



THURBER ENGINEERING LTD.

Preliminary Foundation Investigation Report High Fill Embankments, Deep Cuts, Swamp Crossings and Culverts

**Highway 11/17, Four Lane Expansion From Pearl Lake,
Easterly to 2.8 km West of CPR Overhead at Ouimet, 7.6 km
Ouimet, Ontario**

G.W.P. 129-90-00, GEOCRES No. 52A10-001

Client Name: WSP Canada Inc.

Date: May 6, 2024

File: 21663

TABLE OF CONTENTS

1.	INTRODUCTION.....	1
2.	SITE DESCRIPTION.....	1
2.1	Existing Highway.....	1
2.2	Regional Geology	2
3.	SITE INVESTIGATION AND FIELD TESTING	2
4.	LABORATORY TESTING.....	4
5.	DESCRIPTION OF SUBSURFACE CONDITIONS.....	4
5.1	Swamp 1 (SW1) (Sta. 24+550 to 24+650)	5
5.1.1	Peat.....	5
5.1.2	Upper Silty Sand	5
5.1.3	Silty Clay	6
5.1.4	Silt.....	7
5.1.5	Lower Sand to Sand and Silt	8
5.1.6	Inferred Bedrock.....	8
5.1.7	Groundwater Conditions.....	8
5.2	Deep Cut 1 (DC1) (Sta. 24+720 to 24+790)	9
5.2.1	Topsoil	9
5.2.2	Sandy Silt.....	9
5.2.3	Gravel to Gravelly Sand	10
5.2.4	Inferred Bedrock.....	10
5.2.5	Groundwater Conditions.....	10
5.3	High Fill 1 (HF1) and Welch Creek EBL Culvert (Sta. 24+950 to 26+000).....	11
5.3.1	Topsoil	11
5.3.2	Silty Clay	11
5.3.3	Silt.....	12
5.3.4	Sand to Silt and Sand.....	13
5.3.5	Sand and Gravel	14
5.3.6	Bedrock and Inferred Bedrock.....	14
5.3.7	Groundwater Conditions.....	15
5.4	Deep Cut 2 (DC2) (Sta. 26+080 to 26+175)	16
5.4.1	Gravelly Sand.....	16
5.4.2	Sandy Gravel	17
5.4.3	Sandy Silt.....	17
5.4.4	Bedrock.....	17

5.4.5	Groundwater Conditions	18
5.5	Swamp 2 (SW2) (Sta. 27+850 to 28+240)	18
5.5.1	Upper Silty Sand to Sandy Silt.....	18
5.5.2	Peat.....	19
5.5.3	Sand and Gravel to Sand, Some Gravel.....	19
5.5.4	Upper Sand	20
5.5.5	Lower Silty Sand to Sandy Silt.....	20
5.5.6	Lower Sand	21
5.5.7	Inferred Bedrock.....	21
5.5.8	Groundwater Conditions	21
5.6	High Fill 6 (HF6) (Sta. 28+925 to 29+825)	22
5.6.1	Topsoil	23
5.6.2	Upper Sandy Silt to Silty Sand.....	23
5.6.3	Upper Silt	24
5.6.4	Upper Sand and Gravel.....	24
5.6.5	Silty Clay	25
5.6.6	Lower Silt	26
5.6.7	Lower Sand and Silt to Sand, Some Silt	26
5.6.8	Lower Sand and Gravel.....	27
5.6.9	Bedrock and Inferred Bedrock	27
5.6.10	Groundwater Conditions	28
5.7	Welch Creek WBL Culvert	29
5.7.1	Asphalt	29
5.7.2	Sand and Gravel Fill	29
5.7.3	Silty Clay Fill.....	29
5.7.4	Silty Sand Fill	30
5.7.5	Topsoil	30
5.7.6	Silty Clay	30
5.7.7	Silt to Silt and Sand	31
5.7.8	Sand and Gravel	32
5.7.9	Bedrock.....	33
5.7.10	Groundwater Conditions.....	33
6.	CORROSIVITY AND SULPHATE TEST RESULTS	34
7.	CLOSURE	35

STATEMENT OF LIMITATIONS AND CONDITIONS

IN-TEXT TABLES

Table 3.1: Summary of Investigation Program.....	3
Table 5.1: SW1 Groundwater Measurements	9
Table 5.2: DC1 Groundwater Measurements	11
Table 5.3: HF1 Groundwater Measurements	15
Table 5.4: DC2 Groundwater Measurements	18
Table 5.5: SW2 Groundwater Measurements	22
Table 5.6: HF6 Groundwater Measurements	28
Table 5.7: WBL Groundwater Measurements	33
Table 6.1 Corrosivity Test Results.....	34

APPENDICES

APPENDIX A

Stratigraphic Plan and Profile Drawings

APPENDIX B

B1: Swamp Section 1 Record of Borehole Sheets

B2: Swamp Section 1 Geotechnical Laboratory Testing Results

APPENDIX C

C1: Deep Cut Section 1 Record of Borehole Sheets

C2: Deep Cut Section 1 Geotechnical Laboratory Testing Figures

APPENDIX D

D1: High Fill 1 and Welch Creek EBL Culvert Record of Borehole Sheets

D2: High Fill 1 and Welch Creek EBL Culvert Geotechnical Laboratory Testing Results

APPENDIX E

E1: Deep Cut Section 2 Record of Borehole Sheets

E2: Deep Cut Section 2 Geotechnical Laboratory Testing Results

APPENDIX F

F1: Swamp Section 2 Record of Borehole Sheets

F2: Swamp Section 2 Geotechnical Laboratory Testing Results

APPENDIX G

G1: High Fill Section 6 Record of Borehole Sheets

G2: High Fill Section 6 Geotechnical Laboratory Testing Results

APPENDIX H

H1: Welch Creek WBL Culvert Record of Borehole Sheets

H2: Welch Creek WBL Culvert Geotechnical Laboratory Testing Results

APPENDIX I

Bedrock Laboratory Test Results and Rock Core Photographs

APPENDIX J

Analytical Laboratory Test Results

APPENDIX K

Site Photographs

**PRELIMINARY FOUNDATION INVESTIGATION REPORT
HIGH FILL EMBANKMENTS, DEEP CUTS, SWAMP CROSSINGS AND CULVERTS
HIGHWAY 11/17, FOUR LANE EXPANSION FROM PEARL LAKE, EASTERLY
TO 2.8 KM WEST OF CPR OVERHEAD AT OUIMET, 7.6 KM
MTO NORTHWESTERN REGION
G.W.P. 129-90-00**

GEOCRES No. 52A10-001

1. INTRODUCTION

This report presents the factual findings obtained from a foundation investigation carried out by Thurber Engineering Ltd. (Thurber) for the proposed four lane expansion of Highway 11/17 from Pearl Lake, easterly to 2.8 km west of the CPR Overhead bridge at Ouimet, Ontario.

The proposed works are for preliminary design of a four-lane expansion of Highway 11/17 for approximately 7.6 km between Pearl Lake and Ouimet, in the Municipality of Shuniah, Ontario. The project will include conversion of the existing two-lane Highway 11/17 into a four-lane divided highway, with the eastbound lanes constructed on a new alignment to the southeast of the existing highway. The existing Highway 11/17 will be converted into the new westbound lanes. The foundation aspects of the project include construction of new high fill embankments, deep cut sections and swamp crossings for the new eastbound lanes, as well as the installation of new or replacement culverts where the eastbound and westbound lanes cross Welch Creek.

The purpose of Thurber's investigation was to explore the subsurface conditions along the alignment of the proposed high fill embankments, deep cuts, swamp crossings and culverts, and based on the data obtained, to provide borehole location plans, record of borehole sheets, stratigraphic profiles, laboratory test results and a written description of the subsurface conditions.

Thurber carried out the assignment as a sub-consultant to WSP Canada Inc. (WSP), under the Ministry of Transportation Ontario (MTO) Assignment No. 6017-E-0034.

It is a condition of this report that Thurber's performance of its professional services is subject to the attached Statement of Limitations and Conditions.

2. SITE DESCRIPTION

2.1 Existing Highway

The existing Highway 11/17 within the project limits is a two-lane, undivided roadway with

at-grade intersections. One at-grade intersection is present within the project limits at Superior Shores Road. Although the existing highway is aligned in a generally north/south to northeast/southwest direction within the project limits; for the purposes of this report, the existing and new highway alignments are considered to operate in an east/west direction.

The existing highway corridor is surrounded predominately by heavily wooded areas. A quarry is located near the east end of the proposed new eastbound lanes, on the west side of Superior Shores Road.

Low lying swampy conditions were encountered at the west and east ends of the proposed highway corridor. Occasional knobby bedrock hills were observed between the lower lying areas. Welch Creek was encountered at the lowest elevation along the alignment, with wetland conditions within the creek valley.

Rugged and occasionally steep hills with bedrock at or near surface were observed starting approximately 500 m east of Welch Creek and increasing in elevation, reaching the highest point between two large bedrock hills approximately 3 km east of Welch Creek along the proposed alignment. The centerline runs along the valley bottom or near the bottom of the large bedrock hills.

Typical photographs of the site are included in Appendix K.

2.2 Regional Geology

Quaternary Geological mapping indicates that the proposed highway alignment crosses glaciolacustrine deposits consisting primarily of silt and clay with minor sand.

The bedrock in this area is mapped as Proterozoic conglomerate, sandstone, and shale of the Sibley Formation and Archean massive granodiorite to granite. Generally, low lying areas along the proposed alignment were mapped as Sibley formation. Zones of higher relief were typically mapped as Archean granodiorite to granite.

3. SITE INVESTIGATION AND FIELD TESTING

The scope of the preliminary foundation investigation consisted of a field drilling program of advancing 61 boreholes and 12 Dynamic Cone Penetration Tests (DCPTs) along the proposed highway alignment where high fill embankments (fills of 4.5 m height or greater), deep cuts (cuts of 4.5 m deep or deeper), swamp crossings, and culverts are planned. The field investigation was carried out in several phases between October 20, 2022 and May 24, 2023. The boreholes completed during this investigation, along with the investigation locations and assigned nomenclature are summarized in Table 3.1. Based on a review of the proposed highway profile and cross-section drawings provided by WSP, there are several other high fill embankment and

deep cut sections located along the new eastbound lanes (EBL) that were not investigated due to site access constraints and restrictions on entering private properties. As the proposed westbound lanes (WBL) will generally follow the existing Highway 11/17 alignment and grade, there were no new WBL high fill embankment or deep cut sections investigated. Only the areas investigated during this preliminary investigation are addressed in this report. In addition to the foundation investigation, Thurber conducted separate preliminary pavement and rock cut investigations, which are each discussed under separate covers.

Table 3.1: Summary of Investigation Program

Location and Assigned Nomenclature	Station (EBL)	Boreholes and DCPTs	Appendices
Swamp 1 (SW1)	24+550 to 24+650	SW1-01 to SW1-12	B1, B2
Deep Cut 1 (DC1)	24+720 to 24+790	DC1-01 to DC1-02	C1, C2
High Fill 1 (HF1)	24+950 to 25+990	HF1-01 to HF1-11	D1, D2
Deep Cut 2 (DC2)	26+080 to 26+175	DC2-01 to DC2-02	E1, E2
Swamp 2 (SW2)	27+850 to 28+240	SW2-01 to SW2-25	F1, F2
High Fill 6 (HF6)	28+925 to 29+825	HF6-01 to HF6-13	G1, G2
Welch Creek EBL Culvert (within HF1)	25+288 (at EBL centreline)	WC-EBL-01 to WC-EBL-04	D1, D2
Welch Creek WBL Culvert	25+588 (at WBL centreline)	WC-WBL-01 to WC-WBL-04	H1, H2

The locations of the boreholes and DCPTs are shown on the Borehole Locations and Soil Strata Drawings included in Appendix A. Details of the subsurface conditions encountered during the foundation investigation are presented in the Record of Borehole sheets in Appendices B1 to H1.

The centreline of the proposed new EBL and WBL alignments were surveyed and staked on site by WSP in advance of the drilling investigation. The borehole locations were established in the field based on measurements (stations and offset distances) from the staked centreline alignments. The horizontal coordinates and ground surface elevations at the borehole locations were established from the topographic data provided by WSP. The coordinate system MTM NAD83, Zone 15 was used. Utility clearances were obtained prior to the start of drilling.

The boreholes were advanced using a track-mounted drill rig with solid and hollow stem augers, wash boring with NW casing, and NQ coring methods, supplied and operated by RPM Drilling of Thunder Bay, Ontario. Standard Penetration Testing (SPT) was carried out in accordance with ASTM D1586 at selected depth intervals. Where cohesive soils were encountered, field vane

shear tests typically using an MTO “N” sized shear vane were conducted to measure the undrained shear strengths as per ASTM D2573.

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

The rock cores were logged, and the Total Core Recovery (TCR), Solid Core Recovery (SCR), Rock Quality Designation (RQD) and the Fracture Indices (FI) were determined.

Groundwater conditions were observed in the open boreholes throughout the drilling operation. Standpipe piezometers were installed in selected boreholes to permit measurement of groundwater levels at the site. All boreholes without a standpipe piezometer were backfilled upon completion of drilling in general accordance with O. Reg. 903. Piezometers were decommissioned as per O. Reg. 903 at the end of the field program.

4. LABORATORY TESTING

The recovered soil samples were subjected to visual identification (VI) and to natural moisture content determination. Selected samples were subjected to grain size distribution analyses (sieve and/or hydrometer), and Atterberg Limits testing. Rock core samples were subjected to Point Load Testing. Laboratory testing results are summarized on the Record of Borehole sheets included in Appendices B1 to H1, and presented on the figures included in Appendices B2 to H2 and I.

Selected soil samples for the proposed eastbound and westbound culvert locations at Welch Creek were submitted for analytical testing to assess the corrosion potential of soil on metal culverts and the potential for sulphate attack on subsurface concrete structures. The analyses were carried out by SGS Canada Inc. (SGS), an independent Canadian Association for Laboratory Accreditation (CALA) accredited laboratory. The results of the analytical testing are summarized in Section 6 and the laboratory Certificates of Analysis are included in Appendix J.

5. DESCRIPTION OF SUBSURFACE CONDITIONS

Subsurface conditions encountered during the foundation investigation are shown on the Borehole Locations and Soil Strata Drawings in Appendix A. Detailed descriptions of individual soil stratum are presented on the Record of Borehole sheets included in Appendices B1 to H1.

A general description of the soil stratigraphy for each location investigated is given below. However, the factual data presented on the Record of Borehole sheets takes precedence over

these general descriptions and must be used for interpretation of the site conditions. It should be recognized and expected that soil conditions may vary between and beyond borehole locations.

In general, the overburden soil across the site consists of topsoil overlying silty clay, silt, and sand deposits, typically coarsening with depth and proximity to bedrock. Granite was observed close to the ground surface in hilly areas, and Sibley Group sandstone was observed in lower lying areas.

5.1 Swamp 1 (SW1) (Sta. 24+550 to 24+650)

Eight (8) boreholes and four (4) DCPT Holes (SW-01 to SW-12) were advanced along the proposed EBL alignment between Stations 24+550 and 24+650. The boreholes and DCPT holes were advanced to depths from 9.6 m to 17.3 m (Elev. 219.8 m to 211.5 m). The locations of the boreholes and DCPTs are shown on the Borehole Locations and Soil Strata Drawings 2 to 4 included in Appendix A. The Record of Borehole Sheets are included in Appendix B1.

The soil conditions encountered generally consist of surficial peat deposits overlying silty clay, which occasionally became varved with depth. A layer of silt and localized deposits of sand to sand and silt with some gravel were encountered below the silty clay, overlying possible bedrock.

5.1.1 Peat

Peat was encountered at the ground surface in all SW1 boreholes. The peat thickness ranged from 0.8 to 2.0 m at the borehole locations (base Elev. from 228.4 to 227.1 m). Peat thickness may vary between and beyond the boreholes.

SPT 'N' values recorded in the peat ranged from 1 to 3 blows per 0.3 m penetration, indicating a very loose relative density. Natural moisture contents typically ranged from 88 to 541%.

5.1.2 Upper Silty Sand

A 1.0 to 2.2 m thick upper deposit of silty sand to sand with some silt and trace clay was encountered locally in Boreholes SW1-04 and SW1-06 below the surficial peat at a depth of 0.8 m (Elev. 228.4 to 228.3 m). The silty sand deposit extended to depths from 1.8 to 3.0 m (Elev. 227.3 to 226.1 m).

SPT 'N' values recorded in this deposit ranged from 0 to 9 blows per 0.3 m penetration, indicating a very loose to loose density. The natural moisture content was measured as approximately 22%.

The results of grain size analyses conducted on samples of the silty sand are provided on the Record of Borehole sheets in Appendix B1 and illustrated on Figure B1 of Appendix B2. The results are summarized as follows:

Soil Particle	Percentage (%)
Gravel	0
Sand	69 to 76
Silt	19 to 22
Clay	5 to 9

5.1.3 Silty Clay

A layer of silty clay containing trace to some sand and occasional sand seams was encountered throughout the site underlying the peat and silty sand deposits. The silty clay was encountered at depths ranging from 1.0 to 3.0 m (Elev. 228.3 to 226.1 m). The silty clay layer ranged in thickness from 5.9 to 10.3 m, and the base was encountered at depths ranging from 7.2 to 12.2 m (Elev. 222.2 to 216.9 m).

The silty clay contained occasional sand seams and became varved in Boreholes SW1-10 and SW1-12 at a depth of 5.6 m (Elev. 223.1 m). The varved conditions extended to depths from 9.4 to 11.0 m (Elev. 219.3 to 217.8).

SPT 'N' values recorded in the silty clay ranged from 0 to 9 blows per 0.3 m penetration. Field vane shear tests measured undrained shear strengths ranging from 28 kPa to 118 kPa. Based on the undrained shear strength values, the silty clay typically has a firm to very stiff consistency. The sensitivity of the silty clay based on the shear vane tests was typically 2 to 3 (medium sensitive), but ranged from 1.7 to 10 (low to extra sensitive). Natural moisture contents ranged from 16 to 51%.

The results of grain size analyses conducted on samples of the silty clay and varved silty clay are provided on the Record of Borehole sheets in Appendix B1 and illustrated on Figures B2 to B5 of Appendix B2. The results are summarized as follows:

Soil Particle	Percentage (%)	
	Silty Clay	Varved Silty Clay
Gravel	0	0
Sand	0 to 19	1 to 7
Silt	42 to 76	50 to 71
Clay	21 to 44	28 to 48

The results of the Atterberg Limits tests conducted on samples of the silty clay and varved silty clay are provided on the Record of Borehole sheets in Appendix B1 and illustrated on Figures B9 to B12 of Appendix B2. The results are summarized as follows:

Index Property	Percentage (%)
Liquid Limit	27 to 40
Plasticity Index	8 to 22

The results of the Atterberg Limits tests indicate that the silty clay ranges from low to intermediate plasticity (CL to CI).

5.1.4 Silt

A deposit of silt containing trace to some clay and trace to some sand was encountered underlying the silty clay at depths ranging from 7.2 m to 12.2 m (Elev. 222.2 m to 216.9 m) in all SW1 boreholes. Where fully penetrated, the silt deposit ranged in thickness from 3.0 to 4.5 m, with the base encountered at depths from 11.7 to 15.2 m (Elev. 217.6 to 213.8 m) upon the underlying sand to sand and silt deposit. Boreholes SW1-01, SW1-10, and SW1-12 were terminated within the silt at depths ranging from 11.3 to 15.8 m (Elev. 218.0 to 212.9 m). The DCPT at SW1-03 encountered refusal of 100 blows per 0.3 m penetration at a depth of 9.6 m (Elev. 219.8 m), which is inferred to be within the silt deposit.

SPT 'N' values recorded in the silt ranged from 5 to 49 blows per 0.3 m penetration, indicating a loose to dense relative density (typically compact). Natural moisture contents in the silt ranged from 17 to 29%.

The results of grain size analyses conducted on samples of the silt are provided on the Record of Borehole sheets in Appendix B1 and illustrated in Figure B6 and B7 of Appendix B2. The results are summarized as follows:

Soil Particle	Percentage (%)
Gravel	0 to 1
Sand	3 to 16
Silt	71 to 85
Clay	2 to 13

The results of the Atterberg Limits tests conducted on samples of the silt are provided on the Record of Borehole sheets in Appendix B1 and illustrated on Figure B13 of Appendix B2. The results are summarized as follows:

Index Property	Percentage (%)
Liquid Limit	19 to 23
Plasticity Index	1 to 5

The results of the Atterberg Limits testing indicate that the silt ranges from non-plastic to low plasticity (ML to CL-ML).

5.1.5 Lower Sand to Sand and Silt

A lower deposit of sand ranging to sand and silt with trace to some gravel was encountered below the silt deposit in Boreholes SW1-02, SW1-04, SW1-06, SW1-07, and SW1-08. The sand to sand and silt was encountered at depths from 11.7 to 15.2 m (Elev. 217.6 m to 213.8 m). The boreholes were all terminated due to auger refusal on possible bedrock at the base of the 0.3 to 2.6 m thick sand to sand and silt deposit, at depths ranging from 13.0 to 15.6 m (Elev. 216.4 to 213.5 m). The DCPTs at SW1-05, SW1-09 and SW1-11 encountered refusal of 100 blows or greater per 0.3 m penetration at depths ranging from 13.3 to 17.3 m (Elev. 216.0 to 211.5 m), which is inferred to be within or at the base of the sand to sand and silt deposit.

SPT 'N' values recorded in the sand to sand and silt deposit ranged from 8 to 44 blows per 0.3 m penetration, indicating a loose to dense relative density. Additional SPT 'N' values of greater than 50 blows per 0.3 m of penetration were recorded at the base of the boreholes due to split spoon refusal on possible bedrock. Natural moisture contents ranged from 9 to 23%.

The results of grain size analyses conducted on samples of the sand to sand and silt deposit are provided on the Record of Borehole sheets in Appendix B1 and illustrated on Figure B8 of Appendix B2. The results are summarized as follows:

Soil Particle	Percentage (%)
Gravel	0 to 18
Sand	40 to 86
Silt	28 to 41
Clay	1 to 3
Silt and Clay	8

5.1.6 Inferred Bedrock

The possible bedrock depth was inferred by reaching auger refusal in Boreholes SW1-02, SW1-04, SW1-06, SW1-07, and SW1-08, and DCPTs SW1-05, SW1-09 and SW1-11 at depths ranging from 13.0 to 17.3 m (Elev. 216.4 to 211.5 m)

5.1.7 Groundwater Conditions

The groundwater level was observed throughout drilling and a standpipe piezometer was installed in Borehole SW1-07 to monitor the groundwater table. The measured groundwater levels are summarized in Table 5.1 below.

Table 5.1: SW1 Groundwater Measurements

Borehole	Date	Water Level (m)		Remark
		Depth	Elevation	
SW1-01	February 27, 2023	7.6	221.7	Open Borehole
SW1-02	February 28, 2023	8.0	221.3	Open Borehole
SW1-04	March 2, 2023	5.8	223.4	Open Borehole
SW1-06	March 3, 2023	6.8	222.2	Open Borehole
SW1-07	March 15, 2023	5.5	223.5	Standpipe Piezometer
	March 28, 2023	5.4	223.6	
SW1-08	March 7, 2023	5.5	223.6	Open Borehole
SW1-10	March 9, 2023	3.7	225.0	Open Borehole
SW1-12	March 10, 2023	4.4	224.4	Open Borehole

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

5.2 Deep Cut 1 (DC1) (Sta. 24+720 to 24+790)

Two (2) boreholes (DC1-01 and DC2-02) were advanced along the proposed alignment between Station 24+720 to 24+790. The boreholes were advanced to depths of 0.5 and 3.4 m (Elev 234.7 and 230.4 m). The locations of the boreholes are shown on the Borehole Locations and Soil Strata Drawing 5 included in Appendix A. The Record of Borehole Sheets are included in Appendix C1.

The soil conditions encountered below the topsoil generally consist of sandy silt overlying a gravel deposit and inferred shallow bedrock.

5.2.1 Topsoil

Topsoil was encountered at the ground surface in both boreholes. The topsoil thickness ranged from 200 to 230 mm at the borehole locations. Natural moisture contents ranged from 36 to 42%. The topsoil thickness may vary between and beyond the boreholes.

5.2.2 Sandy Silt

A deposit of sandy silt with trace clay, gravel, and organics was encountered underlying the topsoil in Borehole DC1-02. The sandy silt was 2.1 m thick and extended to a depth of 2.3 m (Elev. 231.5 m).

SPT 'N' values ranging from 11 to 49 blows per 0.3 m penetration was recorded in the sandy silt, indicating a compact to dense relative density. The measured natural moisture contents ranged from 18 to 45%.

The results of a grain size analysis conducted on a sample of the sandy silt are provided on the Record of Borehole sheets in Appendix C1 and illustrated in Figure C1 of Appendix C2. The results are summarized as follows:

Soil Particle	Percentage (%)
Gravel	1
Sand	33
Silt	60
Clay	6

5.2.3 Gravel to Gravelly Sand

A gravel to gravelly sand deposit with trace to some silt and trace clay was encountered in both boreholes below the topsoil and sandy silt layers and overlying possible bedrock. The deposit ranged in thickness from 0.3 to 1.1 m and extended to depths of 0.5 m and 3.4 m (Elev. 234.7 and 230.4 m), where auger refusal on possible bedrock was encountered.

SPT 'N' values recorded in the gravel to gravelly sand layer ranged from 8 to 57 blows per 0.3 m penetration, indicating a loose to very dense relative density. Natural moisture contents ranged from 9 to 22%.

The results of a grain size analysis conducted on one sample of gravelly sand is provided on the Record of Borehole sheets in Appendix C1 and illustrated in Figure C2 of Appendix C2. The results are summarized as follows:

Soil Particle	Percentage (%)
Gravel	31
Sand	50
Silt and Clay	19

5.2.4 Inferred Bedrock

The possible bedrock depth was inferred by encountering auger refusal in both boreholes at depths of 0.5 m and 3.4 m (Elev. 234.7 and 230.4 m).

5.2.5 Groundwater Conditions

Groundwater conditions were observed during drilling operations in the DC1 section. The groundwater levels measured in the open boreholes upon borehole completion are summarized in Table 5.2 below.

Table 5.2: DC1 Groundwater Measurements

Borehole	Date	Water Level (m)		Remark
		Depth	Elevation	
DC1-01	March 27, 2023	Dry	Dry	Open Borehole
DC1-02	March 27, 2023	2.8	231.0	Open Borehole

Seasonal fluctuations of the groundwater levels are to be expected. The groundwater levels may be at a higher elevation after periods of significant or prolonged precipitation.

5.3 High Fill 1 (HF1) and Welch Creek EBL Culvert (Sta. 24+950 to 26+000)

Eleven (11) high fill boreholes (HF1-01 to HF1-11) and four (4) Welch Creek EBL culvert boreholes (WC-EBL-01 to WC-EBL-04) were advanced along the proposed eastbound alignment between Station 24+950 and 26+000. The four culvert boreholes were drilled within the Welch Creek valley near the proposed EBL culvert alignment and approach embankments. The boreholes were advanced to depths ranging from 2.9 to 20.7 m (Elev. 237.5 to 192.3 m). The locations of the boreholes are shown on the Borehole Locations and Soil Strata Drawings 6 to 8 and 17 included in Appendix A. The Record of Borehole Sheets are included in Appendix D1.

The soil conditions typically consist of topsoil overlying silty clay, which occasionally became varved with depth. A layer of silt was encountered below the silty clay, typically overlaying a sand deposit. Sibley Group sandstone bedrock was encountered below the overburden soils at the culvert boreholes.

5.3.1 Topsoil

Topsoil was encountered at the ground surface in all HF1 and EBL culvert boreholes. The soil was typically described as dark brown and contained occasional wood fragments. The topsoil thickness ranged from 25 mm to 600 mm at the HF1 borehole locations. In the EBL Culvert Boreholes, the topsoil thickness ranged from 100 mm to 900 mm. the topsoil thickness may vary between and beyond the boreholes.

SPT 'N' values recorded entirely in the topsoil ranged from 0 to 13 blows per 0.3 m penetration, indicating a very loose to compact relative density. Natural moisture contents ranged from 46 to 184%.

5.3.2 Silty Clay

A layer of silty clay containing trace to some sand and occasional sand and silt seams was encountered underlying the topsoil in all HF1 and EBL culvert boreholes, with the exception of Boreholes HF1-09 and HF1-11. Organics were also occasionally present within the upper 1 to

2 m of the silty clay. The silty clay ranged in thickness from 2.6 to 10.6 m. The base of this layer was encountered at depths ranging from 2.7 to 10.7 m (Elev. 225.8 to 205.6 m).

The silty clay became varved in Boreholes HF1-06, HF1-08, HF1-10, and WC-EBL-01 to WC-EBL-04 and depths from 1.4 to 3.0 m (Elev. 222.1 to 209.0 m) and continued to depths from 2.7 to 7.6 m (Elev. 229.3 to 205.6 m). Borehole HF1-10 was terminated upon auger refusal at the base of the varved silty clay at 6.1 m depth (Elev. 225.8 m).

SPT 'N' values recorded in the silty clay ranged from 0 to 17 blows per 0.3 m penetration. Field vane shear tests measured undrained shear strengths ranging from 36 kPa to greater than 120 kPa. Based on the undrained shear strength values, the silty clay typically has a firm to very stiff consistency. The sensitivity of the silty clay ranged from 1.5 to 3.3 (medium sensitive). Natural moisture contents ranged from 21 to 102%, but typically ranged from 30 to 50%.

The results of grain size analyses conducted on samples of the silty clay and varved silty clay are provided on the Record of Borehole sheets in Appendix D1, and illustrated on Figures D1 to D4 of Appendix D2. The results are summarized as follows:

Soil Particle	Percentage (%)	
	Silty Clay	Varved Silty Clay
Gravel	0	0
Sand	0 to 16	0 to 4
Silt	45 to 76	50 to 78
Clay	24 to 54	19 to 50

The results of the Atterberg Limits tests conducted on samples of the silty clay and varved silty clay are provided on the Record of Borehole sheets in Appendix D1 and illustrated on Figures D9 to D11 of Appendix D2. The results are summarized as follows:

Index Property	Percentage (%)	
	Silty Clay	Varved Silty Clay
Liquid Limit	28 to 55	26 to 42
Plasticity Index	10 to 28	7 to 22

The results of the Atterberg Limits tests indicate that the silty clay ranges from low to high plasticity (CL to CH), with non-plastic zones (ML to MH), and the varved silty clay ranges from low to intermediate plasticity (CL to CI), with non-plastic zones (CL-ML).

5.3.3 Silt

A deposit of silt, containing trace to some sand and trace to some clay was encountered below the silty clay in Boreholes HF1-01, HF1-03 to HF1-08, and WC-EBL-01 to WC-EBL-04. Sand

seams within the silt layer were observed in Borehole WC-EBL-04. The silt deposit was encountered at depths ranging from 2.7 to 10.2 m (Elev. 218.9 to 205.6 m). The thickness of the silt ranged from 1.3 to 6.0 m. The base of this deposit was encountered at depths ranging from 5.2 to 12.8 m (Elev. 216.9 to 201.4 m). Boreholes HF1-01, HF1-04, and HF1-06 were terminated within the silt at depths ranging from 6.1 to 12.8 m (Elev. 216.9 to 209.7 m) upon auger refusal on possible bedrock.

SPT 'N' values recorded in the silt typically ranged from 6 to 34 blows per 0.3 m penetration, indicating a relative density ranging from loose to dense. SPT 'N' values of greater than 100 blows per 0.3 m penetration were also encountered in Boreholes HF1-01, HF1-04, HF1-06, and HF1-08, typically upon the inferred bedrock surface. Natural moisture contents ranged from 11 to 30%.

The results of grain size analyses conducted on samples of the silt are provided on the Record of Borehole sheets in Appendix D1 and illustrated on Figure D5 of Appendix D2. The results are summarized as follows:

Soil Particle	Percentage (%)
Gravel	0
Sand	0 to 7
Silt	85 to 95
Clay	5 to 9

5.3.4 Sand to Silt and Sand

A deposit of sand ranging to silt and sand, containing trace gravel to gravelly and trace to some clay was encountered in Boreholes HF1-03, HF1-05, HF1-08, HF1-09, HF1-11, and WC-EBL-01. The sand to silt and sand deposit was typically encountered below the silt deposit, except locally at Boreholes HF1-09 and HF1-11 where it was encountered below the topsoil. Where fully penetrated, the thickness of the sand to silt and sand deposit ranged from 2.0 to 4.6 m and extended to depths from 2.9 to 10.8 m (Elev. 237.5 to 203.5 m). Boreholes HF1-05, HF1-08, HF1-09 and HF1-11 were terminated in the deposit upon auger refusal on possible bedrock at depths from 2.9 to 10.8 m (Elev. 237.5 m to 211.2 m).

SPT 'N' values recorded in the sand to silt and sand deposit ranged from 14 to greater than 100 blows per 0.3 m penetration, indicating a compact to very dense relative density. Natural moisture contents ranged from 8 to 27%.

The results of grain size analyses conducted on samples of the sand to silt and sand are provided on the Record of Borehole sheets in Appendix D1 and illustrated on Figures D6 and D7 of Appendix D2. The results are summarized as follows:

Soil Particle	Percentage (%)	
	Silt and Sand	Sand
Gravel	7 to 24	12 to 19
Sand	38 to 45	60 to 73
Silt	35 to 45	17
Clay	3 to 11	4
Silt and Clay	---	15 to 19

5.3.5 Sand and Gravel

A deposit of sand and gravel to gravel was encountered below the silt deposit in Boreholes HF1-07 and WC-EBL-01 to 04. The deposit contained trace to some silt and occasional cobbles and boulders of up to 400 mm in diameter. The top of the deposit ranged from 5.2 to 11.6 m (212.3 to 201.4 m). The deposit ranged in thickness from 0.2 m to 4.2 m and the base ranged from 11.9 to 14.9 m depth (Elev. 200.1 to 198.1 m). Borehole HF1-07 was terminated in the gravel deposit upon auger refusal on possible bedrock at a depth of 10.9 m (Elev. 212.1 m). A DCPT driven at the base of Borehole HF1-02 encountered refusal of 125 blows per 0.3 m of penetration at a depth of 16.3 m (Elev. 205.6 m), which is inferred to be within the sand and gravel deposit.

SPT 'N' values of 46 to greater than 100 blows per 0.3 m of penetration were recorded in the sand and gravel, indicating a very dense relative density, typically reaching refusal upon cobbles, boulders, or the underlying bedrock. Rock coring measures were frequently required to penetrate the deposit. Measured moisture contents in the sand and gravel ranged from 5 to 15%.

The results of a grain size analysis conducted on samples of the sand and gravel are provided on the Record of Borehole sheets in Appendix D1 and illustrated on Figure D8 of Appendix D2. The results are summarized as follows:

Soil Particle	Percentage (%)
Gravel	50
Sand	41
Silt and Clay	9

5.3.6 Bedrock and Inferred Bedrock

Bedrock was encountered underlying the overburden soils in Boreholes WC-EBL-01 to WC-EBL-03 at 11.9 to 14.9 m depth (Elev. 200.1 to 198.1 m). The bedrock was described as fresh sandstone of the Sibley Group. The rock is reddish brown with occasional quartz veins. The bedrock was proven by coring 3.0 to 5.8 m of bedrock in the boreholes.

The possible bedrock depth was also inferred by reaching auger refusal in Boreholes HF1-01, HF1-04, HF1-05, HF1-06, HF1-07, HF1-08, HF1-09, HF1-10, and HF1-11 at depths ranging from 2.9 to 12.8 m (Elev. 237.5 to 209.7 m). Generally, the bedrock surface appears to be lower near Welch Creek, and increases in an eastward direction at the eastern portion of the high fill HF1 area.

The Fracture Index (FI), measured as the total number of fractures per 0.3 m of rock core length, was typically between 0 and 3, and locally greater than 10 within the first 0.3 m of rock cored in Borehole WC-EBL-02. Total Core Recovery (TCR) values measured on recovered bedrock samples ranged from 96 to 100%. Solid Core Recovery (SCR) values ranged from 85 to 100%. Rock Quality Designation (RQD) values ranged from 85 to 100%, indicating excellent rock quality.

Estimated rock strength values were interpreted from Point Load Tests conducted on the rock cores. The average uniaxial compressive strength (UCS) values per core run from the point load tests ranged from 60 to 124 MPa, indicating that the bedrock is strong to very strong. The results of the point load tests and photographs of the rock core samples are presented in Appendix I.

5.3.7 Groundwater Conditions

Groundwater conditions were observed during drilling operations, and piezometers were installed in selected boreholes upon completion of drilling. The groundwater levels measured in the piezometers and in the open boreholes are summarized in Table 5.3 below.

Table 5.3: HF1 Groundwater Measurements

Borehole	Date	Water Level (m)		Remark
		Depth	Elevation	
HF1-01	March 24, 2023	Dry	Dry	Standpipe piezometer
	March 28, 2023	5.3	217.7	
	April 16, 2023	3.7	219.3	
HF1-02	March 23, 2023	Dry	Dry	Open borehole
HF1-03	March 29, 2023	9.3	212.7	Open borehole
HF1-04	March 30, 2023	7.3	214.7	Open borehole
HF1-05	April 11, 2023	7.5	214.5	Standpipe piezometer
	April 16, 2023	6.5	215.5	
	April 20, 2023	5.6	216.4	
	June 2, 2023	5.2	216.8	
HF1-06	April 11, 2023	0.0	222.5	Open borehole
HF1-07	April 19, 2023	6.0	217.0	Open borehole
HF1-08	April 19, 2023	0.4	223.1	Standpipe piezometer
	April 20, 2023	3.8	219.7	
HF1-09	April 18, 2023	1.2	223.6	Open borehole
HF1-10	April 15, 2023	1.2	230.6	Open borehole
HF1-11	April 15, 2023	0.0	242.3	Open borehole

Borehole	Date	Water Level (m)		Remark
		Depth	Elevation	
WC-EBL-02	March 28, 2023	-1.0	213.0	Standpipe piezometer
	April 16, 2023	-1.7	213.7	
WC-EBL-04	April 1, 2023	0.0	213.0	Standpipe piezometer
	April 12, 2023	0.0	213.0	
	April 15, 2023	-0.1	213.1	

Artesian pressure was noted in Boreholes WC-EBL-02 and WC-EBL-04, resulting in standpipe piezometer water level measurements that were above the ground surface (represented by negative depth values in Table 5.3).

Seasonal fluctuations of the groundwater levels are to be expected. The groundwater levels may be at a higher elevation after periods of significant or prolonged precipitation.

5.4 Deep Cut 2 (DC2) (Sta. 26+080 to 26+175)

Two boreholes (DC2-01 to DC2-02) were advanced along the proposed EBL alignment, from Stations 26+075 to 26+125. The boreholes were advanced to depths of 5.4 and 8.7 m (Elev. 252.1 and 243.7 m). The locations of the boreholes are shown on the Borehole Locations and Soil Strata Drawing 9 included in Appendix A. The Record of Borehole Sheets are included in Appendix E1.

The soil conditions encountered generally consisted of gravelly sand and sandy gravel overlying bedrock.

5.4.1 Gravelly Sand

A layer of gravelly sand was encountered at the ground surface in DC2-01. The gravelly sand contained trace to some silt and extended to a depth of 2.7 m (Elev. 249.7 m) below the ground surface.

SPT 'N' values of 32 to greater than 100 blows per 0.3 m of penetration were recorded in the gravelly sand indicating a dense to very dense relative density. Natural moisture contents of 6 to 14% were measured on samples of the gravelly sand.

The results of grain size analyses conducted on samples of the gravelly sand are provided on the Record of Borehole sheets in Appendix E1 and illustrated in Figure E1 of Appendix E2. The results are summarized as follows:

Soil Particle	Percentage (%)
Gravel	31 to 33
Sand	50 to 52
Silt and Clay	15 to 19

5.4.2 Sandy Gravel

A layer of sandy gravel with trace to some silt, trace clay and occasional cobbles and boulders was encountered at the ground surface in Borehole DC2-02 and below the gravelly sand at 2.7 m depth (Elev. 249.7 m) in Borehole DC2-01. The sandy gravel was 1.8 to 1.9 m thick and the base was encountered at depths of 1.8 to 4.6 m (Elev. 255.7 to 247.8 m).

SPT 'N' values ranged from 15 to 76 blows per 0.3 m of penetration, indicating that the sandy gravel is compact to very dense. Locally, one SPT reached refusal of greater than 100 blows per 0.3 m of penetration upon the bedrock surface in Borehole DC2-02. Natural moisture contents of 10 to 17% were measured on samples of the sandy gravel.

5.4.3 Sandy Silt

A 1.0 m thick layer of sandy silt with trace gravel, clay, and cobbles was encountered below the sandy gravel at a depth of 4.6 m (Elev. 247.8 m) and extended to the bedrock surface at 5.6 m (Elev. 246.8 m) in Borehole DC2-01.

An SPT 'N' value recorded in the sandy silt was greater than 100 blows per 0.075 m penetration, and was likely due to the presence of occasional cobbles within the deposit. The natural moisture content of the sandy silt was measured as 11%.

5.4.4 Bedrock

Bedrock was encountered underlying the overburden soils in at 5.6 and 1.8 m depth (Elev. 246.8 and 255.7 m) in Boreholes DC2-01 and DC2-02, respectively. The bedrock was described as slightly weathered to fresh, reddish-brown/grey granite. The bedrock appeared to slope downward generally towards the west. The bedrock was proven by coring each borehole from 3.1 to 3.6 m into the bedrock.

The Fracture Index (FI), measured as the total number of fractures per 0.3 m of rock core length, was typically between 0 and 4, and locally greater than 10 within the first 0.3 m of rock cored in Borehole DC2-02. Total Core Recovery (TCR) values measured on recovered bedrock samples ranged from 95 to 100%, with the majority of the TCR values equaling 100%. Solid Core Recovery (SCR) values ranged from 68 to 100%. Rock Quality Designation (RQD) values varied from 57 to 100% with most values exceeding 70% indicating fair to excellent quality (average of 83%).

Estimated rock strength values were interpreted from Point Load Tests conducted on the rock cores. The average uniaxial compressive strength (UCS) values per core run from the point load tests ranged from 177 to 190 MPa, indicating that the bedrock is very strong. The results of the point load tests and photographs of the rock core samples are presented in Appendix I.

5.4.5 Groundwater Conditions

Groundwater conditions were observed during drilling operations and a standpipe piezometer was installed in Borehole DC2-01 to measure the groundwater level upon completion of drilling. The groundwater levels measured in the piezometer and in the open boreholes upon borehole completion are summarized in Table 5.4 below.

Table 5.4: DC2 Groundwater Measurements

Borehole	Date	Water Level (m)		Remark
		Depth	Elevation	
DC2-01	April 14, 2023	0.7	251.7	Standpipe Piezometer
	April 16, 2023	0.3	252.1	
	April 20, 2023	0.4	252.1	
DC2-02	April 14, 2023	0.8	256.7	Open Borehole

Seasonal fluctuations of the groundwater levels are to be expected. The groundwater levels may be at a higher elevation after periods of significant or prolonged precipitation.

5.5 Swamp 2 (SW2) (Sta. 27+850 to 28+240)

Seventeen (17) boreholes and eight (8) DCPT holes (SW2-01 to SW2-25) were advanced along the proposed EBL alignment from Station 27+850 to 28+240. The boreholes and DCPTs reached depths from 0.3 to 14.2 m (Elev. 281.7 to 266.8 m). The locations of the boreholes and DCPTs are shown on the Borehole Locations and Soil Strata Drawings 10 to 13 included in Appendix A. The Record of Borehole Sheets are included in Appendix F1.

The soil conditions encountered typically consist of a thick surficial layer of peat underlain by sand, gravel and silt deposits. The boreholes typically encountered refusal on possible bedrock.

5.5.1 Upper Silty Sand to Sandy Silt

An upper layer of silty sand to sandy silt was encountered at the ground surface in Boreholes SW2-01 and SW2-02, located beyond the west end of the peat layer in the swamp, and below the peat in Borehole SW2-04 at a depth of 4.1 m (Elev. 276.9 m). The silty sand to sandy silt contained trace to some gravel and trace clay, as well as trace organics near the ground surface in Boreholes SW2-01 and SW2-02 and near the overlying peat in Borehole SW2-04. The

boreholes were each terminated in this layer upon auger refusal on possible bedrock at depths from 2.1 to 5.7 m (Elev 278.8 to 275.3 m).

SPT 'N' values recorded in the silty sand to sandy silt ranged from 8 to 145 blows per 0.3 m penetration, typically between 14 and 28. The 'N' values indicate that the deposit ranges from loose to very dense (typically compact). The natural moisture contents of the deposit ranged from 2 to 40%.

The results of grain size analyses conducted on samples of the silty sand to sandy silt are provided on the Record of Borehole sheets in Appendix F1 and illustrated on Figures F1 and F2 of Appendix F2. The results are summarized as follows:

Soil Particle	Percentage (%)	
	Silty Sand	Sandy Silt
Gravel	2 to 5	0
Sand	60 to 72	22
Silt	23 to 31	74
Clay	3 to 4	4

5.5.2 Peat

A deposit of peat was encountered at the ground surface in Boreholes SW2-04 to SW2-24, ranging in thickness from 2.2 to 8.4 m, with the base encountered at Elev. 279.7 to 272.6 m. The peat was described as brown to dark brown and fibrous, except at Borehole SW2-24, where the peat was described as amorphous with frequent fibrous layers.

SPT 'N' values recorded in the peat ranged from typically 0 to occasionally between 1 and 11 blows per 0.3 m of penetration. The 'N' values indicate that the peat was generally very loose, occasionally increasing in relative density to loose or compact. Locally in Borehole SW2-07, an 'N' value of 32 blows per 0.3 m of penetration was measured, likely due to the presence of a cobble or gravel directly above the underlying sand layer. Natural moisture contents measured in the peat ranged from 68 to 1672%.

5.5.3 Sand and Gravel to Sand, Some Gravel

A coarse-grained deposit ranging in composition from sand and gravel to sand, some gravel, with trace to some silt and trace clay was encountered below the peat in Boreholes SW2-06, SW2-07, SW2-08, SW2-10, SW2-12, SW2-13, SW2-14, SW2-19, SW2-20, SW2-22 and SW2-24 at depths from 2.2 and 8.4 m deep (Elev. 279.7 to 272.6 m). The deposit was also encountered at the ground surface in Borehole SW2-25, located beyond the east end of the peat in the swamp at

Elev. 282.0 m. The coarse deposit ranged in thickness from 0.1 to 4.2 m and extended to depths from 2.4 to 10.7 m (Elev. 279.6 to 270.3 m). All of the boreholes except for SW2-06 and SW2-10 were terminated at the base of the deposit upon auger or DCPT refusal on possible bedrock.

SPT 'N' values recorded in the sand and gravel to sand, some gravel typically ranged from 10 to greater than 100 blows per 0.3 m penetration, indicating a compact to very dense relative density. Natural moisture contents of 5 to 23%, were measured within the coarse deposit, with 281% and 126% measured locally in Boreholes SW2-19 and SW2-24 immediately below the peat layer.

The results of grain size analyses conducted on samples of the coarse deposit are provided on the Record of Borehole sheets in Appendix F1 and illustrated on Figures F3 to F5 of Appendix F2. The results are summarized as follows:

Soil Particle	Percentage (%)		
	Sand and Gravel	Gravelly Sand	Sand, Some Gravel
Gravel	35 to 51	21 to 31	12 to 18
Sand	37 to 56	51 to 71	76 to 84
Silt and Clay	7 to 14	8 to 18	4 to 11

5.5.4 Upper Sand

In Boreholes SW2-16 and SW2-18, the peat layer was underlain by a 1.2 to 1.5 m thick upper sand deposit, containing trace gravel, silt and clay. The base of the sand was encountered at 6.8 to 7.2 m depth (Elev. 275.2 to 274.8 m). SPT 'N' values recorded in the sand ranged from 4 to 56 blows per 0.3 m penetration, indicating that the deposit varies in relative density from loose to very dense. Natural moisture contents ranged from 15 to 21%.

The results of grain size analyses conducted on samples of the upper sand are provided on the Record of Borehole sheets in Appendix F1 and illustrated on Figure F6 of Appendix F. The results are summarized as follows:

Soil Particle	Percentage (%)
Gravel	5 to 9
Sand	82 to 86
Silt and Clay	9

5.5.5 Lower Silty Sand to Sandy Silt

A lower deposit of silty sand to sandy silt with trace to some gravel and clay was encountered below the sand and gravel and upper sand layers in Boreholes SW2-06, SW2-10, SW2-16 and SW2-18. The deposit was 1.5 to 6.1 m thick and extended to depths from 8.7 to 12.9 m (Elev. 273.3 to 268.4 m). Boreholes SW2-06, SW2-16 and SW2-18 were terminated in this deposit upon

auger refusal on possible bedrock. SPT 'N' values recorded in the lower silty sand to sandy silt ranged from 16 to 140 blows per 0.3 m penetration, indicating that the deposit varies compact to very dense. Natural moisture contents ranged from 8 to 21%.

The results of grain size analyses conducted on samples of the lower silty sand to sandy silt are provided on the Record of Borehole sheets in Appendix F1 and illustrated on Figure F7 of Appendix F. The results are summarized as follows:

Soil Particle	Percentage (%)
Gravel	2 to 19
Sand	40 to 67
Silt	21 to 36
Clay	2 to 5
Silt and Clay	44

5.5.6 Lower Sand

A 4 m thick lower sand deposit with some silt and trace gravel was encountered below the silty sand in Borehole SW2-10. The borehole was terminated at the base of the lower sand at a depth of 14.2 m (Elev. 266.8 m) upon auger refusal on possible bedrock. SPT 'N' values recorded in the lower sand ranged from 31 to 140 blows per 0.3 m penetration, indicating the deposit ranges from dense to very dense. The natural moisture content was 19 to 20%.

The results of a grain size analysis conducted on a sample of the lower sand are provided on the Record of Borehole sheets in Appendix F1 and illustrated on Figure F8 of Appendix F. The results are summarized as follows:

Soil Particle	Percentage (%)
Gravel	3
Sand	85
Silt and Clay	12

5.5.7 Inferred Bedrock

The possible bedrock depth was inferred by reaching auger or DCPT refusal in all of the SW2 boreholes and DCPTs. The inferred bedrock surface ranges from approximately 0.3 m (Elev. 281.7 m) to 14.2 (Elev. 266.8 m).

5.5.8 Groundwater Conditions

Groundwater conditions were observed during drilling operations and standpipe piezometers were installed in Boreholes SW2-04 and SW2-18 upon drilling completion. The groundwater levels measured in the piezometers and in the open boreholes upon borehole completion are

summarized in Table 5.5 below.

Table 5.5: SW2 Groundwater Measurements

Borehole	Date	Water Level (m)		Remark
		Depth	Elevation	
SW2-01	February 25, 2023	1.0	279.9	Open borehole
SW2-02	February 25, 2023	1.5	279.9	Open borehole
SW2-04	February 26, 2023	4.1	276.9	Standpipe piezometer
	March 28, 2023	0.5	280.5	
SW2-06	February 24, 2023	0.3	280.7	Open borehole
SW2-07	February 21, 2023	0.3	280.7	Open borehole
SW2-08	February 21, 2023	0.4	280.6	Open borehole
SW2-10	February 17, 2023	0.3	280.7	Open borehole
SW2-12	February 16, 2023	0.3	280.7	Open borehole
SW2-13	February 17, 2023	0.3	280.7	Open borehole
SW2-14	February 14, 2023	0.3	281.4	Open borehole
SW2-16	February 12, 2023	0.3	281.7	Open borehole
SW2-18	February 12, 2023	0.0	282.0	Standpipe piezometer
	February 27, 2023	0.0	282.0	
	February 26, 2023	0.0	282.0	
	February 28, 2023	---	---	Could not measure as water was Frozen
SW2-19	February 11, 2023	0.2	281.8	Open borehole
SW2-20	February 10, 2023	0.3	281.7	Open borehole
SW2-21	February 16, 2023	0.3	281.7	Open borehole
SW2-22	February 9, 2023	0.3	281.7	Open borehole
SW2-24	February 9, 2023	0.3	281.7	Open borehole
SW2-25	February 26, 2023	0.8	281.2	Open borehole

Seasonal fluctuations of the groundwater levels are to be expected. The groundwater levels may be at a higher elevation after periods of significant or prolonged precipitation.

5.6 High Fill 6 (HF6) (Sta. 28+925 to 29+825)

Thirteen (13) boreholes (HF6-01 to HF6-13) were advanced along the proposed EBL alignment high fill section between Station 28+925 to 29+825. The boreholes were drilled to depths from 2.3 to 15.8 m (Elev. 250.5 to 217.4 m). The locations of the boreholes are shown on the Borehole Locations and Soil Strata Drawings 14 to 16 included in Appendix A. The Record of Borehole Sheets are included in Appendix G1.

The soil conditions encountered below the topsoil generally consist of silts and sands overlying shallow bedrock near the western end of the high fill area, which decreases in elevation to the

east and ranges to silty clay typically overlying a lower silt and sand layers. Granite bedrock was encountered below the overburden materials at the western end of the site.

5.6.1 Topsoil

Topsoil was encountered at the ground surface in Boreholes HF6-02 to HF6-13. The measured thickness of the topsoil ranged from 50 to 900 mm. Natural moisture contents from 27 to 82% were measured within the topsoil. Topsoil thickness may vary between and beyond the boreholes.

5.6.2 Upper Sandy Silt to Silty Sand

An upper deposit of sandy silt to silty sand was observed at the ground surface or immediately below topsoil in Boreholes HF6-01 to HF6-05. The deposit often contained trace organics near the ground surface, trace to some gravel, trace to some clay and occasional cobbles. Locally, in Borehole HF6-02 the sandy silt is described as gravelly.

The upper sandy silt to silty sand was 0.8 to 3.1 m thick and the base was encountered at depths between 1.0 and 3.2 m (Elev 256.4 to 236.1 m).

SPT 'N' values recorded in the deposit ranged from 32 to greater than 100 blows per 0.3 m penetration, indicating a dense to very dense relative density. Natural moisture contents of the sandy silt to silty sand ranged from 3 to 29%.

The results of grain size analyses conducted on samples of the deposit are provided on the Record of Borehole sheets in Appendix G1 and illustrated on Figures G1 to G3 of Appendix G2. The results are summarized as follows:

Soil Particle	Percentage (%)		
	Sandy Silt	Silt and Sand	Silty Sand
Gravel	6 to 23	2	8
Sand	24 to 35	36	59
Silt	42 to 51	54	28
Clay	8 to 11	8	5

The results of an Atterberg Limits tests conducted on a sample of the silt and sand are provided on the Record of Borehole sheets in Appendix G1 and illustrated on Figure G11 of Appendix G2. The results are summarized as follows:

Index Property	Percentage (%)
Liquid Limit	19
Plastic Index	4

The results of the Atterberg Limits testing indicate that the silt and sand is non-plastic (ML).

5.6.3 Upper Silt

In Boreholes HF6-08 to HF6-10, the topsoil was underlain by a layer of silt with trace sand and trace clay, ranging to clayey silt with trace sand. The silt layer was 1.3 to 2.4 m thick, and the base was encountered at depths between 1.0 and 3.0 m (Elev 231.6 to 231.0 m).

SPT 'N' values recorded in the silt ranged from 6 to 13 blows per 0.3 m penetration, indicating a loose to compact or stiff consistency. Natural moisture contents of the silt ranged from 22 to 30%.

The results of grain size analyses conducted on samples of the silt are provided on the Record of Borehole sheets in Appendix G1 and illustrated on Figure G4 of Appendix G2. The results are summarized as follows:

Soil Particle	Percentage (%)
Gravel	0
Sand	3 to 4
Silt	81 to 87
Clay	10 to 15

The results of Atterberg Limits tests conducted on samples of the silt are provided on the Record of Borehole sheets in Appendix G1 and illustrated on Figure G11 of Appendix G2. The results are summarized as follows:

Index Property	Percentage (%)
Liquid Limit	22 to 24
Plastic Index	3 to 7

The results of the Atterberg Limits testing indicate that the silt ranges from non-plastic (ML) to slight plasticity (CL-ML).

5.6.4 Upper Sand and Gravel

An upper sand and gravel deposit ranging to gravelly sand was encountered below the upper sandy silt to silty sand deposit in Boreholes HF6-01, HF6-04 and HF1-05 at depths from 1.0 to 2.6 m (Elev. 256.4 to 236.1 m). The sand and gravel contained trace to some silt, trace clay, and occasional to frequent cobbles and boulders. The sand and gravel deposit was 1.3 to 3.5 m thick and extended to depths between 2.3 m and 6.1 m (Elev. 252.9 to 234.2 m).

The sand and gravel was typically very dense, based on SPT 'N' values of greater than 100 blows per 0.3 m penetration. Locally, an SPT 'N' value of 5 blows per 0.3 m penetration was recorded in a loose zone in Borehole HF6-01. Natural moisture contents of the sand and gravel ranged from 2 to 11%.

The results of grain size analyses conducted on samples of the sand and gravel are provided on

the Record of Borehole sheets in Appendix G1 and illustrated on Figure G5 of Appendix G2. The results are summarized as follows:

Soil Particle	Percentage (%)
Gravel	26 to 44
Sand	45 to 55
Silt and Clay	11 to 19

5.6.5 Silty Clay

A layer of silty clay was encountered below the topsoil in boreholes HF6-06 to HF6-07 and HF6-11 to HF6-13, and below the upper silt layer in Boreholes HF6-08 to HF6-10. The silty clay extended to depths from 1.8 to 15.8 m (Elev. 232.9 to 217.4 m).

Trace sand, trace gravel, and trace organics were noted within the silty clay layer. Occasional sand and silt seams were observed within the deposit.

Auger refusal on possible bedrock was encountered at the base of the silty clay in Boreholes HF6-12 and HF6-13, which were terminated at depths from 5.2 to 7.9 m (Elev. 227.8 to 225.1 m). The thickness of the silty clay layer ranged from 1.8 to 13.6 m.

SPT 'N' values recorded in the silty clay ranged from 0 to 16 blows per 0.3 m. Field vane shear tests measured undrained shear strengths ranging from 45 kPa to greater than 120 kPa. Based on the undrained shear strength values, the silty clay typically has a firm to very stiff consistency. The sensitivity of the silty clay ranged from 1.5 to 2.9 (low to medium sensitive). Natural moisture contents of the silty clay ranged from 25 to 42%.

The results of grain size analyses conducted on samples of the silty clay are provided on the Record of Borehole sheets in Appendix G1, and illustrated on Figures G6 and G7 of Appendix G2. The results are summarized as follows:

Soil Particle	Percentage (%)
Gravel	0
Sand	1 to 3
Silt	49 to 83
Clay	17 to 49

The results of Atterberg Limits testing conducted on samples of the silty clay are provided on the Record of Borehole sheets in Appendix G1 and illustrated in Figures G12 and G13 of Appendix G2. The results are summarized as follows:

Index Property	Percentage (%)
Liquid Limit	27 to 52
Plastic Index	8 to 26

The results of the Atterberg Limits testing indicate a low to high plasticity, typically low to

intermediate (CL to CI).

5.6.6 Lower Silt

A lower layer of silt, containing trace to some sand and clay, was encountered underlying the silty clay in Boreholes HF6-06 to HF6-09 and HF6-11, and within the silty clay layer in Boreholes HF6-10 and HF6-13. The silt layer ranged from 1.3 to 3.1 m in thickness and extended to depths between 4.9 and 14.8 m below ground surface (Elev. 229.9 to 218.5 m). Borehole HF6-09 was terminated at the base of the lower silt upon auger refusal on possible bedrock at a depth of 9.8 m (Elev. 224.0 m).

SPT 'N' values recorded in the silt ranged from 10 to 70 blows per 0.3 m penetration indicating a compact to very dense relative density. Natural moisture contents of the silt ranged from 3 to 63%, typically 16 to 31%.

The results of grain size analyses conducted on samples of the lower silt are provided on the Record of Borehole sheets in Appendix G1 and illustrated on Figure G8 of Appendix G2. The results are summarized as follows:

Soil Particle	Percentage (%)
Gravel	0
Sand	2 to 16
Silt	79 to 91
Clay	5 to 7

The results of Atterberg Limits testing conducted on a sample of the lower silt are provided on the Record of Borehole sheets in Appendix G1 and illustrated on Figure G11 of Appendix G2. The results are summarized as follows:

Index Property	Percentage (%)
Liquid Limit	22
Plastic Index	4

The results of the Atterberg Limits testing indicate that the silt is non-plastic (ML).

5.6.7 Lower Sand and Silt to Sand, Some Silt

A lower deposit of sand and silt ranging to sand with some silt was encountered below the upper sand and gravel in Borehole HF6-05, and below the lower silt layer in Boreholes HF6-06, HF6-08, and HF6-11. The sand and silt to sand, some silt also contained trace to some gravel and clay, occasional cobbles and occasional silt layers. Where fully penetrated, the deposit ranged in thickness from 1.1 to 2.3 m and extended to depths from 6.3 to 9.8 m (Elev. 231.9 to 224.2 m). Borehole HF6-11 was terminated within the deposit at a depth of 10.4 m (Elev. 222.6 m). Boreholes HF6-05 and HF6-08 were terminated at the base of the deposit upon auger

refusal on possible bedrock.

SPT 'N' values recorded in the lower sand and silt to sand, some silt ranged from 35 to greater than 100 blows per 0.3 m penetration indicating a dense to very dense relative density. Natural moisture contents ranged from 2 to 39%.

The results of a grain size analysis conducted on a sample of the lower sand and silt are provided on the Record of Borehole sheets in Appendix G1, and illustrated on Figure G9 of Appendix G2. The results are summarized as follows:

Soil Particle	Percentage (%)
Gravel	0
Sand	48
Silt	42
Clay	10

5.6.8 Lower Sand and Gravel

A lower sand and gravel deposit with trace silt was encountered below the lower sand in Borehole HF6-06 and below the lower silt in Borehole HF6-07. The sand and gravel deposit was 1.3 to 2.0 m thick, and both boreholes were terminated upon auger refusal on possible bedrock at depths of 8.5 to 9.2 m (Elev. 226.2 to 224.8 m) at the base of the deposit.

SPT 'N' values recorded in the sand and gravel ranged from 28 to greater than 100 blows per 0.3 m penetration, indicating a compact to very dense relative density. Natural moisture contents of the sand and gravel were approximately 8 to 9%.

The results of a grain size analysis conducted on a sample of the lower sand and gravel are provided on the Record of Borehole sheets in Appendix G1 and illustrated on Figure G10 of Appendix G2. The results are summarized as follows:

Soil Particle	Percentage (%)
Gravel	44
Sand	46
Silt and Clay	10

5.6.9 Bedrock and Inferred Bedrock

Bedrock was encountered underlying the soil overburden in Borehole HF6-01 at a depth of 6.1 m (Elev. 252.9 m). The bedrock was described as slightly weathered to fresh reddish brown and grey granite. The bedrock was proven by coring 2.8 m in total length to a depth of 8.9 m (Elev. 250.1 m).

The Fracture Index (FI), measured as the total number of fractures per 0.3 m of rock core length,

was typically between 1 and 5, and locally greater than 10 within the upper 0.3 m. Total Core Recovery (TCR) values measured on recovered bedrock samples was 100%. Solid Core Recovery (SCR) values ranged from 83 to 89%. Rock Quality Designation (RQD) values varied from 77 to 90%, indicating good to excellent rock quality.

Estimated rock strength values were interpreted from Point Load Tests conducted on the rock cores. The average uniaxial compressive strength (UCS) values per core run from the point load tests ranged from 222 to 237 MPa, indicating that the bedrock is very strong. The results of the point load tests and photographs of the rock core samples are presented in Appendix I.

5.6.10 Groundwater Conditions

Water levels were observed in the open boreholes and standpipe piezometers were installed in Boreholes HF6-03, HF6-06, and HF6-11 upon completion of drilling. The groundwater levels measured in the standpipe piezometers and in the open boreholes upon borehole completion are summarized in Table 5.6 below.

Table 5.6: HF6 Groundwater Measurements

Borehole	Date	Water Level (m)		Remark
		Depth	Elevation	
HF6-01	October 31, 2022	Dry	Dry	Open borehole
HF6-02	October 26, 2022	Dry	Dry	Open borehole
HF6-03	October 26, 2022	Dry	Dry	Standpipe piezometer
	October 30, 2022	Dry	Dry	
HF6-04	October 27, 2022	Dry	Dry	Open borehole
HF6-05	October 27, 2022	Dry	Dry	Open borehole
HF6-06	October 28, 2022	6.0	228.7	Standpipe piezometer
	October 30, 2022	4.2	230.5	
HF6-07	October 28, 2022	5.8	228.2	Open borehole
HF6-08	October 29, 2022	0.0	234.0	At ground surface
HF6-09	October 30, 2022	0.0	233.8	At ground surface
HF6-10	February 8, 2023	Dry	Dry	Open borehole
HF6-11	February 8, 2023	2.5	230.5	Standpipe piezometer
	February 11, 2023	3.7	229.3	
	February 17, 2023	5.2	227.8	
	February 27, 2023	5.5	227.5	
	March 28, 2023	5.7	227.3	
HF6-12	October 20, 2022	Dry	Dry	Open borehole
HF6-13	October 20, 2022	5.6	227.4	Open borehole

Seasonal fluctuations of the groundwater levels are to be expected. The groundwater levels may be at a higher elevation after periods of significant or prolonged precipitation.

5.7 Welch Creek WBL Culvert

Four (4) boreholes (WC-WBL-01 to WC-WBL-04) were advanced near the existing Highway 11/17 Welch Creek Culvert. The boreholes were drilled to depths from 14.8 to 20.4 m (Elev. 207.2 to 199.4 to m). The locations of the boreholes are shown on the Borehole Locations and Soil Strata Drawing 18 included in Appendix A. The Record of Borehole Sheets are included in Appendix H1.

The soil conditions encountered in the highway embankment consist of a pavement structure overlying sand and gravel fill, silty clay fill, and silty sand fill. Below the fill material and near the ends of the culvert, the native soils consisted of silty clay, overlying silt and sand and gravel deposits. Bedrock was encountered below the overburden soils in Borehole WC-WBL-02.

5.7.1 Asphalt

Asphalt was encountered in the boreholes advanced through the road surface (WC-WBL-03 and WC-WBL-04). The thickness of the asphalt was 150 mm at the borehole locations.

5.7.2 Sand and Gravel Fill

Sand and gravel embankment fill was encountered beneath the asphalt in Boreholes WC-WBL-03 and WC-WBL-04. The sand and gravel fill extended to depths of 2.3 to 2.4 m (Elev. 220.7 to 220.6 m).

SPT 'N' values recorded in the sand and gravel fill ranged from 23 to 85 blows per 0.3 m penetration indicating a compact to very dense relative density. Natural moisture contents of the sand and gravel ranged from 3 to 7%.

The results of a grain size analysis conducted on a sample of the sand and gravel fill are provided on the Record of Borehole sheets in Appendix H1 and illustrated on Figure H1 of Appendix H2. The results are summarized as follows:

Soil Particle	Percentage (%)
Gravel	42
Sand	43
Silt & Clay	15

5.7.3 Silty Clay Fill

Silty clay fill containing trace to some sand, trace gravel and occasional cobbles was encountered underlying the sand and gravel fill in Boreholes WC-WBL-03 and WC-WBL-04. The silty clay fill was encountered at 2.3 to 2.4 m depth (Elev. 220.7 to 220.6 m) and extended to a depth of 7.2 m (Elev. 215.8 m).

SPT 'N' values recorded in the fill ranged from 5 to 38 blows per 0.3 m penetration indicating a firm to hard consistency. Natural moisture contents of the silty clay fill ranged from 24 to 33%.

The results of a grain size analysis conducted on a sample of the silty clay fill are provided on the Record of Borehole sheets in Appendix H1, and illustrated on Figure H2 of Appendix H2. The results are summarized as follows:

Soil Particle	Percentage (%)
Gravel	0
Sand	5
Silt	44
Clay	51

5.7.4 Silty Sand Fill

The embankment fill also contained layers of silty sand fill, which was encountered at a depth of 2.7 m (Elev. 220.3 m) within the silty clay fill in Borehole WC-WBL-03, and beneath the silty clay fill in Borehole WC-WBL-04 at a depth of 7.2 m (Elev. 215.8 m). The silty sand fill contained some gravel and trace to some clay. The fill extended to depths of 4.9 and 8.7 m (Elev. 218.1 and 214.3 m).

SPT 'N' values recorded in the silty sand fill ranged from 28 to 30 blows per 0.3 m penetration indicating a compact relative density. Natural moisture contents of the silty sand fill ranged from 5 to 10%.

The results of a grain size analysis conducted on a sample of the silty sand fill are provided on the Record of Borehole sheets in Appendix H1, and illustrated on Figure H3 of Appendix H2. The results are summarized as follows:

Soil Particle	Percentage (%)
Gravel	15
Sand	54
Silt	20
Clay	11

5.7.5 Topsoil

Surficial layers of topsoil were encountered in Boreholes WC-WBL-01 and WC-WBL-02, which were drilled near the ends of the existing culvert at the base of the highway embankment. The topsoil thickness was measured as 75 mm in both boreholes. Measured moisture contents in the topsoil and the underlying organic rich silty clay ranged from 286 to 294%

5.7.6 Silty Clay

A layer of native silty clay was encountered underlying the topsoil and highway embankment fill materials. The silty clay was described as containing trace sand to sandy conditions and

contained trace organics, wood fragments and gravel near the top of the deposit. The silty clay became varved in Borehole WC-WBL-03 below 11.7 m depth (Elev. 211.3 m). The silty clay was encountered between 0.1 and 8.7 m depth (Elev. 215.3 to 214.3 m). Along the culvert alignment, the thickness of the native silty clay layer ranged from 2.9 to 5.5 m and the base was encountered between 3.0 to 12.2 m below ground surface (Elev. 212.4 to 209.6 m). At Borehole WC-WBL-03, which was drilled approximately 20 m east of the culvert through the approach embankment, the silty clay thickness was 11.1 m, with the base encountered at 18.3 m below the ground surface (Elev. 204.7 m).

SPT 'N' values of 1 to 12 blows per 0.3 m penetration, typically from 1 to 7 blows, were recorded in the silty clay. Field vane shear tests measured undrained shear strengths ranging from 67 kPa to greater than 120 kPa. Based on the SPT 'N' values and the undrained shear strength values, the silty clay ranges from a very soft to very stiff consistency. The sensitivity of the silty clay ranged from 1.6 to 2.7 (medium sensitive). The natural moisture contents were measured as 24 to 75% within samples of the clay. Locally in Boreholes WC-WBL-01 and -02, moisture contents from 286 to 294% were measured in silty clay samples rich with organics below the overlying topsoil.

The results of grain size analyses conducted on samples of the silty clay are provided on the Record of Borehole sheets in Appendix H1 and illustrated on Figure H4 of Appendix H2. The results are summarized as follows:

Soil Particle	Percentage (%)
Gravel	0
Sand	4 to 22
Silt	47 to 64
Clay	25 to 49

The results of the Atterberg Limits testing conducted on the silty clay are provided on the Record of Borehole sheets in Appendix H1 and illustrated in Figure H8 of Appendix H2. The results are summarized as follows:

Index Property	Percentage (%)
Liquid Limit	42 to 55
Plasticity Index	16 to 29

The results of the Atterberg Limits testing indicates that the clay ranges from intermediate to high plasticity (CI to CH).

5.7.7 Silt to Silt and Sand

A deposit of reddish-brown silt with trace to some sand and clay and trace gravel, ranging to silt and sand with trace clay, was encountered below the silty clay in Boreholes WC-WBL-01 to WC-WBL-03 at depths from 3.0 to 18.3 m (Elev. 212.4 to 204.7 m). The thickness of the silt to silt

and sand deposit ranged from 2.6 to 7.7 m and the base was encountered at depths of 13.3 and 5.6 m (Elev. 201.9 and 209.8 m) in Boreholes WC-WBL-01 and WC-WBL-02 respectively. Borehole WC-WBL-03 was terminated within the silt layer at a depth of 20.4 m (Elev. 202.6 m).

SPT 'N' values recorded in the silt to silt and sand ranged from 8 to 31 blows per 0.3 m penetration, indicating a loose to compact relative density. Natural moisture contents of the silt to silt and sand ranged from 15 to 24%.

The results of grain size analyses conducted on samples of the silt to silt and sand are provided on the Record of Borehole sheets in Appendix H1 and illustrated on Figures H5 and H6 of Appendix H2. The results are summarized as follows:

Soil Particle	Percentage (%)	
	Silt	Silt and Sand
Gravel	0 to 2	0
Sand	0 to 14	40
Silt	78 to 93	54
Clay	6 to 13	6

The results of Atterberg Limits testing conducted on a sample of the silt are provided on the Record of Borehole sheets in Appendix H1 and illustrated in Figure H9 of Appendix H2. The results are summarized as follows:

Index Property	Percentage (%)
Liquid Limit	21
Plastic Index	3

The results of the Atterberg Limits testing indicate that the silt is non-plastic (ML).

5.7.8 Sand and Gravel

A sand and gravel deposit was observed below the silt to silt and sand or silty clay units in Boreholes WC-WBL-01, WC-WBL-02, and WC-WBL-04. The sand and gravel to sand with some gravel contained trace to some silt and occasional cobbles. The deposit was encountered at depths between 5.6 and 13.3 m (Elev. 210.8 to 201.9 m). Boreholes WC-WBL-01 and WC-WBL-04 were terminated within this deposit at depths of 15.8 m below ground surface (Elev. 199.4 and 207.2 m). The sand and gravel deposit was 4.9 m thick in Borehole WC-WBL-02, where it was underlain by bedrock at a depth of 10.5 m (Elev. 204.9 m).

SPT 'N' values recorded in the sand and gravel ranged from 24 to 55 blows per 0.3 m penetration, indicating a compact to very dense relative density. Locally one SPT resulted in 100 blows per 0.025 m of penetration where coring methods were required to penetrate cobbles. Natural moisture contents of the sand and gravel ranged from 9 to 18%.

The results of a grain size analysis conducted on a sample of the sand and gravel are provided

on the Record of Borehole sheets in Appendix H1 and illustrated on Figure H7 of Appendix H2. The results are summarized as follows:

Soil Particle	Percentage (%)
Gravel	40
Sand	49
Silt and Clay	11

5.7.9 Bedrock

Bedrock was encountered below the sand and gravel in Borehole WC-WBL-02. The bedrock was cored from 10.5 m to 14.8 m depth (Elev. 204.9 to 200.6 m). The bedrock is described as Sibley Group Sandstone, which was reddish brown with occasional grey layers and was moderately to slightly weathered, decreasing with depth.

Fracture index (FI), measured as the total number of fractures per 0.3 m of rock core length, were typically between 0 and 3, occasionally increasing to or exceeding 10 fractures in rubble zones. Total Core Recovery (TCR) values measured on recovered bedrock samples ranged from 85 to 97%. Solid Core Recovery (SCR) values ranged from 65 to 94%. Rock Quality Designation (RQD) values varied from 50 to 94% indicating fair to excellent quality (average of 65%).

Estimated rock strength values were interpreted from Point Load Tests conducted on the rock core. The average uniaxial compressive strength (UCS) values per core run from the point load tests ranged from 60 to 94 MPa, indicating that the bedrock is strong. The results of the point load tests and photographs of the rock core samples are presented in Appendix I.

5.7.10 Groundwater Conditions

Standpipe piezometers were installed in Boreholes WC-WBL-01 and WC-WBL-02 upon completion of drilling. The groundwater levels measured in the piezometers are summarized in Table 5.7 below.

Table 5.7: WBL Groundwater Measurements

Borehole	Date	Water Level (m)		Remark
		Depth	Elevation	
WC-WBL-01	April 6, 2023	0.9	214.3	Standpipe piezometer
	April 13, 2023	0.5	214.7	
	April 16, 2023	-0.9	216.1	
	April 20, 2023	---	---	Frozen
WC-WBL-02	April 13, 2023	0.3	215.1	Standpipe piezometer
	April 16, 2023	-0.2	215.6	
	April 20, 2023	-0.3	215.6	
WC-WBL-03	May 24, 2023	4.8	218.2	Open borehole

Artesian pressure was noted in Boreholes WC-WBL-01 and WC-EBL-02, resulting in standpipe piezometer water level measurements that were above the ground surface (represented by negative depth values in Table 5.7).

Seasonal fluctuations of the groundwater levels are to be expected. The groundwater levels may be at a higher elevation after periods of significant or prolonged precipitation.

6. CORROSIVITY AND SULPHATE TEST RESULTS

Four soil samples taken from the proposed Welch Creek EBL and WBL culvert locations were submitted for analytical testing of corrosivity parameters and sulphate. The results of the analytical tests are summarized in Table 6.1 below and presented in Appendix J.

Table 6.1 Corrosivity Test Results

Parameter	Units	WC-EBL-01 SS4 (7.5'-9.5')	WC-EBL-03 SS3 (5'-7')	WC-WBL-02 SS3 (5'-7')	WC-WBL-04 SS3 (5'-7')
		Native Silty Clay, 2.3 to 2.9 m	Native Silty Clay, 1.5 - 2.1 m	Native Silty Clay, 1.5 - 2.1 m	Sand and Gravel Fill, 1.5 - 2.1 m
Redox Potential	mV	213	185	221	315
Resistivity	ohms.cm	7190	9260	1790	1230
Chloride	µg/g	2.5	5.5	350	490
Sulphate	µg/g	47	21	48	47
Sulphide	%	< 0.04	< 0.04	< 0.04	< 0.04
Conductivity	µS/cm	139	108	558	814
pH	-	8.38	7.41	5.93	9.53

7. CLOSURE

The field investigation was supervised on a full-time basis by Mr. Greg Stanhope, E.I.T., Mr. Felipe Kozminski, E.I.T, and Mr. Matthew Macaskill, E.I.T. of Thurber. Overall supervision of the field program was provided by Ms. Rachel Bourassa, E.I.T.

Interpretation of the field data and report preparation was carried out by Ms. Rachel Bourassa, E.I.T., and Mr. Mark Farrant, P.Eng. The report was reviewed by Mr. Jason Lee, P.Eng., a designated principal contact for MTO Foundations Projects.

Thurber Engineering Ltd.



Rachel Bourassa, E.I.T.
Geotechnical Engineering Intern



Mark Farrant, P.Eng.
Associate, Senior Geotechnical Engineer



Date: May 6, 2024
File: 21663

Jason Lee, P.Eng.
Partner, Designated MTO Contact

STATEMENT OF LIMITATIONS AND CONDITIONS

1. STANDARD OF CARE

This Report has been prepared in accordance with generally accepted engineering or environmental consulting practices in the applicable jurisdiction. No other warranty, expressed or implied, is intended or made.

2. COMPLETE REPORT

All documents, records, data and files, whether electronic or otherwise, generated as part of this assignment are a part of the Report, which is of a summary nature and is not intended to stand alone without reference to the instructions given to Thurber by the Client, communications between Thurber and the Client, and any other reports, proposals or documents prepared by Thurber for the Client relative to the specific site described herein, all of which together constitute the Report.

IN ORDER TO PROPERLY UNDERSTAND THE SUGGESTIONS, RECOMMENDATIONS AND OPINIONS EXPRESSED HEREIN, REFERENCE MUST BE MADE TO THE WHOLE OF THE REPORT. THURBER IS NOT RESPONSIBLE FOR USE BY ANY PARTY OF PORTIONS OF THE REPORT WITHOUT REFERENCE TO THE WHOLE REPORT.

3. BASIS OF REPORT

The Report has been prepared for the specific site, development, design objectives and purposes that were described to Thurber by the Client. The applicability and reliability of any of the findings, recommendations, suggestions, or opinions expressed in the Report, subject to the limitations provided herein, are only valid to the extent that the Report expressly addresses proposed development, design objectives and purposes, and then only to the extent that there has been no material alteration to or variation from any of the said descriptions provided to Thurber, unless Thurber is specifically requested by the Client to review and revise the Report in light of such alteration or variation.

4. USE OF THE REPORT

The information and opinions expressed in the Report, or any document forming part of the Report, are for the sole benefit of the Client. NO OTHER PARTY MAY USE OR RELY UPON THE REPORT OR ANY PORTION THEREOF WITHOUT THURBER'S WRITTEN CONSENT AND SUCH USE SHALL BE ON SUCH TERMS AND CONDITIONS AS THURBER MAY EXPRESSLY APPROVE. Ownership in and copyright for the contents of the Report belong to Thurber. Any use which a third party makes of the Report, is the sole responsibility of such third party. Thurber accepts no responsibility whatsoever for damages suffered by any third party resulting from use of the Report without Thurber's express written permission.

5. INTERPRETATION OF THE REPORT

- a) Nature and Exactness of Soil and Contaminant Description: Classification and identification of soils, rocks, geological units, contaminant materials and quantities have been based on investigations performed in accordance with the standards set out in Paragraph 1. Classification and identification of these factors are judgmental in nature. Comprehensive sampling and testing programs implemented with the appropriate equipment by experienced personnel may fail to locate some conditions. All investigations utilizing the standards of Paragraph 1 will involve an inherent risk that some conditions will not be detected and all documents or records summarizing such investigations will be based on assumptions of what exists between the actual points sampled. Actual conditions may vary significantly between the points investigated and the Client and all other persons making use of such documents or records with our express written consent should be aware of this risk and the Report is delivered subject to the express condition that such risk is accepted by the Client and such other persons. Some conditions are subject to change over time and those making use of the Report should be aware of this possibility and understand that the Report only presents the conditions at the sampled points at the time of sampling. If special concerns exist, or the Client has special considerations or requirements, the Client should disclose them so that additional or special investigations may be undertaken which would not otherwise be within the scope of investigations made for the purposes of the Report.
- b) Reliance on Provided Information: The evaluation and conclusions contained in the Report have been prepared on the basis of conditions in evidence at the time of site inspections and on the basis of information provided to Thurber. Thurber has relied in good faith upon representations, information and instructions provided by the Client and others concerning the site. Accordingly, Thurber does not accept responsibility for any deficiency, misstatement or inaccuracy contained in the Report as a result of misstatements, omissions, misrepresentations, or fraudulent acts of the Client or other persons providing information relied on by Thurber. Thurber is entitled to rely on such representations, information and instructions and is not required to carry out investigations to determine the truth or accuracy of such representations, information and instructions.
- c) Design Services: The Report may form part of design and construction documents for information purposes even though it may have been issued prior to final design being completed. Thurber should be retained to review final design, project plans and related documents prior to construction to confirm that they are consistent with the intent of the Report. Any differences that may exist between the Report's recommendations and the final design detailed in the contract documents should be reported to Thurber immediately so that Thurber can address potential conflicts.
- d) Construction Services: During construction Thurber should be retained to provide field reviews. Field reviews consist of performing sufficient and timely observations of encountered conditions in order to confirm and document that the site conditions do not materially differ from those interpreted conditions considered in the preparation of the report. Adequate field reviews are necessary for Thurber to provide letters of assurance, in accordance with the requirements of many regulatory authorities.

6. RELEASE OF POLLUTANTS OR HAZARDOUS SUBSTANCES

Geotechnical engineering and environmental consulting projects often have the potential to encounter pollutants or hazardous substances and the potential to cause the escape, release or dispersal of those substances. Thurber shall have no liability to the Client under any circumstances, for the escape, release or dispersal of pollutants or hazardous substances, unless such pollutants or hazardous substances have been specifically and accurately identified to Thurber by the Client prior to the commencement of Thurber's professional services.

7. INDEPENDENT JUDGEMENTS OF CLIENT

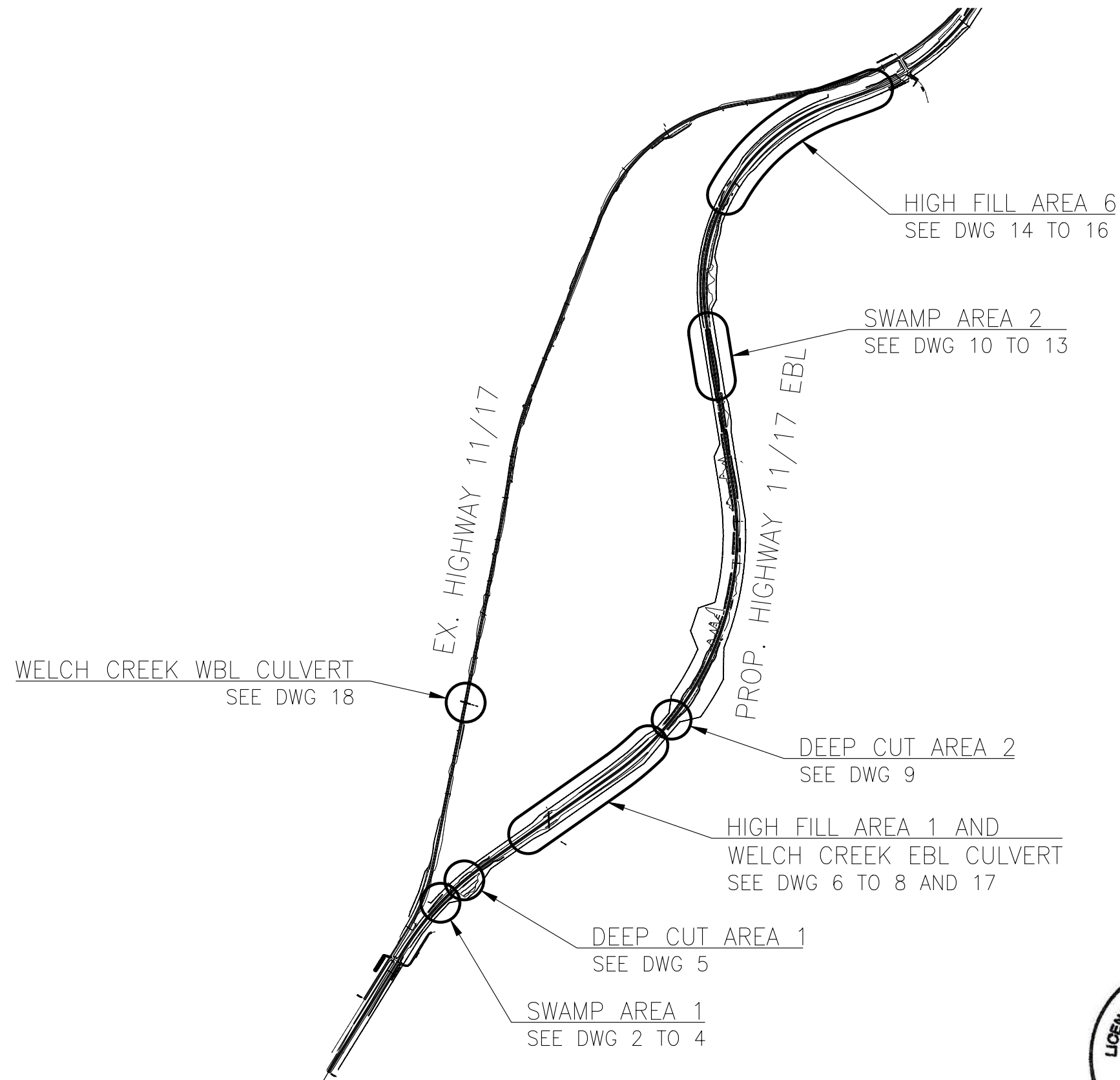
The information, interpretations and conclusions in the Report are based on Thurber's interpretation of conditions revealed through limited investigation conducted within a defined scope of services. Thurber does not accept responsibility for independent conclusions, interpretations, interpolations and/or decisions of the Client, or others who may come into possession of the Report, or any part thereof, which may be based on information contained in the Report. This restriction of liability includes but is not limited to decisions made to develop, purchase or sell land.



THURBER ENGINEERING LTD.

APPENDIX A

Stratigraphic Plan and Profile Drawings



PLAN

500 0 500 1000m

SCALE 1:25,000

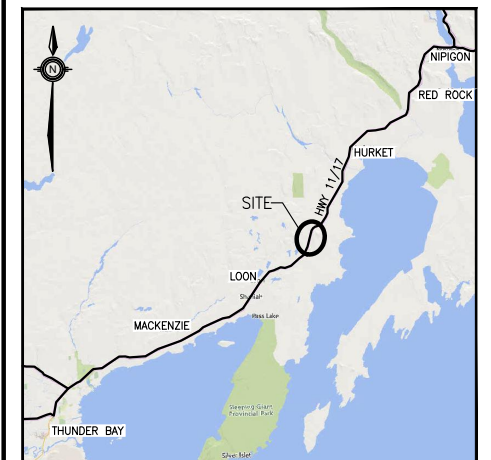
METRIC
DIMENSIONS ARE IN METRES
AND/OR MILLIMETRES
UNLESS OTHERWISE SHOWN

NO	ELEVATION	NORTHING	EASTING
HF1-09	224.8	5 395 621.4	406 405.7
HF1-10	231.8	5 395 672.3	406 460.8
HF1-11	242.3	5 395 725.9	406 513.2
HF6-01	259.0	5 398 512.5	406 876.4
HF6-02	253.7	5 398 584.3	406 921.8
HF6-03	246.8	5 398 636.4	406 960.5
HF6-04	241.9	5 398 693.4	407 009.3
HF6-05	238.2	5 398 746.5	407 062.3
HF6-06	234.7	5 398 795.4	407 119.1
HF6-07	234.0	5 398 837.6	407 181.0
HF6-08	234.0	5 398 878.3	407 243.8
HF6-09	233.8	5 398 913.3	407 309.9
HF6-10	233.3	5 398 945.1	407 377.8
HF6-11	233.0	5 398 970.9	407 448.2
HF6-12	233.0	5 398 996.1	407 518.8
HF6-13	233.0	5 399 022.3	407 589.1
SW1-01	229.3	5 394 838.1	405 371.1
SW1-02	229.3	5 394 831.4	405 378.5
SW1-03	229.4	5 394 844.8	405 363.7
SW1-04	229.2	5 394 856.5	405 388.0
SW1-05	229.4	5 394 849.6	405 395.3
SW1-06	229.0	5 394 863.3	405 380.7
SW1-07	229.0	5 394 874.6	405 405.2
SW1-08	229.1	5 394 867.7	405 412.4
SW1-09	229.0	5 394 881.5	405 398.1
SW1-10	228.7	5 394 892.4	405 422.8
SW1-11	228.9	5 394 885.4	405 429.8
SW1-12	228.8	5 394 899.5	405 415.7
SW2-01	280.9	5 397 466.4	406 818.7
SW2-02	281.4	5 397 492.7	406 824.6
SW2-03	281.0	5 397 489.5	406 804.8
SW2-04	281.0	5 397 515.8	406 810.7
SW2-05	281.0	5 397 542.1	406 816.6
SW2-06	281.0	5 397 538.9	406 796.9
SW2-07	281.0	5 397 565.2	406 802.8
SW2-08	281.0	5 397 591.4	406 808.6
SW2-09	281.0	5 397 588.2	406 788.9
SW2-10	281.0	5 397 614.5	406 794.8
SW2-11	281.0	5 397 640.8	406 800.7
SW2-12	281.0	5 397 637.6	406 780.9
SW2-13	281.0	5 397 663.9	406 786.8
SW2-14	281.7	5 397 690.2	406 792.7
SW2-15	281.9	5 397 687.0	406 773.0
SW2-16	282.0	5 397 713.2	406 778.9
SW2-17	282.0	5 397 739.5	406 784.8
SW2-18	282.0	5 397 736.3	406 765.0
SW2-19	282.0	5 397 762.6	406 770.9
SW2-20	282.0	5 397 788.9	406 776.8
SW2-21	282.0	5 397 785.7	406 757.0
SW2-22	282.0	5 397 812.0	406 762.9
SW2-23	282.0	5 397 838.2	406 768.9
SW2-24	282.0	5 397 835.1	406 749.1
SW2-25	282.0	5 397 851.5	406 756.7
WC-EBL-01	213.2	5 395 283.8	405 940.6
WC-EBL-02	212.0	5 395 265.4	405 959.6
WC-EBL-03	213.0	5 395 303.1	405 936.8
WC-EBL-04	213.0	5 395 306.8	405 973.3
WC-WBL-01	215.2	5 395 904.6	405 488.0
WC-WBL-02	215.4	5 395 892.4	405 555.3
WC-WBL-03	223.0	5 395 909.1	405 532.1
WC-WBL-04	223.0	5 395 885.8	405 523.6

CONT No
GWP No 129-90-00






HIGHWAY 11/17 REALIGNMENT
PEARL LAKE EASTERLY
OVERALL
SITE PLAN

SHEET



KEYPLAN

LEGEND

	Borehole
	Borehole and Cone
N	Blows /0.3m (Std Pen Test, 475J/blow)
CONE	Blows /0.3m (60° Cone, 475J/blow)
PH	Pressure, Hydraulic
	Water Level Upon Completion of Drilling
	Water Level in Monitoring Well/Piezometer
	Monitoring Well/Piezometer Screen
90%	Rock Quality Designation (RQD)
A/R	Auger Refusal

NO	ELEVATION	NORTHING	EASTING
DC1-01	235.2	5 394 950.0	405 498.6
DC1-02	233.8	5 394 994.8	405 551.8
DC2-01	252.4	5 395 785.9	406 566.1
DC2-02	257.5	5 395 820.9	406 594.5
HF1-01	223.0	5 395 183.3	405 797.3
HF1-02	221.8	5 395 218.2	405 864.5
HF1-03	222.0	5 395 355.6	406 042.9
HF1-04	222.0	5 395 398.7	406 104.3
HF1-05	222.0	5 395 441.8	406 165.7
HF1-06	222.5	5 395 484.9	406 227.1
HF1-07	223.0	5 395 528.1	406 288.3
HF1-08	223.5	5 395 573.3	406 348.2

-NOTES-

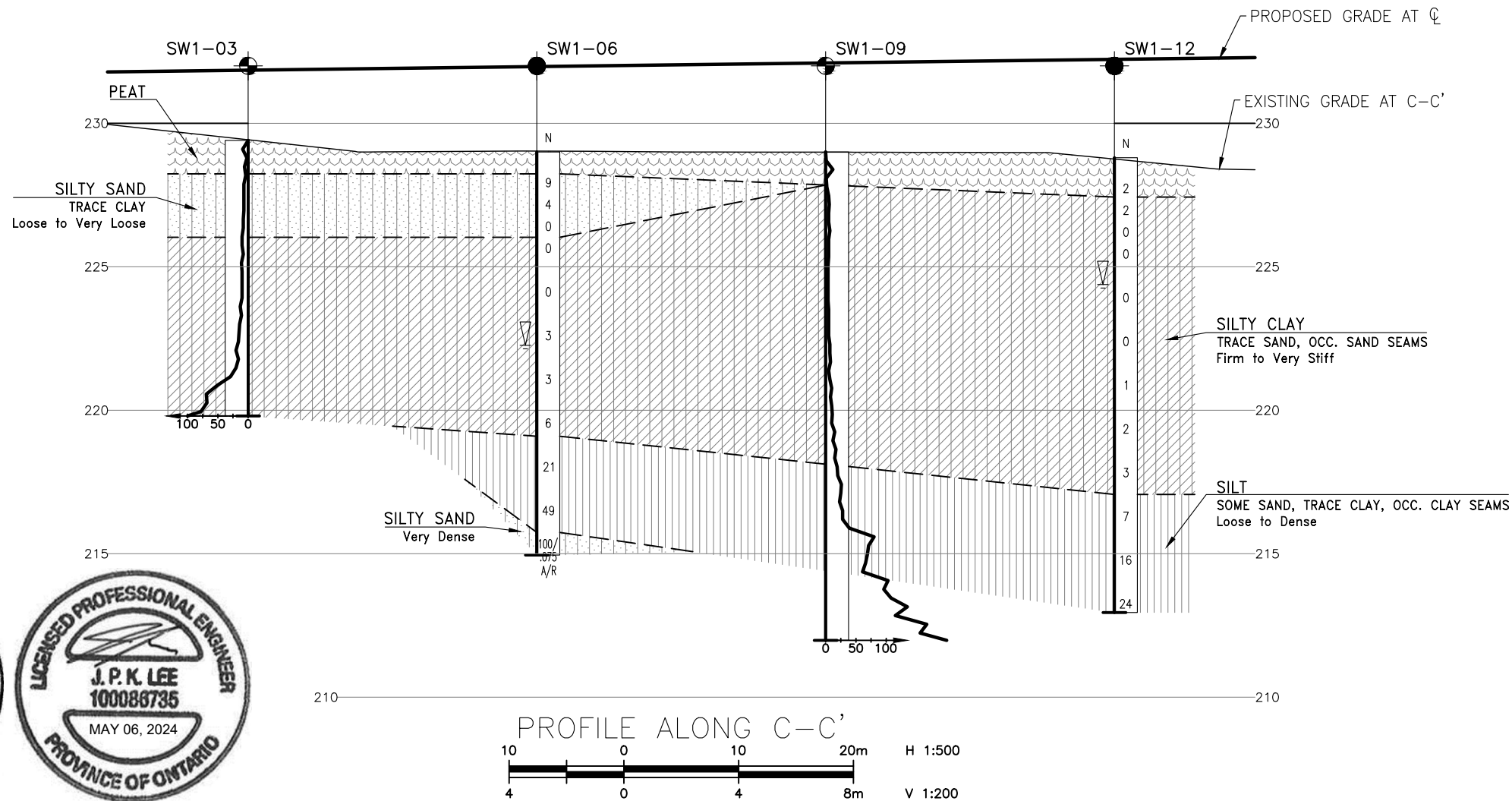
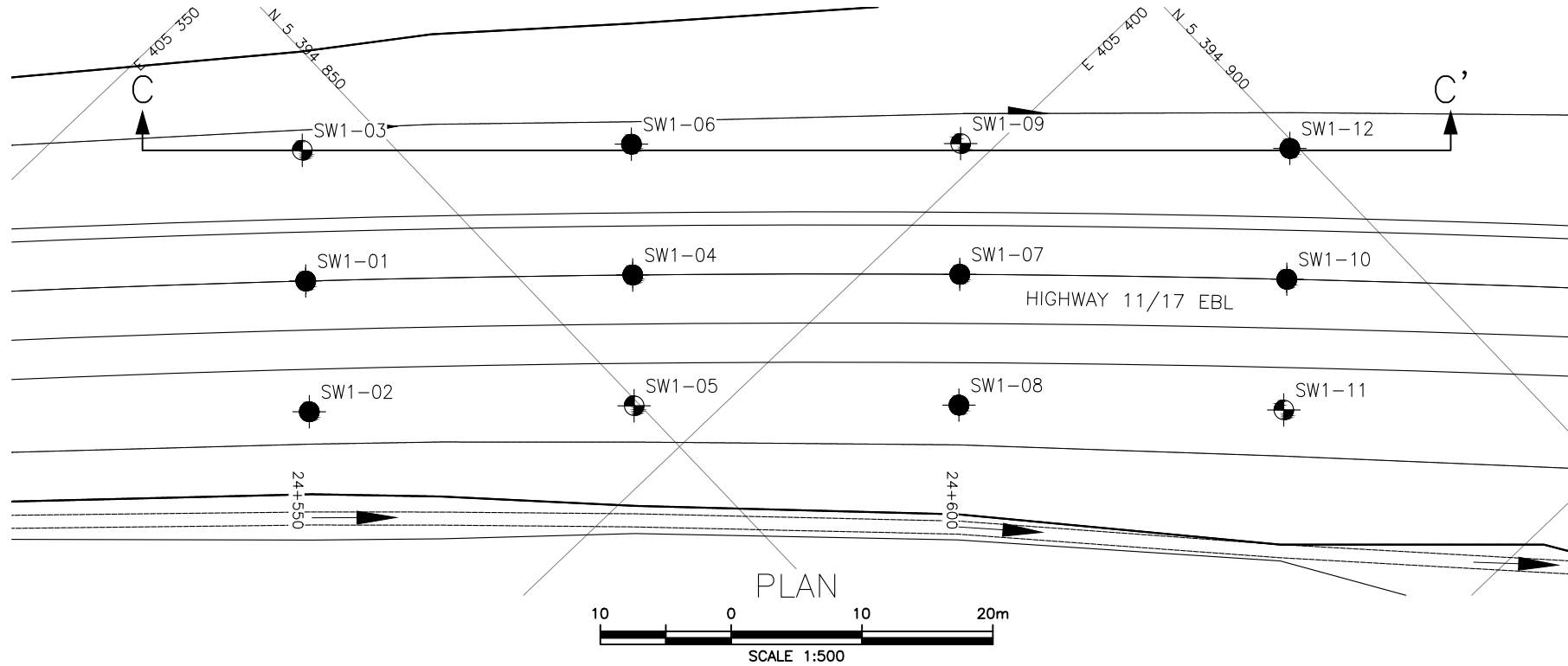
- 1) The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.
- 2) This drawing is for subsurface information only. Surface details and features are for conceptual illustration.
- 3) Coordinate system is MTM NAD 83 Zone 15.

GEOCRES No. 52A10-001



REVISIONS																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																			</
-----------	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	----

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

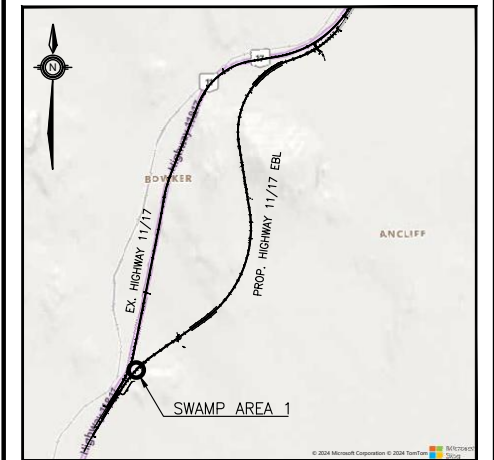


CONT No
GWP No 129-90-00

HIGHWAY 11/17 REALIGNMENT
PEARL LAKE EASTERLY
SWAMP AREA 1
BOREHOLE LOCATIONS AND SOIL STRATA



SHEET



KEYPLAN

LEGEND

●	Borehole
●	Borehole and Cone
N	Blows /0.3m (Std Pen Test, 475J/blow)
CONE	Blows /0.3m (60° Cone, 475J/blow)
PH	Pressure, Hydraulic
▽	Water Level Upon Completion of Drilling
▽	Water Level in Monitoring Well/Piezometer
┆	Monitoring Well/Piezometer Screen
90%	Rock Quality Designation (RQD)
A/R	Auger Refusal

NO	ELEVATION	NORTHING	EASTING
SW1-03	229.4	5 394 844.8	405 363.7
SW1-06	229.0	5 394 863.3	405 380.7
SW1-09	229.0	5 394 881.5	405 398.1
SW1-12	228.8	5 394 899.5	405 415.7

-NOTES-

- The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.
- This drawing is for subsurface information only. Surface details and features are for conceptual illustration.
- Coordinate system is MTM NAD 83 Zone 15.

GEOCRES No. 52A10-001








REVISIONS	DATE	BY	DESCRIPTION
DESIGN	RB	CHK -	CODE
DRAWN	MFA	CHK RB	SITE
LOAD		STRUCT	
DATE	MAY 2024		
DWG	2		



KEYPLAN

LEGEND

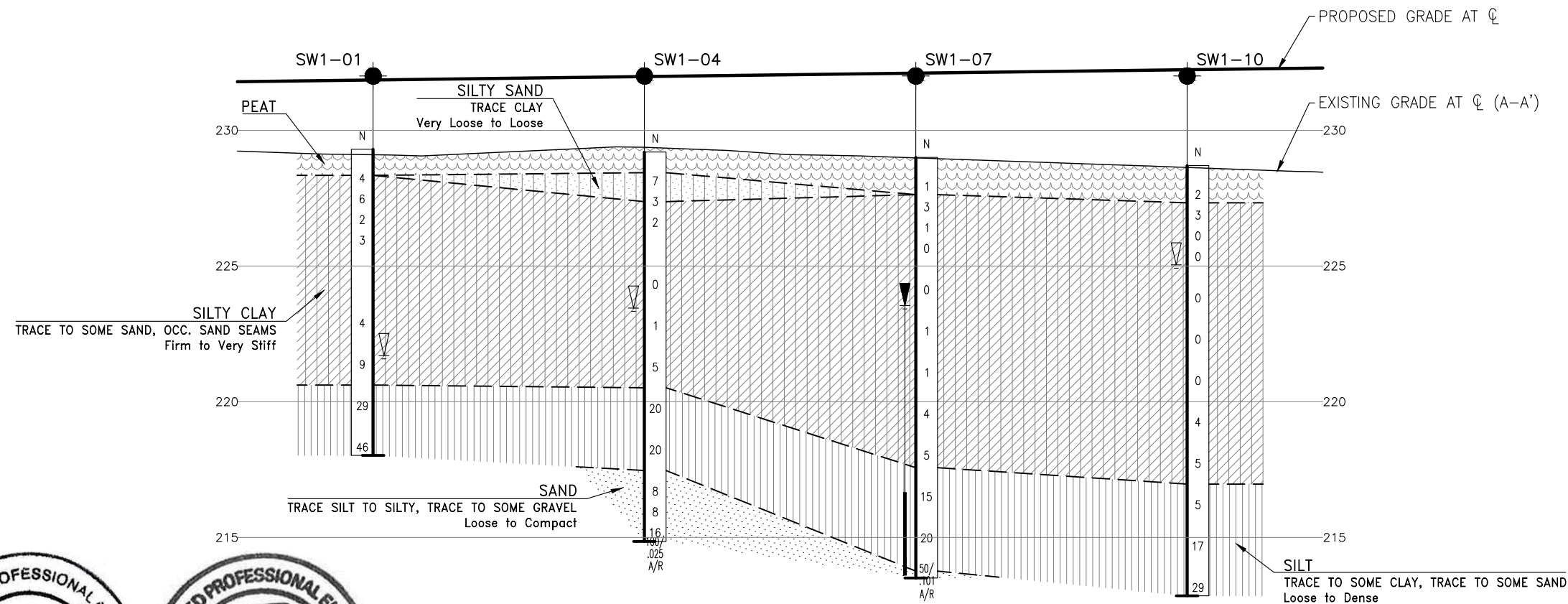
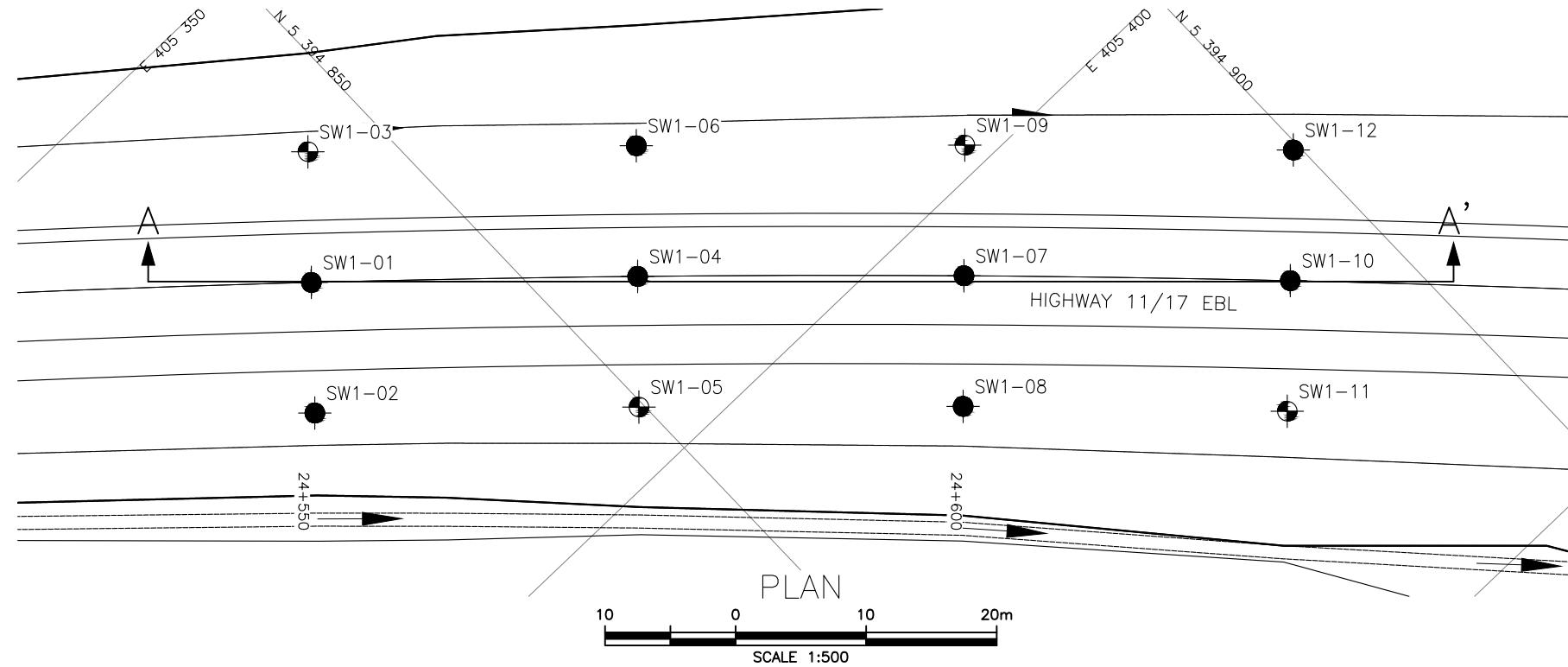
	Borehole
	Borehole and Cone
N	Blows /0.3m (Std Pen Test, 475J/blow)
CONE	Blows /0.3m (60° Cone, 475J/blow)
PH	Pressure, Hydraulic
	Water Level Upon Completion of Drilling
	Water Level in Monitoring Well/Piezometer
	Monitoring Well/Piezometer Screen
90%	Rock Quality Designation (RQD)
A/R	Auger Refusal

NO	ELEVATION	NORTHING	EASTING
SW1-01	229.3	5 394 838.1	405 371.1
SW1-04	229.2	5 394 856.5	405 388.0
SW1-07	229.0	5 394 874.6	405 405.2
SW1-10	228.7	5 394 892.4	405 422.8

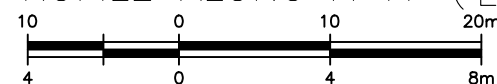
-NOTES-

- 1) The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.
- 2) This drawing is for subsurface information only. Surface details and features are for conceptual illustration.
- 3) Coordinate system is MTM NAD 83 Zone 15.

GEOCRES No. 52A10-001



PROFILE ALONG A-A' (C)



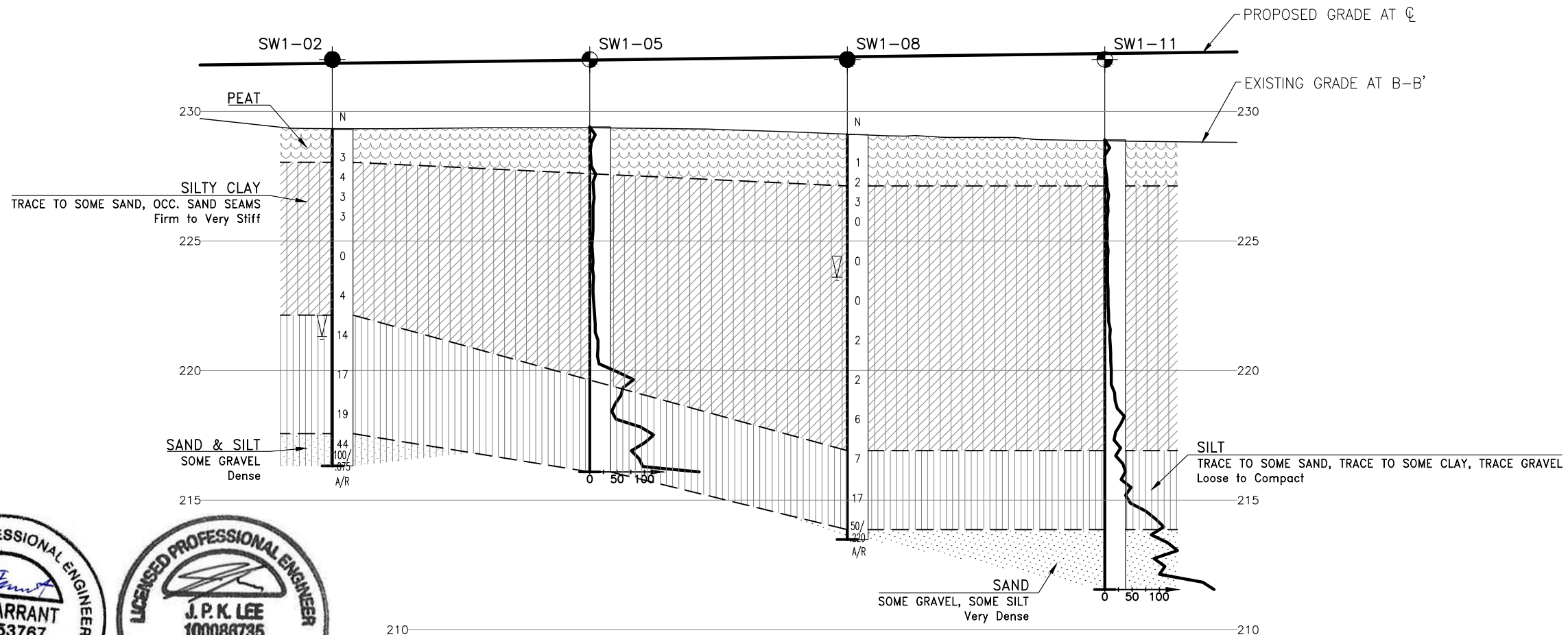
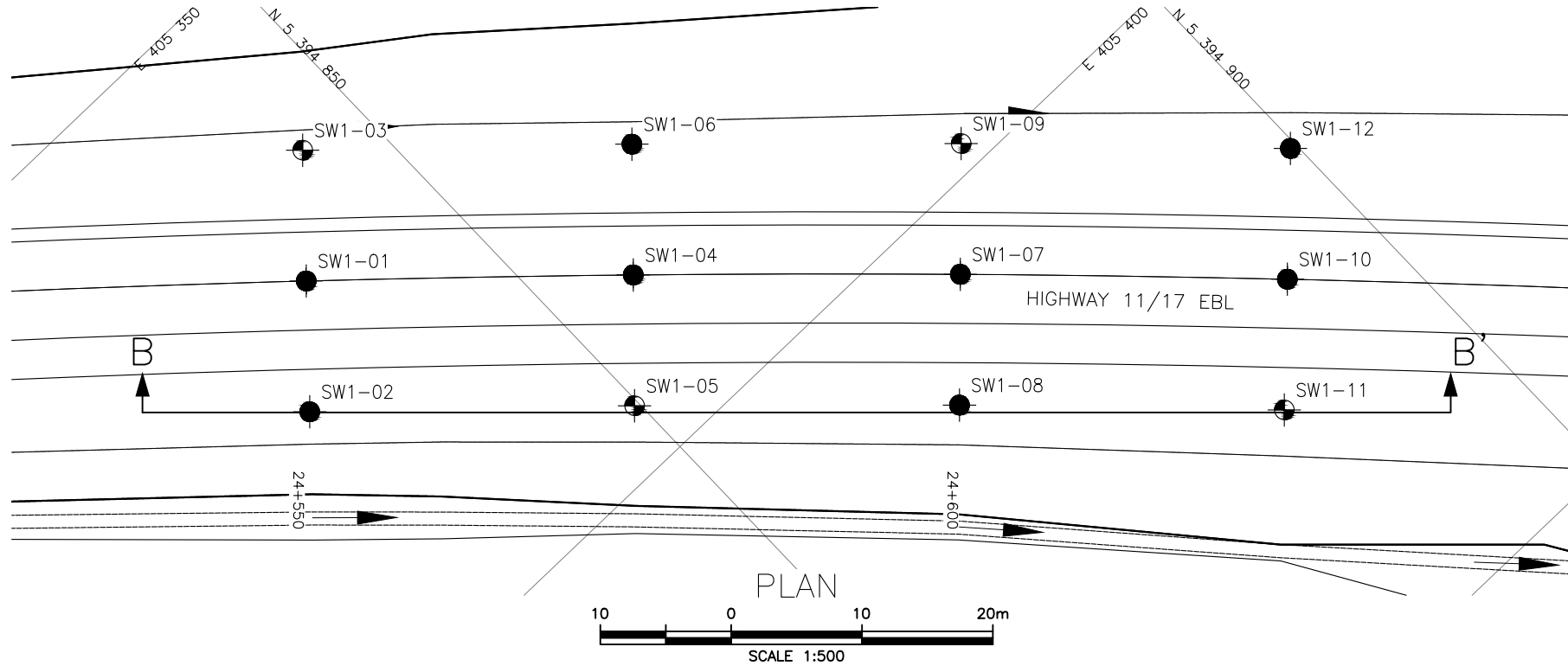
H 1:500

V 1:200



REVISIONS								
	DATE	BY			DESCRIPTION			
DESIGN	RB	CHK	-	CODE	LOAD	DATE	MAY 2024	
DRAWN	MFA	CHK	RB	SITE	STRUCT	DWG	3	

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

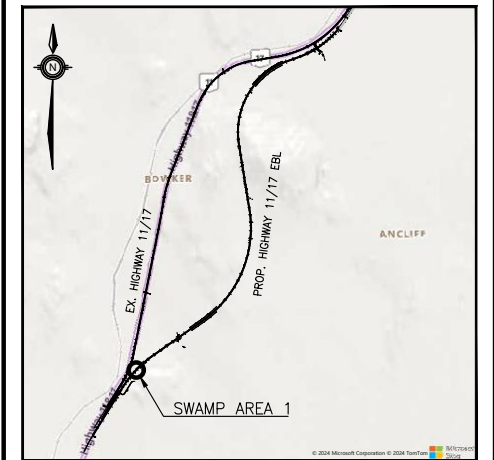


CONT No
GWP No 129-90-00

HIGHWAY 11/17 REALIGNMENT
PEARL LAKE EASTERLY
SWAMP AREA 1
BOREHOLE LOCATIONS AND SOIL STRATA



SHEET



KEYPLAN

LEGEND

●	Borehole
●	Borehole and Cone
N	Blows /0.3m (Std Pen Test, 475J/blow)
CONE	Blows /0.3m (60° Cone, 475J/blow)
PH	Pressure, Hydraulic
▽	Water Level Upon Completion of Drilling
▽	Water Level in Monitoring Well/Piezometer
—	Monitoring Well/Piezometer Screen
90%	Rock Quality Designation (RQD)
A/R	Auger Refusal

NO	ELEVATION	NORTHING	EASTING
SW1-02	229.3	5 394 831.4	405 378.5
SW1-05	229.4	5 394 849.6	405 395.3
SW1-08	229.1	5 394 867.7	405 412.4
SW1-11	228.9	5 394 885.4	405 429.8

-NOTES-

- The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.
- This drawing is for subsurface information only. Surface details and features are for conceptual illustration.
- Coordinate system is MTM NAD 83 Zone 15.

GEOCRES No. 52A10-001

REVISIONS	DATE	BY	DESCRIPTION

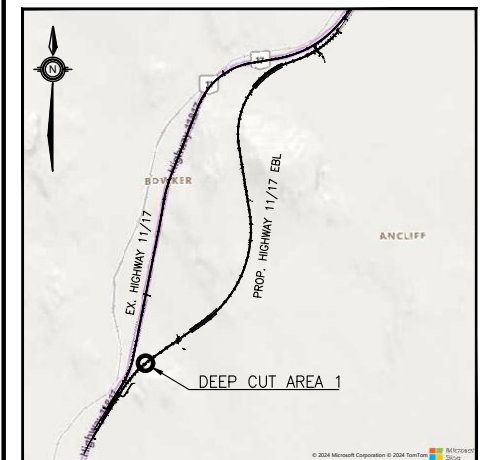
DESIGN	RB	CHK	-	CODE	LOAD	DATE	MAY 2024
DRAWN	MFA	CHK	RB	SITE	STRUCT	DWG	4

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

CONT No
GWP No 129-90-00






HIGHWAY 11/17 REALIGNMENT PEARL LAKE EASTERLY DEEP CUT AREA 1 BOREHOLE LOCATIONS AND SOIL STRATA	
---	--

SHEET



KEYPLAN

LEGEND

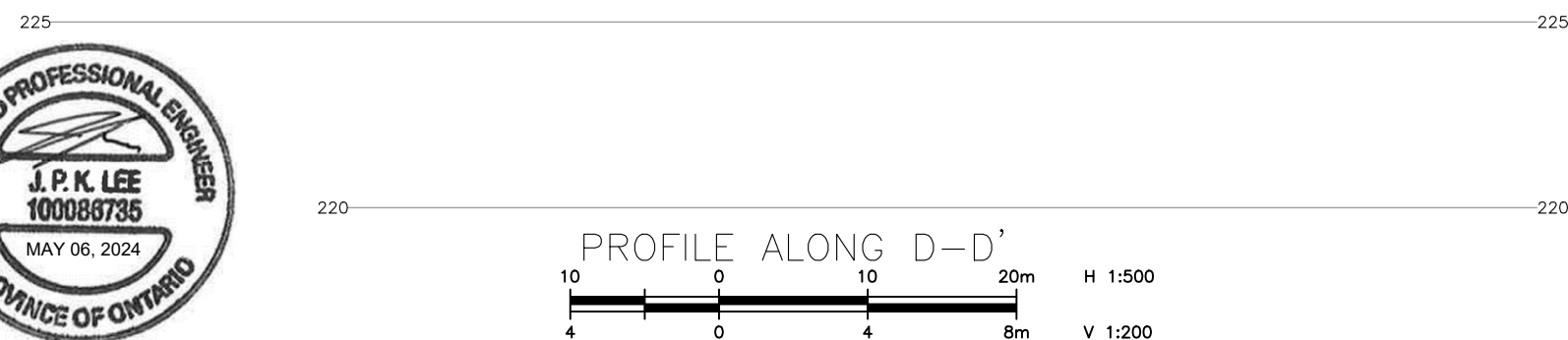
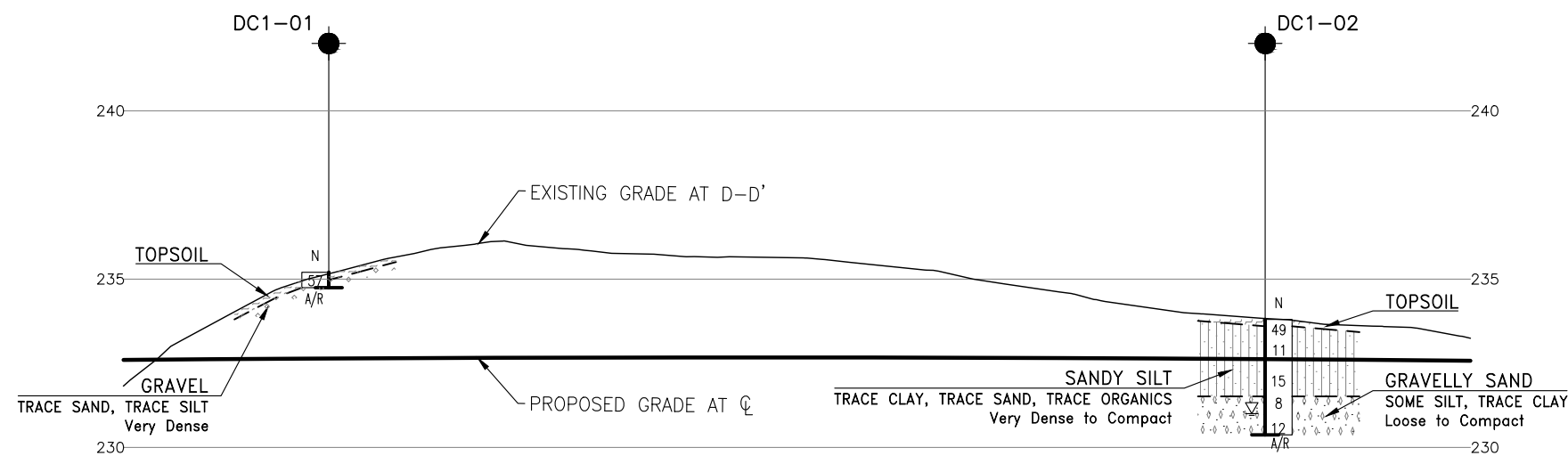
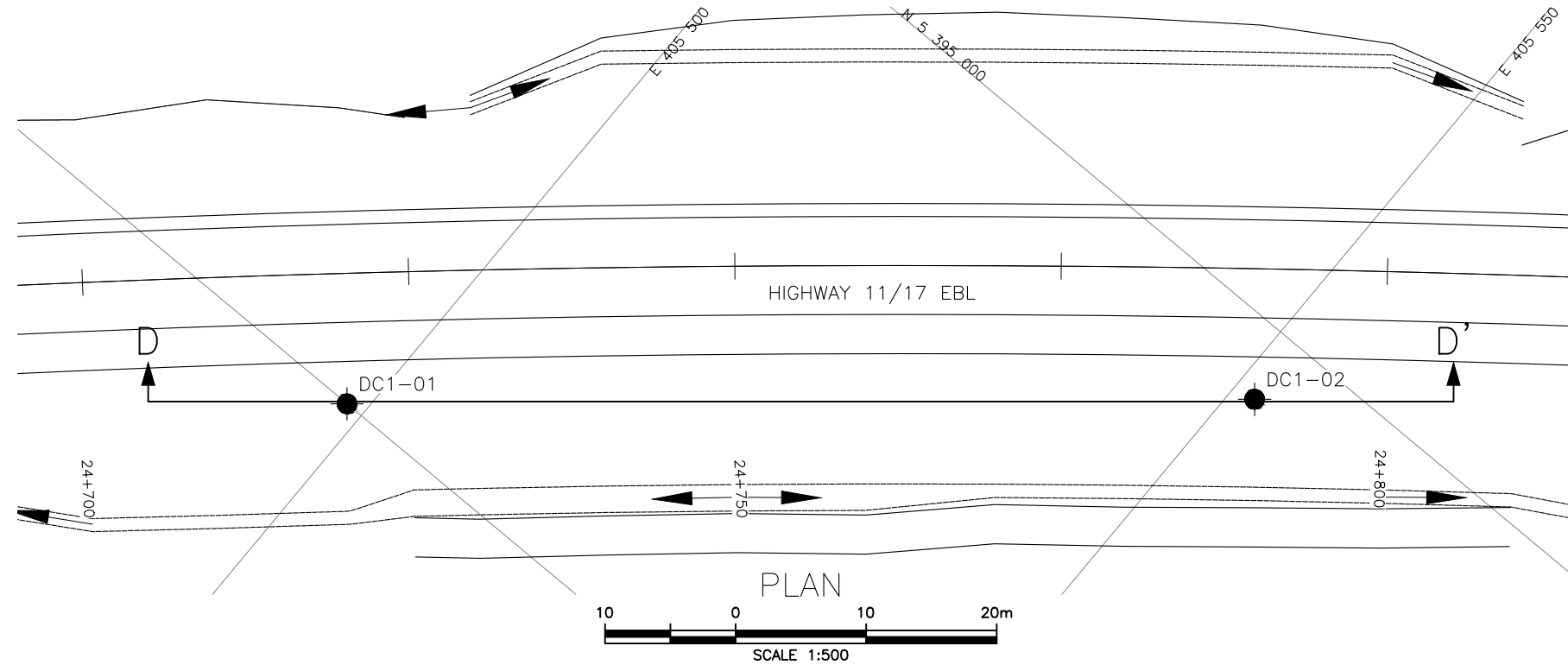
	Borehole
	Borehole and Cone
N	Blows /0.3m (Std Pen Test, 475J/blow)
CONE	Blows /0.3m (60° Cone, 475J/blow)
PH	Pressure, Hydraulic
	Water Level Upon Completion of Drilling
	Water Level in Monitoring Well/Piezometer
	Monitoring Well/Piezometer Screen
90%	Rock Quality Designation (RQD)
A/R	Auger Refusal

[illegible]

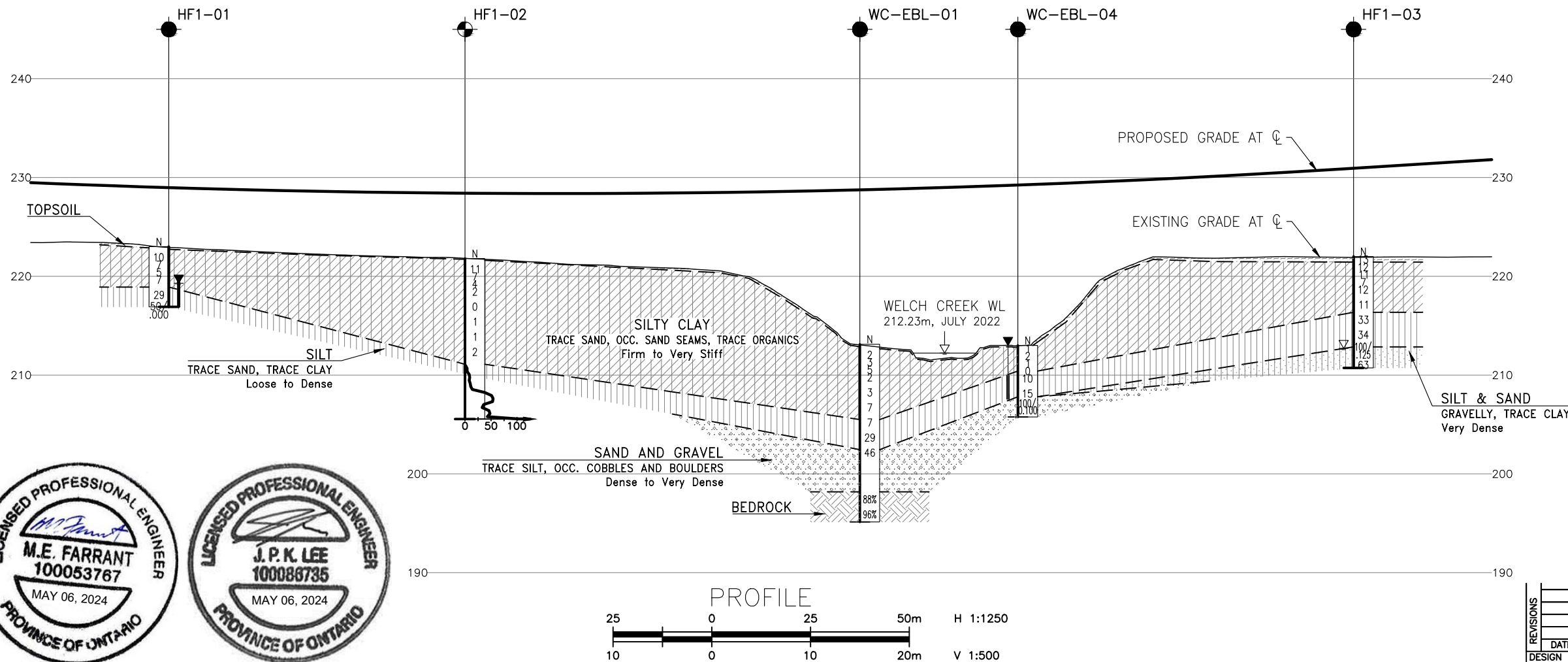
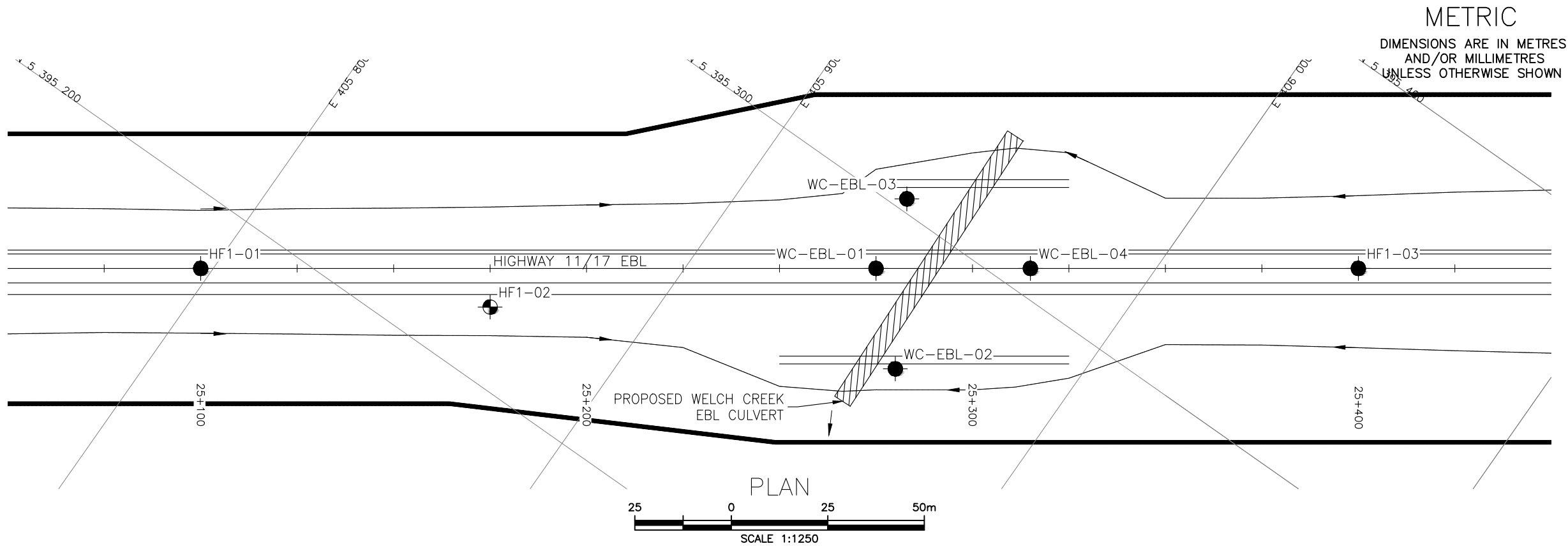
-NOTES-

- 1) The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.
- 2) This drawing is for subsurface information only. Surface details and features are for conceptual illustration.
- 3) Coordinate system is MTM NAD 83 Zone 15.

GEOCRES No. 52A10-001



REVISIONS							
	DATE	BY		DESCRIPTION			
DESIGN	RB	CHK	-	CODE	LOAD	DATE	MAY 2024
DRAWN	MFA	CHK	RB	SITE	STRUCT	DWG	5



CONT No
GWP No 129-90-00

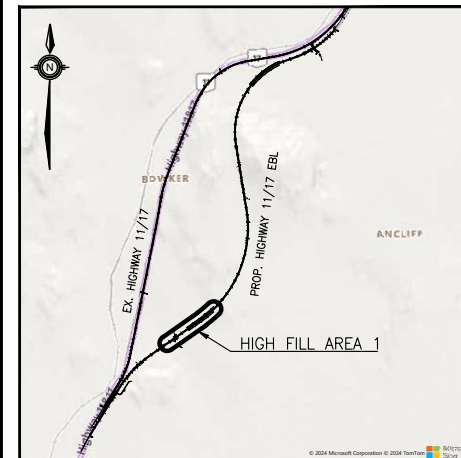
HIGHWAY 11/17 REALIGNMENT
PEARL LAKE EASTERLY
HIGH FILL AREA 1
BOREHOLE LOCATIONS AND SOIL STRATA



SHEET



THURBER ENGINEERING LTD.



KEYPLAN

LEGEND

●	Borehole
●	Borehole and Cone
N	Blows /0.3m (Std Pen Test, 475J/blow)
CONE	Blows /0.3m (60° Cone, 475J/blow)
PH	Pressure, Hydraulic
▽	Water Level Upon Completion of Drilling
▽	Water Level in Monitoring Well/Piezometer
⊥	Monitoring Well/Piezometer Screen
90%	Rock Quality Designation (RQD)
A/R	Auger Refusal

NO	ELEVATION	NORTHING	EASTING
HF1-01	223.0	5 395 183.3	405 797.3
HF1-02	221.8	5 395 218.2	405 864.5
HF1-03	222.0	5 395 355.6	406 042.9
WC-EBL-01	213.2	5 395 283.8	405 940.6
WC-EBL-02	212.0	5 395 265.4	405 959.6
WC-EBL-03	213.0	5 395 303.1	405 936.8
WC-EBL-04	213.0	5 395 306.8	405 973.3

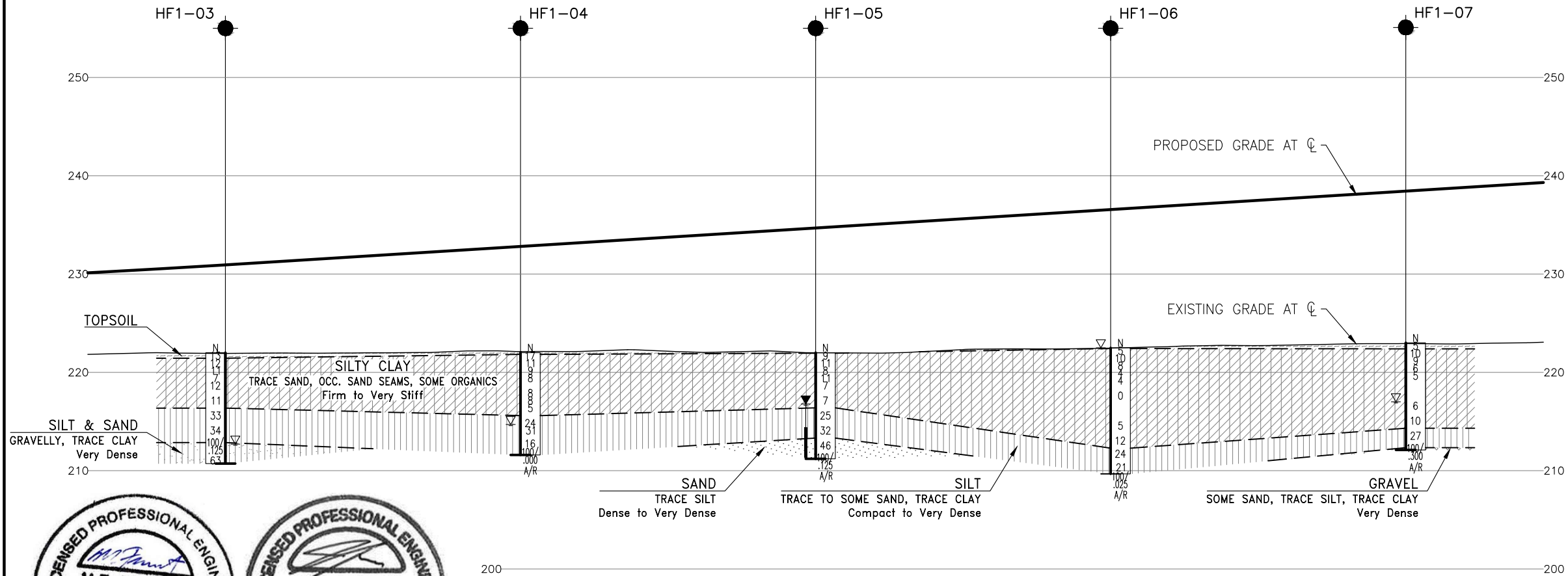
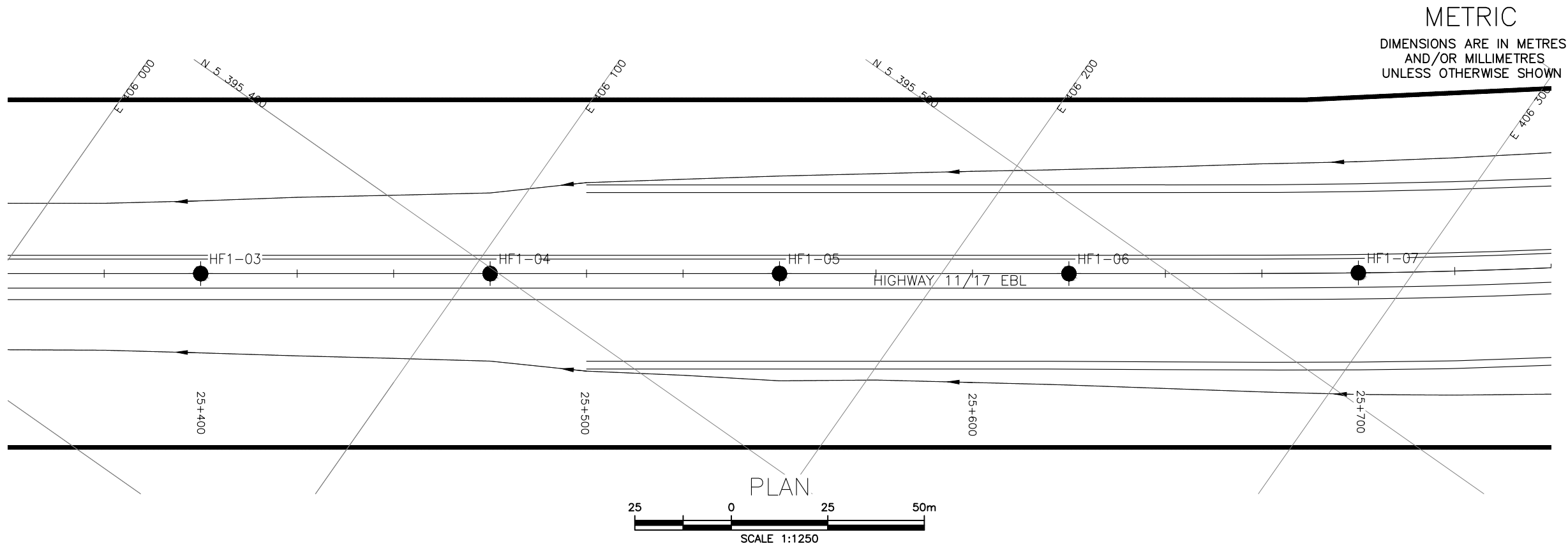
-NOTES-

- The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.
- This drawing is for subsurface information only. Surface details and features are for conceptual illustration.
- Coordinate system is MTM NAD 83 Zone 15.

GEOCRES No. 52A10-001



REVISIONS	DATE	BY	DESCRIPTION
DESIGN	RB	CHK -	CODE
DRAWN	MFA	CHK RB	SITE
			LOAD
			STRUCT
			DWG 6
			DATE MAY 2024



CONT No
GWP No 129-90-00

HIGHWAY 11/17 REALIGNMENT
PEARL LAKE EASTERLY
HIGH FILL AREA 1
BOREHOLE LOCATIONS AND SOIL STRATA

SHEET



KEYPLAN

LEGEND

- Borehole
- Borehole and Cone
- N Blows /0.3m (Std Pen Test, 475J/blow)
- CONE Blows /0.3m (60° Cone, 475J/blow)
- PH Pressure, Hydraulic
- Water Level Upon Completion of Drilling
- Water Level in Monitoring Well/Piezometer
- Monitoring Well/Piezometer Screen
- Rock Quality Designation (RQD)
- Auger Refusal

NO	ELEVATION	NORTHING	EASTING
HF1-03	222.0	5 395 355.6	406 042.9
HF1-04	222.0	5 395 398.7	406 104.3
HF1-05	222.0	5 395 441.8	406 165.7
HF1-06	222.5	5 395 484.9	406 227.1
HF1-07	223.0	5 395 528.1	406 288.3

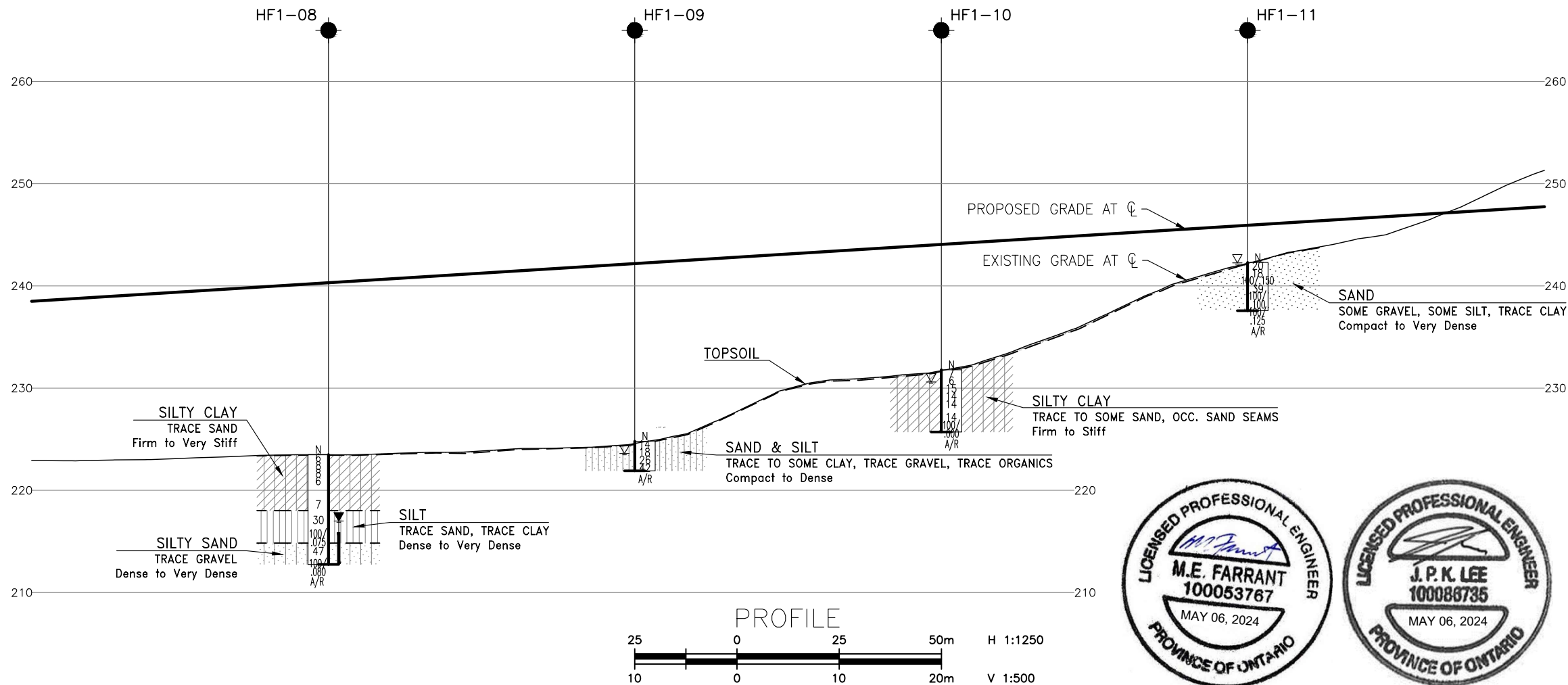
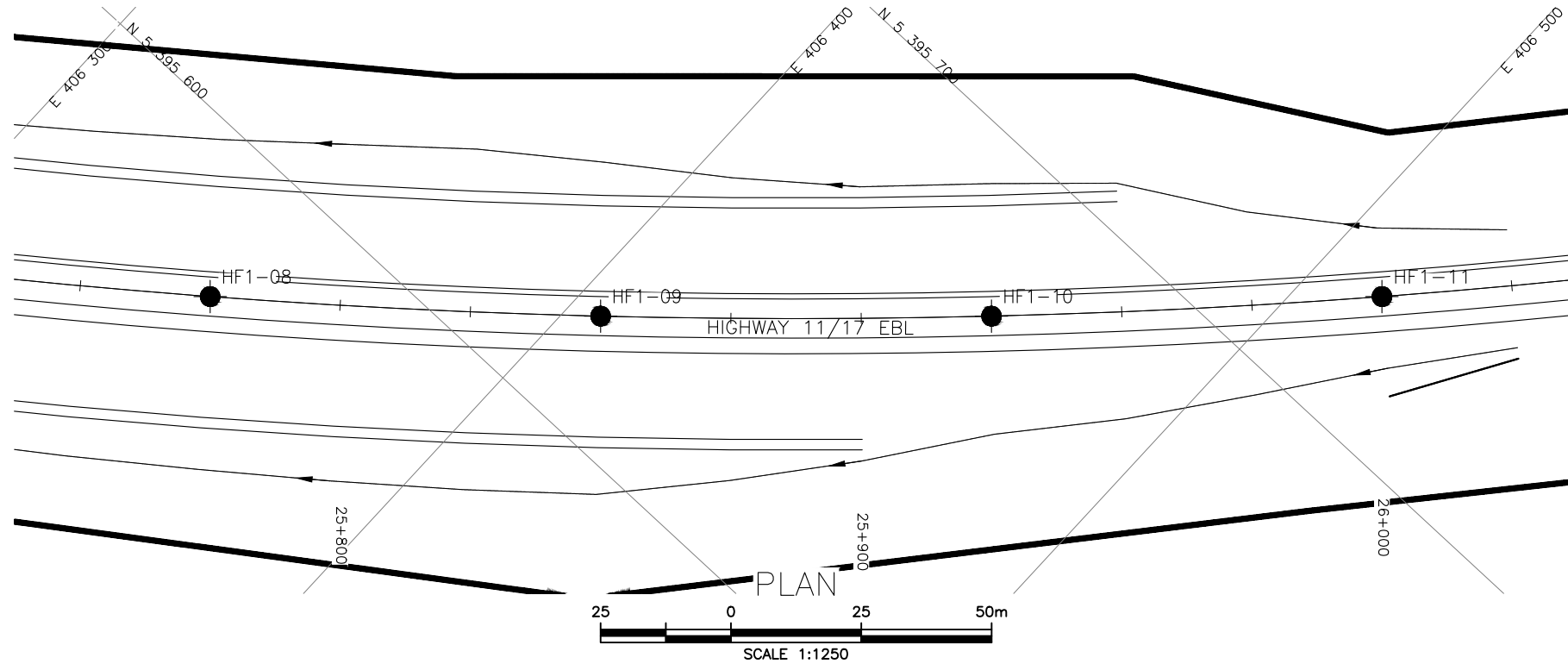
NOTES

- The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.
- This drawing is for subsurface information only. Surface details and features are for conceptual illustration.
- Coordinate system is MTM NAD 83 Zone 15.

GEOCRES No. 52A10-001

REVISIONS	DATE	BY	DESCRIPTION
DESIGN	RB	CHK -	CODE
DRAWN	MFA	CHK RB	SITE
			LOAD
			STRUCT
			DWG 7
			DATE MAY 2024

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

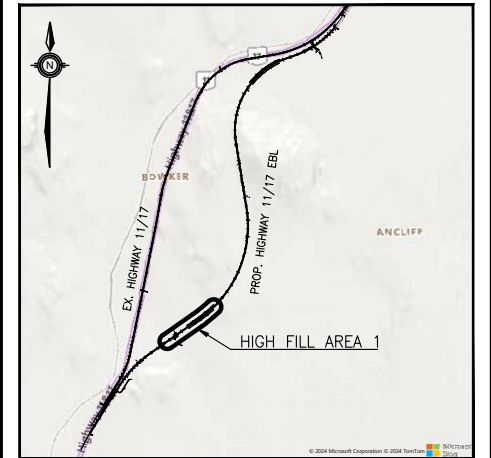


CONT No
GWP No 129-90-00

HIGHWAY 11/17 REALIGNMENT
PEARL LAKE EASTERLY
HIGH FILL AREA 1
BOREHOLE LOCATIONS AND SOIL STRATA



SHEET



KEYPLAN

LEGEND

	Borehole
	Borehole and Cone
N	Blows /0.3m (Std Pen Test, 475J/blow)
CONE	Blows /0.3m (60° Cone, 475J/blow)
PH	Pressure, Hydraulic
	Water Level Upon Completion of Drilling
	Water Level in Monitoring Well/Piezometer
	Monitoring Well/Piezometer Screen
90%	Rock Quality Designation (RQD)
A/R	Auger Refusal

NO	ELEVATION	NORTHING	EASTING
HF1-08	223.5	5 395 573.3	406 348.2
HF1-09	224.8	5 395 621.4	406 405.7
HF1-10	231.8	5 395 672.3	406 460.8
HF1-11	242.3	5 395 725.9	406 513.2

-NOTES-

- The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.
- This drawing is for subsurface information only. Surface details and features are for conceptual illustration.
- Coordinate system is MTM NAD 83 Zone 15.

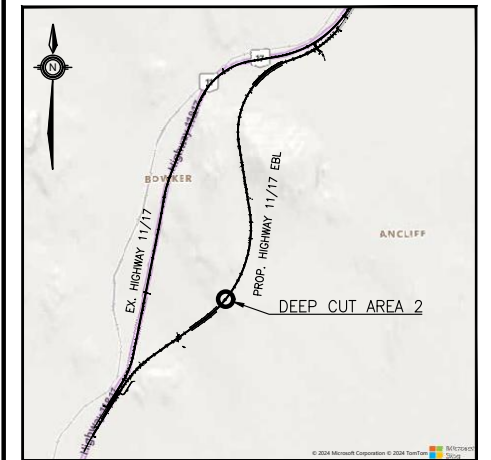
GEOCRES No. 52A10-001



REVISIONS	DATE	BY	DESCRIPTION

DESIGN	RB	CHK	-	CODE	LOAD	DATE	MAY 2024
DRAWN	MFA	CHK	RB	SITE	STRUCT	DWG	8

SHEET



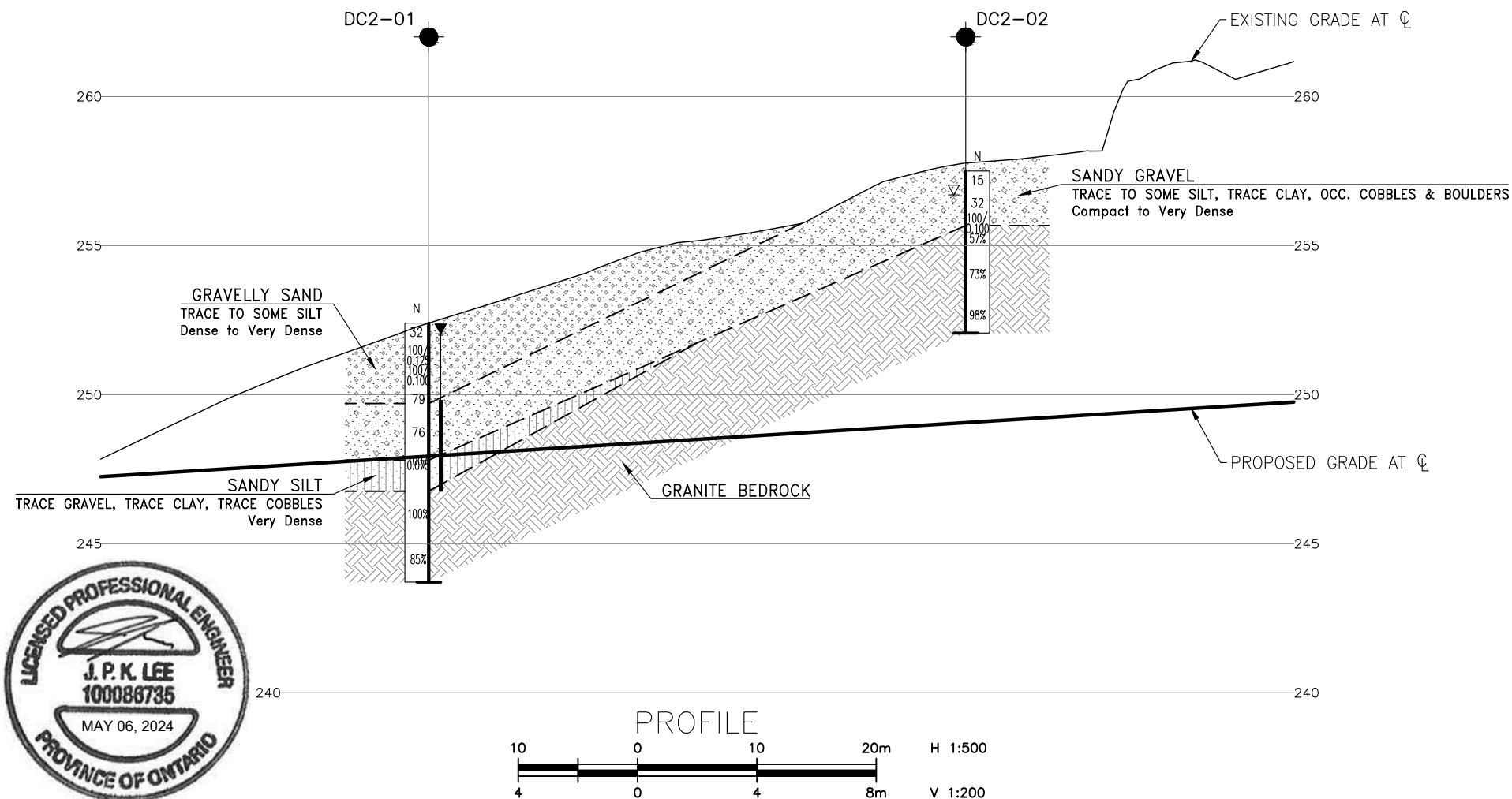
LEGEND

[illegible]

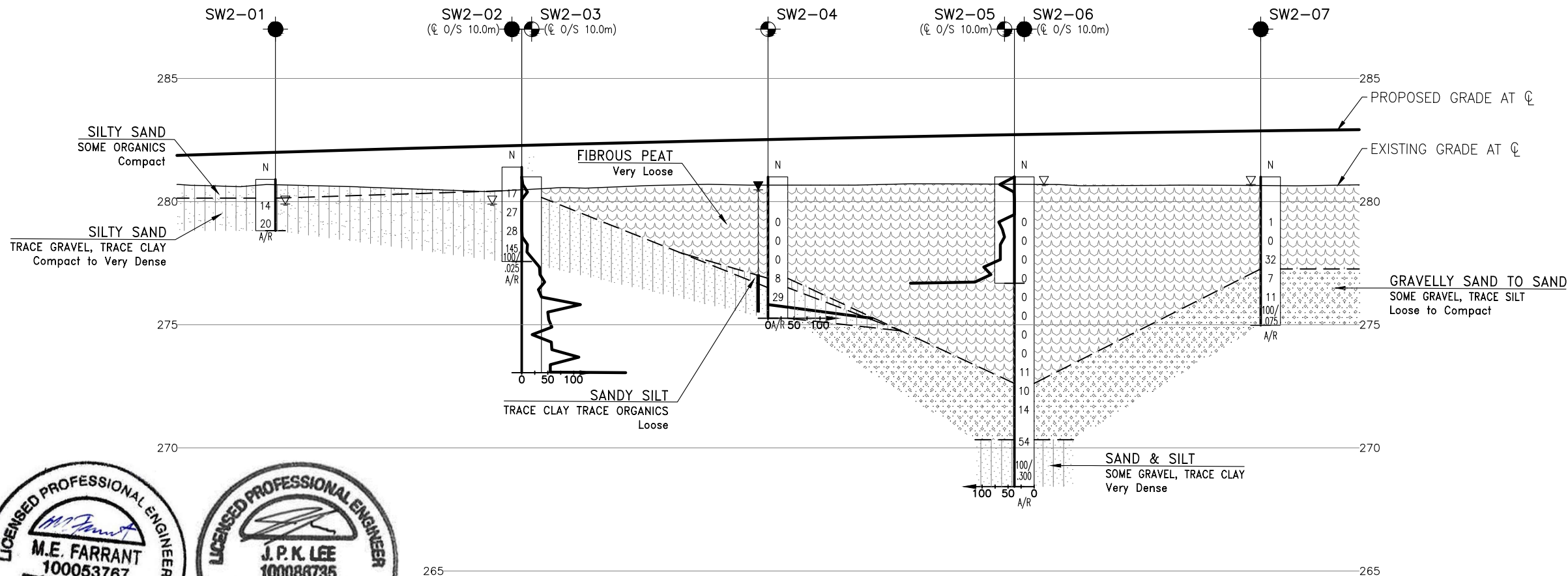
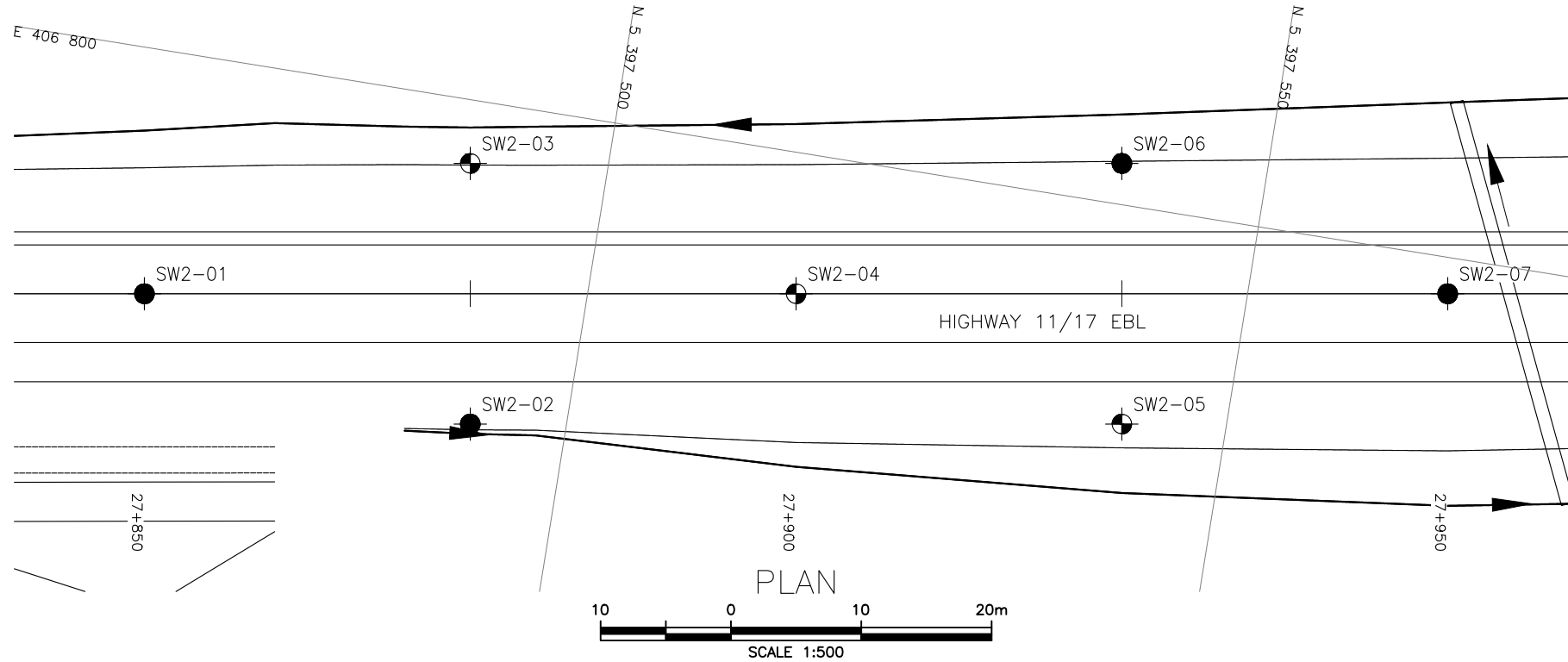
- 1) The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.
- 2) This drawing is for subsurface information only. Surface details and features are for conceptual illustration.
- 3) Coordinate system is MTM NAD 83 Zone 15.

REVISIONS								
	DATE	BY	DESCRIPTION					
DESIGN	RB	CHK	-	CODE	LOAD		DATE	MAY 2024
DRAWN	MFA	CHK	RB	SITE	STRUCT		IDWG	9

FILENAME: H:\Drafting\21000\21663\LED-21663-BHPP.dwg
PLOTDATE: 5/6/2024 2:34 PM



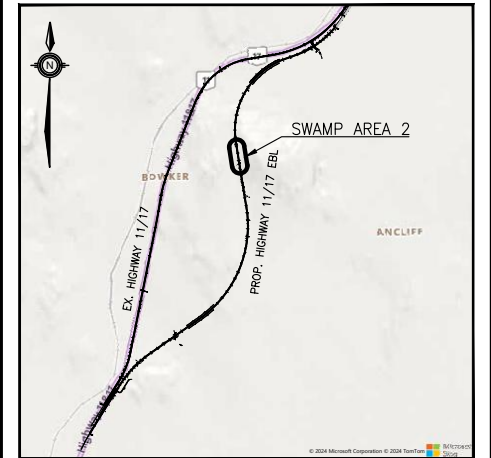
METRIC
DIMENSIONS ARE IN METRES
AND/OR MILLIMETRES
UNLESS OTHERWISE SHOWN



CONT No
GWP No 129-90-00
HIGHWAY 11/17 REALIGNMENT
PEARL LAKE EASTERLY
SWAMP AREA 2
BOREHOLE LOCATIONS AND SOIL STRATA



SHEET



KEYPLAN

LEGEND

●	Borehole
●	Borehole and Cone
N	Blows /0.3m (Std Pen Test, 475J/blow)
CONE	Blows /0.3m (60° Cone, 475J/blow)
PH	Pressure, Hydraulic
▽	Water Level Upon Completion of Drilling
▽	Water Level in Monitoring Well/Piezometer
↓	Monitoring Well/Piezometer Screen
90%	Rock Quality Designation (RQD)
A/R	Auger Refusal

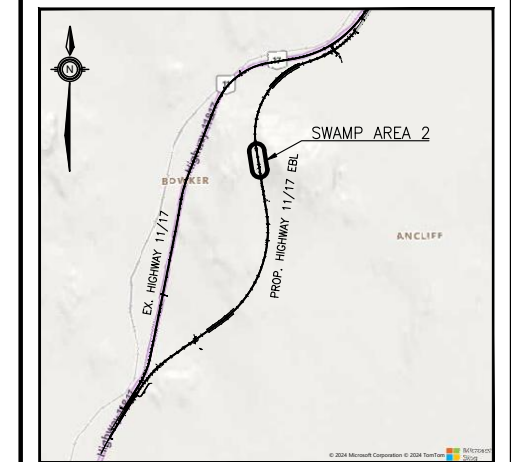
NO	ELEVATION	NORTHING	EASTING
SW2-01	280.9	5 397 466.4	406 818.7
SW2-02	281.4	5 397 492.7	406 824.6
SW2-03	281.0	5 397 489.5	406 804.8
SW2-04	281.0	5 397 515.8	406 810.7
SW2-05	281.0	5 397 542.1	406 816.6
SW2-06	281.0	5 397 538.9	406 796.9
SW2-07	281.0	5 397 565.2	406 802.8

-NOTES-

- The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.
- This drawing is for subsurface information only. Surface details and features are for conceptual illustration.
- Coordinate system is MTM NAD 83 Zone 15.





GEOCRES No. 52A10-001

REVISIONS	DATE	BY	DESCRIPTION
DESIGN	RB	CHK -	CODE
DRAWN	MFA	CHK RB	SITE
			LOAD
			STRUCT
			DWG 10
			DATE MAY 2024



KEYPLAN

LEGEND

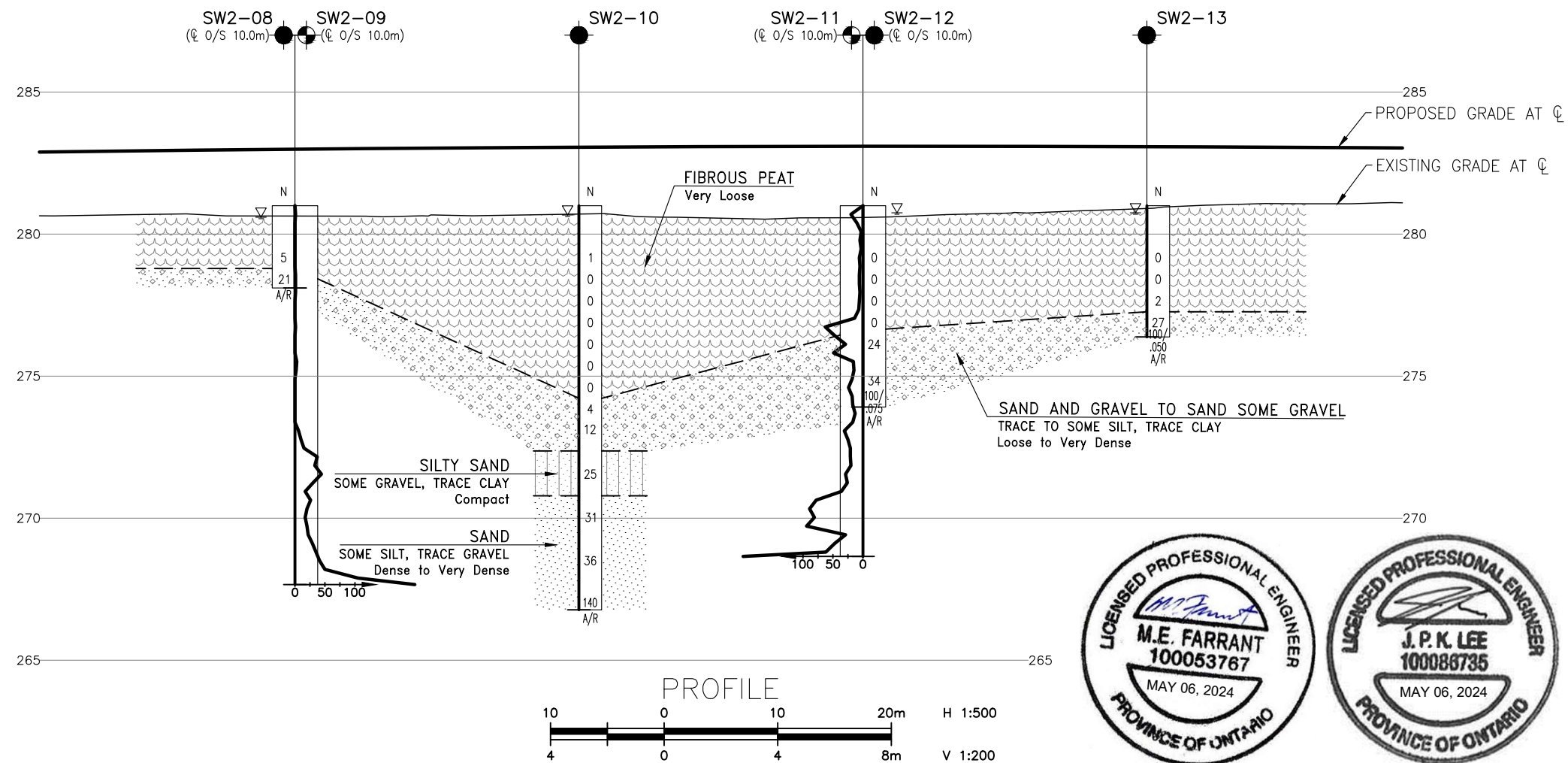
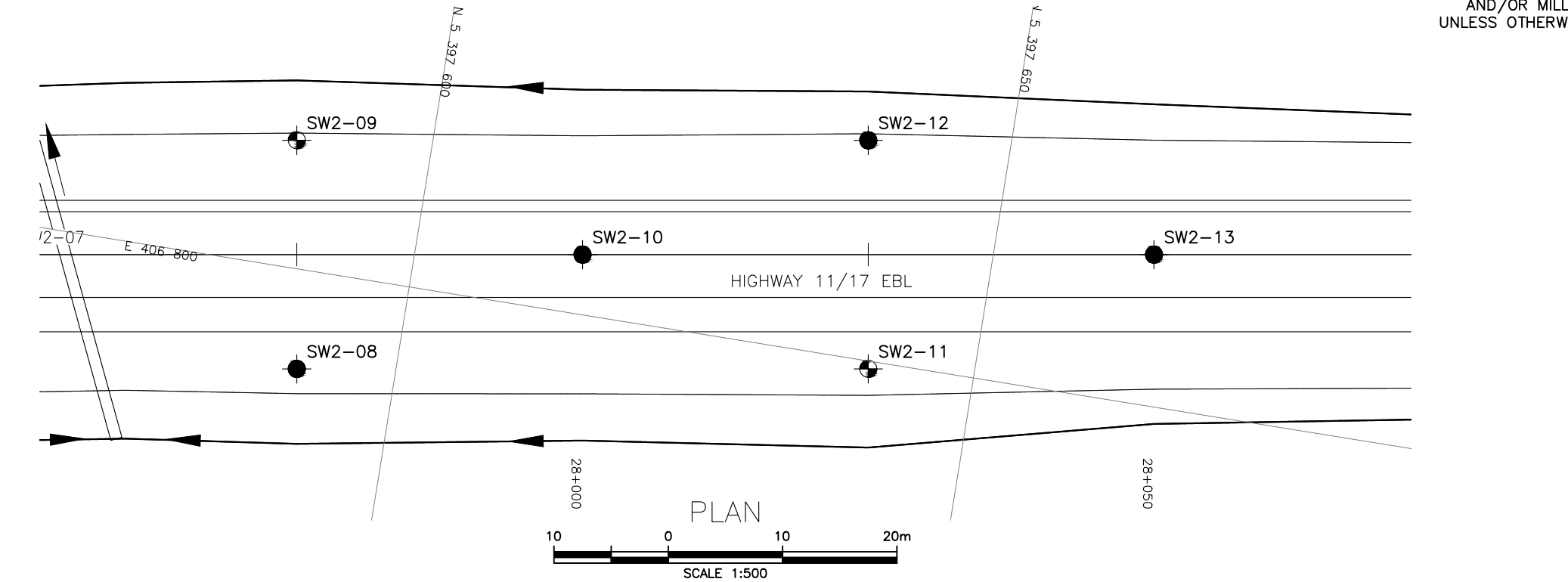
	Borehole
	Borehole and Cone
N	Blows /0.3m (Std Pen Test, 475J/blow)
CONE	Blows /0.3m (60° Cone, 475J/blow)
PH	Pressure, Hydraulic
	Water Level Upon Completion of Drilling
	Water Level in Monitoring Well/Piezometer
90%	Monitoring Well/Piezometer Screen
	Rock Quality Designation (RQD)
A/R	Auger Refusal

[illegible]

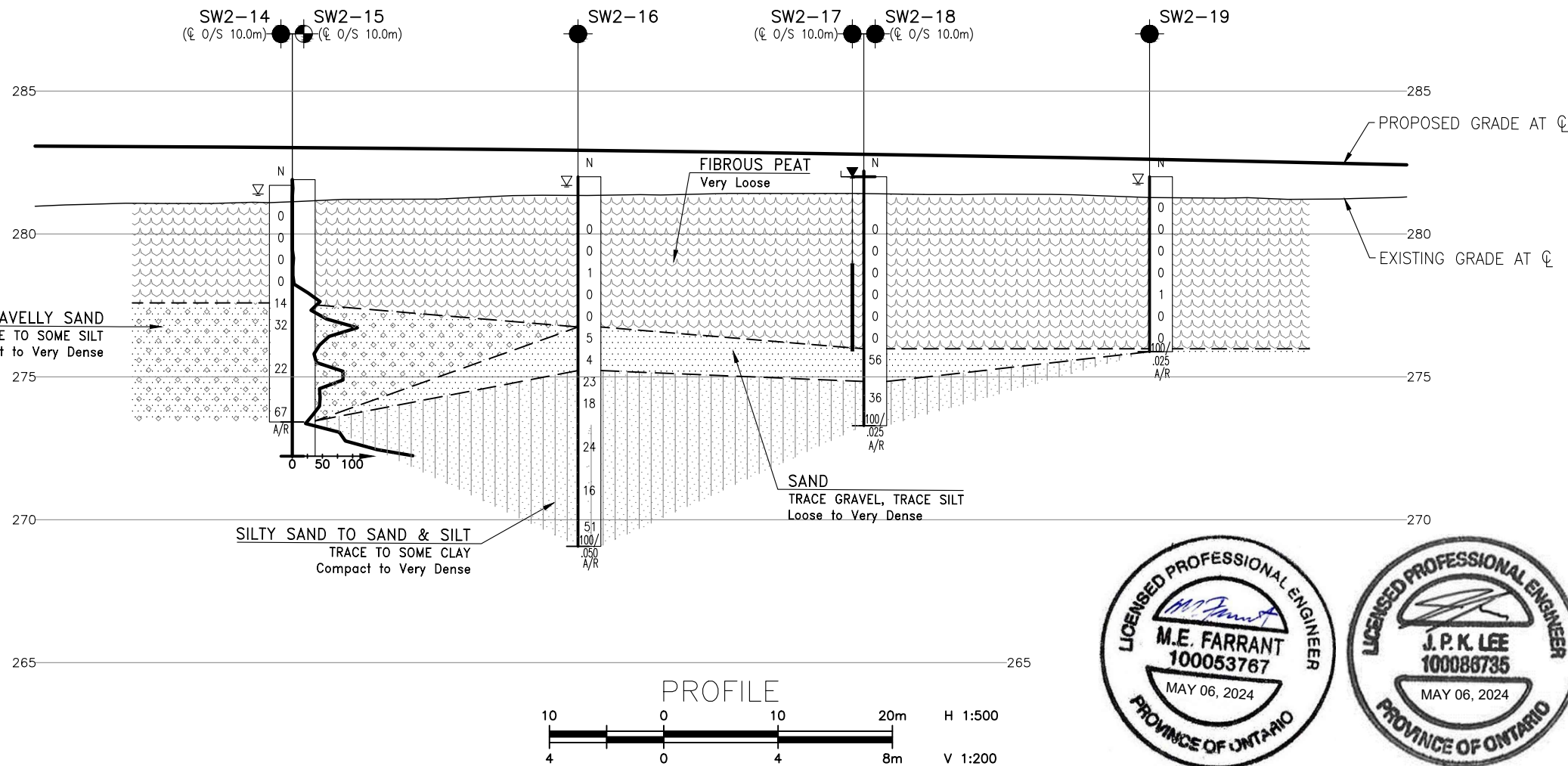
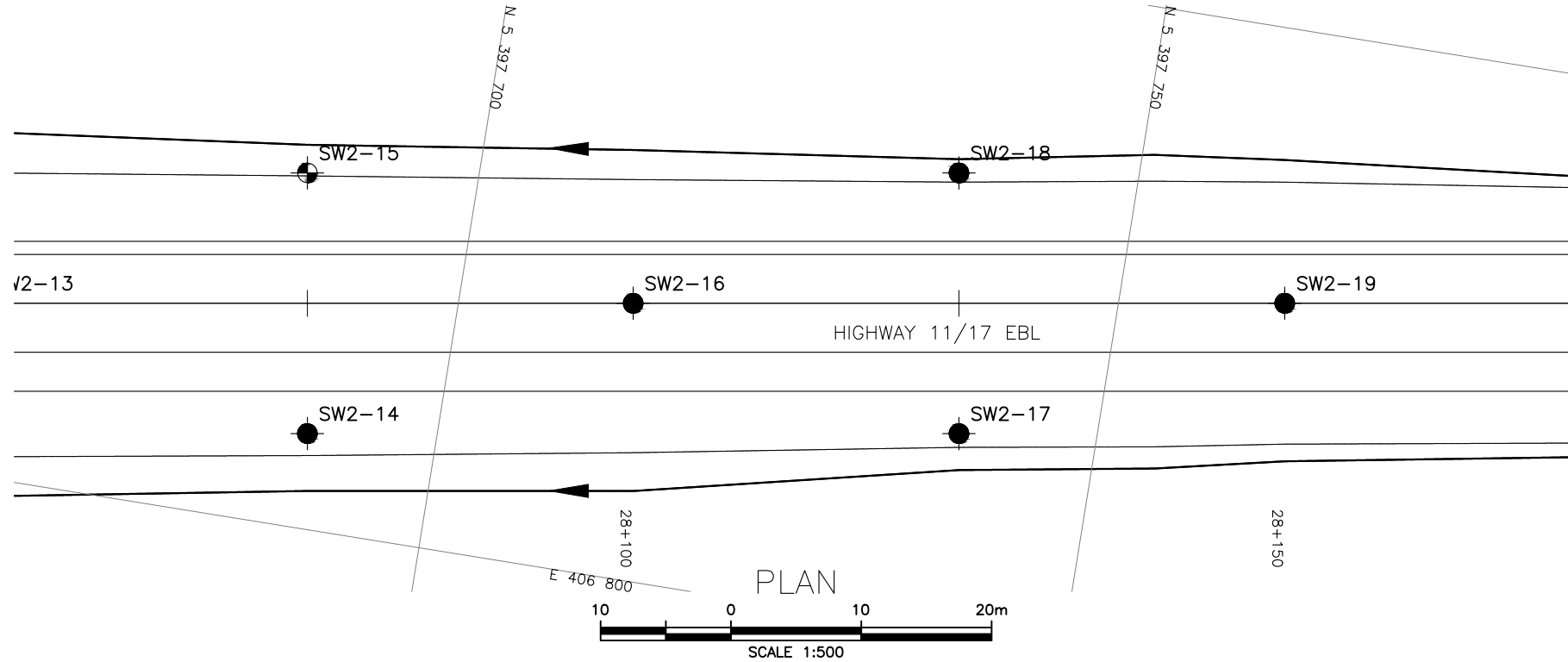
-NOTES-

- 1) The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.
- 2) This drawing is for subsurface information only. Surface details and features are for conceptual illustration.
- 3) Coordinate system is MTM NAD 83 Zone 15.

GEOCRES No. 52A10-001

[illegible]

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



CONT No
GWP No 129-90-00
HIGHWAY 11/17 REALIGNMENT
PEARL LAKE EASTERLY
SWAMP AREA 2
BOREHOLE LOCATIONS AND SOIL STRATA



SHEET



KEYPLAN

LEGEND

●	Borehole
●	Borehole and Cone
N	Blows /0.3m (Std Pen Test, 475J/blow)
CONE	Blows /0.3m (60° Cone, 475J/blow)
PH	Pressure, Hydraulic
▽	Water Level Upon Completion of Drilling
▽	Water Level in Monitoring Well/Piezometer
┆	Monitoring Well/Piezometer Screen
90%	Rock Quality Designation (RQD)
A/R	Auger Refusal

NO	ELEVATION	NORTHING	EASTING
SW2-14	281.7	5 397 690.2	406 792.7
SW2-15	281.9	5 397 687.0	406 773.0
SW2-16	282.0	5 397 713.2	406 778.9
SW2-17	282.0	5 397 739.5	406 784.8
SW2-18	282.0	5 397 736.3	406 765.0
SW2-19	282.0	5 397 762.6	406 770.9

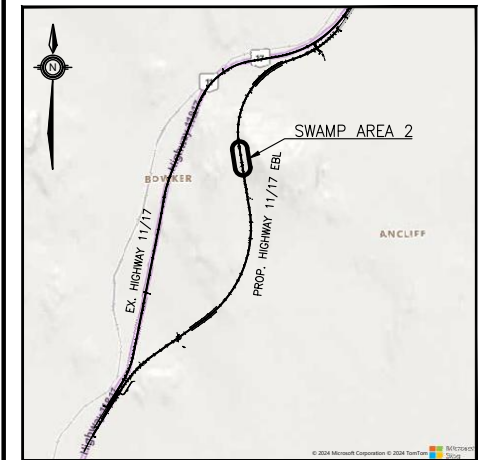
-NOTES-

- The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.
- This drawing is for subsurface information only. Surface details and features are for conceptual illustration.
- Coordinate system is MTM NAD 83 Zone 15.

GEOCRES No. 52A10-001



REVISIONS	DATE	BY	DESCRIPTION
DESIGN	RB	CHK -	CODE
DRAWN	MFA	CHK RB	SITE
			LOAD
			STRUCT
			DWG 12
			DATE MAY 2024



LEGEND

NO	ELEVATION	NORTHING	EASTING
SW2-20	282.0	5 397 788.9	406 776.8
SW2-21	282.0	5 397 785.7	406 757.0
SW2-22	282.0	5 397 812.0	406 762.9
SW2-23	282.0	5 397 838.2	406 768.9
SW2-24	282.0	5 397 835.1	406 749.1
SW2-25	282.0	5 397 851.5	406 756.7

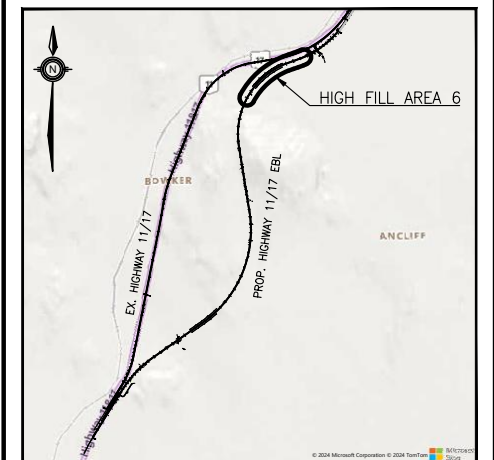
- 1) The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.
- 2) This drawing is for subsurface information only. Surface details and features are for conceptual illustration.
- 3) Coordinate system is MTM NAD 83 Zone 15.

A circular professional engineer seal for the Province of Ontario. The outer ring contains the text "LICENSED PROFESSIONAL ENGINEER" at the top and "PROVINCE OF ONTARIO" at the bottom. Inside the ring, the name "M.E. Farrant" is written in blue ink. Below the name, the license number "100053767" is printed. At the bottom of the seal, the expiration date "MAY 06, 2024" is printed.



FILENAME: H:\Drafting\21000\21663\IED-21663-BHPP.dwg
PLOTDATE: 5/6/2024 2:35 PM

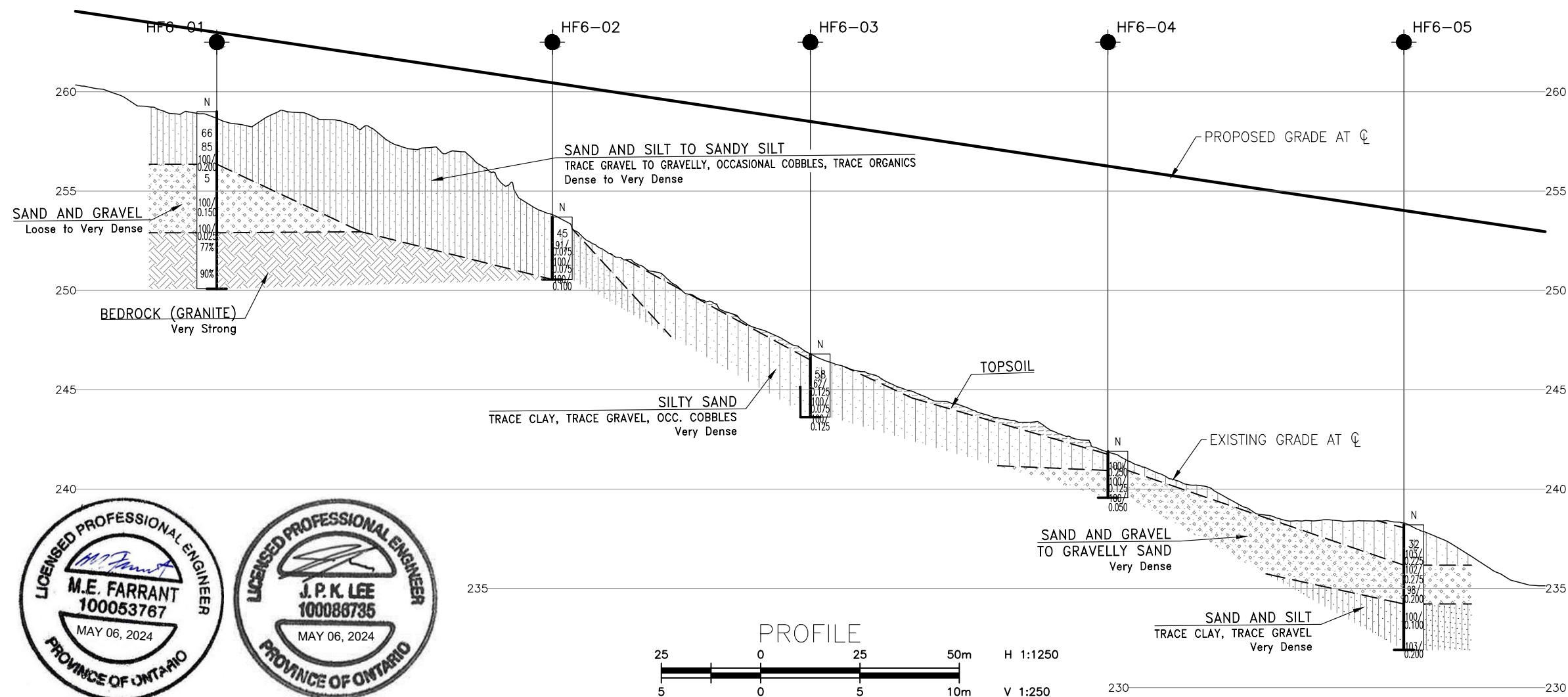
HEET

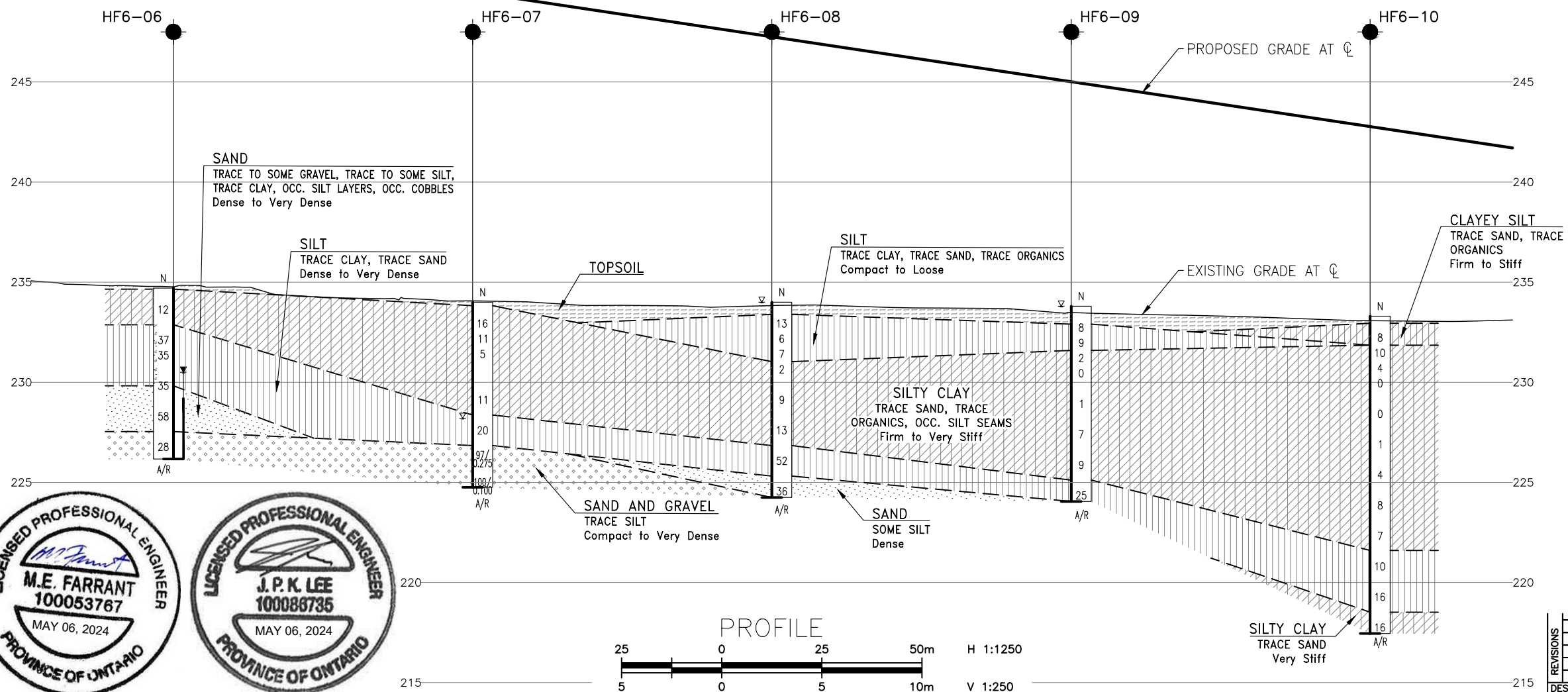
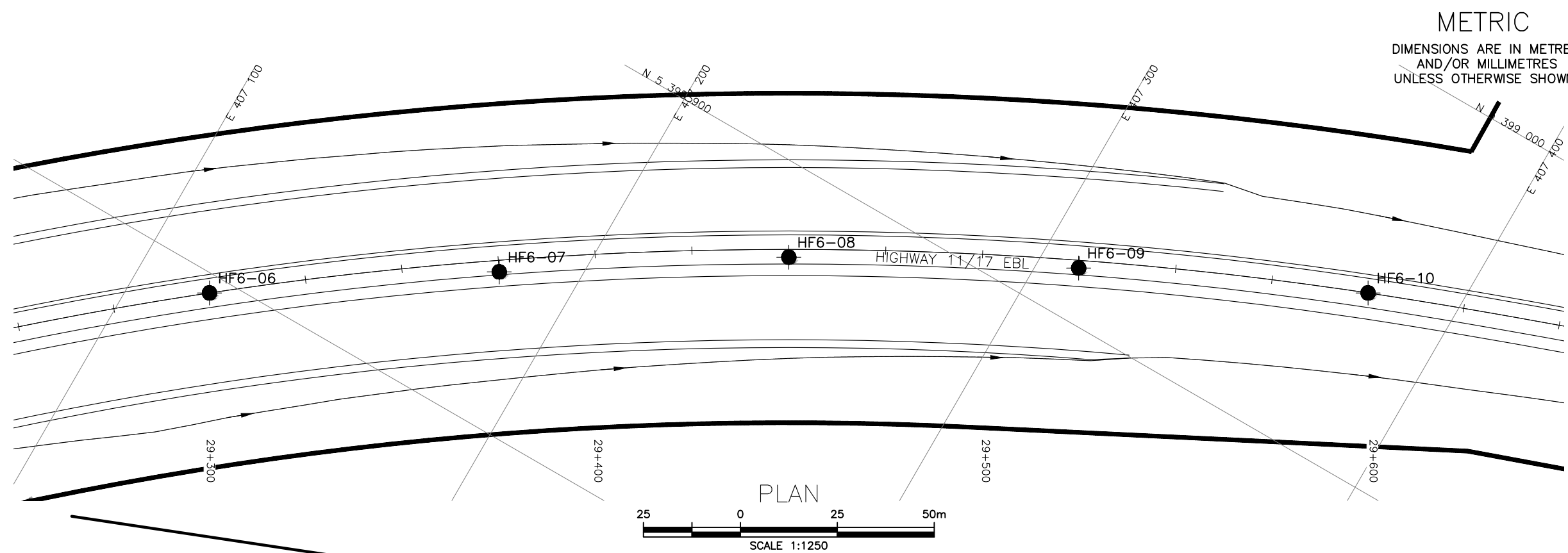


LEGEND

[illegible]

GEOCRES No. 52A10-001

[illegible]



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

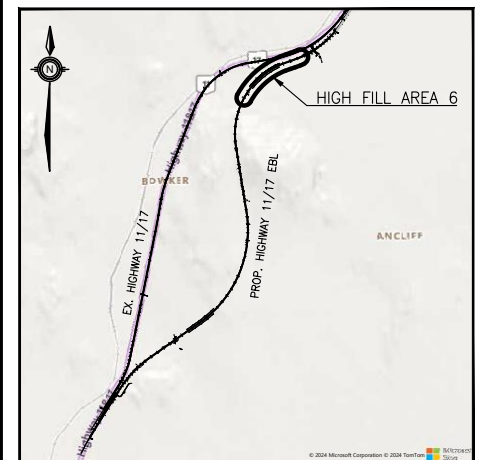
CONT No
GWP No 129-90-00

HIGHWAY 11/17 REALIGNMENT
PEARL LAKE EASTERLY
HIGH FILL AREA 6
BOREHOLE LOCATIONS AND SOIL STRATA

SHEET



THURBER ENGINEERING LTD.



KEYPLAN

LEGEND

[illegible]

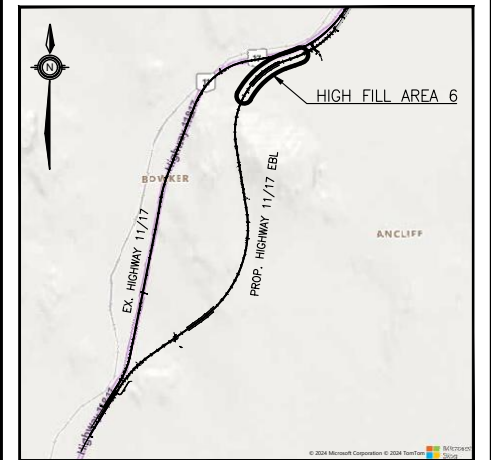
-NOTES-

- 1) The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.
- 2) This drawing is for subsurface information only. Surface details and features are for conceptual illustration.
- 3) Coordinate system is MTM NAD 83 Zone 15.

GEOCRES No. 52A10-001

[illegible]

SHEET



LEGEND

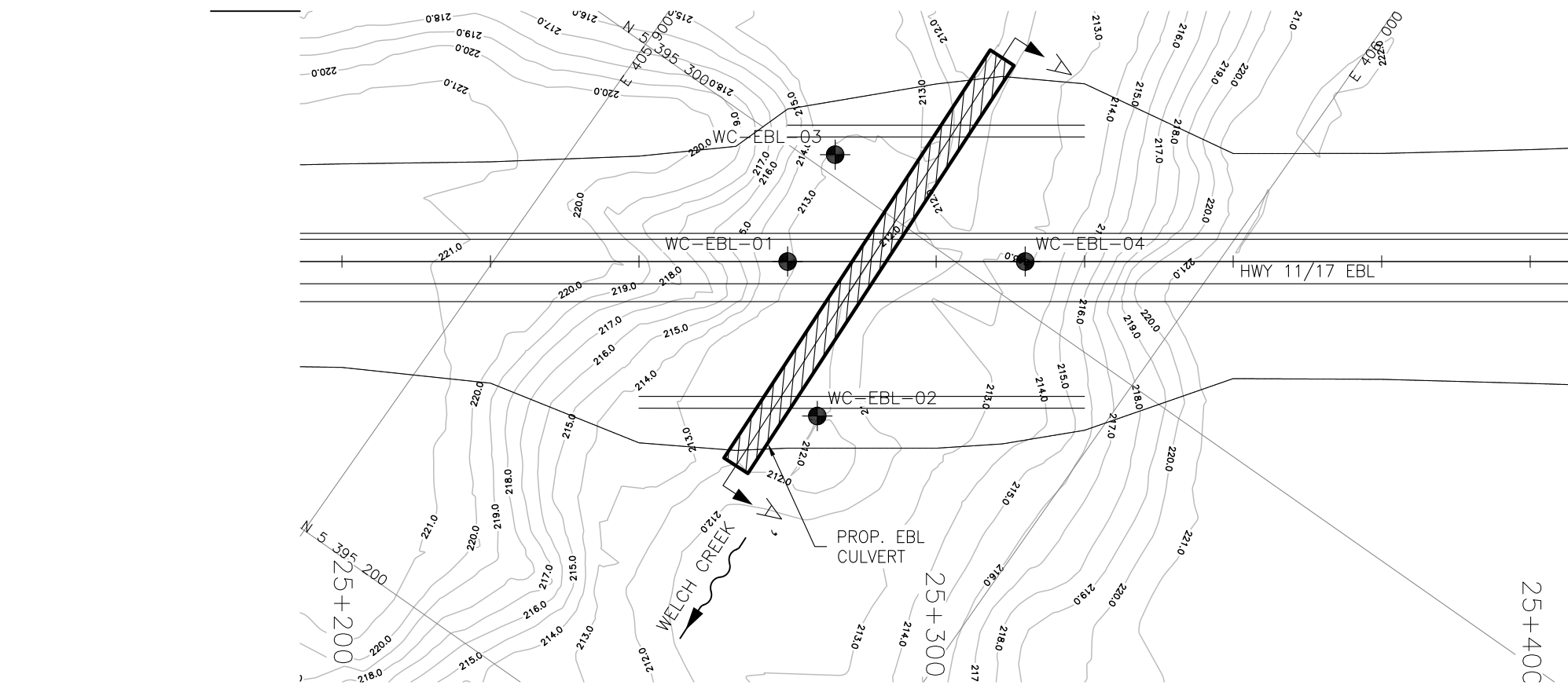
[illegible]

- 1) The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.
- 2) This drawing is for subsurface information only. Surface details and features are for conceptual illustration.
- 3) Coordinate system is MTM NAD 83 Zone 15.

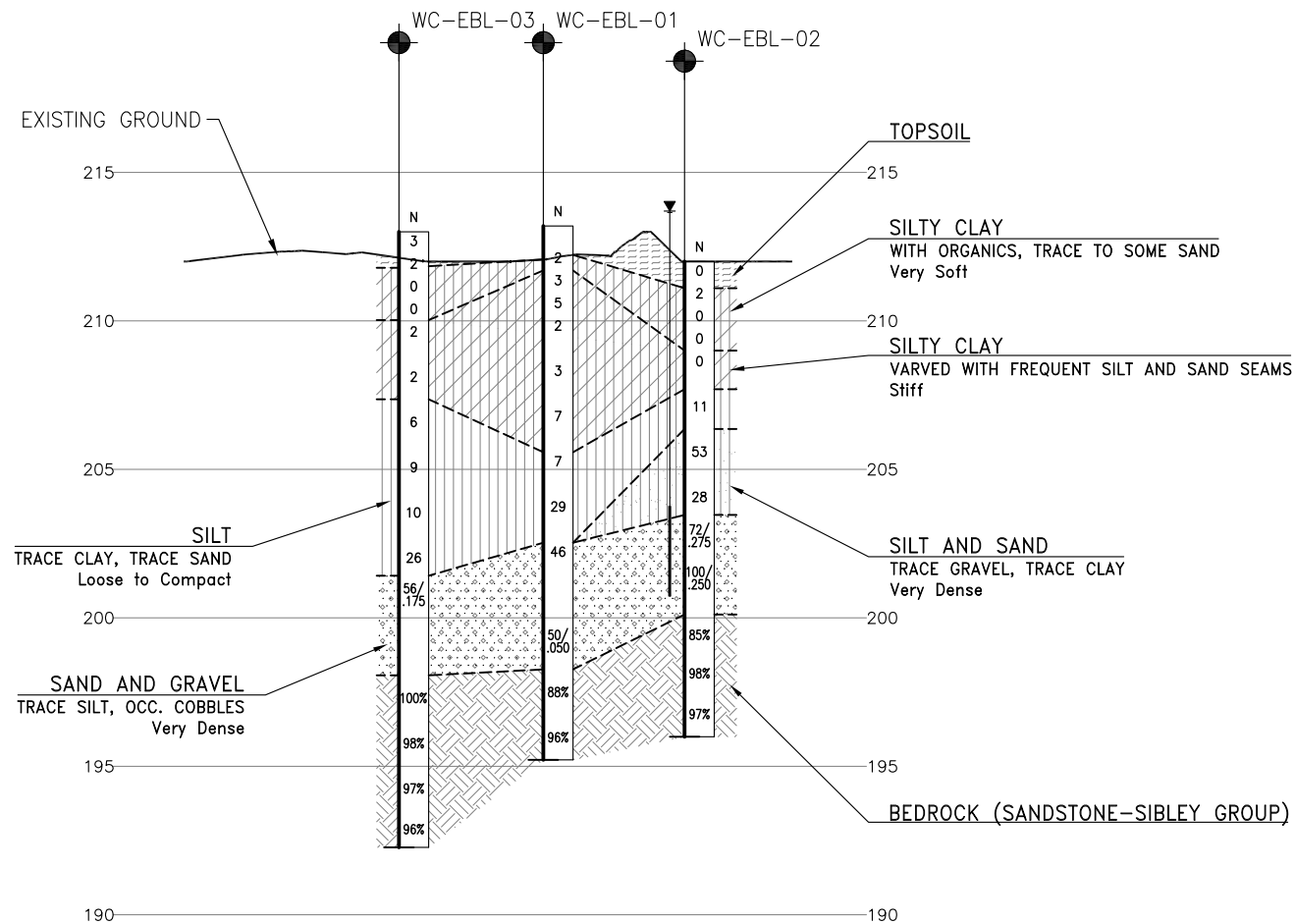
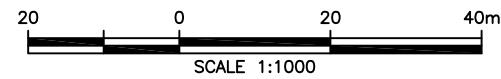
A circular professional engineer seal for the Province of Ontario. The outer ring contains the text "LICENSED PROFESSIONAL ENGINEER" at the top and "PROVINCE OF ONTARIO" at the bottom. Inside the ring, there is a signature "M.E. Farrant" in blue ink. Below the signature, the text "M.E. FARRANT" and the license number "100053767" are printed. At the bottom of the seal, the expiration date "MAY 06, 2024" is printed.



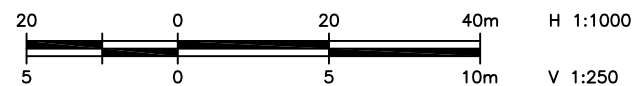
REVISIONS																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																										
-----------	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--



PLAN



SECTION ALONG A-A'



H 1:1000

V 1:250

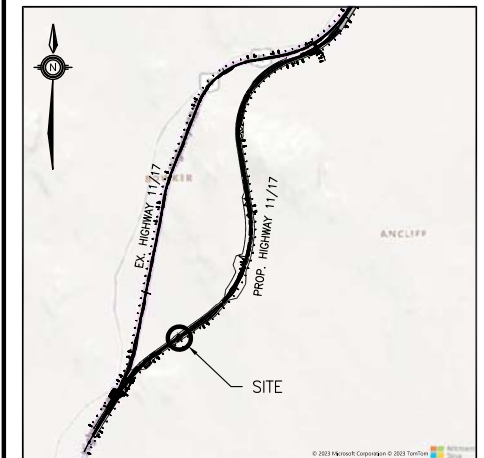
METRIC
DIMENSIONS ARE IN METRES
AND/OR MILLIMETRES
UNLESS OTHERWISE SHOWN

CONT No
GWP No:129-90-00

HIGHWAY 11/17 REALIGNMENT WELCH CREEK CULVERT EASTBOUND LANES BOREHOLE LOCATIONS AND SOIL STRATA








THURBER ENGINEERING LTD.



KEYPLAN

LEGEND

	Borehole
	Borehole and Cone
N	Blows /0.3m (Std Pen Test, 475J/blow)
CONE	Blows /0.3m (60° Cone, 475J/blow)
PH	Pressure, Hydraulic
	Water Level Upon Completion of Drilling
	Water Level in Monitoring Well/Piezometer
	Monitoring Well/Piezometer Screen
90%	Rock Quality Designation (RQD)
A/R	Auger Refusal

[illegible]

-NOTES-

- 1) The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.
- 2) This drawing is for subsurface information only. Surface details and features are for conceptual illustration.
- 3) Coordinate system is MTM NAD 83 Zone 15.

GEOCRES No. 52A10-001

[illegible]

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

CONT No
GWP No:129-90-00

HIGHWAY 11/17 REALIGNMENT
WELCH CREEK CULVERT
WESTBOUND LANES
BOREHOLE LOCATIONS AND SOIL STRATA



KEYPLAN

LEGEND

	Borehole
	Borehole and Cone
N	Blows /0.3m (Std Pen Test, 475J/blow)
CONE	Blows /0.3m (60° Cone, 475J/blow)
PH	Pressure, Hydraulic
	Water Level Upon Completion of Drilling
	Water Level in Monitoring Well/Piezometer
	Monitoring Well/Piezometer Screen
90%	Rock Quality Designation (RQD)
A/R	Auger Refusal

NO	ELEVATION	NORTHING	EASTING
WC-WBL-01	215.2	5 395 904.6	405 488.0
WC-WBL-02	215.4	5 395 892.4	405 555.3
WC-WBL-03	223.0	5 395 909.1	405 532.1
WC-WBL-04	223.0	5 395 885.8	405 523.6

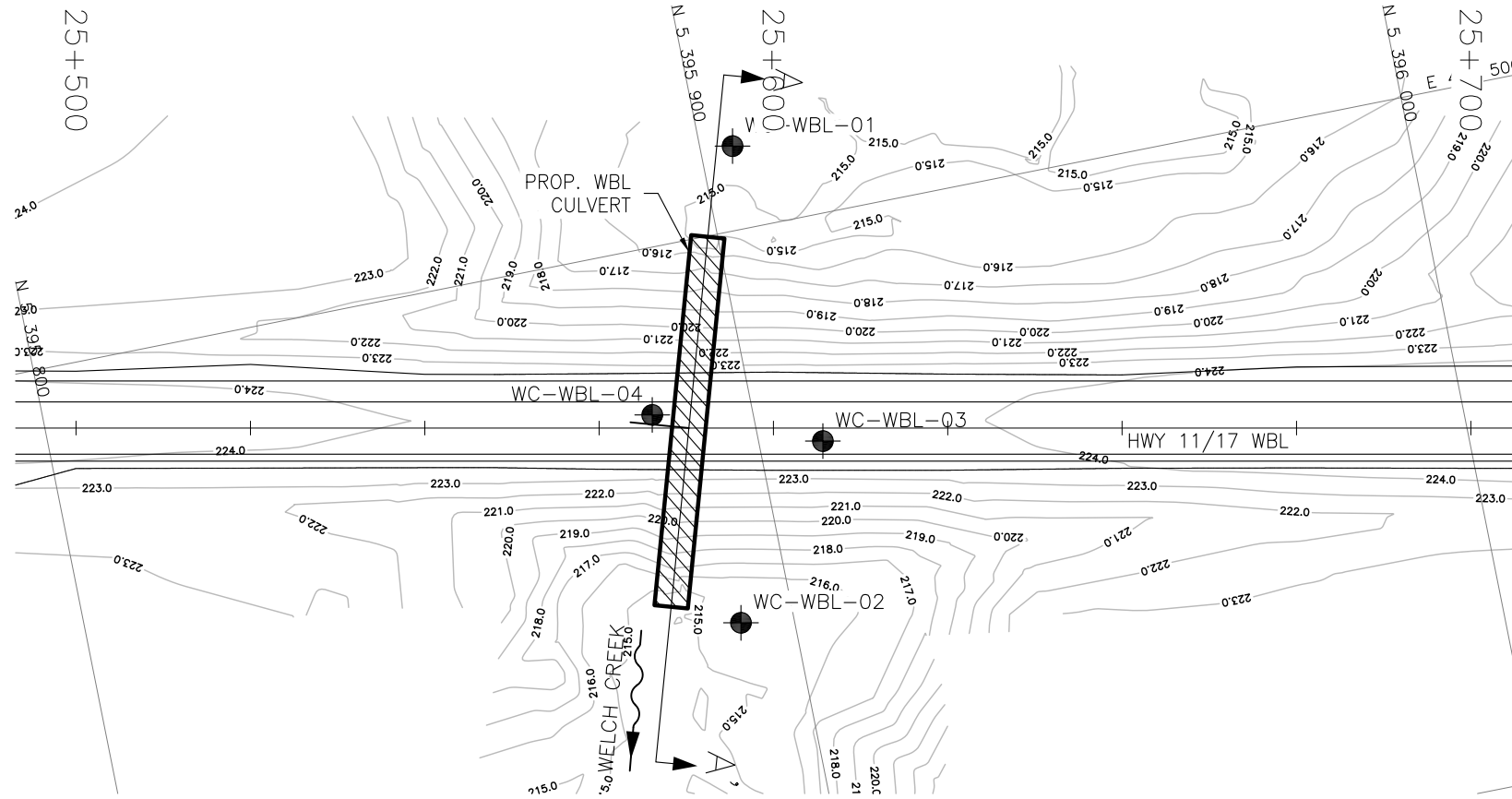
-NOTES-

- The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.
- This drawing is for subsurface information only. Surface details and features are for conceptual illustration.
- Coordinate system is MTM NAD 83 Zone 15.

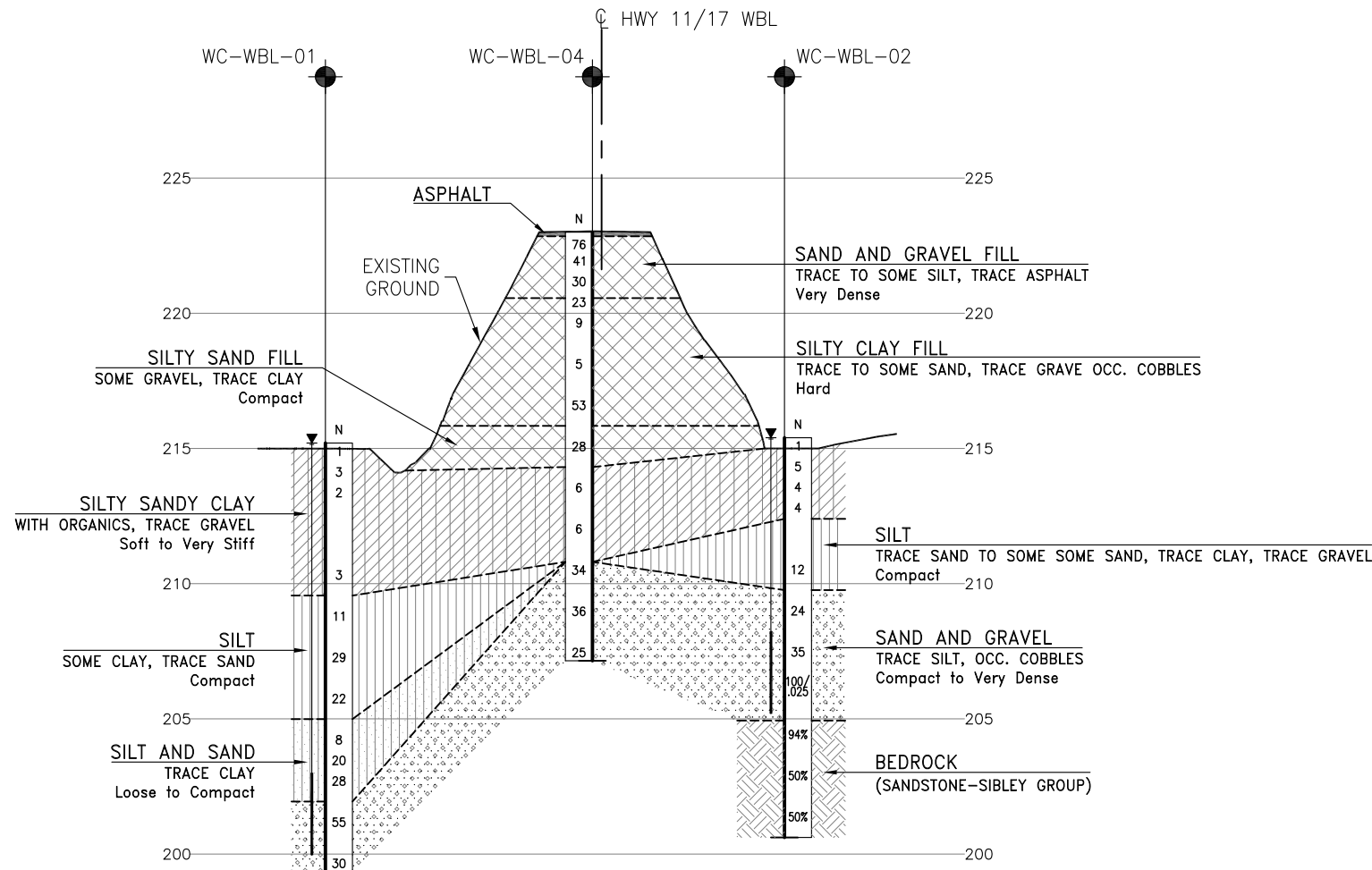
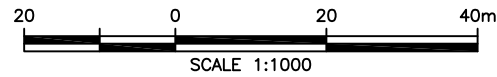
GEOCRES No. 52A10-001

REVISIONS	DATE	BY	DESCRIPTION

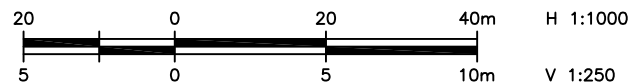
DESIGN	RB	CHK	MFA	CODE	LOAD	DATE	MAY 2024
DRAWN	AN	CHK	RB	SITE	STRUCT	DWG	18



PLAN



SECTION ALONG A-A'



APPENDIX B

B1: Swamp Section 1 Record of Borehole Sheets

SYMBOLS, ABBREVIATIONS AND TERMS USED ON RECORDS OF BOREHOLES

1. TEXTURAL CLASSIFICATION OF SOILS

CLASSIFICATION	PARTICLE SIZE	VISUAL IDENTIFICATION
Boulders	Greater than 200mm	same
Cobbles	75 to 200mm	same
Gravel	4.75 to 75mm	5 to 75mm
Sand	0.075 to 4.75mm	Not visible particles to 5mm
Silt	0.002 to 0.075mm	Non-plastic particles, not visible to the naked eye
Clay	Less than 0.002mm	Plastic particles, not visible to the naked eye

2. COARSE GRAIN SOIL DESCRIPTION (50% greater than 0.075mm)

TERMINOLOGY	PROPORTION
Trace or Occasional	Less than 10%
Some	10 to 20%
Adjective (e.g. silty or sandy)	20 to 35%
And (e.g. sand and gravel)	35 to 50%

3. TERMS DESCRIBING CONSISTENCY (COHESIVE SOILS ONLY)

DESCRIPTIVE TERM	UNDRAINED SHEAR STRENGTH (kPa)	APPROXIMATE SPT ⁽¹⁾ 'N' VALUE
Very Soft	12 or less	Less than 2
Soft	12 to 25	2 to 4
Firm	25 to 50	4 to 8
Stiff	50 to 100	8 to 15
Very Stiff	100 to 200	15 to 30
Hard	Greater than 200	Greater than 30

NOTE: Hierarchy of Soil Strength Prediction

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



4. TERMS DESCRIBING DENSITY (COHESIONLESS SOILS ONLY)

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

5. LEGEND FOR RECORDS OF BOREHOLES

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

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

 Water Level
 Shear Strength Determination by Pocket Penetrometer

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

UNIFIED SOILS CLASSIFICATION

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

RECORD OF BOREHOLE No SW1-01

1 OF 2

METRIC

GWP# 129-90-00 LOCATION Sta. 24+550 EB CL N 5 394 838.1 E 405 371.1 ORIGINATED BY GAS
 DIST Thunder Bay HWY 11/17 BOREHOLE TYPE Hollow Stem Auger/Solid Stem Auger COMPILED BY MC
 DATUM Geodetic DATE 2023.02.27 - 2023.02.27 LATITUDE 48.683916 LONGITUDE -88.634017 CHECKED BY RB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL LIMIT MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa		WATER CONTENT (%)				
229.3	GROUND SURFACE							20 40 60 80 100		W _P W W _L			GR SA SI CL	
0.0	PEAT Very Loose Brown Wet		1	GS				○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE						
228.3								20 40 60 80 100						
1.0	Silty CLAY, trace to some sand, occasional sand seams Firm to Very Stiff Brown to Grey Moist (CL)		2	SS	4									
			3	SS	6									
			4	SS	2								0 17 46 37	
			5	SS	3								0 10 58 32	
			1	TW										
			6	SS	4								0 3 76 21	
			7	SS	9									
220.6														
8.7	SILT, trace to some clay, trace sand Dense Brown Wet (ML)													
			8	SS	29								0 11 82 7	

Continued Next Page

+³, ×³: Numbers refer to
Sensitivity

20
15
10

(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No SW1-01

2 OF 2

METRIC

GWP# 129-90-00 LOCATION Sta. 24+550 EB CL N 5 394 838.1 E 405 371.1 ORIGINATED BY GAS
DIST Thunder Bay HWY 11/17 BOREHOLE TYPE Hollow Stem Auger/Solid Stem Auger COMPILED BY MC
DATUM Geodetic DATE 2023.02.27 - 2023.02.27 LATITUDE 48.683916 LONGITUDE -88.634017 CHECKED BY RB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100					
	Continued From Previous Page																
218.0			9	SS	46												
11.3	END OF BOREHOLE AT 11.3m. BOREHOLE CAVED TO 10.0m AND WATER LEVEL AT 7.6m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE AND CUTTINGS TO SURFACE.																

RECORD OF BOREHOLE No SW1-02

1 OF 2

METRIC

GWP# 129-90-00 LOCATION Sta. 24+550 EB O/S 10R N 5 394 831.4 E 405 378.5 ORIGINATED BY GAS
DIST Thunder Bay HWY 11/17 BOREHOLE TYPE Hollow Stem Auger/Solid Stem Auger COMPILED BY MC
DATUM Geodetic DATE 2023.02.28 - 2023.02.28 LATITUDE 48.683855 LONGITUDE -88.633918 CHECKED BY RB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT		UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)					
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa		W _P W W _L			WATER CONTENT (%)					
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE										
229.3	GROUND SURFACE							20 40 60 80 100						GR	SA	SI	CL	
0.0	PEAT Loose Brown Wet		1	GS			229											
			2	SS	3													
228.1							228											
1.3	Silty CLAY , some sand, occasional sand seams Firm to Stiff Brown to Grey Moist (Cl)		3	SS	4													
			4	SS	3													
			5	SS	3													
			6	SS	0			226										
								225										
							224											
							223											
	No recovery		7	SS	4													
222.2							222											
7.2	SILT , trace to some sand, trace to some clay Compact Grey to Reddish Brown Wet (CL-ML)		8	SS	14		221											
					9		SS	17	220									

Continued Next Page

+³, ×³: Numbers refer to
Sensitivity

20
15
10

(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No SW1-02

2 OF 2

METRIC

GWP# 129-90-00 LOCATION Sta. 24+550 EB O/S 10R N 5 394 831.4 E 405 378.5 ORIGINATED BY GAS
DIST Thunder Bay HWY 11/17 BOREHOLE TYPE Hollow Stem Auger/Solid Stem Auger COMPILED BY MC
DATUM Geodetic DATE 2023.02.28 - 2023.02.28 LATITUDE 48.683855 LONGITUDE -88.633918 CHECKED BY RB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa 20 40 60 80 100 ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE									
217.6	Continued From Previous Page						219										
			10	SS	19		218										
11.7	SAND and SILT, some gravel Dense Reddish Brown Wet		11	SS	44		217									18 40 41 1	
216.4			12	SS	100/0												
13.0	END OF BOREHOLE AT 13.0m UPON AUGER REFUSAL ON POSSIBLE BEDROCK. BOREHOLE OPEN TO 13.0m AND WATER LEVEL AT 8.0m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE AND CUTTINGS TO SURFACE.				.075												

METRIC

[illegible]

ONTMT4S2 2020LIBRARY(MTO).GLB MTO-21663.GPJ 5/2/24

+³, ×³: Numbers refer to Sensitivity

RECORD OF BOREHOLE No SW1-04

1 OF 2

METRIC

GWP# 129-90-00 LOCATION Sta. 24+575 EB CL N 5 394 856.5 E 405 388.0 ORIGINATED BY GAS
DIST Thunder Bay HWY 11/17 BOREHOLE TYPE Hollow Stem Auger/Solid Stem Auger COMPILED BY MC
DATUM Geodetic DATE 2023.03.02 - 2023.03.02 LATITUDE 48.684079 LONGITUDE -88.633783 CHECKED BY RB

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

Continued Next Page

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

RECORD OF BOREHOLE No SW1-04

2 OF 2

METRIC

GWP# 129-90-00 LOCATION Sta. 24+575 EB CL N 5 394 856.5 E 405 388.0 ORIGINATED BY GAS
DIST Thunder Bay HWY 11/17 BOREHOLE TYPE Hollow Stem Auger/Solid Stem Auger COMPILED BY MC
DATUM Geodetic DATE 2023.03.02 - 2023.03.02 LATITUDE 48.684079 LONGITUDE -88.633783 CHECKED BY RB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa							
	Continued From Previous Page							<div>20406080100</div> <div>○ UNCONFINED + FIELD VANE</div> <div>● QUICK TRIAXIAL × LAB VANE</div> <div>20406080100</div>					<div>PLASTIC LIMIT</div> <div>NATURAL MOISTURE CONTENT</div> <div>LIQUID LIMIT</div> <div>W_P W W_L</div> <div>WATER CONTENT (%)</div> <div>204060</div>		
217.4			9	SS	20		219								
							218								
11.7	SAND , trace silt to silty, trace to some gravel Loose to Compact Reddish Brown Wet		10	SS	8		217								
			11	SS	8		216								
			12	SS	16		215								
214.8			13	SS	100/									6 86 8 (SI+CL)	
14.3	END OF BOREHOLE AT 14.3m UPON AUGER REFUSAL ON POSSIBLE BEDROCK. BOREHOLE CAVED TO 12.5m AND WATER LEVEL AT 5.8m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE AND CUTTINGS TO SURFACE.				0.025										

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

METRIC

[illegible]

+³, ×³: Numbers refer to Sensitivity

RECORD OF BOREHOLE No SW1-05

2 OF 2

METRIC

GWP# 129-90-00 LOCATION Sta. 24+575 EB O/S 10R N 5 394 849.6 E 405 395.3 ORIGINATED BY GAS
DIST Thunder Bay HWY 11/17 BOREHOLE TYPE Dynamic Cone Penetration Test COMPILED BY AN
DATUM Geodetic DATE 2023.03.03 - 2023.03.03 LATITUDE 48.684016 LONGITUDE -88.633685 CHECKED BY RB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE		WATER CONTENT (%) w _P w w _L				
	Continued From Previous Page							20 40 60 80 100		20 40 60				
							219							
							218							
							217							
216.0														
13.3	END OF DCPT AT 13.3m UPON REFUSAL.													

ONTMT452 2020LIBRARY(MTO).GLB MTO-21663.GPJ 5/2/24

RECORD OF BOREHOLE No SW1-06

1 OF 2

METRIC

GWP# 129-90-00 LOCATION Sta. 24+575 EB O/S 10L N 5 394 863.3 E 405 380.7 ORIGINATED BY GAS
DIST Thunder Bay HWY 11/17 BOREHOLE TYPE Hollow Stem Auger/Solid Stem Auger COMPILED BY MC
DATUM Geodetic DATE 2023.03.01 - 2023.03.01 LATITUDE 48.684141 LONGITUDE -88.633880 CHECKED BY RB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT w _P	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
229.0	GROUND SURFACE							20 40 60 80 100						
0.0	PEAT Loose Dark Brown Wet		1	GS				○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE					177	
228.3								20 40 60 80 100						
0.8	SAND , some silt to silty Loose to Very Loose Brown Moist		2	SS	9		228							0 76 19 5
	No recovery		3	SS	4		227							
	No recovery		4	SS	0									
226.1							226							
3.0	Silty CLAY , occasional sand seams Firm to Very Stiff Grey Wet (CL)		5	SS	0									0 15 42 43
							225	16.0						
			6	SS	0		224	3.0						
							223							
			7	SS	3									
							222	2.3						
							221							0 4 71 25
							220							
219.1			9	SS	6									

Continued Next Page

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

RECORD OF BOREHOLE No SW1-06

2 OF 2

METRIC

GWP# 129-90-00 LOCATION Sta. 24+575 EB O/S 10L N 5 394 863.3 E 405 380.7 ORIGINATED BY GAS
 DIST Thunder Bay HWY 11/17 BOREHOLE TYPE Hollow Stem Auger/Solid Stem Auger COMPILED BY MC
 DATUM Geodetic DATE 2023.03.01 - 2023.03.01 LATITUDE 48.684141 LONGITUDE -88.633880 CHECKED BY RB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					
								20 40 60 80 100					
Continued From Previous Page							<div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><</div>						

+³, ×³: Numbers refer to
Sensitivity

20
15
10

(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No SW1-07

1 OF 2

METRIC

GWP# 129-90-00 LOCATION Sta. 24+600 EB CL N 5 394 874.6 E 405 405.2 ORIGINATED BY FK
DIST Thunder Bay HWY 11/17 BOREHOLE TYPE Solid Stem Augers/ Hollow Stem Auger COMPILED BY JW
DATUM Geodetic DATE 2023.03.08 - 2023.03.08 LATITUDE 48.684239 LONGITUDE -88.633544 CHECKED BY RB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT		UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE		W _P W W _L WATER CONTENT (%)			
229.0	GROUND SURFACE							20 40 60 80 100					
0.0	PEAT Very Loose Black Wet		1	GS								48	
			2	SS	1		228					54	
227.6													
1.4	Silty CLAY , trace to some sand, occasional sand seams throughout Firm to Very Stiff Grey Moist (CL to CI)												
			3	SS	3		227						0 19 46 35
			4	SS	1		226						
			5	SS	0								
							225	2.5 +					
			6	SS	0		224						0 6 60 34
							223	2.5 +					
			7	SS	1								
							222		2.0 +				
			8	SS	1		221						0 3 53 44
							220						
			9	SS	4								

Continued Next Page

+³, ×³: Numbers refer to
Sensitivity

20
15
10

(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No SW1-07

2 OF 2

METRIC

GWP# 129-90-00 LOCATION Sta. 24+600 EB CL N 5 394 874.6 E 405 405.2 ORIGINATED BY FK
DIST Thunder Bay HWY 11/17 BOREHOLE TYPE Solid Stem Augers/ Hollow Stem Auger COMPILED BY JW
DATUM Geodetic DATE 2023.03.08 - 2023.03.08 LATITUDE 48.684239 LONGITUDE -88.633544 CHECKED BY RB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT NATURAL LIMIT MOISTURE LIQUID CONTENT LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa				WATER CONTENT (%)				
	Continued From Previous Page							<div>20 40 60 80 100</div> <div>○ UNCONFINED + FIELD VANE</div> <div>● QUICK TRIAXIAL × LAB VANE</div>				<div>W_p W W_L</div>				
217.6			10	SS	5		218								0 3 76 21	
11.4	SILT , some sand, trace clay Compact Reddish Brown Moist						217									
			11	SS	15		216									
			12	SS	20		215								0 16 81 3	
213.8							214									
15.2	Silty SAND , trace gravel		13	SS	50/										0 69 28 3	
213.5	Very Dense															
15.5	Reddish Brown Wet				0.101											
	END OF BOREHOLE AT 15.4m UPON AUGER REFUSAL ON POSSIBLE BEDROCK. Well installation consists of 19mm diameter Schedule 40 PVC pipe with a 3.05m slotted screen.															
	WATER LEVEL READINGS DATE DEPTH(m) ELEV.(m) 2023.03.15 5.5 223.5 2023.03.28 5.3 223.7															

ONTMT452 2020LIBRARY(MTO),GLB MTO-21663.GPJ 5/2/24

RECORD OF BOREHOLE No SW1-08

1 OF 2

METRIC

GWP# 129-90-00 LOCATION Sta. 24+600 EB O/S 10R N 5 394 867.7 E 405 412.4 ORIGINATED BY FK
DIST Thunder Bay HWY 11/17 BOREHOLE TYPE Solid Stem Augers/ Hollow Stem Auger COMPILED BY JW
DATUM Geodetic DATE 2023.03.07 - 2023.03.07 LATITUDE 48.684176 LONGITUDE -88.633448 CHECKED BY RB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE	20	40	60					
229.1	GROUND SURFACE						229									
0.0	PEAT Very Loose Black Wet		1	GS												
			2	SS	1		228									
			3	SS	2											
227.1							227									
2.0	Silty CLAY, trace to some sand, occasional to frequent sand seams Firm to Very Stiff Grey Wet (CL to CI)		4	SS	3											
			5	SS	0		226									
							225	1.7								
			6	SS	0											
							224	2.4								
			7	SS	0		223									
							222	1.7								
			8	SS	2		221									
							220	2.5								
			9	SS	2											

Continued Next Page

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

RECORD OF BOREHOLE No SW1-08

2 OF 2

METRIC

GWP# 129-90-00 LOCATION Sta. 24+600 EB O/S 10R N 5 394 867.7 E 405 412.4 ORIGINATED BY FK
DIST Thunder Bay HWY 11/17 BOREHOLE TYPE Solid Stem Augers/ Hollow Stem Auger COMPILED BY JW
DATUM Geodetic DATE 2023.03.07 - 2023.03.07 LATITUDE 48.684176 LONGITUDE -88.633448 CHECKED BY RB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE			WATER CONTENT (%) w _P w w _L								
	Continued From Previous Page							20 40 60 80 100											
216.9							219												
			10	SS	6													0 8 61 31	
							218												
12.2	SILT, trace clay, trace sand Loose to Compact Grey to Reddish Grey Moist (ML)		11	SS	7		217												
							216												
			12	SS	17		215											0 7 85 8	
							214												
15.2	SAND, some gravel, some silt Very Dense		13	SS	50														
213.5	Grey to Reddish Brown				0.220														
15.6	Wet END OF BOREHOLE AT 15.6m UPON AUGER REFUSAL ON POSSIBLE BEDROCK. WATER LEVEL AT 5.5m. BOREHOLE BACKFILLED WITH BENTONITE AND CUTTINGS TO SURFACE.																		

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

METRIC

[illegible]

+³, ×³: Numbers refer to Sensitivity

METRIC

SOIL PROFILE				SAMPLES		GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT		UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	20 40 60 80 100	W _P W W _L			
	Continued From Previous Page							SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE	WATER CONTENT (%)				
							218						
							217						
							216						
							215						
							214						
							213						
212.0													
17.0	END OF DCPT AT 17.0m UPON REFUSAL.						212						

+³, ×³: Numbers refer to Sensitivity

METRIC

[illegible]

+³, ×³: Numbers refer to Sensitivity

ONTMT4S2 2020LIBRARY(MTO).GLB MTO-21663.GPJ 5/2/24

RECORD OF BOREHOLE No SW1-10

2 OF 2

METRIC

GWP# 129-90-00 LOCATION Sta. 24+625 EB CL N 5 394 892.4 E 405 422.8 ORIGINATED BY FK
DIST Thunder Bay HWY 11/17 BOREHOLE TYPE Solid Stem Augers/ Hollow Stem Auger COMPILED BY JW
DATUM Geodetic DATE 2023.03.09 - 2023.03.09 LATITUDE 48.684397 LONGITUDE -88.633302 CHECKED BY RB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _P	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE									
	Continued From Previous Page							20	40	60	80	100					
	Silty CLAY , trace sand Very Stiff Grey Wet						218										
			10	SS	5									○			
217.0							217										
11.7	SILT , some clay to clayey, trace to some sand Loose to Compact Grey to Brown Moist to Wet (CL-ML)																
			11	SS	5		216							H ○			0 16 71 13
							215							○			
			12	SS	17												
							214										
			13	SS	29		213							○			
212.9																	
15.8	END OF BOREHOLE AT 15.8 m. BOREHOLE CAVED TO 8.5m AND WATER LEVEL AT 3.7m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE AND CUTTINGS TO SURFACE.																

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

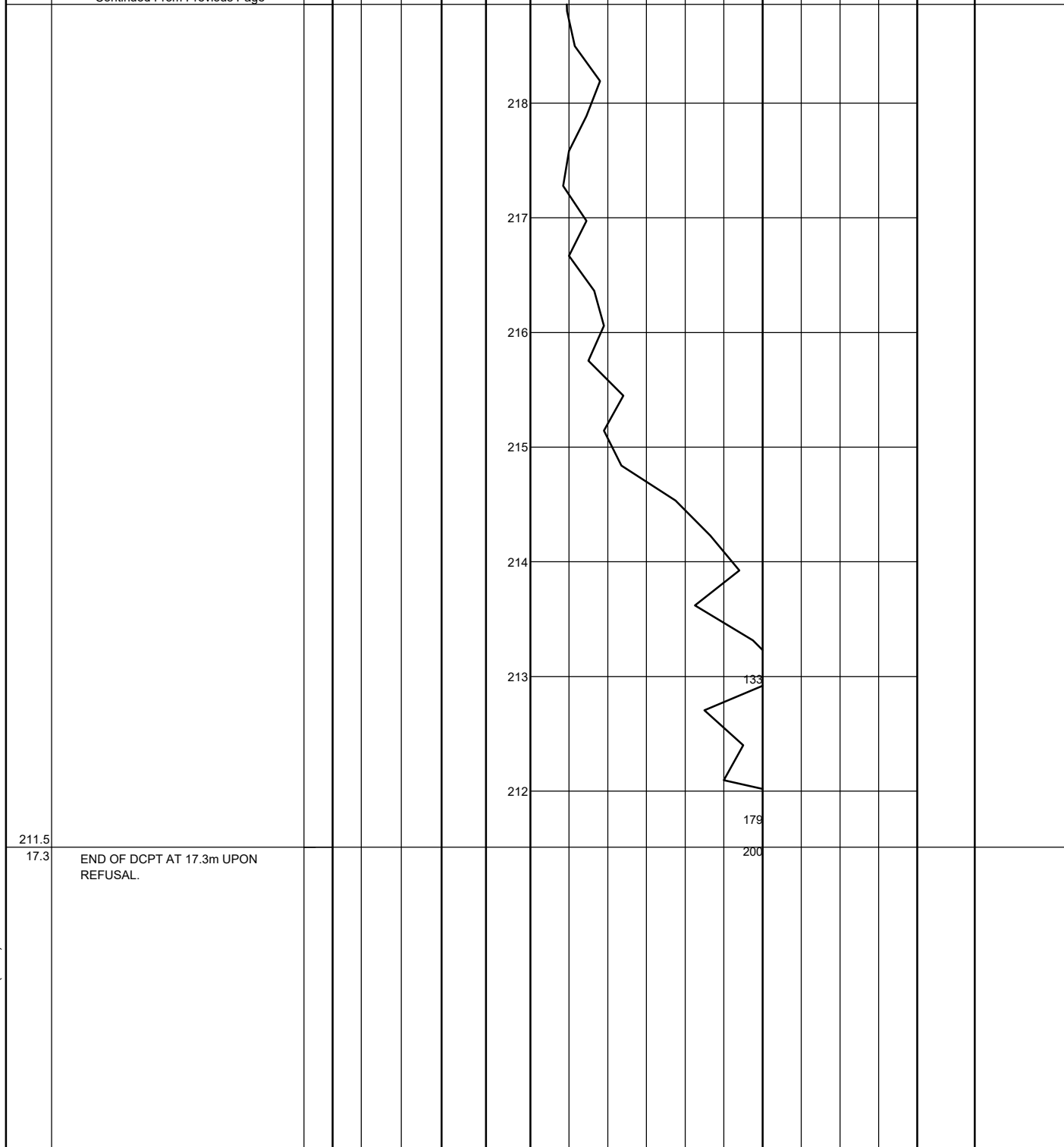
METRIC

[illegible]

+³, ×³: Numbers refer to Sensitivity

METRIC

ELEV. DEPTH	SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					WATER CONTENT (%)
								○ UNCONFINED ● QUICK TRIAXIAL	+ FIELD VANE × LAB VANE				
	Continued From Previous Page												






+³, ×³: Numbers refer to Sensitivity

RECORD OF BOREHOLE No SW1-12

1 OF 2

METRIC

GWP# 129-90-00 LOCATION Sta. 24+625 EB O/S 10L N 5 394 899.5 E 405 415.7 ORIGINATED BY FK
DIST Thunder Bay HWY 11/17 BOREHOLE TYPE Solid Stem Augers/ Hollow Stem Auger COMPILED BY JW
DATUM Geodetic DATE 2023.03.10 - 2023.03.10 LATITUDE 48.684461 LONGITUDE -88.633397 CHECKED BY RB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa				WATER CONTENT (%)				GR	SA	SI	CL	
								○ UNCONFINED ● QUICK TRIAXIAL	+ FIELD VANE × LAB VANE											
228.8	GROUND SURFACE							20	40	60	80	100	20	40	60					
0.0	PEAT Very Soft Black Wet		1	GS																
			2	SS	2															
227.4																				
1.4	Silty CLAY, trace sand, occasional sand seams Firm to Stiff Grey Moist to Wet (CL)		3	SS	2								○							
			4	SS	0								○							
			5	SS	0								○							
	Wet		6	SS	0									○						
223.1																				
5.6	Becoming varved from 5.6m to 8.7m, with frequent interbedded silt seams up to 13mm thick (CL)		7	SS	0									○						
			8	SS	1									○						
220.1																				
8.7																				
			9	SS	2									○						

Continued Next Page

+³, ×³: Numbers refer to
Sensitivity

20
15
10

(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No SW1-12

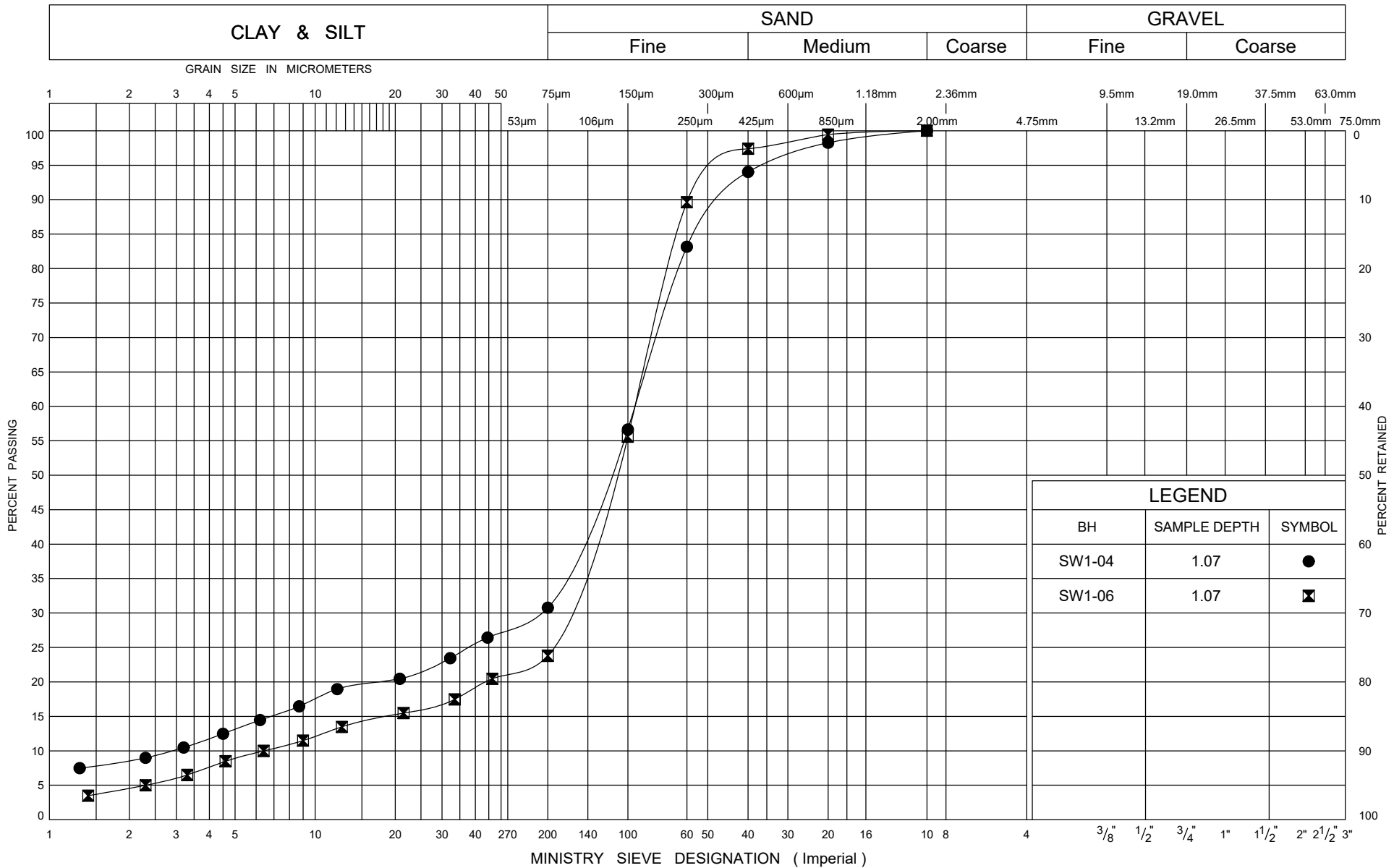
2 OF 2

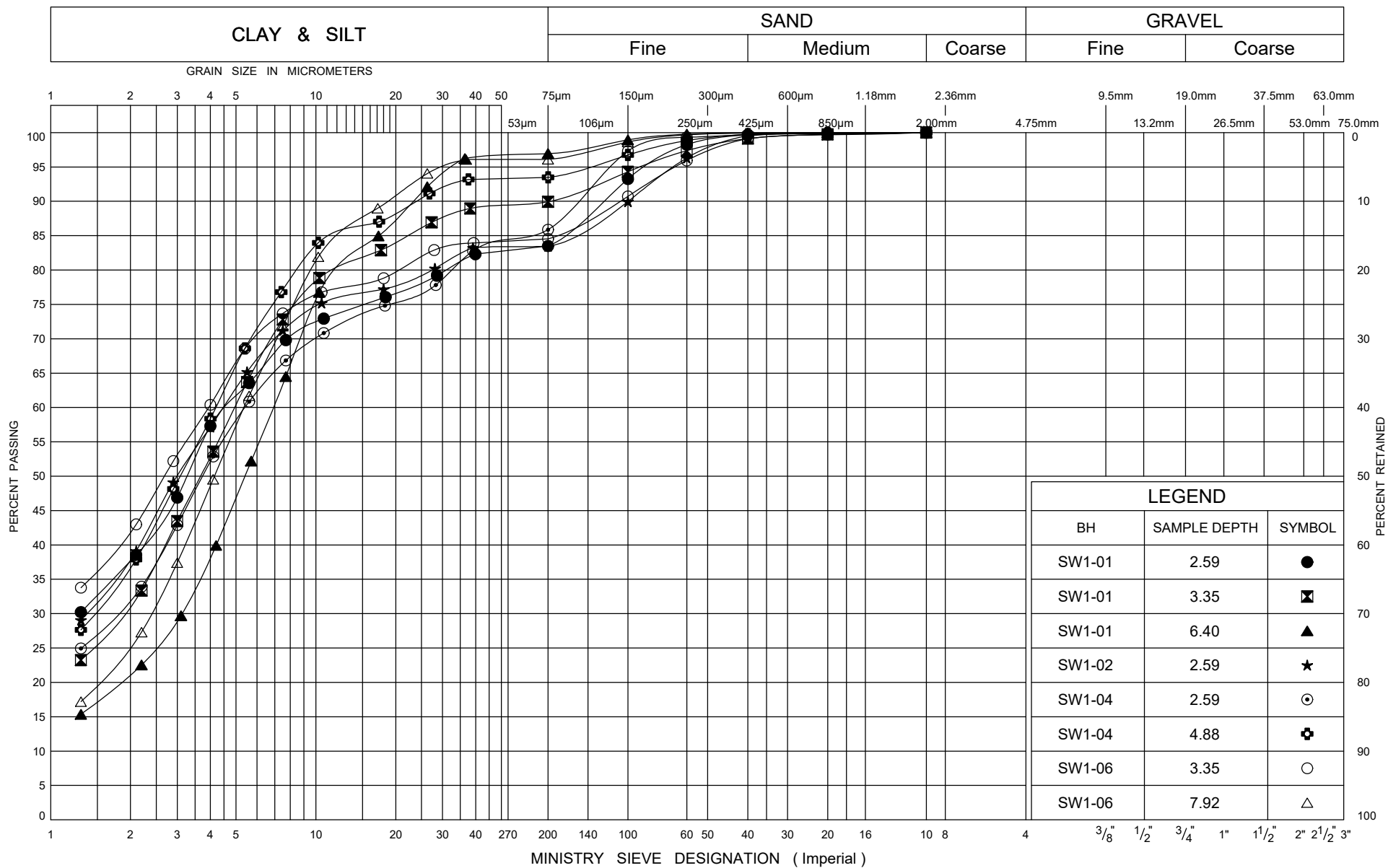
METRIC

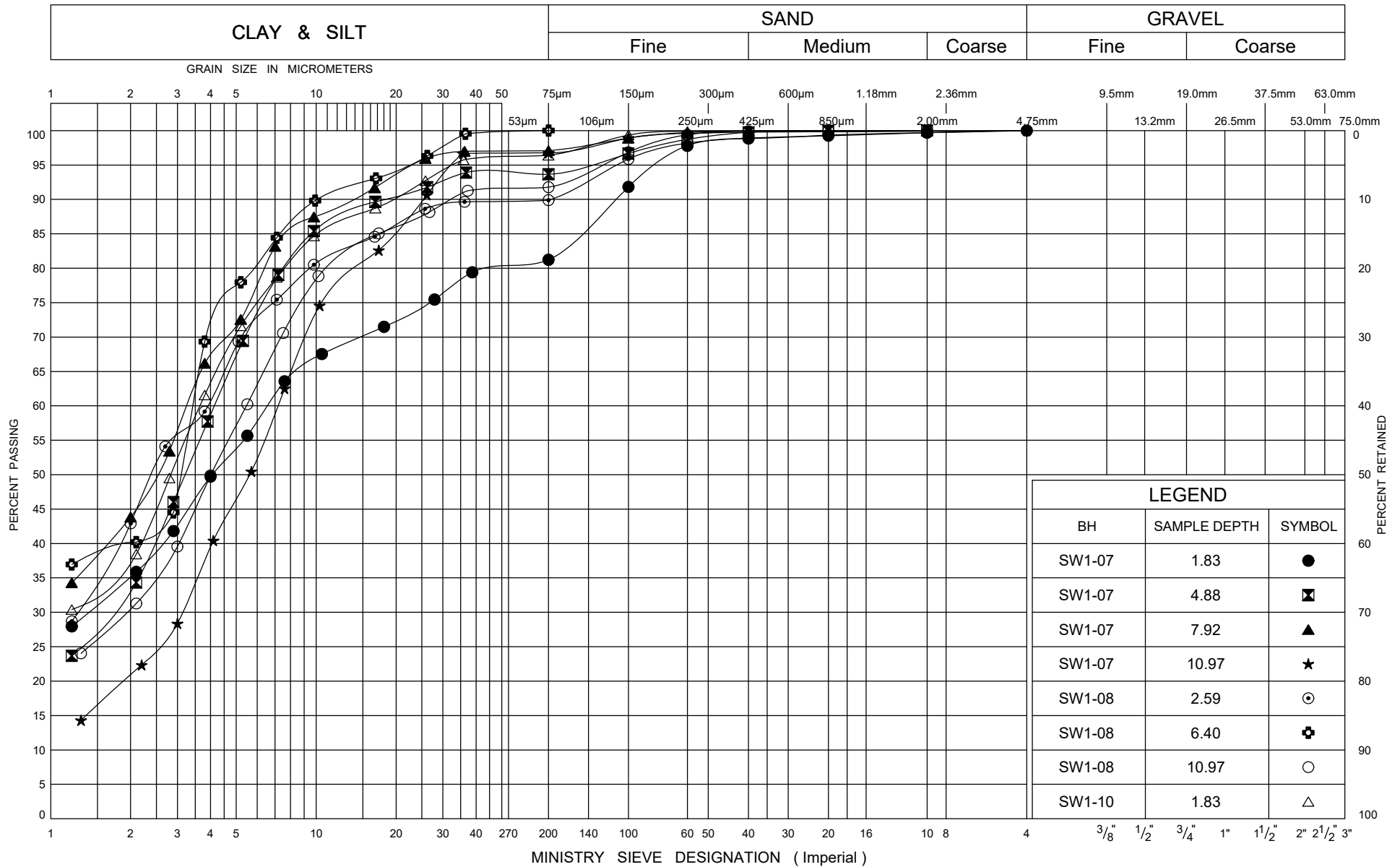
GWP# 129-90-00 LOCATION Sta. 24+625 EB O/S 10L N 5 394 899.5 E 405 415.7 ORIGINATED BY FK
DIST Thunder Bay HWY 11/17 BOREHOLE TYPE Solid Stem Augers/ Hollow Stem Auger COMPILED BY JW
DATUM Geodetic DATE 2023.03.10 - 2023.03.10 LATITUDE 48.684461 LONGITUDE -88.633397 CHECKED BY RB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE								
	Continued From Previous Page															
218.5																
10.2	Becoming varved from 10.2m to 11.0m, with frequent interbedded silt and sand seams (CL)															
217.8			10	SS	3											0 7 63 30
11.0																
217.0																
11.7	SILT, some sand, trace clay, occasional clay seams Loose to Compact Grey to Reddish Brown Wet		11	SS	7											
			12	SS	16											
			13	SS	24											0 7 85 8
212.9																
15.8	END OF BOREHOLE AT 15.8m. BOREHOLE OPEN TO 10.2m AND WATER LEVEL AT 4.4m. BOREHOLE BACKFILLED WITH BENTONITE AND CUTTINGS TO SURFACE.															

B2: Swamp Section 1 Geotechnical Laboratory Testing Results







Ministry of
Transportation

GRAIN SIZE DISTRIBUTION

Silty CLAY

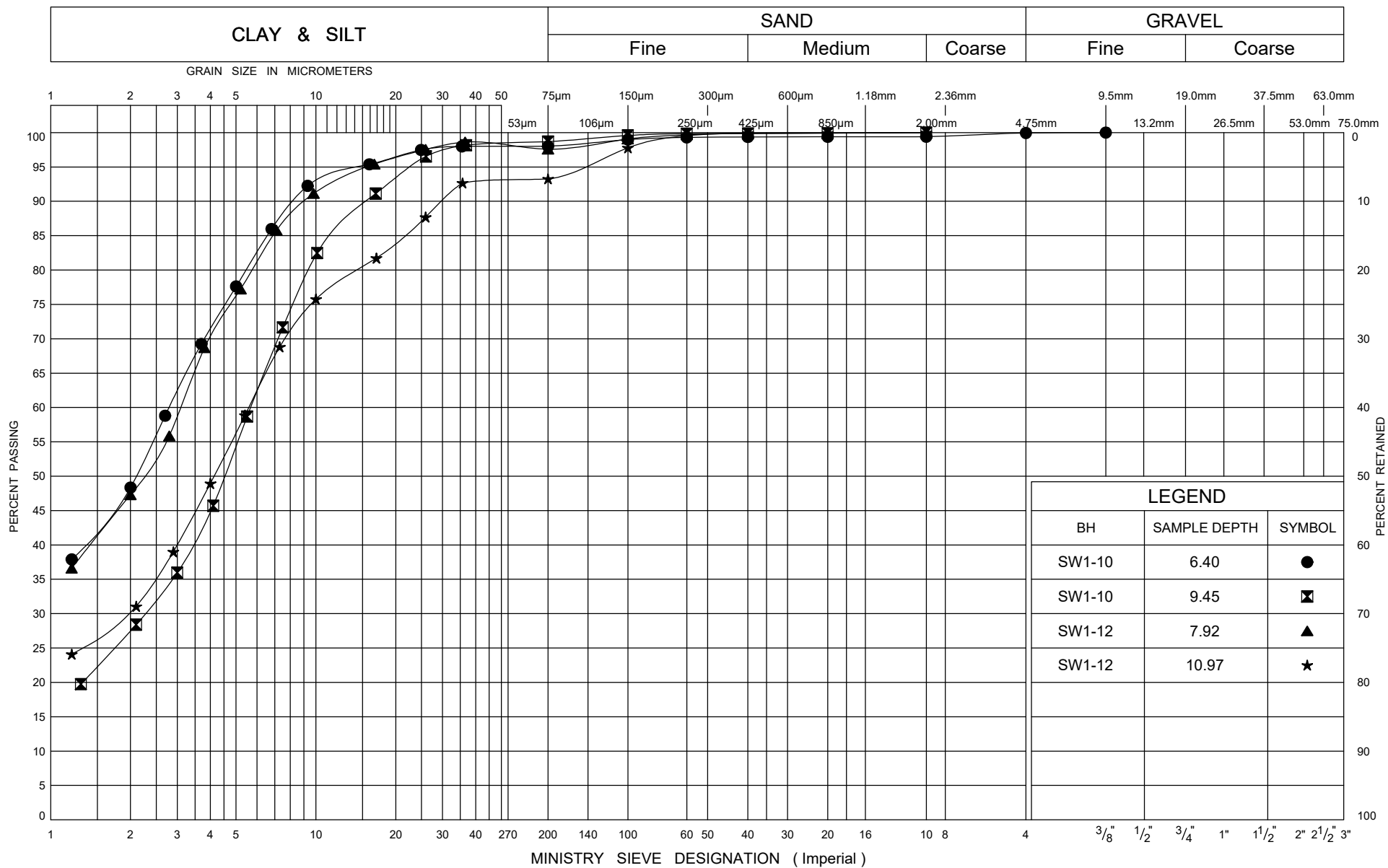
FIG No B3

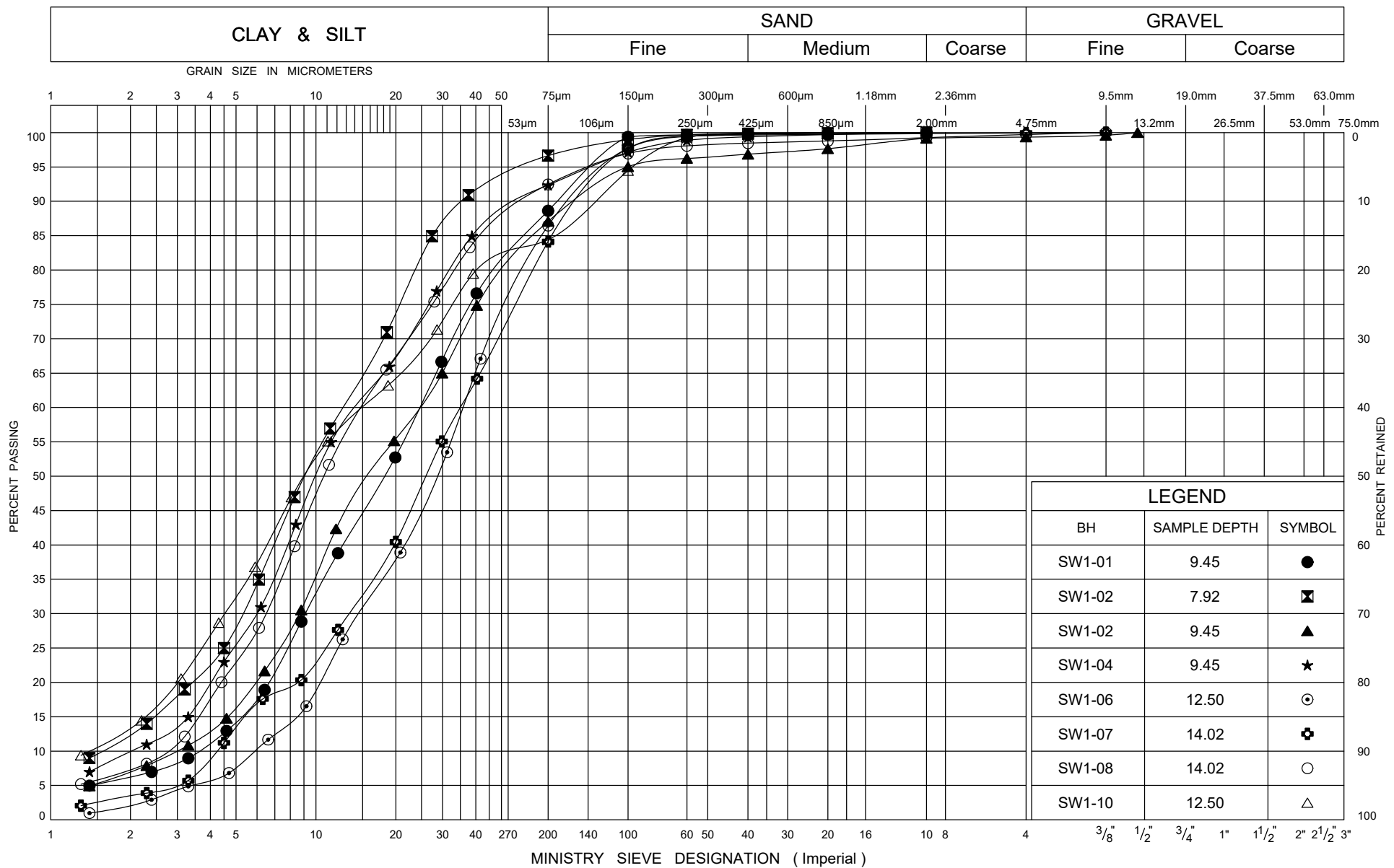
GWP# 129-90-00

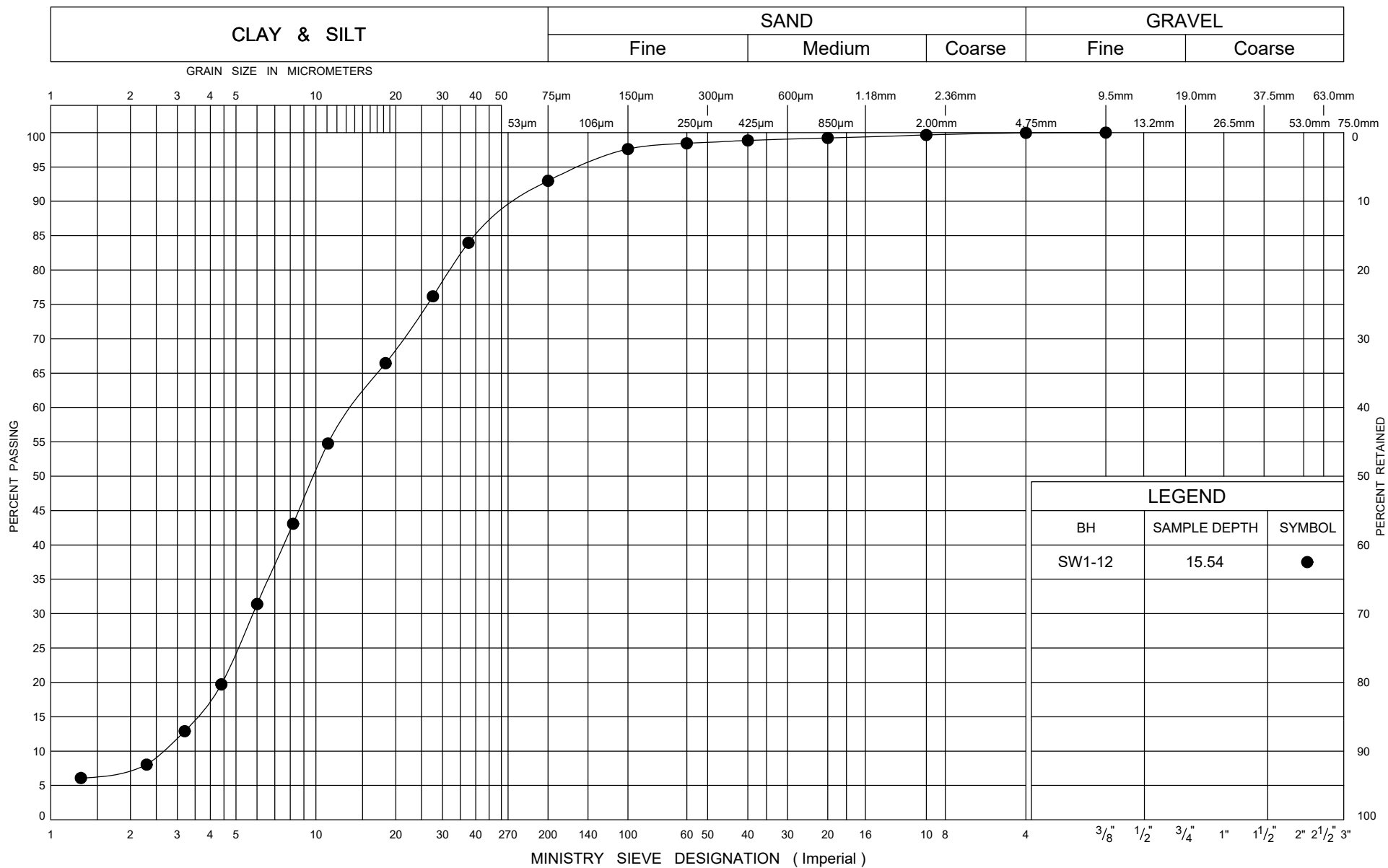


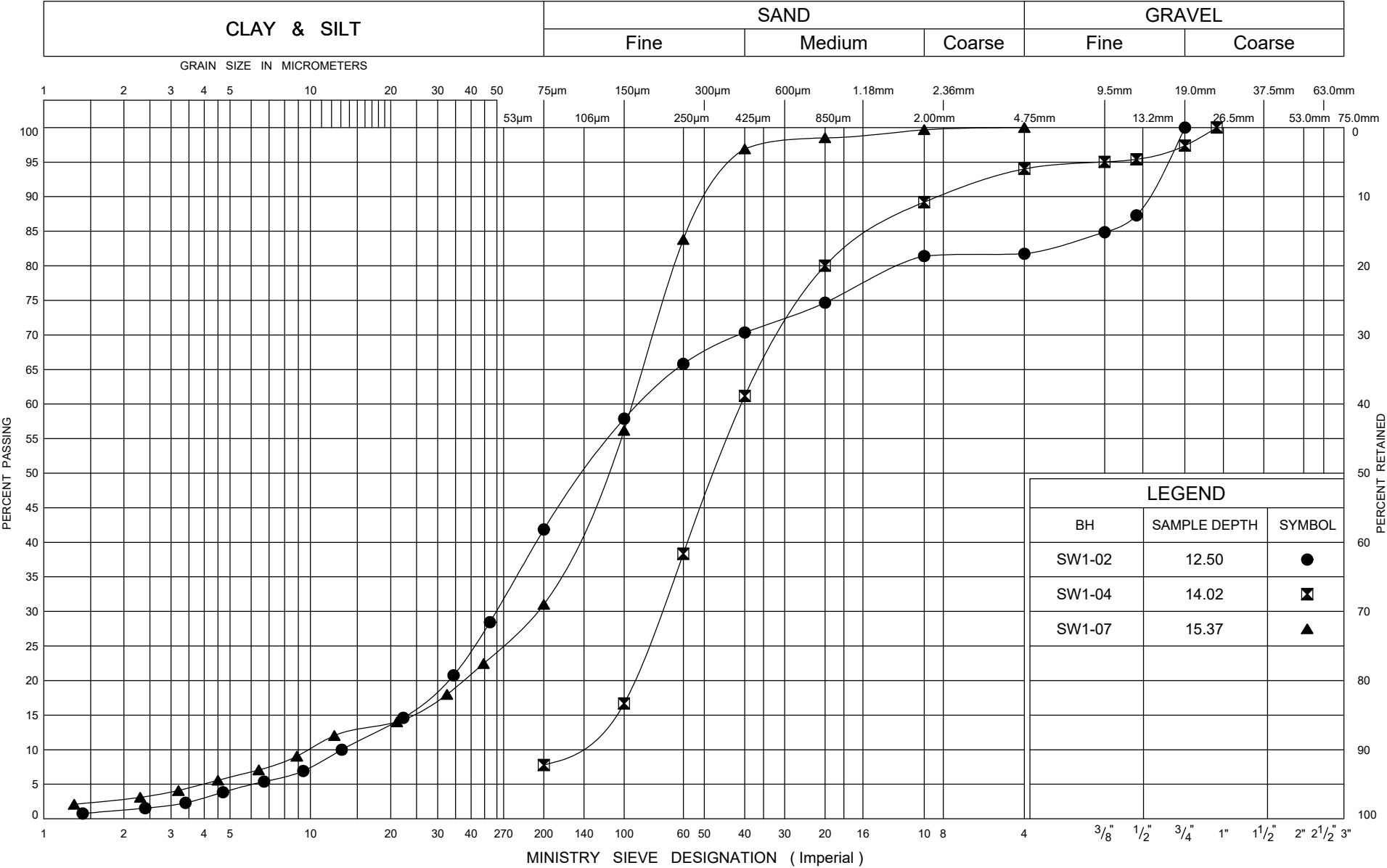
FIG No B4

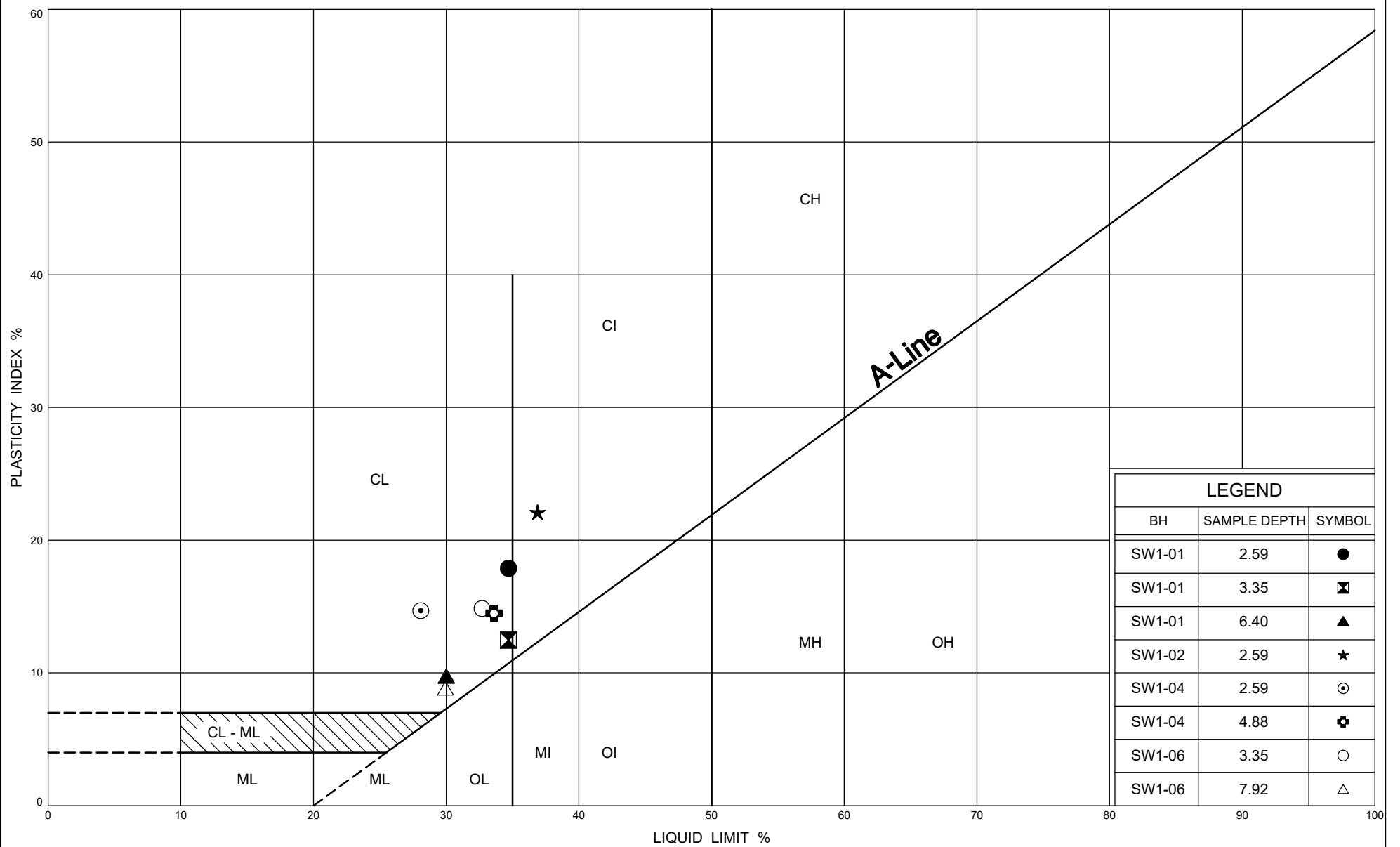
GWP# 129-90-00











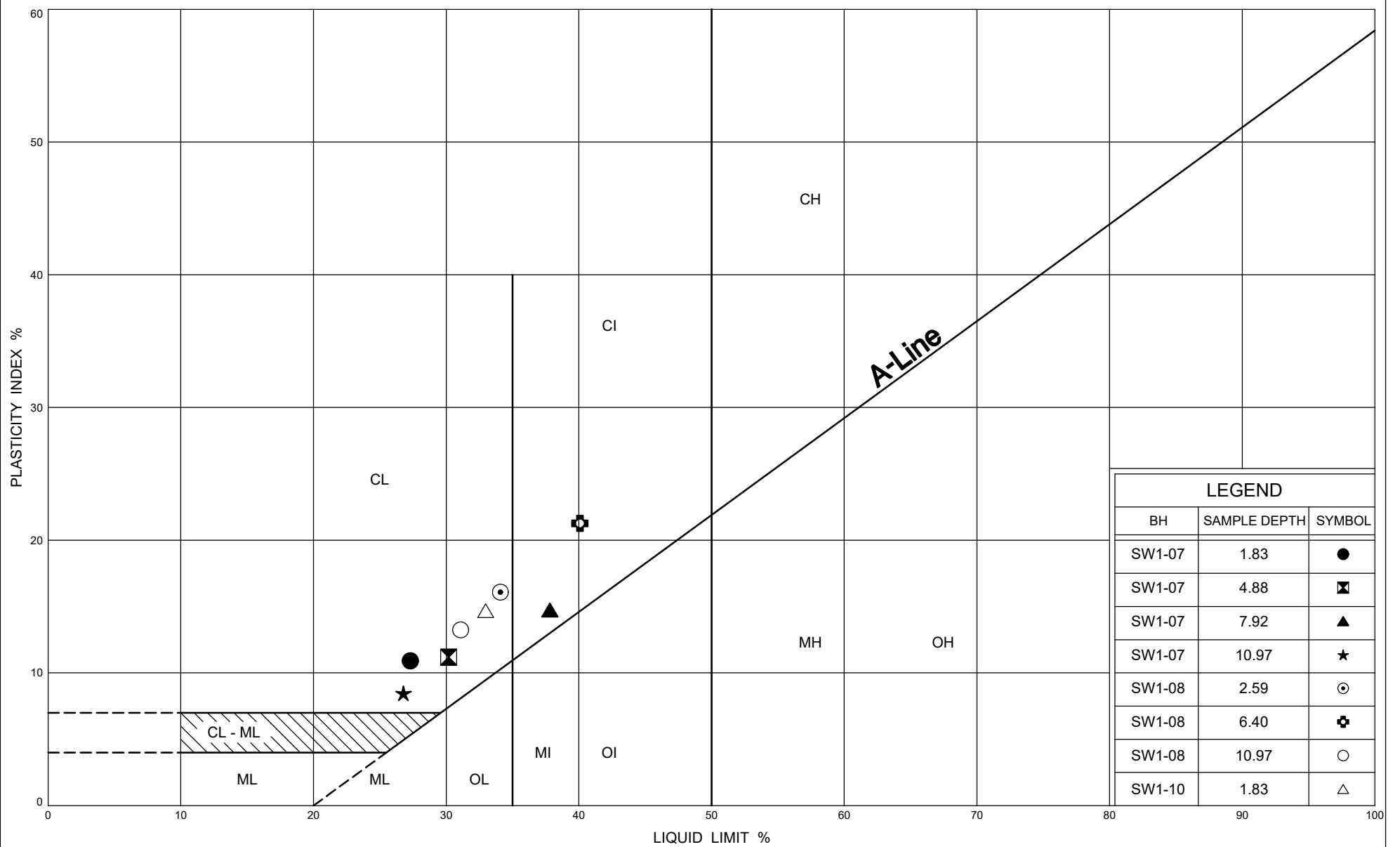
Ministry of
Transportation

PLASTICITY CHART

Silty CLAY

FIG No B9

GWP# 129-90-00



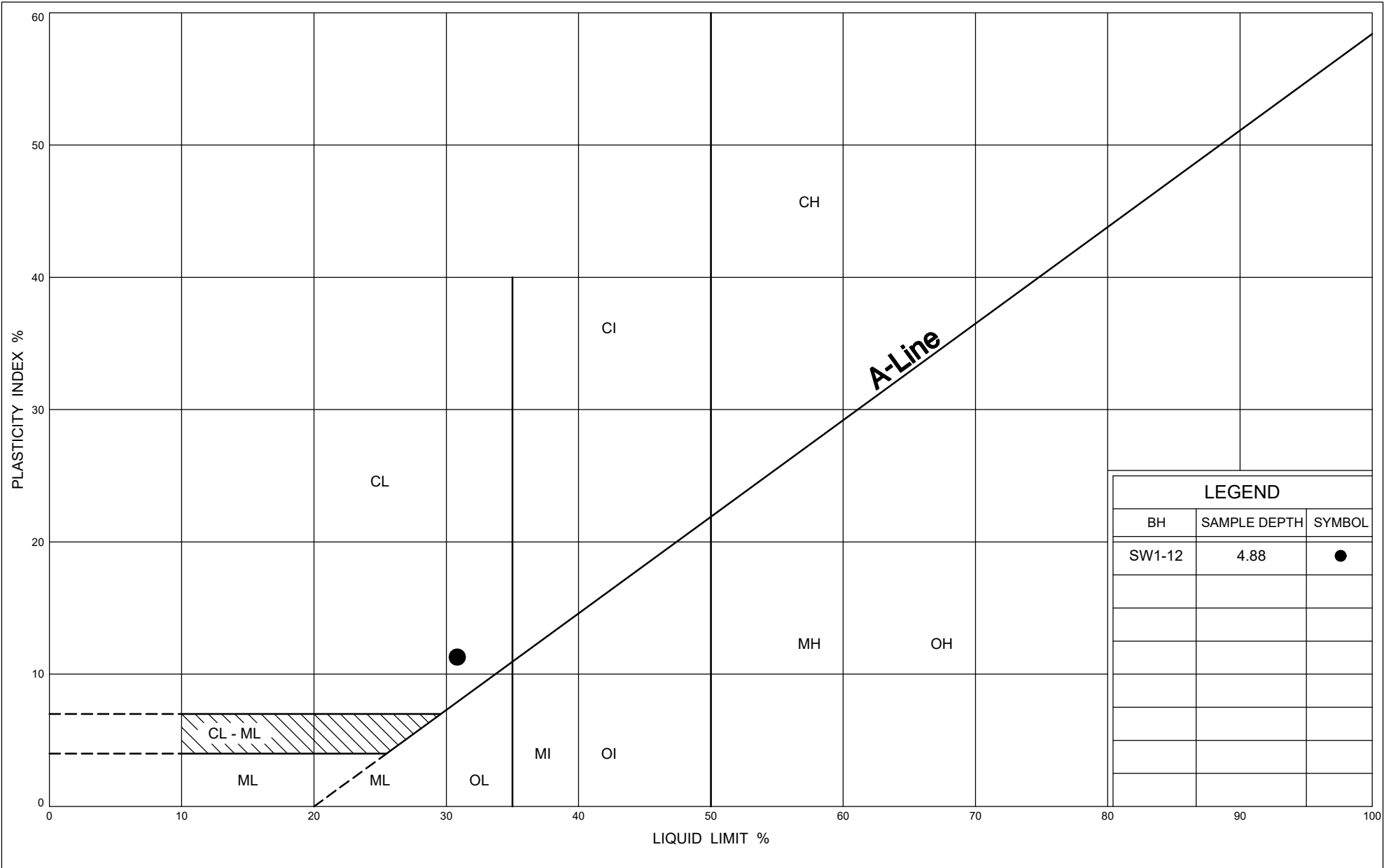
Ministry of
Transportation

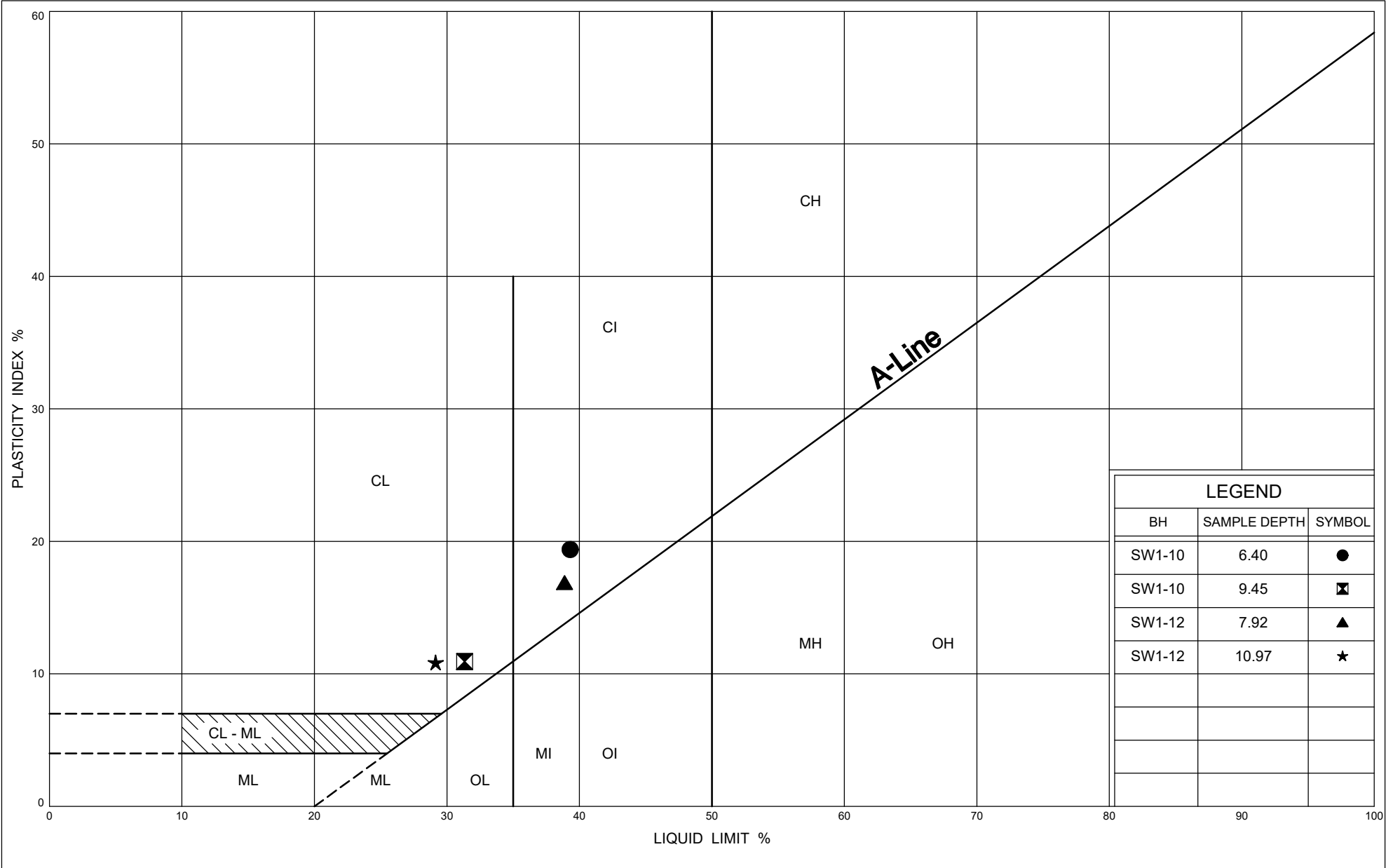
PLASTICITY CHART

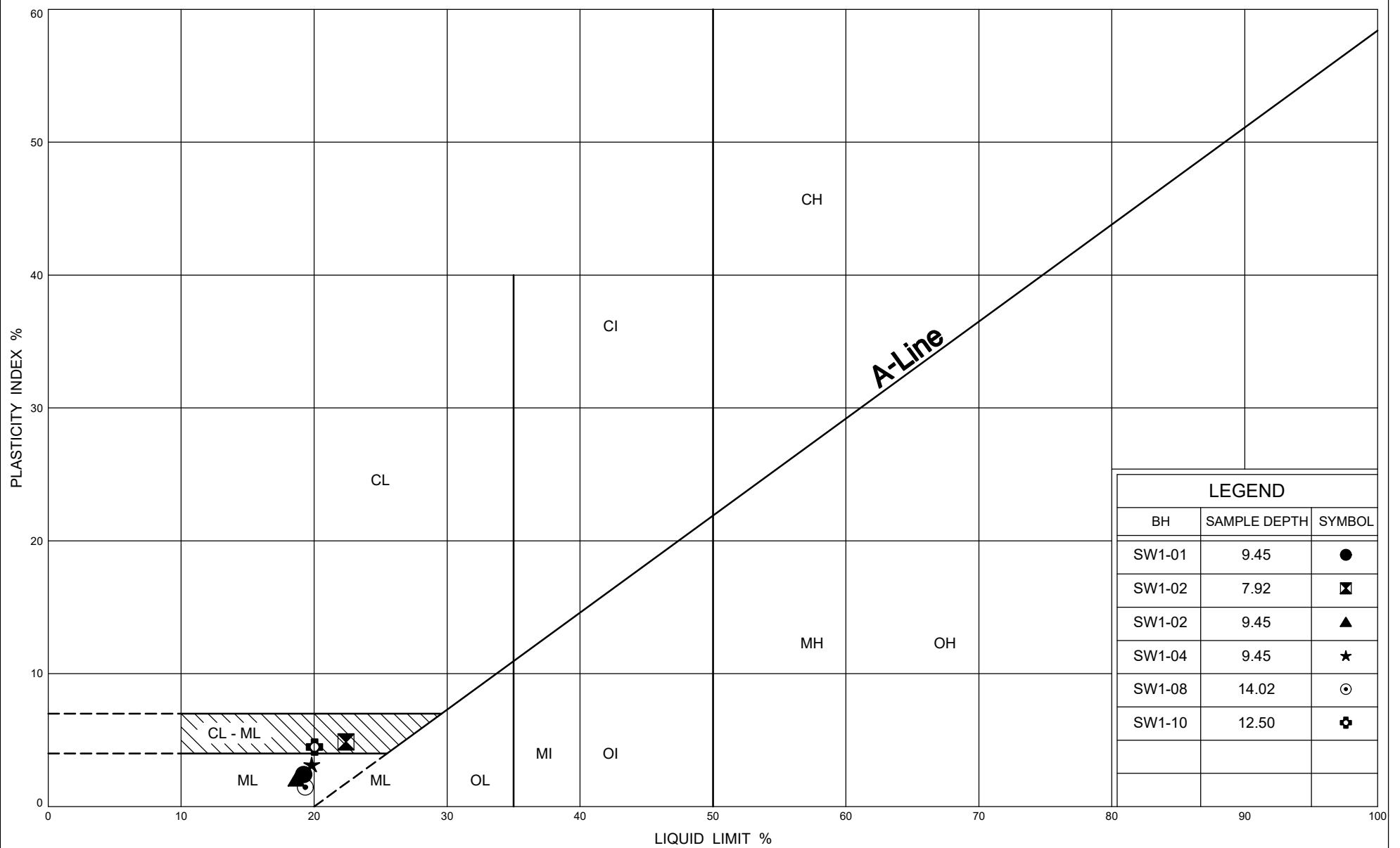
Silty CLAY

FIG No B10

GWP# 129-90-00







Ministry of
Transportation

PLASTICITY CHART SILT

FIG No B13

GWP# 129-90-00

APPENDIX C

C1: Deep Cut Section 1 Record of Borehole Sheets

SYMBOLS, ABBREVIATIONS AND TERMS USED ON RECORDS OF BOREHOLES

1. TEXTURAL CLASSIFICATION OF SOILS

CLASSIFICATION	PARTICLE SIZE	VISUAL IDENTIFICATION
Boulders	Greater than 200mm	same
Cobbles	75 to 200mm	same
Gravel	4.75 to 75mm	5 to 75mm
Sand	0.075 to 4.75mm	Not visible particles to 5mm
Silt	0.002 to 0.075mm	Non-plastic particles, not visible to the naked eye
Clay	Less than 0.002mm	Plastic particles, not visible to the naked eye

2. COARSE GRAIN SOIL DESCRIPTION (50% greater than 0.075mm)

TERMINOLOGY	PROPORTION
Trace or Occasional	Less than 10%
Some	10 to 20%
Adjective (e.g. silty or sandy)	20 to 35%
And (e.g. sand and gravel)	35 to 50%

3. TERMS DESCRIBING CONSISTENCY (COHESIVE SOILS ONLY)

DESCRIPTIVE TERM	UNDRAINED SHEAR STRENGTH (kPa)	APPROXIMATE SPT ⁽¹⁾ 'N' VALUE
Very Soft	12 or less	Less than 2
Soft	12 to 25	2 to 4
Firm	25 to 50	4 to 8
Stiff	50 to 100	8 to 15
Very Stiff	100 to 200	15 to 30
Hard	Greater than 200	Greater than 30

NOTE: Hierarchy of Soil Strength Prediction

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


4. TERMS DESCRIBING DENSITY (COHESIONLESS SOILS ONLY)

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

5. LEGEND FOR RECORDS OF BOREHOLES

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

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

 Water Level

C_{pen} Shear Strength Determination by Pocket Penetrometer

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

UNIFIED SOILS CLASSIFICATION

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

RECORD OF BOREHOLE No DC1-01

1 OF 1

METRIC

GWP# 129-90-00 LOCATION Sta. 24+720 EB O/S 10R N 5 394 950.0 E 405 498.6 ORIGINATED BY GAS
DIST Thunder Bay HWY 11/17 BOREHOLE TYPE Solid stem Auger COMPILED BY AS
DATUM Geodetic DATE 2023.03.27 - 2023.03.27 LATITUDE 48.684902 LONGITUDE -88.632259 CHECKED BY RB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
							20	40	60	80	100						
235.2	GROUND SURFACE																
0.0	TOPSOIL: (230mm)		1	SS	57												
0.2	GRAVEL, trace sand, trace silt																
234.7	Very Dense																
0.5	Reddish Brown																
	Damp																
	END OF BOREHOLE AT 0.5m UPON AUGER REFUSAL ON POSSIBLE BEDROCK. BOREHOLE OPEN AND DRY TO 0.5m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE AND SOIL CUTTINGS TO SURFACE.																

RECORD OF BOREHOLE No DC1-02

1 OF 1

METRIC

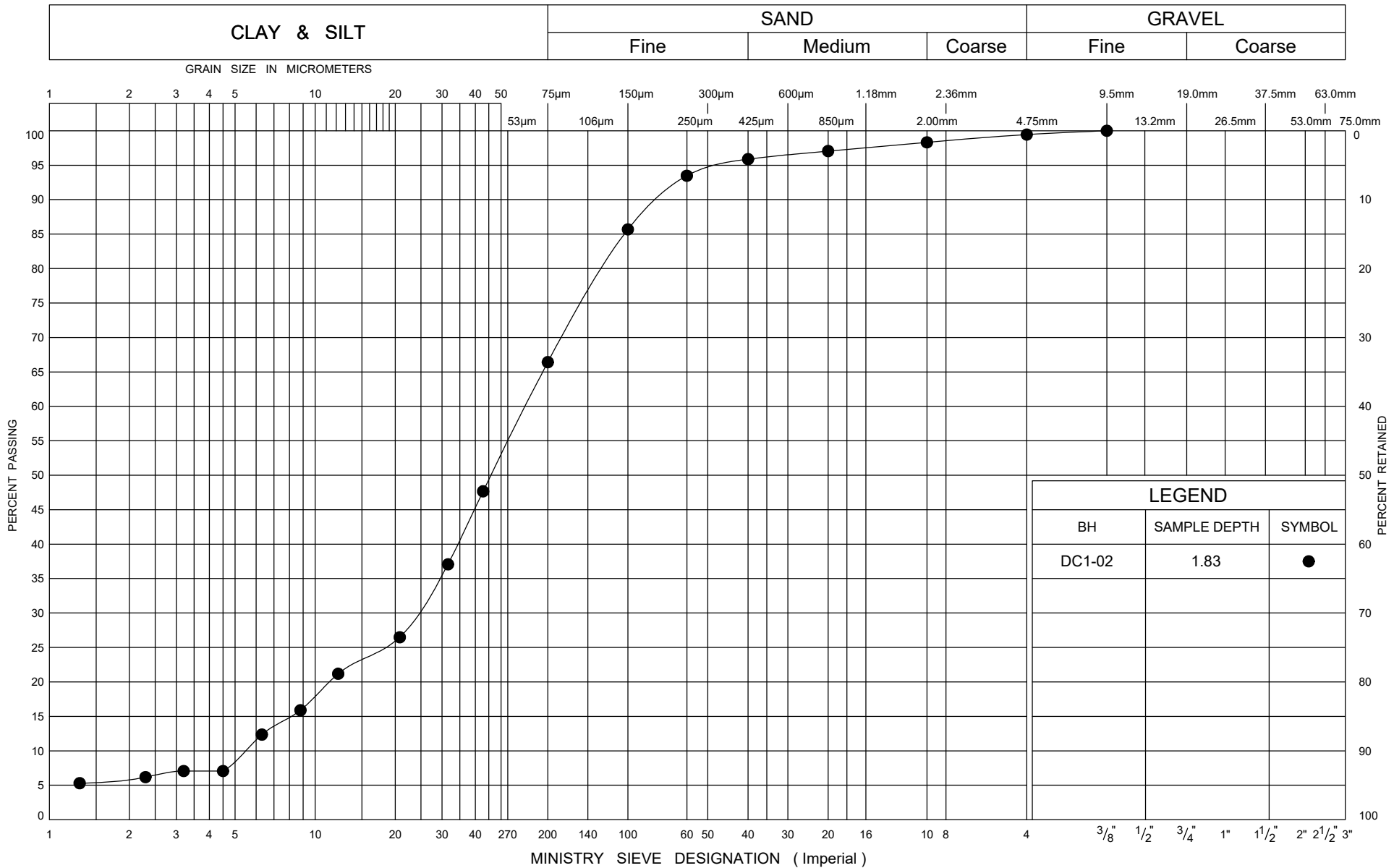
GWP# 129-90-00 LOCATION Sta. 24+790 EB O/S 10R N 5 394 994.8 E 405 551.8 ORIGINATED BY GAS
 DIST Thunder Bay HWY 11/17 BOREHOLE TYPE Solid stem Auger COMPILED BY AS
 DATUM Geodetic DATE 2023.03.27 - 2023.03.27 LATITUDE 48.685296 LONGITUDE -88.631525 CHECKED BY RB

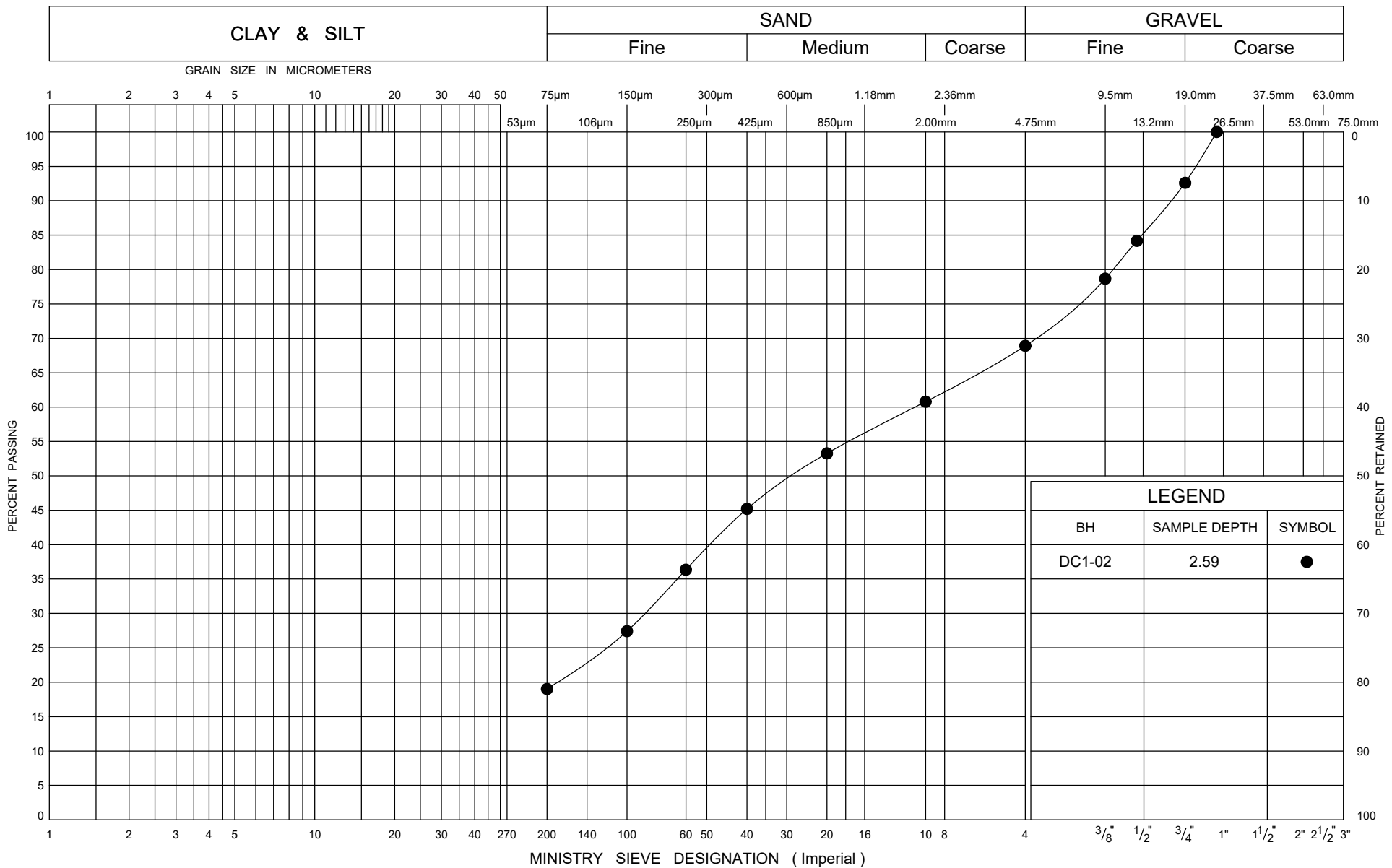
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa										
233.8	GROUND SURFACE							20	40	60	80	100						
0.0	TOPSOIL: (200mm)							20	40	60	80	100						
0.2	Sandy SILT , trace clay, trace gravel, trace organics in upper 0.6m Very Dense to Compact Brown Moist		1	SS	49	233												
			2	SS	11													
			3	SS	15		232											
231.5																		
2.3	Gravelly SAND , some silt, trace clay Loose to Compact Reddish Brown Wet		4	SS	8	231												
230.4			5	SS	12													
3.4	END OF BOREHOLE AT 3.4m UPON AUGER REFUSAL ON POSSIBLE BEDROCK. BOREHOLE CAVED TO 3.1m AND WATER LEVEL AT 2.8m UPON BOREHOLE COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE AND SOIL CUTTINGS TO SURFACE.																	

+³, ×³: Numbers refer to
Sensitivity

20
15
10
(%) STRAIN AT FAILURE

C2: Deep Cut Section 1 Geotechnical Laboratory Testing Figures





APPENDIX D

D1: High Fill 1 and Welch Creek EBL Culvert Record of Borehole Sheets

SYMBOLS, ABBREVIATIONS AND TERMS USED ON RECORDS OF BOREHOLES

1. TEXTURAL CLASSIFICATION OF SOILS

CLASSIFICATION	PARTICLE SIZE	VISUAL IDENTIFICATION
Boulders	Greater than 200mm	same
Cobbles	75 to 200mm	same
Gravel	4.75 to 75mm	5 to 75mm
Sand	0.075 to 4.75mm	Not visible particles to 5mm
Silt	0.002 to 0.075mm	Non-plastic particles, not visible to the naked eye
Clay	Less than 0.002mm	Plastic particles, not visible to the naked eye

2. COARSE GRAIN SOIL DESCRIPTION (50% greater than 0.075mm)

TERMINOLOGY	PROPORTION
Trace or Occasional	Less than 10%
Some	10 to 20%
Adjective (e.g. silty or sandy)	20 to 35%
And (e.g. sand and gravel)	35 to 50%

3. TERMS DESCRIBING CONSISTENCY (COHESIVE SOILS ONLY)

DESCRIPTIVE TERM	UNDRAINED SHEAR STRENGTH (kPa)	APPROXIMATE SPT ⁽¹⁾ 'N' VALUE
Very Soft	12 or less	Less than 2
Soft	12 to 25	2 to 4
Firm	25 to 50	4 to 8
Stiff	50 to 100	8 to 15
Very Stiff	100 to 200	15 to 30
Hard	Greater than 200	Greater than 30

NOTE: Hierarchy of Soil Strength Prediction

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



4. TERMS DESCRIBING DENSITY (COHESIONLESS SOILS ONLY)

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

5. LEGEND FOR RECORDS OF BOREHOLES

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

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


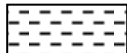



 Water Level
 Shear Strength Determination by Pocket Penetrometer

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

UNIFIED SOILS CLASSIFICATION

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

EXPLANATION OF ROCK LOGGING TERMS

<u>ROCK WEATHERING CLASSIFICATION</u>		<u>SYMBOLS</u>	
Fresh (FR)	No visible signs of weathering.		
Fresh Jointed (FJ)	Weathering limited to the surface of major discontinuities.		CLAYSTONE
Slightly Weathered (SW)	Penetrative weathering developed on open discontinuity surfaces, but only slight weathering of rock material.		SILTSTONE
Moderately Weathered (MW)	Weathering extends throughout the rock mass, but the rock material is not friable.		SANDSTONE
Highly Weathered (HW)	Weathering extends throughout the rock mass and the rock is partly friable.		COAL
Completely Weathered (CW)	Rock is wholly decomposed and in a friable condition, but the rock texture and structure are preserved.		Bedrock (general)

<u>DISCONTINUITY SPACING</u>		<u>STRENGTH CLASSIFICATION</u>			
Bedding	Bedding Plane Spacing	Rock Strength	Approximate Uniaxial Compressive Strength		Field Estimation of Hardness*
			(MPa)	(psi)	
Very thickly bedded	Greater than 2m	Extremely Strong	Greater than 250	Greater than 36,000	Specimen can only be chipped with a geological hammer
Thickly bedded	0.6 to 2m				
Medium bedded	0.2 to 0.6m	Very Strong	100-250	15,000 to 36,000	Requires many blows of geological hammer to break
Thinly bedded	60mm to 0.2m	Strong	50-100	7,500 to 15,000	Requires more than one blow of geological hammer to break
Very thinly bedded	20 to 60mm				
Laminated	6 to 20mm	Medium Strong	25.0 to 50.0	3,500 to 7,500	Breaks under single blow of geological hammer.
Thinly Laminated	Less than 6mm				
<u>TERMS</u>		Weak	5.0 to 25.0	750 to 3,500	Can be peeled by a pocket knife with difficulty
Total Core Recovery: (TCR)	Core recovered as a percentage of total core run length.	Very Weak	1.0 to 5.0	150 to 750	Can be peeled by a pocket knife, crumbles under firm blows of geological pick.
Solid Core Recovery: (SCR)	Percent Ratio of solid core of full cylindrical shape recovered. Expressed with respect to the total length of core run.	Extremely Weak (Rock)	0.25 to 1.0	35 to 150	Indented by thumbnail
Rock Quality Designation: (RQD)	Total length of sound core recovered in pieces 0.1m in length or larger as a percentage of total core run length.				
Uniaxial Compressive Strength (UCS)	Axial stress required to break the specimen				
Fracture Index: (FI)	Frequency of natural fractures per 0.3m of core run.				

RECORD OF BOREHOLE No HF1-01

1 OF 1

METRIC

GWP# 129-90-00 LOCATION Sta. 25+100 EB CL N 5 395 183.3 E 405 797.3 ORIGINATED BY FK
DIST Thunder Bay HWY 11/17 BOREHOLE TYPE Solid Stem Auger/ Hollow Stem Auger/ DCPT COMPILED BY AS
DATUM Geodetic DATE 2023.03.24 - 2023.03.24 LATITUDE 48.686951 LONGITUDE -88.628145 CHECKED BY RB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT							UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL					
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE													WATER CONTENT (%) W _P W W _L
223.0	GROUND SURFACE							20	40	60	80	100									
0.0	TOPSOIL: (200mm)							20	40	60	80	100									
0.2	Silty CLAY , trace sand, occasional sand seams Firm to Very Stiff Brown Moist (Cl)		1	GS																	
			2	SS	10		222														
			3	SS	7		221														
			4	SS	5																
			5	SS	7																
218.9																					
4.1	SILT, trace sand, trace clay Compact Reddish Brown Moist																				
			6	SS	29		218														
216.9																					
6.1	END OF BOREHOLE AT 6.1m UPON AUGER REFUSAL ON POSSIBLE BEDROCK. BOREHOLE OPEN AND DRY TO 6.1m UPON COMPLETION. Piezometer installation consists of 25mm diameter Schedule 40 PVC pipe with a 3.05m slotted screen. WATER LEVEL READINGS DATE DEPTH(m) ELEV.(m) 2023.03.24 Dry - 2023.03.28 5.3 217.7 2023.04.16 3.7 219.3		7	SS	50/ 0.0																

ONTMT452 2020LIBRARY(MTO).GLB MTO-21663.GPJ 5/2/24

RECORD OF BOREHOLE No HF1-02

1 OF 2

METRIC

GWP# 129-90-00 LOCATION Sta. 25+175 EB O/S 10R N 5 395 218.2 E 405 864.5 ORIGINATED BY FK
DIST Thunder Bay HWY 11/17 BOREHOLE TYPE Solid Stem Auger/ Hollow Stem Auger/ DCPT COMPILED BY JW
DATUM Geodetic DATE 2023.03.23 - 2023.03.23 LATITUDE 48.687254 LONGITUDE -88.627225 CHECKED BY RB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa				WATER CONTENT (%)							
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE	20	40	60	80	100	W _P			W	W _L	GR
221.8	GROUND SURFACE																		
0.0	TOPSOIL: (75mm) Silty CLAY , trace sand, occasional sand seams Stiff to Hard Brown Moist (Cl)		1	GS															
0.1			2	SS	11														
			3	SS	7														
			4	SS	4														
			5	SS	2														
	</																		

Continued Next Page


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

RECORD OF BOREHOLE No HF1-02

2 OF 2

METRIC

GWP# 129-90-00 LOCATION Sta. 25+175 EB O/S 10R N 5 395 218.2 E 405 864.5 ORIGINATED BY FK
 DIST Thunder Bay HWY 11/17 BOREHOLE TYPE Solid Stem Auger/ Hollow Stem Auger/ DCPT COMPILED BY JW
 DATUM Geodetic DATE 2023.03.23 - 2023.03.23 LATITUDE 48.687254 LONGITUDE -88.627225 CHECKED BY RB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE				
Continued From Previous Page								20 40 60 80 100	20 40 60			
211.1 10.7	DCPT starts at 10.7m						211					
							210					
							209					
							208					
							207					
							206					
205.6 16.3	END OF BOREHOLE AT 16.3m UPON DCPT REFUSAL. BOREHOLE DRY UPON COMPLETION, BACKFILLED WITH BENTONITE AND CUTTINGS TO SURFACE.											

ONTMT452 2020LIBRARY(MTO).GLB MTO-21663.GPJ 5/2/24

RECORD OF BOREHOLE No HF1-03

1 OF 2

METRIC

GWP# 129-90-00 LOCATION Sta. 25+400 EB CL N 5 395 355.6 E 406 042.9 ORIGINATED BY GAS
DIST Thunder Bay HWY 11/17 BOREHOLE TYPE Hollow Stem Auger COMPILED BY AS
DATUM Geodetic DATE 2023.03.29 - 2023.03.29 LATITUDE 48.688461 LONGITUDE -88.624769 CHECKED BY RB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa				WATER CONTENT (%)				
222.0	GROUND SURFACE															
0.0	TOPSOIL: (600mm)		1	SS	13											
221.4																
0.6	Silty CLAY , trace sand, occasional sand seams, desiccated from 0.6 to 2.9m. Stiff Light Brown Moist (Cl to CH)		2	SS	12											
			3	SS	11											
			4	SS	7											
	Becoming Dark Brown															
			5	SS	12											
			6	SS	11											
216.4																
5.6	SILT , trace clay Dense Reddish Brown Moist															
			7	SS	33											
			8	SS	34											
212.9																
9.1	SILT and SAND , gravelly, trace clay Very Dense Brown Wet		9	SS	100/ 0.125											

Continued Next Page

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

RECORD OF BOREHOLE No HF1-03

2 OF 2

METRIC

GWP# 129-90-00 LOCATION Sta. 25+400 EB CL N 5 395 355.6 E 406 042.9 ORIGINATED BY GAS
DIST Thunder Bay HWY 11/17 BOREHOLE TYPE Hollow Stem Auger COMPILED BY AS
DATUM Geodetic DATE 2023.03.29 - 2023.03.29 LATITUDE 48.688461 LONGITUDE -88.624769 CHECKED BY RB


SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
	Continued From Previous Page																
210.7			10	SS	63		211									24 38 35 3	
11.3	END OF BOREHOLE AT 11.3m. BOREHOLE CAVED TO 9.7m, WATER LEVEL AT 9.3m UPON BOREHOLE COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE AND CUTTINGS TO SURFACE.																

RECORD OF BOREHOLE No HF1-04

1 OF 2

METRIC

GWP# 129-90-00 LOCATION Sta. 25+475 EB CL N 5 395 398.7 E 406 104.3 ORIGINATED BY GAS
DIST Thunder Bay HWY 11/17 BOREHOLE TYPE Hollow Stem Auger COMPILED BY AS
DATUM Geodetic DATE 2023.03.30 - 2023.03.30 LATITUDE 48.688838 LONGITUDE -88.623924 CHECKED BY RB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																									
								20 40 60 80 100																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																									
222.0	GROUND SURFACE																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																
0.0	TOPSOIL: (175mm)																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																
0.2	Silty CLAY , occasional sand seams, desiccated from 0.2 to 5.3m. Very Stiff to Firm Light Brown Moist (CI to CL)		1	SS	17	221																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																											

Continued Next Page

+³, ×³: Numbers refer to
Sensitivity

20
15
10
(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No HF1-04

2 OF 2

METRIC

GWP# 129-90-00 LOCATION Sta. 25+475 EB CL N 5 395 398.7 E 406 104.3 ORIGINATED BY GAS
DIST Thunder Bay HWY 11/17 BOREHOLE TYPE Hollow Stem Auger COMPILED BY AS
DATUM Geodetic DATE 2023.03.30 - 2023.03.30 LATITUDE 48.688838 LONGITUDE -88.623924 CHECKED BY RB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
	Continued From Previous Page																
211.6			11	SS	100/												
10.4	END OF BOREHOLE AT 10.4m UPON AUGER REFUSAL ON POSSIBLE BEDROCK. BOREHOLE CAVED TO 7.3m, WATER LEVEL AT 7.3m UPON BOREHOLE COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE AND CUTTINGS TO SURFACE.				0.0												

RECORD OF BOREHOLE No HF1-05

1 OF 2

METRIC

GWP# 129-90-00 LOCATION Sta. 25+550 EB CL N 5 395 441.8 E 406 165.7 ORIGINATED BY GAS
DIST Thunder Bay HWY 11/17 BOREHOLE TYPE Hollow Stem Auger COMPILED BY AS
DATUM Geodetic DATE 2023.04.11 - 2023.04.11 LATITUDE 48.689216 LONGITUDE -88.623080 CHECKED BY RB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa			WATER CONTENT (%)					
								○ UNCONFINED + FIELD VANE								
								● QUICK TRIAXIAL × LAB VANE								
222.0	GROUND SURFACE							20	40	60	80	100				
0.1	TOPSOIL: (50mm) Silty CLAY , trace sand, some organics from 0.1 to 0.8m Stiff Brown Moist		1	SS	9										0 4 58 38	
			2	SS	11											
			3	SS	8											
			4	SS	11											
			5	SS	7											
			6	SS	7										0 1 67 32	
216.4																
5.6	SILT , trace clay Compact to Dense Reddish Brown Moist		7	SS	25											
			8	SS	32											
213.3																
8.7	SAND , trace silt Dense to Very Dense Reddish Brown Wet		9	SS	46										12 73 15 (SI+CL)	

Continued Next Page

+³ ×³: Numbers refer to
Sensitivity

20
15
10

(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No HF1-05

2 OF 2

METRIC

GWP# 129-90-00 LOCATION Sta. 25+550 EB CL N 5 395 441.8 E 406 165.7 ORIGINATED BY GAS
DIST Thunder Bay HWY 11/17 BOREHOLE TYPE Hollow Stem Auger COMPILED BY AS
DATUM Geodetic DATE 2023.04.11 - 2023.04.11 LATITUDE 48.689216 LONGITUDE -88.623080 CHECKED BY RB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
211.2	Continued From Previous Page		10	SS	100/												
10.8	END OF BOREHOLE AT 10.8m UPON AUGUR REFUSAL ON POSSIBLE BEDROCK Piezometer installation consists of 25mm diameter Schedule 40 PVC pipe with a 3.05m slotted screen. WATER LEVEL READINGS DATE DEPTH(m) ELEV.(m) 2023.04.11 7.5 214.5 2023.04.16 6.5 215.5 2023.04.20 5.6 216.4 2023.06.02 5.2 216.8				0.125												

RECORD OF BOREHOLE No HF1-06

1 OF 2

METRIC

GWP# 129-90-00 LOCATION Sta. 25+625+EB CL N 5 395 484.9 E 406 227.1 ORIGINATED BY GAS
DIST Thunder Bay HWY 11/17 BOREHOLE TYPE Hollow Stem Auger COMPILED BY AS
DATUM Geodetic DATE 2023.04.19 - 2023.04.20 LATITUDE 48.689593 LONGITUDE -88.622236 CHECKED BY RB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE			WATER CONTENT (%) w _p w w _L				GR	SA	SI	CL
222.5	GROUND SURFACE																	
0.0 0.1	TOPSOIL: (75mm)																	
	Silty CLAY , trace sand, frequent organics from 0.1 to 1.7m, desiccated from 0.1 to 4.1m. Stiff to Firm Brown Moist (CI to CL)		1	SS	5		222						○					
			2	SS	10		221						○					
220.6			3	SS	8								—○—			0	1 60 39	
1.9	Becoming varved from 1.9 to 2.9m, with frequent interbedded silt seams		4	SS	4		220						○					
			5	SS	4		219						○					
							218											
			6	SS	0		217											
219.6			1	TW			216											
2.9							215											
			7	SS	5								—○—			0	0 76 24	
							214											
			8	SS	12		213						○					

Continued Next Page

+³, ×³: Numbers refer to
Sensitivity

20
15
10

(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No HF1-06

2 OF 2

METRIC

GWP# 129-90-00 LOCATION Sta. 25+625+EB CL N 5 395 484.9 E 406 227.1 ORIGINATED BY GAS
DIST Thunder Bay HWY 11/17 BOREHOLE TYPE Hollow Stem Auger COMPILED BY AS
DATUM Geodetic DATE 2023.04.19 - 2023.04.20 LATITUDE 48.689593 LONGITUDE -88.622236 CHECKED BY RB

SOIL PROFILE			SAMPLES			GROUND WATER * CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE							PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT w _P w w _L WATER CONTENT (%)		
	Continued From Previous Page							20	40	60	80	100					
212.3																	
10.2	SILT , trace clay Compact to Dense Reddish Brown Wet Bubbles observed in open borehole from 9.1m, dissipated by 11m. Augers grinding on potential gravel from 11.8 to 12.2m.		9	SS	24		212										0 0 95 5
							211										
							210										
209.7	No recovery		10	SS	21												
12.8	END OF BOREHOLE AT 12.8m UPON AUGUR REFUSAL ON POSSIBLE BEDROCK. BOREHOLE CAVED TO 10.6m, GROUNDWATER LEVEL AT GROUND SURFACE UPON BOREHOLE COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE AND CUTTINGS TO SURFACE.		11	SS	100/ 0.025												

+³, ×³: Numbers refer to
Sensitivity

20
15
10
(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No HF1-07

1 OF 2

METRIC

GWP# 129-90-00 LOCATION Sta. 24+700 EB CL N 5 395 528.1 E 406 288.3 ORIGINATED BY GAS
DIST Thunder Bay HWY 11/17 BOREHOLE TYPE Hollow Stem Auger COMPILED BY AS
DATUM Geodetic DATE 2023.04.18 - 2023.04.19 LATITUDE 48.689972 LONGITUDE -88.621393 CHECKED BY RB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W _P	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									WATER CONTENT (%)			
								○ UNCONFINED	+	FIELD VANE	● QUICK TRIAXIAL						×	LAB VANE		
223.0	GROUND SURFACE							20	40	60	80	100								
0.0	TOPSOIL, occasional wood fragments (600mm)		1	SS	5															
222.4																				
0.6	Silty CLAY , desiccated from 0.6 to 2.9m. Stiff to Very Stiff Light Brown Moist (CH)		2	SS	10		222													
			3	SS	9		221													
			4	SS	6															
							220													
			5	SS	5															
	Becoming Grey						219													
			1	TW			218													
							217													
			6	SS	6															
							216													
			7	SS	10		215													
214.3																				
8.7	SILT , trace clay Compact Brown Moist						214													
	Bubbles observed in open borehole from 9.1m, dissipated by 10.6m.		8	SS	27															
							213													

Continued Next Page

+³, ×³: Numbers refer to
Sensitivity

20
15
10

(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No HF1-07

2 OF 2

METRIC

GWP# 129-90-00 LOCATION Sta. 24+700 EB CL N 5 395 528.1 E 406 288.3 ORIGINATED BY GAS
DIST Thunder Bay HWY 11/17 BOREHOLE TYPE Hollow Stem Auger COMPILED BY AS
DATUM Geodetic DATE 2023.04.18 - 2023.04.19 LATITUDE 48.689972 LONGITUDE -88.621393 CHECKED BY RB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
						○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE					WATER CONTENT (%)						
						20	40	60	80	100	20	40	60				
212.3	Continued From Previous Page																
10.7 212.1	GRAVEL, some sand, trace silt, trace clay Very Dense Reddish Brown Moist	◇	9	SS	100/						○						
10.9	END OF BOREHOLE AT 10.9m UPON AUGUR REFUSAL ON POSSIBLE BEDROCK. BOREHOLE CAVED TO 8.8m AND GROUNDWATER LEVEL WAS 6.0m UPON BOREHOLE COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE AND CUTTINGS TO SURFACE.	◇			0.30												

RECORD OF BOREHOLE No HF1-08

1 OF 2

METRIC

GWP# 129-90-00 LOCATION Sta. 25+775 EB CL N 5 395 573.3 E 406 348.2 ORIGINATED BY GAS
DIST Thunder Bay HWY 11/17 BOREHOLE TYPE Hollow Stem Auger COMPILED BY AS
DATUM Geodetic DATE 2023.04.18 - 2023.04.18 LATITUDE 48.690369 LONGITUDE -88.620569 CHECKED BY RB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT W _P	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE								WATER CONTENT (%)
223.5	GROUND SURFACE							20	40	60	80	100	20	40	60	
0.0	TOPSOIL: (25mm) Silty CLAY , trace sand, desiccated from 25mm to 4.1m. Firm to Very Stiff Brown Moist (CH)		1	SS	6		223							○		
			2	SS	8									○		0 3 54 43
222.1							222									
1.4	Becoming varved from 1.4 to 3.0m, with frequent interbedded silt seams		3	SS	8									○		
			4	SS	6		221							○		
220.5																
3.0			1	TW			220									
	Becoming grey		5	SS	7		219							○		
218.0							218									
5.5	SILT , trace sand, trace clay Dense to Very Dense Reddish Brown Moist to Wet		6	SS	30		217							○		0 3 89 8
			7	SS	100/ 0.75		216							○		
214.9							215									
8.7	Silty SAND , trace gravel Dense to Very Dense Reddish Brown Wet		8	SS	47		214							○		

Continued Next Page

+³ ×³: Numbers refer to
Sensitivity

20
15
10
(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No HF1-08

2 OF 2

METRIC

GWP# 129-90-00 LOCATION Sta. 25+775 EB CL N 5 395 573.3 E 406 348.2 ORIGINATED BY GAS
DIST Thunder Bay HWY 11/17 BOREHOLE TYPE Hollow Stem Auger COMPILED BY AS
DATUM Geodetic DATE 2023.04.18 - 2023.04.18 LATITUDE 48.690369 LONGITUDE -88.620569 CHECKED BY RB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa 20 40 60 80 100 ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE	WATER CONTENT (%) 20 40 60								
212.8	Continued From Previous Page		9	SS	100/		213										
10.7	END OF BOREHOLE AT 10.7m, UPON AUGER REFUSAL ON POSSIBLE BEDROCK. Well installation consists of 25mm diameter Schedule 40 PVC pipe with a 3.05m slotted screen. WATER LEVEL READINGS DATE DEPTH(m) ELEV.(m) 2023.04.19 0.4 223.1 2023.04.20 3.8 219.7 2023.06.02 6.5 217.1				0.08												

RECORD OF BOREHOLE No HF1-09

1 OF 1

METRIC

GWP# 129-90-00 LOCATION Sta. 25+850 EB CL N 5 395 621.4 E 406 405.7 ORIGINATED BY GAS
 DIST Thunder Bay HWY 11/17 BOREHOLE TYPE Hollow Stem Auger COMPILED BY AS
 DATUM Geodetic DATE 2023.04.18 - 2023.04.18 LATITUDE 48.690792 LONGITUDE -88.619776 CHECKED BY RB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL					
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa											
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE											
224.8	GROUND SURFACE							20	40	60	80	100		PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT			
0.0	TOPSOIL: (100mm)														W _P	W	W _L		
0.1	SAND and SILT , trace to some clay, trace gravel, trace organics Compact to Dense Reddish Brown Moist		1	SS	14			224								○			
																○			
		3	SS	26		223								○					
		4	SS	42										○					
221.9							222												
2.9	END OF BOREHOLE AT 2.9m UPON AUGER REFUSAL ON POSSIBLE BEDROCK, BOREHOLE OPEN TO 2.4m, WATER LEVEL TO 1.2m UPON BOREHOLE COMPLETION. BOREHOLE BACKFILLED TO SURFACE WITH BENTONITE AND CUTTINGS.																		

+³, ×³: Numbers refer to
Sensitivity

20
15
10
(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No HF1-10

1 OF 1

METRIC

GWP# 129-90-00 LOCATION Sta. 25+925 EB CL N 5 395 672.3 E 406 460.8 ORIGINATED BY GAS
DIST Thunder Bay HWY 11/17 BOREHOLE TYPE Hollow Stem Auger COMPILED BY AS
DATUM Geodetic DATE 2023.04.15 - 2023.04.15 LATITUDE 48.691241 LONGITUDE -88.619016 CHECKED BY RB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE				WATER CONTENT (%) w _p w w _L				GR	SA	SI	CL
231.8	GROUND SURFACE						231								0 16 54 30				
0.0 0.1	TOPSOIL: (75mm) Silty CLAY , trace to some sand, occasional sand seams Firm to Stiff Brown Moist (CL)		1	SS	7														
			2	SS	6														
	Becoming Grey		3	SS	15														
229.3			4	SS	14														
2.6	Becoming varved below 2.6m, with frequent interbedded silt seams		5	SS	14														
			6	SS	14														
		7	SS	100/ 0.0															
225.8							226												
6.1	END OF BOREHOLE AT 6.1m UPON AUGER REFUSAL ON POSSIBLE BEDROCK. BOREHOLE OPEN TO 2.1m, WATER LEVEL TO 1.2m UPON BOREHOLE COMPLETION. BOREHOLE BACKFILLED TO SURFACE WITH BENTONITE AND CUTTINGS.																		

ONTMT452 2020LIBRARY(MTO),GLB MTO-21663.GPJ 5/2/24

RECORD OF BOREHOLE No HF1-11

1 OF 1

METRIC

GWP# 129-90-00 LOCATION Sta. 26+000 EB CL N 5 395 725.9 E 406 513.2 ORIGINATED BY GAS
DIST Thunder Bay HWY 11/17 BOREHOLE TYPE Hollow Stem Auger COMPILED BY AS
DATUM Geodetic DATE 2023.04.15 - 2023.04.15 LATITUDE 48.691714 LONGITUDE -88.618291 CHECKED BY RB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
242.3	GROUND SURFACE		1	SS	20									GR SA SI CL
0.0	TOPSOIL: (50mm)													
	SAND , some gravel, some silt, trace clay Compact to Very Dense Reddish Brown Wet		2	SS	18									
			3	SS	100/ 0.150									
			4	SS	39									
		5	SS	100/ 0.100										
237.5			6	SS	100/									
4.7	END OF BOREHOLE AT 4.7m, AUGUR REFUSAL ON POSSIBLE BEDROCK. BOREHOLE OPEN TO 2.1m, WATER LEVEL AT GROUND SURFACE UPON BOREHOLE COMPLETION. BOREHOLE BACKFILLED TO SURFACE WITH BENTONITE AND CUTTINGS.				0.125									

ONTMT452 2020LIBRARY(MTO).GLB MTO-21663.GPJ 5/2/24

RECORD OF BOREHOLE No WC-EBL-01 1 OF 2 METRIC

GWP# 129-90-00 LOCATION Sta. 25+275 EB CL N 5 395 283.8 E 405 940.6 ORIGINATED BY FK
DIST Thunder Bay HWY 11/17 BOREHOLE TYPE Solid Stem Augers/NW Casing/NQ Coring COMPILED BY JW
DATUM Geodetic DATE 2023.03.11 - 2023.03.14 LATITUDE 48.687663 LONGITUDE -88.625922 CHECKED BY RB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT		UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE		W _P W W _L WATER CONTENT (%)				
213.2	GROUND SURFACE							20	40	60	80	100		
0.0	TOPSOIL: (150 mm)							20	40	60	80	100		
0.2	Silty CLAY , with organics, trace sand Soft Brown Moist (CH-MH)		1	GS			213							
			2	SS	2		212							0 5 48 47
211.7														
1.5	Silty CLAY , trace sand, varved with frequent silt and sand seams Soft to Very Stiff Brown to Grey Moist (CL-ML)		3	SS	3		211							
			4	SS	5		210							
			5	SS	2									0 0 78 22
							209							
			6	SS	3									
							208							
							207							
			7	SS	7									
							206							
205.6														
7.6	SILT , trace clay, trace sand Loose to Compact Reddish Brown Wet		8	SS	7		205							0 7 85 8
							204							
			9	SS	29									

Continued Next Page

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

RECORD OF BOREHOLE No WC-EBL-01 2 OF 2 METRIC

GWP# 129-90-00 LOCATION Sta. 25+275 EB CL N 5 395 283.8 E 405 940.6 ORIGINATED BY FK
DIST Thunder Bay HWY 11/17 BOREHOLE TYPE Solid Stem Augers/NW Casing/NQ Coring COMPILED BY JW
DATUM Geodetic DATE 2023.03.11 - 2023.03.14 LATITUDE 48.687663 LONGITUDE -88.625922 CHECKED BY RB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa				WATER CONTENT (%)					
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE				W _p W W _L					
Continued From Previous Page								20	40	60	80	100	20	40	60		
202.5							203										
10.7	SAND and GRAVEL , some silt, occasional cobbles Dense to Very Dense Brown Wet Cored through cobbles up to 150mm diameter from 11.3 to 12.0m		10	SS	46		202										
			1	RUN			201										
							200										
			11	SS	50/ 0.050		199										
198.3							198										
14.9	BEDROCK (SANDSTONE - SIBLEY GROUP) , reddish brown, fresh, strong to very strong, occasional quartz veins up to 50mm thick		2	RUN			197										
			3	RUN			196										
195.2																	
18.0	END OF BOREHOLE AT 18.0m. BOREHOLE BACKFILLED WITH BENTONITE TO GROUND SURFACE.																

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

RECORD OF BOREHOLE No WC-EBL-02

1 OF 2

METRIC

GWP# 129-90-00 LOCATION Sta. 25+275 O/S 27R N 5 395 265.4 E 405 959.6 ORIGINATED BY FK
DIST Thunder Bay HWY 11/17 BOREHOLE TYPE Solid Stem Augers/NW Casing/NQ Coring COMPILED BY JW
DATUM Geodetic DATE 2023.03.16 - 2023.03.20 LATITUDE 48.688006 LONGITUDE -88.626222 CHECKED BY RB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT		UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa		WATER CONTENT (%)			
212.0	GROUND SURFACE							20 40 60 80 100		w _P w w _L			GR SA SI CL
0.0	TOPSOIL: (900 mm)		1	SS	0			○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE					
211.1	Silty CLAY , with organics, some sand Very Soft Grey Wet (CI-MI)		2	SS	2		211						
0.9			3	SS	0		210			-----			0 16 58 26
			4	SS	0					○			
		209.0		5	SS	0		209			-----		
3.0	Silty CLAY , varved with frequent silt and sand seams Stiff Grey Wet (CI) Auger Refusal reached upon Boulder at 4.3m, Borehole moved 4.0m north and sampling resumed at 3.0m. TW1 sample collected in adjacent borehole from 3.0m to 3.6m.					208	3.3 +						
207.7		4.3	6	SS	11		207			○			
206.4	SILT and SAND , trace gravel, trace clay Very Dense Reddish Brown Moist		7	SS	53		206			○			7 45 45 3
5.6							205						
			8	SS	28		204						
203.5	No recovery												
8.5			9	SS	72/ 0.275		203			○			50 41 9 (SI+CL)
	Casing advancer grinding on potential cobbles from 8.5m to 9.1m.												

Continued Next Page

+³, ×³: Numbers refer to
Sensitivity

20
15
10

(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No WC-EBL-02 2 OF 2 METRIC

GWP# 129-90-00 LOCATION Sta. 25+275 O/S 27R N 5 395 265.4 E 405 959.6 ORIGINATED BY FK
DIST Thunder Bay HWY 11/17 BOREHOLE TYPE Solid Stem Augers/NW Casing/NQ Coring COMPILED BY JW
DATUM Geodetic DATE 2023.03.16 - 2023.03.20 LATITUDE 48.688006 LONGITUDE -88.626222 CHECKED BY RB

SOIL PROFILE			SAMPLES			GROUND WATER * CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE					
	Continued From Previous Page							20 40 60 80 100					
			10	SS	100/ 0.250		201						
200.1	Cobble and boulders from 11.1 to 11.6m												
11.9	BEDROCK (SANDSTONE - SIBLEY GROUP), reddish brown, fresh, strong to very strong		1	RUN			200						
			2	RUN			199						
			3	RUN			198						
196.0							197						
16.0	END OF BOREHOLE AT 16.0m. Well installation consists of 25mm diameter Schedule 40 PVC pipe with a 3.05m slotted screen. WATER LEVEL READINGS DATE DEPTH(m) ELEV.(m) 2023.03.28 -1.0 213.0 2023.04.16 -1.7 213.7												

ONTMT452 2020LIBRARY(MTO).GLB MTO-21663.GPJ 5/6/24

RECORD OF BOREHOLE No WC-EBL-03

1 OF 3

METRIC

GWP# 129-90-00 LOCATION Sta. 25+275 O/S 20L N 5 395 303.1 E 405 936.8 ORIGINATED BY FK
DIST Thunder Bay HWY 11/17 BOREHOLE TYPE Solid Stem Augers/NW Casing/NQ Coring COMPILED BY JW
DATUM Geodetic DATE 2023.03.15 - 2023.03.15 LATITUDE 48.688033 LONGITUDE -88.625725 CHECKED BY RB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT		UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa		WATER CONTENT (%)			
213.0	GROUND SURFACE							20 40 60 80 100		w _p w w _L			GR SA SI CL
0.0	TOPSOIL: (900 mm)		1	SS	3							135	
212.1												115	
0.9	Silty CLAY , with organics, trace sand Very Soft Grey Wet (CI-MI)		2	SS	2		212						
			3	SS	0		211						
			4	SS	0								0 10 61 29
210.0							210						
3.0	Silty CLAY , varved with frequent silt and sand seams Very Stiff Grey Wet (CL)		5	SS	2		209						
			6	SS	2		208						0 0 61 39
207.4													
5.6	SILT , trace clay, trace sand Loose to Compact Grey Wet		7	SS	6		207						
							206						
			8	SS	9		205						0 0 91 9
							204						
	Reddish Brown		9	SS	10								

Continued Next Page

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

RECORD OF BOREHOLE No WC-EBL-03 2 OF 3 METRIC

GWP# 129-90-00 LOCATION Sta. 25+275 O/S 20L N 5 395 303.1 E 405 936.8 ORIGINATED BY FK
DIST Thunder Bay HWY 11/17 BOREHOLE TYPE Solid Stem Augers/NW Casing/NQ Coring COMPILED BY JW
DATUM Geodetic DATE 2023.03.15 - 2023.03.15 LATITUDE 48.688033 LONGITUDE -88.625725 CHECKED BY RB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa				WATER CONTENT (%)				GR	SA	SI	CL
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE											
	Continued From Previous Page																		
201.4			10	SS	26		202										0 0 92 8		
11.6	SAND and GRAVEL Very Dense Reddish Brown Wet		11	SS	56/ 0.175		201												
	Rock coring through cobbles and boulders from 13.4m to 14.9m (up to 400mm in dia.)						200												
198.1			1	RUN			199												
14.9	BEDROCK (SANDSTONE - SIBLEY GROUP) , reddish brown, fresh, strong to very strong		2	RUN			198												
							197										RUN #2 TCR=100% SCR=100% RQD=100% UCS=75MPa		
			3	RUN			196										RUN #3 TCR=98% SCR=98% RQD=98% UCS=60MPa		
			4	RUN			195										RUN #4 TCR=100% SCR=100% RQD=97% UCS=119MPa		
							194												
							193												

Continued Next Page

+³, ×³: Numbers refer to
Sensitivity

20
15
10
(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No WC-EBL-03 3 OF 3 METRIC

GWP# 129-90-00 LOCATION Sta. 25+275 O/S 20L N 5 395 303.1 E 405 936.8 ORIGINATED BY FK
DIST Thunder Bay HWY 11/17 BOREHOLE TYPE Solid Stem Augers/NW Casing/NQ Coring COMPILED BY JW
DATUM Geodetic DATE 2023.03.15 - 2023.03.15 LATITUDE 48.688033 LONGITUDE -88.625725 CHECKED BY RB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
						20 40 60 80 100					20 40 60						
						○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE					WATER CONTENT (%)						
						20 40 60 80 100					20 40 60						
	Continued From Previous Page																
	Grey interbeds from 19.5m to 20.2m.		5	RUN												RUN #5 TCR=100% SCR=100% RQD=96% UCS=85MPa	
192.3																	
20.7	BOREHOLE TERMINATED AT 20.7m. BOREHOLE BACKFILLED WITH BENTONITE TO GROUND SURFACE.																

RECORD OF BOREHOLE No WC-EBL-04 1 OF 1 METRIC

GWP# 129-90-00 LOCATION N 5 395 306.8 E 405 973.3 ORIGINATED BY GAS
 DIST Thunder Bay HWY 11/17 BOREHOLE TYPE Solid Stem Augers/NW Casing/NQ Coring COMPILED BY AS
 DATUM Geodetic DATE 2023.03.31 - 04/01/20230 LATITUDE 48.693487 LONGITUDE -88.632169 CHECKED BY RB

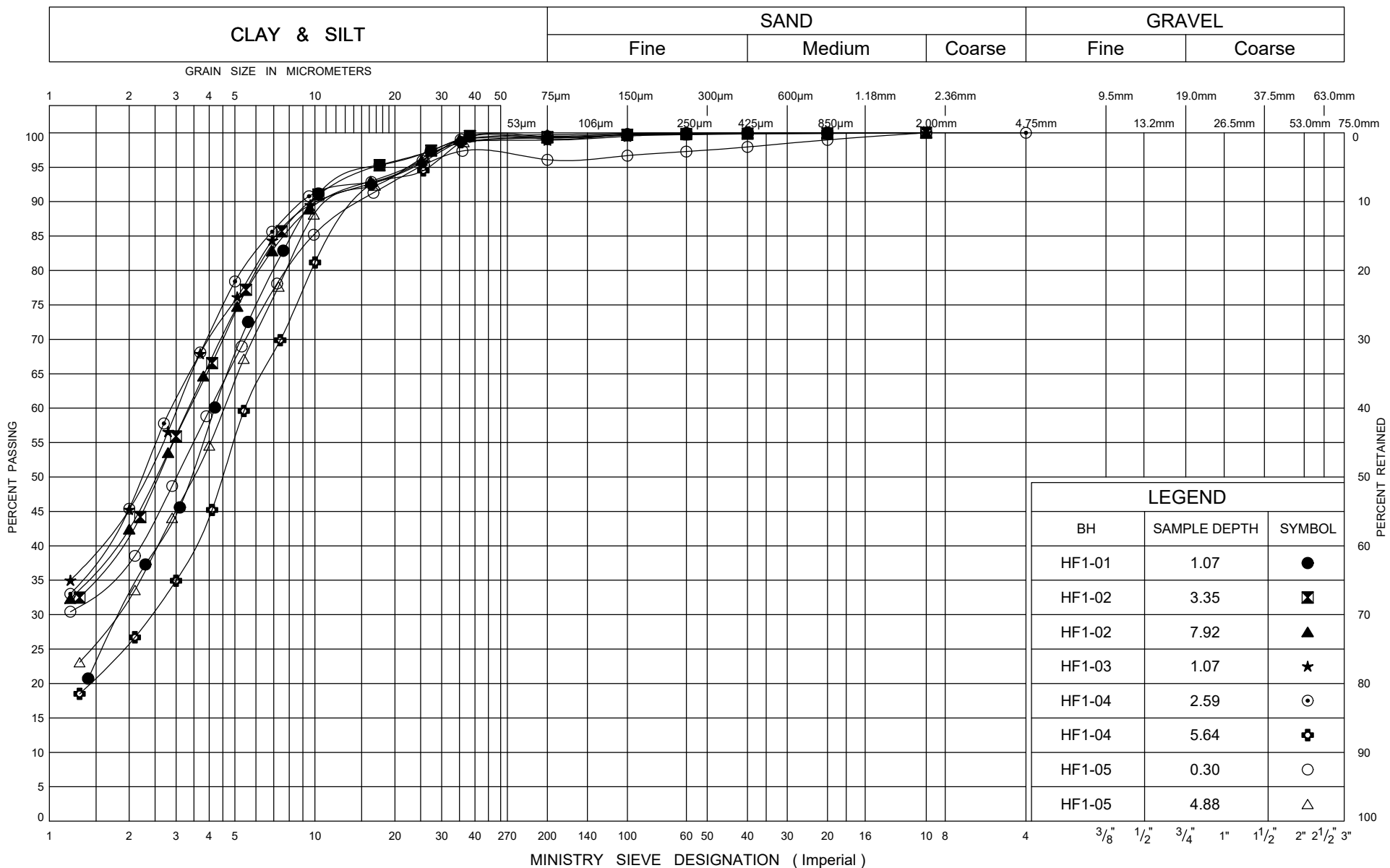
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa				
213.0	GROUND SURFACE											
0.0	TOPSOIL: (100 mm)											
0.1	Silty CLAY , with organics, trace sand Very Soft Brown Wet (CI)		1	SS	1						102	
	Abundant organics from 0.1m to 1.4m No recovery		2	SS	2							
211.6												
1.4	Silty CLAY , trace sand, varved with frequent silt and sand seams Very Soft Brown Wet (CI)		3	SS	1							0 1 66 33
			1	TW								
210.3												
2.7	SILT , trace to some clay, trace sand, occasional sand seams Compact Reddish Brown Wet		4	SS	10							
			5	SS	15							0 1 92 7
207.8												
5.2	SAND and GRAVEL , trace silt, occasional cobbles and boulders Very Dense Reddish Brown Wet											
	Cored through cobbles and boulders up to 350mm diameter from 5.2 to 5.7m		6	SS	100/ 0.100							
	NW cased sheared off at 7.2m in cobbles and boulders											
205.8												
7.2	END OF BOREHOLE AT 7.24m. Well installation consists of 25mm diameter Schedule 40 PVC pipe with a 3.05m slotted screen.											
WATER LEVEL READINGS												
DATE DEPTH(m) ELEV.(m)												
2023.04.01 0.0 213.0												
2023.04.12 0.0 213.0												
2023.04.15 -0.1 213.1												

+³, ×³: Numbers refer to
Sensitivity

20
15
10

(%) STRAIN AT FAILURE

D2: High Fill 1 and Welch Creek EBL Culvert Geotechnical Laboratory Testing Results



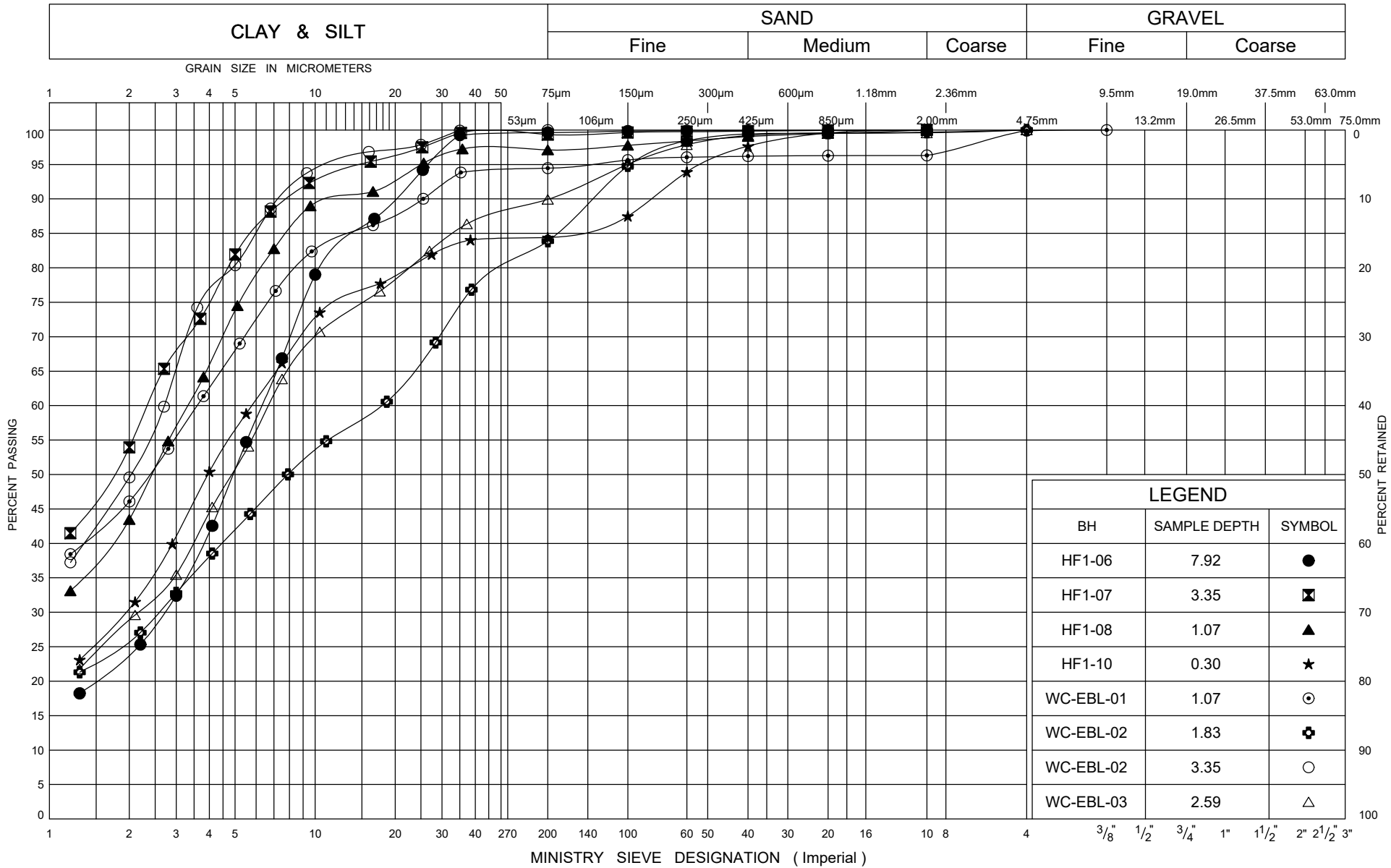
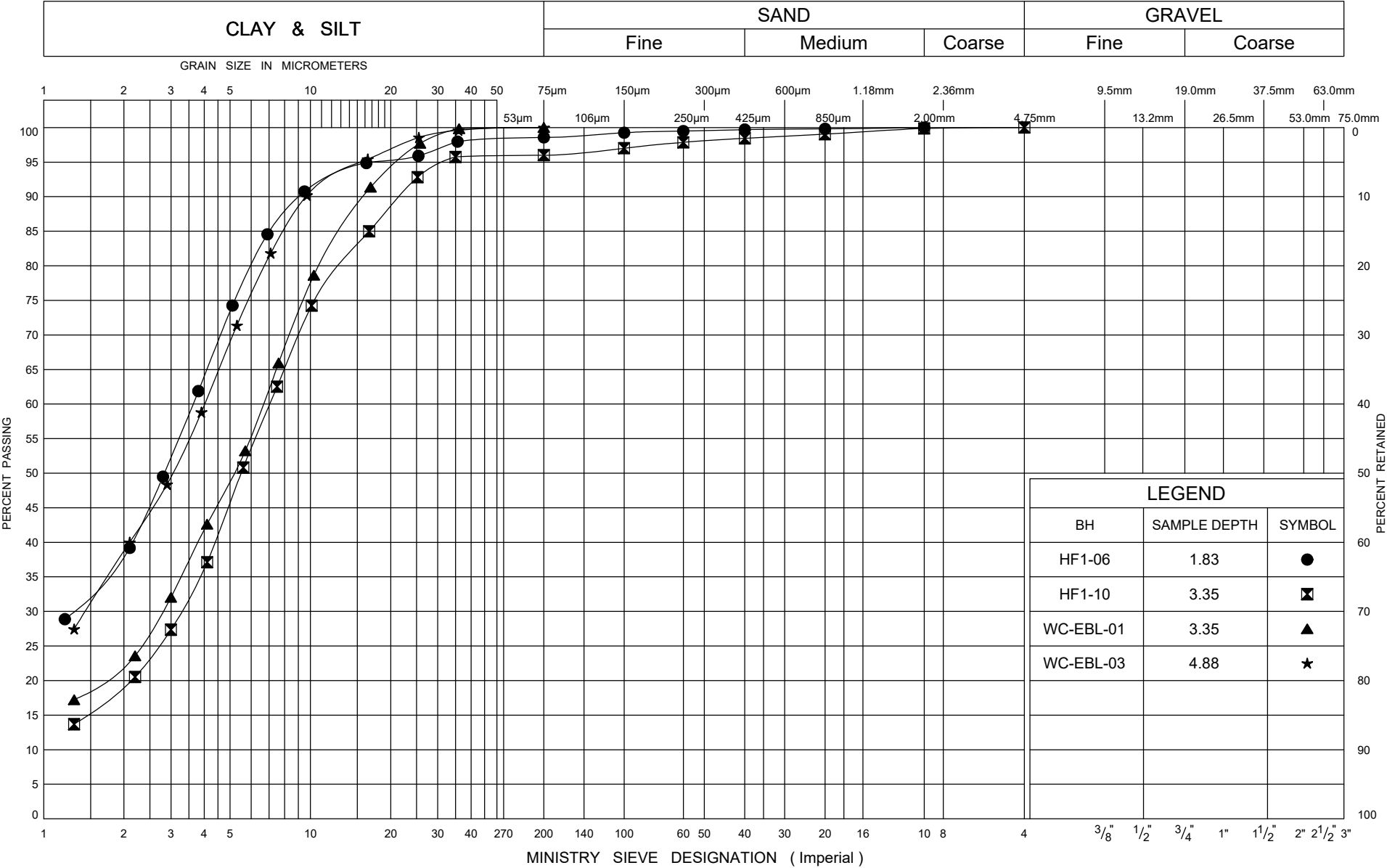




FIG No D3

GWP# 129-90-00



ONTARIO MOT GRAIN SIZE 3 MTO-21663.GPJ ONTARIO MOT.GDT 3/7/24

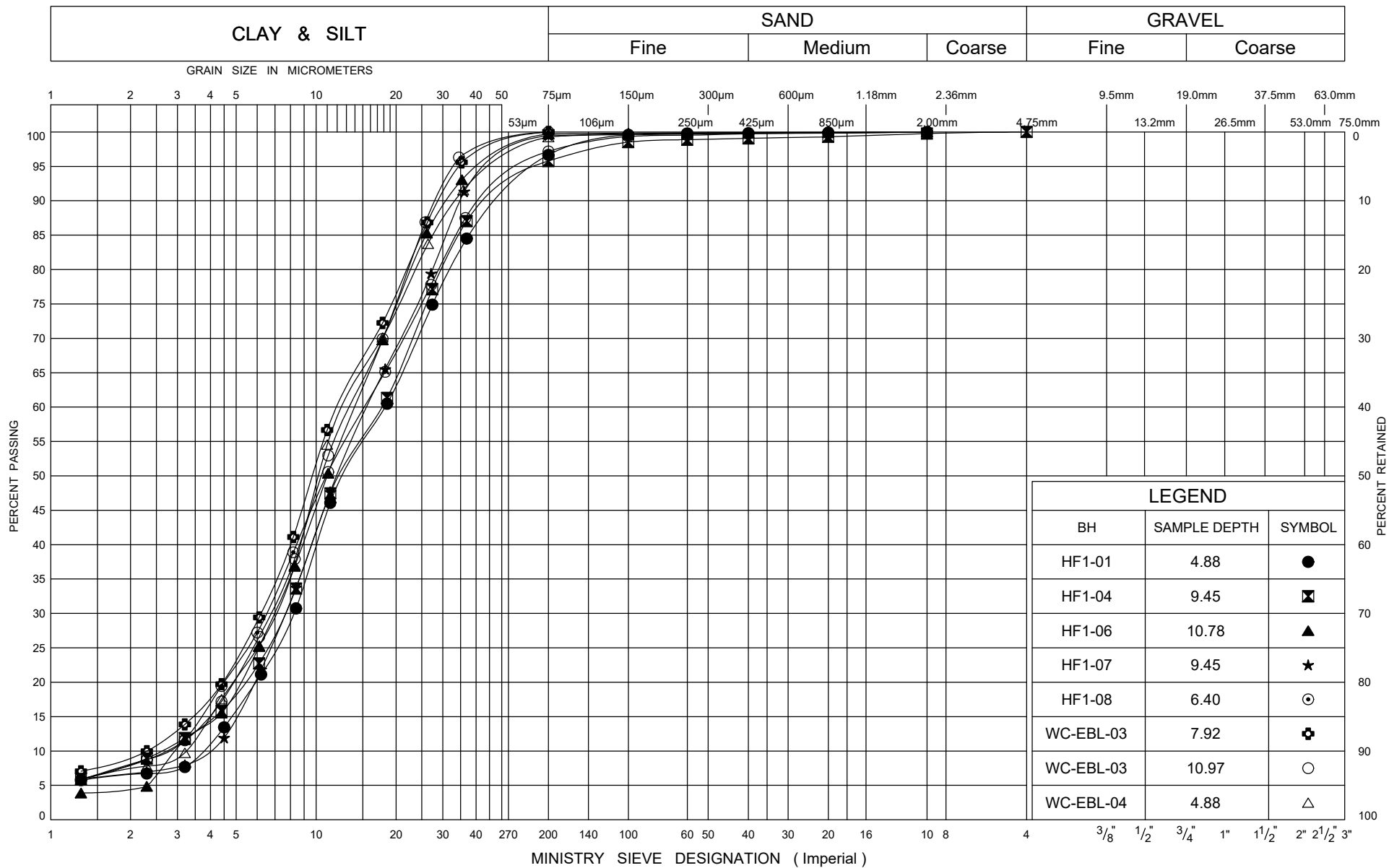


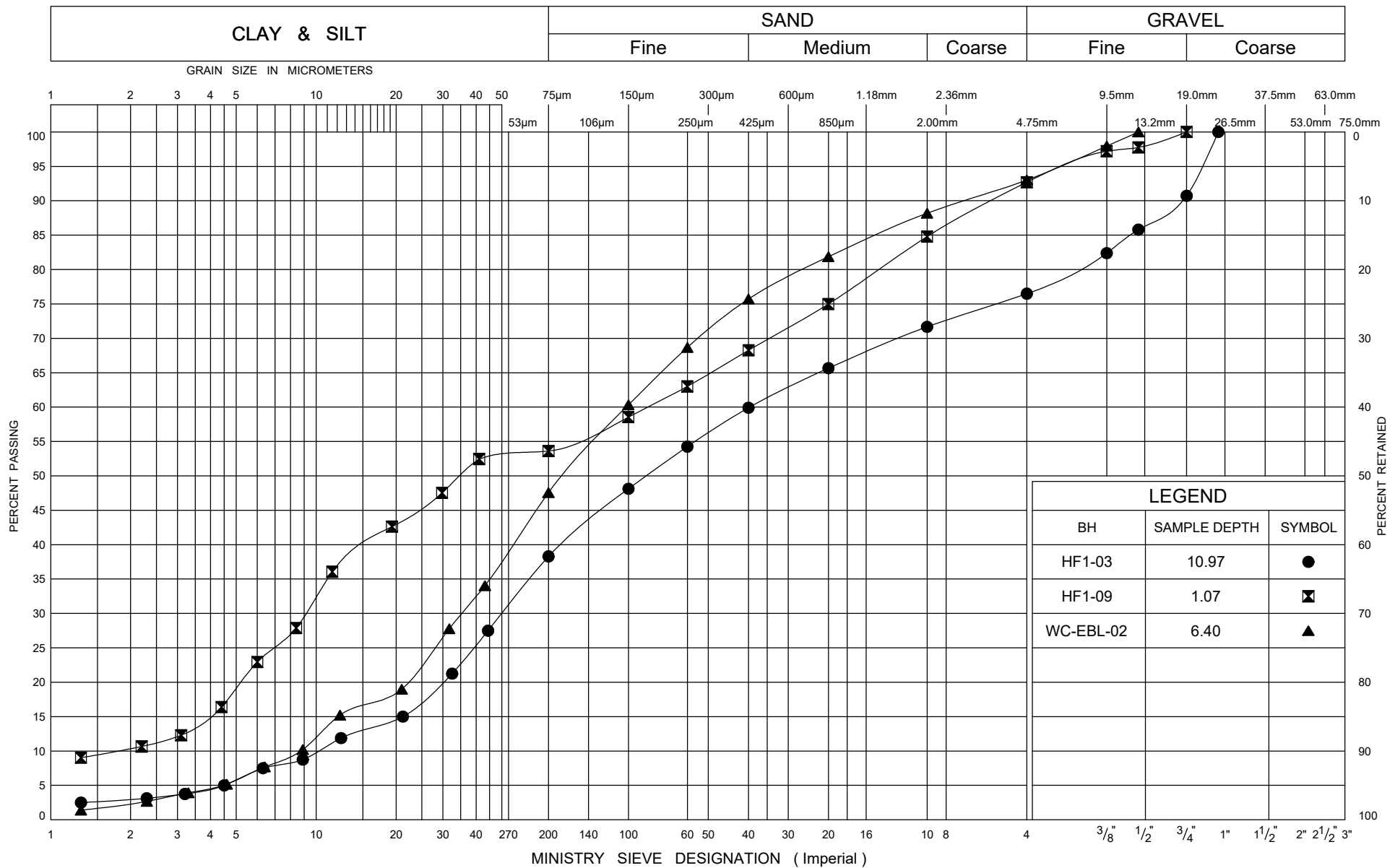
Ministry of
Transportation

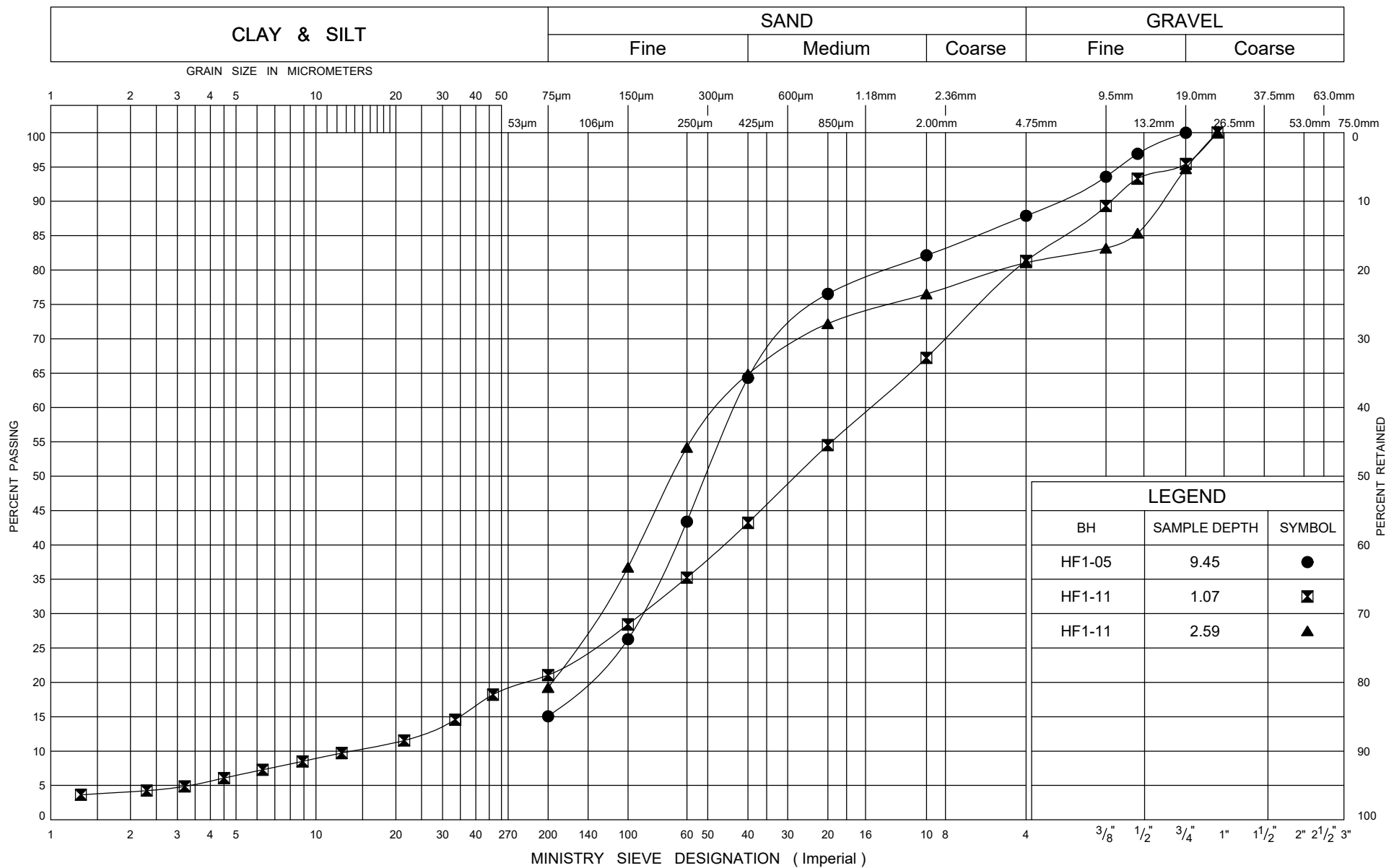
GRAIN SIZE DISTRIBUTION
Varved Silty CLAY

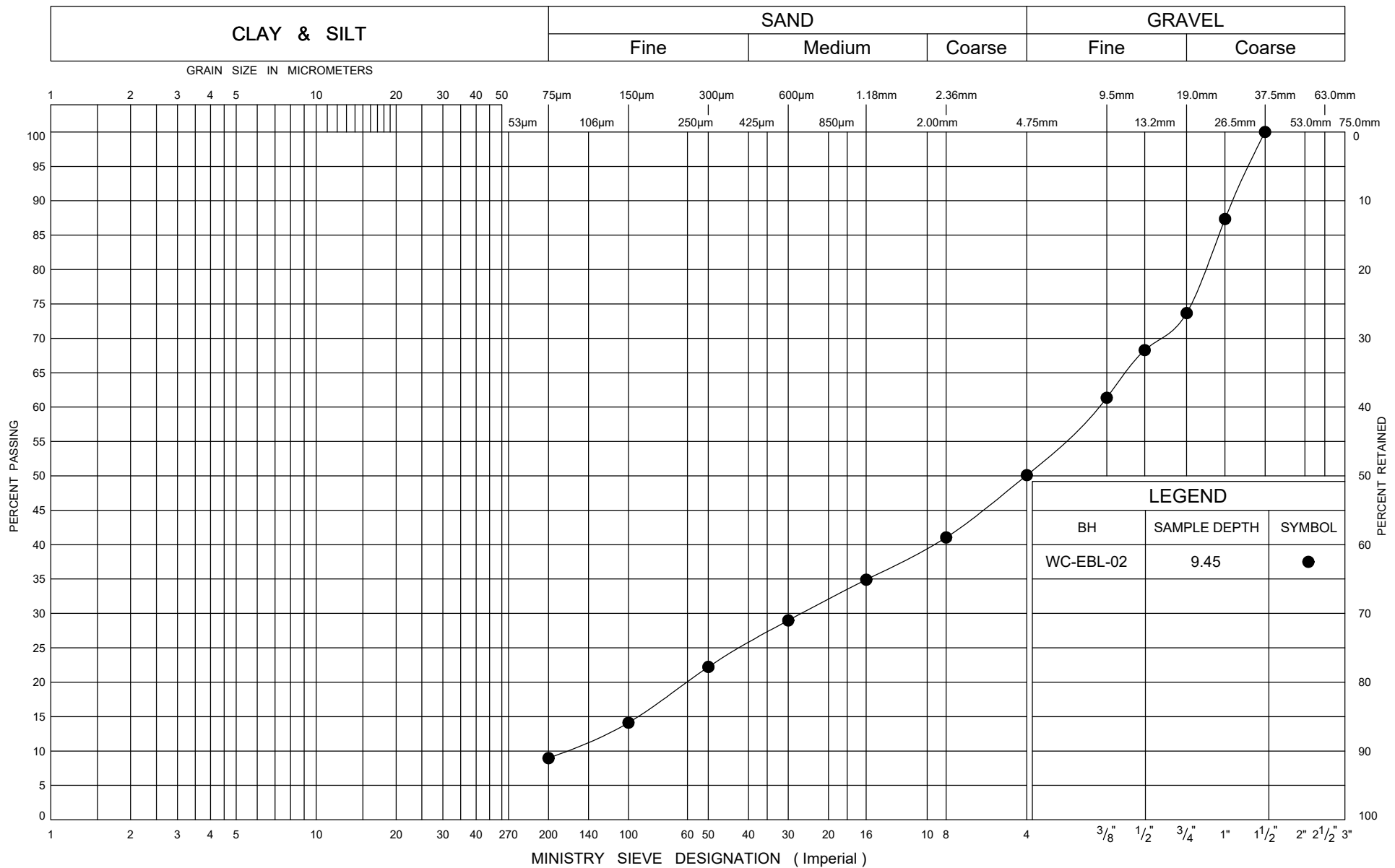
FIG No D4

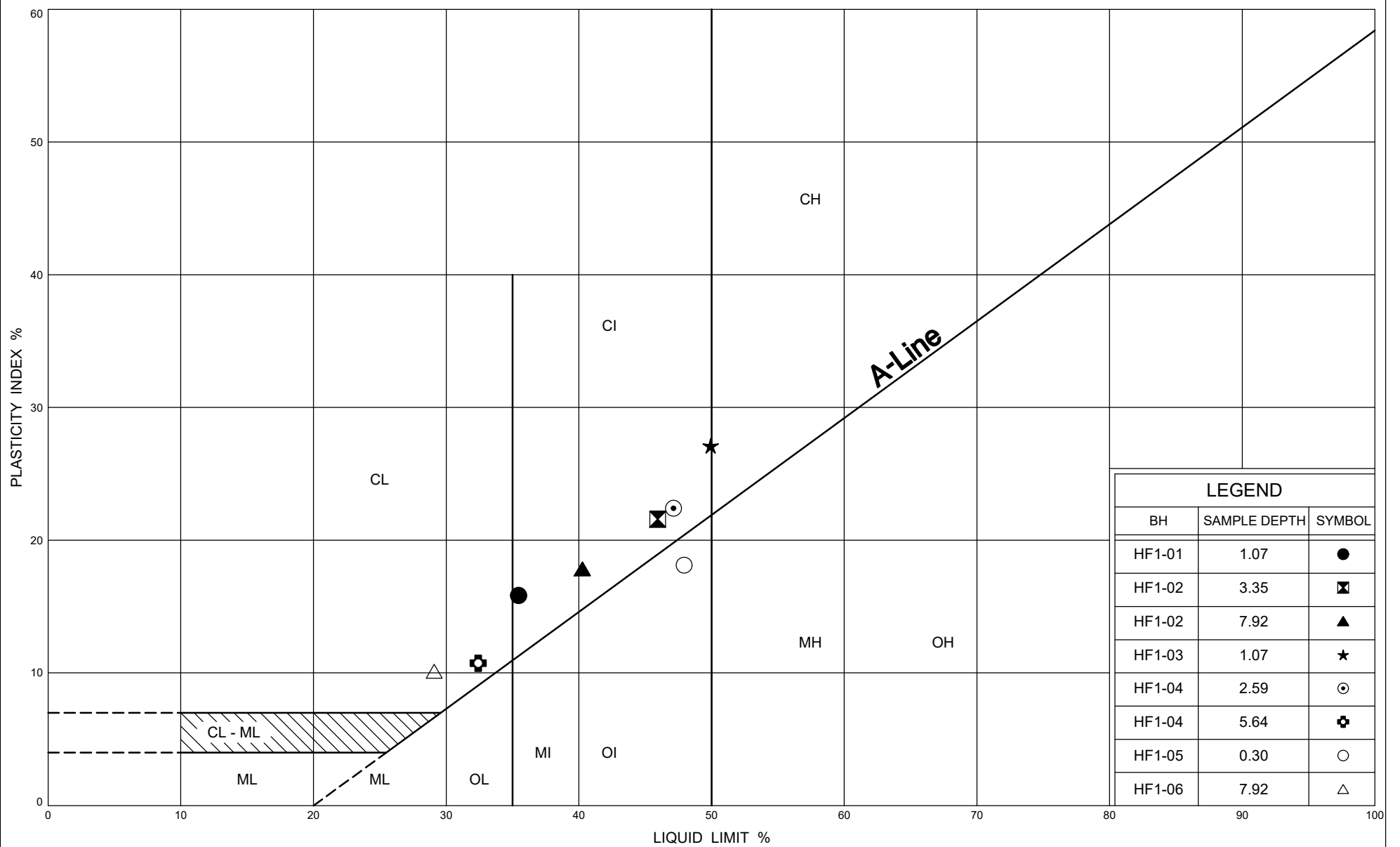
GWP# 129-90-00











Ministry of
Transportation

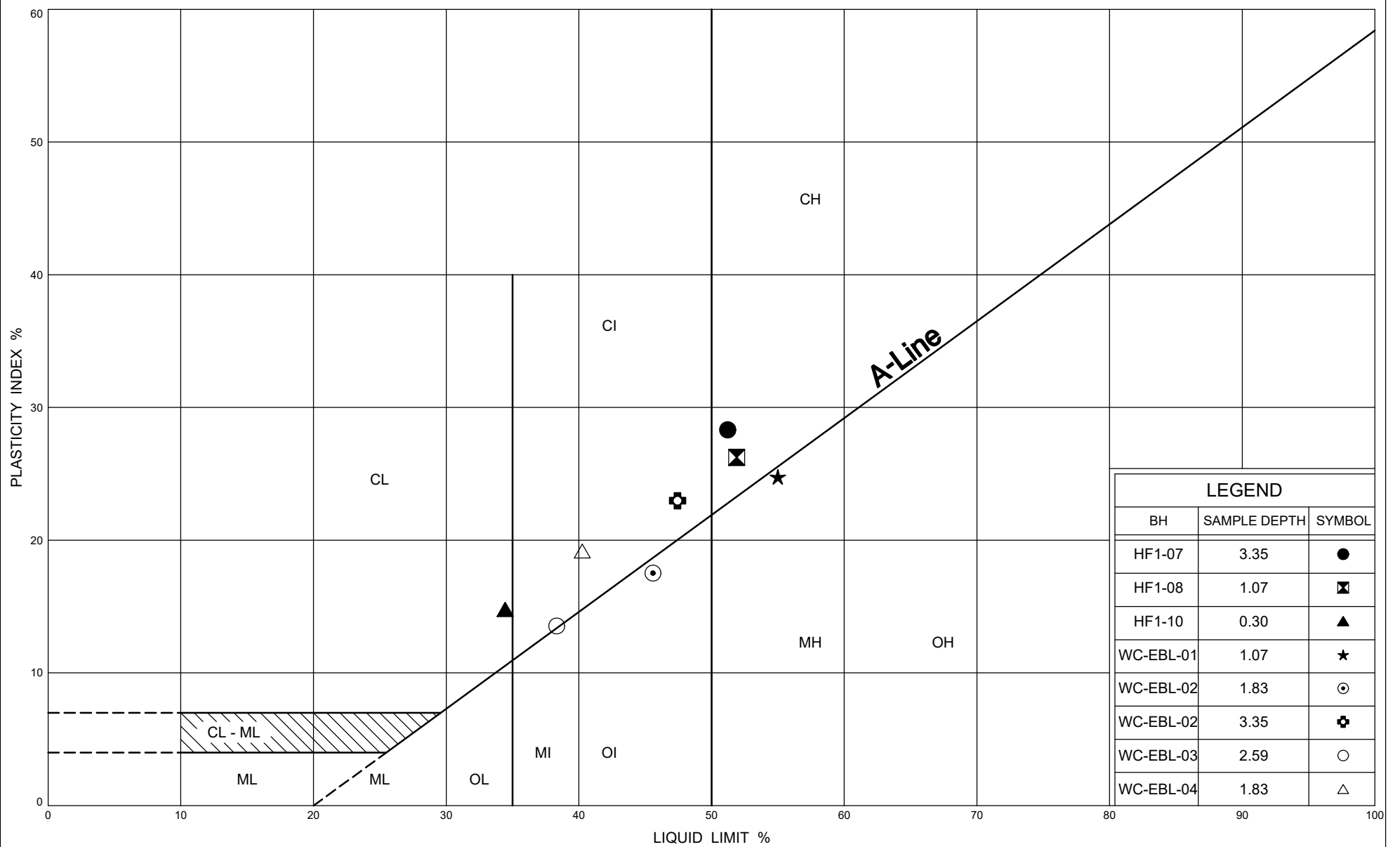
PLASTICITY CHART

Silty CLAY

FIG No D9

GWP# 129-90-00

Sta. 25+625+EB CL



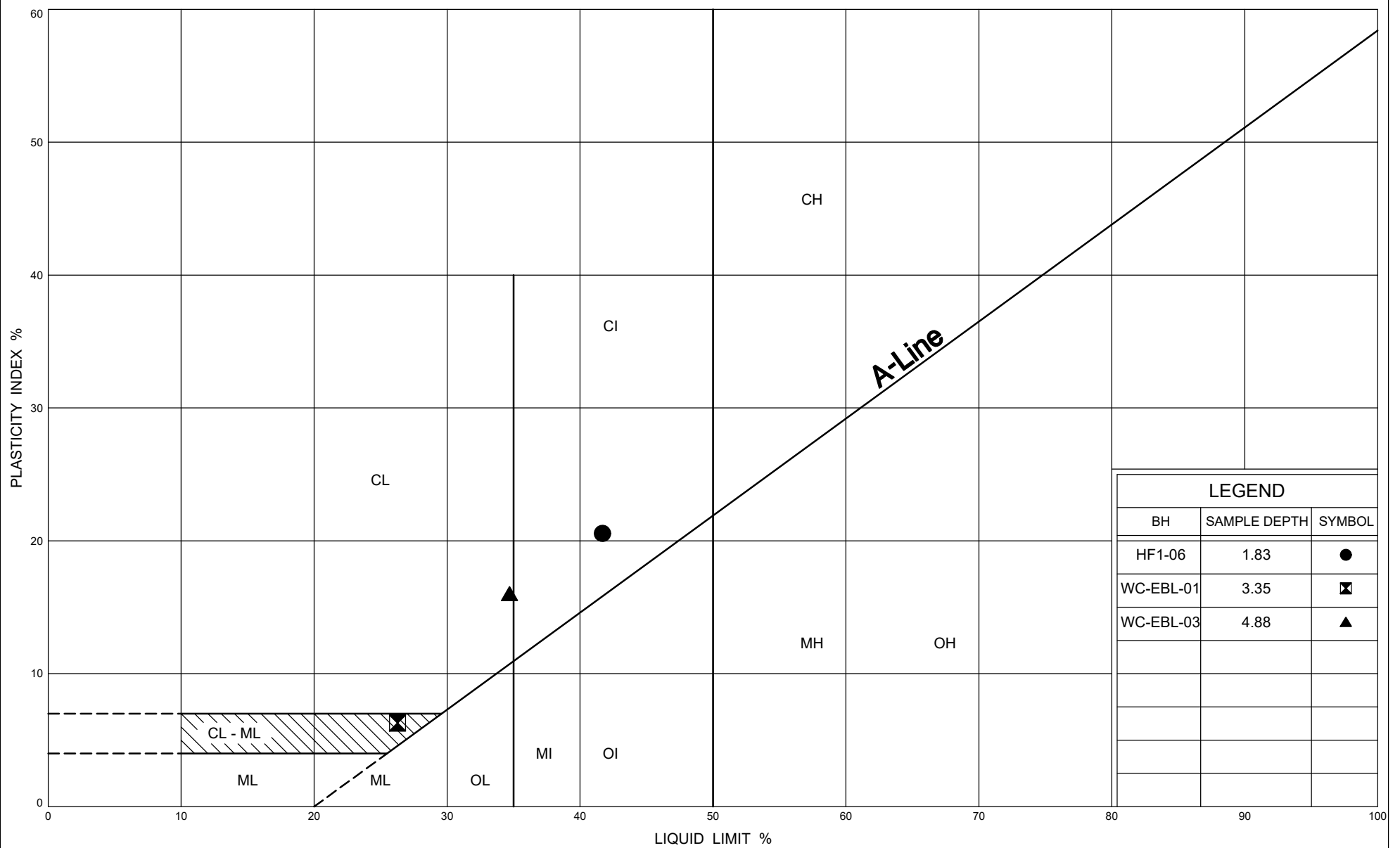
Ministry of
Transportation

PLASTICITY CHART

Silty CLAY

FIG No D10

GWP# 129-90-00



LEGEND		
BH	SAMPLE DEPTH	SYMBOL
HF1-06	1.83	●
WC-EBL-01	3.35	⊠
WC-EBL-03	4.88	▲

PLASTICITY CHART Varved Silty CLAY

FIG No D11

GWP# 129-90-00



Ministry of
Transportation

Ontario



THURBER ENGINEERING LTD.

APPENDIX E

E1: Deep Cut Section 2 Record of Borehole Sheets

SYMBOLS, ABBREVIATIONS AND TERMS USED ON RECORDS OF BOREHOLES

1. TEXTURAL CLASSIFICATION OF SOILS

CLASSIFICATION	PARTICLE SIZE	VISUAL IDENTIFICATION
Boulders	Greater than 200mm	same
Cobbles	75 to 200mm	same
Gravel	4.75 to 75mm	5 to 75mm
Sand	0.075 to 4.75mm	Not visible particles to 5mm
Silt	0.002 to 0.075mm	Non-plastic particles, not visible to the naked eye
Clay	Less than 0.002mm	Plastic particles, not visible to the naked eye

2. COARSE GRAIN SOIL DESCRIPTION (50% greater than 0.075mm)

TERMINOLOGY	PROPORTION
Trace or Occasional	Less than 10%
Some	10 to 20%
Adjective (e.g. silty or sandy)	20 to 35%
And (e.g. sand and gravel)	35 to 50%

3. TERMS DESCRIBING CONSISTENCY (COHESIVE SOILS ONLY)

DESCRIPTIVE TERM	UNDRAINED SHEAR STRENGTH (kPa)	APPROXIMATE SPT ⁽¹⁾ 'N' VALUE
Very Soft	12 or less	Less than 2
Soft	12 to 25	2 to 4
Firm	25 to 50	4 to 8
Stiff	50 to 100	8 to 15
Very Stiff	100 to 200	15 to 30
Hard	Greater than 200	Greater than 30

NOTE: Hierarchy of Soil Strength Prediction

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



4. TERMS DESCRIBING DENSITY (COHESIONLESS SOILS ONLY)

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

5. LEGEND FOR RECORDS OF BOREHOLES

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

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


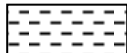



 Water Level
 Shear Strength Determination by Pocket Penetrometer

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

UNIFIED SOILS CLASSIFICATION

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

EXPLANATION OF ROCK LOGGING TERMS

<u>ROCK WEATHERING CLASSIFICATION</u>		<u>SYMBOLS</u>	
Fresh (FR)	No visible signs of weathering.		
Fresh Jointed (FJ)	Weathering limited to the surface of major discontinuities.		CLAYSTONE
Slightly Weathered (SW)	Penetrative weathering developed on open discontinuity surfaces, but only slight weathering of rock material.		SILTSTONE
Moderately Weathered (MW)	Weathering extends throughout the rock mass, but the rock material is not friable.		SANDSTONE
Highly Weathered (HW)	Weathering extends throughout the rock mass and the rock is partly friable.		COAL
Completely Weathered (CW)	Rock is wholly decomposed and in a friable condition, but the rock texture and structure are preserved.		Bedrock (general)

<u>DISCONTINUITY SPACING</u>		<u>STRENGTH CLASSIFICATION</u>			
Bedding	Bedding Plane Spacing	Rock Strength	Approximate Uniaxial Compressive Strength		Field Estimation of Hardness*
			(MPa)	(psi)	
Very thickly bedded	Greater than 2m	Extremely Strong	Greater than 250	Greater than 36,000	Specimen can only be chipped with a geological hammer
Thickly bedded	0.6 to 2m				
Medium bedded	0.2 to 0.6m	Very Strong	100-250	15,000 to 36,000	Requires many blows of geological hammer to break
Thinly bedded	60mm to 0.2m	Strong	50-100	7,500 to 15,000	Requires more than one blow of geological hammer to break
Very thinly bedded	20 to 60mm				
Laminated	6 to 20mm	Medium Strong	25.0 to 50.0	3,500 to 7,500	Breaks under single blow of geological hammer.
Thinly Laminated	Less than 6mm				

<u>TERMS</u>					
Total Core Recovery: (TCR)	Core recovered as a percentage of total core run length.	Weak	5.0 to 25.0	750 to 3,500	Can be peeled by a pocket knife with difficulty
Solid Core Recovery: (SCR)	Percent Ratio of solid core of full cylindrical shape recovered. Expressed with respect to the total length of core run.	Very Weak	1.0 to 5.0	150 to 750	Can be peeled by a pocket knife, crumbles under firm blows of geological pick.
Rock Quality Designation: (RQD)	Total length of sound core recovered in pieces 0.1m in length or larger as a percentage of total core run length.	Extremely Weak (Rock)	0.25 to 1.0	35 to 150	Indented by thumbnail
Uniaxial Compressive Strength (UCS)	Axial stress required to break the specimen				
Fracture Index: (FI)	Frequency of natural fractures per 0.3m of core run.				

RECORD OF BOREHOLE No DC2-01

1 OF 1

METRIC

GWP# 129-90-00 LOCATION Sta. 26+075 EB CL N 5 395 785.9 E 406 566.1 ORIGINATED BY GAS
 DIST Thunder Bay HWY 11/17 BOREHOLE TYPE NQ Wash Boring/NQ Rock Coring COMPILED BY MC
 DATUM Geodetic DATE 2023.04.13 - 2023.04.14 LATITUDE 48.692245 LONGITUDE -88.617558 CHECKED BY RB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
252.4	GROUND SURFACE							20	40	60	80	100					
0.0	Gravelly SAND , trace to some silt Dense to very dense Reddish Brown Moist		1	SS	32		252										
			2	SS	100/ 0.125												33 52 15 (SI+CL)
			3	SS	100/ 0.100		251										
			4	SS	79		250										31 50 19 (SI+CL)
249.7	Sandy GRAVEL , trace silt, occasional cobbles and boulders Very Dense Reddish Brown Wet		5	SS	76		249										
	Cored through cobbles and boulders from 2.7m to 3.4m and cobbles from 4.3m to 4.6m						248										
247.8	Sandy SILT , trace gravel, trace clay, trace cobbles Very Dense Grey Wet Cored through cobbles from 5.3m to 5.6m		6	SS	100/ 0.075		247										
246.8	BEDROCK (GRANITE) , fresh, very strong, reddish brown/grey		1	RUN			246										RUN #1 TCR=100% SCR=100% RQD=100% UCS=187MPa (Average Point Load)
			2	RUN			245										RUN #2 TCR=97% SCR=97% RQD=85% UCS=190MPa (Average Point Load)
243.7	END OF BOREHOLE AT 8.7m. Well installation consists of 25mm diameter Schedule 40 PVC pipe with a 3.05m slotted screen. WATER LEVEL READINGS DATE DEPTH(m) ELEV.(m) 2023.04.14 0.7 251.7 2023.04.16 0.3 252.1 2023.04.20 0.4 252.1						244										
8.7																	

+³, ×³: Numbers refer to
Sensitivity

20
15
10

(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No DC2-02

1 OF 1

METRIC

GWP# 129-90-00 LOCATION Sta. 26+125 EB CL N 5 395 820.9 E 406 594.5 ORIGINATED BY GAS
 DIST Thunder Bay HWY 11/17 BOREHOLE TYPE NQ Wash Boring/NQ Rock Coring COMPILED BY MC
 DATUM Geodetic DATE 2023.04.14 - 2023.04.15 LATITUDE 48.692554 LONGITUDE -88.617164 CHECKED BY RB

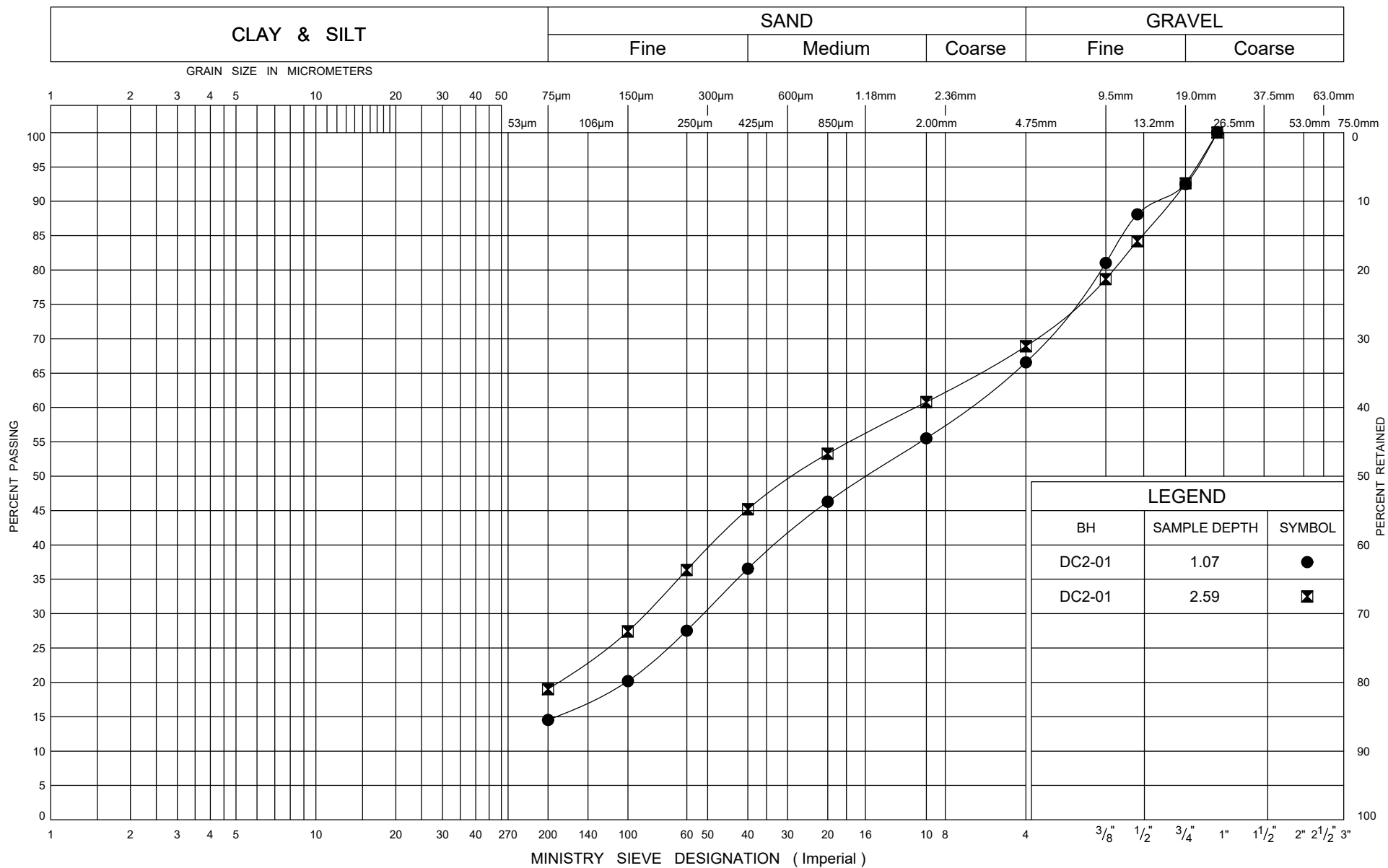
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE LIQUID CONTENT LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					WATER CONTENT (%)					
								○ UNCONFINED + FIELD VANE	● QUICK TRIAXIAL × LAB VANE									
257.5	GROUND SURFACE							20	40	60	80	100		20	40	60		
0.0	Sandy GRAVEL , some to trace silt, trace clay, some organics in upper 0.6m Compact to Dense Reddish Brown Wet		1	SS	15									○				
				2	SS	32									○			
	Sandstone fragments Becoming Very Dense Grey																	
255.7			3	SS	100/ 0.100									○				FI
1.8	BEDROCK (GRANITE) , slightly weathered to fresh, very strong, reddish brown/grey		1	RUN														>10
																		4
																		1
																		2
				2	RUN													1
																		2
	Vertical fracture from 3.8m to 4.6m																3	
																	4	
																	3	
			3	RUN														0
252.1																		1
																		0
5.4	END OF BOREHOLE AT 5.4m. BOREHOLE CAVED TO 1.0m AND WATER LEVEL AT 0.8m UPON BOREHOLE COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE AND SOIL CUTTINGS TO SURFACE.																	0

+³, ×³: Numbers refer to
Sensitivity

20
15
10

(%) STRAIN AT FAILURE

E2: Deep Cut Section 2 Geotechnical Laboratory Testing Results



APPENDIX F

F1: Swamp Section 2 Record of Borehole Sheets

SYMBOLS, ABBREVIATIONS AND TERMS USED ON RECORDS OF BOREHOLES

1. TEXTURAL CLASSIFICATION OF SOILS

CLASSIFICATION	PARTICLE SIZE	VISUAL IDENTIFICATION
Boulders	Greater than 200mm	same
Cobbles	75 to 200mm	same
Gravel	4.75 to 75mm	5 to 75mm
Sand	0.075 to 4.75mm	Not visible particles to 5mm
Silt	0.002 to 0.075mm	Non-plastic particles, not visible to the naked eye
Clay	Less than 0.002mm	Plastic particles, not visible to the naked eye

2. COARSE GRAIN SOIL DESCRIPTION (50% greater than 0.075mm)

TERMINOLOGY	PROPORTION
Trace or Occasional	Less than 10%
Some	10 to 20%
Adjective (e.g. silty or sandy)	20 to 35%
And (e.g. sand and gravel)	35 to 50%

3. TERMS DESCRIBING CONSISTENCY (COHESIVE SOILS ONLY)

DESCRIPTIVE TERM	UNDRAINED SHEAR STRENGTH (kPa)	APPROXIMATE SPT ⁽¹⁾ 'N' VALUE
Very Soft	12 or less	Less than 2
Soft	12 to 25	2 to 4
Firm	25 to 50	4 to 8
Stiff	50 to 100	8 to 15
Very Stiff	100 to 200	15 to 30
Hard	Greater than 200	Greater than 30

NOTE: Hierarchy of Soil Strength Prediction

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



4. TERMS DESCRIBING DENSITY (COHESIONLESS SOILS ONLY)

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

5. LEGEND FOR RECORDS OF BOREHOLES

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

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

 Water Level
 Shear Strength Determination by Pocket Penetrometer

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

UNIFIED SOILS CLASSIFICATION

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

RECORD OF BOREHOLE No SW2-01

1 OF 1

METRIC

GWP# 129-90-00 LOCATION Sta. 27+850 EB O/S 2.3R N 5 397 466.4 E 406 818.7 ORIGINATED BY GAS
DIST Thunder Bay HWY 11/17 BOREHOLE TYPE Solid Stem Augers COMPILED BY MC
DATUM Geodetic DATE 2023.02.25 - 2023.02.25 LATITUDE 48.707312 LONGITUDE -88.613713 CHECKED BY RB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa													
								20	40	60	80	100									
							○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE					WATER CONTENT (%)									
280.9	GROUND SURFACE						20	40	60	80	100	20	40	60							
0.0	Silty SAND , some organics Compact Reddish Brown Moist		1	GS		▽							o				2 72 23 3				
280.1	Silty SAND , trace gravel, trace clay Compact Reddish Brown Wet		2	SS	14								o								
0.8																					
			3	SS	20							o									
278.8	Auger refusal at 2.1m						279														
2.1	END OF BOREHOLE AT 2.1m UPON AUGER REFUSAL ON POSSIBLE BEDROCK. BOREHOLE CAVED TO 1.4m AND WATER LEVEL AT 1.0m UPON COMPLETION. BOREHOLE BACKFILLED WITH CUTTINGS TO SURFACE.																				

RECORD OF BOREHOLE No SW2-02

1 OF 1

METRIC

GWP# 129-90-00 LOCATION Sta. 27+875 EB O/S 10L N 5 397 492.7 E 406 824.6 ORIGINATED BY GAS
DIST Thunder Bay HWY 11/17 BOREHOLE TYPE Solid Stem Augers COMPILED BY MC
DATUM Geodetic DATE 2023.02.25 - 2023.02.25 LATITUDE 48.707548 LONGITUDE -88.613626 CHECKED BY RB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
								20 40 60 80 100									
							○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE					WATER CONTENT (%) 20 40 60					
281.4	GROUND SURFACE																
0.0	Silty SAND , trace clay, trace gravel, some wood, some organics Black Wet		1	GS		▽	281										
280.5							280										
0.9	Silty SAND , trace to some gravel, trace clay Compact to Very Dense Reddish Brown Wet		2	SS	17												5 60 31 4
			3	SS	27												
			4	SS	28		279									3 64 30 3	
			5	SS	145		278										
277.6																	
3.8	END OF BOREHOLE AT 3.8m UPON AUGER REFUSAL ON POSSIBLE BEDROCK. BOREHOLE CAVED TO 1.8m AND WATER LEVEL AT 1.5m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE AND CUTTINGS TO SURFACE.		6	SS	100/ 0.025												

METRIC

[illegible]

+³, ×³: Numbers refer to Sensitivity

RECORD OF BOREHOLE No SW2-04

1 OF 1

METRIC

GWP# 129-90-00 LOCATION Sta. 27+900 EB CL N 5 397 515.8 E 406 810.7 ORIGINATED BY GAS
DIST Thunder Bay HWY 11/17 BOREHOLE TYPE Hollow Stem Auger COMPILED BY MC
DATUM Geodetic DATE 2023.02.25 - 2023.02.25 LATITUDE 48.707758 LONGITUDE -88.613809 CHECKED BY RB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT		NATURAL MOISTURE CONTENT		LIQUID LIMIT		UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa		W P		W		W L				WATER CONTENT (%)
								20 40 60 80 100										
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE										
281.0	GROUND SURFACE																GR SA SI CL	
0.0	PEAT , fibrous Very Loose Dark Brown Very Wet No recovery No recovery No recovery		1	GS												572		
			2	GS													544	
			3	SS	0												465	
			4	SS	0												687	
			5	SS	0												808	
276.9			6	SS	8											370		
4.1	Sandy SILT , trace clay, trace organics Loose Reddish Brown Wet																	
276.5																		
4.5	Silty SAND , trace to some gravel, trace organics Dense Reddish Brown Wet DCPT disturbed due to flowing sand between 5.2m and 5.5m		7	SS	29													
275.3																		
5.7	END OF BOREHOLE AT 5.7m UPON AUGER REFUSAL ON POSSIBLE BEDROCK. Well installation consists of 19mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen. WATER LEVEL READINGS DATE DEPTH(m) ELEV.(m) 2023.02.26 4.1 276.9 2023.03.28 0.5 280.5																	

+³, ×³: Numbers refer to
Sensitivity

20
15
10

(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No SW2-05

1 OF 1

METRIC

GWP# 129-90-00 LOCATION Sta. 27+925 EB O/S 10R N 5 397 542.1 E 406 816.6 ORIGINATED BY GAS
DIST Thunder Bay HWY 11/17 BOREHOLE TYPE Dynamic Cone Penetration Test COMPILED BY AN
DATUM Geodetic DATE 2023.02.24 - 2023.02.24 LATITUDE 48.707993 LONGITUDE -88.613722 CHECKED BY RB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE	WATER CONTENT (%)					
281.0 0.0	GROUND SURFACE DCPT from surface.													
276.7 4.3	END OF DCPT AT 4.3m UPON REFUSAL.													

RECORD OF BOREHOLE No SW2-06

1 OF 2

METRIC

GWP# 129-90-00 LOCATION Sta. 27+925 EB O/S 10R N 5 397 538.9 E 406 796.9 ORIGINATED BY GAS
 DIST Thunder Bay HWY 11/17 BOREHOLE TYPE Hollow Stem Auger COMPILED BY MC
 DATUM Geodetic DATE 2023.02.24 - 2023.02.24 LATITUDE 48.707967 LONGITUDE -88.613991 CHECKED BY RB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa				WATER CONTENT (%)				GR	SA	SI	CL
								○ UNCONFINED + FIELD VANE	● QUICK TRIAXIAL × LAB VANE										
281.0	GROUND SURFACE							20	40	60	80	100	20	40	60				
0.0	PEAT, fibrous Very Loose Brown Wet		1	GS															
			2	GS															
			3	SS	0														
	No recovery		4	SS	0														
	No recovery		5	SS	0														
			6	SS	0														
			7	SS	0														
			8	SS	0														
			9	SS	0														
			10	SS	0														
			11	SS	11														
272.6	Gravelly SAND, trace silt Compact Reddish Brown Wet		12	SS	10														
8.4			13	SS	14														

Continued Next Page

+³, ×³: Numbers refer to
Sensitivity

20
15
10

(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No SW2-06

2 OF 2

METRIC

GWP# 129-90-00 LOCATION Sta. 27+925 EB O/S 10R N 5 397 538.9 E 406 796.9 ORIGINATED BY GAS
DIST Thunder Bay HWY 11/17 BOREHOLE TYPE Hollow Stem Auger COMPILED BY MC
DATUM Geodetic DATE 2023.02.24 - 2023.02.24 LATITUDE 48.707967 LONGITUDE -88.613991 CHECKED BY RB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE									
							20	40	60	80	100	20	40	60			
270.3																	
10.7	SAND and SILT, some gravel, trace clay Very Dense Reddish Brown Wet		14	SS	54		270					○				19 40 36 5	
			15	SS	100/ 0.300		269					○					
268.4																	
12.6	END OF BOREHOLE AT 12.6m UPON AUGER REFUSAL ON POSSIBLE BEDROCK. BOREHOLE CAVED TO 7.2m AND WATER LEVEL AT 0.3m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE AND CUTTINGS TO SURFACE.																

RECORD OF BOREHOLE No SW2-07

1 OF 1

METRIC

GWP# 129-90-00 LOCATION Sta. 27+950 EB CL N 5 397 565.2 E 406 802.8 ORIGINATED BY GAS
DIST Thunder Bay HWY 11/17 BOREHOLE TYPE Hollow Stem Auger COMPILED BY MC
DATUM Geodetic DATE 2023.02.21 - 2023.02.21 LATITUDE 48.708203 LONGITUDE -88.613905 CHECKED BY RB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)							
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE			WATER CONTENT (%) w _p w w _L				GR	SA	SI	CL				
281.0	GROUND SURFACE					▽		20	40	60	80	100		20	40	60						
0.0	PEAT, fibrous Very Loose Brown Wet		1	GS																		
			2	GS																		
			3	SS	1																	
			4	SS	0																	
	Dense		5	SS	32																	
277.3																						
3.7	SAND, some gravel, trace to some silt Loose Reddish Brown Wet		6	SS	7																	
		7	SS	11																		
275.0			8	SS	100/0																	
6.0	END OF BOREHOLE AT 6.0m UPON AUGER REFUSAL ON POSSIBLE BEDROCK. BOREHOLE CAVED TO 4.6m AND WATER LEVEL AT 0.3m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE AND CUTTINGS TO SURFACE.				.075		275															

+³, ×³: Numbers refer to
Sensitivity

20
15
10

(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No SW2-08

1 OF 1

METRIC

GWP# 129-90-00 LOCATION Sta. 27+975 EB O/S 10L N 5 397 591.4 E 406 808.6 ORIGINATED BY GAS
 DIST Thunder Bay HWY 11/17 BOREHOLE TYPE Hollow Stem Auger COMPILED BY MC
 DATUM Geodetic DATE 2023.02.21 - 2023.02.21 LATITUDE 48.708438 LONGITUDE -88.613818 CHECKED BY RB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																											
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									WATER CONTENT (%)		GR	SA	SI	CL																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																					
								20	40	60	80						100	20	40	60																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																							

+³, ×³: Numbers refer to
Sensitivity

20
15
10

(%) STRAIN AT FAILURE

METRIC

[illegible]

+³, ×³: Numbers refer to Sensitivity

RECORD OF BOREHOLE No SW2-09

2 OF 2

METRIC

GWP# 129-90-00 LOCATION Sta. 27+975 EB O/S 10L N 5 397 588.2 E 406 788.9 ORIGINATED BY GAS
DIST Thunder Bay HWY 11/17 BOREHOLE TYPE Dynamic Cone Penetration Test COMPILED BY AN
DATUM Geodetic DATE 2023.02.21 - 2023.02.21 LATITUDE 48.708412 LONGITUDE -88.614087 CHECKED BY RB

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 NATURAL MOISTURE CONTENT LIQUID LIMIT W _p W W _L WATER CONTENT (%) 20 40 60 UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES				
	Continued From Previous Page								
267.7									
13.3	END OF DCPT AT 13.3m UPON REFUSAL.								

RECORD OF BOREHOLE No SW2-10

1 OF 2

METRIC

GWP# 129-90-00 LOCATION Sta. 28+000 EB CL N 5 397 614.5 E 406 794.8 ORIGINATED BY GAS
DIST Thunder Bay HWY 11/17 BOREHOLE TYPE Hollow Stem Auger COMPILED BY MC
DATUM Geodetic DATE 2023.02.17 - 2023.02.17 LATITUDE 48.708648 LONGITUDE -88.614001 CHECKED BY RB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)								
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE						WATER CONTENT (%) w P w w L					GR	SA	SI	CL
281.0	GROUND SURFACE							20	40	60	80	100										
0.0	PEAT, fibrous Loose Brown Wet No recovery No recovery		1	GS			280													1120		
			2	GS																		740
			3	SS	1																	108
			4	SS	0																	1412
			5	SS	0																	
			6	SS	0																	
			7	SS	0																	797
			8	SS	0																	630
			9	SS	0																	220
274.2																						
6.8	SAND, some gravel, trace silt Loose Reddish Brown Wet		10	SS	4		274								○					18 77 5 (SI+CL)		
			11	SS	12		273								○							
272.4																						
8.6	Silty SAND, some gravel, trace clay Compact Reddish Brown Wet Auger grinding from 9.1m to 10.7m						272													14 64 21 1		
			12	SS	25										○							

Continued Next Page

+³, ×³: Numbers refer to
Sensitivity

20
15
10
(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No SW2-10

2 OF 2

METRIC

GWP# 129-90-00 LOCATION Sta. 28+000 EB CL N 5 397 614.5 E 406 794.8 ORIGINATED BY GAS
DIST Thunder Bay HWY 11/17 BOREHOLE TYPE Hollow Stem Auger COMPILED BY MC
DATUM Geodetic DATE 2023.02.17 - 2023.02.17 LATITUDE 48.708648 LONGITUDE -88.614001 CHECKED BY RB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)					
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa				WATER CONTENT (%)				GR	SA	SI	CL		
								20	40	60	80	100	W _p	W		W _L					
	Continued From Previous Page							○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE													
270.8																					
10.2	SAND , some silt, trace gravel Dense to Very Dense Reddish Brown Wet Auger grinding from 10.7m to 12.2m		13	SS	31		270														
							269														
			14	SS	36																
							268														
			15	SS	140		267														
266.8																					
14.2	END OF BOREHOLE AT 14.2m UPON AUGER REFUSAL ON POSSIBLE BEDROCK. BOREHOLE CAVED TO 4.0m AND WATER LEVEL AT 0.3m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE AND CUTTINGS TO SURFACE.																				

+³, ×³: Numbers refer to
Sensitivity

20
15
10

(%) STRAIN AT FAILURE

METRIC

[illegible]

+³, ×³: Numbers refer to Sensitivity

RECORD OF BOREHOLE No SW2-11

2 OF 2

METRIC

GWP# 129-90-00 LOCATION Sta. 28+025 EB O/S 10R N 5 397 640.8 E 406 800.7 ORIGINATED BY GAS
DIST Thunder Bay HWY 11/17 BOREHOLE TYPE Dynamic Cone Penetration Test COMPILED BY AN
DATUM Geodetic DATE 2023.02.14 - 2023.02.14 LATITUDE 48.708883 LONGITUDE -88.613914 CHECKED BY RB

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 NATURAL MOISTURE CONTENT LIQUID LIMIT W _p W W _L WATER CONTENT (%) 20 40 60 UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES				
	Continued From Previous Page								
268.7									
12.3	END OF DCPT AT 12.3m UPON REFUSAL.								

RECORD OF BOREHOLE No SW2-12

1 OF 1

METRIC

GWP# 129-90-00 LOCATION Sta. 28+025 EB O/S 10L N 5 397 637.6 E 406 780.9 ORIGINATED BY GAS
DIST Thunder Bay HWY 11/17 BOREHOLE TYPE Hollow Stem Auger COMPILED BY MC
DATUM Geodetic DATE 2023.02.16 - 2023.02.16 LATITUDE 48.708858 LONGITUDE -88.614183 CHECKED BY RB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
281.0	GROUND SURFACE							20 40 60 80 100									
0.0	PEAT , fibrous Very Loose Brown Wet		1	GS			280							560			
														547			
					2			GS									635
					3			SS	0								
			4	SS	0		278										
			5	SS	0												
			6	SS	0		277										
276.7																	
4.3	SAND and GRAVEL , trace to some silt Compact to Very Dense Reddish Brown Wet																
					7	SS	24		276								
			8	SS	34		275										
273.9																	
			9	SS	100/0		274										
7.1	END OF BOREHOLE AT 7.1m UPON AUGER REFUSAL ON POSSIBLE BEDROCK. BOREHOLE CAVED TO 4.6m AND WATER LEVEL AT 0.3m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE AND CUTTINGS TO SURFACE.				.075												

+³, ×³: Numbers refer to
Sensitivity

20
15
10

(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No SW2-13

1 OF 1

METRIC

GWP# 129-90-00 LOCATION Sta. 28+050 EB CL N 5 397 663.9 E 406 786.8 ORIGINATED BY GAS
DIST Thunder Bay HWY 11/17 BOREHOLE TYPE Hollow Stem Auger COMPILED BY MC
DATUM Geodetic DATE 2023.02.16 - 2023.02.17 LATITUDE 48.709093 LONGITUDE -88.614097 CHECKED BY RB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)							
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE							PLASTIC LIMIT w _p NATURAL MOISTURE CONTENT w LIQUID LIMIT w _L WATER CONTENT (%)						
281.0	GROUND SURFACE							20	40	60	80	100									
0.0	PEAT , fibrous Very Loose Brown Wet		1	GS			280											487			
			2	GS																536	
			3	SS	0																537
			4	SS	0																300
			5	SS	2																86
277.3																					
3.7	SAND and GRAVEL , trace silt, trace clay Compact to Very Dense Reddish Brown Wet		6	SS	27	277												40 50 10 (SI+CL)			
276.4			7	SS	100/																
4.6	END OF BOREHOLE AT 4.6m UPON AUGER REFUSAL ON POSSIBLE BEDROCK. BOREHOLE CAVED TO 3.6m AND WATER LEVEL AT 0.3m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE AND CUTTINGS TO SURFACE.				0.050																

+³, ×³: Numbers refer to
Sensitivity

20
15
10



(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No SW2-14

1 OF 1

METRIC

GWP# 129-90-00 LOCATION Sta. 28+075 EB O/S 10R N 5 397 690.2 E 406 792.7 ORIGINATED BY GAS
 DIST Thunder Bay HWY 11/17 BOREHOLE TYPE Hollow Stem Auger COMPILED BY MC
 DATUM Geodetic DATE 2023.02.14 - 2023.02.14 LATITUDE 48.709328 LONGITUDE -88.614010 CHECKED BY RB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa				WATER CONTENT (%)				GR	SA	SI	CL
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE	20	40	60	80	100	w _p		w	w _L		
281.7	GROUND SURFACE																		
0.0	PEAT , fibrous Very Loose Brown Wet		1	GS															
			2	SS	0														
			3	SS	0														
	No recovery		4	SS	0														
			5	SS	0														
277.6			6	SS	14														
4.1	SAND and GRAVEL to Gravelly SAND , trace to some silt, trace clay, occasional silt seams Compact to Very Dense Reddish Brown Wet		7	SS	32														
			8	SS	22														
			9	SS	67														
273.5																			
278.8	End of sampling and start of DCPT																		
8.3	END OF BOREHOLE AT 8.3m UPON AUGER REFUSAL ON POSSIBLE BEDROCK. BOREHOLE CAVED TO 4.0m AND WATER LEVEL AT 0.3m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE AND CUTTINGS TO SURFACE.																		

+³, ×³: Numbers refer to
Sensitivity

20
15
10

(%) STRAIN AT FAILURE

METRIC

[illegible]

ONTMT4S2 2020LIBRARY(MTO).GLB MTO-21663.GPJ 5/2/24

+³, ×³: Numbers refer to Sensitivity

RECORD OF BOREHOLE No SW2-16

1 OF 2

METRIC

GWP# 129-90-00 LOCATION Sta. 28+100 CL N 5 397 713.2 E 406 778.9 ORIGINATED BY GAS
DIST Thunder Bay HWY 11/17 BOREHOLE TYPE Hollow Stem Auger/Solid Stem Auger COMPILED BY MC
DATUM Geodetic DATE 2023.02.12 - 2023.02.12 LATITUDE 48.709538 LONGITUDE -88.614193 CHECKED BY RB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa			w _p	w	w _L		GR SA SI CL				
282.0	GROUND SURFACE							20 40 60 80 100	○ UNCONFINED + FIELD VANE	WATER CONTENT (%)									
0.0	PEAT , fibrous, some wood Very Loose Brown Wet		1	GS		▽	281							483					
			2	GS			280								588				
			3	SS	0										458				
	No recovery		4	SS	0		279												
			5	SS	1		278								454				
			6	SS	0		277								733				
			7	SS	0										672				
276.7																			
5.3	SAND , trace gravel, trace clay, trace silt Loose to Compact Brown to Reddish Brown Wet		8	SS	5		276									5	86	9 (SI+CL)	
			9	SS	4														
275.2																			
6.8	Silty SAND to SAND and SILT , trace to some clay Compact to Very Dense Brown to Reddish Brown Wet		10	SS	23		275									5	51	44 (SI+CL)	
			11	SS	18		274												
	Auger grinding from 8.4m to 9.1m						273												
			12	SS	24											12	60	26 2	

Continued Next Page

+³, ×³: Numbers refer to
Sensitivity

20
15
10
(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No SW2-16

2 OF 2

METRIC

GWP# 129-90-00 LOCATION Sta. 28+100 CL N 5 397 713.2 E 406 778.9 ORIGINATED BY GAS
DIST Thunder Bay HWY 11/17 BOREHOLE TYPE Hollow Stem Auger/Solid Stem Auger COMPILED BY MC
DATUM Geodetic DATE 2023.02.12 - 2023.02.12 LATITUDE 48.709538 LONGITUDE -88.614193 CHECKED BY RB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa							
	Continued From Previous Page							<div><div>20406080100</div><div>○ UNCONFINED + FIELD VANE</div><div>● QUICK TRIAXIAL × LAB VANE</div></div> <div><div>PLASTIC LIMIT</div><div>NATURAL MOISTURE CONTENT</div><div>LIQUID LIMIT</div><div>W_P W W_L</div><div>WATER CONTENT (%)</div><div>204060</div></div>							
269.1 12.9	Silty SAND to SAND and SILT , trace to some clay Compact to Very Dense Brown to Reddish Brown Wet		13	SS	16		271								
							270								
			14	SS	51										
			15	SS	100/0										
		END OF BOREHOLE AT 12.9m UPON AUGER REFUSAL ON POSSIBLE BEDROCK. BOREHOLE CAVED TO 7.3m AND WATER LEVEL AT 0.3m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE AND CUTTINGS TO SURFACE.				.050									

RECORD OF BOREHOLE No SW2-17

1 OF 1

METRIC

GWP# 129-90-00 LOCATION Sta. 28+125 EB O/S 10R N 5 397 739.5 E 406 784.8 ORIGINATED BY GAS
DIST Thunder Bay HWY 11/17 BOREHOLE TYPE Dynamic Cone Penetration Test COMPILED BY AN
DATUM Geodetic DATE 2023.02.11 - 2023.02.11 LATITUDE 48.709773 LONGITUDE -88.614106 CHECKED BY RB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE	WATER CONTENT (%)					
282.0 0.0	GROUND SURFACE DCPT from surface.													
277.4 4.6	END OF DCPT AT 4.6m UPON REFUSAL.													

RECORD OF BOREHOLE No SW2-18

1 OF 2

METRIC

GWP# 129-90-00 LOCATION Sta. 28+125 EB O/S 10L N 5 397 736.3 E 406 765.0 ORIGINATED BY GAS
 DIST Thunder Bay HWY 11/17 BOREHOLE TYPE Hollow Stem Auger/Solid Stem Auger COMPILED BY MC
 DATUM Geodetic DATE 2023.02.11 - 2023.02.12 LATITUDE 48.709748 LONGITUDE -88.614375 CHECKED BY RB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)						
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa											
282.0	GROUND SURFACE							20	40	60	80	100							
0.0	PEAT , fibrous Very Loose Brown Wet 																		

Continued Next Page

+³, ×³: Numbers refer to
Sensitivity

20
15
10

(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No SW2-18

2 OF 2

METRIC

GWP# 129-90-00 LOCATION Sta. 28+125 EB O/S 10L N 5 397 736.3 E 406 765.0 ORIGINATED BY GAS
DIST Thunder Bay HWY 11/17 BOREHOLE TYPE Hollow Stem Auger/Solid Stem Auger COMPILED BY MC
DATUM Geodetic DATE 2023.02.11 - 2023.02.12 LATITUDE 48.709748 LONGITUDE -88.614375 CHECKED BY RB

SOIL PROFILE			SAMPLES			GROUND WATER * CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
	Continued From Previous Page																
	WATER LEVEL READINGS																
	DATE DEPTH(m) ELEV.(m)																
	2023.02.12 0.0 282.0																
	2023.02.27 0.0 282.0																
	2023.02.26 0.0 282.0																
	2023.02.28 Frozen/Ice -																

RECORD OF BOREHOLE No SW2-19

1 OF 1

METRIC

GWP# 129-90-00 LOCATION Sta. 28+150 EB CL N 5 397 762.6 E 406 770.9 ORIGINATED BY GAS
DIST Thunder Bay HWY 11/17 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
DATUM Geodetic DATE 2023.02.11 - 2023.02.11 LATITUDE 48.709983 LONGITUDE -88.614289 CHECKED BY RB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa			WATER CONTENT (%)					
								○ UNCONFINED + FIELD VANE								
								● QUICK TRIAXIAL × LAB VANE								
282.0	GROUND SURFACE						20 40 60 80 100	20 40 60					GR SA SI CL			
0.0	PEAT , fibrous Very Loose Dark Brown Wet		1	GS									797			
															646	
																1122
																1535
																719
																617
																594
																451
276.0							276						281			
279.9	GRAVEL , some silt, trace sand, some peat Very Dense Reddish Brown Wet		9	SS	100/											
6.1					0.025											
	END OF BOREHOLE AT 6.1m UPON AUGER REFUSAL ON POSSIBLE BEDROCK. BOREHOLE CAVED TO 2.1m AND WATER LEVEL AT 0.2m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE AND CUTTINGS TO SURFACE.															

ONTMT452 2020LIBRARY(MTO),GLB MTO-21663.GPJ 5/2/24

RECORD OF BOREHOLE No SW2-20

1 OF 1

METRIC

GWP# 129-90-00 LOCATION Sta. 28-175 EB O/S 10R N 5 397 788.9 E 406 776.8 ORIGINATED BY GAS
 DIST Thunder Bay HWY 11/17 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2023.02.10 - 2023.02.10 LATITUDE 48.710218 LONGITUDE -88.614202 CHECKED BY RB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT							UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa												
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE												
282.0	GROUND SURFACE							20	40	60	80	100								
0.0	PEAT, fibrous Very Loose Dark Brown Wet		1	SS	2															
			2	SS	2															
			3	SS	0															
279.7																				
2.3	SAND and GRAVEL, some silt Dense to Very Dense Reddish Brown Wet		4	SS	40															
			5	SS	41															
278.3			6	SS	100/															
3.7	END OF BOREHOLE AT 3.7m UPON AUGER REFUSAL ON POSSIBLE BEDROCK. BOREHOLE CAVED TO 2.9m AND WATER LEVEL AT 0.3m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE AND CUTTINGS TO SURFACE.				0.075															

+³, ×³: Numbers refer to
Sensitivity

20
15
10

(%) STRAIN AT FAILURE

METRIC

[illegible]

+³, ×³: Numbers refer to Sensitivity

RECORD OF BOREHOLE No SW2-22

1 OF 2

METRIC

GWP# 129-90-00 LOCATION Sta. 28+200 EB CL N 5 397 812.0 E 406 762.9 ORIGINATED BY GAS
DIST Thunder Bay HWY 11/17 BOREHOLE TYPE Solid Stem Auger/ Hollow Stem Auger COMPILED BY MC
DATUM Geodetic DATE 2023.02.09 - 2023.02.09 LATITUDE 48.710428 LONGITUDE -88.614385 CHECKED BY RB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																														
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa							WATER CONTENT (%)																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																													
								20	40	60	80	100				○ UNCONFINED	+ FIELD VANE	● QUICK TRIAXIAL	× LAB VANE																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																									
282.0	GROUND SURFACE																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																											

Continued Next Page

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

RECORD OF BOREHOLE No SW2-22

2 OF 2

METRIC

GWP# 129-90-00 LOCATION Sta. 28+200 EB CL N 5 397 812.0 E 406 762.9 ORIGINATED BY GAS
DIST Thunder Bay HWY 11/17 BOREHOLE TYPE Solid Stem Auger/ Hollow Stem Auger COMPILED BY MC
DATUM Geodetic DATE 2023.02.09 - 2023.02.09 LATITUDE 48.710428 LONGITUDE -88.614385 CHECKED BY RB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
	Continued From Previous Page																
271.3	SAND , some gravel to SAND and GRAVEL Loose to Very Dense Reddish Brown Wet		13	SS													
10.7	END OF BOREHOLE AT 10.7m UPON AUGER REFUSAL ON POSSIBLE BEDROCK. BOREHOLE CAVED TO 4.9m AND WATER LEVEL AT 0.3m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE AND CUTTINGS TO SURFACE.																

RECORD OF BOREHOLE No SW2-23

1 OF 1

METRIC

GWP# 129-90-00 LOCATION Sta. 28+225 EB O/S 10R N 5 397 838.2 E 406 768.9 ORIGINATED BY GAS
DIST Thunder Bay HWY 11/17 BOREHOLE TYPE Dynamic Cone Penetration Test COMPILED BY AN
DATUM Geodetic DATE 2023.02.09 - 2023.02.09 LATITUDE 48.710663 LONGITUDE -88.614298 CHECKED BY RB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
282.0	GROUND SURFACE													
0.0	DCPT from surface.													
281.7														
0.3	END OF DCPT AT 0.3m UPON REFUSAL.													

RECORD OF BOREHOLE No SW2-24

1 OF 1

METRIC

GWP# 129-90-00 LOCATION Sta. 28+225 EB O/S 10L N 5 397 835.1 E 406 749.1 ORIGINATED BY GAS
 DIST Thunder Bay HWY 11/17 BOREHOLE TYPE Hollow Stem Auger COMPILED BY MC
 DATUM Geodetic DATE 2023.02.09 - 2023.02.09 LATITUDE 48.710638 LONGITUDE -88.614567 CHECKED BY RB



SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
								20 40 60 80 100									
							○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT w _p w w _L WATER CONTENT (%)					
							20 40 60 80 100					20 40 60					
282.0	GROUND SURFACE																
0.0	PEAT, amorphous with frequent fibrous layers Loose to Very Loose Dark Brown Wet		1	SS	7									683			
																446	
																	473
279.7			3	SS	0		280										
2.3	SAND and GRAVEL, trace silt, occasional organics Very Dense Brown Wet		4	SS	100/0									126			
279.5																	
2.5	END OF BOREHOLE AT 2.5m. BOREHOLE OPEN AND WATER LEVEL AT 0.3m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE AND CUTTINGS TO SURFACE.				.050												

RECORD OF BOREHOLE No SW2-25

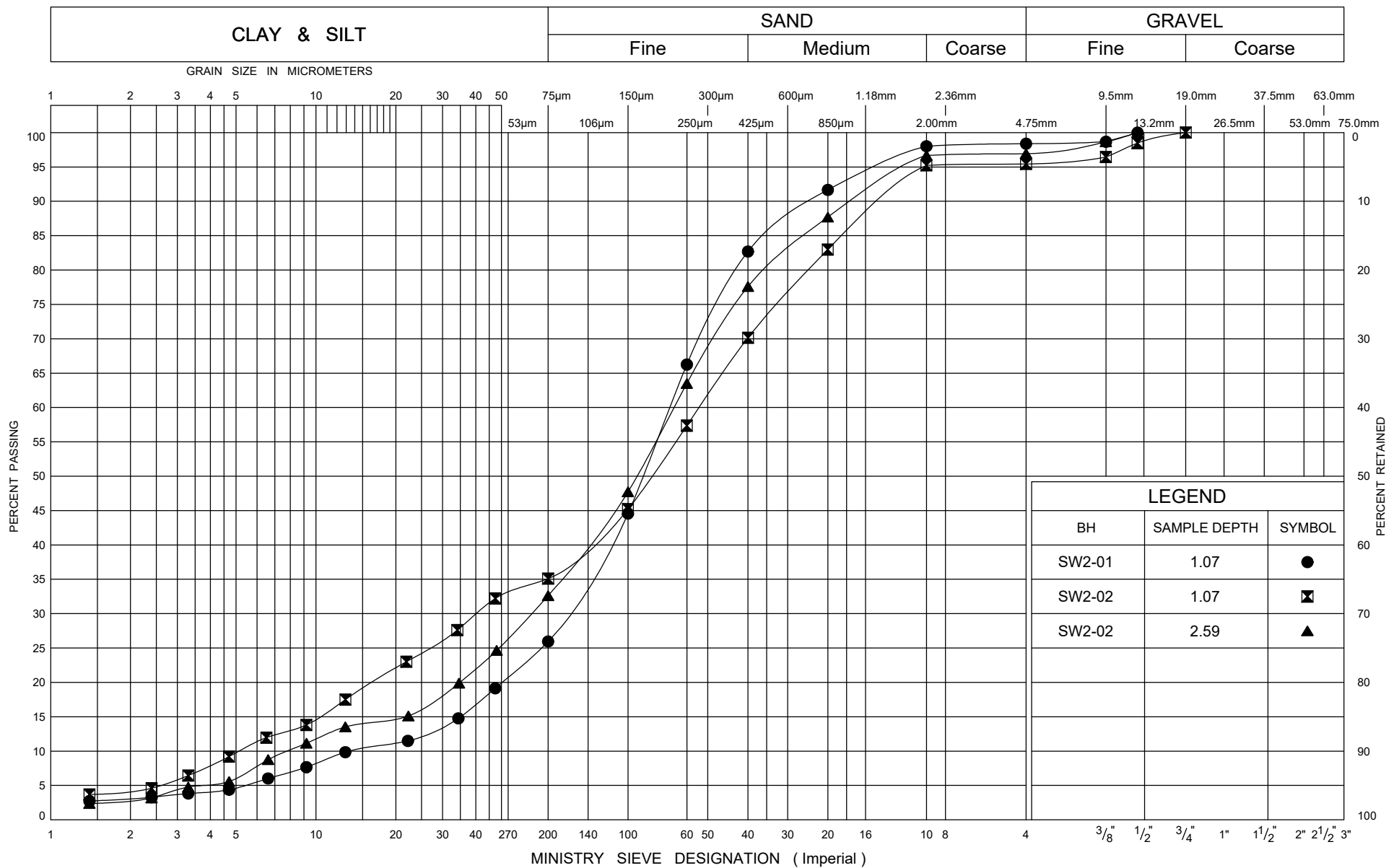
1 OF 1

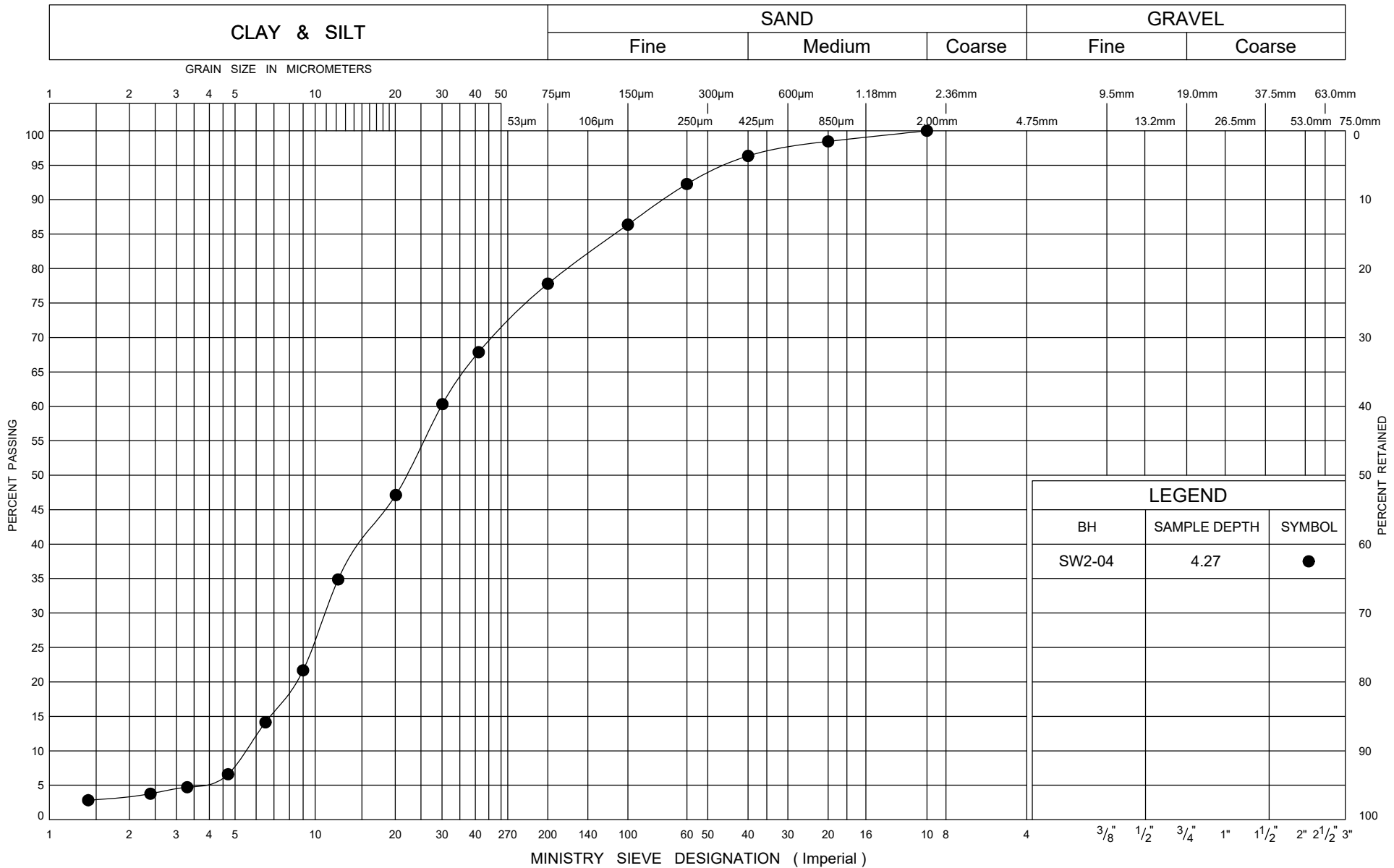
METRIC

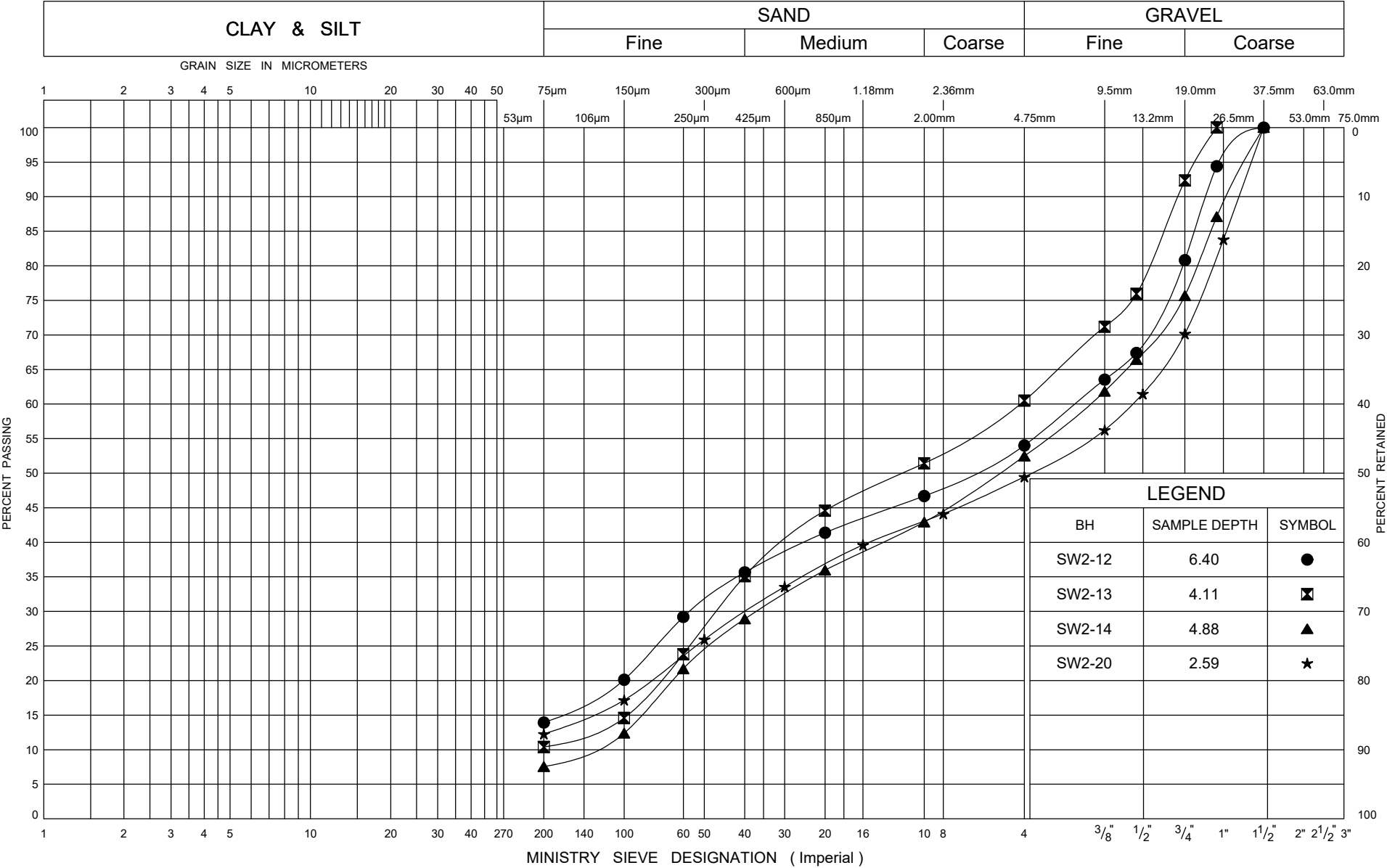
GWP# 129-90-00 LOCATION Sta 28+240 EB CL N 406 756.7 E 5 397 851.5 ORIGINATED BY GAS
DIST Thunder Bay HWY 11/17 BOREHOLE TYPE Hollow Stem Auger COMPILED BY MC
DATUM Geodetic DATE 2023.02.26 - 2023.02.26 LATITUDE 48.687832 LONGITUDE -88.626175 CHECKED BY RB

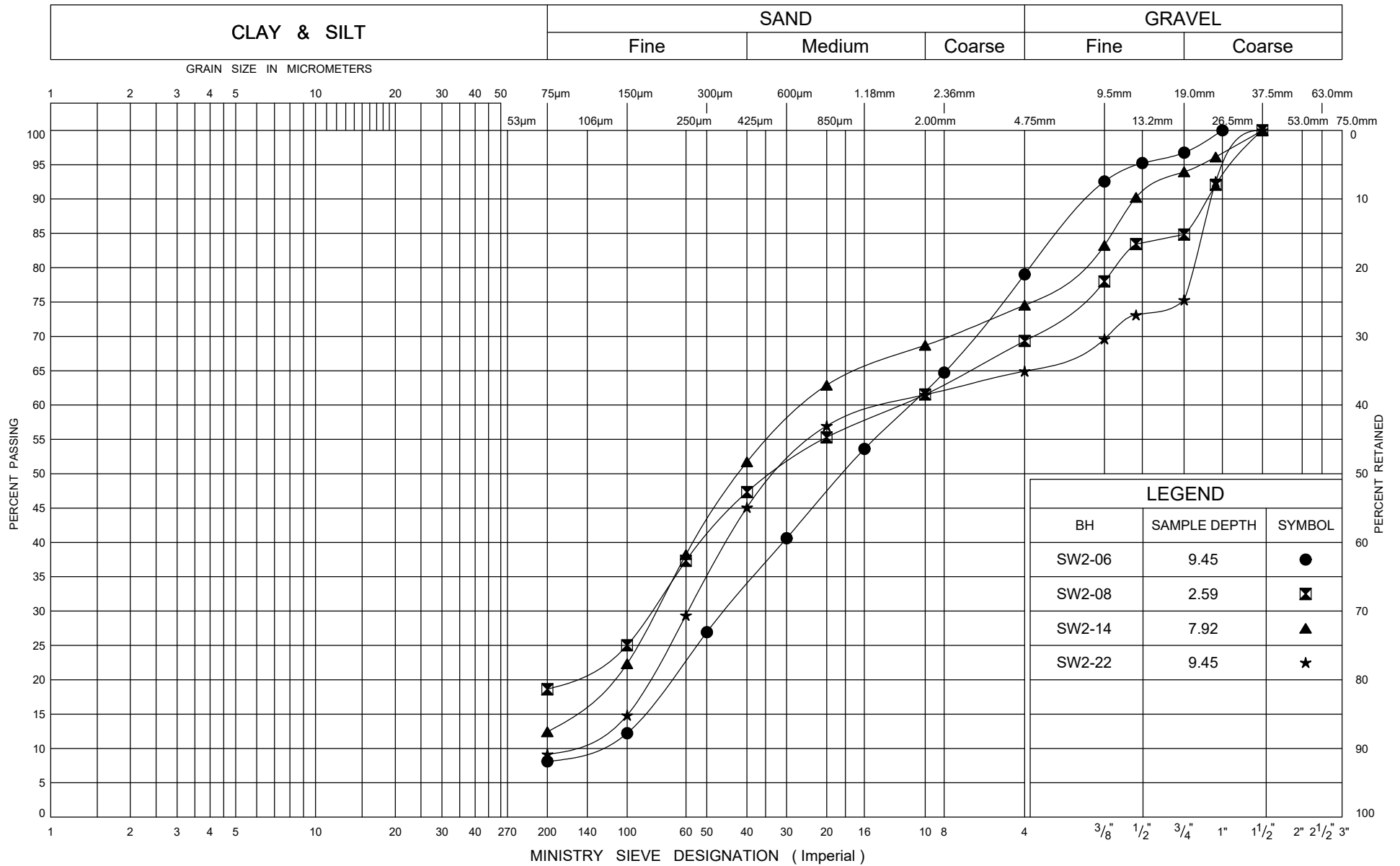
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa											
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE											
282.0	GROUND SURFACE							20	40	60	80	100							
0.0	Gravelly SAND , trace to some silt Very Dense Reddish Brown Wet		1	GS			281												
			2	SS	121														
				3	SS	72		280											
279.6																			
2.4	END OF BOREHOLE AT 2.4m UPON AUGER REFUSAL ON POSSIBLE BEDROCK. BOREHOLE CAVED TO 1.3m AND WATER LEVEL AT 0.8m. BOREHOLE BACKFILLED WITH BENTONITE AND CUTTINGS TO SURFACE.																		

F2: Swamp Section 2 Geotechnical Laboratory Testing Results









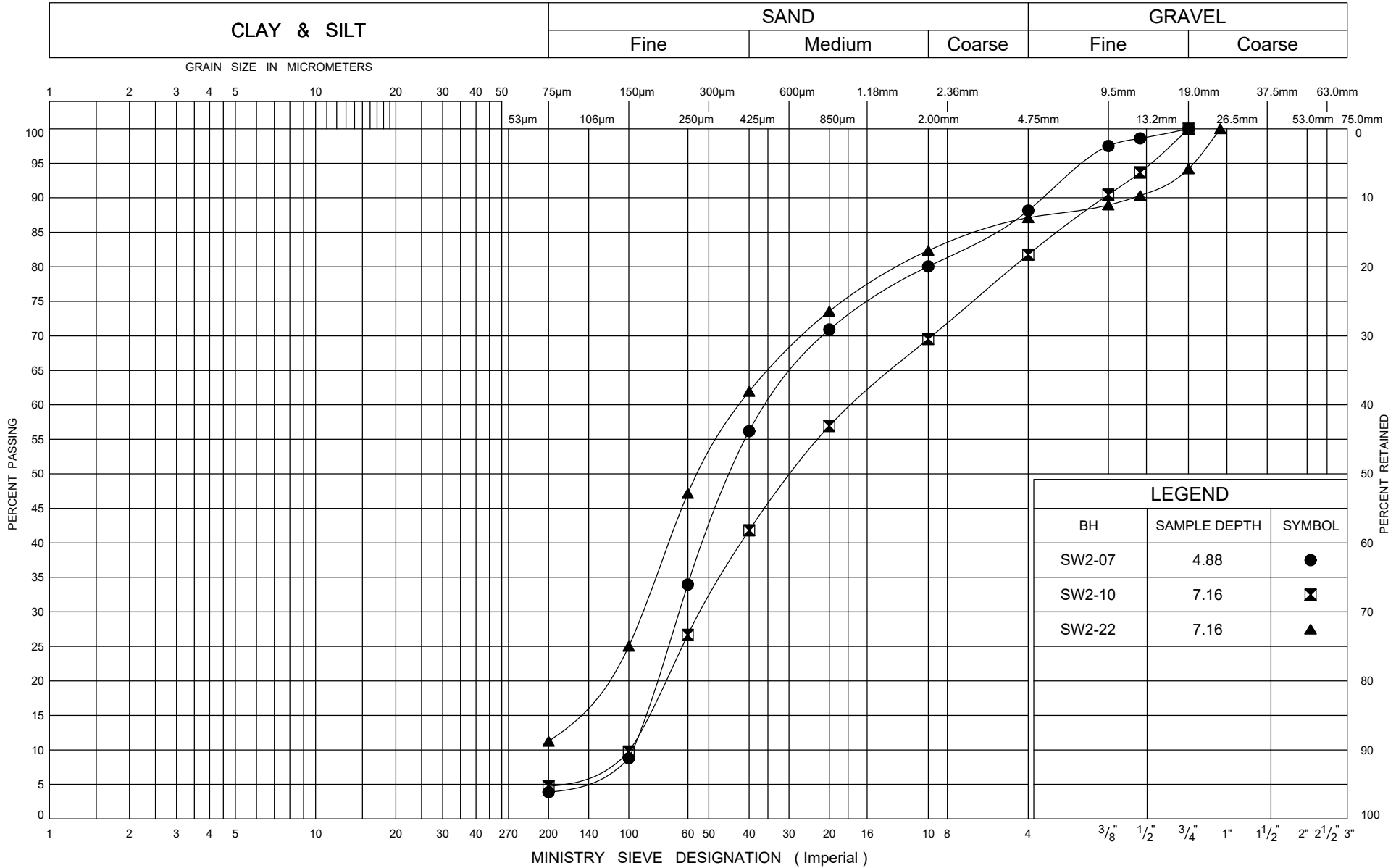
Ministry of
Transportation

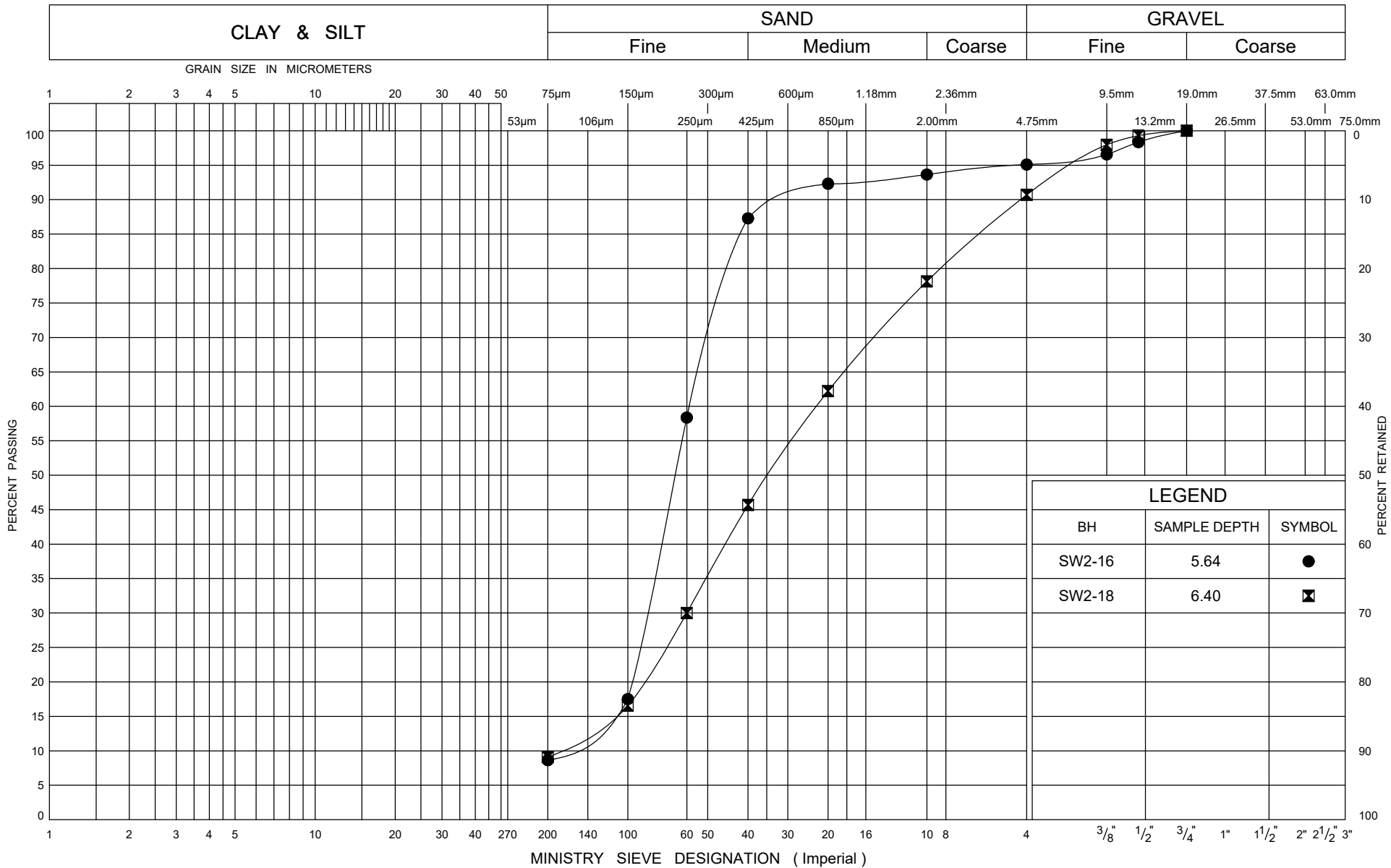
GRAIN SIZE DISTRIBUTION

Gravelly SAND

FIG No F4

GWP# 129-90-00





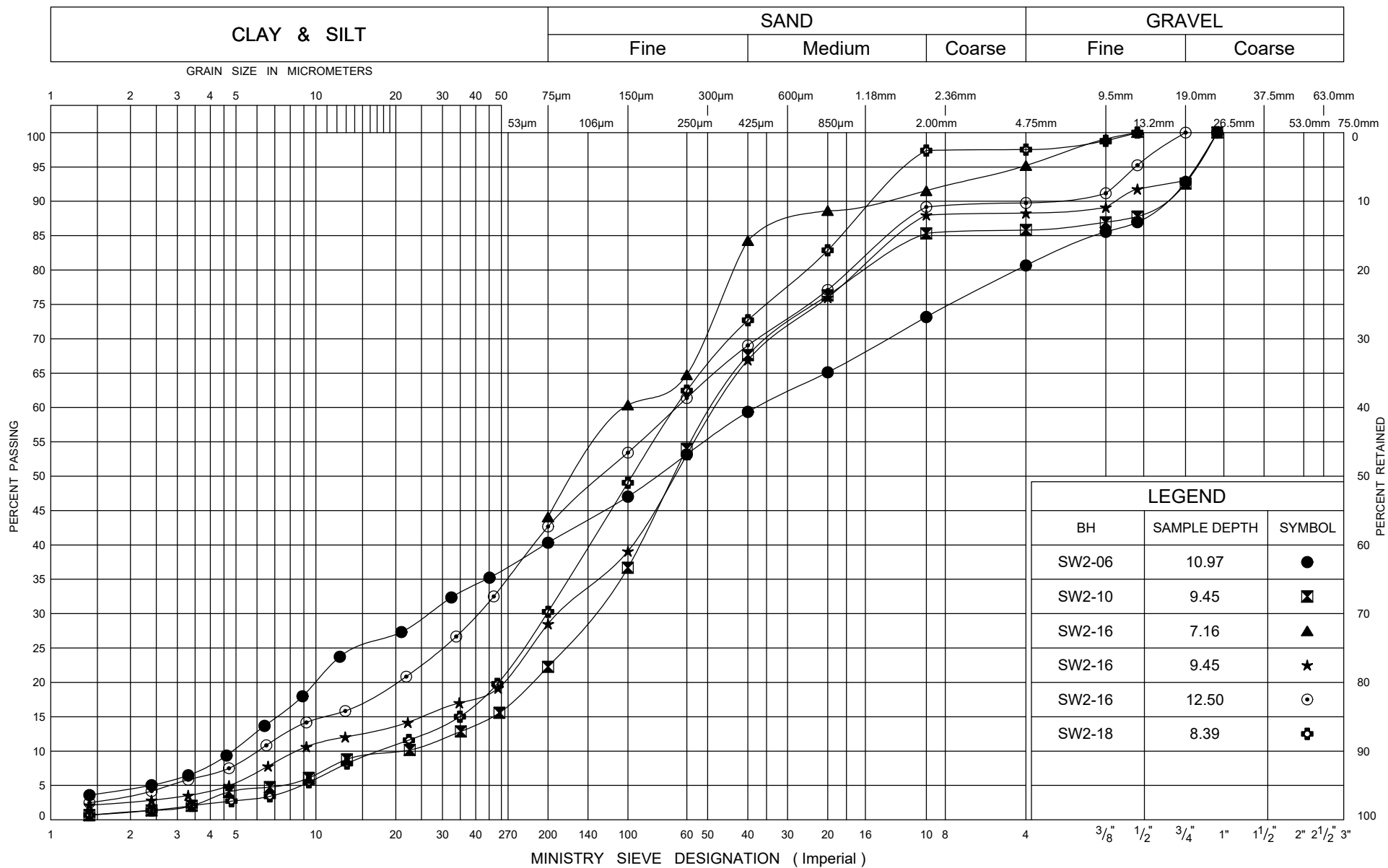




FIG No F8

GWP# 129-90-00



THURBER ENGINEERING LTD.

APPENDIX G

G1: High Fill Section 6 Record of Borehole Sheets

SYMBOLS, ABBREVIATIONS AND TERMS USED ON RECORDS OF BOREHOLES

1. TEXTURAL CLASSIFICATION OF SOILS

CLASSIFICATION	PARTICLE SIZE	VISUAL IDENTIFICATION
Boulders	Greater than 200mm	same
Cobbles	75 to 200mm	same
Gravel	4.75 to 75mm	5 to 75mm
Sand	0.075 to 4.75mm	Not visible particles to 5mm
Silt	0.002 to 0.075mm	Non-plastic particles, not visible to the naked eye
Clay	Less than 0.002mm	Plastic particles, not visible to the naked eye

2. COARSE GRAIN SOIL DESCRIPTION (50% greater than 0.075mm)

TERMINOLOGY	PROPORTION
Trace or Occasional	Less than 10%
Some	10 to 20%
Adjective (e.g. silty or sandy)	20 to 35%
And (e.g. sand and gravel)	35 to 50%

3. TERMS DESCRIBING CONSISTENCY (COHESIVE SOILS ONLY)

DESCRIPTIVE TERM	UNDRAINED SHEAR STRENGTH (kPa)	APPROXIMATE SPT ⁽¹⁾ 'N' VALUE
Very Soft	12 or less	Less than 2
Soft	12 to 25	2 to 4
Firm	25 to 50	4 to 8
Stiff	50 to 100	8 to 15
Very Stiff	100 to 200	15 to 30
Hard	Greater than 200	Greater than 30

NOTE: Hierarchy of Soil Strength Prediction

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



4. TERMS DESCRIBING DENSITY (COHESIONLESS SOILS ONLY)

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

5. LEGEND FOR RECORDS OF BOREHOLES

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

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


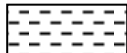



 Water Level
 Shear Strength Determination by Pocket Penetrometer

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

UNIFIED SOILS CLASSIFICATION

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

EXPLANATION OF ROCK LOGGING TERMS

<u>ROCK WEATHERING CLASSIFICATION</u>		<u>SYMBOLS</u>	
Fresh (FR)	No visible signs of weathering.		
Fresh Jointed (FJ)	Weathering limited to the surface of major discontinuities.		CLAYSTONE
Slightly Weathered (SW)	Penetrative weathering developed on open discontinuity surfaces, but only slight weathering of rock material.		SILTSTONE
Moderately Weathered (MW)	Weathering extends throughout the rock mass, but the rock material is not friable.		SANDSTONE
Highly Weathered (HW)	Weathering extends throughout the rock mass and the rock is partly friable.		COAL
Completely Weathered (CW)	Rock is wholly decomposed and in a friable condition, but the rock texture and structure are preserved.		Bedrock (general)

<u>DISCONTINUITY SPACING</u>		<u>STRENGTH CLASSIFICATION</u>			
Bedding	Bedding Plane Spacing	Rock Strength	Approximate Uniaxial Compressive Strength		Field Estimation of Hardness*
			(MPa)	(psi)	
Very thickly bedded	Greater than 2m	Extremely Strong	Greater than 250	Greater than 36,000	Specimen can only be chipped with a geological hammer
Thickly bedded	0.6 to 2m				
Medium bedded	0.2 to 0.6m	Very Strong	100-250	15,000 to 36,000	Requires many blows of geological hammer to break
Thinly bedded	60mm to 0.2m	Strong	50-100	7,500 to 15,000	Requires more than one blow of geological hammer to break
Very thinly bedded	20 to 60mm				
Laminated	6 to 20mm	Medium Strong	25.0 to 50.0	3,500 to 7,500	Breaks under single blow of geological hammer.
Thinly Laminated	Less than 6mm				

<u>TERMS</u>					
Total Core Recovery: (TCR)	Core recovered as a percentage of total core run length.	Weak	5.0 to 25.0	750 to 3,500	Can be peeled by a pocket knife with difficulty
Solid Core Recovery: (SCR)	Percent Ratio of solid core of full cylindrical shape recovered. Expressed with respect to the total length of core run.	Very Weak	1.0 to 5.0	150 to 750	Can be peeled by a pocket knife, crumbles under firm blows of geological pick.
Rock Quality Designation: (RQD)	Total length of sound core recovered in pieces 0.1m in length or larger as a percentage of total core run length.	Extremely Weak (Rock)	0.25 to 1.0	35 to 150	Indented by thumbnail
Uniaxial Compressive Strength (UCS)	Axial stress required to break the specimen				
Fracture Index: (FI)	Frequency of natural fractures per 0.3m of core run.				

RECORD OF BOREHOLE No HF6-01

1 OF 1

METRIC

GWP# 129-90-00 LOCATION Sta. 28+925 EB CL N 5 398 512.5 E 406 876.4 ORIGINATED BY FK
DIST Thunder Bay HWY 11/17 BOREHOLE TYPE Solid Stem Augers/NQ Coring COMPILED BY AS
DATUM Geodetic DATE 2022.10.30 - 2022.10.31 LATITUDE 48.716708 LONGITUDE -88.612671 CHECKED BY RB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
259.0	GROUND SURFACE							<div>20406080100</div> <div>○ UNCONFINED + FIELD VANE</div> <div>● QUICK TRIAXIAL × LAB VANE</div>						
0.0	SAND and SILT , trace gravel, trace clay, trace organics in upper 0.6m, occasional cobbles Very Dense Reddish Brown Moist		1	GS			258	<div>204060</div> <div>○</div>						
			2	SS	66			<div>204060</div> <div>○</div>						
			3	SS	85		257	<div>204060</div> <div>○</div>						
256.4	Coring required to penetrate from 2.6m to 3.0m		4	SS	100/ 0-200			<div>204060</div> <div>○</div>						
2.6	SAND and GRAVEL Loose to very dense Reddish Brown Moist		5	SS	5		256							
	Frequent cobbles and boulders No recovery in SS5						255							
	No recovery in SS6 Coring required to penetrate from 4.7m to 5.9m		6	SS	100/ 0.150		254							
252.9	No recovery in SS7		7	SS	100/ 0.025		253						FI >10	
6.1	BEDROCK (GRANITE) , slightly weathered to fresh, very strong, reddish brown/grey		1	RUN			252						1 2 4	RUN #1 TCR=100% SCR=89% RQD=77% UCS=237MPa (Average Point Load)
	Vertical fracture 7.8m to 9.2m.		2	RUN			251						1 5 4 3 2	RUN #2 TCR=100% SCR=83% RQD=90% UCS=222MPa (Average Point Load)
250.1	END OF BOREHOLE AT 8.9m. BOREHOLE OPEN AND DRY TO 7.4m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE AND SOIL CUTTINGS TO SURFACE.													
8.9														

ONTMT452 2020LIBRARY(MTO).GLB MTO-21663.GPJ 5/2/24

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

RECORD OF BOREHOLE No HF6-02

1 OF 1

METRIC

GWP# 129-90-00 LOCATION Sta. 29+010 EB O/S 10R N 5 398 584.3 E 406 921.8 ORIGINATED BY FK
 DIST Thunder Bay HWY 11/17 BOREHOLE TYPE Solid Stem Augers COMPILED BY AS
 DATUM Geodetic DATE 2022.10.26 - 2022.10.26 LATITUDE 48.717346 LONGITUDE -88.612036 CHECKED BY RB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT						PLASTIC LIMIT W _P	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)					
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa															
								○ UNCONFINED	+ FIELD VANE	● QUICK TRIAXIAL	× LAB VANE	WATER CONTENT (%)											
253.7	GROUND SURFACE																						
0.0	TOPSOIL: (50mm)																						
253.0	Sandy, SILT , gravelly, trace clay, trace organics Reddish Brown Moist		1	GS										○				23	24	42	11		
0.7	Sandy, SILT , trace clay, trace gravel Dense to Very Dense Reddish Brown Moist		2	SS	45									○									
			3	SS	91/ 0.075									○									
			4	SS	100/ 0.075									○									
250.5			5	SS	100/ 0.100									○						6	35	51	8
3.1	END OF BOREHOLE AT 3.1m. BOREHOLE OPEN AND DRY TO 3.1m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE AND SOIL CUTTINGS TO SURFACE.																						

RECORD OF BOREHOLE No HF6-03

1 OF 1

METRIC

GWP# 129-90-00 LOCATION Sta. 29+075 EB CL N 5 398 636.4 E 406 960.5 ORIGINATED BY FK
DIST Thunder Bay HWY 11/17 BOREHOLE TYPE Solid Stem Augers COMPILED BY AS
DATUM Geodetic DATE 2022.10.26 - 2022.10.26 LATITUDE 48.717808 LONGITUDE -88.611496 CHECKED BY RB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _P	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
246.8	GROUND SURFACE							20	40	60	80	100					
0.0	TOPSOIL: (300mm)																
246.5			1	GS													
0.3	SILT and SAND , trace gravel, trace clay, trace organics Hard Brown Moist (ML)																
245.8			2	SS	58												
1.0																	
			3	SS	62/ 0.125												
	Silty SAND , trace clay, trace gravel, occasional cobbles Very Dense Reddish Brown Moist		4	SS	100/ 0.075												
243.7			5	SS	100/ 0.125												
3.2	END OF BOREHOLE AT 3.2m. Piezometer installation consists of 25mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen. WATER LEVEL READINGS DATE DEPTH(m) ELEV.(m) 2022.10.26 Dry - 2022.10.30 Dry -																

RECORD OF BOREHOLE No HF6-04

1 OF 1

METRIC

GWP# 129-90-00 LOCATION Sta. 29+150 EB CL N 5 398 693.4 E 407 009.3 ORIGINATED BY FK
DIST Thunder Bay HWY 11/17 BOREHOLE TYPE Solid Stem Augers COMPILED BY AS
DATUM Geodetic DATE 2022.10.27 - 2022.10.27 LATITUDE 48.718312 LONGITUDE -88.610819 CHECKED BY RB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w _P	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
241.9	GROUND SURFACE							20	40	60	80	100					
0.0	TOPSOIL: (150mm)							20	40	60	80	100					
0.2	Silty SAND , some gravel, some clay, trace organics Brown Moist		1	GS			241										
240.9			2	SS	100/ 0.250												
1.0	SAND and GRAVEL , trace to some silt, occasional cobbles, occasional sandstone gravel Very Dense Reddish Brown Moist		3	SS	100/ 0.125		240										44 45 11 (SI+CL)
239.5	No recovery		4	SS	100/ 0.050												
2.3	END OF BOREHOLE AT 2.3m UPON AUGER REFUSAL ON POSSIBLE BEDROCK. BOREHOLE OPEN AND DRY TO 2.2m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE AND SOIL CUTTINGS TO SURFACE.																

+³, ×³: Numbers refer to
Sensitivity

20
15
10




(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No HF6-05

1 OF 1

METRIC

GWP# 129-90-00 LOCATION Sta. 29+225 EB CL N 5 398 746.5 E 407 062.3 ORIGINATED BY FK
DIST Thunder Bay HWY 11/17 BOREHOLE TYPE Solid Stem Augers COMPILED BY AS
DATUM Geodetic DATE 2022.10.27 - 2022.10.27 LATITUDE 48.718781 LONGITUDE -88.610086 CHECKED BY RB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _P	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa											
238.2	GROUND SURFACE																		
0.0	TOPSOIL: (150mm)																		
0.2	Silty SAND , trace gravel, trace clay, occasional gravel and cobbles Compact to Very Dense Reddish Brown Moist		1	GS															
			2	SS	32														
			3	SS	103/ 0.225														
236.1	Gravelly SAND , some silt, trace clay Very Dense Reddish Brown Moist																		
			4	SS	102/ 0.275														
2.0																			
			5	SS	98/ 0.200														
234.2																			
			6	SS	100/ 0.100														
4.0	SAND and SILT , trace clay, trace gravel Very Dense Reddish Brown Moist																		
			7	SS	103/ 0.200														
231.9																			
			6.3	END OF BOREHOLE AT 6.3m UPON AUGER REFUSAL ON POSSIBLE BEDROCK. BOREHOLE OPEN AND DRY TO 6.3m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE AND SOIL CUTTINGS TO SURFACE.															
																</			

+³, ×³: Numbers refer to
Sensitivity

20
15
10
(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No HF6-06

1 OF 1

METRIC

GWP# 129-90-00 LOCATION Sta. 29+300 EB CL N 5 398 795.4 E 407 119.1 ORIGINATED BY FK
DIST Thunder Bay HWY 11/17 BOREHOLE TYPE Solid Stem Augers COMPILED BY AS
DATUM Geodetic DATE 2022.10.27 - 2022.10.27 LATITUDE 48.719212 LONGITUDE -88.609303 CHECKED BY RB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE							PLASTIC LIMIT w _p NATURAL MOISTURE CONTENT w LIQUID LIMIT w _L WATER CONTENT (%)			
234.7	GROUND SURFACE							20	40	60	80	100						
0.0	TOPSOIL: (50mm) Silty CLAY , trace sand, trace organics Stiff Grey to Brown Moist (Cl)		1	GS			234								○			0 2 56 42
			2	SS	12		233								○			
232.9							232								○			
1.8	SILT , trace clay Dense Grey Moist		3	SS	37		231											
			4	SS	35		230								○			
							229											
229.9			5	SS	35		229								○			
4.9	SAND , trace to some gravel, trace to some silt, trace clay, occasional silt layers, occasional cobbles Dense to Very Dense Reddish Brown Moist						228								○			
			6	SS	58		227								○			
227.6																		
7.2	SAND and GRAVEL , trace silt, occasional sandstone fragments Compact Reddish Brown Moist		7	SS	28										○			
226.2																		
8.5	END OF BOREHOLE AT 8.5m. Piezometer installation consists of 25mm diameter Schedule 40 PVC pipe with a 3.05m slotted screen. WATER LEVEL READINGS DATE DEPTH(m) ELEV.(m) 2022.10.28 6.0 228.7 2022.10.30 4.2 230.5																	

+³, ×³: Numbers refer to
Sensitivity

20
15
10

(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No HF6-07

1 OF 2

METRIC

GWP# 129-90-00 LOCATION Sta. 29+375 EB O/S 3R N 5 398 837.6 E 407 181.0 ORIGINATED BY FK
DIST Thunder Bay HWY 11/17 BOREHOLE TYPE Solid Stem Augers COMPILED BY AS
DATUM Geodetic DATE 2022.10.28 - 2022.10.28 LATITUDE 48.719580 LONGITUDE -88.608450 CHECKED BY RB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE				WATER CONTENT (%) w _P w w _L				GR	SA	SI	CL
234.0	GROUND SURFACE																		
0.0	TOPSOIL: (175mm)																		
0.2	Silty CLAY , some sand, some organics from 0.2 to 2.2m Very Stiff to Firm Brown Moist (CI)		1	GS															
			2	SS	16														
			3	SS	11														
			4	SS	5														
	Occasional silt seams																		
			5	SS	11														
228.4																			
5.6	SILT , trace clay, trace sand Compact Grey Wet (ML)		6	SS	20														
226.9																			
7.2	SAND and GRAVEL , trace silt Very Dense Reddish Brown Wet		7	SS	97/ 0.275														
224.8			8	SS	100/														
9.2	END OF BOREHOLE AT 9.2m UPON AUGER REFUSAL ON POSSIBLE BEDROCK. BOREHOLE OPEN AND WATER LEVEL AT 5.8m UPON				0.100														

Continued Next Page

+³, ×³: Numbers refer to
Sensitivity

20
15
10

(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No HF6-07

2 OF 2

METRIC

GWP# 129-90-00 LOCATION Sta. 29+375 EB O/S 3R N 5 398 837.6 E 407 181.0 ORIGINATED BY FK
DIST Thunder Bay HWY 11/17 BOREHOLE TYPE Solid Stem Augers COMPILED BY AS
DATUM Geodetic DATE 2022.10.28 - 2022.10.28 LATITUDE 48.719580 LONGITUDE -88.608450 CHECKED BY RB

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






ONTMT452 2020LIBRARY(MTO).GLB MTO-21663.GPJ 5/2/24

RECORD OF BOREHOLE No HF6-08

1 OF 2

METRIC

GWP# 129-90-00 LOCATION Sta. 29+450 EB O/S 2R N 5 398 878.3 E 407 243.8 ORIGINATED BY FK
DIST Thunder Bay HWY 11/17 BOREHOLE TYPE Solid Stem Augers COMPILED BY AS
DATUM Geodetic DATE 2022.10.28 - 2022.10.29 LATITUDE 48.719936 LONGITUDE -88.607587 CHECKED BY RB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
234.0	GROUND SURFACE							20 40 60 80 100						
0.0	TOPSOIL: (600mm)		1	GS				○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE						
233.4								20 40 60 80 100						
0.6	SILT , trace clay, trace sand Compact to loose Brown Moist		2	SS	13		233							
			3	SS	6		232							
			4	SS	7									
231.0														
3.0	Silty CLAY , trace sand, trace gravel Stiff Grey Moist (CL)		5	SS	2		231							
							230							
								2.0 +						
			6	SS	9		229							0 1 80 19
							228							
	Frequent sand and silt seams from 5.6m to 7.8m		7	SS	13									
							227							
226.8														
7.2	SILT , trace clay, trace sand Very Dense Reddish Brown Moist		8	SS	52		226							0 2 91 7
225.3														
8.7	SAND , some silt Dense Brown Wet		9	SS	36		225							
224.2														
9.8	END OF BOREHOLE AT 9.8m UPON													

Continued Next Page

+³, ×³: Numbers refer to
Sensitivity

20
15
10

(%) STRAIN AT FAILURE

METRIC

[illegible]

RECORD OF BOREHOLE No HF6-09

1 OF 2

METRIC

GWP# 129-90-00 LOCATION Sta. 29+525 EB O/S 2R N 5 398 913.3 E 407 309.9 ORIGINATED BY FK
DIST Thunder Bay HWY 11/17 BOREHOLE TYPE Solid Stem Augers COMPILED BY AS
DATUM Geodetic DATE 2022.10.29 - 2022.10.30 LATITUDE 48.720240 LONGITUDE -88.606680 CHECKED BY RB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT			NATURAL MOISTURE CONTENT			LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																															
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE				WATER CONTENT (%) w _P w w _L																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																									
233.8	GROUND SURFACE																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																				

Continued Next Page

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

RECORD OF BOREHOLE No HF6-09

2 OF 2

METRIC

GWP# 129-90-00 LOCATION Sta. 29+525 EB O/S 2R N 5 398 913.3 E 407 309.9 ORIGINATED BY FK
DIST Thunder Bay HWY 11/17 BOREHOLE TYPE Solid Stem Augers COMPILED BY AS
DATUM Geodetic DATE 2022.10.29 - 2022.10.30 LATITUDE 48.720240 LONGITUDE -88.606680 CHECKED BY RB

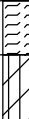


SOIL PROFILE			SAMPLES			GROUND WATER * CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES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

RECORD OF BOREHOLE No HF6-10

1 OF 2

METRIC

GWP# 129-90-00 LOCATION Sta. 29+600 CL N 5 398 945.1 E 407 377.8 ORIGINATED BY GAS
DIST Thunder Bay HWY 11/17 BOREHOLE TYPE Hollow Stem Auger COMPILED BY MC
DATUM Geodetic DATE 2023.02.07 - 2023.02.08 LATITUDE 48.720515 LONGITUDE -88.605750 CHECKED BY RB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE				WATER CONTENT (%) w _P w w _L					
233.3	GROUND SURFACE							20	40	60	80	100					
0.0	TOPSOIL , trace wood, abundant organics Loose Brown Wet		1	GS			233								○		
232.9																	
0.4	Clayey SILT , trace sand, trace organics from 0.4 to 1.4m Stiff Brown Moist (CL-ML)		2	SS	8		232								⊞		0 4 81 15
			3	SS	10										○		
231.1							231										
2.2	Silty CLAY , trace sand, occasional silt seams Firm to Very Stiff Brown to Grey Moist to Wet (CL) No recovery		4	SS	4										○		
			5	SS	0		230										
			1	TW			229										
			6	SS	0		228								⊞		0 1 66 33
			7	SS	1		227								○		
			8	SS	4		226								⊞	○	0 1 76 23
							225										
			9	SS	8		224										

Continued Next Page

+³, ×³: Numbers refer to
Sensitivity

20
15
10
(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No HF6-10

2 OF 2

METRIC

GWP# 129-90-00 LOCATION Sta. 29+600 CL N 5 398 945.1 E 407 377.8 ORIGINATED BY GAS
DIST Thunder Bay HWY 11/17 BOREHOLE TYPE Hollow Stem Auger COMPILED BY MC
DATUM Geodetic DATE 2023.02.07 - 2023.02.08 LATITUDE 48.720515 LONGITUDE -88.605750 CHECKED BY RB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa											
								○ UNCONFINED	+	FIELD VANE									
								● QUICK TRIAXIAL	×	LAB VANE									
	Continued From Previous Page						20	40	60	80	100		20	40	60				
221.6	Silty CLAY , trace sand, occasional silt seams Firm to Very Stiff Brown to Grey Moist to Wet		10	SS	7														
11.7	SILT , trace clay to some clay, trace sand Compact Grey to Reddish Grey Wet		11	SS	10														
			12	SS	16														
218.5																			
14.8	Silty CLAY , trace sand Very Stiff Grey to Reddish Grey Wet		13	SS	16														
217.4																			
15.8	END OF BOREHOLE AT 15.8m. BOREHOLE DRY AND CAVED TO 2.1m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE AND SOIL CUTTINGS TO SURFACE.																		

ONTMT452 2020LIBRARY(MTO).GLB MTO-21663.GPJ 5/2/24

RECORD OF BOREHOLE No HF6-11

1 OF 2

METRIC

GWP# 129-90-00 LOCATION Sta. 29+675 CL N 5 398 970.9 E 407 448.2 ORIGINATED BY GAS
 DIST Thunder Bay HWY 11/17 BOREHOLE TYPE Hollow Stem Auger COMPILED BY MC
 DATUM Geodetic DATE 2023.02.06 - 2023.02.07 LATITUDE 48.720736 LONGITUDE -88.604787 CHECKED BY RB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
233.0	GROUND SURFACE													
0.0	TOPSOIL: (150mm)													
0.2	Silty CLAY , trace sand, trace organics, occasional silt seams Stiff Brown to Grey Moist to Wet (Cl)		1	GS										
			2	SS	10									
			3	SS	8									
			4	SS	5									
			5	SS	3									
228.9														
4.1	Silty CLAY Stiff Brown Moist (CL)		6	SS	4									
			1	TW										
			7	SS	6									
225.8														
7.2	SILT , some sand, some clay, trace to some gravel Very Dense Reddish Brown Moist		8	SS	59									
			9	SS	70									
223.2														
9.8	SAND , some silt, some gravel													

Continued Next Page

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

RECORD OF BOREHOLE No HF6-11

2 OF 2

METRIC

GWP# 129-90-00 LOCATION Sta. 29+675 CL N 5 398 970.9 E 407 448.2 ORIGINATED BY GAS
DIST Thunder Bay HWY 11/17 BOREHOLE TYPE Hollow Stem Auger COMPILED BY MC
DATUM Geodetic DATE 2023.02.06 - 2023.02.07 LATITUDE 48.720736 LONGITUDE -88.604787 CHECKED BY RB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
							20	40	60	80	100						
							○ UNCONFINED	+	FIELD VANE								
							● QUICK TRIAXIAL	×	LAB VANE								
222.6	Continued From Previous Page		10	SS	58												
10.4	SAND , some silt, some gravel, trace clay Very Dense Reddish Brown Wet END OF BOREHOLE AT 10.4m. Well installation consists of 19mm diameter Schedule 40 PVC pipe with a 3.05m slotted screen. WATER LEVEL READINGS DATE DEPTH(m) ELEV.(m) 2023.02.08 2.5 230.5 2023.02.11 3.7 229.3 2023.02.17 5.2 227.8 2023.02.27 5.5 227.5 2023.03.28 5.7 227.3																

RECORD OF BOREHOLE No HF6-12

1 OF 1

METRIC

GWP# 129-90-00 LOCATION Sta. 29+600 EB CL N 5 398 996.1 E 407 518.8 ORIGINATED BY FK
DIST Thunder Bay HWY 11/17 BOREHOLE TYPE Solid Stem Augers COMPILED BY AS
DATUM Geodetic DATE 2022.10.20 - 2022.10.20 LATITUDE 48.720950 LONGITUDE -88.603821 CHECKED BY RB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT NATURAL LIMIT MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa				WATER CONTENT (%)					
								○ UNCONFINED + FIELD VANE	● QUICK TRIAXIAL × LAB VANE								
233.0	GROUND SURFACE							20	40	60	80	100	W _P	W	W _L		
0.0	TOPSOIL: (150mm)							20	40	60	80	100					
0.2	Silty CLAY , trace sand Firm to Hard Brown Moist (CH)		1	SS	7												
			2	SS	4												
			3	SS	9												
			5	SS	27												
	Reddish Brown		6	SS	57												
227.8																	
5.2	END OF BOREHOLE AT 5.2m UPON AUGER REFUSAL ON POSSIBLE BEDROCK. BOREHOLE CAVED AND DRY TO 4.4m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE AND SOIL CUTTINGS TO SURFACE.																

+³, ×³: Numbers refer to
Sensitivity

20
15
10

(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No HF6-13

1 OF 1

METRIC

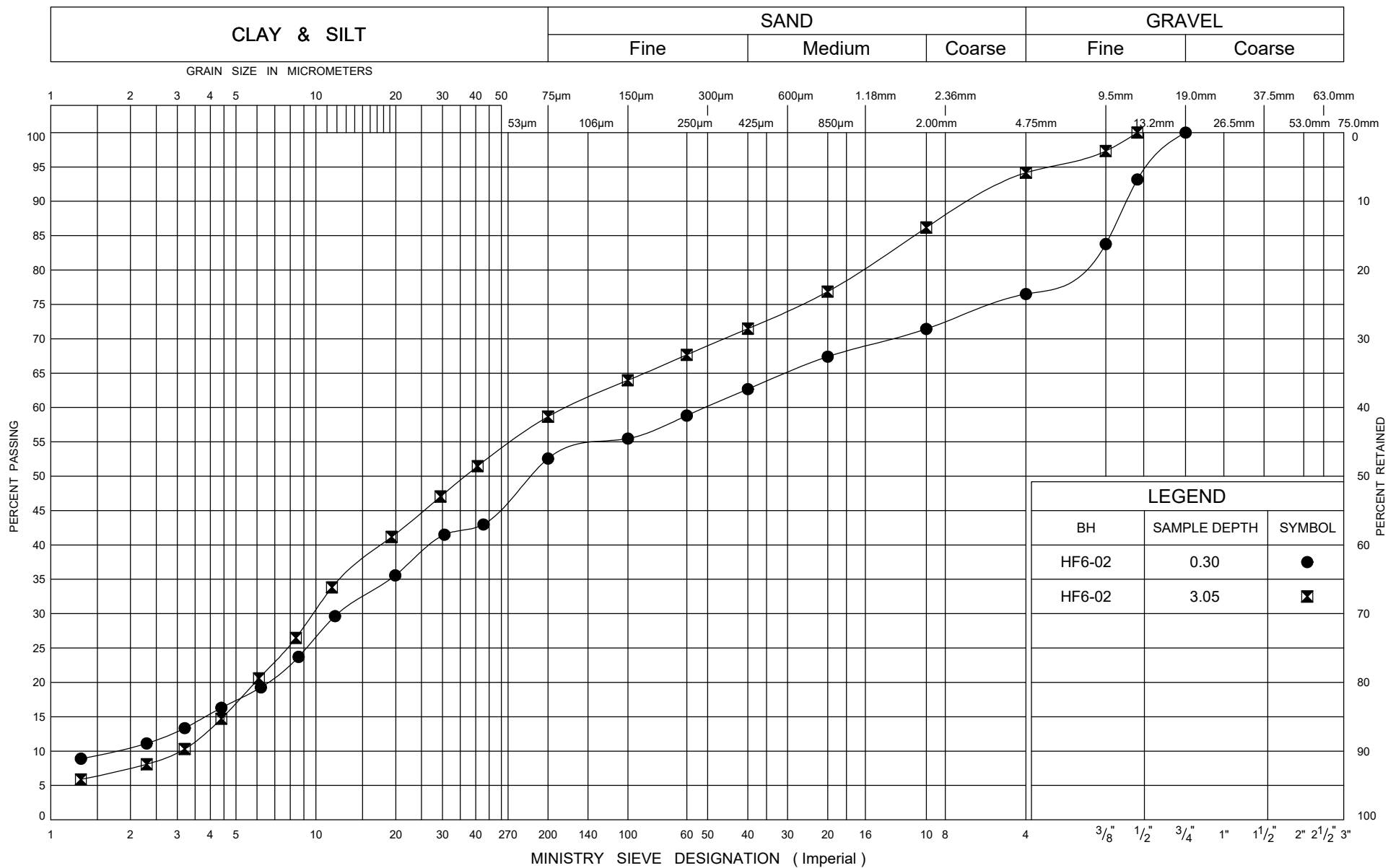
GWP# 129-90-00 LOCATION Sta. 29+825 EB CL N 5 399 022.3 E 407 589.1 ORIGINATED BY FK
DIST Thunder Bay HWY 11/17 BOREHOLE TYPE Solid Stem Augers COMPILED BY AS
DATUM Geodetic DATE 2022.10.20 - 2022.10.20 LATITUDE 48.721174 LONGITUDE -88.602860 CHECKED BY RB

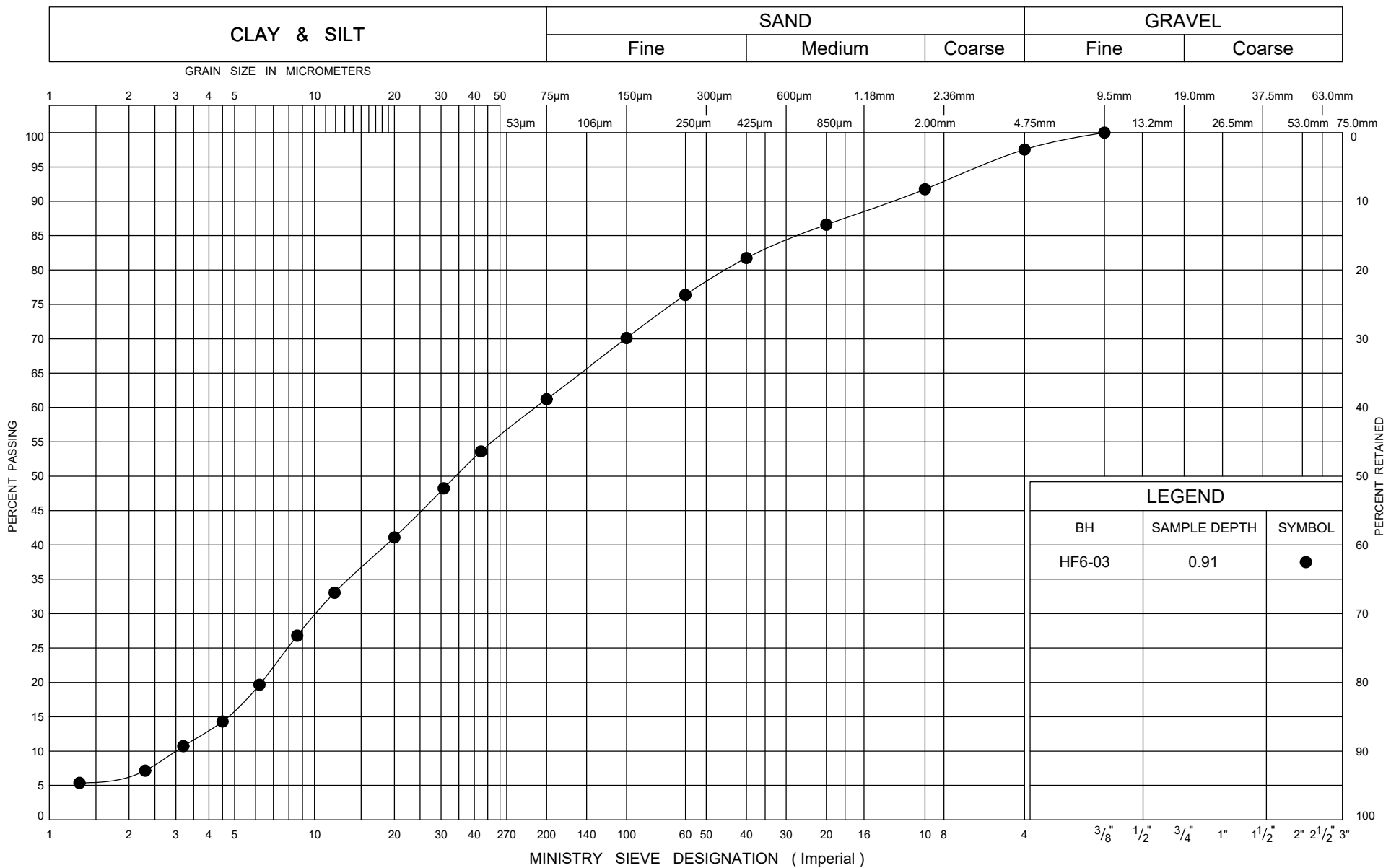
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
233.0	GROUND SURFACE							20 40 60 80 100						GR SA SI CL
0.0	TOPSOIL: (115mm)							20 40 60 80 100						
0.1	Silty CLAY , trace sand Stiff to Very Stiff Brown Moist (Cl)		1	SS	7		232							
			2	SS	14									
			3	SS	10		231							
			4	SS	7									
							230							
				5	SS	12		229						
			6	SS	18		228							
227.3														
5.6	SILT, some sand, trace clay Very Dense Reddish Brown Moist		7	SS	61		227							
							226							
225.8														
7.2	Silty CLAY , some gravel, trace sand Hard Reddish Brown Wet		8	SS	100/									
225.1														
7.9	END OF BOREHOLE AT 7.9m UPON AUGER REFUSAL ON POSSIBLE BEDROCK. BOREHOLE OPEN AND WATER LEVEL AT 5.6m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE AND SOIL CUTTINGS TO SURFACE.				0.00									

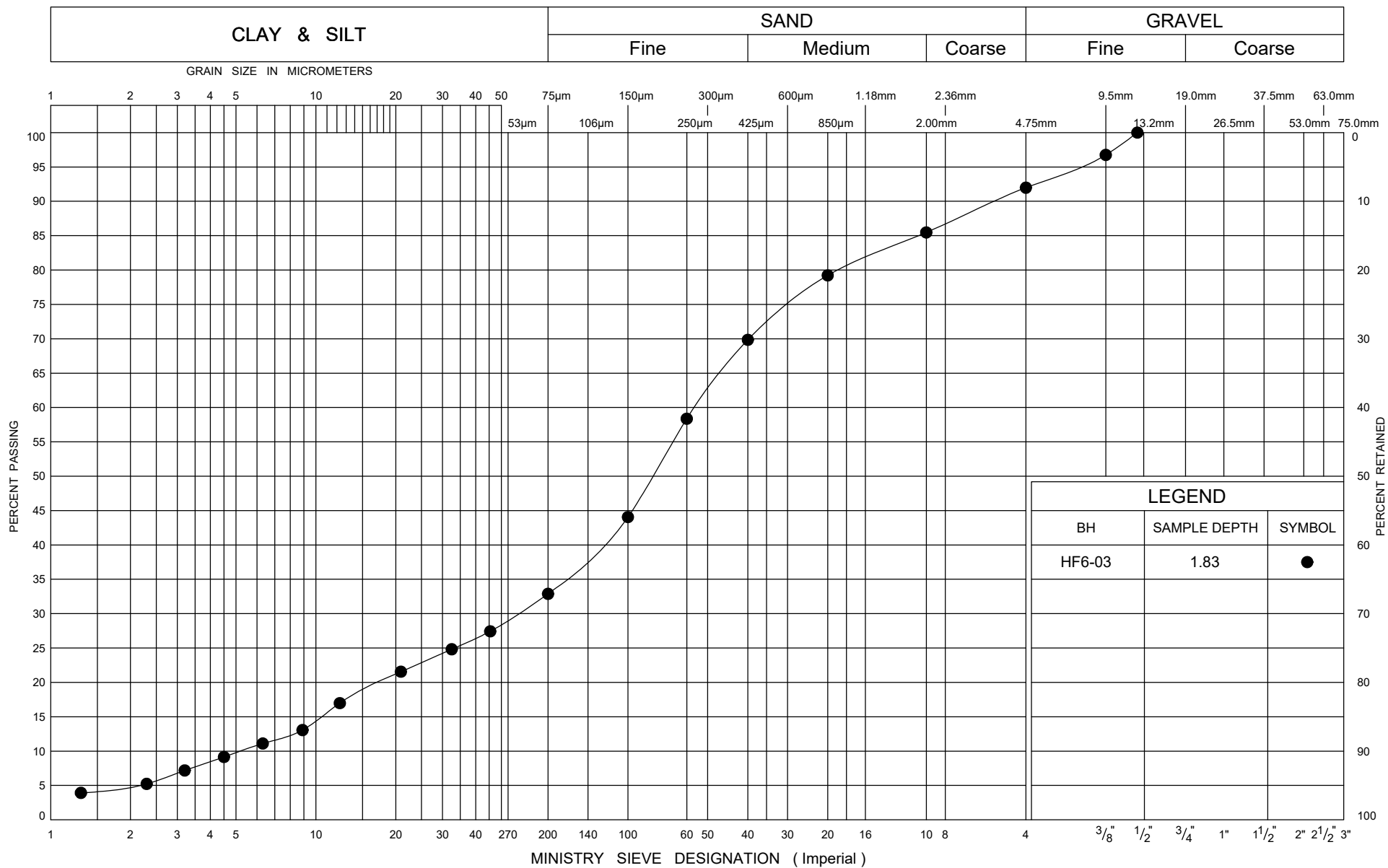
+³, ×³: Numbers refer to
Sensitivity

20
15
10
5
0
5
10
(%) STRAIN AT FAILURE

G2: High Fill Section 6 Geotechnical Laboratory Testing Results







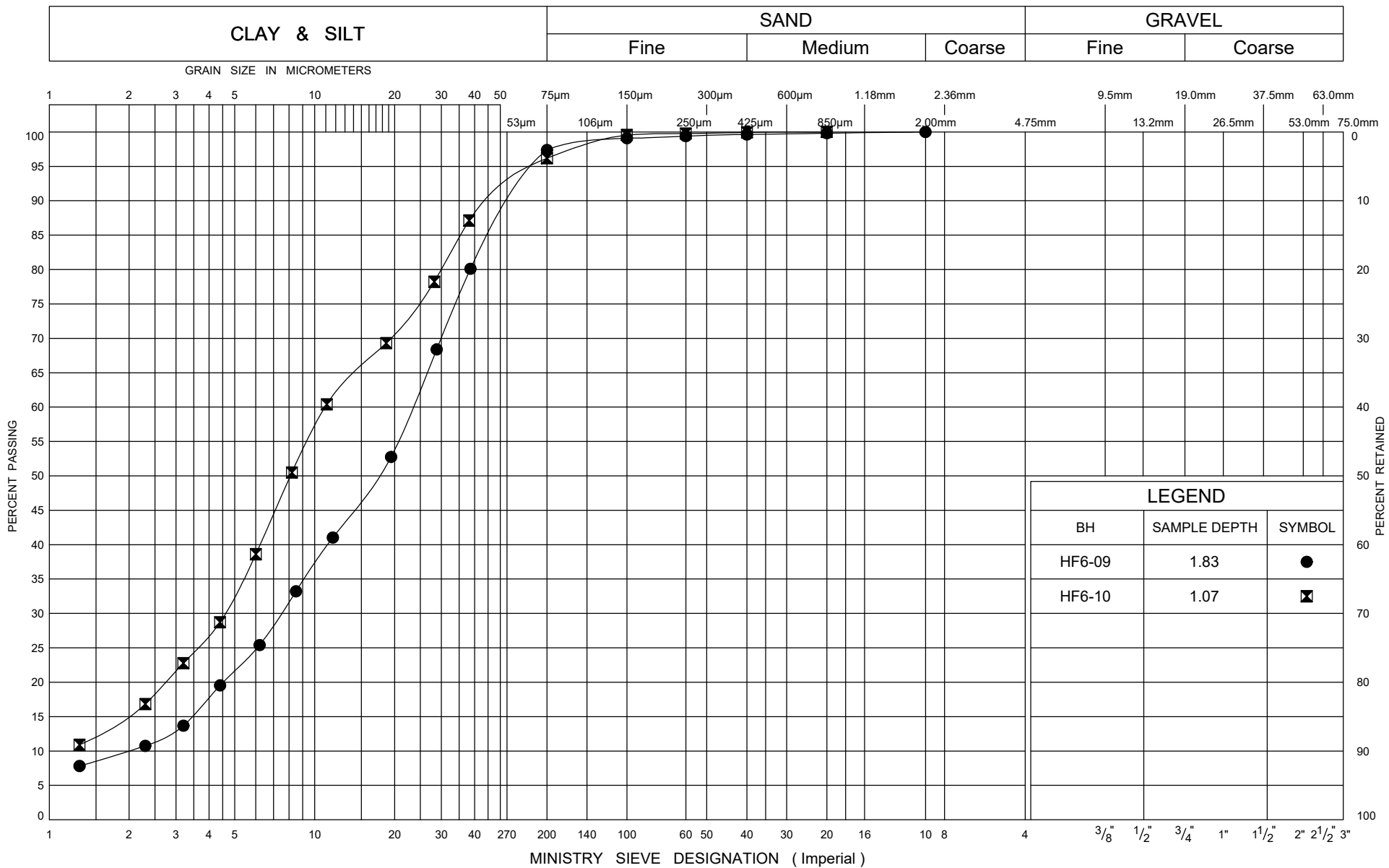
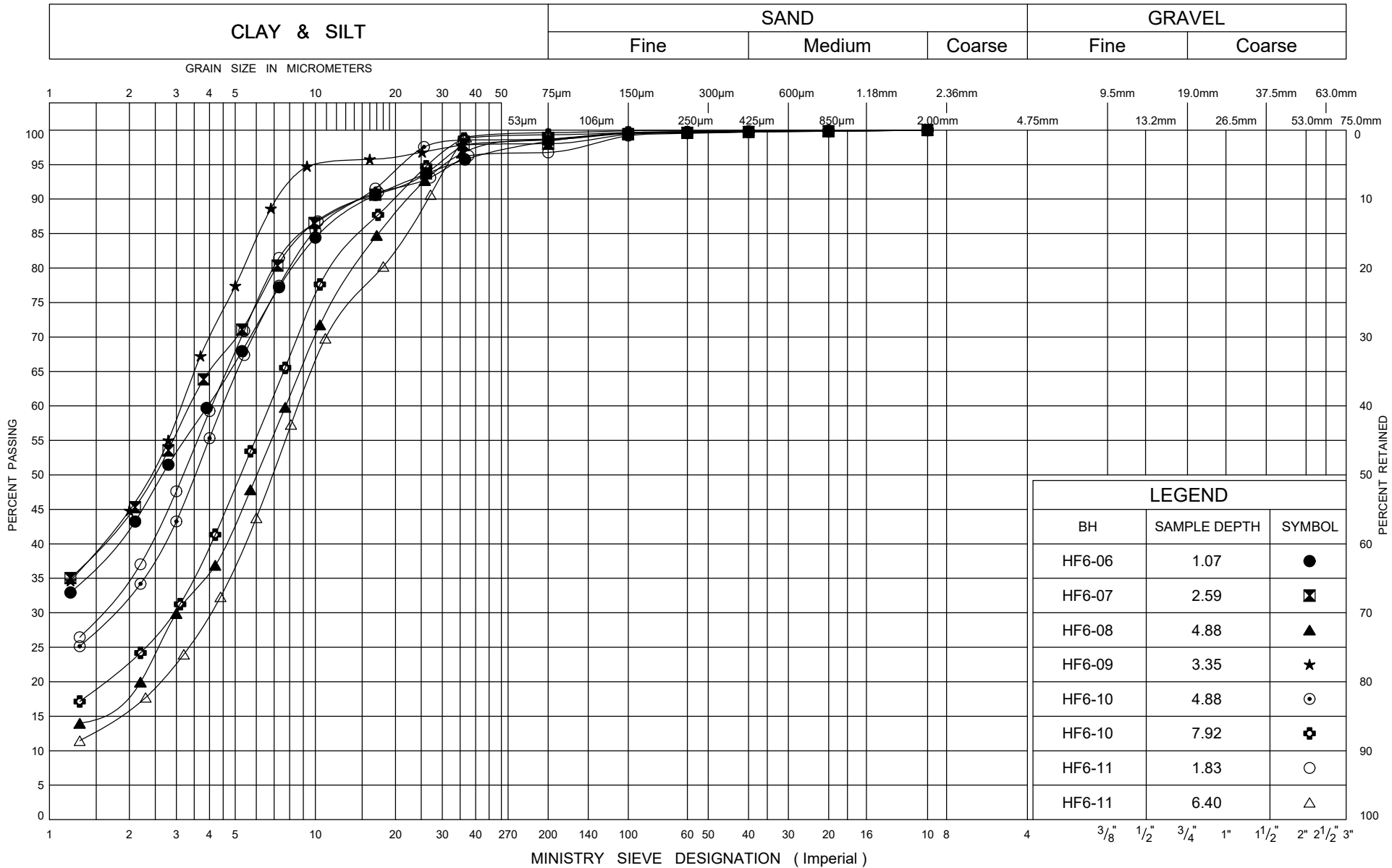
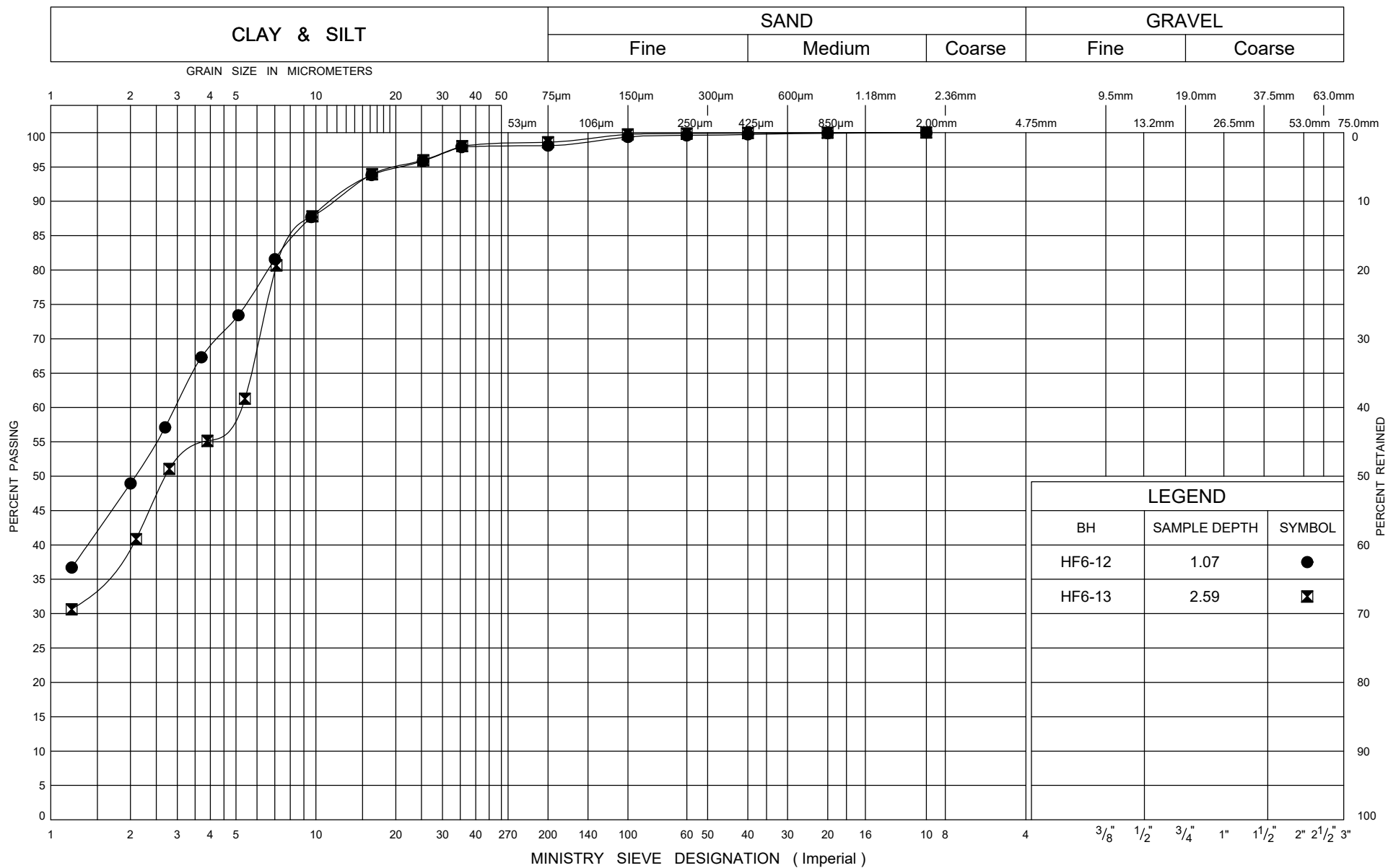


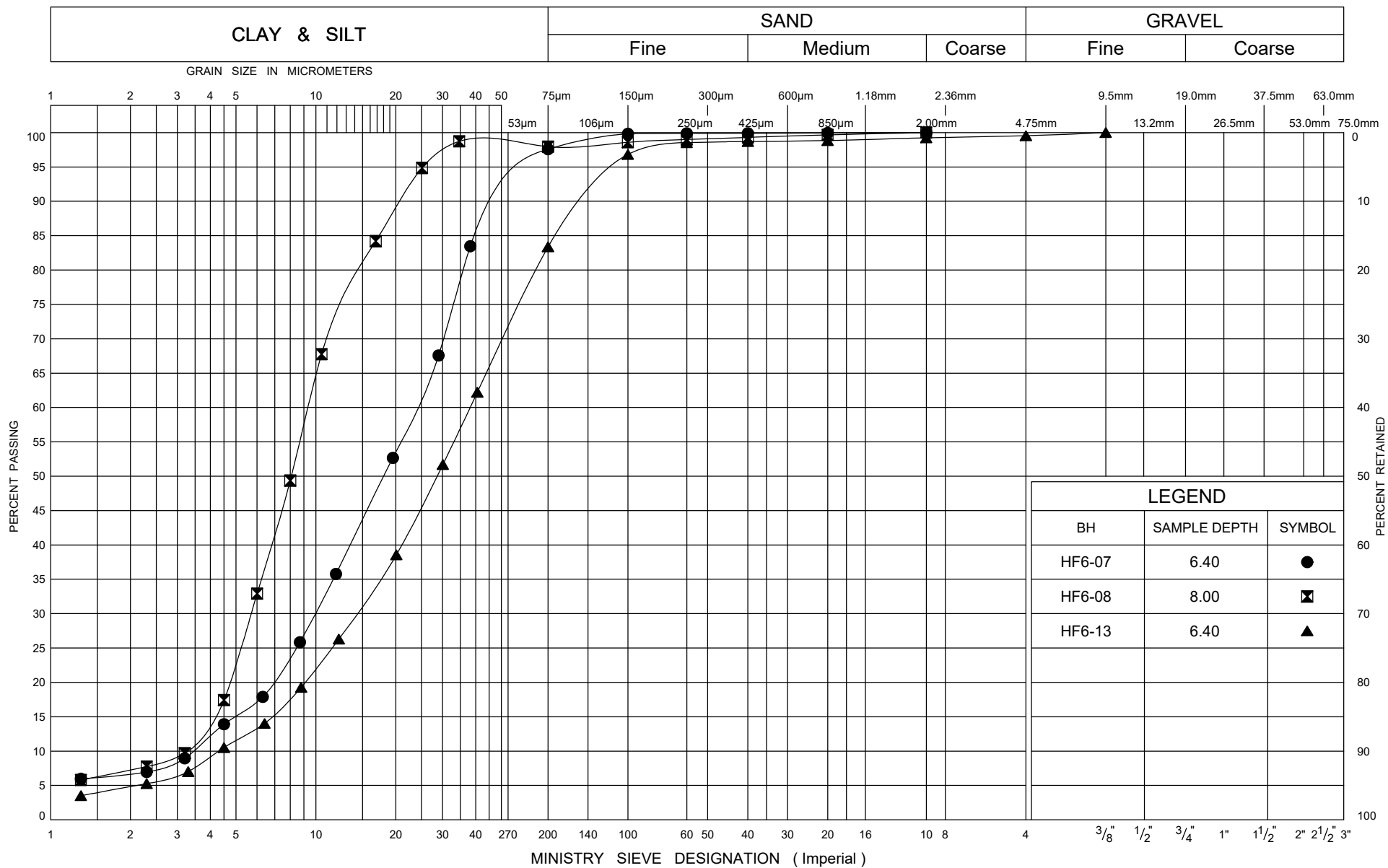


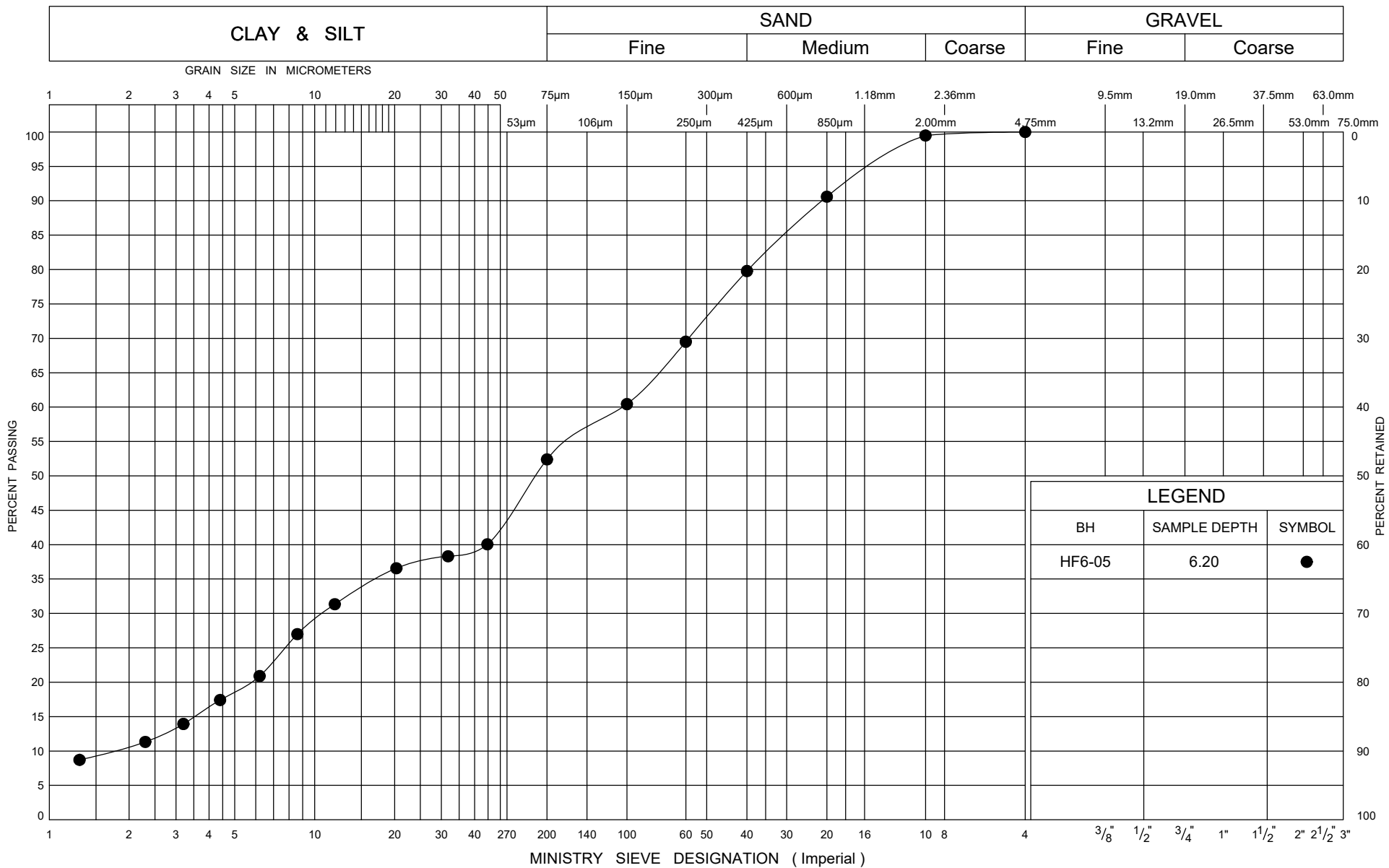
FIG No G5

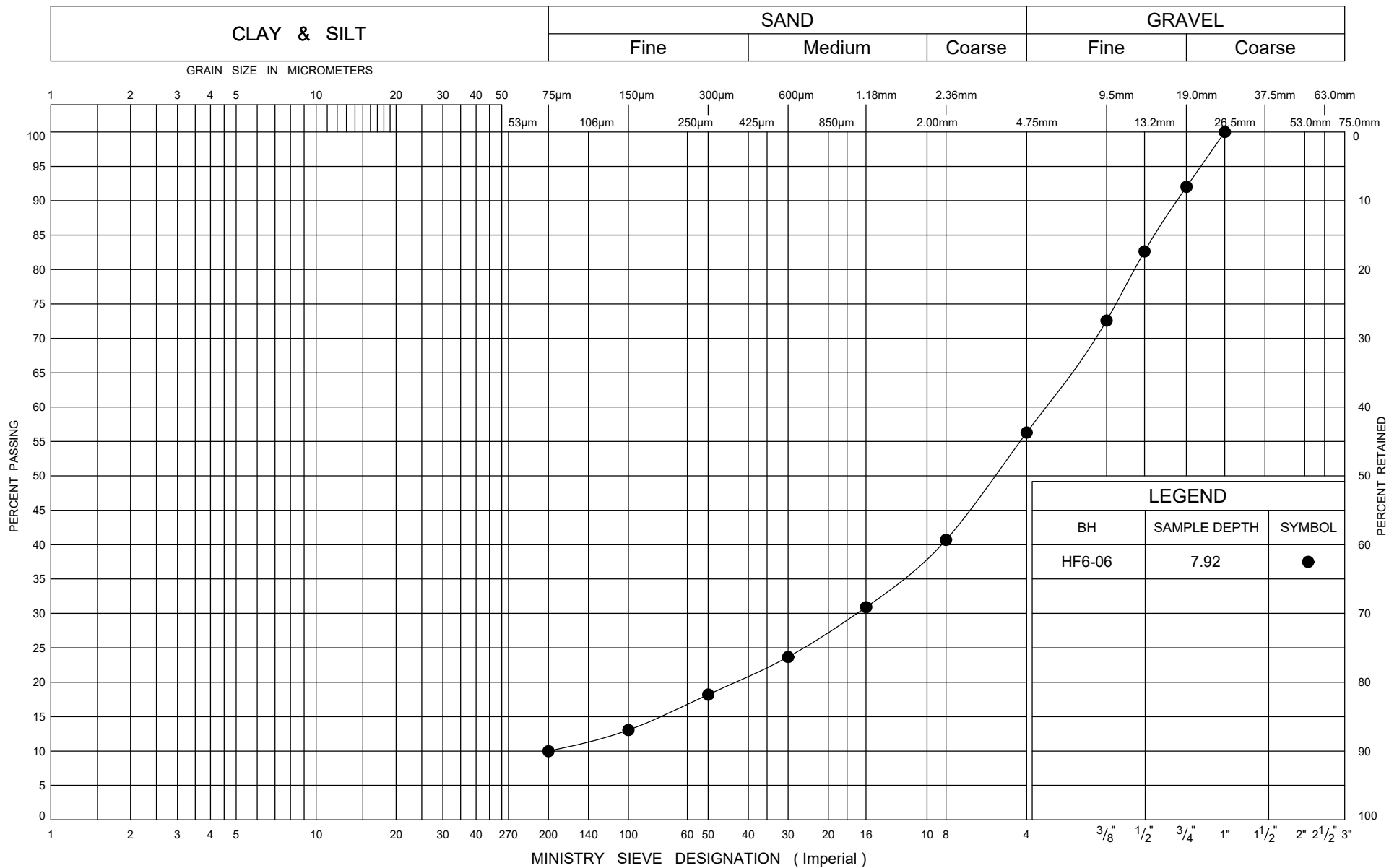
GWP# 129-90-00

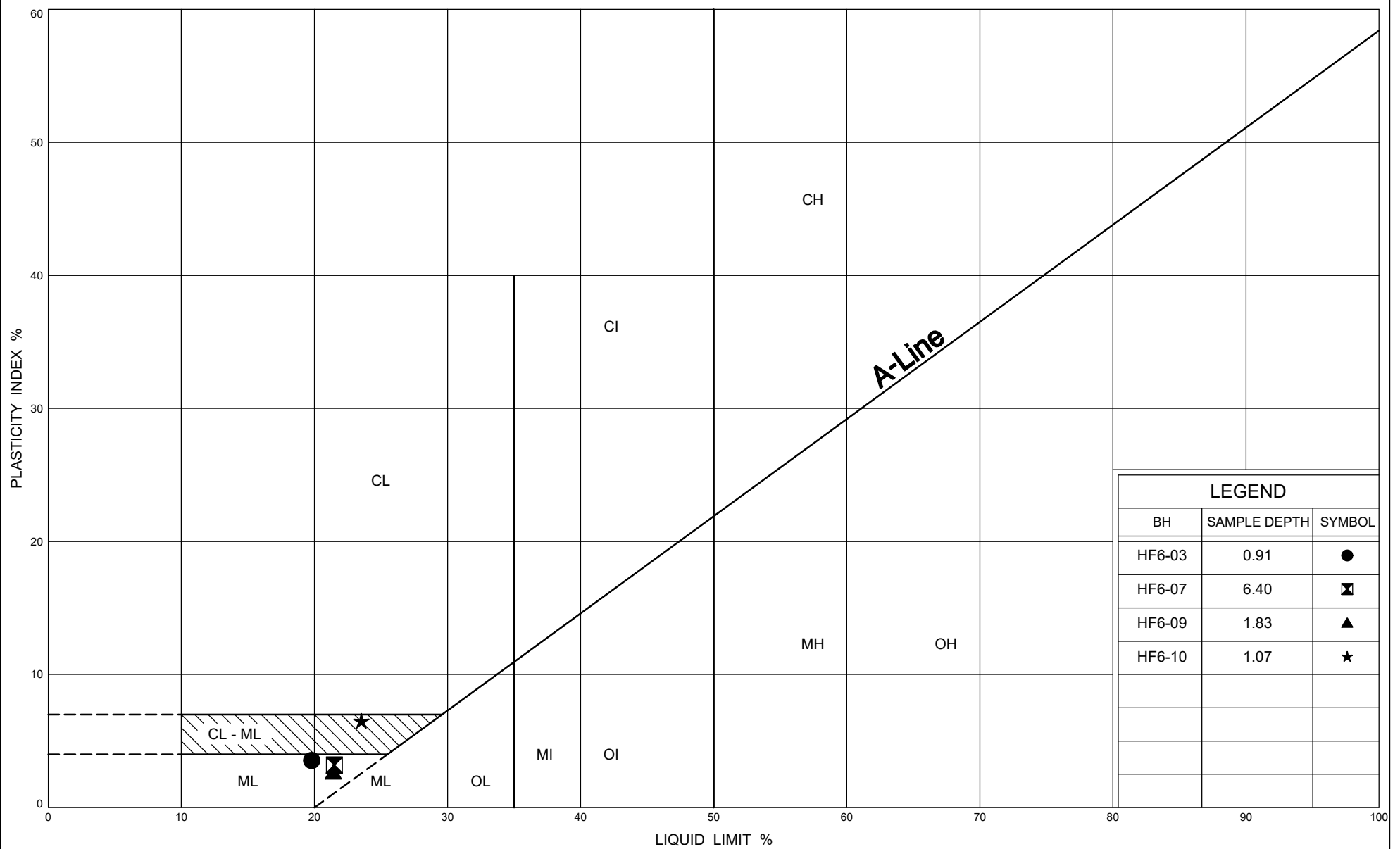












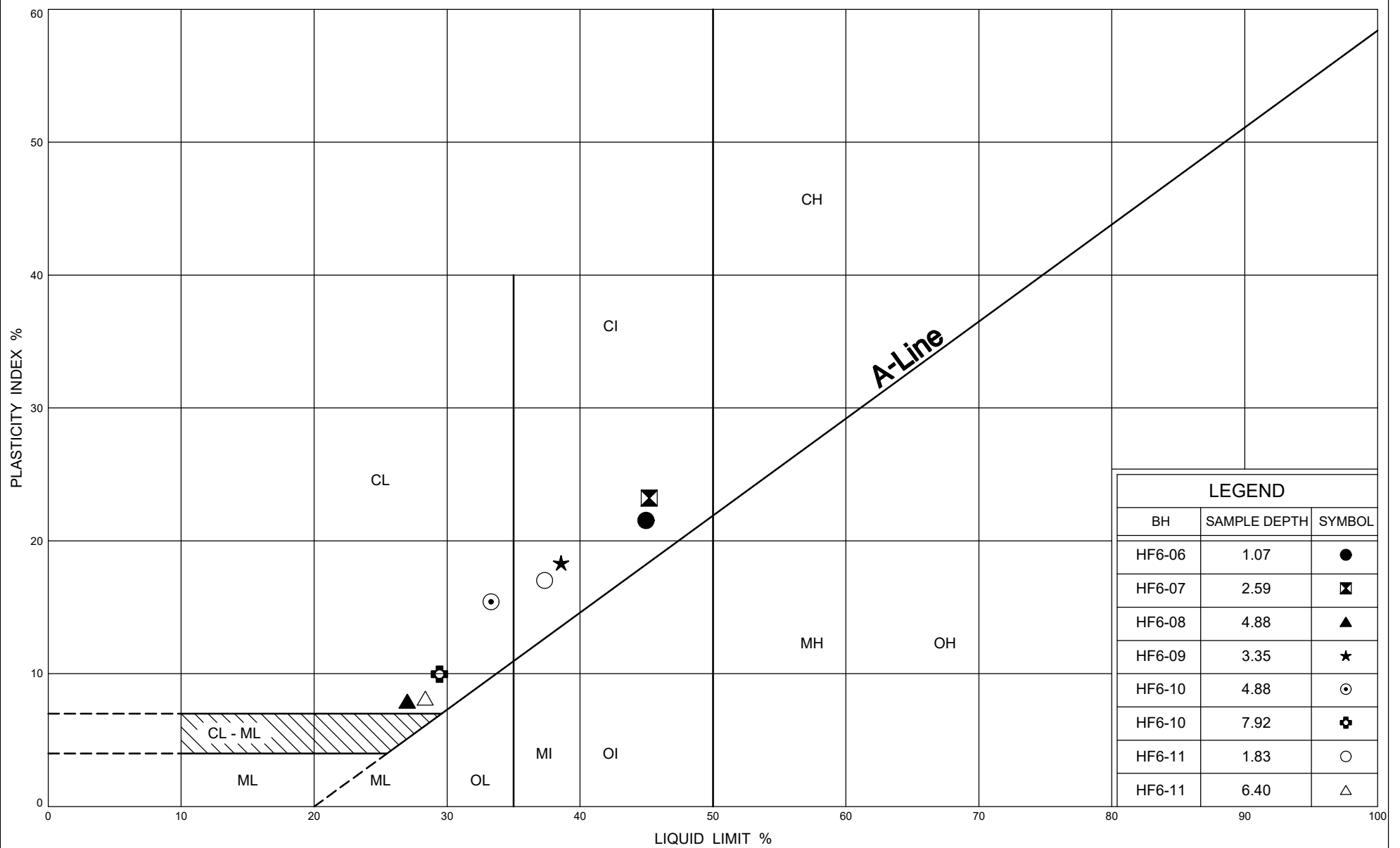
Ministry of
Transportation

PLASTICITY CHART

SILT to SILT and SAND

FIG No G11

GWP# 129-90-00



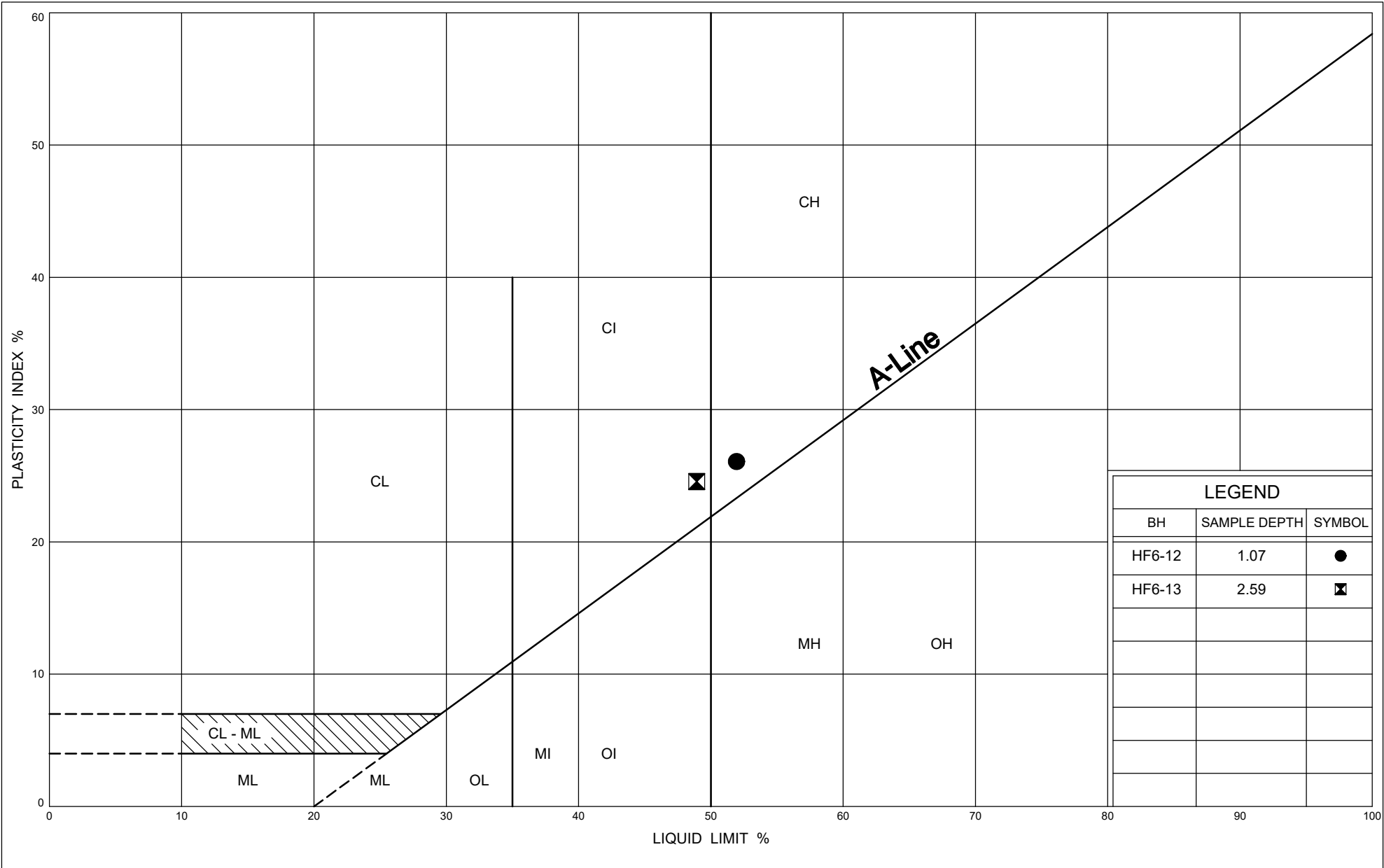
Ministry of
Transportation

PLASTICITY CHART

Silty CLAY

FIG No G12

GWP# 129-90-00



APPENDIX H

H1: Welch Creek WBL Culvert Record of Borehole Sheets

SYMBOLS, ABBREVIATIONS AND TERMS USED ON RECORDS OF BOREHOLES

1. TEXTURAL CLASSIFICATION OF SOILS

CLASSIFICATION	PARTICLE SIZE	VISUAL IDENTIFICATION
Boulders	Greater than 200mm	same
Cobbles	75 to 200mm	same
Gravel	4.75 to 75mm	5 to 75mm
Sand	0.075 to 4.75mm	Not visible particles to 5mm
Silt	0.002 to 0.075mm	Non-plastic particles, not visible to the naked eye
Clay	Less than 0.002mm	Plastic particles, not visible to the naked eye

2. COARSE GRAIN SOIL DESCRIPTION (50% greater than 0.075mm)

TERMINOLOGY	PROPORTION
Trace or Occasional	Less than 10%
Some	10 to 20%
Adjective (e.g. silty or sandy)	20 to 35%
And (e.g. sand and gravel)	35 to 50%

3. TERMS DESCRIBING CONSISTENCY (COHESIVE SOILS ONLY)

DESCRIPTIVE TERM	UNDRAINED SHEAR STRENGTH (kPa)	APPROXIMATE SPT ⁽¹⁾ 'N' VALUE
Very Soft	12 or less	Less than 2
Soft	12 to 25	2 to 4
Firm	25 to 50	4 to 8
Stiff	50 to 100	8 to 15
Very Stiff	100 to 200	15 to 30
Hard	Greater than 200	Greater than 30

NOTE: Hierarchy of Soil Strength Prediction

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



4. TERMS DESCRIBING DENSITY (COHESIONLESS SOILS ONLY)

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

5. LEGEND FOR RECORDS OF BOREHOLES

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

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


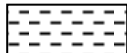



 Water Level
 Shear Strength Determination by Pocket Penetrometer

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

UNIFIED SOILS CLASSIFICATION

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

EXPLANATION OF ROCK LOGGING TERMS

<u>ROCK WEATHERING CLASSIFICATION</u>		<u>SYMBOLS</u>	
Fresh (FR)	No visible signs of weathering.		
Fresh Jointed (FJ)	Weathering limited to the surface of major discontinuities.		CLAYSTONE
Slightly Weathered (SW)	Penetrative weathering developed on open discontinuity surfaces, but only slight weathering of rock material.		SILTSTONE
Moderately Weathered (MW)	Weathering extends throughout the rock mass, but the rock material is not friable.		SANDSTONE
Highly Weathered (HW)	Weathering extends throughout the rock mass and the rock is partly friable.		COAL
Completely Weathered (CW)	Rock is wholly decomposed and in a friable condition, but the rock texture and structure are preserved.		Bedrock (general)

<u>DISCONTINUITY SPACING</u>		<u>STRENGTH CLASSIFICATION</u>			
Bedding	Bedding Plane Spacing	Rock Strength	Approximate Uniaxial Compressive Strength		Field Estimation of Hardness*
			(MPa)	(psi)	
Very thickly bedded	Greater than 2m	Extremely Strong	Greater than 250	Greater than 36,000	Specimen can only be chipped with a geological hammer
Thickly bedded	0.6 to 2m				
Medium bedded	0.2 to 0.6m	Very Strong	100-250	15,000 to 36,000	Requires many blows of geological hammer to break
Thinly bedded	60mm to 0.2m	Strong	50-100	7,500 to 15,000	Requires more than one blow of geological hammer to break
Very thinly bedded	20 to 60mm				
Laminated	6 to 20mm	Medium Strong	25.0 to 50.0	3,500 to 7,500	Breaks under single blow of geological hammer.
Thinly Laminated	Less than 6mm				

<u>TERMS</u>					
Total Core Recovery: (TCR)	Core recovered as a percentage of total core run length.	Weak	5.0 to 25.0	750 to 3,500	Can be peeled by a pocket knife with difficulty
Solid Core Recovery: (SCR)	Percent Ratio of solid core of full cylindrical shape recovered. Expressed with respect to the total length of core run.	Very Weak	1.0 to 5.0	150 to 750	Can be peeled by a pocket knife, crumbles under firm blows of geological pick.
Rock Quality Designation: (RQD)	Total length of sound core recovered in pieces 0.1m in length or larger as a percentage of total core run length.	Extremely Weak (Rock)	0.25 to 1.0	35 to 150	Indented by thumbnail
Uniaxial Compressive Strength (UCS)	Axial stress required to break the specimen				
Fracture Index: (FI)	Frequency of natural fractures per 0.3m of core run.				

RECORD OF BOREHOLE No WC-WBL-01 1 OF 2 METRIC

GWP# 129-90-00 LOCATION N 5 395 904.6 E 405 488.0 ORIGINATED BY GAS
 DIST Thunder Bay HWY 11/17 BOREHOLE TYPE Solid Stem Augers/Wash Boring NW COMPILED BY MC
 DATUM Geodetic DATE 2023.04.04 - 2023.04.06 LATITUDE 48.693366 LONGITUDE -88.631259 CHECKED BY RB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa		WATER CONTENT (%)					
215.2	GROUND SURFACE							20 40 60 80 100		W _P W W _L			GR SA SI CL		
0.0	TOPSOIL: (75mm) Silty, sandy CLAY , with organics, trace gravel Soft Grey Moist (MI-CI)														
0.1															
			1	SS	1										
			2	SS	3										
			3	SS	2										
213.1	Silty, sandy CLAY , trace gravel Stiff to Very Stiff Grey Moist														
2.1															
			1	TW											
			4	SS	3										
209.6	SILT , some clay, trace sand Compact Brown to Reddish Brown Wet (ML)														
5.6															
			5	SS	11										
			6	SS	29										
			7	SS	22										
	Some sand														

Continued Next Page

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

RECORD OF BOREHOLE No WC-WBL-01 2 OF 2 METRIC

GWP# 129-90-00 LOCATION N 5 395 904.6 E 405 488.0 ORIGINATED BY GAS
DIST Thunder Bay HWY 11/17 BOREHOLE TYPE Solid Stem Augers/Wash Boring NW COMPILED BY MC
DATUM Geodetic DATE 2023.04.04 - 2023.04.06 LATITUDE 48.693366 LONGITUDE -88.631259 CHECKED BY RB

SOIL PROFILE			SAMPLES			GROUND WATER * CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa								
	Continued From Previous Page							20	40	60	80	100				
205.0																
10.2	SILT and SAND , trace clay Loose to Compact Reddish Brown Wet		8	SS	8											
			9	SS	20											
	No recovery		10	SS	28											
201.9																
13.3	SAND and GRAVEL , some silt Very Dense to Compact Reddish Brown Wet		11	SS	55											
			12	SS	30											
199.4																
15.8	END OF BOREHOLE AT 15.8m. Well installation consists of 19mm diameter Schedule 40 PVC pipe with a 3.05m slotted screen. WATER LEVEL READINGS DATE DEPTH(m) ELEV.(m) 2023.04.06 0.9 214.3 2023.04.13 0.5 214.7 2023.04.16 -0.9 216.1 2023.04.20 Frozen -															

ONTMT452 2020LIBRARY(MTO).GLB MTO-21663.GPJ 5/2/24

RECORD OF BOREHOLE No WC-WBL-02 1 OF 2 METRIC

GWP# 129-90-00 LOCATION N 5 395 892.4 E 405 555.3 ORIGINATED BY GAS
 DIST Thunder Bay HWY 11/17 BOREHOLE TYPE Solid Stem Augers/NW Casing/NQ Coring COMPILED BY MC
 DATUM Geodetic DATE 2023.04.02 - 2023.04.03 LATITUDE 48.693519 LONGITUDE -88.631570 CHECKED BY RB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa								
215.4	GROUND SURFACE							20 40 60 80 100								
0.0 0.1	TOPSOIL: (75mm)							20 40 60 80 100								
	Silty CLAY , with organics, trace to some sand Very Soft to Firm Brown to Grey Wet (CH)		1	SS	1		215								294	
			2	SS	5		214									0 11 64 25
			3	SS	4		213									
213.0			4	SS	4		212									
2.4	Silty CLAY , trace to some sand Soft to Firm Reddish Brown Wet						211									
212.4			1	TW			210									
3.0	SILT , trace sand to some sand, trace clay, trace gravel Compact Reddish Brown Moist to Wet						209									2 14 78 6
			5	SS	12		208									
							207									
209.8							206									
5.6	SAND and GRAVEL , trace silt, occasional cobbles Compact to Very Dense Reddish Brown Wet		6	SS	24											
	Frequent cobbles		7	SS	35											
	Cored through Gravel and cobbles from 8.5 to 9.1m		8	SS	100/0.025											
	Cored through Gravel and cobbles from 9.4 to 10.2m															

Continued Next Page

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

RECORD OF BOREHOLE No WC-WBL-02 2 OF 2 METRIC

GWP# 129-90-00 LOCATION N 5 395 892.4 E 405 555.3 ORIGINATED BY GAS
DIST Thunder Bay HWY 11/17 BOREHOLE TYPE Solid Stem Augers/NW Casing/NQ Coring COMPILED BY MC
DATUM Geodetic DATE 2023.04.02 - 2023.04.03 LATITUDE 48.693519 LONGITUDE -88.631570 CHECKED BY RB

SOIL PROFILE			SAMPLES			GROUND WATER * CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE									WATER CONTENT (%)
	Continued From Previous Page						20 40 60 80 100					20 40 60					
204.9	Cored through Gravel and cobbles from 10.2 to 10.5m																
10.5	BEDROCK (SANDSTONE - SIBLEY GROUP), reddish brown with occasional grey layers, moderately to slightly weathered, strong		1	RUN			205								FI	RUN #1 TCR=97% SCR=94% RQD=94% UCS=71MPa RUN #2 TCR=87% SCR=65% RQD=50% UCS=94MPa RUN #3 TCR=85% SCR=77% RQD=50% UCS=60MPa	
													1				
													3				
												2					
	Rubble zone 12.5 to 13.2m		2	RUN			203							2			
													>10				
	Rubble zones from 13.2 to 13.3m, 13.4 to 13.5m, 13.7 to 13.8m and 13.9 to 14.0m		3	RUN			202							6			
													>10				
																	>10
																	1
															0		
200.6																	
14.8	END OF BOREHOLE AT 14.8m. Well installation consists of 19mm diameter Schedule 40 PVC pipe with a 3.05m slotted screen. WATER LEVEL READINGS DATE DEPTH(m) ELEV.(m) 2023.04.13 0.3 215.1 2023.04.16 -0.2 215.6 2023.04.20 -0.3 215.6																

RECORD OF BOREHOLE No WC-WBL-03 1 OF 3 METRIC

GWP# 129-90-00 LOCATION N 5 395 909.1 E 405 532.1 ORIGINATED BY MW
 DIST Thunder Bay HWY 11/17 BOREHOLE TYPE Solid Stem Augers/ Wash Boring NW COMPILED BY MC
 DATUM Geodetic DATE 2023.05.23 - 2023.05.24 LATITUDE 48.693312 LONGITUDE -88.631691 CHECKED BY RB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa							WATER CONTENT (%)		
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE							W P W W L		
223.0	GROUND SURFACE					20 40 60 80 100											
0.0	ASPHALT: (150 mm)																
0.2	SAND and GRAVEL, trace to some silt, trace asphalt Very Dense Reddish Brown Moist (FILL)		1	SS	85												
			2	SS	57												
	Trace clay, occasional cobble		3	SS	51												
220.7																	
2.3	Silty CLAY, trace to some sand Very Stiff Grey		4	SS	27												
220.3	Moist (FILL)																
2.7	Silty SAND, some gravel, some clay Compact Reddish Brown (FILL)		5	SS	30												
218.1			6	SS	30												
4.9	Silty CLAY, trace to some sand, trace gravel, occasional cobbles Hard Grey Wet (FILL)																
			7	SS	38												
215.8																	
7.2	Silty CLAY, trace sand Soft to Very Stiff Grey Wet (CH)		8	SS	3												
			9	SS	7												

Continued Next Page

+³, ×³: Numbers refer to
Sensitivity

20
15
10

(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No WC-WBL-03 2 OF 3 METRIC

GWP# 129-90-00 LOCATION N 5 395 909.1 E 405 532.1 ORIGINATED BY MW
DIST Thunder Bay HWY 11/17 BOREHOLE TYPE Solid Stem Augers/ Wash Boring NW COMPILED BY MC
DATUM Geodetic DATE 2023.05.23 - 2023.05.24 LATITUDE 48.693312 LONGITUDE -88.631691 CHECKED BY RB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa				WATER CONTENT (%)				
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE				W _P	W	W _L		
	Continued From Previous Page						20 40 60 80 100									
			10	SS	1		212									
211.3																
11.7	Becoming varved with silt and sand seams at 11.7m		11	SS	1		211									
			12	SS	2		210									
			13	SS	2		209									
			14	SS	12		208									

Continued Next Page

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

RECORD OF BOREHOLE No WC-WBL-03 3 OF 3 METRIC

GWP# 129-90-00 LOCATION N 5 395 909.1 E 405 532.1 ORIGINATED BY MW
DIST Thunder Bay HWY 11/17 BOREHOLE TYPE Solid Stem Augers/ Wash Boring NW COMPILED BY MC
DATUM Geodetic DATE 2023.05.23 - 2023.05.24 LATITUDE 48.693312 LONGITUDE -88.631691 CHECKED BY RB

SOIL PROFILE				SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	SHEAR STRENGTH kPa					WATER CONTENT (%)			GR	SA	SI		CL			
	Continued From Previous Page		16	SS	31																
202.6																					
20.4	END OF BOREHOLE AT 20.4m. WATER LEVEL AT 4.8m IN OPEN BOREHOLE. BOREHOLE BACKFILLED WITH BENTONITE TO 0.6m, DRY CONCRETE TO 0.2m, THEN COLD PATCH TO GROUND SURFACE.																				

RECORD OF BOREHOLE No WC-WBL-04 1 OF 2 METRIC

GWP# 129-90-00 LOCATION N 5 395 885.8 E 405 523.6 ORIGINATED BY MW
 DIST Thunder Bay HWY 11/17 BOREHOLE TYPE Solid Stem Augers/ Wash Boring NW COMPILED BY MC
 DATUM Geodetic DATE 2023.05.24 - 2023.05.24 LATITUDE 48.693312 LONGITUDE -88.631691 CHECKED BY RB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE							WATER CONTENT (%) W _P W W _L		
223.0	GROUND SURFACE							20	40	60	80	100					
0.0	ASPHALT:(150mm)							20	40	60	80	100					
0.2	SAND and GRAVEL, trace silt to silty Very Dense to Dense Brown Dry (FILL)		1	SS	76		222							○			
			2	SS	41									○			
			3	SS	30		221							○			
220.6														○			
2.4	Silty CLAY, trace sand, trace organics Very Stiff to Stiff Grey Moist (FILL)		4	SS	23		220								○		
			5	SS	9										○		
							219										
218.8																	
4.2	Silty CLAY, trace to some sand, trace gravel, occasional cobbles Firm Brown Wet (FILL)		6	SS	5		218								○		
			7	SS	53		217										
	Spoon bouncing on cobble, no recovery						216										
215.8																	
7.2	Silty SAND, some gravel, trace clay Compact Reddish Brown Wet (FILL)		8	SS	28		215							○			
							214										
214.3																	
8.7	Silty CLAY, with organics, sandy, trace gravel, trace to some wood fragments Firm Grey Wet		9	SS	6										○		

Continued Next Page

+³, ×³: Numbers refer to
Sensitivity

20
15
10
(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No WC-WBL-04 2 OF 2 METRIC

GWP# 129-90-00 LOCATION N 5 395 885.8 E 405 523.6 ORIGINATED BY MW
DIST Thunder Bay HWY 11/17 BOREHOLE TYPE Solid Stem Augers/ Wash Boring NW COMPILED BY MC
DATUM Geodetic DATE 2023.05.24 - 2023.05.24 LATITUDE 48.693312 LONGITUDE -88.631691 CHECKED BY RB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W _P	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa								
	Continued From Previous Page							20	40	60	80	100				
210.8			10	SS	6		212									
12.2	SAND and GRAVEL to SAND , some gravel, some silt, occasional cobbles Dense to Compact Grey Wet		11	SS	34											
			12	SS	36		209									
							208									
207.2			13	SS	25											
15.8	END OF BOREHOLE AT 15.8m. BOREHOLE BACKFILLED WITH BENTONITE TO 0.6m, DRY CONCRETE TO 0.2m, THEN COLD PATCH TO GROUND SURFACE.															

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

H2: Welch Creek WBL Culvert Geotechnical Laboratory Testing Results



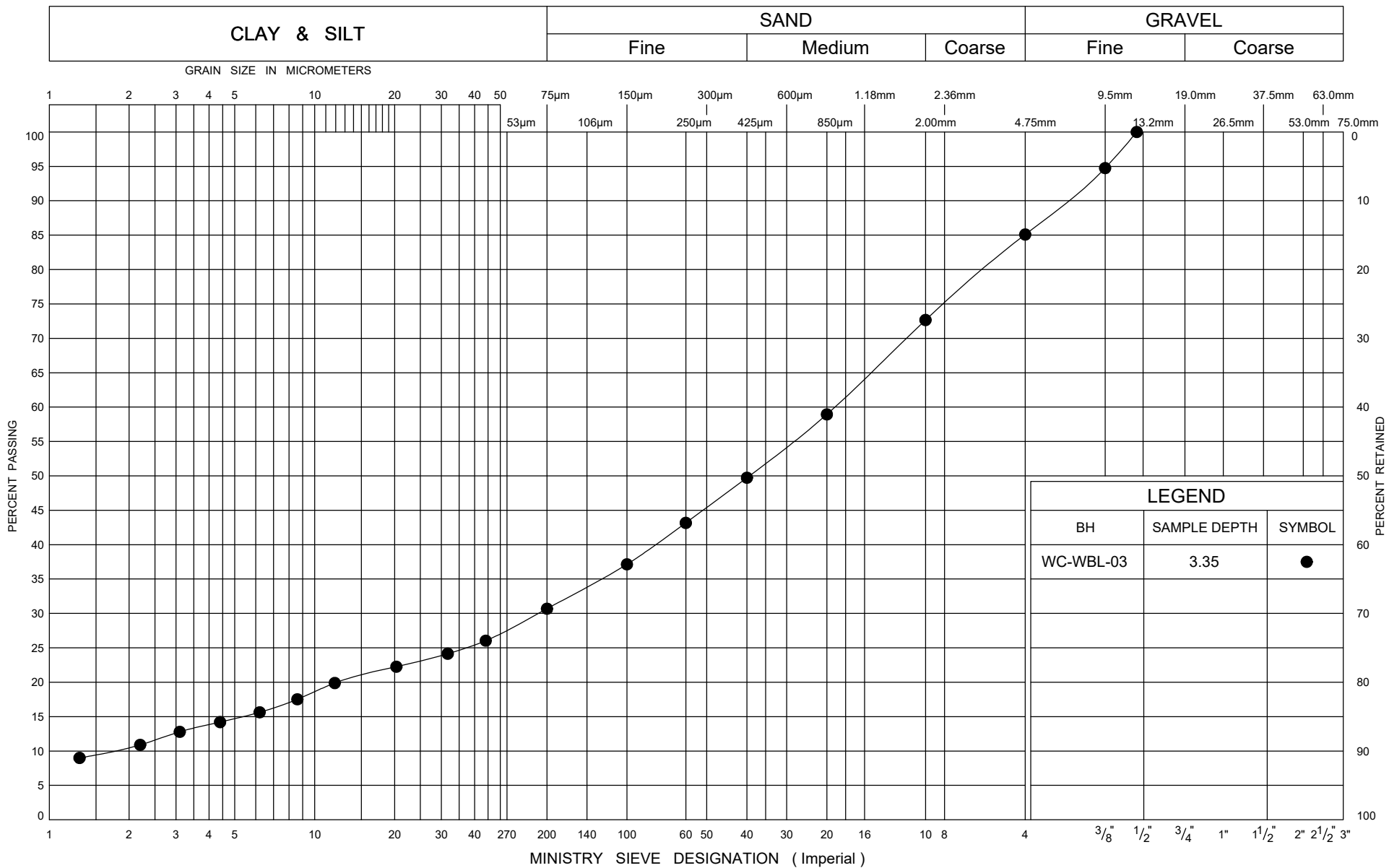
FIG No H1

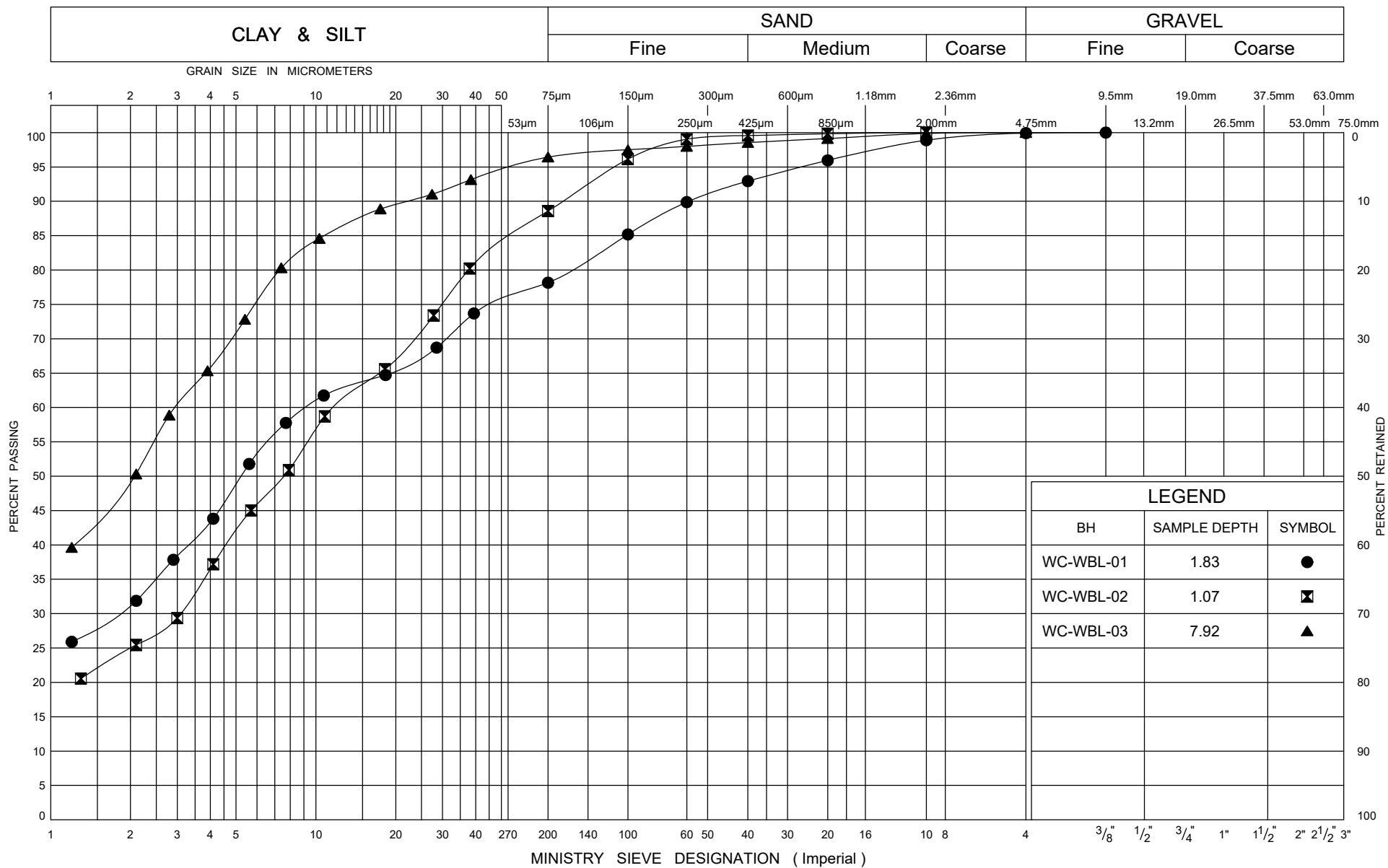
GWP# 129-90-00

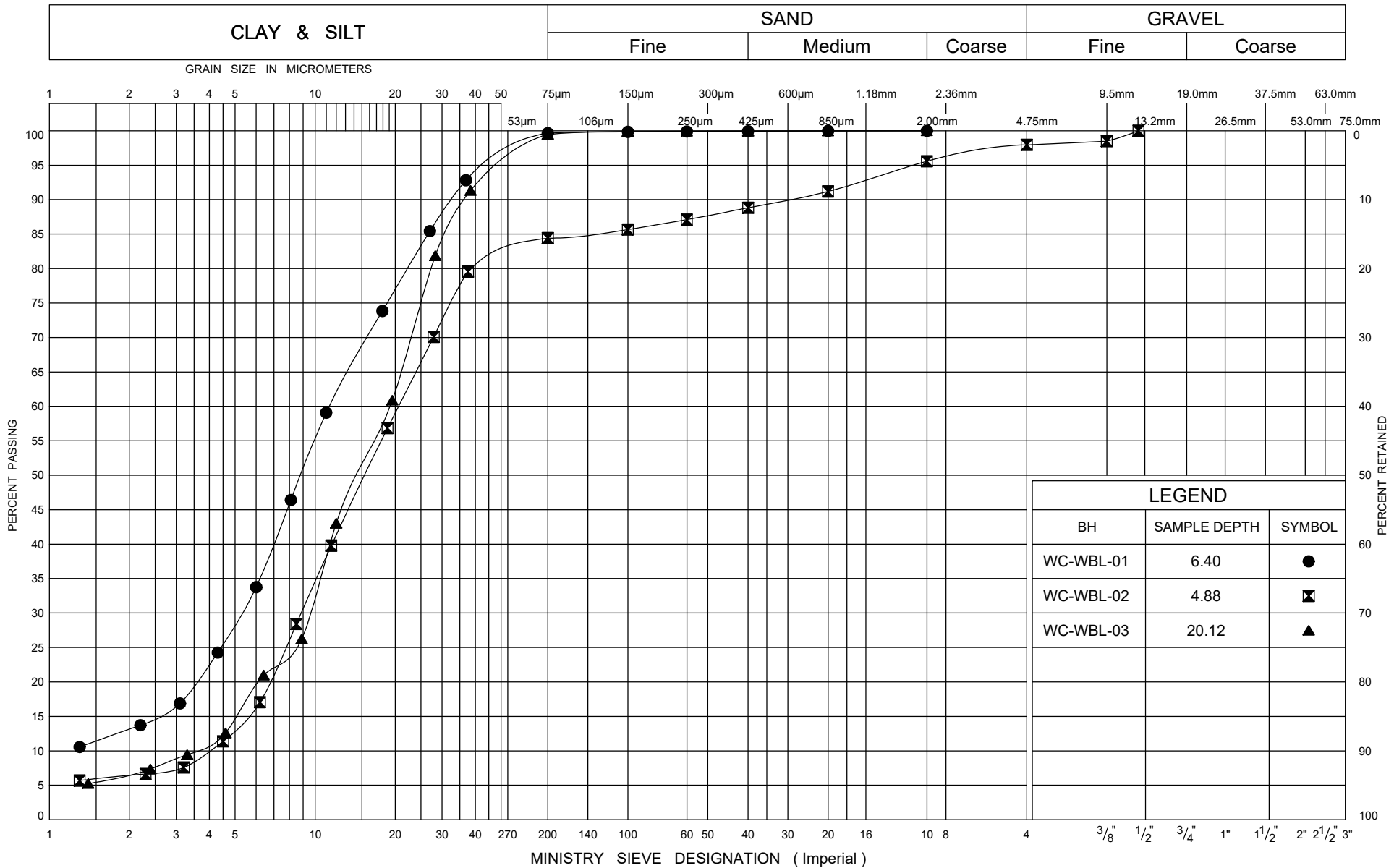


FIG No H2

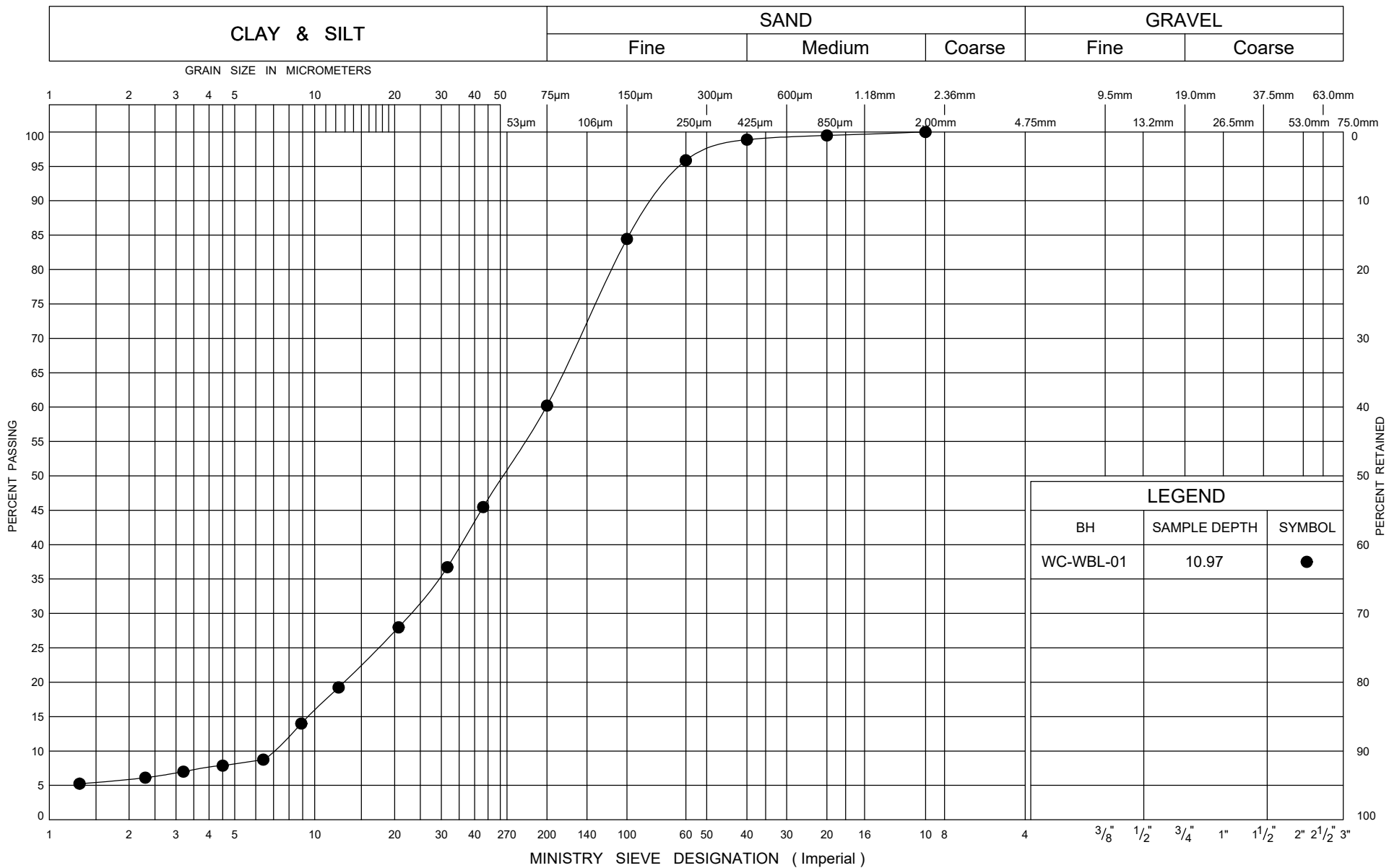
GWP# 129-90-00

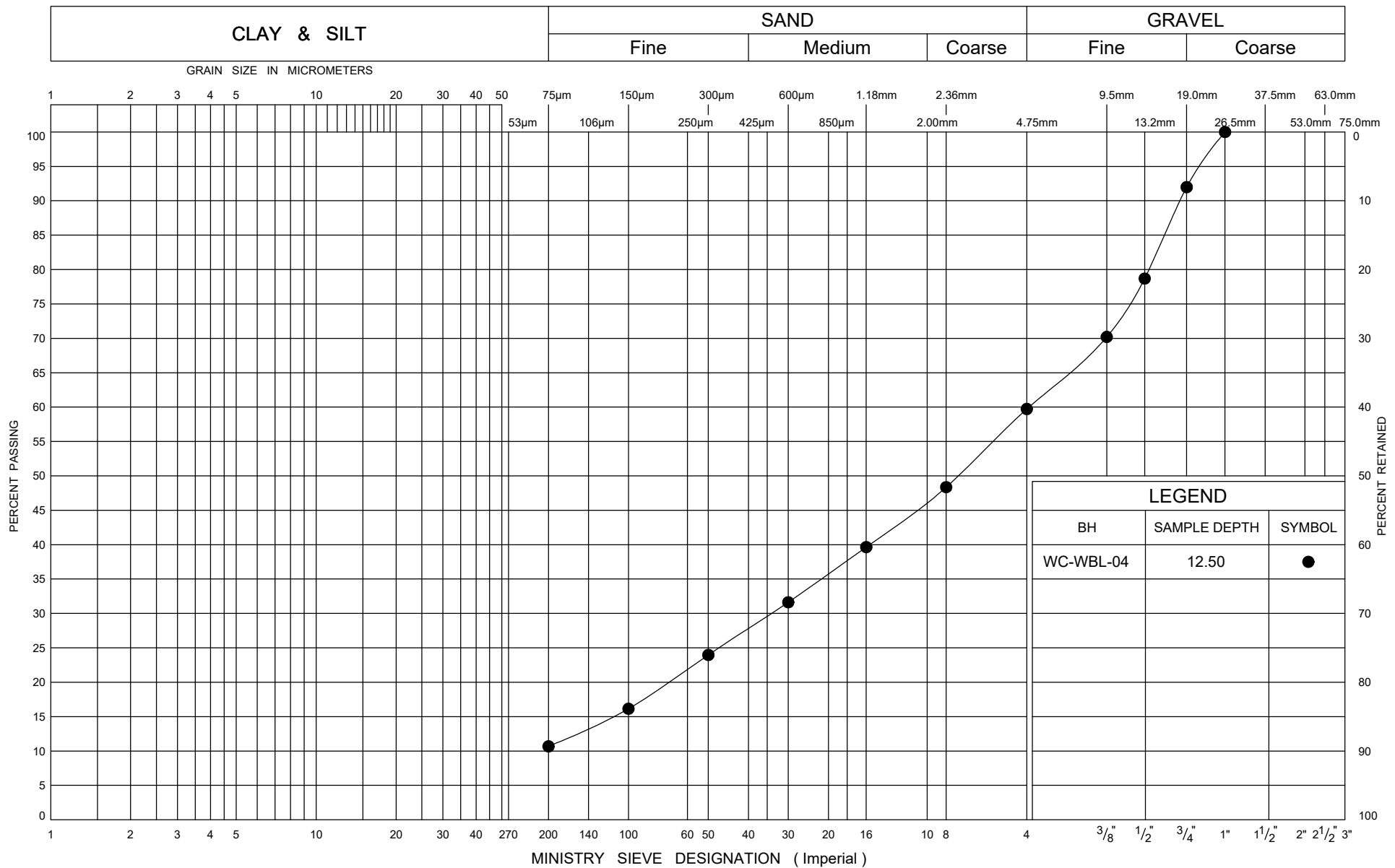


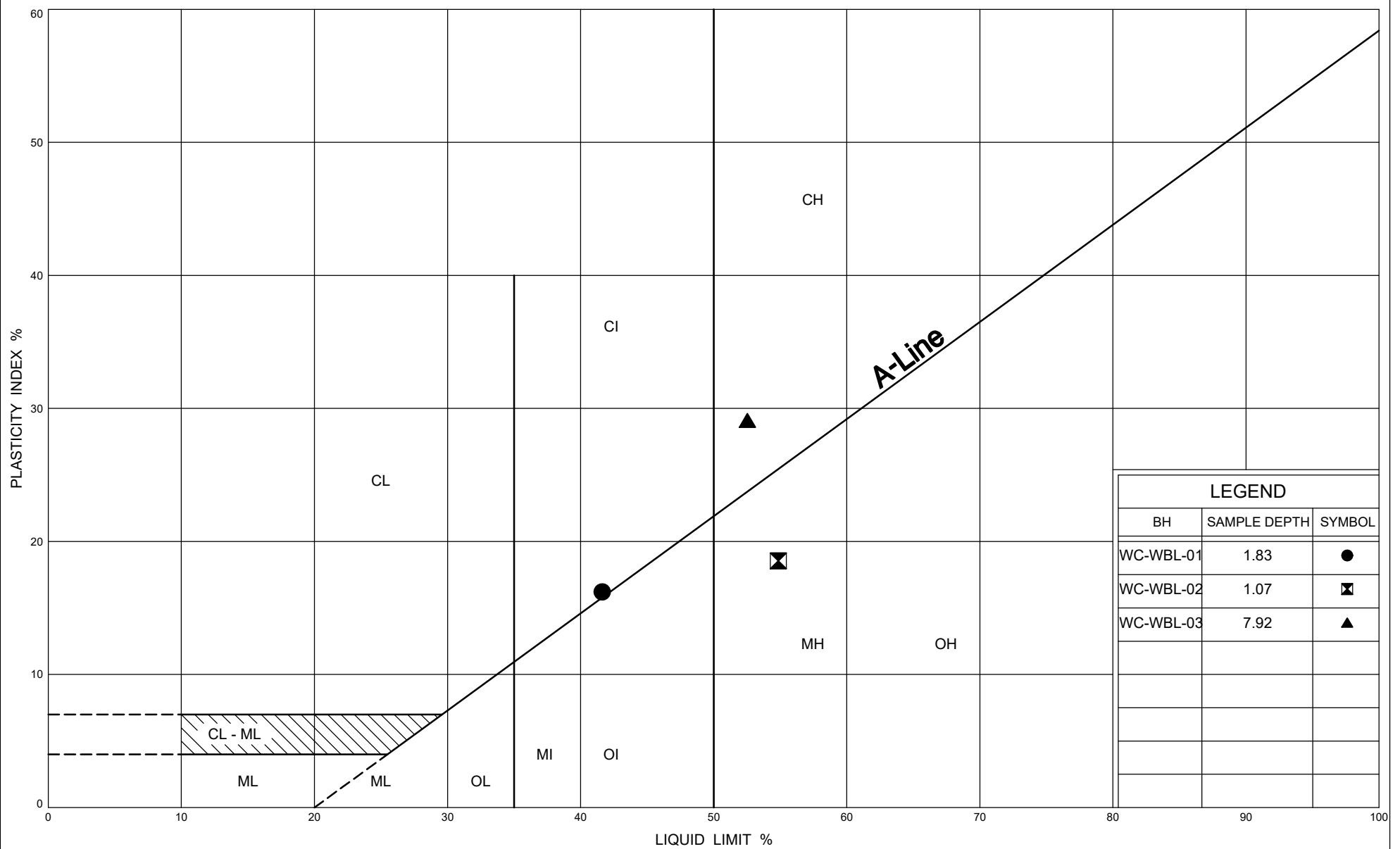




ONTARIO MOT GRAIN SIZE 3 MTO-21663.GPJ ONTARIO MOT.GDT 3/7/24







PLASTICITY CHART Silty CLAY

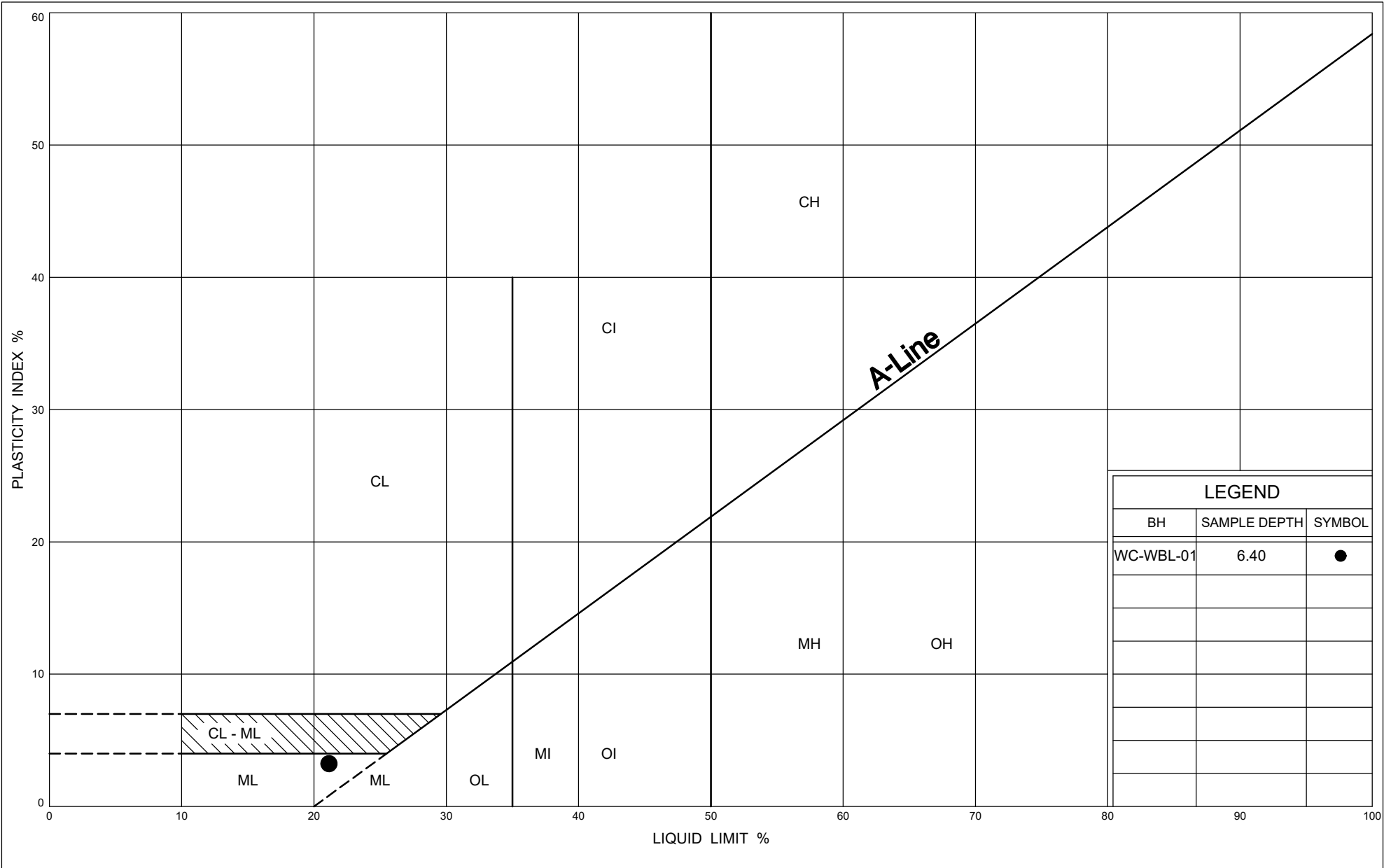
FIG No H8

GWP# 129-90-00



Ministry of
Transportation

Ontario



LEGEND		
BH	SAMPLE DEPTH	SYMBOL
WC-WBL-01	6.40	●

APPENDIX I

Bedrock Laboratory Test Results and Rock Core Photographs



ASTM D5731-08

Date Drilled:	14-Mar-23
Date Tested:	27-Mar-23
Tester:	AK
Client:	WSP

[illegible]

POINT LOAD TEST SHEET

ASTM D5731-08

Job No: 21663

Date Drilled: 21-Mar-23

Project Name: Highway 11/17 4-Laning, Pearl Lake Easterly

Date Tested: 04-Apr-23

Core Size: NQ **BH No :** WC-EBL-02

Tester: AK

Client: WSP

[illegible]

POINT LOAD TEST SHEET

ASTM D5731-08

Job No: 21663

Date Drilled: 15-Mar-23

Project Name: Highway 11/17 4-Laning, Pearl Lake Easterly

Date Tested: 27-Mar-23

Core Size: NQ **BH No :** WC-EBL-03

Tester: AK

Client: WSP

[illegible]

Job No: 21663

Date Drilled: 14-Apr-23

Project Name: _____

Date Tested: 26-Apr-23

Highway 11/17 4-Laning, Pearl Lake Easterly

Tester: AK

Core Size:	NQ	BH No :	DC2-01
-------------------	----	----------------	--------

Client: WSP

[illegible]

Job No: 21663

Date Drilled: 15-Apr-23

Project Name: _____

Date Tested: 26-Apr-23

Highway 11/17 4-Laning, Pearl Lake Easterly

Tester: AK

Core Size:	NQ	BH No :	DC2-02
-------------------	----	----------------	--------

Client: WSP

[illegible]

**ASTM D5731-08**

Client: _____

[illegible]



ASTM D5731-08

Client: WSP

[illegible]

ROCK CORE PHOTOS

Borehole WC-EBL-01, Runs 1: 11.3 to 12.0 m (Elev. 201.9 to 201.2 m)



Borehole WC-EBL-01, Run 2: 14.9 to 16.5 m (Elev. 198.3 to 196.7 m)



Borehole WC-EBL-01, Run 3: 16.5 to 18.0 m (Elev. 196.7 to 195.2 m)



ROCK CORE PHOTOS

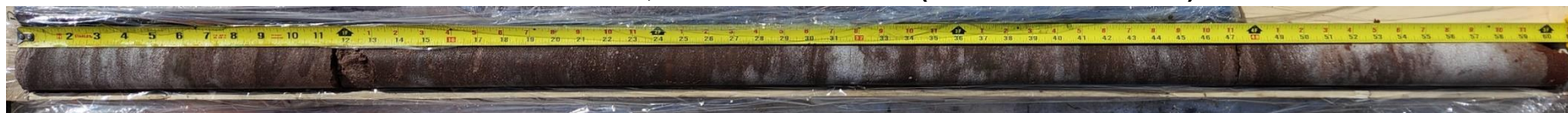
Borehole WC-EBL-02, Run 1: 11.9 to 13.3 m (Elev. 200.1 to 198.7 m)



Borehole WC-EBL-02, Run 2: 13.3 to 14.5 m (Elev. 198.7 to 197.5 m)



Borehole WC-EBL-02, Run 3: 14.5 to 16.0 m (Elev. 197.5 to 196.0 m)



ROCK CORE PHOTOS

Borehole WC-EBL-03, Run 1: 13.4 to 14.9 m (Elev. 199.6 to 198.1 m)



Borehole WC-EBL-03, Run 2: 14.9 to 16.5 m (Elev. 198.1 to 196.5 m)



Borehole WC-EBL-03, Run 3: 16.5 to 18.0 m (Elev. 196.5 to 195.0 m)



Borehole WC-EBL-03, Run 4: 18.0 to 19.5 m (Elev. 195.0 to 193.5 m)



ROCK CORE PHOTOS

Borehole WC-EBL-03, Run 5: 19.5 to 20.7 m (Elev. 193.5 to 192.3 m)



ROCK CORE PHOTOS

Borehole DC2-01, Runs 1 and 2: 5.6 to 8.7 m (Elev. 246.8 to 243.7 m)



Borehole DC2-02, Runs 1 to 3: 1.8 to 5.4 m (Elev. 255.7 to 252.1 m)



ROCK CORE PHOTOS

Borehole HF6-01, Run 1: 6.0 to 7.4 m (Elev. 253.0 to 251.6 m)



Borehole HF6-01, Run 2: 7.4 to 8.9 m (Elev. 251.6 to 250.1 m)



ROCK CORE PHOTOS

Borehole WC-WBL-02, Runs 1, 2, and 3: 10.2 to 14.8 m (Elev. 205.2 to 200.6 m)



APPENDIX J

Analytical Laboratory Test Results



FINAL REPORT

CA40020-JUL23 R1

21663, Pearl Lake

Prepared for

Thurber Engineering Ltd.

First Page

CLIENT DETAILS

Client Thurber Engineering Ltd.

Address 103, 2010 Winston Park Drive
Oakville, ON
L6H 5R7, Canada

Contact Rachel Bourassa

Telephone 905-829-8666 x 263

Facsimile

Email rbourassa@thurber.ca

Project 21663, Pearl Lake

Order Number

Samples Soil (4)

LABORATORY DETAILS

Project Specialist Jill Campbell, B.Sc.,GISAS

Laboratory SGS Canada Inc.

Address 185 Concession St., Lakefield ON, K0L 2H0

Telephone 2165

Facsimile 705-652-6365

Email jill.campbell@sgs.com

SGS Reference CA40020-JUL23

Received 07/06/2023

Approved 07/13/2023

Report Number CA40020-JUL23 R1

Date Reported 07/13/2023

COMMENTS

Temperature of Sample upon Receipt: 6 degrees C

Cooling Agent Present: Yes

Custody Seal Present: Yes

Chain of Custody Number: n/a

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

Jill Campbell, B.Sc.,GISAS





TABLE OF CONTENTS

First Page..... 1-2

Index..... 3

Results..... 4

QC Summary..... 5-6

Legend..... 7

Annexes..... 8



FINAL REPORT

CA40020-JUL23 R1

Client: Thurber Engineering Ltd.

Project: 21663, Pearl Lake

Project Manager: Rachel Bourassa

Samplers: MM/GS

MATRIX: SOIL

Sample Number	5	6	7	8
Sample Name	WC-EBL-01 SS4 (7.5'-9.5')	WC-EBL-03 SS3 (5'-7')	WC-WBL-02 SS3 (5'-7')	WC-WBL-04 SS3 (5'-7')
Sample Matrix	Soil	Soil	Soil	Soil
Sample Date	11/03/2023	15/03/2023	02/04/2023	24/05/2023

Parameter	Units	RL		Result	Result	Result	Result
Corrosivity Index							
Corrosivity Index	none	1		8	6	12	18
Soil Redox Potential	mV	no		213	185	221	315
Sulphide (Na ₂ CO ₃)	%	0.04		< 0.04	< 0.04	< 0.04	< 0.04
pH	pH Units	0.05		8.38	7.41	5.93	9.53
Resistivity (calculated)	ohms.cm	-9999		7190	9260	1790	1230
General Chemistry							
Conductivity	uS/cm	2		139	108	558	814
Metals and Inorganics							
Moisture Content	%	0.1		21.5	30.4	20.4	6.5
Sulphate	µg/g	0.4		47	21	48	47
Other (ORP)							
Chloride	µg/g	0.4		2.5	5.5	350	490



FINAL REPORT

CA40020-JUL23 R1

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	DIO0200-JUL23	µg/g	0.4	<0.4	6	35	100	80	120	100	75	125
Sulphate	DIO0200-JUL23	µg/g	0.4	<0.4	11	35	95	80	120	94	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 (Na2CO3)	ECS0016-JUL23	%	0.04	< 0.04								

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	EWL0152-JUL23	uS/cm	2	2	1	20	100	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	EWL0152-JUL23	pH Units	0.05	NA	0		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

Results relate only to the sample tested.

Data reported represent the sample as submitted to SGS. 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 and Excess Soil Quality" 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.

SGS Canada Inc. statement of conformity decision rule does not consider uncertainty when analytical results are compared to a specified standard or regulation.

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. Reproduction of this analytical report in full or in part is prohibited.

This report supersedes all previous versions.

-- End of Analytical Report --

[illegible]

APPENDIX K

Site Photographs



Photo 1: SW1, looking southwest at the centerline, photo taken October 19, 2022



Photo 2: SW1 at 24+625, looking northeast towards DC1 CL, photo taken October 19, 2022



Photo 3: HF1, at 25+150 CL, looking northeast, photo taken October 19, 2022



**Photo 4: EBL Welch Creek Culvert Section, looking northwest, near 25+255 CL,
photo taken October 19, 2022**



**Photo 5: EBL Welch Creek Culvert Section, looking southeast near 25+555 CL,
photo taken October 19, 2022**



**Photo 6: EBL Welch Creek Culvert Section, looking southeast near 25+555 CL,
photo taken February 28, 2023**



Photo 7: DC2 Section looking north, photo taken April 15, 2023



Photo 8: SW2 Section, 27+850 CL, looking south, photo taken February 11, 2023



Photo 9: SW2 Section, looking east 27+900, photo taken February 11, 2023



Photo 10: SW2 Section, looking northeast from 27+900, photo taken February 11, 2023



Photo 11: HF6 Section, 28+925 CL, looking east, photo taken October 27, 2022



Photo 12: HF6 Section, looking West CL, photo taken October 27, 2022



Photo 13: HF6 Section, Sta 29+625, looking southwest, photo taken October 30, 2022



Photo 14: Existing Welch Creek WBL Culvert, looking northwest at culvert inlet, photo taken March 9, 2023



**Photo 15: Existing Welch Creek WBL Culvert, looking south at culvert outlet,
photo taken March 7, 2023**



**Photo 16: Existing Highway 11/17 at Welch Creek WBL Culvert, looking south,
photo taken May 23, 2023**