



**Preliminary
Foundation Investigation and Design Report
Highway 587 Culvert
Station 14+965
Township of McTavish**

GWP 125-90-00

Geocres No.: 52A-169

**Prepared for
Engineering Northwest Engineering
A Division of Hatch Mott MacDonald
200 South Syndicate Avenue
Thunder Bay, Ontario, P7E 1C9**

**Prepared By:
TBT Engineering Limited
1918 Yonge Street
Thunder Bay, Ontario, P7E 6T9**

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Ref. No. 11-214

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Part A - FOUNDATION INVESTIGATION REPORT

1 Introduction

TBT Engineering Limited (TBTE) has been retained by Engineering Northwest Limited a division of Hatch Mott MacDonald (ENL) to provide preliminary foundation investigation and design services for the proposed culvert replacement on Highway 587 located at Sta. 14+965 Township of McTavish. This site is a part of the Highway 11/17, four-laning project from 5.0 km west of Highway 587 easterly 6.5 km. The foundation investigation was conducted to provide preliminary subsurface data for the development of a new alignment for Hwy 587 at the intersection with Hwy 11/17.

This site is one of several foundation sites being investigated as a part of the Hwy. 11/17 widening project. The remaining foundation sites (Embankments on Hwy. 11/17 and 587 and Culverts on Hwy 11/17) are addressed under separate covers. The Hwy. 587 culvert has been designated as foundation Site 2 for the project.

This investigation consisted of two boreholes drilled adjacent to the existing culvert, laboratory testing and geotechnical analysis of the data. This report (Part A) describes the subsurface conditions encountered during the investigation. The boreholes are labeled from 2-1 and 2-2.

The foundation section has assigned GEOCREC No. 52A-169 to this site.

2 Site Description

The foundation investigation was carried out to investigate subsurface conditions at the culvert at Blende Creek located at Sta. 14+965 along Hwy 587 in the Township of McTavish. The Blende Creek originates at Blende Lake and flows into the Blende River, eventually discharging into Lake Superior.

The culvert crosses Hwy 587 diagonally from the southwest to the northeast. The culvert is 2000 mm CSP approximately 36 m long in fair condition with some rusting on the bottom. The outlet is perched approximately 300 mm. The culvert is at the beginning of the proposed new highway alignment which will intercept Highway 11/17 at an approximate 90° angle. The new highway embankment will have a maximum height of 17 m, with an estimated 2.5 m high raise in the vertical alignment at the culvert location. A bedrock outcrop was observed southerly of the site on the left side.



Site Photo 1 - Culvert at Site 2 Outlet

2.1 Surficial Geology

Based on review of surface geology mapping, the site is located in an area of organic terrain overlying sand and glacial outwash plain. The area also includes bedrock knob terrain with subordinate land forms consisting of till ground moraine.

3 Investigation Procedures

A geotechnical site investigation was undertaken on April 11, 2013 which included 2 boreholes (Borehole 2-1 and 2-2). The borehole locations are illustrated on the Borehole Location Plan found in Appendix A.

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 an all terrain mounted drill rig equipped hollow stem augers and a cat head used to carry out standard penetration testing (SPT). Soil samples were obtained at the boreholes from the auger flights and using a split spoon sampler as a part of the Standard Penetration Testing (SPT).

Surveys were conducted using North American Datum 1983, MTM CSRS Zone 15. Control was established from existing published Horizontal Control Monuments and a Geodetic Benchmark based on the Canadian Geodetic Vertical Datum 1928. The horizontal control point used is identified as HCM 00819710510, and vertical control point is identified as GBM 0011993U171 with a Geodetic Elevation of 244.800. The survey was completed using a Trimble R8 Series 3 RTK GPS.

All boreholes were backfilled with a bentonite mixture following drilling. Temporary standpipe have been removed and decommissioned.

4 Laboratory Testing

Samples which were obtained during the field investigation were subjected to routine laboratory testing. The routine testing included moisture content, Atterberg limits and grain size analysis (where appropriate). The results of this testing are shown on the Borehole Logs (Appendix A) and on the laboratory data reports (Appendix B).

5 Sub-Surface Conditions

Details of the subsurface conditions are provided on the borehole logs (Appendix A) and on the Soil Strata Drawings (Appendix C).

The subsurface soils at this site typically consist of thin topsoil which overlie fill (sand fill/gravel fill) over sand. All boreholes extended to shallow practical refusal on boulders or bedrock.

5.1 Topsoil

Topsoil was encountered at ground surface at both boreholes. The topsoil ranged in thickness from 20 mm to 100 mm. Deeper zones may exist between and/or outside of the test hole locations.

5.2 Fill

Granular fill was encountered beneath the topsoil at both boreholes. The fill has been identified as sand fill and/or gravel fill.

The sand fill ranges in thickness from 0.5 to 1.2 m extending to elevations ranging from 221.0 to 221.1. The sand fill consists of sand, some gravel and trace to some silt. The sand fill has a compact relative density as indicated by a SPT (N) value of 15 blows/0.3 m. It should be noted that Borehole 2-2 terminated at this level.

The gravel fill is encountered beneath the sand fill at Borehole 2-1 with a thickness of 1.3 m, and extending to an elevation of 219.8. A single sample was selected for grain size distribution testing. The test results indicated a grain size distribution of 67 % gravel, 28 % sand, 5 % silt/clay sized particles. Numerous cobbles and boulders were also encountered within this fill. The gravel fill has a compact to very dense relative density as indicated by SPT (N) values of 12 and 56 blows/0.3 m.

5.3 Sand

Gravelly sand with some silt was encountered beneath the gravel fill in Borehole 2-1. The sand was encountered at Borehole 2-1 (Elev. 219.8) with a thickness of 0.9 m. A single sample was selected for grain size distribution testing. The test result indicated a grain size distribution of 25 % gravel, 55 % sand, and 20 % silt/clay sized particles. The sand has a loose to compact relative density as indicated by "N" values ranging from 9 to 11 blows/0.3 m. It should be noted that Borehole 2-1 terminated at this level.

5.4 Refusal

Auger refusal and "N" values of 100+ blows/0.3 m was encountered at both borehole locations. The following table indicates the recorded refusal depths at each borehole. Refusals may be on cobbles, boulders, or bedrock. Refusal material was not sampled.

Table 1: Borehole Refusal

Borehole Number	Refusal Depth (m)	Refusal Elevation (m)
2-1	2.7	218.9
2-2	1.2	221.0

5.5 Ground Water

The ground water level was measured on May 23, 2013 at Borehole 2-1. The ground water was present a depth of 1.4 m from ground surface (Elev. 220.2). Ground water levels will vary from season to season and from the effects of heavy precipitation events.

The water level in the culvert was measured at an elevation 220.6 at the time of the investigation. The downstream water level was approximately 0.4 m (Elev. 220.2) below the culvert level (perched condition).

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 David Binch. Laboratory testing was supervised by T. Fummerton C.E.T. This report was prepared by Steven Seller, P.Eng, and reviewed by W. Hurley, P.Eng (TBTE designated principal contact identified for MTO Foundation Engineering projects).

Part B - FOUNDATION DESIGN RECOMMENDATIONS

7 Introduction

TBT Engineering (TBTE) has been retained by the Engineering Northwest Limited a division of Hatch Mott MacDonald (ENL) to provide preliminary foundation investigation and design services for the proposed culvert replacement on Highway 587 located at Station 14+965 Township of McTavish. The vertical alignment across the culvert location will be raised by approximately 2.5 m. The foundation investigation was conducted to provide preliminary subsurface data for the preliminary design of the culvert. No design details are available at this time, however the new culvert is expected to be an open footing culvert design, spanning at least two metres.

The preliminary foundation investigation as described in Part A, was carried out to investigate subsurface conditions at this site. This preliminary investigation consisted of two boreholes (BH 2-1 and 2-2) located adjacent to the existing culvert.

The subsurface soils at this site typically consist of thin topsoil which overlie fill (sand fill/gravel fill) over sand. All boreholes extended to shallow practical refusal on boulders or bedrock (100+ "N" values as determined from the Standard Penetration Test).

The purpose of this section of the report (Part B) is to provide preliminary foundation recommendations for various foundation options. These are based on the conditions encountered at the borehole locations and TBTE's interpretation of the subsurface conditions at the site.

8 Structure Foundations

Multiple foundation systems have been considered for the proposed culvert replacement. The foundation systems considered are:

- Spread Footings on Native Soil
- Spread Footings on Rock Fill
- Driven Piles

Preliminary design parameters for the above foundation systems are presented below. Preliminary recommendations for the viable foundation systems are presented based on the subsurface conditions encountered on site and the preliminary vertical alignment increase.

Unless noted otherwise, foundation design parameters are given for static, vertically and concentrically loaded foundations in compression.

8.1 Spread Footings

Spread footings will likely be appropriate for open footing culverts. A resistance factor of 0.5 has been applied for the estimation of factored geotechnical resistance at ULS. Settlements for SLS have been estimated assuming a uniform pressure distribution over the entire base of the foundation, with an allowance for potential of some disturbance of the founding surface during construction.

Any divergence from the conditions described herein could result in the reduction of ULS values, presented in Tables 2 and 3. For example if the foundation is placed shallower and/or the ground is sloping away from the foundation, a reduction in the ULS values may be realized.

Preliminary analysis for various spread footing sizes has been completed for spread footings constructed on native compact sand and rock fill over native soils.

8.1.1 Spread Footings on Compact Native Sand

Footings may be placed directly on the native sand subgrade. Preliminary estimates of foundation bearing resistances/reactions of typical designs are provided on Table 2:

Table 2: Geotechnical Resistances and Reactions .

Effective Footing Width (m)	Depth of Cover to Underside of Footing (m)	Factored Geotechnical Resistance, ULS (kPa)	Geotechnical Reaction, SLS (kPa) for 25 mm settlement
1.2	1	140	140
1.5	1	150	150
1.8	1	165	140
2.0	1	170	135

8.1.2 Spread Footings on Rock Fill

Footings may also be founded on a rock fill pad. Typical designs include:

1. Foundation element is on a graded rock fill pad with a specific thickness.
2. The graded rock fill pad will be placed on native compact sand, or potentially on bedrock. Should the rock fill be placed directly on bedrock significantly higher loadings will be available.

Typical geotechnical resistances at ULS and geotechnical reactions at SLS for footings founded on rock fill are provided in Table 3:

Table 3: Geotechnical Resistances and Reactions

Effective Footing Width (m)	Depth of Fill Below Footing (m)	Depth of Cover to Underside of Footing (m)	Factored Geotechnical Resistance, ULS (kPa)	Geotechnical Reaction, SLS (kPa) for 25 mm settlement
1.2	0.5	1	275	270
1.5	0.5	1	275	250
1.8	0.5	1	280	230
2.0	0.5	1	285	220

The rock fill pad should consist of graded rock fill . The base of the pad should extend horizontally beyond the edge of the footings by a distance at least equal to the thickness of the rock fill pad provided. The rock fill pad should be wrapped in a heavy non-woven geotextile to prevent ground loss due to soil migration from adjacent native soils.

8.2 Driven Piles

Driven piles are not considered appropriate as culvert foundations at this site due to the shallow (1.2 to 2.7 m) refusal encountered.

9 Culvert Camber

The culvert cambering requirement is expected to be minimal with less than 20 mm of settlement anticipated below the culvert.

10 Backfill and Bedding Material

The existing site materials are not suitable for use as structural backfill. Any excavated existing fill or native materials shall be replaced by Granular "B" Type II. Granular A may be specified as structural backfill in specific zones.

11 Scour Protection

Where appropriate, foundation elements should be provided with sufficient scour protection in the event of elevated river levels. Scour protection should be designed in accordance with Section 1.10.5 of the Canadian Highway Bridge Design Code

12 Estimated Frost Depth

Based on the Ontario Provincial Standard Drawing 3090.1 "Foundation Frost Depth for Northern Ontario" the estimated frost depth penetration within the expected embankment fill is 2.6 m. The soils anticipated within the frost depth are considered to be of low frost susceptibility (MTO Pavement Design and Rehabilitation Manual).

13 Roadway Protection

The overall embankment will in the order of 5 m, and may require the use of roadway protection during construction.

14 Dewatering, Excavations and Channel Diversion

Excavations should be excavated and sloped in accordance with the requirements of the Occupational Health and Safety act. The soils below the ground water level are coarse grained and permeable. Flows in to open excavations below the ground water level will be relatively rapid.

Channel diversion during construction is not anticipated to be required during construction. Improvements/revisions to the channel may be required following removal of the existing culvert. Foundation implications are expected to be minimal, providing the new culvert spans the full channel width.

15 Potential Construction Issues

No major construction difficulties are foreseen at this site. Issues which may require consideration include:

- Control of surface water during construction. Permanent positive drainage will be ensured during the design phase.
- Control of groundwater during excavation below the creek/groundwater level.
- Potential foundation design/construction constraints resulting from fishery considerations.

16 Scope of Detailed Investigation

The detailed design of the proposed embankment will require additional geotechnical investigation to complete a detailed Foundations Investigation and Design report. The scope of work should address all issues normally included in such a report and should incorporate the following items:

- Review of any existing geological and geotechnical information in the area;
- Foundation field investigation to MTO standards, to determine subsurface conditions, including depth to competent stratum and water levels;
- Confirmation of the refusal material;
- Shear testing of foundation soils;
- Preparation of Foundation Reports (Parts A and B) documenting factual information and recommendations on geotechnical aspects of design and construction.
- Confirmation of potential camber requirements.
- Subsurface investigations should address potential roadway protection requirements.

17 Limitations

Conclusions and recommendations presented in this report are based on the information determined at the test hole locations. These preliminary recommendations are made on the basis that additional investigations, testing and analyses will be carried out during detail design and are not to be used for construction. Subsurface and groundwater conditions between and beyond these locations may differ from those encountered. Conditions may become apparent during detailed design investigations or construction that were not detected and could not be anticipated at the time of the preliminary 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.

18 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



Steven Seller, P.Eng.
Project Engineer



Wayne Hurley, P.Eng.
Senior Engineer
Principal Contact for MTO Foundations

APPENDIX A

Borehole Logs

EXPLANATION OF TERMS USED IN REPORT

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 63.5kg, 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 OR DENSENESS.

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

DENSENESS: COHESIONLESS SOILS ARE DESCRIBED ON THE BASIS OF DENSENESS AS INDICATED BY SPT N VALUES AS FOLLOWS:

N (BLOWS/0.3m)	0 - 5	5 - 10	10 - 30	30 - 50	>50
	VERY LOOSE	LOOSE	COMPACT	DENSE	VERY DENSE

ROCKS ARE DESCRIBED BY THEIR COMPOSITION AND STRUCTURAL FEATURES AND / OR STRENGTH.

RECOVERY: SUM OF ALL RECOVERED ROCK CORE PIECES FROM A CORING RUN EXPRESSED AS A PERCENT OF THE TOTAL LENGTH OF THE CORING RUN.

MODIFIED RECOVERY: SUM OF THOSE INTACT CORE PIECES, 100mm+ IN LENGTH EXPRESSED AS A PERCENT OF THE LENGTH OF THE CORING RUN. THE ROCK QUALITY DESIGNATION (R Q D), FOR MODIFIED RECOVERY, IS:

R Q D (%)	0 - 25	25 - 50	50 - 75	75 - 90	90 - 100
	VERY POOR	POOR	FAIR	GOOD	EXCELLENT

JOINTING AND BEDDING:

	50mm	50 - 300mm	0.3m - 1m	1m - 3m	>3m
JOINTING	VERY CLOSE	CLOSE	MOD. CLOSE	WIDE	VERY WIDE
BEDDING	VERY THIN	THIN	MEDIUM	THICK	VERY THICK

ABBREVIATIONS AND SYMBOLS

FIELD SAMPLING

S S SPLIT SPOON	T P THINWALL PISTON
W S WASH SAMPLE	O S OSTERBERG SAMPLE
S T SLOTTED TUBE SAMPLE	R C ROCK CORE
B S BLOCK SAMPLE	P H T W ADVANCED HYDRAULICALLY
C S CHUNK SAMPLE	P M T W ADVANCED MANUALLY
T W THINWALL OPEN	F S FOIL SAMPLE

MECHANICAL PROPERTIES OF SOIL

m_v	kPa^{-1}	COEFFICIENT OF VOLUME CHANGE
C_c	1	COMPRESSION INDEX
C_s	1	SWELLING INDEX
C_a	1	RATE OF SECONDARY CONSOLIDATION
C_v	m^2/s	COEFFICIENT OF CONSOLIDATION
H	m	DRAINAGE PATH
T_v	1	TIME FACTOR
U	%	DEGREE OF CONSOLIDATION
σ'_{v0}	kPa	EFFECTIVE OVERBURDEN PRESSURE
σ'_p	kPa	PRECONSOLIDATION PRESSURE
τ_f	kPa	SHEAR STRENGTH
c'	kPa	EFFECTIVE COHESION INTERCEPT
ϕ'	-°	EFFECTIVE ANGLE OF INTERNAL FRICTION
C_u	kPa	APPARENT COHESION INTERCEPT
ϕ_u	-°	APPARENT ANGLE OF INTERNAL FRICTION
τ_R	kPa	RESIDUAL SHEAR STRENGTH
τ_r	kPa	REMOULDED SHEAR STRENGTH
S_f	1	SENSITIVITY = $\frac{C_u}{\tau_r}$

STRESS AND STRAIN

u_w	kPa	PORE WATER PRESSURE
r_u	1	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 STRESSES
ϵ	%	LINEAR STRAIN
$\epsilon_1, \epsilon_2, \epsilon_3$	%	PRINCIPAL STRAINS
E	kPa	MODULUS OF LINEAR DEFORMATION
G	kPa	MODULUS OF SHEAR DEFORMATION
μ	1	COEFFICIENT OF FRICTION

PHYSICAL PROPERTIES OF SOIL

ρ_s	kg/m^3	DENSITY OF SOLID PARTICLES	e	1, %	VOID RATIO	e_{\min}	1, %	VOID RATIO IN DENSEST STATE
γ_s	kN/m^3	UNIT WEIGHT OF SOLID PARTICLES	n	1, %	POROSITY	I_D	1	DENSITY INDEX = $\frac{e_{\max} - e}{e_{\max} - e_{\min}}$
ρ_w	kg/m^3	DENSITY OF WATER	w	1, %	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	1	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	1	LIQUIDITY INDEX = $\frac{w - w_p}{I_p}$	i	1	HYDRAULIC GRADIENT
γ_{sat}	kN/m^3	UNIT WEIGHT OF SATURATED SOIL	I_C	1	CONSISTENCY INDEX = $\frac{w_L - w}{I_p}$	k	m/s	HYDRAULIC CONDUCTIVITY
ρ'	kg/m^3	DENSITY OF SUBMERGED SOIL	e_{\max}	1, %	VOID RATIO IN LOOSEST STATE	j	kN/m^2	SEEPAGE FORCE
γ'	kN/m^3	UNIT WEIGHT OF SUBMERGED SOIL						

TBT Engineering Consulting Group			RECORD OF Borehole No 2-1			1 OF 1		METRIC	
W.P. 125-90-00			PROJECT Hwy 11/17 - 4 Laning - Hwy 587			SITE NO. 2		ORIGINATED BY D.B.	
DIST 61 HWY 587			LOCATION MTM 15 395072, 5385251			TBTE JOB# 11-214		COMPILED BY T.B.	
DATE 2013 April 11			BOREHOLE TYPE Hollow Stem Auger			DATUM Geodetic		CHECKED BY S.S.	

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC NATURAL LIQUID LIMIT MOISTURE LIMIT CONTENT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa		W _p	W			W _L
221.6	TOPSOIL - 20 mm FILL - GRAVEL - Sandy, trace silt, occasional cobbles, brown, compact to very dense		1	AS									Water level @ 1.4 m on May 23, 2013. 67 28 (5)	
220.0			2	SS	56									221
219.8			3	SS	12									220
1.8	SAND - Gravelly, some silt, brown, loose to compact		4	SS	9								25 55 (20)	
218.9			5	SS	11									219
2.7			6	SS	100+									219
2.7	End of Borehole @ 2.7 m. Auger Refusal.												Temporary Standpipe installed to 2.7 m.	

³, ³: Numbers refer to Sensitivity
 NP Non Plastic
 3% STRAIN AT FAILURE

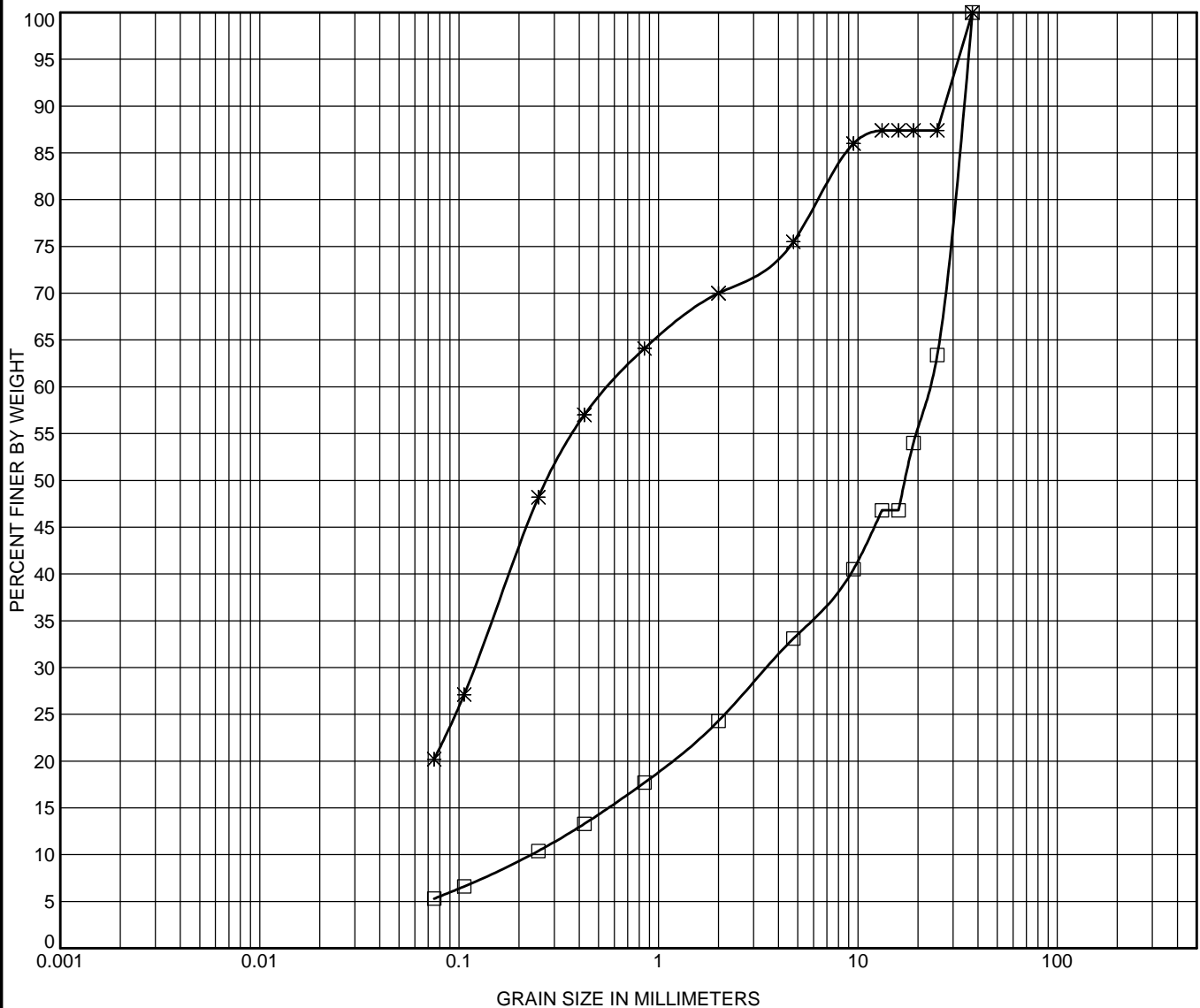
ONL_MOT_BH_MTM 11-214-2.GPJ ON_MOT.GDT 13/9/26

TBT Engineering Consulting Group			RECORD OF Borehole No 2-2			1 OF 1		METRIC	
W.P. 125-90-00			PROJECT Hwy 11/17 - 4 Laning - Hwy 587			SITE NO. 2		ORIGINATED BY D.B.	
DIST 61 HWY 587			LOCATION MTM 15 395062, 5385279			TBTE JOB# 11-214		COMPILED BY T.B.	
DATE 2013 April 11			BOREHOLE TYPE Hollow Stem Auger			DATUM Geodetic		CHECKED BY S.S.	
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS		ELEVATION SCALE	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	DYNAMIC CONE PENETRATION RESISTANCE PLOT		SHEAR STRENGTH kPa	
222.2						20 40 60 80 100		PLASTIC LIMIT W _p NATURAL MOISTURE CONTENT W LIQUID LIMIT W _L	
222.0	TOPSOIL - 100 mm		1	AS		222		WATER CONTENT (%)	
222.0	FILL - SAND - some gravel, trace silt, brown, compact		2	SS	15				
221.0			3	SS	100+	221			
1.2	End of Borehole @ 1.2 m. Auger Refusal.								

ONL_MOT_BH_MTM 11-214-2.GPJ ON_MOT.GDT 13/9/26

APPENDIX B

Laboratory Test Data



SILT OR CLAY	SAND			GRAVEL		COBBLES
	fine	medium	coarse	fine	coarse	

Remarks:
GRAVELS and SANDS

Test Hole	Depth	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
□ 2-1	0.60	37.5	22.638	3.502	0.228	66.9	27.8	5.3	
* 2-1	2.20	37.5	0.57	0.119		24.5	55.3	20.2	



TBT Engineering Limited
1918 Yonge Street
Thunder Bay, Ontario P7C 6T9
PH: 807-624-5160
FX: 807-264-5161
Email: tbte@tbte.ca
Web: www.tbte.ca

GRAIN SIZE DISTRIBUTION

Project: Hwy 11/17 - 4 Laning - Hwy 587

W P: 125-90-00

DIST: 61 HWY: 11/17

APPENDIX C

Borehole Locations, Drawings and Sections

