#63-F-286 m

BRIDGE OVER

BRONTE CREEK

E. FLAMBOROUGH

TWP.

Note -

Footings should be placed on bedrock as recommended in the report. The alternative of footings resting on piles is not practical because of the very small length of piles. The consultants recommendations pertaining to dewatering measures (grouted sheet piles) are impractical. Sump pumping or any other measures cannot cause any damage to the school, dewatering should be left entirely to the contractor.

By phone to G E E Burkhardt

June 11 1963 Attorney

Drawing returned as requested

BA 1661

E. M. PETO ASSOCIATES LTD.

1287 Caledonia Road,
Toronto 19, Ontario.
RUssell 9-1126-7

Job No. 6351

May 13th, 1963.

STRUCTURE SITE No. 37-9

The Township of East Flamborough,
c/o McCargar, Filer and Hachborn,
Consulting Engineers,
10 James Street North,
Hamilton, Ontario.

Attention: Mr. W. A. H. Filer

Re: Foundation Investigation, for
Proposed Bridge over Bronte Creek,
Near Flamboro Station.

Dear Sirs:

We have pleasure in submitting herewith four copies of our soil investigation report.

The soil conditions encountered are described in some detail in the report, together with observations and conclusions regarding the foundation to the proposed structure.

We trust the information contained in the report is complete to your requirements. Should you, however, have some questions arising from the report, please do not hesitate to contact us.

RECEIVED
MAY 14 1963
McCARGAR, FILER & HACHBORN
LIMITED
Consulting Engineers

Yours very truly,

E. M. PETO ASSOCIATES LTD.,

E. M. Peto, P. Eng.

BL:sb

THE TOWNSHIP OF EAST FLAMBOROUGH

c/o McCARGAR FILER AND HACHBORN

CONSULTING ENGINEERS

SOILS REPORT

for

PROPOSED BRIDGE

NEAR FLAMBORO STATION

E. M. PETO ASSOCIATES LTD.,

1287 Caledonia Road,
Toronto 19, Ontario.

A. INTRODUCTION:

We were authorised by the Consulting Engineers, Messrs. McCargar, Filer and Hachborn, to carry out a soil investigation at the site on Bronte Creek of the present bridge, which will be replaced by a 40 ft prestressed bridge.

The existing bridge consists of a 39 ft 3 in. by 12 ft 8 in. deck resting on steel frame; the wing walls and abutments are badly cracked. The foundation depth of the abutments and wing wall is unknown, but in all probability it is resting upon the talus stratum found above the bedrock.

The investigation was required, to establish the subsoil stratification, the depth to bedrock, and any other pertinent characteristics of subsoil and rock which may influence the foundations for the new bridge.

B. GENERAL INFORMATION:

1. The test holes were put down in accordance with our standard procedure as outlined in Appendix A.

2. The location of boreholes and probe holes is shown on the attached site plan together with the inferred soil profile.

3. The elevations as given on the borehole logs, drawing and in the report are Geodetical elevations. The centre of the south end of existing bridge deck was taken as a T.BM., which according to the Surveyors drawing, Sheet No. 2, P. 374 has elevation of 824.68.

4. No laboratory tests were carried out on samples obtained, apart from the determination of natural water contents.

C. SITE AND GEOLOGY:

The new bridge will be located slightly west of the present one, where the road crosses on a north-south alignment. South of the bridge it turns sharply to the west. The ground rises south and north of the site, gently south of the bridge, but much steeper in the northerly direction. To the east of the present bridge there is a railway bridge which crosses the creek at a much higher level. The estimated difference in elevation between these two bridges is about 25 feet. Further east a mill is situated on the south side of the creek; a concrete weir crosses the creek at this point, and controls the flow of the water upstream, at both bridges. Above the weir the velocity of flow at the road bridge is quite

C. SITE AND GEOLOGY:

moderate about 1 ft/second, but downstream of the weir the velocity of the flow is much greater.

The bridge site is in the physiographic region known as the Flamborough Plain. During the retreat of the last ice sheet this region was covered by glacial Lake Warren. The coarse sand and gravel encountered at borehole 2 was deposited on the beach of this Lake. The sandy-silty talus layer, underlying the sands is the product of erosion during the glacial period. The bedrock consists mainly of coarsely crystalline, porous and vuggy dolomite with crinoid stems and small gypsum crystals in the vugs. This formation can probably be correlated to the Gasport Member of the Silurian, Lockport formation. At borehole #1, the porous crystalline dolomite was underlain by a dense argillaceous dolomite with less vugs, but numerous pyrite cyrstals. This is probably the equivalent to the DeCew Member of the Lockport Formation.

D. SOIL CONDITIONS:

The stratification is shown on the attached soil profile, and a more detailed description is given on the borehole logs. All the deposits encountered at the site are non-cohesive, granular material which are quite permeable.

The individual layers were:

i) Fill and Topsoil

These layers were met at test hole 1 only. The fill attained a depth of about 8 ft below grade, and the topsoil was 1 ft 3 in. thick. Generally, the fill consisted of sand, some gravel, and minor silt content, and is probably of local origin.

The density increased with depth, and on the basis of the standard penetration tests (N-values) the fill was very loose near the surface, becoming compact near the lower boundary. The natural water contents of the fill varied between 15 to 19% indicating quite a wet condition.

ii) Sandy silt

There was a very thin layer of sandy silt underlying the fill at test hole 1, where it was only 1 ft 7 ins. thick. It was dark brown, wet, and contained numerous weathered rock fragments.

D. SOIL CONDITIONS: (Cont'd)

iii) Fine to coarse sand, some gravel

At test hole 2 there was 18 ft 8 ins. of sand and gravel with rock fragments. Generally, the N-values were about 7 to 8, thus the layer was loose. The natural water contents varied between 9 and 12% above water table and 10 and 15% below the water table.

iv) Talus

Underlying the sandy silt at test hole 1, and the sand and gravel deposit at test hole 2, there was a stratum of talus, which was overlying the bedrock. It was composed mainly of fine to coarse sand with some silt, fine to coarse gravel and fragments of rock. The overall colour was buff to light brown. According to the results of standard penetration tests this deposit is compact to extremely dense, with N-values ranging from 21 to over 100. The natural water contents were in the order of 5 to 9%.

D. SOIL CONDITIONS: (Cont'd)

v) Bedrock

The bedrock was mainly a dolomite. The upper portion is a limy dolomite, coarse, crystalline and porous; in addition it contained large gypsum crystals. Recovery in this zone was 93 to 97%, which indicates that basically the bedrock is in a sound condition. This portion of the bedrock belongs to the Gasport member of the Lockport formation.

At borehole 1, at a depth of 24 ft 8 ins. below grade, the porous limy dolomite changed to a dense argillaceous dolomite. Some small fissures filled with pyrite crystals, were discernible. The recovery in this zone of the bedrock was 100%, indicating sound bedrock.

The refusal depths and elevations of the upper surface of the bedrock were:

Hole No.	Refusal Depth	Refusal elevation
1	20 ft 10 ins.	802.0
2	22 ft 3 ins.	802.9
Probe Hole #		
3	21 ft 10 ins.	803.2
4	19 ft 4 ins.	800.7

Thus it may be seen that there is a slight dip of the bedrock surface in a westerly direction, that is from the area of probe hole 3 towards the area of probe hole 4.

E. WATER CONDITIONS:

The ground water table is closely inter-related with the water level in the Creek; therefore any fluctuation of the creek level will be reflected by a change of ground water table in the surrounding area.

During the drilling operations, some small "quicking" conditions were observed in the deposits located below ground water level. The test holes did not stay open, caving constantly below water level.

F. OBSERVATIONS AND CONCLUSIONS:

Assuming that the depth of water in the creek at the present bridge is some 5 to 6 feet, and the water level of the creek is at about elevation 813, then the bottom of the creek will be at elevation 807, which is only some 5 feet above the elevation of the bedrock. Further it is known from the data recorded on the surveyors drawing that 1 to 2 feet of muck forms the creek bed, so that in fact only about 3 to 4 feet of intact soil covers the bedrock below the creek bed.

From a scour consideration this depth represents a minimum practical cover to protect the footing, which accordingly should be placed right on the bedrock.

F. OBSERVATIONS AND CONCLUSIONS: (Cont'd)

Bearing conditions are good as the ultimate compressive strength of the bedrock is estimated to be in the order of 2000 tons/sq. ft, which depending on the factor of safety adopted, (between 10 and 20) will give an allowable bearing value on the bedrock in excess of 50 tons/sq. ft. Thus at the site investigated the main problem will be one of construction.

If a conventional spread footing design is contemplated, control of the ground water in excavation below water table will require special consideration. All the strata overlying bedrock are of a granular nature and fairly permeable. The ground water level corresponds with the creek water level, and will fluctuate with the creek water level. Thus, if excavations are made when the creek carries 5 to 6 feet of water, which will correspond to about 11 feet head of water about bedrock surface, close sheeting will be required with probably grouting of the area just immediately above bedrock and possibly the bedrock surface. This will be necessary because of the difficulty of sealing off the water completely at the bottom, as the sheeting will not penetrate the bedrock, and further, the upper zone of the bedrock is porous, permitting water seepage. Driving conditions for the sheet piling through the talus stratum will be difficult. For such conditions a pile foundation would appear to be more appropriate, except for difficult driving conditions through the talus stratum, where jetting in the piles may be necessary.

F. OBSERVATIONS AND CONCLUSIONS: (Cont'd)

Even with a pile foundation, unless a curtain wall is provided in front of the piles, scouring of the embankment may take place behind the piles. Thus this latter method does not provide a satisfactory solution.

It is understood that certain repairs are projected for the mill upstream, in which event the water held by the dam could be released, thereby reducing appreciably the flow together with the water table, at the bridge site.

Under such circumstances, and subject to an arrangement being made whereby the construction of the bridge foundations coincides with the overhaul to be carried out at the mill, then a spread footing type of foundation becomes a practical and advantageous solution.

Spread footings founded on bedrock removes the scour problem, and the lowering of the water table renders the excavation problem very much simpler since sheeting can probably be dispensed with, although some pumping on a fairly continuous basis will be necessary to control the water level within the excavation to bring it down to bedrock level.

A further advantage of this latter method is that it allows a careful inspection of the rock surface to be made.

F. OBSERVATIONS AND CONCLUSIONS: (Cont'd)

In view of the presence of gypsum crystals in the bedrock, the use of Type II cement for the footings in contact with the bedrock and below the water table is recommended to reduce the possibility of sulphate attack on the concrete.

The abutments and any wing walls should be designed for active soil pressure corresponding to a hydrostatic pressure of 30 lbs. per foot height of retained soil, plus an additional pressure arising from the unbalanced water pressures arising from a time lag before equilibrium water level behind the walls is attained, following any periodical or temporary draining of the creek.

Excavations in the overburden materials will meet some difficulties due to the presence of gravel and rock fragments. Bracing of excavations will also be required, if made in vertical cut, due to the variable nature of deposits. The forces on bracing may be calculated as for the abutments and wing walls.

F. OBSERVATIONS AND CONCLUSIONS: (Cont'd)

Alternatively, if space permits, the slopes of excavations may be battered back for temporary purposes at about 1 vertical to 1 horizontal, provided, of course, no appreciable height of water is present in the excavations.

Report prepared by:

B. Lewicki

B. Lewicki, P. Eng.

BL:sb

E. M. PETO ASSOCIATES LTD.,

C. F. Freeman

C. F. Freeman, P. Eng.
Chief Engineer.

Job No. 6351

May, 1963.

APPENDIX "A"

STANDARD PROCEDURE

The field investigation work is carried out by means of a skid mounted diamond drill rig.

Standard sampling procedures are followed. Casing is driven and cleaned, either by augers, tubes or by wash water.

Samples are recovered ahead of the casing at frequent intervals, with either a 2 inch or 3 inch O.D. split barrel sampling tube. Shelby tube, or split barrel sampling tube fitted with brass liners and special sharp cutting hose.

The standard penetration test results are recorded when sampling with the regular 2 inch O.D. split barrel sampler, these being the number of blows of a 140 pound hammer falling 30 inches, required to drive the sampling tube a distance of one foot into undisturbed soil.

The Dutch Cone probe test is made by driving the drill rods into the ground with a 2 inch dia. x 60° cone tip. The number of 4200 inch pound blows per foot of penetration are recorded, as in the standard penetration test.

Where required, "in situ" shear strength tests are made ahead of the casing, using Modified Acker vane test equipment.

Disturbed samples are visually classified in the field, sealed in sample jars, and are re-examined, and tested as necessary, in the soils laboratory. Undisturbed samples are returned to the laboratory for later examination and testing as required.

The test holes are bailed (or pumped out) during the work as necessary, at the end of the day, and on completion. Subsequent water level readings are taken for the duration of the field work. Water pressure readings are recorded when Artesian water conditions are encountered. Moisture content samples are recovered at frequent intervals to assist in the soil classification and the interpretation of water table results.

Borehole logs are prepared giving details of the soil description and condition as recorded in the field. These logs term the basis of the soil profile, which indicates the general stratigraphy assumed to exist between the boreholes as represented by the borehole logs.

The boreholes are normally set out by the Field Engineer, who also records the ground elevations referred to a temporary bench mark or known reference point. If the client has been responsible for setting out the boreholes and recording their ground elevations this is stated in the preamble to the report.

A plan is drawn up from drawings supplied by the Client or his representatives, showing the locations of the boreholes and the T. B. M. where applicable.

Normally, the standard penetration blows and the natural moisture contents are plotted against elevation as a graph, and these graphs form part of the appendices, together with laboratory test result details, ground water readings and other soil characteristics which can be best illustrated in graphical form.

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DEFECTS IN NEGATIVE DUE TO CONDITION OF ORIGINAL DOCUMENT

e. m. peto associates ltd.

SOIL ENGINEERING SERVICE – TORONTO, ONTARIO

BOREHOLE LOG

Job Name: Proposed New Bridge
Job No.: 0151
Borehole No.:
Client: The Township of East Flamborough
Casing: 2" e. 2"X
Boring Date: April 29th & 30th, 1963
Elevation: Geodetic
Compiled By: P. L.
Checked By: V. M.

SAMPLE CONDITION

- UNDISTURBED
- FAIR
- DISTURBED
- LOST

SAMPLE TYPE

- A.S. AUGER SAMPLE
- C.S. CASING SAMPLE
- S.S. 2" STANDARD SPLIT TUBE SAMPLE
- S.L. SPLIT BARREL WITH LINERS
- S.T. THIN-WALLED SHELBY TUBE SAMPLE
- W.S. WASH SAMPLE
- R.C. ROCK CORE

ABBREVIATIONS

- V.T. IN SITU VANE SHEAR TEST
- M. MOIST
- W.L. WATER LEVEL IN CASING
- W.T. GROUND WATER TABLE IN SOIL
- W.T.P.L. WETTER THAN PLASTIC LIMIT
- D.T.P.L. DRIER THAN PLASTIC LIMIT
- A.P.L. ABOUT PLASTIC LIMIT

SOIL DESCRIPTION	COLOUR	Description of Consistency	Depth (Feet)	Sample No. and Condition	Sample Type	No. of Blows per Ft.	Moisture Content %	WATER LEVELS & REMARKS
Existing grade		522.0	0'-0"					
Sandy organic top soil	Dk. brown		1'-3"					
Silty mixed fill (stones, bricks, etc.)	Dk. brown	Very loose		1	SS	3	18.6	Wet
As above (numerous rock fragments)	Mixed brown & grey	Compact		2	SS	27	15.1	Very moist
Silty fine sand or sandy silt with numerous weathered rock fragments; sandy, silty talus	Dk. brown and lt. buff	Loose to compact	8'-1" 9'-8"		SS	14	19.6	Wet w. level 10'-1" (Apr. 29)
	Lt. brown	Dense to very dense		4	SS	48	5.9	Wet to saturated
Silty, sandy talus	Lt. brown	Dense to very dense	15'-0"	5	SS	48	9.3	Saturated
As above	Lt. brown	Compact		6	SS	21	6.6	Saturated
		Extremely dense compact	20'-0"					Water sample #8
As above	Buff-Lt. brown		20'-10"	7	SS	91/10"	9.3	Saturated
Coarsely crystalline porous limy dolomite. Large gypsum crystallization at 22'5". Aragonite crystals at 24'0". Fossiliferous in places. Changes at 24'8" to very dense argillaceous dolomite. Small vugs, fissures filled with numerous, small pyrite crystals, weathered parting at 28'3"	Lt. grey to blush							Refusal at 20'-10" started D.D. from 20'-10"
					RC			Recovery: 97%
			24'8"					
	Lt. to buff Grey	DeCew	25'0"					
					RC			Recovery - 100%
			31'0"					
		TEST HOLE TERMINATED AT					31'0"	

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DEFECTS IN NEGATIVE DUE TO CONDITION OF ORIGINAL DOCUMENT

e. m. peto associates ltd.

SOIL ENGINEERING SERVICE – TORONTO, ONTARIO

BOREHOLE LOG

Job Name: Proposed New Bridge Job No.: [illegible] Borehole No.: 2

Client: The Township of East Flamborough Casing: 4 1/2 & BX Boring Date: May 1st 1963

Elevation: Geodetic Compiled By: [illegible] Checked By: V. M.

SAMPLE CONDITION

- UNDISTURBED
- FAIR
- DISTURBED
- LOST

SAMPLE TYPE

- A.S. AUGER SAMPLE
- C.S. CASING SAMPLE
- S.S. 2" STANDARD SPLIT TUBE SAMPLE
- S.L. SPLIT BARREL WITH LINERS
- S.T. THIN-WALLED SHELBY TUBE SAMPLE
- W.S. WASH SAMPLE
- R.C. ROCK CORE

ABBREVIATIONS

- V.T. IN SITU VANE SHEAR TEST
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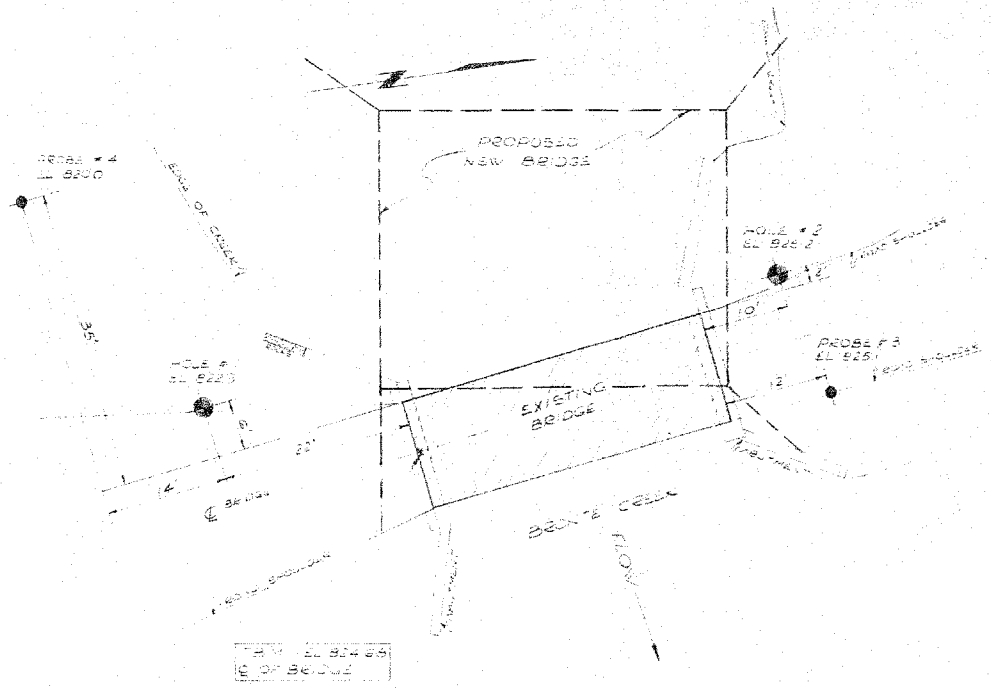
- W.T. GROUND WATER TABLE IN SOIL
- W.T.P.L. WETTER THAN PLASTIC LIMIT
- D.T.P.L. DRIER THAN PLASTIC LIMIT
- A.P.L. ABOUT PLASTIC LIMIT

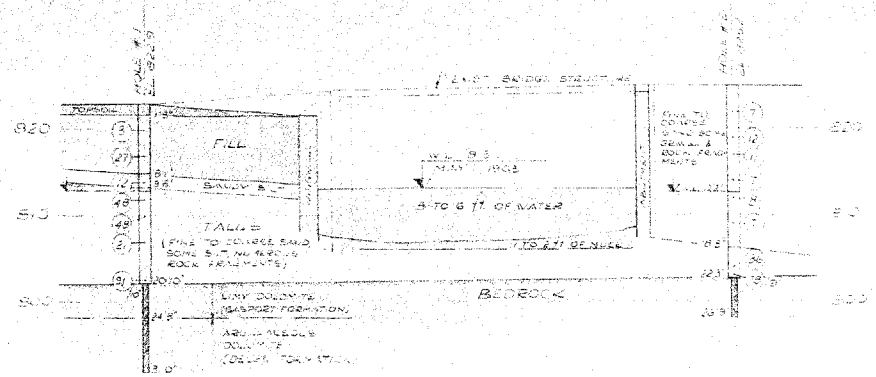
SOIL DESCRIPTION	COLOUR	Density or Consistency	Depth Elevation	Legend	Sample No. and Condition	Sample Type	No. of Blows per 1'	Natural Moisture Content %	WATER LEVELS & REMARKS
Existing grade		6.5.2	0'0"						
Gravelly silty sand	Reddish brown	Loose			1	SS	7	2.6	Very moist
			5'0"						
As above & limestone fragments	Reddish brown & lt. grey	Loose to Compact			2	SS	14	12.1	Wet
Coarse to fine sand with some gravel, limestone fragments	Dk. brown	As above			3	SS	31	9.2	Very moist
			9'0"						
As above	Dk. brown	Loose			4	SS	7		Moist
									W. level at 12'2" (May 1st)
Coarse to fine sand with some gravel	Reddish dark brown	As above			5	SS	8	6.9	Saturated
			15'0"						
Coarse to fine sand, some silt & coarse to fine gravel	Reddish dark brown	As above			6	SS	7	15.4	Saturated
			18'8"						
Coarse to fine sand, some silt, numerous rock fragments (talus) coarse crystalline dolomite quite porous and vuggy (sometime crystals partly filled in with calcite, numerous calcite stems, very easy to pieces	Buff-brown	Dense			7	SS	35/0		Saturated
		extra dense			8	SS	78/9		Refusal at 22'3" started diamond drilling (D.D.)
	Lt. grey	Compact to moderately weathered	22'3"						
						RC			Recovery 93%
			26'9"						

TEST HOLE TERMINATED AT 26'9"



SITE PLAN

SCALE: 10' TO 1'



SECTION THROUGH HOLES 1 & 2

SCALE: 10' TO 1' (NATURAL)

LEGEND

BOREHOLE

PROBE HOLE

BLOWS/FOOT S.P.T.

WATER LEVEL

(SEE BOREHOLE LOGS FOR COMPLETE SOIL DATA)

NOTE: The actual soil stratification has been verified from data obtained at the borehole locations only. The inferred contacts shown are based on geological evidence and these may vary from those shown between borings.

REGISTERED PROFESSIONAL ENGINEER
E. M. PETO
PROVINCE OF ONTARIO

THE TOWNSHIP OF EAST FLAMBOROUGH
R. MCGREGOR FLEO & FLAMBORO CONS. ENGINEERS

PROPOSED BRIDGE
FLAMBORO/ONTARIO

PREPARED BY
E. M. PETO ASSOCIATES LTD.

JOB NO. 6351 | DATE: MAY 1962 | DWN BY: K.K. | CHECKED BY: E.L.