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DIST. 4 REGION

W.P. No. 40-74-05 / 40-74-08

CONT. No.

W. O. No.

STR. SITE No. 1-138
1-179

HWY. No. B. S. A. R.

LOCATION Eastward Creek
Culverts

No of PAGES - —

OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT.

REMARKS:

Ontario
Department of Transportation and Communications

MEMORANDUM

TO: Mr. B. R. Davis,
Bridge Engineer,
Bridge Office,
Admin. Bldg.

FROM: Foundation Section,
Room 107, Lab. Bldg.

ATTENTION: Mr. S. McCombie

DATE: June 18, 1971

OUR FILE REF.

IN REPLY TO June 23, 1971

SUBJECT:

40P1-50
GEOCRES No.

FOUNDATION INVESTIGATION REPORT
For
The Proposed Eastward Creek Culvert
Along the
Future Brantford Expressway No. 2
City of Brantford
District No. 4 (Hamilton)
W.O. 71-11022 -- ~~W.P. 70-68-04 (06,09,07)~~
NEW WP: 40-74-05 AND 08

Attached, we are forwarding to you our detailed foundation investigation report on the subsoil conditions existing at the above structure site.

We believe that the factual data and recommendations contained therein, will prove adequate for your design requirements. Should additional information be required, please feel free to contact our Office.

A. G. Stermac
PRINCIPAL FOUNDATION ENGINEER

AGS/MdeF
Attach.
cc: Messrs. B. R. Davis
F. G. Allen
D. W. Farren
W. Zonnenberg
C. R. Robertson
A. P. Watt (2)
J. Roy
B. J. Giroux
B. A. Singh
M. M. Dillon (Galt) - A. Kobelak
Foundations Files
Gend Files

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FOUNDATION INVESTIGATION REPORT
For
The Proposed Eastward Creek Culvert
Along the
Future Brantford Expressway No. 2
City of Brantford
District No. 4 (Hamilton)
W.O. 71-11022 -- W.P. 70-68-04
(06;09;07)

1. INTRODUCTION:

The Foundation Section was requested by Mr. A. P. Watt, Regional Bridge Planning Engineer, Southwestern Region, to carry out foundation investigations at the sites of several crossings, retaining walls and the Eastward Creek culvert, in conjunction with the proposed Brantford Expressway #2. The request was submitted in a memo, dated March 17, 1971.

In this report the foundation investigation along the proposed Eastward Creek culvert (W.P. 70-68-04) is discussed. As was agreed subsequently by Mr. Watt, this report includes the proposed T.H. & B.R. overhead structure at the Murray-Mohawk Ramp (W.P. 70-68--6), the T.H. & B.R. overhead at the Expressway crossing (W.P. 70-68-09) and two retaining walls, proposed to be built integral with the culvert (W.P. 70-68-07).

In the following sections the field and laboratory investigations are outlined and recommendations are given for the foundations of the individual structures.

2. DESCRIPTION OF THE SITE:

The easterly, approx. 900-ft. length of the proposed creek diversion runs near the existing Mohawk Canal, which is to be abandoned and filled. The vicinity along this section of the canal is wasteland, having been used as a dumping site for waste products of the Massey-Ferguson plant. The middle, roughly 1,800 ft.

2. DESCRIPTION OF THE SITE: (cont'd.) ...

long section of the culvert will be situated immediately north of the proposed expressway. This portion of the area is a residential zone of the City of Brantford, occupied mainly by single family units.

The westerly 700-800 ft. or so, follows the abandoned railway line, crossing Alfred Street, just north of the existing bridge.

The inlet and outlet portions of the Eastward Creek are designed to be open channels, as indicated on the attached drawings.

3. FIELD AND LABORATORY INVESTIGATIONS:

The field investigation consisted of some 26 sampled boreholes and 22 dynamic cone penetration tests. Boreholes were implemented by using one continuous hollow stem auger and one conventional diamond drill rig adapted for soil sampling purposes. Soil specimens were secured at frequent intervals by means of split-spoon and thin-walled 2" dia. Shelby tube samplers. Split-spoon samplers were advanced by the Standard Penetration technique, penetration 'N' values having been recorded on the borelogs. Shelby tubes were pushed into the soil, either manually or hydraulically. Field vane tests were performed at those depths where the consistency of the cohesive deposits permitted.

All the samples were shipped to the Department of Transportation and Communications laboratories, where they were again identified and recorded. The subsequent laboratory testing program consisted of natural moisture contents, Atterberg limits and grain-size analyses. Representative samples were further tested in order to determine unconsolidated, undrained shear strength parameters and consolidation characteristics. On undisturbed samples, taken from the proposed open cut locations, consolidated, undrained triaxial tests were carried out with pore pressure measurements using the stage loading method.

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3. FIELD AND LABORATORY INVESTIGATIONS: (cont'd.) ...

Laboratory and field test results are compiled on the accompanying borelog sheets, while the locations and elevations of the borings are shown on Drawing #71-11022A, B, C & D in the Appendix.

4. SOIL CONDITIONS:

4.1) General:

The various soil strata encountered in the boreholes along the proposed Eastward Canal were identified to be as follows: mixed fills, sands, silty sands and gravelly sands, irregularly stratified silts, clayey silts and silty clays, and the bottom layer of the overburden, consisting of silts and clayey silts with occasional gravel. Since the soils were described at length in our Preliminary Foundation Report (W.J. 68-F-64), a brief summary only, is given under the forthcoming paragraphs.

4.2) Mixed Fills:

The easterly, approx. 500-ft. length of the proposed canal crosses the area adjacent to the Mohawk Canal, where the surficial deposit was found to be a mixed fill, consisting essentially of the waste products of the Massey-Ferguson plant. The material is black in colour, largely fine-grained, containing, however, chunks of slag and cinders and other debris. The depth of this layer varies between 6 ft. and 14 ft. Penetration 'N' values were measured to be between 4 blows per ft. and 17 blows per ft.

4.3) Silty Sands, Sandy Silts, Gravelly Sands, etc.

Underlying the fill along the east end, and right below ground level along the largest portion of the line, a granular deposit, consisting predominantly of fine sand was noted. East of Murray St. at the high ground, however, the sands are covered with a 10 - 20 ft. thick clayey silt deposit. The grain-size distributions of the granular soils are quite varied, but all the

4. SOIL CONDITIONS: (cont'd.) ...

4.3) Silty Sands, Sandy Silts, Gravelly Sands, etc.: (cont'd.) ...

samples exhibited quick dilatancy, thus they are highly susceptible to conditions of unbalanced hydrostatic heads. The silty fine sand and the sandy silt portion of this deposit is considered to be the most treacherous material from the engineering point of view, when situated under water. The lower boundary of the purely granular material lies around the bottom of the proposed culvert footing, or a few feet above this elevation.

Typical grain-size curves of the granular soils are presented on Fig. #1 in the Appendix.

4.4) Irregular Seams of Silts, Clayey Silts and Silty Clays:

Underlying the granular deposit, a stratified stratum of silts, clayey silts and silty clays with occasional seams and pockets of sand, forms the main body of the overburden. This 40 - 70 ft. thick deposit is generally cohesive; however, it is to be emphasized that 'boilings' and 'blow-outs' occurred in the boreholes within some sand layers and pockets. The stratification of the materials is usually horizontal. In some locations the laminae are fairly regular, but in most cases, seams were found to be in a random order, varying in thickness and frequency of occurrence. The undrained shear strengths of the deposit were determined by field vane, laboratory unconfined and quick triaxial tests. In evaluating the tests, it was noted that the field vane test results were somewhat too high, likely on account of the high silt content of the layers. Average values were calculated for each individual structure, and along sections of the proposed culvert. Mean values used varied between 1,250 PSF and 1,500 PSF.

Grain-size curves of the clayey silt and silty clay portions of the stratified stratum are shown on Figs. #2 and #3, whereas all the undrained shear strength results are combined for the various sections and structures on Figs. #4, 5, 6, 7 and 8.

4. SOIL CONDITIONS: (cont'd.) ...

4.4) Irregular Seams of Silts, Clayey Silts and Silty Clays: (cont'd.) ...

Consolidated undrained triaxial tests were performed on two representative samples, taken from the locations of the proposed East and West end open channel sections. Tests were performed in order to obtain shear strenth parameters in terms of effective stresses, by using stage loading techniques. Tests resulted in $C' = 0$ and $\phi' = 29.9^{\circ}$ at the East end open channel and $C' = 185$ PSF and $\phi' = 27.8^{\circ}$ at the West.

4.5) Silts and Clayey Silts:

In some of the boreholes around el. 610 - 620 ft., a silt to clayey silt layer was encountered, having very stiff to hard consistency, with penetration 'N' values ranging from 20 blows per ft. to as high as 90 - 100 blows per ft. Lower penetration resistances obtained in this stratum were considered to be caused by the loosening effect of the hydrostatic uplift pressures. Very little stratification was observed in the silt, and it contained occasional grains of gravel and pebbles, hence this layer is likely a glacial deposit.

Fig. #9 shows typical grain-size curves of this material.

4.6) Bedrock:

Some of the boreholes were advanced down to reach the bedrock surface, which was assumed to be at those elevations where definite bouncing of the drill rod was noted. The bedrock surface was observed to have a slight dip eastward, being established around el. 593 - 600 ft. at the West end of the investigated line, and roughly at 577 - 582 ft. at the East. Since the bedrock had been proved during previous investigations, no diamond drilling was carried out at this time. The underlying bedrock is known to be almost pure dolomite of the Lockport formation.

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5. GROUNDWATER CONDITIONS:

Groundwater levels were measured in each borehole during the field investigation. Observations were made for several days and the equilibrium water levels recorded. These levels are plotted on the respective borelogs. The water level generally lies some 4 - 8 ft. below ground level, corresponding to elevations between 652 ft. and 662. ft. In boreholes placed east of Murray St. on the high ground (B.H.'s #13, 14, 28 and 29), however, water levels were found to be some 20 - 23 ft. below ground level, around el. 667 ft. - 673 ft., indicating a hydrostatic gradient towards the lower ground.

The water level of the Mohawk Canal was at el. 652.2 ft. at the West end, and at el. 652.03 ft. at the East.

6. DISCUSSION AND RECOMMENDATIONS:

6.1) General:

As was mentioned earlier, this report deals with the foundation problems concerning (a) the proposed Eastward Canal and culvert, (b) the T.H. & B.R. overhead at the expressway crossing, (c) the T.H. & B.R. overhead at the Murray-Mohawk ramp and (d & e) two retaining walls, proposed to be monolithic with the culvert.

Subsoils along the investigated line may be summarized to consist of sandy silts to silty sands, underlain by stratified silts, clayey silts and silty clays. Under the East portion of the line, considerable fill of cinders and slag was encountered.

General comments and recommendations - applicable to all structures in question, are given under the next subsection, followed by recommendations for the individual structures.

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6. DISCUSSION AND RECOMMENDATIONS: (cont'd.) ...

6.2) General Comments and Recommendations:

6.2.1) Earth Pressures:

Culverts should be designed to resist vertical pressures developed on the top of the culvert, due to the weight of soil and possible live load. Adjacent to the culvert, a downward force (drag) will develop in cases where settlement will be less under the culvert than under the soil adjacent to it. For computation of this force, a friction resistance coefficient of $\mu = \tan 30^{\circ}$ should be used for the drag of soil (granular type backfill) against concrete, and $\mu = \tan 35^{\circ}$ for the drag of soil against soil above the culvert. The coefficient of earth pressures at rest is assumed to be $K_o = (1 - \sin \phi) = 0.5$ (Jáky, 1938). The same values may be used for designing the retaining walls integral with the culvert. For the wall stability, a coefficient of active earth pressures $K_a = \tan^2 (45^{\circ} - \frac{\phi}{2}) = 0.35$ is suggested. For calculating critical bending moments in the culvert walls and slab, values of K_o max. = 1.0 and K_o min. = 0.4 may be used. In calculating the factor of safety against sliding along the base for retaining walls integral with culverts lying within the sands and sandy silts, a coefficient of friction $\tan \phi = 0.40$ may be assumed; within the cohesive strata (clayey silt, layers of silt, clayey silt and silty clay), an adhesion value of C_{adh} = 1,250 PSF may be employed. The surface of the cohesive material should be roughened before the concrete base is placed.

6.2.2) Dewatering of Excavations:

The prevailing groundwater levels during the field investigation, are marked on the soil profiles. Seasonal fluctuation of the water surface is anticipated within one calendar year.

Excavations above the water level will involve no problems, and all the soils encountered will be stable for a limited time with 1 horizontal to 1 vertical slopes.

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6. DISCUSSION AND RECOMMENDATIONS: (cont'd.) ...

6.2) General Comments and Recommendations: (cont'd.) ...

6.2.2) Dewatering of Excavations: (cont'd.) ...

Excavations below the water level, within the clayey silts and silty clays, are expected to cause no special problems on account of the low permeability of these soils. Conventional open pumping will suffice for the removal of the accumulated seepage water. Excavations within the sands and silts, however, will require some dewatering scheme, since these soils will become unstable and will 'boil' under the uplift pressure of the unbalanced hydrostatic head. In order to prevent 'quick' conditions of the soils, oversize excavations may be constructed as shown on Fig. #10. This method would involve an initial gradual pumping, with final pumping confined to the shallow ditches around the bottom of the excavation. The side slopes should be cut as steep as possible, and the rate of pumping should be such, that the sides of the excavations do not slough in.

Excavations within the above mentioned cohesionless deposits may also be carried out with vertical walls within the protection of interlocking sheet piles. Sheeting should be driven to a distance below the bottom of the excavation equal to, or greater than the distance of the water level above it, to prevent 'boiling'.

It appears, however, that along its entire length, the bottom of the culvert excavation will be either in the cohesive soils or just a short distance above the cohesive layers. In the latter event, due to the relatively impervious nature of these materials, sheet pile penetrations can be reduced, according to the formula given on Fig. #11. The formula may be used only in those cases where the length of the sheeted excavation is at least 4 times larger than the excavation width.

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6. DISCUSSION AND RECOMMENDATIONS: (cont'd.) ...

6.2) General Comments and Recommendations: (cont'd.) ...

6.2.3) Foundations in the Vicinity of Utilities:

Several existing utilities cross the sites of the proposed culvert and structures.

The locations of these sewers and utilities must be taken into consideration when decisions are made regarding the type of foundation to be employed - i.e., spread footings or piles. Our recommendations pertaining to spread footings are, of course, valid only for footings placed in undisturbed original ground. Where piles are to be driven adjacent to existing utilities, special precautions must be taken to ensure that no damage results. We suggest that the following procedure be adopted:

(1) Where piles will be 12 feet or more from the edge of a utility, no special precautions need be taken.

(2) All piles closer than 12 feet from a utility should be prebored to a depth of 6 ft. below the pipe bottom. The size of the augered hole need only be slightly larger than the pile section.

(3) Where holes are augered in non-cohesive subsoil, casing may be required to prevent the holes from caving in.

6.3) Eastward Canal:

6.3.1) Open Channel Sections:

The inlet and outlet portions of the Eastward Canal are proposed to be built as open channels. Subsoils at the upstream open channel were found to consist of a 10 - 15 ft. thick silty sand and sandy silt deposit, followed by clayey silt to silt with occasional seams of silty clay. At this location the bottom of the proposed channel will lie within the clayey silts. At the location of the downstream open channel, slag and cinder fill covers the area,

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6. DISCUSSION AND RECOMMENDATIONS: (cont'd.) ...

6.3) Eastward Canal: (cont'd.) ...

6.3.1) Open Channel Sections: (cont'd.) ...

the thickness of which varies between 2 ft. and 15 ft. Below the fill a fairly thick layer of sand, silt and gravel was found. At this end of the line the channel bottom will likely be in the granular deposits. No overall stability problems are anticipated for the proposed 1-1/2 horizontal to 1 vertical slopes; however, constant maintenance will be required, to eliminate surface erosion, especially within the fills. It is suggested that a protective filter blanket, consisting of a min. 12-inch thick layer of G.B.C. type 'A' material be provided on the slopes, at least up to the flood level, to prevent piping caused by seepage, and consequent sloughing, and to minimize the necessity for maintenance. On the streambed, and at certain locations on the banks, some rip-rap might be required to prevent erosion; the Hydrology Section should be consulted concerning this.

6.3.2) Culvert Sections:

A double box culvert is proposed for the stream diversion at the East end, between the open channel and the proposed railway tunnel, for a length of approx. 250 ft. The same solution will apply between the two proposed railway overheads, roughly for a distance of 560 ft. At the West end, adjacent to the open channel, the box culvert will be around 580 ft. long.

The bottom of the culvert will be placed between el. 642 ft. and 644 ft. Spread footings at the above elevations may be designed with allowable net bearing pressures of 1.3 TSF. No settlements are foreseen under the culvert, provided they are constructed on undisturbed soils.

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6. DISCUSSION AND RECOMMENDATIONS: (cont'd.) ...

6.4) T.H. & B.R. Overhead at the Expressway Crossing - (Structure #8):

Around Station 170+00, the proposed expressway will cross the T.H. & B. railway with an overhead structure. The crossing is designed to be a combined structure, the railway tunnel being constructed at the top of the culvert as a monolithic unit. The base of the structure will be around el. 642 ft. It is anticipated that the bottom of the excavation will be partially in the sands and partially in the clayey silts as shown on the profile of Drawing #71-11022D.

In contemplating a spread footing type of foundation, the net safe bearing capacity of the subsoils, right below the footing elevations may be assumed to be 1.25 TSF. If the structure can economically be designed to keep the pressures within this limit, then spread footings may be constructed.

Alternatively, the structure may also be supported on end-bearing steel H-piles, driven to refusal either on bedrock or on the hard glacial till, right above the rock. Refusal of pile penetration is expected to be reached around el. 575 - 580 ft. Safe design loads equal to the full structural strength of the pile section used may be employed on such piles.

Consideration may also be given to a friction pile type foundation, employing timber piles embedded within the stratified stratum. Calculations indicated that - e.g., a 12-inch diameter timber pile with an embedded length of 45 ft., will support safe loads of 20 tons per pile. A full-scale pile loading test should be carried out prior to adopting such friction pile foundations.

The expressway embankment at the railway crossing will be as high as 30 - 32 ft. Settlement computations, based on laboratory consolidation tests, and using a reduction factor due to overconsolidation (Skempton & Bjerrum, 1957), resulted in consolidation settlements of approx. 10 inches. Since the fill will be supported laterally be retaining walls and not by slopes,

6. DISCUSSION AND RECOMMENDATIONS: (cont'd.) ...

6.4) T.H. & B.R. Overhead at the Expressway Crossing - (Structure #8): (cont'd.) ...

it is anticipated that, almost the full amount of settlement will be differential at the entrance location. If the structure is designed to be supported on spread footings, the culvert will have to be so constructed, that it withstands this approx. 10-inch differential settlement at the tunnel entrances. By employing end-bearing steel H-piles, settlements of the structure itself can entirely be eliminated.

Stability analyses, in terms of total stresses, were carried out for the embankment, by an electronic computer. The geometry of the fill was input with 2 horizontal to 1 vertical slopes, and also with retaining walls at both sides. In the latter case, failure was assumed to take place below the footing of the walls along a circular arc. Both computations resulted in acceptable factors of safety, thus no berms will be required for embankments up to 32 ft. heights.

6.5) T.H. & B.R. Overhead at Ramp E - (N/S/W) (Murray St. Exit) - (Structure #6):

Under Ramp E-(N/S/W) the railway line is proposed to cross in a tunnel independently designed, but adjacent to the culvert crossing. The centre-line of the railway tunnel will run parallel to the centre-line of the culvert, at a distance of some 35 ft. The approximate footing base of the culvert will be around el. 644 ft., while that of the railway, at el. 653 ft.

The values of the undrained shear strengths of the underlying materials at this location were found to be somewhat higher than those at the expressway overhead, so that either spread footings or piled foundations may be constructed. On spread footings, allowable net bearing pressures up to 1.7 TSF may be designed. Because of the close proximity of the culvert to the proposed tunnel, great care should be taken not to disturb

6. DISCUSSION AND RECOMMENDATIONS: (cont'd.) ...

6.5) T.H. & B.R. Overhead at Ramp E - (N/S/W) (Murray St. Exit) - (Structure #6): (cont'd.) ...

the soils at or near the location of the tunnel, by the culvert excavation. If this cannot be avoided, spread footings for the tunnel should be ruled out.

In the case of designing piled foundations, either end-bearing steel H-piles, or shorter timber, frictional piles may be used as described under Subsection (6.4). Steel H-piles should be driven to practical refusal, the depth of which is expected to be reached around el. 585 - 595 ft., within the hard glacial till or on bedrock. Again, design loads equal to the structural strength of the section may be employed on steel H-piles. The use of shorter timber piles ought to be confirmed by a pile loading test, as mentioned earlier.

A dewatering scheme for the excavations will be necessary due to the sandy silt to silty sand subsoils. Details of such schemes were discussed under Subsection (6.2.2).

No appreciable settlements are foreseen under the railway tunnel, since the grade of the ramp at the crossing will be near the existing ground level.

6.6) Retaining Walls:

The proposed sites of the two retaining walls, designed to be built integral with the culvert were included in the field investigations. The wall, located north of the proposed railway tracks between Railway Station 142+30 and Station 151+80 was numbered Wall #1. The length of this wall will be around 950 ft., the height from the footing of the culvert to the top of the retained soils varying between 18 ft. and 42 ft. A short wall is proposed at the south entrance of the railway tunnel at Structure #7, providing lateral support to the partial slope of the expressway embankment. This approx. 110-ft. long wall is identified on the drawing as Wall #2.

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6. DISCUSSION AND RECOMMENDATIONS: (cont'd.) ...

6.6) Retaining Walls: (cont'd.) ...

According to the soil stratigraphy, it appears that the base of the culvert along Wall #1 will be below the surficial sand and sandy silt stratum, within the stratified clayey silts. The footing of Wall #2, however, will lie within the sands or immediately beneath the granular layer.

It is estimated that the soils under Wall #1 will support net safe loads of 1.5 TSF, whereas the net safe bearing capacity under Wall #2 may be taken to be 1.25 TSF. If the above bearing values are not sufficient for the economical design of spread foorings, piled foundations ought to be adopted as discussed under the preceding sections. Probable bedrock elevations along these walls may be read from the stratigraphical profiles on the drawings.

For the suggested factors to be used for earth pressure calculations and resistance against sliding, together with recommended dewatering schemes, reference is made to Section (6.2).

Backfill of the retaining walls - where applicable - should comply with D.H.O. Standard SD-4-58.

7. MISCELLANEOUS:

The field work, carried out during the period April 19 - May 11, 1971, was supervised by Messrs. H. Stankaitis, Field Technician, M. Logan and K. Williams, engineering students, under the general supervision of Mr. A. K. Barsvary, Senior Foundation Engineer, who also wrote this report.

Equipment used was owned and operated by P.V.K. Drilling Co., Burford, Ontario.

Mr. K. G. Selby, Supervising Foundation Engineer, reviewed the report.

June, 1971

APPENDIX I

FORM OB-MT-126 (REV. 1969) OFFICE REPORT ON SOIL EXPLORATION

DEPARTMENT OF HIGHWAYS- ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 2 (2; 71-11021) FOUNDATION SECTION

JOB 71-11022 LOCATION Co-Ord's: 672,821 N.; 799,264 E. ORIGINATED BY H.S.
W.P. 70-68-04 BORING DATE April 7-13, 1971 COMPILED BY A.K.B.
DATUM Geodetic BOREHOLE TYPE Auger & Washboring CHECKED BY

ELEV. / DEPTH	DESCRIPTION	STRAT. PLOT	SAMPLES NUMBER	TYPE	BLOWS / FOOT	ELEV. SCALE
668.5	Ground Level					
0.0	Clayey Silt to Silt, layers of Sand. Fill? Brown.		1	SS	15	660
			2	SS	18	
653.0	Very stiff & compact.		3	SS	13	
15.5	Clayey silt to silt. Irregular seams & layers of silty clay & sandy silt. Firm to hard. Brownish grey.		4	SS	7	650
			5	TW	PM	
			6	SS	12	
			7	TW	PM	640
			8	SS	10	
			9	SS	PM	630
			10	SS	10	
			11	TW	PM	620
			12	SS	35	
			13	SS	49	610
			14	SS	39	
			15	SS	32	600
			16	SS	19	
			17	SS	40	590
586.5			18	SS	22	
82.0	Clayey silt to silt with traces of sand & gravel. (Glacial Till) Hard.		19	SS	37	580
			20	SS	76	
			21	SS	46	
568.8	Probable Bedrock.					570
99.7	End of Borehole					

DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT

SHEAR STRENGTH P.S.F.
○ UNCONFINED + FIELD VANE
● QUICK TRIAXIAL × LAB. VANE
1000 2000

LIQUID LIMIT — w_L
PLASTIC LIMIT — w_p
WATER CONTENT — w
w_p w w_L
WATER CONTENT % 10 20 30

BULK DENSITY γ P.C.F.	REMARKS GR. SA. SI. CL.
126	
135	0 12 85 3
127.5	
129	
130	
	0 0 87 13
	0 1 84 15
	4 15 65 16

+ > 2000

20
15 ⊕ 5 % STRAIN AT FAILURE
10

FORM OB-MT 126 (REV. 1969) OFFICE REPORT ON SOIL EXPLORATION

DEPARTMENT OF HIGHWAYS- ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 3 (3; 71-11021) FOUNDATION SECTION

JOB 71-11022 LOCATION Co-Ord's; 672,752 N.; 799,368 E. ORIGINATED BY H.S.
W.P. 70-68-04 BORING DATE April 8-14, 1971 COMPILED BY A.K.B.
DATUM Geodetic BOREHOLE TYPE Auger & Washboring CHECKED BY

ELEV. / DEPTH	DESCRIPTION	STRAT. PLOT	SAMPLES NUMBER	TYPE	BLOWS/FOOT	ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS/FOOT 20 40 60 80 100 / SHEAR STRENGTH P.S.F. ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB. VANE 1000 2000	LIQUID LIMIT w_L PLASTIC LIMIT w_P WATER CONTENT w / WATER CONTENT % 10 20 30	BULK DENSITY γ P.C.F.	REMARKS GR. SA. SI. CL.
675.7	Ground Level									
0.0	Clayey silt, occasional seams of sand. Firm to stiff Brown.		1	SS	6	670				
			2	SS	10					
658.7			3	TW	P/6"	660			132	
17.0	Clayey silt to silt. Irregular seams of brown silty clay & sandy silt. Firm to very stiff. Brownish grey.		4	SS	9					0 30 60 10
			5	TW	PM				129	
			6	SS	9	650				
			7	TW	PM		+ > 2000	N.P.		
			8	SS	13		+ > 2000			0 5 82 13
			9	TW	PM	640			122	
			10	SS	9		+ > 2000			
			11	TW	PM	630			119	
			12	SS	26					
			13	SS	21	620				
			14	SS	25					
			15	SS	18	610				0 1 78 21
			16	SS	10					
			17	SS	10	600				
			18	TW	PM					0 1 92 7
589.7			19	SS	18	590				
86.0	Clayey silt to silt with some sand & traces of gravel. (Glacial Till) Hard.		20	SS	82					
			21	SS	89	580				
			22	SS	81					
569.7	Probable Bedrock.		23	SS	--	570				8 28 53 1
106.0	End of Borehole.									

FORM OB-MT-126 (REV. 1969) OFFICE REPORT ON SOIL EXPLORATION

DEPARTMENT OF HIGHWAYS- ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 10

FOUNDATION SECTION

JOB 71-11022 LOCATION Co-ords. 672,825 N; 800,132 E. ORIGINATED BY HS
W.P. 70-68-06 BORING DATE April 19 - 20, 1971 COMPILED BY AKB
DATUM Geodetic BOREHOLE TYPE Washboring, NX Casing CHECKED BY

ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	SAMPLES NUMBER	TYPE	BLOWS/FOOT	ELEV. SCALE
668.0	Ground Level					
0.0	Silty sand with some gravel. Dense		1	SS	38	660
656.0	Brown		2	SS	30	
12.0	Clayey silt to silt. Stiff		3	SS	9	650
			4	TW	PM	
	Grey		5	SS	9	
640.0						640
28.0	Irregular seams of silt, clayey silt and silty clay.		6	TW	PM	
			7	SS	8	
			8	TW	PM	630
			9	SS	10	
	Stiff to Hard		10	TW	PM	
			11	SS	8	620
	Grey & Brown		12	TW	PM	
			13	SS	32	610
606.5			14	SS	26	
61.5	End of Borehole					

DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT — 20 40 60 80 100

SHEAR STRENGTH P.S.F.
○ UNCONFINED + FIELD VANE
● QUICK TRIAXIAL × LAB. VANE
1000 2000

+ 2000

LIQUID LIMIT —— w_L
PLASTIC LIMIT —— w_P
WATER CONTENT —— w

w_P w w_L

WATER CONTENT % 10 20 30

BULK DENSITY γ P.C.F.	REMARKS GR. SA. SI. CL.
	32 43 (25)
	0 12 (88)
121	
122	NP
128	

20
15 ⊹ 5 % STRAIN AT FAILURE
10

FORM OB-MT-126 (REV. 1969) OFFICE REPORT ON SOIL EXPLORATION

DEPARTMENT OF HIGHWAYS- ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 11

FOUNDATION SECTION

JOB 71-11022 LOCATION Co-ords. 672,817 N; 800,027 E. ORIGINATED BY HS
W.P. 70-68-06 BORING DATE Apr. 20-21, 1971 COMPILED BY AKB
DATUM Geodetic BOREHOLE TYPE Washboring, NX Casing CHECKED BY

ELEV. / DEPTH	DESCRIPTION	STRAT. PLOT	SAMPLES NUMBER	TYPE	BLOWS / FOOT	ELEV. SCALE
675.2	Ground Level					
0.0	Clayey silt to silt		1	SS	16	670
	Very Stiff to Firm		2	SS	20	
			3	SS	15	660
	Brown and Grey					
652.2			4	SS	7	
23.0	Irregular Seams of		5	TW	PM	650
	silt, clayey silt,		6	SS	9	
	silty clay.		7	TW	PM	640
			8	SS	8	
	Stiff to Very Stiff		9	TW	PM	
			10	SS	12	630
	Grey and Brown		11	TW	PM	
618.7			12	SS	21	620
56.5	End of Borehole					

DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT

SHEAR STRENGTH P.S.F.
○ UNCONFINED ✦ FIELD VANE
● QUICK TRIAXIAL × LAB. VANE

1000 2000

+ >2000
+ >2000
+ >2000
+ >2000

LIQUID LIMIT —— w_L
PLASTIC LIMIT —— w_P
WATER CONTENT —— w

w_P w w_L

WATER CONTENT %
10 20 30

BULK DENSITY γ P.C.F.

127
121
122

REMARKS GR. SA. SI. CL.

0 1 83 16
0 7 82 11
0 1 79 20

20
15 ✦ 5 % STRAIN AT FAILURE
10

FORM OB-MT-126 (REV. 1969) OFFICE REPORT ON SOIL EXPLORATION

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 12

FOUNDATION SECTION

JOB 71-11022 LOCATION Co-ords. 672,794 N; 799,917 E. ORIGINATED BY HS
W.P. 70-68-06 BORING DATE April 19-20, 1971 COMPILED BY AKB
DATUM Geodetic BOREHOLE TYPE Auger CHECKED BY

ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	SAMPLE NUMBER	SAMPLE TYPE	BLOWS / FOOT	ELEV. SCALE
684.0	Ground Level					
0.0	Clayey silt to silt.					680
			1	SS	15	
	Very Stiff					
672.0	Brown		2	SS	18	
12.0						670
	Sandy silt to silt,		3	SS	33	
	random deams of		4	SS	35	
	clayey silt.					660
			5	SS	39	
	Dense to Loose		6	SS	8	
			7	TW	PM	650
	Grey		8	SS	15	
642.0						
42.0			9	TW	PM	640
			10	SS	15	
			11	TW	PM	
	Irregular seams of		12	SS	12	
	silt, clayey silt		13	TW	PM	630
	and silty clay.					
			14	SS	17	
	Stiff to Very Stiff					620
			15	TW	PM	
			16	SS	10	
	Grey & Brown					610
			17	TW	PM	
			18	SS	14	
						600
596.0			19	SS	14	
88.0	Sandy silt with gravel					
592.5	(Till)		20	SS	90	
91.5	End of Borehole					

DYNAMIC PENETRATION RESISTANCE
BLOWS / FOOT — 20 40 60 80 100

SHEAR STRENGTH P.S.F.
○ UNCONFINED + FIELD VANE
● QUICK TRIAXIAL × LAB. VANE
1000 2000

+ > 2000

LIQUID LIMIT —— w_L
PLASTIC LIMIT —— w_P
WATER CONTENT —— w
w_P w w_L
WATER CONTENT % 10 20 30

NP

BULK DENSITY γ P.C.F.

126
122
129
122
123
126
131

REMARKS	GR. SA. SI. CL.
	0 20 73 7
	0 10 61 29
	0 5 87 8
	0 2 83 15
	8 41 41 10

20
15 ⊹ 5 % STRAIN AT FAILURE
10

FORM OB-MT-126 (REV. 1969) OFFICE REPORT ON SOIL EXPLORATION

DEPARTMENT OF HIGHWAYS- ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 13

FOUNDATION SECTION

JOB 71-11022 LOCATION Co-ords. 672,778 N; 799,814 E. ORIGINATED BY HS

W.P. 70-68-06 BORING DATE April 21, 1971 COMPILED BY AKB

DATUM Geodetic BOREHOLE TYPE Auger CHECKED BY

ELEV. / DEPTH	DESCRIPTION	STRAT. PLOT	SAMPLES NUMBER	TYPE	BLOWS / FOOT	ELEV. SCALE
682.8	Ground Level					
0.0	Clayey silt Stiff Brown		1	SS	14	680
670.8			2	SS	14	
12.0	Sandy silt to silt		3	SS	33	670
	Random seams of clayey silt.		4	SS	42	660
			5	SS	25	
			6	SS	21	
	Compact to Dense		7	SS	30	650
640.8			8	SS	20	
42.0	Irregular seams of silt, clayey silt and silty clay		9	SS	15	640
			10	TW	PM	
			11	SS	13	
			12	TW	PH	630
			13	SS	14	
			14	SS	PH	
	Stiff to Hard		15	SS	39	620
	Grey and Brown		16	SS	25	
			17	SS	17	610
			18	SS	18	600
593.8						
591.3	Silt, traces of sand and gravel. (Fill)		19	SS	120	
91.5	End of Borehole					

DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT

SHEAR STRENGTH P.S.F.
○ UNCONFINED + FIELD VANE
● QUICK TRIAXIAL × LAB. VANE
1000 2000

LIQUID LIMIT — w_L
PLASTIC LIMIT — w_P
WATER CONTENT — w
WATER CONTENT % 10 20 30

BULK DENSITY γ P.C.F.

REMARKS GR.SA.SI.CL.

0 53 (47)

0 2 69 29

122
127
123
130

FOOTINGS

20
15 5 % STRAIN AT FAILURE
10

FORM OB-MT-126 (REV. 1969) OFFICE REPORT ON SOIL EXPLORATION

DEPARTMENT OF HIGHWAYS- ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 14

FOUNDATION SECTION

JOB 71-11022 LOCATION Co-Ord's: 672,875 N.; 801,054.5 E. ORIGINATED BY M.L.
W.P. 70-68-09 BORING DATE April 28-29, 1971 COMPILED BY A.K.B.
DATUM Geodetic BOREHOLE TYPE Washboring, NX Casing CHECKED BY

ELEV. / DEPTH	DESCRIPTION	STRAT. PLOT	SAMPLES NUMBER	TYPE	BLOWS/FOOT	ELEV. SCALE
657.2	Ground Level					
0.0	Gravelly sand. Compact to dense.		1	SS	13	650
			2	SS	26	
			3	SS	41	
642.7			4A	SS	14	
			4B	SS	11	
14.5	Irregular seams of silt, clayey silt & silty clay Stiff to very stiff. Grey.		5	SS	11	640
			6	TW	PM	
			7	SS	9	630
			8	TW	PM	
621.2			9	SS	20	620
36.0	Clayey silt with gra. Glacial Till		10	SS	62	
615.7						
41.5	End of Borehole					

DYNAMIC PENETRATION RESISTANCE BLOWS/FOOT — 20 40 60 80 100

SHEAR STRENGTH P.S.F.
o UNCONFINED + FIELD VANE
● QUICK TRIAXIAL × LAB. VANE
1000 2000

LIQUID LIMIT —— w_L
PLASTIC LIMIT —— w_P
WATER CONTENT —— w
WATER CONTENT % 10 20 30

BULK DENSITY γ P.C.F.	REMARKS GR.SA.SI.CL.
122	
126	

20
13 ◇ 5 % STRAIN AT FAILURE
10

FORM OB-MT-126 (REV. 1969) OFFICE REPORT ON SOIL EXPLORATION

DEPARTMENT OF HIGHWAYS- ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 15

FOUNDATION SECTION

JOB 71-11022 LOCATION Co-Ord's: 672,911 N.; 800,918 E. ORIGINATED BY M.L.
W.P. 70-68-09 BORING DATE April 29-30, 1971 COMPILED BY A.K.B.
DATUM Geodetic BOREHOLE TYPE Washboring, NX. Casing CHECKED BY

ELEV. / DEPTH	DESCRIPTION	STRAT. PLOT	SAMPLES NUMBER	TYPE	BLOWS / FOOT	ELEV. SCALE
658.0	Ground Level					
0.0	Sandy gravel, some silt. Compact.		1	SS	32	650
646.5			2	SS	21	
11.5	Irregular seams of silt, clayey silt and silty clay. Traces of sand. Stiff to hard. Grey and brown.		3	SS	17	640
			4	SS	15	
			5	SS	9	
			6	TW	PM	
			7	SS	10	630
			8	TW	PM	
			9	SS	18	620
			10	SS	26	
			11	SS	36	610
			12	SS	29	
			13	SS	28	600
			14	SS	45	
			15	SS	51	590
			16	SS	20	
			17	SS	19	580
577.5	Probable Bedrock.		18	SS	100	
80.5	End of Borehole.					

DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT
SHEAR STRENGTH P.S.F.
○ UNCONFINED + FIELD VANE
● QUICK TRIAXIAL × LAB. VANE
1000 2000
+ > 2000

LIQUID LIMIT —— w_L
PLASTIC LIMIT —— w_P
WATER CONTENT —— w
w_P w w_L
WATER CONTENT %
10 20 30
N.P.

BULK DENSITY γ P.C.F.	REMARKS GR. SA. SI. CL.
	45 36 (19)
	0 1 89 10
119	
117 / 123	
	0 1 74 25
	0 1 78 21

20
15 ⊹ 5 % STRAIN AT FAILURE
10

FORM OB-MT-226 (REV. 1969) OFFICE REPORT ON SOIL EXPLORATION

DEPARTMENT OF HIGHWAYS- ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 16

FOUNDATION SECTION

JOB 71-11022 LOCATION Co-Ord's: 672,926 N; 800,815.5 E. ORIGINATED BY M.L.
W.P. 70-68-09 BORING DATE April 30 - May 3, 1971 COMPILED BY A.K.B.
DATUM Geodetic BOREHOLE TYPE Washboring, NX Casing CHECKED BY

ELEV. / DEPTH	DESCRIPTION	STRAT. PLOT	SAMPLES NUMBER	TYPE	BLOWS/FOOT	ELEV. SCALE
671.0	Ground Level					
0.0	(Fill) Silt, traces of clay and sand. Very stiff. Brown.		1	SS	14	670
			2	SS	16	660
653.0			3	SS	18	
18.0	Sandy gravel, some silt.		4	SS	143	650
644.5	Very dense.		5	SS	80	
26.5	Irregular seams of silt, clayey silt and silty clay. Stiff to hard. Grey and brown.		6	SS	33	640
			7	SS	13	
			8	TW	PM	
			9	SS	14	630
			10	TW	PM	
			11	SS	24	
			12	SS	33	620
			13	SS	31	
			14	SS	30	610
			15	SS	54	
599.5			16	SS	61	600
71.5	End of Borehole.					

DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT — 20 40 60 80 100
SHEAR STRENGTH P.S.F. — ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB. VANE — 1000 2000
LIQUID LIMIT —— w_L PLASTIC LIMIT —— w_P WATER CONTENT —— w
w_P w w_L
WATER CONTENT % — 10 20 30

BULK DENSITY γ P.C.F.	REMARKS GR.SA.SI.CL.
	0 0 (100)
121	
125	

20
15 ⊹ 5 % STRAIN AT FAILURE
10

FORM OB-MT-126 (REV. 1969) OFFICE REPORT ON SOIL EXPLORATION

DEPARTMENT OF HIGHWAYS- ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 17

FOUNDATION SECTION

JOB 71-11022 LOCATION Co-Ord's: 672,922 N.; 800,724 E. ORIGINATED BY M.L.
W.P. 70-68-09 BORING DATE May 4-5, 1971 COMPILED BY A.K.B.
DATUM Geodetic BOREHOLE TYPE Washboring, NX Casing CHECKED BY

ELEV. / DEPTH	DESCRIPTION	STRAT. PLOT	SAMPLE NUMBER	SAMPLE TYPE	BLOWS / FOOT	ELEV. SCALE	REMARKS (GR. SA. SI. CL.)
658.6	Ground Level						
0.0	Gravelly sand. Compact		1	SS	17		0 74 (26)
			2	SS	38	650	
649.1			3	SS	32		
9.5	Silt.		4	SS	24		0 5 92 3
	Very stiff.		5	SS	25		
639.6							
19.0			6	SS	11	640	
	Irregular seams of silt, clayey silt and silty clay.		7	TW	PM		
			8	SS	16	630	
			9	TW	PM		
	Stiff to hard.		10	SS	21	620	
	Grey and brown.		11	SS	17		0 1 49 50
			12	SS	23	610	
			13	SS	41		0 1 74 25
			14	SS	29	600	
			15	SS	29		
588.6						590	
70.0	Clayey si. with some sand. Glacial Till.		16	SS	62		0 3 76 21
582.1	Probable Bedrock.		17	SS	111		
76.5	End of Borehole.						

DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT

SHEAR STRENGTH P.S.F.
○ UNCONFINED + FIELD VANE
● QUICK TRIAXIAL × LAB. VANE
1000 2000

LIQUID LIMIT — w_L
PLASTIC LIMIT — w_P
WATER CONTENT — w
WATER CONTENT % 10 20 30

BULK DENSITY γ P.C.F.
111
126
129

20
15 5 % STRAIN AT FAILURE
10

FORM OB-MT-126 (REV. 1969) OFFICE REPORT ON SOIL EXPLORATION

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 18

FOUNDATION SECTION

JOB 71-11022 LOCATION Co-ords. 672,917 N; 800,597 E. ORIGINATED BY HS
W.P. 70-68-09 BORING DATE April 23 - 26, 1971 COMPILED BY AKB
DATUM Geodetic BOREHOLE TYPE Auger CHECKED BY

ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS/FOOT	ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS/FOOT (20 40 60 80 100) / SHEAR STRENGTH P.S.F. (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB. VANE; 1000 2000)	LIQUID LIMIT w_L / PLASTIC LIMIT w_P / WATER CONTENT w (w_P w w_L); WATER CONTENT % (10 20 30)	BULK DENSITY γ P.C.F.	REMARKS GR. SA. SI. CL.
656.8	Ground Level									
0.0	Gravelly sand.		1	SS	5					
	Compact		2	SS	24	650				42 54 (4)
648.3										
8.5			3	SS	14					
			4	SS	13			N.P.		
	Irregular seams of		5	SS	9	640				
	silt, clayey silt		6	SS	10				121	
	and silty clay.		7	TW	PM					
			8	SS	9					
						630			124	
			9	TW	PM		+>2000			
	Stiff to Hard		10	SS	14					
						620				
			11	TW	P/6"				127	
	Grey and Brown									
			12	SS	20					
						610				
603.8			13	SS	33					
53.0										0 2 88 10
	Silt, some seams of		14	SS	39					
	clayey silt.					600				
			15	SS	30					
			16	SS	21					
						590				
	Very Stiff to Hard		17	SS	17			N.P.		
580.3			18	SS	92					
76.5	End of Borehole									

20
15 ⟡ 5 % STRAIN AT FAILURE
10

FORM OB-MT-126 (REV. 1969) OFFICE REPORT ON SOIL EXPLORATION

DEPARTMENT OF HIGHWAYS- ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 25

FOUNDATION SECTION

JOB 71-11022 LOCATION Co-Ord's: 672,895 N; 798,840 ORIGINATED BY H.S.
W.P. 70-68-04 BORING DATE April 30, 1971 COMPILED BY A.K.B.
DATUM Geodetic BOREHOLE TYPE Auger CHECKED BY

ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	SAMPLES NUMBER	TYPE	BLOWS / FOOT	ELEV. SCALE
660.6	Ground Level					660
0.0	Silty fine sand Compact. Brown		1	SS	12	
			2	SS	27	
650.6			3	SS	17	650
10.0	Irregular seams of silt, clayey silt & silty clay. Firm to Hard. Grey & brown.		4	SS	14	
			5	SS	8	
			6	SS	9	640
			7	TW	PH	
			8	SS	14	630
			9	TW	PH	
			10	SS	27	620
614.1			11	SS	43	
46.5	End of Borehole.					

DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT

SHEAR STRENGTH P.S.F.
o UNCONFINED + FIELD VANE
● QUICK TRIAXIAL × LAB. VANE
1000 2000

LIQUID LIMIT —— w_L
PLASTIC LIMIT —— w_P
WATER CONTENT —— w
w_P w w_L
WATER CONTENT %
10 20 30

BULK DENSITY γ P.C.F.	REMARKS GR.SA.SI.CL.
	0 76 (24)
	0 3 84 13
123	
122	
125	

20
15 ✣ 5 % STRAIN AT FAILURE
10

FORM OB-MT-126 (REV 1969) OFFICE REPORT ON SOIL EXPLORATION

DEPARTMENT OF HIGHWAYS- ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 26

FOUNDATION SECTION

JOB 71-11022 LOCATION Co-Ord's: 672,932 N. 798,838 E. ORIGINATED BY H.S.

W.P. 70-68-04 BORING DATE May 3, 1971 COMPILED BY K.W.

DATUM Geodetic BOREHOLE TYPE Auger CHECKED BY

ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS/FOOT	ELEV. SCALE	REMARKS
661.8	Ground Level						
0.0	Very fine sand to silty sand. Compact. Brown		1	SS	15	660	0 94 (6)
			2	SS	22		
649.8			3	SS	25		7 56 (37)
12.0	Clayey silt to silt, occasional seams of silty clay. Firm to hard.		4	SS	32	650	
			5	SS	13		
			6	SS	12	640	
			7	TW	PM/9"		123
			8	SS	13	630	
			9	SS	17		0 1 (99)
			10	SS	33	620	
			11	SS	40		
			12	SS	40	610	0 3 77 20
			13	SS	52		
			14	SS	14	600	
			15	SS	13		0 1 67 32
			16	SS	13	590	
584.8	Probable Bedrock						
77.0	End of Borehole.						

DYNAMIC PENETRATION RESISTANCE
BLOWS / FOOT 20 40 60 80 100
SHEAR STRENGTH P.S.F.
○ UNCONFINED + FIELD VANE
● QUICK TRIAXIAL × LAB. VANE
1000 2000

LIQUID LIMIT — w_L
PLASTIC LIMIT — w_P
WATER CONTENT — w
WATER CONTENT % 10 20 30

BULK DENSITY γ P.C.F.

+ > 2000

N.P.

GR. SA. SI. CL.

20
15 ⊹ 5 % STRAIN AT FAILURE
10

FORM OB-MT-126 (REV. 1969) OFFICE REPORT ON SOIL EXPLORATION

DEPARTMENT OF HIGHWAYS- ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 27

FOUNDATION SECTION

JOB 71-11022 LOCATION Co-Ord's: 672,939 N; 798,715 E. ORIGINATED BY H.S.
W.P. 70-68-04 BORING DATE April 28, 1971 COMPILED BY K.W.
DATUM Geodetic BOREHOLE TYPE Auger CHECKED BY

ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	SAMPLES NUMBER	TYPE	BLOWS/FOOT	ELEV. SCALE
662.3	Ground Level					
0.0	Silty sand to gravelly sand. Loose to very dense.		1	SS	6	660
			2	SS	22	
			3	SS	57	
649.3			4	SS	12	650
13.0			5	SS	16	
	Clayey silt to silt Random seams of silty clay.		6	SS	10	
			7	TW	PM	640
	Stiff to very stiff.		8	SS	16	
			9	TW	PH	630
	Grey & brown.		10	SS	23	
			11	SS	29	620
			12	SS	24	
			13	SS	30	610
602.3						
60.0	Silt, traces of clay. Brown. Hard.		14	SS	31	
			15	SS	36	600
			16	SS	40	
587.3	Probable Bedrock					590
75.0	End of Borehole.					

DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT — 20 40 60 80 100

SHEAR STRENGTH P.S.F.
o UNCONFINED + FIELD VANE
● QUICK TRIAXIAL × LAB. VANE
1000 2000

+ > 2000

LIQUID LIMIT —— w_L
PLASTIC LIMIT —— w_P
WATER CONTENT —— w
w_P w w_L
WATER CONTENT % 10 20 30

BULK DENSITY γ P.C.F.	REMARKS GR.SA.SI.CL.
	0 71 15 14
	46 44 (10)
	0 4 89 7
126	
129	
	0 5 75 20
	0 1 94 5

20
15 ⟡ 5 % STRAIN AT FAILURE
10

FORM OB-MT - 426 (REV. 1969) OFFICE REPORT ON SOIL EXPLORATION

DEPARTMENT OF HIGHWAYS- ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 28

FOUNDATION SECTION

JOB 71-11022 LOCATION Co-ords. 672,766 N; 799,720 E. ORIGINATED BY HS
W.P. 70-68-04 BORING DATE April 22, 1971 COMPILED BY KW
DATUM Geodetic BOREHOLE TYPE Auger CHECKED BY

SOIL PROFILE ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	SAMPLES NUMBER	TYPE	BLOWS / FOOT
689.5	Ground Level				
0.0	Clayey silt, seams of sand. Stiff to Very Stiff		1	SS	24
			2	SS	18
			3	SS	10
671.0					
18.5	Fine Sandy Silt Dense		4	TW	PM
			5	SS	48
659.5					
30.0	Irregular seams of silt, clayey silt and silty clay Stiff to Very Stiff		6	SS	21
			7	TW	PM
			8	SS	14
			9	TW	PM 6"
			10	SS	15
			11	SS	28
			12	SS	21
			13	SS	25
			14	SS	18
			15	SS	16
			16	TW	PM
	Grey and Brown		17	SS	15
			18	SS	14
			19	TW	PM
			20	SS	16
			21	SS	17
595.5					
593.0	Silty Sand (Till)		22	SS	27
96.5	End of Borehole				

ELEV. SCALE: 680, 670, 660, 650, 640, 630, 620, 610, 600

DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT — 20 40 60 80 100
SHEAR STRENGTH P.S.F. — ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB. VANE — 1000 2000
+ > 2000

LIQUID LIMIT — w_L
PLASTIC LIMIT — w_P
WATER CONTENT — w
WATER CONTENT % — 10 20 30
N.P.

BULK DENSITY γ P.C.F.	REMARKS GR. SA. SI. CL.
127.5	0 26 68 6
	0 41 (59)
124	
	0 13 (87)
	0 0 (100)
130	
131	
	0 1 91 8
	8 56 30 6

20
15 5 % STRAIN AT FAILURE
10

DEPARTMENT OF HIGHWAYS- ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 29

FOUNDATION SECTION

JOB 71-11022 LOCATION Co-Ord's: 672,757 N; 799,570 E ORIGINATED BY H.S.
W.P. 70-68-04 BORING DATE April 26, 1971 COMPILED BY K.W.
DATUM Geodetic BOREHOLE TYPE Auger CHECKED BY

ELEV. / DEPTH	DESCRIPTION	STRAT. PLOT	SAMPLE NUMBER	SAMPLE TYPE	BLOWS / FOOT	ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT (20 40 60 80 100) / SHEAR STRENGTH P.S.F. (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB. VANE) (1000 2000)	LIQUID LIMIT w_L / PLASTIC LIMIT w_P / WATER CONTENT w (w_P w w_L) / WATER CONTENT % (10 20 30)	BULK DENSITY γ P.C.F.	REMARKS GR. SA. SI. CL.
692.4	Ground Level									
0.0	Clayey silt, occasional seams of sand. Hard to stiff.		1	SS	62	690		○		
			2	SS	23			○		0 0 63 37
			3	SS	15	680		○		
669.4			4	SS	10	▼ 670		○		0 0 65 35
23.0	Irregular seams of silt, clayey silt and silty clay. Stiff to very stiff. Grey and brown.		5	TW	PM6" PH12"			○	127	0 54 (46)
			6	SS	22			○		
			7	SS	9	660	+ > 2000	○		
			8	TW	PM			○	125	
			9	SS	9	650		○		0 5 92 3
			10	SS	13			○		
			11	TW	PM	640		○	121	
			12	SS	13			○	127	
			13	TW	PM			○	125	
			14	SS	14	630		○		
			15	TW	PM6" PH6"			○	123	
			16	SS	20			○		
			17	SS	24	620		○		
			18	SS	12			○		0 0 70 30
			19	SS	11	610	+ > 2000	○		
			20	TW	PM			○ N.P.	130	
						600	+ > 2000		128	
595.9			21	SS	19			○		
96.5	End of Borehole									

20
15 ⊹ 5 % STRAIN AT FAILURE
10

FORM OB-MT-126 (REV. 1969) OFFICE REPORT ON SOIL EXPLORATION

DEPARTMENT OF HIGHWAYS- ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 31

FOUNDATION SECTION

JOB 71-11022 LOCATION Co-Ord's: 672,812 N; 799,147 E. ORIGINATED BY H.S.
W.P. 70-68-04 BORING DATE May 5, 1971 COMPILED BY K.W.
DATUM Geodetic BOREHOLE TYPE Auger CHECKED BY

ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS/FOOT	ELEV. SCALE
664.0	Ground Level					
0.0	Very fine sand with some silt, traces of gravel. Loose to compact.		1	SS	6	660
			2	SS	21	
648.0			3	SS	25	650
16.0	Irregular seams of silt, clayey silt and silty clay. Traces of sand.		4	SS	20	
			5	SS	11	640
			6	TW	PH	
			7	SS	14	
			8	TW	PH	630
			9	SS	19	
	Stiff to very stiff.		10	SS	13	
			11	SS	14	620
	Grey and brown.		12	SS	25	
			13	TW	PH	
			14	SS	23	610
			15	SS	18	
			16	SS	14	600
			17	SS	11	
			18	TW	PH	590
583.7	Probable Bedrock		19	SS	30/4"	
80.3	End of Borehole.					

DYNAMIC PENETRATION RESISTANCE BLOWS/FOOT — 20 40 60 80 100
SHEAR STRENGTH P.S.F. — ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB. VANE — 1000 2000
LIQUID LIMIT —— w_L PLASTIC LIMIT —— w_p WATER CONTENT —— w
w_p w w_L
WATER CONTENT % — 10 20 30

BULK DENSITY γ P.C.F.	REMARKS GR. SA. SI. CL.
	0 82 (18)
	5 85 (10)
	N.P.
124	
124	
	0 0 66 34
132	0 2 76 22
129	0 2 69 29
129	

+ > 2000

20
15 ⊹ 5 % STRAIN AT FAILURE
10

FORM OB-MT-126 (REV. 1969) OFFICE REPORT ON SOIL EXPLORATION

DEPARTMENT OF HIGHWAYS- ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 32

FOUNDATION SECTION

JOB 71-11022 LOCATION Co-Ord's: 672,853 N; 798,957 E. ORIGINATED BY H.S.
W.P. 70-68-04 BORING DATE May 4, 1971 COMPILED BY K.W.
DATUM Geodetic BOREHOLE TYPE Auger CHECKED BY

ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	SAMPLES NUMBER	TYPE	BLOWS/FOOT	ELEV. SCALE
663.0	Ground Level					
0.0	Very fine sand with some silt, traces of gravel. Loose to compact.		1	SS	7	660
			2	SS	18	
649.0						650
14.0	Irregular seams of silt, clayey silt and silty clay. Stiff to very stiff. Grey and brown.		3	SS	12	
			4	SS	10	
			5	SS	9	640
			6	TW	PH	
			7	SS	11	
			8	TW	PH	630
			9	SS	20	
			10	SS	22	
			11	SS	23	620
			12	SS	19	
			13	SS	22	610
			14	SS	22	
			15	SS	10	600
			16	SS	10	
			17	SS	11	590
582.0	Probable Bedrock					
81.0	End of Borehole.					

DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT — 20 40 60 80 100

SHEAR STRENGTH P.S.F.
○ UNCONFINED + FIELD VANE
● QUICK TRIAXIAL × LAB. VANE
1000 2000

+ > 2000
+ > 2000

LIQUID LIMIT —— w_L
PLASTIC LIMIT —— w_P
WATER CONTENT —— w
w_P w w_L
WATER CONTENT % 10 20 30

BULK DENSITY γ P.C.F.	REMARKS GR.SA.SI.CL.
	0 85 (15)
	0 74 26
124	
127	

20
15 ⟡ 5 % STRAIN AT FAILURE
10

FORM OB-MT-126 (REV. 1969) OFFICE REPORT ON SOIL EXPLORATION

DEPARTMENT OF HIGHWAYS- ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 44

FOUNDATION SECTION

JOB 71-11022 LOCATION Co-Ord's: 672,863 N.; 801,151 E. ORIGINATED BY M.L.

W.P. 70-68-04 BORING DATE April 26-28, 1971 COMPILED BY A.K.B.

DATUM Geodetic BOREHOLE TYPE Washboring, NX Casing CHECKED BY

ELEV. / DEPTH	DESCRIPTION	STRAT. PLOT	SAMPLES NUMBER	TYPE	BLOWS / FOOT	ELEV. SCALE
660.7	Ground Level					
0.0	Slag, cinder & mixed fill. Very loose.		1	SS	4	660
654.2	Black.		2	SS	18	
6.5	Sandy silt with some gravel & gravelly sand with some si. Compact to dense.		3	SS	26	650
			4	SS	30	
			5	SS	20	
642.2			6	SS	11	
18.5	Silty to clayey silt, a few occasional seams of silty clay.		7	TW	PM	640
			8	SS	6	
			9	TW	PM	630
			10	SS	13	
			11	TW	PM	620
			12	SS	12	
			13	TW	PM	610
606.7						
54.0	Clayey silt.					
601.2	Glacial Till.		14	SS	61	
56.5	End of Borehole.					

DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT

SHEAR STRENGTH P.S.F.
o UNCONFINED + FIELD VANE
● QUICK TRIAXIAL × LAB. VANE
1000 2000

LIQUID LIMIT —— w_L
PLASTIC LIMIT —— w_P
WATER CONTENT —— w
WATER CONTENT %
10 20 30

BULK DENSITY γ P.C.F.

REMARKS GR.SA.SI.CL.

8 34 52 6

123

120

130

118

20
15 ⊹ 5 % STRAIN AT FAILURE
10

FORM OB-MT-226 (REV. 1969) OFFICE REPORT ON SOIL EXPLORATION

DEPARTMENT OF HIGHWAYS- ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 45

FOUNDATION SECTION

JOB 71-11022 LOCATION Co-Ord's : 673,483N., 798,079 E. ORIGINATED BY K.W.
W.P. 70-68-04 BORING DATE May 10, 1971 COMPILED BY W.A.
DATUM Geodetic BOREHOLE TYPE C.M.E. Hollow Stem Auger & Cone CHECKED BY

ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS/FOOT	ELEV. SCALE
659.8	Ground Level					
0.0	Uniform fine sand & silty sand, traces of gravel. Loose to compact.		1	SS	7	
			2	SS	12	
			3	SS	16	650
644.8			4	SS	13	
15.0			5	SS	7	
	Clayey silt to silt, occasional seams of silty clay.		6	TW	PH	640
			7	SS	21	
	Firm to very stiff.		8	TW	PH	630
			9	SS	23	
	Seam of Sand		10	TW	PH	620
			11	SS	10	
	Probable Bedrock		12	TW	PH	610
601.8			13	SS	39	
58.0	End of Borehole.					600
						590

DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT — 20 40 60 80 100
SHEAR STRENGTH P.S.F. — ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB. VANE — 1000 2000
+ > 2000 (at 630, 620, 610)

LIQUID LIMIT —— w_L
PLASTIC LIMIT —— w_P
WATER CONTENT —— w
w_P w w_L
WATER CONTENT % — 10 20 30

BULK DENSITY γ P.C.F.	REMARKS GR.SA.SI.CL.
	0 72 (28)
	8 87 (5)
124	
125	
130	
122	

20
15 ⟡ 5 % STRAIN AT FAILURE
10

FORM OB-MT-126 (REV. 1969) OFFICE REPORT ON SOIL EXPLORATION

DEPARTMENT OF HIGHWAYS- ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 46

FOUNDATION SECTION

JOB 71-1022 LOCATION Co-Ord's 673,282 N.; 798,234 E. ORIGINATED BY K.W.
W.P. 70-68-04 BORING DATE May 11, 1971 COMPILED BY W.A.
DATUM Geodetic BOREHOLE TYPE C.M.E. Hollow Stem Auger & Cone CHECKED BY

ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	SAMPLES NUMBER	TYPE	BLOWS/FOOT	ELEV. SCALE
662.9	Ground Level					
0.0	Sandy gravel, some silt. Fill. Loose to compact.		1	SS	4	660
			2	SS	18	
			3	SS	14	
650.4			4	SS	9	650
12.5	Clayey silt to silt, occasional seams of silty clay. Stiff to very stiff.		5	TW	PH	
			6	SS	10	
			7	TW	PH	640
			8	SS	25	
			9	TW	PH	630
622.9			10	SS	23	
40.0	Silt to clayey silt.		11	SS	78	620
			12	SS	46	
	Hard.		13	SS	70/6"	610
	Grey.		14	SS	81	
	Probable Bedrock.		15	SS	66	600
595.4						
67.5	End of Borehole.					590

DYNAMIC PENETRATION RESISTANCE
BLOWS / FOOT
20 40 60 80 100

SHEAR STRENGTH P.S.F.
○ UNCONFINED + FIELD VANE
● QUICK TRIAXIAL × LAB. VANE
1000 2000

100/10"

LIQUID LIMIT —— w_L
PLASTIC LIMIT —— w_P
WATER CONTENT —— w
w_P w w_L
WATER CONTENT %
10 20 30

BULK DENSITY γ P.C.F.	REMARKS GR.SA.SI.CL.
	45 36 (19)
119.5	
121.0	
122	
126	

20
15 ⊹ 5 % STRAIN AT FAILURE
10

DEPARTMENT OF HIGHWAYS- ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 47

FOUNDATION SECTION

JOB 71-11022 LOCATION Co-Ord's: 673,270 N; 798,314 E. ORIGINATED BY K.W.
W.P. 70-68-04 BORING DATE May 7, 1971 COMPILED BY W.A.
DATUM Geodetic BOREHOLE TYPE C.M.E. Hollow Stem Auger & Cone CHECKED BY

ELEV. / DEPTH	DESCRIPTION	STRAT. PLOT	SAMPLES NUMBER	TYPE	BLOWS / FOOT	ELEV. SCALE
662.3	Ground Level					
0.0	Fine to coarse sand to silty sand, traces of gravel.		1	SS	14	660
			2	SS	15	
			3	SS	23	
648.8	Compact.		4	SS	16	650
13.5	Clayey silt to silt, occasional seams of clayey silt, traces of sand.		5	SS	10	
			6	TW	PH	
						640
			7	SS	12	
			8	TW	PH	
						630
	SAND		9	SS	24	
	Stiff to very stiff.		10	SS	26	620
			11	SS	13	
612.3						
50.0	Silt. Hard. Grey.		12	SS	60	610
			13	SS	50/4"	
			14	SS	55/6"	600
595.3	Probable Bedrock.		15	SS	50/6"	
67.0	End of Borehole.					590

DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT — 20 40 60 80 100
SHEAR STRENGTH P.S.F. — ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB. VANE — 1000 2000
LIQUID LIMIT —— w_L PLASTIC LIMIT —— w_P WATER CONTENT —— w
w_P w w_L
WATER CONTENT % — 10 20 30

BULK DENSITY γ P.C.F.: 127; 128

REMARKS: 0 70 (30); 0 1 59 40; 0 3 81 16

+ > 2000

+ > 2000

20
15 5 % STRAIN AT FAILURE
10

FORM OB-MT-126 (REV. 1969) OFFICE REPORT ON SOIL EXPLORATION

DEPARTMENT OF HIGHWAYS- ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 48

FOUNDATION SECTION

JOB 71-11022 LOCATION Co-Ord's: 673,126 N; 798,453 E. ORIGINATED BY H.S.

W.P. 70-68-04 BORING DATE May 30, 1971 COMPILED BY W.A.

DATUM Geodetic BOREHOLE TYPE C.M.E. Hollow Stem Auger & Cone. CHECKED BY

ELEV. / DEPTH	DESCRIPTION	STRAT. PLOT	SAMPLES NUMBER	TYPE	BLOWS / FOOT	ELEV. SCALE
662.3	Ground Level					
0.0	Silty sand to gravelly sand becoming Silt.		1	SS	28	660
			2	SS	42	
	Dense to very dense.		3	SS	60	650
639.8			4	SS	65	
22.5	Clayey silt, random pockets of silty clay, seams of sand.		5	SS	27	640
			6	SS	26	
			7	SS	17	
	Stiff to very stiff.		8	TW	PH	630
			9	SS	16	
			10	TW	PH	
618.8	Sand		11	SS	23	620
43.5	End of Borehole.					610

DYNAMIC PENETRATION RESISTANCE
BLOWS / FOOT 20 40 60 80 100

SHEAR STRENGTH P.S.F.
○ UNCONFINED + FIELD VANE
● QUICK TRIAXIAL × LAB. VANE
1000 2000

+ > 2000

LIQUID LIMIT —— w_L
PLASTIC LIMIT —— w_P
WATER CONTENT —— w
w_P w w_L
WATER CONTENT % 10 20 30

BULK DENSITY γ P.C.F.	REMARKS GR.SA.SI.CL.
	33 59 (8)
	0 1 69 30
122	
129	

20
15 ⊹ 5 % STRAIN AT FAILURE
10

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 49

FOUNDATION SECTION

JOB 71-11022 LOCATION Co-Ord's: 673,006 N; 798,605 E. ORIGINATED BY H.S.
W.P. 70-68-04 BORING DATE April 29, 1971 COMPILED BY W.A.
DATUM Geodetic BOREHOLE TYPE C.M.E. Hollow Stem Auger & Cone CHECKED BY

ELEV. / DEPTH	DESCRIPTION	STRAT. PLOT	SAMPLES NUMBER	TYPE	BLOWS/FOOT	ELEV. SCALE
662.6	Ground Level					
0.0	Silty sand with some gravel. Dense to very dense.		1	SS	25	660
			2	SS	60	
649.6						650
13.0	Clayey silt to silt, irregular seams of silty clay, pockets of sand. Stiff to very stiff.		3	SS	18	
			4	SS	8	
			5	TW	PH	640
			6	SS	10	
			7	TW	PH	
			8	SS	19	630
			9	TW	PH	
			10	SS	15	
			11	SS	21	620
			12	SS	19	610
			13	SS	12	
			14	SS	18	600
			15	SS	14	
			16	SS	25	
589.6						590
73.0	End of Borehole.					580

DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT — 20 40 60 80 100
SHEAR STRENGTH P.S.F.
o UNCONFINED + FIELD VANE
● QUICK TRIAXIAL × LAB. VANE
1000n 2000
100/8"

LIQUID LIMIT —— w_L
PLASTIC LIMIT —— w_P
WATER CONTENT —— w
WATER CONTENT % 10 20 30

BULK DENSITY γ P.C.F.
119
120
126

REMARKS
GR. SA. SI. CL.

20
15 ⊹ 5 % STRAIN AT FAILURE
10

FORM OB-MT-126 (REV. 1969) OFFICE REPORT ON SOIL EXPLORATION

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 52

FOUNDATION SECTION

JOB 71-11022 LOCATION Co-ords. 672,922 N; 800,415 E. ORIGINATED BY HS
W.P. 70-68-04 BORING DATE May 6, 1971 COMPILED BY WA
DATUM Geodetic BOREHOLE TYPE CME hollow stem auger & cone CHECKED BY

ELEV. / DEPTH	DESCRIPTION	STRAT. PLOT	SAMPLES NUMBER	TYPE	BLOWS/FOOT	ELEV. SCALE
658.1	Ground Level					
0.0	Silty fine sand, traces of gravel.					
651.6	Compact		1	SS	18	
6.5			2	SS	12	650
	Irregular seams of		3	SS	8	
	silt, clayey silt		4	SS	7	640
	and silty clay		5	TW	PH	
			6	SS	9	
			7	TW	PH	630
	Stiff to Very Stiff		8	SS	11	
			9	TW	PH	
			10	SS	13	620
	Grey and brown		11	TW	PH	
611.6			12	SS	18	
46.5	End of Borehole					610

DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT — 20 40 60 80 100
SHEAR STRENGTH P.S.F. — ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB. VANE — 1000 2000
+ > 2000
+ > 2000

LIQUID LIMIT —— w_L
PLASTIC LIMIT —— w_P
WATER CONTENT —— w
w_P w w_L
WATER CONTENT % — 10 20 30

BULK DENSITY γ P.C.F.

650	
640	127.5
	126
630	122
	121.5
620	127
610	

REMARKS GR.SA.SI.CL.

20
15 ◇ 5 % STRAIN AT FAILURE
10

FORM OB-MT-126 (REV. 1969) OFFICE REPORT ON SOIL EXPLORATION

DEPARTMENT OF HIGHWAYS- ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 53

FOUNDATION SECTION

JOB 71-11022 LOCATION Co-Ord's: 672,784 N.; 801,294.5 E. ORIGINATED BY M.L.

W.P. 70-68-04 BORING DATE April 23, 1971 COMPILED BY W.A.

DATUM Geodetic BOREHOLE TYPE Washboring, NX. Casing CHECKED BY

ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	SAMPLES NUMBER	TYPE	BLOWS/FOOT	ELEV. SCALE
658.4	Ground Level					
0.0	Silty sand with some gravel. Compact.		1	SS	15	650
			2	SS	17	
			3	SS	14	
639.9			4	SS	14	640
18.5	Irregular seams of silt, clayey silt and silty clay. Stiff.		5	TW	PM	
			6	SS	11	
			7	TW	PM	630
			8	SS	17	
			9	TW	PM	
						620
			10	SS	14	
	Sand		11	SS	21	
						610
			12	SS	12	
605.4						
13.0	Silt with traces of clay.		13	TW	PM	
						600
596.9	Stiff.		14	SS	12	
61.5	End of Borehole.					

DYNAMIC PENETRATION RESISTANCE
BLOWS / FOOT
20 40 60 80 100

SHEAR STRENGTH P.S.F.
○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB. VANE
1000 2000

LIQUID LIMIT —— w_L
PLASTIC LIMIT —— w_P
WATER CONTENT —— w
w_P w w_L
WATER CONTENT %
10 20 30

BULK DENSITY γ P.C.F.	REMARKS GR. SA. SI. CL.
127	
122	
126.5	
135	0 0 90 10

+> 2000
+> 2000

20
15 ◇ 5 % STRAIN AT FAILURE
10

FORM OB-MT-126 (REV 1969) OFFICE REPORT ON SOIL EXPLORATION

DEPARTMENT OF HIGHWAYS- ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 54

FOUNDATION SECTION

JOB 71-11022 LOCATION Co-Ord's: 672,701 N.; 801,392 E. ORIGINATED BY M.L.

W.P. 70-68-04 BORING DATE April 22, 1971 COMPILED BY W.A.

DATUM Geodetic BOREHOLE TYPE Washboring, NX Casing CHECKED BY

ELEV. / DEPTH	DESCRIPTION	STRAT. PLOT	SAMPLES NUMBER	TYPE	BLOWS/FOOT	ELEV. SCALE
660.3	Ground Level					
0.0	Slag & cinder Fill.					
653.3	Loose, black.		1	SS	9	
7.0	Gravelly sand, traces of silt. Compact		2	SS	45	650
			3	SS	23	
640.8						
19.5	Irregular seams of silt, clayey silt and silty clay. Traces of sand. Stiff to very stiff.		4	SS	7	640
			5	TW	PM	
			6	SS	8	
			7	SS	18	630
			8	SS	13	
			9	TW	PM	
			10	SS	11	620
612.8			11	SS	54	
47.5	Silt, traces of clay. Stiff to hard.		12	SS	17	610
			13	SS	9	
598.8			14	SS	49	600
61.5	End of Borehole.					590

DYNAMIC PENETRATION RESISTANCE
BLOWS / FOOT — 20 40 60 80 100

SHEAR STRENGTH P.S.F.
o UNCONFINED + FIELD VANE
● QUICK TRIAXIAL × LAB. VANE
1000 2000

LIQUID LIMIT —— w_L
PLASTIC LIMIT —— w_P
WATER CONTENT —— w
w_P w w_L
WATER CONTENT % 10 20 30

BULK DENSITY γ P.C.F.

REMARKS	GR. SA. SI. CL.
	21 70 (9)
	0 3 86 11

20
15 ⊹ 5 % STRAIN AT FAILURE
10

FORM OB-MT-126 (REV. 1969) OFFICE REPORT ON SOIL EXPLORATION

DEPARTMENT OF HIGHWAYS- ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 55

FOUNDATION SECTION

JOB 71-11022 LOCATION Co-Ord's: 672,670 N.; 801,502.5 E. ORIGINATED BY M.L.

W.P. 70-68-04 BORING DATE April 21, 1971 COMPILED BY W.A.

DATUM Geodetic BOREHOLE TYPE Washboring, NX Casing & Cone CHECKED BY

ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	SAMPLES NUMBER	TYPE	BLOWS/FOOT	ELEV. SCALE
662.6	Ground Level					
0.0	Slag and cinder fill. Compact. Black.		1	SS	17	660
			2	SS	11	
648.6						650
14.0	Gravelly sand.		3	SS	9	
646.1						
16.5	Irregular seams of silt, clayey silt and silty clay. Traces of sand and gravel.		4	SS	8	
			5	TW	PM	640
			6	SS	9	
			7	TW	PM	
			8	SS	21	630
			9	SS	31	
621.1	Stiff.		10	SS	27	
						620
41.5	End of Borehole.					

DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT — 20 40 60 80 100

SHEAR STRENGTH P.S.F.
○ UNCONFINED + FIELD VANE
● QUICK TRIAXIAL × LAB. VANE
1000 2000

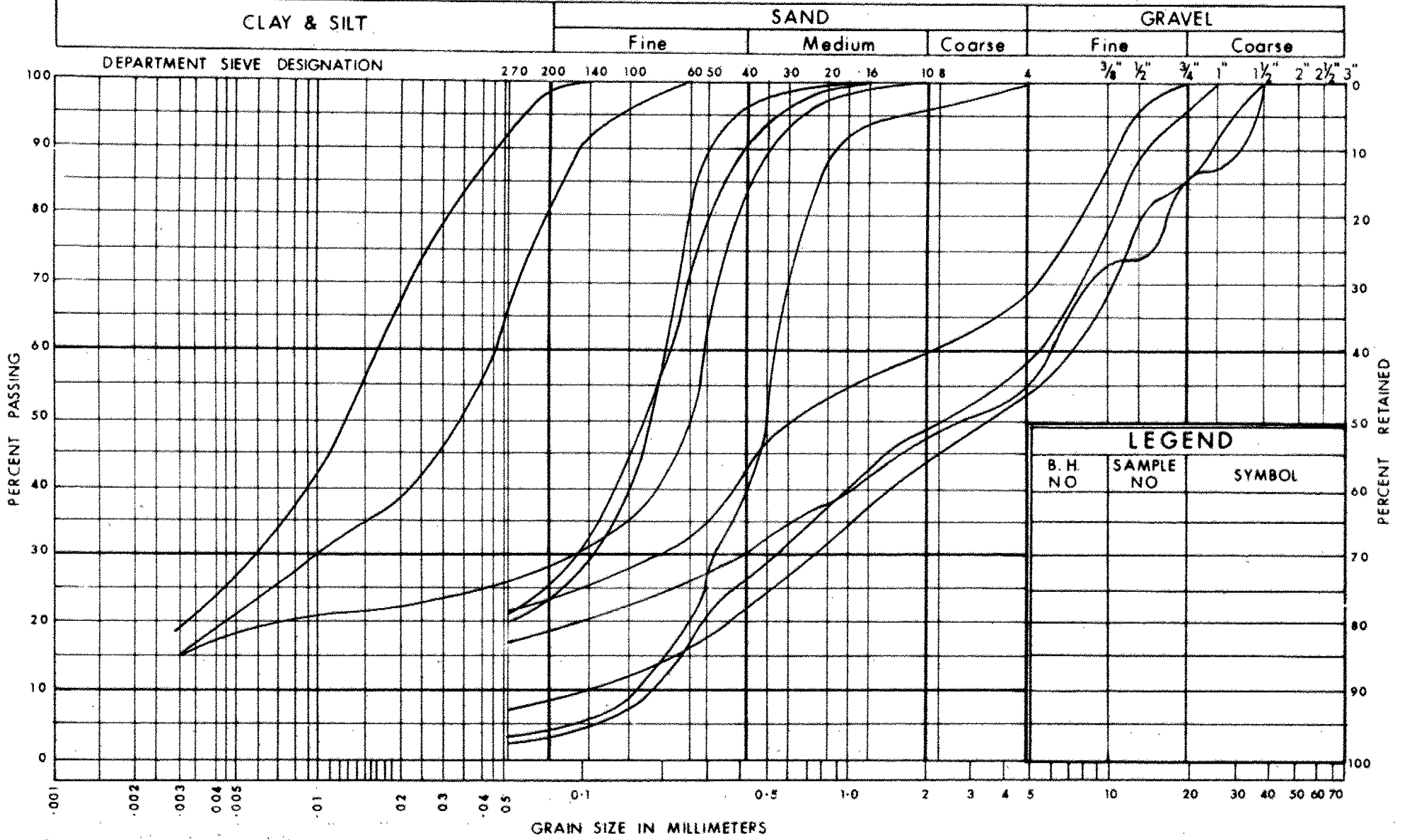
LIQUID LIMIT —— w_L
PLASTIC LIMIT —— w_P
WATER CONTENT —— w
WATER CONTENT % 10 20 30

BULK DENSITY γ P.C.F.	REMARKS GR.SA.SI.CL.
119	
126	
	0 4 73 23

20
15 ⊹ 5 % STRAIN AT FAILURE
10

FORM OB MT - 17
REV. APR. 196

UNIFIED SOIL CLASSIFICATION SYSTEM



DEPARTMENT OF HIGHWAYS
MATERIALS and TESTING DIVISION

GRAIN SIZE DISTRIBUTION

SURFICIAL SAND AND SILT STRATA

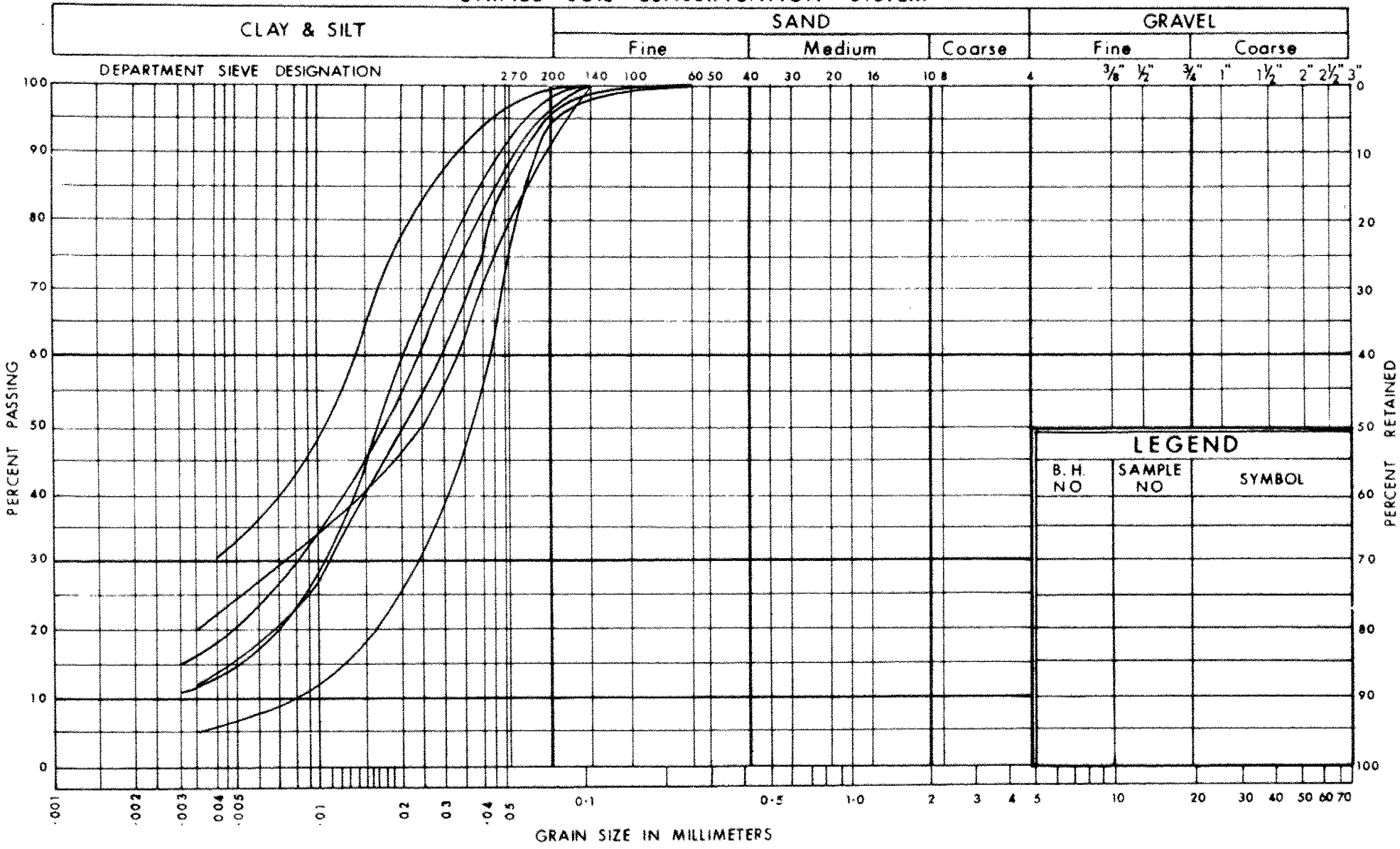
W.P. No. 70-68-04

JOB No: 71-11022

FIG. 1

FORM OB MT-17
REV. APR. 1968

UNIFIED SOIL CLASSIFICATION SYSTEM



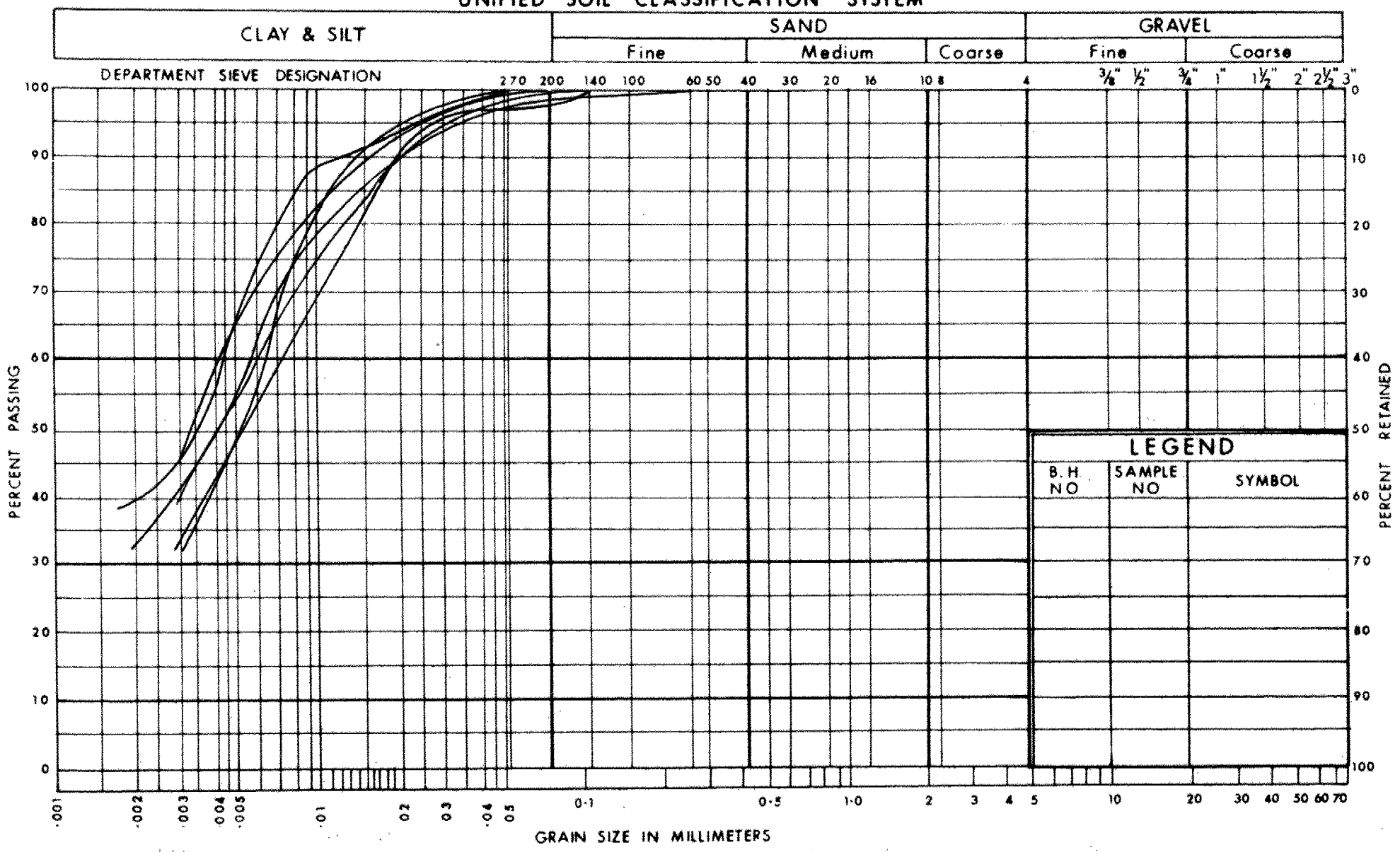
DEPARTMENT OF HIGHWAYS
MATERIALS and TESTING DIVISION

GRAIN SIZE DISTRIBUTION
SILT TO CLAYEY SILT PORTION OF THE STRATIFIED STRATUM

W.P. No. 70-68-04
JOB No: 71-11022
FIG. 2

FORM OB MT-37
REV. APR. 1968

UNIFIED SOIL CLASSIFICATION SYSTEM



DEPARTMENT OF HIGHWAYS
MATERIALS and TESTING DIVISION

GRAIN SIZE DISTRIBUTION

SILTY CLAY PORTION OF THE STRATIFIED STRATUM

W.P. No. 70-68-04

JOB No: 71-11022

FIG. 3

UNDRAINED SHEAR STRENGTH vs. ELEVATION

EAST END

Boreholes No. 44, 53, 54, 55

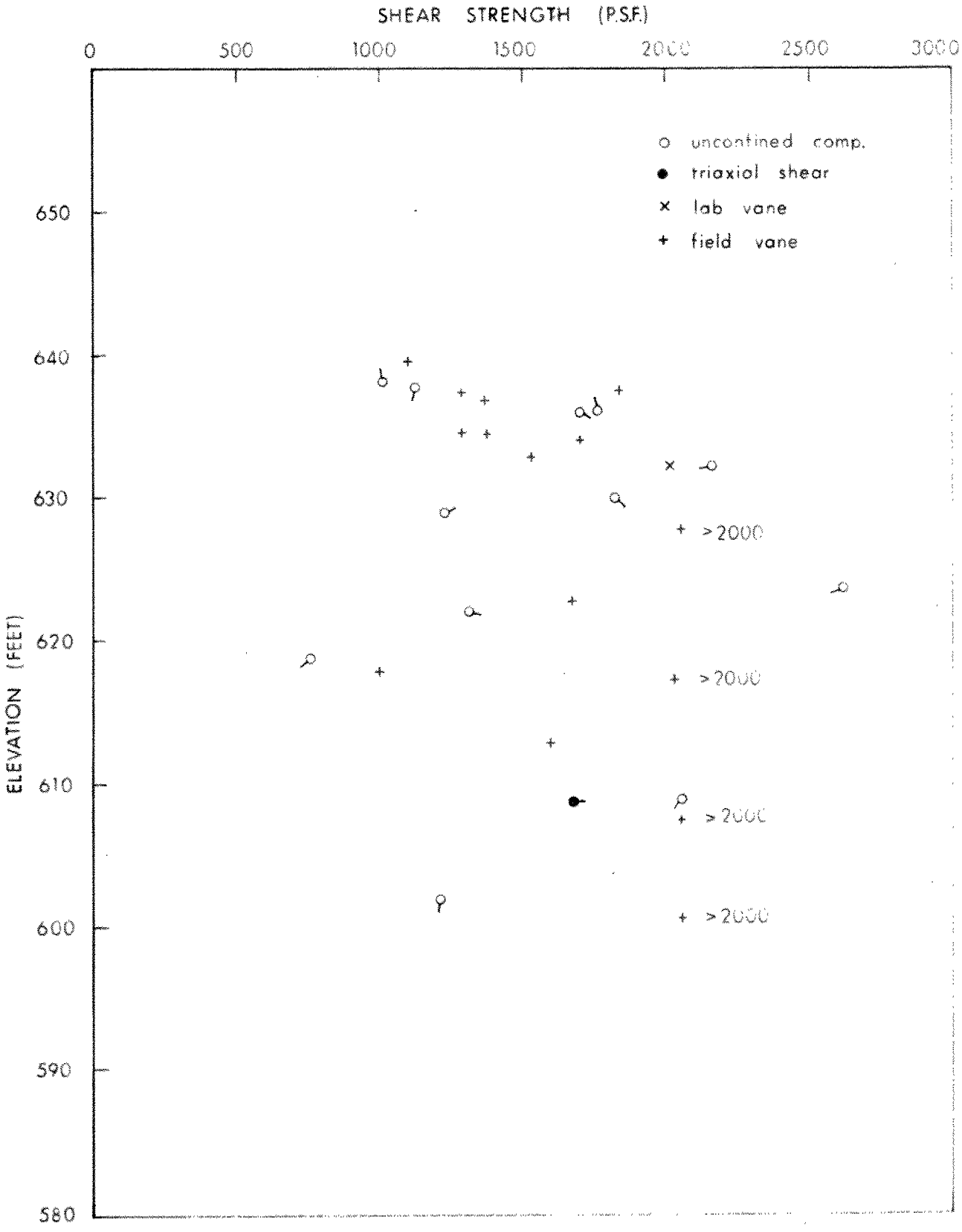


FIG. 4

71-1022

UNDRAINED SHEAR STRENGTH vs. ELEVATION

EXPRESSWAY - OVERHEAD

Boreholes No. 14, 15, 16, 17, 18

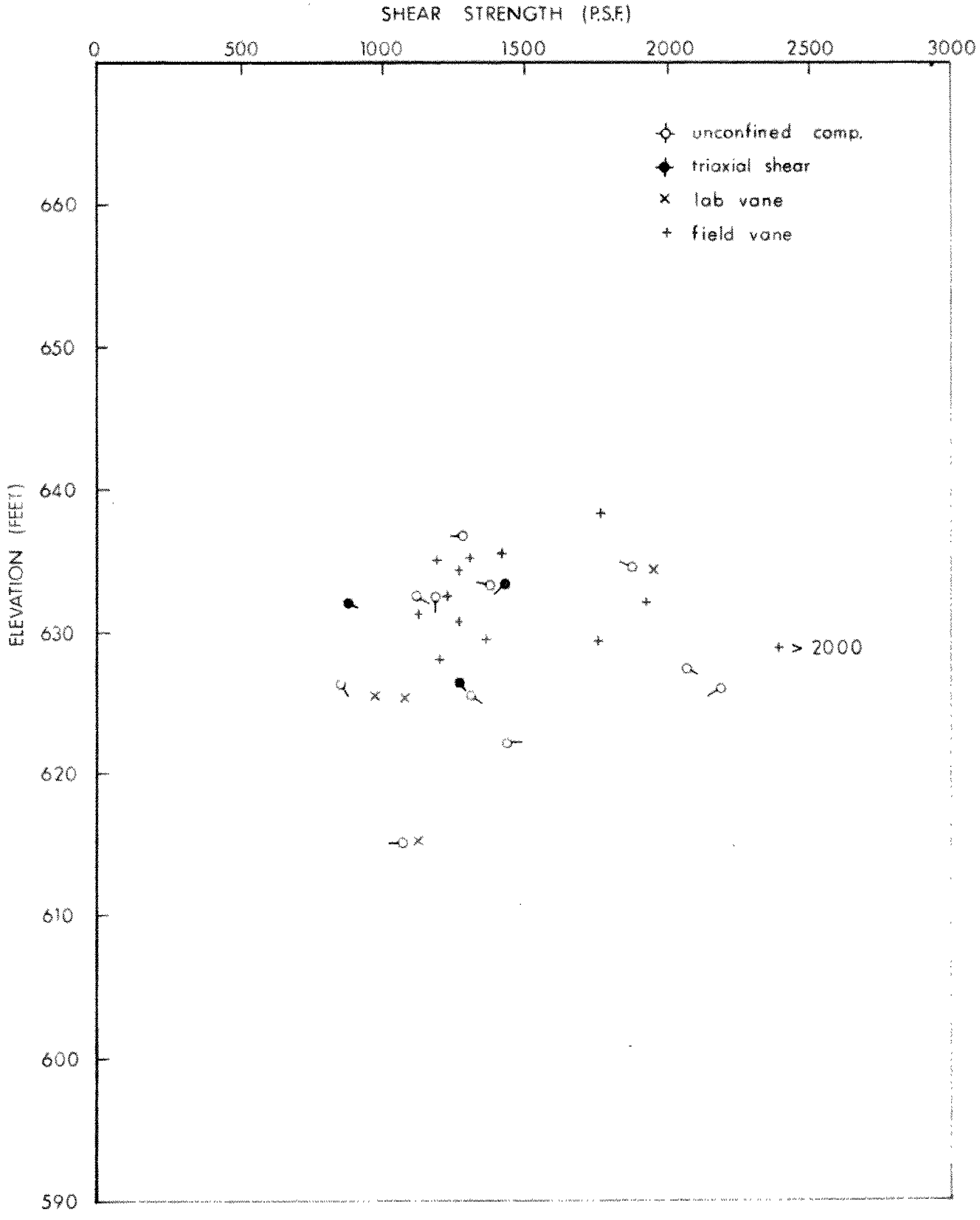


FIG. 5

71-11022

UNDRAINED SHEAR STRENGTH vs. ELEVATION

E-(NSW) RAMP - OVERHEAD

Boreholes No. 10, 11, 12, 13

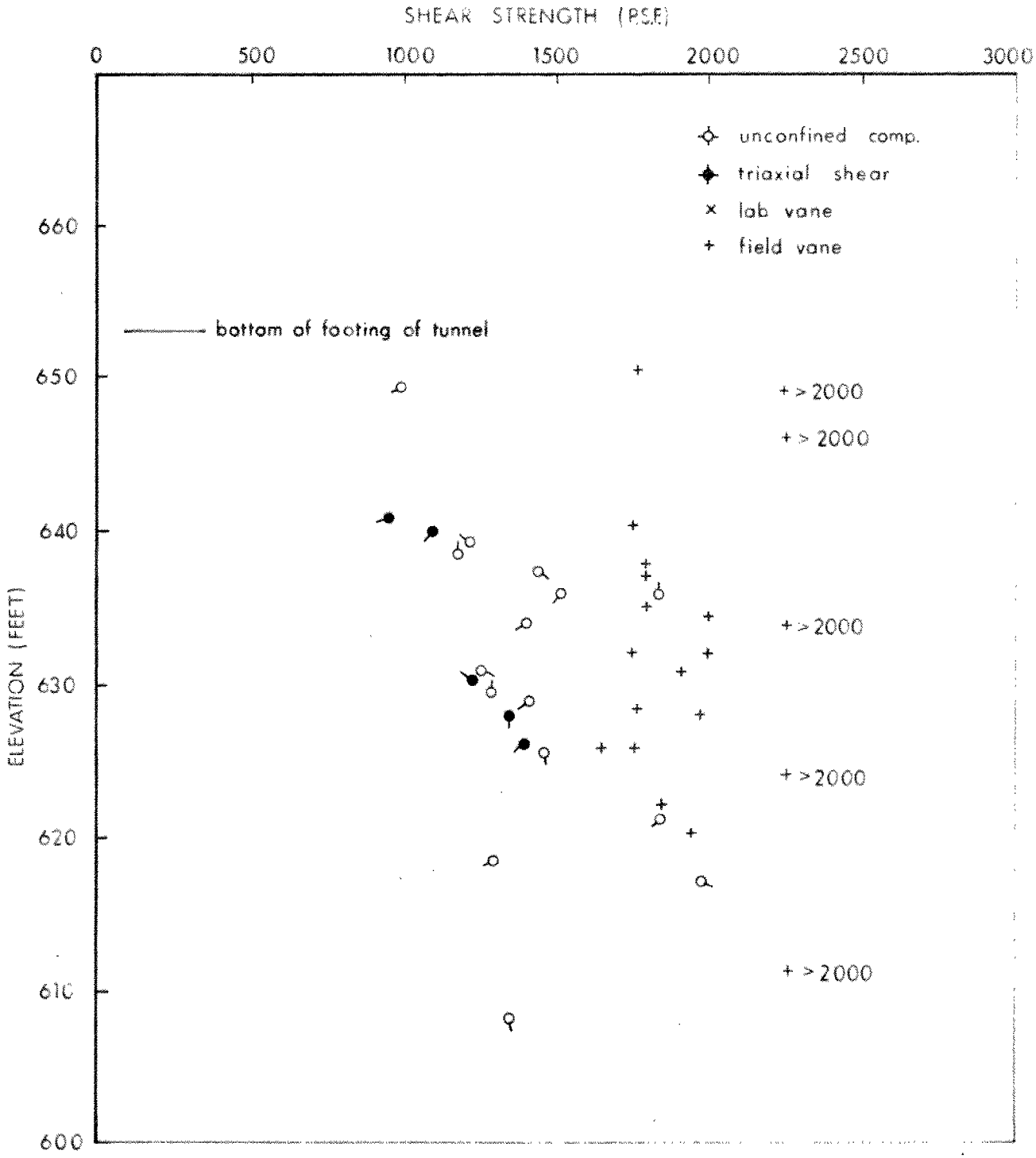


FIG. 6

71-11022

UNDRAINED SHEAR STRENGTH vs. ELEVATION
WEST OF RAMP - RETAINING WALL

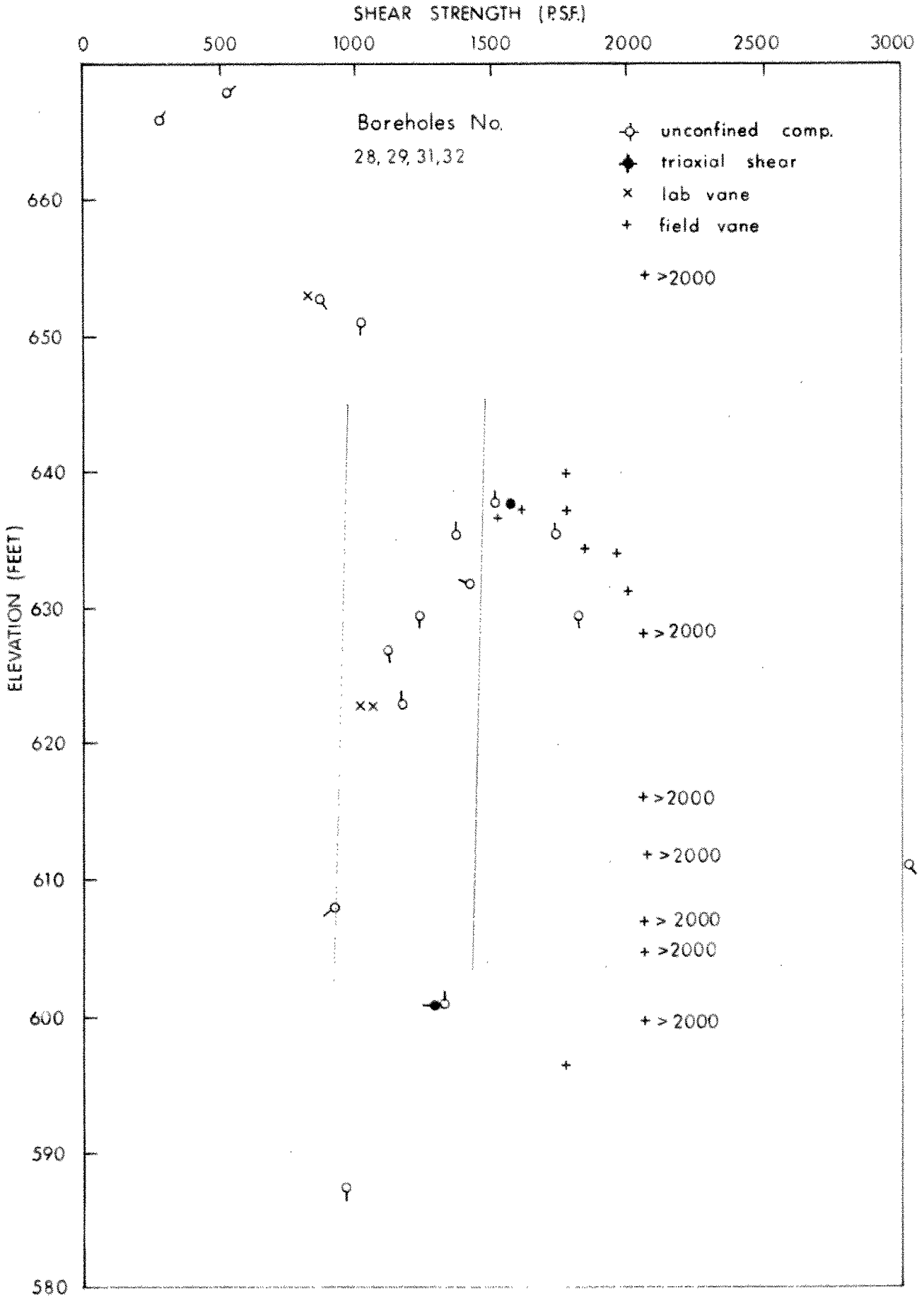


FIG. 7

71-11022

UNDRAINED SHEAR STRENGTH vs. ELEVATION

WEST END

Boreholes No. 25, 26, 27, 45, 46, 47, 48

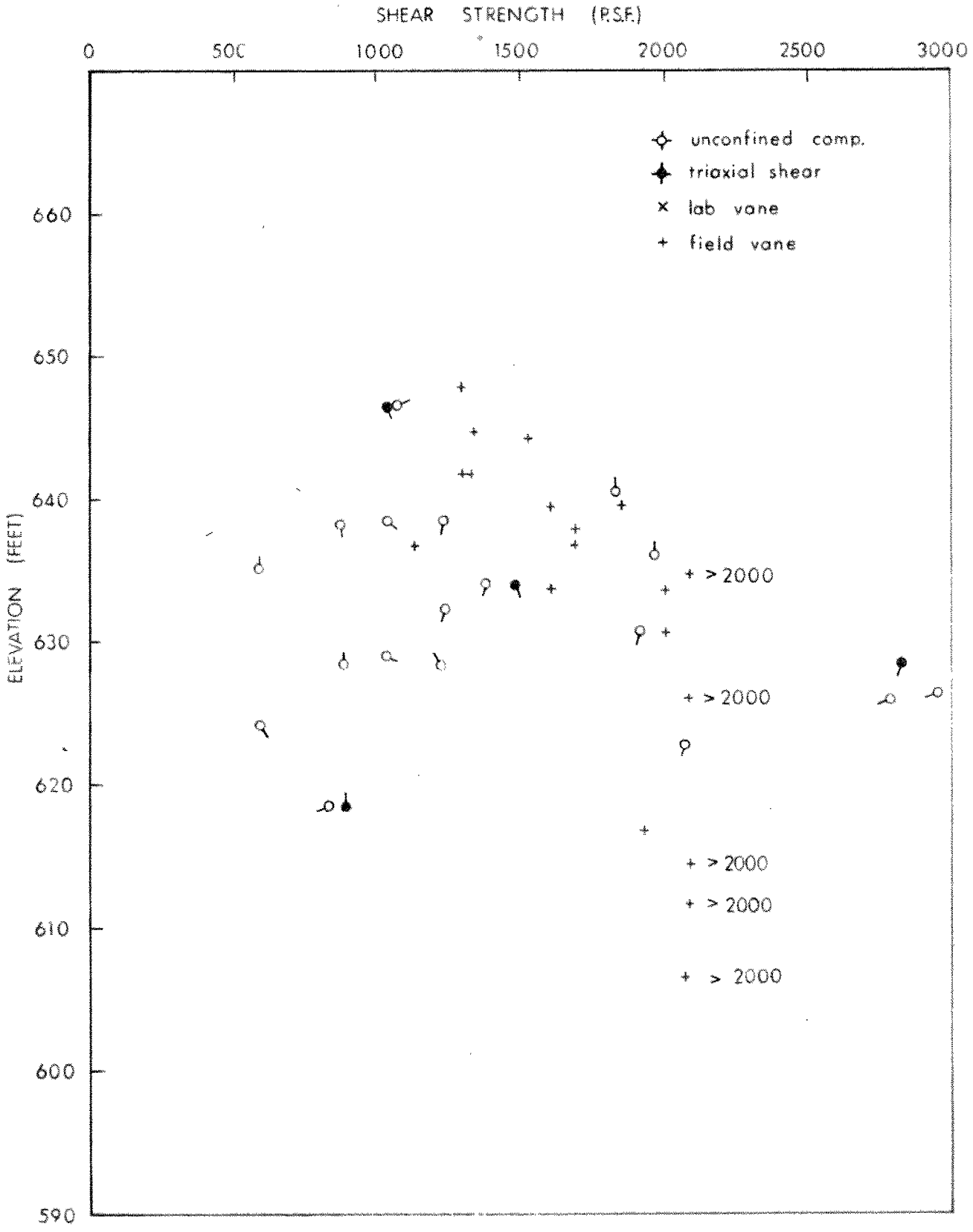
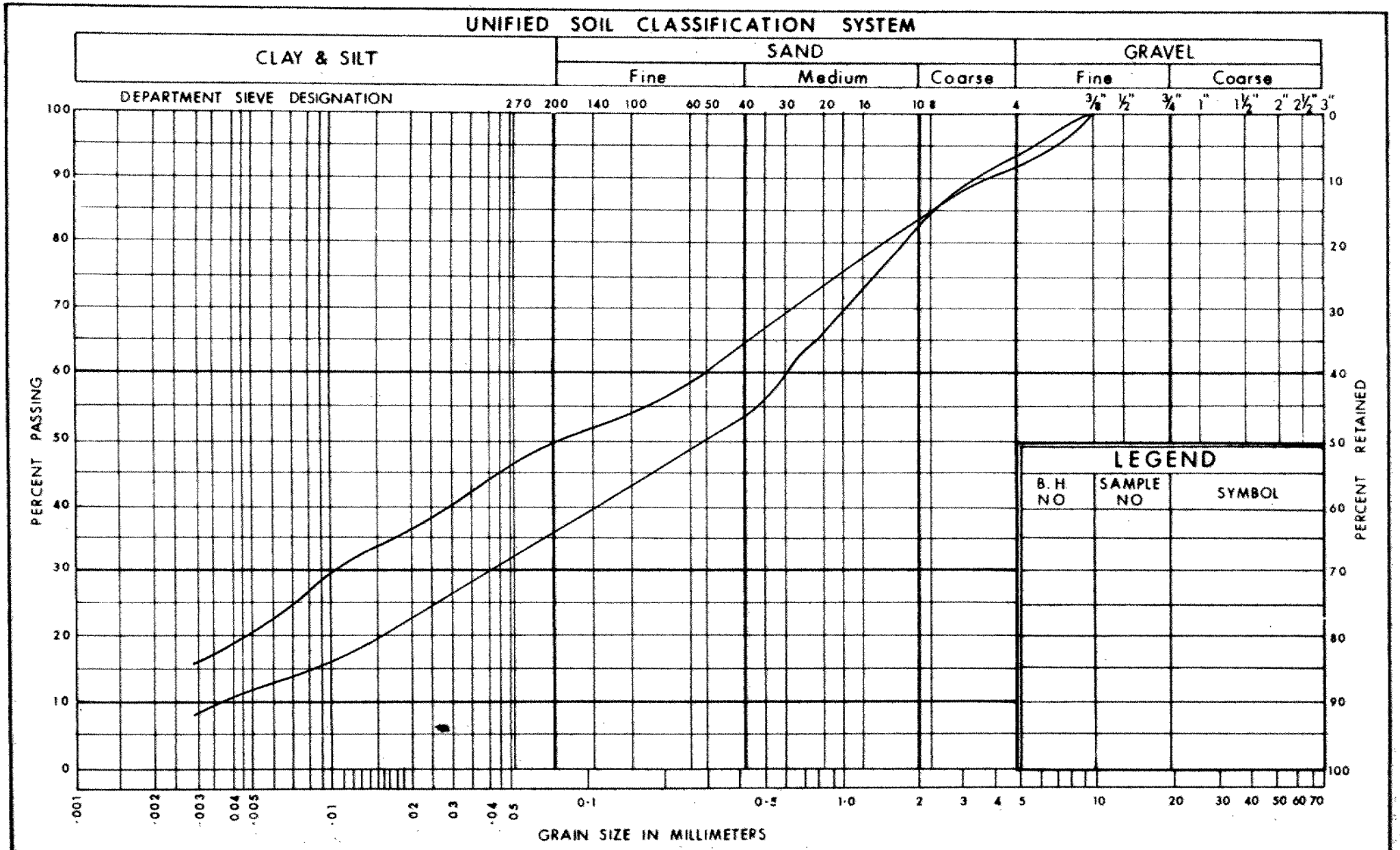


FIG 8

71-11022

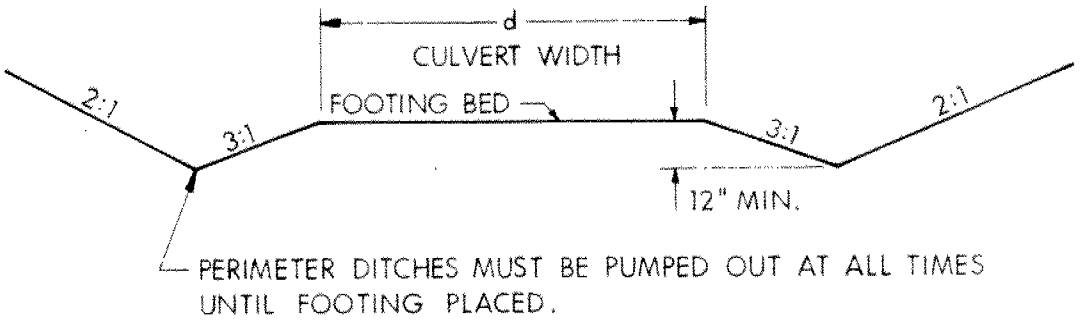
FORM OB MT - 17
REV. APR. 1965



DEPARTMENT OF HIGHWAYS
MATERIALS and TESTING DIVISION

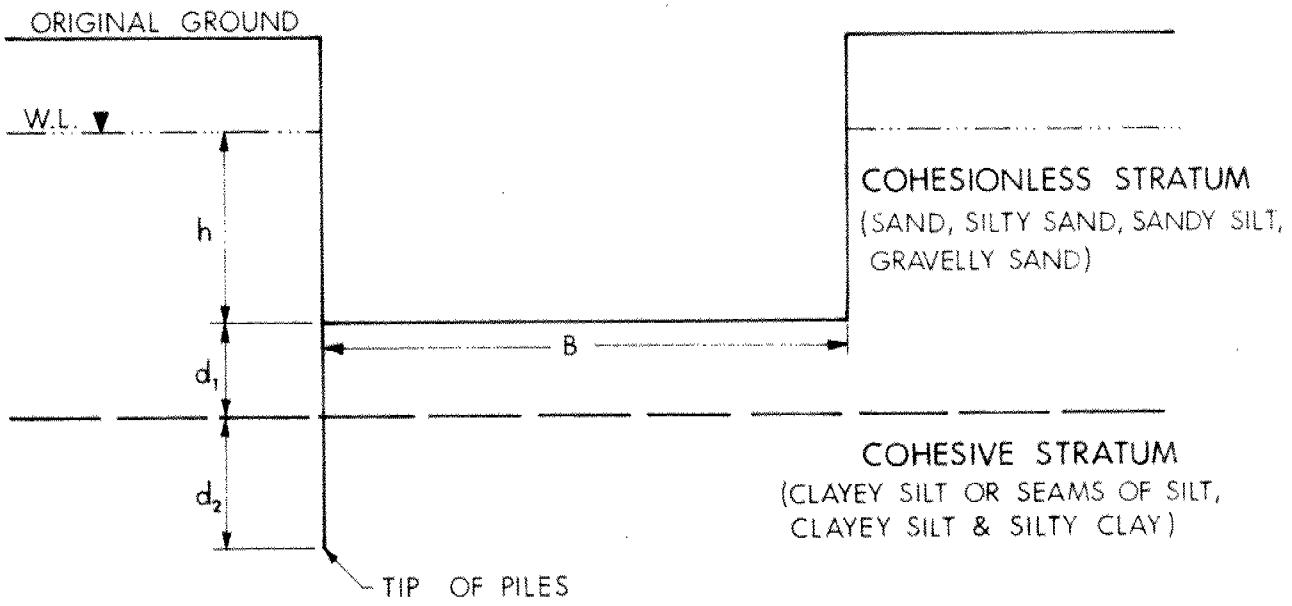
GRAIN SIZE DISTRIBUTION
GLACIAL TILLS

W.P. No. 70-68-04
JOB No: 71-11022
FIG. 9



PROPOSED OVERSIZE EXCAVATION

FIG. 10



$$FS = \frac{[(d_1 + d_2) \times B \times \gamma] + (d_2 \times 2 \times C_{ADH})}{(h + d_1 + d_2) \times \gamma_w} \geq 1$$

WHERE

FS = FACTOR OF SAFETY. SHOULD BE EQUAL TO OR GREATER THAN 1.

γ = BULK DENSITY OF SOIL. USE 125 PCF.

C_{ADH} = ADHESION BETWEEN PILE AND SOIL. USE 800 PSF.

γ_w = DENSITY OF WATER (62.4 PCF)

FORMULA SUGGESTED FOR THE RESTRICTION OF SHEET PILE LENGTHS

FIG. 11

71 - 11022

ABBREVIATIONS USED IN THIS REPORT

PENETRATION RESISTANCE

STANDARD PENETRATION RESISTANCE 'N' :- THE NUMBER OF BLOWS REQUIRED TO ADVANCE A STANDARD SPLIT SPOON SAMPLER 12 INCHES INTO THE SUBSOIL, DRIVEN BY MEANS OF A 140 POUND HAMMER FALLING FREELY A DISTANCE OF 30 INCHES.

DYNAMIC PENETRATION RESISTANCE :- THE NUMBER OF BLOWS REQUIRED TO ADVANCE A 2 INCH, 60 DEGREE CONE, FITTED TO THE END OF DRILL RODS, 12 INCHES INTO THE SUBSOIL, THE DRIVING ENERGY BEING 350 FOOT POUNDS PER BLOW.

DESCRIPTION OF SOIL

THE CONSISTENCY OF COHESIVE SOILS AND THE RELATIVE DENSITY OR DENSENESS OF COHESIONLESS SOILS ARE DESCRIBED IN THE FOLLOWING TERMS :-

CONSISTENCY	'N' BLOWS / FT.	c LB. / SQ. FT.	DENSENESS	'N' BLOWS / FT.
VERY SOFT	0 - 2	0 - 250	VERY LOOSE	0 - 4
SOFT	2 - 4	250 - 500	LOOSE	4 - 10
FIRM	4 - 8	500 - 1000	COMPACT	10 - 30
STIFF	8 - 15	1000 - 2000	DENSE	30 - 50
VERY STIFF	15 - 30	2000 - 4000	VERY DENSE	> 50
HARD	> 30	> 4000		

TYPE OF SAMPLE

S.S.	SPLIT SPOON	T.W.	THINWALL OPEN
W.S.	WASHED SAMPLE	T.P.	THINWALL PISTON
S.B.	SCRAPER BUCKET SAMPLE	O.S.	OESTERBERG SAMPLE
A.S.	AUGER SAMPLE	F.S.	FOIL SAMPLE
C.S.	CHUNK SAMPLE	R.C.	ROCK CORE
S.T.	SLOTTED TUBE SAMPLE		
	P.H. SAMPLE ADVANCED HYDRAULICALLY		
	P.M. SAMPLE ADVANCED MANUALLY		

SOIL TESTS

Qu	UNCONFINED COMPRESSION	L.V.	LABORATORY VANE
Q	UNDRAINED TRIAXIAL	F.V.	FIELD VANE
Qcu	CONSOLIDATED UNDRAINED TRIAXIAL	C	CONSOLIDATION
Qd	DRAINED TRIAXIAL	S	SENSITIVITY

ABBREVIATIONS USED IN THIS REPORT

SOIL PROPERTIES

γ	UNIT WEIGHT OF SOIL (BULK DENSITY)
γ_s	UNIT WEIGHT OF SOLID PARTICLES
γ_w	UNIT WEIGHT OF WATER
γ_d	UNIT DRY WEIGHT OF SOIL (DRY DENSITY)
γ'	UNIT WEIGHT OF SUBMERGED SOIL
G	SPECIFIC GRAVITY OF SOLID PARTICLES $G = \frac{\gamma_s}{\gamma_w}$
e	VOID RATIO
n	POROSITY
w	WATER CONTENT
S_r	DEGREE OF SATURATION
w_L	LIQUID LIMIT
w_P	PLASTIC LIMIT
I_P	PLASTICITY INDEX
s	SHRINKAGE LIMIT
I_L	LIQUIDITY INDEX $= \frac{w - w_P}{I_P}$
I_C	CONSISTENCY INDEX $= \frac{w_L - w}{I_P}$
e_{max}	VOID RATIO IN LOOSEST STATE
e_{min}	VOID RATIO IN DENSEST STATE
I_D	DENSITY INDEX $= \frac{e_{max} - e}{e_{max} - e_{min}}$
	RELATIVE DENSITY D_r IS ALSO USED
h	HYDRAULIC HEAD OR POTENTIAL
q	RATE OF DISCHARGE
v	VELOCITY OF FLOW
i	HYDRAULIC GRADIENT
k	COEFFICIENT OF PERMEABILITY
j	SEEPAGE FORCE PER UNIT VOLUME
m_v	COEFFICIENT OF VOLUME CHANGE $= \frac{-\Delta e}{(1+e)\Delta \sigma'}$
c_v	COEFFICIENT OF CONSOLIDATION
C_c	COMPRESSION INDEX $= \frac{\Delta e}{\Delta \log_{10} \sigma'}$
T_v	TIME FACTOR $= \frac{c_v t}{d^2}$ (d, DRAINAGE PATH)
U	DEGREE OF CONSOLIDATION
τ_f	SHEAR STRENGTH
c'	EFFECTIVE COHESION INTERCEPT
ϕ'	EFFECTIVE ANGLE OF SHEARING RESISTANCE, OR FRICTION
	IN TERMS OF EFFECTIVE STRESS $\tau_f = c' + \sigma' \tan \phi'$
c_u	APPARENT COHESION
ϕ_u	APPARENT ANGLE OF SHEARING RESISTANCE, OR FRICTION
	IN TERMS OF TOTAL STRESS $\tau_f = c_u + \sigma \tan \phi$
μ	COEFFICIENT OF FRICTION
S_t	SENSITIVITY

GENERAL

π	= 3·1416
e	BASE OF NATURAL LOGARITHMS 2·7183
$\log_e a$ OR $\ln a$	NATURAL LOGARITHM OF a
$\log_{10} a$ OR $\log a$	LOGARITHM OF a TO BASE 10
t	TIME
g	ACCELERATION DUE TO GRAVITY
V	VOLUME
W	WEIGHT
M	MOMENT
F	FACTOR OF SAFETY

STRESS AND STRAIN

u	PORE PRESSURE
σ	NORMAL STRESS
σ'	NORMAL EFFECTIVE STRESS ($\bar{\sigma}$ IS ALSO USED)
τ	SHEAR STRESS
ε	LINEAR STRAIN
γ	SHEAR STRAIN
ν	POISSON'S RATIO (μ IS ALSO USED)
E	MODULUS OF LINEAR DEFORMATION (YOUNGS MODULUS)
G	MODULUS OF SHEAR DEFORMATION
K	MODULUS OF COMPRESSIBILITY
η	COEFFICIENT OF VISCOSITY

EARTH PRESSURE

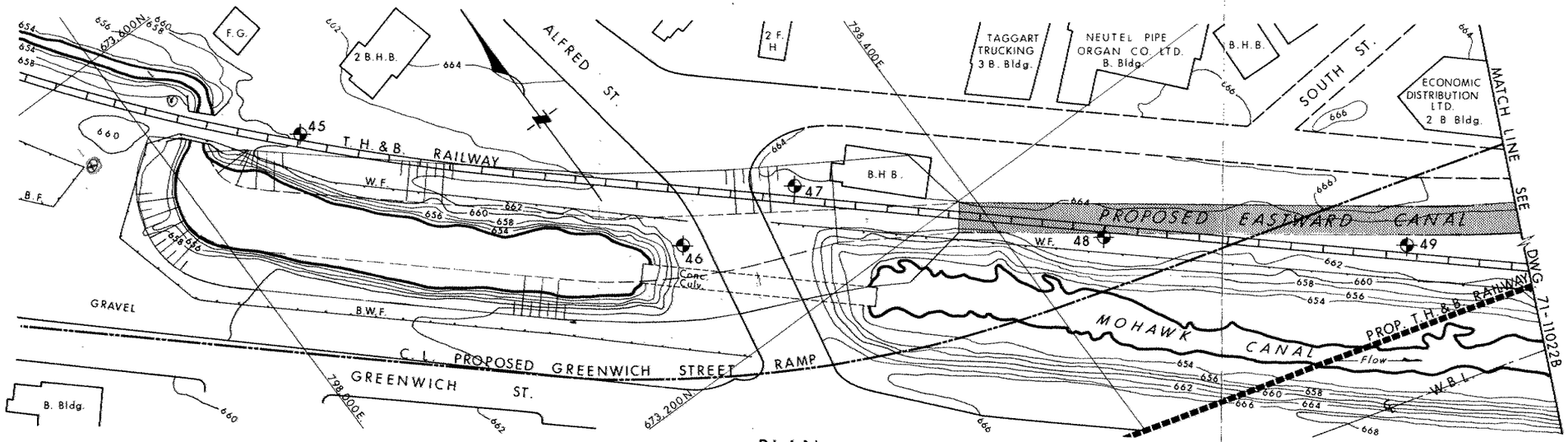
d	DISTANCE FROM TOP OF WALL TO POINT OF APPLICATION OF PRESSURE
δ	ANGLE OF WALL FRICTION
K	DIMENSIONLESS COEFFICIENT TO BE USED WITH VARIOUS SUFFIXES IN EXPRESSIONS REFERRING TO NORMAL STRESS ON WALLS
K_o	COEFFICIENT OF EARTH PRESSURE AT REST

FOUNDATIONS

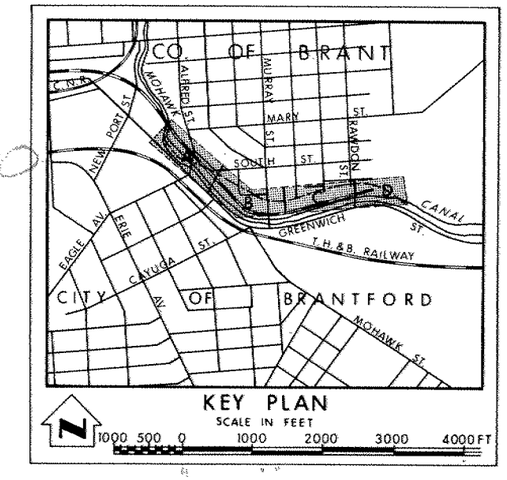
B	BREADTH OF FOUNDATION
L	LENGTH OF FOUNDATION
D	DEPTH OF FOUNDATION BENEATH GROUND
N	DIMENSIONLESS COEFFICIENT USED WITH A SUFFIX APPLYING TO SPECIFIC GRAVITY, DEPTH AND COHESION ETC. IN THE FORMULA FOR BEARING CAPACITY
k_s	MODULUS OF SUBGRADE REACTION

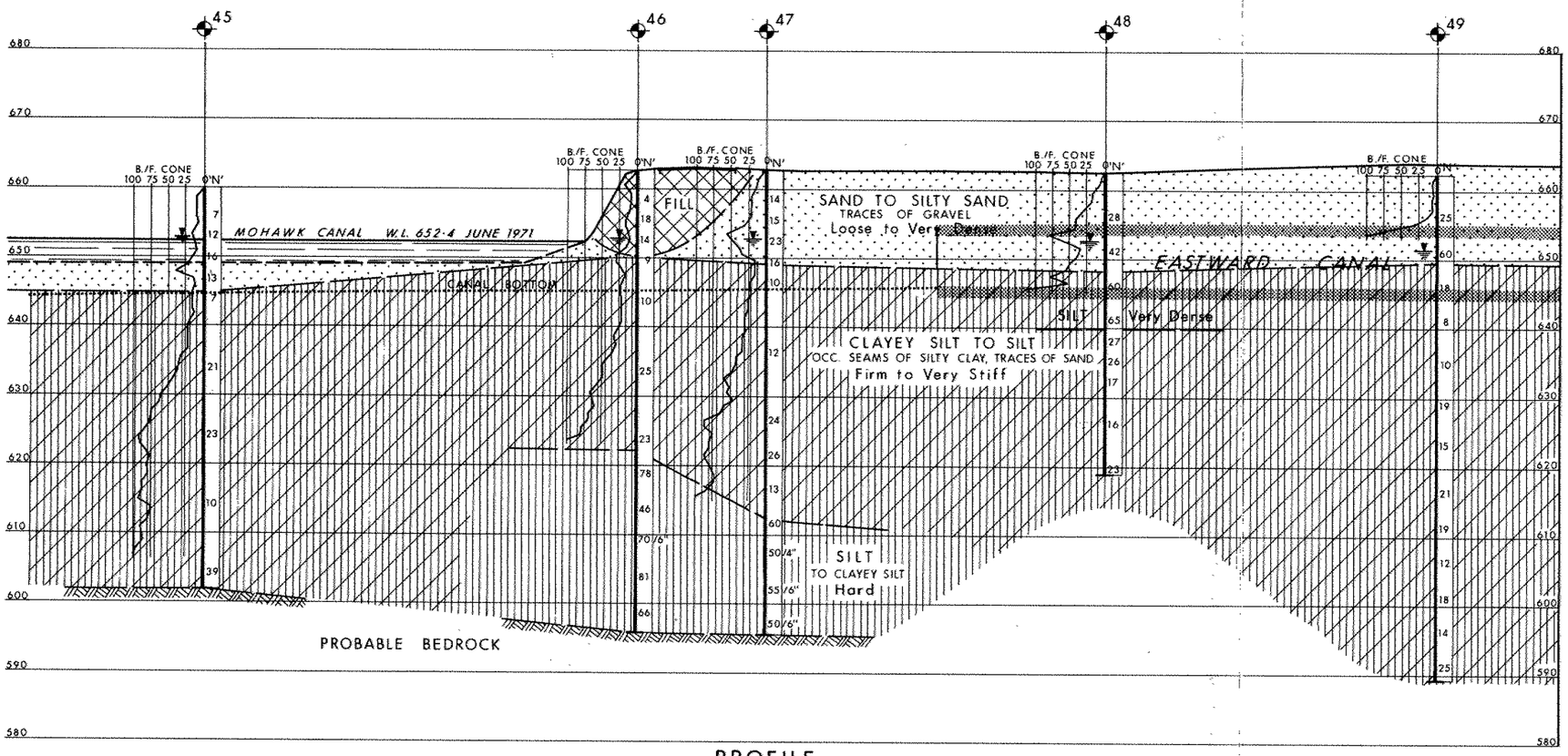
SLOPES

H	VERTICAL HEIGHT OF SLOPE
D	DEPTH BELOW TOE OF SLOPE TO HARD STRATUM
β	ANGLE OF SLOPE TO HORIZONTAL



PLAN
SCALE
40 20 0 40 80 FT.





PROFILE
SCALE
HORIZ. 40 20 0 40 80 FT.
VERT. 10 5 0 10 20 FT.

LEGEND

- Bore Hole
- Cone Penetration Test
- Bore Hole & Cone Test
- Water Levels established at time of field investigation. APRIL & MAY 1971

NO.	ELEVATION	CO-ORDINATES NORTH	CO-ORDINATES EAST
45	659.8	673,483	798,079
46	662.9	673,282	798,234
47	662.3	673,270	798,314
48	662.3	673,126	798,453
49	662.6	673,006	798,605

— 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.

REVISIONS

DATE	BY	DESCRIPTION

REF. NO. B 86-49

DEPARTMENT OF TRANSPORTATION & COMMUNICATIONS
DESIGN SERVICES BRANCH — FOUNDATION SECTION

EASTWARD CANAL

HIGHWAY NO. BRANTFORD EXPRESSWAY DIST. NO. 4
CO. BRANT CITY OF BRANTFORD
TWP. LOT CON.

BORE HOLE LOCATIONS & SOIL STRATA

SUBMD. A.B.	CHECKED 1)	W.P. NO. 70-68-04	DRAWING NO. 71-11022A
DRAWN	CHECKED 2)	JOB NO. 71-11022	
DATE June 15, 1971		SITE NO.	BRIDGE DRAWING NO.
APPROVED PRINCIPAL FOUNDATION ENGINEER		CONT. NO.	

OVERSIZE DRAWING

Foundation Section

Tel 248-3282
(Area Code 416)

Room 107, Lab. Bldg.,
Hwy. 401 & Keele St.,
Downsview 464, Ontario.

July 21, 1971

M.M. Dillon Ltd.,
120 Main St.,
GALT, Ontario.

Attention: Mr. A. Kobelak, P. Eng.,
Project Manager

Re: Brantford Expy. #2,
W.P. 70-68-0-4 W.O. 71-11022
Dist. #4 (Hamilton)

Dear Sirs:

As requested in your letter, dated July 14, 1971, we have reviewed the soil information in the vicinity of B.H.'s 28, 29, and 13 on the abovementioned project. We would not advise increasing the net-bearing pressure on the soil beyond the value of 1.3 t.s.f., recommended in the report and suggest that piles be used to support the structure where necessary.

Yours very truly,

K. G. Selby,
Supervising Foundation Engineer
For:
A. G. Stermac,
Principal Foundation Engineer

KGS/ht

c.c.: Messrs. A.P. Watt
J.L. Keen

Foundation Files
Gen. Files

(3.2) Open Channel

To reshape the connecting open channel section between the two culvert segments, cuts and fills will be required. All slopes should be constructed with 2:1 slopes.

(a) The fill sections should be constructed according to current MTC Standards. Granular 'B' is recommended as fill material. The top 12" (on slope) should consist of Granular 'A' to act as a filter. This zone should extend to the observed high water level. To protect the slopes against erosion, rip-rap should be provided.

(b) An approximate 12" thick Granular 'A' filter blanket should be placed on the cut slopes. Rip-rap should be provided as a means of protection against erosion.

4. GENERAL COMMENTS

This memorandum supersedes the 'Discussion and Recommendations' part of Foundation Investigation Report W.O. 72-11085 issued on November 1, 1972.

The memorandum should be attached to the above quoted Foundation Report.

Should additional information be required, please contact our Office.

P. PAYER
Senior Engineer

for: K. G. SELBY
Supervising Engineer.

c.c. E. J. Orr
B. R. Davis
R. S. Pillar
C. R. Robertson
B. J. Giroux
D. Gunter
G. A. Wrong
P. Lewycky
M. M. Dillon Ltd., Mr. A. Kobelak

Files
Record Services

J. Anderson)
R. Fitzgibbon) memo only

3. RECOMMENDATIONS

Our modified recommendations in connection with the newly proposed culverts and open channel construction are discussed below.

(3.1) Culverts

(a) Excavate muck in creek bed to its full vertical extent. Horizontally, the subexcavation should extend for a minimum distance of 5 ft. beyond the culvert sides, and replaced with suitable Granular material.

(b) A minimum 18" thick pad, consisting of Granular 'A' is required at the underside of the proposed box culverts.

(c) Net safe bearing capacity of 1.25 t.s.f. is suggested for the new box culverts.

(d) Since the compaction of the Granular 'A' pad and formation of the culvert floor requires dry conditions, a dewatering scheme will be necessary. This dewatering scheme may consist either of interlocking sheet piling driven to an approximate distance of 3 ft. into the cohesive stratum (i.e. Elev. 642±) or, an oversize excavation with perimeter ditches. These ditches should have a depth of 2 ft. below the bottom of the Granular 'A' pad.

(e) Long term settlements will take place within the cohesive deposit due to the culvert and embankment loading. It is estimated that the magnitude of settlement will be in the order of 1 - 2" under a 10 ft. high earth cover and 6 - 7" below a 20 ft. high embankment.
A joint system should be designed to accommodate the differential settlement under various fill heights.

(f) The backfill to the culvert should be according to current MTC Specifications. However, it would be advantageous for the backfill to consist of similar material as the existing creek banks (i.e. silty sand).

Ministry of Transportation and Communications
Ontario

W.P. 40-74-08

Memorandum

To: Mr. G. C. E. Burkhardt
Regional Structural Planning Engr.
Central Region
3501 Dufferin St., Downsview

Attention: Mr. W. M. Killin

From: Soil Mechanics Section
Geotechnical Office
West Building, Downsview

Date: April 7, 1975

Our File Ref. W.P. 40-74-05, -08

In Reply to

Subject: ADDENDUM TO FOUNDATION INVESTIGATION REPORT
FOR THE PROPOSED EAST WARD CREEK CULVERT(S)
W.P. 40-74-05 under B.S.A.R.
W.P. 40-74-08 under Murray St.
Brantford Southern Access Road
City of Brantford, District #4

1. INTRODUCTION

Since the issue of our original Foundation Report W.O. 72-11085 (formerly W.P. 70-68-04) dated November 1, 1972, new proposals have been submitted for the construction of the future East Ward Creek culverts by the B.S.A.R. Design Committee.

The new proposals call for construction of a single celled box culvert (9' X 12') under B.S.A.R. and a similar type culvert under Murray St. A reshaped open channel will connect the culverts. The invert of both culverts will be at Elev. 648±. A continuous, 9' X 12' S.P.P.A. culvert with invert level at Elev. 642-643 was proposed previously at this site. The ℄ of the future culvert will remain almost the same as formerly proposed.

In view of the current proposals, we have reviewed the validity of Foundation Investigation Report W.O. 72-11085 and our comments are as follows:

2. SUBSOIL CONDITIONS

For subsoil information, reference should be made to Foundation Investigation Reports W.O. 72-11085 and W.O. 71-11022 (formerly W.P. 70-68-04). We believe that the factual data contained in these Reports pertaining to the subsoil conditions will prove to be adequate for design and construction purposes.

DEPARTMENT OF TRANSPORTATION AND COMMUNICATIONS

MEMORANDUM

TO: Mr. J. G. Forster, (2)
Senior Soils Engineer,
Southwestern Region,
London, Ontario.

FROM: Foundations Office,
Design Services Branch,
West Bldg., Downsview.

ATTENTION:

DATE: October 5, 1972.

OUR FILE REF.

IN REPLY TO NOV 1 1972

SUBJECT:

40 P1-61

FOUNDATION INVESTIGATION REPORT
For
The Modified Proposal of the
Eastward Creek Culvert
Brantford Expressway #2
District #4 00
W.O. 72-11085 -- ~~W.P. 70-68-04~~
NEW WP: 40-74-05 AND 08

Attached we are forwarding to you our detailed foundation investigation report on the subsoil conditions existing at the above-mentioned site.

We believe that the factual data and recommendations contained therein will prove adequate for your design requirements. Should additional information be required, please do not hesitate to contact our Office.

A. G. Stermac,
PRINCIPAL FOUNDATIONS ENGINEER.

AGS/ao
Attach.
cc: E. J. Orr
B. R. Davis
A. Rutka
A. McConnell
C. R. Robertson
B. J. Giroux
A. P. Watt
J. R. Roy
G. A. Wrong
B. A. Singh
M. M. Dillon (Galt) - A. Kobelak

Foundations Files
Documents

TABLE OF CONTENTS

FOUNDATION INVESTIGATION REPORT
For
The Modified Proposal of the
Eastward Creek Culvert
Brantford Expressway #2
W.O. 72-11085 - W.P. 70-68-04

1. INTRODUCTION:

During the Brantford Expressway design subcommittee meeting on August 9, 1972, it was decided that a soil investigation should be carried out along the proposed eastward creek culvert. Subsequent to the meeting Mr. J. G. Forster, Senior Soils Engineer, Southwestern Region, confirmed the request for the investigation in a memo dated August 14, 1972. The present proposal of the eastward creek culvert utilizes the existing creek bed along the larger portion of its length, thus the alignment differs considerably from the one previously proposed.

The purpose of the recent investigation has been (a) to establish subsoil conditions at and below the proposed culvert excavations, (b) to determine dewatering problems in the excavations on account of the presence of susceptible soil strata, (c) to predict consolidation settlements along the section where a fill will be constructed above the culvert, (d) to recommend safe design loads at the bottom of the proposed arch culvert.

Presented in this report are the results of the investigation together with comments concerning above problems.

2. FIELD AND LABORATORY INVESTIGATIONS:

The recent investigation consisted of six sampled boreholes, placed in the creek, by employing a portable raft.

....2

Shallow holes, drilled previously and located on the banks of the creek were also used to estimate soil stratigraphy. A conventional diamond drill adapted for soil sampling purposes was used to advance the holes. Samples were recovered by means of split-spoon and Shelby tube samplers. In situ undrained shear strengths were determined in the borings by field vane tests.

Laboratory unconfined and quick triaxial tests were performed on undisturbed samples and the bulk densities calculated. Several Atterberg limit tests and grain size analyses were carried out in order to define physical characteristics and predict soil behaviour under unbalanced hydrostatic pressures. On the attached borelog sheets there are the results of all the field and laboratory tests.

The locations of the borings are marked on Drawings #72-11085A, B & C. The estimated stratigraphical profile shown on the drawings are based on the borelog sheets.

3. SUBSOIL CONDITIONS:

Boreholes located on the banks of the creek revealed a surficial deposit of fine sands, silty sands and gravelly sands. The lower boundary of this stratum lies around elevation 644-650 ft. This material was described at some length in our original report, numbered 71-11022 under section (4.3). To avoid redundancy it will not be repeated here. This sand and silty sand layer was entirely missing along the creek bed. The surficial layer in the creek was identified to be black organic muck of some 5-6 feet thickness, extending to approximate elevation 645-646 ft. The organic layer contains mainly silts and it is very soft with natural moisture contents in excess of 55-60%. This material has no engineering values.

Underlying the black muck a deep deposit of clayey silt with irregular layers of silt and thin seams of silty clay was found extending to elevation 583-597 ft. This is the

predominant deposit in Brantford and as such was discussed in all of our previous reports dealing with the proposed expressway (See Reports #71-11021, 71-11022, 71-11024, etc.). This stratified stratum under the creek bed was found to exhibit somewhat higher plasticities than elsewhere, pure silts being present mainly in the deeper elevations. The undrained shear strengths of the clayey silts under the proposed culvert invert is estimated to be 1000 - 1200 p.s.f.

Following the laminated deposits, glacial tills were observed, consisting of clayey silts with traces of sand and gravel, and silty sands with clay and gravel. The glacial deposit lies more than 50 ft. below the creek bed, thus will have no effect on the construction of the culvert.

The water level of the eastward creek during the field work was measured to be at elevation 652.2 - 652.3 ft. The depth of water of the creek varies between 1.0 ft. and 2.5 ft.

4. DISCUSSION AND RECOMMENDATIONS: *Superseded in following rpt of apr. 7/75*

4.1) General:

The present proposal calls for the construction of a 19' 14" x 12' 2" multi-plate arch culvert to replace the existing eastward canal. The upstream end of the culvert will be immediately east of the Eagle Ave.-Alfred St. bridge, running easterly for a distance of some 3,400 ft. A short section of the creek, west of the Murray-Mohawk structure will be built as open channel. The invert of the arch culvert will be around elevation 642 - 643 ft., some 7 - 8 ft. below existing creek bed. The culvert will be crossed by several fills, proposed to be built to carry the expressway, Greenwich St. and certain ramps. The depth of cover over the culvert at these locations will range from 6.5 ft. up to 26 ft.

4.2) Soil Stratigraphy:

Soil stratigraphy along the proposed culvert is shown on Drawing #72-11085A, B and C. The uppermost stratum was

identified to be sand, gravelly sand, silt and sandy silt, extending to elevation 644-650 ft. The existing creek bed is covered by a 5-6 ft. thick black organic muck. Under the sands and the muck, clayey silt with irregular seams of silt and silty clay were found within a considerable depth. The consistency of this layer varies between firm and very stiff.

4.3) Dewatering of the Excavations:

Excavations for the culvert will extend to elevation 640 - 642 ft. depending on the thickness of bedding. The average water level is at elevation 652 ft., some 10 - 12 ft. higher than the excavation bottom. The fine sands, sandy silts and silts are highly susceptible to conditions of unbalanced hydrostatic heads. The base of the excavations will, however, likely be within the irregularly stratified clayey silts. To evaluate the behaviour of this material when subjected to hydrostatic pressures is very difficult, on account of the presence of random seams. It is assumed that the silty clay and clayey silt seams have sufficient cohesion to resist uplift pressures. The silt seams and pockets, having no internal strength, will become 'quick' and will boil in the excavations under unbalanced water head. Boreholes placed in the creek bed indicated that soils within the zone effected by the future excavations contain mainly clayey silts, thus no blow out of the bottom may occur. Notwithstanding it is anticipated that some silt and sand intrusions will be encountered along the length of the culvert, causing unstable conditions. In view of the above, provisions should be provided for a dewatering scheme. Such scheme may consist of driving interlocking sheet piles down to a distance below the bottom of the excavation equal to or greater than the height of prevailing water head above it. In adopting this scheme water from the excavation may be pumped out without inducing quick conditions.

Other dewatering schemes such as construction of an oversize excavation and pumping from shallow perimeter sumps, or

a well point system could most probably be equally effective. Their effectiveness, though, cannot be established without the benefit of a full scale field test.

Whether the feasibility of these alternatives should be established in the design stage or whether it should be left to the Contractor to choose his own method is a matter that should be discussed and decided upon. It should be borne in mind that the effectiveness of one of the dewatering schemes is already established.

We feel that the choice of the dewatering scheme should remain the prerogative of the Contractor. The design should only specify that the integrity of the bottom of the foundation excavation shall be preserved under any and all circumstances and conditions. A method to achieve this could but not necessarily should be shown on the design drawings. The Contractor's attention should, though, be drawn to the fact that unless an appropriate dewatering scheme is applied the deterioration of the excavation bottom may occur and it will be his responsibility to rectify it and it will be at his expense.

4.4) Settlements:

a) Long term settlements will take place under the arch culvert along those lengths, where additional fills will be constructed over the culvert, due to the consolidation of cohesive strata. Consolidation settlements were calculated, using laboratory compression curves. Two such curves (void ration versus log. pressure) are shown on Fig. #1 & 2. Stresses caused by the embankment loads were computed by the elastic theory according to Boussinesq. It appears that critical conditions may arise around culvert Sta. 22+00 near the west abutment of the eastbound structure, where differential settlements could cause culvert deformations. As a consequence settlements were calculated under this location (finite end condition).
Assuming the height of the approach fill to be 20 ft, settlements beneath the culvert will be around 6-7 inches. In the case of a 26 ft. approach fill the predicted settlements will be 11 - 12 inches.

....6

The rate of settlements will likely be realtively fast, since pore pressures will dissipate along the more pervious seams and layers. As a rough estimate some 10 years may be assumed for 90% consolidation.

b) Small additional settlements are anticipated to take place immediately upon placing the fills due to the elastic deformations of the subsoil. Elastic settlements are not expected to exceed 1 - 2 inches.

c) Further settlements will also take place along the entire length of the construction because of the lowering of the water table. It is assumed that the creek water will be lowered some 10 ft., which in turn will permanently depress the groundwater in the adjacent areas. This increase of effective overburden pressure will produce settlements, that will be roughly proportional to the descent of the piezometric level. The magnitude of this settlement might be in the order of 1-3 inches.

4.5) Bearing Capacity of the Subsoil:

Below the proposed invert elevation the clayey silts will support safe design loads of 1.2 t.s.f. No bearing capacity problems will be encountered below the arch culvert, due to the imposed vertical loads. Corner bearing pressures will, however, exceed the allowable bearing capacity, under high fills and railway crossings. At these locations beddings should be so designed as to be able to distribute the applied stresses to such an extent, that the remaining stresses at the interface of the bedding and the in situ soil be not more than 1.2 t.s.f.

It is estimated that along the length of the culvert, where stresses at the haunches will be between 4 t.s.f. and 5 t.s.f. the bedding should horizontally extend to a distance of 6 ft., measured at the top of the corner radius of the pipe arch. The depth of the bedding below the culvert invert should be at least 30 inches as shown on Fig. #3.

At those locations where the applied stresses on the haunches of the arch culvert will be between 5 t.s.f. and 6 t.s.f., the

depth of bedding should be increased from 2.5 ft. to 3 ft. The horizontal extent of the backfill, may remain 6 ft.

Along the length of the culvert where stresses at the haunches will be 4 t.s.f. or less, bedding dimensions used in the preliminary design - submitted by Mr. A. Kobelak of M. M. Dillon & Company during the August 30, 1972, Subcommittee meeting - are acceptable.

Bedding at the haunches should be constructed with granular "A" material, compacted to at least 95% Proctor density. It is to be pointed out, that the bottom of the excavation must be entirely dry and undisturbed in order to achieve proper compaction.

It is felt that the removal of sheet piles after completion of the bedding might cause some loosening of the in situ soil and the granular "A", resulting in a small lateral displacement of the bedding. In our estimate this lateral yield would not be more than 1 inch, at both sides. Removal of the sheet piles should, therefore, depend on whether or not the culvert could tolerate such a movement.

Regardless of above comments it is recommended that in the event of using sheet piles at those locations where stresses at the haunches exceeds 5 t.s.f., piles be left in place to facilitate proper compaction of the backfill.

5. MISCELLANEOUS:

The field work carried out during the period of August 21 - September 7, 1972, was supervised by Mr. P. Korgemagi, Project Foundations Engineer.

Equipment used was owned and operated by P.V.K. & Sons Drilling Company, Burford, Ontario.

This report was written by Mr. A. K. Barsvary, Senior Foundations Engineer and reviewed by Mr. K. G. Selby, Supervising Foundations Engineer.

A. K. Barsvary, P. Eng.

K. G. Selby, P. Eng.

AKB/ao
October 4, 1972.

Ministry of Transportation and Communications
Ontario

Memorandum

W.P. ~~70-68-04~~ 40-74-05, -08

To: Mr. G. C. E. Burkhardt
Regional Structural Planning Engr.
Central Region
3501 Dufferin St., Downsview

Attention: Mr. W. M. Killin

From: Soil Mechanics Section
Geotechnical Office
West Building, Downsview

Date: April 7, 1975

Our File Ref. W.P. 40-74-05, -08

In Reply to

Subject: ADDENDUM TO FOUNDATION INVESTIGATION REPORT
FOR THE PROPOSED EAST WARD CREEK CULVERT(S)
W.P. 40-74-05 under B.S.A.R.
W.P. 40-74-08 under Murray St.
Brantford Southern Access Road
City of Brantford, District #4

1. INTRODUCTION

Since the issue of our original Foundation Report W.O. 72-11085 (formerly W.P. 70-68-04) dated November 1, 1972, new proposals have been submitted for the construction of the future East Ward Creek culverts by the B.S.A.R. Design Committee.

The new proposals call for construction of a single celled box culvert (9' X 12') under B.S.A.R. and a similar type culvert under Murray St. A reshaped open channel will connect the culverts. The invert of both culverts will be at Elev. 648±. A continuous, 9' X 12' S.P.P.A. culvert with invert level at Elev. 642-643 was proposed previously at this site. The ℄ of the future culvert will remain almost the same as formerly proposed.

In view of the current proposals, we have reviewed the validity of Foundation Investigation Report W.O. 72-11085 and our comments are as follows:

2. SUBSOIL CONDITIONS

For subsoil information, reference should be made to Foundation Investigation Reports W.O. 72-11085 and W.O. 71-11022 (formerly W.P. 70-68-04). We believe that the factual data contained in these Reports pertaining to the subsoil conditions will prove to be adequate for design and construction purposes.

3. RECOMMENDATIONS

Our modified recommendations in connection with the newly proposed culverts and open channel construction are discussed below.

(3.1) Culverts

(a) Excavate muck in creek bed to its full vertical extent. Horizontally, the subexcavation should extend for a minimum distance of 5 ft. beyond the culvert sides, and replaced with suitable Granular material.

(b) A minimum 18" thick pad, consisting of Granular 'A' is required at the underside of the proposed box culverts.

(c) Net safe bearing capacity of 1.25 t.s.f. is suggested for the new box culverts.

(d) Since the compaction of the Granular 'A' pad and formation of the culvert floor requires dry conditions, a dewatering scheme will be necessary. This dewatering scheme may consist either of interlocking sheet piling driven to an approximate distance of 3 ft. into the cohesive stratum (i.e. Elev. 642±) or, an oversize excavation with perimeter ditches. These ditches should have a depth of 2 ft. below the bottom of the Granular 'A' pad.

(e) Long term settlements will take place within the cohesive deposit due to the culvert and embankment loading. It is estimated that the magnitude of settlement will be in the order of 1 - 2" under a 10 ft. high earth cover and 6 - 7" below a 20 ft. high embankment.
A joint system should be designed to accommodate the differential settlement under various fill heights.

(f) The backfill to the culvert should be according to current MTC Specifications. However, it would be advantageous for the backfill to consist of similar material as the existing creek banks (i.e. silty sand).

(3.2) Open Channel

To reshape the connecting open channel section between the two culvert segments, cuts and fills will be required. All slopes should be constructed with 2:1 slopes.

(a) The fill sections should be constructed according to current MTC Standards. Granular 'B' is recommended as fill material. The top 12" (on slope) should consist of Granular 'A' to act as a filter. This zone should extend to the observed high water level. To protect the slopes against erosion, rip-rap should be provided.

(b) An approximate 12" thick Granular 'A' filter blanket should be placed on the cut slopes. Rip-rap should be provided as a means of protection against erosion.

4. GENERAL COMMENTS

This memorandum supersedes the 'Discussion and Recommendations' part of Foundation Investigation Report W.O. 72-11085 issued on November 1, 1972.

The memorandum should be attached to the above quoted Foundation Report.

Should additional information be required, please contact our Office.

P. PAYER
Senior Engineer

for: K. G. SELBY
Supervising Engineer.

c.c. E. J. Orr
B. R. Davis
R. S. Pillar
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B. J. Giroux
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G. A. Wrong
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M. M. Dillon Ltd., Mr. A. Kobelak
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J. Anderson)
R. Fitzgibbon) memo only

APPENDIX I

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS-ONTARIO

DESIGN SERVICES BRANCH — FOUNDATIONS OFFICE

RECORD OF BOREHOLE Nº 101

JOB 72-11085 — LOCATION Co-ords. 15,673,075 N; 798,503 E. — ORIGINATED BY PM

W.P. 70-68-00 — BORING DATE July 17, 1972 — COMPILED BY AKB

DATUM Geodetic — BOREHOLE TYPE Holow Stem Auger — CHECKED BY

ELEV. / DEPTH	DESCRIPTION	STRAT. PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/FOOT	ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT; SHEAR STRENGTH P.S.F. (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE) 1000 2000	LIQUID LIMIT W_L, PLASTIC LIMIT W_P, WATER CONTENT W, WATER CONTENT % 10 20 30	BULK DENSITY γ P.C.F.	REMARKS GR. SA. SI. CL.
662.3	Ground Level									
0.0	Fine sand becoming gravelly sand. Compact to Dense Brown		1	SS	22	660				
			2	SS	26					
			3	SS	62					0 94 (6)
			4	SS	37					
648.9			5	SS	47	650				18 75 (7)
13.4	Clayey silt with irregular seams of silt and silty clay. Stiff to Very Stiff Grey and Brown		6	SS	28					0 1 76 23
			7	SS	25					
			8	SS	22					
			9	SS	20					
			10	SS	28	640				0 0 72 28
			11	SS	22					
			12	SS	19					
			13	SS	11					
			14	TW	PM					
			15	SS	28	630			123	
			16	SS	21					
			17	SS	18					
			18	SS	16					
620.3			19	SS	16					
42.0	End of Borehole									

15 20 10 5 % STRAIN AT FAILURE

OFFICE REPORT ON SOIL EXPLORATION

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS – ONTARIO

DESIGN SERVICES BRANCH — FOUNDATIONS OFFICE

RECORD OF BOREHOLE Nº 102

JOB 72-11085 — LOCATION Co-ords. 15,672,732N; 798,827 E. — ORIGINATED BY PM

W.P. 70-68-00 — BORING DATE July 19, 1972 — COMPILED BY AKB

DATUM Geodetic — BOREHOLE TYPE Washboring BX Casing — CHECKED BY

SOIL PROFILE ELEV./DEPTH	DESCRIPTION	STRAT. PLOT	SAMPLES NUMBER	TYPE	BLOWS/FOOT	ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS/FOOT / SHEAR STRENGTH P.S.F. (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE)	LIQUID LIMIT w_L / PLASTIC LIMIT w_P / WATER CONTENT w — WATER CONTENT % (10 20 30)	BULK DENSITY γ P.C.F.	REMARKS GR. SA. SI. CL.
655.0	Ground Level									
0.0	Fine sand to gravelly sand.		1	SS	13					
			2	SS	23					
			3	SS	28	650				
			4	SS	17					
644.0	Compact		5	SS	12					
11.0	Seams of silt and clayey silt.		6	SS	12					1 6 76 17
										0 2 82 16
638.5	Stiff		7	SS	10	640				0 0 75 25
16.5	End of Borehole									

OFFICE REPORT ON SOIL EXPLORATION

15 20 10 ◇ 5 % STRAIN AT FAILURE

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS – ONTARIO

DESIGN SERVICES BRANCH — FOUNDATIONS OFFICE

RECORD OF BOREHOLE Nº 103

JOB 72-11085 LOCATION Co-ords. 15,672,405 N; 799,169 E. ORIGINATED BY PM

W.P. 70-68-00 BORING DATE July 20, 1972 COMPILED BY AKB

DATUM Geodetic BOREHOLE TYPE Washboring, BX Casing CHECKED BY

SOIL PROFILE ELEV./DEPTH	DESCRIPTION	STRAT. PLOT	SAMPLES NUMBER	TYPE	BLOWS/FOOT	ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT / SHEAR STRENGTH P.S.F. ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE	LIQUID LIMIT W_L / PLASTIC LIMIT W_P / WATER CONTENT W — WATER CONTENT % 10 20 30	BULK DENSITY γ P.C.F.	REMARKS GR.SA.SI.CL.
652.8	Ground Level									
0.0	Gravelly sand, some silt.		1	SS	2					
			2	SS	10	650		○		18 67 (15)
	Very loose to Compact		3	SS	16			○		
644.3			4	SS	18					
8.5	Clayey silt to silt.							⊢○⊣		
638.3	Stiff		5	SS	9	640		⊢○⊣		0 1 76 23
14.5	End of Borehole									

OFFICE REPORT ON SOIL EXPLORATION

20
15 ◇ 5 % STRAIN AT FAILURE
10

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS – ONTARIO

DESIGN SERVICES BRANCH — FOUNDATIONS OFFICE

RECORD OF BOREHOLE Nº 104

JOB , 72-11085 — LOCATION Co-ords. 15,672,531 N; 799,660 E. — ORIGINATED BY PM

W.P. 70-68-00 — BORING DATE July 20, 1972 — COMPILED BY A.K.T.

DATUM Geodetic — BOREHOLE TYPE Hollow Stem Auger — CHECKED BY

ELEV. / DEPTH	DESCRIPTION	STRAT. PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/FOOT	ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT / SHEAR STRENGTH P.S.F. (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE)	LIQUID LIMIT w_L / PLASTIC LIMIT w_P / WATER CONTENT w — WATER CONTENT % (10 20 30)	BULK DENSITY γ P.C.F.	REMARKS GR. SA. SI. CL.
665.3	Ground Level									
0.0	Slightly organic silt Fill		1	SS	11					
			2	SS	9	660				
			3	SS	12					
	Stiff		4	SS	14					
654.9										
10.4	Silty sand.		5	SS	24					0 68 27 5
652.1			6	SS	29					
13.2	Clayey silt to silt.		7	SS	12	650				0 6 73 21
			8	SS	12					
			9	SS	16					
	Stiff		10	SS	15					
			11	SS	12					0 0 86 14
	Grey		12	SS	9	640				
639.8										
25.5	End of Borehole									

OFFICE REPORT ON SOIL EXPLORATION

20
15 ⊹ 5 % STRAIN AT FAILURE
10

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS – ONTARIO

DESIGN SERVICES BRANCH — FOUNDATIONS OFFICE

RECORD OF BOREHOLE Nº 105

JOB 72-11085 — LOCATION Co-ords. 15,672,658 N; 800,207 E. — ORIGINATED BY PM

W.P. 70-68-00 — BORING DATE July 18, 1972 — COMPILED BY AKB

DATUM Geodetic — BOREHOLE TYPE Hollow Stem Auger — CHECKED BY

ELEV. / DEPTH	DESCRIPTION	STRAT. PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/FOOT	ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT; SHEAR STRENGTH P.S.F. ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE	LIQUID LIMIT W_L / PLASTIC LIMIT W_P / WATER CONTENT W (W_P — W — W_L); WATER CONTENT % 10 20 30	BULK DENSITY γ P.C.F.	REMARKS GR. SA. SI. CL.
658.5	Ground Level									
0.0	Fine sand and gravelly sand.		1	SS	8					
			2	SS	27					
650.5	Loose to Dense		3	SS	32	650				
8.0	Silt, traces of clay and sand.		4	SS	16					
			5	SS	14					0 3 92 5
			6	SS	8					
			7	SS	14					0 9 86 5
	Loose to Compact		8	SS	13					
639.0			9	SS	8	640				
19.5	End of Borehole									

OFFICE REPORT ON SOIL EXPLORATION

20
15 ⊹ 5 % STRAIN AT FAILURE
10

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS – ONTARIO

DESIGN SERVICES BRANCH — FOUNDATIONS OFFICE

RECORD OF BOREHOLE No 106

JOB 72-11085 — LOCATION Co-ords. 15,672,775 N; 800,580 E. — ORIGINATED BY PM

W.P. 70-68-00 — BORING DATE July 21, 1972 — COMPILED BY AKB

DATUM Geodetic — BOREHOLE TYPE Washboring, BX Casing — CHECKED BY AK

SOIL PROFILE ELEV./DEPTH	DESCRIPTION	STRAT. PLOT	SAMPLES NUMBER	TYPE	BLOWS/FOOT	ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS/FOOT; SHEAR STRENGTH P.S.F. ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE	LIQUID LIMIT w_L / PLASTIC LIMIT w_P / WATER CONTENT w — WATER CONTENT % 10 20 30	BULK DENSITY γ P.C.F.	REMARKS GR.SA.SI.CL.
660.1	Ground Level									
0.0	Silty sand to gravelly sand.		1	SS	14	660				
			2	SS	12					
			3	SS	9					
	Loose to Dense.		4	SS	10					2 54 (44)
			5	SS	28					43 46 (11)
			6	SS	41	650				
646.5	Brown		7	SS	35					
13.6 644.1	Silt, traces of clay.		8	SS	30					
16.0	Sandy silt, some		9	SS	21					20 25 51 4
640.1	gravel. Compact		10	SS	14	640				
20.0	End of Borehole									

OFFICE REPORT ON SOIL EXPLORATION

15 20 10 5 % STRAIN AT FAILURE

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS – ONTARIO

DESIGN SERVICES BRANCH — FOUNDATIONS OFFICE

RECORD OF BOREHOLE Nº 107

JOB 72-11085 — LOCATION Co-ords. 15,672,825 N; 801,001 E. — ORIGINATED BY PM

W.P. 70-68-00 — BORING DATE July 18, 1972 — COMPILED BY AKB

DATUM Geodetic — BOREHOLE TYPE Hollow Stem Auger — CHECKED BY

SOIL PROFILE ELEV. / DEPTH	DESCRIPTION	STRAT. PLOT	SAMPLES NUMBER	TYPE	BLOWS/FOOT	ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT; SHEAR STRENGTH P.S.F. (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE)	LIQUID LIMIT w_L, PLASTIC LIMIT w_P, WATER CONTENT w; WATER CONTENT % (10 20 30)	BULK DENSITY γ P.C.F.	REMARKS GR. SA. SI. CL.
657.5	Ground Level									
0.0	Gravelly sand, slightly organic.		1	SS	10	650		○		
			2	SS	22					
	Compact to Dense		3	SS	63					
647.3			4	SS	29			○		43 56 (1)
10.2	Silt, traces of sand and clay. Loose		5	SS	9			⊢○		
			6	SS	9			⊢○		
642.0			7	SS	12			○		0 11 80 9
15.5	End of Borehole									

OFFICE REPORT ON SOIL EXPLORATION

20
15 ◇ 5 % STRAIN AT FAILURE
10

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS – ONTARIO

DESIGN SERVICES BRANCH — FOUNDATIONS OFFICE

RECORD OF BOREHOLE No 108

JOB 72-11085 — LOCATION Co-ords. 15,672,978 N; 798,523 E. — ORIGINATED BY ECB

W.P. 70-68-00 — BORING DATE August 21, 1972 — COMPILED BY AKB

DATUM Geodetic — BOREHOLE TYPE Washboring, NX Casing — CHECKED BY

SOIL PROFILE ELEV./DEPTH	DESCRIPTION	STRAT. PLOT	SAMPLES NUMBER	TYPE	BLOWS/FOOT	ELEV. SCALE
652.3	Water Level					
650.0	Canal Water					650
2.3 / 646.3	Black Muck		1	SS	2	
6.0			2	SS	7	
			3	TW	PM	640
			4	SS	11	
	Irregular seams of		5	TW	PH	
	reddish-brown and		6	SS	16	630
	grey clayey silts		7	TW	PM	
	and grey silts with		8	SS	14	
	traces of clay.					620
			9	TW	PM	
	Stiff to Very Stiff		10	SS	15	
						610
			11	SS	13	
			12	SS	23	
596.8						600
55.5	Glacial Till		13	SS	22	
	Clayey silt, traces of					
591.8	sand & gravel. V.Hard		14	SS	100/2"	
60.5	End of Borehole					

DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT

SHEAR STRENGTH P.S.F. — ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE

1000 2000

LIQUID LIMIT W_L — PLASTIC LIMIT W_P — WATER CONTENT W

W_P W W_L

WATER CONTENT % — 10 20 30

BULK DENSITY γ P.C.F.	REMARKS GR. SA. SI. CL.
60	
126	0 0 74 26
122	
121	
127	
	0 2 73 25
	2 5 82 11

20 / 15 ◇ 5 / 10 % STRAIN AT FAILURE

OFFICE REPORT — SOIL EXPLORATION

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS – ONTARIO

DESIGN SERVICES BRANCH — FOUNDATIONS OFFICE

RECORD OF BOREHOLE Nº 108A

JOB 72-11085 — LOCATION Co-ords. 15,672,618 N; 798,940 E. — ORIGINATED BY ECB

W.P. 70-68-00 — BORING DATE Aug. 22, 1972 — COMPILED BY AKB

DATUM Geodetic — BOREHOLE TYPE Washboring, NX Casing — CHECKED BY

ELEV. / DEPTH	DESCRIPTION	STRAT. PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/FOOT	ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT; SHEAR STRENGTH P.S.F. (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE)	LIQUID LIMIT W_L, PLASTIC LIMIT W_P, WATER CONTENT W (WATER CONTENT %)	BULK DENSITY γ P.C.F.	REMARKS GR.SA.SI.CL.
652.2	Water Level						1000 2000	10 20 30		
650.4 / 1.8	Canal Water					650				
647.7	Black Muck		1	SS	11					
4.5	Irregular seams of clayey silt and silt with traces of clay.		2	TW	PM				121	
			3	SS	6	640				0 0 62 38
	Firm to Very Stiff		4	TW	PM				125	
			5	TW	PM				123	
	Grey & reddish-brown		6	SS	19	630				
623.2			7	TW	PM				123	
29.0	End of Borehole									

OFFICE REPORT ON SOIL EXPLORATION

20
15 ◇ 5 % STRAIN AT FAILURE
10

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS – ONTARIO

DESIGN SERVICES BRANCH — FOUNDATIONS OFFICE

RECORD OF BOREHOLE Nº 109

JOB 72-11085 — LOCATION Co-ords. 15,672,418 N; 799,541 E. — ORIGINATED BY ECB

W.P. 70-68-00 — BORING DATE August 23, 1972 — COMPILED BY AKB

DATUM Geodetic — BOREHOLE TYPE Washboring, NX Casing — CHECKED BY

SOIL PROFILE ELEV./DEPTH	DESCRIPTION	STRAT. PLOT	SAMPLES NUMBER	TYPE	BLOWS/FOOT	ELEV. SCALE
652.1	Water Level					
650.6	Canal Water					650
1.5	Black Muck					
645.7			1	SS	10	
6.4			2	SS	6	
			3	TW	PM	640
			4	SS	6	
			5	TW	PM	
	Irregular seams of grey and brown clayey silt and grey silt with traces of clay.		6	SS	13	630
			7	SS	17	
			8	SS	31	620
	Firm to Very Stiff		9	SS	26	
			10	SS	17	610
			11	TW	PM	
			12	SS	18	600
			13	SS	15	
			14	SS	13	590
585.2						
583.2	Glacial Till Silty sand with cl.&gr.		15	SS	111	
68.9	End of Borehole					

DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT

SHEAR STRENGTH P.S.F.
○ UNCONFINED + FIELD VANE
● QUICK TRIAXIAL × LAB VANE
1000 2000

LIQUID LIMIT W_L
PLASTIC LIMIT W_P
WATER CONTENT W
W_P W W_L
WATER CONTENT % 10 20 30

BULK DENSITY γ P.C.F.

REMARKS	GR.	SA.	SI.	CL.
	0	0	79	21
125				
	1	0	58	41
128				
	0	0	73	27
	17	37	32	14

OFFICE REPORT ON SOIL EXPLORATION

20
15 ◇ 5 % STRAIN AT FAILURE
10

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS – ONTARIO

DESIGN SERVICES BRANCH — FOUNDATIONS OFFICE

RECORD OF BOREHOLE Nº 109A

JOB 72-11085 — LOCATION Co-ords. 15,672,525 N; 799,887 E. — ORIGINATED BY ECB

W.P. 70-68-00 — BORING DATE August 24, 1972 — COMPILED BY AKB

DATUM Geodetic — BOREHOLE TYPE Washboring, NX Casing — CHECKED BY

SOIL PROFILE ELEV./DEPTH	DESCRIPTION	STRAT. PLOT	SAMPLES NUMBER	TYPE	BLOWS/FOOT	ELEV. SCALE
652.1	Water Level					
	Canal Water					650
1.0 / 645.6	Black Muck		1	SS	9	
6.5			2	TW	PM	
	Irregular seams of clayey silt and silt with some clay.		3	SS	14	640
			4	TW	PM	
			5	SS	19	
	Stiff to Very Stiff		6	TW	PM	630
622.6			7	SS	22	
29.5	End of Borehole					

DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT — 1000 — 2000

SHEAR STRENGTH P.S.F. — ○ UNCONFINED — ● QUICK TRIAXIAL — + FIELD VANE — × LAB VANE

LIQUID LIMIT W_L — PLASTIC LIMIT W_P — WATER CONTENT W

WATER CONTENT % — 10 — 20 — 30

BULK DENSITY γ P.C.F.	REMARKS GR. SA. SI. CL.
57	
127	
	0 0 78 22
119	
121	
	0 1 73 26

OFFICE REPORT ON SOIL EXPLORATION

15 — 20 — 10 — 5 % STRAIN AT FAILURE

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS – ONTARIO

DESIGN SERVICES BRANCH — FOUNDATIONS OFFICE

RECORD OF BOREHOLE Nº 110

JOB 72-11085 — LOCATION Co-ords. 15,672,628 N; 800,240 E. — ORIGINATED BY PK

W.P. 70-68-00 — BORING DATE Sept. 6-7, 1972 — COMPILED BY AKB

DATUM Geodetic — BOREHOLE TYPE Washboring, NX Casing — CHECKED BY

ELEV. / DEPTH	DESCRIPTION	STRAT. PLOT	SAMPLES NUMBER	TYPE	BLOWS/FOOT	ELEV. SCALE
652.2	Water Level					
650.6	Canal Water					650
1.6	Black Muck					
645.2			1	SS	10	
7.0			2	SS	11	
			3	TW	PM	640
			4	TW	PM	
			5	TW	PM	
						630
			6	SS	12	
	Irregular seams of		7	TW	PM	
	brown and grey clayey					620
	silt and grey silt.		8	SS	13	
			9	TW	PM	
	Stiff to Very Stiff					610
			10	SS	10	
			11	TW	PM	
						600
			12	SS	13	
			13	TW	PM	
						590
583.7						
68.5	Silty sand with traces of clay and gravel. (Glacial Till)		14	SS	46	580
	Dense to Very Dense					
574.0			15	SS	115/6"	
78.2	End of Borehole Probable Bedrock					

DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT

SHEAR STRENGTH P.S.F. — ○ UNCONFINED — ● QUICK TRIAXIAL — + FIELD VANE — × LAB VANE — 1000 — 2000

LIQUID LIMIT W_L — PLASTIC LIMIT W_P — WATER CONTENT W — W_P W W_L

WATER CONTENT % — 10 — 20 — 30

BULK DENSITY γ P.C.F.	REMARKS GR. SA. SI. CL.
126	
124	
125	
123	
126	
125	
131	
	5 56 31 8
	0 96 (4)
	9 47 33 11

20 / 15 ◇ 5 / 10 % STRAIN AT FAILURE

OFFICE REPORT ON SOIL EXPLORATION

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS – ONTARIO

DESIGN SERVICES BRANCH

FOUNDATIONS OFFICE

RECORD OF BOREHOLE Nº 111

JOB 72-11085 LOCATION Co-ords. 15,672,746 N; 800,576 E. ORIGINATED BY PK

W.P. 70-68-00 BORING DATE Sept. 11-12, 1972 COMPILED BY AKB

DATUM Geodetic BOREHOLE TYPE Washboring NX Casing CHECKED BY

ELEV. / DEPTH	DESCRIPTION	STRAT. PLOT	SAMPLES NUMBER	TYPE	BLOWS/FOOT	ELEV. SCALE
652.1	Water Level					
649.9	Creek Water					650
2.2 / 645.8	Black Muck		1	SS	13	
6.3	Irregular seams of brown & grey clayey silt & grey silt. Stiff to Very Stiff		2	SS	4	
			3	TW	PM	640
			4	TW	PM	
			5	SS	9	
			6	TW	PM	630
			7	SS	15	
			8	SS	13	620
			9	TW	PM	
			10	SS	46	610
592.0			11	SS	25	
60.1	Silty sand with boulder traces of clay and gravel. (Glacial Till) Very Dense		12	SS	50	600
			13	RC	5%	
			14	SS	59	590
568.5						580
83.6 / 563.6	Bedrock Dolomite Sound		15	RC	93%	570
88.5	End of Borehole					

DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT

SHEAR STRENGTH P.S.F. — ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE — 1000 2000

LIQUID LIMIT W_L PLASTIC LIMIT W_P WATER CONTENT W — W_P W W_L — WATER CONTENT % 10 20 30

BULK DENSITY γ P.C.F.	REMARKS GR. SA. SI. CL.
	60
127	
120	
124	
	0 2 77 21
128	
	8 63 24 5

20 15 ◇ 5 10 % STRAIN AT FAILURE

OFFICE REPORT ON SOIL EXPLORATION

VOID RATIO – PRESSURE CURVES

JOB NO. 72 – 11085

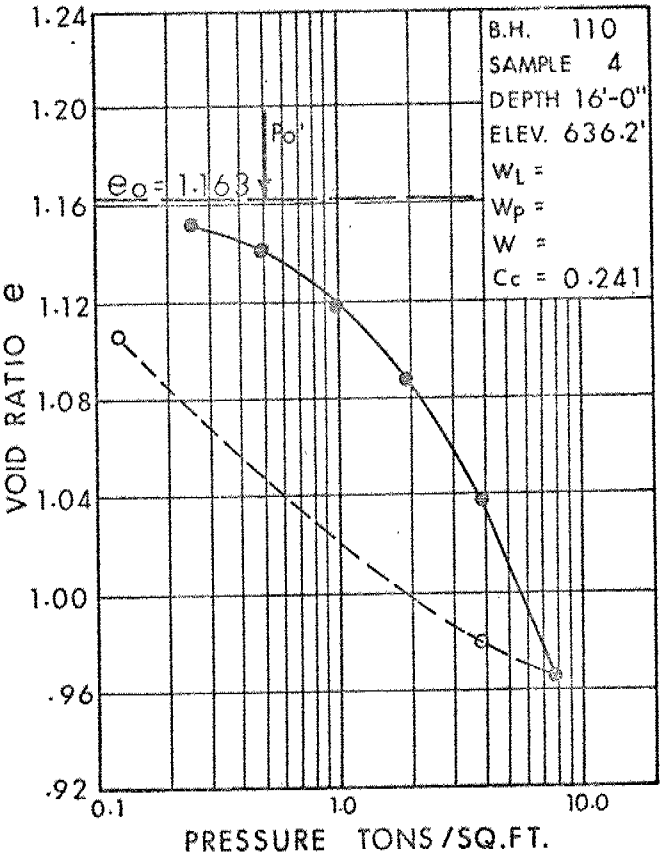


FIG. NO. 1

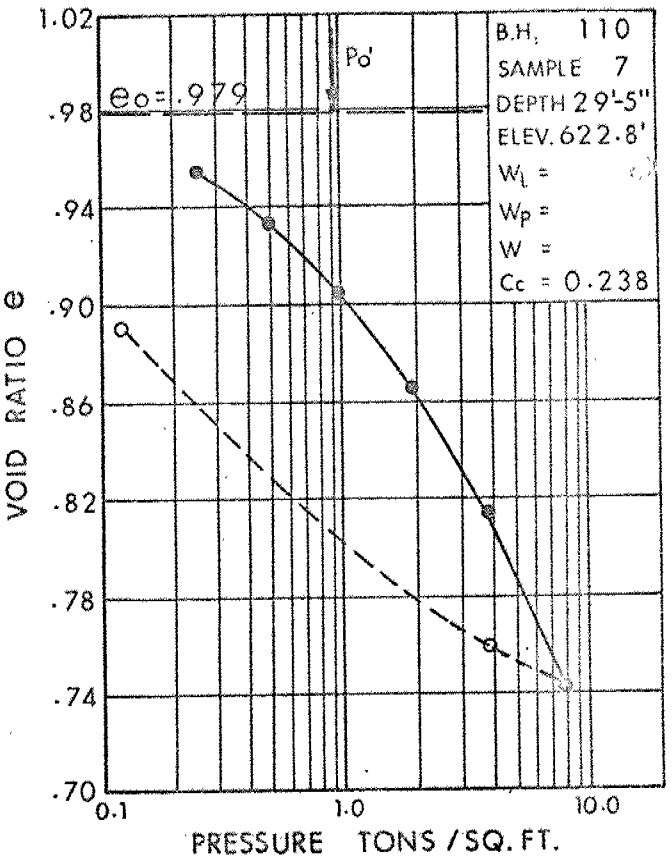
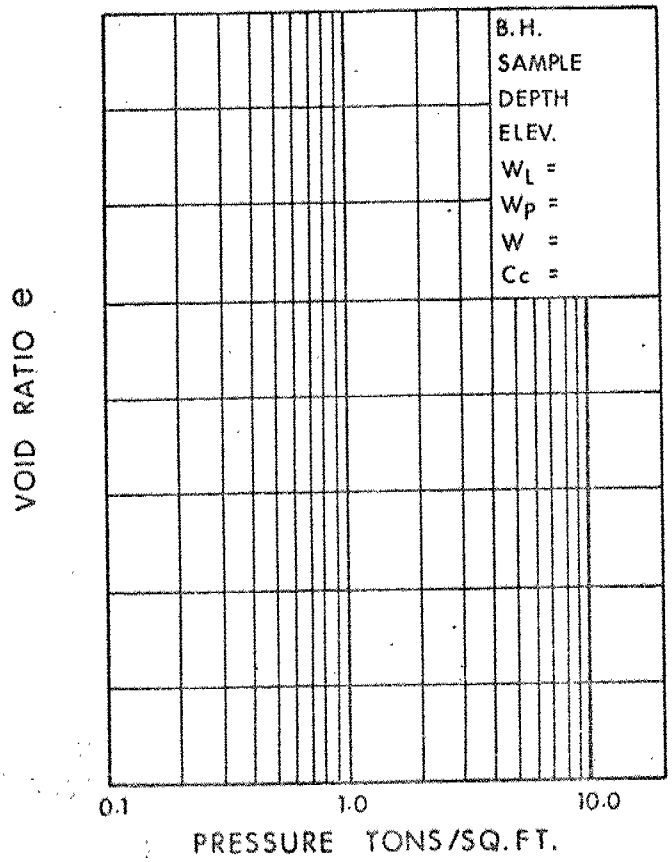


FIG. NO. 2



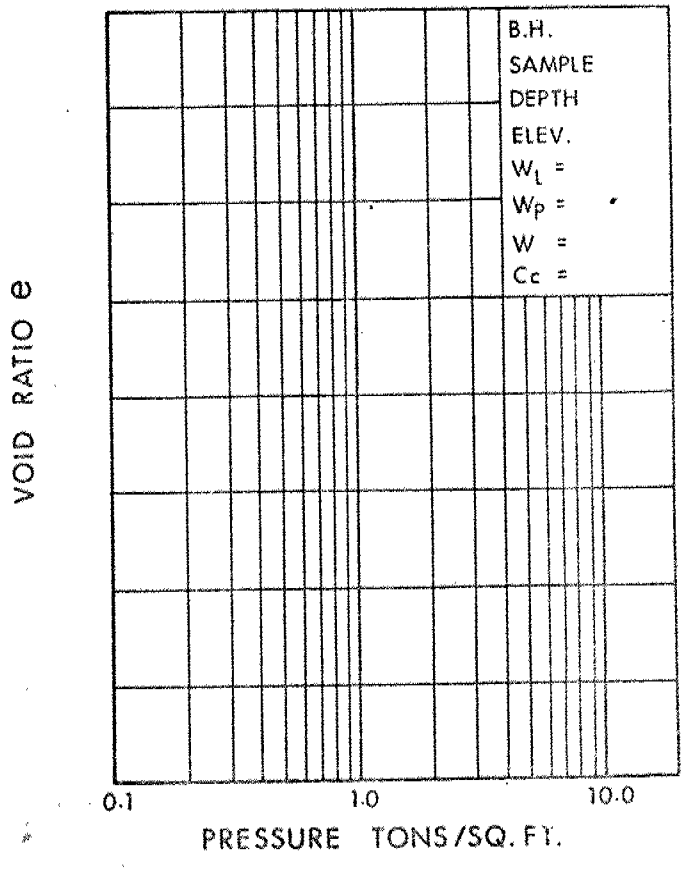
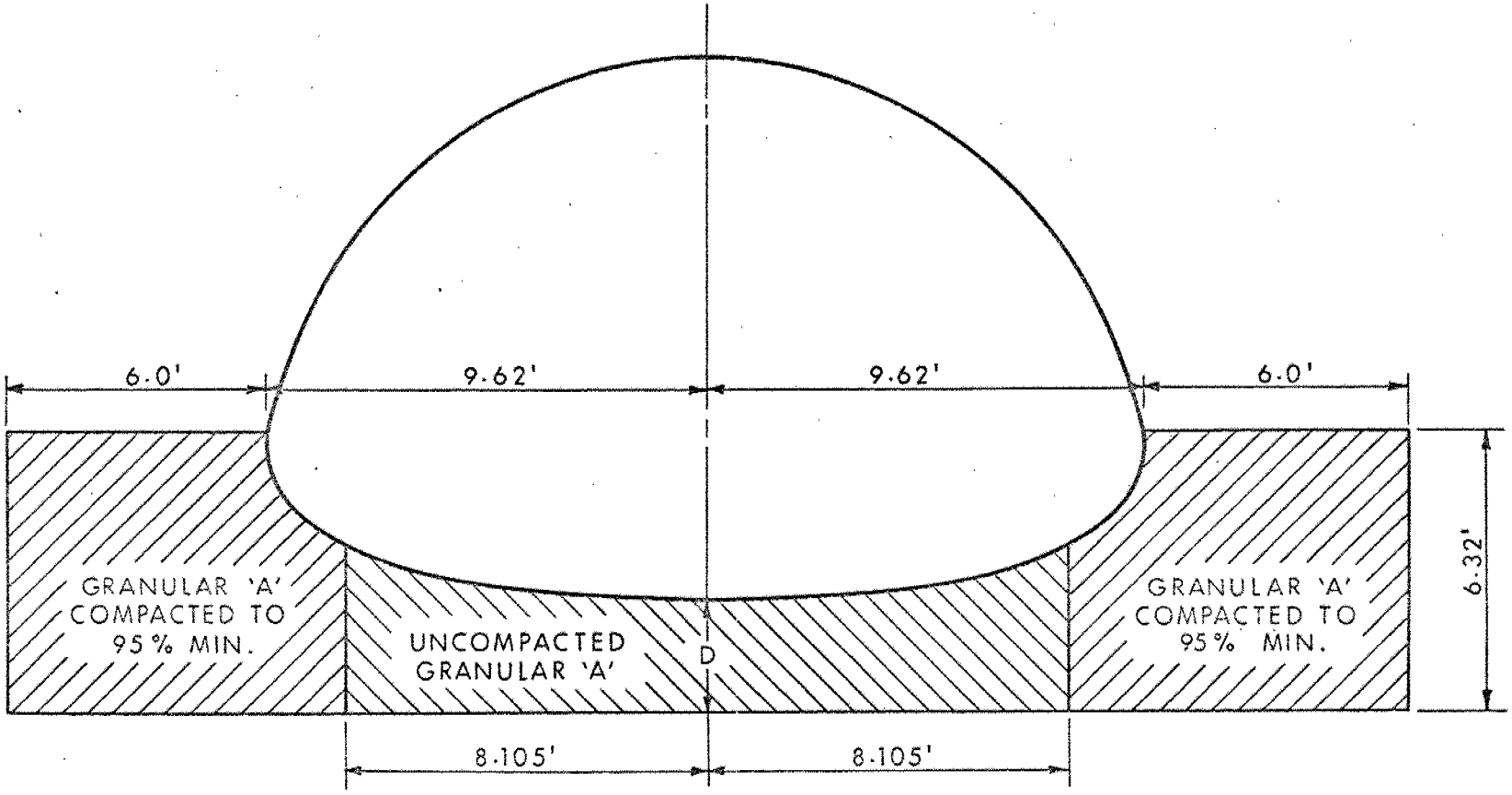


FIG. 1 & 2

PROPOSED BEDDING



NOTE :

IF STRESSES ON THE HAUNCHES ARE BETWEEN 4 t.s.f. & 5 t.s.f. THEN D = 2.5 FT.
IF STRESSES ON THE HAUNCHES ARE BETWEEN 5 t.s.f. & 6 t.s.f. THEN D = 3.0 FT.

FIG. NO. 3

72-11085

ABBREVIATIONS USED IN THIS REPORT

SOIL PROPERTIES

γ	UNIT WEIGHT OF SOIL (BULK DENSITY)
γ_s	UNIT WEIGHT OF SOLID PARTICLES
γ_w	UNIT WEIGHT OF WATER
γ_d	UNIT DRY WEIGHT OF SOIL (DRY DENSITY)
γ'	UNIT WEIGHT OF SUBMERGED SOIL
G	SPECIFIC GRAVITY OF SOLID PARTICLES $G = \frac{\gamma_s}{\gamma_w}$
e	VOID RATIO
n	POROSITY
w	WATER CONTENT
S_r	DEGREE OF SATURATION
w_L	LIQUID LIMIT
w_P	PLASTIC LIMIT
I_P	PLASTICITY INDEX
s	SHRINKAGE LIMIT
I_L	LIQUIDITY INDEX $= \frac{w - w_P}{I_P}$
I_C	CONSISTENCY INDEX $= \frac{w_L - w}{I_P}$
e_{max}	VOID RATIO IN LOOSEST STATE
e_{min}	VOID RATIO IN DENSEST STATE
I_D	DENSITY INDEX $= \frac{e_{max} - e}{e_{max} - e_{min}}$
	RELATIVE DENSITY D_r IS ALSO USED
h	HYDRAULIC HEAD OR POTENTIAL
q	RATE OF DISCHARGE
v	VELOCITY OF FLOW
i	HYDRAULIC GRADIENT
k	COEFFICIENT OF PERMEABILITY
j	SEEPAGE FORCE PER UNIT VOLUME
m_v	COEFFICIENT OF VOLUME CHANGE $= \frac{-\Delta e}{(1+e)\Delta\sigma'}$
c_v	COEFFICIENT OF CONSOLIDATION
C_c	COMPRESSION INDEX $= \frac{\Delta e}{\Delta \log_{10} \sigma'}$
T_v	TIME FACTOR $= \frac{c_v t}{d^2}$ (d, DRAINAGE PATH)
U	DEGREE OF CONSOLIDATION
τ_f	SHEAR STRENGTH
c'	EFFECTIVE COHESION INTERCEPT — IN TERMS OF EFFECTIVE STRESS $\tau_f = c' + \sigma' \tan \phi'$
ϕ'	EFFECTIVE ANGLE OF SHEARING RESISTANCE, OR FRICTION — IN TERMS OF EFFECTIVE STRESS $\tau_f = c' + \sigma' \tan \phi'$
c_u	APPARENT COHESION — IN TERMS OF TOTAL STRESS $\tau_f = c_u + \sigma \tan \phi$
ϕ_u	APPARENT ANGLE OF SHEARING RESISTANCE, OR FRICTION — IN TERMS OF TOTAL STRESS $\tau_f = c_u + \sigma \tan \phi$
μ	COEFFICIENT OF FRICTION
S_t	SENSITIVITY

GENERAL

π	= 3·1416
e	BASE OF NATURAL LOGARITHMS 2·7183
$\log_e a$ OR $\ln a$	NATURAL LOGARITHM OF a
$\log_{10} a$ OR $\log a$	LOGARITHM OF a TO BASE 10
t	TIME
g	ACCELERATION DUE TO GRAVITY
V	VOLUME
W	WEIGHT
M	MOMENT
F	FACTOR OF SAFETY

STRESS AND STRAIN

u	PORE PRESSURE
σ	NORMAL STRESS
σ'	NORMAL EFFECTIVE STRESS ($\bar{\sigma}$ IS ALSO USED)
τ	SHEAR STRESS
ε	LINEAR STRAIN
γ	SHEAR STRAIN
ν	POISSON'S RATIO (μ IS ALSO USED)
E	MODULUS OF LINEAR DEFORMATION (YOUNGS MODULUS)
G	MODULUS OF SHEAR DEFORMATION
K	MODULUS OF COMPRESSIBILITY
η	COEFFICIENT OF VISCOSITY

EARTH PRESSURE

d	DISTANCE FROM TOP OF WALL TO POINT OF APPLICATION OF PRESSURE
δ	ANGLE OF WALL FRICTION
K	DIMENSIONLESS COEFFICIENT TO BE USED WITH VARIOUS SUFFIXES IN EXPRESSIONS REFERRING TO NORMAL STRESS ON WALLS
K_o	COEFFICIENT OF EARTH PRESSURE AT REST

FOUNDATIONS

B	BREADTH OF FOUNDATION
L	LENGTH OF FOUNDATION
D	DEPTH OF FOUNDATION BENEATH GROUND
N	DIMENSIONLESS COEFFICIENT USED WITH A SUFFIX APPLYING TO SPECIFIC GRAVITY, DEPTH AND COHESION ETC. IN THE FORMULA FOR BEARING CAPACITY
k_s	MODULUS OF SUBGRADE REACTION

SLOPES

H	VERTICAL HEIGHT OF SLOPE
D	DEPTH BELOW TOE OF SLOPE TO HARD STRATUM
β	ANGLE OF SLOPE TO HORIZONTAL

ABBREVIATIONS USED IN THIS REPORT

PENETRATION RESISTANCE

STANDARD PENETRATION RESISTANCE 'N' :- THE NUMBER OF BLOWS REQUIRED TO ADVANCE A STANDARD SPLIT SPOON SAMPLER 12 INCHES INTO THE SUBSOIL, DRIVEN BY MEANS OF A 140 POUND HAMMER FALLING FREELY A DISTANCE OF 30 INCHES.

DYNAMIC PENETRATION RESISTANCE :- THE NUMBER OF BLOWS REQUIRED TO ADVANCE A 2 INCH, 60 DEGREE CONE, FITTED TO THE END OF DRILL RODS, 12 INCHES INTO THE SUBSOIL, THE DRIVING ENERGY BEING 350 FOOT POUNDS PER BLOW.

DESCRIPTION OF SOIL

THE CONSISTENCY OF COHESIVE SOILS AND THE RELATIVE DENSITY OR DENSENESS OF COHESIONLESS SOILS ARE DESCRIBED IN THE FOLLOWING TERMS :-

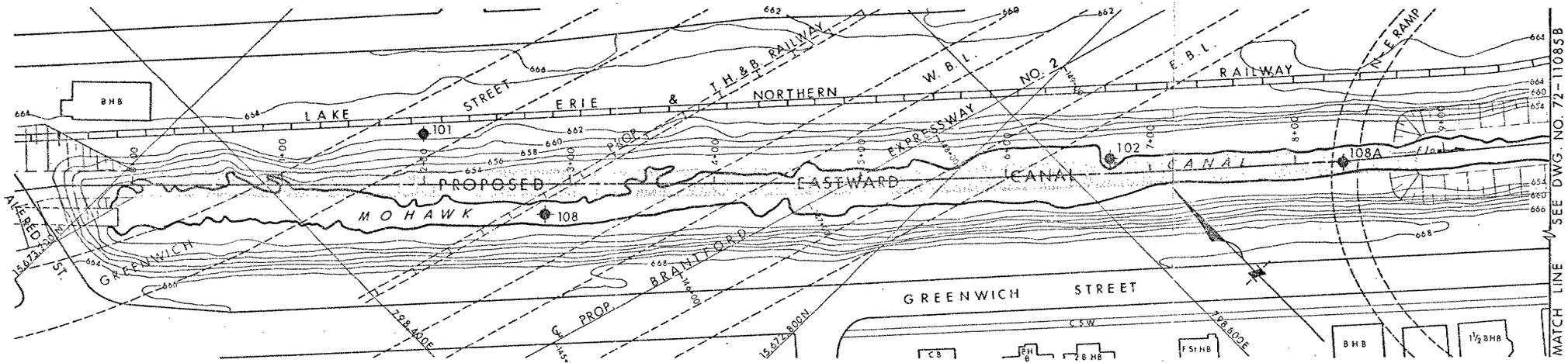
CONSISTENCY	'N' BLOWS / FT.	c LB. / SQ. FT.	DENSENESS	'N' BLOWS / FT.
VERY SOFT	0 - 2	0 - 250	VERY LOOSE	0 - 4
SOFT	2 - 4	250 - 500	LOOSE	4 - 10
FIRM	4 - 8	500 - 1000	COMPACT	10 - 30
STIFF	8 - 15	1000 - 2000	DENSE	30 - 50
VERY STIFF	15 - 30	2000 - 4000	VERY DENSE	> 50
HARD	> 30	> 4000		

TYPE OF SAMPLE

S.S.	SPLIT SPOON	T.W.	THINWALL OPEN
W.S.	WASHED SAMPLE	T.P.	THINWALL PISTON
S.B.	SCRAPER BUCKET SAMPLE	O.S.	OESTERBERG SAMPLE
A.S.	AUGER SAMPLE	F.S.	FOIL SAMPLE
C.S.	CHUNK SAMPLE	R.C.	ROCK CORE
S.T.	SLOTTED TUBE SAMPLE		
	P.H. SAMPLE ADVANCED HYDRAULICALLY		
	P.M. SAMPLE ADVANCED MANUALLY		

SOIL TESTS

Qu	UNCONFINED COMPRESSION	L.V.	LABORATORY VANE
Q	UNDRAINED TRIAXIAL	F.V.	FIELD VANE
Qcu	CONSOLIDATED UNDRAINED TRIAXIAL	C	CONSOLIDATION
Qd	DRAINED TRIAXIAL	S	SENSITIVITY



PLAN

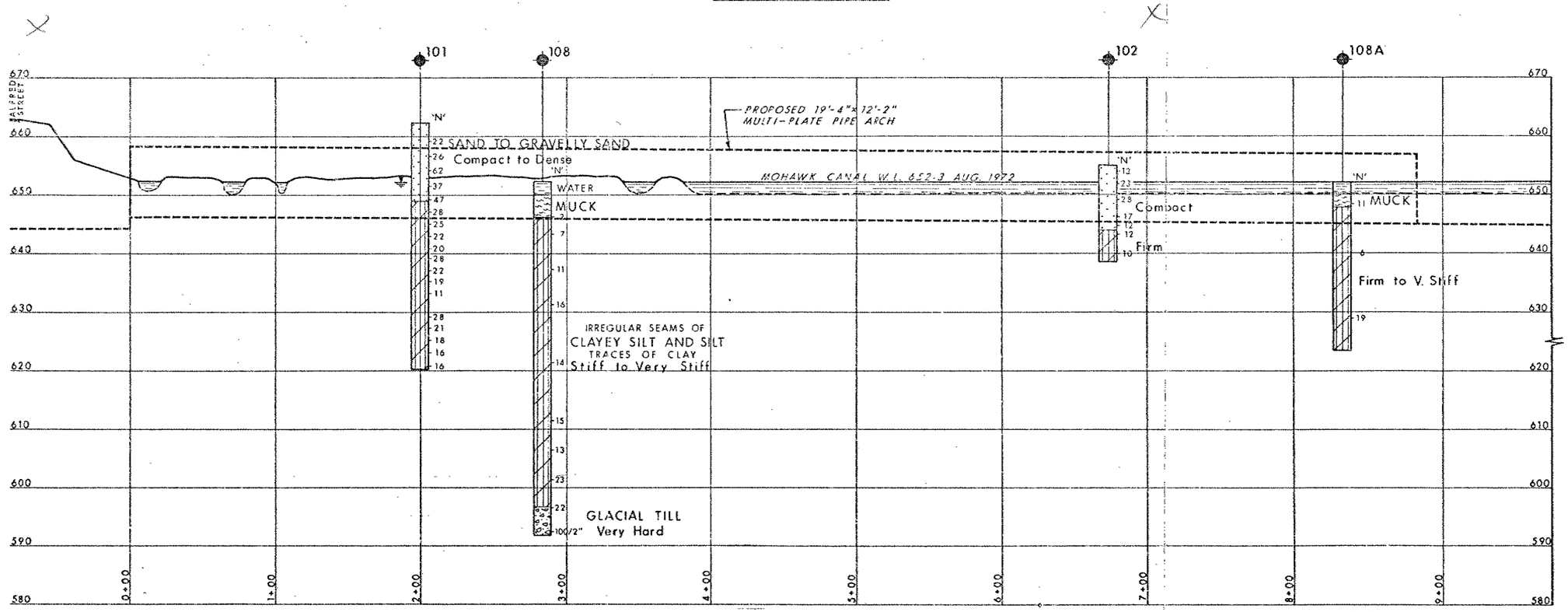
SCALE

40 20 0 40 80FT.

KEY PLAN

SCALE IN FEET

1000 500 0 1000 2000 3000 4000FT



℄ PROFILE ALONG PROPOSED CANAL

SCALE

HORIZ. 40 20 0 40 80FT.

VERT. 10 5 0 10 20FT.

LEGEND

- Bore Hole
- Cone Penetration Test
- Bore Hole & Cone Test
- Water Levels established at time of field investigation. JULY & AUG. 1972

NO.	ELEVATION	CO-ORDINATES	
		NORTH	EAST
101	662.3	15,673,075	798,503
102	655.0	15,672,732	798,827
103	652.8	15,672,405	799,169
104	665.3	15,672,531	799,660
105	658.5	15,672,658	800,207
106	660.1	15,672,775	800,580
107	657.5	15,672,825	801.001
108	652.3	15,672,978	798,523
108A	652.2	15,672,618	798,940
109	652.1	15,672,418	799,541
109A	652.1	15,672,525	799,887
110	652.2	15,672,628	800,240
111	652.1	15,672,746	800,576

— NOTE —

The boundaries between soil strata have been established only at Bore Hole locations. Between Bore Holes the boundaries are assumed from geological evidence.

REVISIONS

DATE	BY	DESCRIPTION

REF. NO. - M.M. DILLON LTD. MC-3

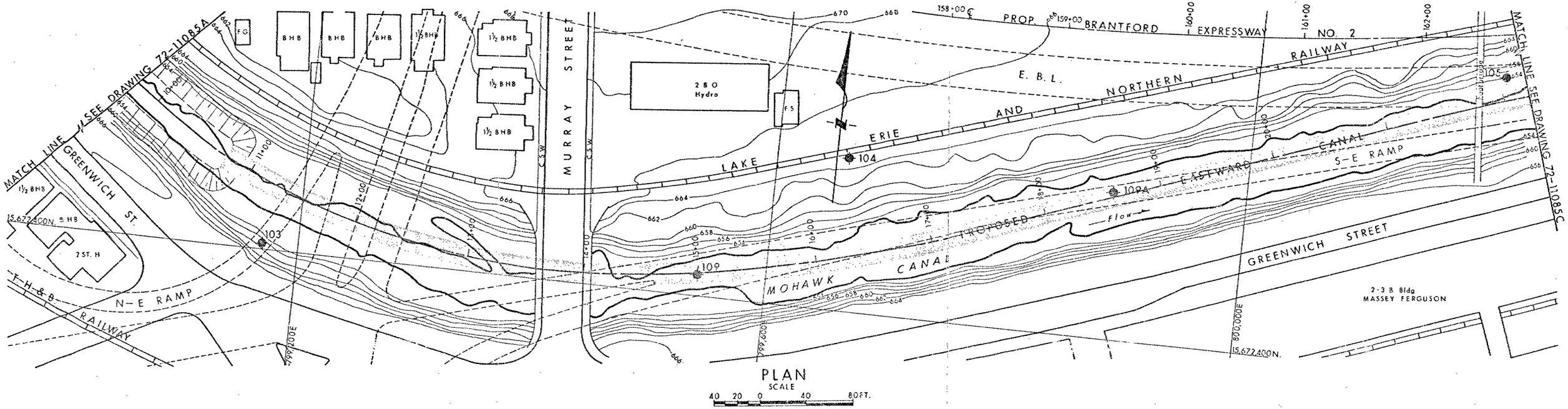
MINISTRY OF TRANSPORTATION AND COMMUNICATIONS—ONTARIO
DESIGN SERVICES BRANCH — FOUNDATIONS OFFICE

EASTWARD CANAL

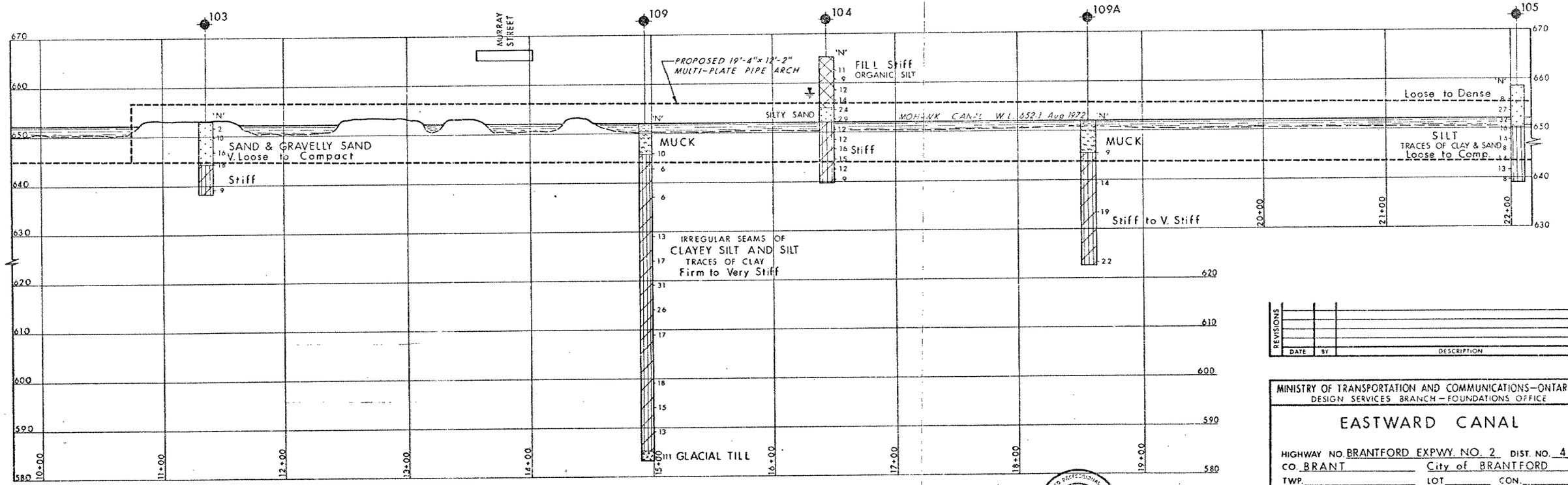
HIGHWAY NO. BRANTFORD EXPWY. NO. 2 DIST. NO. 4
CO. BRANT City of BRANTFORD
TWP. LOT CON.

BORE HOLE LOCATIONS & SOIL STRATA

SUBMD. A.B.	CHECKED	W.P. NO. 70-68-00	DRAWING NO. 72-11085A
DRAWN	CHECKED	W.O. NO 72-11085	
DATE Oct. 16, 1972		SITE NO.	BRIDGE DRAWING NO.
APPROVED PRINCIPAL FOUNDATION ENGINEER		CONT. NO.	



PLAN
SCALE
40 20 0 40 80FT.



℄ PROFILE ALONG PROPOSED CANAL
SCALE
HORIZ. 40 20 0 40 80FT.
VERT. 10 5 0 10 20FT.

REF. NO.- M. M. DILLON LTD. MC-3

REVISIONS

DATE	BY	DESCRIPTION

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS—ONTARIO
DESIGN SERVICES BRANCH—FOUNDATIONS OFFICE

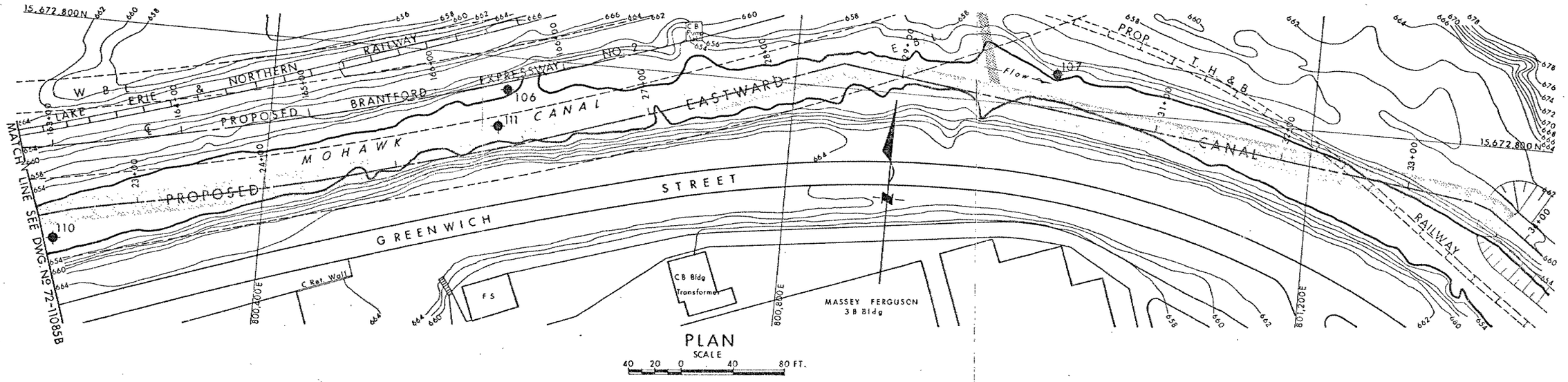
EASTWARD CANAL

HIGHWAY NO. BRANTFORD EXPWY. NO. 2 DIST. NO. 4
CO. BRANT City of BRANTFORD
TWP. LOT CON.

BORE HOLE LOCATIONS & SOIL STRATA

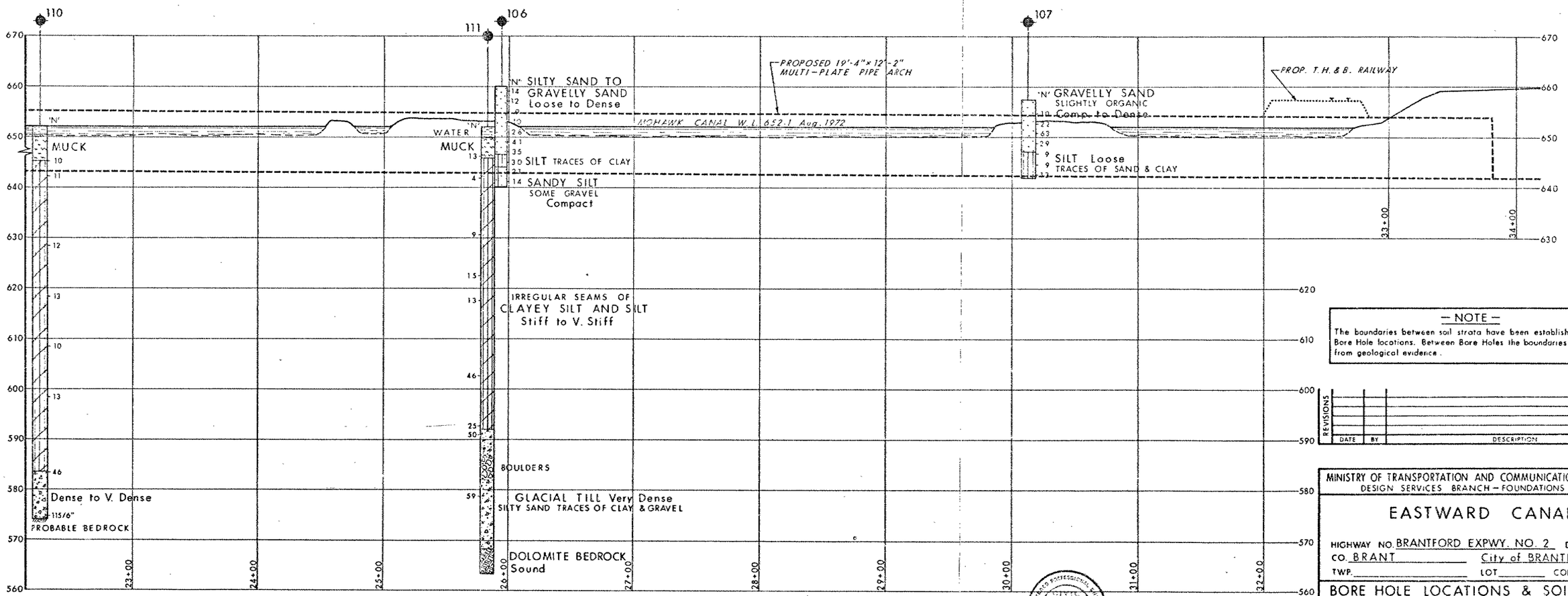
SUBMD. A. B.	CHECKED	W.P. NO. 70-68-00	DRAWING NO. 72-11085B
DRAWN	CHECKED	W.O. NO. 72-11085	
DATE Oct 17, 1972		SITE NO.	BRIDGE DRAWING NO.
APPROVED PRINCIPAL FOUNDATION ENGINEER		CONT. NO.	

RJ END-TRUCE 300-8-72



PLAN

SCALE 40 20 0 40 80 FT.



℄ PROFILE ALONG PROPOSED CANAL

SCALE
HORIZ. 40 20 0 40 80 FT.
VERT. 10 5 0 10 20 FT.

REF. NO. - M. M. DILLON LTD MC-3

— NOTE —

The boundaries between soil strata have been established only at Bore Hole locations. Between Bore Holes the boundaries are assumed from geological evidence.

REVISIONS		
DATE	BY	DESCRIPTION

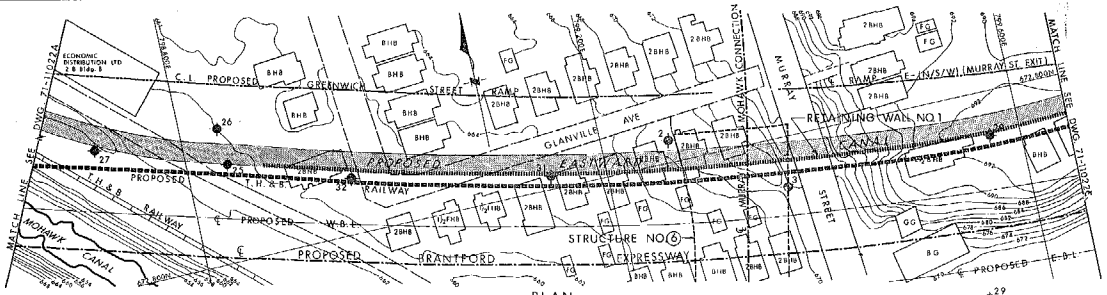
MINISTRY OF TRANSPORTATION AND COMMUNICATIONS—ONTARIO
DESIGN SERVICES BRANCH — FOUNDATIONS OFFICE

EASTWARD CANAL

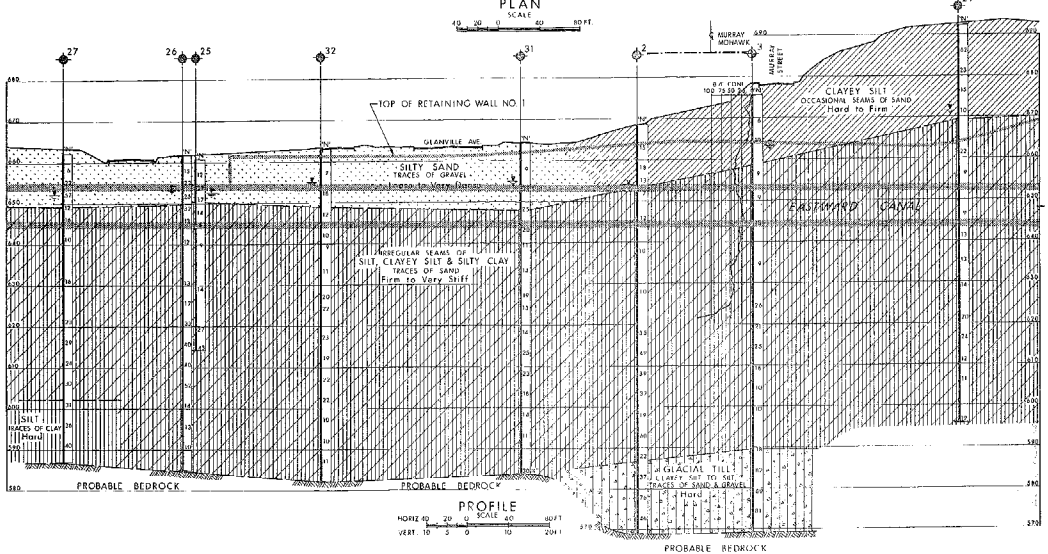
HIGHWAY NO. BRANTFORD EXPWY. NO. 2 DIST. NO. 4
CO. BRANT City of BRANTFORD
TWP. LOT CON

BORE HOLE LOCATIONS & SOIL STRATA

SUBMD A.B.	CHECKED	W.P. NO. 70-68-00	DRAWING NO. 72-11085C
DRAWN	CHECKED	W.O. NO 72-11085	
DATE Oct. 20, 1972		SITE NO.	BRIDGE DRAWING NO.
APPROVED PRINCIPAL FOUNDATION ENGINEER		CONT. NO.	



PLAN
SCALE
40 20 0 40 80 FT.



PROFILE
SCALE
HORIZ 40 20 0 40 80 FT
VERT 10 5 0 10 20 FT

SEE DRAWING NO. 71-11022A

KEY PLAN
SCALE IN FEET

LEGEND

- Bore Hole
- Cone Penetration Test
- Bore Hole & Cone Test
- Water levels established at time of field investigation. APRIL & MAY, 1971

NO	ELEVATION	CO-ORDINATES NORTH	CO-ORDINATES EAST
2	668.5	672,821	799,268
3	675.7	672,752	799,368
25	680.6	672,895	798,840
26	681.8	672,932	798,838
27	682.3	672,930	798,715
29	692.4	672,757	799,570
31	664.0	672,812	798,167
32	662.0	672,853	798,957

— 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.

PRINT RECORD		
NO.	FOR	DATE

KEY SIGNS		
DATE	BY	DESCRIPTION

DEPARTMENT OF TRANSPORTATION & COMMUNICATIONS
DESIGN SERVICES BRANCH — FOUNDATION SECTION

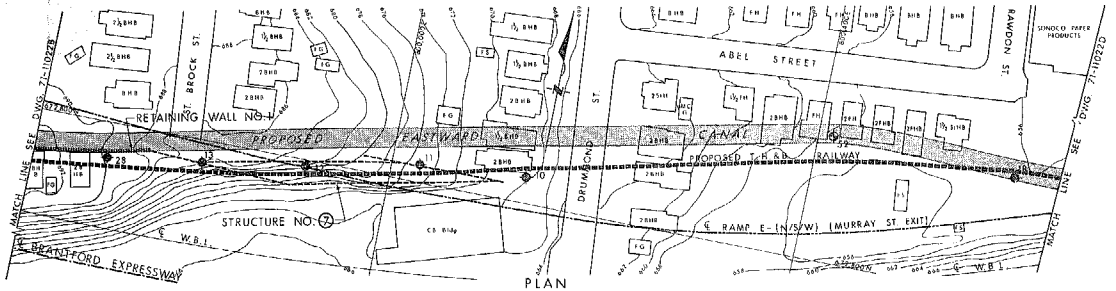
EASTWARD CANAL

HIGHWAY NO. BRANTFORD EXPRESSWAY DIST. NO. 4
CO. BRANT CITY OF BRANTFORD
TWP. LOT. CON.

BORE HOLE LOCATIONS & SOIL STRATA

SURVD. A. B. CHECKED(X) W.P. NO. 70-68-04 DRAWING NO. 71-11022B
DRAWN CHECKED J.P.B. NO. 71-11022 BRIDGE DRAWING NO.
DATE June 15, 1971 SITE NO.
APPROVED CONT. NO.

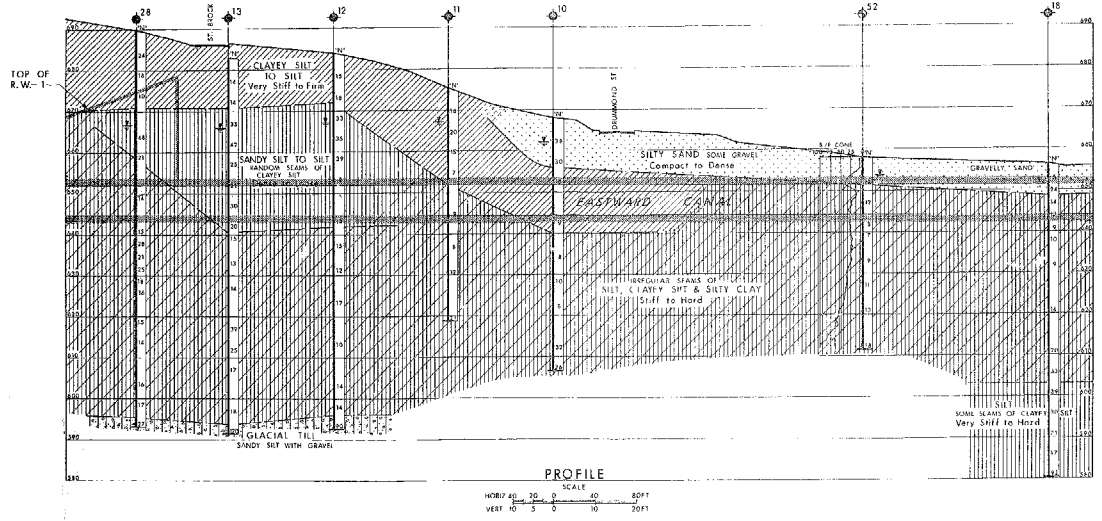
REF. NO. B 86-49



PLAN

SCALE

40 20 0 40 80FT



PROFILE

SCALE

HORIZ 40 20 0 40 80FT

VERT 10 5 0 10 20FT

REF NO. R 86-49

SEE DRAWING NO 71-11022A

KEY PLAN

SCALE IN METRES

LEGEND -

- Bore Hole
- Cone Penetration Test
- Bore Hole & Cone Test
- Water Levels established at time of field investigation. APRIL & MAY, 1971

NO.	ELEVATION	CO-ORDINATES NORTH	CO-ORDINATES EAST
10	660-0	672,825	800,132
11	675-2	672,817	800,027
12	684-0	672,794	799,917
13	682-8	672,778	799,844
18	656-6	672,017	800,597
28	689-5	672,766	799,720
52	658-1	672,922	800,415

— NOTE —

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PRINT RECORD		
NO.	FOR	DATE

REVISIONS		
DATE	BY	DESCRIPTION

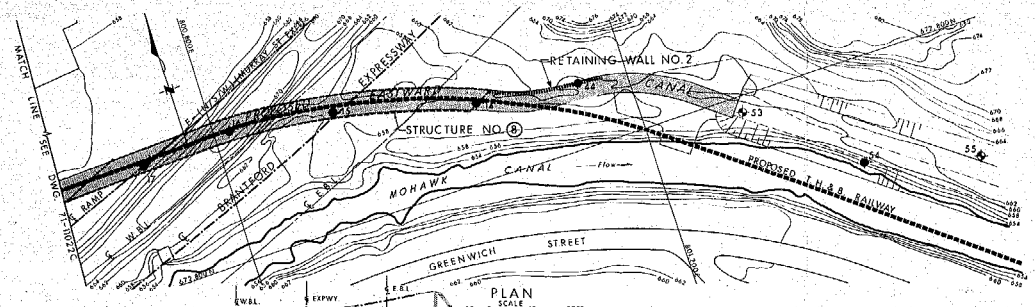
DEPARTMENT OF TRANSPORTATION & COMMUNICATIONS
DESIGN SERVICES BRANCH - FOUNDATION SECTION

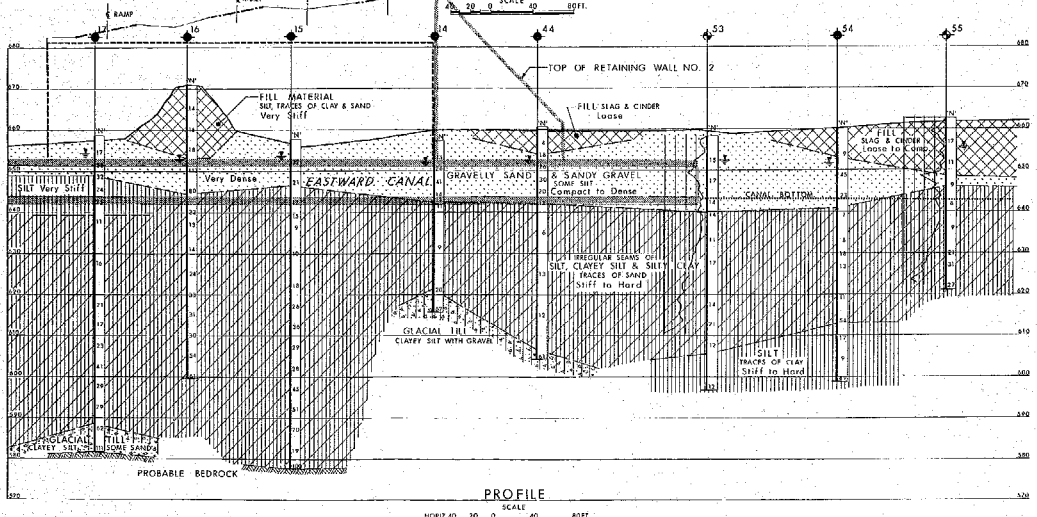
EASTWARD CANAL

HIGHWAY NO. BRANTFORD EXPRESSWAY DIST. NO. 4
CO. BRANT CITY OF BRANTFORD
TWP. LOT CON.

BORE HOLE LOCATIONS & SOIL STRATA

SUBMD. A. B.	CHECKED	WP NO. 70-68-04	DRAWING NO. 71-11022C
DRAWN J.P.	CHECKED	JOB NO. 71-11022	
DATE June 16, 1971		SITE NO.	BRIDGE DRAWING NO.
APPROVED [illegible]		CONT NO.	





REF. NO. B 86-69

SEE DRAWING NO. 71-11022A

KEY PLAN
SCALE IN MILES

LEGEND

- Bore Hole
- Cone Penetration Test
- Bore Hole & Cone Test
- Water Levels established at time of field investigation. APRIL & MAY, 1971

NO.	ELEVATION	CO-ORDINATES NORTH	CO-ORDINATES EAST
14	657-2	672,875	801,054
15	658-0	672,911	800,918
16	671-0	672,926	800,815
17	658-6	672,922	800,734
44	660-7	672,863	801,151
53	658-4	672,784	801,294
54	660-3	672,701	801,392
55	662-6	672,670	801,502

— NOTE —
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PRINT RECORD		
NO.	FOR	DATE

REVISIONS		
NO.	BY	DESCRIPTION

DEPARTMENT OF TRANSPORTATION & COMMUNICATIONS
DESIGN SERVICES BRANCH — FOUNDATION SECTION

EASTWARD CANAL

HIGHWAY NO. BRANTFORD EXPRESSWAY DIST. NO. 4
CO. BRANT CITY OF BRANTFORD
TWP. LOT CON.

BORE HOLE LOCATIONS & SOIL STRATA

SUBMITTED A. B.	CHECKED	W.P. NO. 70-68-04	DRAWING NO. 71-11022D
DRAWN	CHECKED	JOB NO. 71-11022	
DATE June 16, 1971		SITE NO.	BRIDGE DRAWING NO.
APPROVED DIRECTOR, FOUNDATION SERVICES		CONT. NO.	