WILLIAM A. TROW AND ASSOCIATES

SITE INVESTIGATIONS
AND
SOIL MECHANICS CONSULTATION

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

884 WILSON AVE.
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ST. 8-5921

Project: J 367

April 30, 1959.

W.P. ... ✓

DIST 6

Mr. A. Rutka,
Department of Highways of Ontario,
Materials and Soils Laboratory,
Downsview, Ont.

Attention: Mr. L. G. Soderman

Foundation Investigation
C.N.R. Underpass, Highway No. 10
Port Credit, Ont.

Dear Sirs:

Enclosed herewith is our report on the soil conditions encountered at the proposed underpass of Hwy. No. 10 beneath the Canadian National Railways in Port Credit, Ont. This information has been obtained from four borings taken to a maximum depth of about 37 feet below present ground surface.

The soil at this site has been found to consist, in large part, of very hard clayey silt till, which is quite competent to support the loads involved in this subway construction. Attention is drawn to two potential problems which appear to warrant consideration. One concerns the presence of a thick deposit of wet fine sand which lies between approximate Elevations 274 ft. and 267 ft., at the north end of the site. The estimated water table in this stratum is approximately Elev. 275.5 ft. The other matter which requires attention is the high concentration of aggressive CO_2 and sulphate encountered in the sandy topsoil which lies about 4½ to 6 feet below present ground level. Suggested procedures for dealing with these difficulties are considered in the report.

We hope that the information contained herein is in sufficient detail to assist in the planning of this project. If queries come to mind after you have reviewed its contents we shall be pleased to discuss them.

Yours very truly,

W. Trow

William A. Trow (P. Eng.)

WAT/lt
Encl.

DEPARTMENT OF HIGHWAYS OF ONTARIO
MATERIALS AND SOILS LABORATORY
DOWNSVIEW, ONTARIO

FOUNDATION INVESTIGATION
C.N.R. UNDERPASS, HIGHWAY NO. 10
PORT CREDIT, ONT.

Project: J 367

April 30 1959

William A. Trow & Associates

TABLE OF CONTENTS

ENCLOSURES

FOUNDATION INVESTIGATION
C.N.R. UNDERPASS, HIGHWAY NO. 10
PORT CREDIT, ONT.

This report contains the results of a foundation investigation completed recently at the above-noted bridge site. Comments concerning foundation competence, horizontal earth pressures and other soil mechanics problems have been given.

Field Investigation Procedure

The four borings of this investigation were performed using conventional diamond drill equipment adapted for soil sampling purposes. The holes were cased to full depth with BX pipe which was drilled down to the various sampling intervals.

Samples were recovered both in the disturbed state, using a 2-inch O.D. split spoon, and in the relatively undisturbed condition in 2-inch I.D. Shelby tubes. Because of the very dense state of the soil, this undisturbed sampling operation was not too successful, although sufficient samples were recovered to obtain representative measurements of shear strength of the clay till which predominates this site.

In most instances, both the split spoon and Shelby tube samplers were driven into the soil below casing level under an energy of 350 ft.lbs. per blow. The high resistance to sampling presumably had some effect on the strength measurements of the soil recovered, although dense material of this type should be relatively insensitive to disturbance.

Dynamic cone penetration tests were performed adjacent to holes Nos. 1, 3 and 4, in order to supplement other measurements of the relative density of the sand deposits which comprise the surface strata at this site. The driving energy, required to advance this 2-inch diameter cone, conforms to the force used during the soil sampling operations.

Water level observations were taken in each hole as the work progressed. Unfortunately, however, these bores were advanced by drilling the casing and, as a consequence, uncertainty existed regarding the actual source of ground water movements. An example of this uncertainty was in the observations of water levels in hole No. 1 during and after the casing was withdrawn at this location. A gradual rise to Elev. 268 feet was noted as the field work progressed, which could have signified high excess water pressures in the ground below subway level. It could also have been the result of water seeping from the surface cinder fill into the borehole.

In order to resolve the uncertainty regarding true ground water level at the site, a piezometer was installed in borehole No. 3, after sampling had been completed in this hole. This piezometer was backfilled with sand and then sealed, at a depth of about 20 feet, using bentonite. A similar attempt to install a piezometer in hole No. 1 was not successful, so 3 inch casing was driven to a depth of 10 feet below the surface into the impermeable brown clay which underlies the cinder fill at this location. This casing was cleaned out and a hole was drilled with AX casing below it to a depth of 25 feet. The pipe was then filled with water and observations were made thereafter until a stabilized level was obtained.

The elevations of all boreholes were established by a Dept. of Highways Survey crew working in this area. The locations of the bores are shown in Dwg. No. 1.

Description of Soil Types

Detailed descriptions of the various soil types encountered in each boring are shown in Dwgs. 2 to 5 of this report. The estimated stratigraphical profiles of Dwg. 1 are based upon this information. From the surface downward, the various soil types are as follows:

FILL:

This artificial deposit extends from the existing road surface down to the original ground level which lies at approximate Elev. 274 feet on the north side of the tracks and at Elev. 272 feet to the south. This fill has been used locally to raise Hwy. 10 up to railway level. It consists of dry cinder and gravel fill ranging in thickness from 2 to 4½ feet. This in turn is underlain for the most part by stoney stiff sandy clay which contains some organic material. On the basis of cone penetration measurements, the cinder fill can be considered to be in a loose state.

UNIFORM FINE SAND:

This stratum represents the original surface layer in this area. It underlies the fill deposits described above and extends to approximate Elev. 271 feet on the south side of the tracks, and to Elev. 267 feet to the north. The top 6 to 12 inches of this sand consists of topsoil of the original ground surface.

Chemical analysis on samples of the topsoil from Holes No. 1 and 4 indicates an aggressive CO_2 content ranging from 32 to 23 p.p.m. The free sulphate content of the material from Hole No. 4 had a value of 3756 p.p.m. In all cases the topsoil was slightly acidic. The results on a sample of slightly organic sand, taken just above the topsoil level in Hole No. 3, showed much less severe conditions. It was concluded from this that the deleterious conditions were confined in and above topsoil level and that the underlying sand was not saturated with aggressive solutions.

A typical grading of the sand, for a sample at a depth of 10 feet in Hole No. 4, is shown in Dwg. 6. The penetration resistance of the sand north of the tracks increases sharply below the level of the topsoil. A value of the order of 30 blows per foot is considered to be representative.

The sand appeared wet and saturated at and below topsoil level and it is assumed that the ground water is perched in this material. The level of this perched water conforms therefore to the elevations of the adjacent ground surface north and south of the railway.

HARD BROWN CLAY

This material extends from Elev. 271 to 265.8 feet on the south side of the railway, and is almost non-existent to the north. It is an unstratified deposit with some gravel and therefore is assumed to be a till. It exists for the most part at a moisture content below the plastic limit although the top few inches of clay, in contact with the overlying wet sand, has been softened somewhat, as evidenced by the shear strength and moisture content measurements for a sample from a depth of 7 feet in Hole No.1. Neglecting this thin layer of softened clay, the representative values of some of the physical properties of this stratum are:

Undrained shear strength	6.3 to 6.6 k.s.f.
Liquid limit	28.4 to 46.8 % dry wt.
Plastic limit	17.1 to 22 % dry wt.
Natural moisture	14 to 16.6 % dry wt.
Natural unit weight	142 p.c.f.
Penetration resistance	approx. 24 blows per ft.

HARD GREY SANDY CLAYEY SILT:

This stratum probably represents the undessicated portions of the overlying brown clay, although it has a lower plasticity and a higher gravel content. Representative physical properties of this soil are as follows:

Undrained shear strength	6.2 to 6.9 k.s.f.
Liquid limit	25, decreasing with depth to 20% dry wt.
Plastic limit	14.6 to 13.5 % dry wt.
Natural moisture	10 to 13.5 % dry wt.
Natural unit wt.	143 to 150 p.c.f.
Penetration resistance	in excess of 40 blows per ft.

Large slabs or boulders of limestone were encountered in this stratum at a depth of about 20 feet or subway level. This till deposit lies between Elev. 266 and Elev. 253 ft. A representative grading is shown in Dwg. No. 6.

VERY DENSE SILTY SAND:

This material underlies the clayey silt till described in the foregoing section and extends to bedrock. It contains considerable coarse gravel and limestone boulders. Below about 30 feet, thick limestone slabs or boulders predominate. The penetration resistance of this soil was in excess of 50 blows per ft. The level of the ground water in this stratum was about 259.4 feet.

BEDROCK:

Bedrock, consisting of dense dark grey shale, was encountered at a depth of 35 feet, or Elev. 242.5 in Hole No.1. In hole 2, bedrock was found to consist of limestone with some interbeds of shale; it was intersected at a higher Elev. of 247.6 feet. It is probable that shale underlies this limestone at or near the same elevation as applies in Hole No.1. No bedrock was encountered in Holes 3 and 4, north of the tracks, although numerous limestone slabs or boulders were intersected.

Foundation Considerations

Proposed construction at this site involves the excavation of soil to a depth of about 20 feet below present railway level, and the installation of retaining structures to support the earth walls of the resulting cut.

In view of the very hard nature of the cohesive till which predominates this site, no difficulties should be encountered in the performance of this work. However, some of the observations and comments of the following paragraphs may be of some assistance in the preparation of the design for the structure.

The initial stages of the project involve an excavation through the fill, sand and till deposits down to approximate elevation 260 feet. Below Elev. 267 feet, the soil will be quite dry, dense and free of ground water difficulties. Above this level, however, some difficulties may be experienced when excavating through the overlying sand encountered north of the tracks. On the basis of water level observations in an uncased hole to 10 feet, adjacent to Hole No. 4, and of examinations of samples of this sand, the water table in this stratum is estimated to be Elev.275.5 feet. This corresponds approximately to the level of the adjacent ground surface to the north. Since the lower level of this sand is at Elev. 267 feet, the early stages of subway construction will involve an excavation approximately 8½ feet below the free water level in this sand. As a consequence, the sand can be expected to become unstable unless measures are taken to lower the ground water prior to excavation.

This dewatering north of the tracks can be accomplished by means of a well point installation or by pumping from gravel-filled sumps. In the former case each unit should be surrounded by a filter of medium grained sand in order to avoid clogging of the screens. The suggested procedure for the latter method of drainage is to excavate a trench to the bottom of the sand along each side of the highway just beyond the limits of the subway cut. This trench should be backfilled immediately, as earth is removed, with a free-draining coarse sand or fine gravel to approximate Elev. 275 feet. As this free-draining sand is dumped in, the suction end of a sump pump should be lowered into the pit, to approximate elevation 267 feet. The suction end should be covered with a fine wire screen and one or two coarse burlap bags.

The advantage of this latter procedure is that the coarse sand or gravel filter will act as a free-draining support for the sand as the excavation work proceeds. No shoring should be required, except in the immediate vicinity of the travelled portions of the railway, since the natural sand, when drained, will stand on approximately $1\frac{1}{2}$ to 1 slopes. The width of the gravel trench should be about 4 feet; as subway excavation approaches the level of the clay till, this gravel should also assume a stabilized slope of $1\frac{1}{2}$ to 1.

At Elev. 260 ft., the abutment and retaining wall footings will bear in the very hard clayey silt till. Since the moisture content of this material is below the plastic limit and its shear strength is in excess of 6000 p.s.f., a very high bearing capacity is available. The recommended safe bearing value to apply both on this till and on the overlying brown clay is 5 tons per square foot. The settlement associated with this pressure should be well within tolerable limits. No ground water difficulties should be encountered at this bearing level. The static ground water level in the underlying silty sand is at Elev. 259 ft.

During the period of construction, the face of the excavation in this till deposit should stand unsupported. Therefore, from the short term view, the horizontal earth pressure exerted by this clay against abutments and retaining walls should be negligible. The walls will be required only to support the horizontal thrust of the natural sand above the clay and of the gravel backfill installed between the concrete and the natural ground. It is assumed, in this instance, that this gravel fill will be drained so that hydrostatic pressures do not develop behind the wall.

From the long term view, however, the clay till should be expected to assume the shear strength characteristics of a granular soil. Although slow drained shear tests were not performed, it is suggested that the long term shear characteristics of the till will be expressed approximately by the effective strength parameter, - Cohesion $C' = 0$, and angle of internal friction $\phi' = 30°$. These values represent a conservative estimate for the gravel backfill or for the natural sand encountered north of the tracks.

Accordingly the active earth pressure coefficient, used in the design of retaining walls, will have a value of 0.33. The long term resistance to sliding along the contact between the till and the overlying retaining wall and abutment footings will be equal to N tan 30°, where N is the total normal load exerted by these footings.

Chemical analyses on samples of the original topsoil located some 4 to 6 feet below present ground surface showed that this material contains an excess of sulphates and aggressive Carbon-dioxide. This could be the result of gradual leaching of acid-forming compounds from the overlying coal and cinder fill. For static ground water conditions, a free CO_2 content of 20 p.p.m. is considered to be the maximum tolerable limit if deterioration of concrete is to be avoided. The results, in Table 2, contain one value in excess of this amount. The sulphate content is also considered to be very high in one instance. Therefore, it appears desirable to remove all materials above Elev. 272 feet, which may come into contact with concrete or steel. The sand underlying the topsoil at the north end of the site does not seem to be contaminated with these deleterious constituents. Precautions should be taken to obtain a dense good quality concrete since this will provide long term resistance to deterioration.

Summary of Comments

The foregoing observations and comments can be summarized briefly as follows:

1. The proposed underpass of the Canadian National Railway will involve excavations, for the most part, in very hard sandy clayey silt glacial till. The estimated safe bearing value of this material is 5 tons per square foot.

2. In the north half of the site, this till is overlain, to Elev. 267 feet, by wet fine sand which may cause excavation difficulties if water is not drained from it beforehand. Suggested procedures for accomplishing this are discussed in the report. This water may be considered as perched above the till. The ground water table in the silty sand material which underlies the clayey silt till, is at Elev. 259.4 ft.

3. The clayey silt till should stand unsupported during and for a considerable period after construction. However, from the very long term view, it is reasonable to assume that it will assume the characteristics of a granular soil. Suggested values for effective shear strength and active earth pressure coefficient have been given.

4. The estimated stratigraphy at this site has been shown in Dwg. 1. All material above Elev. 272 feet should be removed since some of it is deleterios to concrete.

REGISTERED PROFESSIONAL ENGINEER
CIVIL
W. A. TROW
PROVINCE OF ONTARIO

W. Trow

William A. Trow (P. Eng.)

WAT/lt
April 30 1959
J 367

WILLIAM A. TROW AND ASSOCIATES

TABLE NO. 1
SUMMARY OF LABORATORY TEST MEASUREMENTS

Elev. Feet	Shear Strength K.S.F. and Natural Unit Wt. p.c.f. Hole 1	2	3	4	Natural Moisture % dry Wt. Hole 1	2	3	4	Atterberg Lts. % Dry Wt. Hole 1	2	4
275											
274											
273		γ = 110			10.3						
272								43.7			
271	1.18 (γ=127.2)	γ=132			25.7			(organics)	LL=33.8 PL=20.4		
270					16.1		21.2				
269							(sand)				
268	6.26*				14.4						
267	(γ=142)					16.6				LL=46.8 PL=21.75	
266	6.6				14.0				LL=28.4 PL=17.1		
265	(γ=143)	6.88 (γ=150.4)	6.20 (γ=144.3)			11.4	12.1				
264					10.6			12.0			LL=25.1 PL=14.6
263											
262					10.6		11.4				
261				γ=143.3		13.5		12.4			LL=22.8 PL=13.5
260					10.8				LL=22.7 PL=14.5		
259		6.4 (γ=149)				10.2	12.9			LL=20.5 PL=14.7	
258					9.8				LL=19.6 PL=13.9		
257											
256					9.4			11.3			
255						12.3		10.6			
254					7.4						
253							8.8				
252											
251						9.9					
250								6.9			
249							8.8				

NOTES: All results except where noted represent undrained triaxial test measurements performed at a cell pressure of 10 p.s.i.

* – Unconfined compression test.

TABLE NO. 2

SUMMARY OF CHEMICAL ANALYSIS

Hole No.	Depth	Description	pH	Sulphates at SO_3 ppm	Free CO_2 ppm
1	4 - 6	Wet organic sandy topsoil	5.89	563	23
3	4½- 6	Moist slightly organic fine sand	6.71	8	10
4	6 - 7½	Wet organic sandy topsoil	6.80	3756	32

PROJECT NO. J367

DRAWING NO. 2

WILLIAM A. TROW AND ASSOCIATES

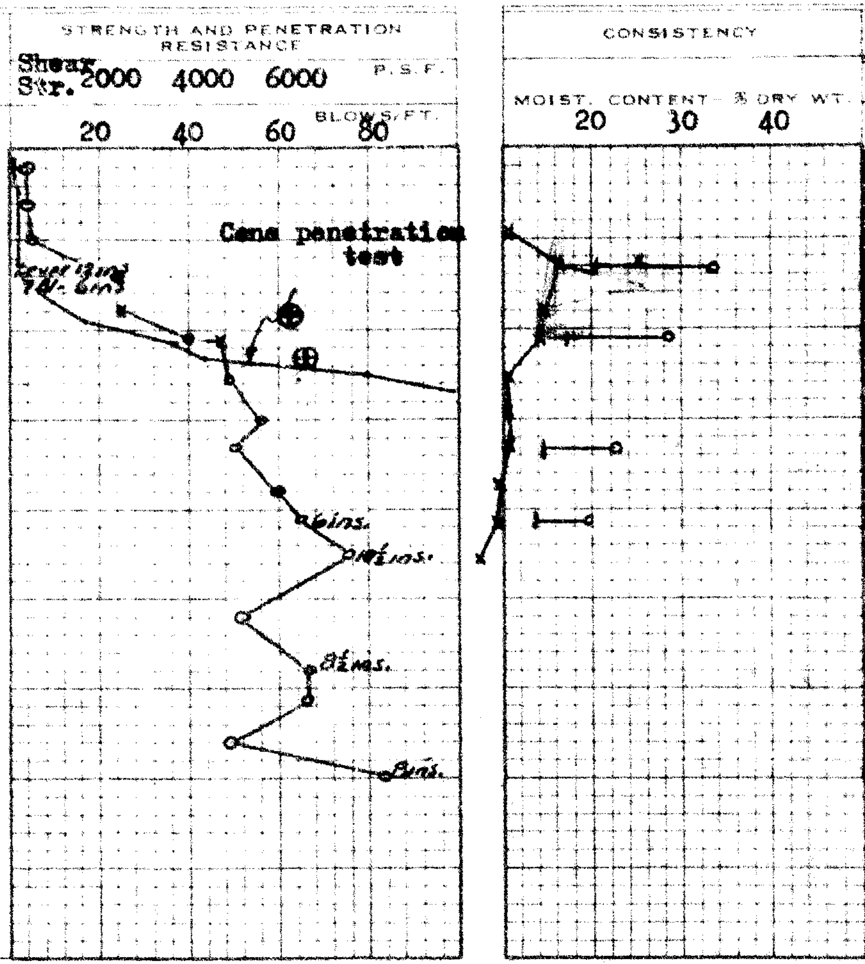
SITE INVESTIGATIONS AND SOIL MECHANICS CONSULTATION

LEGEND
- 2" DIA. SPLIT TUBE
- 2" SHELBY TUBE
- 2" SPLIT TUBE
- 2" DIA. CONE
- CASING
- 2" SHELBY
- 1/2 UNCONFINED COMPRESSION (Qu) ⊕
- VANE TEST (C) AND SENSITIVITY (S) +S
- NATURAL MOISTURE AND LIQUIDITY INDEX ×LI
- LIQUID LIMIT
- PLASTIC LIMIT

PROJECT C.N.R. Underpass Hwy. 10
LOCATION Port Credit, Ont.
HOLE LOCATION See Dwg. 1
HOLE ELEVATION AND DATUM 277.7

BOREHOLE NO. 1
FIELD SUPERVISOR WT
DRILLER
PREP. WT

DESCRIPTION	ELEV FEET	DEPTH FEET
Ground surface	277.7	0
Loose cinders (dry)	273.2	
Wet sandy topsoil (pieces of brick and cinders)	271.7	
Hard brown clay with some gravel	265.7	10
Hard grey sandy clayey silt with pebbles more sand and gravel sizes below 20 ft.	254.7	20
Very dense slightly cohesive silty fine sand with medium to coarse limestone gravel.	242.5	30
Bedrock: hard dark grey shale B core–poor recov. to 35.6; 88% recov. 35.6–40.3 ft.; (may have left core in hole)	237.4	40



SAMPLE	NATURAL UNIT WT. P.C.F.
S1	
S2	
S3	
S4	127.2
T5	142
S6	143
S7	
S8	
S9	
S10	
S11	
S12	
S13	
S14	
S15	
S16	
S17	

NOTES: 1) Hole by BX casing drilled to various sampling intervals.
2) Cone pene. test driven about 6 ft. to west at approx. El. 278.2
3) Observation well installed 4 ft. to west; 3 in. casing driven to seal in the clay at 10 ft.; casing filled to 6" above surface; water level after 5 mins. = elev. 277.6; stabilized within 28 hrs. @ el. 259.5 ft. (confirmed over 3 dy. period)

PROJECT NO. J367

DRAWING NO. 3

WILLIAM A. TROW AND ASSOCIATES

SITE INVESTIGATIONS AND SOIL MECHANICS CONSULTATION

LEGEND

- 2" DIA. SPLIT TUBE
- 2" SHELBY TUBE
- 2" SPLIT TUBE
- 2" DIA. CONE
- CASING
- 2" SHELBY
- 1/2 UNCONFINED COMPRESSION (Qu)
- VANE TEST (C) AND SENSITIVITY (S)
- NATURAL MOISTURE AND LIQUIDITY INDEX
- LIQUID LIMIT
- PLASTIC LIMIT

PROJECT: C.N.R. Underpass Hwy.10

LOCATION: Port Credit, Ont.

HOLE LOCATION: See Dwg.1

HOLE ELEVATION AND DATUM: 278.3

BOREHOLE NO.: 2

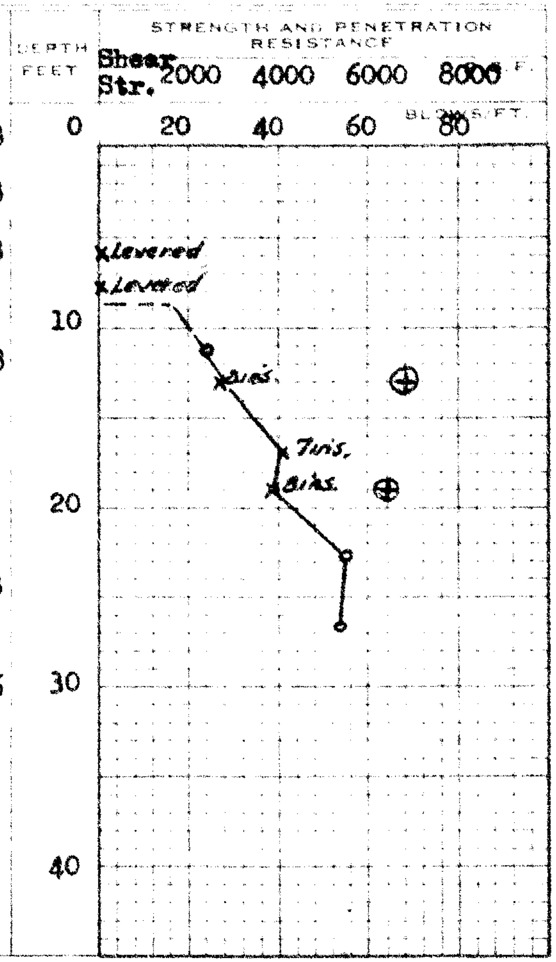
FIELD SUPERVISOR: WT

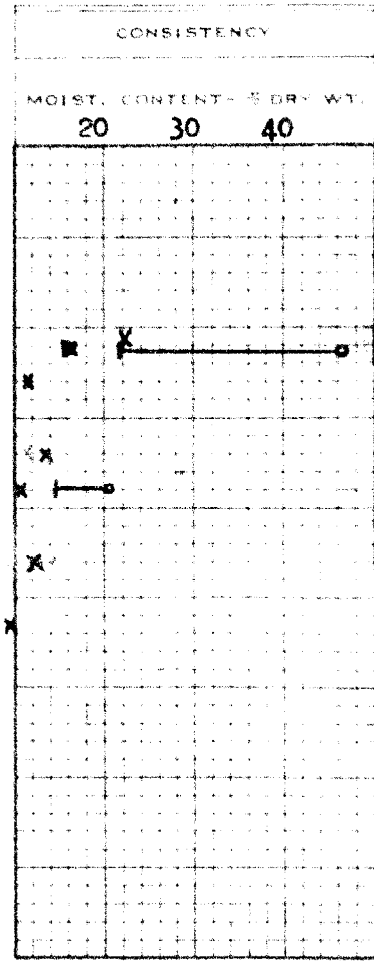
DRILLER:

PREP: WT

DESCRIPTION	ELEV. FEET
Ground surface.	278.3
Loose br.silt,sand & cinders	275.3
Stiff gr.clayey silt & sand & gravel Fill	273
Sandy topsoil brick fragments	272.3
Brown moist clayey silty fine sand	270
Hard brown clay with some pebbles	265.8
Hard grey sandy clayey silt with some gravel. Limestone gravel or slabs at least 2 ins.thick between 19.7 & 21 ft.	253.3
Very dense slightly cohesive silty sand with some gravel.	247.6
Bedrock: Hard limestone with some interbeds of dark grey shale. (81% recov.30.7 ft.to 35.2 ft.-B core)	243.1

NOTES: 1) Hole by BX casing drilled to various sampling intervals.
2) Water level after casing withdrawn = 5.8 ft.
Stabilized water level-5.6 ft.





SAMPLE	NATURAL UNIT WT. P.C.F.
T1	110
T2	132
S3	
T4	150.4
T5	149
T6	
S7	
S8	

PROJECT NO. J 367

DRAWING NO. 4

WILLIAM A. TROW AND ASSOCIATES

SITE INVESTIGATIONS AND SOIL MECHANICS CONSULTATION

LEGEND
- 2" DIA. SPLIT TUBE
- 2" SHELBY TUBE
- 2" SPLIT TUBE
- 2" DIA. CONE
- CASING
- 2" SHELBY
- 1/2 UNCONFINED COMPRESSION (Qu)
- VANE TEST (C) AND SENSITIVITY (S)
- NATURAL MOISTURE AND LIQUIDITY INDEX
- LIQUID LIMIT
- PLASTIC LIMIT

PROJECT .CN.R. Underpass Hwy.10

LOCATION Port Credit, Ont.

HOLE LOCATION See Dwg.1

HOLE ELEVATION AND DATUM 279.5

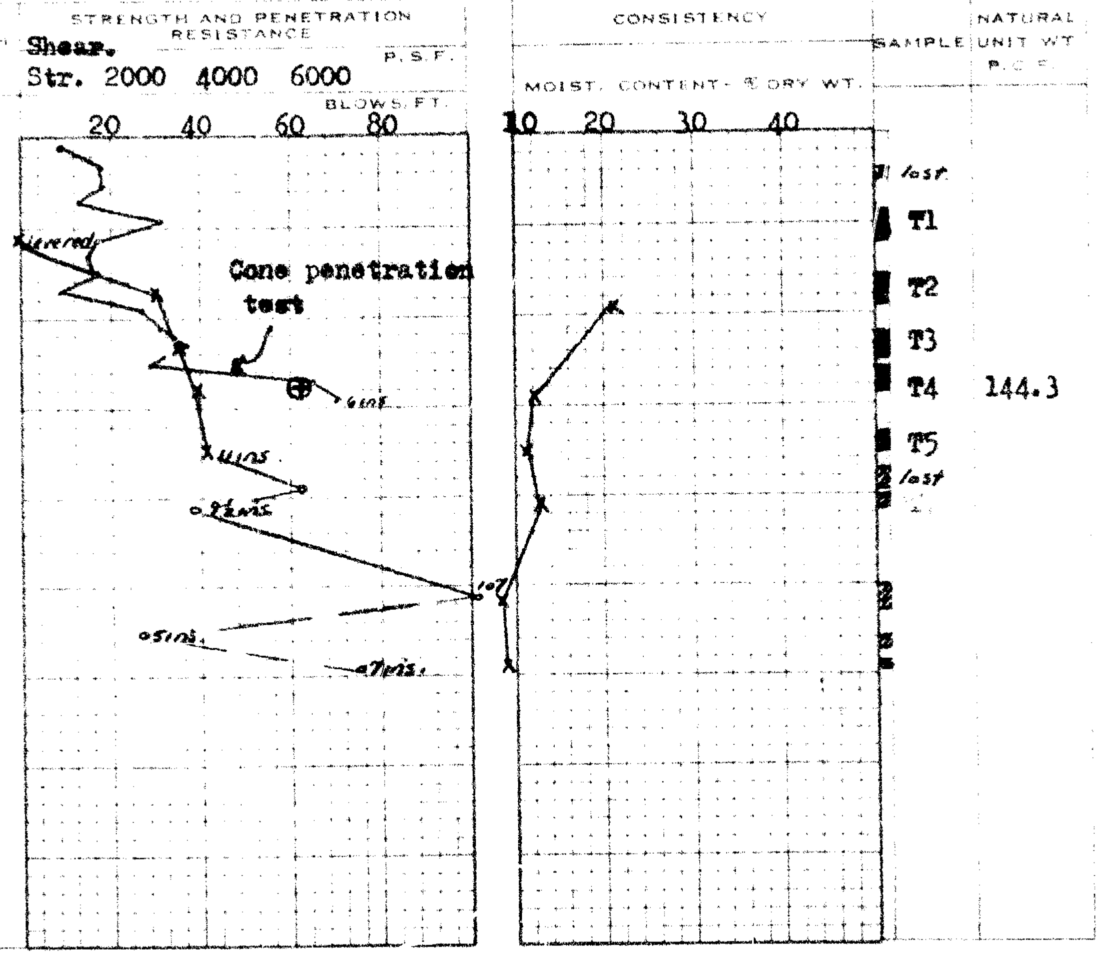
BOREHOLE NO. 3

FIELD SUPERVISOR WT

DRILLER

PREP WT

SYMBOL	DESCRIPTION	ELEV. FEET	DEPTH FEET
	Ground surface	279.5	0
	Cinders & gravel up to 3 ins.	277.5	
	Stiff to very stiff br.clay fill-some organic material & gravel	275.5	
	Moist to wet uniform fine sand some sandy topsoil at 6 ft.	273	
		267	10
	Hard grey sandy clayey silt with gravel. Limestone gravel or slabs up to 5 ins.thick 21.2 - 22.2 ft.		20
		254.5	
	Dense slightly cohesive silty sand with coarse gravel. Limestone boulders or slabs below 28.5 ft. Drilled 32.9 ft.to 37.8 ft.through limestone boulders in glacial till; drill on partial pressure - not bedrock.		30
		241.7	40



NOTES: Installed porous piezometer in drill hole; hole filled with sand and gravel to 23 ft; bentonite seal in unlined borehole - 17-19 ft; Water level stabilized within 4 dys. at El.259.4 ft. (confirmed over 3 dy. period)

PROJECT NO. J 367

DRAWING NO. 5

WILLIAM A. TROW AND ASSOCIATES

SITE INVESTIGATIONS AND SOIL MECHANICS CONSULTATION

LEGEND
- 2" DIA. SPLIT TUBE
- 2" SHELBY TUBE
- 2" SPLIT TUBE
- 2" DIA. CONE
- CASING
- 2" SHELBY
- 1/2 UNCONFINED COMPRESSION (Qu)
- VANE TEST (C) AND SENSITIVITY (S)
- NATURAL MOISTURE AND LIQUIDITY INDEX
- LIQUID LIMIT
- PLASTIC LIMIT

PROJECT C.N.R. Underpass Hwy.10

LOCATION Pt. Credit Ont.

HOLE LOCATION See Dwg.1

HOLE ELEVATION AND DATUM 279.3

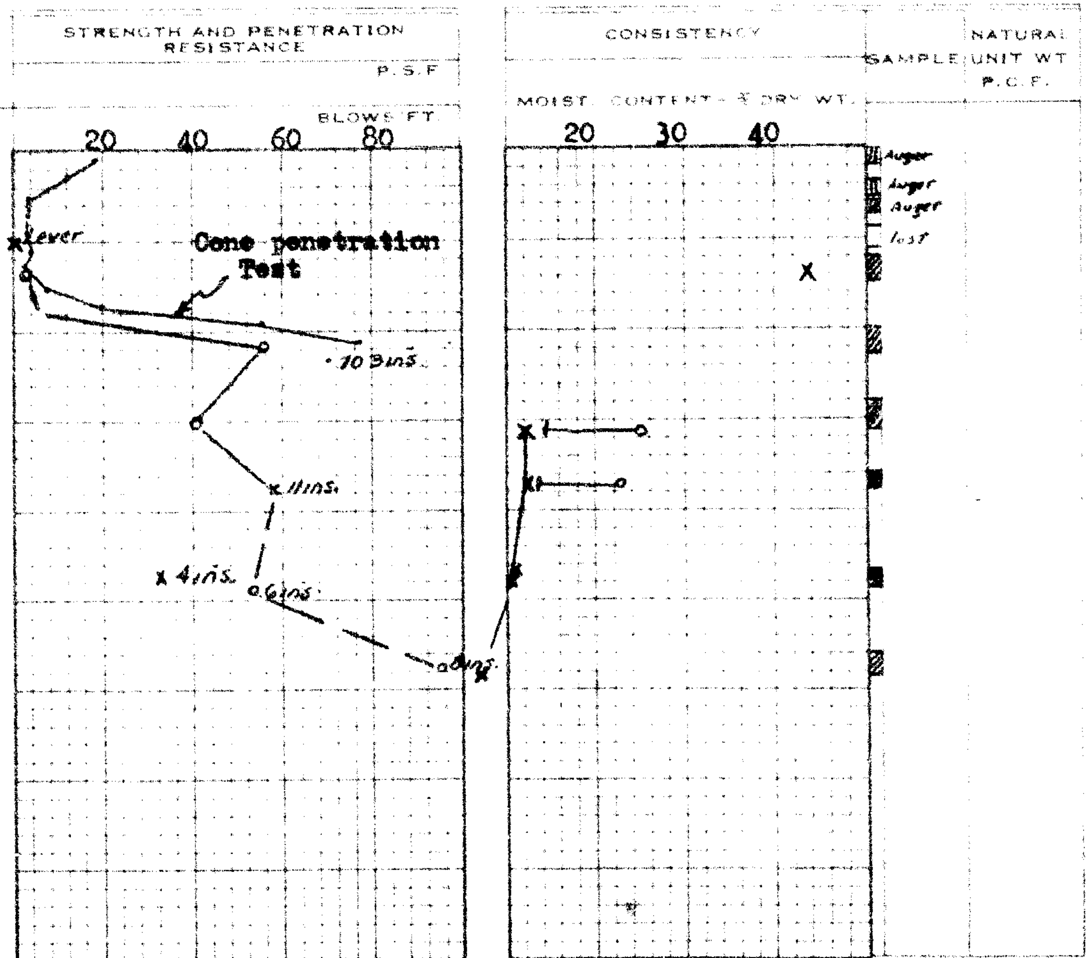
BOREHOLE NO. 4

FIELD SUPERVISOR WT

DRILLER

PREP. WT

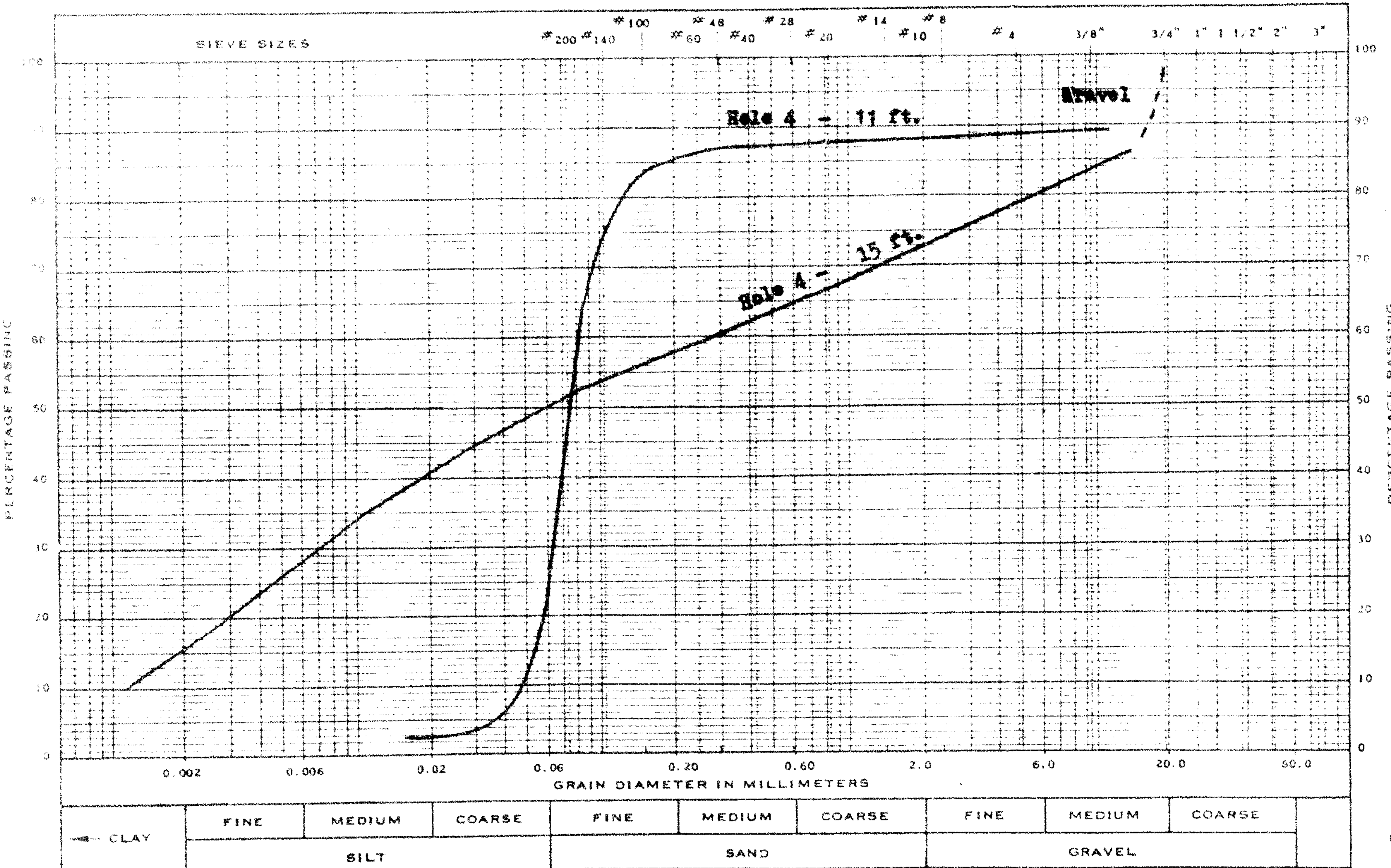
SYMBOL	DESCRIPTION	ELEV. FEET	DEPTH FEET
	Ground surface	279.3	0
	Dry cinders	276.3	
	Dense br. sandy clay fill with large gravel	274	
	Wet clayey sand topsoil becoming wet brown uniform fine sand	267	10
	Very stiff brown clay	266	
	Hard grey sandy clayey silt with gravel – coarser gravel and boulders below 19 ft.	253	20
	Very dense slightly cohesive silty sand with gravel. Numerous limestone slabs and boulders below 30 ft.	242.2	30
			40



NOTES: 1) Dug test pit through cinders and clay fill to 4.9 ft. adjacent to hole – dry and hard with gravel at 4.9 ft.

2) Drove 3 in. pipe to depth 10 ft. washed out and withdrew. Immediate water level – 3.1 ft.; water level after 30 hrs. – 3.5 ft. or Elev. 275.8

MECHANICAL ANALYSIS



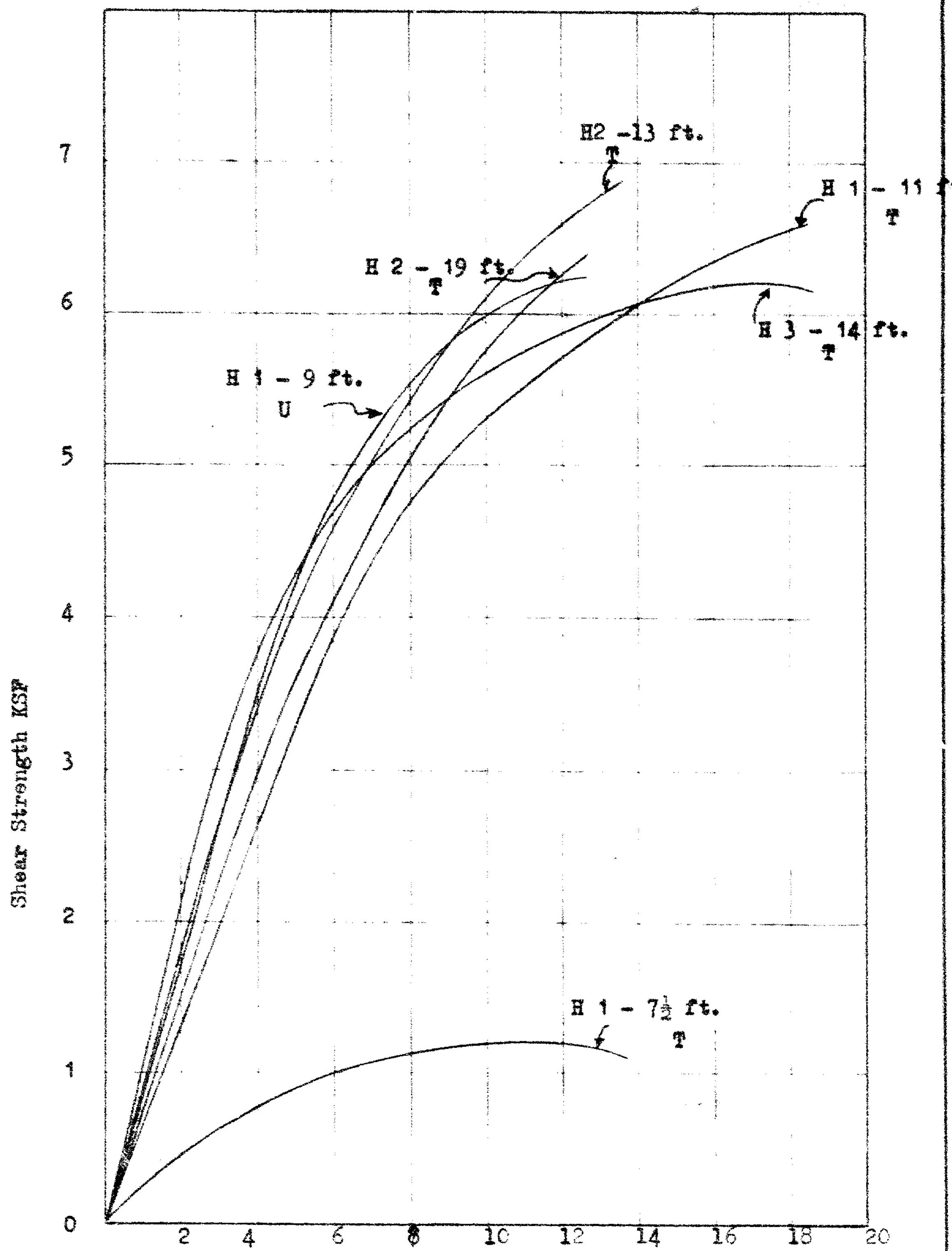
MODIFIED M.I.T. CLASSIFICATION

GRAIN SIZE DISTRIBUTION CURVES - PT. CREDIT UNDERPASS

Project J367

WILLIAM A. TROW AND ASSOCIATES

Dwg. #6



LEGEND: T - Undrained triaxial
at σ_3 = 10 psi
U - Unconfined test

STRESS STRAIN CURVES FOR UNDRAINED TRIAXIAL AND UNCONFINED TESTS ON SAMPLES OF TILL NEAR FOUNDATION LEVEL

WILLIAM A. TROW AND ASSOCIATES

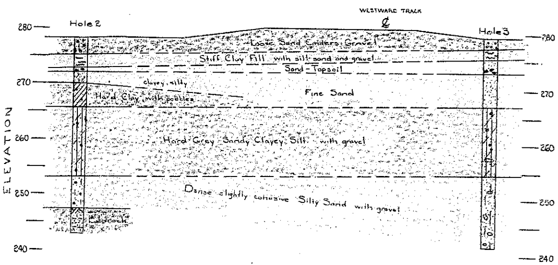
#59-F-266C

W.P. 101-58

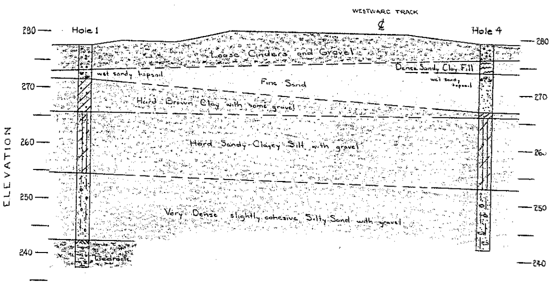
HWY #10

C.N.R

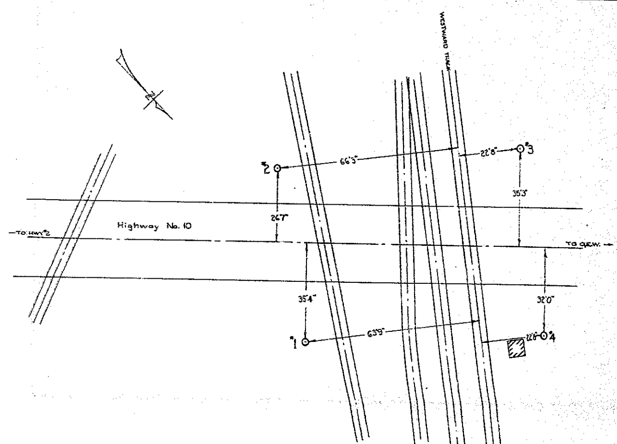
UNDERPASS



Projected Soil Profile
Scales: Hor. 1" = 12' Vert. 1" = 10'



Projected Soil Profile
Scales: Hor. 1" = 12' Vert. 1" = 10'



Sketch Showing Borehole Locations

HIGHWAY No 10 UNDERPASS OF THE
CANADIAN NATIONAL RAILWAYS