



**Foundation Investigation Report  
Highway 11/17(New), Four Laning from 4.06 km  
West of Highway 587 Westerly 14 km  
Foundation Zone 1  
Station 27+380 to 27+680**

**GWP 6120-03-00**

**Geocres No.: 52A-136**

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

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## Table of Contents

### Part A - FOUNDATION INVESTIGATION REPORT

1	Introduction .....	1
2	Site Description.....	2
2.1	Surficial Geology .....	2
2.2	Bedrock Geology .....	2
3	Investigation Procedures .....	3
4	Sub-Surface Conditions.....	5
4.1	Topsoil/Peat.....	5
4.2	Sands and Silts.....	5
4.3	Till .....	6
4.4	Refusal .....	6
4.5	Ground Water .....	6
5	Miscellaneous .....	7
6	Closure .....	7

## APPENDICIES

Appendix A, Borehole Logs

Appendix B, Laboratory Test Data

Appendix C, Borehole Locations and Soil Strata Drawings

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## Part A - FOUNDATION INVESTIGATION REPORT

### 1 Introduction

TBT Engineering (TBTE) has been retained by Engineering Northwest Limited (ENL) to provide foundation investigations and design services for embankments of the new Highway 11/17 Four Laning from MacKenzie Easterly (1.6 km west of Mackenzie Station Road to 0.3 km west of Eldorado Beach Road). As part of this assignment, a foundation investigation was required within four foundation zones:

- Foundation Zone 1
  - Immediately west of MacKenzie Station Road – 300 m Section
- Foundation Zone 2
  - Immediately west of MacKenzie Heights Road – 500 m Section
- Foundation Zone 3
  - 3 km east of MacKenzie Station Road – 600 m Section
- Foundation Zone 4
  - Immediately west of New Connection Birch Beach Road - 2 km Section

This report solely discusses the findings within Foundation Zone 1. Findings of the investigations at Foundation Zones 2, 3 and 4 are presented under separate cover.

The foundation investigation was carried out to investigate subsurface conditions at Foundation Zone 1. This investigation consisted of a number of boreholes drilled in the vicinity of the proposed new alignment, 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-136** to this site.

## **2 Site Description**

Foundation Zone 1 is located immediately west of MacKenzie Station Road and extends easterly for 300 m. Foundation Zone 1 is located between Station 27+380 and 27+680 and is generally level from east to west with a slight downward grade running from north to south. The proposed new alignment will cross swampy terrain and will be located to the north of the existing highway (up to approximately 650 m).

### **2.1 Surficial Geology**

The proposed alignment (all Foundation Zones) traverses several different surficial deposits, such as sand and gravel lacustrine delta deposits, sandy beach deposits, and ground moraine/till deposits all over bedrock, as shown on the best available mapping (OGS NOEGTS Map 5046 – Black Bay). In general, the proposed alignment (all Foundation Zones), has two areas a western and eastern area. The western part is expected to contain thicker, more extensive units than the eastern part; however, the surficial geology of both areas is predominantly controlled by proximity to past elevated levels of glacial lakes and spillways in the Lake Superior basin. Adjacent till deposits are related to sub-glacial processes, and pre-date those formed in a lacustrine paleo-environment.

The area from the western extent of the proposed alignment to approximate station 30+200 (encompassing Foundation Zone 1) is mapped to contain peat, underlain by a sand and gravel lacustrine delta deposit, associated with a former spillway occupying the Mackenzie River valley.

### **2.2 Bedrock Geology**

The majority of the bedrock along the Foundation Zone 1 alignment is mapped to be medium to coarse grained, variably porphyritic pink felsic intrusives of (locally known as 'Mackenzie granite') as indicated on OGS Map P2985 (MacGregor Bedrock – East half).

### **3 Investigation Procedures**

A geotechnical site investigation was undertaken between February 13 and 19, 2009. Sixteen boreholes were carried out along the proposed alignment.

The investigation was carried out using a CME 750 drill rig. The CME 750 drill rig is 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). All boreholes were drilled to auger refusal (N values > 100).

Borehole locations were measured in the field and ground surface elevations surveyed by ENL and referenced to data provided by MTO and the following datum:

Horizontal Datum:	NAD83 MTM Zone 15
Vertical Datum:	Canadian Geodetic Vertical Datum 1928
Benchmark:	GBM 93U168 Elevation 227.917

A summary of the borehole 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)	Refusal (Elevation/Depth) (metres)	Base of Peat (Elevation/Depth) (metres)
BH 1-01	234.7	226.2 / 8.5	234.6 / 0.1
BH 1-02	235.0	228.7 / 6.3	234.8 / 0.2
BH 1-03	235.7	229.2 / 6.5	235.5 / 0.2
BH 1-04	233.3	227.0 / 6.3	232.3 / 1.0
BH 1-05	233.9	231.6 / 2.3	233.1 / 0.8
BH 1-06	233.5	231.1 / 2.4	232.9 / 0.6
BH 1-07	233.0	231.9 / 1.1	232.2 / 0.8
BH 1-08	234.1	231.3 / 2.8	233.5 / 0.6
BH 1-09	232.5	231.3 / 1.2	231.9 / 0.6
BH 1-10	234.2	226.8 / 7.4	232.4 / 1.8
BH 1-11	233.5	229.2 / 4.3	231.8 / 1.7
BH 1-12	234.7	227.7 / 7.0	234.4 / 0.3
BH 1-13	233.7	227.3 / 6.4	233.0 / 0.7
BH 1-14	232.9	227.0 / 5.9	232.6 / 0.3
BH 1-15	235.0	229.2 / 5.8	234.2 / 0.8
BH 1-16	232.9	229.0 / 3.9	232.7 / 0.2

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).

Within the Foundation Zone 1 (between Stations 27+380 and 27+680), the generalized subsurface stratigraphy consists of up to 1.8 m of peat/organics overlying a mixture of sands and silts, and followed by till to the extents of the boreholes.

### **4.1 Topsoil/Peat**

Along the proposed alignment, topsoil/peat (swamp material) was encountered at all borehole locations. This material extended to depths ranging from 0.1 to 1.8 m (elevation 235.5 to 231.8 m) with an average depth of 0.7 m. In general, the peat deposit is deepest at near station 27+600 with depths of 1.7 to 1.8 m and thins out towards the east and west. Natural moisture contents varied between 85 and 872 % (dry weight basis).

### **4.2 Sands and Silts**

Beneath the topsoil/peat a variable deposit of sands and silts was encountered, at all the boreholes with the exception of Borehole 1-09. The sands and silts extend to depths ranging from 0.9 to 6.1 m (elevation 233.4 to 227 m). This deposit consists of zones sand and silt existing in varying proportions. Grain size analysis shows great variation in the sampled material with material varying from 0-19% gravel, 25–96% sand, and 4 - 68% silt sized particles. This stratum is in a very loose to compact condition with SPT (N) values of 1 to 22 blows/0.3 m.

At Borehole 1-01, a clay lens was identified at 4.2m (elevation 230.5 m).

A discontinuous organic layer is present between this stratum at Borehole 1-05 at elevation 232.5 and the till with an approximate thickness of 0.1 m.

Two consolidated drained direct shear tests were carried out, one on a silty sand and the other on a sand and silt. The results of these tests have been illustrated graphically in Appendix B. The test results indicate a lower bound effective angle of internal friction ( $\phi'$ ) of  $32^\circ$  with a effective cohesion intercept ( $C'$ ) of 0 kPa.

### **4.3 Till**

Till was encountered beneath the sands and silts at Boreholes 1-01 to 1-06, 1-08, 1-10 to 1-13, 1-15, 1-16 and beneath the topsoil/peat at Boreholes 1-07 and 1-09. The till extends to the termination of the boreholes. Based on grain size analyses this stratum can consist of 0-21% gravel, 18-70% sand, and 27-81% silt and clay sized particles with occasional cobbles and boulders. This stratum is in compact to very dense condition with SPT (N) values of 10 to greater than 100 blows/0.3 m.

### **4.4 Refusal**

Auger refusal was met at elevations ranging from 226.2 to 232.2 m (depths from 8.5 to 0.8m) at all borehole locations. Auger refusal may be on bedrock, or on cobbles and/or boulders. In addition to auger refusal SPT (N) values greater than 100 were encountered at the auger refusal depths. Coring of the refusal material was not part of the scope of work.

### **4.5 Ground Water**

The ground water level during the field investigations was generally within 0.5 m of the peat surface, with the exception of Boreholes 1-01 to 1-03. At Boreholes 1-01 to 1-03 the ground water was recorded at depths varying from 1.1 to 2.7 m. Ground water levels measured within the boreholes at the time of this investigation generally varied between elevations of 232.5 and 234.9 m

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



## 5 Miscellaneous

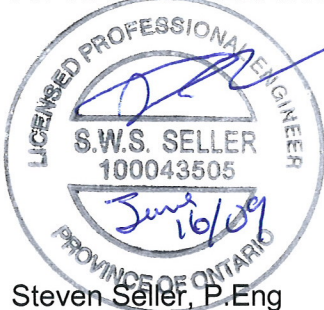
Laboratory testing was carried out at the TBT Engineering laboratory in Thunder Bay. The field operations were supervised by Herman Finke. Laboratory testing was supervised by T. Fummerton C.E.T. This report was prepared by S. Seller, P.Eng. and G. Maki, P.Eng., and reviewed by W. Hurley, P.Eng.

## 6 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



Steven Seller, P.Eng  
Project Engineer



Wayne Hurley, P. Eng  
Vice-President, Engineering



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Manager of Geotechnical 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 (RQD), FOR MODIFIED RECOVERY, IS:

RQD (%)	0 - 25	25 - 50	50 - 75	75 - 90	90 - 100
	VERY POOR	POOR	FAIR	GOOD	EXCELLENT

**JOINTING AND BEDDING:**

SPACING	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

### STRESS AND STRAIN

$u_w$	kPa	PORE WATER PRESSURE
$r_u$	l	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
$\mu$	l	COEFFICIENT OF FRICTION

### MECHANICAL PROPERTIES OF SOIL

$m_v$	$\text{kPa}^{-1}$	COEFFICIENT OF VOLUME CHANGE
$C_c$	l	COMPRESSION INDEX
$C_s$	l	SWELLING INDEX
$C_\alpha$	l	RATE OF SECONDARY CONSOLIDATION
$C_v$	$\text{m}^2/\text{s}$	COEFFICIENT OF CONSOLIDATION
H	m	DRAINAGE PATH
$T_v$	l	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
$S_f$	l	SENSITIVITY = $\frac{C_u}{\tau_r}$

### PHYSICAL PROPERTIES OF SOIL

$\rho_s$	$\text{kg}/\text{m}^3$	DENSITY OF SOLID PARTICLES	e	l, %	VOID RATIO	$e_{\min}$	l, %	VOID RATIO IN DENSEST STATE
$\gamma_s$	$\text{kN}/\text{m}^3$	UNIT WEIGHT OF SOLID PARTICLES	n	l, %	POROSITY	$I_D$	l	DENSITY INDEX = $\frac{e_{\max} - e}{e_{\max} - e_{\min}}$
$\rho_w$	$\text{kg}/\text{m}^3$	DENSITY OF WATER	w	l, %	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	$C_u$	l	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	$I_L$	l	LIQUIDITY INDEX = $\frac{w - w_p}{I_p}$	i	l	HYDRAULIC GRADIENT
$\gamma_{\text{sat}}$	$\text{kN}/\text{m}^3$	UNIT WEIGHT OF SATURATED SOIL	$I_C$	l	CONSISTENCY INDEX = $\frac{w_L - w}{I_p}$	k	m/s	HYDRAULIC CONDUCTIVITY
$\rho'$	$\text{kg}/\text{m}^3$	DENSITY OF SUBMERGED SOIL	$e_{\max}$	l, %	VOID RATIO IN LOOSEST STATE	j	$\text{kN}/\text{m}^3$	SEEPAGE FORCE
$\gamma'$	$\text{kN}/\text{m}^3$	UNIT WEIGHT OF SUBMERGED SOIL						

TBT Engineering Consulting Group			<b>RECORD OF Borehole No 1-01</b>			1 OF 1 <b>METRIC</b>		
W.P. <b>66 120-03-00</b>			PROJECT <b>Four Laning - From Hwy 587 Westerly</b>			SITE NO. <b>Foundation Zone 1</b> ORIGINATED BY <b>AF</b>		
DIST <b>61</b> HWY <b>11/17</b>			LOCATION <b>27+393.9 o/s 16.9 Lt</b>			TBTE JOB# <b>08-171</b> COMPILED BY <b>TB</b>		
DATE <b>2009 February 13</b>			BOREHOLE TYPE <b>Hollow Stem Auger</b>			DATUM <b>Geodetic</b> CHECKED BY <b>SS</b>		
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	ELEVATION SCALE	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
234.7	<b>TOPSOIL</b> <b>SANDS &amp; SILTS (of variable proportions)</b> SAND - trace silt, brown, loose to very dense		1	AS			Water level @ 1.1 m on completion.	
234.6			2	SS	8			0 93 (7)
234.0			3	SS	9			
233.0			4	SS	5			
232.0			5	SS	6			0 92 (9)
231.0			6	SS	8			
230.0	- clay lenses							
4.7	<b>TILL - SAND - Silty, some gravel, occasional cobbles, grey, compact to very dense</b>		7	SS	12		16 55 (29)	
229.0			8	SS	41			
228.0			9	SS	20			
226.2	End of Borehole @ 8.5 m. Auger Refusal.		10	SS	100+			

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

ON\_MOT\_BH-10 08-171 FOUNDATIONS ZONE 1.GPJ ON\_MOT.GDT 09/6/15

TBT Engineering Consulting Group			<b>RECORD OF Borehole No 1-02</b>			1 OF 1 <b>METRIC</b>	
W.P. <b>66 120-03-00</b>			PROJECT <b>Four Laning - From Hwy 587 Westerly</b>			SITE NO. <b>Foundation Zone 1</b> ORIGINATED BY <b>AF</b>	
DIST <b>61</b> HWY <b>11/17</b>			LOCATION <b>27+366.8 o/s 8.8 Lt</b>			TBTE JOB# <b>08-171</b> COMPILED BY <b>TB</b>	
DATE <b>2009 February 13</b>			BOREHOLE TYPE <b>Hollow Stem Auger</b>			DATUM <b>Geodetic</b> CHECKED BY <b>SS</b>	
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	ELEVATION SCALE	REMARKS & GRAIN SIZE DISTRIBUTION (%)
235.0	TOPSOIL						
234.9	<b>SANDS &amp; SILTS (of variable proportions)</b>  SAND - some silt, trace gravel, brown, loose to compact  ----- - occasional cobbles  ----- - trace silt		1	AS			Water level @ 1.6 m on completion.  1 83 (16)  0 96 (4)
0.2			2	SS	6		
			3	SS	11		
			4	SS	6		
			5	SS	9		
			6	SS	11		
			7	SS	8		
			8	SS	100+		
229.3	TILL - SILT - Sandy, grey, very dense						
5.7							
228.7	End of Borehole @ 6.3 m. Auger Refusal.						
6.3							

**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>

ON\_MOT\_BH-10 08-171 FOUNDATIONS ZONE 1.GPJ ON\_MOT.GDT 09/6/15

TBT Engineering Consulting Group			<b>RECORD OF Borehole No 1-03</b>			1 OF 1 <b>METRIC</b>	
W.P. <b>66 120-03-00</b>			PROJECT <b>Four Laning - From Hwy 587 Westerly</b>			SITE NO. <b>Foundation Zone 1</b> ORIGINATED BY <b>AF</b>	
DIST <b>61</b> HWY <b>11/17</b>			LOCATION <b>27+429.4 o/s 42.4 Lt</b>			TBTE JOB# <b>08-171</b> COMPILED BY <b>TB</b>	
DATE <b>2009 February 12</b>			BOREHOLE TYPE <b>Hollow Stem Auger</b>			DATUM <b>Geodetic</b> CHECKED BY <b>SS</b>	
SOIL PROFILE			SAMPLES			DYNAMIC CONE PENETRATION RESISTANCE PLOT	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE
235.7	TOPSOIL						
235.0	<b>SANDS &amp; SILTS (of variable proportions)</b>						
0.2	SAND - Silty, brown, compact to very loose		1	AS			
	- some silt		2	SS	17		
	- sandy silt layer (150 mm)		3	SS	17		
			4	SS	10		
			5	SS	8		
	- brown/grey		6	SS	4		
	- layered, some gravel, occasional cobbles, grey, loose		7	SS	5		
229.4	<b>TILL - SAND &amp; SILT - occasional cobbles, very dense</b>		8	SS	7		
6.3	End of Borehole @ 6.5 m. Auger Refusal.		9	SS	100+		
228.2							
6.5							

SHEAR STRENGTH kPa		WATER CONTENT (%)		UNIT WEIGHT	REMARKS & GRAIN SIZE DISTRIBUTION (%)
UNCONFINED	FIELD VANE	W <sub>p</sub>	W	γ	GR SA SI CL
20	20	20	20	kN/m <sup>3</sup>	Water level @ 2.7 m on completion.
40	40	40	40		0 90 (10)
60	60	60	60		
80	80	80	80		
100	100	100	100		0 58 (42)

ON\_MOT\_BH-10 08-171 FOUNDATIONS ZONE 1.GPJ ON\_MOT.GDT 09/6/15

TBT Engineering Consulting Group			<b>RECORD OF Borehole No 1-04</b>			1 OF 1 <b>METRIC</b>	
W.P. <b>66 120-03-00</b>			PROJECT <b>Four Laning - From Hwy 587 Westerly</b>			SITE NO. <b>Foundation Zone 1</b> ORIGINATED BY <b>HF</b>	
DIST <b>61</b> HWY <b>11/17</b>			LOCATION <b>27+394.9 o/s 6.7 Rt</b>			TBTE JOB# <b>08-171</b> COMPILED BY <b>TB</b>	
DATE <b>2009 February 13</b>			BOREHOLE TYPE <b>Hollow Stem Auger</b>			DATUM <b>Geodetic</b> CHECKED BY <b>SS</b>	
SOIL PROFILE			SAMPLES			DYNAMIC CONE PENETRATION RESISTANCE PLOT	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	<div style="display: flex; justify-content: space-between;"> <div> <p>20 40 60 80 100</p> <p>SHEAR STRENGTH kPa</p> <p>○ UNCONFINED    ✕ FIELD VANE</p> <p>■ SPT (N)        ★ LAB VANE</p> <p>20 40 60 80 100</p> </div> <div> <p>20 40 60</p> <p>WATER CONTENT (%)</p> <p>W<sub>p</sub>    W    W<sub>L</sub></p> </div> </div>
233.3 0.0	PEAT - brown/black		1	AS			<div style="display: flex; justify-content: space-between;"> <div> <p>20 40 60 80 100</p> <p>SHEAR STRENGTH kPa</p> <p>○ UNCONFINED    ✕ FIELD VANE</p> <p>■ SPT (N)        ★ LAB VANE</p> <p>20 40 60 80 100</p> </div> <div> <p>20 40 60</p> <p>WATER CONTENT (%)</p> <p>W<sub>p</sub>    W    W<sub>L</sub></p> </div> </div>
232.3 1.0	SANDS & SILTS (of variable proportions) SAND - Silty, brown, loose ----- - trace silt		2	SS	5		233
		3	SS	4	232		
		4	SS	8	231		
		5	SS	5	230		
		6	SS	4	229		
228.9 4.4	TILL - SAND - Silty, Gravelly, occasional cobbles, grey, compact to very dense	7	SS	17	228		
		8	SS	100+	227		
227.0 6.3	End of Borehole @ 6.3 m. Auger Refusal.						

ON\_MOT\_BH-10 08-171 FOUNDATIONS ZONE 1.GPJ ON\_MOT.GDT 09/6/15

TBT Engineering Consulting Group			<b>RECORD OF Borehole No 1-05</b>			1 OF 1 <b>METRIC</b>					
W.P. <b>66 120-03-00</b>			PROJECT <b>Four Laning - From Hwy 587 Westerly</b>			SITE NO. <b>Foundation Zone 1</b> ORIGINATED BY <b>AF</b>					
DIST <b>61</b> HWY <b>11/17</b>			LOCATION <b>27+481.6 o/s 20.2 Lt</b>			TBTE JOB# <b>08-171</b> COMPILED BY <b>TB</b>					
DATE <b>2009 February 12</b>			BOREHOLE TYPE <b>Hollow Stem Auger</b>			DATUM <b>Geodetic</b> CHECKED BY <b>SS</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> WATER CONTENT (%)	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE							"N" VALUES
233.9 0.0	PEAT - brown/black		1	AS							Water level @ 0.2 m on completion.  12 76 (12)
233.1 0.8	SAND - some silt, some gravel, brown/grey, loose		2	SS	6						
232.5 232.4 1.5	PEAT TILL - SAND - Silty, occasional cobbles, brown, compact to very dense		3	SS	14						
231.6 2.3	End of Borehole @ 2.3 m. Auger Refusal.		4	SS	100+						



TBT Engineering Consulting Group			<b>RECORD OF Borehole No 1-06</b>			1 OF 1		<b>METRIC</b>				
W.P. <b>66 120-03-00</b>			PROJECT <b>Four Laning - From Hwy 587 Westerly</b>			SITE NO. <b>Foundation Zone 1</b>		ORIGINATED BY <b>HF</b>				
DIST <b>61</b> HWY <b>11/17</b>			LOCATION <b>27+474.3 o/s 3.5 Lt</b>			TBTE JOB# <b>08-171</b>		COMPILED BY <b>TB</b>				
DATE <b>2009 February 17</b>			BOREHOLE TYPE <b>Hollow Stem Auger</b>			DATUM <b>Geodetic</b>		CHECKED BY <b>SS</b>				
SOIL PROFILE			SAMPLES			DYNAMIC CONE PENETRATION RESISTANCE PLOT		REMARKS & GRAIN SIZE DISTRIBUTION (%)				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
233.5 0.0	PEAT - some silt, brown		1	AS			233				86.4	Water level @ 0.5 m on completion.
232.9 0.6	<b>SANDS &amp; SILTS (of variable proportions)</b> SAND & SILT - brown, loose		2	SS	7		232					0 37 (63) Non Plastic.
232.2 1.3	<b>TILL - SAND - Silty, trace gravel, occasional cobbles, compact to very dense</b>		3	SS	13		232					4 64 (32)
231.1 2.4	<b>- SILT - Sandy, grey</b> ----- End of Borehole @ 2.4 m. Auger Refusal.		4	SS	100+		>>					

TBT Engineering Consulting Group			<b>RECORD OF Borehole No 1-07</b>				1 OF 1		<b>METRIC</b>						
W.P. <b>66 120-03-00</b>			PROJECT <b>Four Laning - From Hwy 587 Westerly</b>				SITE NO. <b>Foundation Zone 1</b>		ORIGINATED BY <b>HF</b>						
DIST <b>61</b> HWY <b>11/17</b>			LOCATION <b>27+469.2 o/s 12.2 Rt</b>				TBTE JOB# <b>08-171</b>		COMPILED BY <b>TB</b>						
DATE <b>2009 February 17</b>			BOREHOLE TYPE <b>Hollow Stem Auger</b>				DATUM <b>Geodetic</b>		CHECKED BY <b>SS</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 $\gamma$ 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							
233.0								20 40 60 80 100							
0.0	PEAT		1	AS											Water level @ 0.5 m on completion.
232.3															
0.8	TILL - SAND & SILT - some gravel, trace clay, occasional cobbles, grey, very dense		2	SS	100+										13 51 36 1
231.9	End of Borehole @ 1.1 m. Auger Refusal.														
1.1															

TBT Engineering Consulting Group			<b>RECORD OF Borehole No 1-08</b>			1 OF 1 <b>METRIC</b>					
W.P. <b>66 120-03-00</b>			PROJECT <b>Four Laning - From Hwy 587 Westerly</b>			SITE NO. <b>Foundation Zone 1</b> ORIGINATED BY <b>AF</b>					
DIST <b>61</b> HWY <b>11/17</b>			LOCATION <b>27+532.9 o/s 49.3 Lt</b>			TBTE JOB# <b>08-171</b> COMPILED BY <b>TB</b>					
DATE <b>2009 February 12</b>			BOREHOLE TYPE <b>Hollow Stem Auger</b>			DATUM <b>Geodetic</b> CHECKED BY <b>SS</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> WATER CONTENT (%)	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE							"N" VALUES
234.1	0.0	PEAT - brown/black		1	AS		234				Water level @ 0.4 m on completion.   0 46 (54)
233.5	0.6	<b>SANDS &amp; SILTS (of variable proportions)</b> SAND & SILT - layered, brown, very loose to loose  ----- - occasional cobbles, very loose to very dense		2	SS	2	233				
				3	SS	11					
				4	SS	3	232				
231.6	2.5	<b>TILL - SILT - Sandy, occasional cobbles, brown, very dense</b>		5	SS	100+					
231.3	2.8	End of Borehole @ 2.8 m. Auger Refusal.									

TBT Engineering Consulting Group			<b>RECORD OF Borehole No 1-09</b>			1 OF 1		<b>METRIC</b>						
W.P. <b>66 120-03-00</b>			PROJECT <b>Four Laning - From Hwy 587 Westerly</b>			SITE NO. <b>Foundation Zone 1</b>		ORIGINATED BY <b>AF</b>						
DIST <b>61</b> HWY <b>11/17</b>			LOCATION <b>27+531.7 o/s 41.3 Rt</b>			TBTE JOB# <b>08-171</b>		COMPILED BY <b>TB</b>						
DATE <b>2009 February 17</b>			BOREHOLE TYPE <b>Hollow Stem Auger</b>			DATUM <b>Geodetic</b>		CHECKED BY <b>SS</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 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						
232.5 0.0	PEAT		1	AS		▼ 232	<div style="display: flex; justify-content: space-between;"> <div>           ○ UNCONFINED ■ SPT (N)         </div> <div>           ✕ FIELD VANE ★ LAB VANE         </div> </div>		<div style="display: flex; justify-content: space-between;"> <div>20 40 60 80 100</div> <div>20 40 60</div> </div>	<div style="display: flex; justify-content: space-between;"> <div>20 40 60</div> <div>139.7</div> </div>		Water level @ 0.5 m on completion.  2 18 (81) Non Plastic.		
231.9 0.6	TILL - SILT - some sand, trace gravel, occasional cobbles, grey, compact to very dense		2	SS	12									
231.3 1.2	End of Borehole @ 1.2 m. Auger Refusal.		3	SS	100+									

TBT Engineering Consulting Group			<b>RECORD OF Borehole No 1-10</b>			1 OF 1 <b>METRIC</b>		
W.P. <b>66 120-03-00</b>			PROJECT <b>Four Laning - From Hwy 587 Westerly</b>			SITE NO. <b>Foundation Zone 1</b> ORIGINATED BY <b>AF</b>		
DIST <b>61</b> HWY <b>11/17</b>			LOCATION <b>27+579.2 o/s 20.6 Lt</b>			TBTE JOB# <b>08-171</b> COMPILED BY <b>TB</b>		
DATE <b>2009 February 12</b>			BOREHOLE TYPE <b>Hollow Stem Auger</b>			DATUM <b>Geodetic</b> CHECKED BY <b>SS</b>		
SOIL PROFILE			SAMPLES			DYNAMIC CONE PENETRATION RESISTANCE PLOT		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	<div style="display: flex; justify-content: space-between;"> <div> <p>20 40 60 80 100</p> <p>SHEAR STRENGTH kPa</p> <p>○ UNCONFINED    ✕ FIELD VANE</p> <p>■ SPT (N)        ★ LAB VANE</p> <p>20 40 60 80 100</p> </div> <div> <p>W<sub>p</sub>    W    W<sub>L</sub></p> <p>PLASTIC LIMIT    NATURAL MOISTURE CONTENT    LIQUID LIMIT</p> <p>WATER CONTENT (%)</p> <p>20 40 60</p> </div> </div>	
234.2 0.0	PEAT - brown/black		1	AS			<div style="display: flex; justify-content: space-between;"> <div> <p>234</p> <p>233</p> <p>232</p> <p>231</p> <p>230</p> <p>229</p> <p>228</p> <p>227</p> </div> <div> <p>457.3</p> <p>515.6</p> <p>342.6</p> </div> </div>	
232.4 1.8	SANDS & SILTS (of variable proportions) SAND - trace silt, trace gravel, brown, very loose to compact		2	SS	1			
			3	SS	1			
			4	SS	3			
			5	SS	16			
			6	SS	22			
			7	SS	1			
			8	SS	5			
227.2 7.0	TILL - SAND - Silty, trace gravel, occasional cobbles, brown, very dense		9	SS	100+			
226.8 7.4	End of Borehole @ 7.4 m. Auger Refusal.							
							<div style="display: flex; justify-content: space-between;"> <div> <p>3 87 (9)</p> <p>3 71 (26)</p> <p>0 79 (21)</p> </div> <div> <p>Water level @ 0.5 m on completion.</p> </div> </div>	

ON\_MOT\_BH-10 08-171 FOUNDATIONS ZONE 1.GPJ ON\_MOT.GDT 09/6/15

TBT Engineering Consulting Group			<b>RECORD OF Borehole No 1-11</b>			1 OF 1 <b>METRIC</b>	
W.P. <b>66 120-03-00</b>			PROJECT <b>Four Laning - From Hwy 587 Westerly</b>			SITE NO. <b>Foundation Zone 1</b> ORIGINATED BY <b>AF</b>	
DIST <b>61</b> HWY <b>11/17</b>			LOCATION <b>27+582.7 o/s 16.6 Rt</b>			TBTE JOB# <b>08-171</b> COMPILED BY <b>TB</b>	
DATE <b>2009 February 18</b>			BOREHOLE TYPE <b>Hollow Stem Auger</b>			DATUM <b>Geodetic</b> CHECKED BY <b>SS</b>	
SOIL PROFILE			SAMPLES			DYNAMIC CONE PENETRATION RESISTANCE PLOT	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	<div style="display: flex; justify-content: space-between;"> <div> <p>20 40 60 80 100</p> <p>SHEAR STRENGTH kPa</p> <p>○ UNCONFINED    ✕ FIELD VANE</p> <p>■ SPT (N)        ★ LAB VANE</p> <p>20 40 60 80 100</p> </div> <div> <p>20 40 60</p> <p>WATER CONTENT (%)</p> <p>W<sub>p</sub>    W    W<sub>L</sub></p> </div> </div>
233.5 0.0	PEAT		1	AS			<div style="display: flex; justify-content: space-between;"> <div> <p>20 40 60 80 100</p> <p>SHEAR STRENGTH kPa</p> <p>○ UNCONFINED    ✕ FIELD VANE</p> <p>■ SPT (N)        ★ LAB VANE</p> <p>20 40 60 80 100</p> </div> <div> <p>20 40 60</p> <p>WATER CONTENT (%)</p> <p>W<sub>p</sub>    W    W<sub>L</sub></p> </div> </div>
			2	SS	1		
231.8 1.7	SANDS & SILTS (of variable proportions) SAND - some gravel, trace silt, brown, very loose to compact		3	SS	2		<div style="display: flex; justify-content: space-between;"> <div> <p>20 40 60 80 100</p> <p>SHEAR STRENGTH kPa</p> <p>○ UNCONFINED    ✕ FIELD VANE</p> <p>■ SPT (N)        ★ LAB VANE</p> <p>20 40 60 80 100</p> </div> <div> <p>20 40 60</p> <p>WATER CONTENT (%)</p> <p>W<sub>p</sub>    W    W<sub>L</sub></p> </div> </div>
	SILT - Sandy, some gravel, brown, loose to compact		4	SS	11		<div style="display: flex; justify-content: space-between;"> <div> <p>20 40 60 80 100</p> <p>SHEAR STRENGTH kPa</p> <p>○ UNCONFINED    ✕ FIELD VANE</p> <p>■ SPT (N)        ★ LAB VANE</p> <p>20 40 60 80 100</p> </div> <div> <p>20 40 60</p> <p>WATER CONTENT (%)</p> <p>W<sub>p</sub>    W    W<sub>L</sub></p> </div> </div>
229.7 3.8	TILL - SILT - Sandy, some gravel, brown, compact to very dense		5	SS	2		<div style="display: flex; justify-content: space-between;"> <div> <p>20 40 60 80 100</p> <p>SHEAR STRENGTH kPa</p> <p>○ UNCONFINED    ✕ FIELD VANE</p> <p>■ SPT (N)        ★ LAB VANE</p> <p>20 40 60 80 100</p> </div> <div> <p>20 40 60</p> <p>WATER CONTENT (%)</p> <p>W<sub>p</sub>    W    W<sub>L</sub></p> </div> </div>
229.2 4.3	End of Borehole @ 4.3 m. Auger Refusal.		6	SS	10		<div style="display: flex; justify-content: space-between;"> <div> <p>20 40 60 80 100</p> <p>SHEAR STRENGTH kPa</p> <p>○ UNCONFINED    ✕ FIELD VANE</p> <p>■ SPT (N)        ★ LAB VANE</p> <p>20 40 60 80 100</p> </div> <div> <p>20 40 60</p> <p>WATER CONTENT (%)</p> <p>W<sub>p</sub>    W    W<sub>L</sub></p> </div> </div>
			7	SS	100+		<div style="display: flex; justify-content: space-between;"> <div> <p>20 40 60 80 100</p> <p>SHEAR STRENGTH kPa</p> <p>○ UNCONFINED    ✕ FIELD VANE</p> <p>■ SPT (N)        ★ LAB VANE</p> <p>20 40 60 80 100</p> </div> <div> <p>20 40 60</p> <p>WATER CONTENT (%)</p> <p>W<sub>p</sub>    W    W<sub>L</sub></p> </div> </div>

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

TBT Engineering Consulting Group		<b>RECORD OF Borehole No 1-12</b>				1 OF 1 <b>METRIC</b>						
W.P. <b>66 120-03-00</b>		PROJECT <b>Four Laning - From Hwy 587 Westerly</b>		SITE NO. <b>Foundation Zone 1</b>		ORIGINATED BY <b>AF</b>						
DIST <b>61</b> HWY <b>11/17</b>		LOCATION <b>27+629.1 o/s 34.9 Lt</b>		TBTE JOB# <b>08-171</b>		COMPILED BY <b>TB</b>						
DATE <b>2009 February 18</b>		BOREHOLE TYPE <b>Hollow Stem Auger</b>		DATUM <b>Geodetic</b>		CHECKED BY <b>SS</b>						
SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	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 (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE		"N" VALUES	SHEAR STRENGTH kPa					
						20 40 60 80 100 ○ UNCONFINED    ✕ FIELD VANE ■ SPT (N)        ★ LAB VANE						
234.7	0.0	PEAT - brown										
234.4	0.3	<b>SANDS &amp; SILTS (of variable proportions)</b> SAND & SILT - brown, compact to very loose		1	AS							
				2	SS	13						
				3	SS	3						
				4	SS	6						
				5	SS	1						
				6	SS	3						
230.3	4.4	<b>TILL - SAND &amp; SILT</b> - some gravel, occasional cobbles, grey, dense to very dense		7	SS	39						
		----- - SILT - Sandy, trace gravel		8	SS	100+						
227.7	7.0	End of Borehole @ 7.0 m. Auger Refusal.		9	SS	100+						

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

ON\_MOT\_BH-10 08-171 FOUNDATIONS ZONE 1.GPJ ON MOT.GDT 09/6/15



TBT Engineering Consulting Group

# RECORD OF Borehole No 1-13

1 OF 1

**METRIC**

W.P. **66 120-03-00** PROJECT **Four Laning - From Hwy 587 Westerly** SITE NO. **Foundation Zone 1** ORIGINATED BY **AF**  
 DIST **61** HWY **11/17** LOCATION **27+631.3 o/s 2.4 Rt** TBTE JOB# **08-171** COMPILED BY **TB**  
 DATE **2009 February 18** BOREHOLE TYPE **Hollow Stem Auger** DATUM **Geodetic** CHECKED BY **SS**

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 (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa				
								○ UNCONFINED	✕ FIELD VANE			
233.7							■ SPT (N)	★ LAB VANE				
0.0	PEAT - black						20 40 60 80 100	20 40 60 80 100	PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	Water level @ 0.1 m on completion.
233.0			1	AS							502.7	
0.7	<b>SANDS &amp; SILTS (of variable proportions)</b> SAND - trace silt, trace gravel, brown, loose to compact		2	SS	4							4 86 (10)
			3	SS	12							
	----- - some silt											6 75 (18)
			4	SS	7							
	----- - Silty											
			5	SS	11							
	SILT - Sandy, grey, loose											
			6	SS	2							
	----- - brown											Non Plastic.
			7	SS	3							
227.9												
5.8	<b>TILL - SAND - Silty, trace gravel, grey, very dense</b>											3 70 (27)
			8	SS	100+							
227.3												
6.4	End of Borehole @ 6.4 m. Auger Refusal.											

ON\_MOT\_BH-10 08-171 FOUNDATIONS ZONE 1.GPJ ON\_MOT\_GDT 09/6/15



TBT Engineering Consulting Group			<b>RECORD OF Borehole No 1-14</b>			1 OF 1 <b>METRIC</b>							
W.P. <b>66 120-03-00</b>			PROJECT <b>Four Laning - From Hwy 587 Westerly</b>			SITE NO. <b>Foundation Zone 1</b> ORIGINATED BY <b>AF</b>							
DIST <b>61</b> HWY <b>11/17</b>			LOCATION <b>27+624.4 o/s 44.1 Rt</b>			TBTE JOB# <b>08-171</b> COMPILED BY <b>TB</b>							
DATE <b>2009 February 19</b>			BOREHOLE TYPE <b>Hollow Stem Auger</b>			DATUM <b>Geodetic</b> CHECKED BY <b>SS</b>							
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT  SHEAR STRENGTH kPa <div style="display: flex; justify-content: space-around; font-size: 0.8em;"> <span>○ UNCONFINED    ✕ FIELD VANE</span>  <span>■ SPT (N)        ★ LAB VANE</span> </div>	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 (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES								
232.9 0.0	PEAT												
232.6 0.3	<b>SANDS &amp; SILTS (of variable proportions)</b> SAND - some silt, brown, loose to compact ----- - trace gravel		1	AS									Water level @ 0.3 m on completion.
			2	SS	4		232						
			3	SS	10		231						10 70 (20)
			4	SS	15		230						
	----- - Silty		5	SS	13		229						0 61 (40)
	SILT - Sandy, brown, loose		6	SS	4		228						
			7	SS	4		227						0 32 (68)
227.0 5.9	End of Borehole @ 5.9 m. Auger Refusal.		8	SS	100+								

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

ON\_MOT\_BH-10 08-171 FOUNDATIONS ZONE 1.GPJ ON\_MOT.GDT 09/6/15

TBT Engineering Consulting Group			<b>RECORD OF Borehole No 1-15</b>			1 OF 1 <b>METRIC</b>					
W.P. <b>66 120-03-00</b>			PROJECT <b>Four Laning - From Hwy 587 Westerly</b>			SITE NO. <b>Foundation Zone 1</b> ORIGINATED BY <b>AF</b>					
DIST <b>61</b> HWY <b>11/17</b>			LOCATION <b>27+675.9 o/s 19.4 Lt</b>			TBTE JOB# <b>08-171</b> COMPILED BY <b>TB</b>					
DATE <b>2009 February 19</b>			BOREHOLE TYPE <b>Hollow Stem Auger</b>			DATUM <b>Geodetic</b> CHECKED BY <b>SS</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> WATER CONTENT (%)	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE							"N" VALUES
235.0 0.0	PEAT - brown/black		1	AS							Water level @ 0.1 m on completion.
234.2 0.8	<b>SANDS &amp; SILTS (of variable proportions)</b> SAND - some silt, trace gravel, brown, loose		2	SS	9						2 86 (12)
233.6 1.4	<b>TILL - SAND &amp; SILT - layered, trace gravel, occasional cobbles, brown/grey, compact to very dense</b>		3	SS	16						
			4	SS	25						8 40 (52)
			5	SS	100+						
	----- - SILT - trace sand, occasional cobbles, grey, very dense		6	SS	100+						7 41 (53) Non Plastic.
			7	SS	100+						Non Plastic.
229.2 5.8	End of Borehole @ 5.8 m. Auger Refusal.		8	SS	100+						

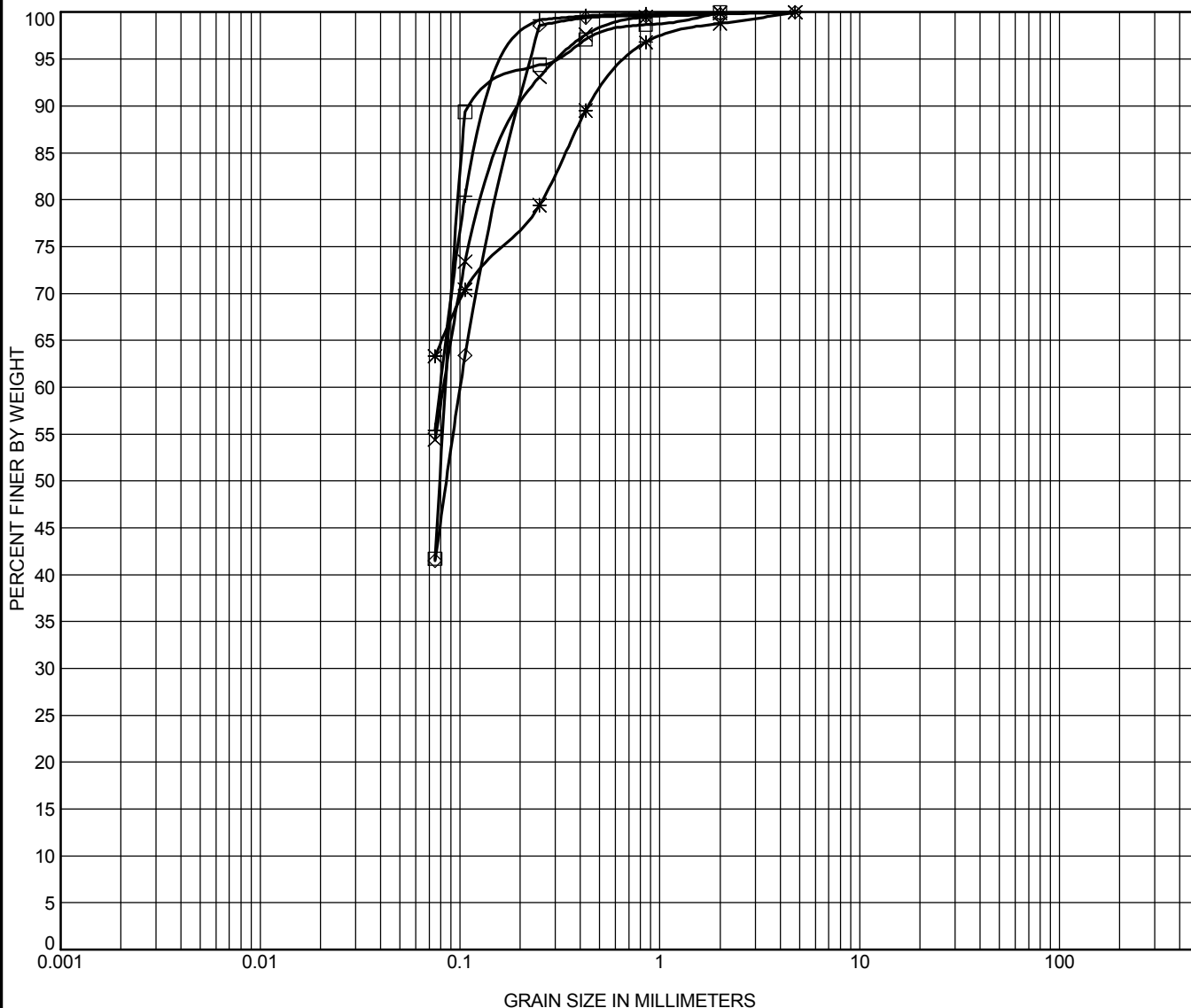
ON\_MOT\_BH-10 08-171 FOUNDATIONS ZONE 1.GPJ ON\_MOT.GDT 09/6/15

TBT Engineering Consulting Group			<b>RECORD OF Borehole No 1-16</b>			1 OF 1 <b>METRIC</b>	
W.P. <b>66 120-03-00</b>			PROJECT <b>Four Laning - From Hwy 587 Westerly</b>			SITE NO. <b>Foundation Zone 1</b> ORIGINATED BY <b>HF</b>	
DIST <b>61</b> HWY <b>11/17</b>			LOCATION <b>27+681.3 o/s 20.3 Rt</b>			TBTE JOB# <b>08-171</b> COMPILED BY <b>TB</b>	
DATE <b>2009 February 19</b>			BOREHOLE TYPE <b>Hollow Stem Auger</b>			DATUM <b>Geodetic</b> CHECKED BY <b>SS</b>	
SOIL PROFILE			SAMPLES			DYNAMIC CONE PENETRATION RESISTANCE PLOT	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	<div style="display: flex; justify-content: space-between;"> <div> <p>20 40 60 80 100</p> <p>SHEAR STRENGTH kPa</p> <p>○ UNCONFINED    ✕ FIELD VANE</p> <p>■ SPT (N)        ★ LAB VANE</p> <p>20 40 60 80 100</p> </div> <div> <p>W<sub>p</sub>      W      W<sub>L</sub></p> <p>PLASTIC   NATURAL   LIQUID</p> <p>LIMIT   MOISTURE   LIMIT</p> <p>CONTENT</p> <p>WATER CONTENT (%)</p> <p>20 40 60</p> </div> </div>
232.9	TOPSOIL						
232.7							
0.2	<b>SANDS &amp; SILTS (of variable proportions)</b> SAND - some gravel, some silt, brown, loose		1	AS			
	----- - trace gravel		2	SS	3		
	SILT - grey, compact		3	SS	13		
230.8							
2.1	<b>TILL - SAND &amp; SILT</b> - some gravel, occasional cobbles, grey, compact to very dense		4	SS	21		
			5	SS	16		
229.0			6	SS	100+		
3.9	End of Borehole @ 3.9 m. Auger Refusal.						

Elevation (m)	SPT (N)	Shear Strength (kPa)
232.7	2	20
232.5	3	25
231.5	13	30
231.0	21	35
230.5	16	40
229.0	100+	100

**APPENDIX B**

**Laboratory Test Data**



SILT OR CLAY	SAND			GRAVEL		COBBLES
	fine	medium	coarse	fine	coarse	

Remarks:  
SAND & SILT

Test Hole	Depth	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
□ 1-03	6.10	2	0.086			0.0	58.3	41.7	
* 1-06	0.75	4.75				0.0	36.7	63.3	
× 1-08	1.50	4.75	0.083			0.0	45.6	54.4	
+ 1-12	0.75	4.75	0.08			0.0	44.6	55.4	
◇ 1-12	3.00	4.75	0.1			0.0	58.5	41.5	



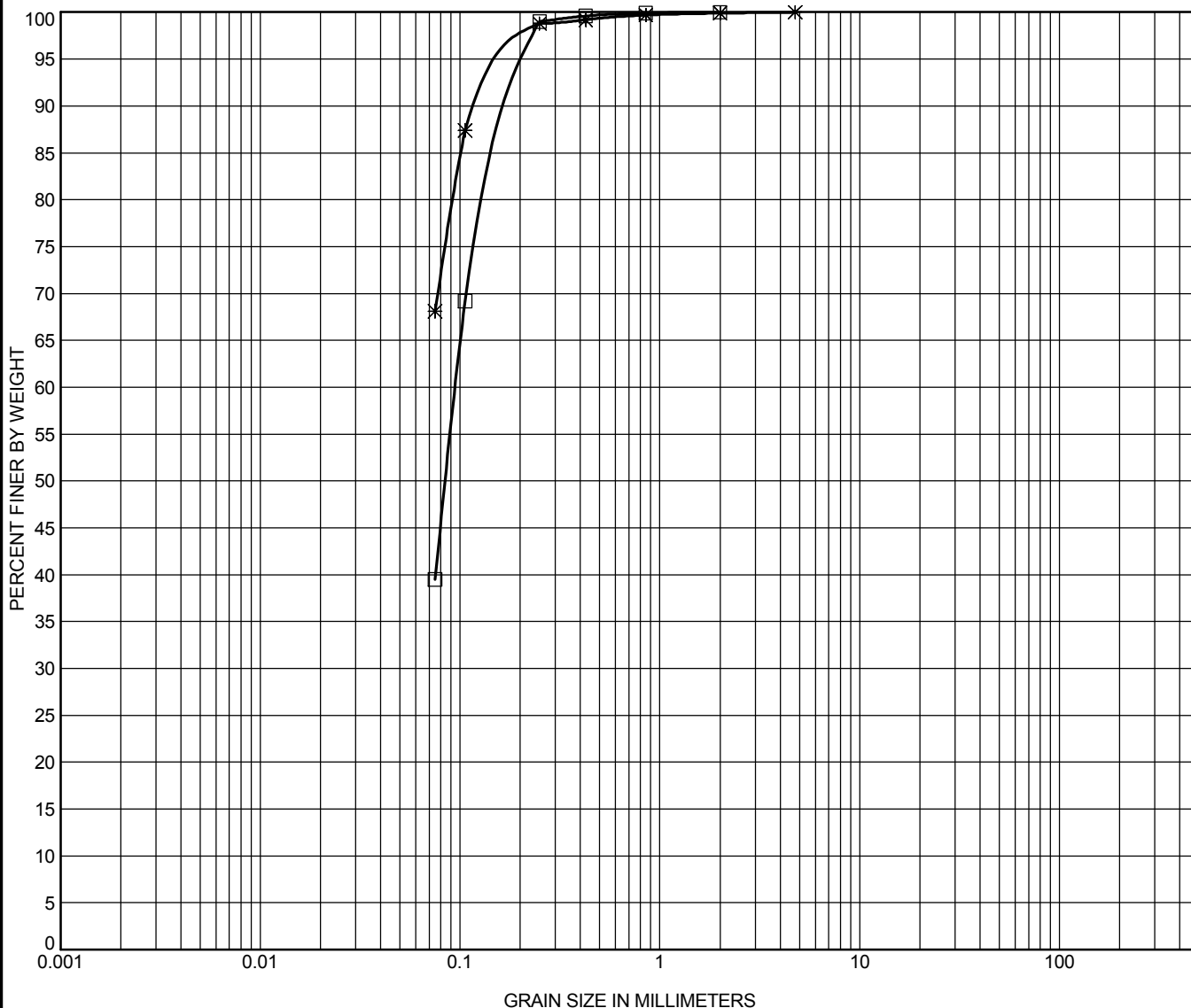
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## GRAIN SIZE DISTRIBUTION

Project: Four Laning - From Hwy 587 Westerly

W P: 66 120-03-00

DIST: 61 HWY: 11/17



SILT OR CLAY	SAND			GRAVEL		COBBLES
	fine	medium	coarse	fine	coarse	

Remarks:  
SAND & SILT

Test Hole	Depth	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
□ 1-14	3.00	2	0.095			0.0	60.5	39.5	
* 1-14	4.60	4.75				0.0	31.9	68.1	



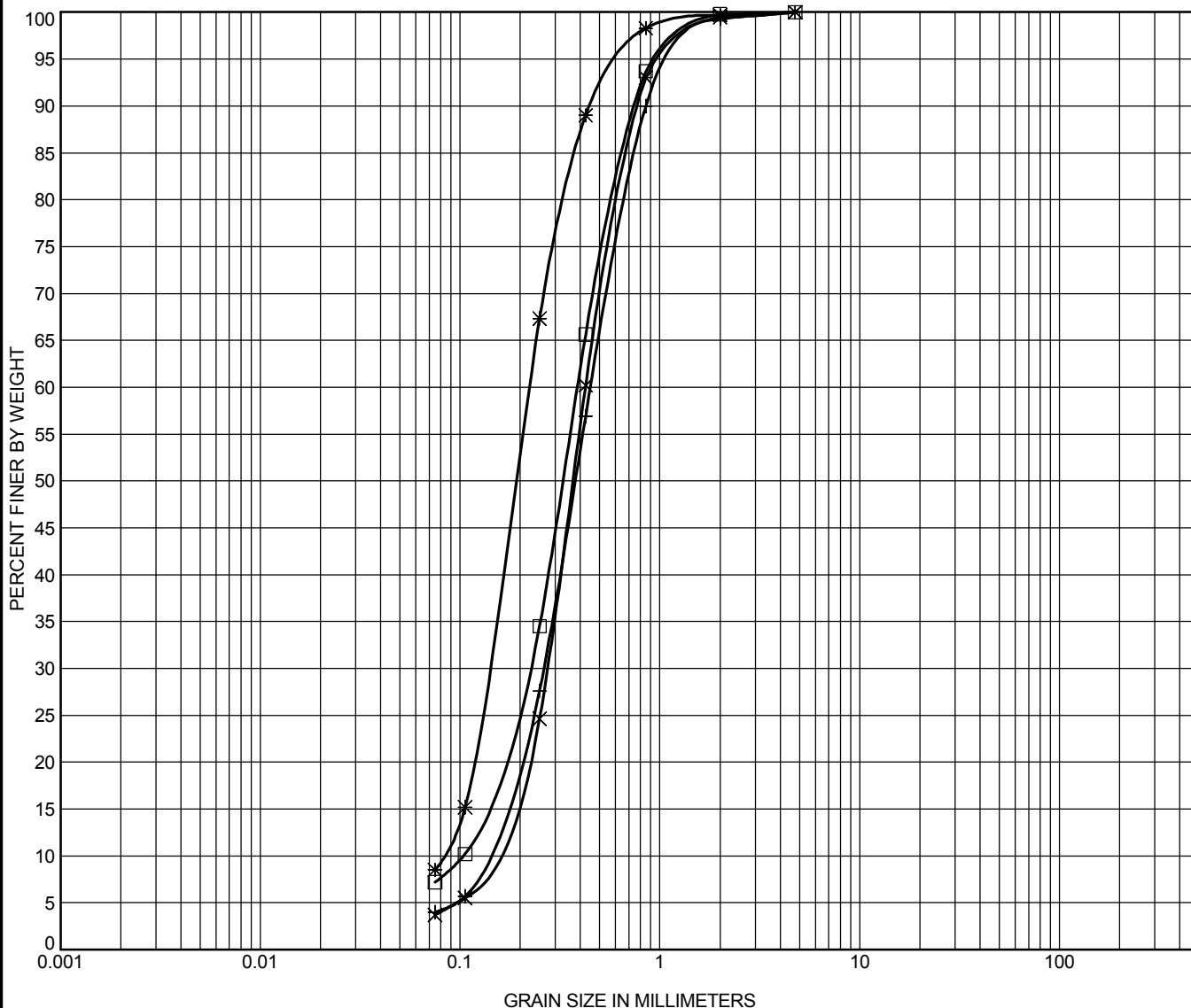
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## GRAIN SIZE DISTRIBUTION

Project: Four Laning - From Hwy 587 Westerly

W P: 66 120-03-00

DIST: 61 HWY: 11/17



SILT OR CLAY	SAND			GRAVEL		COBBLES
	fine	medium	coarse	fine	coarse	

Remarks:  
SAND - trace silt

Test Hole	Depth	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
□ 1-01	0.75	4.75	0.386	0.213	0.104	0.0	92.8	7.2	
* 1-01	3.00	4.75	0.222	0.135	0.081	0.0	91.5	8.5	
× 1-02	4.60	4.75	0.424	0.271	0.13	0.0	96.3	3.7	
+ 1-04	2.30	4.75	0.454	0.261	0.125	0.0	96.0	4.0	



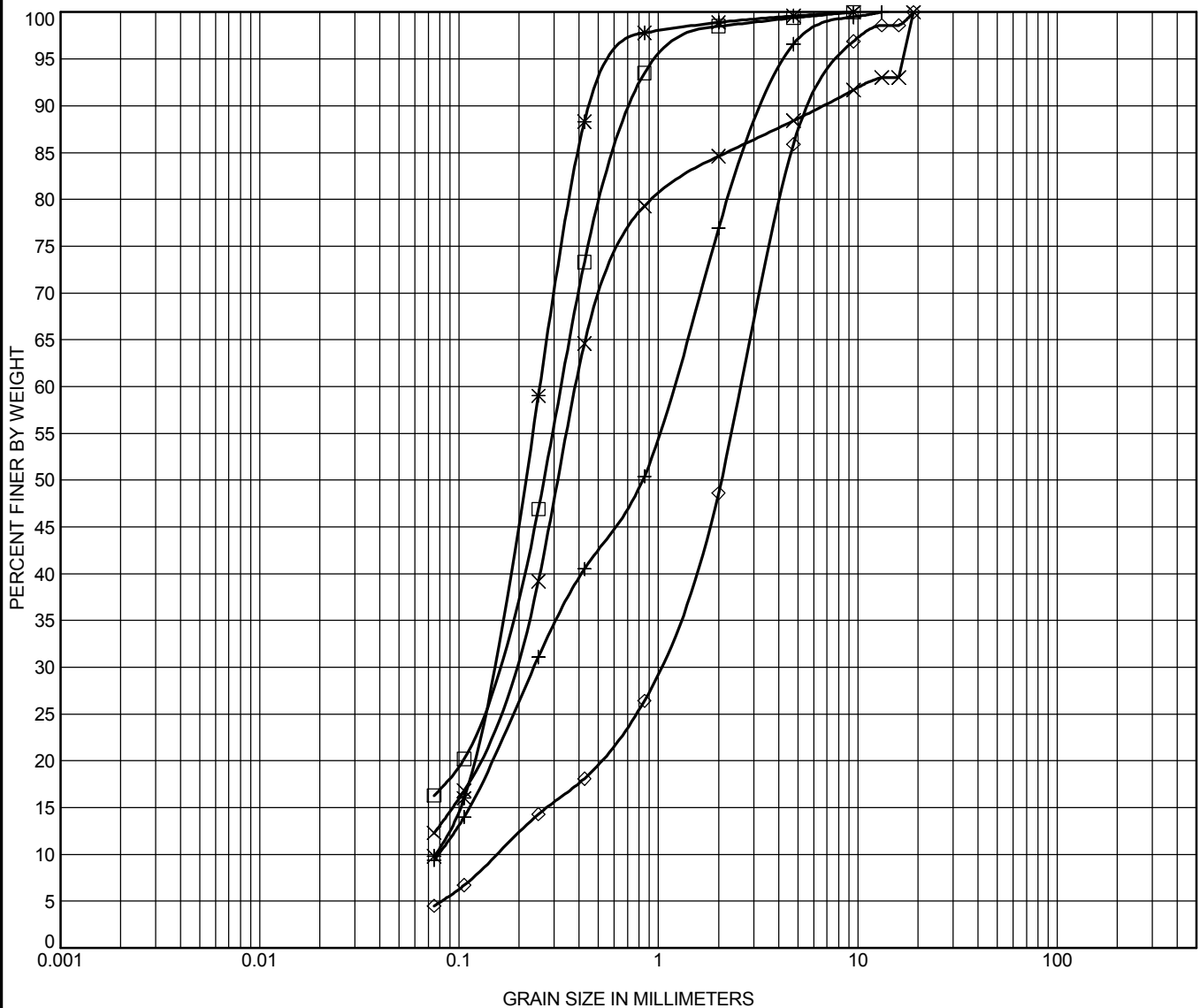
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## GRAIN SIZE DISTRIBUTION

Project: Four Laning - From Hwy 587 Westerly

W P: 66 120-03-00

DIST: 61 HWY: 11/17



Remarks:  
SAND - some silt, trace to some gravel

Test Hole	Depth	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
□ 1-02	1.50	9.5	0.325	0.145		0.6	83.1	16.3	
* 1-03	1.50	9.5	0.255	0.14	0.076	0.4	89.8	9.8	
× 1-05	0.75	19	0.386	0.176		11.6	76.1	12.3	
+ 1-10	2.30	13.2	1.159	0.237	0.078	3.4	87.2	9.4	
◇ 1-11	2.30	19	2.605	0.977	0.154	14.1	81.4	4.5	



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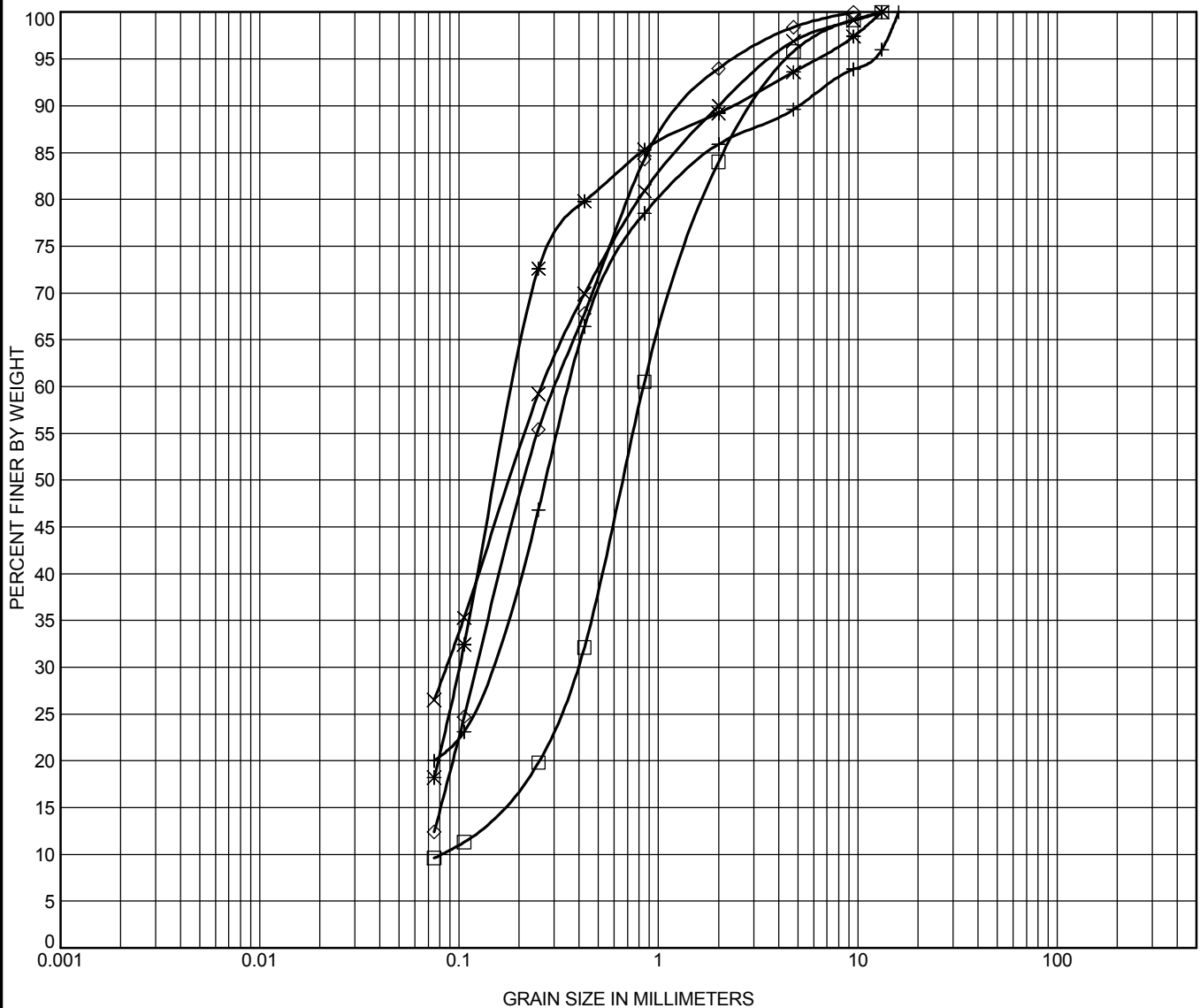
## GRAIN SIZE DISTRIBUTION

Project: Four Laning - From Hwy 587 Westerly

W P: 66 120-03-00

DIST: 61 HWY: 11/17





SILT OR CLAY	SAND			GRAVEL		COBBLES
	fine	medium	coarse	fine	coarse	

Remarks:  
SAND - some silt, trace to some gravel

Test Hole	Depth	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
□ 1-13	0.75	13.2	0.84	0.388	0.081	4.2	86.2	9.6	
* 1-13	2.30	13.2	0.191	0.1		6.4	75.4	18.2	
× 1-13	6.10	13.2	0.26	0.086		3.1	70.4	26.5	
+ 1-14	1.50	16	0.357	0.136		10.4	69.6	20.0	
◇ 1-15	0.75	9.5	0.304	0.123		1.6	86.0	12.4	



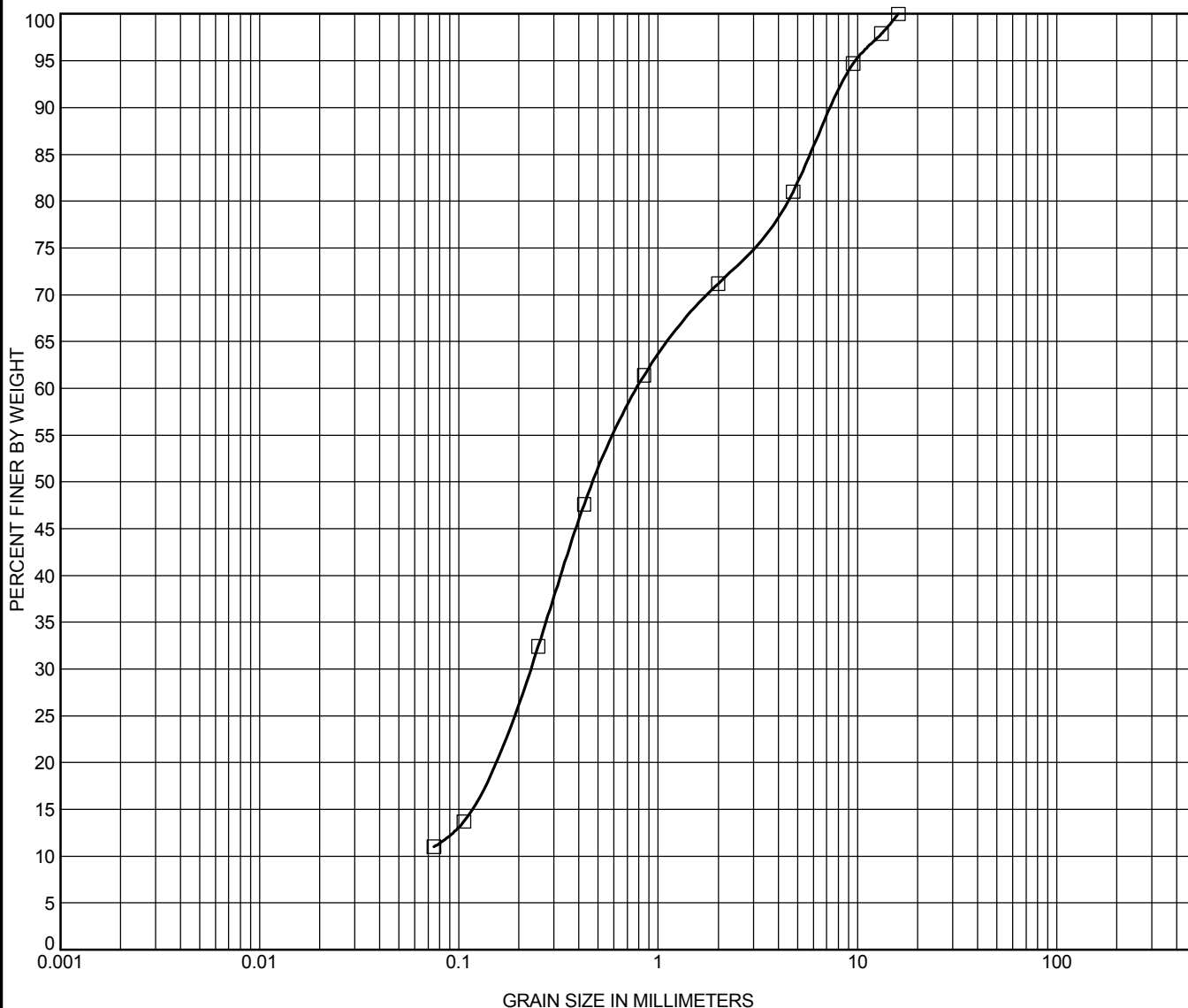
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## GRAIN SIZE DISTRIBUTION

Project: Four Laning - From Hwy 587 Westerly

W P: 66 120-03-00

DIST: 61 HWY: 11/17



SILT OR CLAY	SAND			GRAVEL		COBBLES
	fine	medium	coarse	fine	coarse	

Remarks:  
SAND - some silt, trace to some gravel

Test Hole	Depth	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
1-16	0.75	16	0.792	0.224		19.0	70.0	11.0	



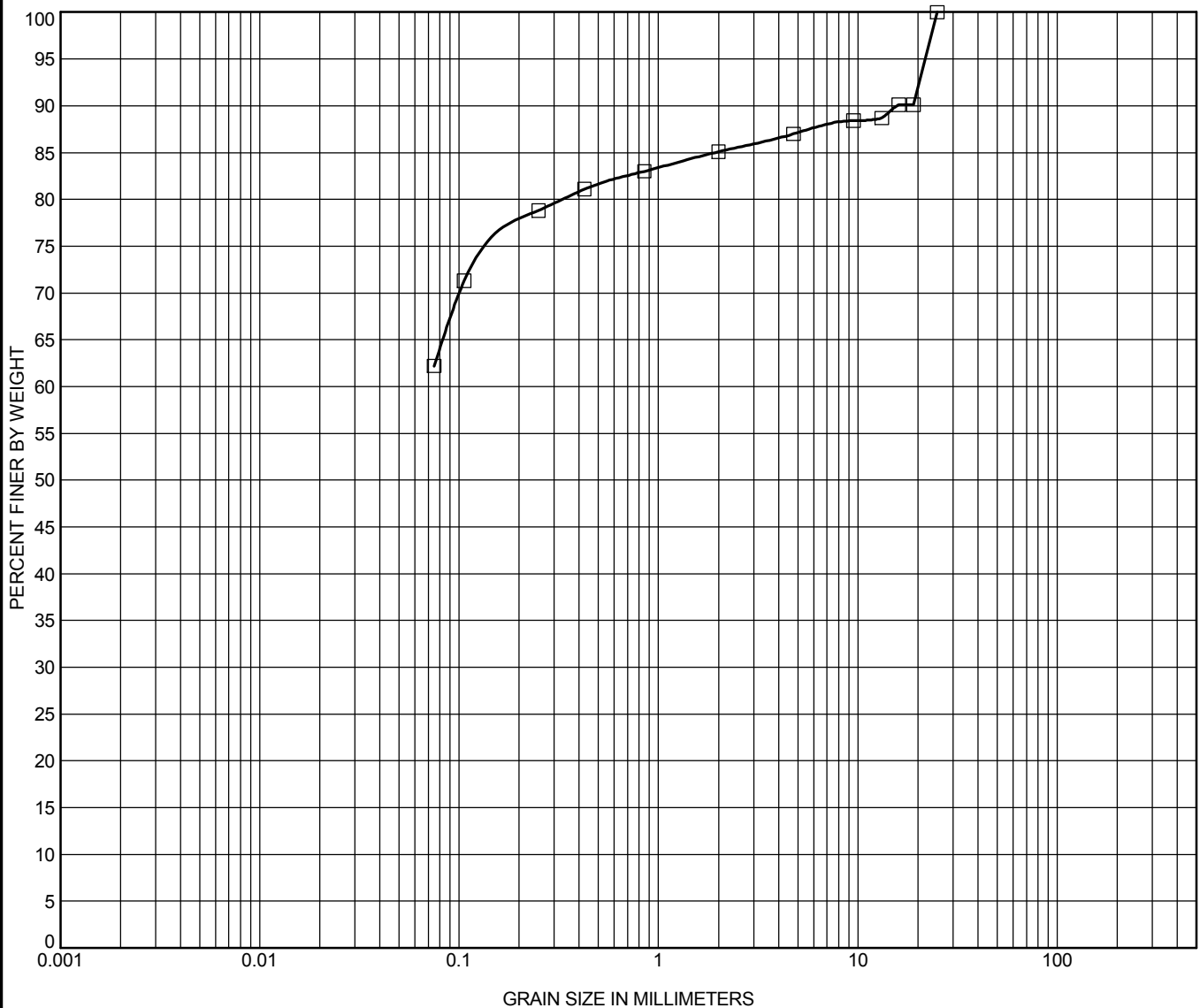
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## GRAIN SIZE DISTRIBUTION

Project: Four Laning - From Hwy 587 Westerly

W P: 66 120-03-00

DIST: 61 HWY: 11/17



SILT OR CLAY	SAND			GRAVEL		COBBLES
	fine	medium	coarse	fine	coarse	

Remarks:  
SILT - Sandy, some gravel

Test Hole	Depth	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
1-11	3.80	25				13.0	24.8	62.2	



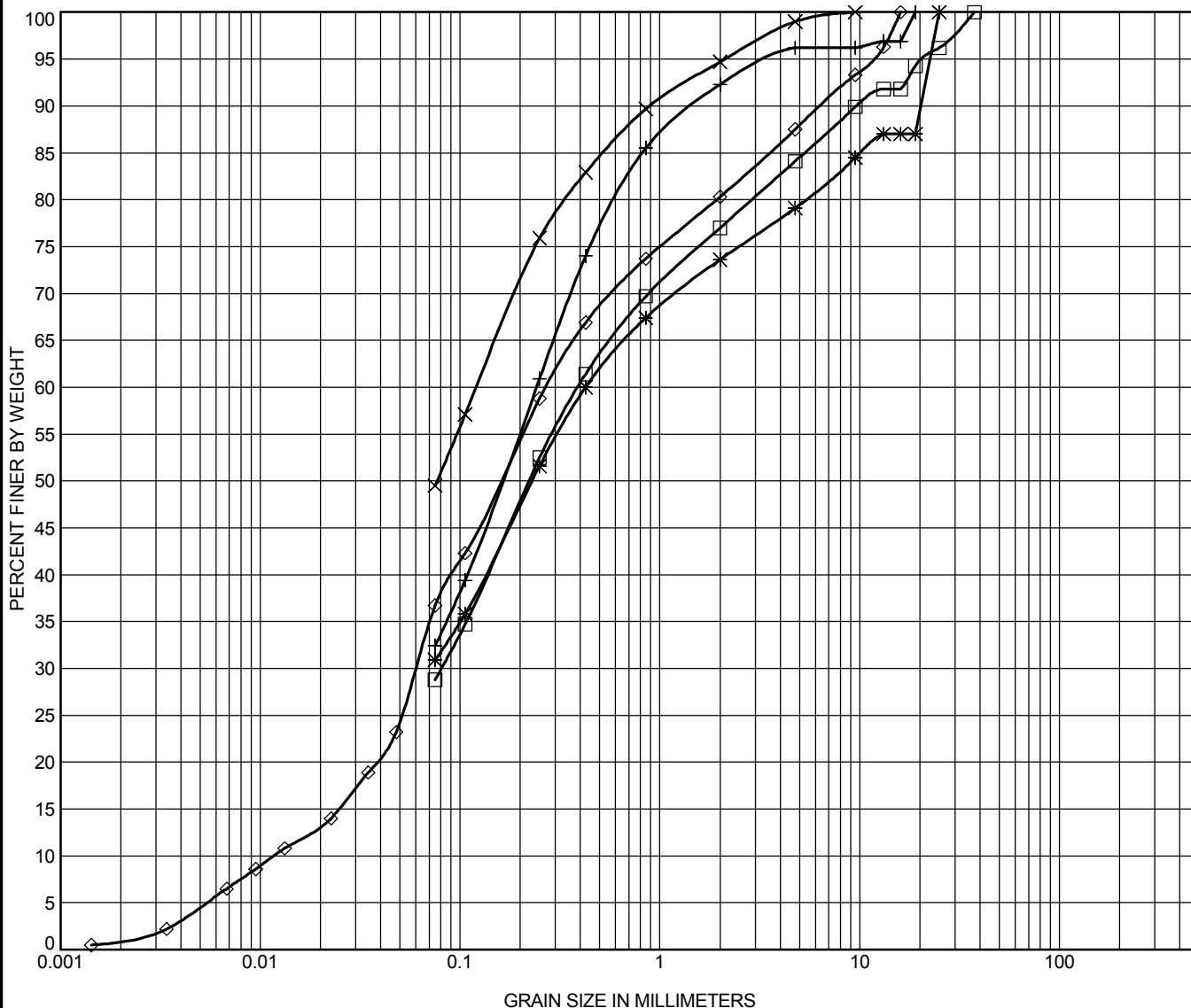
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## GRAIN SIZE DISTRIBUTION

Project: Four Laning - From Hwy 587 Westerly

W P: 66 120-03-00

DIST: 61 HWY: 11/17



SILT OR CLAY	SAND			GRAVEL		COBBLES
	fine	medium	coarse	fine	coarse	

Remarks:  
SAND & SILT to Silty - trace to some gravel

Test Hole	Depth	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
□ 1-01	6.10	37.5	0.391	0.08		15.9	55.3	28.8	
* 1-04	4.60	25	0.425			20.9	48.2	30.9	
× 1-04	6.10	9.5	0.121			1.0	49.5	49.5	
+ 1-06	1.50	19	0.241			3.8	63.8	32.4	
◇ 1-07	0.75	16	0.27	0.06	0.012	12.5	50.8	36.7	



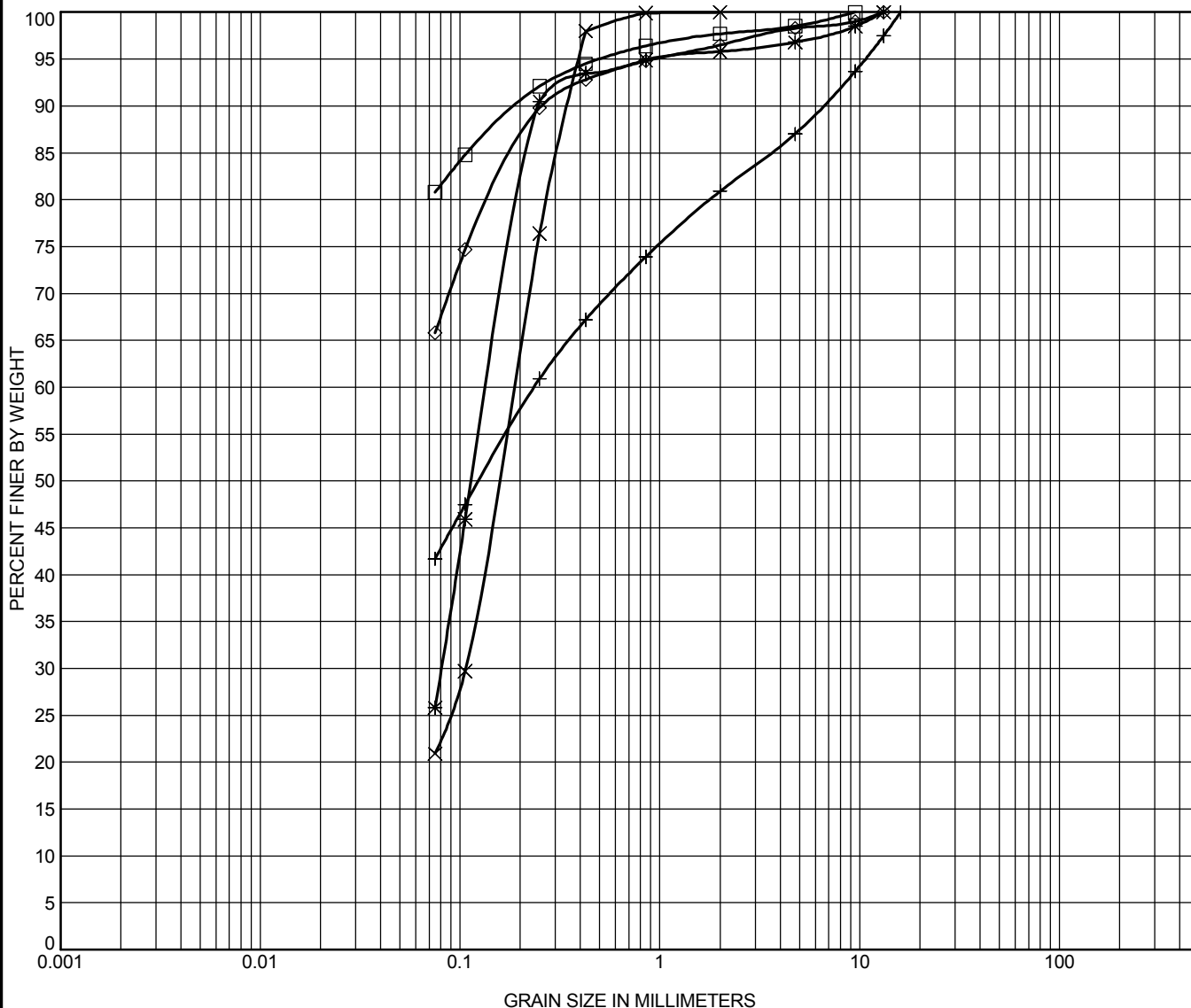
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## GRAIN SIZE DISTRIBUTION

Project: Four Laning - From Hwy 587 Westerly

W P: 66 120-03-00

DIST: 61 HWY: 11/17



SILT OR CLAY	SAND			GRAVEL		COBBLES
	fine	medium	coarse	fine	coarse	

Remarks:  
SAND & SILT to Silty - trace to some gravel

Test Hole	Depth	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
□ 1-09	0.75	9.5				1.5	17.7	80.8	
* 1-10	3.80	13.2	0.139	0.081		3.2	71.0	25.8	
× 1-10	6.10	2	0.185	0.107		0.0	79.1	20.9	
+ 1-12	4.60	16	0.236			13.0	45.3	41.7	
◇ 1-12	6.10	13.2				1.7	32.5	65.8	



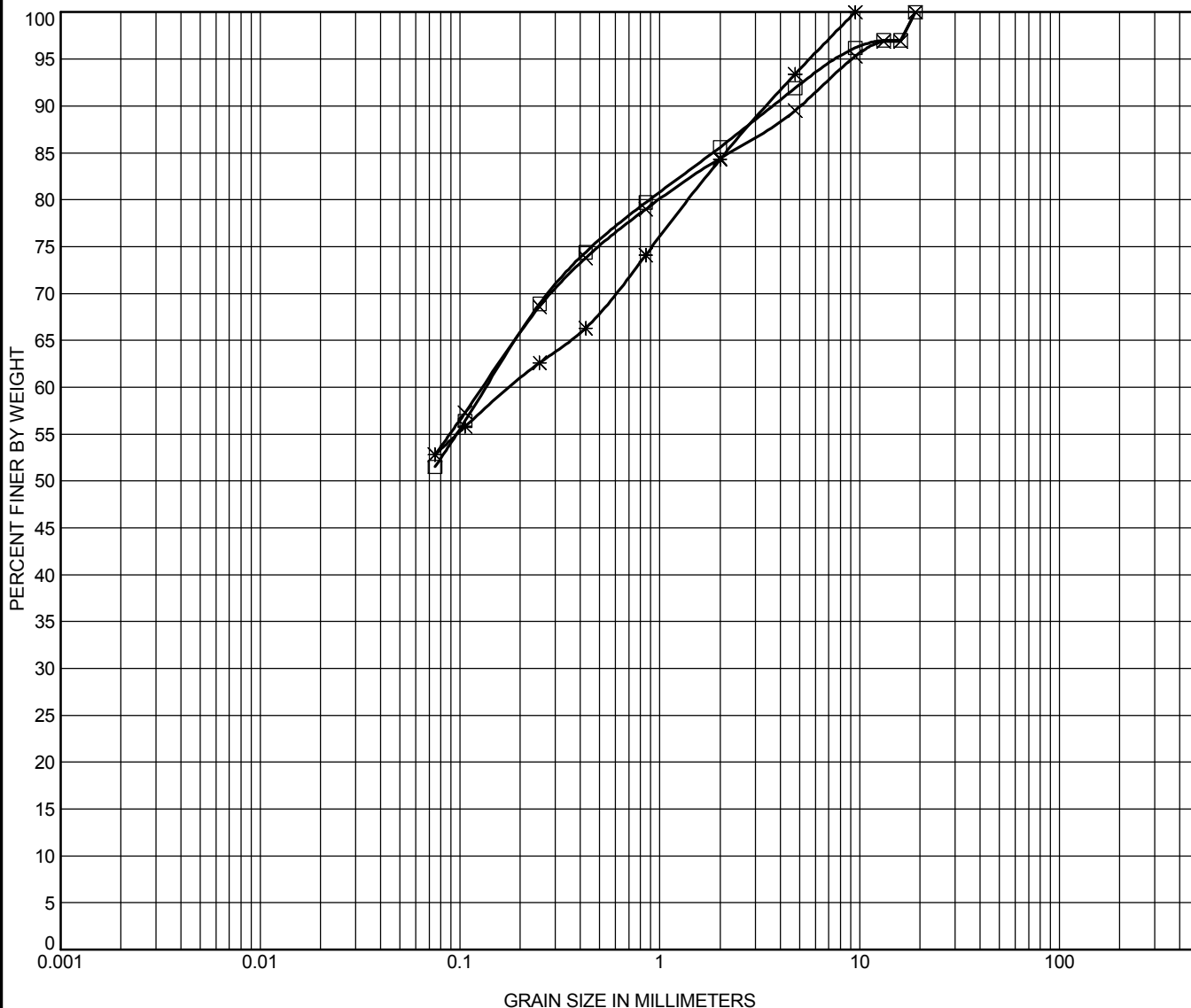
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## GRAIN SIZE DISTRIBUTION

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W P: 66 120-03-00

DIST: 61 HWY: 11/17



SILT OR CLAY	SAND			GRAVEL		COBBLES
	fine	medium	coarse	fine	coarse	

Remarks:  
SAND & SILT to Silty - trace to some gravel

Test Hole	Depth	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
□ 1-15	2.30	19	0.136			8.1	40.4	51.5	
* 1-15	3.80	9.5	0.18			6.6	40.6	52.8	
× 1-16	3.00	19	0.13			10.5	36.7	52.8	



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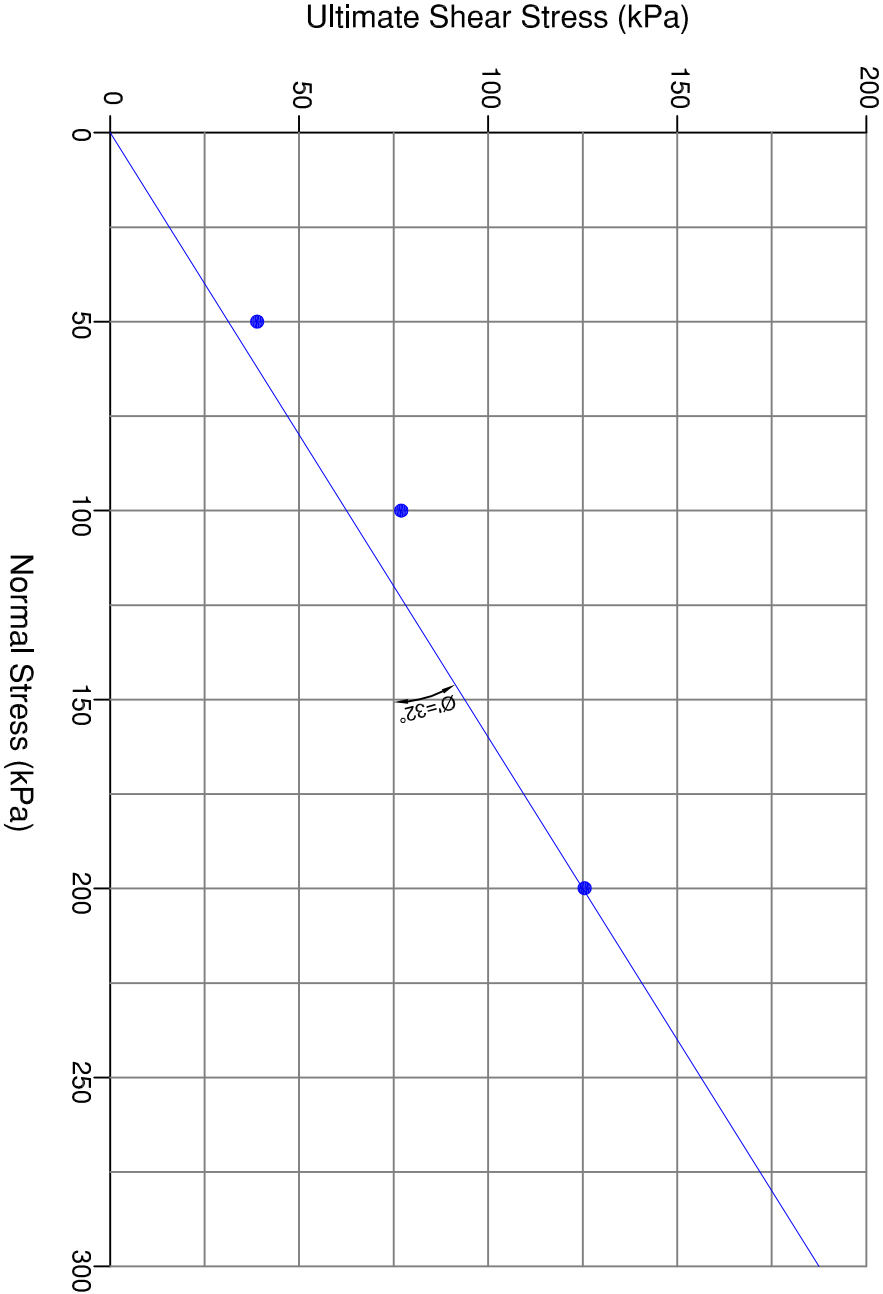
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W P: 66 120-03-00

DIST: 61 HWY: 11/17

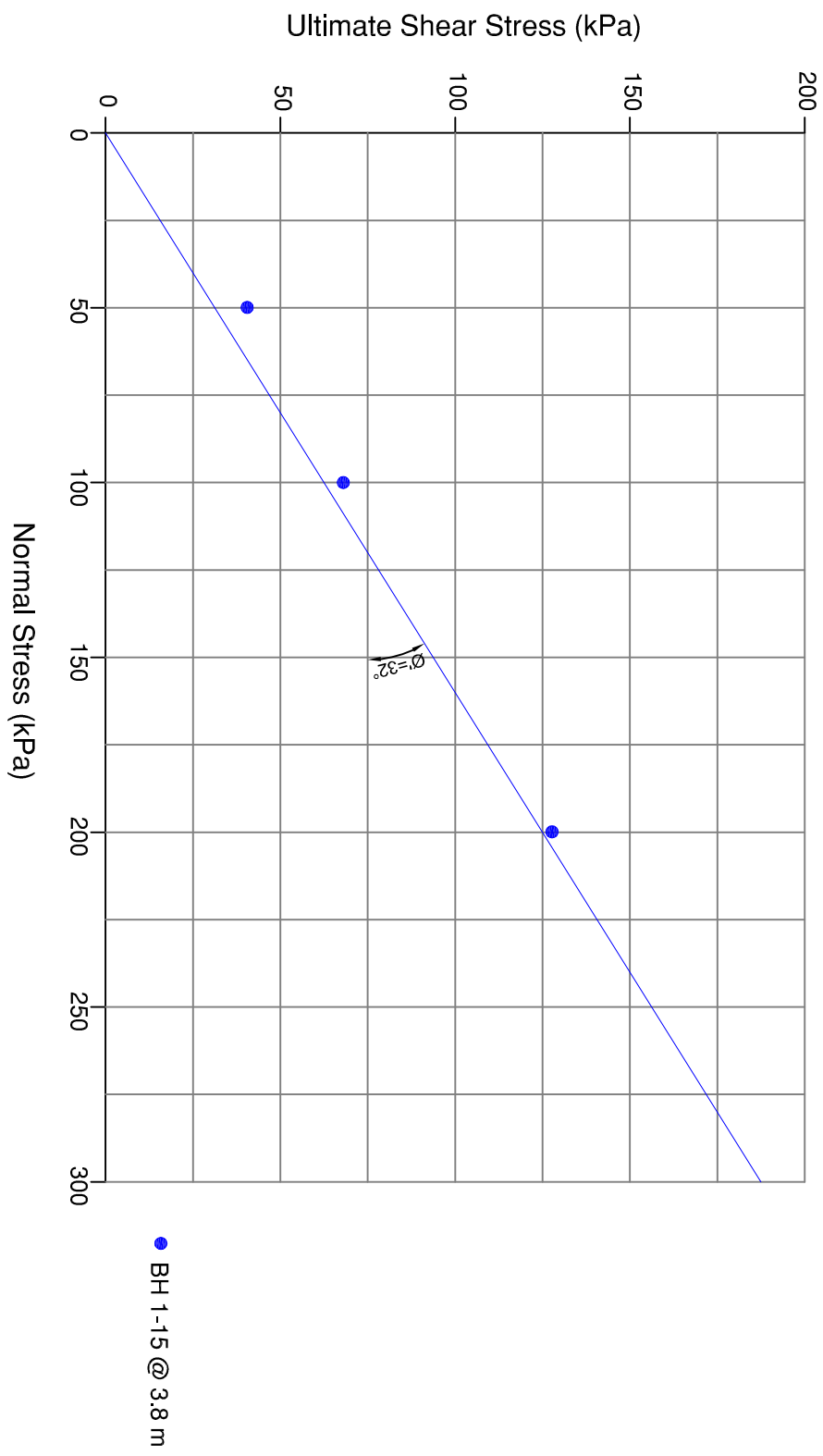
CONSOLIDATED/DRAINED  
DIRECT SHEAR TESTING - Silty Sand

CONT No	xxxxxx
GWP No	6120-03-00
GEOCRES No	52A-136
11/17 4 LAINING	
FOUNDATION ZONE 1	
TOWNSHIP OF MCGREGOR	



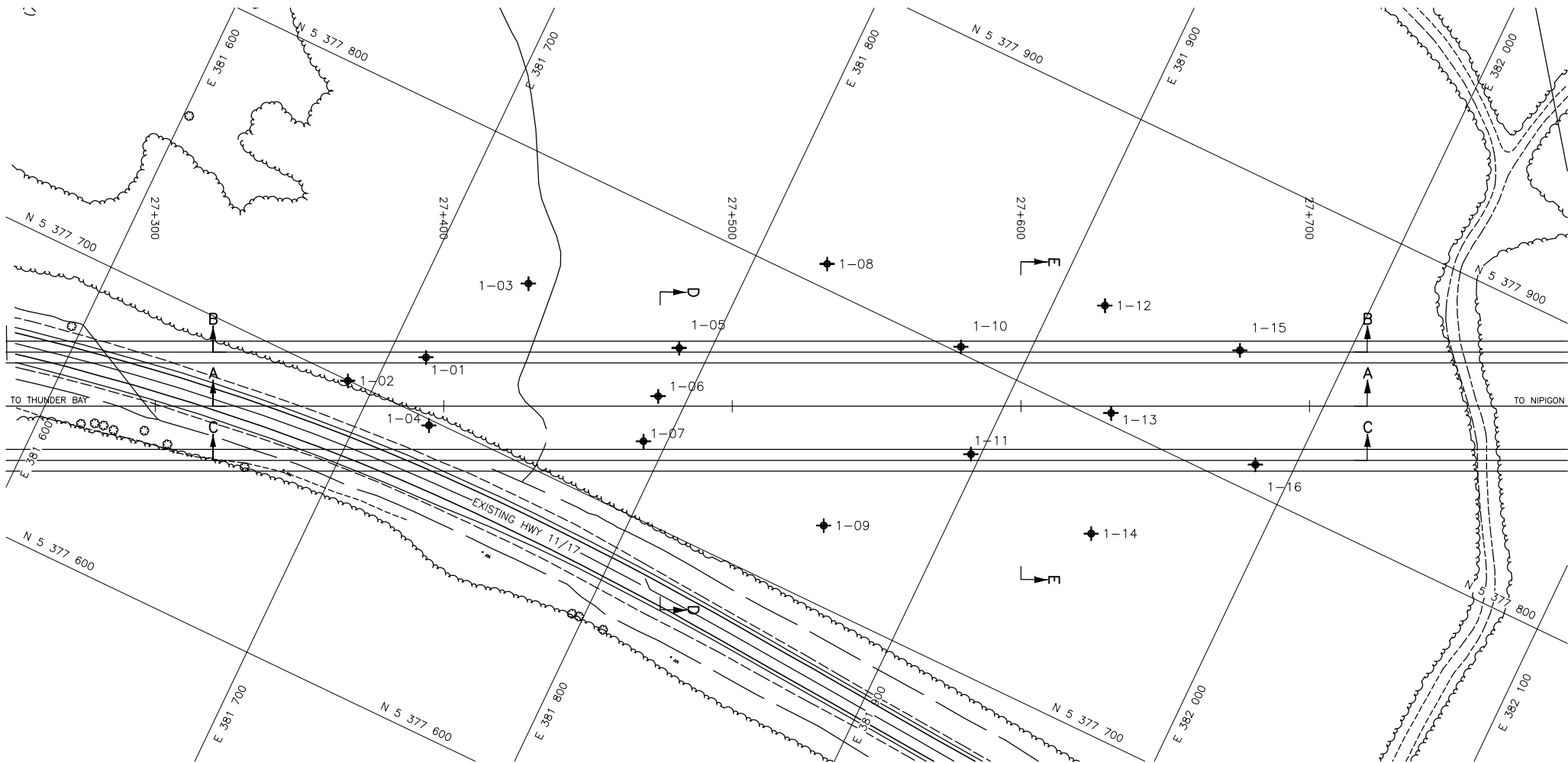
● BH 1-10 @ 3.8 m

<div> <div>CONSOLIDATED/DRAINED</div> <div>DIRECT SHEAR TESTING - Sand &amp; Silt</div> </div>		<div> <div>CONT No</div> <div>xxxxxx</div> </div>
<div> <div>11/17 4 LANING</div> <div>FOUNDATION ZONE 1</div> <div>TOWNSHIP OF MccGREGOR</div> </div>		<div> <div>GWP No</div> <div>6120-03-00</div> </div>
		<div> <div>GEOCRES No</div> <div>52A-136</div> </div>

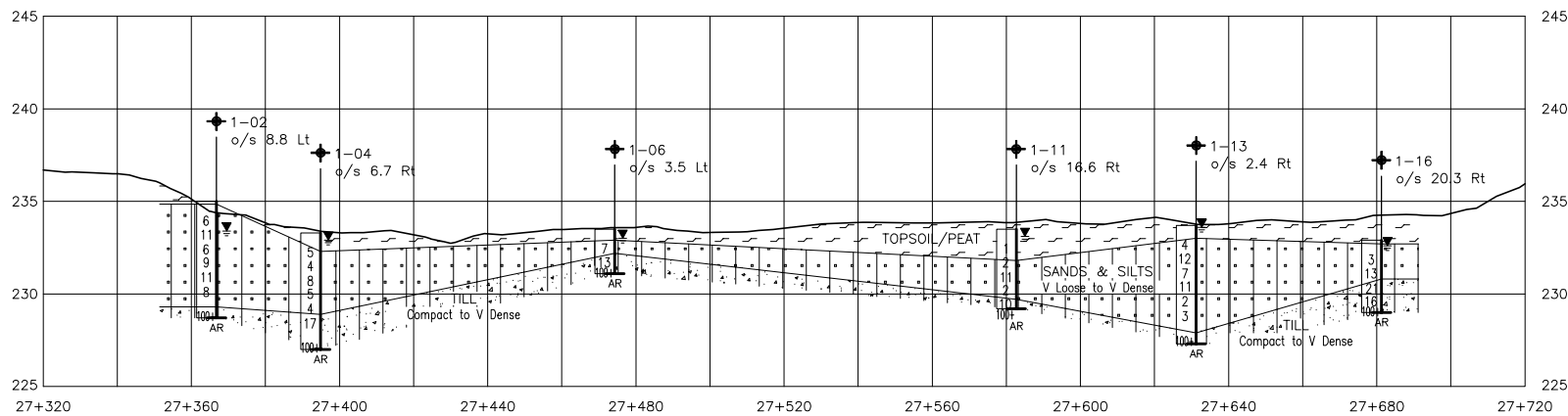
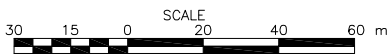




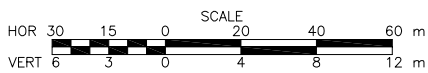
**APPENDIX C**  
Borehole Locations and Soil Strata Drawings



PLAN



SECTION A - A



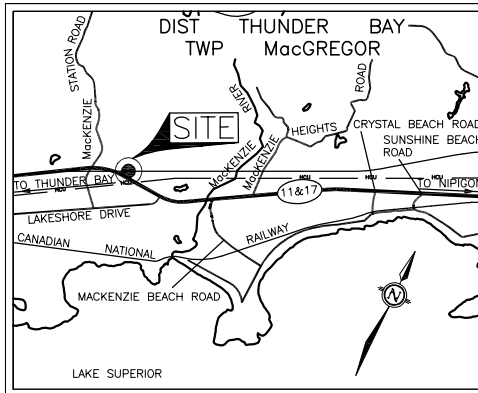
METRIC  
DIMENSIONS ARE IN METRES  
AND/OR MILLIMETRES  
UNLESS OTHERWISE SHOWN

CONT No xxxxxx  
GWP No 6120-03-00  
GEOCRES No 52A-136



4 LANEING EAST McKENZIE EAST  
TOWNSHIP OF MacGREGOR  
BOREHOLE LOCATIONS AND SOIL STRATA

SHEET



KEY PLAN  
1.0 km 0 1.0 km  
SCALE 1:100,000

NOTE

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

LEGEND

- Borehole
- 'N' Std Pen Test (Blows/0.3m)
- WL at time of investigation

SOIL STRATA SYMBOLS			
	PEAT or TOPSOIL		SAND & SILT
	SAND		GLACIAL TILLS Non Cohesive

No	ELEVATION	CO-ORDINATES	
		NORTH	EAST
1-01	234.7	15 5 377 719	381 712
1-02	235.0	15 5 377 700	381 691
1-03	235.7	15 5 377 757	381 733
1-04	233.3	15 5 377 698	381 723
1-05	233.9	15 5 377 760	381 790
1-06	233.5	15 5 377 741	381 790
1-07	233.0	15 5 377 725	381 793
1-08	234.1	15 5 377 808	381 823
1-09	232.5	15 5 377 726	381 861
1-10	234.2	15 5 377 802	381 878
1-11	233.5	15 5 377 770	381 897
1-12	234.7	15 5 377 836	381 917
1-13	233.7	15 5 377 804	381 935
1-14	232.9	15 5 377 763	381 946
1-15	235.0	15 5 377 843	381 965
1-16	232.9	15 5 377 809	381 987

REVISIONS					
	2009/MO/DY	TB	FOR REVIEW		
	DATE	BY	REVISION		
4 LANING MCKENZIE EAST					
SUBM'D	..	CHECKED	DATE XXXXX		DIST THUNDER BAY
DRAWN	TB	CHECKED	W/H	APPROVED	SITE ZONE 1
					DWG 1

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

CONT No xxxxxx  
GWP No 6120-03-00  
GEOCRES No 52A-136

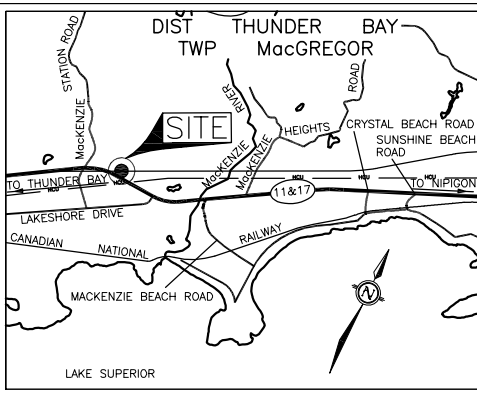


4 LANEING EAST McKENZIE EAST  
TOWNSHIP OF MacGREGOR  
BOREHOLE LOCATIONS AND SOIL STRATA

SHEET



TBT ENGINEERING

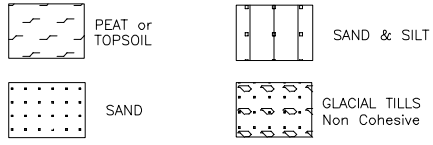


KEY PLAN  
1.0 km 0 1.0 km  
SCALE 1:100,000

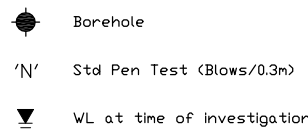
NOTE

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

SOIL STRATA SYMBOLS



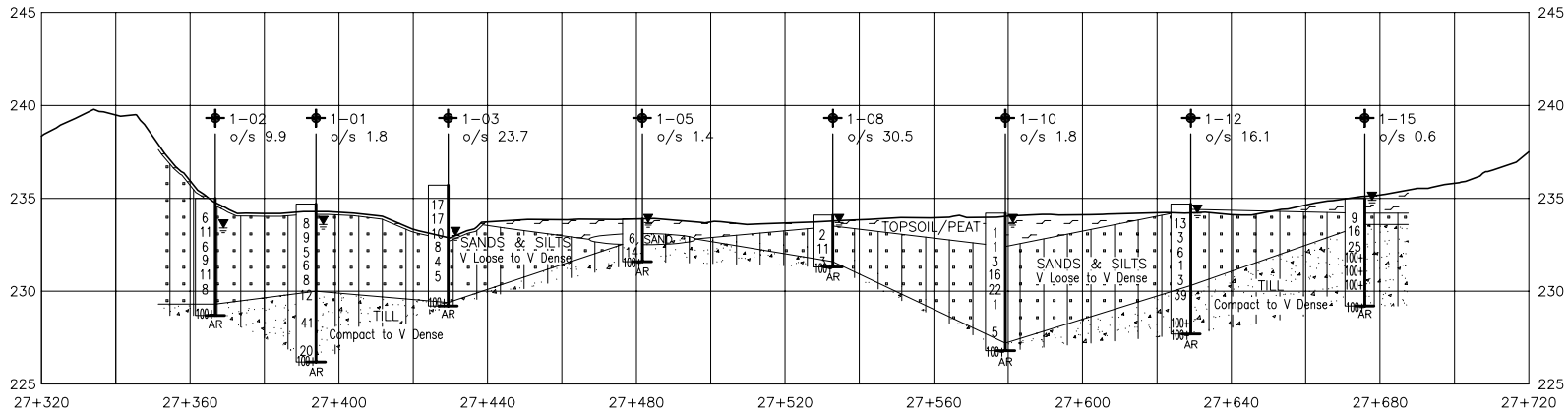
LEGEND



No	ELEVATION	CO-ORDINATES	
		NORTH	EAST
1-01	234.7	15 5 377 719	381 712
1-02	235.0	15 5 377 700	381 691
1-03	235.7	15 5 377 757	381 733
1-04	233.3	15 5 377 698	381 723
1-05	233.9	15 5 377 760	381 790
1-06	233.5	15 5 377 741	381 790
1-07	233.0	15 5 377 725	381 793
1-08	234.1	15 5 377 808	381 823
1-09	232.5	15 5 377 726	381 861
1-10	234.2	15 5 377 802	381 878
1-11	233.5	15 5 377 770	381 897
1-12	234.7	15 5 377 836	381 917
1-13	233.7	15 5 377 804	381 935
1-14	232.9	15 5 377 763	381 946
1-15	235.0	15 5 377 843	381 965
1-16	232.9	15 5 377 809	381 987

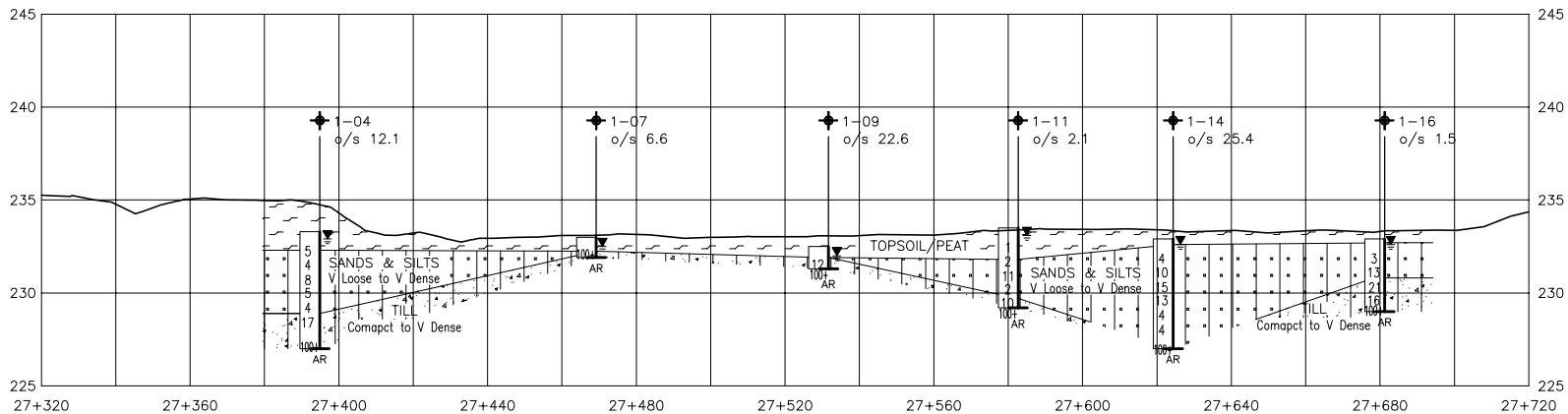
REVISIONS

2009/MD/DY	TB	FOR REVIEW	
DATE	BY	REVISION	
4 LANEING McKENZIE EAST			DIST THUNDER BAY
SUBM'D ..	CHECKED	DATE XXXXX	SITE ZONE 1
DRAWN TB	CHECKED WH	APPROVED	DWG 1



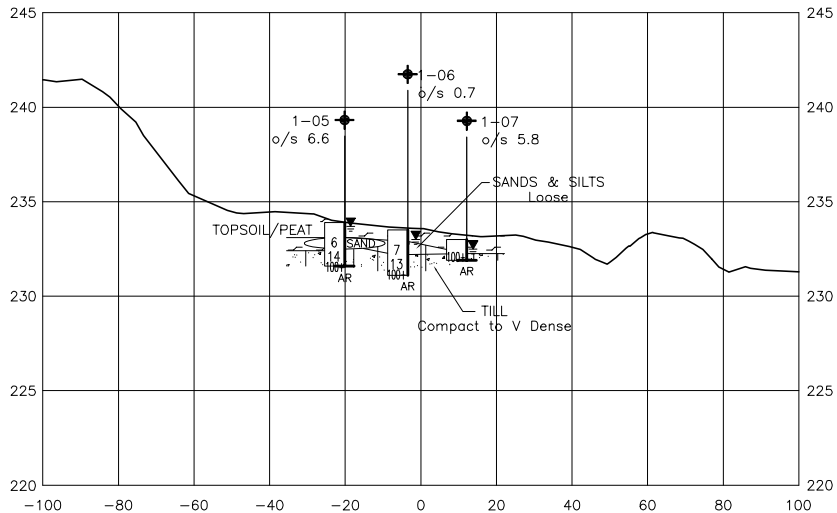
SECTION B-B

SCALE  
HOR 30 15 0 20 40 60 m  
VERT 6 3 0 4 8 12 m



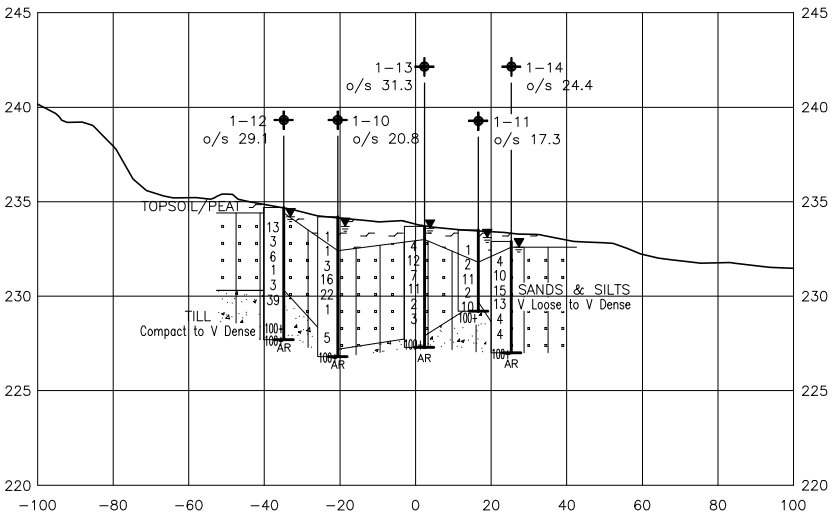
SECTION C-C

SCALE  
HOR 30 15 0 20 40 60 m  
VERT 6 3 0 4 8 12 m



SECTION D-D

SCALE  
HOR 30 15 0 20 40 60 m  
VERT 6 3 0 4 8 12 m



SECTION E-E

SCALE  
HOR 30 15 0 20 40 60 m  
VERT 6 3 0 4 8 12 m