



Foundation Investigation Report
Culvert Replacement
Township of Conmee, Station 11+873
Lat: 48.510342, Lon: -89.651403
District of Thunder Bay
Highway 11/17

Assignment No.: 4 6023-E-0030
GWP No.: 6920-17-00
Geocres No. 52A12-002

Prepared for:
Ontario Ministry of Transportation NWR
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Part A - FOUNDATION INVESTIGATION REPORT

1 Introduction

TBT Engineering Limited (TBTE) has been retained by the Ontario Ministry of Transportation Northwest Region (MTO) to provide foundation investigation in support of replacement of an existing 1500 mm diameter CSP culvert intersecting Highway 11/17, 2.8 km south of the intersection of HWY 11/17 and Hwy 102, between Kakabeka and Shabaqua. Foundation investigation was provided under the Northwest Region (NWR) Geotechnical Retainer Assignment. The foundation investigation was conducted to provide subsurface data for the design of the culvert replacement.

The existing culvert has approximately 2.4 m of cover. The site coordinates are as follows:

- Conmee Township, Station 11+873, Latitude: 48.510342°, Longitude: -89.651403°

A Google Earth image illustrating the site location can be seen in Figure 1.1.

The investigation consisted of a total of two boreholes; one borehole was advanced near the culvert outlet to a depth of 6.9 m, and one was advanced through the embankment to a depth of 11.2 m. In order to provide more data, previously advanced hand augers have been provided for the left-hand side. Planned borehole locations were provided by the MTO in the Terms of Reference, however, final borehole locations were adjusted to suit field conditions. This report (Part A) describes the subsurface conditions encountered during the investigation.

The MTO Foundations Section has assigned Geocres No. 52A12-002 to this site.



Figure 1.1: A Google Earth Image Illustrating the Site Location.

2 Site Description

The existing embankments are within the MTO Right-of-Way but are near the tree line. The photos below were taken by TBTE during site recognisance. Additional site photos are provided in Appendix D. An embankment height of 4.0 m with embankment side slopes estimated at 2.5H:1V for the left-hand side and 1.5H:1V on the right-hand side.

The culvert at the site has an inlet obvert elevation of 396.3 m and invert elevation of 394.8 m; and an outlet obvert elevation of 396.0 m and invert elevation of 394.8 m. Water levels measured at the inlet and outlet of the culvert were both 395.2 m on July 10, 2024, and as the MTO provided drawing 395.25 m at the outlet and 395.45 m at the outlet on May 16, 2018.



**Figure 2.1: Westside Embankment
Looking East, June 7, 2024.**



**Figure 2.2: Westside Embankment
Looking Southeast, June 7, 2024.**

2.1 Surficial Geology

As defined by the Ontario Ministry of Natural Resources' Northern Ontario Engineering Geology Terrain Study (NOEGTS), 1979, Map No. 52A/NW, the site is in an area which primarily consists of a clay/clayey glaciolacustrine plain. The area has low to moderate local relief and is generally dry.

Glaciolacustrine Plains are described in the NOEGTS as deposits with fine grained materials varying in clay, silt and sand content based on depth of water and distance from the shoreline of former glacial lakes. Deposits vary from varved to massive and often have minor inclusions of till and scattered dropstones. The presence of the above soils was confirmed from the field investigation.

3 Investigation Procedures

A geotechnical site investigation was undertaken on June 25, 2024 and June 27, 2024. The field investigation consisted of advancing a total of two boreholes. Borehole locations are illustrated on the Borehole Location and Soil Strata Drawings (Appendix C). Boreholes 1 and 2 were advanced to depths of 6.9 m and 11.2 m respectively.

The borehole locations were identified in the field by TBTE personnel and service clearances were completed prior to mobilizing the drill rig to site. The boreholes were advanced using a drill rig mounted on an all-terrain carrier equipped with a casing advancement system and apparatus used to carry out Standard Penetration Testing as per ASTM D1586.

During the drilling operations for the boreholes, soil samples were obtained from the auger flights and using the techniques of the Standard Penetration Test (SPT). The SPT involves driving a thick walled sampler into the soils under a standardized energy (63.5 kg, falling 760 mm). The number of blows required to drive the sampler 0.3 m is known as the SPT blow count (N). Following completion of the test, a representative soil sample is obtained from within the sampler. SPTs are typically taken at a frequency of every 0.75 m for the first 3 m of the borehole, and every 1.5 m afterwards, to the termination depth of the borehole. Sample frequency may vary due to circumstances experienced in the field.

In addition, thin-walled tube samples were taken within the cohesive materials, alternating with SPT samples. In-situ field vane testing was completed at select depths within the cohesive materials to obtain an indication of the material's undrained shear strength. In-situ field vane testing was completed as per ASTM D2573 with a tapered vane.

Borehole locations were surveyed by TBTE with a level and rod and referenced to a temporary benchmark at the centerline of the highway at Station 10+775. The benchmark has an elevation of 396.7 m from the B-600-1117 surface as provided by the client. A hand-held Garmin GPS device was used in the field to record coordinates of the borehole locations, based on North American Data 1983 NAD83 (CSRS) v6 (2010 epoch).

A summary of the borehole location data is provided below and on the Borehole Location and Soil Strata Drawings (Appendix C).

Table 3.1: Summary of Borehole Information.

Borehole Number	Co-ordinates	Surface Elevation (m)	Depth of Exploration (m)
1	Lat 48.51031774 Lon -89.65160859	396.9	6.9
2	Lat 48.51028554 Lon -89.65144441	398.8	11.2

A temporary standpipe piezometer was installed within Borehole 1.

All boreholes and temporary standpipe piezometers have been backfilled and/or decommissioned with auger cuttings and bentonite in accordance with the Ontario Ministry of the Environment's Regulation 903, as amended by Regulation 128/03 (water well regulation under the Ontario Water Resource Act).

4 Laboratory Testing

Soil samples obtained during the field investigation were subjected to routine laboratory testing. The routine testing included moisture content, Atterberg limit tests and grain size analysis. Typically, 100% of the recovered soil samples are tested for natural moisture content determination, and 25% of the recovered soil samples are chosen for grain size analysis and/or Atterberg limits testing, as applicable. The following test methods/standards are followed for the above testing: LS 602 (sieve analysis for aggregates), LS 701 (moisture content of soils), ASTM C136 (standard test method for sieve analysis of fine and coarse aggregates), ASTM D4318 (standard test for liquid, plastic, and plasticity index of soils), ASTM D2216 (standard test method for laboratory determination of water (moisture) content of soil and rock by mass). The results of this testing are shown on the borehole logs (Appendix A) and on the laboratory data reports (Appendix B).

One soil sample was submitted to the ALS Canada Ltd. laboratory in Thunder Bay, Ontario which was subjected to corrosivity and conductivity testing. Results of this testing have been provided below and in Appendix B.

5 Subsurface Conditions

Details of the subsurface conditions are provided on the borehole logs (Appendix A), and on the Borehole Location and Soil Strata Drawings (Appendix C). In addition to the boreholes advanced at site, a hand auger has been added to the discussion from a previous investigation, 24-HA-029 at 14.2 m LT at 11+875.

The subsurface soils at this site generally consist of fills overlying clay and sands which in turn overlies clay to the termination of the boreholes.

5.1 Asphalt

100 mm of asphalt was identified at the surface of Borehole 2 (elev. 398.8 m).

5.2 Fill

Sand and gravel to gravel with some sand and trace to some silt with occasional cobbles encountered at the surface of Borehole 1 (elev. 396.9 m) and underlying the asphalt at Borehole 2 (elev. 398.7 m) and extended to depths of 1.4 m to 4.1 m (elev. 394.7 to 395.5 m). Thickness of the fill varied from 1.4 m to 4.0 m. Occasional cobbles were noted within this material. The results of the grain size analysis carried out on one sample indicates that this material can consist of 62 % gravel 25% sand and 13% silt/clay sized particles. The condition of this material is loose to compact based on SPT N-values of 6 to 27 blows per 0.3 m. Recorded SPT values of 100+ are likely attributable to cobbles within this material.

5.3 Sand

Sand was identified at the surface of 24-HA-029, it was noted to be loose and extended to a depth of 1.3 m.

5.4 Clay with Sands

Clay and sand to clay with some sand and trace gravel was identified underlying the fill at both borehole locations at depths of 1.4 m and 4.1m (elev. 394.7 to 395.5 m). This material extended to the termination of the boreholes at depths of 6.9 m and 11.2 m (elev. 387.6 to 390.1 m), and to a depth of 1.4 m at 24-HA-029 where further advancement was hindered by sloughing. It should be noted that both boreholes were terminated within this material. Trace organics was noted within this material. Atterberg limits testing indicates that this material is clay of medium to high plasticity, with the natural moisture content ranging from between the plastic and liquid limits to at the liquid limit. The results of two grain size analyses indicate that this material can consist of 0 - 6 % gravel, 11 - 48 % sand, 46 - 89 % silt/clay sized particles. Typically, the clay with higher sand content was encountered at the top of the stratum. This material has a very soft to stiff consistency based on SPT N-values of 1 to 9 blows per 0.3 m, and a firm to very stiff consistency based on field vane tests ranging from 49 kPa to +100 kPa. Field vane test results may be inflated due to intersecting silt or sand varves within the clay.

5.5 Corrosivity and Conductivity Testing

One soil sample from fill at approximate elevation 397.3 m was submitted for corrosivity and conductivity testing, results of which are summarized in the table below. Detailed results are provided in Appendix B.

Table 5.1: Analytical Testing Results.

Test	Unit	Result
Conductivity	mS/cm	543
Moisture	%	25.8
Acidity/Basicity	pH	7.76
Redox Potential	mV	306
Resistivity	ohm-cm	1840
Chloride	mg/kg	247
Sulphide (as S)	mg/kg	<0.26
Sulphate	mg/kg	<20

5.6 Groundwater

Casing advancement with water was utilized at the boreholes during drilling operations. Elevated water levels may have been recorded due to this drilling method and water levels may not have stabilized. A temporary standpipe piezometer was installed to a depth of 2.9 m at Borehole 1. Water level readings were taken upon completion and afterwards, as shown below. Observed groundwater levels have been provided in the table below. Groundwater levels may vary from season to season and from the effects of heavy precipitation events.

Table 5.2: Observed Groundwater Levels.

Location	Surface Elevation (m)	Groundwater Level on Completion of Drilling		Groundwater Level After Completion		
		Depth (m)	Elev. (m)	Depth (m)	Elev. (m)	Time After Comp
Borehole 1	396.7	0.4	396.3	1.1	395.6	15 days

Water levels measured at the inlet and outlet of the culvert were both 395.2 m on July 10, 2024, and as the MTO provided drawing 395.25 m at the outlet and 395.45 at the outlet on May 16, 2018.

6 Miscellaneous

Laboratory testing was carried out at the TBT Engineering laboratory in Thunder Bay. The drill equipment for this investigation was operated by TBT Engineering Limited. The field operations were supervised by Ian Bauman and Allan Finke. Laboratory testing was supervised by Forch Valela, C.Tech. This report was prepared and reviewed by Mike Maki, E.I.T., Dean Vale, P.Eng., and Steven Seller, P.Eng. (TBTE's designated principal contact identified for MTO Foundation Engineering).

7 Limitations

Conclusions and recommendations presented in this report are based on the information determined at a limited number of borehole locations. Subsurface and groundwater conditions between and beyond these locations may differ from those encountered. Conditions may become apparent during construction that were not detected and could not be anticipated at the time of the site investigation.

The design recommendations provided in this report are based on the project described in the text and then only if constructed substantially in accordance with the details stated in this report.

The comments given in this report on potential construction problems and possible methods of construction are intended only for the guidance of the designer.

Groundwater levels indicated are based on the information described within the report. The presence of all conditions that could affect the type and scope of the dewatering procedures which may be considered during construction cannot readily be determined from site investigation or boreholes. These conditions include local and seasonal fluctuations of the groundwater level, changes in soil conditions between borehole locations, thin and/or discontinuous layers of highly permeable soils, etc.

In no way does the information contained within this report reflect any environmental aspect of the site or soil.

8 Closure

We trust the above addresses your project requirements at this time. Should you have any questions or comments, please do not hesitate to contact us at your convenience.

Yours truly,
For TBT ENGINEERING

Mike Maki
Jan 22, 2025

Mike Maki, E.I.T.



Dean Vale, P.Eng.
Geotechnical Engineer



Steve Steller, P.Eng.
Senior Engineer
Principal Contact for MTO Foundations

9 References

Braja M. Das, *Fundamentals of Geotechnical Engineering*, 4th ed. Stamford, CT, USA: Cengage Learning, 2013.

D.E. Becker *et al.*, *Canadian Foundation Engineering Manual*, 4th ed. Richmond, BC, Canada: The Canadian Geotechnical Society, 2006.

Ontario Ministry of Northern Development and Mines; Digital Northern Ontario Engineering Geology Terrain Study (NOEGTS), 2005

APPENDIX A

Borehole Logs

EXPLANATION OF TERMS

N Value: The Standard Penetration Test (SPT) N value is the number of blows required to cause a standard 51mm O.D. split barrel sampler to penetrate 0.3m into undisturbed ground in a borehole when driven by a hammer with a mass of 63.5 kg, falling freely a distance of 0.76m. For penetrations of less than 0.3m N values are indicated as the number of blows for the penetration achieved. Average N value is denoted thus \bar{N} .

Dynamic Cone Penetration Test: Continuous penetration of a conical steel point (51mm O.D. 60° cone angle) driven by 475 J impact energy on 'A' size drill rods. The resistance to cone penetration is measured as the number of blows for each 0.3m advance of the conical point into the undisturbed ground.

Soils are described by their composition and consistency/condition.

Consistency: Cohesive soils are described on the basis of their undrained shear strength (c_u) as follows:

C_u (kPa)	0-12	12-25	25-50	50-100	100-200	>200
	Very Soft	Soft	Firm	Stiff	Very Stiff	Hard

Condition: Cohesionless soils are described on the basis of denseness as indicated by SPT N values as follows:

N (Blows/0.3m)	0-4	4-10	10-30	30-50	>50
	Very Loose	Loose	Compact	Dense	Very Dense

Minor Soil Components: Terminology used to represent the amount of minor components based on their percent of the sample by weight as follows:

% by weight	0-10	10-20	20-35	35-50
	Trace	Some	"ey" or "y"	And

ABBREVIATIONS AND SYMBOLS

Field Sampling, Insitu Testing, Laboratory Testing

S S	Split Spoon	T P	Thin Wall Piston
A S	Auger	O S	Osterberg
W S	Wash	R C	Rock Core
S T	Slotted Tube	P H	T W Advanced Hydraulically
B S	Block	P M	T W Advanced Manually
C S	Chunk	F S	Foil
V T	Vane Test (kPa)	P P	Pocket Penetrometer (kg/cm ²)
T W	Thin Wall Shelby Tube		

EXPLANATION OF TERMS Cont'd.

Stress and Strain

u_w	kPa	Pore Water Pressure
u		Pore Pressure Ratio
σ	kPa	Total Normal Stress
σ'	kPa	Effective Normal Stress
τ	kPa	Shear Stress
$\sigma_1, \sigma_2, \sigma_3$	kPa	Principal Stress
ϵ	%	Linear Strain
$\epsilon_1, \epsilon_2, \epsilon_3$	%	Principal Strains
E	MPa	Young's Modulus
G	kPa	Modulus of Shear Deformation
m	MPa	Constrained Modulus
μ		Coefficient of Friction

Mechanical Properties of Soil

m_v	kPa ⁻¹	Coefficient of Volume Change
C_c		Compression Index
C_s		Swelling Index
C_a		Rate of Secondary Consolidation
c_v	m ² /s	Coefficient of Consolidation
H	m	Drainage Path
T_v		Time Factor
U	%	Degree of Consolidation
P'_o	kPa	Effective Overburden Pressure
P'_c	kPa	Preconsolidation Pressure
τ_f	kPa	Shear Strength
c'	kPa	Effective Cohesion Intercept
ϕ'	°	Effective Angle of Internal Friction
c_u	kPa	Undrained Shear Strength
s		Sensitivity

Physical Properties of Soil

ρ_s	kg/m ³	Density of Solid Particles	e	%	Void Ratio	e_{min}	%	Void Ratio in Densest State
γ_s	kN/m ³	Unit Weight of Solid Particles	n	%	Porosity	I_D		Density Index $= \frac{e_{max}-e}{e_{max}-e_{min}}$
ρ_w	kg/m ³	Density of Water	w	%	Water Content	D	mm	Grain Diameter
γ_w	kN/m ³	Unit Weight of Water	s_r	%	Degree of Saturation	D_n	mm	n Percent Diameter
ρ	kg/m ³	Density of Soil	w_L	%	Liquid Limit	C_u		Uniformity Coefficient
γ	kN/m ³	Unit Weight of Soil	w_p	%	Plastic Limit	h	m	Hydraulic Head or Potential
ρ_d	kg/m ³	Density of Dry Soil	w_s	%	Shrinkage Limit	q	m ³ /s	Rate of Discharge
γ_d	kN/m ³	Unit Weight of Dry Soil	I_p	%	Plasticity Index = $w_L - w_p$	v	m/s	Discharge Velocity
ρ_{sat}	kg/m ³	Density of Saturated Soil	I_L		Liquidity Index = $\frac{w-w_p}{I_p}$	i		Hydraulic Gradient
γ_{sat}	kN/m ³	Unit Weight of Saturated Soil	I_c		Consistency Index = $\frac{w_L-w}{I_p}$	k	m/s	Hydraulic Conductivity
ρ'	kg/m ³	Density of Submerged Soil	e_{max}	%	Void Ratio in Loosest State	j	kN/m ³	Seepage Force
γ'	kN/m ³	Unit Weight of Submerged Soil						

RECORD OF BOREHOLE No 1

1 OF 1

METRIC

W.P. 6920-17-00 LOCATION Station 11+869 o/s 15.3m RT of C/L N:5374693.622; E:330538.798 MTM Zone:15 ORIGINATED BY IB
DIST Thunder Bay HWY 11&17 BOREHOLE TYPE Casing Advancer COMPILED BY TG
DATUM Geodetic DATE 2024.06.25 - 2024.06.25 LATITUDE 48.51031774 LONGITUDE -89.65160859 CHECKED BY SS

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				w _p w w _L						
396.9 0.0	FILL - GRAVEL - some sand, trace silt, brown, loose						20	40	60	80	100				GR	SA	SI	CL
			1	SS	6								○					Water level @ 0.4 m on completion. Water level @ 1.1 m on July 10, 2024.
395.5 1.4	CLAY & SAND - trace gravel, trace organics to 2.1 m, brown, stiff to very stiff		2	SS	9								┌──○──┐		6	48	(46)	
													○					PP = 2.25-3.25 kg/cm ²
			3	TW														Standpipe installed to 2.9 m. Cave @ 3.0 m.
393.1 3.8	CLAY - varved, some sand, brown/grey, firm																	
			4	SS	5								┌────────○────────┐					0 14 (86)
391.2 5.7	CLAY - some sand, brown, stiff																	
			5	TW										○				
390.0 6.9	End of Borehole @ 6.9 m.																	PP = Pocket Penetrometer

ONTARIO MTO MOD 24-179-4-MTO.GPJ ONTARIO MTO.GDT 1-22-25

RECORD OF BOREHOLE No 2

1 OF 1

METRIC

W.P. 6920-17-00 LOCATION Station 11+878 o/s 5.8m RT of C/L N:5374690.096; E:330550.943 MTM Zone:15 ORIGINATED BY IB
DIST Thunder Bay HWY 11&17 BOREHOLE TYPE Casing Advancer COMPILED BY TG
DATUM Geodetic DATE 2024.06.27 - 2024.06.27 LATITUDE 48.51028554 LONGITUDE -89.65144441 CHECKED BY SS

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa							WATER CONTENT (%)		
								○ UNCONFINED	● QUICK TRIAXIAL	+ FIELD VANE	× LAB VANE	20			40	60	80
398.8	ASPHALT - 100 mm													GR SA SI CL			
398.0	FILL - SAND & GRAVEL - trace silt, occasional cobbles, brown, very dense		1	SS	100+									Dry on completion.			
	----- - GRAVEL - some sand, trace silt		2	SS	100+												
	----- - GRAVEL - Sandy, trace silt, occasional cobbles, brown, compact		3	SS	27									62 25 (13) Insufficient material for Pl. Cave @ 2.7 m.			
	----- - SAND & GRAVEL - trace silt, occasional cobbles, brown, compact		4	SS	22												
394.7																	
4.1	CLAY & SAND - brown, firm to stiff		5	SS	7									0 38 (62)			
393.3	CLAY - some sand, brown, stiff																
5.5			6	TW										PP = 0.75-1.00 kg/cm²			
	----- - very soft to firm		7	SS	1												
	----- - occasional sand layers, trace to some silt, trace sand		8	TW										PP = <0.25-0.25 kg/cm²			
														PP = Pocket Penetrometer			
			9	SS	2									0 11 (89)			
387.6																	
11.2	End of Borehole @ 11.2 m.																

ONTARIO MTO MOD 24-179-4-MTO.GPJ ONTARIO MTO.GDT 1-22-25

HIGHWAY 11/17
CONMEE TOWNSHIP

Station 11+854 13.0 Rt (D-2.5)

24-HA-025

MTM15 5374709 N 330534 E

0	-	50	Root Mat
50	-	100	Blk Org (Dry & L)
100	-	400	Br Cl (Dry & Firm)
		300	NFP Poss Cob

Station 11+856 12.0 Lt (D-2.5)

24-HA-030

MTM15 5374717 N 330558 E

0	-	100	Blk Org (Moist & L)
100	-	450	Red Cl (Moist & Firm)
		450	EOH

Station 11+873 14.2 Rt (D-3.0)

24-HA-026

MTM15 5374690 N 330542 E

0	-	200	Blk Org
		200	NFP Prob Cob
			(Multiple Attempts)

Station 11+875 14.2 Lt (D-3.0)

24-HA-029

MTM15 5374701 N 330568 E

0	-	1.3	Br Sa (Wet & L)
			(Wat @ Surf)
1.3	-	1.4	Red Cl (Wet & Soft)
		1.4	NFP Sloughing

Station 11+886 14.2 Lt (D-3.0)

24-HA-028

MTM15 5374691 N 330573 E

0	-	150	Blk Org Tr Sa (Moist)
		150	NFP Prob Cob Poss RF
			(Multiple Attempts)

Station 11+888 14.7 Rt (D-2.5)

24-HA-027

MTM15 5374676 N 330548 E

0	-	50	Root Mat
50	-	100	Blk Org (Dry & L)
100	-	400	Red Cl (Dry & Firm)
		400	EOH

Station 12+373 6.0 Rt

24-PA-006

MTM15 5374295 N 330850 E

0	-	160	Gry Cr Sa(y) Gr
			(Moist & Firm)
160	-	700	Br Gr & Sa W Si
			(Moist & L)
700	-	1.4	Br Cl
		1.4	NFP Bld

Station 12+373 6.0 Rt

24-PA-006

Sample No. 24-AP-241 (350 – 400)

% Passing 4.75 mm	51.8 %
% Passing 75 um	10.7 %
FMC @ 400	2.7 %
Group Symbol	GW-GM
BLAGM Gran 'B' Type III – due to excess fines	

Station 12+376 21.6 Rt (D-3.5)

24-HA-002

MTM15 5374284 N 330840 E

0	-	50	Root Mat
50	-	100	Blk Orgs (Moist)
100	-	400	Br Cl Tr Si & Gr
			(Moist & Firm)
		400	NFP Poss Cob

Station 12+384 12.8 Rt (D-3.5)

24-HA-001

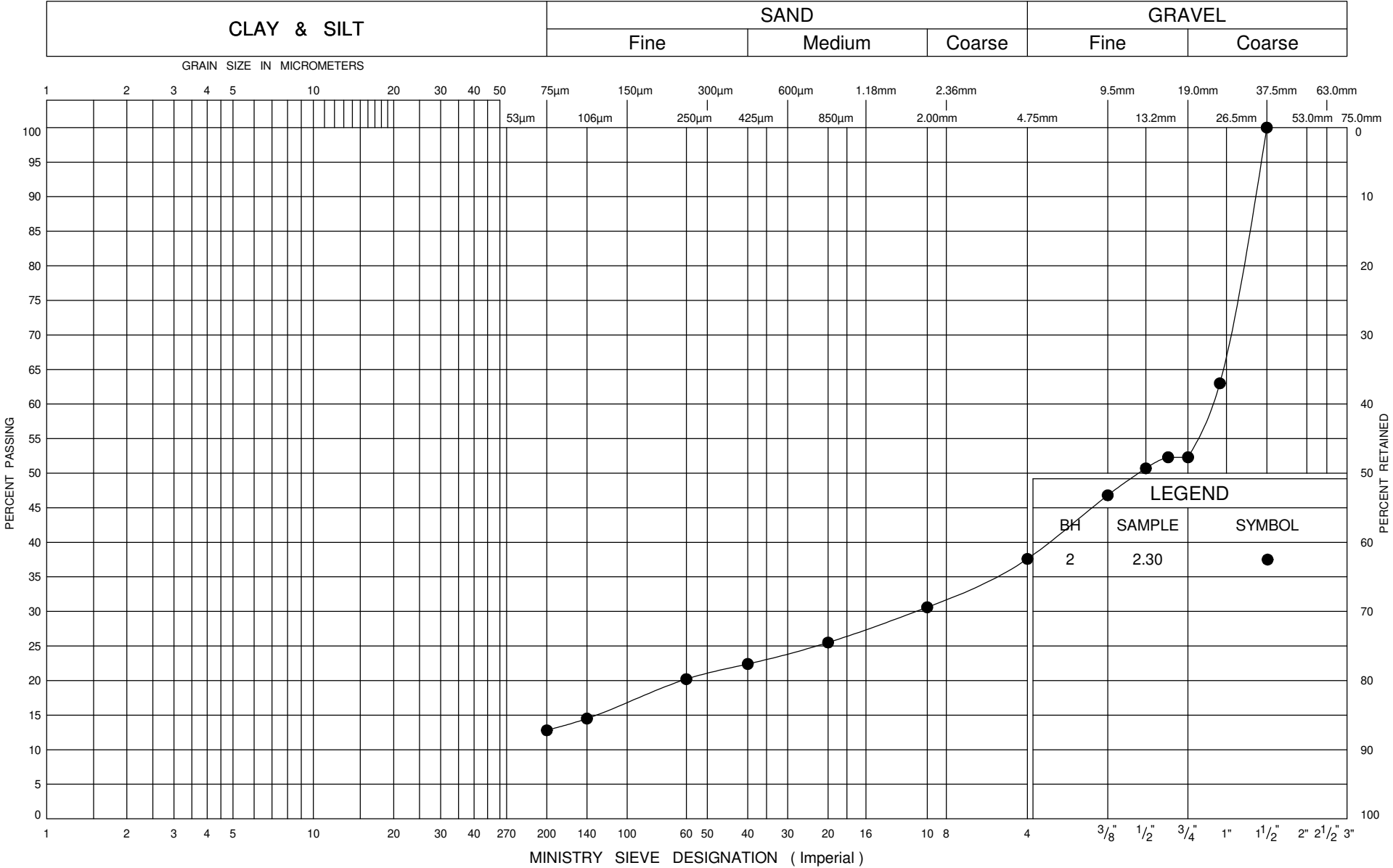
MTM15 5374282 N 330853 E

0	-	50	Root Mat
50	-	100	Br Org (Moist)
100	-	600	Br Org W Gr Tr Cl
600	-	700	Gry Cl (Moist & Wet)
700	-	800	Blk Org (Wet)
800	-	1.1	Br Cl (Moist & Wet)
			(Moist & Wet)
		1.1	NFP Sloughing

APPENDIX B

Laboratory Test Data

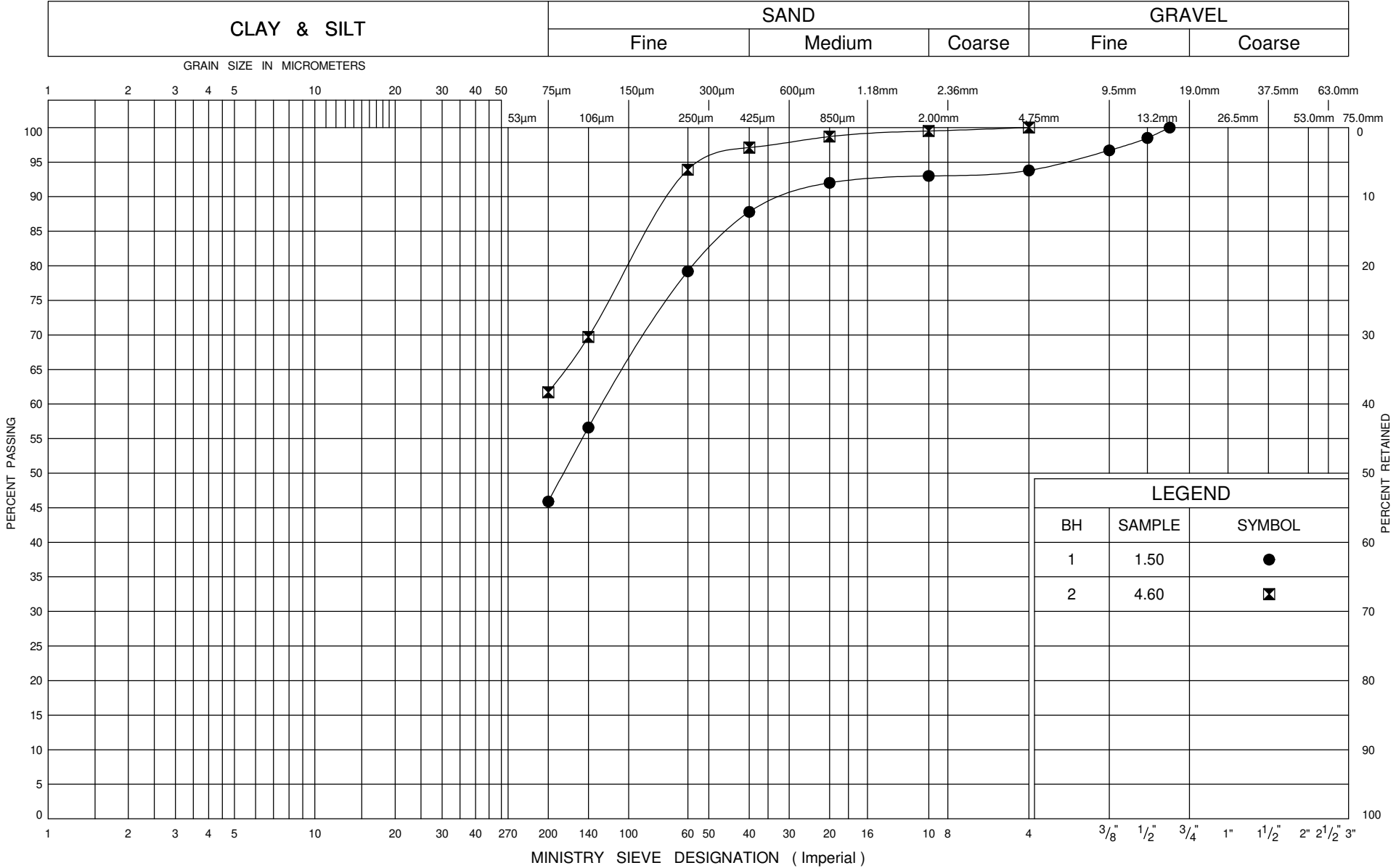
UNIFIED SOIL CLASSIFICATION SYSTEM



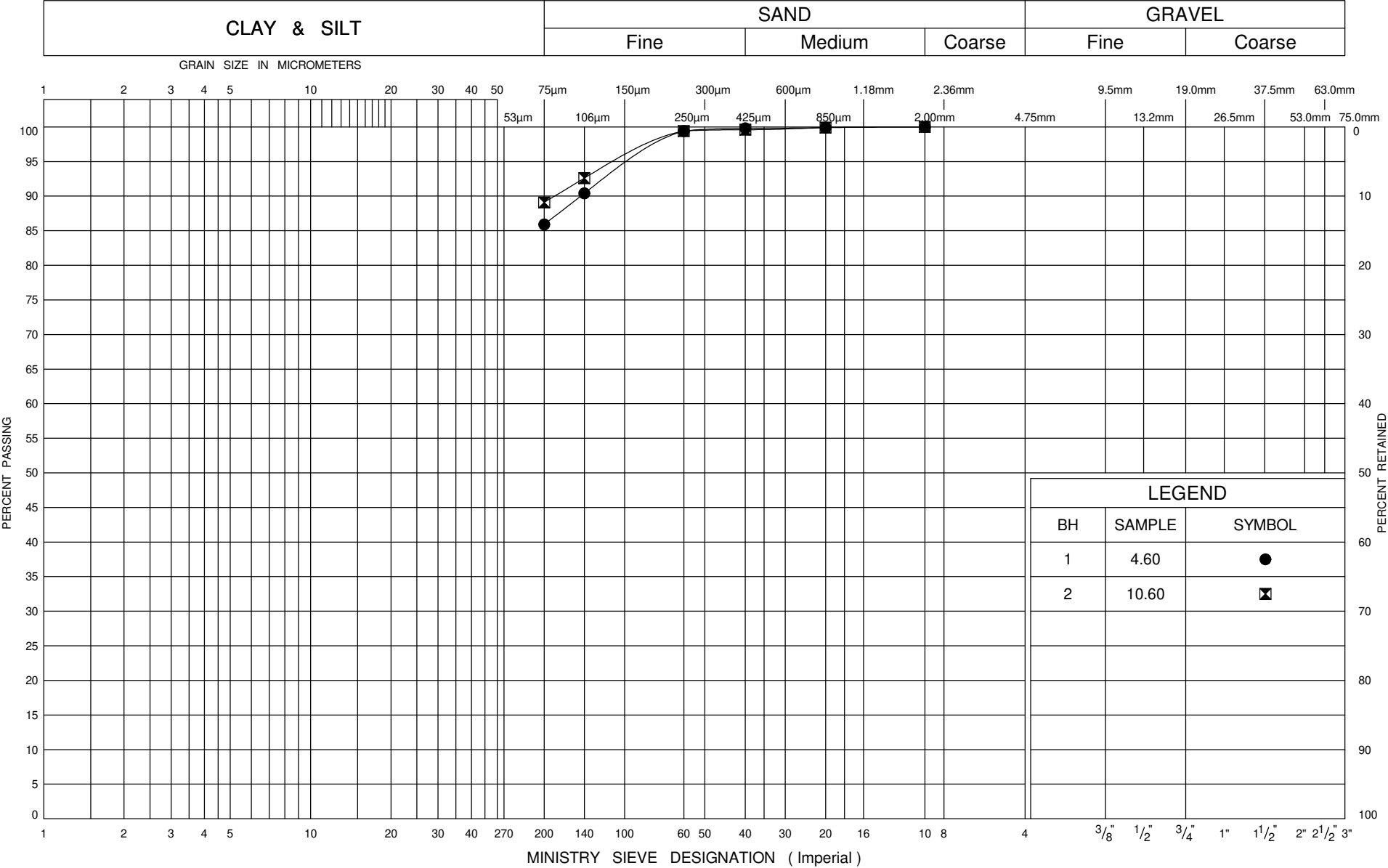
GRAIN SIZE DISTRIBUTION
FILL

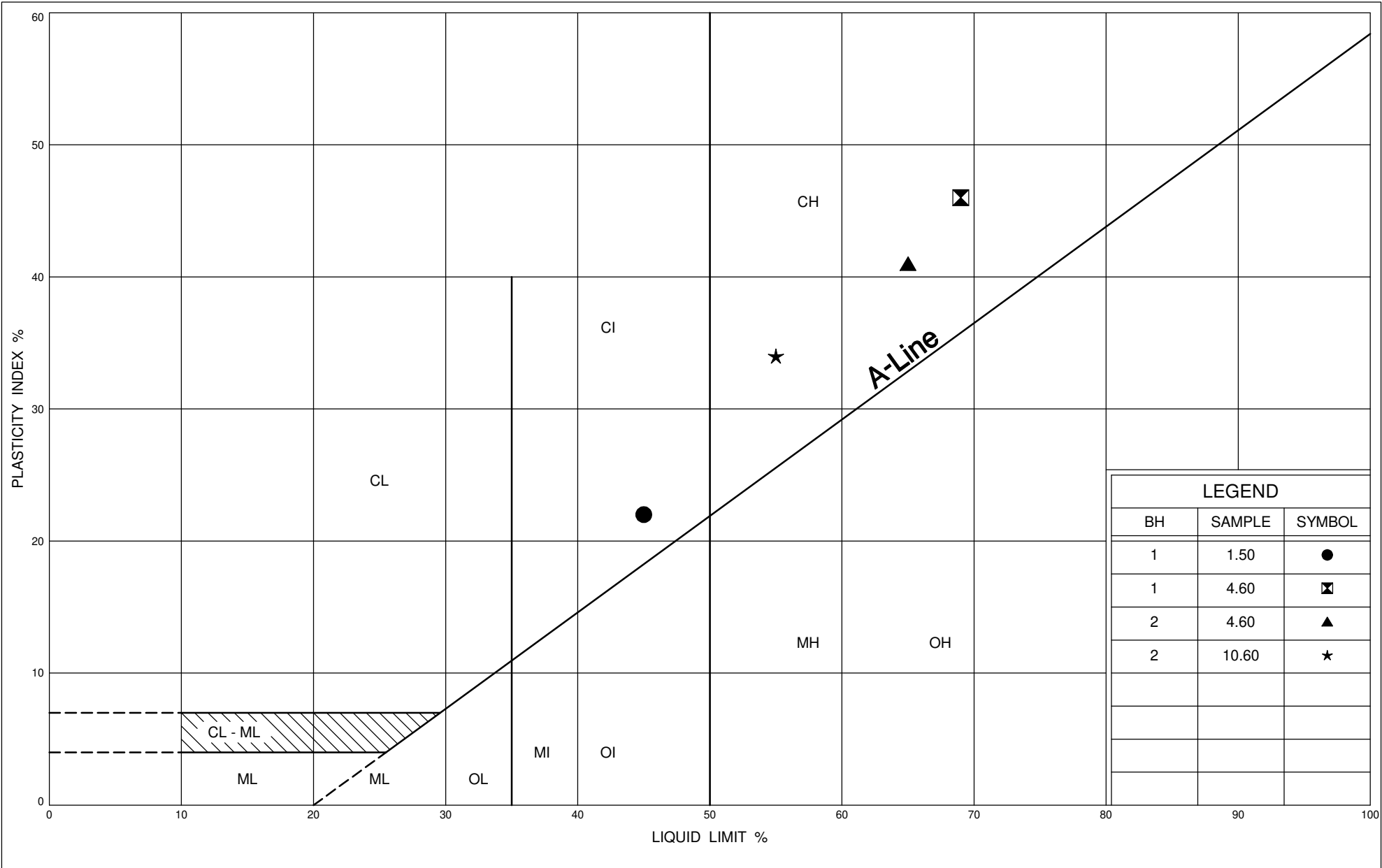
FIG No 1
W P 6920-17-00
Culvert

UNIFIED SOIL CLASSIFICATION SYSTEM



UNIFIED SOIL CLASSIFICATION SYSTEM







CERTIFICATE OF ANALYSIS (GUIDELINE EVALUATION)

Work Order	: TY2407730	Page	: 1 of 3
Client	: TBT Engineering Group	Laboratory	: ALS Environmental - Thunder Bay
Contact	: Doug Steele	Account Manager	: Cassidy Young
Address	: 1918 Young Street Thunder Bay ON Canada P7E 6T9	Address	: 1081 Barton Street Thunder Bay, Ontario Canada P7B 5N3
Telephone	: (807)624-5160	Telephone	: +1 807 623 6463
Project	: 24-179-4	Date Samples Received	: 18-Jul-2024 09:50
PO	: 2407-5132	Date Analysis Commenced	: 19-Jul-2024
C-O-C number	: ----	Issue Date	: 25-Jul-2024 09:15
Sampler	: LF		
Site	:		
Quote number	: Standing Offer - Soil - 2024		
No. of samples received	: 1		
No. of samples analysed	: 1		

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results
- Guideline Comparison

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QC Interpretive report to assist with Quality Review and Sample Receipt Notification (SRN).

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is conducted in accordance with US FDA 21 CFR Part 11.

Signatories	Position	Laboratory Department
Josphin Masihi	Analyst	Centralized Prep, Waterloo, Ontario
Nik Perkio	Senior Analyst	Inorganics, Waterloo, Ontario



No Breaches Found

General Comments

The analytical methods used by ALS are developed using internationally recognized reference methods (where available), such as those published by US EPA, APHA Standard Methods, ASTM, ISO, Environment Canada, BC MOE, and Ontario MOE. Refer to the ALS Quality Control Interpretive report (QCI) for applicable references and methodology summaries. Reference methods may incorporate modifications to improve performance.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Application of guidelines is provided "as is" without warranty of any kind, either expressed or implied, including, but not limited to fitness for a particular purpose, or non-infringement. ALS assumes no responsibility for errors or omissions in the information. Guidelines are not adjusted for the hardness, pH or temperature of the sample (the most conservative values are used). Measurement uncertainty is not applied to test results prior to comparison with specified criteria values.

Key : LOR: Limit of Reporting (detection limit).

<i>Unit</i>	<i>Description</i>
%	percent
µS/cm	microsiemens per centimetre
mg/kg	milligrams per kilogram
mV	millivolts
ohm cm	ohm centimetres (resistivity)
pH units	pH units

>: greater than.

<: less than.

Red shading is applied where the result or the LOR is greater than the Guideline Upper Limit (or lower than the Guideline Lower Limit, if applicable).

For drinking water samples, Red shading is applied where the result for E.coli, fecal or total coliforms is greater than or equal to the Guideline Upper Limit.



Analytical Results Evaluation

Matrix: Soil				Client sample ID	BH2-SS5	----	----	----	----	----	----
				Sampling date/time	27-Jun-2024 12:00	----	----	----	----	----	----
				Sub-Matrix	Soil	----	----	----	----	----	----
Analyte	CAS Number	Method/Lab	Unit	TY2407730-001	-----	-----	-----	-----	-----	-----	-----
Physical Tests											
Conductivity (1:2 leachate)	----	E100-L/WT	µS/cm	543	----	----	----	----	----	----	----
Moisture	----	E144/WT	%	25.8	----	----	----	----	----	----	----
Oxidation-reduction potential [ORP]	----	E125/WT	mV	306	----	----	----	----	----	----	----
pH (1:2 soil:CaCl2-aq)	----	E108A/WT	pH units	7.76	----	----	----	----	----	----	----
Resistivity	----	EC100R/WT	ohm cm	1840	----	----	----	----	----	----	----
Inorganics											
Sulfides, acid volatile	----	E396-L/WT	mg/kg	<0.26	----	----	----	----	----	----	----
Leachable Anions & Nutrients											
Chloride, soluble ion content	16887-00-6	E236.CI/WT	mg/kg	247	----	----	----	----	----	----	----
Sulfate, soluble ion content	14808-79-8	E236.SO4/WT	mg/kg	<20	----	----	----	----	----	----	----

Please refer to the General Comments section for an explanation of any result qualifiers detected.

Please refer to the Accreditation section for an explanation of analyte accreditations.

Key:

CERTIFICATE OF ANALYSIS

Work Order : **TY2407730**
Client : **TBT Engineering Group**
Contact : Doug Steele
Address : 1918 Younge Street
Thunder Bay Ontario Canada P7E 6T9
Telephone : (807)624-5160
Project : 24-179-4
PO : 2407-5132
C-O-C number : ----
Sampler : LF
Site : ----
Quote number : Standing Offer - Soil - 2024
No. of samples received : 1
No. of samples analysed : 1

Laboratory : ALS Environmental - Waterloo
Account Manager : Cassidy Young
Address : 60 Northland Road, Unit 1
Waterloo ON Canada N2V 2B8
Telephone : +1 519 886 6910
Date Samples Received : 18-Jul-2024 09:50
Date Analysis Commenced : 19-Jul-2024
Issue Date : 25-Jul-2024 09:11

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QC Interpretive report to assist with Quality Review and Sample Receipt Notification (SRN).

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is conducted in accordance with US FDA 21 CFR Part 11.

<i>Signatories</i>	<i>Position</i>	<i>Laboratory Department</i>
Josphin Masihi	Analyst	Centralized Prep, Waterloo, Ontario
Nik Perkio	Senior Analyst	Inorganics, Waterloo, Ontario



General Comments

The analytical methods used by ALS are developed using internationally recognized reference methods (where available), such as those published by US EPA, APHA Standard Methods, ASTM, ISO, Environment Canada, BC MOE, and Ontario MOE. Refer to the ALS Quality Control Interpretive report (QCI) for applicable references and methodology summaries. Reference methods may incorporate modifications to improve performance.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

Please refer to Quality Control Interpretive report (QCI) for information regarding Holding Time compliance.

Key: CAS Number: Chemical Abstracts Services number is a unique identifier assigned to discrete substances.
LOR: Limit of Reporting (detection limit).

Unit	Description
ohm cm	ohm centimetres (resistivity)
%	percent
mV	millivolts
pH units	pH units
µS/cm	microsiemens per centimetre
mg/kg	milligrams per kilogram

<: less than.

>: greater than.

Surrogate: An analyte that is similar in behavior to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED on SRN or QCI Report, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.





Analytical Results

Sub-Matrix: Soil (Matrix: Soil/Solid)					Client sample ID	BH2-SS5	----	----	----	----
Client sampling date / time						27-Jun-2024 12:00	----	----	----	----
Analyte	CAS Number	Method/Lab	LOR	Unit		TY2407730-001	----	----	----	----
Result							----	----	----	----
Physical Tests										
Conductivity (1:2 leachate)	----	E100-L/WT	5.00	µS/cm	543		----	----	----	----
Moisture	----	E144/WT	0.25	%	25.8		----	----	----	----
Oxidation-reduction potential [ORP]	----	E125/WT	0.10	mV	306		----	----	----	----
pH (1:2 soil:CaCl2-aq)	----	E108A/WT	0.10	pH units	7.76		----	----	----	----
Resistivity	----	EC100R/WT	100	ohm cm	1840		----	----	----	----
Inorganics										
Sulfides, acid volatile	----	E396-L/WT	0.26	mg/kg	<0.26		----	----	----	----
Leachable Anions & Nutrients										
Chloride, soluble ion content	16887-00-6	E236.Cl/WT	5.0	mg/kg	247		----	----	----	----
Sulfate, soluble ion content	14808-79-8	E236.SO4/WT	20	mg/kg	<20		----	----	----	----

Please refer to the General Comments section for an explanation of any result qualifiers detected.
 Please refer to the Accreditation section for an explanation of analyte accreditations.

QUALITY CONTROL INTERPRETIVE REPORT

Work Order	: TY2407730	Page	: 1 of 7
Client	: TBT Engineering Group	Laboratory	: ALS Environmental - Thunder Bay
Contact	: Doug Steele	Account Manager	: Cassidy Young
Address	: 1918 Younge Street Thunder Bay ON Canada P7E 6T9	Address	: 1081 Barton Street Thunder Bay, Ontario Canada P7B 5N3
Telephone	: (807)624-5160	Telephone	: +1 807 623 6463
Project	: 24-179-4	Date Samples Received	: 18-Jul-2024 09:50
PO	: 2407-5132	Issue Date	: 25-Jul-2024 09:11
C-O-C number	: ----		
Sampler	: LF		
Site	:		
Quote number	: Standing Offer - Soil - 2024		
No. of samples received	: 1		
No. of samples analysed	: 1		

This report is automatically generated by the ALS LIMS (Laboratory Information Management System) through evaluation of Quality Control (QC) results and other QA parameters associated with this submission, and is intended to facilitate rapid data validation by auditors or reviewers. The report highlights any exceptions and outliers to ALS Data Quality Objectives, provides holding time details and exceptions, summarizes QC sample frequencies, and lists applicable methodology references and summaries.

Key

Anonymous: Refers to samples which are not part of this work order, but which formed part of the QC process lot.

CAS Number: Chemical Abstracts Service number is a unique identifier assigned to discrete substances.

DQO: Data Quality Objective.

LOR: Limit of Reporting (detection limit).

RPD: Relative Percent Difference.

Workorder Comments

Holding times are displayed as "----" if no guidance exists from CCME, Canadian provinces, or broadly recognized international references.

Summary of Outliers

Outliers : Quality Control Samples

- No Method Blank value outliers occur.
- No Duplicate outliers occur.
- No Laboratory Control Sample (LCS) outliers occur
- No Test sample Surrogate recovery outliers exist.

Outliers: Reference Material (RM) Samples

- No Reference Material (RM) Sample outliers occur.

Outliers : Analysis Holding Time Compliance (Breaches)

- Analysis Holding Time Outliers exist - please see following pages for full details.

Outliers : Frequency of Quality Control Samples

- No Quality Control Sample Frequency Outliers occur.



Analysis Holding Time Compliance

This report summarizes extraction / preparation and analysis times and compares each with ALS recommended holding times, which are selected to meet known provincial and /or federal requirements. In the absence of regulatory hold times, ALS establishes recommendations based on guidelines published by organizations such as CCME, US EPA, APHA Standard Methods, ASTM, or Environment Canada (where available). Dates and holding times reported below represent the first dates of extraction or analysis. If subsequent tests or dilutions exceeded holding times, qualifiers are added (refer to COA).

If samples are identified below as having been analyzed or extracted outside of recommended holding times, measurement uncertainties may be increased, and this should be taken into consideration when interpreting results.

Where actual sampling date is not provided on the chain of custody, the date of receipt with time at 00:00 is used for calculation purposes.

Where only the sample date without time is provided on the chain of custody, the sampling date at 00:00 is used for calculation purposes.

Matrix: **Soil/Solid**

Evaluation: ✖ = Holding time exceedance ; ✔ = Within Holding Time

Inorganic : Acid Volatile Sulfide in Soil by Colourimetry (0.2 mg/kg)										
Glass soil jar/Teflon lined cap [ON MECP] BH2-SS5	E396-L	27-Jun-2024	19-Jul-2024	14 days	22 days	✖ EHTR	19-Jul-2024	7 days	0 days	✓
Leachable Anions & Nutrients : Water Extractable Chloride by IC										
Glass soil jar/Teflon lined cap [ON MECP] BH2-SS5	E236.Cl	27-Jun-2024	23-Jul-2024	30 days	26 days	✓	23-Jul-2024	28 days	0 days	✓
Leachable Anions & Nutrients : Water Extractable Sulfate by IC										
Glass soil jar/Teflon lined cap [ON MECP] BH2-SS5	E236.SO4	27-Jun-2024	23-Jul-2024	30 days	26 days	✓	23-Jul-2024	28 days	0 days	✓
Physical Tests : Conductivity in Soil (1:2 Soil:Water Extraction) (Low Level)										
Glass soil jar/Teflon lined cap [ON MECP] BH2-SS5	E100-L	27-Jun-2024	23-Jul-2024	30 days	26 days	✓	23-Jul-2024	30 days	26 days	✓
Physical Tests : Moisture Content by Gravimetry										
Glass soil jar/Teflon lined cap [ON MECP] BH2-SS5	E144	27-Jun-2024	----	----	----		19-Jul-2024	----	22 days	
Physical Tests : ORP by Electrode										
Glass soil jar/Teflon lined cap [ON MECP] BH2-SS5	E125	27-Jun-2024	23-Jul-2024	180 days	26 days	✓	24-Jul-2024	180 days	27 days	✓
Physical Tests : pH by Meter (1:2 Soil:0.01M CaCl2 Extraction) - As Received										
Glass soil jar/Teflon lined cap [ON MECP] BH2-SS5	E108A	27-Jun-2024	20-Jul-2024	30 days	23 days	✓	22-Jul-2024	30 days	25 days	✓

Page : 4 of 7
Work Order : TY2407730
Client : TBT Engineering Group
Project : 24-179-4



Legend & Qualifier Definitions

Rec. HT: ALS recommended hold time (see units).



Quality Control Parameter Frequency Compliance

The following report summarizes the frequency of laboratory QC samples analyzed within the analytical batches (QC lots) in which the submitted samples were processed. The actual frequency should be greater than or equal to the expected frequency.

Matrix: **Soil/Solid**

Evaluation: ✖ = QC frequency outside specification; ✔ = QC frequency within specification.

Quality Control Sample Type			Count		Frequency (%)		
Analytical Methods	Method	QC Lot #	QC	Regular	Actual	Expected	Evaluation
Laboratory Duplicates (DUP)							
Acid Volatile Sulfide in Soil by Colourimetry (0.2 mg/kg)	E396-L	1554973	1	2	50.0	4.7	✓
Conductivity in Soil (1:2 Soil:Water Extraction) (Low Level)	E100-L	1554472	1	8	12.5	5.0	✓
Moisture Content by Gravimetry	E144	1554546	1	19	5.2	5.0	✓
ORP by Electrode	E125	1558925	1	17	5.8	5.0	✓
pH by Meter (1:2 Soil:0.01M CaCl2 Extraction) - As Received	E108A	1555648	1	19	5.2	5.0	✓
Water Extractable Chloride by IC	E236.Cl	1559110	1	18	5.5	5.0	✓
Water Extractable Sulfate by IC	E236.SO4	1559111	1	10	10.0	5.0	✓
Laboratory Control Samples (LCS)							
Acid Volatile Sulfide in Soil by Colourimetry (0.2 mg/kg)	E396-L	1554973	1	2	50.0	4.7	✓
Conductivity in Soil (1:2 Soil:Water Extraction) (Low Level)	E100-L	1554472	2	8	25.0	10.0	✓
Moisture Content by Gravimetry	E144	1554546	1	19	5.2	5.0	✓
ORP by Electrode	E125	1558925	1	17	5.8	5.0	✓
pH by Meter (1:2 Soil:0.01M CaCl2 Extraction) - As Received	E108A	1555648	1	19	5.2	5.0	✓
Water Extractable Chloride by IC	E236.Cl	1559110	2	18	11.1	10.0	✓
Water Extractable Sulfate by IC	E236.SO4	1559111	2	10	20.0	10.0	✓
Method Blanks (MB)							
Acid Volatile Sulfide in Soil by Colourimetry (0.2 mg/kg)	E396-L	1554973	1	2	50.0	4.7	✓
Conductivity in Soil (1:2 Soil:Water Extraction) (Low Level)	E100-L	1554472	1	8	12.5	5.0	✓
Moisture Content by Gravimetry	E144	1554546	1	19	5.2	5.0	✓
Water Extractable Chloride by IC	E236.Cl	1559110	1	18	5.5	5.0	✓
Water Extractable Sulfate by IC	E236.SO4	1559111	1	10	10.0	5.0	✓



Methodology References and Summaries

The analytical methods used by ALS are developed using internationally recognized reference methods (where available), such as those published by US EPA, APHA Standard Methods, ASTM, ISO, Environment Canada, BC MOE, and Ontario MOE. Reference methods may incorporate modifications to improve performance (indicated by "mod").

Analytical Methods	Method / Lab	Matrix	Method Reference	Method Descriptions
Conductivity in Soil (1:2 Soil:Water Extraction) (Low Level)	E100-L ALS Environmental - Waterloo	Soil/Solid	CSSS Ch. 15 (mod)/APHA 2510 (mod)	Conductivity, also known as Electrical Conductivity (EC) or Specific Conductance, is measured by immersion of a conductivity cell with platinum electrodes into a soil sample that has been added in a defined ratio of soil to deionized water, then shaken well and allowed to settle. Conductance is measured in the fluid that is observed in the upper layer.
pH by Meter (1:2 Soil:0.01M CaCl ₂ Extraction) - As Received	E108A ALS Environmental - Waterloo	Soil/Solid	MECP E3530	pH is determined by potentiometric measurement with a pH electrode, and is conducted at ambient laboratory temperature (normally 20 ± 5°C) and is carried out in accordance with procedures described in the Analytical Protocol (prescriptive method). A minimum 10g portion of the sample, as received, is extracted with 20mL of 0.01M calcium chloride solution by shaking for at least 30 minutes. The aqueous layer is separated from the soil by centrifuging, settling, or decanting and then analyzed using a pH meter and electrode. This method is equivalent to ASTM D4972 and is acceptable for topsoil analysis.
ORP by Electrode	E125 ALS Environmental - Waterloo	Soil/Solid	APHA 2580 (mod)	Oxidation Reduction Potential (ORP) is reported as the oxidation-reduction potential of the platinum metal-reference electrode employed in the analysis, measured in mV.
Moisture Content by Gravimetry	E144 ALS Environmental - Waterloo	Soil/Solid	CCME PHC in Soil - Tier 1	Moisture is measured gravimetrically by drying the sample at 105°C. Moisture content is calculated as the weight loss (due to water) divided by the wet weight of the sample, expressed as a percentage.
Water Extractable Chloride by IC	E236.Cl ALS Environmental - Waterloo	Soil/Solid	EPA 300.1	Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection using a soil sample that has been added in a defined ratio of soil to deionized water, then shaken well and allowed to settle. Anions are measured in the fluid that is observed in the upper layer.
Water Extractable Sulfate by IC	E236.SO ₄ ALS Environmental - Waterloo	Soil/Solid	EPA 300.1	Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection using a soil sample that has been added in a defined ratio of soil to deionized water, then shaken well and allowed to settle. Anions are measured in the fluid that is observed in the upper layer.
Acid Volatile Sulfide in Soil by Colourimetry (0.2 mg/kg)	E396-L ALS Environmental - Waterloo	Soil/Solid	APHA 4500S2J	This analysis is carried out in accordance with the method described in APHA 4500 S2-J. After extraction the Acid Volatile Sulphide is determined colourimetrically.
Resistivity Calculation for Soil Using E100-L	EC100R ALS Environmental - Waterloo	Soil/Solid	APHA 2510 B	Soil Resistivity (calculated) is determined as the inverse of the conductivity of a 2:1 water:soil leachate (dry weight). This method is intended as a rapid approximation for Soil Resistivity. Where high accuracy results are required, direct measurement of Soil Resistivity by the Wenner Four-Electrode Method (ASTM G57) is recommended.
Preparation Methods	Method / Lab	Matrix	Method Reference	Method Descriptions



Preparation Methods	Method / Lab	Matrix	Method Reference	Method Descriptions
Leach 1:2 Soil:Water for pH/EC	EP108 ALS Environmental - Waterloo	Soil/Solid	BC WLAP METHOD: PH, ELECTROMETRIC, SOIL	The procedure involves mixing the dried (at <60°C) and sieved (No. 10 / 2mm) sample with deionized/distilled water at a 1:2 ratio of sediment to water.
Leach 1:2 Soil : 0.01CaCl ₂ - As Received for pH	EP108A ALS Environmental - Waterloo	Soil/Solid	MOEE E3137A	A minimum 10g portion of the sample, as received, is extracted with 20mL of 0.01M calcium chloride solution by shaking for at least 30 minutes. The aqueous layer is separated from the soil by centrifuging, settling or decanting and then analyzed using a pH meter and electrode.
Preparation of ORP by Electrode	EP125 ALS Environmental - Waterloo	Soil/Solid	APHA 2580 (mod)	Field-moist sample is extracted in a 1:2 ratio with DI water and then analyzed by ORP meter.
Anions Leach 1:10 Soil:Water (Dry)	EP236 ALS Environmental - Waterloo	Soil/Solid	EPA 300.1	5 grams of dried soil is mixed with 50 grams of distilled water for a minimum of 30 minutes. The extract is filtered and analyzed by ion chromatography.
Distillation for Acid Volatile Sulfide in Soil	EP396-L ALS Environmental - Waterloo	Soil/Solid	APHA 4500S ₂ J	Acid Volatile Sulfide is determined by colourimetric measurement on a sediment sample that has been treated with hydrochloric acid within a purge and trap system, where the evolved hydrogen sulfide gas is carried into a basic solution by argon gas for analysis.

QUALITY CONTROL REPORT

Work Order	: TY2407730	Page	: 1 of 5
Client	: TBT Engineering Group	Laboratory	: ALS Environmental - Thunder Bay
Contact	: Doug Steele	Account Manager	: Cassidy Young
Address	: 1918 Younge Street Thunder Bay ON Canada P7E 6T9	Address	: 1081 Barton Street Thunder Bay, Ontario Canada P7B 5N3
Telephone	: (807)624-5160	Telephone	: +1 807 623 6463
Project	: 24-179-4	Date Samples Received	: 18-Jul-2024 09:50
PO	: 2407-5132	Date Analysis Commenced	: 19-Jul-2024
C-O-C number	: ----	Issue Date	: 25-Jul-2024 09:14
Sampler	: LF		
Site	:		
Quote number	: Standing Offer - Soil - 2024		
No. of samples received	: 1		
No. of samples analysed	: 1		

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Quality Control Report contains the following information:

- Laboratory Duplicate (DUP) Report; Relative Percent Difference (RPD) and Data Quality Objectives
- Reference Material (RM) Report; Recovery and Data Quality Objectives
- Method Blank (MB) Report; Recovery and Data Quality Objectives
- Laboratory Control Sample (LCS) Report; Recovery and Data Quality Objectives

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is conducted in accordance with US FDA 21 CFR Part 11.

Signatories	Position	Laboratory Department
Josphin Masihi	Analyst	Waterloo Centralized Prep, Waterloo, Ontario
Nik Perkio	Senior Analyst	Waterloo Inorganics, Waterloo, Ontario



General Comments

The ALS Quality Control (QC) report is optionally provided to ALS clients upon request. ALS test methods include comprehensive QC checks with every analysis to ensure our high standards of quality are met. Each QC result has a known or expected target value, which is compared against predetermined Data Quality Objectives (DQOs) to provide confidence in the accuracy of associated test results. This report contains detailed results for all QC results applicable to this sample submission. Please refer to the ALS Quality Control Interpretation report (QCI) for applicable method references and methodology summaries.

Key :

Anonymous = Refers to samples which are not part of this work order, but which formed part of the QC process lot.

CAS Number = Chemical Abstracts Service number is a unique identifier assigned to discrete substances.

DQO = Data Quality Objective.

LOR = Limit of Reporting (detection limit).

RPD = Relative Percent Difference

= Indicates a QC result that did not meet the ALS DQO.

Workorder Comments

Holding times are displayed as "---" if no guidance exists from CCME, Canadian provinces, or broadly recognized international references.



Laboratory Duplicate (DUP) Report

A Laboratory Duplicate (DUP) is a randomly selected intralaboratory replicate sample. Laboratory Duplicates provide information regarding method precision and sample heterogeneity. ALS DQOs for Laboratory Duplicates are expressed as test-specific limits for Relative Percent Difference (RPD), or as an absolute difference limit of 2 times the LOR for low concentration duplicates within ~ 4-10 times the LOR (cut-off is test-specific).

Sub-Matrix: Soil/Solid					Laboratory Duplicate (DUP) Report						
Laboratory sample ID	Client sample ID	Analyte	CAS Number	Method	LOR	Unit	Original Result	Duplicate Result	RPD(%) or Difference	Duplicate Limits	Qualifier
Physical Tests (QC Lot: 1554472)											
WT2419473-003	Anonymous	Conductivity (1:2 leachate)	----	E100-L	5.00	µS/cm	0.267 mS/cm	266	0.375%	20%	----
Physical Tests (QC Lot: 1554546)											
HA2401690-001	Anonymous	Moisture	----	E144	0.25	%	8.83	9.13	3.27%	20%	----
Physical Tests (QC Lot: 1555648)											
WT2415870-001	Anonymous	pH (1:2 soil:CaCl2-aq)	----	E108A	0.10	pH units	7.85	7.85	0.00%	5%	----
Physical Tests (QC Lot: 1558925)											
TY2407728-001	Anonymous	Oxidation-reduction potential [ORP]	----	E125	0.10	mV	292	292	0.00%	25%	----
Inorganics (QC Lot: 1554973)											
TY2407730-001	BH2-SS5	Sulfides, acid volatile	----	E396-L	0.27	mg/kg	<0.26	<0.27	0.008	Diff <2x LOR	----
Leachable Anions & Nutrients (QC Lot: 1559110)											
TY2407728-001	Anonymous	Chloride, soluble ion content	16887-00-6	E236.Cl	5.0	mg/kg	111	104	6.66%	30%	----
Leachable Anions & Nutrients (QC Lot: 1559111)											
TY2407728-001	Anonymous	Sulfate, soluble ion content	14808-79-8	E236.SO4	20	mg/kg	<20	<20	0.008	Diff <2x LOR	----

Method Blank (MB) Report

A Method Blank is an analyte-free matrix that undergoes sample processing identical to that carried out for test samples. Method Blank results are used to monitor and control for potential contamination from the laboratory environment and reagents. For most tests, the DQO for Method Blanks is for the result to be < LOR.

Sub-Matrix: Soil/Solid						
Analyte	CAS Number	Method	LOR	Unit	Result	Qualifier
Physical Tests (QCLot: 1554472)						
Conductivity (1:2 leachate)	----	E100-L	5	µS/cm	<5.00	----
Physical Tests (QCLot: 1554546)						
Moisture	----	E144	0.25	%	<0.25	----
Inorganics (QCLot: 1554973)						
Sulfides, acid volatile	----	E396-L	0.2	mg/kg	<0.20	----
Leachable Anions & Nutrients (QCLot: 1559110)						
Chloride, soluble ion content	16887-00-6	E236.Cl	5	mg/kg	<5.0	----
Leachable Anions & Nutrients (QCLot: 1559111)						
Sulfate, soluble ion content	14808-79-8	E236.SO4	20	mg/kg	<20	----



Laboratory Control Sample (LCS) Report

A Laboratory Control Sample (LCS) is an analyte-free matrix that has been fortified (spiked) with test analytes at known concentration and processed in an identical manner to test samples. LCS results are expressed as percent recovery, and are used to monitor and control test method accuracy and precision, independent of test sample matrix.

Sub-Matrix: Soil/Solid

					Laboratory Control Sample (LCS) Report				
					Spike	Recovery (%)	Recovery Limits (%)		
Analyte	CAS Number	Method	LOR	Unit	Target Concentration	LCS	Low	High	Qualifier
Physical Tests (QCLot: 1554472)									
Conductivity (1:2 leachate)	----	E100-L	5	µS/cm	1410 µS/cm	98.2	90.0	110	----
Physical Tests (QCLot: 1554546)									
Moisture	----	E144	0.25	%	50 %	100.0	90.0	110	----
Physical Tests (QCLot: 1555648)									
pH (1:2 soil:CaCl2-aq)	----	E108A	----	pH units	7 pH units	100	98.0	102	----
Inorganics (QCLot: 1554973)									
Sulfides, acid volatile	----	E396-L	0.2	mg/kg	100 mg/kg	101	70.0	130	----
Leachable Anions & Nutrients (QCLot: 1559110)									
Chloride, soluble ion content	16887-00-6	E236.Cl	5	mg/kg	1000 mg/kg	99.4	80.0	120	----
Leachable Anions & Nutrients (QCLot: 1559111)									
Sulfate, soluble ion content	14808-79-8	E236.SO4	20	mg/kg	1000 mg/kg	101	80.0	120	----

Reference Material (RM) Report

A Reference Material (RM) is a homogenous material with known and well-established analyte concentrations. RMs are processed in an identical manner to test samples, and are used to monitor and control the accuracy and precision of a test method for a typical sample matrix. RM results are expressed as percent recovery of the target analyte concentration. RM targets may be certified target concentrations provided by the RM supplier, or may be ALS long-term mean values (for empirical test methods).

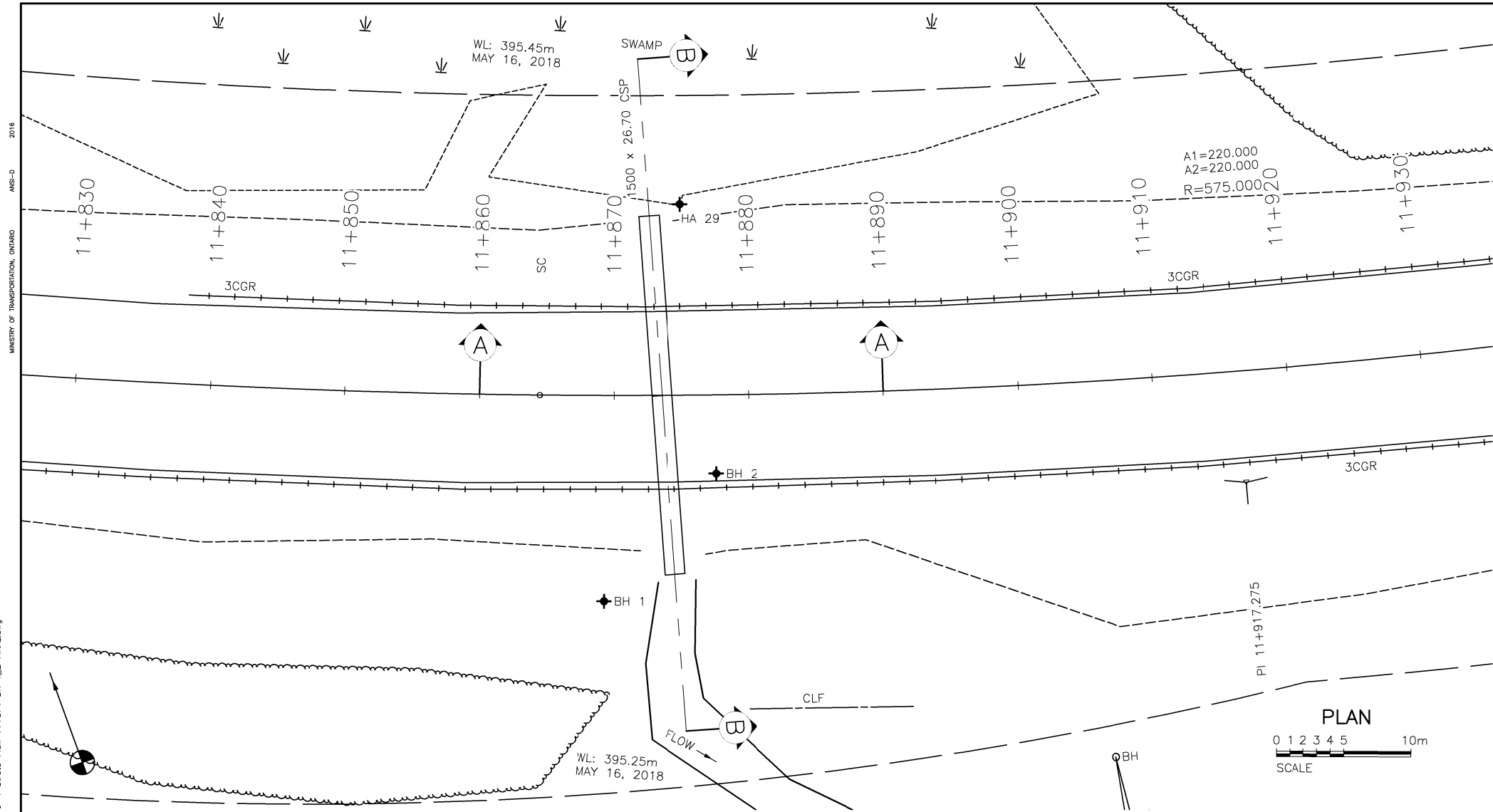
Sub-Matrix:

					Reference Material (RM) Report				
					RM Target Concentration	Recovery (%) RM	Recovery Limits (%)		
Laboratory sample ID	Reference Material ID	Analyte	CAS Number	Method			Low	High	Qualifier
Physical Tests (QCLot: 1554472)									
QC-1554472-003	RM	Conductivity (1:2 leachate)	----	E100-L	3270 µS/cm	108	70.0	130	----
Physical Tests (QCLot: 1558925)									
QC-1558925-001	RM	Oxidation-reduction potential [ORP]	----	E125	475 mV	91.4	90.0	110	----
Leachable Anions & Nutrients (QCLot: 1559110)									
QC-1559110-003	RM	Chloride, soluble ion content	16887-00-6	E236.Cl	601 mg/kg	87.2	70.0	130	----
Leachable Anions & Nutrients (QCLot: 1559111)									
QC-1559111-003	RM	Sulfate, soluble ion content	14808-79-8	E236.SO4	172 mg/kg	94.4	70.0	130	----



APPENDIX C
Borehole Location and Soil Strata Drawings

FILE NAME: Y:\Projects\2023\23-318 MTO, Geotechnical Retainer\23-318-14 Highway 11& 17 - Additional Boreholes\Drawings\24-179-4 Strata Plan 11+874 BH 1_2 FINAL.dwg
MODIFIED: 2025-01-17 14:24

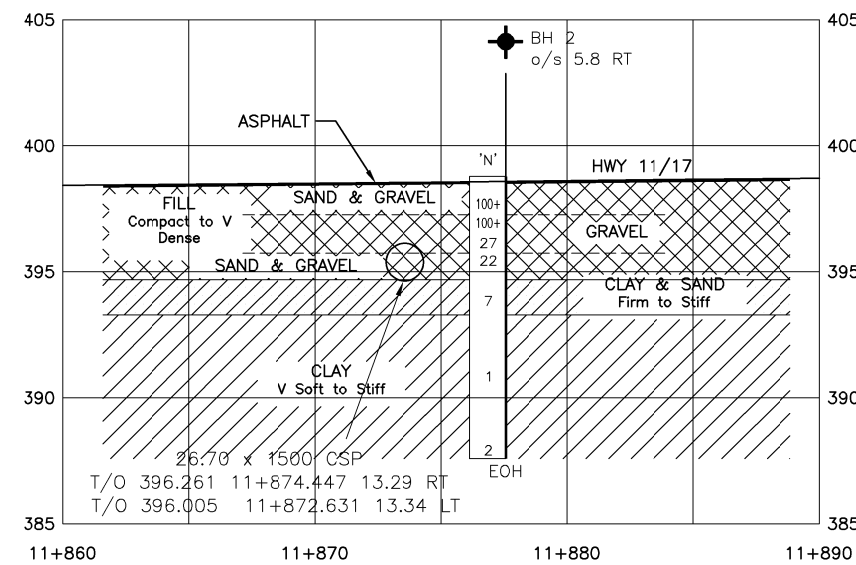
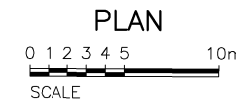
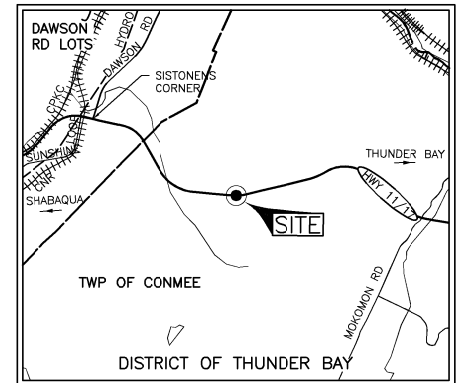


METRIC
DIMENSIONS ARE IN METRES
AND/OR MILLIMETRES UNLESS
OTHERWISE SHOWN

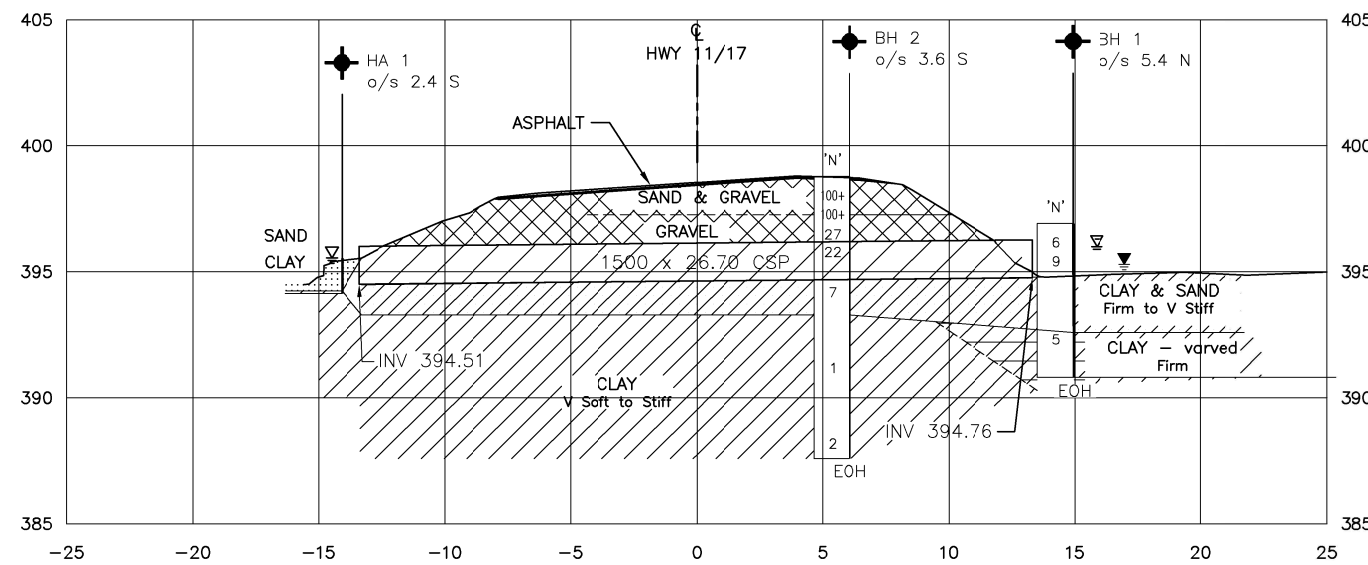
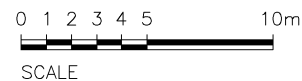
Ontario Ministry of Transportation
GEOCRE 52A12-002
CONT 2025-6021
GWP 6920-17-00

SOIL STRATA
HIGHWAY 11/17 CULVERT 11+873
TOWNSHIP OF CONMEE

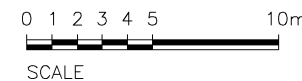
TBT ENGINEERING
CONSULTING GROUP



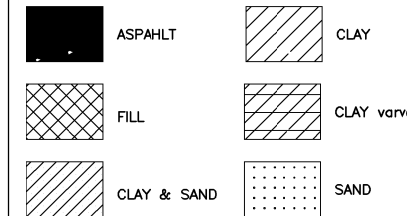
PROFILE A-A



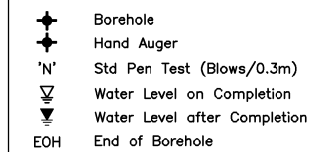
SECTION B-B



SOIL STRATA SYMBOLS



LEGEND



No	ELEVATION	CO-ORDINATES (MTM)	
		NORTH	EAST
BH 1	396.9	15 5 374 694	330 539
BH 2	398.8	15 5 374 690	330 551
HA 29	(D-3.0)	15 5 374 701	330 568

NOTE

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

REVISIONS		ISSUED FOR FIR DRAFT 19/09/24			
1	2	DESIGN XX	CHK SS	CODE XXXXXX	LOAD XXXX
		DRAWN TG	CHK MM	SITE XXXXX	DWG 1

APPENDIX D
Site Photographs



**Westside Embankment
Looking East, June 7, 2024**



**Westside Embankment
Looking Southeast, June 7, 2024.**