

## MEMORANDUM

23-66-299

To: Mr. B. R. Davis,  
Bridge Engineer,  
Bridge Division.

Attention: Mr. S. McCombie

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

DATE: March 22, 1966

OUR FILE REF.

IN REPLY TO

APR 25 1966

SUBJECT:

FOUNDATION INVESTIGATION REPORT  
For

Proposed Crossing of La Fontaine  
Creek and West Connection of Old  
Hwy. 17, Lot 31, Con. I, Ottawa  
Front, Twp. of Clarence, Co. of  
Russell - District 9 (Ottawa).  
W.J. 66-F-15 -- W.P. 48-65

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

We believe that you will find the factual data and  
recommendations contained therein, adequate for your design  
requirements.

Should additional information be required, please  
feel free to contact our Office.

AGS/MdeF  
Attach.

*A. G. Stermac*  
A. G. Stermac,

PRINCIPAL FOUNDATION ENGINEER

cc: Messrs. B. R. Davis (2)  
H. A. Tregaskes  
D. W. Farren  
R. S. Pillar  
L. E. Walker  
J. E. Gruspier  
A. Watt

Foundations Office  
Gen. Files

## TABLE OF CONTENTS

1. INTRODUCTION.
  2. SUBSOIL CONDITIONS:
    - 2.1) General.
    - 2.2) Silty Clay to Clay.
    - 2.3) Heterogeneous Mixture of Silt, Sand and Gravel with Boulders (Glacial Till).
  3. DISCUSSION AND RECOMMENDATIONS.
  4. MISCELLANEOUS.
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FOUNDATION INVESTIGATION REPORT  
For  
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Creek and West Connection of Old  
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Front, Twp. of Clarence, Co. of  
Russell - District 9 (Ottawa).  
W.J. 66-F-15 -- W.P. 48-65

1. INTRODUCTION:

The Foundation Section was requested to carry out an investigation for the proposed crossing at La Fontaine Creek and West connection of old Hwy. #17 in the Twp. of Clarence, District of Ottawa. The request was contained in a memo from the Bridge Location Section, dated December 29, 1965. The site is located at the west limits of the town of Rockland near the east shore of La Fontaine Bay. The general area is flat to undulating.

An investigation was subsequently carried out by this Section to determine the subsoil conditions at the site of the proposed structure. Presented in this report are the results of our investigation, together with the recommendations pertaining to the foundations for the structure and the stability of the proposed approach embankments.

2. SUBSOIL CONDITIONS:

2.1) General:

Two borings and five dynamic cone penetration tests were carried out during the field investigation, revealing subsoil conditions to be generally uniform over the site area. The

2. SUBSOIL CONDITIONS: (cont'd.) ...

2.1) General: (cont'd.) ...

boundaries between different deposits, together with detailed descriptions of the material in the deposits, are shown on the borelog sheets attached to this report. The estimated stratigraphical profile shown on Dwg. 66-F-15A is based on this information. From ground level downward, the different soil types encountered, are as follows:

2.2) Silty Clay to Clay:

This deposit was observed immediately below the creek bed and extends some 70 ft. in B.H. #1 and 60 ft. in B.H. #2. The material varies somewhat in plasticity and is classified as silty clay to clay. Occasional thin seams of silt and sand were observed within this deposit. Physical properties of the material as determined from field and laboratory tests, are as follows:

Bulk Density ..... 99 to 110 p.c.f.

Liquid Limit ..... 50% - 74%

Plastic Limit ..... 20% - 28%

Moisture Content ... 42% - 66%

Unconfined Shear Strength - 750 - 2,300 p.s.f.

Lab. Vane Shear Strength - 640 - 3,180 (sensitivity 4 to 8)

In-situ Field Vane Shear  
Strength - 960 ->2,000 (sensitivity 7 to 17)

Based on the above results, the consistency of the overall deposit is classified as firm to very stiff. The shear strength generally increases with depth.

cont'd. /3 .....

2. SUBSOIL CONDITIONS: (cont'd.) ...

2.3) Heterogeneous Mixture of Silt, Sand and Gravel with Boulders (Glacial Till):

This deposit was observed in both boreholes immediately below the clay stratum. The material is essentially granular in nature, consisting of a heterogeneous mixture of silt, sand and gravel with occasional boulders up to 12" in size. 'N' values ranged from 22 to 172 blows/ft., which indicates a relative density of compact to very dense. This deposit was so dense below approximate elev. 60, that samples could not be recovered by split-spoon samplers. In such cases, samples were recovered by diamond drilling.

3. DISCUSSION AND RECOMMENDATIONS:

It is proposed to construct a new structure at the crossing of the proposed west connection of old Hwy. 17 and La Fontaine Creek. At this location the existing single-span structure on old Hwy. 17 will be demolished. The proposed centre-line of the west connection will be the same as the existing centre-line of old Hwy. 17. The new structure will be about 100 ft. long and 24 ft. wide.

As mentioned in the previous paragraphs, the upper portion of the subsoil consists mainly of firm to stiff silty clay to clay. Such a soil cannot provide adequate bearing for an economical spread footing design. In view of these facts, it is recommended that the structure be supported on end-bearing piles driven to practical refusal in the silt, sand and gravel stratum at approximate elevation 60.0. Design loads to be used are dependent on the pile section selected and may be 75 tons per pile in the case of

cont'd. /4 .....

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

12 BP 73 steel H-piles. Footing bases should be formed on a suitable working slab or a 12" granular pad. Since the excavations for the footings will be carried out below creek water level, a dewatering scheme will be necessary.

No stability problems are anticipated with regard to the approach embankment, using standard 2:1 slopes.

4. MISCELLANEOUS:

The field work, performed during the period February 7 to February 14, 1966, was undertaken by Mr. F. Wang, Project Foundation Engineer.

Equipment used was owned and operated by Johnston Drilling Co. Ltd.

The project was under the general supervision of Mr. M. Devata, Senior Foundation Engineer, who also prepared the report.

March 1966

APPENDIX I

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DEPARTMENT OF HIGHWAYS - ONTARIO

## MATERIALS &amp; TESTING DIVISION

## RECORD OF BOREHOLE NO. 1

FOUNDATION SECTION

JOB 66-F-15

LOCATION Sta. 4/84, 39' Rt. of E

ORIGINATED BY P.L.W.

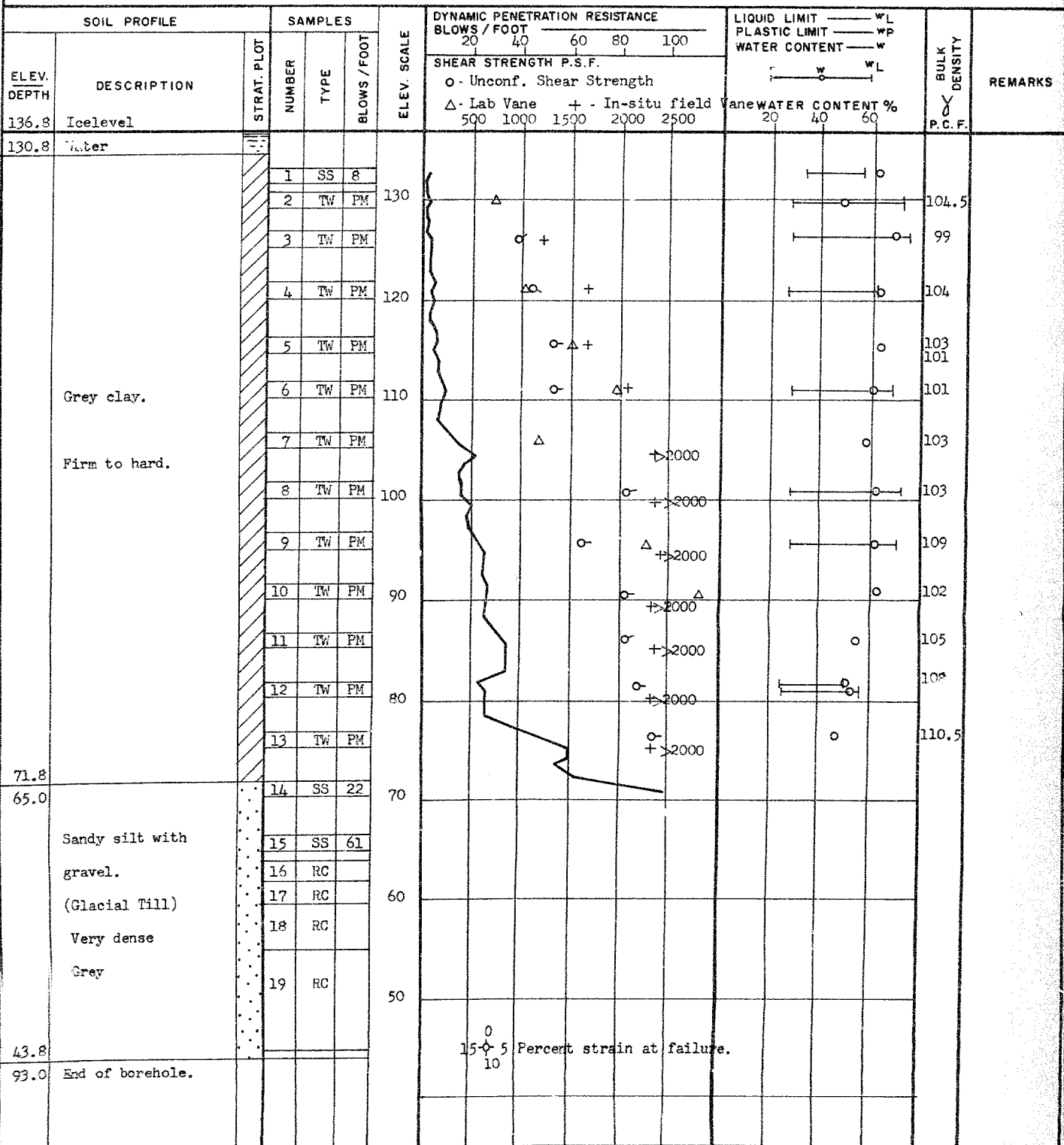
W.P. 48-65

BORING DATE Feb. 7-10, 1966.

COMPILED BY A.K.B. &amp; M.D.

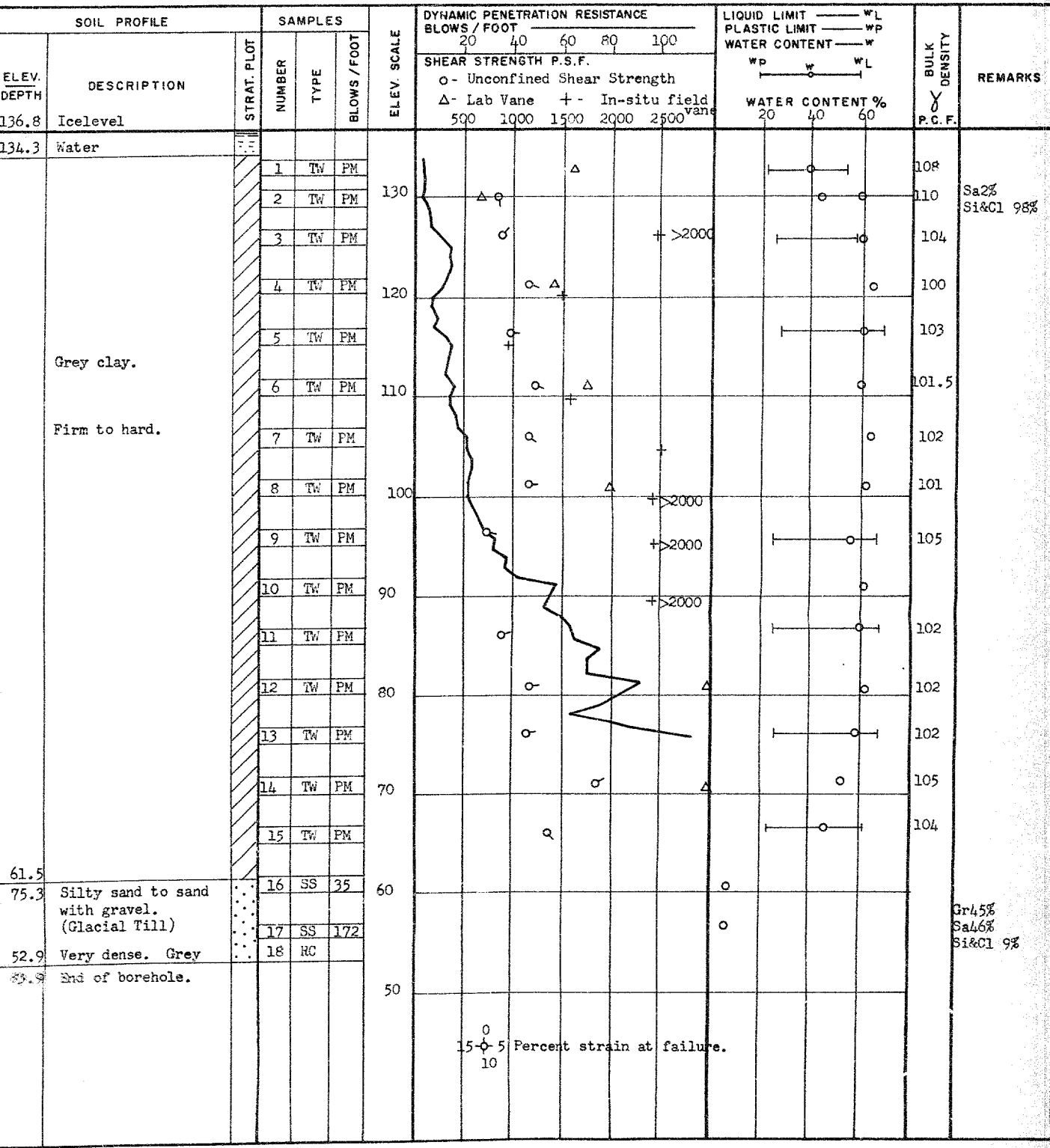
DATUM Geodetic

BOREHOLE TYPE Washboring, NX Casing.

CHECKED BY M.D. *dl*



DEPARTMENT OF HIGHWAYS - ONTARIO		RECORD OF BOREHOLE NO. 2		FOUNDATION SECTION	
MATERIALS & TESTING DIVISION					
JOB 66-F-15	LOCATION Sta. 487, 54' Lt. of E	ORIGINATED BY P.L.W.			
W.P. 48-65	BORING DATE Feb. 14-15, 1966.	COMPILED BY A.K.B. & M.D.			
DATUM Geodetic	BOREHOLE TYPE Washboring, NX Casing.	CHECKED BY M.D.			



DEPARTMENT OF HIGHWAYS - ONTARIO

## RECORD OF BOREHOLE NO. 3

FOUNDATION SECTION

MATERIALS &amp; TESTING DIVISION

JOB 66-F-15

LOCATION Sta. 5409 53' Lt.

ORIGINATED BY P.L.W.

W.P. 48-65

BORING DATE Feb. 13, 1966.

COMPILED BY R.M.

DATUM

BOREHOLE TYPE Cone Penetration Test

CHECKED BY M.D. *HL*

## SOIL PROFILE

## SAMPLES

## DYNAMIC PENETRATION RESISTANCE

BLOWS / FOOT

20 40 60 80 100

SHEAR STRENGTH P.S.F.

LIQUID LIMIT ——— WL

PLASTIC LIMIT ——— WP

WATER CONTENT ——— W

WP ——— W ——— WL

WATER CONTENT %

BULK  
DENSITY  
P.C.F.

REMARKS

ELEV.  
DEPTH

DESCRIPTION

STRAT. PLOT

NUMBER

TYPE

BLOWS / FOOT

ELEV. SCALE

137.1

Icelevel

65.1

72 End of borehole.

130

120

110

100

90

80

70

60

Refusal

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS &amp; TESTING DIVISION

## RECORD OF BOREHOLE NO. 4

FOUNDATION SECTION

JOS 66-F-15

LOCATION Sta. 465 55' Lt.

ORIGINATED BY P.L.W.

W.P. 48-65

BORING DATE Feb. 12, 1966.

COMPILED BY R.M.

DATUM

BOREHOLE TYPE Cone Penetration.

CHECKED BY M.D. *ll*

SOIL PROFILE		SAMPLES		ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT 20 40 60 80 100 SHEAR STRENGTH P.S.F.	LIQUID LIMIT — WL PLASTIC LIMIT — WP WATER CONTENT — W WP — W — WL WATER CONTENT %	BULK DENSITY P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLT	NUMBER					
136.0	Ice level							
66.0								
70.0	End of borehole.							

DEPARTMENT OF HIGHWAYS - ONTARIO  
MATERIALS & TESTING DIVISION  
JOB 66-F-15  
W.P. 48-65  
DATUM Geodetic

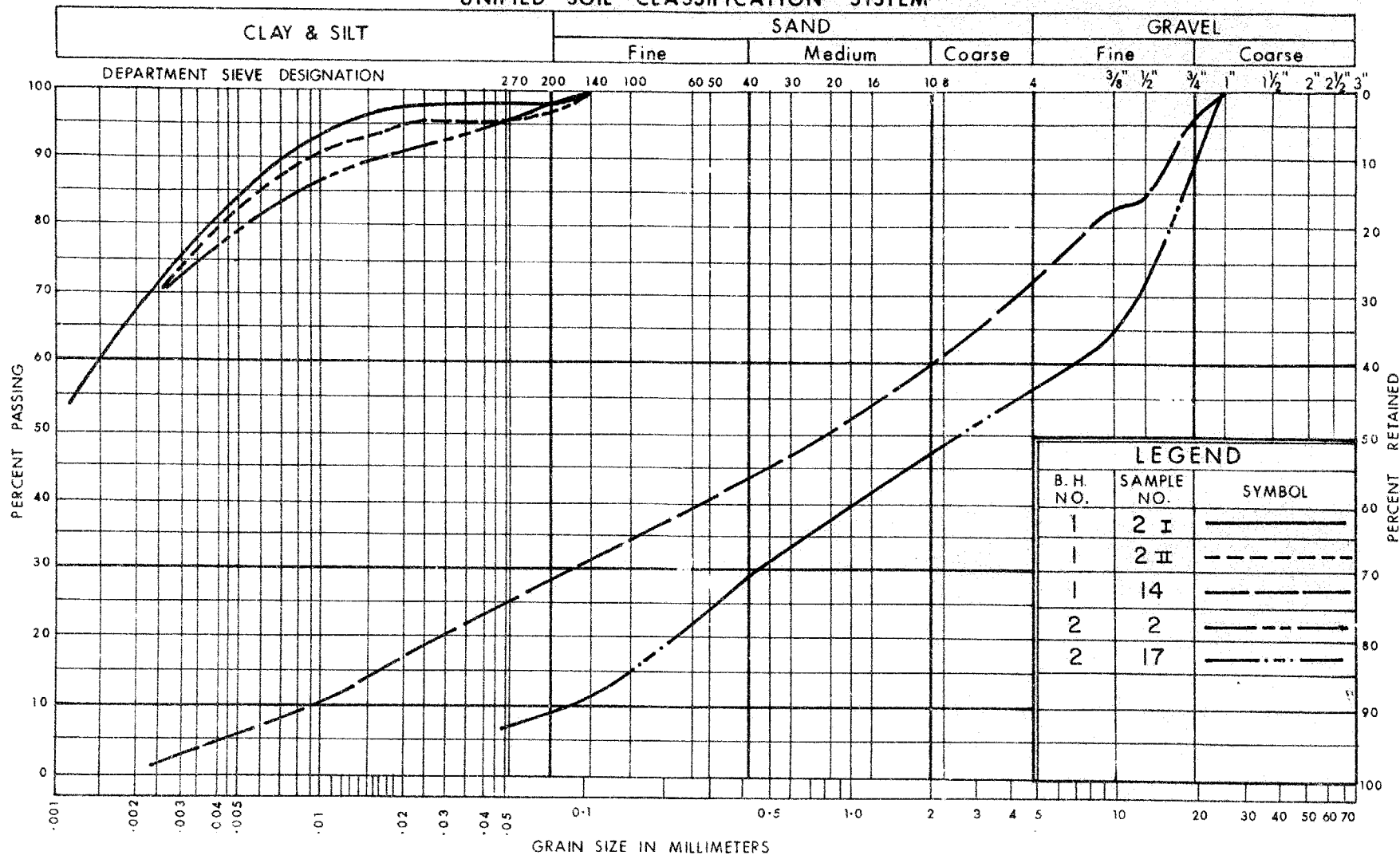
# RECORD OF BOREHOLE NO. 5

FOUNDATION SECTION

LOCATION Sta. 5408 39' Et. ORIGINATED BY P.L.W.  
BORING DATE Feb. 12, 1966. COMPILED BY R.M.  
BOREHOLE TYPE Cone Penetration Test. CHECKED BY M.D.

SOIL PROFILE			SAMPLES			DYNAMIC PENETRATION RESISTANCE					LIQUID LIMIT — WL PLASTIC LIMIT — WP WATER CONTENT — W			BULK DENSITY P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT	ELEV. SCALE	BLOWS / FOOT	20	40	60	80	100	WATER CONTENT %		
136.5	Icelevel														
71.7															
64.8	End of borehole														

# UNIFIED SOIL CLASSIFICATION SYSTEM



## GRAIN SIZE DISTRIBUTION

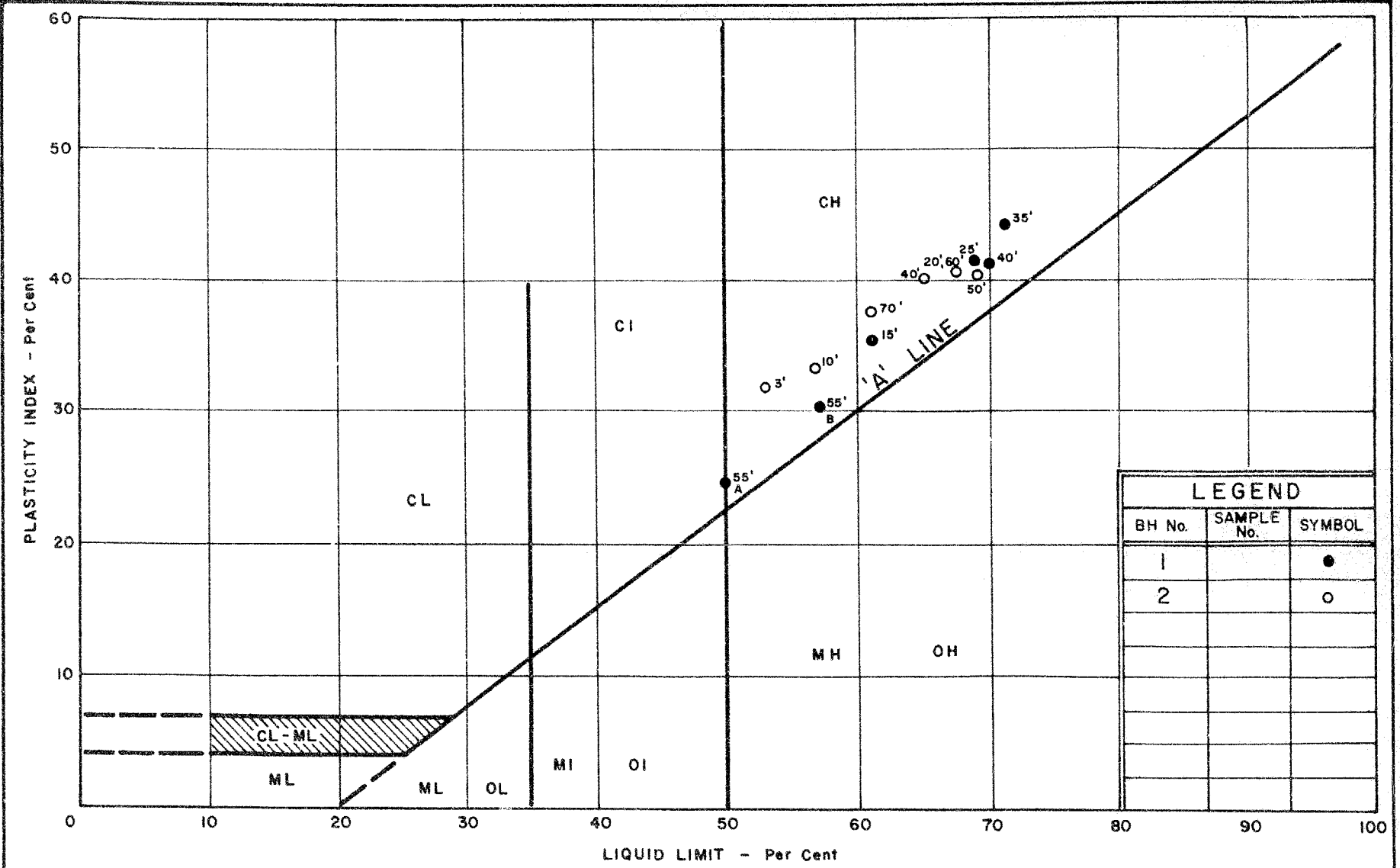


DEPARTMENT OF HIGHWAYS  
MATERIALS and  
TESTING  
DIVISION

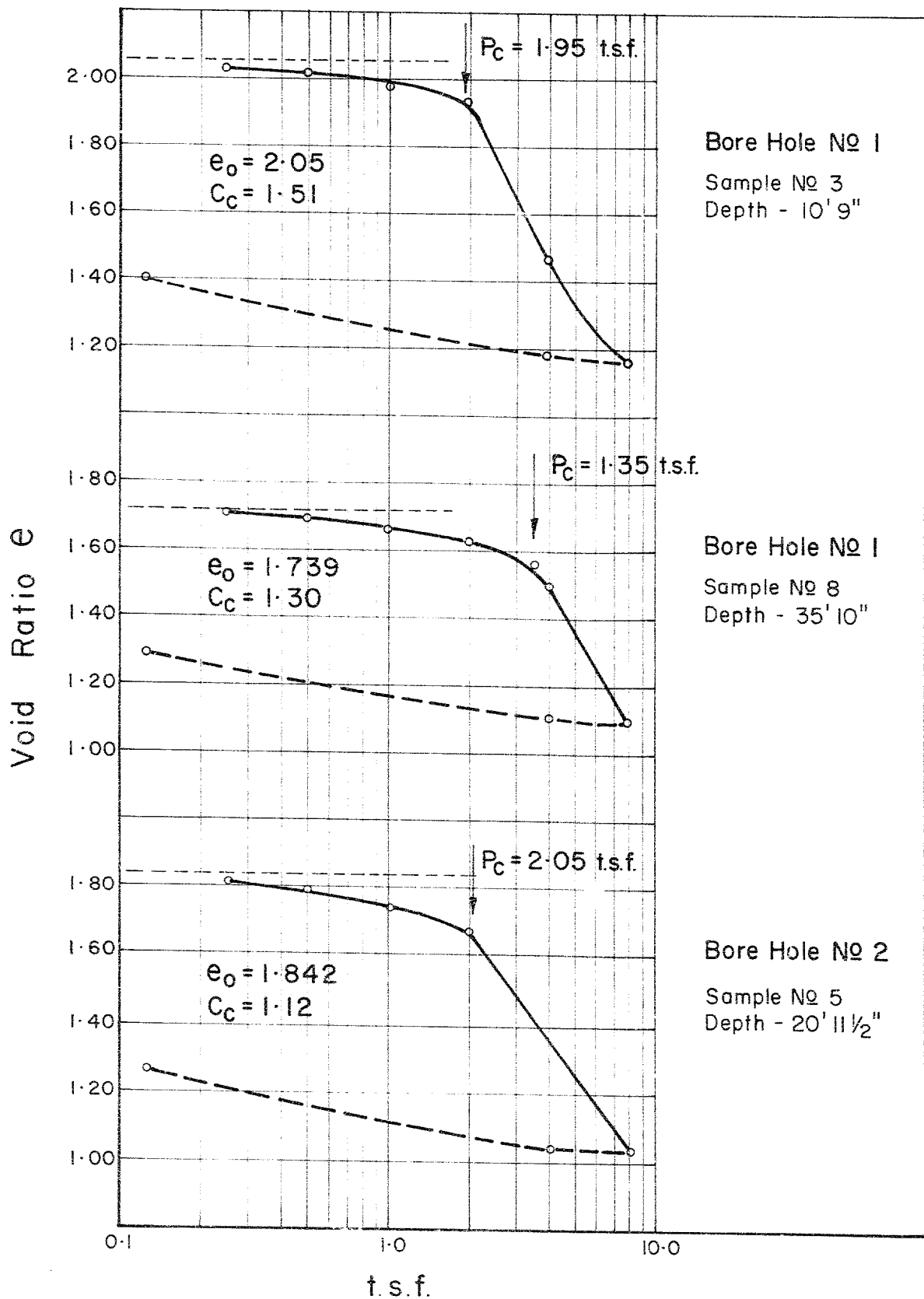
ONTARIO

W.P. No. 48 - 65

JOB No. 66-F-15



LEGEND		
BH No.	SAMPLE No.	SYMBOL
1		●
2		○



## ABBREVIATIONS USED IN THIS REPORT

### PENETRATION RESISTANCE

STANDARD PENETRATION RESISTANCE 'N' - THE NUMBER OF BLOWS REQUIRED TO ADVANCE A STANDARD SPLIT SPOON SAMPLER 12 INCHES INTO THE SUBSOIL, DRIVEN BY MEANS OF A 140 POUND HAMMER FALLING FREELY A DISTANCE OF 30 INCHES.

DYNAMIC PENETRATION RESISTANCE - THE NUMBER OF BLOWS REQUIRED TO ADVANCE A 2 INCH, 60 DEGREE CONE, FITTED TO THE END OF DRILL RODS, 12 INCHES INTO THE SUBSOIL. THE DRIVING ENERGY BEING 350 FOOT POUNDS PER BLOW.

### DESCRIPTION OF SOIL

THE CONSISTENCY OF COHESIVE SOILS AND THE RELATIVE DENSITY OR DENSENESS OF COHESIONLESS SOILS ARE DESCRIBED IN THE FOLLOWING TERMS:-

<u>CONSISTENCY</u>	<u>'N' BLOWS / FT.</u>	<u>c LB. / SQ. FT.</u>	<u>DENSENESS</u>	<u>'N' BLOWS / FT.</u>
VERY SOFT	0 - 2	0 - 250	VERY LOOSE	0 - 4
SOFT	2 - 4	250 - 500	LOOSE	4 - 10
FIRM	4 - 8	500 - 1000	COMPACT	10 - 30
STIFF	8 - 15	1000 - 2000	DENSE	30 - 50
VERY STIFF	15 - 30	2000 - 4000	VERY DENSE	> 50
HARD	> 30	> 4000		

### TYPE OF SAMPLE

S.S.	SPLIT SPOON	T.W.	THINWALL OPEN
W.S.	WASHED SAMPLE	T.P.	THINWALL PISTON
S.B.	SCRAPER BUCKET SAMPLE	O.S.	OESTERBERG SAMPLE
A.S.	AUGER SAMPLE	F.S.	FOIL SAMPLE
C.S.	CHUNK SAMPLE	R.C.	ROCK CORE
S.T.	SLOTTED TUBE SAMPLE		
	P.H.	SAMPLE ADVANCED HYDRAULICALLY	
	P.M.	SAMPLE ADVANCED MANUALLY	

### SOIL TESTS

Q <sub>u</sub>	UNCONFINED COMPRESSION	L.V.	LABORATORY VANE
Q	UNDRAINED TRIAXIAL	F.V.	FIELD VANE
Q <sub>cu</sub>	CONSOLIDATED UNDRAINED TRIAXIAL	C	CONSOLIDATION
Q <sub>d</sub>	DRAINED TRIAXIAL	S	SENSITIVITY



# ABBREVIATIONS USED IN THIS REPORT

## SOIL PROPERTIES

$\gamma$	UNIT WEIGHT OF SOIL (BULK DENSITY)
$\gamma_s$	UNIT WEIGHT OF SOLID PARTICLES
$\gamma_w$	UNIT WEIGHT OF WATER
$\gamma_d$	UNIT DRY WEIGHT OF SOIL (DRY DENSITY)
$\gamma'$	UNIT WEIGHT OF SUBMERGED SOIL
G	SPECIFIC GRAVITY OF SOLID PARTICLES $G = \frac{\gamma_s}{\gamma_w}$
e	VOID RATIO
n	POROSITY
w	WATER CONTENT
$S_r$	DEGREE OF SATURATION
$w_L$	LIQUID LIMIT
$w_p$	PLASTIC LIMIT
$I_p$	PLASTICITY INDEX
s	SHRINKAGE LIMIT
$I_L$	LIQUIDITY INDEX = $\frac{w - w_p}{I_p}$
$I_C$	CONSISTENCY INDEX = $\frac{w_L - w}{I_p}$
$e_{max}$	VOID RATIO IN LOOSEST STATE
$e_{min}$	VOID RATIO IN DENSEST STATE
$I_D$	DENSITY INDEX = $\frac{e_{max} - e}{e_{max} - e_{min}}$
	RELATIVE DENSITY $D_r$ IS ALSO USED
h	HYDRAULIC HEAD OR POTENTIAL
Q	RATE OF DISCHARGE
v	VELOCITY OF FLOW
i	HYDRAULIC GRADIENT
k	COEFFICIENT OF PERMEABILITY
j	SEEPAGE FORCE PER UNIT VOLUME
$m_v$	COEFFICIENT OF VOLUME CHANGE = $\frac{-\Delta e}{(1+e)\Delta\sigma}$
$C_v$	COEFFICIENT OF CONSOLIDATION
$C_c$	COMPRESSION INDEX = $\frac{\Delta e}{\Delta \log_{10} \sigma}$
$T_v$	TIME FACTOR = $\frac{C_v t}{d^2}$ (d, DRAINAGE PATH)
U	DEGREE OF CONSOLIDATION
$\tau_f$	SHEAR STRENGTH
$c'$	EFFECTIVE COHESION
$\phi'$	EFFECTIVE ANGLE OF SHEARING RESISTANCE, OR FRICTION
$C_u$	APPARENT COHESION
$\phi_u$	APPARENT ANGLE OF SHEARING RESISTANCE, OR FRICTION
$\mu$	COEFFICIENT OF FRICTION
$S_t$	SENSITIVITY

## GENERAL

$\pi$	= 3.1416
e	BASE OF NATURAL LOGARITHMS 2.7183
$\log_e a$ OR $\ln a$	NATURAL LOGARITHM OF a
$\log_{10} a$ OR $\log a$	LOGARITHM OF a TO BASE 10
t	TIME
g	ACCELERATION DUE TO GRAVITY
V	VOLUME
W	WEIGHT
M	MOMENT
F	FACTOR OF SAFETY

## STRESS AND STRAIN

u	PORE PRESSURE
$\sigma$	NORMAL STRESS
$\sigma'$	NORMAL EFFECTIVE STRESS ( $\bar{\sigma}$ IS ALSO USED)
$\tau$	SHEAR STRESS
$\epsilon$	LINEAR STRAIN
$\gamma$	SHEAR STRAIN
$\nu$	POISSON'S RATIO ( $\mu$ IS ALSO USED)
E	MODULUS OF LINEAR DEFORMATION (YOUNG'S MODULUS)
G	MODULUS OF SHEAR DEFORMATION
K	MODULUS OF COMPRESSIBILITY
$\eta$	COEFFICIENT OF VISCOSITY

## EARTH PRESSURE

d	DISTANCE FROM TOP OF WALL TO POINT OF APPLICATION OF PRESSURE
$\delta$	ANGLE OF WALL FRICTION
K	DIMENSIONLESS COEFFICIENT TO BE USED WITH VARIOUS SUFFIXES IN EXPRESSIONS REFERRING TO NORMAL STRESS ON WALLS
$K_0$	COEFFICIENT OF EARTH PRESSURE AT REST

## FOUNDATIONS

B	BREADTH OF FOUNDATION
L	LENGTH OF FOUNDATION
D	DEPTH OF FOUNDATION BENEATH GROUND
N	DIMENSIONLESS COEFFICIENT USED WITH A SUFFIX APPLYING TO SPECIFIC GRAVITY, DEPTH AND COHESION ETC. IN THE FORMULA FOR BEARING CAPACITY
$k_s$	MODULUS OF SUBGRADE REACTION

## SLOPES

H	VERTICAL HEIGHT OF SLOPE
D	DEPTH BELOW TOE OF SLOPE TO HARD STRATUM
$\beta$	ANGLE OF SLOPE TO HORIZONTAL

MEMORANDUM

*John Tindew  
Black Meridia Benz  
2 P.O.*

*66-E-15*

To: Mr. A. Stermac,  
Principal Foundation Engineer,  
Room 107, Lab. Building.

FROM: Bridge Division,  
Downsview, Ontario

DATE: December 29, 1965

OUR FILE REF.

IN REPLY TO

SUBJECT: W.P. 48-65 Site #27-6  
La Fontaine Creek Structure  
Town of Rockland  
Old Highway 17  
District 9

Would you kindly arrange to have a foundation investigation conducted at the above location. I have enclosed one copy of the plan number B-58-13 with the probable footing locations marked in red. The footings are located to allow for the possibility of a 24'-0 bridge or a 20' x 12' concrete culvert. The type of structure being dependent upon the foundation investigation. If rock is encountered near the surface, please contact the Bridge Office as the creek is on a slight relocation and should not be located through rock.

Please request Mr. A. G. Boucher, Regional Superintendent of Engineering Surveys, Eastern Region, Kingston telephone number 542-4961 to locate the footings of the structure before proceeding with the investigation.

Please note that the structure is located at the intersection of Old Highway 17 (west connection) and the projection of the centre line of the existing 24'-0 barrel arch culvert on New Highway 17. The angle of intersection to be established by Engineering Surveys.

Also enclosed please find a copy of the profile C-58-13. A copy of the marked up plan and profile have been sent to Mr. A. G. Boucher. Engineering Surveys will prepare a site plan so that you may use it in the preparation of your report.

*A. P. Watt*

APW/pr

A. P. Watt,  
Regional Bridge Location Engineer.

cc. A. G. Boucher  
J. L. Forster  
J. G. Gray

COMPLETION DATE APRIL 16, 1966.

66-F-75

Mr. A. G. Boucher,  
Regional Superintendent of  
Engineering Surveys,  
Kingston Regional Office.

Foundation Section,  
Materials & Testing Div.,  
Room 107, Lab. Bldg.

February 1, 1966

Survey Work for La Fontaine Creek on Hwy. 17  
and Preliminary Survey for Queensway Extension.

Further to our telephone conversation  
of February 1, 1966, we are enclosing the necessary  
drawings for the survey work to be carried out at the  
above-mentioned locations.

MD/MdeF  
Encls.

*M. Devata*  
M. Devata,  
SENIOR FOUNDATION ENGR.  
For:  
A. G. Sternac,  
PRINCIPAL FOUNDATION ENGR.

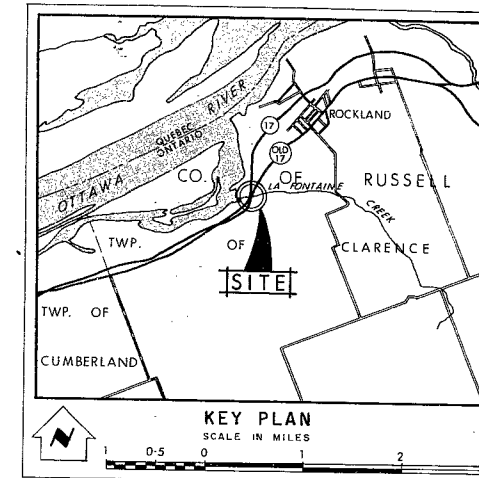
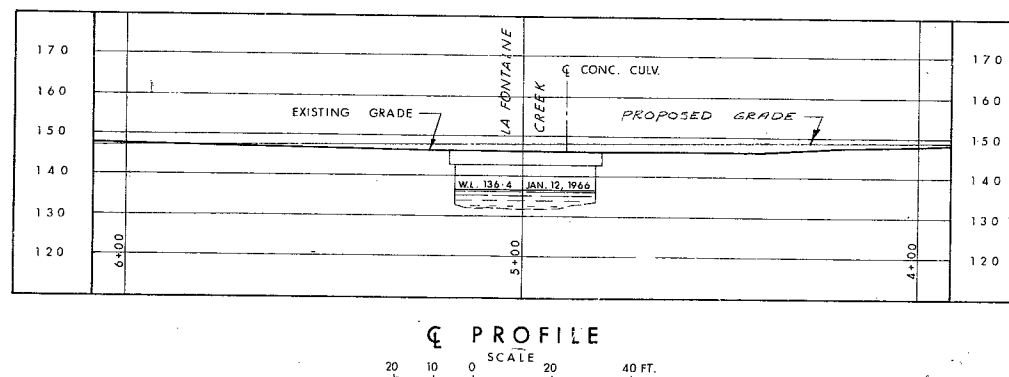
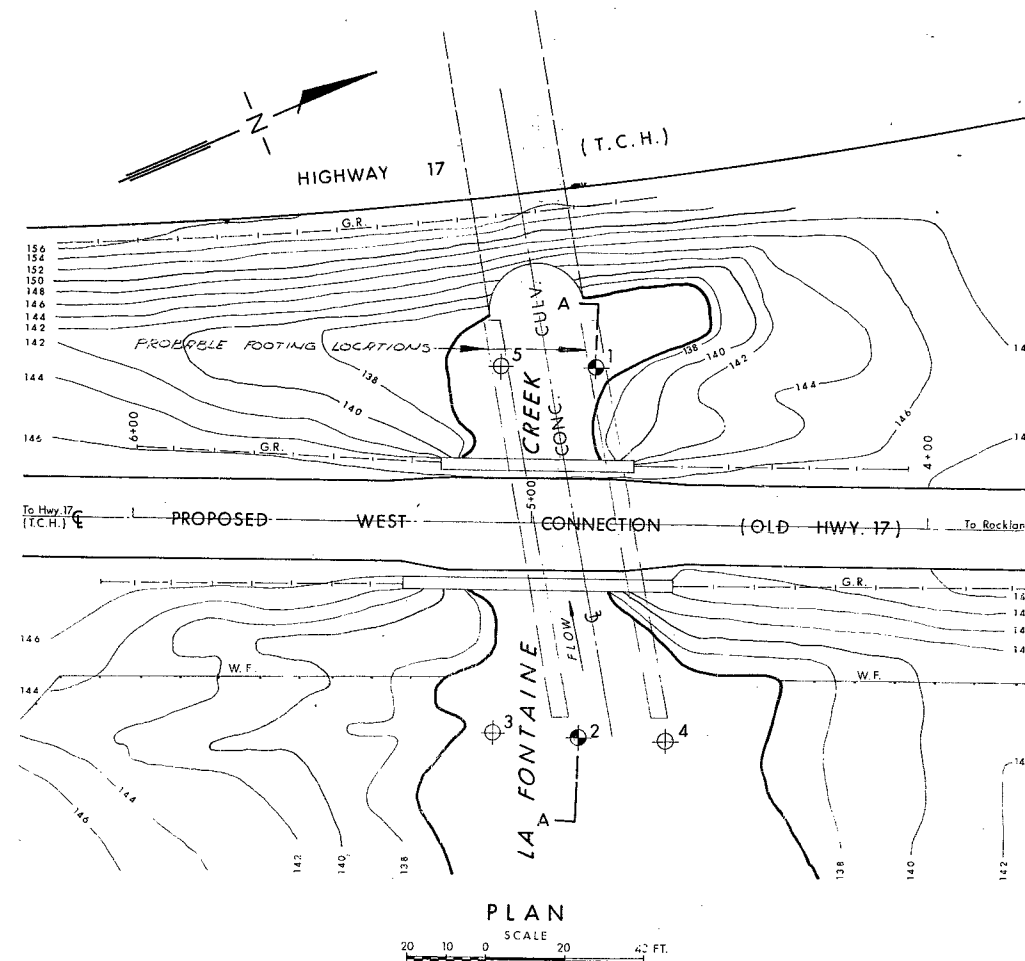
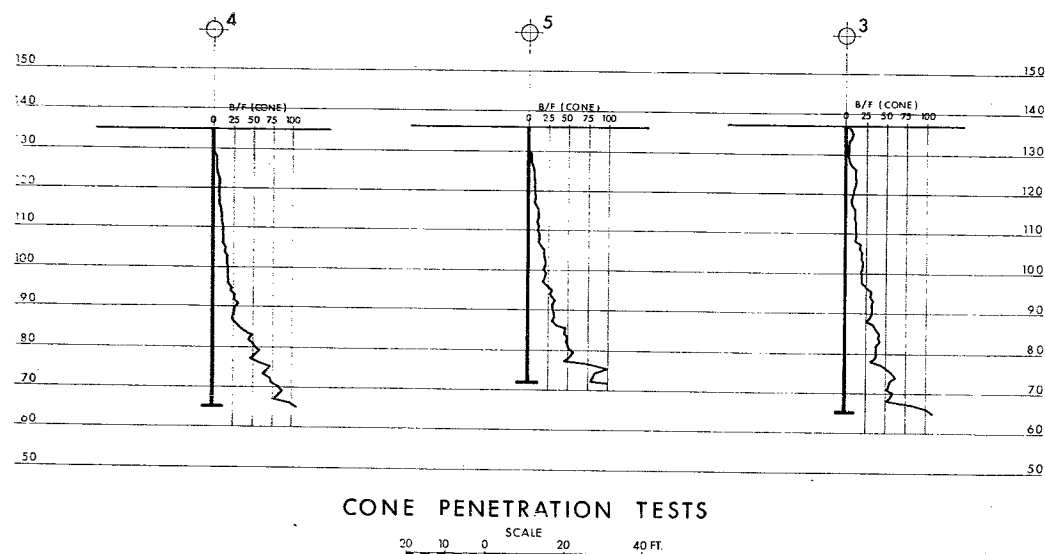
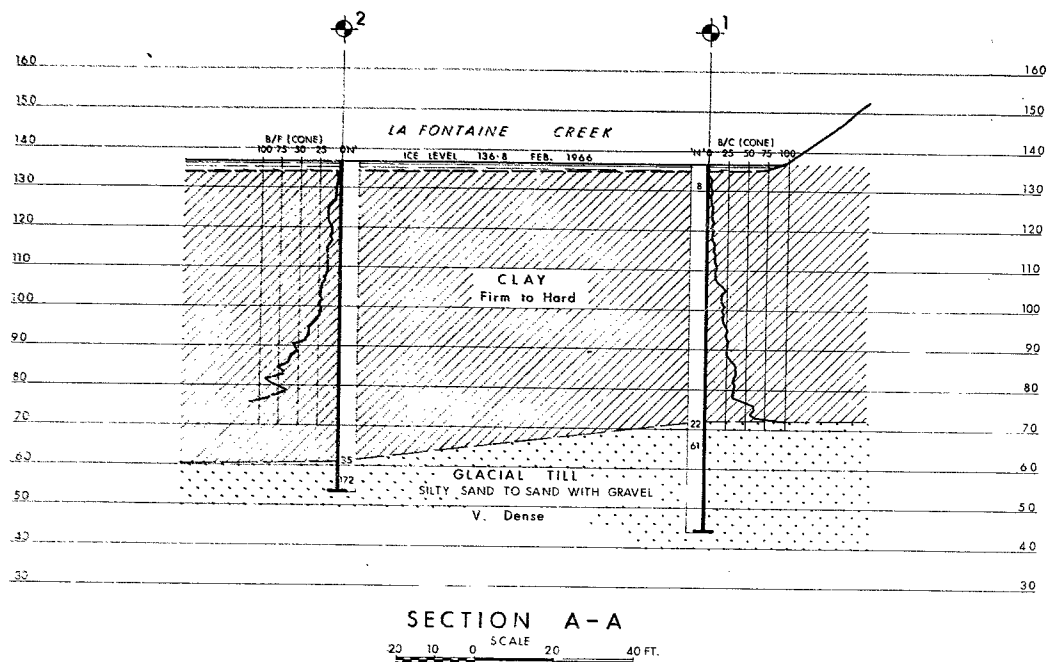
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W.P.#48-65

Old Hwy. #17

LAFONTAINE

CREEK



LEGEND			
	Bore Hole		
	Cone Penetration Hole		
	Bore & Cone Penetration Hole		
	Water Levels established at time of field investigation, FEB. 1966		
NO.	ELEVATION	STATION	OFFSET
1	136.8	4+84	39' RT.
2	136.8	4+87	54' LT.
3	137.1	5+09	53' LT.
4	136.0	4+65	55' LT.
5	136.5	5+08	39' RT.

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

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

**LA FONTAINE CREEK**

KING'S HIGHWAY NO. OLD 17 DIST. NO. 9  
CO. RUSSELL WEST LIMITS OF ROCKLAND  
TWP. CLARENCE LOT 31 CON. I.O.F.

**BORE HOLE LOCATIONS & SOIL STRATA**

SUBM'D. P.W.	CHECKED <u>T.L.R.</u>	W.P. NO. <u>48-65</u>	M.B.T. DRAWING NO.
DRAWN <u>S.O.</u>	CHECKED <u>H.C.</u>	JOB NO. <u>66-F-15</u>	<b>66-F-15A</b>
DATE <u>13 APRIL 1966</u>	SITE NO.	BRIDGE DRAWING NO.	
APPROVED <u>[Signature]</u>	CONT. NO.		

REF. NO. E-4616-1