

**FOUNDATION INVESTIGATION REPORT  
HIGHWAY 11 NORTHBOUND LANES OVER  
MAGNETAWAN RIVER SOUTH CROSSING  
HIGHWAY 11, HIGHWAY 518 WEST to HIGHWAY 520  
G.W.P. 480-93-00, W.P. 474-93-01, SITE 44-122N**

**Geocres Number: 31E-226**

**Report to**

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**PART 1: FACTUAL INFORMATION**

**1 INTRODUCTION**

This report presents the factual findings obtained from a foundation investigation conducted at the site of a proposed bridge to carry the Northbound Lanes of the widened Highway 11 over the Magnetawan River at a point south of the village of Katrine, Ontario. A previous, preliminary investigation had been carried out at the site by Shaheen & Peaker Limited (S&P) and the factual data from that investigation has been incorporated in the current assignment.

The purpose of the investigation was to explore the subsurface conditions at the site and, based on the data obtained, to provide a borehole location plan, borehole logs, stratigraphic profile and cross-sections and a written description of the subsurface conditions. A model of the subsurface conditions was developed through considering a combination of the data from the previous S&P investigation and the data obtained in the course of the present investigation. This model describes the geotechnical conditions influencing design and construction of the foundations and approach embankments for the bridge.

Thurber carried out the investigation as a sub-consultant to Marshall Macklin Monaghan, under the Ministry of Transportation Ontario (MTO) Agreement Number 5005-A-000285.

**2 SITE DESCRIPTION**

The site lies across the Magnetawan River at a location where the proposed northbound lanes of Highway 11 will cross the river south of the Village of Katrine, Armour Township. The site lies approximately 2.8 km north of Highway 518 West and 1.0 km south of Three Mile lake Road. The centreline of the northbound lanes will be approximately 40 m east of the existing Highway 11 centreline.

The general site area is located within the physiographic region known as the Canadian Shield, characterized by Pre-Cambrian bedrock typically occurring as rounded knobs and ridges where exposed. Locally, however, the site lies in the valley of the Magnetawan River, which is underlain by relatively deep deposits of glacio-fluvial and glacio-lacustrine soils.

The river has a broad, poorly defined flood plain at the site. The river channel is approximately 27 m wide and the maximum channel depth, based on May 2003 data, is 3 m. The riverbanks are low and no global stability problems were observed.

The area north and south of the crossing is wooded and there are some buildings within the wooded area to the north of the river.

### 3 SITE INVESTIGATION AND FIELD TESTING

Thurber carried out site investigation and field testing for this project between October 13 and November 1, 2004. Boreholes were also drilled at the site between March 27 and April 10, 2001, as part of the preliminary investigation by Shaheen & Peaker Limited.

The current site investigation consisted of drilling and sampling a total of six boreholes to depths of approximately 11 m at the approach fills and to depths of 36 to 42 m at the foundation locations. The four boreholes drilled at the foundation locations were supplemented by dynamic cone penetration tests. The approximate locations of the boreholes are shown on the attached Borehole Locations and Soil Strata Drawing in Appendix G.

Field layout for the site investigation was carried out by surveyors from Marshall Macklin Monaghan, who provided the coordinates and ground surface elevation data to Thurber.

A combination of hollow stem auger and rotary drilling techniques were used to advance the boreholes and samples were obtained using a split spoon sampler in conjunction with Standard Penetration Testing (SPT). Where significant proportions of cobbles and boulders were encountered and soil boring and SPT sampling were not feasible, diamond coring techniques were employed to penetrate the soils.

The positions of the principal boreholes considered in the preparation of this report, relative to the structure site are as shown in Table 3.1.

**Table 3.1 – Borehole Locations Relative to Structure**

<b>Location on Structure</b>	<b>Boreholes Considered in Design</b>
North Approach	122N-10, M4*
North Abutment	122N-8, M2*, M4*
North Pier	122N-7, M2*
South Pier	122N-4, M1*
South Abutment	122N-3, M1*, M3*
South Approach	122N-1, M3*

\* Boreholes drilled by S&P in 2001

The coordinates and elevations of the boreholes are given on the Borehole Locations and Soil Strata Drawing and on the individual Record of Borehole Sheets in Appendix A.

A standpipe piezometer, consisting of 19 mm PVC pipe with slotted tips, was installed in each of the four deep boreholes drilled at the foundation elements to monitor the groundwater level.

Piezometers were also installed in two deep boreholes drilled in the course of the preliminary investigation.

The completion details for the piezometer are shown in Table 3.2.

**Table 3.2 – Piezometer Details**

<b>Piezometer Location</b>	<b>Piezometer Details</b>	
	<b>Tip Depth/ Elevation</b>	<b>Completion Details</b>
BH 122N-3	41.8/254.1	Piezometer with 1.5 m tip installed at 41.8. Sand filter to 39.6, bentonite seal to 38.4, grout to 1.5 and bentonite seal to the surface.
BH 122N-4	39.6/255.2	Piezometer with 1.5 m tip installed at 39.6. Sand filter to 37.4, bentonite seal to 36.6, grout to 1.5 and bentonite seal to the surface.
BH 122N-7	36.6/260.0	Piezometer with 1.5 m tip installed at 36.6. Sand filter to 34.7, bentonite seal to 33.8, grout to 1.5 and bentonite seal to the surface.
BH 122N-8	32.0/267.0	Piezometer with 1.5 m tip installed at 32.0. Sand filter and sand cave to 22.9, bentonite seal to 22.2, grout to the surface.

A member of Thurber's engineering staff supervised the drilling and sampling operations on a full time basis. The inspector logged the boreholes and the recovered samples and processed them for transport to Thurber's Oakville office.

#### **4 LABORATORY TESTING**

All recovered soil samples were subjected to visual identification and to natural moisture content determination. The results of this testing are shown on the Record of Borehole sheets in Appendix A.

Selected samples were subjected to gradation analysis (sieve and hydrometer) and the results are shown on the Record of Borehole sheets in Appendix A and on the charts in Appendix B. A total of five samples were selected for this testing.

One Shelby tube sample was selected from the area of the north abutment of the NBL structure and was subjected to one-dimensional consolidation testing at the Laboratory of Golder Associates. The results of the consolidation test are included in Appendix B.

#### **5 DESCRIPTION OF SUBSURFACE CONDITIONS**

##### **5.1 General**

Reference is made to the Record of Borehole sheets in Appendix A. Details of the encountered soil stratigraphy are presented in these appendices and on the attached Borehole Locations and Soil Strata Drawing. An overall description of the stratigraphy is

given in the following paragraphs however the factual data presented in the borehole logs governs any interpretation of the site conditions.

The soil stratigraphy encountered at this site is consistent with that encountered in much of the Highway 11 corridor between Huntsville and North Bay. Glacial outwash soils deposited in glacio-fluvial and glacio-lacustrine environments overlie a deposit of very dense sand with gravel, cobbles and boulders. This latter material typically mantles the bedrock but none of the boreholes at this site encountered bedrock, instead terminating in the very dense sand. Locally, the surface soils have been reworked and re-deposited by the Magnetawan River.

In general terms, the site was found to be underlain by a thin veneer of topsoil, a layer of sandy silt, silty clay; silty sand, sand and gravel with cobbles and boulders.

More detailed descriptions of the individual strata are presented below.

## **5.2 Topsoil and Peat**

Topsoil and peat were encountered at the ground surface in several boreholes. The thickness ranged from nil at some boreholes to a maximum of 300 mm. Further variations in thickness may occur between or beyond the boreholes.

## **5.3 Sandy Silt**

A layer of fine-grained non-cohesive soils ranging from sandy silt to silty sand was encountered at the ground surface, or below the topsoil and peat. Interbedded layers of fine sand were also encountered.

Based on SPT values ranging from 1 to 27 blows for 0.3 m of penetration, the deposit is classified as very loose to compact. The results of DCPT adjacent to the boreholes confirmed these conditions.

The measured natural moisture contents range from 1 to 58% and the soil is described as dry to wet.

The layer of silt ranges in thickness from 6.0 m in the south pier to 9.1 m at the north approach. The base of the layer lies between Elevation 290.5 at the north pier to 288.7 at the south pier.

The grain size distributions of selected samples of this soil are plotted on the Record of Borehole sheets and shown in Figures B1 and B2 in Appendix B.

## **5.4 Silty Clay**

A layer of silty clay was encountered on the north side of the river and extending to a point between the south pier and the south abutment. Based on the recorded SPT values ranging from 2 to 28 blows for 0.3 m of penetration, the clay is be classified as soft to very stiff. However, the vane shear strengths measured in the deposit range from 50 to greater than

100 kPa, indicating that the lower bound of the clay strengths is in fact stiff. Variations in the assessed strength are due in part to variations in the silt content and the presence of thin seams of silt. For design purposes, the undrained strength of the clay should be considered to lie in the range of 50 to 80 kPa.

The clay is silty and layered, with the percentage of silt varying between layers. The plasticity of the clay lies in the intermediate range, as shown in Figure B9 in Appendix B.

The recorded natural moisture contents in the clay ranged from 30 to 55% and the soil is described as moist.

The thickness of the clay layer ranges from 4.0 m at the north pier and 4.8 m at the north approach to 10.1 m at the south pier and 13.2 m at the north abutment. The base of the clay layer lies at Elevation 286.5 at the north pier to Elevation 277.3 at the north abutment.

The grain size distributions of selected samples of this soil are plotted on the Record of Borehole sheets and shown in Figures B3 and B4 in Appendix B.

## **5.5 Silt**

A layer of silt was encountered below the silty clay and below the upper sandy silt where the clay was absent. This soil is predominantly silt-sized, with trace sand sizes and trace to some clay-sized particles. Based on SPT values generally ranging from 12 to 40 blows for 0.3 m of penetration, the silt is classified as compact to dense.

The measured natural moisture contents ranged from 24 to 37% and the soil is described as moist.

The thickness of the silt layer ranged from 2.1 m at the north pier to 5.2 m at the south abutment. The base of the silt layer lay between Elevation 284.4 at the north pier and Elevation 275.0 at the south pier.

The grain size distributions of selected samples of this soil are plotted on the Record of Borehole sheets and shown in Figure B5 in Appendix B.

## **5.6 Sand**

The silt layer is underlain by a layer of sandy silt to silty fine sand that forms a substantial thickness under the south approach and abutment but is less pronounced to the north of the river. Based on SPT values ranging generally from 4 to greater than 100 blows for 0.3 m of penetration, this sand is classified as loose to very dense. However, the low SPT values are considered to be due to sample disturbance and the high blows are considered to be due to isolated pockets of coarse sand or gravel. The deposit should, therefore, be treated as compact to dense.

The measured natural moisture contents ranged from 18 to 32% and the soil is described as wet.

The thickness of this soil layer varied from 5.7 m at the north abutment to 17.2 m at the south abutment. The underside of the sand layer ranged from Elevation 271.5 at the north approach to 266.5 at the south abutment.

The grain size distributions of selected samples of this soil are plotted on the Record of Borehole sheets and shown in Figures B6 and B7 in Appendix B.

### 5.7 Sand With Cobbles and Boulders

Below the sandy silt to sand described in the previous paragraph, the boreholes encountered a layer described as sand and gravel, trace silt with cobbles and boulders. Based on SPT values generally in excess of 100 blows for 0.3 m of penetration, this deposit is classified as very dense. Occasional lower values were recorded for some samples, indicating compact to dense conditions.

Where they could be measured, natural moisture contents ranged from 2 to 22% and the deposit is described as wet.

This deposit was not fully penetrated by any borehole but the borehole at the south abutment penetrated 10.9 m into the deposit, to elevation 254.1.

The grain size distributions of selected samples of this soil are plotted on the Record of Borehole sheets and shown in Figure B8 in Appendix B.

### 5.8 Depths to Refusal

The depths at which effective refusal was encountered, defined as an SPT value exceeding 100 blows for 0.3 m of penetration or layers of cobbles and boulders, are shown in Table 5.1.

**Table 5.1 – Refusal Depths (Elevations)**

Location	Borehole	Refusal Elevation (m)	Material
North Abutment	122N-8	268.5	Very dense sand and gravel with cobbles and boulders
North Pier	122N-7	264.5	
South Pier	122N-4	262.0	
South Abutment	122N-3	258.0	

### 5.9 Water Levels

The initial and final groundwater depths and elevations are shown in Table 5.2.

The recorded values are short-term readings and seasonal fluctuations of the groundwater level are to be expected. In particular, the groundwater level will be influenced by the river level and may be at a higher elevation after the spring snowmelt or after periods of heavy rainfall.



**Table 5.2 – Groundwater Depths (in metres) and Elevations**

Date	South abutment		South Pier		North Pier		North Abutment	
	Depth	Elev.	Depth	Elev.	Depth	Elev.	Depth	Elev.
Completion	0.3	295.6	0.3	294.5	4.3	292.3	--	--
Nov 10/04	0.6	295.3	0.3	294.5	--	--	--	--
Jan. 11/05	0.7	295.2	0.4	294.4	4.2	292.4	4.3	294.7

A temporary artesian flow was recorded at the south pier when the borehole reached a depth of 19.8 m or Elevation 275.0. The groundwater level, however, soon stabilized below the ground surface.

## 6 MISCELLANEOUS

Surveying of the locations of the boreholes was carried out by staff from Marshall Macklin Monaghan.

The drill rig and sampling equipment used in the investigation were supplied and operated by All-Terrain Drilling of Waterloo, Ontario.

Full time supervision of field activities, including obtaining utility clearances was carried out by Mr. Mark Farrant, B.Sc. and Mr. Stephane Loranger, C.E.T. of Thurber.

Overall supervision of the field program, interpretation of the data and preparation of the report were carried out by Mr. Alastair E. Gorman, P.Eng..

The report was reviewed by Dr. P.K. Chatterji, P.Eng., a Designated Principal Contact for MTO Foundations Projects.

Thurber Engineering Ltd.

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**Appendix A**

**Record of Borehole Sheets**

## SYMBOLS, ABBREVIATIONS AND TERMS USED ON RECORDS OF BOREHOLES

### 1. TEXTURAL CLASSIFICATION OF SOILS

CLASSIFICATION	PARTICLE SIZE	VISUAL IDENTIFICATION
Boulders	Greater than 200mm	same
Cobbles	75 to 200mm	same
Gravel	4.75 to 75mm	5 to 75mm
Sand	0.075 to 4.75mm	Not visible particles to 5mm
Silt	0.002 to 0.075mm	Non-plastic particles, not visible to the naked eye
Clay	Less than 0.002mm	Plastic particles, not visible to the naked eye

### 2. COARSE GRAIN SOIL DESCRIPTION (50% greater than 0.075mm)

TERMINOLOGY	PROPORTION
Trace or Occasional	Less than 10%
Some	10 to 20%
Adjective (e.g. silty or sandy)	20 to 35%
And (e.g. sand and gravel)	35 to 50%

### 3. TERMS DESCRIBING CONSISTENCY (COHESIVE SOILS ONLY)

DESCRIPTIVE TERM	UNDRAINED SHEAR STRENGTH (kPa)	APPROXIMATE SPT <sup>(1)</sup> 'N' VALUE
Very Soft	12 or less	Less than 2
Soft	12 to 25	2 to 4
Firm	25 to 50	4 to 8
Stiff	50 to 100	8 to 15
Very Stiff	100 to 200	15 to 30
Hard	Greater than 200	Greater than 30

NOTE: Hierarchy of Soil Strength Prediction

- 1) Laboratory Triaxial Testing
- 2) Field Insitu Vane Testing
- 3) Laboratory Vane Testing
- 4) SPT value
- 5) Pocket Penetrometer



### 4. TERMS DESCRIBING DENSITY (COHESIONLESS SOILS ONLY)

DESCRIPTIVE TERM	SPT 'N' VALUE
Very Loose	Less than 4
Loose	4 to 10
Compact	10 to 30
Dense	30 to 50
Very Dense	Greater than 50

### 5. LEGEND FOR RECORDS OF BOREHOLES

SYMBOLS AND ABBREVIATIONS FOR SAMPLE TYPE	SS Split Spoon Sample	WS Wash Sample	AS Auger (Grab) Sample
	TW Thin Wall Shelby Tube Sample	TP Thin Wall Piston Sample	
	PH Sampler Advanced by Hydraulic Pressure	PM Sampler Advanced by Manual Pressure	
	WH Sampler Advanced by Self Static Weight	RC Rock Core	SC Soil Core

$$\text{Sensitivity} = \frac{\text{Undisturbed Shear Strength}}{\text{Remoulded Shear Strength}}$$


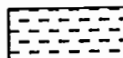



 Water Level  
 Shear Strength Determination by Pocket Penetrometer

- (1) SPT 'N' Value Standard Penetration Test 'N' Value – refers to the number of blows from a 63.5kg hammer free falling a height of 0.76m to advance a standard 50 mm outside diameter split spoon sampler for 0.3 m depth into undisturbed ground.
- (2) DCPT Dynamic Cone Penetration Test – Continuous penetration of a 50 mm outside diameter, 60° conical steel point attached to "A" size rods driven by a 63.5 kg hammer free falling a height of 0.76 m. The resistance to cone penetration is the number of hammer blows required for each 0.3 m advance of the conical point into undisturbed ground.

# UNIFIED SOILS CLASSIFICATION

MAJOR DIVISIONS		GROUP SYMBOL	TYPICAL DESCRIPTION
COARSE GRAINED SOILS	GRAVEL AND GRAVELLY SOILS	GW	Well-graded gravels or gravel-sand mixtures, little or no fines.
		GP	Poorly-graded gravels or gravel-sand mixtures, little or no fines.
		GM	Silty gravels, gravel-sand-silt mixtures.
		GC	Clayey gravels, gravel-sand-clay mixtures.
	SAND AND SANDY SOILS	SW	Well-graded sands or gravelly sands, little or no fines.
		SP	Poorly-graded sands or gravelly sands, little or no fines.
		SM	Silty sands, sand-silt mixtures.
		SC	Clayey sands, sand-clay mixtures.
FINE GRAINED SOILS	SILTS AND CLAYS $W_L < 50\%$	ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity.
		CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays. ( $W_L < 30\%$ ).
		CI	Inorganic clays of medium plasticity, silty clays. ( $30\% < W_L < 50\%$ ).
		OL	Organic silts and organic silty-clays of low plasticity.
	SILTS AND CLAYS $W_L > 50\%$	MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts.
		CH	Inorganic clays of high plasticity, fat clays.
		OH	Organic clays of medium to high plasticity, organic silts.
	HIGHLY ORGANIC SOILS		Pt
CLAY SHALE			
SANDSTONE			
SILTSTONE			
CLAYSTONE			
COAL			

## EXPLANATION OF ROCK LOGGING TERMS

ROCK WEATHERING CLASSIFICATION		SYMBOLS	
Fresh (FR)	No visible signs of weathering.		
Fresh Jointed (FJ)	Weathering limited to the surface of major discontinuities.		CLAYSTONE
Slightly Weathered (SW)	Penetrative weathering developed on open discontinuity surfaces, but only slight weathering of rock material.		SILTSTONE
Moderately Weathered (MW)	Weathering extends throughout the rock mass, but the rock material is not friable.		SANDSTONE
Highly Weathered (HW)	Weathering extends throughout the rock mass and the rock is partly friable.		COAL
Completely Weathered (CW)	Rock is wholly decomposed and in a friable condition, but the rock texture and structure are preserved.		Bedrock (general)

DISCONTINUITY SPACING		STRENGTH CLASSIFICATION			
Bedding	Bedding Plane Spacing	Rock Strength	Approximate Uniaxial Compressive Strength		Field Estimation of Hardness*
			(MPa)	(psi)	
Very thickly bedded	Greater than 2m	Extremely Strong	Greater than 250	Greater than 36,000	Specimen can only be chipped with a geological hammer
Thickly bedded	0.6 to 2m				
Medium bedded	0.2 to 0.6m	Very Strong	100-250	15,000 to 36,000	Requires many blows of geological hammer to break
Thinly bedded	60mm to 0.2m				
Very thinly bedded	20 to 60mm	Strong	50-100	7,500 to 15,000	Requires more than one blow of geological hammer to break
Laminated	6 to 20mm				
Thinly Laminated	Less than 6mm	Medium Strong	25.0 to 50.0	3,500 to 7,500	Breaks under single blow of geological hammer.
		Weak	5.0 to 25.0	750 to 3,500	Can be peeled by a pocket knife with difficulty
		Very Weak	1.0 to 5.0	150 to 750	Can be peeled by a pocket knife, crumbles under firm blows of geological pick.
		Extremely Weak (Rock)	0.25 to 1.0	35 to 150	Indented by thumbnail

TERMS	
Total Core Recovery: (TCR)	Core recovered as a percentage of total core run length.
Solid Core Recovery: (SCR)	Percent Ratio of solid core of full cylindrical shape recovered. Expressed with respect to the total length of core run.
Rock Quality Designation: (RQD)	Total length of sound core recovered in pieces 0.1m in length or larger as a percentage of total core run length.
Uniaxial Compressive Strength (UCS)	Axial stress required to break the specimen
Fracture Index: (FI)	Frequency of natural fractures per 0.3m of core run.

# RECORD OF BOREHOLE No 122N-1

1 OF 2

METRIC

W.P. 474-93-01 LOCATION N 5047474.4 E 316758.4 Magnetawan South, NBL, 122N-1 ORIGINATED BY GA  
HWY 11 BOREHOLE TYPE Hollow Stem Augers/Dynamic Cone Penetration Test (DCPT) COMPILED BY WM/HS  
DATUM Geodetic DATE 21.10.04 - 21.10.04 CHECKED BY AEG

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							WATER CONTENT (%)	
294.9								○ UNCONFINED	+ FIELD VANE							
								● QUICK TRIAXIAL	× LAB VANE							
0.0	PEAT, fibrous, trace rootlets Dark Brown															
0.2	Sandy SILT, occasional iron oxide staining Very Loose to Compact Brown Wet		1	SS	2								47			
			2	SS	6											
	Becoming Grey		3	SS	11									0 3 89 8		
			4	SS	10											
291.9																
3.0	SAND, fine to medium grained, trace gravel Compact Grey Wet		5	SS	15											
			6	SS	16											
288.8																
6.1	Silty SAND, fine to coarse grained Compact Grey Wet		7	SS	20											
287.3																
7.6	Sandy SILT Compact Grey Wet		8	SS	15									0 26 68 6		
			9	SS	21											

Continued Next Page

+ 3, × 3: Numbers refer to  
Sensitivity

20  
15 5  
10 (%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No 122N-1

2 OF 2

METRIC

W.P. 474-93-01 LOCATION N 5047474.4 E 316758.4 Magnetawan South, NBL, 122N-1 ORIGINATED BY GA  
 HWY 11 BOREHOLE TYPE Hollow Stem Augers/Dynamic Cone Penetration Test (DCPT) COMPILED BY WM/HS  
 DATUM Geodetic DATE 21.10.04 - 21.10.04 CHECKED BY AEG

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					
281.8			10	SS	20								1 33 63 3
284													
283													
282													
13.1	END OF BOREHOLE AT 13.11 m. BOREHOLE OPEN TO 10.67 m AND WATER LEVEL AT 3.66 m UPON COMPLETION. BOREHOLE GROUTED TO SURFACE.												

+ 3 . X 3 : Numbers refer to  
Sensitivity

20  
15 5  
10 (%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No 122N-3

1 OF 5

METRIC

W.P. 474-93-01 LOCATION N 5047496.8 E 316752.2 Magnetawan South, NBL, 122N-3 ORIGINATED BY GA  
 HWY 11 BOREHOLE TYPE Hollow Stem Augers/NQ Casing COMPILED BY WM/HS  
 DATUM Geodetic DATE 13.10.04 - 14.10.04 CHECKED BY AEG

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								WATER CONTENT (%)					
								○ UNCONFINED		+ FIELD VANE							● QUICK TRIAXIAL		× LAB VANE		
								20	40	60							80	100	20	40	60
295.9																					
0.0	Sandy SILT, interbedded with layers of silty sand Loose to Very Loose Brown Dry		1	SS	6																
			2	SS	5																
			3	SS	4																
			4	SS	2										0 50 47 3						
			5	SS	2										0 58 39 3						
			6	SS	2																
			7	SS	5										0 91 9 (SI+CL)						
288.9																					
7.0	SILT, trace clay, trace sand Compact Grey Wet		8	SS	20																
			9	SS	14																
	occasional sand seams																				

Continued Next Page

+<sup>3</sup> ×<sup>3</sup>: Numbers refer to  
Sensitivity 20  
15 10 5  
(%) STRAIN AT FAILURE



# RECORD OF BOREHOLE No 122N-3

2 OF 5

METRIC

W.P. 474-93-01 LOCATION N 5047496.8 E 316752.2 Magnetawan South, NBL, 122N-3 ORIGINATED BY GA  
 HWY 11 BOREHOLE TYPE Hollow Stem Augers/NQ Casing COMPILED BY WM/HS  
 DATUM Geodetic DATE 13.10.04 - 14.10.04 CHECKED BY AEG

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								WATER CONTENT (%)			
								○ UNCONFINED + FIELD VANE											
								● QUICK TRIAXIAL × LAB VANE											
					20	40	60	80	100	20	40	60	GR	SA	SI	CL			
			10	SS	12		285					○				0	2	91	7
							284												
283.7																			
12.2	SAND, fine grained, trace silt Loose to Compact Grey Wet		11	SS	8		283					○							
			12	S	7		282					○							
							281												
			13	SS	11		280					○							
			14	SS	6		279					○							
			15	SS	23		278					○					0	86	14
																			(SI+CL)
							277												
			16	SS	50							○							
							276												

Continued Next Page

+ 3, × 3: Numbers refer to  
Sensitivity

20  
15  
10  
(%) STRAIN AT FAILURE

## METRIC

(%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No 122N-3

4 OF 5

METRIC

W.P. 474-93-01 LOCATION N 5047496.8 E 316752.2 Magnetawan South, NBL, 122N-3 ORIGINATED BY GA  
 HWY 11 BOREHOLE TYPE Hollow Stem Augers/NQ Casing COMPILED BY WM/HS  
 DATUM Geodetic DATE 13.10.04 - 14.10.04 CHECKED BY AEG

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						
							20 40 60 80 100	20 40 60 80 100	20 40 60					
	Grey Wet		20	SS	12									GR SA SI CL 19 75 5 (SI+CL)
							265							
							264							
			21	SS	32		263							
							262							
							261							
			22	SS	50		260							
							259							
							258							
	more numerous cobbles and boulders at 258.3m		1	RUN			257							
			2	RUN			256							

Continued Next Page

+ 3 . x 3: Numbers refer to  
Sensitivity 20  
15 5  
10 (%) STRAIN AT FAILURE

## METRIC

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT						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							
								PLASTIC LIMIT      NATURAL MOISTURE CONTENT      LIQUID LIMIT W <sub>P</sub> W                  W <sub>L</sub> ○ UNCONFINED    + FIELD VANE ● QUICK TRIAXIAL   × LAB VANE 20   40   60   80   100      20   40   60							
254.1			3	RUN			255								
41.8	END OF BOREHOLE AT 41.76 m. BOREHOLE OPEN TO 41.76 m. Piezometer installation consists of 19 mm diameter Schedule 40 PVC pipe with a 1.52 m slotted screen.		4	RUN											
	WATER LEVEL READINGS: DATE       DEPTH   ELEVATION (m)        (m) Completion 0.3      295.6 10-NOV-04 0.6      295.3 11-JAN-05 0.7      295.2														

# RECORD OF BOREHOLE No 122N-3A

1 OF 1

METRIC

W.P. 474-93-01 LOCATION N 5047496.8 E 316752.2 Magnetawan South, NBL, 122N-3A ORIGINATED BY GA  
 HWY 11 BOREHOLE TYPE Dynamic Cone Penetration Test (DCPT) COMPILED BY WMHS  
 DATUM Geodetic DATE 15.10.04 - 15.10.04 CHECKED BY AEG

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	UNIT WEIGHT  Y 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 (%)					
295.9	DCPT started at surface.							20 40 60 80 100 ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE	20 40 60 WP W WL					
0.0							295							
							294							
							293							
							292							
							291							
							290							
							289							
288.3	END OF DCPT AT 7.62 m.													
7.6														

ONTMT4S 122N.GPJ 12/01/05

# RECORD OF BOREHOLE No 122N-4

1 OF 5

METRIC

W.P. 474-93-01 LOCATION N 5047511.2 E 316731.3 Magnetawan South, NBL, 122N-4 ORIGINATED BY GA  
 HWY 11 BOREHOLE TYPE Hollow Stem Augers/NQ Casing COMPILED BY WM/HS  
 DATUM Geodetic DATE 19.10.04 - 21.10.04 CHECKED BY AEG

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								WATER CONTENT (%)		
								○ UNCONFINED	+	FIELD VANE						○ QUICK TRIAXIAL	×	LAB VANE
294.8							20	40	60	80	100	20	40	60				
0.0	TOPSOIL (50 mm)		1	SS	2													
0.1	Sandy SILT, interbedded with layers of silty sand Very Loose Brown Wet																	
			2	SS	2													
			3	SS	2											0 34 62 4		
	Becoming Grey		4	SS	2													
			5	SS	2											0 68 30 3		
			6	SS	2													
288.7																		
6.1	Silty CLAY, trace sand Soft to Firm Grey Wet		7	SS	2											0 3 62 35		
			8	SS	2											0 1 41 59		
			9	SS	2													

Continued Next Page

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to  
Sensitivity

20  
15  
10  
(%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No 122N-4

2 OF 5

METRIC

W.P. 474-93-01 LOCATION N 5047511.2 E 316731.3 Magnetawan South, NBL, 122N-4 ORIGINATED BY GA  
 HWY 11 BOREHOLE TYPE Hollow Stem Augers/NQ Casing COMPILED BY WM/HS  
 DATUM Geodetic DATE 19.10.04 - 21.10.04 CHECKED BY AEG

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			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			20 40 60 80 100	PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	
			1	TW	PH							
			10	SS	2		284					
			11	SS	6		283					
							282					
			12	SS	8							
							281					
	Becoming Very Stiff, Varved		13	SS	19		280					
278.7							279					
16.2	SILT, trace sand Compact to Dense Grey Wet		14	SS	24		278					
			15	SS	40		277					
			16	SS	38		276					
275.0							275					
19.8	Sandy SILT											0 0 92 8

Continued Next Page

+<sup>3</sup> ×<sup>3</sup>: Numbers refer to  
Sensitivity

20  
15 5  
10 (%) STRAIN AT FAILURE

ONTMT4S 122N.GPJ 12/01/05

# RECORD OF BOREHOLE No 122N-4

3 OF 5

METRIC

W.P. 474-93-01 LOCATION N 5047511.2 E 316731.3 Magnetawan South, NBL, 122N-4 ORIGINATED BY GA  
 HWY 11 BOREHOLE TYPE Hollow Stem Augers/NQ Casing COMPILED BY WM/HS  
 DATUM Geodetic DATE 19.10.04 - 21.10.04 CHECKED BY AEG

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	WATER CONTENT (%)					
	Loose to Compact Grey Wet Artesian pressure condition from 19.8 m		17	SS	4		274							0 27 67 6
							273							
							272							
			18	SS	23		271							0 10 87 3
							270							
							269							
268.0							268							
26.8	SAND, fine grained, trace silt Dense to Compact Grey Wet		19	SS	40		267							
							266							
							265							

Continued Next Page

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to  
Sensitivity 20  
15 5  
10 (%) STRAIN AT FAILURE



# RECORD OF BOREHOLE No 122N-4

4 OF 5

METRIC

W.P. 474-93-01 LOCATION N 5047511.2 E 316731.3 Magnetawan South, NBL, 122N-4 ORIGINATED BY GA  
HWY 11 BOREHOLE TYPE Hollow Stem Augers/NQ Casing COMPILED BY WM/HS  
DATUM Geodetic DATE 19.10.04 - 21.10.04 CHECKED BY AEG

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						
							20 40 60 80 100	20 40 60 80 100	20 40 60					
263.5			20	SS	20									
31.3	SAND and GRAVEL, with cobbles and boulders, trace silt Very Dense Brown Wet													
			21	SS	100/.075									
			22	SS	100/.025									
			23	SS	100/.200									
			24	SS	100/.150									
254.9			25	SS	100/									

trace gravel below 258m, occasional cobbles inferred from drilling resistance

Continued Next Page

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to Sensitivity

20  
15 5  
10 (%) STRAIN AT FAILURE

ONTMT4S 122N.GPJ 12/01/05

## METRIC

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT	PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	UNIT WEIGHT  Y  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)  GR SA SI CL				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80			100	W <sub>P</sub>	W	W <sub>L</sub>
								SHEAR STRENGTH kPa						WATER CONTENT (%)			
39.9	END OF BOREHOLE AT 39.90 m. Piezometer installation consists of 19 mm diameter Schedule 40 PVC pipe with a 1.52 m slotted screen.				.175												
WATER LEVEL READINGS: DATE      DEPTH    ELEVATION (m)        (m) Completion 0.3      294.5 10-NOV-04 0.3      294.5 11-JAN-05 0.4      294.4																	

CONTMT4\$ 122N.GPJ 12/01/05

+ 3, × 3: Numbers refer to Sensitivity

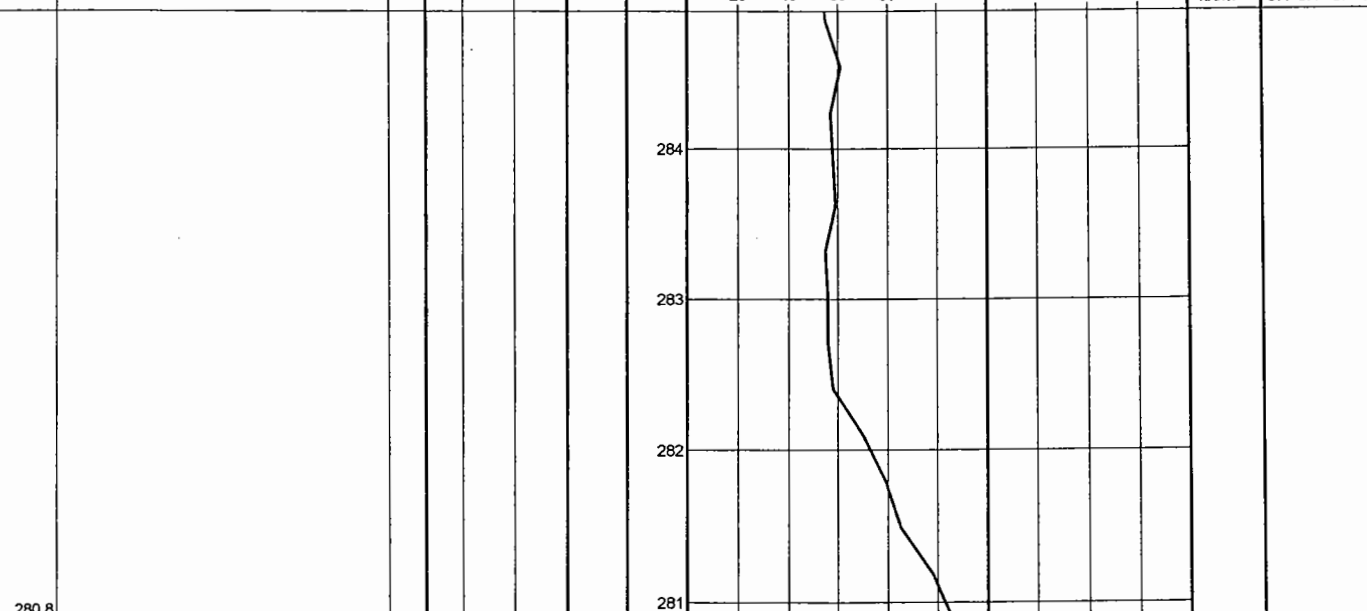
## METRIC

[illegible]

+ 3, x 3: Numbers refer to Sensitivity

## METRIC

ELEV DEPTH	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
	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	20 40 60 80 100			
							SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100				
							WATER CONTENT (%) 20 40 60				

[illegible]

**METRIC**

SOIL PROFILE						DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT		UNIT WEIGHT		REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER TYPE "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE		WATER CONTENT (%) w <sub>p</sub> w w <sub>L</sub>		γ		GR SA SI CL	
296.6 0.0	Sandy SILT, interbedded with layers of silty sand, occasional iron oxide staining, trace rootlets at surface Loose to Compact Dark Brown to Brown Moist to Wet		1 SS 11		296								
			2 SS 18		295								
			3 SS 11		294								
			4 SS 9		293								
			5 SS 9		292								
	becoming grey below 5m		6 SS 15		291								
290.5 6.1	Silty CLAY Very Stiff to Soft Grey		7 SS 16		290								
			8 SS 4		289								
			1 TW PH		288								
					287								

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to Sensitivity

ONTMT4S 122N.GPJ 12/01/05

# RECORD OF BOREHOLE No 122N-7

2 OF 4

METRIC

W.P. 474-93-01 LOCATION N 5047562.0 E 316715.1 Magnetawan South, NBL, 122N-7 ORIGINATED BY GA  
 HWY 11 BOREHOLE TYPE Hollow Stem Augers/NQ Casing COMPILED BY WM/HS  
 DATUM Geodetic DATE 25.10.04 - 28.10.04 CHECKED BY AEG

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			UNIT WEIGHT  Y  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				
								○ UNCONFINED + FIELD VANE				
								● QUICK TRIAXIAL x LAB VANE				
						WATER CONTENT (%)						
						20 40 60 80 100						
						20 40 60 80 100						
286.5												
10.1	SILT, occasional sand seams Compact Grey Wet							4 +				
			9	SS	15		286			○		
							285					
284.4												
12.2	Silty SAND, fine grained, trace silt Loose to Compact Grey Wet		10	SS	5		284			○		0 62 36 2
							283			○		
			11	SS	26		282					
			12	SS	15		281			○		0 37 60 3
							280			○		
	Becoming Dense		13	SS	40		279					
278.3												
18.3	SAND, medium grained, trace gravel Dense to Very Dense Grey Wet		14	SS	30		278			○		
							277					

Continued Next Page

+ 3. x 3: Numbers refer to  
Sensitivity

20  
15 10 5  
(%) STRAIN AT FAILURE

## METRIC

SOIL PROFILE						DYNAMIC CONE PENETRATION RESISTANCE PLOT				UNIT WEIGHT	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	$\gamma$	
			NUMBER	TYPE			SHEAR STRENGTH kPa				
							WATER CONTENT (%)			kN/m <sup>3</sup>	GR SA SI C
							UNCONFINED + FIELD VANE				
							● QUICK TRIAXIAL x LAB VANE				
276			15	SS	24						
275											
274			16	SS	100/.075						
273											
272											
271			17	SS	35						
270											
269.5											
27.1	SAND and GRAVEL, trace silt. occasional cobbles and boulders Very Dense Grey Wet										
	frequent cobbles and boulders below 28.3 m										
269											
268			18	SS	100/.0						
267			19	SS	43						

(%) STRAIN AT FAILURE

ONTMT4S 122N.GPJ 12/01/05

# RECORD OF BOREHOLE No 122N-7

4 OF 4

METRIC

W.P. 474-93-01 LOCATION N 5047562.0 E 316715.1 Magnetawan South, NBL, 122N-7 ORIGINATED BY GA  
 HWY 11 BOREHOLE TYPE Hollow Stem Augers/NQ Casing COMPILED BY WM/HS  
 DATUM Geodetic DATE 25.10.04 - 28.10.04 CHECKED BY AEG

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 (SI+CL)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE								
								20	40	60	80	100				
			20	SS	100/	.150										
			21	SS	100/	.200										
			22	SS	100/	.150										
259.9			23	SS	100/	.150										
36.7	END OF BOREHOLE AT 36.73 m. BOREHOLE OPEN TO 36.58 m IN CASING AND WATER LEVEL AT 4.7 m UPON COMPLETION. Piezometer installation consist of 19 mm diameter Schedule 40 PVC pipe with a 1.52 m slotted screen.  WATER LEVEL READINGS: DATE DEPTH ELEVATION (m) (m) Completion 4.3 292.3 11-JAN-05 4.2 292.4															

ONTMT4S 122N.GPJ 12/01/05

+<sup>3</sup> ×<sup>3</sup>: Numbers refer to  
Sensitivity

20  
15 5  
10 (%) STRAIN AT FAILURE



# RECORD OF BOREHOLE No 122N-7A

1 OF 2

METRIC

W.P. 474-93-01 LOCATION N 5047562.0 E 316715.1 Magnetawan South, NBL, 122N-7A ORIGINATED BY GA  
 HWY 11 BOREHOLE TYPE Dynamic Cone Penetration Test (DCPT) COMPILED BY WM/HS  
 DATUM Geodetic DATE 29.10.04 - 29.10.04 CHECKED BY AEG


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	WATER CONTENT (%)					
296.6 0.0	DCPT started from surface.						20 40 60 80 100 ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE	20 40 60						
296														
295														
294														
293														
292														
291														
290														
289														
288														
287														

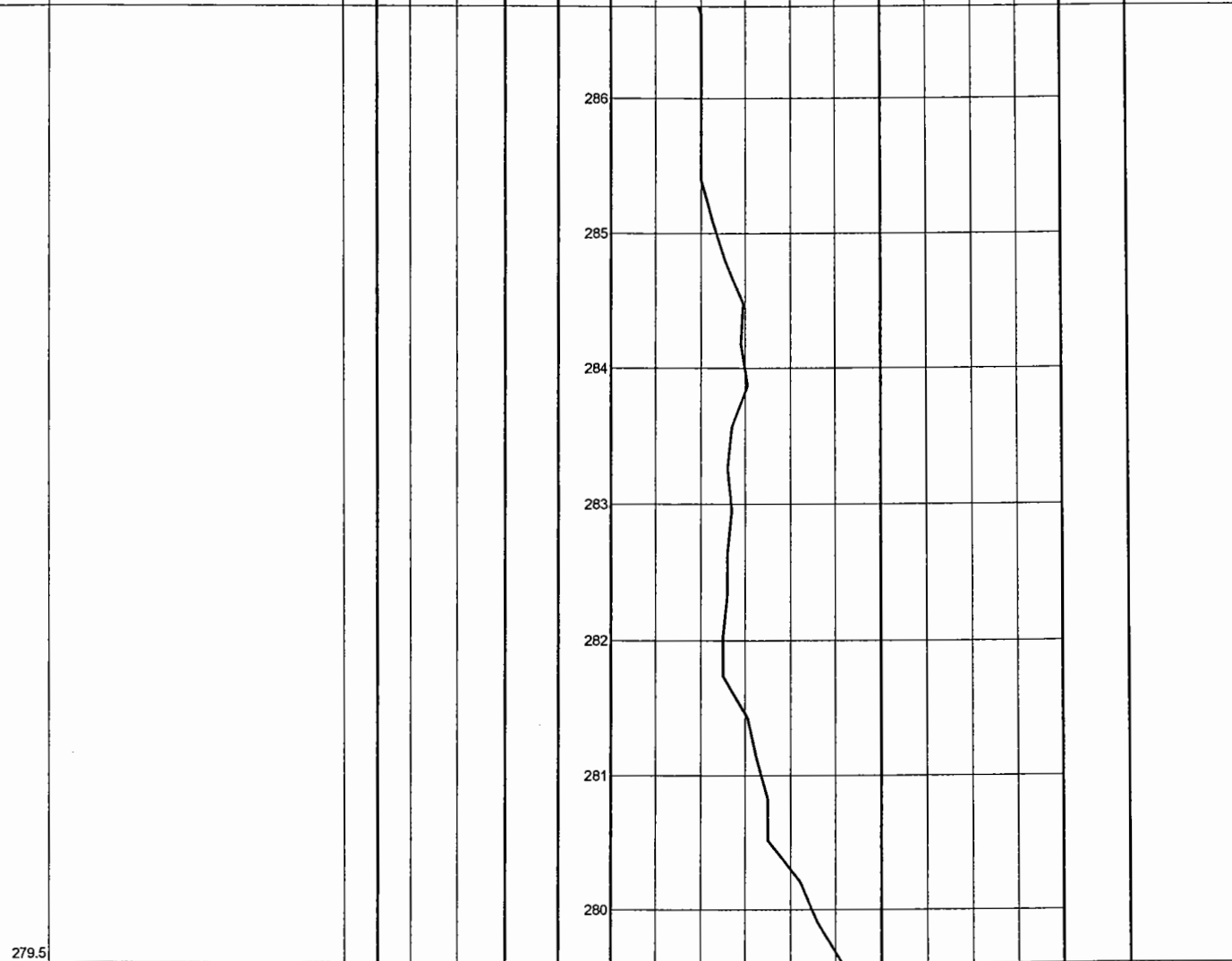
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+ 3, × 3: Numbers refer to  
Sensitivity

20  
15 10 5  
(%) STRAIN AT FAILURE

## METRIC

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 	PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT  W <sub>p</sub> W      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						
						SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	WATER CONTENT (%) 20 40 60			



279.5

17.1	END OF DCPT AT 17.07 m.
------	-------------------------

ONTM4S 122N.GPJ 12/01/05

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to Sensitivity

# RECORD OF BOREHOLE No 122N-8

1 OF 4

METRIC

W.P. 474-93-01 LOCATION N 5047577.0 E 316696.9 Magnetawan South, NBL, 122N-8 ORIGINATED BY GA  
 HWY 11 BOREHOLE TYPE Hollow Stem Augers/INQ Casing COMPILED BY WM/HS  
 DATUM Geodetic DATE 29.10.04 - 31.10.04 CHECKED BY AEG

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							
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE							
								20 40 60 80 100							
299.0															
0.0	Sandy SILT, interbedded with layers of silty sand, trace rootlets and wood fibers at surface Compact to Loose Dark Brown to Brown Moist		1	SS	12										
			2	SS	9										0 61 37 2
			3	SS	13										
			4	SS	8										0 2 93 5
			5	SS	11										
	becoming grey		6	SS	12										
			7	SS	13										
			8	SS	19										0 0 86 14
290.4															
8.5	Silty CLAY Stiff to Firm Grey Wet		9	SS	12										

Continued Next Page

+ 3 . X 3 : Numbers refer to  
Sensitivity

20  
15-20 5  
10 (%) STRAIN AT FAILURE

ONTMT4S 122N.GPJ 12/01/05



# RECORD OF BOREHOLE No 122N-8

3 OF 4

METRIC

W.P. 474-93-01 LOCATION N 5047577.0 E 316696.9 Magnetawan South, NBL, 122N-8 ORIGINATED BY GA  
 HWY 11 BOREHOLE TYPE Hollow Stem Augers/NQ Casing COMPILED BY WMHS  
 DATUM Geodetic DATE 29.10.04 - 31.10.04 CHECKED BY AEG

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								WATER CONTENT (%)			GR	SA	SI	CL			
								20	40	60						80	100	20	40	60	0	0	83	16	
								○ UNCONFINED	+	FIELD VANE						● QUICK TRIAXIAL	×	LAB VANE							
277.3	SAND, trace to some silt Very Dense Grey Wet		15	SS	90		279																		
21.7								278																	
								277																	
					16	SS	85/ .200		276																
							275																		
			17	SS	81		274																		
							273																		
							272																		
271.5							271																		
27.4	SAND and GRAVEL, trace silt, occasional boulders and cobbles		18	SS	42		270																		

Continued Next Page

+ 3, × 3: Numbers refer to  
Sensitivity

20  
15 5  
10 (%) STRAIN AT FAILURE

ONTMT4S 122N.GPJ 12/01/05



# RECORD OF BOREHOLE No 122N-8A

1 OF 2

METRIC

W.P. 474-93-01 LOCATION N 5047577.0 E 316696.9 Magnetawan South, NBL, 122N-8A ORIGINATED BY GA  
 HWY 11 BOREHOLE TYPE Dynamic Cone Penetration Test (DCPT) COMPILED BY WM/HS  
 DATUM Geodetic DATE 01.11.04 - 01.11.04 CHECKED BY AEG

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	WATER CONTENT (%)					
299.0 0.0	DCPT started from surface.						299	20 40 60 80 100	20 40 60					
							298							
							297							
							296							
							295							
							294							
							293							
							292							
							291							
							290							

Continued Next Page

+ 3, × 3: Numbers refer to  
Sensitivity

20  
15 5  
10 (%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No 122N-8A

2 OF 2

METRIC

W.P. 474-93-01 LOCATION N 5047577.0 E 316696.9 Magnetawan South, NBL, 122N-8A ORIGINATED BY GA  
 HWY 11 BOREHOLE TYPE Dynamic Cone Penetration Test (DCPT) COMPILED BY WM/HS  
 DATUM Geodetic DATE 01.11.04 - 01.11.04 CHECKED BY AEG

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	WATER CONTENT (%)					
							289							
							288							
							287							
							286							
							285							
							284							
							283							
							282							
							281							
							280							
279.8	END OF DCPT AT 19.20 m.													
19.2														

ONTMT4S 122N.GPJ 12/01/05



# RECORD OF BOREHOLE No 122N-10

1 OF 2

METRIC

W.P. 474-93-01 LOCATION N 5047594.0 E 316692.2 Magnetawan South, NBL, 122N-10 ORIGINATED BY GA  
 HWY 11 BOREHOLE TYPE Hollow Stem Augers / Dynamic Cone Penetration Test (DCPT) COMPILED BY WMHS  
 DATUM Geodetic DATE 01.11.04 - 01.11.04 CHECKED BY AEG

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	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 ○ UNCONFINED    + FIELD VANE ● QUICK TRIAXIAL    × LAB VANE				WATER CONTENT (%) w <sub>p</sub> w                      w <sub>L</sub>				
299.4								20	40	60	80	100	20	40	60	
0.0	Sandy SILT, interbedded with layers of silty sand Compact to Loose Brown Moist to Wet		1	SS	20		299							○		
			2	SS	9		298							○		0 4 88 8
			3	SS	8		297							○		
			4	SS	20		296							○		
			5	SS	6		295							○		
			6	SS	13		294							○		
	Becoming Grey		7	SS	16		293							○		0 1 87 12
			8	SS	23		292							○		
							291									
290.3							290							○		
9.1	Silty CLAY Very Stiff to Stiff Grey		9	SS	28											

Continued Next Page

+ 3 . × 3 : Numbers refer to  
Sensitivity

20  
15  
10

(%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No 122N-10

2 OF 2

METRIC

W.P. 474-93-01 LOCATION N 5047594.0 E 316692.2 Magnetawan South, NBL, 122N-10 ORIGINATED BY GA  
HWY 11 BOREHOLE TYPE Hollow Stem Augers / Dynamic Cone Penetration Test (DCPT) COMPILED BY WM/HS  
DATUM Geodetic DATE 01.11.04 - 01.11.04 CHECKED BY AEG

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 ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE							
288.2			10	SS	8										0 1 49 50
11.3	END OF SOIL SAMPLING AT 11.28 m. DCPT started at 11.28 m.														
286.3															
13.1	END OF DCPT AT 13.11 m. BOREHOLE OPEN TO 13.11 m AND WATER LEVEL AT 4.27 m UPON COMPLETION. BOREHOLE GROUTED TO SURFACE.														

+<sup>3</sup> ×<sup>3</sup>: Numbers refer to  
Sensitivity

20  
15  
10

(%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No 122N-10A

1 OF 2

METRIC

W.P. 480-93-00 LOCATION Magnetawan South, NBL, 122N-10A ORIGINATED BY WRW  
 HWY 11 BOREHOLE TYPE NW Casing COMPILED BY WM  
 DATUM Geodetic DATE 06.04.05 - 06.04.05 CHECKED BY AEG

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	UNIT WEIGHT  Y 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					
299.4							20 40 60 80 100 ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE	W <sub>P</sub> W W <sub>L</sub> 20 40 60					
0.0	Refer to BH 122N-10 Augered to 11.28 m.												
299													
298													
297													
296													
295													
294													
293													
292													
291													
290													

Continued Next Page

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to  
Sensitivity

20  
 15 10 5  
 (%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No 122N-10A

2 OF 2

METRIC

W.P. 480-93-00 LOCATION Magnetawan South, NBL, 122N-10A ORIGINATED BY WRW  
 HWY 11 BOREHOLE TYPE NW Casing COMPILED BY WM  
 DATUM Geodetic DATE 06.04.05 - 06.04.05 CHECKED BY AEG

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			20 40 60 80 100	20 40 60 80 100	20 40 60 80 100	20 40 60 80 100	20 40 60 80 100		
288.1	SAMPLING STARTED AT 11.3m													
11.3	Silty CLAY Very Stiff Grey		1	SS	23									
			1	TW	PH									
285.5														
13.9	SILT, some clay, some sand Dense Grey		2	SS	33									
284.0														
15.4	Silty SAND, trace clay Dense to Compact Grey Wet		3	SS	30									
			4	SS	28									
281.4														
18.0	END OF BOREHOLE AT 17.98 m. WATER LEVEL AT 0.30 m UPON COMPLETION OF DRILLING. BOREHOLE GROUTED WITH BENSEAL BENTONITE TO SURFACE.													

ONTMT4S 2316.GPJ 13/09/05

+<sup>3</sup> . x<sup>3</sup> : Numbers refer to  
Sensitivity 20  
15 5  
10 (%) STRAIN AT FAILURE

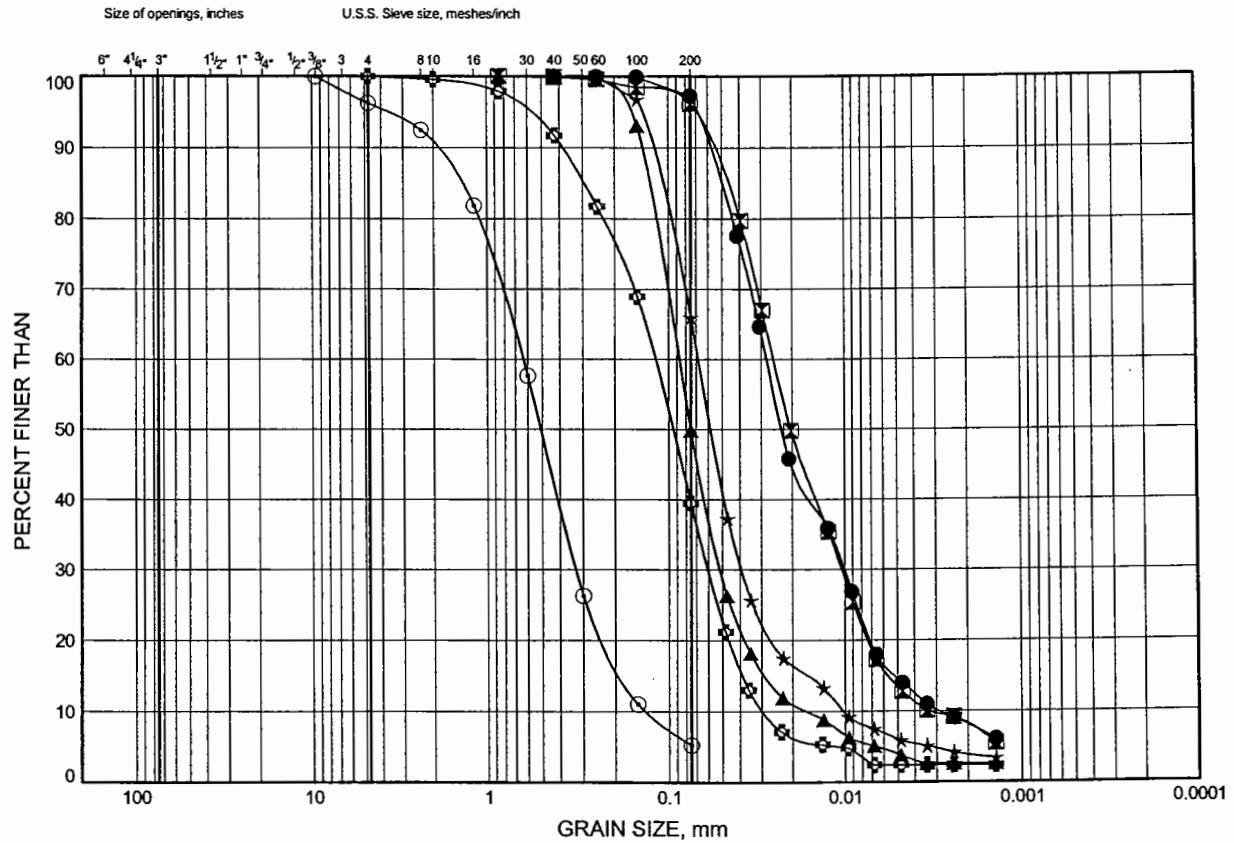
**Appendix B**

**Laboratory Test Results**

# Hwy 11 Katrina GRAIN SIZE DISTRIBUTION

FIGURE B1

## SANDY SILT INTERBEDDED WITH LAYERS OF SILTY SAND

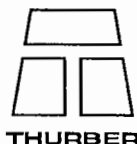


COBBLE SIZE	COARSE	FINE	COARSE	MEDIUM	FINE	SILT and CLAY
	GRAVEL		SAND			FINE GRAINED

SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	122N-1	1.83	293.09
⊠	122N-10	1.07	298.36
▲	122N-3	2.59	293.30
★	122N-4	1.83	293.00
⊙	122N-7	1.07	295.53
⊗	122N-8	1.07	297.89

Date January 2005

Project 474-93-01



THURBER

Prep'd HS

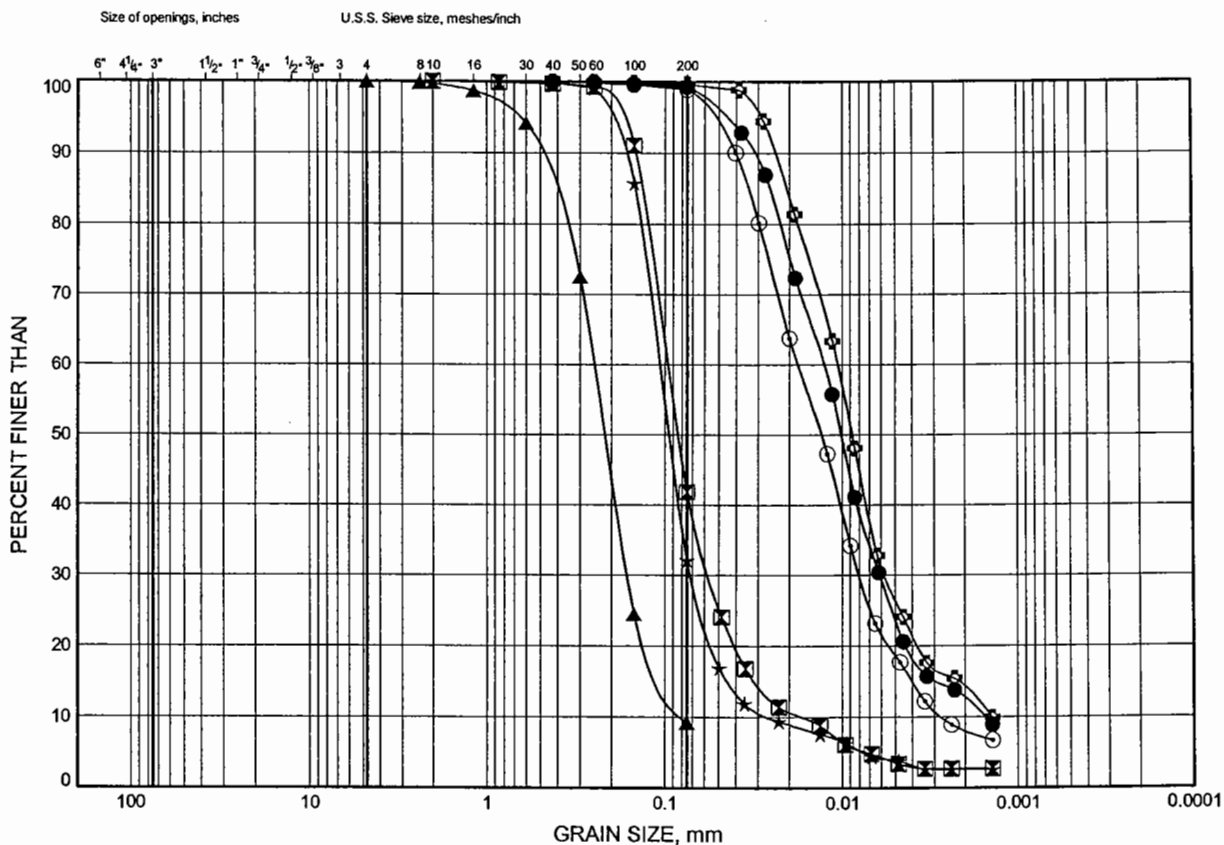
Chkd. AEG

# Hwy 11 Katrine

## GRAIN SIZE DISTRIBUTION

FIGURE B2

### SANDY SILT INTERBEDDED WITH LAYERS OF SILTY SAND



COBBLE SIZE	COARSE	FINE	COARSE	MEDIUM	FINE	SILT and CLAY
	GRAVEL		SAND			FINE GRAINED

SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	122N-10	6.32	293.11
⊠	122N-3	3.35	292.54
▲	122N-3	6.32	289.57
★	122N-4	3.35	291.48
⊙	122N-7	3.35	293.25
⊛	122N-8	7.85	291.11

Date January 2005

Project 474-93-01



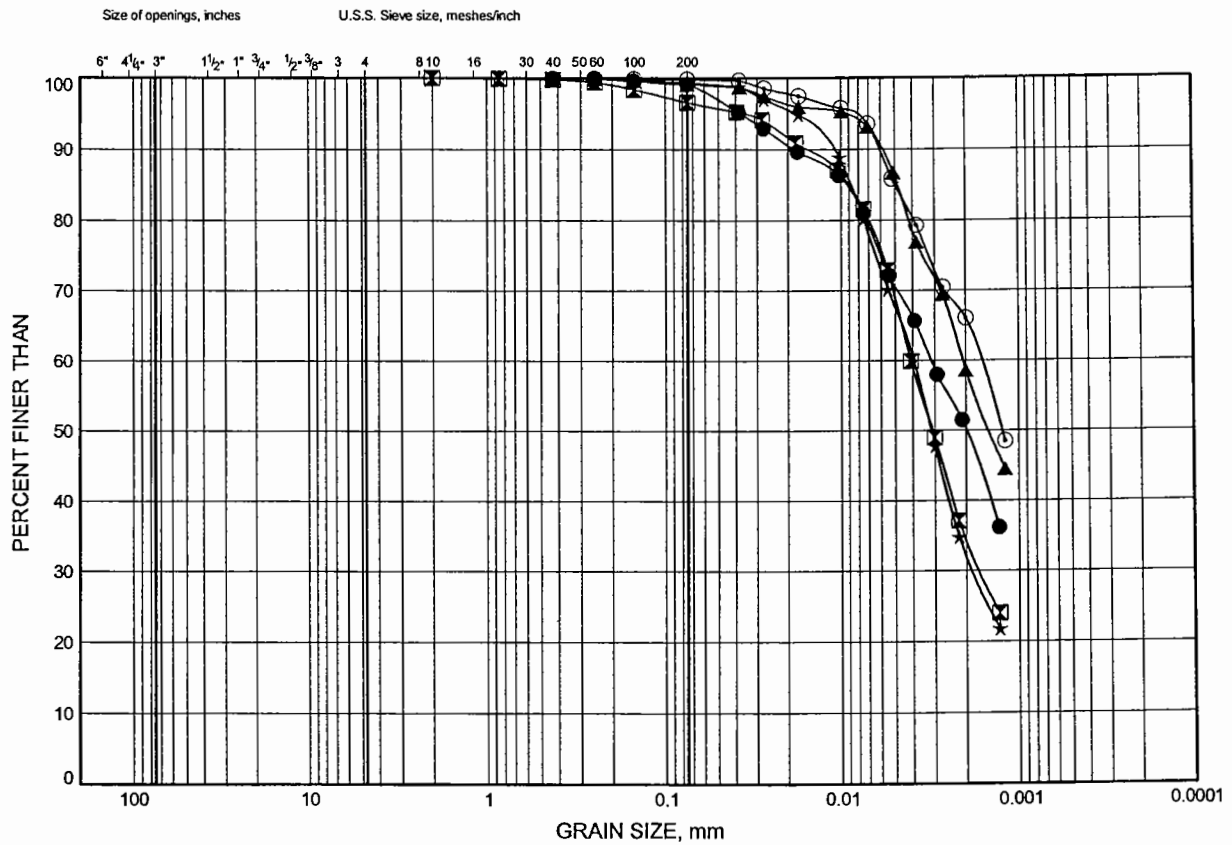
Prep'd HS

Chkd. AEG

# Hwy 11 Katrina GRAIN SIZE DISTRIBUTION

FIGURE B3

## SILTY CLAY

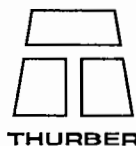


COBBLE SIZE	COARSE	FINE	COARSE	MEDIUM	FINE	SILT and CLAY
	GRAVEL		SAND			FINE GRAINED

SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	122N-10	10.90	288.53
⊠	122N-4	6.32	288.51
▲	122N-4	7.92	286.91
★	122N-7	6.32	290.28
⊙	122N-8	13.94	285.02

Date January 2005

Project 474-93-01



Prep'd HS

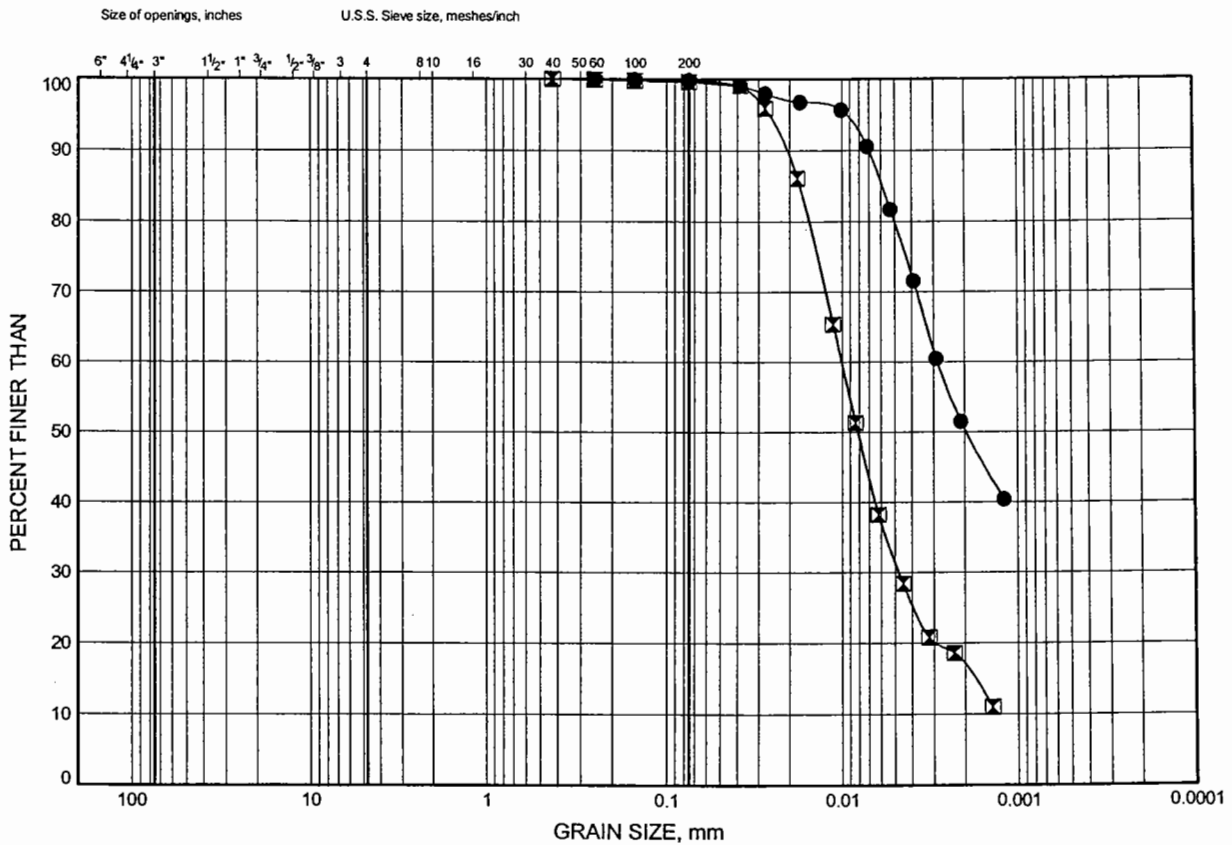
Chkd. AEG



# Hwy 11 Katrine GRAIN SIZE DISTRIBUTION

FIGURE B4

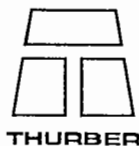
## SILTY CLAY



COBBLE SIZE	COARSE	FINE	COARSE	MEDIUM	FINE	SILT and CLAY
	GRAVEL		SAND			FINE GRAINED

SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	122N-8	15.47	283.49
☒	122N-8	20.04	278.92

Date January 2005  
Project 474-93-01

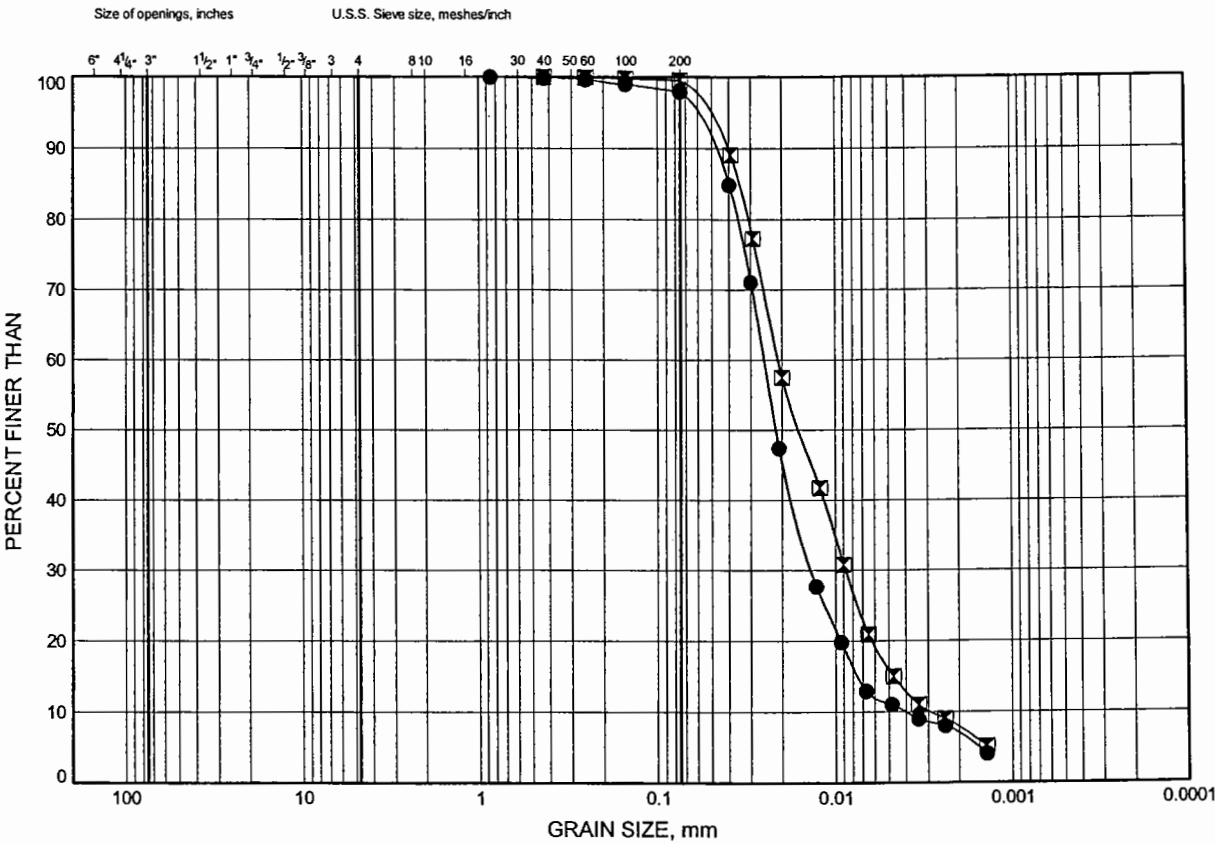


Prep'd HS  
Chkd. AEG

Hwy 11 Katrine  
**GRAIN SIZE DISTRIBUTION**

FIGURE B5

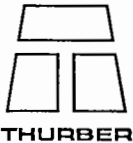
**SILT**



COBBLE SIZE	COARSE	FINE	COARSE	MEDIUM	FINE	SILT and CLAY
	GRAVEL		SAND			FINE GRAINED

SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	122N-3	10.90	284.99
⊠	122N-4	17.91	276.92

Date January 2005  
 Project 474-93-01

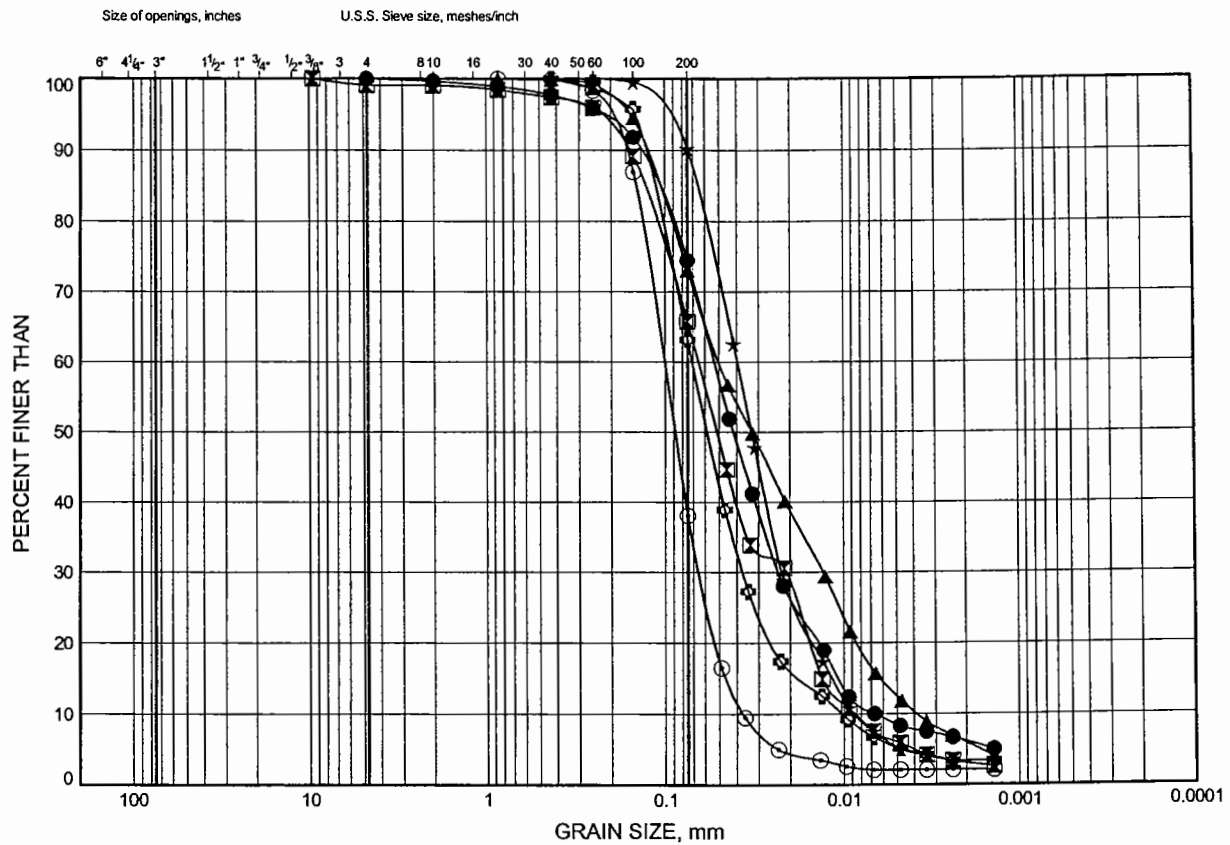


Prep'd HS  
 Chkd. AEG

# Hwy 11 Katrina GRAIN SIZE DISTRIBUTION

FIGURE B6

## SANDY SILT TO SAND

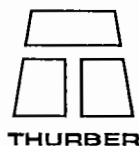


COBBLE SIZE	COARSE	FINE	COARSE	MEDIUM	FINE	SILT and CLAY
	GRAVEL		SAND			FINE GRAINED

SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	122N-1	7.85	287.07
⊠	122N-1	10.90	284.02
▲	122N-4	20.96	273.87
★	122N-4	24.00	270.83
⊙	122N-7	12.42	284.18
⊕	122N-7	15.47	281.13

Date January 2005

Project 474-93-01



Prep'd HS

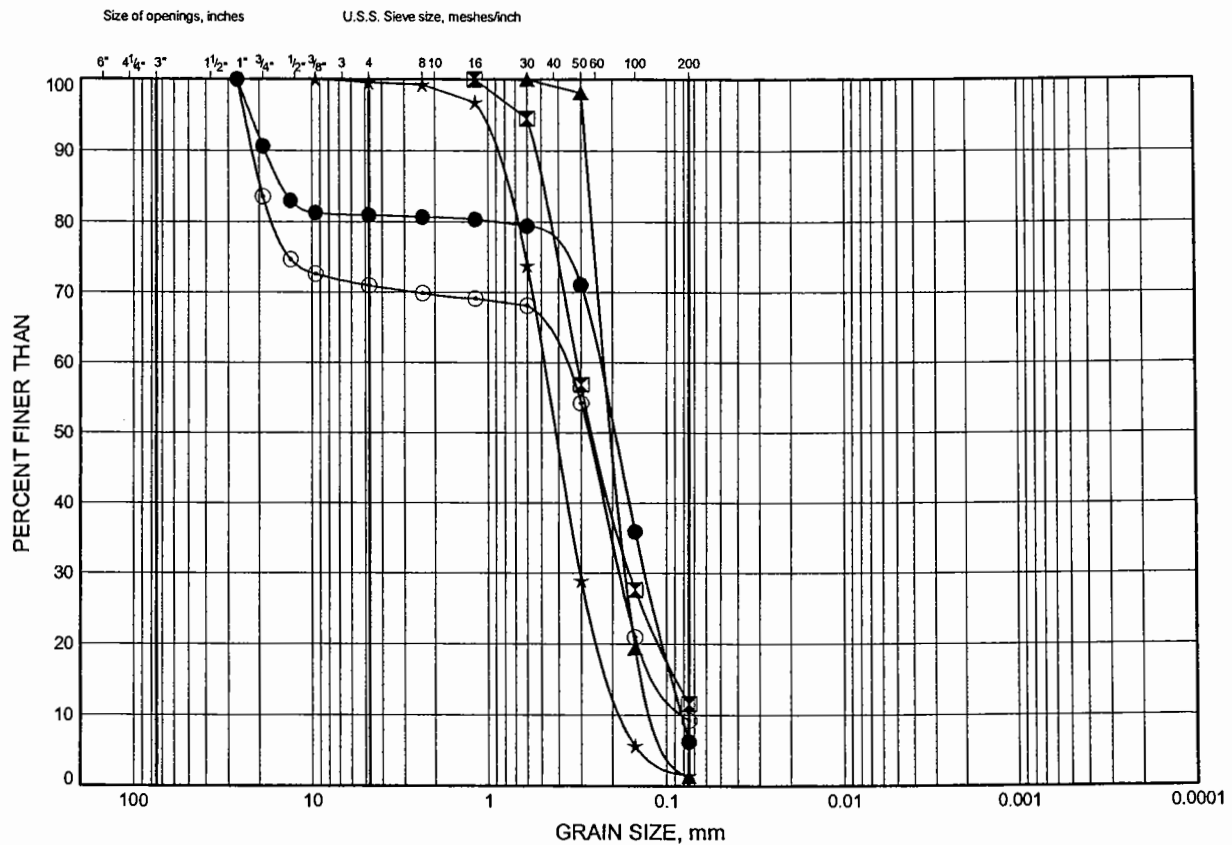
Chkd. AEG



# Hwy 11 Katrina GRAIN SIZE DISTRIBUTION

FIGURE B8

## SAND AND GRAVEL

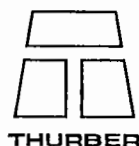


COBBLE SIZE	COARSE	FINE	COARSE	MEDIUM	FINE	SILT and CLAY
	GRAVEL		SAND			FINE GRAINED

SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	122N-3	30.10	265.79
⊠	122N-4	38.25	256.58
▲	122N-7	29.79	266.81
★	122N-8	30.71	268.25
⊙	122N-8	33.53	265.43

Date January 2005

Project 474-93-01



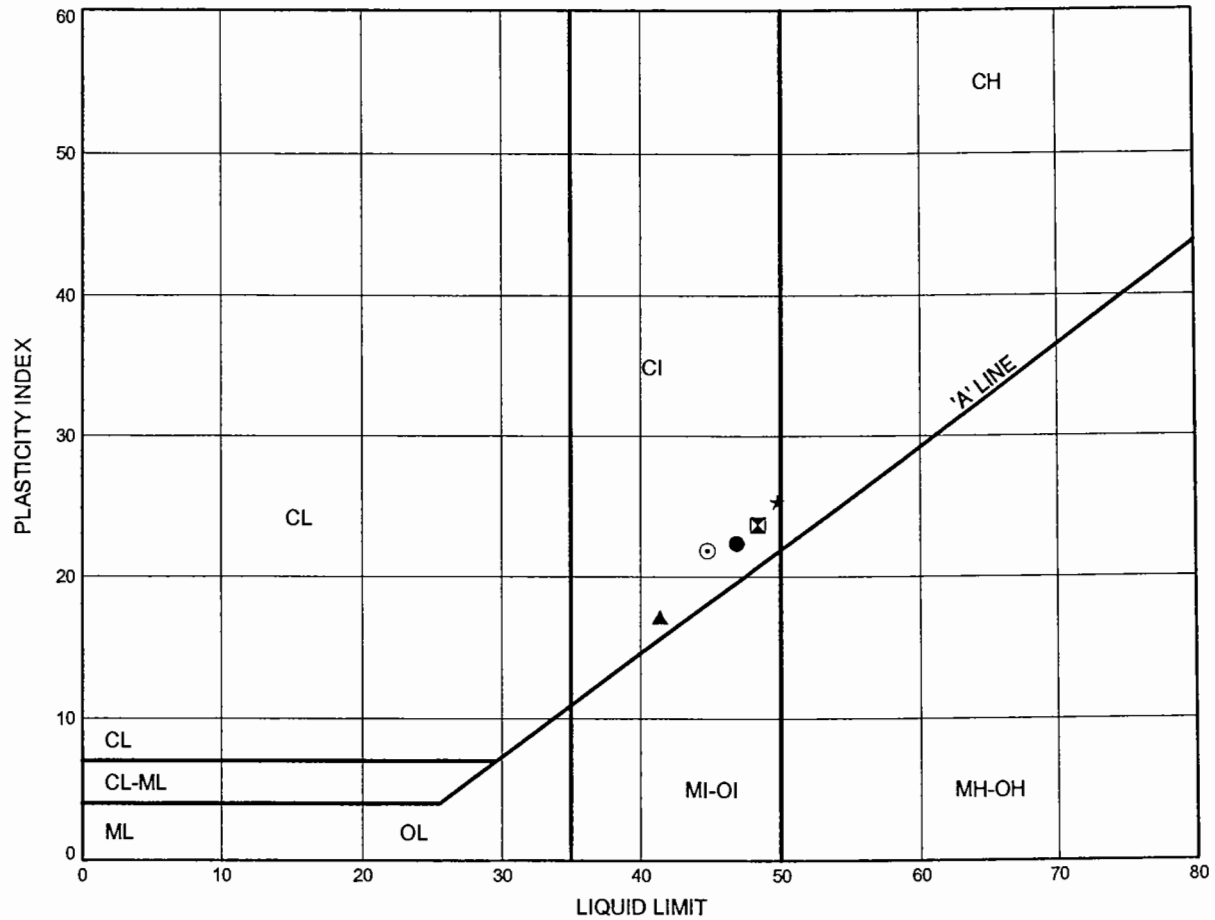
Prep'd HS

Chkd. AEG

# Hwy 11 Katrina ATTERBERG LIMITS TEST RESULTS

FIGURE B9

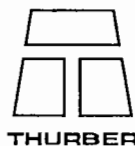
## SILTY CLAY



SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	122N-10	10.90	288.53
⊠	122N-4	7.92	286.91
▲	122N-7	7.85	288.75
★	122N-8	13.94	285.02
⊙	122N-8	15.47	283.49

Date January 2005

Project 474-93-01



Prep'd HS

Chkd. AEG

## OEDOMETER CONSOLIDATION SUMMARY

### SAMPLE IDENTIFICATION

Project Number	04-1116-123	Sample Number	122N-8
Borehole Number	-	Sample Depth, m	12.2-12.9

### TEST CONDITIONS

Test Type	Standard	Load Duration, hr	24
Oedometer Number	9		
Date Started	12/19/2004		
Date Completed	01/03/2005		

### SAMPLE DIMENSIONS AND PROPERTIES - INITIAL

Sample Height, cm	1.92	Unit Weight, kN/m <sup>3</sup>	17.33
Sample Diameter, cm	6.35	Dry Unit Weight, kN/m <sup>3</sup>	11.95
Area, cm <sup>2</sup>	31.67	Specific Gravity, measured	2.75
Volume, cm <sup>3</sup>	60.65	Solids Height, cm	0.848
Water Content, %	45.05	Volume of Solids, cm <sup>3</sup>	26.87
Wet Mass, g	107.18	Volume of Voids, cm <sup>3</sup>	33.78
Dry Mass, g	73.89	Degree of Saturation, %	98.6

### TEST COMPUTATIONS

Pressure kPa	Corr. Height cm	Void Ratio	Average Height cm	t <sub>90</sub> sec	cv, cm <sup>2</sup> /s	mv m <sup>2</sup> /kN	k cm/s
0.00	1.915	1.257	1.915				
4.85	1.912	1.254	1.914	98	7.92E-03	3.23E-04	2.51E-07
9.50	1.907	1.248	1.910	64	1.21E-02	5.61E-04	6.65E-07
19.59	1.898	1.237	1.903	124	6.19E-03	4.66E-04	2.82E-07
39.07	1.883	1.219	1.891	184	4.12E-03	4.02E-04	1.62E-07
77.88	1.859	1.191	1.871	80	9.28E-03	3.23E-04	2.94E-07
155.39	1.823	1.149	1.841	89	8.07E-03	2.43E-04	1.92E-07
311.43	1.758	1.072	1.791	103	6.60E-03	2.18E-04	1.41E-07
622.27	1.627	0.918	1.693	197	3.08E-03	2.20E-04	6.65E-08
1243.06	1.521	0.793	1.574	124	4.24E-03	8.92E-05	3.70E-08
2484.87	1.423	0.677	1.472	108	4.25E-03	4.12E-05	1.72E-08
1243.06	1.434	0.690	1.429				
311.43	1.467	0.729	1.451				
77.88	1.508	0.777	1.488				
19.59	1.560	0.839	1.534				
4.85	1.595	0.880	1.578				

Notes:

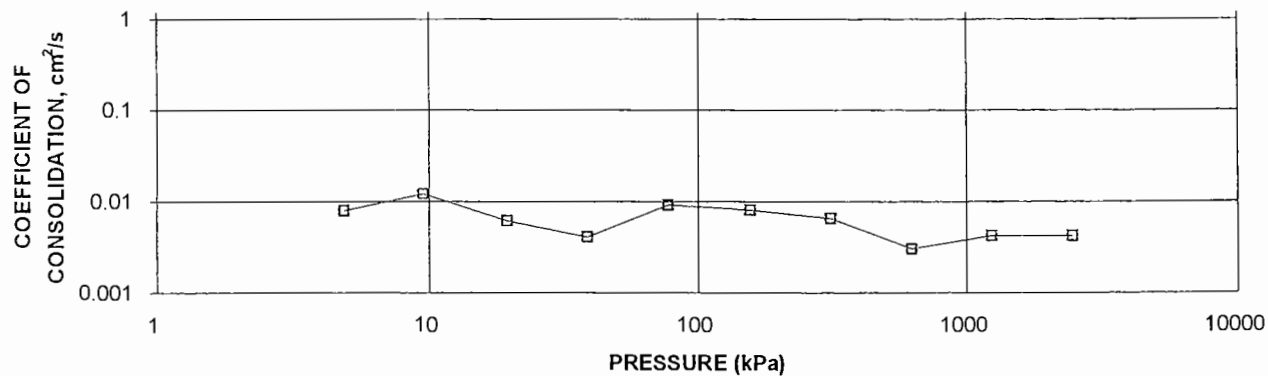
k calculated using cv based on t<sub>90</sub> values.

### SAMPLE DIMENSIONS AND PROPERTIES - FINAL

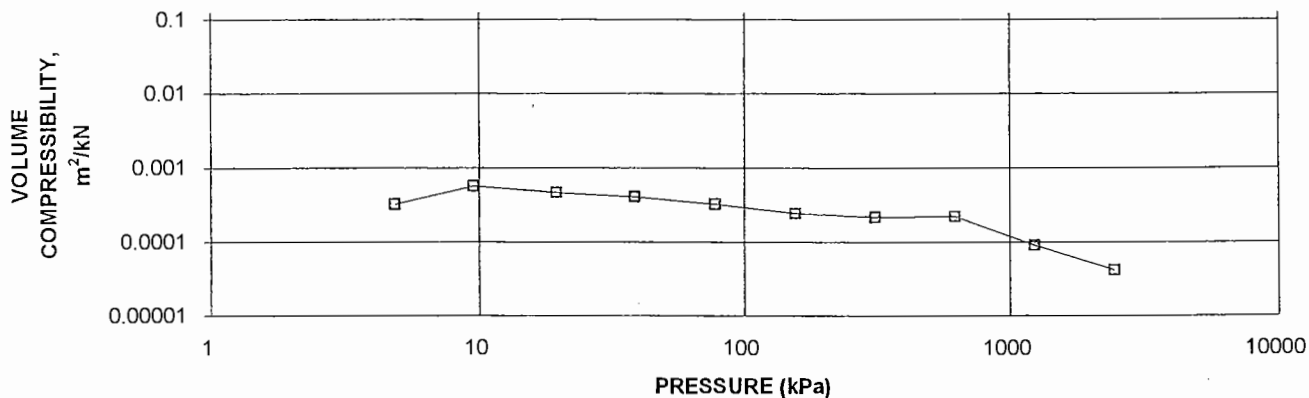
Sample Height, cm	1.60	Unit Weight, kN/m <sup>3</sup>	19.53
Sample Diameter, cm	6.35	Dry Unit Weight, kN/m <sup>3</sup>	14.35
Area, cm <sup>2</sup>	31.67	Specific Gravity, measured	2.75
Volume, cm <sup>3</sup>	50.51	Solids Height, cm	0.848
Water Content, %	36.11	Volume of Solids, cm <sup>3</sup>	26.87
Wet Mass, g	100.57	Volume of Voids, cm <sup>3</sup>	23.64
Dry Mass, g	73.89		

# OEDOMETER CONSOLIDATION SUMMARY

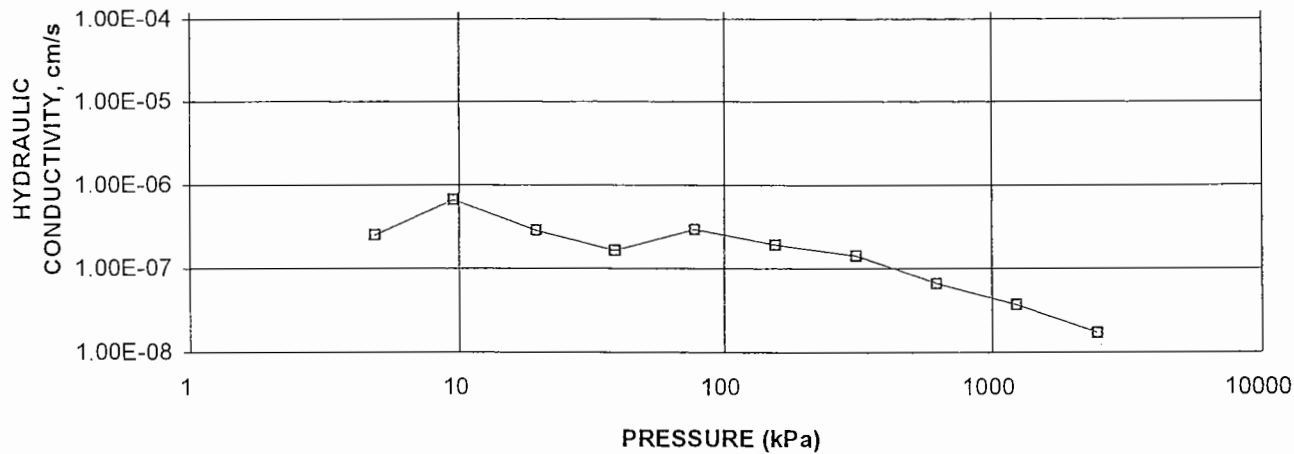
CONSOLIDATION TEST  
CV cm<sup>2</sup>/s VS PRESSURE (kPa)  
SA 122N-8



CONSOLIDATION TEST  
MV m<sup>2</sup>/kN vs PRESSURE (kPa)  
SA 122N-8

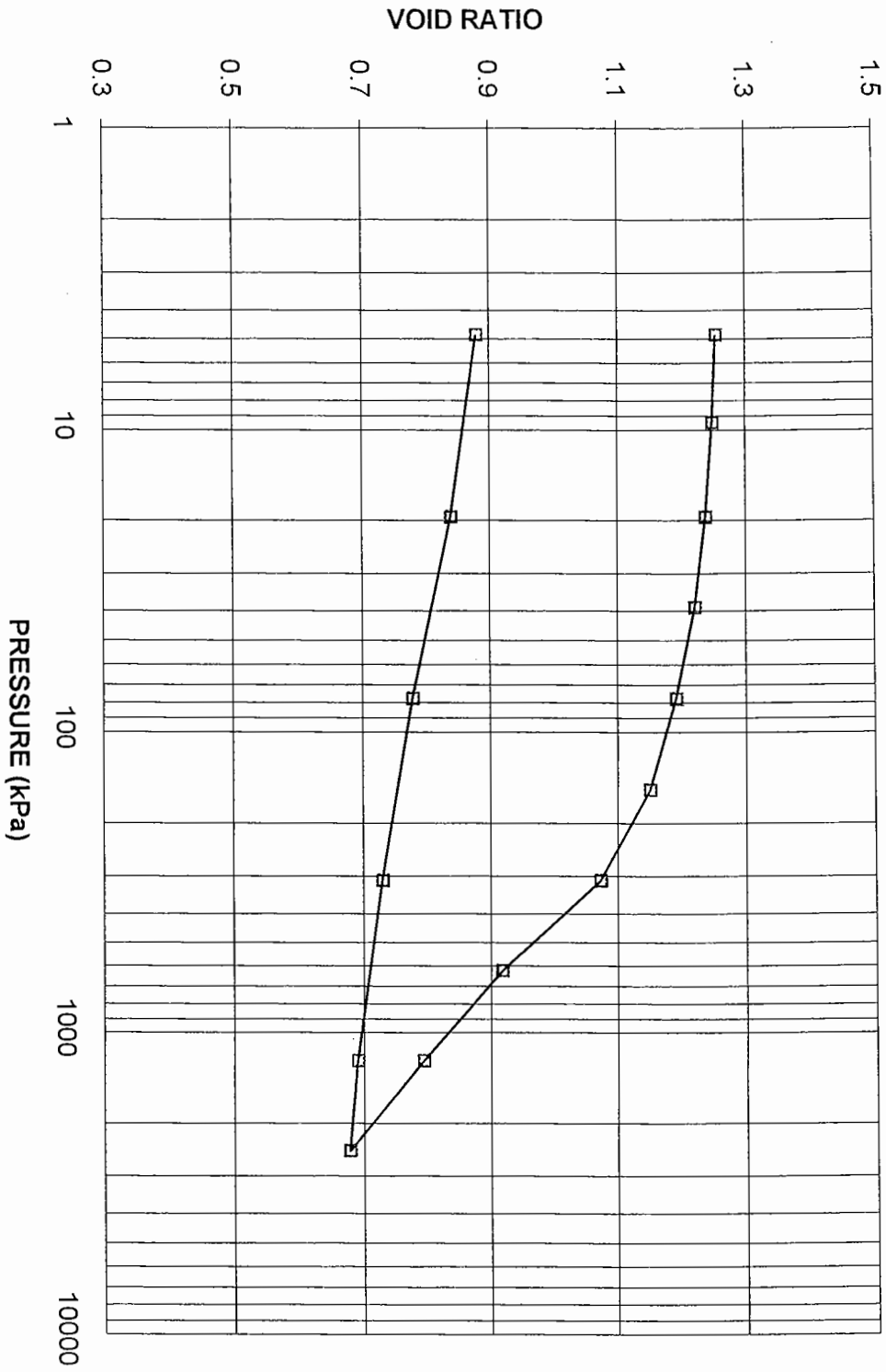


CONSOLIDATION TEST  
HYDRAULIC CONDUCTIVITY vs PRESSURE  
SA 122N-8





CONSOLIDATION TEST  
VOID RATIO vs PRESSURE  
SA 122N-8



CONSOLIDATION TEST  
VOID RATIO vs. LOG PRESSURE

FIGURE

## **Appendix C**

### **Data From Previous Investigation**

# RECORD OF BOREHOLE No M1

1 OF 4

METRIC

W.P. 314-99-00

LOCATION Magnetawan River Bridge NBL, South Crossing Co-ords: N 5 047 506.7; E 316 747.4

ORIGINATED BY G.I

DIST 52 HWY 11

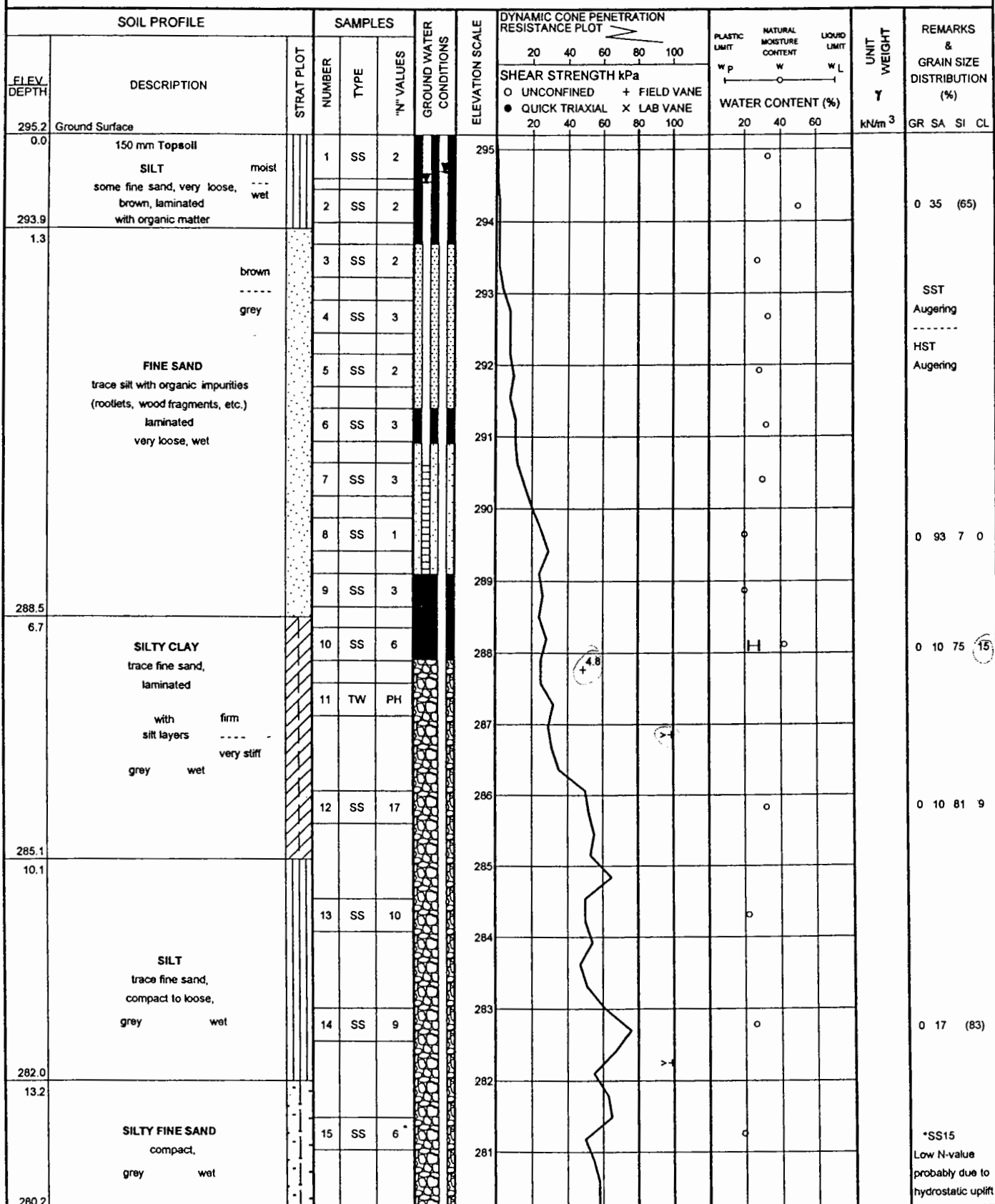
BOREHOLE TYPE Solid Stem and Hollow Stem Augering, Washboring, NQ Rock Coring & D.C.P.T.

COMPILED BY G.T

DATUM Geodetic

DATE 27.03.01 to 30.03.01

CHECKED BY LSR



15.0

Continued Next Page

+ 3, x 3: Numbers refer to Sensitivity

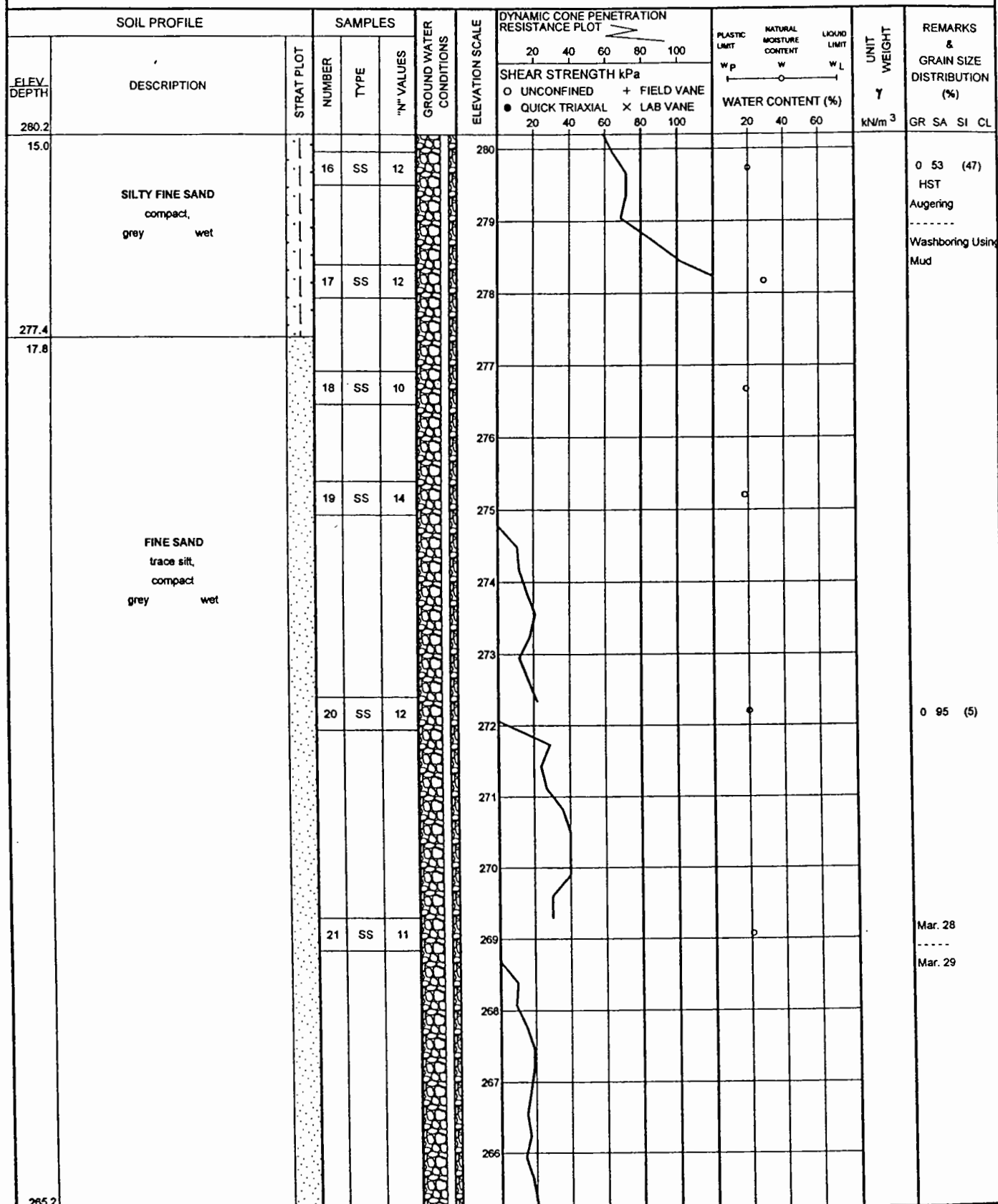
20  
15  
10  
(%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No M1

2 OF 4

METRIC

W.P. 314-99-00 LOCATION Magnetawan River Bridge NBL, South Crossing Co-ords: N 5 047 506.7; E 316 747.4 ORIGINATED BY G.I.  
DIST 52 HWY 11 BOREHOLE TYPE Solid Stem and Hollow Stem Augering, Washboring, NQ Rock Coring & D.C.P.T. COMPILED BY G.T.  
DATUM Geodetic DATE 27.03.01 to 30.03.01 CHECKED BY LSR



30.0

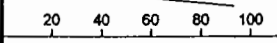

Continued Next Page

+ 3 . X 3 : Numbers refer to  
Sensitivity 20  
15 10 5  
(%) STRAIN AT FAILURE

## 3 OF 4

METRIC

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to Sensitivity

RECORD OF BOREHOLE No M1										4 OF 4		METRIC																					
W.P. 314-99-00		LOCATION Magnetawan River Bridge, NBL South Crossing Co-ords: N 5 047 506.7; E 316 747.4				ORIGINATED BY G.I																											
DIST 52 HWY 11		BOREHOLE TYPE Solid Stem and Hollow Stem Augering, Washboring, NQ Rock Coring & D.C.P.T.				COMPILED BY G.T																											
DATUM Geodetic		DATE 27.03.01 to 30.03.01				CHECKED BY LSR																											
SOIL PROFILE			SAMPLES			DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC NATURAL LIQUID LIMIT MOISTURE CONTENT			UNIT WEIGHT		REMARKS & GRAIN SIZE DISTRIBUTION (%)																			
ELEV. DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE							UNIT WEIGHT γ kN/m <sup>3</sup>	GR SA SI CL																		
	Piezometers installed on March 30/2001 Shallow piezometer to 6.1 m Deep piezometer to 39.6 m Ground water readings in piezometers:  <table border="1" style="margin-left: 20px;"> <thead> <tr> <th>DATE</th> <th>SHALLOW</th> <th>DEEP</th> </tr> </thead> <tbody> <tr><td>02.04.01</td><td>1.1 m</td><td>0.65 m</td></tr> <tr><td>04.04.01</td><td>1.0 m</td><td>0.60 m</td></tr> <tr><td>06.04.01</td><td>1.1 m</td><td>0.60 m</td></tr> <tr><td>09.04.01</td><td>0.8 m</td><td>0.60 m</td></tr> <tr><td>11.04.01</td><td>0.65 m</td><td>0.50 m</td></tr> </tbody> </table> D.C.P.T. from 0 to 17.2 m depth performed on 27.03.01, at 2 m W from Borehole M1 D.C.P.T. performed between samples: SS 19 and SS 20 (20.4 to 22.9 m) SS 20 and SS 21 (23.2 to 25.9 m) SS 21 and SS 22 (26.5 to 30.5 m) SS 22 and SS 23 (31.1 to 35.1 m) SS 23 and SS 24 (35.7 to 39.6 m) SS 24 and SS 25 (40.2 to 41.4 m) SS 25 and SS 26 (41.1 to 41.9 m) SS 26 and SS 27 (42.8 to 43.4 m) Stratigraphy inferred only D.C.P.T. performed after SS 27 (44.5 to 44.7 m)	DATE	SHALLOW	DEEP	02.04.01	1.1 m	0.65 m	04.04.01	1.0 m	0.60 m	06.04.01	1.1 m	0.60 m	09.04.01	0.8 m	0.60 m	11.04.01	0.65 m	0.50 m														
DATE	SHALLOW	DEEP																															
02.04.01	1.1 m	0.65 m																															
04.04.01	1.0 m	0.60 m																															
06.04.01	1.1 m	0.60 m																															
09.04.01	0.8 m	0.60 m																															
11.04.01	0.65 m	0.50 m																															

RECORD OF BOREHOLE No M2										1 OF 3		METRIC			
W.P. 314-99-00		LOCATION Magnetawan River Bridge NBL, South Crossing Co-ords: N 5 047 563.5; E 316 703.7				ORIGINATED BY G.I									
DIST 52 HWY 11		BOREHOLE TYPE Hollow Stem Augering, Washboring, NQ Rock Coring & D.C.P.T.				COMPILED BY G.T									
DATUM Geodetic		DATE 03.04.01 to 09.04.01				CHECKED BY Z.O									
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 (%)	
FLYV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa							WATER CONTENT (%)
297.2	Ground Surface						20	40	60	80	100	20	40	60	
0.0	300 mm Topsoil		1	SS	18										
	SILT some fine sand, laminated compact with occasional loose layers		2	SS	27										
	damp to moist		3	SS	14										
	----- wet		4	SS	13										
	brown		5	SS	6										
	-----		6	SS	10										0 9 84 7
	grey		7	SS	10										0 12 79 9
			8	SS	12										
			9	SS	11										0 7 84 9
			10	TW	PH									20.3	
			11	SS	13										0 8 83 9
288.6															
8.6			12	SS	7										0 7 58 35
	SILTY CLAY trace fine sand, occasional laminated zones firm to stiff grey wet		13	TW	PH										
			14	SS	4										0 13 52 35
			15	SS	8										
			16	SS	6										
282.2															
15.0															Apr. 3 ----- Apr. 5

Continued Next Page

+ 3, x 3: Numbers refer to  
Sensitivity

20  
15 Φ 5  
10 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No M2										2 OF 3		METRIC				
W.P. 314-99-00		LOCATION Magnetawan River Bridge NBL, South Crossing Co-ords: N 5 047 563.5; E 316 703.7				ORIGINATED BY G.I										
DIST 52 HWY 11		BOREHOLE TYPE Hollow Stem Augering, Washboring, NQ Rock Coring & D.C.P.T.				COMPILED BY G.T										
DATUM Geodetic		DATE 03.04.01 to 09.04.01				CHECKED BY Z.O										
SOIL PROFILE			SAMPLES			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	GROUND WATER CONDITIONS	ELEVATION SCALE	SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL X LAB VANE	W <sub>P</sub>	W	W <sub>L</sub>	γ	GR	SA	SI	CL
282.2																
15.0	SILTY CLAY trace fine sand, laminated, with clayey silt layers, stiff to very stiff, grey wet		17	SS	16		282									
							281	2.1								
			18	SS	19		280									
							279									
			19	SS	22		278									
277.2							277									
20.0	SILTY FINE SAND compact, grey wet		20	SS	22		276									
							275									
							274									
							273									
							272									
							271									
							270									
269.5			21	SS	21		269									
27.7	GRAVELLY SAND compact grey wet						268									
267.2																
30.0																

Continued Next Page

+ 3, X 3: Numbers refer to Sensitivity 20 15 10 5 10 (%) STRAIN AT FAILURE



RECORD OF BOREHOLE No M2										3 OF 3	METRIC				
W.P. 314-99-00		LOCATION Magnetawan River Bridge NBL, South Crossing Co-ords: N 5 047 563.5; E 316 703.7				ORIGINATED BY G.I									
DIST 52 HWY 11		BOREHOLE TYPE Hollow Stem Augering, Washboring, NQ Rock Coring & D.C.P.T.				COMPILED BY G.T									
DATUM Geodetic		DATE 03.04.01 to 06.04.01				CHECKED BY Z.O									
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			20	40	60					
267.2															
30.0	GRAVELLY SAND compact														Apr. 5 ---- Apr. 6  After Sample 24 last D.C.P.T. began at El. 265.8 m Blows: 60 41 17 63 100/20
266.4	grey wet														
30.8	SANDY GRAVEL with BOULDERS cobbles and boulders very dense, grey wet		22	NQ	-										
264.9			24	SS	FIELD										
32.3	End of borehole		24	NQ	-										
264.3															
32.9	<p>End of Dynamic Cone Penetration Test</p> <p>Piezometers installed on April 6, 2001</p> <p>Shallow piezometer to 6.1 m</p> <p>Deep piezometer to 27.4 m</p> <p>Ground water readings in piezometers:</p> <p>DATE SHALLOW DEEP</p> <p>11.04.01 2.2 m 3.9 m</p> <p>D.C.P.T. from 0 to 19.1 m depth performed on 03.04.01, at 2 m E of Borehole M2</p> <p>D.C.P.T. performed between samples SS20 and SS21 (21.9 m to 27.4 m) stratigraphy inferred only</p>														

+<sup>3</sup> × 3: Numbers refer to Sensitivity

20  
15  
10  
(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No M3										1 OF 1		METRIC		
W.P. 314-99-00		LOCATION Magnetawan River Bridge NBL, South Crossing Co-ords: N 5 047 486.8; E 316 753.0				ORIGINATED BY G.I								
DIST 52 HWY 11		BOREHOLE TYPE Hollow Stem Augering				COMPILED BY G.T								
DATUM Geodetic		DATE 02.04.01				CHECKED BY LSR								
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV. DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						WATER CONTENT (%)
294.9	Ground Surface						20 40 60 80 100 ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE				PLASTIC LIMIT W <sub>p</sub> NATURAL MOISTURE CONTENT W LIQUID LIMIT W <sub>L</sub>			
0.0	80 mm Topsoil		1	SS	2									
	brown													
	grey		2	SS	1									0 52 48 0
	SILTY FINE SAND													
	very loose to loose		3	SS	6									
	wet													
	traces of organic matter		4	SS	7									
			5	SS	5									0 52 (48)
291.2														
3.7	SILTY CLAY		6	SS	5									0 13 67 20
	trace fine sand,													
	laminated													
	firm to stiff		7	TW	PH									
289.7	grey wet													
5.2			8	SS	8									0 9 84 7
	SILT													
	some fine sand,		9	SS	6									0 16 77 7
	laminated,													
	loose													
	grey wet		10	SS	3*									0 9 88 3
286.3														
8.6	SILTY FINE SAND													* SS10 & 11
	loose, grey, wet													Low N-value
285.3			11	SS	1*									probably due to
														hydrostatic
														uplift
9.6	End of borehole													
	Ground water not stabilized													
	on completion of boring.													
	**Ground water level estimated													
	from moisture condition of soil													
	samples													

RECORD OF BOREHOLE No M4

1 OF 1

METRIC

W.P. 314-99-00 LOCATION Magnetawan River Bridge NBL, South Crossing, Co-ords: N 5 047 582.5; E 316 698.6 ORIGINATED BY G.I  
DIST 52 HWY 11 BOREHOLE TYPE Hollow Stem Augering COMPILED BY G.T  
DATUM Geodetic DATE 09.04.01 & 10.04.01 CHECKED BY LSR

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 (%)
FILE DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	20 40 60 80 100	20 40 60 80 100	20 40 60 80 100		
299.6	Ground Surface												
0.0	300 mm Topsoil		1	SS	3		299						
	very loose damp												
	SILT		2	SS	15		298						0 32 68 0
	some fine sand, laminated, with fine sand layers												
	wet compact						297						Ground water not stabilized on completion of boring.
	loose to very loose		3	SS	6		296						*Ground water estimated from moisture condition of soil samples
	brown						295						
	grey		4	SS	4		294						
			5	SS	6		293						
							292						0 13 (87)
			6	SS	14		291						
			7	SS	15		290						
289.6													
10.0							289						Apr. 09
	SILTY CLAY		8	SS	9		288						Apr. 10
	trace fine sand, with silt layers												
	grey wet												
	stiff		9	SS	5		287						0 9 63 28
	firm												
			10	TW	PH		286						
			11	SS	5								0 12 52 36
285.1													
14.5	End of borehole												

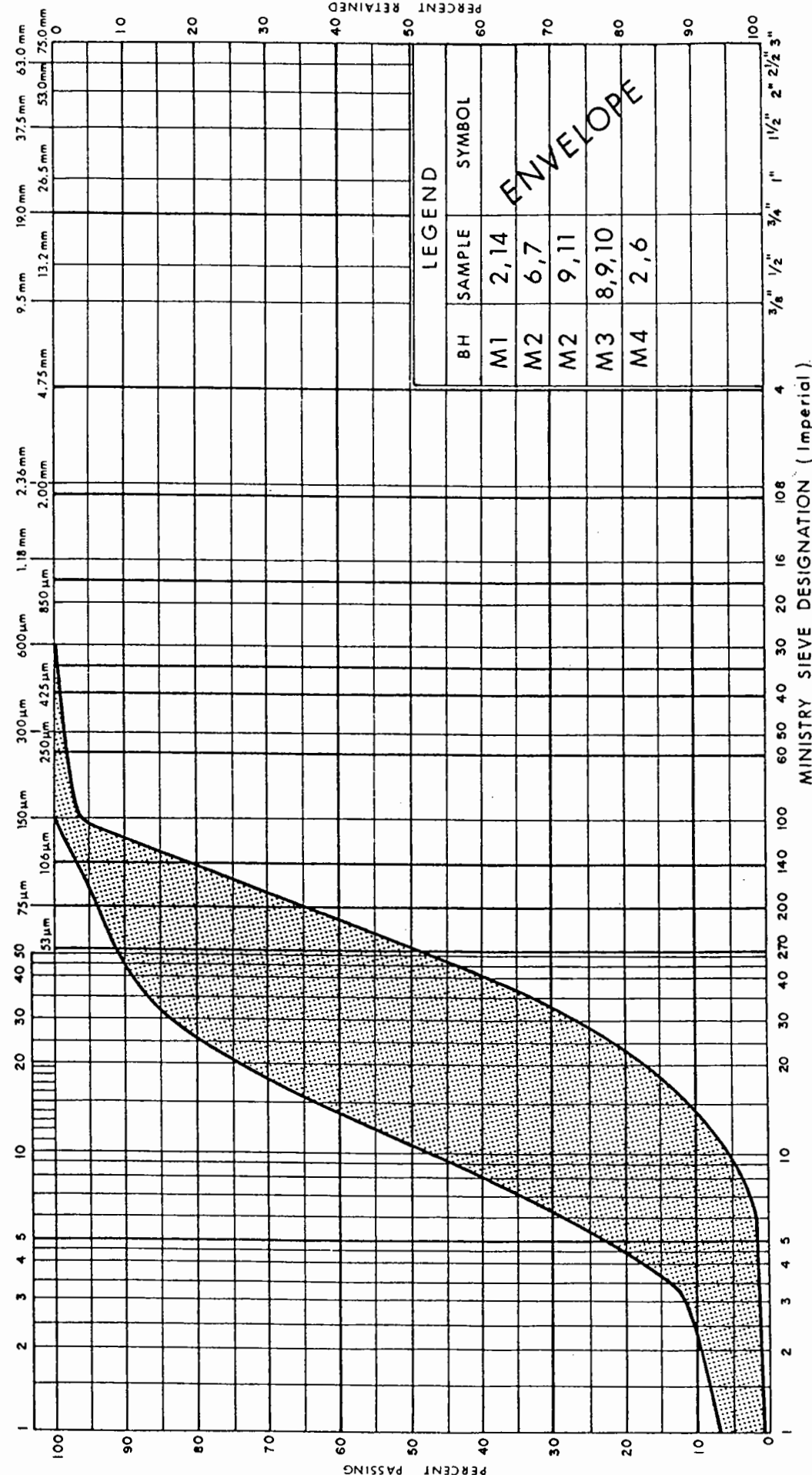
+ 3, x 3: Numbers refer to Sensitivity 20 15 10 5 10 (%) STRAIN AT FAILURE

# UNIFIED SOIL CLASSIFICATION SYSTEM

CLAY & SILT		SAND			GRAVEL		
		Fine	Medium	Coarse	Fine	Coarse	

GRAIN SIZE IN MICROMETERS

MINISTRY SIEVE DESIGNATION (Metric)



## GRAIN SIZE DISTRIBUTION

SILT, SOME FINE SAND

Ministry of  
Transportation



FIG No 1

W P 314-99-00

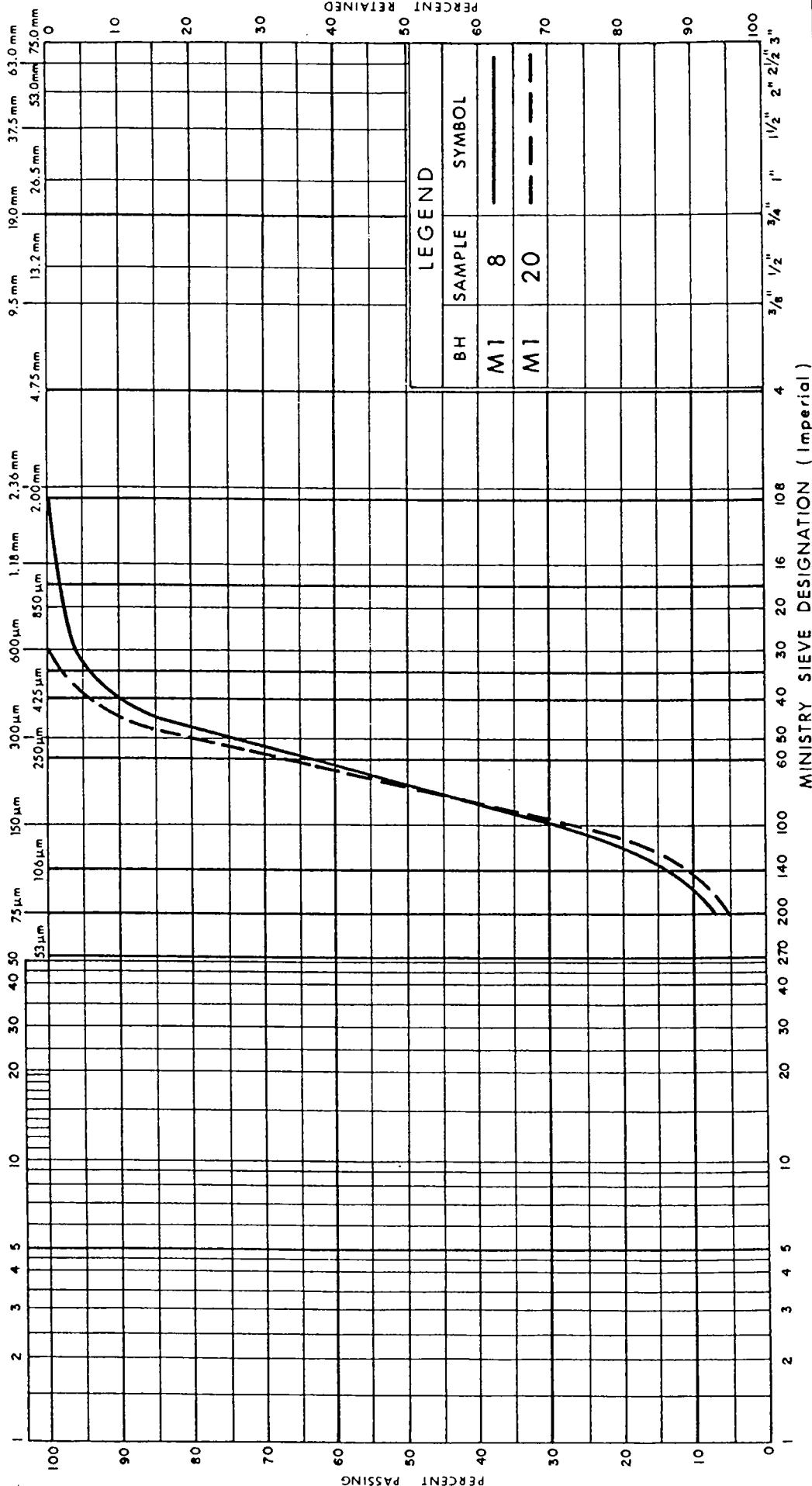
SPT 1010A1

# UNIFIED SOIL CLASSIFICATION SYSTEM

CLAY & SILT		SAND			GRAVEL		
		Fine	Medium	Coarse	Fine	Coarse	

GRAIN SIZE IN MICROMETERS

MINISTRY SIEVE DESIGNATION (Metric)



## GRAIN SIZE DISTRIBUTION

FINE SAND, TRACE SILT

FIG No 2

W P 314-99-00

SPT 1010A1

Ministry of  
Transportation



Ontario

# UNIFIED SOIL CLASSIFICATION SYSTEM

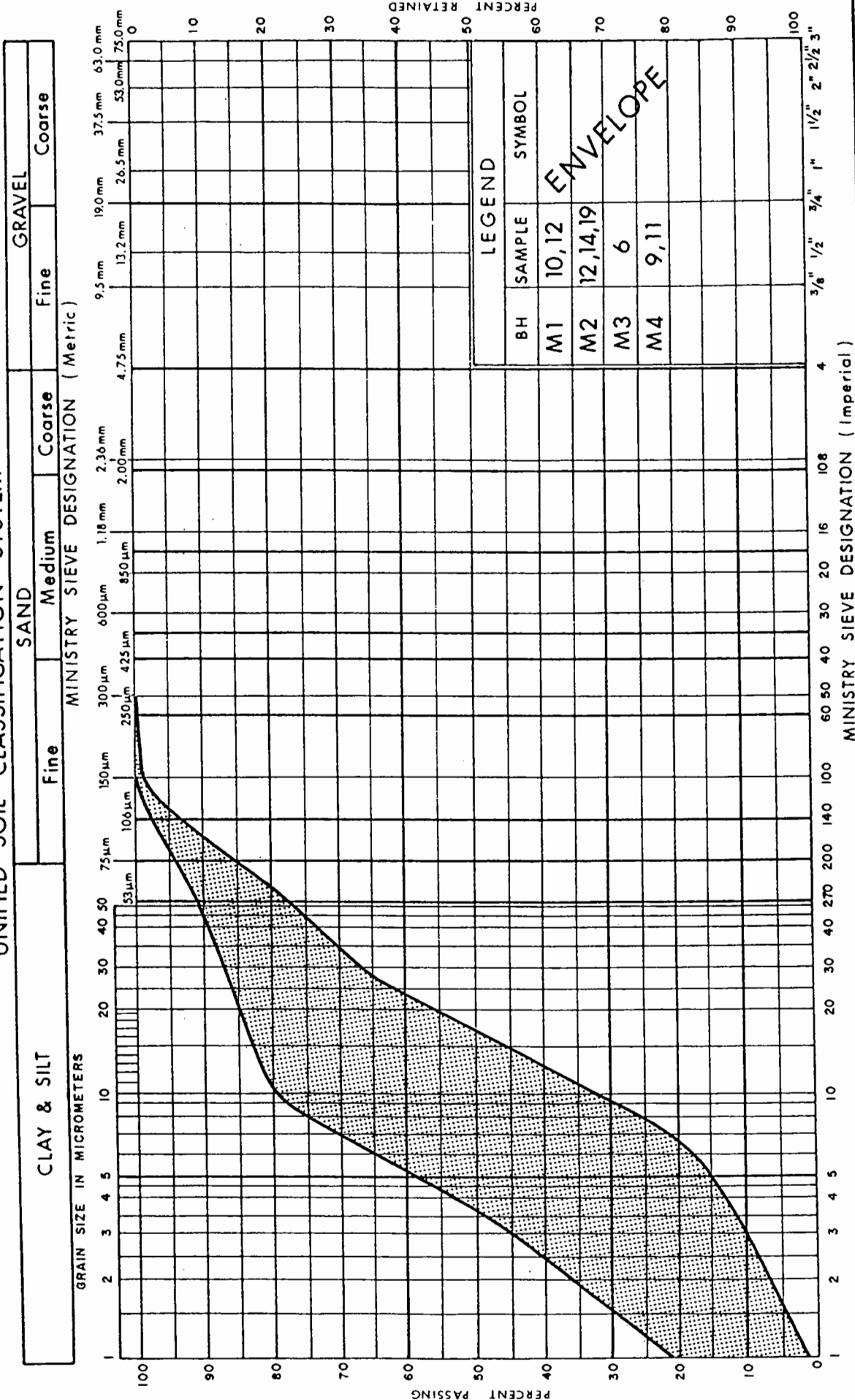
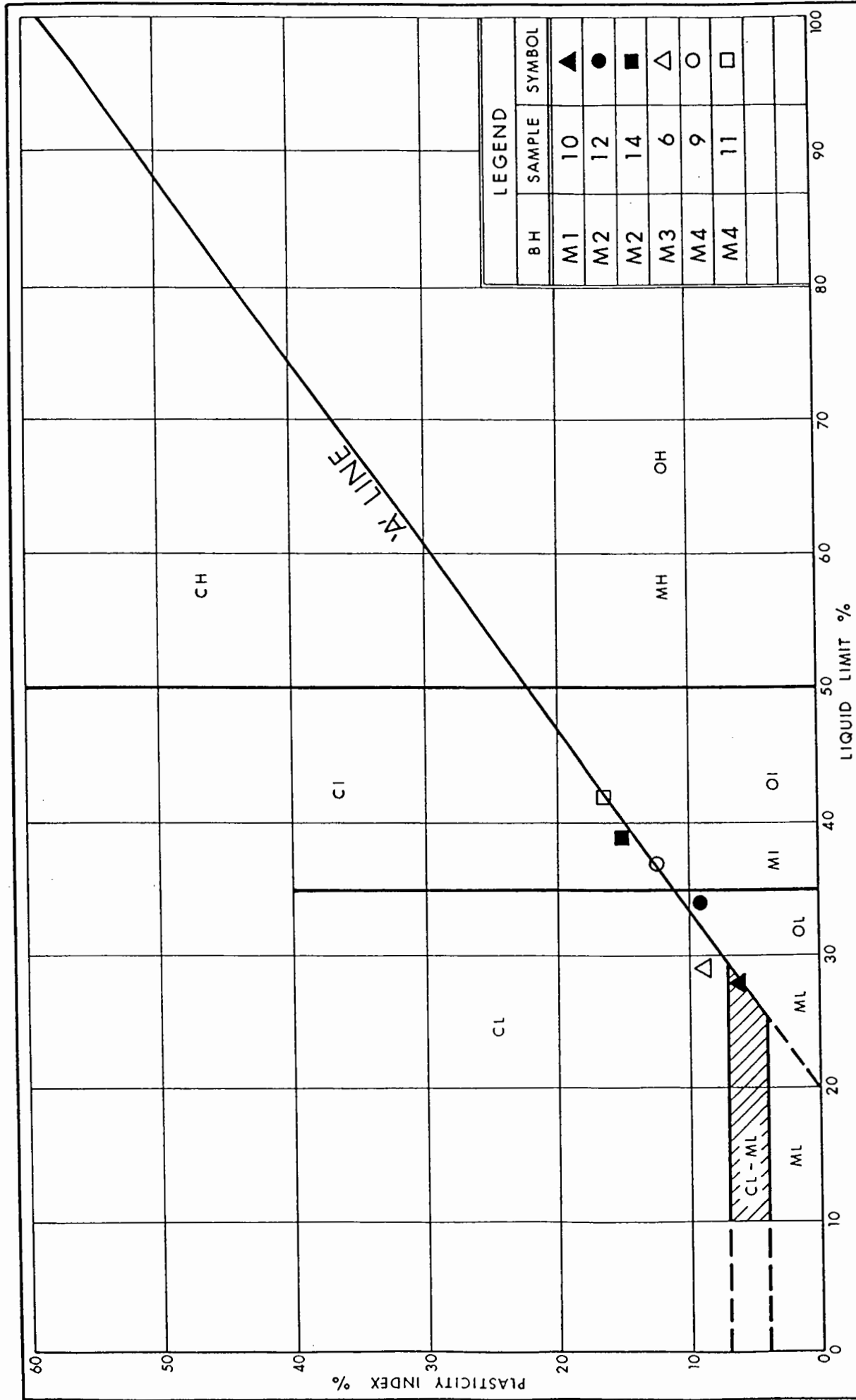


FIG No 3  
GRAIN SIZE DISTRIBUTION  
SILTY CLAY, TRACE FINE SAND

Oct 75, FF-S-21



# PLASTICITY CHART

SILTY CLAY, TRACE FINE SAND

FIG No 4

W P 314-99-00

SPT 1010A1

Ministry of  
Transportation



# UNIFIED SOIL CLASSIFICATION SYSTEM

CLAY & SILT			SAND			GRAVEL		
GRAIN SIZE IN MICROMETERS			Fine	Medium	Coarse	Fine	Coarse	
MINISTRY SIEVE DESIGNATION (Metric)			MINISTRY SIEVE DESIGNATION (Imperial)					

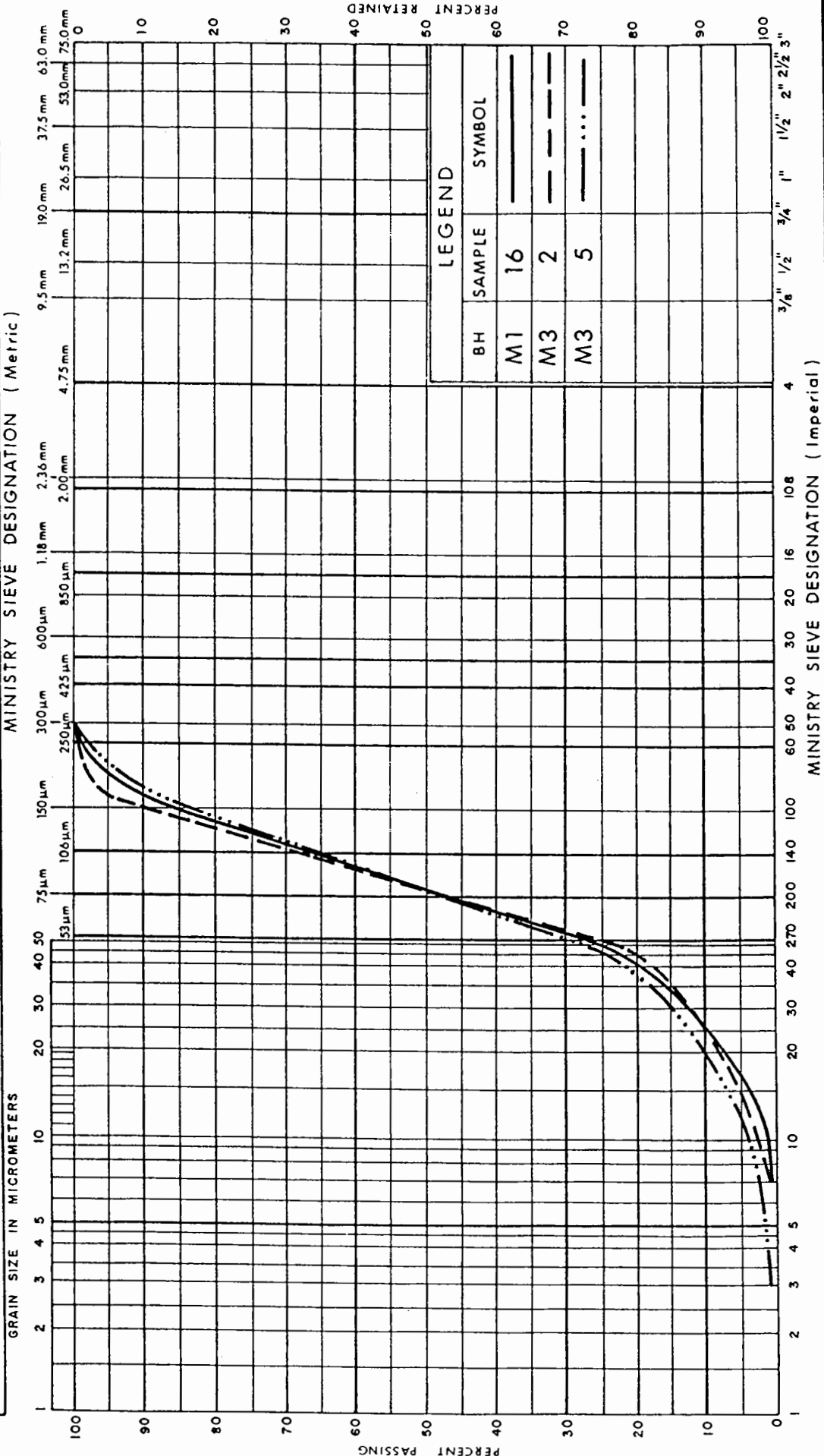


FIG No 5  
W P 314-99-00  
SPT 1010A1

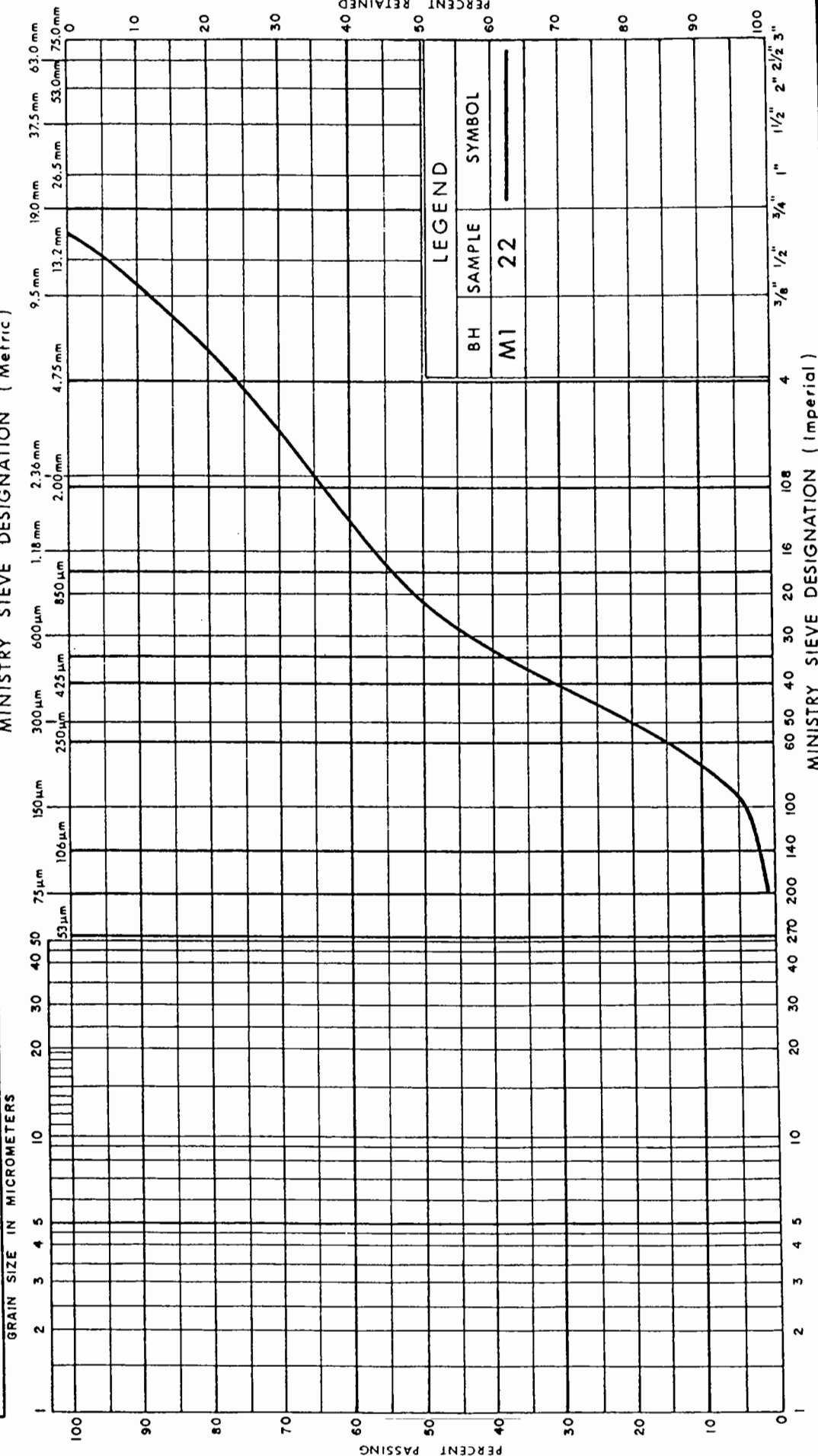
## GRAIN SIZE DISTRIBUTION SILTY FINE SAND



# UNIFIED SOIL CLASSIFICATION SYSTEM

CLAY & SILT		SAND			GRAVEL	
		Fine	Medium	Coarse	Fine	Coarse

MINISTRY SIEVE DESIGNATION (Metric)



## GRAIN SIZE DISTRIBUTION GRAVELLY SAND

FIG No 6

W P 314-99-00

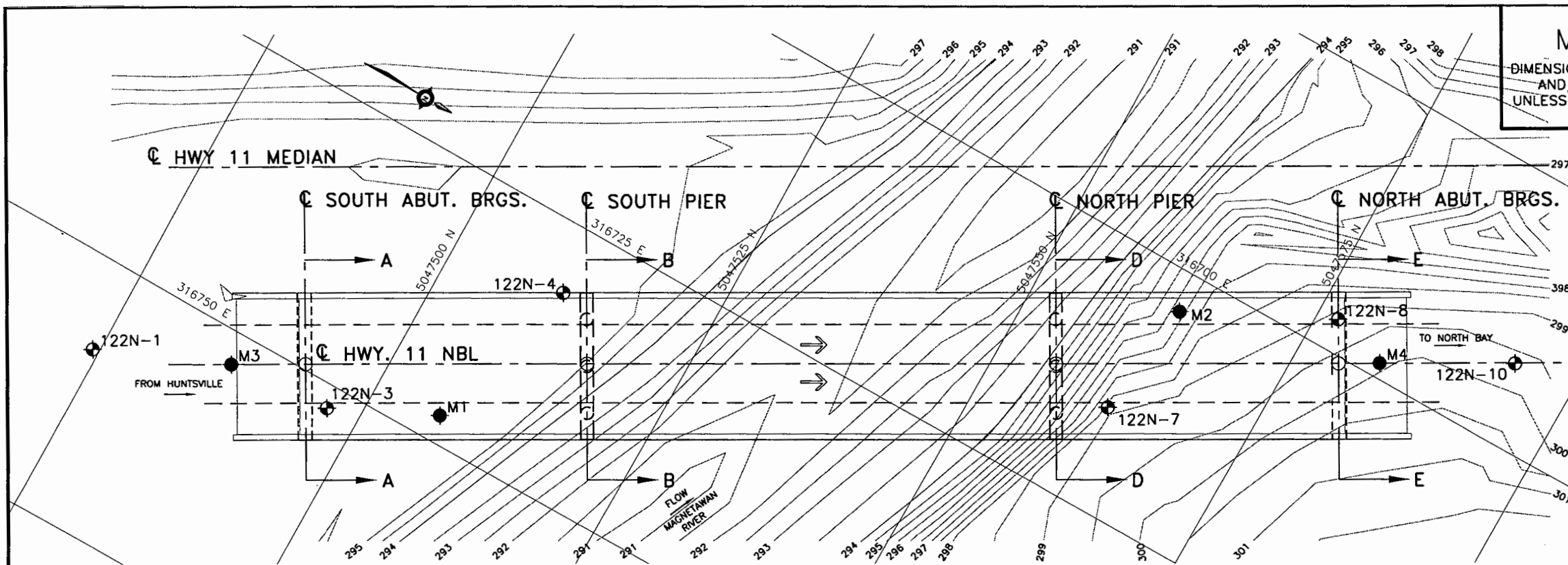
SPT 1010A1

Ministry of  
Transportation

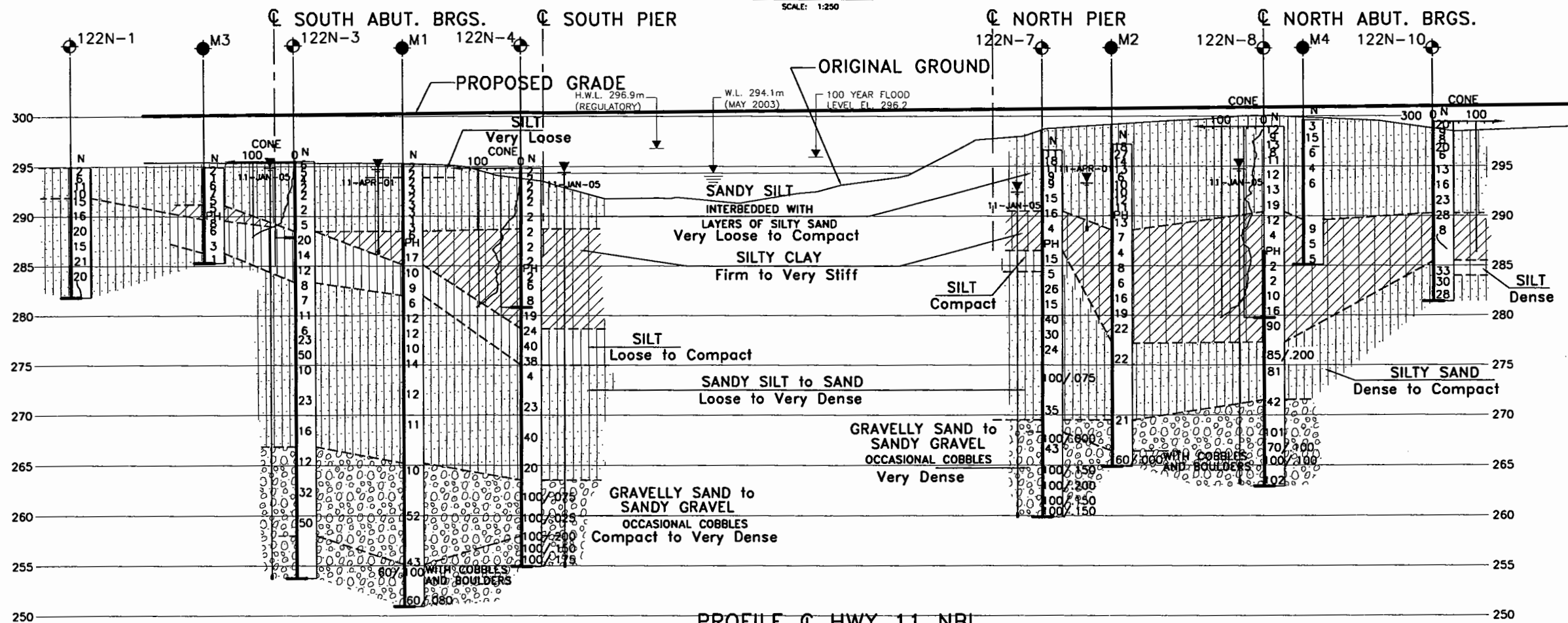


## **Appendix D**

### **Drawings**



PLAN  
SCALE: 1:250



PROFILE  $\perp$  HWY 11 NBL

SCALE: 1:250

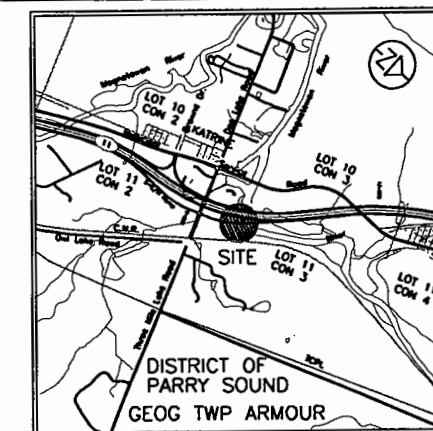
METRIC  
DIMENSIONS ARE IN METRES  
AND/OR MILLIMETRES  
UNLESS OTHERWISE SHOWN

HWY 11  
CONT No  
WP No 474-93-01

MAGNETAWAN RIVER  
SOUTH CROSSING NBL  
GENERAL ARRANGEMENT

**Marshall Macklin Monaghan**  
PROJECT MANAGERS • ENGINEERS • SURVEYORS • PLANNERS

**THURBER ENGINEERING LTD.**  
THURBER



KEY PLAN

SCALE: 1:500

### LEGEND

- $\odot$  Bore Hole by THURBER
- $\oplus$  Dynamic Cone Penetration Test (cone)
- $\bullet$  Bore Hole by SHAHEEN & PEAKER LIMITED
- N Blows /0.3m (Std Pen Test, 475J/blow)
- CONE Blows /0.3m (60° Cone, 475J/blow)
- PH Pressure, Hydraulic
- WL Head Artesian Water
- $\uparrow$  Piezometer
- 90% Rock Quality Designation (RQD)

NO	ELEVATION	NORTHING	EASTING
122N-1	294.9	5047474.4	316758.4
122N-3	295.9	5047496.8	316752.2
122N-4	294.8	5047511.2	316731.3
122N-7	296.6	5047562.0	316715.1
122N-8	299.0	5047577.0	316696.9
122N-10	299.4	5047594.0	316692.2
M1	295.2	5047506.7	316747.4
M2	297.2	5047563.5	316703.7
M3	294.9	5047486.8	316753.0
M4	299.6	5047582.5	316698.6

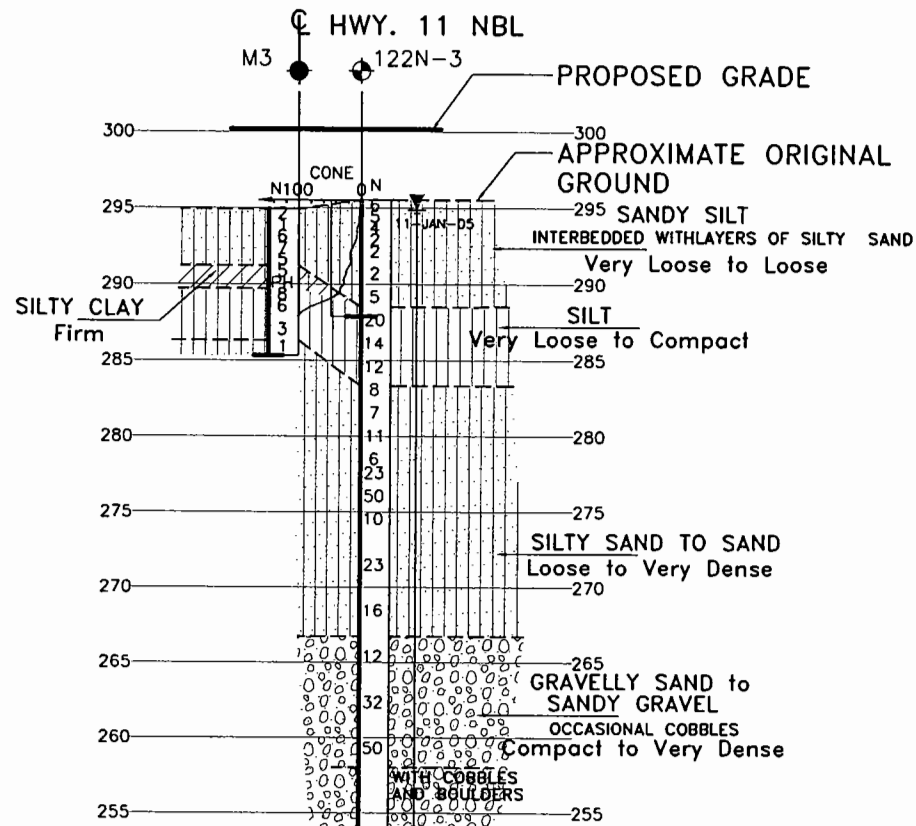
### NOTE

The boundaries between soil strata have been established only at Bore Hole locations. Between Bore Holes the boundaries are assumed from geological evidence.

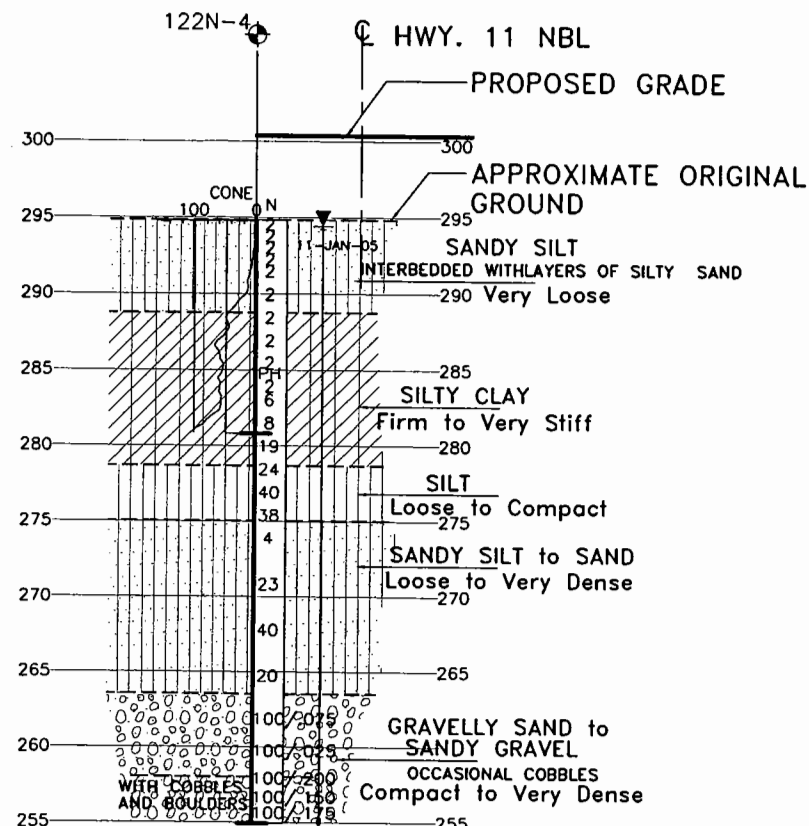
VCP : HCP No. 112  
EL. 298.289  
19mm  $\times$  1.52m IRON BAR  
2.3 LT 2.9km N OF HWY 518  
24.9 LT STA: 11+177.031

DRAWING NOT TO BE SCALED  
100 mm ON ORIGINAL DRAWING

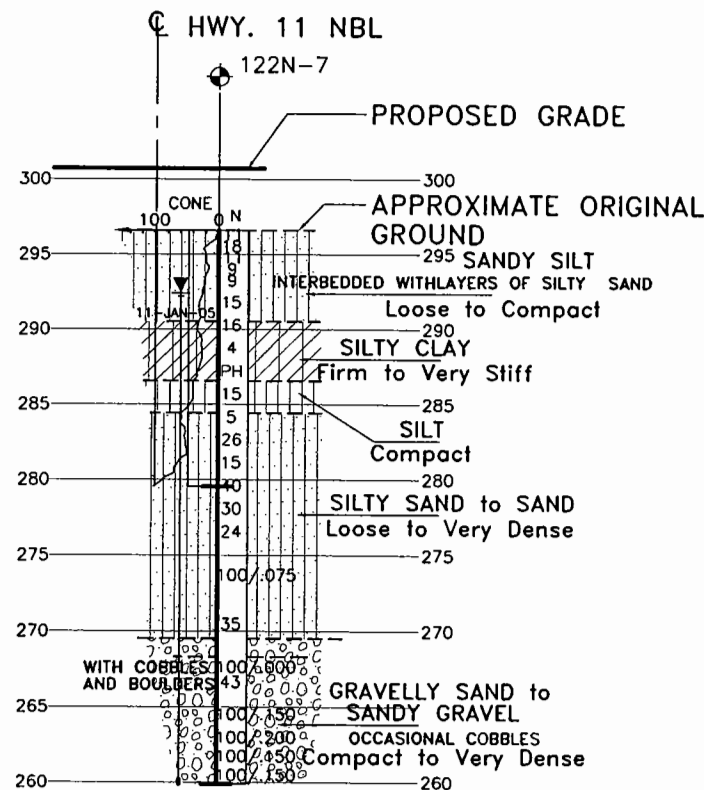
REVISIONS	DATE	BY	DESCRIPTION
DESIGN	CHK		CODE CHBDC 2000[LOAD CL-625-OM]DATE
DRAWN	CHK		SITE 44-122N[STRUCT.] SCHEME DWG



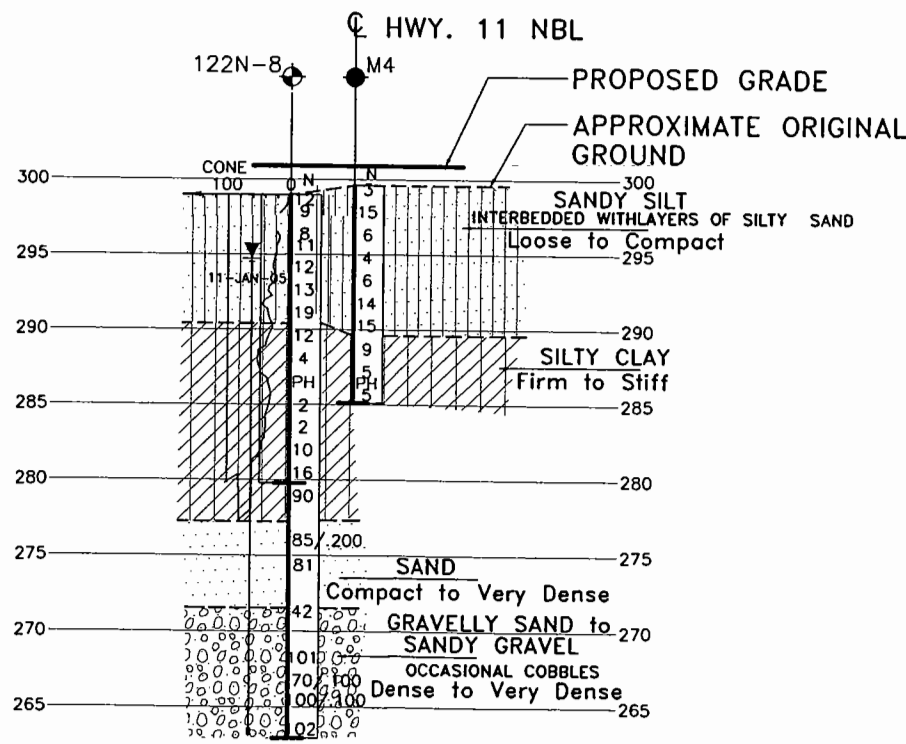
SECTION A-A  
SCALE: 1:250



SECTION B-B  
SCALE: 1:250



SECTION C-C  
SCALE: 1:250



SECTION D-D  
SCALE: 1:250

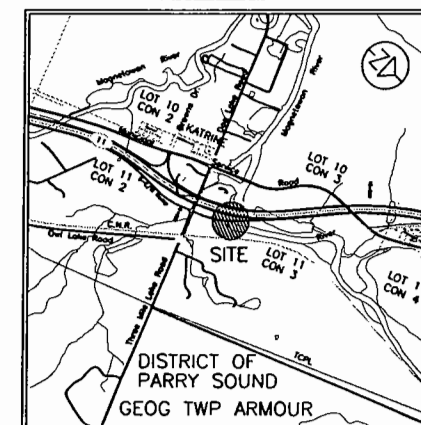
METRIC  
DIMENSIONS ARE IN METRES  
AND/OR MILLIMETRES  
UNLESS OTHERWISE SHOWN

HWY 11  
CONT No  
WP No 474-93-01

MAGNETAWAN RIVER  
SOUTH CROSSING NBL  
GENERAL ARRANGEMENT

**Marshall Macklin Monaghan**  
PROJECT MANAGERS • ENGINEERS • SURVEYORS • PLANNERS

**THURBER ENGINEERING LTD.**  
THURBER



KEY PLAN

0 500m 1km

# LEGEND

- BoreHole by THURBER
- Dynamic Cone Penetration Test (cone)
- BoreHole by SHAHEEN & PEAKER LIMITED
- N Blows /0.3m (Std Pen Test, 475J/blow)
- CONE Blows /0.3m (60° Cone, 475J/blow)
- PH Pressure, Hydraulic
- WL Head Artesian Water
- Piezometer
- 90% Rock Quality Designation (ROD)

NO	ELEVATION	NORTHING	EASTING
122N-1	294.9	5047474.4	316758.4
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122N-7	296.6	5047562.0	316715.1
122N-8	299.0	5047577.0	316696.9
122N-10	299.4	5047594.0	316692.2
M1	295.2	5047506.7	316747.4
M2	297.2	5047563.5	316703.7
M3	294.9	5047486.8	316753.0
M4	299.6	5047582.5	316698.6

## NOTE

The boundaries between soil strata have been established only at Bore Hole locations. Between Bore Holes the boundaries are assumed from geological evidence.

VCP : HCP No. 112  
EL. 298.289  
19mmø x 1.52m IRON BAR  
2.3 LT 2.9km N OF HWY 518  
24.9 LT STA: 11+177.031

DRAWING NOT TO BE SCALED  
100 mm ON ORIGINAL DRAWING

REVISIONS	DATE	BY	DESCRIPTION
DESIGN	CHK	CODE CHBDC 2000	LOAD CL-625-ONT DATE
DRAWN	CHK	SITE 44-122N	STRUCT. SCHEME DWG