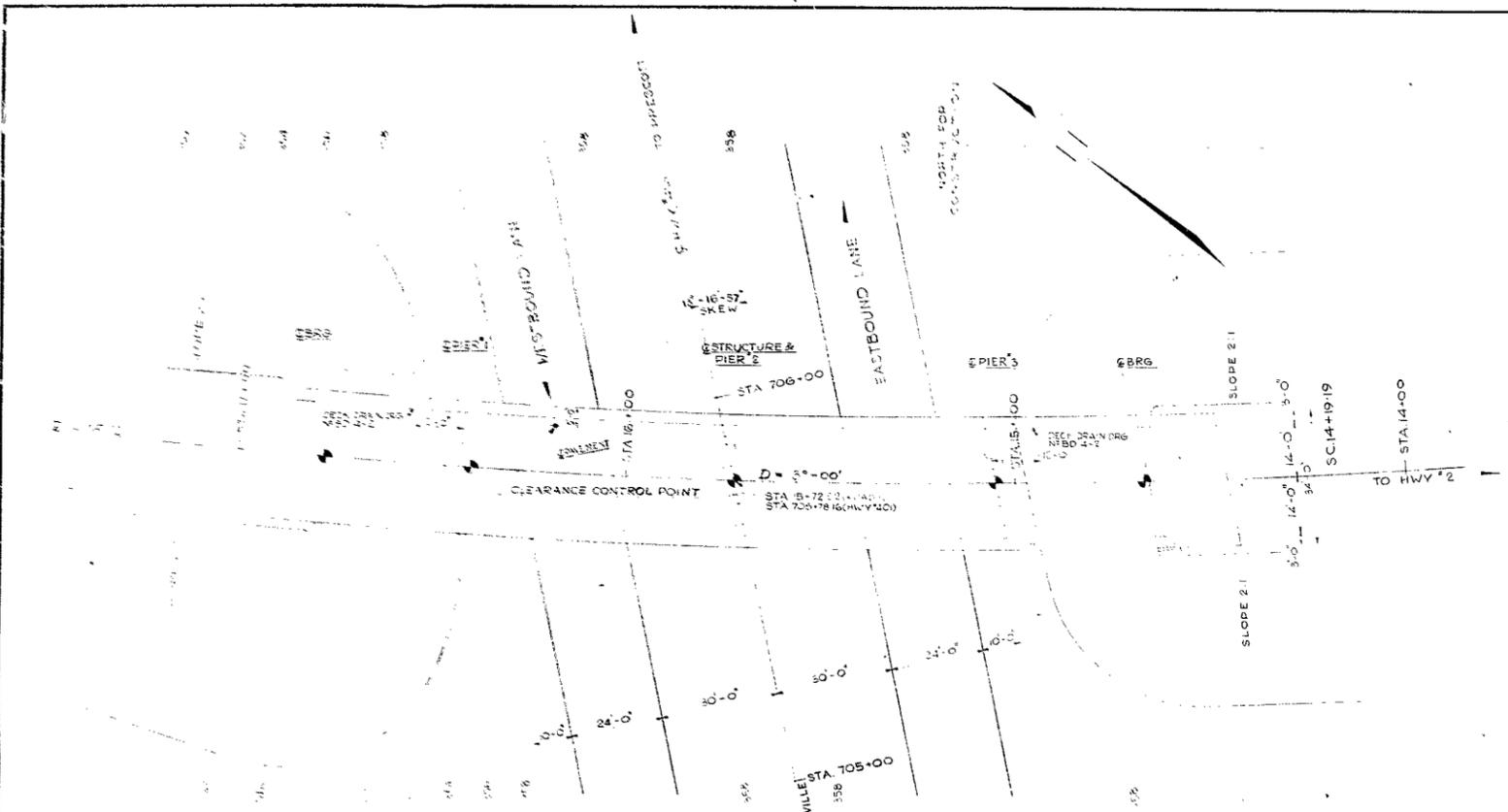


#64-F-59

W.P.# 25-59

HWY #401

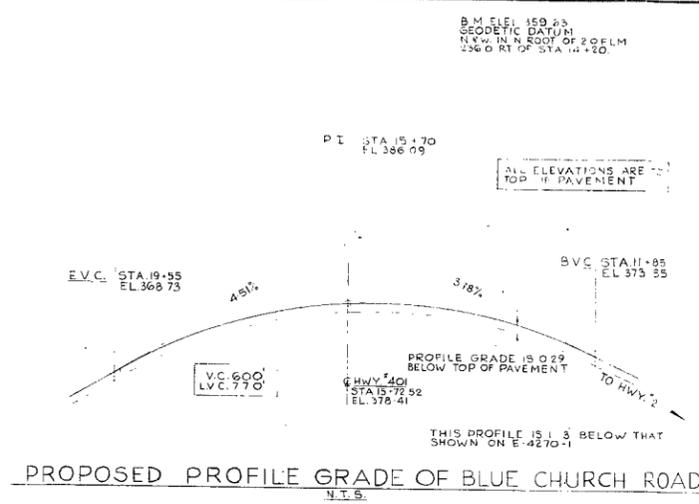
BLUE CHURCH
ROAD



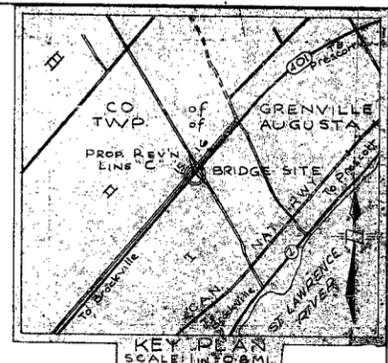
PLAN
SCALE 1"=20'-0"

SHE W 13° 16' 57"
SIN 0.22975
COS 0.97325
TAN 0.23608

CURVE DATA
Δ - 26° 24'
Δc - 21° 54'
D - 3° 00' RT
R - 1909.26
Lc - 730.00
Es - 52° 35'



PROPOSED PROFILE GRADE OF BLUE CHURCH ROAD
N.T.S.

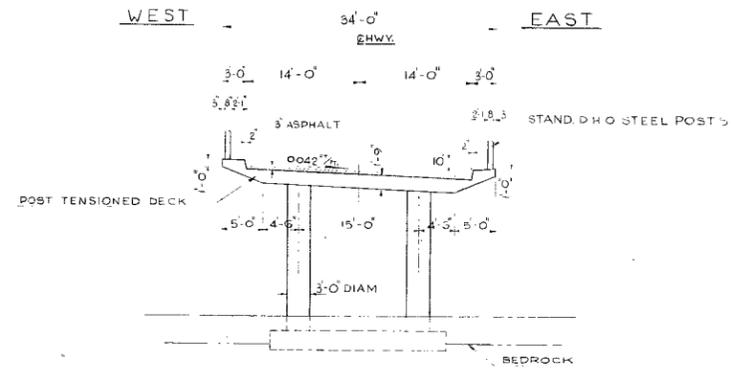


KEY PLAN
SCALE 1"=100'-0"

NOTES TO CONTRACTOR
STRUCTURE TO BE BUILT IN ACCORDANCE WITH FORM NO. 9 AND THE SPECIAL PROVISIONS, EXTRA COPIES OF WHICH MAY BE OBTAINED FROM THE ENGINEER.
CONCRETE MIX

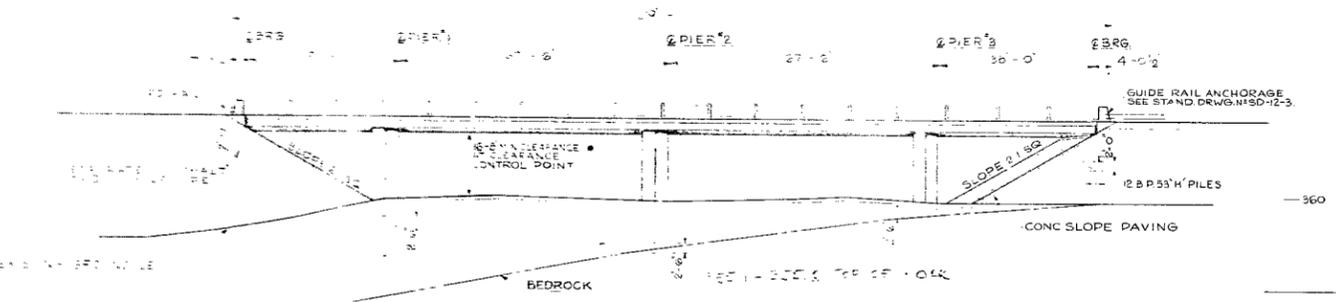
	MIN. STRENGTH AT 28 DAYS
DECK & PIERS	5,000 P.S.I.
FOOTINGS	3,000 P.S.I.
ELSEWHERE	3,000 P.S.I.

CLEAR COVER ON REINFORCING STEEL (UNLESS OTHERWISE STATED) FOOTINGS 3", ABUTMENTS 2", PIERS 2", DECK 1 1/2".
ENDPOSTS 1 1/2", APPROACH SLABS 1 1/2".
CONSTRUCTION NOTES
ALL EXPOSED EDGES TO BE CHAMFERED 1" X 1" EXCEPT AS NOTED. ALL CONSTRUCTION JOINTS MUST BE APPROVED BY THE ENGINEER.

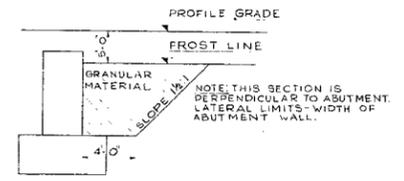


CROSS SECTION AT PIER
SCALE 1"=10'-0"

No Comments Piers 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70, 71, 72, 73, 74, 75, 76, 77, 78, 79, 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97, 98, 99, 100



ELEVATION
SCALE 1"=20'-0"



DETAIL OF MIN. GRANULAR BACKFILL REQUIREMENTS
N.T.S.

REFERENCE PLANS
C-26-15 LINE 'C'
B-26-5
E-4270-1
BA 1911

REVISIONS	DATE	BY	DESCRIPTION

DEPARTMENT OF HIGHWAYS ONTARIO
BRIDGE DIVISION

BLUE CHURCH ROAD UNDERPASS
2.5 MILES WEST OF PRESCOTT

KING'S HIGHWAY No. 401 DIST. No. 8
CO. AUGUSTA
TWP. GRENVILLE LOT 15 CON. I

PRELIMINARY - GENERAL PLAN

APPROVED: _____ SITE No. 17-165 W.P. No. 25-59
DESIGN: B.M.S. CHECK: _____ BRIDGE ENGINEER: _____ CONTRACT No. _____
DRAWING: B.M.S. CHECK: _____ DATE: OCT 64 LOADING: H20/S16 DRAWING No. D5666-P1



MEMORANDUM

TO: Mr. A. M. Toye,
Bridge Engineer,
Bridge Division.

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

Attention: Mr. S. McCombie

DATE: September 14, 1964

OUR FILE REF.

IN REPLY TO

SUBJECT:

FOUNDATION INVESTIGATION REPORT

For

Hwy. #401 and Blue Church Road, Rev.
Line 'C' Underpass, Co. of Grenville,
Twp. of Augusta, Conc. I, Lot 15,
District No. 8

W.J. 64-F-59 W.P. 25-59

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

We believe that you will find the factual data and recommendations contained therein, adequate for your future design requirements. Should you require additional information, please do not hesitate to contact our Office.

FYL/MdeF

Attach.

cc: Messrs. A. M. Toye (2)
H. A. Tregaskes
H. D. McMillan
J. Ford
E. A. Cash
J. E. Gruspier
A. Watt

A. C. Sternac,
PRINCIPAL FOUNDATION ENGINEER

Foundations Office
Gen. Files ✓

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1. INTRODUCTION.
 2. DESCRIPTION OF SITE.
 3. FIELD AND LABORATORY WORK.
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 - 4.3) Clayey, Sandy Silt - Stiff to Hard.
 - 4.4) Limestone Bedrock.
 5. GROUND WATER CONDITIONS.
 6. DISCUSSION AND RECOMMENDATIONS.
 7. SUMMARY.
 8. MISCELLANEOUS.
-

FOUNDATION INVESTIGATION REPORT

For

Hwy. #401 and Blue Church Road, Rev.
Line 'C' Underpass, Co. of Grenville,
Twp. of Augusta, Conc. I, Lot 15,
District No. 8.
W.J. 64-F-59 ----- W.P. 25-59

1. INTRODUCTION:

A request to carry out a foundation investigation at revised Blue Church Road Line 'C' and Hwy. #401, was received from Mr. A. P. Watt, Regional Bridge Location Engineer, dated July 3, 1964.

It is proposed to erect a new bridge to carry revised Blue Church Road Line 'C' over Hwy. #401. The site of the proposed bridge is located approx. 2.5 miles South-West of the Town of Prescott, County of Grenville, Twp. of Augusta. At this location, the chainage of the revised Blue Church Road Line 'C' is from 14+68 to 16+78, and that of Hwy. #401, is 705+78.

In order to determine the soil properties and decide on the type of foundations, an investigation was carried out by this Section. Results and the discussion of the field and laboratory investigations, as well as conclusions 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 underpass is located approximately 2.5 miles South-West of the Town of Prescott. The surrounding area

cont'd. /2 ...

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

is generally flat terrain.

Physiographically, the site is located in the so-called "Iroquois Plain!"

3. FIELD AND LABORATORY WORK:

In order to obtain sufficient information on the type and properties of the subsoil, ten sampled boreholes and seven dynamic cone penetration tests were carried out at this site. Five to ten feet of rock core was taken in each borehole.

Split-spoon samples were taken at various depth intervals. 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 Appendix I of this report, and is also given in subsequent paragraphs. The estimated stratigraphical profile, shown on Dwg. No. 64-F-59A, is based upon this information.

cont'd. /3 ...

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

4.2) Sand and Gravel - Compact (Hwy. Fill):

As can be seen from Dwg. No. 64-F-59A, 3 to 4 feet of sand and gravel fill was spread over the layer of stiff to hard clayey, sandy silt to achieve the desired Hwy. grade. This fill was encountered in B.H.'s #3, 5, 8 and 10, only.

4.3) Clayey, Sandy Silt - Stiff to Hard:

Immediately below the topsoil, or highway fill, is a layer of clayey, sandy silt.

Grain Size Distribution Curves indicated that this stratum is composed of 21% sand, 12% clay and the rest of 67% is formed by silt. Liquid Limits for this stratum vary from 25.7% to 36.8%, while Plastic Limits range from 17.5% to 23.1%. The average Moisture Content in this stratum was found to be 19.5%, ranging from 7.2% to 33.8%. The overall stratum is in a stiff to hard condition, with an average 'N' value of 40 blows/foot. Plasticity Charts for some boreholes are given in Appendix I of this report.

4.4) Limestone Bedrock:

Immediately below the topsoil, or the layer of stiff to hard clayey, sandy silt, is limestone bedrock. The core taken has revealed that the bedrock is arranged in layers from 1 inch to 6 inches thick, and somewhat loose at the surface.

5. GROUND WATER CONDITIONS:

The ground water level, at the time of the investigation, was found at the following elevations:

cont'd. 4 ...

5. GROUND WATER CONDITIONS: (cont'd.) ...

In	B.H. #1	at	El. 335.0
	B.H. #2	at	El. 335.8
	B.H. #3	at	El. 340.0
	B.H. #10	at	El. 339.8

No ground water was found in B.H.'s #4, 5, 6, 7, 8 and 9. It may be assumed that the water level will vary with the seasons of the year.

No artesian water conditions were encountered.

6. DISCUSSION AND RECOMMENDATIONS:

The investigation has revealed that the bedrock at the proposed site has an approx. slope of 15° from South toward North. It is therefore recommended that pier and abutment footings in the vicinity of B.H.'s #4, 5, 6, 7, 8 and 9 be founded directly on bedrock. A net allowable pressure of 10 tons/sq.ft. may be assumed for design purposes. All loose rock, if found necessary, should be removed prior to placing of footings. In the vicinity of B.H.'s #1, 2, 3 and 10 the structure should be supported on H-piles driven down to bedrock. The load per pile will depend on the sections used.

Since the subsoil consists of relatively impermeable material, dewatering of the proposed excavations should present no major problems.

No stability problems for the approach fills are anticipated.

7. SUMMARY:

A foundation investigation at the site of the proposed Blue Church Road Line 'C' and Hwy. #401, is reported.

The subsoil was found to consist of compact sand and gravel (Hwy. fill), followed by stiff to hard clayey, sandy silt which in turn, is underlain by limestone bedrock.

Spread footings with an allowable net pressure of 10 tons/sq.ft. are recommended for footings placed directly on bedrock in the vicinity of B.H.'s #4, 5, 6, 7, 8 and 9. All loose rock, if found necessary, should be removed prior to placing of footings. In the vicinity of B.H.'s #1, 2, 3 and 10 the structure should be supported on H-piles driven down to bedrock. The load per pile will depend on the sections used.

No dewatering problems are anticipated.

No stability problems for the approach fills are anticipated.

8. MISCELLANEOUS:

The field work, performed during the period from August 4 to August 7, 1964, together with the preparation of this report, was undertaken by Mr. W. W. Kulmatickas, Project Foundation Engineer. The investigation was carried out under the general supervision of Mr. K. G. Selby, Senior Foundation Engineer, who reviewed this report.

September 1964.

APPENDIX I.

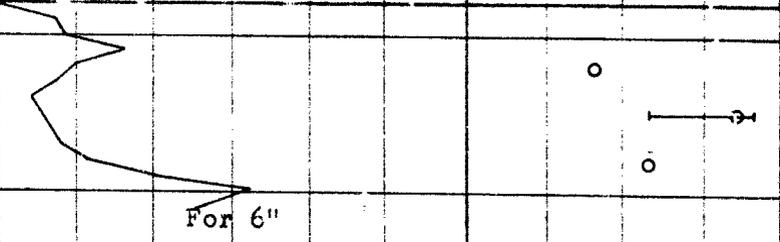
DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & RESEARCH DIVISION

RECORD OF BOREHOLE NO. 2

FOUNDATION SECTION

JOB 64-F-59 LOCATION Hwy. #401 & Blue Church Rd. Line 'C',
Ch. 16+85 - 20'-0" Rt. ORIGINATED BY W.W.K.
 W.P. 25-59 BORING DATE July 21 & 22, 1964 COMPILED BY W.W.K.
 DATUM 352.0 BOREHOLE TYPE Wash Boring BX Casing CHECKED BY A. J.

SOIL PROFILE	ELEV. / DEPTH	DESCRIPTION	STRAT. PLOT	SAMPLES		ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE					LIQUID LIMIT — WP			BULK DENSITY	REMARKS	
				NUMBER	TYPE		BLOWS / FOOT	20	40	60	80	100	PLASTIC LIMIT — WP	WATER CONTENT — W			WP
	352.0	Groundlevel															
	351.5	Black Org. Topsoil															
	0.5	Clayey Sandy Silt	[Hatched Pattern]	1	SS	23											
		Stiff to Hard		2	SS	9											
				3	SS	21											
				4	SS	101											
				5	SS	108											
	23.2	Limestone Bedrock															
	323.6	End of Borehole															
	28.4																



W.L. El.
335.8
Observed in Casing

DEPARTMENT OF HIGHWAYS ONTARIO
MATERIALS & RESEARCH DIVISION

RECORD OF BOREHOLE NO. 3

FOUNDATION SECTION

JOB 64-F-59 LOCATION Hwy. #401 & Blue Church Rd. Line 'C',
Ch. 16+35 - 20' - 0" Lt. ORIGINATED BY W.W.K.
W.P. 25-59 BORING DATE July 22, 1964 COMPILED BY W.W.K.
DATUM 358.0 BOREHOLE TYPE Wash Boring BX Casing CHECKED BY

ELEV. / DEPTH	SOIL PROFILE DESCRIPTION	STRAT. PLOT	SAMPLES		ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT					LIQUID LIMIT _____ W PLASTIC LIMIT _____ WP WATER CONTENT _____ W			BULK DENSITY P.C.F.	REMARKS	
			NUMBER	TYPE		20	40	60	80	100	W _p	W _L	W			
358.0	Groundlevel															
0.0	Compact Sand & Gravel - Hwy. Fill															
353.5																
4.5	Clayey Sandy Silt	[Hatched Pattern]	1	SS 20	350								0			
	Stiff to Hard		2	SS 73										0		
			3	SS 74										0		
338.2	Limestone Bedrock	[Diagonal Pattern]			340											
19.8																
333.0																
25.0	End of Borehole				330											
					320											

For 9"

W.L.
El. 340.0
Observed
in
Casing

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & RESEARCH DIVISION

RECORD OF BOREHOLE NO. 4
Hwy. #401 & Blue Church Rd. Line 'C',
Ch. 15+79 - 31'-0" Rt.

FOUNDATION SECTION

JOB 64-F-59

LOCATION

Ch. 15+79 - 31'-0" Rt.

ORIGINATED BY

W.W.K.

W.P. 25-59

BORING DATE

July 22, 1964

COMPILED BY

W.W.K.

DATUM 356.0

BOREHOLE TYPE

Wash Boring BX Casing

CHECKED BY

ELEV. DEPTH	SOIL PROFILE DESCRIPTION	STRAT. PLCT	SAMPLE		BLOWS / FOOT	ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE					LIQUID LIMIT	PLASTIC LIMIT	WATER CONTENT	BULK DENSITY	REMARKS
			NUMBER	TYPE			BLOWS / FOOT									
356.0	Groundlevel						20	40	60	80	100					
0.5	Black Org. Topsoil															
	Clayey Sandy Silt		1	SS	15											
	Stiff to Hard		2	SS	14	350										
344.4			3	SS	74											
11.6	Limestone Bedrock	71274														
339.1																
16.9	End of Borehole															

For 6"

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & RESEARCH DIVISION

RECORD OF BOREHOLE NO. 6

FOUNDATION SECTION

JOB 64-F-59

LOCATION Hwy. #401 & Blue Church Rd. Line 'C',
Ch. 14+71 - 20'-0" Rt.

ORIGINATED BY W.W.K.

W P 25-59

BORING DATE July 23, 1964

COMPILED BY W.W.K.

DATUM 358.0

BOREHOLE TYPE Wash Boring BX Casing

CHECKED BY K. J.

SOIL PROFILE		SAMPLES		ELEV SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT	SHEAR STRENGTH P S F	LIQUID LIMIT ——— *L		BULK DENSITY	REMARKS
ELEV DEPTH	DESCRIPTION	NUMBER	TYPE				BLOWS / FOOT	PLASTIC LIMIT ——— *P		
358.0	Groundlevel									
0.5	Limestone									
352.0	Bedrock									
6.0	End of Borehole									
				350						
				340						
				330						

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & RESEARCH DIVISION

RECORD OF BOREHOLE NO. 7

FOUNDATION SECTION

JOB 64-F-59
W. P. 25-59
DATUM 358.0

LOCATION Hwy. #401 & Blue Church Rd. Line 'C',
Ch. 14+65 - 20'-0" Lt.
BORING DATE July 23, 1964
BOREHOLE TYPE Wash Boring BX Casing

ORIGINATED BY W.W.K.
COMPILED BY W.W.K.
CHECKED BY R.G.

SOIL PROFILE		SAMPLES			DYNAMIC PENETRATION RESISTANCE		LIQUID LIMIT — WL			BULK DENSITY	REMARKS
ELEV DEPTH	DESCRIPTION	NUMBER	TYPE	BLOWS / FOOT	ELEV SCALE	BLOWS / FOOT	PLASTIC LIMIT — WP	WATER CONTENT — W	WATER CONTENT %		
358.0	Groundlevel										
356.9	Black Org. Topsoil										
	1.1 Limestone Bedrock										
	End of Borehole										
					350						
					340						

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & RESEARCH DIVISION

RECORD OF BOREHOLE NO. 9

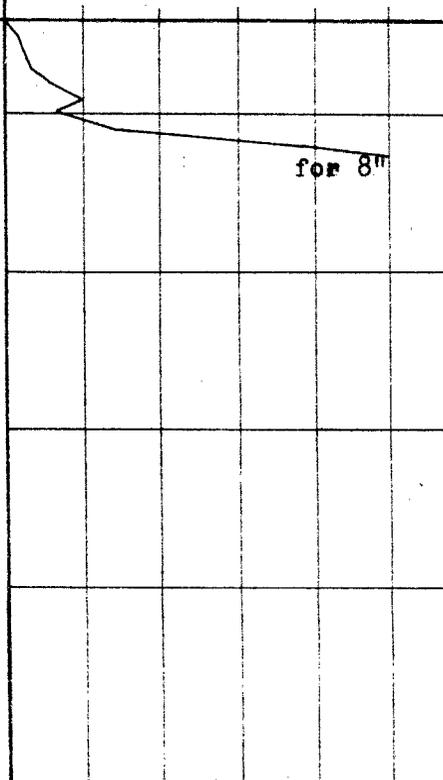
FOUNDATION SECTION

JOB 64-F-59 LOCATION Hwy. #401 & Blue Church Rd. Line 'C',
Ch. 15+66 - 29'-0" Lt. ORIGINATED BY W.W.K.
 W.P. 25-59 BORING DATE July 22, 1964 COMPILED BY W.W.K.
 DATUM 356.0 BOREHOLE TYPE Wash Boring BX Casing CHECKED BY K.G.S.

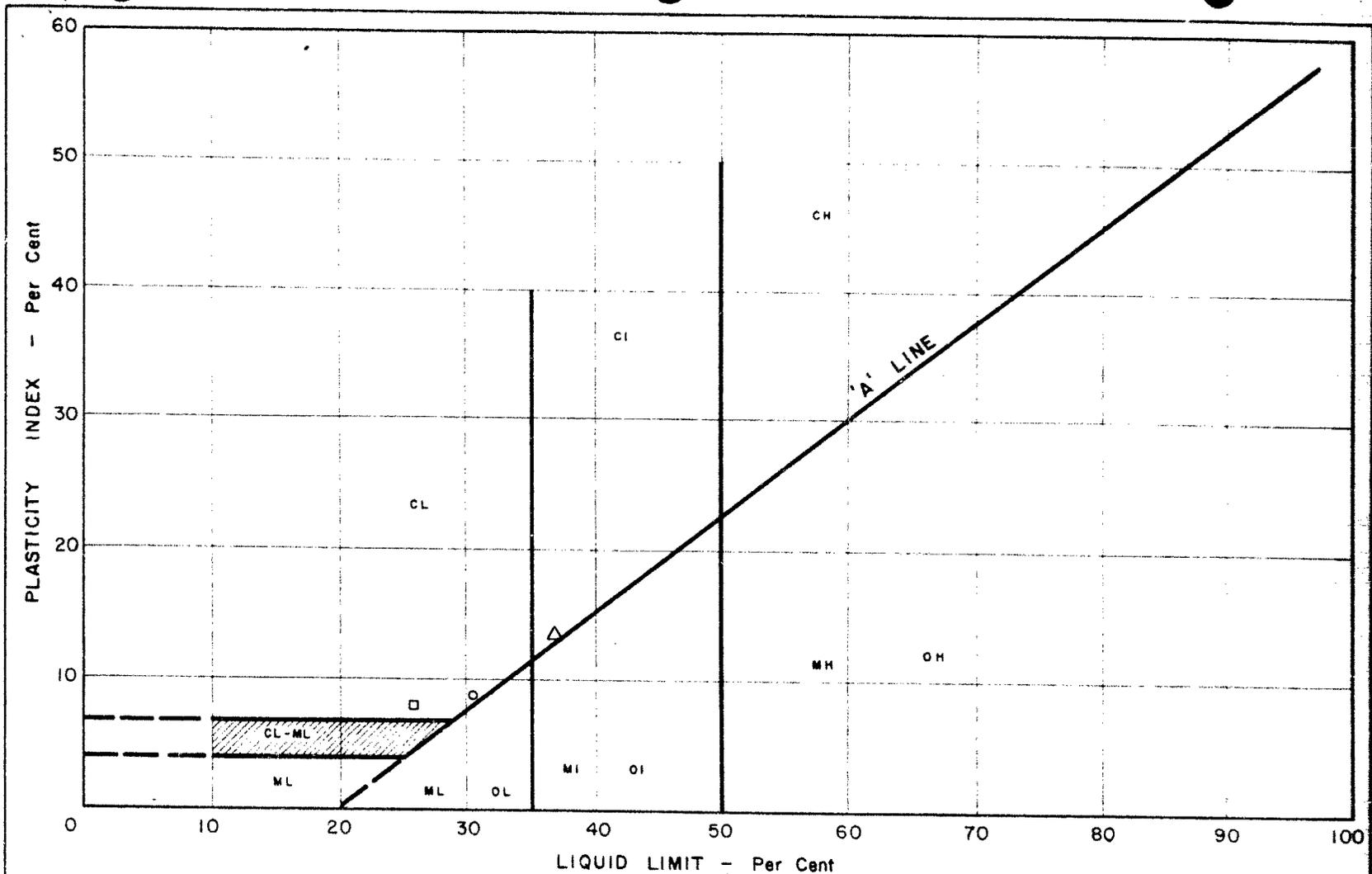
SOIL PROFILE		SAMPLES			DYNAMIC PENETRATION RESISTANCE					LIQUID LIMIT — WL PLASTIC LIMIT — WP WATER CONTENT — W			BULK DENSITY P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	NUMBER	TYPE	BLOWS / FOOT	ELEV. SCALE	20	40	60	80	100	WATER CONTENT % WP — W — WL			
356.0	Groundlevel													
0.7	Black Org. Topsoil													
	Clayey Sandy Silt	1	SS	9										
348.1	Stiff to Hard	2	SS	42	350									
	Limestone													
342.8	Bedrock													
	End of Borehole				340									
					330									
					320									

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 %
 10 20 30



for 8"



NOTES

- - B.H. NO. 1
- Δ - B.H. NO. 2
- - B.H. NO. 3

DEPARTMENT OF HIGHWAYS - ONTARIO
 MATERIALS & RESEARCH DIVISION
PLASTICITY CHART

Job No. 64 - F - 59 W.P. No. 25 - 59
 Location HWY. NO. 401 & BLUE CHURCH ROAD

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

Qu	UNCONFINED COMPRESSION	L.V.	LABORATORY VANE
Q	UNDRAINED TRIAXIAL	F.V.	FIELD VANE
Q _{cu}	CONSOLIDATED UNDRAINED TRIAXIAL	C	CONSOLIDATION
Q _d	DRAINED TRIAXIAL	S	SENSITIVITY

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_o	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
c_u	APPARENT COHESION
ϕ_u	APPARENT ANGLE OF SHEARING RESISTANCE, OR FRICTION
μ	COEFFICIENT OF FRICTION
S_f	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 (YOUNG'S 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

Mr. J. E. Gruspier,
Regional Materials Engineer,
Regional Office, Kingston.

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

January 23, 1967

Foundation Investigations - Accuracy

With reference to your note attached to the minutes of the Contract Review meeting of January 16, 1967 (Contract No. 65-234), we wish to mention a number of things which we hope will contribute to a better understanding of our operations as well as of the approaches and methods we use to complete our assignments:

Whenever our representative goes out in the field to do an investigation, the Regional Engineering Survey Office is contacted and asked to indicate the line and location where the investigation is to be carried out. They are also asked to survey the location of boreholes and provide us with the correct elevations.

There could, however, be cases when this procedure is not followed, the reason being that the old and new lines are identical or that there is practically nothing that can be mistaken or misunderstood.

It can be therefore said that whenever there is even the slightest doubt, the Engineering Surveys are asked to provide us with all the necessary data and information such as: borehole chainage offset and elevation. Theoretically, therefore, there should never be any mistake regarding borehole locations and elevations.

However, as you may recall, there was recently one site - (Hwy. 401 & Blue Church Road - W.P. 25-59) where the investigation was carried out at the wrong location. It was purely a mistake by our Engineer, who made the wrong assumption about the crossing and did not check it out. We would classify this as an oversight, human error, or something like that, because the problem was otherwise very straightforward and, in our opinion, did not require any clarification or assistance on the part of the Regional Engineering Survey crew.

It was also brought to our attention recently, that at the site of the Hwy. 401 and Joyceville Sideroad crossing (W.P. 67-57),

cont'd. /2 ...

Mr. J. E. Gruspier,
Regional Office,
Kingston.

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January 23, 1967

a significant difference in bedrock elevations in the field and, as shown in our report, was discovered. We have investigated this matter and came to the conclusion that the mistake on our part, was due to the use of the wrong and unsuitable boring equipment. A memo explaining this, was sent to Mr. F. Howett, Bridge Construction Liaison Engineer, who brought this to our attention. A copy of this memo was also sent to Mr. E. A. Cash, Kingston District Engineer, in order to keep him informed on the events that led to the wrong interpretation of the boring results. Attached, we are sending you a copy of this memo for your files.

As you may see from the above, a very definite procedure is followed to obtain the necessary survey data, and to tie our boreholes in such a way that there is never any doubt about either their locations or elevations. To the best of our recollection, there may have been only one or two more cases of borehole location ambiguity in the past six to seven years, and this looks to us as a pretty good record, especially, if one keeps in mind that there is a fairly high turnover of personnel doing field investigations.

We would, however, welcome anybody's suggestion which could improve our present procedure, should one feel that it is inadequate.

AGS/MdeF
Attach.

A. G. Sternac
A. G. Sternac
PRINCIPAL FOUNDATION ENGINEER

cc: Foundations Office
Gen. Files

DATE 18/1/67.
 TO A. J. Stemas Prin Adm
 FROM J. E. Gruspier Eng

<input type="checkbox"/>	NOTE AND FILE	J. E. GRUSPIER	<input type="checkbox"/>	PREPARE REPLY FOR MY SIGNATURE
<input type="checkbox"/>	NOTE AND RETURN TO ME		<input type="checkbox"/>	TAKE APPROPRIATE ACTION
<input type="checkbox"/>	RETURN WITH MORE DETAILS		<input type="checkbox"/>	PER YOUR REQUEST
<input type="checkbox"/>	NOTE AND SEE ME		<input type="checkbox"/>	FOR YOUR SIGNATURE
<input type="checkbox"/>	PLEASE ANSWER		<input checked="" type="checkbox"/>	FOR YOUR INFORMATION
<input type="checkbox"/>	FOR YOUR APPROVAL		<input type="checkbox"/>	INVESTIGATE AND REPORT
<input type="checkbox"/>	RETURN WITH YOUR COMMENTS		<input type="checkbox"/>	_____

COMMENTS

*After considerable discussion
 Mr. Cash is still not happy with
 the results of fdr investigations
 in general, due to past problems.
 Does Engineering Surveys lay out
 the line in the field for boreholes
 in all cases?*

Contract Review meeting called under the authority of Circular 62-12 of Contract 65-234, Structure and Approaches and Paving, Highway #401, Underpass Blue Church Road, 3 Miles West of Prescott (Edward Street); held in Board Room No. 1, Counter Street on Monday January 16, 1967 at the hour of 1:30 p.m.

PRESENT: Mr. E. A. Cash, District Engineer - Chairman
Mr. K. Westerby, District Construction Engineer
Mr. J. Boucher, Engineering; Surveys
Mr. S. Markiewicz, Road Design Engineer
Mr. H. B. McKay, Engineering Audit Supervisor
Mr. L. Wannamaker, District Project Supervisor
Mr. A. R. Griff, District Construction Supervisor
Mr. J. E. Gruspier, Materials and Testing
Mrs. S. Russell, Secretary

Considerable discussion took place in an effort to improve the accuracy of the bore holes taken to determine foundation depths.

It is understood that the policy is now for those in charge of boring to check with Engineering Surveys to determine the accurate location of the line.

It is recommended that the line of the final borings to be permanently tied to facilitate checking and layout by District forces. It is also suggested that additional borings be taken, such as along centre line, where possible.

The concrete surface was of a higher quality than on the previous contract 65-165, but on instructions from Head Office an Infraction report was placed because of poor riding qualities. The final surface was asphalt paving.

The following overruns and underruns are noted:

Item 1 - Clearing; Tender Quantity 6 trees, Final Quantity 9 trees.
Three additional trees (second growth from stumps) were encountered on the north of 401 which were not included in the original estimates.
Item 7 - Sand Cushion (Modified, Granular Backfill to Sewers, Manholes and Catchbasins); Tender Quantity 88 cubic yards
Final Quantity Nil.

Earth Excavation or borrow was found of a sandy nature suitable to specifications, and was employed.

Item 9 - Compaction Equipment Rental (Sheepsfoot Roller and Tractor);
Tender Quantity 98 hours, Final Quantity Nil.

Item 10 - Compaction Equipment Rental (Pneumatic-Tired Wobble Wheel Roller and Tractor); Tender Quantity 390 hours, Final
Quantity 502.5 hours.

Material was of a sandy nature, therefore, Wobble Wheel Roller and Tractor was found more suitable for compaction.

Item 11 - Application of Water; Tender Quantity 1,000 M. Gallons,
Final Quantity 358.16 M. Gallons.

The borrow was placed during the wet fall of 1965, therefore, less water was required.

Item 16 - ~~Excavation~~ Excavation for Culverts; Tender Quantity 56 cubic yards, Final Quantity 28.65 cubic yards.

This underrun was due to an error in the original estimate.

Continued .../2

Item 17 - Removal of Culverts (Pipe all sizes); Tender Quantity 172 Linear Feet; Final Quantity 38 Linear Feet.

The remaining pipe was found not salvagable.

Item 22 - Supply and Place Hot Mix H.L.3; Tender Quantity 910 tons, Final Quantity Nil

Item 23 - Supply and Place Hot Mix Sand Asphalt Course; Tender Quantity 270 tons, Final Quantity Nil

Special Provisions, page 14 indicate asphalt cement to be supplied by the Department, therefore, from the ruling of the memorandum of June 22, 1966 from T. C. Muir, Contract Control Engineer prices were negotiated and paid under Work Order 66-32295, Supply and Place H.L.3 including asphalt cement; 932.26 tons at \$11.91.

Item 27 - Place 18' R.C.I.P. Culverts; Tender Quantity 34 linear feet, Final Quantity 104 linear feet

Three additional entrances, not previously estimated, were installed.

Item 41 - Sodding Unstaked, Field; Tender Quantity 930 square yards, Final Quantity 3694.65 square yards.

Additional work was required on the centre line of the boulevard to obtain correct drainage which required this additional sodding.

Item 46 - Drive Steel "H" Piles; Tender Quantity 504 linear feet, Final Quantity 225.09 linear feet.

Item 47 - Cut Off Tops of Steel "H" Piles; Tender Quantity 20 each Final Quantity 12 each.

The above underruns were due to inaccurate ^{borings} ~~borrows~~. (carried out on wrong line)

The following are work orders carried out.

Work Order 66-32295 - Heat Water and Aggregate Type "A" Protection; 32.85 cubic yards at \$1.50.

Heat Water and Aggregate Using 1" Min. Insulated forms, Type "B" Protection; 60.19 cubic yards at \$4.50.

Heat Water and Aggregate using 3" Insulated forms with Protective Housing, Maintaining heat, Type "C" Protection; 506.25 cubic yards at \$8.00.

Work Order 66-32295 - Plate Vibrator Hand Compactor with Operator 18" Wisconsin 350 lbs.; 35.5 hours at \$3.50.

This was required in compaction of granular backfill to the structure.

Vibrator Roller, Hand Compactor with Operator V.R.28" Essick 28" Single Roller; 20 hours at \$5.30.

This was employed in compacting granular backfill to structure and earth underneath the slope paving.

	<u>D.4</u>	<u>EXPENDITURE</u>
Tender	\$173,625.60	\$184,999.26
Material	24,035.63	23,983.74
Engineering	26,000.00	34,191.56
Sundry	16,338.77	15,334.19 (Dec. 15/67)
TOTAL	\$240,000.00	\$258,508.75

Mr. A. Rutka,
Materials & Testing Engr.,
Room 102, Lab. Bldg.

Mr. A. G. Stermac,
Principal Foundation Engr.,
Room 107, Lab. Bldg.

February 21, 1966

7725-59
64-1-59

Memo from Mr. E. A. Cash to J. B. Wilkes -
January 28, 1966 - re Borings for Structure
Foundations.

With reference to the above mentioned memo and your request for an explanation, we wish to make the following comments:

Since the receipt of the memo, we have been in touch with Mr. Cash who advised us that the two structures he referred to in his memo to Mr. Wilkes were: W.P. 170-61, Westbound Entrance Underpass at Gananoque, and W.P. 25-59, Blue Church Rd. Underpass. We have reviewed both jobs very carefully and have arrived at the following conclusions:

(1) The investigation for Blue Church Road (W.P. 25-59) was not carried out on the correct line (Rev. Line 'C'), but seems to have been carried out on the centre-line of the then existing Blue Church Rd. instead. This has to be considered as our mistake.

(2) The investigation for the Westbound Entrance Underpass at Gananoque (W.P. 170-61) was carried out on the correct line and the borings were located correctly. The contractor experienced some difficulties due to the fact that the bridge footing locations were changed slightly (about 15 ft. along the centre-line). Bedrock elevations at this site change abruptly, and since interpolations from adjacent boreholes were necessary, some erring was unavoidable.

At present our method of locating the boreholes is by chainage and offset or co-ordinates. The surveying is usually done for us at the time of our investigations, by Engineering Surveys from the Regions, unless they inform us that the centre-line is already set out. It is the responsibility of our Project Foundation Engineers, however, to request the services of surveyors when they feel that they have not the means to carry out a reasonably accurate survey themselves, or when there is even the slightest doubt about the reliability of the field information.

AGS/MdeP

cc: Foundations Office
Gen. Files

A. G. Stermac
A. G. Stermac,
PRINCIPAL FOUNDATION ENGINEER

