Peto MacCallum Ltd.
CONSULTING ENGINEERS

PRELIMINARY FOUNDATION INVESTIGATION AND DESIGN REPORT

for

DESIGN-BUILD READY ALTERNATIVE BID PACKAGE
MIDBLOCK INTERCHANGE AREA
HIGH FILL AND DEEP CUT SECTIONS
HIGHWAY 6 AND 401 IMPROVEMENTS
FROM HAMILTON NORTH LIMITS TO GUELPH SOUTH LIMITS
CITY OF GUELPH, ONTARIO
GWP NO. 3059-20-00

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GEOCRES No.: 40P8-293
October 13, 2021

Peto MacCallum Ltd.
CONSULTING ENGINEERS

PART A – PRELIMINARY FOUNDATION INVESTIGATION REPORT

for

DESIGN-BUILD READY ALTERNATIVE BID PACKAGE
MIDBLOCK INTERCHANGE AREA
HIGH FILL AND DEEP CUT SECTIONS
HIGHWAY 6 AND 401 IMPROVEMENTS
FROM HAMILTON NORTH LIMITS TO GUELPH SOUTH LIMITS
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Peto MacCallum Ltd.
CONSULTING ENGINEERS

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for
Design-Build Ready Alternative Bid Package
Midblock Interchange Area High Fill and Deep Cut Sections
Highway 6 and 401 Improvements
From Hamilton North Limits to Guelph South Limits
City of Guelph, Ontario
GWP No. 3059-20-00

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1. INTRODUCTION

Peto MacCallum Ltd. (PML) was retained by AECOM Canada Ltd. (AECOM) on behalf of the Ministry of Transportation of Ontario (MTO) to carry out foundation investigations for the preliminary design work of structures and road alignments in the Midblock Interchange (MBI) Area project. The Midblock Interchange (MBI) area is part of the Highway 6 and Highway 401, Hamilton to Guelph advance contract to be delivered on a design-build (DB) basis. The project limits stretch from approximately 0.1 km north of Maltby Road to about 0.3 km south of the intersection of Wellington Road 34 and Highway 6. Drawing 1 presents the limits of the MBI area.

The scope of work under GWP 3059-20-00 involves the construction of Wellington Road 34 Connector Underpass (35X-0618/B0), rehabilitation/widening of Highway 6 North, rehabilitation, widening and/or realignment of Concession Road 7, construction of Wellington Road 34 Underpass (35X-0617/B0), widening, reconstruction and intersection improvements of Wellington Road 34 at Concession Road 7, and the construction of a new mid-concession route (connector route). For the preliminary design, the foundation engineering components included the Wellington Road 34 and Wellington Road 34 Connector underpasses, and high fill and deep cut sections on southbound and northbound lanes of Highway 6, Concession Road 7, the new connector route, and ramps of the proposed Midblock Interchange. During the detail design stage, foundation engineering services may also be required for overhead signs on both sides of the interchange, south of Wellington Road 34 intersection, and near the intersection of Concession Road 7 and Highway 6.

The foundation work reported herein is for high fill and deep cut sections on Wellington Road 34, Concession Road 7, Highway 6, and the new connector route, within the MBI project limits, and involves the preparation of a preliminary foundation investigation report (FIR) and preliminary foundation investigation and design report (FIDR) for the DB ready package. The preliminary FIR presents the factual subsurface information obtained from the boreholes drilled by PML for this

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assignment. The FIDR provides preliminary design level foundation recommendations based on the findings of the subsurface investigation work. The FIR and FIDR also include the two storm ponds located on the east and west side of the proposed Wellington Road 34 Connector Underpass. The scope of work for the foundation engineering services for this assignment was outlined in the PML's change order request for additional foundation investigation, dated June 21, 2021. The change order request was subsequently approved by MTO and AECOM on July 05, 2021.

The FIR and FIDR for Wellington Road 34 Underpass (35X-0617/B0) and Wellington Road 34 Connector Underpass (35X-0618/B0), as well as the hydrogeological and pavement engineering reports for the MBI area, are submitted by PML under separate covers. Previously, a draft technical memorandum was prepared on high fill and deep cut sections by PML based on limited subsurface information and submitted to AECOM on April 8, 2016. It is assumed that foundation investigations and design for the overhead sign support structures, if required, will be carried out by the design-builder.

2. HIGH FILL AND DEEP CUT SECTIONS

Table 1 provides a summary of the high fill and deep cut sections, with heights or depths greater than 4.5 m, based on the preliminary design drawings prepared by AECOM for the various road alignments within the MBI area. The locations of these high fill or deep cut sections within the MBI area are presented in Drawing MBI-1. Generally, fill slopes higher than 4.5 m or cut slopes deeper than 4.5 m require foundation investigation. Based on the Request for Proposal (RFP) for this project, and in accordance with general engineering practice, fill or cut sections less than 4.5 m in height/depth, will be discussed in the Pavement Investigation and Design Report.

As indicated in Table 1, the high fill area are located on both sides of Wellington Road 34 Underpass, and near the intersection of connector route and Concession Road 7. Localized high fills are also planned along the connector route and at S-EW Ramp of the Midblock Interchange.

Table 1 – High Fill and Deep Cut Sections in the MBI Area

ROAD SECTION		HIGH FILL AREAS			DEEP CUT AREAS		
		APPROXIMATE STATION RANGE	LABEL	APPROXIMATE HEIGHT (m)	APPROXIMATE STATION	LABEL	APPROXIMATE HEIGHT (m)
Concession Road 7		10+960 – 11+110	HF-1	4.5 – 7.5	10+730 – 10+800	DC-1	4.5 – 10.0
Proposed Connector Route		10+340 – 10+390	HF-2	4.5 – 6.0	9+050 – 9+110	DC-2	4.5 – 6.0
		9+850 – 9+890	HF-3	4.5 – 5.5	---	---	---
Wellington Road 34		9+820 – 9+970	HF-4	4.5 – 9.1	---	---	---
		10+030 – 10+180	HF-5	4.5 – 9.2	---	---	---
Highway 6 and Proposed Midblock Interchange	S-EW Ramp	10+290 – 10+420	HF-6	4.5 – 4.5	---	---	---
	Southbound (SB)	---	---	---	11+730 – 10+780	DC-3	4.5 – 5.2
	E-N Ramp	---	---	---	9+740 – 10+000	DC-4	4.5 – 7.0
	Northbound (SB)	---	---	---	12+180 – 12+520		4.5 – 8.0
	E-S Ramp	---	---	---	9+790 – 10+000	DC-5	4.5 – 7.5
	Southbound (SB)	---	---	---	12+520 – 12+240	DC-6	4.5 – 9.5
	N-EW Ramp	---	---	---	10+170 – 10+240		4.5 – 10.5

Deep cuts are proposed on the northbound and southbound sides of Highway 6 where existing slopes will be cut or filled over as part of the road widening plan, along Concession Road 7, and near the intersection of the new connector route and Wellington Road 34. Deep cuts are also proposed on the inside section of the E-S Ramp, on the outside section of the E-N Ramp, and at some locations along the N-EW Ramp of the Midblock Interchange.

3. SITE DESCRIPTION

The MBI area is characterized by a landform composed of several geomorphic elements, ranging from low relief areas near the intersection of Wellington Road 34 and Highway 6, to ridges hummocks, and undulations along the new connector route and Concession Road 7. Highway 6 in the region is aligned in the north-south direction and was built in cut slopes in the north and on flat landscape characterised by a wetland and dense vegetation in the south. The road surface, in general, has a low vertical relief. On the other hand, Concession Road 7 has significant sags and undulations within the project limits and the alignment is defined by hilly irregular slopes.

Along the new connector route, the ground surface rises from the low elevated area at its intersection with Wellington Road 34 in the south to the proposed location of Wellington Road 34 Connector Underpass, approximately 900 m north of the intersection of Wellington Road 34 and Highway 6. The surrounding area on both sides of the new connector route and associated ramps is an agricultural land. A golf course exists in the northeast section of the MBI area.

Refer to the Photographs 1 to 18 in Appendix A, for general site conditions.

4. FIELD INVESTIGATION PROGRAM

The field investigation program for the assessment of high fill and deep cut sections was carried out by PML between July 12, 2021 and August 18, 2021. During this time, forty-four (44) boreholes were drilled at the proposed locations of the high fill and deep cut sections listed in Table 1. In addition, two (2) boreholes were drilled on the east and west side of Wellington Road 34 Connector Underpass for

geotechnical and hydrogeological assessment of the locations of infiltration ponds, and seven (7) boreholes were advanced around the intersection of Wellington Road 34 and Highway 6 for hydrogeological studies. A summary of the field investigation program is provided in Table 2. The borehole location plans are presented in Drawings MBI-2, MBI-3, MBI-4, MBI-5, and MBI-6. As shown in these plans, the boreholes were drilled in most cases within the station limits of high fills and deep cuts and at staggered locations, to depths of 3.1 m (El. 307.2) to 15.3 m (El. 294.4) below existing grade. The boreholes drilled by manual drilling reached spoon refusal at shallow depths. In some areas, boreholes were drilled outside the limits of high fill and deep cut sections to obtain a better stratigraphy of the area. The records of borehole sheets are presented in Appendix B.

Table 2 – Summary of the Field Program

NO.	PURPOSE	ROAD SECTION	BOREHOLE NO	MTM NAD 83 COORDINATES		GROUND SURFACE ELEVATION (m)	DEPTH (m)
				NORTHING (m)	EASTING (m)		
1	HF-1	Concession Road 7	21-36	4814435.7	249720.9	325.1	3.6
2			21-37	4814416.7	249749.6	321.1	9.2
3			21-38	4814365.8	249790.9	319.7	9.7
4			21-39	4814284.1	249889.9	318.0	10.5
5			21-40	4814292.3	249854.9	318.5	9.8
6	HF-2	Proposed Connector Route	21-34	4814370.6	249707.8	321.5	4.4
7			21-35	4814396.6	249722.2	321.7	10.5
8	HF-3		21-32	4814013.2	249379.2	325.6	7.7
9			21-33	4813935.1	249354.5	326.9	10.4
10	HF-4	Wellington Road 34	21-04	4813263.5	249663.1	308.9	6.6
11			21-05	4813253.2	249634.1	310.6	11.3
12			21-06	4813246.5	249588.8	309.1	5.2
13			21-07	4813223.9	249574.4	309.4	10.1
14			21-07A	4813242.3	249643.2	310.3	3.1
15			21-08	4813221.3	249538.8	310.8	10.4
16	HF-5		21-01	4813308.7	249977.7	309.1	10.5
17			21-02	4813317.5	249888.4	308.9	10.4
18			21-03	4813299.2	249837.9	309.7	15.3

Table 2 – Summary of the Field Program

NO.	PURPOSE	ROAD SECTION	BOREHOLE NO	MTM NAD 83 COORDINATES		GROUND SURFACE ELEVATION (m)	DEPTH (m)
				NORTHING (m)	EASTING (m)		
19	HF-6	Midblock Interchange	21-26	4814192.4	249610.9	329.9	10.5
20			21-27	4814102.5	249623.5	324.0	10.4
21			21-28	4813971.7	249606.3	320.5	8.2
22	DC-1	Concession Road 7	21-41	4814246.8	249895.5	319.2	3.7
23			21-42	4814206.7	249950.0	321.1	10.0
24			21-43	4814120.8	250017.4	312.4	7.0
25	DC-2	Proposed Connector Route	21-09	4813274.1	249319.2	315.6	5.9
26			21-10	4813309.7	249266.4	316.6	10.5
27			21-11	4813364.8	249271.1	313.0	9.1
28	DC-3	Highway 6	21-29	4813886.7	249519.8	316.5	10.4
29			21-30	4813948.9	249478.3	321.9	10.5
30			21-31	4814028.5	249474.5	320.2	10.4
31	DC-4		21-17	4814216.1	249484.3	330.6	9.8
32			21-18	4814385.2	249433.1	336.8	5.4
33			21-20	4814472.4	249424.5	338.6	9.8
34			21-22	4814552.0	249380.8	339.2	9.8
35			21-24	4814618.2	249342.6	335.8	10.4
36	DC-5	Proposed Midblock Interchange	21-12	4814135.0	249363.0	329.1	9.8
37			21-13	4814150.3	249412.1	330.5	9.3
38			21-14	4814060.5	249385.1	328.9	10.2
39	DC-6		21-15	4814162.2	249327.3	334.4	6.6
40			21-16	4814238.0	249369.2	331.4	10.1
41			21-19	4814358.6	249353.7	336.9	10.1
42			21-21	4814451.1	249347.6	333.4	7.9
43			21-23	4814519.6	249299.5	342.6	10.1
44			21-25	4814637.2	249288.2	335.3	8.2

Table 2 – Summary of the Field Program

NO.	PURPOSE	ROAD SECTION	BOREHOLE NO	MTM NAD 83 COORDINATES		GROUND SURFACE ELEVATION (m)	DEPTH (m)
				NORTHING (m)	EASTING (m)		
45	HydroG	Highway 6	21-44	4813138.6	249747.6	310.5	12.3
46			21-45	4813388.2	249702.0	311.4	14.8
47			21-46	4813425.5	249650.9	310.9	6.1
48			21-47	4813490.5	249685.2	311.6	9.6
49			21-48	4813535.8	249632.7	312.1	11.0
50			21-49	4813590.4	249649.4	312.2	9.6
51		Wellington Road 34	21-52	4813149.7	249165.5	310.9	11.1
52	Storm Pond	Proposed W-N Ramp	21-50	4814100.9	249556.2	325.5	7.7
53		Proposed E-S Ramp	21-51	4814111.5	249385.4	324.6	11.3

Prior to the start of the fieldwork, utility clearance procedures were implemented through Ontario One Call protocol and by contacting MTO locates. The borehole locations were cleared to cover the limits of the foundation areas to avoid conflicts with underground and overhead utilities while allowing for safe operation of a drill rig. Further, fieldwork notification was sent to MTO West Region. In accordance with PML's work plan for the project, project specific health and safety and traffic protection plans were prepared and utilized during the field investigation phase.

In addition, the borehole locations were marked by PML staff prior to drilling based on the preliminary plans provided by AECOM. All drilling activities, soil sampling, and backfilling of boreholes were conducted under the supervision of an experienced PML field technician.

Most of the boreholes were advanced using Geoprobe 7822DT and CME75 truck mounted drill rigs, equipped with continuous flight hollow and solid stem augers, supplemented by wash boring (mud rotary) techniques. The drilling equipment were owned and operated by a specialist contractor, PML Field Services Ltd., based in Hannon, Ontario. Permit to use a drilling rig at some locations of the

MBI area was not granted by AECOM because of environmental restrictions and related issues. For this reason, five (5) boreholes (21-04, 21-06, 21-34, 21-36, 21-18) were advanced by manual drilling, operated by Goetech Support Services Inc. of Markham, Ontario. These boreholes reached spoon refusal at depths between 3.6 m and 6.6 m. Further, Borehole 21-07 was drilled to complement Borehole 21-07A, as the latter reached refusal at a depth of 3.1 m.

Representative soil samples were recovered from the boreholes at 0.75 m intervals to a depth of 6.0 m, and at 1.5 m intervals to a depth of 20.0 m, using a split-spoon sampler in accordance with the Standard Penetration Test (SPT) procedures (ASTM D1586 – Standard Test Method for Standard Penetration Test). The results of the SPTs were reported as “N” values in the attached record of borehole sheets. Bedrock was note encountered within the depth of investigation.

Soil samples obtained from the boreholes were inspected immediately upon retrieval to assess type, texture, and colour and classified in accordance with the MTO Soil Classification procedures. All retrieved samples were sealed in clean plastic bags and transported to PML’s laboratory in Toronto for visual examination and laboratory testing purposes. Preliminary rock core description was also conducted in the field after completion of rock coring operations.

Groundwater levels in open boreholes were observed throughout the drilling operations by visual examination of soil samples, the spilt-spoon sampler, and drill rods as the samples were retrieved, and by measurement of the water level in the open borehole using a Solinst flat tape water level reader. Some boreholes were advanced using water and wash boring techniques, and direct observation or measurement of the water level after completion of drilling could not be established in these boreholes. In addition to real-time observations and measurement, monitoring wells were installed in some boreholes to measure stabilized groundwater levels. The monitoring wells typically consisted of 50 mm outside diameter rigid PVC pipe with a 1.5 m or 3.0 m long screen surrounded by a sand pack and sealed at selected depths within the borehole.

Boreholes were backfilled with soil cuttings in conformance with MTO guidelines and the Ministry of Environment, Conservation and Parks (MECP) Ontario Regulation 903 (as amended by Ontario

Regulation 372). In the case of wells, the annular space between the borehole wall and the well pipe above the filter pack was backfilled to ground surface using bentonite pellets.

Surveying of the as-drilled borehole locations was completed by Callon Dietz of London, Ontario, sub-contracted by PML. All coordinates in this report are in MTM NAD 83 Northing and Easting (MTM Zone – ON10), and the elevations refer to Geodetic datum and are expressed in metres. The horizontal and vertical accuracies of the surveying were under 5 cm and 10 cm, respectively.

5. LABORATORY TEST PROCEDURES

Laboratory tests were conducted on representative SPT soil samples recovered during the fieldwork investigation. Testing was conducted at PML's laboratory facility, located in Toronto, Ontario. The laboratory testing program included the following:

- Natural moisture content determinations (452)
- Grain size distribution analysis (115)
- Atterberg limit test (8)

The laboratory tests to determine soil index properties were performed in accordance with MTO test procedures, which follow the American Society for Testing Materials (ASTM) standards. However, the hydrometer tests were tested based on MTO's standard LS-702.

The results of the grain size distribution analyses and Atterberg Limits tests of representative soil samples are provided in Appendix C. All test results are provided on record of borehole sheets.

6. SITE GEOLOGY AND SUBSURFACE CONDITIONS

6.1 Physiography and Regional Geology

The MBI area is located within the western flank of the northeast to southwest trending Paris Moraine. The Paris Moraine is characterized by a broad band of high-relief hummock topography with hilly irregular slopes and enclosed basins, as demonstrated by the presence of frequent small

ponds and marshy areas. The geomorphic elements include hummocks, front and back slopes, as well as flat, ridge and depressions. The Paris Moraine is composed of an extensive network of coarsely stratified sand and gravel deposits on adjacent outwash plains.

The Quaternary Geology map published by the Ontario Ministry of Northern Development and Mines (MNDM), indicated that the subsurface condition in the area is composed of predominantly sandy silt to silty sand deposits of the Wentworth Till. These till deposits are often boulder and stony. In some places, localized accumulation of sorted and stratified sands and gravels, deposited as outwash materials by sediment-laden meltwater flowed across the region, are also common. The Wentworth Till is the surface material in most places including hummocks and ridges.

The bedrock in the area belongs to the Lower Silurian dolostone of the Guelph Formation. The Guelph Formation is identified as an important aquifer in City of Guelph and surrounding areas.

6.2 Subsurface Conditions

The soil layers encountered during foundation investigations along with laboratory test results are presented in the record of borehole sheets in Appendix B. The stratigraphic profiles across the various high fill and deep cut sections are provided in Drawings MBI-7 to MBI-15. The boundaries between soil strata in these stratigraphic profiles were established at borehole locations only, and using non-continuous sampling methods. The boundaries represent a transition from one soil type to another, and should not be inferred to represent an exact plane of geological change, as the subsurface conditions may vary between and beyond the boreholes.

In general, the stratigraphy at proposed locations of high fills and deep cut sections consists of topsoil underlain by silty sand or sandy silt fill. Beneath the fill, a silty sand/sandy silt native till with varying proportions of gravel and occasionally with silt seams and sand lenses was encountered. The findings of the foundation investigations (subsurface and groundwater conditions) at each high fill and deep cut section are summarized separately in the following subsections.

6.2.1 HF-1 (Concession Road 7)

A total of five (5) boreholes (Boreholes 21-36, 21-37, 21-38, 21-39, and 21-40) were drilled to investigate the subsurface and groundwater conditions beneath this high fill section, located from Sta. 10+960 to Sta. 11+110 of the new alignment of Concession Road 7. The maximum height of the proposed embankment within the limits of this fill is approximately 7.5 m.

The subsurface conditions encountered during the site investigation carried out by PML at this site can be categorized into three (3) soil layers. Drawing MBI-9 provides the subsurface stratigraphy for this site. A brief description of the soil layers and groundwater conditions is given below.

6.2.1.1 Topsoil

A surficial layer of topsoil was encountered in all boreholes. The thickness of the topsoil was approximately 200 mm to 600 mm.

6.2.1.2 Fill – Silty Sand or Sandy Silt

Fill, consisting of loose to compact silty sand/sandy silt, was encountered immediately below the ground surface in Borehole 21-39. The thickness of the fill was 1.5 m.

The SPT ‘N’ values within the fill ranged between 29 blows/300 mm and 79 blows/300 mm, indicating compact to very dense state of denseness.

The moisture contents of the samples tested from the fill ranged from 2.9% to 5.4%.

6.2.1.3 Silty Sand/Sandy Silt (Till)

Silty sand/sandy silt till with occasional zones of gravel, sandy gravel and silt, was encountered in all boreholes beneath the topsoil or fill material. This layer extended to the full depth of investigation of 3.6 m (El. 321.5) to 9.7 m (El. 310.0) below existing ground surface. In Boreholes 21-39 and

21-40, the silty sand/sandy silt layer is represented by a 2.9 m to 3.8 m thick silt underlain by sandy gravel till, extending to the depth of 9.8 m (El. 308.8) to 10.5 m (El. 307.5).

The SPT 'N' values within the till deposit varied from as low as 4 blows/300 mm to spoon refusal (100 blows/300 mm penetration) in sandy gravel zones, indicating a loose to very dense state of denseness. The SPT "N" values within the silt till layer encountered in Boreholes 21-39 and 21-40 ranged from penetration due to the weight of hammer and rods (0 blows/300 mm) to as high as 53 blows/300 mm, indicating a very loose to very dense state of relative density.

The moisture contents of samples tested from this deposit ranged from 1.7% to 26.6%.

The results of the grain size distribution analyses conducted on representative samples of the till are provided in Figures HF1-GS-1A and 618-GS-1B, in Appendix C.

6.2.1.4 Groundwater Conditions

Groundwater was observed in all boreholes during drilling. Groundwater level was also measured in open boreholes upon completion of drilling. The depths of observed and measured groundwater levels ranged from 2.6 m (El. 317.1) to 7.6 m (El. 310.8) below existing ground surface.

It should be noted that the groundwater levels and gradient (directional flow) may be influenced by the topography at the project site, and fluctuate because of seasonal changes, periods of precipitation, and temperature, are usually high during spring and summer and low in winter.

6.2.2 HF-2 (Connector Route)

A total of two (2) boreholes (Boreholes 21-34 and 21-35) were drilled to investigate the subsurface conditions underlying this high fill, located from Sta. 10+340 to Sta. 10+390 of the new connector route. The maximum height of the proposed embankment within the limits of this fill is 6.0 m.

The subsurface conditions encountered during the site investigation carried out by PML at this site can be categorized into two (2) soil layers. Drawing MBI-9 provides the subsurface stratigraphy for this site. A brief description of the soil layers and groundwater conditions is given below.

6.2.2.1 Topsoil

A surficial layer of topsoil was encountered in all boreholes. The thickness of the topsoil was approximately 200 mm to 800 mm.

6.2.2.2 Silty Sand/Sandy Silt (Till)

Silty sand/sandy silt till with occasional zones of gravel and silt layers was encountered in both boreholes beneath the topsoil. This till extended to the full depth of investigations of 4.4 m (El. 311.1) to 10.5 m (El. 311.2) below the existing ground surface.

The SPT 'N' values within the till deposit varied from 2 blows/300 mm to spoon refusal, indicating a loose to very dense state of denseness. The low blow counts in the upper part of the stratigraphy may belong to local outwash sand deposits common in the area.

The moisture contents of samples tested from this deposit ranged from 5.6% to 23.9%.

The results of the grain size distribution analyses conducted on representative samples of the till are provided in Figure HF2-GS-1, in Appendix C.

6.2.2.3 Groundwater Conditions

Groundwater was observed in all boreholes during drilling. Groundwater level was also measured in open boreholes upon completion of drilling. The depths of the measured groundwater levels ranged from 1.7 m (El. 319.8) to 4.2 m (El. 317.5) below the existing ground surface.

It should be noted that the groundwater levels and gradient (directional flow) may be influenced by the topography at the project site, and fluctuate because of seasonal changes, periods of precipitation, and temperature, are usually high during spring and summer and low in winter.

6.2.3 HF-3 (Connector Route)

A total of two (2) boreholes (Boreholes 21-32 and 21-33) were advanced to investigate the subsurface and groundwater conditions beneath this high fill section, located from Sta. 9+850 to Sta. 9+890 of the new proposed connector route. The maximum height of the proposed embankment within the limits of this fill is approximately 5.5 m.

The subsurface conditions encountered during the site investigation carried out by PML at this site can be categorized into two (2) soil layers. Drawing MBI-9 provides the subsurface stratigraphy for this site. A brief description of the soil layers and groundwater conditions is given below.

6.2.3.1 Topsoil

A surficial layer of topsoil was encountered in all boreholes. The thickness of the topsoil was approximately 800 mm.

6.2.3.2 Silty Sand/Sandy Silt (Till)

Silty sand/sandy silt till with occasional zones of gravel and silt layers was encountered in both boreholes beneath the topsoil. This till extended to the full depth of investigations of about 7.7 m (El. 317.9) to 10.4 m (El. 316.5) below the existing ground surface.

The SPT ‘N’ values within the till deposit varied from 14 blows/300 mm to spoon refusal (100 blows/300 mm penetration), indicating a compact to very dense state of denseness.

The moisture contents of samples tested from this deposit ranged from 5.2% to 8.8%.

The results of the grain size distribution analyses conducted on representative samples of the till are provided in Figure HF3-GS-1, in Appendix C.

6.2.3.3 Groundwater Conditions

Groundwater was not encountered in both boreholes during drilling.

It should be noted that the groundwater levels and gradient (directional flow) may be influenced by the topography at the project site, and fluctuate because of seasonal changes, periods of precipitation, and temperature, are usually high during spring and summer and low in winter.

6.2.4 HF-4 (Wellington Road 34)

A total of six (6) boreholes (Boreholes 21-04, 21-05, 21-06, 21-07, 21-07A, and 21-08) were drilled to investigate the subsurface and groundwater conditions within this high fill area located from Sta. 9+820 to Sta. 9+970, on the west side Wellington Road 34 and Highway 6 intersection. The maximum height of the proposed embankment within the limits of this fill is about 9.1 m.

The subsurface conditions encountered during the site investigation carried out by PML at this site can be categorized into four (4) soil layers. Drawing MBI-10 provides the subsurface stratigraphy for this site. A brief description of the soil layers and groundwater conditions is given below.

6.2.4.1 Topsoil/Peat

A layer of topsoil was encountered immediately below the existing ground in Borehole 21-07 located off-road. The thickness of the topsoil was about 800 mm.

In Boreholes 21-04 and 21-06, a layer of peat was encountered below the ground surface. Peat was also encountered in Borehole 21-07 mixed with topsoil and trace sand and trace gravel. The peat was dark brown in color and wet. In the upper part, the peat consisted of undecomposed pieces of wood and rootlets mixed with trace to some sand and gravel. In the lower part, the peat became

amorphous and spongy and was very wet and soft. The thickness of the peat ranged from 1.8 m in Borehole 21-04, 0.8 m in Borehole 21-06 and 1.5 m in Borehole 21-07.

6.2.4.2 Pavement Structure Material

Pavement structure material was encountered in Boreholes 21-05 and 21-08 advanced within the left and right lanes of Wellington Road 34. The pavement structure consisted of 100 mm to 50 mm thick asphaltic concrete over a 600 mm thick granular layer.

The SPT 'N' values in the pavement fill ranged from 21 blows/300 mm to 87 blows/300 mm penetration, indicating a compact to very dense state of compactness.

The moisture contents of the samples tested from the pavement granular fill material ranged from 3.1% to 6.1% with an average value of 4.6%.

6.2.4.3 Fill – Silty Sand/Sandy Silt

Fill consisting of silty sand/sandy silt with significant proportion of gravel was encountered below the pavement granular fill in Boreholes 21-05 and 21-08 and beneath the ground surface in Borehole 21-07A. The fill was brown in color and moist, and had a thickness in the range of 1.5 m 3.0 m, extending to a maximum depth of 3.8 m (El. 306.8).

The SPT 'N' values within this silty sand/sandy silt fill ranged from 4 blows/300 mm to spoon refusal on gravel layer, indicating a loose to very dense state of compactness.

The moisture contents of the samples tested from this fill material ranged from 4.8% to 9.7%.

The results of the grain size distribution analysis conducted on a sample taken from a gravelly zone of this fill in Borehole 21-05 are provided in Figure HF4-GS-1A, in Appendix C.

6.2.4.4 Silty Sand/Sandy Silt (Till)

Silty sand/sandy silt till with zones of gravel, sandy gravel, silt seams and sand layers, was encountered in all boreholes drilled within the limits of this high fill area, beneath the topsoil/peat and the silty sand/sandy silt fill. Sandy gravel till was encountered in Borehole 21-04. The silty sand/sandy silt till was brown in color and wet, and extended to the full depth of investigations of 5.2 m (El. 303.9) to 11.3 m (El. 299.3) below the existing ground surface.

The SPT 'N' values within the till deposit varied from 6 blows/300 mm to spoon refusal (100 blows/300 mm penetration), indicating a loose to very dense state of denseness. The low blow counts correspond to wet silt seams and sand layers encountered at different depths.

The moisture contents of samples tested from this deposit ranged from 2.3% to 31.7%.

The results of the grain size distribution analyses conducted on representative samples of the till are provided in Figure HF4-GS-1B, in Appendix C. The Atterberg limit test results for a sample of a silt seam from Borehole 21-08 are presented in Figure HF4-PC-1, in Appendix C.

6.2.4.5 Groundwater Conditions

Groundwater was observed in all boreholes during drilling. Groundwater level was also measured in open boreholes upon completion of drilling. The depths of measured groundwater levels ranged from 1.8 m (307.3) to 2.0 m (El. 308.8) below the existing ground surface.

It should be noted that the groundwater levels and gradient (directional flow) may be influenced by the topography at the project site, and fluctuate because of seasonal changes, periods of precipitation, and temperature, are usually high during spring and summer and low in winter.

6.2.5 HF-5 (Wellington Road 34)

A total of three (3) boreholes (Boreholes 21-01, 21-02, and 21-03) were advanced to investigate the subsurface and groundwater conditions within this high fill area located from Sta. 10+030 to Sta. 10+180, on the east side of the intersection of Wellington Road 34 and Highway 6. The maximum height of the proposed embankment within the limits of this fill is about 9.2 m.

The subsurface conditions encountered during the site investigation carried out by PML at this site can be categorized into five (5) soil layers. Drawing MBI-11 provides the subsurface stratigraphy for this site. A brief description of the soil layers and groundwater conditions is given below.

6.2.5.1 Topsoil/Peat

A layer of topsoil was encountered immediately below the existing ground in Borehole 21-01 located off-road. The thickness of the topsoil was about 200 mm.

In Borehole 21-02, a 1.5 m thick layer of peat was encountered below the ground surface. Peat and soft clay were also encountered in Borehole 21-03 beneath the road shoulder granular fill. The peat was dark brown in color and wet. In the upper part, it is sandy and fibrous. In the lower part, the peat became amorphous and spongy and was very wet and soft.

6.2.5.2 Pavement Structure Material

Pavement structure material was encountered in Borehole 21-03 drilled at the shoulder of Wellington Road 34. The pavement structure material consisted of 800 mm thick granular fill.

The SPT ‘N’ values in the pavement granular material was 44 blows/300 mm penetration, indicating a dense state of compactness.

The moisture content a sample from the pavement granular fill was 3.2%.

6.2.5.3 Fill – Clayey Silt/Silty Sand

Fill consisting of clayey silt/sandy silt with a significant proportion of gravel was encountered below topsoil in Borehole 21-01 and the pavement granular fill in Borehole 21-03. The thickness of the fill ranged from 1.5 m to 2.3 m, extending to a maximum depth of 2.3 m (El. 306.8).

The SPT 'N' values within this fill ranged from 6 blows/300 mm to 52 blows/300 mm penetration, indicating a loose to very dense state of compactness.

The moisture contents of samples of this fill material ranged from 6.6% to 19.4%.

The results of the grain size distribution analysis conducted on a sample taken from a gravelly zone of this fill in Borehole 21-03 are provided in Figure HF5-GS-1A, in Appendix C.

6.2.5.4 Silty Sand/Sandy Silt (Till)

Silty sand/sandy silt till with occasional zones of gravel, silt seams and sand layers, was encountered in all boreholes drilled within the limits of this high fill area. In Boreholes 21-01 and 21-02, this till was encountered beneath the fill and peat layers, and was fully penetrated. Its thickness ranged from 2.3 m to 3.8 m, and extends to a maximum depth of 5.3 m (El. 303.6). In Borehole 21-03, the silty sand/sandy silt layer was encountered beneath the pavement fill and soft silty clay/peat layer, and extended to the maximum depth of investigation of 15.3 m (El. 294.4).

The SPT 'N' values within the till in Boreholes 21-01 and 21-02 ranged from 8 blows/300 mm to 16 blows/300 mm penetration, indicating a compact state of denseness. In Borehole 21-03, the SPT 'N' values within the till varied from 10 blows/300 mm to spoon refusal (100 blows/300 mm penetration) in gravelly zones, indicating a compact to very dense relative density. The low blow counts correspond to wet silt seams encountered between the depths of El 301.0 and El. 298.0.

The moisture contents of samples tested from the till deposit ranged from 8.8% to 19.2%. The moisture content of a sample from the silty clay in Borehole 21-03 was 42.4%.

The results of the grain size distribution analyses conducted on representative samples of the silty sand/sandy silt till are provided in Figure HF5-GS-1B, in Appendix C. The Atterberg limit test results for a sample from the silt clay/peat layer encountered in Borehole 21-03 are presented in Figure HF5-PC-1, in Appendix C. The Atterberg limit test results for samples from the silty sand/sandy silt till are presented in Figure HF5-PC-2, in Appendix C.

6.2.5.5 Clayey Silt (Till)

Native clayey silt material was encountered in Boreholes 21-01 and 21-02 below the silty sand/sandy silt till. It consisted of trace sand and trace gravel, was brown in color and moist, and extended to the full depth of investigation of 10.4 m (El. 298.5).

The SPT “N”-values in this clayey silt till deposit varied from 15 blows/300 mm to spoon refusal, indicating stiff to hard soil consistency. The low blow counts correspond to the till deposit encountered in the lower part of Borehole 21-02, where thin layers of silt were intercepted.

The moisture content of the clayey silt deposit varied from 11.3% to as high as 18.8%.

The results of the grainsize analyses tests performed on samples taken from Boreholes 21-01 and 21-02 are provided in Figure HF5-GS-1C, in Appendix C. The Atterberg limit test results for the samples of the clayey silt till are presented in Figure HF5-PC-3, in Appendix C.

6.2.5.6 Groundwater Conditions

Groundwater was observed in all boreholes during drilling. Groundwater level was also measured in open boreholes upon completion of drilling. The depths of measured groundwater levels ranged from 0.8 m (308.3) to 1.5 m (El. 308.2) below the existing ground surface. Groundwater level measurement was also taken from a monitoring well installed in Borehole 21-02. The stabilized groundwater level taken 6 days after the installation of the well was at 1.8 m (El. 307.1).

It should be noted that the groundwater levels and gradient (directional flow) may be influenced by the topography at the project site, and fluctuate because of seasonal changes, periods of precipitation, and temperature, are usually high during spring and summer and low in winter.

6.2.6 HF-6 (S-EW Ramp)

A total of three (3) boreholes (Boreholes 21-26, 21-27 and 21-28) were drilled to investigate the subsurface and groundwater conditions beneath this high fill section, located from Sta. 10+290 to Sta. 10+420 of the S-EW Ramp of the midblock interchange. The maximum height of the proposed embankment within the limits of this fill is approximately 4.5 m.

The subsurface conditions encountered during the site investigation carried out by PML at this site can be categorized into two (2) soil layers. Drawing MBI-12 provides the subsurface stratigraphy for this site. A brief description of the soil layers and groundwater conditions is given below.

6.2.6.1 Topsoil

A surficial layer of topsoil was encountered in all boreholes. The thickness of the topsoil was approximately 600 mm to 800 mm.

6.2.6.2 Silty Sand/Sandy Silt (Till)

Silty sand/sandy silt till with occasional zones of gravel and silt layers was encountered in all three boreholes beneath the topsoil. In Borehole 21-27, approximately 1.3 m thick clayey silt layer was encountered within the silty sand/sandy silt till. The silty sand/sandy silt till extended to the full depth of investigations of 8.2 m (El. 312.3) to 10.5 m (El. 319.4) below the existing ground surface.

The SPT ‘N’ values within the till deposit varied from 10 blows/300 mm to spoon refusal (100 blows/300 mm penetration), indicating a compact to very dense state of denseness.

The moisture contents of samples tested from this deposit ranged from 1.4% to 16.6%.

The results of the grain size distribution analyses conducted on representative samples of the till are provided in Figure HF6-GS-1, in Appendix C. The Atterberg limit test results for a clayey silt sample taken from Borehole 21-27 are presented in Figure HF6-PC-1, in Appendix C.

6.2.6.3 Groundwater Conditions

Groundwater was observed in all boreholes during drilling. Groundwater level measurement was also taken from a monitoring well installed in Borehole 21-27. The stabilized groundwater level taken 36 days after the installation of the well was at 8.1 m (El. 315.9).

It should be noted that the groundwater levels and gradient (directional flow) may be influenced by the topography at the project site, and fluctuate because of seasonal changes, periods of precipitation, and temperature, are usually high during spring and summer and low in winter.

6.2.7 DC-1 (Concession Road 7)

A total of three (3) boreholes (Boreholes 21-41, 21-42 and 21-43) were drilled to investigate the subsurface and groundwater conditions beneath this deep cut section, located from Sta. 10+730 to Sta. 10+800 of the new alignment of Concession Road 7. The maximum height of the proposed cut within the limits of this deep cut section is approximately 10.0 m.

The subsurface conditions encountered during the site investigation carried out by PML at this site can be categorized into three (3) soil layers. Drawing MBI-13 provides the subsurface stratigraphy for this site. A brief description of the soil layers and groundwater conditions is given below.

6.2.7.1 Topsoil

A surficial layer of topsoil was encountered in all boreholes. The thickness of the topsoil was approximately 200 mm to 400 mm.

6.2.7.2 Fill – Sandy Silt

Fill consisting of sandy silt with significant proportion of gravel was encountered below the topsoil in Boreholes 21-41 and 21-43. The thickness of the fill ranged from 1.2 m to 1.3 m, extending to depths of 1.4 m (El. 217.8) to 1.5 m (El. 310.8).

The SPT 'N' values within this sandy silt fill ranged from 3 blows/300 mm to 7 blows/300 mm penetration, indicating a loose state of compactness.

The moisture contents of samples of this fill material ranged from 7.5% to 17.9%.

The results of the grain size distribution analysis conducted on a sample taken from this fill in Borehole 21-41 are provided in Figure DC1-GS-1, in Appendix C.

6.2.7.3 Sandy Silt (Till)

Sandy silt till with occasional zones of gravel was encountered in Boreholes 21-41 and 21-42 beneath the topsoil and fill. This till extended to the full depth of investigations of 3.7 m (El. 315.5) to 10.0 m (El. 311.1) below the existing ground surface.

The SPT 'N' values within the till deposit varied from 12 blows/300 mm to spoon refusal (100 blows/300 mm penetration), indicating a compact to very dense state of denseness.

The moisture contents of samples tested from this deposit ranged from 6.0% to 20.3%.

The results of the grain size distribution analyses conducted on representative samples of the till are provided in Figure DC1-GS-2, in Appendix C.

6.2.7.4 Sandy Gravel (Till)

Till consisting of sandy gravel with trace to some silt was encountered in Borehole 21-43 below the sandy silt till. This till extended to the full depth of investigation of 7.0 m (El. 305.4).

The SPT "N"-values in this sandy gravel till deposit varied with depth from 19 blows/300 mm to spoon refusal, indicating dense to very dense relative density.

The moisture content of the clayey silt deposit varied from 7.1% to as high as 19.4%.

The results of the grain size distribution analyses conducted on representative samples of the till are provided in Figure DC1-GS-3, in Appendix C.

6.2.7.5 Groundwater Conditions

Groundwater was observed in all boreholes during drilling. Groundwater level measurement was also taken from a monitoring well installed in Borehole 21-43. The stabilized groundwater level taken 30 days after the installation of the well was at 2.1 m (El. 310.4).

It should be noted that the groundwater levels and gradient (directional flow) may be influenced by the topography at the project site, and fluctuate because of seasonal changes, periods of precipitation, and temperature, are usually high during spring and summer and low in winter.

6.2.8 DC-2 (Connector Route)

A total of three (3) boreholes (Boreholes 21-09, 21-10 and 21-11) were drilled to investigate the subsurface and groundwater conditions beneath this deep cut section, located from Sta. 9+050 to Sta. 9+110 of the proposed alignment of the connector route. The maximum height of the proposed cut within the limits of this deep cut section is approximately 6.0 m.

The subsurface conditions encountered during the site investigation carried out by PML at this site can be categorized into two (2) soil layers. Drawing MBI-13 provides the subsurface stratigraphy for this site. A brief description of the soil layers and groundwater conditions is given below.

6.2.8.1 Topsoil

A surficial layer of topsoil was encountered in all boreholes. The thickness of the topsoil was approximately 200 mm to 600 mm.

6.2.8.2 Sandy Silt (Till)

Sandy silt till was encountered in all boreholes beneath the topsoil. This till extended to the full depth of investigations of 5.9 m (El. 309.7) to 9.1 m (El. 303.9) below the existing ground surface. The lower part of the stratigraphy in all three boreholes consisted of sandy gravel till.

The SPT 'N' values within the till deposit varied with depth from 11 blows/300 mm to spoon refusal (100 blows/300 mm penetration), indicating a compact to very dense state of denseness.

The moisture contents of samples tested from this deposit ranged from 1.7% to 13.0%.

The results of the grain size distribution analyses conducted on representative samples of the till are provided in Figure DC2-GS-1, in Appendix C.

6.2.8.3 Groundwater Conditions

Groundwater was observed in all boreholes during drilling. Groundwater level measurements were also taken from monitoring wells installed in Boreholes 21-09 and 21-011. Groundwater level readings taken 42 days after installation indicated a dry condition in Borehole 21-09. On the other hand, a stabilized groundwater level at 1.9 m (El. 311.1) was measured in Borehole 21-11.

It should be noted that the groundwater levels and gradient (directional flow) may be influenced by the topography at the project site, and fluctuate because of seasonal changes, periods of precipitation, and temperature, are usually high during spring and summer and low in winter.

6.2.9 DC-3 (Highway 6 South Bound)

A total of three (3) boreholes (Boreholes 21-29, 21-30 and 21-31) were drilled to investigate the subsurface and groundwater conditions beneath this deep cut section, located from Sta. 11+730 to Sta. 11+780 of the proposed widening of Highway 6. The maximum height of the proposed cut within the limits of this deep cut section is approximately 5.2 m.

The subsurface conditions encountered during the site investigation carried out by PML at this site can be categorized into two (2) soil layers. Drawing MBI-14 provides the subsurface stratigraphy for this site. A brief description of the soil layers and groundwater conditions is given below.

6.2.9.1 Topsoil

A surficial layer of topsoil was encountered in all boreholes. The thickness of the topsoil was approximately 200 mm to 500 mm.

6.2.9.2 Sandy Silt (Till)

Sandy silt till was encountered in all boreholes beneath the topsoil. This till extended to the full depth of investigations of 10.5 m (El. 311.4 to El. 306.1) below the existing ground surface.

The SPT 'N' values within the till deposit varied with depth from 8 blows/300 mm to spoon refusal (100 blows/300 mm penetration), indicating a loose to very dense state of denseness.

The moisture contents of samples tested from this deposit ranged from 5.1% to 23.1%.

The results of the grain size distribution analyses conducted on representative samples of the till are provided in Figure DC3-GS-1, in Appendix C.

6.2.9.3 Groundwater Conditions

Groundwater was observed in all boreholes during drilling. Groundwater level was also measured in open boreholes upon completion of drilling. The depths of the measured groundwater levels

ranged from 3.7 m (312.8) to 9.1 m (El. 311.1) below existing ground surface. In addition, groundwater level measurements were taken from a monitoring well installed in Borehole 21-29. The groundwater level reading taken 3 days after the well installation was 5.0 m (El. 311.5).

It should be noted that the groundwater levels and gradient (directional flow) may be influenced by the topography at the project site, and fluctuate because of seasonal changes, periods of precipitation, and temperature, are usually high during spring and summer and low in winter.

6.2.10 DC-4 (E-N Ramp and Highway 6 Northbound)

A total of five (5) boreholes (Boreholes 21-17, 21-18, 21-20, 21-22 and 21-24) were drilled to investigate the subsurface and groundwater conditions beneath this deep cut section, located from Sta. 11+740 to Sta. 10+000 of the proposed E-N Ramp of the Midblock Interchange and from Sta. 12+180 to Sta. 12+520 of the proposed widening of Highway 6. The maximum height of the proposed cut within the limits of this deep cut section is approximately 8.0 m.

The subsurface conditions encountered during the site investigation carried out by PML at this site can be categorized into two (2) soil layers. Drawing MBI-15 provides the subsurface stratigraphy for this site. A brief description of the soil layers and groundwater conditions is given below.

6.2.10.1 Topsoil

A surficial layer of topsoil was encountered in all boreholes. The thickness of the topsoil was approximately 200 mm to 400 mm.

6.2.10.2 Silty Sand/Sand (Till)

Silty sand/Sand till with zones of 2.0 m to 8.0 m thick sand layers and significant proportion of gravel was encountered in all boreholes beneath the topsoil. This till extended to the full depth of investigations of 5.4 m (El. 331.4) to 9.8 m (El. 320.8) below the existing ground surface.

The SPT 'N' values within the till deposit varied with depth from 14 blows/300 mm to spoon refusal on gravelly zones, indicating a compact to very dense state of denseness.

The moisture contents of samples tested from this deposit ranged from 2.2% to 22.4%.

The results of the grain size distribution analyses conducted on representative samples of the till are provided in Figure DC4-GS-1, in Appendix C. The Atterberg limit test results for a sample taken from Borehole 21-24 are presented in Figure DC4-PC-1, in Appendix C.

6.2.10.3 Groundwater Conditions

Groundwater was observed in all boreholes during drilling. Groundwater level measurement was also taken from a monitoring well installed in Borehole 21-24. The stabilized groundwater level taken 3 days after the installation of the well was at 8.6 m (El. 327.2).

It should be noted that the groundwater levels and gradient (directional flow) may be influenced by the topography at the project site, and fluctuate because of seasonal changes, periods of precipitation, and temperature, are usually high during spring and summer and low in winter.

6.2.11 DC-5 (E-S Ramp)

A total of three (3) boreholes (Boreholes 21-12, 21-13, and 21-14) were drilled to investigate the subsurface and groundwater conditions beneath this deep cut section, located from Sta. 9+790 to Sta. 10+000 of the proposed E-S Ramp of the Midblock Interchange. The maximum height of the proposed cut within the limits of this deep cut section is approximately 7.5 m.

The subsurface conditions encountered during the site investigation carried out by PML at this site can be categorized into two (2) soil layers. Drawing MBI-14 provides the subsurface stratigraphy for this site. A brief description of the soil layers and groundwater conditions is given below.

6.2.11.1 Topsoil

A surficial layer of topsoil was encountered in all boreholes. The thickness of the topsoil was approximately 200 mm to 400 mm.

6.2.11.2 Silty Sand (Till)

Silty sand till with occasional zones of gravel and silt seams was encountered in all boreholes beneath the topsoil. This silty sand till extended to the full depth of investigations of about 9.3 m (El. 321.2) to 10.2 m (El. 318.7) below the existing ground surface.

The SPT 'N' values within the till deposit varied from 10 blows/300 mm to over 50 blows/300 mm penetration on gravel layers, indicating a compact to very dense state of denseness. In Borehole 21-12 a very loose zone of silt seam with split spoon penetration due to weight of hammer was encountered at the depth of approximately 3.9 m (El. 325.2).

The moisture contents of samples tested from this deposit ranged from 2.1% to 10.6%.

The results of the grain size distribution analyses conducted on representative samples of the till are provided in Figure DC5-GS-1, in Appendix C.

6.2.11.3 Groundwater Conditions

Groundwater was observed in all boreholes during drilling. Groundwater level measurement was also taken from a monitoring well installed in Borehole 21-12. However, groundwater level readings taken 21 days after the installation of the well indicated a dry condition.

It should be noted that the groundwater levels and gradient (directional flow) may be influenced by the topography at the project site, and fluctuate because of seasonal changes, periods of precipitation, and temperature, are usually high during spring and summer and low in winter.

6.2.12 DC-6 (Highway 6 Southbound and N-EW Ramp)

A total of five (5) boreholes (Boreholes 21-15, 21-16, 21-19, 21-21, 21-23, and 21-25) were drilled to investigate the subsurface and groundwater conditions beneath this deep cut section, located from Sta. 12+520 to Sta. 12+240 of the proposed widening of Highway 6 and from Sta. 10+170 to Sta. 10+240 of the proposed N-EW Ramp of the Midblock Interchange. The maximum height of the proposed cut within the limits of this deep cut section is approximately 10.5 m.

The subsurface conditions encountered during the site investigation carried out by PML at this site can be categorized into three (3) soil layers. Drawing MBI-15 provides the stratigraphy for this deep cut section. A brief description of the soil layers and groundwater conditions is given below.

6.2.12.1 Topsoil

A surficial layer of topsoil was encountered in all boreholes. The thickness of the topsoil was approximately 200 mm to 500 mm.

6.2.12.2 Fill – Silty sand/Sandy Gravel

Fill consisting of silty sand/sandy gravel was encountered below the topsoil and ground surface in Boreholes 21-21 and 21-25, respectively, drilled near the existing ditch of the southbound lanes of Highway 6. The thickness of the sandy silt/sandy gravel fill ranged from 1.3 m in Borehole 21-21 to 3.8 m in Borehole 21-25, extending to depths of 1.5 m (El. 333.2) to 3.8 m (El. 331.5).

The SPT ‘N’ values within the silty sand fill in Borehole 21-21 ranged from 11 blows/300 mm to 26 blows/300 mm penetration, indicating a compact state of compactness. The SPT ‘N’ values within the sandy gravel fill in Borehole 21-25 ranged from 5 blows/300 mm to 44 blows/300 mm penetration, indicating a loose to dense state of compactness.

The moisture contents of samples from the silty sand fill ranged from 14.3% to 17.0%. The moisture contents of samples from the sandy gravel fill ranged from 4.0% to 5.1%.

The results of the grain size distribution analyses conducted on samples of the silty sand and sandy gravel fill are provided in Figure DC6-GS-1A and DC6-GS-1B, in Appendix C.

6.2.12.3 Silty Sand/Sandy Silt (Till)

Silty sand/Sandy silt till with occasional zones of gravel and 2.0 m to 5.0 m thick sand layers was encountered in all boreholes beneath the topsoil. In Borehole 21-21, a zone of clayey silt was encountered at a depth of 3.8 m (El. 329.6). This silty sand/sandy silt till extended to the full depth of investigations of about 6.6 m (El. 327.8) to 10.1 m (El. 321.3) below existing ground surface.

The SPT 'N' values within the till deposit varied from 3 blows/300 mm in the upper part of Borehole 21-16 to spoon refusal (100 blows/300 mm penetration) in the lower part of many of the boreholes, indicating a compact to very dense state of denseness.

The moisture contents of samples tested from this deposit ranged from 1.3% to 17.7%.

The results of the grain size distribution analyses conducted on representative samples of the till are provided in Figure DC6-GS-2, in Appendix C. The Atterberg limit test results for a sample taken from Borehole 21-21 are presented in Figure DC6-PC-1, in Appendix C.

6.2.12.4 Groundwater Conditions

Groundwater was observed in all boreholes during drilling. Groundwater level was also measured in open boreholes upon completion of drilling. The depths of measured groundwater levels ranged from 2.4 m (El. 332.9) to 8.9 m (328.0) below existing ground surface. Groundwater level measurement was also taken from a monitoring well installed in Borehole 21-21. The stabilized groundwater level taken 11 days after the installation of the well was at 5.1 m (El. 328.3).

It should be noted that the groundwater levels and gradient (directional flow) may be influenced by the topography at the project site, and fluctuate because of seasonal changes, periods of precipitation, and temperature, are usually high during spring and summer and low in winter.

7. CLOSURE

Mr. Frank Meng, EIT, Mr. Vincent Li, EIT, and Mr. Prarthik Joshi carried out the supervision of the fieldwork for this assignment under the direction of Lul Yimam, PhD, P.Eng.

This report was prepared by Lul Yimam, PhD, P. Eng., Senior Engineer and Project Manager, and reviewed by Geoffrey Uwimana, MEng., P.Eng., MTO Designated Principal Contact.

Yours very truly

Peto MacCallum Ltd.

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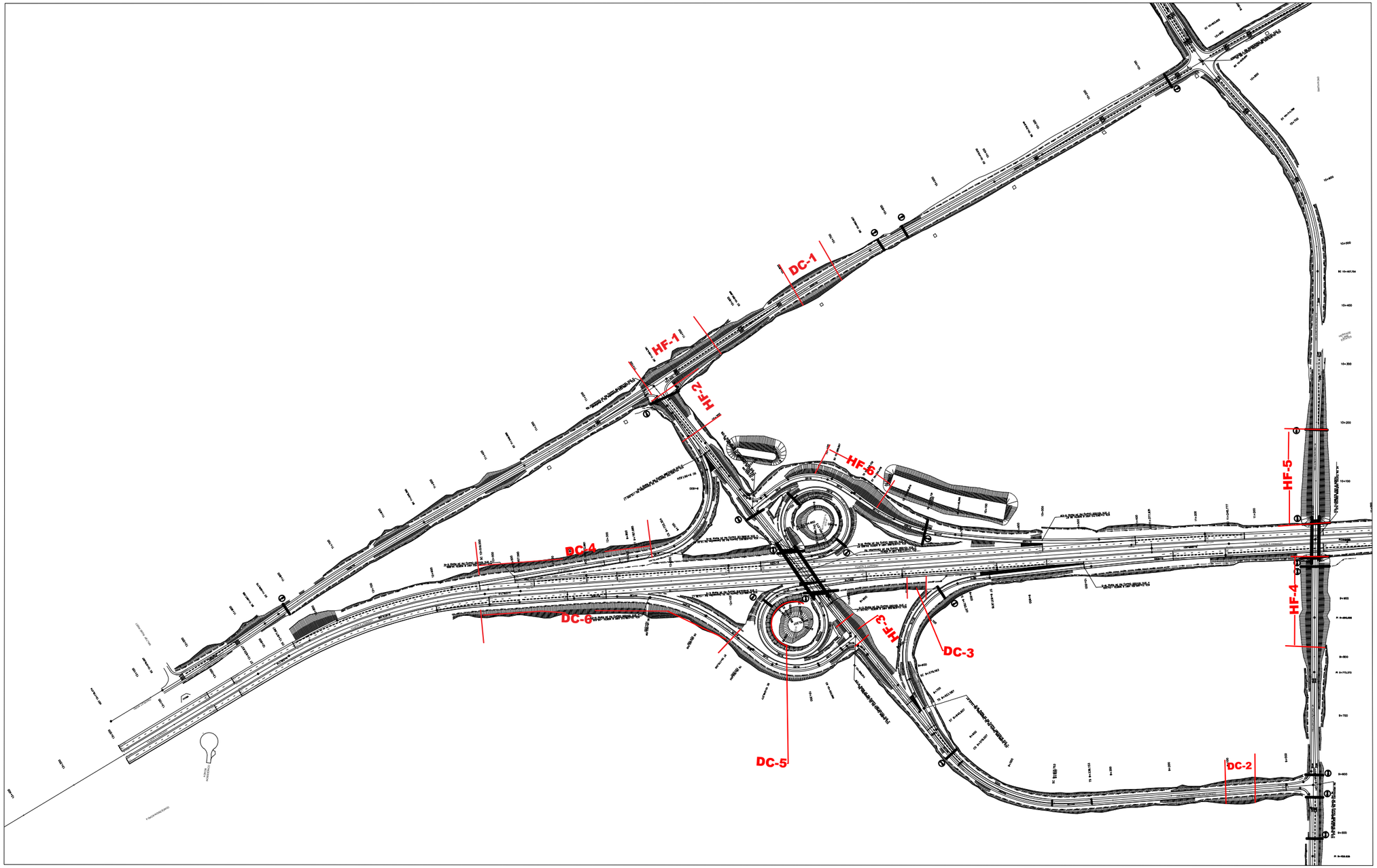

PLAN SCALE 50m 0m 50m 100m

NOTES:

1. THIS DRAWING SHOULD BE READ IN CONJUNCTION WITH THE TEXT OF REPORT AND RECORD OF BOREHOLE LOGS.
2. DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN. STATIONS ARE IN KILOMETRES AND METRES.

GWP No 3059-20-00

Design-Build Ready Alternative Bid Package

Proposed Deep Cut and High Fill Sections

Midblock Interchange Area

Hwy 401& Hwy 6 Improvements

From Hamilton North Limits to Guelph South limits

SHEET

Peto MacCallum Ltd.
CONSULTING ENGINEERS

KEY PLAN
500m 0 500m 1Km 2km

High Fill Areas:

Concession Road 7:
HF-1 - From STN 10+960 to 11+110
Wellington Road 34 Connector Route:
HF-2 - From STN 10+340 to 10+390
HF-3 - From STN 9+850 to 9+890
Wellington Road 34:
HF-4 - From STN 9+820 to 9+970
HF-5 - From STN 10+030 to 10+180
Midblock Interchange:
S-EW Ramp -
HF-6 - From STN 10+290 to 10+420

Deep Cut Areas:

Concession Road 7:
DC-1 - From STN 10+730 to 10+800
Wellington Road 34 Connector Route:
DC-2 - From STN 9+050 to 9+110
Highway 6:
DC-3 - From STN 11+730 to 11+780
DC-4 - From STN 12+180 to 12+520
DC-6 - From STN 12+520 to 12+240
Midblock Interchange:
E-N Ramp -
DC-4- From STN 9+740 to 10+100
E-S Ramp -
DC-5 - From STN 9+790 to 10+000
N-EW Ramp -
DC-6 - From STN 10+170 to 10+240

LICENSED PROFESSIONAL ENGINEER
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100500748
PROVINCE OF ONTARIO
Oct. 08/2021

LICENSED PROFESSIONAL ENGINEER
G. G. UWIMANA
PROVINCE OF ONTARIO
Oct 8, 2021

Reference AECOM Drawing: 01_Wellington Rd._GA.dwg, dated Aug. 2017

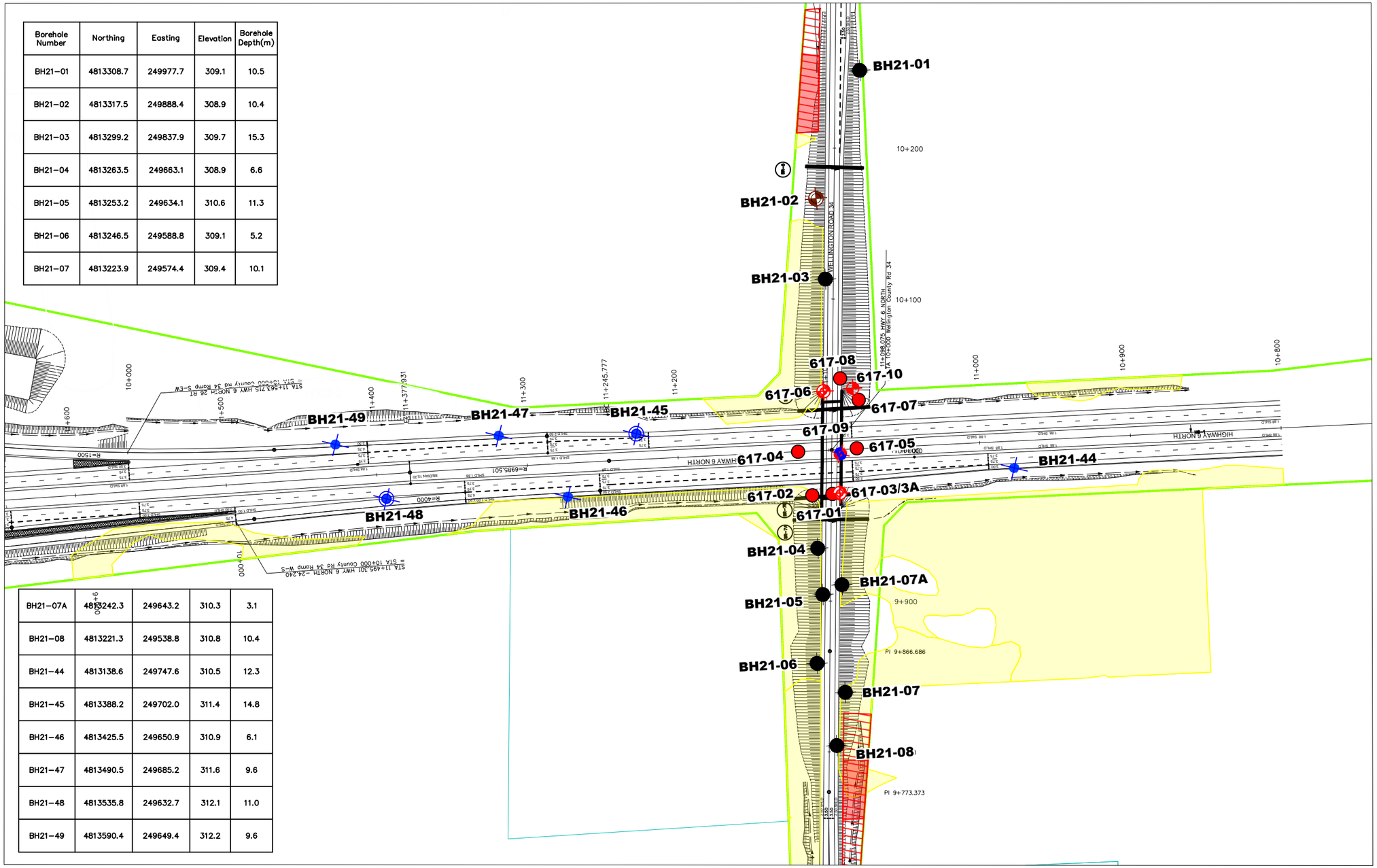
- NOTE -
The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.

REVISIONS	DATE	BY	DESCRIPTION

Geocres No. 40P8-293

HWY No	6					DIST	31
SUBM'D	LY	CHECKED	LY	DATE	Oct 08, 2021	SITE	MBI Area
DRAWN	FM	CHECKED	AC	APPROVED	GU	DWG	MBI-1

Borehole Number	Northing	Easting	Elevation	Borehole Depth(m)
BH21-01	4813308.7	249977.7	309.1	10.5
BH21-02	4813317.5	249888.4	308.9	10.4
BH21-03	4813299.2	249837.9	309.7	15.3
BH21-04	4813263.5	249663.1	308.9	6.6
BH21-05	4813253.2	249634.1	310.6	11.3
BH21-06	4813246.5	249588.8	309.1	5.2
BH21-07	4813223.9	249574.4	309.4	10.1



Borehole Number	Northing	Easting	Elevation	Borehole Depth(m)
BH21-07A	4813242.3	249643.2	310.3	3.1
BH21-08	4813221.3	249538.8	310.8	10.4
BH21-44	4813138.6	249747.6	310.5	12.3
BH21-45	4813388.2	249702.0	311.4	14.8
BH21-46	4813425.5	249650.9	310.9	6.1
BH21-47	4813490.5	249685.2	311.6	9.6
BH21-48	4813535.8	249632.7	312.1	11.0
BH21-49	4813590.4	249649.4	312.2	9.6

100m 0m 100m

PLAN SCALE

NOTES:

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GWP No 3059-20-00
Design-Build Ready Alternative Bid Package
Midblock Interchange Area
Hwy 401& Hwy 6 Improvements
From Hamilton North Limits to Guelph South limits
Borehole Location Plan
SHEET

PML Peto MacCallum Ltd.
CONSULTING ENGINEERS

KEY PLAN
500m 0 500m 1Km 2km

LEGEND

- Foundation Borehole (Deep cut and High Fill)
- Hydrogeology Borehole (with monitoring well)
- Foundation Borehole (Deep Cut and High Fill) with monitoring well
- Foundation Borehole (Structure) with monitoring well (drilled in 2017)
- Foundation Borehole (Structure) with monitoring well
- Foundation Borehole (Structure)
- Hydrogeology Borehole
- Foundation Borehole (Structure) (drilled in 2017)

Borehole Number	Northing	Easting	Elevation	Borehole Depth(m)
617-01	4813256.6	249692.1	310.3	9.8
617-02	4813273.5	249693.4	309.0	19.8
617-03	4813252.4	249699.1	309.1	13.4
617-03A	4813254.4	249700.0	309.1	9.1
617-04	4813289.0	249721.7	311.0	13.3
617-05	4813247.8	249734.0	311.0	18.2
617-06	4813287.4	249756.7	308.7	17.4
617-07	4813255.2	249765.1	308.8	11.6
617-08	4813273.1	249774.5	309.5	9.8
617-09	4813257.1	249721.4	311.2	18.3
617-10	4813257.5	249767.4	309.3	14.6

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Oct. 08/2021
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G. G. UWIMANA
Oct 8, 2021
PROVINCE OF ONTARIO

– NOTE –
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REVISIONS		
DATE	BY	DESCRIPTION

Geocres No. 40P8 – 293

HWY No	6					DIST	31
SUBM'D	LY	CHECKED	LY	DATE	Oct 08, 2021	SITE	MBI Area
DRAWN	FM	CHECKED	AC	APPROVED	GU	DWG	MBI-2

Reference AECOM Drawing: 01_Wellington Rd._GA.dwg, dated Aug. 2017

GWP No 3059-20-00

Design-Build Ready Alternative Bid Package

Midblock Interchange Area

Hwy 401& Hwy 6 Improvements

From Hamilton North Limits to Guelph South limits

Borehole Location Plan

SHEET

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LEGEND

- Foundation Borehole (Deep Cut and High Fill)
- Foundation Borehole (Deep Cut and High Fill) with monitoring well
- Hydrogeology Borehole (with monitoring well)
- Foundation Borehole (Structure) with monitoring well(drilled in 2017)
- Foundation Borehole (Structure)
- Foundation Borehole (Structure) with monitoring well
- Foundation Borehole (Structure) (drilled in 2017)

Borehole Number	Northing	Easting	Elevation	Borehole Depth(m)
618-01	4814069.0	249441.2	328.1	9.8
618-02	4814088.5	249438.0	328.0	34.8
618-03A	4814062.3	249445.5	328.0	13.3
618-03B	4814061.4	249444.5	328.0	14.7
618-04	4814119.6	249471.6	322.3	20.5
618-05	4814093.6	249479.6	321.5	25.0
618-06	4814143.6	249487.0	323.3	25.9
618-07	4814145.9	249520.1	328.2	10.5
618-08	4814138.6	249508.2	328.5	34.5
618-09	4814155.2	249503.6	329.7	29.9

Borehole Number	Notthing	Easting	Elevation	Borehole Depth(m)
BH21-12	4814135.0	249363.0	329.1	9.8
BH21-13	4814150.3	249412.1	330.5	9.3
BH21-14	4814060.5	249385.1	328.9	10.2
BH21-15	4814162.2	249327.3	334.4	6.6
BH21-16	4814238.0	249369.2	331.4	10.1
BH21-17	4814216.1	249484.3	330.6	9.8
BH21-18	4814385.2	249433.1	336.8	5.4
BH21-19	4814358.6	249353.7	336.9	10.1
BH21-20	4814472.4	249424.5	338.6	9.8
BH21-21	4814451.1	249347.6	333.4	7.9
BH21-22	4814552.0	249380.8	339.2	9.8
BH21-23	4814519.6	249299.5	342.6	10.1
BH21-26	4814192.4	249610.9	329.9	10.5
BH21-27	4814102.5	249623.5	324.0	10.4
BH21-28	4813971.7	249606.3	320.5	8.2
BH21-29	4813886.6	249519.8	316.5	10.4
BH21-30	4813948.9	249478.3	321.9	10.5
BH21-31	4814028.5	249474.5	320.2	10.4
BH21-32	4814013.2	249379.2	325.6	7.7
BH21-33	4813935.1	249354.5	326.9	10.4
BH21-34	4814370.6	249707.8	321.5	4.4
BH21-50	4814100.9	249556.2	324.6	7.7
BH21-51	4814111.5	249385.4	325.5	11.3

100m 0m 100m

PLAN SCALE

NOTES:

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LICENSED PROFESSIONAL ENGINEER
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100500748
Oct. 08/2021
PROVINCE OF ONTARIO

LICENSED PROFESSIONAL ENGINEER
G. G. UWIMANA
PROVINCE OF ONTARIO

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REVISIONS		
DATE	BY	DESCRIPTION

Geocres No. 40P8 – 293

HWY No	6					DIST	31
SUBM'D	LY	CHECKED	LY	DATE	Oct 08, 2021	SITE	MBI Area
DRAWN	FM	CHECKED	AC	APPROVED	GU	DWG	MBI-3

Reference AECOM Drawing: 01_Wellington Rd._GA.dwg, dated Aug. 2017

GWP No 3059-20-00

Design-Build Ready Alternative Bid Package

Midblock Interchange Area

Hwy 401& Hwy 6 Improvements

From Hamilton North Limits to Guelph South limits

Borehole Location Plan

SHEET

Peto MacCallum Ltd.
CONSULTING ENGINEERS

KEY PLAN

500m 0 500m 1Km 2km

LEGEND

- Foundation Borehole (Deep Cut and High Fill)
- Foundation Borehole (Deep Cut and High Fill) with monitoring well

Borehole Number	Northing	Easting	Elevation	Borehole Depth(m)
BH21-18	4814385.2	249433.1	336.8	5.4
BH21-19	4814358.6	249353.7	336.9	10.1
BH21-20	4814472.4	249424.5	338.6	9.8
BH21-21	4814451.1	249347.6	333.4	7.9
BH21-22	4814552.0	249380.8	339.2	9.8
BH21-23	4814519.6	249299.5	342.6	10.1
BH21-24	4814618.2	249342.6	335.8	10.4
BH21-25	4814637.2	249288.2	335.3	8.2
BH21-34	4814370.6	249707.8	321.5	4.4
BH21-35	4814396.6	249722.2	321.7	10.5
BH21-36	4814435.7	249720.9	325.1	3.6

100m 0m 100m

PLAN SCALE

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LICENSED PROFESSIONAL ENGINEER
L. A. YIMAM
100500748
Oct. 08/2021
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G. G. UWIMANA
Oct 8, 2021
PROVINCE OF ONTARIO

Reference AECOM Drawing: 01_Wellington Rd._GA.dwg, dated Aug. 2017

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REVISIONS			
DATE	BY	DESCRIPTION	

Geocres No. 40P8 – 293

HWY No	6			DIST	31
SUBM'D	LY	CHECKED LY	DATE Oct 08, 2021	SITE	MBI Area
DRAWN	FM	CHECKED AC	APPROVED GU	DWG	MBI-4

GWP No 3059-20-00

Design-Build Ready Alternative Bid Package

Midblock Interchange Area

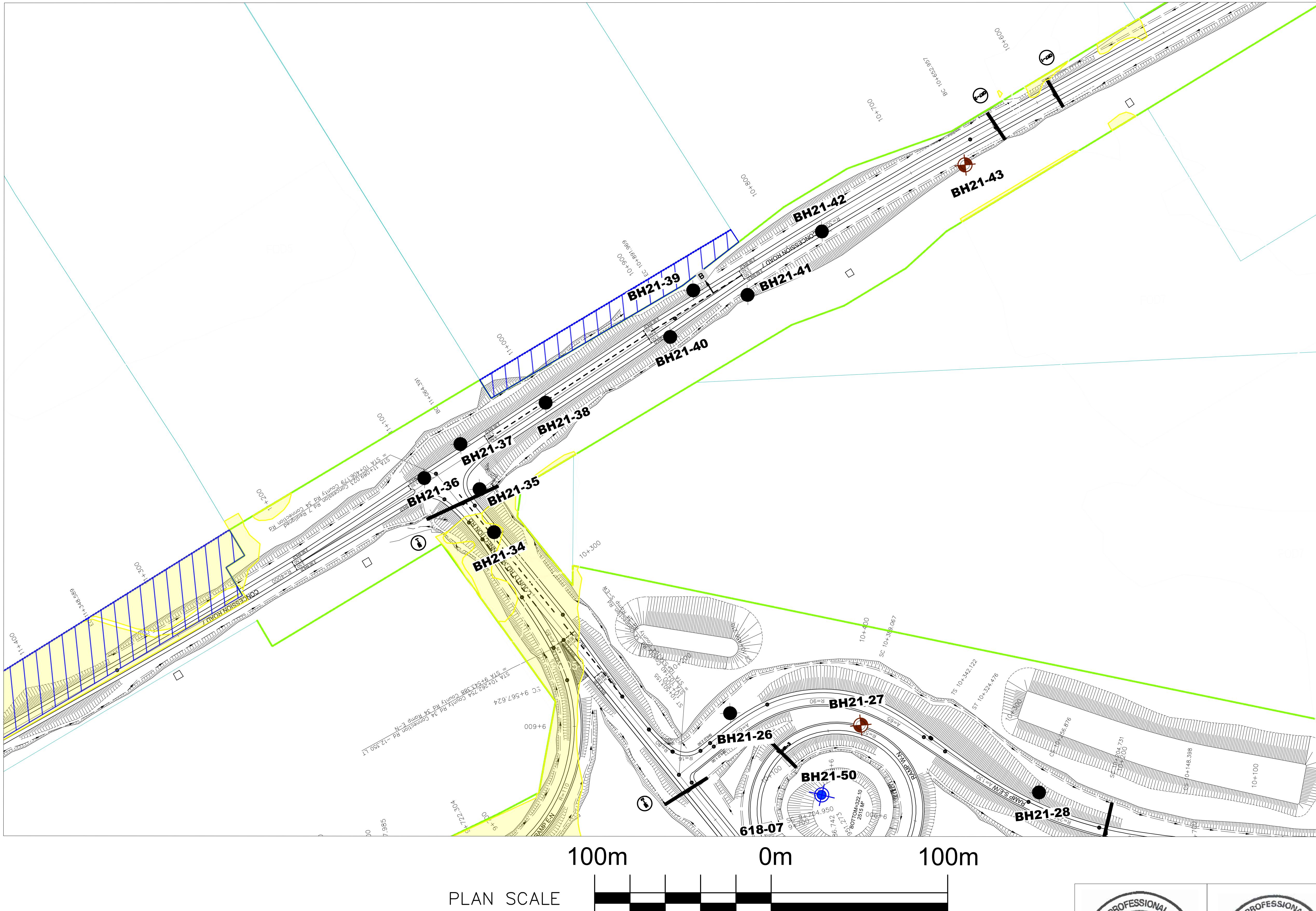
Hwy 401& Hwy 6 Improvements

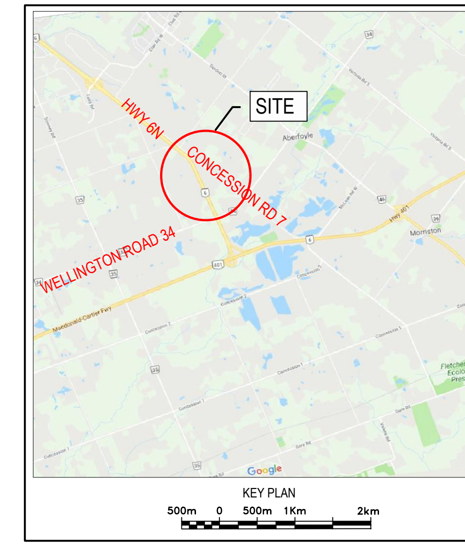
From Hamilton North Limits to Guelph South limits

Borehole Location Plan

SHEET

PML Peto MacCallum Ltd. CONSULTING ENGINEERS





LEGEND

- Foundation Borehole (Deep Cut and High Fill)
- Hydrogeology Borehole (with monitoring well)
- Foundation Borehole (Deep Cut and High Fill) with monitoring well

Borehole Number	Northing	Easting	Elevation	Borehole Depth(m)
BH21-26	4814192.4	249610.9	329.9	10.5
BH21-27	4814102.5	249623.5	324.0	10.4
BH21-28	4813971.7	249606.3	320.5	8.2
BH21-34	4814370.6	249707.8	321.5	4.4
BH21-35	4814396.6	249722.2	321.7	10.5
BH21-36	4814435.7	249720.9	325.1	3.6
BH21-37	4814416.7	249749.6	321.1	9.2
BH21-38	4814365.8	249790.9	319.7	9.7
BH21-39	4814284.1	249889.9	318.0	10.5
BH21-40	4814292.3	249854.9	318.5	9.8
BH21-41	4814246.8	249895.5	319.2	3.7
BH21-42	4814206.7	249950.0	321.1	10.0
BH21-43	4814120.8	250017.4	312.4	7.0
BH21-50	4814100.9	249556.2	324.6	7.7

NOTES:

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LICENSED PROFESSIONAL ENGINEER — L. A. YIMAM — 100500748 — Oct. 08/2021 — PROVINCE OF ONTARIO

LICENSED PROFESSIONAL ENGINEER — G. G. UWIMANA — PROVINCE OF ONTARIO

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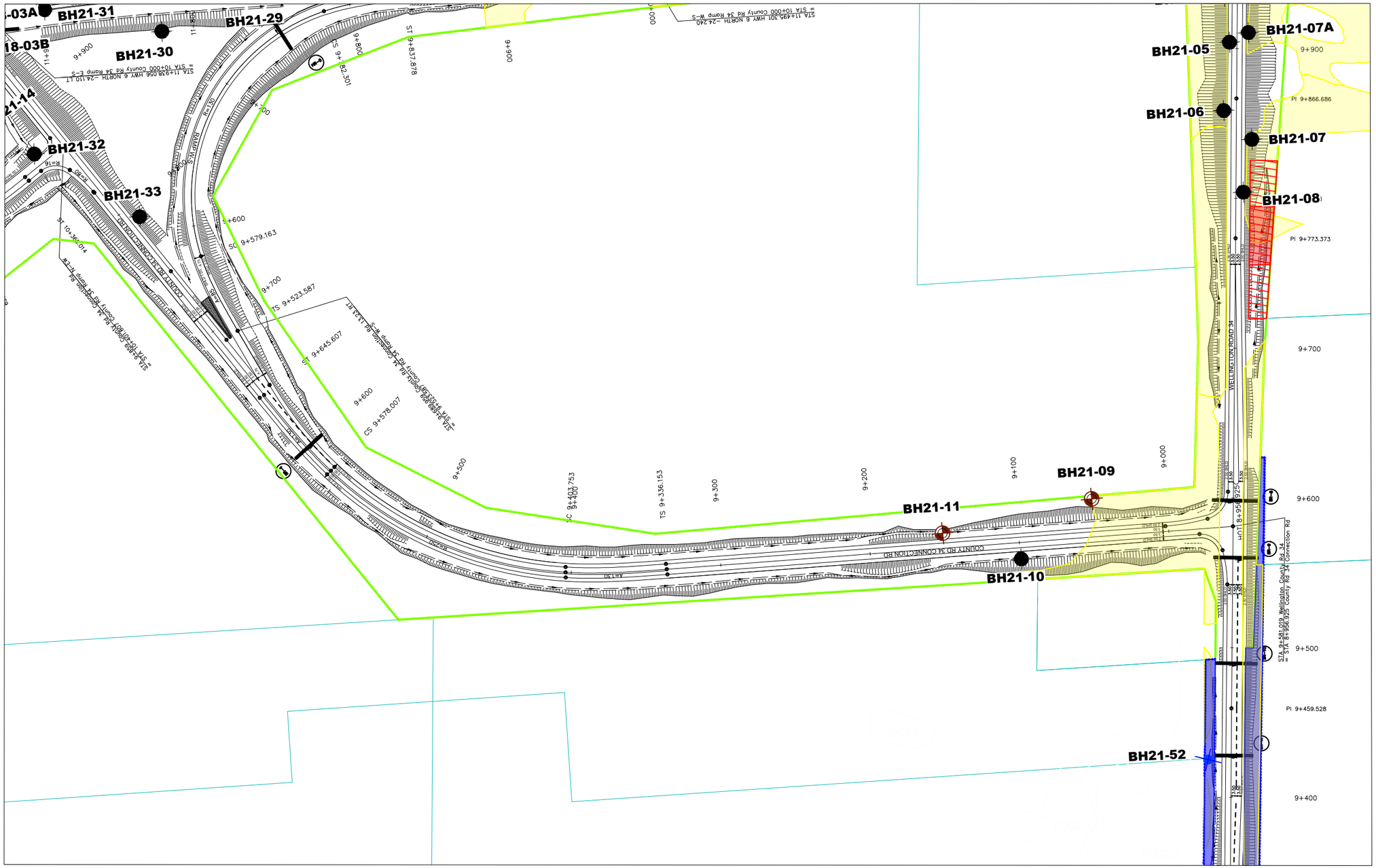
REVISIONS	DATE	BY	DESCRIPTION

Geocres No. 40P8 – 293

HWY No 6			DIST 31
SUBM'D LY	CHECKED LY	DATE Oct 08, 2021	SITE MBI Area
DRAWN FM	CHECKED AC	APPROVED GU	DWG MBI-5

Reference AECOM Drawing: 01_Wellington Rd._GA.dwg, dated Aug. 2017



100m 0m 100m

PLAN SCALE

NOTES:

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Midblock Interchange Area
Hwy 401& Hwy 6 Improvements
From Hamilton North Limits to Guelph South limits
Borehole Location Plan
SHEET

PML Peto MacCallum Ltd.
CONSULTING ENGINEERS

KEY PLAN
500m 0 500m 1Km 2km

LEGEND

- Foundation Borehole (Deep Cut and High Fill)
- Hydrogeology Borehole (with monitoring well)
- Foundation Borehole (Deep Cut and High Fill) with monitoring well

Borehole Number	Northing	Easting	Elevation	Borehole Depth(m)
BH21-05	2413253.2	249634.1	310.6	11.3
BH21-06	4813246.5	249588.8	309.1	5.2
BH21-07	4813223.9	249574.4	309.4	10.1
BH21-07A	4813242.3	249643.2	310.3	3.1
BH21-08	4813221.3	249538.8	310.8	10.4
BH21-09	4813274.1	249319.2	315.6	5.9
BH21-10	4813309.7	249266.4	316.6	10.5
BH21-11	4813364.8	249271.1	313.0	9.1
BH21-52	4813149.7	249165.5	310.9	11.1

LICENSED PROFESSIONAL ENGINEER
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100500748
Oct. 08/2021
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REVISIONS			
DATE	BY	DESCRIPTION	

Geocres No. 40P8 – 293

HWY No.	6			DIST	31
SUBM'D	LY	CHECKED LY	DATE Oct 08, 2021	SITE	MBI Area
DRAWN	FM	CHECKED AC	APPROVED GU	DWG	MBI-6

Reference AECOM Drawing: 01_Wellington Rd._GA.dwg, dated Aug. 2017

CADD FILE NAME:

BLDG. REF. No.

FILE: 18KF037A

SHEET No.

NOTES & REFERENCES

NOTES:

1. THE BOUNDARIES BETWEEN SOIL STRATA HAVE BEEN ESTABLISHED ONLY AT BOREHOLE LOCATIONS. BETWEEN BOREHOLES THE BOUNDARIES ARE ASSUMED FROM GEOLOGICAL EVIDENCES.
2. COORDINATES AND GROUND SURFACE ELEVATIONS AT THE DRILLED BOREHOLE LOCATIONS WERE SURVEYED AND PROVIDED BY CALLON DIETZ, VIA E-MAIL DATED AUGUST, 2021.

REFERENCES:

THESE DRAWINGS WERE REPRODUCED FROM THE COMPOSITE OF BELOW MENTIONED DRAWINGS RECEIVED FROM ***AECOM CANADA LIMITED***:

1. Hwy6_MidBlock_plan.dwg
2. X-Property_Updated.dwg
3. xs_ConRd7_Realign.dwg
4. xs_County Rd 34 Connection Rd.dwg
5. xs_County Rd 34 Ramp E-N.dwg
6. xs_County Rd 34 Ramp E-S.dwg
7. xs_County Rd 34 Ramp N-EW.dwg
8. xs_County Rd 34 Ramp S-EW.dwg
9. xs_County Rd 34 Ramp W-N.dwg
10. xs_County Rd 34 Ramp W-S.dwg
11. xs_Driveways.dwg
12. xs_Hwy6N.dwg
13. xs_Wellington County Rd 34.dwg

LEGEND

- FOUNDATION BOREHOLE (DEEP CUT AND HIGH FILL)
- FOUNDATION BOREHOLE (DEEP CUT AND HIGH FILL) WITH MONITORING WELL
- FOUNDATION BOREHOLE (DEEP CUT AND HIGH FILL) WITH DCPT
- HYDROGEOLOGY BOREHOLE
- HYDROGEOLOGY BOREHOLE WITH MONITORING WELL
- DCPT — BLOWS / 0.3m (60 Cone, 475 J/blow)
- N — BLOWS / 0.3 m (STANDARD PENETRATION TEST, 475 J/BLOW)
- GROUNDWATER LEVEL OBSERVED DURING DRILLING
- GROUNDWATER LEVEL MEASURED UPON COMPLETION OF DRILLING
- GROUNDWATER LEVEL MEASURED IN MONITORING WELL
- * — WATER LEVEL COULD NOT BE ESTABLISHED
- DRY — WATER LEVEL NOT ENCOUNTERED UPON COMPLETION OF DRILLING

MONITORING WELL WITH MONUMENT CASING
Bentonite Seal
Filter Sand
PVC Screen

BOREHOLE LOCATION COORDINATES & ELEVATIONS

Borehole Number	Northing	Easting	Elevation (m)	Borehole Depth (m)
High Fill Section 1 (HF-1)				
BH21-36	4 814 435.7	249 720.9	325.1	3.6
BH21-37	4 814 416.6	249 749.5	321.1	9.2
BH21-38	4 814 365.8	249 790.9	319.7	9.7
BH21-39	4 814 284.1	249 890.0	318.0	10.5
BH21-40	4 814 292.2	249 855.0	318.5	9.8
High Fill Section 2 (HF-2)				
BH21-34	4 814 370.6	249 707.7	321.5	4.4
BH21-35	4 814 396.6	249 722.2	321.7	10.5
High Fill Section 3 (HF-3)				
BH21-32	4 814 013.2	249 379.1	325.6	7.7
BH21-33	4 813 935.0	249 354.4	326.9	10.4
High Fill Section 4 (HF-4)				
35-617-1	4 813 256.6	249 692.1	310.3	9.8
35-617-2	4 813 273.5	249 693.4	309.0	19.8
35-617-3	4 813 252.4	249 699.1	309.1	13.4
35-617-03A	4 813 254.4	249 700.0	309.1	9.1
BH21-04	4 813 263.4	249 663.1	308.9	6.6
BH21-05	4 813 253.1	249 634.0	310.6	11.3
BH21-06	4 813 246.4	249 588.7	309.1	5.2
BH21-07	4 813 223.8	249 574.3	309.4	10.1
BH21-07A	4 813 242.3	249 643.2	310.3	3.1
BH21-08	4 813 221.2	249 538.7	310.8	10.4
High Fill Section 5 (HF-5)				
35-617-06	4 813 287.4	249 756.7	308.7	17.4
35-617-07	4 813 255.2	249 765.1	308.8	11.6
35-617-08	4 813 273.1	249 774.5	309.5	9.8
35-617-10	4 813 257.5	249 767.4	309.3	14.6
BH21-01	4 813 308.7	249 977.7	309.1	10.5
BH21-02	4 813 317.5	249 888.4	308.9	10.4
BH21-03	4 813 299.2	249 837.9	309.7	15.3
High Fill Section 6 (HF-6)				
BH21-26	4 814 192.3	249 610.8	329.9	10.5
BH21-27	4 814 102.4	249 623.4	324.0	10.4
BH21-28	4 813 971.7	249 606.3	320.5	8.2

Borehole Number	Northing	Easting	Elevation (m)	Borehole Depth (m)
Deep Cut Section 1 (DC-1)				
BH21-41	4 814 246.8	249 895.4	319.2	3.7
BH21-42	4 814 206.7	249 950.0	321.1	10.0
BH21-43	4 814 120.7	250 017.4	312.4	7.0
Deep Cut Section 2 (DC-2)				
BH21-09	4 813 274.1	249 319.2	315.6	5.9
BH21-10	4 813 309.7	249 266.4	316.6	10.5
BH21-11	4 813 364.7	249 271.1	313.0	9.1
Deep Cut Section 3 (DC-3)				
BH21-29	4 813 886.6	249 519.8	316.5	10.4
BH21-30	4 813 948.9	249 478.3	321.9	10.5
BH21-31	4 814 028.5	249 474.4	320.2	10.4
Deep Cut Section 4 (DC-4)				
BH21-17	4 814 216.1	249 484.3	330.6	9.8
BH21-18	4 814 385.2	249 433.1	336.8	5.4
BH21-20	4 814 472.4	249 424.4	338.6	9.8
BH21-22	4 814 552.0	249 380.7	339.1	9.8
BH21-24	4 814 618.2	249 342.6	335.8	10.4
Deep Cut Section 5 (DC-5)				
BH21-12	4 814 135.0	249 363.0	329.1	9.8
BH21-13	4 814 150.2	249 412.0	330.5	9.3
BH21-14	4 814 060.4	249 385.0	328.9	10.2
Deep Cut Section 6 (DC-6)				
BH21-15	4 814 162.2	249 327.3	334.4	6.6
BH21-16	4 814 238.0	249 369.2	331.4	10.1
BH21-19	4 814 358.6	249 353.7	336.9	10.1
BH21-21	4 814 451.0	249 347.6	333.4	7.9
BH21-23	4 814 519.5	249 299.5	342.6	10.1
BH21-25	4 814 637.2	249 288.2	335.3	8.2

DRAWING No.

REVISIONS	REVISIONS	DRAWING
		SCALE (HORIZ) / SCALE (VERT)

Peto MacCallum Ltd. CONSULTING ENGINEERS

LICENSED PROFESSIONAL ENGINEER L. A. YIMAM 100500748 OCT. 05/2021 PROVINCE OF ONTARIO

LICENSED PROFESSIONAL ENGINEER G. G. UWIMANA PROVINCE OF ONTARIO

GEOCRES NO. 40P8 - 293
DRAWN NLS
CHECKED LY
APPROVED GU

NOTES & REFERENCES, LEGEND, AND BOREHOLE LOCATIONS AND ELEVATIONS

MIDBLOCK INTERCHAGE AREA
HIGHWAY 401 AND HIGHWAY 6 IMPROVEMENTS
GWP No. 3059-20-00

Plot Date: 10/08/2021

Ontario

Dwg. No. MBI-7

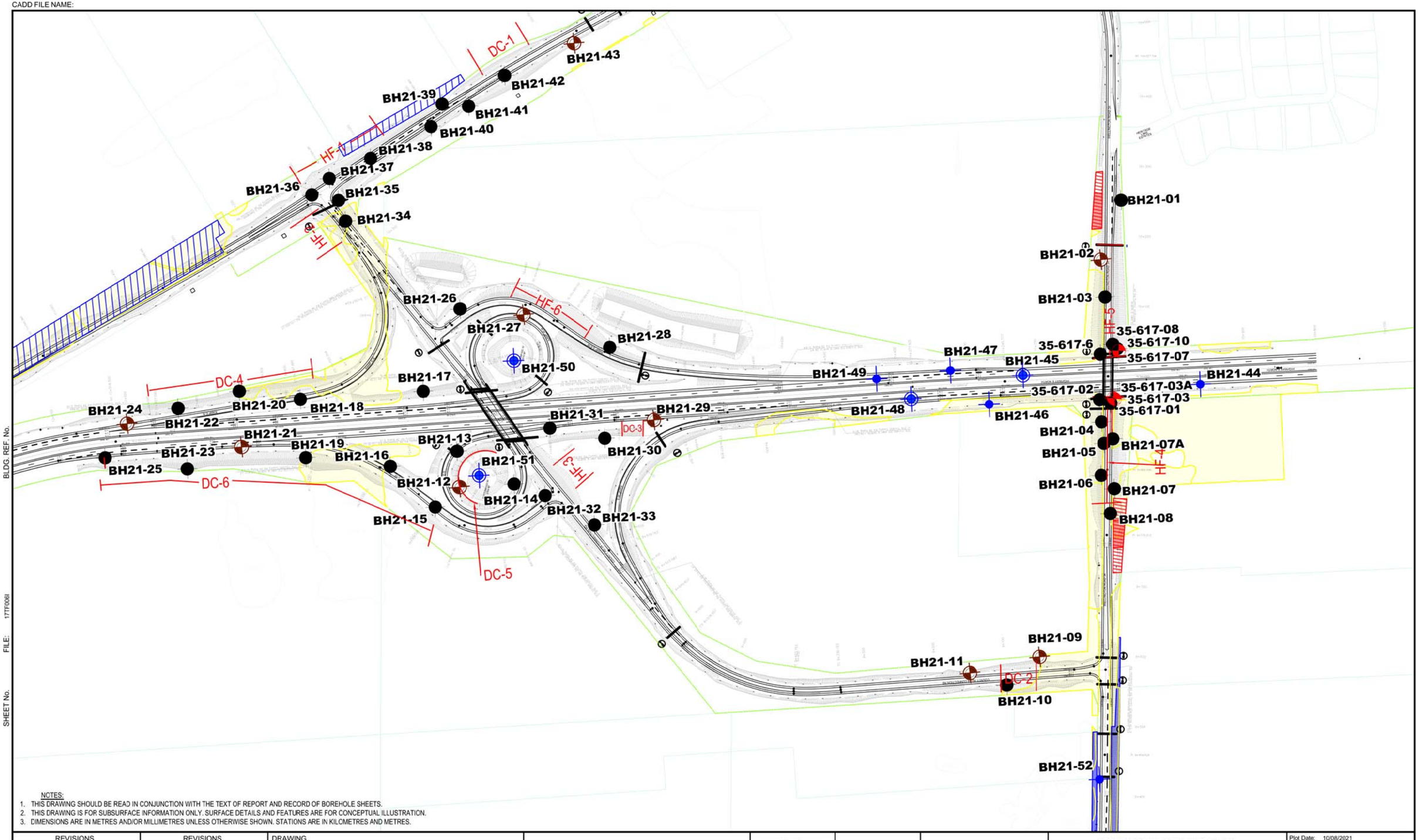
Sheet No.

CADD FILE NAME:

BLDG. REF. No.

FILE: 17TF006I

SHEET No.



NOTES:
1. THIS DRAWING SHOULD BE READ IN CONJUNCTION WITH THE TEXT OF REPORT AND RECORD OF BOREHOLE SHEETS.
2. THIS DRAWING IS FOR SUBSURFACE INFORMATION ONLY. SURFACE DETAILS AND FEATURES ARE FOR CONCEPTUAL ILLUSTRATION.
3. DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN. STATIONS ARE IN KILOMETRES AND METRES.

DRAWING No.

REVISIONS	REVISIONS	DRAWING
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		SCALE (HORIZ) 25m 0 25 50 75 100m SCALE (VERT) 25m 0 25 50 75 100m

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LICENSED PROFESSIONAL ENGINEER L. A. YIMAM 100500748 OCA-05/2021 PROVINCE OF ONTARIO

LICENSED PROFESSIONAL ENGINEER G. G. UWIMANA PROVINCE OF ONTARIO

GEOCRES NO. 40P8 -- 293
DRAWN NLS
CHECKED LY
APPROVED GU

BOREHOLE LOCATION PLAN

MIDBLOCK INTERCHAGE AREA
HIGHWAY 401 AND HIGHWAY 6 IMPROVEMENTS
GWP No. 3059-20-00

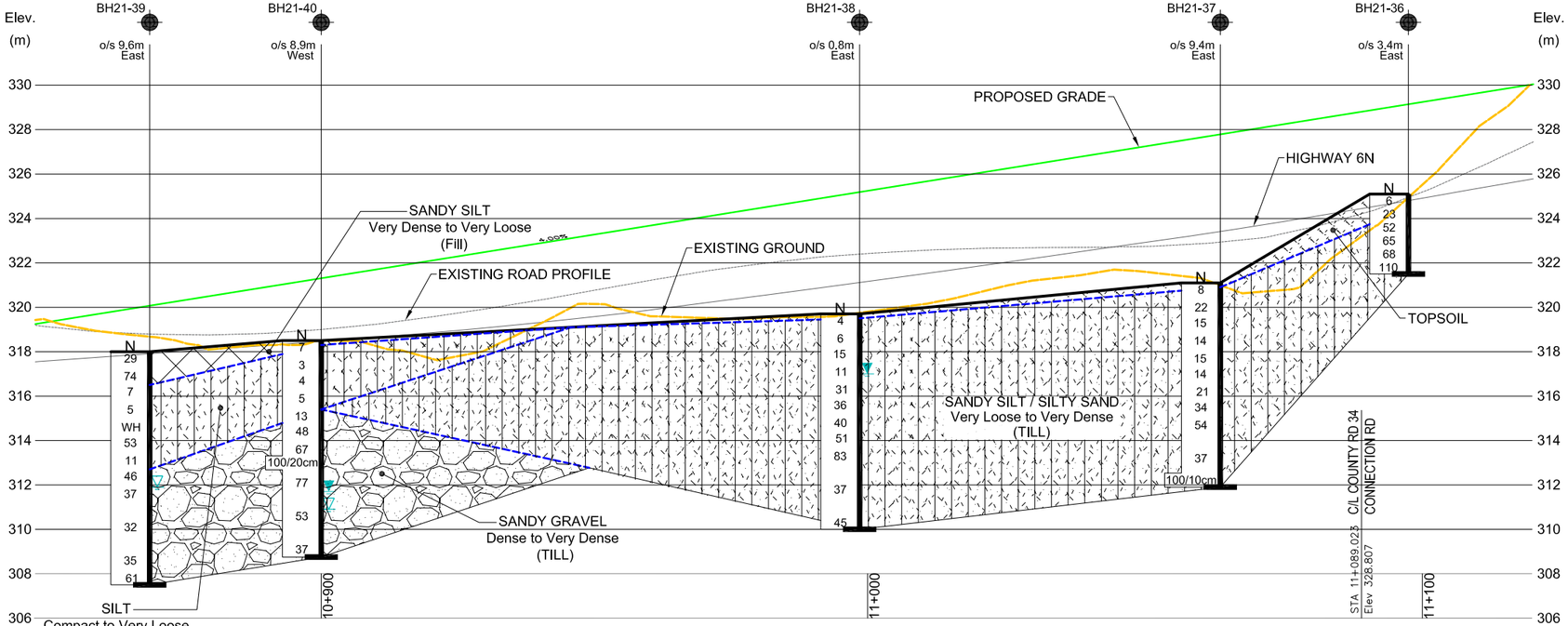
Plot Date: 10/08/2021

Ontario

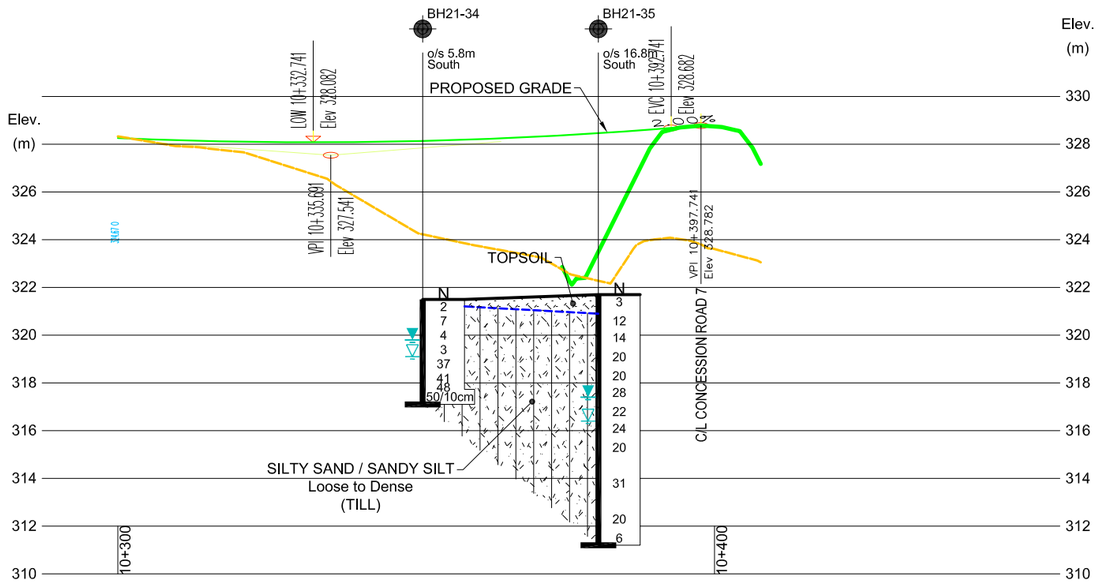
Dwg. No. MBI-8

Sheet No.

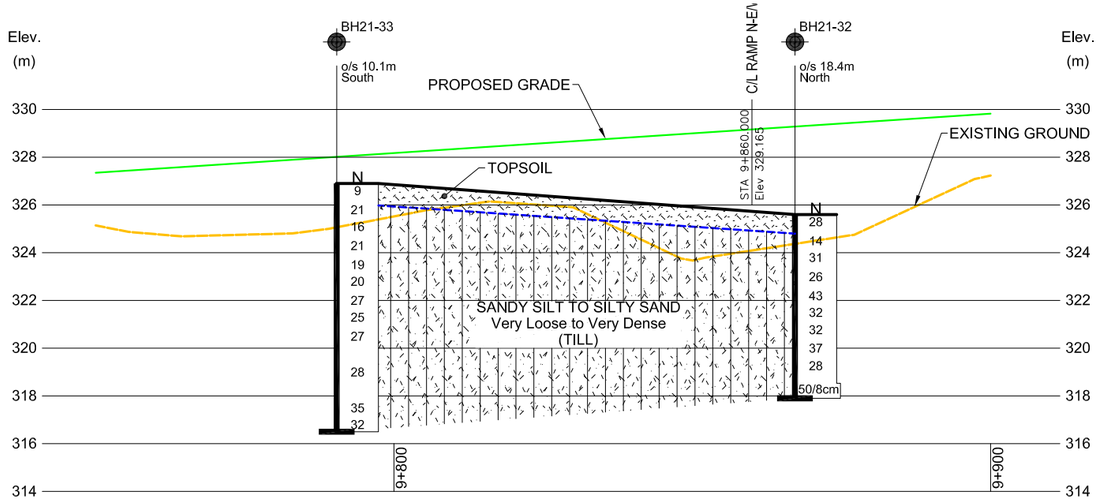
CADD FILE NAME:



HF-1 PROFILE ALONG C/L OF PROPOSED CONCESSION ROAD 7 ALIGNMENT



HF-2 PROFILE ALONG C/L OF PROPOSED WELLINGTON ROAD 34
CONNECTOR ROAD ALIGNMENT



HF-3 PROFILE ALONG C/L OF PROPOSED WELLINGTON ROAD 34
CONNECTOR ROAD ALIGNMENT

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BLDG. REF. No.
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		SCALE (VERT) 1m 0 1 2 3 4 5m

Peto MacCallum Ltd. CONSULTING ENGINEERS

L. A. YIMAM 100500748 OCT. 05/2021 PROVINCE OF ONTARIO

G. G. UWIMANA PROVINCE OF ONTARIO

GEOCRES NO. 40P8 - 293
DRAWN NLS
CHECKED LY
APPROVED GU

SOIL STRATIGRAPHIC PROFILES
HIGH FILL SECTIONS

MIDBLOCK INTERCHAGE AREA
HIGHWAY 401 AND HIGHWAY 6 IMPROVEMENTS
GWP No. 3059-20-00

Plot Date: 10/08/2021

Ontario

Dwg. No. MBI-9

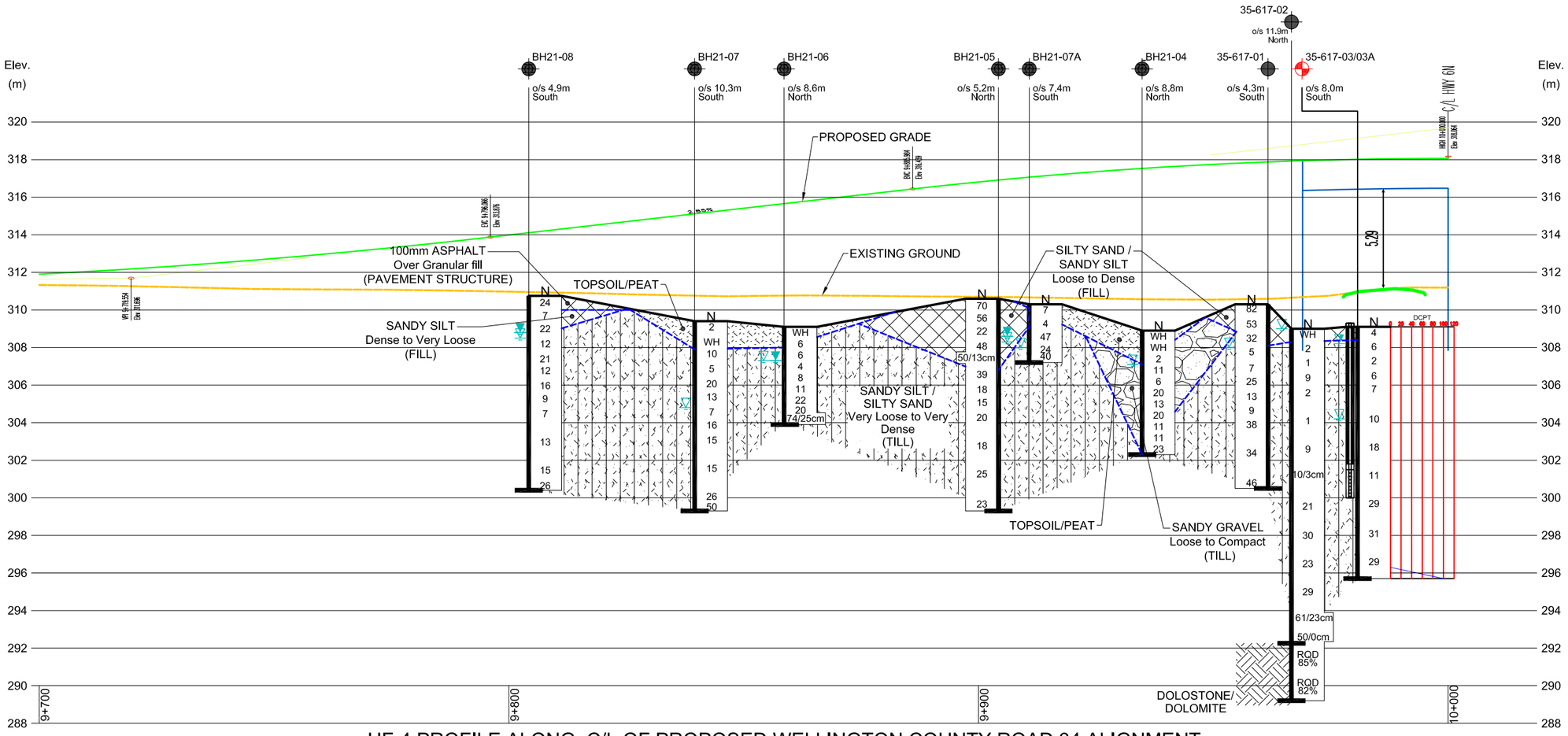
Sheet No.

CADD FILE NAME:

BLDG. REF. No.

FILE: 17TF0068

SHEET No.



HF-4 PROFILE ALONG C/L OF PROPOSED WELLINGTON COUNTY ROAD 34 ALIGNMENT

NOTES:
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DRAWING No.

REVISIONS	REVISIONS	DRAWING
		Reference AECOM Ltd. Drawing: Hwy6_MidBlock_plan.dwg
		SCALE (HORIZ) 25m 0 25 50 75 100m — SCALE (VERT) 1m 0 1 2 3 4 5m

Peto MacCallum Ltd. CONSULTING ENGINEERS

LICENSED PROFESSIONAL ENGINEER L. A. YIMAM 100500748 OCT. 05/2021 PROVINCE OF ONTARIO

LICENSED PROFESSIONAL ENGINEER G. G. UWIMANA OCT. 8, 2021 PROVINCE OF ONTARIO

GEOCRES NO. 40P8 - 293
DRAWN NLS
CHECKED LY
APPROVED GU

SOIL STRATIGRAPHIC PROFILES
HIGH FILL SECTIONS

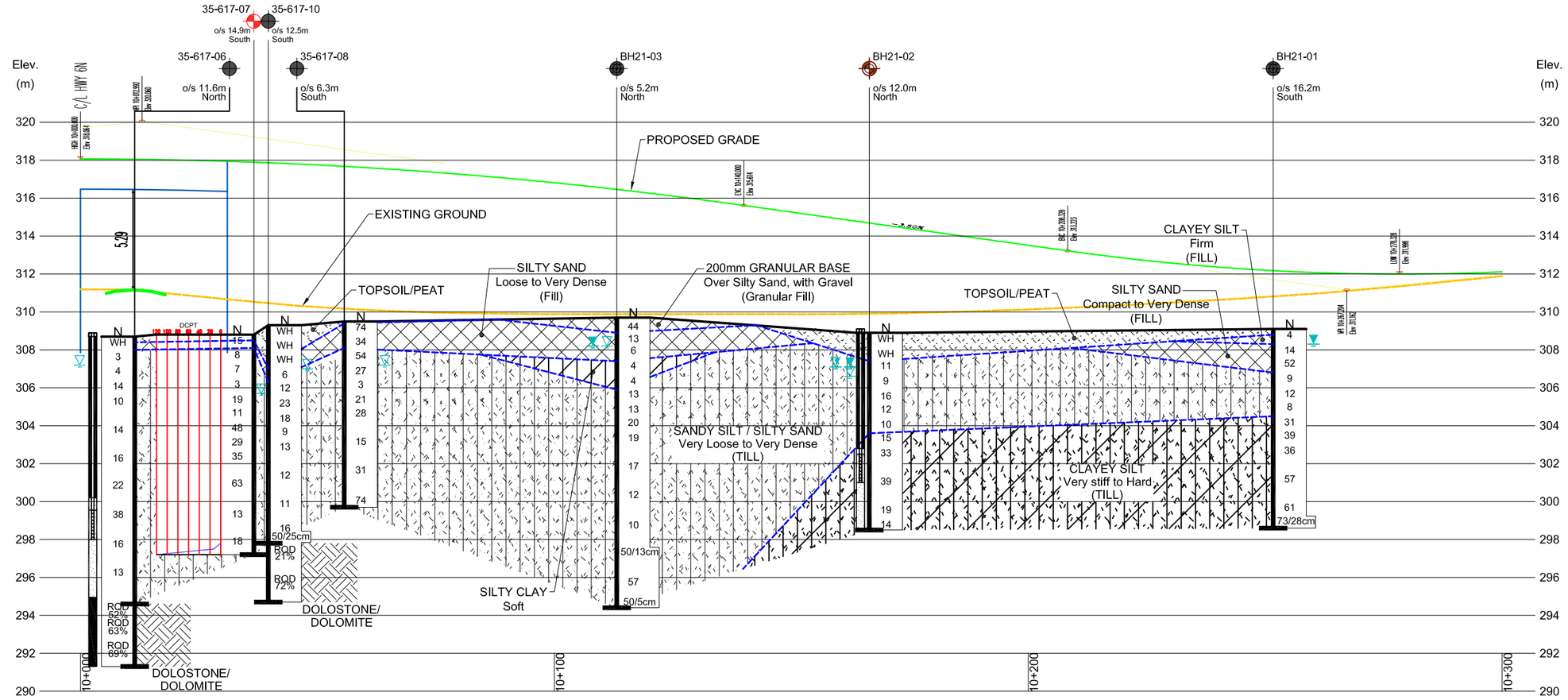
MIDBLOCK INTERCHAGE AREA
HIGHWAY 401 AND HIGHWAY 6 IMPROVEMENTS
GWP No. 3059-20-00

Plot Date: 10/08/2021

Ontario

Dwg. No.	Sheet No.
MBI-10	

CADD FILE NAME:



HF-5 PROFILE ALONG C/L OF PROPOSED WELLINGTON COUNTY ROAD 34 ALIGNMENT

NOTES:

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BLDG. REF. No.
FILE: 17TF008
SHEET No.
DRAWING No.

REVISIONS	REVISIONS	DRAWING
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		SCALE (VERT) 1m 0 1 2 3 4 5m

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LICENSED PROFESSIONAL ENGINEER G. G. UWIMANA OCT 8, 2021 PROVINCE OF ONTARIO

GEOCRES NO. 40P8 - 293
DRAWN NLS
CHECKED LY
APPROVED GU

SOIL STRATIGRAPHIC PROFILES
HIGH FILL SECTIONS

MIDBLOCK INTERCHAGE AREA
HIGHWAY 401 AND HIGHWAY 6 IMPROVEMENTS
GWP No. 3059-20-00

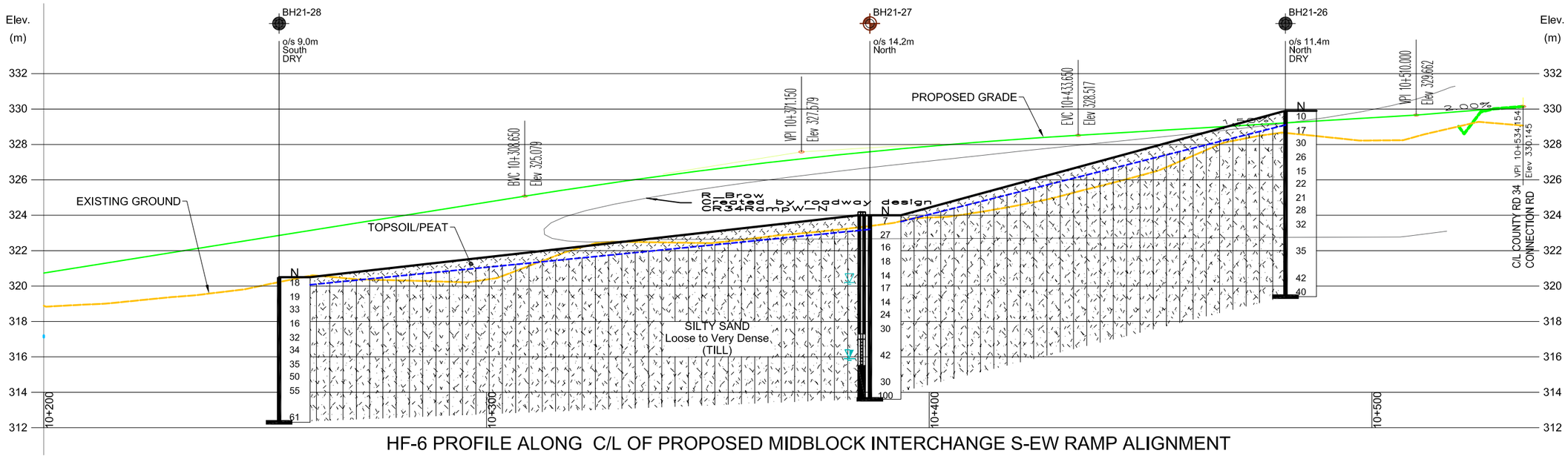
Plot Date: 10/08/2021

Ontario

Dwg. No. MBI-11

Sheet No.

CADD FILE NAME:



HF-6 PROFILE ALONG C/L OF PROPOSED MIDBLOCK INTERCHANGE S-EW RAMP ALIGNMENT

NOTES:
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BLDG. REF. No.
FILE: 17TF0084
SHEET No.
DRAWING No.

REVISIONS	REVISIONS	DRAWING
		Reference AECOM Ltd. Drawing: Hwy6_MidBlock_plan.dwg
		SCALE (HORIZ) 25m 0 25 50 75 100m
		SCALE (VERT) 1m 0 1 2 3 4 5m

Peto MacCallum Ltd. CONSULTING ENGINEERS

LICENSED PROFESSIONAL ENGINEER L. A. YIMAM 100500748 OCT. 05/2021 PROVINCE OF ONTARIO

LICENSED PROFESSIONAL ENGINEER G. G. UWIMANA OCT. 8, 2021 PROVINCE OF ONTARIO

GEOCRES NO. 40P8 - 293
DRAWN NLS
CHECKED LY
APPROVED GU

SOIL STRATIGRAPHIC PROFILES
HIGH FILL SECTIONS

MIDBLOCK INTERCHAGE AREA
HIGHWAY 401 AND HIGHWAY 6 IMPROVEMENTS
GWP No. 3059-20-00

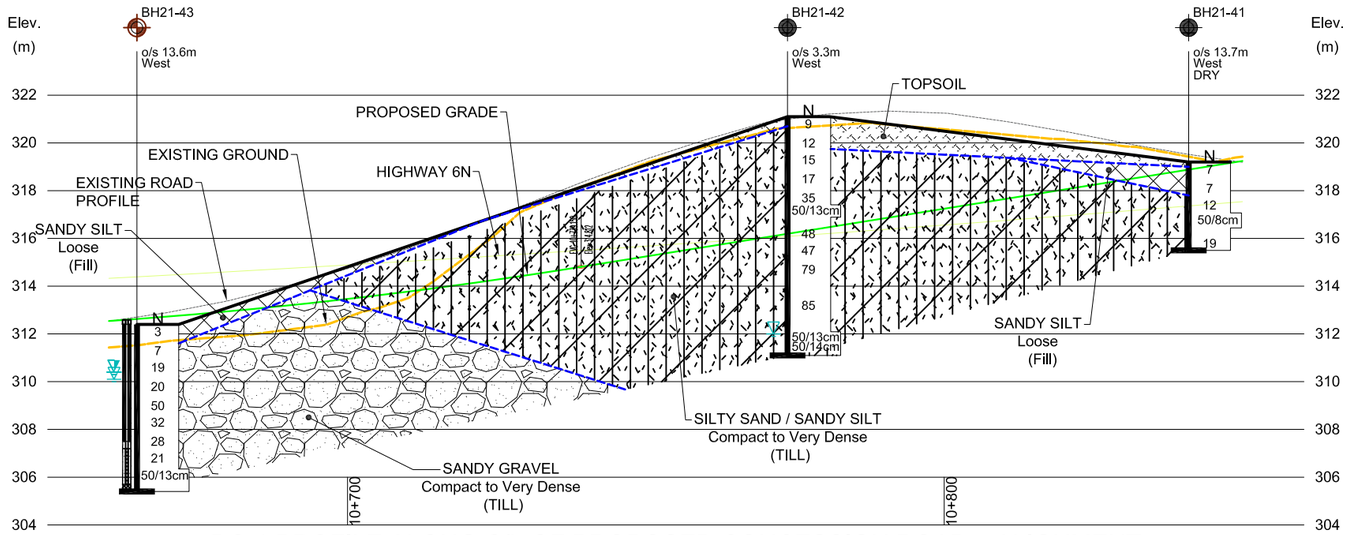
Plot Date: 10/08/2021

Ontario

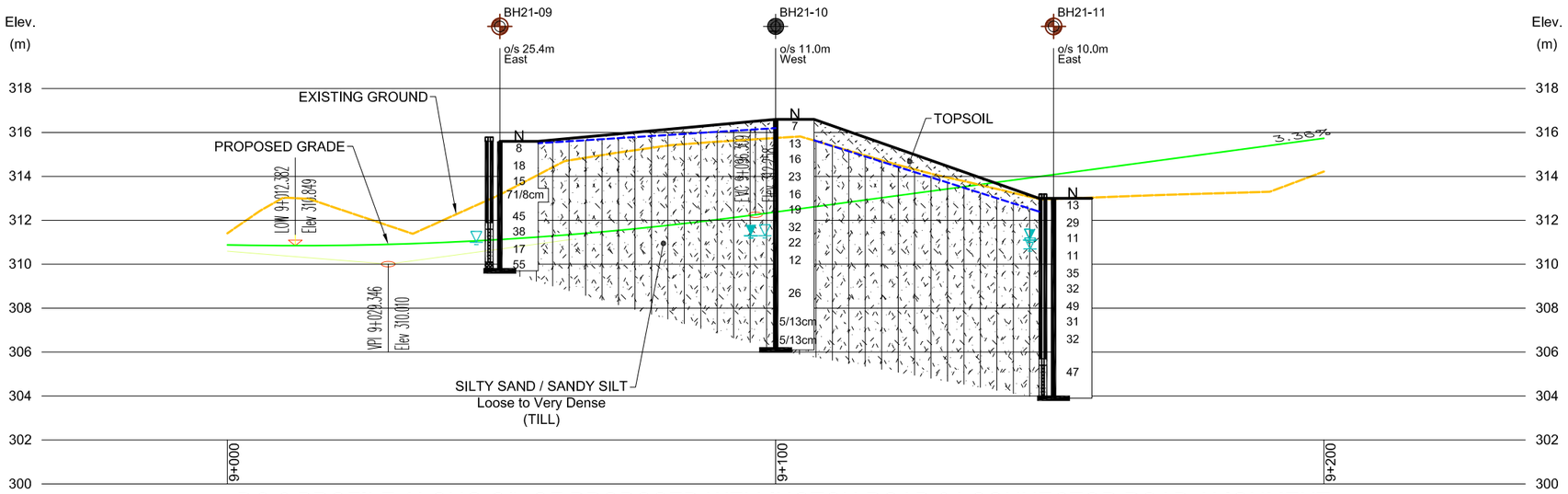
Dwg. No. MBI-12

Sheet No.

CADD FILE NAME:



DC-1 PROFILE ALONG C/L OF PROPOSED CONCESSION ROAD 7 ALIGNMENT



DC-2 PROFILE ALONG C/L OF PROPOSED WELLINGTON ROAD 34 CONNECTOR ROAD ALIGNMENT

NOTES:
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BLDG. REF. No.
FILE: 177FF0084
SHEET No.
DRAWING No.

REVISIONS	REVISIONS	DRAWING
		Reference AECOM Ltd. Drawing: Hwy6_MidBlock_plan.dwg
		SCALE (HORIZ) 25m 0 25 50 75 100m — SCALE (VERT) 1m 0 1 2 3 4 5m

Peto MacCallum Ltd. CONSULTING ENGINEERS

LICENSED PROFESSIONAL ENGINEER L. A. YIMAM 100500748 OCT. 05/2021 PROVINCE OF ONTARIO

LICENSED PROFESSIONAL ENGINEER G. G. UWIMANA PROVINCE OF ONTARIO

GEOCRES NO. 40P8 - 293
DRAWN NLS
CHECKED LY
APPROVED GU

SOIL STRATIGRAPHIC PROFILES
DEEP CUT SECTIONS

MIDBLOCK INTERCHAGE AREA
HIGHWAY 401 AND HIGHWAY 6 IMPROVEMENTS
GWP No. 3059-20-00

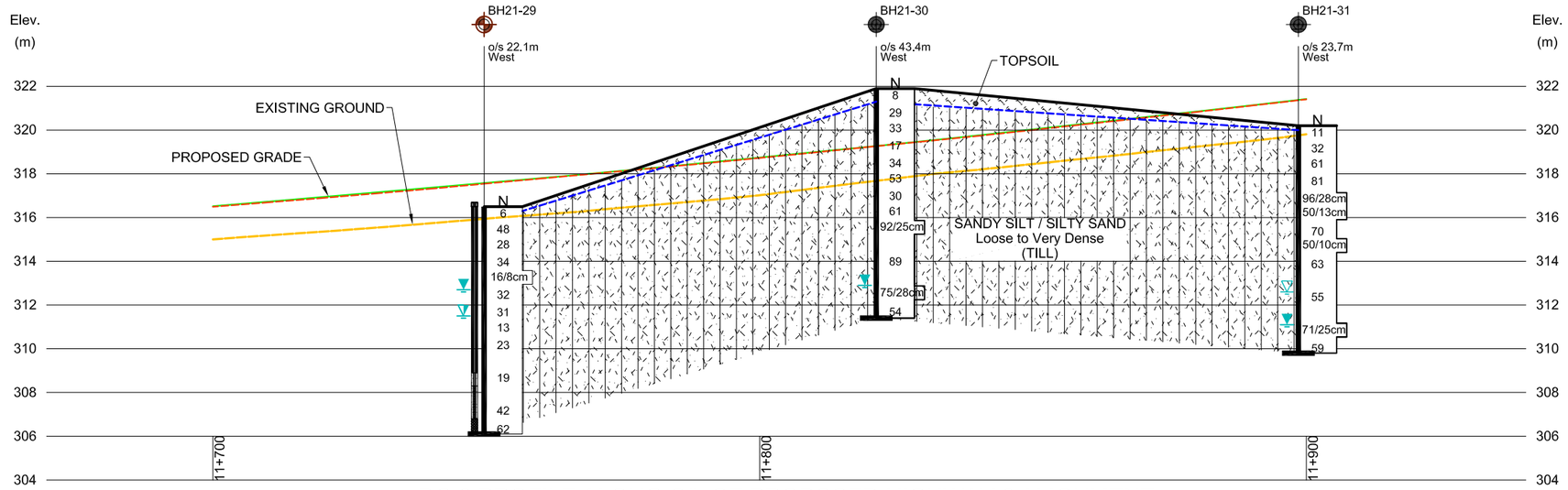
Plot Date: 10/08/2021

Ontario

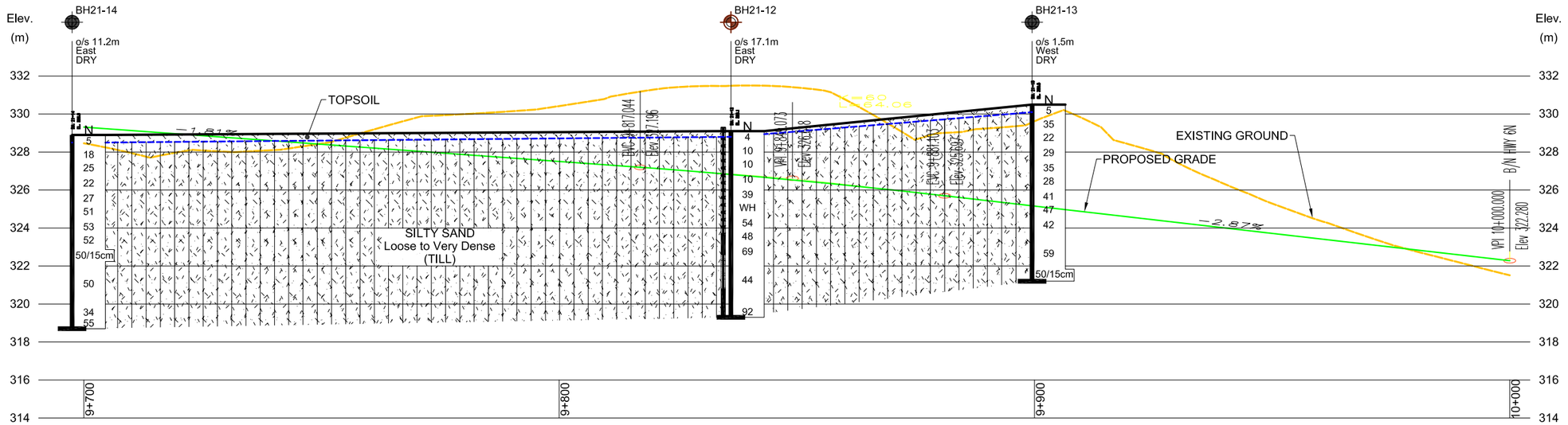
Dwg. No. MBI-13

Sheet No.

CADD FILE NAME:



DC-3 PROFILE ALONG C/L OF PROPOSED HIGHWAY 6 ALIGNMENT



DC-5 PROFILE ALONG C/L OF PROPOSED MIDBLOCK INTERCHANGE E-S RAMP ALIGNMENT

NOTES:
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BLDG. REF. FILE: 17TF0068 SHEET No.

REVISIONS	REVISIONS	DRAWING
		Reference AECOM Ltd. Drawing: Hwy6_MidBlock_plan.dwg
		SCALE (HORIZ) 25m 0 25 50 75 100m — SCALE (VERT) 1m 0 1 2 3 4 5m

DRAWING No.

Peto MacCallum Ltd. CONSULTING ENGINEERS

L. A. YIMAM 100500748 OCT-05/2021 PROVINCE OF ONTARIO

G. G. UWIMANA PROVINCE OF ONTARIO

GEOCRES NO. 40P8 - 293
DRAWN NLS
CHECKED LY
APPROVED GU

SOIL STRATIGRAPHIC PROFILES
DEEP CUT SECTIONS

MIDBLOCK INTERCHAGE AREA
HIGHWAY 401 AND HIGHWAY 6 IMPROVEMENTS
GWP No. 3059-20-00

Plot Date: 10/08/2021

Ontario

Dwg. No. MBI-14 | Sheet No.

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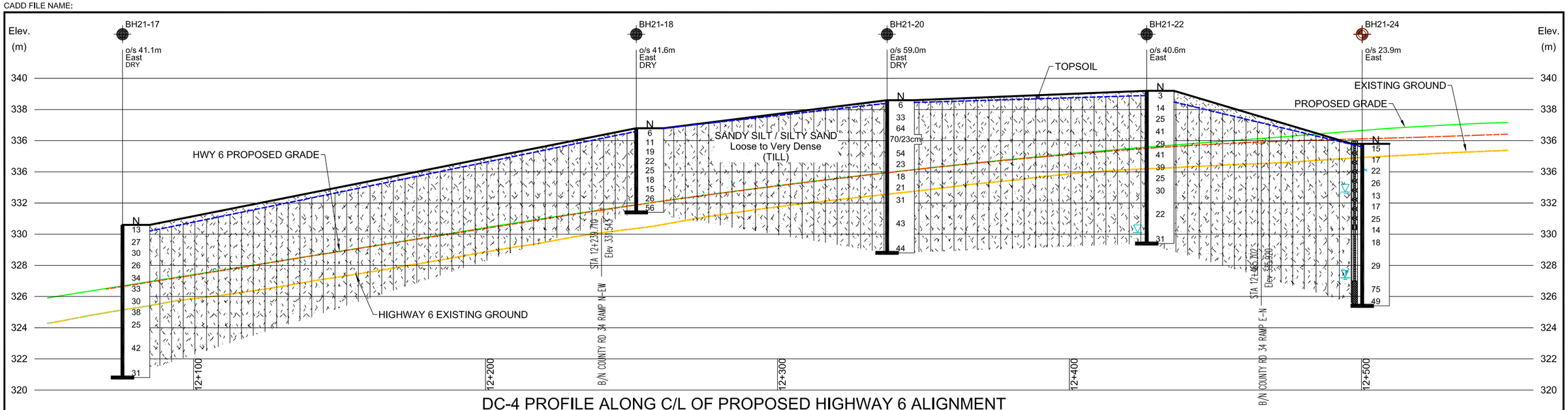
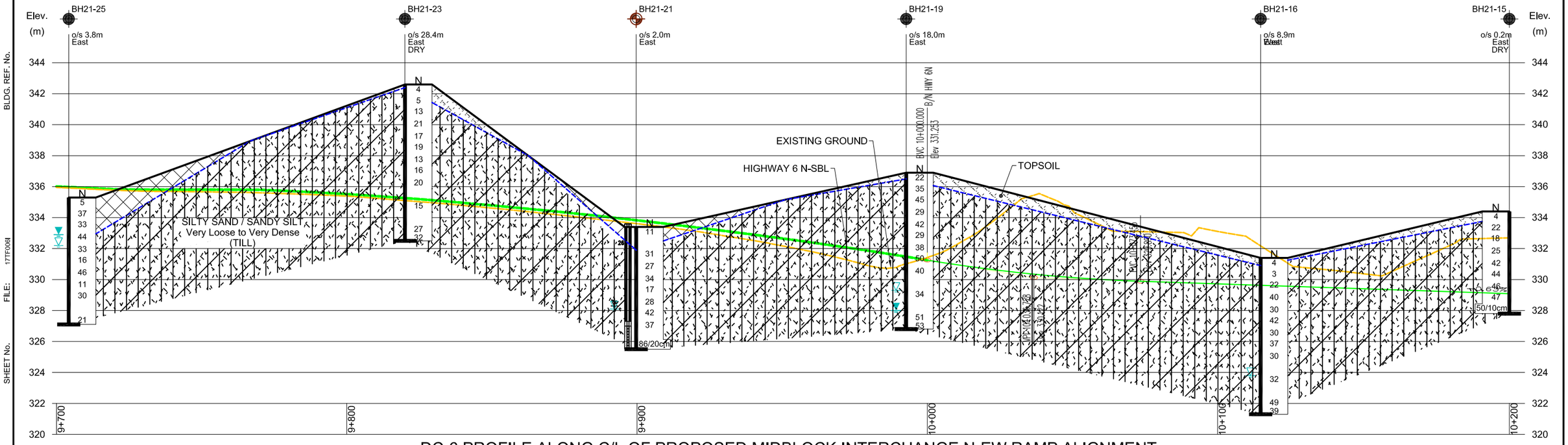


DC-4 PROFILE ALONG C/L OF PROPOSED HIGHWAY 6 ALIGNMENT



DC-6 PROFILE ALONG C/L OF PROPOSED MIDBLOCK INTERCHANGE N-EW RAMP ALIGNMENT

NOTES:
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BLDG. REF. No.
FILE: 177FF0084
SHEET No.
DRAWING No.

REVISIONS	REVISIONS	DRAWING
		Reference AECOM Ltd. Drawing: Hwy6_MidBlock_plan.dwg
		SCALE (HORIZ) 25m 0 25 50 75 100m
		SCALE (VERT) 1m 0 1 2 3 4 5m

Peto MacCallum Ltd. CONSULTING ENGINEERS

LICENSED PROFESSIONAL ENGINEER L. A. YIMAM 100500748 OCT. 05/2021 PROVINCE OF ONTARIO

LICENSED PROFESSIONAL ENGINEER G. G. UWIMANA PROVINCE OF ONTARIO

GEOCRES NO. 40P8 - 293
DRAWN NLS
CHECKED LY
APPROVED GU

SOIL STRATIGRAPHIC PROFILES
DEEP CUT SECTIONS

MIDBLOCK INTERCHAGE AREA
HIGHWAY 401 AND HIGHWAY 6 IMPROVEMENTS
GWP No. 3059-20-00

Plot Date: 10/08/2021

Ontario

Dwg. No. MBI-15

Sheet No.

APPENDIX A

Site Photographs

Photograph 1 - The Location of Borehole 21-01 - Looking East

Photograph 2 - The Location of Borehole 21-02 - Looking East

Photograph 3 - Drilling at Borehole 21-03 - Looking West

Photograph 4 - Manual Drilling at Borehole 21-06

Photograph 5 - Drilling at the Location of Borehole 21-07

Photograph 6 - The Location Borehole 21-08

Photograph 7 - Borehole 21-19 at the Top of the Cut Slope

Photograph 8 - The Location of Borehole 21-20

Photograph 9 - The Location of Borehole 21-22

Photograph10 - Borehole 21-23 on Top of a Cut Slope

Photograph 11- The Location of Borehole 21-24

Photograph 12 - The Location of Borehole 21-26

Photograph 13 - The Location of Borehole 21-33

Photograph 14 - Manual Drilling at Borehole 21-34

Photograph 15 - Manual Drilling and Borehole 21-36

Photograph 16 - Drilling at Borehole 21-40

Photograph 17 - The Location of Borehole 21-41

Photograph 18 - Borehole 21-43 After the Installation of Monitoring Well

APPENDIX B

Explanation of Terms Used on Boreholes and in the Report

Record of Borehole Sheets

EXPLANATION OF TERMS USED IN REPORT

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

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

SOILS ARE DESCRIBED BY THEIR COMPOSITION AND CONSISTENCY OR DENSENESS.

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

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

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

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

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

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

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

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

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

RQD (%)	0 - 25	25 - 50	50 - 75	75 - 90	90 - 100
	VERY POOR	*POOR*	*FAIR*	*GOOD*	*EXCELLENT*

JOINTING AND BEDDING:

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

ABBREVIATIONS AND SYMBOLS

FIELD SAMPLING

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

STRESS AND STRAIN

u_w	kPa	PORE WATER PRESSURE
r_u	1	PORE PRESSURE RATIO
σ	kPa	TOTAL NORMAL STRESS
σ'	kPa	EFFECTIVE NORMAL STRESS
τ	kPa	SHEAR STRESS
$\sigma_1, \sigma_2, \sigma_3$	kPa	PRINCIPAL STRESSES
ϵ	%	LINEAR STRAIN
$\epsilon_1, \epsilon_2, \epsilon_3$	%	PRINCIPAL STRAINS
E	kPa	MODULUS OF LINEAR DEFORMATION
G	kPa	MODULUS OF SHEAR DEFORMATION
μ	1	COEFFICIENT OF FRICTION

MECHANICAL PROPERTIES OF SOIL

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

PHYSICAL PROPERTIES OF SOIL

ρ_s	kg/m^3	DENSITY OF SOLID PARTICLES
γ_s	kN/m^3	UNIT WEIGHT OF SOLID PARTICLES
ρ_w	kg/m^3	DENSITY OF WATER
γ_w	kN/m^3	UNIT WEIGHT OF WATER
ρ	kg/m^3	DENSITY OF SOIL
γ	kN/m^3	UNIT WEIGHT OF SOIL
ρ_d	kg/m^3	DENSITY OF DRY SOIL
γ_d	kN/m^3	UNIT WEIGHT OF DRY SOIL
ρ_{sat}	kg/m^3	DENSITY OF SATURATED SOIL
γ_{sat}	kN/m^3	UNIT WEIGHT OF SATURATED SOIL
ρ'	kg/m^3	DENSITY OF SUBMERGED SOIL
γ'	kN/m^3	UNIT WEIGHT OF SUBMERGED SOIL
e	1,%	VOID RATIO
n	1,%	POROSITY
w	1,%	WATER CONTENT
S_r	%	DEGREE OF SATURATION
w_L	%	LIQUID LIMIT
w_P	%	PLASTIC LIMIT
w_S	%	SHRINKAGE LIMIT
I_P	%	PLASTICITY INDEX = $w_L - w_P$
I_L	1	LIQUIDITY INDEX = $\frac{w - w_P}{I_P}$
I_C	1	CONSISTENCY INDEX = $\frac{w_L - w}{I_P}$
DTPL		DRIER THAN PLASTIC LIMIT
APL		ABOUT PLASTIC LIMIT
WTPL		WETTER THAN PLASTIC LIMIT
e_{max}	1,%	VOID RATIO IN LOOSEST STATE
e_{min}	1,%	VOID RATIO IN DENSEST STATE
I_D	1	DENSITY INDEX = $\frac{e_{max} - e}{e_{max} - e_{min}}$
D	mm	GRAIN DIAMETER
D_n	mm	n PERCENT - DIAMETER
C_U	1	UNIFORMITY COEFFICIENT
h	m	HYDRAULIC HEAD OR POTENTIAL
q	m^3/s	RATE OF DISCHARGE
v	m/s	DISCHARGE VELOCITY
i	1	HYDRAULIC GRADIENT
k	m/s	HYDRAULIC CONDUCTIVITY
j	kN/m^3	SEEPAGE FORCE

RECORD OF BOREHOLE No 21-01

1 OF 1

METRIC

G.W.P. 3059-20-00 LOCATION COORDS: 4 813 308.7 N; 249 977.7 E ORIGINATED BY P.J.

DIST 31 HWY 6 BOREHOLE TYPE Solid Stem Augers COMPILED BY L.Y.

DATUM Geodetic DATE 2021.07.22 LATITUDE 43.457682 LONGITUDE -80.177445 CHECKED BY G.U.

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
309.1	GROUND SURFACE						309				
308.9 / 0.2	TOPSOIL										
	CLAYEY SILT, some sand, trace gravel Firm, Brown, Moist		1	SS	4	▼			○		
	SILTY SAND, gravelly Compact to very dense, Brown, Moist (FILL)		2	SS	14		308		○		
			3	SS	52				○		
306.8 / 2.3	SILTY SAND/SANDY SILT, gravelly Loose to compact, Brown, Moist (TILL)		4	SS	9		307		⊣		
			5	SS	12		306		○		
			6	SS	8		305		○		
304.5 / 4.6	CLAYEY SILT, trace sand, trace gravel Hard, Brown, Moist (TILL)		7	SS	31		304		○		0 2 76 22
			8	SS	39		303		○		
			9	SS	36				○		
			10	SS	57		302		○		
			11	SS	61		301		○		
			12	SS	73/28cm		300		⊣		
298.6 / 10.5	End of borehole						299				

▼ Groundwater level measured upon completion of drilling

NOTE: No cave-in was noted in the borehole upon extration of augers

$+^3$, $\times^3$: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

ONTARIO MTO 17TF006A - PART A_AUGUST 11 2021-NL.GPJ ONTARIO MTO.GDT 10/12/21

RECORD OF BOREHOLE No 21-02

1 OF 1 **METRIC**

G.W.P. 3059-20-00 LOCATION COORDS: 4 813 317.5 N; 249 888.4 E ORIGINATED BY F.M.

DIST 31 HWY 6 BOREHOLE TYPE Solid Stem Augers COMPILED BY L.Y.

DATUM Geodetic DATE 2021.08.18 LATITUDE 43.457755 LONGITUDE -80.178550 CHECKED BY G.U.

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa: ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
308.9	GROUND SURFACE										
0.0	PEAT, fine fibrous to amorphous Dark brown, Wet		1	SS	WH				119.5		
			2	SS	WH		308		140		
307.4											
1.5	SILTY SAND/SANDY SILT, trace gravel Compact, Brown, Moist (TILL)		3	SS	11	▼	307				
			4	SS	9	▽					2 27 64 7
			5	SS	16		306				
			6	SS	12		305				
			7	SS	10		304				
303.6											
5.3	CLAYEY SILT, trace sand, trace gravel Stiff to Hard, Brown, Moist (TILL)		8	SS	15						5 15 61 19
			9	SS	33		303				
			10	SS	39		302				
			11	SS	19		301				
			12	SS	14		300				
298.5							299				1 3 79 17
10.4	End of borehole										

WH Split spoon penetration due to weight of hammer and rods

▽ Groundwater level observed during drilling

▼ Groundwater level observed upon completion of drilling

NOTE: No cave-in was noted in the borehole upon extration of augers

Monitoring Well Readings:

Date	Depth (m)	Elev.
Aug. 19/'21	3.3	305.7
Aug. 24/'21	1.8	307.1

Monitoring Well Legend:

- Monument casing
- Bentonite seal
- Filter sand
- Screen

$+^{3}$, $\times^{3}$: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

ONTARIO MTO 17TF006A - PART A_AUGUST 11 2021-NL.GPJ ONTARIO MTO.GDT 10/12/21

RECORD OF BOREHOLE No 21-03

1 OF 2

METRIC

G.W.P. 3059-20-00 LOCATION COORDS: 4 813 299.2 N; 249 837.9 E ORIGINATED BY V.L./P.J.

DIST 31 HWY 6 BOREHOLE TYPE Solid Stem Augers/Hollow Stem Augers COMPILED BY L.Y.

DATUM Geodetic DATE 2021-07-21/2021-08-10 LATITUDE 43.457587 LONGITUDE -80.179172 CHECKED BY G.U.

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa: ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
309.7	GROUND SURFACE										
0.0	200mm Granular Base over silty sand, with gravel (GRANULAR FILL)		1	SS	44						
308.9							309				
0.8	SILTY SAND, gravelly Compact to loose, Brown, Moist (FILL)		2	SS	13						22 38 28 12
			3	SS	6	▼	308				
307.4											
2.3	SILTY CLAY, peat and organics Soft, Dark Brown, Wet		4	SS	4		307		147.6		
			5	SS	4						
305.9							306				
3.8	SILTY SAND/SANDY SILT, trace gravel Compact to very dense, Brown, Moist (TILL)		6	SS	13						
			7	SS	13		305				
			8	SS	20		304				
			9	SS	19		303				
	clayey silt, very stiff		10	SS	17		302				4 22 57 17
			11	SS	12		301				
			12	SS	10		300				
	gravelly		13	SS	50/13cm		299				27 36 28 9
			14	SS	57		298				
							297				
							296				34 40 22 4
							295				

Continued Next Page

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

RECORD OF BOREHOLE No 21-03

2 OF 2 **METRIC**

G.W.P. 3059-20-00 LOCATION COORDS: 4 813 299.2 N; 249 837.9 E ORIGINATED BY V.L./P.J.

DIST 31 HWY 6 BOREHOLE TYPE Solid Stem Augers/Hollow Stem Augers COMPILED BY L.Y.

DATUM Geodetic DATE 2021-07-21/2021-08-10 LATITUDE 43.457587 LONGITUDE -80.179172 CHECKED BY G.U.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P NATURAL MOISTURE CONTENT w LIQUID LIMIT w_L WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES						
294.7											
294.4			15	SS	50/5cm						
15.3	End of Borehole										

▽ Groundwater level observed during drilling

▼ Groundwater level measured upon completion of drilling

NOTES:

1. Borehole caved-in at a depth of 2.3 m (EL. 307.4) below the existing ground surface upon extraction of augers.

2. Borehole was terminated at a depth of 10.7 m (EL. 299.0) below the existing ground surface. Borehole was moved 1.1 m north of the original staked location and drilling was continued.

$+^{3}$, $\times^{3}$: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

RECORD OF BOREHOLE No 21-04

1 OF 1

METRIC

G.W.P. 3059-20-00 LOCATION COORDS: 4 813 263.5 N; 249 663.1 E ORIGINATED BY F.M.

DIST 31 HWY 6 BOREHOLE TYPE Manual SPT COMPILED BY L.Y.

DATUM Geodetic DATE 2021.08.11 LATITUDE 43.457252 LONGITUDE -80.181328 CHECKED BY G.U.

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
308.9	GROUND SURFACE										
0.0	PEAT, fine fibrous to amorphous Dark brown, Wet		1	SS	WH				255.5		
			2	SS	WH		308		186		
307.1			3	SS	2	▽					
1.8	SANDY GRAVEL, some silt, trace clay Loose to compact, Brown, Wet (TILL)		4	SS	11		307				
			5	SS	6						
			6	SS	20		306				54 31 13 2
			7	SS	13		305				
			8	SS	20						
			9	SS	11		304				49 47 (4)
			10	SS	11						
302.3			11	SS	23		303				
6.6	End of borehole										

WH Split spoon penetration due to weight of hammer and rods

▽ Groundwater level observed during drilling

NOTES:

1. Groundwater not encountered upon completion of drilling
2. Borehole caved-in at a depth of 3.0 m (EL. 305.9) below the existing ground surface upon extraction of augers.

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

RECORD OF BOREHOLE No 21-05

1 OF 1

METRIC

G.W.P. 3059-20-00 LOCATION COORDS: 4 813 253.2 N; 249 634.1 E ORIGINATED BY V.L

DIST 31 HWY 6 BOREHOLE TYPE Solid Stem Augers COMPILED BY L.Y.

DATUM Geodetic DATE 2021.07.21 LATITUDE 43.457157 LONGITUDE -80.181685 CHECKED BY G.U.

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa: ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
310.6	GROUND SURFACE										
310.6 / 0.0	150mm ASPHALT over										
310.4 / 0.2	150mm granular fill over silty sand, some gravel (PAVEMENT STRUCTURE)		1	SS	70				○		
309.8							310				
0.8	SILTY SAND, gravelly Very dense to compact, Brown, Moist		2	SS	56				○		
			3	SS	22	▼ ▽	309		○		
	GRAVEL, sandy Dense to very dense, Brown, Moist to wet (FILL)		4	SS	48		308				54 39 (7)
			5	SS	50/ 125mm						
306.8							307				
3.8	SILTY SAND, some gravel Dense to compact, Brown, Wet (TILL)		6	SS	39				○		
			7	SS	18		306		○		
			8	SS	15		305		○		14 73 (13)
			9	SS	20				○		
							304				
			10	SS	18		303		○		
							302				
			11	SS	25				○		17 59 (24)
							301				
							300				
			12	SS	23				○		
299.3											
11.3	End of borehole										

▽ Groundwater level observed during drilling

▼ Groundwater level measured upon completion of drilling

NOTE: Borehole caved-in at a depth of 2.3 m (EL. 308.3) below the existing ground surface upon extraction of augers.

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

$○^{3\%}$ STRAIN AT FAILURE

ONTARIO MTO 17TF006A - PART A_AUGUST 11 2021-NL.GPJ ONTARIO MTO.GDT 10/12/21

RECORD OF BOREHOLE No 21-06

1 OF 1

METRIC

G.W.P. 3059-20-00 LOCATION COORDS: 4 813 246.5 N; 249 588.8 E ORIGINATED BY F.M.

DIST 31 HWY 6 BOREHOLE TYPE Manual SPT COMPILED BY L.Y.

DATUM Geodetic DATE 2021.08.11 LATITUDE 43.457093 LONGITUDE -80.182244 CHECKED BY G.U.

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa: ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
309.1	GROUND SURFACE						309				
0.0	PEAT, fine fibrous to amorphous Dark brown, Wet		1	SS	WH	▽			○		
308.3							308				
0.8	SAND, some silt, some to trace gravel Loose to very dense, Brown, Wet to moist (TILL)		2	SS	6						
			3	SS	6	▼			○		
			4	SS	4		307		○		18 69 (13)
			5	SS	8				○		
			6	SS	11		306		○		4 84 9 3
			7	SS	22						
			8	SS	20		305		○		
303.9			9	SS	74/25cm		304		○		8 81 (11)
5.2	End of borehole										

WH Split spoon penetration due to weight of hammer and rods

▽ Groundwater level observed during drilling

▼ Groundwater level measured upon completion of drilling

NOTE: Borehole caved-in at a depth of 2.4 m (EL. 306.7) below the existing ground surface upon extraction of augers.

+ 3, × 3: Numbers refer to Sensitivity

○ 3% STRAIN AT FAILURE

RECORD OF BOREHOLE No 21-07

1 OF 1

METRIC

G.W.P. 3059-20-00 LOCATION COORDS: 4 813 223.9 N; 249 574.4 E ORIGINATED BY F.M.

DIST 31 HWY 6 BOREHOLE TYPE Solid Stem Augers COMPILED BY L.Y.

DATUM Geodetic DATE 2021.08.17 LATITUDE 43.456889 LONGITUDE -80.182420 CHECKED BY G.U.

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
309.4	GROUND SURFACE										
0.0	TOPSOIL/PEAT		1	SS	2		309				
			2	SS	WH				279.6		
307.9							308				
1.5	SILTY SAND/SANDY SILT, gravelly Loose to dense, Brown to grey, Wet (TILL)		3	SS	10						
			4	SS	5		307				25 61 (14)
			5	SS	20		306				
			6	SS	13						
			7	SS	7	▽	305				29 32 32 7
			8	SS	16		304				
			9	SS	15		303				
			10	SS	15		302				
	some clay, trace gravel		11	SS	26		301				
299.3			12	SS	50		300				1 13 69 17
10.1	End of borehole										

WH Split spoon penetration due to weight of hammer and rods

▽ Groundwater level observed during drilling

NOTES:
1. Groundwater not encountered upon completion of drilling.
2. Borehole caved-in at a depth of 8.8 m (EL. 300.6) below the existing ground surface upon extraction of augers.

+ 3, × 3: Numbers refer to Sensitivity

○ 3% STRAIN AT FAILURE

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RECORD OF BOREHOLE No 21-07A

1 OF 1

METRIC

G.W.P. 3059-20-00 LOCATION COORDS: 4 813 242.3 N; 249 643.2 E ORIGINATED BY F.M.

DIST 31 HWY 6 BOREHOLE TYPE Solid Stem Augers COMPILED BY L.Y.

DATUM Geodetic DATE 2021.08.17 LATITUDE 43.457060 LONGITUDE -80.181571 CHECKED BY G.U.

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa: ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
310.3	GROUND SURFACE										
310.1 0.0	TOPSOIL										
0.2	SILTY SAND/SANDY SILT, some gravel to gravelly Loose, Brown, Moist		1	SS	7		310		○		
309.1 1.2	(FILL) SILTY SAND/SANDY SILT, gravelly Compact to dense, Brown, Moist		2	SS	4				○		18 32 40 10
	(TILL)		3	SS	47		309		○		
			4	SS	24	▽	308		○		47 39 (14)
307.2			5	SS	40				○		
3.1	End of borehole										

▽ Groundwater level observed during drilling

NOTES:
1. Groundwater not encountered upon completion of drilling.
2. No cave-in was noted in the borehole upon extration of augers.

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

RECORD OF BOREHOLE No 21-08

1 OF 1

METRIC

G.W.P. 3059-20-00 LOCATION COORDS: 4 813 221.3 N; 249 538.8 E ORIGINATED BY V.J.

DIST 31 HWY 6 BOREHOLE TYPE Solid Stem Augers COMPILED BY L.Y.

DATUM Geodetic DATE 2021.07.20 LATITUDE 43.456863 LONGITUDE -80.182860 CHECKED BY G.U.

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa: ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
310.8	GROUND SURFACE										
310.8 / 0.0	100mm ASPHALT over										
310.7 / 0.1	150mm granular fill over silty sand, some gravel (PAVEMENT STRUCTURE)		1	SS	24				○		
310.0							310				
0.8	SANDY SILT, trace gravel, peat, organics Loose to compact, Brown, Moist (FILL)		2	SS	7				○		
			3	SS	22	▼ ▽	309		○		
308.5											
2.3	SANDY SILT, trace gravel Loose to compact, Brown, Moist to wet (TILL)		4	SS	12		308		○H		8 13 66 13
			5	SS	21				○		
			6	SS	12		307		○		
			7	SS	16		306		○		
			8	SS	9				○		0 27 66 7
			9	SS	7		305		○		
							304				
			10	SS	13		303		○		
							302				
			11	SS	15				○		4 19 63 14
							301				
300.4			12	SS	26				○		
10.4	End of Borehole										

▽ Groundwater level observed during drilling

▼ Groundwater level measured upon completion of drilling

NOTE: Borehole caved-in at a depth of 2.3 m (EL. 308.5) below the existing ground surface upon extraction of augers.

$+^3$, $\times^3$: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

ONTARIO MTO 17TF006A - PART A_AUGUST 11 2021-NL.GPJ ONTARIO MTO.GDT 10/12/21

RECORD OF BOREHOLE No 21-09

1 OF 1

METRIC

G.W.P. 3059-20-00 LOCATION COORDS: 4 813 274.1 N; 249 319.2 E ORIGINATED BY F.M.

DIST 31 HWY 6 BOREHOLE TYPE Solid Stem Augers COMPILED BY L.Y.

DATUM Geodetic DATE 2021.07.12 LATITUDE 43.457322 LONGITUDE -80.185578 CHECKED BY G.U.

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa: ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
315.6	GROUND SURFACE										
315.4 0.2	TOPSOIL										
	SILTY SAND, some gravel Loose to very dense, Brown, Moist to wet (TILL)		1	SS	8		315		○		
			2	SS	18				○		17 47 31 5
			3	SS	15		314		○		
			4	SS	71/8cm				○		
	Sandy gravel, some silt, dense		5	SS	45		313		○		48 36 (16)
			6	SS	38		312		○		
			7	SS	17		311		○		
309.7			8	SS	55		310		○		42 46 (12)
5.9	End of borehole										

▽ Groundwater level observed during drilling

NOTES:

1. Groundwater not encountered upon completion of drilling
2. Borehole caved-in at a depth of 5.5 m (EL. 310.1) below the existing ground surface upon extraction of augers.

Monitoring Well Readings:

Date	Depth (m)	Elev.
Aug. 04/'21	4.3	311.3
Aug. 16/'21	4.6	311.1
Aug. 24/'21	Dry	---

Monitoring Well Legend:

- Monument Casing
- Bentonite Seal
- Filter Sand
- Screen
- Cave-in

$+^{3}$, $\times^{3}$: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

ONTARIO MTO 17TF006A - PART A_AUGUST 11 2021-NL.GPJ ONTARIO MTO.GDT 10/12/21

RECORD OF BOREHOLE No 21-10

1 OF 1

METRIC

G.W.P. 3059-20-00 LOCATION COORDS: 4 813 309.7 N; 249 266.4 E ORIGINATED BY P.J.

DIST 31 HWY 6 BOREHOLE TYPE Solid Stem Augers COMPILED BY L.Y.

DATUM Geodetic DATE 2021.07.28 LATITUDE 43.457639 LONGITUDE -80.186234 CHECKED BY G.U.

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
316.6	GROUND SURFACE										
0.0 / 316.2	TOPSOIL		1	SS	7		316	○	○		
0.4	SILTY SAND/SANDY SILT, trace gravel to gravelly Loose to very dense, Brown, Moist (TILL)		2	SS	13				○		1 13 77 9
			3	SS	16		315		○		
			4	SS	23		314		○		
			5	SS	16		313		○		
			6	SS	19				○		16 48 29 7
			7	SS	32	▼	312		○		
			8	SS	22		311		○		
			9	SS	12				○		24 63 (13)
			10	SS	26		310				
			11	SS	5/13cm		309		○		
			12	SS	5/13cm		308				
306.1							307		○		
10.5	End of borehole										

▽ Groundwater level observed during drilling

▼ Groundwater level measured upon completion of drilling

NOTE: Borehole caved-in at a depth of 5.5 m (EL. 311.1) below the existing ground surface upon extraction of augers.

$+^{3}, \times^{3}$: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

RECORD OF BOREHOLE No 21-11

1 OF 1

METRIC

G.W.P. 3059-20-00 LOCATION COORDS: 4 813 364.8 N; 249 271.1 E ORIGINATED BY P.J.

DIST 31 HWY 6 BOREHOLE TYPE Solid Stem Augers COMPILED BY L.Y.

DATUM Geodetic DATE 2021.07.28 LATITUDE 43.458135 LONGITUDE -80.186181 CHECKED BY G.U.

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa: ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
313.0	GROUND SURFACE										
0.0 / 312.4	TOPSOIL		1	SS	13			○			
0.6	SILTY SAND, gravelly Compact to dense, Brown, Moist (TILL) Sandy gravel, some silt		2	SS	29		312	○			
			3	SS	11	▽	311	○			35 37 21 7
			4	SS	11	▽		○			
			5	SS	35		310	○			
			6	SS	32		309	○			
			7	SS	49		308	○			38 42 (20)
			8	SS	31			○			
			9	SS	32		307	○			
							306				
			10	SS	47		305	○			
303.9							304				
9.1	End of borehole										

▽ Groundwater level observed during drilling

▽ Groundwater level measured in monitoring well

NOTE: No cave-in was noted in the borehole upon extraction of augers.

Monitoring Well Readings:

Date	Depth (m)	Elev.
Aug. 04/'21	1.7	311.3
Aug. 16/'21	1.9	311.1
Aug. 11/'21	1.9	311.1
Aug. 24/'21	1.9	311.1

Monitoring Well Legend:

- Monument Casing
- Bentonite Seal
- Filter Sand
- Screen

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

$\circ^{3\%}$ STRAIN AT FAILURE

RECORD OF BOREHOLE No 21-12

1 OF 1

METRIC

G.W.P. 3059-20-00 LOCATION COORDS: 4 814 135 N; 249 363.0 E ORIGINATED BY F.M.

DIST 31 HWY 6 BOREHOLE TYPE Solid Stem Augers COMPILED BY L.Y.

DATUM Geodetic DATE 2021.08.03 LATITUDE 43.465075 LONGITUDE -80.185124 CHECKED BY G.U.

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa: ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
329.1	GROUND SURFACE										
0.0 / 328.8	TOPSOIL, organics										
0.3	SILTY SAND, trace gravel to gravelly Loose to very dense, Brown, Moist (TILL)		1	SS	4		329		○		
			2	SS	10		328		○		7 49 (44)
			3	SS	10				○		
			4	SS	10		327		○		
			5	SS	39		326		○		
	very loose		6	SS	WH		325		○		
			7	SS	54		324		○		20 55 (25)
			8	SS	48				○		
			9	SS	69		323		○		
			10	SS	44		322		○		24 36 36 4
			11	SS	92		321				
319.3							320		○		
9.8	End of borehole										

WH Split-spoon penetration due to weight of hammer and rods

NOTES:

1. Groundwater not encountered during or upon completion of drilling.
2. No cave-in was noted in the borehole upon extraction of augers.

Monitoring Well Readings:

Date	Depth (m)	Elev.
Aug. 04/'21	Dry	---
Aug. 17/'21	Dry	---
Aug. 24/'21	Dry	---

Monitoring Well Legend:

- Monument casing
- Soil cuttings and bentonite seal
- Bentonite seal
- Filter sand
- Screen

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

ONTARIO MTO 17TF006A - PART A_AUGUST 11 2021-NL.GPJ ONTARIO MTO.GDT 10/12/21

RECORD OF BOREHOLE No 21-13

1 OF 1

METRIC

G.W.P. 3059-20-00 LOCATION COORDS: 4 814 150.3 N; 249 412.1 E ORIGINATED BY F.M.

DIST 31 HWY 6 BOREHOLE TYPE Solid Stem Augers COMPILED BY L.Y.

DATUM Geodetic DATE 2021.08.03 LATITUDE 43.465215 LONGITUDE -80.184520 CHECKED BY G.U.

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa: ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
330.5	GROUND SURFACE										
0.0 / 330.1	TOPSOIL, organics		1	SS	5		330	○	○		
0.4	SILTY SAND, gravelly to some gravel Loose to very dense, Brown, Moist (TILL)		2	SS	35				○		22 53 (25)
			3	SS	22		329		○		
			4	SS	29		328		○		
			5	SS	35				○		37 31 (32)
			6	SS	28		327		○		
			7	SS	41		326		○		
			8	SS	47		325		○		
			9	SS	42		324		○		
			10	SS	59		323		○		18 44 (38)
							322				
321.2			11	SS	50/15cm				○		
9.3	End of borehole										

NOTES:
1. Groundwater not encountered during or upon completion of drilling.
2. No cave-in was noted in the borehole upon extraction of augers.

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

RECORD OF BOREHOLE No 21-14

1 OF 1

METRIC

G.W.P. 3059-20-00 LOCATION COORDS: 4 814 060.5 N; 249 385.1 E ORIGINATED BY F.M.

DIST 31 HWY 6 BOREHOLE TYPE Solid Stem Augers COMPILED BY L.Y.

DATUM Geodetic DATE 2021.07.30 LATITUDE 43.464405 LONGITUDE -80.184844 CHECKED BY G.U.

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
328.9	GROUND SURFACE										
0.0 / 328.5	TOPSOIL, organics		1	SS	5				○		
0.4	SILTY SAND, trace to some gravel Loose to very dense, Brown, Moist (TILL)		2	SS	18		328		○		
			3	SS	25		327		○		
			4	SS	22				○		0 50 (50)
			5	SS	27		326		○		
			6	SS	51		325		○		
			7	SS	53		324		○		19 52 (29)
			8	SS	52				○		
			9	SS	50/15cm		323		○		
			10	SS	50		321		○		19 54 (27)
			11	SS	34		320		○		
318.7			12	SS	55		319		○		
10.2	End of borehole										

NOTES:
1. Groundwater not encountered during or upon completion of drilling.
2. No cave-in was noted in the borehole upon extraction of augers.

$+^3, \times^3$: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

RECORD OF BOREHOLE No 21-15

1 OF 1

METRIC

G.W.P. 3059-20-00 LOCATION COORDS: 4 814 162.2 N; 249 327.3 E ORIGINATED BY F.M.

DIST 31 HWY 6 BOREHOLE TYPE Solid Stem Augers COMPILED BY L.Y.

DATUM Geodetic DATE 2021.08.03 LATITUDE 43.465317 LONGITUDE -80.185568 CHECKED BY G.U.

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa: ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
334.4	GROUND SURFACE										
0.0 / 334.1	TOPSOIL, organics										
0.3	SILTY SAND, some gravel to gravelly Loose to very dense, Brown, Moist (TILL)		1	SS	4		334		○		
			2	SS	22				○		
			3	SS	18		333		○		13 50 (37)
			4	SS	25		332		○		
			5	SS	42		331		○		
			6	SS	44				○		
			7	SS	46		330		○		
			8	SS	47		329		○		
			9	SS	50/10cm				○		21 48 23 8
327.8							328				
6.6	Borehole terminated due to auger refusal										

NOTES:
1. Groundwater not encountered during or upon completion of drilling.
2. No cave-in was noted in the borehole upon extraction of augers.

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

RECORD OF BOREHOLE No 21-16

1 OF 1

METRIC

G.W.P. 3059-20-00 LOCATION COORDS: 4 814 238 N; 249 369.2 E ORIGINATED BY F.M.

DIST 31 HWY 6 BOREHOLE TYPE Solid Stem Augers COMPILED BY L.Y.

DATUM Geodetic DATE 2021.08.04 LATITUDE 43.466002 LONGITUDE -80.185058 CHECKED BY G.U.

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa: ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
331.4	GROUND SURFACE										
0.0 / 330.9	TOPSOIL, organics		1	SS	4		331	○	○		
0.5	SILTY SAND, some gravel to gravelly Very loose, Brown, Moist (TILL)		2	SS	3			○	○		
	Compact to dense		3	SS	22		330	○	○		
			4	SS	40		329	○	○		14 50 (36)
			5	SS	30		328	○	○		
			6	SS	42			○	○		
	Sand, dense		7	SS	30		327	○	○		
			8	SS	37		326	○	○		29 54 (17)
			9	SS	30		325	○	○		
			10	SS	32	▽	324	○	○		
			11	SS	49		323	○	○		
			12	SS	39		322	○	○		13 62 19 6
321.3 / 10.1	End of borehole										

▽ Groundwater observed during drilling

NOTES:
1. Groundwater not encountered during or upon completion of drilling.
2. Borehole caved-in at a depth of 7.8 m (EL. 323.6) below the existing ground surface upon extraction of augers.

$+^{3}, \times^{3}$: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

ONTARIO MTO 17TF006A - PART A_AUGUST 11 2021-NL.GPJ ONTARIO MTO.GDT 10/12/21

RECORD OF BOREHOLE No 21-17

1 OF 1

METRIC

G.W.P. 3059-20-00 LOCATION COORDS: 4 814 216.1 N; 249 484.3 E ORIGINATED BY F.M.

DIST 31 HWY 6 BOREHOLE TYPE Solid Stem Augers COMPILED BY L.Y.

DATUM Geodetic DATE 2021.07.12 LATITUDE 43.465814 LONGITUDE -80.183633 CHECKED BY G.U.

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
330.6	GROUND SURFACE								
0.0	TOPSOIL								
330.2			1	SS	13		330		
0.4	SILTY SAND, some gravel to gravelly Compact to dense, Brown, Moist (TILL)		2	SS	27				
			3	SS	30		329		10 43 40 7
			4	SS	26		328		
			5	SS	34		327		
			6	SS	33				
			7	SS	30		326		13 43 35 9
			8	SS	38		325		
			9	SS	25		324		
	gravelly		10	SS	42		323		39 49 9 3
			11	SS	31		322		
320.8							321		
9.8	End of borehole								

DYNAMIC CONE PENETRATION RESISTANCE PLOT: 20 40 60 80 100

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

PLASTIC LIMIT w_P NATURAL MOISTURE CONTENT w LIQUID LIMIT w_L

WATER CONTENT (%): 20 40 60

NOTES:
1. Groundwater level was not encountered in the borehole during or upon completion of drilling.
2. No cave-in was noted in the borehole upon extraction of augers.

$+^3, \times^3$: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

ONTARIO MTO 17TF006A - PART A_AUGUST 11 2021-NL.GPJ ONTARIO MTO.GDT 10/12/21

RECORD OF BOREHOLE No 21-18

1 OF 1

METRIC

G.W.P. 3059-20-00 LOCATION COORDS: 4 814 385.2 N; 249 433.1 E ORIGINATED BY F.M.

DIST 31 HWY 6 BOREHOLE TYPE Manual SPT COMPILED BY L.Y.

DATUM Geodetic DATE 2021.08.16 LATITUDE 43.467332 LONGITUDE -80.184284 CHECKED BY G.U.

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa: ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
336.8	GROUND SURFACE										
336.6	TOPSOIL										
0.2	SILTY SAND/SAND Loose to very dense, Brown, Moist (TILL) Sand, Compact		1	SS	6				○		
			2	SS	11		336		○		0 44 42 14
			3	SS	19				○		0 88 (12)
			4	SS	22		335		○		
			5	SS	25				○		
			6	SS	18		334		○		
			7	SS	15		333		○		
			8	SS	26				○		
			9	SS	56		332		○		0 65 (35)
331.4											
5.4	End of borehole										

NOTES:
1. Groundwater not encountered during or upon completion of drilling.
2. No cave-in was noted in the borehole upon extration of augers.

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

RECORD OF BOREHOLE No 21-19

1 OF 1

METRIC

G.W.P. 3059-20-00 LOCATION COORDS: 4 814 358.6 N; 249 353.7 E ORIGINATED BY F.M.

DIST 31 HWY 6 BOREHOLE TYPE Solid Stem Augers COMPILED BY L.Y.

DATUM Geodetic DATE 2021.08.05 LATITUDE 43.467086 LONGITUDE -80.185262 CHECKED BY G.U.

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
336.9	GROUND SURFACE										
0.0 / 336.5	TOPSOIL, organics		1	SS	22		336		○		
0.4	SILTY SAND/SANDY SILT, trace gravel Compact to dense, Brown, Moist (TILL)		2	SS	35				○		
			3	SS	45		335		○		
			4	SS	29				○		1 55 (44)
			5	SS	42		334		○		
			6	SS	29		333		○		
			7	SS	38		332		○		
	gravelly		8	SS	50				○		32 39 (29)
			9	SS	40		331		○		
			10	SS	34	▽	330		○		
	Silt, Very dense, Wet		11	SS	51	▼	329		○		
326.8			12	SS	53		328		○		0 4 82 14
10.1	End of borehole						327				

▽ Groundwater level observed during drilling

▼ Groundwater level measured upon completion of drilling

NOTE: Borehole caved-in at a depth of 9.1 m (EL. 327.8) below the existing ground surface upon extraction of augers.

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

RECORD OF BOREHOLE No 21-20

1 OF 1

METRIC

G.W.P. 3059-20-00 LOCATION COORDS: 4 814 472.4 N; 249 424.5 E ORIGINATED BY P.J.

DIST 31 HWY 6 BOREHOLE TYPE Solid Stem Augers COMPILED BY L.Y.

DATUM Geodetic DATE 2021.07.21 LATITUDE 43.468116 LONGITUDE -80.184399 CHECKED BY G.U.

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa: ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
338.6	GROUND SURFACE										
338.4 0.2	TOPSOIL, organics										
	SILTY SAND, gravelly to trace gravel Loose to very dense, Brown, Moist (TILL)		1	SS	6		338		○		
	gravelly		2	SS	33				○		
			3	SS	64		337		○		32 50 (18)
			4	SS	70/23cm				○		
	Sand		5	SS	54		336		○		
			6	SS	23		335		○		5 71 21 3
			7	SS	18		334		○		
			8	SS	21		333		○		
			9	SS	31		332		○		
			10	SS	43		331		○		1 72 (27)
			11	SS	44		330		○		
328.8 9.8	End of borehole						329				

NOTES:
1. Groundwater level was not encountered in the borehole during or upon completion of drilling.
2. No cave-in was noted in the borehole upon extraction of augers.

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

RECORD OF BOREHOLE No 21-21

1 OF 1

METRIC

G.W.P. 3059-20-00 LOCATION COORDS: 4 814 451.1 N; 249 347.6 E ORIGINATED BY F.M.

DIST 31 HWY 6 BOREHOLE TYPE Hollow Stem Augers COMPILED BY L.Y.

DATUM Geodetic DATE 2021.08.06 LATITUDE 43.467918 LONGITUDE -80.185347 CHECKED BY G.U.

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa: ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
333.4	GROUND SURFACE										
333.2 0.2	TOPSOIL										
	SILTY SAND Compact, Brown, Moist (FILL)		1	SS	11		333	○			
			2	SS	26			○			0 49 45 6
331.9 1.5	SANDY SILT Compact to very dense, Brown, Moist (TILL)		3	SS	31		332	○			
			4	SS	27		331	○			
			5	SS	34		330	○			
	Clayey silt, Very stiff		6	SS	17			⊕			0 0 68 32
			7	SS	28		329	○			
			8	SS	42		328	○			0 41 50 9
			9	SS	37		327	○			
325.5			10	SS	86/20cm		326	○			
7.9	Borehole terminated due to auger refusal										

▽ Groundwater observed during drilling

▼ Groundwater measured in monitoring well

NOTE: No cave-in was noted in the borehole upon extraction of augers.

Monitoring Well Readings:

Date	Depth (m)	Elev.
Aug. 09/'21	5.0	328.4
Aug. 16/'21	5.1	328.3
Aug. 19/'21	5.1	328.3

Monitoring Well Legend:

- Monument casing
- Bentonite seal
- Filter sand
- Screen

+ 3, × 3: Numbers refer to Sensitivity

○ 3% STRAIN AT FAILURE

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RECORD OF BOREHOLE No 21-22

1 OF 1

METRIC

G.W.P. 3059-20-00 LOCATION COORDS: 4 814 552 N; 249 380.8 E ORIGINATED BY P.J.

DIST 31 HWY 6 BOREHOLE TYPE Solid Stem Augers COMPILED BY L.Y.

DATUM Geodetic DATE 2021.07.22 LATITUDE 43.468830 LONGITUDE -80.184947 CHECKED BY G.U.

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa: ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
339.2	GROUND SURFACE										
0.0 / 338.9	TOPSOIL, organics										
0.3	SILTY SAND, gravelly to trace gravel Loose to dense, Brown to grey, Moist (TILL)		1	SS	3		339		○		
			2	SS	14		338		○		
			3	SS	25				○		
			4	SS	41		337		○		
	Sand		5	SS	29		336		○		
			6	SS	41		335		○		35 42 19 4
			7	SS	39				○		
			8	SS	25		334		○		
			9	SS	30		333		○		
							332				
			10	SS	22				○		0 75 (25)
						▽	331				
			11	SS	31		330		○		
329.4 / 9.8	End of borehole										

▽ Groundwater level observed during drilling

NOTES:
1. Groundwater not encountered during or upon completion of drilling.
2. No cave-in was noted in the borehole upon extraction of augers.

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

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RECORD OF BOREHOLE No 21-23

1 OF 1 **METRIC**

G.W.P. 3059-20-00 LOCATION COORDS: 4 814 519.6 N; 249 299.5 E ORIGINATED BY F.M.

DIST 31 HWY 6 BOREHOLE TYPE Solid Stem Augers COMPILED BY L.Y.

DATUM Geodetic DATE 2021.08.05 LATITUDE 43.468531 LONGITUDE -80.185948 CHECKED BY G.U.

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa: ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
342.6	GROUND SURFACE										
342.4 0.2	TOPSOIL										
	SILTY SAND/SANDY SILT, gravelly to trace gravel Loose, Brown, Moist (TILL) Compact to dense		1	SS	4		342		○		
			2	SS	5				○		
			3	SS	13		341		○		
			4	SS	21		340		○		
			5	SS	17				○		35 42 (23)
			6	SS	19		339		○		
			7	SS	13		338				
			8	SS	16		337		○		0 50 46 4
			9	SS	20				○		
			10	SS	15		336				
			11	SS	27		335		○		
			12	SS	32		334				
332.5 10.1	End of borehole						333		○		

NOTES:
1. Groundwater level was not encountered in the borehole during or upon completion of drilling.
2. No cave-in was noted in the borehole upon extraction of augers.

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

RECORD OF BOREHOLE No 21-24

1 OF 1

METRIC

G.W.P. 3059-20-00 LOCATION COORDS: 4 814 618.2 N; 249 342.6 E ORIGINATED BY F.M.

DIST 31 HWY 6 BOREHOLE TYPE Solid Stem Augers COMPILED BY L.Y.

DATUM Geodetic DATE 2021.08.18 LATITUDE 43.469422 LONGITUDE -80.185425 CHECKED BY G.U.

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
335.8	GROUND SURFACE										
335.6 0.2	TOPSOIL										
	SANDY SILT/SILTY SAND, trace gravel to gravelly Compact to very dense, Brown, Moist (TILL)		1	SS	15		335		○		
			2	SS	17				○		
			3	SS	22		334		○		0 48 (52)
			4	SS	26				○		
			5	SS	13		333		○		
			6	SS	17		332		○		
			7	SS	25		331		○		
	Clayey silt, Stiff		8	SS	14				○		
			9	SS	18		330		⊳⊢		0 0 69 31
							329				
			10	SS	29		328		○		
							327				
			11	SS	75				○		25 40 28 7
325.4			12	SS	49		326		○		
10.4	End of borehole										

▽ Groundwater level observed during drilling

▼ Groundwater level measured in monitoring well

NOTE: Borehole caved-in at a depth of 8.8 m (EL. 327.0) below the existing ground surface upon extraction of augers.

Monitoring Well Readings:

Date	Depth (m)	Elev.
Aug. 19/'21	8.6	327.2
Aug. 24/'21	8.6	327.2

Monitoring Well Legend:

- Monument casing
- Soil cuttings and bentonite seal
- Bentonite seal
- Filter sand
- Screen
- Cave-in

+ 3, × 3: Numbers refer to Sensitivity

○ 3% STRAIN AT FAILURE

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RECORD OF BOREHOLE No 21-25

1 OF 1

METRIC

G.W.P. 3059-20-00 LOCATION COORDS: 4 814 637.2 N; 249 288.2 E ORIGINATED BY F.M.

DIST 31 HWY 6 BOREHOLE TYPE Solid Stem Augers COMPILED BY L.Y.

DATUM Geodetic DATE 2021.08.06 LATITUDE 43.469589 LONGITUDE -80.186100 CHECKED BY G.U.

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
335.3	GROUND SURFACE										
0.0	SANDY GRAVEL Loose to dense, Brown, Moist (FILL)		1	SS	5		335		○		
			2	SS	37				○		
			3	SS	33		334		○		
			4	SS	44	▼	333		○		48 38 (14)
			5	SS	33	▽	332		○		
331.9											
3.4	SILTY SAND, gravelly Compact to dense, Brown, Moist (TILL)		6	SS	16				○		
			7	SS	46		331		○		
			8	SS	11		330		○		
			9	SS	30		329		○		23 52 22 3
			10	SS	21		328		○		
327.1											
8.2	End of borehole										

▽ Groundwater level observed during drilling

▼ Groundwater level measured upon completion of drilling

NOTE: Borehole caved-in at a depth of 2.7 m (EL. 332.6) below the existing ground surface upon extraction of augers.

$+^{3}$, $\times^{3}$: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

RECORD OF BOREHOLE No 21-26

1 OF 1

METRIC

G.W.P. 3059-20-00 LOCATION COORDS: 4 814 192.4 N; 249 610.9 E ORIGINATED BY F.M.

DIST 31 HWY 6 BOREHOLE TYPE Solid Stem Augers COMPILED BY L.Y.

DATUM Geodetic DATE 2021.07.12 LATITUDE 43.465609 LONGITUDE -80.182067 CHECKED BY G.U.

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
329.9	GROUND SURFACE										
0.0	TOPSOIL		1	SS	10				○		
329.1							329				
0.8	SILTY SAND, some gravel to gravelly Compact to dense, Brown, Moist (TILL)		2	SS	17				○		18 40 35 7
			3	SS	30		328		○		
			4	SS	26				○		
							327				
			5	SS	15				○		25 42 27 6
			6	SS	22		326		○		
			7	SS	21		325		○		
			8	SS	28				○		
			9	SS	32		324		○		
							323				
			10	SS	35		322		○		
							321				
			11	SS	42				○		22 53 21 4
			12	SS	40		320		○		
319.4											
10.5	End of borehole										

NOTES:
1. Groundwater level was not encountered in the borehole during or upon completion of drilling.
2. No cave-in was noted in the borehole upon extraction of augers.

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

RECORD OF BOREHOLE No 21-27

1 OF 1

METRIC

G.W.P. 3059-20-00 LOCATION COORDS: 4 814 102.5 N; 249 623.5 E ORIGINATED BY F.M.

DIST 31 HWY 6 BOREHOLE TYPE Solid Stem Augers COMPILED BY L.Y.

DATUM Geodetic DATE 2021.07.13 LATITUDE 43.464801 LONGITUDE -80.181902 CHECKED BY G.U.

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa: ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
324.0	GROUND SURFACE										
0.0	TOPSOIL		1	SS	7				○		
323.2							323				
0.8	SILTY SAND, some gravel Compact to very dense, Brown, Moist (TILL)		2	SS	27				○		
			3	SS	16		322		○		12 47 36 5
			4	SS	18				○		
			5	SS	14		321		○		
	Clayey silt, Stiff to very stiff		6	SS	17		320		⊕		15 21 49 15
			7	SS	14		319		○		
			8	SS	24				○		
			9	SS	30		318		○		26 45 23 6
							317				
			10	SS	42		316		○		
							315				
			11	SS	30				○		
							314				
313.6			12	SS	100				○		
10.4	End of borehole										

▽ Groundwater level observed during drilling

▼ Groundwater level measured in monitoring well

NOTE: No cave-in was noted in the borehole upon extraction of augers.

Monitoring Well Readings:

Date	Depth (m)	Elev.
Aug. 04/'21	Dry	---
Aug. 09/'21	8.1	315.9
Aug. 19/'21	8.1	315.9

Monitoring Well Legend:

- Monument casing
- Bentonite seal
- Filter sand
- Screen

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

$\circ^{3\%}$ STRAIN AT FAILURE

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RECORD OF BOREHOLE No 21-28

1 OF 1

METRIC

G.W.P. 3059-20-00 LOCATION COORDS: 4 813 971.7 N; 249 606.3 E ORIGINATED BY F.M.

DIST 31 HWY 6 BOREHOLE TYPE Solid Stem Augers COMPILED BY L.Y.

DATUM Geodetic DATE 2021.07.13 LATITUDE 43.463623 LONGITUDE -80.182101 CHECKED BY G.U.

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
320.5	GROUND SURFACE										
0.0 / 319.9	TOPSOIL		1	SS	18		320		○		
0.6	SILTY SAND, gravelly to trace gravel Compact to very dense, Brown, Moist (TILL)		2	SS	19				○		
			3	SS	33		319		○		
			4	SS	16		318		○		25 48 23 4
			5	SS	32		317		○		
			6	SS	34				○		
			7	SS	35		316		○		8 50 36 6
			8	SS	50		315		○		
			9	SS	55				○		
							314				
			10	SS	61		313		○		
312.3											
8.2	End of borehole										

NOTES:

1. Groundwater level was not encountered in the borehole during or upon completion of drilling.
2. No cave-in was noted in the borehole upon extraction of augers.

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

RECORD OF BOREHOLE No 21-29

1 OF 1

METRIC

G.W.P. 3059-20-00 LOCATION COORDS: 4 813 886.7 N; 249 519.8 E ORIGINATED BY P.J.

DIST 31 HWY 6 BOREHOLE TYPE Solid Stem Augers - Switched to Hollow Stem Augers at 3.8 m COMPILED BY L.Y.

DATUM Geodetic DATE 2021.08.09 - 2021.08.16 LATITUDE 43.462851 LONGITUDE -80.183161 CHECKED BY G.U.

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa: ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
316.5	GROUND SURFACE										
316.3 0.2	TOPSOIL, organics										
	SILTY SAND/SANDY SILT, gravelly to trace gravel Loose to very dense, Brown, Moist to wet (TILL)		1	SS	6		316		○		
			2	SS	48				○		
			3	SS	28		315		○		23 45 (32)
			4	SS	34		314		○		
			5	SS	16/8cm				○		
			6	SS	32		313		○		
			7	SS	31		312		○		
			8	SS	13		311		○		8 58 (34)
			9	SS	23		310		○		
			10	SS	19		309		○		
	Silt, Dense to very dense		11	SS	42		308		○		1 16 77 6
306.1			12	SS	62		307		○		
10.4	End of borehole										

▼ Groundwater level measured upon completion of drilling

▼ Groundwater level measured in monitoring well

NOTE: Borehole caved-in at a depth of 9.8 m (EL. 306.7) below the existing ground surface upon extraction of augers.

Monitoring Well Readings:

Date	Depth (m)	Elev.
Aug. 17/'21	5.0	311.5
Aug. 19/'21	5.0	311.5

Monitoring Well Legend:

- Monument casing
- Bentonite seal
- Filter sand
- Screen
- Cave-in

+ 3, × 3: Numbers refer to Sensitivity

○ 3% STRAIN AT FAILURE

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RECORD OF BOREHOLE No 21-30

1 OF 1

METRIC

G.W.P. 3059-20-00 LOCATION COORDS: 4 813 948.9 N; 249 478.3 E ORIGINATED BY P.J.

DIST 31 HWY 6 BOREHOLE TYPE Solid Stem Augers COMPILED BY L.Y.

DATUM Geodetic DATE 2021.07.29 LATITUDE 43.463408 LONGITUDE -80.183680 CHECKED BY G.U.

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
321.9	GROUND SURFACE										
0.0 / 321.3	TOPSOIL		1	SS	8		321	○	○		
0.6	SILTY SAND/SANDY SILT, trace gravel to gravelly Compact to very dense, Brown to grey, Moist (TILL)		2	SS	29			○	○		
			3	SS	33		320	○	○		
			4	SS	17			○	○		6 49 (45)
			5	SS	34		319	○	○		
			6	SS	53			○	○		
			7	SS	30		318	○	○		
			8	SS	61			○	○		29 46 (25)
			9	SS	92/25cm		317	○	○		
			10	SS	89			○	○		
			11	SS	75/28cm	▼	316	○	○		
			12	SS	54			○	○		0 30 65 5
311.4							315				
10.5	End of borehole						314				
							313				
							312				

▼ Groundwater level measured upon completion of drilling

NOTES:

1. No cave-in was noted in the borehole upon extraction of augers.
2. Auger refusal on probable boulder was encountered at a depth of 6.7 m (EL. 315.2) below the existing ground surface. Borehole was moved 2.0 m north of the original staked location and drilling was continued.

$+^{3}, \times^{3}$: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

RECORD OF BOREHOLE No 21-31

1 OF 1

METRIC

G.W.P. 3059-20-00 LOCATION COORDS: 4 814 028.5 N; 249 474.5 E ORIGINATED BY P.J.

DIST 31 HWY 6 BOREHOLE TYPE Solid Stem Augers COMPILED BY L.Y.

DATUM Geodetic DATE 2021.08.09 LATITUDE 43.464124 LONGITUDE -80.183736 CHECKED BY G.U.

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
320.2	GROUND SURFACE										
320.0 0.0	TOPSOIL										
0.2	SILTY SAND/SANDY SILT, some gravel Compact to very dense, Brown, moist (TILL)		1	SS	11		320		○		
			2	SS	32				○		14 49 (37)
			3	SS	61		319		○		
			4	SS	81		318		○		
			5	SS	96/28cm		317		○		
			6	SS	50/13cm				○		
			7	SS	70		316		○		15 46 33 6
			8	SS	50/10cm		315		○		
			9	SS	63		314		○		
			10	SS	55	▽	313		○		0 46 (54)
			11	SS	71/25cm	▼	312		○		
			12	SS	59		311		○		
309.8 10.4	End of borehole						310				

▽ Groundwater level observed during drilling

▼ Groundwater level measured upon completion of drilling

NOTE: No cave-in was noted in the borehole upon extraction of augers.

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

RECORD OF BOREHOLE No 21-32

1 OF 1

METRIC

G.W.P. 3059-20-00 LOCATION COORDS: 4 814 013.2 N; 249 379.2 E ORIGINATED BY F.M.

DIST 31 HWY 6 BOREHOLE TYPE Solid Stem Augers COMPILED BY L.Y.

DATUM Geodetic DATE 2021.07.30 LATITUDE 43.463979 LONGITUDE -80.184912 CHECKED BY G.U.

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
325.6	GROUND SURFACE										
0.0	TOPSOIL		1	SS	28		325		○		
324.8											
0.8	SILTY SAND, gravelly to some gravel Compact to very dense, Brown, Moist (TILL)		2	SS	14				○		
			3	SS	31		324				
			4	SS	26		323		○		
			5	SS	43				○		
			6	SS	32		322		○		33 41 21 5
			7	SS	32		321		○		
			8	SS	37		320		○		
			9	SS	28				○		18 48 28 6
317.9			10	SS	50/8cm		319				
7.7	Borehole terminated due to auger refusal						318		○		

NOTES:
1. Groundwater level was not encountered in the borehole during or upon completion of drilling.
2. No cave-in was noted in the borehole upon extraction of augers.

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

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RECORD OF BOREHOLE No 21-33

1 OF 1

METRIC

G.W.P. 3059-20-00 LOCATION COORDS: 4 813 935.1 N; 249 354.5 E ORIGINATED BY F.M.

DIST 31 HWY 6 BOREHOLE TYPE Solid Stem Augers COMPILED BY L.Y.

DATUM Geodetic DATE 2021.07.30 LATITUDE 43.463274 LONGITUDE -80.185210 CHECKED BY G.U.

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa: ○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
326.9	GROUND SURFACE										
0.0	TOPSOIL		1	SS	9				○		
326.1											
0.8	SANDY SILT/SILTY SAND, trace gravel to gravelly Compact to dense, Brown, Moist (TILL)		2	SS	21		326		○		
			3	SS	16		325				1 33 (66)
			4	SS	21		324		○		
			5	SS	19				○		
			6	SS	20		323		○		
			7	SS	27		322		○		
			8	SS	25		321				21 42 31 6
			9	SS	27				○		
							320				
			10	SS	28		319		○		
							318				
			11	SS	35						12 41 41 6
			12	SS	32		317		○		
316.5											
10.4	End of borehole										

NOTES:
1. Groundwater level was not encountered in the borehole during or upon completion of drilling.
2. No cave-in was noted in the borehole upon extraction of augers.

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

RECORD OF BOREHOLE No 21-34

1 OF 1 **METRIC**

G.W.P. 3059-20-00 LOCATION COORDS: 4 814 370.6 N; 249 707.8 E ORIGINATED BY F.M.

DIST 31 HWY 6 BOREHOLE TYPE Manual SPT COMPILED BY L.Y.

DATUM Geodetic DATE 2021.08.11 LATITUDE 43.467221 LONGITUDE -80.180888 CHECKED BY G.U.

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
321.5	GROUND SURFACE										
321.3 0.2	TOPSOIL										
	SILTY SAND/SANDY SILT, trace gravel Loose to very dense, Brown, Moist to wet (TILL)		1	SS	2		321		○		
			2	SS	7				○		
			3	SS	4	▼	320		○		
			4	SS	3	▽			○		29 37 30 4
			5	SS	37		319		○		
			6	SS	41				○		
			7	SS	48		318		○		3 19 63 15
317.1			8	SS	50/10cm				○		
4.4	End of borehole										

▽ Groundwater level observed during drilling

▼ Groundwater level measured upon completion of drilling

NOTE: Borehole caved-in at a depth of 1.8 m (EL. 319.7) below the existing ground surface upon extraction of augers.

$+^{3}$, $\times^{3}$: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

RECORD OF BOREHOLE No 21-35

1 OF 1

METRIC

G.W.P. 3059-20-00 LOCATION COORDS: 4 814 396.6 N; 249 722.2 E ORIGINATED BY F.M.

DIST 31 HWY 6 BOREHOLE TYPE Solid Stem Augers COMPILED BY L.Y.

DATUM Geodetic DATE 2021.07.16 LATITUDE 43.467194 LONGITUDE -80.180628 CHECKED BY G.U.

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
321.7	GROUND SURFACE										
0.0	TOPSOIL		1	SS	3				○		
320.9							321				
0.8	SANDY SILT, trace gravel Loose to dense, Brown, Moist to wet (TILL)		2	SS	12				○		
			3	SS	14		320		○		
			4	SS	20		319		○		0 18 69 13
			5	SS	20		318		○		
			6	SS	28	▼			○		
			7	SS	22	▽	317		○		
			8	SS	24		316		○		
	Silt, Compact		9	SS	20				○		0 4 87 9
			10	SS	31		314		○		
			11	SS	20		313		○		
			12	SS	6		312		○		
311.2											
10.5	End of borehole										

▽ Groundwater level observed during drilling

▼ Groundwater level measured upon completion of drilling

NOTE: Borehole caved-in at a depth of 4.3 m (EL. 315.2) below the existing ground surface upon extraction of augers.

+ 3, × 3: Numbers refer to Sensitivity

○ 3% STRAIN AT FAILURE

RECORD OF BOREHOLE No 21-36

1 OF 1

METRIC

G.W.P. 3059-20-00 LOCATION COORDS: 4 814 435.7 N; 249 720.9 E ORIGINATED BY F.M.

DIST 31 HWY 6 BOREHOLE TYPE Manual SPT COMPILED BY L.Y.

DATUM Geodetic DATE 2021.08.11 - 2021.08.16 LATITUDE 43.467808 LONGITUDE -80.180731 CHECKED BY G.U.

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa: ○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
325.1	GROUND SURFACE										
0.0 / 324.5	TOPSOIL		1	SS	6		325		○		
0.6	SILTY SAND/SANDY SILT, some gravel Compact to very dense, Brown, Moist (TILL)		2	SS	23				○		
			3	SS	52		324		○		
			4	SS	65		323		○		10 39 43 8
			5	SS	68				○		
	gravelly		6	SS	110		322		○		43 37 (20)
321.5											
3.6	End of borehole										

NOTES:

1. Groundwater level was not encountered during or upon completion of drilling
2. Cave-in was not noted in the borehole upon extraction of augers.
3. Split spoon refusal was encountered at a depth of 1.8 m (EL. 323.3) below the existing ground surface. Borehole was moved 6.0 m south of the original staked location and drilling was continued.

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

RECORD OF BOREHOLE No 21-37

1 OF 1

METRIC

G.W.P. 3059-20-00 LOCATION COORDS: 4 814 416.7 N; 249 749.6 E ORIGINATED BY F.M.

DIST 31 HWY 6 BOREHOLE TYPE Solid Stem Augers COMPILED BY L.Y.

DATUM Geodetic DATE 2021.07.15 LATITUDE 43.467638 LONGITUDE -80.180376 CHECKED BY G.U.

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa: ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
321.1	GROUND SURFACE						321				
321.0	TOPSOIL										
0.2	SANDY SILT/SILTY SAND, gravelly Loose to dense, Brown, Moist to wet (TILL)		1	SS	8				○		
			2	SS	22		320		○		
			3	SS	15				○		
			4	SS	14		319		○		3 24 65 8
			5	SS	15		318		○		
			6	SS	14				○		
			7	SS	21		317		○		
			8	SS	34				○		
	Sandy gravel, Dense to very dense		9	SS	54		316		○		40 44 (16)
			10	SS	37		315		○		
311.9			11	SS	100/10cm		314		○		
9.2	End of borehole						313				
							312				

NOTES:
1. Groundwater level was not encountered in the borehole during or upon completion of drilling.
2. Borehole caved-in at a depth of 6.7 m (EL. 314.4) below the existing ground surface upon extraction of augers.

$+^{3}, \times^{3}$: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

RECORD OF BOREHOLE No 21-38

1 OF 1

METRIC

G.W.P. 3059-20-00 LOCATION COORDS: 4 814 365.8 N; 249 790.9 E ORIGINATED BY F.M.

DIST 31 HWY 6 BOREHOLE TYPE Solid Stem Augers COMPILED BY L.Y.

DATUM Geodetic DATE 2021.07.16 LATITUDE 43.467184 LONGITUDE -80.179860 CHECKED BY G.U.

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa: ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
319.7	GROUND SURFACE										
319.6 / 0.1	TOPSOIL										
319.5 / 0.2	SILTY SAND/SANDY SILT, trace gravel to gravelly Loose to very dense, Brown, Moist (TILL)		1	SS	4		319		○		
			2	SS	6				○		
			3	SS	15		318		○		7 21 61 11
			4	SS	11	▼	317		○		
			5	SS	31				○		
			6	SS	36		316		○		22 49 25 4
			7	SS	40		315		○		
			8	SS	51		314		○		
			9	SS	83		313		○		
			10	SS	37		312		○		
			11	SS	45		311		○		
310.0 / 9.7	End of borehole						310				

▼ Groundwater level measured upon completion of drilling

NOTE: Borehole caved-in at a depth of 3.0 m (EL. 316.7) below the existing ground surface upon extraction of augers.

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

RECORD OF BOREHOLE No 21-39

1 OF 1

METRIC

G.W.P. 3059-20-00 LOCATION COORDS: 4 814 284.1 N; 249 889.9 E ORIGINATED BY F.M.

DIST 31 HWY 6 BOREHOLE TYPE Solid Stem Augers COMPILED BY L.Y.

DATUM Geodetic DATE 2021.07.15 LATITUDE 43.466455 LONGITUDE -80.178628 CHECKED BY G.U.

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
318.0	GROUND SURFACE										
0.0	SANDY SILT, trace gravel Compact to very dense, Brown, Moist (FILL)		1	SS	29				○		
			2	SS	74		317		○		
316.5											
1.5	SILT, some clay, some sand Very loose to very dense, Brown, Moist (TILL)		3	SS	7				○		
			4	SS	5		316		○		
			5	SS	WH		315		○		1 20 65 14
			6	SS	53		314		○		
			7	SS	11		313		○		
312.7											
5.3	SANDY GRAVEL, some silt Dense to very dense, Brown, Moist (TILL)		8	SS	46	▽	312		○		34 32 28 6
			9	SS	37				○		
			10	SS	32		311		○		
			11	SS	35		310		○		43 42 12 3
			12	SS	61		309		○		
307.5							308				
10.5	End of borehole										

WH Split spoon penetration due to weight of hammer and rods

▽ Groundwater level observed during drilling

NOTES:

1. Groundwater level was not encountered in the borehole upon completion of drilling.
2. No cave-in was noted in the borehole upon extraction of augers.

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

ONTARIO MTO 17TF006A - PART A_AUGUST 11 2021-NL.GPJ ONTARIO MTO.GDT 10/12/21

RECORD OF BOREHOLE No 21-40

1 OF 1

METRIC

G.W.P. 3059-20-00 LOCATION COORDS: 4 814 292.3 N; 249 854.9 E ORIGINATED BY F.M.

DIST 31 HWY 6 BOREHOLE TYPE Solid Stem Augers COMPILED BY L.Y.

DATUM Geodetic DATE 2021.07.16 LATITUDE 43.466526 LONGITUDE -80.179061 CHECKED BY G.U.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa: ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES						GR SA SI CL
318.5	GROUND SURFACE										
318.3 0.2	TOPSOIL										
	SILT, some clay, trace sand Very loose to loose, Brown, Moist (TILL)		1	SS	7		318		○		
			2	SS	3				○		
			3	SS	4		317		○		
			4	SS	5		316		○		0 11 70 19
315.4											
3.1	SANDY GRAVEL, some silt Compact to very dense, BRown, Moist to wet (TILL)		5	SS	13		315		○		
			6	SS	48				○		
			7	SS	67		314		○		
			8	SS	100/20cm		313		○		
			9	SS	77	▼	312		○		
						▽					
			10	SS	53		311		○		47 39 (14)
							310				
			11	SS	37		309		○		
308.8											
9.8	End of borehole										

▽ Groundwater level observed during drilling

▼ Groundwater level measured upon completion of drilling

NOTE: Borehole caved-in at a depth of 7.0 m (EL. 311.5) below the existing ground surface upon extraction of augers.

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

RECORD OF BOREHOLE No 21-41

1 OF 1 **METRIC**

G.W.P. 3059-20-00 LOCATION COORDS: 4 814 246.8 N; 249 895.5 E ORIGINATED BY P.J.

DIST 31 HWY 6 BOREHOLE TYPE Solid Stem Augers COMPILED BY L.Y.

DATUM Geodetic DATE 2021.07.19 LATITUDE 43.466120 LONGITUDE -80.178555 CHECKED BY G.U.

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
319.2	GROUND SURFACE										
319.0 0.0	TOPSOIL										
0.2	SANDY SILT, trace gravel Loose, Brown, Moist (FILL)		1	SS	7		319		○		
317.8			2	SS	7		318		○		1 27 55 17
1.4	SANDY SILT, trace gravel to gravelly Compact to very dense, Brown, Moist (TILL)		3	SS	12				○		
			4	SS	50/8cm		317		○		
315.5			5	SS	19		316		○		24 34 34 8
3.7	End of borehole										

NOTES:
1. Groundwater level was not encountered in the borehole during or upon completion of drilling.
2. No cave-in was noted in the borehole upon extraction of augers.

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

RECORD OF BOREHOLE No 21-42

1 OF 1

METRIC

G.W.P. 3059-20-00 LOCATION COORDS: 4 814 206.7 N; 249 950 E ORIGINATED BY P.J.

DIST 31 HWY 6 BOREHOLE TYPE Solid Stem Augers COMPILED BY L.Y.

DATUM Geodetic DATE 2021.07.19 LATITUDE 43.465763 LONGITUDE -80.177878 CHECKED BY G.U.

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
321.1	GROUND SURFACE										
0.0 / 320.7	TOPSOIL		1	SS	9		321		○		
0.4	SILTY SAND/SANDY SILT, trace gravel to gravelly Compact to very dense, Brown, Moist (TILL)		2	SS	12		320		○		
			3	SS	15				○		21 39 33 7
			4	SS	17		319		○		
			5	SS	35		318		○		
			6	SS	50/13cm				○		3 16 69 12
			7	SS	48		317		○		
			8	SS	47		316		○		
			9	SS	79		315		○		
			10	SS	85		314		○		1 10 64 25
			11	SS	50/13cm	▽	313		○		
311.1			12	SS	50/14cm		312		○		
10.0	End of borehole										

▽ Groundwater level observed during drilling

NOTE: Borehole caved-in at a depth of 10.4 m (EL. 310.7) below the existing ground surface upon extraction of augers.

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

ONTARIO MTO 17TF006A - PART A_AUGUST 11 2021-NL.GPJ ONTARIO MTO.GDT 10/12/21

RECORD OF BOREHOLE No 21-43

1 OF 1

METRIC

G.W.P. 3059-20-00 LOCATION COORDS: 4 814 120.8 N; 250 017.4 E ORIGINATED BY P.J.

DIST 31 HWY 6 BOREHOLE TYPE Solid Stem Augers COMPILED BY L.Y.

DATUM Geodetic DATE 2021.07.19 LATITUDE 43.464994 LONGITUDE -80.177036 CHECKED BY G.U.

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
312.4	GROUND SURFACE										
312.2 / 0.2	TOPSOIL										
	SANDY SILT, trace to some clay, trace gravel Loose, Brown, Moist (FILL)		1	SS	3		312		○		
			2	SS	7				○		
310.9 / 1.5	SANDY GRAVEL, some silt Compact to very dense, Brown, Wet to moist (TILL)		3	SS	19	▽	311		○		
			4	SS	20	▽	310		○		
			5	SS	50		309		○		45 42 (13)
			6	SS	32				○		
			7	SS	28		308		○		
			8	SS	21		307		○		37 41 17 5
			9	SS	50/13cm				○		
305.4 / 7.0	Borehole terminated due to auger refusal						306				

▽ Groundwater level observed during drilling

▼ Groundwater level measured in monitoring well

NOTE: Borehole caved-in at a depth of 6.7 m (EL. 305.7) below the existing ground surface upon extraction of augers.

Monitoring Well Readings:

Date	Depth (m)	Elev.
Aug. 04/'21	1.9	310.6
Aug. 09/'21	2.1	310.3
Aug. 11/'21	2.0	310.4
Aug. 19/'21	2.0	310.4

Monitoring Well Legend:
- Monument casing
- Bentonite seal
- Filter sand
- Screen
- Cave-in

+ 3, × 3: Numbers refer to Sensitivity

○ 3% STRAIN AT FAILURE

RECORD OF BOREHOLE No 21-44

1 OF 2

METRIC

G.W.P. 3059-20-00 LOCATION COORDS: 4 813 138.6 N; 249 747.6 E ORIGINATED BY F.M.

DIST 31 HWY 6 BOREHOLE TYPE Solid Stem Augers, Wash Boring COMPILED BY L.Y.

DATUM Geodetic DATE 2021.07.29 LATITUDE 43.456134 LONGITUDE -80.180272 CHECKED BY G.U.

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
310.5	GROUND SURFACE										
0.0	SILTY SAND, trace gravel Very dense to compact, Brown, moist (FILL)		1	AS			310		○		
			2	SS	58				○		9 48 38 5
			3	SS	17		309				
			4	SS	12		308		○		
307.4											
3.1	SILTY SAND/SANDY SILT, trace gravel Very loose to compact, Brown, Moist (TILL)		5	SS	3		307		○		
			6	SS	16				○		25 41 29 5
			7	SS	16		306		○		21 69 9 1
			8	SS	16		305		○		
	Very dense		9	SS	64				○		
	Compact to dense		10	SS	26		303		○		5 15 67 13
			11	SS	38		301		○		
			12	SS	24		299		○		
298.2	rock fragments, very dense		13	SS	50/8cm				○		
12.3	End of borehole										

▽ Groundwater level observed during drilling

NOTES:

1. Artesian conditions were encountered at a depth of about 12.2 m (EL. 298.3) below the existing ground surface and rose to an estimated height of 0.4 m (EL. 310.9) above the existing ground surface.

Continued Next Page

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

RECORD OF BOREHOLE No 21-44

2 OF 2 **METRIC**

G.W.P. 3059-20-00 LOCATION COORDS: 4 813 138.6 N; 249 747.6 E ORIGINATED BY F.M.

DIST 31 HWY 6 BOREHOLE TYPE Solid Stem Augers, Wash Boring COMPILED BY L.Y.

DATUM Geodetic DATE 2021.07.29 LATITUDE 43.456134 LONGITUDE -80.180272 CHECKED BY G.U.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa	PLASTIC LIMIT / NATURAL MOISTURE CONTENT / LIQUID LIMIT	UNIT WEIGHT	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	w_P w w_L	γ kN/m³	GR SA SI CL
295.5								○ UNCONFINED + FIELD VANE; ● QUICK TRIAXIAL × LAB VANE	WATER CONTENT (%) 20 40 60		
	2. Due to artesian conditions, a monitoring well was not installed as planned.										
	3. The borehole was backfilled with cement grout immediately after the artesian conditions were encountered.										
	4. No cave-in was noted in the borehole upon extraction of augers.										

$+^{3}, \times^{3}$: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

RECORD OF BOREHOLE No 21-45

1 OF 2

METRIC

G.W.P. 3059-20-00 LOCATION COORDS: 4 813 388.2 N; 249 702.0 E ORIGINATED BY V.L

DIST 31 HWY 6 BOREHOLE TYPE Hollow Stem Augers, Wash Boring COMPILED BY L.Y.

DATUM Geodetic DATE 2021.07.22 LATITUDE 43.458378 LONGITUDE -80.180723 CHECKED BY G.U.

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
311.4	GROUND SURFACE										
0.0	SILTY SAND, some gravel to gravelly Compact to very dense, Brown, moist (FILL)		1	SS	27		311		○		
			2	SS	44				○		
309.6			3	SS	50/13cm		310		○		
1.8	SILT/SILTY SAND, some clay, trace gravel to gravelly Loose to dense, Brown, Moist (TILL) moist to wet		4	SS	21		309		○		18 58 21 3
			5	SS	10		308		○		
			6	SS	9				⊕		
			7	SS	8		307		○		
			8	SS	10		306		○		
			9	SS	14		305		○		
			10	SS	20		304		○		0 0 79 21
			11	SS	34		303		○		
			12	SS	9		302		○		
			13	SS	18		301		○		
			14	SS	9		300		○		
296.6	bedrock fragments		15	SS	50/3cm		299		○		25 52 20 3
14.8	Auger refusal on probable bedrock						298				
							297				

Continued Next Page

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

RECORD OF BOREHOLE No 21-45

2 OF 2 **METRIC**

G.W.P. 3059-20-00 LOCATION COORDS: 4 813 388.2 N; 249 702.0 E ORIGINATED BY V.L

DIST 31 HWY 6 BOREHOLE TYPE Hollow Stem Augers, Wash Boring COMPILED BY L.Y.

DATUM Geodetic DATE 2021.07.22 LATITUDE 43.458378 LONGITUDE -80.180723 CHECKED BY G.U.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P NATURAL MOISTURE CONTENT w LIQUID LIMIT w_L WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES						GR SA SI CL
296.4											

▽ Groundwater level observed during drilling

▼ Groundwater level measured upon completion of drilling

▼ Groundwater level measured in monitoring well

NOTE: Borehole caved-in at a depth of 13.1 m (EL. 298.3) below the existing ground surface upon extraction of augers.

Monitoring Well Readings:

Date	Depth (m)	Elev.
Aug. 04/'21	0.7	310.7
Aug. 09/'21	0.8	310.6
Aug. 19/'21	0.8	310.6

Monitoring Well Legend:

- Flushmount casing
- Bentonite seal
- Filter sand
- Screen
- Cave-in

$+^{3}$, $\times^{3}$: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

RECORD OF BOREHOLE No 21-46

1 OF 1

METRIC

G.W.P. 3059-20-00 LOCATION COORDS: 4 813 425.5 N; 249 650.9 E ORIGINATED BY P.J.

DIST 31 HWY 6 BOREHOLE TYPE Hollow Stem Augers, Wash Boring COMPILED BY L.Y.

DATUM Geodetic DATE 2021.08.16 LATITUDE 43.458710 LONGITUDE -80.181376 CHECKED BY G.U.

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa: ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
310.9	GROUND SURFACE										
0.0	TOPSOIL, organics		1	SS	8				○		
310.1											
0.8	SILTY SAND, trace gravel Compact to very dense, Brown, Moist (TILL)		2	SS	14		310		○		0 62 36 2
			3	SS	32				○		
						▼	309				
			4	SS	27				⊕		
			5	SS	29		308		○		
			6	SS	47		307		○		
			7	SS	34		306		○		
			8	SS	50/13cm				○		
304.8			9	SS	50/4cm		305				
6.1	End of borehole										

▼ Groundwater level measured upon completion of drilling

NOTE:

1. Borehole caved-in at a depth of 2.3 m (EL. 308.6) below the existing ground surface upon extraction of augers.
2. Auger refusal on probable boulder was encountered at a depth of 5.3 m (EL. 305.6) below the existing ground surface. Borehole was moved 3.0 m south of the original staked location and drilling was continued.

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

RECORD OF BOREHOLE No 21-47

1 OF 1

METRIC

G.W.P. 3059-20-00 LOCATION COORDS: 4 813 490.5 N; 249 685.2 E ORIGINATED BY V.L

DIST 31 HWY 6 BOREHOLE TYPE Solid Stem Augers COMPILED BY L.Y.

DATUM Geodetic DATE 2021.07.22 LATITUDE 43.459297 LONGITUDE -80.181077 CHECKED BY G.U.

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
311.6	GROUND SURFACE										
0.0	SANDY SILT/SILTY SAND, some gravel Compact, Brown, Moist to wet (FILL)		1	SS	23		311	○	○		
			2	SS	16				○		
			3	SS	13	▽ ▼	310		○		
309.3											
2.3	SANDY SILT/SILTY SAND, trace gravel to gravelly Very loose to very dense, Brown, Wet (TILL)		4	SS	7		309		○		
			5	SS	3				○		6 34 52 8
			6	SS	3		308		○		
			7	SS	15		307	○			14 52 28 6
			8	SS	12		306		○		
			9	SS	23				○		21 65 13 1
			10	SS	65		305				
							304		○		
			11	SS	31		303				
302.0							302		○		
9.6	End of borehole										

▽ Groundwater level observed during drilling

▼ Groundwater level measured in monitoring well

NOTE: Borehole caved-in at a depth of 2.3 m (EL. 309.3) below the existing ground surface upon extraction of augers.

+ 3, × 3: Numbers refer to Sensitivity

○ 3% STRAIN AT FAILURE

ONTARIO MTO 17TF006A - PART A_AUGUST 11 2021-NL.GPJ ONTARIO MTO.GDT 10/12/21

RECORD OF BOREHOLE No 21-48

1 OF 2

METRIC

G.W.P. 3059-20-00 LOCATION COORDS: 4 813 535.8 N; 249 632.7 E ORIGINATED BY V.L

DIST 31 HWY 6 BOREHOLE TYPE Hollow Stem Augers, Wash Boring COMPILED BY L.Y.

DATUM Geodetic DATE 2021.07.23 LATITUDE 43.459701 LONGITUDE -80.181731 CHECKED BY G.U.

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
312.1	GROUND SURFACE										
0.0	SILTY SAND, trace gravel, trace clay Compact, Brown, Moist (FILL)		1	SS	18		312		○		
310.9			2	SS	16		311		○		
1.3	SILTY SAND/SANDY SILT, trace gravel to gravelly Loose to very dense, Brown, Moist to wet (TILL)		3	SS	23		310		○		
			4	SS	28				○		0 67 30 3
			5	SS	15		309		○		
			6	SS	15		308		○		
			7	SS	7		307		○		
			8	SS	9				○		27 45 25 3
			9	SS	11		306		○		
	Clayey silt, Stiff		10	SS	8		305		○		
			11	SS	43		304		○		22 35 39 4
301.1	bedrock fragments		12	SS	50/3cm		303				
11.0	Auger refusal on probable bedrock						302				

▽ Groundwater level observed during drilling

▼ Groundwater level measured upon completion of drilling

▼ Groundwater level measured in monitoring well

NOTE: No cave-in was noted in the borehole upon extraction of augers.

Monitoring Well Readings:

Date	Depth (m)	Elev.
Aug.04/'21	1.3	310.8
Aug.17/'21	1.4	310.7
Aug.24/'21	1.4	310.7

Continued Next Page

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

RECORD OF BOREHOLE No 21-48 2 OF 2 METRIC

G.W.P. 3059-20-00 LOCATION COORDS: 4 813 535.8 N; 249 632.7 E ORIGINATED BY V.L

DIST 31 HWY 6 BOREHOLE TYPE Hollow Stem Augers, Wash Boring COMPILED BY L.Y.

DATUM Geodetic DATE 2021.07.23 LATITUDE 43.459701 LONGITUDE -80.181731 CHECKED BY G.U.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P NATURAL MOISTURE CONTENT w LIQUID LIMIT w_L WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES						GR SA SI CL
297.1											
	Monitoring Well Legend: Flushmount casing; Bentonite seal; Filter sand; Screen										

$+^{3}$, $\times^{3}$: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

RECORD OF BOREHOLE No 21-49

1 OF 1 **METRIC**

G.W.P. 3059-20-00 LOCATION COORDS: 4 813 590.4 N; 249 649.4 E ORIGINATED BY V.L

DIST 31 HWY 6 BOREHOLE TYPE Solid Stem Augers COMPILED BY L.Y.

DATUM Geodetic DATE 2021.07.21 LATITUDE 43.460194 LONGITUDE -80.181475 CHECKED BY G.U.

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
312.2	GROUND SURFACE										
0.0	GRAVEL, sandy, some silt Dense to compact, Brown, Moist (FILL)		1	SS	39		312		○		
			2	SS	30		311		○		
			3	SS	20	▼			○		73 21 5 1
309.9							310				
2.3	SILTY SAND, gravelly Loose to compact, Brown to grey, Moist to wet (TILL)		4	SS	17				○		34 57 8 1
			5	SS	17		309		○		
			6	SS	17		308		○		
			7	SS	19				○		26 38 32 4
			8	SS	16		307		○		
			9	SS	15		306		○		
			10	SS	8		305		○		
			11	SS	20		304				
302.6							303		○		
9.6	End of borehole										

▽ Groundwater level observed during drilling

▼ Groundwater level measured upon completion of grilling

NOTE: Borehole caved-in at a depth of 2.1 m (EL. 310.1) below the existing ground surface upon extraction of augers.

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

ONTARIO MTO 17TF006A - PART A_AUGUST 11 2021-NL.GPJ ONTARIO MTO.GDT 10/12/21

RECORD OF BOREHOLE No 21-50

1 OF 1

METRIC

G.W.P. 3059-20-00 LOCATION COORDS: 4 814 100.9 N; 249 556.1 E ORIGINATED BY F.M.

DIST 31 HWY 6 BOREHOLE TYPE Solid Stem Augers COMPILED BY L.Y.

DATUM Geodetic DATE 2021.07.21 LATITUDE 43.464782 LONGITUDE -80.182734 CHECKED BY G.U.

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
324.6	GROUND SURFACE										
0.0	TOPSOIL		1	SS	2		324		○		
323.8											
0.8	SILTY SAND, some gravel to gravelly Compact to very dense, Moist (TILL)		2	SS	16				○		
			3	SS	13		323		○		
			4	SS	28		322				14 43 37 6
			5	SS	37				○		
			6	SS	30		321		○		
			7	SS	100/10cm		320				
			8	SS	100/28cm		319		○		
			9	SS	77						15 45 33 7
							318				
316.9			10	SS	100/10cm		317		○		
7.7	End of borehole										

Groundwater level measured in monitoring well

NOTES:
1. Groundwater not encountered during or upon completion of drilling.
2. No cave-in was noted in the borehole upon extraction of augers.

Monitoring Well Readings:

Date	Depth (m)	Elev.
Aug. 04/'21	Dry	---
Aug. 09/'21	6.8	318.7
Aug. 19/'21	Dry	---

Monitoring Well Legend:
- Monument casing
- Soil cuttings and bentonite seal
- Bentonite seal
- Filter sand
- Screen

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

ONTARIO MTO 17TF006A - PART A_AUGUST 11 2021-NL.GPJ ONTARIO MTO.GDT 10/12/21

RECORD OF BOREHOLE No 21-51

1 OF 2

METRIC

G.W.P. 3059-20-00 LOCATION COORDS: 4 814 111.5 N; 249 385.4 E ORIGINATED BY F.M.

DIST 31 HWY 6 BOREHOLE TYPE Solid Stem Augers COMPILED BY L.Y.

DATUM Geodetic DATE 2021.08.04 LATITUDE 43.464865 LONGITUDE -80.184845 CHECKED BY G.U.

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa: ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
325.5	GROUND SURFACE										
0.0	TOPSOIL, organics, alluvium Very loose, Dark brown, Moist		1	SS	3		325		○		
			2	SS	2				○		4 50 (46)
324.0							324				
1.5	SILTY SAND, some gravel to gravelly Compact to very dense, Brown, Moist (TILL)		3	SS	27				○		
			4	SS	37		323		○		
			5	SS	37				○		
			6	SS	53		322		○		
			7	SS	58		321		○		28 45 (27)
			8	SS	50/15cm				○		
			9	SS	48		320		○		
			10	SS	36		319		○		
			11	SS	42		318		○		18 40 32 10
			12	SS	50		317				
314.2							316		○		
11.3	End of borehole						315				

▼ Groundwater level measured in monitoring well

NOTES:
1. Groundwater not encountered during or upon completion of drilling.
2. No cave-in was noted in the borehole upon extraction of augers.

Continued Next Page

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

RECORD OF BOREHOLE No 21-51 2 OF 2 METRIC

G.W.P. 3059-20-00 LOCATION COORDS: 4 814 111.5 N; 249 385.4 E ORIGINATED BY F.M.

DIST 31 HWY 6 BOREHOLE TYPE Solid Stem Augers COMPILED BY L.Y.

DATUM Geodetic DATE 2021.08.04 LATITUDE 43.464865 LONGITUDE -80.184845 CHECKED BY G.U.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P NATURAL MOISTURE CONTENT w LIQUID LIMIT w_L WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES						GR SA SI CL
310.5											

Monitoring Well Readings:

Date	Depth (m)	Elev.
Aug. 09/'21	Dry	---
Aug. 17/'21	Dry	---

Monitoring Well Legend:

- Monument casing
- Soil cuttings and bentonite seal
- Bentonite seal
- Filter sand
- Screen

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

RECORD OF BOREHOLE No 21-52

1 OF 1

METRIC

G.W.P. 3059-20-00 LOCATION COORDS: 4 813 149.7 N; 249 165.5 E ORIGINATED BY F.M.

DIST 31 HWY 6 BOREHOLE TYPE Hollow Stem Augers COMPILED BY L.Y.

DATUM Geodetic DATE 2021.08.17 LATITUDE 43.456191 LONGITUDE -80.187465 CHECKED BY G.U.

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
310.9	GROUND SURFACE										
0.0	TOPSOIL/PEAT		1	SS	3		310				
			2	SS	WH				87.3		
309.4											
1.5	CLAYEY SILT, sandy, trace gravel Firm to stiff, Brown, Moist		3	SS	12	▼	309		H		
			4	SS	6						
307.8							308				
3.1	SANDY SILT, trace to some gravel Compact to dense, Brown, Wet to moist (TILL)		5	SS	12	▽					9 31 45 15
			6	SS	10		307				
			7	SS	10		306				
			8	SS	18		305				
			9	SS	29						
	Very loose		10	SS	1		304				
			11	SS	23		303				
							302				
							301				
299.8			12	SS	43		300				
11.1	End of borehole										

WH Split spoon penetration due to weight of hammer and rods

▽ Groundwater level observed during drilling

▼ Groundwater level measured upon completion of drilling

NOTE: No cave-in was noted in the borehole upon extraction of augers.

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

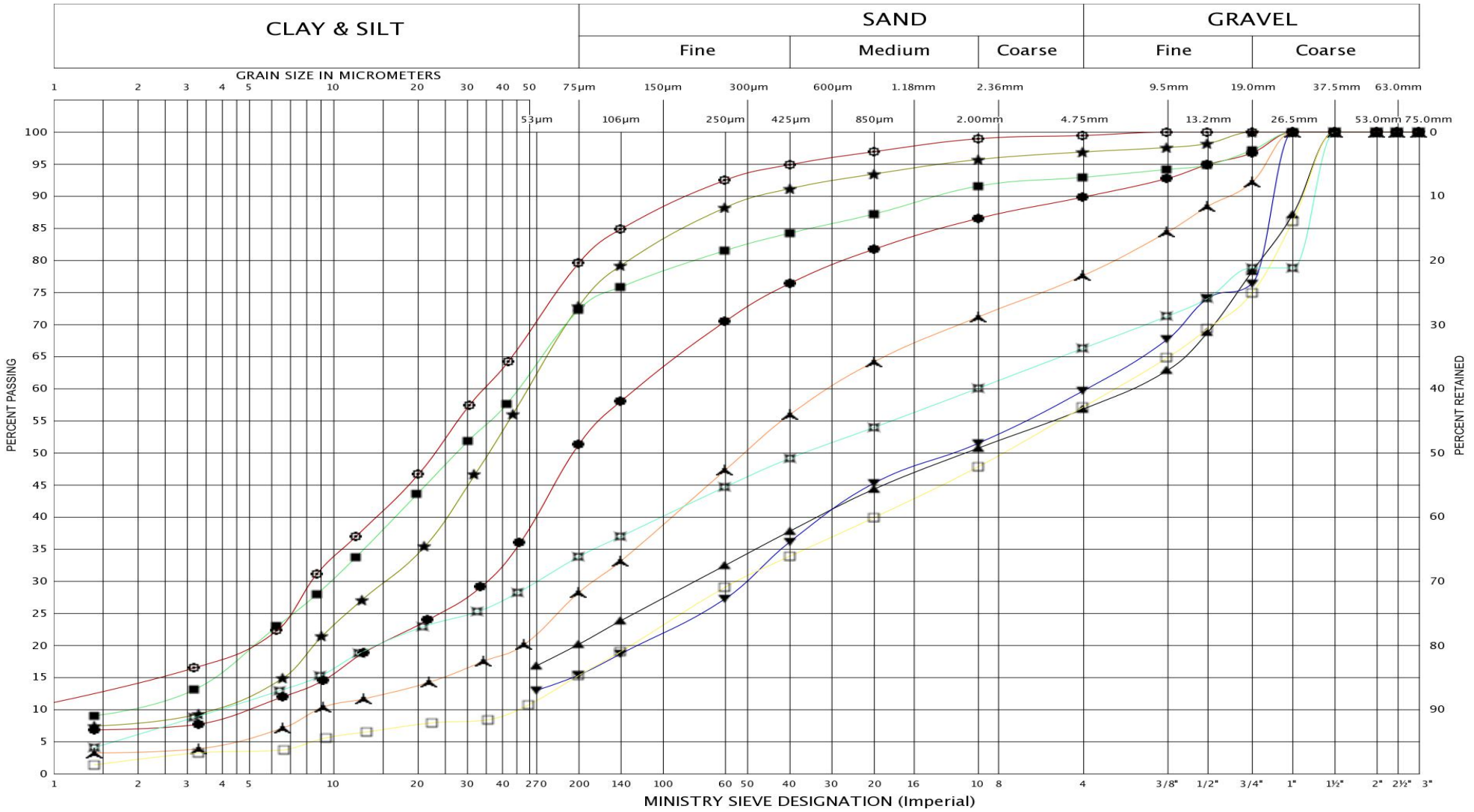
ONTARIO MTO 17TF006A - PART A_AUGUST 11 2021-NL.GPJ ONTARIO MTO.GDT 10/12/21

APPENDIX C

Results of Grain Size Analyses

Results of Atterberg Limit Tests

UNIFIED SOIL CLASSIFICATION SYSTEM



LEGEND	BH	21-36	21-36	21-37	21-37	21-38	21-38	21-39	21-39	21-39
	SAMPLE	4	6	4	9	3	6	5	8	11
	SYMBOL	●	▲	★	▼	■	⅄	⊙	⊠	□

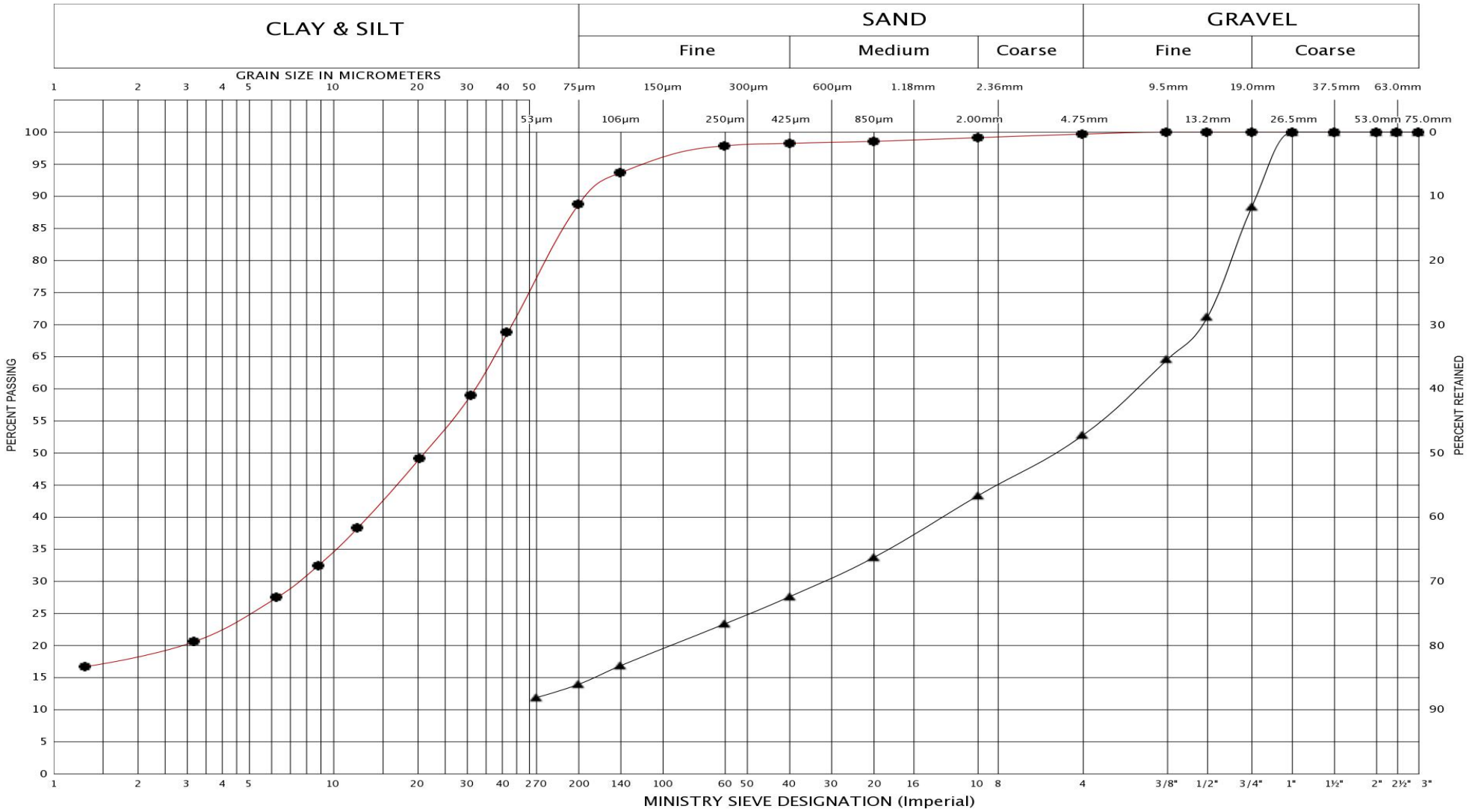
Ontario

GRAIN SIZE DISTRIBUTION

SILTY SAND/SANDY SILT, trace gravel to gravelly (TILL)

FIG No.:	HF1-GS-1A
HWY :	6
GWP	3059-20-00

UNIFIED SOIL CLASSIFICATION SYSTEM



LEGEND	BH	21-40	21-40
	SAMPLE	4	10
	SYMBOL	●	▲

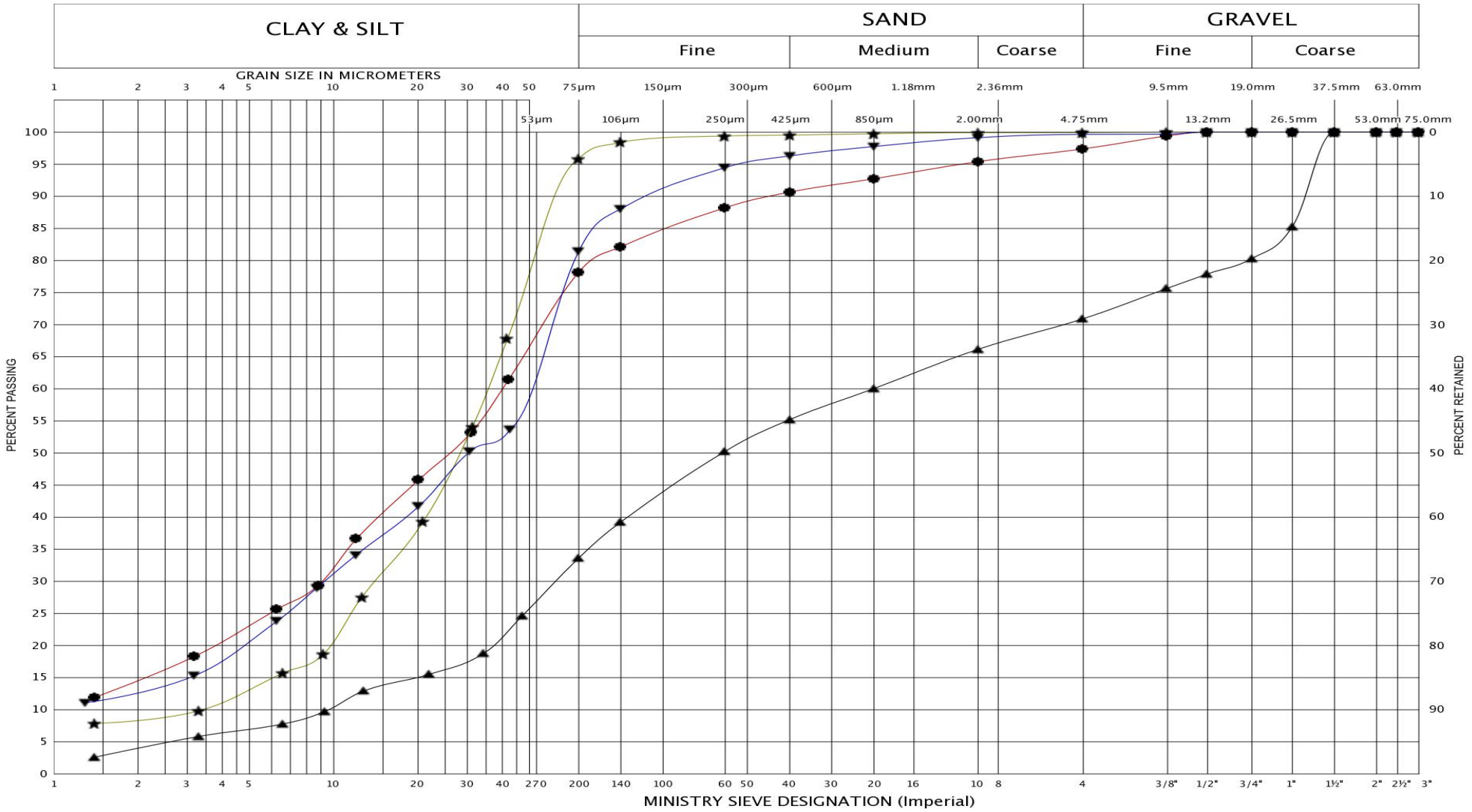
Ontario

GRAIN SIZE DISTRIBUTION

SILTY SAND/SANDY SILT, trace gravel to gravelly (TILL)

FIG No.:	HF1-GS-1B
HWY :	6
GWP	3059-20-00

UNIFIED SOIL CLASSIFICATION SYSTEM



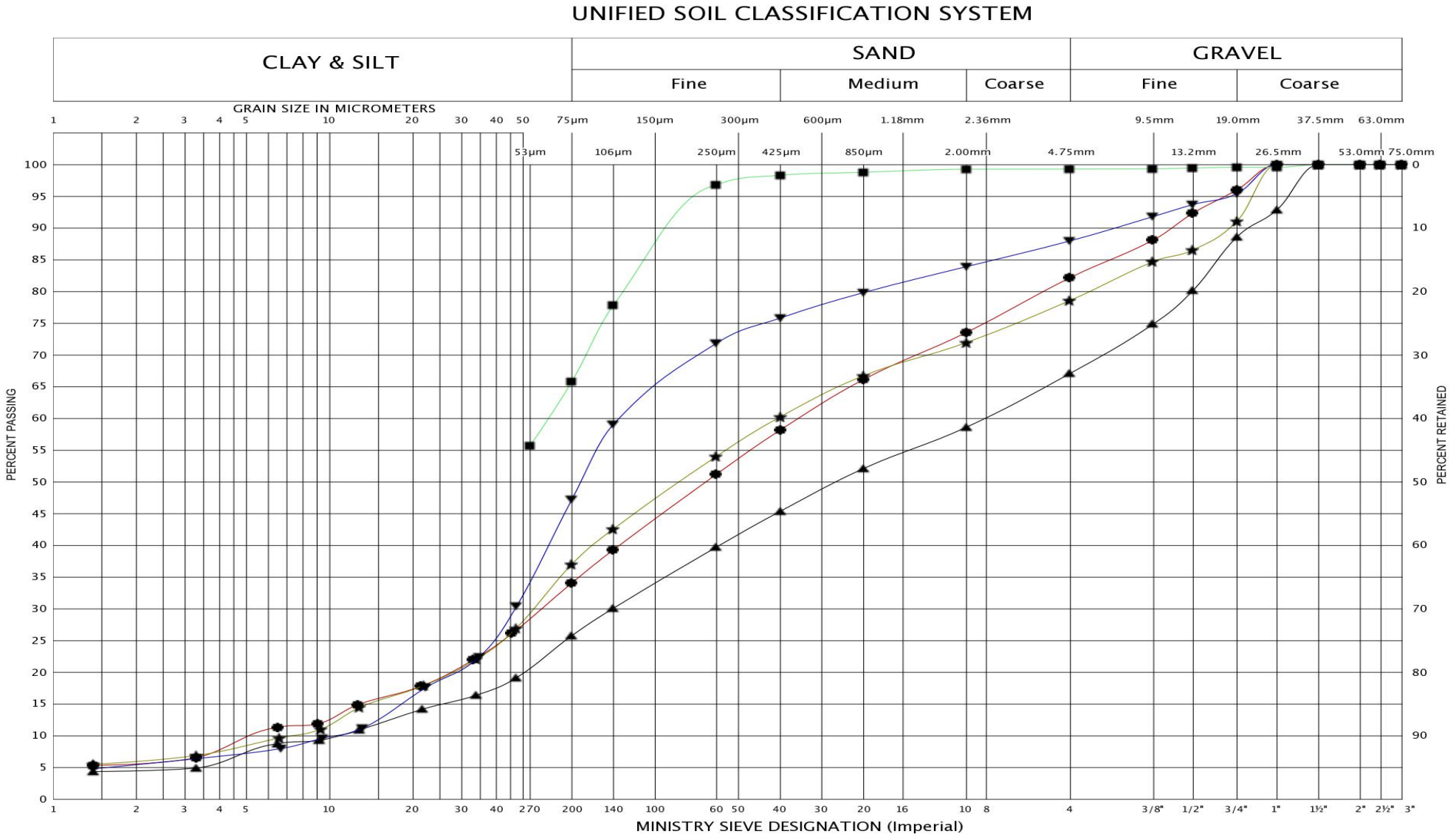
LEGEND	BH	21-34	21-34	21-35	21-35
	SAMPLE	4	7	4	9
	SYMBOL	▲	●	▼	★

Ontario

GRAIN SIZE DISTRIBUTION

SILTY SAND/SANDY SILT, trace gravel (TILL)

FIG No.:	HF2-GS-1
HWY :	6
GWP	3059-20-00



LEGEND	BH	21-32	21-32	21-33	21-33	21-33
	SAMPLE	6	9	3	8	11
	SYMBOL	▲	●	■	★	▼

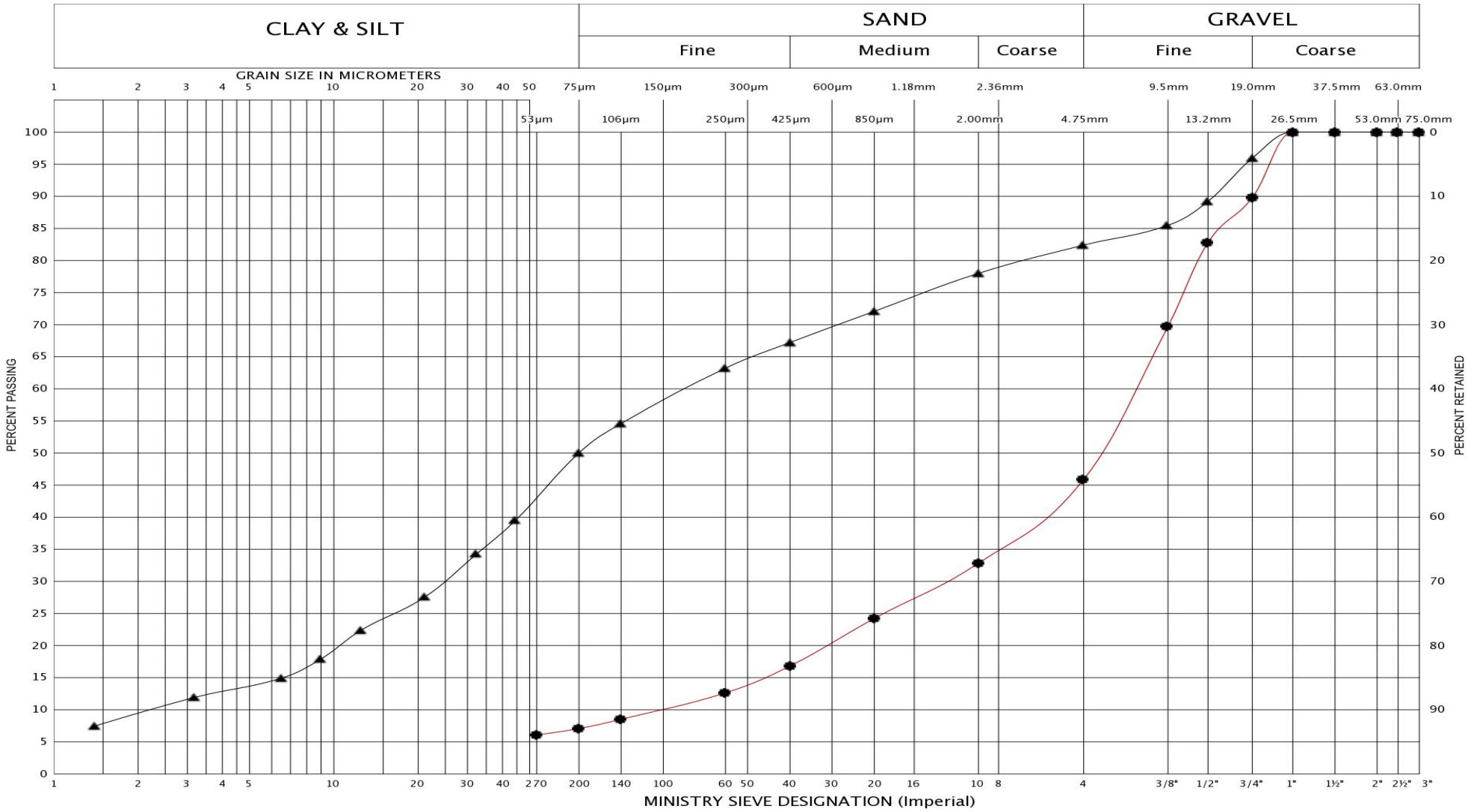
Ontario

GRAIN SIZE DISTRIBUTION

SILTY SAND/SANDY SILT, trace gravel to gravelly (TILL)

FIG No.:	HF3-GS-1
HWY :	6
GWP	3059-20-00

UNIFIED SOIL CLASSIFICATION SYSTEM



LEGEND	BH	21-05	21-07A
	SAMPLE	4	2
	SYMBOL	●	▲

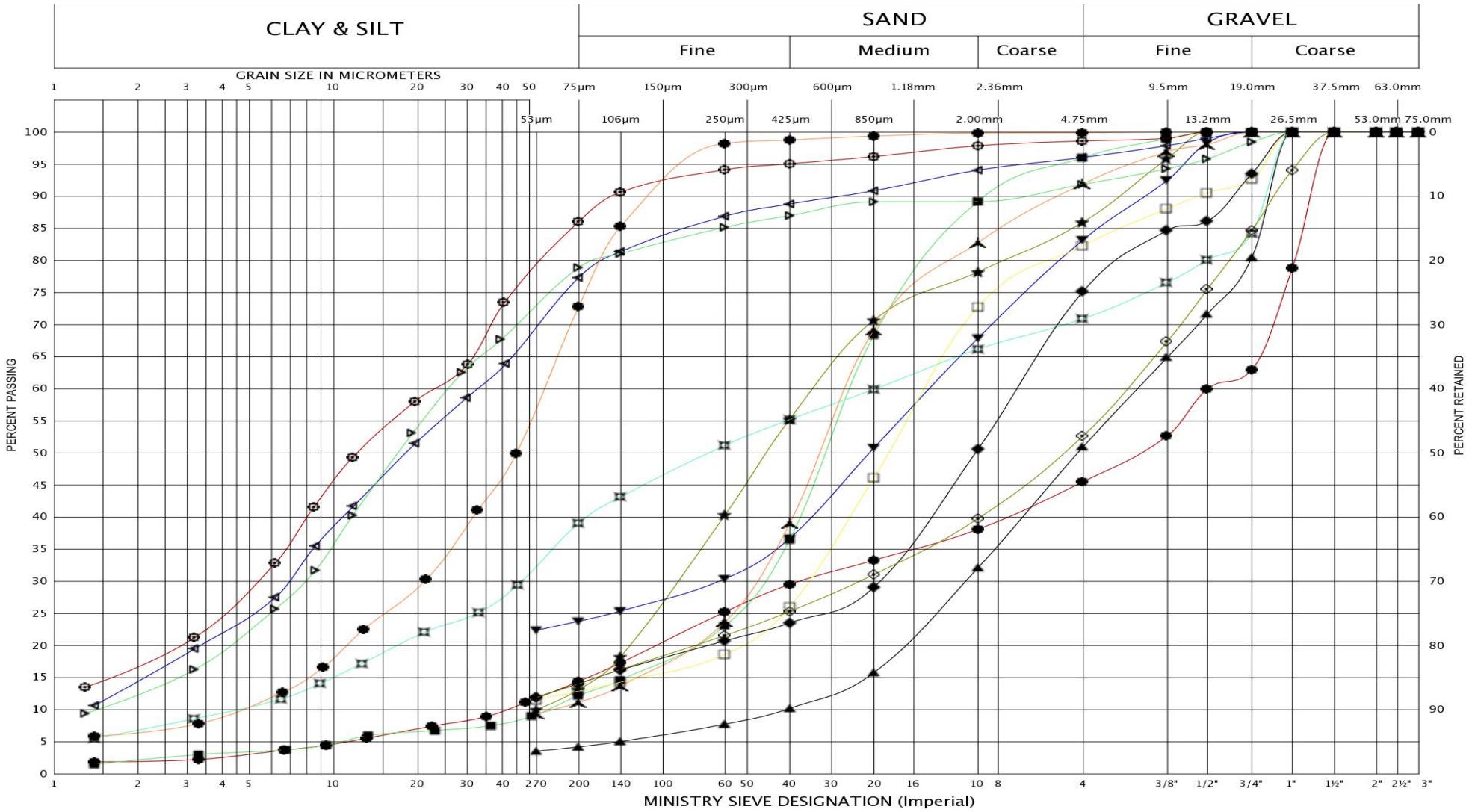
Ontario

GRAIN SIZE DISTRIBUTION

SILTY SAND/SANDY SILT, some gravel to gravelly (FILL)

FIG No.:	HF4-GS-1A
HWY :	6
GWP	3059-20-00

UNIFIED SOIL CLASSIFICATION SYSTEM



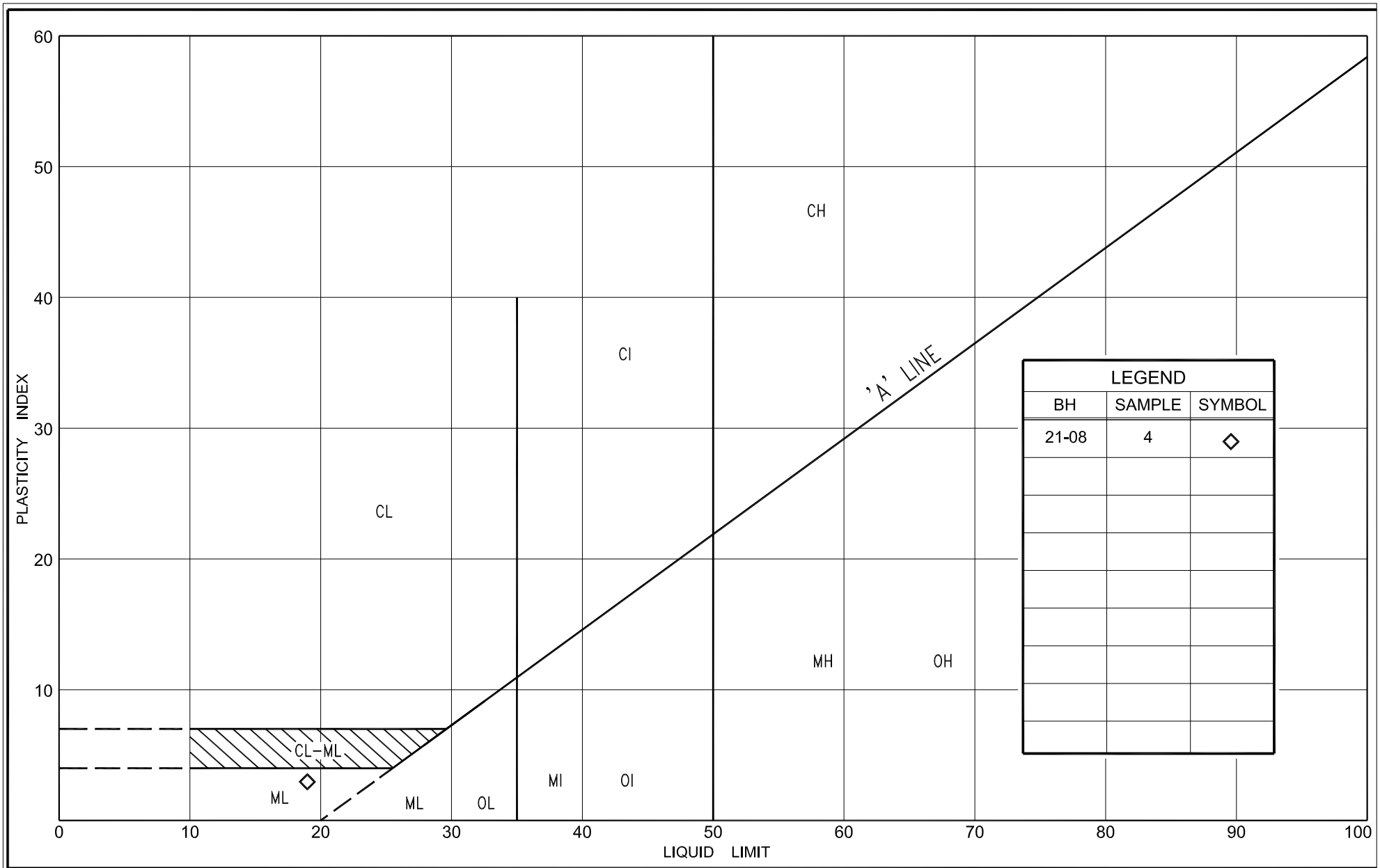
	BH	21-04	21-04	21-05	21-05	21-06	21-06	21-06	21-07	21-07A	21-07	21-07	21-08	21-08	21-08
LEGEND	SAMPLE	6	9	8	11	4	6	9	4	4	7	11	4	8	11
	SYMBOL	●	▲	★	▼	□	■	⅄	◆	◇	⊠	⊕	◗	⬢	◀

Ontario

GRAIN SIZE DISTRIBUTION

SILTY SAND/SANDY SILT, trace gravel to gravelly (Till)

FIG No.:	HF4-GS-1B
HWY :	6
GWP	3059-20-00



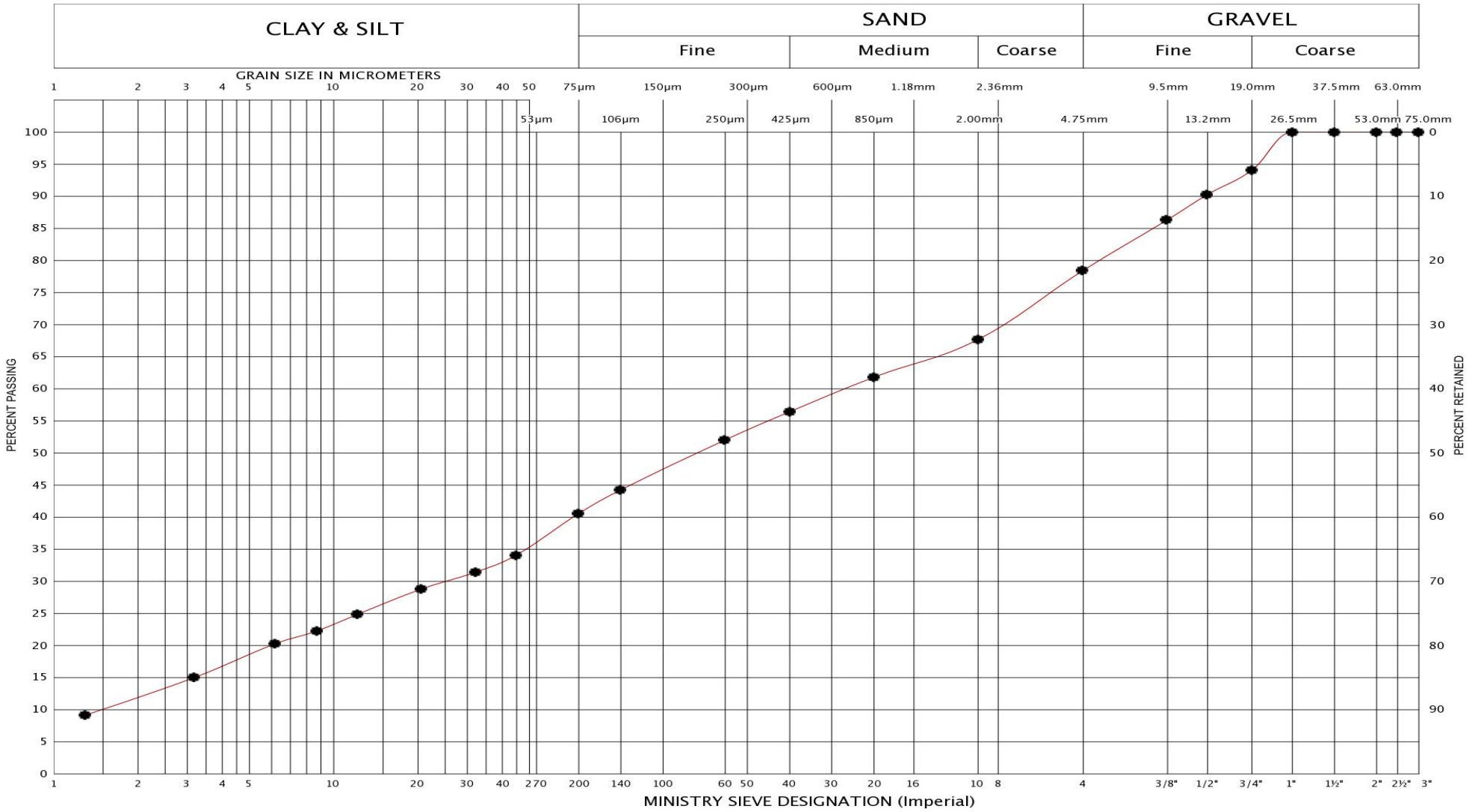
Ontario
Ministry of Transportation

PLASTICITY CHART

SANDY SILT, trace gravel (TILL)

FIG No.	HF4-PC-1
HWY:	6
G.W.P. No.	3059-20-00

UNIFIED SOIL CLASSIFICATION SYSTEM



LEGEND	BH	21-03
	SAMPLE	2
	SYMBOL	●

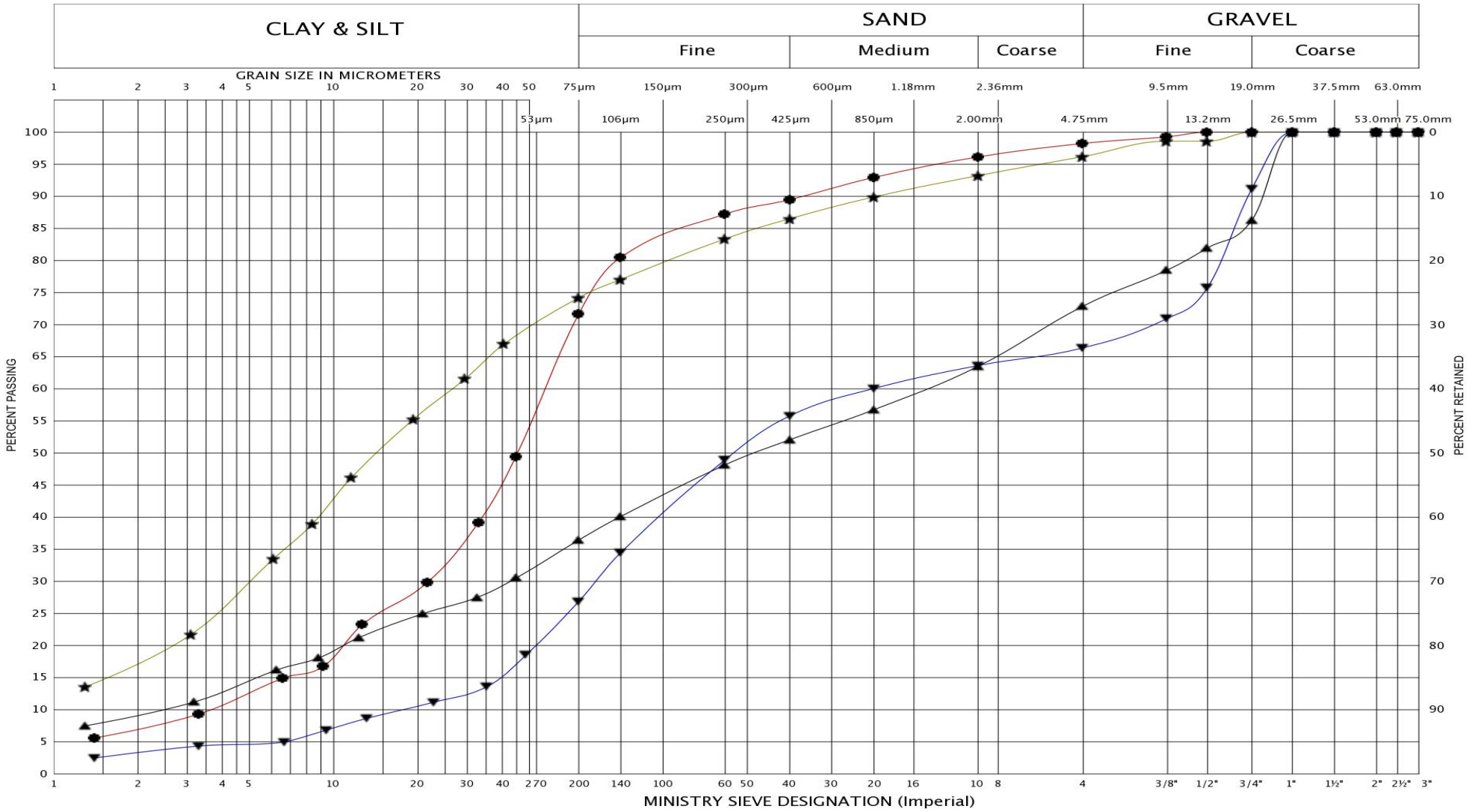
Ontario

GRAIN SIZE DISTRIBUTION

SILTY SAND, gravelly (FILL)

FIG No.:	HF5-GS-1A
HWY :	6
GWP	3059-20-00

UNIFIED SOIL CLASSIFICATION SYSTEM



LEGEND	BH	21-02	21-03	21-03	21-03
	SAMPLE	4	10	12	14
	SYMBOL	●	★	▲	▼

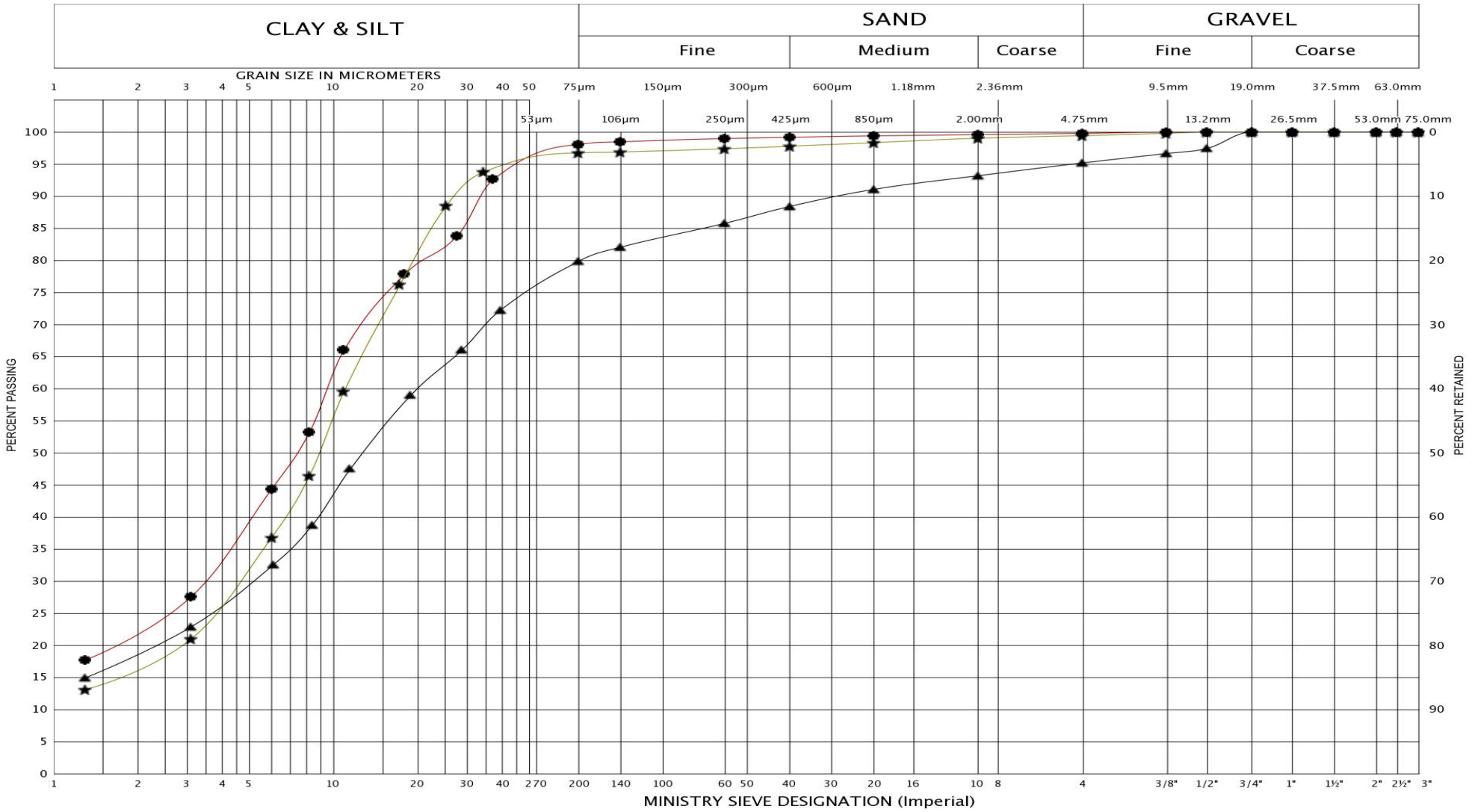
Ontario

GRAIN SIZE DISTRIBUTION

SILTY SAND/SANDY SILT, trace gravel to gravelly (TILL)

FIG No.:	HF5-GS-1B
HWY :	6
GWP	3059-20-00

UNIFIED SOIL CLASSIFICATION SYSTEM



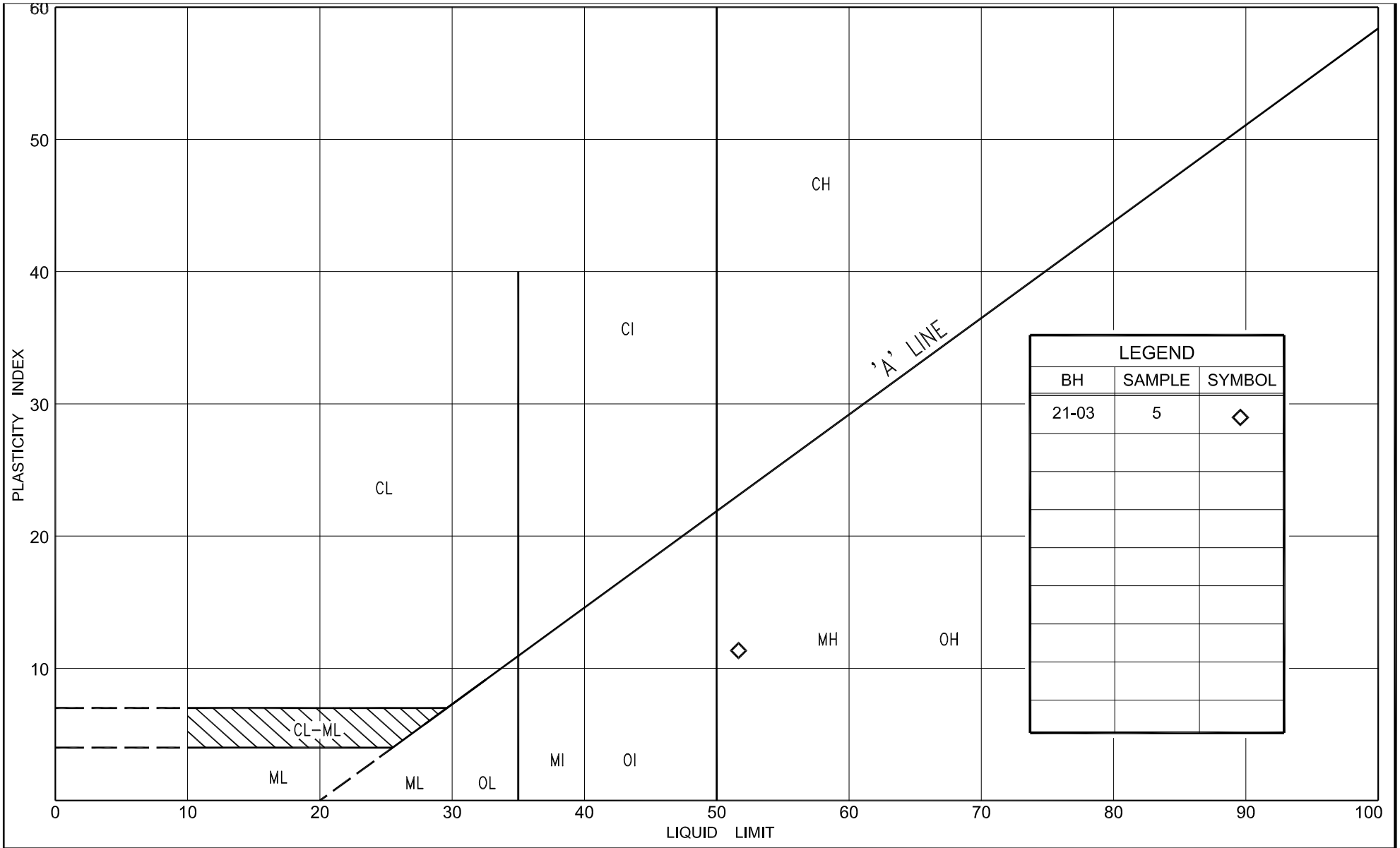
LEGEND	BH	21-01	21-02	21-02
	SAMPLE	7	8	12
	SYMBOL	●	▲	★

Ontario

GRAIN SIZE DISTRIBUTION

CLAYEY SILT, trace sand, trace gravel (TILL)

FIG No.:	HF5-GS-1C
HWY :	6
GWP	3059-20-00

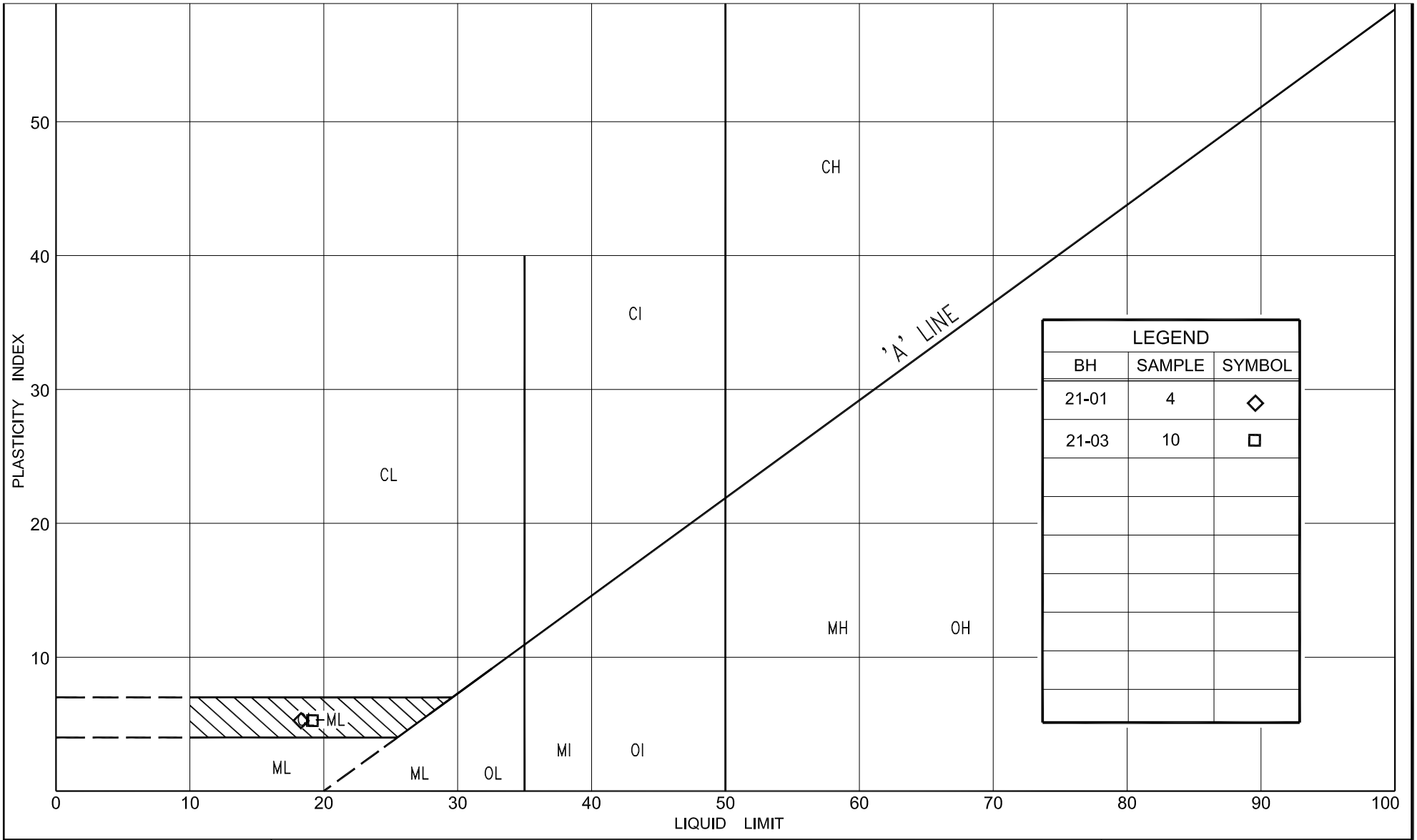


Ontario
Ministry of Transportation

PLASTICITY CHART

SILTY CLAY, peat and organics

FIG No.	HF5-PC-1
HWY:	6
G.W.P. No.	3059-20-00

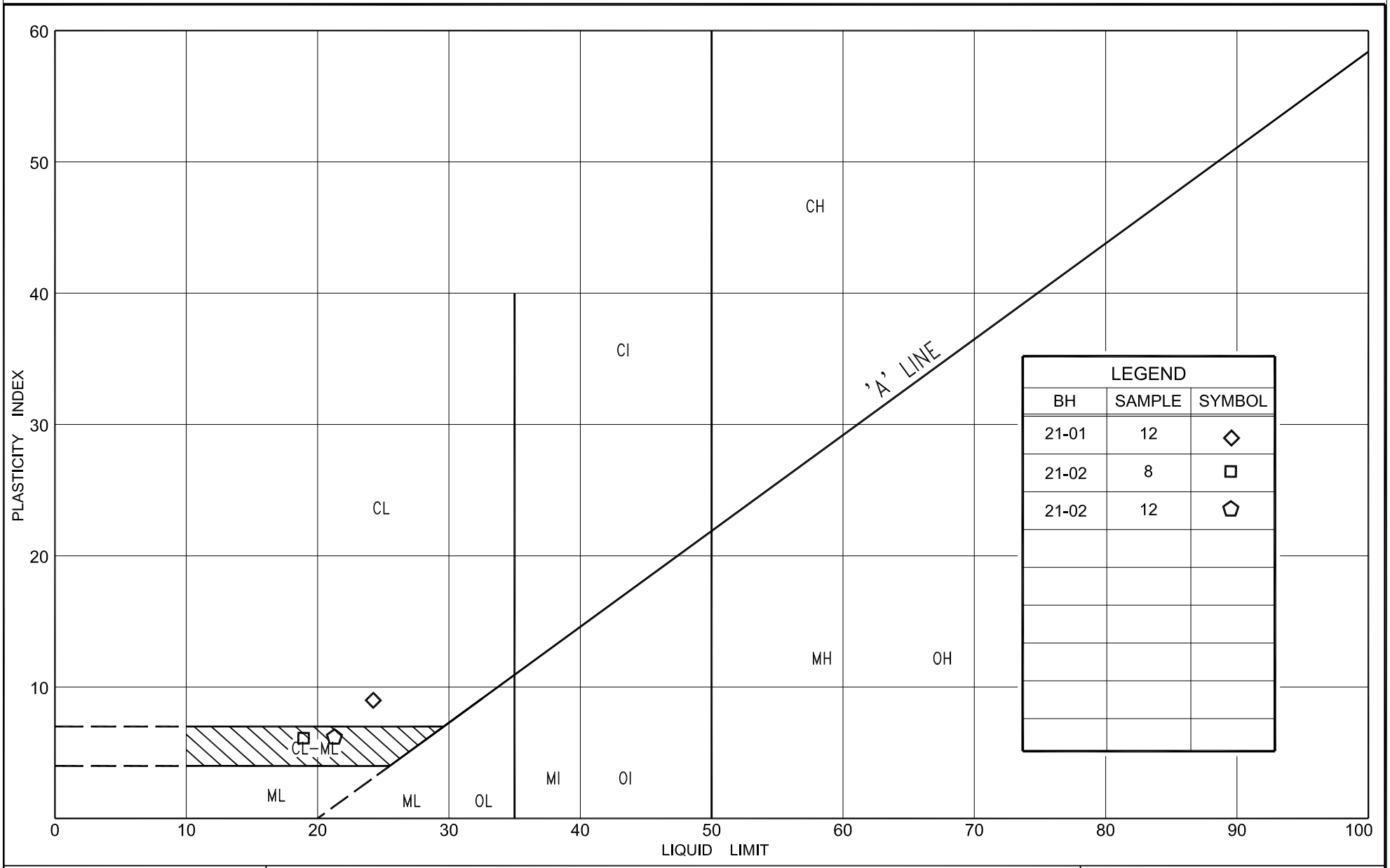


Ontario
Ministry of Transportation

PLASTICITY CHART

SILTY SAND/SANDY SILT, trace gravel to gravelly (TILL)

FIG No.	HF5-PC-2
HWY:	6
G.W.P. No.	3059-20-00



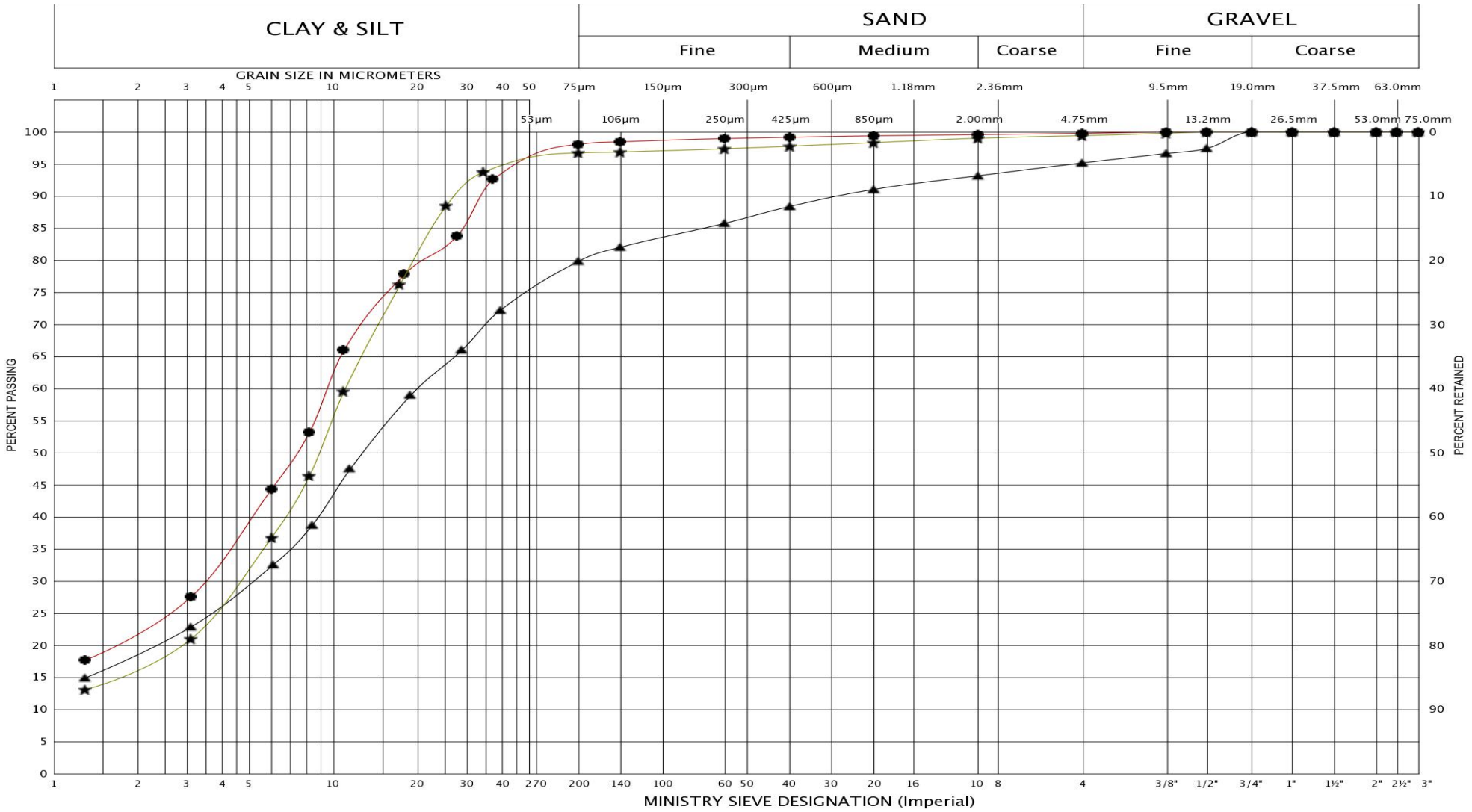
Ontario
Ministry of Transportation

PLASTICITY CHART

CLAYEY SILT, trace sand, trace gravel (TILL)

FIG No.	HF5-PC-3
HWY:	6
G.W.P. No.	3059-20-00

UNIFIED SOIL CLASSIFICATION SYSTEM



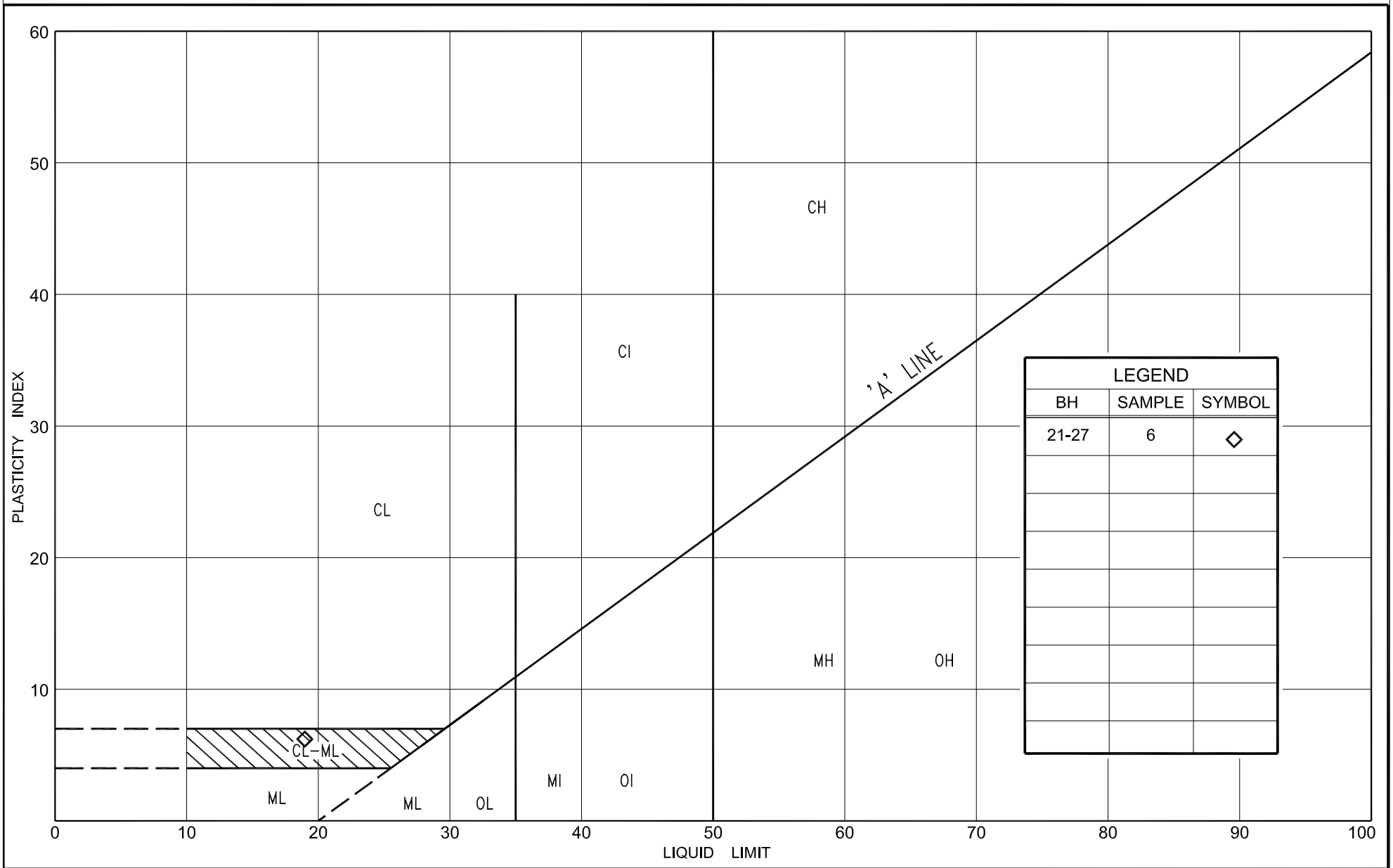
LEGEND	BH	21-26	21-26	21-26	21-27	21-27	21-27	21-28	21-28
	SAMPLE	2	5	11	3	6	9	4	7
	SYMBOL	●	▲	★	■	⅄	▼	□	⊠

Ontario

GRAIN SIZE DISTRIBUTION

SILTY SAND/SANDY SILT, trace gravel to gravelly (TILL)

FIG No.:	HF6-GS-1
HWY :	6
GWP	3059-20-00



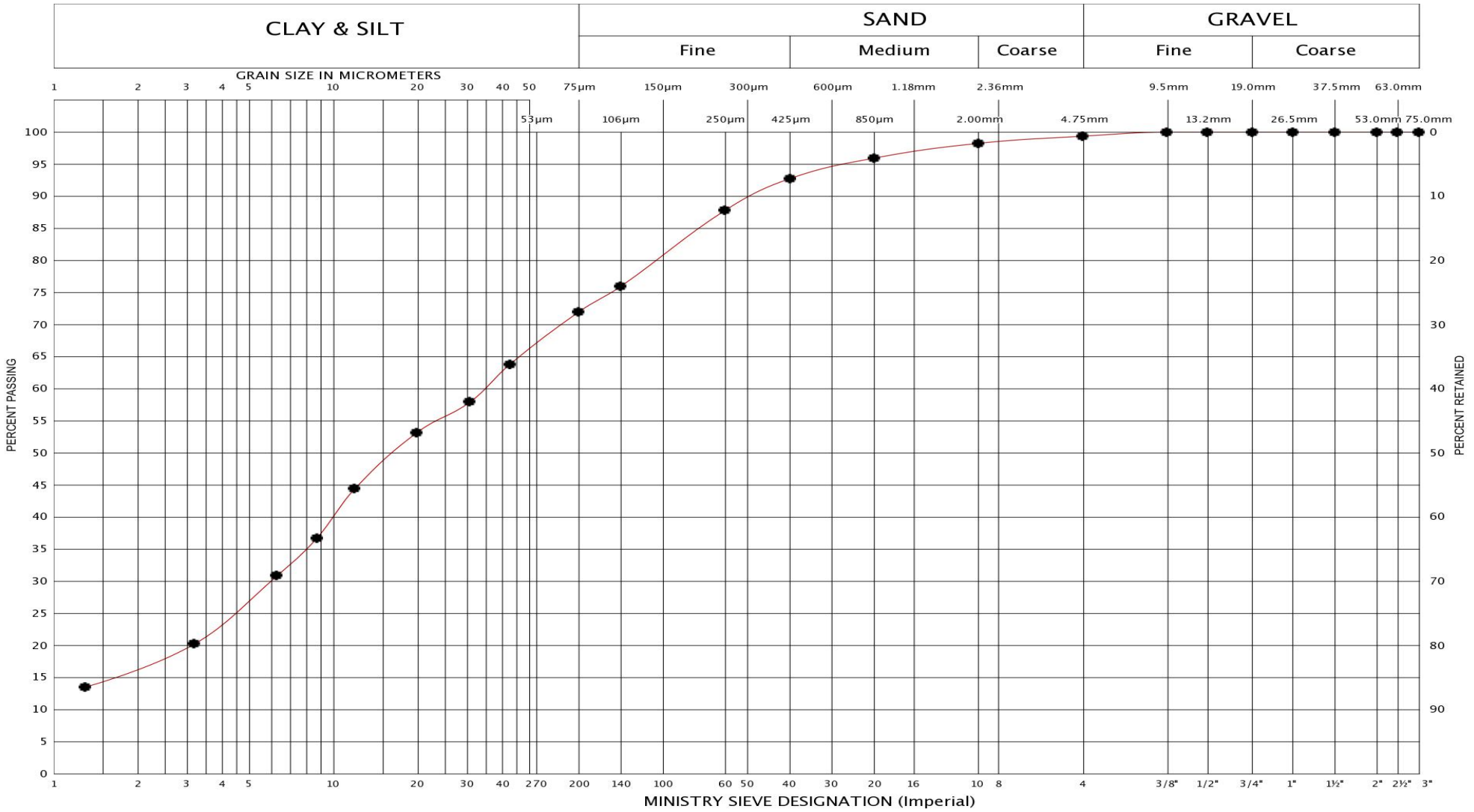
Ontario
Ministry of Transportation

PLASTICITY CHART

SILTY SAND/SANDY SILT, some gravel (TILL)

FIG No.	HF6-PC-1
HWY:	6
G.W.P. No.	3059-20-00

UNIFIED SOIL CLASSIFICATION SYSTEM



LEGEND	BH	21-41
	SAMPLE	2
	SYMBOL	●

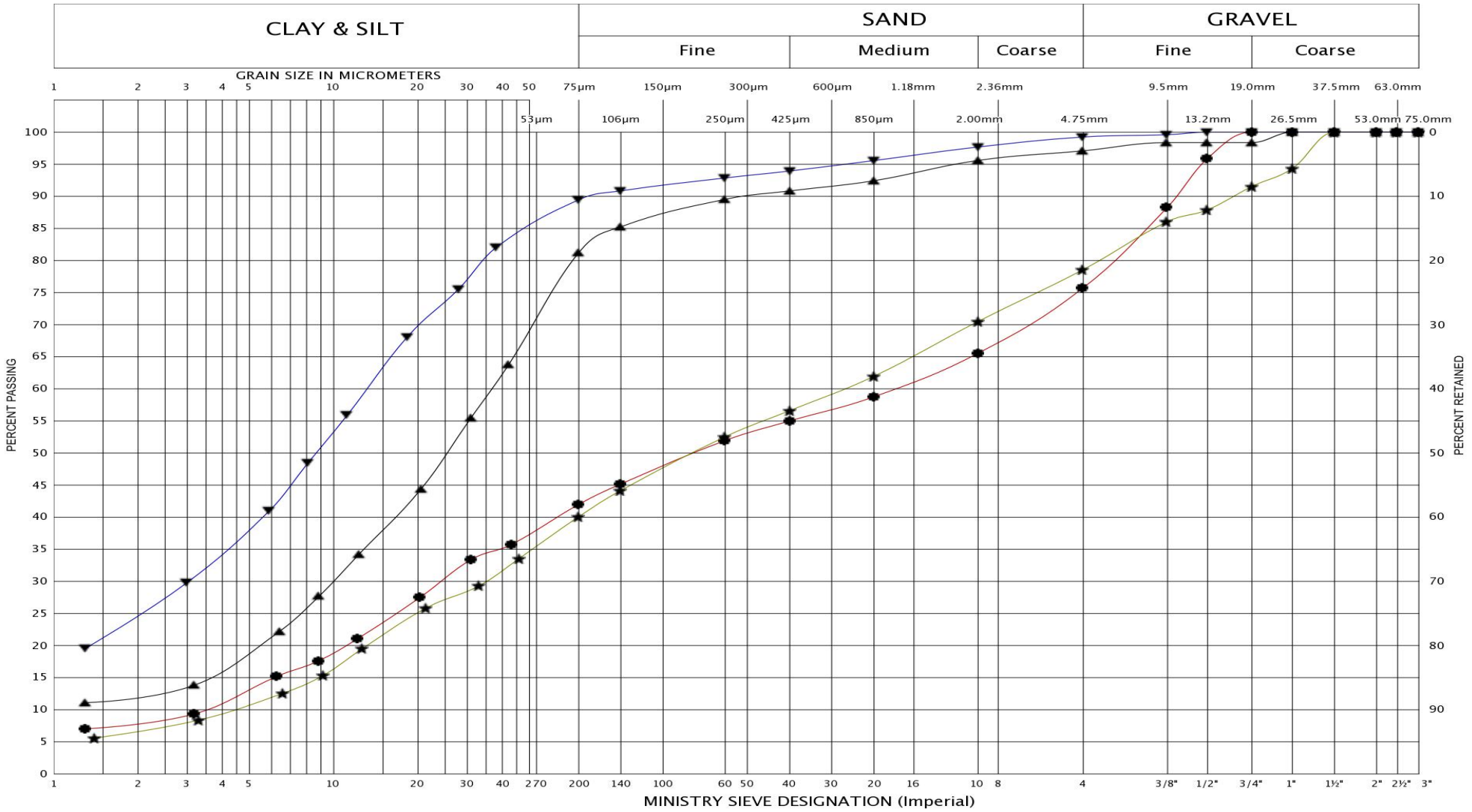
Ontario

GRAIN SIZE DISTRIBUTION

SANDY SILT, trace gravel (FILL)

FIG No.:	DC1-GS-1
HWY :	6
GWP	3059-20-00

UNIFIED SOIL CLASSIFICATION SYSTEM



LEGEND	BH	21-41	21-42	21-42	21-42
	SAMPLE	5	3	6	10
	SYMBOL	●	✱	▲	▼

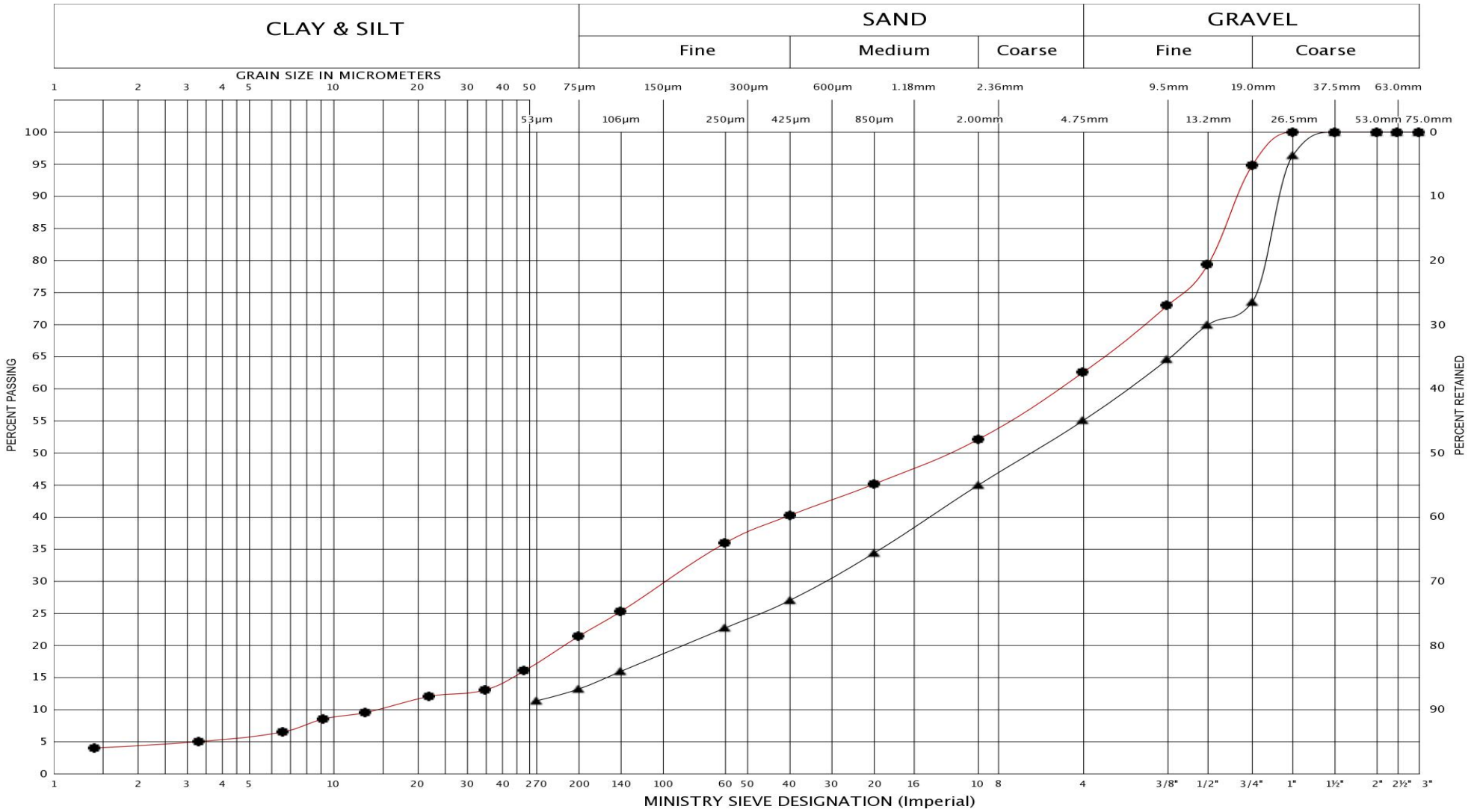
Ontario

GRAIN SIZE DISTRIBUTION

SANDY SILT, trace gravel to gravelly (TILL)

FIG No.:	DC1-GS-2
HWY :	6
GWP	3059-20-00

UNIFIED SOIL CLASSIFICATION SYSTEM



LEGEND	BH	21-43	21-43
	SAMPLE	5	8
	SYMBOL	▲	●

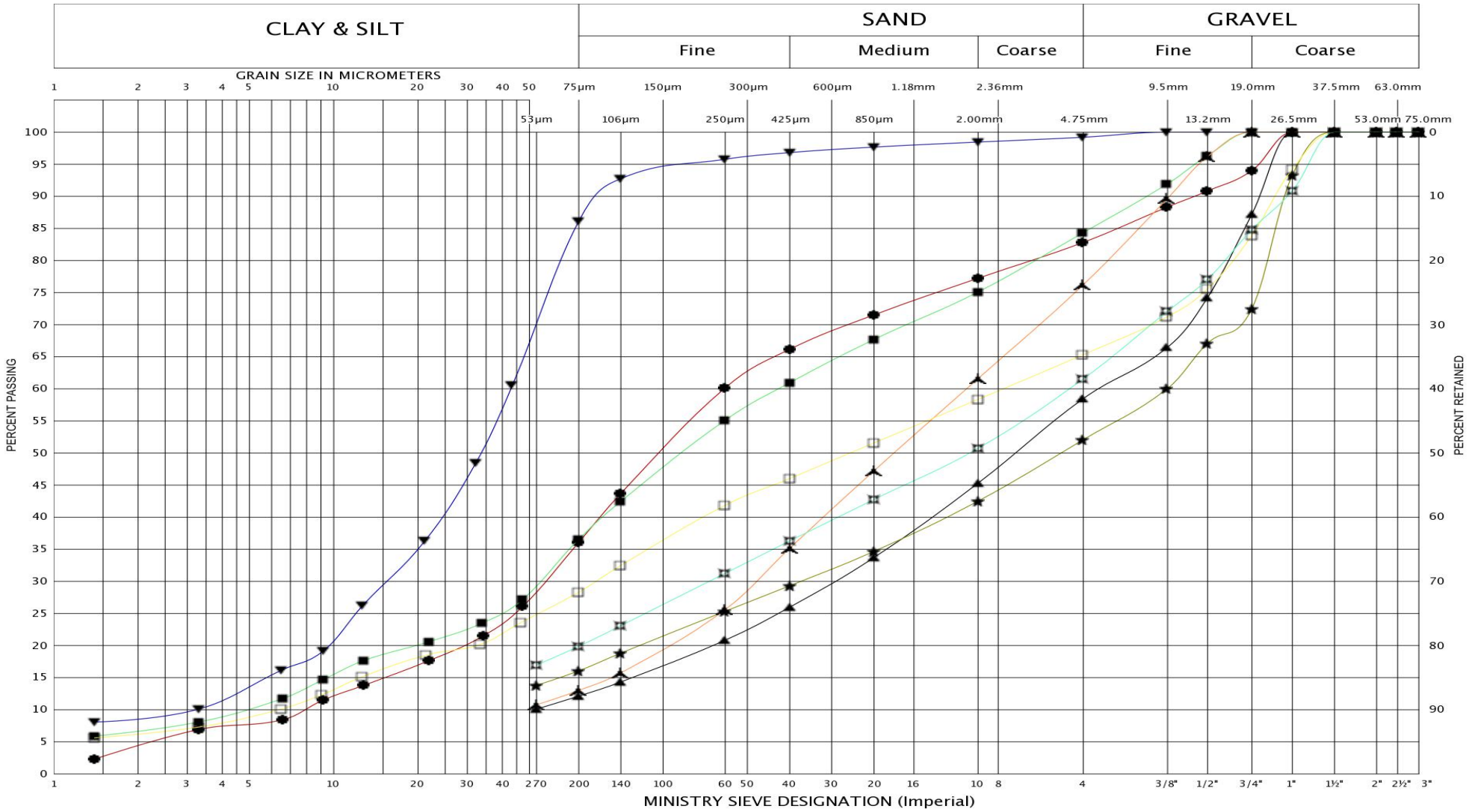
Ontario

GRAIN SIZE DISTRIBUTION

SANDY GRAVEL, some silt (TILL)

FIG No.:	DC1-GS-3
HWY :	6
GWP	3059-20-00

UNIFIED SOIL CLASSIFICATION SYSTEM



LEGEND	BH	21-09	21-09	21-09	21-10	21-10	21-10	21-11	21-11
	SAMPLE	2	5	8	2	6	9	3	7
	SYMBOL	●	✱	▲	▼	■	⅄	□	⊠

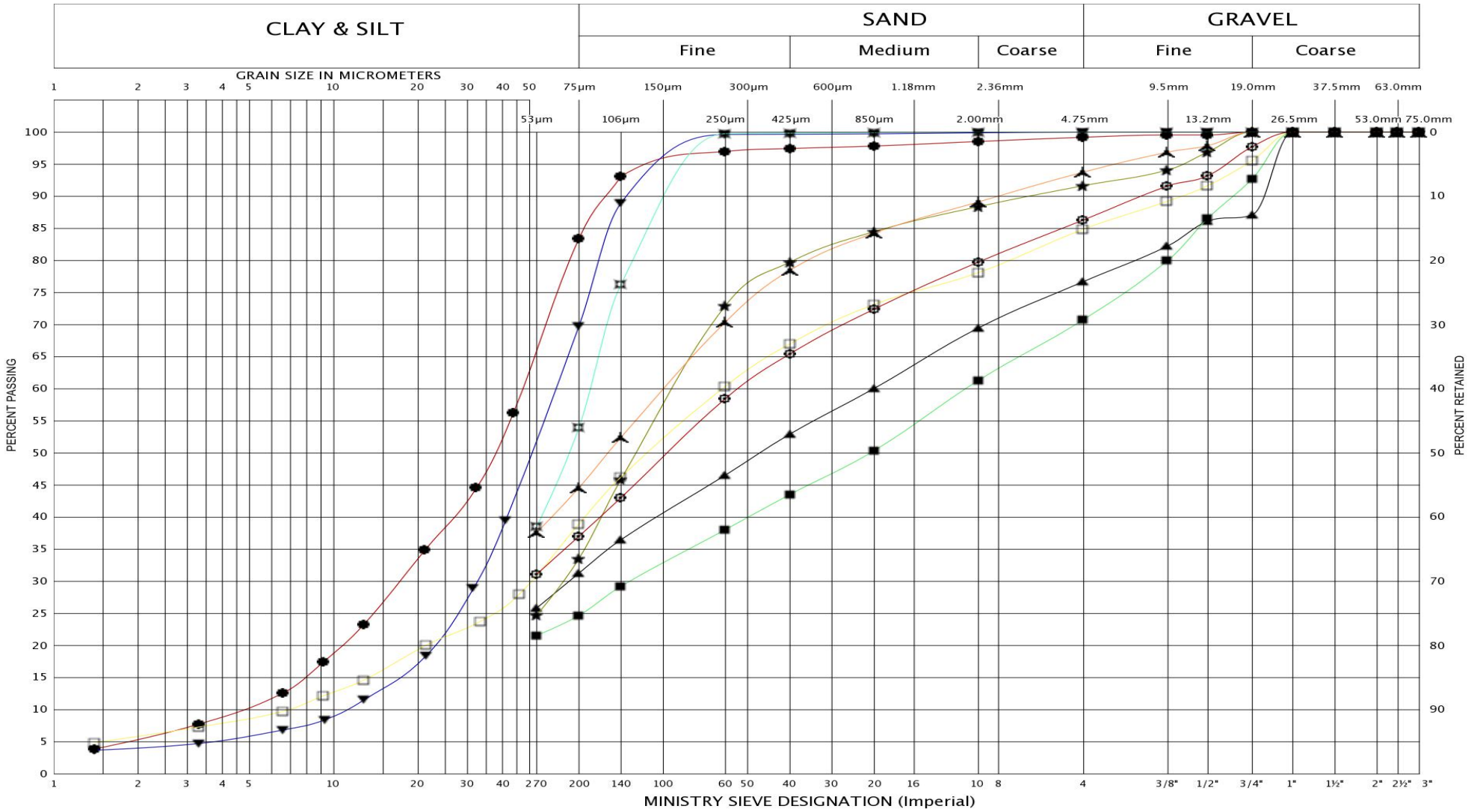
Ontario

GRAIN SIZE DISTRIBUTION

SILTY SAND/SANDY SILT, trace gravel to gravelly (TILL)

FIG No.:	DC2-GS-1
HWY :	6
GWP	3059-20-00

UNIFIED SOIL CLASSIFICATION SYSTEM



LEGEND	BH	21-29	21-29	21-29	21-30	21-30	21-30	21-31	21-31	21-31
	SAMPLE	3	8	11	4	8	12	2	7	10
	SYMBOL	▲	✱	●	⅄	■	▼	⊙	□	⊠

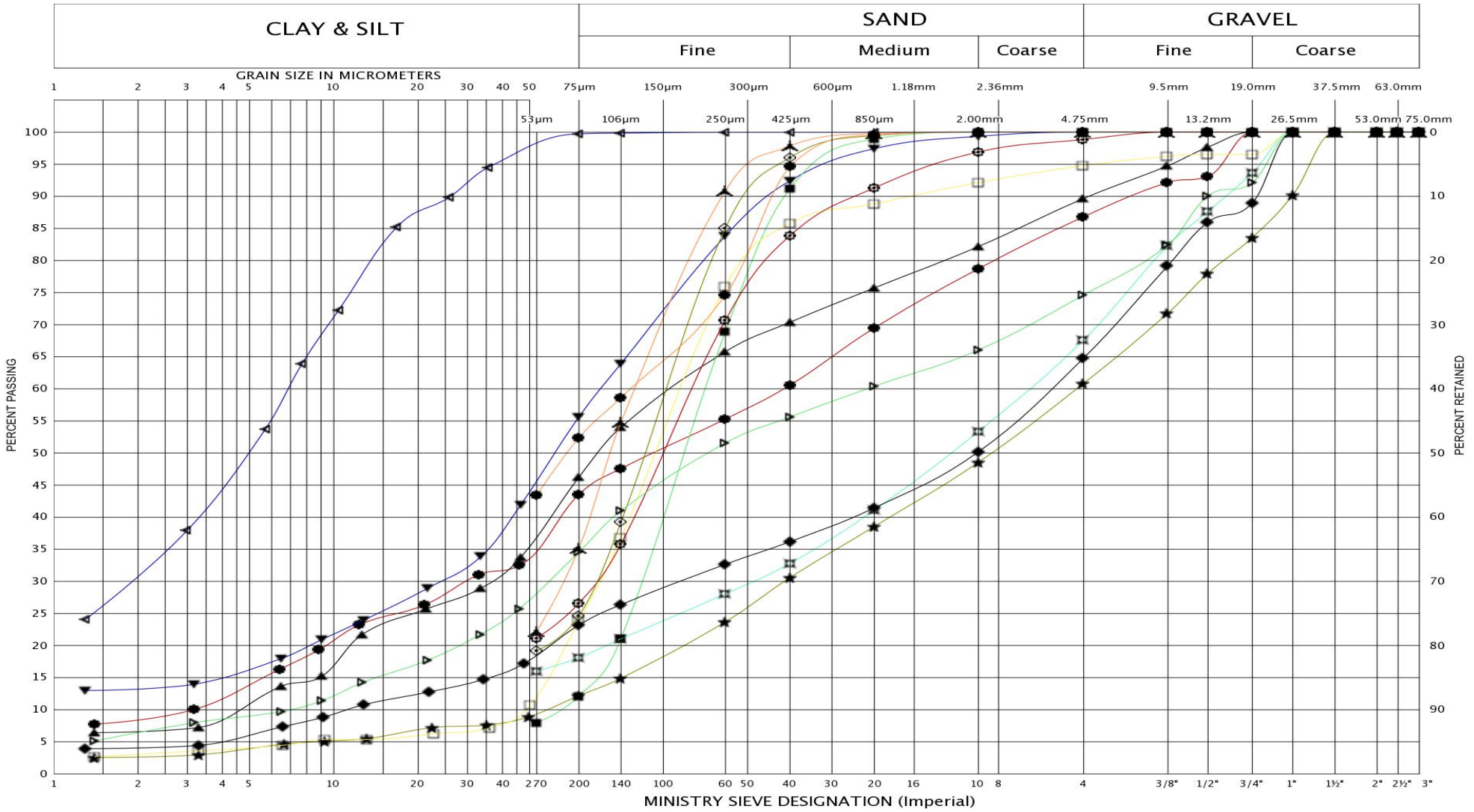
Ontario

GRAIN SIZE DISTRIBUTION

SILTY SAND/SANDY SILT, trace gravel to gravelly (TILL)

FIG No.:	DC3-GS-1
HWY :	6
GWP	3059-20-00

UNIFIED SOIL CLASSIFICATION SYSTEM



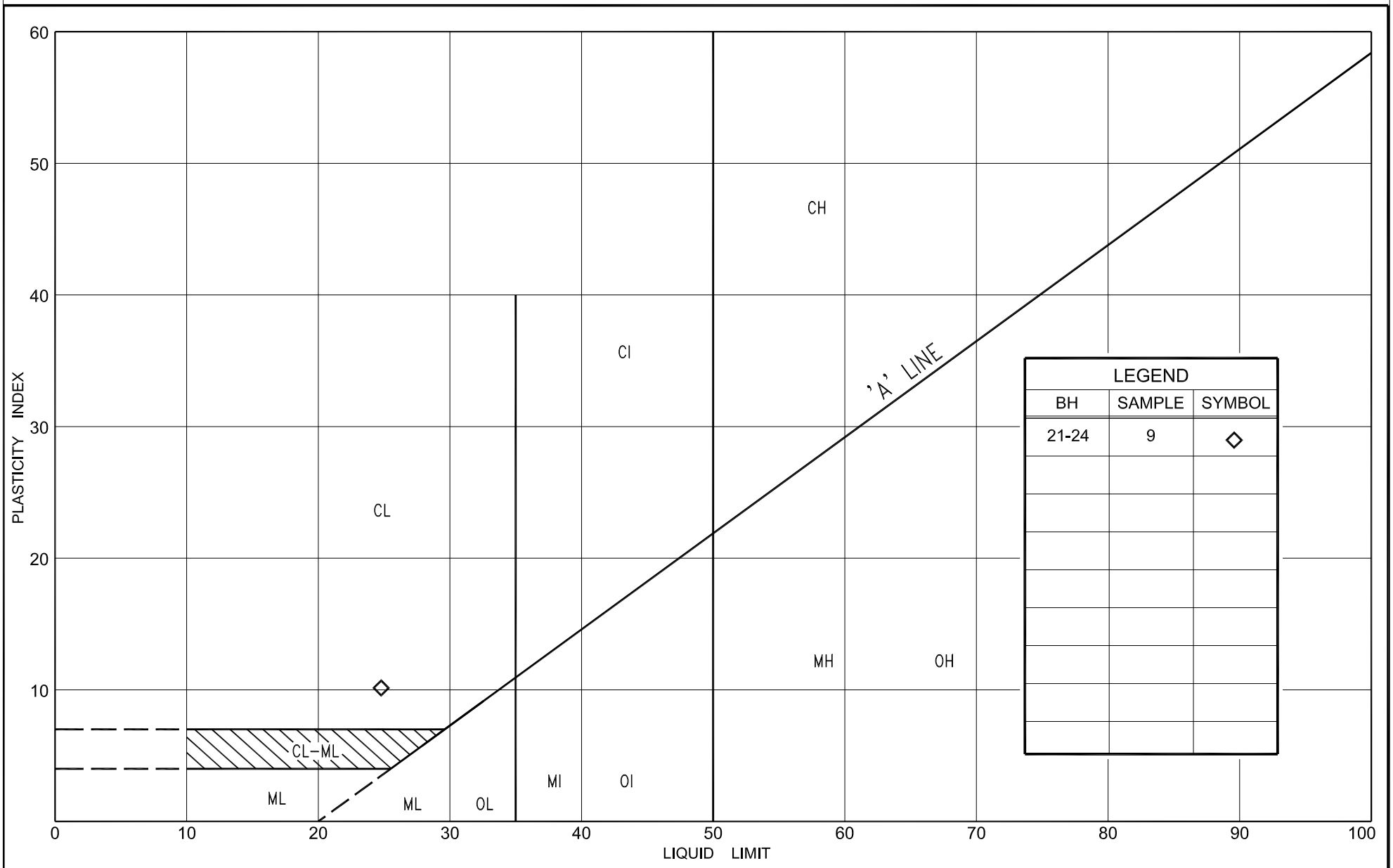
	BH	21-17	21-17	21-17	21-18	21-18	21-18	21-20	21-20	21-20	21-22	21-22	21-24	21-24	21-24
LEGEND	SAMPLE	3	7	10	2	3	9	3	6	10	6	10	3	9	11
	SYMBOL	▲	●	★	▼	■	⅄	✖	□	⊕	◆	◇	⬢	◀	▶

Ontario

GRAIN SIZE DISTRIBUTION

SILTY SAND/SAND, trace gravel to gravelly (TILL)

FIG No.:	DC4-GS-1
HWY :	6
GWP	3059-20-00



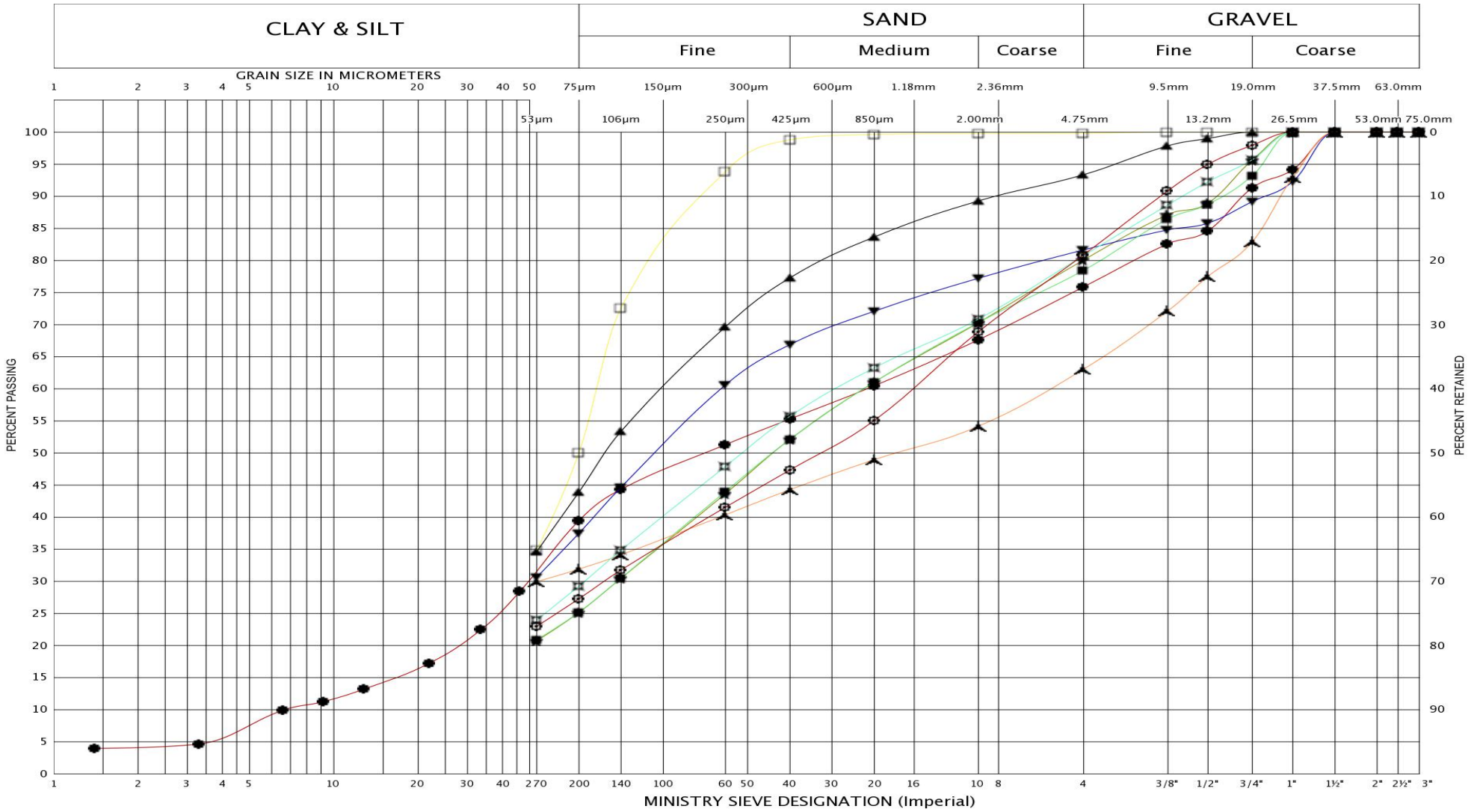
Ontario
Ministry of Transportation

PLASTICITY CHART

CLAYEY SILT (TILL)

FIG No.	DC4-PC-1
HWY:	6
G.W.P. No.	3059-20-00

UNIFIED SOIL CLASSIFICATION SYSTEM



LEGEND	BH	21-12	21-12	21-12	21-13	21-13	21-13	21-14	21-14	21-14
	SAMPLE	2	7	10	2	5	10	4	7	10
	SYMBOL	▲	✱	●	■	⅄	▼	□	⊠	⊙

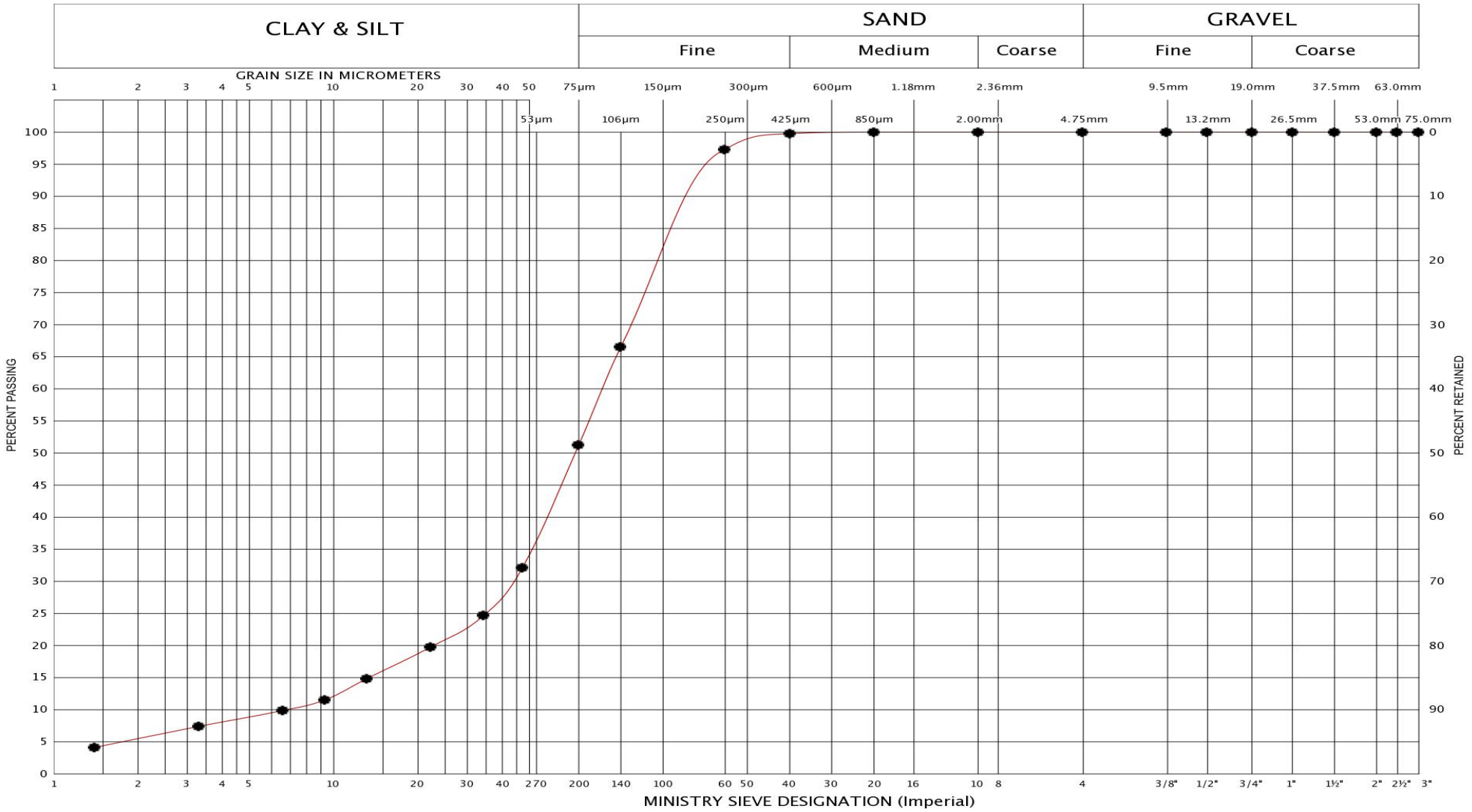
Ontario

GRAIN SIZE DISTRIBUTION

SILTY SAND, trace gravel to gravelly (TILL)

FIG No.:	DC5-GS-1
HWY :	6
GWP	3059-20-00

UNIFIED SOIL CLASSIFICATION SYSTEM



LEGEND	BH	21-21
	SAMPLE	2
	SYMBOL	●

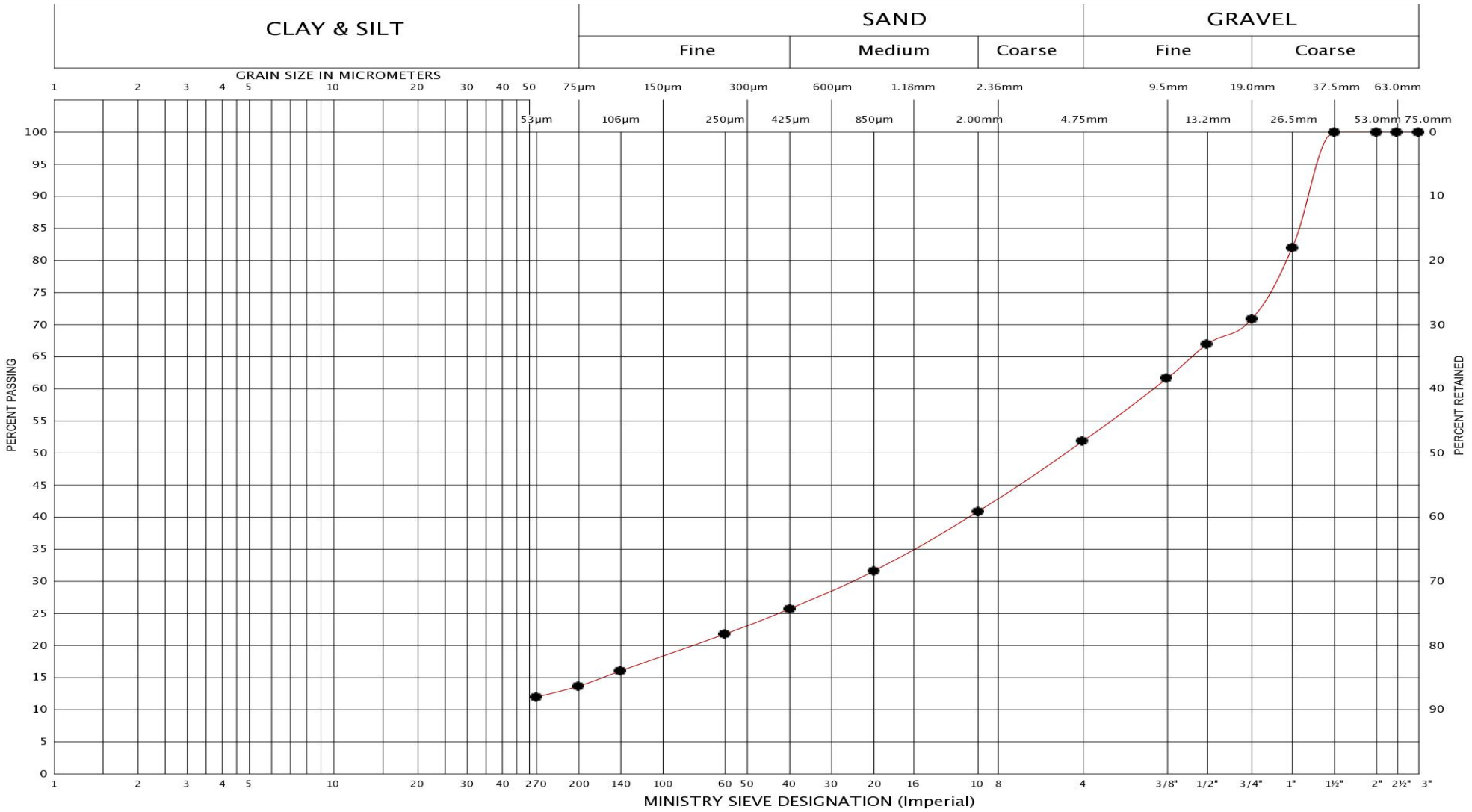
Ontario

GRAIN SIZE DISTRIBUTION

SILTY SAND (FILL)

FIG No.:	DC6-GS-1A
HWY :	6
GWP	3059-20-00

UNIFIED SOIL CLASSIFICATION SYSTEM



LEGEND	BH	21-25
	SAMPLE	4
	SYMBOL	●

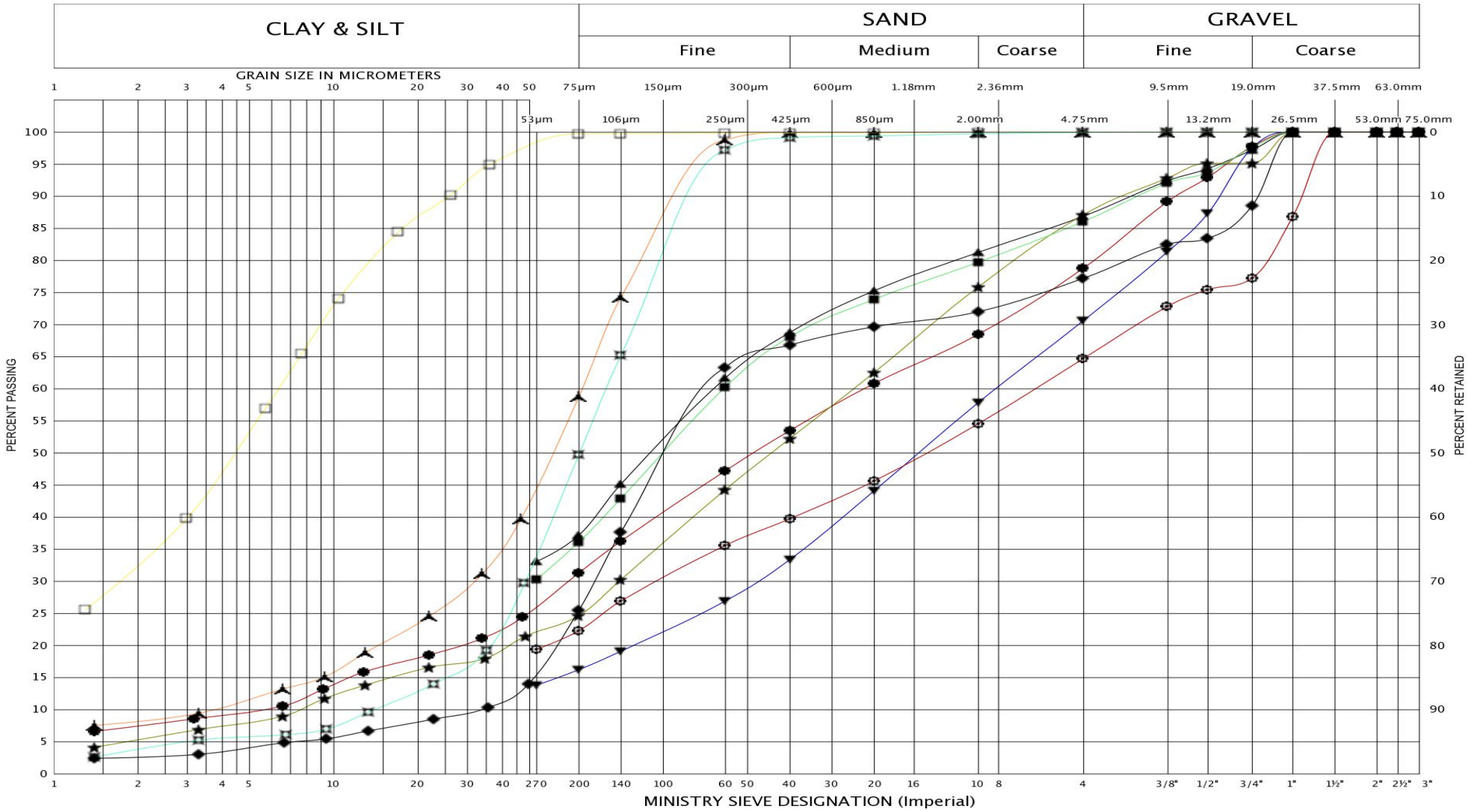
Ontario

GRAIN SIZE DISTRIBUTION

SANDY GRAVEL (FILL)

FIG No.:	DC6-GS-1B
HWY :	6
GWP	3059-20-00

UNIFIED SOIL CLASSIFICATION SYSTEM



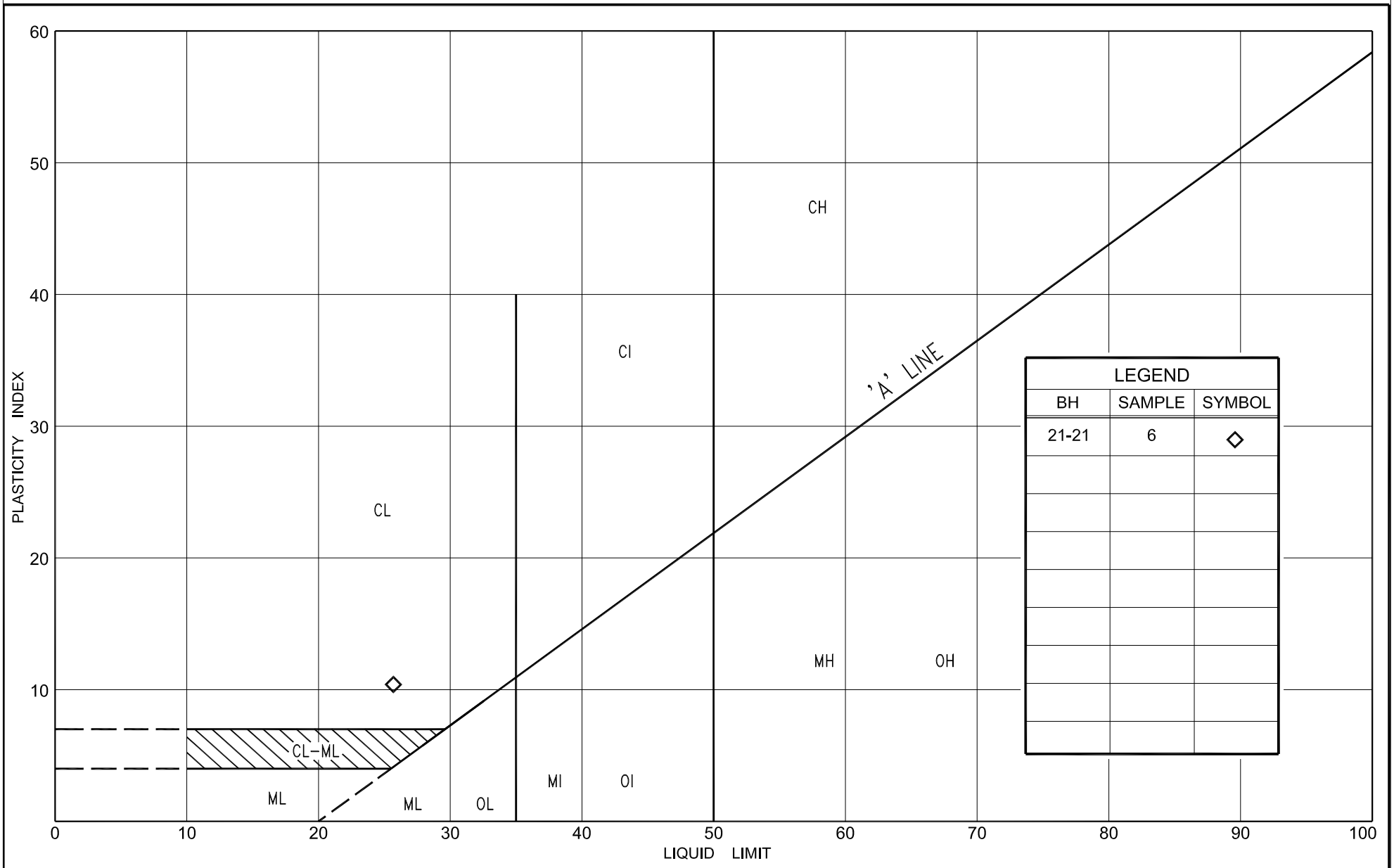
LEGEND	BH	21-15	21-15	21-16	21-16	21-16	21-21	21-21	21-23	21-23	21-25
	SAMPLE	3	9	4	8	11	6	8	5	8	9
	SYMBOL	▲	●	■	▼	★	□	⅄	⊕	⊠	◆

Ontario

GRAIN SIZE DISTRIBUTION

SILTY SAND/SANDY SILT, trace gravel to gravelly (TILL)

FIG No.:	DC6-GS-2
HWY :	6
GWP	3059-20-00



Ontario
Ministry of Transportation

PLASTICITY CHART

CLAYEY SILT (TILL)

FIG No.	DC6-PC-1
HWY:	6
G.W.P. No.	3059-20-00

PART B – PRELIMINARY FOUNDATION DESIGN REPORT

for

DESIGN-BUILD READY ALTERNATIVE BID PACKAGE MIDBLOCK INTERCHANGE AREA HIGH FILL AND DEEP CUT SECTIONS HIGHWAY 6 AND 401 IMPROVEMENTS FROM HAMILTON NORTH LIMITS TO GUELPH SOUTH LIMITS CITY OF GUELPH, ONTARIO GWP NO. 3059-20-00

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October 13, 2021

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PART B – PRELIMINARY FOUNDATION DESIGN REPORT
for
Design-Build Ready Alterative Bid Package
Midblock Interchange Area High Fill and Deep Cut Sections
Highway 6 and 401 Improvements
From Hamilton North Limits to Guelph South Limits
City of Guelph, Ontario
GWP No. 3059-20-00

8. INTRODUCTION

The Ministry of Transportation of Ontario (MTO), West Region has proposed the re-alignment, improvement and replacement of existing structures located on Highway 6 and Highway 401 from Hamilton North Limits to Guelph South Limits, and retained AECOM Canada Ltd. (AECOM) to provide Owner's Engineer Services. The assignment consists of separate projects to be tendered under different delivery models. The Midblock Interchange (MBI) area is part of the Highway 6 and Highway 401, Hamilton to Guelph advance contract to be delivered on a design-build (DB) basis. MTO requires a Design-Build Ready alternative package for delivery of this project.

This Foundation Design Report (FDR) provides discussions and recommendations on foundation aspects of the proposed high fill and deep cut sections located on Wellington Road 34, Concession Road 7, Highway 6, and the new connector route of the MBI area, based on the factual foundation investigation data presented in the Preliminary Foundation Investigation Report (Part A) and the cross sections and profile drawings provided by AECOM on March 08, 2021. The report discusses the stability of embankments and deep cuts under the proposed fill and cut slopes geometries using the findings of stability analyses and settlement assessments conducted for selected high fill and deep cut sections. The report also provides general recommendations on the use of alternative fill materials for embankment construction, and implementation of foundation mitigation alternatives that may be required as a means to improve slope stability. The report also addresses potential construction concerns and geotechnical problems associated with high fill and cut slope construction, sub-excavation of soft/organic materials and backfilling, and dewatering.

It should be understood that this report is intended for use by AECOM, as MTO's authorized engineer, for the purpose of designing the proposed high fill and deep cut sections within the MBI project area, at the locations where the foundation investigation was conducted. This report shall not be used for any other purpose or for any other locations, or by any other parties including design-

build contractors. Where comments are made on construction, they are provided to highlight aspects that could affect the design of the project and, for which, special provisions could potentially be required for construction. These comments identify only some issues and are not presented as an exhaustive list of construction concerns. The design-builder will remain responsible for making its own interpretation. Recommendations regarding construction aspects of the foundation elements should be provided during the detail design phase of the project.

Where necessary, reference is made in this report to the Ontario Provincial Standard Specifications (OPSSs) and their Special Provision (SP) amendments, the Ontario Provincial Standard Drawings (OPSDs), MTO Guidelines for Embankment Settlement Criteria for Design (July 2, 2010), the Canadian Highway Bridge Design Code (CSA S6:19, 2019) and its commentary, the Canadian Foundation Engineering Manual (CFEM), and other applicable manuals and references.

The list of OPSSs and OPSDs cited in this report is provided in Appendix D.

9. PROJECT DESCRIPTION

9.1 Proposed High Fill and Deep Cut Sections

AECOM provided preliminary cross sections and profiles of the proposed road alignments in the MBI area for review by PML, in an email dated March 08, 2021. The review of these cross sections and profiles indicated that some of the road sections at different locations will require the construction of embankments or slope cuts higher or deeper than 4.5 m. The construction and excavation of such high fill and deep cut sections would in turn require foundation investigations to identify the soil materials and subsurface conditions underneath the footprints of embankments and deep cuts, and slope stability analyses and settlement assessments to evaluate the global stability of embankments and roadside deep cuts under the proposed slope geometries.

In the MBI area, the review of the preliminary cross sections and profiles provided AECOM allowed the identification of six (6) high fill and six (6) deep cut sections located along Wellington Road 34, Concession Road 7, Highway 6 northbound and southbound, the new connector route, and the

ramps of the proposed Midblock Interchange. A summary of these high fill and deep cut sections is provided in Table 1 of the Foundation Investigation Report (Part A). The locations of these high fill or deep cut sections in the MBI project area are also presented in Drawing 1.

Generally, the high fill areas are located on both sides of Wellington Road 34 Underpass, and near the intersection of new connector route and Concession Road 7. Localized high fills are also proposed along the connector route and at S-EW Ramp of the Midblock Interchange.

Deep cuts are proposed on the northbound and southbound sides of Highway 6 where existing slopes will be cut or filled over as part of the road widening plan, along Concession Road 7, and near the intersection of the new connector route and Wellington Road 34. Deep cuts are also proposed on the inside section of the E-S Ramp, on the outside section of the E-N Ramp, and at some locations along the N-EW Ramp of the Midblock Interchange.

Design and construction of high fill embankments usually requires stability and settlement analyses of the underlying soils and the embankment fill itself, the assessment of the impact of the stability and settlement of soils on construction staging and time requirements, and the impact of the embankment construction to nearby structures, such as buildings, bridge foundations, and utilities. Since MTO requires a Design-Build Ready alternative package for the MBI project, the construction schedules are unknown to PML at this time, and it is assumed that recommendations on construction staging and related aspects, if required, will be addressed during detailed design. Further, the MBI project area is located in a rural environment and the construction of high fill embankments will have no impact on buildings, bridge foundations and other major structures. Hence, the foundation engineering issues that will be addressed in the following sections, will be the slope stability and settlement analyses of proposed high fill embankments. Stability and settlement analyses were carried out for critical sections of the proposed high fills. Critical sections in all areas correspond to places where embankments with maximum heights are located.

Further, the design of cut slopes is based on the performance of similar slopes in the region or on the basis of detail slope stability analyses. In the MBI area, a visual assessment of the condition/stability of existing cut slopes along Highway 6 and Concession Road 7 was performed at the time of the fieldwork. In general, no major signs of slope instability, sloughing, deformation or

cracking were observed along existing cut slopes, although some cut slopes along Concession Road 7 showed minor erosion features. Usually, a major cause of cut slope failure is related to the release of stress within the soil upon excavation. These include undermining the toe of the slope and oversteepening the slope angle. For dry cohesionless soils (silty sand/sandy silt till) encountered in many boreholes of the MBI area, stability of a cut slope is independent of height and therefore slope angle becomes the parameter of concern. Hence, the slope stability analyses on deep cut sections provided herein were conducted to verify safe slope angles.

9.2 Foundation Conditions

The subsurface and groundwater conditions beneath the proposed deep cut and high fill sections in the MBI area are provided in the Foundation Investigation Report (Part A). In general, review of borehole logs and soil strata profiles prepared for high fill and deep cut sections indicated a uniform stratigraphy across the region consisting of 200 mm to 800 mm topsoil underlain by compact to very dense silty sand/sandy silt till, extending to the maximum depth of investigations. In some boreholes drilled near existing roads, approximately 300 mm to 500 mm thick silty sand/sandy silt fill was encountered on top of the till deposits, with or without an overlying topsoil.

Peat mixed with topsoil was encountered in boreholes advanced in areas near wetlands, such as the intersection of Wellington Road 34 and Highway 6. The thickness of the peat ranged from 2 m to 3 m. In addition, a thin soft clay was found beneath the peat. A layer of stiff to hard clayey silt till was also encountered beneath the silty sand/sandy silt till in boreholes drilled in HF-5, located on the east side of the proposed Wellington Road 34, Further, sand layers as thick as 5 m as well as silt seams and zones off sandy gravel, were encountered in boreholes drilled on the west side of the Midblock Interchange and on the sides of Highway 6 northbound and southbound lanes.

The condition of groundwater was observed in boreholes during drilling. Groundwater level was also measured in open boreholes upon completion of drilling and also in wells installed in boreholes. Generally, except in areas near the intersection of Wellington Road 34 and Highway 6 and in the southern part of Concession Road 7, the groundwater levels measured after drilling was deeper than 3 m. Some boreholes drilled on the west and east side of the proposed Wellington Road 34 Connector Underpass and in the norther portion of the MBI area were observed to be dry.

Further, groundwater level measurements were taken from monitoring wells installed in some boreholes. In general, the depths of stabilized groundwater levels in the northern part of the MBI project area varied from approximately 5.0 m below existing ground surface to dry conditions. On the other hand, the groundwater levels near the intersection of Wellington Road 34 and Highway 6, was close to the ground surface based on measurement/observations.

No artesian groundwater conditions or signs of confined and pressurized aquifer (phreatic surface) were encountered within the depth of investigation in the northern part of the MBI area. However, artesian groundwater conditions and pressurized aquifer were encountered in boreholes located near the intersection of Wellington Road 34 and Highway 6 (southern part of the MBI area).

9.3 Slope Stability Analyses

Slope stability analyses of the proposed high fill and deep cut sections in the MBI area were carried out using a computer program called Slope-W. The analyses considered critical sections of the proposed high fill and cut sections. The results for all analyses are presented in Appendix E.

The factors governing the stability and performance of new high fill embankments, as well as the design and construction of deep cuts along existing and new road alignments include the geometry of proposed high fills or deep cuts, the type and thickness of embankment fill material, the thickness and extent of peat, organic, soft and loose materials within the footprints of embankments, thickness and engineering properties of foundation soils, surcharge loads, and groundwater conditions.

For the slope stability analyses in this assignment, embankment and cut slope profiles (geometries) were obtained from the cross sections obtained from AECOM. All fill and cut slopes are assumed to be constructed with 2H:1V side slopes or flatter. Further, for high fills, the use of a well compacted granular fill was assumed to ensure that post-construction settlement of the embankment itself is negligible. It was also assumed that any peat, organic material, existing asphalt, and near-surface soft and loose soil layers encountered below the footprint of new embankments will be removed prior to construction. The subsurface and groundwater conditions at critical sections of high fills and

deep cuts were obtained from boreholes drilled in the area. In addition, a surcharge load of 12 kN/m^2 was considered in all analyses to account for a typical highway traffic load.

A summary of the assumed shear strength parameters for soil layers encountered in boreholes drilled at or near the proposed locations of high fills and deep cuts are given in Table 3. The parameters were determined using the information from boreholes, the soil profiles presented in Foundation Investigation Report (Part A), and based on literature and previous experiences.

Table 3 – Soil Strength Parameters

MATERIAL	SOIL PROPERTY			
	BULK UNIT WEIGHT (kN/m^3)	INTERNAL FRICTION ANGLE (ϕ')	DRAINED SHEAR STRENGTH (c') kPa	UNDRAINED SHEAR STRENGTH (Cu) kPa
Pavement Fill	21	32	-	-
Embankment Fill	20	30	-	-
Peat	10	20	1	5
Compact Silty Sand/Sandy Silt (Till)	19	28	-	-
Clayey Silt (Till)	19	20	5	30
Very Dense Silty Sand/Sandy Silt (Till)	19	34	-	-

Since the materials encountered in boreholes in most cases are cohesionless soils (silty sand/sandy silt with zones of gravel) in dry (unsaturated) conditions, effective stress parameters were used for most analyses assuming drained conditions. In areas consisting of soils of widely differing permeabilities, the more permeable soils were considered as drained whereas the less permeable soils were taken as undrained. In such cases, the drained soils were treated in terms of effective stresses and the undrained soils were analyzed using total stress approaches.

For all stability analyses, the Spencer method was used to estimate the factor of safety against rotational shear failures. The Spencer method analyzes potential circular shear surfaces by

separating the materials above the failure plane into multiple segments and then using force and moment equilibrium to balance the forces in each segment. A minimum factor of safety (FOS) of 1.3 is usually utilized for the design of highway embankments, under static conditions. The FOS values will increase to 1.5 for critical structures such as bridge approach embankments. For cut slopes, an FOS of 1.25 is often considered sufficient to establish and maintain static slope stability. However, in consultation with MTO, a minimum FOS of 1.3 was used for cut slope.

In general, although embankment/cut slope instability typically occurs either during or shortly after embankment construction/excavation, it can also happen over the long-term. Embankment instability occurs in the form of either a planar slide extending out into the adjacent area, or a deep-seated, rotational failure plane extending through the embankment and any underlying soft soils. Deep seated failure plane development can occur either quickly with the formation of a large head scarp and heaving of the adjacent ground near the toe of the slope, or very slowly in a creeping type failure, where the failure plane may move only a small amount over a long period of time. Hence, proper level of visual inspection all high fill and deep cut slopes is required at all times. If failure is expected based on visual observation and engineering judgment, then instrument monitoring using inclinometers and piezometers should be implemented.

Further, the assessment of the stability of high fill embankment slopes and deep cuts should be reviewed and confirmed during design and construction, based on the actual subsoil conditions encountered within the embankment footprints. Mitigation measures to improve slope stability include use of lightweight fill materials, wick drains, preloading (surcharging) or a combination of these options, which will also control magnitude and time rate of settlements. Stabilization measures include the use of retaining walls, soil reinforcement and anchor systems.

9.3.1 High Fill Sections

9.3.1.1 HF-1 (Concession Road 7)

In HF-1, the slope stability analysis considered a critical section located at Sta. 11+070. At this location, the new embankment will involve the placement of 6.5 m embankment fill and about 1 m

pavement fill. Based on borehole information, the subsurface consisted of 200 mm to 600 mm topsoil and 1.5 m thick fill, underlain by loose to very dense silty sand/sandy silt till. The groundwater levels measured upon completion of drilling ranged from 2.6 m (El. 317.1) to 7.6 m (El. 310.8) below ground surface. The slope stability analysis assumed that any topsoil or existing fill underneath the new embankment will be removed. Further, a groundwater level at El. 317.1 was considered.

The result of the slope stability analysis is presented on Drawing MBI-16 in Appendix E. The FOS value for a rotational slip plane that passes through the new fill and the native silty sand/sandy silt till was found to be 2.1. This is higher than the 1.3 required for highway embankments. The result of the stability analysis indicated that deep-seated slope failures are unlikely to occur in the area, if the topsoil, any fill, and the loose upper part of the silty sand/sandy silt till are removed, and the embankments are constructed of well compacted granular fill at a slope of 2H:1V or flatter.

9.3.1.2 HF-2 (Connector Route)

In HF-2, the slope stability analysis considered a critical section located at Sta. 10+380. At this location, the new embankment will involve the placement of about 5 m embankment fill and 1 m pavement granular fill. Based on the findings of the foundation investigations within this high fill section, the subsurface consisted of 200 mm to 800 mm topsoil underlain by loose to very dense silty sand/sandy silt till deposit. The groundwater levels measured at the completion of drilling of the boreholes in the area ranged from 1.7 m (El. 319.8) to 4.2 m (El. 317.5) below existing ground surface. The slope stability analysis assumed that any topsoil encountered underneath the new embankment will be removed. Further, a groundwater level at El. 319.1 was considered.

The result of the slope stability analysis is presented on Drawing MBI-17 in Appendix E. The FOS value for a rotational slip plane that passes through the new fill and the upper part of the native sandy silt till was found to be 1.8. This is higher than the 1.3 required for highway embankments. The result of the stability analysis indicated that deep-seated slope failures are unlikely in this area, if the topsoil and the loose upper part of the silty sand/sandy silt till are removed, and the embankments are constructed of well compacted granular fill at a slope of 2H:1V or flatter.

9.3.1.3 HF-3 (Connector Route)

In HF-3, the slope stability analysis considered a critical section located at Sta. 9+860. At this location, the new embankment will involve the placement of about 4.5 m embankment fill and 1 m pavement granular fill. Based on the findings of the foundation investigations within this high fill section, the subsurface in this area consisted of about 800 mm topsoil underlain by compact to very dense silty sand/sandy silt till layer. During drilling, no signs of groundwater was observed in this area. The slope stability analysis assumed that any topsoil encountered underneath the new embankment will be removed. Further, a groundwater level at El. 314.0 was considered.

The result of the slope stability analysis is presented on Drawing MBI-18 in Appendix E. The FOS value for a rotational slip plane that passes through the new fill and the upper part of the native silty sand till was found to be 1.9. This is higher than the 1.3 required for highway embankments. The result of the stability analysis indicated that deep-seated slope failures are unlikely if the topsoil, loose fill, and the upper part of the silty sand till are removed, and the embankments are constructed of well compacted granular fill at a slope of 2H:1V or flatter.

9.3.1.4 HF-4 (Wellington Road 34)

In HF-4, embankment stability with respect to rotational shear failure extending through the embankment and out into the proposed widening, was analyzed to assess the performance of the new approach embankment constructed with 2H:1V side slopes or flatter. The stability analysis was performed for a “typical section” near the west abutment of the proposed Wellington Road 34 Underpass (Site No. 35X-0617/B0) or at Sta. 9+060 and considered an embankment of 9.1 m.

A fine fibrous to amorphous peat/organics of about 3 m thick was encountered in boreholes advanced in this area. The strength parameters of this peat/organics given in Table 3 were estimated based on experience. Generally, amorphous peat has lower shear strength parameters than fibrous peat. The peat outside of the limit of the existing embankment was assumed to be in an undrained condition. The drained or long-term condition reflects no excess pore water pressure present within the peat. Thus, its strength is normally represented by the angle of internal friction.

However, the undisturbed peat strength was assumed to be controlled by cohesion or undrained shear strength. Further, a groundwater level near the surface was assumed in this area as a "likely case" scenario because of the presence of wetlands in the surrounding region.

The result of the slope stability analysis is given on Drawing MBI-19, in Appendix E. The FOS value for a rotational slip plane that passes through a 9.1 m high fill was 1.5. This value is equal to the 1.5 that is often used as a threshold to design highway approach embankments.

In general, the result indicates that deep-seated failures are not anticipated for 9.1 m high approach embankment constructed on the west side of the proposed underpass with 2H:1V side or flatter, if any peat, organic, and soft materials underneath the embankment are removed, and the embankments are constructed of very well compacted granular fill.

9.3.1.5 HF-5 (Wellington Road 34)

In HF-5, embankment stability with respect to rotational shear failure extending through the embankment and out into the proposed widening, was analyzed to assess the performance of the new approach embankment constructed with 2H:1V side slopes or flatter. The stability analysis was performed for a "typical section" near the west abutment of the proposed Wellington Road 34 Underpass (Site No. 35X-0617/B0) or at Sta. 10+040 and considered an embankment of 9.2 m.

The road widening and embankment construction on both the south and north sides of Wellington Road 34 at this location will be on top of native silt sand and gravelly sand materials. The stability analyses also involved the topsoil, peat (organic), and soft and loose soils beyond the footprint of the new embankment. The soil strength parameters assumed for these materials and the embankment fill are summarized in Table 3. A groundwater level near the ground surface was used as a "likely case" for the analyses because of the presence of wetlands in the surrounding region.

The result of the slope stability analysis is given on Drawing MBI-20, in Appendix E. The FOS value for a rotational slip plane that passes through a 9.2 m high fill was 1.5. This value is equal to the 1.5 that is often used as a threshold to design highway approach embankments.

The results indicate that deep-seated failures are not anticipated for 9.2 m high embankment constructed on east side of the proposed underpass with 2H:1V side slopes or flatter, if any peat, organic, and soft or compressible materials underneath the embankment are removed, and the embankments are constructed of very well compacted granular fill.

9.3.1.6 HF-6 (S-EW Ramp)

In HF-6, the slope stability analysis considered a critical section located at Sta. 10+350. At this location, the new embankment will involve the placement of about 3.5 m embankment fill and 1 m pavement granular fill. Based on the borehole information, the soil layers encountered in this area consisted of 600 mm to 800 mm topsoil, and compact to very dense silty sand/sandy silt till deposit. The stabilized groundwater level measured in a monitoring well installed in the area was at El. 315.9. The slope stability analysis assumed that any topsoil encountered underneath the new embankment will be removed. Further, a groundwater level at El. 315.9 was considered.

The result of the slope stability analysis is presented on Drawing MBI-21 in Appendix E. The FOS value for a rotational slip plane that passes through the new fill and the upper part of the native silty sand till was found to be 2.0. This is higher than the 1.3 required for the design of highway embankments. The result of the stability analysis indicated that deep-seated slope failures are unlikely if the topsoil, loose fill, and the upper part of the silty sand till are removed, and the embankments are constructed of well compacted granular fill at a slope of 2H:1V or flatter.

9.3.2 Deep Cut Sections

9.3.2.1 DC-1 (Concession Road 7)

In DC-1, the cross sections provided by AECOM indicated that the cut slope will involve the upper part of the silty sand till up to the depth of El. 315.5. The stabilized groundwater level reading in a well installed in the area was at 2.0 m (El. 310.4). The slope stability analysis for this area considered a 10 m high cut slope section located at Sta. 10+780.

The result of the slope stability analysis is presented on Drawing MBI-22 in Appendix E. The FOS value for a rotational slip plane that passes through the upper part of the silty sand till, including the ditch and part of the road shoulder was 1.7. This is higher than the 1.3 required for roadside cut slopes. The result of the stability analysis indicated that major deep-seated slope failures are unlikely if the slopes are excavated at a gradient of 2H:1V or flatter.

9.3.2.2 DC-2 (Connector Route)

In DC-2, the cross sections provided by AECOM indicated that the cut slope will involve the upper part of the silty sand till up to the depth of El. 310.2. The depth of the stabilized groundwater level measured in a well installed in the area was 1.9 m (El. 311.1). The slope stability analysis considered a 6 m high cut slope section located at Sta. 9+080.

The result of the slope stability analysis is presented on Drawing MBI-23 in Appendix E. The FOS value for a rotational slip plane that passes through the upper part of the silty sand till, including the ditch area and part of the road shoulder was 1.5. This is higher than the 1.3 required for stable roadside cut slopes. The result of the stability analysis indicated that major deep-seated slope failures are unlikely if the slopes are excavated at a gradient of 2H:1V or flatter.

9.3.2.3 DC-3 (Highway 6 Southbound)

In DC-3, the cross sections provided by AECOM indicated that the cut slope will involve the upper part of the silty sand till up to the depth of El. 316.2. The depth of the stabilized groundwater level measured in a well installed in the area was 5.0 m (El. 311.5). The slope stability analysis considered a 5.2 m high cut slope section located at Sta. 11+780.

The result of the slope stability analysis is presented on Drawing MBI-24 in Appendix E. The FOS value for a rotational slip plane that passes through the upper part of the silty sand till, including the ditch area and part of the road shoulder was 1.7. This is higher than the 1.3 required for stable roadside cut slopes. The result of the stability analysis indicated that major deep-seated slope failures are unlikely if the slopes are excavated at a gradient of 2H:1V or flatter.

9.3.2.4 DC-4 (E-N Ramp and Highway 6 Northbound)

In DC-4, the cross sections provided by AECOM indicated that the cut slope will involve the upper part of the silty sand till up to the depth of El. 331.1. The depth of the stabilized groundwater level measured in a well installed in the area was 8.6 m (El. 327.2). The slope stability analysis considered an 8 m high cut slope section located at Sta. 9+830.

The result of the slope stability analysis is presented on Drawing MBI-25 in Appendix E. The FOS value for a rotational slip plane that passes through the upper part of the silty sand till, including the ditch area and part of the road shoulder was 1.7. This is higher than the 1.3 required for stable roadside cut slopes. The result of the stability analysis indicated that major deep-seated slope failures are unlikely if the slopes are excavated at a gradient of 2H:1V or flatter.

9.3.2.5 DC-5 (E-S Ramp)

In DC-5, the cross sections provided by AECOM indicated that the cut slope will involve the upper part of a compact silty sand till up to the depth of El. 321.8. The groundwater level measured in a well installed in the area indicated a dry condition. The slope stability analyses considered a 7.5 m high cut slope section located at Sta. 9+960 and a groundwater level within the silty sand till.

The result of the slope stability analysis is presented on Drawing MBI-26 in Appendix E. The FOS value for a rotational slip plane that passes through the upper part of the silty sand till, including the ditch area and part of the road shoulder was 1.6. This is higher than the 1.3 required for stable roadside cut slopes. The result of the stability analysis indicated that major deep-seated slope failures are unlikely if the slopes are excavated at a gradient of 2H:1V or flatter.

9.3.2.6 DC-6 (Highway 6 Southbound and N-EW Ramp)

In DC-6, the cross sections provided by AECOM indicated that the cut slope will involve the upper part of a compact silty sand till up to the depth of El. 333.4. The depth of the stabilized groundwater level measured in a well installed in the area was 5.1 m (El. 328.3). Two slope stability analyses were carried out using two critical sections located on Highway 6 and at the start of the proposed

N-EW Ramp. The slope stability analyses considered a 9.5 m high cut slope section on Highway 6 (Sta. 12+410) and a 10.5 m high cut slope section on N-EW Ramp (Sta. 10+020).

The results of the slope stability analyses are presented on Drawings MBI-27 and MBI-28 in Appendix E. The FOS values for rotational slip planes that pass through the upper part of the till, including the ditch area and part of the road shoulder were 1.5 and 1.9, respectively. These are higher than 1.3 required for roadside stable cut slopes. The result of the stability analyses indicated that major slope failures are unlikely if slopes are excavated at a gradient of 2H:1V or flatter.

9.4 Embankment Settlement

In addition to stability analyses, the potential for the occurrence of settlement of the new embankments at various high fill locations was also assessed in accordance with the MTO guideline for "Embankment Settlement Criteria for Design – dated July 2, 2010". Table 4 presents the maximum recommended permissible total and differential settlements provided in this guideline in terms the type of subgrade materials. As shown in this table, the maximum post-construction settlement of new embankments on non-compressible soils is limited to 50 mm with a differential settlement rate of 200:1. In the case of Freeways, such has Highway 6 and associated ramps, the maximum post construction settlement is set at 100 mm with a differential settlement rate of 200:1. For Non-Freeways, such as Wellington Road 34, the new Connector Route, and Concession Road 7, the total settlement is limited to 200 mm and differential settlement is 100:1. Post-construction settlements are based on a pavement design life of 20 years for Freeways and 15 years for Non-Freeways.

Table 4 – MTO Settlement Criteria for Design of New Embankments

MATERIAL	SETTLEMENT LIMITS	
	Total Settlement (mm)	Differential Settlement (mm)
Embankment on Non-Compressible Soils	50	200:1
Freeways on Compressible Soils	100	200:1
Non-Freeways on Compressible Soils	200	100:1
Surface Treated and Gravel on Compressible Soils	300	50:1

9.4.1 HF-1 (Concession Road 7)

In HF-1, the cross sections provided by AECOM indicated that the new embankment within this high fill area will be placed between El. 319 and El. 325. Based on the foundation investigations in this area, the soil layers encountered with these elevation ranges include 200 mm to 600 mm topsoil, about 1.5 m fill and loose to compact silty sand/sandy silt till layer. The groundwater levels measured upon completion drilling ranged from 2.6 m (El. 317.1) to 7.6 m (El. 310.8) below existing grade.

The settlement analyses considered the placement of about 6.5 m embankment fill and 1 m pavement granular fill with no topsoil or existing fill underneath the new embankment. This fill is expected to impose a maximum load of 150 kPa at subgrade level, assuming a compacted fill with an average density of 20 kN/m^3. The estimates of total settlements assume the removal of topsoil, any fill and loose or compressible subgrade material, and are based on the elastic compression of the newly placed fill and the immediate settlement of the subgrade silty sand/sandy silt till. No clayey materials were encountered in this area and the primary consolidation (time-dependent) and the secondary compression (creep) of the subgrade under the embankment was considered negligible for settlement analyses. The immediate settlement of cohesionless soils (silty sand/sandy silt till) was estimated assuming elastic modulus of 30 MPa to 40 MPa based on SPT blow counts.

The results of the settlement analyses indicated that the proposed embankment is expected to induce a settlement of about 20 mm to 30 mm of the founding soil. In addition, the fill itself may settle by 0.5% - 1.0% (37.5 mm – 75 mm) of the fill height, depending on the type of fill material and the method of placement. Hence, the total settlement will range from 60 mm to 100 mm. These values are higher than the 50 mm required by MTO settlement criterion for new embankments on non-compressible soils as shown in Table 4. However, the majority of the estimated settlement will be in the form of elastic compression and will be completed immediately after construction.

Generally, since the foundation soils consisted mainly of granular soils, it is anticipated that there will be no significant settlement problems in this area, provided any topsoil and loose soils are removed from the embankment footprint prior to construction and the exposed subgrade surface is proof-rolled and backfilled with well compacted material. Based on the information from boreholes drilled in the area, the

depth to the bottom of loose soil within the limits of the new embankment varies throughout, and may reach a maximum of 3 m below existing grade. If possible, the removal of topsoil and loose soils beyond the footprints of the new embankment is recommended where the Right of Way (ROW) permits.

Sub-excavation of loose soil is the best option for mitigating long-term settlement of the new embankment without the need for implementing any special construction procedure or to adjust construction schedule. That means, construction of the above grade embankment could proceed once excavation and replacement is completed. To mitigate post-construction settlement, the road paving may need to be delayed by two to four weeks after the placement of fills to the designed grade.

9.4.2 HF-2 (Connector Route)

In HF-2, the cross sections provided by AECOM indicated that the embankment fill will be placed between El. 320 and El. 326. Based on the information obtained from boreholes drilled in the area, the subsurface within this elevation range consisted of 200 mm to 800 mm topsoil and loose to compact silty sand/sandy silt till. The groundwater levels measured upon completion of drilling ranged from 1.7 m (El. 319.8) to 4.2 m (El. 317.5) below existing grade.

The settlement analyses considered the placement of about 5 m embankment fill and 1 m pavement granular fill with no topsoil underneath the new embankment. This fill is expected to impose a maximum load of 120 kPa at subgrade level, assuming a compacted fill with an average density of 20 kN/m^3. The estimates of total settlements assume the removal of topsoil, fill and loose or compressible subgrade material, and are based on the elastic compression of the newly placed fill and the immediate settlement of the subgrade silty sand/sandy silt till. No clayey materials were encountered in this area and the primary consolidation (time-dependent) and the secondary compression (creep) of the subgrade under the embankment was considered negligible for settlement analyses. The immediate settlement of cohesionless soils (silty sand/sandy silt till) was estimated assuming elastic modulus of 30 MPa to 40 MPa based on SPT blow counts.

The results of the settlement analyses indicated that the proposed embankment is expected to induce a settlement of approximately 20 mm to 30 mm of the founding soil. In addition, the fill itself

is anticipated to settle by 0.5% - 1.0% (30 mm – 60 mm) of the fill height, depending on the type of fill material and the method of placement. Hence, the total settlement will range from 50 mm to 90 mm. The upper limit of these values is higher than the 50 mm required by MTO settlement criterion for new embankments on non-compressible soils. However, the majority of the estimated settlement will be in the form of elastic compression and will be completed immediately after construction.

Generally, since the foundation soils consisted mainly of granular soils, it is anticipated that there will be no significant settlement problems in this area, provided any topsoil and loose soils are removed from the embankment footprint prior to construction and the exposed subgrade surface is proof-rolled and backfilled with well compacted material. Based on the information from boreholes drilled in the area, the depth to the bottom of loose soil within the limits of the new embankment varies throughout, and may reach a maximum of 3 m below existing grade. If possible, the removal of topsoil and loose soils beyond the footprints of the new embankment is recommended where the Right of Way (ROW) permits.

Sub-excavation of loose soil is the best option for mitigating long-term settlement of the new embankment without the need for implementing any special construction procedure or to adjust construction schedule. That means, construction of the above grade embankment could proceed once excavation and replacement is completed. To mitigate post-construction settlement, the road paving may need to be delayed by two to four weeks after the placement of fills to the designed grade.

9.4.3 HF-3 (Connector Route)

In HF-3, the cross sections provided by AECOM indicated that the embankment fill will be placed between El. 323 and El. 327. Based on the information obtained from boreholes drilled in the area, the subsurface within this elevation range consisted of about 800 mm topsoil underlain by compact silty sand/sandy silt till deposit. During drilling, no signs of groundwater was observed in this area.

The settlement analyses considered the placement of about 4.5 m embankment fill and 1 m pavement granular fill. This fill is expected to impose a maximum load of 110 kPa at subgrade level, assuming a compacted fill with an average density of 20 kN/m^3. The estimates of total settlements assume the removal of topsoil and any compressible subgrade material, and are based on the

elastic compression of the newly placed fill and the immediate settlement of the compact silty sand/sandy silt till. No clayey materials were encountered in this area and the primary consolidation (time-dependent) and the secondary compression (creep) of the subgrade under the embankment was considered negligible. The immediate settlement of the silty sand/sandy silt till deposit was estimated assuming elastic modulus of 40 MPa to 50 MPa based on SPT blow counts.

The results of the settlement analyses indicated that the proposed embankment is expected to induce a settlement of approximately 10 mm of the founding soil. In addition, the fill itself may settle by about 0.5% - 1.0% (27.5 mm – 55 mm) of the fill height, depending on the type of fill material and the method of placement. Hence, the total settlement will range from 40 mm to 65 mm. The upper limit of these values is slightly higher than the 50 mm required by MTO settlement criterion for new embankments on non-compressible soils. However, the majority of the estimated settlement will be in the form of elastic compression and will be completed immediately after construction.

Generally, since the foundation soils consisted mainly of granular soils, it is anticipated that there will be no significant settlement problems in this area, provided any topsoil and loose soils are removed from the embankment footprint prior to construction and the exposed subgrade surface is proof-rolled and backfilled with well compacted material. Based on the information from boreholes drilled in the area, the depth to the bottom of topsoil within the limits of the new embankment varies throughout, and may reach a maximum of 800 mm below existing grade. If possible, the removal of topsoil and loose soils beyond the footprints of the new embankment is recommended where the Right of Way (ROW) permits.

Sub-excavation of topsoil is the best option for mitigating long-term settlement of the new embankment without the need for implementing any special construction procedure or to adjust construction schedule. That means, construction of the above grade embankment could proceed once excavation and replacement is completed. To mitigate post-construction settlement, the road paving may need to be delayed by two to four weeks after the placement of fills to the designed grade.

9.4.4 HF-4 (Wellington Road 34)

In HF-4, the cross sections provided by AECOM indicated that the embankment fill will be placed approximately at El. 309. Based on the information obtained from boreholes drilled in the area, the subsurface across the area at this elevation consisted of peat/topsoil, existing pavement structure material and fill. These materials are underlain by loose to dense silty sand/sandy silt till deposit. The depths of measured groundwater levels ranged from 1.8 m (307.3) to 2.0 m (El. 308.8) below the existing ground surface. However, a groundwater near the ground surface is assumed for settlement analyses because the presence of wetlands in the surrounding area.

The settlement analyses considered the placement of about 8.1 m embankment fill and 1 m pavement granular fill. This fill is expected to impose a maximum load of 182 kPa at subgrade level, assuming a compacted fill with an average density of 20 kN/m^3. The estimates of total settlements assume the removal of peat/topsoil/existing pavement material, fill, and any compressible subgrade soil. The estimates are based on the elastic compression of the newly placed fill and the immediate settlement of the compact silty sand/sandy silt till. Any soft clay that can present in the upper part of the subsurface is also assumed to be excavated and replaced, and the primary consolidation (time-dependent) and the secondary compression (creep) of the subgrade under the embankment was considered to be negligible. The immediate settlement of the silty sand/sandy silt till deposit was estimated assuming elastic modulus of 20 MPa to 40 MPa based on SPT blow counts.

The results of the settlement analyses indicated that the proposed embankment is expected to induce a settlement of 20 mm to 30 mm of the founding soil. In addition, the fill itself may settle by about 0.5% - 1.0% (45.5 mm – 90 mm) of the fill height, depending on the type of fill material and the method of placement. Hence, the total settlement will range from 65 mm to 120 mm. These values are higher than the 50 mm required by MTO settlement criterion for new embankments placed on non-compressible soils. However, the majority of the estimated settlement will be in the form of elastic compression and will be completed immediately after construction.

Generally, any peat, organic or deleterious material, spongy or soft area observed under the plan limits of embankments should be sub-excavated before the placement of any fill and the exposed subgrade

surface should be proof-rolled and backfilled with acceptable fill material. If possible, the removal of soft or loose soils beyond the footprints of the new embankments is recommended where the Right of Way (ROW) permits. With the removal of compressible material from within the footprint of the new embankment, the foundation will consist well compacted granular soils, and the effect of settlement will be minimized. Based on the information from boreholes drilled in the area, the depth to the bottom of peat/topsoil, pavement material, fill and loose and soft compressible material within the limits of the new embankment varies throughout, and may reach a maximum of 4 m below existing grade.

Sub-excavation of peat/topsoil, soft and loose soil or any compressible material is the best option for mitigating long-term settlement of the new embankment without the need for implementing any special construction procedure or to adjust construction schedule. However, in this area, the placement of fills beyond the edge of the existing roadway, as part of road widening may need preloading/surcharging for as long as possible, but at least for a period of one month prior to paving of the new road, immediately preceded by final fine-grading of the Granular A pavement base to achieve the design grade. The use of sub-excavation in this area requires proper level of visual inspection at all times.

9.4.5 HF-5 (Wellington Road 34)

In HF-5, the cross sections provided by AECOM indicated that the embankment fill will be placed approximately at El. 309.5. Based on the information obtained from boreholes drilled in the area, the subsurface across the area at this elevation consisted of peat/topsoil, existing pavement material, fill, and soft silty clay deposit. These materials are underlain by loose to dense silty sand/sandy silt till deposit. The depths of measured groundwater levels ranged from 0.8 m (308.3) to 1.5 m (El. 308.2) below the existing ground surface. However, a groundwater near the ground surface is assumed for settlement analyses because the presence of surrounding wetlands.

The settlement analyses considered the placement of about 8.2 m embankment fill and 1 m pavement granular fill. This fill is expected to impose a maximum load of 184 kPa at subgrade level, assuming a compacted fill with an average density of 20 kN/m^3. The estimates of total settlements assume the removal of peat/topsoil/existing pavement material, fill, soft silty clay and any compressible soil. The estimates are based on the elastic compression of the newly placed fill and

the immediate settlement of the silty sand/sandy silt till. The soft silty clay encountered in the upper part of the subsurface is assumed to be excavated and replaced, and the primary consolidation (time-dependent) and the secondary compression (creep) of the subgrade under the embankment was considered to be negligible. The immediate settlement of the silty sand/sandy silt till deposit was estimated assuming elastic modulus of 20 MPa to 40 MPa based on SPT blow counts.

The results of the settlement analyses indicated that the proposed embankment is expected to induce a settlement of 20 mm to 30 mm of the founding soil. In addition, the fill itself may settle by about 0.5% - 1.0% (46 mm – 92 mm) of the fill height, depending on the type of fill material and the method of placement. Hence, the total settlement will range from 65 mm to 120 mm. These values are higher than the 50 mm required by MTO settlement criterion for new embankments placed on non-compressible soils. However, the majority of the estimated settlement will be in the form of elastic compression and will be completed immediately after construction.

Generally, any peat, organic or deleterious material, spongy or soft area observed under the plan limits of embankments should be sub-excavated before the placement of any fill and the exposed subgrade surface should be proof-rolled and backfilled with acceptable fill material. If possible, the removal of soft or loose soils beyond the footprints of the new embankments is recommended where the Right of Way (ROW) permits. With the removal of compressible material from within the footprint of the new embankment, the foundation will consist well compacted granular soils, and the effect of settlement will be minimized. Based on the information from boreholes drilled in the area, the depth to the bottom of peat/topsoil, pavement material, fill and loose and soft compressible material within the limits of the new embankment varies throughout, and may reach a maximum of 4 m below existing grade.

Sub-excavation of peat/topsoil, soft and loose soil or any compressible material is the best option for mitigating long-term settlement of the new embankment without the need for implementing any special construction procedure or to adjust construction schedule. However, in this area, the placement of fills beyond the edge of the existing roadway, as part of road widening may need preloading for as long as possible, but at least for a period of one month prior to paving of the new road, immediately preceded by final fine-grading of the Granular A pavement base to achieve the design grade. The use of sub-excavation in this area requires proper level of visual inspection at all times.

9.4.6 HF-6 (S-EW Ramp)

In HF-6, the cross sections provided by AECOM indicated that the embankment fill will be placed between El. 319 and El. 325. Based on the information obtained from boreholes drilled in the area, the subsurface within this elevation range consisted of 600 mm to 800 mm topsoil and compact silty sand/sandy silt till deposit. The stabilized groundwater level was at 8.1 m (El. 315.9).

The settlement analyses considered the placement of about 3.5 m embankment fill and 1 m pavement granular fill with no topsoil underneath the new embankment. This fill is expected to impose a maximum load of 90 kPa at subgrade level, assuming a compacted fill with an average density of 20 kN/m^3. The estimates of total settlements assume the removal of topsoil, any loose or compressible subgrade material, and are based on the elastic compression of the newly placed fill and the immediate settlement of the subgrade silty sand/sandy silt till. No clayey materials were encountered in this area and the primary consolidation (time-dependent) and the secondary compression (creep) of the subgrade under the embankment was considered negligible for settlement analyses. The immediate settlement of cohesionless soils (silty sand/sandy silt till) was estimated assuming elastic modulus of 40 MPa to 50 MPa based on SPT blow counts.

The results of the settlement analyses indicated that the proposed embankment is expected to induce a settlement of about 10 mm of the founding soil. In addition, the fill itself is anticipated to settle by 0.5% - 1.0% (22.5 mm – 45 mm) of the fill height, depending on the type of fill material and the method of placement. Hence, the total settlement will range from 30 mm to 50 mm, equal to the 50 mm required by MTO settlement criterion for new embankments on non-compressible soils.

Generally, since the foundation soils consisted mainly of granular soils, it is anticipated that there will be no significant settlement problems in this area, provided any topsoil and loose soils are removed from the embankment footprint prior to construction and the exposed subgrade surface is proof-rolled and backfilled with well compacted material. Based on the information from boreholes drilled in the area, the depth to the bottom of topsoil within the limits of the new embankment varies throughout, and may reach a maximum of 800 mm below existing grade. If possible, the removal of topsoil and loose soils beyond the footprints of the new embankment is recommended where the Right of Way (ROW) permits.

Sub-excavation of the topsoil is the best option for mitigating long-term settlement of the new embankment without the need for implementing any special construction procedure or to adjust construction schedule. That means, construction of the above grade embankment could proceed once excavation and replacement is completed. To mitigate post-construction settlement, the road paving may need to be delayed by two to four weeks after the placement of fills to the designed grade.

10. SEISMICITY

Based on the average SPT "N" values of the sandy silt to silty sand till deposit and the underlying bedrock, the subsurface at the site can be classified as Type D for seismic design purposes. The site class as well as the history of seismicity indicates that the risk of seismic activity affecting the area is low. Hence, no seismic design considerations are required for the project site.

11. CONSTRUCTION CONSIDERATIONS

11.1 Excavation

All excavations should be carried out in accordance with the Occupational Health and Safety Act (OHSA) and MTO Regulations for Construction Projects. The existing compact to very dense silty sand/sandy silt till should be considered as Type 3 soil in accordance with OHSA. As per OHSA regulations, the open-cut excavation procedures are governed by soils with the highest number of soil type. Temporary excavation slopes of 1H:1V or flatter, over the full depth of excavation should be provided assuming that adequate dewatering measures are in place. Shoring systems will be required if such slopes cannot be provided. This is especially true if the groundwater levels at proposed high fill and deep cut sections are found to be high during construction. Below the groundwater level, caving is anticipated and thus shoring is likely be required.

The contractor or design-builder is responsible for the design of temporary shoring for excavation walls. It is anticipated that excavation walls will be shored using trench boxes and sheet piles or a combination of shoring systems, depending on the depth of excavation. The design of temporary shoring should account for lateral pressures exerted by the soil, surcharge load from construction

traffic, and temporary stockpiles adjacent to the excavation. If dewatering is not considered, the design should also include the hydrostatic pressure behind the shoring.

Excavation of the soils at all deep cut locations should be feasible using conventional excavation equipment. All excavated surfaces should be kept free of frost and water during the period of construction. Runoff shall be directed away from open excavations and should not be allowed to flow into the excavation. Excavated material shall not be stockpiled on top of the excavation.

Prior to excavation, the locations and depths of existing underground utilities should be verified. All underground utilities that might be exposed and become unsupported as a result of the excavation should be properly supported and managed to avoid potential damage. In addition, power transmission towers were observed on top of existing cut slopes at some locations along Concession Road 7, and a discussion with the utility company will be required for relocation. The minimum horizontal clearance from the tower to the top of a cut slope depends on the type of the power line, right of way requirements, type of tower foundation, and subsurface conditions.

11.2 Groundwater Control

Measured groundwater levels at most locations of proposed cut slopes are relatively deep and excavation and construction is expected to be carried out in the dry. However, in areas near the intersection of Wellington Road 34 and Highway 6, stabilized groundwater levels were observed to be near the ground surface and all required excavations may have to be carried out under wet conditions. In this area, low head artesian conditions from the zone of medium to coarse silty sand till, and/or the underlying fractured bedrock, were confirmed in other boreholes drilled recently by PML.

For construction in the dry, groundwater should be lowered a minimum of 0.5 m below the base of excavation. Dewatering could be carried out by oversize excavations and sump pumping, pumping of well points or deep wells, or sheet pile cofferdams or using a combination of these techniques. Where artesian conditions are encountered, dewatering can be performed to lower the water pressure beneath the confining layer (bedrock level) using deep wells and/or well point systems. Using these dewatering techniques, the water pressure can be reduced to a level where it is less than the total weight of the

confining layer, until at least construction is completed. The contractor (design-builder) should be responsible for selection, design, and installation and performance of the dewatering systems. The dewatering system should be designed to conform to the requirements of OPSS.PROV 517.

In general, if pumping of groundwater at volumes greater than 50,000 L/day and less than 400,000 L/day is required during construction, the Environmental Activity Sector Registry (EASR) must be completed. An EASR may not be required to temporarily pump surface water from behind a dewatering system (sheet pile or a sand bag cofferdam), as long as the water is returned to the original source. If water taking in excess of 400,000 litres/day is required, a Permit to Take Water (PTTW) must be obtained in advance from the Ministry of the Environment, Conservation, and Parks (MECP). If sheet piles are installed to adequate depths to cut-off groundwater inflows, pumping volumes are anticipated to be less than 400,000 litres/day and PTTW applications would not be required. In general, the actual rate of groundwater taking will be a function of the final design, time of year, and the contractor's schedule, equipment, and techniques. At the time of processing, it is advisable to check any other requirements for taking water including potential municipality permits and requisites of other levels of government.

11.3 Subgrade Preparation and Embankment Construction

The embankment fills should consist of well compacted and acceptable native or granular material. To meet MTO settlement criteria provided in MTO Guidelines for Embankment Settlement Criteria for Design, any topsoil/peat as well as soft area and organic deposits observed within the base or limits of the embankments should be removed before placing the fill materials.

After stripping of soft and compressible materials to the specified depths, the exposed subgrade should be proof-rolled to identify any soft and compressible materials requiring sub excavation. Excavated areas shall be backfilled with well compacted approved/acceptable fill. Embankment fill should be placed and compacted in accordance with OPSS.PROV 206. Sod application and vegetation cover should be in conformance with OPSS.PROV 803. Measures to reduce erosion of fill and cut slopes due to runoff should be considered during the detail design phase of the project and may include placement of topsoil and sod as soon as practicable after construction of the embankments. Erosion protection measures should be in accordance with OPSS.PROV 804.

11.4 Infiltration Ponds

The preliminary plan obtained from AECOM identifies infiltration ponds on the sides of the W-N Ramp and the E-S Ramps of the Midblock Interchange. It is anticipated that stormwater collected in the areas will be directed into these ponds and ultimately flows to stormwater blocks. Boreholes 21-50 and 21-51 were drilled at the locations of proposed infiltration ponds. Monitoring wells were installed in these boreholes to measure stabilized groundwater level. The subsurface at the locations of the infiltration ponds comprised of sandy silt/silty sand till with trace amount of clay and significant proportion of gravel. Reference should be made to the Hydrogeological Report prepared by PML as part of this project for permeability characteristics of these soils.

Generally, the permeability or infiltration capacity of a soil depends on a number of factors, including particle size distribution, degree of saturation, compactness, adsorbed water, etc. The heterogeneous nature of glacial till deposits can also contribute to variations in soil permeability where the soil composition may include localized areas with increased fine material or sandy material which can influence soil permeability at different points within the soil strata.

It is recommended that pond side slopes be constructed with an inclination flatter than 2.5H:1V. Ideally, slopes no steeper than 3.0H:1V are encouraged in order to decrease surficial erosion. In the event that sandy pockets are encountered in the pond bases or sidewalls, localized subgrade improvement to remove and replace the sandy soils with excavated onsite silty sand till can be carried out. Finished pond slopes should be provided with a topsoil layer on the surface to assist establishing grass-type vegetation to help prevent erosion. A synthetic erosion blanket can be considered to assist the growth of vegetation. Erosion protection measures should be in accordance with OPSS.PROV 804. Sod application and vegetation cover should be based on OPSS.PROV 803. Maintenance of the slope surfaces is advised to address long-term erosion.

12. CLOSURE

This report was prepared by Lul Yimam, P. Eng., Senior Engineer and Project Manager, and reviewed by Geoffrey Uwimana, MEng., P.Eng., MTO Designated Principal Contact.

Yours very truly

Peto MacCallum Ltd.

Lul Yimam, P.Eng.
Senior Engineer, Geotechnical Services

Geoffrey Uwimana, MEng., P.Eng.
Senior Engineer, Discipline Head, Geotechnical Services
MTO Designated Principal Contact

LY/GU:nk

APPENDIX D

List of Ontario Provincial Standard Specifications and Drawings Cited in the Report

LIST OF ONTARIO PROVINCIAL STANDARD SPECIFICATION (OPSSS) AND DRAWINGS (OPSDS) MENTIONED IN THE REPORT

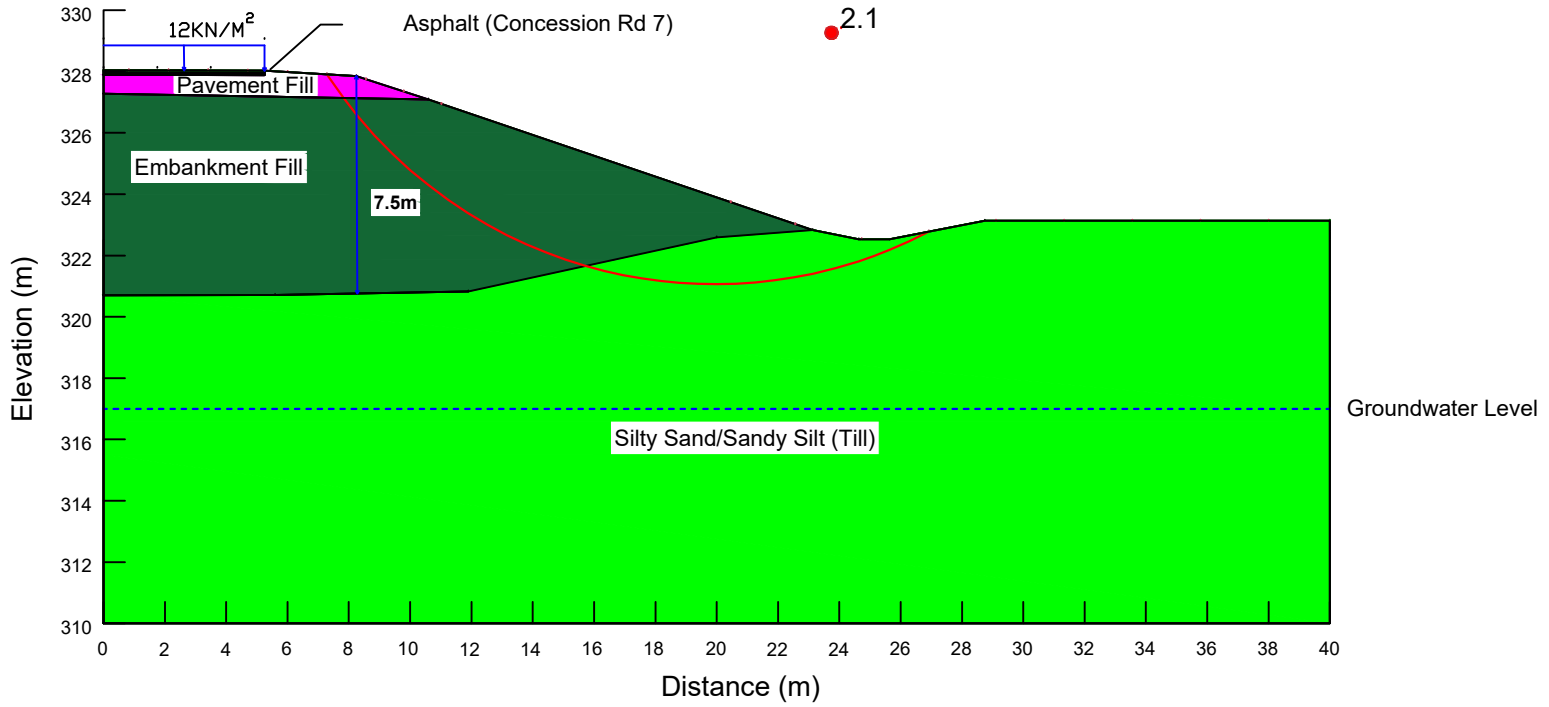
DOCUMENT	TITLE	Revision Date
OPSS.PROV 206	Construction Specification for Grading	November, 2014
OPSS.PROV 517	Construction Specification for Dewatering	November, 2016
OPSS.PROV 803	Construction Specification for Vegetative Cover	November, 2020
OPSS.PROV 804	Construction Specification for Temporary Erosion Control	November, 2020
OPSD 201.010	Slope Flattening using Surplus Excavated Material on Earth or Rock Embankment	November 2016

APPENDIX E

Results of Fill and Cut Slope Stability Analyses

SOIL STRENGTH PARAMETERS

PROPERTY / MATERIAL	ASPHALT	PAVEMENT FILL	EMBANKMENT FILL	SILTY SAND / SANDY SILT COMPACT (TILL)
Bulk Unit Weight (kN/m^3)	–	21	20	19
Internal Friction Angle (°)	–	32	30	28
Drained Shear Strength, (Cohesion) (kPa)	–	–	–	–
Undrained Shear Strength, (Cohesion) (kPa)	–	–	–	–



HF–1 Concession Rd 7 (STATION 11+070) Slope Stability Analysis
Embankment Height = 7.5 m
MIDBLOCK INTERCHANGE AREA, HIGHWAY 6 & HIGHWAY 401 IMPROVEMENTS
CITY OF GUELPH, ONTARIO

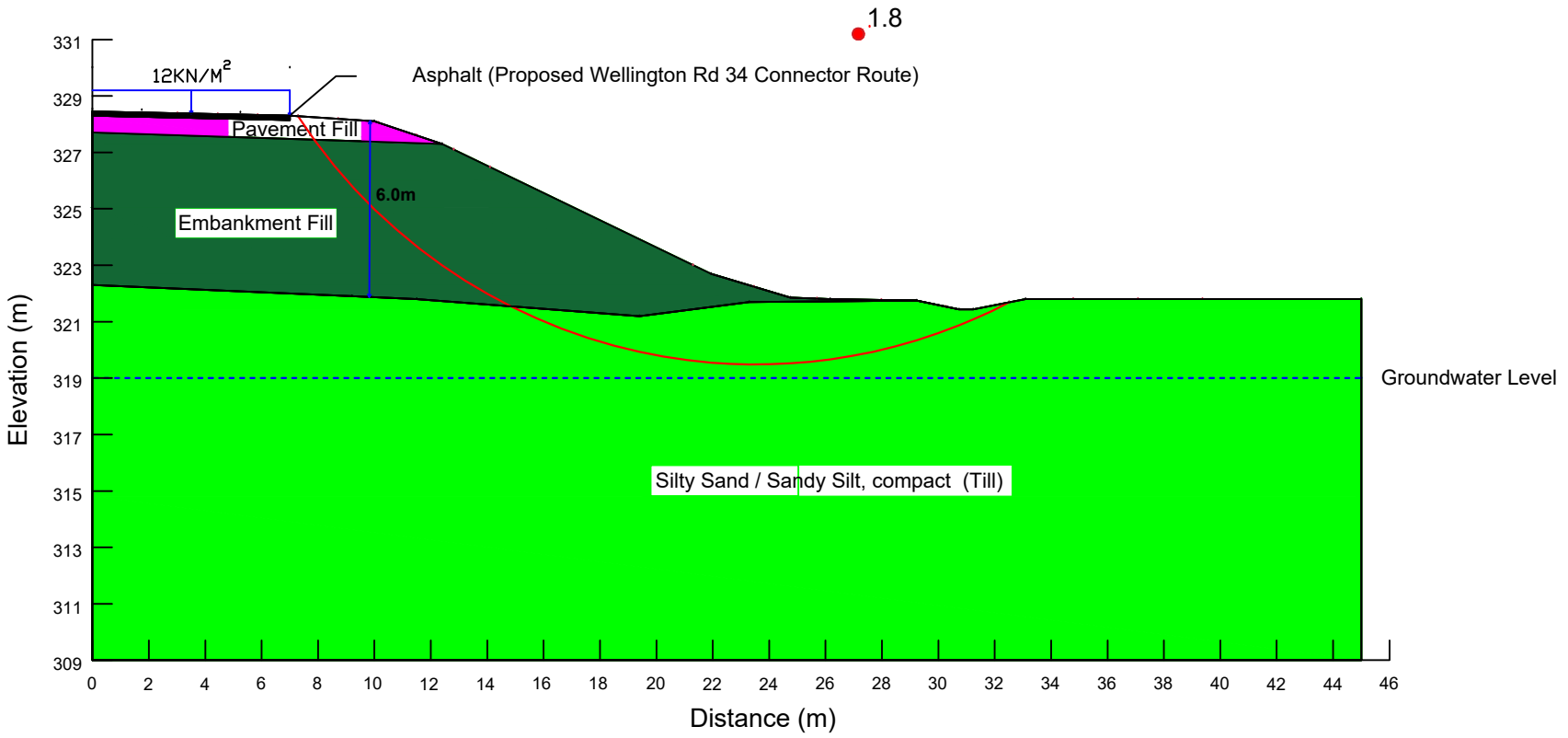
CONTRACT NO:	
G.W.P.:	3059–20–00
HWY NO.:	6
DISTRICT:	31

PML Peto MacCallum Ltd. CONSULTING ENGINEERS

DRAWN:	P.J.	JOB NO.	DATE	DRAWING NO.
CHECKED:	L.Y.	17TF006I	Sep 29, 2021	MBI–16
APPROVED:	G.U.			

SOIL STRENGTH PARAMETERS

PROPERTY \ MATERIAL	ASPHALT	PAVEMENT FILL	EMBANKMENT FILL	SILTY SAND / SANDY SILT, COMPACT (TILL)
Bulk Unit Weight (kN/m^3)	–	21	20	19
Internal Friction Angle (°)	–	32	30	28
Drained Shear Strength, (Cohesion) (kPa)	–	–	–	–
Undrained Shear Strength, (Cohesion) (kPa)	–	–	–	–



HF–2 Proposed Wellington Rd 34 Connector Route (STATION 10+380)
Slope Stability Analysis
Embankment Height = 6.0 m
MIDBLOCK INTERCHANGE AREA, HIGHWAY 6 & HIGHWAY 401 IMPROVEMENTS
CITY OF GUELPH, ONTARIO

CONTRACT NO:	
G.W.P.:	3059–20–00
HWY NO.:	6
DISTRICT:	31

PML Peto MacCallum Ltd. CONSULTING ENGINEERS

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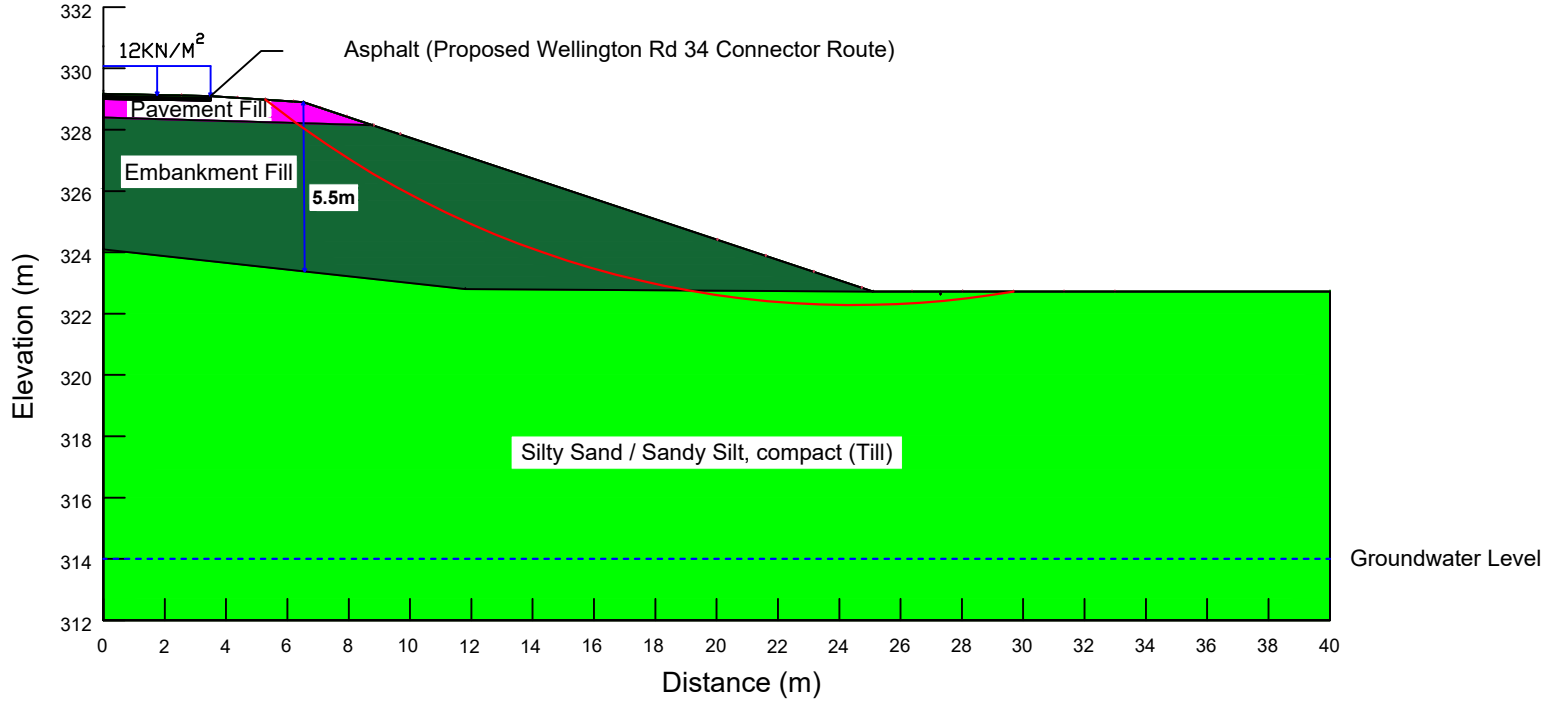
APPROVED:	G.U.			

SOIL STRENGTH PARAMETERS

PROPERTY / MATERIAL	ASPHALT	PAVEMENT FILL	EMBANKMENT FILL	SILTY SAND / SANDY SILT, COMPACT (TILL)
Bulk Unit Weight (kN/m^3)	–	21	20	19
Internal Friction Angle (°)	–	32	30	28
Drained Shear Strength, (Cohesion) (kPa)	–	–	–	–
Undrained Shear Strength, (Cohesion) (kPa)	–	–	–	–

1.9



HF–3 Proposed Wellington Rd 34 Connector Route (STATION 9+860)
Slope Stability Analysis
Embankment Height = 5.5 m
MIDBLOCK INTERCHANGE AREA, HIGHWAY 6 & HIGHWAY 401 IMPROVEMENTS
CITY OF GUELPH, ONTARIO

CONTRACT NO:	
G.W.P.:	3059–20–00
HWY NO.:	6
DISTRICT:	31

PML Peto MacCallum Ltd. CONSULTING ENGINEERS

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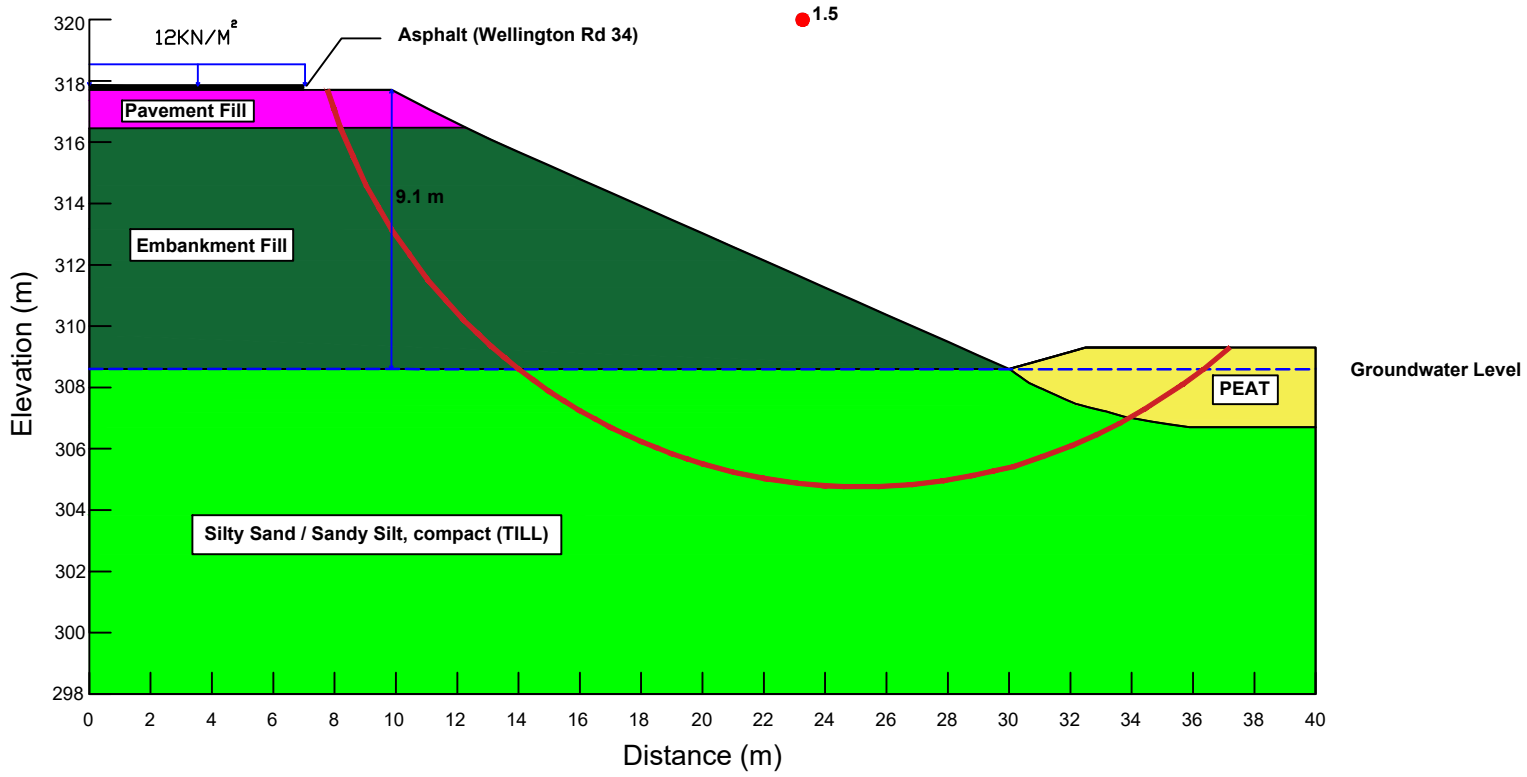
CHECKED:	L.Y.	17TF006I	Sep 29, 2021	MBI–18
APPROVED:	G.U.			

SOIL STRENGTH PARAMETERS

PROPERTY / MATERIAL	ASPHALT	PAVEMENT FILL	EMBANKMENT FILL	PEAT	SILTY SAND / SANDY SILT, COMPACT (TILL)
Bulk Unit Weight (kN/m^3)	–	21	20	10	19
Internal Friction Angle (°)	–	32	30	20	28
Drained Shear Strength, (Cohesion) (kPa)	–	–	–	1	–
Undrained Shear Strength, (Cohesion) (kPa)	–	–	–	5	–



HF–4 Wellington Road 34 West Approach Embankment (STATION 9+960)
Slope Stability Analysis
Embankment Height = 9.1 m
MIDBLOCK INTERCHANGE AREA, HIGHWAY 6 & HIGHWAY 401 IMPROVEMENTS
CITY OF GUELPH, ONTARIO

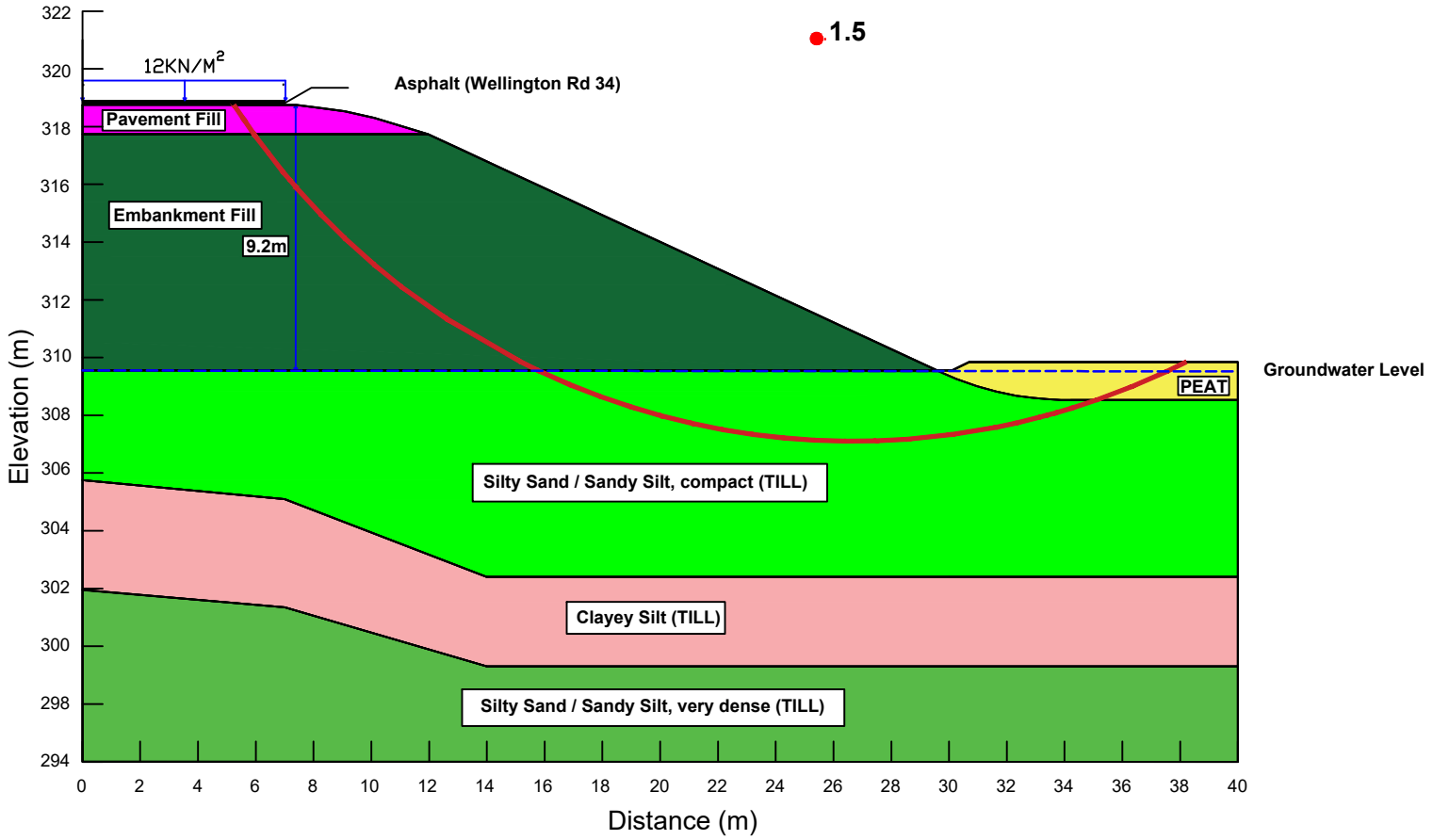
CONTRACT NO:	
G.W.P.:	3059–20–00
HWY NO.:	6
DISTRICT:	31

PML Peto MacCallum Ltd. CONSULTING ENGINEERS

DRAWN:	P.J.	JOB NO.	DATE	DRAWING NO.
CHECKED:	L.Y.	17TF006I	SEP 29, 2021	MBI–19
APPROVED:	G.U.			

SOIL STRENGTH PARAMETERS

PROPERTY / MATERIAL	ASPHALT	PAVEMENT FILL	EMBANKMENT FILL	PEAT	SILTY SAND / SANDY SILT, COMPACT (TILL)	CLAYEY SILT (TILL)	SILTY SAND / SANDY SILT, VERY DENSE (TILL)
Bulk Unit Weight (kN/m^3)	–	21	20	10	19	19	19
Internal Friction Angle (°)	–	32	30	20	28	20	34
Drained Shear Strength, (Cohesion) (kPa)	–	–	–	1	–	5	–
Undrained Shear Strength, (Cohesion) (kPa)	–	–	–	5	–	30	–



HF–5 Wellington Road 34 East Approach Embankment (STATION 10+040)
Slope Stability Analysis
Embankment Height = 9.2 m
MIDBLOCK INTERCHANGE AREA, HIGHWAY 6 & HIGHWAY 401 IMPROVEMENTS
CITY OF GUELPH, ONTARIO

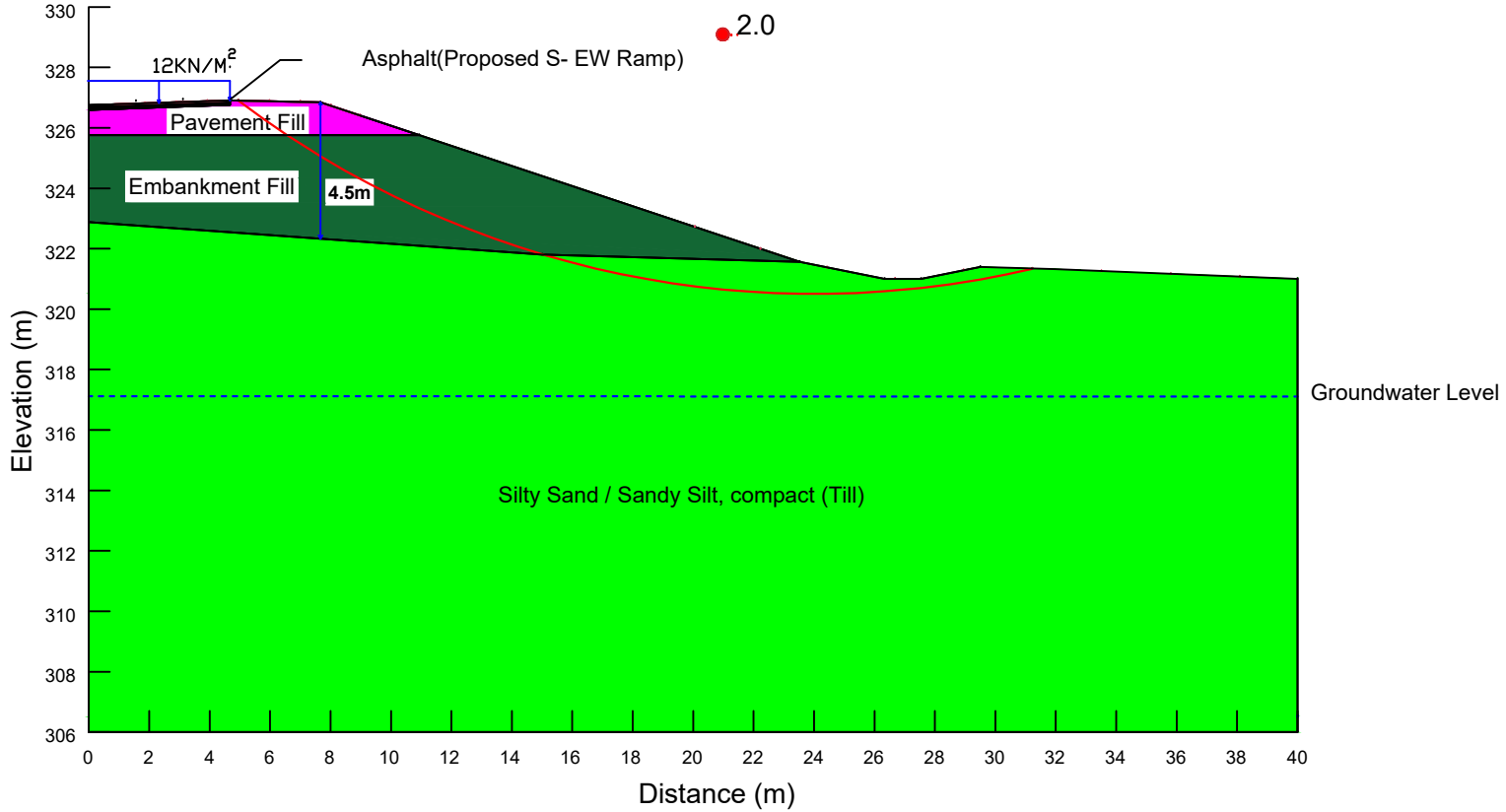
CONTRACT NO:	
G.W.P.:	3059–20–00
HWY NO.:	6
DISTRICT:	31

PML Peto MacCallum Ltd. CONSULTING ENGINEERS

DRAWN:	P.J.	JOB NO.	DATE	DRAWING NO.
CHECKED:	L.Y.	17TF006I	Sep 29, 2021	MBI–20
APPROVED:	G.U.			

SOIL STRENGTH PARAMETERS

PROPERTY / MATERIAL	ASPHALT	PAVEMENT FILL	EMBANKMENT FILL	SILTY SAND / SANDY SILT, COMPACT (TILL)
Bulk Unit Weight (kN/m^3)	–	21	20	19
Internal Friction Angle (°)	–	32	30	28
Drained Shear Strength, (Cohesion) (kPa)	–	–	–	–
Undrained Shear Strength, (Cohesion) (kPa)	–	–	–	–



HF–6 Proposed S–EW Ramp (STATION 10+350)
Slope Stability Analysis
Embankment Height = 4.5 m
MIDBLOCK INTERCHANGE AREA, HIGHWAY 6 & HIGHWAY 401 IMPROVEMENTS
CITY OF GUELPH, ONTARIO

CONTRACT NO:	
G.W.P.:	3059–20–00
HWY NO.:	6
DISTRICT:	31

PML Peto MacCallum Ltd. CONSULTING ENGINEERS

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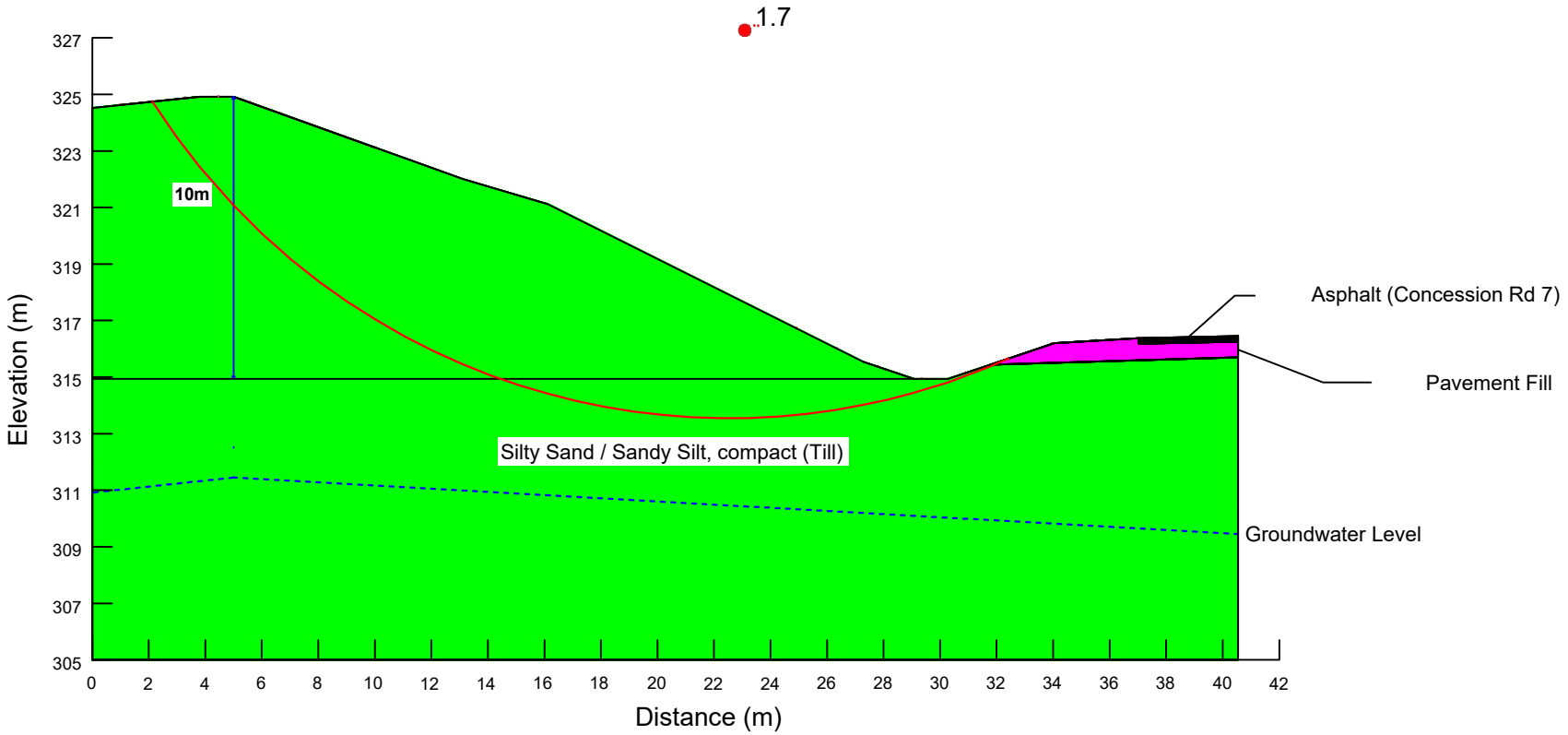
CHECKED:	L.Y.	17TF006I	Sep 29, 2021	MBI–21
APPROVED:	G.U.			

SOIL STRENGTH PARAMETERS

PROPERTY / MATERIAL	ASPHALT	PAVEMENT FILL	SILTY SAND / SANDY SILT, COMPACT (TILL)
Bulk Unit Weight (kN/m^3)	–	21	19
Internal Friction Angle (°)	–	32	25
Drained Shear Strength, (Cohesion) (kPa)	–	–	–
Undrained Shear Strength, (Cohesion) (kPa)	–	–	–



DC–1 Concession Rd 7 (STATION 10+780) Slope Stability Analysis
Cut Slope Height = 10m
MIDBLOCK INTERCHANGE AREA, HIGHWAY 6 & HIGHWAY 401 IMPROVEMENTS
CITY OF GUELPH, ONTARIO

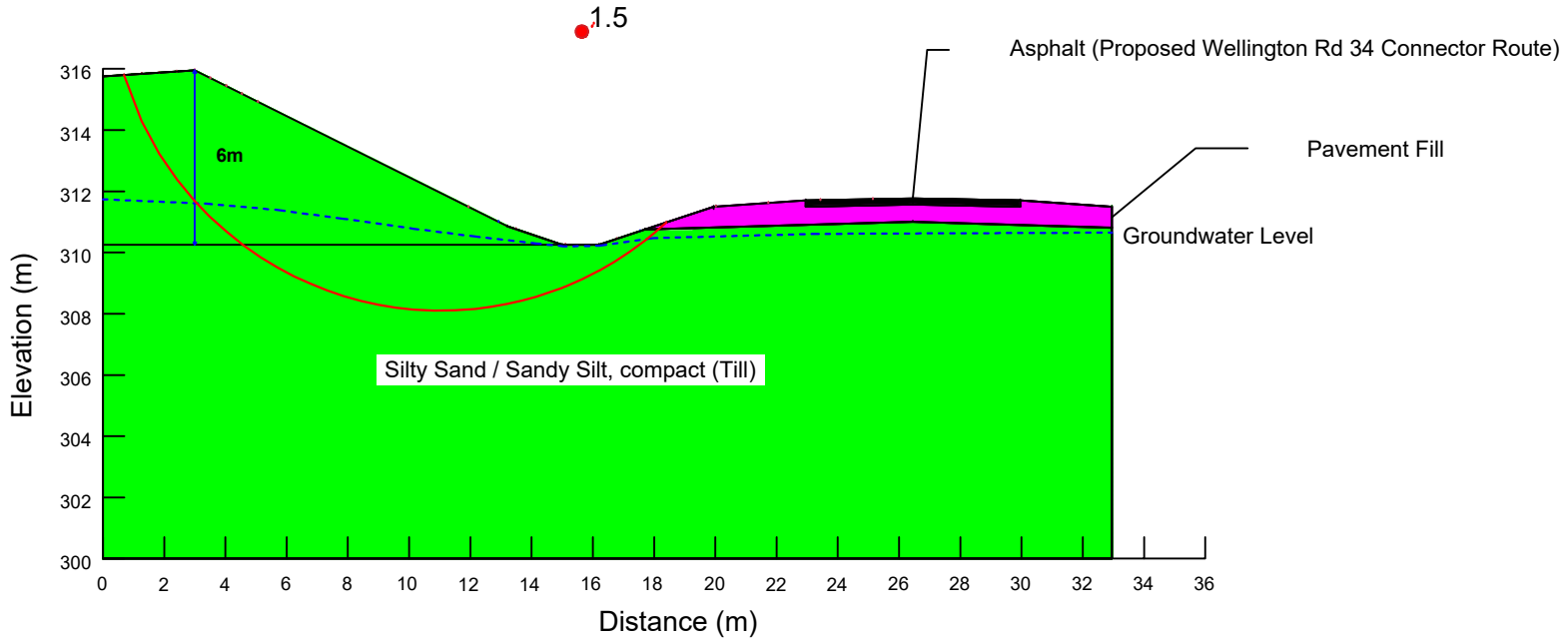
CONTRACT NO:	
G.W.P.:	3059–20–00
HWY NO.:	6
DISTRICT:	31

PML Peto MacCallum Ltd. CONSULTING ENGINEERS

DRAWN:	P.J.	JOB NO.	DATE	DRAWING NO.
CHECKED:	L.Y.	17TF006I	Sep 29, 2021	MBI–22
APPROVED:	G.U.			

SOIL STRENGTH PARAMETERS

PROPERTY / MATERIAL	ASPHALT	PAVEMENT FILL	SILTY SAND / SANDY SILT, COMPACT (TILL)
Bulk Unit Weight (kN/m^3)	–	21	19
Internal Friction Angle (°)	–	32	28
Drained Shear Strength, (Cohesion) (kPa)	–	–	–
Undrained Shear Strength, (Cohesion) (kPa)	–	–	–



DC–2 Proposed Wellington Rd 34 Connector Route (STATION 9+080)
Slope Stability Analysis
Cut Slope Height = 6m
MIDBLOCK INTERCHANGE AREA, HIGHWAY 6 & HIGHWAY 401 IMPROVEMENTS
CITY OF GUELPH, ONTARIO

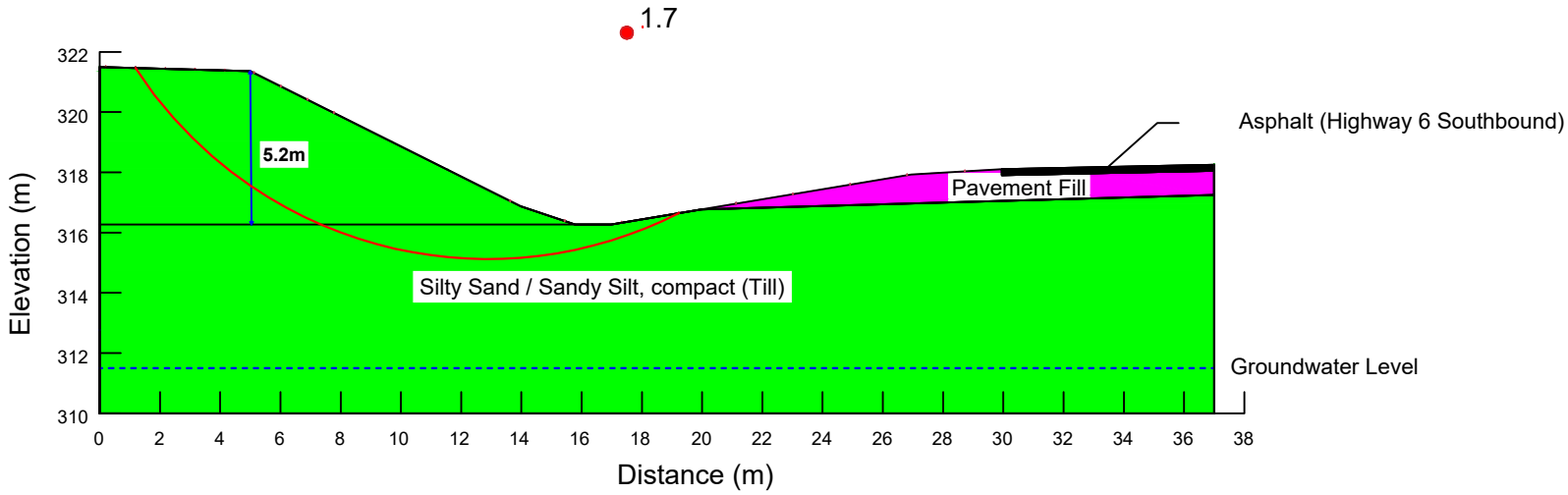
CONTRACT NO:	
G.W.P.:	3059–20–00
HWY NO.:	6
DISTRICT:	31

PML Peto MacCallum Ltd. CONSULTING ENGINEERS

DRAWN:	P.J.	JOB NO.	DATE	DRAWING NO.
CHECKED:	L.Y.	17TF006I	Sep 29, 2021	MBI–23
APPROVED:	G.U.			

SOIL STRENGTH PARAMETERS

PROPERTY / MATERIAL	ASPHALT	PAVEMENT FILL	SILTY SAND / SANDY SILT, COMPACT (TILL)
Bulk Unit Weight (kN/m^3)	–	21	19
Internal Friction Angle (°)	–	32	28
Drained Shear Strength, (Cohesion) (kPa)	–	–	–
Undrained Shear Strength, (Cohesion) (kPa)	–	–	–



DC–3 Highway 6 Southbound (STATION 11+780)
Slope Stability Analysis
Cut Slope Height = 5.2m
MIDBLOCK INTERCHANGE AREA, HIGHWAY 6 & HIGHWAY 401 IMPROVEMENTS
CITY OF GUELPH, ONTARIO

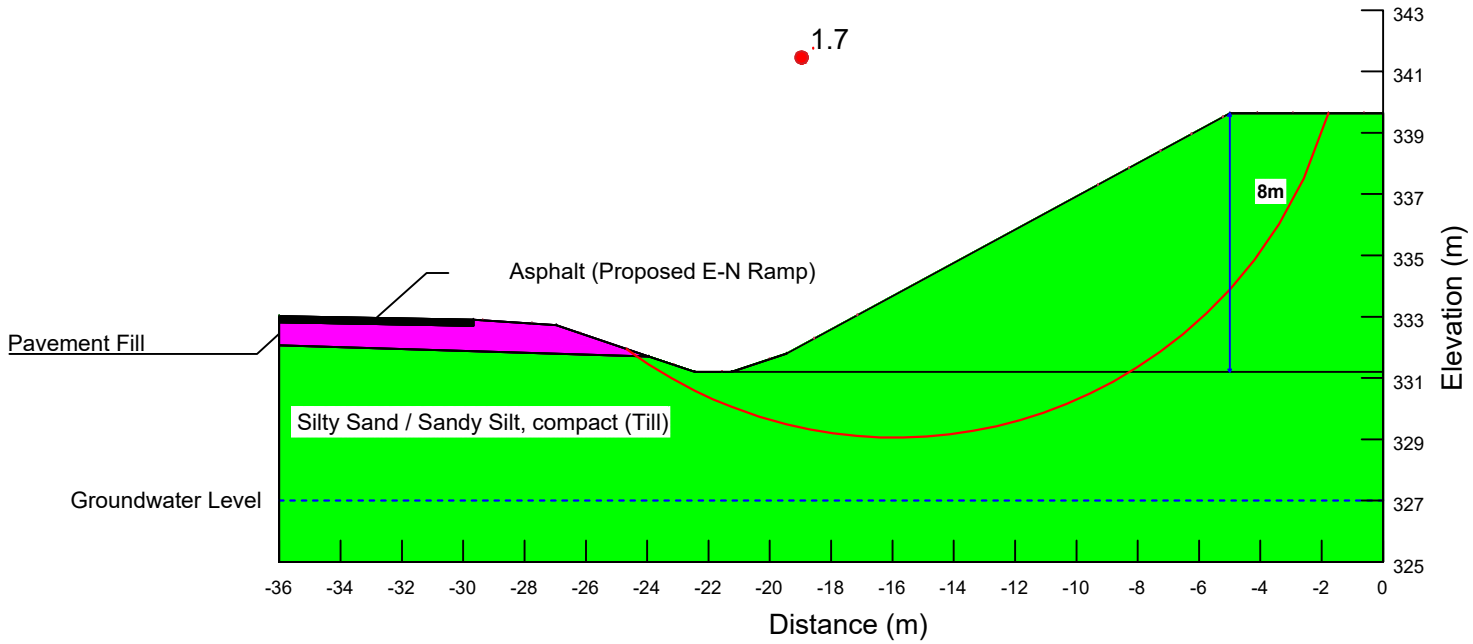
CONTRACT NO:	
G.W.P.:	3059–20–00
HWY NO.:	6
DISTRICT:	31

PML Peto MacCallum Ltd. CONSULTING ENGINEERS

DRAWN:	P.J.	JOB NO.	DATE	DRAWING NO.
CHECKED:	L.Y.	17TF006I	Sep 29, 2021	MBI–24
APPROVED:	G.U.			

SOIL STRENGTH PARAMETERS

PROPERTY / MATERIAL	ASPHALT	PAVEMENT FILL	SILTY SAND / SANDY SILT, COMPACT (TILL)
Bulk Unit Weight (kN/m^3)	–	21	19
Internal Friction Angle (°)	–	32	28
Drained Shear Strength, (Cohesion) (kPa)	–	–	–
Undrained Shear Strength, (Cohesion) (kPa)	–	–	–



DC–4 Proposed E–N Ramp (STATION 9+830)
Slope Stability Analysis
Cut Slope Height = 8m
MIDBLOCK INTERCHANGE AREA, HIGHWAY 6 & HIGHWAY 401 IMPROVEMENTS
CITY OF GUELPH, ONTARIO

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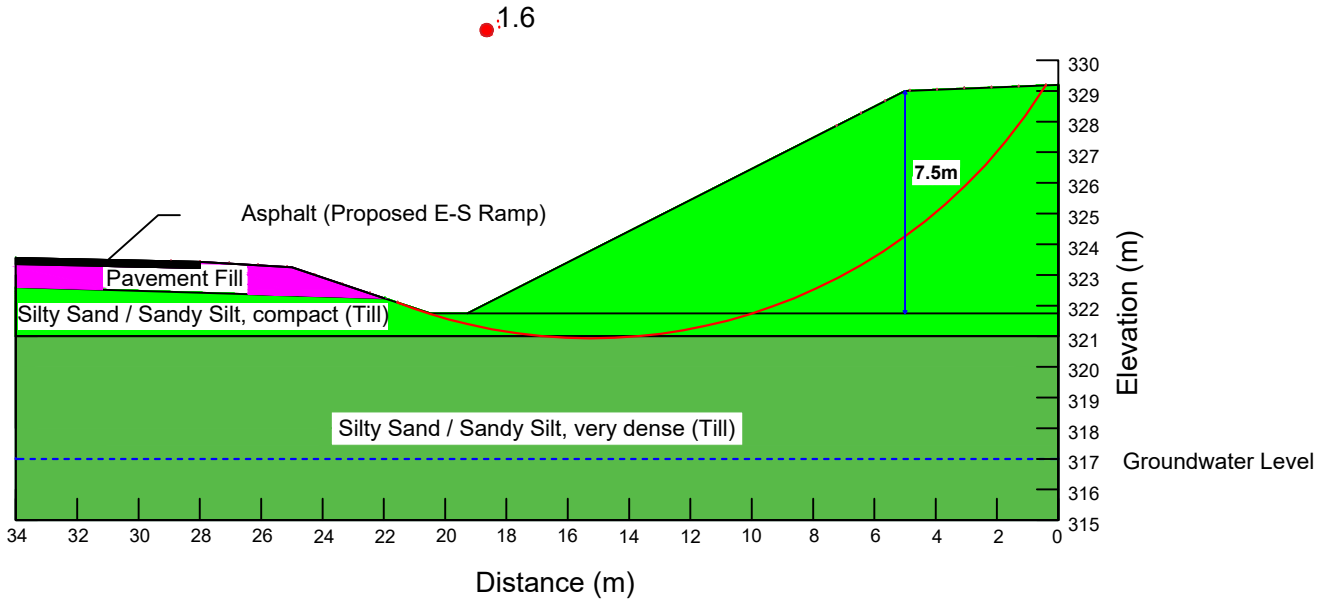
PML Peto MacCallum Ltd. CONSULTING ENGINEERS

DRAWN:	P.J.	JOB NO.	DATE	DRAWING NO.
CHECKED:	L.Y.	17TF006I	Sep 29, 2021	MBI–25
APPROVED:	G.U.			

SOIL STRENGTH PARAMETERS

PROPERTY / MATERIAL	ASPHALT	PAVEMENT FILL	SILTY SAND / SANDY SILT, COMPACT (TILL)	SILTY SAND / SANDY SILT, VERY DENSE (TILL)
Bulk Unit Weight (kN/m^3)	–	21	19	19
Internal Friction Angle (°)	–	32	28	34
Drained Shear Strength, (Cohesion) (kPa)	–	–	–	–
Undrained Shear Strength, (Cohesion) (kPa)	–	–	–	–



DC–5 Proposed E–S Ramp (STATION 9+960)
Slope Stability Analysis
Cut Slope Height = 7.5m
MIDBLOCK INTERCHANGE AREA, HIGHWAY 6 & HIGHWAY 401 IMPROVEMENTS
CITY OF GUELPH, ONTARIO

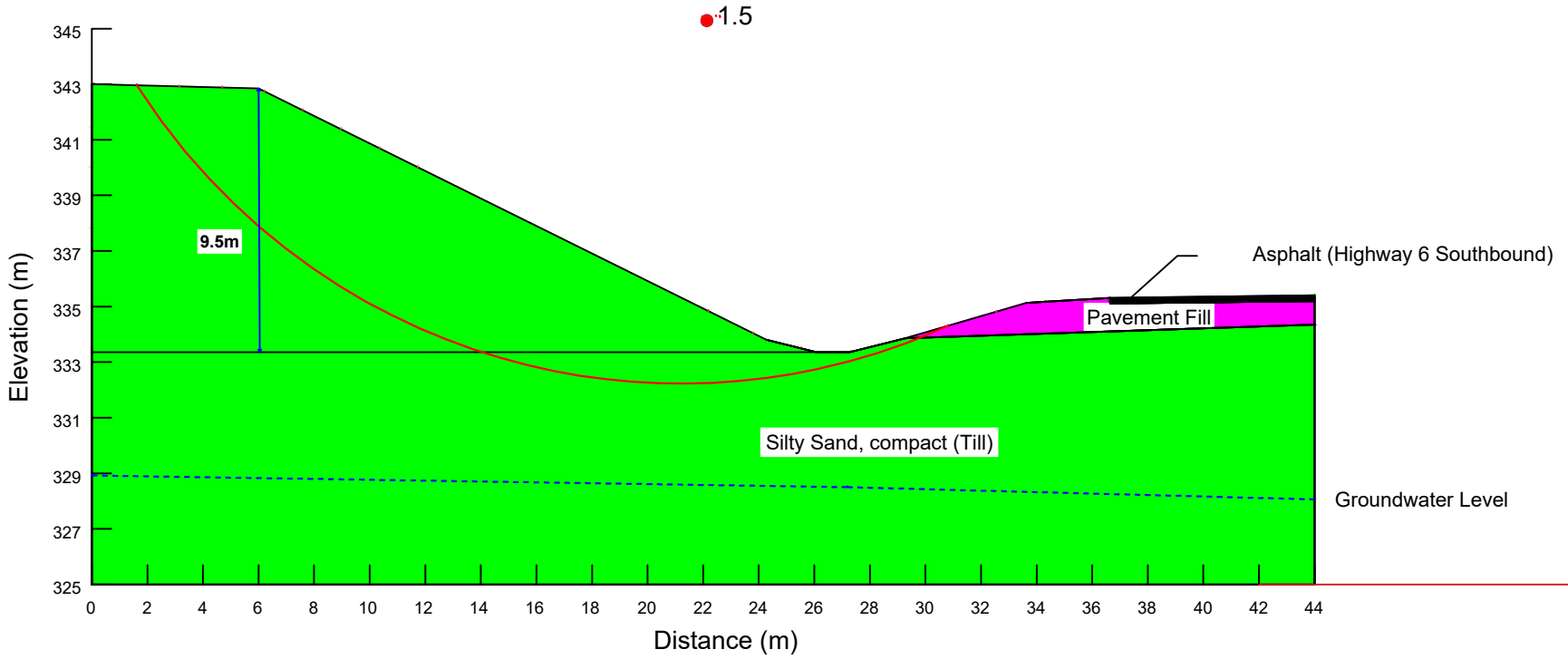
CONTRACT NO:	
G.W.P.:	3059–20–00
HWY NO.:	6
DISTRICT:	31

PML Peto MacCallum Ltd. CONSULTING ENGINEERS

DRAWN:	P.J.	JOB NO.	DATE	DRAWING NO.
CHECKED:	L.Y.	17TF006I	Sep 29, 2021	MBI–26
APPROVED:	G.U.			

SOIL STRENGTH PARAMETERS

PROPERTY / MATERIAL	ASPHALT	PAVEMENT FILL	SILTY SAND / SANDY SILT, COMPACT (TILL)
Bulk Unit Weight (kN/m^3)	–	21	19
Internal Friction Angle (°)	–	32	28
Drained Shear Strength, (Cohesion) (kPa)	–	–	–
Undrained Shear Strength, (Cohesion) (kPa)	–	–	–



DC–6 Highway 6 Southbound (STATION 12+410)
Slope Stability Analysis
Cut Slope Height = 9.5m
MIDBLOCK INTERCHANGE AREA, HIGHWAY 6 & HIGHWAY 401 IMPROVEMENTS
CITY OF GUELPH, ONTARIO

CONTRACT NO:	
G.W.P.:	3059–20–00
HWY NO.:	6
DISTRICT:	31

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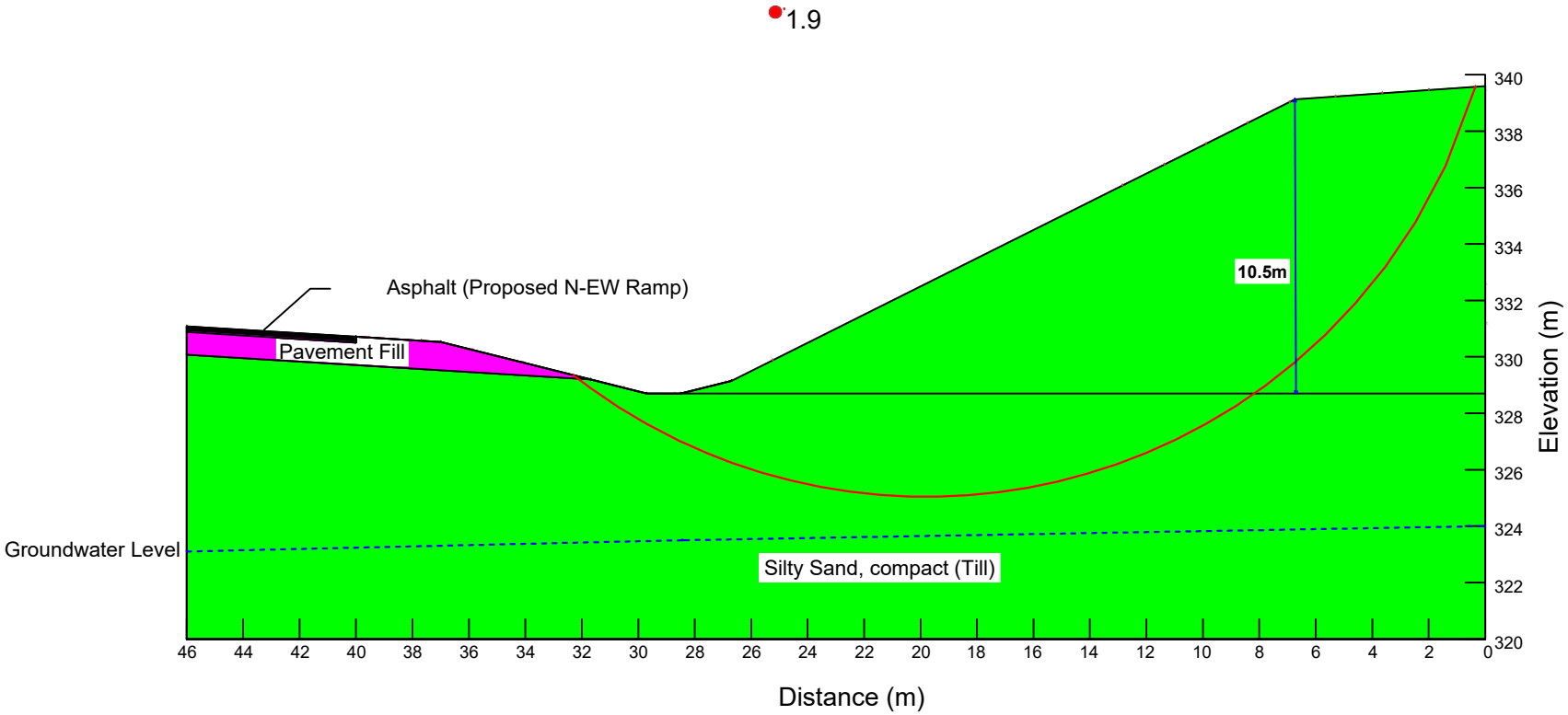
DRAWN:	P.J.	JOB NO.	DATE	DRAWING NO.
CHECKED:	L.Y.	17TF006I	Sep 29, 2021	MBI–27
APPROVED:	G.U.			

SOIL STRENGTH PARAMETERS

PROPERTY / MATERIAL	ASPHALT	PAVEMENT FILL	SILTY SAND / SANDY SILT, COMPACT (TILL)
Bulk Unit Weight (kN/m^3)	–	21	19
Internal Friction Angle (°)	–	32	28
Drained Shear Strength, (Cohesion) (kPa)	–	–	–
Undrained Shear Strength, (Cohesion) (kPa)	–	–	–



DC–6 Proposed N–EW Ramp (STATION 10+020)
Slope Stability Analysis
Cut Slope Height = 10.5m
MIDBLOCK INTERCHANGE AREA, HIGHWAY 6 & HIGHWAY 401 IMPROVEMENTS
CITY OF GUELPH, ONTARIO

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HWY NO.:	6
DISTRICT:	31

PML Peto MacCallum Ltd. CONSULTING ENGINEERS

DRAWN:	P.J.	JOB NO.	DATE	DRAWING NO.
CHECKED:	L.Y.	17TF006I	Sep 29, 2021	MBI–28
APPROVED:	G.U.			