



PRELIMINARY FOUNDATION INVESTIGATION REPORT

for

**RECONSTRUCTION OF AYR PATROL YARD
HIGHWAY 401 AND HIGHWAY 97 INTERCHANGE
NORTH DUMFRIES TOWNSHIP
MUNICIPALITY OF WATERLOO, ONTARIO
ASSIGNMENT NO. 3017-E-0002, GWP 3039-16-00
LATITUDE: 43.329863; LONGITUDE: - 80.451409**

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PML Ref.: 17TF036A
Index No.: 016FIR
GEOCREs No.: 40P8-259
December 20, 2018



PART A – PRELIMINARY FOUNDATION INVESTIGATION REPORT

for

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PART A – PRELIMINARY FOUNDATION INVESTIGATION REPORT

For

Reconstruction of Ayr Patrol Yard
Highway 401 and Highway 97 Interchange, North Dumfries Township
Municipality of Waterloo, Ontario
Assignment No. 3017-E-0002, GWP 3039-16-00

1. INTRODUCTION

Ministry of Transportation Ontario (MTO) has retained Morrison Hershfield Limited (MH) as the Prime Consultant, to provide Design Build Ready services for the development of a New Patrol Yard and access road at the northwest quadrants of the Highway 401 and Regional Road 97 Interchange, located in the Township of New Dumfries, Municipality of Waterloo, Ontario.

MH has retained Peto MacCallum Ltd. (PML) on behalf of (MTO) to provide foundation engineering services for the assignment. The foundation investigation work reported herein is part of MTO Assignment No. 3017-E-0002. The terms of reference and scope of work for the design build ready package are outlined in the Request for Proposals (RFP) Version 8.1 dated May 2016.

This report presents the factual findings obtained from the foundation investigation carried out for the proposed Reconstruction of Ayr Patrol Yard. The proposed developments included a 533 m² office space, 3 Bay maintenance garage, wash bay, 12-bay vehicle storage, salt and sand storage facility, 9 brine tanks containment bay, 4 bay bulk material storage, storage shed, fuel pad, and outdoor parking.

The purpose of the investigation is to assess the subsurface conditions and to provide the preliminary foundation recommendation for planning and preliminary design of the proposed Reconstruction of Ayr Patrol Yard.

2. SITE DESCRIPTION

The topography of the project area is generally flat, except for the highway embankments. The site surrounding the patrol yard is covered with trees, bushes, and grass. The area along the highway on both the north and south sides is moderately vegetated with grass, trees, and shrubs. The site is an abandoned MTO Patrol Yard which currently, contains a salt dome, asphalt surfaces with an access road from Cedar Creek Road (Highway 97) north of Highway 401.



The grade slopes upward towards the east with grades varying between approximate elevations of about 335 and 338, with topographic relief of in the order of approximately 3 m to 3.5 m. Adjacent land uses include industrial, commercial, and farmland.

3. FIELD INVESTIGATION PROCEDURES

The field work for this investigation was supervised on a full-time basis by members of PML's technical staff. PML staff located the boreholes in the field, arranged for the clearance of underground service locations, directed the drilling, sampling and in situ testing operations, and logged the boreholes.

The fieldwork was carried out between May 10 and 22, 2018 and the location of boreholes in the field was established by PML staff using a portable GPS device. Subsequently, Callon Dietz, London, Ontario, under PML subcontract carried out the survey of the locations and elevations of the boreholes and provided the co-ordinates for locations in MTM NAD 83 northing and easting. PML used the survey data provided by Callon Dietz for preparation of this report. All elevations reported in this report are referred to Geodetic datum and expressed in meters.

The investigation included advancing 18 boreholes numbered BH 17-1 to BH 17-18. The boreholes were drilled to depths ranging from 9.6 m to 12.6 m below the existing ground surface (El. 328.6 to El. 322.4), as required by the RFP, and were terminated in competent soil. These boreholes were advanced using hollow stem augers powered by a D50 track-mounted drill rig. The drilling equipment from two (2) different drilling contractors were used for the field investigation. The equipment used were owned and operated by Landshark Drilling, and Aardvark Drilling Inc., who are specialist drilling contractors.

The borehole locations and the ground surface elevations at the borehole locations are presented in Table 1 and on the Record of Borehole sheets attached in Appendix A.



Table 1: Summary of Boreholes

BOREHOLE NO.	BOREHOLE LOCATION	MTM NAD 83 COORDINATES		GROUND SURFACE ELEVATION (m)	SURFICIAL FILL MATERIAL	BOREHOLE DEPTH (m)
		NORTHING	EASTING			
BH17-1	Outdoor Storage	4799374.6	227562.4	335.3	Silty Sand	12.6
BH17-2	Bulk Material Storage/Storage Shed	4799275.3	227578.9	335.0	Silty Sand	12.6
BH17-3	Sand/Salt Storage	4799351.5	227600.7	335.2	Pavement Structure on Clayey Silt	12.6
BH17-4	Sand/Salt Storage	4799354.2	227636.0	335.3	Pavement Structure on Clayey Silt	12.6
BH17-5	12-Bay Vehicle Storage/3-Wash Bay	4799341.8	227711.8	335.4	Clayey Silt	12.6
BH17-6	12-Bay Vehicle Storage	4799348.3	227657.4	335.5	Pavement Structure on Clayey Silt	12.6
BH17-7	3-Bay Garage	4799382.7	227729.5	335.2	Clayey Silt	12.6
BH17-8	Fuel Pad	4799337.9	227757.1	335.6	Pavement Structure on Sandy Silt	12.6
BH17-9	West Limit of Property	4799318.7	227531.1	335.0	Clayey Silt Silty Sand	12.6
BH17-10	Sand/Salt Storage	4799316.4	227575.6	335.4	Pavement Structure on Clayey Silt	11.1
BH17-11	12-Bay Vehicle Storage	4799325.0	227645.3	335.6	Clayey Silt	9.6
BH17-12	12-Bay Vehicle Storage/3-Wash Bay	4799371.6	227705.0	335.3	Pavement Structure on Clayey Silt	9.6
BH17-13	Office Building/Staff Parking Lot	4799385.6	227752.9	335.2	Silty Sand	9.6
BH17-14	Leeching Bed/Septic Tank	4799414.0	227779.5	336.6	Silty Sand	9.6
BH17-15		4799378.9	227804.1	337.7	Clayey Silt	9.6
BH17-16	East Limit of Property	4799416.5	227904.7	338.2	Clayey Silt	9.6



Table 1: Summary of Boreholes

BOREHOLE NO.	BOREHOLE LOCATION	MTM NAD 83 COORDINATES		GROUND SURFACE ELEVATION (m)	SURFICIAL FILL MATERIAL	BOREHOLE DEPTH (m)
		NORTHING	EASTING			
BH17-17	Storm Water Pond	4799250.5	227694.2	334.8	Clayey Silt	9.6
BH17-18		4799238.8	227637.8	334.4	Clayey Silt	9.6

N.B: The thickness of pavement structure is measured to be 800 mm.

Representative soil samples were recovered from the boreholes at 0.75 m intervals to a depth of 5.0 m, using a conventional 51 mm O.D split spoon sampler in accordance with the Standard Penetration Test (SPT) procedure (ASTM D1586 – Standard Test Method for Standard Penetration Test and Split-Barrel Sampling of Soil). The frequency of sampling was increased to 1.5 m intervals below the depth of 6.0 m. Standard penetration tests were conducted with the sampling operation to assess the strength characteristics of the substrata. The soil samples retrieved were identified in the field, placed in labelled containers and transported to the PML laboratory in Toronto, for further examination and testing. Visual examinations of soil samples and index tests consisting of water content determination, Atterberg limits and grain size distribution analyses were conducted on selected representative soil samples.

The groundwater conditions at the borehole locations were observed during the drilling by visual examination of the soil samples, sampler, and drill rods, as the samples were retrieved. Upon completion of drilling, water level measurements were taken in open boreholes. Three monitoring wells were installed in Borehole Nos. BH17-8, BH17-13 and BH17-18 to monitor groundwater level, although these were originally planned to install at Borehole Nos. BH17-3, BH17-6 and BH17-17. The revised monitoring well locations were recommended by Tom Hlavacek, P.Eng., a senior Geo-Environmental Engineer from MH during field investigation for not encountering any instant perched/groundwater in three original monitoring wells. The monitoring wells typically consisted of 50 mm outside diameter rigid PVC pipe with a 3.0 m long screen surrounded by a sand pack and sealed at selected depths using bentonite pellets within the borehole.

All the boreholes were backfilled upon completion of drilling in accordance with Ontario Regulation 903 – Wells (as amended by Ontario Regulation 372). In the case of monitoring well installations, the annular space between the borehole wall and the monitoring well pipe above the filter pack was backfilled to ground surface using bentonite pellets.



4. LABORATORY TEST PROCEDURES

Laboratory tests on representative SPT samples recovered during the fieldwork were carried out by the Canadian Council of Independent Laboratories (CCIL) certified laboratory owned by PML, located in Toronto, Ontario. The laboratory testing program included the following:

- Natural moisture content determinations (205)
- Grain size distribution analyses (77)
- Atterberg Limits Tests (10)

The laboratory tests to determine the index properties were performed in accordance with the MTO test procedures, which follow American Society for Testing Materials (ASTM) test procedures, with the exception of hydrometer test (LS-702). The results of the grain size distribution analyses are presented on Figures GS-1, GS-2, GS-3A, GS-3B, GS-3C, GS-3D, GS-3E, GS-4A, GS-4B, GS-4C and GS-5, and the Atterberg limits test results are presented on Figures PC-1 and PC-2 attached in Appendix A. All of the test results are summarized on the Record of Borehole Sheets.

5. SITE GEOLOGY AND SUBSURFACE CONDITIONS

5.1 Site Geology

In general, the project area is located within the physiographic region known as the Waterloo Hills of the Kame Moraines land formation. This region mainly consists of sandy hills and adjoins the Grand River Spillway system, which contains more uniform sandy and gravelly material, as outlined in *The Physiography of Southern Ontario* (Chapman and Putnam, 1984). The project area is mainly surrounded by farmland and commercial use.

The Quaternary Geology map published by the Ontario Ministry of Northern Development and Mines (MNDM), indicates that the surface conditions in the vicinity of the project site consist of Glaciofluvial outwash deposits: gravel and sand; includes Proglacial River and deltaic deposits. In general, the area consists of outwash sand, and sand and gravel overlying glacial tills. Undrained depressions or “kettles”, formed amongst the hill during glaciation, are now generally occupied by organic deposits and seasonally intermittent water.



Based on the Bedrock Geology map (MRD126-REV1, 2011) published by the MNDM, the site lies within the Salina Formation of the Upper Silurian rock formations. The bedrock underlying the project area consists mainly of limestone, dolostone, shale, sandstone, gypsum and salt.

5.2 Subsurface Conditions

The subsurface conditions encountered during the course of the investigation, together with the field and laboratory test results are shown on the Record of Borehole Sheets in Appendix A. The locations of the boreholes and monitoring wells are shown in Reconstruction of Ayr Patrol Yard Borehole and Monitoring Well Location Plan, DWG. 1.

In general, the subsurface conditions immediately below the existing ground level consist of 800 mm of pavement structure in the paved area and 100 mm to 200 mm of topsoil in boreholes that were advanced outside the perimeter of paved area. The topsoil and pavement structure are underlain by fill comprised of silty sand and clayey silt to depths ranging from 1.4 m (El. 333.0) to 4.3 m (El. 331.3). The fill is followed by silty sand to sand throughout the project site. For classification purposes, the soils encountered at this site can be divided into four (4) distinct zones.

- a) Topsoil
- b) Asphalt over Sand and Gravel (Pavement Structure)
- c) Sandy Silt to Silty Sand/Clayey Silt (Fill)
- d) Silty Sand to Sand, trace/with gravel

5.2.1 Topsoil

Surficial topsoil was encountered in borehole locations BH17-1, BH17-2, BH17-5, BH17-7, BH17-9, BH17-11 and BH17-13 through BH17-18, advanced outside of the paved area of the abandoned MTO Patrol Yard. The thickness of the topsoil was observed to vary from 100 mm to 200 mm.

5.2.2 Asphalt over Sand and Gravel (Pavement Structure)

The pavement structure was encountered immediately below the existing paved surface of the abandoned patrol yard area in Borehole locations BH17-3, BH17-4, BH17-6, BH17-8, BH17-10, and BH17-12. The pavement structure was 800 mm in thickness and includes 120 mm to 175 mm of asphalt over sand and gravel.



The moisture content of samples tested from the pavement base vary between 4.1% and 15.0% with an average value of 8.9%.

5.2.3 Sandy Silt to Silty Sand/Clayey Silt (Fill)

The topsoil and pavement structure layers are followed by fill materials comprised of either non-cohesive sandy silt to silty sand, or cohesive clayey silt layer of thickness ranging from 0.7 m to 3.5 m and extended to El. 333.8 to El. 331.3. Both non-cohesive and cohesive fill materials were encountered in BH17-9, located at the west limit of the study area.

5.2.3.1 Sandy Silt to Silty Sand, Trace Gravel (Fill)

This non-cohesive fill material was encountered in six (6) borehole locations. The SPT N values in this fill layer ranged from 1 to 17 blows, indicating a very loose to compact of state.

The moisture content of samples tested from this fill materials varies from 2.5% to 26.2% with an average value of 14.4%. The results of the gradation (sieve and hydrometer) analysis test performed on seven (7) representative samples from the fill are provided on Figure GS-1. The test results indicate that the fill consists of 0% to 14% gravel, 33% to 86% sand, 7% to 47% silt, and 7% to 12% clay sized particles.

5.2.3.2 Clayey Silt, Trace/with Sand (Fill)

Fill consisting of clayey silt was encountered in thirteen (13) boreholes advanced. The SPT N values in this fill layer vary from as low as 1 to 20 blows, indicating a very soft to very stiff state consistency.

The moisture content of samples tested from this fill vary from 2.3% to 27.6% with an average value of 15.8%. The results of the gradation analysis test performed on seven (7) representative samples from the fill are provided on Figure GS-2. The test results indicate that this fill consists of 0% to 5% gravel, 5% to 43% sand, 41% to 74% silt and 11% to 24% clay. Atterberg limit tests performed on nine (9) representative samples from the clayey silt fill are provided on Figure PC-1. The results of Atterberg tests conducted on soil samples are summarized below Table 2.



Table 2: Summary of The Atterberg Limits Test Results on Soil Samples

BOREHOLE NO.	SAMPLE ID	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	REMARKS
BH 17-3	SS3	24	18	6	Low Plasticity
BH 17-4	SS3	22	15	7	Low Plasticity
BH 17-5	SS2	19	12	7	Low Plasticity
BH 17-6	SS3	19	15	4	Low Plasticity
BH 17-7	SS4	17	13	4	Low Plasticity
BH 17-11	SS3	26	16	10	Low Plasticity
BH 17-15	SS4	23	21	2	Low Plasticity
BH 16-17	SS2	25	17	8	Low Plasticity
BH 17-17	SS4	34	17	17	Medium Plasticity

5.2.4 Silty Sand to Sand, Trace/with Gravel

The fill layers are immediately underlain by the silty sand to sand deposit, which contains occasional gravel and silt seams with varying proportions of sand, and extends to a maximum termination depth of 12.6 m (El. 322.4) below the existing ground surface. The SPT N values in this deposit vary widely from as low as 11 blows to refusal (100 blows/30 cm of sampler penetration), indicating compact to very dense compactness state. The termination depths of boreholes range from 9.6 m to 12.6 m (El. 328.6 to El. 322.4).

The moisture content of samples tested from this deposit varies widely from 0.7% to 23.7% with an average value of 4.7%. Laboratory gradation analysis tests were performed on a total of 63 representative samples from silty sand to sand deposit, including samples from gravel and silt seams/deposits. The results of 41 representative samples of the silty sand to sand are provided on Figures GS-3A to GS-3E. The test results indicate that this deposit consists of 0% to 21% gravel, 37% to 94% sand, 3% to 40% silt, and 0% to 4% clay sized particles.

The results of the sieve analysis test performed on 19 representative samples from the gravel layers/seams are provided in Figures GS-4A to GS-4C. The test results indicate that the gravel layers/seams consist of 21% to 51% gravel, 42% to 73% sand, and 3% to 12% silt and clay sized particles.

The results of the gradation analysis test performed on three (3) representative samples from the silt seams are provided on Figure GS-5. The test results indicate that the silt seams/layers consist



of 0% to 1% gravel, 6% to 47% sand, 50% to 78% silt and 3% to 15% clay sized particles. Atterberg limit tests performed on a representative silt sample below the native sand deposit in borehole location BH17-13, are included on Figure PC-2. The results of Atterberg tests conducted on soil samples are summarized below Table 3.

Table 3: Summary of The Atterberg Limits Test Results on Soil Samples

BOREHOLE NO.	SAMPLE ID	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	REMARKS
BH 17-13	SS7	19	16	3	Low Plasticity

5.3 Groundwater

Groundwater was not encountered during the drilling or upon completion of drilling operation. However, after 17 days of completion of drilling, the water level was measured at Borehole No. BH17-13 on June 5, 2018 and found to be at El. 333.1. On June 27, 2018, the water level was measured to be at El. 332.9. As confirmed by MH, this monitoring well did not recover after purging dry. It is inferred that the groundwater initially observed was shallow perched water and the measured groundwater level was not the representative of static groundwater conditions. Refer to Table 4 for groundwater level readings following the installation of monitoring wells. The water levels may fluctuate due to the influence of precipitation and seasonal changes.

Table 4: Monitoring Well Readings

BOREHOLE NO.	WELL INSTALLATION DATE	WELL SCREEN DEPTH (m)	DATE	DEPTH (m)	ELEVATION (m)
BH 17-8	May 17, 2018	2.5 to 5.5	June 5, 2018 June 27, 2018	Dry	---
BH 17-13	May 18, 2018	3.1 to 5.8	June 5, 2018 June 27, 2018	2.1* 2.3**	333.1 332.9
BH 17-18	May 14, 2018	6.1 to 9.1	June 5, 2018 June 27, 2018	Dry	---

Note: (*) – Perched water; (**) – After purging water from the well, the water level did not recover to depths of 2.3 m and remains dry.

The information from the website of the Ministry of the Environment, Conservation and Park indicates that there is a registered well within the proposed site. The existing well was registered under Well No. 6500594 and was drilled through a thin layer of clay underlain by sand and gravel,



followed by cohesive glacial till. The water level in this well was recorded at a depth of 61.0 m below the ground surface.

5.4 Chemical Analysis

SGS Canada Inc. (SGS), accredited by the Standards Council of Canada (SCC) and the Canadian Association of Laboratory Accreditation (CALA) carried out the chemical analyses. A total of six (6) samples (one sample from each of below listed six boreholes) were tested to determine the soil corrosivity. Details of the chemical test results provided by SGS are presented in Appendix A.

A summary of the chemical test results provided by SGS Canada (SGS) are presented in Table 5.

Table 5: Soil Chemical Analysis Results

BOREHOLE	SAMPLE	DEPTH (ELEVATION) (m)	SOIL TYPE	Redox Potential (mV)	Sulphide (%)	pH	Resistivity (Ohm-cm)	Conductivity (µS/cm)	Sulphate (µg/g)	Chloride (µg/g)	Moisture Content (%)
BH 17-2	8	5.3 - 5.8 (329.7 - 329.2)	Silty Sand to Sand	245	< 0.02	9.30	15200	66	2.3	11	4.8
BH 17-3	5	3.1 - 3.6 (332.1 - 331.6)	Silty Sand to Sand	288	< 0.02	9.43	10600	94	2.9	9.9	7.2
BH 17-6	6	3.8 - 4.3 (331.7 - 331.2)	Silty Sand to Sand	299	< 0.02	9.39	19600	51	1.7	4.0	2.3
BH 17-7	8	5.3 - 5.8 (329.9 - 329.4)	Silty Sand to Sand	308	< 0.02	9.62	4170	240	8.9	91	7.8
BH 17-14	5	3.1 - 3.6 (333.5 - 333.0)	Silty Sand to Sand	303	< 0.02	9.30	16500	61	1.3	8.0	2.5
BH 17-15	5	3.1 - 3.6 (334.6 - 334.1)	Sand	290	< 0.02	9.34	16200	62	2.0	13	3.5



6. CLOSURE

Mr. Dylan Brice carried out the field investigations under the supervision of Mr. M. Zamshad, MEng, P.Eng. Landshark Drilling from Brantford, ON and Aardvark Drilling Inc. from Guelph, ON, supplied the drilling equipment for the subsurface exploration. The laboratory testing of the selected samples was carried out in the PML geotechnical laboratory located in Toronto, Ontario.

This report was prepared by Ms. N. Leong-Sem, EIT, and reviewed by Mr. M. Vasavithasan, M.Sc. Eng., P.Eng. and Mr. M. Zamshad, MEng, P.Eng, Senior Engineer, Geotechnical Services. Mr. R. Ng, MBA, PhD, P.Eng., Principal Consultant, conducted an independent review of the report.

Yours very truly

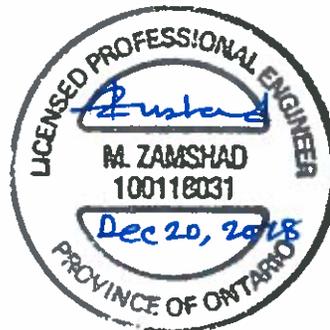
Peto MacCallum Ltd.

Natasha Leong-Sem, EIT.
Geotechnical Services



Robert Ng, MBA, PhD, P.Eng.
Project Manager and
MTO Designated Principal Contact

NL/MZ/RN:nk-ap



Mohammed Zamshad, MEng, P.Eng.
Senior Engineer, Geotechnical Services



APPENDIX A

Reconstruction of Ayr Patrol Yard Borehole and Monitoring Well Location Plan with
Soil Stratigraphy (Section A-A') – DWG. 1

Reconstruction of Ayr Patrol Yard Soil Stratigraphy
(Sections B₁-B₁', B₂-B₂' C₁-C₁' & C₂-C₂') – DWG. 2

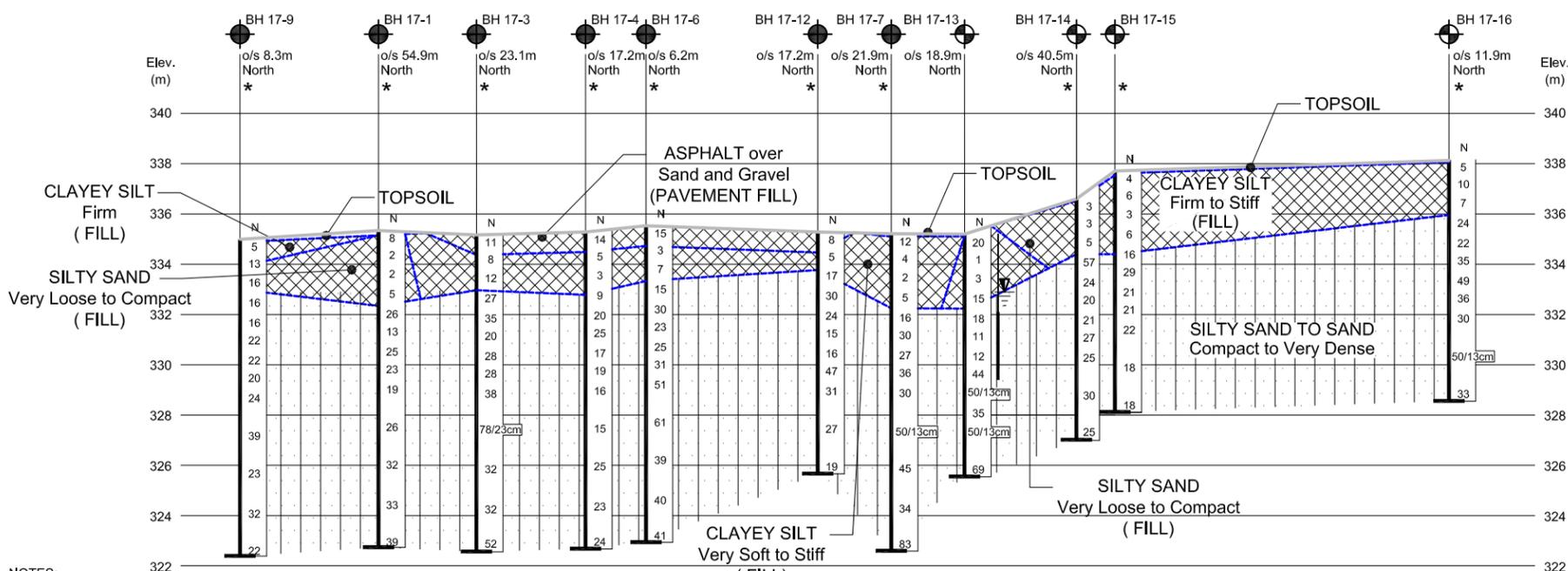
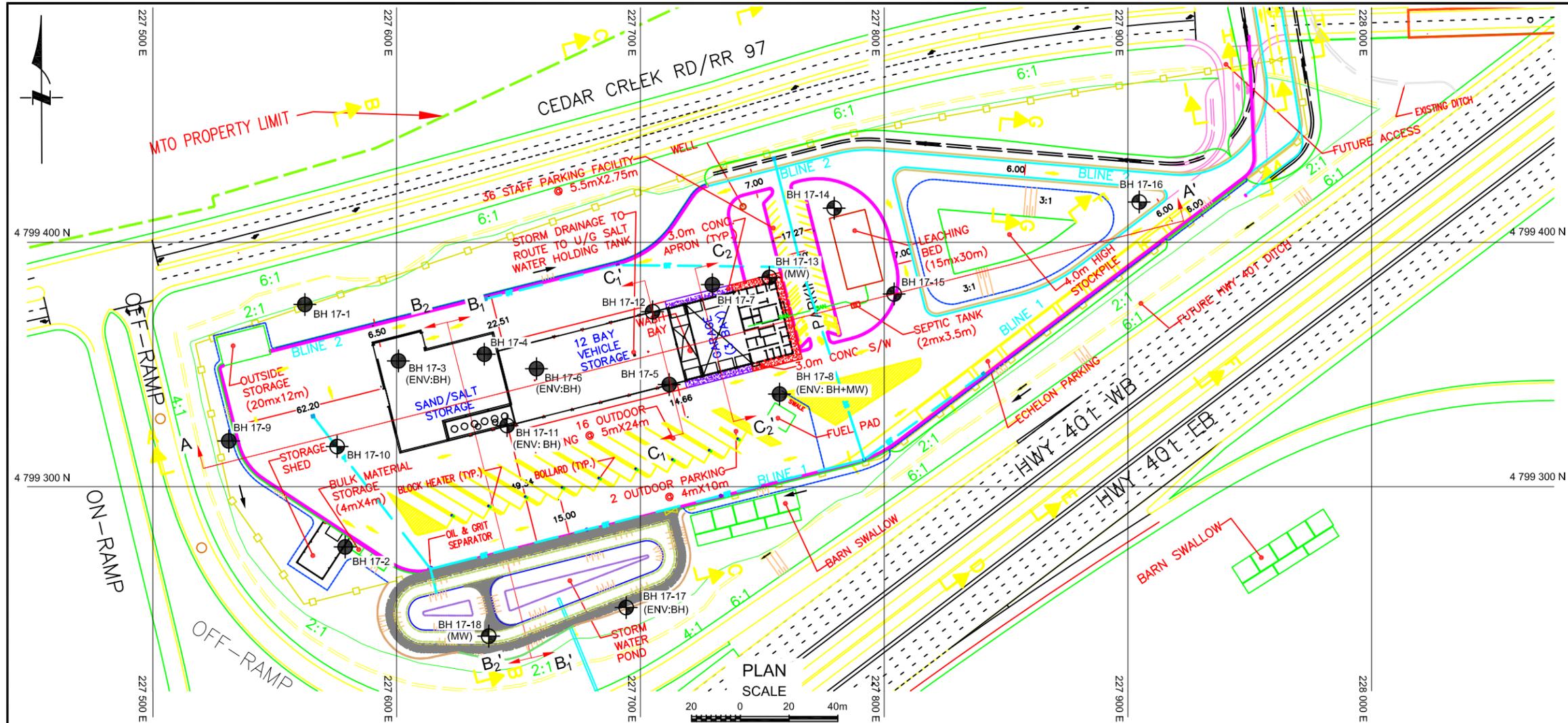
Explanation of Terms Used in Report

Record of Borehole Sheets

Results of Grain Size Distribution Analyses –
Figures GS-1, GS-2, GS-3A/B/C/D/E GS-4A/B/C, and GS-5

Results of Atterberg Limits Tests – Figures PC-1 and PC-2

Results of Chemical Tests Provided by SGS Canada

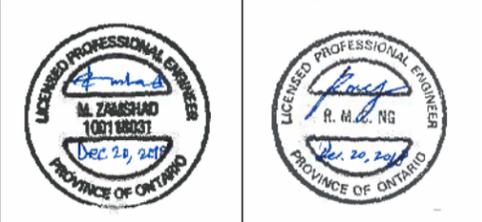


LEGEND

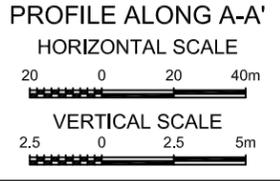
- Borehole (17-1 to 17-9) depth 12.6 m
- Borehole (17-10 to 17-18) depth 9.6 m to 11.1 m
- (ENV: BH) - Environmental Borehole
- (ENV: BH+MW) - Environmental BH with 50 mm dia. Monitoring Well
- * Groundwater was not encountered during and upon completion of augering
- Piezometer
- Water Level in Piezometer, June 27, 2018

BH No	ELEVATION	NORTHINGS	EASTINGS
BH 17-1	335.3	4 799 374.6	227 562.4
BH 17-2	335.0	4 799 275.3	227 578.9
BH 17-3	335.2	4 799 351.5	227 600.7
BH 17-4	335.3	4 799 354.2	227 636.0
BH 17-5	335.4	4 799 341.8	227 711.8
BH 17-6	335.5	4 799 348.3	227 657.4
BH 17-7	335.2	4 799 382.7	227 729.5
BH 17-8	335.6	4 799 337.9	227 757.1
BH 17-9	335.0	4 799 318.7	227 531.1
BH 17-10	335.4	4 799 316.4	227 575.6
BH 17-11	335.6	4 799 325.0	227 645.3
BH 17-12	335.3	4 799 371.6	227 705.0
BH 17-13	335.2	4 799 385.6	227 752.9
BH 17-14	336.6	4 799 414.0	227 779.5
BH 17-15	337.7	4 799 378.9	227 804.1
BH 17-16	338.2	4 799 416.5	227 904.7
BH 17-17	334.8	4 799 250.5	227 694.2
BH 17-18	334.4	4 799 238.8	227 637.8

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



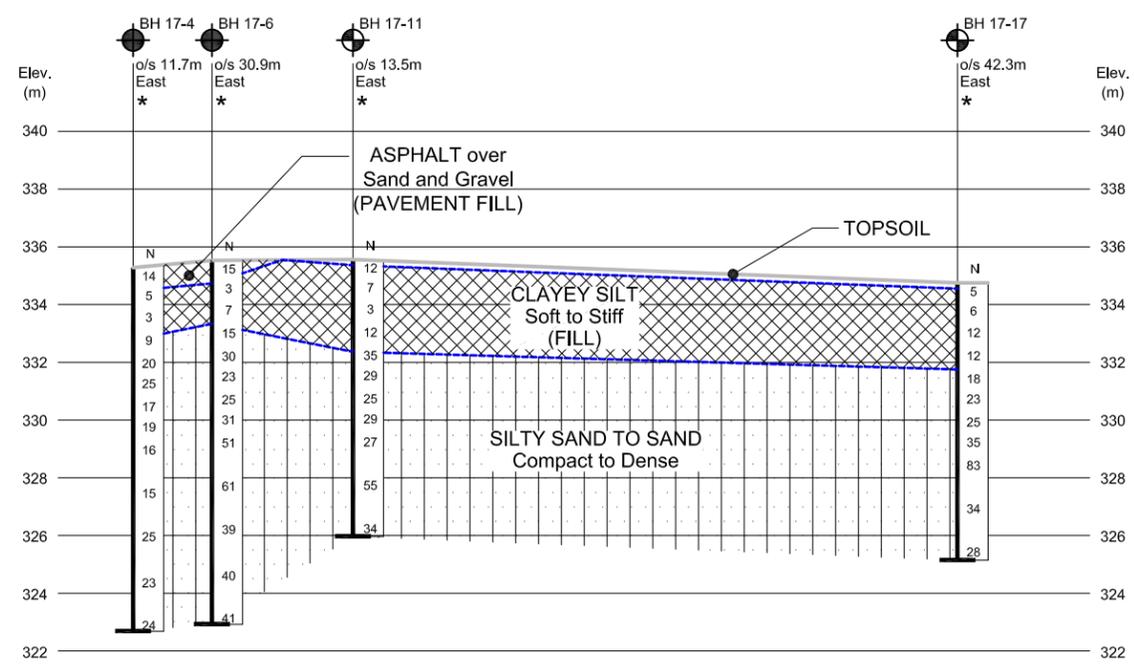
- NOTES:**
- THIS DRAWING SHOULD BE READ IN CONJUNCTION WITH THE TEXT OF REPORT AND RECORD OF BOREHOLE LOGS.
 - THIS DRAWING IS FOR SUBSURFACE INFORMATION ONLY. SURFACE DETAILS AND FEATURES ARE FOR CONCEPTUAL ILLUSTRATION.
 - DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN. STATIONS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



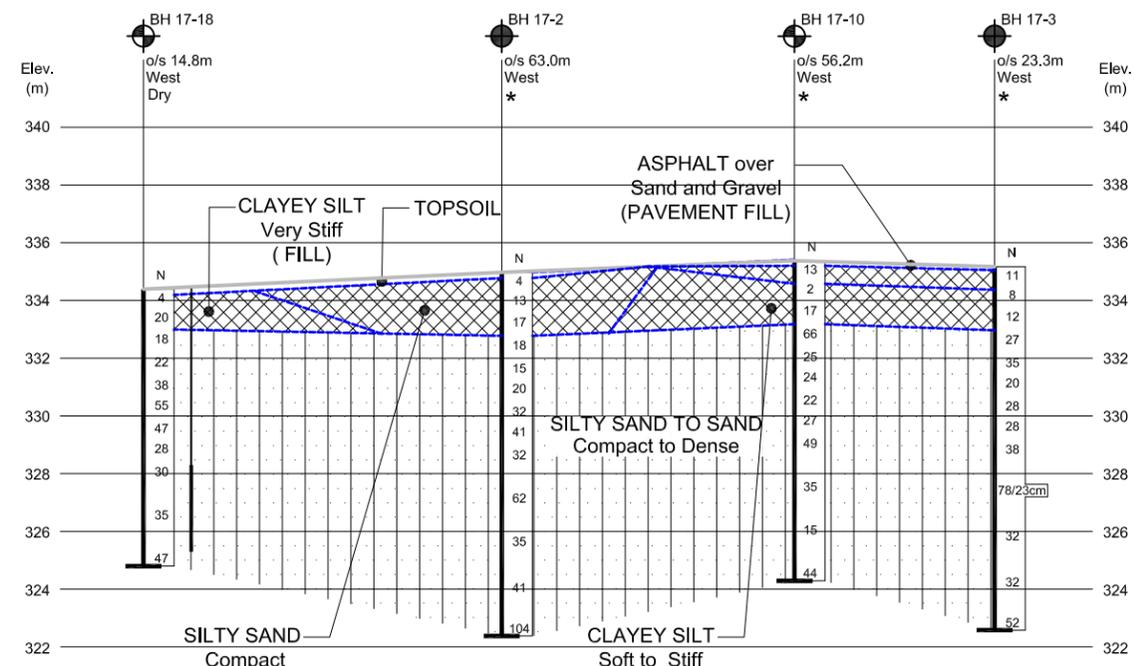
DATE	BY	DESCRIPTION

Geores No. 40P8-259

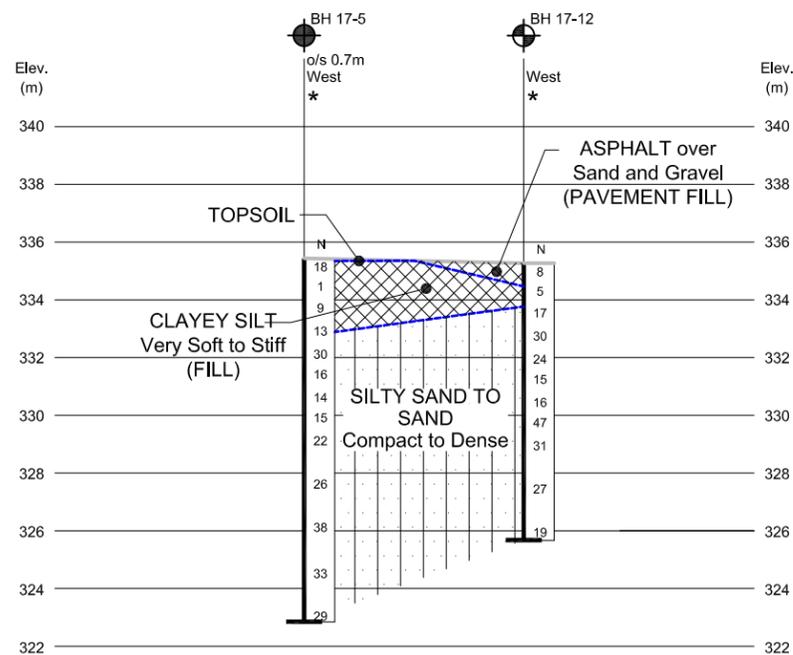
HWY No	401	DIST		
SUBM'D	NL	CHECKED MZ	DATE DEC. 20, 2018	SITE
DRAWN	NL	CHECKED NR	APPROVED RN	DWG. 1



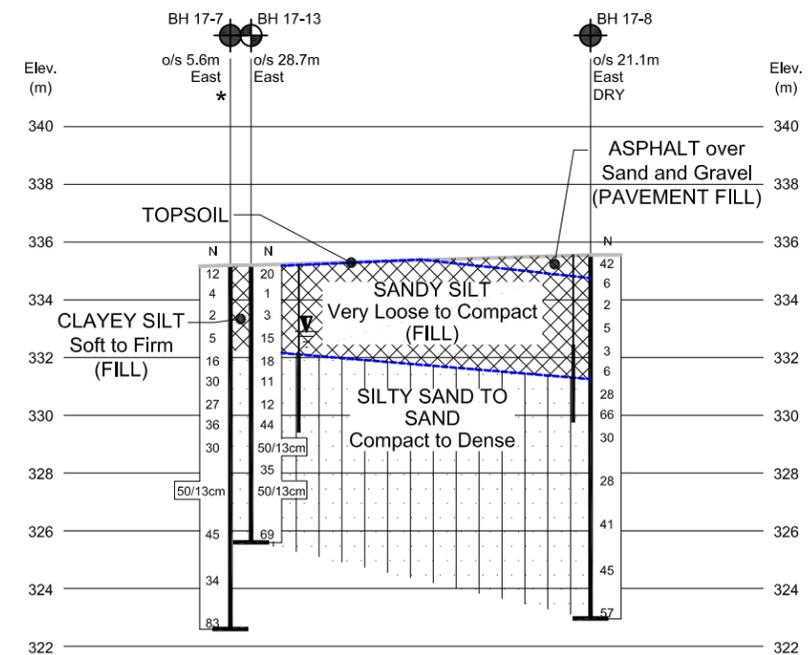
PROFILE ALONG B₁-B₁'



PROFILE ALONG B₂-B₂'



PROFILE ALONG C₁-C₁'



PROFILE ALONG C₂-C₂'

LEGEND

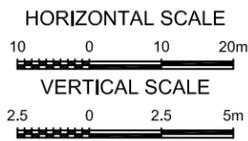
- Borehole (17-1 to 17-9) depth 12.6 m
- Borehole (17-10 to 17-18) depth 9.6 m to 11.1 m
- (ENV; BH)- Environmental Borehole
- (ENV; BH+MW)- Environmental BH with 50 mm dia. Monitoring Well
- * Groundwater was not encountered during and upon completion of augering
- Piezometer
- Water Level in Piezometer, June 27, 2018

BH No	ELEVATION	NORTHINGS	EASTINGS
See Drawing 1 for Borehole Details			

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

NOTES:

1. THIS DRAWING SHOULD BE READ IN CONJUNCTION WITH THE TEXT OF REPORT AND RECORD OF BOREHOLE LOGS.
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.



DATE	BY	DESCRIPTION

Geocres No. 40P8-259

HWY No	401	DIST	
SUBM'D	NL	CHECKED	MZ
DATE	DEC. 20, 2018	SITE	
DRAWN	NL	CHECKED	NR
APPROVED	RN	DWG.	2

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:

R Q D (%)	0-25	25-50	50-75	75-90	90-100
	VERY POOR	POOR	FAIR	GOOD	EXCELLENT

JOINTING AND BEDDING:

SPACING	50mm	30-300mm	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	F 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
u	l	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	l	COEFFICIENT OF FRICTION

MECHANICAL PROPERTIES OF SOIL

m_v	kPa^{-1}	COEFFICIENT OF VOLUME CHANGE
C_c	l	COMPRESSION INDEX
C_s	l	SWELLING INDEX
C_{α}	l	RATE OF SECONDARY CONSOLIDATION
c_v	m^2/s	COEFFICIENT OF CONSOLIDATION
H	m	DRAINAGE PATH
T_v	l	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_l	l	SENSITIVITY = $\frac{c_u}{\tau_r}$

PHYSICAL PROPERTIES OF SOIL

ρ_s	kg/m^3	DENSITY OF SOLID PARTICLES	n	l, %	POROSITY	e_{max}	l, %	VOID RATIO IN LOOSEST STATE
γ_s	kN/m^3	UNIT WEIGHT OF SOLID PARTICLES	w	l, %	WATER CONTENT	e_{min}	l, %	VOID RATIO IN DENSEST STATE
ρ_w	kg/m^3	DENSITY OF WATER	S_r	%	DEGREE OF SATURATION	I_D	l	DENSITY INDEX = $\frac{e_{max} - e}{e_{max} - e_{min}}$
γ_w	kN/m^3	UNIT WEIGHT OF WATER	w_L	%	LIQUID LIMIT	D	mm	GRAIN DIAMETER
ρ	kg/m^3	DENSITY OF SOIL	w_p	%	PLASTIC LIMIT	D_n	mm	n PERCENT - DIAMETER
γ	kN/m^3	UNIT WEIGHT OF SOIL	w_s	%	SHRINKAGE LIMIT	C_u	l	UNIFORMITY COEFFICIENT
ρ_d	kg/m^3	DENSITY OF DRY SOIL	I_p	%	PLASTICITY INDEX = $w_L - w_p$	h	m	HYDRAULIC HEAD OR POTENTIAL
γ_d	kN/m^3	UNIT WEIGHT OF DRY SOIL	I_L	l	LIQUIDITY INDEX = $\frac{w - w_p}{I_p}$	q	m^2/s	RATE OF DISCHARGE
ρ_{sat}	kg/m^3	DENSITY OF SATURATED SOIL	I_C	l	CONSISTENCY INDEX = $\frac{w_L - w}{I_p}$	v	m/s	DISCHARGE VELOCITY
γ_{sat}	kN/m^3	UNIT WEIGHT OF SATURATED SOIL	DTPL		DRIER THAN PLASTIC LIMIT	i	l	HYDRAULIC GRADIENT
ρ'	kg/m^3	DENSITY OF SUBMERGED SOIL	APL		ABOUT PLASTIC LIMIT	k	m/s	HYDRAULIC CONDUCTIVITY
γ'	kN/m^3	UNIT WEIGHT OF SUBMERGED SOIL	WTPL		WETTER THAN PLASTIC LIMIT	j	kN/m^2	SEEPAGE FORCE
e	l, %	VOID RATIO						

RECORD OF BOREHOLE No BH17-1

1 OF 1

METRIC

G.W.P. 3039-16-00 LOCATION Coords: 4 799 374.6 N; 227 562.4 E ORIGINATED BY K.P.
 DIST Central HWY 401 BOREHOLE TYPE Hollow Stem Augers COMPILED BY M.Z.
 DATUM Geodetic DATE 2018.05.16 LATITUDE 43.330292 LONGITUDE -80.452434 CHECKED BY M.V.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100						20
335.3	GROUND SURFACE																	
335.1	TOPSOIL																	
0.2	SILTY SAND, trace gravel		1	SS	8													
	Loose to very loose, Brown, Moist		2	SS	2													
			3	SS	2													1 65 27 7
	(FILL)		4	SS	5													
332.3	SILTY SAND TO SAND, trace/some gravel		5	SS	26													
3.0	Compact, Brown, Moist		6	SS	13													
			7	SS	25													15 72 (13)
			8	SS	23													
			9	SS	19													
			10	SS	26													0 93 (7)
			11	SS	32													
	Dense		12	SS	33													0 47 50 3
	Sandy Silt		13	SS	39													
322.7	End of borehole																	
12.6	Notes: 1. Groundwater was not encountered during and upon completion of augering. 2. Borehole was moved by 3.0 m south of the original staked location to locate inside the fence. 3. Borehole caved-in at 11.0 m																	

ONTARIO MTO 17TF036A-REVISED-JULY 30 2018.GPJ ONTARIO MTO.GDT 12/18/18

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

RECORD OF BOREHOLE No BH17-2

1 OF 1

METRIC

G.W.P. 3039-16-00 LOCATION Coords: 4 799 275.3 N; 227 578.9 E ORIGINATED BY K.P.
 DIST Central HWY 401 BOREHOLE TYPE Hollow Stem Augers COMPILED BY M.Z.
 DATUM Geodetic DATE 2018.05.14 LATITUDE 43.329409 LONGITUDE -80.452221 CHECKED BY M.V.

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	20	40	60	80						100	20
335.0	GROUND SURFACE																	
334.8	TOPSOIL																	
0.2	SILTY SAND, trace gravel Compact, Brown, Moist		1	SS	4													
	(FILL)		2	SS	13													1 81 (18)
			3	SS	17													0 69 (31)
332.8	SILTY SAND TO SAND, trace gravel Compact, Brown, Moist		4	SS	18													
2.2			5	SS	15													
			6	SS	20													
			7	SS	32													
	Dense		8	SS	41													
			9	SS	32													
			10	SS	62													32 62 (6)
	with gravel		11	SS	35													
			12	SS	41													
			13	SS	104													0 60 (40)
322.4	End of borehole																	
12.6	Notes: 1. Groundwater was not encountered during and upon completion of augering. 2. Borehole caved-in at 6.4 m																	

ONTARIO.MTO_17TF036A.GPJ ONTARIO.MTO.GDT 12/7/18

RECORD OF BOREHOLE No BH17-3

1 OF 1

METRIC

G.W.P. 3039-16-00 LOCATION Coords: 4 799 351.5 N; 227 600.7 E ORIGINATED BY K.P.
 DIST Central HWY 401 BOREHOLE TYPE Hollow Stem Augers COMPILED BY M.Z.
 DATUM Geodetic DATE 2018.05.15 LATITUDE 43.330096 LONGITUDE -80.451962 CHECKED BY M.V.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100						20
335.2	GROUND SURFACE																	
335.0	120mm ASPHALT over Sand and Gravel		1	SS	11													
334.4	(PAVEMENT STRUCTURE)																	
334.4	CLAYEY SILT, some sand		2	SS	8													
0.8	Stiff, Brown, Moist																	
	(FILL)		3	SS	12													0 12 74 14
333.0	SILTY SAND TO SAND, trace/some gravel		4	SS	27													
2.2	Compact, Brown, Moist																	
			5	SS	35													0 79 (21)
			6	SS	20													
			7	SS	28													
	Dense to very dense		8	SS	28													6 87 (7)
			9	SS	38													
			10	SS	78/23cm													21 73 (6)
			11	SS	32													
			12	SS	32													
			13	SS	52													
322.6	End of borehole																	
12.6	Notes: 1. Groundwater was not encountered during and upon completion of augering. 2. Borehole caved-in at 9.2 m																	

ONTARIO.MTO_17TF036A.GPJ ONTARIO.MTO.GDT 12/7/18

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

RECORD OF BOREHOLE No BH17-4

1 OF 1

METRIC

G.W.P. 3039-16-00 LOCATION Coords: 4 799 354.2 N; 227 636.0 E ORIGINATED BY K.P.
 DIST Central HWY 401 BOREHOLE TYPE Hollow Stem Augers COMPILED BY M.Z.
 DATUM Geodetic DATE 2018.05.16 LATITUDE 43.330125 LONGITUDE -80.451528 CHECKED BY M.V.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100						20
335.3	GROUND SURFACE																	
335.2 0.1	120mm ASPHALT over Sand and Gravel (PAVEMENT STRUCTURE)		1	SS	14													
334.5 0.8	CLAYEY SILT, with sand Firm, Brown, Moist to wet		2	SS	5													0 24 53 23
			3	SS	3													
332.8 2.5	(FILL) SILTY SAND TO SAND, trace gravel Compact, Brown, Moist		4	SS	9													
			5	SS	20													2 87 (11)
			6	SS	25													
			7	SS	17													
			8	SS	19													
			9	SS	16													2 94 (4)
			10	SS	15													
			11	SS	25													
			12	SS	23													1 93 (6)
322.7 12.6	End of borehole		13	SS	24													
Notes: 1. Groundwater was not encountered during and upon completion of augering. 2. Borehole caved-in at 9.2 m																		

ONTARIO.MTO_17TF036A.GPJ ONTARIO.MTO.GDT 12/7/18

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

RECORD OF BOREHOLE No BH17-5

1 OF 1

METRIC

G.W.P. 3039-16-00 LOCATION Coords: 4 799 341.8 N; 227 711.8 E ORIGINATED BY K.P.
 DIST Central HWY 401 BOREHOLE TYPE Hollow Stem Augers COMPILED BY M.Z.
 DATUM Geodetic DATE 2018.05.17 LATITUDE 43.330021 LONGITUDE -80.450591 CHECKED BY M.V.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100						20	40	60	GR
335.4	GROUND SURFACE																				
335.4	TOPSOIL																				
0.1	CLAYEY SILT, with sand, trace gravel		1	SS	18																
	Very soft to stiff, Brown, Moist to wet		2	SS	1																
			3	SS	9																
	(FILL)		4	SS	13																
332.7	SILTY SAND TO SAND, with gravel																				
2.7	Compact to dense, Brown, Moist		5	SS	30													35	57	(8)	
			6	SS	16																
			7	SS	14																
			8	SS	15																
			9	SS	22																
			10	SS	26														31	64	(5)
			11	SS	38																
			12	SS	33														20	74	(6)
			13	SS	29																
322.8	End of borehole																				
12.6	Notes: 1. Groundwater was not encountered during and upon completion of augering. 2. Borehole caved-in at 9.2 m																				

ONTARIO.MTO_17TF036A.GPJ ONTARIO.MTO.GDT 12/7/18

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

RECORD OF BOREHOLE No BH17-6

1 OF 1

METRIC

G.W.P. 3039-16-00 LOCATION Coords: 4 799 348.3 N; 227 657.4 E ORIGINATED BY K.P.
 DIST Central HWY 401 BOREHOLE TYPE Hollow Stem Augers COMPILED BY M.Z.
 DATUM Geodetic DATE 2018.05.16 LATITUDE 43.330074 LONGITUDE -80.451262 CHECKED BY M.V.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100						20
335.5	GROUND SURFACE																	
335.4 0.1	130mm ASPHALT over Sand and Gravel (PAVEMENT STRUCTURE)		1	SS	15													
334.7 0.8	CLAYEY SILT, with sand, trace gravel Soft to firm, Brown, Moist (FILL)		2	SS	3													
333.3 2.2	SILTY SAND TO SAND, trace/some gravel Compact, Brown, Moist		3	SS	7													
			4	SS	15													5 30 54 11
			5	SS	30													4 85 (11)
			6	SS	23													9 85 (6)
			7	SS	25													2 88 (10)
			8	SS	31													7 87 (6)
			9	SS	51													
			10	SS	61													14 78 (8)
			11	SS	39													41 55 (4)
			12	SS	40													4 61 33 2
			13	SS	41													0 36 61 3
322.9 12.6	End of borehole																	
Notes:			1. Groundwater was not encountered during and upon completion of augering. 2. Borehole caved-in at 8.5 m															

ONTARIO.MTO_17TF036A.GPJ ONTARIO.MTO.GDT 12/10/18

RECORD OF BOREHOLE No BH17-7

1 OF 1

METRIC

G.W.P. 3039-16-00 LOCATION Coords: 4 799 382.7 N; 227 729.5 E ORIGINATED BY K.P.
 DIST Central HWY 401 BOREHOLE TYPE Hollow Stem Augers COMPILED BY M.Z.
 DATUM Geodetic DATE 2018.05.18 LATITUDE 43.330390 LONGITUDE -80.450379 CHECKED BY M.V.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100						20
335.2	GROUND SURFACE																	
335.1	TOPSOIL																	
0.1	CLAYEY SILT, with sand		1	SS	12													
	Soft to firm, Brown, Moist to wet		2	SS	4													
			3	SS	2													
	(FILL)		4	SS	5													
332.2	SILTY SAND TO SAND, some/with gravel																	
3.0	Compact, Brown, Moist		5	SS	16													
			6	SS	30													
			7	SS	27													
	Dense to very dense		8	SS	36													
			9	SS	30													
			10	SS	50/13cm													
			11	SS	45													
			12	SS	34													
			13	SS	83													
322.6	End of borehole																	
12.6	Notes: 1. Groundwater was not encountered during and upon completion of augering. 2. Borehole caved-in at 7.0 m																	

ONTARIO.MTO_17TF036A.GPJ ONTARIO.MTO.GDT 12/7/18

RECORD OF BOREHOLE No BH17-8

2 OF 2

METRIC

G.W.P. 3039-16-00 LOCATION Coords: 4 799 337.9 N; 227 757.1 E ORIGINATED BY K.P.
 DIST Central HWY 401 BOREHOLE TYPE Hollow Stem Augers COMPILED BY M.Z.
 DATUM Geodetic DATE 2018.05.17 LATITUDE 43.32999 LONGITUDE -80.450032 CHECKED BY M.V.

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)								
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	20	40	60	80						100	20	40	60	GR	SA	SI	CL
320.6	<p><u>Monitoring Well Legend:</u></p> <p>■ Bentonite seal □ Filter sand □ Screen</p> <p><u>Monitoring Well Readings:</u></p> <table border="1"> <tr> <td>Date</td> <td>Depth (m)</td> <td>Elev.</td> </tr> <tr> <td>June. 5/18</td> <td>Dry</td> <td>---</td> </tr> </table>	Date	Depth (m)	Elev.	June. 5/18	Dry	---																	
Date	Depth (m)	Elev.																						
June. 5/18	Dry	---																						

ONTARIO.MTO_17TF036A.GPJ ONTARIO.MTO.GDT 12/7/18

RECORD OF BOREHOLE No BH17-10

1 OF 1

METRIC

G.W.P. 3039-16-00 LOCATION Coords: 4 799 316.4 N; 227 575.6 E ORIGINATED BY K.P.
 DIST Central HWY 401 BOREHOLE TYPE Hollow Stem Augers COMPILED BY M.Z.
 DATUM Geodetic DATE 2018.05.15 LATITUDE 43.329778 LONGITUDE -80.452267 CHECKED BY M.V.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100						20
335.4	GROUND SURFACE																	
335.2 0.2	175mm ASPHALT over Sand and Gravel (PAVEMENT STRUCTURE)		1	SS	13													
334.6 0.8	CLAYEY SILT Soft to stiff, Brown, Moist		2	SS	2													
333.2 2.2	(FILL) SAND, trace/some gravel, trace silt Compact to dense, Brown, Moist to wet		3	SS	17													
			4	SS	66													19 37 40 4
			5	SS	25													
			6	SS	24													
			7	SS	22													
			8	SS	27													1 93 (6)
			9	SS	49													
			10	SS	35													
			11	SS	15													6 89 (5)
			12	SS	44													
324.3 11.1	End of borehole																	

Note: 1. Groundwater was not encountered during and upon completion of augering.

ONTARIO.MTO.17TF036A.GPJ ONTARIO.MTO.GDT.12/7/18

RECORD OF BOREHOLE No BH17-11

1 OF 1

METRIC

G.W.P. 3039-16-00 LOCATION Coords: 4 799 325.0 N; 227 645.3 E ORIGINATED BY K.P.
 DIST Central HWY 401 BOREHOLE TYPE Hollow Stem Augers COMPILED BY M.Z.
 DATUM Geodetic DATE 2018.05.17 LATITUDE 43.329863 LONGITUDE -80.451409 CHECKED BY M.V.

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	NUMBER	TYPE	"N" VALUES			20	40	60	80	100						20
335.6	GROUND SURFACE																
335.4	TOPSOIL																
0.2	CLAYEY SILT, with sand, trace gravel	1	SS	12													
	Firm to stiff, Brown, Moist	2	SS	7													
		3	SS	3													1 28 49 22
	(FILL)	4	SS	12													
332.4	SAND, trace/some gravel, trace silt	5	SS	35													
3.2	Compact to dense, Brown, Moist	6	SS	29													1 90 (9)
		7	SS	25													
		8	SS	29													0 94 (6)
		9	SS	27													
		10	SS	55													12 82 (6)
		11	SS	34													
326.0	End of borehole																
9.6																	

Note: 1. Groundwater was not encountered during and upon completion of augering.

ONTARIO.MTO_17TF036A.GPJ ONTARIO.MTO.GDT 12/7/18

RECORD OF BOREHOLE No BH17-12

1 OF 1

METRIC

G.W.P. 3039-16-00 LOCATION Coords: 4 799 371.6 N; 227 705.0 E ORIGINATED BY K.P.
 DIST Central HWY 401 BOREHOLE TYPE Hollow Stem Augers COMPILED BY M.Z.
 DATUM Geodetic DATE 2018.05.17 LATITUDE 43.330288 LONGITUDE -80.450679 CHECKED BY M.V.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100						20
335.3	GROUND SURFACE																	
335.1 0.1	130mm ASPHALT over Sand and Gravel (PAVEMENT STRUCTURE)		1	SS	8													
334.5 0.8	CLAYEY SILT, with sand Firm, Brown, Moist (FILL)		2	SS	5													
333.8 1.5	SAND, trace/some gravel, trace silt Compact to dense, Brown, Moist		3	SS	17													
			4	SS	30													17 75 (8)
			5	SS	24													
			6	SS	15													1 93 (6)
			7	SS	16													
			8	SS	47													
			9	SS	31													29 67 (4)
			10	SS	27													
			11	SS	19													7 88 (5)
325.7 9.6	End of borehole																	

Notes: 1. Groundwater was not encountered during and upon completion of augering.
 2. Borehole caved-in at 6.1 m

ONTARIO MTO 17TF036A-REVISED-JULY 30 2018.GPJ ONTARIO MTO.GDT 12/19/18

RECORD OF BOREHOLE No BH17-13

1 OF 1

METRIC

G.W.P. 3039-16-00 LOCATION Coords: 4 799 385.6 N; 227 752.9 E ORIGINATED BY K.P.
 DIST Central HWY 401 BOREHOLE TYPE Hollow Stem Augers COMPILED BY M.Z.
 DATUM Geodetic DATE 2018.05.18 LATITUDE 43.330419 LONGITUDE -80.450091 CHECKED BY M.V.

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH	DESCRIPTION	NUMBER	TYPE	"N" VALUES			20	40	60	80	100						20	40
335.2	GROUND SURFACE																	
335.1	TOPSOIL																	
0.1	SILTY SAND, trace gravel	1	SS	20														
	Very loose to compact, Brown, Moist to wet	2	SS	1														
		3	SS	3														
	(FILL)	4	SS	15											7	62	26	5
332.2	SAND, trace silt, trace gravel	5	SS	18														
3.0	Compact, Brown, Wet to moist	6	SS	11														
	Silt, trace sand	7	SS	12											1	6	78	15
		8	SS	44														
	with gravel dense to very dense	9	SS	50/13cm														
		10	SS	35											21	71	(8)	
		11	SS	50/13cm														
		12	SS	69											36	56	(8)	
325.6	End of borehole																	
9.6																		

Note: 1. Groundwater was not encountered during and upon completion of augering.
 2. After purging water from well, water level didn't recover to depth of 2.3 m and remained dry.
 Monitoring Well Readings:
 Date Depth Elev.
 (m) (m)
 June. 5/18 2.1 333.1
 June. 27/18 2.3 332.9

-  Bentonite seal
-  Filter sand
-  Screen

ONTARIO MTO 17TF036A-REVISED-DEC 19 2018.GPJ ONTARIO MTO.GDT 12/20/18

RECORD OF BOREHOLE No BH17-14

1 OF 1

METRIC

G.W.P. 3039-16-00 LOCATION Coords: 4 799 414.0 N; 227 779.5 E ORIGINATED BY K.P.
 DIST Central HWY 401 BOREHOLE TYPE Hollow Stem Augers COMPILED BY M.Z.
 DATUM Geodetic DATE 2018.05.10 LATITUDE 43.330678 LONGITUDE -80.449766 CHECKED BY M.V.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100						20
336.6	GROUND SURFACE																	
336.4	TOPSOIL																	
0.2	SILTY SAND, trace/with gravel		1	SS	3													
	Very loose to loose, Brown, Wet to moist		2	SS	3													2 60 26 12
	(FILL)		3	SS	5													
334.4	SILTY SAND TO SAND, with gravel		4	SS	57													46 42 (12)
2.2	Compact, Brown, Moist		5	SS	24													
			6	SS	20													
			7	SS	21													
	trace gravel		8	SS	27													2 90 (8)
			9	SS	25													
			10	SS	30													36 52 (12)
			11	SS	25													
327.0	End of borehole																	
9.6																		

Notes: 1. Groundwater was not encountered during and upon completion of augering.
 2. Borehole caved-in at 6.1 m

ONTARIO.MTO_17TF036A.GPJ ONTARIO.MTO.GDT 12/7/18

RECORD OF BOREHOLE No BH17-15

1 OF 1

METRIC

G.W.P. 3039-16-00 LOCATION Coords: 4 799 378.9 N; 227 804.1 E ORIGINATED BY K.P.
 DIST Central HWY 401 BOREHOLE TYPE Hollow Stem Augers COMPILED BY M.Z.
 DATUM Geodetic DATE 2018.05.22 LATITUDE 43.330364 LONGITUDE -80.449458 CHECKED BY M.V.

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	20	40	60	80						100	20
337.7	GROUND SURFACE																	
337.6	TOPSOIL																	
0.1	CLAYEY SILT, with sand, trace gravel		1	SS	4													
	Firm, Brown, Moist to wet		2	SS	6													
			3	SS	3													1 43 41 15
	(FILL)		4	SS	6													
334.7	SAND, trace silt, trace gravel		5	SS	16													
3.0	Compact, Brown, Moist		6	SS	29													
	with gravel		7	SS	21													34 63 (3)
			8	SS	21													
			9	SS	22													
			10	SS	18													4 92 (4)
			11	SS	18													
328.1	End of borehole																	
9.6																		

Notes: 1. Groundwater was not encountered during and upon completion of augering.
 2. Borehole caved-in at 6.1 m

ONTARIO.MTO_17TF036A.GPJ ONTARIO.MTO.GDT 12/7/18

RECORD OF BOREHOLE No BH17-16

1 OF 1

METRIC

G.W.P. 3039-16-00 LOCATION Coords: 4 799 416.5 N; 227 904.7 E ORIGINATED BY K.P.
 DIST Central HWY 401 BOREHOLE TYPE Hollow Stem Augers COMPILED BY M.Z.
 DATUM Geodetic DATE 2018.05.22 LATITUDE 43.330713 LONGITUDE -80.448223 CHECKED BY M.V.

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	20	40	60	80						100	20
338.2	GROUND SURFACE																	
338.1	TOPSOIL																	
0.1	CLAYEY SILT, trace silt, trace sand		1	SS	5													
	Firm to stiff, Brown, Wet to moist		2	SS	10													0 5 71 24
	(FILL)		3	SS	7													
336.0	SAND, trace silt, trace gravel		4	SS	24													0 94 (6)
2.2	Compact to dense, Brown, Moist		5	SS	22													
			6	SS	35													
	with gravel		7	SS	49													24 70 (6)
			8	SS	36													
			9	SS	30													1 92 (7)
			10	SS	50/13cm													
			11	SS	33													
328.6	End of borehole																	
9.6																		

Notes: 1. Groundwater was not encountered during and upon completion of augering.
 2. Borehole caved-in at 8.5 m

ONTARIO.MTO_17TF036A.GPJ ONTARIO.MTO.GDT 12/10/18

RECORD OF BOREHOLE No BH17-17

1 OF 1

METRIC

G.W.P. 3039-16-00 LOCATION Coords: 4 799 250.5 N; 227 694.2 E ORIGINATED BY K.P.
 DIST Central HWY 401 BOREHOLE TYPE Hollow Stem Augers COMPILED BY M.Z.
 DATUM Geodetic DATE 2018.05.14 LATITUDE 43.329197 LONGITUDE -80.450795 CHECKED BY M.V.

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	20	40	60	80						100	20	40
334.8	GROUND SURFACE																		
334.6	TOPSOIL																		
0.2	CLAYEY SILT, with sand		1	SS	5														
	Firm to stiff, Brown, Wet to moist		2	SS	6														
			3	SS	12														
	(FILL)		4	SS	12														
331.8	SAND, trace silt, trace gravel																		
3.0	Compact to dense, Brown, Moist		5	SS	18														
			6	SS	23														7 88 (5)
			7	SS	25														
			8	SS	35														4 92 (4)
			9	SS	83														
	with gravel		10	SS	34														39 57 (4)
		11	SS	28															
325.2	End of borehole																		
9.6																			

Notes: 1. Groundwater was not encountered during and upon completion of augering.
 2. Borehole caved-in at 6.4 m

ONTARIO_MTO_17TF036A.GPJ ONTARIO_MTO.GDT 12/7/18

RECORD OF BOREHOLE No BH17-18

1 OF 1

METRIC

G.W.P. 3039-16-00 LOCATION Coords: 4 799 238.8 N; 227 637.8 E ORIGINATED BY K.P.
 DIST Central HWY 401 BOREHOLE TYPE Hollow Stem Augers COMPILED BY M.Z.
 DATUM Geodetic DATE 2018.05.14 LATITUDE 43.329086 LONGITUDE -80.451489 CHECKED BY M.V.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100						20
334.4	GROUND SURFACE																	
334.2	TOPSOIL																	
0.2	CLAYEY SILT, with sand		1	SS	4													
	Very stiff, Brown, Moist (FILL)		2	SS	20													
333.0	SAND, some/trace gravel, trace silt		3	SS	18											14	82	(4)
1.4	Compact to dense, Brown, Moist		4	SS	22													
			5	SS	38													
	with gravel		6	SS	55											46	48	(6)
			7	SS	47													
			8	SS	28											13	82	(5)
			9	SS	30													
			10	SS	35											8	87	(5)
			11	SS	47													
324.8	End of borehole																	
9.6																		

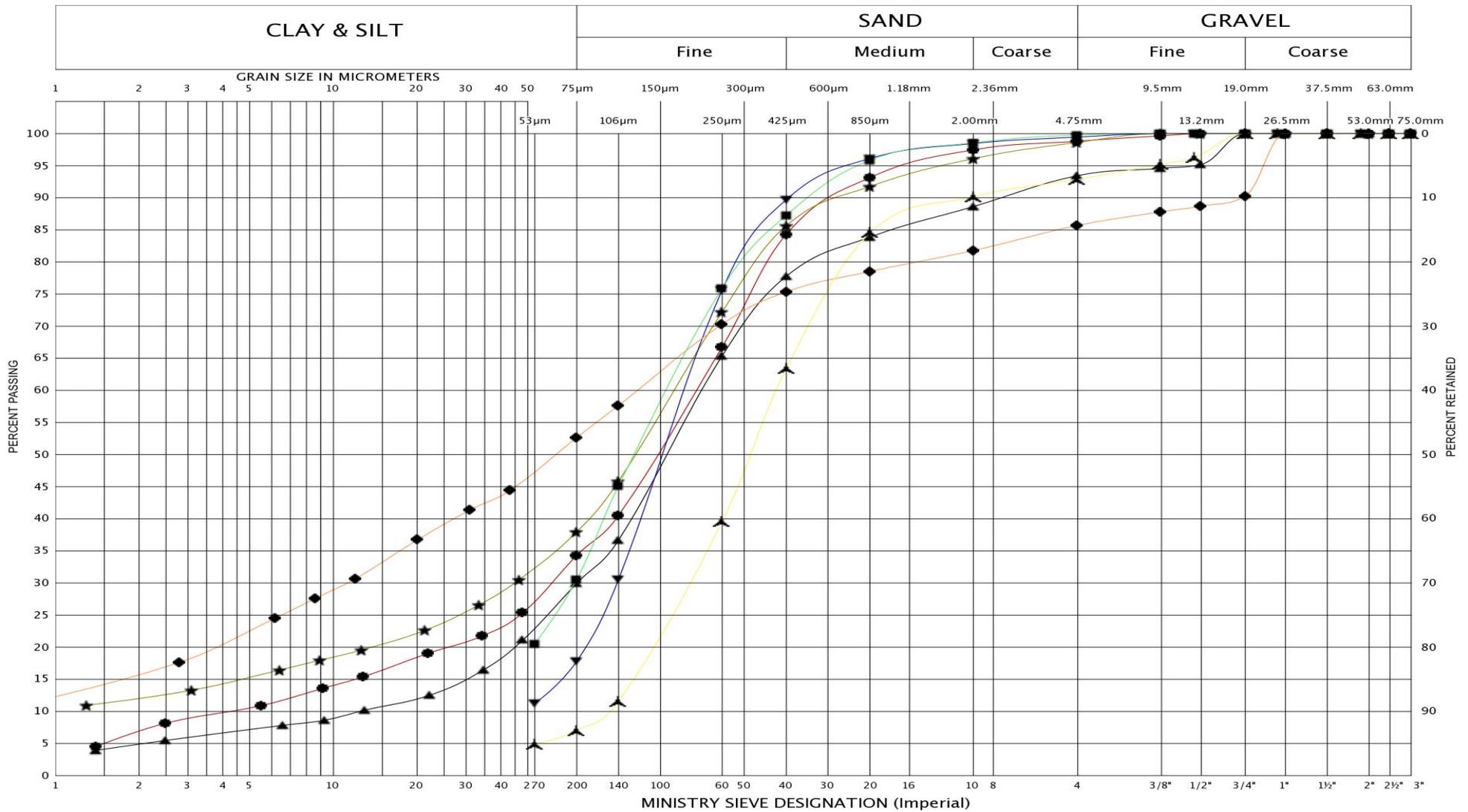
Monitoring Well Readings:
 Date Depth Elev.
 June. 5/18 (m) Dry --,--

Monitoring Well Legend:
 Bentonite seal
 Filter sand
 Screen

ONTARIO.MTO_17TF036A.GPJ ONTARIO.MTO.GDT 12/7/18

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

UNIFIED SOIL CLASSIFICATION SYSTEM



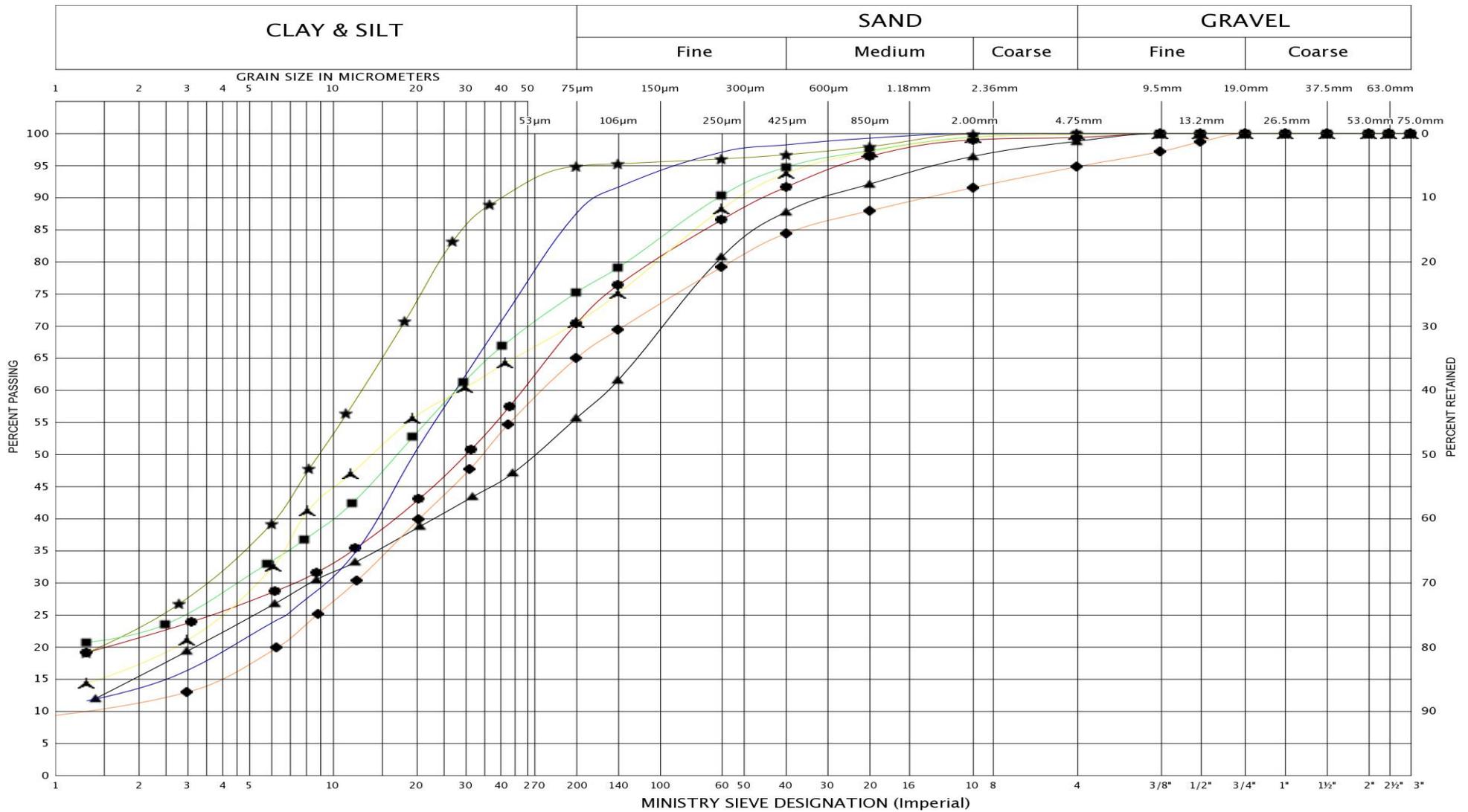
LEGEND	BH	17-1	17-2	17-2	17-8	17-9	17-13	17-14
	SAMPLE	3	2	3	5	3	4	2
	SYMBOL	●	▼	■	◆	▲	▲	★



GRAIN SIZE DISTRIBUTION
SANDY SILT TO SILTY SAND, trace gravel (FILL)

FIG No.: GS-1
HWY : 401/97 Interchange
GWP: 3039-16-00

UNIFIED SOIL CLASSIFICATION SYSTEM



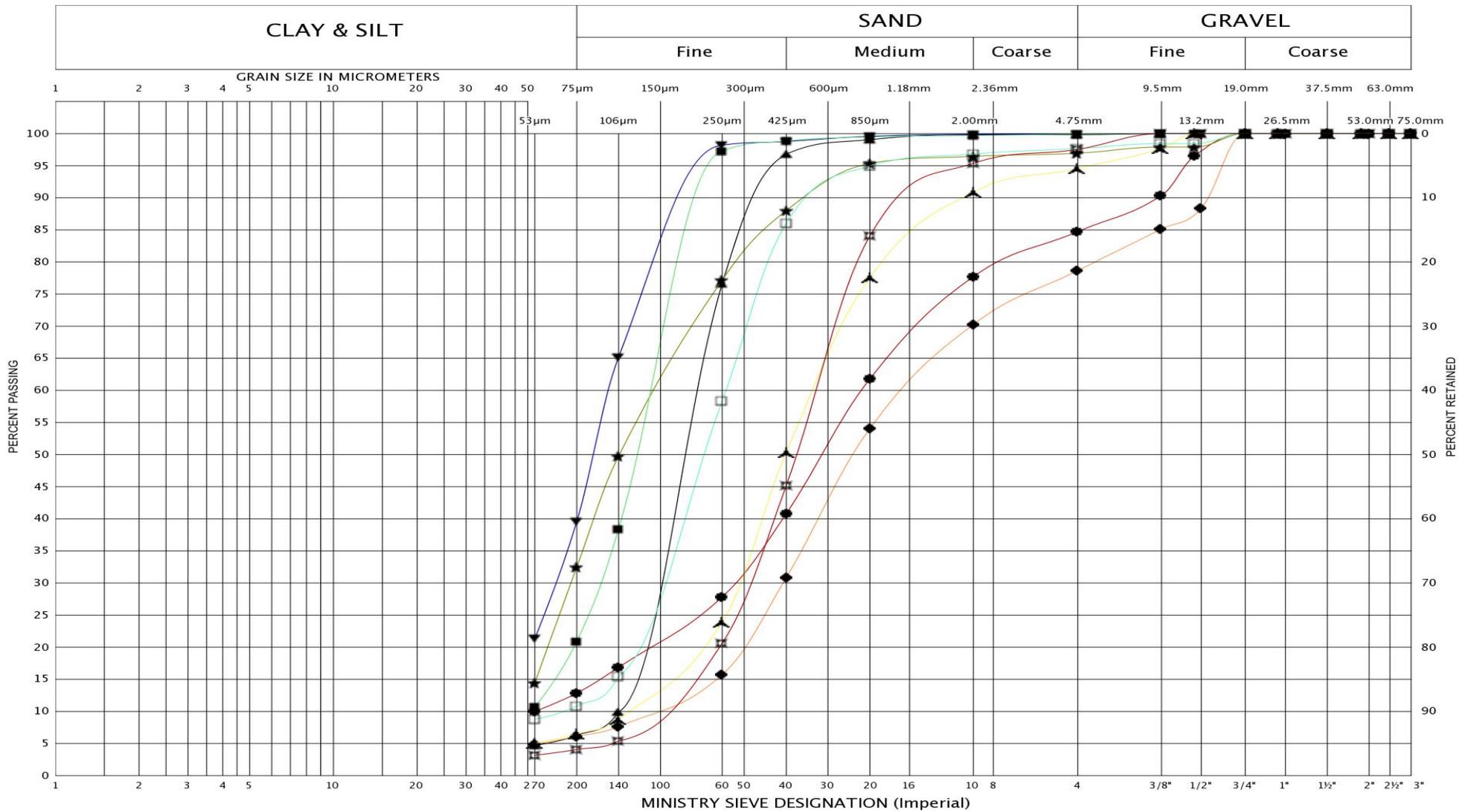
LEGEND	BH	17-3	17-4	17-6	17-7	17-11	17-15	17-16
SAMPLE		3	2	3	4	3	3	2
SYMBOL		▼	■	◆	▲	●	▲	★



GRAIN SIZE DISTRIBUTION
CLAYEY SILT, trace/with sand (FILL)

FIG No.: GS-2
HWY : 401/97 Interchange
GWP: 3039-16-00

UNIFIED SOIL CLASSIFICATION SYSTEM



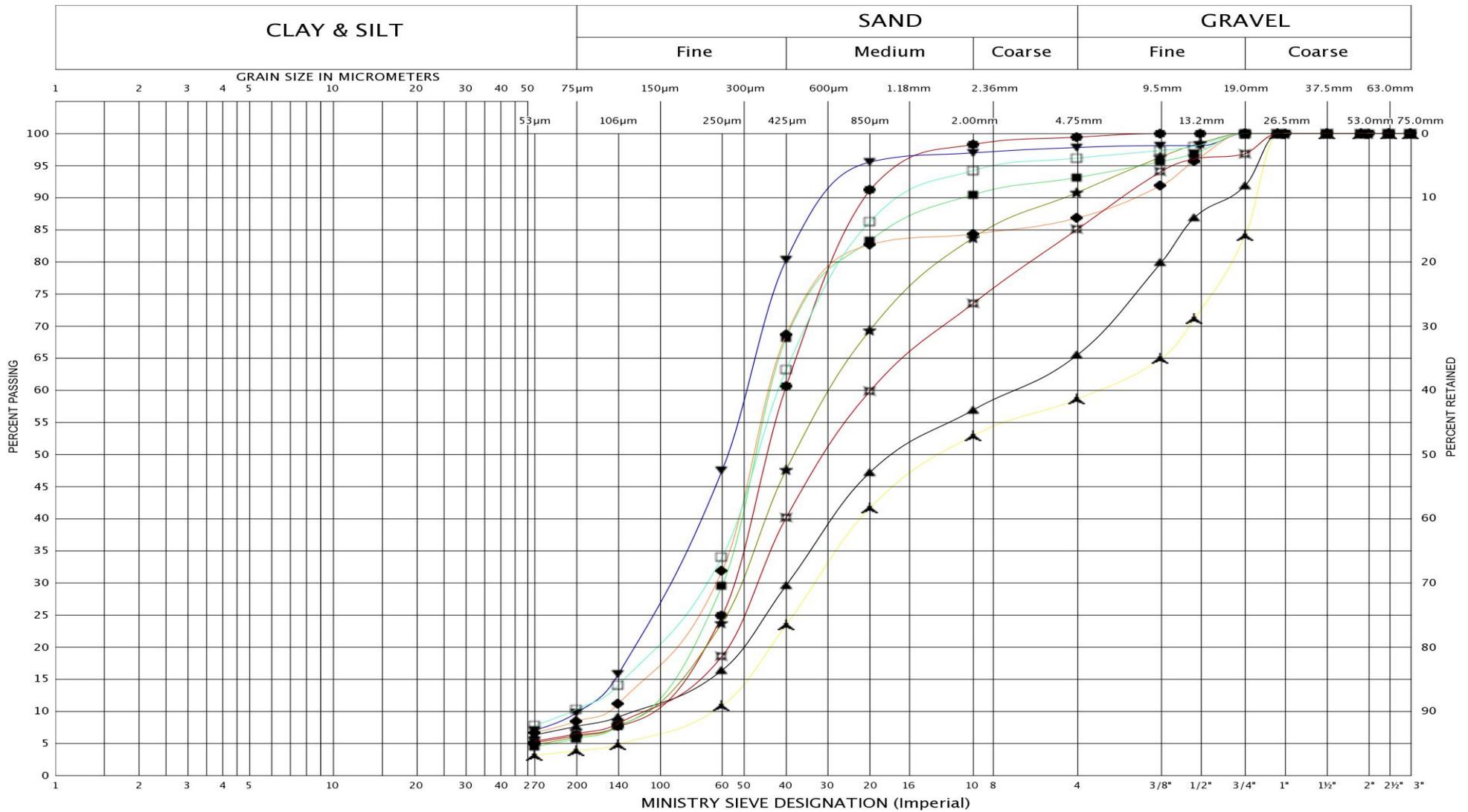
LEGEND	BH	17-1	17-1	17-2	17-2	17-3	17-3	17-3	17-4	17-4
SAMPLE		7	10	6	13	5	8	10	5	9
SYMBOL		●	▲	★	▼	■	▲	◆	□	⊠



GRAIN SIZE DISTRIBUTION
SILTY SAND to SAND, trace/some gravel

FIG No.: GS-3A
HWY : 401/97 Interchange
GWP: 3039-16-00

UNIFIED SOIL CLASSIFICATION SYSTEM



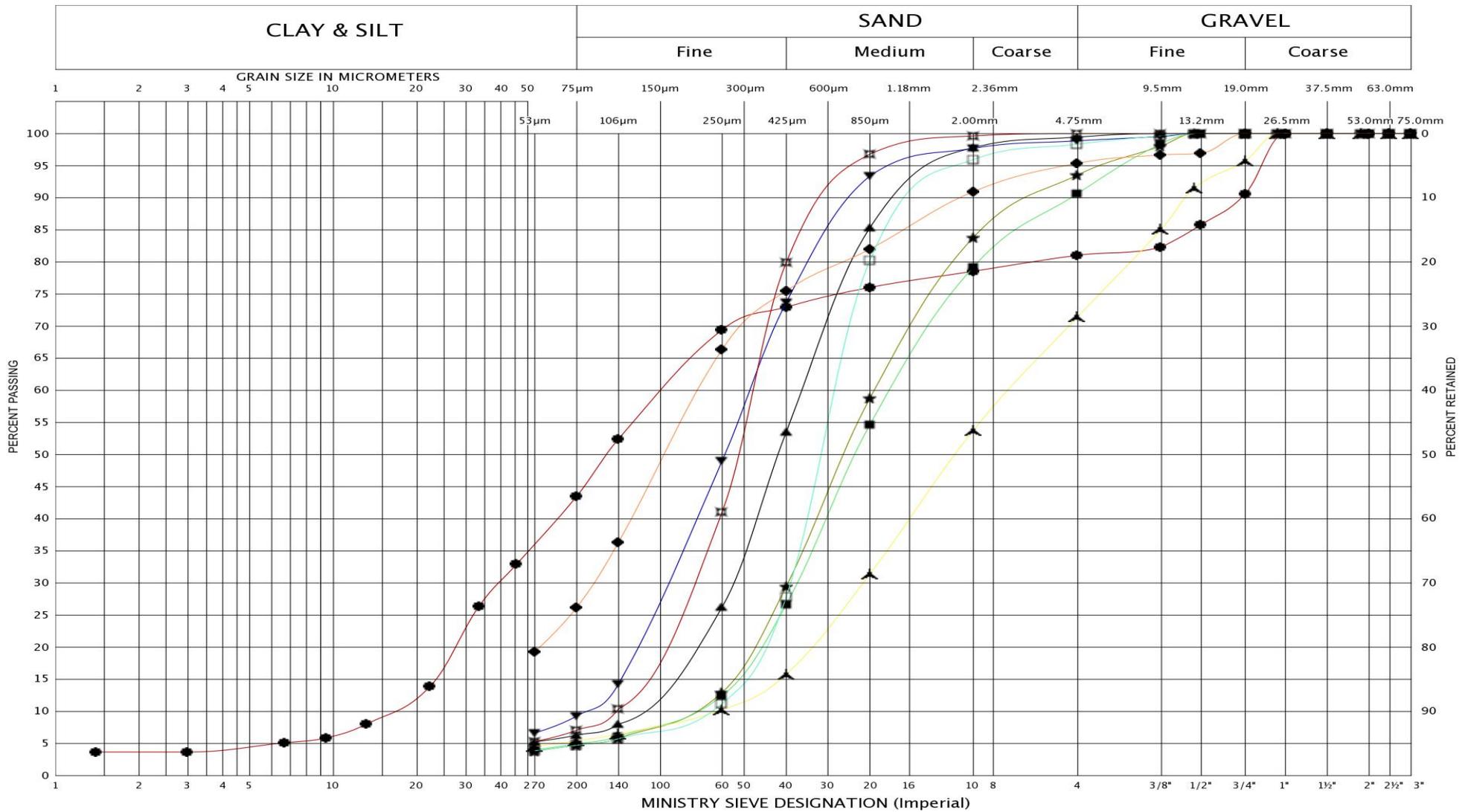
LEGEND	BH	17-4	17-5	17-6	17-6	17-6	17-6	17-6	17-6	17-7
	SAMPLE	12	5	4	5	7	8	10	11	7
	SYMBOL	●	▲	◻	★	▼	■	◆	▲	◻



GRAIN SIZE DISTRIBUTION
SILTY SAND to SAND, trace/some gravel

FIG No.: GS-3B
HWY : 401/97 Interchange
GWP: 3039-16-00

UNIFIED SOIL CLASSIFICATION SYSTEM



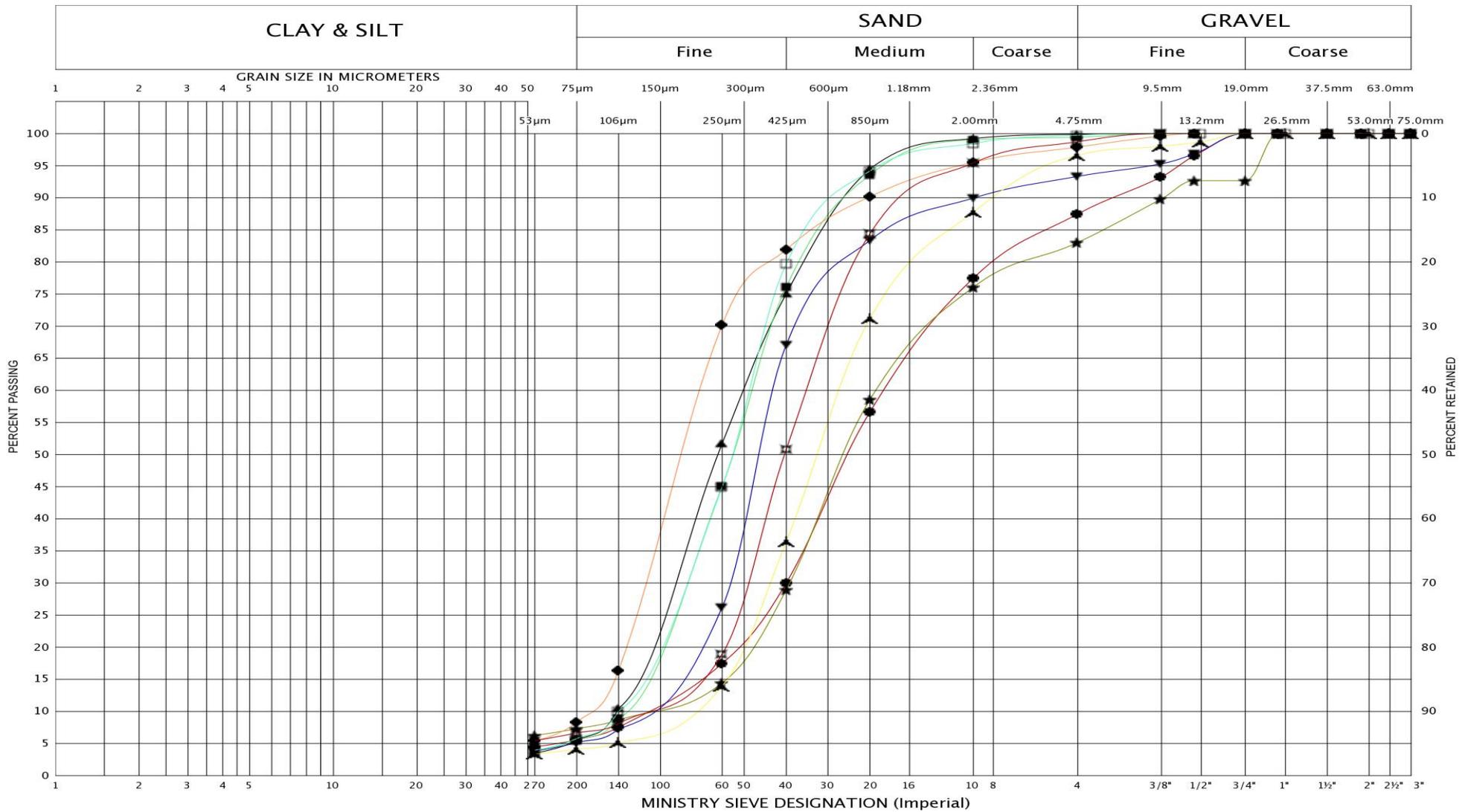
LEGEND	BH	17-8	17-8	17-9	17-9	17-9	17-10	17-10	17-10	17-11
	SAMPLE	7	9	6	10	13	4	8	11	6
	SYMBOL	◆	■	⊠	▲	□	●	▲	★	▼



GRAIN SIZE DISTRIBUTION
SILTY SAND to SAND, trace/some gravel

FIG No.: GS-3C
HWY : 401/97 Interchange
GWP: 3039-16-00

UNIFIED SOIL CLASSIFICATION SYSTEM



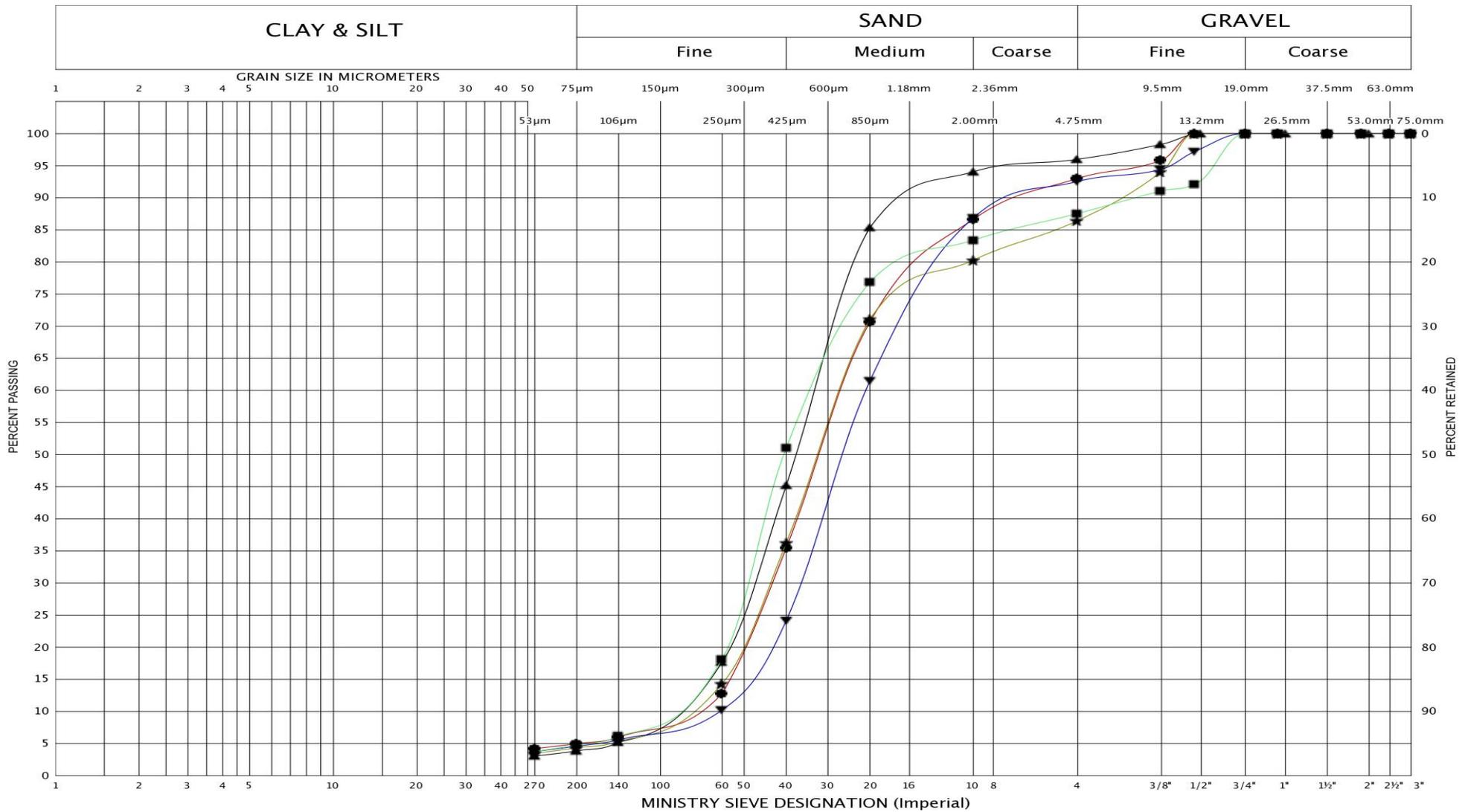
LEGEND	BH	17-11	17-11	17-12	17-12	17-12	17-14	17-15	17-16	17-16
SAMPLE	8	10	4	6	11	8	10	4	9	
SYMBOL	▲	●	*	■	▼	◆	▲	□	⊠	



GRAIN SIZE DISTRIBUTION
SILTY SAND to SAND, trace/some gravel

FIG No.: GS-3D
HWY : 401/97 Interchange
GWP: 3039-16-00

UNIFIED SOIL CLASSIFICATION SYSTEM



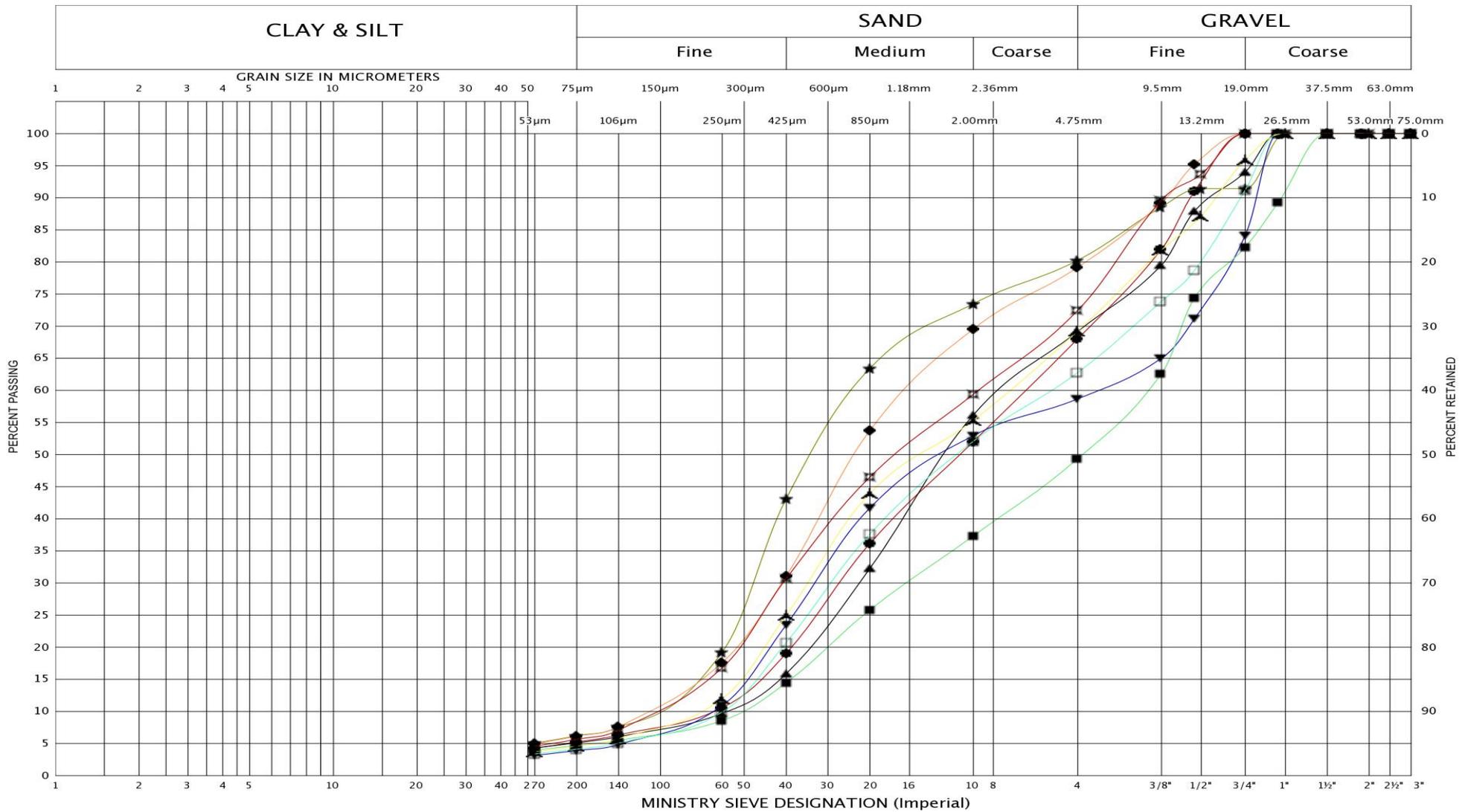
LEGEND	BH	17-17	17-17	17-18	17-18	17-18
SAMPLE	6	8	3	8	10	
SYMBOL	●	▲	★	■	▼	



GRAIN SIZE DISTRIBUTION
SILTY SAND to SANDY SILT, trace/some gravel

FIG No.: GS-3E
HWY : 401/97 Interchange
GWP: 3039-16-00

UNIFIED SOIL CLASSIFICATION SYSTEM



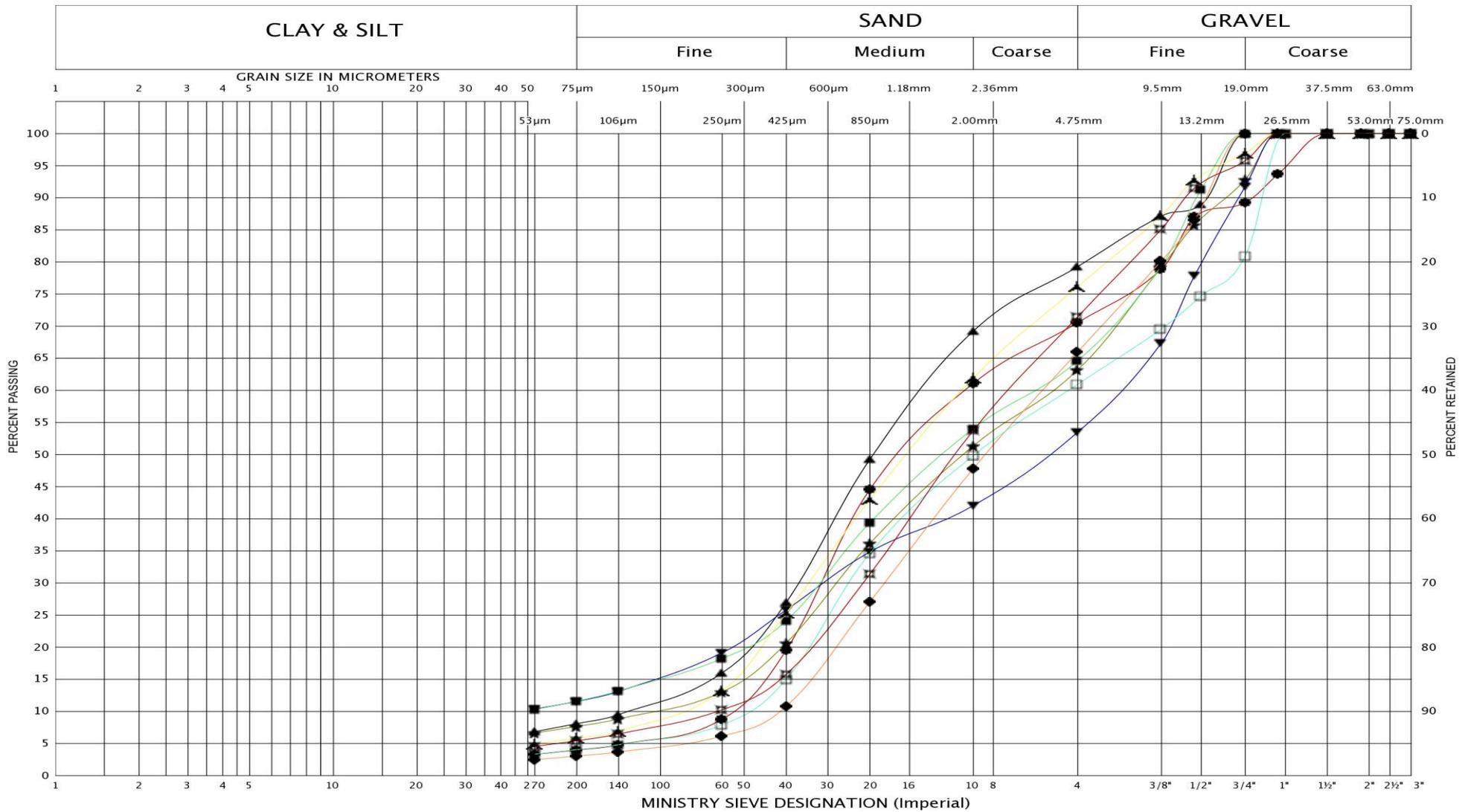
LEGEND	BH	17-2	17-5	17-5	17-6	17-7	17-7	17-7	17-8	17-8
SAMPLE		10	10	12	11	9	11	13	11	12
SYMBOL		●	▲	★	▼	□	▲	■	◆	■



GRAIN SIZE DISTRIBUTION
SILTY SAND to SAND, with gravel

FIG No.: GS-4A
HWY : 401/97 Interchange
GWP: 3039-16-00

UNIFIED SOIL CLASSIFICATION SYSTEM



LEGEND	BH	17-9	17-12	17-13	17-13	17-14	17-14	17-15	17-16	17-17
SAMPLE		10	9	10	12	4	10	7	7	10
SYMBOL		⊠	•	▲	★	▼	■	◆	▲	□



GRAIN SIZE DISTRIBUTION

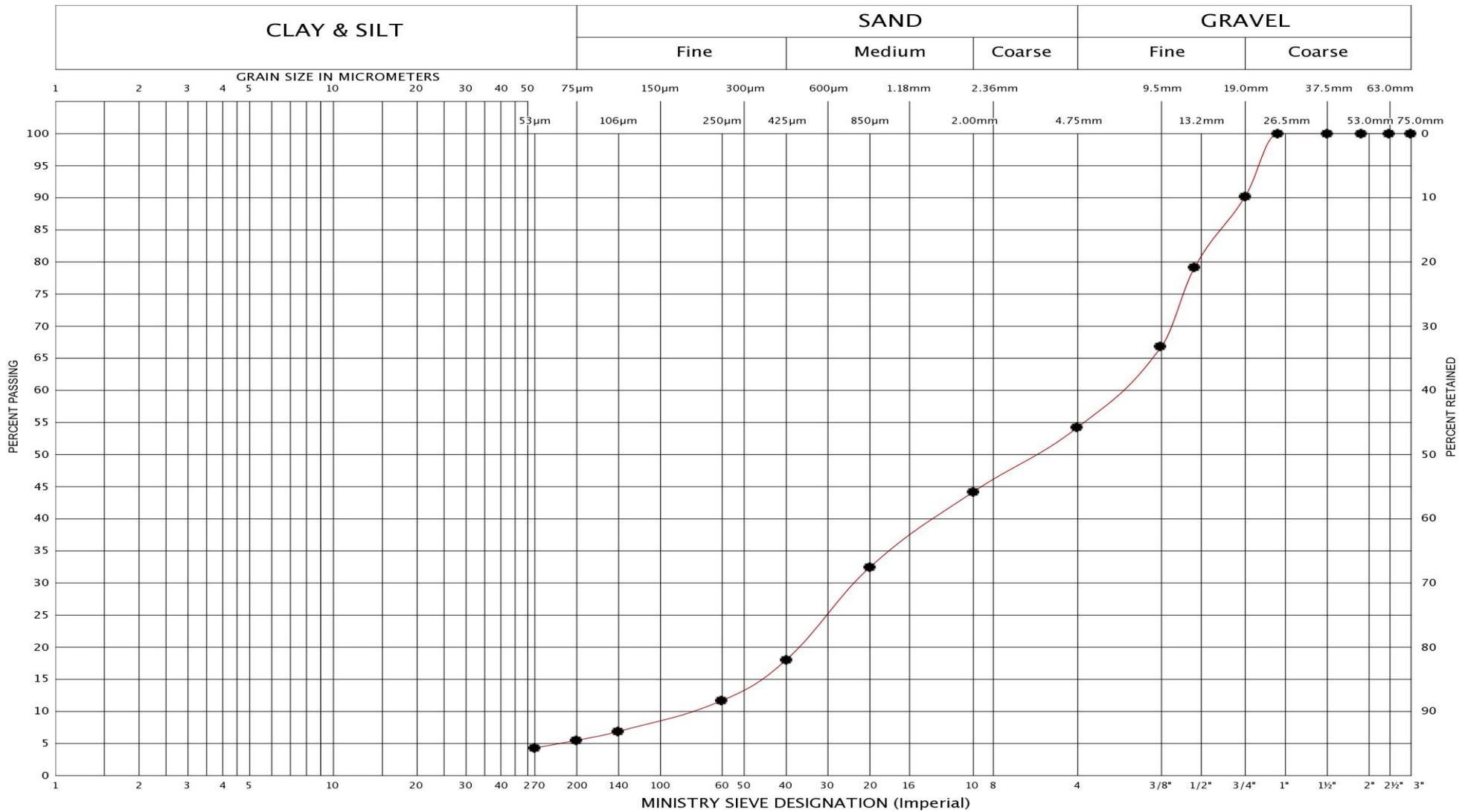
SILTY SAND to SAND, with gravel

FIG No.: GS-4B

HWY : 401/97 Interchange

GWP: 3039-16-00

UNIFIED SOIL CLASSIFICATION SYSTEM



LEGEND	BH	17-18
	SAMPLE	6
	SYMBOL	•



GRAIN SIZE DISTRIBUTION

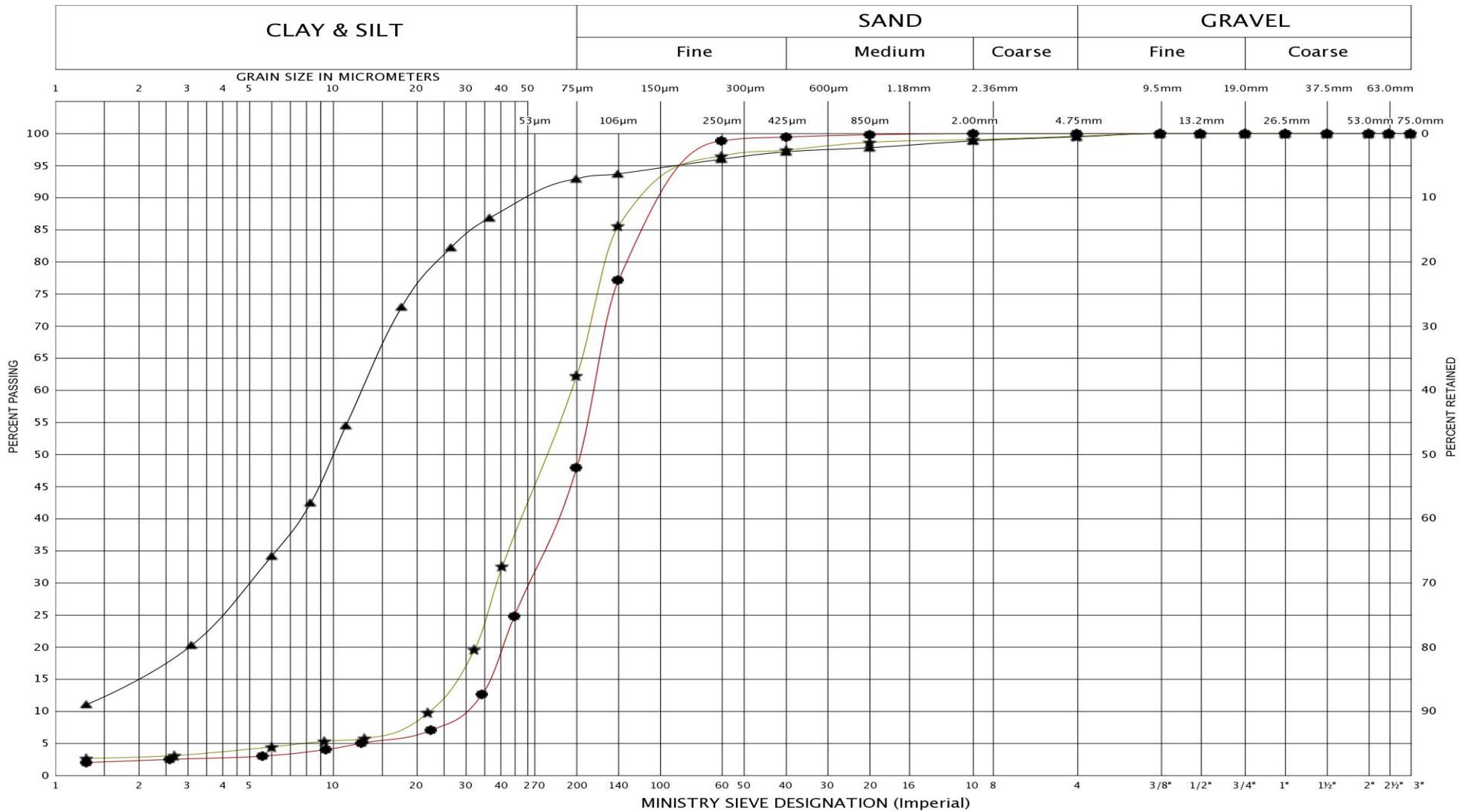
SILTY SAND to SAND, with gravel

FIG No.: GS-4C

HWY : 401/97 Interchange

GWP: 3039-16-00

UNIFIED SOIL CLASSIFICATION SYSTEM



LEGEND	BH	17-1	17-6	17-13
	SAMPLE	12	13	7
	SYMBOL	●	★	▲



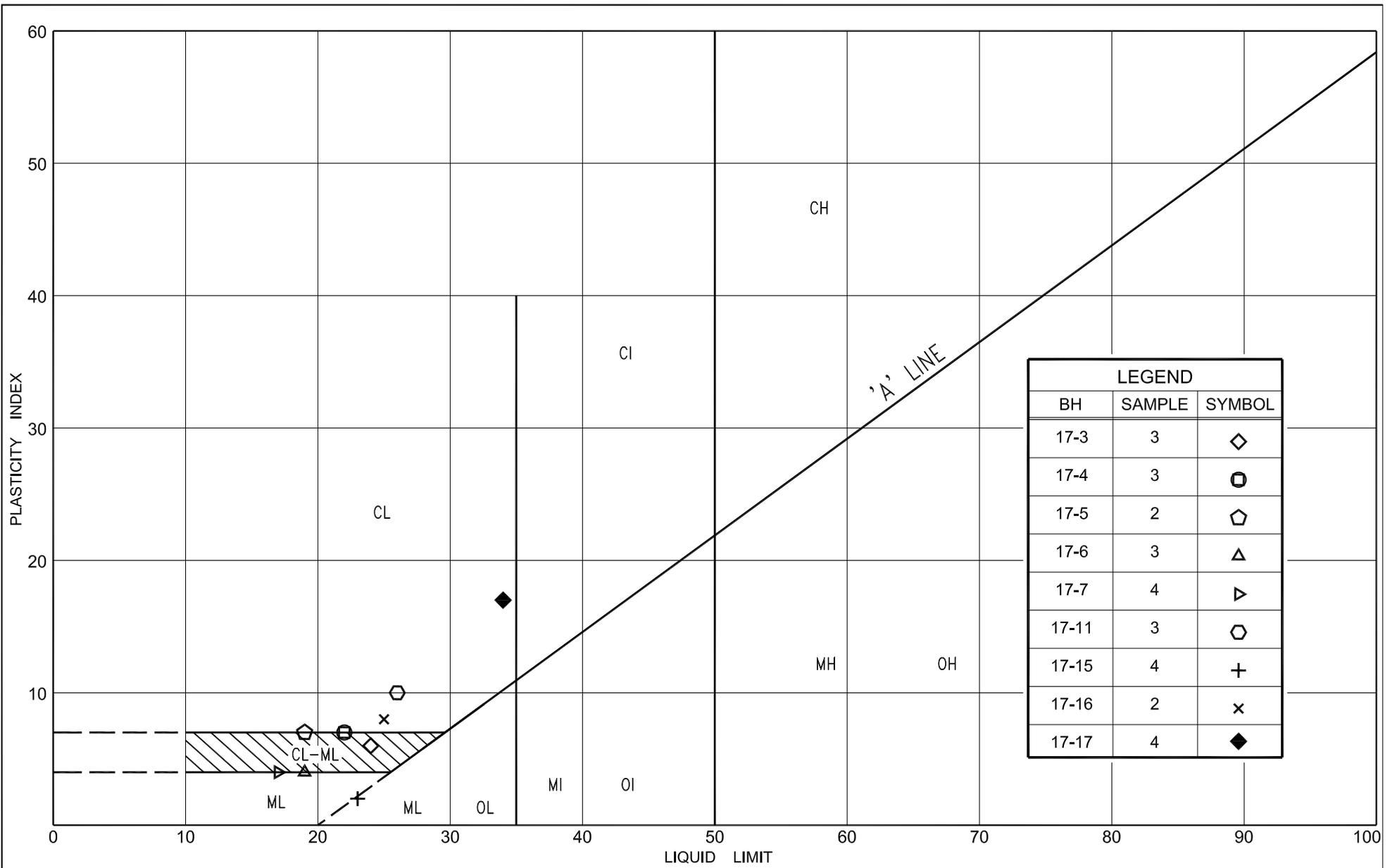
GRAIN SIZE DISTRIBUTION

SANDY SILT/SILT, trace/some clay, trace gravel

FIG No.: GS-5

HWY : 401/97 Interchange

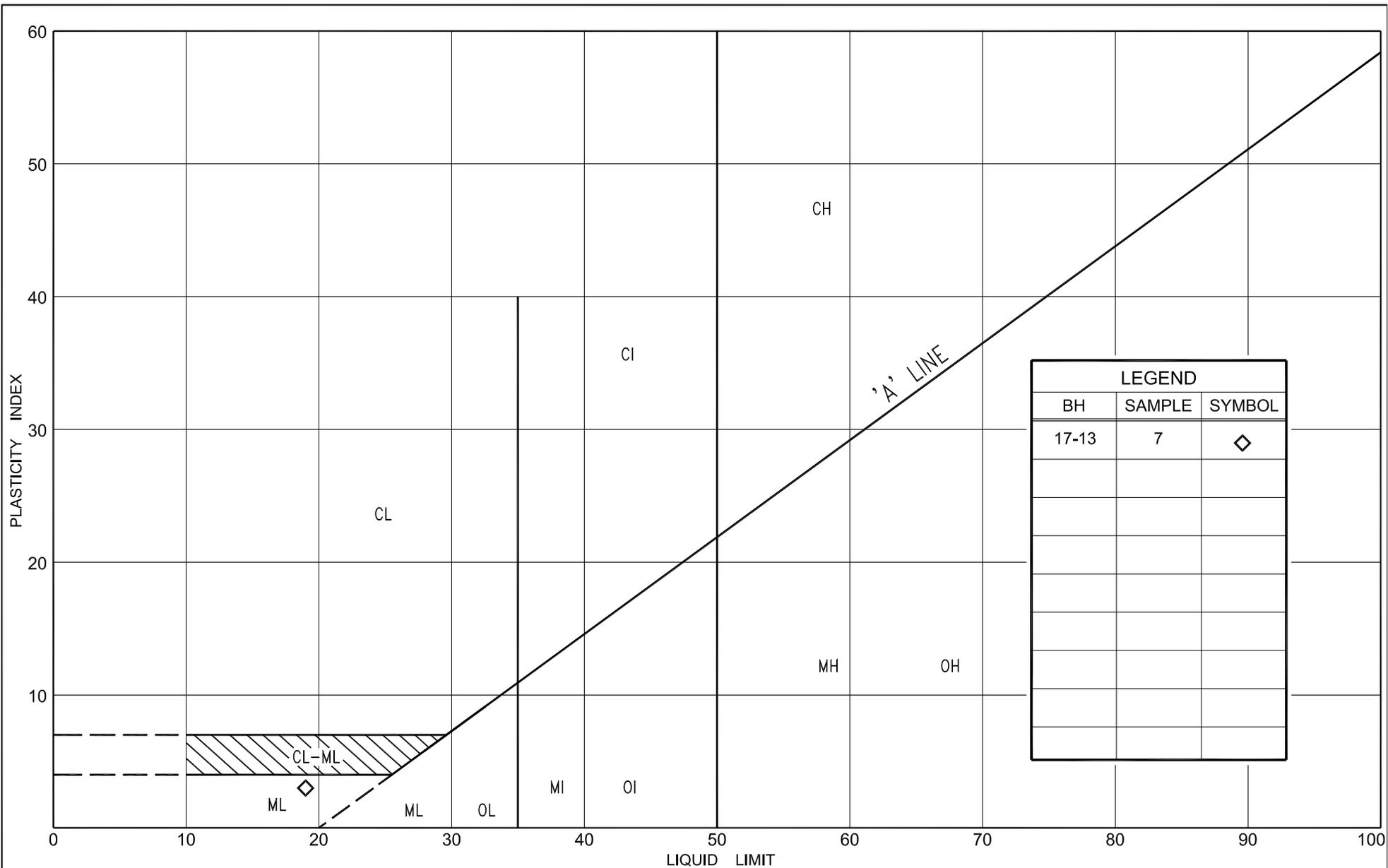
GWP: 3039-16-00



PLASTICITY CHART

CLAYEY SILT, trace/with sand (CL-ML / CL) (FILL)

FIG No.	PC-1
HWY:	401/97 Interchange
GWP:	3039-16-00



PLASTICITY CHART

Silt Seam (ML)

FIG No.	PC-2
HWY:	401/97 Interchange
GWP:	3039-16-00



FINAL REPORT

CA14781-MAY18 R1

17TF036A Ayr

Prepared for

Peto MacCallum Ltd

First Page

CLIENT DETAILS

Client Peto MacCallum Ltd
 Address 16 Franklin St S
 Kitchener, ON
 N2C 1R4.
 Contact Dylan Brice
 Telephone 519-893-7500
 Facsimile 519-893-0654
 Email dbrice@petomacallum.com
 Project 17TF036A Ayr
 Order Number
 Samples Soil (6)

LABORATORY DETAILS

Project Specialist Deanna Edwards, B.Sc, C.Chem
 Laboratory SGS Canada Inc.
 Address 185 Concession St., Lakefield ON, K0L 2H0
 Telephone 705-652-2000
 Facsimile 705-652-6365
 Email deanna.edwards@sgs.com
 SGS Reference CA14781-MAY18
 Received 05/25/2018
 Approved 05/31/2018
 Report Number CA14781-MAY18 R1
 Date Reported 05/31/2018

COMMENTS

Temperature of Sample upon Receipt: 10 degrees C
 Cooling Agent Present: Yes
 Custody Seal Present: No

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

SIGNATORIES

Deanna Edwards, B.Sc, C.Chem



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Legend.....	7
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FINAL REPORT

CA14781-MAY18 R1

Client: Peto MacCallum Ltd

Project: 17TF036A Ayr

Project Manager: Dylan Brice

Samplers: O Brice

PACKAGE: - Corrosivity Index (SOIL)

Sample Number	5	6	7	8	9	10
Sample Name	BH 17-2 GS 8A	BH 17-3 GS 5A	BH 17-6 SS6	BH 17-7 SS8	BH 17-14 SS5	BH 17-15 SS5
Sample Matrix	Soil	Soil	Soil	Soil	Soil	Soil
Sample Date	14/05/2018	15/05/2018	16/05/2019	18/05/2020	18/05/2020	22/05/2020

Parameter	Units	RL	Result	Result	Result	Result	Result	Result
Corrosivity Index								
Corrosivity Index	none	1	3	4	3	4	3	3
Soil Redox Potential	mV	-	245	288	299	308	303	290
Sulphide	%	0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
pH	no unit	0.05	9.30	9.43	9.39	9.62	9.30	9.34
Resistivity (calculated)	ohms.cm	-9999	15200	10600	19600	4170	16500	16200

PACKAGE: - General Chemistry (SOIL)

Sample Number	5	6	7	8	9	10
Sample Name	BH 17-2 GS 8A	BH 17-3 GS 5A	BH 17-6 SS6	BH 17-7 SS8	BH 17-14 SS5	BH 17-15 SS5
Sample Matrix	Soil	Soil	Soil	Soil	Soil	Soil
Sample Date	14/05/2018	15/05/2018	16/05/2019	18/05/2020	18/05/2020	22/05/2020

Parameter	Units	RL	Result	Result	Result	Result	Result	Result
General Chemistry								
Conductivity	uS/cm	2	66	94	51	240	61	62

PACKAGE: - Metals and Inorganics (SOIL)

Sample Number	5	6	7	8	9	10
Sample Name	BH 17-2 GS 8A	BH 17-3 GS 5A	BH 17-6 SS6	BH 17-7 SS8	BH 17-14 SS5	BH 17-15 SS5
Sample Matrix	Soil	Soil	Soil	Soil	Soil	Soil
Sample Date	14/05/2018	15/05/2018	16/05/2019	18/05/2020	18/05/2020	22/05/2020

Parameter	Units	RL	Result	Result	Result	Result	Result	Result
Metals and Inorganics								
Moisture Content	%	0.1	4.8	7.2	2.3	7.8	2.5	3.5
Sulphate	µg/g	0.4	2.3	2.9	1.7	8.9	1.3	2.0



FINAL REPORT

CA14781-MAY18 R1

Client: Peto MacCallum Ltd

Project: 17TF036A Ayr

Project Manager: Dylan Brice

Samplers: O Brice

PACKAGE: - Other (ORP) (SOIL)

Sample Number	5	6	7	8	9	10
Sample Name	BH 17-2 GS 8A	BH 17-3 GS 5A	BH 17-6 SS6	BH 17-7 SS8	BH 17-14 SS5	BH 17-15 SS5
Sample Matrix	Soil	Soil	Soil	Soil	Soil	Soil
Sample Date	14/05/2018	15/05/2018	16/05/2019	18/05/2020	18/05/2020	22/05/2020

Parameter	Units	RL	Result	Result	Result	Result	Result	Result
Other (ORP)								
Chloride	µg/g	0.4	11	9.9	4.0	91	8.0	13

QC SUMMARY

Anions by IC

Method: EPA300/MA300-Ions1.3 | Internal ref.: ME-CA-IENVIIC-LAK-AN-001

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Chloride	DIO0477-MAY18	µg/g	0.4	<0.4	14	20	94	80	120	105	75	125
Sulphate	DIO0477-MAY18	µg/g	0.4	<0.4	21	20	97	80	120	96	75	125

Carbon/Sulphur

Method: ASTM E1915-07A | Internal ref.: ME-CA-IENVIARD-LAK-AN-020

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Sulphide	ECS0044-MAY18	%	0.02	<0.02	ND	20	93	80	120			

Conductivity

Method: SM 2510 | Internal ref.: ME-CA-IENVIEWL-LAK-AN-006

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Conductivity	EWL0442-MAY18	uS/cm	2	< 0.002	29	10	101	90	110	NA		

QC SUMMARY

pH

Method: SM 4500 | Internal ref.: ME-CA-ENVIEWL-LAK-AN-001

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
pH	EWL0442-MAY18	no unit	0.05	NA	1		100			NA		

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

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

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

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

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

RL: Reporting limit

RPD: Relative percent difference

AC: Acceptance criteria

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

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

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

LEGEND**FOOTNOTES**

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

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

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

SGS provides criteria information (such as regulatory or guideline limits and summary of limit exceedances) as a service. Every attempt is made to ensure the criteria information in this report is accurate and current, however, it is not guaranteed. Comparison to the most current criteria is the responsibility of the client and SGS assumes no responsibility for the accuracy of the criteria levels indicated. This document is issued, on the Client's behalf, by the Company under its General Conditions of Service available on request and accessible at http://www.sgs.com/terms_and_conditions.htm. The Client's attention is drawn to the limitation of liability, indemnification and jurisdiction issues defined therein. Any other holder of this document is advised that information contained hereon reflects the Company's findings at the time of its intervention only and within the limits of Client's instructions, if any. The Company's sole responsibility is to its Client and this document does not exonerate parties to a transaction from exercising all their rights and obligations under the transaction documents.

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-- End of Analytical Report --



Request for Laboratory Services and CHAIN OF CUSTODY

No: 00314

Page ___ of ___

SGS Environment, Health and Safety
- Lakefield: 185 Concession St., Lakefield, ON K0L 2H0 Phone: 705-652-2000 Toll Free: 877-747-7658 Fax: 705-652-6365
- London: 657 Consortium Court, London, ON, N6E 2S8 Phone: 519-672-4500 Toll Free: 877-848-8060 Fax: 519-672-0361 Web: www.ca.sgs.com

Laboratory Information Section - Lab use only

Received By: Ismael
Received Date: 05/25/18 (mm/dd/yy)
Received Time: 11:30 am / pm (circle)

Received By (signature):
Custody Seal Present: Y / N (circle)
Custody Seal Intact: Y / N

Cooling Agent Present: Y / N Type:
Temperature Upon Receipt (°C): 6.7, 7.7

LAB LIMS #: CA 14781-MAY18

REPORT INFORMATION

Company: PETRO MACALUM LTD
Contact: DULAN BRICE
Address: 16 FRANKLIN ST S
KIT, ONT, N2C 1R4
Phone: 519-893-7500
Fax: 519-893-0654
Email: dbrice@petromacalum.com

INVOICE INFORMATION

(same as Report Information)
Company:
Contact:
Address:
Phone:
Email: mzamshad@petromacalum.com

PROJECT INFORMATION

Quotation #: _____ P.O. #: _____
Project #: 17F036A Site Location/ID: AYR
TURNAROUND TIME (TAT) REQUIRED
TAT's are quoted in business days (exclude statutory holidays & weekends).
Samples received after 3pm or on weekends : TAT begins the next business day
 Regular TAT (5-7days) 1 Day 2 Days 3-4 Days
RUSH TAT (Additional Charges May Apply) 1 Day 2 Days 3-4 Days
PLEASE CONFIRM RUSH FEASIBILITY WITH SGS REPRESENTATIVE PRIOR TO SUBMISSION
Specify Due Date: _____ Rush Confirmation ID: _____

REGULATIONS

Regulation 153 (2011):
 Table 1 Res/Park Soil Texture:
 Table 2 Ind/Com Coarse
 Table 3 Agri/Other Medium
 Table Fine
Other Regulations:
 Reg 347/558 (3 Day min TAT)
 PWQO MMER
 CCME Other:
 MISA
Sewer By-Law:
 Sanitary
 Storm
Municipality: _____

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

ANALYSIS REQUESTED

SAMPLE IDENTIFICATION	DATE SAMPLED	TIME SAMPLED	# OF BOTTLES	MATRIX
1 BH 17-2 658A	May 14/18	13:00	1	S
2 BH 17-3 655A	May 15/18	11:00	1	S
3 BH 17-6 556	May 16/18	13:30	1	S
4 BH 17-7 558	May 18/18	9:30	1	S
5 BH 17-14 555	May 18/18	15:30	1	S
6 BH 17-15 555	May 22/18	9:00	1	S
7				
8				
9				
10				

COMMENTS:
Field Filtered (F)
Preserved (P)

Observations/Comments/Special Instructions

Sampled By (NAME): D. BRICE
Relinquished by (NAME): D. BRICE

Signature: [Signature]
Signature: [Signature]

Date: 05/22/18 (mm/dd/yy)
Date: 05/25/18 (mm/dd/yy)

Pink Copy - Client
Yellow & White Copy - SGS



SAMPLE INTEGRITY REPORT

Project Number: 17TF036A

ONTARIO REGULATION 153/04

SGS Sample ID CA14781 - MAY 18

Date / Time Sampled May 14, 15, 18 + 22 / 2018

Client Sample ID See CoC

ALL

Sample Submission General Sample Integrity Violations

- Temperature >10 C upon receipt if not sampled same day
- No evidence of cooling trend initiated if sampled same day
- Chain of Custody not submitted
- Chain of Custody incomplete
- Chain of Custody not signed / dated
- Chain of Custody not a current version
- Bottles / Samples listed on CoC but not received
- Bottles / Samples received but not listed on the CoC
- Sample container received empty

Sample Specific Sample Integrity Violations

- | | | | | | | | |
|---|-------------------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| Sample received past hold time | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Incorrect preservation (including no preservation where required) | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Headspace present in VOC vial (aqueous) | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Sample(s) received frozen | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Bottle(s) broken or damaged in transport | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Discrepancy between sample label and chain of custody | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Analysis requirements absent / unclear | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Missing or incorrect sample label(s) | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Inappropriate sample container used | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Insufficient number of bottles received | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Limited sample volume | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Insufficient sample volume | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Sample contains multiple phases | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

Sediment Log

- | | | | | | | | |
|--|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| Groundwater samples contain visible sediment / particulate | <input type="checkbox"/> |
| Groundwater contains greater than 1cm of sediment / particulate matter in bottle | <input type="checkbox"/> |

Additional Comments/Remarks:

No issues upon receipt

Initials: KH

* Soil Jar BH 17-15 SSS → rec'd labelled BH 17-5 SSC.



APPENDIX B

Site Photographs (P1- P12, Dated May 18, 2018)



Photograph P1: Entrance Gate, Facing West.



Photograph P2: Entrance Gate, Facing Southwest.



Photograph P3: At the entrance gate, Facing South.



Photograph P4: At the entrance gate, Facing Southwest.



Photograph P5: Corner of the Existing Asphalt Pad, Facing West.



Photograph P6: Corner of the Existing Asphalt Pad, Facing Northwest.



Photograph P7: Corner of the Existing Asphalt Pad, Facing North.



Photograph P8: Corner of the Existing Asphalt Pad, Facing Northeast.



Photograph P9: Corner of the Existing Asphalt Pad, Facing East.



Photograph P10: Near East Tree Line, Facing North.



Photograph P11: Near East Tree Line, Facing Northwest.



Photograph P12: Near East Tree Line, Facing West.