DEPARTMENT OF HIGHWAYS ONTARIO

MEMORANDUM

To: Mr. K. R. Ernesaks,
Functional Planning Engineer,
Eastern Region,
KINGSTON, Ontario.

From: Foundation Section,
Materials & Testing Office,
Room 107, Lab. Bldg.

Attention:

Date: March 12, 1970

Our File Ref.

In reply to MAR 16 1970

Subject:

PRELIMINARY FOUNDATION REPORT
For
Structure Crossings of Revised Hwy. #17
From Antrim Westerly to Lochiel Creek
Region Municipality of Ottawa
Carleton and Renfrew County
District No. 9 (Ottawa)
W.J. 69-F-86 -- W.P.'s 5-67 & 190-67

Attached, we are forwarding to you our Preliminary Foundation Investigation Report pertaining to the above sites. Presented in this report are the results of the investigation, together with our general comments pertaining to the stability of the approaches and recommendations regarding structure foundations at various crossings.

We believe that the information contained therein, will prove adequate for your immediate use. Should you require further data, or clarification of the report, please do not hesitate to contact this Office.

A. G. Stermac,
PRINCIPAL FOUNDATION ENGINEER

AGS/KdeF
Attach.
cc: Messrs. K. R. Ernesaks (2)
B. R. Davis
H. A. Tregaskes
D. W. Parre
S. J. Markiewicz
C. R. Robertson
I. C. Campbell
T. C. Kingsland (2)
J. E. Gruspier
B. A. Singh

Foundations Files
Gen. Files

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1. INTRODUCTION:

The Foundation Section was requested to obtain preliminary subsoil information at five possible structure sites, to be situated within the aforementioned portion of the proposed revision of Hwy. #17. These will be structure crossings at the intersection of revised Hwy. #17 and various county roads.

This information will be supplementary to preliminary subsurface investigations previously carried out at seven other sites, including the Mississippi and Madawaska River crossings; all these sites are located within the same area. Foundation reports have been submitted on these latter sites (Reports No. W.J. 68-F-70, 69-F-6 and 69-F-19).

The request for the supplementary foundation investigation was contained in a memo from Mr. B. B. Khojajian, Project Planning Engineer, Functional Planning Section, Eastern Region, dated October 7, 1969. An investigation was subsequently carried out by this Section to determine the subsoil, bedrock and groundwater conditions at the five structure sites.

This report presents information on the subsoil, bedrock and groundwater conditions encountered at all the sites located within the limits defined above. Also included are the recommendations pertaining to foundation design, as well as the stability and settlement of the associated approach fills at the five county road crossings.

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2. DESCRIPTION OF THE SITE AND GEOLOGY:

The portion of proposed revised Hwy. #17, being considered in this report, extends approximately 8 miles east and west of the Town of Arnprior (i.e., 16 miles in length). This section will be located south of Arnprior and transverse across the Regional Municipality of Ottawa - Carleton, in the east, and the County of Renfrew in the west. The tableland in the area is quite rolling in relief, ranging between about elevations 320 and 470. The majority of this land is cultivated and being used for farming purposes.

The Madawaska and Mississippi Rivers are deeply incised into the topography within this area. The Madawaska River, which is the most tortuous of the two, is approximately 1,200 feet wide from crest to crest with the water level at about elevation 259 - i.e., approximately 30 feet below the high ground. The slope of the banks is as steep as 2:1 to 3:1 (along the west bank).

In Renfrew County there are prominent east-west trending scarps (fault zones) on both sides of a valley which encompasses the alignments being investigated. The southwesterly one, lying south of Calabogie Lake and Clear Lake, is known as the St. Patrick fault, while on the northeastern side the Coulonge fault separates the valley from the Laurentian Plateau. Thus a block, 35 miles in width, has been downdropped, forming a depression which is geologically known as the "Ottawa-Bonnechère" graben. The Ottawa River is located within this downdropped block. Within it are many minor breaks, the major of which, as far as this project is concerned, is the Packenham fault; this north-facing scarp transverses between Packenham and Arnprior. Geologic evidence indicates that the fault zones terminate immediately east of Arnprior (i.e., within the western limits of the Regional Municipality of Ottawa - Carleton).

The majority of this area is situated in the physiographic region known as the "Ottawa Valley Clay Plains". Here extensive clay deposits are interrupted by ridges, primarily composed of shallow glacial deposits overlying bedrock. The

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

sensitive marine clay, which was deposited in the geologic past in the Champlain Sea, varies markedly in thickness over the region; in some localized areas it is known to extend to depths in excess of 150 feet. The clay is generally underlain by glacial till and/or interglacial sand and gravel deposits, followed in turn by bedrock, which west of Arnprior is of Precambrian Age, while to the east is predominantly limestone of the Trenton - Black River formations, Ordovician Period.

Within the river channel, as well as along the west approach, of the Madawaska River, bedrock either outcrops, or is encountered at a shallow depth below ground surface.

The drainage in the area is controlled by the two major rivers, namely: the Madawaska and the Mississippi.

3. FIELD AND LABORATORY WORK:

A detailed borehole was put down at each of five structure sites, during the course of the recent investigation (Site Nos. 12, 13, 14, 19 and 21). In addition, a vane hole was put down at Site #19. The borings were advanced by using a conventional diamond drill rig adapted for soil sampling purposes.

Samples of the cohesive portion of the overburden were obtained in 2" I.D. Shelby tubes, which were manually pushed into the soil. In addition, field vanes were carried out, where possible, to determine the undrained shear strength of the clay stratum. Samples of the granular and glacial till deposits were obtained in a 2" O.D. split-spoon sampler, which was hammered into the soil in accordance with the specifications for the Standard Penetration Test. Bedrock was proven in 9 of the boreholes by obtaining AXT size rock core sampling.

Groundwater level observations were carried out, during the period of the investigation, in the open boreholes. Artesian groundwater conditions were encountered at Site #20 (refer to Report No. W.J. 69-P-6). Following completion of the drilling

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

operations, the artesian flow was stopped by sealing the borehole with bentonite.

The subsoil and bedrock conditions, encountered at the various boring locations, carried out during the present, as well as the previous investigations, are presented on the Record of Borelog sheets. The location and elevation of the various boreholes were provided by personnel from the Eastern Region Engineering Surveys Section. The elevations in this report are referenced to a geodetic datum. Boring locations and elevations, together with a centre-line stratigraphical profile along revised Hwy. #17, are shown on Drawing No. W.J. 69-F-86A.

All the samples were subjected to a careful visual examination in the field, and subsequently in the laboratory. Following this examination, laboratory testing was carried out on selected representative samples to determine the following engineering properties of the overburden:

Bulk Densities
Natural Water Contents
Atterberg Limits
Grain-Size Distributions
Undrained Shear Strengths
Consolidation Characteristics

The results of the testing, carried out on the samples obtained during this recent investigation, are summarized on Figures 1, 2 and 3, contained in Appendix I of this report.

4. SUBSOIL AND BEDROCK CONDITIONS:

4.1) General:

The predominant overburden deposit, across the area, is generally composed of a firm to stiff clay to silty clay stratum of marine origin; in most instances the upper portion has been

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4. SUBSOIL AND BEDROCK CONDITIONS: (cont'd.) ...

4.1) General: (cont'd.) ...

desiccated forming a 'crust'. The thickness of the deposit, where encountered, varies from 3 to 165 feet, being most extensive within the Mississippi River valley.

At random locations, particularly in the vicinity of the Madawaska River, the cohesive strata is surficially covered by a thin (approx. 4 feet thick) layer of compact silty sand. The clay is, generally, underlain by either a basal glacial till or an interglacial granular deposit, varying from 2 to 8 feet in thickness.

The overburden is underlain by sound bedrock, which ranges from metamorphosed greywacke in the western portion under investigation, to crystalline limestone in the eastern portion.

The stratigraphy encountered in the borings is plotted on the Record of Borelog sheets. The stratigraphical profile, along the alignment, has been inferred from this data and plotted on Drawing Nos. 69-P-86A. The subsoil and bedrock sequence, encountered from ground surface downward, is presented in the following sub-sections.

4.2) Clay to Silty Clay (Sensitive):

Over the majority of the area under investigation the predominant stratum is composed of a sensitive clay to silty clay with a trace of sand. The overall thickness of the stratum ranges from 3 feet, immediately west of the Madawaska River, to as much as 166 feet in the vicinity of the Mississippi River valley. The upper 3 to 15 feet of the cohesive subsoil has been subjected to desiccation, thus forming a 'crust'. Numerous partings and seams of silt, up to 2 inches thick, were encountered throughout the deposit. Three grain-size distribution curves, carried out on samples obtained from the clay, are plotted on Figure #1, in the Appendix of this report.

4. SUBSOIL AND BEDROCK CONDITIONS: (cont'd.) ...

4.2) Clay to Silty Clay (Sensitive): (cont'd.) ...

The engineering properties of that portion of the cohesive subsoil, encountered below the upper desiccated 'crust', are summarized in the following table:

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4. SUBSOIL AND BEDROCK CONDITIONS: (cont'd.) ...

4.2) Clay to Silty Clay (Sensitive): (cont'd.) ...

		Range	Average
Bulk Density (p.c.f.)	(γ)	106 - 116	(110)
Liquid Limit (%)	(W_L)	34 - 71	(43)
Plastic Limit (%)	(W_P)	17 - 27	(21)
Natural Water Content (%)	(W)	32.5 - 87	(48)
Liquidity Index	(I_L)	0.4 - 2.0	(1.4)

Compressibility Characteristics

Void Ratio	(e_o)	1.5 - 2.4 (1.7)
Compression Index	(C_c)	0.7 - 3.0 (1.4)
Degree of Preconsolidation ($P_c - P_o$) (p.s.f.)	(P_c)	1,500 to 4,000

Undrained Shear Strengths (C_u) (p.s.f.)	
In-situ Field Vane Tests	550 - >2,000
Laboratory Tests	500 - 1,800

NOTE: This table includes only the field and laboratory testing carried out during this most recent investigation - i.e., Sites Nos. 12, 13, 14, 19 and 21.

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4. SUBSOIL AND BEDROCK CONDITIONS: (cont'd.) ...

4.2) Clay to Silty Clay (Sensitive): (cont'd.) ...

The Atterberg limit test results, given in the table, are also summarized on the Plasticity Chart, Figure #2. The testing indicates that the clay basically inorganic with a plasticity in the intermediate to high range. The corresponding liquidity indices are consistently greater than 1.0.

The field and laboratory undrained shear strength results are plotted on the Record of Borelog sheets. The results indicate that the consistency of the clay varies typically from firm, immediately below the 'crust', to stiff with depth. The consistency of the upper desiccated zone ranges from stiff to very stiff.

The consolidation characteristics of the cohesive stratum were determined by carrying out a series of laboratory consolidation tests, the results of which are shown as Void Ratio vs. Pressure plots, on Figure #3. Referring to the table, it can be seen that the clay is preconsolidated in excess of existing overburden pressure by up to 4,000 p.s.f., immediately below the desiccated zone; at a greater depth, however, it is inferred that the preconsolidation may be as low as 1,500 p.s.f.

At a few random locations, west of the Madawaska River, the clay is surficially covered by up to 4 feet of compact silty sand with some gravel (refer to Sites No. 15 and 17).

4.3) Silty Sand to Sandy Silt:

At some random locations the clay is underlain by a deposit of compact to very dense ('N' values between 24 and 84 blows/ft.) silty sand to sandy silt; occasionally some gravel sizes are present. The thickness of the granular deposit, where encountered, ranged from 2 to 7 feet (refer to Sites No. 10, 11, 12, 19 and 21).

4. SUBSOIL AND BEDROCK CONDITIONS: (cont'd.) ...

4.4) Glacial Till:

At two site locations, namely, Sites #13 and 14, the cohesive stratum is underlain by a 4.5 to 8-foot thick basal glacial till. At Site #14 the glacial till outcrops at ground surface. The matrix of the till is generally cohesive - i.e., a clayey silt (of low plasticity) binding sand and gravel. There are, however, zones where the matrix is basically granular (silt, sand and gravel). Two grain-size distribution curves, for samples from the deposit, obtained with 2" O.D. equipment, are plotted on Figure #1.

Based on the results of the standard penetration resistance testing carried out within the deposit, it is estimated that the consistency of the cohesive portions is in the very stiff to hard range. The relative density of the non-cohesive portions is considered to be dense to very dense.

4.5) Bedrock:

Bedrock was proven at 9 of the boring locations by obtaining between 4 and 10 feet of AXT size rock core samples. The surface of the bedrock was found to vary from elevation 135 (Site #20) to 386 (Site #12), which corresponds to depths of between 3 and 166 feet below ground surface. In general, the surface of the bedrock increases in elevation, west of the Madawaska River, being at its lowest elevation in the vicinity of the Mississippi River.

The bedrock is quite variable in composition. Along the western portion of revised Hwy. #17 under investigation (in Renfrew County), it is generally composed of metamorphosed greywacke. East of Renfrew the bedrock is a crystalline limestone (sedimentary rock). In general, bedrock is sound throughout; however, some signs of fracturing and jointing were observed in the upper 2 to 3 feet at a few of the boring locations.

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5. GROUNDWATER CONDITIONS:

Groundwater level observations have been carried out during the period of the investigation by recording the water level in the open borings. The observations are recorded on the borelog sheets and summarized on Drawing No. W.J. 69-F-86A. The results of the measurements indicate that the piezometric groundwater level, within the overburden deposits, generally varies between 2 and 13 feet below existing ground surface. These correspond to groundwater elevations ranging between 325 and 433. The groundwater level elevations tend to decrease as the Madawaska and Mississippi River valleys are approached - i.e., there is a natural hydrostatic gradient towards the river. This indicates that these rivers do, in fact, control the drainage in the immediate area under investigation.

At the boreholes, put down on the bank of the Mississippi River (Site No. 20), during the previous investigation, an artesian condition was encountered along the valley floor. This was noticed once the borehole penetrated into the upper fractured and jointed portion of the bedrock (i.e., at about elevation 135). The groundwater rose instantaneously in the casing; the artesian head stabilized at about elevation 280 - i.e., some 7 feet above the river water level recorded at the time of the investigation. It is inferred that the upper jointed portion of the bedrock is acting as a confined aquifer; such a zone is probably being charged with groundwater from the surrounding terrain, which is at a higher elevation.

6. DISCUSSION AND RECOMMENDATIONS:

6.1) General:

It is proposed to realign Hwy. #17; this report will be concerned with the section from Antrim westerly approximately 16 miles to Locheil Creek; this will form the Arnprior By-pass network. The proposed highway will incorporate 4 lanes with a wide median.

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

6.1) General: (cont'd.) ...

Twelve structure crossings are proposed within this section (designated Sites No. 10 to 21, inclusive). At this stage the profile grades of these crossings, as well as other pertinent design data, have not been finalized. Preliminary drawings and profiles (unnumbered) have, however, been provided by the Functional Planning Section (Eastern Region).

The subsoil, bedrock and groundwater conditions, encountered along the proposed alignment, are shown on Drawing No. W.J. 69-F-86A.

Foundation investigations were carried out previously at seven of the sites. Preliminary reports, containing all the factual data obtained, as well as recommendations pertaining to foundation design at these sites, have been submitted. The sites involved are tabulated below:

Site No.		Revised Hwy. #17 Crossing of	Report No.
10	-	Lochiel Creek	W.J. 68-F-70
11	-	Existing Hwy. #17 - (South of Glasgow Station)	
15	-	County Road No. 2	W.J. 69-F-19
16	-	Side Road (Western Town Limits of Arnprior)	
17	-	Madawaska River	
18	-	Relocated Hwy. #29	
20	-	Mississippi River	W.J. 69-F-6

These sites will not be discussed further in this report.

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

6.1) General: (cont'd.) ...

Preliminary design data, recommendations pertaining to the foundations, as well as the stability and settlement considerations for the associated approach fills, will be presented in tabular form for each of the remaining structures. The structure sites included are designated as Nos. 12, 13, 14, 19 and 21.

FOUNDATION RECOMMENDATIONS - SITE #12

Underpass Structure - Revised Hwy. #17 and Existing Twp. Rd.

Approx. Exist. Ground Level (Approx. Grade of Hwy. #17	Predominant Overburden Strata Total Thickness (Ft.)	RECOMMENDATIONS		Remarks
		Structure	Embankments (Height - Longitudinal Direction - 20') (Height - Transverse Direction - 27')	
397 to 400 (406.5±)	Silty Clay (Very Stiff) - (9.5') Sandy Silt (Very Dense) - (1') Underlain by Bedrock (Sound)	Piers Spread footings founded within silty clay stratum, allowable bearing value 2.5 t.s.f. Alternatively, footings carried down to bedrock, allowable bearing value up to 20.0 t.s.f. Abutments 'Perched' on spread footings, in the approach fills, within a zone composed of well compacted granular material, using an allowable bearing value of 2.0 t.s.f. NOTE: Differential settlement, between the spread footing supported abutments and piers will be negligible.	Stability No stability problems are anticipated at this site for fills 27 ft. in height (with 2:1 slopes). Estimated Settlement 2" to 3" (max.) (recompression) - will take place during or immediately following, the construction period.	--

cont'd. ... 14

FOUNDATION RECOMMENDATIONS - SITE #13

Underpass Structure - Revised Hwy. #17 and Existing Twp. Rd.

Approx. Exist. Ground Level (Approx. Grade of Hwy. #17)	Predominant Overburden Strata Total Thickness (Ft.)	RECOMMENDATIONS		Remarks
		Structure	Embankments (Height - Longitudinal Direction - 20') (Height - Transverse Direction - 26')	
369 to 371 (375±)	Silty Clay (Stiff to Very Stiff) - (39') Glacial Till (Dense) - (3.5') Underlain by Bedrock (Sound)	Piers Spread footings founded at as high an elev. as possible within the upper desiccated portion of the cohesive stratum (elev. 368), using an allowable bearing value of 2.0 t.s.f. Alternatively, end-bearing piles driven to bedrock - designed for the max. capacity of the pile section chosen. Abutments End-bearing piles driven to bedrock. NOTE: Differential settlement, between the pile-supported abutments and spread footing supported piers will be within 1 to 1½ inches.	Stability No stability problems are anticipated at this site for fills 26' in height (with 2:1 slopes). Estimated Settlement 3" to 4" (Max.) (Recompression) - majority of settlement will take place within a period of 3 months following construction.	--

cont'd. ... 15

FOUNDATION RECOMMENDATIONS - SITE # 14

Underpass Structure - Revised Hwy. #17 and Existing Twp. Rd.

pprox. Exist. round Level Approx. Grade of Hwy. #17)	Predominant Overburden Strata Total Thickness (Ft.)	RECOMMENDATIONS		Remarks
		Structure	Embankments (Height - Longitudinal Direction - 20') (Height - Transverse Direction - 26')	
365 ± (369)	Glacial Till (Very Stiff) - (13') Underlain by Bedrock (Sound)	Piers Spread footings founded within the glacial till deposit, allowable bearing value 2.5 t.s.f. Abutments 'Perched' on spread footings, in the approach fills, within a zone composed of well compacted granular material, allowable bearing value of 2.0 t.s.f. NOTE: Differential settlement, between spread footing supported piers and abutments, will be negligible.	Stability No stability problems are anticipated at this site for fills 26' in height (with 2:1 slopes) Estimated Settlement 1" to 2" (Max.) (Recompression) - will take place during or immediately following the construction period.	--

FOUNDATION RECOMMENDATIONS - SITE # 21

Underpass Structure - Revised Hwy. #17 and Existing Co. Rd. #20

Approx. Exist. Ground Level (Approx. Grade of Hwy. #17)	Predominant Overburden Strata Total Thickness (Ft.)	RECOMMENDATIONS		Remarks
		Structure	Embankments (Height - Longitudinal Direction - 20') (Height - Transverse Direction - 23' to 24')	
355 ± (358)	Clay to Silty Clay (Firm to Stiff) - (92'). Sand and Gravel (Dense) - (1.5') Underlain by Bedrock - (Sound)	Piers and Abutments End-bearing piles driven to bedrock. - designed for the max. capacity of the pile section, at the pier locations. NOTE: Capacity of piles supporting abutments may have to be reduced in order to allow for negative skin frictional effects.	Stability No stability problems are anticipated for fills up to 24' in height (with 2:1 slopes). Estimated Consolidation Settlements 8" to 10" in 4 years 15" to 21" in 25 years (Max.)	Consideration should be given to: i) constructing the approach fills prior to construction of the foundation in order to minimize post-construction settlements; ii) surcharging the approaches in order to accelerate the settlements prior to construction of the structure elements.

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FOUNDATION RECOMMENDATIONS - SITE # 19

Underpass Structure - Revised Hwy. #17 and Existing Co. Rd. #22

Approx. Exist. Ground Level (Approx. Grade of Hwy. #17)	Predominant Overburden Strata Total Thickness (Ft.)	RECOMMENDATIONS		Remarks
		Structure	Embankments (Height - Longitudinal Direction - 20') (Height - Transverse Direction - 25')	
328 ± (332.5)	Clay to Silty Clay (Firm to Stiff) - (166') Underlain by Sand and Silt (Very Dense)	Piers and Abutments End-bearing piles driven to practical refusal within the granular stratum, or to bedrock. - designed for max. capacity of the pile section chosen at pier locations. NOTE: At abutment locations the piles should be designed, taking into account the negative skin frictional forces.	Stability No stability problems are anticipated for fills up to 25' in height (with 2:1 slopes) F.S. = 1.3) NOTE: If fills are built to a height in excess of 25', berms will be required. Estimated Consolidation Settlement 25' fill (2:1 slope) 10" to 12" in 4 years. 18" to 24" in 25 years - (Max.).	Consideration should be given to: i) constructing the approach fills prior to construction of the structure foundations, in order to minimize the post-construction settlements. ii) Surcharging the approaches in order to accelerate the settlements prior to construction of the structure elements.

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

It should be stressed that the recommendations, given in this report, are of a preliminary nature. A complete foundation investigation will be required at all the sites, when design details become available for the various sites along the alignment of revised Hwy. #17.

7. MISCELLANEOUS:

The field work, performed during the period of September 26 to October 1, 1969, was under the supervision of Mr. W. Hutton, Project Foundation Engineer.

Equipment was owned and operated by the F. E. Johnston Drilling Co. Ltd., Ottawa, Ontario.

The preparation of this report was undertaken by Mr. B. T. Darch, Senior Foundation Engineer.

This project was carried out under the general supervision of Mr. K. Devata, Supervising Foundation Engineer, who reviewed this report.

March, 1970

APPENDIX I

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

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE SITE 10 (BH #3,68-F-70) FOUNDATION SECTION

JOB 69-F-86 LOCATION Revised Hwy. 17 (Refer to Dwg. No. 69-F-86A) ORIGINATED BY CM
W.P. 5-67 BORING DATE Sept. 18-19, 1968 COMPILED BY CM
DATUM Geodetic BOREHOLE TYPE Diamond Drill, Washboring CHECKED BY

ELEV. / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	TYPE	BLOWS/FOOT
435.3	Ground Level				
0.0	Desiccated & fissured Very stiff to stiff. Grey - Brown		1	TW	PM
423.8			2	TW	PM
11.5	Silty clay to clay with occ. sand seams. Sensitive Firm to stiff. Grey		3	TW	PM
			4	TW	PM
			5	TW	PM
			6	TW	Lost
			7	TW	PM
			8	TW	PM
			9	TW	PM
			10	TW	PM
360.5					
74.8	Probably sand and gravel.				
356.0					
79.0	End of Borehole Practical refusal Probably Bedrock				

ELEV SCALE: 430, 420, 410, 400, 390, 380, 370, 360, 350

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

SHEAR STRENGTH P.S.F. — ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB. VANE
500 1000 1500 2000 2500

LIQUID LIMIT —— w_L
PLASTIC LIMIT —— w_p
WATER CONTENT —— w
WATER CONTENT % 15 30 45

BULK DENSITY γ P.C.F.	REMARKS
	▼433.0
110	
111	
109	
109	
107	
109	
116	
118	0 3 66 31

20
12 ⊣◇⊢ 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 SITE 11 (BH.6-68-F-70) FOUNDATION SECTION

JOB 69-F-86 LOCATION Revised Hwy. 17 (Refer to Dwg. No. 69-F-86A) ORIGINATED BY CM
W.P. 5-67 BORING DATE Sept. 16-18, 1968 COMPILED BY CM
DATUM Geodetic BOREHOLE TYPE Diamond Drill, Washboring CHECKED BY

ELEV. / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	TYPE	BLOWS/FOOT
423.3	Ground Level				
0.0	Desiccated & fissured Very stiff to stiff		1	SS	15
			2	SS	8
			3	TW	PM
	Mottled grey-brown		4	TW	PM
408.3			5	TW	PM
15.0			6	TW	PM
	Silty clay to clay Sensitive		7	TW	PM
	Stiff		8	TW	PM
	Grey		9	TW	PM
			10	TW	PM
377.3			11	TW	PM
46.0	Silty sand with gravel. Compact to very dense		12	SS	25
369.8			13	SS	105
53.5	Crystalline limestone bedrock		14	AXT	
362.1	Sound		15	AXT	
61.2	End of Borehole				

ELEV SCALE: 420, 410, 400, 390, 380, 370, 360

DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT 20 40 60 80 100

SHEAR STRENGTH P.S.F. 500 1000 1500 2000 2500
○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB. VANE

LIQUID LIMIT —— w_L
PLASTIC LIMIT —— w_P
WATER CONTENT —— w
WATER CONTENT % 15 30 45

BULK DENSITY γ P.C.F.: 110, 110, 110, 108, 111, 111, 108

REMARKS
422.0
419.7
1" dia. black pipe
GR SA SI CL
29 46 23

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 SITE 12

FOUNDATION SECTION

JOB 69-F-86 LOCATION Revised Hwy. #17 (See Dwg. 69-F-86A) ORIGINATED BY WH
W.P. 5-67 BORING DATE Sept. 26, 1969 COMPILED BY BHD
DATUM Geodetic BOREHOLE TYPE Washboring-NX Casing, AXT Rock Core 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. (o UNCONFINED, • QUICK TRIAXIAL, + FIELD VANE, × LAB. VANE) 400 800 1200 1600 2000	LIQUID LIMIT w_L — PLASTIC LIMIT w_p — WATER CONTENT w — WATER CONTENT % 20 40 60	BULK DENSITY γ P.C.F.	REMARKS GR.SA.SI.CL.
396.8	Ground Level									
0.0	Silty clay, trace of sand (occ. parting of silt) (Desiccated)		1	TW	PH	390	+	o		▼ 391.
387.5	Very stiff									WL in open BH, Sept. 26/69
386.3	Sandy silt. Very dense		2	SS	84					
10.5	Greywacke Bedrock (metamorphosed grey)		3	AXT	83%					
380.8	Sound					380				
16.0	End of Borehole									

FORM OB-MT-126 (REV. 1969)

OFFICE REPORT ON SOIL EXPLORATION

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE SITE 13

FOUNDATION SECTION

JOB 69-F-86 | LOCATION Revised Hwy. 17 (See drawing No. 69-F-86A) | ORIGINATED BY WH
WP 5-67 | BORING DATE Sept. 29, 1969 | COMPILED BY BTD
DATUM Geodetic | BOREHOLE TYPE Washboring-NX, HX Casing - AXT Rock Core | CHECKED BY

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) 400 800 1200 1600 2000	LIQUID LIMIT w_L, PLASTIC LIMIT w_p, WATER CONTENT w — WATER CONTENT % 20 40 60	BULK DENSITY γ P.C.F.	REMARKS GR. SA. SI. CL.
369.1	Ground Level									
368.1	Topsoil									
1.0	Desiccated Grey-Brown Very stiff		1	TW	PH					▼364. WL in open BH, Sept. 26/69
	Silty clay, trace of sand (occ. partings and seams of silt up to 2" thick, particularly below el. 340)		2	TW	PH	360	+7			
			3	TW	PH		×6 +8		110	0 16 54 30
	Grey-brown to grey		4	TW	PH	350	+5.5			
			5	TW	PH		+8			
			6	TW	PH	340	● +7 ×8			
	Stiff to very stiff									
330.1			7	SS	2		× +			
39.0	Het. mix. of silt, sand & gr., tr. of clay (Gl. Till)		8	SS	43	330				47 39 (14)
326.6	Dense									
42.5	Greywacke Bedrock Grey		9	AXT	85%					
321.5	Sound									
47.6	End of Borehole					320				

FORM OB-MT-[illegible] (REV 1969) OFFICE REPORT ON SOIL EXPLORATION

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE SITE 14

FOUNDATION SECTION

JOB 69-F-86 LOCATION Revised Hwy.17 (refer to drawing 69-F-86A) ORIGINATED BY WH
W.P 5-67 BORING DATE Sept. 29, 1969 COMPILED BY BTD.
DATUM Geodetic BOREHOLE TYPE Washborin-NX, HX Casing - AXT Rock Core 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 % 20 40 60	BULK DENSITY γ P.C.F.	REMARKS GR.SA.SI.CL.
364.5	Ground Level									
363.5	Topsoil									
1.0	Het.mix.of clay,silt, sand & gravel (Glacial Till) Grey		1	SS	24	360				
351.5	Very stiff		2	SS	15					▼ 351. 1 1 48 30 15
13.0	Greywacke Bedrock Grey		3	AXT	98%	350				WL in open BH.
346.3	Sound									
18.2	End of Borehole					340				Sept.29/69

FORM OB-MT-126 (REV 1969)

OFFICE REPORT ON SOIL EXPLORATION

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE SITE 15 (BH.R-1, 69-F-19) FOUNDATION SECTION

JOB 69-F-86 LOCATION Revised Hwy. 17 (refer to drawing 69-F-86A) ORIGINATED BY BTD
W.P. 5-67 BORING DATE April 28, 1969 COMPILED BY BTD
DATUM Geodetic BOREHOLE TYPE Washboring NX, AX Casing, AXT Rocke Core CHECKED BY

ELEV / DEPTH	SOIL PROFILE DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	TYPE	BLOWS/FOOT	ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS/FOOT / SHEAR STRENGTH P.S.F. (o UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, x LAB. VANE)	LIQUID LIMIT w_L / PLASTIC LIMIT w_P / WATER CONTENT w — WATER CONTENT % (20, 40, 60)	BULK DENSITY γ P.C.F.	REMARKS
347.4	Ground Level									
0.0	Silty sand, trace of gravel (Fill)		1	SS	15			o		7 25 63 5
343.9	Brown Compact									
3.5	Clayey silt to silty clay, trace of sand mottled grey & brown		2	SS	24			o		Borehole dry Apr. 28/69
339.2	very stiff					340				
8.2	Crystalline Limestone Bedrock (medium grained)		3	AXT	100%					
330.2	Grey Sound		4	AXT	100%					
17.2	End of Borehole					330				

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

DEPARTMENT OF HIGHWAYS- ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE SITE 16 (BH. Y1, 69-F-19) FOUNDATION SECTION

JOB 69-F-86 LOCATION Revised Hwy. 17 (refer to drawing 69-F-86A) ORIGINATED BY BTD
W.P. 5-67 BORING DATE April 29, 1969 COMPILED BY BTD
DATUM Geodetic BOREHOLE TYPE Washboring-NX, AX Casing - AXT Rock Core 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 %	BULK DENSITY γ P.C.F.	REMARKS GR.SA.SI.CL.
345.4	Ground Level									
	Clayey silt topsoil									
0.8	Silty clay to clayey silt, trace of sand		1	SS	7					
341.5	Desiccated Stiff									
3.9	Crystalline limestone bedrock (massive, medium grained)		2	AXT	100%	340				Borehole dry April 29/69
			3	AXT	95%					
330.4	Grey Spund		4	AXT	100%					
15.0	End of Borehole					330				

FORM OB-MT-136 (REV. 1969) OFFICE REPORT ON SOIL EXPLORATION

DEPARTMENT OF HIGHWAYS- ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE SITE 17-2 (BH.Y3, 69-F-19) FOUNDATION SECTION

JOB 69-F-86 LOCATION Revised Hwy. 17 (refer to drawing 69-F-86A) ORIGINATED BY BTD
W.P. 5-67 BORING DATE April 30, 1969 COMPILED BY BTD
DATUM Geodetic BOREHOLE TYPE Washboring-NX, HX Casing, AXT Rock Core CHECKED BY

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) 400 800 1200 1600 2000	LIQUID LIMIT w_L, PLASTIC LIMIT w_p, WATER CONTENT w; WATER CONTENT % 20 40 60	BULK DENSITY γ P.C.F.	REMARKS GR.SA.SI.CL.
340.2	Ground Level					340				
1.0	Silty sand topsoil									
1.0	Silty sand w. of gravel		1	SS	3					
337.2	Brown Compact									
3.0	Silty clay to clayey silt, with a trace of sand. (occ. seams of silt & sand up to 1/4" thick)		2	SS	14					
			3	SS	6	330	375 ○ ● ×s?			
	mottled grey & brown		4	TW	PM				110.5	▼ 324. 0 3 61 36
322.2	desiccated. Very stiff									
18.0			5	SS	8	320				WL in open BH. Apr. 30/69
	(Numerous silt & sand layers up to 5" thick particularly below el. 315.)		6	TW	PM		×s2.5		119	
309.3	Grey. Stiff to v.stiff		7	SS	3	310				
30.9	Crystalline Limestone Bedrock (massive, medium grained)		8	AXT	94%					
303.7	Grey Sound									
36.5	End of Borehole					300				

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

DEPARTMENT OF HIGHWAYS- ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE SITE 17-1 (SH. 12, 69-F-19) FOUNDATION SECTION

JOB 69-F-86 LOCATION Revised Hwy. 17 (refer to drawing 69-F-86A) ORIGINATED BY BTD
W.P. 5-67 BORING DATE April 30, 1969 COMPILED BY BTD
DATUM BOREHOLE TYPE Hand Dug CHECKED BY

SOIL PROFILE ELEV / DEPTH	DESCRIPTION	STRATA 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.
280.5										
0.0	Clayey silt topsoil					280				Hand dug hole dry Apr. 30/69
7.0	Silty clay to clayey silt trace of sand									
277.2	Stratified very stiff									
3.3	Crystalline Limestone Bedrock Grey					270				

FORM OB-MT-126 (REV. 1969)

OFFICE REPORT ON SOIL EXPLORATION

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE SITE 18(BH.X4,69-F-19) FOUNDATION SECTION

JOB 69-F-86 LOCATION Revised Hwy. 17 (refer to drawing 69-F-86A) ORIGINATED BY BTD
W.P. 5-67 BORING DATE April 24 & 25, 1969 COMPILED BY BTD
DATUM Geodetic BOREHOLE TYPE Washboring-NX, AX Casing - AXT Rock Core CHECKED BY

ELEV. / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	TYPE	BLOWS/FOOT	ELEV. SCALE
348.5	Ground Level					
0.0	Clayey silt topsoil		1	SS	5	
1.5	Clayey silt to silty clay, trace of sand (numerous sand layers up to 4" in thickness below elev. 340) (mottled grey & brown)		2	TW	PM	
	Desiccated		3	TW	PM	
335.5	Stiff to very stiff					340
13.0	(layers of sand up to 6" in thickness) (particularly below el. 329)		4	TW	PM	
326.7	Grey. Stiff to firm		5	SS	9	330
21.8	Crystalline limestone Bedrock with pockets of coarsely crystalline calcite (medium grained)		6	AXT	94%	
321.0	Grey Sound					
27.5	End of Borehole					320

DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT
SHEAR STRENGTH P.S.F.
○ UNCONFINED + FIELD VANE
● QUICK TRIAXIAL × LAB. VANE
400 800 1200 1600 2000

LIQUID LIMIT — w_L
PLASTIC LIMIT — w_p
WATER CONTENT — w
WATER CONTENT % 20 40 60

BULK DENSITY γ P.C.F.	REMARKS GR.SA.SI.CL.
	▼345.9 WL in open BH. April 25/69
117.5	
111	2 8 62 28 0 94 (6)

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

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE SITE 19

FOUNDATION SECTION

JOB 69-F-86 LOCATION Revised Hwy. 17 (refer to drawing 69-F-86A) ORIGINATED BY WH
W.P. 5-67 BORING DATE Sept. 30 & Oct. 1, 1969 COMPILED BY BTD
DATUM Geodetic BOREHOLE TYPE Washboring-NX Casing CHECKED BY

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 (400 800 1200 1600 2000)	LIQUID LIMIT w_L — PLASTIC LIMIT w_p — WATER CONTENT w — WATER CONTENT % (20 40 60)	BULK DENSITY γ P.C.F.	REMARKS GR. SA. SI. CL.
327.8	Ground Level									
0.0	Silty Clay (desiccated crust) Grey-Brown		1	TW	PM					▼322.5 WL in open BH, Oct. 1/69
	Very stiff		2	TW	PM	320				
	Clay to silty clay, trace of sand (occasional organic mottling) (random partings and seams of silt up to 1/4" thick throughout)		3	TW	PM	310	+4.5; ●+6 ×4		93	0 18 35 47
			4	TW	PM		+4			
			5	TW	PM	300	●4 ×5		91	
			6	TW	PM		+4			
			7	TW	PM	290	+4			
	Grey Firm to stiff		8	SS	-		+3			
			9	TW	PM	280	+3.5			
			10	SS	PM	270	+3			
			11	TW	PM	260	●+6 ×4			
			12	SS	PM	250	+2			
161.8										
166.0 158.3	Sand & silt Very dense. (Brown)					160				
169.5	End of Borehole									

20
15 ⊕ 5 % STRAIN AT FAILURE
10

FORM OB-MT [illegible]6 (REV 1969) OFFICE REPORT [illegible]N SOIL EXPLORATION

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF VANE HOLE SITE 19

FOUNDATION SECTION

JOB 69-F-86 LOCATION Revised Hwy. 17 (refer to drawing 69-F-86A) ORIGINATED BY WH
W.P. 5-67 BORING DATE Oct. 1, 1969 COMPILED BY BTD
DATUM Geodetic BOREHOLE TYPE NX Casing CHECKED BY [illegible]

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/FOOT	ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS/FOOT — SHEAR STRENGTH P.S.F. (O UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB. VANE) 400 800 1200 1600 2000	LIQUID LIMIT w_L — PLASTIC LIMIT w_P — WATER CONTENT w — WATER CONTENT %	BULK DENSITY γ P.C.F.	REMARKS GR. SA. SI. CL.
327.8	Ground Level									
0.0	Probable Desiccated Zone					320				▼322.7 WL in open BH Oct1/69
	Clay to silty clay, trace of sand, occ. organic mottling					310	+6			
							+6			
						300				
							+5			
	Firm					290	+5			
286.3										
41.5	End of Hole						+4			
						280				

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE SITE 20 (BH.A2,69-F-6) FOUNDATION SECTION

JOB 69-F-86 LOCATION Revised Hwy. 17 (refer to drawing 69-F-86A) ORIGINATED BY CM
W.P. 5-67 BORING DATE March 7 - 10, 1969 COMPILED BY CM
DATUM Geodetic BOREHOLE TYPE Washboring, NX Casing CHECKED BY

ELEV. DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/FOOT	ELEV SCALE
272.4	**Ground Level**					270
			1	TW	PM	
			2	TW	PM	260
			3	TW	PM	
			4	TW	PM	250
	Silty clay to clay		5	TW	PM	
			6	TW	PM	240
	Firm to stiff		7	TW	PM	
	Grey					230
	Occ. organic mottling		8	TW	PM	
						220
			9	TW	PM	
						210
			10	TW	PM	
						200
			11	TW	PM	
						190
			12	TW	PM	
						180
			13	TW	PM	
						170
						160
			14	TW	PM	150
						140
136.8	Fine sand seam					
135.6	End of Borehole Probably bedrock					

DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT

SHEAR STRENGTH P.S.F.
○ UNCONFINED + FIELD VANE
● QUICK TRIAXIAL × LAB. VANE
500 1000 1500 2000 2500

LIQUID LIMIT —— w_L
PLASTIC LIMIT —— w_P
WATER CONTENT —— w
w_P w w_L
WATER CONTENT %
15 30 45

BULK DENSITY γ P.C.F.

BULK DENSITY γ P.C.F.	REMARKS GR.SA.SI.CL.
100	
103	
112	
109	
113	
111	

71.6
63.3

Art. water encountered ▽
Practical refusal

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

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE SITE 21

FOUNDATION SECTION

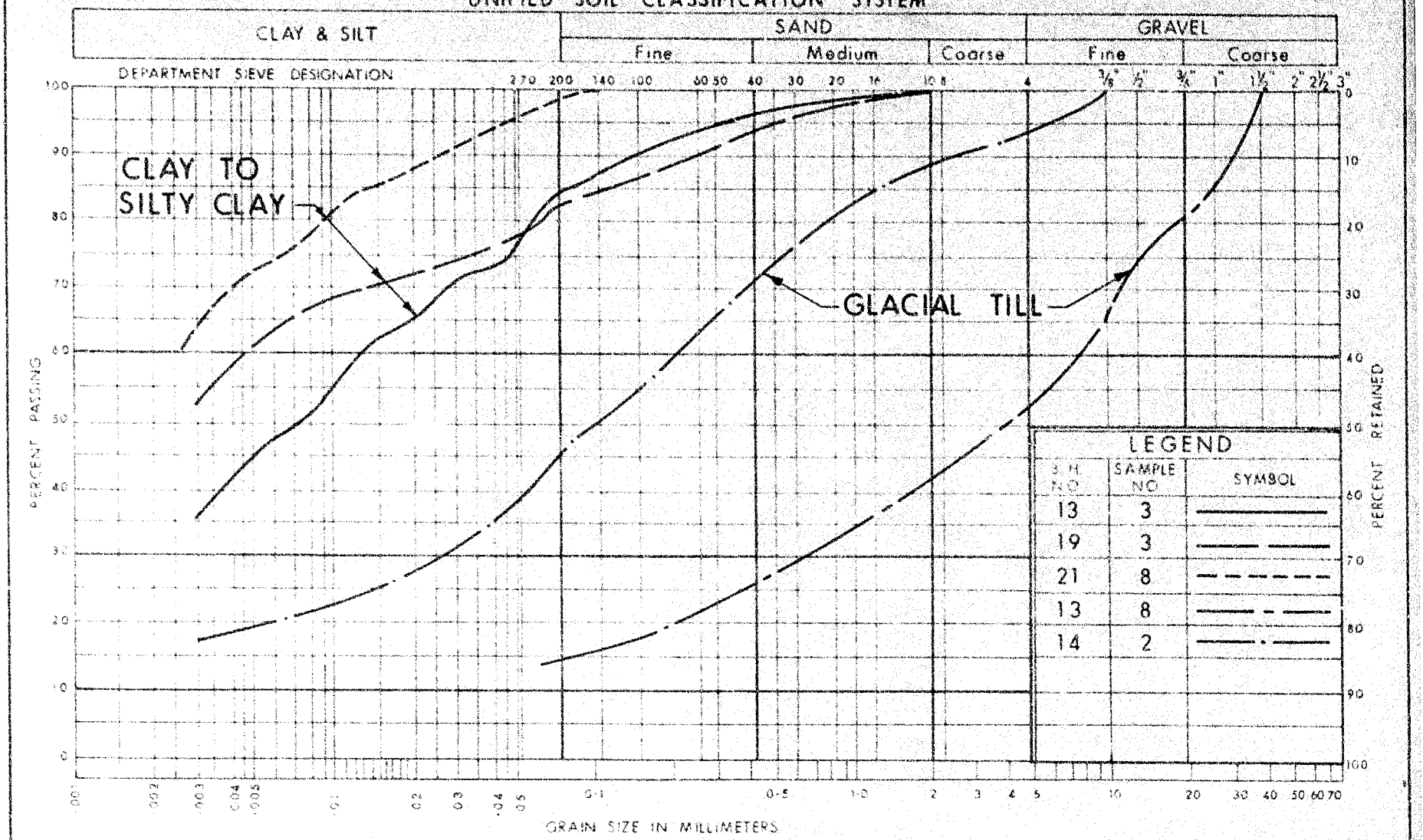
JOB 69-F-86 LOCATION Revised Hwy. 17 (refer to drawing 69-F-86A) ORIGINATED BY WH
W.P. 190-67 BORING DATE Sept. 30 and Oct. 1, 1969 COMPILED BY RFD
DATUM Geodetic BOREHOLE TYPE Washboring-NX, AX Casing, AXT Rock Core CHECKED BY

ELEV. DEPTH	SOIL PROFILE 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) 400 800 1000 1600 2000	LIQUID LIMIT w_L PLASTIC LIMIT w_p WATER CONTENT w — WATER CONTENT % 20 40 60	BULK DENSITY γ P.C.F.	REMARKS GR.SA.SI.CL.
354.4	Ground Level									
353.4	Topsoil									
1.0	Grey-brown Desiccated Zone		1	SS	5	350	+12			
	Clay to silty clay, trace of sand, occ. organic mottlings (random partings & seams of silt up to 1/4" thick throughout)		2	TW	PM		5			
			3	TW	PM	340	+3.5			▼336. WL in open BH on Oct. 1/69
			4	TW	PM					
			4A	SS	PM		+5			
			5	TW	PM	330	8	o		
	Grey		6	TW	PM		+8			
			7	TW	PM	320	+ 4			
			8	TW	PM		× 6 +6		106	0 1 4 55
	Firm to stiff		9	SS	2	310	+5.5			
			10	TW	PM	300	+7			
			11	SS	PM	290				
			12	TW	PM	280	+5 +6		112	
262.4	Sand & gravel					270				
260.9	Brown. Dense									
93.5	Crystalline Limestone Bedrock (Grey) Sound		13	AXT	100%	260				
255.9										
98.5	End of Borehole									

20
13 ⊕ 5 % STRAIN AT FAILURE
10

FORM 08 MT - 17
REV. APR. 1965

UNIFIED SOIL CLASSIFICATION SYSTEM

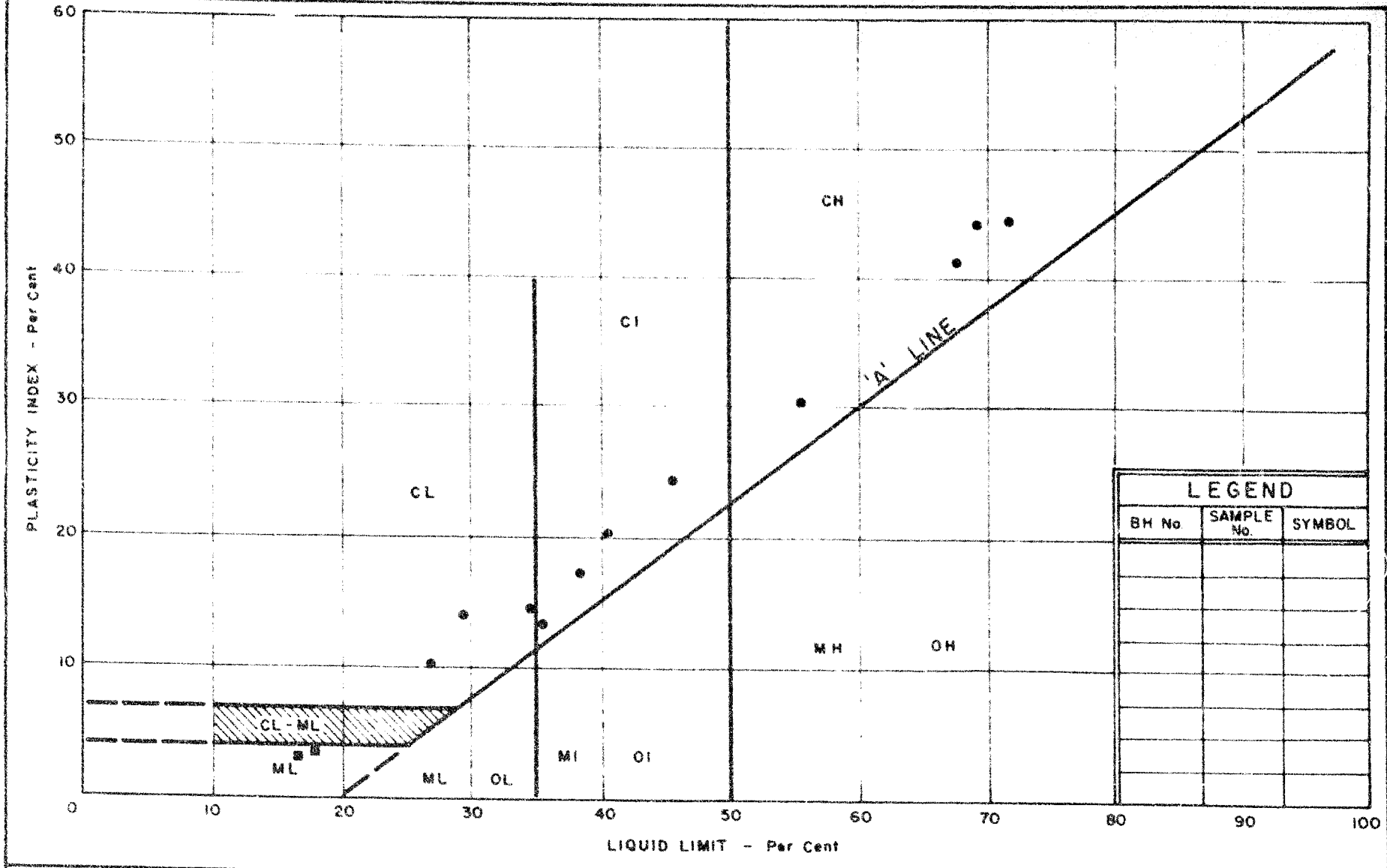


DEPARTMENT OF HIGHWAYS
MATERIALS and TESTING DIVISION

GRAIN SIZE DISTRIBUTION

W.P No. 5-67 & 190-67
JOB No. 69 - F - 86
FIG 1

REVISED JUL 1966



DEPARTMENT OF HIGHWAYS
MATERIALS and TESTING DIVISION

PLASTICITY CHART

• CLAY TO SILTY CLAY ▪ GLACIAL TILL

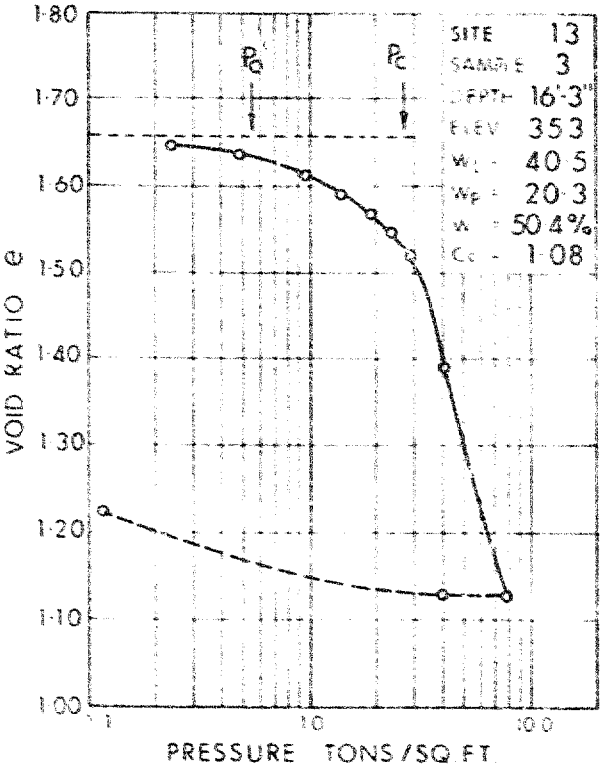
W.P. No. 5-67 & 190-67

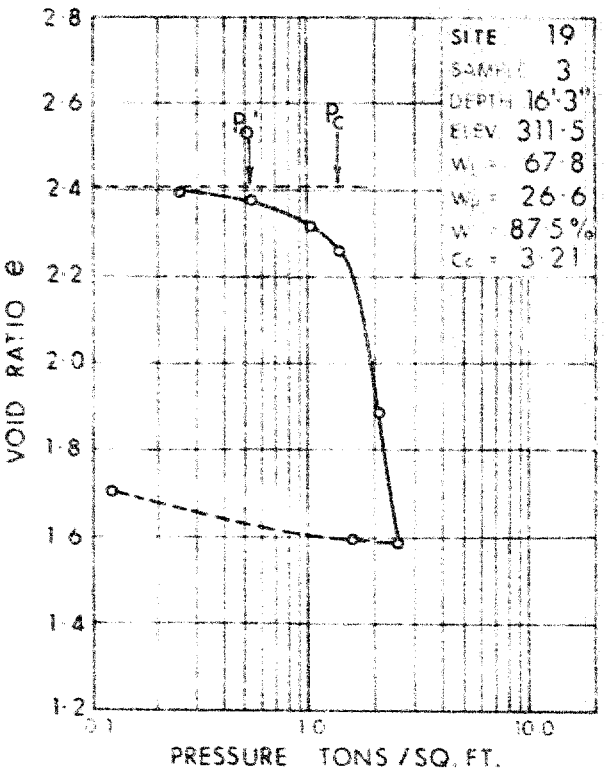
JOB No. 69 - F - 86

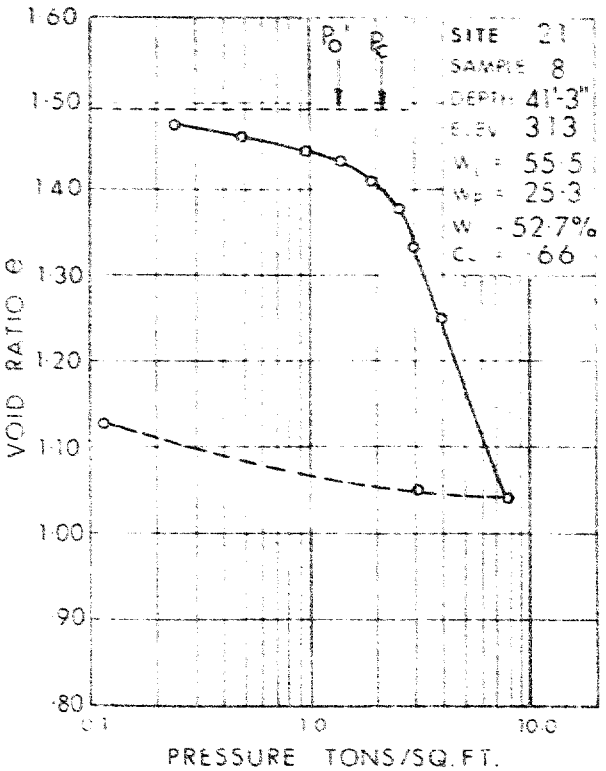
FIG. 2

VOID RATIO – PRESSURE CURVES

JOB NO. 69-F-86







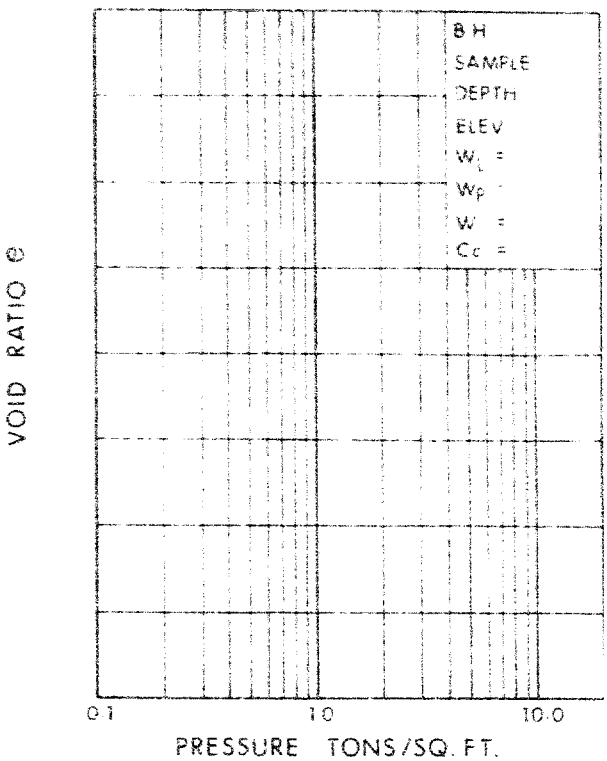


FIG 3

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 — 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
$\log_e\sigma$ OR $\ln\sigma$	NATURAL LOGARITHM OF σ
$\log_{10}\sigma$ OR $\log\sigma$	LOGARITHM OF σ 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

69-F-86

DEPARTMENT OF HIGHWAYS ONTARIO

MEMORANDUM

To: Mr. A.G. Sterrett,
Provincial Foundation Engineer,
Downsview, Ontario.

From: Functional Planning Section,
Kingston, Ontario.

Attention: Mr. M. Devata

Date: October 7, 1969.

Our File Ref.

In reply to

Subject: W.P. 5-67 & 190-67, Hwy. 17 (New), Highway 44 to Haley's Station, District 9 - Ottawa

Thank you for your co-operation in carrying out foundation investigations in the Renfrew area.

We would be grateful if this work could be extended to cover future structure sites east of Renfrew. These sites are indicated on the plans already supplied to you and are numbered as sites 12 to 22 inclusive.

B. Khojajian,
for: M. R. Ernesaks,
Regional Functional Planning Engineer.

PB/mjh

c.c. T.C. Kingsland
R. Forrest

Drilling commenced Sept. 26/69

completed Oct 1/69

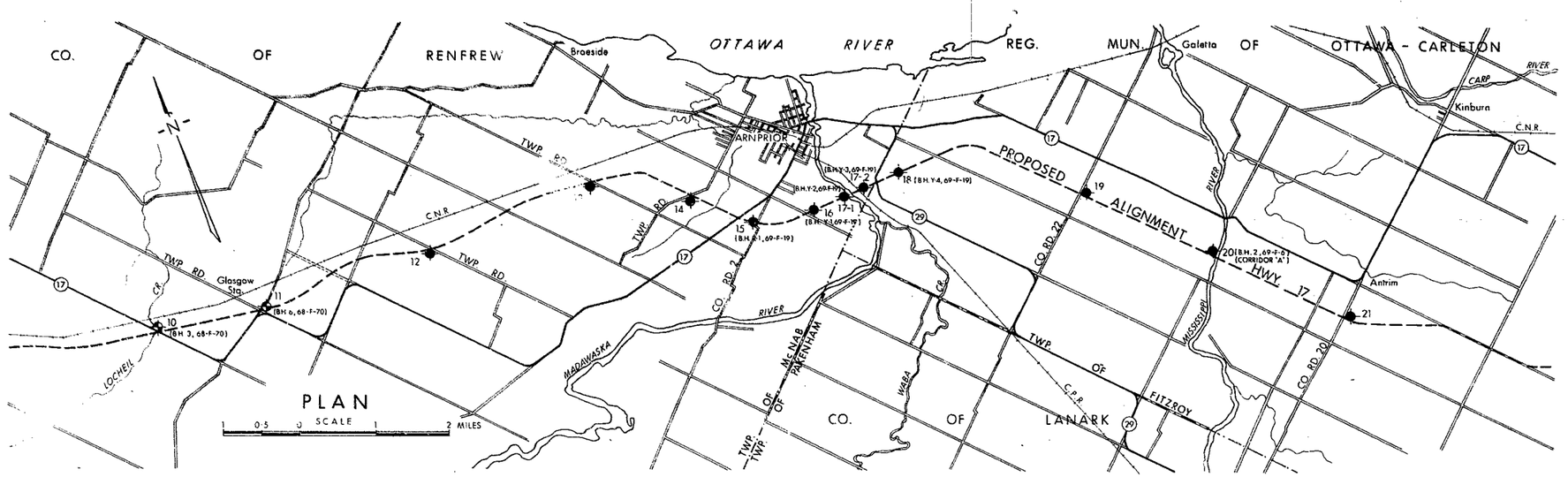
#69-F-86

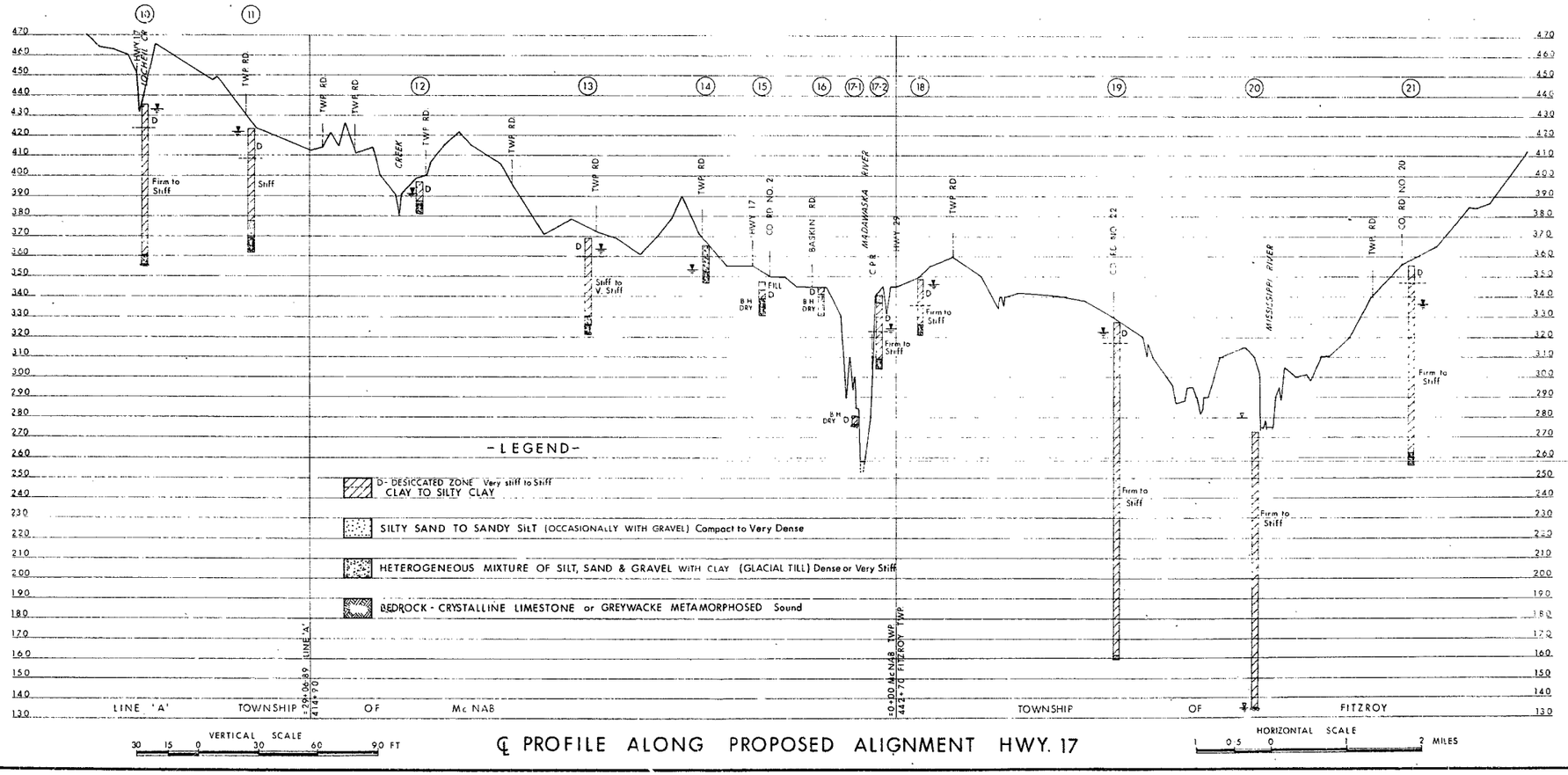
W.P.'s 5-67 AND 190-67

H.W.Y. #17

ANTRIM WESTERLY

TO LOCHEIL CREEK





℄ PROFILE ALONG PROPOSED ALIGNMENT HWY. 17

- LEGEND -

D- DESICCATED ZONE Very stiff to Stiff CLAY TO SILTY CLAY

SILTY SAND TO SANDY SILT (OCCASIONALLY WITH GRAVEL) Compact to Very Dense

HETEROGENEOUS MIXTURE OF SILT, SAND & GRAVEL WITH CLAY (GLACIAL TILL) Dense or Very Stiff

BEDROCK - CRYSTALLINE LIMESTONE or GREYWACKE METAMORPHOSED Sound

KEY PLAN
SCALE IN MILES

LEGEND

- Bore Hole
- Cone Penetration Hole
- Bore & Cone Penetration Hole
- Water Levels established at time of field investigation. APR. & SEPT. 69
  - Head
  - Encountered
  - ARTESIAN CONDITION

SITE	ELEVATION	REMARKS
10	435·3	68-F-70
11	423·3	68-F-70
12	396·8	RECENT INVESTIGATION
13	369·1	" "
14	364·5	" "
15	347·4	69-F-19
16	345·4	" "
17-1	280·5	" "
17-2	240·2	" "
18	348·5	" "
19	327·8	RECENT INVESTIGATION
20	272·4	69-F-6
21	354·4	RECENT INVESTIGATION

- 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

REVISIONS		
DATE	BY	DESCRIPTION

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING OFFICE - FOUNDATION SECTION

PRELIMINARY INVESTIGATION
PROPOSED ALIGNMENT
(ARNPRIOR VICINITY)

KING'S HIGHWAY NO. 17 DIST. NO. 9
CO. RENFREW & REG. MUN. OF OTTAWA - CARLETON
TWP. McNAB & FITZROY LOT CON.

BORE HOLE LOCATIONS & SOIL STRATA

SUBM'D. B. D.	CHECKED	W.P. NO. 5-67 & 190-67	M.B.T. DRAWING NO.
DRAWN S. O.	CHECKED:	JOB NO. 69-F-86	69-F-86A
DATE 28 JAN. 1970		SITE NO.	BRIDGE DRAWING NO.
APPROVED		CONT. NO.	

PRINCIPAL FOUNDATION ENGINEER