

## DEPARTMENT OF HIGHWAYS ONTARIO

## MEMORANDUM

TO: Mr. B. R. Davis,  
Bridge Engineer,  
Bridge Division,  
Admin. Bldg.

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

Attention: Mr. S. McCombie

DATE: November 15, 1967

NOV 22 1967

OUR FILE REF.

IN REPLY TO

SUBJECT:

## FOUNDATION INVESTIGATION REPORT

For

Proposed Crossing at Batteaux River  
And Hwy. #26, Twp. of Nottawasaga  
Lot 39 & 40, Con. 6, County of Simcoe  
District No. 5 (Owen Sound)  
W.J. 67-F-88 -- W.P. 138-66-03

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

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

AGS/MdeF  
Attach.

cc: Messrs. B. R. Davis (2)  
H. A. Tregaskes  
D. W. Farren  
W. Zonnenberg  
H. F. Gilbert (2)  
A. P. Watt  
J. Roy  
B. A. Singh  
Foundations Files  
Gen. Files

*A. G. Stermac*

A. G. Stermac  
PRINCIPAL FOUNDATION ENGINEER

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FOUNDATION INVESTIGATION REPORT  
For  
Proposed Crossing at Batteaux River  
And Hwy. #26, Twp. of Nottawasaga  
Lot 39 & 40, Con.6, County of Simcoe  
District No. 5 (Owen Sound)  
W.J. 67-F-88 -- W.P. 138-66-03

1. INTRODUCTION:

A request to carry out a foundation investigation for the proposed structure to carry Hwy. #26 over the Batteaux River, was received from Mr. A. P. Watt, Regional Bridge Location Engineer, in a memo dated September 6, 1967.

An investigation was subsequently carried out by this Section to determine the subsoil conditions existing at the site of the proposed crossing.

This report contains the results of our field and laboratory investigations, together with our recommendations for the foundations of the new structure.

2. DESCRIPTION OF SITE AND GEOLOGY:

The new structure is proposed to be located 22.0 ft. north of the existing one, about 0.5 mile east of Collingwood East Limits on Hwy. #26. The existing bridge is a 30.0-ft. clear span concrete and steel continuous beam bridge, founded on spread footings, and is generally in sound condition.

The site of the crossing is situated in the physiological region known as the 'Simcoe Lowlands'. At this location, the Batteaux River flows in a southwest to northeast direction, through fairly flat terrain. The general topography is flat to undulating, covered with pasture.

The bedrock outcrops at the site of the existing bridge and farther upstream.

cont'd. /2 ...

### 3. FIELD AND LABORATORY WORK:

The field work at the site consisted of four sampled boreholes and three dynamic cone penetration tests. All holes were advanced using conventional diamond drilling equipment adapted for soil sampling purposes. A driving energy of 350 ft.-lbs. per blow was used for the dynamic cone penetration tests.

Disturbed samples were obtained using a 2-inch O.D. split-spoon sampler driven according to the specifications for the Standard Penetration Test. Bedrock samples were obtained in all boreholes using AXT coring equipment, except borehole 1, where BXT coring equipment was used.

Samples were visually examined in the field and subsequently in the laboratory. The tests were carried out on selected samples to determine the following properties of the soil:

- 1) Grain-Size Distribution
- 2) Natural Moisture Content

The results of field and laboratory tests are summarized in the Record of Borehole sheets, which are contained in the appendix to the report.

The locations and elevations of boreholes are given on Drawing No. 67-F-88A, which is also contained in the appendix to this report.

The borehole locations were provided by the Owen Sound District Office, D.H.O.

### 4. SUBSOIL CONDITIONS:

#### 4.1) General:

The subsoil at the site consists of a mixture of sand and gravel with some silt and clay overlying limestone bedrock.

cont'd. /3 ...

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

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

The boundaries between the different deposits are shown on the attached Record of Borehole sheets. The estimated stratigraphical profiles shown on Drawing No. 67-F-88A, are based upon this information.

From ground level downwards, the different deposits are described as follows:

4.2) Mixture of Sand and Gravel with some Silt and Clay:

The thickness of the soil deposit was from 9.5 ft. to 12.5 ft. It is composed of sand and gravel with some silt and clay. The material on the river slopes is mainly sand and gravel only. The grain-size distribution curves showed the following ranges:

Gravel .....	10 - 72%
Sand .....	24 - 49%
Silt and Clay .....	4 - 42%

The 'N' values indicate a dense to very dense compactness.

4.3) Bedrock:

The bedrock was proven to various depths in all boreholes. It was visible under the existing bridge in the west half of the river bed. The bedrock core samples were examined by Mr. B. K. Glassford, Geologist, Materials and Testing Division, Department of Highways, whose report is as follows:

"The rock core is limestone. Dark to medium grey colour, medium grained texture, hard with some shale partings throughout."

The elevations of bedrock in various boreholes are as follows:

cont'd. /4 ...

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

4.3) Bedrock: (cont'd.) ...

<u>Borehole No.</u>	<u>Elev. Weathered Bedrock</u>	<u>Elev. Sound Bedrock</u>
1	583.1	581.6
2	584.2	583.7
3	582.3	581.8
4	583.2	582.7
Exposed along West Abutment (existing)	585.0	-

5. GROUNDWATER:

The water level in the river at the time of investigation was at elevation 586.5. It may be assumed that the groundwater level in the vicinity of the river is equal to or slightly higher than the prevailing river water level.

6. DISCUSSION AND RECOMMENDATIONS:

It is proposed to replace the existing bridge with a new structure located 22.0 ft. north of the existing one. The new bridge will be 30.0 ft. clear span and skewed at an angle of 10°. An approach fill 13.0 ft. above the river bed is required.

Because of relatively shallow bedrock, it is recommended that spread footing type foundations, placed on sound bedrock, be provided. A safe bearing pressure of 10.0 tons/sq.ft. may be used for design purposes.

No stability problems are anticipated for forward and side slopes of 2:1.

Since the spread footings have to be founded under water, it will be necessary to provide a dewatering scheme.

Rip-rap should be provided on the slopes as protection against scour.

cont'd. /5 ...

7. SUMMARY:

A foundation investigation at the site of the proposed crossing of Hwy. #26 and the Batteaux River is reported.

Subsoil at the site consists of sand and gravel with some silt and clay overlying limestone bedrock. The bedrock is exposed under the existing bridge.

It is recommended that the structure be supported on spread footings placed on sound bedrock.

No stability problems are anticipated for standard 2:1 forward and side slopes of the embankment.

No major dewatering problems are anticipated.

Scour protection should be provided.

8. MISCELLANEOUS:

The field work for this project was carried out during the period September 11 to 14, 1967, under the supervision of Mr. A. Prakash, Project Foundation Engineer, who also prepared this report.

The equipment used was owned and operated by Dominion Soil Investigation Ltd.

This report was reviewed by Mr. K. G. Selby, Supervising Foundation Engineer.

November 1967.

APPENDIX I.

Continued from the back of the preceding page



DEPARTMENT OF HIGHWAYS - ONTARIO

## MATERIALS & TESTING DIVISION

JOB 67-F-88

LOCATION Hwy. 26 Line 'B' 447 + 83 Rt. 33 Ft.

W. P. 138-66-03

BORING DATE Sept. 11-12, 1967

ORIGINATED BY AP

DATUM Geodetic

BOREHOLE TYPE BX Casing

COMPILED BY AP

CHECKED BY                     

# RECORD OF BOREHOLE NO. 1

## FOUNDATION SECTION

SOIL PROFILE			SAMPLES			ELEV. SCALE	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		SHEAR STRENGTH P.S.F.					wp      w      WL 10      20      30 WATER CONTENT %				
595.6	Ground Level															
0.0	Mixture of sand and gravel, some silt and clay.					595										
			1	SS	93											
			2	CS		590										
	Dense to very dense.		3	SS	35											
			4	CS												
			5	SS	100/6"											
			6	CS		585										
			7	SS	100/5 1/2"											
583.1	Bedrock - Weathered		8	RC	BXT											
582.6	Bedrock - Limestone				100%											
581.6	sound															
14.0	End of Borehole					580										

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

# RECORD OF BOREHOLE NO. 2

FOUNDATION SECTION

JOB 67-F-88

LOCATION Hwy. 26 Line 'B' 447 + 89 Rt. 6 Ft.

ORIGINATED BY AP

W.P. 138-66-03

BORING DATE Sept. 12, 1967

COMPILED BY AP

DATUM Geodetic

BOREHOLE TYPE BX Casing, Cone

CHECKED BY AP

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 WATER CONTENT % 10 20 30	BULK DENSITY P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT					
593.7	Ground Level									
0.0	Mixture of sand and gravel, some silt and clay.					590				
	Dense to very dense.		1	SS	31					72 24 4
584.2			2	SS	100/7"	585				13 46 41
583.7	Bedrock - Weathered									
10.0	Bedrock - Limestone		3	RC	AXT 95%					
	Sound									
579.7						580				
14.0	End of Borehole									
						575				

DEPARTMENT OF HIGHWAYS - ONTARIO  
MATERIALS & TESTING DIVISION

# RECORD OF BOREHOLE NO. 3

FOUNDATION SECTION

JOB 67-F-88 LOCATION Hwy. 26 Line 'B' 447 + 20 Rt. 36 Ft. ORIGINATED BY AP  
W.P. 138-66-03 BORING DATE Sept. 13, 1967 COMPILED BY AP  
DATUM Geodetic BOREHOLE TYPE BX Casing, Cone CHECKED BY AK

SOIL PROFILE			SAMPLES			ELEV. SCALE	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		BLOWS / FOOT		WATER CONTENT %				
							20	40	60	80			100
							SHEAR STRENGTH P.S.F.						
591.8	Ground Level												
0.0	Mixture of sand and gravel, some silt and clay.					590							
	Dense to very dense.		1	SS	47								
			2	CS									
			3	SS	60	585							
582.3			4	SS	50 1/2"								
581.0	Bedrock - Weathered												
10.0	Bedrock - Limestone		5	RC	AXT 100%	580							
	Sound												
575.3													
16.5	End of Borehole					575							

CHECKED BY

575

## 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	U.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

# 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 = $\frac{\Delta e}{\Delta \log \sigma}$
$T_v$	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
$S_r$	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

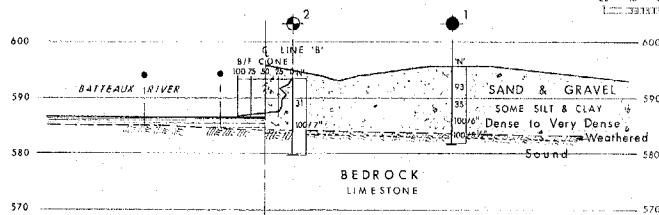
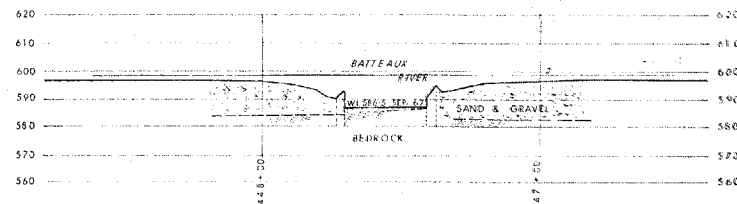
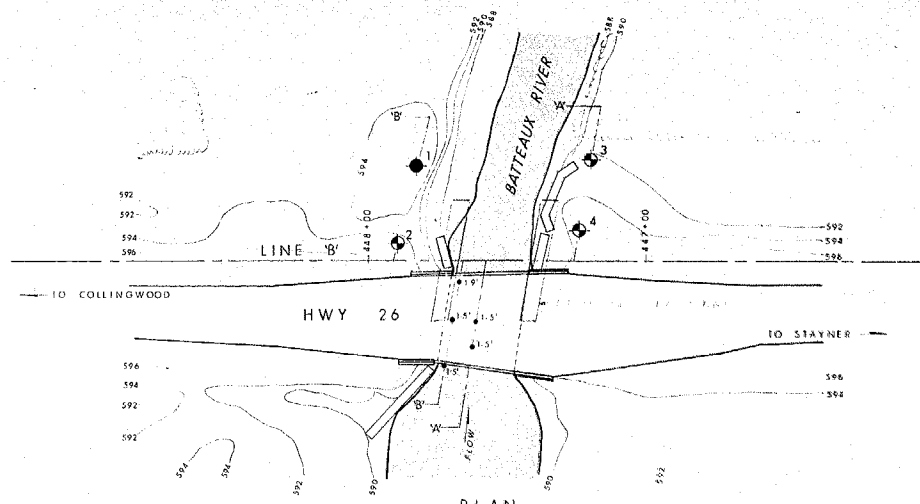
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W.P.# 138-66-03

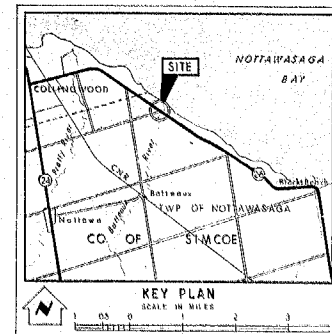
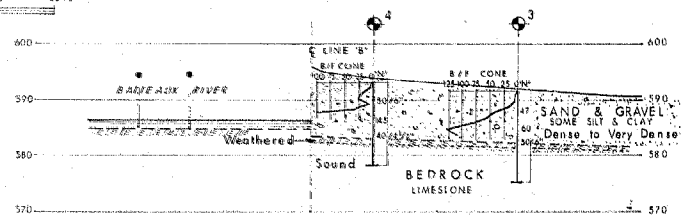
Hwy# 26

BATTEAUX

RIVER



SECTIONS



# LEGEND

- Bore Hole
- ⊕ Cone Penetration Hole
- ⊕ Bore & Cone Penetration Hole
- ⊕ Water Levels established at time of field investigation, SEPT. 1967
- Probe Hole (depth of water to bedrock)

NO.	ELEVATION	STATION	OFFSET
1	595.4	447+83	33' R1
2	593.7	447+89	8' R1
3	591.6	447+20	36' R1
4	593.2	447+24	11' R1

# 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	REVISIONS

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

# BATTEAUX RIVER

KING'S HIGHWAY NO. 26 LINE 'B' DIST. NO. 5  
CO. SIMCOE  
TWP. NOTTAWASAGA LOT 39 CON. VI.

# BORE HOLE LOCATIONS & SOIL STRATA

SUBD. A.P. CHECKED	W.P. NO. 128-44-2	W.B.T. DRAWING NO.
DRAWN A.B. CHECKED	W.P. NO. 47-2-68	67-F-88.A
DATE 20 NOV. 1967	W.P. NO. 128-44-2	BORE HOLE NO.
APPROVED	W.P. NO. 128-44-2	BORE HOLE NO.



# 67-F-88

W.P.# 138-66-03

Hwy# 26

BATTEAUX

RIVER

