

MEMORANDUM

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

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

ATTENTION: Mr. S. McCombie

DATE: August 7, 1969

OUR FILE REF.

IN REPLY TO

SUBJECT:

FOUNDATION INVESTIGATION REPORT

For

Proposed Culverts

Forty Mile Creek Relocation in the

Town of Grimsby

Twp. of N. Grimsby - County of Lincoln

District No. 4 (Hamilton)

W.J. 69-F-14 -- W.P. 222-63-07,-08,-09

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

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/MseF
Attach.

A. G. Sternac
A. G. Sternac
PRINCIPAL FOUNDATION ENGINEER

cc: Messrs. E. R. Davis (2)
H. A. Tregaskes
D. W. Farren
G. K. Hunter (2)
H. Greenland
W. S. Melinyshyn
T. J. Kovich
B. A. Singh

Foundations Files ✓
Gen. Files

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FOUNDATION INVESTIGATION REPORT
For
Proposed Culverts
Forty Mile Creek Relocation in the
Town of Grimsby
Twp. of N. Grimsby - County of Lincoln
District No. 4 (Hamilton)
W.J. 69-F-14 -- W.P. 222-63-07, -08, -09

1. INTRODUCTION:

The Foundation Section was requested to carry out subsurface investigations at various proposed culvert locations where the realigned Forty Mile Creek will cross beneath roadways associated with the Q.E.W. improvements in the Town of Grimsby. The request was contained in a memo from the Bridge Office - (Mr. W. S. Melinyshyn, Regional Bridge Location Engineer) dated February 18, 1969. Subsequently, foundation investigations were carried out for the proposed culverts at Christie St. Rev'n., Ramp W. - Grimsby - E., Ramp E. - Grimsby - W. and Olive St. extension easterly. This report contains the results of our investigations at the aforementioned locations, together with our recommendations pertaining to the design of the various culverts.

2. DESCRIPTION OF THE SITES AND GEOLOGY:

The sites investigated are located in the Town of Grimsby. Forty Mile Creek through the Town of Grimsby is a meandering, shallow stream which has, at some locations, cut its course through shale bedrock. In certain areas, the Creek is bordered by steep shaly bluffs.

Physiographically, the sites are located in the "Niagara Fruit Belt" sub-section of the "Iroquois Plains" physiographic region which is underlain by shale bedrock of the Queenston Formation, Ordovician Period.

3. FIELD AND LABORATORY WORK:

A total of 16 boreholes, 15 of which were accompanied by dynamic cone penetration tests, was carried out at the proposed culvert locations using a standard diamond drill rig adapted for soil sampling purposes. In addition, three shallow test pits were dug out manually in order to observe the natural soil and rock stratification.

Samples were obtained at the required depths by hammering a 2-inch O.D. split-spoon sampler in accordance with the specifications for the Standard Penetration Test. The same method was used to advance the dynamic cone penetration tests. In the weathered shale, the boreholes were advanced by drilling with a tricone bit. Sound bedrock was proven by core drilling in EXL or AXT core size at all the borehole locations.

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 the boreholes and test pits are shown on Drawing 69-F-14A, together with estimated stratigraphic sections through the proposed culvert locations.

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

4. SUBSOIL CONDITIONS:

4.1) General:

The subsoil at the various sites consists of a thin layer of topsoil or fill material followed by shale bedrock at a depth of 2 to 5 ft. below the ground surface.

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

4.2) Fill Material:

Fill material was encountered beneath a surficial layer of topsoil at Boreholes 2, 3 and 12 to 17 inclusive. At Boreholes 2 and 3, the fill material consisted of clayey silt with fragments of wood and occasional pieces of glass. At Boreholes 12 to 17 inclusive, the fill material consisted of reworked shale containing gravel and decayed wood fragments. Based on a limited number of standard penetration tests, the fill is considered to be poorly compacted.

4.3) Shale Bedrock:

Underlying the fill material at Boreholes 2, 3 and 12 to 17 inclusive, or a surficial 2-ft. thick layer of topsoil at the other borehole locations, a reddish-coloured bedrock was encountered at depths of 2 to 5 ft. below the ground surface at the various sites.

4.3.1) Weathered Shale -

The shale bedrock was found to be in a weathered condition at most of the borehole locations. The thickness of the weathered shale ranged from a few inches to almost 6 ft., generally averaging about 3 ft. The weathered material consists of shale fragments embedded in a clayey silt matrix believed to have been derived from the in-situ decomposition of the parent rock. Standard Penetration Resistance 'N' values in the weathered rock exceeded 100 blows/ft.

4.3.2) Sound Shale -

Sound shale bedrock was encountered between elevations 255 and 262 at Boreholes 1 to 9 and between elevations 243 and 253 at the other borehole locations. The recovery of rock cores below these elevations averaged about 80 per cent; however, occasionally lower recoveries were also obtained, indicating the bedrock to be generally sound, with occasional, random, localized weathered zones.

5. GROUNDWATER CONDITIONS:

Water level observations were carried out in the open boreholes upon completion of the field work. These observations indicate the groundwater to be situated at depths of 1 to 6 ft. below the existing ground surface at the various sites. At Boreholes 1 to 3 inclusive, the groundwater level was situated between elevations 262 and 266, whereas at Boreholes 12 to 15 inclusive, the groundwater level was between elevations 252 and 256.

6. DISCUSSION AND RECOMMENDATIONS:

6.1) General:

It is proposed to relocate Forty Mile Creek through the Town of Grimsby as a result of the Q.E.W. improvements contemplated in that area. The realignment will follow approximately the existing channel, with minor changes. According to available information, the invert elevation of the relocated Creek will be about the same as the existing stream bed elevation. The new channel will be unlined.

Present proposals call for arch type culverts, about 35 ft. in span, at the crossings of the relocated Forty Mile Creek with Christie St. Revision, Ramp W. - Grimsby - E., Ramp E. - Grimsby - W. and Olive St. extension easterly. All the available information at these proposed crossings is summarized below:

<u>Location</u>	<u>Length of Culvert</u>	<u>Height of Fill Above Creek Bed</u>	<u>Probable Invert Elevation</u>	
			<u>@ Entrance</u>	<u>@ Exit</u>
Christie St.	320'	45' ±	265	261.5
Ramp W. - E.	190'	40' ±	261	259
Ramp E. - W.	180'	30' ±	254	252.5
Olive St.	180'	30' ±	250 ±	

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

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

The investigation shows that the subsoil at the various sites consists of a thin layer of topsoil or fill material followed by shale bedrock 2 to 5 ft. below the ground surface.

6.2) Structure Foundations:

In view of the presence of shale bedrock at a relatively shallow depth, it is recommended that the arch type culverts at the aforementioned locations be founded on spread footings.

Since both the weathered and sound shales are considered frost susceptible, the spread footings should be founded at least 4 ft. below the invert elevation. For the proposed invert elevations (See Section 6.1)), such footings will be located on the sound shale and may therefore be designed for a safe allowable bearing pressure of 10 Tsf.

The sound shale can deteriorate and soften when exposed to water. Therefore, the excavations should be kept dry either by ordinary pumping methods and/or by driving temporary sheeting in order to prevent excessive seepage, if any, from the weathered shale into the excavation. In any event, it is recommended that a thin mat of lean concrete be poured as soon as excavation bottom is reached.

6.3) Fill Stability:

No stability problems are anticipated for the fill heights contemplated at the proposed culvert locations provided the fills are constructed of well compacted material, with standard 2:1 slopes. The settlement of the structures under the proposed fill heights will be negligible.

7. MISCELLANEOUS:

The field work, performed during the period May 8 - 21, 1969, was carried out by Mr. V. Korlu, Project Foundation Engineer.

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

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

The entire project was under the general supervision of Mr. E. Devata, Supervising Foundation Engineer, who also reviewed this report.

August 1969.

APPENDIX I

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 1

FOUNDATION SECTION

JOB 69-F-14

W.P. 222-63-7,-8,-9

DATUM Geodetic

LOCATION Forty Mile Creek & Prop. Christie St. Rev'n. - Grimsby

BORING DATE May 9, 1969

BOREHOLE TYPE Washboring - NX Casing; Cone

ORIGINATED BY V.K.

COMPILED BY C.M.

CHECKED BY

SOIL PROFILE		SAMPLES		DYNAMIC PENETRATION RESISTANCE		LIQUID LIMIT		BULK X DENSITY	REMARKS
ELEV. DEPTH	DESCRIPTION	NUMBER	TYPE	BLOWS / FOOT	ELEV. SCALE	20	40		
268.9	Ground Level								
268.9	Topsoil								
2.0	(Weathered)	1	SS	100/6"					W.L. Elev. 266.1
262.4		2	SS	100/4"					
6.5			BXL	68%					
	Shale Bedrock	3	RC	Rec. 260					
	(Sound)	4	RC	Rec.					
			BXL	80%					
		5	RC	Rec. 250					
247.9									
21.0	End of Borehole								
					240				

FOUNDATION SECTION

V.K.

COMPILED BY C.M.

CHECKED BY *[Signature]*

[illegible]

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No 3

FOUNDATION SECTION

JOB 69-F-14 LOCATION Forty Mile Creek & Prop. Christie St. Rev'n - Grimsby ORIGINATED BY V.K.
 W.P. 222-63-7,-8,-9 BORING DATE May 8, 1969 COMPILED BY C.M.
 DATUM Geodetic BOREHOLE TYPE Washboring - NX Casing; Cone CHECKED BY

SOIL PROFILE		SAMPLERS		DYNAMIC PENETRATION RESISTANCE					LIQUID LIMIT ———	PLASTIC LIMIT ———	WATER CONTENT ———	WATER CONTENT %	REMARKS
ELEV	DEPTH	NUMBER	TYPE	BLOWS / FOOT	FEET	20	40	60	80	100			
267.1	Ground Level												
0.0	Fill Material												
263.1	(Weathered)	1	SS	69									
4.0		2	SS	100/2"									
259.0		3	BXL	40% 260									
8.1			RC Rec										
	Shale Bedrock		BXL	60%									
	(Sound)	4											
			RC Rec.										
			BXL	100%									
247.1		5			250								
			RC Rec.										
20.0	End of Borehole												
					240								

W.L.
Elev. 264.6

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 4

FOUNDATION SECTION

JOB 69-F-14

LOCATION Forty Mile Creek & Prop. Christie St. Rev'n - Grimsby

ORIGINATED BY

V.K.

W.P. 222-63-7,-8,-9

BORING DATE

May 12, 1969

COMPILED BY

C.M.

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	20	40			60	80	100	PLASTIC LIMIT	WATER CONTENT
268.4	Ground Level													
0.0	Topsoil													
266.4	(Weathered)	1	SS	63										
2.0		2	SS	100/2"										
262.2			BXL	80%	260									
6.2	Shale Bedrock (Sound)	3	RC	Rec.										
			BXL	80%										
252.4		4	RC	Rec										
16	End of Borehole				250									

P.C. FIG. SA, SI, CL

W.L.
Elev. 266.4

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 5

FOUNDATION SECTION

JOB 69-F-14 LOCATION Forty Mile Creek & Prop. Christie St. Rev'n - Grimsby ORIGINATED BY V.K.
 W.P. 222-63-7,-8,-9 BORING DATE May 13, 1969 COMPILED BY C.M.
 DATUM Geoditic 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	SHEAR STRENGTH P.S.F. ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB. VANE			
263.7	Ground Level												
261.7	Topsoil	1	SS	100/4"	260								W.L. Elev. 262.7
259.0	(Weathered)	2	BXL	80%									
4.7	Shale Bedrock (Sound)	3	RC	Rec.	250								
		4	BXL	80%									
244.7	End of Borehole		RC	Rec.									
19.0					240								

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 6

FOUNDATION SECTION

JOB 69-P-11

W.P. 222-63-7,-8,-9

DATUM Geodetic

LOCATION Forty Mile Creek & Prop. Christie St. Rev'n - Grimsby

BORING DATE May 14, 1969

BOREHOLE TYPE Washboring - NX Casing; Cone

ORIGINATED BY V.K.

COMPILED BY C.M.

CHECKED BY

SOIL PROFILE		SAMPLES		DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT	LIQUID LIMIT — % PLASTIC LIMIT — % WATER CONTENT — %	REMARKS
ELEV DEPTH	DESCRIPTION	NUMBER	TYPE			
264.2	Ground Level					
0.0	Topsoil					
262.2	(Weathered)	1	SS 100/5"			
259.2		2	BXL 50%			W.L. Elev. 262.2
5.0	Shale Bedrock (Sound)	3	RC Rec.			
		4	BXL 96%			
245.2			RC Rec.			
19.0	End of Borehole					

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 7

FOUNDATION SECTION

JOB 69-P-14 LOCATION Forty Mile Creek & Ramp W. - Grimsby - E
 W.P. 222-63-7,-8,-9 BORING DATE May 15, 1969
 DATUM Geodetic BOREHOLE TYPE Washboring - NX Casing; Cone

ORIGINATED BY V.K.
 COMPILED BY C.M.
 CHECKED BY

SOIL PROFILE		SAMPLES		DYNAMIC PENETRATION RESISTANCE					LIQUID LIMIT ———— PLASTIC LIMIT ———— WATER CONTENT ————		REMARKS
ELEV DEPTH	DESCRIPTION	NUMBER	TYPE	BLWS/FOOT	ELEV	DATE	SHEAR STRENGTH (PSF)			WATER CONTENT %	
263.0	Ground Level						0 UNTESTED — FIELD VANE ● QUICK TRIAXIAL — LAB VANE				
261.0	Topsoil										
2.0	(Weathered)	1	SS	13 7/10"	260						
258.0		2	BXL 90%								
5.0	Shale Bedrock (Sound)		RC Rec.								
		3	BXL 95%								
248.0			RC Rec.		250						
15.0	End of Borehole										
					240						

W.L.
 Elev. 262.5

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 8

FOUNDATION SECTION

JOB 69-F-14 LOCATION Forty Mile Creek & Ramp W. - Grimsby - E
 W.P. 222-63-7,-8,-9 BORING DATE May 15, 1969
 DATUM Geodetic BOREHOLE TYPE Washboring - NX Casing; Cone

ORIGINATED BY V.K.
 COMPILED BY G.M.
 CHECKED BY

SOIL PROFILE		SAMPLES		DYNAMIC PENETRATION RESISTANCE		LIQUID LIMIT		REMARKS						
ELEV	DEPTH	NUMBER	TYPE	BLOWS/FOOT	ELEV	20	40		60	80	100	PLASTIC LIMIT	WATER CONTENT	
263.3	Ground Level													
9.0														
261.3	Topsoil													
2.0														
258.3	(Weathered)	1	SS	126	260									
5.0														
	Shale Bedrock	2	BXL 80%											
253.3	(Sound)		RC Rec.											
10.0	End of Borehole													

W.L.
 Elev. 261.8

FOUNDATION SECTION

CHECKED 91

SOIL PROFILE		SAMPLES		DYNAMIC PENETRATION RESISTANCE		LIQUID LIMIT		REMARKS
ELEV DEPTH	DESCRIPTION	NUMBER	TYPE	BLOWS/FOOT	ELEV DEPTH	PLASTIC LIMIT	WATER CONTENT	
262.5	Ground Level							
0.0	Topsoil							
160.5	(Weathered)	1	ss 100/6"	260				No W.L. observations
255.0		2	BXL 60%					
7.5	Shale Bedrock (Sound)	3	RC Rec.					
247.5			BXL 100%					
15.0	End of Borehole		RC Rec.	250				
				240				

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 13

FOUNDATION SECTION

JOB 69-P-14

LOCATION Forty Mile Creek & Ramp E. - Grimsby -W

ORIGINATED BY V.K.

W.P. 222-63-7,-8,-9

BORING DATE May 21, 1969

COMPILED BY C.M.

DATUM Geodetic

BOREHOLE TYPE Washboring - NX Casing; Cone

CHECKED BY

SOIL PROFILE		SAMPLES		ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE					LIQUID LIMIT		PLASTICITY INDEX	REMARKS
ELEV. DEPTH	DESCRIPTION	NUMBER	TYPE		BLOWS	20	40	60	80	100	WATER CONTENT %		
256.5	Ground Level												
0.0	Topsoil & Fill												
253.5	(Weathered)	1	SS	150									▼ W.L. Elev. 254.2
251.5		2	BXL	90%	250								
5.0													
	Shale Bedrock												
	(Sound)	3	RC	Rec.									
			AXT	72%									
		4	RC	Rec.									
			AXT	100%	240								
236.5			RC	REC.									
20.0	End of Borehole												
					230								

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 14

FOUNDATION SECTION

JOB 69-F-14
W.P. 222-63-7,-8,-9LOCATION Forty Mile Creek & Ramp E. - Grimsby - W.
BORING DATE May 21, 1969ORIGINATED BY V.K.
COMPILED BY C.M.

DATUM Geodetic

BOREHOLE TYPE Washboring, - NX Casing; Cone

CHECKED BY

SOIL PROFILE		SAMPLES			DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT					LIQUID LIMIT — % PLASTIC LIMIT — % WATER CONTENT — %		BULK LENGTH Y	REMARKS
ELEV. DEPTH	DESCRIPTION	NUMBER	TYPE	BLOWS / FOOT	ELEV. SCALE	20	40	60	80	100	SHEAR STRENGTH — P.S.F.		
256.9	Ground Level										O UNCONFINED — FIELD VANE ● QUICK TRIAXIAL — LAB VANE		
0.0	Fill Material	1	SS 22										
251.9	(Weathered)	2	BXL 60%	250									W.L. Elev. 254.4
250.4	Shale Bedrock		RC Rec.										
6.5	(Sound)	3	BXL 90%										
241.9	End of Borehole		RC Rec.	240									
15.0													

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 15

FOUNDATION SECTION

JOB 69-F-14

LOCATION

Forty Mile Creek & Olive St. - Grimsby

ORIGINATED BY

V.K.

W.P. 222-63-7,-8,-9

BORING DATE

May 15, 1969

COMPLETED BY

C.M.

DATUM Geodetic

BOREHOLE TYPE

Washboring - NX Casing; Cone

CHECKED BY

SOIL PROFILE		SAMPLES		DYNAMIC PENETRATION RESISTANCE					LIQUID LIMIT		REMARKS
ELEV DEPTH	DESCRIPTION	NUMBER	TYPE	BLOWS / FOOT	ELEV. / FEET	20	40	60	80	100	
254.2	Ground Level										
0.0											
249.0	Fill Material	1	SS Sl	85%	250						W.L. Elev. 252.2
5.2		2	BXL	85%							
	Shale Bedrock		RC	Rec.							
	(Sound)	3	BXL	100%							
			RC	Rec. 240							
		4	BXL	100%							
			RC	Rec.							
234.2											
20.0	End of Borehole										
					230						

CONCLUSION SECTION

V.K.

C.M.

CONFIDENTIAL

[illegible]

Washboring - NX Casing; Cone

Figure 1. Schematic representation of the experimental design.

C.M.

SOIL PROFILE		SAMPLES		DYNAMIC PENETRATION RESISTANCE		LIQUID LIMIT PLASTIC LIMIT WATER CONTENT		REMARKS
SLEV DEPTH	DESCRIPTION	NUMBER	TYPE	BLOWS / FOOT	FEET SCALE			
253.8	Ground Level							
0.0								
248.8	Topsoil & Fill Material	1	SS	6	250			
247.6	(Weathered)	2	SS	150/9"				
6.2			BXL					
	Shale Bedrock	3	RC					
	(Sound)	4	BXL		240			
237.8			RC					
16.0	End of Borehole				230			

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

SS	SPLIT SPOON	TW	THINWALL OPEN
WS	WASHED SAMPLE	TP	THINWALL PISTON
SB	SCRAPER BUCKET SAMPLE	OS	OESTERBERG 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
QCU	CONSOLIDATED UNDRAINED TRIAXIAL	C	CONSOLIDATION
QD	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_f	SHEAR STRENGTH
c	EFFECTIVE COHESION INTERCEPT
ϕ	EFFECTIVE ANGLE OF SHEARING RESISTANCE, OR FRICTION
c_u	APPARENT COHESION
ϕ_u	APPARENT ANGLE OF SHEARING RESISTANCE, OR FRICTION
μ	COEFFICIENT OF FRICTION
S_v	SENSITIVITY

GENERAL

π	= 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
σ	NORMAL STRESS
σ'	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

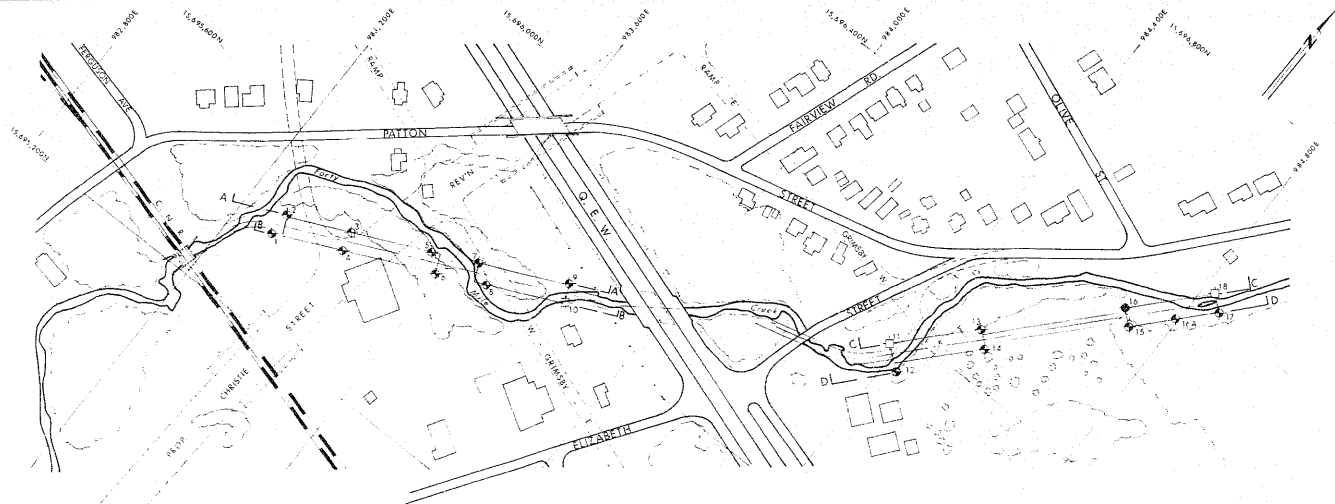
a	DISTANCE FROM TOP OF WALL TO POINT OF APPLICATION OF PRESSURE
δ	ANGLE OF WALL FRICTION
K	DIMENSIONLESS COEFFICIENT TO BE USED WITH VARIOUS SUFFIXES IN EXPRESSIONS REFERRING TO NORMAL STRESS ON WALLS
K_0	COEFFICIENT OF EARTH PRESSURE AT REST

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

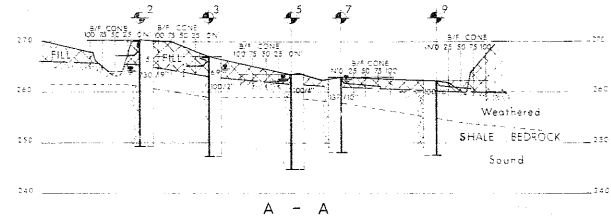
SLOPES

H	VERTICAL HEIGHT OF SLOPE
D	DEPTH BELOW TOE OF SLOPE TO HARD STRATUM
β	ANGLE OF SLOPE TO HORIZONTAL

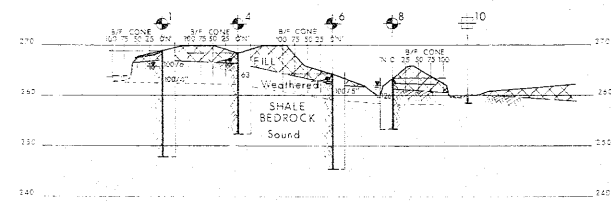


PLAN

SCALE 100 200 300 FT.



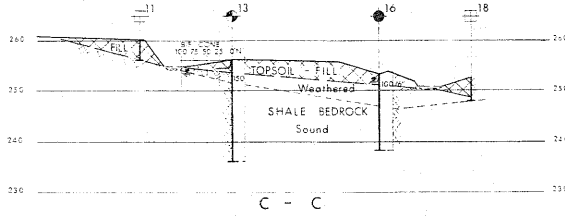
A - A



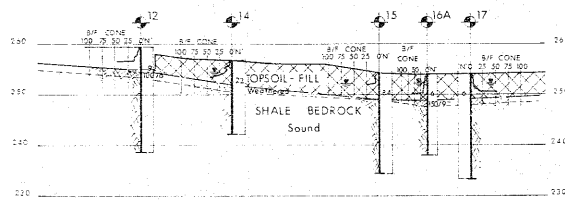
B - B

SECTIONS

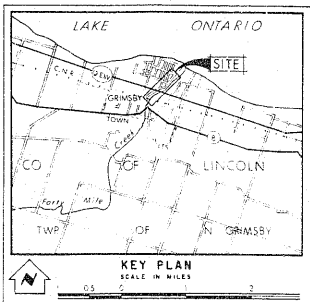
HORIZ. 100 200 300 FT.
VERT. 10 20 30 FT.



C - C



D - D



KEY PLAN

- LEGEND**
- Bore Hole
 - Cone Penetration Hole
 - Bore B Cone Penetration Hole
 - Water Levels established at time of field investigation MAY 1969
 - Test P-1

NO.	ELEVATION	CO-ORDINATES	
		EASTING	NORTH
1	262.7	15,000,000	942,100
2	262.8	15,000,000	942,100
3	262.7	15,000,000	942,100
4	262.8	15,000,000	942,100
5	262.7	15,000,000	942,100
6	262.7	15,000,000	942,100
7	262.7	15,000,000	942,100
8	262.7	15,000,000	942,100
9	262.7	15,000,000	942,100
10	262.7	15,000,000	942,100
11	262.7	15,000,000	942,100
12	262.7	15,000,000	942,100
13	262.7	15,000,000	942,100
14	262.7	15,000,000	942,100
15	262.7	15,000,000	942,100
16	262.7	15,000,000	942,100
17	262.7	15,000,000	942,100
18	262.7	15,000,000	942,100

The boundaries between soil strata have been established only at Bore Hole locations. Between Bore Holes the boundaries are assumed from geological evidence and may be subject to considerable error.

REVISIONS	DATE	BY	DESCRIPTION

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

FORTY MILE CREEK
CHANNEL RELOCATION

KING'S HIGHWAY NO. Q.E.W. DIST. NO. 14
CO. LINCOLN LOT CON.
TWP. N. CRIMSBY

BORE HOLE LOCATIONS & SOIL STRATA

SUBMIT V.C. ☒ CHECKED W.P. NO. 222 - 63-781 M.S.T. DRAWING NO.
DRAWN A.N. ☒ CHECKED JOH. NO. 69-F-14 **69-F-14A**
DATE JULY 1970 SITE NO. BORE HOLE NO.
APPROVED BY CONT. NO.

MEMORANDUM

TO: Mr. J. Sternac,
Principal Foundation Engineer,
Room 107, Lab. Building

FROM: S.C. Grabari,
Bridge Office

ATTENTION:

DATE: April 15, 1970

OUR FILE REF.

IN REPLY TO

SUBJECT: Glave St. Extension
over Forty Mile Creek
H.R. 222-63-6, Site 12-001
M.E.L., District No. 1

6-9-6-14

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.

Shul

S.C. Grabari,
Bridge Design Engineer

cc:rd

attach.

M.E.L. Foundation Office

Note: D. 1000 concrete mat should be poured as soon as excavations
are completed for structure foundations.

J.D. Dennis
15 April 70

SR

DEPARTMENT OF HIGHWAYS — ONTARIO
MATERIALS AND TESTING DIVISION

VISUAL CLASSIFICATION SHEET

PROJECT <u>69-F-14</u>		SITE <u>Grimsky</u>		BOREHOLE No. <u>1-8</u>		GROUND ELEVATION _____										
SAMPLE No.	DEPTH	GRAIN SIZE DISTRIBUTION					DRY STRENGTH	SHINE	DIALATANCY	TOUGHNESS	ODOR	COLOUR	ACID TEST	CONSISTENCY OR UNDRAINED SHEAR STRENGTH	CLASSIFICATION WITH DESCRIPTION	SYMBOL
		LARGEST GRAIN SIZE	SHAPE	PERCENTAGE												
				GRAVEL	SAND	SILT & CLAY										
1	1 3-3 1/2	-	-	-	100	-	-	-	-	-	Earth	Red	strong		weathered shale	
2	6 6 1/2	-	-	-	100	-	-	-	-	-	"	"	"		"	
2	1 5-4 1/2	-	-	-	-	-	-	-	-	-	org.	Br.	More		clayey silt - pieces of wood & glass.	
	2 6-7 1/2	-	-	-	10 90	-	dull	-	-	-	Earth	Gray	strong		weathered shale	
3	1 3-4 1/2	-	-	-	100	-	"	-	-	-	"	Red	"		"	
5	1 3-3 1/2	-	-	-	100	-	"	-	-	-	"	"	"		"	
6	1 3-3 1/2	-	-	-	100	-	"	-	-	-	"	"	"		"	
7	1 3-4 1/2	-	-	-	100	-	"	-	-	-	"	"	"		"	
8	1 3-4 1/2	-	-	-	10 90	-	"	-	-	-	"	Grey mottling Red	"		"	

NOTES:- VISUAL CLASSIFICATION MUST BY CARRIED OUT ON ALL SAMPLES BY THE ENGINEER AS SOON AS POSSIBLE AFTER THE SAMPLES REACH THE LABORATORY.

REMARKS:- 4/1 missing.

DEPARTMENT OF HIGHWAYS — ONTARIO
MATERIALS AND TESTING DIVISION

VISUAL CLASSIFICATION SHEET

PROJECT <u>69-F-14</u>		SITE <u>Grimsby</u>		BOREHOLE No. <u>9-16A</u>		GROUND ELEVATION _____										
SAMPLE No.	DEPTH	GRAIN SIZE DISTRIBUTION			DRY STRENGTH	SHINE	DILATANCY	TOUGHNESS	ODOR	COLOUR	ACID TEST	CONSISTENCY OR UNDRAINED SHEAR STRENGTH	CLASSIFICATION WITH DESCRIPTION	SYMBOL		
		LARGEST GRAIN SIZE	SHAPE	PERCENTAGE												
				GRAVEL											SAND	SILT & CLAY
BH ND 9	1	5-4	—	—	—	100	—	dull	—	—	Earthy	Red	strong	weathered shale		
11	1	3-4 1/2	3/4	subang	5	15	80	—	"	none	low	org.	Red	none	Reworked shale fill with T. sig matter	
11A	3-4	1/4	Round	50	50	Tr	—	"	—	—	Earthy	Red Br.	slow	sand & gravel fill.		
2	6-7 1/2	—	—	—	—	100	—	"	—	—	Earthy	Red	strong	weathered shale		
13	1	3-4 1/2	—	—	—	100	—	"	—	—	"	"	none	"	"	
14	1	3-4 1/2	1 1/2	Subangular	10	20	70	—	"	none	low	"	"	"	Reworked shale fill with Gravel	CL
15	1	3-4 1/2	1/2	flat subangular	10	15	75	—	"	"	"	"	"	"	Reworked shale - glacial Till Transition zone?	CL
16	1	3-3 1/2	—	—	—	100	—	"	—	—	"	"	slow	weathered shale		
16A	1	3-4 1/2	—	—	—	100	—	"	—	—	org	Red	strong	Reworked shale fill? - decayed wood fragments.	OL CL	

NOTES:- VISUAL CLASSIFICATION MUST BY CARRIED OUT ON ALL SAMPLES BY THE ENGINEER AS SOON AS POSSIBLE AFTER THE SAMPLES REACH THE LABORATORY.

REMARKS:-

DEPARTMENT OF HIGHWAYS — ONTARIO
MATERIALS AND TESTING DIVISION

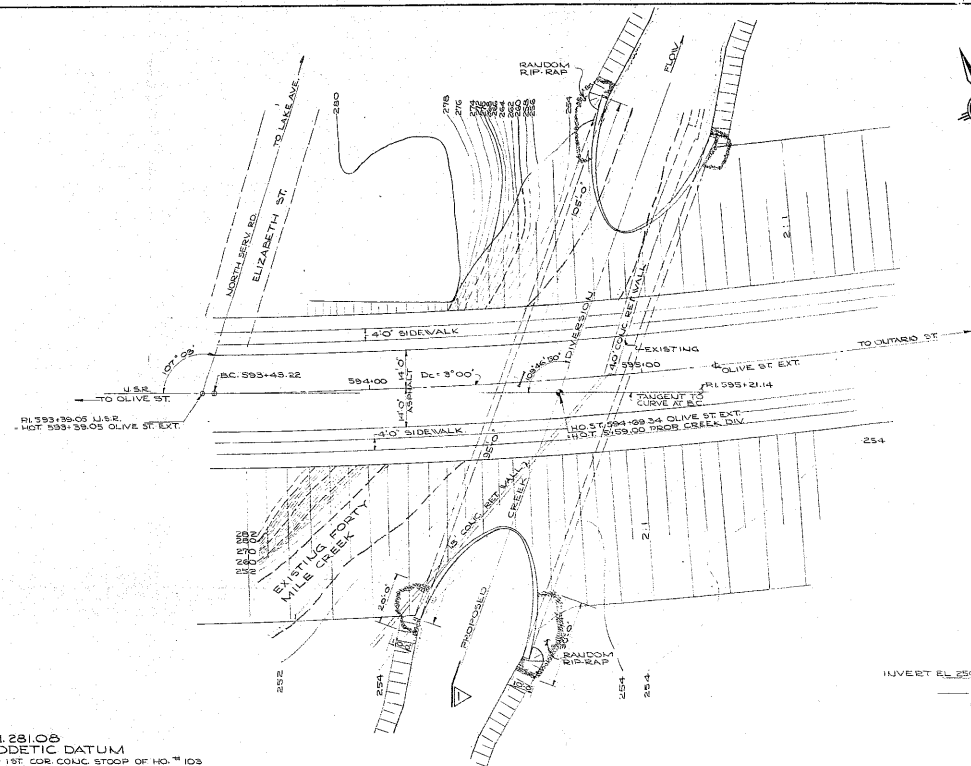
VISUAL CLASSIFICATION SHEET

PROJECT 69-F-14 SITE Grimsby BOREHOLE No. 16A-17 GROUND ELEVATION _____

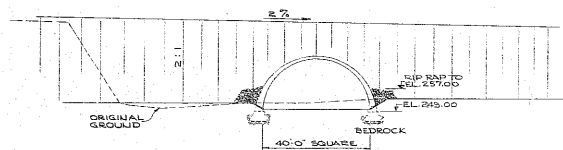
SAMPLE No.	DEPTH	GRAIN SIZE DISTRIBUTION					DRY STRENGTH	SHINE	DIALATANCY	TOUGHNESS	ODOR	COLOUR	ACID TEST	CONSISTENCY OR UNDRAINED SHEAR STRENGTH	CLASSIFICATION WITH DESCRIPTION	SYMBOL
		LARGEST GRAIN SIZE	SHAPE	PERCENTAGE												
				GRAVEL	SAND	SILT & CLAY										
29	5-6	-	-		20	80		dull	—	—	Earthy	Red-Grey	strong		weathered shale	
1	3-4 1/2"	1"	Subang	15	20	65	-	"	none	low	org	Brown	"		Re-worked shale full w/ grs org matter	
UNMARKED SAMPLE											Earthy	Grey	"		shale weathered (mainly silt from shale)	

NOTES:- VISUAL CLASSIFICATION MUST BE CARRIED OUT ON ALL SAMPLES BY THE ENGINEER AS SOON AS POSSIBLE AFTER THE SAMPLES REACH THE LABORATORY.

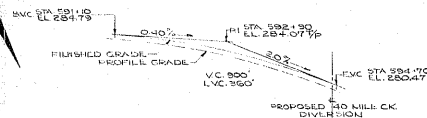
REMARKS:-



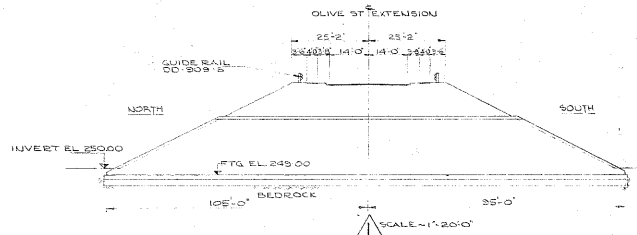
PLAN
SCALE - 1" = 20'-0"



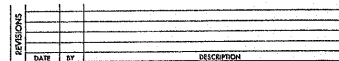
ELEVATION
SCALE-1"=20'-0"



PROFILE OLIVE ST. EXTENSION



SCALE = 1" = 20' 0"

DEPARTMENT OF HIGHWAYS ONTARIO
BRIDGE DIVISION

69-5-14

OLIVE ST. EXTENSION
OVER FORTY MILE CREEK

KING'S HIGHWAY No. Q.E.W. DIST. No. 4
CO. LINCOLN
TOWNTOWN OF GRIMSBY LOT 9 CON. I

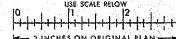
GENERAL PLAN

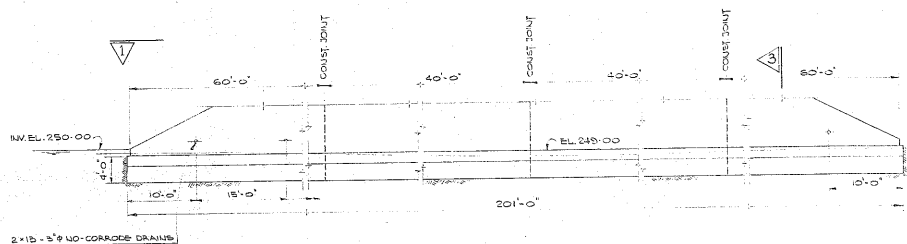
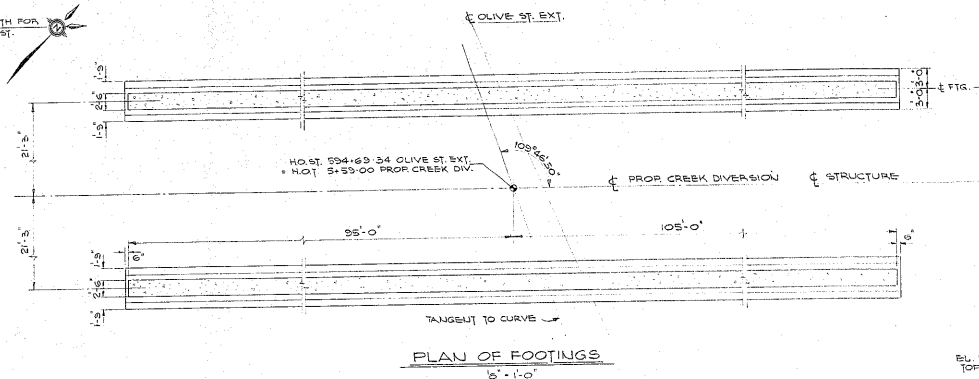
APPROVED _____				SITE No. 15-221		W.P. No. 222-63-4	
WISDOT ENGINEER				CONTRACT No.			
DESIGN	D.R.G.	CHECK	R.K.				
DRAWING	D.H.B.	CHECK	D.R.G.	DRAWING No.		D-6679-1	
DATE	APR 75	LOADING	11520-44				



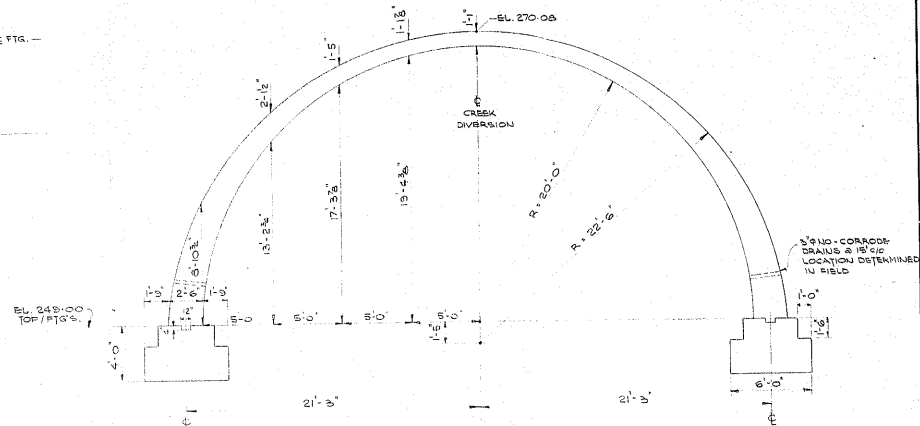
FOR REDUCED PLAN

USE SCALE BELOW

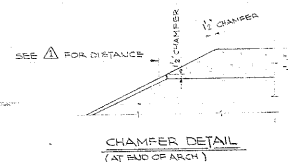
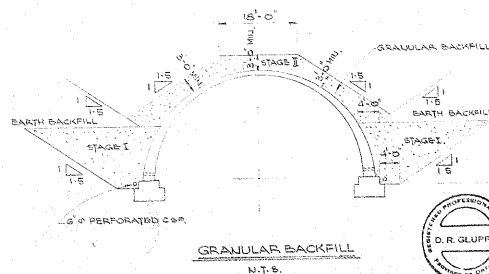
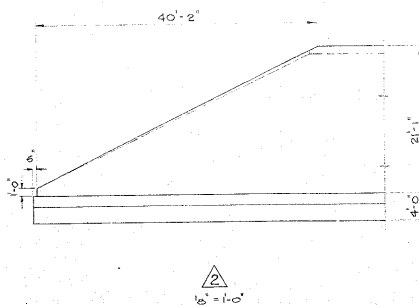
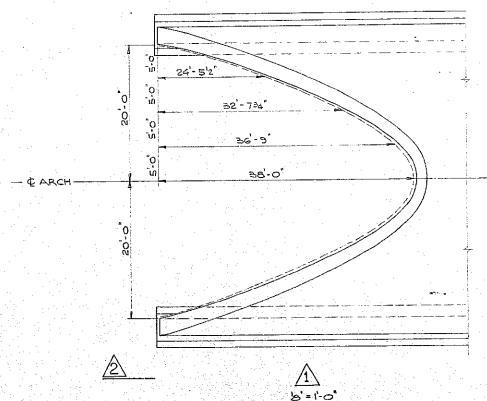




ELEV. EAST FOOTING
5'-1'-0"

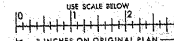


ARCH CROSS SECTION


$$\triangle 3$$


GRANULAR BACKFILL
N.T.S.

FOR REDUCED PLAN

[illegible]

DEPARTMENT OF HIGHWAYS ONTARIO
BRIDGE DIVISION

69-F-18

OLIVE ST. EXTENSION

OVER FORTY MILE CREEK

KING'S HIGHWAY No. Q. E. W.

DIST. No. 4

CO. LINCOLN
TWP. TOWN OF GRIMSBY

LOT 9

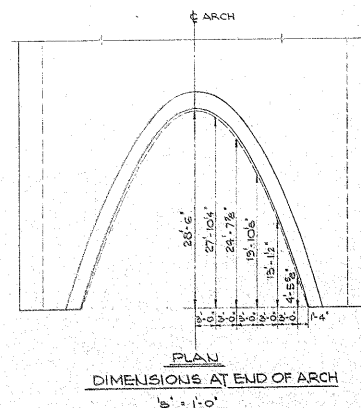
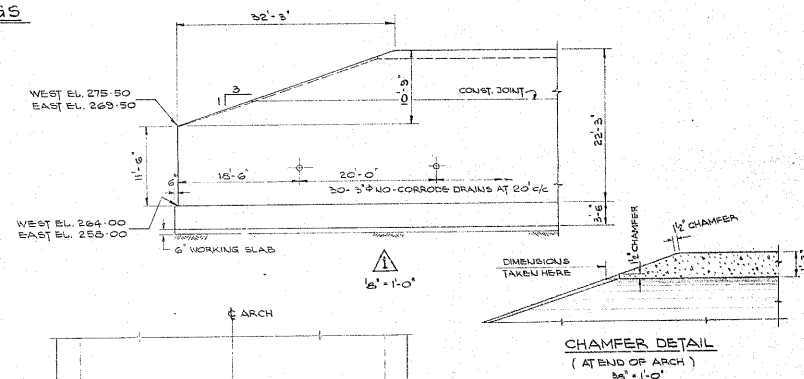
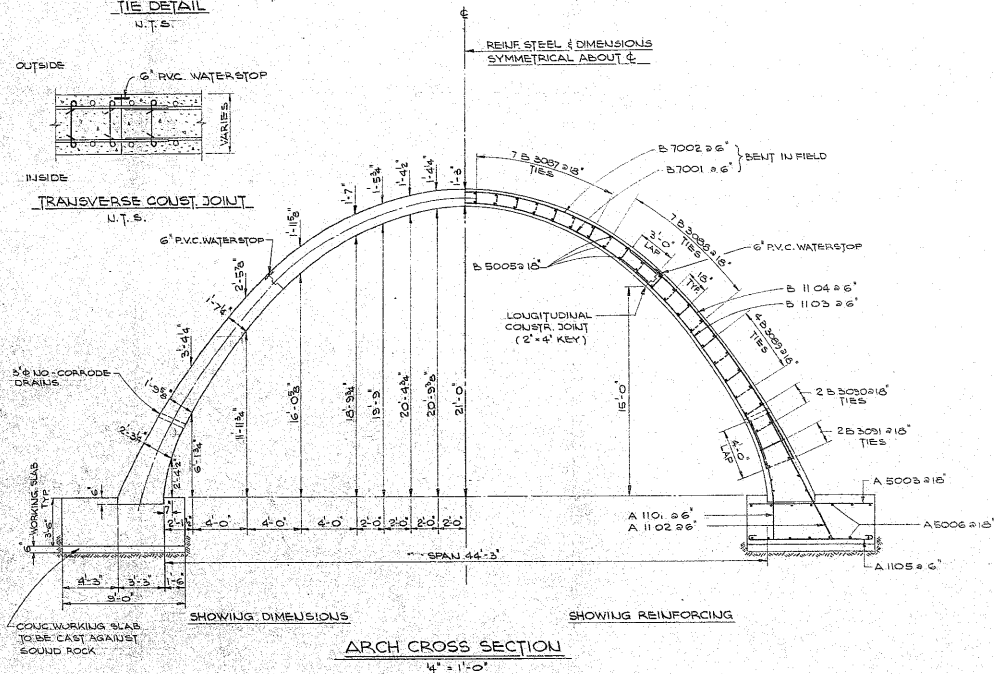
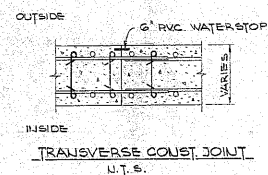
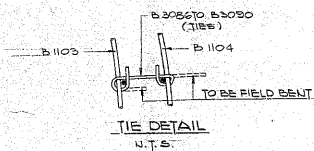
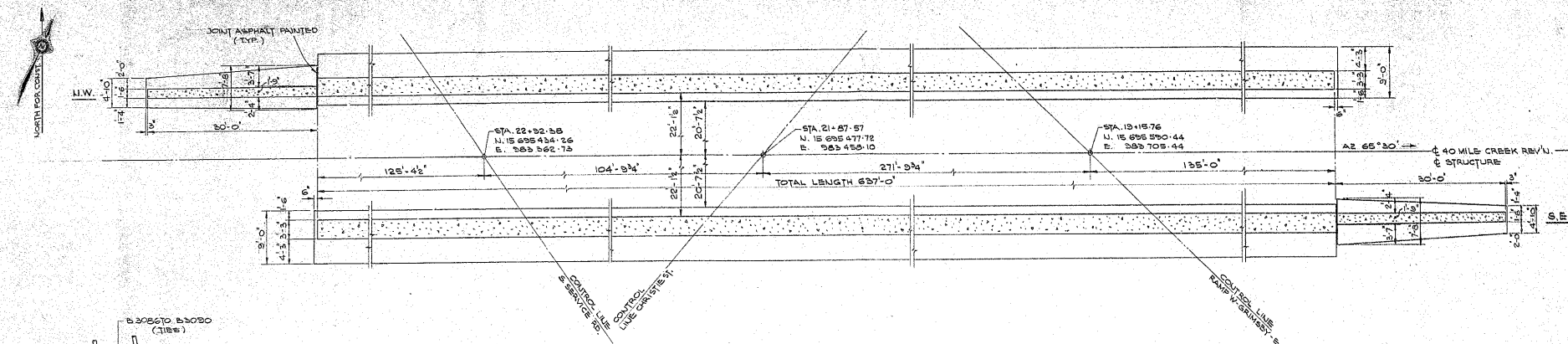
CON. I

LAYOUT & DIMENSIONS

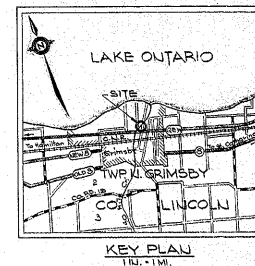
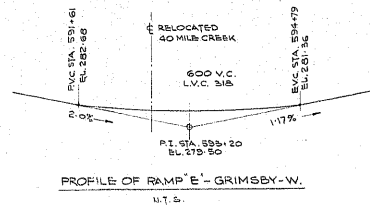
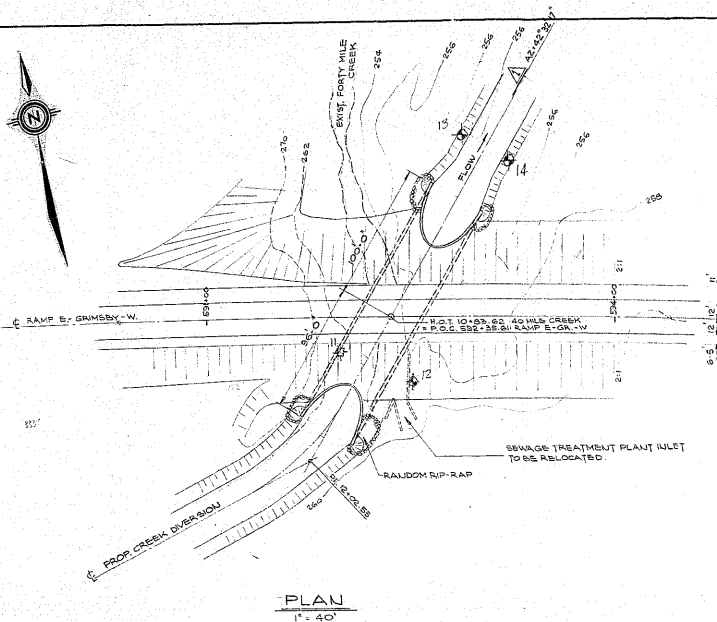
APPROVED _____				SITE NO. 18-221		NOTES 222-63	
DESIGN D.R.G.				CHECK R.K.		CONTRACT No.	
DRAWING W.L.				CHECK D.R.G.		Drawing No. D6679-3	
DATE APR 17		LOADING H520-44					

PRINT RECORD

[illegible]

[illegible][illegible]

DEPARTMENT OF HIGHWAYS ONTARIO BRIDGE DIVISION			
67-2-14			
40 MILE CREEK AT CHRISTIE ST. STRUCTURE			
KING'S HIGHWAY No. <u>4</u> E.V.		DIST. No. <u>4</u>	
CO. <u>CLYNOU</u>		TWP. <u>TOWN OF GRIMESBY</u> LOT <u>3</u> CON. <u>1</u>	
LAYOUT & DIMENSIONS			
APPROVED _____ <small>SECTION ENGINEER</small>		DATE: <u>12-22-65</u>	
DRAWING NO. <u>246</u> CHECKED <u>R.F.</u> DATE <u>12-22-65</u>		W.P. No. <u>222-65</u> CONTRACT NO. _____ DRAWING NO. <u>D-6681-3</u>	



GENERAL NOTES

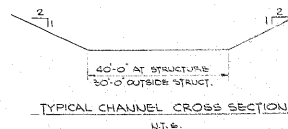
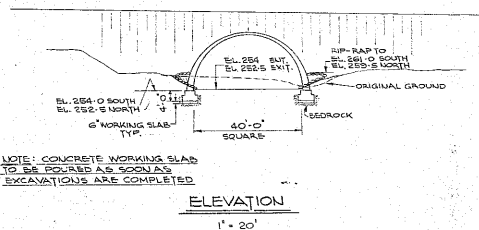
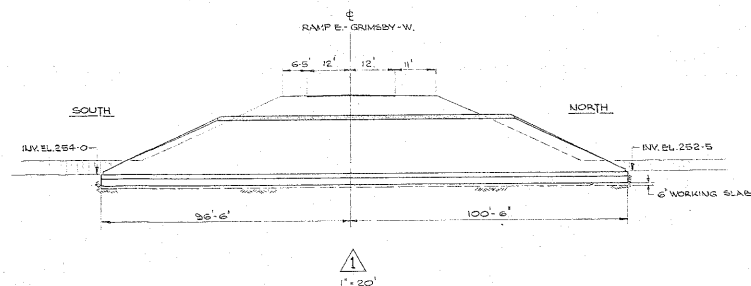
CLASS OF CONCRETE
ARCH & FOOTINGS 3000 P.S.I.
CLEAR COVER ON REINF. STEEL
ENTIRE STRUCTURE 3"

CONSTRUCTION NOTES

BACKFILL TO BE PLACED AND COMPACTED
AT BOTH SIDES OF STRUCTURE SIMULTANEOUSLY

LIST OF DRAWINGS

D-6680-1 GENERAL PLAN
- 2 BOREHOLE LOCATION & SOIL STRATA
- 3 LAYOUT & DIMENSIONS
- 4 REINF. DETAILS

[illegible]

REVISIONS		DESCRIPTION
1	1	
2	2	
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DEPARTMENT OF HIGHWAYS ONTARIO			
BRIDGE DIVISION			
69-114			
<u>RAMP E - GRIMSBY S.W. STRUCTURE</u>			
OVER 40 MILE CREEK			
KING'S HIGHWAY No. G.E.W.		DIST. No. 4	
CO. LINCOLN			
TWP. TOWN OF GRIMSBY		LOT 5	CON. 1
<u>GENERAL PLAN</u>			
APPROVED		FILE NO.	W.A. No.
BRIDGE INCHES		1B-282	222-63
DESIGN	D.R. G. CHECK	CONTRACT	
DRAWING	731 L. CHECK		
DATE	JAN. 70	SHAPING	
LOADING	M52-046	D 6680-	

FOR REDUCED PLAN

USE SCALE BELOW

0 1 2

3 INCHES ON ORIGINAL PLAN

