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## **FOUNDATION DESIGN SECTION**

**foundation  
investigation and  
design report**

ENGINEERING MATERIALS OFFICE  
FOUNDATION DESIGN SECTION

WP 122-87-03

DIST 9

HWY 416

STR SITE 3-547

Hwy. 416 and Log Farm Access Road Underpass

*CONT 93-66*

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GEOCRES 31G5-182

DATE JUL 29 1991

# FOUNDATION INVESTIGATION REPORT

For

Hwy. 416 and Log Farm Access Road Underpass

W.P. 122-87-03

Hwy. 416, District 9, Ottawa, Nepean

## INTRODUCTION

This report summarizes the results of a foundation investigation conducted at the aforementioned site. A two span structure has been proposed to carry the Log Farm Access Road over Hwy. 416. The subsurface conditions encountered at the site and recommendations pertaining to structure foundations and related earthworks are included in the scope of this report.

## SITE DESCRIPTION

The site is located on the Log Farm Access Road, specifically in the gravel parking lots, which lies off Cedarview Road between Knoxdale Road and Fallowfield Road in the City of Nepean Region Municipality of Ottawa-Carleton.

The topography of the area is thickly forested deciduous and coniferous trees with the immediate vicinity being used for a gravel parking lot for a government owned log farm conservation centre open to the public. A small simulation historic farming community is located north of the parking lot on the log farm, to the south is a small residential community and to the east is farm land owned and operated by Agriculture Canada. The natural ground level slopes downwards from the north (west approach) to the south (east approach) with elevations of 100.11 m to 99.03 m respectively.

Physiographically the site lies in the area known as the Ottawa Valley Clay Plains founded in the lowlands of the St. Lawrence, which are characterized by clay plains interrupted by rides of rock or sand and gravel. The bedrock in the area is of the Gull River Formation of the middle ordovician period. It consists of limestone with interbedded shale layers. The overburden is relatively thin and was deposited during and immediately following the wisconsin glaciation at which time the area was deposited during and immediately following the wisconsin glaciation at which time the area was depressed from the effect of the glaciation. Following the retreat of the glacier, the brackish waters of

the champlain sea flooded the area and then gradually receded as the land rebounded with the deposition of sediments to its present level.

### Investigation Procedures

Soil data and inherent properties were obtained by in situ and laboratory testing conducted on select samples. The procedures employed are discussed below.

### Field Investigation

The fieldwork for the investigation was carried out between 90 08 09 to 90 08 10 and consisted of a total of five boreholes. Two approach ramp holes, two abutment holes and one centreline pier hole were advanced. The surficial deposit was very shallow thus refusal ranged from 0.15 m to 2 m.

The elevations on the boreholes advanced at the site varied from 91.1 m to 100.2 m. The ground slopes down towards the east.

Disturbed split spoon, test pits and rock core samples were taken. Track Mount CME55 equipment employing solid stem techniques was used to advance only one borehole where overburden was too deep for hand digging. Disturbed subsoil samples were retrieved at 0.75 m intervals and Rock Core sampling was performed for the abutment and pier holes down 3.5 metres into bedrock while the approach ramp holes were terminated upon refusal. All other samples were hand dug. Samples were identified in the field and then returned to the laboratory for applicable testing.

Groundwater levels were monitored throughout the duration of the field investigation. All open boreholes were backfilled at the completion of the fieldwork.

Survey information related to the location and elevation of boreholes was provided by MTO Surveys and Plans, Eastern Region.

### Laboratory Analysis

To identify the properties of the soil, the following laboratory testing were performed.

- 1) Atterberg Limit Tests
- 2) Grain Size Analysis
- 3) Natural Moisture Content
- 4) Unit Weights

Laboratory test results are given in the following section of this report and are illustrated on figures and borehole logs included in the Appendix.

### SUBSURFACE CONDITIONS

The subsoil stratigraphy at the site consists mainly of a thin topsoil layer of a heterogeneous mixture of sand, silt and gravel, trace of clay from a depth ranging from 0.1 to 0.3 metres at all boreholes throughout the site except at the most easterly borehole (BH 7) where this deposit had a depth of 2 m.

A quartz sandstone bedrock was found which was observed to be outcrop at several locations near the site.

The plan and location of boring and the stratigraphical profile are shown on Drawing No. 1228703-A in the attached appendix. The observed field and laboratory tests are plotted on the Record of Borehole sheets also in the Appendix of this report. A brief description of the different soil types is given below.

#### Topsoil Het. Mixture of Sand, Silt, trace of Gravel, trace of Clay

Underlying the site and explored to depth ranging from the original ground surface to depths between 0.1 m and 2 m, is a non-cohesive topsoil which is composed of a heterogeneous mixture of sand, silt, trace of gravel, trace of clay.

Grain Size Distribution tests were carried out, see Figure 1 in the Appendix, showing the results in an envelop form . From the above figure, it is evident that the layer can be classified as having a large percentage of silt and sand with a trace of clay and gravel. This deposit is comprised of 4-59% gravel, 32-53% sand, 7-37% silt and 2-6% clay.

The result from the Atterberg Limit test performed is summarized below.

	<u>Range</u>	<u>Tests</u>
Natural Moisture Content (w)	5.5-23.8	3
Liquid Limit ( $w_L$ )	21.5-41.5	3
Plastic Limit ( $w_p$ )	18.5-34	3
Plasticity Index ( $I_p$ )	3-7.5	3

From the plasticity chart (Figure 2), the layer can be classified as a non-cohesive mixture of silt, sand, with traces of gravel and clay.

In this stratum the 'N' values ranged from 3-17 blows/0.3 m indicating a very loose to compact relative state of density. These values were obtained from BH 7 since all other boreholes were hand dug.

### Bedrock

The surficial deposit is directly underlain by bedrock of the Gull River Formation and was cored at two abutment locations by obtaining up to 1.5 metres of sound rock core samples. The bedrock mainly consists of a quartz sandstone, detailed descriptions of the rock are attached in the Appendix entitled "Rock Core Designation".

Core Recoveries (CR) and Rock Quality Designation (RQD) were determined in situ and also in the laboratory to evaluate the competence and integrity of the rock. Based on these results, the rock can be classified as medium strong and predominantly unweathered to slightly weathered.

### GROUNDWATER CONDITIONS

Observation of the groundwater level was carried out by measuring the water level in the open boreholes. Levels obtained at the time of the investigation revealed that the area was completely dry.

## DISCUSSION AND RECOMMENDATIONS

The recommendations in this report apply to the bridge structure and related approaches.

It is proposed to construct an underpass structure that will carry Hwy. 416 under the existing Log Farm Access Road. The proposed structure is a two span structure having an approximate length and width of 77 m and 23 metres respectively. The proposed profile grade of the Log Farm Access Road is 101.6 m or 1.8 m above existing grade. Hwy. 416 will be excavated 7 m below existing ground level to an elevation of 94 m. Blasting into the bedrock will become necessary.

To facilitate the design and construction of the proposed structure foundations and related earthworks for the approach ramps, the following foundation and geotechnical recommendations are provided in the scope of this report.

- 1) Structure Foundations
- 2) Lateral Earth Pressures
- 3) Slope Stability
- 4) Construction Considerations

### 1. Structure Foundations

#### Abutment and Wingwalls

In consideration of shallow bedrock it is recommended that the abutments and wingwalls are supported on shallow spread footings, located on or below bedrock surface as high as possible with open rock cut slopes of 4H:1V. A footing width of 3 m is assumed.

#### Piers

At the location of the piers an 8 metre deep excavation is proposed. Foundations for the piers shall be designed as spread footings resting on excavated bedrock surface.

## General

For purposes of the O.H.B.D.C., it is recommended that the footings be designed using a factored capacity at U.L.S. of 3000 kPa. The bedrock is considered to be an unyielding foundation base and hence the bearing capacity at S.L.S. Type II will not govern. For this capacity we recommend the east and west footings be placed 3 m from the crest of slope. Alternatively the footings could be designed with a factored capacity at U.L.S. of 1500 kPa if the east and west footings are placed 2 m from the crest of the slope.

Unfactored coefficient of friction of 0.58 may be used for checking sliding resistance of footings resting on bedrock, additional lateral resistance if required may be provided with the use of dowels into rock.

## Lateral Earth Pressure

For backfill requirements, it is recommended to use free draining material such as Granular 'A' to prevent hydrostatic pressure buildup. Design parameters of the soil are given below for purposes of the O.H.B.D.C..

Table 1 - Backfill Properties

	<u>Granular 'A'</u>	<u>Granular 'B'</u>
Angle of Internal Friction ( $\phi$ )	35°	30°
Unit Weight (kN/m <sup>3</sup> )	22.8	21.2
*Coefficient of Active Earth Pressure ( $K_a$ )		
- S.L.S.	0.27	0.33
- U.L.S.	0.33	0.4
*Coefficient of Earth Pressure at Rest ( $K_o$ )		
- S.L.S.	0.43	0.5
- U.L.S.	0.5	0.58

\*Horizontal surface backfill only. Appropriate consideration must be given to sloping backfill.

The earth pressure coefficient at rest is to be used in design if the abutments are rigid and unyielding. The tabulated earth pressure coefficients are applicable to horizontal surfaces only. The values must be modified to represent sloping surfaces. Weep holes in the abutment walls should be designed to drain any accumulation of water in the backfill.

### 3. Approach Embankments

The proposed finished grade is set at about 1.5 m-2.8 metres above the existing grade. No stability problems are anticipated for the approach embankments constructed with 2H:1V side slopes and forward slopes. The fill material should consist of well compacted acceptable material. Open cuts of the bedrock should be at a slope of 4H:1V.

It is anticipated that approximately 10 mm of total settlement can be realized as a result of elastic settlements induced within the fill. It is expected that the majority of these settlements will be realized during or immediately following construction.

### 4. Construction Considerations

Within the limits of the approach fills the soft topsoil should be excavated and replaced by compacted granular fill.

The proposed construction would involve excavations to about 8 m depths at the pier locations and about 5 to 6 metres along the NBL and SBL of Hwy. 417. Excavation of bedrock would require drilling and blasting techniques. Rock grading should be carried out in accordance with OPSD 201.01. Careful attention should be provided in order to prevent excessive fracturing of the bedrock, foundations and slopes, and to prevent damage to adjacent buildings. Controlled blasting techniques, such as line blasting, are recommended and the surrounding area should be surveyed for damage prior to construction and monitored for vibration during construction. The contractor should be instructed of these property damage concerns and should also be instructed to construct the cut to the required geometry without fracturing the bedrock at the footing or on the slopes.

Dewatering

No dewatering problems are anticipated during footing excavation and construction.

MISCELLANEOUS

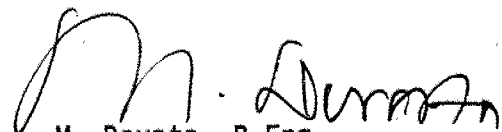
The fieldwork for this investigation was carried out under the supervision of Tae C. Kim, Foundation Engineer, Martin Michalek, Foundation Engineer Trainee and John LeMessurier, Mike Iampietro, Student Engineers. The equipment was owned and operated by Marathon Drilling Co. Ltd., and F.E. Johnston Drilling Co. Ltd., Ottawa.

The report was written by M. Michalek, Foundation Engineer Trainee, under the general supervision of Dr. B. Iyer and reviewed by Mr. M. Devata, Chief Foundation Engineer.



M. Michalek

Foundation Engineer Trainee



M. Devata, P.Eng.

Chief Foundation Engineer

## APPENDIX

## EXPLANATION OF TERMS USED IN REPORT

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

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

SOILS ARE DESCRIBED BY THEIR COMPOSITION AND CONSISTENCY OR DENSENESS.

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

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

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

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

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

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

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

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

**JOINTING AND BEDDING:**

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

## ABBREVIATIONS AND SYMBOLS

### FIELD SAMPLING

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

### MECHANICAL PROPERTIES OF SOIL

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

### STRESS AND STRAIN

$u_w$	kPa	PORE WATER PRESSURE
$r_u$	1	PORE PRESSURE RATIO
$\sigma$	kPa	TOTAL NORMAL STRESS
$\sigma'$	kPa	EFFECTIVE NORMAL STRESS
$\tau$	kPa	SHEAR STRESS
$\sigma_1, \sigma_2, \sigma_3$	kPa	PRINCIPAL STRESSES
$\epsilon$	%	LINEAR STRAIN
$\epsilon_1, \epsilon_2, \epsilon_3$	%	PRINCIPAL STRAINS
E	kPa	MODULUS OF LINEAR DEFORMATION
G	kPa	MODULUS OF SHEAR DEFORMATION
$\mu$	1	COEFFICIENT OF FRICTION

### PHYSICAL PROPERTIES OF SOIL

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

# **ROCK CORE DESCRIPTION** **WP 122-87-03**

Page 1 of 1

CORE RECOVERY					CORE DESCRIPTION	
BH#	RC#	DEPTH (m)	% CR*	% RQD*	DEPTH (m)	DESCRIPTION
1	2	0.23-1.78	96	51	0.23-3.22	QUARTZ SANDSTONE (calcareous), white to medium light grey to moderate brown; fine grained; medium strong; unweathered to slightly weathered; moderately close to very close spaced fractures (flat, undulating to planar, smooth to rough).
	3	1.78-3.22	100	88		
5	2	0.08-1.52	96	40	0.08-1.52	QUARTZ SANDSTONE (calcareous), very light grey to medium light grey to moderate brown; fine grained; medium strong; unweathered to slightly weathered; moderately close to very close spaced fractures (flat, undulating to planar, smooth to rough).

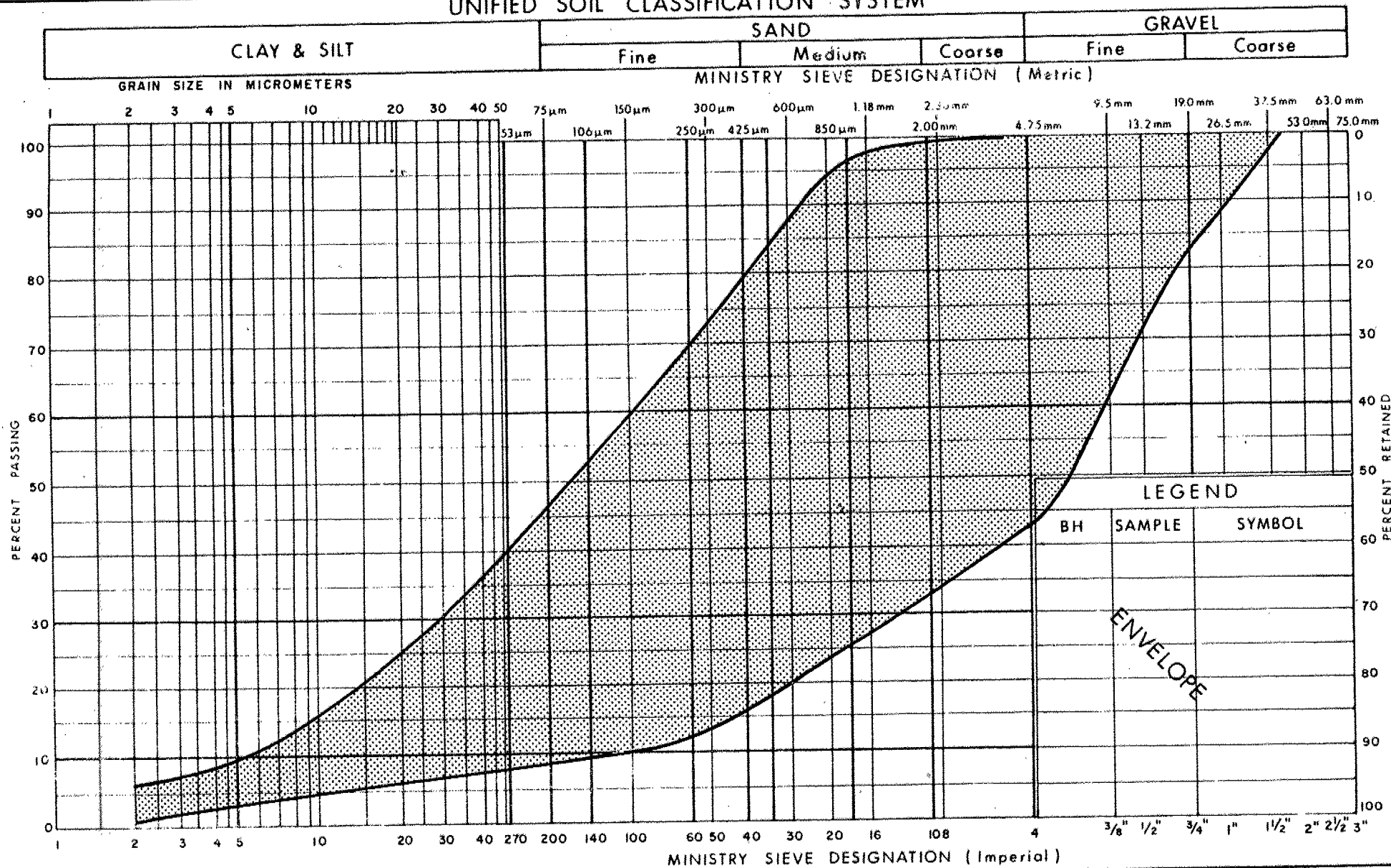
\*CR = CORE RECOVERY

\*RQD = ROCK QUALITY DESIGNATION

*(NOTE: Depths are approximated where core recovery is less than 100%)*

Logged by: DAW, Soils and Aggregates Section

## UNIFIED SOIL CLASSIFICATION SYSTEM



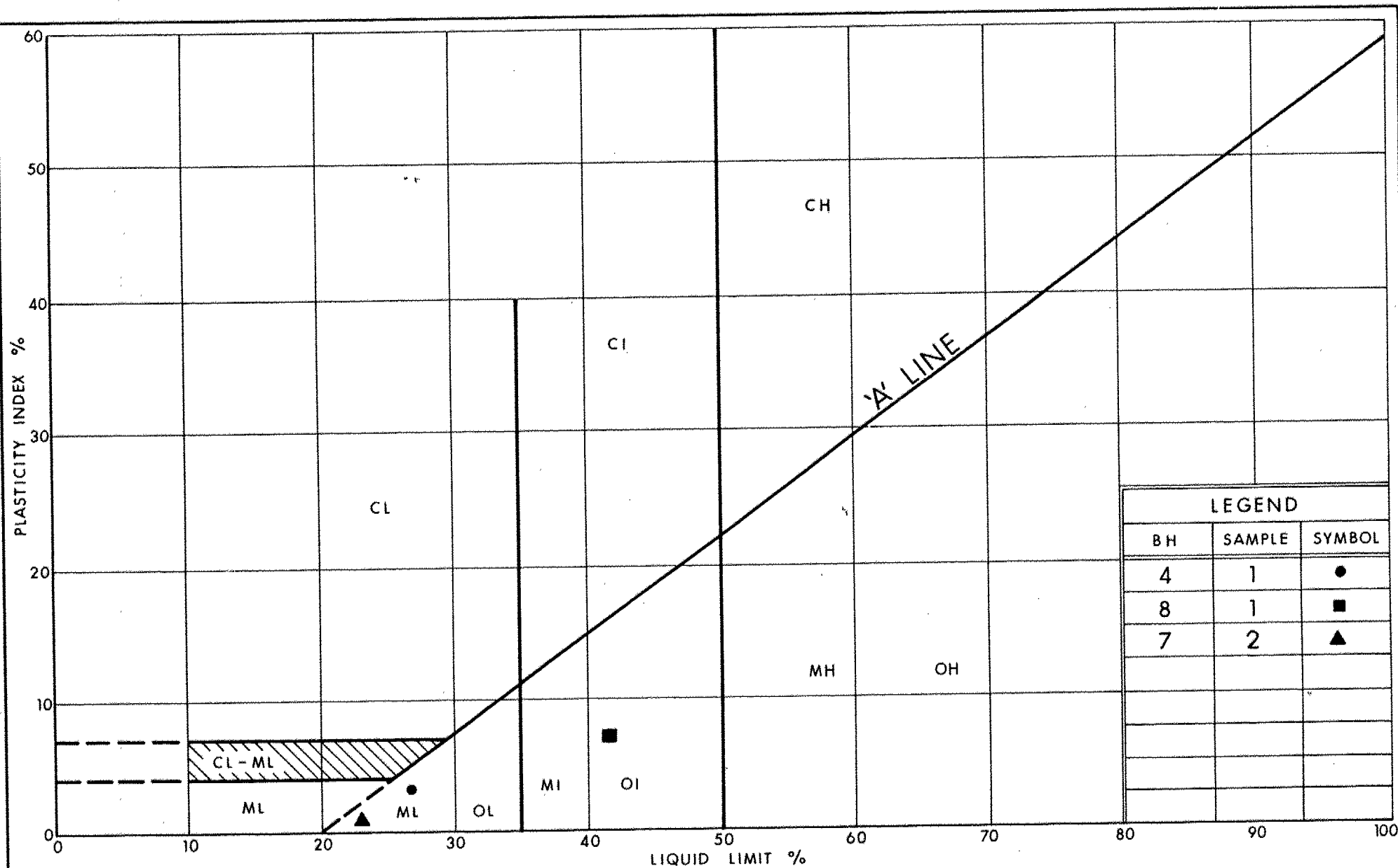
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**GRAIN SIZE DISTRIBUTION**  
**HETEROGENEOUS MIXTURE OF SILTY SAND**  
 TRACE GRAVEL, TRACE CLAY

FIG No 1

W P 122-87-03



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PLASTICITY CHART  
HETEROGENEOUS MIXTURE OF SILTY SAND,  
TRACE GRAVEL, TRACE CLAY


FIG No 2

W P 122-87-03

# RECORD OF BOREHOLE No 1

1 OF 1 METRIC

W.P. 122-87-03 LOCATION Co-ords: N 5 017 455.1, E 360 170.2 ORIGINATED BY M.M.  
 DIST 9 HWY 415 BOREHOLE TYPE Hand Shovel COMPILED BY M.M.  
 DATUM Geodetic DATE 90/08/30 CHECKED BY B.I.

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									
100.2	Ground Surface																
100.0	*		1	LS		DRY	100										
0.2	Quartz Sandstone Bedrock Medium Strong Unweathered to Slightly weathered		2	RC	REC 96%		99									RQD 51%	
			3	RC	REC 100%		98								RQD 88%		
97.0																	
3.2	End of Borehole * Het. mix. of Silty Sand, trace Gravel, trace Clay																

# RECORD OF BOREHOLE No 4

1 OF 1

METRIC

W.P. 122-87-03 LOCATION Co-ords: N 5 017 434.4, E 360 193.5 ORIGINATED BY M.M.  
 DIST 9 HWY 416 BOREHOLE TYPE Hand Shovel COMPILED BY M.M.  
 DATUM Geodetic DATE 90/08/30 CHECKED BY B.L.

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	UNIT WEIGHT 7 KN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			20	40	60	80	100	W <sub>p</sub>	W	W <sub>L</sub>		
99.9	Ground Surface															
99.8	*	1	1	LS	DRY											59 32 7 2
0.2	End of Borehole * Heterogeneous mixture of Silty Sand, trace Gravel, trace Clay  Auger refusal at probable bedrock															

# RECORD OF BOREHOLE No 5

1 OF 1

METRIC

W.P. 122-87-03 LOCATION Co-ords: N 5 017 425.8, E 380 224.2 ORIGINATED BY M.M.  
 DIST 9 HWY 416 BOREHOLE TYPE Hand Shovel COMPILED BY M.M.  
 DATUM Geodetic DATE 90/08/30 CHECKED BY B.L.

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 7 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									
99.3 99.2	Ground Surface							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	25 50 75	25 50 75	25 50 75	7	
0.1	Quartz Sandstone Bedrock Medium Strong Unweathered to Slightly Weathered		2	RC	REC 95%	DRY	98										RQD 40%
1.5	End of Borehole * Heterogeneous mixture of Silty Sand, trace Gravel, trace Clay																

# RECORD OF BOREHOLE No 7

1 OF 1

METRIC

W.P. 122-87-03 LOCATION Co-ords: N 5 017 412.1 E 360 245.7 ORIGINATED BY M.N.  
 DIST 18 HWY 416 BOREHOLE TYPE Hollow Stem Auger COMPILED BY M.M.  
 DATUM Geodetic DATE 90/08/30 CHECKED BY D.T.

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC NATURAL LIQUID UNIT			UNIT WEIGHT	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			'N' VALUES	20	40	60	80	100	W <sub>p</sub>	W		
99.1	Ground Surface		1	SS	3	DRY										
0.5	Heterogeneous mixture of Silty Sand, trace Gravel, trace Clay		2	SS	9											
			3	SS	17											
97.1	Very Loose to Loose		4	SS	4											
2.0	End of Borehole Auger refusal at probable bedrock															

+3, x5: Numbers refer to Sensitivity

20  
15-5 (%) STRAIN AT FAILURE  
10

# RECORD OF BOREHOLE No 8

1 OF 1

METRIC

W.P. 122-87-03 LOCATION Co-ords: N 5 017 465.6, E 360 146.1 ORIGINATED BY M.M.  
DIST 9 HWY 416 BOREHOLE TYPE Hand Shovel COMPILED BY M.M.  
DATUM Geodetic DATE 90/08/30 CHECKED BY B.L.

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC NATURAL LIQUID UNIT MOISTURE UNIT			UNIT WEIGHT 7 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		
100.1	Ground Surface		1	LS												
99.8	*				DRY											
0.3	End of Borehole * Heterogeneous mixture of Silty Sand, trace Gravel, trace Clay Auger refusal at probable bedrock															

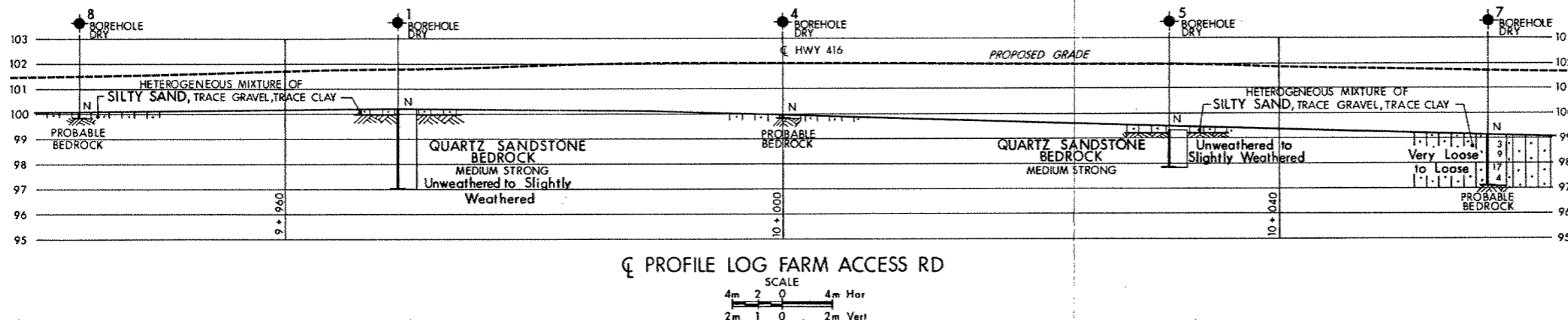
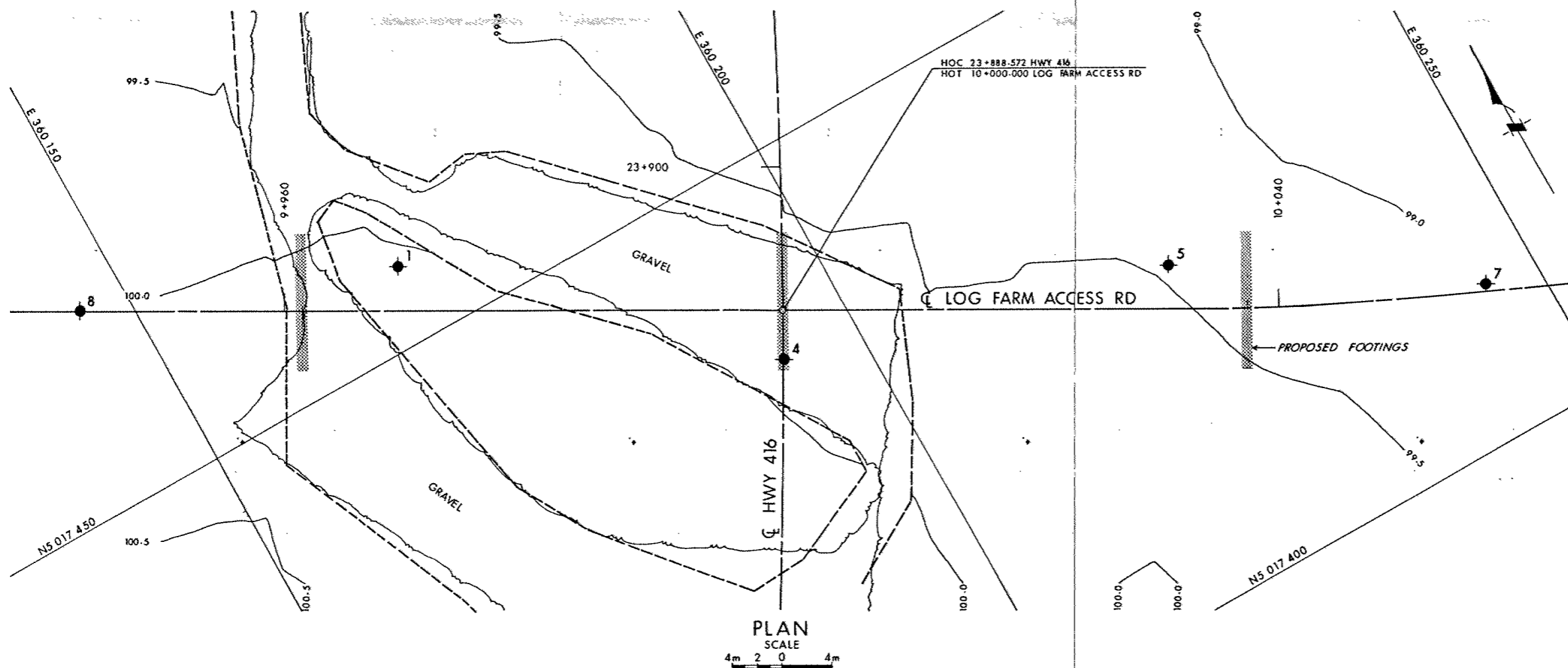
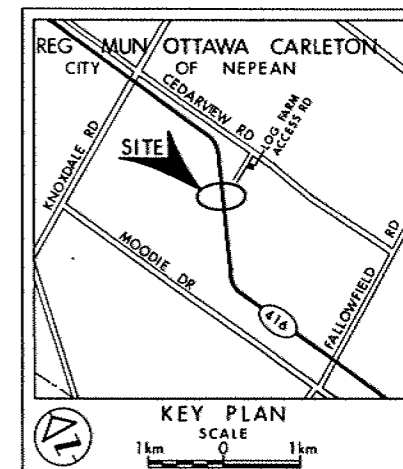
**METRIC**  
DIMENSIONS ARE IN METRES  
AND/OR MILLIMETRES UNLESS  
OTHERWISE SHOWN. STATIONS  
IN KILOMETRES + METRES.

CONT No  
WP No 122-87-03

LOG FARM ACCESS RD

SHEET

BORE HOLE LOCATIONS & SOIL STRATA



LEGEND

- Bore Hole
- ⊕ Dynamic Cone Penetration Test (Cone)
- ⊕ Bore Hole & Cone
- N Blows/0.3m (Std Pen Test, 475 J/blow)
- CONE Blows/0.3m (60° Cone, 475 J/blow)
- W L at time of investigation 90 08

No	ELEVATION	CO-ORDINATES	
		NORTH	EAST
1	100.2	5 017 456.1	360 170.2
4	99.9	5 017 434.4	360 193.5
5	99.3	5 017 425.8	360 224.2
7	99.1	5 017 412.1	360 245.7
8	100.1	5 017 465.6	360 146.1

NOTE

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

NOTE: The complete foundation investigation and design report for this project and other related documents may be examined at the Engineering Materials Office, Downsview. Information contained in this report and related documents is specifically excluded in accordance with the conditions of Section 102-2 of Form 100.

DATE	BY	DESCRIPTION
DATE	BY	DESCRIPTION
Geocres No 31G5-182		
HWY No 416		
SUBM'D MM	CHECKED	DATE 91 06 25
DRAWN DT	CHECKED	APPROVED
DIST 9		SITE 3-547
DWG 1228703-A		



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

DIST. 9  
CONT No  
WP No 122-87-03

LOG FARM ACCESS ROAD  
GENERAL ARRANGEMENT

SHEET

# GENERAL NOTES:

## CLASS OF CONCRETE:

DECK & ADJUTMENTS.....35MPa  
FOOTINGS & REMAINDER.....30MPa

## CLEAR COVER TO REINFORCING STEEL:

FOOTINGS.....100525  
ADJUTMENTS.....70920  
DECK  
TOP SLAB-TOP.....20750  
BOTTOM.....40210  
BOTTOM SLAB-TOP.....40710  
BOTTOM.....50710  
REMAINDER.....10750  
UNLESS OTHERWISE NOTED.

REINFORCING STEEL SHALL BE GRADE 400 UNLESS OTHERWISE SPECIFIED. BARS MARKED WITH "S" OR "X" "C" DENOTE COATED BARS.

## CONSTRUCTION NOTES:

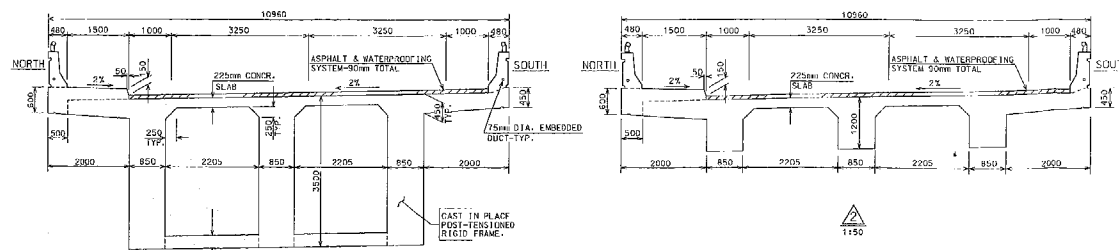
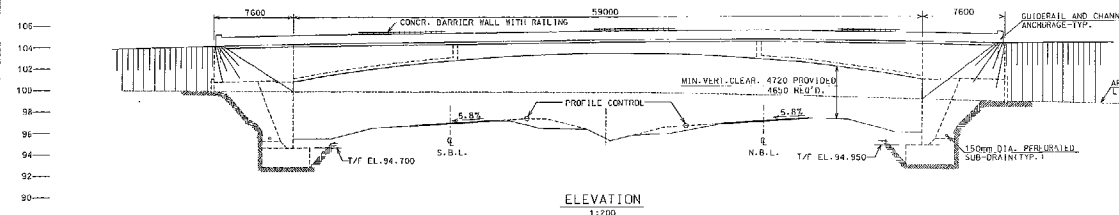
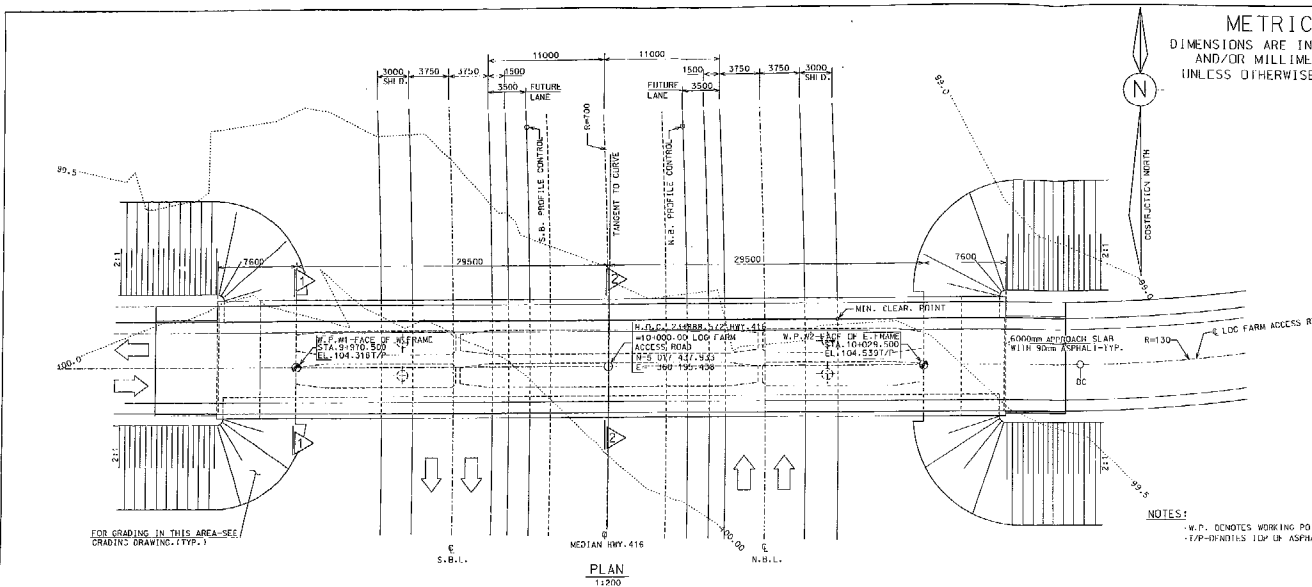
BACKFILL SHALL BE PLACED SIMULTANEOUSLY BEHIND BOTH ADJUTMENTS KEEPING THE HEIGHT OF THE BACKFILL APPROXIMATELY THE SAME. AT NO TIME SHALL THE DIFFERENCE IN ELEVATION BE GREATER THAN 100MM.

## LIST OF DRAWINGS:

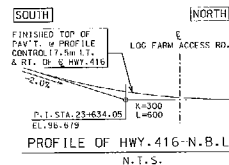
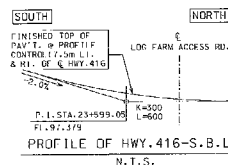
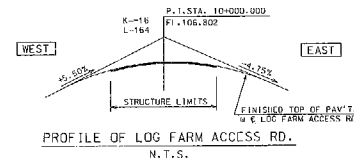
1. GENERAL ARRANGEMENT
2. BORE HOLE LOCATIONS & SOIL STRATA
3. FOOTING & FRAME DETAILS
4. DECK DETAILS
5. DECK REINFORCING I
6. DECK REINFORCING II
7. POST-TENSIONING DETAILS
8. BARRIER WALL WITH RAILING-I
9. BARRIER WALL WITH RAILING-II
10. RAILING FOR BARRIER WALL
11. GROUND APPROACH SLAB
12. AS CONSTRUCTED ELEV. & DIM.
13. STANDARD DETAILS
14. QUANTITIES I

## NOTES:

W.P. DENOTES WORKING POINTS  
T.P. DENOTES TOP OF ASPHALT PAV'T.



B.M. EL. 100.942  
N.W. IN ROOT OF 0.3 FINE  
50.31 LT. 23+615.600



DRAWING NOT TO BE SCALED  
100 mm ON ORIGINAL DRAWING

REVISIONS	DESCRIPTION
1	DESIGN & DRAWING BY: S.S.W. NING & S.S. BHATIA DATE: JULY 92
2	DRAWN: J.U. CHK'D: B.S. SITE: 3-547 STRUCT. SCHEME: 2/92