



**THURBER** ENGINEERING LTD.

**FOUNDATION INVESTIGATION AND DESIGN REPORT  
OVERHEAD, HIGH OCCUPANCY TOLL  
HIGH OCCUPANCY MESSAGE, EMERGENCY DETOUR ROUTE,  
HIGHWAY 407 ETR. AND TOLL STATION SIGN SUPPORTS  
CONTRACT 2  
HIGHWAY 404 HOV LANE EXPANSION AND REHABILITATION  
FROM MAJOR MACKENZIE DRIVE TO SOUTH OF HIGHWAY 7  
MARKHAM, ONTARIO  
G.W.P. 2930-17-00**

**GEOCRES NO. 30M14-488**

**Latitude: 43.86527  
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**Report**

to

**WSP Canada Inc.**

Date: February 5, 2019  
File: 15786



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**GEOCRETS NO. 30M14-488**

**PART 1: FACTUAL INFORMATION**

**1. INTRODUCTION**

This report presents the factual findings obtained from a foundation investigation conducted for detailed design of overhead sign (OHS), high occupancy toll sign (HOV), high occupancy message sign (HMS), emergency detour route (EDR), Highway 407 ETR sign (407ETR), and toll station sign (TS) support structures along Highway 404 from 0.3 km north of Major Mackenzie Drive to 0.6 m south of Highway 7 in the City of Markham, Ontario.

The purpose of this investigation was to explore the subsurface conditions near the sign locations along the highway alignment, and based on the data obtained, to provide a borehole location plan, records of boreholes, laboratory test results, and a written description of the subsurface conditions.

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

For preparation of this report, reference has been made to subsurface information contained in other reports for this Highway 404 project listed in the following:

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- Draft Foundation Investigation Report for Highway 404 16<sup>th</sup> 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 January 2019 (Reference 1).
- Draft Foundation Investigation Report for Rouge River NBL and SBL Bridges, Replacement and Widening, Highway 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 January 2019. (Reference 2).
- Foundation Investigation Report for Median Sewer, Highway 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 January 2019. (Reference 3).

## **2. PROJECT AND SITE DESCRIPTION**

The overhead sign support structures covered in this report are located along Highway 404 from approximately 0.3 km north of Major Mackenzie Drive to 0.7 m south of Highway 7. The general locations of the proposed signs are shown on the key plan on the Borehole Location Plan drawings in Appendix D.

The project limits are 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.

The land use adjacent to this section of Highway 404 is largely rural and agricultural, although there is increasing residential and commercial developments in recent years. The vegetation cover beyond the paved areas of the highway comprises grass, shrubs and stands of trees.

## **3. SITE INVESTIGATION AND FIELD TESTING**

A selected forty-two (42) boreholes to approximate depths ranging from 7.7 m to 12.8 m below existing grade have been utilized to address foundation design for the sign supports. The site

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investigation and field testing program for these boreholes was carried out from July 8 to October 23<sup>rd</sup>, 2018.

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 locations of the boreholes are shown on the Borehole Location Plan drawings included in Appendix D. Northing and easting co-ordinates at the borehole locations were obtained by Thurber using a GPS unit, 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 in Appendix D and on the individual Record of Borehole Sheets in Appendices A to C. The precision of the horizontal survey of the boreholes is rated at within 1 m, whereas the precision of the elevation is the same as that of the DTM survey.

The boreholes were advanced using truck-mounted Marl 5 and D-90 drill rigs. Solid stem augers were used to advance the boreholes, and soil samples were obtained at selected intervals using a 50 mm diameter split spoon sampler in conjunction with the Standard Penetration Test (SPT).

A member of Thurber's engineering staff supervised the drilling and sampling operations on a full-time basis. The supervisor 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 in selected boreholes to permit monitoring of groundwater levels. The piezometers consisted of 19 mm PVC pipes with slotted screens. At the time of writing of this report, the piezometers have not been decommissioned. Upon completion, the boreholes were abandoned in general accordance with Ontario Regulation 903 amended by Ontario Reg. 372 (O.Reg. 903). Once final readings are taken, all piezometer installations will be decommissioned in general accordance with O.Reg. 903. In general, groundwater level readings observed from boreholes drilled for other aspects of this Highway 404 project have been used. The details of borehole completion are summarized in Table 3.1.



**Table 3.1 – Borehole Completion Details**

<b>Borehole No.</b>	<b>Borehole Depth / Base Elevation (m)</b>	<b>Piezometer Tip Depth /Elevation (m)</b>	<b>Completion Details</b>
EDR2-01	8.2/204.5	None installed	Borehole backfilled with bentonite holeplug and auger cuttings to 0.2 m, then dry mix concrete and cold patch asphalt to surface
EDR2-02	8.2/203.6	None installed	Borehole backfilled with bentonite holeplug and auger cuttings to 0.2 m, then dry mix concrete and cold patch asphalt to surface
TS2-01	8.0/201.6	None installed	Borehole backfilled with bentonite holeplug and auger cuttings to 0.2 m, then dry mix concrete and cold patch asphalt to surface
MS2-03	8.2/198.7	None installed	Borehole backfilled with bentonite holeplug and auger cuttings to 0.2 m, then dry mix concrete and cold patch asphalt to surface
MS2-05	8.2/197.7	7.6/198.3	Borehole backfilled with sand filter from 8.2 m to 4.6 m, bentonite holeplug from 4.6 m to 3.4 m, then bentonite holeplug and auger cuttings from 3.4 m to 0.2 m, then dry mix concrete and cold patch asphalt to surface.
MS2-08	8.2/196.0	None installed	Borehole backfilled with bentonite holeplug and auger cuttings to 0.2 m, then dry mix concrete and cold patch asphalt to surface
MS2-09	12.8/191.2	None installed	Borehole backfilled with bentonite holeplug and auger cuttings to 0.2 m, then dry mix concrete and cold patch asphalt to surface
MS2-10	8.2/194.5	None installed	Borehole backfilled with bentonite holeplug and auger cuttings to 0.2 m, then dry mix concrete and cold patch asphalt to surface
MS2-11	8.2/194.0	None installed	Borehole backfilled with bentonite holeplug and auger cuttings to 0.2 m, then dry mix concrete and cold patch asphalt to surface
MS2-12	12.3/189.7	11.0/191.0	Borehole backfilled with sand filter from 11.0 m to 7.9 m, bentonite holeplug from 7.9 m to 6.7 m, then bentonite holeplug and auger cuttings from 6.7 m to 0.2 m, then dry mix concrete and cold patch asphalt to surface.



MS2-15	8.0/191.9	None installed	Borehole backfilled with bentonite holeplug and auger cuttings to 0.2 m, then dry mix concrete and cold patch asphalt to surface
MS2-17	8.2/190.9	None installed	Borehole backfilled with bentonite holeplug and auger cuttings to 0.2 m, then dry mix concrete and cold patch asphalt to surface
MS2-18	12.8/185.4	None installed	Borehole backfilled with bentonite holeplug and auger cuttings to 0.2 m, then dry mix concrete and cold patch asphalt to surface
TS2-02	12.8/182.5	None installed	Borehole backfilled with bentonite holeplug and auger cuttings to 0.2 m, then dry mix concrete and cold patch asphalt to surface
MS2-23	8.2/184.6	None installed	Borehole backfilled with bentonite holeplug and auger cuttings to 0.2 m, then dry mix concrete and cold patch asphalt to surface
MS2-25	8.2/183.2	None installed	Borehole backfilled with bentonite holeplug and auger cuttings to 0.2 m, then dry mix concrete and cold patch asphalt to surface
MS2-26	12.6/178.7	None installed	Borehole backfilled with bentonite holeplug and auger cuttings to 0.2 m, then dry mix concrete and cold patch asphalt to surface
MS2-27	8.2/182.2	None installed	Borehole backfilled with bentonite holeplug and auger cuttings to 0.2 m, then dry mix concrete and cold patch asphalt to surface
MS2-29	7.9/181.9	6.1/183.6	Borehole backfilled with sand filter from 6.1 m to 2.4 m, bentonite holeplug from 2.4 m to 0.9 m, then bentonite holeplug and auger cuttings from 0.9 m to 0.2 m, then dry mix concrete and cold patch asphalt to surface.
MS2-31	8.2/181.2	None installed	Borehole backfilled with bentonite holeplug and auger cuttings to 0.2 m, then dry mix concrete and cold patch asphalt to surface
TS2-03	8.2/182.2	None installed	Borehole backfilled with bentonite holeplug and auger cuttings to 0.2 m, then dry mix concrete and cold patch asphalt to surface
HMP2-01	12.8/190.4	None installed	Borehole backfilled with bentonite holeplug and auger cuttings to 0.2 m, then dry mix concrete and cold patch asphalt to surface
HMS2-01	8.2/182.6	None installed	Borehole backfilled with bentonite holeplug and auger cuttings to 0.2 m, then dry mix concrete and cold patch asphalt to surface



TS2-04	7.7/184.7	None installed	Borehole backfilled with bentonite holeplug and auger cuttings to 0.2 m, then dry mix concrete and cold patch asphalt to surface
TS2-05	7.8/185.4	None installed	Borehole backfilled with bentonite holeplug and auger cuttings to 0.2 m, then dry mix concrete and cold patch asphalt to surface
TS2-06	8.2/186.0	None installed	Borehole backfilled with bentonite holeplug and auger cuttings to 0.2 m, then dry mix concrete and cold patch asphalt to surface
HOV2-01	8.2/176.9	None installed	Borehole backfilled with bentonite holeplug and auger cuttings to 0.2 m, then dry mix concrete and cold patch asphalt to surface
OHS2-01	8.2/183.1	None installed	Borehole backfilled with bentonite holeplug and auger cuttings to 0.2 m, then dry mix concrete and cold patch asphalt to surface
OHS2-02	8.2/187.2	None installed	Borehole backfilled with bentonite holeplug and auger cuttings to 0.2 m, then dry mix concrete and cold patch asphalt to surface
OHS2-03	7.9/191.4	None installed	Borehole backfilled with bentonite holeplug and auger cuttings, then dry mix concrete and cold patch asphalt to surface
OHS2-04	7.9/194.5	None installed	Borehole backfilled with bentonite holeplug and auger cuttings to 0.2 m, then dry mix concrete and cold patch asphalt to surface
OHS2-05	8.2/195.5	None installed	Borehole backfilled with bentonite holeplug and auger cuttings to 0.2 m, then dry mix concrete and cold patch asphalt to surface
OHS2-06	8.2/197.5	None installed	Borehole backfilled with bentonite holeplug and auger cuttings to 0.2 m, then dry mix concrete and cold patch asphalt to surface
HMS2-02	8.1/182.5	None installed	Borehole backfilled with bentonite holeplug and auger cuttings to 0.2 m, then dry mix concrete and cold patch asphalt to surface
HMS2-03	8.2/184.4	None installed	Borehole backfilled with bentonite holeplug and auger cuttings to 0.2 m, then dry mix concrete and cold patch asphalt to surface
HMS2-04	8.2/193.5	None installed	Borehole backfilled with bentonite holeplug and auger cuttings to 0.2 m, then dry mix concrete and cold patch asphalt to surface



HMS2-05	8.2/195.9	None installed	Borehole backfilled with bentonite holeplug and auger cuttings to 0.2 m, then dry mix concrete and cold patch asphalt to surface
VMS2-01	8.2/181.9	None installed	Borehole backfilled with bentonite holeplug and auger cuttings to 0.2 m, then dry mix concrete and cold patch asphalt to surface
407ETR2-01	8.0/181.8	None installed	Borehole backfilled with bentonite holeplug and auger cuttings to 0.2 m, then dry mix concrete and cold patch asphalt to surface
407ETR2-02	8.2/180.5	None installed	Borehole backfilled with bentonite holeplug and auger cuttings to 0.2 m, then dry mix concrete and cold patch asphalt to surface
SWM-C2-1A	8.2/181.6	None installed	Borehole backfilled with bentonite holeplug and auger cuttings to surface
HWY7-02	10.9/184.2	None installed	Borehole backfilled with bentonite holeplug and auger cuttings to 0.2 m, then dry mix concrete and cold patch asphalt to surface

#### 4. LABORATORY TESTING

The recovered soil samples were subjected to Visual Identification (VI) and to natural moisture content determination. Selected samples were also subjected to grain size analysis and Atterberg Limits testing. All the laboratory tests were carried out in accordance to 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 borehole locations that are relevant to the proposed sign supports. Borehole location along Highway 404 are presented on the Borehole Location Plan drawings in Appendix D. These boreholes 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.



**Table 5.1  
Section Identification and Stations**

<b>Identification</b>	<b>Approximate Hwy. 404 Station No.</b>	<b>Highway Section</b>	<b>Reference Boreholes</b>
Section 1	18+500 to 17+275	From 0.3 km North of Major Mackenzie Drive to Rouge River	EDR2-01, EDR2-02, TS2-01, MS2-03, MS2-05, MS2-08, MS2-09, OHS2-05, OHS2-06, HMS2-05
Section 2	17+200 to 16+250	From Rouge River to 16 <sup>th</sup> Avenue	HMP2-01, MS2-10, MS2-11, MS2-12, MS2-15, MS2-17, MS2-18, OHS2-04, OHS2-03, HMS2-04
Section 3	16+200 to 13+550	From 16 <sup>th</sup> Avenue to 0.7 km South of Highway 7	TS2-02, MS2-23, MS2-25, MS2-26, MS2-27, MS2-29, MS2-31, OHS2-02, OHS2-01, HMS2-03, HMS2-02, HMS2-01, VMS2-01, 407ETR2-01, 407ETR2-02, TS2-03, TS2-04, TS2-05, TS2-06, HOV2-01, SWM-C2-1A, HWY7-02

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

In general, the soil stratigraphy encountered along these sections of Highway 404 consists of a pavement structure (asphalt on granular) and embankment fill overlying native, typically stiff to hard silty clay to clayey silt till, and/or compact to very dense sand and silt tills. Sand, silt and silty clay interlayers and lenses are present between and/or within the glacial till deposits. Groundwater levels measured in installed standpipe piezometers typically range between 2 m and 10 m depths 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.

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



## **5.1 Section 1 - From 0.3 km North of Major Mackenzie Drive to Rouge River (Stations 18+500 to 17+275)**

### **5.1.1 Asphalt**

Boreholes EDR2-01, EDR2-02, TS2-01, MS2-03, MS2-05, MS2-08, MS2-09, OHS2-05, OHS2-06 and HMS2-05 were drilled through an approximately 150 mm to 200 mm thick layer of asphalt.

### **5.1.2 Cohesionless Fill**

Sand and gravel pavement granular fill and silty sand fill were encountered below the asphalt in Boreholes EDR2-01, EDR2-02, TS2-01, MS2-03, MS2-05, MS2-08, MS2-09, OHS2-05, OHS2-06, and HMS2-05. The thickness of the pavement granular fill at the boreholes typically varied between 0.4 m and 0.8 m, and up to 1.9 m and 2.8 m in Boreholes HMS2-05 and MS2-09, respectively. The base of the cohesionless fill was encountered ranging between 0.6 m and 3.0 m (Elevations 211.9 m to 201.0 m).

The measured moisture contents of selected samples of this fill varied between 2 percent and 14 percent.

### **5.1.3 Silty Clay Fill**

Fill materials consisting of silty clay was encountered below the existing granular fill in Borehole MS2-05. The thickness of the silty clay fill was 0.4 m, with the base at 1.4 m depth (Elevation 204.5 m)

AN SPT 'N' value recorded in the silty clay fill was 14 blows per 0.3 m penetration, indicating a stiff consistency and a measured moisture content of 22 percent.

### **5.1.4 Silt**

Layers of brown native silt with trace to some clay were encountered in Borehole MS2-09. The thickness of this layer was 2.6 m, with the base at 5.6 m depth (Elevation 198.3 m).



SPT 'N' values recorded in the silt layers ranged from 12 blows to 14 blows per 0.3 m penetration indicating a compact condition. The measured moisture contents of samples of this till varied between 12 percent and 36 percent.

The results of grain size distribution analyses carried out on a sample of silt are presented on Record of Borehole Sheets and on Figure A1 in Appendix A. The results of laboratory gradation tests are summarized as follows:

Soil Particles	Percentage (%) Silt
Gravel	0
Sand	0
Silt	88
Clay	12

#### 5.1.5 Silty Clay Till

Deposits of grey native silty clay till with sand and trace gravel were encountered in all nine boreholes. Where fully penetrated in Boreholes OHS2-05 and MS2-09, the thickness of this till was found to be about 6.5 m and 2.9 m, respectively. The remaining boreholes were terminated within this till at 8.0 to 8.2 m depths (Elevations 204.5 m to 195.9 m).

SPT 'N' values recorded in the silty clay till ranged from 10 blows for 0.3m of penetration to greater than 50 blows for less than 0.3 m of penetration, indicating a stiff to hard consistency. The measured moisture contents of selected samples of this till varied between 7 percent and 27 percent.

Grain size distribution results for the tested cohesive till samples are presented on the Record of Borehole sheets and on Figures A2 and A3 in Appendix A. Atterberg Limit test results are presented on Figure A4 in Appendix A. The results of laboratory gradation and Atterberg Limits tests are summarized as follows:



Soil Particles	Percentage (%)
Gravel	0 to 5
Sand	9 to 41
Silt	30 to 42
Clay	19 to 50
Index Property	Percentage (%)
Liquid Limit	18 to 34
Plasticity Index	7 to 17

The above results show that the tills have low to slight plasticity with a group symbol of CL and CL-ML.

Glacial tills inherently contain cobbles and boulders.

#### **5.1.6 Sand**

Brown native sand with trace gravel and silt was encountered below the silty clay till in Borehole OHS2-05 which was terminated within this deposit at 8.2 m depth (Elevation 195.5 m).

An SPT 'N' value recorded in the sand was 66 blows per 0.3 m penetration, indicating a very dense condition. The measured moisture content of the sample of this sand was 6 percent.

#### **5.1.7 Sand and Silt Till**

Brown to grey native sand and silt till with trace gravel and clay were encountered below the silty clay till in Borehole MS2-09, which was terminated within this till at 12.8m depth (Elevation 191.2 m).

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



### 5.1.8 Water Levels

The groundwater level in open boreholes was observed and noted during and upon completion of drilling. One piezometer was installed in Borehole MS2-05. The water levels measured in this and other installed piezometers in the area (Reference 2 and Reference 3) are summarized in Table 5.2.

**Table 5.2  
Measured Groundwater Levels**

Approximate Station	Borehole	Date	Water Level (m)	
			Depth	Elevation
18+000	MS2-02	2018-09-30	5.5	202.1
17+700	MS2-05	2018-09-30	2.3	203.6
17+275	RR-2	2014-12-18	9.9	193.3

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 Rouge River to 16<sup>th</sup> Avenue (Stations 17+200 to 16+250)

### 5.2.1 Asphalt

Boreholes HMP2-01, MS2-10, MS2-11, MS2-12, MS2-15, MS2-17, MS2-18, OHS2-04, OHS2-03, and HMS2-04 were drilled through an approximately 75 mm to 200 mm thick layer of asphalt.

### 5.2.2 Cohesionless Fill

Sand and gravel pavement granular fill, silty sand fill with some gravel, and sand and silt fill with trace clay were encountered below the asphalt in Boreholes HMP2-01, MS2-10, MS2-11, MS2-12, MS2-15, MS2-17, MS2-18, OHS2-03, OHS2-04, and HMS2-04. The thickness of the granular fills at the boreholes was typically between 0.1 m and 1.3 m, and up to 2.4 m and 10.0 m in Boreholes MS2-12 and HMP2-01,



respectively. The base of this cohesionless fill was encountered at 0.3 m to 10.2 m depths (Elevations 202.9 m to 193.0 m).

SPT 'N' values within the cohesionless fill ranged from 10 blows per 0.3 m to greater than 50 blows for less than 0.3 m of penetration, indicating compact to very dense conditions. The measured moisture contents of samples of the cohesionless fill varied between 2 percent and 20 percent.

The results of grain size distribution analyses carried out on a representative sample of the granular and cohesionless fills are presented on the Record of Borehole Sheets included in Figures B1 and B2 of Appendix B. The results of the gradation testing from a selected borehole are summarized below:

Soil Particles	Percentage (%) Granular Fill	Percentage (%) Sand and Silt Fill
Gravel	26	0
Sand	67	27 to 40
Silt	7	52 to 64
Clay		8 to 9

### 5.2.1 Sandy to Clayey Silt Fill

Fill materials consisting of sandy to clayey silt was encountered below the existing granular fill in Boreholes MS2-10 and OHS2-04, respectively. The thickness of this fill was between 0.7 m and 1.4 m. The base of the fill varied between 1.4 m and 2.2 m depths (Elevations 201.3 to 200.2 m)

SPT 'N' values recorded in the clayey silt fill were 11 blows and 17 blows per 0.3 m penetration, indicating a stiff to very stiff consistency. An 'N' value of 25 blows per 0.3 m penetration was recorded for the sandy silt fill indicating a compact condition. The measured moisture contents of samples of this fill varied between 5 percent and 18 percent.

### 5.2.2 Silts and Sands

Layers of brown to grey native silts and sands with trace to some gravel and clay were encountered in Boreholes MS2-10, MS2-11, MS2-15, MS2-17, OHS2-03, OHS2-04, HMP2-01, and HMS2-04. Where fully penetrated, the thickness of the cohesionless



soils ranged from 1.2 m to 4.7 m. The base of the cohesionless soils was at 2.2 m to 6.1 m depths (Elevations 200.1 m and 192.9m). Borehole HMP2-01 was terminated in the sand at a 12.8 m depth (Elevation 190.4 m).

SPT 'N' values recorded in the cohesionless soils typically ranged from 10 blows to 61 blows per 0.3 m penetration, indicating compact to very dense conditions. Occasional 'N' values of 8 blows and 9 blows per 0.3 m penetration were measured in Boreholes MS2-17 and MS2-11, indicating loose zones. The measured moisture contents of samples of this cohesionless soils varied between 10 percent and 25 percent.

Grain size distribution results for the silt and sand samples tested are presented on the Record of Borehole sheets and on Figures B3 and B4 of Appendix B. The results of laboratory gradation tests are summarized as follows:

Soil Particles	Percentage (%) Sand	Percentage (%) Sand and Silt	Percentage (%) Silt
Gravel	2	2 to 8	0 to 2
Sand	91	39 to 54	4 to 13
Silt	7	34 to 56	77 to 87
Clay		4 to 5	8 to 11

### 5.2.3 Silty Clay Till

Brown to grey native silty clay till with sand and trace gravel were encountered in all but Borehole HMP2-01. Where fully penetrated in Borehole OHS2-04, the thickness of this till was 2.4 m, and the base at 7.2 m depth (Elevation 195.2 m). Boreholes MS2-10, MS2-11, MS2-12, MS2-15, MS2-17, MS2-18, OHS2-03, and HMS2-04 were terminated within this till at 7.9 to 12.8 m depths, or Elevations 194.5 to 184.4 m.

SPT 'N' values recorded in the silty clay till typically ranged from 15 blows to 90 blows per 0.3 m, indicating very stiff to hard consistency. Higher 'N' values of greater than 50 blows for less than 0.3 m penetration near the bottom of some boreholes may indicate the presence of cobbles and boulders. An occasional 'N' value of 12 was measured in each of Boreholes OHS2-03 and MS2-18 indicating a stiff zone. The measured moisture contents of selected samples of this till varied between 7 percent and 23 percent.



Grain size distribution results for the tested cohesive till samples are presented on the Record of Borehole sheets and on Figures B5 and B6 of Appendix B. Atterberg Limit test results are presented on Figure B7 of Appendix B.

The results of laboratory gradation and Atterberg Limits tests are summarized as follows:

Soil Particles	Percentage (%)	
Gravel	0 to 3	
Sand	18 to 38	
Silt	70	35 to 53
Clay		16 to 36
Index Property	Percentage (%)	
Liquid Limit	18 to 26	
Plasticity Index	7 to 12	

The above results show that the tills have typically low to slight plasticity with group symbols of CL and CL-ML.

Glacial tills inherently contain cobbles and boulders.

#### 5.2.4 Sand and Silt Till

Brown to grey sand and silt till with gravel, and trace clay was encountered in Borehole OHS 2-04 and was terminated within this till at a 7.9 m depth, or Elevation 194.5 m

An SPT 'N' value recorded in the cohesionless till greater than 100 blows for less than 0.3 m penetration indicated very dense conditions, and may also indicate the presence of cobbles or boulders. The measured moisture content of this till was 7 percent.

#### 5.2.5 Water Levels

The groundwater level in open boreholes was observed and noted during and upon completion of drilling. One piezometer was installed in Borehole MS 2-12. The water levels measured in this and other installed piezometers in the area (References 1, 2 and 3) are also summarized in Table 5.3.



**Table 5.3  
Measured Groundwater Levels**

Approximate Station	Borehole	Date	Water Level (m)	
			Depth	Elevation
17+000	MS2-12	2018-09-30	8.1	193.8
17+170	RR-1	2014-12-18	9.4	193.5
17+165	R-07	2018-06-22	9.3	193.3
16+240	16TH-01	2018-08-22	5.7	189.8

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 – From 16th Avenue to 0.7 km South of Highway 7  
(Station 16+200 to 13+550)**

**5.3.1 Asphalt**

Boreholes TS2-02, MS2-23, MS2-25, MS2-26, MS2-27, MS2-29, MS2-31, OHS2-02, OHS2-01, HMS2-03, HMS2-02, HMS2-01, VMS2-01, 407ETR2-01, 407ETR2-02, TS2-03, TS2-04, TS2-05, TS2-06, HOV2-01 and HWY7-02 were drilled through an approximately 125 to 200 mm thick layer of asphalt.

**5.3.2 Topsoil**

Borehole SWM-C2-1A was drilled through approximately a 75 mm thick layer of topsoil

**5.3.3 Cohesionless Fill**

Sand and gravel pavement granular fill and silty sand fill with some gravel, were encountered below the asphalt in Boreholes TS2-02, MS2-23, MS2-25, MS2-26, MS2-27, MS2-29, MS2-31, OHS2-02, OHS2-01, HMS2-03, HMS2-02, HMS2-01, VMS2-01, 407ETR2-01, 407ETR2-02, TS2-03, TS2-04, TS2-05, TS2-06 HOV2-01 and HWY7-



02. The thickness of the cohesionless fills at the boreholes was typically between 0.5m and 1.2 m, and up to 2.4 m and 2.8 m in Boreholes HMS2-02 and TS2-04, respectively. The base of this cohesionless fill was encountered at 0.6 m to 4.1 m depths (Elevations 194.8 m to 184.6 m).

SPT 'N' values recorded in the cohesionless fill typically ranged from 7 blows to 64 blows per 0.3m penetration, indicating a loose to very dense condition. The measured moisture contents of samples of cohesionless fill ranged between 3 percent and 19 percent.

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

Soil Particles	Percentage (%)
Gravel	34
Sand	55
Silt	11
Clay	

#### 5.3.4 Silty Clay Fill

Fill materials consisting of silty clay with sand and trace gravel was encountered below existing granular fill in Boreholes SWM-C2-1A, HMS2-01, HMS2-02, HOV2-01, OHS2-02, TS2-06 and HWY7-02. The thickness of this fill typically ranged from 0.7 to 1.6 m, and up to the range of 2.1 to 6.4 m in Boreholes HWY7-02, TS2-03, and HMS2-01. The base of this cohesive fill ranged from 1.4 m to 7.2 m (Elevations 194.0 m and 182.9 m).

SPT 'N' values recorded in the silty clay fill ranged from 7 blows to 44 per 0.3 m penetration, indicating a firm to hard consistency. The measured moisture contents of samples of this fill ranges between 7 percent and 21 percent.

Grain size distribution results for silty clay fill samples tested are presented on the Record of Borehole sheets and on Figure C2 of Appendix C.

The results of laboratory gradation are summarized as follows:



Soil Particles	Percentage (%)
Gravel	1 to 4
Sand	28 to 44
Silt	33 to 40
Clay	22 to 28

### 5.3.5 Silty Clay

A layer of native brown silty clay with trace to some sand were encountered in Boreholes 407ETR2-01, 407ETR2-02, and HMS2-03. The thickness of this cohesive soil ranged from 0.8 m to 2.2 m, and the base of layer was at 2.2 m to 3.0 m depths (Elevations 189.6 m and 186.5 m).

SPT 'N' values recorded in the silty clay were 5 blows and 17 blows for 0.3 m of penetration, indicating firm to very stiff consistency. The measured moisture contents of selected samples of this cohesive soil were 14 percent and 31 percent.

Grain size distribution results for silty clay samples tested are presented on the Record of Borehole sheets and on Figure C3 and Atterberg Limit test results are presented on Figures C11 of Appendix C.

The results of laboratory gradation are summarized as follows:

Soil Particles	Percentage (%)
Gravel	0
Sand	9 to 16
Silt	19 to 27
Clay	57 to 72

Index Property	Percentage (%)
Liquid Limit	49
Plasticity Index	27

The above results show that the silty clay has typically medium plasticity with a group symbol of CI.



### 5.3.6 Silts and Sands

A deposit of brown to grey native silts and sands with trace to some gravel, trace clay were encountered in Boreholes TS2-02, HWY7-02, SWM-C2-1A, 407ETR2-01, 407ETR2-02, HMS2-02, HMS2-03, HOV2-01, MS2-23, MS2-26, MS2-27, MS2-31, OHS2-01, OHS2-02, and VMS2-01. Where fully penetrated in the boreholes, with the exception of Borehole 407ETR2-02, the thickness of the cohesionless soils ranged from 1.0 m to 5.8 m, and the base of layers were at 3.0 to 8.7 m depths (Elevations 189.8m to 180.4 m). Borehole 407ETR2-02 was terminated within this deposit at a depth of 8.2 m (Elevation 180.5 m)

SPT 'N' values recorded in these silts and sands ranged from 7 blows to 72 blows per 0.3 m penetration, indicating loose to very dense conditions. The measured moisture contents of selected samples of these soils varied between 7 percent and 29 percent.

Grain size distribution results for the sand and silt samples are presented on the Record of Borehole sheets and on Figure C4 to C7 of Appendix C.

The results of laboratory gradation tests are summarized as follows:

Soil Particles	Percentage (%) Sand		Percentage (%) Silt	Percentage (%) Silty Sand	Percentage (%) Sands and Silts
Gravel	0 to 15		0 to 1	2	0
Sand	79		0 to 18	72	32 to 36
Silt	6	17	63 to 91	22	59 to 64
Clay		4	7 to 19	4	4 to 5

### 5.3.7 Silty Clay Till

Deposits of brown to grey native silty clay till with sand and trace to some gravel were encountered in Boreholes HWY7-02, SWM-C2-1A, TS2-02, MS2-23, MS2-25, MS2-26, MS2-27, MS2-29, MS2-31, OHS2-02, OHS2-01, HMS2-03, HMS2-02, HMS2-01, VMS2-01, TS2-06, and HOV2-01. Where fully penetrated in Boreholes MS2-25 and MS2-31, the thickness of this till varied between 1.7 m and 4.9 m. The base of this cohesive till ranged from 2.5 m to 5.6 m depths (Elevations 188.9 m and 183.8 m).



The remaining boreholes were terminated within this till at 7.9 m to 12.8 m depths (Elevations 187.2 m to 176.9 m).

SPT 'N' values recorded in the silty clay till typically ranged from 10 blows to 87 blows per 0.3 m of penetration, indicating a stiff to hard consistency. An occasional 'N' value of 4 was measured in Borehole MS2-29 indicating a firm zone. Higher 'N' values of greater than 100 blows for less than 0.3 m penetration in Boreholes HWY7-02, MS2-26, MS2-27, MS2-29, and VMS2-01 may indicate the presence of cobbles or boulders. The measured moisture contents of samples of this till varied between 6 percent and 31 percent.

Grain size distribution results for the cohesive till samples tested are presented on the Record of Borehole sheets and on Figures C8 and C9 of Appendix C. Atterberg Limit test results are presented on Figure C12 of Appendix C.

The results of laboratory gradation and Atterberg Limits tests are summarized as follows:

<b>Soil Particles</b>	<b>Percentage (%)</b>
Gravel	0 to 3
Sand	6 to 38
Silt	27 to 55
Clay	17 to 58
<b>Index Property</b>	<b>Percentage (%)</b>
Liquid Limit	20 to 38
Plasticity Index	8 to 20

The above results show that the silty clay till has typically low plasticity with a group symbol of CL, except for occasional zones of medium plasticity with a group symbol of CI.

Glacial tills inherently contain cobbles and boulders.

### **5.3.8 Sand and Silt Till**

Layers of brown to grey native sand and silt till with trace to some gravel and clay were encountered in Boreholes 407ETR2-01, MS2-25, MS2-31, TS2-02, TS2-03, TS2-04,



and TS2-05. Where fully penetrated in Borehole TS2-02, the thickness of this till was 3.0 m and the base was at 11.7 m depth (Elevation 183.5 m). The remaining boreholes were terminated within this till at 7.7 to 8.2 m depths (Elevations 185.4 m to 181.2 m).

SPT 'N' values recorded in this cohesionless till typically ranged from 11 blows to 65 blows per 0.3 m of penetration, indicating compact to very dense conditions. An occasional 'N' value of 8 was measured in Borehole TS2-03 indicating a loose zone. Higher 'N' values of greater than 100 blows for less than 0.3 m penetration in Boreholes 407ETR2-01, TS2-02, TS2-04 and TS2-05 may indicate the presence of cobbles or boulders. The measured moisture contents of this till varied between 5 percent and 30 percent.

Grain size distribution results for samples of sands and silts are presented on the Record of Borehole sheets and on Figure C10 of Appendix C. The results of laboratory gradation test are summarized as follows:

Soil Particles	Percentage (%)
Gravel	0 to 13
Sand	20 to 45
Silt	27 to 61
Clay	4 to 18

### 5.3.9 Water Levels

The groundwater level in open boreholes was observed and noted during and upon completion of drilling. One piezometer was installed in Borehole MS2-29. The water levels measured in this and other installed piezometers in the area (References 1 and 3) are also summarized in Table 5.4.

**Table 5.4  
Measured Groundwater Levels**

Approximate Station	Borehole	Date	Water Level (m)	
			Depth	Elevation
16+180	16TH-09	2018-08-22	6.0	189.2
15+400	MS2-29	2018-09-30	2.4	187.3
15+170	MS2-32	2018-09-30	2.2	187.3



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.

## 6. MISCELLANEOUS

Thurber staked and/or marked the borehole locations in the field and obtained utility clearances prior to drilling. Northing and easting coordinates at the borehole locations were obtained by Thurber using a Garmin GPSMAP 62sc, and the corresponding ground surface elevations were provided by WSP.

Walker Drilling of Utopia, Ontario and Drill Tech Drilling Ltd. of Newmarket, Ontario, supplied and operated a truck-mounted D-90 drill rig and a truck-mounted Mar15 drill rig, respectively, to carry out the drilling, sampling and in-situ testing operations for the boreholes.

The drilling and sampling operations in the field were supervised on a full-time basis by Mr. Bryan Lui, Mr. Stephen Jones, Ms. Jacqueline Pigeon, and Mr. Kevin Kweon 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 Mr. Rod de Castro, P.Eng. The report was reviewed by Messrs. Sydney Pang, P.Eng. and P.K. Chatterji, P.Eng., a Designated Principal Contact for MTO Foundations Projects.



THURBER ENGINEERING LTD.



Rod de Castro, P.Eng.  
Geotechnical Engineer



Sydney Pang, P.Eng.  
Associate, Senior Foundation Engineer



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

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**FOUNDATION INVESTIGATION AND DESIGN REPORT  
OVERHEAD, HIGH OCCUPANCY TOLL  
HIGH OCCUPANCY MESSAGE, EMERGENCY DETOUR ROUTE,  
HIGHWAY 407 ETR AND TOLL STATION SIGN SUPPORTS  
CONTRACT 2  
HIGHWAY 404 HOV LANE EXPANSION AND REHABILITATION  
FROM MAJOR MACKENZIE DRIVE TO HIGHWAY 7  
MARKHAM, ONTARIO  
G.W.P. 2930-17-00**

**GEOCREG NO. 30M14-488**

**PART 2: ENGINEERING DISCUSSION AND RECOMMENDATIONS**

**7. GENERAL**

This section of the report presents interpretation of the geotechnical data presented in the factual information section and provides foundation recommendations for the detailed design of sign support structures along Highway 404 from 0.3 km north of Major Mackenzie Drive to 0.6 m south of Highway 7 in the City of Markham, Ontario.

Forty-two (42) boreholes have been referenced for foundation design of the proposed sign supports. The Borehole Location Plan drawings in Appendix E illustrate the approximate locations of the proposed sign supports and relevant boreholes.

Information on the proposed locations of the signs was provided to Thurber by WSP. Based on the proposed sign layout, boreholes drilled during the present and other investigations, that were in proximity to each proposed sign location, have been selected to provide subsurface information for foundation design. The Record of Borehole sheets for these boreholes are presented in Appendices A to C. Table 1 immediately following the text of this report provides foundation design parameters for each sign support locations.

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.

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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 information provided by WSP to Thurber, and on the factual data obtained during the course of this investigation.

## **7.1 Foundation Design Parameters**

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

- Ministry of Transportation, Ontario (2015) "Sign Support Manual", Highway Standards Branch, Bridge Office (Reference 4).

Reference should also be made to the following documents.

- Ministry of Transportation, Ontario (2004) "Guidelines for the Design of High Mast Pole Foundations", Fourth Edition, BRO-009, Engineering Standards Branch, Bridge Office (Reference 5).
- Canadian Highway Bridge Design Code and Commentary (2014). CAN/CSA-S6-14 and S6.1-14 (Reference 6).

It is understood that a typical sign support consists of a single conventional augered caisson (drilled shaft). Each OHS, VMS, and HMS sign is designed for two supports, while each TS, HOV, EDR and HWY 407 sign is designed for one support. Table 1 following the text of this report presents the recommended parameters for foundation design of such caissons.

It is recommended that MTO's standard designs in Reference 4 be used as a basis for the sign support foundations. The foundation design parameters in Table 1 may be used in conjunction with References 5 and 6 to confirm that the standard designs are adequate.



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

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

Where an unconfined compressive strength,  $q_u$ , ( $q_u = 2 \times C_u$ , undrained shear strength) is provided for cohesive soils (clayey silt to silty clay fill and native, silty clay till), the ultimate lateral passive resistance should be calculated in conjunction with the total soil unit weight. When designing for portions of the caissons below the groundwater level in cohesionless sands and silts, the submerged soil unit weight,  $\gamma'$ , should be used. The required depth of the caisson will be governed by lateral loads, including wind loads, acting on the sign. The length of the caisson should also be sufficient to counteract frost jacking (upward) forces.

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

## 7.2 Caisson Installation

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

The contract documents should contain an NSSP alerting the contract bidders of the specific aspects relating to caisson construction for foundation supports at this site. Suggested wordings for this NSSP are provided in Appendix E.



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

The short-term groundwater levels were typically between 2 m and 10 m depths below existing ground surface. The stabilized groundwater levels are anticipated to be higher (see Table 1). Soil sloughing and water seepage may occur in unsupported holes especially in sands and silts below the groundwater level. The cohesionless soils would also be susceptible to disturbance (basal and sidewall instability) under conditions of unbalanced hydrostatic head. Temporary liners must be available to support the caisson sidewalls and to provide seepage cut-off where required. Any accumulated water may have to be pumped out from the hole prior to placing concrete. A balancing water/slurry head should be used inside the caisson hole in cases where the caisson base is within sands and silts. Should it be considered impractical to remove the accumulated water/slurry inside the hole, it is recommended that the concrete be placed by the tremie method. Suggested wording for an NSSP to cover the above aspects are provided in Appendix E.

### **7.3 Construction Concerns**

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

### **7.4 Construction Inspection and Testing**

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

## **8. CLOSURE**

Engineering analysis and preparation of the foundation design report was carried out by Messrs. Rod de Castro, P.Eng. and Sydney Pang, P.Eng. Dr. P.K. Chatterji, P.Eng., a Designated MTO Contact for Foundations, reviewed the report.

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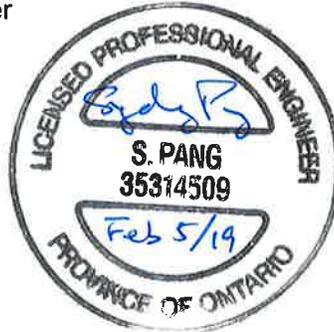
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THURBER ENGINEERING LTD.



Rod de Castro, P.Eng.  
Geotechnical Engineer



Sydney Pang, P.Eng.  
Associate, Senior Foundation Engineer



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

Client: WSP  
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**TABLE 1  
FOUNDATION DESIGN PARAMETERS  
OVERHEAD SIGN SUPPORTS  
HIGHWAY 404 HOV LANE EXPANSION AND REHABILITATION  
CONTRACT 2  
MARKHAM, ONTARIO  
G.W.P. 2930-17-00**

Sign Number	Sign Station	Reference Boreholes	Reference Simplified Subsurface Stratigraphy For Design	Depth Below Existing Ground Surface (m)	Foundation Design Parameters							
					$q_u$ (kPa)	$\phi'$ (deg.)	$n_h$ (kN/m <sup>3</sup> )	$K_p$	$\gamma$ (kN/m <sup>3</sup> )	$\gamma'$ (kN/m <sup>3</sup> )	Ground water Depth (m)	
<b>Section 1</b>												
EDR	18+490	EDR2-01	Sand and Gravel (Fill) Silty Clay (Till) Silty Clay (Till)	0.2 - 0.8 0.8 - 4.0 4.0 - 8.2	- 150 200	30 - -	3,000 - -	3.0 - -	20 20 21	- - -	2 (below existing grade)	
EDR	18+390	EDR2-02	Sand and Gravel (Fill) Silty Clay (Till)	0.2 - 0.7 0.7 - 8.2	- 150	30 -	3,000 -	3.0 -	20 20	- -	2 (below existing grade)	
TS Footing	18+200	TS2-01	Sand and Gravel (Fill) Silty Clay (Till)	0.2 - 1.0 1.0 - 8.0	- 200	30 -	3,000 -	3.0 -	20 21	- -	2 (below existing grade)	
TS Footing	17+900	MS2-03	Sand and Gravel (Fill) Silty Clay (Till)	0.2 - 0.6 0.6 - 8.2	- 200	30 -	3,000 -	3.0 -	20 21	- -	2 (below existing grade)	

- Notes: 1. This table must be read in conjunction with the text of this report.  
 2. In order to take into account frost action and surficial disturbance, the ultimate lateral passive resistance in front of the caisson within the upper 1.4 m below final grade should be neglected in the foundation design.  
 3. If new fill is placed, some caissons may be partially embedded within the new fill.

Sign Number	Sign Station	Reference Boreholes	Reference Simplified Subsurface Stratigraphy For Design	Depth Below Existing Ground Surface (m)	Foundation Design Parameters						
					$q_u$ (kPa)	$\phi'$ (deg.)	$n_h$ (kN/m <sup>3</sup> )	$K_p$	$\gamma$ (kN/m <sup>3</sup> )	$\gamma'$ (kN/m <sup>3</sup> )	Ground water Depth (m)
OHS#7	17+708	OHS2-06, MS2-05	Sand and Gravel (Fill)	0.1 - 1.0	-	30	3,000	3.0	20	-	2 (below existing grade)
			Silty Clay (Fill)	1.0 - 1.5	100	-	-	19	-		
			Silty Clay (Till)	1.5 - 6.0	160	-	-	20	-		
			Silty Clay (Till)	6.0 - 8.2	200	-	-	21	-		
TS Footing	17+700	MS2-05	Sand and Gravel (Fill)	0.1 - 1.0	-	30	3,000	3.0	20	-	2 (below existing grade)
			Silty Clay (Fill)	1.0 - 1.5	100	-	-	19	-		
			Silty Clay (Till)	1.5 - 6.0	160	-	-	20	-		
			Silty Clay (Till)	6.0 - 8.2	200	-	-	21	-		
HMS#4	17+406	MS2-08, HMS2-05	Sand and Gravel (Fill)	0.2 - 0.8	-	30	3,000	3.0	20	-	3 (below existing grade)
			Silty Sand (Fill)	0.8 - 2.0	-	-	-	18	-		
			Silty Clay (Till)	2.0 - 8.2	150	-	-	19	-		
TS Footing	17+413	MS2-08	Sand and Gravel (Fill)	0.2 - 0.8	-	30	3,000	3.0	20	-	3 (below existing grade)
			Silty Sand (Fill)	0.8 - 2.0	-	-	-	18	-		
			Silty Clay (Till)	4.2 - 8.2	150	-	-	19	-		
OHS#6	17+325	OHS2-05, MS2-09	Sand and Gravel (Fill)	0.2 - 0.7	-	30	3,000	3.0	20	-	3 (below existing grade)
			Silty Sand (Fill)	0.7 - 3.0	-	30	3,000	3.0	20	-	
			Silt	3.0 - 5.5	-	30	2,500	3.0	-	10	
			Silty Clay (Till)	5.5 - 8.5	180	-	-	20	-		
			Sand and Silt (Till)	8.5 - 12.8	-	35	7,000	3.7	-	11	
<b>Section 2</b>											
TS Footing	17+169	HMP2-01	Sand and Gravel (Fill)	0.2 - 0.5	-	30	3,000	3.0	20	-	3 (below existing grade)
			Sand and Silt (Fill)	0.5 - 2.0	-	31	4,000	3.1	19	-	
			Sand and Silt (Fill)	2.0 - 10.0	-	31	3,000	3.1	-	9	
			Sand	10.0 - 12.8	-	34	5,500	3.5	-	10	

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3. If new fill is placed, some caissons may be partially embedded within the new fill.

Sign Number	Sign Station	Reference Boreholes	Reference Simplified Subsurface Stratigraphy For Design	Depth Below Existing Ground Surface (m)	Foundation Design Parameters						
					$q_u$ (kPa)	$\phi'$ (deg.)	$n_h$ (kN/m <sup>3</sup> )	$K_p$	$\gamma$ (kN/m <sup>3</sup> )	$\gamma'$ (kN/m <sup>3</sup> )	Ground water Depth (m)
OHS#5	17+105	OHS2-04, MS2-10	Sand and Gravel (Fill)	0.2 – 0.8	-	30	3,000	3.0	20	-	4 (below existing grade)
			Clayey Silt (Fill)	0.8 - 2.0	100	-	-	19	-		
			Silt	2.0 – 5.0	-	31	4,000	3.1	-	10	
			Silty Clay (Till)	5.0 - 8.2	200	-	-	21	-		
HMS#3	17+025	HMS2-04, MS2-11	Sand and Gravel (Fill)	0.2 – 1.0	-	30	3,000	3.0	20	-	3 (below existing grade)
			Sandy Silt / Silt	1.0 – 3.0	-	30	2,500	3.0	20	-	
			Silty Clay (Till)	3.0 - 8.2	200	-	-	21	-		
TS Footing	16+992	MS2-12	Sand and Gravel (Fill)	0.2 – 1.0	-	30	3,000	3.0	20	-	3 (below existing grade)
			Silty Sand (Fill)	1.0 – 2.5	-	30	3,000	3.0	20	-	
			Silty Clay (Till)	2.5 – 12.3	200	-	-	21	-		
OHS#4	16+725	OHS2-03, MS2-15	Sand and Gravel (Fill)	0.2 – 1.0	-	30	3,000	3.0	20	-	2 (below existing grade)
			Sand and Silt	1.0 – 2.5	-	31	4,000	3.1	20	10	
			Silty Clay (Till)	2.5 – 7.0	140	-	-	-	19	-	
			Silty Clay (Till)	7.0 – 8.0	200	-	-	-	21	-	
TS Footing	16+592	MS2-17	Sand and Gravel (Fill)	0.2 – 0.5	-	30	3,000	3.0	20	-	2 (below existing grade)
			Silty Sand (Fill)	0.5 – 1.5	-	30	3,000	3.0	20	-	
			Sand and Silt	1.5 – 6.0	-	31	5,000	3.2	20	10	
			Silty Clay (Till)	6.0 – 7.0	160	-	-	-	20	-	
			Silty Clay (Till)	7.0 - 8.2	200	-	-	-	21	-	
HOV	16+500	MS2-18	Sand and Gravel (Fill)	0.2 – 1.5	-	30	3,000	3.0	20	-	3 (below existing grade)
			Silty Clay (Till)	1.5 – 5.5	180	-	-	-	20	-	
			Silty Clay (Till)	5.5 – 9.0	150	-	-	-	19	-	
			Silty Clay (Till)	9.0 - 12.8	200	-	-	-	21	-	

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Sign Number	Sign Station	Reference Boreholes	Reference Simplified Subsurface Stratigraphy For Design	Depth Below Existing Ground Surface (m)	Foundation Design Parameters						
					$q_u$ (kPa)	$\phi'$ (deg.)	$n_h$ (kN/m <sup>3</sup> )	$K_p$	$\gamma$ (kN/m <sup>3</sup> )	$\gamma'$ (kN/m <sup>3</sup> )	Ground water Depth (m)
<b>Section 3</b>											
OHS#3	16+184	OHS2-02, TS2-02	Sand and Gravel (Fill)	0.2 – 1.0	-	30	3,000	3.0	20	-	2 (below existing grade)
			Silty Clay (Fill)	1.0 – 1.5	100	-	-	-	19	-	
			Silt	1.5 – 3.0	-	28	2,000	2.8	19	9	
			Silt	3.0 - 7.0	-	30	3,000	3.0	-	10	
			Silty Clay (Till)	7.0 - 8.5	160	-	-	-	20	-	
TS Footing	16+150	TS2-02	Sand and Gravel (Fill)	0.2 – 1.0	-	30	3,000	3.0	20	-	3 (below existing grade)
			Silty Clay (Till)	1.0 – 4.0	180	-	-	-	20	-	
			Sand and Silt (Till)	4.0 – 9.0	-	30	3,000	3.0	-	10	
			Sand and Silt (Till)	9.0 - 11.7	-	35	7,000	3.7	-	11	
HMS#2	15+855	HMS2-03, MS2-23	Sand and Gravel (Fill)	0.2 – 1.0	-	30	3,000	3.0	20	-	2 (below existing grade)
			Silty Clay	1.0 – 3.0	120	-	-	-	19	-	
			Silt	3.0 - 4.0	-	30	3,000	3.0	-	10	
			Silty Clay (Till)	4.0 – 8.2	180	-	-	-	20	-	
OHS#2	15+714	OHS2-01, MS2-25	Sand and Gravel (Fill)	0.2 – 1.0	-	30	3,000	3.0	20	-	2 (below existing grade)
			Silty Clay (Till)	1.0 – 2.5	120	-	-	-	18	-	
			Silt	2.5 – 4.0	-	30	3,000	3.0	-	10	
			Sand and Silt (Till)	2.5 – 8.2	-	32	4,000	3.2	-	11	
TS Footing	15+652	MS2-26	Sand and Gravel (Fill)	0.2 – 1.0	-	30	3,000	3.0	20	-	2 (below existing grade)
			Silty Clay (Till)	1.0 – 2.0	120	-	-	-	19	-	
			Silt	2.0 – 4.0	-	30	3,000	3.0	-	10	
			Silty Clay (Till)	4.0 – 12.6	200	-	-	-	21	-	
VMS#1	15+555	VMS2-01, MS2-27	Sand and Gravel (Fill)	0.1 – 1.5	-	30	3,000	3.0	20	-	2 (below existing grade)
			Silt	1.5 – 4.0	-	30	3,000	3.0	-	10	
			Silty Clay (Till)	4.0 – 8.2	200	-	-	-	21	-	

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Sign Number	Sign Station	Reference Boreholes	Reference Simplified Subsurface Stratigraphy For Design	Depth Below Existing Ground Surface (m)	Foundation Design Parameters						
					$q_u$ (kPa)	$\phi'$ (deg.)	$n_h$ (kN/m <sup>3</sup> )	$K_p$	$\gamma$ (kN/m <sup>3</sup> )	$\gamma'$ (kN/m <sup>3</sup> )	Ground water Depth (m)
Hwy 407 ETR	15+495	407ETR2-01	Sand and Gravel (Fill)	0.1 – 1.0	-	30	3,000	3.0	20	-	2 (below existing grade)
			Silty Clay	0.8 – 2.0	100	-	-	18	-		
			Silt	2.0 – 5.5	-	30	3,000	3.0	-	10	
			Sand and Silt (Till)	5.5 – 8.0	-	35	7,000	3.7	-	11	
TS Footing	15+400	MS2-29	Sand and Gravel (Fill)	0.2 – 1.0	-	30	3,000	3.0	20	-	2 (below existing grade)
			Silty Clay (Till)	1.0 – 3.0	100	-	-	18	-		
			Silty Clay (Till)	3.0 – 5.5	120	-	-	19	-		
			Silty Clay (Till)	5.5 – 7.9	200	-	-	21	-		
Hwy 407 ETR	15+365	407ETR2-02	Sand and Gravel (Fill)	0.1 – 1.5	-	30	3,000	3.0	20	-	2 (below existing grade)
			Silty Clay	1.5 – 2.0	160	-	-	20	-		
			Silt	2.0 – 4.0	-	32	3,000	3.0	-	10	
			Silt	4.0 – 8.2	-	33	5,000	3.4	-	10	
OHS#1	15+254	MS2-31, SWM-C2-1A	Sand and Gravel (Fill)	0.2 – 0.7	-	30	3,000	3.0	20	-	3 (below existing grade)
			Silty Clay (Fill)	0.7 – 2.2	100	-	-	18	-		
			Silty Clay (Till)	2.2 – 5.0	140	-	-	19	-		
			Sand and Silt (Till)	5.0 – 7.0	-	32	4,000	3.2	-	10	
			Sand and Silt (Till)	7.0 – 8.2	-	35	7,000	3.7	-	11	
TS Footing	14+980	TS2-03	Sand and Gravel (Fill)	0.2 – 0.8	-	30	3,000	3.0	20	-	2 (below existing grade)
			Silty Sand (Fill)	0.8 – 1.5	-	30	3,000	3.0	20	-	
			Silty Clay (Fill)	1.5 – 5.5	120	-	-	18	-		
			Sand and Silt	5.5 – 8.2	-	32	4,000	3.2	-	10	
HMS#1	14+900	HMS2-01, HMS2-02	Sand and Gravel (Fill)	0.1 – 0.8	-	30	3,000	3.0	20	-	3 (below existing grade)
			Silty Clay (Fill)	0.8 – 7.0	100	-	-	18	-		
			Silty Clay (Till)	7.0 - 8.2	150	-	-	19	-		

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Sign Number	Sign Station	Reference Boreholes	Reference Simplified Subsurface Stratigraphy For Design	Depth Below Existing Ground Surface (m)	Foundation Design Parameters						
					$q_u$ (kPa)	$\phi'$ (deg.)	$n_h$ (kN/m <sup>3</sup> )	$K_p$	$\gamma$ (kN/m <sup>3</sup> )	$\gamma'$ (kN/m <sup>3</sup> )	Ground water Depth (m)
TS Footing	14+707	TS2-04	Sand and Gravel (Fill)	0.2 - 0.8	-	30	3,000	3.0	20	-	3 (below existing grade)
			Silty Sand (Fill)	0.8 - 3.0	-	30	3,000	3.0	20	-	
			Sand and Silt (Till)	3.0 - 6.0	-	32	4,000	3.2	-	10	
			Sand and Silt (Till)	6.0 - 7.7	-	34	6,000	3.5	-	11	
TS Footing	14+572	TS2-05	Sand and Gravel (Fill)	0.2 - 1.5	-	30	3,000	3.0	20	-	2 (below existing grade)
			Sand and Silt (Till)	1.5 - 2.2	-	34	6,000	3.5	21	11	
			Sand and Silt (Till)	2.2 - 7.8	-	35	7,000	3.7	-	11	
TS Footing	14+207	HWY7-02	Sand and Gravel (Fill)	0.2 - 0.7	-	30	3,000	3.0	20	-	3 (below existing grade)
			Silty Clay (Fill)	0.7 - 4.0	100	-	-	-	18	-	
			Silt	4.0 - 7.5	-	31	3,000	3.1	-	10	
			Silty Clay (Till)	7.5 - 8.5	170	-	-	-	20	-	
			Silty Clay (Till)	8.5 - 10.9	200	-	-	-	21	-	
TS Footing	14+070	TS2-06	Sand and Gravel (Fill)	0.2 - 1.3	-	30	3,000	3.0	20	-	2 (below existing grade)
			Silty Clay (Fill)	1.3 - 2.2	100	-	-	-	18	-	
			Silty Clay (Till)	2.2 - 5.5	150	-	-	-	19	-	
			Silty Clay (Till)	5.5 - 8.2	180	-	-	-	20	-	
HOV	13+563	HOV2-01	Sand and Gravel (Fill)	0.2 - 0.8	-	30	3,000	3.0	20	-	2 (below existing grade)
			Silty Clay (Fill)	0.8 - 2.2	100	-	-	-	18	-	
			Sand	2.2 - 5.0	-	32	4,000	3.2	-	10	
			Silty Clay (Till)	5.0 - 8.2	200	-	-	-	-	11	
All Locations	-	New Fill (see Note 3)	Variable height above ground surface	-	-	30	3,000	3.0	20	-	Below base of new fill

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LEGEND

$q_u$	=	Unconfined Compressive Strength (= 2 x $C_u$ , undrained shear strength) (kPa)
$\phi'$	=	Angle of Internal Friction (degrees)
$n_h$	=	Coefficient of Horizontal Subgrade Reaction (MN/m <sup>3</sup> or x 10 <sup>3</sup> kN/m <sup>3</sup> )
$K_p$	=	Coefficient of Passive Earth Pressure
$\gamma$	=	Soil Unit Weight (kN/m <sup>3</sup> )
$\gamma'$	=	Submerged Soil Unit Weight (kN/m <sup>3</sup> ) – to be used only for cohesionless soils below the groundwater table

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# 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 <sup>(1)</sup> 'N' VALUE
Very Soft	12 or less	Less than 2
Soft	12 to 25	2 to 4
Firm	25 to 50	4 to 8
Stiff	50 to 100	8 to 15
Very Stiff	100 to 200	15 to 30
Hard	Greater than 200	Greater than 30

NOTE: Hierarchy of Soil Strength Prediction

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

## 4. TERMS DESCRIBING DENSITY (COHESIONLESS SOILS ONLY)

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

## 5. LEGEND FOR RECORDS OF BOREHOLES

SYMBOLS AND ABBREVIATIONS FOR SAMPLE TYPE	SS Split Spoon Sample	WS Wash Sample	AS Auger (Grab) Sample
	TW Thin Wall Shelby Tube Sample	TP Thin Wall Piston Sample	
	PH Sampler Advanced by Hydraulic Pressure	PM Sampler Advanced by Manual Pressure	
	WH Sampler Advanced by Self Static Weight	RC Rock Core	SC Soil Core

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

 Water Level  
 $C_{pen}$  Shear Strength Determination by Pocket Penetrometer

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

UNIFIED SOILS CLASSIFICATION

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

## EXPLANATION OF ROCK LOGGING TERMS

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



## **Appendix A**

### **Section 1 (Stations 18+500 to 17+275 Rouge River)**

RECORD OF BOREHOLE No EDR 2-01

1 OF 1

METRIC

W.P. 2930-17-00 LOCATION N 4 860 599.8 E 314 443.6 ORIGINATED BY BL  
 HWY 404 BOREHOLE TYPE Solid Stem Augers COMPILED BY MP  
 DATUM Geodetic DATE 2018.08.03 - 2018.08.03 LATITUDE 43.885309 LONGITUDE -79.379984 CHECKED BY RD

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa						
212.7	GROUND SURFACE													
0.0	ASPHALT: (150mm)													
0.2	SAND and GRAVEL, trace silt, trace clay Compact Brown Moist (FILL)		1	SS	14									
211.9						212								
0.8	Silty CLAY, with sand, trace gravel Stiff to Very Stiff Brown Moist (TILL)		2	SS	11									
						211								
						210								
						209								
208.7	Hard													
4.0														
						208							1 40 35 24	
						207								
						206								
						205								
204.5														
8.2	END OF BOREHOLE AT 8.2m. BOREHOLE CAVED TO 5.5m AND WATER LEVEL AT 2.7m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO 0.2m, THEN COLD PATCH ASPHALT TO SURFACE.													

ONT/MT/4S2\_MTO-15786.GPJ\_2017TEMPLATE(MTO).GDT\_11/8/18

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



### RECORD OF BOREHOLE No TS 2-01

1 OF 1

**METRIC**

W.P. 2930-17-00 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			PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa						
209.6	GROUND SURFACE													
0.0	ASPHALT: (150mm)													
0.2	SAND and GRAVEL Compact Brown Moist (FILL)		1	SS	26									
208.6	Silty CLAY, with sand, trace gravel Hard Grey Moist (TILL)		2	SS	40									
1.0			3	SS	100/ 0.275									
			4	SS	90								1 34 40 25	
			5	SS	100/ 0.200									
			6	SS	100/ 0.250									
			7	SS	100/ 0.250								1 32 36 31	
			8	SS	100/ 0.250									
201.6	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.													

ONTMT4S2\_MTO-15786.GPJ 2017TEMPLATE(MTO).GDT 11/8/18

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

**RECORD OF BOREHOLE No MS 2-03**

1 OF 1

**METRIC**

W.P. 2930-17-00 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			PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa						
206.9	GROUND SURFACE													
0.0	ASPHALT: (150mm)													
0.2	SAND and GRAVEL, trace silt, trace clay (FILL)		1	GS										
206.3														
0.6	Silty CLAY, with sand, trace gravel Hard Brown Moist (TILL)		2	SS	61									
			3	SS	81									
			4	SS	103/ 0.275									
			5	SS	45								1 35 41 23	
	Grey		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.													

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

### RECORD OF BOREHOLE No MS 2-05

1 OF 1

METRIC

W.P. 2930-17-00 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				UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV. DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					
						20 40 60 80 100				PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	
						○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE				WATER CONTENT (%) 20 40 60			GR SA SI CL
205.9	GROUND SURFACE												
0.0	ASPHALT: (150mm)												
0.2	SAND and GRAVEL, trace silt, trace clay Compact Brown Moist		1	SS	21								
204.9	(FILL)												
1.0	Silty CLAY, some sand, trace gravel, occasional organics		2	SS	14								
204.5	Stiff Brown Moist												
1.4	(FILL)												
	Silty CLAY, with sand, trace gravel Very Stiff to Hard Brown Moist		3	SS	16								
	(TILL)												
			4	SS	19								5 41 35 19
			5	SS	32								
			6	SS	16								1 29 39 31
			7	SS	27								
	Grey												
			8	SS	53								
197.7													
8.2	END OF BOREHOLE AT 8.2m. BOREHOLE OPEN AND WATER LEVEL AT 6.4m DEPTH 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 2.3 203.6												

ONTMT452\_MTO-15786.GPJ 2017TEMPLATE(MTO).GDT 11/8/18

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

### RECORD OF BOREHOLE No MS 2-08

1 OF 1

**METRIC**

W.P. 2930-17-00 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 W <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa						
204.2	GROUND SURFACE													
0.0	ASPHALT: (200mm)													
0.2	SAND and GRAVEL, trace silt, trace clay Dense Brown Moist (FILL)		1	SS	35									
203.5	Silty CLAY, with sand, trace gravel Hard to Very Stiff Brown Moist (TILL)		2	SS	36									
0.8			3	SS	20								0 33 48 19	
			4	SS	37									
			5	SS	23									
			6	SS	19									
	Stiff to Very Stiff		7	SS	14								4 31 33 32	
			8	SS	22									
196.0	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.													

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

### RECORD OF BOREHOLE No MS 2-09

1 OF 2

METRIC

W.P. 2930-17-00 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 W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60					
204.0	GROUND SURFACE														
0.0	ASPHALT: (150mm)														
0.2	SAND and GRAVEL, trace silt, trace clay (FILL)		1	SS											
203.3	Silty SAND, some gravel, trace clay Dense to Compact Brown Moist (FILL)		2	SS	45										
0.7			3	SS	30										
			4	SS	24										
201.0	SILT, some clay Compact Brown Moist		5	SS	14										
3.0			6	SS	12										
201.0															
199.3															
198.3	Silty CLAY, trace sand, trace gravel Very Stiff to Hard Brown Moist (TILL)		7	SS	22										
5.6			8	SS	35										
196.3															
195.4	SAND and SILT, trace gravel, trace clay Very Dense Brown Moist (TILL)		9	SS	89										
8.5															
195.4															
194.4															

ONTMT4S2\_MTO-15786.GPJ\_2017TEMPLATE(MTO).GDT\_11/8/18

Continued Next Page

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

**RECORD OF BOREHOLE No MS 2-09**

2 OF 2

**METRIC**

W.P. 2930-17-00 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 W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	20 40 60	20 40 60					
	Continued From Previous Page														
	<b>SAND</b> and <b>SILT</b> , trace gravel, trace clay Very Dense Grey Moist (TILL)		10	SS	56	▽	193								
191.2			11	SS	62		192								
12.8	END OF BOREHOLE AT 12.8m. WATER LEVEL AT 10.7m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO 1.5m, AUGER CUTTINGS TO 0.2, THEN COLD PATCH ASPHALT TO SURFACE.														

ONTMT4S2\_MTO-15786.GPJ 2017TEMPLATE(MTO).GDT 11/8/18

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

**RECORD OF BOREHOLE No OHS 2-05**

1 OF 1

**METRIC**

GWP# 2930-17-00 LOCATION N 4 859 448.8 E 314 595.8 ORIGINATED BY KK  
 HWY 404 BOREHOLE TYPE Solid Stem Augers COMPILED BY MP  
 DATUM Geodetic DATE 2018.08.09 - 2018.08.09 CHECKED BY RD

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa		WATER CONTENT (%)			
203.7	GROUND SURFACE												
0.0	ASPHALT: (150mm)												
0.2	SAND and GRAVEL (FILL)		1	GS									
203.0	Silty CLAY, trace to some gravel, trace sand Hard to Stiff Brown Moist (TILL)		2	SS	40								
0.7			3	SS	23								
			4	SS	22								
			5	SS	14								3 30 35 32
			6	SS	15								
			7	SS	22								
196.6	SAND, trace silt, trace gravel Very Dense Brown Moist		8	SS	66								
7.2													
195.5	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.												
8.2													

ONTMT4S\_MTO-15786.GPJ\_2017TEMPLATE(MTO).GDT\_2/5/19

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

### RECORD OF BOREHOLE No OHS 2-06

1 OF 1

**METRIC**

W.P. 2930-17-00 LOCATION N 4 859 818.0 E 314 588.5 ORIGINATED BY KK  
 HWY 404 BOREHOLE TYPE Solid Stem Augers COMPILED BY MP  
 DATUM Geodetic DATE 2018.07.26 - 2018.07.26 LATITUDE 43.878270 LONGITUDE -79.378195 CHECKED BY RD

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa						
205.7	GROUND SURFACE													
0.0	ASPHALT: (150mm)													
0.2	SAND and GRAVEL (FILL)		1	GS										
205.0	Silty CLAY, some sand to with sand, trace gravel Stiff to Hard Brown Moist (TILL)  Grey		2	SS	10									
0.7			3	SS	20									1 32 31 36
			4	SS	41									
			5	SS	20									
			6	SS	42									3 27 41 29
			7	SS	42									
			8	SS	45									
197.5			END OF BOREHOLE AT 8.2m. BOREHOLE CAVED TO 7.4m AND WATER LEVEL AT 5.4m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO 1.8m. AUGER CUTTINGS TO 0.2m, THEN COLD PATCH ASPHALT TO SURFACE.											

ONT/MT/452, MTO-15786.GPJ 2017TEMPLATE(MTO).GDT 11/8/18

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

### RECORD OF BOREHOLE No HMS 2-05

1 OF 1

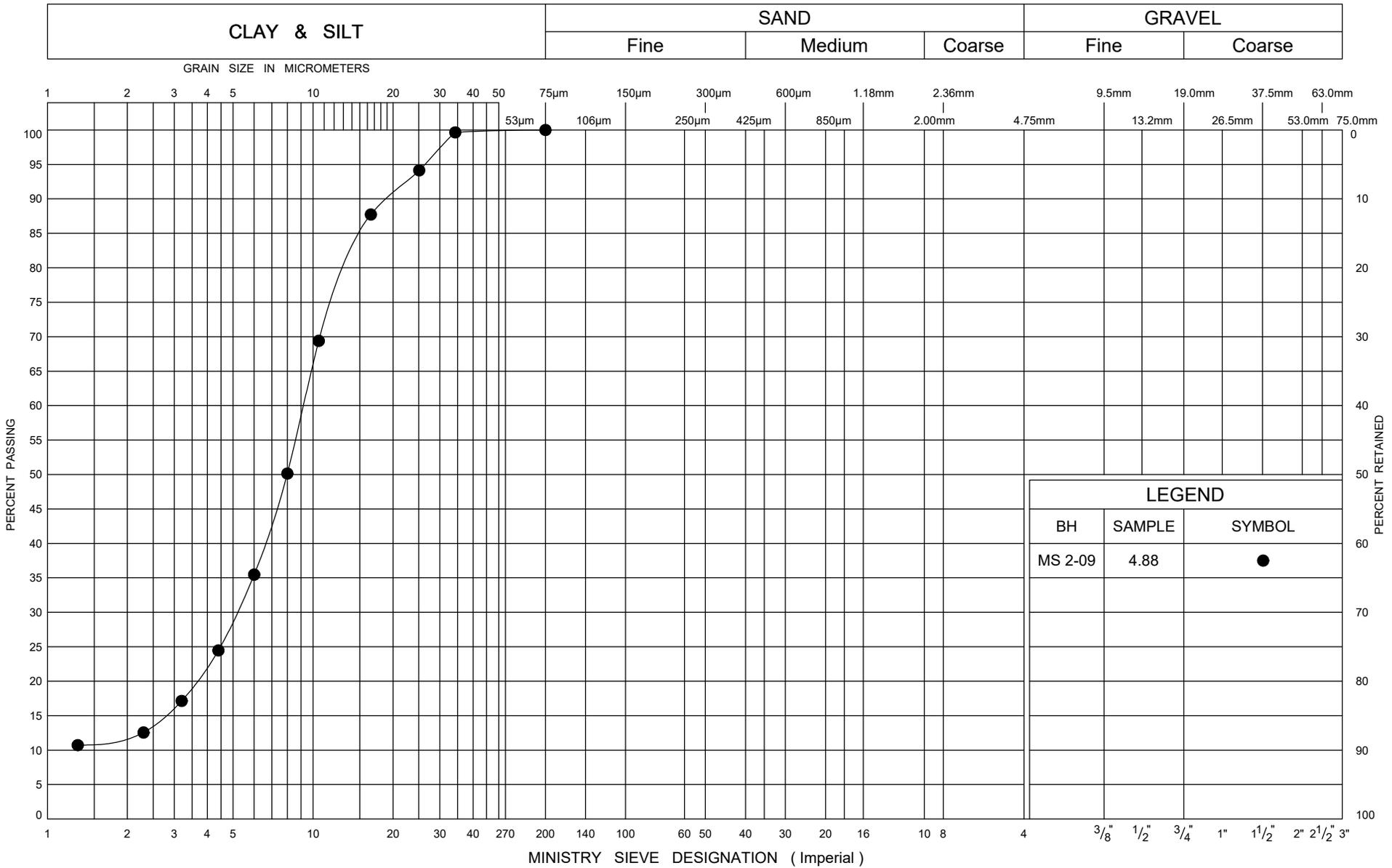
**METRIC**

W.P. 2930-17-00 LOCATION N 4 859 532.0 E 314 638.3 ORIGINATED BY KK  
 HWY 404 BOREHOLE TYPE Solid Stem Augers COMPILED BY MP  
 DATUM Geodetic DATE 2018.07.26 - 2018.07.26 LATITUDE 43.875695 LONGITUDE -79.377581 CHECKED BY RD

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60					
204.2	GROUND SURFACE														
0.0	ASPHALT: (150mm)														
0.2	SAND and GRAVEL, trace silt, trace clay Grey Moist (FILL)  Silty SAND Loose to Compact Brown Moist (FILL)		1	GS											
203.6			2	SS	8										
0.6			3	SS	11										
202.1	Silty CLAY, trace sand, trace gravel Stiff to Very Stiff Grey Moist (TILL)		4	SS	14										
2.1			5	SS	23										
			6	SS	11										
			7	SS	16										
			8	SS	23										
195.9	END OF BOREHOLE AT 8.2m. BOREHOLE CAVED TO 7.4m AND WATER LEVEL AT 5.8m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO 1.5m. AUGER CUTTINGS TO 0.2m, THEN COLD PATCH ASPHALT TO SURFACE.														

ONT/MT/452\_MTO-15786.GPJ\_2017TEMPLATE(MTO).GDT\_11/8/18

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



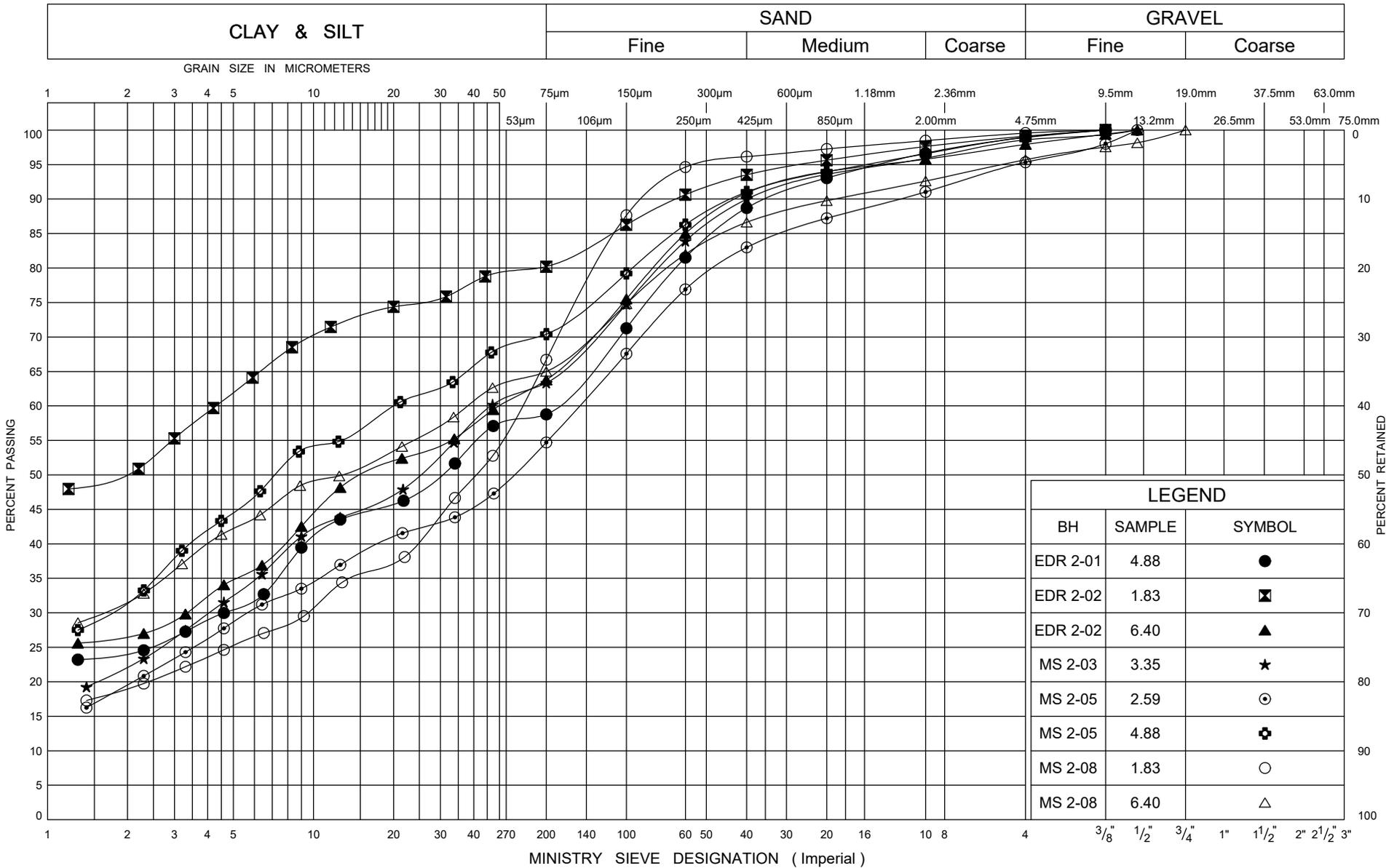
ONTARIO MOT GRAIN SIZE 2 MTO-15786.GPJ ONTARIO MOT.GDT 1/18/19



## GRAIN SIZE DISTRIBUTION SILT

FIG No A1

W P 2930-17-00



ONTARIO MOT GRAIN SIZE 2 MTO-15786.GPJ ONTARIO MOT.GDT 1/18/19

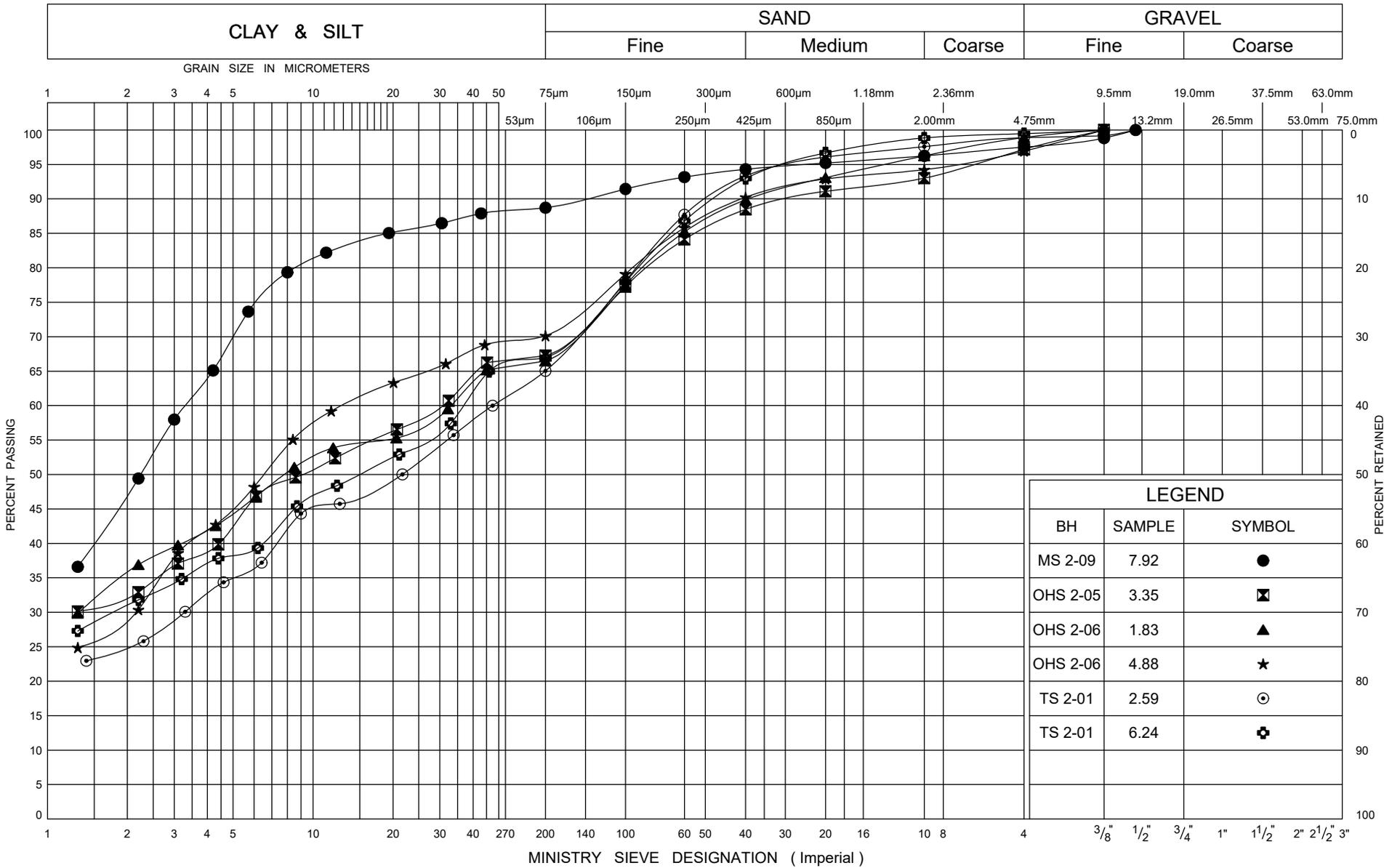


## GRAIN SIZE DISTRIBUTION

### Silty CLAY TILL

FIG No A2

W P 2930-17-00

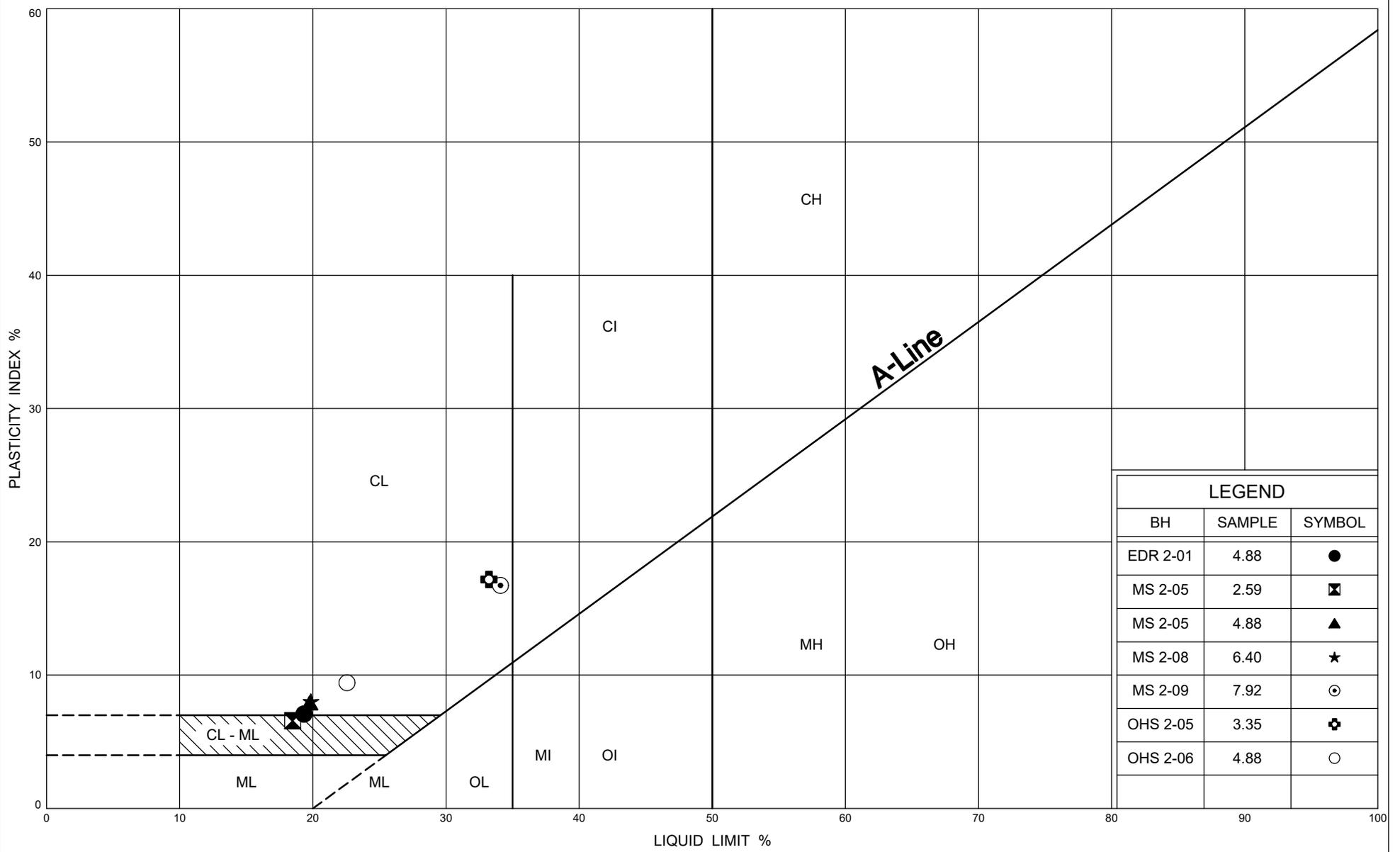


ONTARIO MOT GRAIN SIZE 2 MTO-15786.GPJ ONTARIO MOT.GDT 2/5/19



**GRAIN SIZE DISTRIBUTION**  
Silty CLAY TILL

FIG No A3  
W P 2930-17-00



LEGEND		
BH	SAMPLE	SYMBOL
EDR 2-01	4.88	●
MS 2-05	2.59	⊠
MS 2-05	4.88	▲
MS 2-08	6.40	★
MS 2-09	7.92	⊙
OHS 2-05	3.35	⊕
OHS 2-06	4.88	○

ONTARIO MOT PLASTICITY CHART MTO-15786.GPJ ONTARIO MOT.GDT 2/5/19



**PLASTICITY CHART**  
Silty CLAY TILL

FIG No A4

W P 2930-17-00



## **Appendix B**

**Section 2 (Stations 17+275 Rouge River to 16+250 16<sup>th</sup> Avenue)**

### RECORD OF BOREHOLE No HMP 2-01

1 OF 2

**METRIC**

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 <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa						
203.2	GROUND SURFACE													
0.0	ASPHALT: (175mm)													
203.0														
0.2	SAND and GRAVEL, trace silt, trace clay Grey Moist (FILL)													
0.3	SAND and SILT, trace clay Dense to Compact Brown Moist (TILL)		1	SS	31									
			2	SS	40									
			3	SS	26								0 27 64 9	
			4	SS	25									
			5	SS	15									
			6	SS	10									
			7	SS	31								0 40 52 8	
			8	SS	11									

ONTMT452\_MTO-15786.GPJ\_2017TEMPLATE(MTO).GDT\_11/8/18

Continued Next Page

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

**RECORD OF BOREHOLE No HMP 2-01**

2 OF 2

**METRIC**

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 $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa							
	Continued From Previous Page						20 40 60 80 100	20 40 60	W <sub>p</sub> W W <sub>L</sub>						
193.0	SAND and SILT, trace clay	○													
10.2	SAND, trace gravel, trace clay Dense to Very Dense Grey Wet	▽	9	SS	31									Split Spoon Wet	
192															
191			10	SS	61									2 91 7 (SI+CL)	
190.4															
12.8	END OF BOREHOLE AT 12.8m. WATER LEVEL INFERRED AT 10.7m. BOREHOLE CAVED TO 7.6m. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND AUGER CUTTINGS TO 0.2m, THEN COLD PATCH ASPHALT TO SURFACE.														

ONT/MT/452\_MTO-15786.GPJ\_2017TEMPLATE(MTO).GDT\_11/8/18

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

### RECORD OF BOREHOLE No MS 2-10

1 OF 1

METRIC

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			PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60					
202.7	GROUND SURFACE														
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)														
0.7	Sandy SILT, trace gravel		2	SS	25										
201.3	Compact Brown Moist (FILL)														
1.4	Sandy SILT, trace gravel		3	SS	22										
200.1	Compact Grey Moist														
2.6	Silty CLAY, with sand, trace gravel		4	SS	27										
	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.														

ONTMT4S2\_MTO-15786.GPJ 2017TEMPLATE(MTO).GDT 11/8/18

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

### RECORD OF BOREHOLE No MS 2-11

1 OF 1

**METRIC**

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			PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	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)													
200.0	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								2 5 82 11	
199.2														
3.0	Silty CLAY, with sand, trace gravel Hard to Very Stiff Grey Moist (TILL)		4	SS	52									
			5	SS	54								0 34 39 27	
			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.													

ONT/MT/452\_MTO-15786.GPJ\_2017TEMPLATE(MTO).GDT\_11/8/18

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

### RECORD OF BOREHOLE No MS 2-12

1 OF 2

METRIC

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 $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa					
						20 40 60 80 100 ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100							
						WATER CONTENT (%)							
						PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT					
						W <sub>p</sub>	W	W <sub>L</sub>					
202.0	GROUND SURFACE												
0.0	ASPHALT: (150mm)												
0.2	SAND and GRAVEL, trace silt, trace clay Dense to Compact Brown Moist (FILL)	[Hatched Pattern]	1	SS	42								
201.0			2	SS	20								
0.9			3	SS	28								
199.4	Silty SAND, trace gravel, trace clay Compact Brown Moist (FILL)	[Hatched Pattern]	4	SS	15								
2.6			5	SS	47								
	Silty CLAY, with sand, trace gravel Hard Grey Moist (TILL)	[Dotted Pattern]	6	SS	71							1 25 41 33	
			7	SS	72								
			8	SS	45								2 28 40 30
			9	SS	90								

ONTMT452\_MTO-15786.GPJ 2017TEMPLATE(MTO).GDT 11/8/18

Continued Next Page

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

**RECORD OF BOREHOLE No MS 2-12**

2 OF 2

**METRIC**

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			PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	20 40 60 80 100	20 40 60 80 100					
Continued From Previous Page															
189.7	Silty <b>CLAY</b> , with sand, trace gravel Hard Grey Moist (TILL)		10	SS	100/ 0.275		191								
12.3	END OF BOREHOLE AT 12.3m. BOREHOLE CAVED TO 11.0m AND WATER LEVEL AT 8.5m DEPTH 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 8.1 193.8		11	SS	100/ 0.100		190								

ONTMT4S2\_MTO-15786.GPJ 2017TEMPLATE(MTO).GDT 11/8/18

+<sup>3</sup>, x<sup>3</sup>: Numbers refer to Sensitivity 20  
15  
10 (%) STRAIN AT FAILURE

### RECORD OF BOREHOLE No MS 2-15

1 OF 1

**METRIC**

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			PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa							
199.9	GROUND SURFACE														
0.0	ASPHALT: (175mm)														
0.2	SAND and GRAVEL Grey Moist (FILL)  SILT, some sand, trace gravel, trace clay Compact Brown Moist														
199.5															
0.4			1	SS	23										
			2	SS	23									2 13 77 8	
197.7	Silty CLAY, with sand, trace gravel Very Stiff to Hard Grey Moist (TILL)														
2.2															
			3	SS	15										
			4	SS	15									3 30 39 28	
			5	SS	16										
			6	SS	101/ 0.275										
			7	SS	100/ 0.250										
191.9	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.														
8.0															

ONTMT4S2\_MTO-15786.GPJ 2017TEMPLATE(MTO).GDT 11/8/18

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

### RECORD OF BOREHOLE No MS 2-17

1 OF 1

METRIC

W.P. 2930-FI-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 $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60			80	100
199.0	GROUND SURFACE													
0.0	ASPHALT: (155mm)													
198.6	SAND and GRAVEL, trace silt, trace clay Brown Moist (FILL)													
0.4														
197.6	Silty SAND, trace gravel, trace clay Compact Brown Moist (FILL)		1	SS	30									
1.4														
197.6	SAND and SILT, trace clay Compact Brown Moist		2	SS	28									
196.1	Loose		3	SS	15									
2.9														
196.1			4	SS	8									
194.9			5	SS	12									
4.1														
192.9	Silty CLAY, with sand, trace gravel Very Stiff to Hard Grey Moist (TILL)		6	SS	18									
6.1														
192.9			7	SS	84									
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														

ONT/MT/452, MTO-15786.GPJ 2017 TEMPLATE (MTO).GDT 11/8/18

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



**RECORD OF BOREHOLE No MS 2-18**

2 OF 2

**METRIC**

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 <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa							
185.4	Continued From Previous Page Silty <b>CLAY</b> , with sand, trace gravel Hard Brown to Grey Moist (TILL)		10	SS	37		188								
							187								
			11	SS	37		186								
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.														

ONTMT4S2\_MTO-15786.GPJ\_2017TEMPLATE(MTO).GDT\_11/8/18

### RECORD OF BOREHOLE No OHS 2-03

1 OF 1

**METRIC**

W.P. 2930-17-00 LOCATION N 4 858 864.9 E 314 692.2 ORIGINATED BY BL  
 HWY 404 BOREHOLE TYPE Solid Stem Augers COMPILED BY MP  
 DATUM Geodetic DATE 2018.08.10 - 2018.08.10 LATITUDE 43.869689 LONGITUDE -79.376922 CHECKED BY RD

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60					
199.3	GROUND SURFACE														
0.0	ASPHALT: (150mm)														
0.2	SAND and GRAVEL, trace silt, trace clay Very Dense Brown Moist (FILL)		1	SS	56										
			2	SS	56										
197.8	SAND and SILT, trace gravel, trace clay Compact Brown Moist		3	SS	29										8 54 34 4
196.6	Silty CLAY, with sand, trace gravel Stiff to Hard Grey Moist (TILL)		4	SS	17										
			5	SS	12										
			6	SS	100/ 0.200										
			7	SS	100/ 0.275										0 26 43 31
			8	SS	100/ 0.275										
191.4	END OF BOREHOLE AT 7.9m. BOREHOLE CAVED TO 1.5m AND WATER LEVEL AT 2.3m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO 0.2m, THEN COLD PATCH ASPHALT TO SURFACE.														

ONT/MT/4S2\_MTO-15786.GPJ\_2017TEMPLATE(MTO).GDT\_11/8/18

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

### RECORD OF BOREHOLE No OHS 2-04

1 OF 1

**METRIC**

W.P. 2930-17-00 LOCATION N 4 859 220.9 E 314 692.6 ORIGINATED BY BL  
 HWY 404 BOREHOLE TYPE Solid Stem Augers COMPILED BY MP  
 DATUM Geodetic DATE 2018.07.30 - 2018.07.30 LATITUDE 43.872894 LONGITUDE -79.376910 CHECKED BY RD

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa								
						20	40	60	80	100	20	40	60	kn/m <sup>3</sup>	GR SA SI CL	
202.4	GROUND SURFACE															
0.0	ASPHALT: (150mm)															
0.2	SAND and GRAVEL, trace silt, trace clay Very Dense Brown Moist (FILL)		1	GS	100/ 0.225						○					
201.6												○				
0.8													○			
	Clayey SILT, trace gravel, occasional organics Very Stiff to Stiff Brown Moist (FILL)		2	SS	17											
													○			
	SILT, some clay, trace sand, trace gravel Dense to Compact Brown Moist		3	SS	11											
200.2																
2.2																
	SAND and SILT, trace gravel Very Dense Brown Moist (TILL)		4	SS	41											
	Silty CLAY, with sand, trace gravel Very Stiff to Hard Grey Moist (TILL)		5	SS	22											
197.6			6	SS	29						○					
4.8											○				0 31 53 16	
	SAND and SILT, trace gravel Very Dense Brown Moist (TILL)		7	SS	52											
195.2																
7.2																
194.5			8	SS	100/ 0.300											
7.9	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.															

ONT/MT/452\_MTO-15786.GPJ 2017TEMPLATE(MTO).GDT 11/8/18

### RECORD OF BOREHOLE No HMS 2-04

1 OF 1

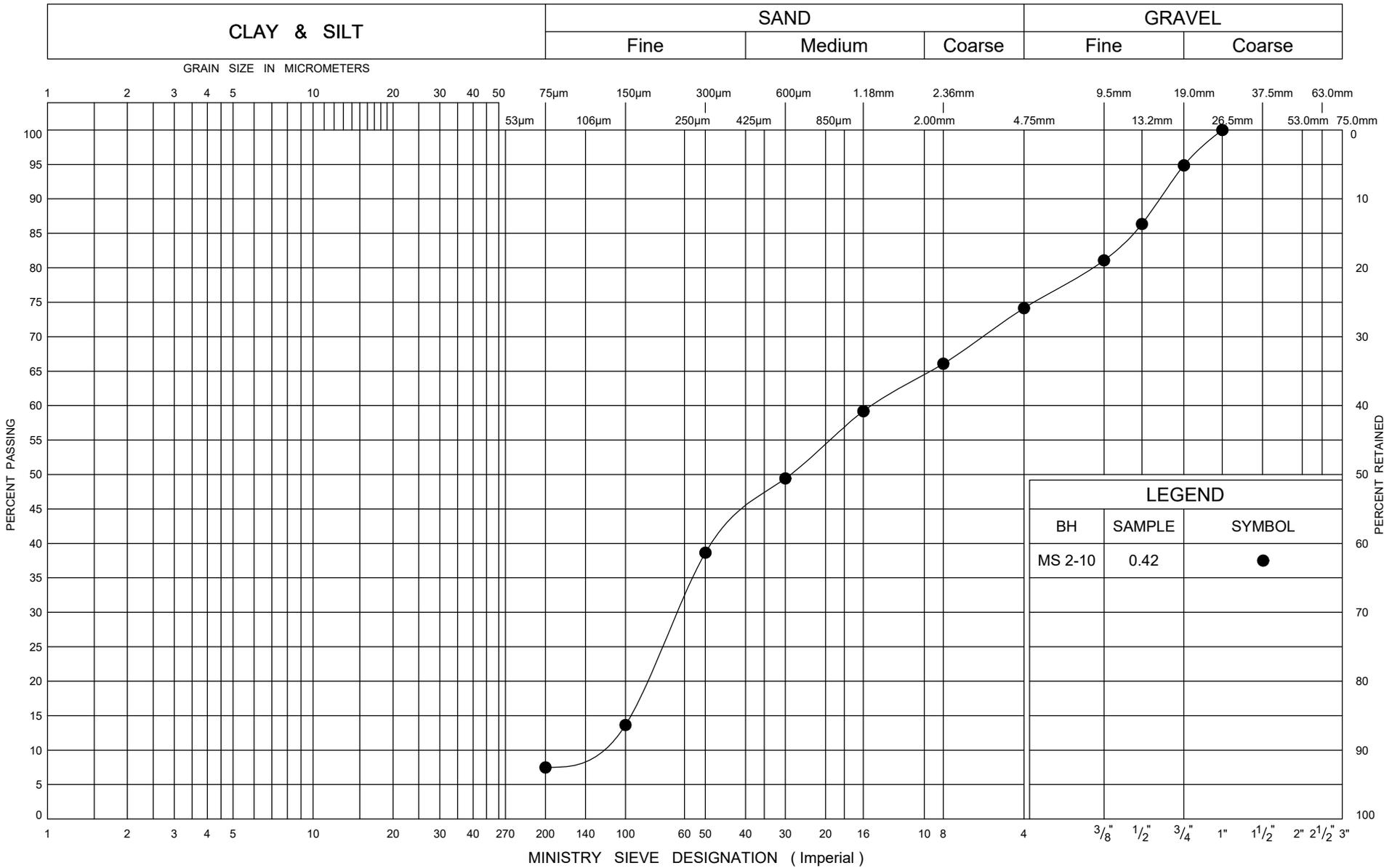
METRIC

W.P. 2930-17-00 LOCATION N 4 859 154.8 E 314 644.4 ORIGINATED BY BL  
 HWY 404 BOREHOLE TYPE Solid Stem Augers COMPILED BY MP  
 DATUM Geodetic DATE 2018.08.10 - 2018.08.10 LATITUDE 43.872300 LONGITUDE -79.377511 CHECKED BY RD

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa						
201.8	GROUND SURFACE													
0.0	ASPHALT: (150mm)													
0.2	SAND and GRAVEL, trace silt, trace clay Very Dense Brown Moist (FILL)		1	SS	60									
201.0						201								
0.8	SILT, trace sand, trace clay Dense to Compact Brown Moist		2	SS	31									
			3	SS	27	200							0 4 87 9	
199.5														
2.2	Silty CLAY, with sand, trace gravel Hard to Very Stiff Grey Moist (TILL)  occasional cobbles at 3.0m		4	SS	36	199								
			5	SS	64	198								
			6	SS	46	197								
			7	SS	31	196								
			8	SS	28	195								
193.5						194							1 32 41 26	
8.2	END OF BOREHOLE AT 8.2m. BOREHOLE CAVED TO 6.4m AND WATER LEVEL AT 6.1m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO 0.2m, THEN COLD PATCH ASPHALT TO SURFACE.													

ONTMT4S2\_MTO-15786.GPJ 2017TEMPLATE(MTO).GDT 11/8/18

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



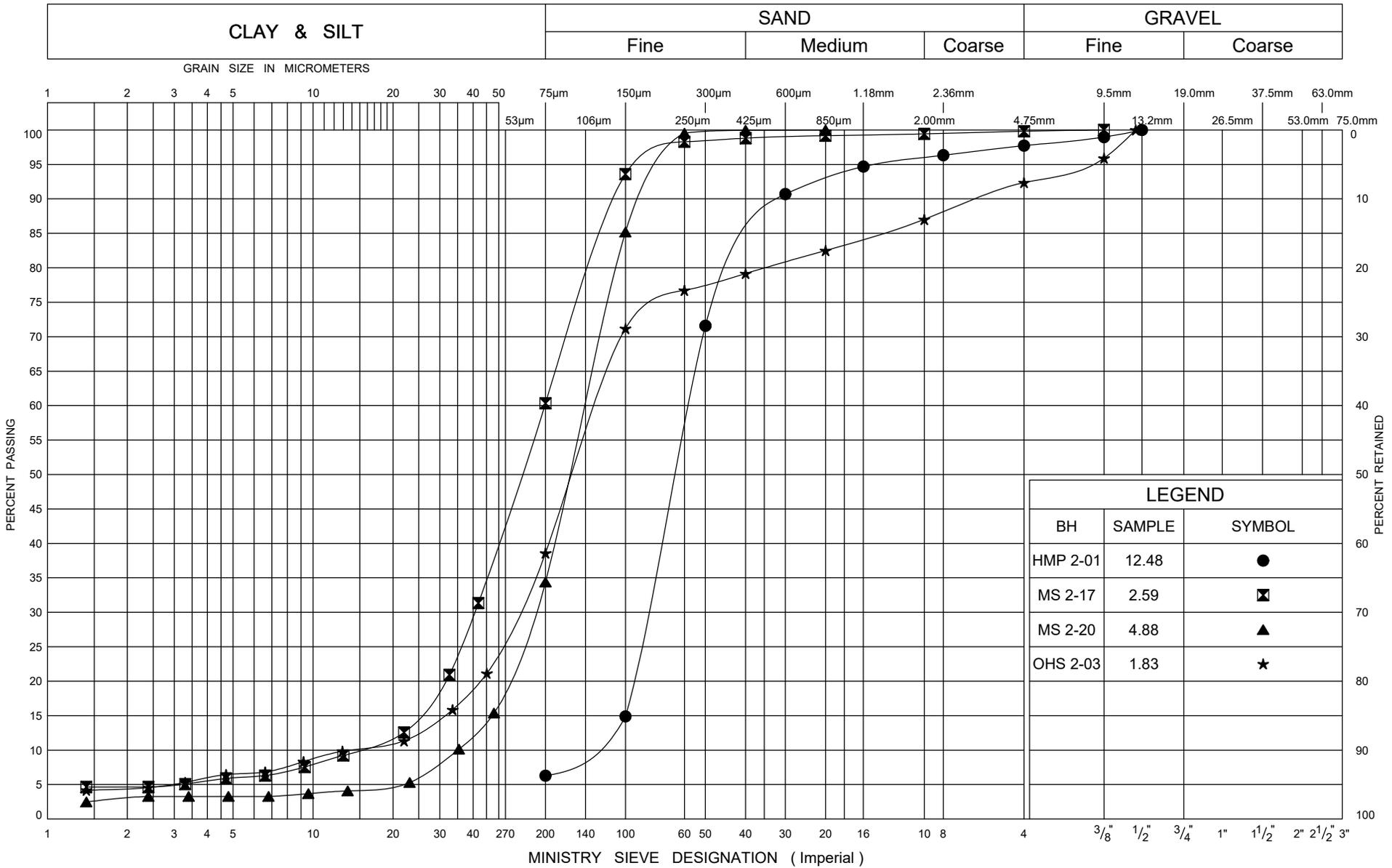
ONTARIO MOT GRAIN SIZE MTO-15786.GPJ ONTARIO MOT.GDT 10/22/18



## GRAIN SIZE DISTRIBUTION SAND and GRAVEL FILL

FIG No B1

W P 2930-17-00



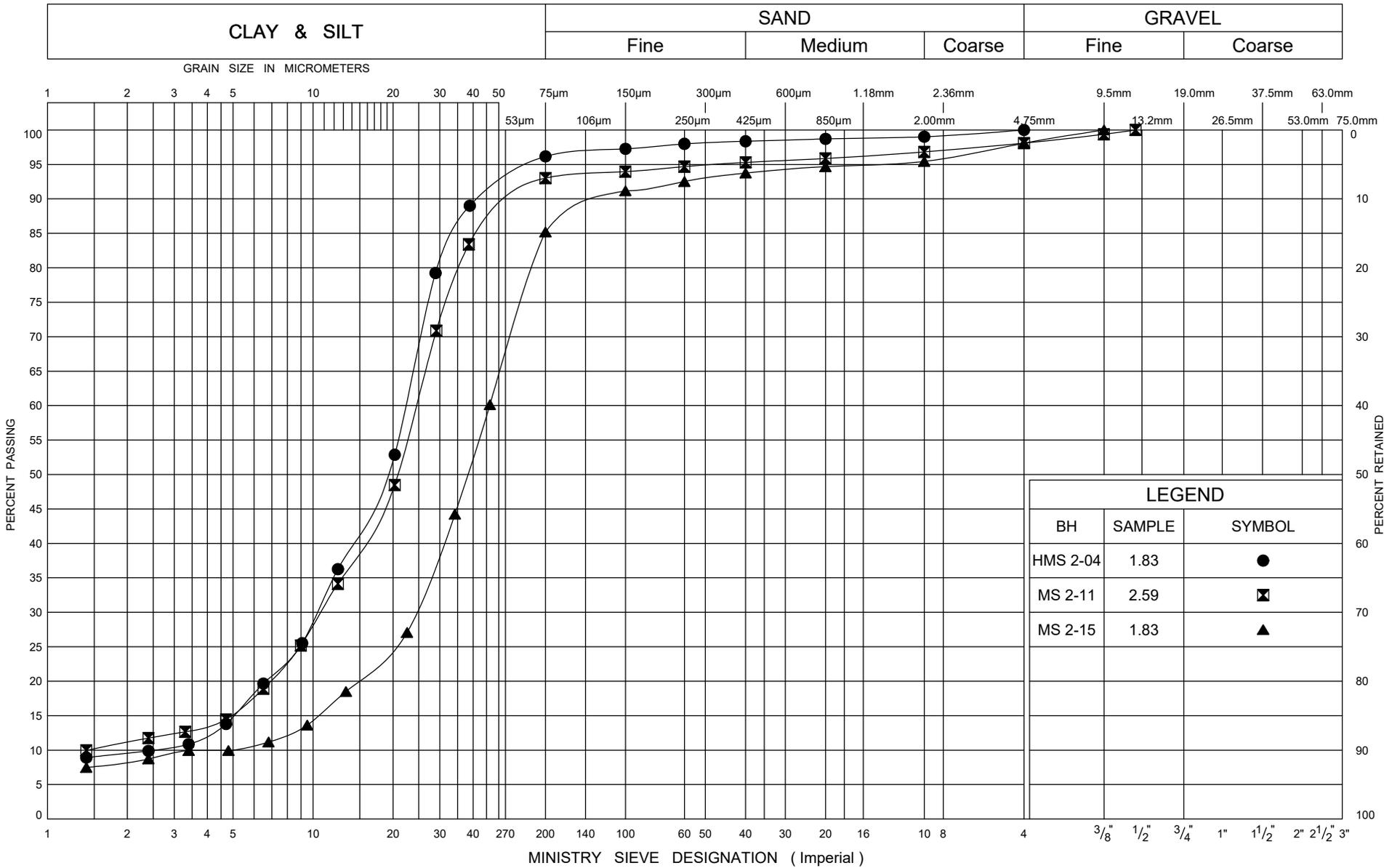
LEGEND		
BH	SAMPLE	SYMBOL
HMP 2-01	12.48	●
MS 2-17	2.59	⊠
MS 2-20	4.88	▲
OHS 2-03	1.83	★

ONTARIO MOT GRAIN SIZE MTO-15786.GPJ ONTARIO MOT.GDT 10/22/18



## GRAIN SIZE DISTRIBUTION SAND and SILT

FIG No B2  
W P 2930-17-00



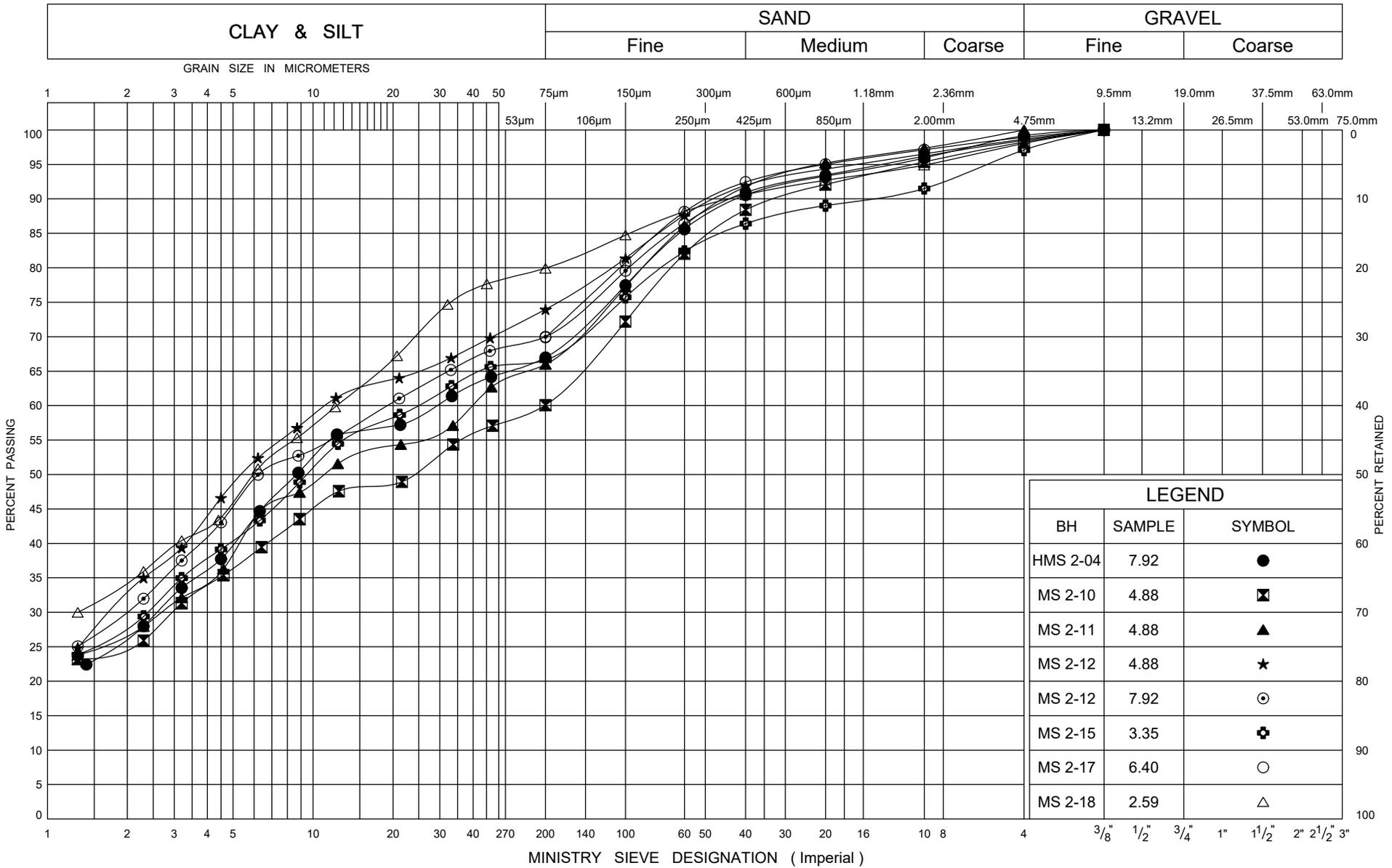
ONTARIO MOT GRAIN SIZE MTO-15786.GPJ ONTARIO MOT.GDT 10/22/18



## GRAIN SIZE DISTRIBUTION SILT

FIG No B3

W P 2930-17-00



ONTARIO MOT GRAIN SIZE MTO-15786.GPJ ONTARIO MOT.GDT 10/22/18

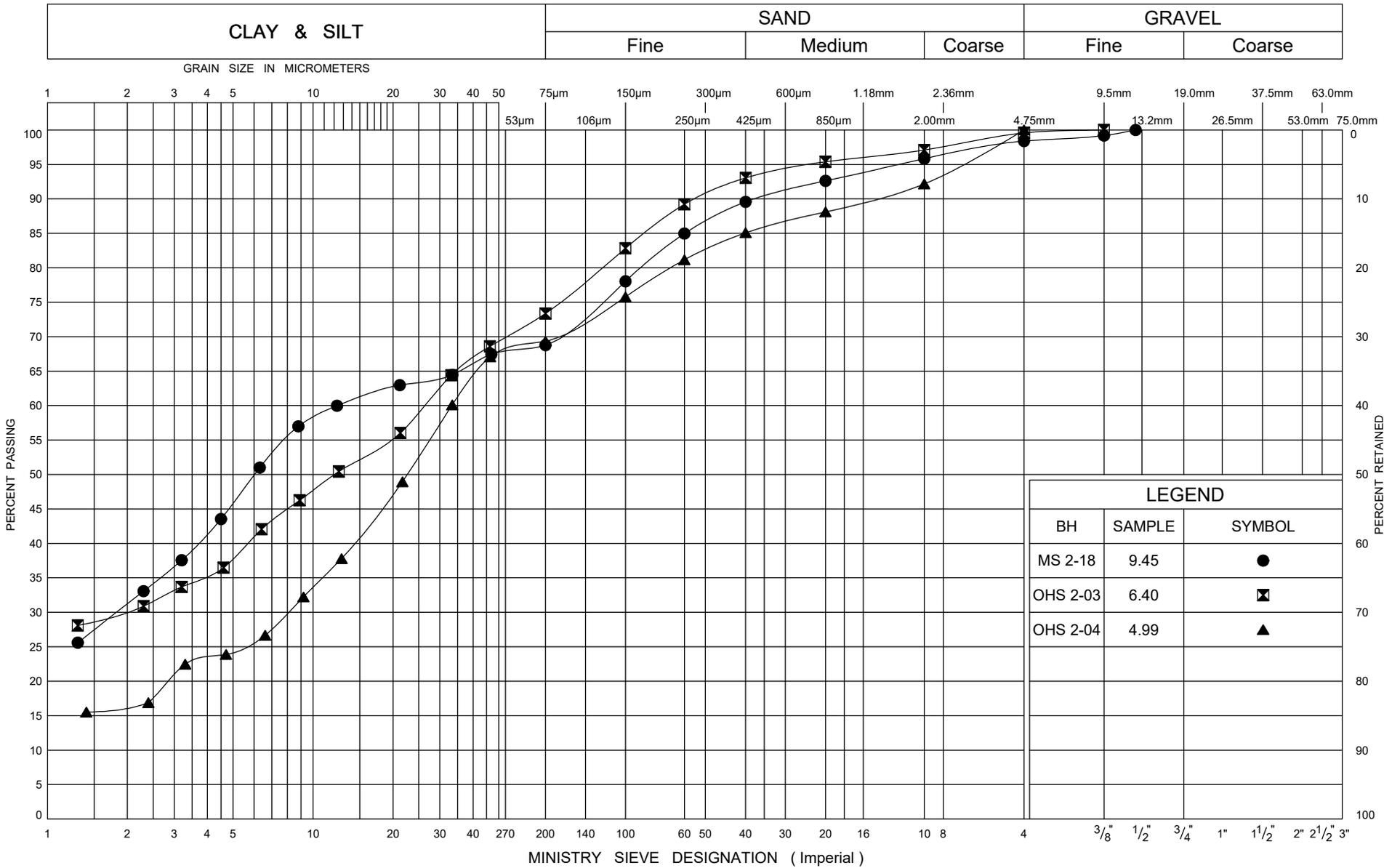


## GRAIN SIZE DISTRIBUTION

### Silty CLAY TILL

FIG No B4

W P 2930-17-00



ONTARIO MOT GRAIN SIZE 2 MTO-15786.GPJ ONTARIO MOT.GDT 1/18/19

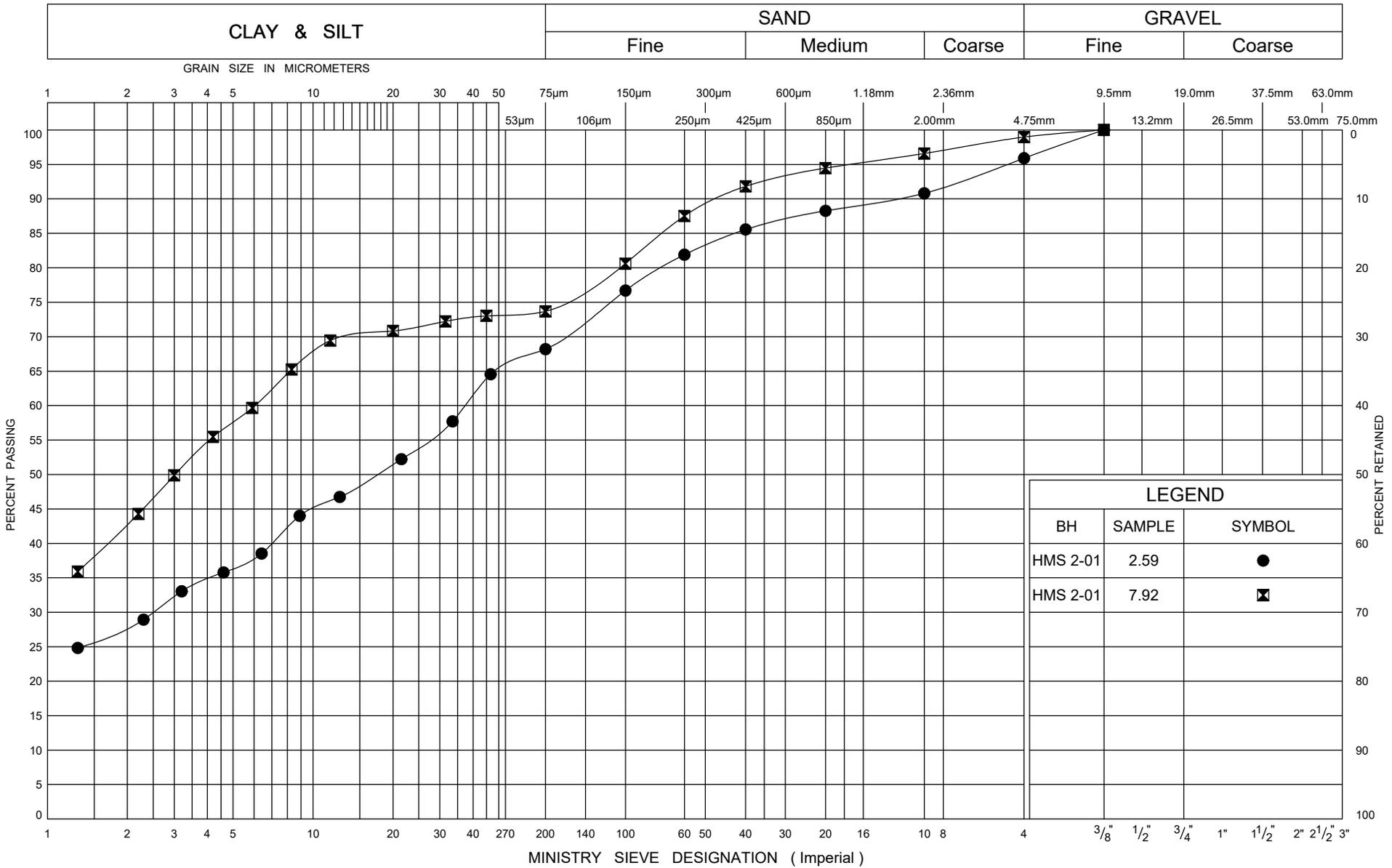


## GRAIN SIZE DISTRIBUTION

### Silty CLAY TILL

FIG No B5

W P 2930-17-00



LEGEND		
BH	SAMPLE	SYMBOL
HMS 2-01	2.59	●
HMS 2-01	7.92	⊠

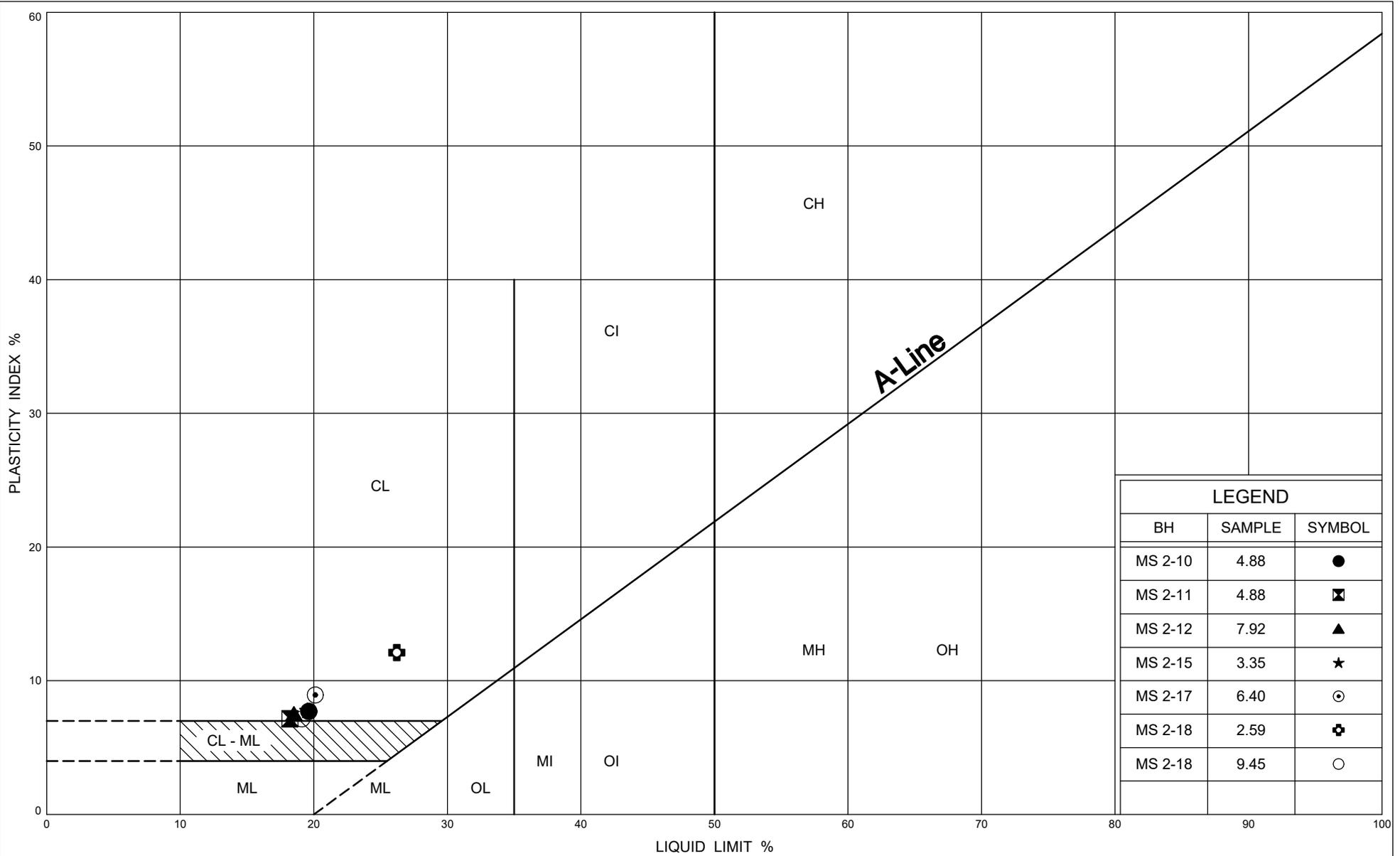
ONTARIO MOT GRAIN SIZE MTO-15786.GPJ ONTARIO MOT.GDT 10/22/18



## GRAIN SIZE DISTRIBUTION

### SAND and SILT TILL

FIG No B6  
W P 2930-17-00



LEGEND		
BH	SAMPLE	SYMBOL
MS 2-10	4.88	●
MS 2-11	4.88	⊠
MS 2-12	7.92	▲
MS 2-15	3.35	★
MS 2-17	6.40	⊙
MS 2-18	2.59	⊕
MS 2-18	9.45	○



PLASTICITY CHART  
Silty CLAY TILL

FIG No B7

W P 2930-17-00



## **Appendix C**

**Section 3 (Stations 16+200 16<sup>th</sup> Avenue to 13+550)**

### RECORD OF BOREHOLE No TS 2-02

1 OF 2

METRIC

W.P. 2930-17-00 LOCATION N 4 858 301.1 E 314 836.0 ORIGINATED BY BL  
 HWY 404 BOREHOLE TYPE Solid Stem Augers COMPILED BY MP  
 DATUM Geodetic DATE 2018.07.30 - 2018.07.30 LATITUDE 43.864613 LONGITUDE -79.375144 CHECKED BY RD

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60					
195.3	GROUND SURFACE														
0.0	ASPHALT: (150mm)														
0.2	SAND and GRAVEL Compact Brown Moist (FILL)		1	SS	25										
194.5	Silty CLAY, some sand, trace gravel Very Stiff Brown Moist (TILL)		2	SS	26										
0.8			3	SS	22										
			4	SS	21										
			5	SS	28										
				6	SS	14									
191.2	SAND and SILT, trace clay Compact Grey Moist to Wet		7	SS	11										
			8	SS	11										
			9	SS	100/ 0.275										
186.6	SAND and SILT, trace clay, trace gravel Very Dense Grey Moist to Wet (TILL)														

ONTMT4S2\_MTO-15786.GPJ\_2017TEMPLATE(MTO).GDT\_10/26/18

Continued Next Page

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

**RECORD OF BOREHOLE No TS 2-02**

2 OF 2

**METRIC**

W.P. 2930-17-00 LOCATION N 4 858 301.1 E 314 836.0 ORIGINATED BY BL  
 HWY 404 BOREHOLE TYPE Solid Stem Augers COMPILED BY MP  
 DATUM Geodetic DATE 2018.07.30 - 2018.07.30 LATITUDE 43.864613 LONGITUDE -79.375144 CHECKED BY RD

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60					
Continued From Previous Page															
183.5	SAND and SILT, trace clay Very Dense Grey Wet (TILL)		10	SS	100/ 0.300										
11.7	Silty CLAY, with sand, trace gravel Hard Grey Moist (TILL)		11	SS	54										
182.5	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.														

ONTMT4S2\_MTO-15786.GPJ 2017TEMPLATE(MTO).GDT 10/26/18

RECORD OF BOREHOLE No MS 2-23

1 OF 1

METRIC

W.P. 2930-17-00 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			PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	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	20 40 60	20 40 60						
192.8	GROUND SURFACE													
0.0	ASPHALT: (150mm)													
0.2	SAND and GRAVEL, trace silt, trace clay		1	GS										
192.1	Brown Moist (FILL)													
0.7	Silty CLAY, trace gravel, trace sand		2	SS	13									
	Stiff Brown Moist (TILL)													
190.8	SILT, some sand, trace clay		3	SS	12									
2.0	Compact Grey Wet													
			4	SS	13									
189.8	Silty CLAY, with sand, trace gravel													
3.0	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 30 41 26	

ONT/MT/4S2\_MTO-15786.GPJ\_2017TEMPLATE(MTO).GDT\_10/26/18

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

### RECORD OF BOREHOLE No MS 2-25

1 OF 1

**METRIC**

W.P. 2930-17-00 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			PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	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									
190.6			2	SS	19									
0.8			3	SS	21									
188.9	Silty CLAY, trace sand, trace gravel Very Stiff Brown Moist (TILL)		4	SS	14									
2.5			5	SS	19									
	SAND and SILT, trace to some clay, trace gravel Compact to Dense Grey Moist (TILL)		6	SS	23									
			7	SS	33									
			8	SS	20									
183.2	END OF BOREHOLE AT 8.2m. BOREHOLE CAVED TO 3.0m AND WATER LEVEL AT 4.6m DEPTH UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO 0.1m, THEN COLD PATCH ASPHALT TO SURFACE.													
8.2														

ONTMT4S2\_MTO-15786.GPJ\_2017TEMPLATE(MTO).GDT\_10/26/18

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

### RECORD OF BOREHOLE No MS 2-26

1 OF 2

METRIC

W.P. 2930-17-00 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 <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60						80	100
191.3	GROUND SURFACE																
0.0	ASPHALT: (150mm)																
0.2	SAND and GRAVEL, trace silt, trace clay Compact Brown Moist (FILL)		1	SS	27												
190.3			2	SS	12												
1.0			3	SS	17												
189.1	Silty CLAY, some sand, trace gravel Stiff to Very Stiff Brown Moist (TILL)		4	SS	20												
2.2			5	SS	18												
187.2	Silty CLAY, with sand, trace gravel Very Stiff to Hard Grey Moist (TILL)		6	SS	29												
			7	SS	100/ 0.150												
			8	SS	100/ 0.200												
			9	SS	82												

ONTMT452\_MTO-15786.GPJ\_2017TEMPLATE(MTO).GDT\_10/26/18

Continued Next Page

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

**RECORD OF BOREHOLE No MS 2-26**

2 OF 2

**METRIC**

W.P. 2930-17-00 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 <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60					
Continued From Previous Page															
178.7	Silty <b>CLAY</b> , with sand, trace gravel Hard Grey Moist (TILL)		10	SS	77									2 29 42 27	
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.		11	SS	100/ 0.275										

ONTMT4S2\_MTO-15786.GPJ\_2017TEMPLATE(MTO).GDT\_10/26/18

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

RECORD OF BOREHOLE No MS 2-27

1 OF 1

METRIC

W.P. 2930-17-00 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			PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	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							
190.5	GROUND SURFACE														
0.0	ASPHALT: (150mm)														
0.2	SAND and GRAVEL, trace silt, trace clay (FILL)		1	GS											
189.8															
0.7	Silty CLAY, some sand, trace gravel Stiff Brown Moist (TILL)		2	SS	12									1 14 27 58	
189.0															
1.4	SILT, trace clay, trace sand, trace gravel Compact to Loose Grey Moist		3	SS	13									0 9 84 7	
			4	SS	12										
			5	SS	9									0 10 78 12	
186.3															
4.1	Silty CLAY, with sand, trace gravel Hard Grey Moist (TILL)		6	SS	58									1 36 41 22	
			7	SS	100/ 0.200										
			8	SS	31										
182.2															
8.2	END OF BOREHOLE AT 8.2m. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO 1.5m. AUGER CUTTINGS TO 0.2m, THEN COLD PATCH ASPHALT TO SURFACE.														

ONT/MT/4S2\_MTO-15786.GPJ\_2017TEMPLATE(MTO).GDT\_10/26/18

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

### RECORD OF BOREHOLE No MS 2-29

1 OF 1

**METRIC**

W.P. 2930-17-00 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			PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60					
189.7	GROUND SURFACE														
0.0	ASPHALT: (150mm)														
0.2	SAND and GRAVEL Compact Brown Moist (FILL)		1	SS	20										
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										
	Firm to Stiff		4	SS	4										
			5	SS	11										
			6	SS	23										
	Very Stiff Grey		7	SS	70										
	Hard		8	SS	100/										3 21 51 25
181.9	END OF BOREHOLE AT 7.9m. BOREHOLE CAVED TO 6.1m AND WATER LEVEL AT 4.6m DEPTH UPON COMPLETION. Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 3.0m slotted screen.				0.200										
7.9															
	WATER LEVEL READINGS DATE            DEPTH(m)    ELEV.(m) 2018.09.30        2.4            187.3														

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

### RECORD OF BOREHOLE No MS 2-31

1 OF 1

**METRIC**

W.P. 2930-17-00 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				PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									WATER CONTENT (%)		
							20	40	60	80	100	20	40	60	GR SA SI CL				
189.4	GROUND SURFACE																		
0.0	ASPHALT: (150mm)																		
0.2	SAND and GRAVEL Grey Moist (FILL)			GS															
188.7	Silty CLAY, some sand to sandy, trace gravel Stiff to Very Stiff Brown Moist (TILL)		1	SS	13														
0.7			2	SS	15														
			3	SS	14											1	20	37	42
			4	SS	11														
			5	SS	23														
183.8	SAND and SILT, trace clay Dense Grey Moist		6	SS	31											0	36	59	5
182.3	SAND and SILT, trace clay Very Dense Grey Moist (TILL)		7	SS	65														
181.2	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.																		

ONTMT452, MTO-15786.GPJ 2017TEMPLATE(MTO).GDT 10/26/18

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

### RECORD OF BOREHOLE No OHS 2-01

1 OF 1

**METRIC**

W.P. 2930-17-00 LOCATION N 4 857 865.2 E 314 934.1 ORIGINATED BY BL  
 HWY 404 BOREHOLE TYPE Solid Stem Augers COMPILED BY MP  
 DATUM Geodetic DATE 2018.07.31 - 2018.07.31 LATITUDE 43.860688 LONGITUDE -79.373931 CHECKED BY RD

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60						80	100
191.3	GROUND SURFACE																
0.0	ASPHALT: (150mm)																
0.2	SAND and GRAVEL (FILL)		1	GS	12												
190.6																	
0.7	Silty CLAY, some sand to sandy, trace gravel Stiff Brown Moist (TILL)		2	SS	8												
190.6																	
0.7			3	SS	15												
189.1																	
2.2	SILT, some clay Compact Grey Moist to Wet		4	SS	12									0	0	88	12
189.1																	
2.2			5	SS	13												
187.2																	
4.1	Clayey SILT, some sand to sandy, trace gravel Very Stiff to Hard Grey Moist (TILL)		6	SS	25									2	26	55	17
187.2																	
4.1			7	SS	65												
187.2																	
4.1			8	SS	45												
183.1																	
8.2	END OF BOREHOLE AT 8.2m. BOREHOLE CAVED TO 5.8m AND WATER LEVEL 5.8m AT UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO 0.2m, THEN COLD PATCH ASPHALT TO SURFACE.																

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

### RECORD OF BOREHOLE No OHS 2-02

1 OF 1

METRIC

W.P. 2930-17-00 LOCATION N 4 858 332.9 E 314 849.6 ORIGINATED BY BL  
 HWY 404 BOREHOLE TYPE Solid Stem Augers COMPILED BY MP  
 DATUM Geodetic DATE 2018.07.31 - 2018.07.31 LATITUDE 43.864899 LONGITUDE -79.374974 CHECKED BY RD

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa							
195.5	GROUND SURFACE														
0.0	ASPHALT: (150mm)														
0.2	SAND and GRAVEL, trace silt, trace clay Dense Brown Moist (FILL) Silty CLAY, some sand, trace gravel Stiff Brown Moist (FILL) SILT, some clay Loose to Compact Brown Moist	[Strat Plot Pattern]	1	GS	37	195									
194.8			2	SS	12	194									
0.7			3	SS	8	194									
194.0			4	SS	7	193									
1.4			5	SS	24	192									
			6	SS	18	191									0 0 87 13
			7	SS	20	189									
			8	SS	20	188									2 23 43 32
188.3	Silty CLAY, some sand, trace gravel Very Stiff Grey Moist (TILL)	[Strat Plot Pattern]													
7.2															
187.2	END OF BOREHOLE AT 8.2m. BOREHOLE CAVED TO 1.8m AND WATER LEVEL 1.8m AT UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO 0.2m, THEN COLD PATCH ASPHALT TO SURFACE.														
8.2															

ONTMT452\_MTO-15786.GPJ 2017TEMPLATE(MTO).GDT 10/26/18

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



### RECORD OF BOREHOLE No HMS 2-02

1 OF 1

**METRIC**

W.P. 2930-17-00 LOCATION N 4 857 064.4 E 315 079.6 ORIGINATED BY KK  
 HWY 404 BOREHOLE TYPE Solid Stem Augers COMPILED BY MP  
 DATUM Geodetic DATE 2018.08.09 - 2018.08.09 LATITUDE 43.853478 LONGITUDE -79.372137 CHECKED BY RD

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	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							
190.7	GROUND SURFACE														
0.0	ASPHALT: (150mm)														
0.2	SAND and GRAVEL, trace silt, trace clay (FILL)			GS											
190.0							190								
0.7	Silty CLAY, trace gravel and sand Stiff Brown Moist (FILL)		1	SS	9										
			2	SS	10		189								
188.5															
2.2	SAND, some gravel, trace silt Loose to Compact Brown Moist (FILL)		3	SS	8										
			4	SS	16		188								
186.6															
4.1	Sandy SILT, trace gravel Compact Grey Wet		5	SS	18										
							186								
185.0															
5.6	SAND, some gravel, trace silt, trace clay Dense Grey Moist		6	SS	39									15 79 6 (SI+CL)	
							185								
183.5															
7.2	Silty CLAY, with sand, trace gravel Hard Grey Moist (TILL)		7	SS	87									1 36 38 25	
							183								
182.5															
8.1	END OF BOREHOLE AT 8.1m. WATER LEVEL AT 5.5m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO 5.8m, AUGER CUTTINGS TO 0.2m, THEN COLD PATCH ASPHALT TO SURFACE.														

ONTMT4S2\_MTO-15786.GPJ\_2017TEMPLATE(MTO).GDT\_10/26/18

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

### RECORD OF BOREHOLE No HMS 2-03

1 OF 1

**METRIC**

W.P. 2930-17-00 LOCATION N 4 857 998.8 E 314 848.5 ORIGINATED BY BL  
 HWY 404 BOREHOLE TYPE Solid Stem Augers COMPILED BY MP  
 DATUM Geodetic DATE 2018.08.08 - 2018.08.08 LATITUDE 43.861892 LONGITUDE -79.374994 CHECKED BY RD

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60						80	100
192.6	GROUND SURFACE																
0.0	ASPHALT: (150mm)																
0.2	SAND and GRAVEL, trace silt, trace clay Compact Brown Moist (FILL)  Silty CLAY, trace sand, trace gravel Firm to Stiff Brown to Grey Moist		1	SS	16												
191.9																	
0.8																	
			2	SS	5												
			3	SS	15										0 9 19 72		
			4	SS	12												
189.6	SILT, some sand, trace clay Compact Grey Moist to Wet																
3.0																0 17 76 7	
			5	SS	14												
188.5	Silty CLAY, with sand, trace gravel Very Stiff to Hard Grey Moist (TILL)																
4.1																	
			6	SS	26												
			7	SS	35												
			8	SS	24												
184.4	END OF BOREHOLE AT 8.2m. BOREHOLE CAVED TO 3.4m AND WATER LEVEL AT 2.4m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO 0.2m, THEN COLD PATCH ASPHALT TO SURFACE.																
8.2																	

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

**RECORD OF BOREHOLE No VMS 2-01**

1 OF 1

**METRIC**

W.P. 2930-17-00 LOCATION N 4 857 702.7 E 314 904.2 ORIGINATED BY \_\_\_\_\_  
 HWY 404 BOREHOLE TYPE \_\_\_\_\_ COMPILED BY \_\_\_\_\_  
 DATUM Geodetic DATE 2018.08.08 - 2018.08.08 LATITUDE 43.859226 LONGITUDE -79.374307 CHECKED BY \_\_\_\_\_

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60					
190.2	GROUND SURFACE														
0.0	ASPHALT: (150mm)														
0.2	SAND and GRAVEL Compact to Loose Brown Moist (FILL)		1	SS	20						○				
			2	SS	7						○				
188.7	SILT, some sand, trace clay, trace gravel Compact Brown Moist		3	SS	12						○				
1.4	Grey		4	SS	17						○				0 17 75 8
			5	SS	13						○				
186.0	Silty CLAY, with sand, trace gravel Hard Grey Moist (TILL)		6	SS	39						○				1 38 40 21
4.1			7	SS	100/ 0.100						○				
			8	SS	40						○				
181.9	END OF BOREHOLE AT 8.2m. BOREHOLE CAVED TO 3.0m AND WATER LEVEL AT 1.5m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO 0.2m, THEN COLD PATCH ASPHALT TO SURFACE.														
8.2															

ONT/MT/452\_MTO-15786.GPJ\_2017TEMPLATE(MTO).GDT\_10/26/18

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

**RECORD OF BOREHOLE No 407 ETR 2-01 1 OF 1 METRIC**

W.P. 2930-17-00 LOCATION N 4 857 612.3 E 314 923.5 ORIGINATED BY KK  
 HWY 404 BOREHOLE TYPE Solid Stem Augers COMPILED BY MP  
 DATUM Geodetic DATE 2018.08.07 - 2018.08.07 LATITUDE 43.858412 LONGITUDE -79.374068 CHECKED BY RD

ELEV DEPTH	SOIL PROFILE DESCRIPTION	STRAT PLOT	SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
			NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa							
							20 40 60 80 100	PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	W P	W	W L		
								WATER CONTENT (%)							
								20 40 60							
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE							
189.8	GROUND SURFACE														
0.0	ASPHALT: (150mm)														
0.2	SAND and GRAVEL, trace silt, trace clay Brown Moist		1	GS											
189.1	(FILL)														
0.8	Silty CLAY, trace sand, trace gravel Stiff Brown Moist		2	SS	10		189								
			3	SS	10		188								
187.6															
2.2	SILT, some sand, some clay, trace gravel Compact Grey Moist		4	SS	16		187								1 10 70 19
			5	SS	14		186								
			6	SS	19		185								
184.2															
5.6	SAND and SILT, trace clay, trace gravel, occasional cobbles Very Dense Grey Moist (TILL)		7	SS	63		184								
			8	SS	100/ 0.250		182								9 43 39 9
181.8															
8.0	END OF BOREHOLE AT 8.0m. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND AUGER CUTTINGS TO 0.2m, THEN COLD PATCH ASPHALT TO SURFACE.														

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**RECORD OF BOREHOLE No 407 ETR 2-02 1 OF 1 METRIC**

W.P. 2930-17-00 LOCATION N 4 857 501.1 E 314 937.5 ORIGINATED BY KK  
 HWY 404 BOREHOLE TYPE Solid Stem Augers COMPILED BY MP  
 DATUM Geodetic DATE 2018.08.07 - 2018.08.07 LATITUDE 43.857410 LONGITUDE -79.373896 CHECKED BY RD

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa							
188.7	GROUND SURFACE														
0.0	ASPHALT: (150mm)														
0.2	SAND and GRAVEL, trace silt, trace clay Loose Brown Moist (FILL)		1	GS											
188															
187.2			2	SS	8										
187.2	Silty CLAY, some sand Very Stiff Brown Moist		3	SS	17									0 16 27 57	
186.5															
2.2	SILT, some sand, some clay, trace gravel Loose to Very Dense Grey Moist		4	SS	9										
186															
185			5	SS	11										
184															
184			6	SS	40										
183															
182			7	SS	20									1 18 63 18	
181															
181	Sand seams		8	SS	72										
180.5															
8.2	END OF BOREHOLE AT 8.2m. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND AUGER CUTTINGS TO 0.2m, THEN COLD PATCH ASPHALT TO SURFACE.														

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### RECORD OF BOREHOLE No TS 2-03

1 OF 1

**METRIC**

W.P. 2930-17-00 LOCATION N 4 857 123.0 E 315 046.7 ORIGINATED BY BL  
 HWY 404 BOREHOLE TYPE Solid Stem Augers COMPILED BY MP  
 DATUM Geodetic DATE 2018.07.24 - 2018.07.24 LATITUDE 43.854006 LONGITUDE -79.372545 CHECKED BY RD

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60						80
190.4	GROUND SURFACE															
0.0	ASPHALT: (200mm)															
0.2	SAND and GRAVEL, trace clay, trace silt	[Strat Plot: Diagonal Hatching]	1	SS	48											
189.6	Dense Brown Moist (FILL)															
0.8	Silty SAND, some gravel and clay		2	SS	39											
189.0	Dense Brown Moist (FILL)															
1.4	Silty CLAY, with sand, trace gravel		3	SS	17											
	Very Stiff to Stiff															
	Brown Moist (FILL)															
	Hard to Very Stiff															
	occasional organics, wood pieces															
			4	SS	12										1 44 33 22	
			5	SS	44											
			6	SS	17											
184.8	SAND and SILT, trace gravel, trace clay	[Strat Plot: Dotted]														
5.6	Loose to Compact Grey Moist to Wet (TILL)		7	SS	8										0 43 53 4	
			8	SS	20											
182.2	END OF BOREHOLE AT 8.2m. BOREHOLE CAVED TO 7.0m AND WATER LEVEL AT 6.1m UPON COMPLETION. BOREHOLE BACKFILLED WITH AUGER CUTTINGS TO 0.2m, THEN COLD PATCH ASPHALT TO SURFACE.															

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

### RECORD OF BOREHOLE No TS 2-04

1 OF 1

**METRIC**

W.P. 2930-17-00 LOCATION N 4 856 882.1 E 315 092.3 ORIGINATED BY BL  
 HWY 404 BOREHOLE TYPE Solid Stem Augers COMPILED BY MP  
 DATUM Geodetic DATE 2018.07.23 - 2018.07.23 LATITUDE 43.851837 LONGITUDE -79.371982 CHECKED BY RD

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa								WATER CONTENT (%)	
						20	40	60	80	100	20	40	60	GR	SA	SI	CL
192.4	GROUND SURFACE																
0.0	ASPHALT: (150mm)																
0.2	SAND and GRAVEL Very Dense		1	SS	64						○			34	55	11	(SI+CL)
191.6	Brown Moist (FILL)																
0.8	Silty SAND, some to trace gravel, trace clay		2	SS	17						○						
	Compact Brown Moist (FILL)																
			3	SS	21						○						
			4	SS	15						○						
189.4	SAND and SILT, trace gravel																
3.0	Compact to Very Dense Brown Moist (TILL)		5	SS	18						○						
			6	SS	19						○						
			7	SS	43						○						
			8	SS	100/						○						
184.7	END OF BOREHOLE AT 7.7m. WATER LEVEL AT 5.5m UPON COMPLETION. BOREHOLE BACKFILLED WITH AUGER CUTTINGS TO 0.2m, THEN COLD PATCH ASPHALT TO SURFACE.				0.100												

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

### RECORD OF BOREHOLE No TS 2-05

1 OF 1

**METRIC**

W.P. 2930-17-00 LOCATION N 4 856 757.9 E 315 101.1 ORIGINATED BY KK  
 HWY 404 BOREHOLE TYPE Solid Stem Augers COMPILED BY MP  
 DATUM Geodetic DATE 2018.08.18 - 2018.08.18 LATITUDE 43.850719 LONGITUDE -79.371876 CHECKED BY RD

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
						20 40 60 80 100 ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE WATER CONTENT (%) 20 40 60								
193.2	GROUND SURFACE													
0.0	ASPHALT: (150mm)													
0.2	SAND and GRAVEL, trace silt, trace clay Dense Brown Moist (FILL)	[Cross-hatched pattern]	1	SS										
			2	SS	43									
191.8	SAND and SILT, some clay, trace gravel Compact to Very Dense Grey Moist (TILL)	[Dotted pattern]												
1.4			3	SS	23									
			4	SS	81/ 0.250									
			5	SS	100/ 0.275									13 45 27 15
			6	SS	60									1 36 45 18
			7	SS	100/ 0.100									
			8	SS	100/ 0.050									
185.4	END OF BOREHOLE AT 7.8m. WATER LEVEL AT 5.1m UPON COMPLETION. BOREHOLE BACKFILLED WITH AUGER CUTTINGS TO 0.2m, THEN COLD PATCH ASPHALT TO SURFACE.													

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

**RECORD OF BOREHOLE No TS 2-06**

1 OF 1

**METRIC**

W.P. 2930-17-00 LOCATION N 4 856 242.8 E 315 211.8 ORIGINATED BY BL  
 HWY 404 BOREHOLE TYPE Solid Stem Augers COMPILED BY MP  
 DATUM Geodetic DATE 2018.07.27 - 2018.07.27 LATITUDE 43.846081 LONGITUDE -79.370509 CHECKED BY RD

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	20 40 60	20 40 60					
194.2	GROUND SURFACE														
0.0	ASPHALT: (200mm)														
0.2	SAND and GRAVEL, trace silt, trace clay Dense Brown Moist (FILL)		1	SS	37										
192.9			2	SS	46										
1.3	Silty CLAY, with sand, trace to some gravel Very Stiff Brown Moist (FILL)		3	SS	27										
192.0															
2.2	Silty CLAY, some sand, trace gravel Stiff to Very Stiff Brown Moist (TILL)		4	SS	13										
			5	SS	21										
			6	SS	18										
			7	SS	38									0 23 32 45	
	Hard to Very Stiff		8	SS	25										
186.0															
8.2	END OF BOREHOLE AT 8.2m. BOREHOLE OPEN AND DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH AUGER CUTTINGS TO 4.6m, BENTONITE HOLEPLUG TO 0.2m, THEN COLD PATCH ASPHALT TO SURFACE.														

ONTMT452, MTO-15786.GPJ 2017TEMPLATE(MTO).GDT 10/26/18

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

### RECORD OF BOREHOLE No HOV 2-01

1 OF 1

**METRIC**

W.P. 2930-17-00 LOCATION N 4 855 746.6 E 315 325.8 ORIGINATED BY BL  
 HWY 404 BOREHOLE TYPE Solid Stem Augers COMPILED BY MP  
 DATUM Geodetic DATE 2018.07.27 - 2018.07.27 LATITUDE 43.841613 LONGITUDE -79.369101 CHECKED BY RD

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60						80
185.1	GROUND SURFACE															
0.0	ASPHALT: (200mm)															
0.2	SAND and GRAVEL, trace silt, trace clay Compact Brown Moist (FILL)  Silty CLAY, trace gravel, trace sand Stiff to Very Stiff Brown Moist (FILL)		1	SS	19											
184.6			1	SS	12											
0.6			2	SS	17											
182.9	SAND, some silt, trace clay Compact Brown Wet		3	SS	13											
2.2			4	SS	19											0 79 17 4
180.4	Silty CLAY, trace sand, trace gravel Hard to Very Stiff Grey Moist (TILL)		5	SS	60											
4.7			6	SS	28											1 6 55 38
176.9			7	SS	37											
8.2	END OF BOREHOLE AT 8.2m. BOREHOLE CAVED TO 2.4m AND WATER LEVEL AT 2.3m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO 0.9m. AUGER CUTTINGS TO 0.2m, THEN COLD PATCH ASPHALT TO SURFACE.															

ONT/MT/452, MTO-15786.GPJ 2017 TEMPLATE (MTO), GDT 10/26/18

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

**RECORD OF BOREHOLE No HWY 7-02 1 OF 2 METRIC**

W.P. 2930-17-00 LOCATION N 4 856 385.3 E 315 184.3 ORIGINATED BY KK  
 HWY 404 BOREHOLE TYPE Solid Stem Augers COMPILED BY MP  
 DATUM Geodetic DATE 2018.10.22 - 2018.10.22 LATITUDE \_\_\_\_\_ LONGITUDE \_\_\_\_\_ CHECKED BY RD

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60					
195.1	GROUND SURFACE														
0.0	ASPHALT: (150mm)														
0.2	SAND and GRAVEL Very Dense Brown Moist (FILL)		1	SS	100/ 0.100										
194.5															
0.7	CLAY, some sand, trace gravel, trace silt Stiff to Very Stiff Brown Moist (FILL)		1	SS	11										
			2	SS	17										
192.9															
2.2	Silty CLAY, some sand, trace gravel Stiff to Very Stiff Brown Moist (FILL)		3	SS	9										
			4	SS	15										
191.0															
4.1	SILT, trace to some sand Very Stiff Brown Moist		5	SS	21										
			6	SS	21										
188.0															
7.2	Silty CLAY, with sand, trace gravel Very Stiff Grey Moist (TILL)		7	SS	20										
			8	SS	49										

ONTMT4S2\_MTO-15786.GPJ 2017TEMPLATE(MTO).GDT 10/26/18

Continued Next Page

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

**RECORD OF BOREHOLE No HWY 7-02      2 OF 2      METRIC**

W.P. 2930-17-00      LOCATION N 4 856 385.3 E 315 184.3      ORIGINATED BY KK  
 HWY 404      BOREHOLE TYPE Solid Stem Augers      COMPILED BY MP  
 DATUM Geodetic      DATE 2018.10.22 - 2018.10.22      LATITUDE \_\_\_\_\_      LONGITUDE \_\_\_\_\_      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 $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa							
	Continued From Previous Page						20	40	60	80	100				
184.2			9	SS	100/										
10.9	END OF BOREHOLE AT 10.89m. BOREHOLE OPEN AND DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO 0.9m, AUGER CUTTINGS TO 0.2m, THEN COLD PATCH ASPHALT TO SURFACE.				0.075										

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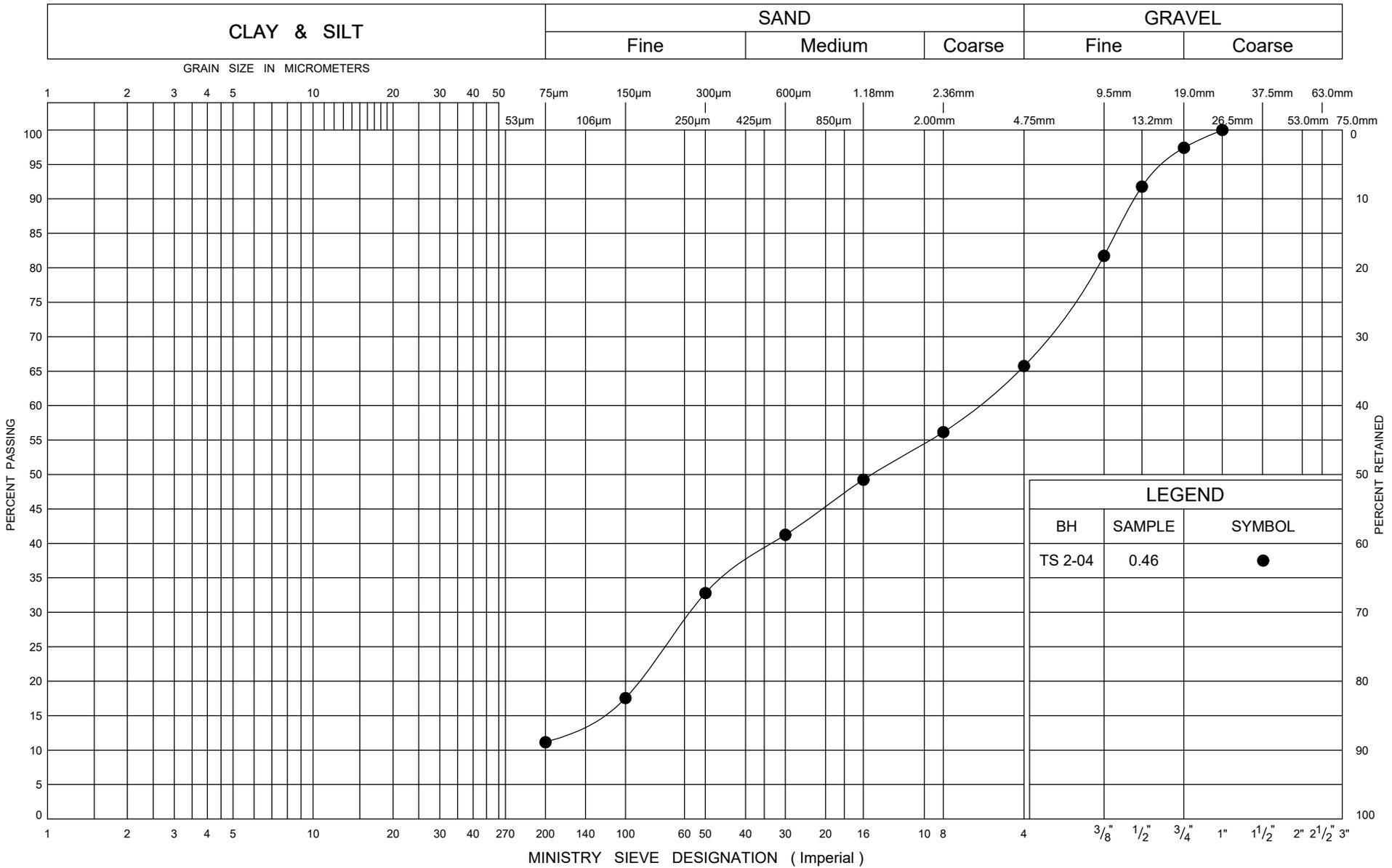
## RECORD OF BOREHOLE No SWM C2-1A 1 OF 1 METRIC

W.P. 2930-17-00 LOCATION N 4 857 404.0 E 314 940.7 ORIGINATED BY JNP  
 HWY 404 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MP  
 DATUM Geodetic DATE 2018.09.19 - 2018.09.19 LATITUDE \_\_\_\_\_ LONGITUDE \_\_\_\_\_ CHECKED BY RD

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
						20 40 60 80 100 ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100 WATER CONTENT (%) W P      W      W L								
189.8	GROUND SURFACE													
0.0 0.1	TOPSOIL: (75mm)													
	Silty <b>CLAY</b> , trace gravel and sand Stiff to Very Stiff Brown Moist (FILL)		1	SS	12									
			2	SS	21									
			3	SS	19									
187.6														
2.2	Silty <b>CLAY</b> , sandy, trace gravel, trace rootlets Stiff Brown Moist (TILL) trace orange oxidization		4	SS	11								1 22 33 44	
			5	SS	14									
184.9														
4.9	Silty <b>SAND</b> , trace clay, trace gravel Compact Grey Wet		6	SS	18								2 72 22 4	
183.4														
6.4	Clayey <b>SILT</b> , with sand, trace gravel Stiff to Very Stiff Grey Moist (TILL)		7	SS	11									
181.6														
8.2	END OF BOREHOLE AT 8.2m. BOREHOLE CAVED TO 4.3m AND WATER LEVEL AT 4.3m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE PELLETS AND AUGER CUTTINGS TO SURFACE.		8	SS	20									

ONTMT452, MTO-15786.GPJ 2017TEMPLATE(MTO).GDT 10/26/18

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



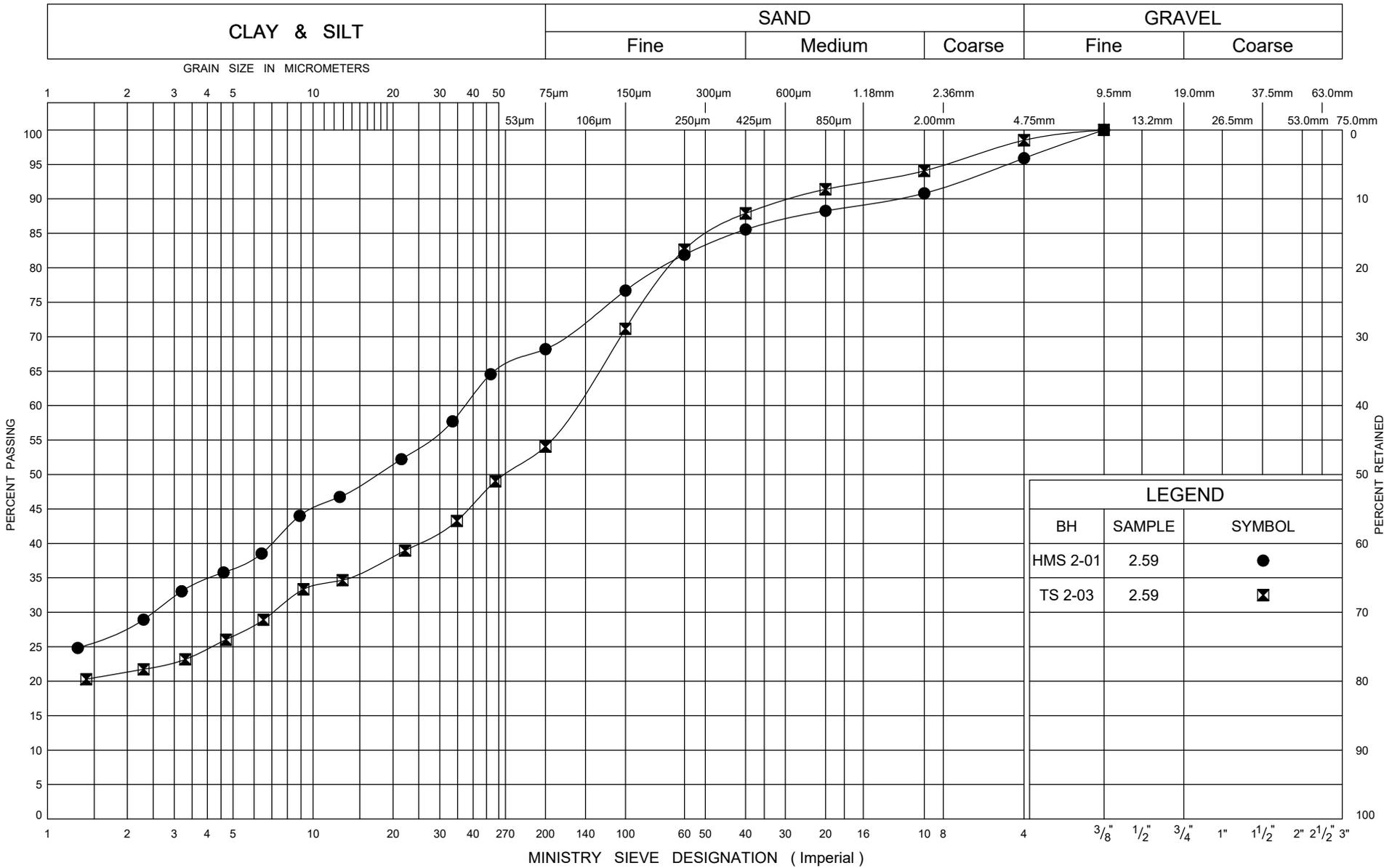
ONTARIO MOT GRAIN SIZE MTO-15786.GPJ ONTARIO MOT.GDT 10/22/18



## GRAIN SIZE DISTRIBUTION SAND and GRAVEL FILL

FIG No C1

W P 2930-17-00



ONTARIO MOT GRAIN SIZE MTO-15786.GPJ ONTARIO MOT.GDT 10/22/18

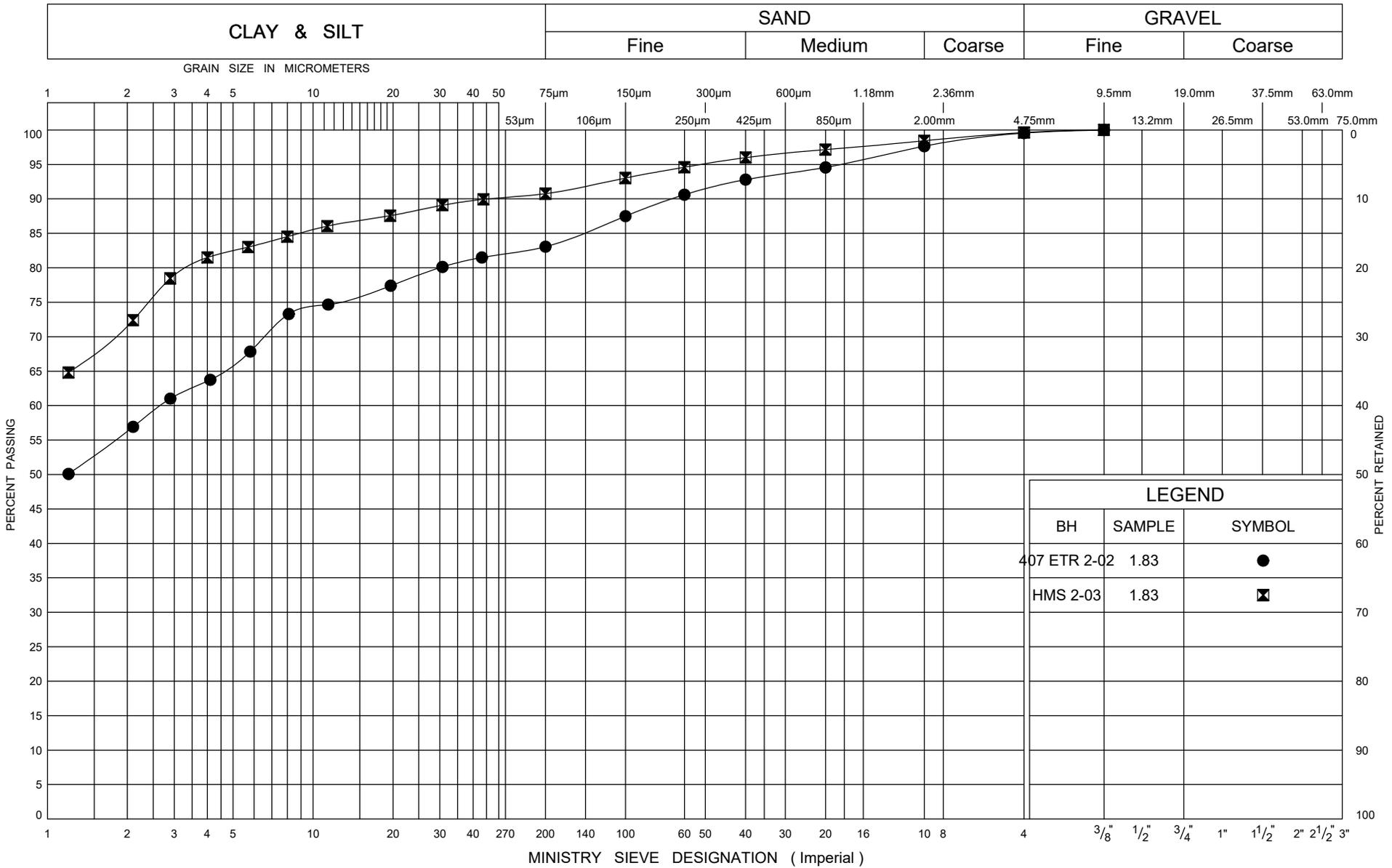


## GRAIN SIZE DISTRIBUTION

### Silty CLAY FILL

FIG No C2

W P 2930-17-00



LEGEND		
BH	SAMPLE	SYMBOL
407 ETR 2-02	1.83	●
HMS 2-03	1.83	⊠

ONTARIO MOT GRAIN SIZE MTO-15786.GPJ ONTARIO MOT.GDT 10/22/18

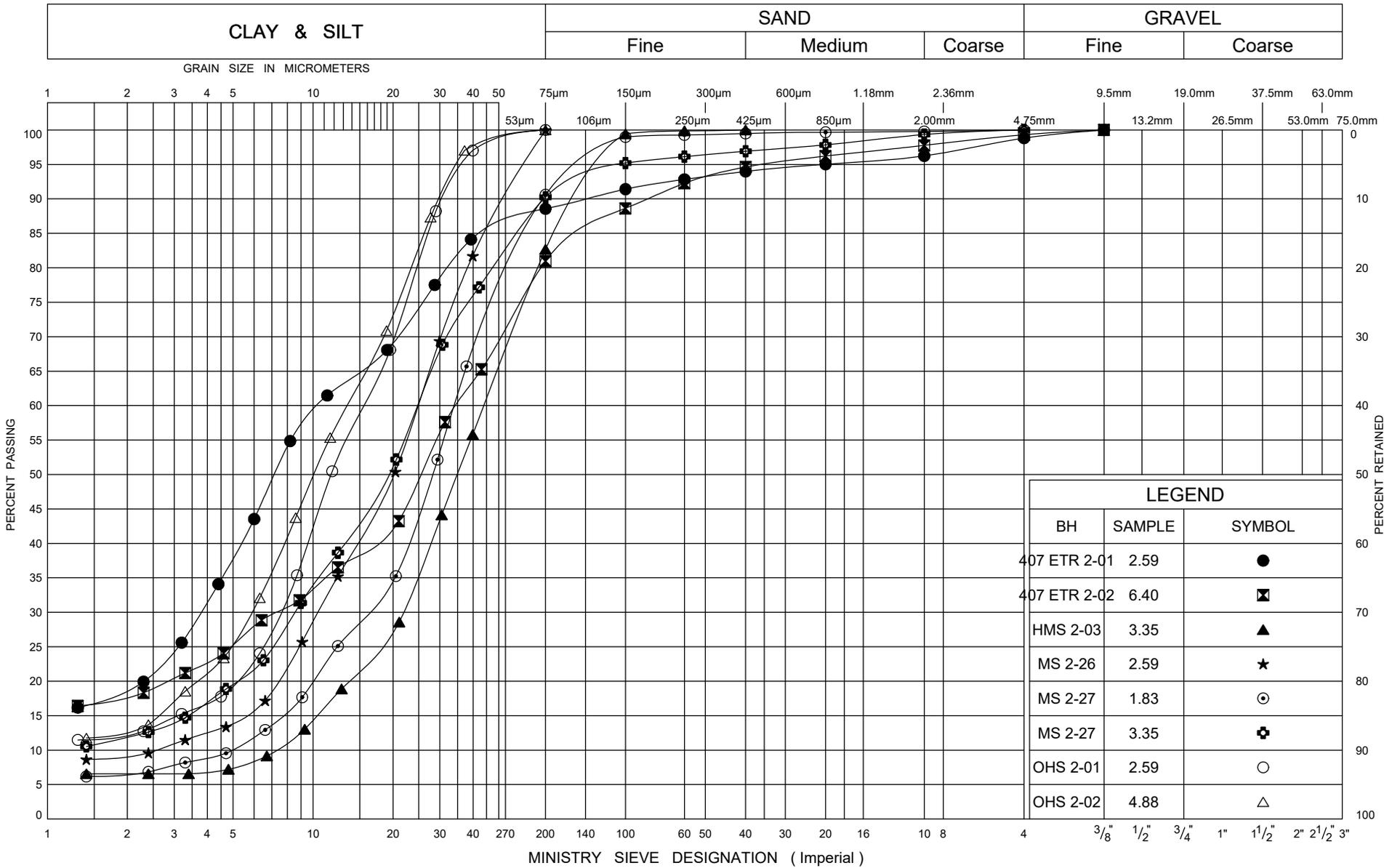


## GRAIN SIZE DISTRIBUTION

### Silty CLAY

FIG No C3

W P 2930-17-00



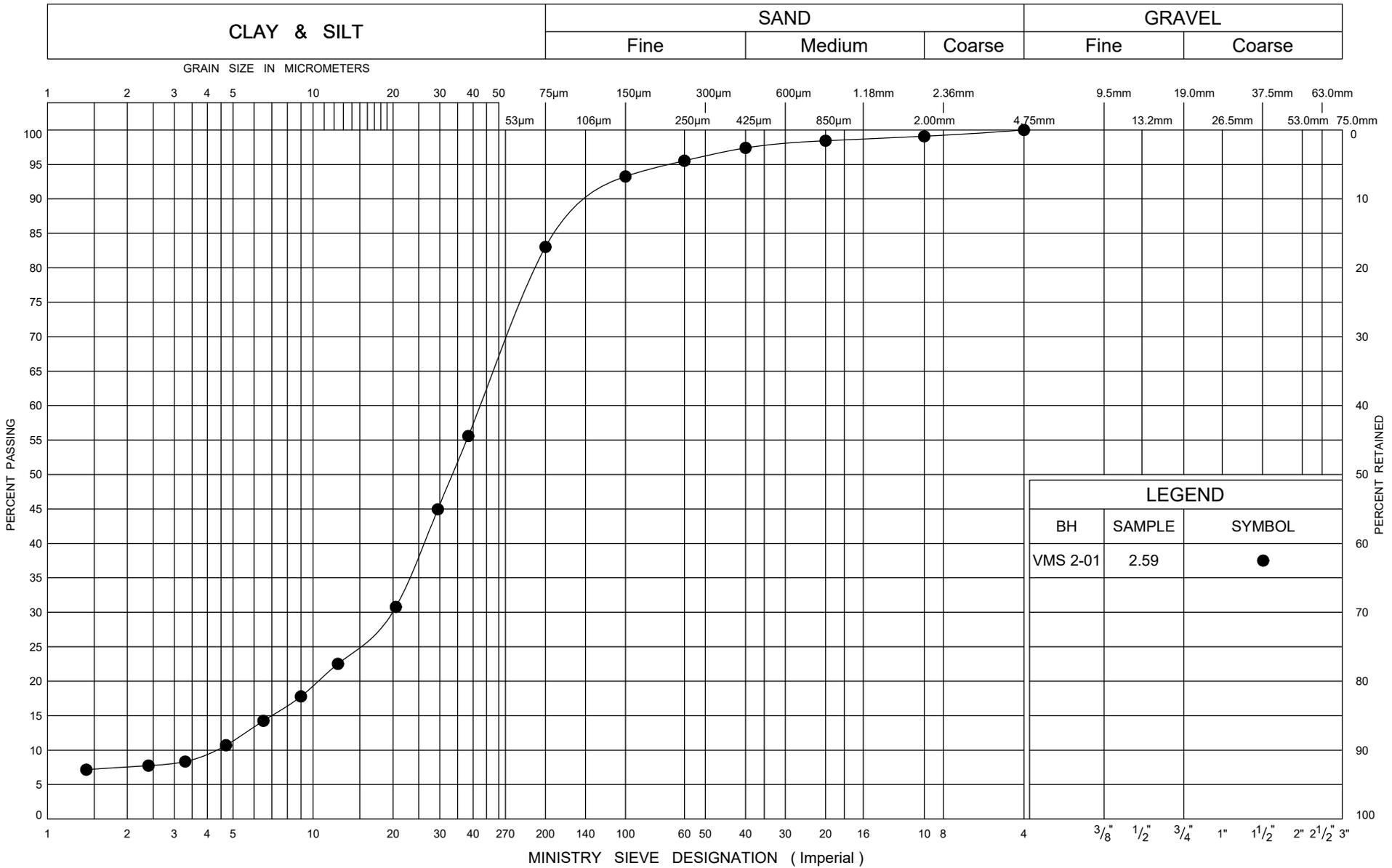
ONTARIO MOT GRAIN SIZE MTO-15786.GPJ ONTARIO MOT.GDT 10/22/18



## GRAIN SIZE DISTRIBUTION SILT

FIG No C4

W P 2930-17-00

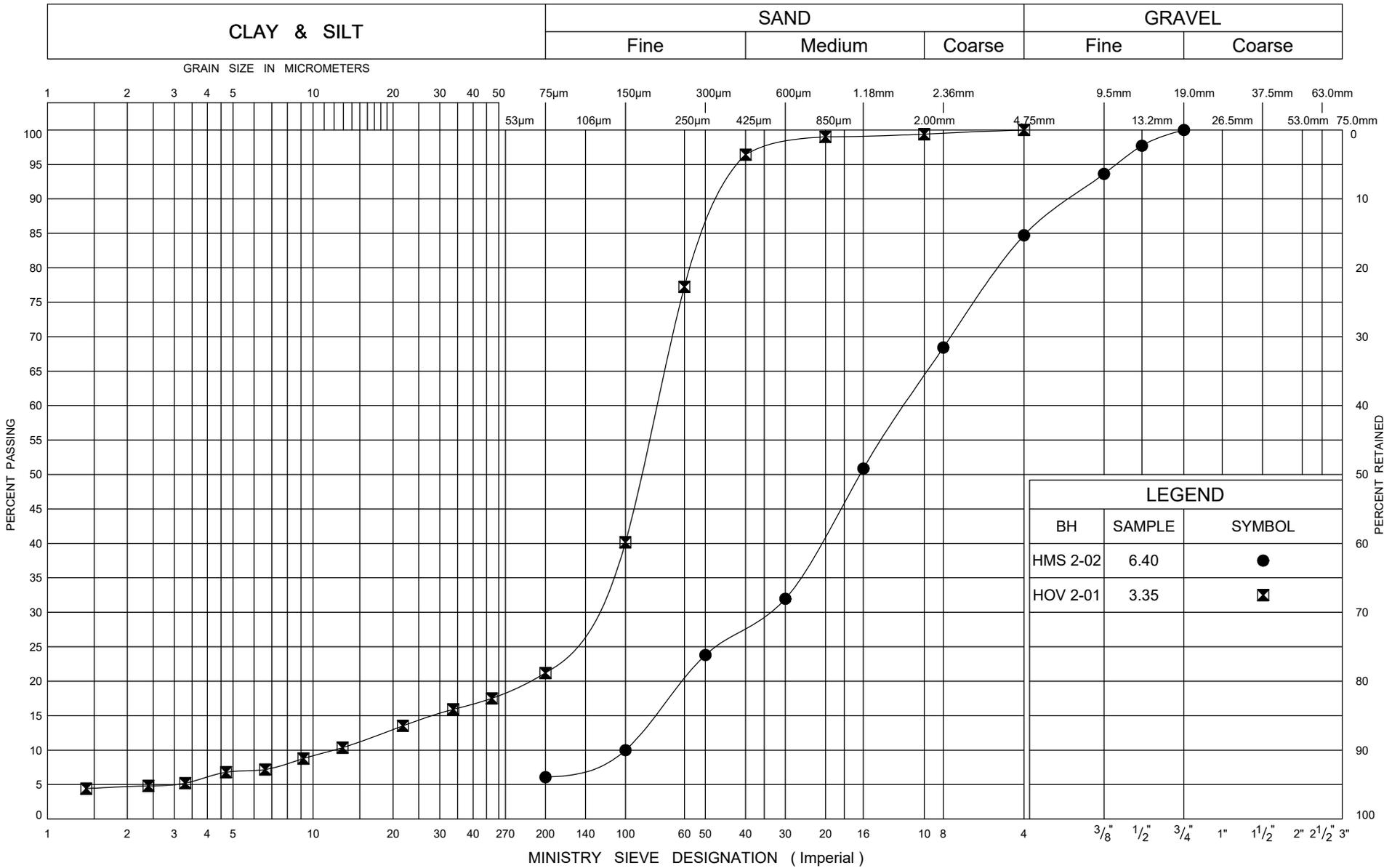


ONTARIO MOT GRAIN SIZE MTO-15786.GPJ ONTARIO MOT.GDT 10/22/18



## GRAIN SIZE DISTRIBUTION SILT

FIG No C5  
W P



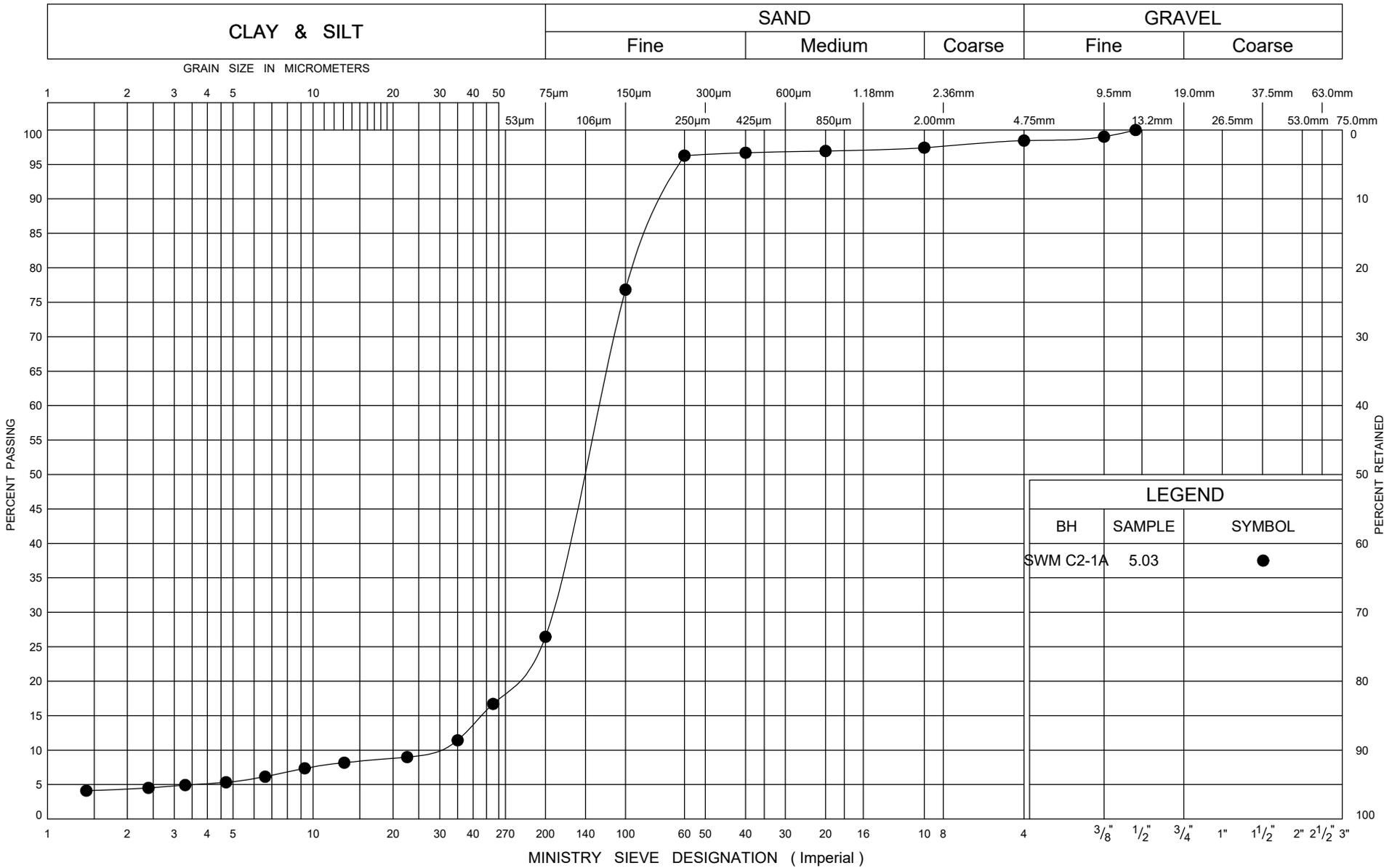
LEGEND		
BH	SAMPLE	SYMBOL
HMS 2-02	6.40	●
HOV 2-01	3.35	⊠

ONTARIO MOT GRAIN SIZE MTO-15786.GPJ ONTARIO MOT.GDT 10/22/18



## GRAIN SIZE DISTRIBUTION SAND

FIG No C6  
W P 2930-17-00



LEGEND		
BH	SAMPLE	SYMBOL
SWM C2-1A	5.03	●

ONTARIO MOT GRAIN SIZE MTO-15786.GPJ ONTARIO MOT.GDT 10/22/18

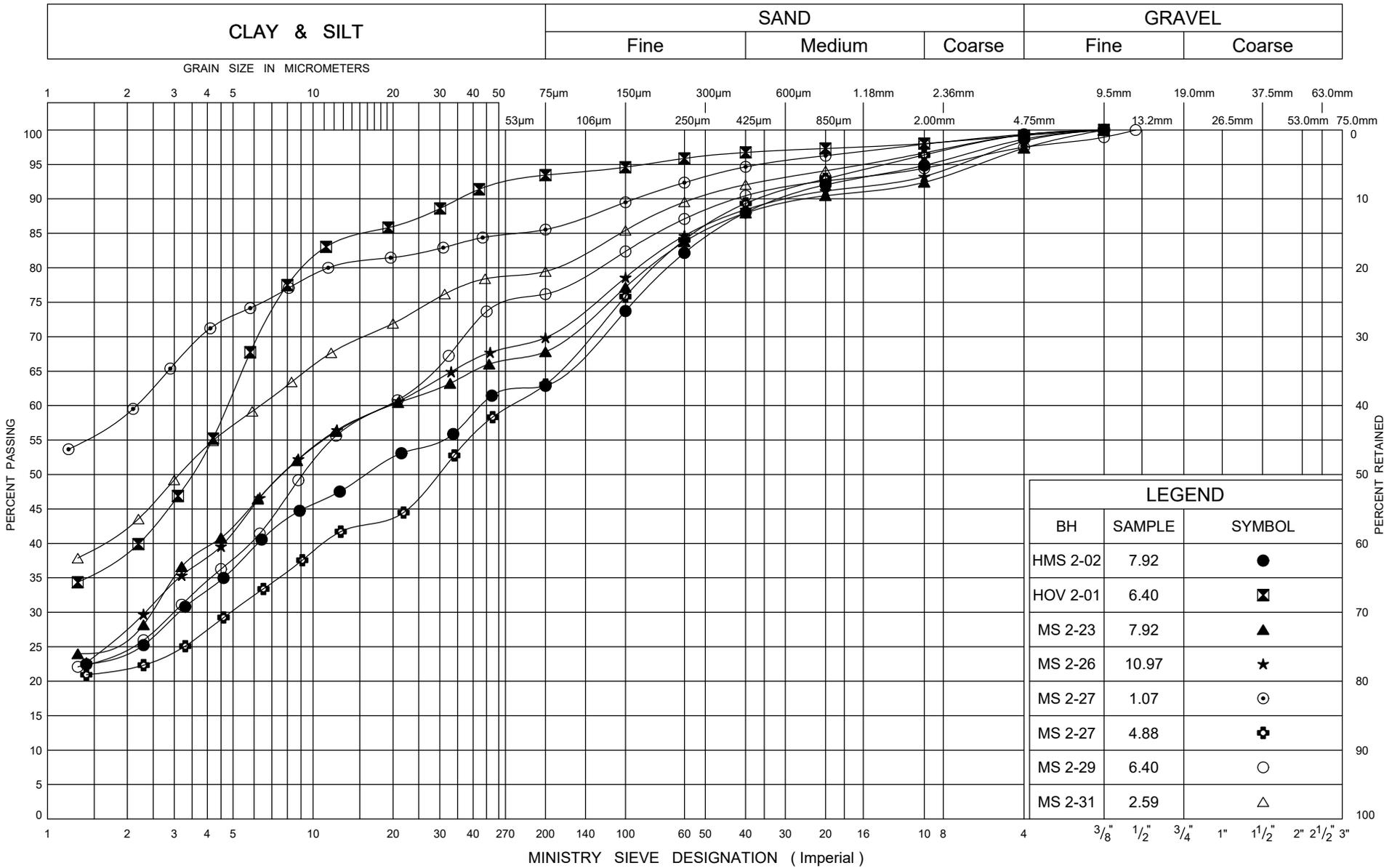


## GRAIN SIZE DISTRIBUTION

### Silty SAND

FIG No C7

W P 2930-17-00



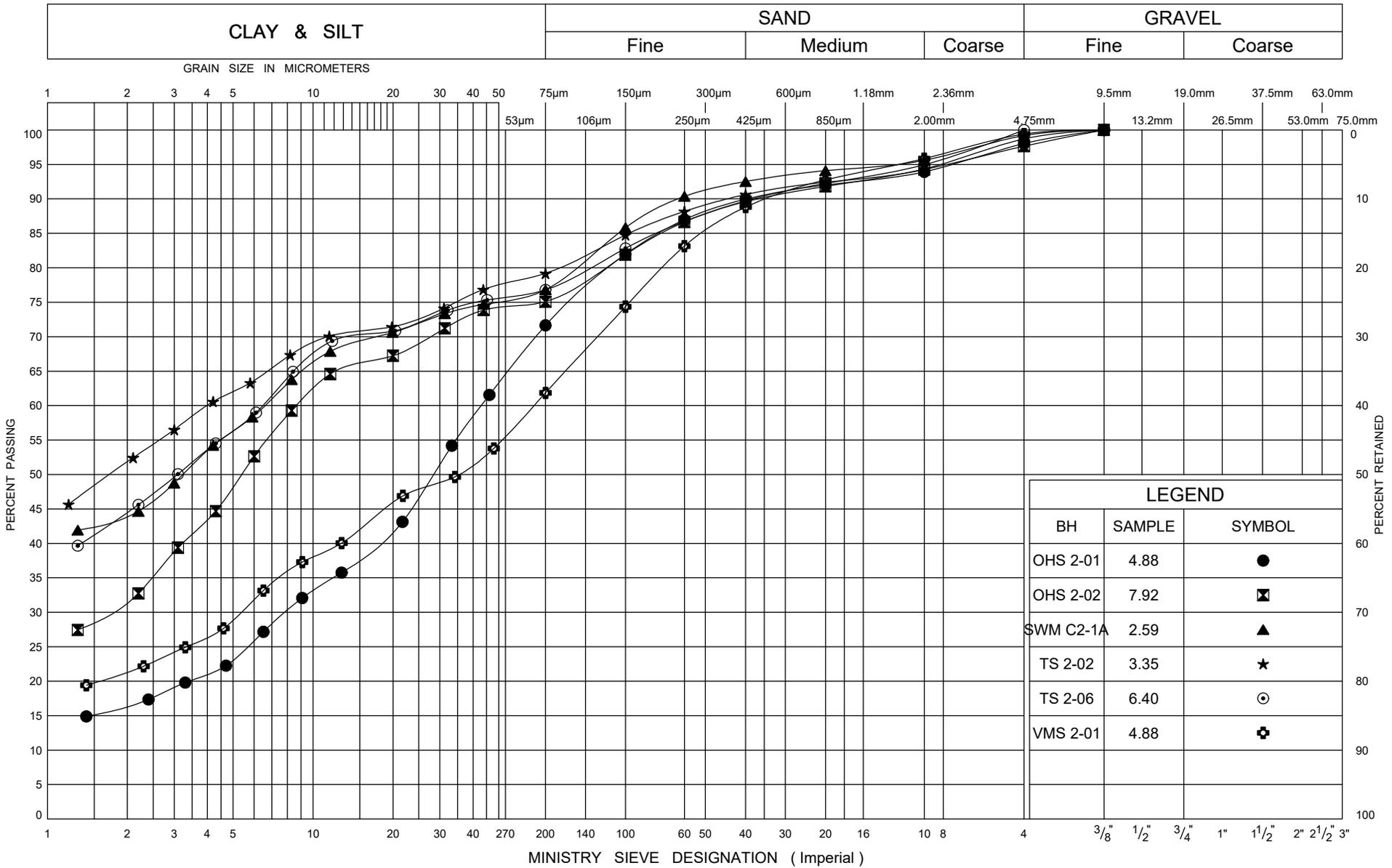
ONTARIO MOT GRAIN SIZE MTO-15786.GPJ ONTARIO MOT.GDT 10/22/18



**GRAIN SIZE DISTRIBUTION**  
 Silty CLAY TILL

FIG No C8

W P 2930-17-00



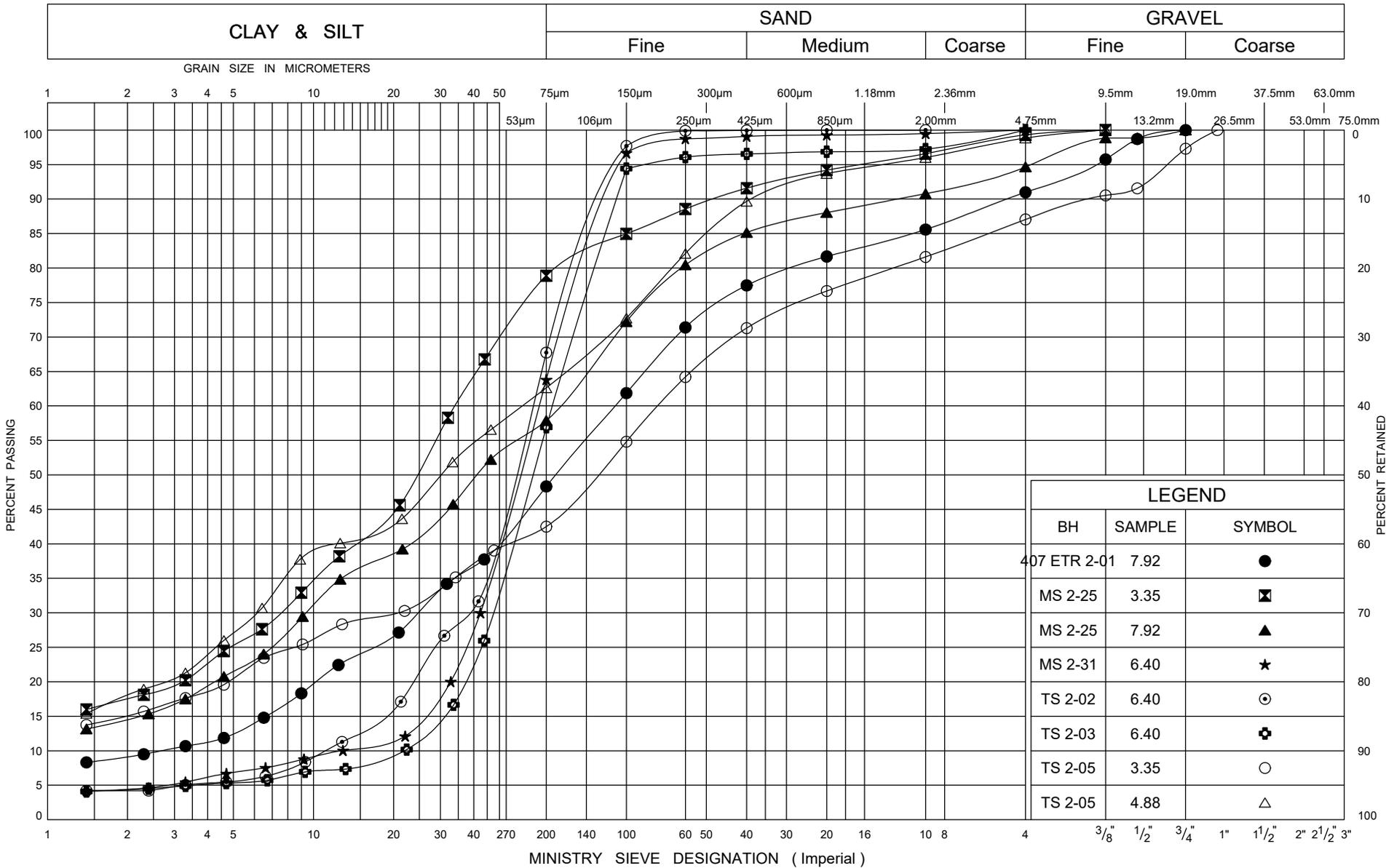
ONTARIO MOT GRAIN SIZE MTO-15786.GPJ ONTARIO MOT.GDT 10/22/18



## GRAIN SIZE DISTRIBUTION

### Silty CLAY TILL

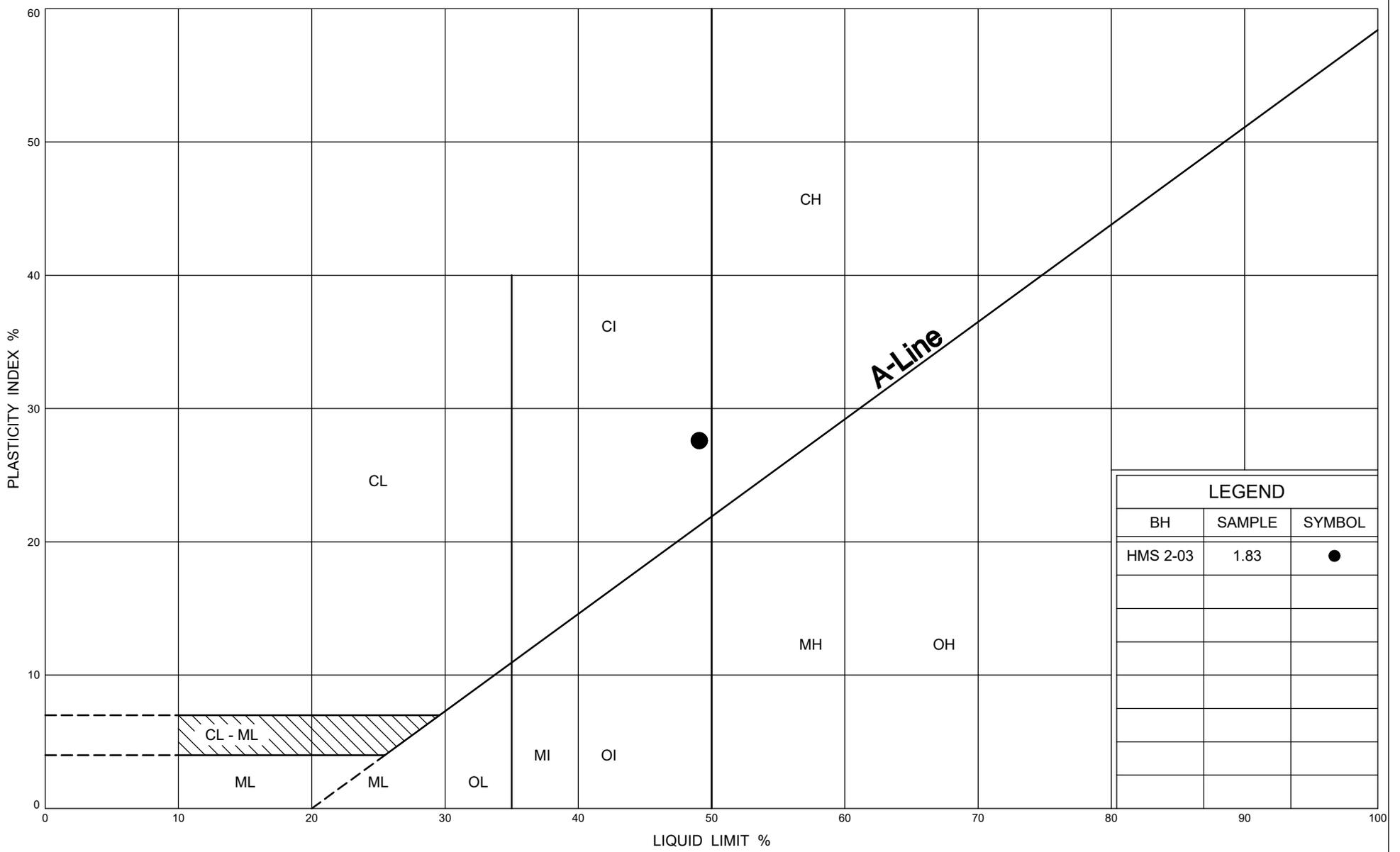
FIG No C9  
W P



**GRAIN SIZE DISTRIBUTION**  
SAND and SILT TILL

FIG No C10

W P 2930-17-00



ONTARIO MOT PLASTICITY CHART MTO-15786.GPJ ONTARIO MOT.GDT 10/22/18

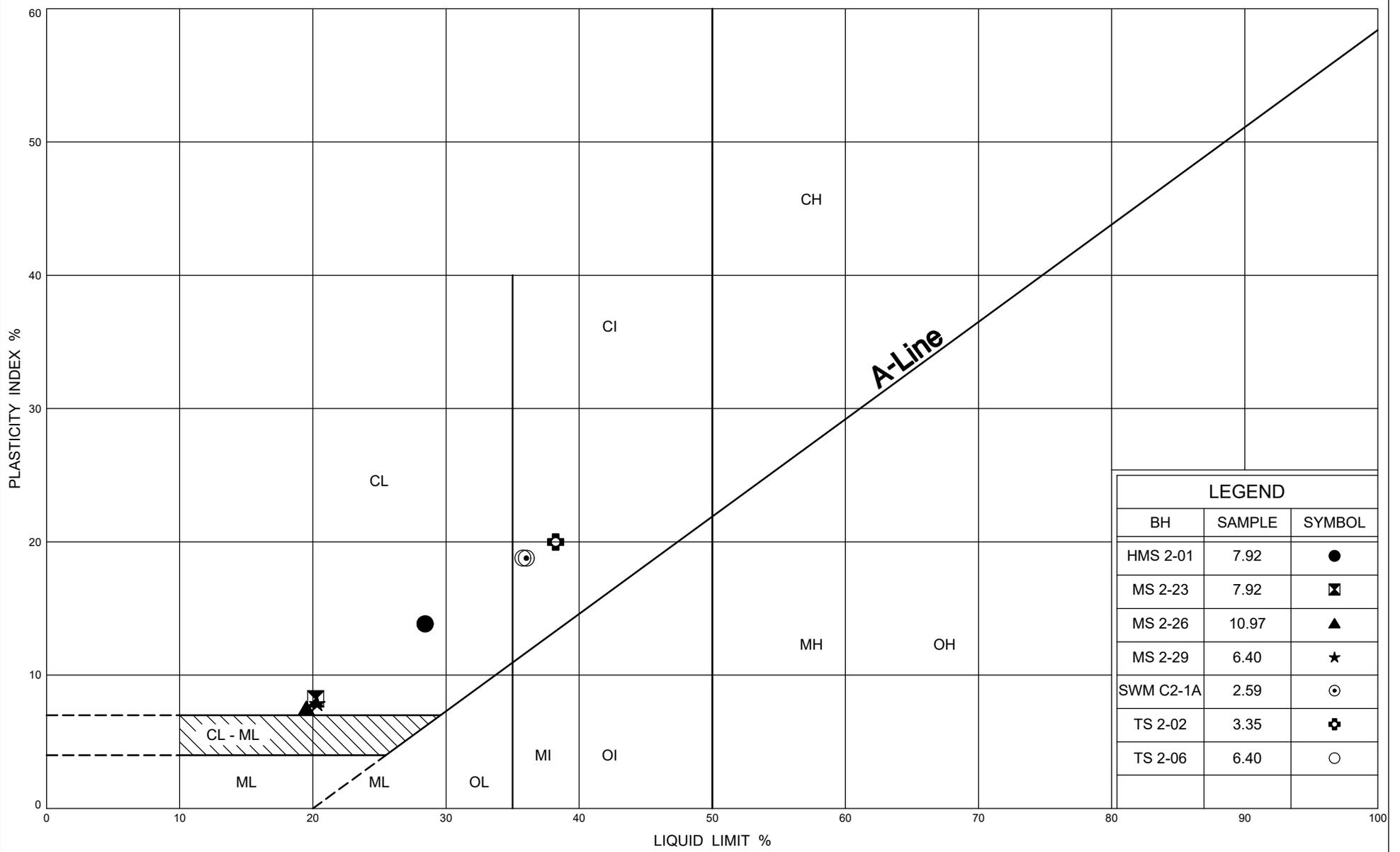


## PLASTICITY CHART

### Silty CLAY

FIG No C11

W P 2930-17-00



LEGEND		
BH	SAMPLE	SYMBOL
HMS 2-01	7.92	●
MS 2-23	7.92	⊠
MS 2-26	10.97	▲
MS 2-29	6.40	★
SWM C2-1A	2.59	⊙
TS 2-02	3.35	⊠
TS 2-06	6.40	○

ONTARIO MOT PLASTICITY CHART MTO-15786.GPJ ONTARIO MOT.GDT 10/22/18



**PLASTICITY CHART**  
Silty CLAY TILL

FIG No C12

W P 2930-17-00



## **Appendix D**

### **Borehole Location Drawings**

MINISTRY OF TRANSPORTATION, ONTARIO

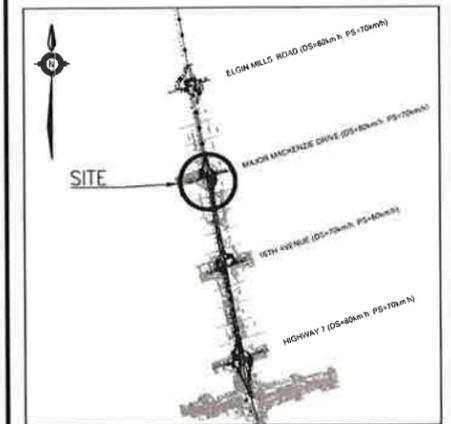
METRIC  
DIMENSIONS ARE IN METRES  
AND/OR MILLIMETRES  
UNLESS OTHERWISE SHOWN

CONT No  
WP No 2930-17-00



HIGHWAY 404  
OVERHEAD SIGNS  
CONTRACT 2  
BOREHOLE LOCATIONS PLAN

SHEET



KEYPLAN

LEGEND

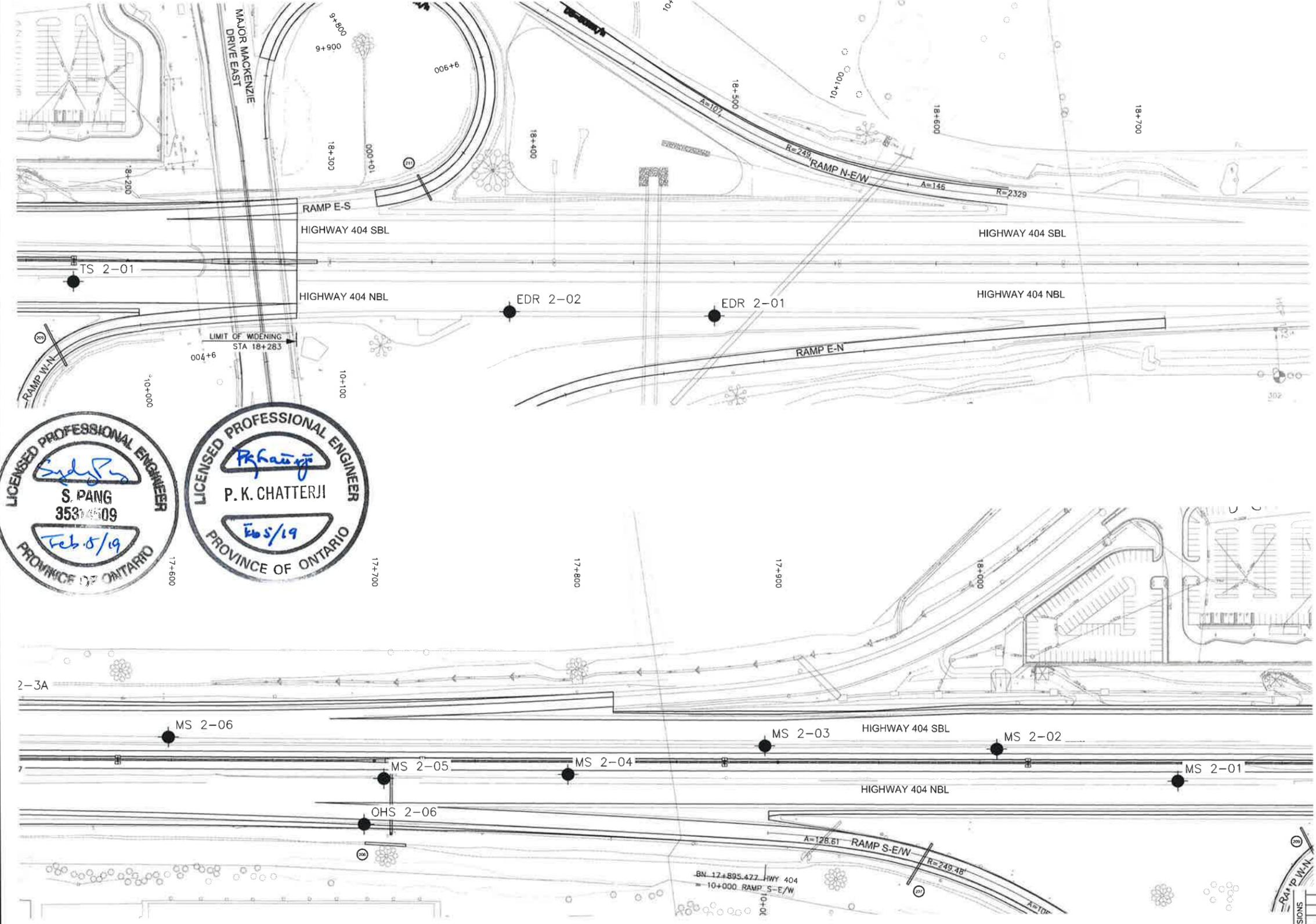
- Borehole
- ◆ Borehole and Cone
- N Blows /0.3m (Std Pen Test, 475J/blow)
- CONE Blows /0.3m (60° Cone, 475J/blow)
- PH Pressure, Hydraulic
- ▽ Water Level
- ⊕ Head Artesian Water
- ⊖ Piezometer
- 90% Rock Quality Designation (RQD)
- A/R Auger Refusal

NO	ELEVATION	NORTHING	EASTING
EDR 2-01	212.7	4 860 599.8	314 443.6
EDR 2-02	211.8	4 860 499.5	314 459.8
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
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
OHS 2-06	205.7	4 859 818.0	314 588.5
TS 2-01	209.6	4 860 285.0	314 483.9

-NOTES-

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GEOCREs No. 30M14-488



SCALE 1:2000

REVISIONS	DATE	BY	DESCRIPTION

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AND/OR MILLIMETRES  
UNLESS OTHERWISE SHOWN

CONT No  
WP No 2930-17-00

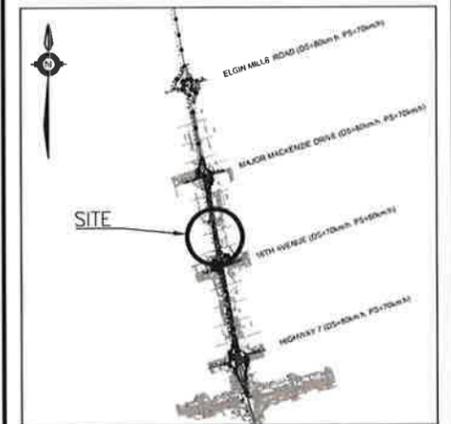


HIGHWAY 404  
OVERHEAD SIGNS  
CONTRACT 2  
BOREHOLE LOCATIONS PLAN

SHEET



THURBER ENGINEERING LTD.



KEYPLAN

LEGEND

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

NO	ELEVATION	NORTHING	EASTING
MS 2-16	199.6	4 858 813.9	314 746.3
MS 2-17	199.0	4 858 748.0	314 735.1
MS 2-18	198.2	4 858 656.3	314 775.4
MS 2-19	197.3	4 858 555.0	314 790.6
MS 2-20	197.2	4 858 520.8	314 799.0
OHS 2-03	199.3	4 858 864.9	314 692.2
OHS 2-04	202.4	4 859 220.9	314 692.6
OHS 2-05	203.7	4 859 448.8	314 595.8
SWM C2-2A	198.5	4 858 578.2	314 725.0
SWM C2-2B	199.4	4 858 815.2	314 727.3
SWM C2-2C P	197.6	4 858 538.0	314 733.3
SWM C2-2D	197.3	4 858 526.1	314 729.0
SWM C2-3A	204.6	4 859 632.5	314 559.1
SWM C2-3B	204.5	4 859 588.3	314 568.3
SWM C2-3C P	204.2	4 859 521.0	314 581.1
SWM C2-3D	203.9	4 859 472.9	314 590.2

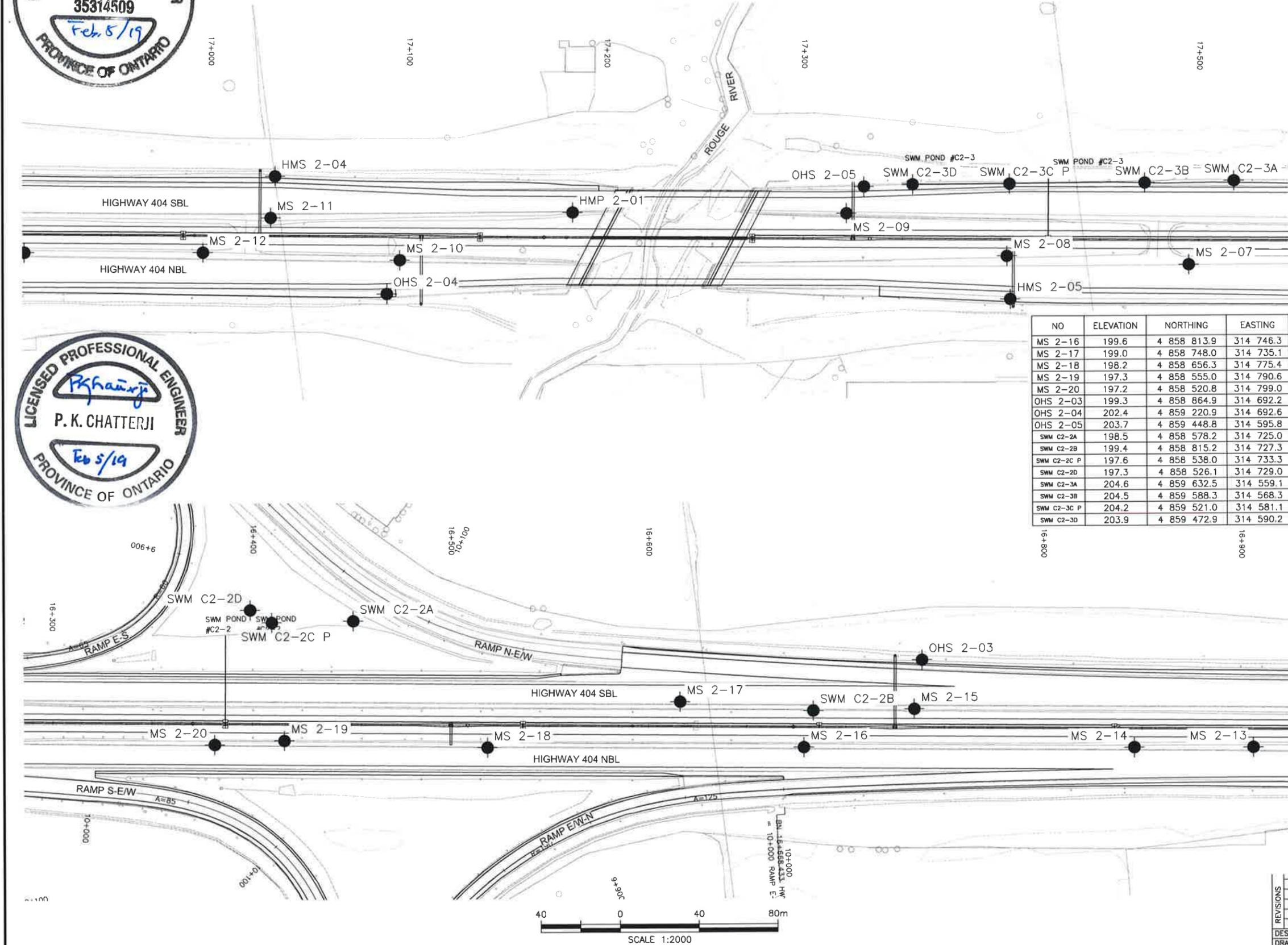
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HMP 2-01	203.2	4 859 306.0	314 635.2
HMS 2-04	201.8	4 859 154.8	314 644.4
HMS 2-05	204.2	4 859 532.0	314 638.3
MS 2-07	204.9	4 859 617.6	314 604.8
MS 2-08	204.2	4 859 526.4	314 617.2
MS 2-09	204.0	4 859 442.5	314 610.6
MS 2-10	202.7	4 859 224.3	314 674.7
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
MS 2-15	199.9	4 858 865.4	314 717.2

NOTES

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GEOGRES No. 30M14-488

DATE	BY	DESCRIPTION
DESIGN	RD	CHK SKP CODE
DRAWN	MFA	CHK RD SITE
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		DATE DEC 2018
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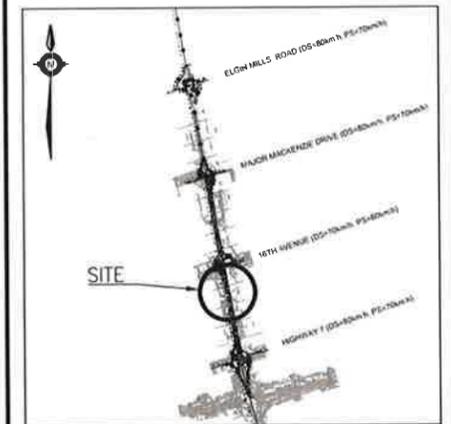
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AND/OR MILLIMETRES  
UNLESS OTHERWISE SHOWN

CONT No  
WP No 2930-17-00



HIGHWAY 404  
OVERHEAD SIGNS  
CONTRACT 2  
BOREHOLE LOCATIONS PLAN

SHEET



KEYPLAN

LEGEND

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

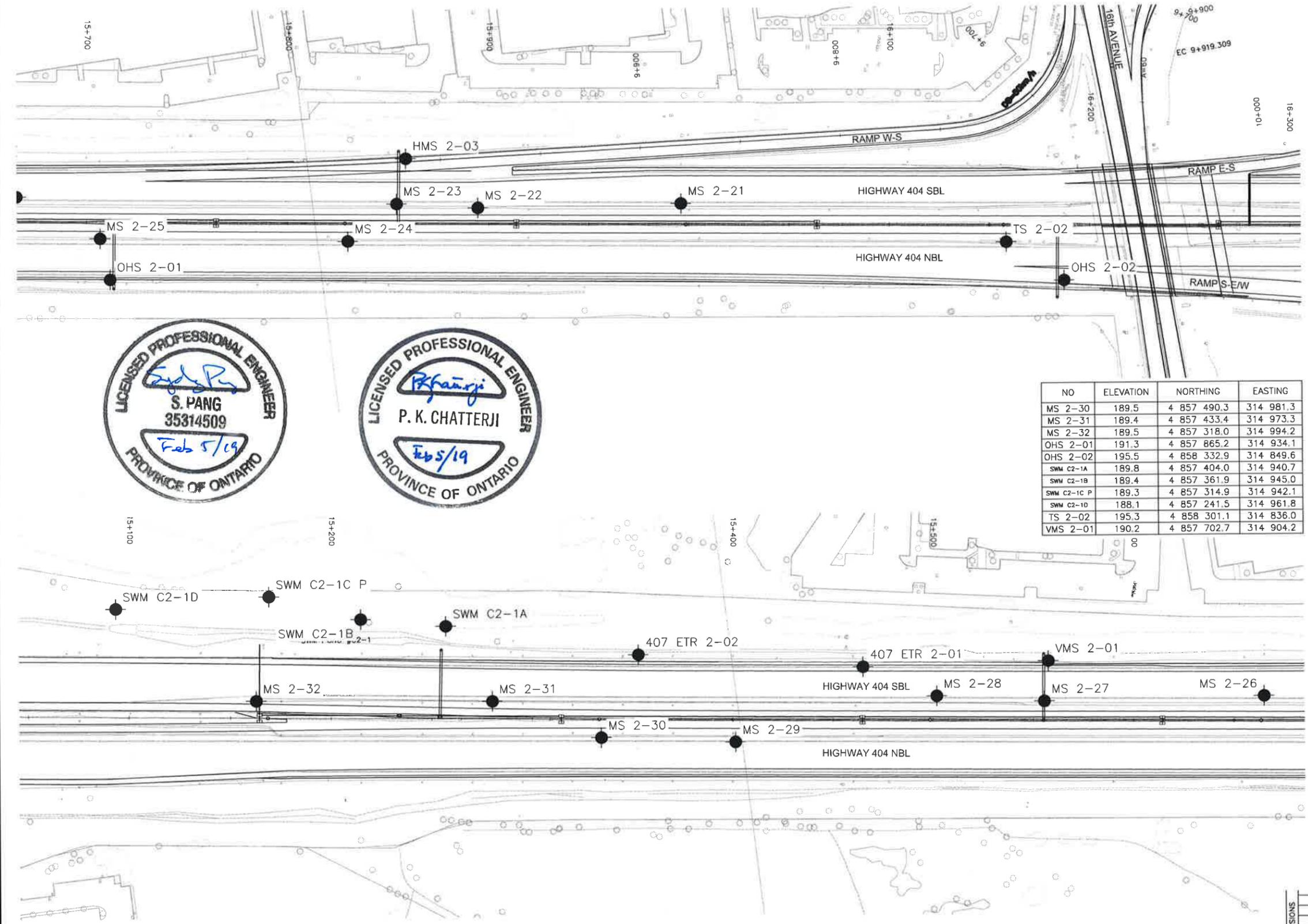
NO	ELEVATION	NORTHING	EASTING
407 ETR 2-01	189.8	4 857 612.3	314 923.5
407 ETR 2-02	188.7	4 857 501.1	314 937.5
HMS 2-03	192.6	4 857 998.8	314 848.5
MS 2-21	194.0	4 858 137.9	314 846.0
MS 2-22	193.0	4 858 038.5	314 866.2
MS 2-23	192.8	4 857 998.4	314 871.5
MS 2-24	192.6	4 857 978.0	314 894.1
MS 2-25	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
MS 2-29	189.7	4 857 556.4	314 971.5

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GEOCREs No. 30M14-488

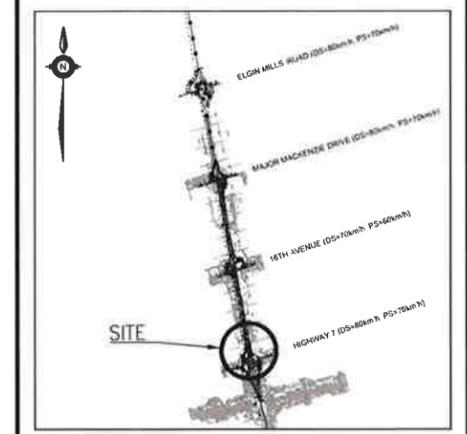
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DRAWN	MFA	CHK	RD	SITE	STRUCT	DWG	3



MINISTRY OF TRANSPORTATION, ONTARIO

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

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HIGHWAY 404 OVERHEAD SIGNS CONTRACT 2 BOREHOLE LOCATIONS PLAN	



**KEYPLAN**

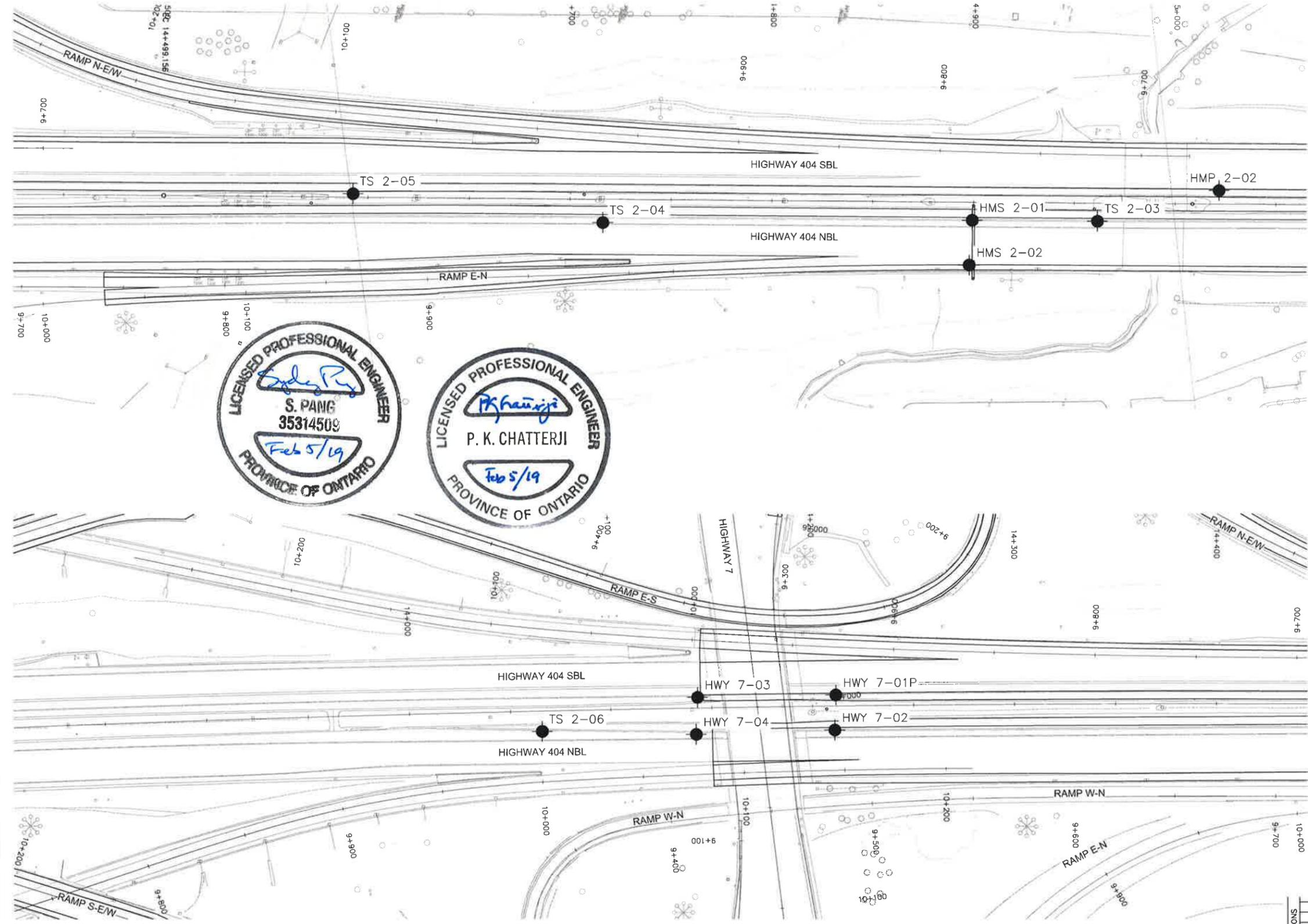
**LEGEND**

◆	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 2-02	190.0	4 857 179.5	315 020.7
HMS 2-01	190.8	4 857 061.8	315 057.6
HMS 2-02	190.7	4 857 064.4	315 079.6
HWY 7-01P	195.2	4 856 382.6	315 167.3
HWY 7-02	195.1	4 856 385.3	315 184.3
HWY 7-03	194.8	4 856 315.3	315 181.1
HWY 7-04	194.8	4 856 318.0	315 199.1
TS 2-03	190.4	4 857 123.0	315 046.7
TS 2-04	192.4	4 856 882.1	315 092.3
TS 2-05	193.2	4 856 757.9	315 101.1
TS 2-06	194.2	4 856 242.8	315 211.8

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**GEOCREs No. 30M14-488**



REVISIONS	DATE	BY	DESCRIPTION

DESIGN	RD	CHK	SKP	CODE	LOAD	DATE	DEC 2018
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**Appendix E**

**List of Special Provisions**

**And**

**Suggested Text for NSSP**



## List of Special Provisions Referenced in this Report

OPSS.PROV 903

### Suggested Text for NSSP on:

#### **“Augered Caisson Construction for Sign Support Foundations”**

The Contractor is advised that variable types of subsurface materials may be encountered at the locations of the sign support foundations. For additional information regarding subsurface conditions, the Contractor is referred to the Foundation Investigation Report.

The Contractor is alerted to the following:

1. Cobbles, boulders and rock fragments may be encountered within the glacial till deposits. In addition to the above, man-made obstructions may also be present within the embankment fills. The soil matrix is anticipated to become harder or denser with depth. Caisson installation equipment must be able to dislodge, handle, remove or otherwise penetrate these obstructions and hard/very dense layers.
2. Water seepage and/or soil sloughing into the caisson hole will occur from existing fill and cohesionless soils which would be susceptible to disturbance (basal and sidewall) under conditions of unbalanced hydrostatic head. Temporary liners shall be available on site to support the caisson sidewalls and provide partial seepage cut-off where required. A balancing water/slurry head shall be maintained inside the caisson hole where required. A combination of the above along with feasible techniques of advancing the caisson hole shall be employed to minimize disturbance at the base and the sides of the caisson foundation. Consideration should be given to using the tremie technique to place the concrete.

The Contractor is responsible for constructing all the sign support foundations without disturbing the material at the sides or bases of the foundations.