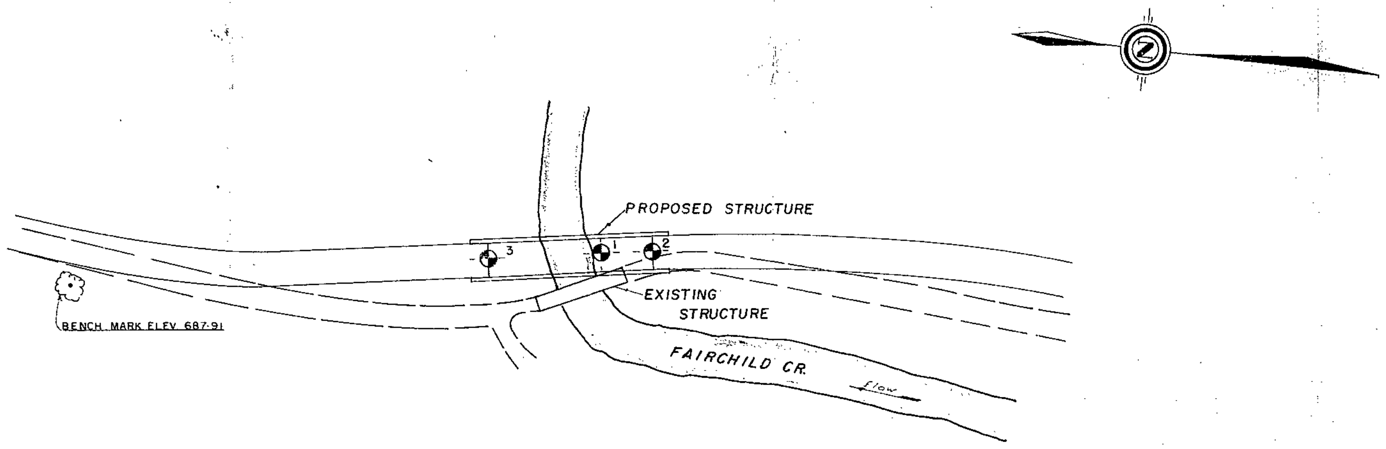
65-F-265M
FAIRCHILD CREEK
McMILLAN BRIDGE
BRANTFORD



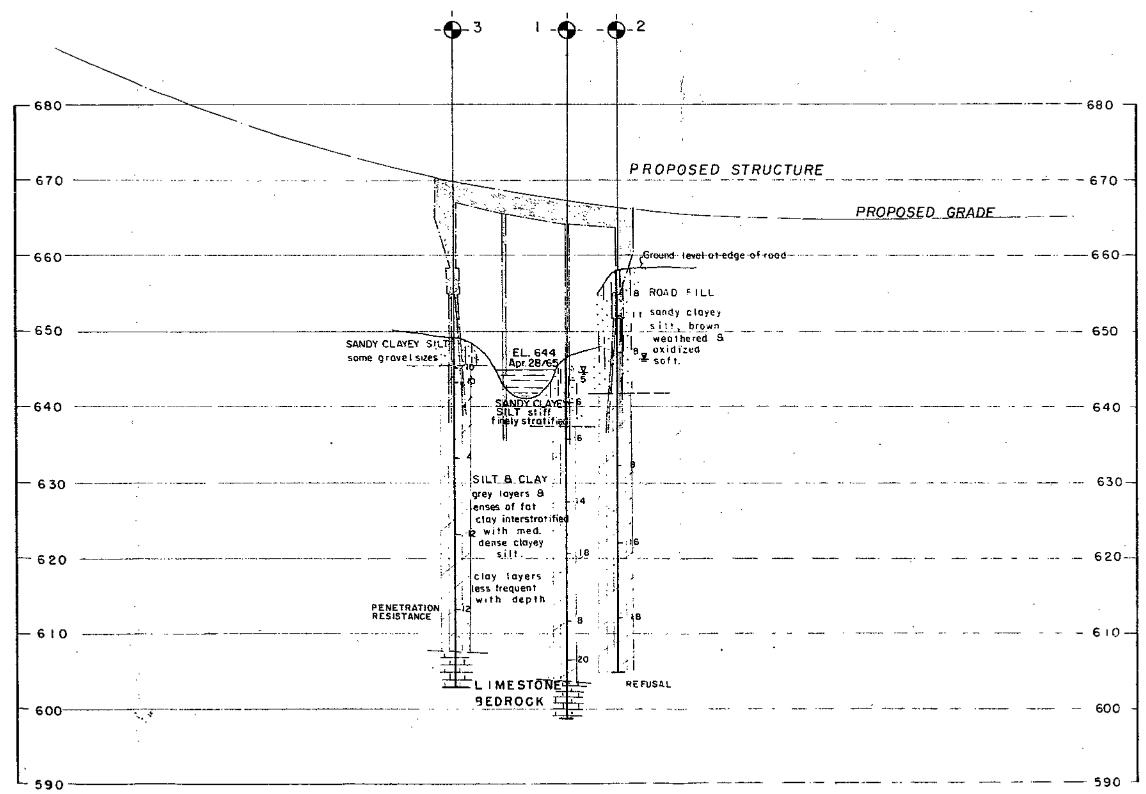
PLAN

SCALES

HORIZONTAL 1" = 60'

VERTICAL 1" = 10'

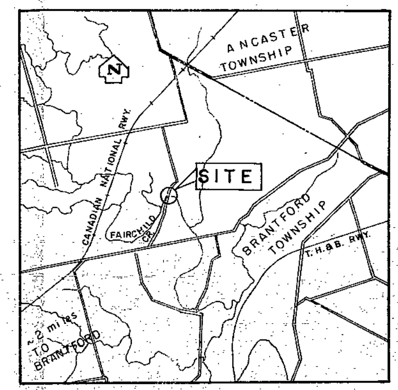
INTERPRETED SUBSOIL STRATIGRAPHY



BENCH MARK ELEV. 687·91

Nail set in root on west side of 30" Elm tree 380± north of exist. structure top of nail.

NOTE: Level of bridge deck according to this survey = 658·03 as opposed to EL. 661 given by Mr. Langley (traversed close back to B.M., within ·03 ft.)



LOCATION PLAN

Scale 1 in = 0.8 mi.

— 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.

William Trow & Associates Ltd.

FOUNDATION INVESTIGATION

PROPOSED McMILLAN BRIDGE OVER FAIRCHILD CREEK

NEAR BRANTFORD ONTARIO

PROJ. 1879	DATE MAY 1965	DWG. № 1

J.D. LEE AND COMPANY
CONSULTING ENGINEERS
19 WILLIAM STREET
PARIS, ONTARIO

1-48 65-F-265M

SOILS INVESTIGATION
MacMILLAN BRIDGE, OVER FAIRCHILD CREEK
TOWNSHIP OF BRANTFORD, ONTARIO

Project: J1879 **May, 1965**

William Trow Associates Limited

80 Milvan Drive
Weston, Ontario
749-1290

William Trow
Associates Ltd.

Soil Mechanics
Consultants
W. A. Trow
MSc. MEIC. P. Eng.
K. Peaker
PhD. MEIC. P. Eng.
D. H. Shields
PhD. MEIC. P. Eng.

Project: J1879

May 7, 1965

J.D. Lee and Company,
Consulting Engineers,
19 William Street,
Paris, Ontario.

Attention: Mr. James F. Langley, P.Eng.

Soils Investigation
MacMillan Bridge, over Fairchild Creek
Township of Brantford, Ontario

Dear Sir:

In conformance with your written authorization of April 19, 1965, we have carried out a soils investigation at the above site near Brantford where an existing bridge over Fairchild Creek is to be replaced.

A summary of the conclusions and recommendations arising from this study is given below.

1) The subsoil at this site consists of stiff clay to depths of 40 to 53 feet below existing ground level, at which level competent limestone bedrock occurs. Some alluvium was encountered down to creek bed level adjacent to the creek.

2) As the overlying subsoil is relatively weak the bridge should be supported on end bearing piles driven to

refusal on competent bedrock. The permissible capacity of any end bearing pile will equal its safe loading when considered as a column.

3) A spill-through design for the abutments is recommended to reduce the earth pressures due to the fill.

4) No stability problem will arise if the fill is placed on the existing surface. The long term settlement of the subsoil due to the addition of fill is estimated to be about 3 inches.

LOCATION, PROJECT AND FIELD WORK

The site is located about 3 miles north east of Brantford where at present a narrow bridge provides access over Fairchild Creek. It is proposed to replace the existing bridge by a somewhat larger structure placed at a higher elevation. The proposed bridge will be positioned about 40 feet east of the present bridge.

Three boreholes were put down using wash boring techniques with field vane measurements of the shear strength of the soil obtained during boring. Two of the boreholes were continued into bedrock to a depth of 5 feet.

Hole 4 could not be made because of high water levels. In view of the uniformity of subsurface conditions, there did not seem to be any serious need for this boring.

Attention is drawn to the difference in elevation noted for the existing bridge deck (see Dwg. 1). Using the level of 658 feet the level of the river bed agrees well with the elevation shown on your drawings (depth = 18 feet approximately below deck level).

SITE DESCRIPTION

Fairchild Creek meanders through fairly rolling country in a general south easterly direction. The bridge itself is located at a meander of the river where a fairly broad flood plane has been formed in the lee, while the opposite bank has been cut by stream erosion.

At the time of the investigation the creek was about 5½ feet deep; during exceptional flood years however, the level can rise as much as 20 feet above this level. It was possible to push a drill rod 1 to 2 feet into the river bed before refusal to hand pushing was encountered.

SUBSOIL CONDITIONS

The subsoil consists of sandy clayey silt with occasionally some gravel sizes to depths of up to 10 feet. In general this flood plain alluvial material continued to a greater depth on the south side of the river than on the north. Borehole 2 was positioned on the edge of the present roadway at a somewhat higher elevation than the general ground level. Thus at this location, fill material which consists of the same sandy clayey silt as noted above continues to a depth of about 16 feet. Beneath the sandy clayey silt lies a glacial lake deposit of clayey silt interbedded with fat clay. The silt layers which in general make up most of the deposit are medium dense while the thinner clay layers and lenses are soft to stiff only.

Bedrock consisting of competent limestone occurs at a depth below the general ground level of about 43 feet (i.e. El 604 to 608 feet). Five feet of AX core was recovered from 2 boreholes in order to prove the existence and competence of the bedrock.

The interpreted subsoil stratigraphy is shown in Dwg. 1 and the borehole logs in Dwgs. 2 - 4.

BRIDGE FOUNDATIONS

Due to the low strength of the silt and clay deposit, the bridge should be founded on piles driven to refusal on bedrock. Bedrock is a competent limestone which showed no weathered or softened zone near the top. Thus, H piles or cylindrical piles driven to refusal will not penetrate the limestone very much. With the contact occurring at an elevation of about 604 feet at borehole 1 and 2 and El 608 feet at borehole 3 piles for the abutments will be about 40 feet below river surface level while those for the piers will be about 60 feet below proposed bridge level.

As the actual structure will bear on bedrock, the settlement will be negligible.

ABUTMENTS

As abutments of up to 15 feet deep are proposed, a spill through design is recommended to reduce the lateral pressure of the fill on the abutments. There appears to be sufficient space for this type of design.

Attention should be given to stream erosion of the fill, particularly the north bank which will be more affected because of the bend in the river. Any rip-rap designed to prevent such erosion must be placed on a bed of well graded pit run gravel to prevent the river current from washing out the finer soil underneath.

EMBANKMENTS

Embankments of depths up to 20 feet will be required to bring the road up to the elevation of the proposed bridge. No stability problem exists if the fill is placed directly on existing surface. Calculations are given in the appendix which show that the factor of safety against failure is about 3.

The settlement of the subsoil due to the weight of fill will be about 3 inches (see Appendix) this will occur over a period of years. The road surface will settle a slight additional amount due to the compression of the fill, the actual magnitude of which will depend on how well the fill is compacted. Since the abutments will only settle a negligible amount, any settlement of the road surface due to the above two factors will result in a differential settlement at the edge of the abutments. This settlement should not be of great consequence, but the road near the abutment may require some maintenance after a few years to bring it up to the level of the abutments.

If you have any queries after examining the contents of this report please do not hesitate to contact this office.

Yours very truly,

B. P. Walker.

B.P. Walker, P.Eng.

BPW/bs.
Encls.

REGISTERED PROFESSIONAL ENGINEER
B. P. WALKER
PROVINCE OF ONTARIO

APPENDIX 1

STABILITY OF SUBSOIL UNDER THE WEIGHT OF THE EMBANKMENT FILL

Consider the stability of the north embankment where the height of fill is greater. The maximum height of a slope in a clay soil is given by the following expression:

$$Hc = Ns \frac{Cu}{\gamma}$$

where: Cu is the undrained shear strength (1300 psf under the north embankment)

γ is the unit weight of the soil (125 pcf)

Ns is a dimensionless stability factor which depends mainly on the slope angle.

If it is assumed that the slope angle is uniform at 50 degrees or less and that γ (fill)

$= \gamma$ (subsoil) $=$ 125 pcf; Ns = 5.52

substituting Hc = 57 feet

and the factor of safety with a 20 foot high embankment is $\frac{57}{20} = 2.8$.

APPENDIX 2

SETTLEMENT OF THE SUBSOIL DUE TO THE WEIGHT OF EMBANKMENT FILL

The settlement due to consolidation is given approximately by the following expression:

$$Sc = Mv\ \Delta h\ \Delta p$$

where: Mv is the modulus of compressibility of the soil (assume .005 ft^2/kip)

Δh is the thickness of compressible soil (41 feet for the north embankment)

Δp is the increase in stress at the midpoint of the compressible soil.

Assuming the unit weight of the fill is 125 pcf, the increase in stress at the surface is 20 + 125 = 2500 psf. The stress at a depth of 10 feet can be assumed to be 0.8 of the pressure at the surface; thus Δp approximately 2 ksf.

substituting

$$Sc \sim 5 \text{ inches}$$

Due to the fact that much of the subsoil is made up of medium dense silt layers, the calculation is considered to overestimate the actual settlement which will occur. From experience with similar soil, a settlement of about 3 inches is considered more reasonable.

WILLIAM A. TROW & ASSOCIATES LTD.

SITE INVESTIGATIONS   SOIL MECHANICS CONSULTATION

DRAWING NO. 2
PROJECT NO. J16[illegible]

LEGEND

PENETRATION RESISTANCE
2" O.D. SPLIT TUBE
2" I.D. SHELBY TUBE
2" DIA. CONE

SHEAR STRENGTH
UNDRAINED TRIAXIAL AT OVERBURDEN PRESSURE
UNCONFINED COMPRESSION
VANE TEST AND SENSITIVITY (S)

NATURAL MOISTURE CONTENT AND LIQUIDITY INDEX X[LI]

ATTERBERG LIMITS
LIQUID LIMIT
PLASTIC LIMIT

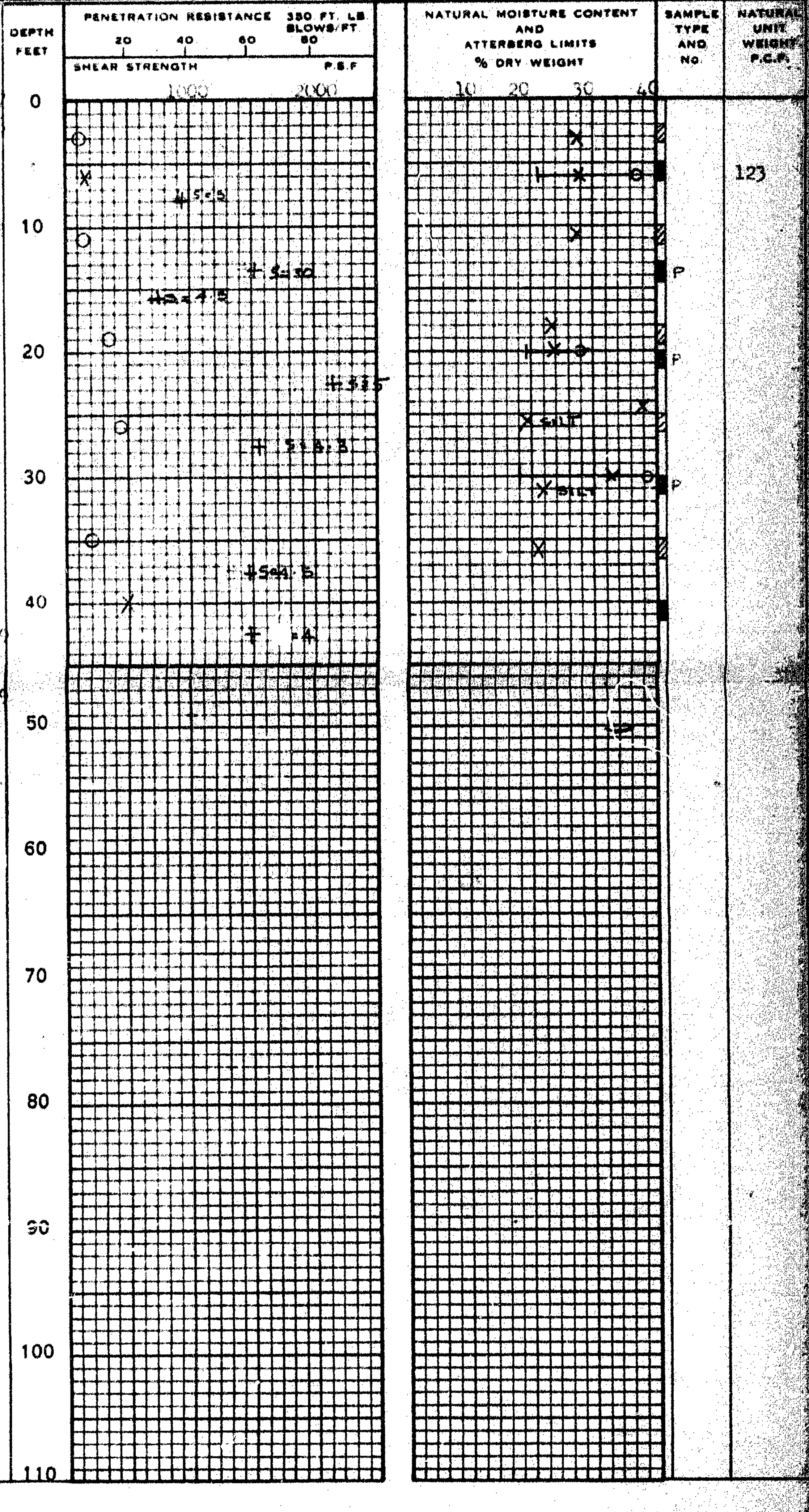
SAMPLE TYPE
2" O.D. SPLIT TUBE
2" I.D. SHELBY TUBE
3" O.D. SHELBY TUBE

BOREHOLE NO. 1
PROJECT Proposed Replacement, McMillan Bridge,
LOCATION Near Brantford.
HOLE LOCATION See Dwg. 1
HOLE ELEVATION 646.7 ft.
DATUM See Dwg. 1

SYMBOL	SOIL DESCRIPTION	ELEV FEET
		646.7
	SANDY CLAYEY SILT- finely stratified, brown; some fine roots above 3 ft; stiff (probable river alluvium) A layer of fine pebbles - about 1 ft. thick.*	646.4
	SILT and CLAY- layers and lenses of med. dense silt interstratified with stiff clay, grey; layers vary from less than ¼ inch to over 2 inches. clay layers become thinner below 25 feet (Bubbling of gas noted below 32 ft.) Bouncing Refusal to wash rods at 42.8 ft.	637.3
	LIMESTONE BEDROCK- grey, dense 100% Recovery	603.9
	End of Bore	598.9

Notes:
1) Hole advanced using wash boring techniques.
2) On completion, Water Level at 1.7 ft. Three days after pulling rods, Water Level at 2.1 ft., open to 28.8 ft, Apr. 27th.,
Creek Level = 644 ft. approx.
3) 100% AX core recovered from limestone, depths 42.8 ft. to 47.8 ft.

* Gravel at 9 to 10 feet believed to be indication of scour level



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SITE INVESTIGATIONS · SOIL MECHANICS CONSULTATION

DRAWING NO. 3

PROJECT NO. J1879

LEGEND

PENETRATION RESISTANCE	
2" O.D. SPLIT TUBE	—o—o—o—
2" I.D. SHELBY TUBE	—x—x—x—
2" DIA. CONE	———

SHEAR STRENGTH	
UNDRAINED TRIAXIAL AT OVERBURDEN PRESSURE	⊕
UNCONFINED COMPRESSION	⊖
VANE TEST AND SENSITIVITY (S)	+ S

NATURAL MOISTURE CONTENT AND LIQUIDITY INDEX	X LI

ATTERBERG LIMITS	
LIQUID LIMIT	—o
PLASTIC LIMIT	|—

SAMPLE TYPE	
2" O.D. SPLIT TUBE	▨
2" I.D. SHELBY TUBE	■
3" O.D. SHELBY TUBE	■

BOREHOLE NO. 2

PROJECT Proposed Replacement, McMillan Bridge,

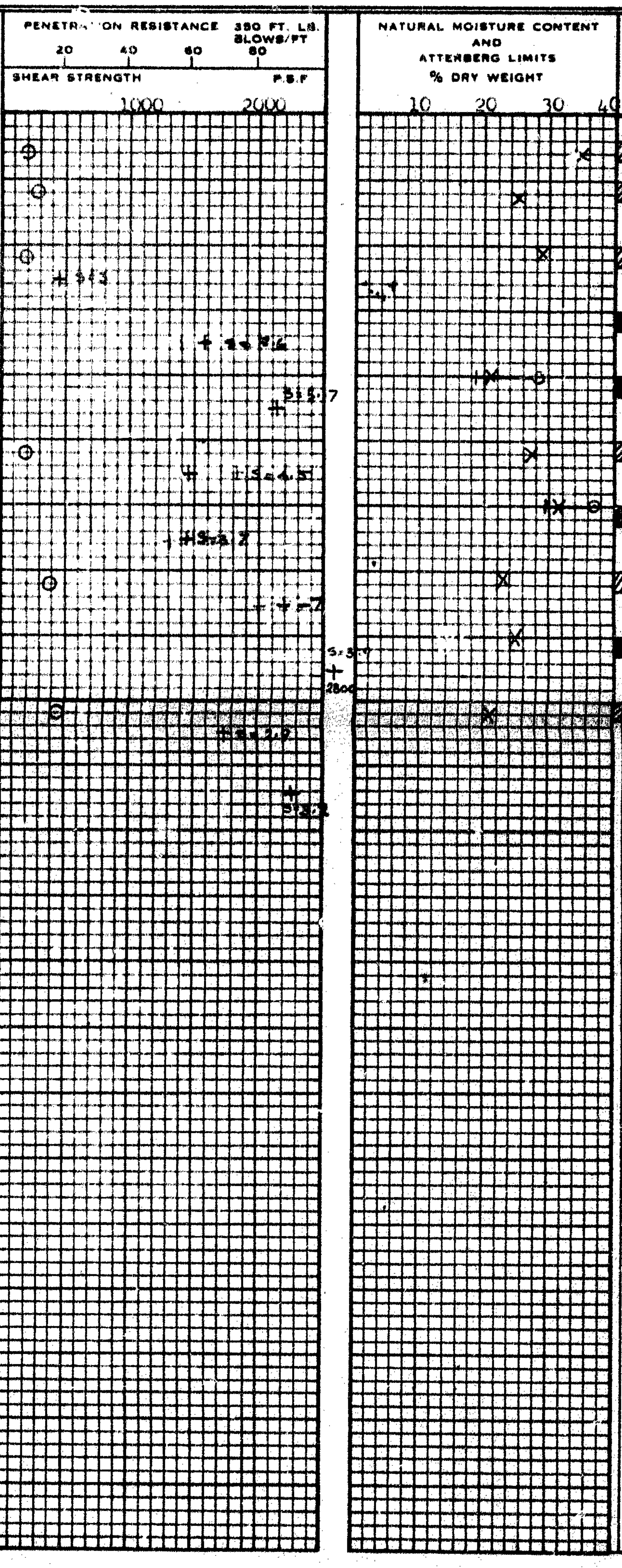
LOCATION Near Brantford,

HOLE LOCATION See Dwg. 1

HOLE ELEVATION 657.8 ft.

DATUM See Dwg. 1

SYMBOL	SOIL DESCRIPTION	ELEV. FEET	DEPTH FEET	SAMPLE TYPE AND NO.	NATURAL UNIT WEIGHT P.C.F.
	Borehole located on edge of road	657.8	0		
	ROAD FILL- sandy clayey silt, brown weathered and oxidized soft				
		646.5	10		
		641.8		P	
	SILT and CLAY- grey; layers and lenses of fat clay interstratified with med. dense clayey silt.		20	P	
	Clay layers become thinner and less frequent below about 30 ft.		30	P	125
			40	P	
	Bouncing refusal to Wash rods		50		
	End of Bore	604.9			
			60		
			70		
			80		
			90		
			100		
			110		



Notes: 1)Hole advanced using wash boring techniques.

2)After pulling rods, Water Level at 11.3 ft, open to 35.3 ft. After 1½ days, Water Level at 11.3 ft. open to 37.7 ft.

Creek Level = El 644 approx.

WILLIAM A. TROW & ASSOCIATES LTD.

SITE INVESTIGATIONS · SOIL MECHANICS CONSULTATION

DRAWING NO. 4
PROJECT NO. J1879

LEGEND

BOREHOLE NO. 3
PROJECT Proposed Replacement, McMillan Bridge,
LOCATION Near Brantford,
HOLE LOCATION See Dwg. 1
HOLE ELEVATION 649.2 ft.
DATUM See Dwg. 1

PENETRATION RESISTANCE
2" O.D. SPLIT TUBE
2" I.D. SHELBY TUBE
2" DIA. CONE
SHEAR STRENGTH
UNDRAINED TRIAXIAL AT OVERBURDEN PRESSURE
UNCONFINED COMPRESSION
VANE TEST AND SENSITIVITY (S)

NATURAL MOISTURE CONTENT AND LIQUIDITY INDEX
ATTERBERG LIMITS
LIQUID LIMIT
PLASTIC LIMIT
SAMPLE TYPE
2" O.D. SPLIT TUBE
2" I.D. SHELBY TUBE
3" O.D. SHELBY TUBE

SYMBOL	SOIL DESCRIPTION	ELEV. FEET	DEPTH FEET
		649.2	0
	SANDY CLAYEY SILT- some gravel sizes to 3 ft; stratified, soft, probable river alluvium	645.2	
	SILT and CLAY- brown to 3 ft., grey below; layers and lenses of fat clay interstratified with med. dense clayey silt; silt layers stratified as well.		10
			20
	clay layers less frequent with depth		
			30
	Bouncing refusal to wash rods		40
	LIMESTONE BEDROCK - grey, competent.	607.9	
	End of Bore	602.9	
Notes:	1) Hole advanced using wash boring techniques; casing to 5 ft. only.		50
	2) 100% AX core recovered from limestone, depths 41.3 ft, to 46.3 ft. Gas and some oil under pressure encountered from limestone, blew 15 ft. above ground. Next morning gas diminished to a trace. Hole sealed with cement and bentonite slurry.		60
			70
			80
			90
			100
			110