DOCUMENT MICROFILMING IDENTIFICATION

G.I.-30 SEPT. 1976

GEOCRES No. 31G-49

DIST. _____ REGION _____

W.P. No. _____

CONT. No. MUNICIPAL

W. O. No. 71-11105

STR. SITE No. N/A

HWY. No. LOC

LOCATION THE PROP. NEW ACCESS RD. TO CASSELMAN

NOTES -

OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT. _____

REMARKS: _____

DEPARTMENT OF HIGHWAYS ONTARIO

MEMORANDUM

316-49

TO: Mr. K. Westerby,
District Municipal Engineer,
District No. 9,
Ottawa, Ontario.

ATTENTION:

FROM: Foundations Office,
Design Services Branch,
Central Bldg., Downsview.

DATE: November 1, 1971.

OUR FILE REF.

IN REPLY TO NOV 4 1971

SUBJECT:

FOUNDATION INVESTIGATION REPORT
For
The Proposed New Access Road
To Casselman
Twp. of Cambridge -- County of Russell
W.O. 71-11105

1. INTRODUCTION:

This Office was requested to carry out a subsurface investigation for the proposed new access road to the Village of Casselman, Ontario. The request was contained in a memo from Mr. K. Westerby, Municipal Engineer, District No. 9, Ottawa, dated October 12, 1971. This investigation was completed on October 22, 1971.

Due to the urgency of this project we have been requested to forward our comments relating to the stability and settlement considerations associated with the fill and cut sections along this alignment as soon as possible. These are presented in this letter.

Following completion of the necessary laboratory testing and draughting a detailed Borelog sheet for each of the borings, as well as a drawing showing the alignment, boring locations and an inferred stratigraphical profile, will be submitted. These should be appended to this letter.

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2. SUBSOIL AND GROUNDWATER CONDITIONS:

Five sampled boreholes were put down along the proposed alignment. The predominant stratum across the site is composed of a firm to stiff sensitive silty clay to clay; this cohesive stratum is located immediately beneath a 5 to 7 feet thick surficial cover of loose to compact silty sand. On the top of the gully banks the clay was found to be of the order of 50 feet thick. The thickness is less beneath the gully floors, however. At Station 9+00, for instance, only 5.5 feet of clay is present. The clay is underlain by a competent glacial till deposit.

At the time of the investigation the groundwater level, on the top of the banks, was found to vary from elevation 190 to 200, which corresponds to depths of from 9 to 12 feet below existing ground surface.

3. DISCUSSION AND RECOMMENDATIONS:

3.1) General:

The terrain in the area under investigation, which is cultivated and being used for farming purposes, is gently rolling in relief. Three major gullies dissect this terrain. These gullies, which vary from 20 to 40 feet in depth, have side slopes which range from 2:1 to 3:1.

In May of 1971 a major land slide took place along the east bank of the South Nation River at Lemieux, Ontario. This slide blocked the river thus raising the water level upstream of the failure. This led to considerable flooding in the lower depressed areas. One area affected was the two lane road to the Village of Casselman which was washed out. This letter deals with an investigation carried out along a proposed new alignment for the road.

The location of the new alignment as well as the proposed profile grade were shown on Drawing No. 70-3310, dated September, 1971. This drawing was provided by McNeely, Lecompte and Associates Ltd., Consulting Engineers, Rockland, Ontario. Referring to this drawing it can be seen that there will be cuts up to 16 feet in depth, and fills up to 21 feet in height required.

.....3

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

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

Comments with regard to the stability and settlement considerations associated with the cuts and fills will be discussed separately below.

3.2) Fill Sections:

There will be fills placed across four gullies; the location and height of fill involved at each are tabulated below:

Stations	Maximum Height of Fill
0+00 to 2+50	9 ft.
4+00 to 5+00	20 ft.
7+50 to 10+70	21 ft.
18+00 to 21+00	14 ft.

At all the locations, with the exception of the one between Stations 7+50 to 10+70, flexible culverts are to be located at the base of the gullies to carry the creek water through the fills. The fill material in these areas is to be composed of the locally available silty sand. The gully, between Stations 7+50 and 10+70, has been flooded. In this area it is understood that the embankment is to be composed of rock fill; no provision has been made to place a culvert in this area.

3.2.1) Stability Considerations:

Computations were carried out to determine the stability of the fill sections, which will be underlain by the firm to stiff sensitive silty clay stratum. The computations indicated that, for the height of fill contemplated (maximum 21 feet), the embankments would be inherently stable, provided:

a) 2:1 slopes are employed, and

b) the fill is properly placed and compacted.

It would be advisable to sod the slopes in order to protect them against surficial erosion caused by uncontrolled surface runoff.

....4

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

3.2) Fill Sections: (cont'd) ...

3.2.2) Settlement Considerations:

The cohesive subsoil beneath the fills will consolidate, over a period of time, due to the applied embankment loadings. Settlement computations were carried out, therefore, to predict the expected magnitude of these settlements. The magnitude of the settlements will be dependent on the

a) thickness of the compressible material,
b) magnitude of the applied loads, and
c) compressibility characteristics of the cohesive subsoil.

Taking these factors into consideration it is estimated that the consolidation settlements induced in the foundation subsoil, in the critical fill areas, will range between 4 and 6 inches. The major portion of these settlements should occur within 2 years after placement.

3.3) Cut Treatment:

The major cuts will be located on the banks of the gully located between Stations 7+50 and 10+70. The maximum depth of cut will be 8 and 16 feet on the west and east banks of the gully, respectively. Elsewhere the cuts will be 5 feet deep or less.

It will be necessary to ensure the long-term stability of these permanent cut slopes. This being the case analyses were carried out in terms of effective stresses, a method which considers the changes in the engineering characteristics of the subsoil with time, as well as the fluctuations in the groundwater pressure regime. Based on results of these analyses it is recommended that the geometry of the cut slopes be as follows:

Depth of Cut	Permanent Cut Slopes
Up to 11 ft.	2:1
14 ft.	3:1
16 ft. (max. depth)	$3\frac{1}{2}$:1

....5

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

3.3) Cut Treatment: (cont'd) ...

A smooth transition should be affected between the various slopes for the different cut depths.

The cut on the east bank (Stations 10+70 to 12+00) will, in places, extend below the groundwater level recorded during the period of the investigation (groundwater level elevation 200). In order to prevent sloughing of the slopes in the area extending below the groundwater level it would be advisable to place a 12 inch thick blanket of Granular 'A' material on the slopes. This blanket should extend from the toe of the cut to a level at least 1 foot above the recorded high water level. It is recommended that the permanent cut slopes be sodded as a precaution against surficial erosion.

We trust that the comments and recommendations presented in this letter are sufficient for your needs. If any of the aforementioned requires clarification, or if we can be of any further assistance to you on this project, please contact this Office.

B. T. Darch

BTD/ao

B. T. Darch, P. Eng.,
Senior Foundation Engineer,
For: M. Devata, P. Eng.,
Supervising Foundation Engineer

cc: Messrs. D. W. Farren
S. J. Markiewicz
E. R. Saint
A. Rutka
G. A. Wrong
C. Yuill
B. A. Singh
J. Lecompte (McNeely, Lecompte and Assoc. Ltd. (2)

Foundations Files
Documents

REGISTERED PROFESSIONAL ENGINEER
B. T. DARCH
PROVINCE OF ONTARIO

APPENDIX I

FORM OD-MT- 126 (REV. 1969) OFFICE REPORT ON SOIL EXPLORATION

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 1

FOUNDATION SECTION

JOB 71-11105 LOCATION Sta. 10 + 81 ℄ of Road ORIGINATED BY VK
W.P. BORING DATE Oct. 18 & 19, 1971 COMPILED BY HS
DATUM Geodetic BOREHOLE TYPE Washboring-NX Casing CHECKED BY

ELEV. / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	TYPE	BLOWS / FOOT	ELEV SCALE
206.5	Ground Level					
205.5 1.0	Silty sand to sand, trace Compact		1	SS	21	
201.5 5.0	Desiccated Zone Mottled Grey-Brown Stiff to Very Stiff		2	TW	PM	
			3	TW	PM	200
	Silty clay to clay, occ. organic pockets and (sensitive)		4	TW	PM	
			5	TW	PM	
			6	TW	PM	
			7	TW	PM	190
			8	TW	PM	
	occasional sand & silt		9	TW	PM	
	partings and seams up		10	TW	PM	
	to 8" thick throughout		11	SS	2	
			12	TW	PM	
	Grey		13	SS	2	180
			14	TW	PM	
	Firm to Stiff		15	SS	1	
						170
			16	TW	PM	
153.0			17	SS	1	
56.5	End of Borehole					150

DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT

SHEAR STRENGTH P.S.F.
○ UNCONFINED + FIELD VANE
● QUICK TRIAXIAL × LAB. VANE
400 800 1200 1600 2000

LIQUID LIMIT —— w_L
PLASTIC LIMIT —— w_p
WATER CONTENT —— w
WATER CONTENT % 20 40 60

BULK DENSITY γ P.C.F.

REMARKS GR.SA.SI.CL.

▼ 200. W.L. in open BH Oct.19/71

96.5
102.5
104.5

% STRAIN AT FAILURE

FORM OD-MAT 126 (REV. 1969) OFFICE REPORT ON SOIL EXPLORATION

DEPARTMENT OF HIGHWAYS- ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 2

FOUNDATION SECTION

JOB 71-1105 LOCATION Sta. 9 + 20 ℄ of Road ORIGINATED BY VK
W.P. BORING DATE Oct. 21, 1971 COMPILED BY HS
DATUM Geodetic BOREHOLE TYPE Washboring- NX Casing CHECKED BY AK

ELEV. / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/FOOT	ELEV. SCALE
182.0	Water Level					
0.0	Water					180
167.5	Valley Bottom					
14.5	Sandy silt with trace of org. matter. Loose		1	SS	4	
165.2						
16.8	Clayey silt (numerous seams & layers of silt)		2	TW	PH	170
160.2	Stiff					
21.8	Silty clay to clay (sand partings throughout)		3	TW	PH	
154.7	Very Stiff					
27.3	Clayey silt with some sand and gravel (Glacial Till)		4	SS	34	160
147.2	Hard		5	SS	50	
34.8	End of Borehole					150
						140

DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT

SHEAR STRENGTH P.S.F.
○ UNCONFINED + FIELD VANE
● QUICK TRIAXIAL × LAB. VANE
500 800 1200 1600 2000

+3.6
+6.5

LIQUID LIMIT ——— w_L
PLASTIC LIMIT ——— w_P
WATER CONTENT ——— w
w_P w w_L
WATER CONTENT %
20 40 60

BULK DENSITY γ P.C.F.	REMARKS GR. SA. SI. CL.
	0 24 66 10
118.5	2 40 32 26

20
15 ⟡ 5 % STRAIN AT FAILURE
10

FORM OD-M 126 (REV. 1969) OFFICE REPORT ON SOIL EXPLORATION

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 3

FOUNDATION SECTION

JOB 71-11105 LOCATION Sta. 7 + 70 ℄ of Road ORIGINATED BY VK
W.P. BORING DATE Oct. 19 & 20, 1971 COMPILED BY HS
DATUM Geodetic BOREHOLE TYPE Washboring - NX Casing CHECKED BY

ELEV. / DEPTH	DESCRIPTION	STRAT. PLOT	SAMPLES NUMBER	TYPE	BLOWS/FOOT	ELEV. SCALE
207.0	Ground Level					
206.0	Topsoil					
1.0	Silty sand to sandy silt. Loose		1	SS	4	
202.0						
5.0	Desiccated Zone Mottled Grey-Brown Stiff		2	SS	7	200
			3	TW	PM	
			4	TW	PM	
			5	TW	PM	190
	Silty clay to clay, occasional organic mottlings throughout (sensitive)		6	SS	1	
			7	TW	PM	
	occasional partings & seams of silt & sand up to 2" thick throughout.		8	SS	2	180
			9	TW	PM	
			10	SS	2	170
	Grey		11	TW	PM	
	Firm to Stiff		12	SS	1	160
152.0						
55.0	Sandy Silt. Compact		13	TW	PM	
150.0	Met.mix.silt,sand & gr. trace of clay					150
57.0	(Glacial Till) V.Dense		14	SS	126	
145.5						
61.5	End of Borehole					140

DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT

SHEAR STRENGTH P.S.F.
○ UNCONFINED + FIELD VANE
● QUICK TRIAXIAL × LAB. VANE
400 800 1200 1600 2000

+7.5
+4.6
+6
+4
+10.0
+8.6
+5
14.0
+7.2

LIQUID LIMIT —— W_L
PLASTIC LIMIT —— W_P
WATER CONTENT —— W
W_P W W_L
WATER CONTENT %

BULK DENSITY γ P.C.F.

REMARKS
GR.SA.SI.CL

▼ 197.
in open BH
Oct.20/71

20
15 ⊹ 5 % STRAIN AT FAILURE
10

FORM OD-MT 126 (REV. 1969) OFFICE REPORT ON SOIL EXPLORATION

DEPARTMENT OF HIGHWAYS- ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 4

FOUNDATION SECTION

JOB 71-11105 LOCATION Sta. 5 + 30 30' Rt. of ℄ ORIGINATED BY VK

W.P. BORING DATE Oct. 20, 1971 COMPILED BY HS

DATUM Geodetic BOREHOLE TYPE Washboring - NX Casing CHECKED BY

ELEV. / DEPTH	DESCRIPTION	STRAT. PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/FOOT	ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS/FOOT — SHEAR STRENGTH P.S.F. ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB. VANE (400 800 1200 1600 2000)	LIQUID LIMIT w_L PLASTIC LIMIT w_P WATER CONTENT w — WATER CONTENT %	BULK DENSITY γ P.C.F.	REMARKS GR.SA.SI.CL.
208.0	Ground Level									
207.5	Topsoil									
0.5	Silty sand to sandy silt. Loose		1	SS	2					
203.5										
4.5	Desiccated Zone Mottled Grey-Brown Stiff		2	SS	5	200				
			3	TW	TW		+ 7.5			El. 196. ▼ in open BH Oct. 20/71
	Silty clay to clay, occasional organic mottlings (sensitive) occasional sand & silt seams & partings up to 2" thick throughout.		4	SS	1		+ 7			
			5	TW	TW	190	+ 5.3			
			6	SS	-		+ 4.3			
			7	TW	TW	180	+ 7			
	Grey		8	SS	-		+ 7.1 + 7.6			
169.0	Firm to Stiff					170				
39.0	End of Borehole									
						160				

20
15 ✧ 5 % STRAIN AT FAILURE
10

FORM OD-MT - 126 (REV. 1969) OFFICE REPORT ON SOIL EXPLORATION

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 5

FOUNDATION SECTION

JOB 71-11105 LOCATION Sta. 18 + 00 ℄ of Road ORIGINATED BY VK
W.P. BORING DATE Oct. 22, 1971 COMPILED BY HS
DATUM Geodetic BOREHOLE TYPE Washboring - NX Casing CHECKED BY

ELEV. / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/FOOT	ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS/FOOT / SHEAR STRENGTH P.S.F. (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB. VANE) 400 800 1200 1600 2000	LIQUID LIMIT w_L / PLASTIC LIMIT w_P / WATER CONTENT w — WATER CONTENT %	BULK DENSITY γ P.C.F.	REMARKS GR.SA.SI.CL.
200.0	Ground Level									
0.0	Desiccated Zone Mottled Grey-Brown Stiff		1	SS	4					Elev. ▼190. in open BH Oct.22/71
	Clay to silty clay, occ. organic mottlings (sensitive) occ. partings & seams of silt & sand up to 2" thick throughout.		2	TW	PH	190	+ 6.8 + 5.7			
172.0	Firm					180	+ 8.4 + 7.7			
28.0	End of Borehole					170				

20
15 ✛ 5 % STRAIN AT FAILURE
10

ABBREVIATIONS USED IN THIS REPORT

SOIL PROPERTIES

γ	UNIT WEIGHT OF SOIL (BULK DENSITY)
γ_s	UNIT WEIGHT OF SOLID PARTICLES
γ_w	UNIT WEIGHT OF WATER
γ_d	UNIT DRY WEIGHT OF SOIL (DRY DENSITY)
γ'	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
τ_f	SHEAR STRENGTH
c'	EFFECTIVE COHESION INTERCEPT
ϕ'	EFFECTIVE ANGLE OF SHEARING RESISTANCE, OR FRICTION
	IN TERMS OF EFFECTIVE STRESS $\tau_f = c' + \sigma' \tan \phi'$
c_u	APPARENT COHESION
ϕ_u	APPARENT ANGLE OF SHEARING RESISTANCE, OR FRICTION
	IN TERMS OF TOTAL STRESS $\tau_f = c_u + \sigma \tan \phi$
μ	COEFFICIENT OF FRICTION
S_t	SENSITIVITY

GENERAL

π	= 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
σ	NORMAL STRESS
σ'	NORMAL EFFECTIVE STRESS ($\bar{\sigma}$ IS ALSO USED)
τ	SHEAR STRESS
ε	LINEAR STRAIN
γ	SHEAR STRAIN
ν	POISSON'S RATIO (μ IS ALSO USED)
E	MODULUS OF LINEAR DEFORMATION (YOUNGS MODULUS)
G	MODULUS OF SHEAR DEFORMATION
K	MODULUS OF COMPRESSIBILITY
η	COEFFICIENT OF VISCOSITY

EARTH PRESSURE

d	DISTANCE FROM TOP OF WALL TO POINT OF APPLICATION OF PRESSURE
δ	ANGLE OF WALL FRICTION
K	DIMENSIONLESS COEFFICIENT TO BE USED WITH VARIOUS SUFFIXES IN EXPRESSIONS REFERRING TO NORMAL STRESS ON WALLS
K_o	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
β	ANGLE OF SLOPE TO HORIZONTAL

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 :-

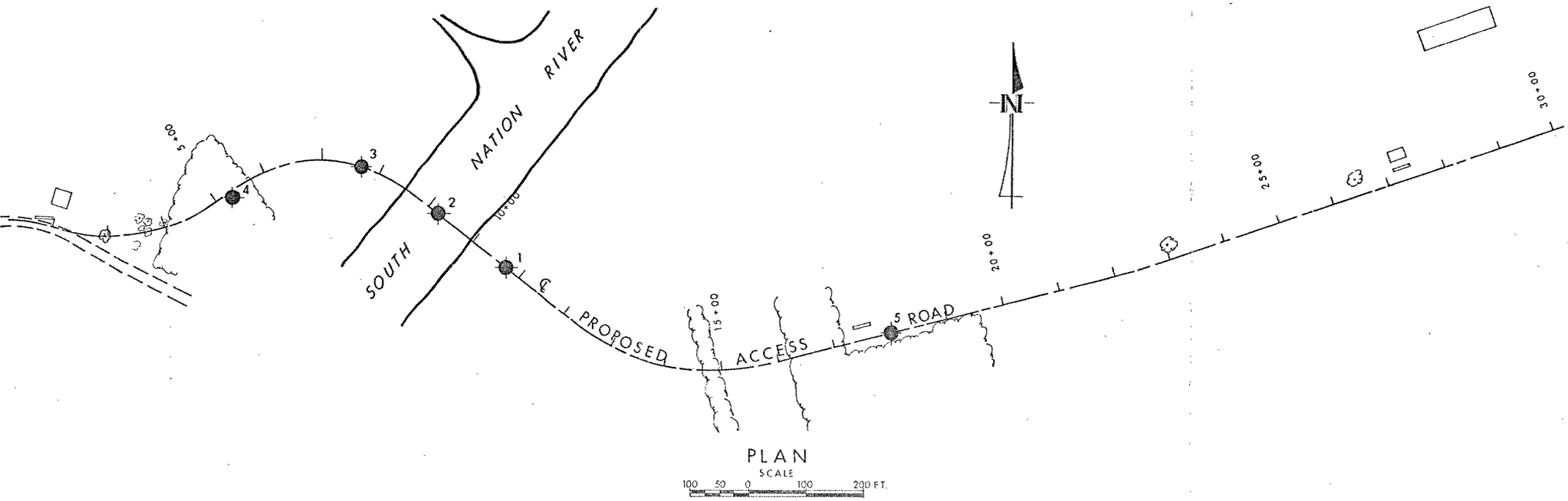
CONSISTENCY	'N' BLOWS / FT.	c LB. / SQ. FT.	DENSENESS	'N' BLOWS / FT.
VERY SOFT	0 - 2	0 - 250	VERY LOOSE	0 - 4
SOFT	2 - 4	250 - 500	LOOSE	4 - 10
FIRM	4 - 8	500 - 1000	COMPACT	10 - 30
STIFF	8 - 15	1000 - 2000	DENSE	30 - 50
VERY STIFF	15 - 30	2000 - 4000	VERY DENSE	> 50
HARD	> 30	> 4000		

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

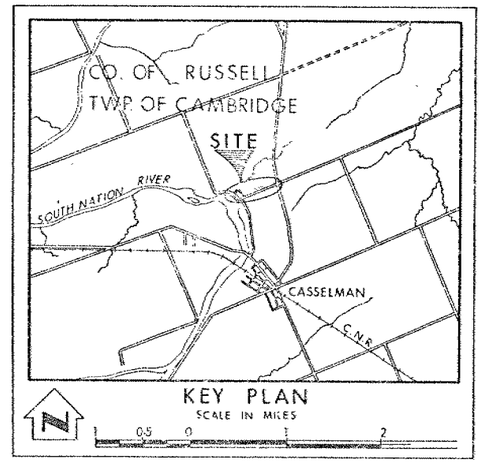
Qu	UNCONFINED COMPRESSION	L.V.	LABORATORY VANE
Q	UNDRAINED TRIAXIAL	F.V.	FIELD VANE
Qcu	CONSOLIDATED UNDRAINED TRIAXIAL	C	CONSOLIDATION
Qd	DRAINED TRIAXIAL	S	SENSITIVITY



PLAN

SCALE

100 50 0 100 200 FT.



KEY PLAN

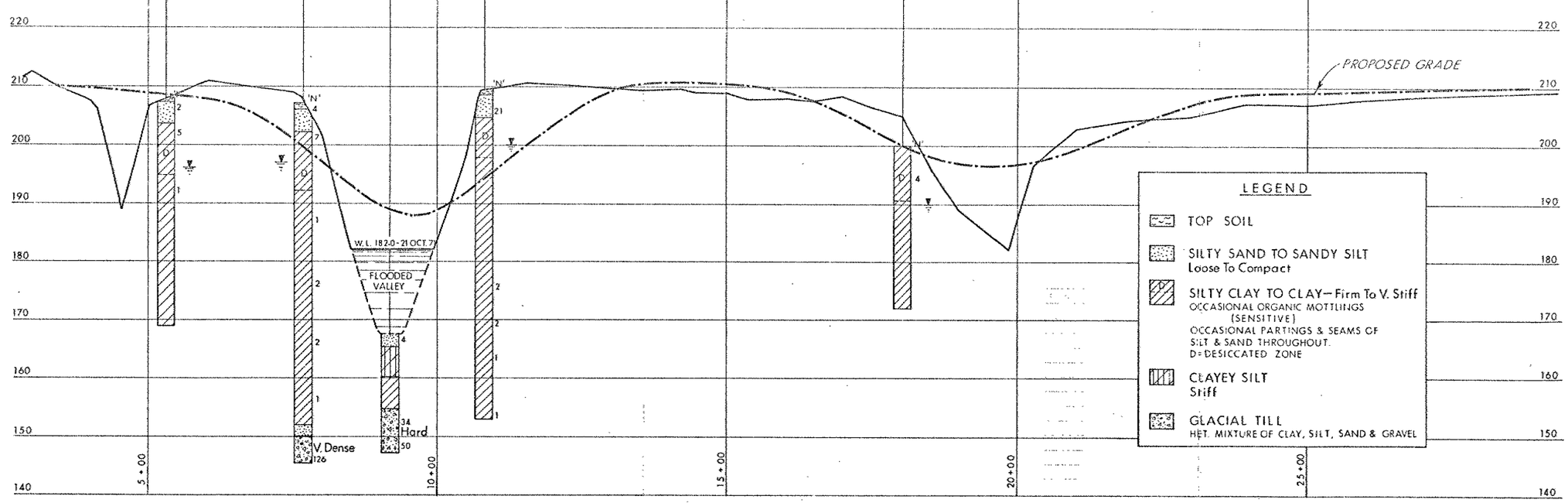
SCALE IN MILES

1 0.5 0 1 2

LEGEND

- Bore Hole
- Cone Penetration Test
- Bore Hole & Cone Test
- Water Levels established at time of field investigation. OCT., 1971

NO.	ELEVATION	STATION	OFFSET
1	209.5	10+81	℄
2	182.0	9+20	℄
3	207.0	7+70	℄
4	208.0	5+30	10' RT.
5	200.0	18+00	℄



PROFILE

SCALE

HORIZ. 100 50 0 100 200 FT

VER. 10 5 0 10 20 FT.

LEGEND

- TOP SOIL
- SILTY SAND TO SANDY SILT
  Loose To Compact
- SILTY CLAY TO CLAY—Firm To V. Stiff
  OCCASIONAL ORGANIC MOTTLINGS (SENSITIVE)
  OCCASIONAL PARTINGS & SEAMS OF SILT & SAND THROUGHOUT.
  D=DESICCATED ZONE
- CLAYEY SILT
  Stiff
- GLACIAL TILL
  HET. MIXTURE OF CLAY, SILT, SAND & GRAVEL

— 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

REF. NO. 70-3310 (McNEELY, LECOMPTE & ASSOC. LTD.)

DEPARTMENT OF TRANSPORTATION & COMMUNICATIONS
DESIGN SERVICES BRANCH — FOUNDATION OFFICE

PROPOSED ACCESS RD. TO CASSELMAN

HIGHWAY NO. _____ DIST. NO. 9

CO. RUSSELL

TWP. CAMBRIDGE LOT _____ CON. _____

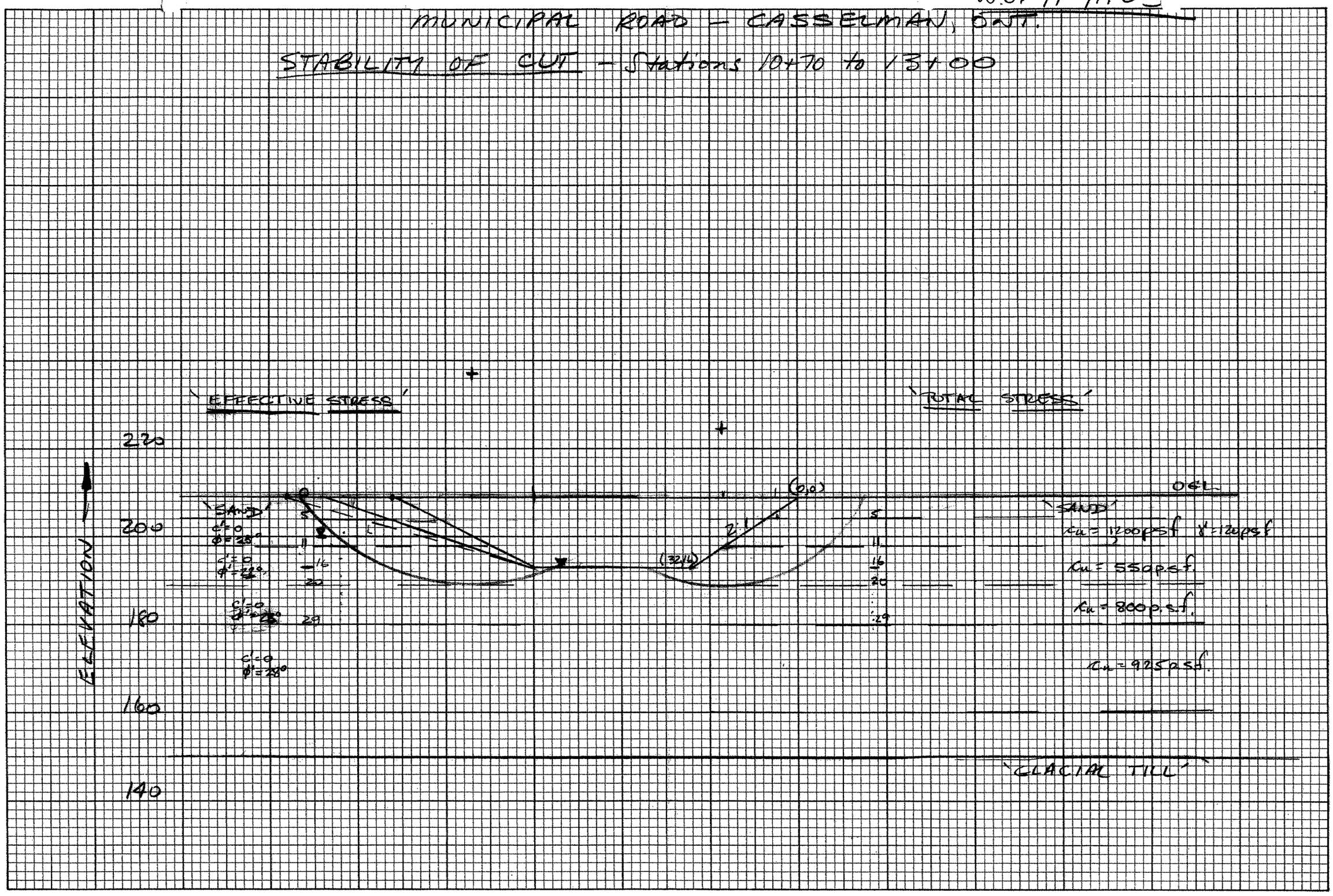
BORE HOLE LOCATIONS & SOIL STRATA

SUBM'D. V.K.	CHECKED	W.P. NO.	DRAWING NO. 71-11105A
DRAWN	CHECKED	JOB NO. 71-11105	
DATE NOV. 16, 1971		SITE NO.	BRIDGE DRAWING NO.
APPROVED PRINCIPAL FOUNDATION ENGINEER		CONT. NO.	

W.O. 71-1105

MUNICIPAL ROAD – CASSELMAN, ONT.

STABILITY OF CUT – Stations 10+70 to 13+00



K&E 10 X 10 TO THE INCH 47 0782
10 X 15 INCHES MADE IN U.S.A.
KEUFFEL & ESSER CO.

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10 X 15 INCHES MADE IN U.S.A.
KEUFFEL & ESSER CO.

W.O. 71-1105

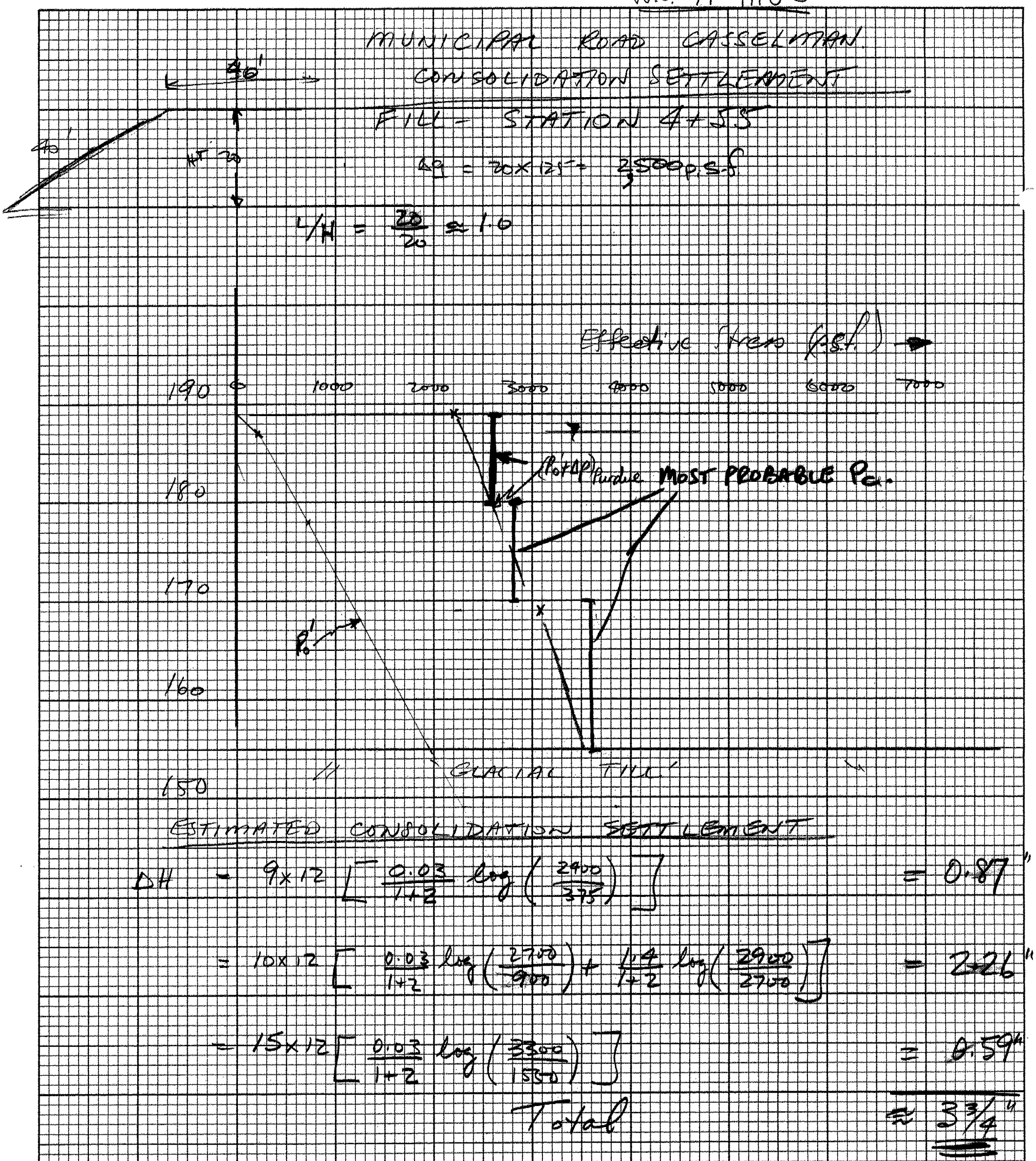
MUNICIPAL ROAD CASSELMAN

CONSOLIDATION SETTLEMENT

FILL - STATION 4+55

Δp = 20 × 125 = 2500 p.s.f

L/H = 20/20 ≅ 1.0



ESTIMATED CONSOLIDATION SETTLEMENT

$$\Delta H = 9\times12\left[\frac{0.03}{1+2}\log\left(\frac{2400}{375}\right)\right] = 0.87''$$

$$= 10\times12\left[\frac{0.03}{1+2}\log\left(\frac{2750}{900}\right)+\frac{1.4}{1+2}\log\left(\frac{29000}{2750}\right)\right] = 2.26''$$

$$= 15\times12\left[\frac{0.03}{1+2}\log\left(\frac{3300}{1550}\right)\right] = 0.59''$$

Total

$\cong 3\frac{3}{4}''$

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613

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Jacques

McNEELY, LECOMPTE & ASSOCIATES LTD.

CONSULTING CIVIL ENGINEERS
INGENIEURS CIVILS – CONSEILS

REPORT ON

THE PROPOSED NEW ACCESS ROAD TO CASSELMAN

TO REPLACE THE FLOODED ROAD

ALONG THE SOUTH NATION RIVER NORTH OF CASSELMAN, ONTARIO

Municipality of Cambridge

TERMS OF REFERENCE

This Company was requested by a resolution of the Township of Cambridge Council to prepare a report including estimates for the proposed new access road to Casselman.

The proposed new access road was to commence in front of the house of A. Drouin and was to join County Road No. 16 in the most economical manner.

On Friday, September 10th, 1971, members of the Township Council expressed their opinions of the most economical and desirable routes and investigated the site with members of this Company.

EXTENT OF WORK

Two alignments have been studied for the new access road. Sufficient elevations, sections, etc. have been taken to evaluate the two routes and to prepare an estimate on the most economical route. Additional studies must be carried out to assess the problems if any of the high fills across gullies. *

A plan, profile, key plan and cost estimate have been prepared and are attached.

REQUIREMENTS FOR THIS ROAD

The landslide at Lemieux which occured on May 16th, 1971, has caused the South Nation River to rise approximately thirty eight (38) feet. The direct road to Casselman for eight farmers, twelve (12) home owners and approximately thirty five (35) cottagers was flooded with up to twenty (20) feet of water for a distance of approximately 1900 feet. No consideration can be given to reopening or rebuilding the existing road for several years. The new conditions require a detour by the people affected of up to 3.5 miles more than the previous route. In addition, the alternate route on Township Roads is narrow and County Road No. 16 is not passable under spring conditions. A direct alternate route to that which has been flooded is required.

ESTIMATED COST OF PROPOSED NEW ACCESS ROAD TO CASSELMAN

ITEM	QUANTITY	UNIT	UNIT PRICE	TOTAL
CLEARING & GRUBBING	1	ACRE	$800.00	$800.00
EXCAVATION	15,910	Cu. Yd.	$1.00	$15,910.00
ROCK FILL	9,860	Cu. Yd.	$3.00	$29,580.00
EARTH FILL	7,775	Cu. Yd.	$1.00	$7,775.00
GRANULAR "A"	3,000	TON	$2.10	$6,300.00
GRANULAR "C" (SAND CUSHION)	4,400	TON	$1.40	$6,160.00
18" C.S.P. 16 Ga.	180	L.F.	$6.00	$1,080.00
36" C.S.P. 12 Ga.	106	L.F.	$11.00	$1,166.00
60" C.S.P. 10 Ga.	90	L.F.	$30.00	$2,700.00
60" C.S.P. 8 Ga.	166	L.F.	$36.00	$5,976.00
ENGINEERING, LAND PURCHASE & MISCELLANEOUS				$12,553.00
TOTAL ESTIMATE				$90,000.00

REGISTERED PROFESSIONAL ENGINEER
P. A. McNEELY
PROVINCE OF ONTARIO