

FILE COPY



Ministry  
of  
Transportation

---

## **FOUNDATION DESIGN SECTION**

**foundation  
investigation and  
design report**

ENGINEERING MATERIALS OFFICE  
FOUNDATION DESIGN SECTION

*CONT 95-09*

WP 70-85-02

DIST 2

HWY 7

STR SITE 19-47

Ausable River Bridge  
at West Limits of Ailsa Craig

DISTRIBUTION

A. Ho (2)

C.M. Bond

A.E. Irving

E.J. Zavitski (2)

K.G. Bassi

S.J. Dunham

E.A. Joseph

G. Laithwaite (Cover Only)

F. Bacchus (Cover Only)

File ✓

# FOUNDATION INVESTIGATION REPORT

For

Ausable River Bridge

at West Limits of Ailsa Craig

W.P. 70-85-02, Site 19-47

Highway 7, District 2, London

## INTRODUCTION

This report contains the results of a soils investigation carried out at the above mentioned site. The field work for this project was carried out between 1991 10 23 and 1991 11 05, and comprised of four sampled boreholes and Dynamic Cone Penetration Test adjacent to two of the boreholes.

Boreholes were advanced to a maximum depth of 27.5 m (El: 200) below the existing ground level. Two of the boreholes which are located in the river bed were advanced using a diamond drill and other two holes were advanced by employing a continuous flight auger machine equipped with 82 mm I.D. hollow stem auger and BW casing.

## SITE DESCRIPTION

The site under investigation is located at the crossing of Hwy. 7 and Ausable River at the west limits of Ailsa Craig in the Township of East Williams.

In this area, the Ausable River follows the depression in front of the moraines. The topography of the site on the west side of the Ausable River is generally undulating with morainic ridges. However, on the east side of the river, the topography is generally flat with isolated swamps to the southeast. Physiographically, the area is located in the region known as the "Horseshoe Moraines".

## SUBSURFACE CONDITIONS

### General

The approach embankment fill on the east side of the river is underlain by 4.3 m of loose to compact silty sand to sandy silt with occasional clayey silt seams and, on the west side, the fill is underlain by 2.6 m of stiff to very stiff clayey silt which overlies 2.3 m of very dense silty sand to sandy silt. However, the underlying subsoil in the project area consists of 11.9 m to 15.4 m of very stiff to hard silty clay to clayey silt underlain by hard heterogeneous mixture of clayey silt, sand and gravel with boulders near the terminal depth. For classification purposes, the soils encountered at this site can be divided into five different zones.

- a) Embankment Fill
- b) Clayey Silt
- c) Silty Sand to Sandy Silt
- d) Silty Clay to Clayey Silt, Trace of Sand, Trace of Gravel
- e) Heterogeneous Mixture of Clayey Silt, Sand & Gravel (Glacial Till)

The subsurface conditions encountered during the course of the investigation, together with the field and laboratory test results are shown on the Record of Borehole Sheets contained in the Appendix of this report. A stratigraphical section is shown on Drawing No. 708502-A. This drawing also shows the locations and elevations of the borings. Description of the strata encountered are given below.

### Embankment Fill

The approach embankment fill on the east side of the river consists of 3.1 m of loose silty sand with gravel underlain by 1.8 m of firm to stiff clayey silt. However, on the west side of the river, the fill consists of 2.9 m of stiff clayey silt.

### Clayey Silt

This clayey silt deposit was encountered immediately below the fill on the west side of the river. The thickness of the clayey silt layer is about 2.6 m and extends to elevation 225.2. The natural moisture content was observed in the range of 20.5% to 27%. The Atterberg Limits determined for the representative soil samples of this deposit are shown on Figure 1. The Standard Penetration Test values were observed to vary from 12 blows/0.3 m to 21 blows/0.3 m. The consistency may be classified as stiff to very stiff.

### Silty Sand to Sandy Silt

Considering the difference in geological origin of this deposit on both sides of the river, the descriptions are given separately.

This deposit, on the west side of the river, was encountered immediately below the clayey silt layer. The thickness of the layer was observed to be about 2.3 m and extends to elevation 222.9. The Standard Penetration Test values were observed to vary from 62 blows/0.3 m to 144 blows/0.3 m, indicating very dense state of denseness.

This silty sand to sandy silt deposit, on the east side of the river, was encountered immediately below the fill. Occasional clayey silt seams as well as organics were observed in this deposit. The thickness of this layer was observed to be about 4.3 m and extends to elevation 218.3. The Standard Penetration Test values (5 blows/0.3 m to 13 blows/0.3 m) indicate loose to compact denseness.

### Silty Clay to Clayey Silt, Trace of Sand, Trace of Gravel

In the approach embankment area, this clayey deposit was encountered at about 7.8 m to 9.2 m (El: 222.9 to 218.3) below the existing ground level. However, in the river bed, it was encountered at about 0.15 m to 0.5 m (El: 219.1 to El: 217.6) below the river bed level. The thickness of this layer varies from 11.7 m to 15.4 m and extends to elevations 207.7 to 206.2. The natural moisture content

was observed in the range of 17% to 21%. The Atterberg Limits determined for the representative soil samples of this deposit are shown on Figure 2. The Standard Penetration Test values (17 blows/0.3 m to 62 blows/0.3 m) indicate very stiff to hard consistency.

#### Heterogeneous Mixture of Clayey Silt, Sand and Gravel (Glacial Till)

The silty clay to clayey silt layer is underlain by this cohesive glacial till deposit. The Atterberg Limits determined for the representative soil samples are shown on Figure 3. The Gradation Test results are shown on Figure 4 in an envelope form. These results indicate 8% to 41% gravel, 15% to 31% sand 39% to 77% clayey silt. The Standard Penetration Test results in this stratum vary from 79 blows/0.3 m to over 100 blows/0.3 m indicating hard consistency. Boulders were encountered near the terminal depth (below El: 204.5). This layer extends to the depth probed (ie. El: 200), however, the full extent of this deposit was not proven.

#### Groundwater Conditions

The groundwater level measurements were taken in open boreholes during investigation and was observed in boreholes 1 and 4 at about El: 218.6 and 223.5, respectively. However, the water level observed in borehole 4 was in the form of perched. Seasonal fluctuation of the groundwater level may be expected.

## DISCUSSION AND RECOMMENDATIONS

### General

It is proposed to replace the existing bridge at the crossing of Ausable River and Highway 7. Two alternatives are under consideration for the replacement structure and the alternatives are as follows:

- 1) Three span (app. 18.6 m end spans and 22.4 m centre span) CPCI 1200 type of structure.
- 2) Single span 44 m long steel plate girder type of structure.

We understand that during the construction of this bridge, the traffic will be diverted through Township Roads and no provision will be allowed for roadway protection.

The existing bridge is a single span steel structure. The clear span between the face of the abutments is about 33.5 m. The abutments as well as the approach embankments appear in very good condition and also, no major erosion problems have been identified. However, the steel beams have been corroded and spalling of concrete have been noted at several locations.

It appears from structural drawings that the abutments of the existing bridge as well as the wing walls are supported on spread footings founded at about El. 218.0±. The foundation of the abutments as well as the wing walls are protected from erosion by placing large boulders.

## Structure Foundations

### Scheme #1

The subsoil condition at this site would permit the structure to be supported on shallow foundation placed at about elevation 218.0, and the footings may be designed assuming the following bearing capacities.

Factored Bearing Capacity at U.L.S. = 500 kPa

Bearing Capacity at S.L.S. Type II = 300 kPa

However, the construction of footings in the river bed will require positive dewatering scheme. Considering the dewatering problems and construction difficulties in the river bed, the structure may be supported on steel H-piles driven to elevation 204. The following bearing capacity values are recommended for the design of the pile foundation.

	HP 310 X 110	HP 310 X 79
Factored Bearing Capacity at U.L.S.	1600 kN	1150 kN
Bearing Capacity at S.L.S. Type II	1150 kN	900 kN

Driving of piles shall be carefully monitored and controlled employing the Hiley Dynamic Pile Driving formula driven in accordance with MTO Standards SS103-10 or SS103-11 assuming an ultimate capacity as follows:

<u>Pile Type</u>	<u>Ultimate Capacity (kN)</u>
HP 310 X 79	2700
HP 310 X 110	3450

In view of the presence of boulders, no attempt should be made to penetrate the piles below El: 204, since the piles may be damaged. If the recommended capacity is not achieved above El: 204, this office should be contacted. This information should be included in the note on structural drawings. The pile tips should be reinforced with pile driving shoes as per MTO Standards (DD-3301 latest revision).



### Scheme #2

The foundation for the abutments may be placed at about elevation 218.0. The following bearing capacity values may be used for the design of the abutment foundations.

Factored Bearing Capacity at U.L.S. = 500 kPa

Bearing Capacity at S.L.S. Type II = 300 kPa

Alternatively, the structure may be supported on pile foundation. For the design of pile foundation, the recommendations given under Scheme #1 should be used.

Earth pressure for the design of the abutments should be computed as per Section 6.1.2.2 of the O.H.B.D.C., and an unyielding foundation condition may be assumed for the computations. However, for the design of wing walls, yielding condition may be assumed. The Granular "A" or "B" backfill should be in accordance with the Special Provision No. 109F03. The following parameters are recommended for the granular fill.

	Granular "A"	Granular "B"
Angle of Internal Friction $\phi$	35°	30°
Unit Weight (kN/m <sup>3</sup> ) $\gamma$	22.8	21.2

For scheme #2, if the structure is placed on shallow foundation, the sliding resistance may be estimated based on effective angle of internal friction neglecting the effective shear strength of the founding soil. An unfactored coefficient of friction value of  $\tan 26^\circ$  may be assumed for the estimate.

### Approach Embankment

The proposed finished grade on the east side of the river is expected to be about 0.6 m higher than the existing grade. However, on the west side, the finished grade will be maintained at the present level. If the finished grades are set at the heights indicated above, no major instability problems are anticipated for

the approach embankments constructed with 2H:1V side slopes. The fill material should consist of well compacted acceptable material.

#### Other Considerations

The pile caps as well as the shallow footings should have a minimum of 1.2 m earth cover for frost protection. If scheme #1 is considered, pile bents may be used to support the bridge deck instead of pile caps to avoid construction below water level.

If scheme #2 is considered and proposed to be placed on shallow footings, the footing will have to be constructed below the river water level which may be expected to fluctuate. In view of impervious nature of the subsurface at the founding level, no major dewatering problems are anticipated during construction. Any minor seepage or surface run-off into the excavation may be readily handled by pumping from the sump. Care shall be exercised during construction to prevent any flow of water from the river into the excavation. The base of the excavation at the founding level should be covered with 150 mm thick lean concrete pad upon exposure to avoid any deterioration.

The river banks as well as the shallow foundations should be protected against scour using rip-raps.

The large boulders which were placed to protect the existing abutments from erosion should be removed to facilitate driving of piles.

MISCELLANEOUS

The field work for this investigation was carried out under the supervision of M. Vasavithasan, Foundation Engineer. The equipment used was owned and operated by Master Soil Investigation Ltd. and London Soil Test. This report was prepared by M. Vasavithasan, Foundation Engineer, reviewed by Mr. P. Payer, Senior Foundation Engineer, and approved by Mr. M. Devata, Chief Foundation Engineer.



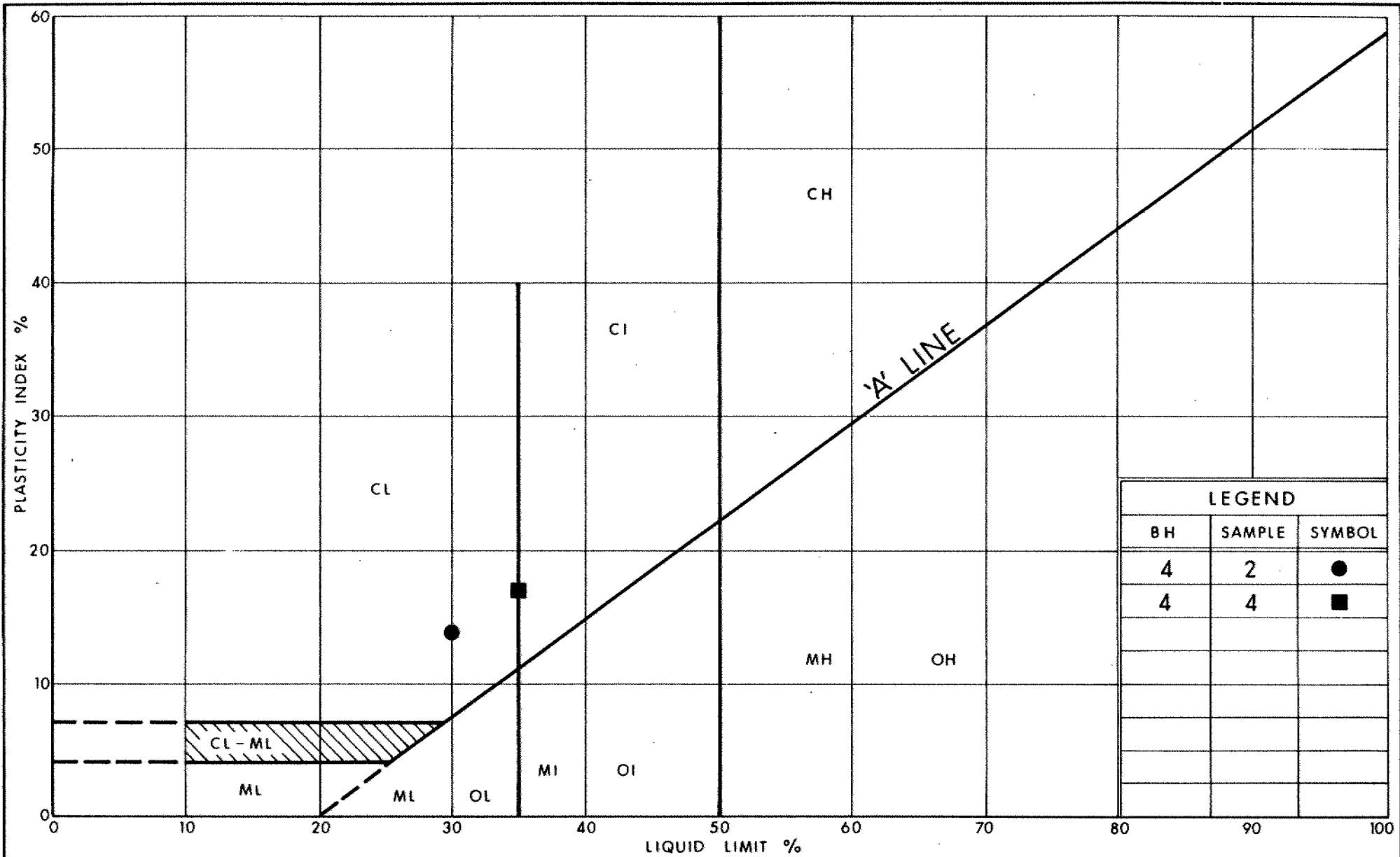
*M. Vasavithasan*

M. Vasavithasan, P. Eng.  
Foundation Engineer

*M. Devata*

M. Devata, P. Eng.  
Chief Foundation Engineer

## APPENDIX



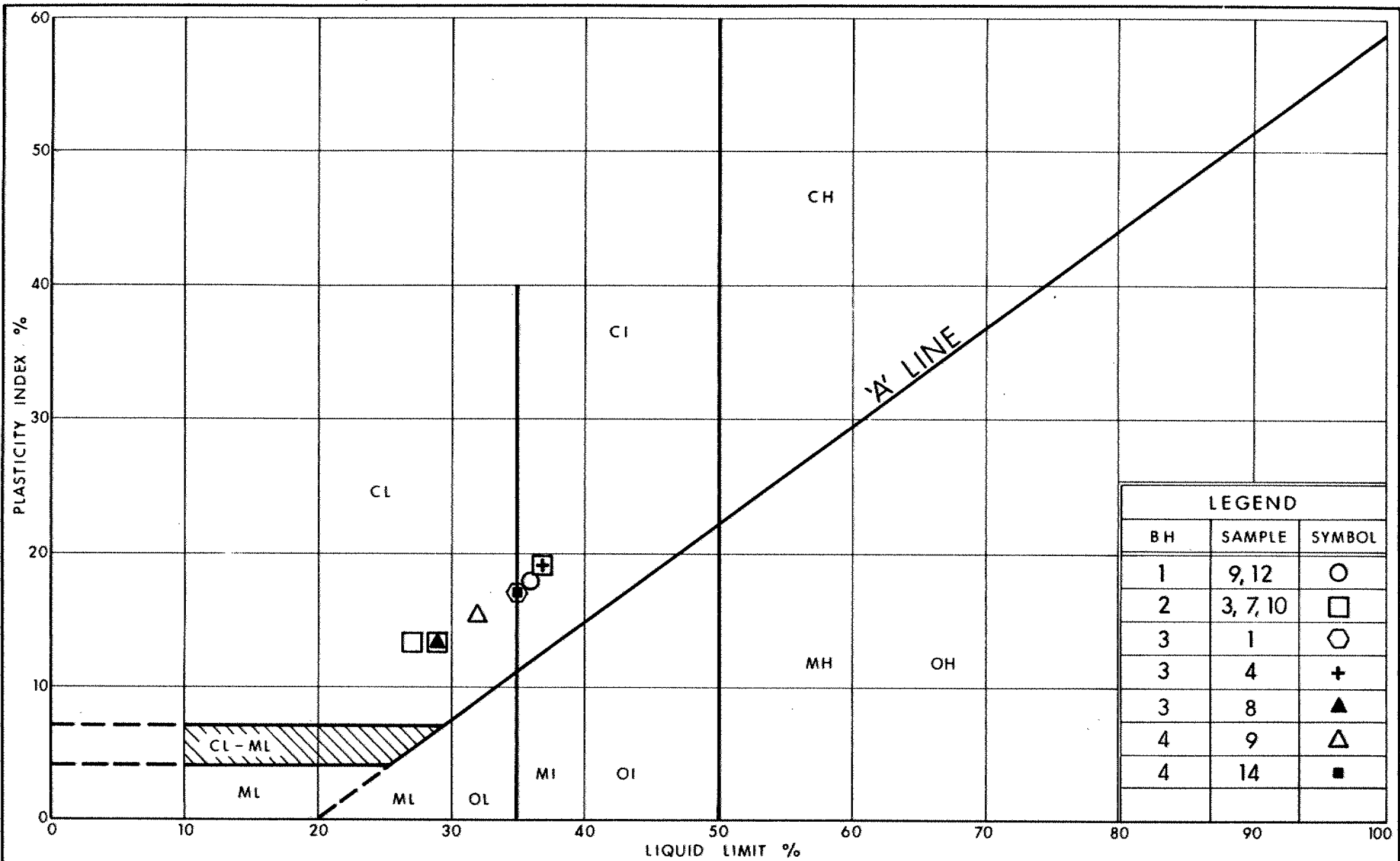
Ontario

Ministry of  
Transportation

# PLASTICITY CHART CLAYEY SILT

FIG No 1

W P 70-85-02



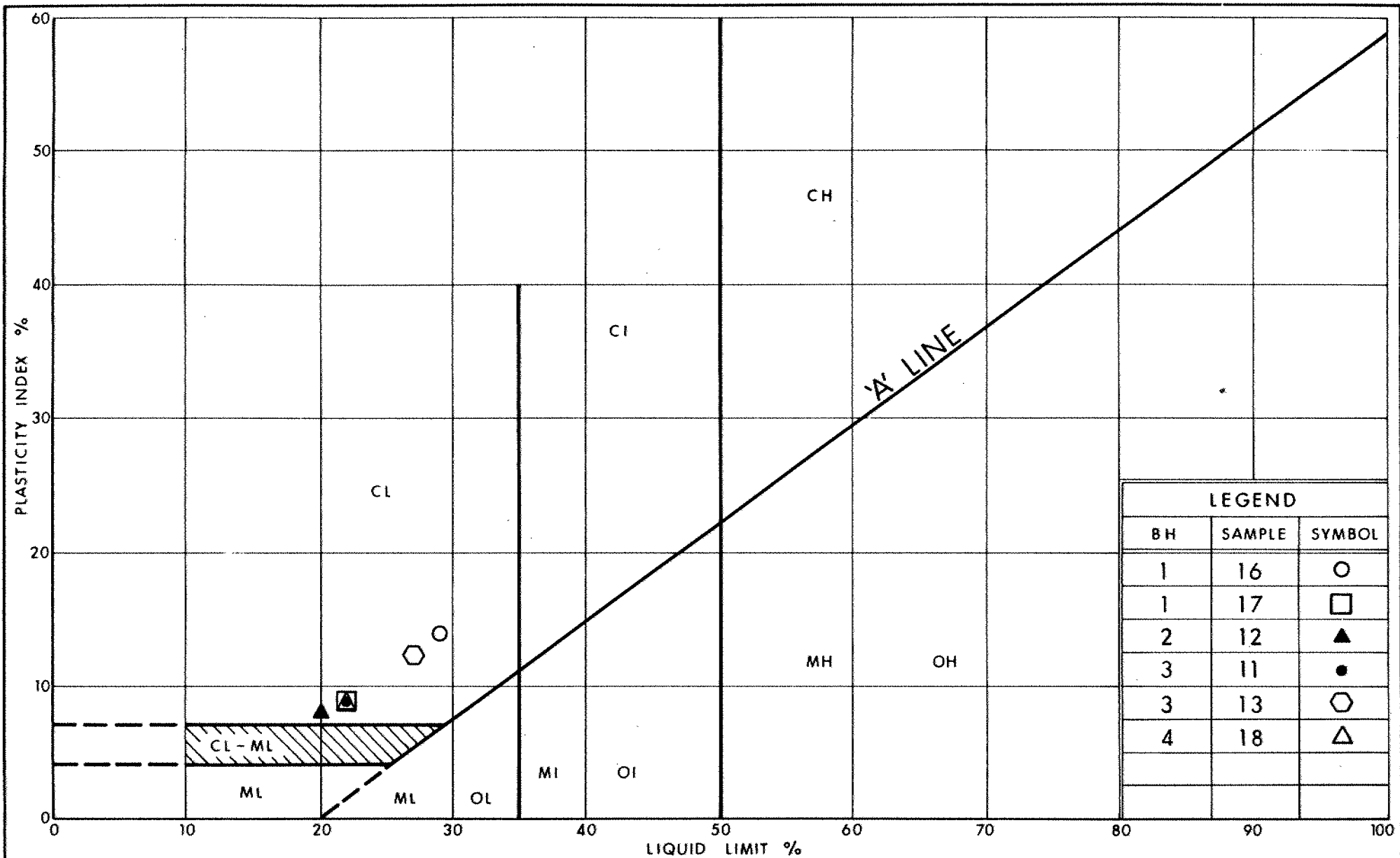
Ministry of  
Transportation

Ontario

PLASTICITY CHART  
SILTY CLAY to CLAYEY SILT  
TRACE OF SAND, TRACE OF GRAVEL

FIG No 2

W P 70-85-02



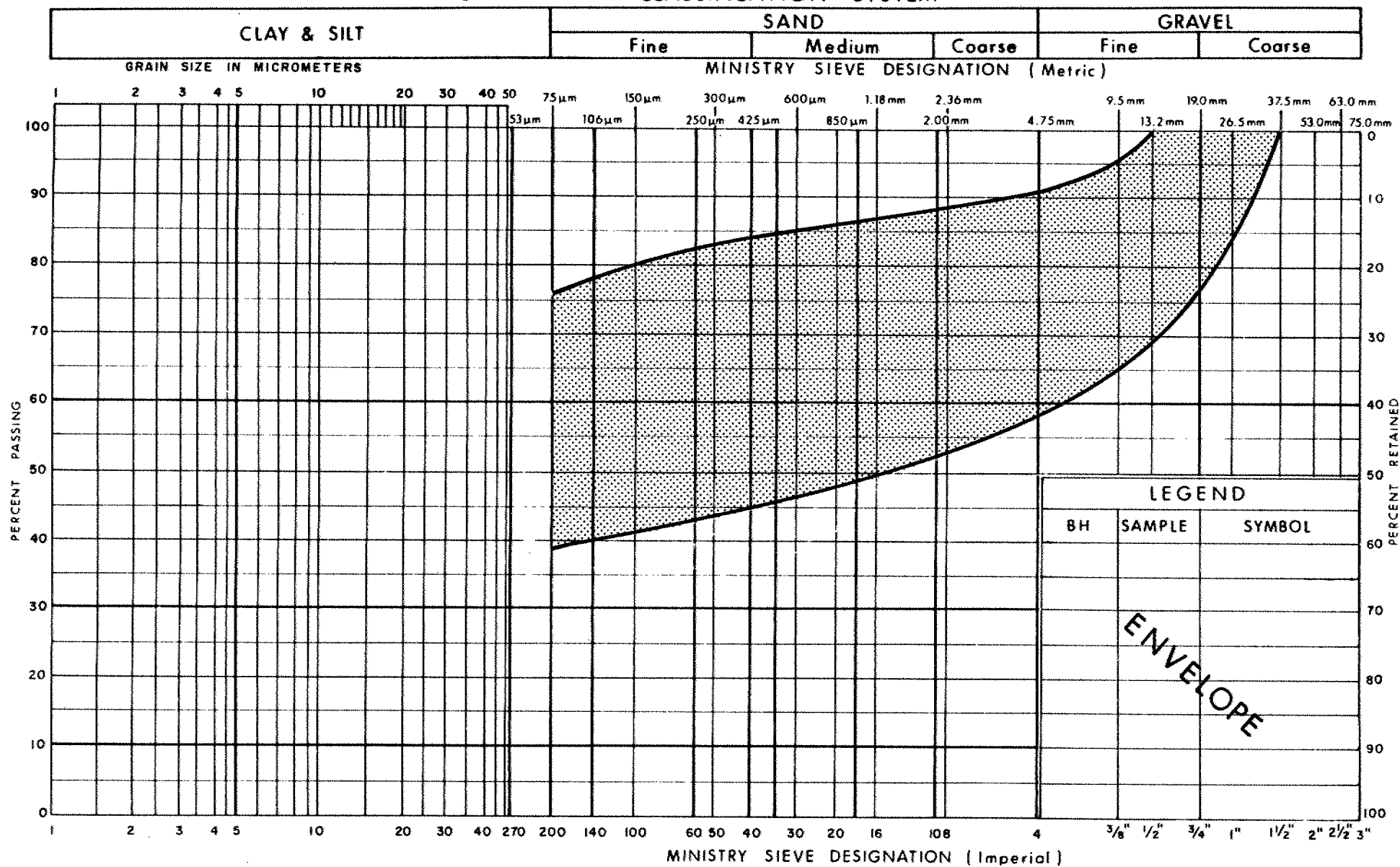
Ministry of  
Transportation

# PLASTICITY CHART HET MIXTURE OF CLAYEY SILT, SAND & GRAVEL ( Glacial Till )

FIG No 3

W P 70-85-02

## UNIFIED SOIL CLASSIFICATION SYSTEM



Ministry of  
Transportation

**GRAIN SIZE DISTRIBUTION**  
**HET MIXTURE OF CLAYEY SILT, SAND & GRAVEL**  
**( Glacial Till )**

FIG No 4

W P 70-85-02



## 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
$r_u$	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

$\rho_s$	$\text{kg}/\text{m}^3$	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
$\rho$	$\text{kg}/\text{m}^3$	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
$\rho_{\text{sat}}$	$\text{kg}/\text{m}^3$	DENSITY OF SATURATED SOIL	$I_L$	1	LIQUIDITY INDEX = $\frac{w - w_p}{I_p}$	i	1	HYDRAULIC GRADIENT
$\gamma_{\text{sat}}$	$\text{kN}/\text{m}^3$	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 1

1 OF 1

METRIC

W.P. 70 - 85 - 02 LOCATION Co-ords: N 4 779 010.5; E 382 453.8 ORIGINATED BY M V  
 DIST 2 HWY 7 BOREHOLE TYPE CONE TEST, HOLLOW STEM AUGER & BW CASING COMPILED BY M V  
 DATUM GEODETIC DATE 91 11 04 & 91 11 05 CHECKED BY P P

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100	20 40 60 80 100					
227.5	Hwy. 7 Shoulder													
0.0	SILTY SAND With Gravel, Loose ( Fill )		1	SS	5		226							
224.4			2	SS	5		224							0 9 48 43
3.1	CLAYEY SILT, Trace of Sand, Firm to Stiff ( Fill )		3	SS	9		222							
222.6			4	SS	12		220							
4.9	Clayey Silt, Trace of Gravel		5	SS	13		218							
	SILTY SAND to SANDY SILT, Some Gravel, Trace of Organics, Loose to Compact		6	SS	7		216							
218.3			7	SS	5		214							
9.2			8	SS	10		212							
			9	SS	17		210							
			10	SS	20		208							
			11	SS	26		206							
			12	SS	21		204							
	SILTY CLAY to CLAYEY SILT, Trace of Sand, Trace of Gravel, Very Stiff to Hard		13	SS	33		202							
206.2			14	SS	26									
			15	SS	31									
21.3	Heterogeneous Mixture of CLAYEY SILT, SAND and GRAVEL, Hard ( Glacial Till ) Boulders,		16	SS	79		206							8 15 39 38
			17	SS	100	/5cm	204							
			18	SS	100	/1cm	202							14 26 43 17
200.0														
27.5	End of Borehole													

# RECORD OF BOREHOLE No 2

1 OF 1

METRIC

W.P. 70 - 85 - 02 LOCATION Co-ords: N 4 779 036.7; E 382 434.5 ORIGINATED BY M V  
 DIST 2 HWY 7 BOREHOLE TYPE NW CASING COMPILED BY M V  
 DATUM GEODETIC DATE 91 10 23 & 91 10 24 CHECKED BY P P

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			20	40	60	80	100					
219.6	Water Level															
0.0	Gravel With Clayey Silt, Some Sand		0	CS												44 25 18 13
			1	SS		218										
			2	SS												
			3	SS												0 2 46 52
			4	SS		216										
			5	SS												
			6	SS												
	SILTY CLAY to CLAYEY SILT, Trace of Sand, Trace of Gravel, Very Stiff to Hard		7	SS		214										
			8	SS		212										
			9	SS		210										
			10	SS		208										
207.4																
12.2	Heterogeneous Mixture of CLAYEY SILT, SAND and GRAVEL, Hard, ( Glacial Till )		11	SS	102	206										
204.0																
			12	SS	91											14 31 38 17
15.6	End of Borehole															

# RECORD OF BOREHOLE No 3

1 OF 1

METRIC

W.P. 70 - 85 - 02 LOCATION Co-ords: N 4 779 018.8; E 382 412.6 ORIGINATED BY M V  
 DIST 2 HWY 7 BOREHOLE TYPE NW CASING COMPILED BY M V  
 DATUM GEODETIC DATE 91 10 28 & 91 10 29 CHECKED BY P P

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					
219.6	Water Level															
0.0																
217.8	River Bed					218										
1.8	Silt		1	SS	22											0 3 42 55
			2	SS	52											
			3	SS	47	216										
			4	SS	44											1 2 45 52
			5	SS	42											
	SILTY CLAY to CLAYEY SILT, Trace of Sand, Trace of Gravel, Very Stiff to Hard		6	SS	62	214										
			7	SS	42											
			8	SS	42	212										
			9	SS	55	210										
			10	SS	27											
207.7						208										
11.9	Heterogeneous Mixture of CLAYEY SILT, SAND and GRAVEL, Hard ( Glacial Till )		11	SS	103											21 21 35 23
			12	SS	81	206										
203.8																
			13	SS	100	204										25 25 30 20
15.8	End of Borehole															

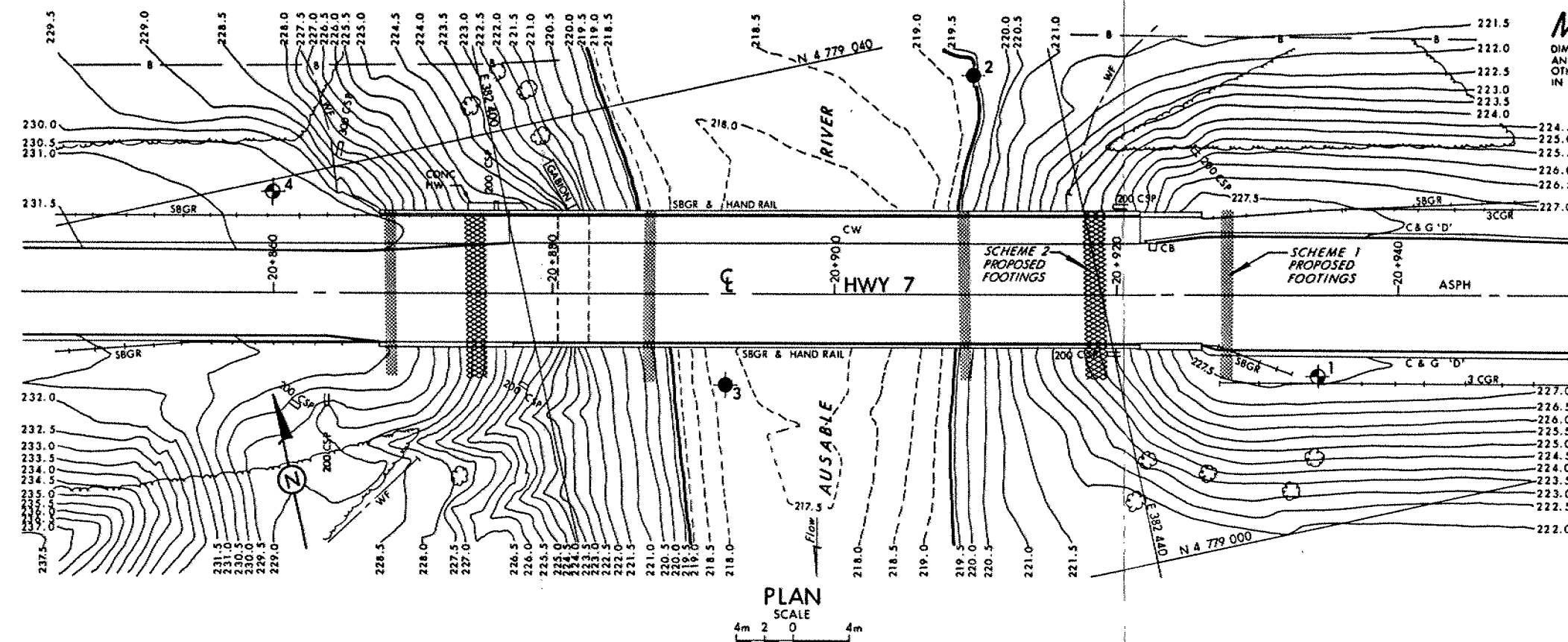
# RECORD OF BOREHOLE No 4

1 OF 1

METRIC

W.P. 70 - 85 - 02 LOCATION Co-ords: N 4 779 039.2; E 382 383.8 ORIGINATED BY M V  
 DIST 2 HWY 7 BOREHOLE TYPE CONE TEST, HOLLOW STEM AUGER & BW CASING COMPILED BY M V  
 DATUM GEODETIC DATE 91 10 30 & 91 11 01 CHECKED BY P P

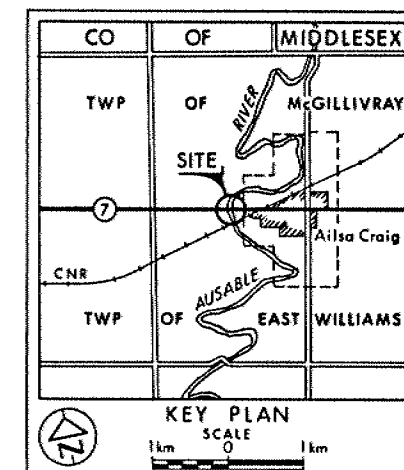
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100	20 40 60 80 100					
230.7	Ground Surface													
0.0	Organic Silt													
	CLAYEY SILT, Trace of Sand, Trace of Gravel, Stiff ( Fill )		1	SS	14		230							
227.8							228							
2.9	CLAYEY SILT, Stiff to Very Stiff		2	SS	13									
			3	SS	21									
225.2			4	SS	12		226							
5.5	SILTY SAND to SANDY SILT, Occasional Gravel Seams, Very Dense		5	SS	136									
			6	SS	144									
222.9			7	SS	62		224							
7.8			8	SS	37									
			9	SS	48		222							11 5 42 42
			10	SS	40									
			11	SS	37		220							
	SILTY CLAY to CLAYEY SILT, Trace of Sand, Trace of Gravel, Hard to Very Stiff		12	SS	38									
			13	SS	38		218							
			14	SS	24		216							1 2 45 52
			15	SS	32		214							
			16	SS	24		212							
207.5			17	SS	78		210							
23.2	Heterogeneous Mixture of CLAYEY SILT, SAND and GRAVEL, Hard ( Glacial Till )		18	SS	112		208							
204.3							206							41 20 22 17
26.4	End of Borehole													
	Perched Water Table													



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

CONT No  
WP No 70-85-02

AUSABLE RIVER  
(At W. Limits of Ailsa Craig)  
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 1991 10 and 11

No	ELEVATION	CO-ORDINATES NORTH	EAST
1	227.5	4 779 010.5	382 453.8
2	219.6	4 779 036.7	382 434.5
3	219.6	4 779 018.8	382 412.6
4	230.7	4 779 039.2	382 383.8

**NOTE**

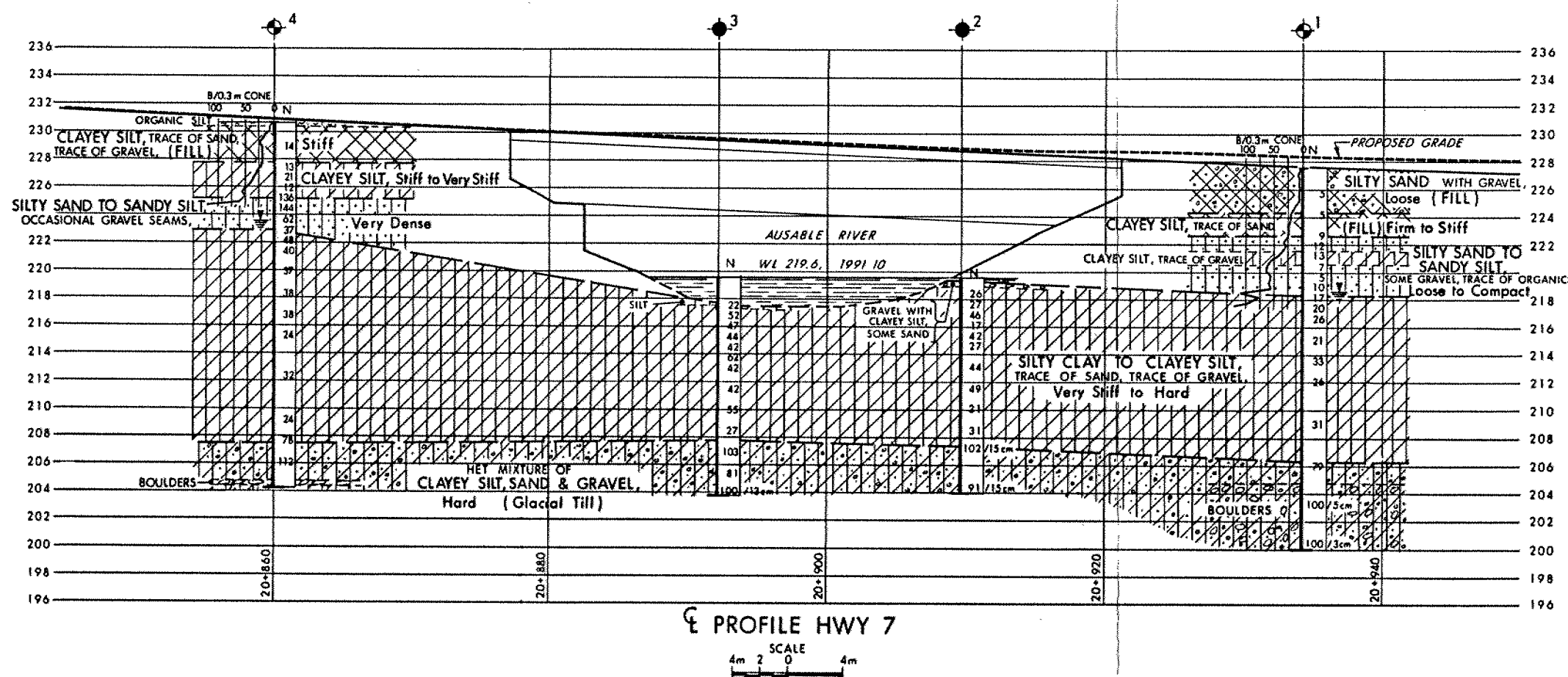
The boundaries between soil strata have been established only at Bore Hole locations. Between Bore Holes the boundaries are assumed from geological evidence.

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.

REV.	DATE	BY	DESCRIPTION
------	------	----	-------------

Geocres No 40P4-43

HWY No 7	SUBMD MV	CHECKED	DATE 1992 02 25	DIST 2
DRAWN RS	CHECKED	APPROVED		SITE 19-47
				DWG 708302-A





# **FOUNDATION INVESTIGATION REPORT**

**CONTRACT NO. 95-09**



**Ontario**

**Ministry of  
Transportation**

INDEX

<u>Page No:</u>	<u>DESCRIPTION</u>
1	Index
2	Abbreviations & Symbols
3 - 16	Foundation Investigation Report for  Ausable River Bridge at West Limits of Ailsa Craig W.P. 70-85-02, Site 19-47 Hwy 7, District 2, London

Note: For purposes of the contract, this report supersedes all other Foundation Reports prepared by, or for the Ministry in connection with the above mentioned project.



**N VALUE:** THE STANDARD PENETRATION TEST (SPT) N VALUE IS THE NUMBER OF BLOWS REQUIRED TO CAUSE A STANDARD 50mm C.D. SPLIT BARREL SAMPLER TO PENETRATE 300mm INTO UNDISTURBED GROUND IN A BOREHOLE WHEN DRIVEN BY A HAMMER WITH A MASS OF 63.5kg, FALLING FREELY A DISTANCE OF 0.762m. 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: N

**DYNAMIC CONE PENETRATION TEST:** CONTINUOUS PENETRATION OF A CONICAL STEEL POINT (50mm C.D. 60° CONE ANGLE) DRIVEN BY 475 J IMPACT ENERGY ON 12.5mm DIA. 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 UNPAINTED 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:

(1. BLOWS TO 300mm)	0 - 5	5 - 10	10 - 30	30 - 50	> 50
	VERY LOOSE	LOOSE	COMPACT	DENSE	VERY DENSE

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

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

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

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

**JOINTING AND BEDDING:**

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

## ABBREVIATIONS AND SYMBOLS

### FIELD SAMPLING

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

### STRESS AND STRAIN

$u_w$	kPa	PORE WATER PRESSURE
$u_v$	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

### MECHANICAL PROPERTIES OF SOIL

$\pi_v$	kPa <sup>-1</sup>	COEFFICIENT OF VOLUME CHANGE
$C_c$	1	COMPRESSION INDEX
$C_s$	1	SWELLING INDEX
$C_\alpha$	1	RATE OF SECONDARY CONSOLIDATION
$C_v$	m <sup>2</sup> /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 = $\frac{c_u}{\tau_r}$

### PHYSICAL PROPERTIES OF SOIL

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

## FOUNDATION INVESTIGATION REPORT

For

Ausable River Bridge  
at West Limits of Ailsa Craig  
W.P. 70-85-02, Site 19-47  
Highway 7, District 2, London

### INTRODUCTION

This report contains the results of a soils investigation carried out at the above mentioned site. The field work for this project was carried out between 1991 10 23 and 1991 11 05, and comprised of four sampled boreholes and Dynamic Cone Penetration Test adjacent to two of the boreholes.

Boreholes were advanced to a maximum depth of 27.5 m (El: 200) below the existing ground level. Two of the boreholes which are located in the river bed were advanced using a diamond drill and other two holes were advanced by employing a continuous flight auger machine equipped with 82 mm I.D. hollow stem auger and BW casing.

### SITE DESCRIPTION

The site under investigation is located at the crossing of Hwy. 7 and Ausable River at the west limits of Ailsa Craig in the Township of East Williams.

In this area, the Ausable River follows the depression in front of the moraines. The topography of the site on the west side of the Ausable River is generally undulating with morainic ridges. However, on the east side of the river, the topography is generally flat with isolated swamps to the southeast. Physiographically, the area is located in the region known as the "Horseshoe Moraines".

## SUBSURFACE CONDITIONS

### General

The approach embankment fill on the east side of the river is underlain by 4.3 m of loose to compact silty sand to sandy silt with occasional clayey silt seams and, on the west side, the fill is underlain by 2.6 m of stiff to very stiff clayey silt which overlies 2.3 m of very dense silty sand to sandy silt. However, the underlying subsoil in the project area consists of 11.9 m to 15.4 m of very stiff to hard silty clay to clayey silt underlain by hard heterogeneous mixture of clayey silt, sand and gravel with boulders near the terminal depth. For classification purposes, the soils encountered at this site can be divided into five different zones.

- a) Embankment Fill
- b) Clayey Silt
- c) Silty Sand to Sandy Silt
- d) Silty Clay to Clayey Silt, Trace of Sand, Trace of Gravel
- e) Heterogeneous Mixture of Clayey Silt, Sand & Gravel (Glacial Till)

The subsurface conditions encountered during the course of the investigation, together with the field and laboratory test results are shown on the Record of Borehole Sheets contained in the Appendix of this report. A stratigraphical section is shown on Drawing No. 708502-A.\* This drawing also shows the locations and elevations of the borings. Description of the strata encountered are given below.

### Embankment Fill

The approach embankment fill on the east side of the river consists of 3.1 m of loose silty sand with gravel underlain by 1.8 m of firm to stiff clayey silt. However, on the west side of the river, the fill consists of 2.9 m of stiff clayey silt.

\* Dwg No 2, (Sheet 143) of the Contract Drawings.

### Clayey Silt

This clayey silt deposit was encountered immediately below the fill on the west side of the river. The thickness of the clayey silt layer is about 2.6 m and extends to elevation 225.2. The natural moisture content was observed in the range of 20.5% to 27%. The Atterberg Limits determined for the representative soil samples of this deposit are shown on Figure 1. The Standard Penetration Test values were observed to vary from 12 blows/0.3 m to 21 blows/0.3 m. The consistency may be classified as stiff to very stiff.

### Silty Sand to Sandy Silt

Considering the difference in geological origin of this deposit on both sides of the river, the descriptions are given separately.

This deposit, on the west side of the river, was encountered immediately below the clayey silt layer. The thickness of the layer was observed to be about 2.3 m and extends to elevation 222.9. The Standard Penetration Test values were observed to vary from 62 blows/0.3 m to 144 blows/0.3 m, indicating very dense state of denseness.

This silty sand to sandy silt deposit, on the east side of the river, was encountered immediately below the fill. Occasional clayey silt seams as well as organics were observed in this deposit. The thickness of this layer was observed to be about 4.3 m and extends to elevation 218.3. The Standard Penetration Test values (5 blows/0.3 m to 13 blows/0.3 m) indicate loose to compact denseness.

### Silty Clay to Clayey Silt, Trace of Sand, Trace of Gravel

In the approach embankment area, this clayey deposit was encountered at about 7.8 m to 9.2 m (El: 222.9 to 218.3) below the existing ground level. However, in the river bed, it was encountered at about 0.15 m to 0.5 m (El: 219.1 to El: 217.6) below the river bed level. The thickness of this layer varies from 11.7 m to 15.4 m and extends to elevations 207.7 to 206.2. The natural moisture content

was observed in the range of 17% to 21%. The Atterberg Limits determined for the representative soil samples of this deposit are shown on Figure 2. The Standard Penetration Test values (17 blows/0.3 m to 62 blows/0.3 m) indicate very stiff to hard consistency.

#### Heterogeneous Mixture of Clayey Silt, Sand and Gravel (Glacial Till)

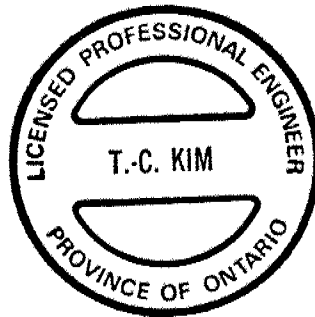
The silty clay to clayey silt layer is underlain by this cohesive glacial till deposit. The Atterberg Limits determined for the representative soil samples are shown on Figure 3. The Gradation Test results are shown on Figure 4 in an envelope form. These results indicate 8% to 41% gravel, 15% to 31% sand 39% to 77% clayey silt. The Standard Penetration Test results in this stratum vary from 79 blows/0.3 m to over 100 blows/0.3 m indicating hard consistency. Boulders were encountered near the terminal depth (below El: 204.5). This layer extends to the depth probed (ie. El: 200), however, the full extent of this deposit was not proven.

#### Groundwater Conditions

The groundwater level measurements were taken in open boreholes during investigation and was observed in boreholes 1 and 4 at about El: 218.6 and 223.5, respectively. However, the water level observed in borehole 4 was in the form of perched. Seasonal fluctuation of the groundwater level may be expected.

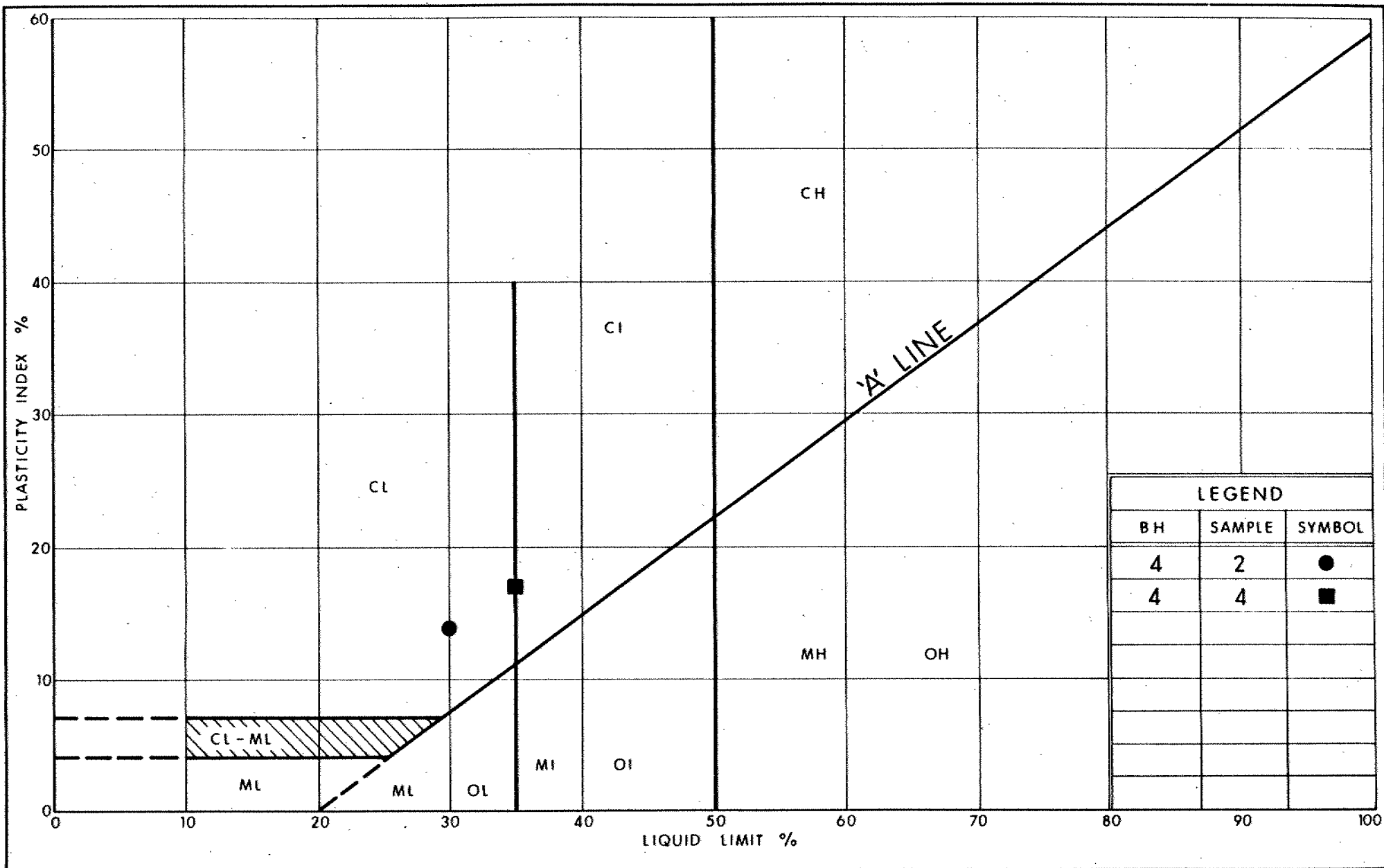
MISCELLANEOUS

The field work for this investigation was carried out under the supervision of M. Vasavithasan, Foundation Engineer. The equipment used was owned and operated by Master Soil Investigation Ltd. and London Soil Test. This report was prepared by M. Vasavithasan, Foundation Engineer, reviewed by Mr. P. Payer, Senior Foundation Engineer, and approved by Mr. M. Devata, Chief Foundation Engineer.



*Taeck Kim*  
T.C. Kim, P. Eng.  
Senior Foundation Engineer

APPENDIX



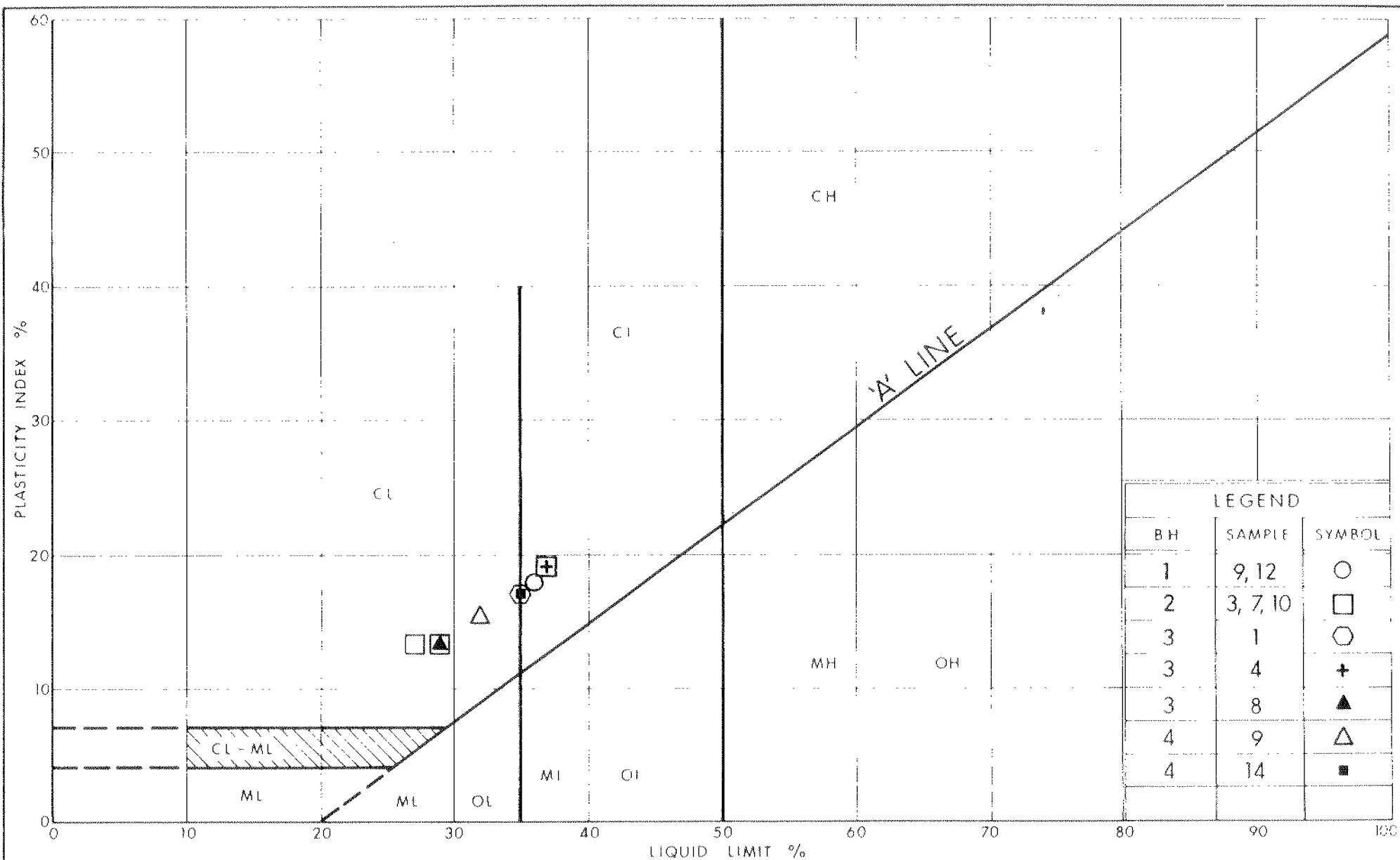
Ministry of  
Transportation

# PLASTICITY CHART CLAYEY SILT

FIG No 1

W P 70-85-02



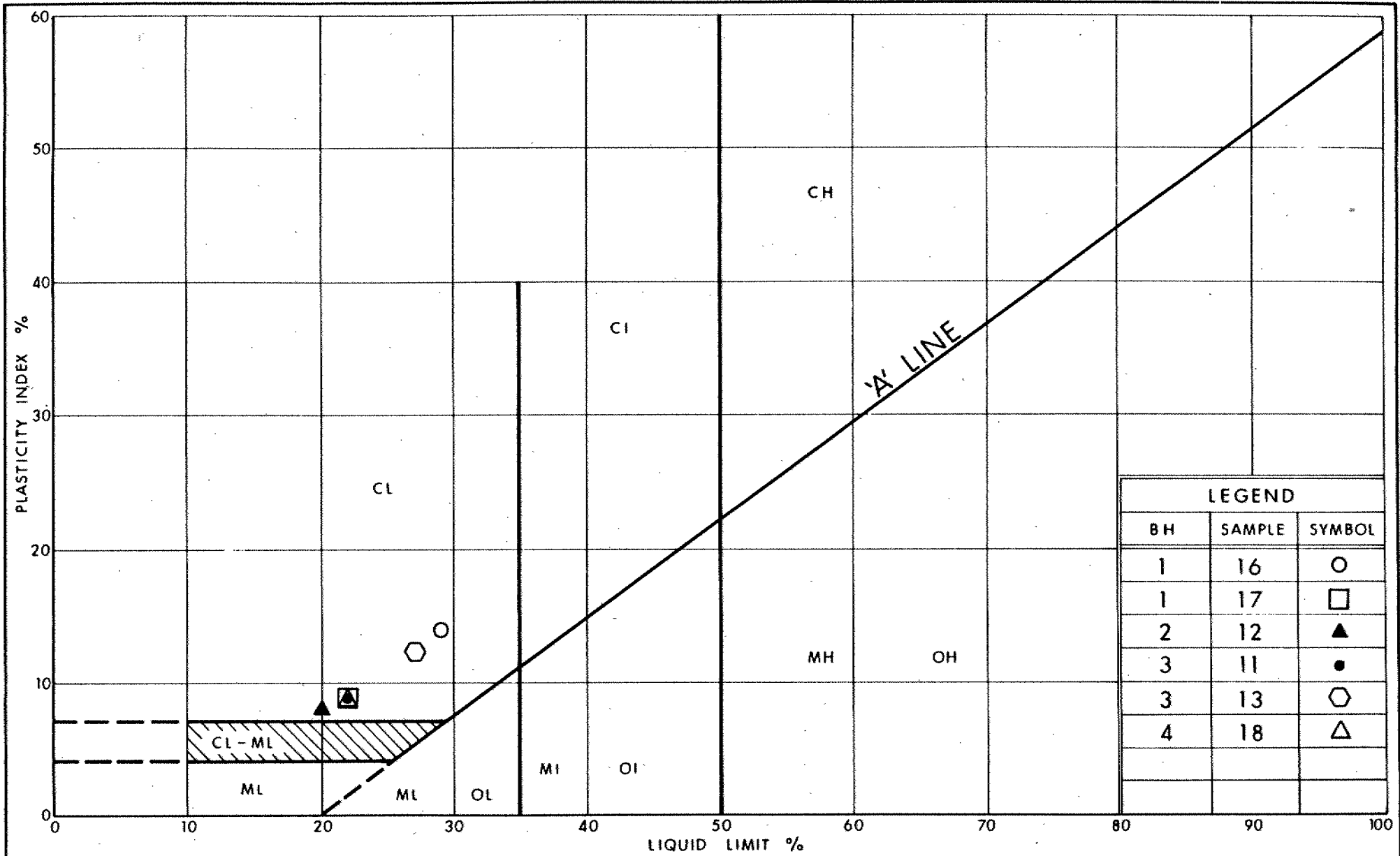


Ministry of  
Transportation

PLASTICITY CHART  
SILTY CLAY to CLAYEY SILT  
TRACE OF SAND, TRACE OF GRAVEL

FIG No 2

W P 70-85-02



Ministry of  
Transportation

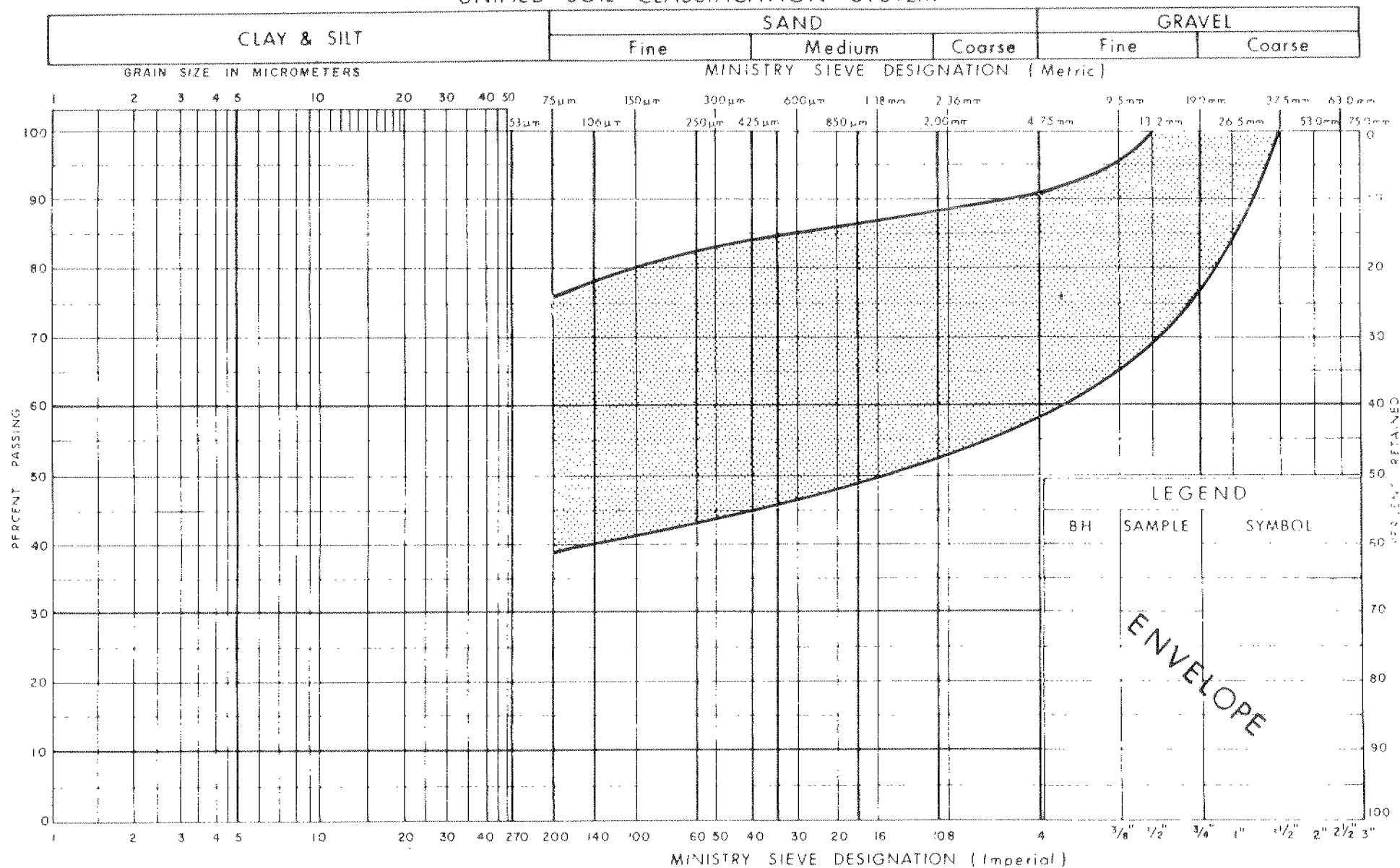
Ontario

# PLASTICITY CHART HET MIXTURE OF CLAYEY SILT, SAND & GRAVEL ( Glacial Till )

FIG No 3

W P 70-85-02

## UNIFIED SOIL CLASSIFICATION SYSTEM



Ontario

Ministry of  
Transportation

GRAIN SIZE DISTRIBUTION  
HET MIXTURE OF CLAYEY SILT, SAND & GRAVEL  
( Glacial Till )

FIG No 4

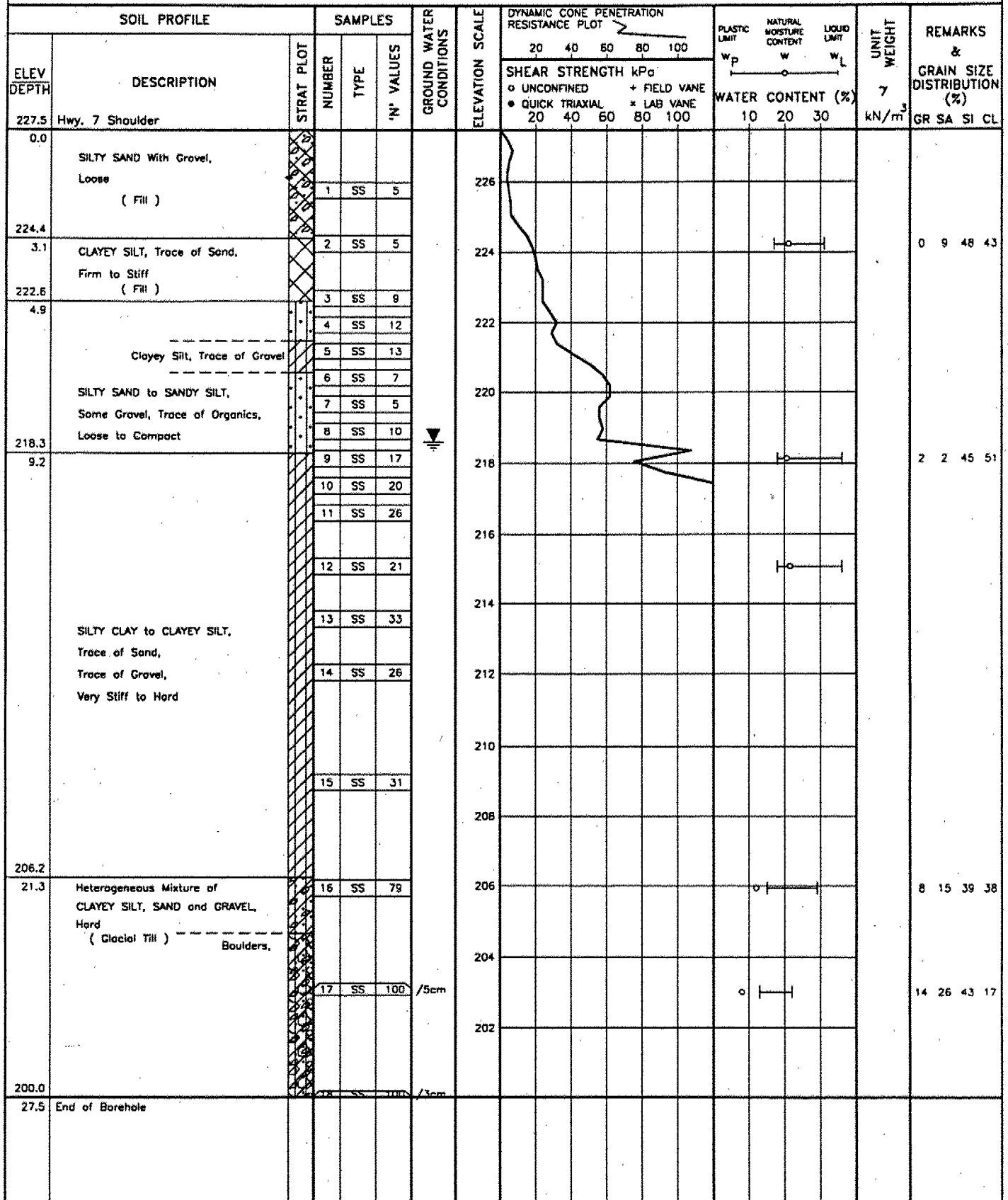
W P 70 - 85 - 02

RECORD OF BOREHOLE No 1

1 OF 1

METRIC

W.P. 70 - 85 - 02 LOCATION Co-ords: N 4 779 010.5; E 382 453.8 ORIGINATED BY M V  
DIST 2 HWY 7 BOREHOLE TYPE CONE TEST, HOLLOW STEM AUGER & BW CASING COMPILED BY M V  
DATUM GEODETIC DATE 91 11 04 & 91 11 05 CHECKED BY P P



RECORD OF BOREHOLE No 2

1 OF 1

METRIC

W.P. 70 - 85 - 02 LOCATION Co-ords. N 4 779 036.7 E 382 434.9 ORIGINATED BY M.V.  
DIST 2 HWY 7 BOREHOLE TYPE NW CASING COMPILED BY M.V.  
DATUM GEOIDETIC DATE 91 10 23 & 91 10 24 CHECKED BY P.P.

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			20 40 60 80 100	20 40 60 80 100					
219.6	Water Level												
0.0	Gravel With Clayey Silt, Some Sand		0	GS									44 25 18 13
			1	SS		218							
			2	SS									
			3	SS									
			4	SS		216							0 2 46 52
			5	SS									
			6	SS									
	SILTY CLAY in CLAYEY SILT Trace of Sand, Trace of Gravel, Very Stiff to Hard		7	SS		214							
			8	SS		212							
			9	SS		210							
			10	SS		208							
207.4													
17.2			11	SS	102 /15cm								
	Heterogeneous Mixture of CLAYEY SILT, SAND and GRAVELL Hard, ( Glacial Till )					206							
204.0			12	SS	81 /15cm								14 31 38 17
15.6	End of Borehole												

RECORD OF BOREHOLE No 3

1 OF 1

METRIC

W.P. 70 - 85 - 02 LOCATION Co-ords: N 4 779 018.8; E 382 412.6 ORIGINATED BY M V  
DIST 2 HWY 7 BOREHOLE TYPE NW CASING COMPILED BY M V  
DATUM GEODETIC DATE 91 10 28 & 91 10 29 CHECKED BY P P

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 (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100	20 40 60 80 100	w <sub>p</sub>	w	w <sub>L</sub>		
219.6	Water Level													
0.0														
217.8	River Bed													
1.8	Silt		1	SS	22		218							0 3 42 55
			2	SS	52									
			3	SS	47		216							
			4	SS	44									1 2 45 52
			5	SS	42									
			6	SS	62		214							
			7	SS	42									
			8	SS	42		212							
			9	SS	55		210							
			10	SS	27		208							
207.7														
11.9	Heterogeneous Mixture of CLAYEY SILT, SAND and GRAVEL Hard ( Glacial Till )		11	SS	103		206							21 21 35 23
			12	SS	81									
203.8			13	SS	100	/13cm	204							25 25 30 20
15.8	End of Borehole													

RECORD OF BOREHOLE No 4

1 OF 1

METRIC

W.P. 20 85 02 LOCATION Co-ords: N 4 779 039.2, E 382 383.6 ORIGINATED BY M.V.  
DIST 2 HWY 7 BOREHOLE TYPE CONE TEST, HOLLOW STEM AUGER & BW CASING COMPILED BY M.V.  
DATUM GEOIDAL DATE 91 10 30 & 91 11 01 CHECKED BY P.P.

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			20 40 60 80 100	20 40 60 80 100					
230.7	Ground Surface													
0.0	Organic Silt													
	CLAYEY SILT, Trace of Sand, Trace of Gravel, Stiff ( Fill )		1	SS	14		230							
227.6							228							
2.9	CLAYEY SILT, Stiff to Very Stiff		2	SS	13									
			3	SS	21									
225.2			4	SS	12		226							
5.5	SILTY SAND to SANDY SILT Occasional Gravel Seams, Very Dense		5	SS	136									
			6	SS	144									
222.9			7	SS	62		274							
7.8			8	SS	37									
			9	SS	48		222							11 5 42 42
			10	SS	40									
			11	SS	37		220							
	SILTY CLAY to CLAYEY SILT, Trace of Sand, Trace of Gravel, Hard to Very Stiff		12	SS	38		218							
			13	SS	38		216							
			14	SS	24									1 2 45 52
			15	SS	32		214							
			16	SS	24		212							
			17	SS	78		210							
207.5			18	SS	112		208							
23.2	Heterogeneous Mixture of CLAYEY SILT, SAND and GRAVEL, Hard ( Glacial Till )						206							41 20 22 17
204.3														
25.4	End of Borehole													
	* Perched Water Table													

DIST. No 2  
CONT No  
WP No 70 - 85 - 02



SHEET

AUSABLE RIVER BRIDGE  
AT WEST LIMITS OF AILSA CRAIG  
GENERAL ARRANGEMENT

## GENERAL NOTES

## CLASS OF CONCRETE

```

PRECAST GIRDERS.....40 MPa
REMAINDER, UNLESS OTHERWISE NOTED.....30 MPa

```

CLEAR COVER TO REINFORCING STEEL

FOOTINGS.....100 ± 25

ABUTMENTS & WINGWALLS : FRONT FACE....80 ± 20  
BACK FACE....70 ± 20

PIERS.....80 ± 20  
 OFCK.....TOP.....70 ± 20

BOTTOM.....40 + 10  
REMAINDER, UNLESS OTHERWISE NOTED.....70 ± 20

## REINFORCING STEEL

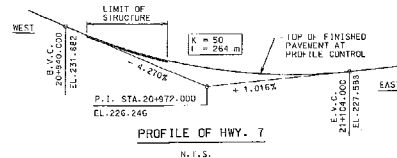
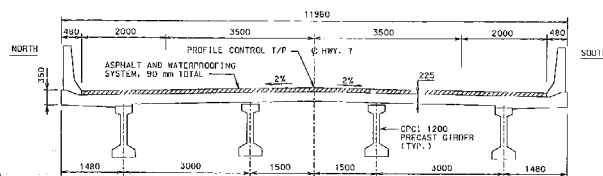
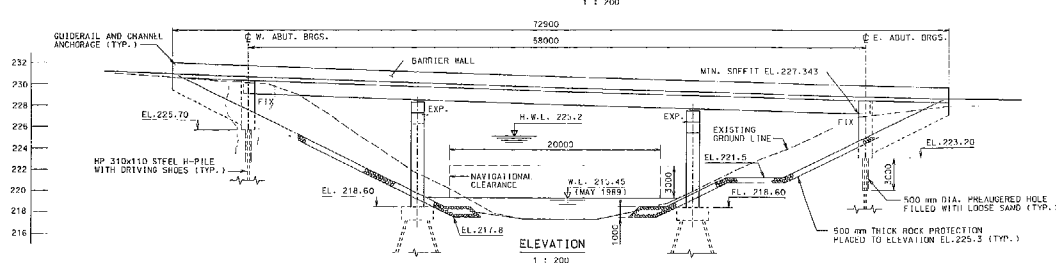
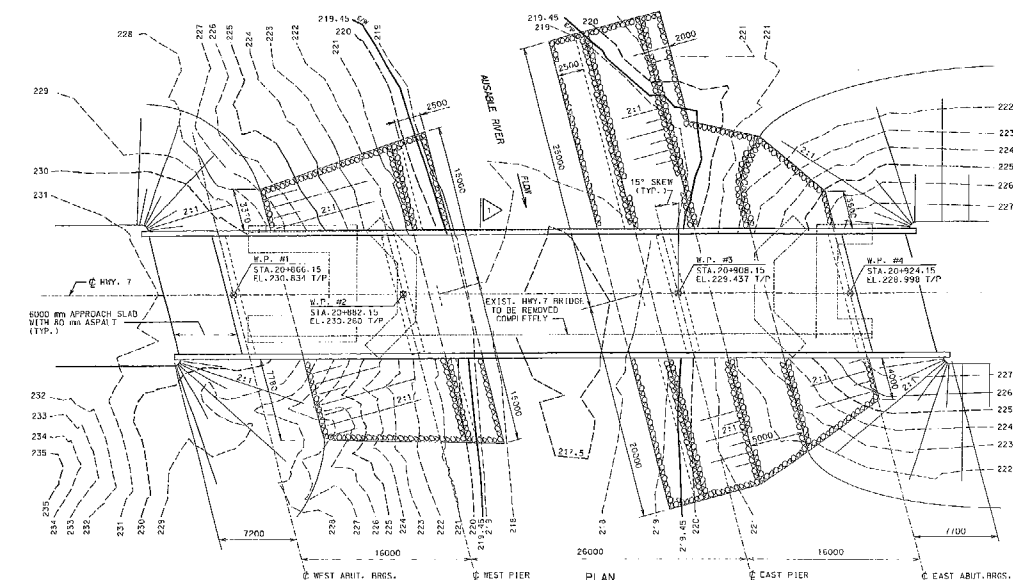
REINFORCING STEEL SHALL BE GRADE 400 UNLESS OTHERWISE SPECIFIED.

BAR MARKS WITH SUFFIX 'C' DENOTE COATED BARS.

CONSTRUCTION NOTES

THE CONTRACTOR SHALL ESTABLISH THE BEARING  
SEAT ELEVATIONS BY DEDUCTING THE ACTUAL  
BEARING THICKNESSES FROM THE TOP OF BEARING  
ELEVATIONS. IF THE ACTUAL BEARING  
THICKNESSES ARE DIFFERENT FROM THOSE GIVEN  
WITH THE BEARING DESIGN DATA, THE CONTRACTOR  
SHALL ADJUST THE REINFORCING STEEL TO SUIT.

## LIST OF DRAWINGS



MTCBM 758547  
 241.617  
 Tablet Set Horiz S E Face  
 Conc Fdn FB  
 88.0 Lf 19+538.4  
 Route 131  
 Alisa Craig

APPLICABLE STANDARD DRAWINGS  
 UPSD-3502.00 GRANULAR BACKFILL REQUIREMENTS

[illegible]