

MEMORANDUM

To: Mr. B. R. Davis,
Bridge Engineer,
Bridge Office,
Admin. Bldg.

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

ATTENTION: Mr. S. McCombie

DATE: July 11, 1969

OUR FILE REF:

IN REPLY TO

JUL 15 1969

SUBJECT:

FOUNDATION INVESTIGATION REPORT
For

Proposed Crossing at
G.E.W. Rev'n. and Bartlett Ave. Rev'n.
Twp. of N. Grimsby, County of Lincoln
District No. 4 (Hamilton)
W.J. 69-F-12 -- W.P. 370-65-01

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. Parren
G. K. Hunter (2)
H. Greenland
W. S. Melinyshyn
T. J. Kovich
B. A. Singh

Foundations Files
Gen. Files

A. S. Stermac
A. S. Stermac
PRINCIPAL FOUNDATION ENGINEER

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FOUNDATION INVESTIGATION REPORT

For

Q.E.W. Rev'n. and Bartlett Ave. Rev'n.
Twp. of N. Grimsby, County of Lincoln
District No. 4 (Hamilton)

W.J. 69-F-12

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W.P. 370-65-01

1. INTRODUCTION:

The Foundation Section was requested to carry out a subsurface investigation for the above crossing. The request was contained in a memo from the Bridge Office (Mr. W. S. Melinyshyn, Regional Bridge Location Engineer), dated February 18, 1969. Subsequently, an investigation was carried out by this Section at the above site in order to determine the subsoil conditions. This report contains the results of the investigation as well as our recommendations for the design of foundations for the proposed structure and the stability of the approaches.

2. DESCRIPTION OF THE SITE AND GEOLOGY:

The site is located in Grimsby Beach, just east of the existing County Rd. No. 36 (Park Rd.) and Q.E.W. underpass. At this location, the Q.E.W. is located in a 10 - 12 ft. deep cut and is bordered on either side at the top of the cut by approach ramps connecting the Park Rd. Underpass to the Q.E.W.

Physiographically, the site is located in the "Niagara Fruit Belt" sub-section of the "Iroquois Plain Physiographic Region". This area is underlain by shale bedrock of the Queenston Formation, Ordovician Period.

3. FIELD AND LABORATORY WORK:

A total of 12 cased boreholes, 7 of which were accompanied by dynamic cone penetration resistance tests, was carried out during the course of the investigation by means of a standard diamond drill rig adapted for soil sampling purposes. Samples were obtained at

3. FIELD AND LABORATORY WORK: (cont'd.) ...

the required depths by hammering a 2-inch O.D. split-spoon sampler into the ground in accordance with the specifications for the Standard Penetration Test. The same method was used to advance the dynamic cone penetration tests. The boreholes were advanced in the weathered shale bedrock by drilling with a tricone bit. Sound bedrock was proven at all boreholes by core drilling in either AXT or BXL sizes.

Surveying was carried out by personnel from the Central Region Engineering Surveys Section. The elevations given in this report are referenced to geodetic datum. The locations and elevations of all boreholes are shown on Dwg. 69-F-12A, together with a number of estimated stratigraphical sections across the site.

All samples were subjected to careful visual examination in the field and subsequently in the laboratory. Following this examination, the stratigraphical boundaries were established at each borehole location, as shown on the Record of Borelog sheets in the Appendix to this report.

4. SUBSOIL CONDITIONS:

4.1) General:

Shale bedrock is encountered at depths of 1 to 3 ft. below ground surface at the site. The upper 6 to 14 ft. of the bedrock is in a weathered condition.

4.2) Bedrock:

Bedrock was encountered at depths of 1 to 3 ft. below the ground surface at all the boreholes, the surficial overburden consisting of either topsoil or granular fill material.

4.2.1) Weathered Shale -

The upper 6 to 14 ft. of the bedrock was found to consist essentially of horizontally oriented shale fragments embedded in a matrix of red clayey silt believed to have been derived from the "in-situ" decomposition of the shale bedrock. The Standard

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

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

4.2.1) Weathered Shale - (cont'd.) ...

Penetration Resistance 'N' values in the weathered shale ranged from 38 blows per ft. near the surface to over 100 blows/ft. at depths of 4 to 6 ft. below ground surface.

4.2.2) Sound Shale -

Sound shale bedrock was encountered across the site at depths ranging from 9 to 15 ft. - i.e., at elevations 275 to 285. The shale is red in colour but occasionally, grey-coloured layers are also present. Isolated gypsum filled cavities are noticeable throughout the rock profile.

The core recoveries ranged between 80 and 100 per cent. In two isolated runs the core recoveries were much lower viz: 40 per cent at Borehole 5 and 50 percent at Borehole 7A. On the basis of the cores recovered, it is estimated that the bedrock below elevations 275 to ~~325~~²⁸⁵ is basically sound with isolated weathered seams occurring at random.

5. GROUNDWATER CONDITIONS:

Water level observations were carried out in the open boreholes upon completion of the field work. These observations are recorded on the individual Borelog sheets and are summarized on Drawing 69-F-12A. The groundwater level across the site is located within or near the surface of the weathered shale bedrock - i.e., at between elevations 285 and 289.

6. DISCUSSION AND RECOMMENDATIONS:

6.1) General:

It is proposed to construct an overpass to carry revised Q.E.W. over Bartlett Ave. Revision in Grimsby Beach. The revised Q.E.W. centre-line will be located some 40 ft. to the north of the existing Q.E.W. centre-line. The grade of the revised Q.E.W. will

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

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

be raised by about 13 ft. to elevation 304 - 305, whereas the proposed grade for Bartlett Avenue Revision will be at about elevation 281 - i.e., some 10 ft. below the existing Q.E.W. grade. The overpass is to be a 4-span (55'-56.5'-58.5'-55') structure having a width of 166 ft.

The investigation has revealed the presence of shale bedrock at a shallow depth (1 - 3 ft. below ground surface). The upper 6 to 14 ft. of the bedrock is in a weathered condition. Groundwater is encountered near the surface of, or within the weathered shale bedrock.

6.2) Structure Foundations:

The subsoil conditions at this site are favourable for the support of the proposed structure on spread footing type foundations, as discussed below:

6.2.1) Pier Footings -

The pier footings will be located below the proposed grade elevation of 281 for Bartlett Avenue Revision. Since both the weathered shale and sound shale are considered susceptible to frost action, the pier footings should be provided with a minimum soil cover of 4 ft. above the underside of the footings in order to prevent frost heaving. Therefore, the pier footings should be located at or below elevation 277. For the given pier locations, such footings will be located within the sound shale bedrock and may therefore be designed for allowable bearing pressures of 10 TSF.

6.2.2) Abutment Footings -

The abutments can be supported on spread footings founded on or within the weathered shale. Such footings may be designed for a safe allowable bearing pressure of 5 TSF.

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

6.2) Structure Foundations: (cont'd.) ...

6.2.3) Excavation and Dewatering -

In order to simplify dewatering of the proposed overpass, it is recommended that the approach cuts along Bartlett Avenue Revision be completed to profile grade (as discussed in Section 6.3 to follow), before construction of the structure foundations. If this procedure is followed, the resulting depth of excavation for the footings will be in the order of 4 to 5 feet below the finished grade. Any seepage from the weathered shale into the excavations can be handled by ordinary pumping methods.

In view of the susceptibility of the weathered shale to further deteriorate, and the sound shale to decompose rapidly upon exposure to water, it is recommended that the footing excavations be kept dry and be protected with a working slab of lean concrete as soon as excavation bottom is reached.

6.3) Approach Cuts and Fills:

The approach cuts for Bartlett Avenue Revision will vary in depth from about 13 ft. (north of the Q.E.W.) to 19 ft. (south of the Q.E.W.). The approach fills for the revised Q.E.W. grade will vary in height from about 19 ft. at the west approach to 9 ft. at the east approach.

The approach cuts will be made through weathered shale and partially through the sound shale bedrock. Previous experience in this area indicates that this shale is particularly susceptible to weathering and consequent erosion. Therefore, the cuts through this material should be treated as earth cuts and should be constructed with standard 2:1 slopes. The approach fills should also be constructed with standard 2:1 slopes. All cuts and fills should be treated with an adequate cover of topsoil and either seeded or sodded.

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

6.3) Approach Cuts and Fills: (cont'd.) ...

The existing groundwater level is situated approximately 6 to 7 ft. above the bottom of the proposed approach cut; some seepage through, and local sloughing of the weathered shale can therefore be expected when the excavation bottom is taken below the groundwater level. However, this problem will be of a temporary duration and minor in nature, since the overall excavation will result in a general lowering of the groundwater level across the site.

7. MISCELLANEOUS:

The field work, performed during the period April 21 - April 30, 1969, was carried out by Mr. V. Korlu, Project Foundation Engineer.

Equipment used was owned and operated by Dominion Soil Investigation Ltd.

This report was prepared by Mr. C. Mirza, Project Foundation Engineer.

General supervision and review of report was undertaken by Mr. M. Devata, Supervising Foundation Engineer.

July 1969

دانشگاه تهران، دانشکده مدیریت، تهران، ایران

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 1

FOUNDATION SECTION

JOB 69-F-12

LOCATION Sta 288 + 39 ∇ Prop. Q.E.W. Rev'n. o/s 81.1' Rt.

ORIGINATED BY VK

W.P. 370-65-01

BORING DATE April 21, 1969

COMPILED BY WH & CM

DATUM Geodetic

BOREHOLE TYPE Washboring - NX Casing Cone

CHECKED BY

SOIL PROFILE		SAMPLES		ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT					LIQUID LIMIT ——— % PLASTIC LIMIT ——— % WATER CONTENT ——— %		BULK DENSITY Y	REMARKS
ELEV. DEPTH	DESCRIPTION	NUMBER	TYPE		20	40	60	80	100	W _L ——— % W _P ——— %	W _c ——— %		
287.5	Ground Level												
285.5	Fill Material												
2.0		1	SS 100/6"										
	Weathered	2	SS 100/1"	280									
277.5		3	SS 100/1"										
10.0	Shale Bedrock	4	BXL 80%										
	Sound	5	BXL 95%	270									
		6	BXL 100%										
262.5													
25.0	End of Borehole			260									

P.C.F. GR. SA. SI. CL.

▼ 286.5

Apr. 30/69

DEPARTMENT OF HIGHWAYS- ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No 2

FOUNDATION SECTION

JOB 69-F-12 LOCATION Sta. 288+56 \varnothing Prop. Q.E.W. Rev'n. o/s 88.5' Lt.
 W.P. 370-65-01 BORING DATE April 24, 1969
 DATUM Geodetic BOREHOLE TYPE Washboring - NX Casing; Cone

ORIGINATED BY VK
 COMPILED BY WH & CM
 CHECKED BY

SOIL PROFILE		SAMPLES			DYNAMIC PENETRATION RESISTANCE					LIQUID LIMIT ——— % PLASTIC LIMIT ——— % WATER CONTENT ——— %		BULK DENSITY γ P.C.F.	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS/FOOT	ELEV SCALE	20	40	60	80	100		
296.1	Ground Level												
0.0	Topsoil & Fill												
293.1	Material												
3.0			1	SS	38								
			2	SS	100/6"	290							
	Weathered		3	SS	100/4"								
			4	SS	100/2"								
281.0			5	SS	100/1"	280							
15.1			6	BXL	87%								
	Shale Bedrock		7	BXL	83%								
	Sound		8	BXL	100%	270							
			9	BXL	100%								
261.1													
35.0	End of Borehole					260							

287.4
 Apr. 30/69

DEPARTMENT OF HIGHWAYS- ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 3

FOUNDATION SECTION

JOB 69-F-12

LOCATION Sta. 288+94 \varnothing Prop. Q.E.W. Rev;n. o/s 85.0' Rt.

ORIGINATED BY

VK

W.P. 370-65-01

BORING DATE April 22, 1969

COMPILED BY

WH & CM

DATUM Geodetic

BOREHOLE TYPE Washboring - NX Casing; Cone

CHECKED BY

/L

SOIL PROFILE		SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE	LIQUID LIMIT		BULK DENSITY	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE		BLOWS / FOOT	20 40 60 80 100	PLASTIC LIMIT		
						SHEAR STRENGTH PSF		WATER CONTENT %		
						○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB. VANE		W _L W _P W		
290.3	Ground level									
0.0	Fill Material	X			290					▼ 288.3
1.0			1	SS 100/1"						June 19/69
			2	SS 100/1"						
	Weathered		3	SS 100/3"	280					
			4	SS 100/3"						
275.2			5	SS 100/1"						
15.1	Shale Bedrock		6	BXL 90%	270					
	Sound		7	BXL 100%						
265.3										
25.0	End of Borehole				260					

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No 3A

FOUNDATION SECTION

JOB 69-P-12

LOCATION Sta. 289+04 0 Prop. C.B.W. Rev'n. 9/s 13.0' Lt.

ORIGINATED BY

VK

W.P. 370-65-01

BORING DATE April 24, 1969

COMPILED BY

WH & CM

LOCATION Goodetio

BOREHOLE TYPE Washboring NX Casing

CHECKED BY

ELEV. (FEET)	ADJ. PROFILE	DESCRIPTION	STRAT. POS.	SAMPLES NUMBER	TYPE	BLOWS/FOOT	ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS/FOOT					LIQUID LIMIT PLASTIC LIMIT WATER CONTENT	SHEAR STRENGTH	REMARKS
								20	40	60	80	100			
								SHEAR STRENGTH (PSF)							
								O UNCONFINED - FIELD VANE ● QUICK TRIAXIAL - LAB VANE							
								WATER CONTENT %							
289.5		Ground Level													OR SA SI CL
288.2															▼ 288.2
280.4		Weathered		1	SS	100/6"									Apr. 30/69
				2	SS	100/5"									
280.4				3	SS	100/1"	280								
9.1				4	AXT	100%									
		Shale Bedrock		5	AXT	90%									
		Sound		6	AXT	100%	270								
260.5				7	AXT	100%									
29.0		End of Borehole					260								

DEPARTMENT OF HIGHWAYS- ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No.4

FOUNDATION SECTION

JOB 69-F-12

LOCATION Sta. 289+12 @ Prop. Q.E.W. Rev'n. o/s 88.5' Lt.

ORIGINATED BY VK

M.P. 370-65-01

BORING DATE April 23, 1969

COMPILED BY WH & CM

DATUM Geodetic

BOREHOLE TYPE Washboring - NX Casing; Cone

CHECKED BY

SOIL PROFILE		SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE		LIQUID LIMIT		BULK DENSITY	REMARKS
ELEV. / DEPTH	DESCRIPTION	NUMBER	TYPE	BLOWS / FOOT		BLOWS / FOOT		PLASTIC LIMIT			
						20	40	60	80		
SHEAR STRENGTH P.S.F.						UNCONFINED		FIELD VANE		WATER CONTENT %	
						QUICK TRIAXIAL		LAB. VANE			
294.4	Ground Level										
0.0	Topsoil & Fill										
291.4	Material										
3.0		1	SS	48	290						
		2	SS	100/6"							
	Weathered	3	SS	100/6"							
		4	SS	100/3"							
279.4					280						
15.0		5	BXL	100%							
	Shale Bedrock										
	Sound	6	BXL	83%	270						
		7	BXL	93%							
264.4											
30.0	End of Borehole				260						

288.0

June 19/69

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No 5

FOUNDATION SECTION

JOB 69-F-12

LOCATION Sta. 289 + 51 E Prop. Q.E.W. Rev'n. o/s 89.5' Rt.

ORIGINATED BY VK

W.P. 370-65-01

BORING DATE April 23, 1969

COMPILED BY WH & CM

DATUM Geodetic

BOREHOLE TYPE Washboring - NX Casing

CHECKED BY

SOIL PROFILE		SAMPLES		ELEV. SCALE	DYNAMIC PENETRATION BLOWS / FOOT	RESISTANCE	LIQUID LIMIT ——— w_L PLASTIC LIMIT ——— w_p WATER CONTENT ——— w		BULK DENSITY Y	REMARKS
ELEV. DEPTH	DESCRIPTION	NUMBER	TYPE				SHEAR STRENGTH P.S.F. ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB. VANE			
291.3	Ground Level									
289.0	Fill Material			290						▼ 289.3
2.3	Weathered	1	SS 100/6"							Apr. 30/69
		2	SS 100/5"							
281.3		3	SS 100/2"							
10.0	Shale Bedrock Sound	4	BXL 90%	280						
		5	BXL 90%							
		6	BXL 40%	270						
		7	BXL 100%							
261.3	End of Borehole									
30.0				260						

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 7

FOUNDATION SECTION

JOB 69-F-12 LOCATION Sta. 290+10 Ø Prop. Q.E.W. Rev'n. o/s 91.0' Rt. ORIGINATED BY VK
 W.P. 370-65-01 BORING DATE April 22, 1969 COMPILED BY WH & CM
 DATUM Geodetic BOREHOLE TYPE Washboring - NX Casing CHECKED BY *SK*

SOIL PROFILE		SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE		LIQUID LIMIT ——— % PLASTIC LIMIT ——— % WATER CONTENT ——— %		BULK DENSITY	REMARKS
ELEV. DEPTH	DESCRIPTION	NUMBER	TYPE	BLOWS / FOOT		SHEAR STRENGTH P.S.F.		WATER CONTENT %			
						○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE					
292.0	Ground Level										
0.0	Fill Material				290						▼ 288.7
1.0											
	Weathered	1	SS 100/6"								
		2	SS 100/5"								
282.9		3	SS 100/1"								June 19/69
9.1		4	BXL 81%	280							
	Shale Bedrock	5	AXT 100%								
	Sound	6	AXT 100%	270							
		7	AXT 100%								
263.0											
29.0	End of Borehole				260						

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No 7A

FOUNDATION SECTION

JOB 69-F-12

LOCATION Sta. 290 + 19 @ Prop. Q.E.W. Rev'n. o/s 6.0' Lt,

ORIGINATED BY

VK

W P 370-65-01

BORING DATE April 23, 1969

COMPILED BY

WH & CM

DATUM Geodetic

BOREHOLE TYPE Washboring - NX Casing

CHECKED BY

SOIL PROFILE		SAMPLES		ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT	LIQUID LIMIT PLASTIC LIMIT WATER CONTENT	LOG CORRECTION	REMARKS
ELEV. DEPTH	DESCRIPTION	NUMBER	TYPE		SHEAR STRENGTH P.S.F. ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL X LAB VANE	WATER CONTENT %		
291.5	Ground Level							
0.0	Fill Material			290				▼ 289.1
1.0		1	SS 100/6"					
	weathered	2	SS 100/3"					Apr. 30/69
282.3		3	SS 100/2"					
9.2		4	AXT 50%	280				
	Shale Bedrock	5	AXT 100%					
	Sound	6	AXT 100%	270				
		7	AXT 100%					
262.5								
29.0	End of Borehole			260				

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 8

FOUNDATION SECTION

JOB 69-F-12

LOCATION Sta. 290 + 28 @ Prop. Q.E.W. Rev'n. o/s 88.5' Lt.

ORIGINATED BY

VK

W.P. 370-65-01

BORING DATE April 24, 1969

COMPILED BY

WH & CM

DATUM Geodetic

BOREHOLE TYPE Washboring - NX Casing; Cone

CHECKED BY

[Signature]

SOIL PROFILE		SAMPLES		DYNAMIC PENETRATION		RESISTANCE		LIQUID LIMIT		PLASTIC LIMIT		WATER CONTENT		BULK DENSITY	REMARKS
ELEV. DEPTH	DESCRIPTION	NUMBER	TYPE	BLOWS/FOOT	ELEV. SCALE	20	40	60	80	100	W _L	W _P	W		
292.1	Ground Level														
0.0	Topsoil & Fill														
289.1	Material														
3.0	Weathered	1	SS 150		290										
		2	SS 100/3"												
283.0		3	SS 100/1"												
9.1		4	AXT 82%		280										
		5	AXT 90%												
	Shale Bedrock														
	Sound	6	AXT 100%		270										
		7	AXT 100%												
		8	AXT 100%		260										
258.1															
34.0	End of Borehole														
					250										

201 GR. SA. SI. CL.

285.8

Apr. 30/69

DEPARTMENT OF HIGHWAYS - ONTARIO

RECORD OF BOREHOLE No 9

FOUNDATION SECTION

MATERIALS & TESTING OFFICE

JOB 69-F-12

LOCATION Sta. 290 + 64 ½ PROP. Q.E.W. Rev'n. o/s 91.0' Rt. ORIGINATED BY VK

W.P. 370-65-01

BORING DATE April 21, 1969

COMPILED BY

WH & CM

DATUM Geodetic

BOREHOLE TYPE Washboring - NX Casing

CHECKED BY

SOIL PROFILE		STRAT POT	SAMPLES		BLOWS / FOOT	ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT		LIQUID LIMIT ——— w_L PLASTIC LIMIT ——— w_p WATER CONTENT ——— w		BULK DENSITY γ P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION		NUMBER	TYPE			SHEAR STRENGTH PSF		WATER CONTENT %			
							○ UNCONFINED ● QUICK TRIAXIAL	+ FIELD VANE x LAB VANE				
293.5	Ground Level											
291.5	Fill Material		1	SS 100/6"	290							▼ 289.5
2.0			2	SS 100/5"								June.19/69
	Weathered		3	SS 100/4"								
281.5												
12.0			4	BXL 100%	280							
	Shale Bedrock											
271.5	Sound		5	BXL 100%								
22.0	End of Borehole				270							

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 10

FOUNDATION SECTION

JOB 69-P-12

LOCATION Sta. 290 + 83 @ Prop. Q.E.W. Rev'n. o/s 88.5' Lt.

ORIGINATED BY VK

W.P. 370-65-01

BORING DATE April 25, 1969

COMPILED BY

WH & CM.

DATUM Geodetic

BOREHOLE TYPE Washboring - NX Casing; Cone

CHECKED BY

SOIL PROFILE		SAMPLES		DYNAMIC PENETRATION RESISTANCE					LIQUID LIMIT - W _L PLASTIC LIMIT - W _P WATER CONTENT - W ₁		REMARKS
ELEV DEPTH	DESCRIPTION	NUMBER	TYPE	BLOWS/FOOT	ELEV	20	40	60	80	100	
290.2	Ground Level										
0.0	Topsoil & Fill				290						
288.2	Material										
2.0		1	SS	74							
	Weathered	2	SS	100/4"							
281.1		3	SS	100/1"							
9.1		4	AXT	80%	280						
		5	AXT	80%							
	Shale Bedrock	6	AXT	80%	270						
	Sound	7	AXT	100%							
		8	AXT	100%	260						
256.2											
34.0	End of Borehole				250						

▼ 285.5
Apr. 30/69

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>g. 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

SS	SPLIT SPOON	TW	THINWALL OPEN
WS	WASHED SAMPLE	TP	THINWALL PISTON
SB	SCRAPER BUCKET SAMPLE	US	GESTERBERG 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
Q	UNDRAINED TRIAXIAL	FV	FIELD VANE
Q _{cu}	CONSOLIDATED UNDRAINED TRIAXIAL	C	CONSOLIDATION
Q _d	DRAINED TRIAXIAL	S	SENSITIVITY

ABBREVIATIONS USED IN THIS REPORT

SOIL PROPERTIES

γ	UNIT WEIGHT OF SOIL (BULK DENSITY)
γ_s	UNIT WEIGHT OF SOLID PARTICLES
γ_w	UNIT WEIGHT OF WATER
γ_d	UNIT DRY WEIGHT OF SOIL (DRY DENSITY)
γ'	UNIT WEIGHT OF SUBMERGED SOIL
G	SPECIFIC GRAVITY OF SOLID PARTICLES $G = \frac{\gamma_s}{\gamma_w}$
e	VOID RATIO
n	POROSITY
w	WATER CONTENT
S_r	DEGREE OF SATURATION
w_L	LIQUID LIMIT
w_p	PLASTIC LIMIT
I_p	PLASTICITY INDEX
s	SHRINKAGE LIMIT
I_L	LIQUIDITY INDEX $= \frac{w - w_p}{I_p}$
I_C	CONSISTENCY INDEX $= \frac{w_L - w}{I_p}$
e_{max}	VOID RATIO IN LOOSEST STATE
e_{min}	VOID RATIO IN DENSEST STATE
I_D	DENSITY INDEX $= \frac{e_{max} - e}{e_{max} - e_{min}}$
	RELATIVE DENSITY D_r IS ALSO USED
h	HYDRAULIC HEAD OR POTENTIAL
q	RATE OF DISCHARGE
v	VELOCITY OF FLOW
i	HYDRAULIC GRADIENT
k	COEFFICIENT OF PERMEABILITY
j	SEEPAGE FORCE PER UNIT VOLUME
m_v	COEFFICIENT OF VOLUME CHANGE $= \frac{-\Delta e}{(1+e)\Delta\sigma}$
c_v	COEFFICIENT OF CONSOLIDATION
C_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
τ	SHEAR STRENGTH
c	EFFECTIVE COHESION
	INTERCEPT
ϕ	EFFECTIVE ANGLE OF SHEARING RESISTANCE OR FRICTION
	IN TERMS OF EFFECTIVE STRESS $\tau = c' + \sigma' \tan \phi'$
c_u	APPARENT COHESION
ϕ_u	APPARENT ANGLE OF SHEARING RESISTANCE OR FRICTION
	IN TERMS OF TOTAL STRESS $\tau = c_u + \sigma \tan \phi$
μ	COEFFICIENT OF FRICTION
S	SENSITIVITY

GENERAL

π	$= 3.1416$
e	BASE OF NATURAL LOGARITHMS 2.7183
$\log_e \sigma$ OR $\ln \sigma$	NATURAL LOGARITHM OF σ
$\log_{10} \sigma$ OR $\log \sigma$	LOGARITHM OF σ TO BASE 10
t	TIME
g	ACCELERATION DUE TO GRAVITY
V	VOLUME
W	WEIGHT
M	MOMENT
F	FACTOR OF SAFETY

STRESS AND STRAIN

u	PORE PRESSURE
σ	NORMAL STRESS
$\bar{\sigma}$	NORMAL EFFECTIVE STRESS ($\bar{\sigma}$ IS ALSO USED)
τ	SHEAR STRESS
ϵ	LINEAR STRAIN
γ	SHEAR STRAIN
ν	POISSON'S RATIO (μ IS ALSO USED)
E	MODULUS OF LINEAR DEFORMATION (YOUNG'S MODULUS)
G	MODULUS OF SHEAR DEFORMATION
K	MODULUS OF COMPRESSIBILITY
η	COEFFICIENT OF VISCOSITY

EARTH PRESSURE

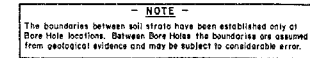
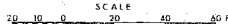
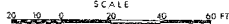
d	DISTANCE FROM TOP OF WALL TO POINT OF APPLICATION OF PRESSURE
δ	ANGLE OF WALL FRICTION
K	DIMENSIONLESS COEFFICIENT TO BE USED WITH VARIOUS SUFFIXES IN EXPRESSIONS REFERRING TO NORMAL STRESS ON WALLS
K_0	COEFFICIENT OF EARTH PRESSURE AT REST

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
β	ANGLE OF SLOPE TO HORIZONTAL

[illegible]

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

BARTLETT		AVE.		REV'N	
KING'S HIGHWAY NO.		Q.E.W.		DIST. NO. 4	
CO. LINCOLN					
TWP. N GRIMSBY		LOT 2		CON. 1	
BORE HOLE LOCATIONS & SOIL STRATA					
SHEATH, J. L. CHECKED		WP NO. 370 - 65 - 1		U.S.T. DRAWING NO.	
DRAWN A. J. CHECKED		JOB NO. 69 - F - 12		69 - F - 12	
DATE JULY 24, 1969		SITE NO.		GR-502 DRAWING NO.	
APPROVED <i>[Signature]</i>		ENGINEER			
DATE		CONTRACT NO.			

MEMORANDUM

To: Mr. H. Devata
Supervising Foundation
Engineer

From: K. Tughan
Materials and Testing Office

Date: August 14, 1969

Our File Ref.

IN REPLY TO

Subject: Foundation Conditions in the Vicinity of the
Proposed Grimsby Interchange Complex

69-F-12

This memo will summarize our visit to the site, and collective observations concerning the stratigraphy of the area. Attached are a list of the exposures examined, together with a brief description.

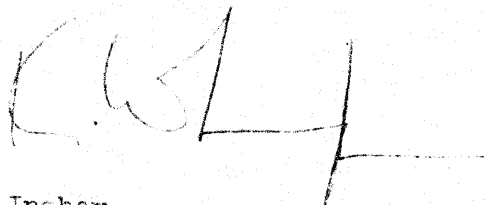
Different zones are present which correspond approximately with layers described in foundation reports for the various structures. The Queenston shale bedrock is overlain by a dense till but between the till and the bedrock horizon that can be positively identified as sound and unweathered, a variable thickness of broken or partly weathered shale exists which is transitional with the till above and the undisturbed shale below.

The Queenston shale is thin bedded but relatively homogeneous, that is, it does not possess the characteristic fissility that is common to shale - this may be partly due to the calcareous content. Harder calcareous or sandy bands are occasionally present throughout the sections exposed. The sound shale breaks down slowly in the presence of water by the spalling of small flakes from the surface. This effect becomes progressively slower unless the detritus is continually removed. The resulting material will eventually form a relatively plastic clay. It is believed that the zone of broken shale is a preliminary stage in this process. If a veneer of clay originally capped the broken shale this has been incorporated in the till.

The broken shale, although still preserving the original bedding, is fragmented into pieces up to 24 in. size; the ~~thinner~~ beds are often broken into flat slabs 1 to 2 ft. in length. It is assumed that in any cut drainage channel the broken fragments would eventually form a stable bed. This zone will in all probability be a water bearing horizon. In open excavations steep cut slopes would be stable; however, from a

maintenance point of view your decision to use normal earth slopes seems more logical in this case.

Transitions from till to broken shale and broken shale to sound shale are relatively sharp with only 0.5 to 1.0 ft. of transition zone between each horizon. The transition from broken to sound shale is largely academic as very little difference should be noticed during excavation.

A handwritten signature in dark ink, appearing to read 'K. Ingham', with a long horizontal line extending to the right.

K. Ingham
Geologist

RI:nm
Encl.

Exposures

1. The west bank of 40 mile creek and the future centre line of Cristie Street.

0 - 5.0 ft. Dense clayey silt till - 0.5 ft. transition zone with broken shale fragments at the base.

5.0 - 15.0 ft. Broken red and brown shale with occasional green - gray layers. Preserving original stratification.

15.0 - 16.0 ft. Transition from broken to sound shale.

16.0 - 35.0 ft. Red and brown thin bedded shale with minor thin green bands. Occasional grey interbeds of calcareous or sandy shale, 0.1 to 0.3 ft. in thickness.

2. Bank of 40 mile creek south of the intersection of Fairview and Patton Streets. Hand-dug trench.

0 - 7.5 ft. Dense clayey silt till.

7.5 - 8.0 ft. Transition zone, abundant red shale fragments in the lower half.

8.0 - 18.0 ft. Broken red and brown shale.

18.0 - 20.0 ft. Transition from broken to sound shale.

20.0 ft. + Red and brown thin bedded shale with minor thin green bands.

3. Future O.E.W. and Bartlett Rd. Interchange, south of D.F. track 10 ft. north of hole No. 5 (P-13) in small creek bank.

0 - 4.0 ft. Dense till.

4.0 - 4.7 ft. Transition from till to broken shale.

4.7 - 5.5 ft. Broken shale.

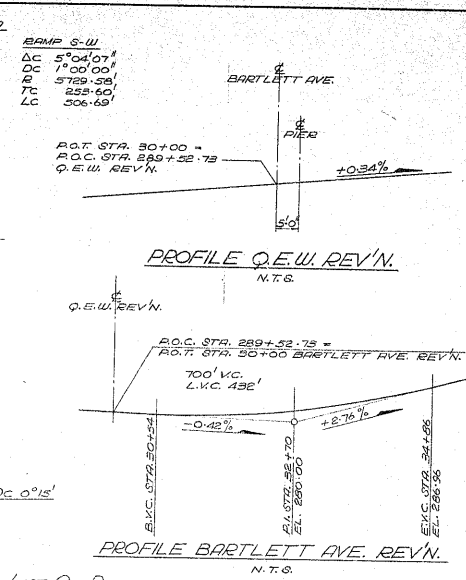
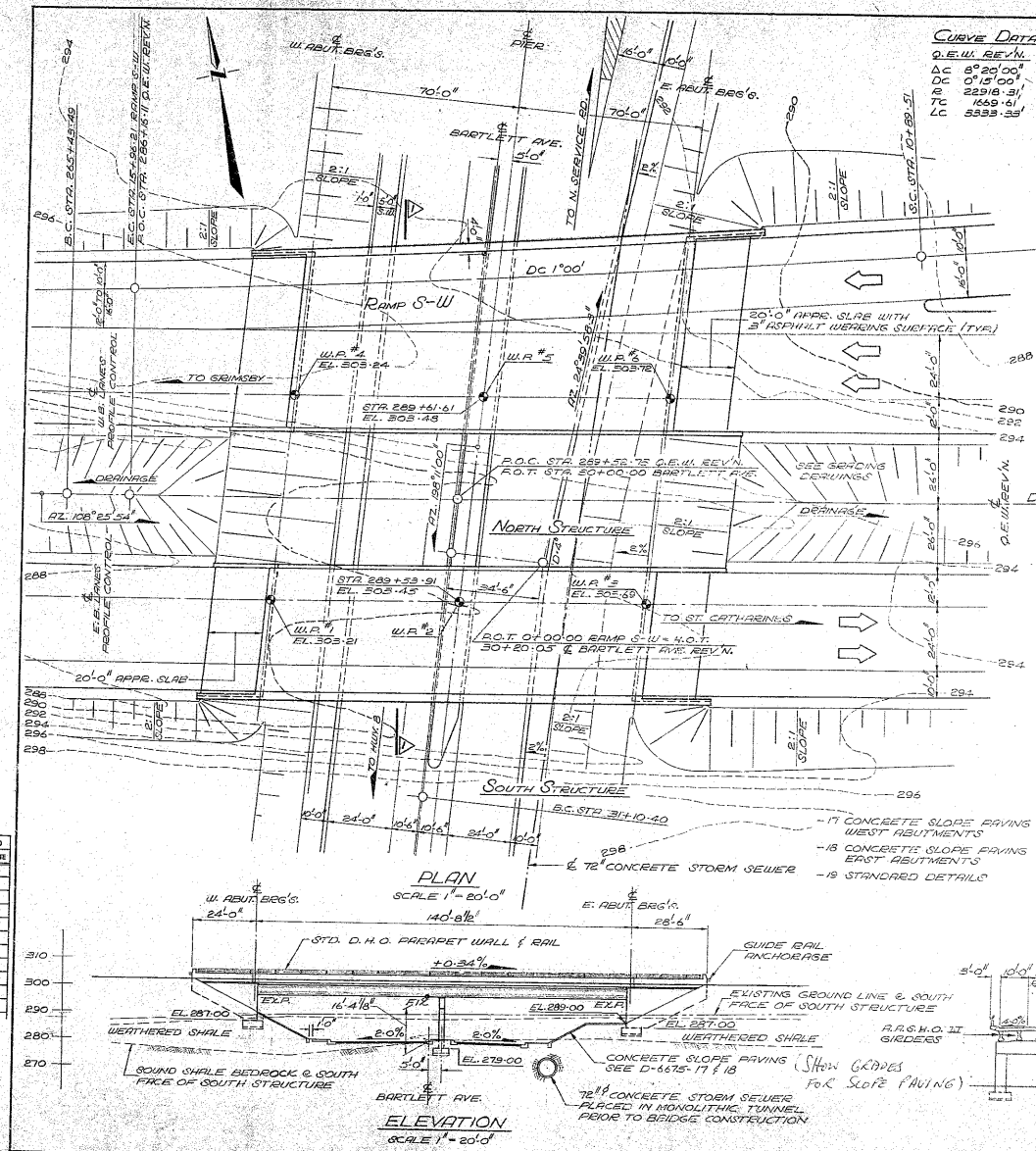
5.5 - 12.0 ft. + Broken shale in banks of O.E.W. road cut.

#69-F-12

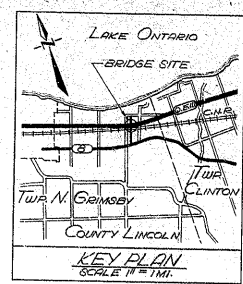
W.P. 370-65-01

Q.E.W. REV'D. AND

BARTLETT AVE. REV'D.



- LIST OF DRAWINGS**
- D-6675-1 GENERAL LAYOUT ✓
 - 2 BORE HOLE LOCATIONS ✓
 - 3 FOOTINGS AND SITE LAYOUT PLANS ✓
 - 4 PIER DETAILS-SOUTH STRUCTURE ✓
 - 5 PIER DETAILS-NORTH STRUCTURE ✓
 - 6 WEST ABUT-SOUTH STRUCTURE ✓
 - 7 EAST ABUT-SOUTH STRUCTURE ✓
 - 8 WEST ABUT-NORTH STRUCTURE ✓
 - 9 EAST ABUT-NORTH STRUCTURE ✓
 - 10 PRESTRESSED GIRDERS AND BEARINGS ✓
 - 11 DECK DETAILS-SOUTH STRUCTURE ✓
 - 12 DECK DETAILS-NORTH STRUCTURE ✓
 - 13 PARAPET WALL DETAILS ✓
 - 14 STANDARD STEEL PARAPET RAIL ✓
 - 15 APPROACH SLABS-SOUTH STRUCTURE ✓
 - 16 APPROACH SLABS-NORTH STRUCTURE ✓



NOTES

CLASS OF CONCRETE
DECK, CURBS AND PARAPET WALLS 4000 P.S.I.
REINFORCERS 3,000 P.S.I. (OR AS NOTED)

CLERS COVER ON REINFORCING STEEL

FOOTINGS
REINFORCEMENTS 3"

PIER COLUMNS
3"

DECK
1 1/2" TOP
1 1/2" BOT.

CLERS APPROACH SLABS
2"

PARAPET WALLS
DIAPHRAGMS 1 1/2"

PIER CAPS
1 1/2"

AND/OR AS NOTED ON DRAWINGS

CONSTRUCTION NOTES
THE CONTRACTOR IS RESPONSIBLE FOR FINISHING THE BEARING SEATS DEAD LEVEL TO THE SPECIFIED ELEVATIONS WITH A TOLERANCE OF 1/8 INCH.
NO CONCRETE SHALL BE PLACED ABOVE THE BEARING SEATS UNTIL THE CONCRETE IN THE DECK HAS BEEN PLACED.

B.M. 304.40
GEODETIC DATUM
CUT CORNER ON TOP OF N.W. CORNER CONCRETE PLATFORM 15.2' ET. STA. 287+57 (Q.E.W.)
22.2' ET. STA. 287+10 (Q.E.W. REV'N.)

REVISIONS	DATE	BY	DESCRIPTION

DEPARTMENT OF HIGHWAYS ONTARIO
BRIDGE DIVISION

(9-P-12)

BARTLETT AVE. OVERPASS

KING'S HIGHWAY No. Q.E.W. DIST. No. 4
CO. LINCOLN
TWP. N. GRIMSBY LOT 2 CON. 1

GENERAL LAYOUT

APPROVED: [Signature] DATE: JUNE 70

DESIGNED: [Signature] CHECK: [Signature] CONTRACT: [Signature]
DRAWING: [Signature] DATE: JUNE 70

FOR REDUCED PLAN
USE SCALE BELOW
1" = 3 INCHES ON ORIGINAL PLAN

