

Ministry of Transportation

Northern Region
North Bay, Ontario

Geocres No. 31E-155

Foundation Investigation Report Highway 510 Embankment

WP 301-00-01

FINAL

February 20, 2001



Acres International
Oakville, Ontario, Canada

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Part 1 Foundation Investigations

1 Introduction

Acres International (Acres) was retained by the Ministry of Transportation Ontario (MTO) to undertake foundation investigations and testing, laboratory testing, engineering analysis and preparation of foundation reports for (i) Highway (Hwy) 510 swamp, (ii) Hwy 607A swamp, and 3 sand/salt storage structures located in the Northern Region. The work was authorized by MTO Agreement P.O.5005A000167 dated July 2000.

This report presents the results of foundation investigations for the proposed embankment raising/widening at Highway 510 in Northern Ontario.

2 Site Description

Highway 510 is located west of Highway 11 north of Huntsville and runs south off Highway 124, Figure 1.

Approximately 1 km south of the intersection of Highway 124 and 510, the existing road consists of a low embankment approximately 1200 m long and 9 m wide. The embankment is situated near the west edge of the swamp. The traveled surface of the roadway is about 0.3 m above the water level in the adjacent swamp.

Toward the south end of the embankment, the road stretches over a slight topographic rise south of which it traverses another 200 m of low embankment across the swamp. Bedrock outcrop is visible near the road at both the south and north end of the embankment. It appears that the swamp is contained within a shallow underlying depression.

The main objective of the investigation is to provide information for raising and widening the road embankment to mitigate distortion of the road surface.

3 Investigation Procedures

3.1 Field Investigations

The site investigations were carried out between August 1 and 4, 2000. A total of 38 boreholes, labelled BH-1 to BH-38, were drilled at the locations shown in Figure 1.

The boreholes were advanced to depths ranging from 2.3 to 8.8 m using truck-mounted continuous flight hollow-stem augering and sampling equipment owned and operated by Boart Longyear Inc. of Maple, Ontario. Soil samples were obtained at approximately 0.75 m and 1.5 m intervals using a split spoon sampler in conjunction with Standard Penetration Test (SPT), in accordance with ASTM D1586 designation. SPT 'N' values were recorded and used to provide an assessment of the relative denseness of the cohesionless soils and consistency of cohesive soils. Boreholes were terminated at auger refusal at depths ranging from 1 to 9 metres.

A representative of Acres was present throughout the drilling and sampling operations to monitor and inspect drilling and sampling operations. All soil samples were identified and described in the field, and then transported to Acres Geotechnical Laboratory in Niagara Falls for further detailed examination and laboratory testing.

A summary of borehole data is given in Table 1. Detailed information for each borehole is presented in the Record of Boreholes in Appendix A.

As per MTO guidelines, soil samples were classified according to Unified Soil Classification Systems. The clay content reported as per MTO format in the Record of Boreholes forms is based on grain size less than 0.002 mm.

3.2 Field Survey

Survey of location and ground surface elevation of the boreholes was carried out by Acres. The elevation was referenced to an MTO marker and incorporated into an MTO site plan that was modified to produce Figure 1. Boreholes were located relative to the distance along the embankment south using the MTO's stations and east or west of the centre line.

3.3 Laboratory Testing

Selected samples of the overburden obtained from the boreholes were tested in accordance with applicable ASTM standards, as follows:

- moisture content
- Atterberg index limits
- grain size distribution
- natural unit weight.

Testing was carried out at Acres Geotechnical Laboratory in Niagara Falls and the results are summarized in Table 2 and also included as part of Record of Borehole in Appendix A. The results are presented as follows:

Test	Number of tests	Figure No.
Grain Size	17	4 to 6
Plasticity Chart	9	7

4 Subsurface Conditions

The soils encountered at the site, shown in Figures 2 and 3 comprise granular embankment fill overlying discontinuous, predominantly silty fill. Below the fill is wet loose organic silt with fine sand which contains thin layers of fibrous organic material. This is underlain with a deposit of clayey silt to silty clay (ML-CI) to a resistant level indicated by auger refusal. A discontinuous layer of sandy material was found immediately above refusal in some of the boreholes.

Details of the various soils encountered at the borehole locations, together with the summary of SPT 'N' and CPT and other test results are given in the Record of Boreholes in Appendix A. The water level is at about the same level as the swamp. A brief description of the soils encountered at the site in the order of depth is given below.

4.1 Fill (SW)

The existing granular road base extends from 0.3 to 1.6 m below the existing traveled surface of the roadway, from el 303 to 308 m at ground surface to el 301.8 to 306.8 m. The fill varies from sand to sand and gravel with cobbles.

4.2 Fill (ML - CI)

Underlying the road base, a silt to clayey silt fill was encountered in several boreholes between el 302.9 to 303.6 m immediately underneath the granular embankment fill to el 300.6 to 302.9 m at the top of native ground. This layer was found to be up to 2.4 m in thickness. The material has a high moisture content and is soft to firm, with a on SPT 'N' values ranging from 3 to 12. The material is variable; but is composed predominantly of silt.

4.3 Organic Silt and Fine Sand (SM - OL)

Beneath the embankment, a layer of organic silt with fine sand containing a substantial fraction of organic material represents the original surface of the swamp between el 300.4 and 302.9 m. This layer was encountered in 19 of the 38 boreholes and ranged from 0.1 to 1.6 m thick. Within this material, thin layers of fibrous organic material were encountered. The predominant material in this layer was loose wet sandy silt mixed with decomposed organic debris. These organic materials are weak and compressible.

The moisture content ranged from 28 to 34%; however some samples lost during drilling would have higher moisture. This material is very loose with SPT 'N' values which ranged from 0 to 3. The material consists of predominantly silt and fine sand with a trace of clay. Based on MTO criteria, this material is considered to be highly frost susceptible.

4.4 Clayey Silt to Silty Clay (ML - CI)

A deposit of silty clay to clayey silt was encountered in most boreholes between el 296.3 and 303.1 m with a thickness of 0 to 4.4 m. This material is predominantly silt sized, with typically 14 to 37% clay and a trace to 20% sand. Plasticity index ranges from 12 to 24%. It has a consistency ranging from very soft to firm to stiff, based on SPT 'N' values ranging from 0 to 35. Where this material is

located within the depth of frost penetration, it is likely to be moderately to highly frost susceptible.

The very soft to soft material was found in the northern portion of the embankment, specifically in Boreholes BH-1, BH-3, HB-7 to BH-9 and BH-14 to BH-16 where N values were 0 to 4. In most of the remaining boreholes, higher N values of 4 to 14 were recorded at the top of the clayey silt indicating a slightly stronger crust overlying the weak soil.

To the south, higher N values were obtained indicating firm to stiff consistency.

4.5 Silty Sand to Sand (SW)

Below the clayey silt to silty clay layer, a discontinuous sandy zone up to 1.3 m thick was encountered in several boreholes immediately above the depth of auger refusal (295 to 299.5 m). This layer is wet and loose to compact with SPT 'N' values ranging from 0 to 30.

4.6 Bedrock

The roadway crosses an assumed bedrock depression inferred from the local topography and rock outcrops. The depth to assumed bedrock ranges from 0.9 m below ground surface at Borehole BH-38 at the south end of embankment to 8.8 m at BH-1 at the north end of the swamp crossing. The elevation of auger refusal (inferred bedrock) ranges from 295 to 303 m.

5 Groundwater Conditions

During drilling, the water level in all boreholes was approximately similar to the water level in the adjacent swamp which was about 0.3 m below the existing surface of the road.

Design and Construction

Information in this report is intended to provide general characterization of ground conditions. Variations in the subsurface should be expected and provided for in detailed engineering and construction practices. Supervision of excavations and backfill should be performed and approved by experienced geotechnical staff familiar with the requirements of design.

I. R. Fleming, P.Eng.



A. H. Tawil, P.Eng.



Tables

Table 1**Summary of Borehole Data**

Borehole	Ground Surface Elevation (m)	Bottom of Borehole (m)	
		Depth	Elevation
BH-1	303.84	8.83	295.01
BH-2	303.83	2.43	301.40
BH-3	303.86	3.65	300.21
BH-4	303.72	4.26	299.46
BH-5	303.43	2.60	300.83
BH-6	303.43	1.73	301.70
BH-7	303.77	4.57	299.20
BH-8	303.59	6.09	297.50
BH-9	303.65	3.30	300.35
BH-10	303.42	2.33	301.01
BH-11	303.25	1.75	301.50
BH-12	303.37	2.28	301.09
BH-13	303.24	2.72	300.52
BH-14	303.51	4.42	299.09
BH-15	303.35	6.25	297.10
BH-16	303.25	4.57	298.68
BH-17	302.77	3.50	299.27
BH-18	303.05	2.74	300.31
BH-19	303.06	2.43	300.63
BH-20	302.92	3.53	299.57

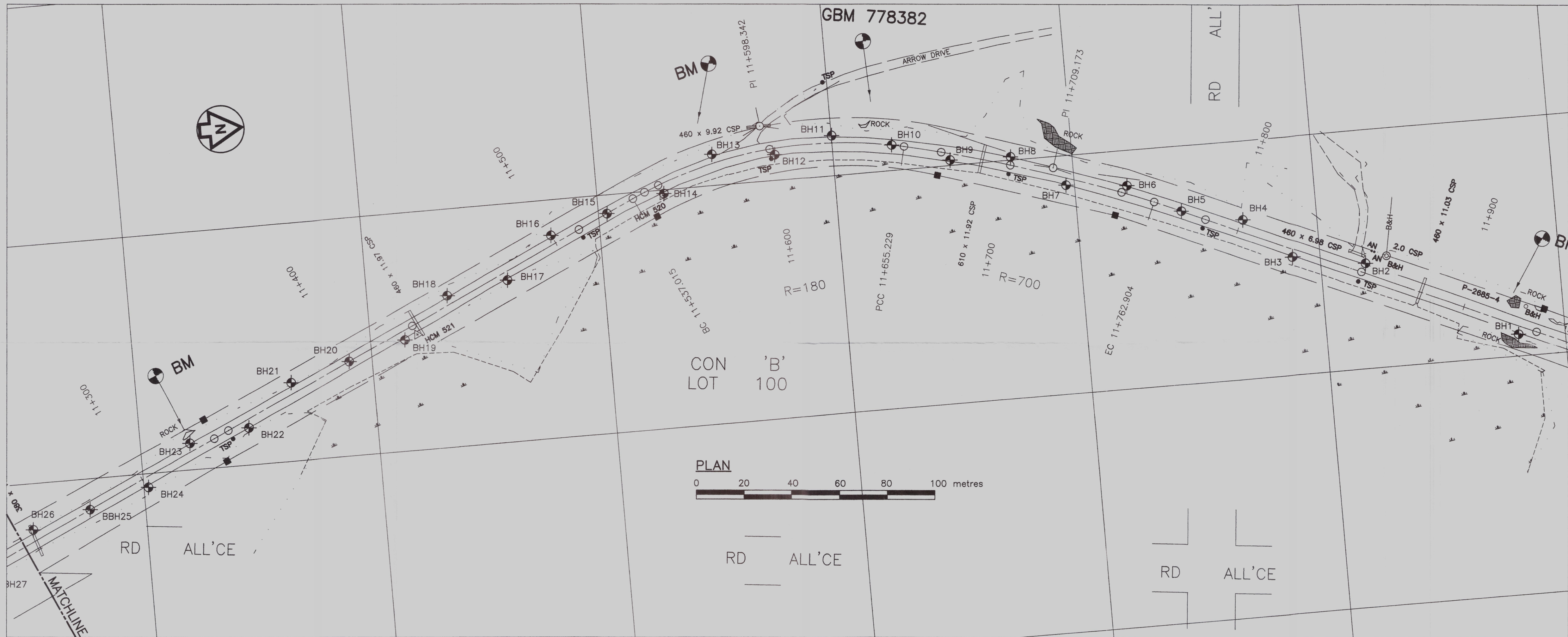
Table 1**Summary of Borehole Data (continued)**

BH-21	303.72	1.83	301.89
BH-22	302.65	4.20	298.45
BH-23	303.67	0.76	302.91
BH-24	303.82	4.80	299.02
BH-25	304.01	5.70	298.31
BH-26	304.11	4.62	299.49
BH-27	304.00	1.52	302.48
BH-28	304.14	4.72	299.42
BH-29	304.19	3.20	300.99
BH-30	303.68	3.35	300.33
BH-31	309.92	1.60	308.32
BH-32	306.39	2.67	303.72
BH-33	305.33	1.37	303.96
BH-34	304.83	5.33	299.50
BH-35	305.16	1.52	303.64
BH-36	307.13	2.28	304.85
BH-37	307.76	2.90	304.86
BH-38	309.56	0.85	308.71

Table 2**Summary of Laboratory Test Results**

Borehole	Depth From-To (m)	Moisture Content (%)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index	Unit Weight (kN/m3)
BH-1	0.61 - 1.22	24.5	41	23	18	
	2.29 - 2.90	33.7				
	6.10 - 6.71	38.2				
	6.86 - 7.47	47.4				
BH-4	1.52 - 2.13	23.5	50	26	24	19.60
	2.28 - 2.90					
	3.05 - 3.66	33.7				
BH-5	1.52 - 2.13	1.7				
BH-7	1.52 - 2.13	19.0				
	2.28 - 2.90	20.5				
BH-9	0.76 - 1.37	20.6	34	21	13	
	1.52 - 2.13	22.3				
	2.28 - 2.74	32.4				
BH-15	3.05 - 3.66	39.3	43	24	19	
	4.57 - 5.18	40.3				
BH-20	1.52 - 2.13	23.3	43	24	19	
	2.28 - 2.90	34.5				
BH-25	2.28 - 2.90	35.1	38	24	14	19.60
	3.05 - 3.66	42.2	39	22	17	
BH-28	3.05 - 3.66	33.9				
BH-30	2.28 - 2.90	35.3	42	24	18	19.00
BH-32	1.52 - 2.13		33	21	12	

Figures



NOTE: BASE PLAN INFORMATION TAKEN FROM
"MINISTRY OF TRANSPORT" DRAWING B-543-510-1

NOTES

LEGEND

BH11 BOREHOLE



KEY PLAN

REV. BY	REV. No.	DESCRIPTION OF REVISION	APPROVED BY	DATE
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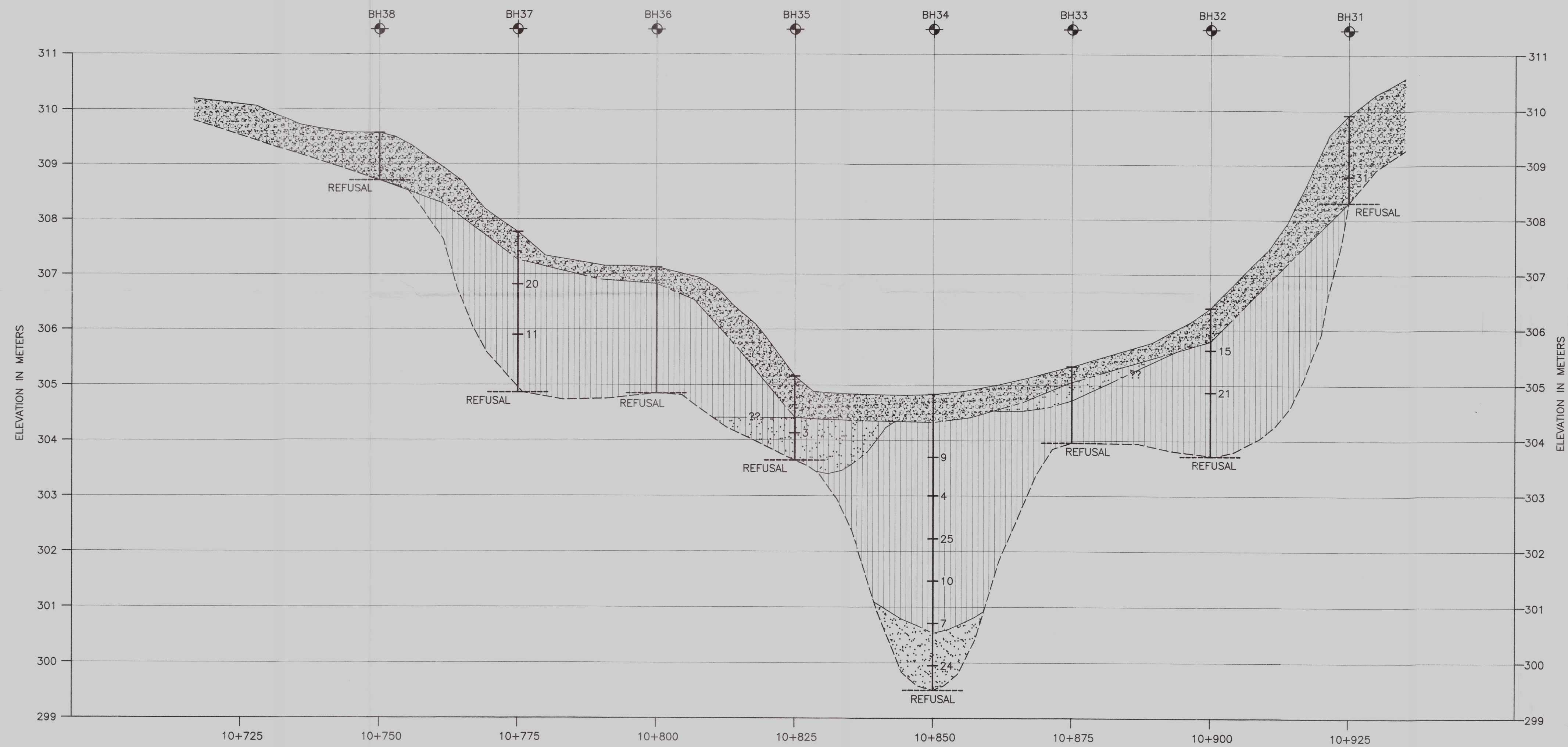
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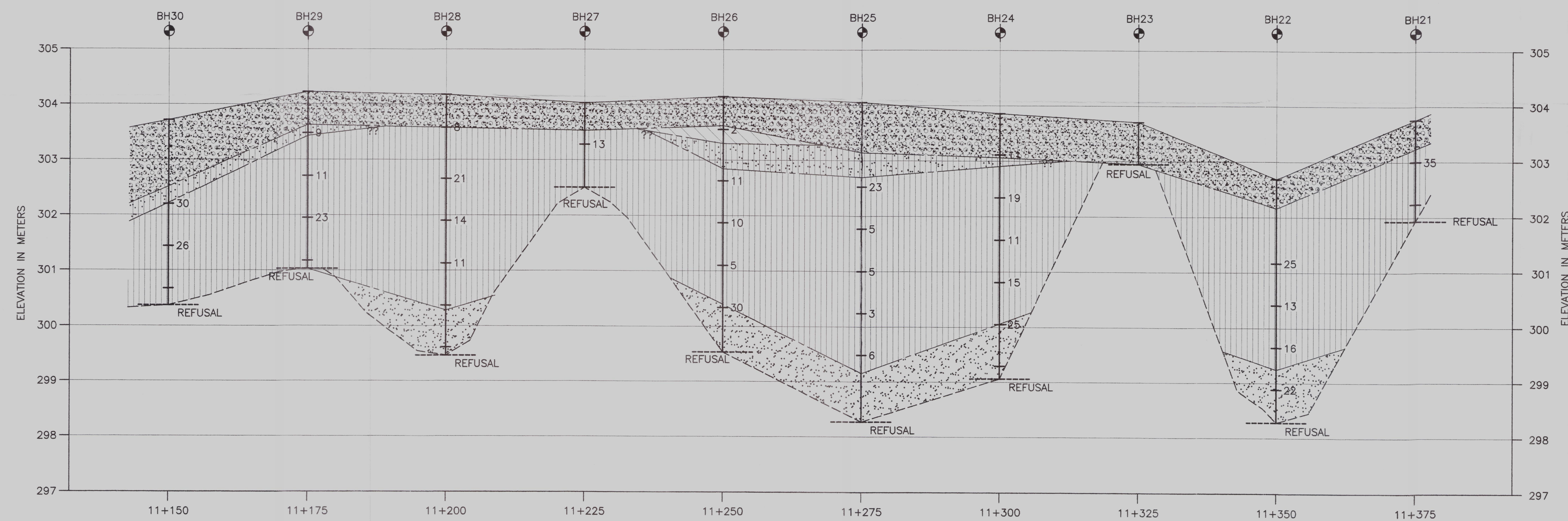
DISTRICT	LOT
PARRY SOUND	CON.
	TWP
	CHAPMAN

PROJECT TITLE	DRAWING DESCRIPTION/TITLE
HIGHWAY 510	FIGURE 1. PLAN LOCATION OF BOREHOLES STA. 10+725 TO 11+950

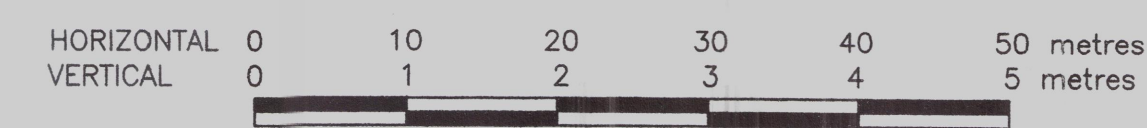
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DESIGNED BY		PROJ. No.	P1349800
CHECKED BY		FILE No.	WP301-00-01
APPROVED BY			



PROFILE FROM STA 10+725 TO STA 10+925

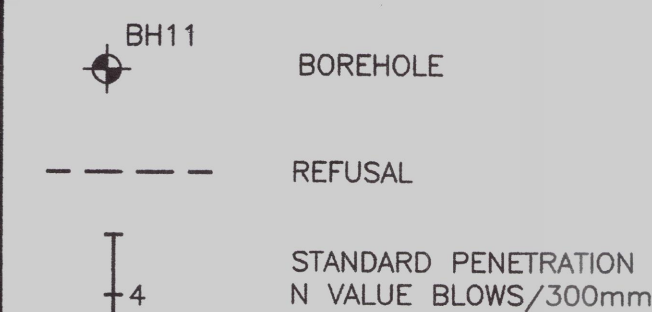
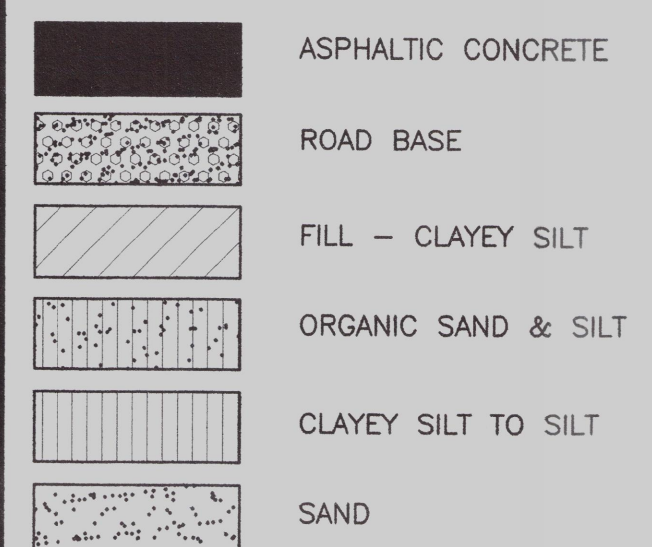


PROFILE FROM STA 11+150 TO STA 11+375

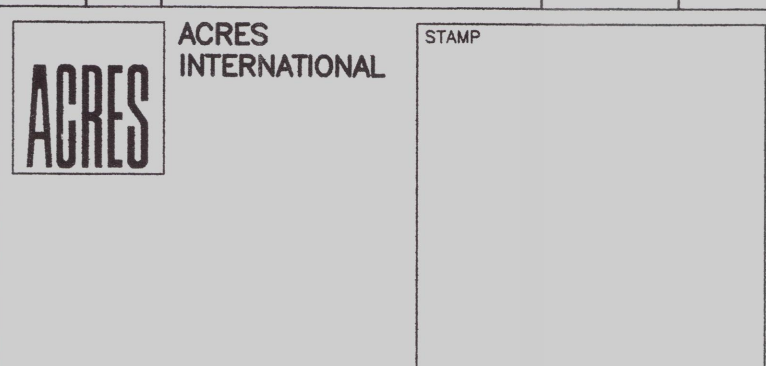


NOTES

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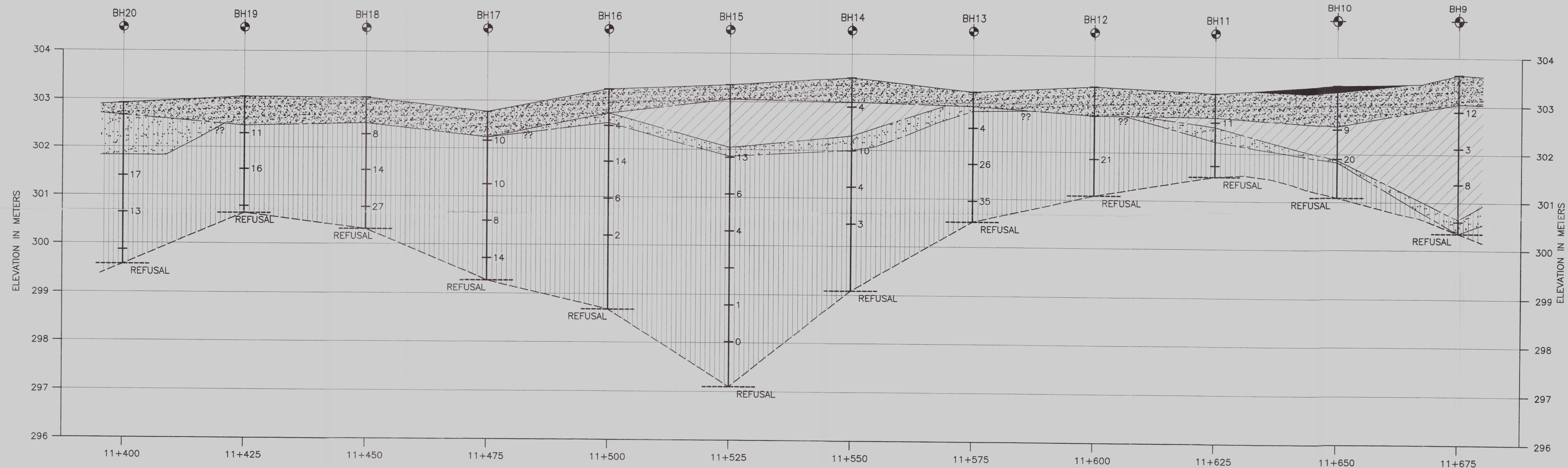
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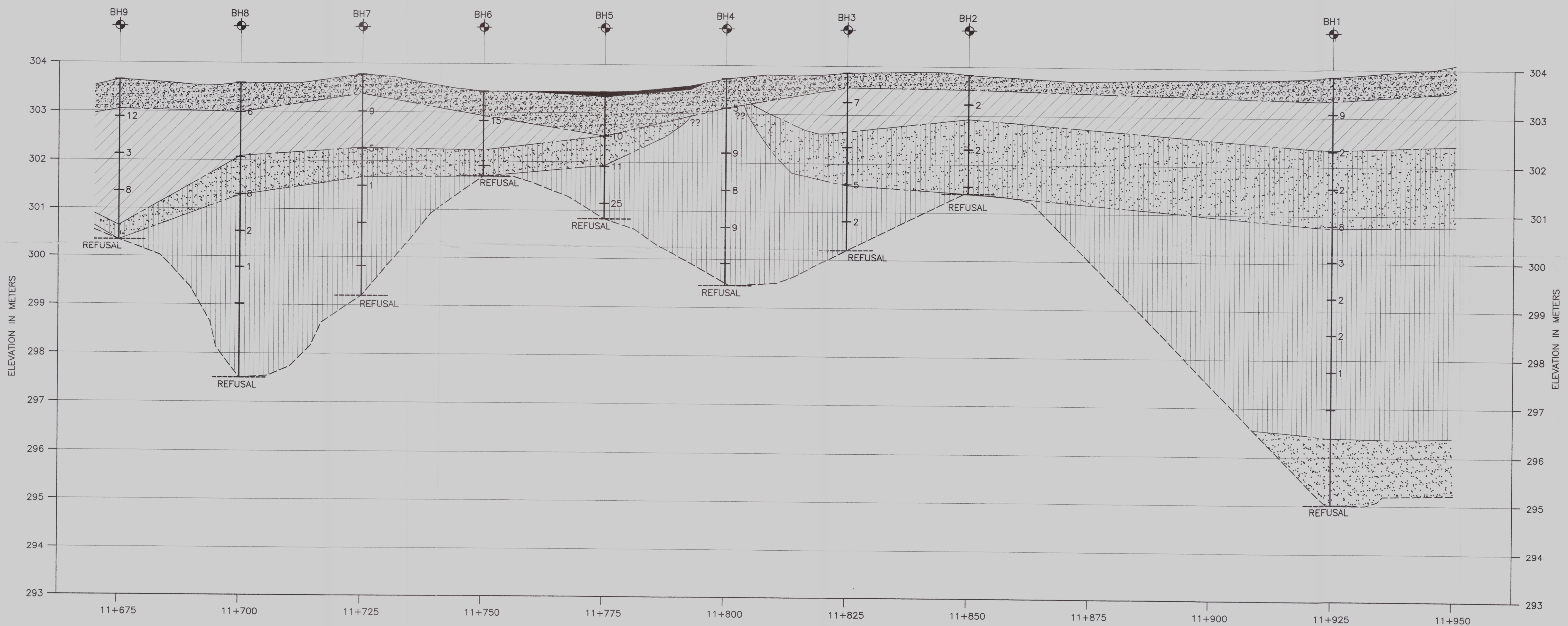
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PARRY SOUND	CON.
	TWP
	CHAPMAN

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HIGHWAY 510	FIGURE 2 SOIL STRATIGRAPHIC SECTIONS LOCATION OF BOREHOLES STA. 10+725 TO 11+375

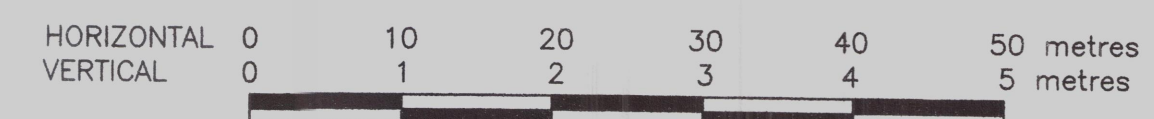
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DRAWN BY	T.DANIEL	DWG. No.	of
DESIGNED BY		PROJ. No.	P1349800
CHECKED BY		FILE No.	WP301-00-01
APPROVED BY			



PROFILE FROM STA 11+400 TO STA 11+675



PROFILE FROM STA 11+675 TO STA 11+950



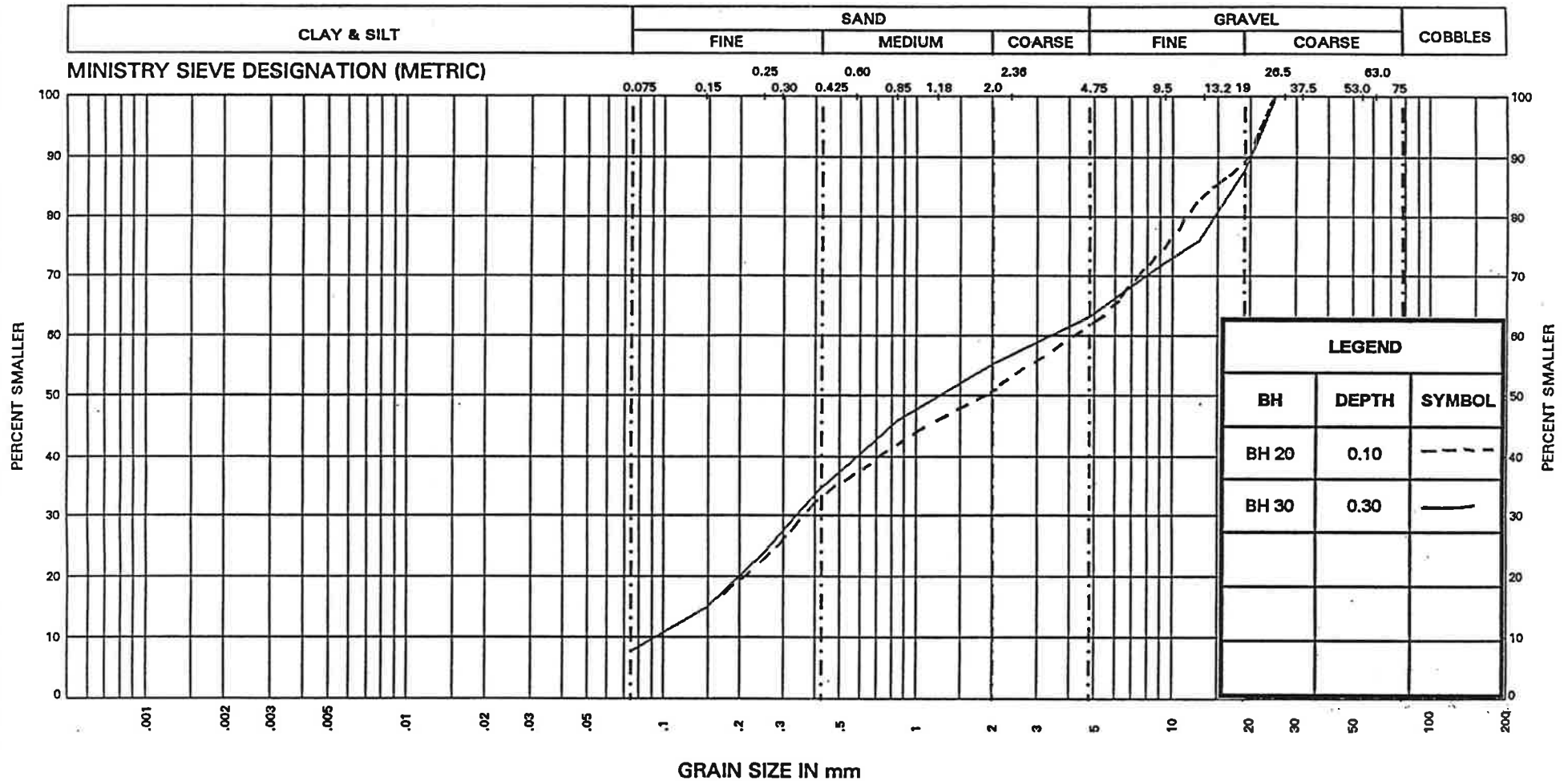
NOTES

LEGEND

- ASPHALTIC CONCRETE
- ROAD BASE
- FILL - CLAYEY SILT
- ORGANIC SAND & SILT
- CLAYEY SILT TO SILT
- SAND
- BH11 BOREHOLE
- REFUSAL
- STANDARD PENETRATION N VALUE BLOWS/300mm

REV. BY	REV. No.	DESCRIPTION OF REVISION	APPROVED BY	DATE
DISTRICT		LOT		
PARRY SOUND		CON.		
		TWP	CHAPMAN	
PROJECT TITLE		DRAWING DESCRIPTION/TITLE		
HIGHWAY 510		FIGURE 3 SOIL STRATIGRAPHIC SECTIONS LOCATION OF BOREHOLES STA. 11+400 TO 11+950		
DATE	FEBRUARY 2001	SCALE	AS NOTED	
DRAWN BY	T.DANIEL	DWG. No.	of	
DESIGNED BY		PROJ. No.	P1349800	
CHECKED BY		FILE No.	WP301-00-01	
APPROVED BY				

UNIFIED SOIL CLASSIFICATION SYSTEM



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Ontario

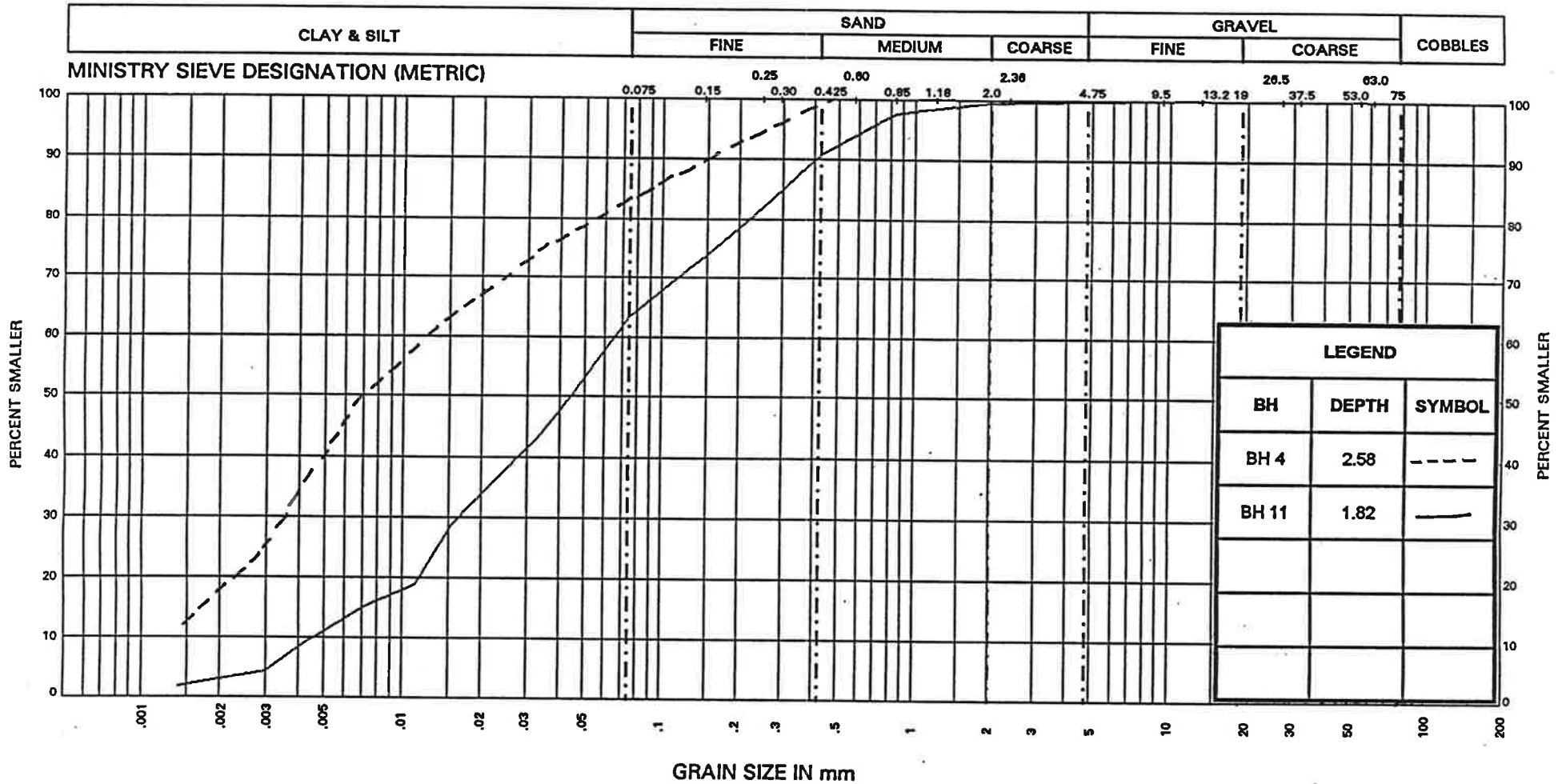
GRAIN SIZE DISTRIBUTION GRAVELLY SAND

FIGURE 4

W.P 301-00-01

HWY 510

UNIFIED SOIL CLASSIFICATION SYSTEM



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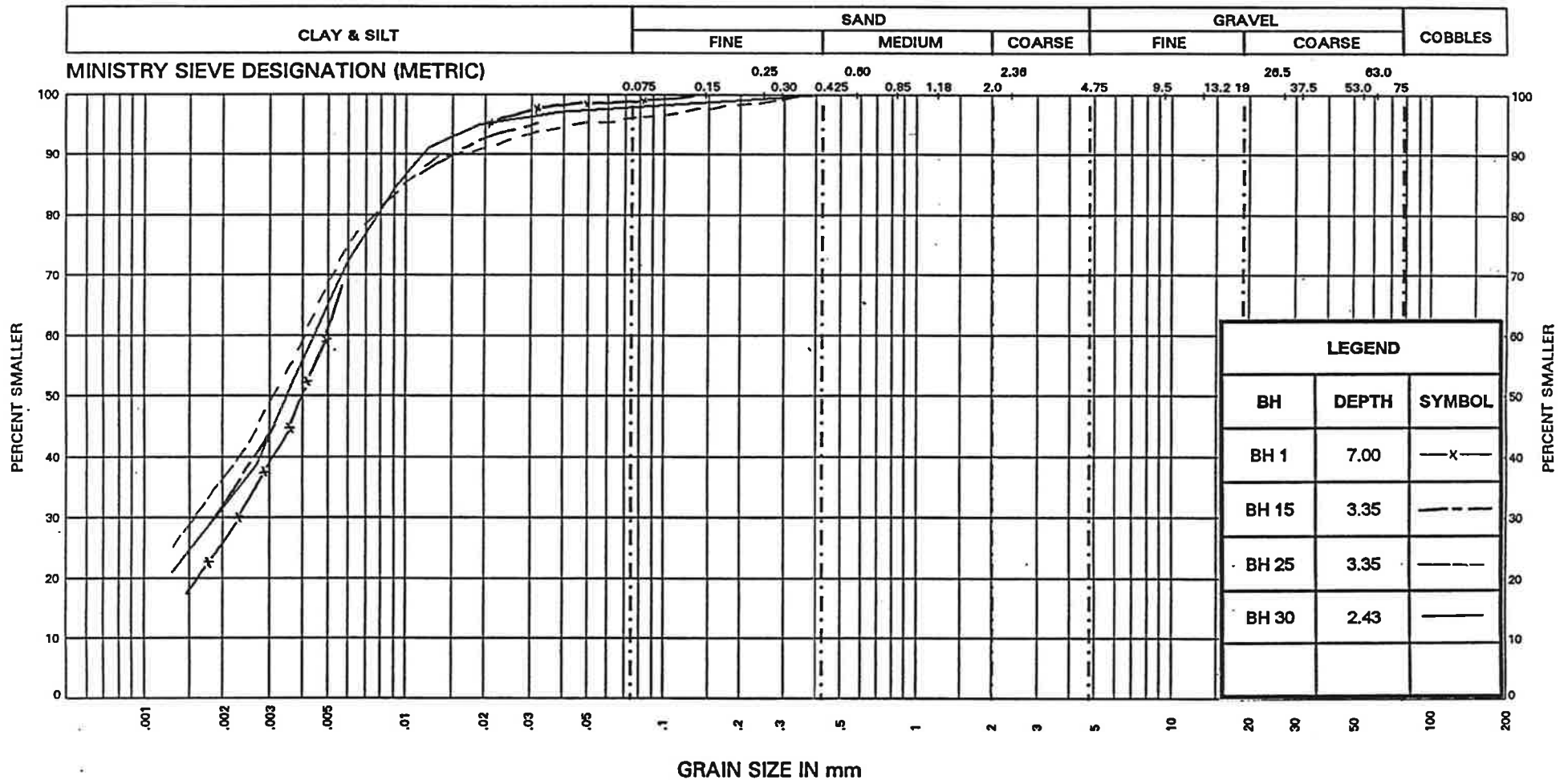
GRAIN SIZE DISTRIBUTION SANDY SILT (ML)

FIGURE 5

W.P. 301-00-01

HWY 510

UNIFIED SOIL CLASSIFICATION SYSTEM



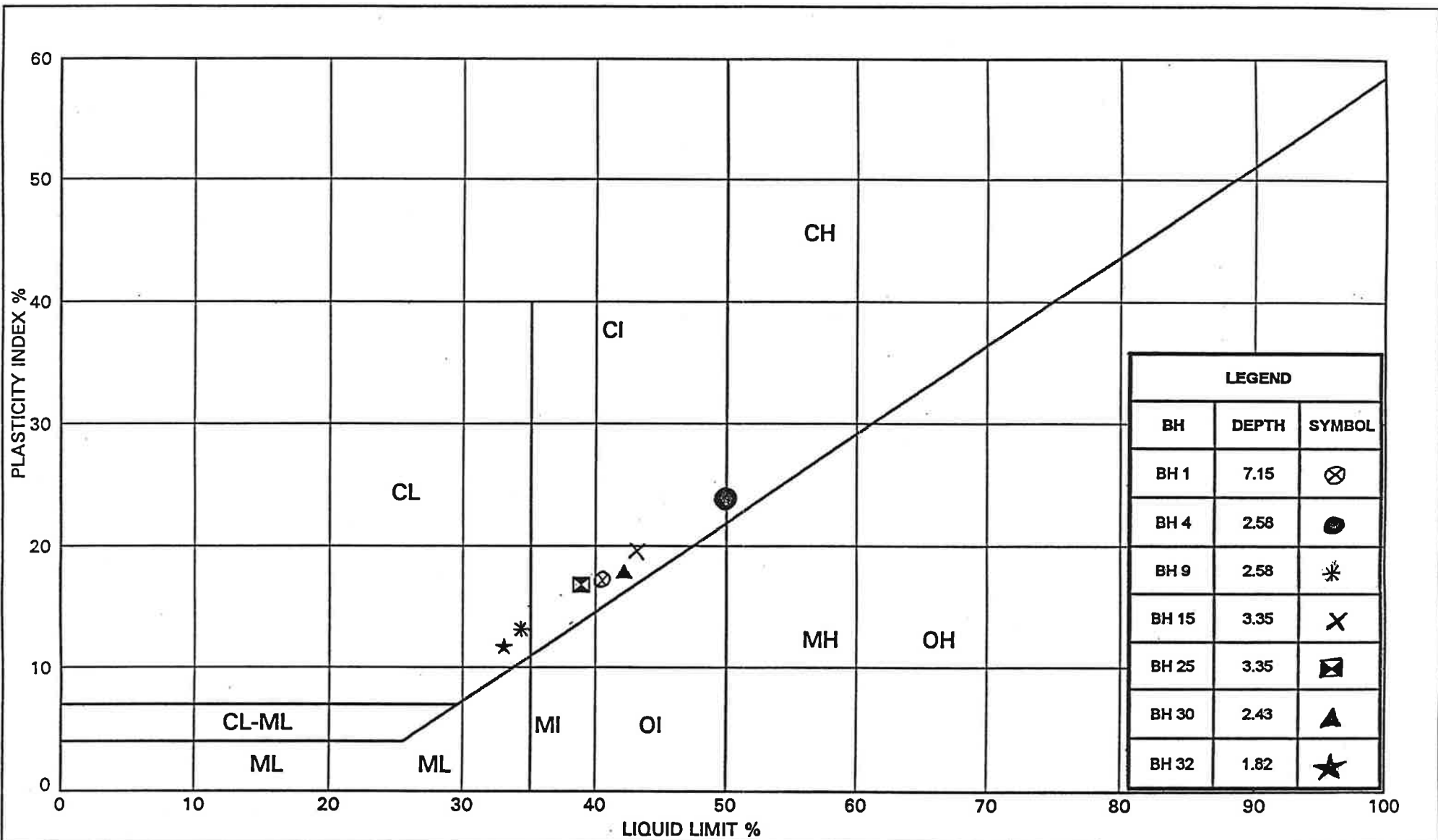
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GRAIN SIZE DISTRIBUTION CLAYEY SILT (CL)

FIGURE 6

W.P 301-00-01

HWY 510



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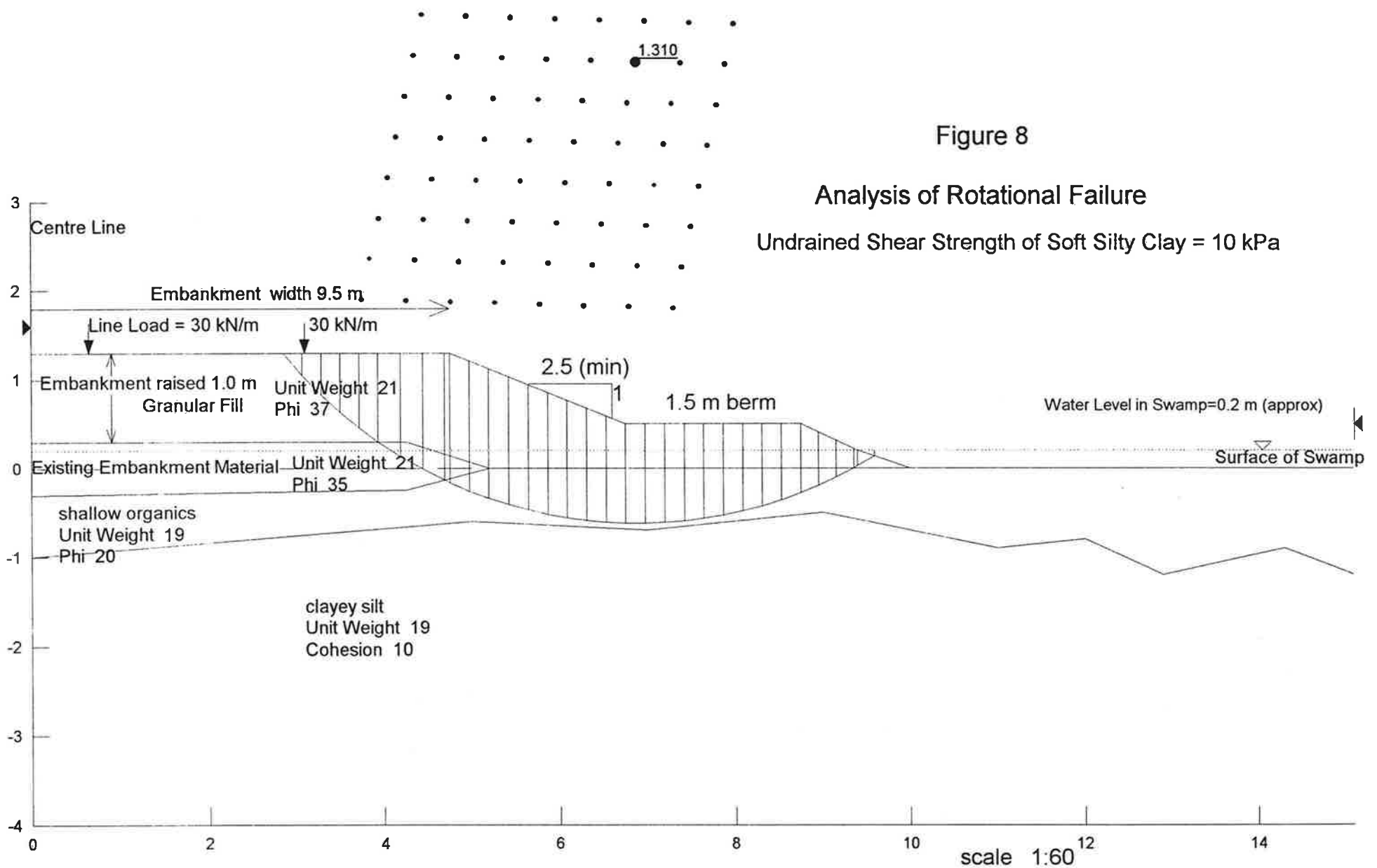
PLASTICITY CHART

SILTY CLAY (CL-CI)

FIGURE 7

W.P. 7508-00-00

HWY 510



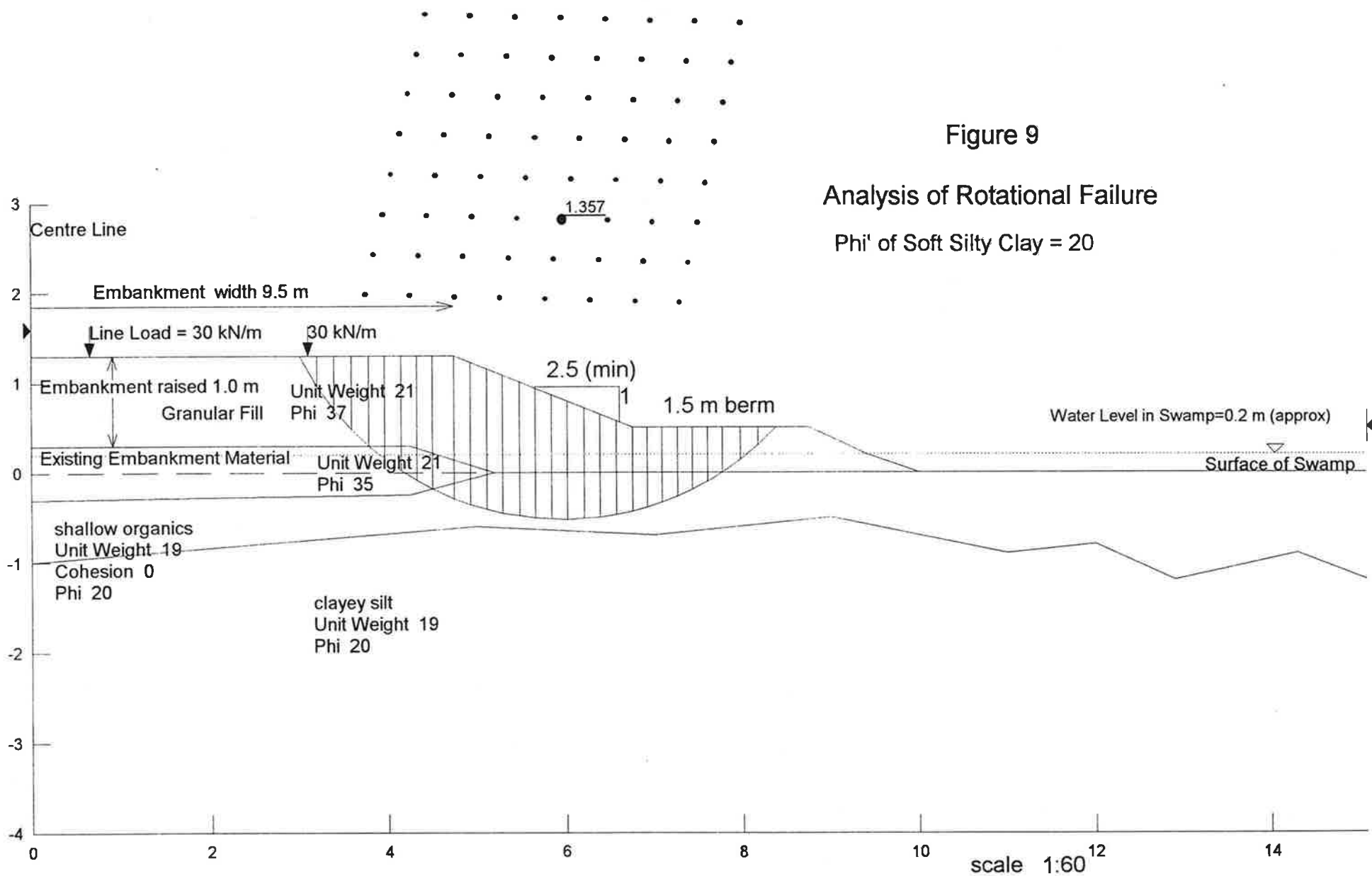


Figure 10

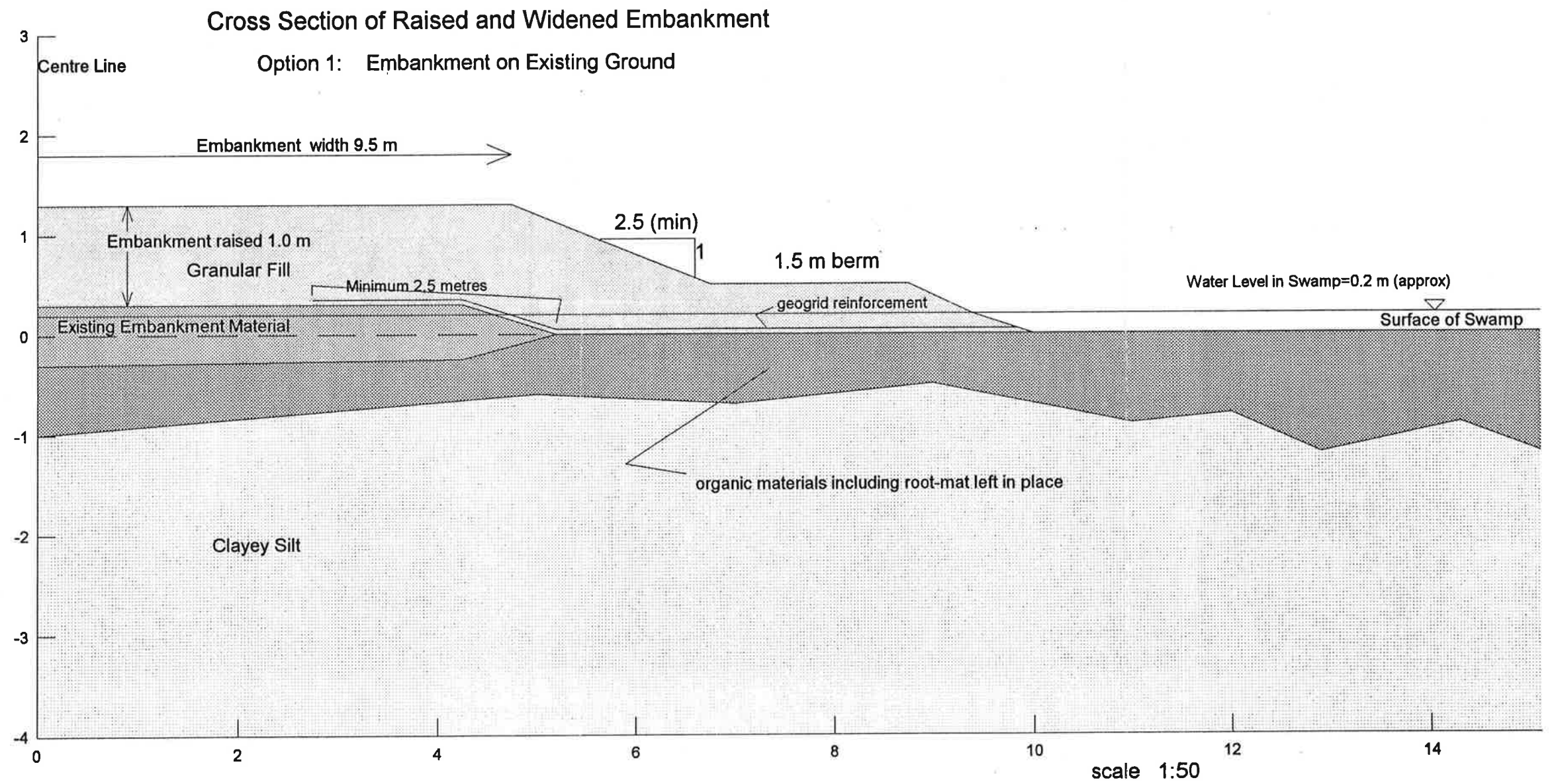
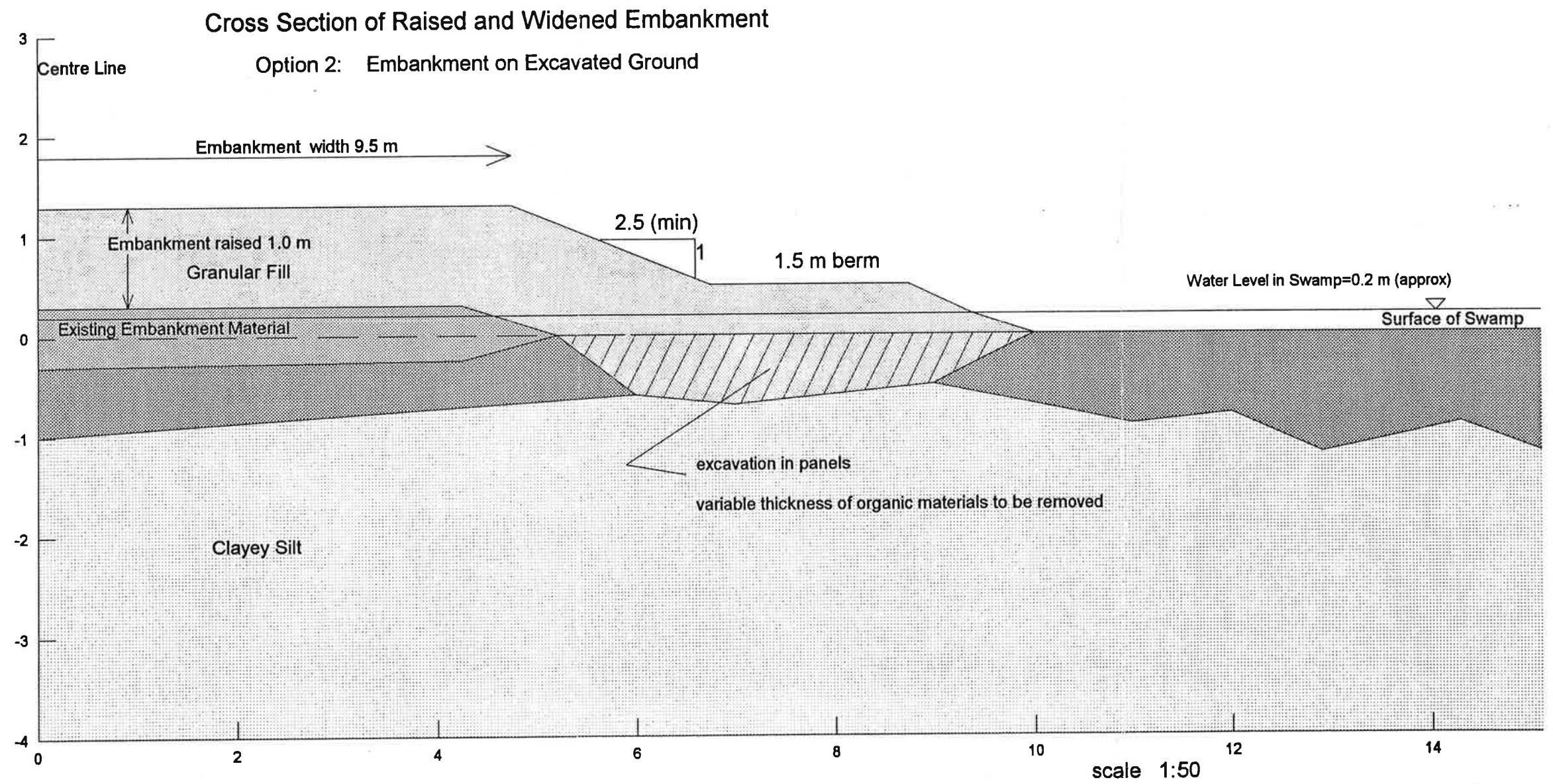


Figure 11



Appendix A

Record of Boreholes

METRIC

ORIGINATED BY R.S

COMPILED BY R.S

DATE August 8, 2000

CHECKED BY I.F

SOIL PROFILE			SAMPLES			GROUNDWATER CONDITIONS	ELEVATION SCALE	STANDARD PENETRATION TEST (N) VALUE ●		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT kN/m3	REMARKS & GRAIN SIZE DISTRIBUTION			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			SHEAR STRENGTH (kPa)							WATER CONTENT (%)		
303.84 0.00	Gravelly sand (SW), brown, compact.													GR SA SI CL			
303.34 .50	Fill - Clayey silt (CL), compact, light gray, moist.		1	SS	9									Description based on auger cuttings for samples 2 and 3			
302.34 1.5	Organic silt and fine sand (SM-OL), dark brown, very loose, very wet, some root and fine leaf matter, occasional clayey seams Upper 0.1m : fibrous, compressible		2	SS	2												
			3	SS	2												
300.74 3.1	Silty clay to clayey silt (ML-CL) with trace to some fine sand, gray, very soft to firm, moist.		4	SS	8												
			5	SS	3												
			6	SS	2												
			7	SS	2												
			8	SS	1												
			9	SS	0												
296.38 7.46	Sand (SW) with trace of fine gravel, brown, wet, loose. Cone penetration testing initiated at 8.53m.																
295.01 8.83	Water level not measured. Assumed to be at swamp elevation																
END OF BOREHOLE														Refusal to cone penetration testing			

METRIC

W.P:	WP 301-00-01 HWY 510	LOCATION	STA. 11+856, 4.0m LT of cl.	ORIGINATED BY	R.S
DIST	Northern Region HWY 510	BOREHOLE TYPE	Hollow Stem Augers	COMPILED BY	R.S
DATUM	Geodetic	DATE	August 9, 2000	CHECKED BY	I.F

SOIL PROFILE			SAMPLES			GROUNDWATER CONDITIONS	ELEVATION SCALE	STANDARD PENETRATION TEST (N) VALUE ●					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT	REMARKS & GRAIN SIZE DISTRIBUTION			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			SHEAR STRENGTH (kPA)					WATER CONTENT (%)							
								✕ FIELD VANE	◆ LAB VANE									W _P	W _N	W _L
								✦ POCKET PEN.	○ CONE PENETRATION											
303.83								20	40	60	80	100								
0.00	Gravelly sand (SW), brown, compact.																			
303.53 .30	Fill- Clayey silt (CL), soft, gray, moist.																			
302.93 0.90	Organic silt and fine sand (SM-OL), dark brown, very loose, very wet, some root and fine leaf matter, occasional clayey seams		1	SS	2															
			2	SS	2															
301.40 2.43	Upper 0.1m : fibrous, compressible		3	SS																
	Water level not measured. Assumed to be at swamp elevation						END OF BOREHOLE								Refusal to auger penetration.					

METRIC

ORIGINATED BY R.S

COMPILED BY R.S

CHECKED BY I.F

SOIL PROFILE			SAMPLES			GROUNDWATER CONDITIONS	ELEVATION SCALE	STANDARD PENETRATION TEST (N) VALUE ●					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT kN/m3	REMARKS & GRAIN SIZE DISTRIBUTION
ELEV	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			SHEAR STRENGTH (kPA)					WATER CONTENT (%)				
DEPTH								X FIELD VANE + LAB VANE ◆ POCKET PEN. ○ CONE PENETRATION									
303.86 0.00	<div>Gravelly sand (SW), brown, compact.</div> <div>Fill - Clayey silt with some fine sand, trace organic matter, compact, light gray, moist.</div> <div>Organic silt and fine sand (SM-OL), dark brown, very loose, very wet, some root and fine leaf matter, occasional clayey seams</div> <div>Upper 0.1m : fibrous, compressible</div> <div>Silty clay (CL) with some sand, gray, soft to firm, moist.</div>													Description based on auger cuttings for sample 2			
303.56 .30			1	SS	7	303.0	●										
302.66 1.20			2	SS	0	302.0	●										
301.56 2.30			3	SS	5	301.0	●										
300.71 3.65			4	SS	2		●										
END OF BOREHOLE																	
Water level not measured. Assumed to be at swamp elevation																	

METRIC

CHECKED BY I.F

SOIL PROFILE			SAMPLES			GROUNDWATER CONDITIONS	ELEVATION SCALE	STANDARD PENETRATION TEST (N) VALUE					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT kN/m3	REMARKS & GRAIN SIZE DISTRIBUTION																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			SHEAR STRENGTH (kPA)					WATER CONTENT (%)				GR SA SI CL																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																
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303.72 0.00	Gravelly sand (SW), brown, compact.																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																

METRIC

ORIGINATED BY R.S

COMPILED BY R.S

CHECKED BY I.F

SOIL PROFILE			SAMPLES			GROUNDWATER CONDITIONS	ELEVATION SCALE	STANDARD PENETRATION TEST (N) VALUE					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT kN/m3	REMARKS & GRAIN SIZE DISTRIBUTION
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			SHEAR STRENGTH (kPA)					WATER CONTENT (%)				
303.43 303.23 .10	Asphaltic Concrete																
302.53 .90	Gravelly sand (SW), brown, compact, moist.		1				303.0								Description based on auger cuttings for sample 2		
301.93 1.5	Organic silt and fine sand (SM-OL), dark brown, very loose, very wet, some root and fine leaf matter, occasional clayey seams		2	SS	10		302.0										
			3	SS	11												
300.83 2.6	Clayey silt to silt (ML) with some fine sand, gray, compact, moist.		4	SS	25		301.0										
END OF BOREHOLE																	
	Water level not measured. Assumed to be at swamp elevation														Refusal to auger penetration.		

RECORD OF BOREHOLE 6

METRIC

W.P: WP 301-00-01 HWY 510

LOCATION STA. 11+750, 3.9m LT of cl.

ORIGINATED BY R.S

DIST Northern Region HWY 510

BOREHOLE TYPE Hollow Stem Augers

COMPILED BY R.S

DATUM Geodetic






DATE August 9, 2000

CHECKED BY I.F

SOIL PROFILE		SAMPLES			GROUNDWATER CONDITIONS	ELEVATION SCALE	STANDARD PENETRATION TEST (N) VALUE					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT kN/m3	REMARKS & GRAIN SIZE DISTRIBUTION GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			'N' VALUES	SHEAR STRENGTH (kPa)					WATER CONTENT (%)				
								20	40	60	80	100	W _p	W _n			W _L
303.43 0.00	Gravelly sand (SW), brown, compact.																
302.93 .50	Fill - Clayey silt (ML), light gray, dense, moist.		1	SS	15												
302.23 1.2	Organic silt and fine sand (SM-OL), dark brown, very loose, very wet, some root and fine leaf matter, occasional clayey seams																
301.70 1.73	Upper 0.1m : fibrous, compressible Water level not measured. Assumed to be at swamp elevation		2	SS													
END OF BOREHOLE																	
Refusal to auger penetration.																	

METRIC

CHECKED BY I.F

SOIL PROFILE			SAMPLES			GROUNDWATER CONDITIONS	ELEVATION SCALE	STANDARD PENETRATION TEST (N) VALUE		PLASTIC NATURAL LIQUID LIMIT MOISTURE LIMIT CONTENT			UNIT WEIGHT kN/m3	REMARKS & GRAIN SIZE DISTRIBUTION
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			SHEAR STRENGTH (kPA)		WATER CONTENT (%)				
								20 40 60 80 100	100	W _p W _N W _L	15 30 45			
303.77 0.00	Gravelly sand (SW), brown, compact.													Description based on auger cuttings for sample 2
303.37 .40	Fill - Clayey silt (CL) with trace to some fine sand, compact, gray, moist.		1	SS	9									
302.27 1.5	Organic silt and fine sand (SM-OL), dark brown, very loose, very wet, some root and fine leaf matter, occasional clayey seams		2	SS	5									
301.67 2.1	Upper 0.1m : fibrous, compressible		3	SS	1									
	Clayey fine sand and silt (ML), light gray, very loose, wet		4	SS	0									
299.20 4.57			5	SS	0									
Water level not measured. Assumed to be at swamp elevation						END OF BOREHOLE							Refusal to auger penetration	

RECORD OF BOREHOLE 8

METRIC

W.P: WP 301-00-01 HWY 510

LOCATION STA. 11+700, 3.6m LT of cl.

ORIGINATED BY R.S

DIST Northern Region HWY 510

BOREHOLE TYPE Hollow Stem Augers

COMPILED BY R.S

DATUM Geodetic

DATE August 9, 2000

CHECKED BY I.F

SOIL PROFILE			SAMPLES			GROUNDWATER CONDITIONS	ELEVATION SCALE	STANDARD PENETRATION TEST (N) VALUE		PLASTIC NATURAL LIQUID LIMIT MOISTURE LIMIT			UNIT WEIGHT kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			SHEAR STRENGTH (kPa)		WATER CONTENT (%)				
								20 40 60 80 100	25 50 75 100 125	15 30 45				
303.58 0.00	Gravelly sand (SW), brown, compact.													
302.98 .6	Fill - Clayey silt (ML), gray, loose, moist.		1	SS	6									
302.08 1.5	Organic silt and fine sand (SM-OL), dark brown, very loose, very wet, some root and fine leaf matter, occasional clayey seams		2	SS	1									
301.28 2.3	Upper 0.1m : fibrous, compressible		3	SS	8									
	Clayey silt (CL) with some fine sand, gray, soft to firm, moist.		4	SS	2									
299.88 3.7	Silty clay (CI-CH), gray, very soft, wet		5	SS	1									
			6	SS	0									
297.49 6.09	Water level not measured. Assumed to be at swamp elevation													
END OF BOREHOLE														
													Refusal to auger penetration.	




Description based
on auger cuttings
for sample 2

METRIC

ORIGINATED BY R.S

COMPILED BY R.S

CHECKED BY I.F

SOIL PROFILE			SAMPLES			GROUNDWATER CONDITIONS	ELEVATION SCALE	STANDARD PENETRATION TEST (N) VALUE		PLASTIC LIMIT NATURAL LIQUID LIMIT MOISTURE LIMIT CONTENT			UNIT WEIGHT KN/m3	REMARKS & GRAIN SIZE DISTRIBUTION	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			SHEAR STRENGTH (kPA)		W _p W _N W _L					WATER CONTENT (%)
								20 40 60 80 100							
								25 50 75 100 125				15 30 45			
303.65															
0.00	Road Base - Gravelly sand (SW), brown, compact, moist.														
303.05															
.60	Silty clay (CL-Cl) with trace to some fine sand, gray, soft to firm, moist.		1	SS	12										
			2	SS	3										
			3	SS	8										
300.65															
3.0	Fine sand and silt (ML), gray, loose, wet		4	SS											
300.35															
3.30	Water level not measured. Assumed to be at swamp elevation														
						END OF BOREHOLE								Refusal to auger penetration.	

METRIC

ORIGINATED BY R.S

COMPILED BY R.S

CHECKED BY I.F

[illegible]

RECORD OF BOREHOLE 11

METRIC

W.P: WP 301-00-01 HWY 510

LOCATION STA. 11+625, 3.7m LT of cl.

ORIGINATED BY R.S

DIST Northern Region HWY 510

BOREHOLE TYPE Hollow Stem Augers

COMPILED BY R.S

DATUM Geodetic

DATE August 9, 2000

CHECKED BY I.F

SOIL PROFILE		SAMPLES			GROUNDWATER CONDITIONS	ELEVATION SCALE	STANDARD PENETRATION TEST (N) VALUE		PLASTIC NATURAL LIQUID LIMIT MOISTURE LIMIT			UNIT WEIGHT kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			'N' VALUES	20 40 60 80 100	100	W _P	W _N		
303.25 0.00	Gravelly sand (SW), brown, compact.												
302.75 .50	Fill - Clayey silt (ML), gray, soft, moist.		1	SS									
302.25 1.0	Organic silt and fine sand (SM-OL), dark brown, very loose, very wet, some root and fine leaf matter, occasional clayey seams		2	SS									0 38 58 4
301.50 1.75	Silt and fine sand (ML), trace clay, gray, compact, wet												Refusal to auger penetration.
END OF BOREHOLE													

Water level not measured. Assumed to be at swamp elevation

RECORD OF BOREHOLE 12

METRIC

W.P: WP 301-00-01 HWY 510

LOCATION STA. 11+600, 2.5m RT of cl.

ORIGINATED BY R.S

DIST Northern Region HWY 510

BOREHOLE TYPE Hollow Stem Augers

COMPILED BY R.S

DATUM Geodetic

DATE August 8, 2000

CHECKED BY I.F

SOIL PROFILE			SAMPLES			GROUNDWATER CONDITIONS	ELEVATION SCALE	STANDARD PENETRATION TEST (N) VALUE					PLASTIC NATURAL LIQUID LIMIT MOISTURE LIMIT CONTENT			UNIT WEIGHT kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			SHEAR STRENGTH (kPa)					WATER CONTENT (%)				
								20	40	60	80	100	W _p	W _N	W _L		
303.37 0.00	Gravelly sand (SW), brown, compact.																
302.77 60	Clayey silt (ML), brownish light gray, stiff, moist		1	SS													
			2	SS	21												
301.09 2.28	Water level not measured. Assumed to be at swamp elevation																
END OF BOREHOLE																	
Refusal to auger penetration.																	

RECORD OF BOREHOLE 13

METRIC

W.P: WP 301-00-01 HWY 510

LOCATION STA. 11+575, 4.6m LT of cl.

ORIGINATED BY R.S

DIST Northern Region HWY 510

BOREHOLE TYPE Hollow Stem Augers

COMPILED BY R.S

DATUM Geodetic

DATE August 9, 2000

CHECKED BY I.F

SOIL PROFILE		SAMPLES			GROUNDWATER CONDITIONS	ELEVATION SCALE	STANDARD PENETRATION TEST (N) VALUE		PLASTIC NATURAL LIQUID LIMIT MOISTURE LIMIT CONTENT			UNIT WEIGHT kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION GR SA SI CL		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			'N' VALUES	SHEAR STRENGTH (kPa)		WATER CONTENT (%)					
						20	40	60	80	100	W _p	W _N	W _L		
303.24 0.00 302.94 30 302.84 .40	Gravelly sand (SW), brown, compact.														
	Organic silt and fine sand (SM-OL), dark brown, very loose, very wet, some root and fine leaf matter, occasional clayey seams		1	SS	4										
	Clayey silt (ML), gray, loose to dense, moist.		2	SS	26										
			3	SS	35										
300.52 2.72	Water level not measured. Assumed to be at swamp elevation													Refusal to auger penetration.	

END OF BOREHOLE

RECORD OF BOREHOLE 14

METRIC

W.P: WP 301-00-01 HWY 510

LOCATION STA. 11+550, 3.6m RT of cl.

ORIGINATED BY R.S

DIST Northern Region HWY 510

BOREHOLE TYPE Hollow Stem Augers

COMPILED BY R.S

DATUM Geodetic

DATE August 9, 2000

CHECKED BY I.F

SOIL PROFILE			SAMPLES			GROUNDWATER CONDITIONS	ELEVATION SCALE	STANDARD PENETRATION TEST (N) VALUE		PLASTIC NATURAL LIQUID LIMIT MOISTURE LIMIT CONTENT			UNIT WEIGHT kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			SHEAR STRENGTH (kPa)		WATER CONTENT (%)				
								20 40 60 80 100	100	W _p W _N W _L	15 30 45			
303.51														
0.00	Gravelly sand (SW), brown, compact.													
303.01														
.50	Fill - Silty clay (CL) with trace to some fine sand, gray, soft to firm, moist		1	SS	4									
302.31														
1.2	Organic silt and fine sand (SM-OL), dark brown, very loose, very wet, some root and fine leaf matter, occasional clayey seams		2	SS	10									
302.01														
1.5	Silty clay (CL), with trace to some fine sand, gray, soft, wet		3	SS	4									
			4	SS	3									
299.09														
4.42	Water level not measured. Assumed to be at swamp elevation													
END OF BOREHOLE														

Description based on auger cuttings for samples 2 and 4

METRIC

CHECKED BY I.F

SOIL PROFILE			SAMPLES			GROUNDWATER CONDITIONS	ELEVATION SCALE	STANDARD PENETRATION TEST (N) VALUE		PLASTIC LIMIT NATURAL LIQUID LIMIT MOISTURE LIMIT CONTENT			UNIT WEIGHT kN/m3	REMARKS & GRAIN SIZE DISTRIBUTION							
ELEV	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			SHEAR STRENGTH (kPa)							WATER CONTENT (%)						
DEPTH																					
							20	40	60	80	100	W _p	W _N	W _L		GR	SA	SI	CL		
303.35																					
303.25 .10	Asphaltic Concrete																				
303.05 .30	Loose granular asphalt with sand and gravel.																				
	Gravelly sand (SW), brown, compact.																				
302.05 1.30	Organic silt and fine sand (SM-OL), dark brown, very loose, very wet, some root and fine leaf matter, occasional clayey seams																				
301.85 1.5			1																		
			2	SS	13																
			3	SS	6																
			4	SS	4																
	Silty clay (CL) with trace fine sand, gray, soft to firm, very moist.		5	SS																	
298.55 4.8	Silt (ML), with some fine sand, very loose, light gray, wet		6	SS	1																
			7	SS	0																
297.10 6.25	Water level not measured. Assumed to be at swamp elevation																				
							END OF BOREHOLE											Refusal to auger penetration.			

METRIC

ORIGINATED BY R.S

COMPILED BY R.S

DATE August 9, 2000

CHECKED BY I.F

SOIL PROFILE			SAMPLES			GROUNDWATER CONDITIONS	ELEVATION SCALE	STANDARD PENETRATION TEST (N) VALUE ●					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT kN/m3	REMARKS & GRAIN SIZE DISTRIBUTION
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			SHEAR STRENGTH (kPA)					WATER CONTENT (%)				
303.25 0.00																	
302.75 .50	Gravelly sand (SW), brown, compact. Organic silt and fine sand (SM-OL), dark brown, very loose, very wet, some root and fine leaf matter, occasional clayey seams Silty clay (CL-CI), with traces of organic matter, gray, soft to firm, very moist																
302.55 .70			1	SS	4												
			2	SS	14												
			3	SS	6												
			4	SS	2												
298.68 4.57																	
	Water level not measured. Assumed to be at swamp elevation						END OF BOREHOLE								Refusal to auger penetration.		

RECORD OF BOREHOLE 17

METRIC

W.P: WP 301-00-01 HWY 510

LOCATION STA. 11+475, 3.6m RT of cl.

ORIGINATED BY R.S

DIST Northern Region HWY 510

BOREHOLE TYPE Hollow Stem Augers

COMPILED BY R.S

DATUM Geodetic

DATE August 9, 2000

CHECKED BY I.F

SOIL PROFILE			SAMPLES			GROUNDWATER CONDITIONS	ELEVATION SCALE	STANDARD PENETRATION TEST (N) VALUE					PLASTIC NATURAL LIQUID LIMIT MOISTURE LIMIT			UNIT WEIGHT KN/m3	REMARKS & GRAIN SIZE DISTRIBUTION
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			SHEAR STRENGTH (kPa)					WATER CONTENT (%)				
						20 40 60 80 100 X FIELD VANE * LAB VANE * POCKET PEN. O CONE PENETRATION					25 50 75 100 125 15 30 45						
302.77 0.00	Gravelly sand (SW), brown, compact.															Description based on auger cuttings	
302.24 .53	Silty clay (CL-CI), with trace fine sand, gray, firm, moist.		1	SS	10												
			2	SS	10												
			3	SS	8												
			4	SS	14												
299.42 3.35 299.27 3.50	Sand (SW) with trace of fine gravel, brown, wet, loose. Water level not measured. Assumed to be at swamp elevation					END OF BOREHOLE											Refusal to auger penetration.

METRIC

ORIGINATED BY R.S

COMPILED BY R.S

CHECKED BY I.F

[illegible]

RECORD OF BOREHOLE 19

METRIC

W.P: WP 301-00-01 HWY 510

LOCATION STA. 11+425, 3.8m RT of cl.

ORIGINATED BY R.S

DIST Northern Region HWY 510

BOREHOLE TYPE Hollow Stem Augers

COMPILED BY R.S

DATUM Geodetic

DATE August 9, 2000

CHECKED BY I.F

SOIL PROFILE		SAMPLES			GROUNDWATER CONDITIONS	ELEVATION SCALE	STANDARD PENETRATION TEST (N) VALUE		PLASTIC NATURAL LIQUID LIMIT MOISTURE LIMIT CONTENT			UNIT WEIGHT kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			'N' VALUES	20	40	60	80			100
303.06 0.00	Gravelly sand (SW), brown, compact.													
302.46 60	Clayey silt (CL) with trace fine sand, trace organics, gray, firm, moist.		1	SS	11									
			2	SS	16									
300.76 2.30	Sand (SW) with trace of fine gravel, brown, wet, loose.		3	SS										
300.63 2.43	Water level not measured. Assumed to be at swamp elevation					END OF BOREHOLE								Refusal to auger penetration.


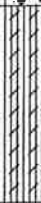
METRIC

CHECKED BY I.F

SOIL PROFILE			SAMPLES			GROUNDWATER CONDITIONS	ELEVATION SCALE	STANDARD PENETRATION TEST (N) VALUE		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			SHEAR STRENGTH (kPA)		W _P W _N W _L					WATER CONTENT (%)
								✕ FIELD VANE	• LAB VANE						
								✚ POCKET PEN.	○ CONE PENETRATION						
								25 50 75 100 125				15 30 45			
302.92													GR SA SI CL		
302.82	Asphaltic Concrete												39 52 9 0		
302.67	Loose granular asphalt with sand and gravel.		1												
301.82	Gravelly sand (SW), brown, compact.														
301.32	Organic silt and fine sand (SM-OL), dark brown, very loose, very wet, some root and fine leaf matter, occasional clayey seams		2	SS	17								0 5 74 21		
301.32	Clayey silt (ML), gray to brown, firm, moist.		3	SS	13										
299.57			4	SS									0 12 74 14		
3.35	Water level not measured. Assumed to be at swamp elevation						END OF BOREHOLE						Refusal to auger penetration.		

METRIC

W.P.	WP 301-00-01 HWY 510	LOCATION	STA. 11+375, 3.9m LT of cl.	ORIGINATED BY	R.S
DIST	Northern Region HWY 510	BOREHOLE TYPE	Hollow Stem Augers	COMPILED BY	R.S
DATUM	Geodetic	DATE	August 9, 2000	CHECKED BY	I.F

SOIL PROFILE			SAMPLES			GROUNDWATER CONDITIONS	ELEVATION SCALE	STANDARD PENETRATION TEST (N) VALUE					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT kN/m3	REMARKS & GRAIN SIZE DISTRIBUTION	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			SHEAR STRENGTH (KPA)					WATER CONTENT (%)					
								20	40	60	80	100	W _P	W _N	W _L			
303.72																		
0.00	Gravelly sand (SW), brown, compact.																	
303.19 .53	Clayey silt (ML), gray to brown, soft, moist.		1	SS	35												0 3 61 36	
301.89 1.83			2	SS														
	Water level not measured. Assumed to be at swamp elevation					END OF BOREHOLE												Refusal to auger penetration.

RECORD OF BOREHOLE 22

METRIC

W.P: WP 301-00-01 HWY 510

LOCATION STA. 11+350, 3.3m RT of cl.

ORIGINATED BY R.S

DIST Northern Region HWY 510

BOREHOLE TYPE Hollow Stem Augers

COMPILED BY R.S

DATUM Geodetic


DATE August 16, 2000

CHECKED BY I.F

SOIL PROFILE		SAMPLES			GROUNDWATER CONDITIONS	ELEVATION SCALE	STANDARD PENETRATION TEST (N) VALUE					PLASTIC NATURAL LIQUID LIMIT MOISTURE LIMIT			UNIT WEIGHT kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			'N' VALUES	SHEAR STRENGTH (kPa)					WATER CONTENT (%)				
						20	40	60	80	100	W _p	W _N	W _L				
302.65 0.00	Gravelly sand (SW), brown, compact.																
302.12 .53	Clayey silt (CL) with traces of sand and organics, gray, stiff, moist.																
			1	SS	25												
			2	SS	13												
299.20 3.45	Sand (SW) with trace of fine gravel, brown, wet, loose.																
			3	SS	16												
			4	SS	22												
298.24 4.41	Water level not measured. Assumed to be at swamp elevation					END OF BOREHOLE											Refusal to auger penetration.




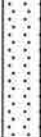

METRIC

CHECKED BY I.F

SOIL PROFILE		SAMPLES			GROUNDWATER CONDITIONS	ELEVATION SCALE	STANDARD PENETRATION TEST (N) VALUE					PLASTIC NATURAL LIQUID LIMIT MOISTURE LIMIT CONTENT			UNIT WEIGHT kN/m3	REMARKS & GRAIN SIZE DISTRIBUTION GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			'N' VALUES	SHEAR STRENGTH (kPA)					WATER CONTENT (%)				
								20	40	60	80	100	W _p	W _N			W _L
303.67 0.00	Gravelly sand (SW), brown, compact.																
302.91 .76	Water level not measured. Assumed to be at swamp elevation					303.0	END OF BOREHOLE									Refusal to auger penetration.	

METRIC

CHECKED BY I.F

SOIL PROFILE			SAMPLES			GROUNDWATER CONDITIONS	ELEVATION SCALE	STANDARD PENETRATION TEST (N) VALUE		PLASTIC NATURAL LIQUID LIMIT MOISTURE LIMIT CONTENT			UNIT WEIGHT kN/m3	REMARKS & GRAIN SIZE DISTRIBUTION
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			SHEAR STRENGTH (kPa)		WATER CONTENT (%)				
								20 40 60 80 100	W _p W _N W _L					
								25 50 75 100 125	15 30 45					
303.82 0.00	Gravelly sand (SW), brown, compact.													
303.02 .80 302.87 0.95	Organic silt and fine sand (SM-OL), dark brown, very loose, very wet, some root and fine leaf matter, occasional clayey seams		1	SS	11									
			2	SS	19									
	Clayey silt (CL) with traces of sand and organics, gray, stiff, moist.		3	SS	11									
			4	SS	15									
300.02 3.80	Sand (SW) with trace of fine gravel, brown, wet, loose.		5	SS	25									
299.02 4.80			6	SS										
	Water level not measured. Assumed to be at swamp elevation													Refusal to auger penetration.

METRIC

ORIGINATED BY R.S

COMPILED BY R.S

CHECKED BY I.F

SOIL PROFILE			SAMPLES			GROUNDWATER CONDITIONS	ELEVATION SCALE	STANDARD PENETRATION TEST (N) VALUE		PLASTIC LIMIT NATURAL MOISTURE LIMIT LIQUID LIMIT		UNIT WEIGHT kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			SHEAR STRENGTH (kPA)						WATER CONTENT (%)		
								20	40	60	80			100	15	30
								✕ FIELD VANE	✱ LAB VANE							
								✱ POCKET PEN.	○ CONE PENETRATION							
								25	50	75	100	125				
304.01																
303.91	Asphaltic concrete															
303.75	Loose granular asphalt with sand and gravel.															
303.10	Gravelly sand (SW), brown, compact.						303.0									
302.65	Organic silt and fine sand (SM-OL), dark brown, very loose, very wet, some root and fine leaf matter, occasional clayey seams		1	SS	23		302.0									
1.35	Clayey silt to silt (ML) with trace fine sand, gray, loose, moist.		2	SS	5							19.6				
			3	SS	5		301.0									
			4	SS	3		300.0									
			5	SS	6		299.0									
299.11	Sand (SW) with trace of fine gravel, brown, wet, loose.															
4.90			6	SS												
298.31																
5.70																
	Water level not measured. Assumed to be at swamp elevation															
								</								


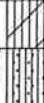


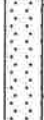

METRIC

ORIGINATED BY R.S

COMPILED BY R.S

DATE August 9, 2000

CHECKED BY I.F

SOIL PROFILE			SAMPLES			GROUNDWATER CONDITIONS	ELEVATION SCALE	STANDARD PENETRATION TEST (N) VALUE		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT KN/m3	REMARKS & GRAIN SIZE DISTRIBUTION		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			SHEAR STRENGTH (kPA)		WATER CONTENT (%)						
								20 40 60 80 100		W _p W _N W _L						
								25 50 75 100 125		15 30 45						
304.11 0.00	Gravelly sand (SW), brown, compact.															
303.58 0.53	Clayey silt (CL) with traces of sand and organics, gray, very soft, moist.		1	SS	2											
303.26 0.85																
302.81 1.30																
	Organic silt and fine sand (SM-OL), dark brown, very loose, very wet, some root and fine leaf matter, occasional clayey seams		2	SS	11											
	Clayey silt to silt (ML), gray to brown, compact/firm, moist.		3	SS	10											
			4	SS	5											
300.36 3.75	Sand (SW) with trace of fine gravel, brown, wet, loose.		5	SS	30											
299.49 4.62	Water level not measured. Assumed to be at swamp elevation					END OF BOREHOLE							Refusal to auger penetration.			

RECORD OF BOREHOLE 27

METRIC

W.P: WP 301-00-01 HWY 510

LOCATION STA. 11+225, 4.0m RT of cl.

ORIGINATED BY R.S

DIST Northern Region HWY 510

BOREHOLE TYPE Hollow Stem Augers

COMPILED BY R.S

DATUM Geodetic

DATE August 18, 2000

CHECKED BY I.F

SOIL PROFILE			SAMPLES			GROUNDWATER CONDITIONS	ELEVATION SCALE	STANDARD PENETRATION TEST (N) VALUE		PLASTIC NATURAL LIQUID LIMIT MOISTURE LIMIT CONTENT			UNIT WEIGHT kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			SHEAR STRENGTH (kPa)		WATER CONTENT (%)				
							20 40 60 80 100							
							25 50 75 100 125							
303.99 0.00	Gravelly sand (SW), brown, compact.													
303.49 0.5	Clayey silt to silt (ML), gray, moist		1	SS	13									
302.47 1.52	Water level not measured. Assumed to be at swamp elevation													
END OF BOREHOLE														

RECORD OF BOREHOLE 28

METRIC

W.P: WP 301-00-01 HWY 510

LOCATION STA. 11+200, 3.0m LT of cl.

ORIGINATED BY R.S

DIST Northern Region HWY 510

BOREHOLE TYPE Hollow Stem Augers

COMPILED BY R.S

DATUM Geodetic

DATE August 9, 2000

CHECKED BY I.F

SOIL PROFILE			SAMPLES			GROUNDWATER CONDITIONS	ELEVATION SCALE	STANDARD PENETRATION TEST (N) VALUE		PLASTIC NATURAL LIQUID LIMIT MOISTURE LIMIT CONTENT			UNIT WEIGHT kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			SHEAR STRENGTH (kPa)		W _p	W _N	W _L		
304.14 0.00	Gravelly sand (SW), brown, compact.													
303.54 .60	Silt and fine sand (SM) gray, compact, moist.		1	SS	8									
			2	SS	21									
301.84 2.30	Clayey silt (CL), gray, firm, moist.		3	SS	14									
			4	SS	11									
300.24 3.9	Clayey silt with sand and gravel (till) well graded, brown, firm and moist.		5	SS										
299.42 4.72	Water level not measured. Assumed to be at swamp elevation		6	SS										
END OF BOREHOLE														refusal to auger penetration

METRIC

ORIGINATED BY R.S

COMPILED BY R.S

CHECKED BY I.F

SOIL PROFILE			SAMPLES			GROUNDWATER CONDITIONS	ELEVATION SCALE	STANDARD PENETRATION TEST (N) VALUE					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT kN/m3	REMARKS & GRAIN SIZE DISTRIBUTION
ELEV	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			SHEAR STRENGTH (kPA)					WATER CONTENT (%)				
DEPTH																	
304.19 0.00																	
303.59 60 303.39 8	Gravelly sand (SW), brown, compact.															Description based on auger cuttings for samples 1 and 2	
	Organic silt and fine sand (SM-OL), dark brown, very loose, very wet, some root and fine leaf matter, occasional clayey seams		1	SS	9												
	Silt with trace clay (ML), gray to brown, soft, moist		2	SS	11												
			3	SS	23												
300.99 3.2			4	SS													
	Water level not measured. Assumed to be at swamp elevation						END OF BOREHOLE									Refusal to auger penetration.	

RECORD OF BOREHOLE 30

METRIC

W.P: WP 301-00-01 HWY 510

LOCATION STA. 11+150, on cl.

ORIGINATED BY R.S

DIST Northern Region HWY 510

BOREHOLE TYPE Hollow Stem Augers

COMPILED BY R.S

DATUM Geodetic

DATE August 18, 2000

CHECKED BY I.F

SOIL PROFILE			SAMPLES			GROUNDWATER CONDITIONS	ELEVATION SCALE	STANDARD PENETRATION TEST (N) VALUE					PLASTIC NATURAL LIQUID LIMIT MOISTURE LIMIT CONTENT			UNIT WEIGHT kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100	W _p	W _N	W _L		
303.68 0.00 303.45 .23	Asphalt road base.																
302.48 1.20 302.18 1.50	Gravelly sand (SW), brown, compact.																
	Organic silt and fine sand (SM-OL), dark brown, very loose, very wet, some root and fine leaf matter, occasional clayey seams		1	SS	30												
	Clayey silt (CL), gray, stiff, moist.		2	SS	26												
300.33 3.35	Water level not measured. Assumed to be at swamp elevation		3	SS													
END OF BOREHOLE																	
Refusal to auger penetration.																	

METRIC

W.P:	<u>WP 301-00-01 HWY 510</u>	LOCATION	<u>STA. 10+925, 4.0m RT of cl.</u>	ORIGINATED BY	<u>R.S</u>
DIST	<u>Northern Region HWY 510</u>	BOREHOLE TYPE	<u>Hollow Stem Augers</u>	COMPILED BY	<u>R.S</u>
DATUM	<u>Geodetic</u>	DATE	<u>August 18, 2000</u>	CHECKED BY	<u>I.F</u>

SOIL PROFILE			SAMPLES			GROUNDWATER CONDITIONS	ELEVATION SCALE	STANDARD PENETRATION TEST (N) VALUE					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT kN/m3	REMARKS & GRAIN SIZE DISTRIBUTION
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			SHEAR STRENGTH (KPA)					WATER CONTENT (%)				
								20	40	60	80	100	W _p	W _N	W _L		
309.92 0.00	Gravelly sand (SW), brown, compact.														GR SA SI CL		
			1	SS	31												
308.32 1.60	Water level not measured. Assumed to be at swamp elevation					END OF BOREHOLE											Refusal to auger penetration.

RECORD OF BOREHOLE 32

METRIC

W.P: WP 301-00-01 HWY 510

LOCATION STA. 10+900, 4.0m LT of cl.

ORIGINATED BY R.S

DIST Northern Region HWY 510

BOREHOLE TYPE Hollow Stem Augers

COMPILED BY R.S

DATUM Geodetic

DATE August 18, 2000

CHECKED BY I.F




SOIL PROFILE		SAMPLES			GROUNDWATER CONDITIONS	ELEVATION SCALE	STANDARD PENETRATION TEST (N) VALUE		PLASTIC NATURAL LIQUID LIMIT MOISTURE LIMIT CONTENT			UNIT WEIGHT kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			'N' VALUES	20 40 60 80 100	100	W _P	W _N			W _L
306.39 0.00	Gravelly sand (SW), brown, compact.												GR SA SI CL 0 4 60 36	
305.79 .60	Clayey silt to silt (ML) with some fine sand, brown to gray, compact, moist.		1	SS	15									
			2	SS	21									
303.72 2.67	Water level not measured. Assumed to be at swamp elevation					END OF BOREHOLE							Refusal to auger penetration.	

METRIC

ORIGINATED BY R.S

COMPILED BY R.S

CHECKED BY I.F

SOIL PROFILE			SAMPLES			GROUNDWATER CONDITIONS	ELEVATION SCALE	STANDARD PENETRATION TEST (N) VALUE					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT	REMARKS & GRAIN SIZE DISTRIBUTION
ELEV	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			SHEAR STRENGTH (kPA)					WATER CONTENT (%)				
DEPTH																	
305.33																	
0.00	Asphaltic concrete																
305.06																	
.275	Gravelly sand (SW), brown, compact.																
304.72																	
.610	Organic silt and fine sand (SM-OL), dark brown, very loose, very wet, some root and fine leaf matter, occasional clayey seams		1														
303.96																	
1.37	Water level not measured. Assumed to be at swamp elevation														Refusal to auger penetration.		
END OF BOREHOLE																	

RECORD OF BOREHOLE 34

METRIC

W.P: WP 301-00-01 HWY 510

LOCATION STA. 10+850, 3.5m RT of cl.

ORIGINATED BY R.S

DIST Northern Region HWY 510

BOREHOLE TYPE Hollow Stem Augers

COMPILED BY R.S

DATUM Geodetic

DATE August 18, 2000

CHECKED BY I.F

SOIL PROFILE			SAMPLES			GROUNDWATER CONDITIONS	ELEVATION SCALE	STANDARD PENETRATION TEST (N) VALUE					PLASTIC NATURAL LIQUID LIMIT MOISTURE CONTENT			UNIT WEIGHT kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			SHEAR STRENGTH (kPa)					WATER CONTENT (%)				
						20 40 60 80 100 X FIELD VANE + LAB VANE * POCKET PEN. O CONE PENETRATION					W _p W _N W _L 15 30 45						
						25	50	75	100	125							
304.83 0.00	Gravelly sand (SW), brown, compact.																
304.33 .50	Clayey silt to silt (ML), gray, loose to compact, moist to wet.		1	SS	9												
			2	SS	4												
			3	SS	25												
			4	SS	10												
			5	SS	7												
300.53 4.30	Silty sand (SW) with trace of fine gravel, brown, compact, very wet		6	SS	24												
299.50 5.33	Water level not measured. Assumed to be at swamp elevation					END OF BOREHOLE											Refusal to auger penetration.

RECORD OF BOREHOLE 35

METRIC

W.P: WP 301-00-01 HWY 510

LOCATION STA. 10+825, 4.0m LT of cl.

ORIGINATED BY R.S

DIST Northern Region HWY 510

BOREHOLE TYPE Hollow Stem Augers

COMPILED BY R.S

DATUM Geodetic

DATE August 18, 2000

CHECKED BY I.F

SOIL PROFILE		SAMPLES			GROUNDWATER CONDITIONS	ELEVATION SCALE	STANDARD PENETRATION TEST (N) VALUE		PLASTIC NATURAL LIQUID LIMIT MOISTURE LIMIT CONTENT			UNIT WEIGHT kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			'N' VALUES	SHEAR STRENGTH (kPa)		WATER CONTENT (%)			
						20 40 60 80 100			W _p W _N W _L				
						25 50 75 100 125			15 30 45				
305.16													
0.00	Gravelly sand (SW), brown, compact.												
304.41 .75	Organic silt and fine sand (SM-OL), dark brown, very loose, very wet, some root and fine leaf matter, occasional clayey seams		1	SS	3								
303.64 1.52	Water level not measured. Assumed to be at swamp elevation												
END OF BOREHOLE													
													Refusal to auger penetration.

RECORD OF BOREHOLE 36

METRIC

W.P: WP 301-00-01 HWY 510

LOCATION STA. 10+800, on cl.

ORIGINATED BY R.S

DIST Northern Region HWY 510






BOREHOLE TYPE Hollow Stem Augers

COMPILED BY R.S

DATUM Geodetic

DATE August 18, 2000

CHECKED BY I.F

SOIL PROFILE		SAMPLES			GROUNDWATER CONDITIONS	ELEVATION SCALE	STANDARD PENETRATION TEST (N) VALUE					PLASTIC NATURAL LIQUID LIMIT MOISTURE LIMIT			UNIT WEIGHT kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			'N' VALUES	SHEAR STRENGTH (kPa)					WATER CONTENT (%)				
						20 40 60 80 100 ✕ FIELD VANE ✕ LAB VANE ✕ POCKET PEN. ○ CONE PENETRATION					W _p W _N W _L						
						25	50	75	100	125	15	30	45		GR SA SI CL		
307.13 0.00	Asphaltic concrete					307.0											
306.83 .30	Gravelly sand (SW), brown, compact.																
306.53 .60	Silt (ML) with trace clay and fine sand, brown to gray, compact, moist					306.0											
																	
						305.0											
304.85 2.28	Water level not measured. Assumed to be at swamp elevation					END OF BOREHOLE											Refusal to auger penetration.

RECORD OF BOREHOLE 37

METRIC

W.P: WP 301-00-01 HWY 510

LOCATION STA. 10+775, 4.0m RT of cl.

ORIGINATED BY R.S

DIST Northern Region HWY 510



BOREHOLE TYPE Hollow Stem Augers

COMPILED BY R.S

DATUM Geodetic

DATE August 18, 2000

CHECKED BY I.F

SOIL PROFILE			SAMPLES			GROUNDWATER CONDITIONS	ELEVATION SCALE	STANDARD PENETRATION TEST (N) VALUE		PLASTIC NATURAL LIQUID LIMIT MOISTURE LIMIT CONTENT			UNIT WEIGHT kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			SHEAR STRENGTH (kPa)		WATER CONTENT (%)				
								20 40 60 80 100	25 50 75 100 125	15 30 45				
307.76 0.00	Gravelly sand (SW), brown, compact.													
307.26 .50	Clayey silt to silt (ML), trace to nil clay, gray, compact, moist to wet.		1	SS	20									
			2	SS	11									
			3	SS	7 62									
304.86 2.90	Water level not measured. Assumed to be at swamp elevation						END OF BOREHOLE						Refusal to auger penetration.	

RECORD OF BOREHOLE 38

METRIC

W.P: WP 301-00-01 HWY 510

LOCATION STA. 10+750, 3.5m LT of cl.

ORIGINATED BY R.S

DIST Northern Region HWY 510


BOREHOLE TYPE Hollow Stem Augers

COMPILED BY R.S

DATUM Geodetic

DATE August 18, 2000

CHECKED BY I.F

SOIL PROFILE		SAMPLES			GROUNDWATER CONDITIONS	ELEVATION SCALE	STANDARD PENETRATION TEST (N) VALUE					PLASTIC NATURAL LIQUID LIMIT MOISTURE LIMIT			UNIT WEIGHT	REMARKS & GRAIN SIZE DISTRIBUTION
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			N' VALUES	SHEAR STRENGTH (kPa)					WATER CONTENT (%)			
						20 40 60 80 100 X FIELD VANE * LAB VANE + POCKET PEN. O CONE PENETRATION					W _p W _N W _L 15 30 45			kn/m ³	GR SA SI CL	
309.56 0.00	Gravelly sand (SW), brown, compact.															
308.71 0.85	Water level not measured. Assumed to be at swamp elevation															Refusal to auger penetration.
END OF BOREHOLE																

Explanation of Terms Used in Report

EXPLANATION OF TERMS USED IN REPORT

N VALUE: THE STANDARD PENETRATION TEST (SPT) N VALUE IS THE NUMBER OF BLOWS REQUIRED TO CAUSE A STANDARD 51mm O.D. SPLIT BARREL SAMPLER TO PENETRATE 0.3m INTO UNDISTURBED GROUND IN A BOREHOLE WHEN DRIVEN BY A HAMMER WITH A MASS OF 63.5kg, FALLING FREELY A DISTANCE OF 0.76m. FOR PENETRATIONS OF LESS THAN 0.3m N VALUES ARE INDICATED AS THE NUMBER OF BLOWS FOR THE PENETRATION ACHIEVED. AVERAGE N VALUE IS DENOTED THUS \bar{N} .

DYNAMIC CONE PENETRATION TEST: CONTINUOUS PENETRATION OF A CONICAL STEEL POINT (51mm O.D. 60° CONE ANGLE) DRIVEN BY 475 J IMPACT ENERGY ON 'A' SIZE DRILL RODS. THE RESISTANCE TO CONE PENETRATION IS MEASURED AS THE NUMBER OF BLOWS FOR EACH 0.3m ADVANCE OF THE CONICAL POINT INTO THE UNDISTURBED GROUND.

SOILS ARE DESCRIBED BY THEIR COMPOSITION AND CONSISTENCY OR DENSENESS.

CONSISTENCY: COHESIVE SOILS ARE DESCRIBED ON THE BASIS OF THEIR UNDRAINED SHEAR STRENGTH (c_u) AS FOLLOWS:

c_u (kPa)	0 - 12	12 - 25	25 - 50	50 - 100	100 - 200	> 200
	VERY SOFT	SOFT	FIRM	STIFF	VERY STIFF	HARD

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

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

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

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

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

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

JOINTING AND BEDDING:

SPACING	30mm	30 - 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	P S	FOIL SAMPLE

MECHANICAL PROPERTIES OF SOIL

u_w	kPa	PORE WATER PRESSURE	m_v	kPa^{-1}	COEFFICIENT OF VOLUME CHANGE
u	l	PORE PRESSURE RATIO	C_c	l	COMPRESSION INDEX
σ	kPa	TOTAL NORMAL STRESS	C_s	l	SWELLING INDEX
σ'	kPa	EFFECTIVE NORMAL STRESS	C_{α}	l	RATE OF SECONDARY CONSOLIDATION
τ	kPa	SHEAR STRESS	C_v	m^2/s	COEFFICIENT OF CONSOLIDATION
$\sigma_1, \sigma_2, \sigma_3$	kPa	PRINCIPAL STRESSES	H	m	DRAINAGE PATH
ϵ	%	LINEAR STRAIN	T_v	l	TIME FACTOR
$\epsilon_1, \epsilon_2, \epsilon_3$	%	PRINCIPAL STRAINS	U	%	DEGREE OF CONSOLIDATION
E	kPa	MODULUS OF LINEAR DEFORMATION	σ'_{vo}	kPa	EFFECTIVE OVERBURDEN PRESSURE
G	kPa	MODULUS OF SHEAR DEFORMATION	σ'_p	kPa	PRECONSOLIDATION PRESSURE
μ	l	COEFFICIENT OF FRICTION	τ_f	kPa	SHEAR STRENGTH
			c'	kPa	EFFECTIVE COHESION INTERCEPT
			ϕ'	°	EFFECTIVE ANGLE OF INTERNAL FRICTION
			c_u	kPa	APPARENT COHESION INTERCEPT
			ϕ_u	°	APPARENT ANGLE OF INTERNAL FRICTION
			τ_R	kPa	RESIDUAL SHEAR STRENGTH
			τ_f	kPa	REMOULDED SHEAR STRENGTH
			S_i	l	SENSITIVITY = $\frac{c_u}{\tau_f}$

STRESS AND STRAIN

PHYSICAL PROPERTIES OF SOIL

ρ_s	kg/m^3	DENSITY OF SOLID PARTICLES	e	l, %	VOID RATIO	e_{min}	l, %	VOID RATIO IN DENSEST STATE
γ_s	kN/m^3	UNIT WEIGHT OF SOLID PARTICLES	n	l, %	POROSITY	I_D	l	DENSITY INDEX = $\frac{e_{max} - e}{e_{max} - e_{min}}$
ρ_w	kg/m^3	DENSITY OF WATER	w	l, %	WATER CONTENT	D	mm	GRAIN DIAMETER
γ_w	kN/m^3	UNIT WEIGHT OF WATER	S_r	%	DEGREE OF SATURATION	D_n	mm	n PERCENT - DIAMETER
ρ	kg/m^3	DENSITY OF SOIL	w_L	%	LIQUID LIMIT	C_u	l	UNIFORMITY COEFFICIENT
γ	kN/m^3	UNIT WEIGHT OF SOIL	w_p	%	PLASTIC LIMIT	h	m	HYDRAULIC HEAD OR POTENTIAL
ρ_d	kg/m^3	DENSITY OF DRY SOIL	w_s	%	SHRINKAGE LIMIT	q	m^2/s	RATE OF DISCHARGE
γ_d	kN/m^3	UNIT WEIGHT OF DRY SOIL	I_p	%	PLASTICITY INDEX = $w_L - w_p$	v	m/s	DISCHARGE VELOCITY
ρ_{sat}	kg/m^3	DENSITY OF SATURATED SOIL	I_L	l	LIQUIDITY INDEX = $\frac{w - w_p}{I_p}$	i	l	HYDRAULIC GRADIENT
γ_{sat}	kN/m^3	UNIT WEIGHT OF SATURATED SOIL	I_C	l	CONSISTENCY INDEX = $\frac{w_L - w}{I_p}$	k	m/s	HYDRAULIC CONDUCTIVITY
ρ'	kg/m^3	DENSITY OF SUBMERGED SOIL	e_{max}	l, %	VOID RATIO IN LOOSEST STATE	j	kN/m^2	SEEPAGE FORCE
γ'	kN/m^3	UNIT WEIGHT OF SUBMERGED SOIL						