

63-F-242 M

TOWNSHIP BRIDGE No. 16

BEAR CREEK

MEMORANDUM

TO: Mr. A. Stermac
Principal Foundations Engineer,
Room 107, Lab. Bldg.,

FROM: G.C.E. Burkhardt

Bridge Division,
DATE: April 24, 1963.

OUR FILE REF.

IN REPLY TO


SUBJECT: County of Lambton,
Bear Creek Bridge,
Plympton-Enniskillen Townline,
Lot 27/28, Con I, Plympton Twp.,
Structure Site #15-100,
Our File # BA 1630.

Attached please find one copy of the Foundation Report
by E.M. Peto Associates Limited, for your comments.

The designer has proposed a simply supported structure
with one 80 foot clear span. The footings have been carried down
to EL. 641.0 and will be supported on piles.

We intend to approve the preliminary design as soon as
possible and we would appreciate it very much, if we could
have your comments at your earliest convenience.

GCEB/dm


G.C.E. Burkhardt,
for K.L. Kleinsteinber,
Municipal Bridge Liaison Engineer.

No comment!

A. Stermac

April 25, 1963

By phone to G.C.E.B.

BA 1630

E. M. PETO ASSOCIATES LTD.

Job No. 6328

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

April 2nd, 1963.

**The County of Lambton,
c/o J. A. Monteith Associates Ltd.,
Consulting Engineers,
P. O. Box 579,
Petrolia, Ontario.**

63-242M

Attention: Mr. G. Ingram, P. Eng.

**Re: Subsoil Investigation
Township Bridge No. 16, Bear Creek,
4.5 miles ESE of Wyoming, Ontario.**

Dear Sirs:

**We have pleasure in submitting four copies of our
Report No. 6328 on the above site investigation.**

**The shale bedrock was encountered near elevation 630,
which is about 35 ft below the existing bridge deck. Because of the soft
nature of much of the overburden, a pile foundation resting on the bedrock
is recommended. Some settlement of reconstructed embankments is
anticipated.**

We consider the Report to be complete, but we would gladly provide additional assistance should you wish to discuss further any of the points.

Yours very truly,

E. M. PETO ASSOCIATES LTD.,

A handwritten signature in dark ink, appearing to read 'E. M. Peto', written in a cursive style.

E. M. Peto, P. Eng.

RK:sb

THE COUNTY OF LAMBTON

**c/o J. A. MONTEITH ASSOCIATES LTD.,
CONSULTING ENGINEERS**

SOILS REPORT

for

TOWNSHIP BRIDGE NO. 16

BEAR CREEK

E. M. PETO ASSOCIATES LTD.,

**1287 Calejonia Road,
Toronto 19, Ontario.**

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BOREHOLE LOGS

SITE PLAN and SUBSOIL PROFILE

A. INTRODUCTION:

The investigation described in this Report was authorized verbally by Mr. G. Ingram, of J. A. Montelth Associates Ltd., Consulting Engineers, on February 11th, 1963.

A new bridge is to be provided on the Bear Creek, at a point located approximately 4.5 miles east-south-east of Wyoming, Ontario. A site investigation was required to determine the subsoil conditions for the design of foundations.

It is anticipated that the present road alignment will be unchanged, but the new structure is to be built some 40 ft east of the existing bridge. The new bridge will have an 80 ft single span and will be either simply supported or of pre-stressed concrete. The span will be at right angles to the stream, the channel of which is to be modified.

The existing bridge is a steel truss construction, 82 ft long and supported on concrete abutments, which show severe cracking, obviously caused by settlement.

B. GENERAL INFORMATION:

1. Two test holes were performed at the site in the positions indicated in the field directly to our drilling crew by Mr. G. Ingram, who subsequently supplied us with a sketch showing the locations in relation to the existing bridge, as well as the Geodetic ground elevations. The site plan included on the enclosed drawing is based on the above sketch.

2. Test hole 1, located approximately 50 ft east of the eastern abutment of the existing bridge, encountered the shale bedrock at a depth of 31.8 ft. The bedrock was proved by diamond drilling for 10 ft.

Test hole 2, located 55 ft west of the western abutment, encountered refusal at a similar elevation as in test hole 1, presumably on surface of the shale bedrock, and diamond drilling was not performed in this test hole.

3. The field work was carried out by our drilling rig unit No. 7, between March 12th and 14th, 1963. Our standard drilling and sampling procedures were followed, as outlined in the enclosed Appendix.

4. Details of the soil conditions encountered in the test holes are described on the borehole logs, which include also results of in-situ standard penetration tests and water content measurements.

5. In view of the strong probability that the bridge will be constructed on piles resting on the bedrock, no laboratory soil tests, apart from water content measurements, were considered necessary.

C. SITE AND GEOLOGY:

The site of the proposed bridge is located on the Bear Creek, approximately 4.5 miles east-south-east of Wyoming, Ontario, at a point where the creek is crossed by a gravel road. The road runs in an east-west direction and forms the boundary between Plympton and Enniskillen Townships. The creek cuts diagonally across the road, flowing roughly from the east-north-east to the south-west. The area around the site is relatively flat and undeveloped and contains scrub lands and pastures. A few trees are present along the creek channel.

Geologically, the area is located in the St. Clair Clay Plain, where glacial processes have deposited a mantle of clayey till over the surface of Ordovician shale bedrock. The till was found to be only 2.3 to 5.7 ft thick, and was overlain in turn by a lacustrine silty clay with some pebbles and by a soft organic silt, of alluvial origin.

The shale bedrock was encountered near the elevation 630.

D. SUMMARY OF SUBSOIL CONDITIONS:

Details of the soil conditions encountered in the test holes are described on the enclosed borehole logs, while a simplified subsoil profile, in the form of a section through the test holes, is included on the enclosed drawing.

The following soil types were encountered, in the order of occurrence.

a) Sand and gravel fill

The test holes were put down from the shoulders of the existing embankment and the surficial layer was found to consist of a sand and gravel fill, extending to a depth of 1.2 ft in test hole 1 and 0.4 ft in test hole 2.

b) Brown clayey silt

In test hole 1, a clayey silt, of firm consistency and including some organic matter and shell fragments, extended to a depth of 12.5 ft below the existing grade.

In test hole 2, what appeared to be the virgin silt extended between the depth of 88 and 11 ft, (this test hole is approximately 5 ft higher) and was covered by approximately 7.5 ft of very weathered silt mixed with sand and clay, which was obviously a fill forming the existing embankment.

Due to the high silt content and organic inclusions, the brown clayey silt must be considered as an inferior backfilling material, and its use in areas where settlements would be undesirable, should be avoided.

D. SUMMARY OF SUBSOIL CONDITIONS: (Cont'd)

c) Soft organic silt

A clayey silt, with a considerable proportion of organic matter and some peat and decayed wood inclusions, extended in test hole 1 between the approximate elevations 648.8 and 645.6. In test hole 2, the organic silt was encountered between the elevations 655.2 and 647.2.

The organic silt had a soft consistency and a greenish-grey colour with some yellowish stains and dark brown to black organic inclusions.

This deposit has a low shear strength and is highly compressible, and would be the main seat of settlements of any structures or embankments placed above it.

Due to its composition, this material is entirely unsuitable as a backfill behind foundations or in reconstructed embankments.

d) Firm silty clay

The silt stratum was followed below elevation 645.6 to 647.2 by a stratum of silty clay which included some pebbles. The material had a laminated structure, indicating a possible lacustrine origin. It extended to elevation 635.1 in test hole 1 and 633.2 in test hole 2, and was followed by 2 to 6 ft of stiff sandy clay till.

D. SUMMARY OF SUBSOIL CONDITIONS:

d) Firm silty clay (Cont'd)

The laminated silty clay had a generally firm consistency, but included some softer layers. Standard penetration test results in this deposit ranged from 7 to 16 blows per foot, while the moisture contents were in the range of 18.9% to 26.7%. The consistency of the material was generally wetter, or much wetter than the plastic limit.

Shear strength tests were not performed, as they were not considered necessary, but the allowable bearing capacity is estimated as not more than 1.0 ton/sq. ft.

e) Sandy clay till

A layer of sandy clay till was found immediately above the surface of the shale bedrock and was 5.6 ft thick in test hole 1 and 2.3 ft in test hole 2. It had a stiff consistency and was composed of a mixture of silty clay with sand and frequent pebbles, including many angular fragments of black shale. Standard penetration test results in this layer were in the range of 56 to 80 blows per foot, and the water contents ranged from 11.2 to 15.0%.

Although this deposit could be considered as suitable for the support of foundations, in view of its small thickness it appears more practical to support the structure on the shale bedrock.

D. SUMMARY OF SUBSOIL CONDITIONS: (Cont'd)

f) Shale Bedrock

In test hole 1, the shale surface was encountered at a depth of 31.8 ft below the existing grade, corresponding to elevation 629.5. In this test hole the shale was proved by 10 ft of diamond drilling and was found to be very solid. It included a 5 ft thick layer of hard limestone between approximate elevations 522 and 527.

In test hole 2, refusal was encountered at a depth of 35.3 ft, corresponding to elevation 630.9. As this is only 1.4 ft above the surface of bedrock in test hole 1, which was about 195 ft away from testhole 2, it was concluded that the refusal was met on the surface of the shale, which is thus likely to be practically horizontal at this site.

The shale bedrock therefore probably commences near the elevation 630; the rock is capable of supporting very high end-bearing pressures.

E. WATER CONDITIONS:

Some seepage of water occurred in the test hole 1 at a depth of 12.5 ft and in test hole 2 at a depth of 17.8 ft, near the bottom of the organic silt layers, probably corresponding to the old creek bed. All water seepage was cut off when the test hole casing penetrated into the stratum of laminated silty clay, described in Chapter D as deposit (d).

No free ground water was encountered at a greater depth. Provided that the seepage from the creek through the organic silt is cut off, it is expected that any excavation penetrating into the clay could be performed dry.

If prebored caissons were considered at this site, lining would have to be provided to the approximate elevation 645. Below this depth, lining would not be required.

F. CONCLUSIONS AND RECOMMENDATIONS:

Apart from a layer of stiff clayey till, the thickness of which was, however, only 2.3 to 5.6 ft, the allowable bearing capacity of the subsoil is estimated as not more than 1.0 ton/sq. ft. It therefore appears that the most economic type of foundation will be end-bearing piles, resting on the shale bedrock. The bedrock commenced at elevation 629.5 in test hole 1 and probably at 630.9 at test hole 2.

F. CONCLUSIONS AND RECOMMENDATIONS: (Cont'd)

Steel H-piles may be appropriate and will be easy to drive down to elevation 633 to 635. Below this level, a considerably greater resistance will be encountered in the stiff clay till layer.

The allowable bearing capacity of piles reaching the bedrock will be equal to the maximum design capacity of the piles themselves. However, care should be taken not to shatter the rock by overdriving.

Should prebored caissons be considered, lining would probably be necessary to cut off water seepage above elevation 645. Below this level, the borings would probably be dry.

The subsoil, and in particular the organic silt layer encountered between elevations 645 and 655, is compressible, and appreciable settlement of new embankments must be anticipated.

It is recommended to construct the embankments as far ahead as possible of bridge erection, so that most of the settlement should occur before construction of the pavement.

F. CONCLUSIONS AND RECOMMENDATIONS: (Cont'd)

Most of the local subsoil is an inferior fill material, containing a high proportion of silt and much organic matter. Its use in reconstructed embankments is undesirable, and if it cannot be avoided, prolonged settlement of the embankment itself (in addition to the subsoil settlement) must be expected. The grade of the pavement may have to be raised periodically in the first few years after construction to prevent formation of a step between the bridge deck and the embankments.

E. M. PETO ASSOCIATES LTD.,

C. F. Freeman.

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

RK:sb

Report prepared by:

R. Kulesza

R. Kulesza, P. Eng.

Job No. 6328

April, 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 augere, 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 form 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.

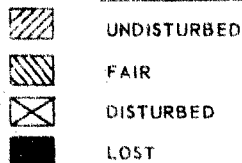
Normally, the standard penetration blows and the natural moisture contents are plotted against elevation as a graph, and these graphs form a part of the appendices, together with laboratory test result details, ground water readings and other soil characteristics which can be best illustrated in graphical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

e. m. peto associates ltd.
SOIL ENGINEERING SERVICE - TORONTO, ONTARIO

BOREHOLE LOG

Job Name Twp. Bridge #16, Bear Creek Job No. 6328 Borehole No. 1
 County of Lambton
 Client e/o J. A. Monteth Associates Ltd. Casing 4" to 5" BX. to 31'10" Boring Date March 12 and 13, 1963
 Elevation 661.3 Compiled By R. K. Checked By P. M. A.

SAMPLE CONDITION



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	Density or Consistency	Depth (Elevation)	Legend	Sample No. and Condition	Sample Type	No. of Blows per F	Unit Weight (pcf)	WATER LEVELS & REMARKS
Sand and gravel fill			0'0"		1	CS			
Silty clay very fissured and weathered	Brown	Soft	1'2"		2	SS	32	25.1	W. T. P. L. W. T. P. L. Frozen to 3'10"
Clayey and sandy silt with organic matter and shell fragments	Dk. brown-grey	Ditto	5'0"		3	SS	13	29.2	Moist from 5'3". Slightly
	Ditto	Ditto			4	SS	9		W. T. P. L. W. T. P. L.
Ditto	Ditto	V. Soft	10'0"		5	SS	2		T. P. L.
Ditto	Ditto	Ditto	12'6"		6	2"S. L.			Water in hole
Organic silt	Grey-brown	Ditto							
Silty clay, fissured with organic traces	Ditto	Firm to stiff	15'8"		7	SS	11	18.9	W. T. P. L. Clay laminated.
			645.6			2"S. L.			
			20'0"						
Silty clay with occasional grits	Grey	Ditto			8	SS	14	26.6	W. T. P. L.
					9	2"S. L.			
Ditto	Ditto		26'2"		10	SS	3/6"	15.0	W. T. P. L.
Sandy clay with pebbles	Dark grey	Stiff					5/6"		
					11	2"S. L.	10/8"		
			30'0"						
Sandy clay and shale fragments	Dk. grey				12	SS	50	13.4	MW. T. P. L.
			31'10"		13	AX			Refusal at 31'10". Wet
Shale	Black	Solid hard							Diamond drilled from 31'10" to 36'11". Recovery 5'1" (100%).
			35'0"			RC			
Limestone	Dark grey	Ditto	37'0"						Diamond drilled from 36'11" to 42'0".
									Recovery 51'1" (100%)
			40'0"			RC			
Shale	Black	Ditto	42'0"						

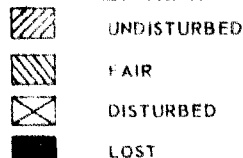
Test Hole Terminated at 42 ft

e. m. peto associates ltd.
SOIL ENGINEERING SERVICE - TORONTO, ONTARIO

BOREHOLE LOG

Job Name **Twp. Bridge #16, Bear Creek** Job No. **6328** Borehole No. **2**
Client **County of Lambton,** Casing **4" to 5"** Boring Date **March 13 and 14, 1963**
c/o J. A. Monteth Associates Ltd. Casing **BX to 30'**
Elevation **666.2** Compiled By **R. K.** Checked By **P. M. A.**

SAMPLE CONDITION



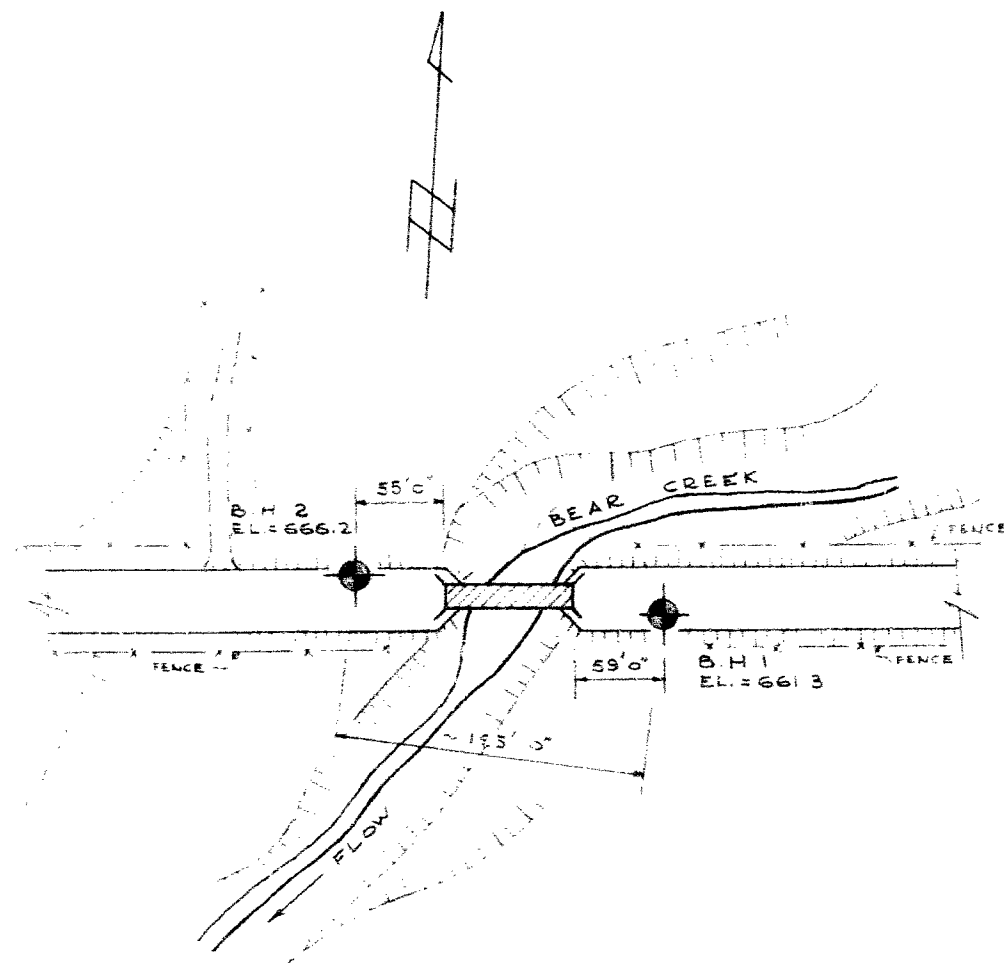
SAMPLE TYPE

A.S. AUGER SAMPLE
C.S. CASING SAMPLE
S.S. 2" STANDARD SPLIT TUBE SAMPLE
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M. MOIST
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D.T.P.L. DRIER THAN PLASTIC LIMIT
A.P.L. ABOUT PLASTIC LIMIT

SOIL DESCRIPTION	COLOUR	Density or Consistence	Depth Elevation	Legend	Sample No. and Condition	Sample Type	No. of Blows per Ft.	Water Level (Feet)	WATER LEVELS & REMARKS
			0'0"						
Sand and gravel fill			0'5"						
Clayey and sandy silt, grits pebbles , fissured (probably fill)	Mottled grey-brown	Firm			1	SS	50	17.1	Frozen to 4'3" D. T. P. L.
Ditto	Ditto	Ditto	5'0"		2	SS	11	20.9	A. P. L.
Ditto	Ditto	Ditto	6'0"		3	SS	8	25.1	W. T. P. L.
Ditto	Ditto	Ditto	11'0"		4	SS	10	20.2	Moist from 11' W. T. P. L.
Decayed wood & peat. Organic, clayey -sandy silt with peat pockets	Black Grey to black	Soft Soft			5	2"S. L.			
Ditto	Ditto	Soft to firm	15'0"		6	SS	6	31.4	M. W. T. P. L.
Clayey silt	Greenish-grey	Firm			7	2"S. L.			
Silty clay with pebbles, laminated	Grey	Firm	19'0" 647.2		8	SS	12	19.4	Seepage seam between 17'10" & approx. 19' cut off with casing to 20'
					9	2"S. L.			
Ditto	Ditto	Soft to	25'0"		10	SS	7	26.7	MW. T. P. L.
Ditto					11	2"S. L.			
Ditto	Ditto	Ditto	30'0"		12	SS	16	25.4	MW. T. P. L.
Silty and sandy clay with shale fragments	Dark grey	Hard	33'0"		13	2"S. L.			Harder and more stones from 33' . D. T. P. L.
			35'4"		14	SS	56	11.2	
			630.9		15	SS	8'4"		



SITE PLAN

SCALE: 100' TO 1"

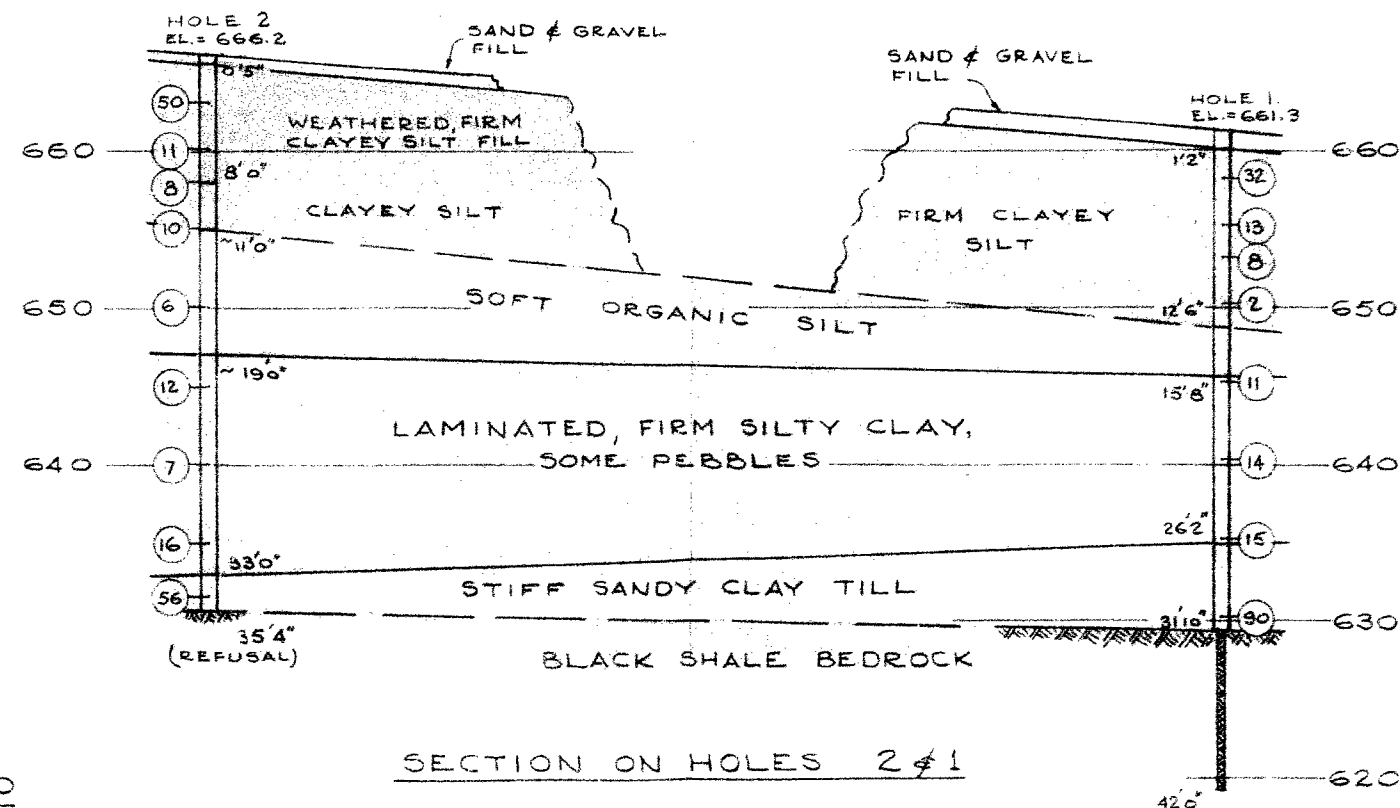
LEGEND

- BOREHOLE
- ⑥ BLOWS/FOOT (S.T.)

NOTE:

SEE BOREHOLE LOGS FOR COMPLETE SOIL DETAILS.

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.



SECTION ON HOLES 2 & 1

SCALES: HOR: 30' TO 1"
VERT: 10' TO 1"



THE COUNTY OF LAMBTON
% J. A. MONTEITH ASSOCIATES LTD

TWP. BRIDGE No 16, BEAR CREEK
WYOMING, ONT.

PREPARED BY:
e.m.peto associates ltd.

JOB # 6328 | APRIL 1963 | DWN.: W.G. | CHECKED: RK