

#59-F-15

W.P.# 31-55

Hwy. # 401

CROSSING

HIGHBURY AVE. EXT.

WESTMINSTER TWP.

DEPARTMENT OF HIGHWAYS - ONTARIO  
MATERIALS & RESEARCH SECTION

**HIGHWAY AVE. EXT'N.  
PROPOSED CROSSING**

SHOWING POSITIONS & ELEVATIONS OF HOLES

HWY. 401 DISTRICT 11 COUNTY, MIDLESEX  
TOWNSHIP WESTMINSTER LOT 16. COR. 1  
LOCATION **APP. 5 MI. S. OF LONDON**  
QUANTITY 1 MILLION  
DATE **5/26/59** SCALE **1" = 30 FT.**  
APPROVED BY **111**  
DRAWING NO. **F59-15A**

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

July 1, 1959.

FOUNDATION REPORT -

W.P. 31-55 - W.J. F-59-15.

Attention: Mr. S. McCombie.

New Bridge at Highway #401 and  
Highbury Ave. Extension (Line 'A')  
Crossing in Westminster Township.

This memorandum accompanies our detailed report on a foundation investigation recently completed at the above noted underpass location.

For your convenience, the recommendations contained in this report are repeated as follows:-

- (1) Subsoil conditions at this site consist of a shallow surface veneer of cohesive fill material ( $\approx$  4 feet in thickness) overlying a dense stratum of dry fine to medium sand.
- (2) It is recommended that spread footings be used to support the abutments and pier members for the proposed structure. Footings should be founded at a depth of at least 5 feet below existing ground surface. The safe permissible bearing pressure to be used has been determined as 3 1/2 tons/sq.ft. This bearing pressure incorporates a safety factor in excess of 3 against a foundation shear failure and limits settlement to a value less than 1 inch. Differential movement between abutments and pier members will be of the order of 1/2 inch.
- (3) No problem need be anticipated with respect to embankment fill stability. Standard 2:1 slopes on the fills are adequate.
- (4) No construction difficulties due to ground water conditions, need be anticipated at this structure location.

If we can be of assistance in the clarification of data or recommendations contained in this report, please contact our office.

LGS/MdeF  
Encl.

cc: Messrs. A. M. Toye ✓  
H. A. Tregaskes  
D. G. Ramsay  
H. Orlando

W. L. Fraser  
J. Roy

*L. G. Soderman*  
L. G. Soderman,  
PRINCIPAL SOILS & FOUNDATIONS ENGINEER.

A. Watt  
Foundation Section - Gen. Files.

# FOUNDATION REPORT

on

New Bridge at Highway #401 and  
Highbury Ave. Extension (Line 'A')  
Crossing in Westminster Township.

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Profile No: F-3775-2

Plan No: F-3775-1

Chainage: Station 223+75.

## Distribution:

Mr. A. M. Toye, Bridge Engineer.	(2)
Mr. H. A. Tregaskes, Construction Engineer.	(1)
Mr. D. G. Ramsay, Design Engineer.	(1)
Mr. H. Orlando, Project Design Engr., London.	(1)
Mr. W. L. Fraser, District Engineer, London.	(1)
Mr. J. Roy, Regional Soils Engr., London.	(1)
Mr. A. Watt, Ont. Water Resources Commission.	(1)
Foundation Section.	(1)
Gen. Files.	(1)

W.P. 31-55

W.J. F-59-15.

## INTRODUCTION:

Reported herein are the results of a foundation investigation recently completed at the above noted site. A brief description of the field work carried out and our recommendations pertaining to footing design based upon the factual data obtained are given in the following paragraphs:-

## SITE LOCATION AND DESCRIPTION:

The structure is located at the intersection of Highway #401 and the proposed extension of Highbury Avenue (Line 'A') in Westminster Township (see Profile No. F-3529-12, chainage - 223+75).

The site is located in the physiographic region known as the Carodoc Sand Plains which is a well drained formation with gently rolling to flat topography.

## INVESTIGATION PROCEDURE:

Field work consisted of two detailed sampled borings and four dynamic cone penetration tests located on either side of the centre line of Hwy. 401 as shown on enclosed plan numbered F 59-15A.

Samples were recovered at a maximum depth interval of five feet in each boring. The granular nature of the subsoil precluded the taking of relatively undisturbed samples; disturbed samples were recovered using a 2-inch diameter split barrelled sampling spoon. The driving energy used in driving the sampler conformed to the requirements of the empirical Standard Penetration Test, and 'N' values were recorded and have been presented on the data sheets included with this report.

INVESTIGATION PROCEDURE: (cont'd.) ...

Borings were terminated in the underlying sand stratum at a depth of 26 1/2 feet below existing ground surface.

Elevation of the top of the borings and the chainage locations have been noted on the profiles appended to this report.

SOIL TYPES ENCOUNTERED:

In order of stratigraphic succession from existing ground surface to the depth investigated by the borings, the following subsoil strata were encountered:-

(1) Fill: A surface layer of brown silty clay, containing some gravel sizes was intersected in each of the two borings. This material is believed to be embankment fill placed during grading operations during construction of Hwy. 401. The thickness of this fill layer varied from 4 1/2 feet at the location of Hole No. 1, to 3 feet at the location of Hole No. 2.

(2) Dense Brown Fine to Medium Sand: Underlying the surface veneer of recently placed fill material, a deep deposit of dense fine to medium dry sand was intersected at each borehole location. Standard Penetration test resistance values (N) are in excess of 25 blows/ft. throughout this stratum. Ground water was not encountered in either of the two borings during the period of the field work.

Representative strength and in-situ density values for this sand stratum are as follows:-

'N' value - 30 blows/ft.

Unit Weight in-situ - 115 p.c.f.

Angle of Shearing Resistance =  $\phi = 36^{\circ}$ .

cont'd. /3 ...

FOUNDATION CONSIDERATIONS:

Simple spread footings founded at a shallow depth in the dense sand stratum is the obvious choice of footing support for this structure.

For footings founded in fine-grained granular sand, the safe allowable bearing pressure, based upon a shear failure is evaluated from the following equation,

$$q_s = \frac{1}{2} \frac{B \gamma N_\gamma}{F} + \frac{\gamma D_f N_\phi}{F}$$

where B is the footing width,

D<sub>f</sub> is the depth of footing,

γ is the unit weight of subsoil,

N<sub>γ</sub> & N<sub>φ</sub> are bearing capacity factors depending upon subsoil strength,

F = safety factor = 3.

Assuming a typical footing width of 5 feet placed at a depth of 5 feet below existing ground surface and using bearing capacity factors consistent with the previously noted φ value for the sand stratum substitution in the above equation gives -

$$q_s = \frac{1}{2} \frac{5 \times 115 \times 45}{3 \times 2000} + \frac{115 \times 5 \times 43}{3 \times 2000}$$

$$\approx 6 \text{ Tons/sq. ft.}$$

In order to limit settlements to a generally accepted value of 1 to 1 1/2 inches under each footing, and to allow for possible slight variation in relative density of the sand stratum, an allowable safe bearing pressure of 3 1/2 tons/sq. ft. is recommended for design.

cont'd. /4 ...

SUMMARY AND RECOMMENDATIONS:

- (1) Subsoil conditions at this site consist of a shallow surface veneer of cohesive fill material ( $\approx$  4 feet in thickness) overlying a dense stratum of dry fine to medium sand.
- (2) It is recommended that spread footings be used to support the abutments and pier members for the proposed structure. Footings should be founded at a depth of at least 5 feet below existing ground surface. The safe permissible bearing pressure to be used has been determined as  $3 \frac{1}{2}$  tons/sq.ft. This bearing pressure incorporates a safety factor in excess of 3 against a foundation shear failure and limits settlement to a value less than 1 inch. Differential movement between abutments and pier members will be of the order of  $\frac{1}{2}$  inch.
- (3) No problem need be anticipated with respect to embankment fill stability. Standard 2:1 slopes on the fills are adequate.
- (4) No construction difficulties due to ground water conditions, need be anticipated at this structure location.

V. Korlu,  
PROJECT FOUNDATION ENGR.



APPENDIX I.

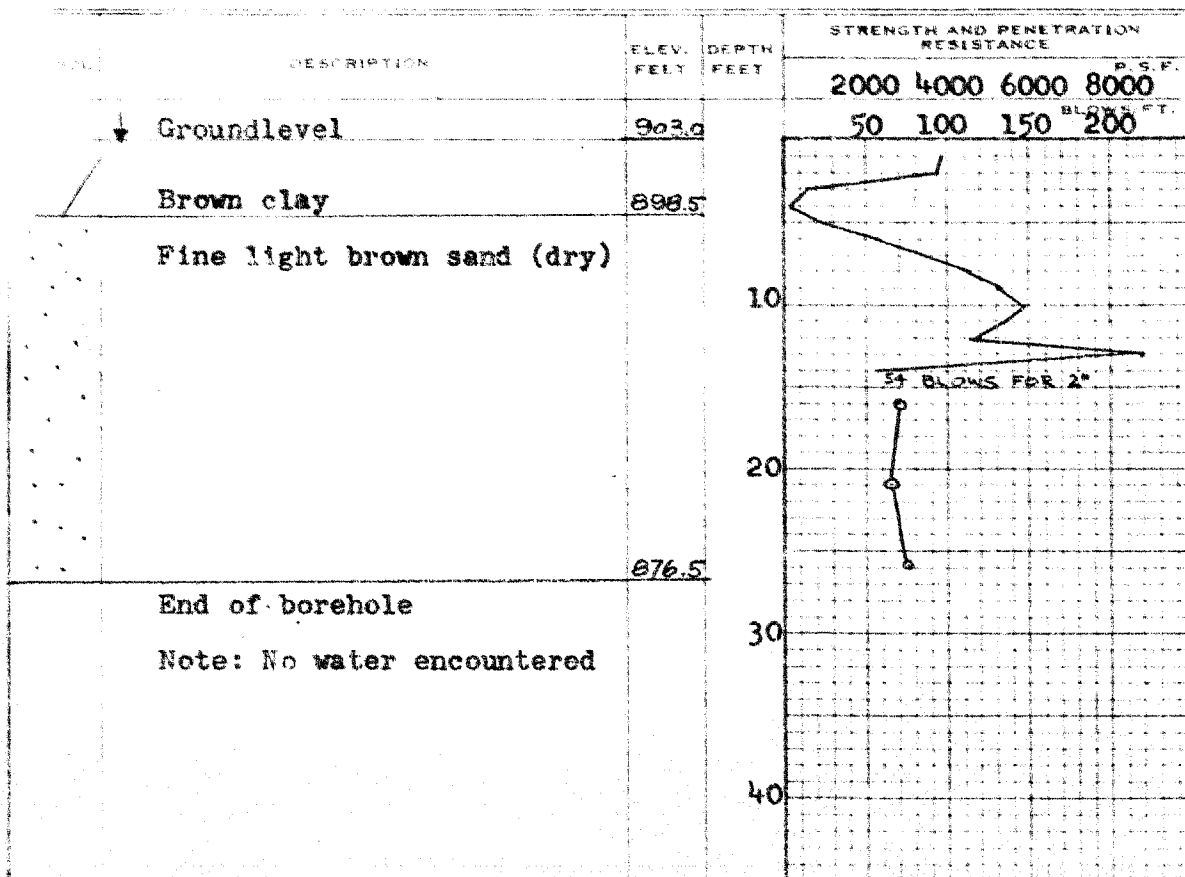
# DEPARTMENT OF HIGHWAYS - ONTARIO MATERIALS AND RESEARCH SECTION

W.P. 31-55 BORE HOLE NO. 1  
 JOB F-59-15 STATION 223+86 (70' R)  
 DATUM Geodetic COMPILED BY B.K.  
 BORING DATE Feb 25/59 CHECKED BY V.K.

2" DIA. SPLIT TUBE \_\_\_\_\_  
 2" SHELBY TUBE \_\_\_\_\_  
 2" SPLIT TUBE \_\_\_\_\_  
 2" DIA. CONE \_\_\_\_\_  
 2" SHELBY \_\_\_\_\_  
 CASING \_\_\_\_\_

## LEGEND

1/2 UNCONFINED COMPRESSION ( $Q_u$ ) \_\_\_\_\_  
 VANE TEST ( $C$ ) AND SENSITIVITY ( $S$ ) \_\_\_\_\_  
 NATURAL MOISTURE AND LIQUIDITY INDEX \_\_\_\_\_  
 LIQUID LIMIT \_\_\_\_\_  
 PLASTIC LIMIT \_\_\_\_\_



CONSISTENCY	SAMPLE	NATURAL UNIT WT. (G.C.F.)
MOIST. CONTENT - % DRY WT.		
	TW1	
	SS2	
	SS3	
	SS4	
	SS5	
	SS6	

DEPARTMENT OF HIGHWAYS - ONTARIO  
MATERIALS AND RESEARCH SECTION

W.P. \_\_\_\_\_ BORE HOLE NO. 2

JOB F-59-15 STATION 224/18 (70' R.)

DATUM Geodetic COMPILED BY B.K.

BORING DATE Feb. 26/59. CHECKED BY V.K.

2" DIA. SPLIT TUBE -----  
2" SHE. BY TUBE -----  
2" SPLIT TUBE -----  
2" DIA. CONE -----  
2" SHELBY -----  
CASING -----

### LEGEND

1/2 UNCONFINED COMPRESSION (Qu) \_\_\_\_\_ 0  
VANE TEST (C) AND SENSITIVITY (S) \_\_\_\_\_ +5  
NATURAL MOISTURE AND \_\_\_\_\_ LI  
LIQUIDITY INDEX \_\_\_\_\_ X  
LIQUID LIMIT \_\_\_\_\_ 0  
PLASTIC LIMIT \_\_\_\_\_ 1

SYMBOL	DESCRIPTION	ELEV. FEET	DEPTH FEET	STRENGTH AND PENETRATION RESISTANCE			
				2000	4000	6000	8000
	↓ Groundlevel	903.0		P.S.F. BLOWS/FT.			
				50	100	150	200
				187 P.S.F.			
				BLOWN BY			
				40			

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# DEPARTMENT OF HIGHWAYS - ONTARIO

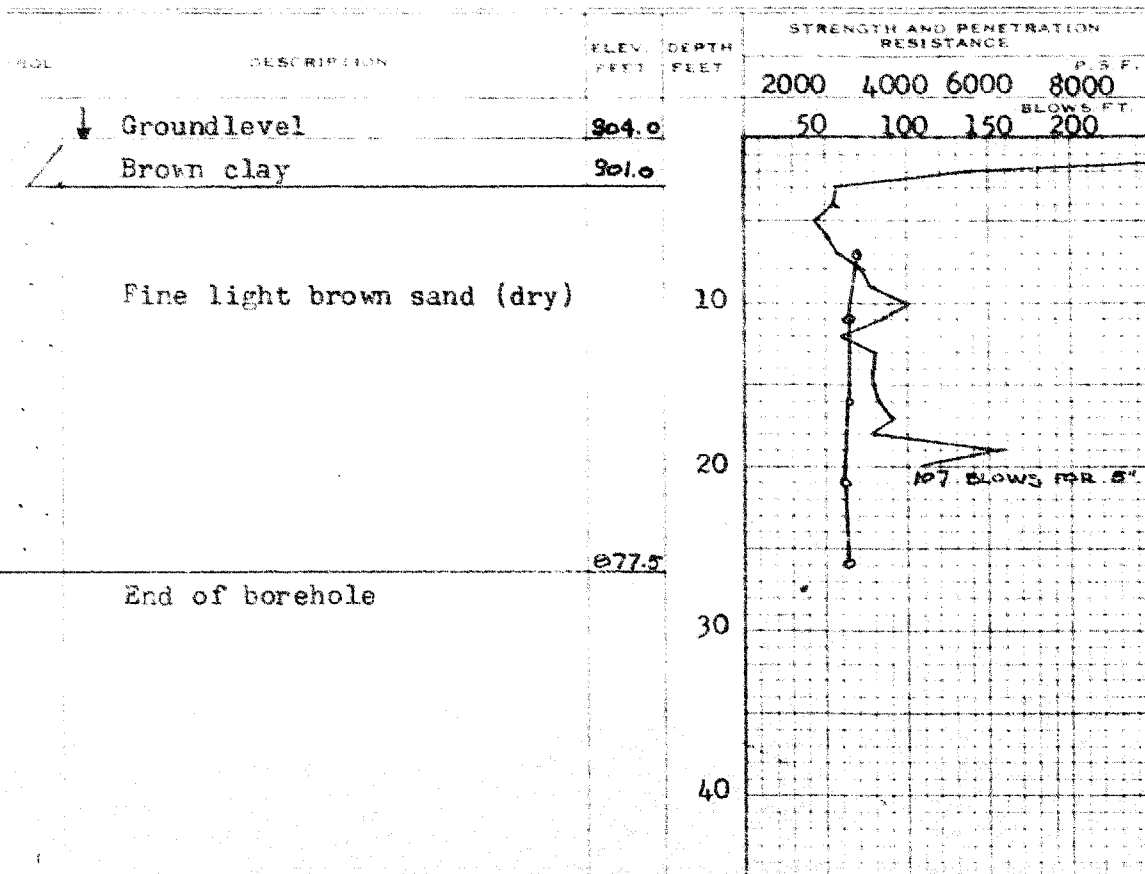
## MATERIALS AND RESEARCH SECTION

W.P. - - - - - BORE HOLE NO. 3  
 JOB F-59-15 STATION 223/63 (60' L)  
 DATUM Geodetic COMPILED BY B.K.  
 BORING DATE Feb. 26/59. CHECKED BY V.K.

2" DIA. SPLIT TUBE  
 2" SHELBY TUBE  
 2" SPLIT TUBE  
 2" DIA. CONC.  
 2" SHELBY  
 CASING

### LEGEND

1/2 UNCONFINED COMPRESSION ( $Q_u$ ) O  
 VANE TEST (C) AND SENSITIVITY (S) +  
 NATURAL MOISTURE AND LIQUIDITY INDEX LI  
 LIQUID LIMIT X  
 PLASTIC LIMIT



CONSISTENCY			NATURAL
MOIST. CONTENT- % DRY WT.			SAMPLE UNIT WT. P.C.F.
10	20	30	
			SS1
			SS2
			SS3
			SS4
			SS5

## MATERIALS AND RESEARCH SECTION

2" DIA. SPLIT TUBE  
2" SHELBY TUBE  
2" SPLIT TUBE  
2" DIA. CONE  
2" SHELBY  
CASING

1/2 UNCONFINED COMPRESSION (Qu) ---	O
VANE TEST (C) AND SENSITIVITY (S) ---	+S
NATURAL MOISTURE AND	
LIQUIDITY INDEX ---	L
LIQUID LIMIT ---	X
PLASTIC LIMIT ---	

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#59-F-15

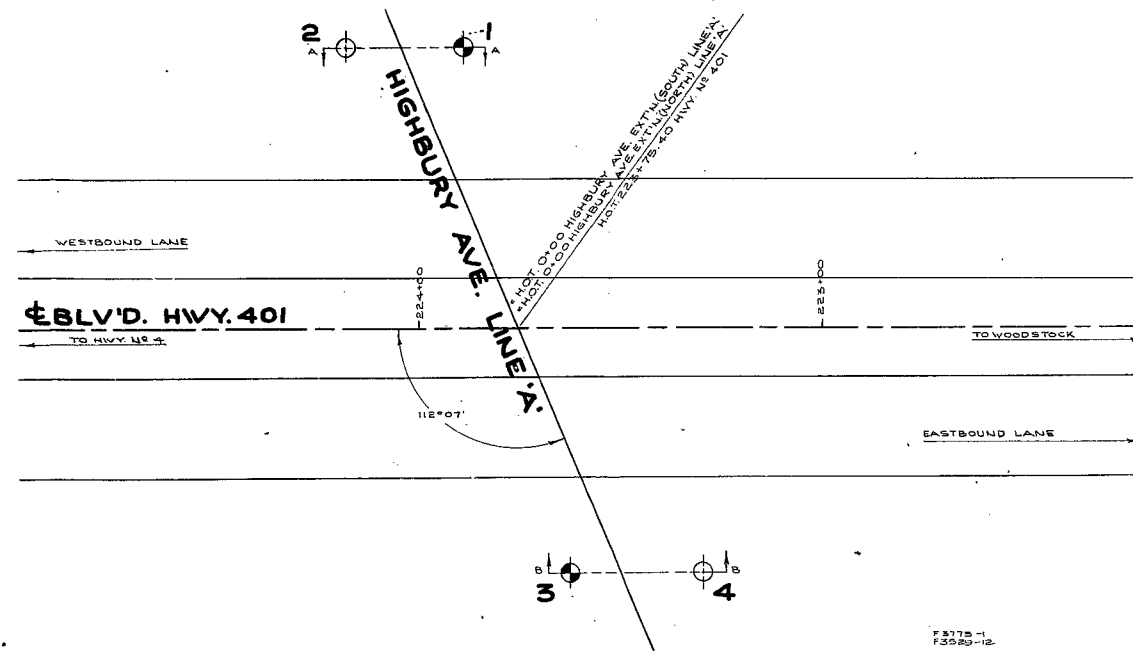
W.P.# 31-55

Hwy.# 401

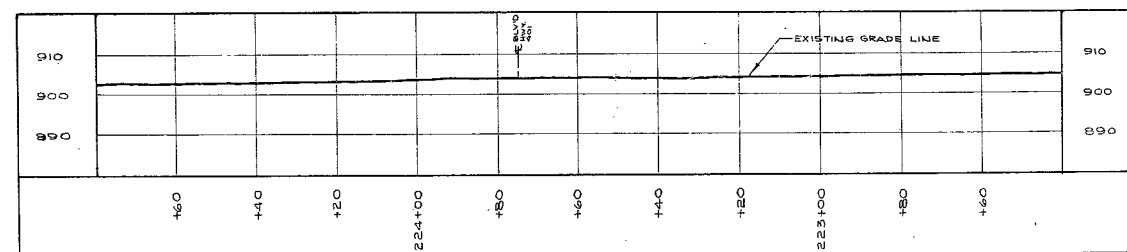
CROSSING

HIGHBURY AVE. EXT.

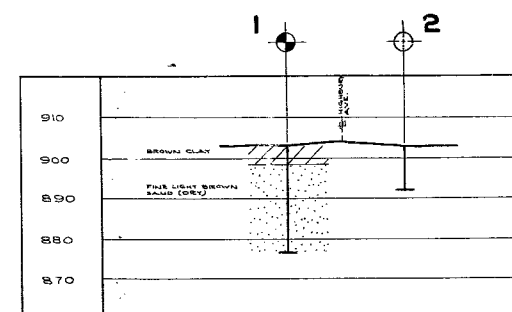
WESTMINSTER TWP.



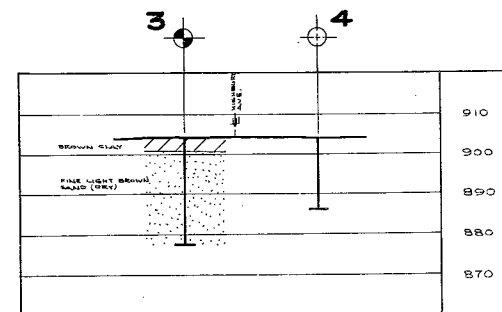
PLAN



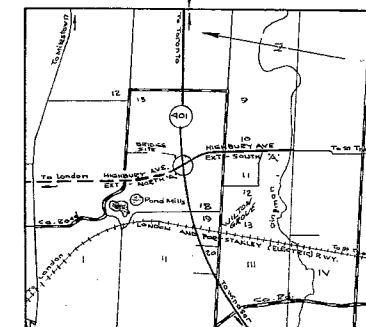
PROFILE



A-A



B-B



KEY PLAN

SCALE: 1 in = 1 mi

LEGEND

BORE HOLE  
PENETRATION HOLE  
BORE & PENETRATION HOLE

HOLE NO.	ELEVATION	STATION	DISTANCE FROM E.
1	905.0	225+86	70' RT.
2	905.0	224+18	70' RT.
3	904.0	223+63	60' LT.
4	904.0	225+30	60' LT.

- 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.

DEPARTMENT OF HIGHWAYS - ONTARIO  
MATERIALS & RESEARCH SECTION

### HIGHBURY AVE. EXT'N. PROPOSED CROSSING

SHOWING POSITIONS & ELEVATIONS OF HOLES

HWY. 401 DISTRICT 2 COUNTY MIDDLESEX  
TOWNSHIP WESTMINSTER LOT 16 CON. II  
LOCATION APP. 3 MI. S. OF LONDON  
DRAWN BY: T. MELLORS CHECKED BY: W.P. 31-55  
DATE: 5 JUNE 1959 APPROVED BY: DRAWING NO. F59-15A  
SCALE: 1 in. = 20 FT.