cc: Geo. Files

DEPARTMENT OF HIGHWAYS ONTARIO

W.P. 337-61.

MEMORANDUM

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

Attention: Mr. S. McCombie

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

Date: June 28, 1967

Our File Ref.

In reply to

JUL 12 1967

Subject:

FOUNDATION INVESTIGATION REPORT
For
Proposed Crossing at Oxtongue River
(Marsh Falls) and Hwy. #35,
Twp. of Franklin, Lot 9, Con. VIII,
District No. 11 (Huntsville)
W.J. 67-F-46 ... W.P. 337-61

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 feel free to contact our Office.

A. G. Sterrac
PRINCIPAL FOUNDATION ENGINEER

AGS/MdeF
Attach.
cc: Messrs. B. R. Davis (2)
H. A. Tregaskes
D. W. Ferren
H. McArthur
W. S. Aitken
J. B. Curtis
T. J. Kovich
B. A. Singh

Foundations Files
Gen. Files

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FOUNDATION INVESTIGATION REPORT
For
Proposed Crossing at Oxtongue River
(Marsh Falls) and Hwy. #35,
Twp. of Franklin, Lot 9, Con. VIII,
District No. 11 (Huntsville)
W.J. 67-F-46 -- W.P. 337-61

1. INTRODUCTION:

A request to carry out a foundation investigation for the proposed new bridge to carry Hwy. #35 over the Oxtongue River was received from Mr. J. B. Curtis, Regional Bridge Location Engineer, in a memo dated May 3, 1967.

An investigation was subsequently carried out by this Section to determine the subsoil conditions existing at the site of the proposed bridge.

This report contains the results of our field and laboratory investigation, together with our recommendations for the foundations of the new structure.

2. DESCRIPTION OF SITE:

The proposed bridge site is 30 ft. to 70 ft. upstream from the existing bridge at the crossing of Hwy. #35 and the Oxtongue River, some 1.5 miles South of Dwight, Ontario. The proposed bridge is skewed at an angle of 13° to the centre line.

Bedrock outcrops at the site of the existing bridge, the South abutment of which is founded on the exposed bedrock. At the existing bridge site and further downstream, the bedrock forms a shallow rocky valley with the Oxtongue River flowing through it and descending in steps, thus forming the falls. The bedrock is seen to dip in a South-East direction at an angle of about 20°. It has well defined joint systems, parallel and perpendicualr to the direction of dip. The bedrock was identified

cont'd. /2 ...

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

by the geologist to be quartzitic gneiss of Precambrian Age. The land surrounding the falls is forested with mixed bush.

The river level rose from El. 1051.0 to El. 1051.5 after a rainstorm on the night of June 6 - 7, 1967.

3. FIELD AND LABORATORY WORK:

The field work at the proposed bridge location consisted of four sampled boreholes and fourteen dynamic cone penetration tests. All holes were advanced using conventional diamond drilling equipment adapted for soil sampling purposes. A driving energy of 350 ft.-lbs. per blow was used for the dynamic cone penetration tests.

Samples were obtained using a 2-inch O.D. split-spoon sampler driven according to the specifications for the Standard Penetration Test. Bedrock samples were obtained in Boreholes 3, 4, 10 and 12, using AXT coring equipment.

Samples were visually examined in the field and subsequently in the laboratory. Grain-size distribution curves were carried out on selected samples.

No artesian conditions were encountered.

The results of the laboratory and field tests are summarized in the Record of Borehole sheets which are contained in the appendix to the report.

The locations and elevations of the boreholes are given on Drawing No. 67-F-46A, which is also contained in the appendix to this report.

The borehole locations were set out and surveyed in the field by the Huntsville District Office of the D.H.O.

cont'd. /3 ...

4. SUBSOIL CONDITIONS:

4.1) General:

The subsoil over the site consists essentially of alluvial deposits overlying an irregular bedrock surface.

In general, the subsoil was found to consist of deposits of silty sand and fine sand overlying granitic gneiss bedrock.

The boundaries between the different deposits are shown on the attached Record of Borehole sheets. The estimated stratigraphical profiles shown on Drawing No. 67-F-46A, are based upon this information.

From ground level downwards, the different soil deposits are described as follows:

4.2) Silty Sand with Traces of Gravel and Clay:

This deposit occurred in all boreholes. On the North bank and within the river bed, it extended down to the bedrock. In Borehole 10 on the North bank, it is 6.7 ft. and in Borehole 3 on the South bank, 5.5 feet deep. Under the river water, its depth varies from 6 ft. to 12 ft. On the ground, the denseness of the material ranges from loose on the North side to compact on the South side. Under the water, it is in a compact to dense state. The range of grain-size distribution was found to be: gravel 0 - 18%, sand 60 - 70%, silt and clay 15 - 27%.

4.3) Fine Sand with Traces of Silt and Gravel:

This deposit was found in Borehole 3 only on the South bank, where it was 24 ft. in thickness. It is mainly fine sand with traces of silt and gravel. The average grain-size distribution is: gravel 1%, sand 93%, silt and clay 6%. Standard Penetration tests gave 'N' values from 4 to 15 blows/ft., indicating a loose to compact denseness. It is underlain by bedrock.

cont'd. /4 ...

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

4.4) Bedrock:

The bedrock was proven to a depth of approximately 5 feet in Boreholes 3, 4, 10 and 12. The bedrock was found to be sound quartzitic gneiss in all boreholes. The core samples were examined by Mrs. Z. Dunikowska, Geologist, whose report is reproduced below:

"The core samples from Oxtongue River, Hwy. 35 area consist of para-gneisses of Precambrian Age. They are characterized by a high percent of quartz, feldspar, abundant garnet crystals, biotite and some accessory ferromagnesian minerals. All four drilling samples show very little variety.

Hole 10 - Medium to coarse grained quartzitic gneiss with abundant garnet crystals. Visual weathering down to 2 ft. (may be a boulder). Occasional high angle (60 - 80°) fissures with thin film of biotite. Lineation of biotite in the core not consistent.

Holes 3, 4 and 12 - Consist of the same para-gneiss with abundant garnet crystals. Incipient weathering down 2 to 4 inch. Lineation of biotite not consistent."

The bedrock surface was found to be very irregular and slopes from West to East and North to South in general. The rock was exposed just downstream of the proposed structure, right under the existing bridge. The South abutment of the existing bridge is founded on the exposed rock which forms a hump at that location. On the North river bank at the location of the proposed structure, the bedrock was visible inside the water and appeared to dip at a slope of 1 in 2 from North to South.

cont'd. /5 ...

5. GROUNDWATER:

Groundwater level in Borehole 3 was found to be at a depth of 6.2 ft. (El. 1052.0). As the result of a rainstorm on the night of June 6 - 7, 1967, the water level in the river rose from El. 1051.0 to 1051.5.

6. DISCUSSION AND RECOMMENDATIONS:

It is proposed to construct a new bridge to carry Hwy. #35 over the Oxtongue River. The presently proposed bridge is a three-span structure (22'-42'-22'). An approach fill of about 8 ft. at the North abutment location and of about 14 ft. at the South abutment location is required.

6.1) North Abutment:

At the location of the proposed North abutment, the depth to bedrock at the West end of it is 7 ft., while at the East end the bedrock is visible under water. The bedrock dips sharply from West to East. The overburden is silty sand, but on the slopes of the river bank, boulders have been dumped. Because of relatively shallow bedrock, it is recommended that the abutment be founded directly on sound bedrock. A safe bearing pressure of 20 tons/sq.ft. may be used for design purposes. Since a small portion of the abutment is to be constructed under water, it will be necessary to temporarily divert the river water away from this area. The foundation must be properly keyed into the bedrock.

6.2) North Pier:

The West end of the proposed pier is situated on the sloping bank of the river, while the East end is in deep water. The overburden on the bank is the same as in the case of the North abutment. At the West end, the depth to bedrock is 5 ft., and at the East end, 13 ft. below the water level including 3 ft. of alluvial deposit. In the middle of the location of the proposed pier, the bedrock is exposed under water. It is recommended that

cont'd. /6 ...

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

6.2) North Pier: (cont'd.) ...

the North pier be supported on spread footings founded on sound bedrock. Since most o the foundation is to be placed under water, some dewatering scheme will be necessary.

6.3) South Pier:

The South pier is situated over an irregular bedrock surface, the depth to which varies from 6 ft. to 19 ft. below the river bed - 11 ft. to 22 ft. below the water level.

The proposed pier can be supported on large diameter caissons drilled at least 3 feet into the bedrock. Such caissons (48-inch Ø) would be capable of supporting a load of about 400 tons each.

Alternatively, the pier can be supported on spread footings founded on bedrock. Since the excavation will have to be carried out under water, it will be necessary to provide some dewatering system, which can be done by driving sheet piles to the bedrock.

6.4) South Abutment:

At the location of the South abutment, the depth to bedrock varies from 23 ft. to 30 ft., with loose to compact alluvial deposit overlying it, which is not suitable for spread footing type foundations. Therefore, it is recommended that the structure be supported by means of end-bearing H-piles driven to bedrock.

Because of the sloping nature of the bedrock surface, some keying is necessary, and therefore, the piles should penetrate the bedrock for a distance of about 2 - 3 inches. To achieve this, the following procedure is suggested:

cont'd. /7 ...

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

6.4) South Abutment: (cont'd.) ...

Driving should be carried out by means of a drop hammer. Immediately the contact with rock is achieved, driving should be stopped and the pile elevation observed. Driving should then be continued using small heights of drop of the ram (6 in. - 8 in.). After the pile has been subjected to so many series (at least five series), each of twenty blows, that penetration has ceased, the fall should be increased to double the height. In this way, the driving should be continued with a stepwise increase in the height of drop until no further penetration is observed. By the great number of blows used in this procedure, it should be possible to chisel the pile into the rock, until a satisfactory contact is achieved. It is recommended that Oslo-points be fitted to the piles if this procedure is adopted. For H-piles, the points should be made of tempered steel bars of 3 - 4 inch diameter, with the lower end hollow ground. A slice is cut into the web of the H-section and the bar is then welded to the profile. Further information about these points may be obtained from the Norwegian Geotechnical Institute publication No. 23, or Geotechnique, Vol. VII, p. 73, 1957. Design loads to be used are dependent on the pile section and may be 100 tons in the case of 12 BP at 74.

As an alternative, 12-3/4" O.D. tube piles may be used to support the structure. These should be driven open-ended to the bedrock, then jetted out clean to the bottom.

The following keying methods are suggested:

1. Drilling the pile into the bedrock 3 - 4 feet. For this method, a minimum pile diameter of 16 in. is required.

2. Forming a concrete plug, forced out by means of a mandrell, to bond with the bedrock surface.

3. Placing a suitable sized dowel bar into the rock about 6 ft. by core drilling means, at the pile tip.

cont'd. /8 ...

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

In this manner, a satisfactory toe-hold for the pile can be achieved. Design loads for the tube piles are dependent on the pile section selected and may be as high as 70 tons per pile in the case of 12-3/4" O.D. tubes.

Pile caps should be founded at sufficient depth to ensure frost protection. In the event that pile caps are founded below the groundwater level, a dewatering scheme will be necessary to ensure that the concrete can be poured in the dry.

No stability problems are anticipated for the construction of the approach embankments, provided all surface organic deposits are removed and replaced with suitable fill.

7. SUMMARY:

A foundation investigation of a proposed new structure at Hwy. #35 and Oxtongue River is reported.

Subsoil conditions at this site consist of loose to dense alluvial deposits which overlie a sloping bedrock surface. The bedrock is exposed 50 ft. downstream from the location of the proposed bridge. Bedrock can be seen under water on the North bank of the river and slopes steeply to the South-East at approximately 1 in 2.

It is recommended that the North abutment and North pier be supported on spread footings founded on sound bedrock. The South pier can be supported on large diameter caissons drilled into the bedrock, or on spread footings. The South abutment should be supported on end-bearing piles founded on bedrock.

Procedures for construction and dewatering have been outlined in this report.

No stability problems are anticipated for the construction of the approach embankments, provided all surface organic deposits are removed and replaced with suitable fill.

cont'd. /9 ...

8. MISCELLANEOUS:

The field work for this project was carried out during the period June 3 - 7, 1967, under the supervision of Mr. A. Prakash, Project Foundation Engineer, who also prepared this report.

The equipment used was owned and operated by Master Soil Investigations Ltd., and F. E. Johnston Drilling Co. Ltd.

This report was reviewed by Mr. K. G. Selby, Supervising Foundation Engineer.

June 1967

APPENDIX I

FORM DB-MT-126
66-4546

OFFICE REPORT ON SOIL EXPLORATION

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO. 1

FOUNDATION SECTION

JOB 67-F-46 LOCATION Oxtongue River & Hwy.35; Sta.381 + 29, 19' Lt. ORIGINATED BY AP
W.P. 337-61 BORING DATE June 5, 1967 COMPILED BY AP
DATUM Geodetic BOREHOLE TYPE Dynamic Cone Penetration Test CHECKED BY AK

SOIL PROFILE ELEV. / DEPTH	DESCRIPTION	STRAT. PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/FOOT	ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS/FOOT 20 40 60 80 100 / SHEAR STRENGTH P.S.F.	LIQUID LIMIT w_L / PLASTIC LIMIT w_P / WATER CONTENT w — WATER CONTENT %	BULK DENSITY γ F.C.F.	REMARKS
1054.3	GROUND LEVEL									
0.0						1050				
						1040				
1031.1	Hammer Bouncing						170/2"			
23.2	End of Cone Test					1030				
	Probable Bedrock									

FORM 08-MT-126
66-4546

OFFICE REPORT ON SOIL EXPLORATION

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO. 2

FOUNDATION SECTION

JOB 67-F-46 LOCATION Oxtongue River & Hwy.35, Sta. 381 + 24; ℄ ORIGINATED BY AP
W.P. 337-61 BORING DATE June 5, 1967 COMPILED BY AP
DATUM Geodetic BOREHOLE TYPE Dynamic Cone Penetration Test CHECKED BY

SOIL PROFILE ELEV. / DEPTH	DESCRIPTION	STRAT. PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS / FOOT	ELEV. SCALE
1056.1	Ground Level					
0.0						1050
						1040
1030.1	Hammer Bouncing					1030
26.0	End of Cone Test					
	Probable Bedrock					

DYNAMIC PENETRATION RESISTANCE
BLOWS / FOOT — 20 40 60 80 100
SHEAR STRENGTH P.S.F.

LIQUID LIMIT —— w_L
PLASTIC LIMIT —— w_p
WATER CONTENT —— w
w_p — w — w_L
WATER CONTENT %

BULK DENSITY γ P.C.F.

REMARKS

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66-4546

OFFICE REPORT ON SOIL EXPLORATION

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO. 3

FOUNDATION SECTION

JOB 67-F-46 LOCATION Oxtongue River & Hwy.35; Sta. 381 + 20, 20' Rt. ORIGINATED BY AP
W.P. 337-61 BORING DATE June 5, 1967 COMPILED BY AP
DATUM Geodetic BOREHOLE TYPE Washboring, BX Casing; Cone CHECKED BY

ELEV. / DEPTH	DESCRIPTION	STRAT. PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS / FOOT	ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT (20 40 60 80 100) SHEAR STRENGTH P.S.F.	LIQUID LIMIT w_L / PLASTIC LIMIT w_p / WATER CONTENT w — WATER CONTENT %	BULK DENSITY γ P.C.F.	REMARKS
1058.2	Ground Level									
0.0	Silty sand, traces of clay.									Gr.0,Sa.73 Si.& Cl.27
1052.7	Compact		1	SS	14					▼1052.0
5.5	Fine sand, traces of silt and gravel.		2	SS	9	1050				Gr.2,Sa.92 Si.& Cl. 6
			3	SS	15					
	Loose to compact		4	SS	8	1040				Gr.0,Sa.93 Si.& Cl. 7
			5	SS	4					
			6	SS	6					
			7	SS	11					
1028.7			8	SS	7	1030	Bouncing 20/3"			
29.5	Bedrock - Gneiss		9	RC	AXT RC 100%					
1023.7	(Sound)									
34.5	End of Borehole									

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OFFICE REPORT ON SOIL EXPLORATION

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO. 4

FOUNDATION SECTION

JOB 67-F-46 LOCATION Oxtongue River & Hwy. 35; Sta. 381 + 49; 21' Lt. ORIGINATED BY AP
W.P. 337-61 BORING DATE June 6, 1967 COMPILED BY AP
DATUM Geodetic BOREHOLE TYPE Washboring, BX Casing; Cone CHECKED BY

ELEV. / DEPTH	DESCRIPTION	STRAT. PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS / FOOT	ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT (20 40 60 80 100) SHEAR STRENGTH P.S.F.	LIQUID LIMIT w_L / PLASTIC LIMIT w_P / WATER CONTENT w — WATER CONTENT %	BULK DENSITY γ P.C.F.	REMARKS
1051.9	Top of Raft									
1051.0										
0.9	Water					1050				
1046.9										
5.0	Silty sand with little gravel, traces of clay									Gr.18,Sa.60 Si.& Cl. 22
1040.6	Dense		1	SS	38/10"		Bouncing			
11.3	Bedrock - Gneiss					1040				
1036.1	(Sound)		2	RC						
15.8	End of Borehole					1030				

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OFFICE REPORT ON SOIL EXPLORATION

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO. 5

FOUNDATION SECTION

JOB 67-F-46 LOCATION Oxtongue River & Hwy. 35; Sta. 381 + 52; ℄ ORIGINATED BY AP
W.P. 337-61 BORING DATE June 7, 1967 COMPILED BY AP
DATUM Geodetic BOREHOLE TYPE Dynamic Cone Penetration Test CHECKED BY AP

SOIL PROFILE			SAMPLES				DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT 20 40 60 80 100 SHEAR STRENGTH P.S.F.	LIQUID LIMIT — w_L PLASTIC LIMIT — w_P WATER CONTENT — w WATER CONTENT %	BULK DENSITY γ P.C.F.	REMARKS
ELEV. / DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT	ELEV. SCALE				
1052.4	Top of Raft									
1051.5										
0.9	Water					1050				
						1040				
1036.4	Hammer Bouncing									
16.0	End of Cone Test					1030				

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OFFICE REPORT ON SOIL EXPLORATION

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO. 6

FOUNDATION SECTION

JOB 67-F-46 LOCATION Oxtongue River & Hwy. 35; Sta. 381 + 50, 19' Rt. ORIGINATED BY AP
W.P. 337-61 BORING DATE June 7, 1967 COMPILED BY AP
DATUM Geodetic BOREHOLE TYPE Dynamic Cone Penetration Test CHECKED BY

ELEV. / DEPTH	SOIL PROFILE DESCRIPTION	STRAT. PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS / FOOT	ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT (20 40 60 80 100) SHEAR STRENGTH P.S.F.	LIQUID LIMIT w_L / PLASTIC LIMIT w_P / WATER CONTENT w — WATER CONTENT %	BULK DENSITY γ P.C.F.	REMARKS
1052.4	Top of Raft									
1051.5										
0.9	Water					1050				
						1040				
1030.4	Hammer Bouncing									
22.0	End of Cone Test					1030				
	Probable Bedrock									

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OFFICE REPORT ON SOIL EXPLORATION

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO. 7

FOUNDATION SECTION

JOB 67-F-46 LOCATION Oxtongue River & Hwy. 35; Sta. 391 + 51, 10' Lt. ORIGINATED BY AP
W.P. 337-61 BORING DATE June 7, 1967 COMPILED BY AP
DATUM Geodetic BOREHOLE TYPE Dynamic Cone Penetration Test CHECKED BY AR

SOIL PROFILE ELEV. / DEPTH	DESCRIPTION	STRAT. PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS / FOOT	ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT (20 40 60 80 100) SHEAR STRENGTH P.S.F.	LIQUID LIMIT w_L / PLASTIC LIMIT w_P / WATER CONTENT w — WATER CONTENT %	BULK DENSITY γ P.C.F.	REMARKS
1052.4	Top of Raft									
1051.5 / 0.9	Water					1050				
1039.7	Hammer Bouncing					1040				
12.7	End of Cone Test Probable Bedrock					1030				

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OFFICE REPORT ON SOIL EXPLORATION

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO. 8

FOUNDATION SECTION

JOB 67-F-46 LOCATION Oxtongue River & Hwy. 35; Sta. 381 + 47; 10' Rt. ORIGINATED BY AP
W.P. 337-61 BORING DATE June 7, 1967 COMPILED BY AP
DATUM Geodetic BOREHOLE TYPE Dynamic Cone Penetration Test CHECKED BY

SOIL PROFILE ELEV. / DEPTH	DESCRIPTION	STRAT. PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS / FOOT	ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT 20 40 60 80 100 / SHEAR STRENGTH P.S.F.	LIQUID LIMIT w_L / PLASTIC LIMIT w_P / WATER CONTENT w / WATER CONTENT %	BULK DENSITY γ P.C.F.	REMARKS
1052.4	Top of Raft									
1051.5										
0.9	Water					1050				
						1040				
1032.4	Hammer Bouncing									
20.0	End of Cone Test					1030				
	Probable Bedrock									

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OFFICE REPORT ON SOIL EXPLORATION

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO. 9

FOUNDATION SECTION

JOB 67-F-46 LOCATION Oxtongue River & Hwy. 35: Sta. 381 + 42, 34' Rt. ORIGINATED BY AP
W.P. 337-61 BORING DATE June 7, 1967 COMPILED BY AP
DATUM Geodetic BOREHOLE TYPE Dynamic Cone Penetration Test CHECKED BY

SOIL PROFILE ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/FOOT	ELEV. SCALE
1052.4	Top of Raft					
1051.5						1050
0.9	Water					
						1040
						1030
1026.4	Hammer Bouncing					
26.0	End of Cone Test Probable Bedrock					1020

DYNAMIC PENETRATION RESISTANCE
BLOWS / FOOT
20 40 60 80 100
SHEAR STRENGTH P.S.F.

LIQUID LIMIT —— w_L
PLASTIC LIMIT —— w_p
WATER CONTENT —— w
w_p w w_L
WATER CONTENT %

BULK DENSITY γ P.C.F.

REMARKS

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OFFICE REPORT ON SOIL EXPLORATION

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO. 10

FOUNDATION SECTION

JOB 67-F-46 LOCATION Oxtongue River & Hwy. 35; Sta. 382 + 03, 19' LT ORIGINATED BY AP
W.P. 337-61 BORING DATE June 6, 1967 COMPILED BY AP
DATUM Geodetic BORENCLE TYPE BX Casing; Cone CHECKED BY

SOIL PROFILE ELEV. / DEPTH	DESCRIPTION	STRAT. PLOT	SAMPLES NUMBER	TYPE	BLOWS / FOOT	ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT 20 40 60 80 100 / SHEAR STRENGTH P.S.F.	LIQUID LIMIT w_L / PLASTIC LIMIT w_P / WATER CONTENT w — WATER CONTENT %	BULK DENSITY γ P.C.F.	REMARKS
1063.9	Ground Level									
0.0	Silty sand, traces of gravel & clay,		1	SS	9	1060				Gr.9,Sa.76 Si.& Cl.15
1057.2	Loose						Bouncing			
6.7	Bedrock - Gneiss (Sound)		2	RC	AXT B? 10(		50/7"			
1050.9						1050				
13.0	End of Borehole									

FORM 08-MT-126
66-4546

OFFICE REPORT ON SOIL EXPLORATION

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO. 11

FOUNDATION SECTION

JOB 67-F-46 LOCATION Oxtongue River & Hwy. 35; Sta. 382 + 18, ℄ ORIGINATED BY AP
W.P. 337-61 BORING DATE June 6, 1967 COMPILED BY AP
DATUM Geodetic BOREHOLE TYPE Dynamic Cone Penetration Test CHECKED BY

SOIL PROFILE ELEV. / DEPTH	DESCRIPTION	STRAT. PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS / FOOT	ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT 20 40 60 80 100 / SHEAR STRENGTH P.S.F.	LIQUID LIMIT w_L / PLASTIC LIMIT w_P / WATER CONTENT w — w_P w w_L WATER CONTENT %	BULK DENSITY γ P.C.F.	REMARKS
1062.8	GROUND LEVEL									
0.0						1060				
1055.2	Hammer Bouncing									
7.6	End of Cone Test Probable Bedrock					1050				

FORM DB-MT-126
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OFFICE REPORT ON SOIL EXPLORATION

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO. 12

FOUNDATION SECTION

JOB 67-F-46 LOCATION Oxtongue River & Hwy.35; Sta. 382 + 03; 20' Rt. ORIGINATED BY AP
W. P. 337-61 BORING DATE June 6, 1967 COMPILED BY AP
DATUM Geodetic BOREHOLE TYPE BX Casing CHECKED BY

SOIL PROFILE ELEV / DEPTH	DESCRIPTION	STRAT. PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS / FOOT	ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT — SHEAR STRENGTH P.S.F.	LIQUID LIMIT w_L — PLASTIC LIMIT w_P — WATER CONTENT w — WATER CONTENT %	BULK DENSITY γ P.C.F.	REMARKS
1051.9	Top of Raft									
1051.0										
0.9	Water					1050				
1046.4										
6.5	Bedrock - Gneiss (Sound)		1	RC	AXT RC 100%					
1042.4										
10.5	End of Borehole					1040				

FORM 08-MT-126
66-4546

OFFICE REPORT ON SOIL EXPLORATION

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO. 13

FOUNDATION SECTION

JOB 67-F-46 LOCATION Oxtongue River & Hwy. 35; Sta. 382 + 30; 20' Rt. ORIGINATED BY AP
W.P. 337-61 BORING DATE June 6, 1967 COMPILED BY AP
DATUM Geodetic BOREHOLE TYPE Dynamic Cone Penetration Test CHECKED BY

SOIL PROFILE ELEV./DEPTH	DESCRIPTION	STRAT. PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/FOOT	ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS/FOOT 20 40 60 80 100 / SHEAR STRENGTH P.S.F.	LIQUID LIMIT w_L / PLASTIC LIMIT w_P / WATER CONTENT w — w_P w w_L — WATER CONTENT %	BULK DENSITY γ P.C.F.	REMARKS
1063.2	Ground Level									
0.0						1060				
1053.0	Hammer Bouncing									
10.2	End of Cone Test Probable Bedrock					1050				

FORM DB-MT-126
56-4546

OFFICE REPORT ON SOIL EXPLORATION

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO. 14

FOUNDATION SECTION

JOB 67-F-46 LOCATION Ostongue River & Hwy. 35; Sta. 381 / 67, 2' Rt. ORIGINATED BY AP
W.P. 337-61 BORING DATE June 7, 1967 COMPILED BY AP
DATUM Geodetic BOREHOLE TYPE Washboring, BX Casing, Cone CHECKED BY AR

SOIL PROFILE ELEV. / DEPTH	DESCRIPTION	STRAT. PLOT	SAMPLES NUMBER	TYPE	BLOWS / FOOT	ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT 20 40 60 80 100 / SHEAR STRENGTH P.S.F.	LIQUID LIMIT w_L / PLASTIC LIMIT w_P / WATER CONTENT w / w_P w w_L / WATER CONTENT %	BULK DENSITY γ P.C.F.	REMARKS
1052.4	Top of Raft									
1051.5										
0.9	Water					1050				
1043.9										
8.5	Silty sand with traces of gravel & clay. Compact		1	SS	11	1040				Gr.1, Sa.72 Si.& Cl.27
1032.0	Hammer Bouncing									
20.4	End of Conc Test					1030				
	Probable Bedrock									

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 :-

CONSISTENCY	'N' BLOWS/FT.	c LB./SQ.FT	DENSENESS	'N' BLOWS/FT.
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

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
	IN TERMS OF EFFECTIVE STRESS $\tau_f = c' + \sigma' \tan \phi'$
c_u	APPARENT COHESION
ϕ_u	APPARENT ANGLE OF SHEARING RESISTANCE, OR FRICTION
	IN TERMS OF TOTAL STRESS $\tau_f = c_u + \sigma \tan \phi$
μ	COEFFICIENT OF FRICTION
S_t	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 (YOUNGS 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_o	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

DEPARTMENT OF HIGHWAYS ONTARIO

MEMORANDUM

To:

Mr. A.G. Stermac
Principal Foundation Engr.
Downsview

From:

Mr. J.B. Curtis
Bridge Planning Section
Northern Region

Date: May 3, 1967

Our File Ref.

In reply to

Subject: Oxtongue River (Marsh Falls) Bridge, Highway No. 35, approximately one mile south of the junction of Highway Nos. 35 and 60. W.P. 337-61, Bridge Site No. 42-2

Enclosed find two copies of the preliminary site plan for the above noted crossing with the probable footing locations marked thereon.

Would you kindly arrange to have a foundation investigation carried out at this crossing of a sufficient magnitude to enable us to design the proposed structure and also to determine the hydrolic requirements of the crossing. I have indicated two additional areas where I would like to know the underlying stratum make-up. The first of these is located at the approximate centre line of the river and the second on the north bank of the existing river at the edge of the road. It is my feeling at this time that we will likely require this bank to be removed and I would like to know at what elevation bedrock is likely to be found.

For purposes of your investigation the grade may be taken as 1067.

J. B. CURTIS
REGIONAL BRIDGE LOCATION ENGINEER

COMPLETION: JULY 12TH 67

DEPARTMENT OF HIGHWAYS ONTARIO

MEMORANDUM

To: Mr. K. Selby,

From: Z. Dunikowska

Date: June 9, 1967.

Our File Ref.

In reply to

Subject: W.P. 337-61
W.J. 67-F-46, Hwy. 35 & Oxtonge River

The core samples from Oxtonge River, Hwy. 35 area consist of para-gneisses of Precambrian Age. They are characterized by high percent of quartz, feldspar, abundant garnet crystals, biotite and some accessory ferromagnesian minerals. All four drilling samples show very little variety.

Hole 10 - Medium to coarse grained quartzitic gneiss with abundant garnet crystals. Visual weathering down to 2 ft. (may be a boulder). Occasional high angle (60 - 80°) fissures with thin film of biotite. Lineation of biotite in the core not consistent.

Holes 3, 4 & 12 - Consist of the same para-gneiss with abundant garnet crystals. Incipient weathering down 2 to 4 inch. Lineation of biotite not consistent.

Z. Dunikowska

Z. Dunikowska,
Geologist.

ZD/ls

401 & Keele St.
Downsview, Ontario

June 19, 1967

Johnston Drilling Co. Ltd.
377 Munster Ave.
Toronto, Ontario

Dear Sirs:

This is to confirm our request of May 29, 1967 for the supply of a Diamond Drill together with all necessary equipment, as specified under the terms of our Contract Agreement, at Hwy. 35 & Oxtongue River, Dwight, Ontario.

This project bears Job Number 67-F-46.

Yours truly,

K. Selby

KS:mt

K. Selby
Supervising Foundation Engineer
for A. G. Stermac
Principal Foundation Engineer

401 & Keele St.
Downsview, Ontario

June 19, 1967

Master Soil Investigation
104 Kenhar Drive
Weston, Ontario

Dear Sirs:

This is to confirm our request of May 29, 1967 for the supply of a Diamond Drill together with all necessary equipment, as specified under the terms of our Contract Agreement, at Hwy. 35 and Oxtongue River, Dwight, Ontario.

This project bears Job Number 67-F-46.

Yours truly,

K. L. Selby

~~N. Bernie~~ K. SELBY
Supervising Foundation Engineer
for A. G. Stermac
Principal Foundation Engineer

KS:mt

(KLS)

Department of Highways Ontario
Copy for the information of
Mr. A. Stermac,
Principal Foundation Engineer

Mr. J.S. Curtis,
Reg. Bridge Location Engineer,
North Bay Regional Office,
North Bay, Ontario

Bridge Division,
Downsview, Ontario

September 29, 196[illegible]

Ontonagon River Bridge
W.P. 337-61, Site 48-2
Highway 35, District No. 11

11-F-46

Attached herewith are prints of the Preliminary Bridge Plan Drawing B-6307-P1 for the above-mentioned structure.

The estimated cost of the proposed structure is $65,000. This cost includes tender, materials, engineering and sundry construction.

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

G.S. Grebski,
Bridge Design Engineer

GSG:rd

Attach.

c.c. S. McCombie
A. Stermac (2)
R. Forrest
E. Cross

No comments ap

No Comments: Oct 19th 1967

K. L. Sully

Department of Highways Ontario
Copy for the information of

Mr. A. Stermac

Mr. J.C. McAllister,
Reg. Bridge Planning Supervisor,
North Bay Regional Office,
North Bay, Ontario

Bridge Office,
Downsview

March 13, 1970

Oxtongue River Bridge at Marsh Falls
W.P. 337-61, Site 42-2
Highway 35, District 11

D-F-46

Attached herewith are printr of the Preliminary Bridge Plan Drawing D-6798-P1 for the above-mentioned structure.

The estimated cost of the proposed structure is $130,000. This cost includes tender, materials, engineering and sundry construction.

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

CSG:rd

Attach.

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

C.S. Grebski,
Bridge Design Engineer

No comments

M. L. Bailey
March 25th 1970

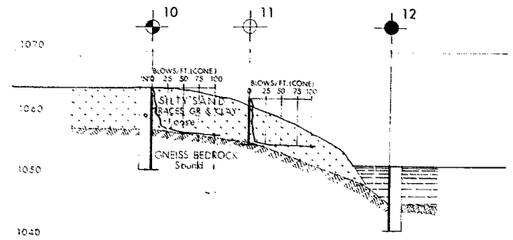
67-F-46

W.P. # 337-61

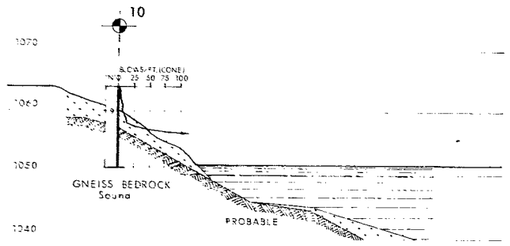
HWY. # 35

OXTONGUE RIVER

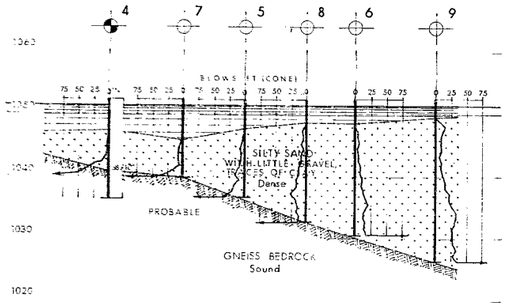
(MARSH FALLS)



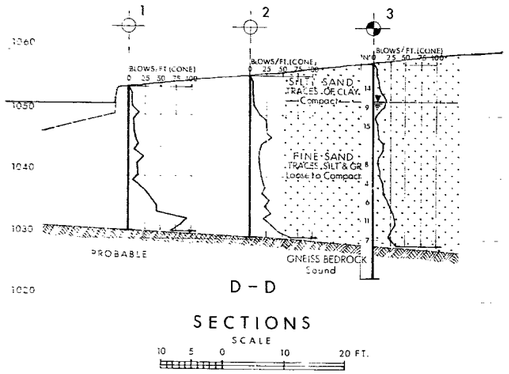
A – A



B – B

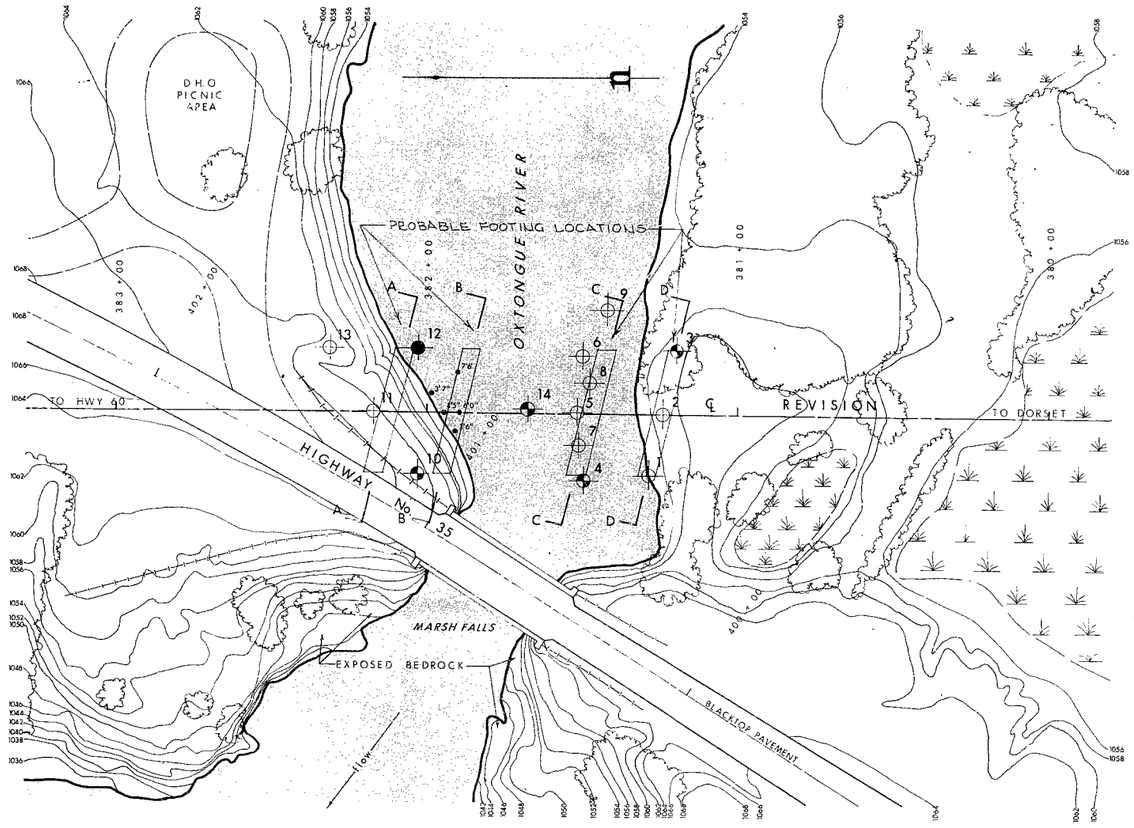


C – C

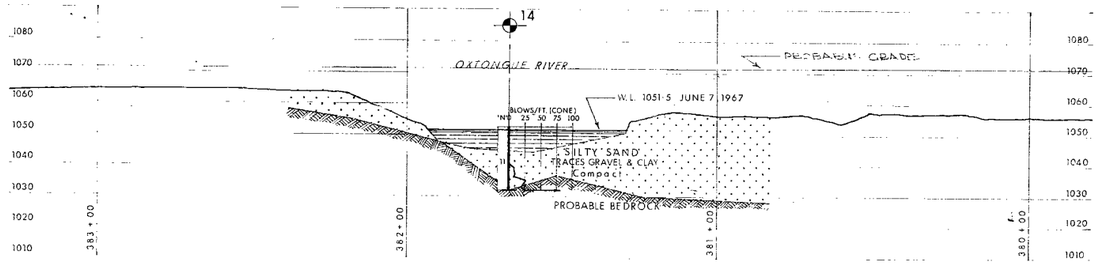


D – D

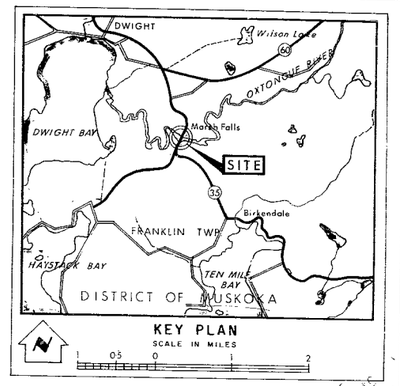
SECTIONS
SCALE
10 5 0 10 20 FT.



PLAN
SCALE
20 10 0 20 40 FT.



℄ PROFILE
SCALE
20 10 0 20 40 FT.



KEY PLAN
SCALE IN MILES
0.5 0 1 2

LEGEND

- Bore Hole
- Cone Penetration Hole
- Bore & Cone Penetration Hole
- Water Levels established at time of field investigation, June 7, 1967
- Probe Hole showing depth to rock

NO.	ELEVATION	STATION	OFFSET
1	1054.3	381+29	19' LT.
2	1051.1	381+24	℄
3	1054.1	381+20	20' RT.
4	1051.5	381+49	21' LT.
5	1051.5	381+52	℄
6	1051.5	381+50	19' RT.
7	1051.5	381+51	10' LT.
8	1051.5	381+47	10' RT.
9	1051.5	381+42	34' RT.
10	1063.9	382+03	19' LT.
11	1062.8	382+18	℄
12	1051.5	382+03	20' RT.
13	1063.2	382+30	20' RT.
14	1051.5	381+67	2' 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.

PRINT RECORD		
NO	FOR	DATE

REVISIONS			
	DATE	BY	DESCRIPTION

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

OXTONGUE RIVER

KING'S HIGHWAY NO. 35 REVISION DIST. NO. 11
DIST. MUSKOKA
TWP. FRANKLIN LOT 8&9 CON. VIII

BORE HOLE LOCATIONS & SOIL STRATA

SUBM'D A.P.	CHECKED,	W.P. NO 337-61	M.B.T. DRAWING NO 67-F-46A
DRAWN P.G.O.	CHECKED,	JOB NO 67-F-46	
DATE JULY 10, 1967		SITE NO	BRIDGE DRAWING NO. -
APPROVED A.B. Thomas PRINCIPAL FOUNDATION ENGINEER		CONT NO	

REF. No. : E-4254-1