



THURBER ENGINEERING LTD.

**FINAL
FOUNDATION INVESTIGATION REPORT
HIGHWAY 11 NON-STRUCTURAL CULVERT AT STATION 12+650
LEDGER TOWNSHIP, ONTARIO
AGREEMENT NO.: 6022-E-0038
ASSIGNMENT NO.: 1**

GEOCRES NO.: 52H01-001

Location: Lat: 49.163634°, Long: -88.233413°

Client Name: Ministry of Transportation

Date: December 5, 2023

File: 40101



TABLE OF CONTENTS

PART 1. FACTUAL INFORMATION

1.	INTRODUCTION.....	1
2.	SITE DESCRIPTION.....	1
2.1	General.....	1
2.2	Site Geology.....	2
2.3	Existing Information.....	2
3.	SITE INVESTIGATION AND FIELD TESTING.....	3
4.	LABORATORY TESTING.....	4
5.	DESCRIPTION OF SUBSURFACE CONDITIONS.....	4
5.1	Topsoil.....	4
5.2	Fill.....	4
5.3	Clayey Silt.....	5
5.4	Silty Clay.....	6
5.5	Groundwater Level.....	6
6.	MISCELLANEOUS.....	7

STATEMENT OF LIMITATIONS AND CONDITIONS



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IN-TEXT TABLES

Table 3-1 Borehole Summary 3
Table 5-1 Groundwater Level Measurements 6



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APPENDICES

APPENDIX A

Borehole Locations and Strata Drawing

APPENDIX B

Record of Boreholes Sheets

APPENDIX C

Laboratory Test Results

APPENDIX D

Site Photographs



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PART 1. FACTUAL INFORMATION

1. INTRODUCTION

This section of the report presents the factual findings obtained from a foundation investigation conducted by Thurber Engineering Ltd. (Thurber) for a new temporary detour embankment for the replacement of a box culvert that crosses Highway 11 at Sta. 12+650 in Ledger Township approximately 17.8 km north of Nipigon, Ontario. Thurber carried out the foundation investigation for the Ontario Ministry of Transportation (MTO) under Retainer Agreement No. 6022-E-0038, Assignment No. 1.

The purpose of the investigation was to explore the subsurface conditions at the site and based on this data obtained, provide a borehole location plan, record of boreholes, stratigraphic profile, laboratory test results and a written description of the subsurface conditions. The stratigraphic profile of the subsurface conditions was developed during the current investigation.

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 General

The culvert site crosses Highway 11 approximately 17.8 km north of the junction between Highway 11 and Highway 17 near Nipigon. For project purposes, Highway 17 is herein described as oriented north-south, and the culvert is described as oriented east-west.

In the area of the culvert, Highway 11 is a two-lane highway and has a posted speed limit of 90 km/h. The road surface near the culvert is at approximate elevation 228 m. The shoulders to the highway are partially paved and steel cable guiderails on wooden posts are present along



both northbound and southbound shoulders of the highway. The 2016 traffic volume for this section of Highway 11 is understood to be approximately 1,500 AADT.

The existing box culvert is reported in drawings provided by MTO to be 1.83 m wide, 1.22 m high and 31.37 m long, with an alignment approximately perpendicular to the highway alignment. The culvert has a relatively flat gradient with the invert of the culvert near elevations 223.40 m and 223.27 m at the inlet and outlet, respectively. The culvert inlet and outlet were both observed to be dry during the field investigation.

The cover above the existing culvert is approximately 4.5 m at the highway centerline. Embankment side slopes, in the vicinity of the culvert, are generally inclined at approximately 1.6H:1V and 2.5H:1V on the west and east sides, respectively. The existing highway embankment side slopes at the culvert site did not show any visible signs of global instability at the time of the investigation.

The site is in a rural setting and the area adjacent to the highway is undeveloped and densely vegetated with mixed forests of coniferous and some deciduous trees and shrubs. Overhead utility lines were not present.

Photographs of the project area are included in Appendix D. These photographs show the existing condition of the highway embankment and the culvert at the time of the field investigation.

2.2 Site Geology

According to Crins et al. 2009¹ the project area is described as Ecoregion 3W (Lake Nipigon Ecoregion) within the Ontario Shield Ecozone. According to Wester et al. 2018² the ecoregion is subdivided into Ecodistrict 3W-3 (Black Sturgeon Ecodistrict). The project area is located in the south part of the ecodistrict, which is characterized by Precambrian bedrock overlain with a very shallow to shallow layer of mineral material and morainal deposits. Bedrock Geology Map (M2542)³ indicates the site is underlain by metasedimentary rocks: paragneisses and migmatites.

2.3 Existing Information

A historical foundation investigation report was not available for this site within the online Geocres Library.

¹ <https://files.ontario.ca/mnrf-ecosystemspart1-accessible-july2018-en-2020-01-16.pdf>

² <https://files.ontario.ca/ecosystems-ontario-part2-03262019.pdf>

³ <https://www.geologyontario.mndm.gov.on.ca/mndmfiles/pub/data/imaging/M2542/M2542.pdf>

Base plan mapping was provided by MTO for the preparation of this report.

3. SITE INVESTIGATION AND FIELD TESTING

The foundation investigation and field-testing program was carried out between September 18 and September 19, 2023, and consisted of one off-road borehole drilled near the toe of the existing highway embankment identified as 23-01 and one on-road borehole identified as 23-02. Both boreholes were advanced with a CME 750 buggy drill rig utilizing hollow stem augers. Prior to commencement of drilling, utility clearances were obtained in the vicinity of the borehole locations.

A summary of the borehole coordinates, elevations, and termination depths is provided in the table below. The as-drilled borehole elevations were measured by Thurber following completion of the field program. Horizontal locations were measured by Thurber relative to existing site features. The elevations and borehole coordinates were reviewed and referenced to the survey data provided by MTO. The borehole coordinates and elevations are shown on the Borehole Location and Soil Strata drawing included in Appendix A and on the individual Record of Borehole sheets included in Appendix B. The borehole coordinates are referenced to MTM Zone 14.

Table 3-1 Borehole Summary

Borehole	Northing (m)	Easting (m)	Ground Surface Elevation (m)	Termination Depth Below Ground Surface (m)
23-01	5,448,040.5	214,850.0	225.3	12.8
23-02	5,448,015.6	214,847.0	227.5	17.4

Soil samples were obtained at selected intervals using a split spoon sampler in conjunction with Standard Penetration Testing (SPT) in general accordance with ASTM D 1586. In-situ vane testing was carried out within the cohesive layers, where possible, using an MTO 'N' sized vane in general accordance with ASTM D 2573.

The drilling and sampling operations were supervised on a full-time basis by a member of Thurber's technical staff. The drilling supervisor logged the boreholes and processed the recovered soil samples for transport to Thurber's Oakville laboratory for further examination and testing.

Following completion of the field investigation, the boreholes were decommissioned in general in accordance with O. Reg. 903, as amended.



4. LABORATORY TESTING

Laboratory testing was selected in general accordance with the current MTO Guideline for Foundation Engineering Services, Section 5. Geotechnical laboratory testing consisted of natural moisture content determination and visual identification of all retained soil samples. Recovered soil samples were selected for grain size distribution and, where appropriate, Atterberg Limit testing in accordance with MTO and ASTM standards. The results of these tests are summarized on the Record of Borehole sheets included in Appendix B.

All laboratory test results from the field investigation are provided in Appendix C.

5. DESCRIPTION OF SUBSURFACE CONDITIONS

Details of the encountered subsurface conditions are presented on the Record of Borehole sheets included in Appendix B and on the Borehole Location and Soil Strata Drawing included in Appendix A. A general description of the stratigraphy, based on the conditions encountered in the boreholes, is given in the following sections. However, the factual data presented on the Record of Borehole sheets takes precedence over this general description for interpretation of the site conditions. It must be recognized that the soil and groundwater conditions may vary between and beyond borehole locations.

In general, the encountered stratigraphy consists of topsoil or gravelly sand embankment fill underlain by a deposit of clayey silt. A layer of silty clay was encountered within the clayey silt deposit in the off-road borehole (23-01).

5.1 Topsoil

Topsoil was encountered at the ground surface in Borehole 23-01. The topsoil was measured to have a thickness of 50 mm.

5.2 Fill

A fill layer consisting of gravelly sand was encountered at the ground surface in Borehole 23-02. The fill layer was 3.1 m thick (base elev. 224.4 m). SPT N-values in the fill ranged from 9 to 15 blows, indicating a loose to compact relative density.

Moisture contents ranging from 5 to 12% were recorded. The results of a gradation analysis completed on a sample of the gravelly sand fill are illustrated in Figure C1 of Appendix C. The results of the test are summarized in the table below and on the Record of Borehole sheets in Appendix B.



Soil Particle	Percentage (%)
Gravel	37
Sand	50
Silt	13
Clay	

5.3 Clayey Silt

A deposit of clayey silt was encountered below the topsoil in Borehole 23-01 and below the gravelly sand fill in Borehole 23-02. The layer was not fully penetrated in the boreholes but was proven to have a thickness of at least 10.1 to 14.3 m and extend to depths of 12.8 to 17.4 m below the ground surface (base elev. 212.5 to 210.1 m) where the boreholes were terminated. SPT N-values ranged from 5 to 43 blows, indicating a loose to dense relative density.

Moisture contents ranging from 12 to 46% were recorded. The results of gradation analyses completed on seven samples of the clayey silt are illustrated in Figure C2 of Appendix C. The results of the tests are summarized in the table below and on the Record of Borehole sheets in Appendix B.

Soil Particle	Percentage (%)
Gravel	0
Sand	0 – 11
Silt	75 – 94
Clay	6 – 22

Atterberg limits testing was completed on four samples of the clayey silt. The results are illustrated in Figure C3 of Appendix C and summarized below and on the Record of Borehole sheets in Appendix B. The laboratory results indicate that the clayey silt exhibits low plastic behaviour (CL-ML).

Parameter	Value
Liquid Limit	22 – 26
Plastic Limit	18 – 20
Plasticity Index	4 – 7



5.4 Silty Clay

A layer of silty clay was encountered within the clayey silt deposit in Borehole 23-01. The silty clay layer was 2.7 m thick and extended to a depth of 4.9 m (base elev. 220.4 m). SPT N-values of 4 blows were recorded in the silty clay layer. A field vane test was performed within this layer and indicated an undrained shear strength of 63 kPa. The layer is described as firm to stiff based on the SPT N-values and in-situ vane testing.

The recorded moisture contents ranged from 27 to 34%. The results of a gradation analysis completed on a sample of the silty clay are illustrated in Figure C4 of Appendix C. The results of the tests are summarized in the table below and on the Record of Borehole sheets in Appendix B.

Soil Particle	Percentage (%)
Gravel	0
Sand	0
Silt	61
Clay	39

Atterberg limits testing was completed on a sample of the silty clay. The results are illustrated in Figure C5 of Appendix C and summarized below and on the Record of Borehole sheets in Appendix B. The laboratory results indicate that the silty clay exhibits intermediate plastic behaviour (CI).

Parameter	Value
Liquid Limit	38
Plastic Limit	21
Plasticity Index	17

5.5 Groundwater Level

The groundwater levels within the open boreholes were recorded upon completion of drilling and are summarized in the following table.

Table 5-1 Groundwater Level Measurements

Borehole	Groundwater Level		Date of Reading	Note
	Depth (m)	Elevation (m)		
23-01	Dry	-	September 18, 2023	Open Borehole
23-02	7.3	220.2	September 19, 2023	Open Borehole



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It should be noted that the values shown above are considered short-term readings and may not reflect groundwater levels at the time of construction. Seasonal fluctuations of the groundwater level are to be expected. In particular, the groundwater level may be at a higher elevation after periods of significant and/or prolonged precipitation events.

6. MISCELLANEOUS

The borehole locations reflect existing site features and access constraints. The as-drilled borehole locations and ground surface elevations were measured by Thurber following completion of the field program. RPM Drilling of Thunder Bay, Ontario, supplied and operated the drill rig used to drill, test, sample, and decommission the boreholes. Traffic control was performed in accordance with Ontario Book 7 and was provided by RPM Drilling of Thunder Bay, Ontario. The field investigation was supervised on a full-time basis by Mr. L. Scalena, EIT. Overall supervision of the field investigation program was provided by Mr. M. Eastman, P.Eng.

Routine geotechnical laboratory testing was completed by Thurber's laboratory in Oakville.

Interpretation of the factual data and preparation of this report was completed by M. Eastman, P.Eng. The report was reviewed by Dr. P.K. Chatterji, P.Eng., a Designated Principal Contact for MTO Foundation Projects.



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Report Prepared By:



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Senior Geotechnical Engineer



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

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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.

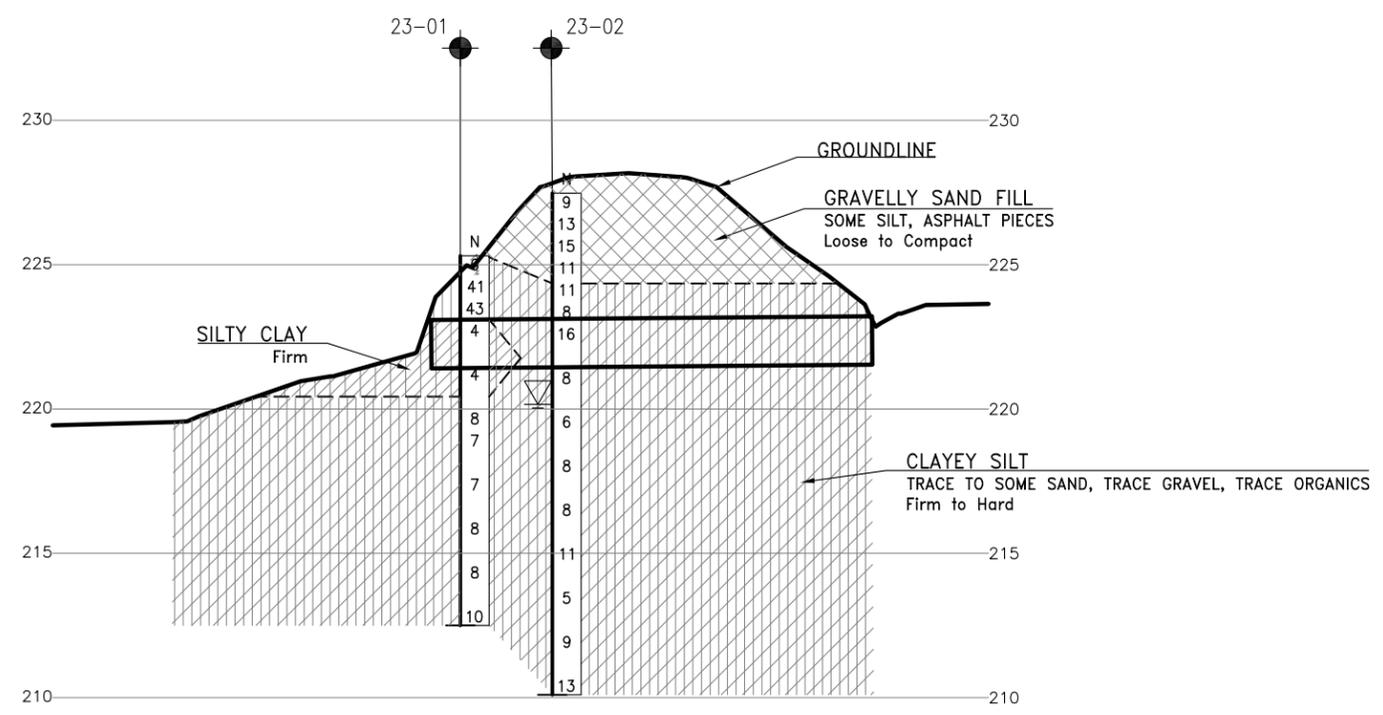
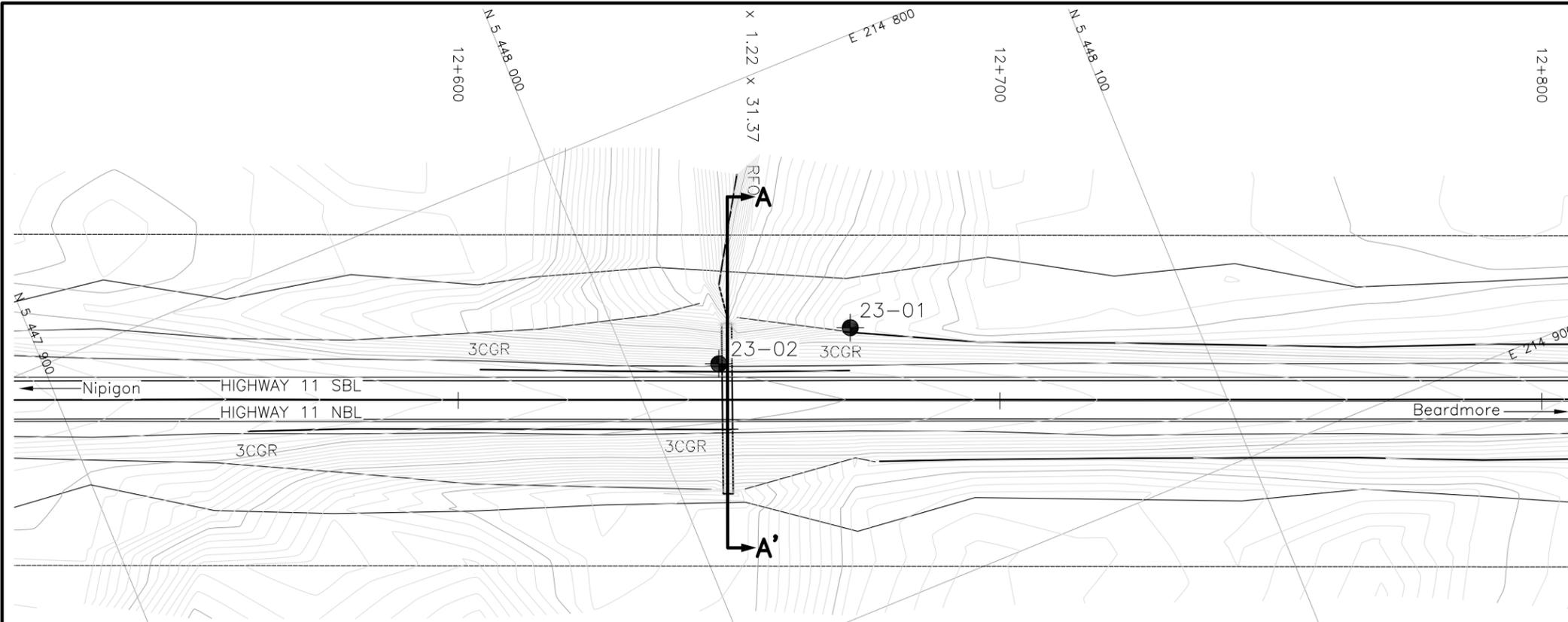


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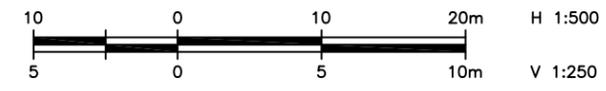
APPENDIX A

Borehole Locations and Strata Drawing

MINISTRY OF TRANSPORTATION, ONTARIO

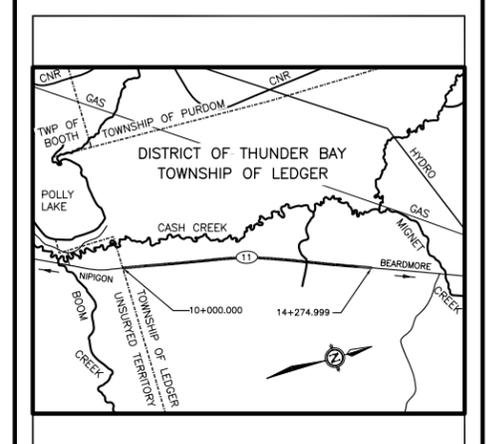


SECTION A-A' ALONG ϕ CULVERT



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

CONT No WP No	HIGHWAY 11 DEEP FILL CULVERT	SHEET
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
23-01	225.3	5 448 040.5	214 850.0
23-02	227.5	5 448 015.6	214 846.9



-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 14.

GEOCREs No. 52H01-001

REVISIONS	DATE	BY	DESCRIPTION

DESIGN	MKE	CHK	PKC	CODE	LOAD	DATE	DEC 2023
DRAWN	JW	CHK	SITE	STRUCT	DWG	1	

FILENAME: H:\Drafting\40000\40101\1ED-40101-PLPR.dwg
PLOTDATE: 12/17/2023 2:57 PM



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APPENDIX B

Record of Boreholes Sheets

RECORD OF BOREHOLE No 23-01

1 OF 2

METRIC

W.P. 6022-E-0038 LOCATION N 5 448 040.5 E 214 850.0 ORIGINATED BY LS
 DIST Thunder Bay HWY 11 BOREHOLE TYPE CME 750 Buggy, HSA (150 mm O.D.) COMPILED BY MC
 DATUM Geodetic DATE 2023.09.18 - 2023.09.18 LATITUDE 49.163878 LONGITUDE -88.233487 CHECKED BY MKE

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					
225.3	GROUND SURFACE														
0.0	TOPSOIL: (50 mm)														
	Clayey SILT , trace sand, trace gravel Firm to Hard Brown-Grey Moist		1	SS	6							○			
			2	SS	41							○			0 2 85 13
			3	SS	43							○			
223.1	Silty CLAY Firm Grey Moist		4	SS	4							○			
			5	SS	4							○			0 0 61 39
220.4	Clayey SILT , trace sand Firm to Stiff Grey Wet		6	SS	8				2.4			○			
4.9			7	SS	7							○			
			8	SS	7							○			
			9	SS	8							○			0 1 87 12

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

RECORD OF BOREHOLE No 23-01

2 OF 2

METRIC

W.P. 6022-E-0038 LOCATION N 5 448 040.5 E 214 850.0 ORIGINATED BY LS
 DIST Thunder Bay HWY 11 BOREHOLE TYPE CME 750 Buggy, HSA (150 mm O.D.) COMPILED BY MC
 DATUM Geodetic DATE 2023.09.18 - 2023.09.18 LATITUDE 49.163878 LONGITUDE -88.233487 CHECKED BY MKE

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							
212.5	Continued From Previous Page														
	Clayey SILT , trace sand Firm to Stiff Grey Wet		10	SS	8										
			11	SS	10										0 0 94 6
12.8	END OF BOREHOLE AT 12.8 m. BOREHOLE OPEN TO 12.2 m AND DRY UPON COMPLETION.														

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RECORD OF BOREHOLE No 23-02

1 OF 2

METRIC

W.P. 6022-E-0038 LOCATION N 5 448 015.6 E 214 847.0 ORIGINATED BY LS
 DIST Thunder Bay HWY 11 BOREHOLE TYPE CME 750 Buggy, HSA (150 mm O.D.) COMPILED BY MC
 DATUM Geodetic DATE 2023.09.19 - 2023.09.19 LATITUDE 49.163653 LONGITUDE -88.233523 CHECKED BY MKE

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								
						20	40	60	80	100	20	40	60	kn/m ³	GR SA SI CL	
227.5	GROUND SURFACE															
0.0	Gravelly SAND, some silt, asphalt pieces Loose to Compact Brown Moist (FILL)		1	SS	9						○					
			2	SS	13						○					
			3	SS	15						○					37 50 13 (SI+CL)
			4	SS	11						○					
224.4																
3.1	Clayey SILT, trace to some sand, trace organics Firm to Very Stiff Grey Moist		5	SS	11						○					
			6	SS	8						○					
			7	SS	16						⊕					0 11 75 14
			8	SS	8						○					
	Becoming wet		9	SS	6						○					
			10	SS	8						○					0 1 89 10

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Continued Next Page

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

RECORD OF BOREHOLE No 23-02

2 OF 2

METRIC

W.P. 6022-E-0038 LOCATION N 5 448 015.6 E 214 847.0 ORIGINATED BY LS
 DIST Thunder Bay HWY 11 BOREHOLE TYPE CME 750 Buggy, HSA (150 mm O.D.) COMPILED BY MC
 DATUM Geodetic DATE 2023.09.19 - 2023.09.19 LATITUDE 49.163653 LONGITUDE -88.233523 CHECKED BY MKE

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 Clayey SILT , trace to some sand Firm to Very Stiff Grey Wet														
			11	SS	8										
			12	SS	11									0 3 84 13	
			13	SS	5										
			14	SS	9									0 0 78 22	
			15	SS	13										
210.1 17.4	END OF BOREHOLE AT 17.4 m. BOREHOLE OPEN TO 11.6 m AND WATER LEVEL AT 7.3 m UPON COMPLETION.														

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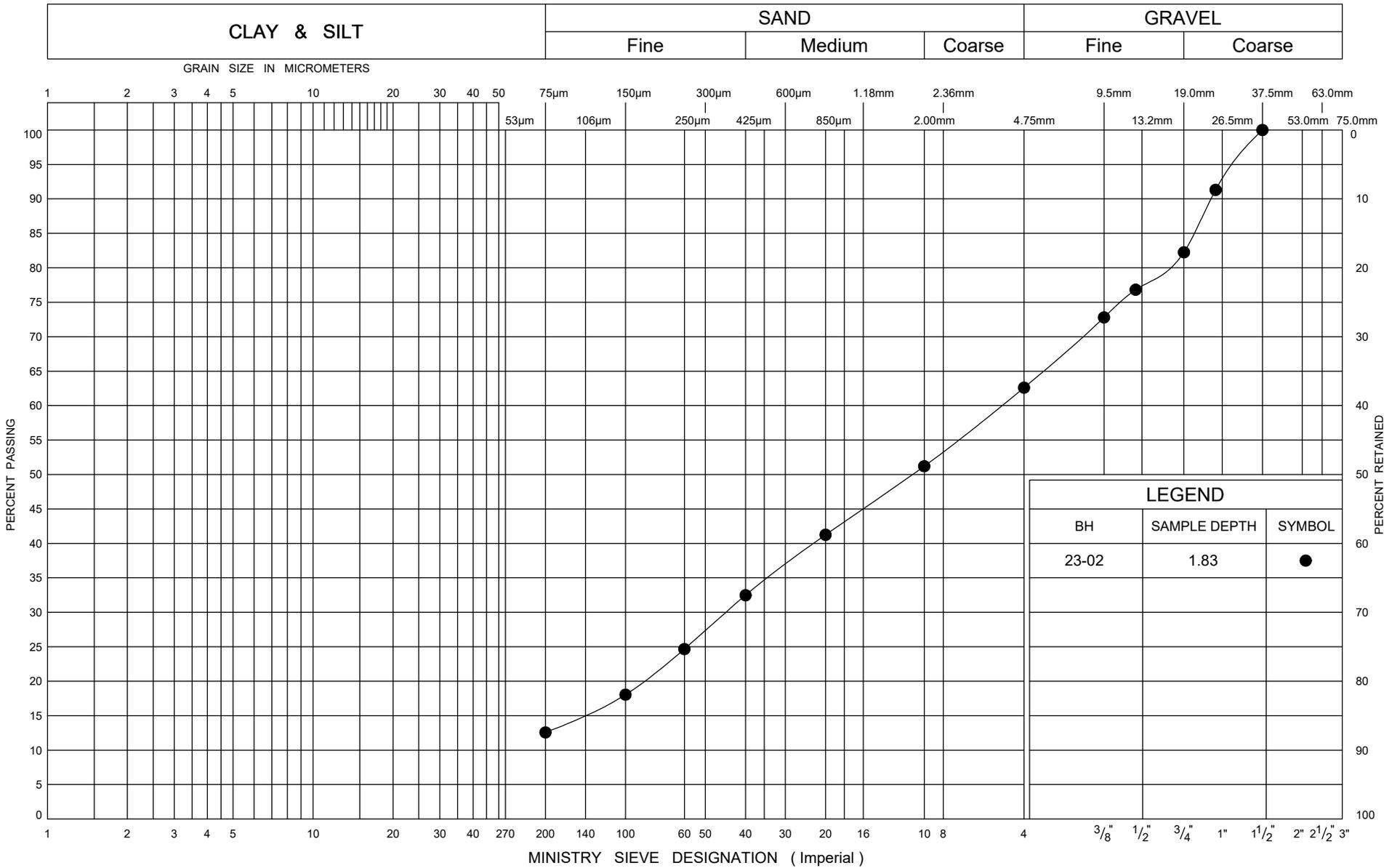
+³, ×³: Numbers refer to Sensitivity
 20
 15
 10
 (%) STRAIN AT FAILURE



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APPENDIX C

Laboratory Test Results



ONTARIO MOT GRAIN SIZE 3 MTO-40101.GPJ ONTARIO MOT.GDT 11/7/23

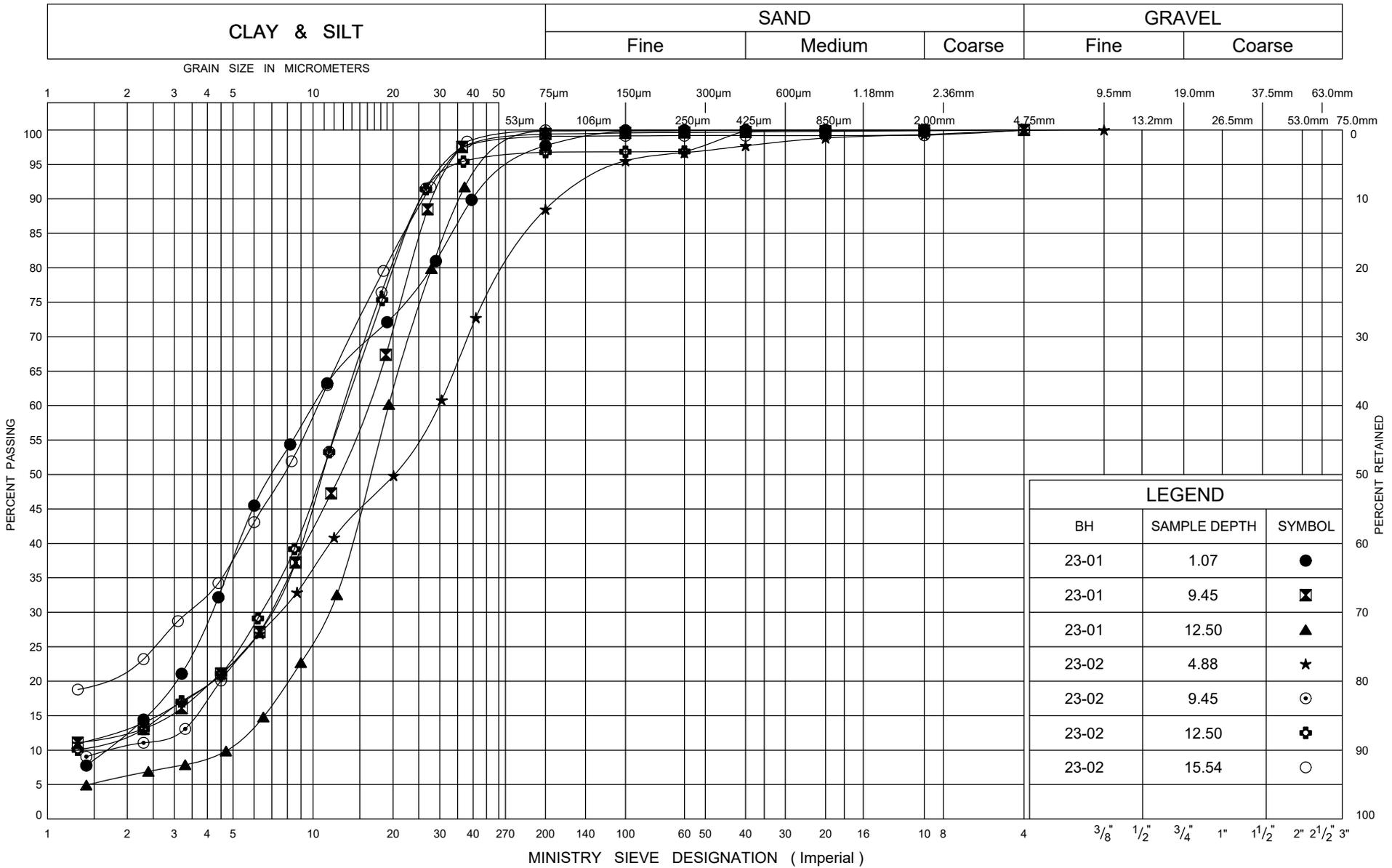


GRAIN SIZE DISTRIBUTION

Gravelly SAND FILL

FIG No C1

W.P. 6022-E-0038



ONTARIO MOT GRAIN SIZE 3 MTO-40101.GPJ ONTARIO MOT.GDT 11/7/23

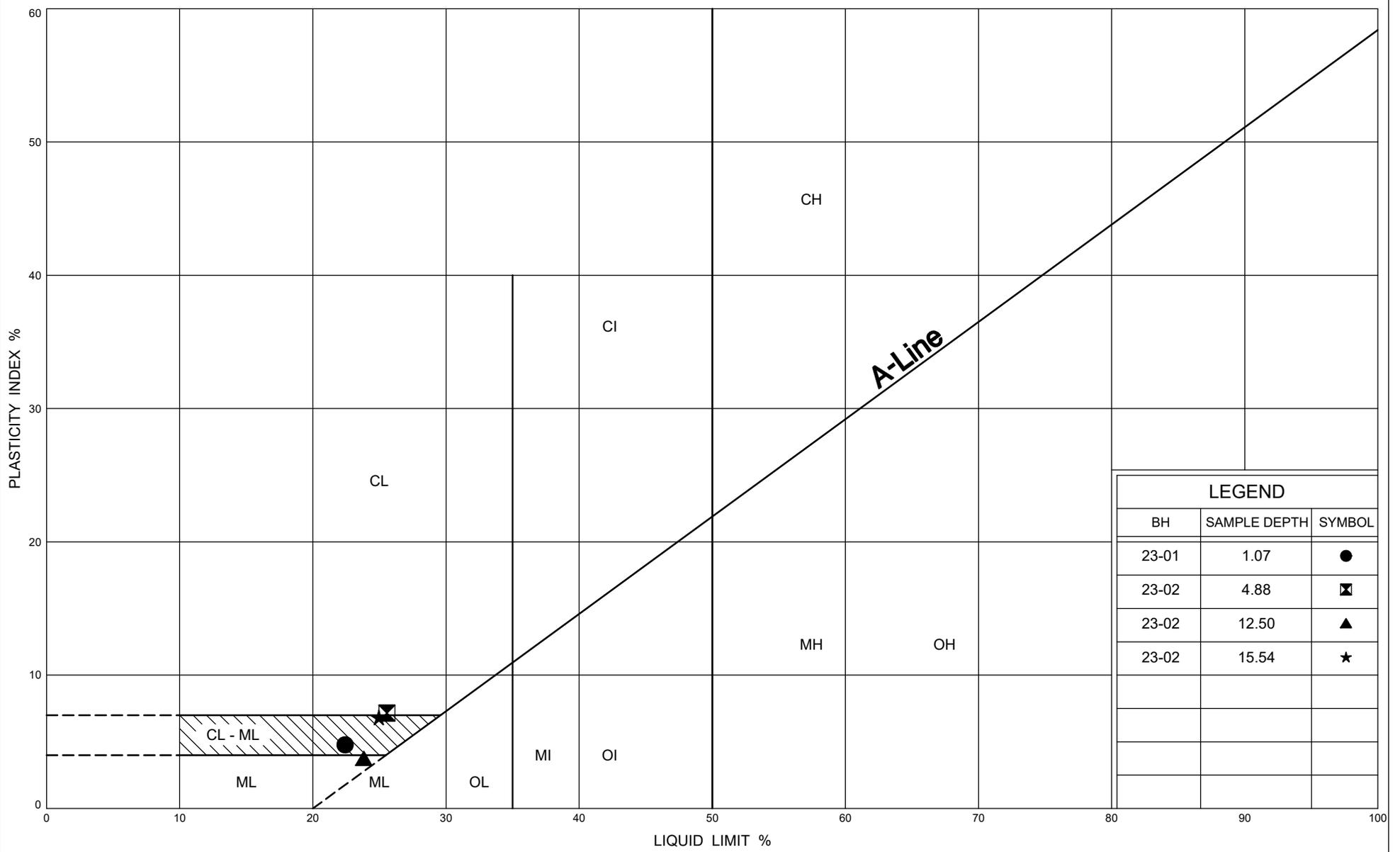


GRAIN SIZE DISTRIBUTION

Clayey SILT

FIG No C2

W.P. 6022-E-0038



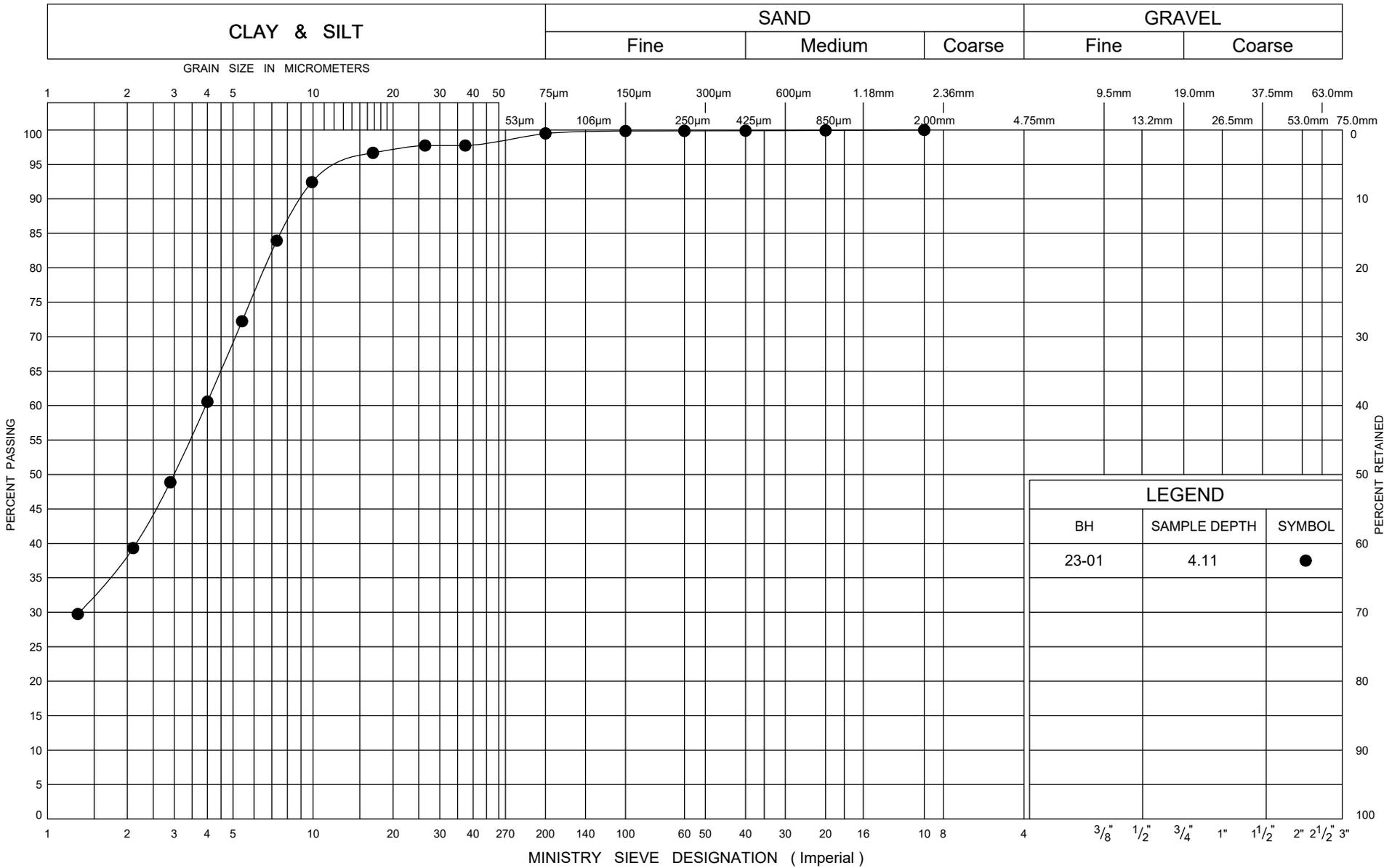
LEGEND		
BH	SAMPLE DEPTH	SYMBOL
23-01	1.07	●
23-02	4.88	⊠
23-02	12.50	▲
23-02	15.54	★

ONTARIO MOT PLASTICITY CHART 2_MTO-40101.GPJ_ONTARIO MOT.GDT 11/7/23



PLASTICITY CHART
Clayey SILT

FIG No C3
W.P. 6022-E-0038



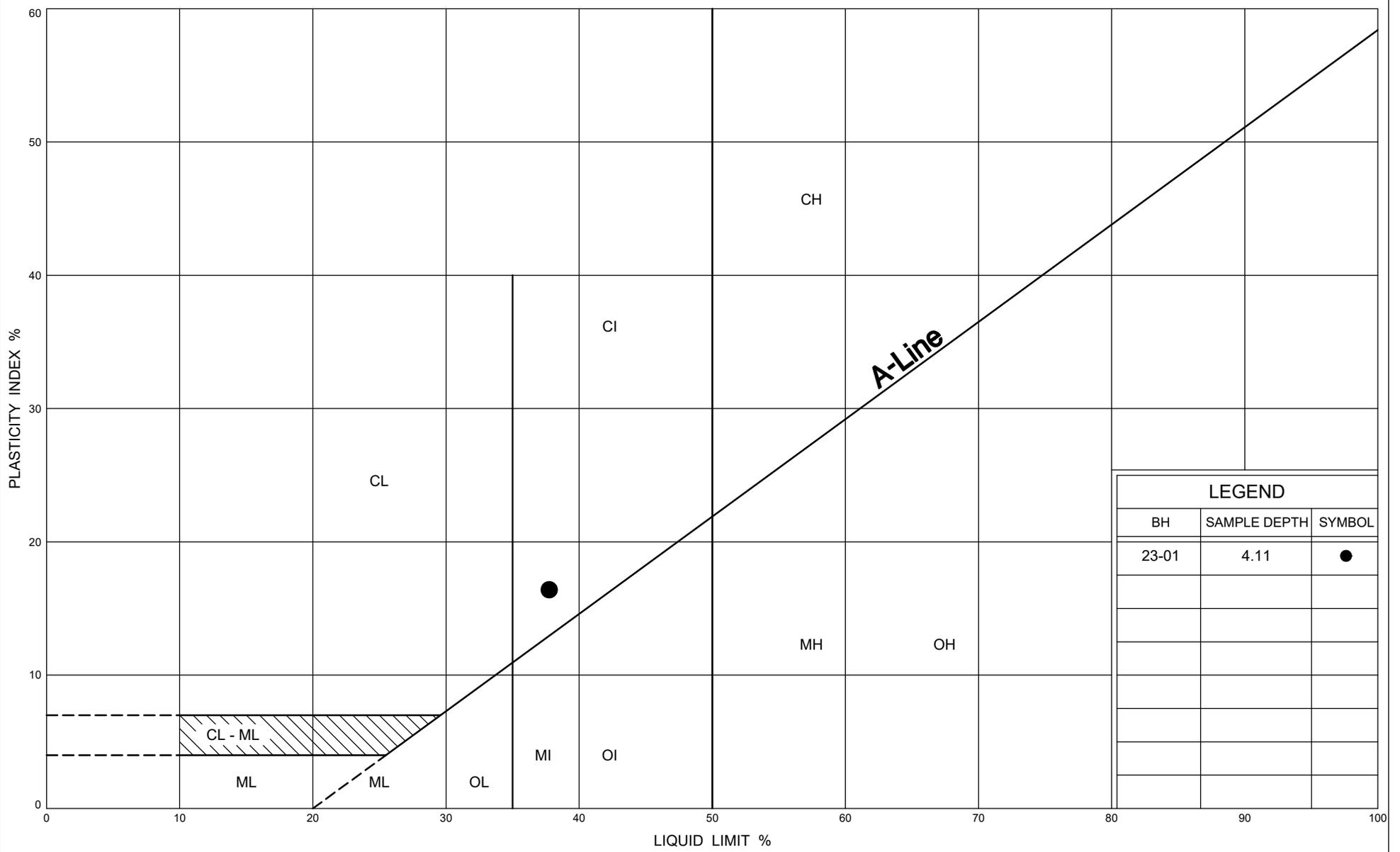
ONTARIO MOT GRAIN SIZE 3 MTO-40101.GPJ ONTARIO MOT.GDT 11/7/23



GRAIN SIZE DISTRIBUTION
Silty CLAY

FIG No C4

W.P. 6022-E-0038



ONTARIO MOT PLASTICITY CHART 2_MTO-40101.GPJ_ONTARIO MOT.GDT 11/7/23



PLASTICITY CHART

Silty CLAY

FIG No C5
W.P. 6022-E-0038



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APPENDIX D

Site Photographs



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Photo 1: Culvert outlet *(taken on September 18, 2023)*



Photo 2: Highway 11 south of the culvert alignment *(taken on September 19, 2023)*



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Photo 3: Highway 11 north of the culvert alignment (taken on September 19, 2023)



Photo 4: Traffic control set-up (taken on September 19, 2023)