

WILLIAM A. TROW AND ASSOCIATES LTD.

SITE INVESTIGATIONS  
LABORATORY TESTING  
SOIL MECHANICS CONSULTATION

SEP 30 1963

W. A. TROW, M.A.Sc., M.E.I.C., P.ENG.

1850 JANE ST.,  
WESTON, ONT.  
CH. 1-4644

Project: J1109

June 20, 1963

63-f-218 M

Sutcliffe Company,  
Consulting Engineers,  
P.O. Box 430,  
New Liskeard, Ontario

Attention: Mr. V.R.O. Pr [unclear] P.Eng.

Re: Foundation Conditions - Proposed Main Street Subway  
Under the Ontario Northland Railway, Haileybury, Ontario

Dear Sirs:

Enclosed herewith is our report on the subsoil conditions encountered at this railway crossing site. This work was carried out in conformance with your authorization of April 30, 1963.

The ground underlying this crossing was found to consist of heavily desiccated varved clay down to proposed road grade level and the soil below consists of dense essentially granular till. The subsurface stratigraphy is shown on Dwg. 1.

The footings for the subway abutments can be supported in the till which is competent to support a net bearing stress of 8000 psf quite safely. The settlement resulting from this loading will be negligible.

No ground water difficulties are envisaged in the excavation to proposed road grade level or after the work has been completed. It is recommended that the side slopes of the subway approaches be cut to 2 on 1.

We hope that the contents of this report assist you in the design of this railway crossing. Please contact us if you have any queries on the subject.

Yours very truly,

*W. Trow*

WAT/gc  
Encls.

William A. Trow, P.Eng.

FOUNDATION CONDITIONS  
MAIN STREET UNDERPASS  
HAILEYBURY, ONTARIO.

PROJECT

The Municipal Authority of the Town of Haileybury has proposed the construction of an underpass to facilitate the extension of Main Street beyond the O. N. R. tracks, which run in a north-south direction on the west extremity of the Town. The project will involve the regrading of the existing section of Main Street, to the east of the tracks, the construction of a support structure for the railway under which the road will pass, and the construction of the Main Street extension west of the tracks. The regrading of the existing road and the westerly extension of Main Street will require the excavation of cuttings to an approximate maximum depth of 25 feet.

This report contains the factual results of this sub-surface survey, together with recommendations concerning the excavation and foundation requirements for this subway structure.

Details of the field test methods employed are appended.

SITE DESCRIPTION AND TOPOGRAPHY

The existing west end of Main Street, which terminates at a parking area adjacent to the O.N.R. tracks, is used as an access road to the Haileybury railway station, the Morissette Drilling Co. building, and to the Brewers Retail Store. West of its intersection with Hwy. 11, (see Dwg. 1), the road rises very sharply towards the railway tracks. The present railway consists of two tracks with several spurs leading

to sidings, in the vicinity of the proposed underpass structure. It is understood that, - before commencement of the proposed construction, - the O.N.R. intends to re-route the most westerly of these sidings. To the west of the tracks, the terrain rises gently into open grassland for a distance of about 400 feet, and then into bushland.

#### SUBSOILS ENCOUNTERED

A total of four sampled borings were completed at the site, together with three dynamic cone penetration tests. The locations of these holes are indicated on Dwg. 1.

The soil types encountered in each test boring, together with a record of some of their physical properties, are outlined in the respective boring logs, Dwgs. 2 to 5. The penetration data from Cones A and B are plotted on Dwgs. 3 and 4 respectively, and the results of all three cone tests are set out in Table 1.

The subsoil profile of the site consists of stiff to very stiff, light brown, varved clay overlying very stiff sandy clay till, which becomes very dense silty sand till with depth. At the location of boreholes 1 and 2, there is a layer of loose sandy fill, 10 and 6 feet in depth, respectively, overlying the clay. In boreholes 1 to 3, the varved clay extends to a depth of about 20 feet, whereas, in borehole 4, it is 14 feet in depth.

The varved clay consists of light brown, fat, fissured, somewhat brittle clay layers ranging in thickness from 0.3 inch to 0.5 inch. Between the clay layers, are light grey, 0.2 inch thick, brittle, silty clay layers containing numerous brown oxidation specks. At the intersection of the layers, there is a thin line of rusty-brown colouring. Occasional patches of the clay layers are coloured grey, and vertical fault planes run through the soil.

A subsoil stratigraphy is shown on Dwg. 1.

### BEDROCK

The bedrock underlying the area is known to be Ordovician (Trenton) limestone. The rock outcrops about one mile to the west of the site where it has been quarried for some years. Exposed faces of the rock in the quarry show it to be in flat beds up to 3 feet thick and consisting of fine grained, bluish grey, fossiliferous limestone. The top beds are thin and rubbly due to partial disintegration of the magnesium material. Between the quarry and the shore of Lake Temiskaming, the ground falls a considerable distance and the bedrock is believed to reduce in elevation, as it proceeds east, by a series of steps. Past drilling operations in the vicinity of the Morrisette Drilling Co., about 100 yards south-east of the site, revealed bedrock of poor quality at a depth of about 68 feet.

Considerable difficulty was experienced in the putting down of boreholes 2 and 3 because of the presence of boulders and the extremely hard nature of the till below 30 feet. As a result of the findings of hole 2, it is believed that bedrock is deeper than the 50 feet penetrated by the boring on the east side of the railway tracks. However, between depths of 30 feet and 40 feet in borehole 3, several limestone "boulders" were cored and it is possible that the bedrock, at a substantial depth on the east side of the tracks, is stepped up to a depth of only 30 feet to 40 feet on the west side. The till sampled at 35 feet in borehole 3 could be present in a solution cavity in the limestone.

As explained later in this report, the level of bedrock is not of material significance in this project, but it has been felt necessary to enumerate the difficulties involved in determining its true depth.

GROUND WATER

Readings of water levels were taken in boreholes 2, 3 and 4, as the investigation programme proceeded. These results are detailed on the relevant borehole logs. It appears, from these observations, that the true water table is below elevation 734.5 feet (below 30' 2" in borehole 2), whereas the higher water levels observed in boreholes 3 and 4 are probably the result of drilling water perched or trapped in the clayey phases of the till. These conclusions are reasonable in view of the topography of the site and of the surrounding area.

FOUNDATION AND EXCAVATION REQUIREMENTS

On the basis of the factual results of holes 1 to 4, it is apparent that extremely competent subsoil conditions prevail at this location. It is seen from Dwg. 1, that the grade level of the road in the subway section, lies entirely within the low plasticity till underlying the stiff clay.

Footings of the subway walls supporting the track section therefore, can be supported directly on this till, at the minimum depth below ground level required for frost protection. On the basis of field penetration resistance measurements, - which provide an empirical indication of the safe net bearing of this granular material, - a net bearing stress of 4 t.s.f. can be used in the design of footings. The settlement resulting from this load application will be negligible. According to the water level measurements of hole 2, no ground water difficulties will be experienced when digging to the required footing level, or in the general excavation.

If the railway traffic is diverted to the west, while the subway construction proceeds, the slope of the cutting from the near edge of the ties down into the cutting should not exceed 2 horizontal

to 1 vertical. Assuming a Cooper's E 60 loading to be uniformly distributed through ties, the following expression shows that this slope is quite safe. The ultimate bearing capacity of a footing on a slope is given by the expression -

$$q = C N$$

where  $C = 3200$  psf, the ultimate shear of the clay, from test in

$N$  is a bearing capacity factor for a footing near the edge of a 2:1 slope = 4 approx. \*

Solving:  $q$  is determined to be 13,000 psf approx.

Since the uniformly distributed load from the train will be in the order of 1000 psf., it is seen that this excavation requirement is quite safe.

If the tracks are to be maintained in their present position in order to minimize delays in train movements, the railway must be temporarily supported on piles. Simple timber piles should be satisfactory for this purpose and they should encounter refusal at shallow depths of penetration into the till.

It is assumed that the retaining and abutment walls of this subway will be backfilled with compact free-draining gravel. The earth pressure exerted by this material, at any depth,  $h$ , below the surface of the backfill, assuming some freedom of movement of the tops of the walls, is estimated to equal -

$$P_A = 0.3 \gamma h$$

where  $\gamma$ , the unit weight of the backfill, is estimated to be 120 pcf.

\* - "The Ultimate Bearing Capacity of Foundations on Slopes" - Meyerhof - 4th Int. Conference Soil Mechanics & Foundation Engineering

This force will be resisted at the base of the abutment by the friction generated between the footings and the underlying soil and by the passive resistance of the soil in front of the footings. For concrete poured against a rough footing bed, the sliding resistance generated along this contact is estimated to be in the order of  $0.7 q$ , where  $q$  is the unit bearing stress exerted by the abutment.

The long term passive resistance developed in front of the footing at any depth  $h_1$  below the road shoulder, is conservatively given by the expression -

$$P_p = 4 \gamma h_1$$

Some allowance is given for wall friction and for a possible loosening of the till by frost action, in the selection of a passive earth pressure coefficient = 4.

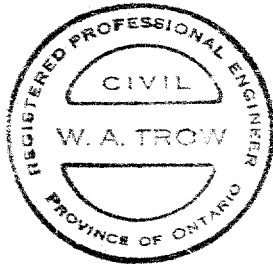
In view of the well-drained character of the clay and of the underlying till, no particular excavation difficulty or drainage requirement is envisaged for the road cutting into the present hillside. It is suggested that the sides of the road excavation be cut back on 2 horizontal to 1 vertical slopes, and that adequate drainage or ditching be provided at the base of the hillside. It may be desirable to pave the ditches or protect them in some similar manner from the erosion effects of surface run-off.

The subgrade of the road itself must be crowned at a slope of at least 3 inches in 10 feet from the centre to the verges. The prepared surface then must be thoroughly compacted. Tile drains should be installed along the edges of the road to carry off any water collecting in the granular base. These drains should be set at the base of a gravel-filled trench, extending at least one foot below subgrade level. At least 12 inches of granular base course material should be placed on the subgrade surface. This should consist of 4 inches of Class A crushed gravel under-



lain by Class B pit run material, both conforming to the D.H.O. select granular base course requirements. Three inches of asphaltic concrete should be placed over this granular base.

WAT/lt  
J1109



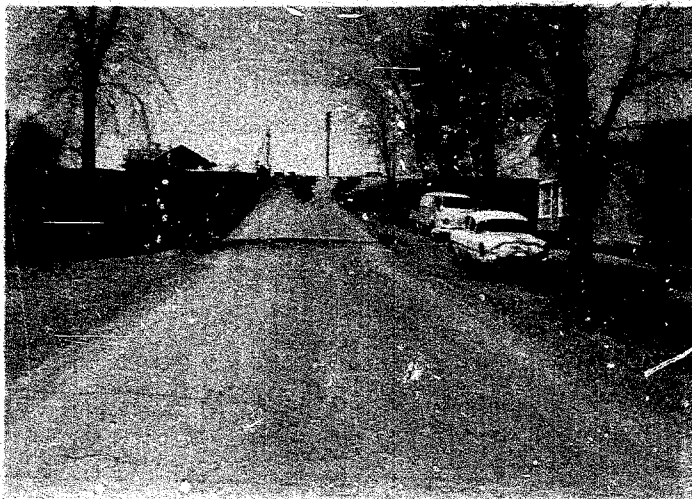
*W. Trow*  
William A. Trow (P. Eng.)

APPENDIX

FIELD WORK

The borings for this investigation were made using conventional wet sampling methods. The holes were cased using NX casing. Disturbed samples were taken using a 2-inch split spoon driven into the ground under an energy of 350 ft.lbs. per blow. Undisturbed samples were recovered using 2-inch shelby tubes and field vane tests were performed where applicable. In boreholes 2 and 3, below 30 feet, the holes were advanced using an AX core barrel fitted with a diamond bit. Experimentation indicated that this was the only practicable method of gaining samples below 30 feet, especially in view of the numbers of boulders present.

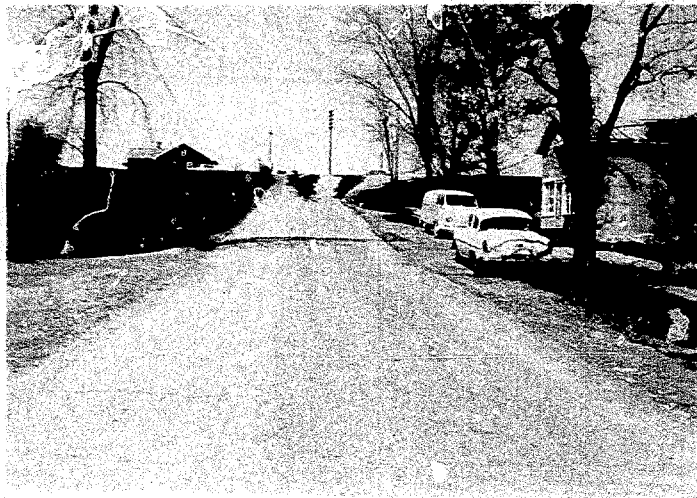
Cone penetration tests were performed to gain a continuous record of the subsoil penetration resistance in the positions A, B and C, shown on Dwg. 1. The cone was hammered into the ground using an energy of 350 ft.lbs. per blow.



Looking West Along Existing Main St. Towards O.N.R. Tracks  
Drill on B.H. 2



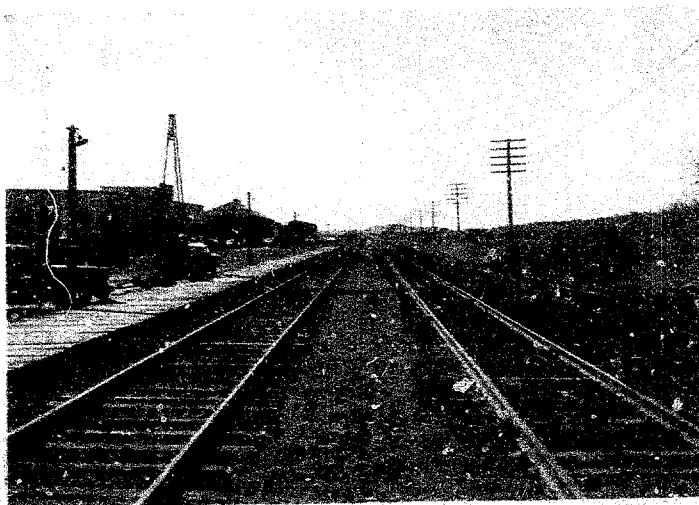
Looking West Along CL of Proposed Main St. Extension  
O.N.R. Tracks in Foreground



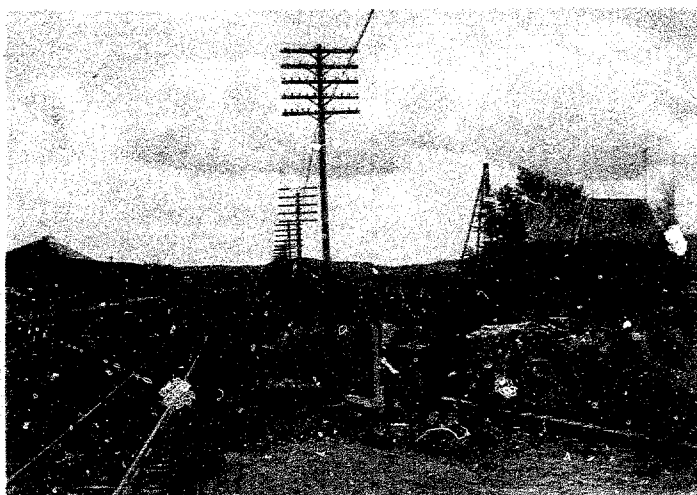
Looking West Along Existing Main St. Towards O.N.R. Tracks  
Drill on B.H. 2



Looking West Along CL of Proposed Main St. Extension  
O.N.R. Tracks in Foreground



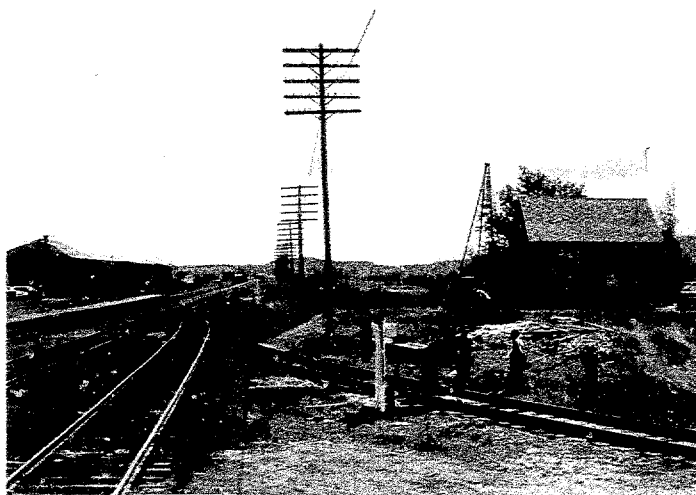
Looking South Along Mainline O.N.R. Tracks  
Drill on B.H. 2



Looking South Along O.N.R. Right of Way  
Drill on B.H. 3



Looking South Along Mainline O.N.R. Tracks  
Drill on B.H. 2



Looking South Along O.N.R. Right of Way  
Drill on B.H. 3

TABLE 1RESULTS OF DYNAMIC CONE PENETRATION TESTS

Depth Feet	No. blows/ft. of 350 ft.lb. hammer		
	Cone A	Cone B	Cone C
1	Dug hole in road	10	3
2	16	6	3
3	6	3	6
4	4	10	10
5	2	14	15
6	2	16	32
7	5	20	44
8	8	22	65
9	7	23	70
10	11	26	84
11	17	26	70
12	25	28	65
13	30	30	52
14	34	31	80
15	33	30	92
16	37	30	103
17	33	32	125
18	36	36	
19	73	39	
20	140 for 11½"	50	
21		66	
22		150 for 10"	

Cone hole elevations:

A - 764.7 ft.

B - 768.6 ft.

C - 775.0 ft.

## SITE INVESTIGATIONS SOIL MECHANICS CONSULTATION

DRAWING NO. 2  
PROJECT NO. J1109

### PENETRATION RESISTANCE

2" O.D. SPLIT TUBE      ○ — ○ — ○  
2" I.D. SHELBY TUBE      \* — \* — \* — \*  
3" 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

BOREHOLE NO. 1  
PROJECT Main Street Underpass  
LOCATION Haileybury, Ontario  
HOLE LOCATION See Dwg. 1.  
HOLE ELEVATION 761.3 Ft.  
DATUM See Dwg. 1.

SYMBOL	SOIL DESCRIPTION	ELEV FEET	DEPTH FEET	PENETRATION RESISTANCE		350 FT LB BLOWS/FT	NATURAL MOISTURE CONTENT AND ATTERBERG LIMITS		SAMPLE TYPE AND NO	NATURAL UNIT WEIGHT P.C.F		
				20	40		60	80			% DRY WEIGHT	
				SHEAR STRENGTH				P.S.F				
							20	40	60			
	Turf, 5" topsoil. Some boulders on & near ground surface.	761.3	0									
	FILL-loose, grey & brown fine to coarse sand with fine to coarse gravel.											
	CLAY-very stiff, light brown, varved with light grey silty clay layers. Some sand.	751.0	10									
	TILL-very dense, light brown slightly clayey silty sand with fine & med. gravel.	740	20									
	End of Hole	735.3										
Notes: 1) Hole advanced by standard wet sampling method. Casing washed & driven, not rotated. Cased to 15 ft. & then washed and sampled ahead of casing.			30									
			40									



## 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: 15, +<sup>s</sup>

NATURAL MOISTURE CONTENT AND LIQUIDITY INDEX

X

## ATTERBERG LIMITS

LIQUID LIMIT —○—

PLASTIC LIMIT ———

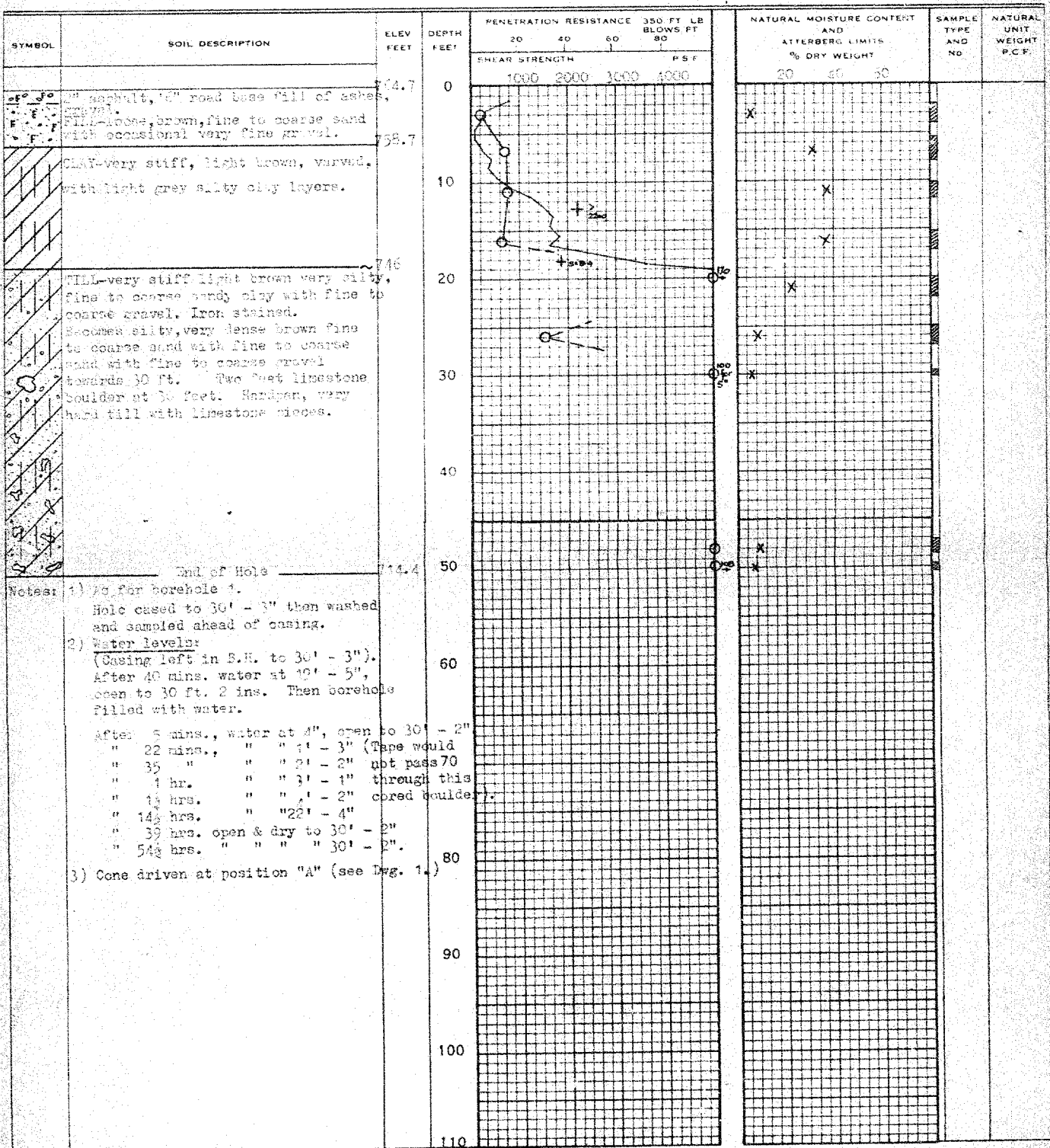
## SAMPLE TYPE

2" O.D. SPLIT TUBE: ⊗

2" I.D. SHELBY TUBE: ⊗







3" O.D. SHELBY TUBE: ⊗

BOREHOLE NO. 2  
 PROJECT Main Street Underpass  
 LOCATION McLearyburg, Ontario  
 HOLE LOCATION See Dwg. 1.  
 HOLE ELEVATION 764.7 ft.  
 DATUM See Dwg. 1.



BOREHOLE NO. 3  
PROJECT Main Street Underpass  
LOCATION Halleybury, Ontario  
HOLE LOCATION See Dwg. 1.  
HOLE ELEVATION 768.3 ft.  
DATUM See Dwg. 1.

### PENETRATION RESISTANCE

2 O.D. SPLIT TUBE	
2 I.D. SHELBY TUBE	
2 DIA. CONE	
<b>SHEAR STRENGTH</b>	
UNDRAINED TRIAXIAL AT OVERBURDEN PRESSURE	
UNCONFINED COMPRESSION	
VANE TEST AND SENSITIVITY (%)	

### NATURAL MOISTURE CONTENT AND LIQUIDITY INDEX

### ATTERBERG LIMITS

LIQUID LIMIT

PLASTIC LIMIT

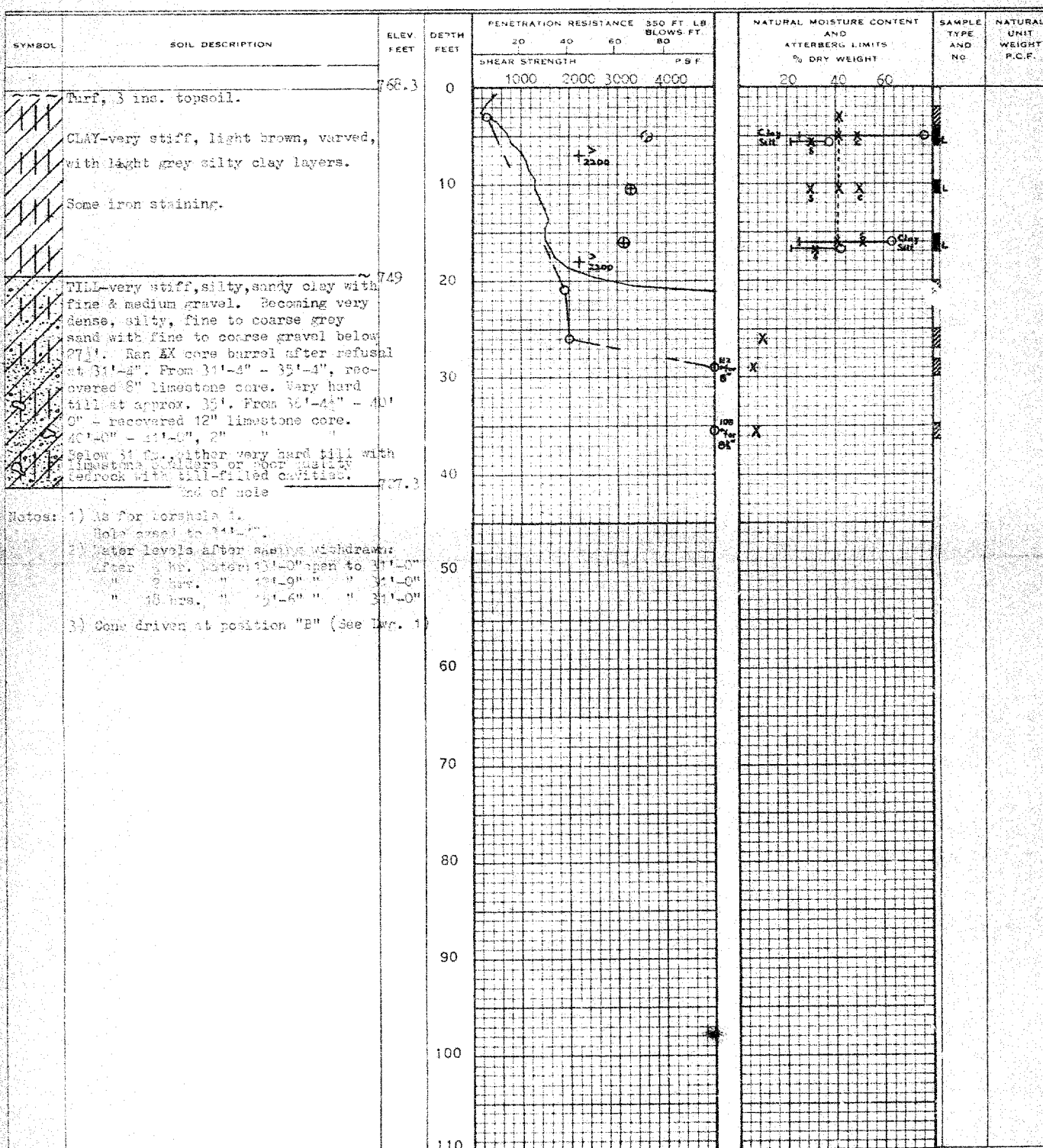
SAMPLE TYPE

SAMPLE 11E

2" O.D. SPLIT TUBE...

2" 10. SHELBY TUBE.


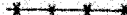

3" O.D. SHELBY TUBE






## LEGEND


BOREHOLE NO. 4  
PROJECT Main Street Underpass  
LOCATION Halleybury, Ontario  
HOLE LOCATION See Dwg. 1.  
HOLE ELEVATION 770.8 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) 

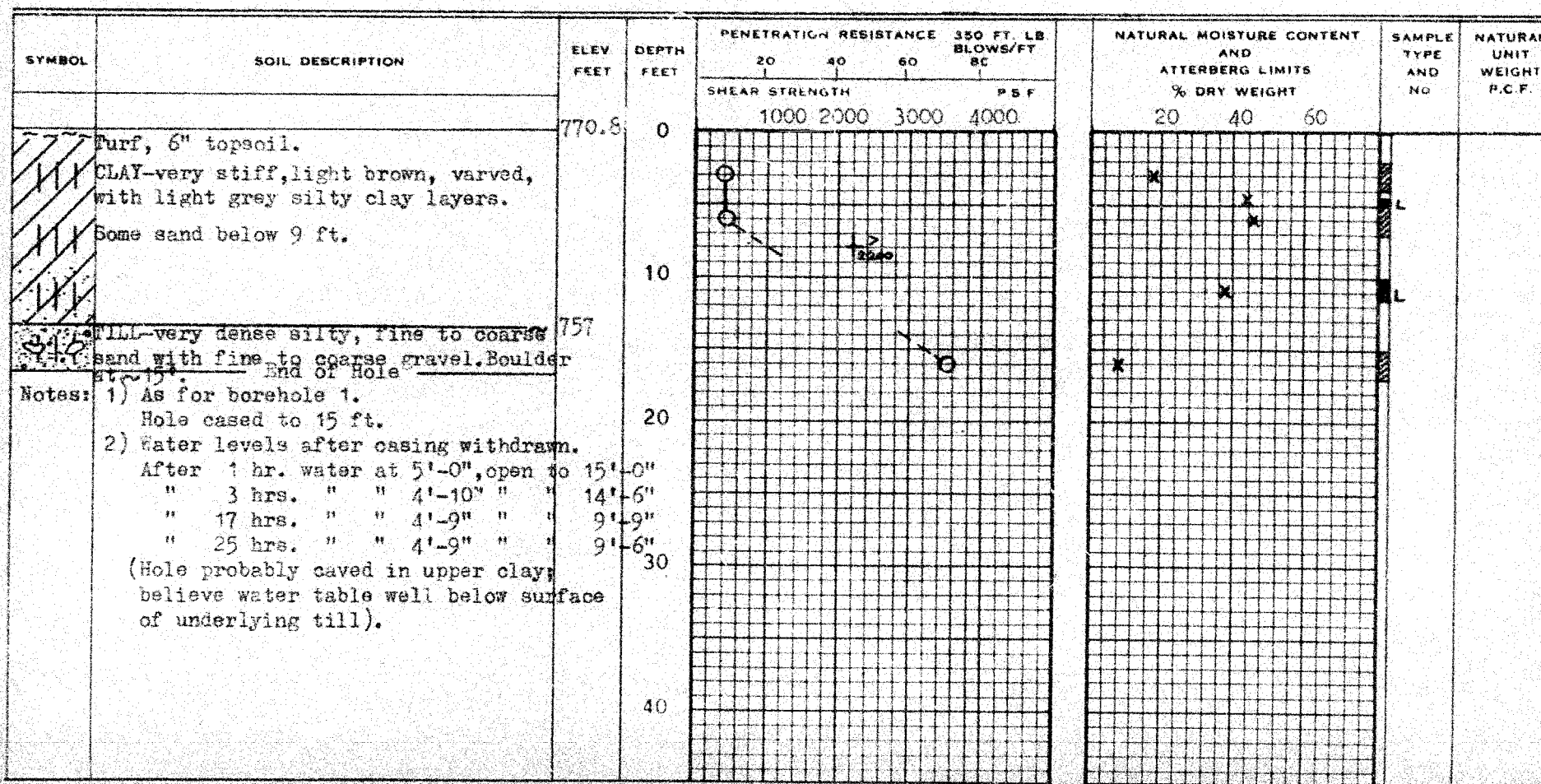
NATURAL MOISTURE CONTENT  
AND LIQUIDITY INDEX 

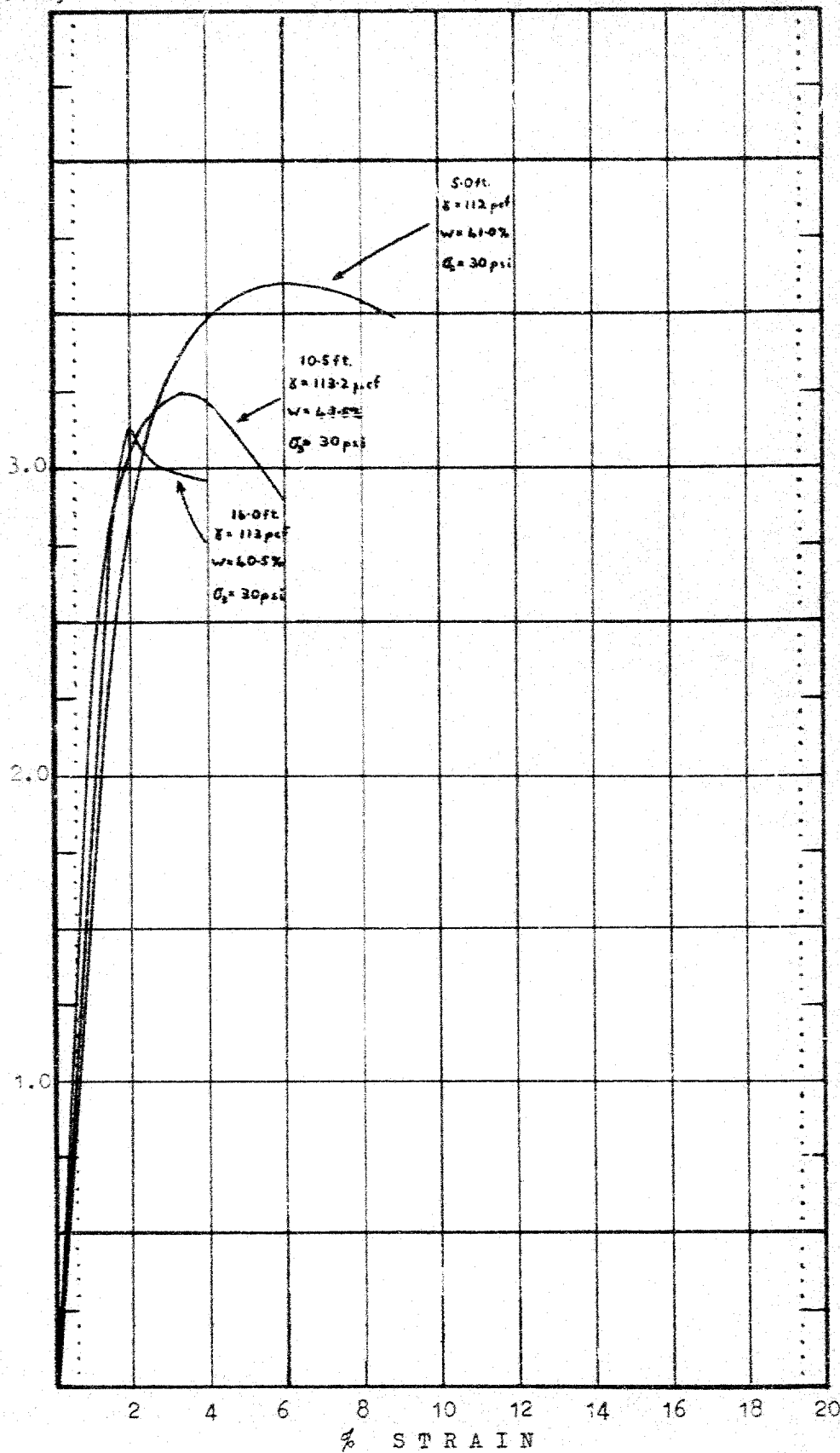
## ATTERBERG LIMITS

LIQUID LIMIT   
PLASTIC LIMIT 

## SAMPLE TYPE

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



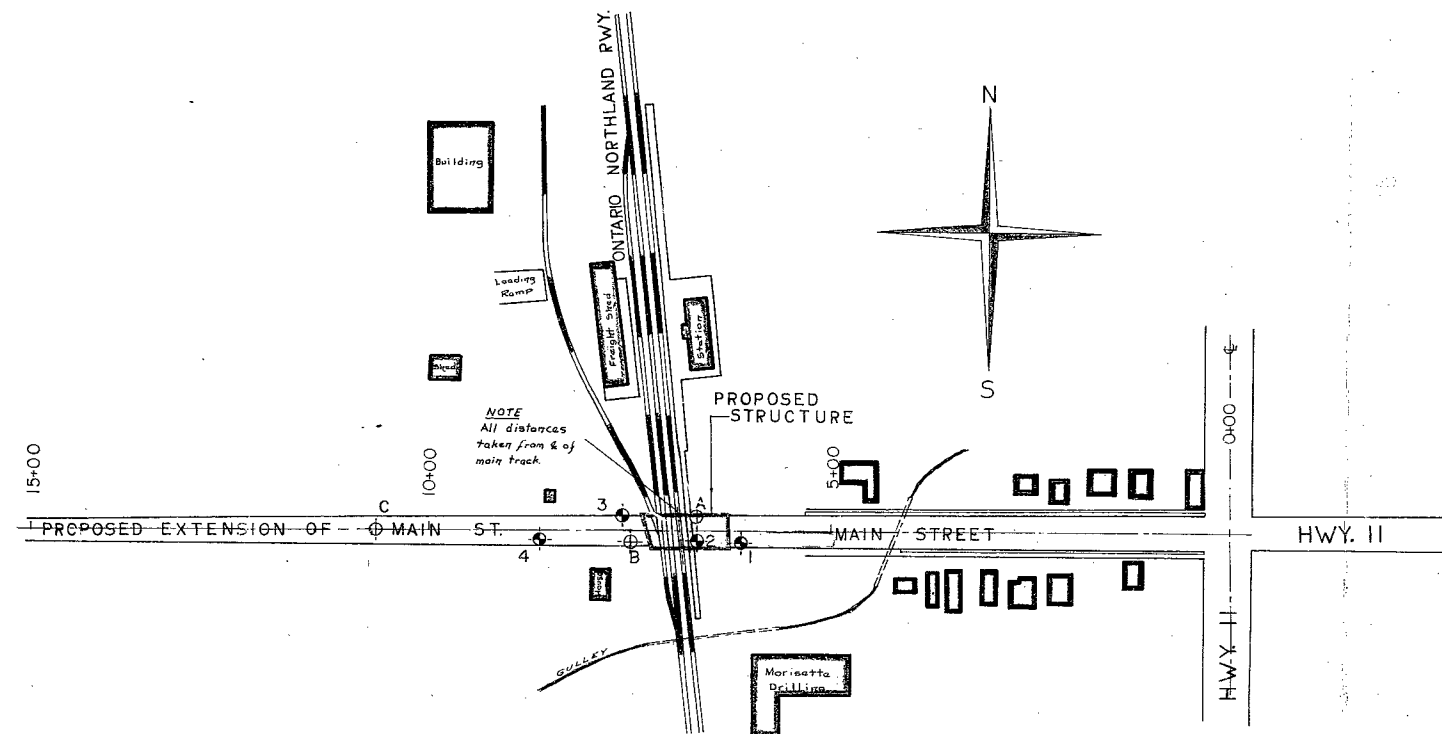
SHEAR STRESS  $\text{kef}$ 

UNDRAINED TRIAXIAL TESTS

63-F-218M  
MAIN ST. UNDERPASS  
OF ONT. NORTHLAND  
RAILWAY  
HAILEYBURY

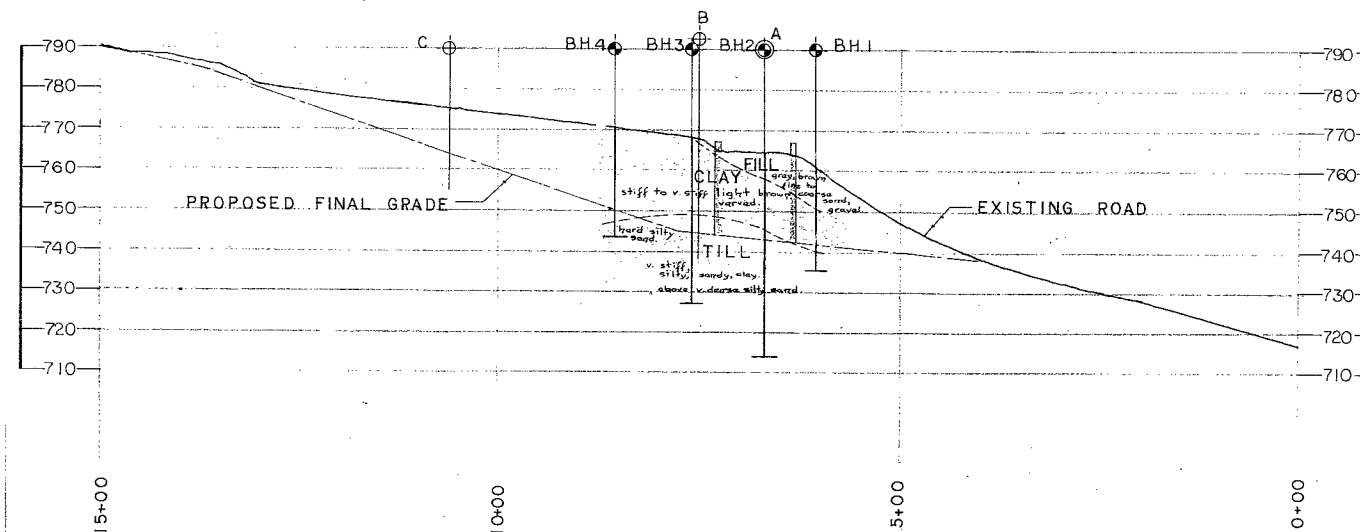
# BOREHOLE LOCATION PLAN

SCALE: 1 IN. = 100 FT.



## INTERPRETED SUBSOIL STRATIGRAPHY

SCALE: HOR. 1 IN. = 100 FT.  
VERT. 1 IN. = 20 FT.



### LEGEND

- BOREHOLE
- ⊕ CONE
- ⊕ BOREHOLE & CONE

HOLE	ELEV.	DIST FROM C OF TRACK	DIST. FROM C OF MAIN ST.
1	761.3	82'-0" EAST	14'-0" SOUTH
2	764.7	18'-0" EAST	12'-6" SOUTH
3	768.2	72'-0" WEST	21'-0" NORTH
4	770.8	167'-0" WEST	5'-0" SOUTH
A	764.7	19'-0" EAST	18'-0" NORTH
B	768.6	63'-6" WEST	12'-8" SOUTH
C	775.0	373'-0" WEST	ON - C

W. A. TROW & ASSOCIATES LIMITED  
FOUNDATION INVESTIGATION

PROPOSED  
MAIN ST. UNDERPASS  
AT ONTARIO NORTHLAND RAILWAY  
HAILEYBURY ONTARIO

PROJ. 1109 DATE JUNE/83 DWG. NO. 1