

cc: Gen. Files

28-10 Re:

Proposed New Bridge  
over Madawaska River

(Copy)

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

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

Attention: Mr. A. Watt.

February 20, 1963

Proposed New Bridge over the Madawaska River,  
Murchison Twp., Lot 20, Conc. XI, District of  
Nipissing. W.O. MU 62-156 -- W.J. 62-F-135.

As discussed with you by 'phone (Feb. 18, 1963),  
we are forwarding our recommendations with regard to a piled  
foundation for the above-mentioned structure.

The structure may be supported by displacement piles.  
Design loads will be dependent on the dimensions of the pile,  
but in the particular case of 12 $\frac{1}{4}$ " O.D. steel tubes, it is anti-  
cipated that a design load of 60 tons/pile can be achieved at  
or about el. 945.0. In view of the fact that boulders are present  
in the subsoil deposits, it is recommended that a minimum wall  
thickness of 0.25" for the above piles, be adopted. Driving of  
the piles should be controlled by means of the Hiley Formula  
according to D.H.O. standards DD 1218 - 1219.

An economical solution for the piers appears to be to  
design these as pile bents, but this would be dependent on hydro-  
logical and other considerations, and it may be necessary to use  
a larger diameter pile.

An alternative type of pile which could probably be  
advantageously used at this site, is the Franki pile. Such piles  
could support very high loads, depending on the diameter of the  
pile. A 24" diameter pile could support loads in the order of  
150 tons and, therefore, such piles may well be the most economical  
solution.

We suggest that you review all of the above recommend-  
ations, together with the recommendation contained in our Report  
No. 62-F-135, in order to decide on the most economical solution.  
In the course of this work, if required, we shall be pleased to  
give further assistance in this matter.

KGS/MdeF

cc: Foundations Office  
Gen. Files ✓

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

~~Foundations Office (D-110)~~  
*Dist. 28-10.*  
Mr. A. M. Toye,  
Bridge Engineer,  
Bridge Division.

Attn: Mr. K. L. Kleinsteiber,  
Mun. Bridge Liaison Engr.

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

January 29, 1963.

Re: D.H.O. FOUNDATION INVESTIGATION REPORT -  
Municipal District #10 - Co. of Nipissing,  
Township of Murchison - Lot 20 - Conc. XI,  
Madawaska River Bridge -- W.O. MU 62-156  
W.J. 62-F-135 -- W.P. (N11)

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

We believe you will find the factual data and  
recommendations contained therein, adequate for your future  
design work. Should there be any queries concerning this  
project, please feel free to contact our Office.

AGS/MdeF  
Attach.

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

cc: Messrs. A. M. Toye (3)  
J. P. Howard  
C.I.R. Greer  
J. E. Gruspier  
A. Watt

Foundations Office  
Gen. Files.

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# FOUNDATION INVESTIGATION

For

Municipal District #10 - Co. of Nipissing  
Township of Murchison - Lot 20 - Conc. XI  
Madawaska River Bridge -- W.O. MU 62-156  
W.J. 62-F-135 -- W.P. (Nil).

## 1. INTRODUCTION:

A memorandum dated November 27, 1962 requesting a subsoil investigation at the site of the proposed new Madawaska River Bridge was received from the Bridge Location Section.

The requested investigation was carried out by this Section and presented in this report are all the field results, their interpretation and discussion, together with the necessary recommendations for the foundations of the proposed new structure.

## 2. DESCRIPTION OF SITE:

The proposed structure is located approximately 8 miles north-west of Madawaska in an undeveloped bush area. The immediate area surrounding the proposed bridge location is a valley through which the Madawaska River flows rapidly. Granite bedrock is visible some 500 yards to half mile on either side, and generally rises sharply; in places where the slopes are less steep, they are strewn with large boulders.

The river bottom is covered with fairly flat, rounded boulders, up to 12" in size, giving a rip-rap appearance

cont'd. /2 ...

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

in places.

3. FIELD INVESTIGATION:

Four sampled boreholes, supplemented by two dynamic cone penetration tests, were drilled at the site, utilizing a conventional diamond drill rig adapted for soil sampling procedures.

Disturbed samples were recovered in a 2-inch O.D. split-spoon sampler driven into the soil with an energy of 350 ft. lbs. per blow.

Dynamic cone penetration tests were carried out at boreholes #1 and #4, and the penetration values thus obtained are plotted on the attached borehole logs. Additional penetration values, obtained by overdriving the split-spoon sampler, are also plotted on the borehole logs, immediately below the standard penetration resistance obtained at each sample elevation.

Each sample of the subsoil was visually classified in the field before transportation to the laboratory, where a further classification was performed. No laboratory testing was required.

The locations and elevations of all boreholes are shown on the attached Drawing No. 62-F-135A, the former were established by a D.H.O. survey crew, the latter transferred by means of a hand-level from a geodetic origin.

cont'd. /3 ...

4. SUBSOIL CONDITIONS:

4.1 General:

Conditions at the site were found to be generally uniform with small local variations only, and from groundlevel down are as follows:

4.2) Sand and Organic Matter:

This material was found in borehole #1 only, to a depth of 4 feet. It is a very loose deposit, brown to black in color forming the swampy surface of the south bank of the river.

4.3) Sand and Gravel with Boulders:

From 1 foot below the ground in BH #1, and from groundlevel in the other boreholes, a deposit of sand and gravel, with boulders up to 12" in size, was found. This stratum extends approximately 75' below groundlevel to elevation 952<sub>+</sub>. The sand and gravel is generally brown in color, becoming grey with depth, except in BH #1, where only brown color was found.

Standard penetration resistance ranged from 4 to 100 blows per foot where boulders were encountered. Ignoring the excessive blows at the boulder locations, the range of standard penetration resistance is 4 to 26 blows per foot, with an average of 18 blows per foot, indicating the relative density to be loose to compact.

There is no marked increase of relative density

cont'd. /4 ...

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

4.3) Sand and Gravel with Boulders:

with depth.

4.4) Sand:

Below the sand and gravel layer in borehole #2, and to a depth of 82 feet, a brown and grey sand was found.

Standard penetration values of 29 and 58 blows per foot were obtained from 2 samples in this stratum, indicating the relative density to be compact to very dense.

The extent of this stratum was not determined, but it probably extends over the entire area, below elevation 952+ as indicated by the cone probe in borehole #4 which met practical refusal (130 blows per foot) at elevation 941.5, some 88 feet below the ground.

5. GROUNDWATER CONDITIONS:

The groundwater table was found to coincide with the water level in the river at elevation 1029.0.

No artesian water pressures were observed.

6. DISCUSSION AND RECOMMENDATIONS:

A new 3-span bridge is proposed as the crossing of the Madawaska River at the investigated site 8 miles north-west of the town of Madawaska in what is presently a bush area.

The investigation has shown that for a considerable depth (approx. 75 ft.) below the present ground line the subsoil consists of granular material, loose to compact sand and

cont'd. /5 ...

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

gravel with occasional boulders. The size of boulders is believed to be up to 12 inches in diameter. Underlying this deposit is a layer of undetermined thickness of very dense sand. Only at the location of BH #1 a four foot layer of sandy soft organic material was found.

Borehole No. 4 at Sta. 4+75 is situated nearly in the middle of the river. The penetration resistance in the upper 15 ft. is quite low indicating possible scour effects. A similar condition although not quite as pronounced was found in borehole No. 3, Sta. 5+20 at the site of the proposed north abutment.

It is recommended that the structure be founded on spread footings using a safe bearing pressure of 2.0 T/sq. ft. This is considered as an average value for which neither stability nor settlement problems are anticipated.

If the normal depths for frost protection are maintained both abutment footings will be below ground water level. Because of the granular nature of the subsoil an appropriate dewatering scheme will have to be applied. If pumping is carried out from a simple excavation boiling conditions could be created that would have most undesirable consequences. It is therefore suggested that steel sheet piling be driven to a depth below the footing level equal to the distance of water above this level. This would prevent

cont'd. /6 ...



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

boiling but might not be sufficient as a permanent scour protection measure. This will depend on the findings and recommendations of the hydrologists.

The same recommendations of course apply also to the pier footings except that the problem here is more serious because of the greater water depth. Because of the looseness of the subsoil at the location of the proposed north pier it is recommended that the footing be placed 10 ft. below ground level i.e. at elevation 1016.0. For the pier footings we would recommend that the steel sheet piling be left permanently in place for reasons of scour protection and bearing capacity increase.

The footing for the south pier should be placed at elevation 1022.0.

Although the presence of boulders is reported it was possible to drive the cone for a considerable depth and except for a very few instances at greater depth the casing for the drilling was also driven without difficulty. It is therefore, believed that it will also be possible to drive the steel sheet piling. However, should this become impossible due to the undetected much more unfavourable conditions i.e. to excessive presence of boulders the following alternatives are suggested. The excavation for the footings should be continued or carried out under water and the obstacles to sheet

cont'd. /7 ...

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

pile driving thus removed and construction continued as planned, or the sheet piling should be entirely dispensed with and the footings placed at the previously recommended elevations except in the case of the north pier where an elevation of 1012.0 would be recommended. This method would require the pouring of an adequate tremie seal prior to the commencement of any pumping. The above recommendation is satisfactory from the foundation's point of view but does not necessarily satisfy the requirements of the hydrologists who may request that the footings be lowered. Such a request would have no qualitative but only quantitative bearing on the problem and the same procedures, as outlined earlier, would therefore apply.

Due to the presence of occasional boulders the use of piles was not considered in detail.

It is also recommended that the soft organic layer found in BH #1 be removed prior to embankment placement.

7. SUMMARY:

The subsoil is composed of granular material, the upper 75 feet of loose to compact sand and gravel mixture with occasional boulders up to 12 inch in diameter, underlain by a layer of dense sand of undetermined thickness.

It is recommended that the structure be founded on spread footings using a safe bearing pressure of 2.0 T/sq. ft.

7. SUMMARY: (cont'd.) ...

Normal footing depths, 5-6 ft. below existing ground level for all footings except the north pier are suggested. For the north pier 10 ft. is recommended. Because dewatering of excavations will be necessary the use of steel sheet piling driven below excavation bottom for the distance equaling the height of water above excavation bottom is suggested. For piers the sheeting should be left in ground permanently.

If difficulties in sheet driving are encountered two alternatives are suggested and described in detail under Discussion and Recommendations.

The soft sandy organic layer found in BH #1 should be removed prior to embankment placement.

In this report the recommended measures and procedures represent the minimum requirements that satisfy this Section only and could be therefore subject to alternations and additions due to hydrological requirements.

8. MISCELLANEOUS:

The field work, performed during the period of December 11, 1962 to January 9, 1963, together with the preparation of this report, was carried out by G. Mierzynski under the general supervision of Mr. K. G. Selby of the Foundation Section.

Equipment was owned and operated by Dominion Soil Investigation Ltd. of Toronto.

January, 1963.

APPENDIX I.

## 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.C.	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 $U_r$ 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
$\log_e a$ 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
$\bar{\sigma}$	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

FOUNDATION SECTION

JOB 62-F-135 LOCATION E Sta. 3+75 ORIGINATED BY G.M.  
W.P. W.O. No. MU 62-156 BORING DATE Dec. 11 - 14, 1962. COMPILED BY B.K.  
DATUM Profile BOREHOLE TYPE Washboring - BX Casing. CHECKED BY G.M.

SOIL PROFILE		SAMPLES		ELEV SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT 20 40 60 80 100	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					
1034.5	Groundlevel							
0.0	Sand and organic matter.							
1030.5	Very loose.			1030				
4.0			1 SS 26					
			2 SS 36					
	Sand and gravel (with boulders up to 12").		3 SS 25					
			4 SS 18					
			4A SS 18	1010				
	Compact		5 SS 18					
	- Brown.							
			6 SS 18					
			7 SS 18	990				
			8 SS 54					
980.5								
54.0	End of borehole.							
				970				

DEPARTMENT OF HIGHWAYS - ONTARIO  
MATERIALS & RESEARCH DIVISION

## RECORD OF BOREHOLE NO. 2

FOUNDATION SECTION

JOB 62-F-135 LOCATION E. Sta. 4425 ORIGINATED BY G.M.  
W.P. W.O. No. M 62-156 BORING DATE Dec. 17 - 20, 1962. COMPILED BY B.K.  
DATUM Profile BOREHOLE TYPE Washboring - BK Casing. CHECKED BY G.M.

DATUM Profile BOREHOLE TYPE Washboring - EX Casing. CHECKED BY G.M.

DATUM Profile BOREHOLE TYPE Washboring - EX Casing. CHECKED BY G.M.

SOIL PROFILE		SAMPLES		ELEV SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT	SHEAR STRENGTH P.S.F.	LIQUID LIMIT ——— WL PLASTIC LIMIT ——— WP WATER CONTENT ——— W W P ——— W L WATER CONTENT %	BULK DENSITY P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT PLOT	NUMBER TYPE BLOWS / FOOT						
1029.5	Ice Level			1030					4" of ice
1028.0	Groundlevel		1029.0 0.5						
1.5									
	Sand and gravel (with boulders up to 12").		1 SS 31						
			2 SS 15						
	Loose to compact.			1010					
	Brown changing to grey @25.0'		3 SS 15						
			4 SS 14						
				990					
			5 SS 12						
			6 SS 14						
				970					
			7 SS 21						
			25						
			30						
954.5									
75.0	Sand Compact to v. dense		8 SS 29						
				950					
947.5	Grey and brown.		9 SS 58						
82.0	End of borehole.								Sampler overdriven 2.0'



DEPARTMENT OF HIGHWAYS - ONTARIO  
MATERIALS & RESEARCH DIVISION

## RECORD OF BOREHOLE NO. 3

FOUNDATION SECTION

JOB 62-F-135 LOCATION 6 Sta. 5420 ORIGINATED BY G.M.  
W.P. W.O. No. MW 62-15b BORING DATE Jan. 2 - 6, 1963. COMPILED BY B.K.  
DATUM Profile BOREHOLE TYPE Washboring - B X Casing. CHECKED BY G.M.

SOIL PROFILE		SAMPLES			DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT		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	SHEAR STRENGTH P.S.F.	W P ——— W L WATER CONTENT %		
1030.0	Groundlevel					1030				
0.0										
	Sand and gravel (with boulders up to 12")		1	SS	40					
			1A	SS	26					
			2	SS	7					
			2A	SS	7					
					4	1010				
					6					
					11					
	Loose to compact.		3	SS	>100					
			4	RC	-					
	Brown changing to grey @23.0'		5	SS	17					
			5A	SS	17					
					13					
					14					
					22	990				
			6	SS	16					
					25					
					18					
					18					
					20					
			7	SS	6					
					10					
					29					
					25					
					17	970				
			8	SS	36					
					41					
					28					
					12					
			9	SS	62					
			9A	SS	>100					
958.0										
72.0	End of borehole.					950				



NOTE: DISCUSSION WITH W. McFARLANE - BRIDGE DW.  
NOV. 19, 1963.

THE LOAD ON THE PILES SUPPORTING THE  
PIERS IS IN THE ORDER OF ONLY 12 TO 15  
TONS PER PILE.

THE ORIGINAL RECOMMENDATION CALLS FOR  
PILES TO BE EMBEDDED 30 FEET IN THE GROUND  
AND AN ALLOWABLE LOAD OF 20 TONS/PILE  
WAS SUGGESTED.

Q.: CAN PILES BE EMBEDDED IN THE SOIL  
ONLY 25 FT AND HAVE AN ALLOWABLE  
LOAD OF UP TO 15 TONS/PILE?

A.: YES

EXPLANATION:

(a) 5 FT LESS IN THE GROUND IS  
~17% OF THE RECOMMENDED LENGTH (30 FT)

(b) 5 TONS LESS PER PILE IS 25%  
OF THE RECOMMENDED LOAD (20 TONS)

(c) THERE WILL BE ABOUT 18 PILES PER  
PIER AND BECAUSE THE MATERIAL IS GRANULAR  
A FAIR DEGREE OF COMPACTION WILL RESULT

Mr. B. P. Davis,  
Bridge Design Engr.,  
Bridge Division.

Attn: Mr. W. McFarlane

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

March 22, 1963

Proposed Madawaska River Bridge -  
W.C. MU-62-156 -- W.J. 62-F-135  
District No. 10

Regarding your request (verbal - by 'phone - Mar. 13/63) for recommendations as to length and capacity of timber piles if used in a trestle type structure at the above location, we submit the following comments:

We estimate that a design capacity of 20 tons per pile may be achieved if these are driven so as to penetrate the subsoil for a depth of about 30' at the particular pier or abutment location. Driving of piles in the field may be controlled by means of the Hiley Formula according to D.H.C. Standards PD 1218 and 1219; however, the piles should be advanced to such a depth so as to be compatible with hydrological requirements, which are at present not known to us.

The foundation investigation revealed the presence of some boulders in the subsoil. We would like to point out, therefore, that some jetting may be necessary during pile driving. However, the possibility of ineffectiveness of this measure cannot be entirely excluded because the subsoil conditions between the boreholes may be somewhat different from the one revealed at the borehole locations.

If you have any further queries in connection with this matter, please contact this Office.

KGS/mdeF

cc: Mr. A. Watt  
Foundations Office ✓  
Gen. Files.

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

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

Attention: Mr. A. Watt.

Mr. A. G. Stermac,  
Principal Foundation Engr.,  
Foundation Section,  
Materials & Research Division.  
February 20, 1963

Proposed New Bridge over the Madawaska River,  
Murchison Twp., Lot 20, Conc. XI, District of  
Nipissing. W.O. MU 62-156 -- W.J. 62-F-135.

As discussed with you by 'phone (Feb. 18, 1963),  
we are forwarding our recommendations with regard to a piled  
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The structure may be supported by displacement piles.  
Design loads will be dependent on the dimensions of the pile,  
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or about el. 945.0. In view of the fact that boulders are present  
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according to D.H.O. standards DD 1218 - 1219.

An economical solution for the piers appears to be to  
design these as pile bents, but this would be dependent on hydro-  
logical and other considerations, and it may be necessary to use  
a larger diameter pile.

An alternative type of pile which could probably be  
advantageously used at this site, is the Franki pile. Such piles  
could support very high loads, depending on the diameter of the  
pile. A 24" diameter pile could support loads in the order of  
150 tons and, therefore, such piles may well be the most economical  
solution.

We suggest that you review all of the above recommend-  
ations, together with the recommendation contained in our Report  
No. 62-F-135, in order to decide on the most economical solution.  
In the course of this work, if required, we shall be pleased to  
give further assistance in this matter.

KGS/MdeF

cc: Foundations Office ✓  
Gen. Files

K. G. Selby,  
SENIOR FOUNDATION ENGR.,  
For:

A. G. Stermac,  
PRINCIPAL FOUNDATION ENGR.

*franki pile 30' load 20 tons  
Testing necessary probably*

Piled Foundations

Large displacement end bearing tubular steel piles only considered for following reasons.

- 1) Timber piles - too large a length required
- 2) H-piles not feasible - bedrock elevation not known
- 3) Presence of boulders requires steel, thick wall piles

According to G.C. Meyerhof

$$Q = \frac{4NA_p}{F} + \frac{\bar{N}A_c}{kF} \quad (k=50; F=3)$$

Assume  $12\frac{3}{4}" \phi$  and  $\frac{1}{4}"$  thickness

Average N Values

$$BH\#1 \rightarrow 26 + 36 + 25 + 18 + 18 + 18 + 18 + 18 + 54 = \frac{231}{9} = \underline{25}$$

$$BH\#2 \rightarrow 31 + 15 + 15 + 14 + 12 + 14 + 21 + 25 + 30 + 29 = \frac{204}{10} = \underline{20}$$

$$BH\#3 \rightarrow 40 + 26 + 7 + 7 + 4 + 6 + 11 + 17 + 17 + 13 + 14 + 22$$

$$+ 16 + 25 + 18 + 18 + 20 + 6 + 10 + 29 + 25 + 17 + 36 + 41 + 28 + 12 + 62 = \frac{548}{27} = \underline{20}$$

$$BH\#4 \rightarrow 4 + 5 + 5 + 7 + 24 + 20 + 53 + 29 + 35 + 12 + 11 + 12 + 7 + 12$$

$$+ 37 + 23 + 24 + 20 + 28 + 14 + 17 + 18 + 18 + 26 + 9 + 12$$

$$= \frac{483}{26} = \underline{18.5}$$

USE  $\bar{N} = 18$  &  $N = 50$

For Pile tip elevation  $\pm 94.5$ , Pile length = 80.0

$$\therefore Q = \frac{4 \times 50 \times 0.87}{3} + \frac{18 \times 80 \times \pi}{50 \times 3} = 59.4 + 9.6 = 69.0$$

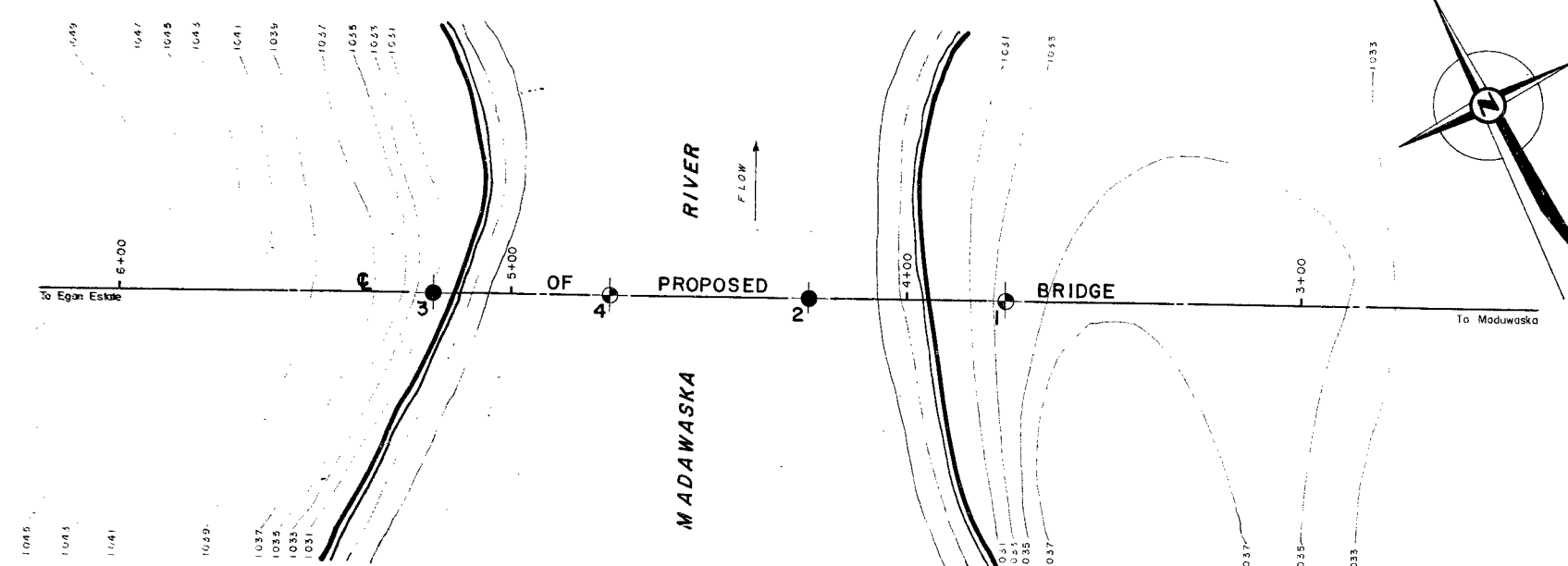
FOR  $12\frac{3}{4}" \phi \times \frac{1}{4}" @ 33\#/ft.$  USE 60 TONS/PILE

#62-F-135

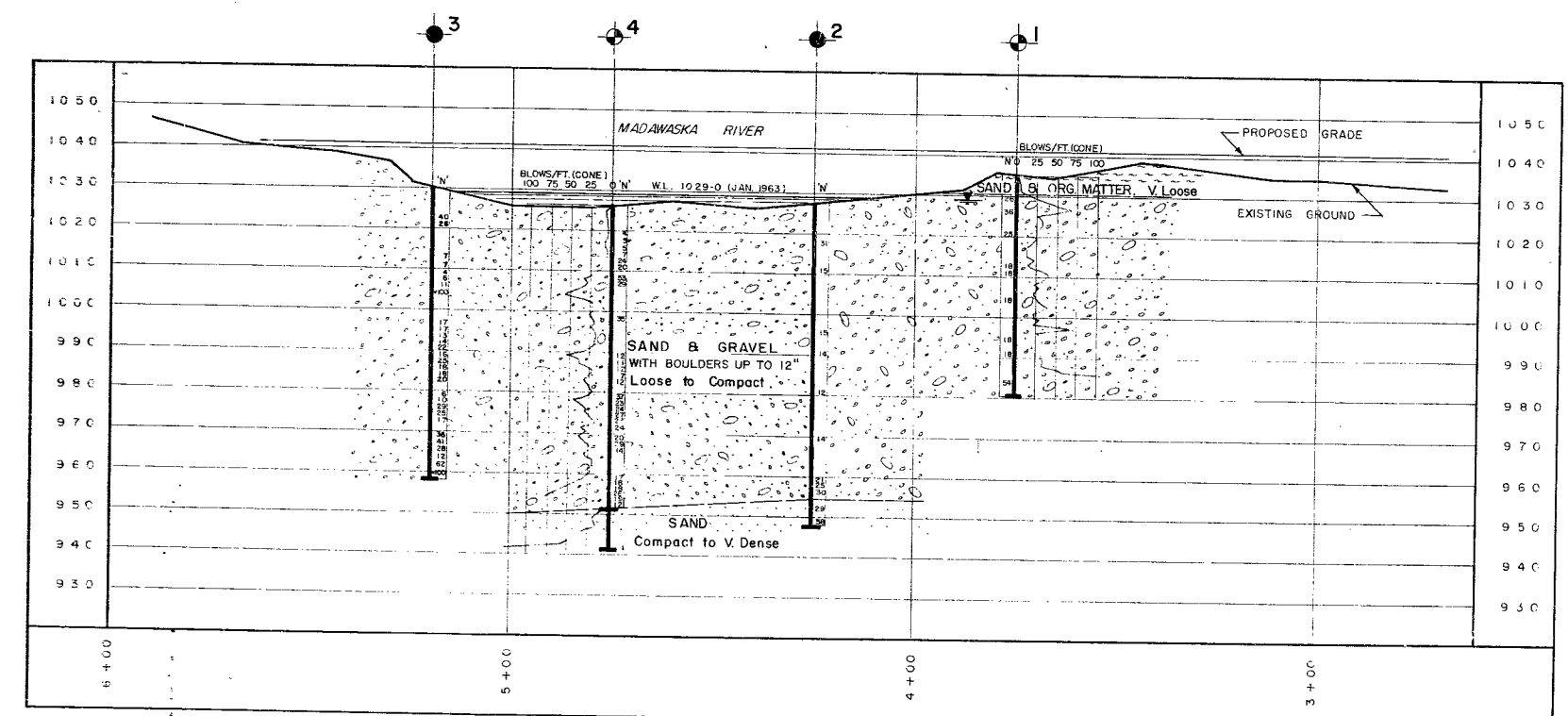
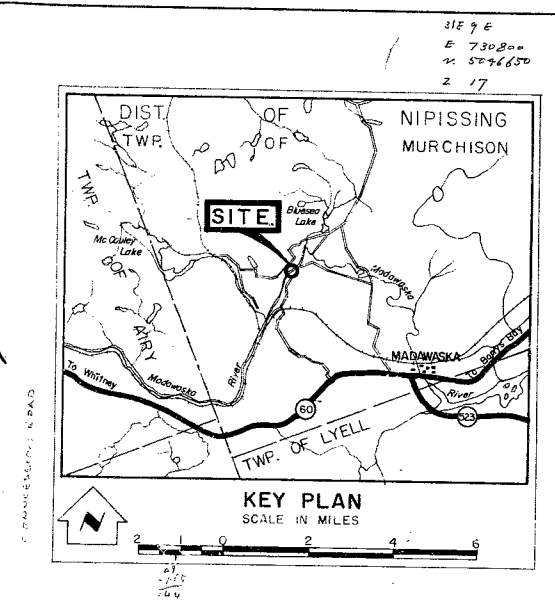
PROP. NEW

BRIDGE

MADAWASKA R.



**PLAN**  
SCALE IN FEET  
20 10 0 20 40



**PROFILE**  
SCALE IN FEET  
20 10 0 20 40

LEGEND			
	Bore Hole		
	Cone Penetration Hole		
	Bore & Cone Penetration Hole		
	Water Levels established at time of field investigation (JAN. 1963)		
NO.	ELEVATION	STATION	OFFSET
1	1034.5	3+75	CL
2	1028.0	4+25	CL
3	1025.0	5+20	CL
4	1026.5	4+75	CL

**- 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.

DEPARTMENT OF HIGHWAYS - ONTARIO  
MATERIALS & RESEARCH SECTION

**MADAWASKA RIVER BRIDGE**  
DISTRICT OF NIPISSING TWP. OF MURCHISON

ORIGINATED G. MIERZYNSKI	DISTRICT NO. 10	DATE 1 FEBRUARY 1963
DRAWN D. MUMFORD	WD. NO. MU-62-156	JOB NO. 62-F-135
CHECKED <i>[Signature]</i>	SCALE AS SHOWN	DRAWING NO. 62-F-135 A
APPROVED <i>[Signature]</i>		

$$\frac{4 \times 20 \times \frac{3}{4} + \frac{10 \times 50}{3 \times 56}}{3}$$