

MEMORANDUM

33-69-03

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

From: Foundation Section,  
Materials & Testing Division,  
Room 107, Lab. Bldg.

Attention: Mr. S. McConbie

Date: June 21, 1965

Our File Ref.

In Reply To

Subject:

FOUNDATION INVESTIGATION REPORT

At  
The Site of the C.P.R. Overhead  
Extension, Hwy. #17 in Mattawa, Ont.  
District No. 13 (North Bay)

M.J. 65-F-47

-- W.P. 329-64

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.

KYL/NdeF  
Attach.

cc: Messrs. A. M. Toye (2)  
H. A. Tregaskes  
D. W. Farren  
H. McArthur  
G. Martens  
E. R. Saint  
A. Watt

Foundations Office  
Gen. Files

*K. Y. Lo.*  
K. Y. Lo,  
SUPERVISING FOUNDATION ENGINEER

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# FOUNDATION INVESTIGATION REPORT

At

The Site of the C.P.R. Overhead  
Extension, Hwy. #17 in Mattawa, Ont.  
District No. 13 (North Bay)  
W.J. 65-F-47      --      W.P. 329-64

## 1. INTRODUCTION:

In a memo, dated April 27, 1965, the Bridge Planning Section requested a foundation investigation at the site of the proposed C.P.R. Overhead extension at Hwy. No. 17 in the Town of Mattawa.

The supervision of the field exploration and the subsequent laboratory tests was carried out by this Section, in order to determine the existing soil conditions.

Presented in this report are the results of the above investigations, together with our recommendations pertaining to the foundations of the extension.

## 2. DESCRIPTION OF THE SITE:

The site is located in downtown Mattawa. The existing overhead carries Hwy. No. 17 - which is a town street (Pembroke St.) at this location - over the C.P.R. track. The C.P.R. grade is some 22 ft. deeper than the street level. The present reinforced concrete structure was constructed in 1953, and is still in fairly good condition. The slopes of the railway approach cuts are very steep, roughly 1:1. The side slopes of the cut at the south side of the

cont'd. /2 ...

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

overhead are protected by Armco bin type retaining structures, constructed of 10-ft. sections. On the free surfaces of the cut slopes occasional large size boulders (3 - 4 ft. diam.) are exposed as well as pebbles and gravelly coarse-grained soils. The near vicinity of the crossing is a built-up area; farther away, the countryside is hilly, generally woodland.

3. FIELD INVESTIGATION PROCEDURE:

The soil exploration consisted of 4 sampled boreholes and an additional cone penetration test. Borings were carried out by a conventional diamond drill rig, adapted for soil sampling purposes. Samples were obtained by means of split-spoon samplers, and the Standard Penetration 'N' values were recorded. A driving energy of 350 ft.-lbs. was used for the Standard and Cone penetration tests.

Boreholes No. 1 and 2 were located on the near horizontal top of the Armco bin retaining structure, while B.N.'s No. 3 and 4 were driven by the rig mounted on a railway "platform".

Locations and elevations of the boreholes are shown on Drawing 65-P-47A, accompanying this report. All elevations shown are relative, and were taken from the C.P.R. Sudbury Division Engineering Plan No. 15441.

cont'd. /3 ...

#### 4. SUBSOIL CONDITIONS:

Soil samples were visually examined and identified upon recovery, and again after arrival in the laboratory. In addition, standard laboratory tests for Atterberg limits, moisture contents and grain size determination, were carried out. Laboratory and field data are plotted on the borelog sheets under Appendix I, whereas the estimated soil stratigraphy, based upon this data, may be seen on Drawing 65-F-47A. A brief discussion of the subsoils follows:

In B.H.'s #3 and 4, extending from ground elevation to a depth of 14 - 15 ft., a silty sand material was found; in B.H.'s #1 and 2, the same stratum occurred underneath the granular backfill of the Arco bins and it was somewhat shallower. Underlying the silty sand in each borehole, a more pronounced sand stratum was encountered, containing gravels (1/2 - 1 in. diam.) and occasional seams or pockets of silt. This soil extended to the bottom of B.H.'s #2, 3 and 4, while in B.H. #1, at a depth of 43 ft. (relative elevation 44.00 ft.), a dark grey-coloured sandy silt material was observed. All the layers were found to have exceptionally high relative densities, corresponding to Standard Penetration 'N' values of 63 to greatly in excess of 100 blows per ft. In view of the very dense nature of the mainly coarse-grained deposits, they are considered to have excellent load bearing properties.

cont'd. /4 ...

5. WATER AND DRAINAGE CONDITIONS:

No free water level was observed in the boreholes, mainly due to the high permeability of the subsoils.

An open ditch is provided for the surface drainage along the left side of the railway track, right beside the west Armco bins and bridge abutment. During the time of field investigation, water was running in the ditch from south to north. The ditch drains the swampy area, some 100 - 150 ft. south-east of the structure, providing run-off towards a pond, north-west of the bridge. The water eventually seeps to the Ottawa River.

According to the oral report of the railway personnel, during the winter the water freezes under the bridge and, consequently, there is a considerable build up of the water, so that the ice reaches the height of the tracks. The ice is removed usually twice weekly, but the effect of this freezing water already may be seen by the moderate disintegration of the surface layer of the concrete abutment, near the ground. It is recommended that a drainage pipe be incorporated in the design of the new extension, below the freezing zone, in place of the open ditch. A drop inlet should be provided at the south end of the Armco bins for the inflow of the water.

6. DISCUSSION AND RECOMMENDATIONS:

It is intended to extend the present C.P.R. Overhead of Hwy. No. 17 at Mattawa. The maximum length of the proposed extension is 65 ft. in a southerly direction.

cont'd. /5 ...

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

As was discussed earlier, the subsoil at the site is composed of very dense, coarse-grained deposits. On account of this, the soil appears to be suitable to support the extension on spread footings at a shallow depth. It is, therefore, suggested that the footings be placed right below the zone of frost penetration, in which case, a safe bearing pressure of 4 t.s.f. may be assumed for design purposes. No settlements of noticeable magnitude are forecast. Nevertheless, the application of vertical expansion joints between the existing bridge and the new extension is recommended.

It is to be mentioned, that the C.P.R. drawing supplied for us by the Bridge Division, indicates piled footings for the existing structure. During the field investigation, it has become obvious, that due to the high relative densities of the soil, piles did not appear to be justified. Since no official report of the actual construction was available, we interviewed local people to find out the type of footings used for the bridge. According to Mr. Cournoyer (451 Brydges St., Mattawa), one of the foremen of the construction, the bridge was built on spread footings; however, he was unable to recall the actual depth of foundation.

No foundation or soils problems are anticipated in connection with the lowering of the track by about 1.25 ft., in order to maintain the existing vertical clearance.

It is felt that sheet piling or bracing should be used during the excavations of the footings, in order to restrict possible lateral displacement of the railway track.

cont'd. /6 ...

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

No dewatering problems are foreseen during the excavation.

7. SUMMARY:

An extension of 65 ft. maximum length is proposed at the site of the C.P.R. Overhead of Hwy. No. 17 at Mattawa.

The subsoils at the site consist of deposits of a very dense nature.

Spread footings at shallow depths are recommended, using an allowable bearing pressure of 4.0 t.s.f. Although no settlements of noticeable magnitude are forecast, it is suggested that vertical expansion joints be applied between the existing structure and the proposed extension.

No soils problems are anticipated concerning the lowering of the track by 1.25 ft.

Bracing or sheet piling is suggested during the excavations in order to avoid lateral displacement of the track.

No dewatering problems for the excavations are anticipated.

The construction of underground pipe drainage is recommended rather than the present open ditch at the left side of the track.

8. MISCELLANEOUS:

The field investigation was carried out during the period of May 26 - June 1, 1965.

cont'd. /7 ...



8. MISCELLANEOUS: (cont'd.) ...

Equipment used was owned and operated by Canadian Longyear Company Ltd.

The field supervision and preparation of this report was undertaken by Mr. A. K. Barsvary, Project Foundation Engineer, under the general supervision of Mr. K. C. Selby, Senior Foundation Engineer.

June 1965.



## 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 WEIGHT 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 300 FOOT POUNDS PER BLOW.

### DESCRIPTION OF SOIL

THE CONSISTENCY OF COHESIVE SOILS AND THE RELATIVE DENSITY OR DENSITY OF COHESIONLESS SOILS ARE DESCRIBED IN THE FOLLOWING TERMS:-

<u>CONSISTENCY</u>	<u>"N" BLOWS/FT.</u>	<u>G. LB./SQ. FT.</u>	<u>DENSITY</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

SS	SPLIT SPOON	TM	THINWALL OPEN
WS	WASHED SAMPLE	TP	THINWALL PISTON
SB	SCRAPER BUCKET SAMPLE	DS	DISTURBED SAMPLE
AS	AUGER SAMPLE	FS	FOIL SAMPLE
CS	CHUNK SAMPLE	RC	ROCK CORE
ST	SLOTTED TUBE SAMPLE		
	PH		SAMPLE ADVANCED HYDRAULICALLY
	PM		SAMPLE ADVANCED MANUALLY

### SOIL TESTS

QU	UNCONFINED COMPRESSION	LV	LABORATORY VANE
U	UNDRAINED TRIAXIAL	FW	FIELD VANE
CU	CONSOLIDATED UNDRAINED TRIAXIAL	C	CONSOLIDATION
CB	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
$S_v$	DEGREE OF SATURATION
$w_L$	LIQUID LIMIT
$w_p$	PLASTIC LIMIT
$I_p$	PLASTICITY INDEX
$LL$	SHRINKAGE LIMIT
$I_L$	LIQUIDITY INDEX $= \frac{w - w_p}{I_p}$
$I_C$	CONSISTENCY INDEX $= \frac{w_L - w}{I_p}$
$e_{max}$	VOID RATIO IN LOOSEST STATE
$e_{min}$	VOID RATIO IN DENSEST STATE
$I_D$	DENSITY INDEX $= \frac{e_{max} - e}{e_{max} - e_{min}}$
	RELATIVE DENSITY $D_r$ IS ALSO USED
$h$	HYDRAULIC HEAD OR POTENTIAL
$Q$	RATE OF DISCHARGE
$v$	VELOCITY OF FLOW
$i$	HYDRAULIC GRADIENT
$k$	COEFFICIENT OF PERMEABILITY
$j$	SEEPAGE FORCE PER UNIT VOLUME
$m_v$	COEFFICIENT OF VOLUME CHANGE $= \frac{-\Delta e}{(1+e)\Delta \sigma}$
$C_v$	COEFFICIENT OF CONSOLIDATION
$C_c$	COMPRESSION INDEX $= \frac{\Delta e}{\Delta \log_{10} \sigma}$
$T_v$	TIME FACTOR $= \frac{C_v t}{d^2}$ ( $d$ , DRAINAGE PATH)
$U$	DEGREE OF CONSOLIDATION
$\tau_s$	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
$f$	COEFFICIENT OF FRICTION
$S_t$	SENSITIVITY

### GENERAL

$T$	TEMPERATURE
$\theta$	BASE OF NATURAL LOGARITHMS 2.718
$\log_e \sigma$ OR $\ln \sigma$	NATURAL LOGARITHM OF $\sigma$
$\log_{10} \sigma$ OR $\log \sigma$	LOGARITHM OF $\sigma$ TO BASE 10
$t$	TIME
$g$	ACCELERATION DUE TO GRAVITY
$V$	VOLUME
$W$	WEIGHT
$W_s$	WEIGHTING
$F$	FACTOR OF SAFETY

### STRESS AND STRAIN

$\sigma$	PORE FLUID STRESS
$\sigma'$	NORMAL STRESS
$\bar{\sigma}$	NORMAL EFFECTIVE STRESS ( $\sigma'$ IS ALSO USED)
$\tau$	SHEAR STRESS
$\epsilon$	LINEAR STRAIN
$\gamma'$	SHEAR STRAIN
$\epsilon_v$	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

$z$	DISTANCE FROM TOP OF WALL TO POINT OF APPLICATION OF PRESSURE
$\delta$	ANGLE OF WALL FRICTION
$K$	DIMENSIONLESS COEFFICIENT TO BE USED WITH VARIOUS SURFACES IN EXPRESSIONS RELATING 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 SURFIX 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

DEPARTMENT OF HIGHWAYS - ONTARIO

## RECORD OF BOREHOLE NO. 1

FOUNDATION SECTION

## MATERIALS &amp; TESTING DIVISION

JOB 65-F-47 LOCATION CPR Sta. 3810-34; 13' Rt. of C ORIGINATED BY A.B.

W. P. 329-64 BORING DATE May 26-27, 1965 COMPILED BY A.B.

DATUM \_\_\_\_\_ BOREHOLE TYPE Washboring, MI Casing. CHECKED BY K.G.S. *[Signature]*

[illegible]



FOUNDATION SECTION

CHECKED BY K.G.S.

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT		LIQUID LIMIT ——— WL PLASTIC LIMIT ——— WP WATER CONTENT ——— W		BULK DENSITY P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT		SHEAR STRENGTH P.S.F.		WATER CONTENT % 10 20 30			
80.0	Groundlevel											
0.0												
	Silty sand.											
	Very dense.		1	SS	82							
	Grey.											
			2	SS	75 1/4"	70						
66.0												
14.0	Sand with gravel.											
64.0	Very dense.		3	SS	150 1/5"							
16.0	End of borehole.					60						

FOUNDATION SECTION

CHECKED BY K.G.S.

[illegible]



*Foundation  
Office*

*CS-F-47*

May 19, 1965.

E. J. Denenfeld  
Division Engineer, C.P.R.  
9 Elgin Street South  
Sudbury, Ontario.

Dear Sir:

Re: Soils Testing Programme at  
Mattawa - C.P.R. & Hwy #17  
W.P. 329-64.

Following our discussion by phone today we are enclosing for your information C.P.R. Plan 15441 on which we have shown the locations of the proposed test holes. As we agreed however it would be wiser to drill them through the binwalls.

This is a formal request for permission to carry out the proposed test programme on C.P.R. property and for the supply of any equipment and personnel necessary for safety precautions which your regulations require. Our engineer who will be supervising the drill in the field is Mr. A. Barsvary and he will be instructed to give you at least two days notice of his intention to move into the site.

The D.H.O. will of course be responsible for any expenses incurred by the C.P.R. for providing safety measures.

Yours truly,

*K. G. Selby*

K. G. Selby  
Senior Foundation Engineer

MEMORANDUM

To: Mr. A. Stermac,  
Principal Foundation Eng.,  
Room 107, Lab. Bldg.

FROM: Bridge Division,  
Downsview, Ontario

DATE: April 27, 1965.

OUR FILE REF.

IN REPLY TO

SUBJECT: W.F. 329-04, C.P.R. Overhead Extension  
Rwy. #17, at Mattawa, District #13

It is intended to extend the above structure in a southerly direction. Site plans for the extension are not yet available so I am enclosing plans of the existing structure showing the location of test holes which would cover the area of the extension.

A decision has not yet been made on the intersection design to be used here. The extension will have a maximum length of about 60' south of the existing structure. Due to the track profile and the need to maintain the existing vertical clearance it will be necessary to lower the track by about 1.25'. We would like to have your recommendations on how to lower the track as well as the foundation design.

The extension will be of a similar design to that existing, and entailing the removal of the concrete retaining walls and partial removal of the bin walls. The drawing of the existing structure show the general layout of the bridge and footing design.

As soon as a site plan is available, prints will be forwarded to you.

*Ken Smith*

John A.  
C. N. Smith  
A. H. Gibson

J. C. McAllister,  
for S. McCombie  
Bridge Planning Engineer

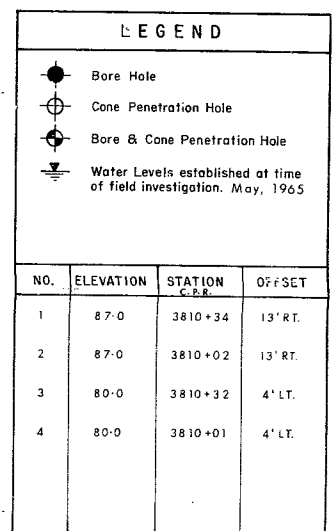
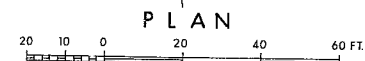
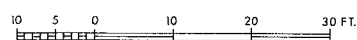
#65-F-47

W.P.#329-64

HWY.#17

C.P.R.

MATTAWA

[illegible]

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

# CANADIAN PACIFIC RAILWAY

KING'S HIGHWAY NO. 17 DIST. NO. 13  
 DIST. NIPISSING (TOWN OF MATTAWA)  
 TWP. PAPINEAU LOT CON.

## BORE HOLE LOCATIONS & SOIL ST'

SUBMD. A. 3.	CHECKED <input checked="" type="checkbox"/>	W.P. NO. 329 - 64	M.T. DRAWING NO.
DRAWN JK	CHECKED <input checked="" type="checkbox"/>	JOB NO. 65 - F - 47	65 - F - 47A
DATE JUNE 24, 1965		SITE NO.	
APPROVED <i>A. J. B. Mac</i>	CONT. NO.		