



**Foundation Investigation Report  
Highway 11/17, Embankment Widening for New  
Eastbound Passing Lane  
East of Kakabeka Falls  
Station 14+110 to Station 14+240  
Township of Paipoonge**

**GWP 544-00-00**

**Geocres No.: 52A-141**

**Prepared for  
Ministry of Transportation, Northwestern Region**

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Ref. No. 09-068

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## **Part A - FOUNDATION INVESTIGATION REPORT**

### **1 Introduction**

TBT Engineering (TBTE) has been retained by the Ministry of Transportation (MTO) to provide foundation investigation and design services for a proposed embankment widening (4.5 m) to facilitate an eastbound passing lane east of Kakabeka Falls along the Highway 11/17. The foundation investigation was carried out to investigate subsurface conditions between Sta. 14+110 and Sta. 14+240 Paipoonge Township (east of the intersection with Highway 588), where the embankment crosses an existing valley.

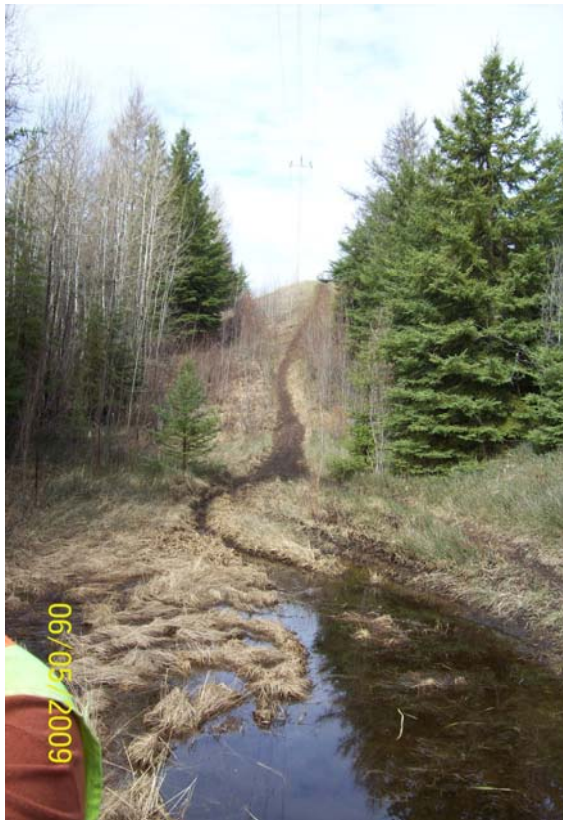
This investigation consisted of a number of boreholes drilled in the vicinity of the proposed new widening, laboratory testing and geotechnical analysis of the data. This report (Part A) describes the subsurface conditions encountered during the investigation.

The foundation section has assigned GEOCRES No. 52A-141 to this site.

### **2 Site Description**

The foundation investigation was carried out to investigate subsurface conditions between Sta. 14+110 and Sta. 14+240 Paipoonge Twp. (starting approximately 200 m east of the intersection with Highway 588). The highway embankment is approximately 13 m in height and crosses a relatively narrow natural valley.

The site is located approximately 30 km west of Thunder Bay. At this location, the highway runs in an east west direction.



Standing on the culvert looking West



Standing on the Culvert looking East

## 2.1 Surficial Geology

The project area is mapped (Ontario Geological Survey Report GR164, Burwasser, 1977) as underlain by deposits associated with the Kaministiquia glacial spillway. The shallow sands and silts (and organics) encountered were likely deposited as part of an extensive delta upland, where melt waters and sediment of the spillway entered a post-Minong level of a glacial lake in the Superior basin. Further down in the sequence, silts and massive or varved clays represent deeper water, offshore environment on more distal parts of the delta where the spillway entered glacial Lake Minong (highest level of glacial lake in the Superior Basin) approximately 9300 years ago.

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### **3 Investigation Procedures**

A geotechnical site investigation was undertaken between June 15 and 17, 2009 which included 4 boreholes. The borehole locations are illustrated on the Borehole Location Plan and Strata Drawings, Appendix C. Subsequent to this investigation a number of hand auger (Pedo) holes were drilled to delineate organic deposits identified in the initial field work.

Borehole 1 was advanced with a 75 mm diameter PVC casing using wash boring techniques through the water at the end of the existing culvert. Split spoon sampling and testing was carried out by hand using a 70 lb hammer. SPT “N” values were estimated by dividing the number of blows / 0.3 m obtained with the 70 lb hammer by a factor of 2.

Boreholes 2 to 4 were carried out using a CME 750 drill rig equipped for geotechnical testing and sampling. Hollow stem auger methods were utilized. Soil samples were obtained at the boreholes using a split spoon sampler as a part of the Standard Penetration Testing (SPT). The SPT involves driving a thick walled sampler into the soils under a standardized energy (63.5 kg, falling 760 mm). The number of blows required to drive the sampler 0.3 m is known as the SPT blow count (N).

Borehole locations were measured in the field and ground surface elevations surveyed. Boreholes were referenced to the centre line grade at Station 14+200. The centre line elevation at this station was interpreted as 258.77 m based on survey data obtained from B&C plans 297-11&17-4 survey dated September 2002.

In addition to the boreholes, 11 pedo holes were carried out to better define the limits and extent of shallow peat / organics. Pedo holes 1 to 8 were advanced along the east bound right-of-way. Pedo holes 9 to 11 were advanced along the south toe of slope.

A summary of the borehole and pedo hole location data is provided on the enclosed Borehole Location Plan and Strata Drawings, Appendix C.

The borehole characteristics are summarized in Table 1.

**Table 1: Drill Summary**

Location	Surface Elevation (metres)	Bottom of Borehole (metres)		Ground Water at Completion (metres)		Base of Peat/Organics (metres)	
		Elevation	Depth	Elevation	Depth	Elevation	Depth
BH 1	246.4	242.1	4.3	Water at surface		-	-
BH 2	246.4	237.0	9.4	244.2	4.2	245.1	1.3
BH 3	246.3	232.3	14.0	238.9	7.4	245.0	1.3
BH 4 (through embankment)	258.4	242.9	15.5	Dry		-	-
P1	246.4	243.5	2.9	Water at surface		-	-
P2	246.4	244.2	2.2	Water at surface		244.7	1.7
P3	246.5	244.4	2.1	246.3	0.2	244.5	2.0
P4	246.9	245.3	1.6	246.6	0.3	245.6	1.3
P5	246.4	244.6	1.8	Water at surface		244.7	1.7
P6	247.3	246.3	1.0	Dry		246.3	1.0
P7	249.0	246.5	2.5	247.0	2.0	-	-
P8	248.2	246.6	1.6	Dry		-	-
P9	246.6	245.5	1.1	246.4	0.2	245.9	0.8
P10	247.1	245.0	2.1	246.4	0.7	-	-
P11	246.8	244.5	2.3	246.3	0.5	244.8	2.0

The boreholes were backfilled at the completion of the investigations using a bentonite backfill mixture to ensure the environmental integrity of the site and in compliance with Ontario Regulation 903.

Soil samples were transported to TBT Engineering's laboratory in Thunder Bay for testing. Routine testing included moisture content, Atterberg limits and grain size analysis. The results of this testing are shown on the Borehole Logs (Appendix A) and on the laboratory data reports (Appendix B).

## **4 Sub-Surface Conditions**

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

As observed at Borehole 4, the embankment was found to consist of asphalt hot mix underlain by 15 m of granular fills (varying from sands to sandy silt). Along the right (south) side toe of the embankment, peat was encountered below shallow fills and extended to depths of up to 2.0 m. At the culvert outlet, the creek bed was found to consist of silty sand. Below the embankment fills and the peat, the native foundation soils were found to consist of upper strata of sands and silts underlain by a thick clay stratum with occasional silt substratum.

### **4.1 Asphalt**

A 75 mm thick layer of asphalt hot mix was encountered at the surface of Borehole 4.

### **4.2 Fill**

As indicated at Borehole 4, the existing embankment consists of up to 15 m of granular fill which consists of variable zones of sand and gravel, sand and silty sand. Grain size analyses carried out on selected samples indicates the embankment fills can consist of 0-1 % gravel, 71-90 % sand, and 9-29 % silt and clay sized particles. The fill within the embankment is generally in a compact to dense condition with SPT (N) values of 21 to 31 blows/0.3 m. One loose zone, with an SPT “N” value of 4 blows/0.3 m, was identified at a depth of 7.6 m.

Fill encountered at/adjacent to the south embankment toe can consist of sand to sandy silt with trace to some organic. This fill was encountered in Boreholes 1, 2 and 3 and within all the probeholes, with the exception of Probeholes, 7, and 8. The fill ranged in thickness around the culvert location from 1.3 to 2.1 m and extended to elevations ranging from 243.5 and 245.0 m (Borehole 1, Probeholes 1, 10 and 11). Fill, away from the culvert ranged in thickness from 0.2 to 0.9 m and extended to elevations ranging from 245.1 and 246.7 m.

### **4.3 Peat**

Peat with trace to some silt and sand was encountered below the above noted fills at and to the right of the right side toe generally between stations 14+152 and 14+217. The peat extends to depths of up to 2.0 m with a base elevation of 244.5 m. Deeper zones may exist

between and/or outside of the test hole locations. The natural moisture contents of the peat varied from 62 to 229% (dry weight basis). Peat was not encountered below the culvert.

#### **4.4 Sands and Silts**

Below the embankment fill and organic layer along the south side toe, interbedded layers of sand, silty sand and silt were encountered. The sands and silts generally vary from 0.3 to 3.3 m in thickness and extend to elevations of 241.7 to 243.5 m at the boreholes. Zones with trace to some organics were noted throughout this stratum. The sands silts are in a loose to compact condition with SPT "N" values of 5 to 25 blows / 0.3 m.

#### **4.5 Clay**

Silty clay was encountered below the sands and silts at Boreholes 1 to 3. The top of the clay layer was encountered between elevations of 241.7 m to 243.5 m. The clay stratum was not encountered at Borehole 4 as this borehole was terminated at an elevation of 243.0 m. The clay stratum has a stiff to hard consistency as indicated by SPT "N" values of 9 to 57 blows / 0.3 m and a field vane test in excess of 100 kPa. An undrained direct shear test was carried out on sample from Borehole 3 at a depth of 9.1 m. The results of this test indicate an undrained shear strength of 68 kPa. A set of drained direct shear tests were also carried out on this sample and indicate a lower bound effective angle of internal friction of  $27^{\circ}$  with an effective cohesion intercept of 0 kPa. Atterberg limit testing indicates the clay is of low to medium plasticity with the natural moisture contents generally between the liquid and plastic limits.

Two discontinuous silt layers were noted within the clay stratum. One at Borehole 2 which exists between depths of 4.6 and 5.2 m (el 241.9 to 241.2), and one at the bottom of Borehole 3 which was encountered at a depth of 13.1 m and extended to borehole terminations (14.0 m). These silt layers are in a dense to very dense condition as indicated by SPT "N" values of 36 to 76 blow/0.3 m.



## **4.6 Ground Water**

The ground water levels observed during the field drilling investigation have been provided in Table 1. The observed ground water levels varied from dry to water at surface. Groundwater level readings taken upon completion of the boreholes would not have had time to stabilize. It should be noted that at the time of this investigation, ponded water had flooded a large area along the south side of the embankment due to the presence of a beaver dam. The ponded water level was measured at elevation 246.4 m. Observed ground water levels at the boreholes below an elevation of 246.4 m are not considered to be representative of the actual ground water level at the time of this investigation. The actual ground water level is expected to at or above elevation 246.4 m.

Ground water levels will vary from season to season and from the effects of heavy precipitation events.

## **5 Miscellaneous**

Laboratory testing was carried out at the TBT Engineering laboratory in Thunder Bay. The field operations were supervised by Herman Finke. Laboratory testing was supervised by T. Fummerton C.E.T. This report was prepared by G. Maki, P.Eng, and reviewed by W. Hurley, P.Eng.

## **6 Limitations**

Conclusions and recommendations presented in this report are based on the information determined at the 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.

## 7 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



Gordon Maki, P.Eng  
Manager of Geotechnical Engineering



Wayne Hurley, P.Eng.  
Vice President of Engineering

**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

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

### STRESS AND STRAIN

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

### PHYSICAL PROPERTIES OF SOIL

$\rho_s$	$\text{kg}/\text{m}^3$	DENSITY OF SOLID PARTICLES	e	1, %	VOID RATIO	$e_{\min}$	1, %	VOID RATIO IN DENSEST STATE
$\gamma_s$	$\text{kN}/\text{m}^3$	UNIT WEIGHT OF SOLID PARTICLES	n	1, %	POROSITY	$I_D$	1	DENSITY INDEX = $\frac{e_{\max} - e}{e_{\max} - e_{\min}}$
$\rho_w$	$\text{kg}/\text{m}^3$	DENSITY OF WATER	w	1, %	WATER CONTENT	D	mm	GRAIN DIAMETER
$\gamma_w$	$\text{kN}/\text{m}^3$	UNIT WEIGHT OF WATER	$S_r$	%	DEGREE OF SATURATION	$D_n$	mm	n PERCENT - DIAMETER
$\rho$	$\text{kg}/\text{m}^3$	DENSITY OF SOIL	$w_L$	%	LIQUID LIMIT	$C_u$	1	UNIFORMITY COEFFICIENT
$\gamma$	$\text{kN}/\text{m}^3$	UNIT WEIGHT OF SOIL	$w_p$	%	PLASTIC LIMIT	h	m	HYDRAULIC HEAD OR POTENTIAL
$\rho_d$	$\text{kg}/\text{m}^3$	DENSITY OF DRY SOIL	$w_s$	%	SHRINKAGE LIMIT	q	$\text{m}^3/\text{s}$	RATE OF DISCHARGE
$\gamma_d$	$\text{kN}/\text{m}^3$	UNIT WEIGHT OF DRY SOIL	$I_p$	%	PLASTICITY INDEX = $w_L - w_p$	v	m/s	DISCHARGE VELOCITY
$\rho_{\text{sat}}$	$\text{kg}/\text{m}^3$	DENSITY OF SATURATED SOIL	$I_L$	1	LIQUIDITY INDEX = $\frac{w - w_p}{I_p}$	i	1	HYDRAULIC GRADIENT
$\gamma_{\text{sat}}$	$\text{kN}/\text{m}^3$	UNIT WEIGHT OF SATURATED SOIL	$I_C$	1	CONSISTENCY INDEX = $\frac{w_L - w}{I_p}$	k	m/s	HYDRAULIC CONDUCTIVITY
$\rho'$	$\text{kg}/\text{m}^3$	DENSITY OF SUBMERGED SOIL	$e_{\max}$	1, %	VOID RATIO IN LOOSEST STATE	j	$\text{kN}/\text{m}^2$	SEEPAGE FORCE
$\gamma'$	$\text{kN}/\text{m}^3$	UNIT WEIGHT OF SUBMERGED SOIL						

TBT Engineering Consulting Group			<b>RECORD OF Borehole No 1</b>			1 OF 1		<b>METRIC</b>					
W.P. <b>544-00-00</b>			PROJECT <b>Embankment Widening</b>			SITE NO. _____		ORIGINATED BY <b>HF</b>					
DIST <b>61</b> HWY <b>11/17</b>			LOCATION <b>Sta 14+191 o/s 35.5 m Rt</b>			TBTE JOB# <b>09-068</b>		COMPILED BY <b>DS</b>					
DATE <b>2009 June 16</b>			BOREHOLE TYPE <b>Hollow Stem Auger</b>			DATUM <b>Geodetic</b>		CHECKED BY <b>GM</b>					
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					
246.4 0.0	WATER												Water level @ 0.4 m on completion.
245.3 1.1	FILL - SAND - Silty, some organics, grey, very loose												
	----- - trace gravel		1	SS									
243.8 2.6	SILT - Sandy, some gravel, grey, loose		2	SS	3								
243.5 2.9	CLAY - Silty, grey/brown, stiff		3	SS	9								
242.5 3.9	End of Borehole @ 3.9 m.		4	SS	13								

$\times^3, \star^3$ : Numbers refer to Sensitivity  
 NP Non Plastic  
 $\bigcirc^3$  STRAIN AT FAILURE

ON\_MOT\_BH-10 09-068.GPJ ON\_MOT.GDT 10/1/12

TBT Engineering Consulting Group			<b>RECORD OF Borehole No 2</b>		1 OF 1		<b>METRIC</b>	
W.P. <b>544-00-00</b>			PROJECT <b>Embankment Widening</b>		SITE NO. _____		ORIGINATED BY <b>HF</b>	
DIST <b>61</b> HWY <b>11/17</b>			LOCATION <b>Sta 14+172 o/s 34.6 m Rt</b>		TBTE JOB# <b>09-068</b>		COMPILED BY <b>DS</b>	
DATE <b>2009 June 15</b>			BOREHOLE TYPE <b>Hollow Stem Auger</b>		DATUM <b>Geodetic</b>		CHECKED BY <b>GM</b>	
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			
246.4 0.1	TOPSOIL - 75 mm		1	AS				
245.8 0.6	FILL - SILT - Sandy, trace organics, grey		2	SS	2			
245.1 1.3	PEAT - some silt, black, very loose		3	SS	5			
243.5 2.9	SILT - some organics, trace sand, brown, loose to compact		4	SS	17			
241.9 4.5	CLAY - Silty, silt layers, grey/brown, very stiff		5	SS	15			
241.2 5.2	SILT - trace clay, grey, dense		6	SS	21			
237.0 9.4	CLAY - Silty, layered, grey/brown, hard		7	SS	36			
	- very stiff		8	SS	31			
	- grey/black		9	SS	46			
	End of Borehole @ 9.4 m.		10	SS	17			
			11	SS	16			

DYNAMIC CONE PENETRATION RESISTANCE PLOT		SHEAR STRENGTH kPa		WATER CONTENT (%)		UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEVATION SCALE		UNCONFINED ○ SPT (N)	FIELD VANE ✕ LAB VANE	PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W		
246							Water level @ 4.2 m on completion.
245							
244							
243							
242							
241							
240							
239							
238							
237							

ON\_MOT\_BH-10 09-068.GPJ ON\_MOT.GDT 10/1/12

TBT Engineering Consulting Group			<b>RECORD OF Borehole No 3</b>		1 OF 2		<b>METRIC</b>	
W.P. <b>544-00-00</b>			PROJECT <b>Embankment Widening</b>		SITE NO. _____		ORIGINATED BY <b>HF</b>	
DIST <b>61</b> HWY <b>11/17</b>			LOCATION <b>Sta 14+201 o/s 34.2 m Rt</b>		TBTE JOB# <b>09-068</b>		COMPILED BY <b>DS</b>	
DATE <b>2009 June 15</b>			BOREHOLE TYPE <b>Hollow Stem Auger</b>		DATUM <b>Geodetic</b>		CHECKED BY <b>GM</b>	
SOIL PROFILE			SAMPLES			DYNAMIC CONE PENETRATION RESISTANCE PLOT		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	REMARKS & GRAIN SIZE DISTRIBUTION (%)
246.3 0.1	TOPSOIL - 100 mm		1	AS			246	Water level @ 7.4 m on completion.
245.6 0.8	FILL - SILT - Sandy, trace organics, brown		2	SS	2		245	
245.0 1.3	PEAT - some silt, black, very loose		3	SS			244	Organic Content 8.6 %.
242.4 4.0	SILT - some organics, trace sand, brown		4	TW			243	
241.7 4.6	SAND - some clay lumps, trace silt, trace gravel		5	TW			242	
	CLAY - Silty, grey/brown, very stiff		6	TW			241	
			7	SS	29		240	
			8	SS	21		239	
			9	SS	9		238	
			10	SS			237	
			11	TW				

Continued Next Page

x<sup>3</sup>, \*<sup>3</sup>: Numbers refer to Sensitivity  
 NP Non Plastic  
 O 3% STRAIN AT FAILURE

ON\_MOT\_BH-10 09-068.GPJ ON\_MOT.GDT 10/1/12



TBT Engineering Consulting Group			<b>RECORD OF Borehole No 3</b>			2 OF 2		<b>METRIC</b>										
W.P. <b>544-00-00</b>			PROJECT <b>Embankment Widening</b>			SITE NO. _____		ORIGINATED BY <b>HF</b>										
DIST <b>61</b> HWY <b>11/17</b>			LOCATION <b>Sta 14+201 o/s 34.2 m Rt</b>			TBTE JOB# <b>09-068</b>		COMPILED BY <b>DS</b>										
DATE <b>2009 June 15</b>			BOREHOLE TYPE <b>Hollow Stem Auger</b>			DATUM <b>Geodetic</b>		CHECKED BY <b>GM</b>										
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS		DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT		UNIT WEIGHT		REMARKS & GRAIN SIZE DISTRIBUTION (%)				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES		ELEVATION SCALE	SHEAR STRENGTH kPa ○ UNCONFINED    ✕ FIELD VANE ■ SPT (N)        ★ LAB VANE		WATER CONTENT (%) W <sub>p</sub> W                  W <sub>L</sub>		γ		GR	SA	SI	CL	
	----- - hard		12	SS	32		236											
							235											
			13	SS	57		234											
233.2																		
13.1	SILT - trace clay. grey, very dense						233											
232.3			14	SS	76													
14.0	End of Borehole @ 14.0 m.																	

✕<sup>3</sup>, ★<sup>3</sup>: Numbers refer to Sensitivity    ○ 3% STRAIN AT FAILURE  
NP Non Plastic

ON\_MOT\_BH-10 09-068.GPJ ON\_MOT.GDT 10/1/12



TBT Engineering Consulting Group

# RECORD OF Borehole No 4

1 OF 2

METRIC

W.P. **544-00-00** PROJECT **Embankment Widening** SITE NO. \_\_\_\_\_ ORIGINATED BY **HF**  
 DIST **61** HWY **11/17** LOCATION **Sta 14+186 o/s 4.8 m Rt** TBTE JOB# **09-068** COMPILED BY **DS**  
 DATE **2009 June 17** BOREHOLE TYPE **Hollow Stem Auger** DATUM **Geodetic** CHECKED BY **GM**

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							
258.4 258.0 0.1	ASPHALT - 75 mm FILL - SAND & GRAVEL - brown														
	----- - SAND - some silt, brown, dense		1	AS											0 84 (16)
	----- - Silty		2	SS	39										
			3	SS	35										
			4	SS	34										
			5	SS	31										
	----- - compact		6	SS	29										
	----- - dense		7	SS	35										
	----- - compact		8	SS	21										
	----- - trace silt, trace gravel, loose		9	SS	4										1 90 (9)
	----- - compact		10	SS	25										

Continued Next Page

$\times^3, \star^3$ : Numbers refer to Sensitivity  
 NP Non Plastic  
 O 3% STRAIN AT FAILURE

ON\_MOT\_BH-10 09-068.GPJ ON\_MOT.GDT 10/1/12

TBT Engineering Consulting Group			<b>RECORD OF Borehole No 4</b>			2 OF 2		<b>METRIC</b>	
W.P. <b>544-00-00</b>			PROJECT <b>Embankment Widening</b>			SITE NO. _____		ORIGINATED BY <b>HF</b>	
DIST <b>61</b> HWY <b>11/17</b>			LOCATION <b>Sta 14+186 o/s 4.8 m Rt</b>			TBTE JOB# <b>09-068</b>		COMPILED BY <b>DS</b>	
DATE <b>2009 June 17</b>			BOREHOLE TYPE <b>Hollow Stem Auger</b>			DATUM <b>Geodetic</b>		CHECKED BY <b>GM</b>	
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS		ELEVATION SCALE	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES				
248.4	- occasional cobbles		11	SS	26				
247.4	- Silty, clay lumps, brown, compact								
246.4	- SAND - Silty, trace gravel, brown, compact		12	SS	13				
245.4	- trace organics, grey								
244.4	- some silt, some organics		13	SS	16				
243.4	SILT - grey, compact		14	SS	25				
242.9	End of Borehole @ 15.5 m.								

**DYNAMIC CONE PENETRATION RESISTANCE PLOT**

**SHEAR STRENGTH kPa**

○ UNCONFINED    ✕ FIELD VANE  
 ■ SPT (N)       ★ LAB VANE

**WATER CONTENT (%)**

W<sub>p</sub>    W    W<sub>L</sub>

PLASTIC LIMIT    NATURAL MOISTURE CONTENT    LIQUID LIMIT

UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)
	GR SA SI CL
0 71 (29)	
93	Non Plastic.
0 85 (15)	Non Plastic.
	Non Plastic.

TBT Engineering Consulting Group			<b>RECORD OF Pedo Hole No P1</b>				1 OF 1		<b>METRIC</b>				
W.P. <b>544-00-00</b>			PROJECT <b>Embankment Widening</b>				SITE NO. _____		ORIGINATED BY <b>BS</b>				
DIST <b>61</b> HWY <b>11/17</b>			LOCATION <b>Sta 14+191 o/s 36.5 m Rt</b>				TBTE JOB# <b>09-068</b>		COMPILED BY <b>TB</b>				
DATE <b>2009 July 31</b>			BOREHOLE TYPE <b>Pedo</b>				DATUM <b>Geodetic</b>		CHECKED BY <b>GM</b>				
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					
							<div style="display: flex; justify-content: space-between;"> <span>20 40 60 80 100</span> <span>20 40 60 80 100</span> </div> <div style="display: flex; justify-content: space-between;"> <span>W<sub>p</sub></span> <span>W</span> <span>W<sub>L</sub></span> </div> <div style="display: flex; justify-content: space-between;"> <span>PLASTIC LIMIT</span> <span>NATURAL MOISTURE CONTENT</span> <span>LIQUID LIMIT</span> </div> <div style="display: flex; justify-content: space-between;"> <span>○ UNCONFINED</span> <span>✕ FIELD VANE</span> </div> <div style="display: flex; justify-content: space-between;"> <span>■ SPT (N)</span> <span>★ LAB VANE</span> </div> <div style="display: flex; justify-content: space-between;"> <span>20 40 60 80 100</span> <span>20 40 60</span> </div> <div style="display: flex; justify-content: space-between;"> <span>WATER CONTENT (%)</span> </div>						
246.4 0.0	WATER												
244.8 1.6	FILL - SAND - Silty, some organics, grey												
243.5 2.9	End of Borehole @ 2.9 m. On Cobbles.		1	BS									

ON\_MOT\_PEDO 09-068.GPJ ON\_MOT.GDT 10/1/12

TBT Engineering Consulting Group			<b>RECORD OF Pedo Hole No P2</b>				1 OF 1		<b>METRIC</b>					
W.P. <b>544-00-00</b>			PROJECT <b>Embankment Widening</b>				SITE NO. _____		ORIGINATED BY <b>BS</b>					
DIST <b>61</b> HWY <b>11/17</b>			LOCATION <b>Sta 14+180 o/s 37.9 m Rt</b>				TBTE JOB# <b>09-068</b>		COMPILED BY <b>TB</b>					
DATE <b>2009 July 31</b>			BOREHOLE TYPE <b>Pedo</b>				DATUM <b>Geodetic</b>		CHECKED BY <b>GM</b>					
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	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
246.4 0.0	WATER													
245.9 0.5	FILL - SAND - Silty, grey													
245.4 1.0	PEAT - some sand, some silt, black		1	BS										
244.7 1.7	SAND - grey													
244.2 2.2	- Silty End of Borehole @ 2.2 m.													

✕<sup>3</sup>, ★<sup>3</sup>: Numbers refer to Sensitivity  
 NP Non Plastic  
 ○<sup>3%</sup> STRAIN AT FAILURE

TBT Engineering Consulting Group				<b>RECORD OF Pedo Hole No P4</b>				1 OF 1		<b>METRIC</b>						
W.P. <b>544-00-00</b>		PROJECT <b>Embankment Widening</b>				SITE NO. _____		ORIGINATED BY <b>BS</b>								
DIST <b>61</b> HWY <b>11/17</b>		LOCATION <b>Sta 14+161 o/s 36.5 m Rt</b>				TBTE JOB# <b>09-068</b>		COMPILED BY <b>TB</b>								
DATE <b>2009 July 31</b>		BOREHOLE TYPE <b>Pedo</b>				DATUM <b>Geodetic</b>		CHECKED BY <b>GM</b>								
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa								
							<div style="display: flex; justify-content: space-between;"> <span>20 40 60 80 100</span> <span>20 40 60 80 100</span> </div> <div style="display: flex; justify-content: space-between;"> <span>UNCONFINED</span> <span>FIELD VANE</span> </div> <div style="display: flex; justify-content: space-between;"> <span>SPT (N)</span> <span>LAB VANE</span> </div>					<div style="display: flex; justify-content: space-between;"> <span>W<sub>p</sub></span> <span>W</span> <span>W<sub>L</sub></span> </div> <div style="display: flex; justify-content: space-between;"> <span>PLASTIC LIMIT</span> <span>NATURAL MOISTURE CONTENT</span> <span>LIQUID LIMIT</span> </div> <div style="display: flex; justify-content: space-between;"> <span>20 40 60</span> </div>				
246.9	TOPSOIL - 250 mm, brown															
0.0																
246.7	FILL - SAND - brown															
0.3																
246.4	PEAT - black															
0.5																
245.6																
1.3	SAND - some silt, trace clay, grey															
245.3																
1.6	End of Borehole @ 1.6 m.															

ON\_MOT\_PEDO 09-068.GPJ ON\_MOT.GDT 10/1/12

TBT Engineering Consulting Group			<b>RECORD OF Pedo Hole No P5</b>				1 OF 1		<b>METRIC</b>					
W.P. <b>544-00-00</b>			PROJECT <b>Embankment Widening</b>				SITE NO. _____		ORIGINATED BY <b>BS</b>					
DIST <b>61</b> HWY <b>11/17</b>			LOCATION <b>Sta 14+200 o/s 36.1 m Rt</b>				TBTE JOB# <b>09-068</b>		COMPILED BY <b>TB</b>					
DATE <b>2009 July 31</b>			BOREHOLE TYPE <b>Pedo</b>				DATUM <b>Geodetic</b>		CHECKED BY <b>GM</b>					
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	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
246.4 0.0	WATER													
246.0 0.4	FILL - SAND - some organics, trace gravel, grey													
245.1 1.3	----- - Silty, some clay													
244.7 1.8	PEAT - some sand, some silt, grey													
244.0 1.8	SAND - trace silt, trace organics End of Borehole @ 1.8 m. Sloughing.													

ON\_MOT\_PEDO 09-068.GPJ ON\_MOT.GDT 10/1/12



TBT Engineering Consulting Group		<b>RECORD OF Pedo Hole No P6</b>										1 OF 1		<b>METRIC</b>			
W.P. <b>544-00-00</b>		PROJECT <b>Embankment Widening</b>										SITE NO. _____		ORIGINATED BY <b>BS</b>			
DIST <b>61</b> HWY <b>11/17</b>		LOCATION <b>Sta 14+209 o/s 37.0 m Rt</b>										TBTE JOB# <b>09-068</b>		COMPILED BY <b>TB</b>			
DATE <b>2009 July 31</b>		BOREHOLE TYPE <b>Pedo</b>										DATUM <b>Geodetic</b>		CHECKED BY <b>GM</b>			
SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT   NATURAL MOISTURE   LIQUID CONTENT			UNIT WEIGHT  $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa					WATER CONTENT (%)				
247.3							20	40	60	80	100						
247.0	TOPSOIL - 180 mm, brown																
0.2	FILL - SAND - brown					247											
246.7																	
0.6	PEAT - brown																
246.3																	
1.0	End of Borehole @ 1.0 m. On Boulder, Possible Cobble.																

ON\_MOT\_PEDO 09-068.GPJ ON\_MOT.GDT 10/1/12

TBT Engineering Consulting Group			<b>RECORD OF Pedo Hole No P7</b>				1 OF 1		<b>METRIC</b>					
W.P. <b>544-00-00</b>			PROJECT <b>Embankment Widening</b>				SITE NO. _____		ORIGINATED BY <b>BS</b>					
DIST <b>61</b> HWY <b>11/17</b>			LOCATION <b>Sta 14+219 o/s 36.9 m Rt</b>				TBTE JOB# <b>09-068</b>		COMPILED BY <b>TB</b>					
DATE <b>2009 July 31</b>			BOREHOLE TYPE <b>Pedo</b>				DATUM <b>Geodetic</b>		CHECKED BY <b>GM</b>					
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				UNIT WEIGHT  $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
							<div style="display: flex; justify-content: space-between;"> <span>20 40 60 80 100</span> <span>20 40 60 80 100</span> </div> <div style="display: flex; justify-content: space-between;"> <span>UNCONFINED</span> <span>FIELD VANE</span> </div> <div style="display: flex; justify-content: space-between;"> <span>SPT (N)</span> <span>LAB VANE</span> </div>				<div style="display: flex; justify-content: space-between;"> <span>W<sub>p</sub></span> <span>W</span> <span>W<sub>L</sub></span> </div> <div style="display: flex; justify-content: space-between;"> <span>PLASTIC LIMIT</span> <span>NATURAL MOISTURE CONTENT</span> <span>LIQUID LIMIT</span> </div>			
249.0	TOPSOIL - 220 mm													
0.0 248.8 0.2	SAND - brown													
246.5	End of Borehole @ 2.5 m. Possible Cobbles.													

ON\_MOT\_PEDO 09-068.GPJ ON\_MOT.GDT 10/1/12

TBT Engineering Consulting Group		<b>RECORD OF Pedo Hole No P8</b>				1 OF 1		<b>METRIC</b>										
W.P. <b>544-00-00</b>		PROJECT <b>Embankment Widening</b>				SITE NO. _____		ORIGINATED BY <b>BS</b>										
DIST <b>61</b> HWY <b>11/17</b>		LOCATION <b>Sta 14+152 o/s 36.9 m Rt</b>				TBTE JOB# <b>09-068</b>		COMPILED BY <b>TB</b>										
DATE <b>2009 July 31</b>		BOREHOLE TYPE <b>Pedo</b>				DATUM <b>Geodetic</b>		CHECKED BY <b>GM</b>										
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	REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa										
							20 40 60 80 100 ○ UNCONFINED    ✕ FIELD VANE ■ SPT (N)        ★ LAB VANE					20 40 60 WATER CONTENT (%)						GR SA SI CL
248.2 0.0	TOPSOIL - 200 mm					248												
248.0 0.2	SAND - some silt, trace gravel, brown ----- - Clayey					247												
246.6 1.6	End of Borehole @ 1.6 m.																	

ON\_MOT\_PEDO 09-068.GPJ ON\_MOT.GDT 10/1/12

TBT Engineering Consulting Group			<b>RECORD OF Pedo Hole No P9</b>				1 OF 1		<b>METRIC</b>							
W.P. <b>544-00-00</b>			PROJECT <b>Embankment Widening</b>				SITE NO. _____		ORIGINATED BY <b>BS</b>							
DIST <b>61</b> HWY <b>11/17</b>			LOCATION <b>Sta 14+172 o/s 30.2 m Rt</b>				TBTE JOB# <b>09-068</b>		COMPILED BY <b>TB</b>							
DATE <b>2009 July 31</b>			BOREHOLE TYPE <b>Pedo</b>				DATUM <b>Geodetic</b>		CHECKED BY <b>GM</b>							
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa								
							<div style="display: flex; justify-content: space-between;"> <span>20 40 60 80 100</span> <span>20 40 60 80 100</span> </div> <div style="display: flex; justify-content: space-between;"> <span>○ UNCONFINED</span> <span>✕ FIELD VANE</span> </div> <div style="display: flex; justify-content: space-between;"> <span>■ SPT (N)</span> <span>★ LAB VANE</span> </div>					<div style="display: flex; justify-content: space-between;"> <span>W<sub>p</sub></span> <span>W</span> <span>W<sub>L</sub></span> </div> <div style="display: flex; justify-content: space-between;"> <span>PLASTIC LIMIT</span> <span>NATURAL MOISTURE CONTENT</span> <span>LIQUID LIMIT</span> </div>				
246.6																
246.0	TOPSOIL - 150 mm															
246.2	FILL - SAND - trace silt, occasional cobbles, brown															
245.9	PEAT - black															
245.5	SAND - Silty, grey															
245.5	End of Borehole @ 1.1 m.															

ON\_MOT\_PEDO 09-068.GPJ ON\_MOT.GDT 10/1/12

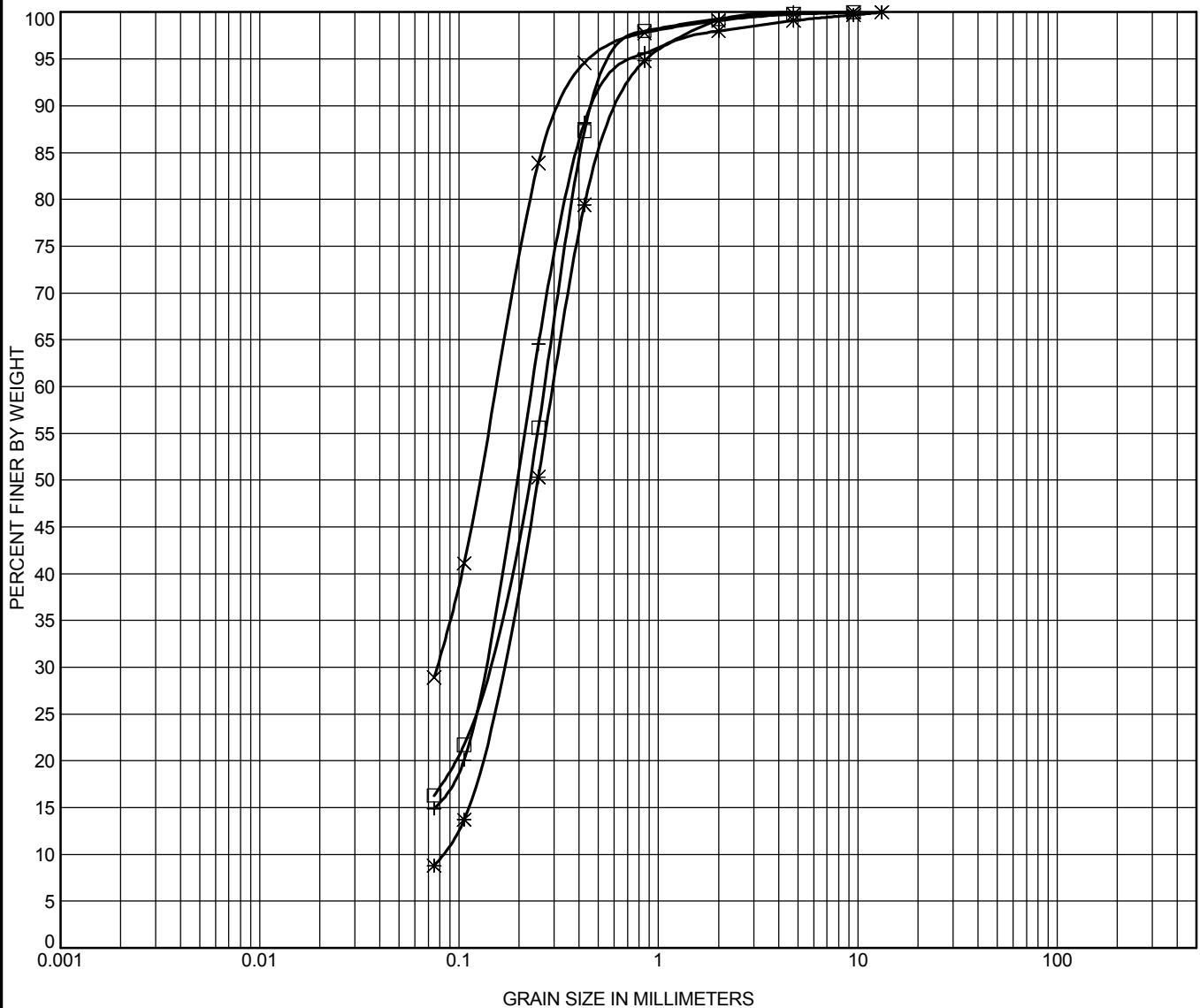
TBT Engineering Consulting Group		<b>RECORD OF Pedo Hole No P10</b>				1 OF 1		<b>METRIC</b>								
W.P. <b>544-00-00</b>		PROJECT <b>Embankment Widening</b>				SITE NO. _____		ORIGINATED BY <b>BS</b>								
DIST <b>61</b> HWY <b>11/17</b>		LOCATION <b>Sta 14+186 o/s 28.7 m Rt</b>				TBTE JOB# <b>09-068</b>		COMPILED BY <b>TB</b>								
DATE <b>2009 July 31</b>		BOREHOLE TYPE <b>Pedo</b>				DATUM <b>Geodetic</b>		CHECKED BY <b>GM</b>								
SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa								
							<div style="display: flex; justify-content: space-between;"> <span>20 40 60 80 100</span> <span>20 40 60 80 100</span> </div> <div style="display: flex; justify-content: space-between;"> <span>○ UNCONFINED</span> <span>✕ FIELD VANE</span> </div> <div style="display: flex; justify-content: space-between;"> <span>■ SPT (N)</span> <span>★ LAB VANE</span> </div>					<div style="display: flex; justify-content: space-between;"> <span>W<sub>p</sub></span> <span>W</span> <span>W<sub>L</sub></span> </div> <div style="display: flex; justify-content: space-between;"> <span>PLASTIC LIMIT</span> <span>NATURAL MOISTURE CONTENT</span> <span>LIQUID LIMIT</span> </div>				
247.1																
0.0	FILL - SAND - brown					247							Wet @ 0.7 m.			
	----- - trace silt, grey					246										
245.0						245										
2.1	End of Borehole @ 2.1 m. On Cobbles.															

ON\_MOT\_PEDO\_09-068.GPJ ON\_MOT.GDT 10/1/12

TBT Engineering Consulting Group			<b>RECORD OF Pedo Hole No P11</b>				1 OF 1		<b>METRIC</b>					
W.P. <b>544-00-00</b>			PROJECT <b>Embankment Widening</b>				SITE NO. _____		ORIGINATED BY <b>BS</b>					
DIST <b>61</b> HWY <b>11/17</b>			LOCATION <b>Sta 14+197 o/s 29.3 m Rt</b>				TBTE JOB# <b>09-068</b>		COMPILED BY <b>TB</b>					
DATE <b>2009 July 31</b>			BOREHOLE TYPE <b>Pedo</b>				DATUM <b>Geodetic</b>		CHECKED BY <b>GM</b>					
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	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
246.8								20 40 60 80 100	20 40 60					
0.0	FILL - SAND - trace gravel, brown					▼	246							Wet @ 0.5 m.
	----- - Silty, grey													
245.2	PEAT - black		1	BS			245							
1.6														
244.8	SILT - Sandy, trace clay, grey													
2.0														
244.5														
2.3	End of Borehole @ 2.3 m.													

## **APPENDIX B**

### **Laboratory Test Data**



SILT OR CLAY	SAND			GRAVEL		COBBLES
	fine	medium	coarse	fine	coarse	

Remarks:  
SAND

Test Hole	Depth	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
□ 4	0.75	9.5	0.269	0.131		0.2	83.5	16.3	
* 4	7.60	13.2	0.298	0.155	0.082	0.9	90.3	8.8	
× 4	10.70	9.5	0.155	0.077		0.2	70.9	28.9	
+ 4	13.70	4.75	0.229	0.128		0.0	85.1	14.9	



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Web: [www.tbte.ca](http://www.tbte.ca)

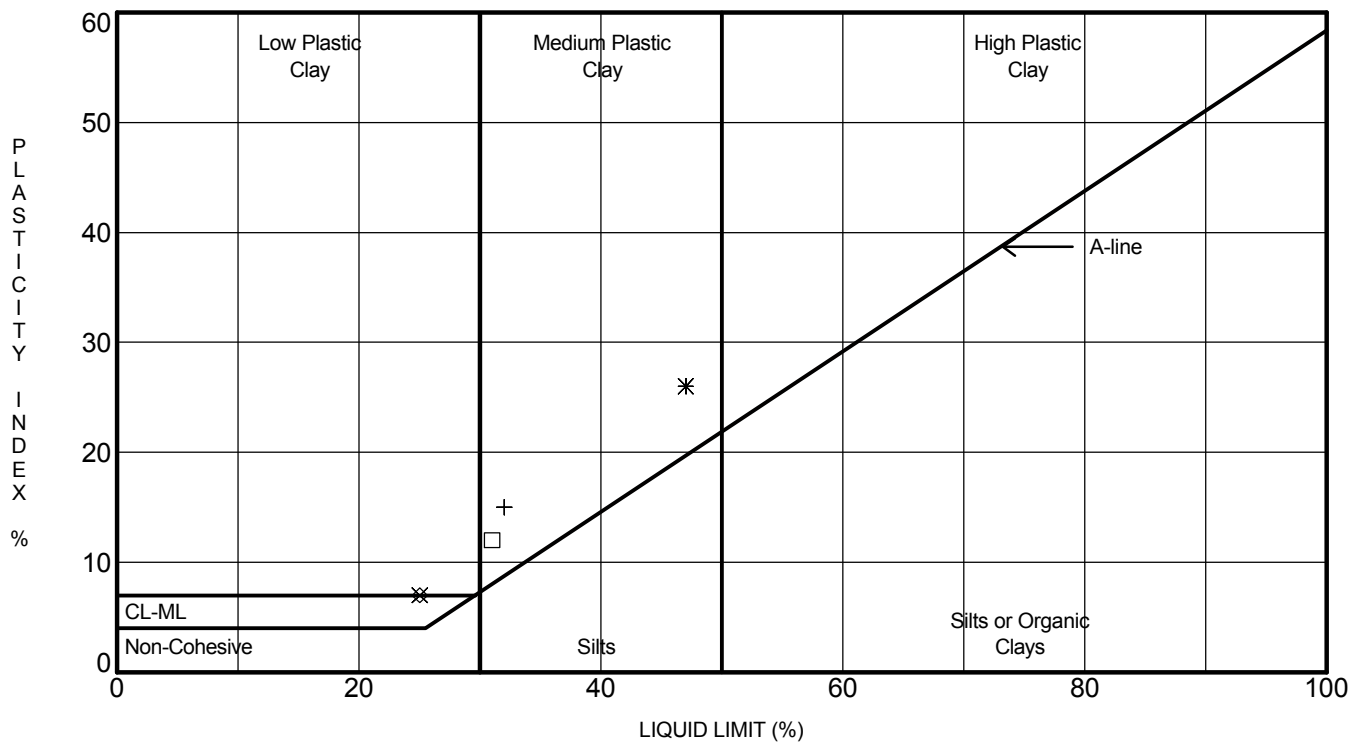
## GRAIN SIZE DISTRIBUTION

Project: Embankment Widening

W P: 544-00-00

DIST: 61 HWY: 11/17





	Borehole No.	Sample No.	Depth (m)	LL %	PL %	PI %	M/C %	
□	2		3.00	31	19	12	27	
✱	2		7.60	47	21	26	32	
×	3		5.30	25	18	7	21	
+	3		6.10	32	17	15	22	
◇	3		12.20	25	18	7	17	



**TBT Engineering Ltd.**  
 Suite 200, 101 Syndicate Ave. N.  
 Thunder Bay, Ontario P7C 3V4  
 Telephone: 807-624-5160  
 Fax: 807-264-5161

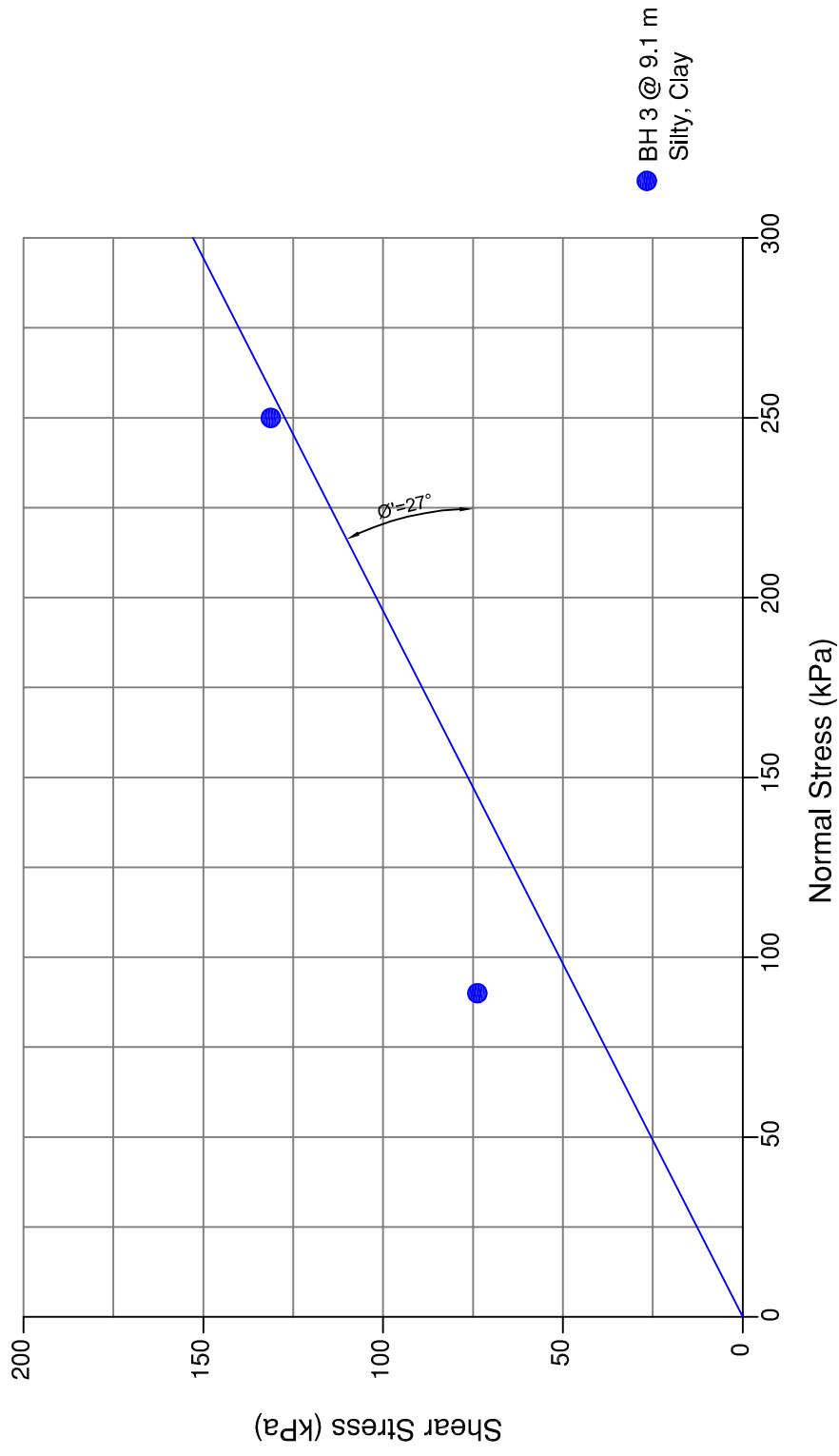
## ATTERBERG LIMIT RESULTS

W P: 544-00-00

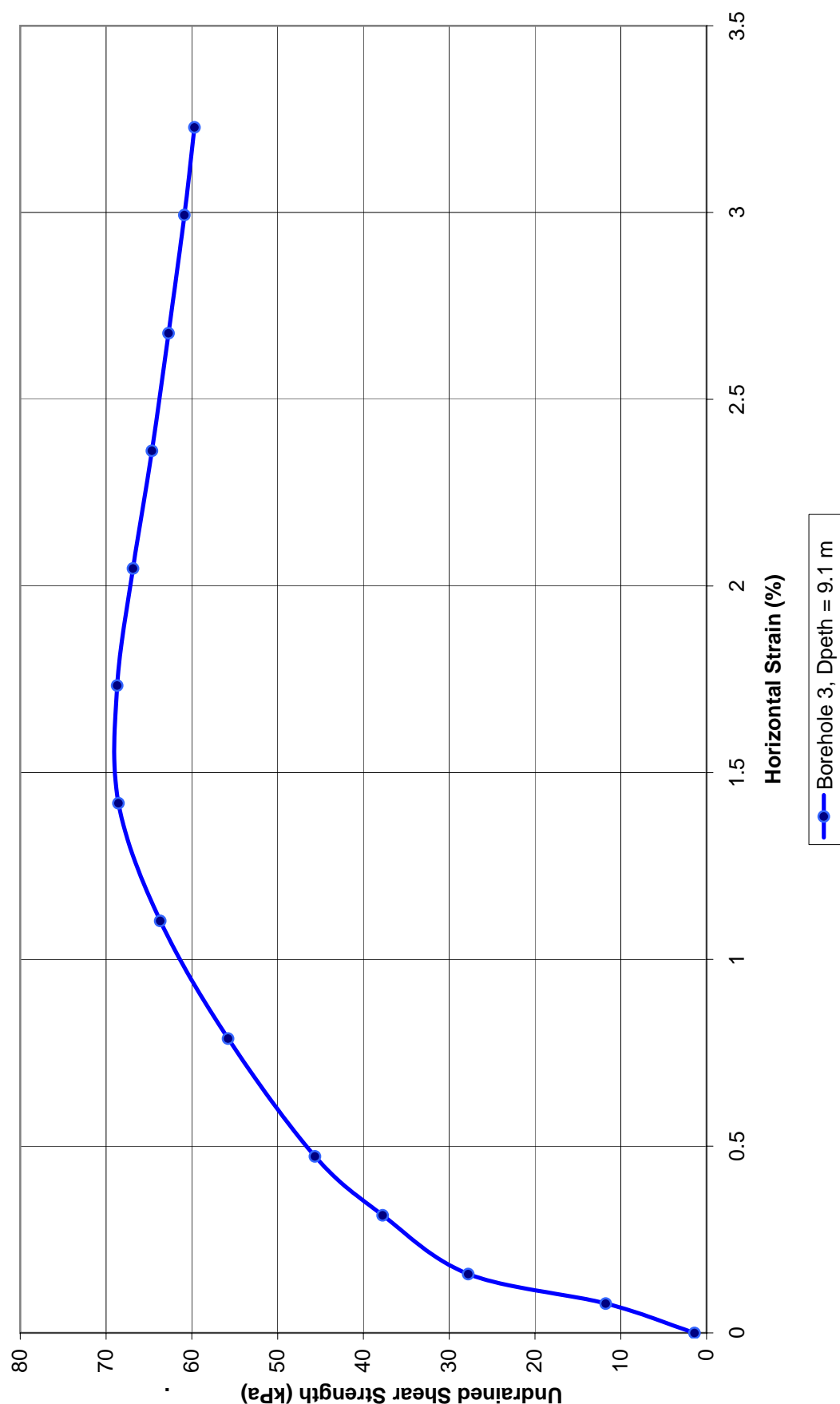
District: 61

Highway: 11/17

# CONSOLIDATED/DRAINED DIRECT SHEAR TESTING




**Undrained Direct Shear Testing - Clay**  
Consolidated to Effective Overburden Pressure



**APPENDIX C**  
Borehole Locations and Soil Strata Drawing

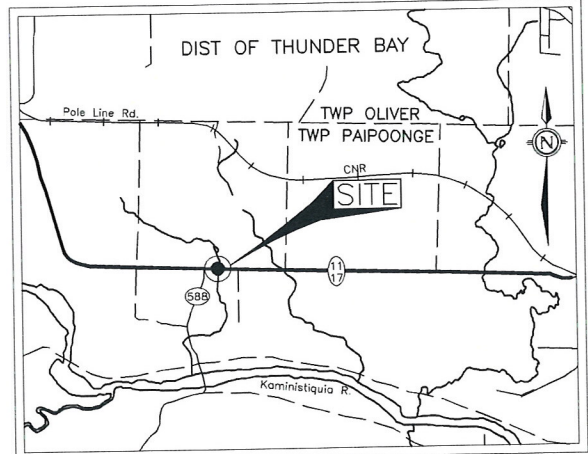
METRIC  
DIMENSIONS ARE IN METRES  
AND/OR MILLIMETRES  
UNLESS OTHERWISE SHOWN

CONT No        xxxxxx  
GWP No        544-00-00  
GEOCRES No    52A-141



VIBERT TO KAKABEKA EMBANKMENT WIDENING  
TOWNSHIP OF OLIVER-PAIPOONGE  
BOREHOLE LOCATIONS AND SOIL STRATA

SHEET



KEY PLAN

1.0 km 0 1.0 km

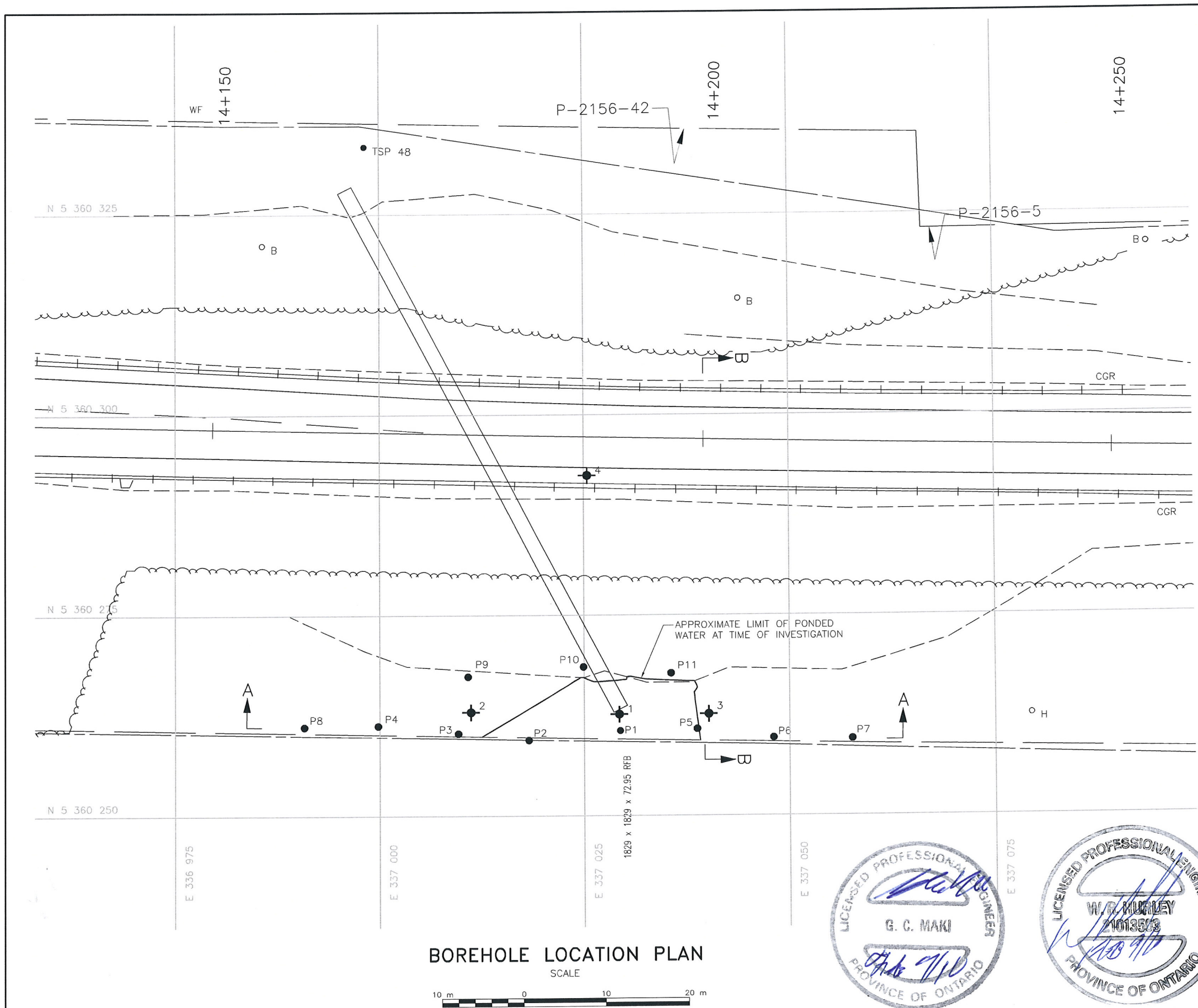
SCALE 1:50,000

—NOTE—

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

LEGEND				
	Borehole			
	Pedo Hole			
	'N' Std Pen Test (Blows/0.3m)			
	WL at time of investigation			
No	ELEVATION	CO-ORDINATES		
		NORTH	EAST	
1	246.0	15 5 360 262	337 029	
2	246.6	15 5 360 263	337 011	
3	246.6	15 5 360 263	337 040	
4	258.5	15 5 360 293	337 025	
P1	246.0	15 5 360 262	337 029	
P2	246.0	15 5 360 259	337 018	
P3	246.5	15 5 360 260	337 010	
P4	246.7	15 5 360 261	337 000	
P5	246.0	15 5 360 259	337 036	
P6	247.3	15 5 360 260	337 048	
P7	248.9	15 5 360 260	337 058	
P8	248.0	15 5 360 261	336 991	
P9	246.5	15 5 360 267	337 011	
P10	246.6	15 5 360 269	337 025	
P11	246.6	15 5 360 268	337 036	

REVISIONS											
	2010/01/08	TB	FOR FINAL								
	2009/08/13	TB	FOR REVIEW								
	DATE	BY	REVISION								
VIBERT TO KAKABEKA EMBANKMENT WIDENING										DIST	THUNDER BAY
SUBM'D		..	CHECKED	DATE		XXXXX		SITE	-		
DRAWN		TB	CHECKED	WH	APPROVED		DWG		1		

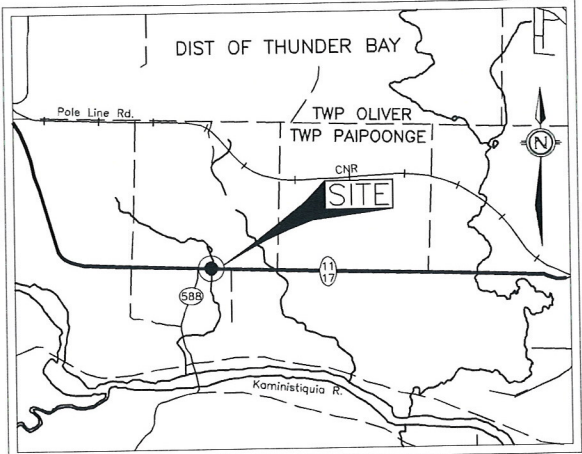


BOREHOLE LOCATION PLAN

SCALE





10 m 0 10 20 m

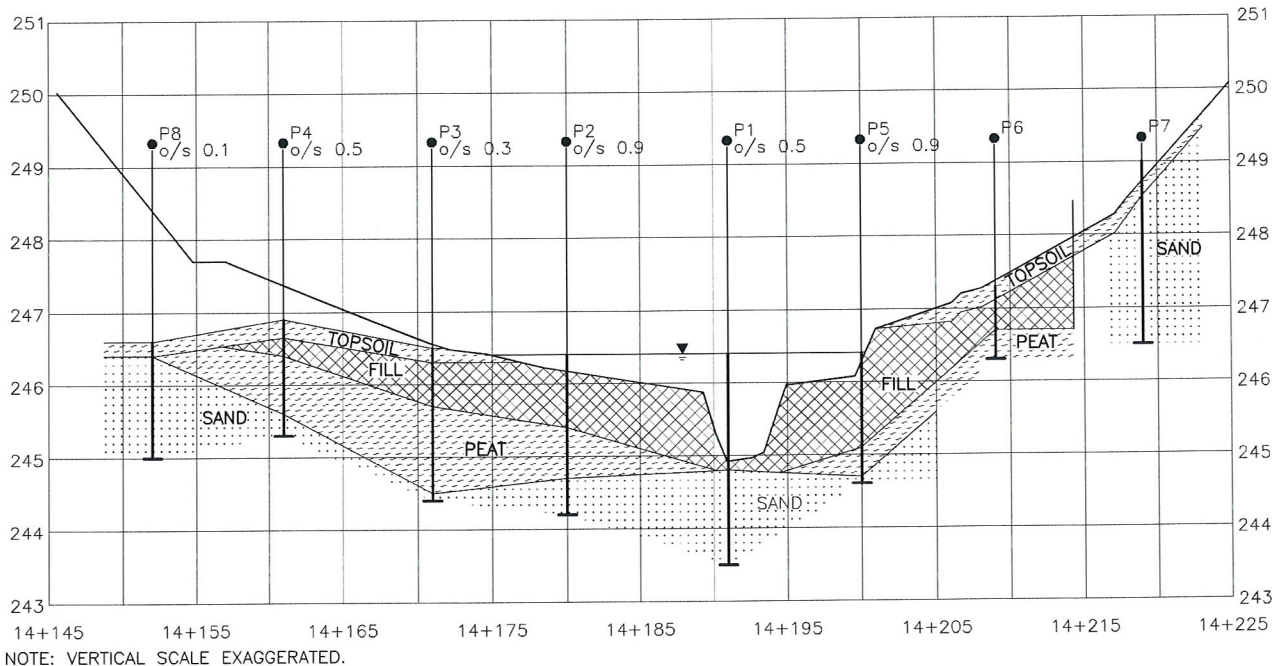




KEY PLAN  
1.0 km 0 1.0 km  
SCALE 1:50,000

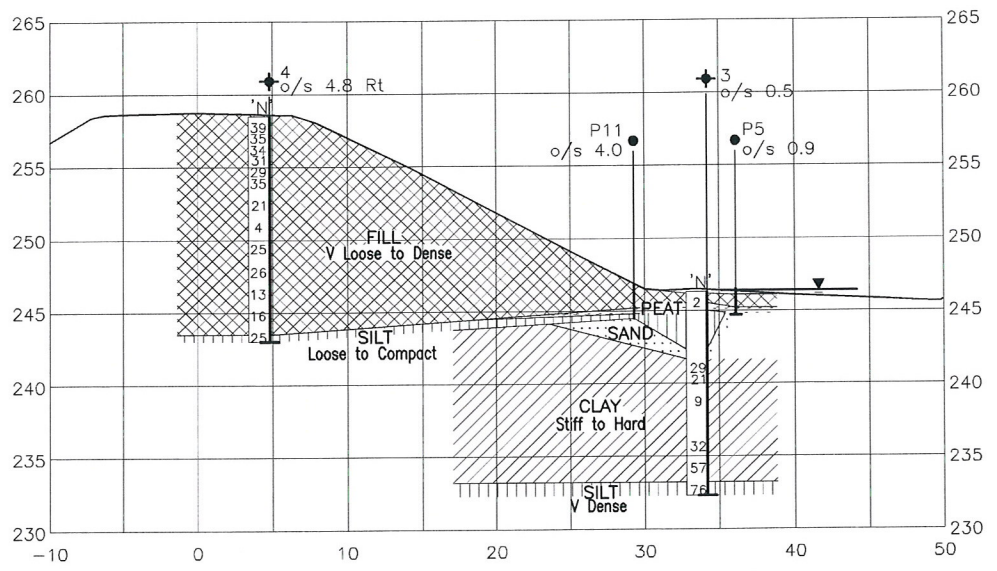
—NOTE—  
The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.

LEGEND			
	Borehole		
	Pedo Hole		
	'N' Std Pen Test (Blows/0.3m)		
	WL at time of investigation		
No	ELEVATION	CO-ORDINATES	
		NORTH	EAST
1	246.0	15 5 360 262	337 029
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P9	246.5	15 5 360 267	337 011
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




NOTE: VERTICAL SCALE EXAGGERATED.

PROFILE A-A



SECTION B-B STA. 14+200



SOIL STRATA SYMBOLS			
	PEAT or TOPSOIL		FILL
	SAND		SILT
	CLAY		

REVISIONS			
2010/01/08	TB	FOR FINAL	
DATE	BY	REVISION	
VIBERT TO KAKABEKA			DIST THUNDER BAY
SUBM'D ..	CHECKED	DATE XXXXX	SITE
DRAWN TB	CHECKED WH	APPROVED	DWG 2