

## MEMORANDUM

31G-3

To: Mr. J. E. Gruppier,  
Regional Materials Engineer,  
Eastern Region,  
KINGSTON, Ontario.

FROM: Foundation Section,  
Materials & Testing Office,  
Room 107, Lab. Bldg.

ATTENTION:

DATE: April 1, 1970

OUR FILE REF.

IN REPLY TO

APR - 7 1970

SUBJECT:

FOUNDATION INVESTIGATION REPORT  
For  
Proposed Cuts and Fills at the  
Hwy. 417 - Corillon Park Rd.  
Interchange

Twp. of E. Newkesbury, Co. of Russell  
District No. 9 (Ottawa)  
H.J. 70-F-13 -- M.P. 37-66-06

CENT 71-066

31G-3

Attached, we are forwarding to you our Foundation investigation report on the subsoil conditions existing at the above structure site.

We believe this report contains the necessary factual data pertaining to the stability of the proposed cuts and fills, for your use. Should additional information be required, please feel free to contact our Office.

AGS/ade  
Attach.

*A. G. Stenroos*  
A. G. Stenroos  
PRINCIPAL FOUNDATION ENGINEER

Messrs. J. E. Gruppier (2)  
R. A. Fregaskes  
D. W. Ferron  
S. J. Verkhovics  
S. R. Davis  
F. C. Kingland  
J. E. Callaghan  
X. R. Przesaks  
B. A. Singh

Foundations Files  
Gen. Files

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FOUNDATION INVESTIGATION REPORT  
For  
Proposed Cuts and Fills at the  
Hwy. 417 - Carillon Park Rd.  
Interchange  
Twp. of E. Hawkesbury, Co. of Russell  
District No. 9 (Ottawa)  
W.J. 70-F-13      --      W.P. 37-66-06

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1. INTRODUCTION:

The Foundation Section was requested by Mr. J. E. Gruspier, Regional Materials Engineer (Eastern Region) to investigate the stability of proposed cuts and fills for the above interchange. Subsequently, a subsurface investigation consisting of four sampled boreholes with accompanying dynamic cone penetration tests, was carried out by this Section using three diamond drill rigs adapted for soil sampling purposes. The borehole locations and elevations were surveyed by personnel from the Eastern Region Engineering Surveys Section, and are shown on Drawing 70-F-13A. The elevations given in this report are referenced to geodetic datum.

2. SITE AND SUBSOIL:

2.1) Site:

The site is located near Hwy. 17, some 13 miles east of Hawkesbury. The ground surface in the area of the investigation slopes in a southeasterly direction and the terrain is gently undulating. The area to the north of Hwy. 17 is covered with light to dense bush, whereas to the south, the land is cleared for agricultural purposes. A small meandering creek traverses the site in a north - south direction, just east of and almost parallel to the existing Twp. Rd. to St. Eugene.

2. SITE AND SUBSOIL: (cont'd.) ...!

2.2) Subsoil:

Underlying a thin cover of topsoil is a surficial stratum of sand varying in thickness between 1 ft. at B.H. C-1 and 4 ft. at B.H. A-1. Standard Penetration Resistance 'N' values indicate that the sand is compact to dense.

The sand stratum is followed by a clay deposit which ranges in thickness from 43 ft. at B.H. A-1 to 6.5 ft. at B.H. F-1. The upper 2 to 5 ft. of the clay is in a desiccated condition. The results of field and laboratory testing are summarized on the individual Borelog sheets. Atterberg limit tests were carried out on typical samples (see Figure 1) and the results indicate that the soil is inorganic and of high plasticity (CH). The undrained shear strength measurements indicate that the consistency of the clay deposit ranges from firm to stiff, being generally stiff in the desiccated zone. Two consolidation tests on samples of this clay from B.H.'s C-1 and D-1 indicate that the deposit is preconsolidated by in the order of 3000 - 4000 PSF in excess of the existing effective overburden pressure (see Figure 2). Three triaxial compression tests (consolidated-undrained with pore pressure measurements) confirm that the clay deposit is overconsolidated. These tests resulted in an effective cohesion intercept ( $C'$ ) of about 340 PSF and an effective angle of shearing resistance ( $\phi'$ ) of about 15 degrees for samples obtained at the location of B.H. A-1.

The clay deposit is underlain by a glacial till stratum below elevations 136 (at B.H. C-1) and 129 (at B.H. D-1). The total thickness of the glacial till was not established during this investigation. The glacial till is essentially cohesive and consists of a heterogeneous mixture of clayey silt, sand and gravel; however, occasional granular zones are present at random within this deposit. Atterberg limit test results and grain-size distributions are shown respectively on Figures 3 and 4. The 'N' values in the glacial till stratum ranged between

2. SITE AND SUBSOIL: (cont'd.) ...

2.2) Subsoil: (cont'd.) ...

4 and 32 blows/ft. from which the consistency of the deposit is estimated to range from firm to hard, the granular zones being generally dense.

2.3) Groundwater:

Water level observations were carried out in the open boreholes during the period of this investigation. These observations indicate that the groundwater level at B.H.'s C-1, D-1 and F-1 is located at about elevations 144 - 145 which is slightly higher than the creek water level. At B.H. A-1, which was located on higher ground, the groundwater level was about 7 ft. below the ground surface - i.e., at about elevation 173.

3. DISCUSSION AND RECOMMENDATIONS:

3.1) General:

It is proposed to construct an interchange at the crossing of Carillon Park Rd. and Hwy. 417, some 13 miles east of Hawkesbury. (The foundation investigation for the proposed underpass and associated approach fills at this interchange was reported earlier under W.J. 69-F-37 - Foundation Section Report dated July 17, 1969.) In order to accommodate the access ramps for this interchange, it is proposed to relocate the existing east - west Twp. Rd. south of the interchange. This relocation will involve cuts up to 20 ft. deep and fills up to 18 ft. in height at locations respectively west and east of the future Carillon Park Rd. North of the existing Hwy. 17, the future westbound lane of Hwy. 417 and the inner and outer loops in Quadrant 'C' of the interchange will require the construction of 20-ft. high fills in the vicinity of the existing creek.

The present investigation has revealed that the predominant stratum in the area of the proposed cut and fills is a firm to stiff, clay deposit of 6.5 to 43 ft. thickness.

3. DISCUSSION AND RECOMMENDATIONS: (cont'd.) ...

3.2) 20-Ft. Cut - Relocated Twp. Rd. (refer B.H. A-1):

Analyses for both the end-of-construction and the long-term stability of the proposed 20-ft. cut were carried out using total as well as effective stress parameters. These analyses indicate that the proposed cut will be stable with standard 2:1 slopes. It is recommended that, in order to prevent surficial sloughing and erosion from surface run-off, the cut slopes be provided with a 12-inch thickness of freely draining granular type of material overlain by topsoil and sod.

3.3) 18-Ft. Fill over Creek - Relocated Twp. Rd. (refer B.H. D-1):

The thickness of the clay deposit at this location is about 17 ft. The undrained shear strengths of the clay are in the order of 1400 PSF. On the basis of stability analyses, it is concluded that the proposed fill will be stable with standard 2:1 side slopes. Settlement computations indicate that the total settlement, due to consolidation of the clay stratum at this location, will be about 2 to 3 inches.

3.4) 20-Ft. Fill - Interchange Quadrant 'C' - Inner and Outer Loops (refer B.H. C-1):

The clay deposit at this location is about 9 ft. thick with an undrained shear strength in the order of 1000 PSF. No stability problems are anticipated for the proposed fills constructed with standard 2:1 side slopes. The total settlement, due to the consolidation of the clay stratum in this area, is estimated to be about 2 inches.

3.5) 20-Ft. Fill - Crossing of Hwy. 417 W.B.L. and Existing Creek (refer B.H. P-1):

The subsoil conditions at this site are similar to those encountered at the location of B.H. C-1. Therefore, no stability problems are anticipated for the proposed fills constructed with 2:1 side slopes.

3. DISCUSSION AND RECOMMENDATIONS: (cont'd.) ...

3.5) 20-Ft. Fill - Crossing of Hwy. 417 W.B.L. and Existing Creek (refer B.H. F-1): (cont'd.) ...

It is estimated that the total settlement at this location, due to consolidation of the clay stratum, will be about 2 inches.

4. MISCELLANEOUS:

The field work for this project was carried out during the period February 10 - 13, 1970, by Mr. C. Mirza, Project Foundation Engineer, who also prepared this report.

General supervision of the project and review of the report were undertaken by Mr. M. Devata, Supervising Foundation Engineer.

April, 1970

APPENDIX I

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DEPARTMENT OF HIGHWAYS- ONTARIO  
MATERIALS & TESTING OFFICE

# RECORD OF BOREHOLE No. 02

FOUNDATION SECTION

JOB 70-F-13 LOCATION Sta. 35+60 @ Prop. Carillon Park Rd. Line A o/s 312' Rt. ORIGINATED BY CM  
W.P. 37-66-06 BORING DATE February 12-13, 1970 COMPILED BY CM  
DATUM Geodetic BOREHOLE TY Washboring-NX Casing; Cone CHECKED BY 4/

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE					LIQUID LIMIT — $w_L$ PLASTIC LIMIT — $w_p$ WATER CONTENT — $w$			BULK DENSITY $\gamma$ P.C.F.	REMARKS		
ELEV. DEPTH	DESCRIPTION	STRAT. PLT	NUMBER	TYPE	BLOWS / FOOT		BLOWS / FOOT					SHEAR STRENGTH P.S.F.					WATER CONTENT %	
							20	40	60	80	100	400	800	1200	1600		2000	$w_p$
145.6	Ground Level																	
141.8	Silty sand		1	SS	5													
2.0	Stiff; desiccated		2	SS	16													
140.1	mottled Gray-brown		3	TN	FM													
5.5	Clay		4	TN	FM													
134.3	Firm Grey		5	TN	FM													
10.8	Glacial Till																	
	Het. mix. of clayey silt, sand & gravel with occ. granular zone. Very stiff-hard or dense		6	SS	29													
127.6			7	SS	32													
18.0	End of Borehole																	

$E_o = 1.87$   
 $P_c = 2.55$  TSP  
 $C_c = 1.40$

Practical refusal to cone at el. 124.0

140

130

120

x 8

x 7

+ 10

101

118

$E_o = 1.87$   
 $P_c = 2.55$  TSM  
 $C_c = 1.40$

Practical refusal to cone at el. 124.0

DEPARTMENT OF HIGHWAYS- ONTARIO  
MATERIALS & TESTING OFFICE

# RECORD OF BOREHOLE No. D1

FOUNDATION SECTION

JOB 70-F-13

LOCATION Sta. 17+06 @ Prop. Carillon Park Rd. Line A o/s 171' Rt.

ORIGINATED BY CM

W.P. 37-66-06

BORING DATE February 11-12, 1970

COMPILED BY CM

DATUM Geodetic

BOREHOLE TYPE Washboring-NX Casing; Cone

CHECKED BY

SOIL PROFILE		SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE					LIQUID LIMIT — w <sub>L</sub> PLASTIC LIMIT — w <sub>P</sub> WATER CONTENT — w			BULK DENSITY Y	REMARKS	
ELEV. DEPTH	DESCRIPTION	NUMBER	TYPE	BLOWS / FOOT		20	40	60	80	100	SHEAR STRENGTH PS					WATER CONTENT %
											○ UNCONFINED      + FIELD VANE ● QUICK TRIAXIAL    x LAB VANE					
						400	800	1200	1600	2000				25    50    75		
148.3	Ground Level															
146.3	Topsoil	1	SS	15												
143.8	Stiff, desiccated occ. sand seams	2	SS	14												
145	Clay with trace sand.	3	SS	2												
		4	TW	PH												
		5	TW	PH												
	Stiff to firm. Grey; occ. black mottling	6	TW	PH												
		7	TW	PH												
129.0																
19.3	Glacial Till Het. mix. clayey silt, sand & gravel.	8	SS	10												
123.3	Stiff-Hard. Grey															
25.0	End of Borehole															

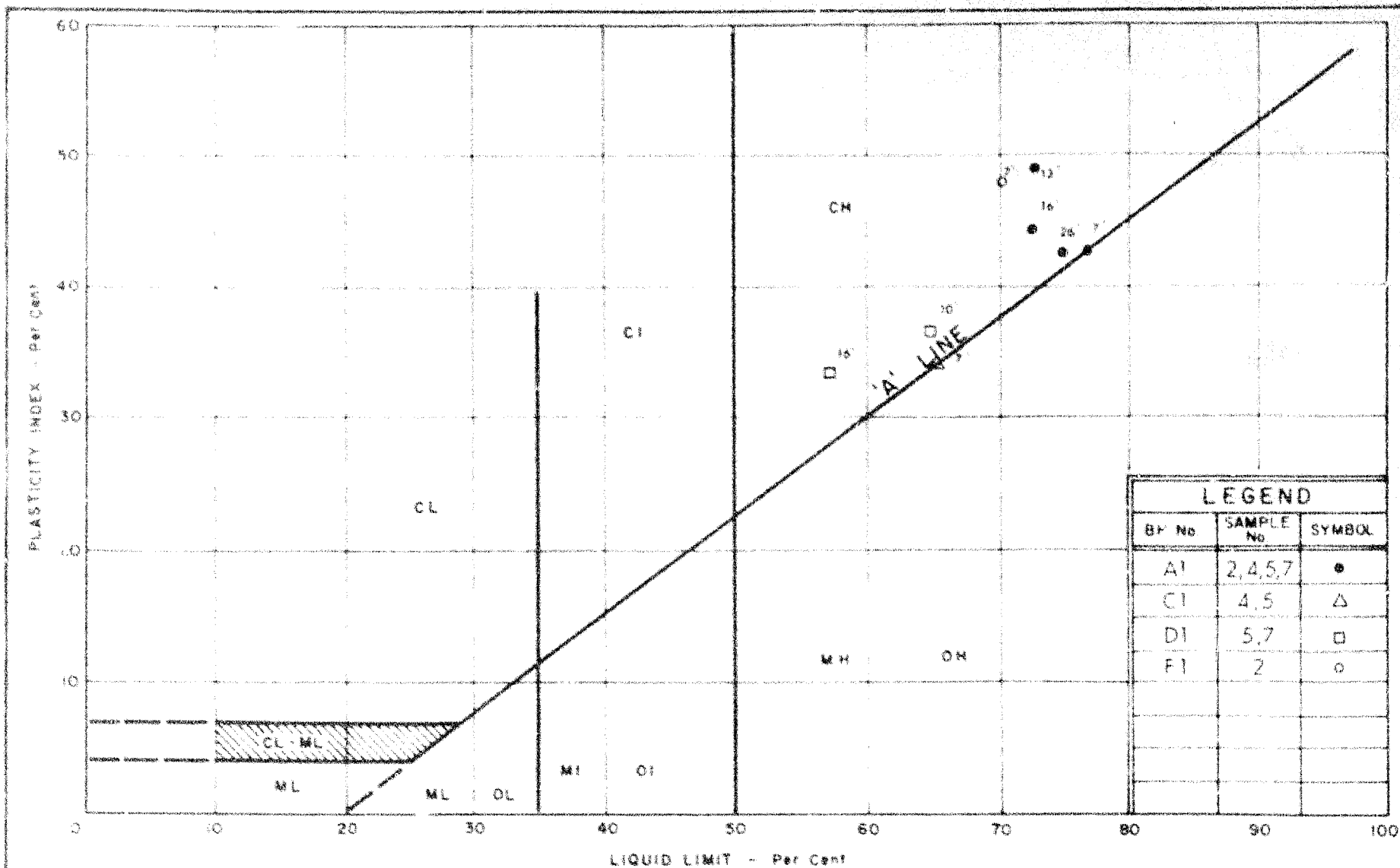
FOUNDATION SECTION

ORIGINATED BY CM

COMPILED BY CJ

CHECKED BY

SOIL PROFILE		SAMPLES			ELEV SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT	LIQUID LIMIT — % PLASTIC LIMIT — % WATER CONTENT — %	BULK DENSITY $\gamma$ P.C.F.	REMARKS
ELEV DEPTH	DESCRIPTION	NUMBER	TYPE	BLOWS / FOOT		20 40 60 80 100			
115.9	Ground Level					SHEAR STRENGTH P.S.F. ○ UNCONFINED * FIELD VANE ● QUICK TRIAXIAL x LAB VANE			
0.0	Topsoil					400 800 1200 1600 2000	25 50 75		
112.6	Sand Brown	1	SS	6					
3.3	Clay Firm. Grey with occ. black mottling.	2	TW	PM	140	x 5			
136.0	Glacial Till Het. mix. of clayey silt, sand & gravel. Firm to hard. Occ. granular zones	3	TW	PM				130	29 33 29 9
9.9		4	SS	13					
		5	SS	4	130				
		6	SS	4					21 21 36 9
120.7	Loose to dense Grey	7	SS	125/2"					
25.2	End of Borehole				120				



LEGEND		
BP No	SAMPLE No	SYMBOL
A1	2,4,5,7	•
CI	4,5	△
DI	5,7	□
F1	2	○



DEPARTMENT OF HIGHWAYS  
MATERIALS and  
TESTING  
DIVISION

## PLASTICITY CHART CLAY

WP No. 37-66-06

JOB No. 70-F-13

FIG. 1

# VOID RATIO - PRESSURE CURVES

JOB NO. 70-F-13

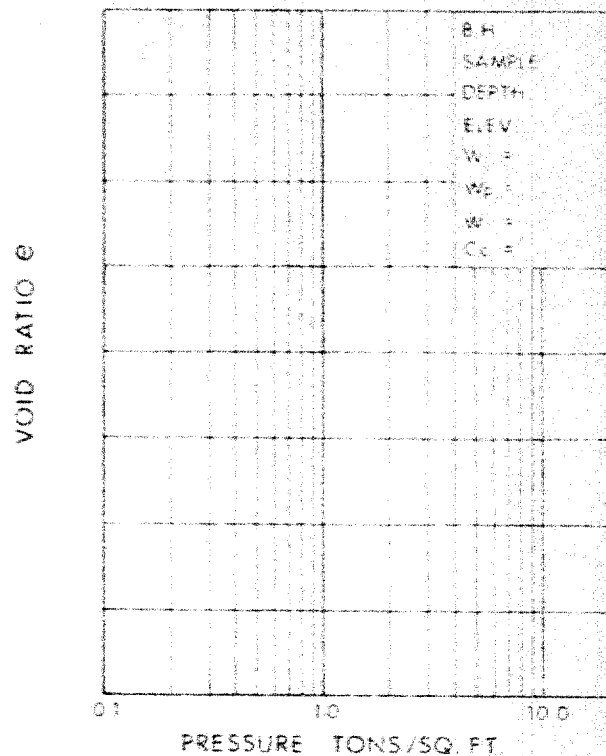
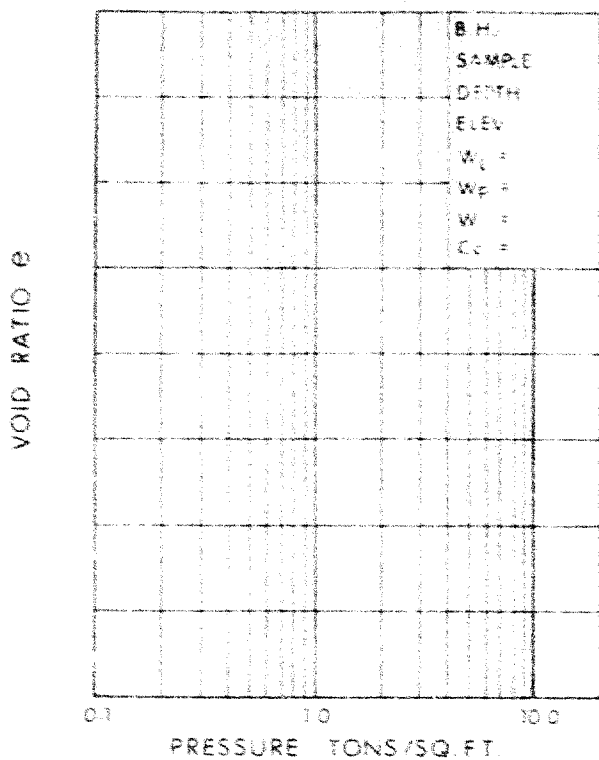
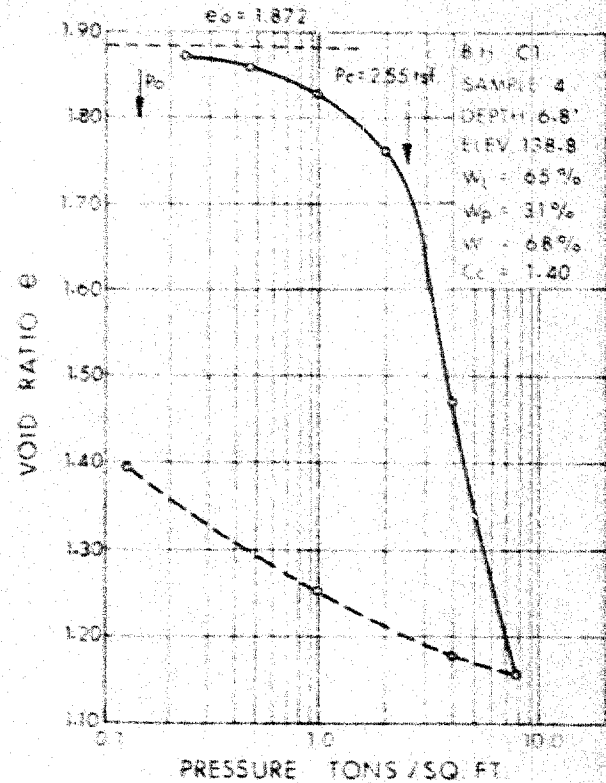
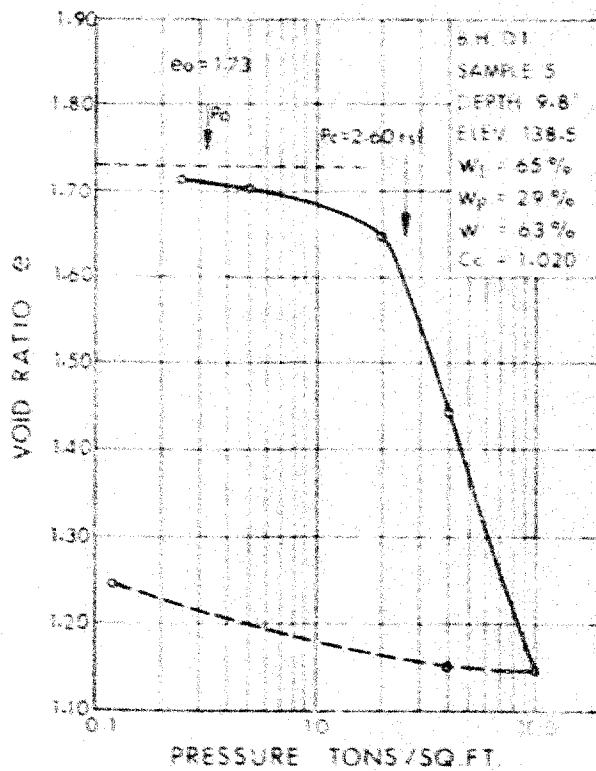
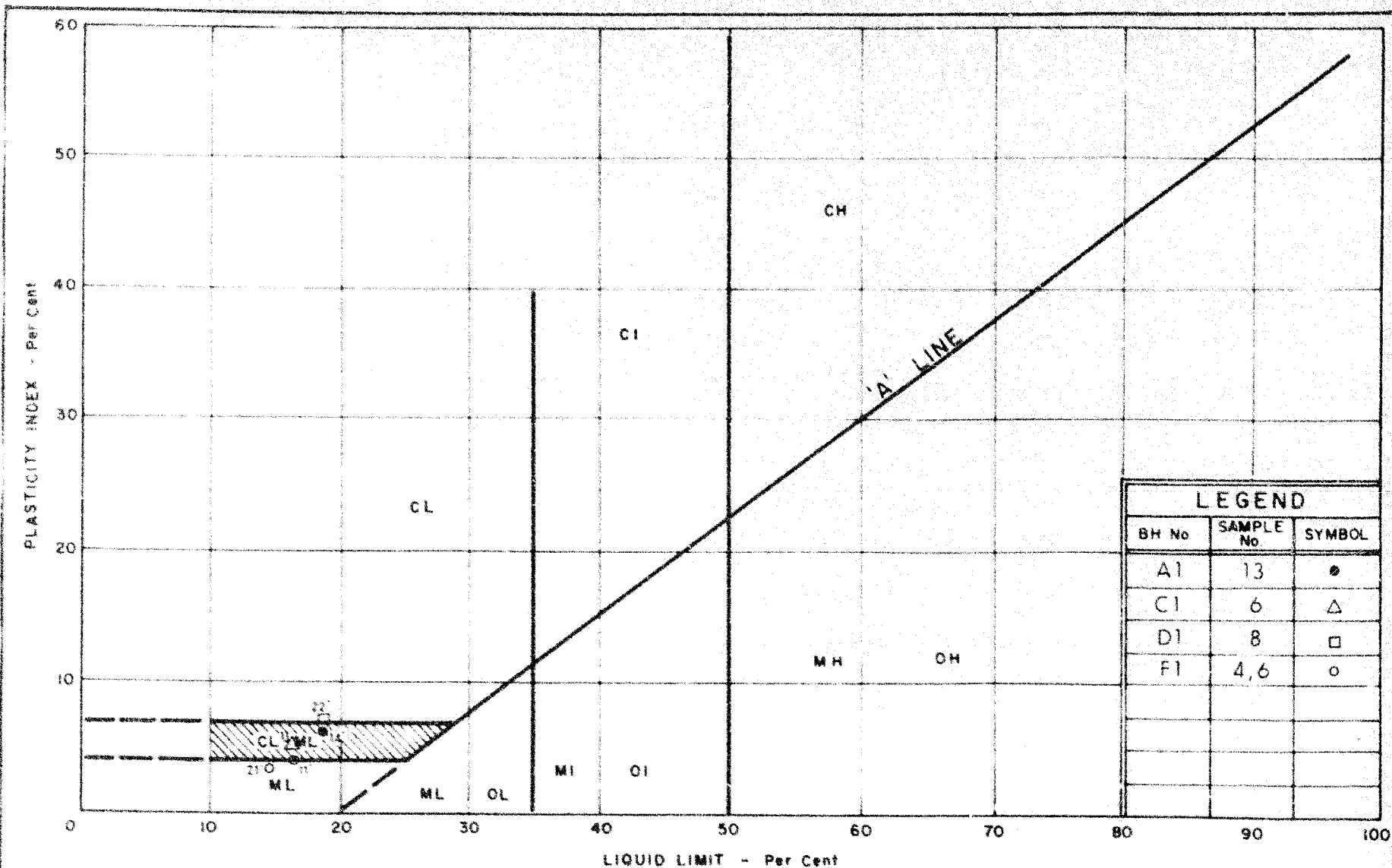


FIG. 2



DEPARTMENT OF HIGHWAYS  
MATERIALS and  
TESTING  
DIVISION

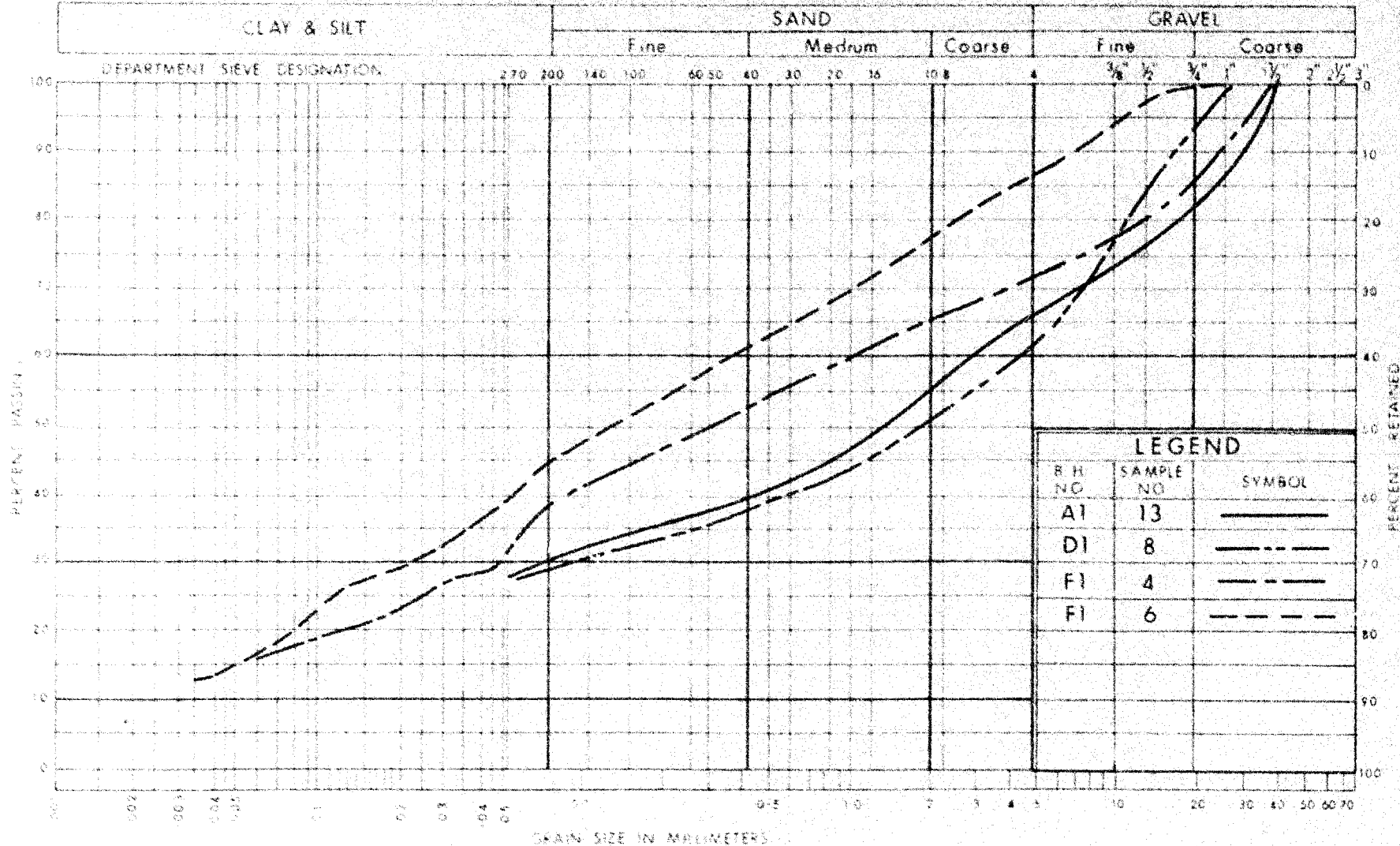
# PLASTICITY CHART GLACIAL TILL

WP No. 37-66-06

JOB No. 70-F-13

FIG 3

# UNIFIED SOIL CLASSIFICATION SYSTEM



DEPARTMENT OF HIGHWAYS  
MATERIALS and  
TESTING  
DIVISION

## GRAIN SIZE DISTRIBUTION GLACIAL TILL

W.P. No. 37-66-06

JOB No. 70-F-13

FIG. 4



MEMORANDUM

To: Mr. A. G. Stermac,  
Principal Foundation Engineer,  
Materials & Testing Office,  
Downsview, Ontario.

From: Materials & Testing Office,  
Kingston, Ontario.

ATTENTION:

DATE: April 18, 1969.

OUR FILE REF.

IN REPLY TO

SUBJECT:

Re: W.P. 37-66-05, Hwy. 417,  
Quebec Boundary Westerly,  
District 9, Ottawa.

Attached please find the logs of borings and records of vane tests carried out for a preliminary soils investigation at several low areas on this project. The borings were carried out by hand equipment.

Final plans and profiles have not been issued by Engineering Surveys Section as yet. We are forwarding therefore, a preliminary plan and profile. The groundline is based on contour maps and the groundline for existing Hwy. 17.

Approximately 4' of fill will be placed in the vicinity of Station 264<sup>+</sup>. It is felt that excavation of the organic layer only is necessary since excessive settlement is not expected. We would appreciate any comments you might have, however, regarding the expected settlements at this location.

The two low areas in the vicinity of Station 463<sup>+</sup> to Station 471<sup>+</sup>, referred to in your preliminary foundation report of February 26th, were also investigated. These areas were investigated to a depth of only 5' - 6' since it is impractical to penetrate further into firm to stiff material with hand equipment.

It is felt that a foundation investigation should be carried out at these locations to check the stability and estimate the settlement.

The borings we have carried out in the vicinity of Station 498<sup>+</sup> and on County Road #24 are in conjunction with structure site No. 88 and the approach fills. This information may be useful to you in carrying out the complete foundation investigation at this site.

*H. A. Meyer*  
H. A. Meyer

HAM/jk

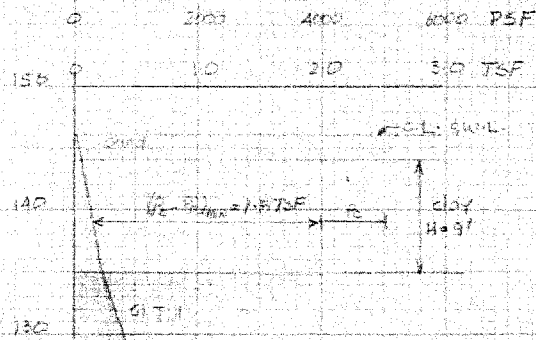
for J. E. Gruspier,  
Regional Materials Engineer.

c.c. J. L. Forster  
G. A. Wrong

Attached

# TO F13 - SETTLEMENT COMPUTATIONS

## SITE C BHC-1



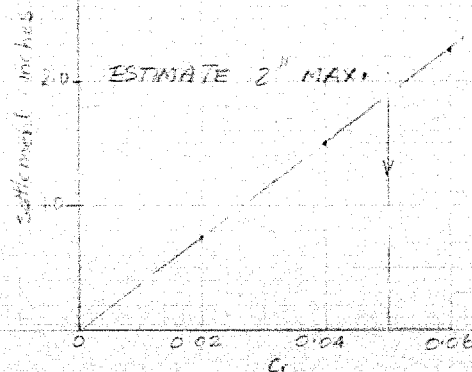
$$P_0 = 0.10 \text{ TSF}$$

$$P_e = 2.0 \text{ TSF (MAX)}$$

$$20 \text{ FT FILL @ } 130 \text{ PSF} = 2600 = 13 \text{ TSF (MAX)}$$

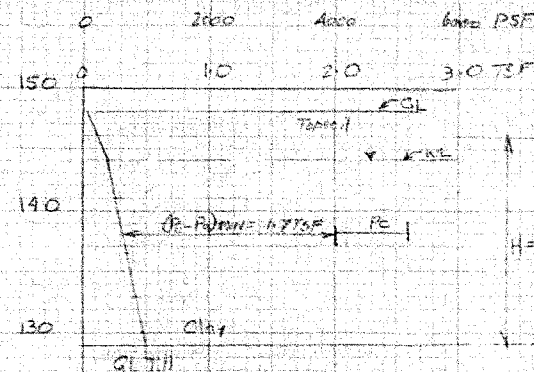
$$S = \frac{q}{1+e_0} C_r \left[ \log \left( 1 + \frac{1.3}{0.10} \right) \right]$$

$$S = \frac{9}{2.87} \times 1.013 = 3.185 \text{ ft.}$$



SITE F IS SIMILAR TO SITE C.

## SITE D BHD-1



$$AP = 1.3 \text{ TSF (20' FILL)}$$

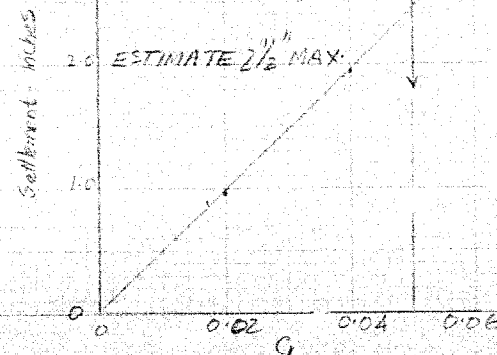
$$P_0 = 0.126 \text{ TSF}$$

$$P_e = 0.42 \text{ TSF}$$

$$S = \frac{q}{2.73} C_r \left[ \log \left( 1 + \frac{1.3}{0.126} \right) + \log \left( 1 + \frac{1.3}{0.42} \right) \right]$$

$$= 2.93 C_r [0.778 + 0.612]$$

$$S = 4.07 C_r$$



QUADRANT

WP 37-66-06

TO-F 13

CUT

FILL RELOCATED TWP

SOUTH OF CARILLON PARK RD  
5 HWY 47 INTERCHANGESTABILITY COMPUTATIONSParameters used in stability Analyses

$$c' = 350 \text{ PSF}$$

$$\phi = 17.5^\circ$$

$$D = 1.25$$

$$L_u = 0.35$$

$$\text{Slope} = 2:1$$

$$\therefore c'/\gamma H = 350/100.20 = 0.175 \rightarrow 0.05$$

$$\textcircled{1} \text{ For } c'/\gamma H = 0.05, F = 1.359 - (0.35)(1.108) = 0.971$$

By extrapolation:  $F \approx 1.3$  for  $c'/\gamma H = 0.175$ .

$$\textcircled{2} H = \frac{45}{1} = \frac{3200}{100} = 32'$$

$$\text{CUT IS } 20' \ll 32'$$

NO LONG TERM STABILITY PROBLEM ANTICIPATED.  $\leftarrow \textcircled{1}$ NO STABILITY PROBLEM DURING CONSTRUCTION  $\leftarrow \textcircled{2}$ 

clay, silty  
 $\phi = 25^\circ$   
 $c' = 50 \text{ PSF}$

 $r_u$  values  $\rightarrow$ 

$$200 \text{ TBL TIE } L_u = 0.35$$

Fail in fill  
 $(\gamma_u \neq \gamma_{fill})$

assume base of failure is level  
 from elev 155

$$\text{Then } D = \frac{25}{20} = 1.25$$

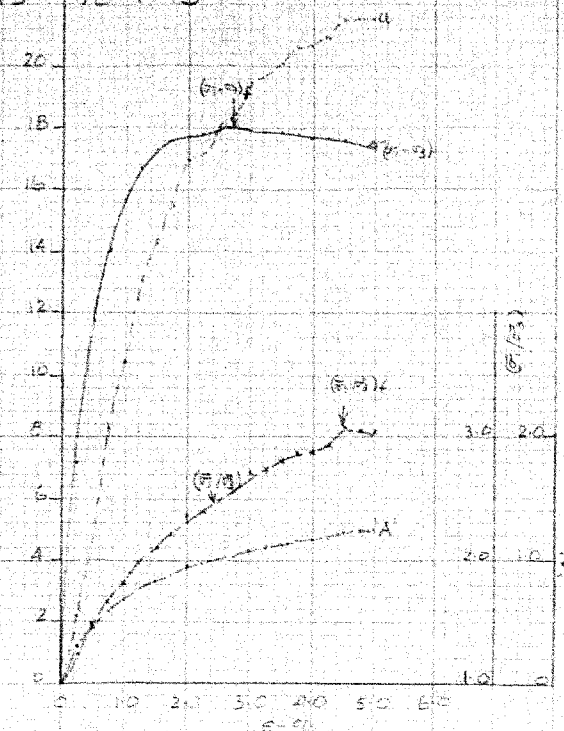
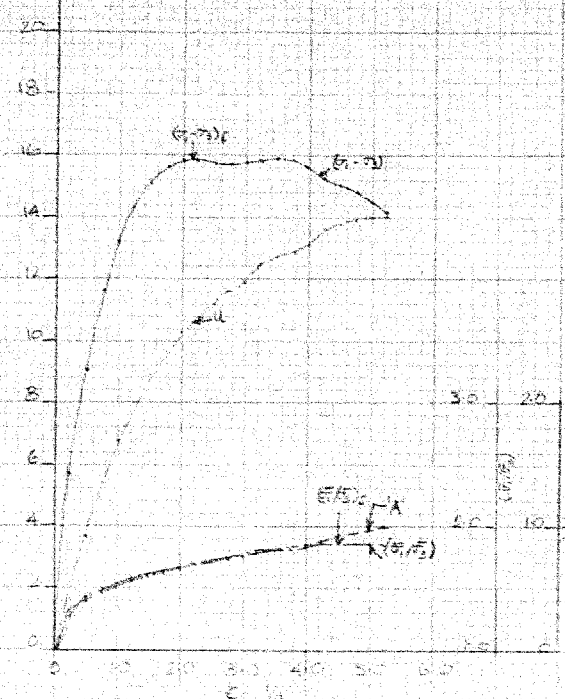
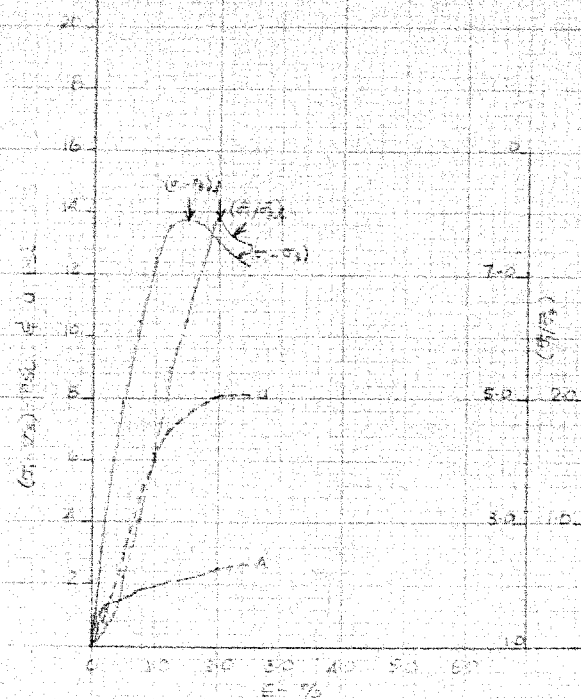
Ref. Geot 1260

Bishop & Morgenstern  
stability coeffs.

CONCLUSION: OK @ 2:1

Prep by CM  
March 2/70

# CONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION TEST RESULTS - 70-F-13

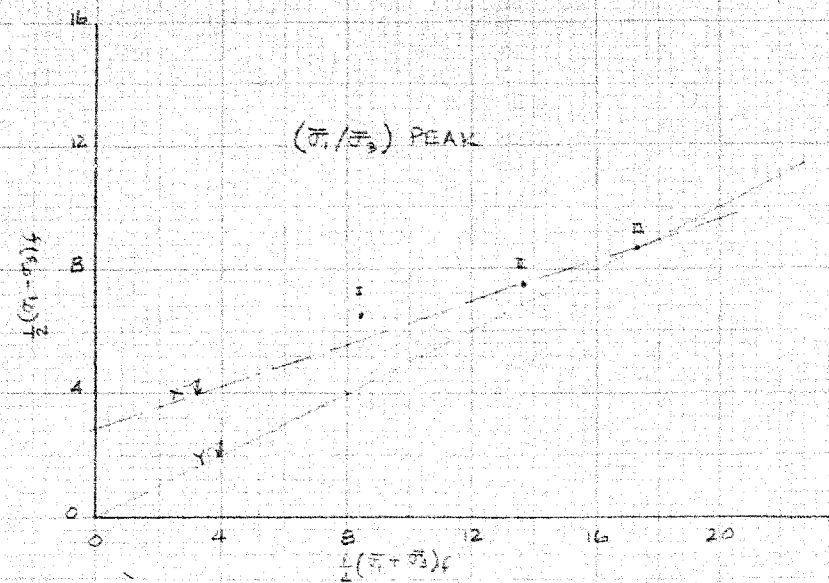
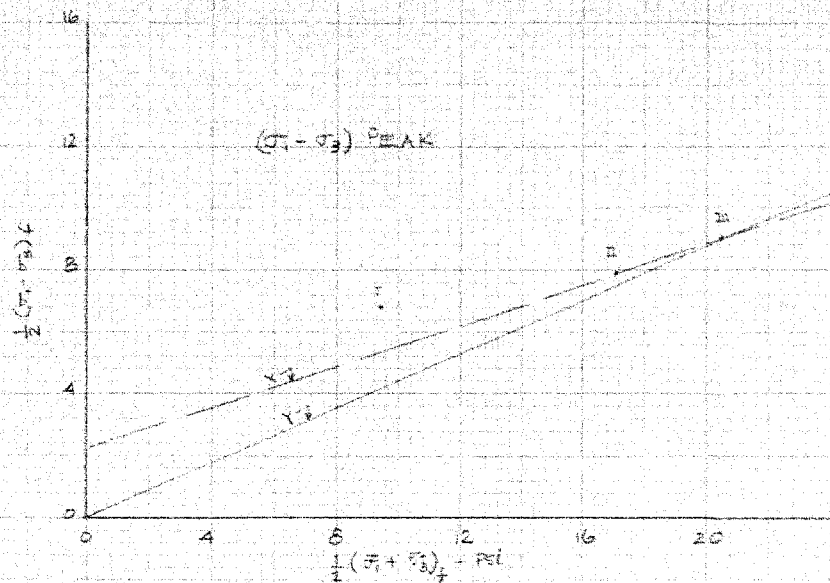


BR 52 DPH Ek	A1	5	15-9"	15-0
N.W. 1/2 1/2	81.5%	78.7%	10-4	12-0
Criteria	Peak (σ1-σ3)	Peak (σ1/σ3)		
(σ1-σ3)	13.7 psi	1.2		
(σ1/σ3)	6.3	7.9		
ε <sub>c</sub>	1.5%	2.0%		
U <sub>c</sub>	7.4 psi	6.1 psi		
A <sub>1</sub>	0.54	0.62		
1/2 (σ1-σ3)	6.85 psi	6.55 psi		
1/2 (σ1+σ3)	3.45 psi	3.45 psi		

A1	6	20-9"	16-0
81.5%	73.4%	20 psi	12-0
Peak (σ1-σ3)	Peak (σ1/σ3)		
15.8 psi	15.0 psi		
2.7	3.4		
2.25%	4.5%		
10.8 psi	13.8		
0.68	0.92		
7.9 psi	7.5 psi		
17.1 psi	13.7 psi		

A1	6	20-6"	16-0"
79.6%	59.7%	30 psi	12-0
Peak (σ1-σ3)	Peak (σ1/σ3)		
18.0 psi	17.0 psi		
2.6	3.1		
2.75%	4.5%		
18.5 psi	21.5 psi		
11.03	1.22		
9.0 psi	6.5 psi		
20.5 psi	13.3 psi		

**Figure 1**



$\beta$		$\tan \beta$		$\phi' = \sin^{-1}(\tan \beta)$		$d$		$\cos \phi'$		$C' = \frac{d}{\cos \phi'}$	
x	y	x	y	x	y	x	y	x	y	x	y
185	237	384	459	19.5	26	2.2	0	443	0	2.23	0

$\beta$		$\tan \beta$		$\phi = \sin^{-1}(\tan \beta)$		$d$		$\cos \phi$		$d' = \frac{d}{\cos \phi}$	
x	y	x	y	x	y	x	y	x	y	x	y
18.5	26.5	33.4	.477	19.5°	30°	2.5	0	.943	0	2.91	0

I MAY BE OVERVALUED

Since excavation is involved, assume Line X applies.  $\therefore$  use  $c' = 350$  PSF  
 $\phi' = 17.5^\circ$  in Stability Analyses.

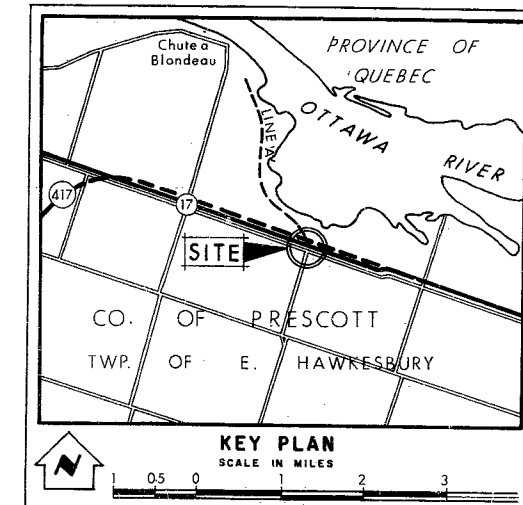
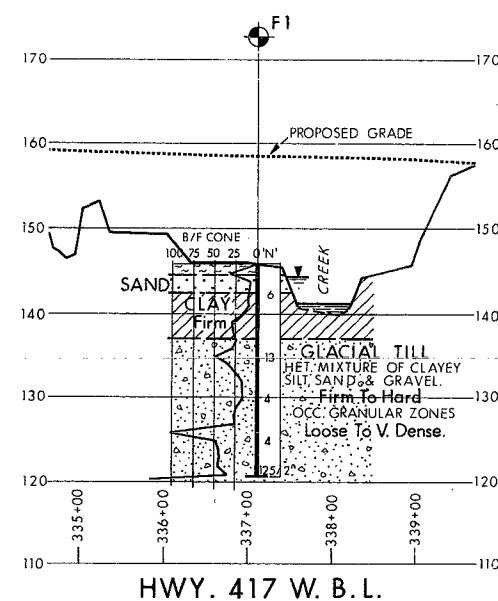
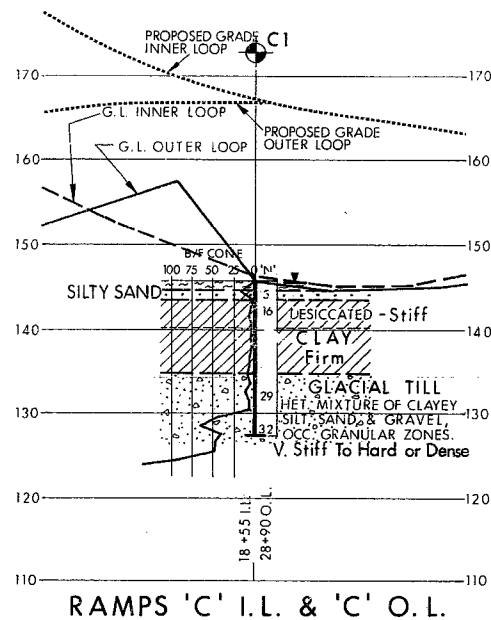
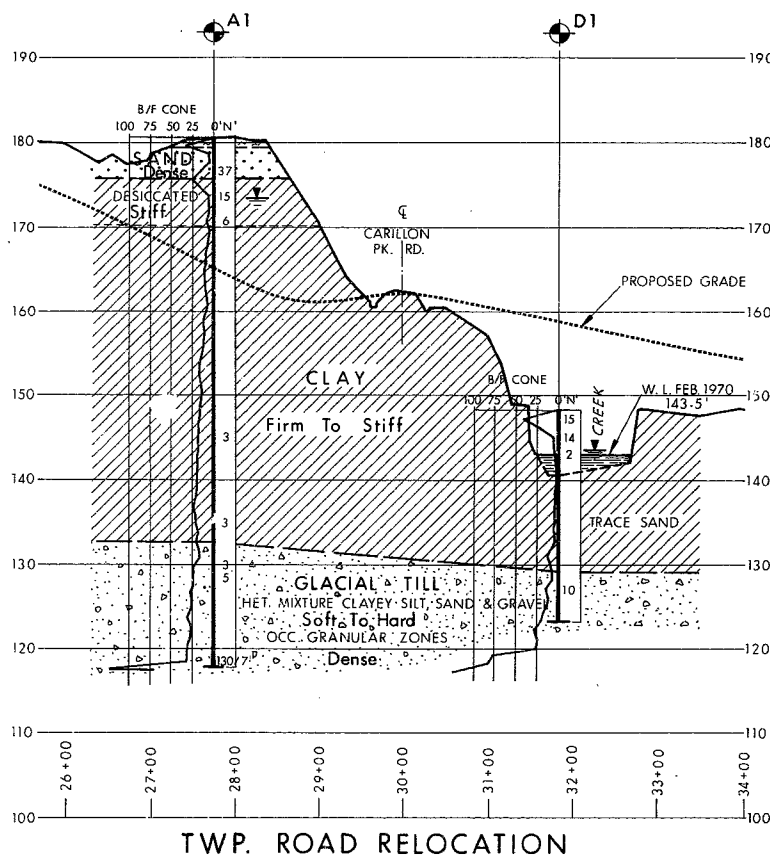
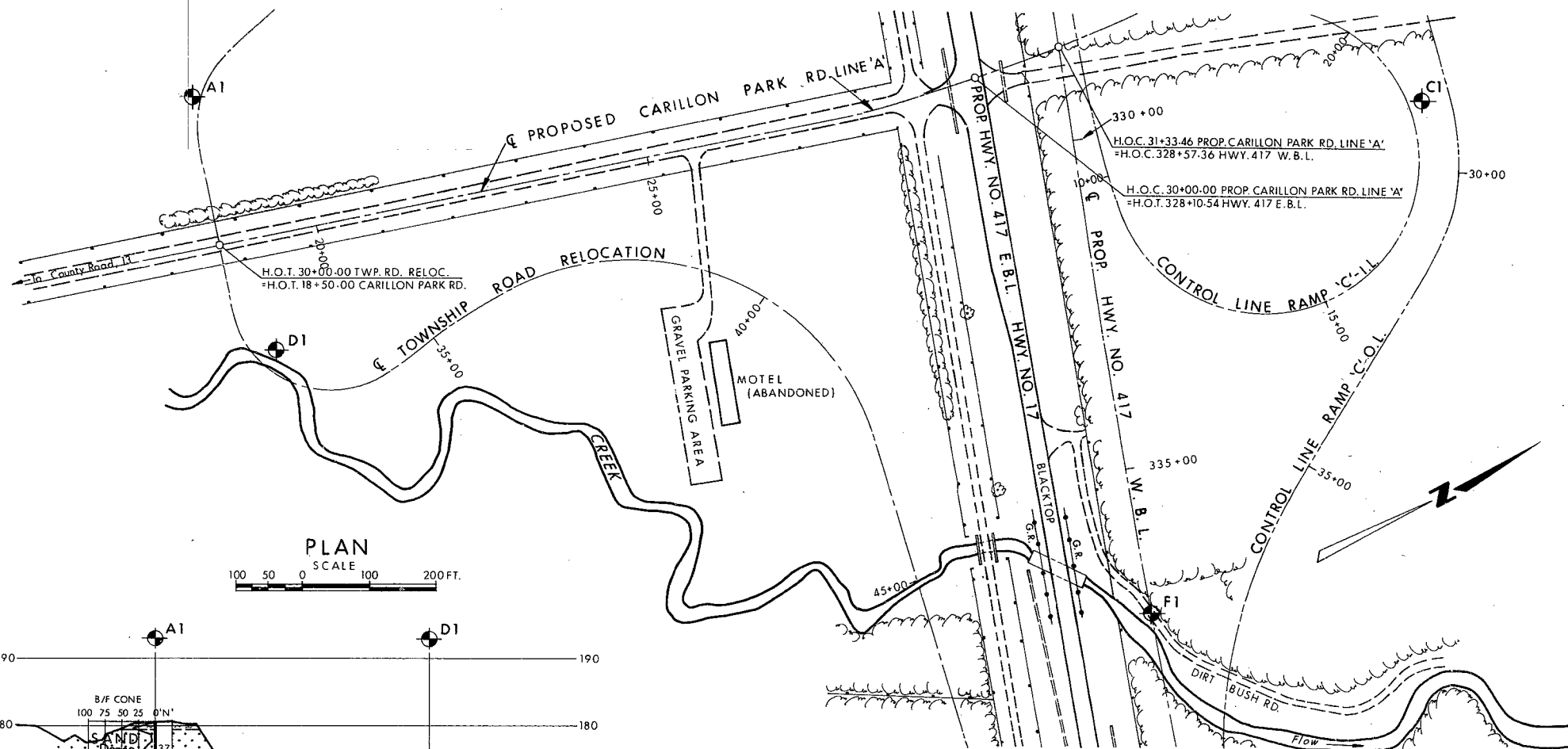
CM Mar 24/72

CONT. 71-66

HWY. 417 -

CARILLON PK. RD.

316-3



LEGEND			
	Bore Hole		
	Cone Penetration Hole		
	Bore & Cone Penetration Hole		
	Water Levels established at time of field investigation, FEB., 1970.		

NO.	ELEVATION	STATION	OFFSET
A1	180.8	19+57	228' LT
C1	145.6	35+60	312' RT.
D1	148.3	19+08	171' RT.
F1	145.9	337+18	CL HWY. 417 W.B.L.

**NOTE**  
The boundaries between soil strata have been established only at Bore Hole locations. Between Bore Holes the boundaries are assumed from geological evidence and may be subject to considerable error.

REVISIONS	DATE	BY	DESCRIPTION

GEOCRIS NO. 31G-3

DEPARTMENT OF HIGHWAYS - ONTARIO  
MATERIALS & TESTING OFFICE - FOUNDATION SECTION

STABILITY INVESTIGATION  
**CARILLON PARK RD. INTERCHANGE**  
KING'S HIGHWAY NO. 417 E.B.L. & W.B.L. DIST. NO. 9  
CO. PRESCOTT  
TWP. E. HAWKESBURY LOT 12 & 13 CON. B.F. & 1

**BORE HOLE LOCATIONS & SOIL STRATA**

SUBM'D C.M.	CHECKED	W.P. NO. 37-66-05	M.B.T. DRAWING NO.
DRAWN E.D.	CHECKED	JOB NO. 70-F-13	<b>70-F-13A</b>
DATE 1 APRIL, 1970	SITE NO.		BRIDGE DRAWING NO.
APPROVED <i>A.P. Thomas</i>	PRINCIPAL FOUNDATION ENGINEER	CONT. NO.	



REF. NO. B-63-10