

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: October 3, 1967

OUR FILE REF.

IN REPLY TO

100-61907

SUBJECT:

FOUNDATION INVESTIGATION REPORT  
For Proposed Widening of the C.N.R.  
And Q.E.W. Overhead and the Proposed  
Off Ramp Overhead; Lot 2, Con. II,  
Twp. of Berrie, Co. of Welland  
District No. 4 (Hamilton)  
W.J. 67-F-77 -- W.P. 162-64-05

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

We believe that you will find the factual data and recommendations contained therein, 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  
G. K. Hunter (2)  
H. Greenland  
W. S. Melinyshyn  
T. J. Kovich  
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*A. G. Sterniac*  
A. G. Sterniac  
PRINCIPAL FOUNDATION ENGINEER

Foundations Files  
Gen. Files

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FOUNDATION INVESTIGATION REPORT  
For Proposed Widening of the C.N.R.  
And Q.E.W. Overhead and the Proposed  
Off-Ramp Overhead, Lot 2, Con. II.  
Twp. of Bertie, Co. of Welland  
District No. 4 (Hamilton)  
W.J. 67-F-77      --      W.P. 162-64-05

1. INTRODUCTION:

The Foundation Section was requested to carry out an investigation at the crossing of the C.N.R. and Q.E.W. about one mile west of Hwy. 3 in Fort Erie. The request was contained in a memo from the Bridge Division (Mr. W. S. Melinyshyn, Regional Bridge Location Engineer), dated August 10, 1967. An investigation was subsequently carried out by this Section to determine the subsoil conditions existing at the site. This report contains the results of the investigation, together with recommendations pertaining to the foundations of the proposed structure and stability of the approaches.

2. DESCRIPTION OF THE SITE AND GEOLOGY:

The site is located about one mile west of Hwy. 3 in Fort Erie. At this location the Queen Elizabeth Highway grade is some 20 ft. above the surrounding ground surface. The Highway itself, consists of four paved lanes with a median strip and associated gravel shoulders. The topography at the site is generally flat with a slight general slant towards the east.

Physiographically, the site is situated in the "Haldimand Clay Plain". Based on available geological information, it is known that the overburden of this region consists of lacustrine clay deposited in glacial Lake Warren formed during the retreat of the last continental glacier.

### 3. FIELD AND LABORATORY WORK:

Nine boreholes and nine dynamic cone penetration tests were carried out during the course of the field work. Boring was achieved by means of a conventional diamond drill adapted for soil sampling purposes. Samples were recovered at required depths in a 2-inch O.D. split-spoon sampler, which was hammered into the soil, or in 2-inch I.D. Shelby tubes which were manually pushed into the soil. The method of driving the split-spoon sampler conformed to the requirements of the Standard Penetration Test. The same method was used to advance the cone in the dynamic cone penetration test. Bedrock was proven in nine boreholes by obtaining AXT-size rock core samples.

The locations and elevations of all borings are shown on Drawing 67-F-77A, together with the estimated stratigraphical profile.

All samples were subjected to a careful visual inspection and on selected samples, laboratory tests were carried out to determine the following physical properties:

- Natural Moisture Content
- Bulk Density
- Atterberg Limits
- Grain-Size Distribution

The results of these tests are summarized and plotted on the Record of Borelog sheets contained in the Appendix attached to this report.

### 4. SOIL TYPES AND SOIL CONDITIONS:

#### 4.1) General:

The subsoil at the site was found to be quite uniform. The natural subsoil is a layer of stiff to hard clayey silt with traces of sand and occasional gravel followed by limestone bedrock.

4. SOIL TYPES AND SOIL CONDITIONS: (cont'd.) ...

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

In certain areas the natural deposit is overlain by highway embankment fill material (clayey silt with traces of sand and gravel).

The boundaries between various soil strata are shown on the Record of Borelog sheets contained in the Appendix of the report. The estimated stratigraphical profile Dwg. 67-F-77A is based upon this information. From ground level downwards, the different soil types are described in detail as follows:

4.2) Fill Material (Clayey Silt with Sand and Gravel):

The approach fill embankments of the existing bridge extend down to approximate elev. 631 as detected in B.H.'s 2, 3, and 6. The material is clayey silt with sand and gravel and has a consistency of firm to very stiff, as indicated by 'N' values from 6 to 18 blows per foot.

4.3) Clayey Silt with traces of Sand and occasional Gravel:

The original subsoil extended down to approximate elev. 610 - elev. 608 where the bedrock was encountered. The layer essentially consists of clayey silt with traces of sand and occasional gravel. Its consistency is stiff to hard with 'N' values between 11 and 73 blows per foot. Physical properties of the material as determined in the laboratory, are as follows:

Natural Moisture Content	:	7% - 22%
Bulk Density	:	135% - 146%
Plastic Limit	:	12% - 20%
Liquid Limit	:	18% - 35%

4.4) Bedrock:

The bedrock was proven in all nine boreholes by recovering 5 feet of AXT-size core samples. The bedrock elevation varied approximately from elev. 610 in B.H. 7 to elev. 606 in B.H. 8.

The bedrock is identified as coarse crystalline limestone and is generally sound from the surface.

cont'd. /4 ...

5. GROUNDWATER:

The groundwater level measurements were carried out during the investigation, and were found to range from elev. 619, or some 4 ft. below ground level in B.H. 8 to elev. 627, or some 8 ft. below ground level in B.H. 4.

6. DISCUSSION AND RECOMMENDATIONS:

6.1) General:

It is proposed to widen the existing C.N.R. overhead and also to construct a new overhead structure, located north of the existing one, to accommodate a two-lane ramp to the Thompson Road Interchange. Alternatively, the existing structure could be demolished and replaced.

Present proposals call for the existing structure to be widened some 21 ft.; as well, a new three-span (35'-35'-35') two-lane overhead is to be constructed some 114 ft. north of the present Q.E.W. centre-line. The subsoil at the site consists of a very stiff to hard deposit of clayey silt with traces of sand and gravel overlying crystalline limestone.

The following are the recommendations for the foundations of the proposed two new structures.

6.2) C.N.R. Overhead Structure at Q.E.W.:

The abutments can be founded on spread footing-type foundations at or below elev. 630, and a safe design load of 3 t.s.f. can be used. The piers can be founded on spread footing-type foundations placed 5 ft. below the existing ground surface, and a safe design load of 2 t.s.f. can be used. Alternatively, the piers can also be founded on end-bearing piles driven to practical refusal on the bedrock. These piles may be designed for the maximum allowable load for the pile section chosen.

cont'd. /5 ...

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

6.3) C.N.R. and Off-Ramp Overhead:

The abutments may be supported on spread footings placed within the approach fills. The fill material below the tops of the footings should consist of well compacted G.B.C. Class 'A' material, and should extend for a horizontal distance of at least 10 feet from the footing edges in the plane of the footing tops. This portion of the fill should be built with side-slopes of 2:1. The remainder of the fill should be completed to above profile grade for a distance of about 50 feet behind the abutments before re-excavating for the abutment footings. A design load of 2 t.s.f. may be used for the abutment foundations.

Alternatively, the abutments may be founded on end-bearing piles driven to bedrock. These piles may be designed for the maximum allowable load for the pile section chosen.

The piers may be founded on spread-footing type foundations at or below elev. 619.0 (provided that there is adequate cover for frost protection), and may be designed for an allowable load of 2 t.s.f.

6.4) Embankments:

No stability problems are anticipated, provided that standard 2:1 side-slopes are constructed.

6.5) Dewatering:

Due to the relative impermeability of the subsoil, no problems are anticipated for the excavations for the foundations. A working slab should be cast as soon as the desired excavated elevation is reached to prevent softening of the excavation base.

cont'd. /6 ...



7. SUMMARY:

A foundation investigation at the site of the proposed widening of the C.N.R. and Q.E.W. overhead structure in Fort Erie, and the proposed adjacent off-ramp structure, is reported.

Subsoil at the site consists of a deposit of stiff to hard clayey silt with traces of sand and occasional gravel underlain by sound limestone bedrock.

A combination of spread footing-type and pile-type foundations are recommended for the foundations of the two structures.

No dewatering problems nor embankment stability problems are anticipated.

8. MISCELLANEOUS:

The field work was carried out during August 21 to August 31, 1967, by Mr. V. Korlu, Project Foundation Engineer, who also wrote this report. The work was carried out under the general supervision of Mr. M. Devata, Supervising Foundation Engineer, who reviewed this report.

The field equipment was provided by Dominion Soil Investigation Ltd. of Toronto.

October 1967.



APPENDIX I

DEPARTMENT OF HIGHWAYS - ONTARIO  
MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO. 1

**FOUNDATION SECTION**

JOB 67-F-77 LOCATION Q.E.W. & C.M.R., Fort Erie, Sta. 313+63 140' Lt. ORIGINATED BY VK  
W.P. 162-64-05 BORING DATE August 21, 1967 COMPILED BY \_\_\_\_\_  
DATUM Geodetic BOREHOLE TYPE Drive Casing & Wash CHECKED BY SR

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT 20 40 60 80 100 SHEAR STRENGTH P.S.F.	LIQUID LIMIT ——— w <sub>L</sub> PLASTIC LIMIT ——— w <sub>p</sub> WATER CONTENT ——— w w <sub>p</sub> ——— w ——— w <sub>L</sub> WATER CONTENT % 10 20 30	BULK DENSITY P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT					
624.0	Ground Level									
0.0	Clayey silt with some sand and traces of gravel.  Very stiff to hard.		1	SS	29	620    610 2"			129	▽ 622.0  Gr. 5, Sa. 17 Sl. 48, Cl. 30
			2	SS	35					
			3	SS	32					
			4	SS	22					
608.0			5	SS	100					
16.0	Bedrock		6	AXT	100%					
603.0	Crystalline Limestone Sound									
21.0	End of Borehole					600				

DEPARTMENT OF HIGHWAYS - ONTARIO  
MATERIALS & TESTING DIVISION

# RECORD OF BOREHOLE NO. 2

## FOUNDATION SECTION

JOB 67-F-77

LOCATION Sta. 313+45 83' Lt.

ORIGINATED BY VK

W. P. 162-64-05

BORING DATE August 22, 1967

**COMPILED BY**

**DATUM** Geodetic

BOREHOLE TYPE Drive Casing and wash

**CHECKED BY**

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 WP ——— W ——— WL WATER CONTENT % 10 20 30	BULK DENSITY P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT					
640.5	Ground Level									
0.0	Fill					640				
	Clayey silt with sand and gravel.		1	SS	9					
	Stiff		2	SS	8					
631.0										
9.5	Clayey silt with some sand and traces of gravel.		3	SS	52	630				
			4	SS	64					
			5	SS	66					
	Very stiff to hard.		6	SS	40	620				
			7	SS	22					
			8	SS	32	610				
607.5										
33.0	Bedrock									
602.5	Sound Crystalline Limestone		9	AXT	100%					
38.0	End of Borehole					600				

DEPARTMENT OF HIGHWAYS - ONTARIO  
 MATERIALS & TESTING DIVISION

## RECORD OF BOREHOLE NO. 3

FOUNDATION SECTION

JOB 67-F-77 LOCATION Sta. 313+26 62' Rt. ORIGINATED BY VK  
 W.P. 102-54-05 BORING DATE August 28, 1967 COMPILED BY \_\_\_\_\_  
 DATUM Geodetic BOREHOLE TYPE Drive casing and wash CHECKED BY SL

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	BLC NO. / FOOT		BLOWS / FOOT 20 40 60 80 100	SHEAR STRENGTH P.S.F.				
650.5	Ground Level											
0.0	Fill					650						
	Clayey silt with some sand and gravel.		1	SS	18							
	Stiff		2	SS	8							
			3	SS	10	640						
			4	SS	14							
632.5			5	SS	10							
18.0	Clayey silt with sand and traces of gravel.		6	SS	67	630						
			7	SS	73							
	Very stiff to hard.		8	SS	38	620						
			9	SS	23							
			10	SS	68	610						
608.5												
42.0	Bedrock											
603.5	Crystalline Limestone		11	AXT	100%							
147.0	End of Borehole					600						

638.5  
 Gr. 5, Sa. 25  
 Cl. 48, Cl. 22

Gr. 3, Sa. 48  
 Sl. 35, Cl. 14



DEPARTMENT OF HIGHWAYS - ONTARIO  
MATERIALS & TESTING DIVISION

# RECORD OF BOREHOLE NO. 4

FOUNDATION SECTION

JOB 67-F-77 LOCATION Sta. 314+80 127' Lt. ORIGINATED BY VK  
W.P. 162-64-05 BORING DATE August 31, 1967 COMPILED BY \_\_\_\_\_  
DATUM Geodetic BOREHOLE TYPE Drive casing and wash CHECKED BY [Signature]

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE	LIQUID LIMIT — WL			BULK DENSITY	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT		BLOWS / FOOT	PLASTIC LIMIT — WP	WATER CONTENT — W	WATER CONTENT %		
							20 40 60 80 100					
SHEAR STRENGTH P.S.F.							WP — W — WL			P.C.F.		
635.5	Ground Level											
0.0	Clayey silt with sand and traces of gravel.		1	SS	54	630					140	▽ 627.3
			2	SS	52							
			3	SS	65							
	Very stiff to hard.		4	SS	44							
			5	SS	32	620						
			6	SS	20							
			7	SS	15	610						
607.0												
28.5	Bedrock		8	AXT	100%							
602.0	Crystalline Limestone Sound											
33.5	End of Borehole					600						

DEPARTMENT OF HIGHWAYS - ONTARIO  
MATERIALS & TESTING DIVISION

## RECORD OF BOREHOLE NO. 5

FOUNDATION SECTION

JOB 67-F-77 LOCATION Sta. 314 + 77 93' Lt.  
W.P. 162-64-05 BORING DATE August 30, 1967  
DATUM Geodetic BOREHOLE TYPE Drive Casing and WashORIGINATED BY VK  
COMPILED BY \_\_\_\_\_  
CHECKED BY HL

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE	LIQUID LIMIT — $w_L$	BULK DENSITY	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT		BLOWS / FOOT	PLASTIC LIMIT — $w_p$		
							20 40 60 80 100	WATER CONTENT — $w$		
							SHEAR STRENGTH P.S.F.	$w_p$ — $w$ — $w_L$		
								WATER CONTENT %		
								10 20 30		
635.8	Ground Level									
0.0	Clayey silt with some sand and traces of gravel.		1	SS	34	630			146	
			2	SS	56					
			3	SS	45					
	Very stiff to hard.		4	SS	40					
			5	SS	44	620				
			6	SS	22					
			7	SS	16	610				
607.8										
28.0	Bedrock									
602.8	Sound Crystalline Limestone		8	AXT	100%					
33.0	End of Borehole					600				

DEPARTMENT OF HIGHWAYS - ONTARIO

**MATERIALS & TESTING DIVISION**

JOB 67-F-77

LOCATION Sta. 314 + 45 66<sup>th</sup> Rt.

W. P. 162-64-05

BORING DATE August 29, 1967

DATUM Geodetic

BOREHOLE TYPE Drive casing & wash

## FOUNDATION SECTION

ORIGINATED BY           VK          

COMPILED BY

**CHECKED BY**

# RECORD OF BOREHOLE NO. 6

[illegible]



DEPARTMENT OF HIGHWAYS - ONTARIO  
MATERIALS & TESTING DIVISION

# RECORD OF BOREHOLE NO. 7

**FOUNDATION SECTION**

JOB 67-F-77  
W.P. 162-64-05  
DATUM Geodetic

LOCATION Sta. 314 + 04 138' Lt.

ORIGINATED BY VK

BORING DATE August 23, 1967

COMPILED BY \_\_\_\_\_

BOREHOLE TYPE Drive Casing and Wash

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	20	40	60			80	100	WP	W	WL	WATER CONTENT %					
							SHEAR STRENGTH P.S.F.							10			20	30					
622.8	Ground Level																						
0.0	Clayey silt with some sand and traces of gravel.		1	SS	24	620    610 5"			135	Gr. 5, Sa. 22 Si. 48, Cl. 24													
	Very stiff to hard.		2	SS	19																		
			3	SS	16																		
609.8			4	SS	100																		
13.0	Bedrock	5	AXT	100%																			
604.8	Sound Crystalline Limestone																						
18.0	End of Borehole					600																	

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO. 8

FOUNDATION SECTION

JOB 67-F-77 LOCATION Sta. 313 + 98 70' Lt. ORIGINATED BY VK  
W.P. 162-64-05 BORING DATE August 24, 1967 COMPILED BY \_\_\_\_\_  
DATUM Geodetic BOREHOLE TYPE Drive Casing & Wash CHECKED BY [Signature]

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	20	40	60	80	100		
623.3	Ground Level						SHEAR STRENGTH P.S.F.			WATER CONTENT %				
0.0	Clayey silt with some sand and traces of gravel.		1	SS	16	620								619.1 Gr. 7, Sa. 21 Sl. 64, Gl. 28
			2	SS	26									
	Stiff to hard.		3	SS	17									
			4	SS	11	610								
605.8			5	SS	75									
17.5	Bedrock		6	AXT	100%									
600.8	Sound Crystalline Limestone													
22.5	End of Borehole					600								

DEPARTMENT OF HIGHWAYS - ONTARIO  
MATERIALS & TESTING DIVISION

## RECORD OF BOREHOLE NO. 9

FOUNDATION SECTION

JOB 67-F-77 LOCATION Sta. 313 + 84 66' Rt. ORIGINATED BY VK  
W.P. 162-64-05 BORING DATE August 25, 1967 COMPILED BY \_\_\_\_\_  
DATUM Geodetic BOREHOLE TYPE Drive Casing & Wash CHECKED BY LL

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE					LIQUID LIMIT — WL PLASTIC LIMIT — WP WATER CONTENT — W wp — w — WL WATER CONTENT % 10 20 30	BULK DENSITY P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT		BLOWS / FOOT	20	40	60	80	100		
625.1	Ground Level													
0.0	Clayey silt with some sand and traces of gravel.		1	SS	17	620								Gr. 11, Sa. 22 Si. 45, Cl. 19  non-plastic
			2	SS	20									
			3	SS	21									
			4	SS	21									
			5	SS	55									
607.1						610								
18.0	Bedrock													
602.1	Sound Crystalline Limestone		6	AXT	100%									
23.0	End of Borehole					600								

## 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
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 = $\frac{\Delta e}{\Delta \log_{10} \sigma'}$
$T_v$	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
$\sigma'$	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

## MEMORANDUM

67-F-72

To: Mr. A. Stermac,  
Principal Foundation Engineer,  
Room 107, Lab. Building.

FROM: Bridge Division,  
Downsview, Ontario.

DATE: August 10th, 1967.

OUR FILE REF.

IN REPLY TO

SUBJECT: C.N.R. Overhead, W.P. 162-64-5,  
Site 34-131, Q.E.W., Dist. #4.

Herewith are two prints of the bridge site plan E-4780-1 on which the approximate location of footings have been marked in red, existing footings have been shown dotted.

At the ~~QEW~~ it is presently proposed to widen the existing twin structures. There is a possibility that completely new structures may be required at this location. We are awaiting a report on the condition of these twin bridges from the Bridge Maintenance Section.

To the north of the existing structures a separate structure is shown to accommodate the two lane off ramp to the Thompson Road Interchange. The location of this structure is approximate as the line has not been run in the field as yet. It is also probable that this structure will get a separate W.P. number and perhaps E plan. I also suspect that the location is outside our right of way and on Railway and Fort Erie Jockey Club property. The dimensions shown in blue are taken from the detailed intersection drawing which will be available next week.

The embankments at the railway are quite steep (1½:1) and will pose problems for your equipment.

Please arrange for a foundation investigation of sufficient scope to enable us to proceed with the design.

Attached is the preliminary structure site report.

*Joseph F. Walshe*

JFW/cew

Encl.

cc R. Forrest  
A. Crowley

J. F. Walshe,  
for W. S. Melinyshyn,  
Regional Bridge Location Engineer.

Aug 16th 1967

Sub - CRR overhead on Q Ave near 7th Ave  
WP 162-64-5      WT 67-A-77  
Dist # 4, Hamilton.

Permission obtained to enter CRR property and to carry out foundation investigation work for the above mentioned project. Mr. Casey of the London Regional Office of CRR agreed to provide flapman at the site on Monday Aug 21st 1967.

DM. Hevata  
Supervising Foundation Engr.



1957 AUG 17 0000 9414

B

HAMN DOWN 1 AUG 17/67 909A VR

H GREENLAND DIST ENGR

ATTN D A WALLER MTCE ENGR

COPY TO T J KOVICH RGN MAT ENGR DOWNSVIEW

RE CNR OVERHEAD QEW DIST 4 HAMILTON WP162-64-5 WJ67-F-77.

THE FIELD INVESTIGATION WORK FOR THE ABOVEE MENTIONED STRUCTURE

WILL COMMENCE ON AUGUST 21/67. THIS IS FOR YOUR INFORMATION

M DEVATA FOR A G STERMAC MAT AND TESTING

BB

T  
E  
L  
E  
T  
Y  
P  
E

401. & Keels St.  
Downsview, Ontario

August 17, 1967

Dominion Soil Investigation Ltd.  
77 Crockford Blvd.  
Scarborough, Ontario

Dear Sirs:

This is confirm our request of August 16, 1967 for the supply of a Diamond Drill together with all necessary equipment, as specified under the terms of our Contract Agreement, at Port Erie, Ontario (C.N.R. & Q.E.W.) on August 21, 1967 at 1 p.m.

This project bears job number 67-P-77.

Yours truly,

*M. Devata*

MD:mt

M. Devata  
Supervising Foundation Engineer  
for: A. G. Stermac  
Principal Chemical Engineer

cc: H. Konings  
Foundation Files 110  
General File

*M. Devata*

Telephone: 248-3446

Mr. M. Wigle,  
Program Engineer,  
Administration Bldg.

E.J. McCabe,  
Toronto Regional Road Design.

March 13, 1968.

Re: Queen Elizabeth Way from  
Highway 405 to Fort Erie,  
District 4, Hamilton.

Your letter of February 12, 1968 requesting a program for placement of early fill as recommended by the Foundation Section has been passed on to me for comment.

This afternoon Mr. Devata, Foundations Section, Mr. Melnychyn, Bridge Planning Section, and the writer met to consider our needs for early fill placement. It was determined that early fill would be placed:

- 1) If required for bridge construction.
- 2) If required for grading purposes. A 6" settlement or more was used as a basis to determine the need for early fill placement for grading purposes.

The following is a summary of our conclusions:

- 1) Mountain Road Interchange - W.P. 154-64.

Bridge Office to decide in one month whether early fill placement required for bridge purposes.

- 2) Thorold Stone Road - W.P. 155-64-03.

No early fill placement required.

- 3) McLeod Road - W.P. 156-64.

- 4) Northbound West Service Road - W.P. 157-64-2.

Both bridges will be on piles. An 8½" settlement is predicted. We propose delaying the final paving of the fill areas from one to two years.

Continued .... /2

March 13, 1968.

Mr. W. Wigle - Re: Queen Elizabeth Way.

- 5) Lyons Creek - W.P. 158-64-01.
- 6) Back Road - W.P. 442-65.
- 7) Bossert Road - W.P. 443-65.
- 8) Sodom Road - W.P. 159-64.
- 9) Baker Road - W.P. 445-65.
- 10) Towaline Road, Black Creek, Service Road - W.P. 167-64.
- 11) Ridgemount Road - W.P. 165-64.
- 12) Bowen Road
- 13) Sunset Drive - W.P. 447-65.
- 14) Gilmore Road - W.P. 448-65.

Considerable settlement can be anticipated for the above structure sites and approach thereto. We propose that early fill placement be considered two years in advance of the current construction program year.

- 15) West-North and South Ramp - W.P. 162-64-2.
- 16) Thompson Road - W.P. 162-64-1.
- 17) - W.P. 162-64-3.
- 18) C.H.R. Widening - W.P. 162-64-05, 67-F-77
- 19) Concession Road (Erie St.) - W.P. 161-64.
- 20) North Street Revision - W.P. 160-64.

No early fill placement required at these sites.

*E.J. McCabe*

E.J. McCabe  
Expressway Consultant Control Engineer  
For:  
G.E. Hunter  
Regional Road Design Engineer

EJA/GS

c.c. H. Devata  
W. Melinyshyn  
A.J. Fletcher  
E.A. Fletcher

Department of Highways Ontario

Copy for the information of

Mr. A. Stermac

~~Mr. W. Melnychuk,~~  
Reg. Bridge Location Engineer,  
Central Region, Admin. Bldg.

Bridge Office,  
Downsview, Ontario

December 12, 1968

Q.E.W. & E-S Ramp - C.N.R. Overhead  
Approx. 0.3 Mi. West of West Limits of Fort Erie  
W.F. 162-64-05, Site 34-131  
Q.E.W., District No. 4

67-F-77

Attached herewith are prints of the Preliminary Bridge  
Plan Drawing D-6600-P for the above-mentioned structure.

The estimated cost of the proposed structure is \$142,000.  
This cost includes tender, materials, engineering and sundry  
construction.

Any comments or revisions you may have should be submitted  
within three weeks.

CSB:rd

C.S. Grebaki,  
Bridge Design Engineer

Attach.

c.c. S. McConchie  
A. Stermac (2)  
J. Anderson

no comment.  
BTD

Department of Highways Ontario  
Copy for the information of  
Foundation Section

Mr. A. Stermac,  
Principal Foundation Engineer,  
Room 107, Lab. Building

C.S. Grebski,  
Bridge Office

September 15, 1969

C.N.R. Overhead at Q.E.W. & E.S. Ramp  
W.P. 162-64-05, Site No. 34-131  
District No. 4

67-F-77

Attached herewith we are submitting the final  
bridge drawings which show the foundation design for  
this structure.

Kindly give us your comments at your earliest  
convenience.

CSG:rd

C.S. Grebski,  
Bridge Design Engineer

Attach.

c.c. Foundation Section

No comments, except for error in  
elevation see correction on drawing D-6600.

\*  
\* Talked to Ho on Tel @ 4:30 PM.  
about correcting the error.

Sept 22/69

Mr. M. Devata,  
Supervising Foundation Engineer,  
Foundation Office,  
Downsview, Ontario.

Foundations Office,  
Design Services Branch,  
Downsview, Ontario.

November 9, 1971.

Contract Review Meeting - W.P. 163-64-04  
Q.E.W. Fort Erie  
Gilmore Road to C.N.R.  
District 4, Hamilton.

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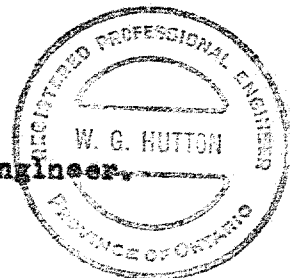
The meeting was held at the 'Estaminet' Restaurant, 2084 Lakeshore, Burlington on November 3 and 4, 1971. The structures were discussed on November 4, 1971.

- |   |  |
|---|--|
| Thompson Rd. & Bertie St. Ramp<br>67-F-80 | - The Pile Table was changed to read West Abutment where it showed East Abutment and vice versa. |
| Thompson Rd. & Q.E.W.<br>67-F-76          | - It was suggested to G. Burkhardt that a working slab be shown under the spread footings.       |
| E.S. Ramp to Thompson Rd.<br>67-F-79      | - No Comments  |
| C.N.R. Widening<br>67-F-77                | - No Comments  |

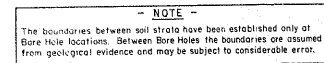
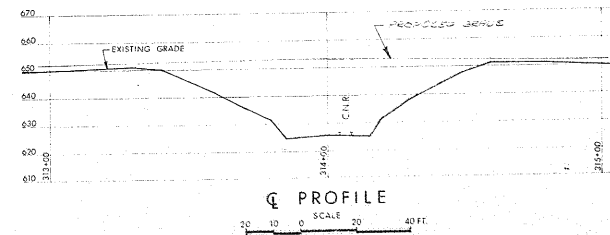
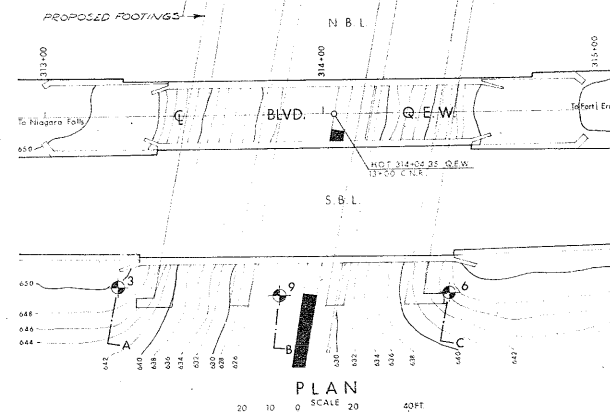
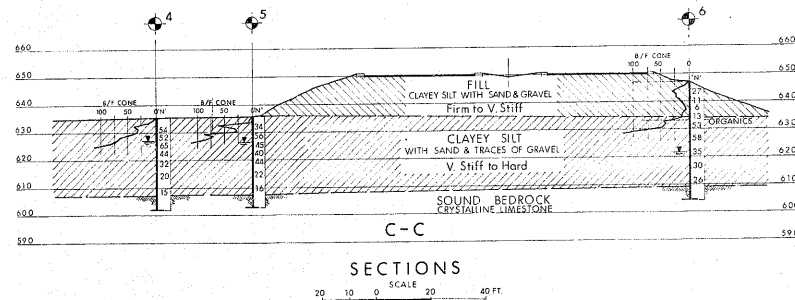
In both structures on piles 67-F-80 & 67-F-79 it was decided to show the pile lengths to the nearest foot + and delete the inches. Also the charts for the Hilley Formula were deleted from both contract drawings.

WH/ao  
cc: Foundations Files  
Documents

*B. G. Hutton*  
W. Hutton,  
Project Foundation Engineer.





[illegible]

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

CANADIAN NATIONAL RAILWAY

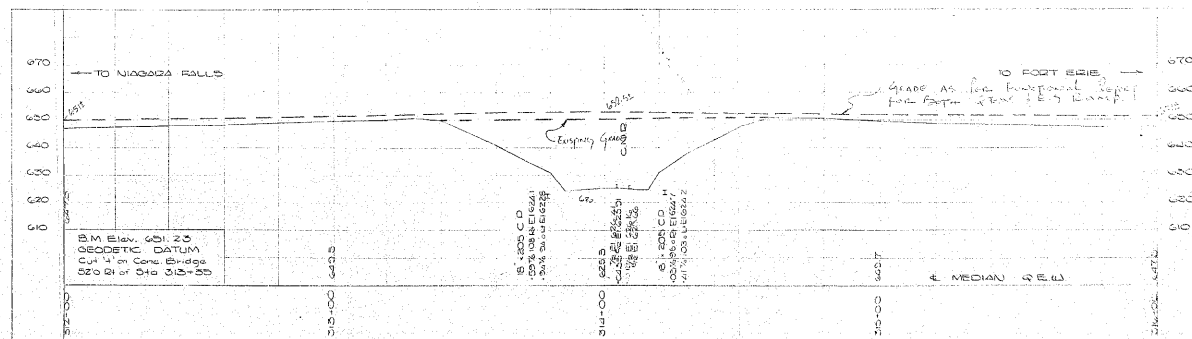
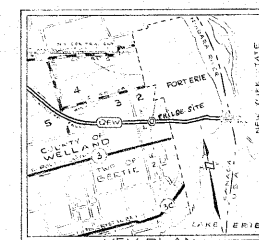
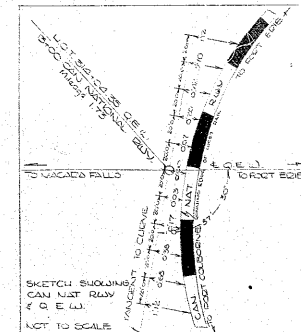
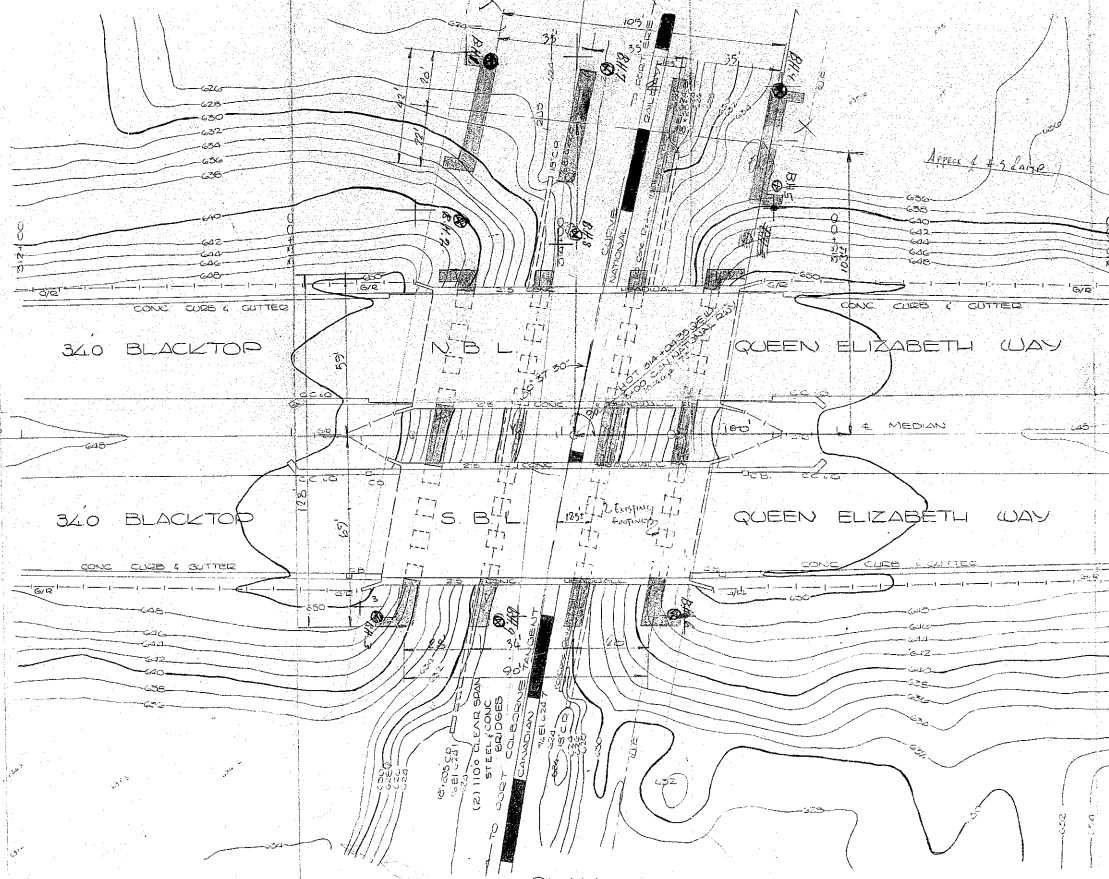
KING'S HIGHWAY NO. Q.E.W. DIST. NO. 4  
CO. WELLAND FORT ERIE  
TWP. BERTIE LOT 2 CON. 2

BORE HOLE LOCATIONS &amp; SOIL STRATA

SUB'D V. K.	CHECKED PD	W.P. NO. 162-64-05	M.B.T. DRAWING NO. <b>67-F-77A</b>
DRAWN S. O.	CHECKED	JOB NO. 67-F-77	

DATE 29 SEPT. 1967	SITE NO.	BRIDGE DRAWING NO.
APPROVED <i>A. G. Thomas</i>	CONT. NO.	

COUNTY OF WELLAND TOWNSHIP of BERTIE  
CON. 2 LOT 2



LOT 34-36-38 Q.E.W. - 10-00 CANADIAN NATIONAL RAILWAY  
Scales: VERT. 1 in. = 20 ft.

WP 162-64-05

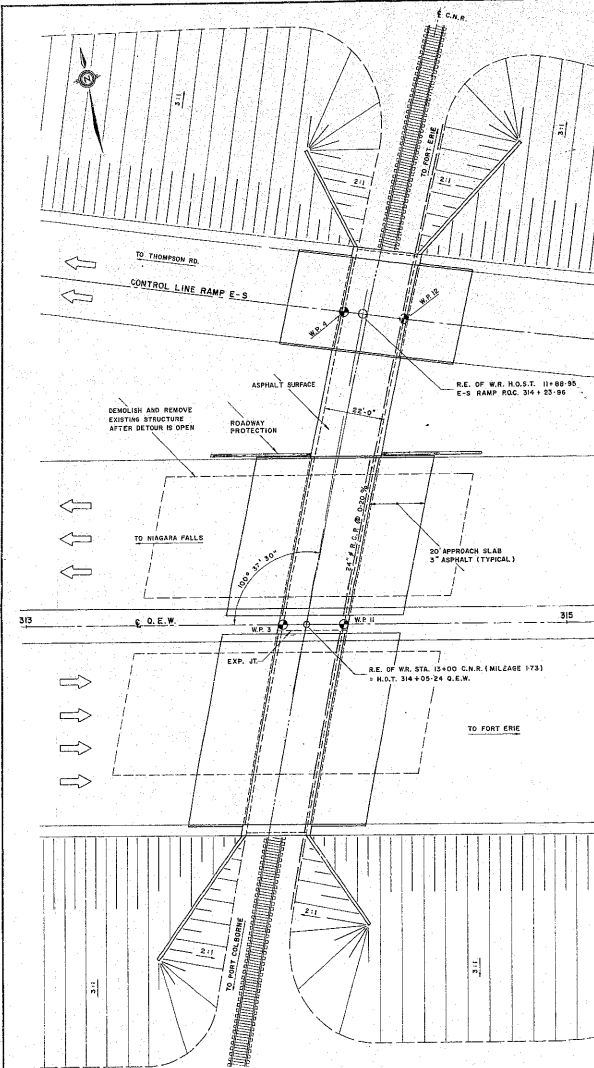
DATE REVISIONS & ADDITIONS BY

67-F-77

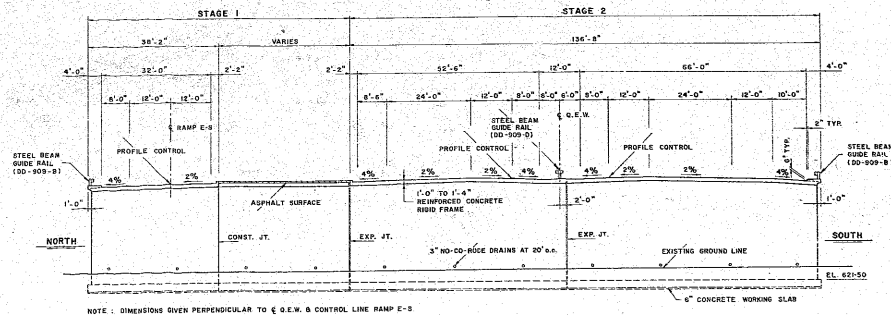
DEPARTMENT OF HIGHWAYS ONTARIO  
ENGINEERING SURVEYS DIVISION

BRIDGE SITE  
PROPOSED CROSSING  
AT  
CANADIAN NATIONAL RAILWAY  
AND  
QUEEN ELIZABETH WAY  
APPROX. 1.1 MILES WEST OF HWY 3  
LOT 2  
CON. 2  
TWP. of BERTIE COUNTY of WELLAND

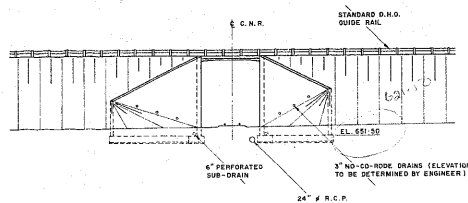
SCALE AS SHOWN	DISTRICT WILKINSON	REGION CENTRAL
UNPROCESSED-67-5	DATE OF SURVEY: 1967	SITE NO. 34-131
SURVEYED BY: CHAS. A. GUNN	DESIGNED BY: D. G. GUNN	DRAWN BY: J. G. GUNN
CHECKED BY: D. G. GUNN	APPROVED BY: J. G. GUNN	PLAN NO. E4780-1



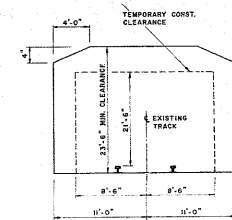
PLAN  
SCALE 1" = 20'-0"



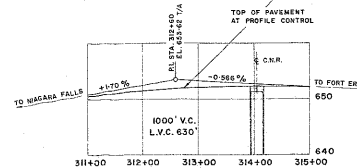
LONGITUDINAL SECTION  
SCALE 1/8" = 1'-0"



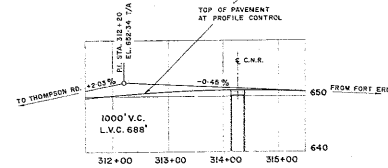
ELEVATION  
SCALE 1" = 20'-0"



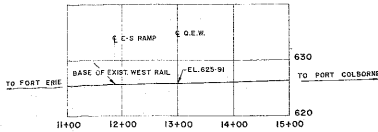
CLEARANCE DIAGRAM  
N.T.S.



PROFILE Q.E.W.

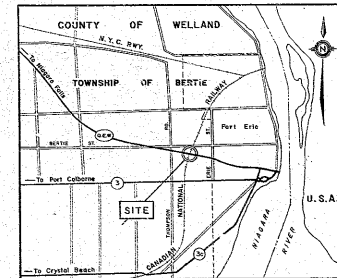


PROFILE E-S RAMP



PROFILE C.N.R.

E-S RAMP CURVE DATA  
A = 4'-00" - 15"  
D = 1'-00"  
R = 5729.578  
T = 201.954  
L = 403.704  
E = 3.558



KEY PLAN  
SCALE 1" = 0.5 MILE

CONSTRUCTION NOTES:  
CLASS OF CONCRETE  
DECK, CURBS 4,000 P.S.I.  
REMAINDER 3,000 P.S.I.  
CLEAR COVER ON REINFORCING STEEL  
DECK SLAB 1 1/2" TOP & BOT.  
CURBS & APPROACH SLABS 1"  
REMAINDER  
GRANULAR BACKFILL TO BE PLACED SIMULTANEOUSLY BEHIND BOTH ABUTMENTS.

LIST OF DRAWINGS:  
1. GENERAL ARRANGEMENT  
2. BORE HOLE LOCATIONS & SOIL STRATA  
3. FOOTINGS DIMENSIONS & REINFORCING  
4. FRAME I.F.O. DETAILS  
5. FRAME DETAILS  
6. SCREED ELEVATIONS  
7. RETAINING WALLS - 1  
8. RETAINING WALLS - 2  
9. APPROACH SLAB  
10. STANDARDS  
11. EMBEDDED WORK LAYOUT & DETAILS

B.M. Elev. 651.23 (Geodetic Datum)  
Cut Cross on Curb West of Bridge  
52'-0" Rt. of Sta. 313+35

REVISIONS	DATE	BY	DESCRIPTION

67-F-77

DEPARTMENT OF HIGHWAYS ONTARIO  
BRIDGE DIVISION

McCORMICK, RANKIN & ASSOCIATES LIMITED  
Perf Credit CONSULTING ENGINEERS Ottawa

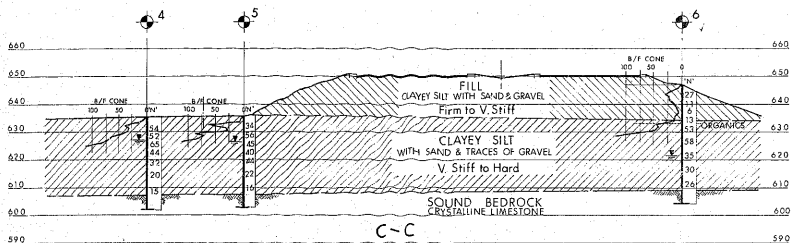
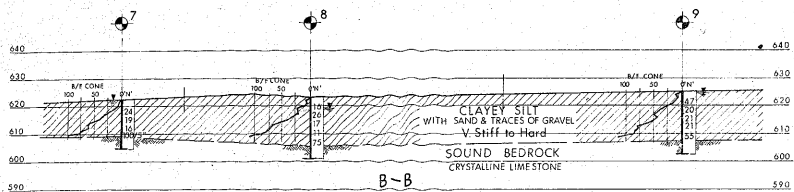
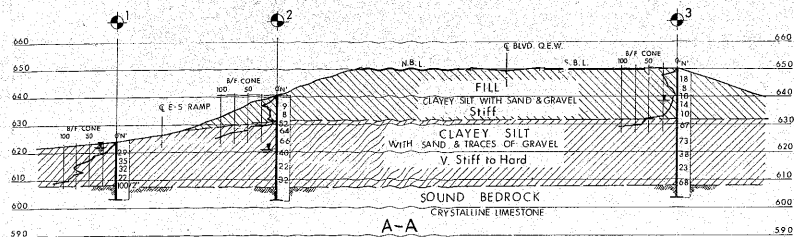
C.N.R. OVERHEAD AT Q.E.W. & E-S RAMP  
0.3 MILES WEST OF FORT ERIE LIMITS

KING'S HIGHWAY No. Q.E.W. DIST. No. 4  
CO. WELLAND FORT ERIE  
TWP. BERTIE LOT 2 CON. 2

GENERAL ARRANGEMENT

APPROVED [Signature] 34-131 W.P. 162-64-05

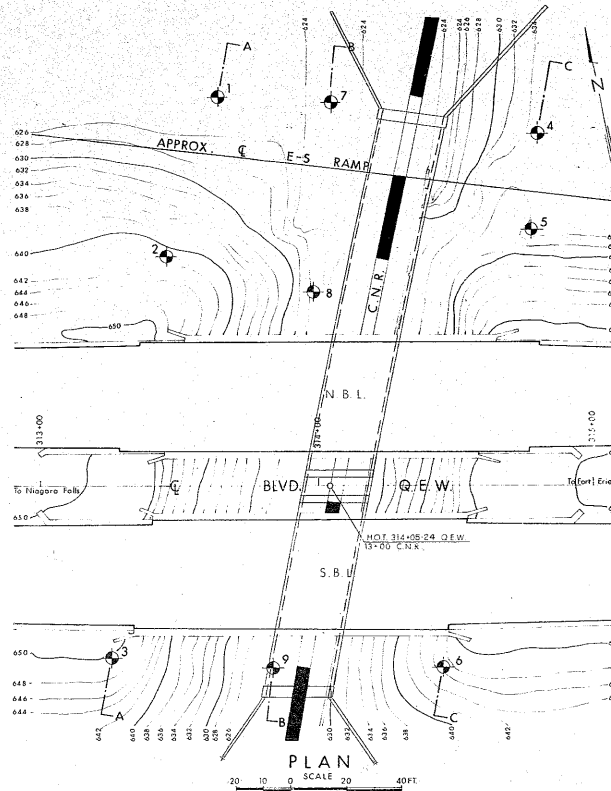
DESIGN L. C. H. CHECK R. D. N.  
DRAWING R. M. T. CHECK L. C. H. CONTRACT No.  
DATE AUG / 69 LOADING 19520-44 DRAWING No. D-6600-1



SECTIONS

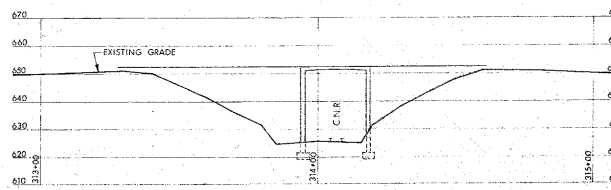
20 10 0 20 40 FT.

The boundaries and locations of 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.



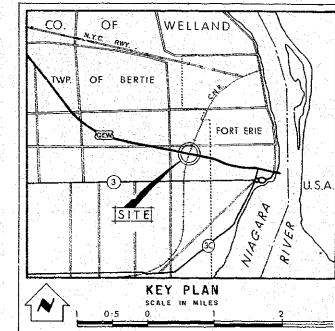
PLAN

20 10 0 20 40 FT.



Q PROFILE

20 10 0 20 40 FT.



LEGEND

- Bore Hole
- Cone Penetration Hole
- Bore & Cone Penetration Hole
- Water Levels established at time of field investigation. AUG 1967

NO.	ELEVATION	STATION	OFFSET
1	624.0	313+03	140' LT.
2	640.5	313+45	83' LT.
3	650.5	313+20	62' RT.
4	635.5	314+80	127' LT.
5	635.8	314+77	93' LT.
6	647.8	314+45	66' RT.
7	622.8	314+04	138' LT.
8	623.3	313+98	70' LT.
9	625.1	313+84	66' RT.

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.

DATE	BY	DESCRIPTION

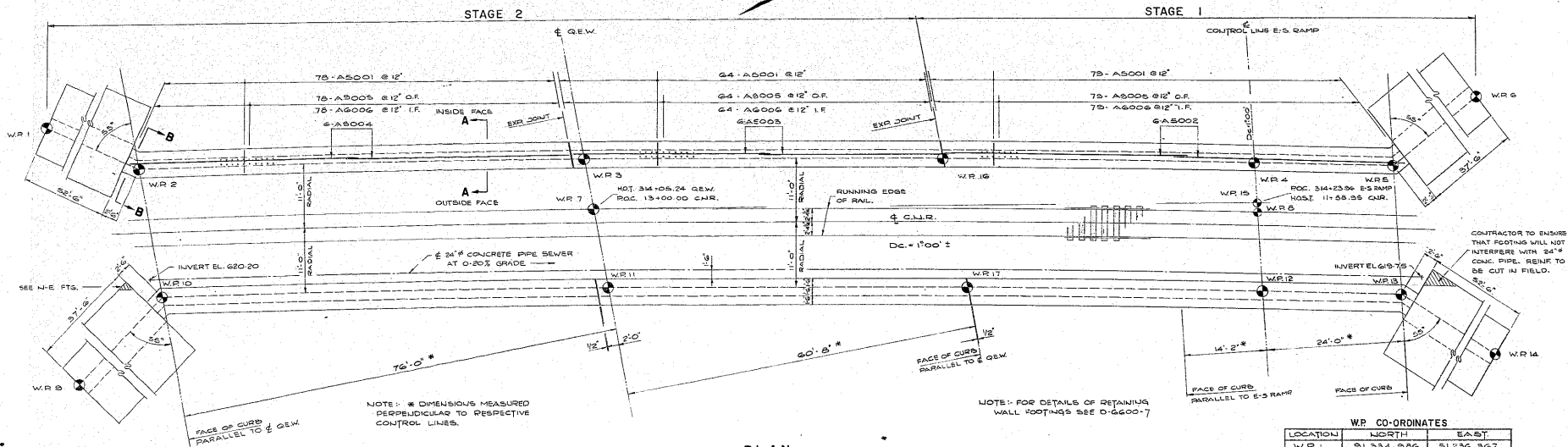
DEPARTMENT OF HIGHWAYS - ONTARIO  
MATERIALS & TESTING DIVISION - FOUNDATION SECTION

# CANADIAN NATIONAL RAILWAY

KING'S HIGHWAY NO. Q.E.W. DIST. NO. 4  
CO. WELLAND FORT ERIE  
TWP. BERTIE LOT 2 CON. 2

## BORE HOLE LOCATIONS & SOIL STRATA

SUBWD. V.K. CHECKED P.D. WP. NO. 102-04-05 H.S.T. DRAWING NO. 67-F-77A  
DRAWN S.O. CHECKED J.S. NO. 67-F-77  
DATE 29 SEPT. 1967 SITE NO. 34-131 BY THE DRAWING NO.  
APPROVED [Signature] H.S.T. NO. D-6600-2



PLAN  
SCALE 1/8" = 1'-0"

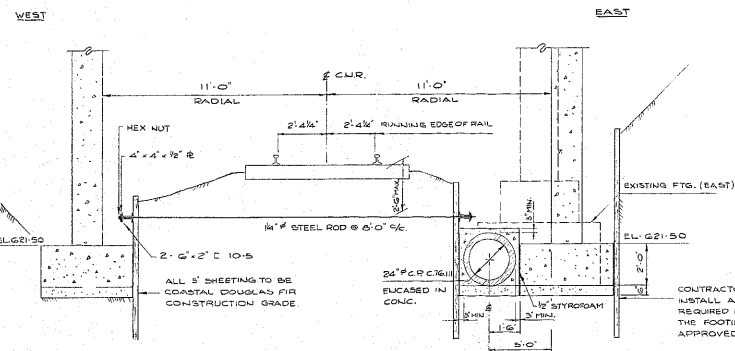
W.P. CO-ORDINATES		
LOCATION	NORTH	EAST
W.P. 1	51,334.266	51,236.367
2	51,373.920	51,275.214
3	51,444.414	51,301.830
4	51,551.002	51,342.192
5	51,573.300	51,351.146
6	51,611.254	51,355.250
7	51,444.697	51,310.454
8	51,548.546	51,350.534
9	51,533.633	51,341.154
10	51,570.066	51,297.203
11	51,442.551	51,323.878
12	51,544.831	51,363.419
13	51,557.224	51,372.575
14	51,601.693	51,415.236
15	51,649.670	51,345.456
16	51,504.132	51,323.628
17	51,500.281	51,345.915

CO-ORDINATES FOR ABOVE WORKING POINTS ARE CALCULATED BASED ON THE ASSUMPTION THAT DS = 1'00' FOR E CUR. ALL WORKING POINTS TO BE CHECKED IN THE FIELD WITH RESPECT TO E CUR. TRACKS.

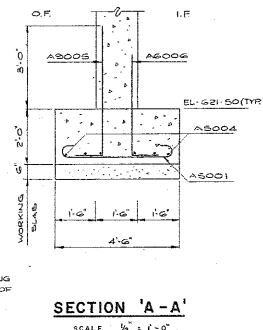
REVISIONS	DATE	BY	DESCRIPTION

67-F-99

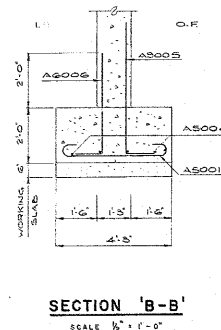
DEPARTMENT OF HIGHWAYS ONTARIO			
BRIDGE DIVISION			
McCORMICK, RANKIN & ASSOCIATES LIMITED			
Perit Credit		Consulting Engineers	
C.N.R. OVERHEAD AT Q.E.W. & E-S RAMP			
0.3 MILES WEST OF FORT ERIE LIMITS			
KING'S HIGHWAY No. Q.E.W.		DIST. No. 4	
CO. WELLAND		FORT ERIE	
TWP. BERTIE		LOT 2 CON. 2	
FOOTINGS DIMENSIONS AND REINFORCING			
DESIGN		CONTRACT	
DRAWING		DRAWING	
DATE		DATE	



TYPICAL TRACK PROTECTION  
SCALE 1/8" = 1'-0"



SECTION 'A-A'  
SCALE 1/8" = 1'-0"



SECTION 'B-B'  
SCALE 1/8" = 1'-0"

CONTRACTOR TO SUPPLY AND INSTALL ALL NECESSARY SHORING REQUIRED FOR THE CONSTRUCTION OF THE FOOTINGS. METHOD TO BE APPROVED BY ENGINEER.