

ENGINEERING MATERIALS OFFICE  
FOUNDATION DESIGN SECTION

*CONT. 90-36*

WP 120-87-00D DIST 9

HWY 417 STR SITE N/A

A Median Retaining Wall Along the South  
Shoulder of the New Hwy. 417 W.B.L.  
from Station 16 + 675 to Station 16 + 790

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FOUNDATION INVESTIGATION REPORT  
For  
A Median Retaining Wall along the South  
Shoulder of the New Hwy. 417 W.B.L.  
from Station 16+675 to Station 16+790  
W.P. 120-87-00D  
District 9, Ottawa

INTRODUCTION

This report summarizes the information obtained from a foundation investigation carried out at the above-mentioned site during the period of 89 11 03 to 89 11 04. A 115 m long median retaining wall is proposed to construct along the South shoulder of the new Hwy. 417 Westbound lane between Sta. 16+675 and Sta. 16+790.

Four boreholes (BH #R-1 and BH #R-4) were advanced and sampled as part of this project by means of hollow stem augers. These boreholes extended down to depth of 9.6 m below the ground surface. In addition to split spoon sampling in all boreholes, cone penetration tests were conducted in the vicinity of the boreholes.

This report contains factual information obtained from this investigation together with discussion and recommendations pertaining to structure foundations, approach embankments and related earthworks for the retaining wall as shown on Drawing No. 1208700D-A.

SITE DESCRIPTION AND GEOLOGY

The proposed structure site is located in the median lane immediately north of the existing Hwy. 417 eastbound lane between Richmond Road and existing Acres Road in the City of Nepean, Ottawa-Carleton Municipality. The topography of the area is generally flat to gently undulating with the land in the immediately vicinity being used for commercial purposes. Residential development exists east of the site.

Physiographically, the site lies in the area known as the Ottawa Valley Clay Plains founded in the lowlands of the St. Lawrence. The subsoil consists of clay plains interrupted by ridges of rock or sand. Fault scarps are also

evident within the area; an illustration of the numerous normal faults that dominate the region. The bedrock in the area is of the Rockcliffe and Gull River Formations of the middle Ordovician period. It consists of interbedded fine grained quartz sandstone, silty dolostone, and limestone. The overburden was deposited during and immediately following the Wisconsin glacialiation at which time the area was depressed from the effect of the glacialiation. 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.

#### SUBSURFACE CONDITIONS

The subsoil conditions are generally quite variable across the site. The upper 4 to 6 m of the subsoil consists of interbedded layers of silty clay to clayey silt and sandy silt or silty sand. The consistency of the silty clay to clayey silt layers varies from soft to hard, whereas the denseness of the sand layers may be described as loose to compact. The stratigraphy is quite irregular and reference should be made to the individual borehole log sheets. Beneath this layered deposit is a deposit of sandy silt to sand. The denseness of this deposit generally varies from loose to dense. However, this deposit was not proven for the full depth.

It should be noted that in the vicinity of the east end of retaining wall near BH #R-4 a layer of silty clay to clayey silt is gradually diminished. In stead, silty sand with some clayey silt layers was encountered at BH #R-4. In certain areas sand fill was encountered near the road way at two boreholes (BH #R-1 and #R-2).

A detailed description of the subsurface conditions encountered is given below.

#### Fill material

The fill material was encountered in the vicinity of the west portion of the site at two borehole locations (BH #R-1 and #R-2). This fill consists of a brown sand and gravel. The thickness of this layer is found to be 1.4 m at both boreholes as shown on the Record of Borehole sheets. No Grain size distribution

analysis was carried out. However, through visual observation, it is apparent that the fill material can be classified as a sand and gravel.

#### Silty Clay to Clayey Silt

This stratum was encountered in most of the boreholes except near the east portion of the site (BH #R-4). This material consists of a silty clay to clayey silt ranging in thickness between 1.5 and 2.3 m. The material is grey in colour.

Three Atterberg Limit Tests were performed on these samples and the results are plotted on Figure 1 and summarized as follows:

<u>Property</u>	<u>Range (%)</u>	<u>Average (%)</u>
Natural Moisture Content (w)	25.0-46.5	34.7
Liquid Limit ( $w_L$ )	21.0-43.0	38.0
Plastic Limit ( $w_p$ )	14.0-19.0	16.7
Plasticity Index ( $I_p$ )	17.0-26.0	21.3

From the plasticity chart (see Figure 1) it is evident that the layer can be classified as an inorganic silty clay to clayey silt with intermediate to low plasticity (CI or CL).

Grain size distribution tests were carried out on these materials. Figure 2 in the Appendix shows the results.

Undrained shear strength of the soil was determined by in situ vane tests. The results are plotted on the Record of Borehole sheets in Appendix. As shown on the borehole logs, in situ vane tests were not successful probably due to some sand seam within this layer. However based on the Standard Penetration Tests, the soil has generally a soft to stiff consistency.

#### Clayey Silt with Interbedded Layers of Sandy Silt

This deposit occurred underlying the silty clay to clayey silt layer or underlying a thick layer of silty sand to a depth of 4.4 to 6.3 m. The thickness of the individual layers varies between 0.7 m at BH #R-2 and 5.6 m at BH #R-3.

The results from five Atterberg Limit Tests performed on this material are summarized as follows:

<u>Property</u>	<u>Range (%)</u>	<u>Average (%)</u>
Natural Moisture Content (w)	15.0-33.5	27.7
Liquid Limit (w <sub>L</sub> )	21.0-26.5	23.9
Plastic Limit (w <sub>p</sub> )	11.5-14.5	13.1
Plasticity Index (I <sub>p</sub> )	8.5-14.0	10.8

From the plasticity chart (Figure 3), it is evident that the layer can be classified as an inorganic clayey silt with interbedded sandy silt with low plasticity (CL).

Grain size distribution tests were carried out on these materials. Figure 4 in the Appendix shows the results in an envelope form.

Undrained shear strength measurements were determined by in situ vane tests and the result varies from 58 to 68 kPa. Due to the irregular nature of the deposit, that reveals numerous seams and layers of sandy silt interbedded within the clayey silt, the results provided in the above are not necessarily indicative of the shear strength of the clayey silt portion. In view of this consideration, the consistency of the clayey silt portion can be described as firm to stiff. The sandy silt portion was generally very loose in denseness. For design purposes, an undrained shear strength of 65 kPa can be assumed for this stratum.

#### Silty Sand to Sand

This deposit encountered at various depths from ground surface to the end of boreholes. However, below an elevation of about 60.6 m, this granular deposit extended as a continuous layer to proven depth of 9.6 m below the ground surface. The thickness of the layers varies from 0.7 to 5.2 m.

This deposit contains minor variations in gravel content throughout its thickness. Generally, the deposit contains trace of gravel, but at some

locations, considerable gravel was encountered. Grain size distribution analysis indicate that the soil varies between a silty sand to sand. This layer is basically non-plastic. Figure 5 in the Appendix shows the results of grain size distribution tests in an envelope form.

In this stratum, the 'N' values generally ranged from 2 to 36 blows/0.3 m indicating a state of compaction described as very loose to dense.

However, at certain locations no resistance was encountered and the samples penetrated by its own weight. This may be attributed to 'boiling' of subsoil due to unbalanced hydrostatic head and consequently do not represent the undisturbed denseness of the soil.

No rock samples was cored at the location.

#### GROUNDWATER CONDITIONS

Observation of the groundwater level was carried out by measuring the water level in the open boreholes. Groundwater level in the boreholes was found to range from 60.9 m at BH #R-1 to 63.7 m at BH #R-4 which corresponds to depths of 4.5 m to 2.5 m below the existing ground surface.

## DISCUSSION AND RECOMMENDATIONS

The recommendations in this report apply to the retaining wall and related approaches.

It is proposed to construct a 115 m long median retaining wall ranging in height from 1 m to about 2 m.

Based on the site investigation, the foundation recommendations for the design of the retaining wall are as follows.

### Retaining Wall Foundation

The proposed retaining wall be supported on spread footings within the stiff silty clay to clayey silt deposit or clayey silt with sandy silt layers at or below the original ground surface.

For the purpose of the O.H.B.D.C., the following design values are recommended.

Factored Bearing Capacity at U.L.S.	250 kPa
Bearing Capacity at S.L.S. Type II	150 kPa

All footings must be minimum cover of 1.8 m for frost protection. It should be noted that the subsoil be not disturbed by construction or related activities. It is recommended that a working slab be placed to protect the footing founding soil within 4 hours of exposure.

Alternatives, such as reinforced earth wall, geo-crete wall or unilock wall, can also be considered. However, it should be noted that if any alternatives are considered, this office will provide further information.

### Other Considerations

Free draining material such as Granular 'A' or Granular 'B' is recommended as appropriate backfill to the retaining wall to prevent hydrostatic pressure build-up.

Design parameters of the soil are given below for purpose of the O.H.B.D.C.

	<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 ( $K_A$ )	0.27	0.33

Lateral pressures should be computed in accordance with Section 6.6.1.2.1 of the code. A yielding foundation condition may be assumed. Sliding resistance may be computed by assuming an adhesion of 75 kPa to apply between underside of footings and the founding soil. Weep holes in the retaining walls should be designed to drain any accumulation of water in the backfill.

#### Dewatering

No major dewatering difficulties are anticipated for footing excavations in consideration of the low groundwater level and the relatively low permeability of the cohesive foundation soils. However, if localized seepage or surface water do accumulate in excavations, it can be controlled by perimeter ditches and pumping from sumps.

Temporary cuts should not be steeper than 1H:1V slope. It should be noted that cut slope should not be left for a long period of time in order to prevent slope failure due to sudden rainfall.

#### MISCELLANEOUS

The fieldwork for this investigation was carried out under the supervision of Tae C. Kim, Foundation Design Engineer, and Dale Colquhoun, visiting Engineer from Jamaica. The equipment was owned and operated by Marathon Drilling Co. and Johnston Drilling Co., Ottawa.



The project was carried out by Tae C. Kim under the general supervision of Dr. B. Iyer. This report was written by Tae C. Kim, Foundation Design Engineer, reviewed by Dr. B. Iyer, Sr. Foundation Engineer and approved by M. Devata, Chief Foundation Engineer.



*Tae C. Kim*

Tae C. Kim, P.Eng.

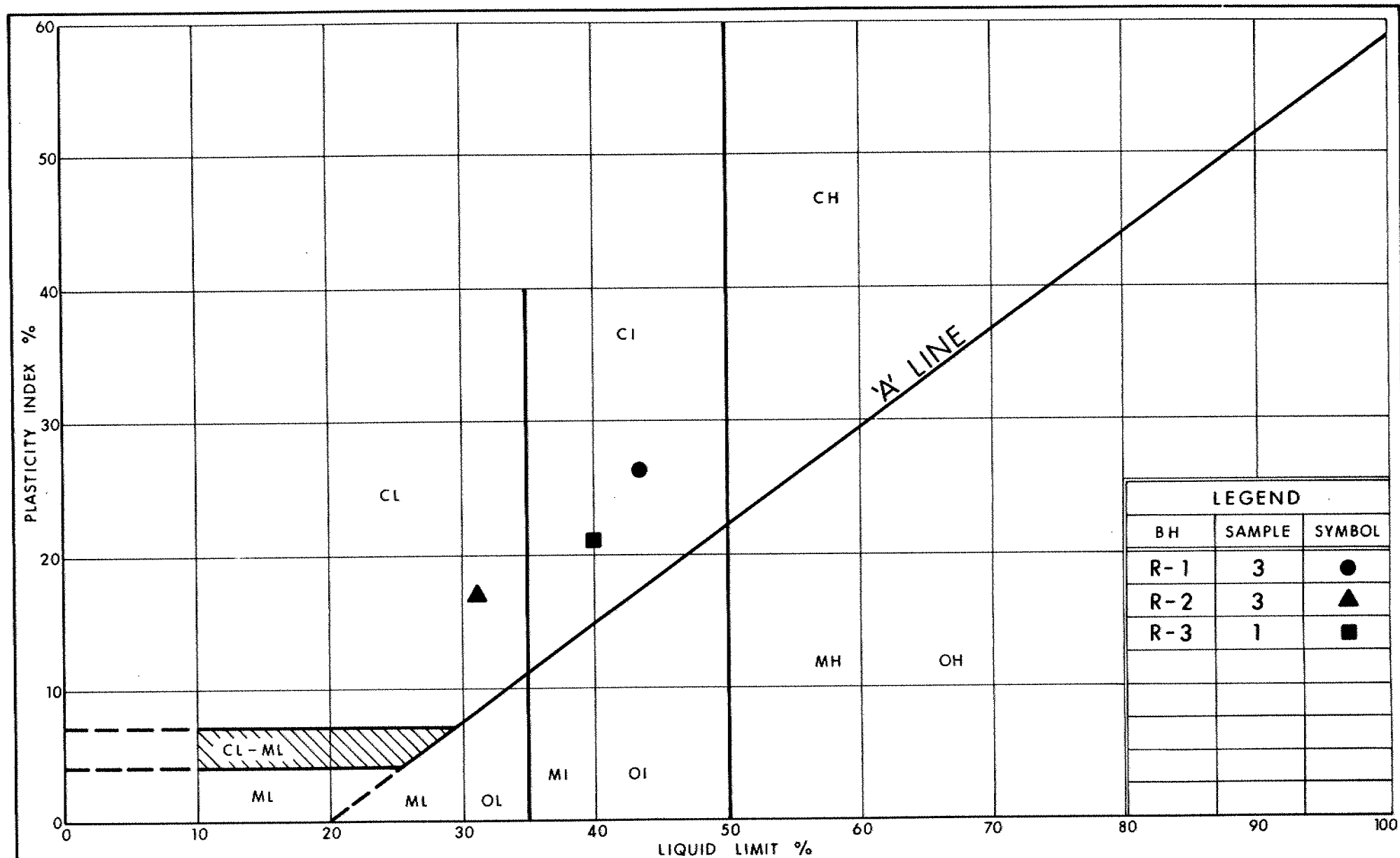
Foundation Design Engineer

*M. Devata*

M. Devata, P.Eng.

Chief Foundation Engineer

## APPENDIX



Ministry of  
Transportation

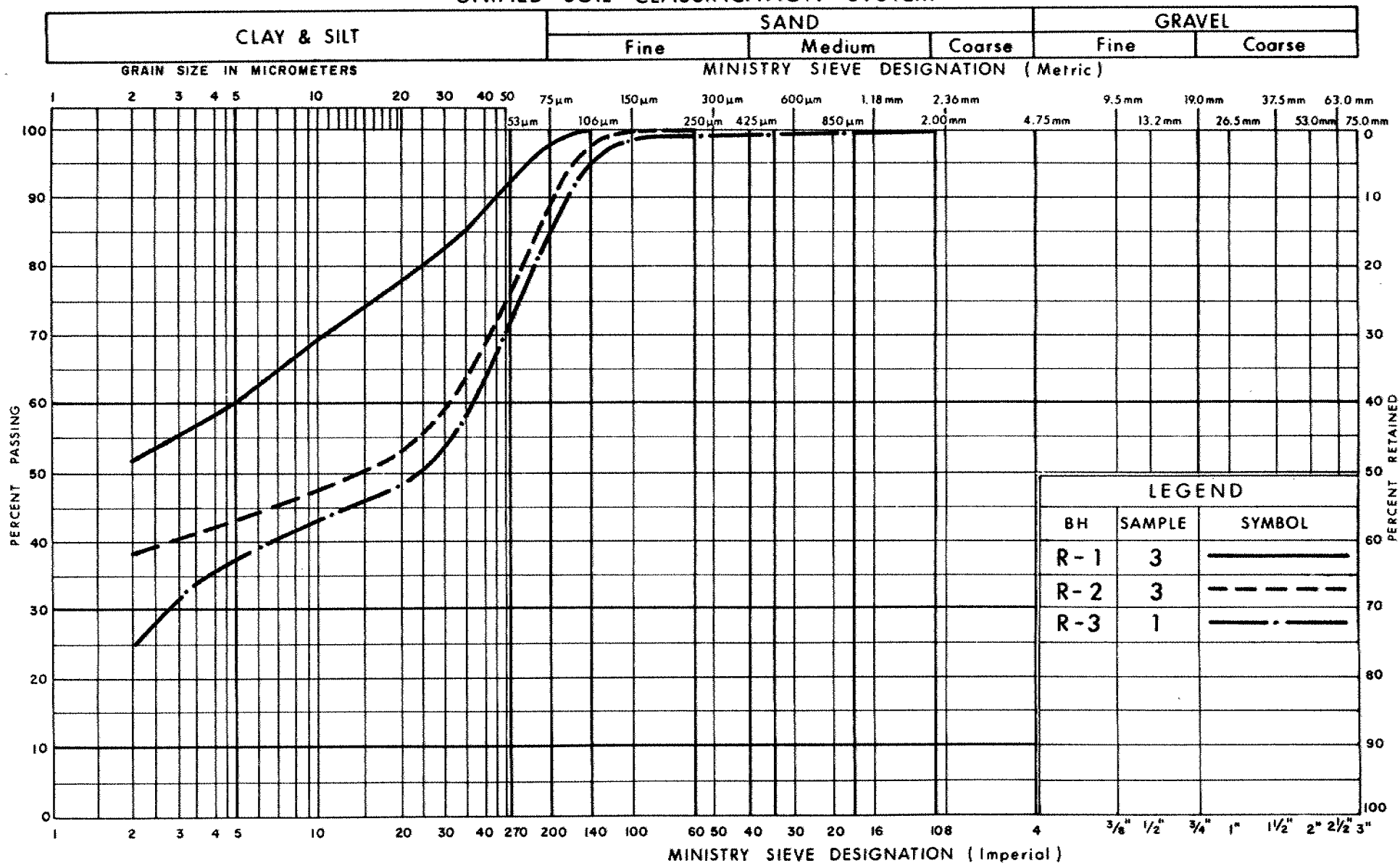
Ontario

# PLASTICITY CHART SILTY CLAY TO CLAYEY SILT

FIG No 1

W P 120-87-00 D

## UNIFIED SOIL CLASSIFICATION SYSTEM

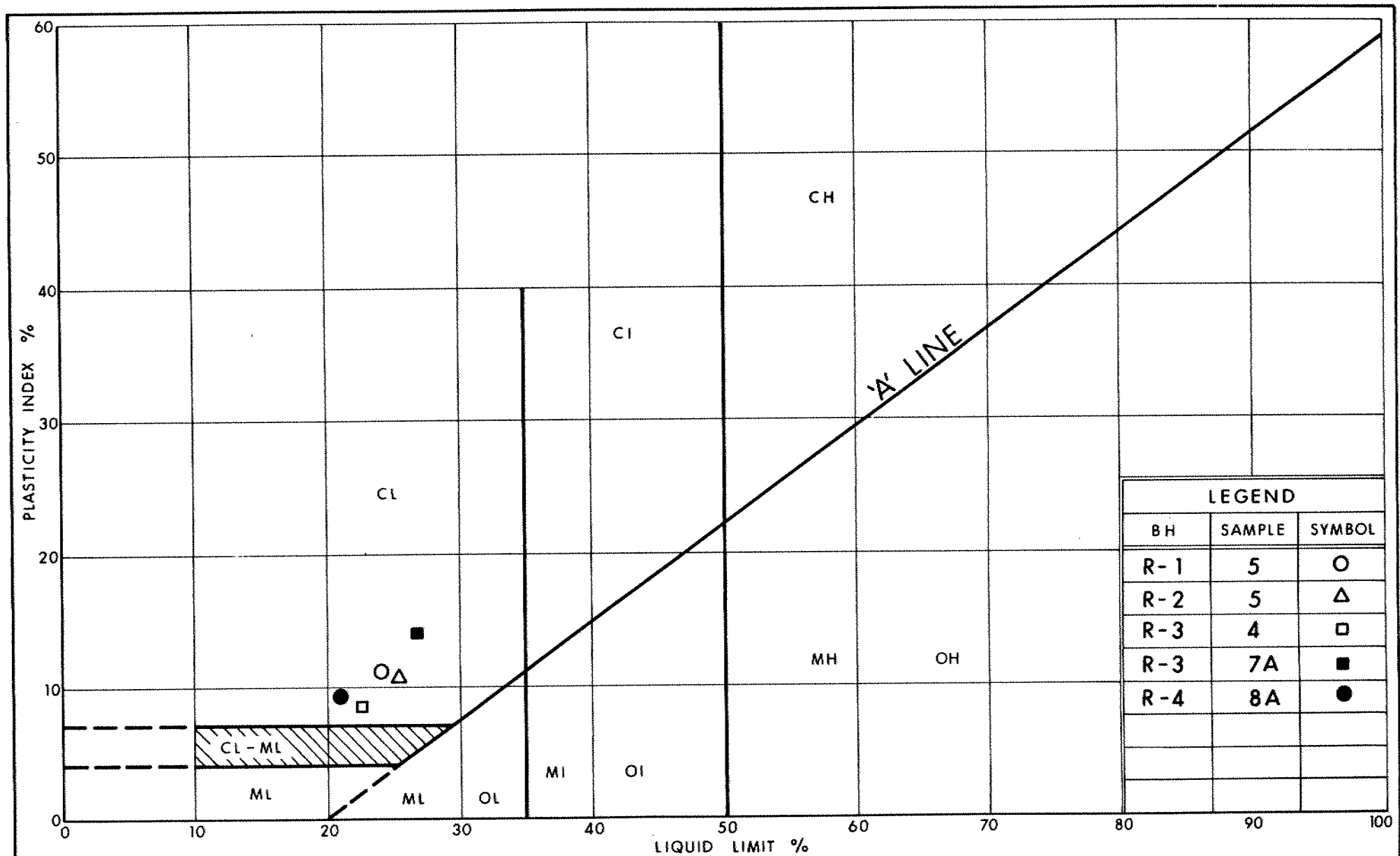


Ministry of  
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GRAIN SIZE DISTRIBUTION  
SILTY CLAY TO CLAYEY SILT

FIG No 2

W P 120-87-00 D



Ontario

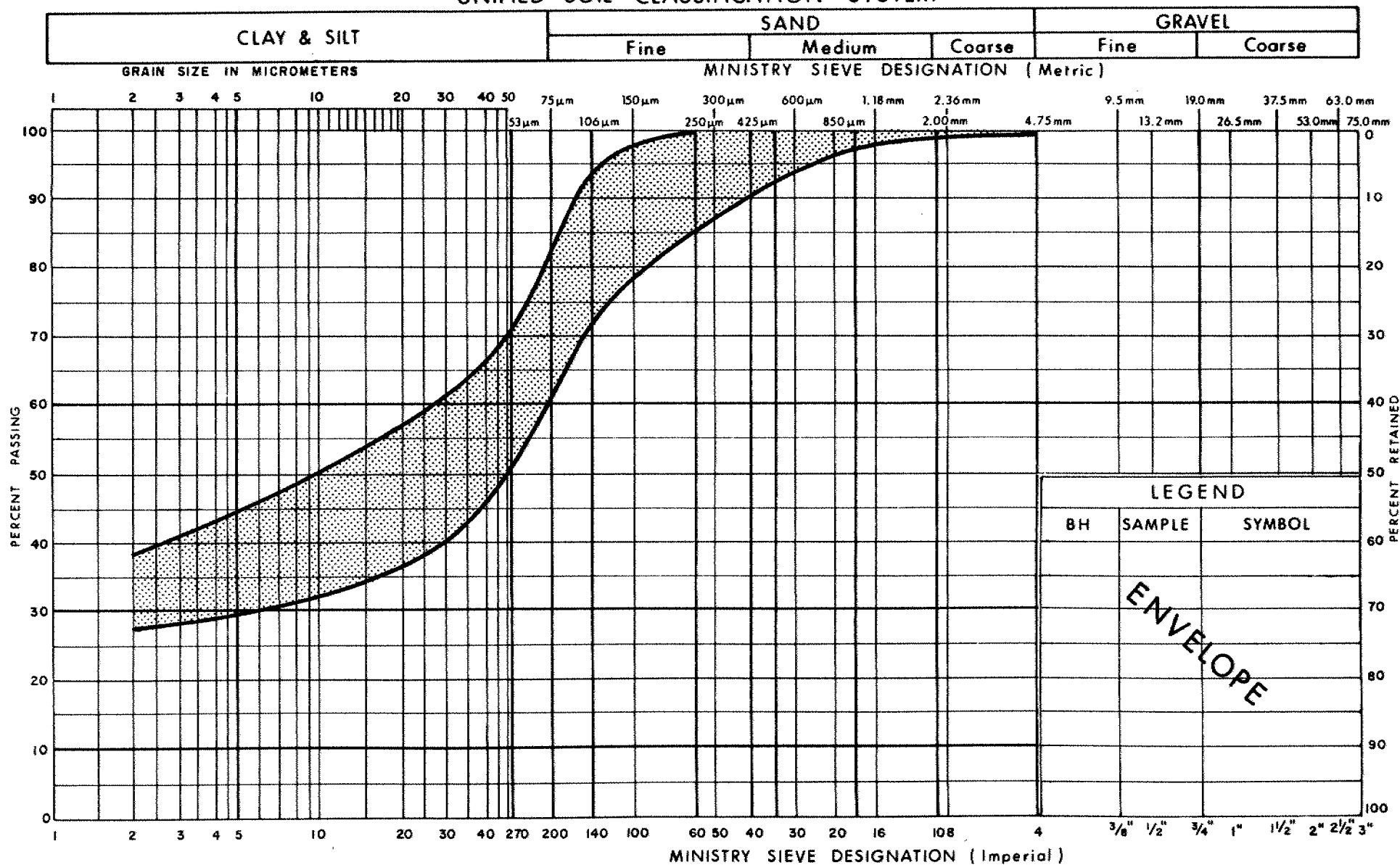
Ministry of  
Transportation

# PLASTICITY CHART CLAYEY SILT WITH INTERBEDDED SANDY SILT

FIG No 3

W P 120-87-00 D

## UNIFIED SOIL CLASSIFICATION SYSTEM



Ministry of  
Transportation

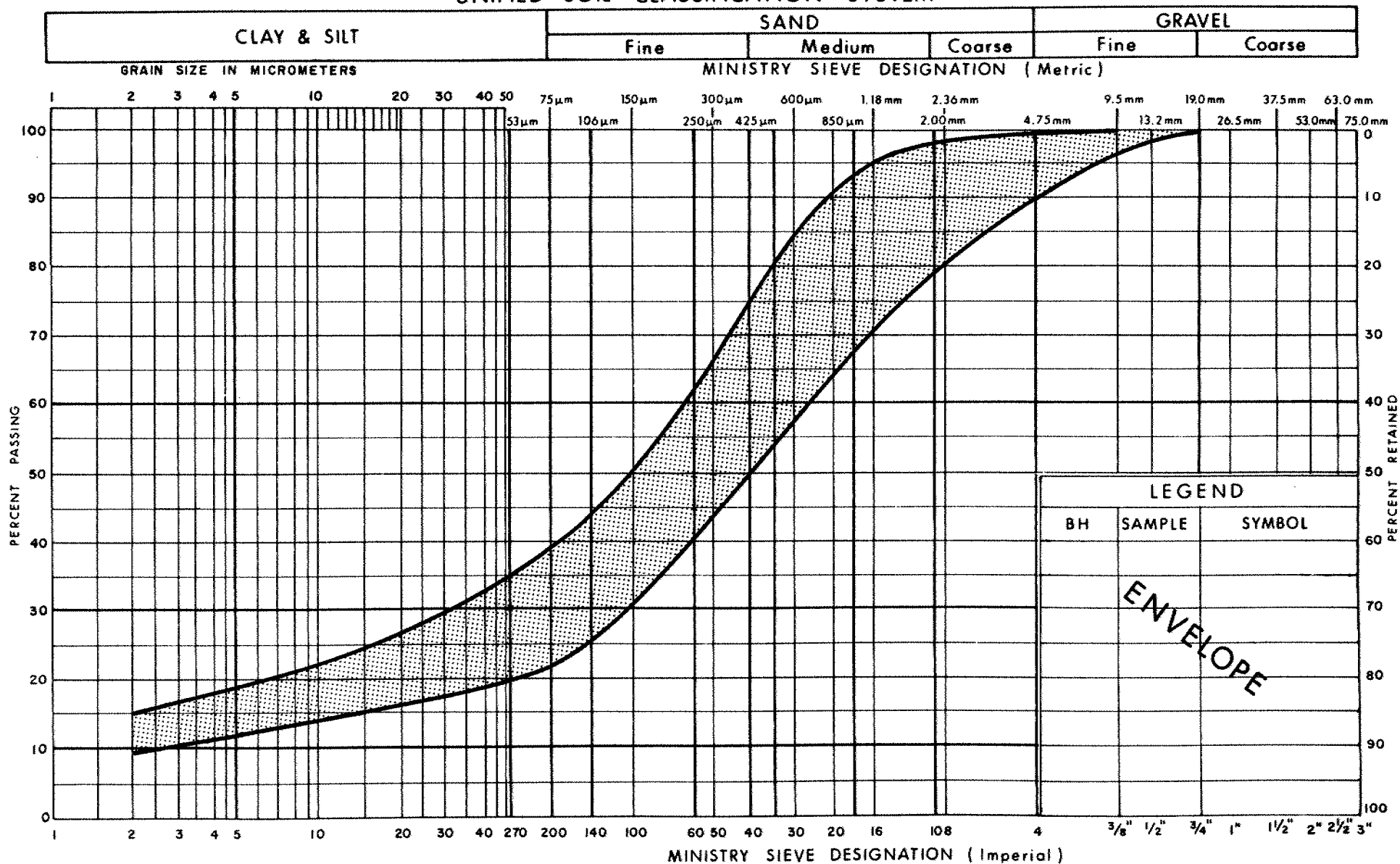
## GRAIN SIZE DISTRIBUTION

### CLAYEY SILT WITH INTERBEDDED SANDY SILT

FIG No 4

WP 120-87-00D

## UNIFIED SOIL CLASSIFICATION SYSTEM



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**GRAIN SIZE DISTRIBUTION**  
**SILTY SAND TO SAND TRACE TO SOME GRAVEL**

FIG No 5

W P 120-87-00D

## 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

$m_v$	$\text{kPa}^{-1}$	COEFFICIENT OF VOLUME CHANGE
$C_c$	1	COMPRESSION INDEX
$C_s$	1	SWELLING INDEX
$C_\alpha$	1	RATE OF SECONDARY CONSOLIDATION
$c_v$	$\text{m}^2/\text{s}$	COEFFICIENT OF CONSOLIDATION
H	m	DRAINAGE PATH
$T_v$	1	TIME FACTOR
U	%	DEGREE 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
$\gamma_u$	1	PORE PRESSURE RATIO
$\sigma$	kPa	TOTAL NORMAL STRESS
$\sigma'$	kPa	EFFECTIVE NORMAL STRESS
$\tau$	kPa	SHEAR STRESS
$\sigma_1, \sigma_2, \sigma_3$	kPa	PRINCIPAL STRESSES
$\epsilon$	%	LINEAR STRAIN
$\epsilon_1, \epsilon_2, \epsilon_3$	%	PRINCIPAL STRAINS
E	kPa	MODULUS OF LINEAR DEFORMATION
G	kPa	MODULUS OF SHEAR DEFORMATION
$\mu$	1	COEFFICIENT OF FRICTION

### PHYSICAL PROPERTIES OF SOIL

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



# RECORD OF BOREHOLE No R-1

METRIC

W P 120-87-00D LOCATION Co-ords: N 5 022 796.4; E 358 855.0 ORIGINATED BY DC  
 DIST 9 HWY 416/417 BOREHOLE TYPE H.S. Auger and Cone Test COMPILED BY TCK  
 DATUM Geodetic DATE 89 11 03 CHECKED BY TCK

OFFICE REPORT ON SOIL EXPLORATION

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE	PLASTIC LIMIT W <sub>p</sub> NATURAL MOISTURE CONTENT W LIQUID LIMIT W <sub>L</sub> WATER CONTENT (%) 10 20 30	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES						
66.2	Ground Surface										
0.0	Sand and Gravel (Fill)		1	SS	19						
64.8	Brown Grey		2	SS	9						
1.4	Silty Clay to Clayey Silt Soft to Stiff		3	SS	2						
62.5			4	SS	13						
3.7	Silty Sand, Compact		5	SS	1						
61.8	Clayey Silt With Interbedded Sandy Silt Soft to Firm		6	SS	2						
4.4			7	SS	11						
59.9			8	SS	13						
6.3	Silty Sand to Sand, Trace to Some Gravel Loose to Compact										
56.6											
9.6	End of Borehole										
55.5											
10.7	End of Cone Test										

# RECORD OF BOREHOLE No R-2

METRIC

W P 120-87-00D LOCATION Co-ords: N 5 022 805.0; E 358 903.0 ORIGINATED BY DC  
 DIST 9 HWY 416/417 BOREHOLE TYPE H.S. Auger and Cone Test COMPILED BY TCK  
 DATUM Geodetic DATE 89 11 04 CHECKED BY TCK

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100	20 40 60 80 100	20 40 60 80 100					
66.2	Ground Surface														GR SA SI CL
0.0	Sand and Gravel Compact (Fill)		1	SS	15		66								
64.8	Brown														
1.4	Grey		2	SS	7		64								0 11 51 38
63.3	Silty Clay to Clayey Silt Firm		3	SS	4										
2.9	Silty Sand, Loose		4	SS	PH										
62.5	Clayey Silt With Interbedded Sandy Silt Layers Soft		5	SS	1		62								0 19 44 37
61.8			6	SS	1										
4.4															
	Silty Sand to Sand, Trace to Some Gravel		7	SS	5		60								
	Loose to Compact		8	SS	11		58								11 68 13 8
56.6	Clayey Silt		9	SS	8										
9.6	End of Borehole														



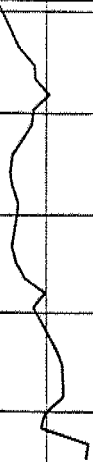
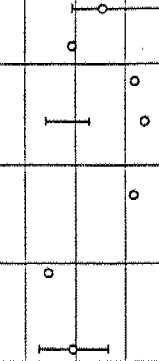





OFFICE REPORT ON SOIL EXPLORATION



# RECORD OF BOREHOLE No R-3

METRIC

W P 120-87-00D LOCATION Co-ords: N 5 022 814.1; E 358 952.1 ORIGINATED BY DC  
DIST 9 HWY 416/417 BOREHOLE TYPE H.S. Auger and Cone Test COMPILED BY TCK  
DATUM Geodetic DATE 89 11 04 CHECKED BY TCK

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT	PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	UNIT WEIGHT  Y	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100	W <sub>p</sub>	W	W <sub>L</sub>			WATER CONTENT (%)
66.2	Ground Surface												GR SA SI CL	
0.0	Grey Silty Clay to Clayey Silt Stiff		1	SS	8		66						0 13 64 23	
64.5			2	SS	21		64						0 61 24 15	
1.7	Silty Sand		3	SS	3		62	2.9					0 29 44 27	
	Clayey Silt With Interbedded Sandy Silt Layers Soft to Stiff		4	SS	2		60						3 57 27 13	
60.6			5	SS	2		58						1 33 42 24	
5.6	Silty Sand to Sand Trace to Some Gravel		6	SS	3									
	Clayey Silt		7	SS	7									
56.6	Loose to Compact		8	SS	34									
9.6	End of Borehole													

OFFICE REPORT ON SOIL EXPLORATION



# RECORD OF BOREHOLE No R-4

METRIC

W P 120-87-00D LOCATION Co-ords: N 5 022 822.8; E 359 002.3 ORIGINATED BY DC  
DIST 9 HWY 416/417 BOREHOLE TYPE H.S. Auger and Cone Test COMPILED BY TCK  
DATUM Geodetic DATE 89 11 03 CHECKED BY TCK

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100	20 40 60 80 100	20 40 60 80 100	20 40 60 80 100		
66.2	Ground Surface												
0.0	Silty Sand With Some Clayey Silt Layers  Very Loose to Compact		1	SS	9		66						0 38 48 14
			2	SS	7		64						
			3	SS	3								
			4	SS	2								
			5	SS	2								
59.8	Silty Sand to Sand, Trace to Some Gravel Loose to Dense		6	SS	17		60						1 72 17 10
6.4			7	SS	2								
56.6	Clayey Silt		8	SS	36		58						3 73 14 10
9.6	End of Borehole												

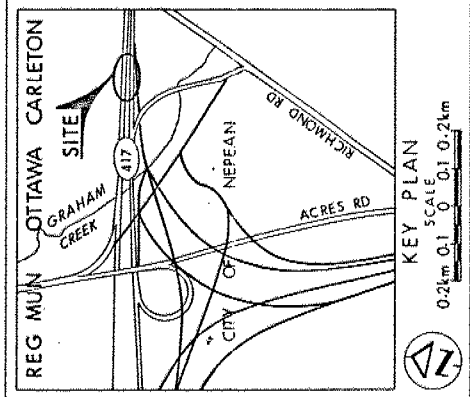
OFFICE REPORT ON SOIL EXPLORATION

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

CONT No  
WP No 120-87-00D

RETAINING WALL-HWY 417 WBL  
STA 16+675 TO STA 16+790  
BORE HOLE LOCATIONS & SOIL STRATA

SHEET



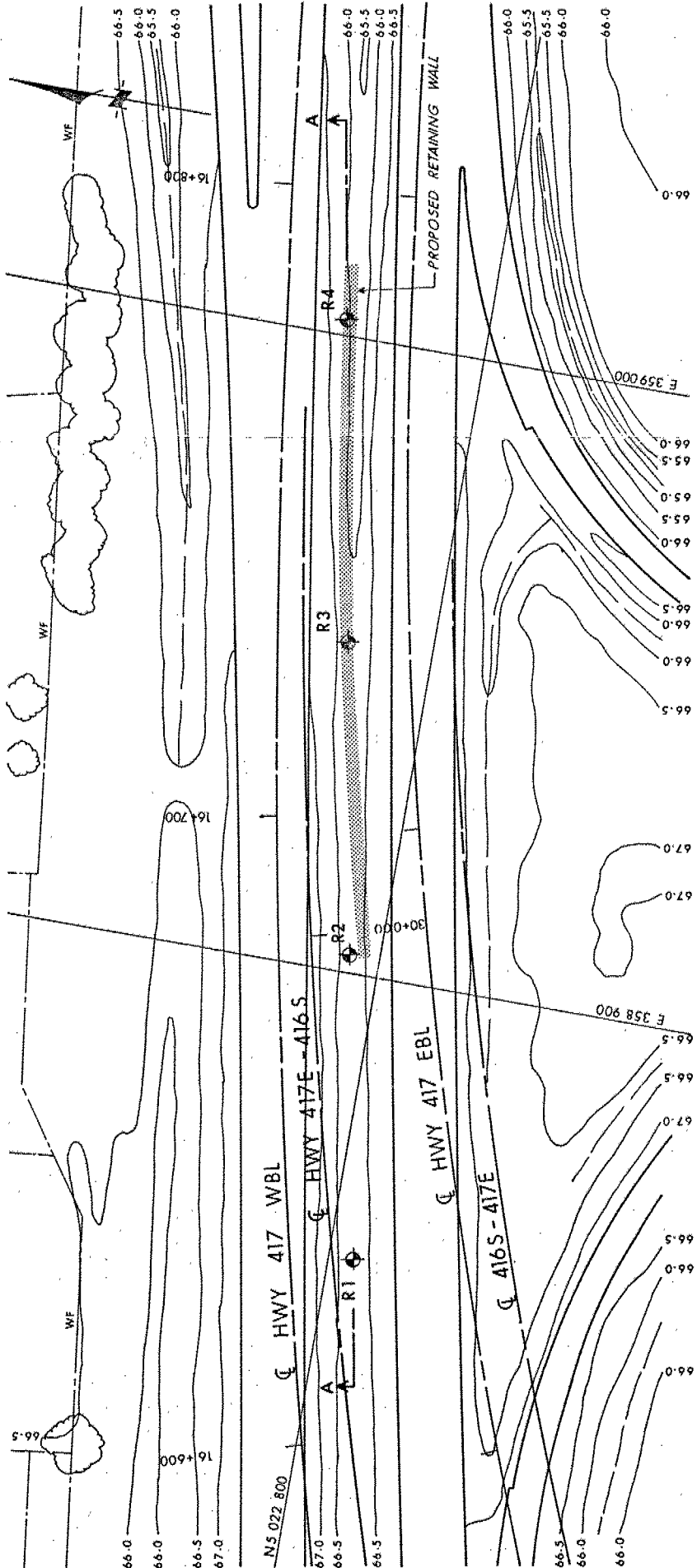
- LEGEND
- Bore Hole
  - Dynamic Cone Penetration Test (Cone)
  - Bore Hole & Cone
  - N Blows/0.3m (Std Pen Test, 475 J/blow)
  - CONE Blows/0.3m (60° Cone, 475 J/blow)
  - WL at time of investigation 89 11

No	ELEVATION	CO-ORDINATES	
		NORTH	EAST
R-1	66.2	5 022 796.4	358 855.0
R-2	66.2	5 022 805.0	358 903.0
R-3	66.2	5 022 814.1	358 952.1
R-4	66.2	5 022 822.8	359 002.3

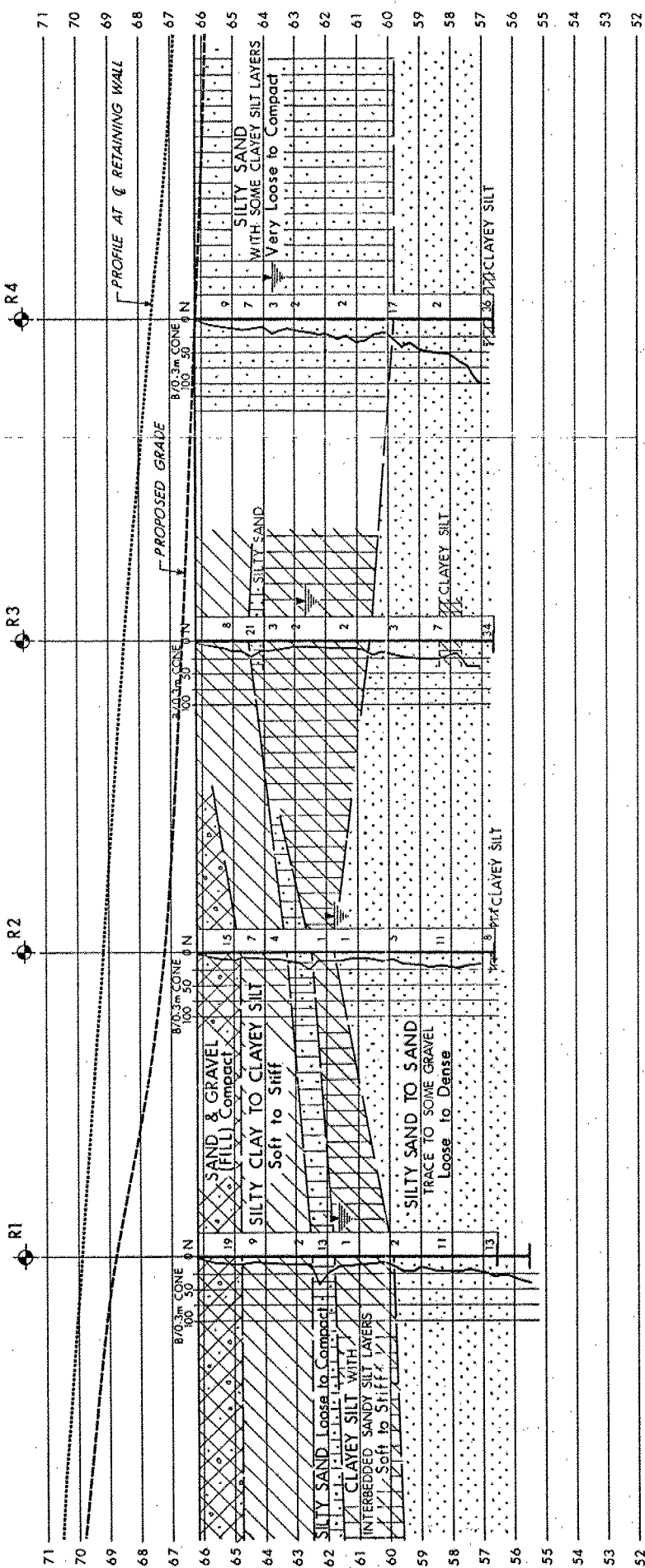
NOTE: The boundaries between soil strata have been established only on Bore Hole locations. Between Bore Holes the boundaries are assumed from geological evidence.

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
16/7/47		
Geocres No 3105-175		
HWY No. 416/417		
SHEET NO. 416/417		
DATE 90 02 23		
SITE		
DRAWN BY CHECKED BY		
DWG 1208700D-A		



PLAN  
SCALE  
10m 0 10m

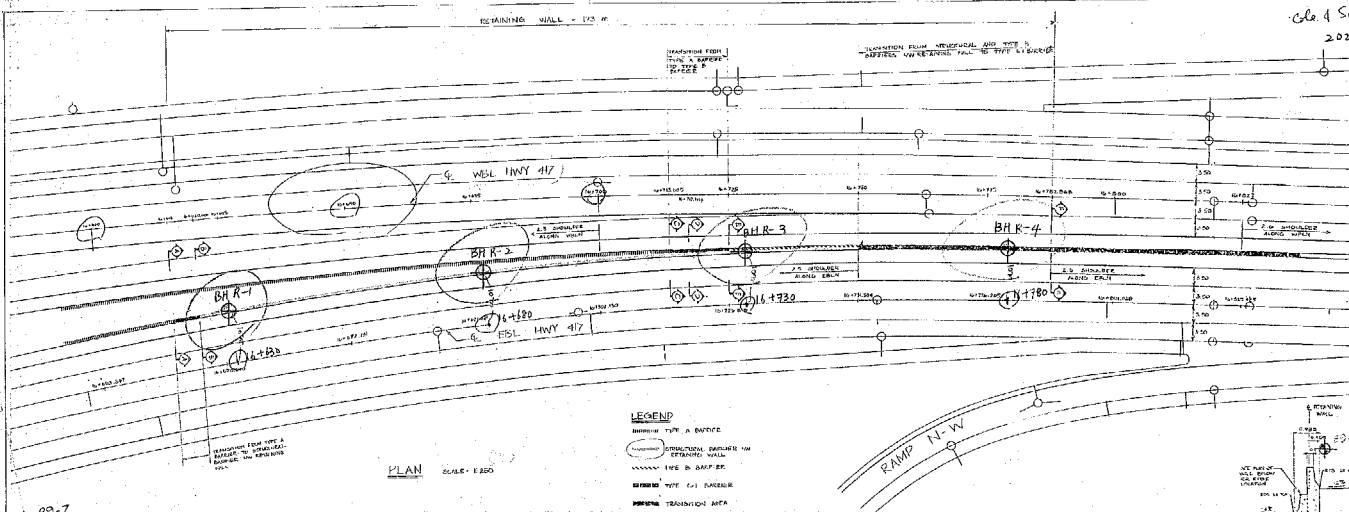


SECTION A-A  
SCALE  
10m 2m 10m Hor 2m Vert

491-4503

Clas 4 Shann  
2025 Shopp rd. C.  
Wetzel, Ov  
m2 8 1 W3

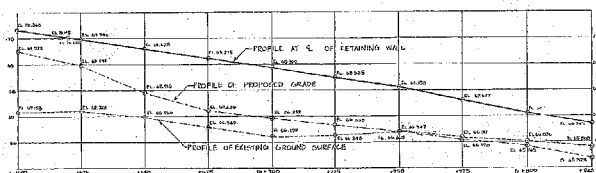
Stan Leppan



## LEGEND

- BRIDGE TYPE A BRIDGE
- STRUCTURAL BARriers IN RETAINING WALL
- TYPE B BRIDGE
- TYPE C BRIDGE
- TRANSITION AREA

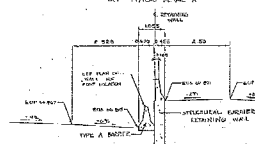
PLAN SCALE: 1:500



PROFILE - RETAINING WALL

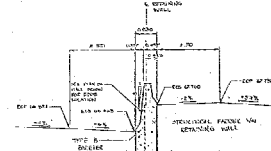
SCALE: 1:100

NOTE: FOR EACH OF SHAPES OF BRIDGE AT CONCRETE BRIDGES AND RETAINING WALL, SEE 'TYPICAL' DETAIL 'A'.



SECTION C-C SCALE: 1:50

STA. 1+710.025 (N.S.)

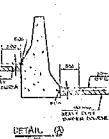


SECTION E-E SCALE: 1:50

STA. 1+725.0 (N.S.)

SECTION D-D SCALE: 1:50

STA. 1+717.100 (N.S.)



DETAIL

PLAN - RETAINING WALL &amp; BRIDGE

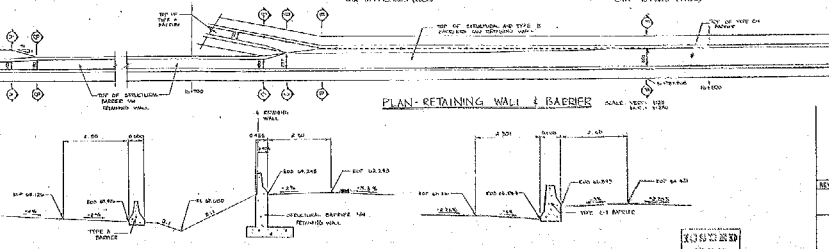
SCALE: 1:500



SECTION A-A

SCALE: 1:50

STA. 1+710.0 (N.S.)



SECTION B-B

SCALE: 1:50

STA. 1+710.0 (N.S.)

SECTION F-F

SCALE: 1:50

STA. 1+710.0 (N.S.)

COLL. SHERMAN ASSOCIATES LTD.

PRELIMINARY

REV.	DATE	DESCRIPTION
1	12/15/80	COLL. SHERMAN
2	12/15/80	MINISTRY OF TRANSPORTATION
3	12/15/80	PROPOSED TREATMENT OF CONCRETE BRIDGE
4	12/15/80	FOR RETAINING WALL BETWEEN E&A & W&A P&T
5	12/15/80	FROM STA. 1+710.0 TO STA. 1+730.0
6	12/15/80	27688-51