

23-64-181

Mr. A. M. Teye,  
Bridge Engineer,  
Bridge Division.

Mr. A. G. Stermac,  
Principal Foundation Engr.,  
Foundation Section,  
Materials & Research Division.

Attention: Mr. S. McCombie

April 2, 1963


D.H.C. FOUNDATION INVESTIGATION REPORT -  
Proposed New Bridge - Hwy. #74 and Kettle  
Creek in the Village of Belmont, Twp. of  
Westminster, County of Middlesex, Dist. #2.  
W.J. 63-F-28 -- W.P. 324-61

Attached, we are forwarding to you, our detailed  
foundation investigation report dealing with the subsoil  
conditions existing at the above-noted site.

We believe the factual data and recommendations  
contained therein, will prove adequate for your future design  
work. Should further information be required, however, please  
feel free to contact our Office.

KYL/MdeF  
Attach.

cc: Messrs. A. M. Teye (2)  
H. A. Tregaskes  
H. D. McMillan  
A. Gater  
W. L. Fraser  
J. Roy  
A. Watt

  
K. Y. Lo,  
SUPERVISING FOUNDATION ENGR.  
For:  
A. G. Stermac,  
PRINCIPAL FOUNDATION ENGR.

Foundations Office  
Gen. Files

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## FOUNDATION INVESTIGATION

For

Proposed New Bridge - Hwy. #74 and Kettle  
Creek in the Village of Belmont, Twp. of  
Westminster, County of Middlesex, District #2  
W.J. 63-F-28 --- W.P. 324-61

### 1. INTRODUCTION:

A request, to carry out a Foundation Investigation, at the existing crossing of Hwy. #74 and Kettle Creek, was received from the Bridge Location Engineer Mr. G. Scott, dated March 5, 1963.

It is proposed to erect a new bridge, to carry Hwy. #74 over Kettle Creek. The site of the proposed bridge is located in the Village of Belmont, Twp. of Westminster. At this location the chainage of Hwy. #74 is from 15+00 to 16+45.

In order to determine the soil properties and decide on the type of foundation, an investigation was carried out by this Section. Results and the discussion of the field and laboratory investigations, as well as conclusion and recommendations for the future design work are contained in the following paragraphs of this report.

### 2. DESCRIPTION OF SITE:

The site of the proposed bridge is located in the Village of Belmont. The surrounding area is generally flat terrain. The width of Kettle Creek, at the proposed crossing

cont'd. /2 ...

2. DESCRIPTION OF SITE: (Cont'd.) ...

is about 30 feet and the depth approx. 2'-0" to 3'-0".

Physiographically, the site is located in the so-called Mount Elgin Ridges.

3. FIELD AND LABORATORY WORK:

In order to obtain sufficient information on the type and properties of the subsoil, four sampled boreholes, and one dynamic cone penetration test, were carried out at this site.

Split-spoon samples were taken at various depth intervals. Because of the dense nature of the soil, it was not possible to obtain undisturbed samples. Samples recovered in the split-spoon sampler were used to determine the following physical properties:

1. Natural Moisture Content
2. Atterberg Limits
3. Grain Size Distribution

Results of these laboratory tests are summarized in Appendix I of this report.

4. SUBSOIL CONDITIONS:

4.1 General:

The stratigraphy of the soil at the site was found to be generally uniform. A detailed description of various soil types encountered during the investigation, is shown in

cont'd. /3 ...

4. SUBSOIL CONDITIONS: (Cont'd.)...

4.1 General:

Appendix I of this report, and is also given in subsequent paragraphs. The estimated stratigraphical profile, shown on Dwg. No. 63-F-28A, is based upon this information.

4.2 Medium Dense to Very Dense Silty Sand and Gravel:

This stratum, which extends for a depth of from 5'-0" to 20'-0" was found in B.H. #3 and #4 just below the topsoil.

It may be classified as dense with an average "N" value of 47 blows/foot.

4.3 Dense to Very Dense Sandy, Clayey Silt (Till):

Following the stratum of medium dense to very dense silty sand and gravel in B.H. #3 & 4 and in B.H. #1 & 2 below the topsoil is a layer of dense to very dense sandy, clayey silt (Till). The deposit extends to the maximum depth tested, which was 51.5' in B.H. #2 & 4.

The overall stratum is in a dense to very dense condition with an average "N" value of approx. 43 blows/foot.

The percentage of sand in this layer is 4%, clay forms 29% and the rest of 67% is silt. The plastic limits, of this material, vary from 11.4% to 19.4% and the liquid limits vary from 20.7% to 27.7%, the average moisture content is 19%.

cont'd. /4 ...

5. GROUND WATER CONDITIONS:

The ground water level, at the time of the investigation was found to be between El. 819.0 and 820.0.

No artesian water conditions were encountered.

6. DISCUSSION AND RECOMMENDATIONS:

As can be seen from the previously described soil stratigraphy, the soil consists of compact to very dense silty sand and gravel, followed by dense to very dense sandy, clayey silt. The upper layers could provide adequate support for spread footings. The Hydrology Section of the D.H.O. indicated that a 6'-0" deep scour, or more, may be expected in the Kettle Creek Channel. Therefore, the bottom of the footings should be placed at El. 811.0. This, however, should be checked with the Hydrology Section when their study is complete. .

Spread footings founded at El. 811.0 can support a safe load of 2.0 tons/sq. ft. A dewatering scheme will be necessary as excavations will be carried out below creek or ground water table levels.

As an alternative to spread footings, piled footings may be used for the abutments and capped piles for piers. In this case tube piles 12 $\frac{3}{4}$ " O.D. x  $\frac{1}{4}$ " wall thickness, should be driven 20'-0" into the original ground. A design load of 30 tons/pile may be used in this case.

No stability problems for the approach fills are anticipated.

cont'd. /5 ...

7. SUMMARY:

1. The stratification of the soil is quite uniform. The relative density of the materials encountered varies from compact to very dense.
2. Because of the density of the upper layers, spread footings could be used for the structure.
3. The bottom of the footings should be at approx. El. 811.0. This, however, should be checked by the Hydrology Section. A safe bearing pressure of 2.0 tons/sq. ft. may be used.
4. A dewatering scheme will be necessary as excavations will be carried out below creek or ground water levels.
5. As an alternative to spread footings, piled footing may be used for the abutments and capped piles for piers. In this case tube piles 12 $\frac{3}{4}$ " O.D. x  $\frac{1}{4}$ " wall thickness should be driven 20'-0" into the original ground. A design load of 30 tons/pile may be used in this case.
6. No stability problems for the approach fills are anticipated.

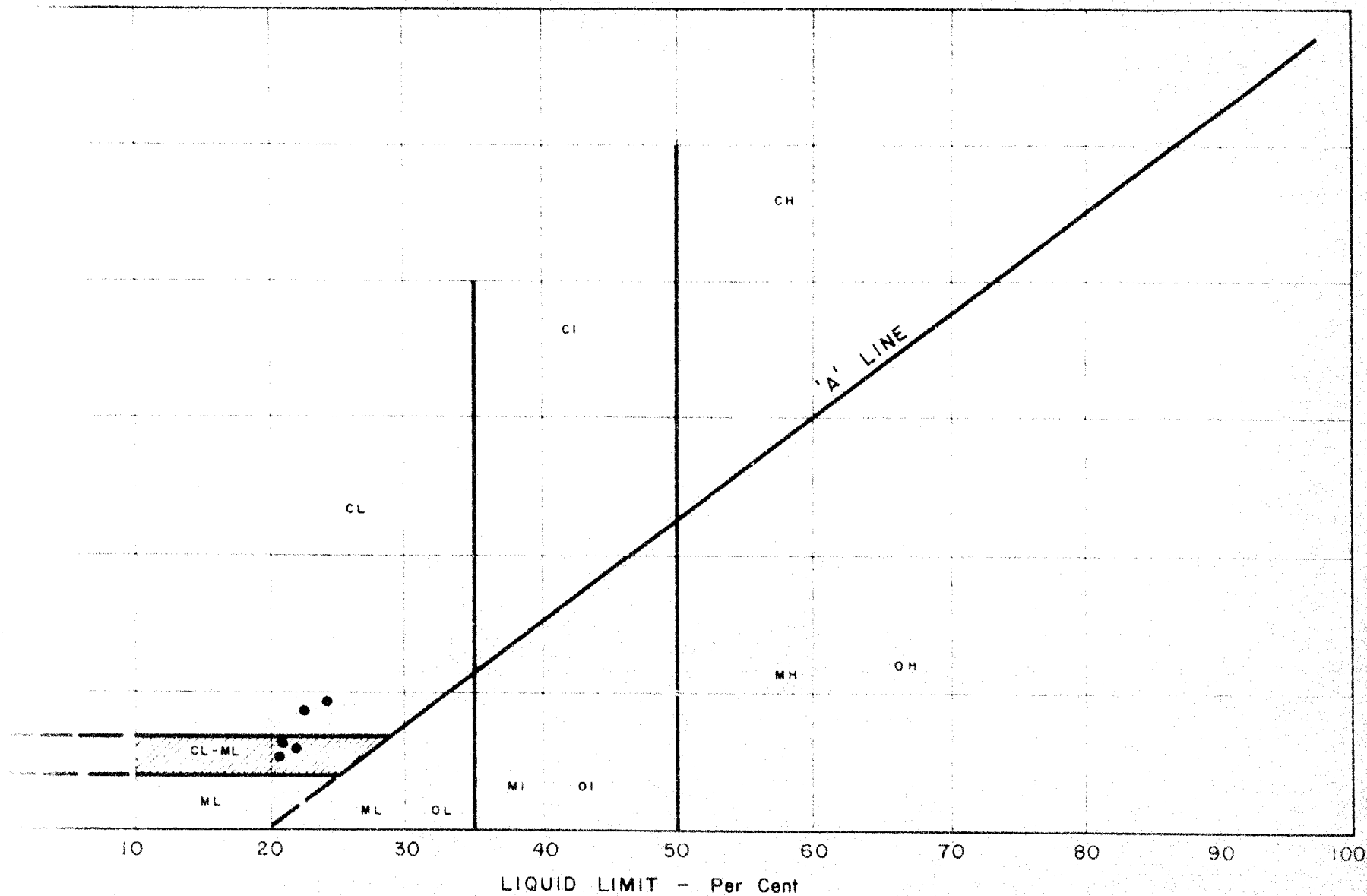
8. MISCELLANEOUS:

The field work, performed during the period from March 10, to March 23 - 1963, together with the preparation of this report, was undertaken by Mr. W. W. Kulmatickas. The investigation was carried out under the general supervision of Mr. K. G. Selby, who also reviewed this report.

April 1963

APPENDIX I

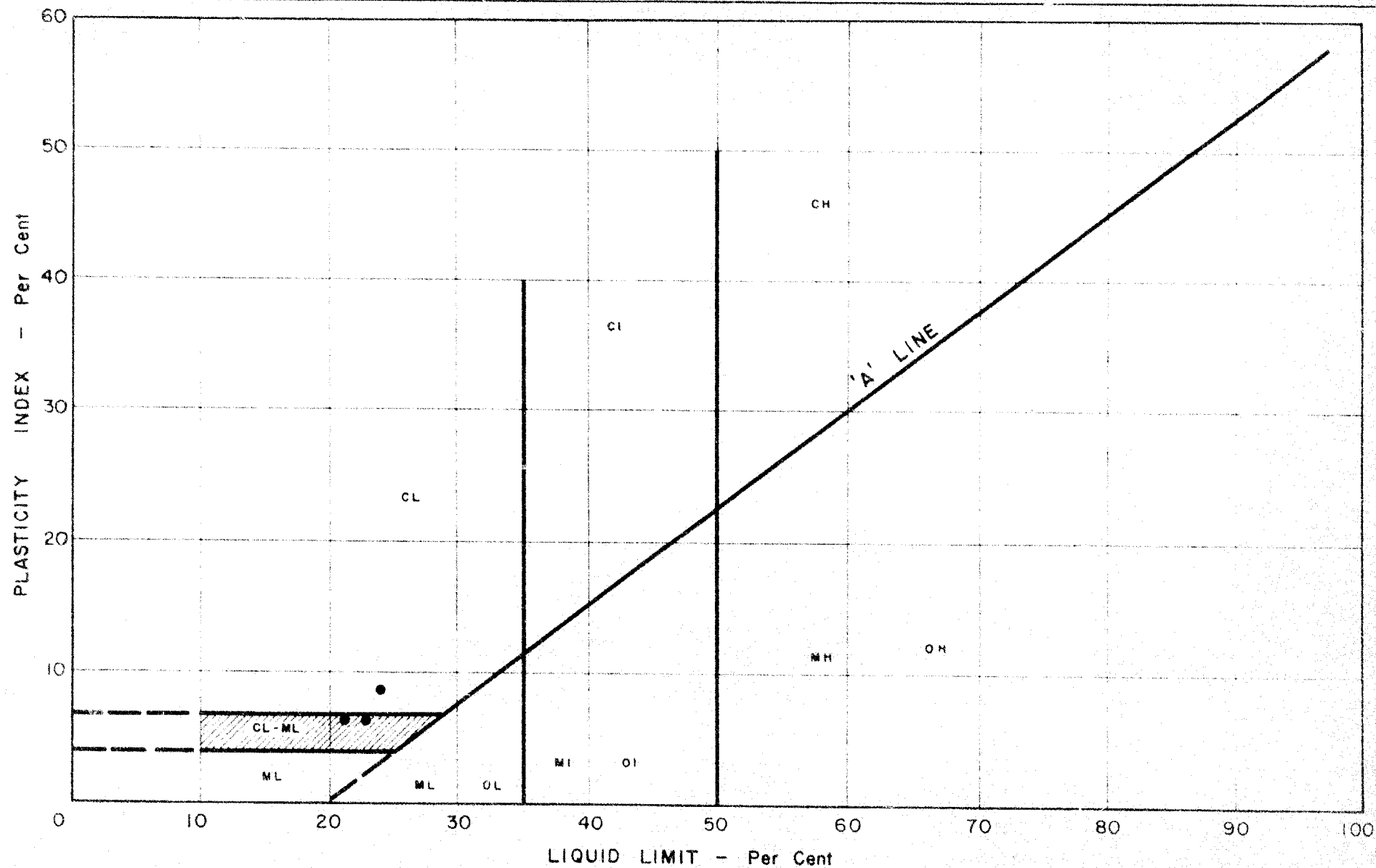




Bore Hole No. 2

DEPARTMENT OF HIGHWAYS - ONTARIO  
MATERIALS & RESEARCH DIVISION  
PLASTICITY CHART

Job No. 63 - F - 28 W.P. No. 324 - 61  
Location Hwy. No. 74 and Kettle Creek

NOTES Bore Hole No. 4

DEPARTMENT OF HIGHWAYS - ONTARIO  
MATERIALS & RESEARCH DIVISION  
PLASTICITY CHART

Job No. 63-F-28

W.P. No. 324-61

Location Hwy. No. 74 and Kettle Creek

## 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 INTERCEPT
$\phi'$	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
$\log_e \sigma$ OR $\ln \sigma$	NATURAL LOGARITHM OF $\sigma$
$\log_{10} \sigma$ OR $\log \sigma$	LOGARITHM OF $\sigma$ 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

Mr. S. McCombie,  
Bridge Planning Engr.,  
Bridge Division.

Attention: Mr. G. Scott

Mr. A. G. Stermac,  
Principal Foundation Engr.,  
Foundation Section,  
Materials & Research Division.

November 13, 1963

Kettle Creek Bridge on Hwy. #74 -  
Review of Preliminary Plan #D-5310-P  
W.P. 324-61 -- W.J. 63-F-28  
District #2

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The designer appears to have followed  
the recommendations given in the Foundation Report.

KGS/MdeF

cc: Foundations Office ✓  
Gen. Files

*K. G. Selby*  
K. G. Selby,  
SENIOR FOUNDATION ENGR.  
For:  
A. G. Stermac,  
PRINCIPAL FOUNDATION ENGR.

23-64-181

*Kettle Creek Bridge*

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Gen. Files ✓

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For:  
A. G. Stermac,  
PRINCIPAL FOUNDATION ENGR.

## RECORD OF BOREHOLE NO. 1

FOUNDATION SECTION

106 63-F-28

LOCATION Kettle Creek and Hwy. #74 Ch. 16/25-36'-0" Lt.

ORIGINATED BY R.W.K.

W. P. 324-61

BORING DATE March 19, 1963.

COMPILED BY W.W.K.

DATUM 822.0

BOREHOLE TYPE Wash boring - BX Casing.

CHECKED BY

SOIL PROFILE			SAMPLES		ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE		LIQUID LIMIT ——— WL		BULK DENSITY	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. LOT	NUMBER	TYPE		BLOWS / FOOT	BLOWS / FOOT	PLASTIC LIMIT ——— WP	WATER CONTENT ——— W		
822.0	Ground Elevation										
819.5	Black Organic topsoil										
2.5			1	SS	5	816					
			2	SS	32	811					
	Dense to very dense sandy, clayey silt (Till)		3	SS	43	806					
			4	SS	51	801					
			5	SS	43						
790.5			6	SS	46	790					
31.5	End of borehole.										
						780					

DEPARTMENT OF HIGHWAYS - ONTARIO  
MATERIALS & RESEARCH DIVISION

RECORD OF BOREHOLE NO. 2

FOUNDATION SECTION

JOB 63-F-28 LOCATION Kettle Creek and Hwy. #74 Ch. 16/28-30'-0" Rt. ORIGINATED BY W.W.K.  
W.P. 324-61 BORING DATE March 20, 1963. COMPILED BY W.W.K.  
DATUM 824.0 BOREHOLE TYPE Washboring - BX Casing CHECKED BY \_\_\_\_\_

SOIL PROFILE		SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE		LIQUID LIMIT — — %		BULK DENSITY	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE		BLOWS / FOOT	SHEAR STRENGTH P.S.F.	PLASTIC LIMIT — — %	WATER CONTENT — — %		
824.0	Ground Elevation										
821.0	Black Organic Topsoil										
					820						
			1	SS	25	218			0		
			2	SS	48	813			10-1		
			3	SS	57	810			0		
			4	SS	56	808			10-1		
			5	SS	57	800			10-1		
			6	SS	59				0		
			7	SS	57	790			10-1		
			8	SS	32				0		
			9	SS	23	780			10-1		
772.5			10	SS	27				0		
51.5	End of borehole.				770						

Dense to very dense  
sandy, clayey silt  
(Till)

wl El. 820.7  
Observed  
in casing.



DEPARTMENT OF HIGHWAYS - ONTARIO  
MATERIALS & RESEARCH DIVISION

## RECORD OF BOREHOLE NO. 3

FOUNDATION SECTION

JOB 63-F-28 LOCATION Kettle Creek and Hwy. #14 Ch. 14+97-36'-0" Rt. ORIGINATED BY W.W.K.  
 W.P. 324-61 BORING DATE March 21, 1963. COMPILED BY W.W.K.  
 DATUM 821.0 BOREHOLE TYPE Washboring - BX Casing. CHECKED BY \_\_\_\_\_

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT		LIQUID LIMIT — WL PLASTIC LIMIT — WP WATER CONTENT — W		BULK DENSITY P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLT	NUMBER	TYPE	BLOWS / FOOT		SHEAR STRENGTH P.S.F.		WL PL W	15 30 45		
821.0	Ground Elevation					820						
820.0	Black Organic topsoil											
1.0	Med. dense silty sand and gravel.		1	SS	16	815						
815.0			2	SS	29	810						
6.0			3	SS	37	805						
	Dense to very dense sandy, clayey silt (Till)		4	SS	44	800						
			5	SS	51	795						
789.5			6	SS	55	790						
31.5	End of borehole											

wl El. 819.3

Observed in casing.



#

63-F-28

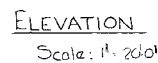
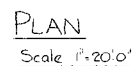
W.P. 324-61

HWY #74

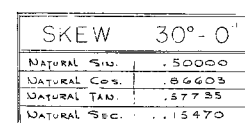
KETTLE CREEK



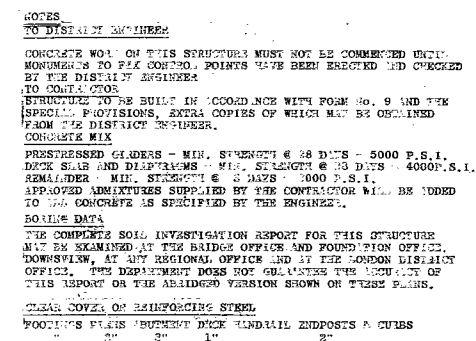
40114E



O.K.  
W.W.K.  
Oct 22-1963.



1. GENERAL PLAN.
2. FOUNDATION LAYOUT & BOREHOLE DATA.
- 3.

[illegible]

<div style="text-align: center;"> <u>DEPARTMENT OF HIGHWAYS ONTARIO</u>  <u>BRIDGE DIVISION</u> </div>				
PETER T MITCHES CONSULTING		& ASSOCIATES ENGINEERS		
LONDON		ONTARIO		
<div style="font-size: 1.5em; font-weight: bold;">KETTLE CREEK BRIDGE</div>				
KING'S HIGHWAY No. 74			DIST. No. 2	
CO. MIDDLESEX		VILLAGE OF		BELMONT
TWP. WESTMINSTER & S. DORCHESTER		LOT I		CON. VII
<div style="font-size: 1.5em; font-weight: bold;">GENERAL PLAN</div>				
APPROVED _____ <small>MANAGER - ENGINEER</small>			SITE No. _____ _____	
DESIGN P T M CHECK _____			W.P. No. 324 - 61	
DRAWING B CHECK _____			CONTRACT No. _____	
DATE _____			DRAWING No. <span style="font-size: 1.2em;">D-5310-P</span>	