



# **Foundation Investigation Report**

**Culvert 52**

**~21.5 km North of the Corner of HWY 17 and 72**

**Township of McAree**

**Station 16+526, Lat: 49.852372, Lon: -92.395825**

**District of Kenora**

**Highway 72**

**6021-E-0045 & 0046**

**Geocres No. 52F16-003**

**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 services under the Northwest Region (NWR) Geotechnical Retainer Assignment. The site is located on Highway 72, approximately 21.5 km north of the intersection of Highway 17 and Highway 72. The site coordinates are as follows:

- Station 16+526, Latitude: 49.852376°, Longitude: -92.395821°

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

It is understood that this investigation was completed to facilitate the replacement of a culvert and the installation of a temporary protection system. The investigation consisted of two boreholes and one hand auger hole; one borehole was advanced through the centre of the left-hand lane and one borehole at the toe of the right-hand embankment. Borehole W3 was advanced for another project and is located, at Station 16+541, due to its proximity to this site it has been included for consideration within this report. The hand auger hole was advanced at the toe of the righthand side of the embankment. Boreholes were advanced to depths ranging from 5.5 to 14.8 m. The hand auger was advanced to a depth of 1.2 m. 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. 52F16-003 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. An embankment height of 5.5 m with embankment side slopes have been estimated at 2H:1V. The culvert at the site has an inlet obvert elevation of 379.7 m and invert elevation of 378.8 m and an outlet obvert elevation of 378.4 m and invert elevation of 377.4 m. The culvert was dry at the time of the field investigation.



**Figure 2.1: Left Embankment**  
**Looking South, June 28, 2023.**



**Figure 2.2: Right Embankment**  
**Looking South, June 28, 2023.**

## **2.1 Surficial Geology**

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

Glaciolacustrine deltas are described in the NOEGTS as deposits with glaciolacustrine clay and silt at depths.

The presence of the above soils were confirmed from the field investigation.

## **3 Investigation Procedures**

A geotechnical site investigation was undertaken on September 10, 2023 to Sept 25, 2023. The field investigation consisted of advancing a total of two boreholes and one hand auger. An additional borehole was advanced for the widening portion of the project, at Station 16+541, and is included within this report. Test hole locations are illustrated on the Borehole Location and



Soil Strata Drawings (Appendix C). The boreholes were advanced to depths of 5.5 to 14.8 m. The hand auger was advanced to a depth of 1.2 m.

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 hollow stem augers, 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 51 mm O.D. thick walled split barrel 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. Due to the changing soil conditions at Borehole 1 sampling frequency was altered in the first 5 m, to obtain sample from all encountered soils. 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.

Test hole locations were surveyed by TBTE with a level and rod and referenced to a temporary benchmark at the centreline of the highway. The benchmark has an elevation of 384.1 m from the B&C-633-664-8 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.**

Tess Hole Number	Co-ordinates	Surface Elevation (m)	Depth of Exploration (m)
1	Lat 49.8523504 Lon -92.3957847	383.9	14.8
2	Lat 49.8523845 Lon -92.3959981	381.3	5.5
W3	Lat 49.8524427 Lon -92.3955704	381.3	8.2
HA 001	Lat 49.852174 Lon -92.395713	377.8	1.2

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).

#### **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).

The subsurface soils at this site generally consist of topsoil or asphalt at surface overlying fill. Clay and sand was encountered underlying the fill or top soil and extended to the termination of the boreholes.

### **5.1 Asphalt**

300 mm of asphalt was present at the surface of Borehole 1.

### **5.2 Topsoil**

150 to 300 mm of topsoil was identified at the surface of Boreholes 2 and W3.

### **5.3 Fill**

Two types of fill were identified at the test hole locations.

Gravelly sand with some silt present underlying the asphalt at Borehole 15 and extended to a depth of 2.8 m (elev. 381.1 m). The results of the grain size analyses carried out on one sample indicates that this material can consist of 27 %gravel, 63 % sand and 10 % silt/clay sized particles. The condition of this material is compact with SPT N-value of 27 blows per 0.3 m. Numerous cobbles were noted within this material.

Clay with some sand and gravel was encountered underlying the sand fill at Borehole 1 and extended to a depth of 4.9 m (elev. 379.0 m). The consistency of this material is firm to very stiff with SPT N-values ranging from 7 to 23 blows per 0.3 m.

### **5.4 Wood**

400 mm of wood debris was identified underlying the fill at Borehole 1 at a depth of 4.9 m (elev. 379.0 m).

### **5.5 Clay**

Clay was encountered underlying the wood at Borehole 1 and extended to a depth of 7.6 m (elev. 376.3 m). The clay has a firm soft consistency with an SPT "N" value of 6 blows / 0.3 m and a very stiff consistency with a single field vane in excess of 100 kPa.

### **5.6 Clay and Sand**

Varved clay and sand was present at the surface of Hand Auger Hole 1, underlying the clay at Borehole 1 and underlying the topsoil at Boreholes 2 and W3 and extended to depths ranging from 1.2 to 11.2 m (elev. 376.6 to 372.7 m). Atterberg limits testing indicates that this material is silty clay to clay of medium plasticity, with the natural moisture content above the liquid limit. The results of two grain size analyses indicate that this material can consist of 0% gravel, 38 to 58%



sand, 42 to 62% silt/clay sized particles. This material has a very soft to firm consistency based on SPT N-values of 1 to 7 blow per 0.3 m, and a firm to very stiff consistency based on field vane tests (4) ranging from 50 to over 100 kPa, however, it is expected that presence of sand seams may have inflated the test results.

### 5.7 Silt

Sandy silt was identified underlying the clay and sand at Borehole W3 at a depth of 5.6 m (elev. 375.7 m) and extended to the termination of the borehole at a depth of 8.2 m (elev. 373.1 m). The results of the grain size analyses carried out on one sample indicates that this material can consist of 0 %gravel, 34 % sand and 66 % silt/clay sized particles. The condition of this material is loose with SPT N-value of 1blows per 0.3 m. Atterberg Limit testing indicates this material is non plastic.

### 5.8 Refusal

Auger and spoon refusal was encountered at Borehole 2 at depth of 5.5 m (elev. 375.8 m). Refusal to hand operated equipment at Hand Auger Hole 1 was encountered at a depth of 1.2 m.

### 5.9 Bedrock

Bedrock was encountered at Borehole 1 at a depth of 11.2 m (elev. 372.7 m). The depth to, and elevation of the bedrock surface can be expected to vary across the site. Bedrock was sampled for a length of 3.6 m. Detailed logs of the rock cores and core photographs have been provided in the enclosures. In general, the bedrock is fine grained metavolcanics.

The RQD is an indirect measure of the number of fractures and the amount of jointing in the rock mass. The RQD is expressed as a percentage of the ratio of summed core lengths greater than 100 mm to the total length cored. The RQD index is used to provide a classification for the rock quality according to the limits provided by the Canadian Foundation Engineering Manual (CFEM) 4<sup>th</sup> Edition which are shown below in Table 5.1.

**Table 5.1: Classification of Rock with Respect to RQD Value.**

RQD Classification	RQD Value (%)
Very Poor Quality	< 25
Poor Quality	25 to 50
Fair Quality	50 to 75
Good Quality	75 to 90
Excellent Quality	90 to 100

The quality of bedrock encountered at this site is generally “fair” to “excellent” based on the range of RQD values of 64 to 94%.

To estimate the strength of the bedrock encountered at this site, four point load tests were completed on the core samples. The test results are provided below in Table 5.2.

**Table 5.2: Estimated Uniaxial Compressive Strength of Bedrock Samples.**

Borehole	Depth Below Ground Surface (m)	Mean Estimated Uniaxial Compressive Strength* (MPa)
BH 1	11.3	238
BH 1	12.3	245
BH 1	13.7	339
BH 1	14.7	267

\* Estimated in accordance with ASTM D5731-16.

Based on the range of estimated uniaxial compressive strengths, the bedrock is classified as “very strong” to “extremely strong” at this site, according to the CFEM 4<sup>th</sup> Edition.

## 5.10 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 6. 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 5.3: 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. (hrs)
Borehole 1	383.9	4.6	379.3	-	-	-
Borehole 2	381.3	-	-	1.5	379.8	72
Borehole W3	381.3	0.2	381.1	0.2	381.1	24

## 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 Baumann and Allan Finke. Laboratory testing was supervised by Forch

Valela, C.Tech. This report was prepared and reviewed by 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



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*, 4<sup>th</sup> ed. Stamford, CT, USA: Cengage Learning, 2013.

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

Ontario Ministry of Northern Development and Mines; Digital Northern Ontario Engineering Geology Terrain Study (NOEGTS), 2000



## **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 <sup>2</sup> )
T W	Thin Wall Shelby Tube		

## EXPLANATION OF TERMS Cont'd.

### Stress and Strain

$u_w$	kPa	Pore Water Pressure
$u$		Pore Pressure Ratio
$\sigma$	kPa	Total Normal Stress
$\sigma'$	kPa	Effective Normal Stress
$\tau$	kPa	Shear Stress
$\sigma_1, \sigma_2, \sigma_3$	kPa	Principal Stress
$\epsilon$	%	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
$\mu$		Coefficient of Friction

### Mechanical Properties of Soil

$m_v$	kPa <sup>-1</sup>	Coefficient of Volume Change
$C_c$		Compression Index
$C_s$		Swelling Index
$C_a$		Rate of Secondary Consolidation
$c_v$	m <sup>2</sup> /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
$\tau_f$	kPa	Shear Strength
$c'$	kPa	Effective Cohesion Intercept
$\phi'$	°	Effective Angle of Internal Friction
$c_u$	kPa	Undrained Shear Strength
$s$		Sensitivity

### Physical Properties of Soil

$\rho_s$	kg/m <sup>3</sup>	Density of Solid Particles	$e$	%	Void Ratio	$e_{min}$	%	Void Ratio in Densest State
$\gamma_s$	kN/m <sup>3</sup>	Unit Weight of Solid Particles	$n$	%	Porosity	$I_D$		Density Index
$\rho_w$	kg/m <sup>3</sup>	Density of Water	$w$	%	Water Content	$D$	mm	Grain Diameter
$\gamma_w$	kN/m <sup>3</sup>	Unit Weight of Water	$s_r$	%	Degree of Saturation	$D_n$	mm	n Percent Diameter
$\rho$	kg/m <sup>3</sup>	Density of Soil	$w_L$	%	Liquid Limit	$C_U$		Uniformity Coefficient
$\gamma$	kN/m <sup>3</sup>	Unit Weight of Soil	$w_P$	%	Plastic Limit	$h$	m	Hydraulic Head or Potential
$\rho_d$	kg/m <sup>3</sup>	Density of Dry Soil	$w_S$	%	Shrinkage Limit	$q$	m <sup>3</sup> /s	Rate of Discharge
$\gamma_d$	kN/m <sup>3</sup>	Unit Weight of Dry Soil	$I_P$	%	Plasticity Index = $w_L - w_P$	$v$	m/s	Discharge Velocity
$\rho_{sat}$	kg/m <sup>3</sup>	Density of Saturated Soil	$I_L$		Liquidity Index = $\frac{w - w_P}{I_P}$	$i$		Hydraulic Gradient
$\gamma_{sat}$	kN/m <sup>3</sup>	Unit Weight of Saturated Soil	$I_C$		Consistency Index = $\frac{w_L - w}{I_P}$	$k$	m/s	Hydraulic Conductivity
$\rho'$	kg/m <sup>3</sup>	Density of Submerged Soil	$e_{max}$	%	Void Ratio in Loosest State	$j$	kN/m <sup>3</sup>	Seepage Force
$\gamma'$	kN/m <sup>3</sup>	Unit Weight of Submerged Soil						

# RECORD OF BOREHOLE No 1

1 OF 1

METRIC

W.P. 6033-19-00 LOCATION Station 16+525 o/s 3.7m Rt of C/L N:5524047; E:348248 MTM Zone:16 ORIGINATED BY AF  
 DIST NWR HWY 72 BOREHOLE TYPE Hollow Stem Auger COMPILED BY ZA/TG  
 DATUM Geodetic DATE 2023.09.10 - 2023.09.10 LATITUDE 49.8523504 LONGITUDE -92.3957847 CHECKED BY DV

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT  γ  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
								○ UNCONFINED	+ FIELD VANE	● QUICK TRIAXIAL	× LAB VANE			
383.9														GR SA SI CL
389.8	ASPHALT - 300 mm													
0.3	FILL - SAND - Gravelly, some silt, numerous cobbles, brown		1	SS	100+					○				Water level @ 4.6 m on completion. On cobble.
			2	SS	100+									On cobble.
	----- - compact		3	SS	27					○				27 63 (10) Cave @ 2.5 m.
	----- - CLAY - some sand, some gravel, layered, brown, firm to very stiff		4	SS	7					○				
			5	SS	23					○				
379.0			6	SS	10					○		140.6		
4.9	WOOD									○				
378.6														
5.3	CLAY - grey, firm		7	SS	6						○			Borehole Continued @ 2.2 m to the Right.
			8	TW							○			
376.3														
7.6	CLAY & SAND - varved, grey, firm to stiff		9	SS	4					┌┐	○			0 38 (62)
			10	TW							○			
			11	SS	6						○			
372.7														
11.2	BEDROCK - METAVOLCANICS  See Rock Core Log for full description.			RC										RC #1 REC 97% RQD 94%
				RC										RC #2 REC 97% RQD 74%
				RC										RC #3 REC 100% RQD 64%
369.1														
14.8	End of Borehole @ 14.8 m.													


+ 3, X 3: Numbers refer to  
Sensitivity

○ 3% STRAIN AT FAILURE

PP=Pocket Penetrometer (Kg/cm<sup>2</sup>)

ONTARIO MTO MOD CULVERT 52 HWY 72 16+526 MCAREE.GPJ ONTARIO MTO.GDT 4-15-24

## ROCK CORE LOG

 <b>TBT ENGINEERING</b> CONSULTING GROUP			<b>Project #:</b>	22-146-10	<b>Site:</b>	16+526		<b>Logger:</b>	L.Cosby			<b>Borehole #:</b>	BH 1										
			<b>Lab #:</b>	23-2909	<b>Client:</b>	MTO		<b>Date:</b>	18-Oct-23			<b>Page #:</b>	1 of 1										
DEPTH FROM SURFACE (m)	BOX/RUN	% REC (m)	% RQD (m)	GENERAL DESCRIPTION (Rock type(s), %, colour, texture, etc.)	STRENGTH*	WEATHERING	DISCONTINUITIES						OCCASIONAL FEATURES										
							# OF SETS	TYPE(S)	ORIENTATION	SPACING	ROUGHNESS	APERTURE		FILLING									
From 11.20	1/1	97%	94%	METAVOLCANICS - black, fine-grained, light schistocity, massive texture, intact and broken pieces	M/H	U	2	F	F	M	SU	O	N										
To 12.13								F	V	N/A	SU	O	SA										
From 12.13	1/2	97%	74%	METAVOLCANICS - black, fine-grained, greasy, massive texture, broken pieces	M/H	U	2	F	F	C/M	SU	O	N										
To 13.43								F	V	N/A	SU	O	SA										
From 13.43	1/3	100%	64%	METAVOLCANICS - black, fine-grained, light schistocity, massive texture, intact and broken pieces	M/H	U	2	F	D	VC/C	SU	O	SA	-sulfides throughout									
To 14.75								F	V	N/A	RU	C	T										
From 14.75																							
To 0.00																							
From 0.00																							
To 0.00																							
<b>NOTES:</b>																							
<b>Strength (MPa)</b>			<b>Weathering</b>			<b>Type</b>			<b>Orientation</b>			<b>Spacing</b>			<b>Roughness</b>			<b>Aperture</b>			<b>Filling</b>		
VH = Very High = >200			U = Unweathered (No signs)			B = Bedding joint			F = Flat (0-20°)			VW = Very wide = >3m			RU = Rough undulating			O = Open			T = Tight, hard		
H = High = 50-200			S = Slightly (Oxidized)			J = Cross Joint			D = Dipping (20-50°)			W = Wide = 1-3m			RP = Rough planar			C = Closed			SA = Slightly altered, clay free		
M = Medium = 15-50			M = Moderately (Discoloured)			F = Fault			V = Near Vertical (>50°)			M = Moderate = 0.3-1m			SU = Smooth undulating			F = Filled			S = Sandy, Clay free		
L = Low = 4-15			H = Highly (Friable)			S = Shear Plane						C = Close = 5-30cm			SP = Smooth planar						Si = Sandy, silty, minor clay		
VL = Very Low = 1-4			C = Completely (Soil-like)									VC = Very close = <5cm			LU = Slicken sided undulating						NC = Non-softening clay		
															LP = Slicken sided planar						SC = Swelling, softening clay		
																					N= No filling		
*Strength shown above is estimated and not measured laboratory values																							



FULL ROCK CORE: Dry



FULL ROCK CORE: Wet





ROCK CORE: Detail #1



ROCK CORE: Detail #2





ROCK CORE: Detail #3

# RECORD OF BOREHOLE No 2

1 OF 1

**METRIC**

W.P. 6033-19-00 LOCATION Station 16+520 o/s 11.5m Lt of C/L N:5524051; E:348232 MTM Zone:16 ORIGINATED BY AF  
 DIST NWR HWY 72 BOREHOLE TYPE Hollow Stem Auger COMPILED BY ZA/TG  
 DATUM Geodetic DATE 2023.09.10 - 2023.09.10 LATITUDE 49.8523845 LONGITUDE -92.3959981 CHECKED BY DV











SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT   NATURAL MOISTURE CONTENT   LIQUID LIMIT			UNIT WEIGHT  $\gamma$  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa		W <sub>p</sub>	W	W <sub>L</sub>			WATER CONTENT (%)
381.3	TOPSOIL - 150 mm CLAY & SAND - varved, brown, very soft to very stiff						20	40	60	80	100				GR   SA   SI   CL
380.0															
380.2			1	SS	7										
			2	SS	1										
			3	TW											
			4	SS	3										
														0   58   (42) Temporary standpipe installed to 2.8 m.	
						</									

# RECORD OF BOREHOLE No W3

1 OF 1

METRIC

W.P. 6033-19-00 LOCATION Station 16.541 o/s 11.7m Rt of C/L N:5524057; E:348263 MTM Zone:16 ORIGINATED BY AF  
 DIST NWR HWY 72 BOREHOLE TYPE Hollow Stem Auger COMPILED BY ZA/TG  
 DATUM Geodetic DATE 2023.09.22 - 2023.09.22 LATITUDE 49.8524427 LONGITUDE -92.3955704 CHECKED BY DV

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      + FIELD VANE ● QUICK TRIAXIAL    × LAB VANE	20	40	60	80	100	20		
381.3																
380.0	TOPSOIL						381								Water level @ 0.2 m on completion and 24 hours after.	
0.3	CLAY & SAND - varved, Silty, grey, soft to firm		1	SS	4		380									
			2	SS	6		379									
			3	SS	7		378									
			4	TW			377									
			5	SS	1		376									
375.7																
5.6	SILT - Sandy, grey, very loose		6	TW			375									
																
			7	SS	1		374								0 34 (66) Non Plastic.	
373.1																
8.2	End of Borehole @ 8.2 m.															

ONTARIO MTO MOD CULVERT 52 HWY 72 16+526 MCAREE.GPJ ONTARIO MTO.GDT 4-15-24

**HIGHWAY 664/72**  
**MCAREE TOWNSHIP**

Station 16+528 18.1 m Rt

23-FDN-HA-005

MTM16 5522370 N 543440 E

0	-	1.2	Br CL & Sa
		1.2	NFP Firm Cl

Station 16+528 18.1 m Rt

23-FDN-HA-005

Sample No. 23-AF-537 (1.0 – 1.2)

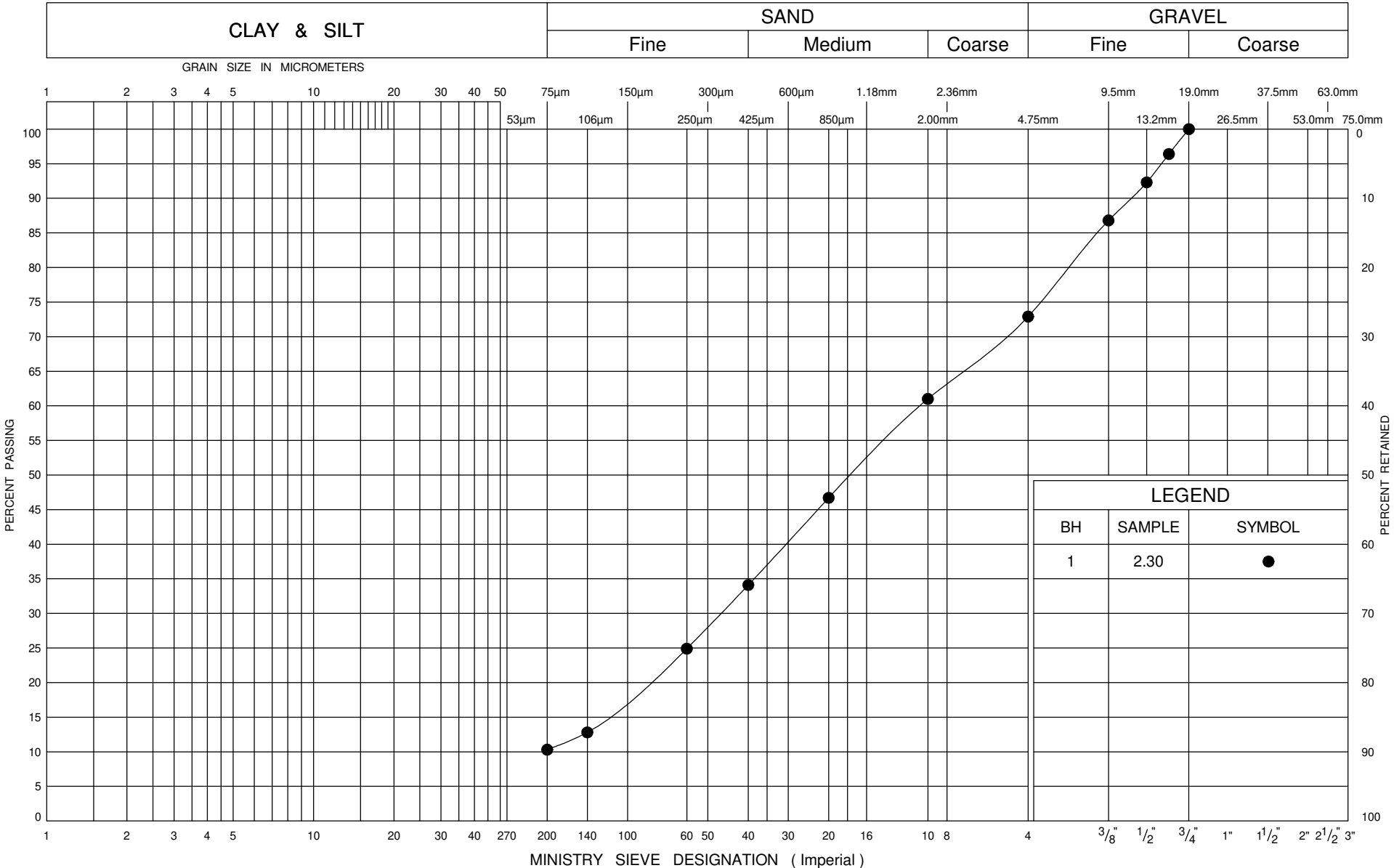
Lab number 23-3151, Nmc – 32%



## **APPENDIX B**

### **Laboratory Test Data**

UNIFIED SOIL CLASSIFICATION SYSTEM



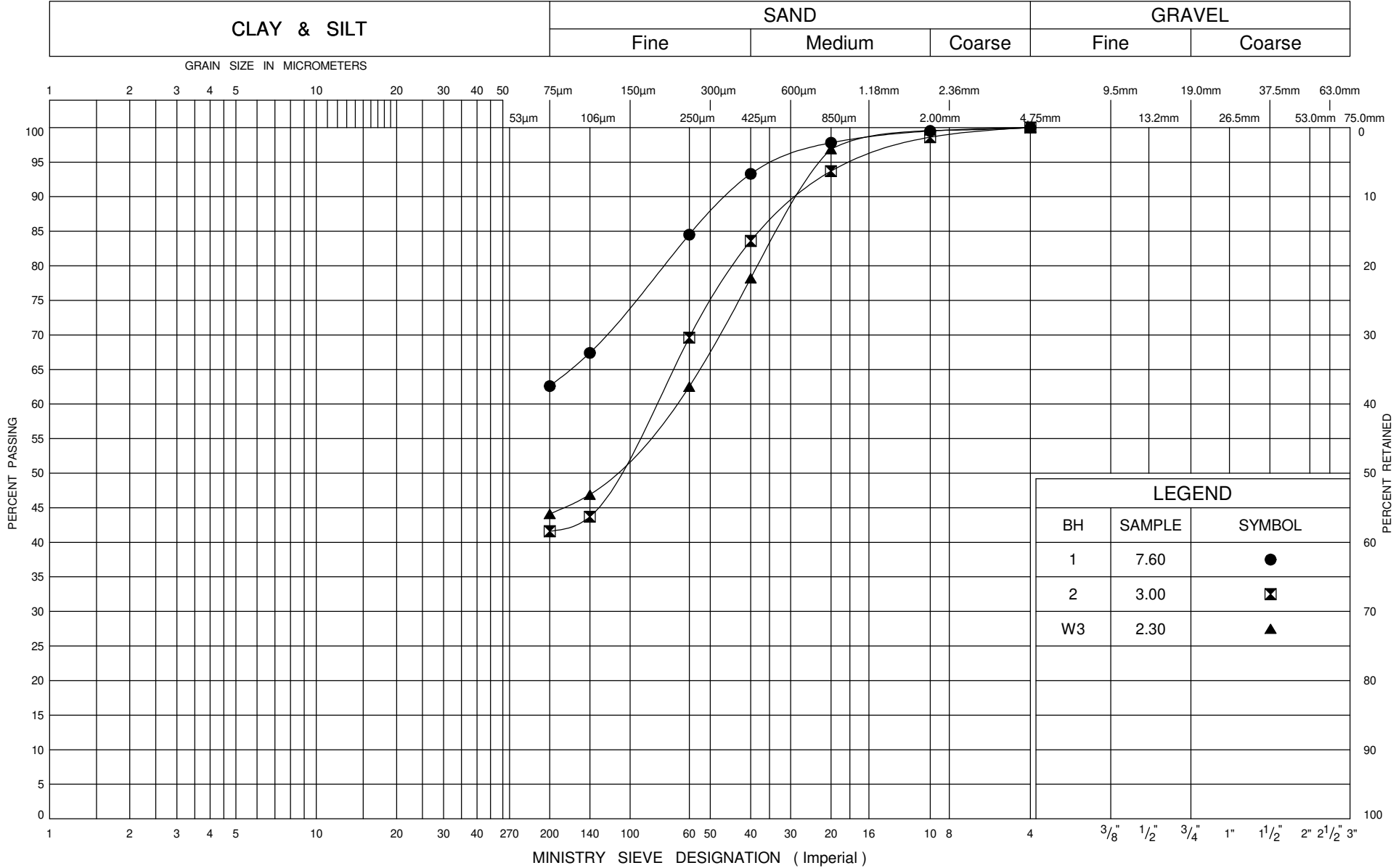
GRAIN SIZE DISTRIBUTION  
FILL - SAND

FIG No 1

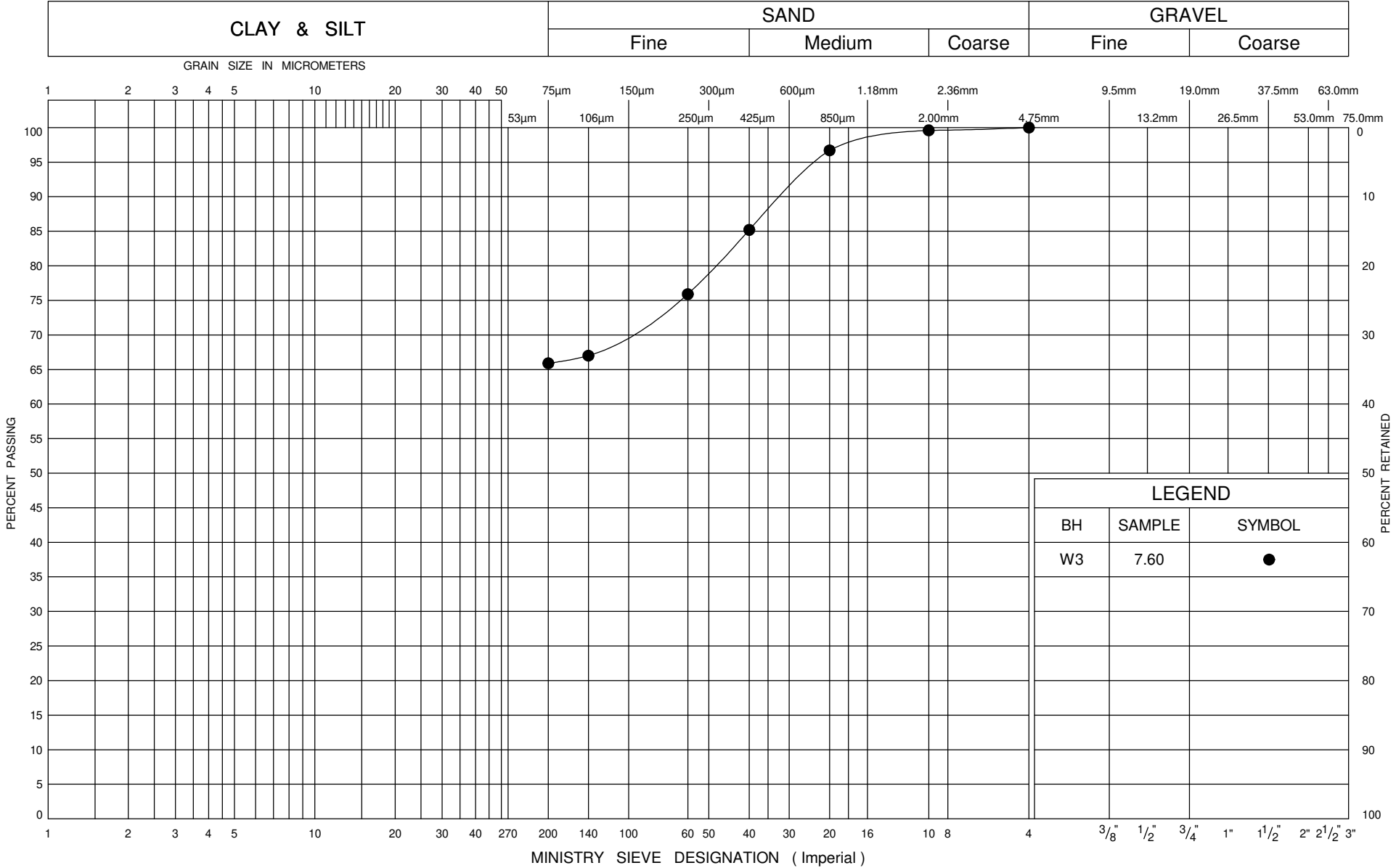
W P 6033-19-00

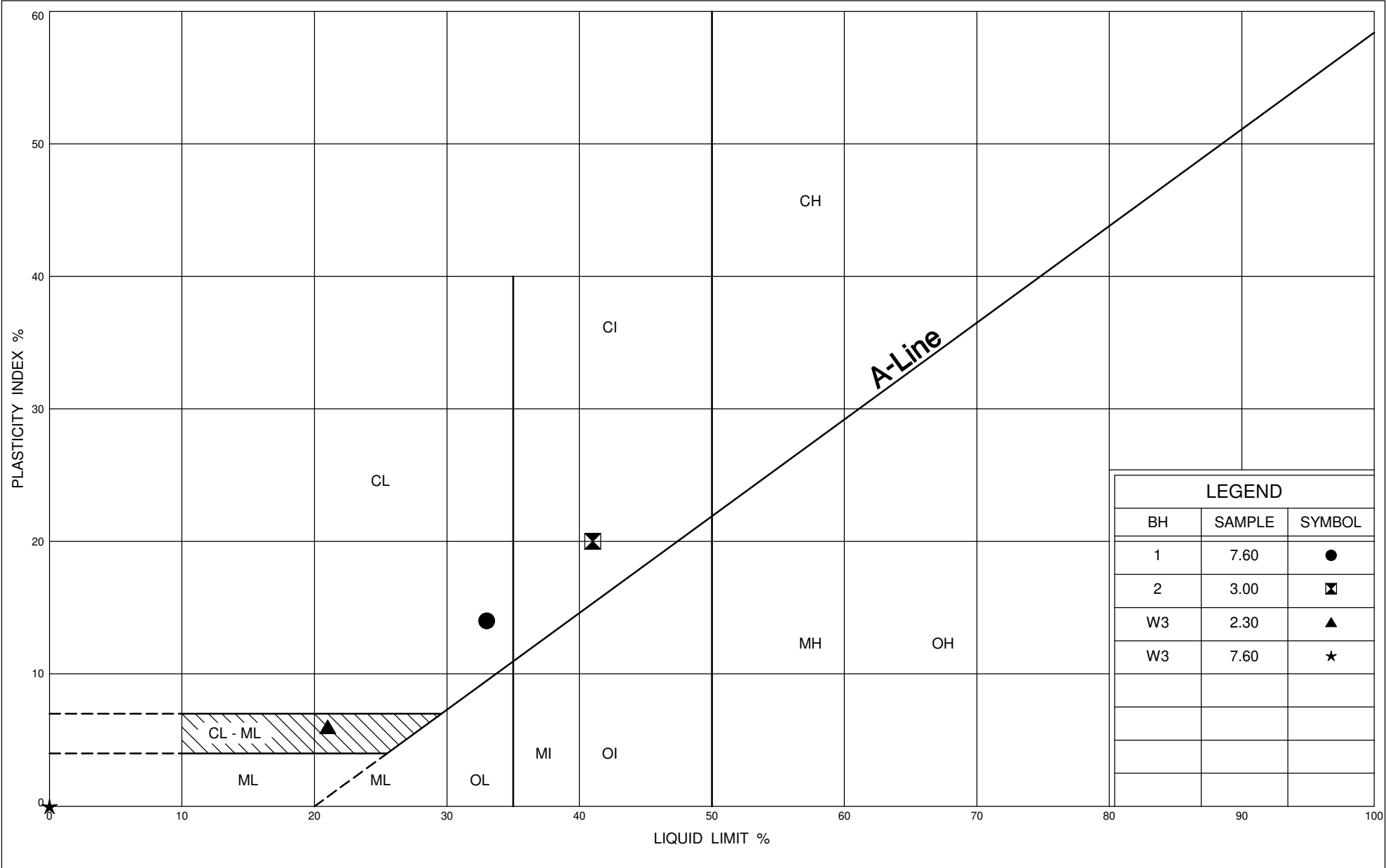
Culvert 52 McAree TWP 16+526

UNIFIED SOIL CLASSIFICATION SYSTEM



UNIFIED SOIL CLASSIFICATION SYSTEM





Ministry of  
Transportation

# PLASTICITY CHART

FIG No 4  
W P 6033-19-00  
Culvert 52 McAree TWP 16+526



## CERTIFICATE OF ANALYSIS

<b>Work Order</b>	<b>: TY2311889</b>	<b>Page</b>	<b>: 1 of 4</b>
<b>Client</b>	<b>: TBT Engineering Group</b>	<b>Laboratory</b>	<b>: ALS Environmental - Thunder Bay</b>
<b>Contact</b>	<b>: Doug Steele</b>	<b>Account Manager</b>	<b>: Cassidy Young</b>
<b>Address</b>	<b>: 1918 Younge Street</b> <b>Thunder Bay ON Canada P7E 6T9</b>	<b>Address</b>	<b>: 1081 Barton Street</b> <b>Thunder Bay ON Canada P7B 5N3</b>
<b>Telephone</b>	<b>: (807)624-5160</b>	<b>Telephone</b>	<b>: +1 807 623 6463</b>
<b>Project</b>	<b>: 22-146-10</b>	<b>Date Samples Received</b>	<b>: 14-Nov-2023 12:36</b>
<b>PO</b>	<b>: 11080</b>	<b>Date Analysis Commenced</b>	<b>: 16-Nov-2023</b>
<b>C-O-C number</b>	<b>: ----</b>	<b>Issue Date</b>	<b>: 21-Nov-2023 14:37</b>
<b>Sampler</b>	<b>: ----</b>		
<b>Site</b>	<b>:</b>		
<b>Quote number</b>	<b>: Standing Offer - Soil - 2023</b>		
<b>No. of samples received</b>	<b>: 6</b>		
<b>No. of samples analysed</b>	<b>: 6</b>		

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	Inorganics Analyst	Inorganics, Waterloo, Ontario
Niral Patel		Centralized Prep, Waterloo, Ontario
Walt Kippenhuck	Supervisor - Inorganic	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
%	percent
µS/cm	microsiemens per centimetre
mg/kg	milligrams per kilogram
mV	millivolts
ohm cm	ohm centimetres (resistivity)
pH units	pH units

<: 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/Solid (Matrix: Soil/Solid)				Client sample ID	Laval 12+487	Draytom 25+380	Laval 12+270	Laval 13+299	McAree 16+526
Client sampling date / time					11-Nov-2023 12:00	11-Nov-2023 12:05	11-Nov-2023 12:10	11-Nov-2023 12:15	11-Nov-2023 12:20
Analyte	CAS Number	Method/Lab	LOR	Unit	TY2311889-001	TY2311889-002	TY2311889-003	TY2311889-004	TY2311889-005
					Result	Result	Result	Result	Result
Physical Tests									
Conductivity (1:2 leachate)	----	E100-L/WT	5.00	µS/cm	58.2	4430	284	81.3	283
Moisture	----	E144/WT	0.25	%	8.42	26.2	19.9	18.3	23.5
Oxidation-reduction potential [ORP]	----	E125/WT	0.10	mV	429	328	354	464	325
pH (1:2 soil:CaCl2-aq)	----	E108A/WT	0.10	pH units	6.64	6.32	6.48	6.49	7.19
Resistivity	----	EC100R/WT	100	ohm cm	17200	220	3520	12300	3530
Inorganics									
Sulfides, acid volatile	----	E396-L/WT	0.20	mg/kg	<0.22	<0.27	<0.25	<0.24	<0.26
Leachable Anions & Nutrients									
Chloride, soluble ion content	16887-00-6	E236.Cl/WT	5.0	mg/kg	19.3	2670	131	23.9	62.4
Sulfate, soluble ion content	14808-79-8	E236.SO4/WT	20	mg/kg	<20	104	<20	<20	<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.



Analytical Results

Sub-Matrix: Soil/Solid					Client sample ID	Grand Trunk 14+567	----	----	----	----
(Matrix: Soil/Solid)					Client sampling date / time	11-Nov-2023 12:25	----	----	----	----
Analyte	CAS Number	Method/Lab	LOR	Unit	TY2311889-006	-----	-----	-----	-----	
					Result	----	----	----	----	
Physical Tests										
Conductivity (1:2 leachate)	----	E100-L/WT	5.00	µS/cm	324	----	----	----	----	
Moisture	----	E144/WT	0.25	%	19.6	----	----	----	----	
Oxidation-reduction potential [ORP]	----	E125/WT	0.10	mV	287	----	----	----	----	
pH (1:2 soil:CaCl2-aq)	----	E108A/WT	0.10	pH units	5.66	----	----	----	----	
Resistivity	----	EC100R/WT	100	ohm cm	3090	----	----	----	----	
Inorganics										
Sulfides, acid volatile	----	E396-L/WT	0.20	mg/kg	<0.24	----	----	----	----	
Leachable Anions & Nutrients										
Chloride, soluble ion content	16887-00-6	E236.Cl/WT	5.0	mg/kg	194	----	----	----	----	
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	: TY2311889	Page	: 1 of 10
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	: 22-146-10	Date Samples Received	: 14-Nov-2023 12:36
PO	: 11080	Issue Date	: 21-Nov-2023 14:34
C-O-C number	: ----		
Sampler	: ----		
Site	:		
Quote number	: Standing Offer - Soil - 2023		
No. of samples received	: 6		
No. of samples analysed	: 6		

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)

- No Analysis Holding Time Outliers exist.

### ***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

Analyte Group : Analytical Method Container / Client Sample ID(s)	Method	Sampling Date	Extraction / Preparation				Analysis			
			Preparation Date	Holding Times		Eval	Analysis Date	Holding Times		Eval
				Rec	Actual			Rec	Actual	
Inorganics : Acid Volatile Sulfide in Soil by Colourimetry (0.2 mg/kg)										
Glass soil jar/Teflon lined cap [ON MECP] Draytom 25+380	E396-L	11-Nov-2023	19-Nov-2023	14 days	8 days	✓	19-Nov-2023	7 days	0 days	✓
Inorganics : Acid Volatile Sulfide in Soil by Colourimetry (0.2 mg/kg)										
Glass soil jar/Teflon lined cap [ON MECP] Grand Trunk 14+567	E396-L	11-Nov-2023	19-Nov-2023	14 days	8 days	✓	19-Nov-2023	7 days	0 days	✓
Inorganics : Acid Volatile Sulfide in Soil by Colourimetry (0.2 mg/kg)										
Glass soil jar/Teflon lined cap [ON MECP] Laval 12+270	E396-L	11-Nov-2023	19-Nov-2023	14 days	8 days	✓	19-Nov-2023	7 days	0 days	✓
Inorganics : Acid Volatile Sulfide in Soil by Colourimetry (0.2 mg/kg)										
Glass soil jar/Teflon lined cap [ON MECP] Laval 12+487	E396-L	11-Nov-2023	19-Nov-2023	14 days	8 days	✓	19-Nov-2023	7 days	0 days	✓
Inorganics : Acid Volatile Sulfide in Soil by Colourimetry (0.2 mg/kg)										
Glass soil jar/Teflon lined cap [ON MECP] Laval 13+299	E396-L	11-Nov-2023	19-Nov-2023	14 days	8 days	✓	19-Nov-2023	7 days	0 days	✓
Inorganics : Acid Volatile Sulfide in Soil by Colourimetry (0.2 mg/kg)										
Glass soil jar/Teflon lined cap [ON MECP] McAree 16+526	E396-L	11-Nov-2023	19-Nov-2023	14 days	8 days	✓	19-Nov-2023	7 days	0 days	✓
Leachable Anions & Nutrients : Water Extractable Chloride by IC										
Glass soil jar/Teflon lined cap [ON MECP] Grand Trunk 14+567	E236.Cl	11-Nov-2023	17-Nov-2023	30 days	6 days	✓	17-Nov-2023	28 days	0 days	✓



Matrix: Soil/Solid

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

Analyte Group : Analytical Method Container / Client Sample ID(s)	Method	Sampling Date	Extraction / Preparation				Analysis			
			Preparation Date	Holding Times		Eval	Analysis Date	Holding Times		Eval
				Rec	Actual			Rec	Actual	
Leachable Anions & Nutrients : Water Extractable Chloride by IC										
Glass soil jar/Teflon lined cap [ON MECP] Laval 12+270	E236.Cl	11-Nov-2023	17-Nov-2023	30 days	6 days	✓	17-Nov-2023	28 days	0 days	✓
Leachable Anions & Nutrients : Water Extractable Chloride by IC										
Glass soil jar/Teflon lined cap [ON MECP] Laval 12+487	E236.Cl	11-Nov-2023	17-Nov-2023	30 days	6 days	✓	17-Nov-2023	28 days	0 days	✓
Leachable Anions & Nutrients : Water Extractable Chloride by IC										
Glass soil jar/Teflon lined cap [ON MECP] Laval 13+299	E236.Cl	11-Nov-2023	17-Nov-2023	30 days	6 days	✓	17-Nov-2023	28 days	0 days	✓
Leachable Anions & Nutrients : Water Extractable Chloride by IC										
Glass soil jar/Teflon lined cap [ON MECP] McAree 16+526	E236.Cl	11-Nov-2023	17-Nov-2023	30 days	6 days	✓	17-Nov-2023	28 days	0 days	✓
Leachable Anions & Nutrients : Water Extractable Chloride by IC										
Glass soil jar/Teflon lined cap [ON MECP] Draytom 25+380	E236.Cl	11-Nov-2023	20-Nov-2023	30 days	9 days	✓	20-Nov-2023	28 days	0 days	✓
Leachable Anions & Nutrients : Water Extractable Sulfate by IC										
Glass soil jar/Teflon lined cap [ON MECP] Grand Trunk 14+567	E236.SO4	11-Nov-2023	17-Nov-2023	30 days	6 days	✓	17-Nov-2023	28 days	0 days	✓
Leachable Anions & Nutrients : Water Extractable Sulfate by IC										
Glass soil jar/Teflon lined cap [ON MECP] Laval 12+270	E236.SO4	11-Nov-2023	17-Nov-2023	30 days	6 days	✓	17-Nov-2023	28 days	0 days	✓
Leachable Anions & Nutrients : Water Extractable Sulfate by IC										
Glass soil jar/Teflon lined cap [ON MECP] Laval 12+487	E236.SO4	11-Nov-2023	17-Nov-2023	30 days	6 days	✓	17-Nov-2023	28 days	0 days	✓
Leachable Anions & Nutrients : Water Extractable Sulfate by IC										
Glass soil jar/Teflon lined cap [ON MECP] Laval 13+299	E236.SO4	11-Nov-2023	17-Nov-2023	30 days	6 days	✓	17-Nov-2023	28 days	0 days	✓



Matrix: Soil/Solid

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

Analyte Group : Analytical Method Container / Client Sample ID(s)	Method	Sampling Date	Extraction / Preparation				Analysis			
			Preparation Date	Holding Times		Eval	Analysis Date	Holding Times		Eval
				Rec	Actual			Rec	Actual	
Leachable Anions & Nutrients : Water Extractable Sulfate by IC										
Glass soil jar/Teflon lined cap [ON MECP] McAree 16+526	E236.SO4	11-Nov-2023	17-Nov-2023	30 days	6 days	✓	17-Nov-2023	28 days	0 days	✓
Leachable Anions & Nutrients : Water Extractable Sulfate by IC										
Glass soil jar/Teflon lined cap [ON MECP] Draytom 25+380	E236.SO4	11-Nov-2023	20-Nov-2023	30 days	9 days	✓	20-Nov-2023	28 days	0 days	✓
Physical Tests : Conductivity in Soil (1:2 Soil:Water Extraction) (Low Level)										
Glass soil jar/Teflon lined cap [ON MECP] Draytom 25+380	E100-L	11-Nov-2023	17-Nov-2023	30 days	6 days	✓	17-Nov-2023	30 days	6 days	✓
Physical Tests : Conductivity in Soil (1:2 Soil:Water Extraction) (Low Level)										
Glass soil jar/Teflon lined cap [ON MECP] Grand Trunk 14+567	E100-L	11-Nov-2023	17-Nov-2023	30 days	6 days	✓	17-Nov-2023	30 days	6 days	✓
Physical Tests : Conductivity in Soil (1:2 Soil:Water Extraction) (Low Level)										
Glass soil jar/Teflon lined cap [ON MECP] Laval 12+270	E100-L	11-Nov-2023	17-Nov-2023	30 days	6 days	✓	17-Nov-2023	30 days	6 days	✓
Physical Tests : Conductivity in Soil (1:2 Soil:Water Extraction) (Low Level)										
Glass soil jar/Teflon lined cap [ON MECP] Laval 12+487	E100-L	11-Nov-2023	17-Nov-2023	30 days	6 days	✓	17-Nov-2023	30 days	6 days	✓
Physical Tests : Conductivity in Soil (1:2 Soil:Water Extraction) (Low Level)										
Glass soil jar/Teflon lined cap [ON MECP] Laval 13+299	E100-L	11-Nov-2023	17-Nov-2023	30 days	6 days	✓	17-Nov-2023	30 days	6 days	✓
Physical Tests : Conductivity in Soil (1:2 Soil:Water Extraction) (Low Level)										
Glass soil jar/Teflon lined cap [ON MECP] McAree 16+526	E100-L	11-Nov-2023	17-Nov-2023	30 days	6 days	✓	17-Nov-2023	30 days	6 days	✓
Physical Tests : Moisture Content by Gravimetry										
Glass soil jar/Teflon lined cap [ON MECP] Draytom 25+380	E144	11-Nov-2023	----	----	----		16-Nov-2023	----	5 days	





Matrix: Soil/Solid

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

Analyte Group : Analytical Method Container / Client Sample ID(s)	Method	Sampling Date	Extraction / Preparation				Analysis			
			Preparation Date	Holding Times		Eval	Analysis Date	Holding Times		Eval
				Rec	Actual			Rec	Actual	
Physical Tests : Moisture Content by Gravimetry										
Glass soil jar/Teflon lined cap [ON MECP] Grand Trunk 14+567	E144	11-Nov-2023	----	----	----		16-Nov-2023	----	5 days	
Physical Tests : Moisture Content by Gravimetry										
Glass soil jar/Teflon lined cap [ON MECP] Laval 12+270	E144	11-Nov-2023	----	----	----		16-Nov-2023	----	5 days	
Physical Tests : Moisture Content by Gravimetry										
Glass soil jar/Teflon lined cap [ON MECP] Laval 12+487	E144	11-Nov-2023	----	----	----		16-Nov-2023	----	5 days	
Physical Tests : Moisture Content by Gravimetry										
Glass soil jar/Teflon lined cap [ON MECP] Laval 13+299	E144	11-Nov-2023	----	----	----		16-Nov-2023	----	5 days	
Physical Tests : Moisture Content by Gravimetry										
Glass soil jar/Teflon lined cap [ON MECP] McAree 16+526	E144	11-Nov-2023	----	----	----		16-Nov-2023	----	5 days	
Physical Tests : ORP by Electrode										
Glass soil jar/Teflon lined cap [ON MECP] Draytom 25+380	E125	11-Nov-2023	16-Nov-2023	180 days	5 days	✓	17-Nov-2023	180 days	6 days	✓
Physical Tests : ORP by Electrode										
Glass soil jar/Teflon lined cap [ON MECP] Grand Trunk 14+567	E125	11-Nov-2023	16-Nov-2023	180 days	5 days	✓	17-Nov-2023	180 days	6 days	✓
Physical Tests : ORP by Electrode										
Glass soil jar/Teflon lined cap [ON MECP] Laval 12+270	E125	11-Nov-2023	16-Nov-2023	180 days	5 days	✓	17-Nov-2023	180 days	6 days	✓
Physical Tests : ORP by Electrode										
Glass soil jar/Teflon lined cap [ON MECP] Laval 12+487	E125	11-Nov-2023	16-Nov-2023	180 days	5 days	✓	17-Nov-2023	180 days	6 days	✓



Matrix: Soil/Solid

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

Analyte Group : Analytical Method Container / Client Sample ID(s)	Method	Sampling Date	Extraction / Preparation				Analysis			
			Preparation Date	Holding Times		Eval	Analysis Date	Holding Times		Eval
				Rec	Actual			Rec	Actual	
Physical Tests : ORP by Electrode										
Glass soil jar/Teflon lined cap [ON MECP] Laval 13+299	E125	11-Nov-2023	16-Nov-2023	180 days	5 days	✓	17-Nov-2023	180 days	6 days	✓
Physical Tests : ORP by Electrode										
Glass soil jar/Teflon lined cap [ON MECP] McAree 16+526	E125	11-Nov-2023	16-Nov-2023	180 days	5 days	✓	17-Nov-2023	180 days	6 days	✓
Physical Tests : pH by Meter (1:2 Soil:0.01M CaCl2 Extraction) - As Received										
Glass soil jar/Teflon lined cap [ON MECP] Draytom 25+380	E108A	11-Nov-2023	16-Nov-2023	30 days	5 days	✓	17-Nov-2023	30 days	6 days	✓
Physical Tests : pH by Meter (1:2 Soil:0.01M CaCl2 Extraction) - As Received										
Glass soil jar/Teflon lined cap [ON MECP] Grand Trunk 14+567	E108A	11-Nov-2023	16-Nov-2023	30 days	5 days	✓	17-Nov-2023	30 days	6 days	✓
Physical Tests : pH by Meter (1:2 Soil:0.01M CaCl2 Extraction) - As Received										
Glass soil jar/Teflon lined cap [ON MECP] Laval 12+270	E108A	11-Nov-2023	16-Nov-2023	30 days	5 days	✓	17-Nov-2023	30 days	6 days	✓
Physical Tests : pH by Meter (1:2 Soil:0.01M CaCl2 Extraction) - As Received										
Glass soil jar/Teflon lined cap [ON MECP] Laval 12+487	E108A	11-Nov-2023	16-Nov-2023	30 days	5 days	✓	17-Nov-2023	30 days	6 days	✓
Physical Tests : pH by Meter (1:2 Soil:0.01M CaCl2 Extraction) - As Received										
Glass soil jar/Teflon lined cap [ON MECP] Laval 13+299	E108A	11-Nov-2023	16-Nov-2023	30 days	5 days	✓	17-Nov-2023	30 days	6 days	✓
Physical Tests : pH by Meter (1:2 Soil:0.01M CaCl2 Extraction) - As Received										
Glass soil jar/Teflon lined cap [ON MECP] McAree 16+526	E108A	11-Nov-2023	16-Nov-2023	30 days	5 days	✓	17-Nov-2023	30 days	6 days	✓

**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	1244062	1	12	8.3	4.7	✓
Conductivity in Soil (1:2 Soil:Water Extraction) (Low Level)	E100-L	1238739	1	8	12.5	5.0	✓
Moisture Content by Gravimetry	E144	1240825	2	37	5.4	5.0	✓
ORP by Electrode	E125	1240804	1	9	11.1	5.0	✓
pH by Meter (1:2 Soil:0.01M CaCl2 Extraction) - As Received	E108A	1239289	1	18	5.5	5.0	✓
Water Extractable Chloride by IC	E236.Cl	1244207	2	23	8.7	5.0	✓
Water Extractable Sulfate by IC	E236.SO4	1244206	2	20	10.0	5.0	✓
Laboratory Control Samples (LCS)							
Acid Volatile Sulfide in Soil by Colourimetry (0.2 mg/kg)	E396-L	1244062	1	12	8.3	4.7	✓
Conductivity in Soil (1:2 Soil:Water Extraction) (Low Level)	E100-L	1238739	2	8	25.0	10.0	✓
Moisture Content by Gravimetry	E144	1240825	2	37	5.4	5.0	✓
ORP by Electrode	E125	1240804	1	9	11.1	5.0	✓
pH by Meter (1:2 Soil:0.01M CaCl2 Extraction) - As Received	E108A	1239289	1	18	5.5	5.0	✓
Water Extractable Chloride by IC	E236.Cl	1244207	4	23	17.3	10.0	✓
Water Extractable Sulfate by IC	E236.SO4	1244206	4	20	20.0	10.0	✓
Method Blanks (MB)							
Acid Volatile Sulfide in Soil by Colourimetry (0.2 mg/kg)	E396-L	1244062	1	12	8.3	4.7	✓
Conductivity in Soil (1:2 Soil:Water Extraction) (Low Level)	E100-L	1238739	1	8	12.5	5.0	✓
Moisture Content by Gravimetry	E144	1240825	2	37	5.4	5.0	✓
Water Extractable Chloride by IC	E236.Cl	1244207	2	23	8.7	5.0	✓
Water Extractable Sulfate by IC	E236.SO4	1244206	2	20	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 <sub>2</sub> 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.
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 <sub>4</sub>  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 4500S <sub>2</sub> J	This analysis is carried out in accordance with the method described in APHA 4500 S <sub>2</sub> -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 <sub>2</sub> - 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 <sub>2</sub> 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

<b>Work Order</b>	<b>: TY2311889</b>	<b>Page</b>	<b>: 1 of 6</b>
<b>Client</b>	: TBT Engineering Group	<b>Laboratory</b>	: ALS Environmental - Thunder Bay
<b>Contact</b>	: Doug Steele	<b>Account Manager</b>	: Cassidy Young
<b>Address</b>	: 1918 Younge Street Thunder Bay ON Canada P7E 6T9	<b>Address</b>	: 1081 Barton Street Thunder Bay, Ontario Canada P7B 5N3
<b>Telephone</b>	:	<b>Telephone</b>	: +1 807 623 6463
<b>Project</b>	: 22-146-10	<b>Date Samples Received</b>	: 14-Nov-2023 12:36
<b>PO</b>	: 11080	<b>Date Analysis Commenced</b>	: 16-Nov-2023
<b>C-O-C number</b>	: ----	<b>Issue Date</b>	: 21-Nov-2023 14:34
<b>Sampler</b>	: ---- (807)624-5160		
<b>Site</b>	:		
<b>Quote number</b>	: Standing Offer - Soil - 2023		
<b>No. of samples received</b>	: 6		
<b>No. of samples analysed</b>	: 6		

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.

<i>Signatories</i>	<i>Position</i>	<i>Laboratory Department</i>
Josphin Masihi	Analyst	Waterloo Centralized Prep, Waterloo, Ontario
Nik Perkio	Inorganics Analyst	Waterloo Inorganics, Waterloo, Ontario
Niral Patel		Waterloo Centralized Prep, Waterloo, Ontario
Walt Kippenhuck	Supervisor - Inorganic	Waterloo Inorganics, Waterloo, Ontario



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## 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.

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## 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
<b>Physical Tests (QC Lot: 1238739)</b>											
WT2337389-001	Anonymous	Conductivity (1:2 leachate)	----	E100-L	5.00	µS/cm	0.516 mS/cm	530	2.68%	20%	----
<b>Physical Tests (QC Lot: 1239220)</b>											
EO2310494-001	Anonymous	Moisture	----	E144	0.25	%	29.6	28.0	5.49%	20%	----
<b>Physical Tests (QC Lot: 1239289)</b>											
TY2311832-001	Anonymous	pH (1:2 soil:CaCl2-aq)	----	E108A	0.10	pH units	6.39	6.26	2.06%	5%	----
<b>Physical Tests (QC Lot: 1240804)</b>											
TY2311889-001	Laval 12+487	Oxidation-reduction potential [ORP]	----	E125	0.10	mV	429	399	7.25%	25%	----
<b>Physical Tests (QC Lot: 1240825)</b>											
HA2301055-015	Anonymous	Moisture	----	E144	0.25	%	46.5	53.1	13.2%	20%	----
<b>Inorganics (QC Lot: 1244062)</b>											
TY2311889-001	Laval 12+487	Sulfides, acid volatile	----	E396-L	0.22	mg/kg	<0.22	<0.22	0	Diff <2x LOR	----
<b>Leachable Anions &amp; Nutrients (QC Lot: 1238741)</b>											
TY2311889-001	Laval 12+487	Sulfate, soluble ion content	14808-79-8	E236.SO4	20	mg/kg	<20	<20	0	Diff <2x LOR	----
<b>Leachable Anions &amp; Nutrients (QC Lot: 1238742)</b>											
TY2311889-001	Laval 12+487	Chloride, soluble ion content	16887-00-6	E236.Cl	5.0	mg/kg	19.3	19.2	0.07	Diff <2x LOR	----
<b>Leachable Anions &amp; Nutrients (QC Lot: 1244206)</b>											
TY2311889-002	Draytom 25+380	Sulfate, soluble ion content	14808-79-8	E236.SO4	20	mg/kg	104	106	1	Diff <2x LOR	----
<b>Leachable Anions &amp; Nutrients (QC Lot: 1244207)</b>											
TY2311889-002	Draytom 25+380	Chloride, soluble ion content	16887-00-6	E236.Cl	5.0	mg/kg	2670	2740	2.53%	30%	----



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: 1238739)						
Conductivity (1:2 leachate)	----	E100-L	5	µS/cm	<5.00	----
Physical Tests (QCLot: 1239220)						
Moisture	----	E144	0.25	%	<0.25	----
Physical Tests (QCLot: 1240825)						
Moisture	----	E144	0.25	%	<0.25	----
Inorganics (QCLot: 1244062)						
Sulfides, acid volatile	----	E396-L	0.2	mg/kg	<0.20	----
Leachable Anions & Nutrients (QCLot: 1238741)						
Sulfate, soluble ion content	14808-79-8	E236.SO4	20	mg/kg	<20	----
Leachable Anions & Nutrients (QCLot: 1238742)						
Chloride, soluble ion content	16887-00-6	E236.Cl	5	mg/kg	<5.0	----
Leachable Anions & Nutrients (QCLot: 1244206)						
Sulfate, soluble ion content	14808-79-8	E236.SO4	20	mg/kg	<20	----
Leachable Anions & Nutrients (QCLot: 1244207)						
Chloride, soluble ion content	16887-00-6	E236.Cl	5	mg/kg	<5.0	----



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	Concentration	LCS	Low	High	Qualifier
Physical Tests (QCLot: 1238739)									
Conductivity (1:2 leachate)	----	E100-L	5	µS/cm	1409 µS/cm	101	90.0	110	----
Physical Tests (QCLot: 1239220)									
Moisture	----	E144	0.25	%	50 %	99.1	90.0	110	----
Physical Tests (QCLot: 1239289)									
pH (1:2 soil:CaCl2-aq)	----	E108A	----	pH units	7 pH units	100	98.0	102	----
Physical Tests (QCLot: 1240825)									
Moisture	----	E144	0.25	%	50 %	100	90.0	110	----
Inorganics (QCLot: 1244062)									
Sulfides, acid volatile	----	E396-L	0.2	mg/kg	2.506 mg/kg	74.2	70.0	130	----
Leachable Anions & Nutrients (QCLot: 1238741)									
Sulfate, soluble ion content	14808-79-8	E236.SO4	20	mg/kg	5000 mg/kg	99.5	80.0	120	----
Leachable Anions & Nutrients (QCLot: 1238742)									
Chloride, soluble ion content	16887-00-6	E236.Cl	5	mg/kg	5000 mg/kg	99.9	80.0	120	----
Leachable Anions & Nutrients (QCLot: 1244206)									
Sulfate, soluble ion content	14808-79-8	E236.SO4	20	mg/kg	5000 mg/kg	101	80.0	120	----
Leachable Anions & Nutrients (QCLot: 1244207)									
Chloride, soluble ion content	16887-00-6	E236.Cl	5	mg/kg	5000 mg/kg	101	80.0	120	----



Reference Material (RM) Report

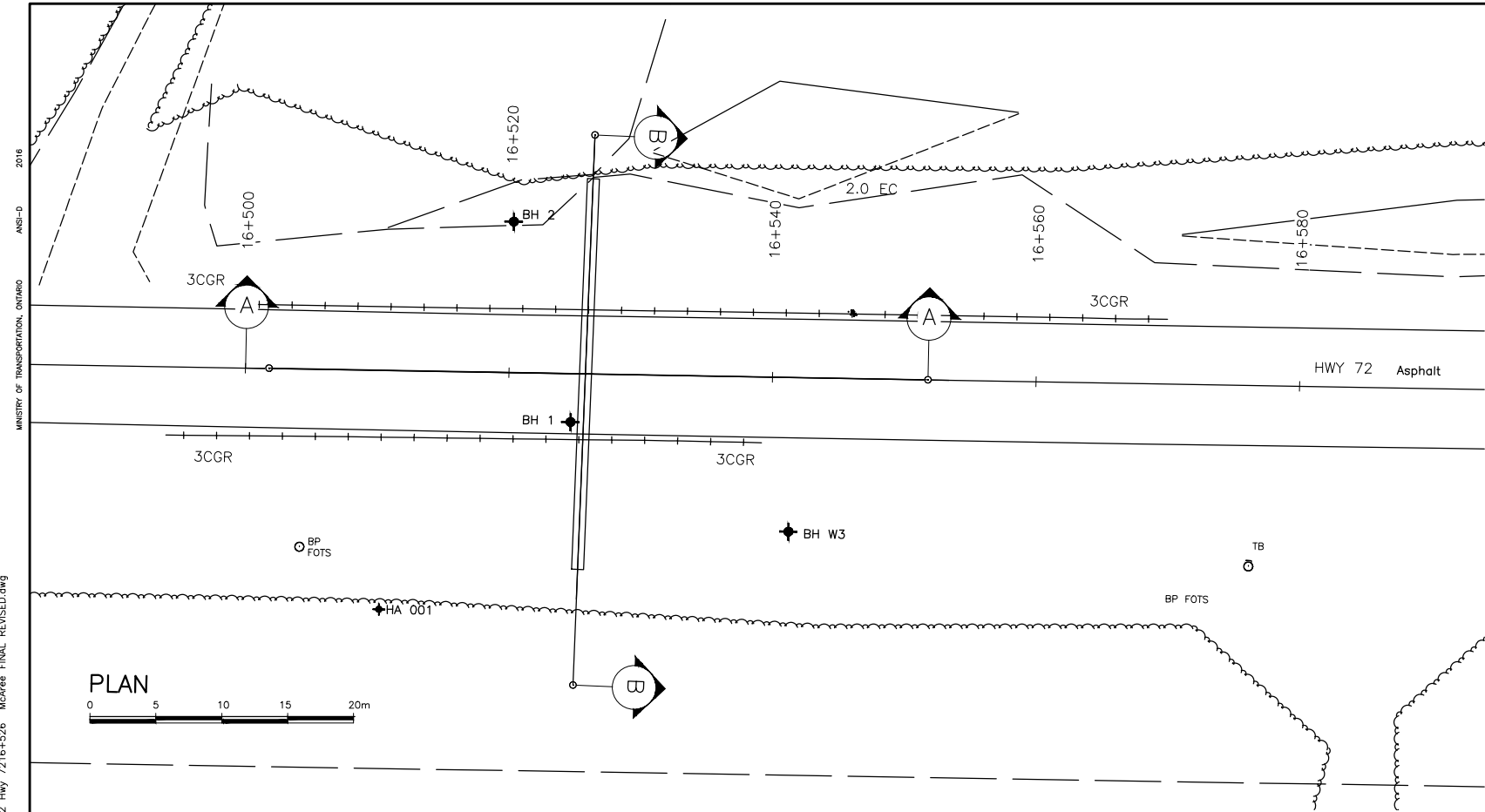
A Reference Material (RM) is a homogenous material with known and well-established analyte concentrations. RMs are processed in an identical manner to test samples, and are used to monitor and control the accuracy and precision of a test method for a typical sample matrix. RM results are expressed as 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:

Sub-Matrix:					Reference Material (RM) Report				
					RM Target Concentration	Recovery (%) RM	Recovery Limits (%)		Qualifier
Laboratory sample ID	Reference Material ID	Analyte	CAS Number	Method			Low	High	
Physical Tests (QCLot: 1238739)									
	RM	Conductivity (1:2 leachate)	----	E100-L	1970.3 µS/cm	110	70.0	130	----
Physical Tests (QCLot: 1240804)									
	RM	Oxidation-reduction potential [ORP]	----	E125	475 mV	98.7	90.0	110	----
Leachable Anions & Nutrients (QCLot: 1238741)									
	RM	Sulfate, soluble ion content	14808-79-8	E236.SO4	1070 mg/kg	109	70.0	130	----
Leachable Anions & Nutrients (QCLot: 1238742)									
	RM	Chloride, soluble ion content	16887-00-6	E236.Cl	432 mg/kg	88.4	70.0	130	----
Leachable Anions & Nutrients (QCLot: 1244206)									
	RM	Sulfate, soluble ion content	14808-79-8	E236.SO4	1070 mg/kg	101	70.0	130	----
Leachable Anions & Nutrients (QCLot: 1244207)									
	RM	Chloride, soluble ion content	16887-00-6	E236.Cl	432 mg/kg	93.9	70.0	130	----

**APPENDIX C**  
**Borehole Location and Soil Strata Drawings**

FILE NAME: Y:\Projects\2023\22-146 MTD, NMR Geotechnical Retainer\22-146-10 - Hwy 72 & 664 FND\Drawings\Culvert Drawings\Finals\Culvert 52 Hwy 7216+526 McArree FINAL REVISED.dwg  
MODIFIED: 2024-04-15 13:48



DIMENSIONS ARE IN METRES  
AND/OR MILLIMETRES UNLESS  
OTHERWISE SHOWN



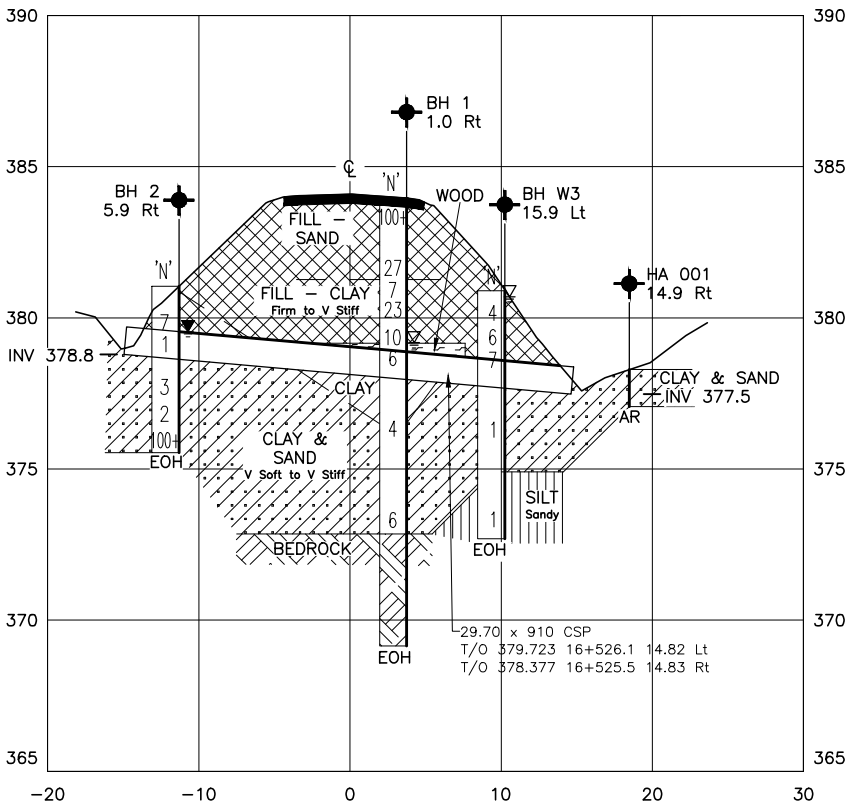
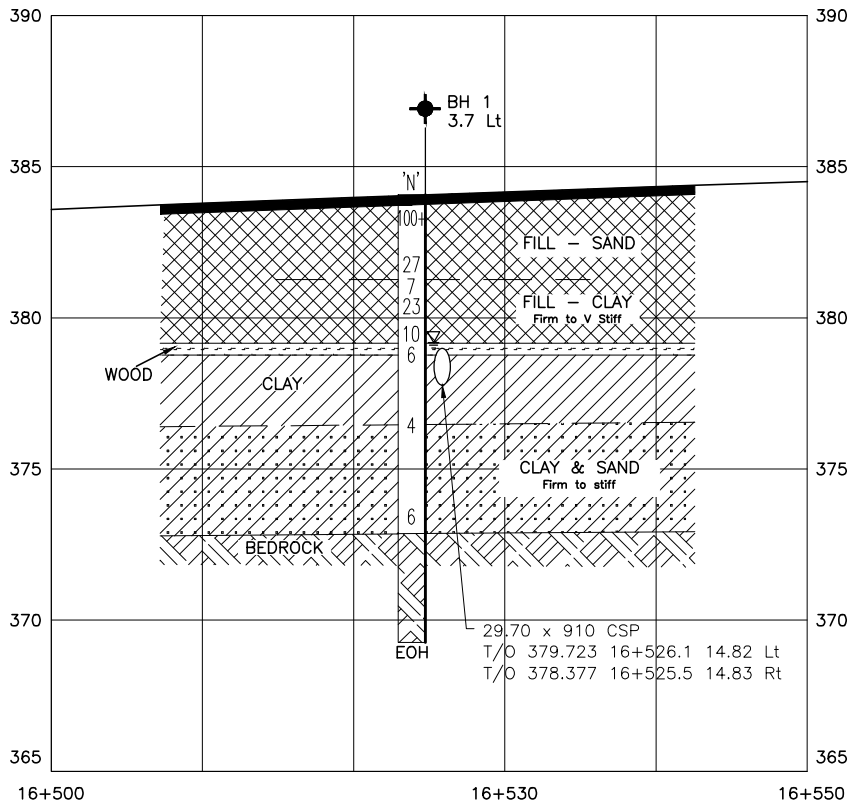
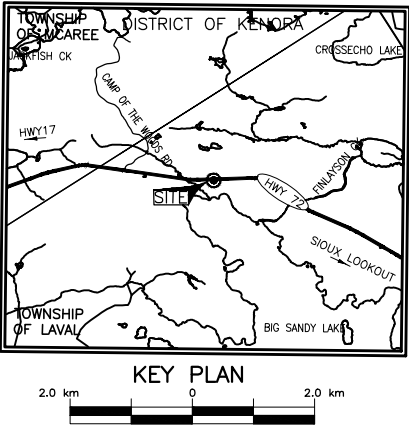
**Ontario** Ministry of Transportation

**GEOCRES** 52F16-003  
**CONT** -  
**WP** 6033-19-00

SOIL STRATA  
STA 16+526 CULVERT #52  
STA 16+526 HIGHWAY 72

**TBT ENGINEERING**  
CONSULTING GROUP

SHEET



SOIL STRATA SYMBOLS	
	ASPHALT
	WOOD
	FILL
	CLAY
	CLAY & SAND
	SILT - Sandy
	BEDROCK

LEGEND			
	Borehole		
	Std Pen Test (Blows/0.3m)		
	Water Level on Completion		
	Water Level after Completion		
	EOH		
No	ELEVATION	CO-ORDINATES (MTM 16)	
		NORTH	EAST
BH 1	383.9	16 5 524 047	348 247
BH 2	381.3	16 5 240 051	348 232
BH W 3	381.3	16 5 524 057	348 263
HA 001	377.8	16 5 524 027	348 253

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

REVISIONS					
3	SS	CHANGE TO CULVERT NUMBER 16/04/24			
2	SS	ISSUED FOR FINAL 28/03/24			
1	SS	ISSUED FOR REVIEW			
DESIGN	XX	CHK	TG	CODE XXXXXX	LOAD XXXX
DRAWN	NB	CHK	SS	SITE XXXXX	DATE 12/01/24
					DWG 1

**APPENDIX D**  
**Site Photographs**





**Left Embankment**  
**Looking South, June 28, 2023.**



**Right Embankment**  
**Looking South, June 28, 2023.**



**Left Embankment**  
**Looking West, June 28, 2023.**