Foundation Investigation Report

Manitouwadge Rest Area Washroom Facility
Assignment #8 6019-E-0042
District Thunder Bay
Highway 17 & 614

Prepared for
NWR Ministry of Transportation
615 James Street South
Thunder Bay, ON
P7E 6P6

Prepared By:
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Ref. No. 20-108-8

Table of Contents

APPENDICIES

Part A - FOUNDATION INVESTIGATION REPORT

1 Introduction

TBT Engineering Limited (TBTE) has been retained by the Ministry of Transportation (MTO) – North West Region to provide a foundation investigation and design services for the proposed new, year round, rest area washroom facility located at Manitouwadge rest area at the corner of Highways 17 and 614, in the district of Thunder Bay. It is understood that the final building footprint has not been finalized, however, sizing provided by MTO show that the proposed new washroom building footprint may be constructed up to 7 m x 7 m (49 m^2). Currently, there is an existing building with a single drop toilet at the proposed investigation area. The rest area is located approximately 45 km east of Marathon. The site co-ordinates for the site are as follows:

- Manitouwadge Rest Area, lat: 48.703884, lon: -85.859644

A foundation investigation was carried out to investigate subsurface conditions for the proposed new washroom facility. The investigation consisted of four test pits at the site. Two test pits were for the proposed washroom and two for the septic field design. This report (Part A) describes the subsurface conditions encountered during the investigation.

2 Site Description

Manitouwadge rest area is located at the intersection of Highways 17 and 614, approximately 45 km east of Marathon, ON and approximately 54 km South of Manitouwadge, ON. The existing rest area consists of a large gravel parking lot, several picnic areas, several displays, and one privy/outhouse building.

Vegetation surrounding the rest area is dense. Several trees and other dense vegetation are located to the north and west of the rest area. The terrain is gently sloping from East to West towards ditching adjacent to the highway.

Figure 1: Existing privy at the West end Manitouwadge park rest stop (area of investigation)

Figure 2: Existing privy, looking West

2.1 Surficial Geology

As defined by the Ontario Ministry of Natural Resources' Northern Ontario Engineering Geology Terrain Study (NOEGTS), 1981, Map No. 42CnW "White River", the site is located in an area which consists of a veneer till ground moraine over rock with subordinate areas of rock knob with low local relief and dry surface conditions.

Till was encountered underlying the fill and topsoil during the investigation.

3 Investigation Procedures

A geotechnical site investigation was undertaken on October 27, 2020 and consisted of advancing two test pits to depths of ranging from 3.2 m to 4.0 m. The test pits were completed using a Caterpillar 322 track mounted excavator. Originally a drill rig was to be utilized for this project. However due to the timing of the project and current drilling obligations, it was determined through consultation with the client to utilize an excavator for this project.

During the field operations, representative disturbed samples were obtained from the backhoe bucket and/or the walls of the test pit. A modified SPT (modified using a 70 lb hammer) test was also used to obtain soil samples and to estimated SPT N values. The modified SPT test involves driving a 51 mm diameter thick-walled sampler into the soil under the energy of a 31.8 kg weight falling through 760 mm. The blows recorded to advance the split spoon are divided by two to provide the estimated “N” value. Hand operated cone penetration testing and field vane tests were also carried out to provide an indication of the condition or consistency of the soil.

Water levels were measured within open test pits. The test pits were backfilled and with the excavated material and tamped with the excavator.

The location of test holes was established in the field by TBTE personnel and service clearances were completed prior to mobilization to site. Borehole locations were surveyed by TBTE and were referenced to North American Datum 1983 (NAD83 CSRS CBNv6-2010.0) 3 Degree Modified Transverse Mercator (MTM), Central Scale Factor 0.9999 Grid Coordinates. Test Hole Locations and Soil Stratification drawings have been provided in Appendix C.

4 Laboratory Testing

Samples which were obtained during the field investigation were subjected to routine laboratory testing. The routine testing included moisture content, and grain size analysis conducted on select samples. The results of these tests are shown on the Test Pit 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 Test Hole Location and Soil Strata drawings (Appendix C).

The generalized subsurface soils at this site consists of topsoil and/or fill at surface overlying till. A discontinuous organic layer was noted underlying the fill at one test hole location.

5.1 Topsoil

100 mm of topsoil was encountered at the surface of Test Pit 1 at an elevation of 315.9 m.

5.2 Fill

Variable fill consisting of sand with some gravel and trace to some silt was present underlying the top soil at Test Pit 1 and at the surface of Test Pit 2 and extended to depths of 0.9 to 1.5 m (elev. 315.0 m at both test hole locations). Grain size analysis carried out on three selected samples indicates that the fill can consist of 13 to 20 % gravel, 67 to 80 % sand, and 4 to 13 % silt/clay sized particles. Modified SPT testing carried out indicates that this material is in a compact condition, with estimated SPT N-values ranging from 11 to 29 blows per 0.3 m. This material has not been documented during placement and the composition and condition may vary across the site. No documentation has been provided indicating the condition of the subgrade prior to the fill placement. The existing fill may be selectively reused as structural back fill, but must be tested. Careful sorting will be required.

5.3 Organic

Organic material was encountered beneath the fill at Test Pit 2. The organic material was encountered at a depth of 1.5 m (elev. 315.0 m) and is 0.1 m thick.

5.4 Till

Till consisting of a heterogeneous mixture of gravels, sand, and silt with occasional cobbles/boulders was identified underlying the fill at Test Pit 1 and underlying the topsoil at Test Pit 2. This material extended to the termination of the test pits (elev.311.9 to 312.7 m). Grain size analysis carried out on four selected samples indicates that the till can consist of 7 to 12 % gravel, 39 to 55 % sand, and 33 to 54 % silt/clay sized particles. Modified SPT testing carried out indicates that this material is in a loose to dense condition, with estimated SPT N-values ranging from 8 to 42 blows per 0.3 m.

5.5 Refusal

Refusal was not encountered in any of the test holes. Test Pits were terminated due to limitations of the excavator.

5.6 Groundwater

The groundwater levels were read upon completion of field investigation and were found to be dry to the extent of the test pit. Seepage was noted at 2.0 m within Test Pit 1 (elev. 313.9 m). Groundwater levels will vary from season to season and from the effects of heavy precipitation events.

6 Miscellaneous

Laboratory testing was carried out at the TBT Engineering laboratory in Thunder Bay. The excavator equipment for this investigation was operated by Pioneer Construction. The field operations were supervised by Steven Anderson, B.Eng, E.I.T. 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 designated principal contact identified for this MTO Foundation Engineering project).

7 Limitations

Conclusions and recommendations presented in this report are based on the information determined at a limited number of test hole 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 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 dewatering procedures which may be considered cannot readily be determined from boreholes. These include local and seasonal fluctuations of the groundwater level, changes in soil conditions between test locations, thin and/or discontinuous layers of highly permeable soils, etc.

The information contained within this report in no way reflects 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 the contact us at your convenience.

Yours truly,
For TBT ENGINEERING

Dean Vale, P.Eng
Project Engineer

Steven Seller, P.Eng.
Senior Engineer
Principal Contact for MTO Foundations

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 Shellby 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
$\varepsilon_1, \varepsilon_2, \varepsilon_3$	%	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	Undrainded 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	$m^{3}/_{5}$	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 TEST PIT No 1

1 OF 1

METRIC

W.P. 6001-20-00 LOCATION N:5396787.2; E:388670.16 MTM Zone:14 ORIGINATED BY S.A.

DIST NWR HWY 614 BOREHOLE TYPE Excavator COMPILED BY T.B.

DATUM Geodetic DATE 2020.10.26 LATITUDE 48.703908 LONGITUDE -85.860407 CHECKED BY D.V.

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES ESTIMATED MODIFIED "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
315.9											
0.0 / 315.8	TOPSOIL - rootlets										Dry on completion.
0.1	FILL - SAND - some gravel, some silt, brown, compact		1	SS	11				○		13 76 (11)
315.0							315		○		9 50 (41)
0.9	TILL - SAND & SILT - trace gravel, brown, loose to dense		2	SS	8						
	- - - - - - brown/grey		3	SS	31		314		○		Water seepage @ 2.0 m.
			4	SS	26		313		○		7 39 (54)
311.9			5	GRAB			312		○		
4.0	End of Testpit @ 4.0 m. Extent of Excavator.										

+ ³, × ³: Numbers refer to Sensitivity ○ ³% STRAIN AT FAILURE PP=Pocket Penetrometer (Kg/cm²)

RECORD OF TEST PIT No 2

1 OF 1

METRIC

W.P. 6001-20-00 LOCATION N:5396784.2; E:388693.17 MTM Zone:14 ORIGINATED BY S.A.

DIST NWR HWY 614 BOREHOLE TYPE Excavator COMPILED BY T.B.

DATUM Geodetic DATE 2020.10.26 LATITUDE 48.703878 LONGITUDE -85.860095 CHECKED BY D.V.

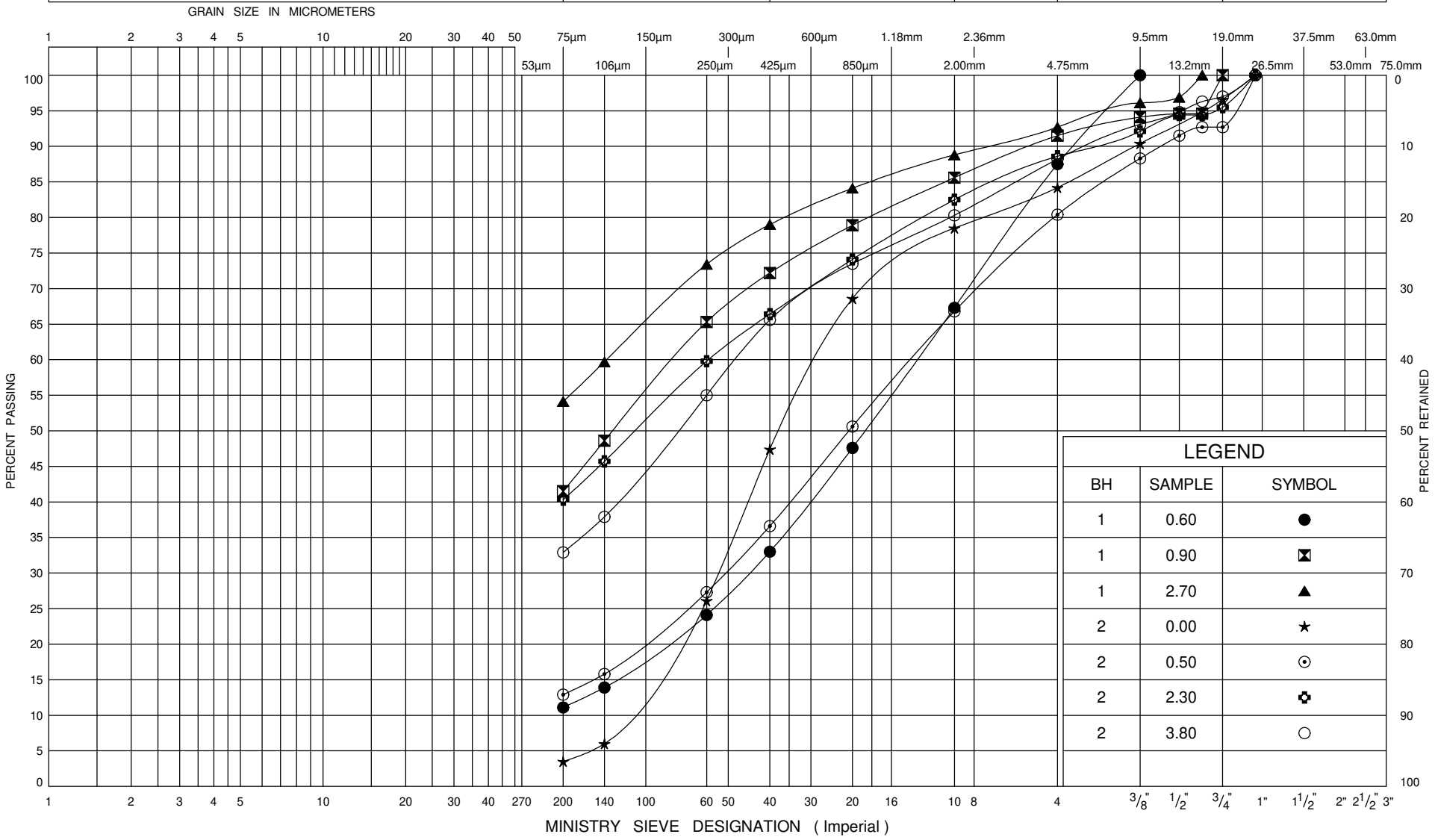
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES ESTIMATED MODIFIED "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
316.5											
0.0	FILL - SAND - some gravel, trace to some silt, brown, compact		1	GRAB							16 80 (4) Dry on completion.
			2	SS	29		316				20 67 (13)
315.0											
1.5	ORGANICS						315				
314.9											
1.6	TILL - SAND & SILT - some gravel, some organics, occasional cobbles & boulders, grey, compact to dense		3	SS	10						
			4	SS	42		314				12 48 (40)
	- - - - - - Silty		5	GRAB			313				12 55 (33)
312.7											
3.8	End of Testpit @ 3.8 m. Extent of Excavator.										

+ 3, × 3: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE PP=Pocket Penetrometer (Kg/cm²)

ONTARIO MTO MOD TESTPIT EST N 20-108-8 MTO HWY 17_614.GPJ ONTARIO MTO.GDT 11-10-20

APPENDIX B
Laboratory Test Data

UNIFIED SOIL CLASSIFICATION SYSTEM



LEGEND		
BH	SAMPLE	SYMBOL
1	0.60	●
1	0.90	⊠
1	2.70	▲
2	0.00	★
2	0.50	⊙
2	2.30	✿
2	3.80	○

Ministry of Transportation
Ontario

GRAIN SIZE DISTRIBUTION
TILLS

FIG No 1

W P 6001-20-00

Manitouwadge Rest Area

ONTARIO MOT GRAIN SIZE 20-205-7 MTO HWY 17_614.GPJ ONTARIO MOT.GDT 11-10-20

APPENDIX C
Borehole Locations and Soil Strata Drawing

METRIC

DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN

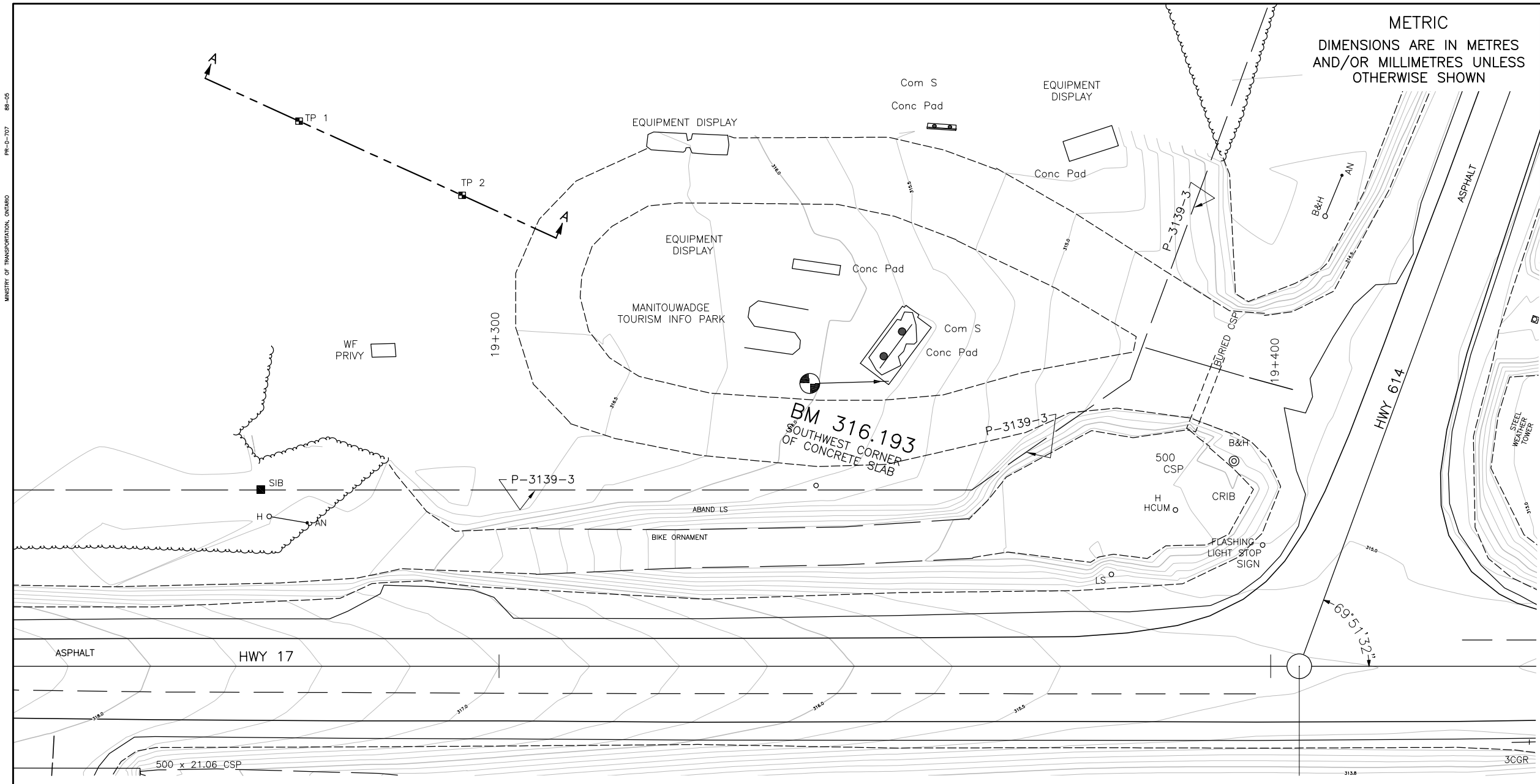
GEOCRES	No.	XXX-XXX
CONT	No.	202x-xx
GWP	No.	6001-20-00

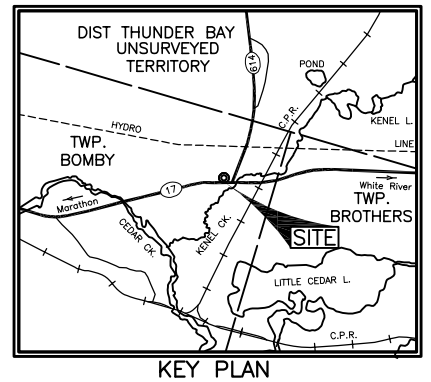
MANITOUWADGE REST AREA
FOUNDATION INVESTIGATION
BOREHOLE LOCATIONS AND SOIL STRATA

SHEET

Ontario — Ministry of Transportation
Northwestern Region
Structural Section

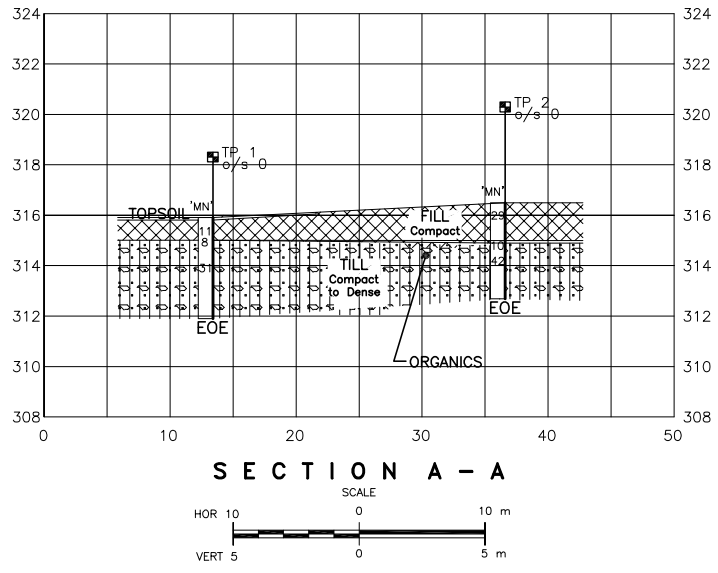
TBT ENGINEERING
CONSULTING GROUP





LEGEND

	Testpit
'MN'	Modified Pen Test (Blows/0.3m) (Estimated 'N')
	Water Level on completion
EOE	Extent of Excavator



SECTION A-A

SCALE

HOR 10 — 0 — 10 m

VERT 5 — 0 — 5 m

SOIL STRATA SYMBOLS

TOPSOIL

TILL

FILL

No	ELEVATION	CO-ORDINATES (MTM) NORTH	EAST
1	315.9	14 5 396 787	388 670
2	316.5	14 5 396 784	388 693

LICENSED PROFESSIONAL ENGINEER
S.W.S. SELLER
100043505
PROVINCE OF ONTARIO
Nov 10/2020

LICENSED PROFESSIONAL ENGINEER
D. VALE
100117156
PROVINCE OF ONTARIO
Nov 10/2020

NOTE

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

DRAWING REFERENCED FROM B-484855-614-8.

REVISIONS			
09/11/20	DV	DRAFT	
		DESCRIPTION	

DESIGN		CHK		CODE	XXXXX-XX	LOAD XX-XXX-XXX	DATE 09112020
DRAWN	TB	CHK	DV	SITE	XXX-XXX		DWG 1

MINISTRY OF TRANSPORTATION, ONTARIO PR-D-707 88-05

Nov 10 , 2020 , 3:02pm Login name: tblarsen
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