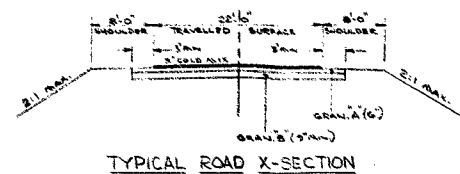


#63-F-270M

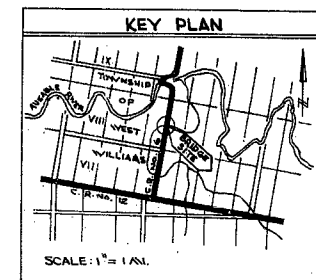
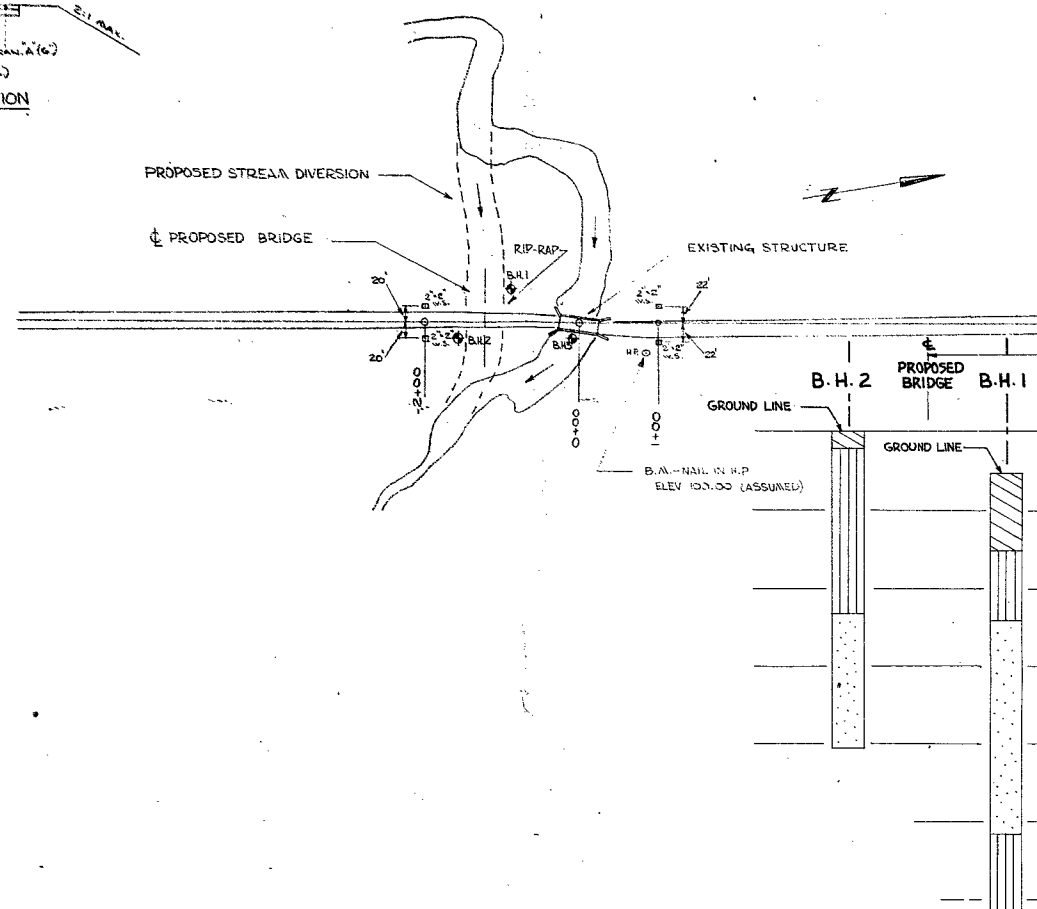
COUNTY BRIDGE

#29

MIDDLESEX CTY



SITE PLAN  
SCALE HOR. 1"=100'



- DATA**
- SPECIAL FEATURES:** - ILLUSTRATED PROFILE IS TYPICAL OF SURROUNDING TERRAIN;
  - UPSTREAM STRUCTURES:** - 51' SIMPLE SPAN WITH STEEL TRUSSES; 0.45 MILES UPSTREAM - BUILT ABOUT 1920; CROSS-SECTIONAL AREA AT H.W. = 650 SQ. FT.; APPROACHES NOT FLOODED DURING PERIOD OF H.W.; HEIGHT ABOVE N.H.W.L. = 3 FT.; EXISTING STRUCTURE TO BE REPLACED IN 1963.
  - DOWNSIDE STRUCTURES:** - NONE; CREEK ENTERS AUSABLE RIVER 1 MILE DOWNSTREAM.

**EXISTING STRUCTURE:** - CROSS-SECTIONAL AREA AT H.W. = 650 SQ. FT.; STREAMBED AT STRUCTURE (UPSTREAM SIDE) IS 2-4 FT. DEEPER THAN IMMEDIATE DOWNSTREAM SIDE DUE TO SCOUR; APPROACHES ARE NOT SUBMERGED DURING THE PERIOD OF HIGH WATER; HEIGHT ABOVE N.H.W.L. = 4 FT.

- Reasons why these bridges are fair indications of size of proposed bridge:** - THERE IS EVIDENCE OF SCOUR AT EXISTING BRIDGE. THEREFORE, PROPOSED BRIDGE = 55' x 12.6' = 693 SQ. FT.

- Is the stream gradient liable to be lowered? NO
- Navigation clearance required, if any: - N.A.
- Railway clearance required, if any: - N.A.
- Is a temporary detour required? YES
- Who will build it? CONTRACTOR
- Who will maintain it? CONTRACTOR
- Information on water level according to local residents: - H.W.L. = 98.0; L.W.L. = 89.0
- Road Design Information: - ESTIMATED A.D.T. (1982) = 400-1000; DESIGN SPEED = 55 M.P.H.; STOPPING SIGHT DISTANCE (MIN) = 425 FT.

**STRUCTURAL DATA**

- Net span and type of bridge: - 55' SIMPLE SPAN - PRESTRESSED GIRDERS
- Roadway width on bridge: - 50 FT.
- Number and width of sidewalks: - NONE
- Skew Angle: - NONE
- Approximate Volume of Concrete: \_\_\_\_\_
- Approximate Weight of Reinforcing Steel: \_\_\_\_\_
- Drainage Area: - 24.5 SQ. MI.

Field Investigation Made By  
J. P. McIntyre



STRUCTURE SITE No. 20-90

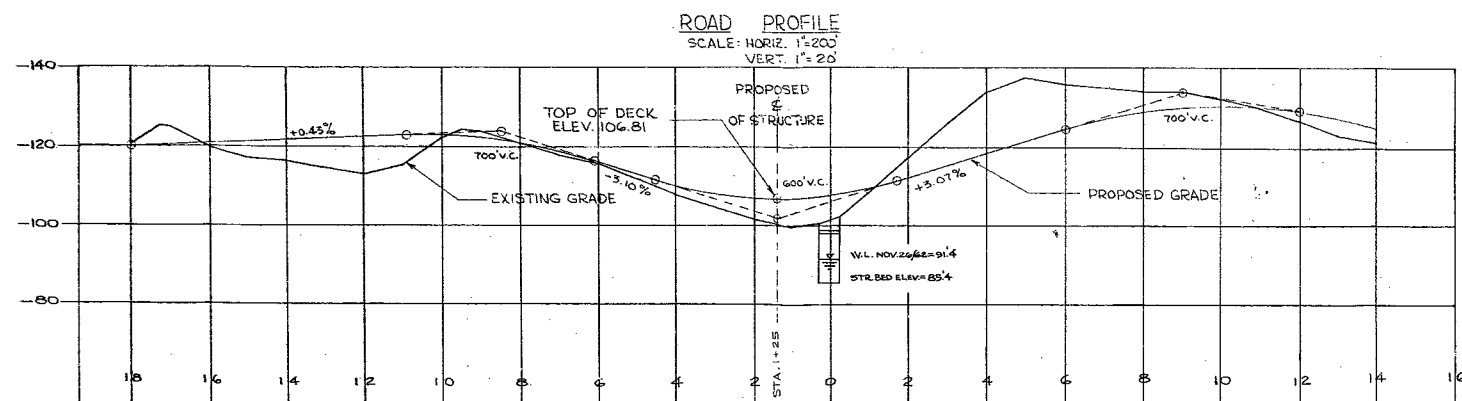
PAGE 1 OF

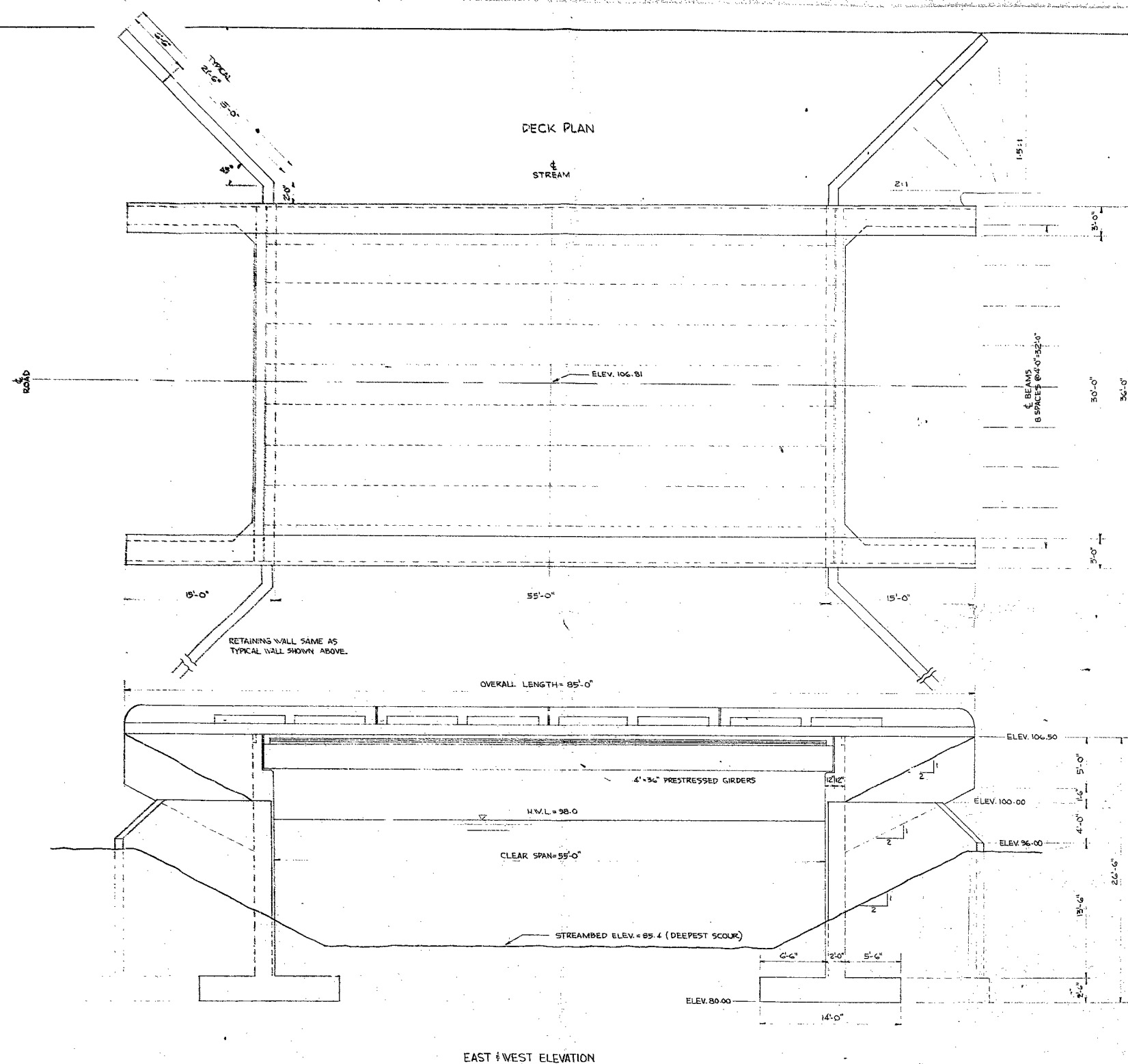
COUNTY OF MIDDLESEX

PROPOSED  
BRIDGE NO. 29

LOTS 10+11-CON. VIII-C.R. NO. 6  
TOWNSHIP OF WEST WILLIAMS

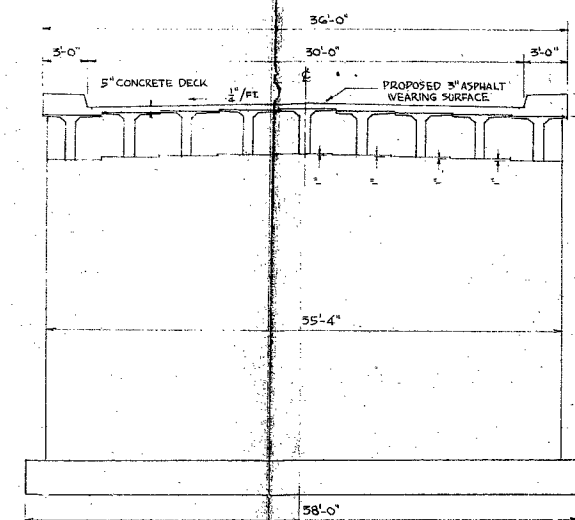
SCALE: AS NOTED  
DRAWN BY: J.P.M.  
DATE: 7/1/79  
ENGINEER





EAST &amp; WEST ELEVATION

- ### GENERAL NOTES
1. Structure to be built in accordance with N.H.O. Spec. Form 9, revised October 1959 and County of Middlesex supplemental specifications.
  2. Excavation for footing to be finished by hand to the exact dimensions and the concrete shall be placed on undisturbed material on front, back, and bottom faces.
  3. Excavation for footing shall be made as near as possible but in any case shall be filled completely with footing concrete.
  4. Footing depth is subject to revision by the Engineer.
  5. Footings are designed for an allowable soil pressure of 4.0 k/sq. ft.
  6. Reinforced Concrete shall have a minimum compressive strength of 3000 p.s.i. in 28 days and maximum slump of 3". County to design a mix on receiving samples of sand and aggregate from the successful bidder.
  7. Note the added addendum in County specifications regarding the addition of an admixture containing an air entraining agent. For estimating purposes assume that 1 lb. of Highway Pozzolith shall be added per bag of cement.
  8. Maximum Size Aggregate:
    - 2" in deck slabs, curb, and guard rails
    - 1 1/2" in footing
    - 1" elsewhere
  9. Concrete Cover (main reinforcing)
    - 3" in contact with earth and water
    - 2" in top deck
    - 1 1/2" in bottom of deck
    - 2" elsewhere
  10. Deck falsework shall not be struck until all backfill has been placed and compacted behind the abutments to the satisfaction of the Engineer.
  11. All exposed concrete edges to have 2" chamfer unless otherwise noted.
  12. Drain pipes and joint materials shall be supplied by the Contractor.
  13. Construction work to appear on two diagonally opposite corners. Templates to be supplied by the County.
  14. Design Loading: H 20 - S 16
  15. Estimated Concrete: \_\_\_\_\_
  16. Estimated Reinforcing Steel: \_\_\_\_\_



CROSS SECTION

PAGE 2 OF

COUNTY OF MIDDLESEX

PROPOSED  
BRIDGE NO. 29

LOTS 10 & 11, CON. VIII; C.R. NO. 6  
TOWNSHIP OF WEST WILLIAMS

SCALE:  $\frac{3}{8}'' = 1 \text{ FT.}$  *J.M. Chubb*  
DRAWN BY: J.P.A. ENGINEER  
DRWG. NO: 156/VIII/B DATE MAR. 5, 1963

STRUCTURE SITE No. 20-90

63-F-270M

REPORT

TO

COUNTY OF MIDDLESEX

ON

SOIL CONDITIONS AND FOUNDATIONS

PROPOSED COUNTY BRIDGE NO. 29

COUNTY OF MIDDLESEX, ONTARIO

## Distribution:

6 copies - County of Middlesex,  
London, Ontario.

2 copies - H. Q. Golder & Associates Ltd.,  
Toronto, Ontario.

March, 1963

6269

GOLDER &amp; ASSOCIATES

**H. Q. GOLDER & ASSOCIATES LTD.**

**CONSULTING CIVIL ENGINEERS**

H. Q. GOLDER  
V. MILLIGAN  
L. G. SODERMAN

2444 BLOOR STREET WEST  
TORONTO 9, ONTARIO  
767-9201  
763-4103  
March 6, 1963

County of Middlesex,  
County Buildings,  
LONDON, Ontario.

Attention: Mr. F.B.D. Arnold, P. Eng.,  
County Engineer.

RE: SITE INVESTIGATION,  
COUNTY BRIDGE NO. 29,  
TOWNSHIP OF WEST WILLIAMS,  
NEAR ADELAIDE, ONTARIO.

Dear Sirs,

This letter reports the results of an investigation carried out at the site of a proposed bridge replacement over the Adelaide Creek on County Road No. 6 some 5 miles north of Highway 22 in the vicinity of Adelaide, Ontario. The purpose of this investigation was to determine the subsoil conditions at the site and to provide information for the foundation design of the new bridge.

PROCEDURE

The field work for this investigation was carried out during the period January 14 to January 18, 1963. Two boreholes in NX casing size were put down at the proposed location of the new bridge and a third borehole was put down from the existing bridge.

The borings were carried out using a skid-mounted diamond drillrig adapted for soil sampling, supplied and operated by F.E. Johnston Drilling Company Ltd. Samples of the subsoil were taken at intervals of depth not exceeding 5 feet. After completion of the borings at the new bridge location, a piezometer was installed to determine the piezometric groundwater level.

The locations of the borings together with a schematic section of the inferred soil stratigraphy across the site are shown on Figure 1. A detailed log for each borehole is given on the Records of Boreholes at the end of the report.

The samples obtained during the investigation were brought to our laboratory for examination and testing. The results of the laboratory testing are shown on the Records of Boreholes and on Figures 2 and 3.

The elevations in this report are referred to local datum and were determined by reference to a bench mark consisting of a nail in a hydro pole located on the northeast side of the existing bridge. The elevation of this bench mark was set at 100.00 by the County of Middlesex. The ground elevation at the borehole locations was supplied by R. C. Dunn & Associates Ltd.

## SITE AND GEOLOGY

The site is located on County Road No. 6 where it crosses Adelaide Creek in West Williams Township some 11 miles south of Parkhill, Ontario. Adelaide Creek flows into the Ausable River about 1 mile north of the site. The general area is characterized by gently rolling topography.

The stratigraphy in this area generally consists of a complex succession of glacial clay tills and interglacial or lacustrine deposits of clays, silts and sands of the Pleistocene period extending to bedrock. The bedrock, which is a sedimentary formation of the Devonian Period, is more than 100 feet below general ground surface at the site.

## SOIL CONDITIONS

The borings put down at the location of the new bridge show that a geologically recent alluvial deposit forms the floodplain on the south side of the creek. The deposit generally increases in thickness in a northerly direction from about 2 feet at borehole 2 to about 10 feet at borehole 1 and is about 2 feet thick in the creek bed. It is comprised mainly of sandy silt to silty fine sand with a trace of clay and organic matter.

A grain size distribution curve obtained on a sample from the recent alluvium is given on Figure 2. An organic content determination on this same sample gave a value of about 10 percent. Based on the results of standard penetration tests which gave 'N' values between about 2 and 6 blows per foot, the floodplain deposit is very loose to loose and generally very loose.

The recent alluvium is underlain by a stratum of dark grey silty clay which extends down to about elevation 76. The silty clay is about 6 feet thick at the creek increasing to about 20 feet in thickness at borehole 2 some 200 feet to the south. The stratum is in general homogeneous in structure and is comprised of silty clay with a trace of sand and fine gravel dispersed throughout. This silty clay stratum is considered to be a glacial till deposit.

A stratum of lacustrine layered clay of interglacial origin underlies the upper clay till across the site. The layered clay in borehole 1, where it was completely penetrated, is 27 feet thick and extends down to about elevation 48. This lacustrine deposit is comprised of brownish grey silty clay and dark grey silty clay to clayey silt layers and contains small pockets and thin seams of silt and fine sand throughout, together with occasional fine gravel sizes dispersed throughout. Except for the silt and sand seams, the layering in the stratum is generally indistinct to visual examination and where it is evident the individual silty clay and



clayey silt layers are up to several inches thick and form no regular pattern. The stratum, below about elevation 60, grades into essentially a clayey silt with silty fine sand lenses or seams up to several feet thick. A grading curve obtained on a sample from the stratum is given on Figure 2.

The lacustrine clay is underlain by a stratum of glacial till. The till was penetrated for a depth of 10 feet in borehole 1, where the boring was terminated. This stratum is similar in composition to the upper till. A grain size distribution curve obtained on a sample of the clay till is given on Figure 2.

Atterberg limit tests were carried out on samples of the clay strata discussed above and the results are presented on the Records of Boreholes. A liquid limit ranging from about 30 in the upper clay till to as high as 50 in the lacustrine clay stratum was obtained. The corresponding plastic limit ranged between about 15 and 25. The liquidity index, which is the ratio of natural water content minus the plastic limit to plasticity index, is below about 0.2 for the clay till and is an average of about 0.3 for the lacustrine clay.

A number of undrained triaxial compression tests were carried out on samples of the clay strata. The results of these tests are presented on the Records of Boreholes and on Figure 3 which

gives typical stress-strain curves from these tests. The undrained shear strength measured for the clay above elevation 70 ranges generally between about 1,500 and 2,000 pounds per square foot. One value of 1,250 pounds per square foot was obtained for the lacustrine clay in this zone at about elevation 75. Two undrained shear strength values of about 3,000 pounds per square foot were measured at approximately elevation 65.

Based on the results of the above strength tests together with the standard penetration resistance values given on the Records of Boreholes, the upper clay till and lacustrine clay deposits are stiff to very stiff and the lower clay till is generally very stiff.

Unit weight determinations on samples of the clay gave total unit weight values generally between about 130 and 135 pounds per cubic foot for the upper clay till and between about 120 and 130 pounds per cubic foot for the lacustrine clay.

#### WATER CONDITIONS

A porous pot piezometer was installed in each of the two boreholes at the new bridge location to determine the piezometric groundwater level within the lacustrine clay deposit underlying the site. The piezometer installation details and the stabilized reading obtained in the piezometers at the conclusion of the field work are

given on the Records of Boreholes.

The readings taken show that the piezometric water level within the lacustrine clay was about 1 to 4 feet below ground surface and at about elevation 94 and 97 in boreholes 1 and 2, respectively. This is up to about 5 feet above the creek ice level at elevation 91.5 during the period of the investigation. This apparent artesian effect is probably produced by the presence of permeable sand seams within the lacustrine clay stratum.

A perched water level at about creek ice level was observed in the surface floodplain deposit overlying the relatively impervious upper clay till in borehole 1. Because of the relatively permeable nature of the recent alluvium, the perched water level may be expected to fluctuate with the creek level.

## DISCUSSION

### General

It is understood that the existing bridge structure over Adelaide Creek at the site is to be replaced to accommodate a rise in the roadway grade and a realignment of the County Road. As part of the construction program, the creek is to be diverted to the location shown on Figure 1 and a new bridge for the crossing is to be provided over the diverted creek channel.

The proposed bridge is to be a simply supported single span reinforced concrete structure about 45 feet in length with a channel opening of 40 feet. The bottom elevation of the new channel at the crossing will be approximately the same as the creek bed at the existing crossing which is at elevation 85.

#### Foundations

It is recommended that the abutments of the proposed bridge be supported on spread footings founded in the upper clay till stratum which underlies the site. To provide adequate scour and frost protection the footings should be taken down at least 5 feet below the creek channel bed. Thus the foundation level will be at about elevation 80.

The results of the strength tests indicate that the undrained shear strength of the clay strata below elevation 80 is between about 1,250 and 2,000 pounds per square foot. Taking an average minimum value of 1,500 pounds per square foot for design, an allowable net bearing pressure of  $1\frac{1}{2}$  tons per square foot is computed for the footings. This allowable bearing value has a normal factor of safety of 3 against ultimate failure. However, as the measured shear strength is generally of the order of 2,000 pounds per square foot, we consider that an allowable net bearing pressure of up to 2 tons per square foot may be used in design of

the footings.

The total settlement of the bridge abutments founded on spread footings as discussed above, due to consolidation of the underlying clay strata, is estimated to be within about 2 inches with the differential settlement between the abutments within 1 inch.

If an allowable net bearing pressure of 2 tons per square foot for spread footings is not sufficient to support the bridge abutments economically, an alternative is to use piles. In this case lightly loaded displacement piles driven into the clay till underlying the lacustrine clay would provide a suitable foundation. Piles penetrating the lacustrine clay deposit at the site would have to be designed as mainly end bearing because of the possibility of artesian pressures within the sand layers in relation to the proposed channel bottom elevation.

It is recommended that free draining granular backfill, compacted in lifts not exceeding 12 inches, be placed behind the abutments of the proposed structure. The granular backfill should extend horizontally from the back face of the abutment walls for a minimum distance of 5 feet. Any topsoil or very soft organic clayey silt as in the existing creek bed, should be removed prior to placement of the approach fill.

To provide stability of the approach fill, particularly in the existing creek bed, it is recommended that the side slopes be made no steeper than 2 horizontal to 1 vertical. The fill should be well compacted in place in lifts generally not exceeding 12 inches in thickness. As a protection against surface water erosion, growth should be encouraged on the side slopes and a rip rap cover or the like provided where the approach embankments may be subject to scour during creek high water level conditions.

To prevent softening of the clayey till due to entrance of surface water and construction operations, it is recommended that the base of footing excavations, once foundation grade is reached, be immediately covered by a thin mat of lean concrete.

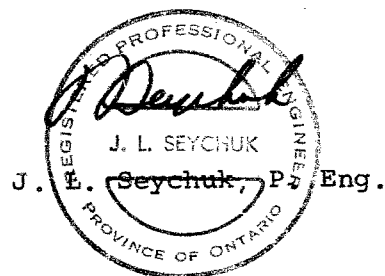
No major construction problems are envisaged for the bridge abutments to be founded in the relatively impervious clayey till. However, water seepage into footing excavations through the floodplain deposit overlying the clay till and in communication with the creek water level should be prevented. This may be achieved by the construction of an impervious earth dyke resting on the clayey till, around the perimeter of the proposed excavations.

We believe that the above information is sufficient to enable foundation design of the proposed structure. If you have any questions or require further information, please call us.

Yours faithfully,

H. Q. GOLDER & ASSOCIATES LTD.

JLS/jb  
6269



**GOLDER & ASSOCIATES**

## LIST OF STANDARD ABBREVIATIONS

The standard abbreviations commonly employed on each "Record of Borehole", on the figures, and in the text of the report are as follows:

### SAMPLE TYPES

A.S. - Auger Sample	R.C. - Rock Core
C.S. - Chunk Sample	S.T. - Slotted Tube
D.O. - Drive Open	T.O. - Thin-walled, Open
D.S. - Denison Type Sample	T.P. - Thin-walled, Piston
F.S. - Foil Sample	W.S. - Wash Sample

### PENETRATION RESISTANCES

Dynamic Penetration Resistance - The energy required to drive a 2 inch diameter, 60 degree cone attached to the end of the drilling rods into the ground: expressed in blows per foot, where each blow represents 4,200 inch-pounds of energy.

Standard Penetration Resistance, N - The number of blows by a 140 pound hammer dropped 30 inches required to drive a 2 inch drive open sampler one foot into the ground.

Sampler advanced by static weight	- weight, hammer	- Wh
Sampler advanced by pressure	- pressure, hydraulic	- Ph
Sampler advanced by pressure	- pressure, manual	- Pm

### SOIL DESCRIPTION

The standard terminology for the descriptions of the relative density of cohesionless soils and the consistency of cohesive soils is as follows:

<u>Relative Density</u>	<u>N, Blows/ft.</u>	<u>Consistency</u>	<u>c, lb/sq. ft.</u>
Very Loose	0 to 4	Very Soft	Less than 250
Loose	4 to 10	Soft	250 to 500
Compact	10 to 30	Firm	500 to 1,000
Dense	30 to 50	Stiff	1,000 to 2,000
Very Dense	over 50	Very Stiff	2,000 to 4,000
		Hard	over 4,000

### SOIL TESTS

C - Consolidation Test	Q - Undrained Triaxial
H - Hydrometer Analysis	Qc - Consolidated Undrained Triaxial
M - Sieve Analysis	S - Drained Triaxial
MH - Combined Analysis, Sieve and Hydrometer	U - Unconfined Compression
	V - Field Vane Test

Note: Undrained triaxial tests in which pore pressures are measured are shown as Q' or Q'c.

### SOIL PROPERTIES

$\gamma$ - Total Unit Weight	K - Coefficient of Permeability
$\gamma_d$ - Dry Unit Weight	c - Undrained Shear Strength (1/2 Compressive Strength)
$\gamma_b$ - Submerged Unit Weight	St - Sensitivity
L <sub>L</sub> - Liquid Limit	$\phi'$ - Effective Angle of Shearing Resistance
P <sub>L</sub> - Plastic Limit	c' - Effective Cohesion Intercept
W - Natural Water Content	Cc - Compression Index
G - Specific Gravity	Cv - Coefficient of Consolidation
e - Void Ratio	

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## RECORD OF BOREHOLE 1

LOCATION SEE FIGURE 1

BORING DATE JAN. 14-16, 1963

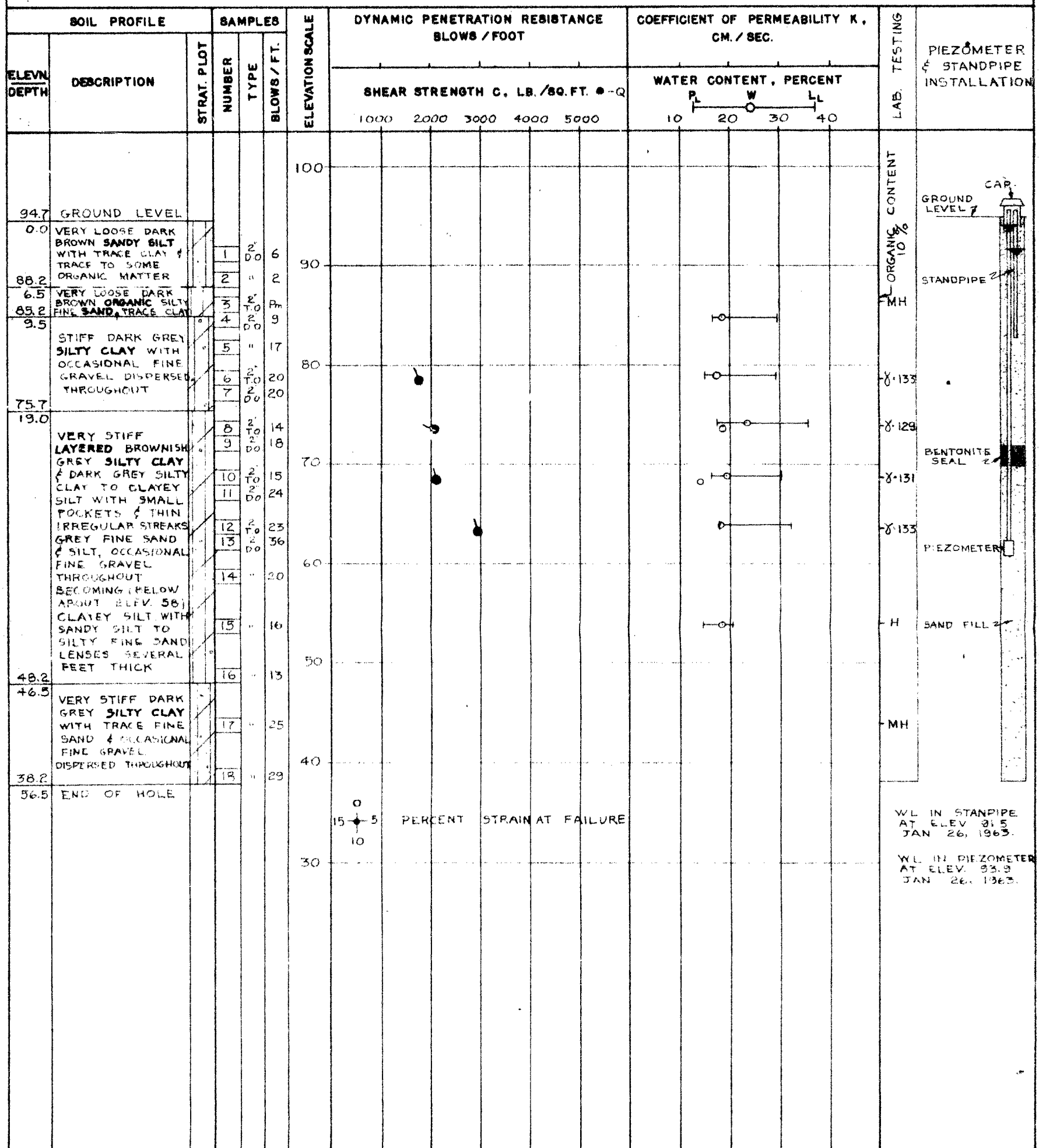
DATUM LOCAL

BOREHOLE TYPE WASH BORING

BOREHOLE DIAMETER NX CASING

SAMPLER HAMMER WEIGHT 140 LB. DROP 30 INCHES

PEN. TEST HAMMER WEIGHT — LB. DROP — INCHES

VERTICAL SCALE  
1 INCH TO 10'-0"

GOLDER &amp; ASSOCIATES

DRAWN AV  
CHECKED *dyg*

## RECORD OF BOREHOLE 2 &amp; 3

LOCATION SEE FIGURE 1

BORING DATE JAN 17-18, 1963.

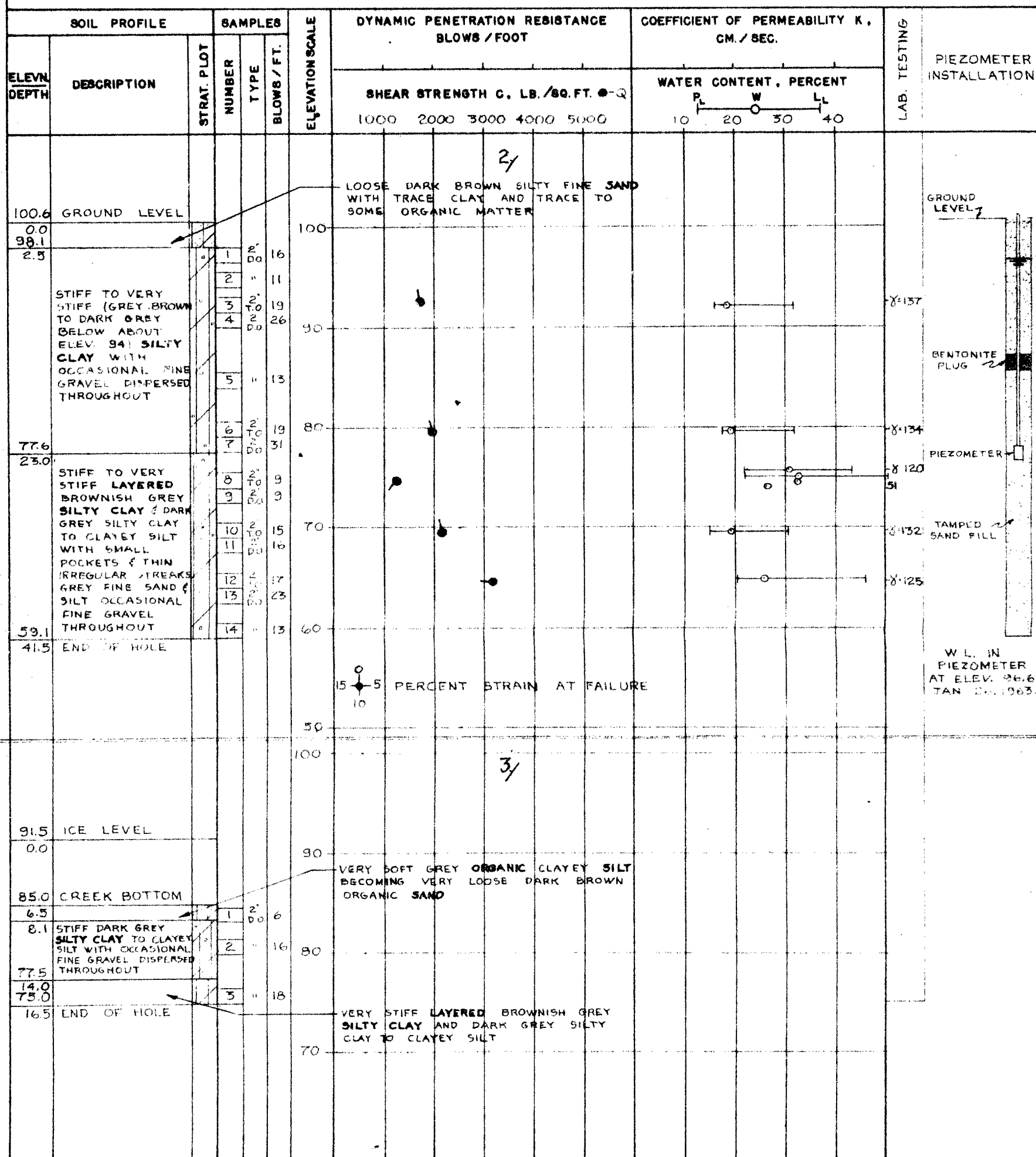
DATUM LOCAL

BOREHOLE TYPE      WASH      BORING

BOREHOLE DIAMETER      NX      CASING

**SAMPLER HAMMER WEIGHT 40 LB. DROP 30 INCHES**

PEN. TEST HAMMER WEIGHT — LB. DROP — INCHES



VERTICAL SCALE  
1 INCH TO 10'-0"

**GOLDER & ASSOCIATES**

DRAWN A.V.

CHECKED *[Signature]*

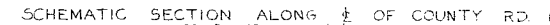
## FIGURE 1






KEY, PLAN  
SCALE: 1" TO 0.5 M

**GOLDER & ASSOCIATES**




Made A.V.  
Chkd JS  
Appd. by



LEGEND

-  BOREHOLE IN PLAN
-  BOREHOLE IN ELEVATION
-  W.L. IN BOREHOLE JAN. 26, 1963

## STRATIGRAPHY

-  VERY LOOSE DARK BROWN ORGANIC SANDY SILT  
TO SILTY FINE SAND
-  STIFF TO VERY STIFF DARK GREY SILTY CLAY  
WITH FINE GRAVEL DISPERSED THROUGHOUT
-  STIFF TO VERY STIFF LAYERED BROWNISH GREY  
SILTY CLAY AND DARK GREY SILT CLAY TO  
CLAYEY SILT WITH SMALL POCKETS AND LENSES  
SILT AND FINE SAND THROUGHOUT.



COUNTY OF MIDDLESEX DRWG. NO. 15/6/VIII/B  
PROPOSED BRIDGE 29  
LOTS 10 & 11 - CON. VIII - COUNTY ROAD NO.  
TOWNSHIP OF WEST WILLIAMS

PLAN  
SCALE: 1" TO 40'-

SPECIAL NOTE: DATA CONCERNING THE VARIOUS  
SPRAYS HAVE BEEN OBTAINED AT BOSHOLT LOCATIONS  
ONLY. THE AQ. SPRAY CORRELATION BETWEEN  
HOMERIDGE HAS BEEN INFERRED FROM GEOLOGICAL  
EVIDENCE AND AQ MAY VARY FROM THAT SHOWN.

# GRAIN SIZE DISTRIBUTION

FIGURE 2

M.I.T. GRAIN SIZE SCALE

SIZE OF OPENING - INS. U.S.S. SIEVE SIZE - MESHES/IN.

6" 3" 1 1/2" 3/4" 3/8" 4 10 20 40 60 140 200

PERCENT FINER THAN

## LEGEND

SYMBOL HOLE SAMPLE ELEV

● 1 3 86.5  
○ 1 15 54.0  
x 1 17 44.0

GRAIN SIZE - MM

0.0001

0.001

0.01

0.1

1.0

10

100

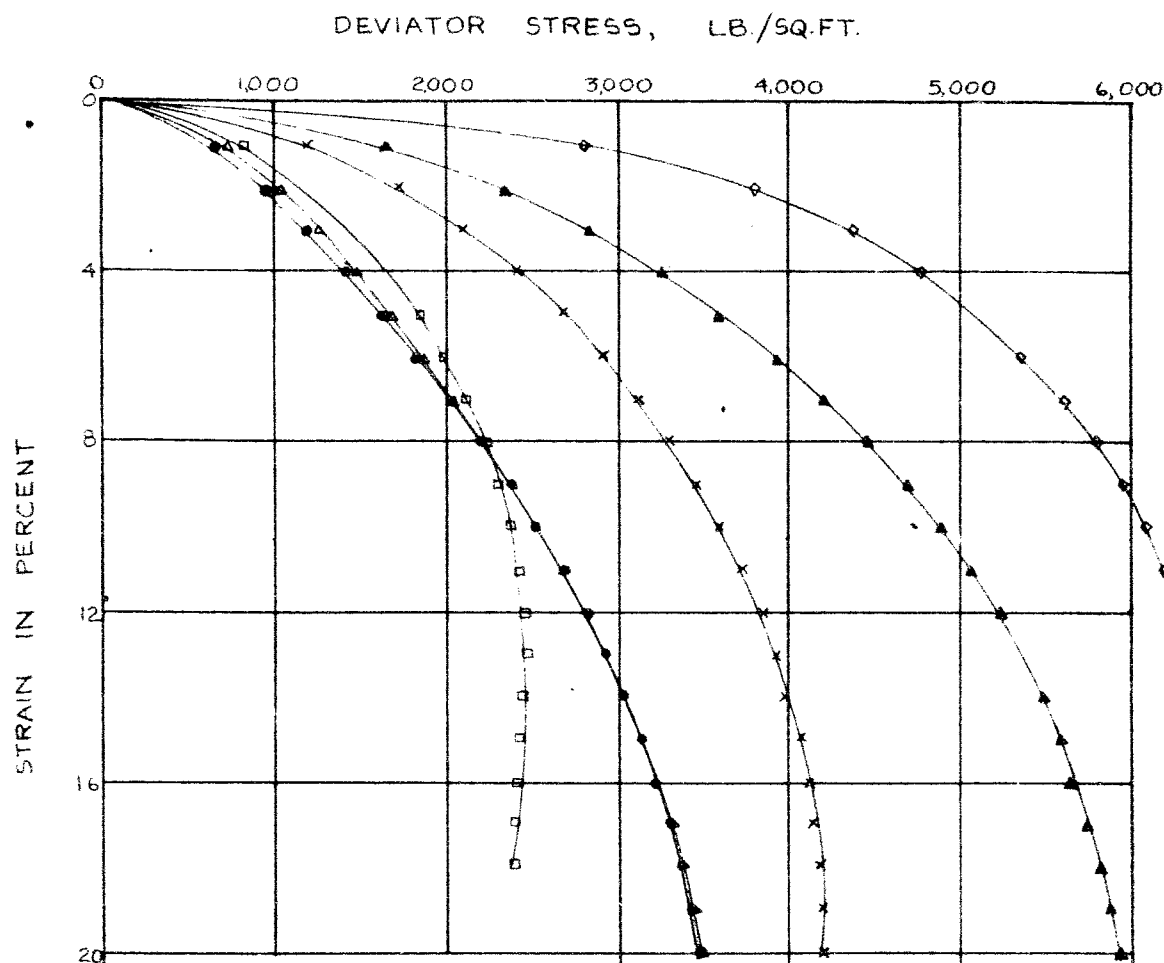
COBBLE SIZE	COARSE	MEDIUM	FINE	SAND SIZE			SILT SIZE		CLAY SIZE	
	GRAVEL SIZE			COARSE	MEDIUM	FINE	FINE GRAINED			

GOLDER & ASSOCIATES

# UNDRAINED TRIAXIAL COMPRESSION TESTS

## TYPICAL STRESS-STRAIN CURVES

FIGURE 3



### LEGEND

SYMBOL HOLE SAMPLE ELEVATION

●	1	6	79.0
x	1	10	69.0
▲	1	12	64.0
△	2	3	62.4
□	2	8	74.9
◇	2	12	64.9