

61-F-249 m

BRIDGE# 44

MIDDLESEX CTY.

S7177
REPORT
TO
R. C. DUNN AND ASSOCIATES LTD.
ON
SOIL INVESTIGATION
PROPOSED BRIDGE NO. 44
COUNTY OF MIDDLESEX
NEAR LONDON ONTARIO

Distribution:

- 4 copies - R. C. Dunn and Associates Ltd.,
London, Ontario.
- 10 copies - Department of Highways, Ontario,
Downsview, Ontario.
- 2 copies - Geocon Ltd,
Rexdale, Ontario.

GEOCON

Mr. A. M. Toye, Bridge Engineer
Bridge Division.
Materials & Research Section.

February 8, 1961.

FOUNDATION INVESTIGATION REPORT
To E.C. Dunn & Associates, Ltd.
37 Beacon, Ltd.

attention: Mr. K. Kleinsteinber,
Municipal Bridge Liaison Engr.

Re: Proposed Bridge No. 44,
County of Middlesex,
Near London, Ontario.

Attached, we are forwarding to you, two copies
of the above-mentioned report for your information. A review
of this report by this Section has not been undertaken, but
will be done when the preliminary design drawings are
submitted.

L. G. Soderman,
PRINCIPAL FOUNDATION ENGR.
Per:

AGG/MGaf
Encls.

cc: Messrs. W. L. Fraser
J. Roy

(L. G. Stermac,
SUPERVISING FOUNDATION ENGR.)

Foundations Office
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GEOCON LTD

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VANCOUVER 5, B.C.
TEL. MU. 1-8226

Rexdale, Ontario,
February 1st, 1961.

R. C. Dunn and Associates Ltd.,
Consulting Engineers,
410 Third Street,
London, Ontario.

Attention: Mr. N. M. Warner, P. Eng.

Re: Soil Investigation,
Proposed Bridge No. 44,
County of Middlesex,
Near London, Ontario.

Dear Sirs:

This letter reports the results of the above investigation carried out in accordance with your letter of authorization dated January 10th, 1961. The object of the investigation was to determine and interpret the subsoil conditions at the above site, as they affect the design of foundations for the proposed bridge.

PROCEDURE

The field work was commenced on January 12th, 1961 and completed on January 17th, 1961. A total of 2 boreholes with accompanying dynamic penetration tests was put down using a mobile power auger. The locations of the boreholes together with a section showing the inferred soil stratigraphy are shown on Drawing S7177-1 attached to this letter. A detailed log of each boring is shown on the Office Reports on Soil Exploration in Appendix I.

PROCEDURE (continued)

The testing of the soil samples was carried out in the Toronto Soil Mechanics Laboratory of Geocon Ltd and the results are shown on the Office Reports and on the figure in Appendix II. The soil samples remaining after testing will be stored until August 1st, 1961, at which time you will be contacted for instructions regarding their disposal.

The elevations at the site are referred to the north end of the east curb of an existing concrete culvert located approximately 300 feet north of the site of the existing bridge. This bench mark, which was established by R. C. Dunn and Associates Ltd., has an elevation of 100.22.

SITE

The site of the investigation is at an existing bridge over a tributary of the Sydenham River on the Melbourne Townline between Concession VII of Caradoc Township and Concession XIV of Metcalfe Township. The site is about 9 miles north of Melbourne on County Road No. 9. The general topography of the area is flat.

SOIL CONDITIONS

The principal soil strata encountered by the borings are as follows:

Very Loose to Loose Fine Sand

A stratum of fine sand was encountered at ground surface in both boreholes 1 and 2. It extends to depths of 11 and 10 feet below ground surface respectively. The colour of the stratum is

SOIL CONDITIONS (continued)

Very Loose to Loose Fine Sand (continued)

generally dark brown in the upper 7 to 8 feet and grey-brown below this depth. The stratum is composed predominantly of fine sand with some medium sand and silt sizes. Some horizontal stratification was observed in the samples. Some organic matter in the form of thin organic silt layers and grass roots was found in the upper few feet of the stratum.

Standard penetration tests carried out in the stratum gave "N" values ranging from 2 to 13 blows per foot, which together with the results of the dynamic penetration tests, indicate that the relative density ranges from very loose to compact and is generally very loose to loose. It is estimated that the stratum has wet and submerged unit weights of 110 and 50 pounds per cubic foot, respectively.

Firm to Stiff Layered Silt and Silty Clay

Underlying the very loose to loose fine sand is a stratum of grey-brown layered silt and silty clay. The thickness of the stratum ranges from about 26 to 30 feet as encountered in boreholes 2 and 1, respectively. The thickness of the separate layers comprising the stratum varies irregularly, but from examination of the soil samples obtained the clay layers are from 3 to 8 inches thick and the silt layers from about 6 to 12 inches thick. A few occasional thin layers of grey-brown sandy silt were encountered throughout the stratum.

SOIL CONDITIONS (continued)

Firm to Stiff Layered Silt and Silty Clay (continued)

A grain size analysis was carried out on separate samples obtained from a typical silt layer and silty clay layer. The resulting grain size distribution curves are shown on Figure 1 in Appendix II. These curves indicate that the silt layer is composed of about 90 percent silt and 10 percent fine sand sizes and the silty clay layer is composed of about 40 percent clay and 60 percent silt sizes.

Two Atterberg limit determinations on typical silty clay samples gave liquid limits of about 33 and 38 and plasticity indices of about 16 and 21 at corresponding natural moisture contents of about 25 percent. The silt layers are estimated to be of low plasticity.

Two wet unit weight determinations on samples of the silty clay gave values of 129 and 130 pounds per cubic foot.

Two quick triaxial compression tests performed on samples from the silty clay obtained near the upper portion of the stratum gave shear strengths of 730 and 1720 pounds per square foot. Standard penetration tests carried out in the stratum gave "N" values ranging from 5 to 38 blows per foot with an average value of about 15 blows per foot. Based on the results of the strength tests together with the results of the standard and dynamic penetration tests the consistency of the stratum is generally firm to stiff.

SOIL CONDITIONS (continued)

Stiff to Very Stiff Silty Clay

Underlying the firm to stiff layered silt and silty clay at an approximate elevation of 58 is a stratum of grey silty clay. The stratum was penetrated for a depth of about 10 feet, at which depth the borings were terminated. The clay is estimated to be of medium plasticity. The clay contains occasional subrounded gravel sizes ranging from about 1/8 to 1/2 inch in size. Samples obtained from the stratum indicated that the clay has a very finely laminated structure.

Standard penetration tests carried out in the stratum gave "N" values ranging from 10 to 19 blows per foot with an average value of about 16 blows. Based on the "N" values it is estimated that the consistency of the stratum is generally stiff to very stiff.

WATER CONDITIONS

During the period of the investigation, the groundwater level in the boreholes was up to one foot above creek level. The creek water level was at about elevation 93.0.

DISCUSSION

General

It is proposed to relocate the creek at the site, as shown on Drawing S7177-1, and to replace the existing County Bridge No. 44 and another existing bridge, located about 300 feet to the south, by a single bridge structure. The proposed bridge, to be located at the site of

DISCUSSION (continued)

General (continued)

existing bridge 44, is to be a single span reinforced concrete skew structure, with an effective span of about 55 feet and a waterway opening of about 40 feet.

It is understood that the new creek channel will be dredged to about the same depth as the existing creek channel, the bottom of which is at about elevation 92 at the site under investigation. It is further understood that strip or spread footing foundations, if used for the proposed structure, would be founded about 4 to 5 feet below creek bottom to prevent possible scour beneath the footings.

Foundations - Proposed Structure

The stratum of firm to stiff layered silt and silty clay, which was encountered at elevations 87.1 and 86.7 in boreholes 1 and 2, respectively, is considered a suitable bearing stratum for the founding of the proposed structure. It is thus recommended that the bridge be founded on spread or strip footings, placed 1 foot below the surface of the silt and clay stratum, at about elevation 86.

Based on the estimated consistency from the "N" values and the results of the triaxial tests, which gave shear strengths of 1720 and 730 pounds per square foot, a net allowable bearing pressure of 2500 pounds per square foot may be used for design purposes.

Under this allowable load and assuming footings of the width which will be required, the total consolidation settlement of the structure should not exceed 3/4 inches. This should be within tolerable limits for the structure proposed.

DISCUSSION (continued)

Foundations - Proposed Structure (continued)

As the recommended footing elevation is below the groundwater table, precautions should be taken to control the inflow of water into the excavation during construction and to prevent the inflow of the overlying sand stratum into the excavations. This may be accomplished by sloping the sides of the excavation below the water table at flat slopes, of about 3 horizontal to 1 vertical, or by the use of sheeting, together with pumping from sumps which should be located a foot or so below excavation level. Local experience indicates that timber sheeting could be employed. Such sheeting should extend to below the bottom of sumps and be adequately braced. The sheeting need not be designed to resist hydrostatic pressure providing provision is made to allow the groundwater to seep through the joints, without the egress of fines from the soil. For this case the pressures on the sheeting should be computed using the wet unit weight and a coefficient of lateral earth pressure of 0.4.

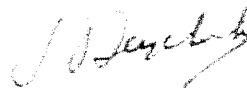
A thin layer of lean concrete should be laid down immediately the excavation is down to footing elevation to prevent softening of the stratum.

R. C. Dunn and Associates Ltd.,
February 1st, 1961.
Page 8.

We believe that this letter report, which was written by Mr. R. Gibson and checked by Mr. J. L. Seychuk, contains the information necessary for the foundation design of the proposed structure. However, should any questions arise, please give us a call.

Yours very truly,

GEOCON LTD



J. L. Seychuk, P. Eng.,
District Soils Engineer.

JLS/dw
S7177

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APPENDIX I

OFFICE REPORTS ON SOIL EXPLORATION

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EXPLANATION OF THE FORM "OFFICE REPORT ON SOIL EXPLORATION"

The object of this form is to enable a comprehensive study of the soil to be made by combining on one sheet all of the information obtained from the boring. An explanation of the various columns of the report follows.

ELEVATION AND DEPTH

This column gives the elevation and depth of boundaries between the various soil strata. The elevation is referred to the datum shown in the general heading.

WATER CONDITIONS

In this column the water level in the casing at the time of boring or the water table in the ground, determined by a series of observations in a piezometer or standpipe, is indicated to scale by a horizontal line with the symbol W.L. or W.T. above the line. A notation of any complicated groundwater conditions will be made in this column.

DESCRIPTION

A description of the soil, using standard terminology, is contained in this column. The consistency of cohesive soils and the relative density of non-cohesive soils are described by the following terms:

<u>Consistency</u>	<u>U-Strength Tons/sq. ft.</u>	<u>Relative Density</u>	<u>Standard Penetration Resistance, Blows/ft.</u>
Very soft	0.23 to 0.25	Very loose	0 to 4
Soft	0.25 to 0.5	Loose	4 to 10
Firm	0.5 to 1.0	Compact	10 to 30
Stiff	1.0 to 2.0	Dense	30 to 50
Very stiff	2.0 to 4.0	Very dense	over 50
Hard	over 4.0		

STRATIGRAPHIC PLOT

The stratigraphic plot follows the standard symbols of the National Research Council, Canada.

ELEVATION SCALE

The information in all columns is plotted to a true elevation scale which is shown in this column.

GRAPHS

The main body of the report forms a graph which is used to plot to correct elevation the important soil properties which are obtained through field and laboratory tests. The scales and symbols for the plotting are shown at the head of the column.

OTHER TESTS

In this column are shown, by symbol, the other field or laboratory tests which have been performed on the soil and for which the results have not been plotted on the above graph.

SAMPLES

The first three columns describe the condition, type and number of each sample obtained from the boring. The location and extent of each sample is plotted to scale.

In the last column is shown the penetration resistance in blows or 4200 inch-pounds required to drive one foot of the sampler into the ground. When a 2 inch Drive Sampler is used the result obtained is termed the "Standard Penetration Resistance".

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OFFICE REPORT ON SOIL EXPLORATION

CONTRACT 37177 BORING # 1 DATUM LOCAL CASING
 BORING DATE JAN. 12, 1961 REPORT DATE JAN. 20, 1961 COMPILED BY M.W. CHECKED BY
 SAMPLER HAMMER WT. 140 LBS. DROP 30 INCHES (PENETRATION RESISTANCES CONVERTED TO BLOWS OF 4200 IN - LBS. ENERGY)

SAMPLE CONDITION

☐ DISTURBED
☐ FAIR
☐ GOOD
☐ LOST

SAMPLE TYPES

A.S. - AUGER SAMPLE
 S.T. - SLOTTED TUBE
 W.S. - WASHED SAMPLE
 D.O. - DRIVE-OPEN
 D.F. - DRIVE-FOOT VALVE
 C.S. - CHUNK SAMPLE

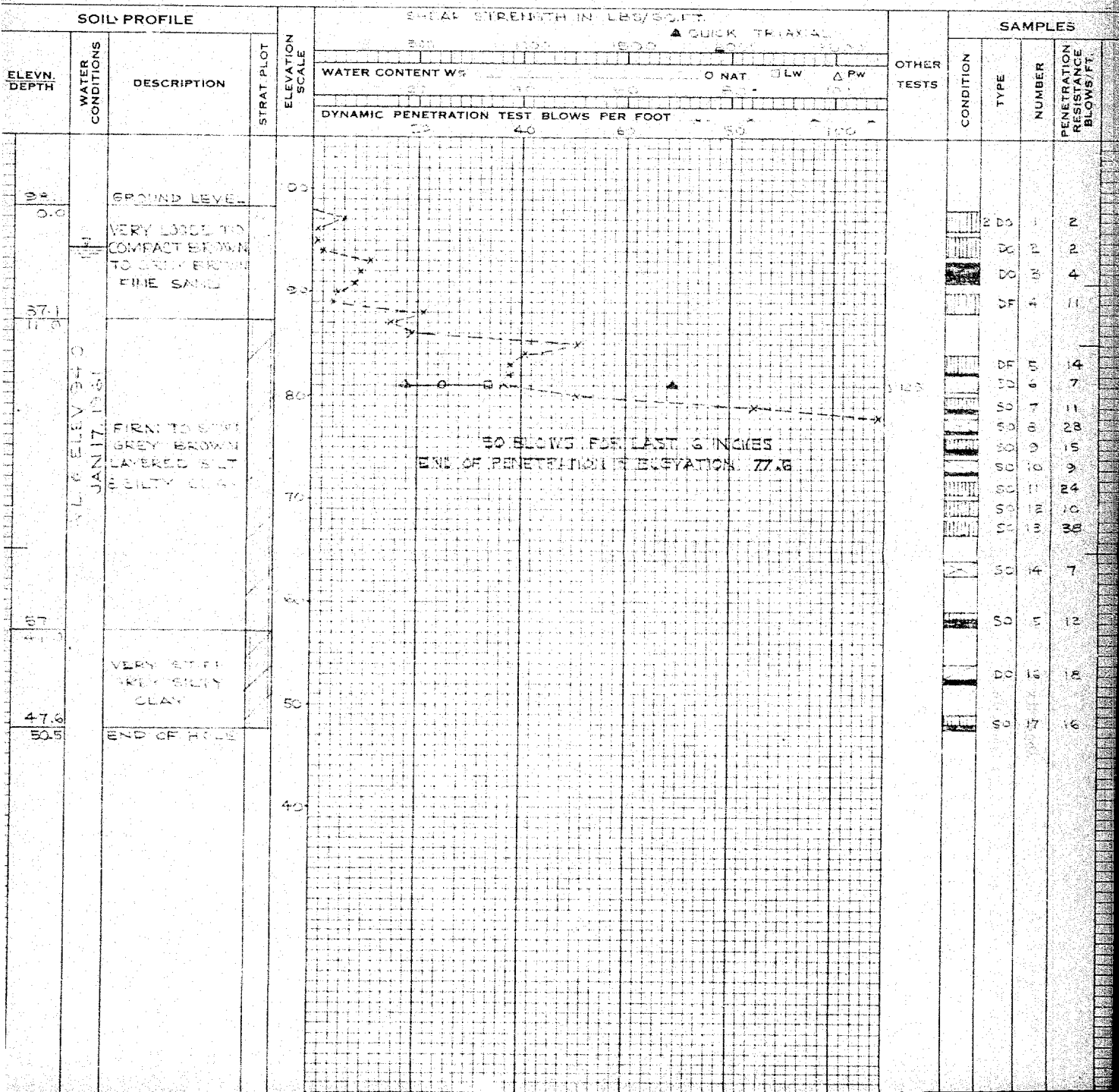
F.S. - FOIL SAMPLE
 S.O. - SLEEVE-OPEN
 S.F. - SLEEVE-FOOT VALVE
 T.O. - THIN WALLED OPEN
 R.C. - ROCK CORE

ABBREVIATIONS

V - IN-SITU VANE TEST
 M - MECHANICAL ANALYSIS
 U - UNCONFINED COMPRESSION
 QC - TRIAXIAL CONSOLIDATED QUICK
 Q - TRIAXIAL QUICK
 S - TRIAXIAL SLOW

γ - WET UNIT WEIGHT
 K - PERMEABILITY
 C - CONSOLIDATION

WL - WATER LEVEL IN CASING
 WT - WATER TABLE IN SOIL



APPENDIX II

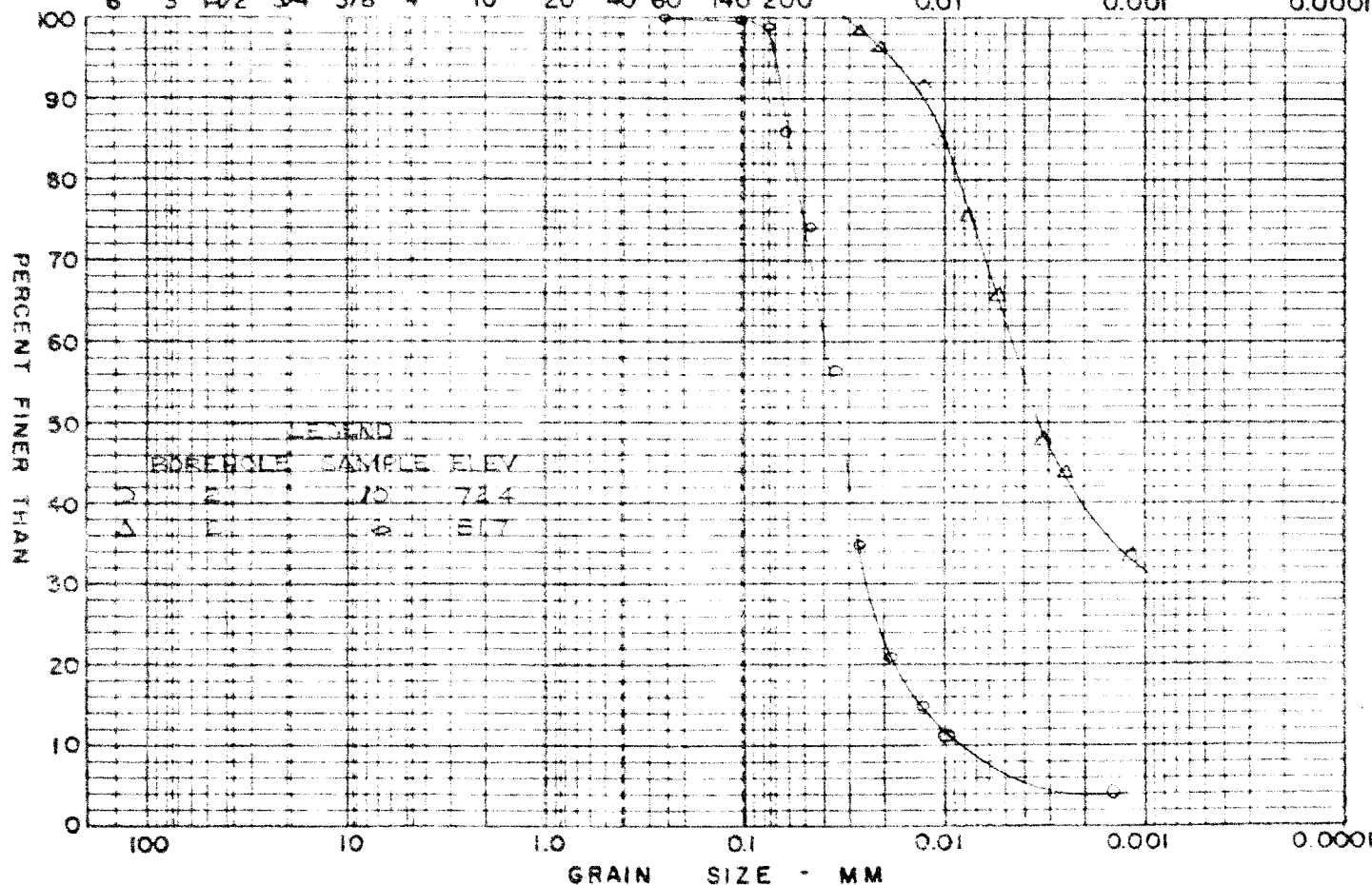
FIGURE - LABORATORY TESTING

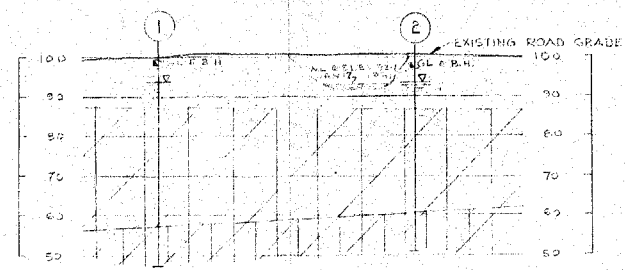
GRAIN SIZE DISTRIBUTION

APPENDIX II
FIGURE 1
PROJECT SITE

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

SIZE OF OPENING - INS. U.S.S. SIEVE SIZE - MESHES/IN EQUIVALENT GRAIN DIAMETER - MM
 6" 3" 1 1/2" 3/4" 3/8" 4 10 20 40 60 140 200 0.01 0.001 0.0001





SECTION A-A
SCALE 1"=20'-0"

LEGEND

- 4 BOREHOLE WITH PENETRATION
TEST IN PLAIN
- 2 BOREHOLE IN ELEVATION
- 7 WELL IN BOREHOLE JAN 17 1968

STRATIGRAPHY

- | | |
|--|--|
| | VERY LOOSE TO LOOSE BROWN TO GREY BROWN FINE SAND |
| | FIRM TO STIFF GREY BROWN LAYERED SILT & SILTY CLAY |
| | STIFF TO VERY STIFF GREY SILTY CLAY |

SPECIAL NOTE: DATA CONCERNING THE VARIOUS STRATA HAVE BEEN OBTAINED AT BOREHOLE LOCATIONS ONLY. THE SOIL STRATIGRAPHY BETWEEN BOREHOLES HAS BEEN INFERRED FROM GEOLOGICAL EVIDENCE AND SO MAY VARY FROM THAT SHOWN.

PLAN
SCALE 1"=60'-0"

KEY PLAN
CASE FILES CAPTION

REFERENCE
PLANS PROFILE BRIDGE SITE
NO. 4, SUPPLIED BY
R. C. DANN & ASSOCIATES LTD.

R. C. DUNN & ASSOCIATES LIMITED
LONDON ONTARIO
PROPOSED BRIDGE No. 44
COUNTY OF MIDDLESEX ONTARIO
BORING PLAN & SOIL STRATIGRAPHY

GEOCON LTD
DATE JAN 31 1961 SCALE AS SHOWN

MADE	CNCD.	APPD.
M W	Res.	HY
		No. S 7177-1