Stiff to Hard Grey Wet (TILL)							○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE					
	with sand		10	SS	14			20 40 60 80 100					
			11	SS	27								
			12	SS	55								
			13	SS	29								
180.2													
15.5	Silty SAND , trace gravel Compact Grey Wet (TILL)		14	SS	17								
			15	SS	11								
			16	SS	16								
177.1													
18.6	Silty CLAY , some to trace sand, trace gravel Very Stiff Grey Moist to Wet (TILL)		17	SS	25								

Continued Next Page

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

RECORD OF BOREHOLE No 16TH-04

3 OF 5

METRIC

G.W.P. 2930-17-00 LOCATION 16th Ave. Overpass, MTM NAD 83 Zone10: N 4 858 397.5 E 314 804.7 ORIGINATED BY SB
 HWY 404 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2018.06.06 - 2018.06.12 LATITUDE 43.865481 LONGITUDE -79.375532 CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE				WATER CONTENT (%) W _p W W _L				
	Continued From Previous Page															
	Silty CLAY , some to trace sand, trace gravel Stiff to Hard Grey Wet (TILL)		18	SS	11		175									
							174									
							173									
			19	SS	31		172									
							171									
							170									
			20	SS	24		169								0 0 55 45	
							168									
							167									
							166									

Continued Next Page

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

RECORD OF BOREHOLE No 16TH-04

4 OF 5

METRIC

G.W.P. 2930-17-00 LOCATION 16th Ave. Overpass, MTM NAD 83 Zone10: N 4 858 397.5 E 314 804.7 ORIGINATED BY SB
 HWY 404 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2018.06.06 - 2018.06.12 LATITUDE 43.865481 LONGITUDE -79.375532 CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W _P	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa								
	Continued From Previous Page		21	SS	24			20	40	60	80	100				
	Silty CLAY , trace sand Very Stiff to Hard Grey Moist (TILL)															
161.4																
34.3	Clayey SILT , trace sand, trace gravel Hard Grey Moist (TILL)		22	SS	31											

Continued Next Page

+³, ×³: Numbers refer to
Sensitivity

20
15
10

(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 16TH-04

5 OF 5

METRIC

G.W.P. 2930-17-00 LOCATION 16th Ave. Overpass, MTM NAD 83 Zone10: N 4 858 397.5 E 314 804.7 ORIGINATED BY SB
 HWY 404 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2018.06.06 - 2018.06.12 LATITUDE 43.865481 LONGITUDE -79.375532 CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100					
	Continued From Previous Page																
	pipe with a 3.05m slotted screen.																
	WATER LEVEL READINGS DATE DEPTH(m) ELEV.(m) 2018.08.22 6.7 189.0 2018.11.23 5.2 190.5																

RECORD OF BOREHOLE No HMP 2-01

1 OF 2

METRIC

G.W.P. 2930-17-00 LOCATION N 4 859 306.0 E 314 635.2 ORIGINATED BY SJ
 HWY 404 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MP
 DATUM Geodetic DATE 2018.07.23 - 2018.07.23 LATITUDE 43.873661 LONGITUDE -79.377624 CHECKED BY RD

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 (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa				W _P	W	W _L			GR
203.2	GROUND SURFACE																
0.0	ASPHALT (175mm)																
203.0	SAND and GRAVEL, trace silt, trace clay Grey Moist (FILL)																
0.2																	
0.3	SAND and SILT, trace clay Dense to Compact Brown Moist (FILL)		1	SS	31												
			2	SS	40												
			3	SS	26												
			4	SS	25												
			5	SS	15												
			6	SS	10												
	Some clay																
			7	SS	31												
			8	SS	11												

Continued Next Page

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

RECORD OF BOREHOLE No HMP 2-01

2 OF 2

METRIC

G.W.P. 2930-17-00 LOCATION N 4 859 306.0 E 314 635.2 ORIGINATED BY SJ
 HWY 404 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MP
 DATUM Geodetic DATE 2018.07.23 - 2018.07.23 LATITUDE 43.873661 LONGITUDE -79.377624 CHECKED BY RD

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W _P	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE									WATER CONTENT (%)
	Continued From Previous Page							20	40	60	80	100					
193.0	SAND and SILT , trace clay	⊗				▽	193									Split Spoon Wet	
10.2	SAND , trace gravel, trace clay Dense to Very Dense Grey Wet	⋮	9	SS	31		192										
			10	SS	61		191										
190.4																	
12.8	END OF BOREHOLE AT 12.8m. WATER LEVEL AT 10.7m BEFORE BOREHOLE CAVING TO 7.6m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND AUGER CUTTINGS TO 0.2m, THEN COLD PATCH ASPHALT TO SURFACE.																

+³, ×³: Numbers refer to
Sensitivity

20
15
10

(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No MS 2-10

1 OF 1

METRIC

G.W.P. 2930-17-00 LOCATION N 4 859 224.3 E 314 674.7 ORIGINATED BY BL
 HWY 404 BOREHOLE TYPE Solid Stem Augers COMPILED BY MP
 DATUM Geodetic DATE 2018.07.18 - 2018.07.18 LATITUDE 43.872925 LONGITUDE -79.377133 CHECKED BY RD

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						
202.7	GROUND SURFACE							20	40	60	80	100		
0.0	ASPHALT (200mm)													
0.2	SAND and GRAVEL, trace silt, trace clay		1	SS	20									26 67 7 (SI+CL)
202.0	Compact Brown Moist (FILL)		2	SS	25									
0.7	Sandy SILT, trace gravel													
201.3	Compact Brown Moist (FILL)		3	SS	22									
1.4	Sandy SILT, trace gravel													
200.1	Compact Grey Moist		4	SS	27									
2.6	Silty CLAY, with sand, trace gravel													
	Very Stiff to Hard Brown Moist (TILL)		5	SS	27									
			6	SS	59									2 38 35 25
			7	SS	30									
			8	SS	53									
194.5	END OF BOREHOLE AT 8.2m. BOREHOLE OPEN AND DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO 7.0m, AUGER CUTTINGS TO 0.2m, THEN COLD PATCH ASPHALT TO SURFACE.													
8.2														

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

RECORD OF BOREHOLE No MS 2-11

1 OF 1

METRIC

G.W.P. 2930-17-00 LOCATION N 4 859 156.4 E 314 665.5 ORIGINATED BY SJ
 HWY 404 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MP
 DATUM Geodetic DATE 2018.07.23 - 2018.07.23 LATITUDE 43.872314 LONGITUDE -79.377249 CHECKED BY RD

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					
202.2	GROUND SURFACE												
0.0	ASPHALT (175mm)												
200.9	SAND and GRAVEL, trace silt, trace clay (FILL)												
0.3													
201.3	Silty SAND, trace gravel, trace clay Loose Brown Moist (FILL)		1	SS	9								
0.9													
	SILT, some clay, trace sand, trace gravel Loose to Compact Brown Moist		2	SS	26								
			3	SS	15								
199.2													
3.0	Silty CLAY, with sand, trace gravel Hard to Very Stiff Grey Moist (TILL)		4	SS	52								
			5	SS	54								
			6	SS	27								
			7	SS	30								
194.0													
8.2	END OF BOREHOLE AT 8.2m. BOREHOLE OPEN AND DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG, AUGER CUTTINGS TO 0.2m, THEN COLD PATCH ASPHALT TO SURFACE.												

ONTMT452 MTO-15786.GPJ 2017TEMPLATE(MTO).GDT 12/3/18


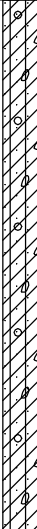
+³, ×³: Numbers refer to Sensitivity
 20
 15
 10
 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No MS 2-12

1 OF 2

METRIC

G.W.P. 2930-17-00 LOCATION N 4 859 126.0 E 314 688.9 ORIGINATED BY BL
 HWY 404 BOREHOLE TYPE Solid Stem Augers COMPILED BY MP
 DATUM Geodetic DATE 2018.07.19 - 2018.07.19 LATITUDE 43.872040 LONGITUDE -79.376958 CHECKED BY RD

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE							PLASTIC LIMIT w _P NATURAL MOISTURE CONTENT w LIQUID LIMIT w _L WATER CONTENT (%)		
202.0	GROUND SURFACE							20	40	60	80	100					
0.0	ASPHALT (150mm)																
0.2	SAND and GRAVEL, trace silt, trace clay Dense to Compact Brown Moist		1	SS	42												
201.0	(FILL)		2	SS	20												
0.9	Silty SAND, trace gravel, trace clay Compact Brown Moist (FILL)		3	SS	28												
199.4			4	SS	15												
2.6	Silty CLAY, with sand, trace gravel Hard Grey Moist (TILL)																
			5	SS	47												
				6	SS	71											
			7	SS	72												
			8	SS	45												
			9	SS	90												

Continued Next Page

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

RECORD OF BOREHOLE No MS 2-12

2 OF 2

METRIC

G.W.P. 2930-17-00 LOCATION N 4 859 126.0 E 314 688.9 ORIGINATED BY BL
 HWY 404 BOREHOLE TYPE Solid Stem Augers COMPILED BY MP
 DATUM Geodetic DATE 2018.07.19 - 2018.07.19 LATITUDE 43.872040 LONGITUDE -79.376958 CHECKED BY RD

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						
	Continued From Previous Page							○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE						
								20 40 60 80 100						
								W _P W W _L						
								WATER CONTENT (%)						
								20 40 60						

RECORD OF BOREHOLE No MS 2-13

1 OF 1

METRIC

G.W.P. 2930-17-00 LOCATION N 4 859 037.7 E 314 705.3 ORIGINATED BY BL
 HWY 404 BOREHOLE TYPE Solid Stem Augers COMPILED BY MP
 DATUM Geodetic DATE 2018.07.10 - 2018.07.10 LATITUDE 43.871245 LONGITUDE -79.376756 CHECKED BY RD

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						
201.4	GROUND SURFACE							<div>20406080100</div> <div>○ UNCONFINED + FIELD VANE</div> <div>● QUICK TRIAXIAL × LAB VANE</div>						
0.0	ASPHALT (125mm)							<div>204060</div> <div>W_P W W_L</div> <div>WATER CONTENT (%)</div>						
0.1	SAND and GRAVEL, trace silt, trace clay Brown Moist (FILL)		1	SS	15		201							
200.4														
0.9	Silty CLAY, with sand, trace gravel Hard Brown Moist (TILL)		2	SS	35		200							
			3	SS	32									
			4	SS	100/ 0.200		199							2 30 45 23
	Grey													
			5	SS	100/ 0.075		198							
							197							
			6	SS	100/ 0.225									1 31 40 28
							196							
194.9			7	SS	100/ 0.275		195							
6.5	END OF BOREHOLE AT 6.5m. BOREHOLE CAVED TO 4.9m AND WATER LEVEL AT 4.6m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO 3.7m, AUGER CUTTINGS TO 0.7m, BENTONITE HOLEPLUG TO 0.1m, THEN COLD PATCH ASPHALT TO SURFACE.													

ONTMT452 MTO-15786.GPJ 2017TEMPLATE(MTO).GDT 12/3/18

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

RECORD OF BOREHOLE No MS 2-14

1 OF 2

METRIC

G.W.P. 2930-17-00 LOCATION N 4 858 978.4 E 314 716.3 ORIGINATED BY BL
 HWY 404 BOREHOLE TYPE Solid Stem Augers COMPILED BY MP
 DATUM Geodetic DATE 2018.07.17 - 2018.07.17 LATITUDE 43.870711 LONGITUDE -79.376621 CHECKED BY RD

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa				WATER CONTENT (%)				
200.9	GROUND SURFACE							20	40	60	80	100				
0.0	ASPHALT (125mm)							20	40	60	80	100				
0.1	SAND and GRAVEL, trace silt, trace clay Compact Brown Moist (FILL)		1	SS	27		200									29 60 11 (SI+CL)
199.8			2	SS	37											
1.1	Silty SAND, trace gravel, trace clay Dense to Very Dense Brown Moist (FILL)		3	SS	52		199									
198.7			4	SS	100/ 0.300											
2.2	Silty CLAY, with sand, trace gravel Hard Grey Wet (TILL)		5	SS	100/ 0.250		198									
			6	SS	100/ 0.150		197									
			7	SS	66		196									
			8	SS	86		195									
			9	SS	100/ 0.300		194									
							193									
							192									
							191									

Continued Next Page

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

RECORD OF BOREHOLE No MS 2-14

2 OF 2

METRIC

G.W.P. 2930-17-00 LOCATION N 4 858 978.4 E 314 716.3 ORIGINATED BY BL
 HWY 404 BOREHOLE TYPE Solid Stem Augers COMPILED BY MP
 DATUM Geodetic DATE 2018.07.17 - 2018.07.17 LATITUDE 43.870711 LONGITUDE -79.376621 CHECKED BY RD

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						
	Continued From Previous Page							20 40 60 80 100						
	Silty CLAY , with sand, trace gravel Hard Grey Wet (TILL)		10	SS	100/ 0.275		190							
							189							
188.3			11	SS	100/ 0.300									
12.6	END OF BOREHOLE AT 12.6m. WATER LEVEL AT 6.1m DEPTH BEFORE BOREHOLE CAVING TO 2.1m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO 0.9m, AUGER CUTTINGS TO 0.7m, BENTONITE HOLEPLUG TO 0.1m, THEN COLD PATCH ASPHALT TO SURFACE.													

RECORD OF BOREHOLE No MS 2-15

1 OF 1

METRIC

G.W.P. 2930-17-00 LOCATION N 4 858 865.4 E 314 717.2 ORIGINATED BY SJ
 HWY 404 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MP
 DATUM Geodetic DATE 2018.07.24 - 2018.07.25 LATITUDE 43.869694 LONGITUDE -79.376611 CHECKED BY RD

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					
199.9	GROUND SURFACE							20 40 60 80 100					
0.0	ASPHALT (175mm)							20 40 60 80 100					
0.2	SAND and GRAVEL							20 40 60 80 100					
199.5	Grey Moist (FILL)							20 40 60 80 100					
0.4	SILT, some sand, trace gravel, trace clay Compact Brown Moist		1	SS	23		199	20 40 60 80 100					
			2	SS	23		198	20 40 60 80 100					2 13 77 8
197.7								20 40 60 80 100					
2.2	Silty CLAY, with sand, trace gravel Very Stiff to Hard Grey Moist (TILL)		3	SS	15		197	20 40 60 80 100					
			4	SS	15			20 40 60 80 100					3 30 39 28
							196	20 40 60 80 100					
			5	SS	16		195	20 40 60 80 100					
								20 40 60 80 100					
			6	SS	101/ 0.275		194	20 40 60 80 100					
							193	20 40 60 80 100					
			7	SS	100/ 0.250		192	20 40 60 80 100					
191.9								20 40 60 80 100					
8.0	END OF BOREHOLE AT 8.0m. BOREHOLE OPEN AND DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO 2.1m, AUGER CUTTINGS TO 0.2m, THEN COLD PATCH ASPHALT TO SURFACE.							20 40 60 80 100					

+³, ×³: Numbers refer to
Sensitivity

20
15
10
(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No MS 2-16

1 OF 2

METRIC

G.W.P. 2930-17-00 LOCATION N 4 858 813.9 E 314 746.3 ORIGINATED BY BL
 HWY 404 BOREHOLE TYPE Solid Stem Augers COMPILED BY MP
 DATUM Geodetic DATE 2018.07.16 - 2018.07.16 LATITUDE 43.869230 LONGITUDE -79.376250 CHECKED BY RD

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												
199.6	GROUND SURFACE							20	40	60	80	100								
0.0	ASPHALT (150mm)																			
0.2	SAND and GRAVEL, trace silt, trace clay Compact Brown Moist (FILL)		1	SS	27		199													
198.8																				
0.8	SAND and SILT, trace gravel and clay Dense to Compact Brown Moist (FILL)		2	SS	32		198													
			3	SS	16														1 42 54 3	
197.3																				
2.2	Silty CLAY, with sand, trace gravel Stiff to Very Stiff Grey Moist (TILL)		4	SS	14		197													
			5	SS	16		196													
195.4																				
4.1	Hard		6	SS	32		195												1 28 40 31	
							194													
			7	SS	60		193													
							192													
			8	SS	100/ 0.300															
							191													
			9	SS	100/ 0.150		190												2 25 44 29	

Continued Next Page

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

RECORD OF BOREHOLE No MS 2-16

2 OF 2

METRIC

G.W.P. 2930-17-00 LOCATION N 4 858 813.9 E 314 746.3 ORIGINATED BY BL
 HWY 404 BOREHOLE TYPE Solid Stem Augers COMPILED BY MP
 DATUM Geodetic DATE 2018.07.16 - 2018.07.16 LATITUDE 43.869230 LONGITUDE -79.376250 CHECKED BY RD

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 (%)				
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE									
	Continued From Previous Page						20 40 60 80 100										
	Silty CLAY , with sand, trace gravel Hard Grey Moist (TILL)		10	SS	79												
			11	SS	56												
186.7																	
12.8	END OF BOREHOLE AT 12.8m. WATER LEVEL AT 2.3m DEPTH BEFORE BOREHOLE CAVING TO 1.2m UPON COMPLETION. Piezometer installation consists of 50mm diameter Schedule 40 PVC pipe with a 3.0m slotted screen. WATER LEVEL READINGS DATE DEPTH(m) ELEV.(m) 2018.09.30 1.7 197.9 2018.11.23 1.7 197.9																

RECORD OF BOREHOLE No MS 2-17

1 OF 1

METRIC

G.W.P. 2930-17-00 LOCATION N 4 858 748.0 E 314 735.1 ORIGINATED BY SJ
 HWY 404 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MP
 DATUM Geodetic DATE 2018.07.24 - 2018.07.24 LATITUDE 43.868637 LONGITUDE -79.376391 CHECKED BY RD

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							
199.0	GROUND SURFACE							20	40	60	80	100			
0.0	ASPHALT (155mm)							20	40	60	80	100			
0.2	SAND and GRAVEL, trace silt, trace clay														
0.4	Brown Moist (FILL)														
198.6	Silty SAND, trace gravel, trace clay		1	SS	30		198								
197.6	Compact Brown Moist (FILL)														
1.4	SAND and SILT, trace clay		2	SS	28		197								
	Compact Brown Moist														
			3	SS	15										
196.1	Loose						196								0 39 56 5
			4	SS	8										
194.9							195								
4.1			5	SS	12		194								
192.9	Silty CLAY, with sand, trace gravel						193								
6.1	Very Stiff to Hard Grey Moist (TILL)		6	SS	18		192								1 29 70 (SI+CL)
			7	SS	84		191								
190.9	END OF BOREHOLE AT 8.2m. BOREHOLE CAVED TO 3.0m AND WATER LEVEL AT 2.1m DEPTH UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND AUGER CUTTINGS TO 0.2m, THEN COLD PATCH ASPHALT TO SURFACE.														
8.2															

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

RECORD OF BOREHOLE No MS 2-18

1 OF 2

METRIC

G.W.P. 2930-17-00 LOCATION N 4 858 656.3 E 314 775.4 ORIGINATED BY BL
 HWY 404 BOREHOLE TYPE Solid Stem Augers COMPILED BY MP
 DATUM Geodetic DATE 2018.07.10 - 2018.07.10 LATITUDE 43.867811 LONGITUDE -79.375891 CHECKED BY RD

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					
198.2	GROUND SURFACE							20 40 60 80 100					
0.0	ASPHALT (125mm)							20 40 60 80 100					
0.1	SAND and GRAVEL, trace silt, trace clay Compact Brown Moist (FILL)		1	SS	16		198						
197.0			2	SS	19								
1.2	Silty CLAY, with sand, trace gravel Very Stiff to Hard Brown to Grey Moist (TILL)		3	SS	28		197						
			4	SS	22		196						
			5	SS	32		195						
			6	SS	24		194						
			7	SS	18		193						
191.1			8	SS	12		192						
7.2	Stiff		9	SS	45		191						
189.6							190						
8.7							189						

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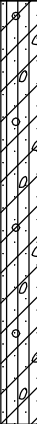
+³, ×³: Numbers refer to Sensitivity
 20
 15
 10
 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No MS 2-18

2 OF 2

METRIC

G.W.P. 2930-17-00 LOCATION N 4 858 656.3 E 314 775.4 ORIGINATED BY BL
 HWY 404 BOREHOLE TYPE Solid Stem Augers COMPILED BY MP
 DATUM Geodetic DATE 2018.07.10 - 2018.07.10 LATITUDE 43.867811 LONGITUDE -79.375891 CHECKED BY RD

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W _P	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE									
	Continued From Previous Page							20	40	60	80	100					
185.4	Silty CLAY , with sand, trace gravel Hard Brown to Grey Moist (TILL)						188										
			10	SS	37												
							187										
			11	SS	37												
12.8	END OF BOREHOLE AT 12.8m. BOREHOLE CAVED TO 5.5m AND WATER LEVEL AT 3.0m DEPTH UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO 4.3m, AUGER CUTTINGS TO 0.7m, BENTONITE HOLEPLUG TO 0.1m, THEN COLD PATCH ASPHALT TO SURFACE.																

RECORD OF BOREHOLE No MS 2-19

1 OF 1

METRIC

G.W.P. 2930-17-00 LOCATION N 4 858 555.0 E 314 790.6 ORIGINATED BY BL
 HWY 404 BOREHOLE TYPE Solid Stem Augers COMPILED BY MP
 DATUM Geodetic DATE 2018.07.09 - 2018.07.09 LATITUDE 43.866899 LONGITUDE -79.375704 CHECKED BY RD

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 ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE						PLASTIC LIMIT w _p NATURAL MOISTURE CONTENT w LIQUID LIMIT w _L WATER CONTENT (%)
197.3	GROUND SURFACE													
0.0	ASPHALT (125mm)													
0.1	SAND and GRAVEL Compact Brown Moist (FILL)		1	SS	21		197							
196.2			2	SS	39									
1.1	Silty SAND, trace gravel, trace clay Dense to Compact Brown Moist (FILL)						196							
			3	SS	16									
195.1							195							
2.2	Silty CLAY, with sand, trace gravel Very Stiff Brown Moist (TILL)		4	SS	16									
			5	SS	28		194							
193.6														
3.7	SILT, some sand, some clay Compact Grey Wet		6	SS	17		193							
			7	SS	14		192							
							191							
190.6			8	SS	21									
6.7	END OF BOREHOLE AT 6.7m. WATER LEVEL AT 4.6m DEPTH BEFORE BOREHOLE CAVING TO 4.0m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO 2.7m, AUGER CUTTINGS TO 0.1m, THEN COLD PATCH ASPHALT TO SURFACE.													

+³, ×³: Numbers refer to
Sensitivity

20
15
10

(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No MS 2-20

1 OF 2

METRIC

G.W.P. 2930-17-00 LOCATION N 4 858 520.8 E 314 799.0 ORIGINATED BY BL
 HWY 404 BOREHOLE TYPE Solid Stem Augers COMPILED BY MP
 DATUM Geodetic DATE 2018.07.09 - 2018.07.09 LATITUDE 43.866591 LONGITUDE -79.375600 CHECKED BY RD

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 (%)				
								○ UNCONFINED + FIELD VANE				W _P	W	W _L		
								● QUICK TRIAXIAL × LAB VANE								
197.2	GROUND SURFACE						20	40	60	80	100					
0.0 0.1	ASPHALT (75mm)															
	SAND and GRAVEL Compact Brown Moist (FILL)		1	SS	27								○			
196.1			2	SS	42											
1.1	Silty SAND, trace gravel, trace clay												○			
195.7	Dense															
1.4	Brown Wet (FILL)												○			
	Silty CLAY, with sand, trace gravel Very Stiff to Hard		3	SS	27											0 24 40 36
	Brown															
	Moist (TILL)		4	SS	17								○			
			5	SS	32								○			
193.4																
3.8	SAND and SILT, trace clay Compact Brown Wet															
			6	SS	12								○			0 66 31 3
			7	SS	20								○			
190.0																
7.2	Silty CLAY, with sand, trace gravel Hard Grey Moist to Wet (TILL)															
			8	SS	36								○			
			9	SS	36								○			

Continued Next Page


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

RECORD OF BOREHOLE No MS 2-20

2 OF 2

METRIC

G.W.P. 2930-17-00 LOCATION N 4 858 520.8 E 314 799.0 ORIGINATED BY BL
 HWY 404 BOREHOLE TYPE Solid Stem Augers COMPILED BY MP
 DATUM Geodetic DATE 2018.07.09 - 2018.07.09 LATITUDE 43.866591 LONGITUDE -79.375600 CHECKED BY RD

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT						UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL					
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa												
								○ UNCONFINED + FIELD VANE												
								● QUICK TRIAXIAL × LAB VANE												
Continued From Previous Page						20 40 60 80 100						PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT w _p w w _L WATER CONTENT (%)								
184.4	Silty CLAY , with sand, trace gravel Hard Grey Moist (TILL)		10	SS	46	187														
						186														
						185														
			11	SS	50/ 0.125															
12.8	END OF BOREHOLE AT 12.8m. WATER LEVEL AT 4.6m DEPTH BEFORE BOREHOLE CAVING TO 4.3m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO 3.0m, AUGER CUTTINGS TO 0.6m, BENTONITE HOLEPLUG TO 0.1m, THEN COLD PATCH ASPHALT TO SURFACE.																			

RECORD OF BOREHOLE No R-07

1 OF 3

METRIC

G.W.P. 2930-17-00 LOCATION Rouge River Bridge - MTM NAD 83 Zone10: N 4 859 318.3 E 314 637.6 ORIGINATED BY SB
 HWY 404 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MP
 DATUM Geodetic DATE 2018.05.22 - 2018.05.23 LATITUDE 43.873771 LONGITUDE -79.377593 CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
202.6	GROUND SURFACE							20	40	60	80	100	PLASTIC LIMIT w _P	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L		
0.0	SILT , some sand, trace gravel, trace clay, occasional organics Loose to Compact Brown Moist (FILL)		1	SS	8		202										
			2	SS	20												
			3	SS	22		201										
			4	SS	25		200										
			5	SS	20		199										
			6	SS	100/ 0.225		198										
	Cobbles						197										Resistance to augering at 5.8m
	Sand seams at 5.9m																
196.5																	
6.1	Silty CLAY , with sand, trace gravel Stiff to Hard Grey Moist (FILL)		7	SS	11		196										Resistance to augering at 6.9m
			8	SS	32		195										2 36 39 23
							194										
193.4																	
9.2	Silty SAND , trace gravel, trace clay Dense Grey Wet		9	SS	41		193										Resistance to augering at 9.4m
192.6																	

Continued Next Page

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

METRIC

[illegible]

+³, ×³: Numbers refer to Sensitivity

ONTMT4S2 MTO-15786.GPJ 2017TEMPLATE(MTO).GDT 12/3/18

RECORD OF BOREHOLE No R-07

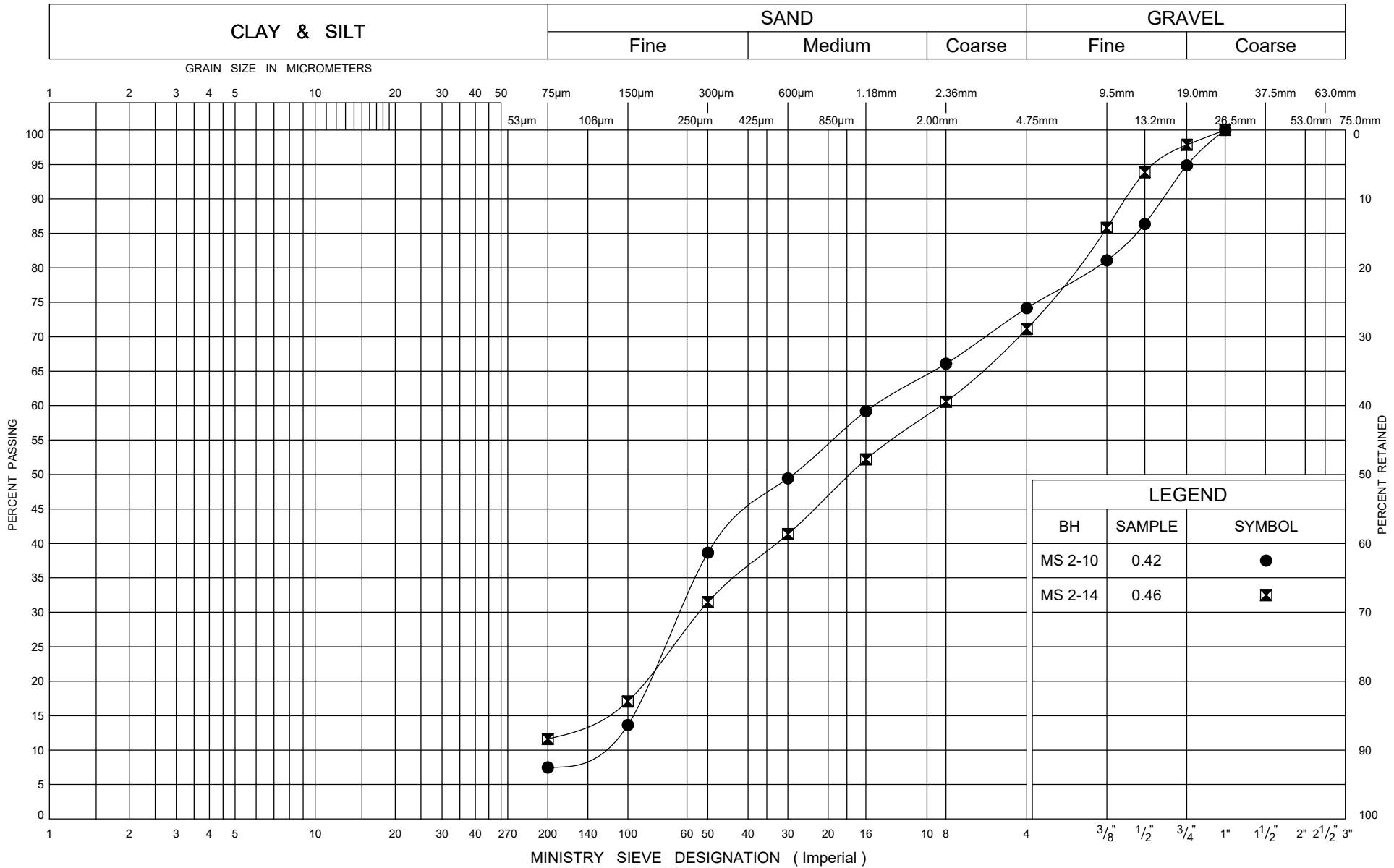
3 OF 3

METRIC

G.W.P. 2930-17-00 LOCATION Rouge River Bridge - MTM NAD 83 Zone10: N 4 859 318.3 E 314 637.6 ORIGINATED BY SB
 HWY 404 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MP
 DATUM Geodetic DATE 2018.05.22 - 2018.05.23 LATITUDE 43.873771 LONGITUDE -79.377593 CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) 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 20 40 60 80 100					WATER CONTENT (%)						
	Continued From Previous Page																
	Silty CLAY , trace sand, trace gravel Hard Grey Moist (TILL)		16	SS	100/ 0.250												
			17	SS	100/ 0.200												
			18	SS	100/ 0.225												
177.9				SS	100/ 0.175											0 0 63 37	
24.7	END OF BOREHOLE AT 24.7m. WATER LEVEL AT 10.7m UPON COMPLETION. Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 3.0m slotted screen. WATER LEVEL READINGS DATE DEPTH(m) ELEV.(m) 2018.06.22 9.3 193.3 2018.11.22 9.2 193.4																

ONTMT452 MTO-15786.GPJ 2017TEMPLATE(MTO).GDT 12/3/18



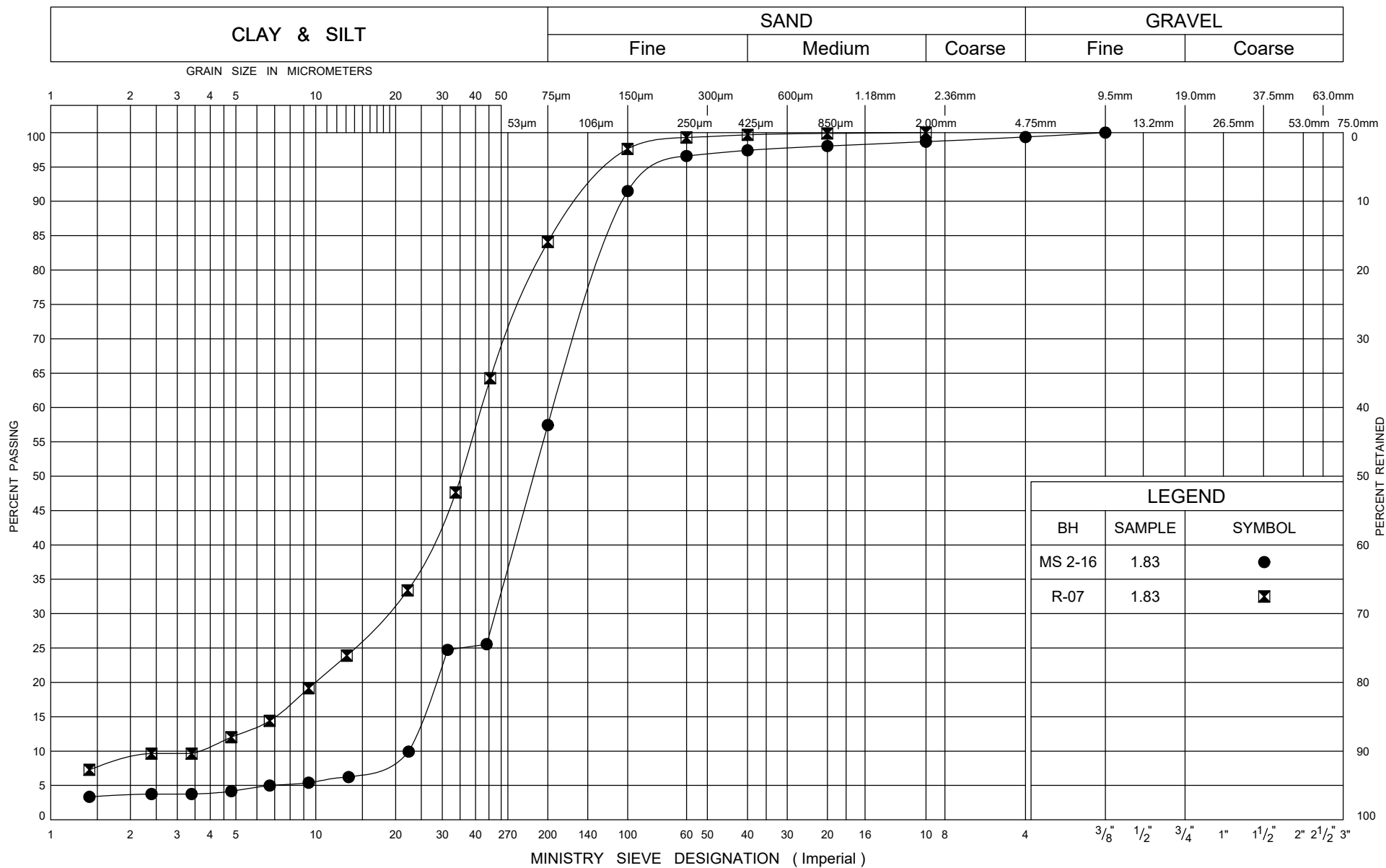
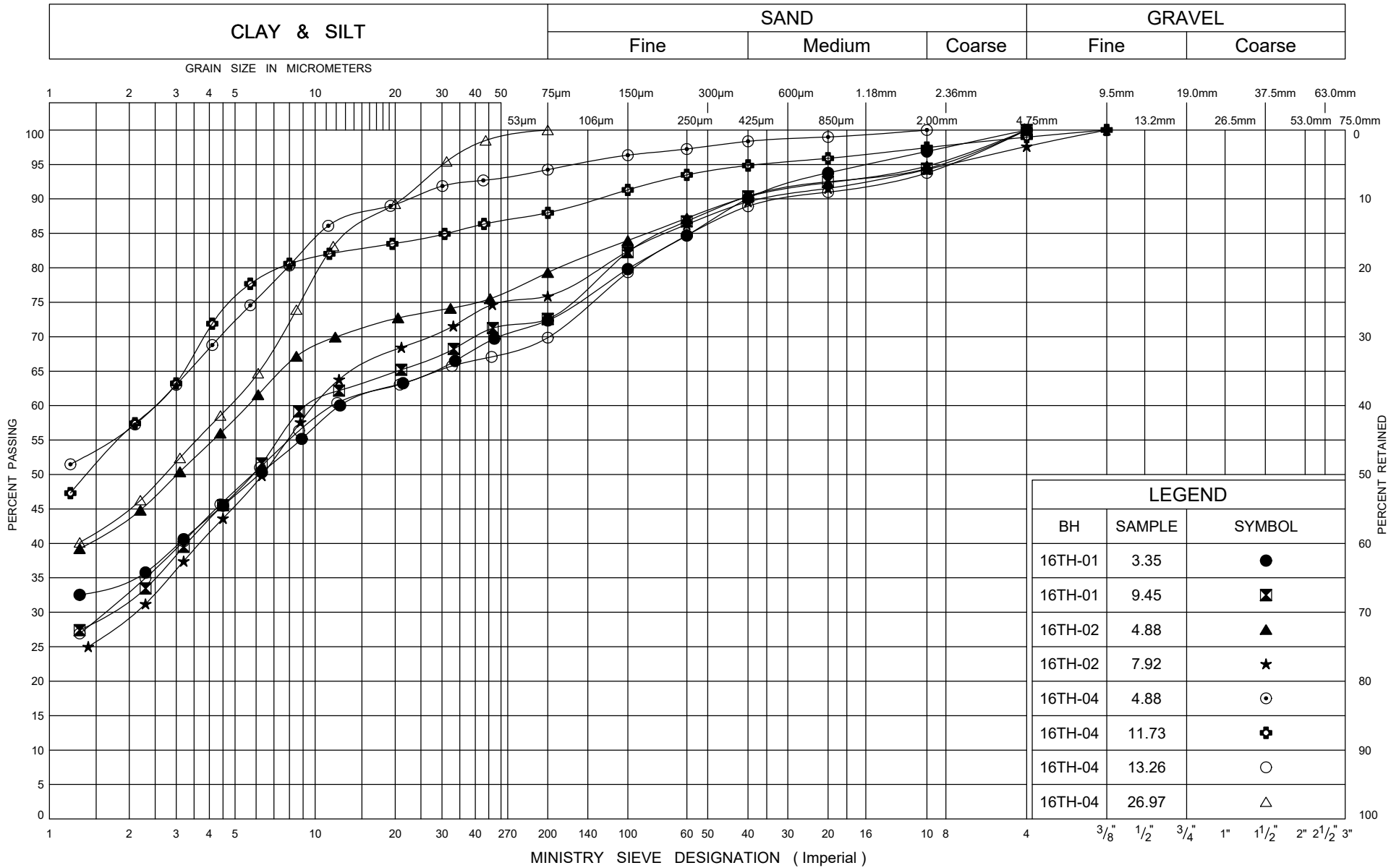
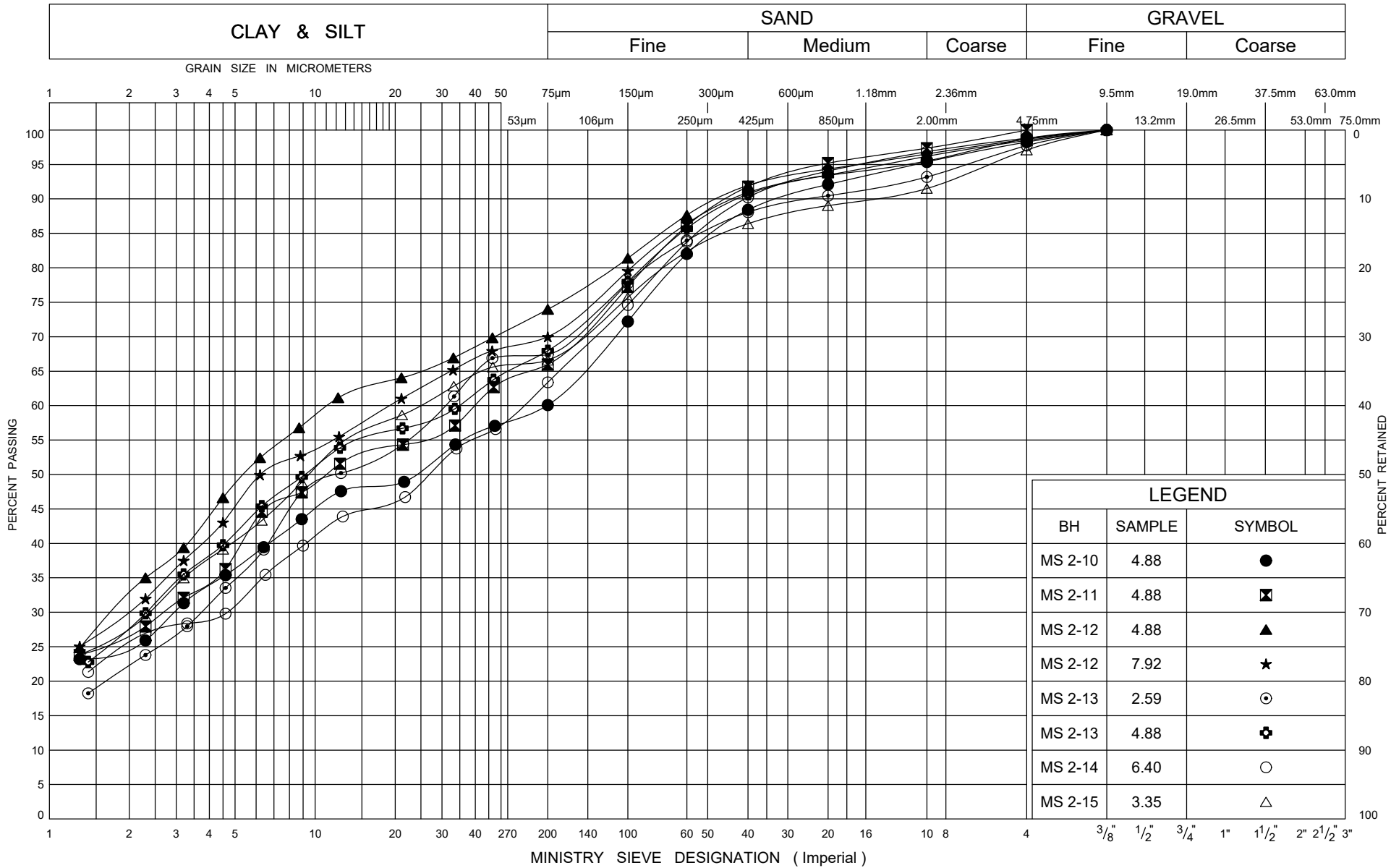
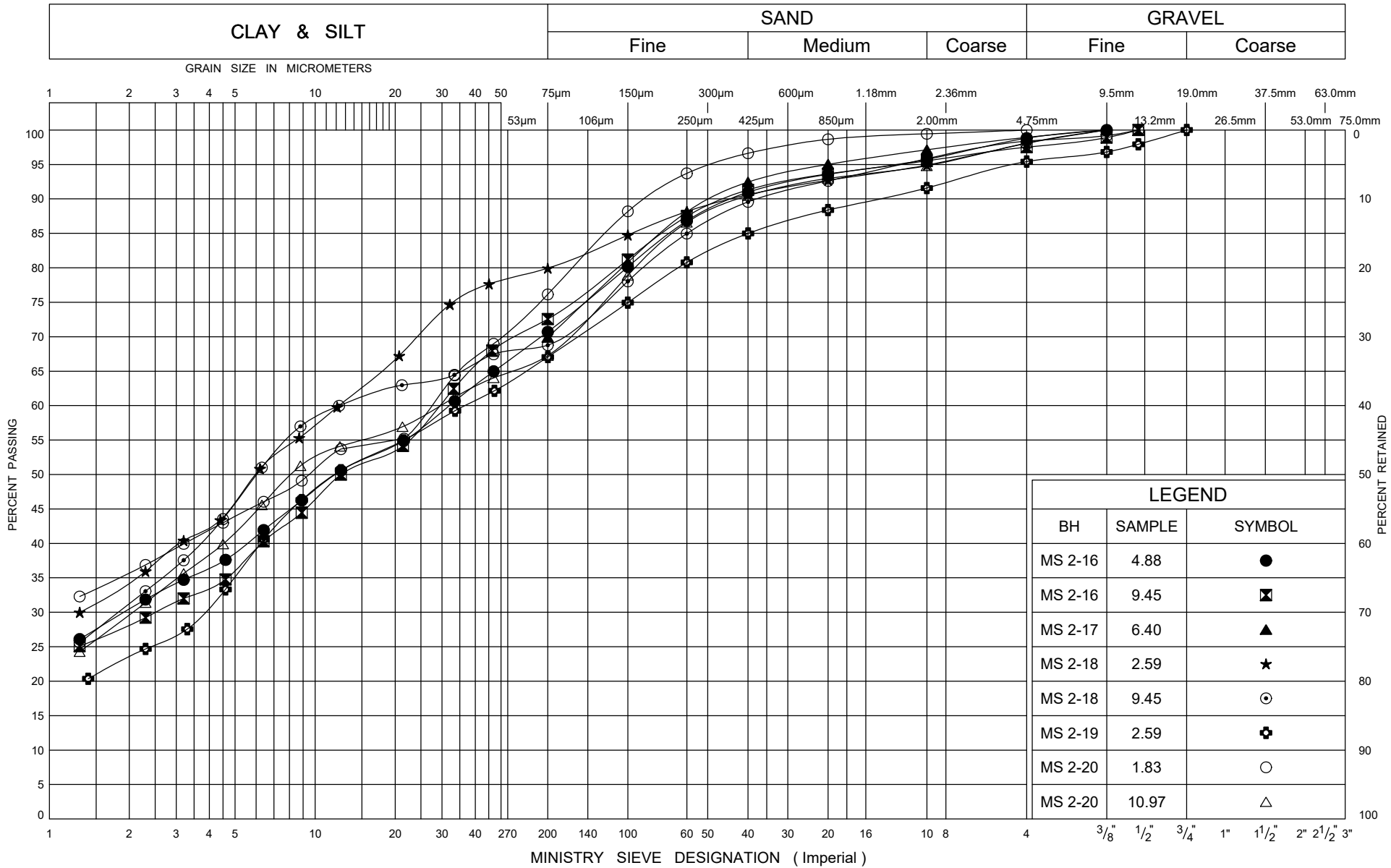


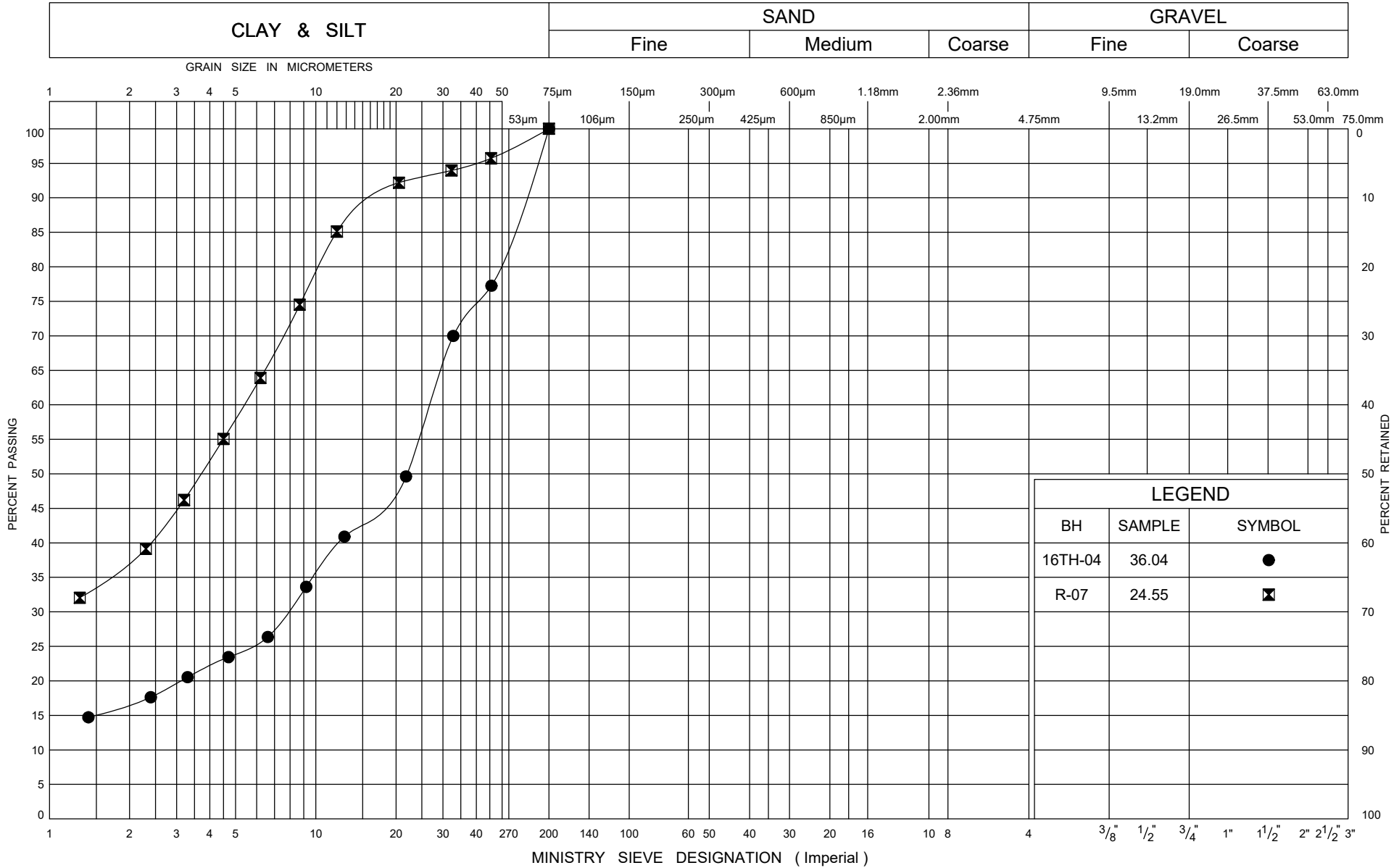


FIG No B3
G W P 2930-17-00







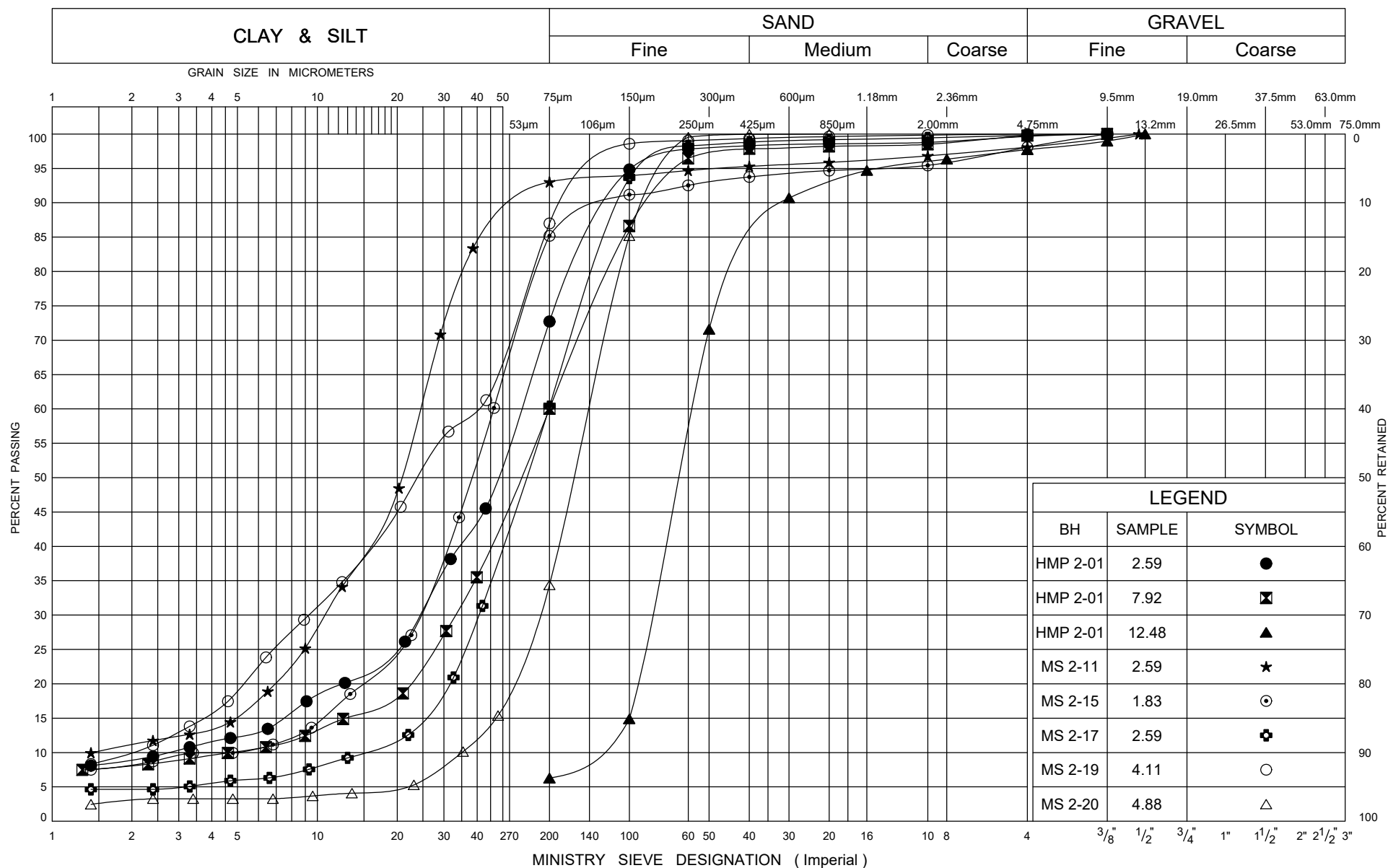


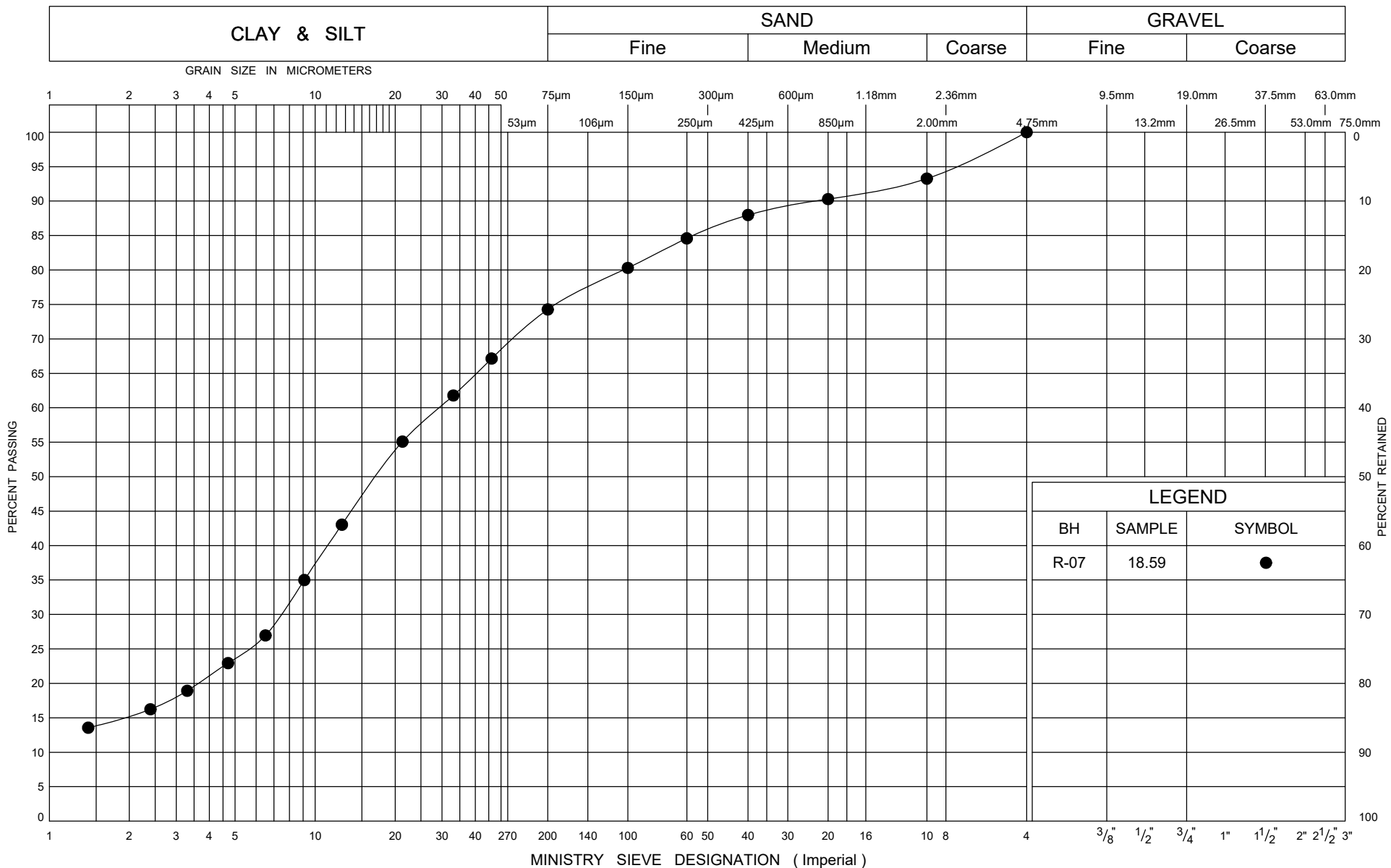
LEGEND		
BH	SAMPLE	SYMBOL
16TH-04	36.04	●
R-07	24.55	⊠

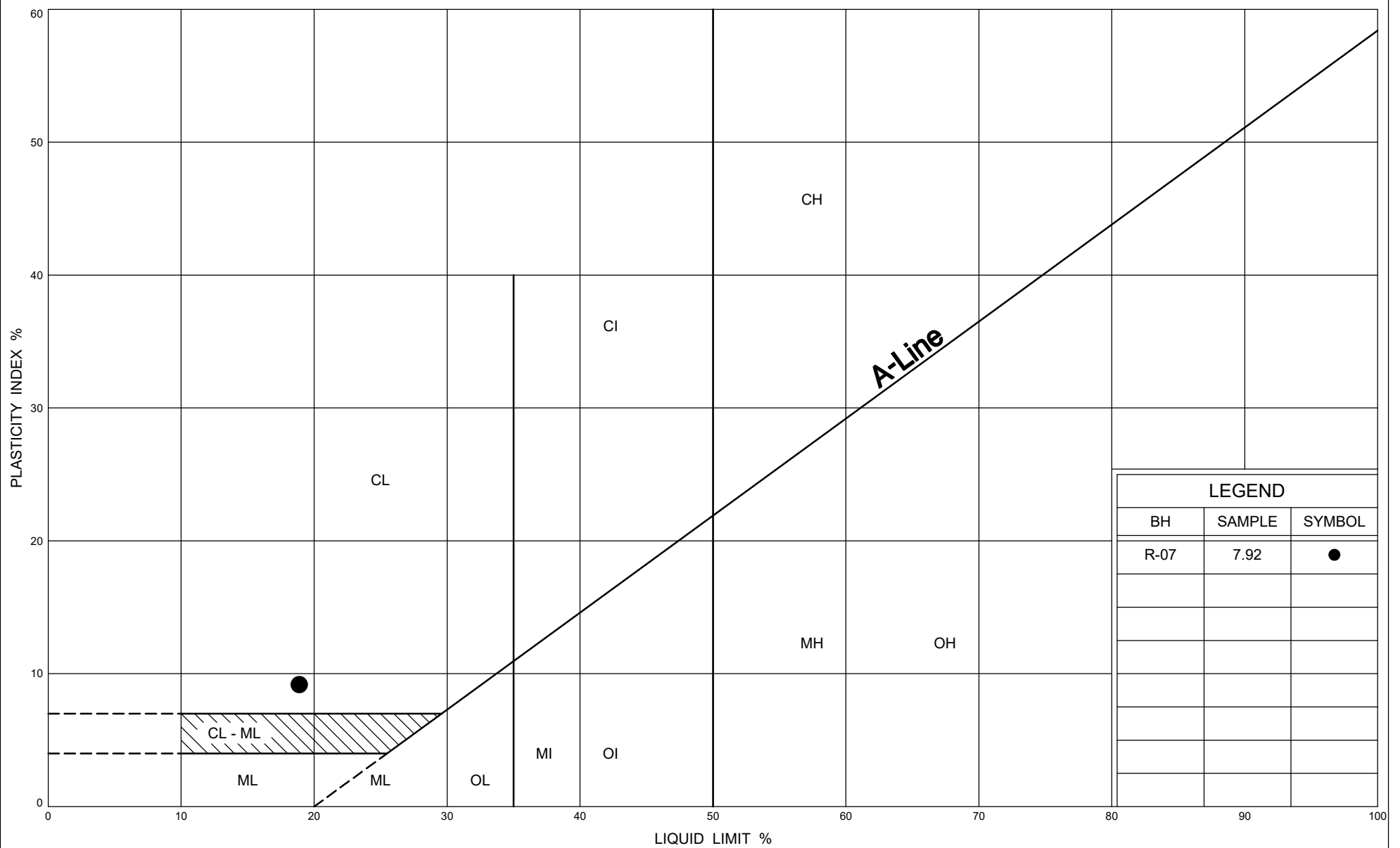


GRAIN SIZE DISTRIBUTION
Silty CLAY to Clayey SILT TILL

FIG No B7
G W P 2930-17-00

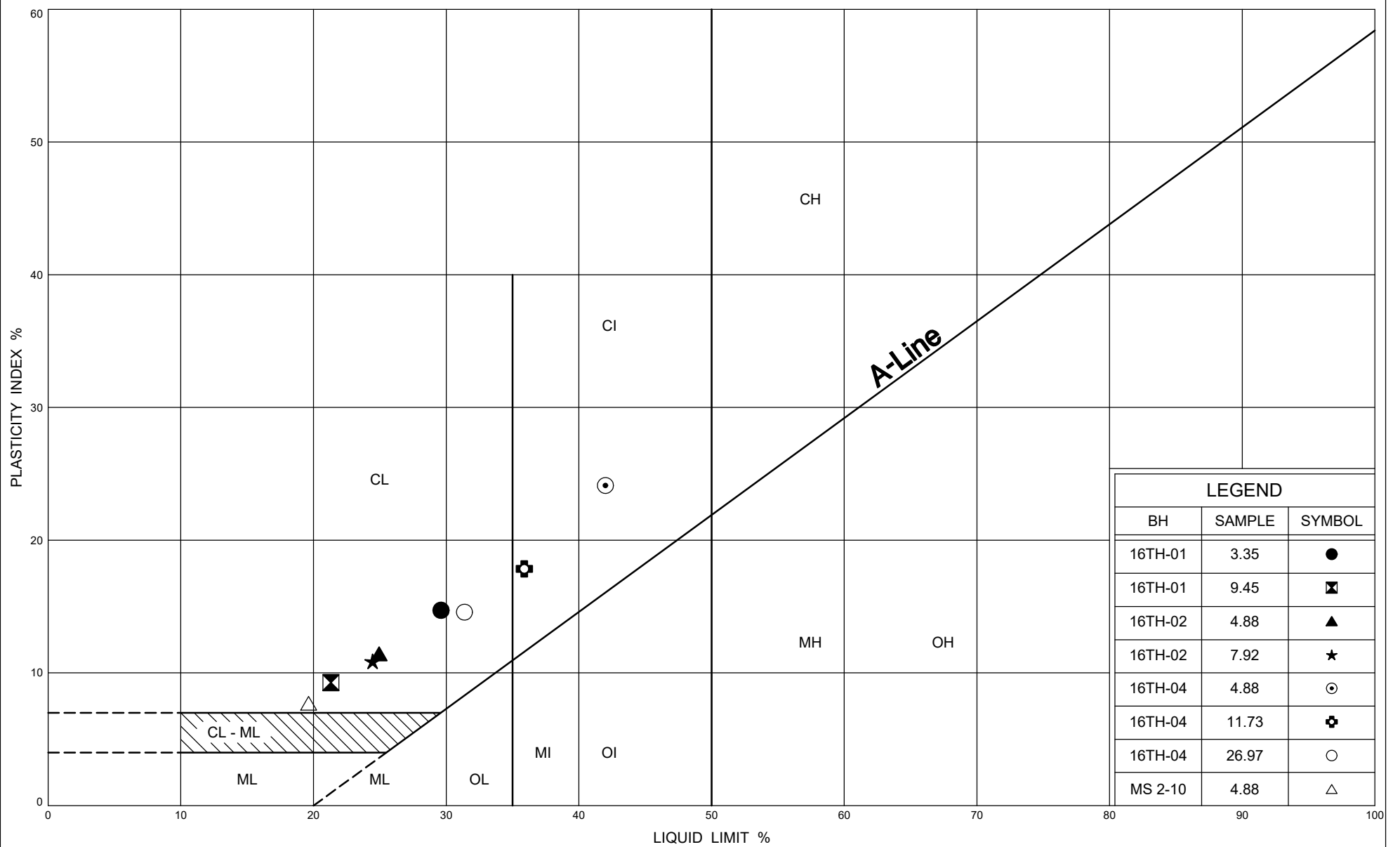






LEGEND		
BH	SAMPLE	SYMBOL
R-07	7.92	●

ONTARIO MOT PLASTICITY CHART MTO-15786.GPJ ONTARIO MOT.GDT 12/3/18



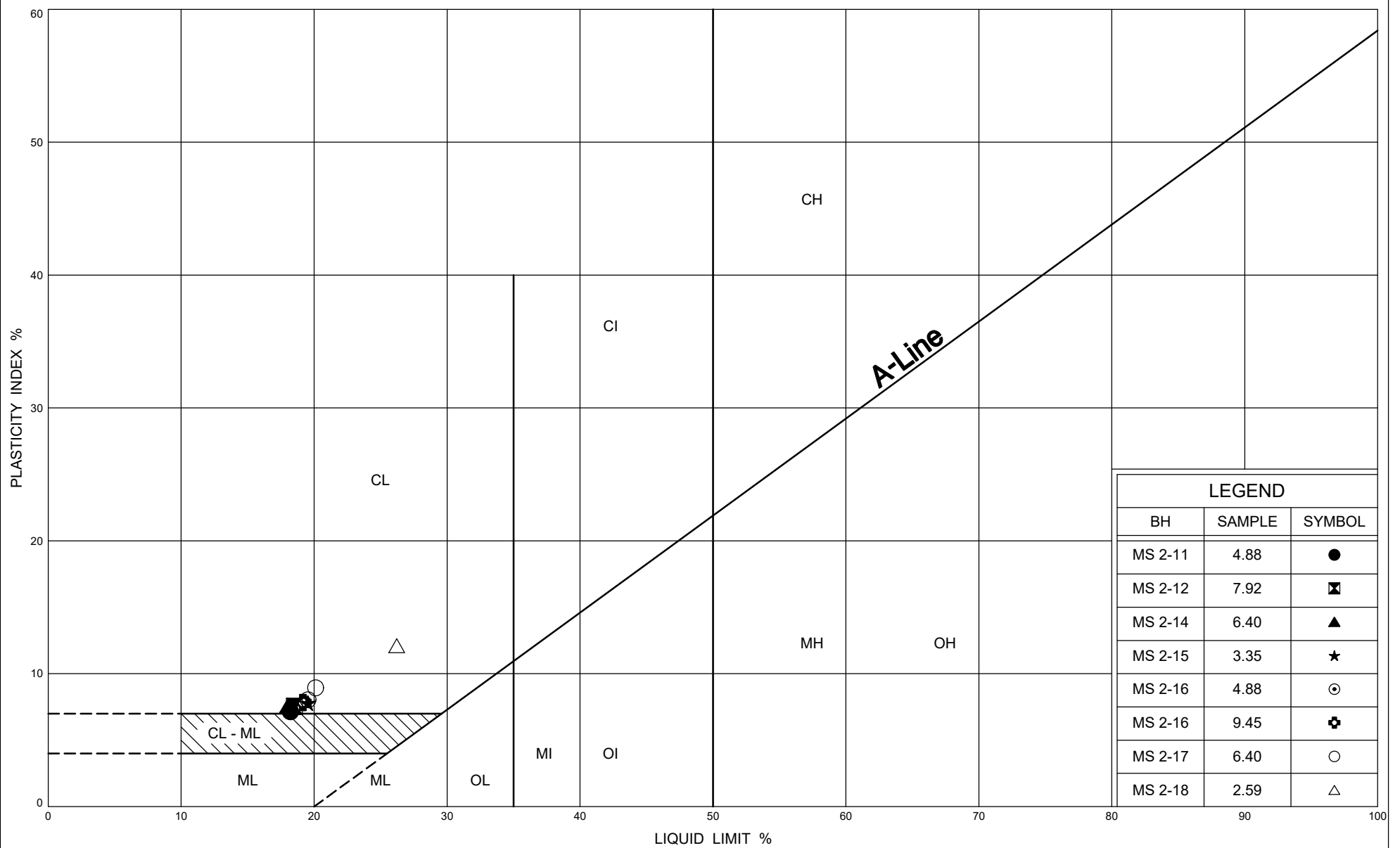
Ministry of
Transportation

PLASTICITY CHART

Silty CLAY TILL

FIG No B11

G W P 2930-17-00



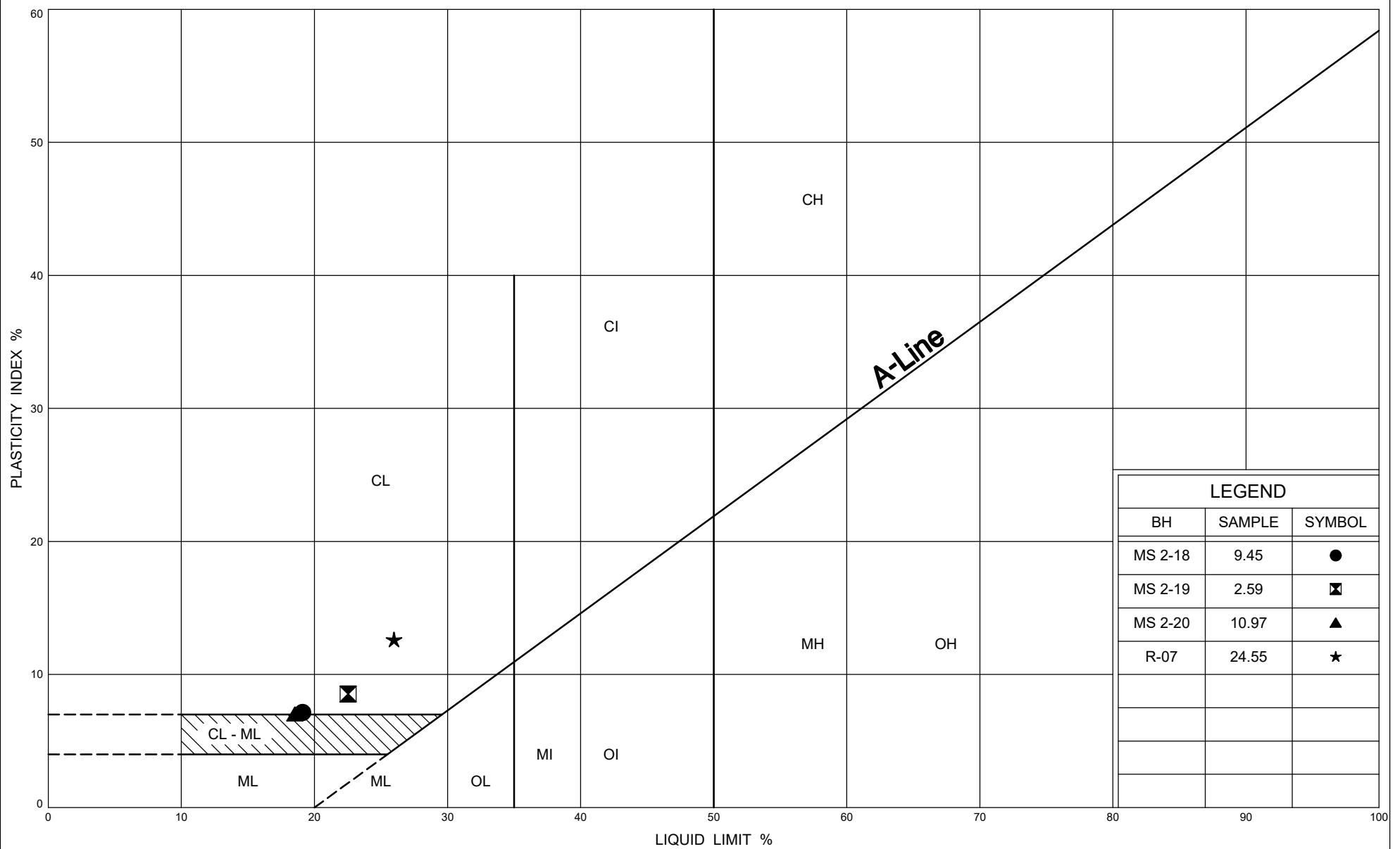
Ministry of
Transportation

PLASTICITY CHART

Silty CLAY TILL

FIG No B12

G W P 2930-17-00



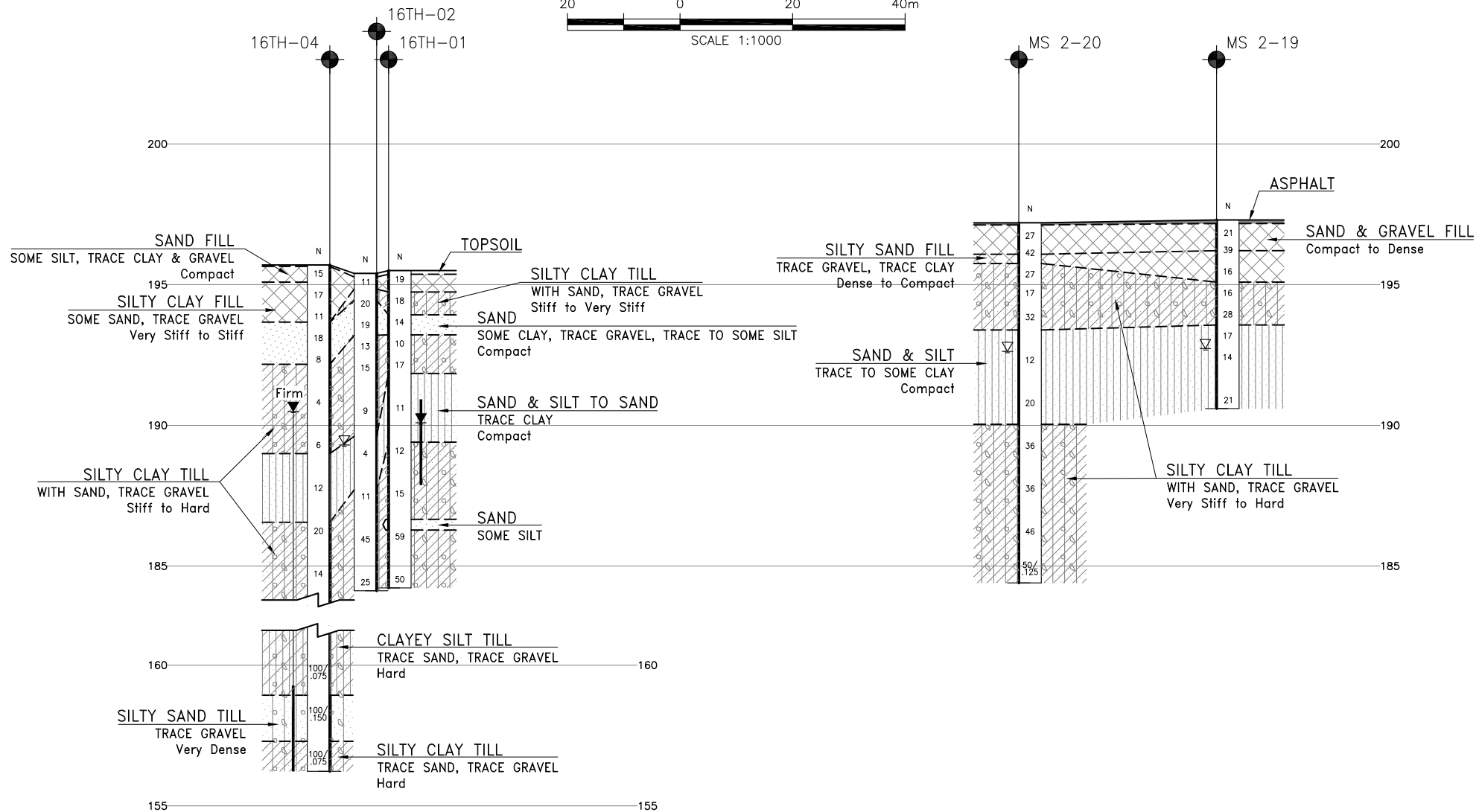
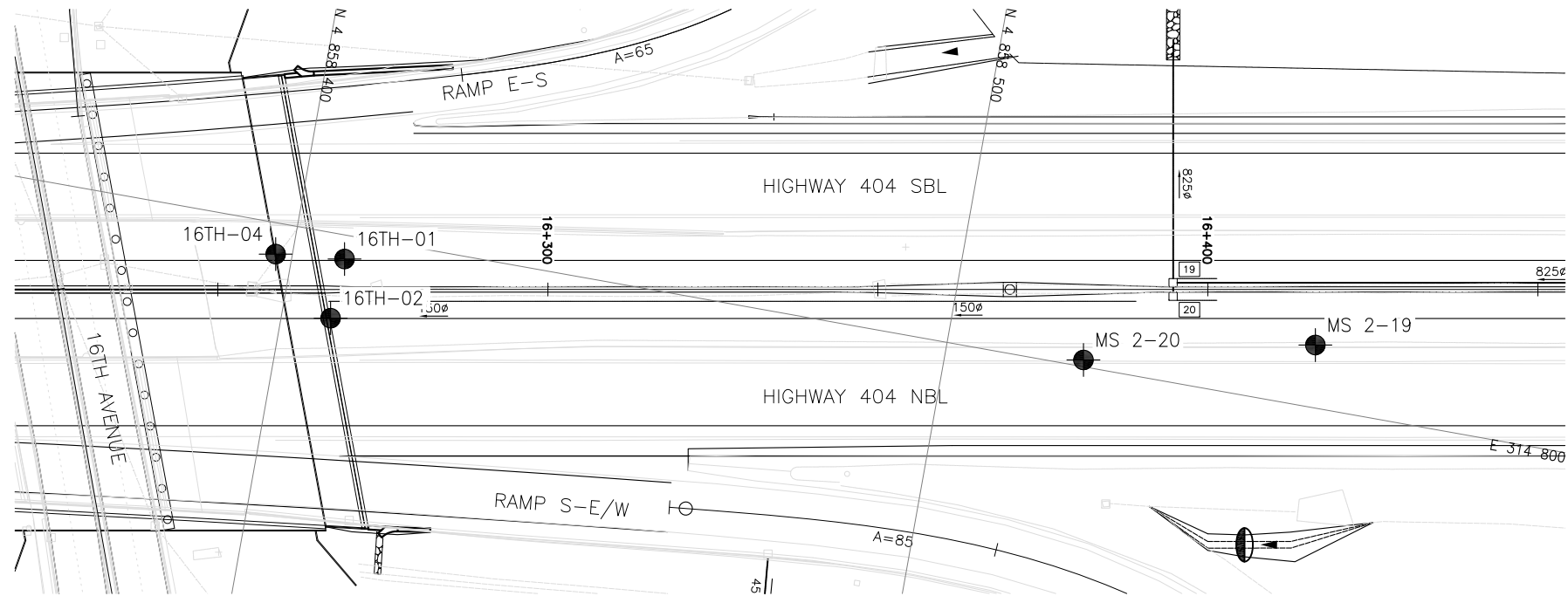
Ministry of
Transportation

PLASTICITY CHART

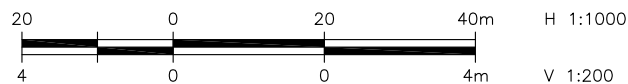
Silty CLAY TILL

FIG No B13

G W P 2930-17-00



PROFILE ALONG CL HWY 404

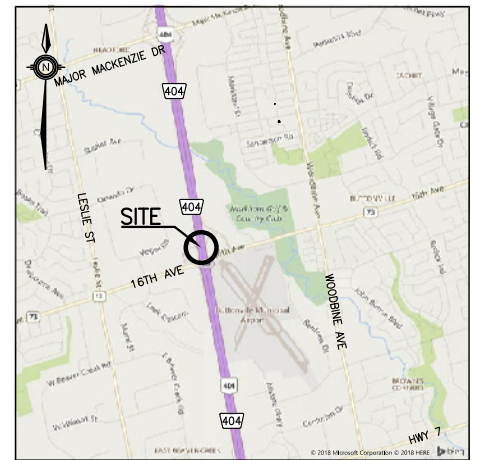


METRIC
DIMENSIONS ARE IN METRES
AND/OR MILLIMETRES
UNLESS OTHERWISE SHOWN



CONT No
GWP No 2930-17-00

HIGHWAY 404 WIDENING
MEDIAN SEWER
STA 16+250 TO STA 16+450
BOREHOLE LOCATIONS AND SOIL STRATA



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

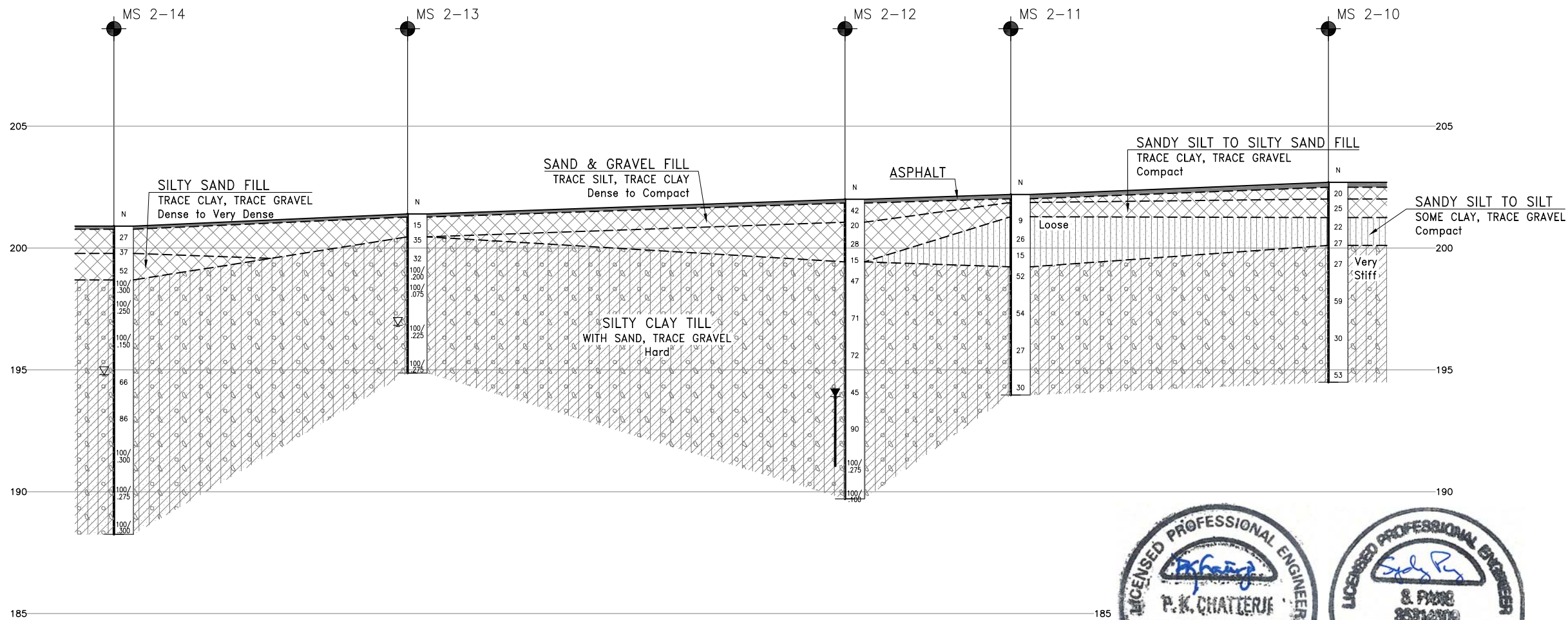
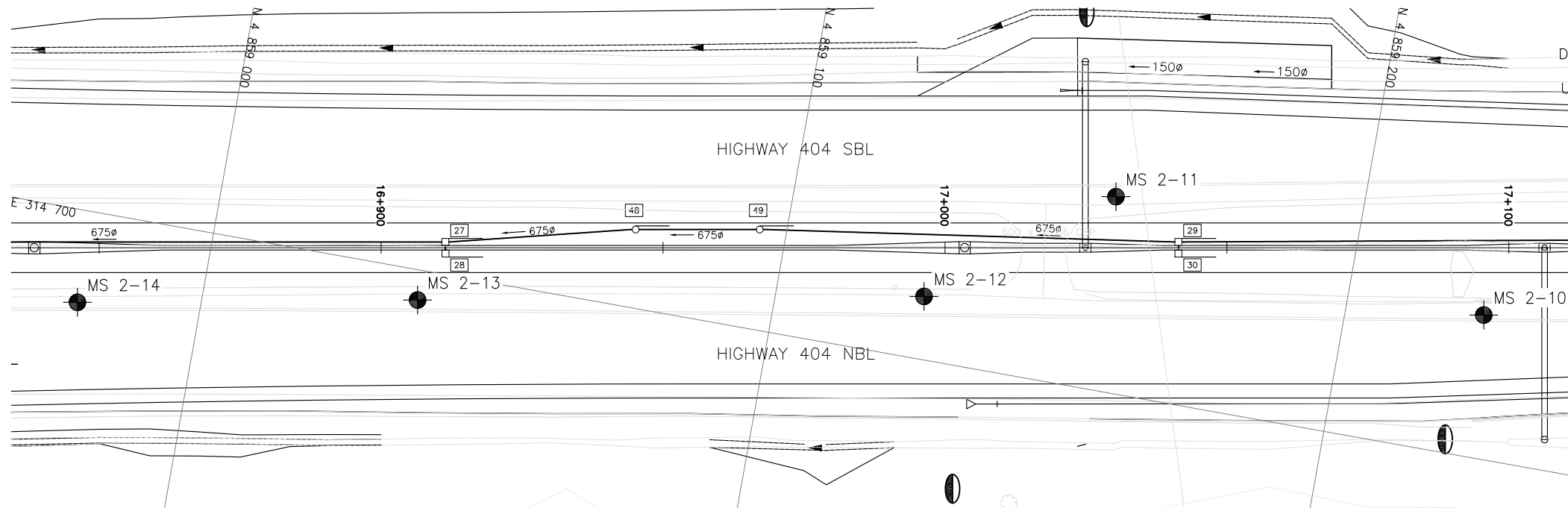
NO	ELEVATION	NORTHING	EASTING
16TH-01	195.5	4 858 407.9	314 803.6
16TH-02	195.4	4 858 407.4	314 812.8
16TH-04	195.7	4 858 397.5	314 804.7
MS 2-19	197.3	4 858 555.0	314 790.6
MS 2-20	197.2	4 858 520.8	314 799.0

-NOTES-

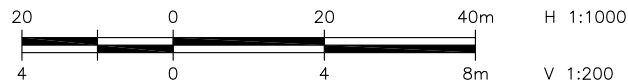
- The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.
- This drawing is for subsurface information only. Surface details and features are for conceptual illustration.
- Coordinate system is MTM NAD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

GEOCRES No. 30M14-497

REVISIONS	DATE	BY	DESCRIPTION



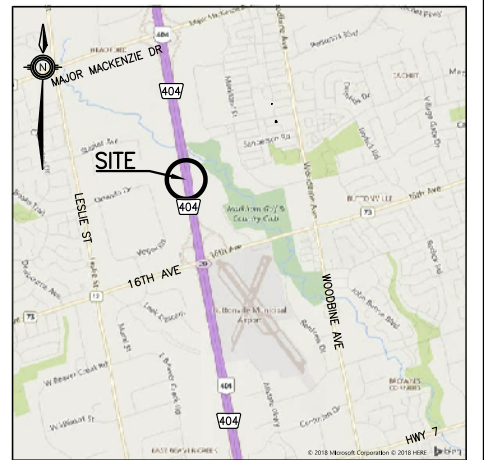
PROFILE ALONG CL HWY 404



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

CONT No
GWP No 2930-17-00

HIGHWAY 404 WIDENING
MEDIAN SEWER
STA 16+850 TO 17+100
BOREHOLE LOCATIONS AND SOIL STRATA



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
MS 2-10	202.7	4 859 224.3	314 674.7
MS 2-11	202.2	4 859 156.4	314 665.5
MS 2-12	202.0	4 859 126.0	314 688.9
MS 2-13	201.4	4 859 037.7	314 705.3
MS 2-14	200.9	4 858 978.4	314 716.3

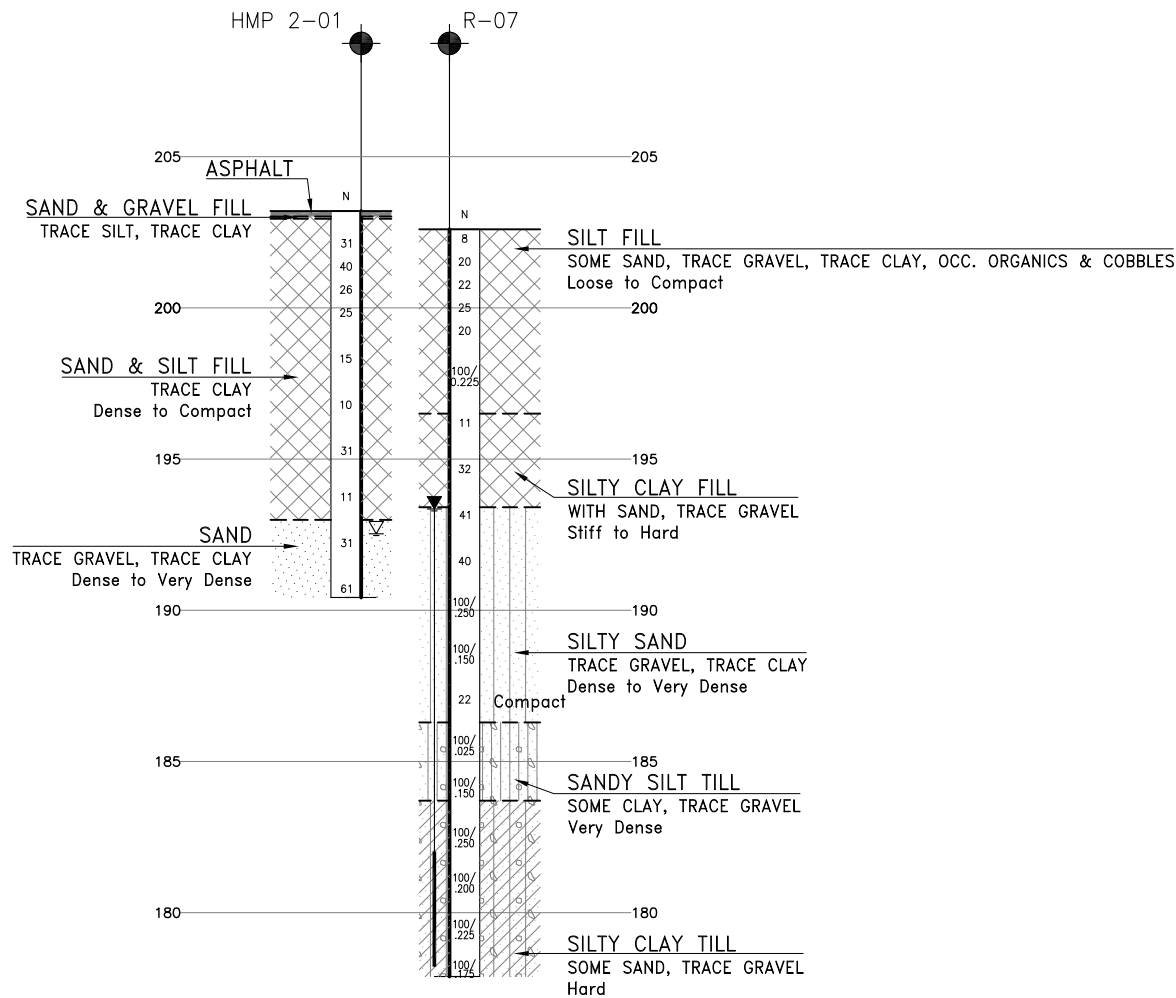
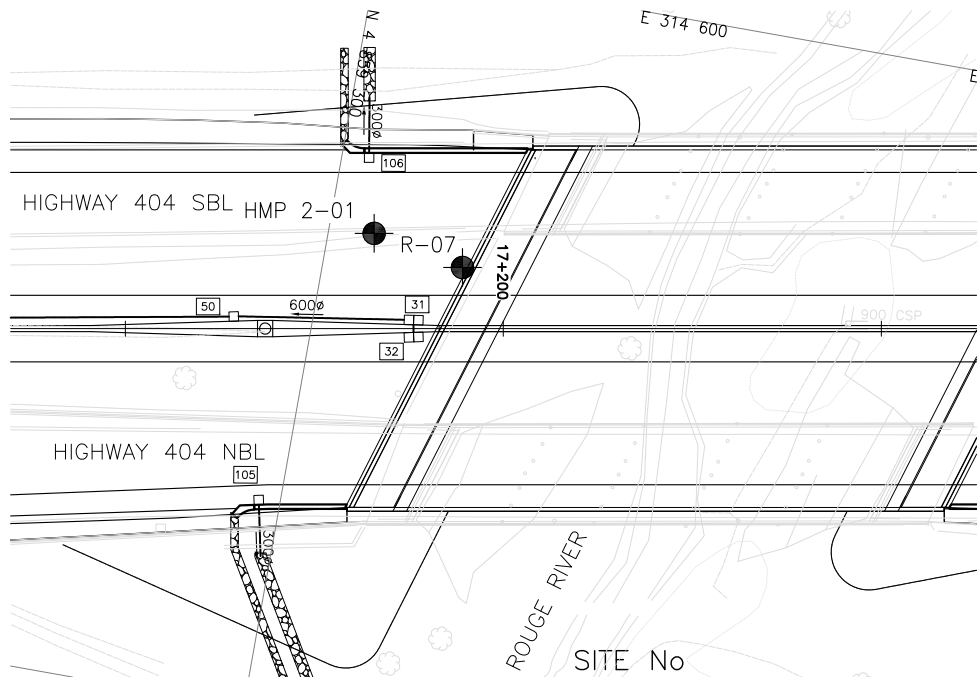
-NOTES-

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

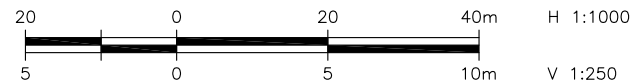
GEOCRES No. 30M14-497



REVISIONS	DATE	BY	DESCRIPTION
DESIGN	RPR	CHK SKP	CODE
DRAWN	AN	CHK RPR	SITE
			LOAD
			STRUCT
			DWG B3
			DATE JAN 2019



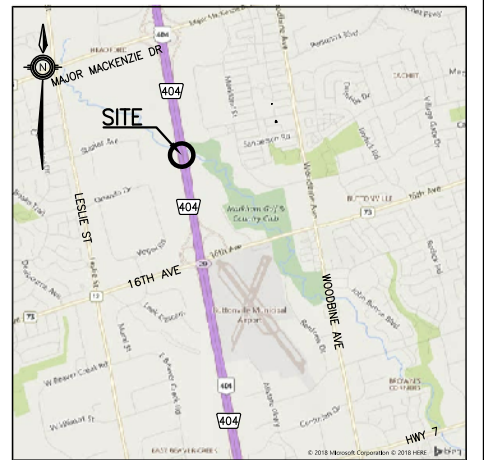
PROFILE ALONG C HWY 404



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

CONT No
GWP No 2930-17-00

HIGHWAY 404 WIDENING
MEDIAN SEWER
STA 17+150 TO STA 17+250
BOREHOLE LOCATIONS AND SOIL STRATA



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
HMP 2-01	203.2	4 859 306.0	314 635.2
R-07	202.6	4 859 318.3	314 637.6

NOTES-

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

GEOCRES No. 30M14-497

REVISIONS	DATE	BY	DESCRIPTION
DESIGN	RPR	CHK SKP	CODE
DRAWN	AN	CHK RPR	SITE
			LOAD
			DATE
			JAN 2019
			STRUCT
			DWG B4



Appendix C

Section 3

**From north of Rouge River to south of Major Mackenzie
(Stations 17+270 to 18+190)**

RECORD OF BOREHOLE No MS 2-01

1 OF 1

METRIC

Ō.W.P. 2930-FI-00 LOCATION N 4 860 210.8 E 314 495.6 ORIGINATED BY BL
 HWY 404 BOREHOLE TYPE Solid Stem Augers COMPILED BY MP
 DATUM Geodetic DATE 2018.08.02 - 2018.08.02 LATITUDE 43.881806 LONGITUDE -79.379344 CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE							PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT w _P w w _L WATER CONTENT (%)			
208.7	GROUND SURFACE							20	40	60	80	100						
0.0	ASPHALT (150mm)																	
0.2	SAND and GRAVEL, trace silt, trace clay Dense Brown Moist (FILL)		1	SS	35		208											
207.7			2	SS	75													
1.1	Silty CLAY, with sand, trace gravel Hard Grey Moist (TILL)																	
			3	SS	100/ 0.225		207											
			4	SS	100/ 0.200		206											
			5	SS	100/ 0.200		205											
			6	SS	100/ 0.250		204											
							203											
202.3			7	SS	100/ 0.250													
6.4	END OF BOREHOLE AT 6.4m. BOREHOLE DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH AUGER CUTTINGS TO 0.2m, THEN COLD PATCH ASPHALT TO SURFACE.																	

ONTMT452 MTO-15786.GPJ 2017TEMPLATE(MTO).GDT 12/4/18

RECORD OF BOREHOLE No MS 2-02

1 OF 1

METRIC

ŌB.V.P. 2930-FI-00 LOCATION N 4 860 119.7 E 314 495.9 ORIGINATED BY KK
 HWY 404 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MP
 DATUM Geodetic DATE 2018.07.25 - 2018.07.25 LATITUDE 43.880987 LONGITUDE -79.379342 CHECKED BY RD

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 (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	W _P W W _L	SHEAR STRENGTH kPa			WATER CONTENT (%)				GR	SA	SI	CL
207.6	GROUND SURFACE																			
0.0	ASPHALT (150mm)																			
0.2	SAND and GRAVEL, , trace silt, trace clay (FILL)		1	GS																
207.0							207													
0.6	Silty CLAY, with sand, trace gravel Very Stiff to Hard Brown Moist (TILL)		2	SS	26															
			3	SS	101/ 0.270		206													
			4	SS	87		205													
	Grey																			
			5	SS	85		204													
							203													
			6	SS	100/ 0.250															
							202													
			7	SS	84		201													
200.9																				
6.7	END OF BOREHOLE AT 8.2m. BOREHOLE DRY UPON COMPLETION. Piezometer installation consists of 25mm diameter Schedule 40 PVC pipe with a 3.0m slotted screen. WATER LEVEL READINGS DATE DEPTH(m) ELEV.(m) 2018.09.30 5.5 202.1																			

ONTMT452 MTO-15786.GPJ 2017TEMPLATE(MTO).GDT 12/4/18

RECORD OF BOREHOLE No MS 2-03

1 OF 1

METRIC

O.B.P. 2930-FI-00 LOCATION N 4 860 006.4 E 314 514.9 ORIGINATED BY KK
 HWY 404 BOREHOLE TYPE Solid Stem Augers COMPILED BY MP
 DATUM Geodetic DATE 2018.07.25 - 2018.07.25 LATITUDE 43.879966 LONGITUDE -79.379108 CHECKED BY RD

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE							PLASTIC LIMIT w _P NATURAL MOISTURE CONTENT w LIQUID LIMIT w _L WATER CONTENT (%)		
206.9	GROUND SURFACE							20	40	60	80	100					
0.0	ASPHALT (150mm)																
0.2	SAND and GRAVEL, trace silt, trace clay (FILL)		1	GS													
206.3	Silty CLAY, with sand, trace gravel Hard Brown Moist (TILL) Grey		2	SS	61												
0.6			3	SS	81												
			4	SS	103/ 0.275												
			5	SS	45												
			6	SS	54												
			7	SS	100/ 0.250												
			8	SS	70												
198.7																	
8.2	END OF BOREHOLE AT 8.2m. BOREHOLE OPEN AND DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH AUGER CUTTINGS TO 0.2m, THEN COLD PATCH ASPHALT TO SURFACE.																

ONTMT452 MTO-15786.GPJ 2017TEMPLATE(MTO).GDT 12/4/18

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

RECORD OF BOREHOLE No MS 2-04

1 OF 1

METRIC

O&V.P. 2930-FI-00 LOCATION N 4 859 912.8 E 314 546.2 ORIGINATED BY BL
 HWY 404 BOREHOLE TYPE Solid Stem Augers COMPILED BY MP
 DATUM Geodetic DATE 2018.07.20 - 2018.07.20 LATITUDE 43.879124 LONGITUDE -79.378720 CHECKED BY RD

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE					W _P W W _L WATER CONTENT (%)				kN/m ³	GR	SA	SI
206.0	GROUND SURFACE																			
0.0	ASPHALT (150mm)																			
0.2	SAND and GRAVEL, trace silt, trace clay Dense to Compact Brown Moist (FILL)		1	SS	34															
204.9			2	SS	26		205													
1.1	Silty CLAY, with sand, trace gravel Very Stiff Brown to Grey Moist (TILL)																			
			3	SS	45		204											1	41 32 26	
			4	SS	77															
			5	SS	68		203											1	37 36 26	
			6	SS	50		202													
			7	SS	59		200													
199.3																				
6.7	END OF BOREHOLE AT 6.7m. BOREHOLE OPEN AND DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH AUGER CUTTINGS TO 0.2m, THEN COLD PATCH ASPHALT TO SURFACE.																			

ONTMT452 MTO-15786.GPJ 2017TEMPLATE(MTO).GDT 12/4/18

RECORD OF BOREHOLE No MS 2-05

1 OF 1

METRIC

O&P. 2930-FI-00 LOCATION N 4 859 823.4 E 314 564.5 ORIGINATED BY BL
 HWY 404 BOREHOLE TYPE Solid Stem Augers COMPILED BY MP
 DATUM Geodetic DATE 2018.07.20 - 2018.07.20 LATITUDE 43.878319 LONGITUDE -79.378493 CHECKED BY RD

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 (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE				WATER CONTENT (%) w _P w w _L				GR	SA	SI	CL
205.9	GROUND SURFACE							20	40	60	80	100							
0.0	ASPHALT (150mm)																		
0.2	SAND and GRAVEL, trace silt, trace clay Compact Brown Moist (FILL)		1	SS	21									○					
204.9														○					
1.0	Silty CLAY, some sand, trace gravel, occasional organics Stiff Brown Moist (FILL)		2	SS	14										○				
204.5																			
1.4	Silty CLAY, with sand, trace gravel Very Stiff to Hard Brown Moist (TILL)		3	SS	16										○				
			4	SS	19										○				
			5	SS	32										○				
			6	SS	16										○				

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

RECORD OF BOREHOLE No MS 2-06

1 OF 1

METRIC

ŌNV.P. 2930-FI-00 LOCATION N 4 859 715.4 E 314 563.6 ORIGINATED BY KK
 HWY 404 BOREHOLE TYPE Solid Stem Augers COMPILED BY MP
 DATUM Geodetic DATE 2018.07.29 - 2018.07.29 LATITUDE 43.877347 LONGITUDE -79.378507 CHECKED BY RD

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					
205.4	GROUND SURFACE												
0.0	ASPHALT (150mm)												
0.2	SAND and GRAVEL, trace silt, trace clay (FILL)		1	GS			205						
204.7													
0.7	Silty CLAY, with sand, trace gravel Hard to Very Stiff Brown Moist (TILL)		2	SS	51		204						
			3	SS	25								
			4	SS	15		203						
			5	SS	15		202						
							201						
			6	SS	32								
	Grey						200						
			7	SS	26		199						
198.7													
6.7	END OF BOREHOLE AT 6.7m. BOREHOLE DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO 1.8m, AUGER CUTTINGS TO 0.2m, THEN COLD PATCH ASPHALT TO SURFACE.												

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

METRIC

[illegible]

+³, ×³: Numbers refer to Sensitivity

RECORD OF BOREHOLE No MS 2-08

1 OF 1

METRIC

O&P. 2930-FI-00 LOCATION N 4 859 526.4 E 314 617.2 ORIGINATED BY BL
 HWY 404 BOREHOLE TYPE Solid Stem Augers COMPILED BY MP
 DATUM Geodetic DATE 2018.07.19 - 2018.07.19 LATITUDE 43.875645 LONGITUDE -79.377843 CHECKED BY RD

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 (%)					
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					WATER CONTENT (%)									
204.2	GROUND SURFACE						204	<div><div></div><div></div><div></div><div></div><div></div></div>					<div><div></div><div></div><div></div></div>			0 33 48 19						
0.0	ASPHALT (200mm)							<div><div></div><div></div><div></div><div></div><div></div></div>					<div><div></div><div></div><div></div></div>									
0.2	SAND and GRAVEL, trace silt, trace clay Dense Brown Moist (FILL)		1	SS	35			<div><div></div><div></div><div></div><div></div><div></div></div>					<div><div></div><div></div><div></div></div>									
203.5								203	<div><div></div><div></div><div></div><div></div><div></div></div>					<div><div></div><div></div><div></div></div>								
0.8	Silty CLAY, with sand, trace gravel Hard to Very Stiff Brown Moist (TILL)		2	SS	36				<div><div></div><div></div><div></div><div></div><div></div></div>					<div><div></div><div></div><div></div></div>								
									202	<div><div></div><div></div><div></div><div></div><div></div></div>					<div><div></div><div></div><div></div></div>							
			3	SS	20					<div><div></div><div></div><div></div><div></div><div></div></div>					<div><div></div><div></div><div></div></div>							
										201	<div><div></div><div></div><div></div><div></div><div></div></div>							<div><div></div><div></div><div></div></div>				
			4	SS	37						<div><div></div><div></div><div></div><div></div><div></div></div>							<div><div></div><div></div><div></div></div>				
											200	<div><div></div><div></div><div></div><div></div><div></div></div>						<div><div></div><div></div><div></div></div>				
			5	SS	23	<div><div></div><div></div><div></div><div></div><div></div></div>						<div><div></div><div></div><div></div></div>										
						199	<div><div></div><div></div><div></div><div></div><div></div></div>					<div><div></div><div></div><div></div></div>										
			6	SS	19		<div><div></div><div></div><div></div><div></div><div></div></div>					<div><div></div><div></div><div></div></div>										
							198	<div><div></div><div></div><div></div><div></div><div></div></div>					<div><div></div><div></div><div></div></div>									
198.6								197				<div><div></div><div></div><div></div><div></div><div></div></div>					<div><div></div><div></div><div></div></div>					
5.6									197			<div><div></div><div></div><div></div><div></div><div></div></div>					<div><div></div><div></div><div></div></div>					
	Stiff		7	SS	14							<div><div></div><div></div><div></div><div></div><div></div></div>					<div><div></div><div></div><div></div></div>					
										196		<div><div></div><div></div><div></div><div></div><div></div></div>					<div><div></div><div></div><div></div></div>					
197.1												196	<div><div></div><div></div><div></div><div></div><div></div></div>					<div><div></div><div></div><div></div></div>				
7.2			8	SS	22						<div><div></div><div></div><div></div><div></div><div></div></div>					<div><div></div><div></div><div></div></div>						
											195		<div><div></div><div></div><div></div><div></div><div></div></div>					<div><div></div><div></div><div></div></div>				
196.0						194							<div><div></div><div></div><div></div><div></div><div></div></div>					<div><div></div><div></div><div></div></div>				
8.2	END OF BOREHOLE AT 8.2m. BOREHOLE OPEN AND WATER LEVEL AT 7.3 DEPTH UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO 7.0m, AUGER CUTTINGS TO 0.8m, BENTONITE HOLEPLUG TO 0.2m, THEN COLD PATCH ASPHALT TO SURFACE.												193	<div><div></div><div></div><div></div><div></div><div></div></div>					<div><div></div><div></div><div></div></div>			
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													113			<div><div></div><div></div><div></div><div></div><div></div></div>					<div><div></div><div></div><div></div></div>	
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								111								<div><div></div><div></div><div></div><div></div><div></div></div>					<div><div></div><div></div><div></div></div>	
									110							<div><div></div><div></div><div></div><div></div><div></div></div>					<div><div></div><div></div><div></div></div>	
														109		<div><div></div><div></div><div></div><div></div><div></div></div>					<div><div></div><div></div><div></div></div>	
										108						<div><div></div><div></div><div></div><div></div><div></div></div>					<div><div></div><div></div><div></div></div>	
												107				<div><div></div><div></div><div></div><div></div><div></div></div>					<div><div></div><div></div><div></div></div>	
															106	<div><div></div><div></div><div></div><div></div><div></div></div>					<div><div></div><div></div><div></div></div>	
											105					<div><div></div><div></div><div></div><div></div><div></div></div>					<div><div></div><div></div><div></div></div>	
						104										<div><div></div><div></div><div></div><div></div><div></div></div>					<div><div></div><div></div><div></div></div>	
													103			<div><div></div><div></div><div></div><div></div><div></div></div>					<div><div></div><div></div><div></div></div>	
							102									<div><div></div><div></div><div></div><div></div><div></div></div>					<div><div></div><div></div><div></div></div>	
								101								<div><div></div><div></div><div></div><div></div><div></div></div>					<div><div></div><div></div><div></div></div>	
									100							<div><div></div><div></div><div></div><div></div><div></div></div>					<div><div></div><div></div><div></div></div>	
														99		<div><div></div><div></div><div></div><div></div><div></div></div>					<div><div></div><div></div><div></div></div>	
										98						<div><div></div><div></div><div></div><div></div><div></div></div>					<div><div></div><div></div><div></div></div>	
												97				<div><div></div><div></div><div></div><div></div><div></div></div>					<div><div></div><div></div><div></div></div>	
															96	<div><div></div><div></div><div></div><div></div><div></div></div>					<div><div></div><div></div><div></div></div>	
											95					<div><div></div><div></div><div></div><div></div><div></div></div>					<div><div></div><div></div><div></div></div>	
						94										<div><div></div><div></div><div></div><div></div><div></div></div>					<div><div></div><div></div><div></div></div>	
													93			<div><div></div><div></div><div></div><div></div><div></div></div>					<div><div></div><div></div><div></div></div>	
							92									<div><div></div><div></div><div></div><div></div><div></div></div>					<div><div></div><div></div><div></div></div>	
								91								<div><div></div><div></div><div></div><div></div><div></div></div>					<div><div></div><div></div><div></div></div>	
									90							<div><div></div><div></div><div></div><div></div><div></div></div>					<div><div></div><div></div><div></div></div>	
														89		<div><div></div><div></div><div></div><div></div><div></div></div>					<div><div></div><div></div></div>	

ONTMT452 MTO-15786.GPJ 2017TEMPLATE(MTO).GDT 12/4/18

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

RECORD OF BOREHOLE No MS 2-09

1 OF 2

METRIC

ŌNV.P. 2930-FI-00 LOCATION N 4 859 442.5 E 314 610.6 ORIGINATED BY KK
 HWY 404 BOREHOLE TYPE Solid Stem Augers COMPILED BY MP
 DATUM Geodetic DATE 2018.07.29 - 2018.07.29 LATITUDE 43.874890 LONGITUDE -79.377926 CHECKED BY RD

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa				WATER CONTENT (%)				
204.0	GROUND SURFACE							20 40 60 80 100								
0.0	ASPHALT (150mm)		1	SS												
0.2	SAND and GRAVEL, trace silt, trace clay (FILL)															
203.3																
0.7	Silty SAND, some gravel, trace clay Dense to Compact Brown Moist (FILL)		2	SS	45		203									
			3	SS	30		202									
			4	SS	24											
201.0							201									
3.0	SILT, some clay Compact Brown Moist		5	SS	14		200									
			6	SS	12		199									0 0 88 12
198.3																
5.6	Silty CLAY, trace sand, trace gravel Very Stiff to Hard Brown Moist (TILL)		7	SS	22		198									
							197									
			8	SS	35		196									2 9 42 47
195.4							195									
8.5	SAND and SILT, trace gravel, trace clay Very Dense Brown Moist (TILL)		9	SS	89											
							194									

Continued Next Page

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

METRIC





[illegible]

RECORD OF BOREHOLE No R-04

1 OF 3

METRIC

O&V.P. 2930-FI-00 LOCATION Rouge River Bridge - MTM NAD 83 Zone10: N 4 859 394.1 E 314 640.6 ORIGINATED BY SB
 HWY 404 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MP
 DATUM Geodetic DATE 2018.05.24 - 2018.05.25 LATITUDE 43.874453 LONGITUDE -79.377555 CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE					W _P W W _L WATER CONTENT (%)				GR	SA	SI	CL	
202.9	GROUND SURFACE							20	40	60	80	100									
0.0	Silty CLAY , with sand, trace gravel, occasional organics Firm to Very Stiff Brown Moist (FILL)		1	SS	16		202							○							
			2	SS	10								○								
			3	SS	7								○								
			4	SS	9									○							
			5	SS	6									○							
			6	SS	17				198						○						
			7	SS	17										○						
	Brown to Grey		8	SS	25		195							○							
193.3			9	SS	16								○								
9.6	ORGANICS: (400mm)						193														
192.9	Dark Brown																				

Continued Next Page

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

METRIC

SOIL PROFILE					
ELEV DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES	GROUND WATER CONDITIONS	ELEVATION SCALE
<div>DYNAMIC CONE PENETRATION RESISTANCE PLOT<div>20406080100</div><div>SHEAR STRENGTH kPa○ UNCONFINED + FIELD VANE● QUICK TRIAXIAL × LAB VANE</div></div> <div><div>PLASTIC LIMITNATURAL MOISTURE CONTENTLIQUID LIMIT</div><div>w_P w w_L</div><div>WATER CONTENT (%)</div><div>204060</div></div> <div>UNIT WEIGHTγkN/m³</div> <div>REMARKS & GRAIN SIZE DISTRIBUTION (%)GR SA SI CL</div>					
Continued From Previous Page					
10.0	<div>SAND, trace silt, trace to some gravel</div> <div>Very Dense to Dense</div> <div>Brown</div> <div>Wet</div>				
	Clay pockets		10SS78		192
					191
			11SS43		190
					189
			12SS62		188
188.4					187
14.5	<div>Gravelly SAND, trace silt, trace clay, occasional cobbles</div> <div>Very Dense</div> <div>Grey</div> <div>Wet</div>		13SS100/ 0.275		186
					185
186.3					184
16.6	<div>Silty CLAY, trace sand, trace gravel</div> <div>Hard</div> <div>Grey</div> <div>Wet</div> <div>(TILL)</div>		14SS100/ 0.150		183
			15SS100/ 0.125		

+³, ×³: Numbers refer to Sensitivity

RECORD OF BOREHOLE No R-04

3 OF 3

METRIC

O&M.P. 2930-FI-00 LOCATION Rouge River Bridge - MTM NAD 83 Zone10: N 4 859 394.1 E 314 640.6 ORIGINATED BY SB
 HWY 404 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MP
 DATUM Geodetic DATE 2018.05.24 - 2018.05.25 LATITUDE 43.874453 LONGITUDE -79.377555 CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W _P	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE								
	Continued From Previous Page		16	SS	100/ 0.200											
	Silty CLAY , trace sand, trace gravel Hard Grey Wet (TILL)						182									
			17	SS	77		181									0 0 35 65
			18	SS	100/ 0.200		180									
							179									
177.9			19	SS	95		178									
25.0	END OF BOREHOLE AT 25.0m. WATER LEVEL AT 11.6m UPON COMPLETION. Well installation consists of 19mm diameter Schedule 40 PVC pipe with a 3.05m slotted screen. WATER LEVEL READINGS DATE DEPTH(m) ELEV.(m) 2018.06.22 9.5 193.4 2018.09.30 9.5 193.4 2018.11.23 12.3 190.6															

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RECORD OF BOREHOLE No TS 2-01

1 OF 1

METRIC

O&P. 2930-FI-00 LOCATION N 4 860 285.0 E 314 483.9 ORIGINATED BY BL
 HWY 404 BOREHOLE TYPE Solid Stem Augers COMPILED BY MP
 DATUM Geodetic DATE 2018.08.02 - 2018.08.02 LATITUDE 43.882475 LONGITUDE -79.379488 CHECKED BY RD

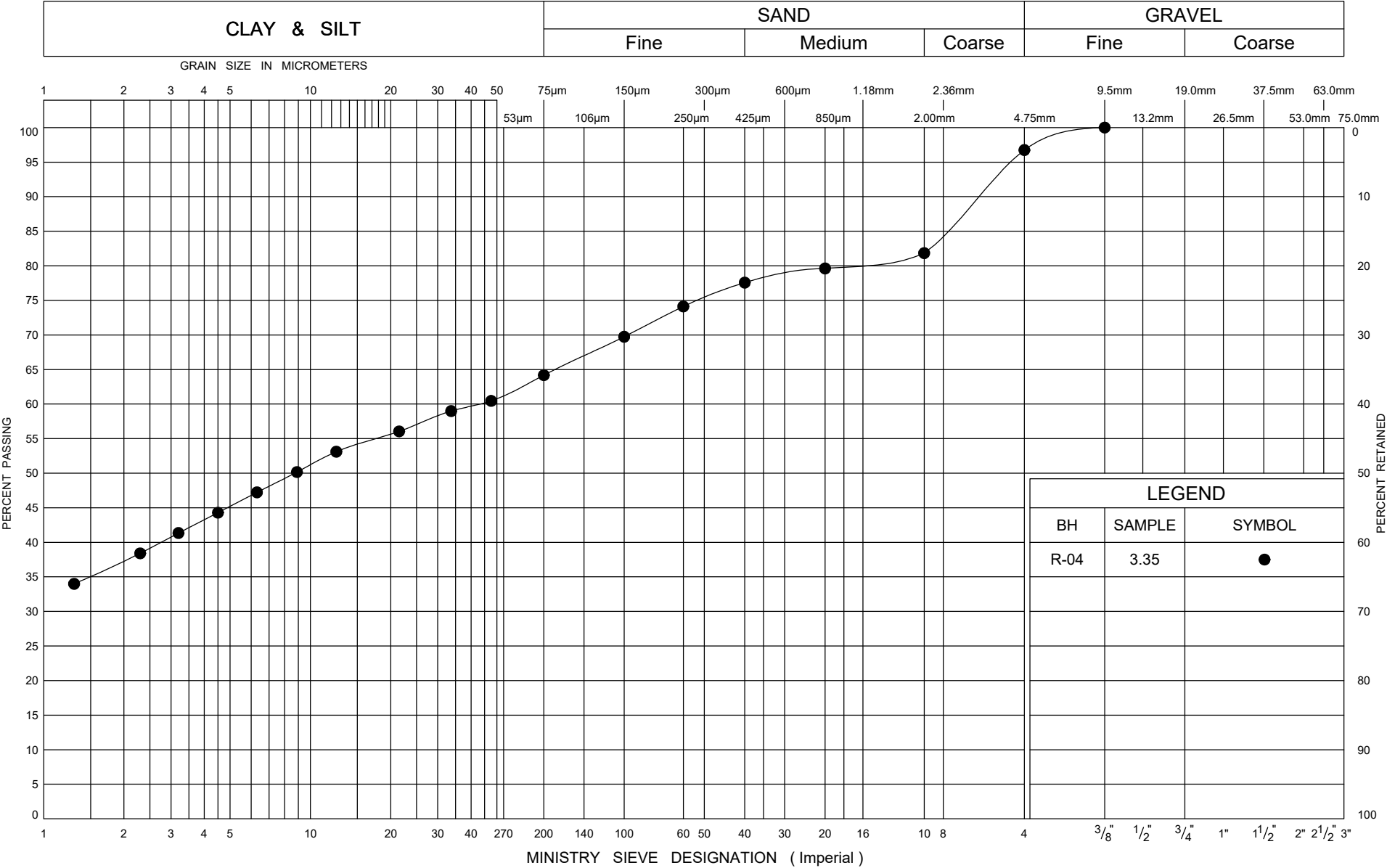
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)						
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa												
209.6	GROUND SURFACE							20	40	60	80	100								
0.0	ASPHALT (150mm)																			
0.2	SAND and GRAVEL Compact Brown Moist (FILL)		1	SS	26		209													
208.6																				
1.0	Silty CLAY, with sand, trace gravel Hard Grey Moist (TILL)		2	SS	40		208													
			3	SS	100/ 0.275		208													
			4	SS	90		207													
			5	SS	100/ 0.200		207													
							206													
			6	SS	100/ 0.250		205													
							204													
			7	SS	100/ 0.250		203													
							202													
201.6			8	SS	100/ 0.250															
8.0	END OF BOREHOLE AT 8.0m. BOREHOLE OPEN AND DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH AUGER CUTTINGS TO 0.2m, THEN COLD PATCH ASPHALT TO SURFACE.																			

+³, ×³: Numbers refer to
Sensitivity

20
15
10

(%) STRAIN AT FAILURE

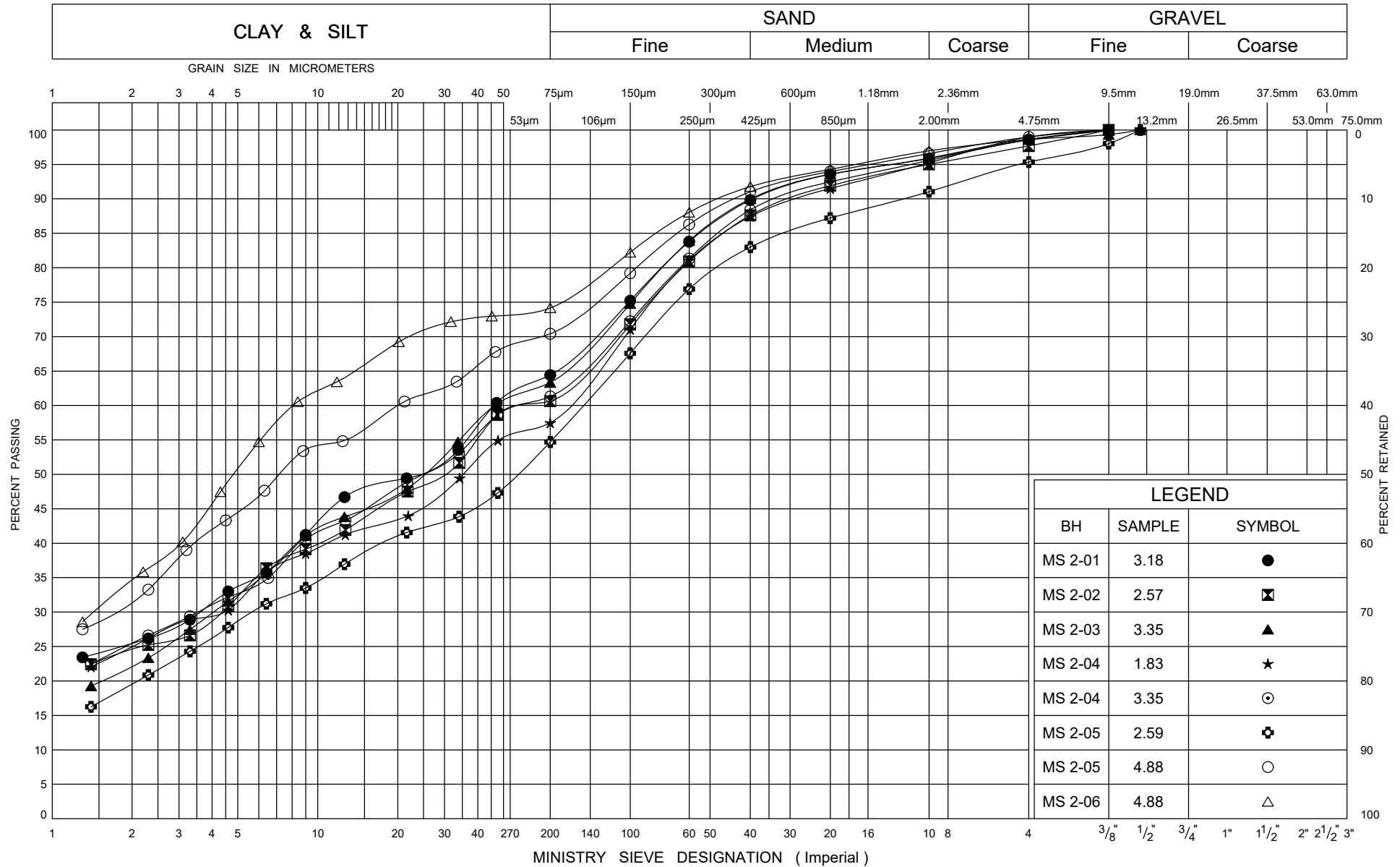
UNIFIED SOIL CLASSIFICATION SYSTEM



GRAIN SIZE DISTRIBUTION
Silty CLAY FILL

FIG No C1
G W P 2930-17-00

UNIFIED SOIL CLASSIFICATION SYSTEM



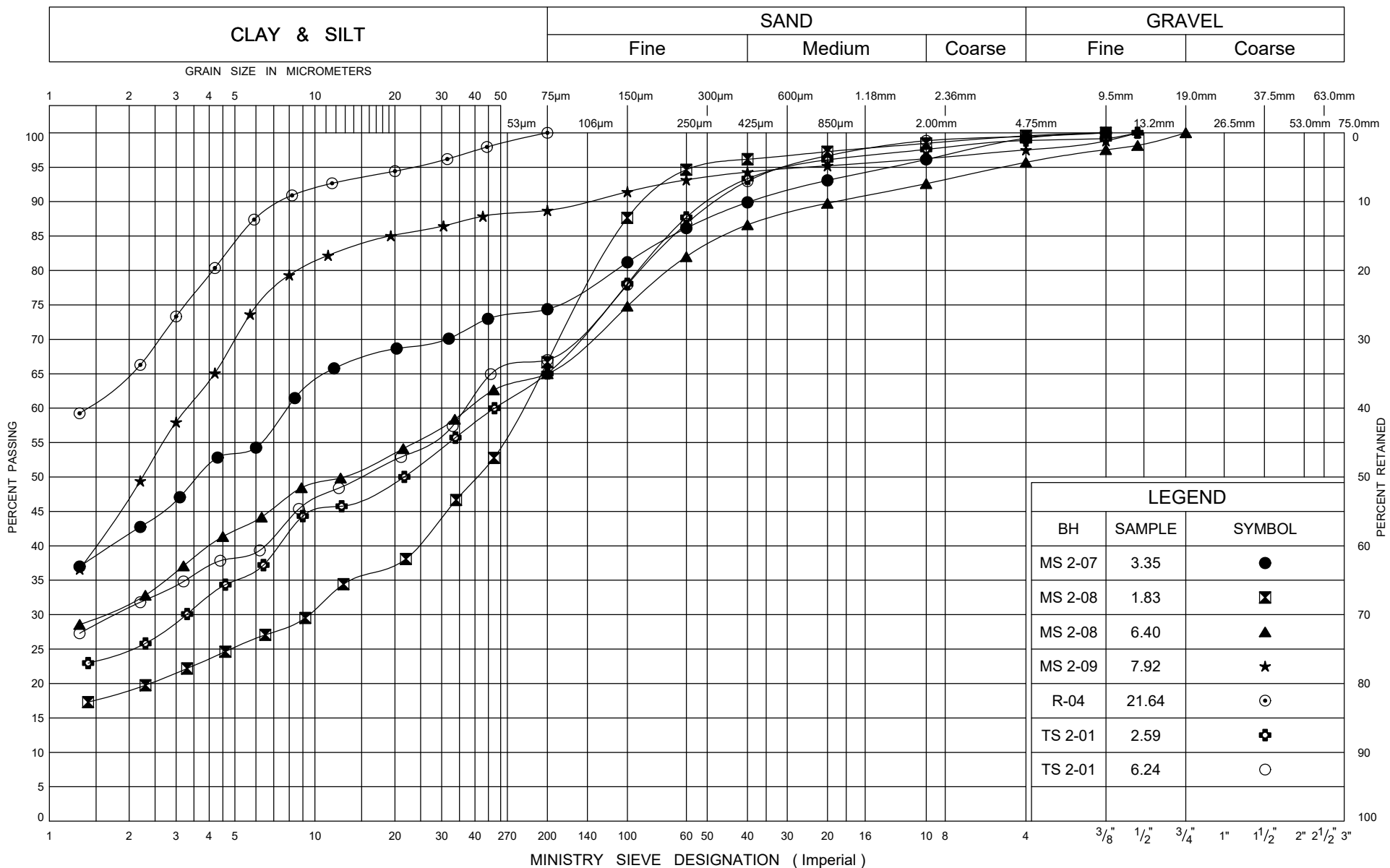
Ministry of
Transportation

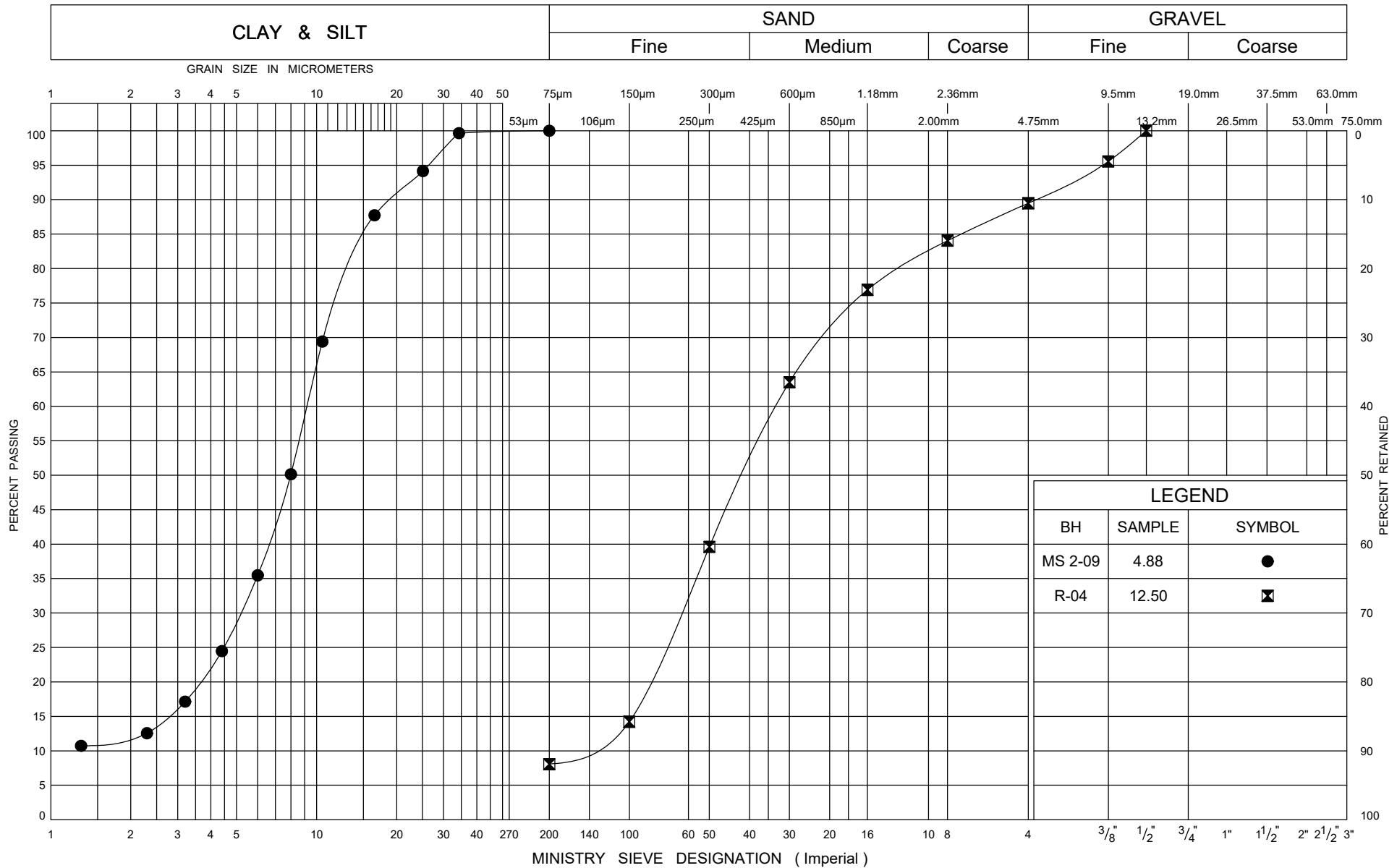
GRAIN SIZE DISTRIBUTION

Silty CLAY TILL

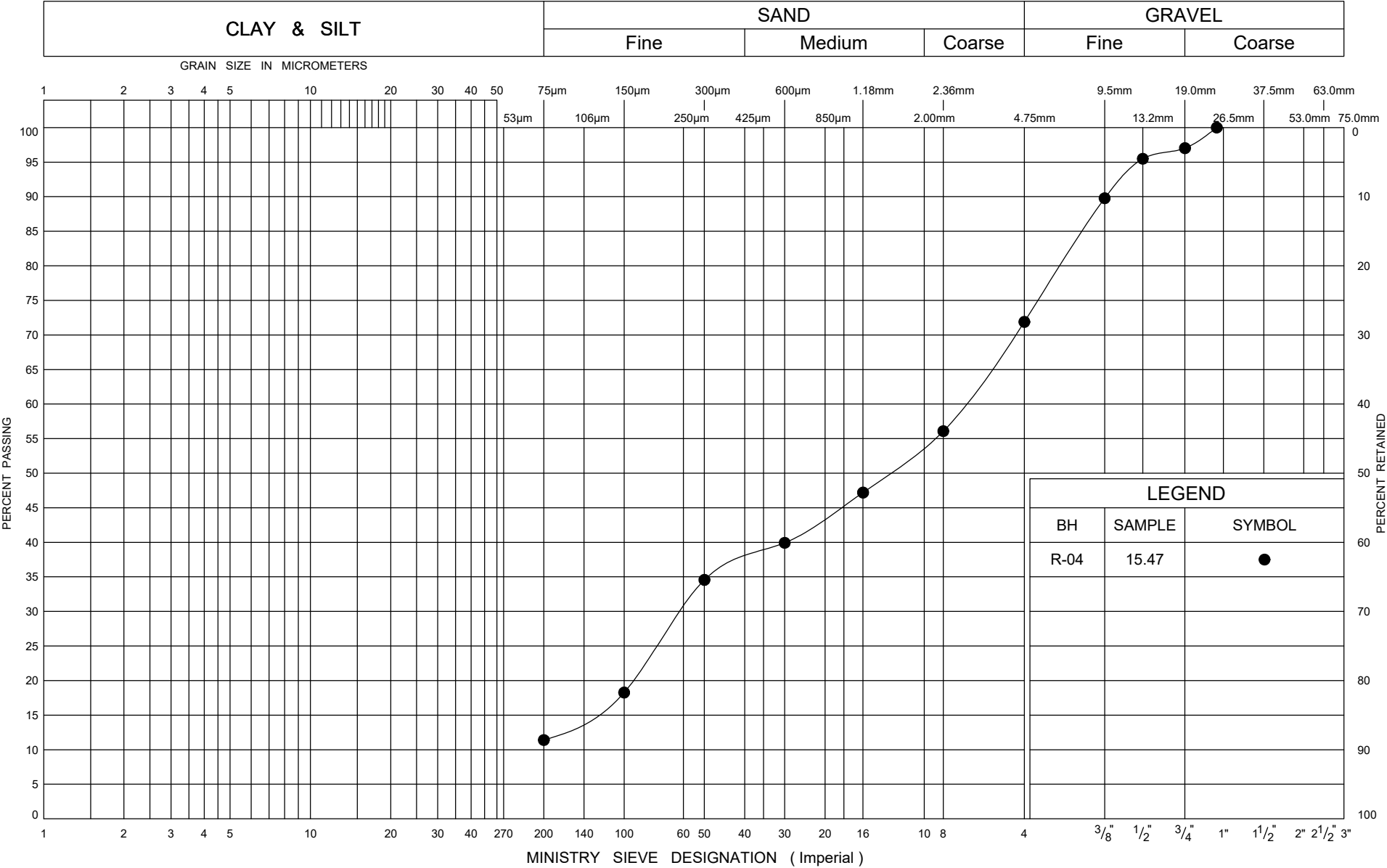
FIG No C2

G W P 2930-17-00



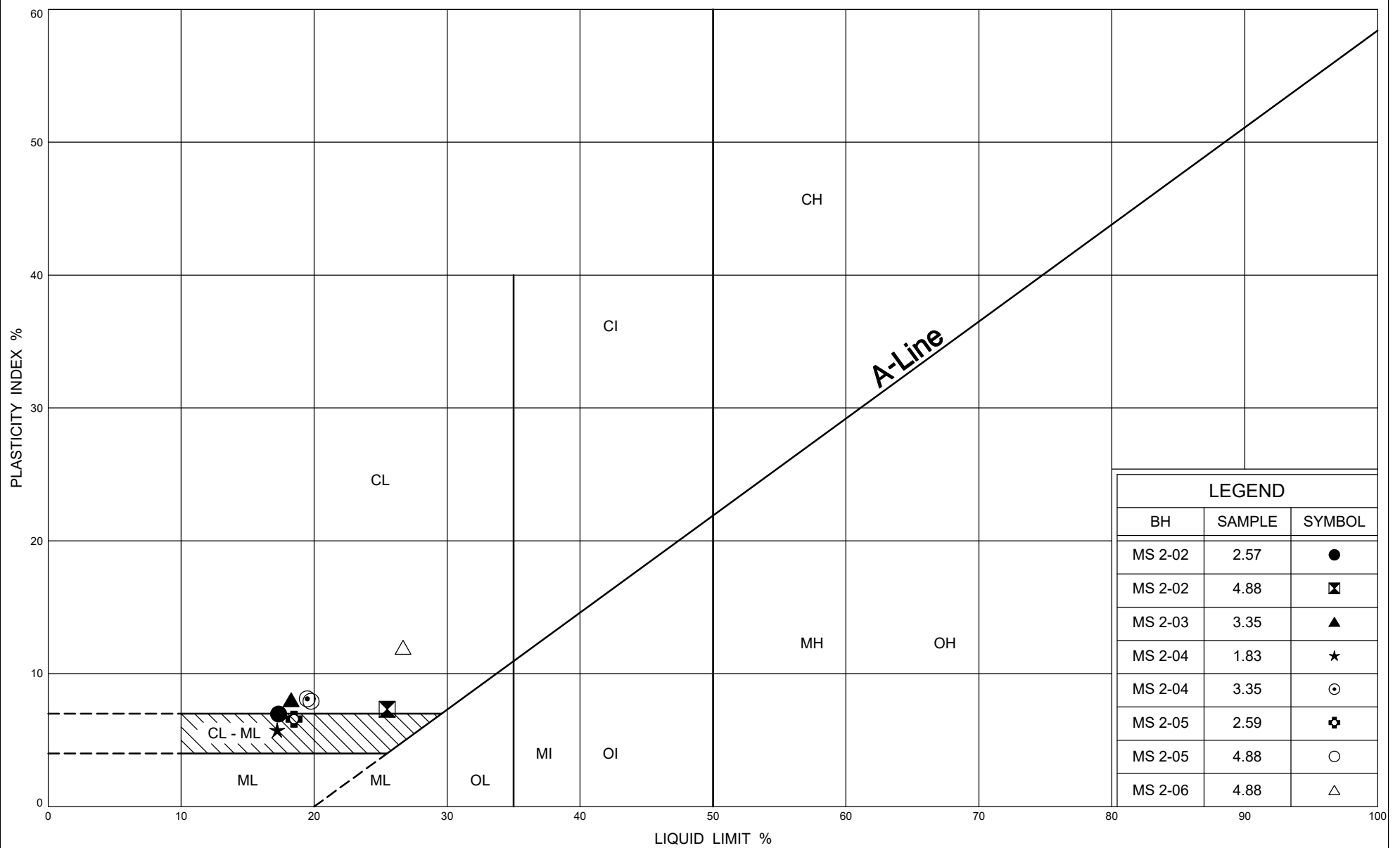


UNIFIED SOIL CLASSIFICATION SYSTEM



GRAIN SIZE DISTRIBUTION
Gravelly SAND

FIG No C5
G W P 2930-17-00



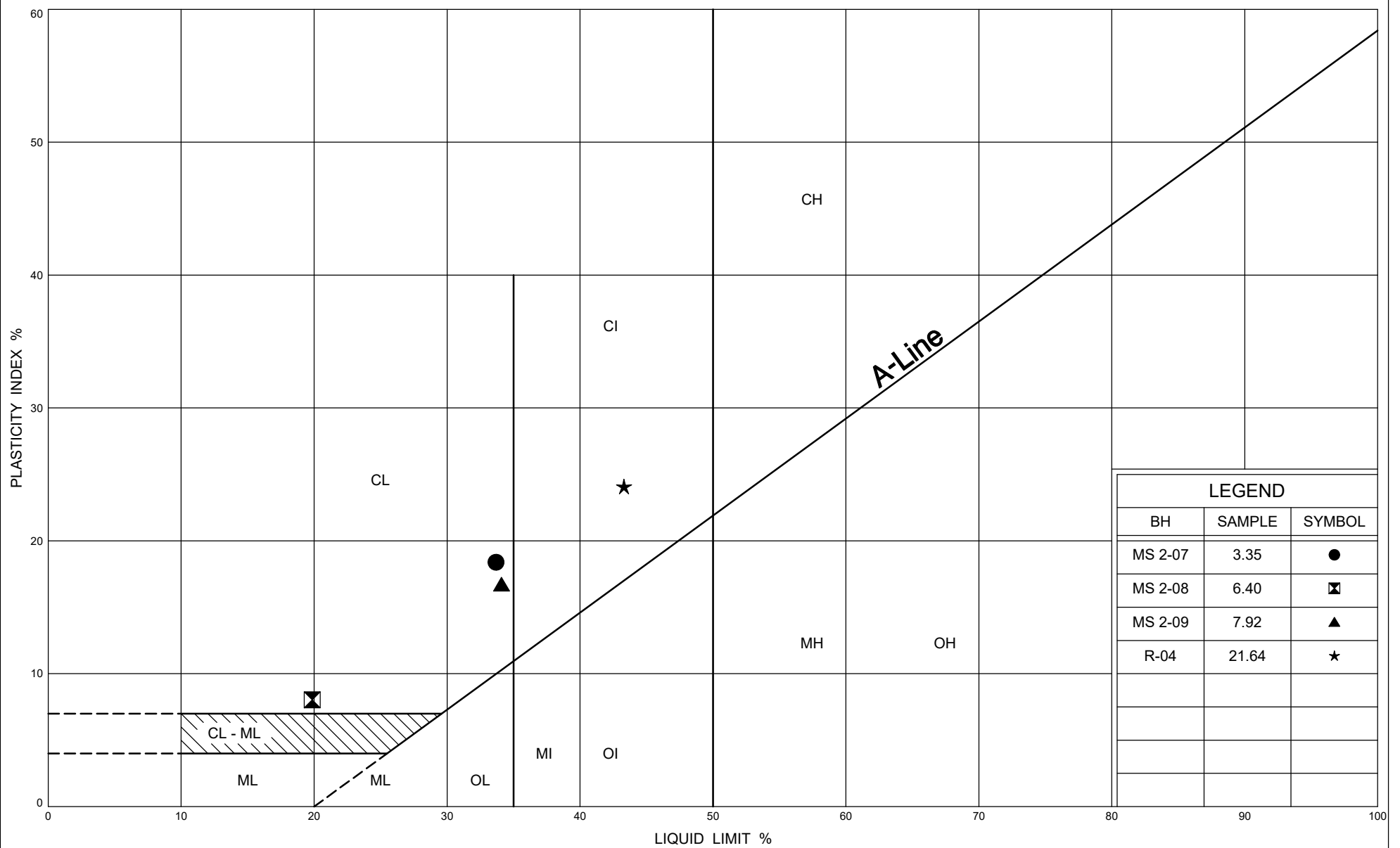
Ministry of
Transportation

PLASTICITY CHART

Silty CLAY TILL

FIG No C6

G W P 2930-17-00



LEGEND		
BH	SAMPLE	SYMBOL
MS 2-07	3.35	●
MS 2-08	6.40	⊠
MS 2-09	7.92	▲
R-04	21.64	★

PLASTICITY CHART Silty CLAY TILL

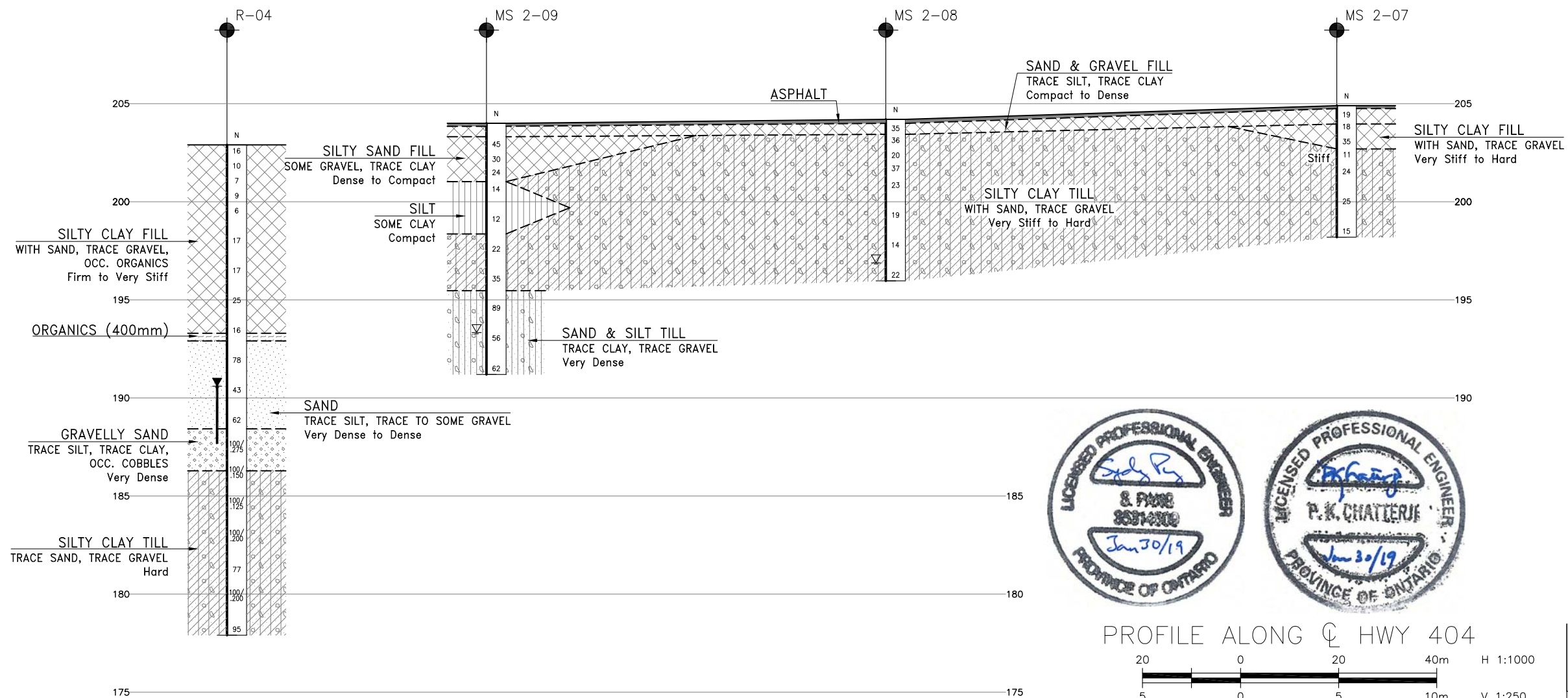
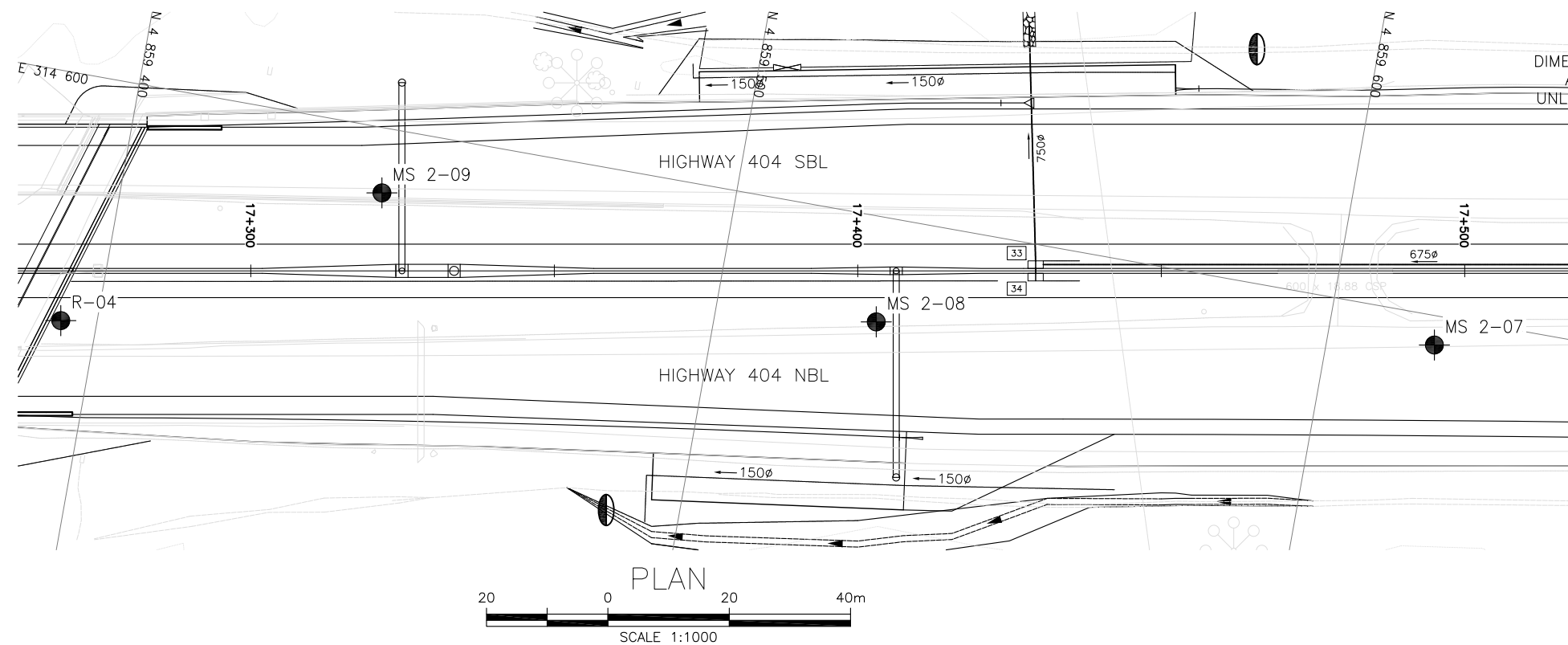
FIG No C7

G W P 2930-17-00



Ministry of
Transportation

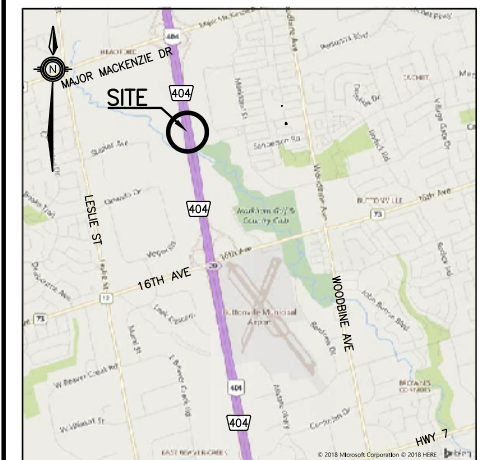
Ontario



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






CONT No
GWP No 2930-17-00

HIGHWAY 404 WIDENING MEDIAN SEWER STA 17+280 TO STA 17+500 BOREHOLE LOCATIONS AND SOIL STRATA	
--	--



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

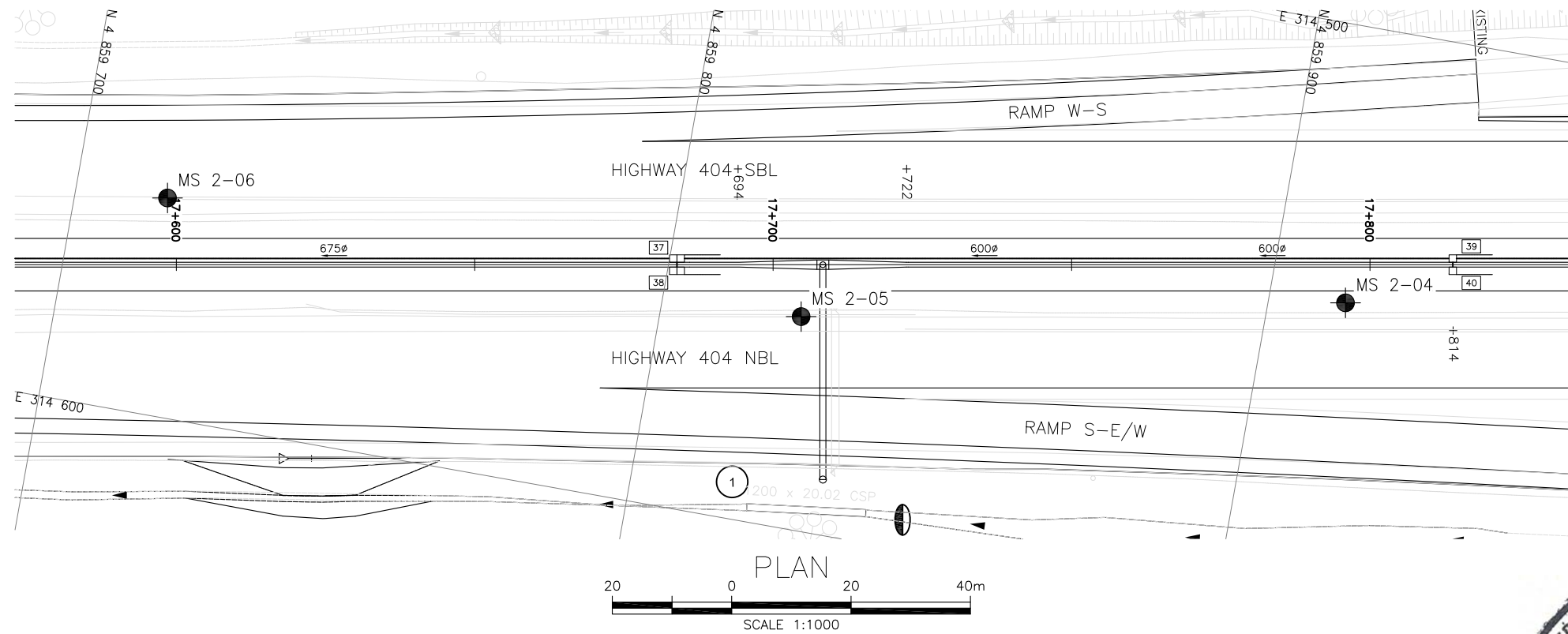
[illegible]

-NOTES-

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

GEOCRES No. 30M14-497

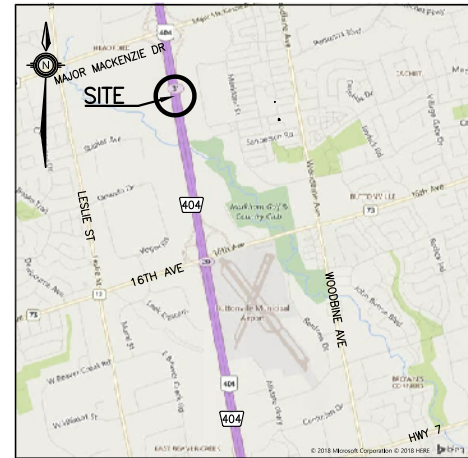
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METRIC
DIMENSIONS ARE IN METRES
AND/OR MILLIMETRES
UNLESS OTHERWISE SHOWN

CONT No
GWP No 2930-17-00

HIGHWAY 404 WIDENING
MEDIAN SEWER
STA 17+600 TO STA 17+800
BOREHOLE LOCATIONS AND SOIL STRATA



KEYPLAN

LEGEND

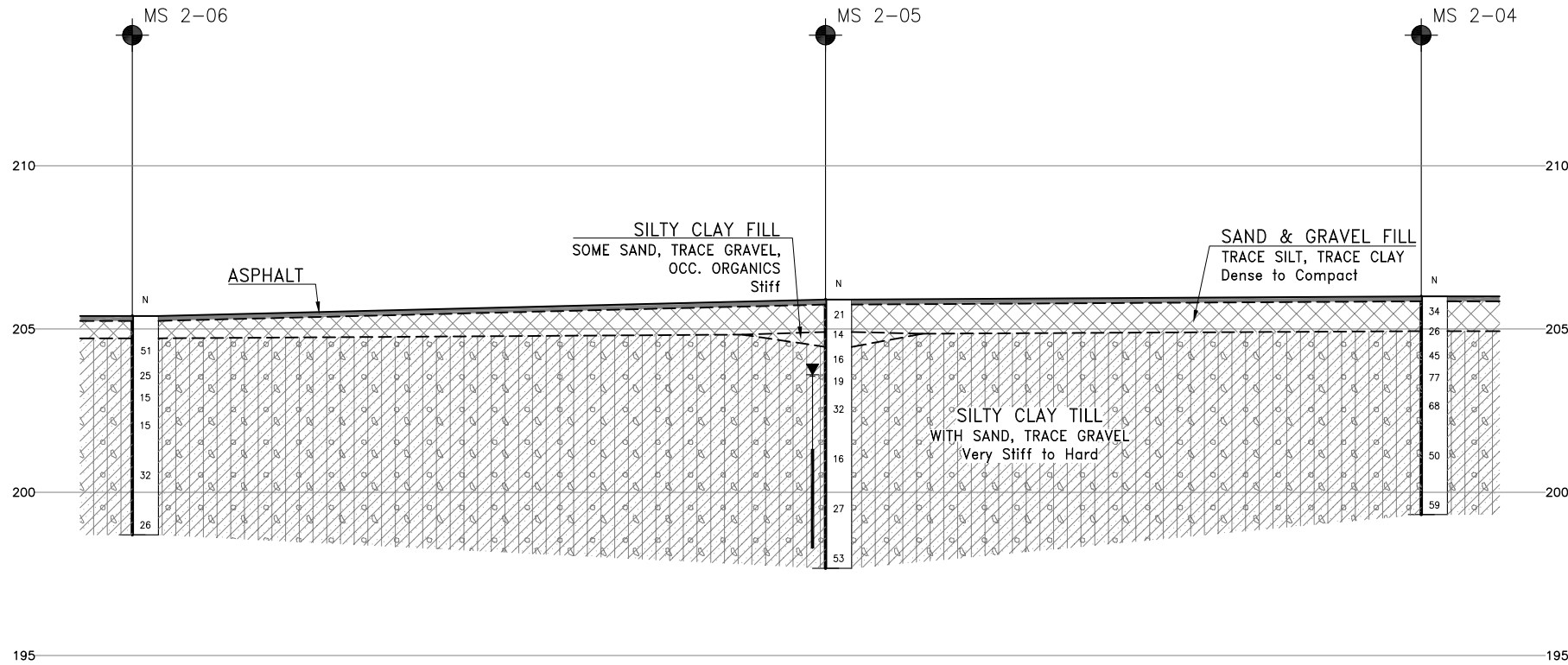
	Borehole
	Borehole and Cone
N	Blows /0.3m (Std Pen Test, 475J/blow)
CONE	Blows /0.3m (60° Cone, 475J/blow)
PH	Pressure, Hydraulic
	Water Level
	Head Artesian Water
	Piezometer
90%	Rock Quality Designation (RQD)
A/R	Auger Refusal

NO	ELEVATION	NORTHING	EASTING
MS 2-04	206.0	4 859 912.8	314 546.2
MS 2-05	205.9	4 859 823.4	314 564.5
MS 2-06	205.4	4 859 715.4	314 563.6

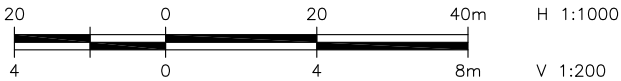
-NOTES-

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

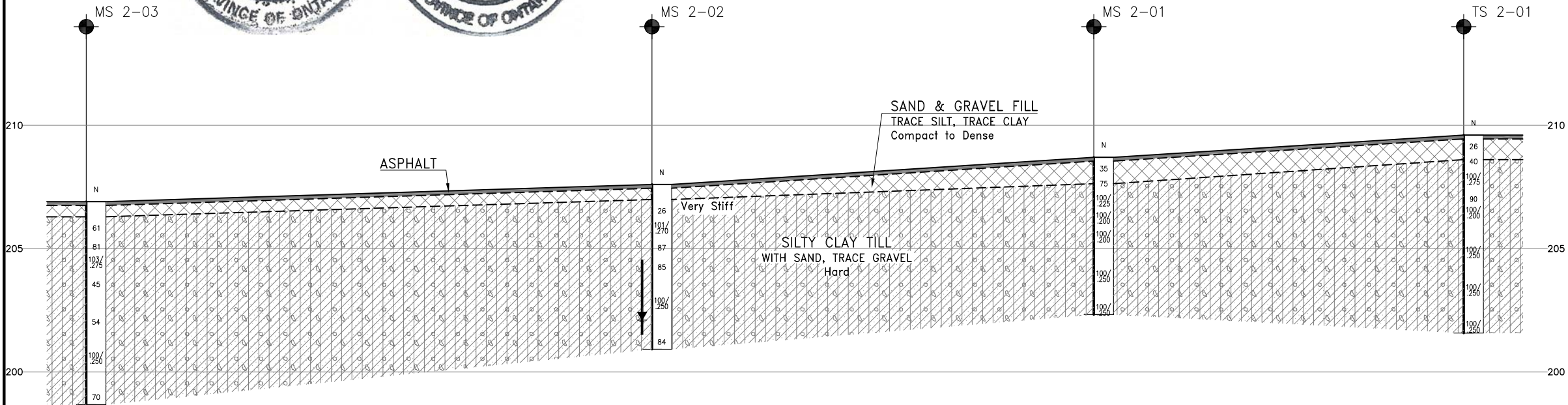
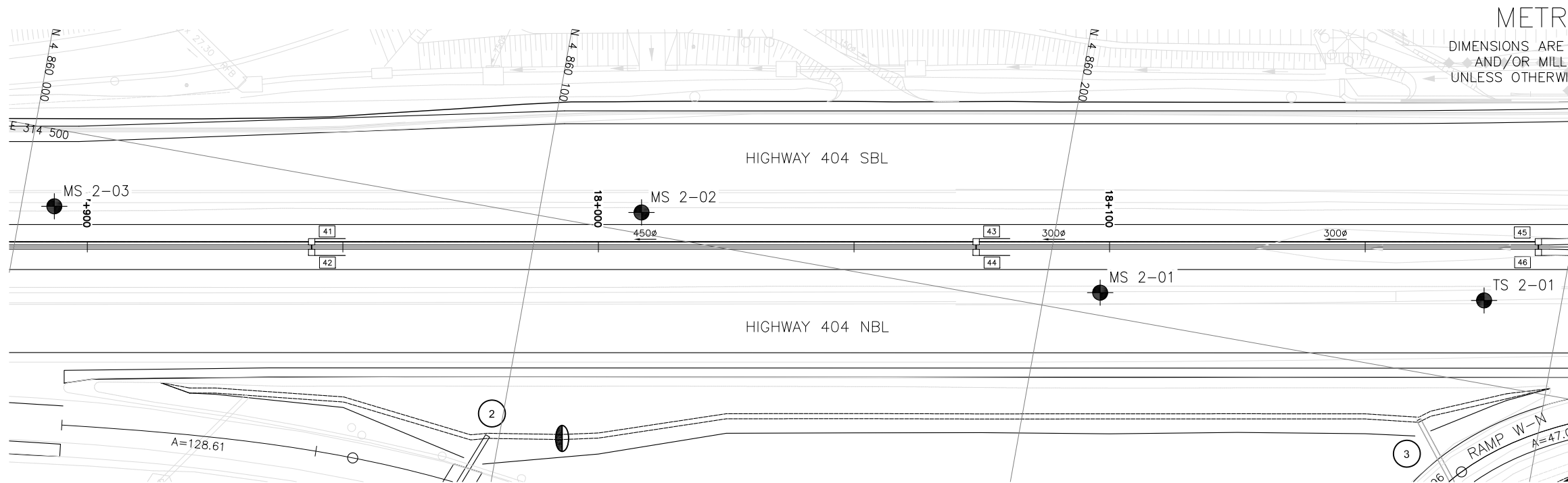
GEOCRES No. 30M14-497



PROFILE ALONG C HWY 404



REVISIONS	DATE	BY	DESCRIPTION
DESIGN	RPR	CHK SKP	CODE
DRAWN	AN	CHK RPR	SITE
			LOAD
			DATE
			JAN 2019
			STRUCT
			DWG C2

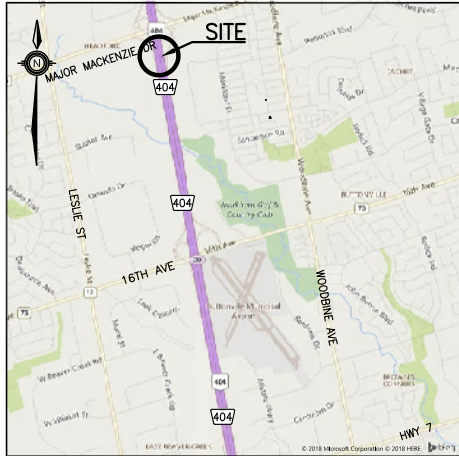


PROFILE ALONG HWY 404

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

CONT No
GWP No 2930-17-00

HIGHWAY 404 WIDENING
MEDIAN SEWER
STA 17+900 TO STA 18+190
BOREHOLE LOCATIONS AND SOIL STRATA



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
MS 2-01	208.7	4 860 210.8	314 495.6
MS 2-02	207.6	4 860 119.7	314 495.9
MS 2-03	206.9	4 860 006.4	314 514.9
TS 2-01	209.6	4 860 285.0	314 483.9

-NOTES-

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

GEOCRES No. 30M14-497

REVISIONS	DATE	BY	DESCRIPTION
DESIGN	RPR	CHK SKP	CODE
DRAWN	AN	CHK RPR	SITE
			LOAD
			STRUCT
			DWG C3
			DATE JAN 2019



Appendix D

List of Ontario Provincial Standards and Suggested Working for NSSP



1. List of Ontario Provincial Standards Referenced in this Report

- OPSS.PROV 401
- OPSS.PROV 410
- OPSS 492
- OPSS.PROV 501
- OPSS.PROV 539
- OPSS.PROV 1004
- OPSS.PROV 1010
- OPSD 802.030
- OPSD 802.031
- OPSD 802.032

2. Suggested Text for NSSP on Open Cut Excavation.

The Contractor's attention is drawn to the following:

- The fill materials and glacial till deposits may contain cobbles and boulders. The Contractor must be equipped to dislodge, remove and otherwise hand such obstructions during excavation.

3. Suggested Text for NSSP on Ground Movement Adjacent to Trenches.

The Contractor's attention is drawn to the following:

- All trenching and other excavations shall not adversely affect the adjacent highway operation. Regardless of whether open cutting, trench box or other types of ground support is used, ground movement adjacent to trenches and excavations must not exceed the limit provided in Performance Level 2 as per Clause 539.04.01.01 in OPSS.PROV 539.