

DOCUMENT MICROFILMING IDENTIFICATION

G.I.-30 SEPT. 1976

GEOCRES No. 31F-60

DIST. 9 REGION _____

W.P. No. 3-67-01

CONT. No. _____

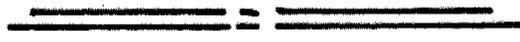
W. O. No. 71-11056

STR. SITE No. _____

HWY. No. 17

LOCATION PETAWAWA By PASS

No of PAGES -



OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT. _____

REMARKS: _____

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS, ONTARIO

MEMORANDUM

TO: Mr. T. C. Kingsland, (2) FROM: Foundations Office,
Reg. Structural Planning Eng., Design Services Branch,
Eastern Region, West Bldg., Downsview.
Kingston, Ontario.

ATTENTION: DATE: January 17, 1973.

OUR FILE REF. IN REPLY TO FEB - 5 1973

SUBJECT:

31F-60

PRELIMINARY
FOUNDATION INVESTIGATION REPORT
For
Structure and Related Crossings Along
Hwy. 17 'New'
From the Existing Hwy. 17 at Brindle Road
(Twp. of Petawawa), South-easterly 14
Miles to Hwy. 62 (Twp. of Alice)
Alternate Alignments A, B and C
County of Renfrew, District 9 (Ottawa)
W.O. 71-11056 -- W.P. 3-67

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 FOUNDATIONS ENGINEER.

AGS/ao
Attch.

cc: E. J. Orr
B. R. Davis
A. Rutka
A. J. Percy
J. E. Callaghan
B. J. Giroux
E. R. Saint
G. A. Wrong
B. A. Singh

Foundations Files
Documents ✓

TABLE OF CONTENTS

1. INTRODUCTION.
 2. DESCRIPTION OF THE AREA AND GEOLOGY.
 3. FIELD AND LABORATORY WORK.
 4. SUBSOIL AND BEDROCK CONDITIONS.
 - 4.1) General.
 - 4.2) Fill Material.
 - 4.3) Organic Deposits.
 - 4.4) Upper Granular Deposits.
 - 4.4.1) Sand and Gravel.
 - 4.4.2) Silty Sand to Sandy Silt.
 - 4.5) Cohesive Deposits.
 - 4.6) Glacial Till.
 - 4.7) Irregularly Layered Deposits.
 - 4.8) Lower Granular Material.
 - 4.9) Bedrock Conditions.
 5. GROUNDWATER CONDITIONS.
 6. DISCUSSION AND RECOMMENDATIONS.
 - 6.1) General.
 - 6.2) Hwy. 17 'N' Crossings - Proposed Alignment C.
 7. MISCELLANEOUS.
-

PRELIMINARY FOUNDATION INVESTIGATION REPORT
For
Structures and Related Crossings Along
Hwy. 17 'New'
From the Existing Hwy. 17 at Brindle Road
(Twp. of Petawawa), South-easterly 14
Miles to Hwy. 62 (Twp. of Alice)
Alternate alignments A, B and C
County of Renfrew, District 9 (Ottawa)
W.O. 71-11056 W.P. 3-67

1. INTRODUCTION:

The Foundations Office was requested to carry out a preliminary investigation for the possible structures and related crossings within the aforementioned 14 mile stretch of Hwy. 17N. Three alternate alignments were investigated (designated Lines A, B and C). The purpose of the investigation is to provide information pertaining to foundation design to aid in the planning studies for Hwy. 17N in this area.

The request for this foundation investigation was contained in a memo from Mr. T. C. Kingsland, Regional Planning Engineer, Eastern Region, dated June 7, 1971. An investigation was subsequently carried out by this Office to determine the subsoil, bedrock and groundwater conditions across the area.

The engineering aspects related to foundation design have been verbally discussed as well as presented at meetings held between personnel from the Eastern Region and this Office. This report is a follow-up to these discussions. It presents the factual information obtained from this investigation. Included are recommendations pertaining to foundation design at the various possible crossings, as well as the stability and settlement considerations associated with the required fills.

2. DESCRIPTION OF THE AREA AND GEOLOGY:

The area under investigation extends from the existing Hwy. 17 at Brindle Road to Hwy. 62 at a point 1.8 miles south-west

of Pembroke, a distance of approximately 14 miles. The whole area lies parallel to the Ottawa River and is located within the Townships of Petawawa and Alice.

Numerous creeks and the Petawawa River cross the area in the south-west to north-east direction. The area is flat with some small hills. The ground surface ranges from elevation 453 to elevation 530.

It is a mixed agricultural and natural woodland area with the insertion of the Camp Petawawa Military Reserve at the north-western end.

Geologically the western and central parts of the area belong to the physiographic region known as the Petawawa Sand Plain. In origin, it is a delta built in the Champlain Sea by the Petawawa, Barron, Indian and Ottawa Rivers during the Fossmill stage of Lake Algonquin. The predominant deposit in this area consists of a 13 to more than 100 feet deep stratum of granular material.

The eastern part enters the physiographic region known as the Ottawa Valley Clay Plains. Here extensive 5 to 30 feet deep clay deposits are interrupted by ridges of sand and/or bedrock. The sensitive marine clay was deposited in the geologic past in the Champlain Sea. The clay is generally underlain by glacial till followed in turn by granitic gneiss bedrock of Precambrian Age.

3. FIELD AND LABORATORY WORK:

A total of thirty-three boreholes were put down by means of conventional diamond drill rigs adapted for soil sampling purposes. The sites were located at the possible structure and creek crossings.

Samples of the overburden were obtained, at specific intervals, in a 2-inch O.D. split-spoon sampler, which was hammered into the soil in accordance with the specifications for the Standard Penetration Test. Where cohesive deposits were encountered, the split-spoon sampling was supplemented by taking 2-inch O.D. Shelby tubes, which were pushed manually or hydraulically into the soil. In addition, field vane tests were carried out, where possible to obtain the undrained shear

strength of the clay strata. Bedrock was proven in thirteen of the borings by obtaining either AXT or BX size rock core samples. Groundwater level observations were carried out, during the period of the investigation, in the open boreholes.

The soil, bedrock and groundwater conditions encountered at the boring locations are presented on the Record of Borelog sheets, appended to this report. The location and elevation of the various boreholes were provided by personnel from the Eastern Region Engineering Surveys Office. The elevations in this report are referenced to a Geodetic Datum. Boring locations and elevations are shown on Drawing No. W.O. 71-11056A. Estimated stratigraphical profiles, along proposed alignments A and C are plotted on Drawing No. 71-11056B.

All samples were subjected to 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:

- Natural Moisture Content
- Atterberg Limits
- Bulk Density
- Grain Size Distribution
- Undrained Shear Strength
- Lab Vane Test
- Consolidation Characteristics

The results of this testing are plotted on the Record of Borelog Sheets and summarized on Figures No. 1 to 8, inclusive, all contained in Appendix I of this report.

4. SUBSOIL AND BEDROCK CONDITIONS:

4.1) General:

The extent and composition of the overburden, within the area under investigation, varies markedly. West of the Petawawa River, the predominant stratum is composed of a dense

to very dense sand and gravel. This stratum varies in thickness from 13 feet near the river to 100 feet at Hwy. 17 (site #1). In the most westerly part of the stratum of sand and gravel is underlain by a layer of sandy silt or silty sand which, in turn, is followed by very dense gravel, which in turn is probably followed by gneiss bedrock. Closer to the river the sand and gravel stratum, is directly underlain by gneiss bedrock.

East of the Petawawa River and West of the Boundary Road between the Townships of Petawawa and Alice, four of the eight investigated sites have the stratigraphical sequence of a 12 to 25 feet thick surficial granular deposit followed by a 5 to 28 feet thick cohesive deposit, which in turn, is followed by a 1 to 7 feet thick layer of glacial till then bedrock. In two of the sites the granular material is directly underlain by bedrock, the cohesive layer was not encountered in another two. In three of the abovementioned 8 sites, there is a 6 to 8 feet thick layer of sand overlying the bedrock and underlying the glacial till or cohesive deposits.

East of the Boundary Road between the Townships of Alice and Petawawa to Hwy. 62, in three of the seven investigated sites, a 16 to 30 feet thick surficial cohesive layer is underlain by a 8 to 12 feet thick glacial till layer, which in turn, is underlain by bedrock. In another site the cohesive material is overlain by a 7 feet thick granular deposit. In two sites the glacial till was found directly under a thin layer of topsoil and underlain by bedrock or a 27 feet thick granular deposit. In one site a 8 feet thick surficial cohesive layer is directly underlain by bedrock.

4.2) Fill Material:

Fill material was encountered at sites #23 and #24. At site #23, the depth of the fill varies from 7 to 16.5 feet and its composition is quite random, varying from sand and gravel

to clayey silt with ash, nails and organic material. Standard penetration testing carried out within the fill gave 'N' values ranging from 8 to 115 blows/foot. These values would indicate that the fill has been subjected to a considerable degree of compaction.

At site #24, 8 feet of compact granular road fill was encountered.

4.3) Organic Deposits:

Approximately 1,500 feet east of Petawawa River, at a point about 1-1/2 miles south-east of the existing Hwy. #17, there is a 500 feet wide swamp filled with organic material. In this area the surficial deposit is composed of a dark brown, very soft, fibrous peat. The thickness of the peat deposit ranges from 2 feet, along the edges of the swamp, to as much as 23.5 feet at the centre. In the central part of the swamp, the organic material is directly underlain by bedrock. Elsewhere, however, the organic material is underlain by the dense to very dense sand and gravel deposit common to this area. (Refer also to the Final Foundation Report No. 72-11021).

Organic material was not encountered at any other boring locations, except in some topsoil and the fill material discussed above. It is inferred, however, that surficial organic material may be present in isolated localized areas, as well as in the vicinity of the numerous creeks which cross this area.

4.4) Upper Granular Deposits:

4.4.1) Sand and Gravel:

From the existing Hwy. #17 to Airport Road (Site #14) a surficial sand and gravel deposit is present. This deposit is interrupted by the organic deposit located east of the Petawawa River, and at the upper 7 feet by the fill material of site #23. The thickness of this sand and gravel deposit varies

randomly from 100 feet at site #1 to 11 feet at site #4. Close to the Petawawa River and at site #12, this granular deposit contains numerous 6" to 12" boulders.

Grain-size distribution tests were carried out on samples from this deposit; the resulting curves are plotted in envelope form on Fig. 1 of the Appendix. Standard penetration testing was carried out within this deposit; the results are plotted on the Record of Borelog sheets. This testing gave 'N' values which range from 9 to more than 100 blows/foot, being generally in the 35 to 55 blows/foot range. Based on these results, it is estimated that the relative density of the granular material varies from loose to very dense, being generally in the dense to very dense range.

4.4.2) Silty Sand to Sandy Silt:

At some locations east of Petawawa River 27 to 25 feet surficial silty sand to sandy silt deposit is present. This deposit is interrupted by sand and gravel or clay surficial deposits.

Grain-size distribution tests were carried out on this deposit; the resulting curves are plotted in envelope form on Fig. 2 of the Appendix. The results from the Standard Penetration Tests carried out within this deposit are plotted on the Record of Borelog sheets. This testing gave 'N' values which range from 18 to 136 blows/foot. Based on these results, it is estimated that the relative density of this granular deposit varies from compact to very dense.

4.5) Cohesive Deposits:

At numerous sites east of the Petawawa River, there is a 5 to 28 feet thick cohesive layer of clay to silty clay. This layer is overlain by a 9 to 25 feet thick granular deposit at ten sites and by a thin topsoil layer at four other sites, and underlain by a 1 to 16 feet thick deposit of glacial till

(at eight sites) or bedrock (at three sites).

The engineering properties of the cohesive layer are summarized in the following table:

<u>Silty Clay to Clayey Silt</u>	<u>Range</u>	<u>Average</u>
Bulk Density (γ) (p.c.f.)	102 - 129	111.5
Liquid Limit (W_L) (%)	20 - 65	38
Plastic Limit (W_p)	15 - 26	22.5
Natural Water Content (W)	13.5 - 75	39
Liquidity Index (I_c)	0.4 - 7.6	1.3
Field Vane Test (p.s.f.)	850 - 2000+	
Lab Vane Test (p.s.f.)	615 - 7100	1900
Quick Triaxial Test (p.s.f.)	495 - 3190	1470

Consolidation Properties

<u>Borehole-Site/Sample</u>	<u>e_o</u>	<u>C_c</u>	<u>P_c (t.s.f.)</u>	<u>$P_c - P_o$ (t.s.f.)</u>	
5	3	1.19	0.20	5.90	5.48
1 - 8	6	2.12	1.30	2.12	1.40
2 - 8	5	1.82	1.91	2.30	1.34
11	5	1.29	0.69	0.90	0.15
13	4	1.24	0.66	2.00	1.40
16	10	1.43	0.69	3.00	1.32
16	12	1.37	0.79	3.25	0.91

The Atterberg limit test results, given in the table, are also summarized on the Plasticity Chart, Figure #3. The testing indicates that the clay is inorganic with the plasticity being generally in the intermediate range. The natural moisture content is at or above the liquid limit as indicated by the high liquidity indices quoted (average 1.3). This means that the clay is sensitive marine Leda clay.

The results of field and laboratory vane tests and quick triaxial tests are plotted on the Record of Borelog sheets. The results indicate that the consistency of the cohesive material varies from firm to hard.

The grain size distribution of the cohesive deposit is presented on the Record of Borelog sheets and summarized on Fig. 3. Consolidation tests were carried out on seven samples; the void ratio vs. pressure graphs are shown in Fig. Nos. 5 and 7.

4.6) Glacial Till:

Glacial till is present at 16 sites out of the total 24. It is at the surface at sites 9 and 12, between the cohesive soil and the bedrock at sites 5, 11, 14, 16, 18 and 22, and under the granular deposit at the other eight sites. The thickness of the deposit varies from 2 to 51 feet.

As shown in the Record of Borelog sheets, the matrix of the till varies randomly. At some locations, it is cohesive (clayey silt binding sand and gravel) while at others it is granular in nature (silt and sand binding gravel); at some locations the till contains cobbles and small sized boulders. Grain-size distribution testing was carried out on samples from this deposit; the resulting curves are plotted in envelope form on Fig. 4.

Standard Penetration testing was carried out within this deposit. This testing gave 'N' values which vary from 3 to 92 blows/ft. in the cohesive till and 14 to more than 100 blows/ft. in the granular till. Based on these results, it is estimated that the cohesive till has a consistency which varies from soft to hard, being very stiff or hard in most areas. The granular till has a relative density in the compact to very dense range, being dense to very dense in most areas.

4.7) Irregularly Layered Deposits:

West of the Petawawa River, at sites 2 and 20, an irregularly layered deposit of sand, silt and clayey silt is present. The thickness of this deposit is 42 feet at site 2 and 72 feet at site 20. The relative density of the granular part of this deposit varies from loose to compact and the consistency of the cohesive part varies from firm to very stiff.

4.8) Lower Granular Material:

At four of the sites, west of the Petawawa River there is a 6 to 27 foot thick layer of sand to silty sand with boulders under the glacial till or the cohesive deposit.

Standard Penetration testing carried out within this deposit, gave 'N' values which range from 23 to 84 blows/foot. Based on these results, it is estimated that the relative density of the deposit varies from compact to very dense. Grain-size distribution testing was carried out on samples from this deposit; the resulting curves are plotted on Fig.5 of the Appendix.

4.9) Bedrock Conditions:

Bedrock was proven at 19 sites and refusal was reached in three more sites. Boreholes at sites 1 and 6 were ended when more than 110 feet had been augered without reaching bedrock.

The bedrock surface was found to vary randomly from lower than elevation 368 (at site 6) to elevation 506 (at site 7). The bedrock core samples were examined by Mr. K. W. Ingham, Geologist, Ministry of Transportation and Communications. The dominant type of bedrock encountered in the drilling is pink to dark grey gneiss of granitic or/and biotitic origin. This gneiss bedrock is interrupted at sites 10 and 18 where granite with biotitic inclusions was found.

In general the bedrock was found to be in a sound condition as evidenced by the high percentage of core recovery. At a few of the borings the upper 2 to 5 feet were in a fractured condition, and at Borehole #1 at site 3 the upper 16 feet was badly fractured.

5. GROUNDWATER CONDITIONS:

Groundwater level observations were carried out during the period of the investigation in the open boreholes. The observations are presented on the individual borelog sheets

as well as on Drawing No. 71-11056B. The results indicate that the groundwater level varies between elevation 441 (site 2) to elevation 518 (at site 15). The depth of the water level ranges from 2 feet below ground level at site 12 to 33 feet below ground level at site 3 (Borehole #1).

6. DISCUSSION AND RECOMMENDATIONS:

6.1) General:

Three alternative alignments (A, B and C) were investigated for the proposed Hwy. #17 'New' Petawawa By-pass extending from the existing Hwy. 17 easterly to Hwy. 62. It is understood that the latest proposed alignment C will be adopted. Therefore, although the factual information given in the sections above covers the whole area (all the sites investigated on the three alignments) this section will provide the foundation engineering aspects associated with alignment C only.

The proposed highway will be a two lane highway. Later when Hwy. 17 'N' becomes a portion of Hwy. 417, the roadway will consist of two lanes in each direction, separated by a median.

The subsoil, bedrock and groundwater conditions, encountered in the area under investigation, have been discussed previously in this report in Sections No. 4 and 5. An inferred stratigraphical profile, along the proposed alignment C, is shown on Drawing No. W.O. 71-11056 B.

The following will be discussed in Subsection 6.2) of this report.

- i) Highway and roadway structure crossings of Hwy. 17 'N' (a total of six in all);
- ii) C.N. and C.P. Railway overhead structure crossings (two)
- iii) River crossing (one)
- iv) Treatment of deep organic fill (one)
- v) Fill on garbage dump area
- vi) Creek crossing (one)

These crossings are shown in plan on Drawing No. W.O. 71-11056A.

At this stage, the profile grades at the crossings,

as well as other pertinent data, have not been finalized.

Preliminary design data, recommendations pertaining to foundation design of the various structures, as well as the stability and settlement considerations for the approach fills, will be presented in the subsection previously mentioned.

6.2) Hwy. 17 'N' Crossings - Proposed Alignment C:

<u>Site No.</u>	<u>Crossing</u>	<u>Type</u>	<u>Page No.</u>
1	C.P.R.	Overhead Structure	
6	Baelstadt Road	Underpass Structure	
24	Paquette Road	Underpass Structure	
18	Petawawa River Swamp Treatment	Overpass Structure (Site 424+00 to 429+00)	
19	Murphy Road	Underpass Structure	
20	County Road 26	Underpass Structure	
21	Creek	Culvert, Fill	
22	County Road 17	Underpass Structure	
11	C.N.R.	Overhead Structure	
10	Hwy. 62	Underpass Structure	

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, once the design details for the proposed alignment 'C' become available.

7. MISCELLANEOUS:

The field work was carried out from June 11, 1971, to July 8, 1971 and September 15, 1971 to October 7, 1971 and it was supervised by A. E. Dyer, Student Technician (Field).

The equipment used was owned and operated by Johnston Drilling Co. Limited and Dominion Soils Investigation Limited.

This report was prepared by Mr. J. Cortabarría, Student Technician, and reviewed by Mr. M. Devata, Supervising Foundations Engineer.

James Bangs
for

J. Cortabarría,

M. Devata
M. Devata, P. Eng.

JC/ao
Jan. 16, 1973.



FOUNDATION RECOMMENDATIONS - SITE #1
Overhead Structure - Hwy. 17N & C.P.R.

Approx. Existing Ground Level	Predominant Overburden Strata Approx. Thickness (ft.)	Recommendations		Remarks
		Structure	Approaches	

FINAL FOUNDATION REPORT SUBMITTED
Refer to W.O. 72-11021, dated April 10, 1972.

FOUNDATION RECOMMENDATIONS - SITE #6
Underpass Structure - Hwy. #17N & Baefstadt Rd.

Approx. Existing Ground Level	Predominant Overburden Strata Approx. Thickness (Ft.)	Recommendations		Remarks
		Structure	Approaches Fill Heights 21' to 25'	
484+	Sand, trace of silt and gravel Loose to dense (65') Sandy silt with some clay & gravel Compact to very dense (51'+)	<u>Pier(s)</u> Spread footings founded at elevations 478 within the granular deposit (6 feet below the final ground level) Allowable bearing pressure up to 3.0 t.s.f. <u>Abutments</u> 'Perched' on spread footings in the approach fills,, within a zone composed of well compacted granular material, using an allowable bearing value of 2.5 t.s.f. Alternatively, friction piles extending a minimum of 40' into parent subsoil, e.g. #14 timber piles with 25 tons/pile allowable load. <u>Note:</u> Differential settlements between the abutments and adjacent piers will not exceed 1/2".	<u>Stability</u> Fills up to 25' (with 2:1 slopes) will be stable <u>Probable Elastic Settlement</u> 25' Fill (2:1 slope) 1" (max.)	

FOUNDATION RECOMMENDATIONS - SITE #24
Underpass Structure - Hwy. #17N & Paquette Rd.

Approx. Existing Ground Level	Predominant Overburden Strata Approx. Thickness (Ft.)	Recommendations		Remarks
		Structure	Approaches	
465.5	Fill (sand & gravel and some silt) Compact (8') Very bouldery sand and gravel with trace of silt and clay (Glacial till) Very dense (26')	<u>Pier(s)</u> Spread footings founded at or below elevation 457.5 within the granular deposit (6 feet below the final ground level) Allowable bearing pressure up to 4.5 t.s.f. <u>Abutments</u> 'Perched' on spread footings in the approach fills, within a zone composed of well compacted granular material, using an allowable bearing value of 2.5 t.s.f. Alternatively, end-bearing piles driven into Glacial till stratum. Estimated pile tip elevation 450 designed for the max. capacity for the pile section chosen. <u>Note:</u> Differential settlements between the abutments and adjacent piers will not exceed 1/2".	<u>Approaches</u> Heights 20' to 25' <u>Stability:</u> Fills up to 25' (with 2:1 slopes) will be stable. Probable Elastic Settlement - 25' Fill (2:1 slope) 1/2" (max.)	

FOUNDATION RECOMMENDATIONS - SITE #18
Bridge Structure - Hwy. 17N and Petawawa River

Approx. Existing Ground Level	Predominant Overburden Strata Approx. Thickness (Ft.)	Recommendations		Remarks
		Structure	Approaches	

FINAL FOUNDATION REPORT SUBMITTED

Refer to W.O. 72-11010, dated Feb. 29, 1972.

FOUNDATION RECOMMENDATIONS
Treatment of Deep Organic Deposits

Approx. Existing Ground Level	Predominant Overburden Strata Approx. Thickness (Ft.)	Recommendations	Remarks
--	--	-----------------	---------

FINAL FOUNDATION REPORT SUBMITTED

Refer to W.O. 72-11012, dated Sept. 14, 1972.

FOUNDATION RECOMMENDATIONS - SITE #20

Hwy. 17N Fill on Garbage Dump Area

Approx. Existing Ground Level	Predominant Overburden Strata Approx. Thickness (Ft.)	Approx. Height of Fill (2:1 Slopes)	Stability and Settlement Considerations	Remarks
	Sand, Gravel, clayey silt, ash, nails, etc. (Garbage Dump) Compact to very dense (16.5) Sand and gravel Very dense (3')	6' to 10'	<u>Stability</u> No stability problems anticipated <u>Probable Settlement</u> 1" (max.)	

FOUNDATION RECOMMENDATIONS - SITE#19
Underpass Structure - Hwy. #17N & Murphy Rd.

Approx. Existing Ground Level	Predominant Overburden Strata Approx. Thickness (Ft.)	Recommendations		Remarks
		Structure	Approaches Heights 20' to 25'	
505+	Sand with trace of silt Compact (24') Sand, silt gravel (Glacial till) Very dense (6') Bedrock	<u>Pier(s)</u> Spread footings founded at or below elevation 500 within the granular deposit (6 feet below the final ground level) Allowable bearing pressure up to 2.5 t.s.f. Alternatively, end-bearing piles driven to practical refusal within the glacial till stratum. Estimated pile tip elevation 475 - designed for the max. allowable capacity for the pile section chosen.	<u>Stability:</u> Fills up to 25' (with 2:1 slopes) will be stable Probable Elastic Settlement: 25' fill (2:1 slope) 1" (max.)	
		<u>Abutments:</u> 'Perched' on spread footings in the approach fills, within a zone composed of well compacted granular material, using an allowable bearing value of 25 t.s.f. Alternatively, end-bearing piles driven to practical refusal in the glacial till stratum.- Estimated pile tip elevation 475 designed for the max. allowable capacity for the pile section chosen.		
		<u>Note:</u> Differential settlements between the abutments and adjacent piers will not exceed 1".		

FOUNDATION RECOMMENDATIONS - SITE #20
Underpass Structure - Hwy. #17 N & County Rd. 26

Approx. Existing Ground Level	Predominant Overburden Strata Approx. Thickness (Ft.)	Recommendations		Remarks
		Structure	Approaches Heights 20' to 25'	
515+	Silty Sand Dense to very dense (15') Silty Clay Firm to stiff (10') Irregularly layered SiH ₄ clayey silt and silty clay Loose to compact or firm to very stiff (72') Sand Dense (2') Glacial Till Very dense (5.5'+)	<u>Pier(s)</u> Spread footings founded at or below elevation 509 within the granular deposit (6 ft. below the final ground level). Allowable bearing pressure up to 3.0 t.s.f. <u>Abutments:</u> '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. Alternatively, friction piles extending a minimum of 40' into parent subsoil, e.g. #14 timber piles with 25 tons/pile allowable load. <u>Note:</u> Differential settlements between the abutments and adjacent piers will not exceed 1.	<u>Stability:</u> Fills up to 25' (with 2:1 slopes will be stable Probable elastic settlement: 25' Fill (2:1 slope) 1" (max.)	

FOUNDATION RECOMMENDATIONS - SITE #21

Culvert at Hwy. 17 N & Creek Crossing

Approx. Creek Water Level.	Predominant Overburden Strata Approx. Thickness (Ft.)	Approx. Height of Fill (2:1 Slopes)	Stability and Settlement Considerations	Remarks
464+ Approx. ground level 465.5+	Clayey silt to silty clay Firm (9') Silty sand (seams of clay throughout) Compact (6') Glacial Till Dense to very dense (10') Granite-gneiss bedrock Fractured	14' to 16'	<u>Stability:</u> No stability problems anticipated <u>Probable Settlement:</u> 1" (Max.)	A corrugated steel culvert pipe could be used at this location.

FOUNDATION RECOMMENDATIONS - SITE #22
Underpass Structure - Hwy. 17 N & Co. Rd. #17

Approx. Existing Ground Level	Predominant Overburden Strata Approx. Thickness (Ft.)	Recommendations		Remarks
		Structure	Approaches Heights 20' to 25'	
481+	Silty sand Dense (7.5') Clayey silt to silty clay Firm (21') Sand, Gravel, Silt Clay and boulders (Glacial Till) Very dense (21')	<u>Pier(s)</u> End-bearing piles driven to refusal within the glacial till stratum. Estimated pile tip elevation 447, designed for the max. capacity of the pile section chosen <u>Abutments:</u> Same as above	<u>Stability:</u> Fills up to 25' (with 2:1 slopes) will be stable. Probable settlement 25' Fill (2:1 slopes) 7" (max.)	

FOUNDATION RECOMMENDATIONS - SITE #11
Overhead Structure - Hwy. 17 N & C.N.R. Rail

Approx. Existing Ground Level	Predominant Overburden Strata Approx. Thickness (Ft.)	Recommendations		Remarks
		Structure	Approaches Heights 28' to 32'	
468.5+	Topsoil (2') Clayey silt to silty clay, trace of sand Firm to very stiff (28') Sand, gravel, silt, clay and boulders (Glacial till) Dense (13') Solid Bedrock	<u>Pier(s)</u> End-bearing piles driven into the glacial till stratum. Estimated pile tip elevation 428, designed for the max. capacity of the pile section chosen. <u>Abutments;</u>	<u>Stability:</u> Fills up to 32' (with 2:1 slopes) will be stable Probable settlement 32' fill (2:1 slopes) 3" - 5" (max.)	

FOUNDATION RECOMMENDATIONS - SITE #10
Underpass Structure - Hwy. 17 N & Hwy. 62

Approx. Existing Ground Level	Predominant Overburden Strata Approx. Thickness (Ft.)	Recommendations		Remarks
		Structure	Approaches Heights 20' to 25'	
469.5+	Sand, trace of gravel and clay (fill) (3') Clayey silt to silty clay Very stiff (16.5') Silt, sand and gravel, occasional boulders (Glacial Till) Very dense Granite Bedrock (sound)	<u>Pier(s)</u> Spread footings founded at or below elevation 464 within the cohesive deposit. Allowable bearing pressure up to 2.5 t.s.f. <u>Abutments</u> '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. Alternatively, end-bearing piles driven to practical refusal in the glacial till stratum. Estimated pile tip elevation 440, designed for the max. allowable capacity for the pile section chosen. <u>Note:</u> Differential settlements between the abutments and adjacent spread footing supported piers will not exceed 1-1/2".	<u>Stability:</u> Fills up to 25' (with 2:1 slopes) will be stable. Probable settlement 25' Fill (2:1 slope) (1-1/2" (max.))	

APPENDIX I

DESIGN SERVICES BRANCH

FOUNDATIONS OFFICE

RECORD OF BOREHOLE - SITE NO 1

JOB 71-11056

LOCATION Hwy. 17 - Petawawa Airport Line 'A'

ORIGINATED BY AED

W.P. 3-67-01

BORING DATE June 18, 21, 22, 23, 1971

COMPILED BY BTB

DATUM Geodetic

BOREHOLE TYPE Washboring, BX Casing

CHECKED BY [Signature]

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT			LIQUID LIMIT W_L PLASTIC LIMIT W_P WATER CONTENT W			BULK DENSITY γ P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLT	NUMBER	TYPE	BLOWS/FOOT		SHEAR STRENGTH P.S.F. ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE			W_P	W	W_L		
500.7	Ground Level													
1.0	Topsoil		1	SS	8	500								
	Sand (medium to fine) trace of gravel.		2	SS	19									
			3	SS	28									
			4	SS	26	490								6 92 (2)
			5	SS	35									
			6	SS	51									
			7	SS	42	480								3 90 (7)
			8	SS	32									
			9	SS	43	470								▼ 470.7 July 8/71
			10	SS	96									
			11	SS	43	460								
			12	SS	69									
			13	SS	81	450								1 99
			14	SS	109									
			15	SS	61	440								
			16	SS	44									
			17	SS	38	430								
			18	Wash	-	420								
			19	SS	48									
			20	SS	65	410								
		Compact to Very Dense												
400.7						400								
100.0	Silty sand Very Dense		21	SS	54								0 71 27 2	

Continued

OFFICE REPORT ON SOIL EXPLORATION

DESIGN SERVICES BRANCH

FOUNDATIONS OFFICE

RECORD OF BOREHOLE - SITE No 1 Cont.

JOB 71-11056 LOCATION Hwy. 17 - Petawawa Airport Line 'A' ORIGINATED BY AED
 W.P. 3-67-01 BORING DATE June 18, 21, 22, 23, 1971 COMPILED BY BTD
 DATUM Geodetic BOREHOLE TYPE Washboring, BX Casing CHECKED BY C.S.

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT	LIQUID LIMIT W_L PLASTIC LIMIT W_P WATER CONTENT W	SHEAR STRENGTH P.S.F. ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE	WATER CONTENT % 20 40 60	BULK DENSITY γ P.C.F. GR. SA. SI. CL.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS/FOOT							
387.2	Silty sand. Very Dense	22	SS	74	390						
113.5	End of Borehole					380						

OFFICE REPORT ON SOIL EXPLORATION

DESIGN SERVICES BRANCH

FOUNDATIONS OFFICE

RECORD OF BOREHOLE - SITE NO 2

JOB 71-11056

LOCATION Paquette Rd. @ Camp Petawawa Line 'A'

ORIGINATED BY AED

W.P. 3-67-01

BORING DATE June 12 & 14, 1971

COMPILED BY HT

DATUM Geodetic

BOREHOLE TYPE NX, BX Casing, BX, AXT Rock Core

CHECKED BY [Signature]

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE					LIQUID LIMIT — WL			BULK DENSITY	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLT	NUMBER	TYPE	BLOWS/FOOT		BLOWS / FOOT					PLASTIC LIMIT — WP				
						SHEAR STRENGTH P.S.F.					WATER CONTENT — W					
						○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE					WP — W — WL WATER CONTENT %			γ		
						400	800	1200	1600	2000	20	40	60	P.C.F.	GR.SA.SI.CL.	
464.2	Ground Level															
0.0	Sand (medium to fine).		1	SS	11											
			2	SS	13	460										
			3	SS	17											
	Compact to Dense		4	SS	35										1 96 (3)	
451.6			5	SS	11											
12.6	Irregularly layered silt, sand and clayey silt.		6	TW	108	450										
			7	SS	15											
			8	TW	PM					2520					129 0 23 58 19	
			9	SS	7	440									440.6 June 15/71	
	Loose to Compact or Stiff to Very Stiff		10	SS	26											
			11	SS	9	430										
			12	SS	24										0 37 58 5	
			13	SS	9	420										
			14	TW	PM											
409.7			15	BX	90%	410										
54.5	Gneiss Bedrock		16	RC AXT	87%											
			17	RC AXT	99%											
398.7	Sound					400										
65.5	End of Borehole					390										

OFFICE REPORT ON SOIL EXPLORATION

DESIGN SERVICES BRANCH

FOUNDATIONS OFFICE

RECORD OF BOREHOLE NO 1- SITE NO 3

JOB 71-11056

LOCATION Petawawa River - West Bank Line 'A'

ORIGINATED BY AED

W.P. 3-67-01

BORING DATE June 23 - 25, 1971

COMPILED BY HT

DATUM Geodetic

BOREHOLE TYPE NX, BX, AXT Casing, AXT, BX Rock Core

CHECKED BY

SOIL PROFILE		SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT	LIQUID LIMIT w_L PLASTIC LIMIT w_p WATER CONTENT w $w_p \quad w \quad w_L$	BULK DENSITY γ P.C.F.	REMARKS	
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE						BLOWS/FOOT
480.5	Ground Level									
0.0	Sand and gravel (numerous 6" to 10" boulders throughout.) Compact to Very Dense		1	SS	18	480				
			1A	BX	52%					
			2	SS	10					
			3	SS	13	470				82 17 (1)
			4	SS	28					
			5	SS	124	460				
			6	SS	19					
			7	SS	97%	450				447.6 June 28/71
			7A	RC BX	14%					
			8	SS	99	440				44 48 (8)
			8A	BX	30%					
	9	SS	65%							
	10	SS	80%							
	10A	BX	40%							
	11	SS	60%	430						
429.0	Fractured Sound Biotite Gneiss Bedrock		12	AXT	83%					
51.5			13	AXT	80%	420				
415.5			14	AXT	99%					
65.0	End of Borehole				410					

OFFICE REPORT ON SOIL EXPLORATION

DESIGN SERVICES BRANCH

FOUNDATIONS OFFICE

RECORD OF BOREHOLE NO 2- SITE NO 3

JOB 71-11056 LOCATION Portage Road River Crossing Line 'A' ORIGINATED BY AED
 W.P. 3-67-01 BORING DATE June 21, 22, 1971 COMPILED BY HT
 DATUM Geodetic BOREHOLE TYPE NX, BX Casing CHECKED BY

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE				LIQUID LIMIT w_l			BULK DENSITY	REMARKS	
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS/FOOT		BLOWS / FOOT	SHEAR STRENGTH P.S.F.			WATER CONTENT w					
							○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE			w_p — w — w_l WATER CONTENT % 20 40 60			γ P.C.F. GR.SA.SI.CL			
180.2	Ground Level															
0.0	Sand and gravel, Trace of silt, clay with numerous boulders		1	SS	51	480									477.3 June 22/71	
			2	SS	79											
			3	SS	65	470										27 60 (13)
468.7	Very Dense			4	BX	75%										
11.5	Fractured			5	BX	85%	460									
	Biotite Gneiss Bedrock			6	BX	80%										
456.1	Sound															
24.1	End of Borehole					450										

OFFICE REPORT ON SOIL EXPLORATION

DESIGN SERVICES BRANCH

FOUNDATIONS OFFICE

RECORD OF BOREHOLE NO 3 - SITE NO 3

JOB 71-11056

LOCATION Top W. Bank Petawawa River at Portage Rd. Line 'A'

ORIGINATED BY AED

W.P. 3-67-01

BORING DATE June 16 & 17, 1971

COMPILED BY HT

DATUM Geodetic

BOREHOLE TYPE AX, BX Casing; BX Rock Core

CHECKED BY [Signature]

SOIL PROFILE		SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE		LIQUID LIMIT			BULK DENSITY	REMARKS	
ELEV. DEPTH	DESCRIPTION	NUMBER	TYPE	BLOWS/FOOT		BLOWS / FOOT	SHEAR STRENGTH P.S.F.	W _L	W _P	W			W _L
464.5	Ground Level												
0.0	Sand and gravel (numerous 6" to 8" boulders throughout) Compact to Very Dense	1	SS	52	460								
		2	SS	14									
		3	SS	54									
		3A	BX	33%	450								
		4	SS	21									
		5	SS	30									
440.5	Biotite Gneiss Bedrock Fractured	6	SS	103	440								
24.0		7	AXT	79%									
		8	AXT	38%		430							
	9	AXT	28%										
424.5	End of Borehole				420								
40.0													

56 h1 (3)
450.1
June 17/71

OFFICE REPORT ON SOIL EXPLORATION

DESIGN SERVICES BRANCH

FOUNDATIONS OFFICE

RECORD OF BOREHOLE NO 1- SITE NO 4

JOB 71-11056

LOCATION Top W. Bank Petawawa River at Portage Rd. Line 'B'

ORIGINATED BY AED

W.P. 3-67-01

BORING DATE June 15, 1971

COMPILED BY HT

DATUM Geodetic

BOREHOLE TYPE NX, BX Casing, BX Rock Core

CHECKED BY

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE				LIQUID LIMIT w_L			BULK DENSITY	REMARKS	
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS/FOOT		BLOWS / FOOT	SHEAR STRENGTH P.S.F.				WATER CONTENT w				
							○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE				w_p — w — w_L WATER CONTENT %					
158.8	Ground Level															
0.0	Sand and gravel Trace of clay (numerous 7" to 10" boulders)		1	SS	16	450									GR SA. SI. CL Hole caved June 16/71 55 32 (13)	
			2	SS	11h											
			3	BX	29%											
448.3	Compact to Very Dense		4	SS	80%											
10.5	Biotite Gneiss		5	EX	88%	440										
	Bedrock		6	EX	87%											
			7	EX	81%											
			8	EX	99%											
438.0	Sound		9	EX	99%											
20.8	End of Borehole					430										

OFFICE REPORT ON SOIL EXPLORATION

DESIGN SERVICES BRANCH

FOUNDATIONS OFFICE

RECORD OF BOREHOLE NO 2- SITE NO 4

JOB 71-11056
 W.P. 3-67-01
 DATUM Geodetic

LOCATION Portage Rd. Line 'B'
 BORING DATE June 17, 1971
 BOREHOLE TYPE NX, BX Casings

ORIGINATED BY ASD
 COMPILED BY HT
 CHECKED BY

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE				LIQUID LIMIT			BULK DENSITY	REMARKS	
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS/FOOT		BLOWS / FOOT				WATER CONTENT %					
						SHEAR STRENGTH P.S.F.				W _p	W	W _L				
						○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE				W _p — W — W _L 20 40 60			γ	P.C.F. GR. SA. SI. CL.		
478.8	Ground Level															
0.0	Sand and gravel (numerous 6" to 8" boulders throughout)	STRAT. PLOT	1	SS	72	470									26 56 (18) ▽ 468.3 June 21/71	
			2	SS	103											
			3	SS	88											
			4	SS	63											
465.8	Very Dense															
13.0	Biotite Gneiss Bedrock	STRAT. PLOT	5	BX	97%	460										
			6	BX	96%											
454.8	Sound															
24.0	End of Borehole					450										

OFFICE REPORT ON SOIL EXPLORATION

DESIGN SERVICES BRANCH

FOUNDATIONS OFFICE

RECORD OF BOREHOLE - SITE NO 5

JOB 71-11056 LOCATION County Rd. 17 Line 'A' ORIGINATED BY AED
 W.P. 3-67-01 BORING DATE June 11, 1971 COMPILED BY HT
 DATUM Geodetic BOREHOLE TYPE NX Casing CHECKED BY [Signature]

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT					LIQUID LIMIT w_L PLASTIC LIMIT w_p WATER CONTENT w			BULK DENSITY γ	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS/FOOT		SHEAR STRENGTH P.S.F.					WATER CONTENT %				
						○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 400 800 1200 1600 2000					w_p — w — w_L 20 40 60					
160.7	Ground Level															
150.0	Topsoil		1	SS	5	460										
	Clay to silty clay		2	TW	FM											
	Grey		3	TW	FM											
	Very Stiff		4	TW	FM	450										
143.7			5	TW	FM											
17.0	Het. mix. of sand, silt & gravel, trace of clay (Glacial Till)		6	TW	PM											
	Dense		7	SS	32	440										
135.7	Bouldery Zone (boulders up to 6" in size)		8	FX	40%											
25.0	Granite Gneiss Bedrock		9	BX	95%											
128.7	Sound		10	HX	100%	430										
32.0	End of Borehole					420										

OFFICE REPORT ON SOIL EXPLORATION

DESIGN SERVICES BRANCH

FOUNDATIONS OFFICE

RECORD OF BOREHOLE - SITE NO 6

JOB 71-11056

LOCATION Haelstadt Rd. Line 'A'

ORIGINATED BY AED

W.P. 3-67-01

BORING DATE June 24, 25 & 26, 1971

COMPILED BY HT

DATUM Geodetic

BOREHOLE TYPE NX, BX Casing

CHECKED BY

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT					LIQUID LIMIT W_L PLASTIC LIMIT W_P WATER CONTENT W			BULK DENSITY γ P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS/FOOT		SHEAR STRENGTH P.S.F.					WATER CONTENT %				
						○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL X LAB VANE 400 800 1200 1600 2000					W_p — W — W_L 20 40 60					
484.0	Ground Level		1	SS	9											
			2	SS	30	480										
			3	SS	30											
			4	SS	23											
			5	SS	19	470										
			6	SS	15											
	Sand, trace of silt and gravel		7	SS	24	460										
			8	SS	20											
			9	SS	33	450										
			10	SS	20											
			11	SS	14	440										
			12	SS	12											
			13	SS	16	430										
	Loose to Dense		14	SS	27	420										
419.0			15	SS	40											
65.0			16	SS	66	410										
	Sandy silt with some clay (thin seams) and some gravel		17	SS	18	400										
			19	SS	31	390										
	Glacial Till		20	SS	31	380										
	Compact to Very Dense															

June 26/71
472.0
593 (2)

7 91 (2)

0 92 (8)

0 26 72 2

3 25 53 19

Continued

20
15 ϕ 5 % STRAIN AT FAILURE
10

OFFICE REPORT ON SOIL EXPLORATION

DESIGN SERVICES BRANCH

FOUNDATIONS OFFICE

RECORD OF BOREHOLE - SITE NO 6 Cont.

JOB 71-11056
 W.P. 3-67-01
 DATUM Geodetic

LOCATION Baelstadt Rd. Line 'A'
 BORING DATE June 24, 25 & 26, 1971
 BOREHOLE TYPE NX, BX Casing

ORIGINATED BY ABD
 COMPILED BY HT
 CHECKED BY [Signature]

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE					LIQUID LIMIT W_L			BULK DENSITY	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS/FOOT		BLOWS / FOOT					PLASTIC LIMIT W_p	WATER CONTENT W			
						SHEAR STRENGTH P.S.F.					W_p — W — W_L WATER CONTENT %					
368.0	Glacial Till Compact to Very Dense	[Strat. Plot]				370										
116.0	End of Borehole					360										

OFFICE REPORT ON SOIL EXPLORATION

DESIGN SERVICES BRANCH

FOUNDATIONS OFFICE

RECORD OF BOREHOLE NO 1 - SITE NO 8

JOB 71-11056

LOCATION North Side Alice-Petawawa Twp. Boundary Rd., Line 'A'

ORIGINATED BY VK

W.P. 3-67-01

BORING DATE June 29, 1971

COMPILED BY VK

DATUM Geodetic

BOREHOLE TYPE Wash & bore with NX & BX Casing

CHECKED BY OF

SOIL PROFILE		STRAT. PLOT	SAMPLES		ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT					LIQUID LIMIT w_L PLASTIC LIMIT w_p WATER CONTENT w			BULK DENSITY γ P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION		NUMBER	TYPE		BLOWS/FOOT	SHEAR STRENGTH P.S.F.					WATER CONTENT %			
						○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 100 800 1200 1600 2000					w_p — w — w_L 20 40 60				
487.4	Ground Level														
1.5	Silt with sand and trace of clay.		1	SS	11										487.9
			2	SS	27										487.8/71
			3	SS	34										0 37 (63)
478.4	Compact to Dense		4	SS	34	480									
9.0	Clay to silty clay.		5	TW	PM										
			6	TW	PM										
			7	TW	PM	470									
			8	SS	-										
	Grey		9	TW	PM	460									
			10	SS	-										
450.4	Firm to Stiff					450									103.5
37.0	Granite Gneiss Bedrock		11	BX RC	100%										
			12	BX RC	100%										
437.4	Sound					440									
50.0	End of Borehole					430									

OFFICE REPORT ON SOIL EXPLORATION

DESIGN SERVICES BRANCH

FOUNDATIONS OFFICE

RECORD OF BOREHOLE NO 2 - SITE NO 8

JOB 71-11056 LOCATION South Side Alice-Petawawa Twp. Boundary Rd. Line 'A' ORIGINATED BY VE
 W.P. 3-67-01 BORING DATE June 28, 1971 COMPILED BY ECB
 DATUM Geodetic BOREHOLE TYPE Wash and bore with NX Casing CHECKED BY VE

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE					LIQUID LIMIT w_L			BULK DENSITY	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS/FOOT		BLOWS / FOOT					PLASTIC LIMIT w_p				
						SHEAR STRENGTH P.S.F.					WATER CONTENT w			P.C.F.	GR.SA.SI.CL.	
						○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE					w_p w w_L WATER CONTENT % 20 40 60					
187.1	Ground Level															
0.0	Sandy silt with trace of clay.		1	SS	12											
			2	SS	26	180									2 29 67 2	
			3	SS	26											
			4	SS	5											
171.4	Loose to Dense															
16.0	Clay to silty clay. Grey		5	TW	FM	170							103	0 27 49 24		
165.6	Firm to Stiff														Pc=2.3tsf Cc=1.91 eo=1.822	
21.8	Het. mix. sand, gravel, silt, clay (Glac. Till)		6	SS	38											
162.7	Dense															
24.7	Granite Gneiss															
157.9	Bedrock Sound		7	AXT	100%	160										
29.5	End of Borehole															
						150										

OFFICE REPORT ON SOIL EXPLORATION

DESIGN SERVICES BRANCH

FOUNDATIONS OFFICE

RECORD OF BOREHOLE - SITE NO 9

JOB 71-11056
 W.P. 3-67-01
 DATUM Gedetic

LOCATION Hwy. 62 Pembroke
 BORING DATE July 5, 1971
 BOREHOLE TYPE Wash and Bore with BX & NX Casing

ORIGINATED BY VK
 COMPILED BY ECB
 CHECKED BY (Signature)

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT		LIQUID LIMIT w_L PLASTIC LIMIT w_p WATER CONTENT w			BULK DENSITY γ P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS/FOOT		SHEAR STRENGTH P.S.F. ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE		w_p	w	w_L		
453.6	Ground Level												
0.0	Topsoil		1	SS	h								
1.5	Het. mix. of sand, gravel, silt, clay (Glacial Till) (6" to 15" boulders below 8' depth)		2	TW	PM	450							
			3	SS	54								
			4	SS	65								
			5	SS	73 1/2	440							
			6	AXT	50%								
			7	AXT	16%								
			8	SS	52								
			9	SS	38 1/2	430							
	Very Dense		10	AXT RC	15%								
418.6			11	AXT	7%	420							
35.0			12	SS	63								
			13	SS	85								
	Silty sand, trace of gravel.					410							
	Very Dense												
	Blocky Zone (boulders up to 5" in size)					400							
390.9													
62.7	Granite Gneiss		14	AXT	88%	390							
387.6	Bedrock Fractured												
66.0	End of Borehole					380							

OFFICE REPORT ON SOIL EXPLORATION

DESIGN SERVICES BRANCH

FOUNDATIONS OFFICE

RECORD OF BOREHOLE - SITE NO 10

JOB 71-11056 LOCATION Hwy. 62 Line 'A' ORIGINATED BY VK
 W.P. 3-67-01 BORING DATE July 2, 1971 COMPILED BY ECB
 DATUM Geodetic BOREHOLE TYPE Wash & Bore with NX & BX Casing CHECKED BY ?

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE		LIQUID LIMIT — w_L			BULK DENSITY	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS/FOOT		BLOWS / FOOT	SHEAR STRENGTH P.S.F.	PLASTIC LIMIT — w_p	WATER CONTENT — w			
							○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE	w_p — w — w_L	WATER CONTENT %		P.C.F. GR.SA.SI.CL.		
469.5	Ground Level												
466.5	Sand, trace of gravel (Roadway Fill)												
3.0	Clayey silt to silty clay. Grey Very Stiff	[Strat. Plot]	1	SS	19	460							July 8/71 462.5 0 12 63 25
			2	SS	17								
			3	TM	PM								
			4	TM	PM								
			5	SS	8								
450.0	Het. mix. of silt, sand & gravel, some clay (Glacial Till) (boulders up to 12" in size throughout)	[Strat. Plot]	6	SS	57	450							0 9 70 21 19 59 20 2
19.5			7	SS	63								
439.0	Very Dense Granite Bedrock	[Strat. Plot]	8	SS	92	440							
30.5			9	RC AXT	100%								
426.6	Sound	[Strat. Plot]	10	RC AXT	100%	430							
42.9			End of Borehole				420						

OFFICE REPORT ON SOIL EXPLORATION

DESIGN SERVICES BRANCH

FOUNDATIONS OFFICE

RECORD OF BOREHOLE - SITE NO 11

JOB 71-11056

LOCATION C.N.R. - East of Co. Rd. #15 Line 'A'

ORIGINATED BY VK

W.P. 3-67-01

BORING DATE July 8, 1971

COMPILED BY BCB

DATUM Geodetic

BOREHOLE TYPE Wash & Bore with NX & BX Casing

CHECKED BY [Signature]

SOIL PROFILE		SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT				LIQUID LIMIT W_L PLASTIC LIMIT W_P WATER CONTENT W			BULK DENSITY γ	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE		BLOWS/FOOT	SHEAR STRENGTH P.S.F.				WATER CONTENT %			
						○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 100 800 1200 1600 2000				W_P — W — W_L 20 40 60				
468.4	Ground Level													
466.4	Topsoil		1	SS	17									
2.0	some sand		2	SS	11									
	Clayey silt to silty clay, trace of sand.		3	TW	PM									
			4	TW	PM									
			5	TW	PM									
			6	TW	PM									
			7	TW	PM									
	Grey		8	TW	PM									
	Firm to Very Stiff		8A	BX	84%									
438.4			9	SS	37									
30.0	Het. mix. sand & gravel with silt & clay (boulders up to 2.5' in size throughout) (Glacial Till)		10	SS	100%									
425.6	Dense to Very Dense		11	BX	100%									
42.8	Granite Gneiss Bedrock		12	BX	70%									
414.2	Sound													
54.2	End of Borehole													

OFFICE REPORT ON SOIL EXPLORATION

DESIGN SERVICES BRANCH

FOUNDATIONS OFFICE

RECORD OF BOREHOLE - SITE NO 12

JOB 71-11056 LOCATION Co. Rd. #15 Line 'A' ORIGINATED BY VK
 W.P. 3-67-01 BORING DATE June 30, 1971 COMPILED BY ECB
 DATUM Geodetic BOREHOLE TYPE Wash & Bore with NX & BX Casings CHECKED BY [Signature]

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT			LIQUID LIMIT W_L PLASTIC LIMIT W_P WATER CONTENT W			BULK DENSITY γ P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLLOT	NUMBER	TYPE	BLOWS/FOOT		SHEAR STRENGTH P.S.F. ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE			W_P	W	W_L		
488.7	Ground Level													
0.0	Topsoil		1	SS	11									
1.5	Sand, gravel, silt, clay (with boulders up to 10" throughout) (Glacial Till)		2	SS	21									487.7 July 1/71
			3	SS	32									
477.5	Compact to Dense fractured		4	AXT	38%	480								31 60 (9)
11.2	Granite Gneiss Bedrock		5	AXT	94%	470								
467.2	Sound		6	AXT	100%									
21.5	End of Borehole					460								

OFFICE REPORT ON SOIL EXPLORATION

DESIGN SERVICES BRANCH

FOUNDATIONS OFFICE

RECORD OF BOREHOLE - SITE No 13

JOB 71-11056 LOCATION Biesenthal Rd. Line 'A' ORIGINATED BY VK
 W.P. 3-67-01 BORING DATE June 29, 1971 COMPILED BY ECB
 DATUM Geodetic BOREHOLE TYPE Wash & Bore with NX & BX Casing CHECKED BY _____

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE					LIQUID LIMIT w_L			BULK DENSITY γ	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS/FOOT		BLOWS / FOOT					WATER CONTENT w				
						SHEAR STRENGTH P.S.F.					WATER CONTENT %					
						○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL X LAB VANE					w_p — w — w_L 20 40 60			P.C.F.		
473.3	Ground Level															
0.0	Topsoil		1	SS	6											
469.3	Clayey silt with some sand, <u>Stiff</u>		2	SS	14										hole caved in June 29/71 0 22 58 20	
4.0	Clay to silty clay		3	TW	PM											
462.7	Grey Firm to Very Stiff		4	TW	PM											
10.6	Granite Gneiss														Cc=0.660 Pc=2.0 TFS	
457.5	Bedrock Sound		5	AXT	100%											
15.8	End of Borehole															
						450										

OFFICE REPORT ON SOIL EXPLORATION

DESIGN SERVICES BRANCH

RECORD OF BOREHOLE - SITE NO 14

FOUNDATIONS OFFICE

JOB 71-11056

LOCATION Airport Rd. Line 'A'

ORIGINATED BY VK

W.P. 3-67-01

BORING DATE July 6, 1971

COMPILED BY ECB

DATUM Geodetic

BOREHOLE TYPE Wash & Bore with NX & BX Casing

CHECKED BY

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE					LIQUID LIMIT W_L			BULK DENSITY	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS/FOOT		BLOWS / FOOT					PLASTIC LIMIT W_P				
525.7	Ground Level					SHEAR STRENGTH P.S.F.					WATER CONTENT %					
						○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE 400 800 1200 1600 2000					W_P — W — W_L 20 40 60					
0.0	Sand, trace of silt to silt, trace of sand.		1	SS	15											
			2	SS	10											
			3	SS	15											
			4	SS	28											
	Compact to Very Dense		5	SS	64											
507.2			6	SS	15											
18.5	Clayey silt, trace of sand.		7	TW	PM											
501.2	Very Stiff		8	TW	PM											
24.5	Sand with gravel, some silt, trace clay. (Glacial Till)															
494.1	Dense		9	SS	41											
31.6	Granite Gneiss Bedrock		10	BX	83%											
487.2	Sound		11	AXT	100%											
38.5	End of Borehole															

OFFICE REPORT ON SOIL EXPLORATION

DESIGN SERVICES BRANCH

FOUNDATIONS OFFICE

RECORD OF BOREHOLE - SITE NO 15

JOB 71-11056

LOCATION Black Bay Rd. Line 'A'

ORIGINATED BY WK

W.P. 3-67-01

BORING DATE July 2, 1971

COMPILED BY EGB

DATUM Geodetic

BOREHOLE TYPE Wash & Bore with BX & NX Casing

CHECKED BY [Signature]

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT					LIQUID LIMIT W_L PLASTIC LIMIT W_P WATER CONTENT W			BULK DENSITY γ P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS/FOOT		SHEAR STRENGTH P.S.F.					W_p	W	W_L		
						○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE 400 800 1200 1600 2000					WATER CONTENT % 20 40 60					
531.5	Ground Level															
0.0	Silty sand to sandy silt, with a trace to some gravel.	[Strat. Plot]	1	SS	25	530										
	Compact to Very Dense		2	SS	40											
			3	SS	85	520										
			4	SS	136											
			5	SS	52	510										
506.5			6	SS	133											
25.0	Het. mix. of sand, silt and some gravel (Glacial Till)	[Strat. Plot]	7	TW	PM	500										
			8	SS	120											
			8A	AXT	30%											
			9	SS	43	490										
			10	SS	21											
			10A	BX	55%											
			11	SS	120	480										
	(boulders up to 12" in size throughout)		12	SS	150	473"										
			13	BX	100%											
			13A	SS	120	473"	470									
	Compact to Very Dense	14	SS	171	466"											
161.3			15	SS	150	460										
70.2	Diotite Gneiss Bedrock (some weathering.)		16	BX	72%											
156.2																
75.3	End of Borehole					450										

OFFICE REPORT ON SOIL EXPLORATION

DESIGN SERVICES BRANCH

FOUNDATIONS OFFICE

RECORD OF BOREHOLE - SITE NO 16

JOB 71-11056

LOCATION Murray Rd. - Petawawa Line 'A'

ORIGINATED BY VK

W.P. 3-67-01

BORING DATE June 29, 1971

COMPILED BY ECH

DATUM Geodetic

BOREHOLE TYPE Wash & Bore with MK & BX Casing

CHECKED BY [Signature]

SOIL PROFILE		STRAT. PLOT	SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT					LIQUID LIMIT w_L PLASTIC LIMIT w_p WATER CONTENT w			BULK DENSITY γ	REMARKS
ELEV. DEPTH	DESCRIPTION		NUMBER	TYPE	BLOWS/FOOT		SHEAR STRENGTH P.S.F.					WATER CONTENT %				
						400	800	1200	1600	2000	20	40	60	P.C.F.	GR. SA. SI. CL.	
512.0	Ground Level															
0.0	Sand, some gravel, trace of silt. Compact to Very Dense	[Dotted Pattern]	1	SS	24										No W.L. on June 30/71	
			2	SS	28											8 85 (7)
			3	SS	35											
			4	SS	48											
			5	SS	58											25 67 (8)
492.0	Silty clay with some sand. Stiff to Very Stiff	[Diagonal Hatching]	6	TW	PM											
20.0			7	TW	PM											
			8	TW	PM											
			9	TW	PM											
			10	TW	PM											
			11	TW	PM											
			12	TW	PM											
457.0	Sand, silt, clay, gravel (Glas. Till). V. Dense	[Dotted Pattern]	13	SS	110											
55.0																2 52 31 15
57.0	Biotite Gneiss	[Cross-hatching]	14	AXT	90											
151.6	Bedrock. Sound															
60.1	End of Borehole															

OFFICE REPORT ON SOIL EXPLORATION

DESIGN SERVICES BRANCH

FOUNDATIONS OFFICE

RECORD OF BOREHOLE - SITE No 17

JOB 71-11056 LOCATION County Rd.#17 & Hales Cr. ORIGINATED BY VK
 W.P. 3-67-01 BORING DATE July 7, 1971 COMPILED BY ECB
 DATUM Geodetic BOREHOLE TYPE Wash & Bore with NX & BX Casing CHECKED BY [Signature]

SOIL PROFILE		SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE		LIQUID LIMIT W_L		BULK DENSITY	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE		BLOWS/FOOT	BLOWS / FOOT	PLASTIC LIMIT W_P	WATER CONTENT W		
390.8	Ground Level										
0.0	Clayey silt with some sand.		1	SS	7						
387.8	Stiff										
3.0	Gray with sand (boulders)		2	SS	11.75"						
3.3	Granite Gneiss		3	BX	100%						
	Bedrock		4	BX	100%						
377.0	Sound										
13.8	End of Borehole										

P.C.F. GR.SA.SI.CL.

▼ 387.5
July 8/71

OFFICE REPORT ON SOIL EXPLORATION

DESIGN SERVICES BRANCH

RECORD OF BOREHOLE NO 1-SITE NO 18

FOUNDATIONS OFFICE

JOB 71-11056
 W.P. 3-67-01
 DATUM Geodetic

LOCATION Petawawa River - East Bank Line '0'
 BORING DATE Sept. 15, 1971
 BOREHOLE TYPE Wash & Bore with NX & BX Casing

ORIGINATED BY VK
 COMPILED BY ECB
 CHECKED BY [Signature]

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT					LIQUID LIMIT w_L PLASTIC LIMIT w_P WATER CONTENT w			BULK DENSITY γ	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS/FOOT		SHEAR STRENGTH P.S.F.					WATER CONTENT %				
						O UNCONFINED + FIELD VANE * QUICK TRIAXIAL x LAB VANE 400 800 1200 1600 2000					w_p — w — w_L 20 40 60			P.C.F.	GR.SA.SI.CL.	
471.4	Ground Level															
0.0	Sand and Gravel		1	SS	100	3"	470									
			2	SS	199											
	Very Dense		3	SS	150		460									
458.4	Silty clay with trace of sand & gravel.		4	SS	4											
			5	TW	FW									105		
	Firm to Stiff		6	TW	FW		450							102		
25.0	Glac.Fill. Very Dense		7	SS	60		440									
26.3	Sand (boulders up to 10" in size throughout)		8	AXT	23											
439.4	Very Dense		9	AXT	17											
32.0	End of Borehole						430									

OFFICE REPORT ON SOIL EXPLORATION

DESIGN SERVICES BRANCH

FOUNDATIONS OFFICE

RECORD OF BOREHOLE NO 2 - SITE NO 18

JOB 71-11056
 W.P. 3-67-01
 DATUM Geodetic

LOCATION Petawawa River - West Bank Line '0'
 BORING DATE Sept. 21, 1971
 BOREHOLE TYPE Wash & Bore with BX Casing

ORIGINATED BY VK
 COMPILED BY ECB
 CHECKED BY [Signature]

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT	LIQUID LIMIT w_L PLASTIC LIMIT w_p WATER CONTENT w $w_p \quad w \quad w_L$	BULK DENSITY γ P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS/FOOT					
1156.2	Ground Level									
0.0	Sand and Gravel (boulders up to 10" in size throughout)		1	SS	100	1"	450			
	Very Dense		2	SS	100	1"				
141.7	Fine Sand Layers		3	SS	100	1"				
14.5	Granite Bedrock (biotite gneiss inclusions)		4	AXT	93%		440			
431.7	Sound		5	AXT	95%					
24.5	End of Borehole					430				

OFFICE REPORT ON SOIL EXPLORATION

DESIGN SERVICES BRANCH

RECORD OF BOREHOLE NO 3-SITE NO 18

FOUNDATIONS OFFICE

JOB 71-11056 LOCATION Petawawa River, West Approach Line 'C' ORIGINATED BY VK
 W.P. 3-67-01 BORING DATE Sept. 22/71 COMPILED BY EGP
 DATUM Geodetic BOREHOLE TYPE Wash & Bore with BA Casing CHECKED BY [Signature]

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT	LIQUID LIMIT W_L PLASTIC LIMIT W_P WATER CONTENT W	SHEAR STRENGTH P.S.F. ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE	WATER CONTENT % W_P W W_L 20 40 60	BULK DENSITY γ P.C.F.	REMARKS GR.SA.SI.CL.	
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS/FOOT								
460.1	Ground Level												
0.0	Sand and gravel (boulders up to 12" in size throughout)		1	SS	100	45						29 65 (6)	
446.3	Very Dense		2	SS	100	45							
13.8	Granite Bedrock (Biotite Gneiss inclusions)		3	AXT	97%		440						
437.1	Sound		4	AXT	92%								
23.0	End of Borehole					430							

OFFICE REPORT ON SOIL EXPLORATION

DESIGN SERVICES BRANCH

RECORD OF BOREHOLE NO 4-SITE NO 18

FOUNDATIONS OFFICE

JOB 71-11056

LOCATION Petawawa River Line 'C'

ORIGINATED BY VK

W.P. 3-67-01

BORING DATE Sept. 2, 1971

COMPILED BY ECB

DATUM Geodetic

BOREHOLE TYPE Wash & Bore with NX & BX Casing

CHECKED BY

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT					LIQUID LIMIT w_L PLASTIC LIMIT w_p WATER CONTENT w			BULK DENSITY γ P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS/FOOT		SHEAR STRENGTH P.S.F.					w_p	w	w_L		
						○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE 400 800 1200 1600 2000										
467.2	Ground Level															
0.0	Sand & gravel to gravelly sand (occasional boulders throughout)	[Soil Profile Diagram]	1	SS	125	460										▽463.7 Sept. 29/71
	Compact to Very Dense		2	SS	20											33 61 (6)
453.2																
44.0	Silty clay, trace of sand.	[Soil Profile Diagram]	3	TW	PM	450										114
			4	TW	PM											
	Firm to Stiff		5	TW	PM	440										
437.2																
30.0	Silty sand.	[Soil Profile Diagram]	6	SS	23											
431.2	Compact		7	SS	6	430										A- 0 81 (19) B- 0 17 60 23
36.0	Clayey silt with some sand & gravel (Glacial Till)	[Soil Profile Diagram]	8	SS	45											
420.7	Firm to Hard															
46.5	Granite Bedrock	[Soil Profile Diagram]				420										
415.7	Sound		9	AXT	100%											
51.5	End of Borehole					410										

OFFICE REPORT ON SOIL EXPLORATION

DESIGN SERVICES BRANCH

FOUNDATIONS OFF

RECORD OF BOREHOLE - SITE No 19

JOB 71-11056 LOCATION Murphy Rd. Line 'C' ORIGINATED BY VK
 W.P. 3-67-01 BORING DATE Sept. 28, 1971 COMPILED BY ECB
 DATUM Geodetic BOREHOLE TYPE Wash & Bore with NY & BX Casing CHECKED BY [Signature]

SOIL PROFILE		SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT		LIQUID LIMIT W_L PLASTIC LIMIT W_P WATER CONTENT W			BULK DENSITY γ P.C.F.	REMARKS	
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE		BLOWS/FOOT	SHEAR STRENGTH P.S.F.		WATER CONTENT %				
							○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE	W_p — W — W_L	20	40	60		
505.2	Ground Level												
0.0	Silty Sand		1	SS	25	500							503.2 Sept. 30/71
			2	SS	20								1 84 (15)
			3	SS	20	490							
	Compact		4	SS	18								
481.2													
24.0	Het. mix. of sand, silt, gravel (Glacial Till)		5	SS	64	480							34 53 (13)
	Very Dense Bouldery Zone												
	boulders up to 10" in size)		6	AXT	50%								
470.0						470							
35.2	End of Borehole					460							

OFFICE REPORT ON SOIL EXPLORATION

DESIGN SERVICES BRANCH

FOUNDATIONS OFFICE

RECORD OF BOREHOLE - SITE NO 20

JOB 71-11056

LOCATION Co. Rd. #26 & Line 'C'

ORIGINATED BY VK

W.P. 3-67-01

BORING DATE Sept. 30, 1971

COMPILED BY EOB

DATUM Geodetic

BOREHOLE TYPE Wash & Bore with M & BK Casing

CHECKED BY 3/

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT					LIQUID LIMIT w_L PLASTIC LIMIT w_p WATER CONTENT w			BULK DENSITY γ P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS/FOOT		SHEAR STRENGTH P.S.F.					WATER CONTENT %				
						○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE 100 800 1200 1600 2000					w_p w w_L 20 40 60					
515.2	Ground Level															
0.0	Silty Sand		1	SS	50	510										
	Dense to Very Dense		2	SS	32											
500.2						500										
15.0	Silty Clay		3	TW	PM									106		
	Grey		4	TW	PM											
	Firm to Stiff		5	SS	19	490										
490.2																
25.0	Irregularly layered silt, clayey silt and silty clay, trace of sand throughout.		6	TW	PM											
			7	TW	PM	480								120		
			8	TW	PM											
			9	SS	12	470									0 18 63 19	
			10	SS	12											
	Loose to Compact or Firm to Very Stiff		11	SS	10	460									0 17 59 24	
			12	SS	8											
			13	TW	PM	450										
			14	TW	PM											
			15	TW	PM	440									114	
			16	TW	PM											
			17	TW	PM	430										
			18	TW	PM											
			19	TW	PM	420									119(B)	
418.2																
97.0	Sand		20	SS	10											
	Dense															

OFFICE REPORT ON SOIL EXPLORATION

Continued

20
15 \diamond 5 % STRAIN AT FAILURE
10

DESIGN SERVICES BRANCH

FOUNDATIONS OFFICE

RECORD OF BOREHOLE - SITE No 20 Cont.

JOB 71-11056
 W.P. 3-67-01
 DATUM Geodetic

LOCATION Co. Rd. #26 & Line '0'
 BORING DATE Sept. 30, 1971
 BOREHOLE TYPE Wash & Bore with NX & BX Casing

ORIGINATED BY VK
 COMPILED BY ECB
 CHECKED BY [Signature]

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT					LIQUID LIMIT w_L PLASTIC LIMIT w_p WATER CONTENT w			BULK DENSITY γ P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS/FOOT		SHEAR STRENGTH P.S.F.					WATER CONTENT %				
							○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE 400 800 1200 1600 2000					w_p — w — w_L 20 40 60				
105.0	Sand & gravel & silt (Glacial Till) Very Dense	[Symbol]	21	SS	87	410										
104.7	Boulder	[Symbol]														
110.5	End of Borehole					400										

OFFICE REPORT ON SOIL EXPLORATION

DESIGN SERVICES BRANCH

RECORD OF BOREHOLE NO 1-SITE NO 21

FOUNDATIONS OFFICE

JOB 71-11056

LOCATION Hales Creek-West Branch Line 10'

ORIGINATED BY VK

W.P. 3-67-01

BORING DATE Oct. 7/71

COMPILED BY ECB

DATUM Geodetic

BOREHOLE TYPE Wash & Bore with NX & BX Casing

CHECKED BY

SOIL PROFILE		SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT					LIQUID LIMIT w_L PLASTIC LIMIT w_p WATER CONTENT w			BULK DENSITY γ P.C.F.	REMARKS	
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE		BLOWS/FOOT	SHEAR STRENGTH P.S.F.					WATER CONTENT %				
						○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL X LAB VANE 400 800 1200 1600 2000					w_p — w — w_L					
479.2	Ground Level															
0.0	Topsoil															
1.0	Clayey silt to silty clay. Grey Very Stiff to Firm		1	SS	23											
			2	SS	20	470										
				3	TW	PM										
				4	TW	PM	460			15						
455.1				5	SS	100	450									
24.1	End of Borehole															

OFFICE REPORT ON SOIL EXPLORATION

DESIGN SERVICES BRANCH

FOUNDATIONS OFFICE

RECORD OF BOREHOLE NO 2-SITE NO 21

JOB 71-11056 LOCATION Hales Creek-West Branch Line 'C' ORIGINATED BY VK
 W.P. 3-67-01 BORING DATE Oct. 6, 1971 COMPILED BY ECB
 DATUM Geodetic BOREHOLE TYPE Wash & Bore with NX & BX Casing CHECKED BY [Signature]

SOIL PROFILE		STRAT. PLOT	SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT					LIQUID LIMIT W_L PLASTIC LIMIT W_P WATER CONTENT W			BULK DENSITY γ P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION		NUMBER	TYPE	BLOWS/FOOT		SHEAR STRENGTH P.S.F.					WATER CONTENT %				
						○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 400 800 1200 1600 2000					W_p — W — W_L					
465.4	Ground Level															
0.0	Sandy silt.															
462.4	Compact															
3.0	Clayey silt to silty clay.		1	TW	PM	460										
456.4	Firm															
9.0	Silty sand (seams of clay throughout)		2	SS	25											
450.4	Compact															
15.0	Het. mix. of sand, silt & gravel (Glacial Till)		3	SS	39	450										
			4	SS	63											
440.9	Dense to Very Dense															
24.5	Biotite Granite Gneiss Bedrock (fractured layers above el. 432.5)		5	AXT	80%	440										
			6	AXT	100%											
430.9	Sound															
34.5	End of Borehole					430										

OFFICE REPORT ON SOIL EXPLORATION

DESIGN SERVICES BRANCH

FOUNDATIONS OFFICE

RECORD OF BOREHOLE - SITE NO 22

JOB 71-11056

LOCATION County Rd. #17 Line 'C'

ORIGINATED BY VK

W.P. 3-67-01

BORING DATE Oct. 4, 1971

COMPILED BY ECB

DATUM Geodetic

BOREHOLE TYPE Wash & Bore with NX & BX Casing

CHECKED BY

SOIL PROFILE		STRAT. PLOT	SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT					LIQUID LIMIT w_L PLASTIC LIMIT w_p WATER CONTENT w			BULK DENSITY γ	REMARKS
ELEV. DEPTH	DESCRIPTION		NUMBER	TYPE	BLOWS/FOOT		SHEAR STRENGTH P.S.F.					WATER CONTENT %				
						○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL X LAB VANE 400 800 1200 1600 2000					w_p — w — w_L					
181.0	Ground Level															
0.0	Silty Sand				480											
173.5	Dense		1	SS	32											
7.5	Clayey silt to silty clay. Grey		2	TW	PM	470										
			3	TW	PM											
			4	TW	PM	460										
			5	TW	PM	452.5										
28.5	Het. mix. of sand, silt, and gravel, trace of clay (Glacial Till) (boulders up to 8" in size throughout)		6	SS	100	450										
			7	SS	150/2"	440										
137.0	Very Dense															
44.0	End of Borehole					430										

OFFICE REPORT ON SOIL EXPLORATION

DESIGN SERVICES BRANCH

FOUNDATIONS OFFICE

RECORD OF BOREHOLE NO 1 - SITE NO 23

JOB 71-11056
 W.P. 2-67-01
 DATUM Geodetic

LOCATION S-E Murphy Rd. Line 'C'
 BORING DATE Sept. 29/71
 BOREHOLE TYPE Wash & Bore NX & BX Casing

ORIGINATED BY WK
 COMPILED BY BCB
 CHECKED BY [Signature]

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT	LIQUID LIMIT w_L PLASTIC LIMIT w_p WATER CONTENT w $w_p \quad w \quad w_L$	SHEAR STRENGTH P.S.F. ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL X LAB VANE	BULK DENSITY γ P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS/FOOT						
502.8	Ground Level										
0.0	Sand, gravel, ash, trash (Garbage Dump)	X	1	SS	4	500					
			2	SS	17						
			3	SS	8						
195.8	Very Loose to Compact	X	4	SS	11	490					
7.0	Sand and gravel	O	5	SS	19						
			6	SS	21						
	Compact to Very Dense	O	7	SS	29	480					
			8	SS	59						
478.8		O	9	SS	100.75"						
24.0	End of Borehole					470					

OFFICE REPORT ON SOIL EXPLORATION

DESIGN SERVICES BRANCH

FOUNDATIONS OFFICE

RECORD OF BOREHOLE NO 2-SITE NO 23

JOB 71-11056
 W.P. 3-67-01
 DATUM Geodetic

LOCATION S-E of Murphy Rd. Line 'C'
 BORING DATE Sept. 29/71
 BOREHOLE TYPE Wash & Bore with NX & BX Casing

ORIGINATED BY VK
 COMPILED BY ECB
 CHECKED BY [Signature]

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT		LIQUID LIMIT W_L PLASTIC LIMIT W_P WATER CONTENT W			BULK DENSITY γ P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS/FOOT		SHEAR STRENGTH P.S.F. O UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE		W_P	W	W_L		
505.8	Ground Level												
0.0	Sand, gravel, clayey silt, ash, trash, nails etc. (Garbage Dump) Compact to Very Dense	[X]	1	SS	22	500							
			2	SS	14								
			3	SS	15								
			4	SS	47								
			5	SS	185								
			6	SS	23								
489.3			7	SS	115	490							
16.5	Sand and gravel.												
486.8	Very Dense		8	SS	100	480							
19.0	End of Borehole												

OFFICE REPORT ON SOIL EXPLORATION

DESIGN SERVICES BRANCH

RECORD OF BOREHOLE - SITE NO 24

FOUNDATIONS OFFICE

JOB 71-11056

LOCATION Paquette Rd. - Canadian Forces Base Line 'C'

ORIGINATED BY VK

W.P. 3-67-01

BORING DATE Sept. 24, 1971

COMPILED BY VK

DATUM Geodetic

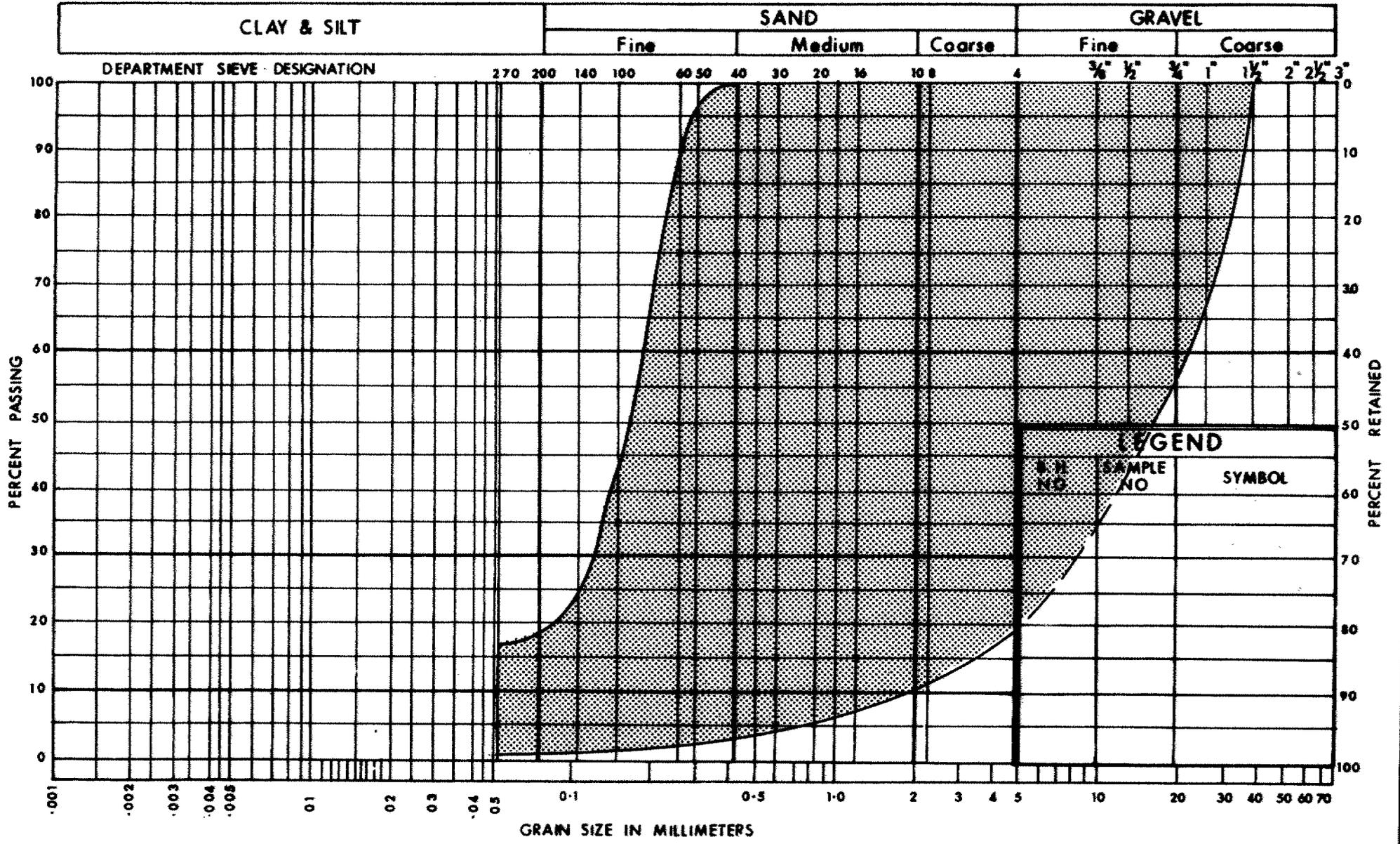
BOREHOLE TYPE Wash & Bore with NX & BX Casing

CHECKED BY C.C.

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT				LIQUID LIMIT W_L PLASTIC LIMIT W_P WATER CONTENT W			BULK DENSITY γ P.C.F. GR. SA. SI. CL.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS/FOOT		SHEAR STRENGTH P.S.F.				WATER CONTENT %				
						○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE				W_P — W — W_L 20 40 60					
465.6	Ground Level														
0.0	Sand and gravel and some silt (Fill)														
457.6	Compact		1	SS	18	460									0 82 (18)
8.0	Sand with gravel, trace silt, clay (boulders up to 10" in size throughout)		2	SS	94										
	(Glacial Till)		3	SS	100/8"	450									
			4	SS	100/8"										
	Very Dense		5	SS	225	440									25 69 (6)
			6	SS	100/8"										
431.4			7	SS	100/8"										
34.2	End of Borehole					430									

OFFICE REPORT ON SOIL EXPLORATION

UNIFIED SOIL CLASSIFICATION SYSTEM



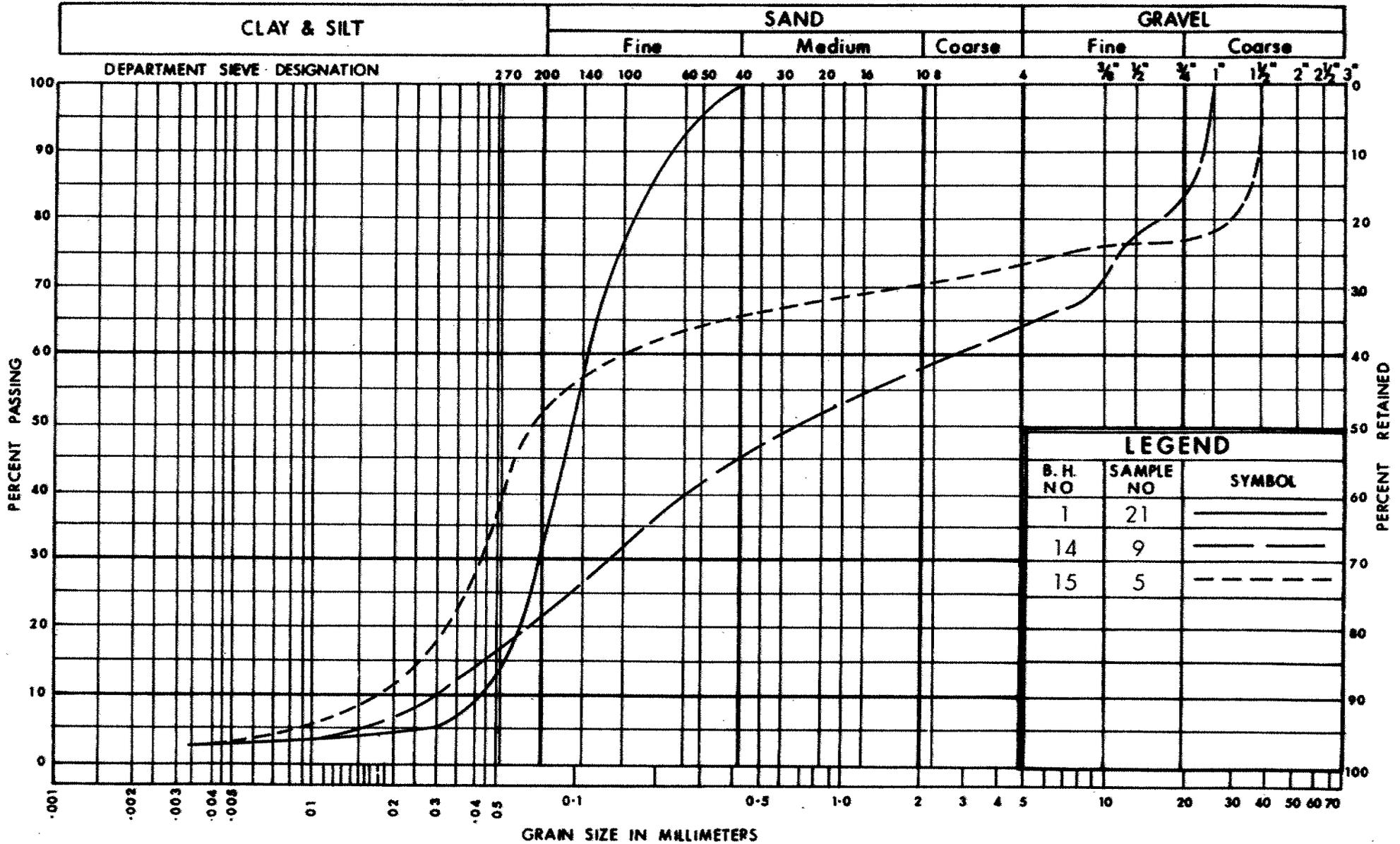
LEGEND		
S. N. NO.	SAMPLE NO.	SYMBOL

DEPARTMENT OF TRANSPORTATION AND COMMUNICATIONS
DESIGN SERVICES BRANCH

GRAIN SIZE DISTRIBUTION
SAND & GRAVEL
(UPPER DEPOSIT)

W.P. No. 3-67-01
JOB No. 71-11056
FIG. 1

UNIFIED SOIL CLASSIFICATION SYSTEM



DEPARTMENT OF TRANSPORTATION AND COMMUNICATIONS
DESIGN SERVICES BRANCH

GRAIN SIZE DISTRIBUTION SAND & GRAVEL TO SILTY SAND (LOWER DEPOSIT)

W.P. No. 3-67-01
JOB No. 71-11056
FIG. 5

VOID RATIO - PRESSURE CURVES

JOB NO. 71-11056

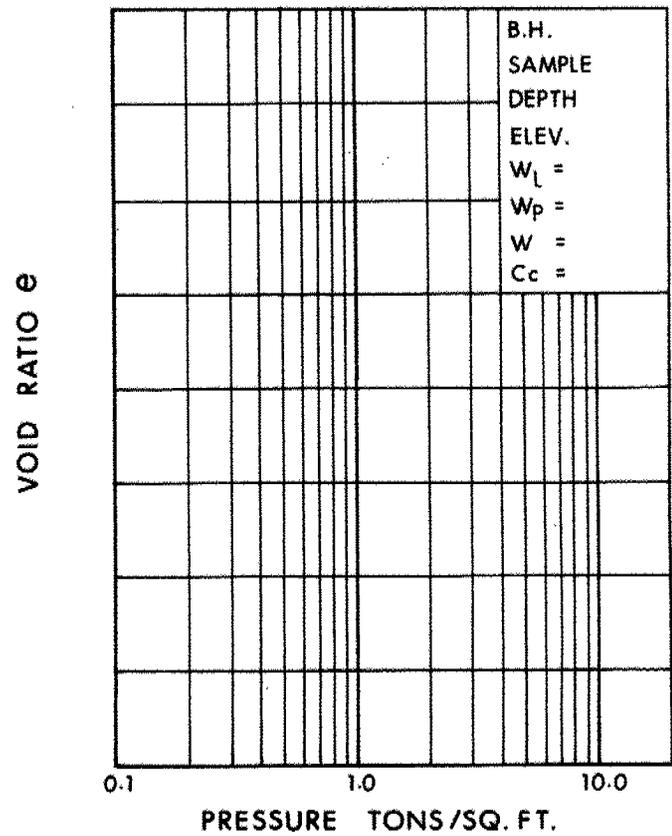
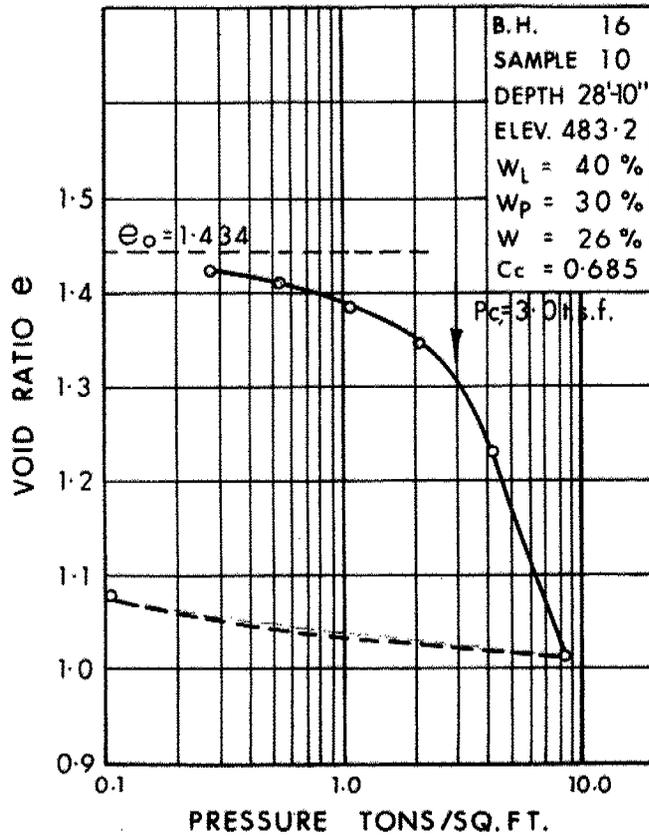
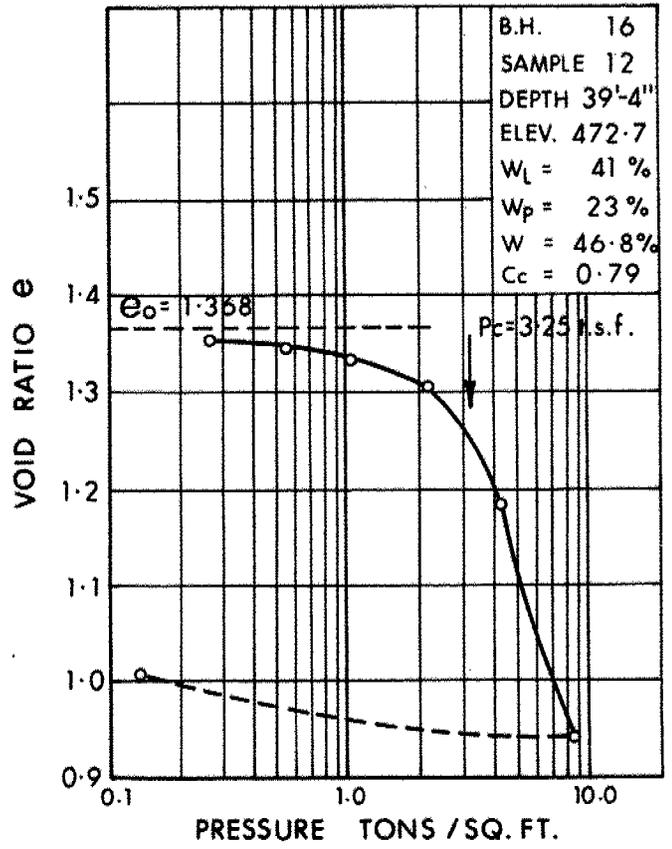
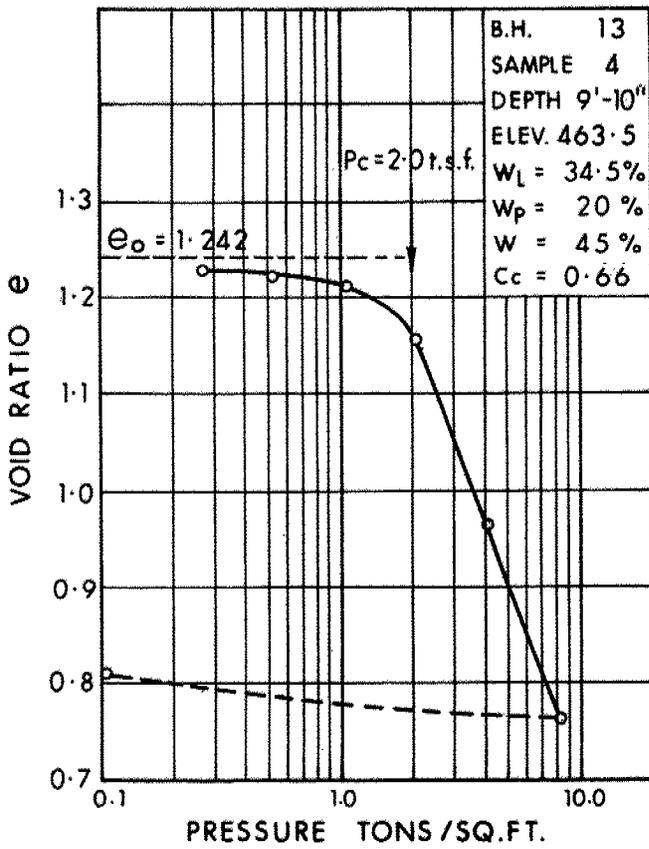


FIG. 6

VOID RATIO - PRESSURE CURVES

JOB NO. 71-11056

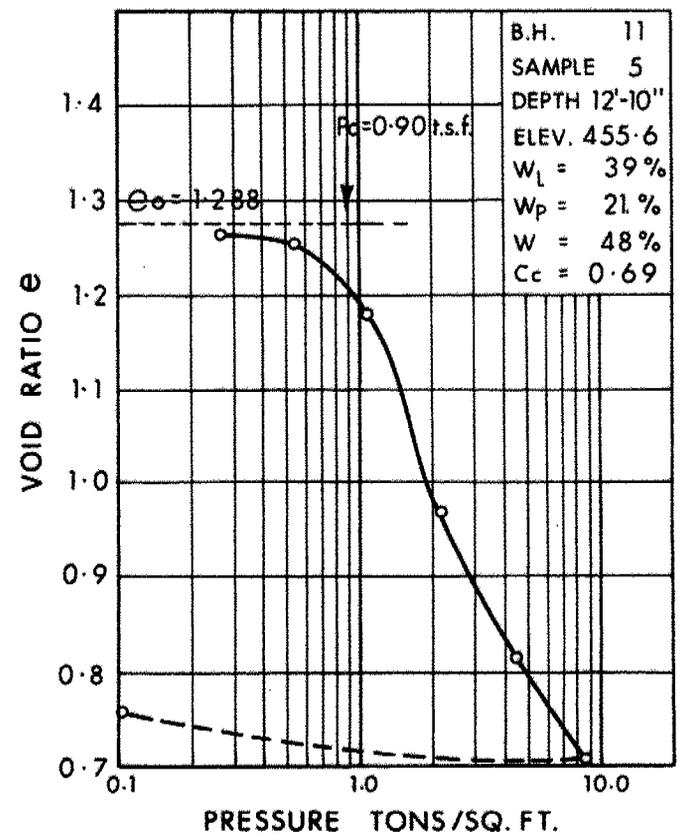
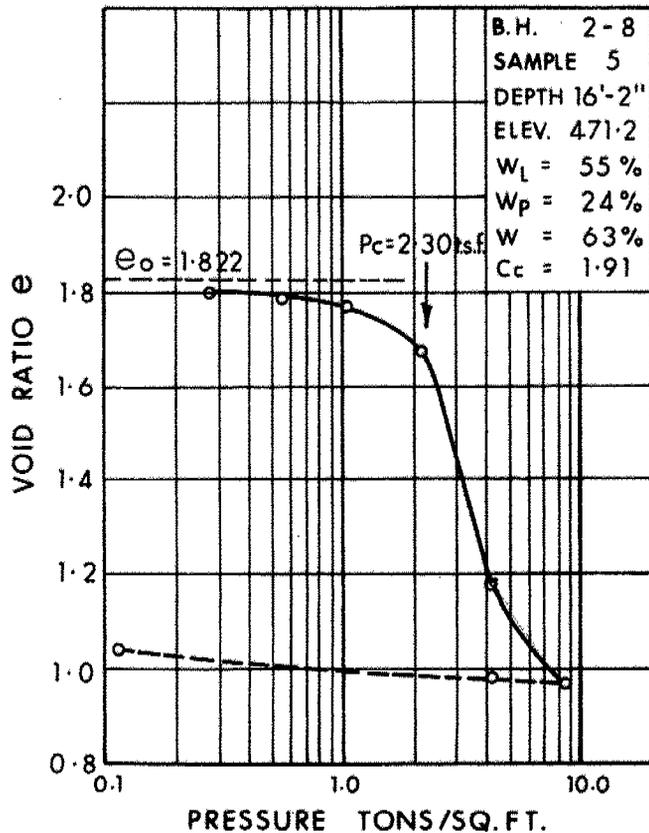
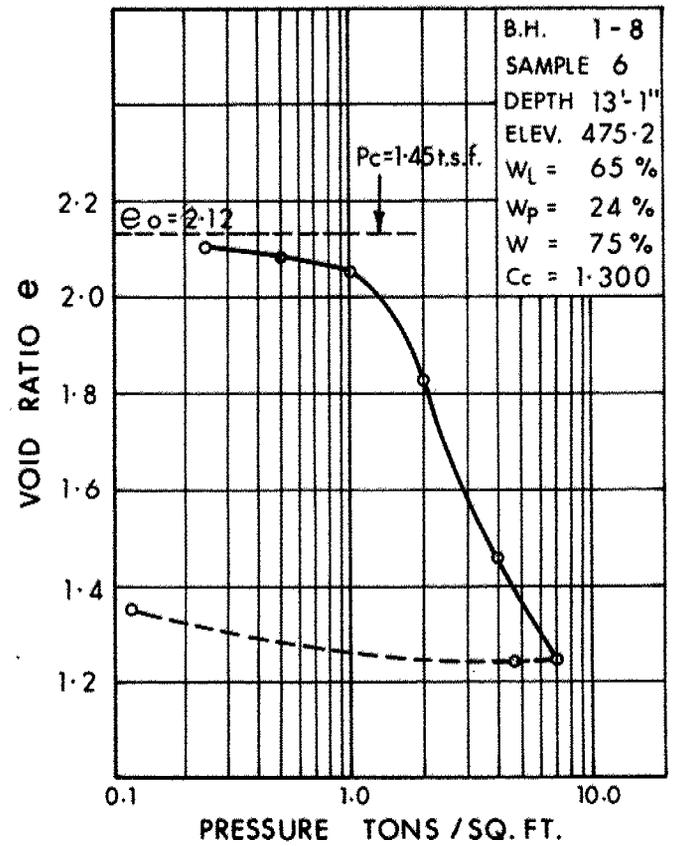
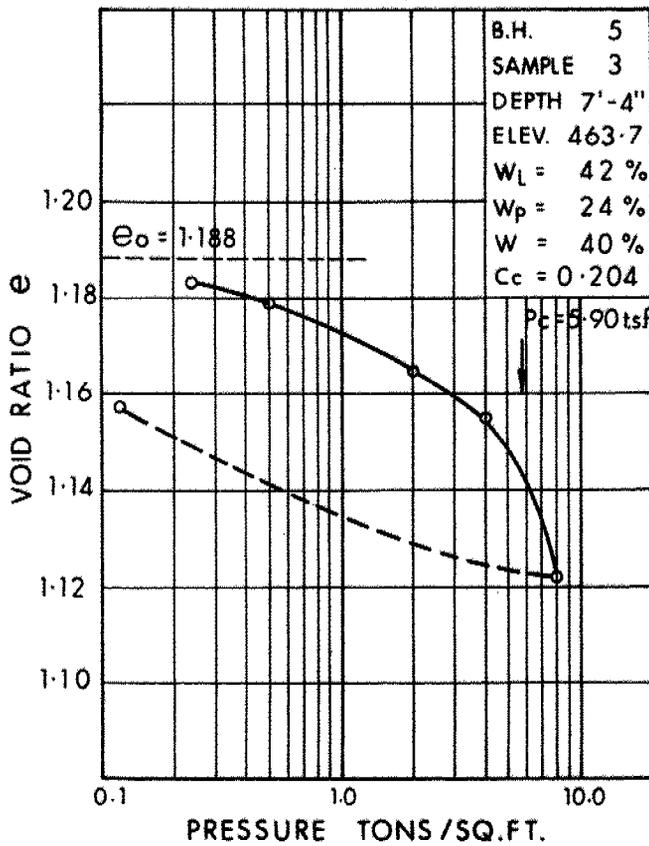


FIG. 7

ABBREVIATIONS & SYMBOLS USED IN THIS REPORTPENETRATION RESISTANCE

'N'-STANDARD PENETRATION RESISTANCE : - 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 :-

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

TERMS TO BE USED IN DESCRIBING SOILS:-

TRACE < 10% , SOME 10-25% , WITH 25-40% , > 40% SILTY, SANDY, GRAVELLY, CLAYEY ETC.

TYPE OF SAMPLE

S.S.	SPLIT SPOON	T.W.	THINWALL OPEN
W.S.	WASHED SAMPLE	T.P.	THINWALL PISTON
S.T.	SLOTTED TUBE SAMPLE	O.S.	OESTERBERG SAMPLE
A.S.	AUGER SAMPLE	F.S.	FOIL SAMPLE
C.S.	CHUNK SAMPLE	R.C.	ROCK CORE

P.H. SAMPLE ADVANCED HYDRAULICALLY

P.M. SAMPLE ADVANCED MANUALLY

SOIL TESTS

U	UNCONFINED COMPRESSION	L.V.	LABORATORY VANE
UU	UNCONSOLIDATED UNDRAINED TRIAXIAL	F.V.	FIELD VANE
CIU	CONSOLIDATED ISOTROPIC UNDRAINED TRIAXIAL	C	CONSOLIDATION
CID	" " DRAINED "	S	SENSITIVITY
CAU	" ANISOTROPIC UNDRAINED "		
CAD	" " DRAINED "		

ABBREVIATIONS & SYMBOLS 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
- w_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
- c_u APPARENT COHESION
- ϕ_u APPARENT ANGLE OF SHEARING RESISTANCE, OR FRICTION
- μ COEFFICIENT OF FRICTION
- S_t SENSITIVITY

IN TERMS OF EFFECTIVE STRESS
 $\tau_f = c' + \sigma' \tan \phi'$

IN TERMS OF TOTAL STRESS
 $\tau_f = c_u + \sigma \tan \phi$

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_0 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

OVERSIZE DRAWING

W. P. 3-67-01, Highway 17 'New'
Meeting on the Treatment of Organic Terrain
350 feet in Length Using a Blasting Technique

AGENDA

1. Introduction
2. Discussion on the removal of deep muskeg sections by:
 - a) Rolling surcharge method - brief discussion
 - b) Blasting method - main discussion
 - (i) "Underfill" method
 - (ii) The displacement of residual muskeg under the fill by blasting.

Section b) - (ii) is applicable to both methods a) and b)

- (iii) Success of blasting methods with approximate costs.
3. General Discussion.

NOTE

Discussion on alternate methods of muskeg treatment is most welcomed, but should be reserved for the general discussion period.

ATTENDANCE

Canadian Industries Limited
(C.I.L.)

Mr. H. Brennan - Explosives
Consultant

M. T. C.

Head Office Foundations

Mr. M. Devata - Supervising
Foundations Engineer

Mr. B. Darch - Senior Foundations
Engineer

M & T., Eastern Region

Mr. E. Saint - Regional Materials
Engineer

Mr. M. Batten - Regional Senior
Soils Supervisor.

District #8

Mr. M. Bernhardt - Construction
Engineer

District #9

Mr. J. Cruikshank - Construction
Engineer

District #10

Mr. D. A. O. White - District
Engineer

Systems Design, Eastern Region

Mr. A. E. Irving - Project
Design Engineer

Mr. J. H. Tondeur - Design Group
Engineer

Mr. J. R. Bestvater - Design
Group Supervisor

Mr. M. Nanton - Junior Engineer

Queens University, Civil
Engineering Department

Dr. G. Raymond
Dr. G. Mitchell
Dr. P. Gaskin

Royal Military College,
Civil Engineering Department

Mr. G. Hollingshead

Resume of the M. T. C. Foundation Investigation Report/Soils Design Report on Organic Terrain Treatment Highway 17 New.

Introduction

The excavation of organic materials to firm bottom or to a maximum of 12 feet has been recommended for all deposits within Highway 17 "New" (Soils Design Report - Kingston Region).

The Eastern Region has also proposed that a 13'0" surcharge above the profile grade be constructed from Station 424+50 - Station 428+00 using a rolling surcharge fill procedure.

The Foundation Office in Toronto in their report have suggested as an alternative to the above an "Underfill Blasting" technique described in L. Casagrande's paper entitled "Construction of Embankments Across Peaty Soils".

Outlined below are both methods of peat disposal and their respective estimates.

Methods of Removal of Muskeg Deposit

In order to check for residual muskeg trapped between the fill and firm bottom it will be necessary to use "jetting" to probe this backfill. This "jetting" procedure will be carried out at various locations and if substantial muskeg deposits are located, explosives will be used for spreading or distributing the trapped peat. This will reduce or eliminate localized settlement. The above procedure is common to both methods.

It is assumed that the organic silt and clay, sandwiched between the peat and firm bottom, has similar structural properties to that of the peat.

1. Surcharge Rolling Fill Method

See attached sheet for details. Systems Design- Kingston Region has come up with an estimate for the dragline time as follows:--

590 hours @ \$30.00/hour = \$17,700.00

Size of dragline using $1\frac{1}{2}$ yard bucket was recommended and this was to be obtained from Special Provision 8207 - Rental of swamp excavation equipment.

The Estimating Office assumed an excavation machine rate of 60 yds/hr.

2. Underfill Blasting Method

See attached sheet for details.

Surficial blasting = 590 lbs.

Charges placed on firm
bottom for 30'0" width
of excavation = 5840 lbs.

Total wt. of explosives

= 6430 lbs.

Total Cost = $\frac{6430}{50} \times \$60.00/\text{unit} = \$7,716.00$

The Estimating Office recommended an average unit price /50 lb. of explosives of \$60.00.

This appears to be a most conservative estimate. It is hoped that this meeting will shed further light on the subject so that a more realistic estimate can be compiled, and this information used for this, and, or, future projects.

Stations 424+00 and 429+00 the new highway will cross organic terrain. The depth of organic material ranges from 2 to 31.5 feet. The organic deposits are underlain by a competent sand and gravel deposit. In this area Hwy. #17 'New' will be carried on an embankment varying between 6 and 8 feet in height.

Since this is to be a Controlled Access Highway, special measures will have to be initiated in order to ensure proper performance of this localized section. Specifically, it is proposed to completely remove the organic deposits from beneath the embankment section. Two possible methods of displacing the peaty soils will be discussed in the subsections to follow; namely,

- i) displacement by blasting, and
- ii) displacement by the utilization of a rolling surcharge fill.

6.2) Displacement of Peaty Soil by Blasting:

Dr. L. Casagrande* has outlined the American and German experiences using blasting to displace deep deposits of peaty soils. Four methods were discussed; namely,

- i) toe shooting,
- ii) underfill blasting,
- iii) ditching,
- iv) relief method.

As far as this project is concerned the underfill blasting method, as refined by the Germans, is believed to be the most suitable under the conditions at this site. A proposed construction scheme is shown on Drawing No. W.O. 72-11012B; it will be discussed in the paragraphs to follow.

.....6

*Casagrande, L., "Construction of Embankments Across Peaty Soils." Contributions to Soil Mechanics - Boston Society of Civil Engineers, 1962 to 1964, Pp. 272 - 315.

Where the thickness of the organic material is less extensive (15 feet or less) it can be excavated completely using a conventional technique, such as with draglines. This operation can, therefore, be employed between the following:

Station 423+50 to 424+75

Station 428+00 to 429+50

Following the peat excavation in these areas acceptable granular fill should be placed and brought up to the profile grade of Hwy. #17 'New'. The treatment in these two areas should be completed prior to the operations to be adopted in the central area of the swamp.

Blasting will be required to displace the thick peaty material in the central area (between Stations 424+75 and 428+00). Since the highway embankment will be quite wide (75' to 100' crest to crest) best results will be realized if the blasting operations are carried out in stages. Using this technique a central core of fill, approximately 30 feet wide, should be sunk to firm bottom. Two additional stages then would be required to sink the outer portions of the embankment to firm bottom. During each of these stages the fill should be placed over the full length of the section. The first stage operational sequence is described in the following paragraphs:

- a) The integrity of the 4 to 6 feet thick surficial mat should be destroyed for a width of approximately 10 feet along the proposed centre line of Hwy. #17 'N'. This could be accomplished by pushing or jetting light charges to a depth of several feet below the original ground surface; these charges should be placed on 3 foot centres. This procedure will lessen the danger of cracks developing in the vegetative mat which might lead to sudden sliding during filling operations. Further, it will facilitate a uniform settlement of the fill and prevent the crust from being trapped beneath the fill.
- b) Fill can now be placed to form the central core; it should extend to a height well above the design grade. This is necessary so that the fill will realize a level which is close to the design grade following the blasting operation.

The fill should be composed of granular material with a minimum of coarse gravel sizes.

- c) The dynamite charges should be placed on firm bottom by using the jetting techniques outlined by Dr. Casagrande in his paper. The spacing of the charges, both in a longitudinal and traverse direction, as well as the quantity of dynamite in each charge, are outlined in Tables V and VI of this paper. These tables are presented in Appendix II of this report. A typical cross-sectional charge layout is shown on Drawing No. 72-11012B.
- d) All the charges should be set off simultaneously, thus sinking the central core through the displaced organic material down to hard bottom.

The core could be widened in either direction by placing fill then sinking these extensions down to hard bottom using blasting techniques similar to those discussed for the first stage operation.

In order to ensure the lateral stability of the finalized embankment section, it is recommended that berms be constructed; the berms can be formed of dumped organic soil obtained from the excavation. Recommended berm dimensions for various fill heights and organic depths have been specified by Dr. Casagrande. The berm requirements at a typical section are illustrated on Drawing No. W.O. 72-11012B.

Past experience has indicated that some subsidence and cracking often occur on the shoulder and along the slope of embankments placed in areas where peat has been displaced. This is due to the relative movement between the granular fill and adjacent organic material. Post-construction maintenance, due to these factors, can be minimized by constructing temporary surcharges over the crests of the embankment section in order to accelerate these movements. Typical surcharge details are shown on Drawing 72-11012B. The surcharges should be left in place for a period of at least two months; it then can be removed and used as a top dressing to the berms already in place.

6.3) Displacement of Peaty Soil Using Rolling Surcharge Fill:

As an alternative to the underfill blasting method a rolling surcharge fill could be used.

As discussed in Subsection 6.2) the organic material, where it is less extensive (Stations 423+50 to 424+75 and 428+00 to 429+50) could be excavated using conventional techniques. Between Stations 424+75 and 428+00, however, the peat is too thick (20 to 32 feet) to be economically removed using direct methods. An attempt to displace the organic material in this area could be made by progressively advancing fill composed of coarse granular material. The surcharge should be advanced across the organic terrain by end-dumping granular material over the front face of the fill and by employing bulldozers to push the previously placed surcharge material forward. The forward portion of the fill should be built up to a height considerably above the proposed profile grade, say to a height of 25 to 30 feet. The organic material squeezed out in front of the advancing fill should be removed using draglines.

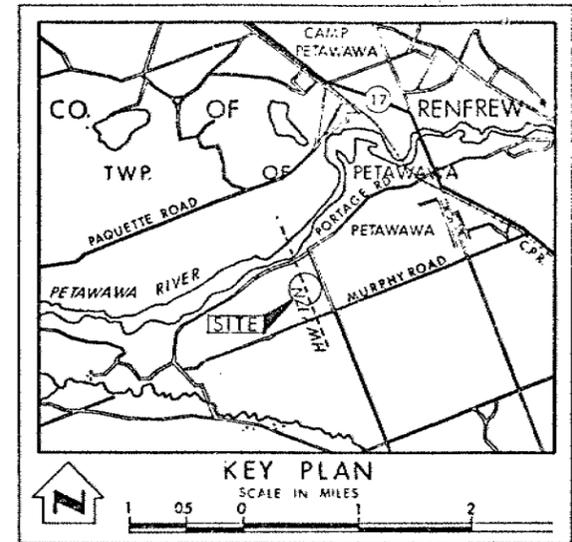
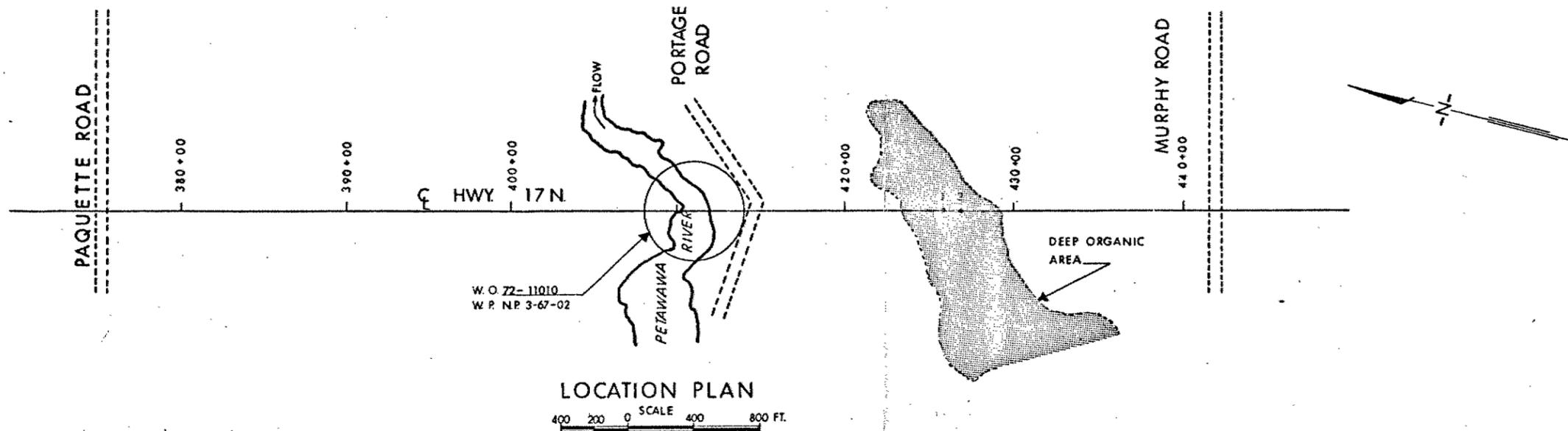
There is a possibility that the rolling surcharge may not be totally effective in displacing all the organic material. Organic soil, trapped beneath the granular fill, would adversely affect the performance of this section of the Hwy. #17 'N' embankment. Under these circumstances the embankment would settle differentially, and thus be a continuing maintenance problem. In this regard, it is recommended that, as soon as the surcharging operation is completed, probes be put down to determine if any organic soil has been trapped beneath the fill. If, in some localized areas a considerable thickness of organic soil is found to be present measures will have to be taken to displace it. The best method would be to employ the underfill blasting technique discussed in detail in Subsection 6.2).

Questions Pertinent to the Blasting Method

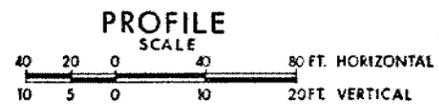
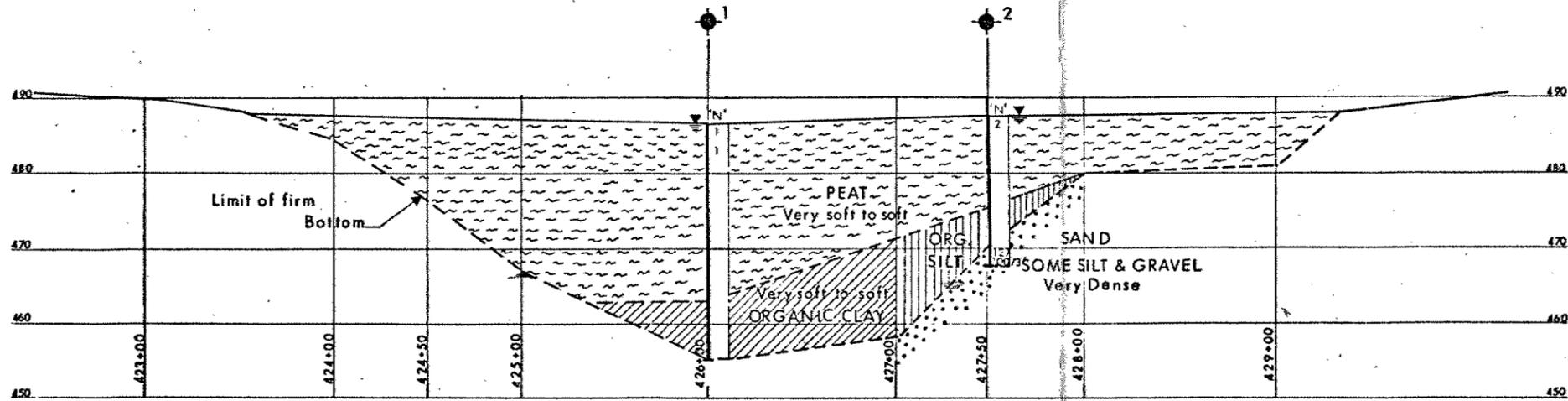
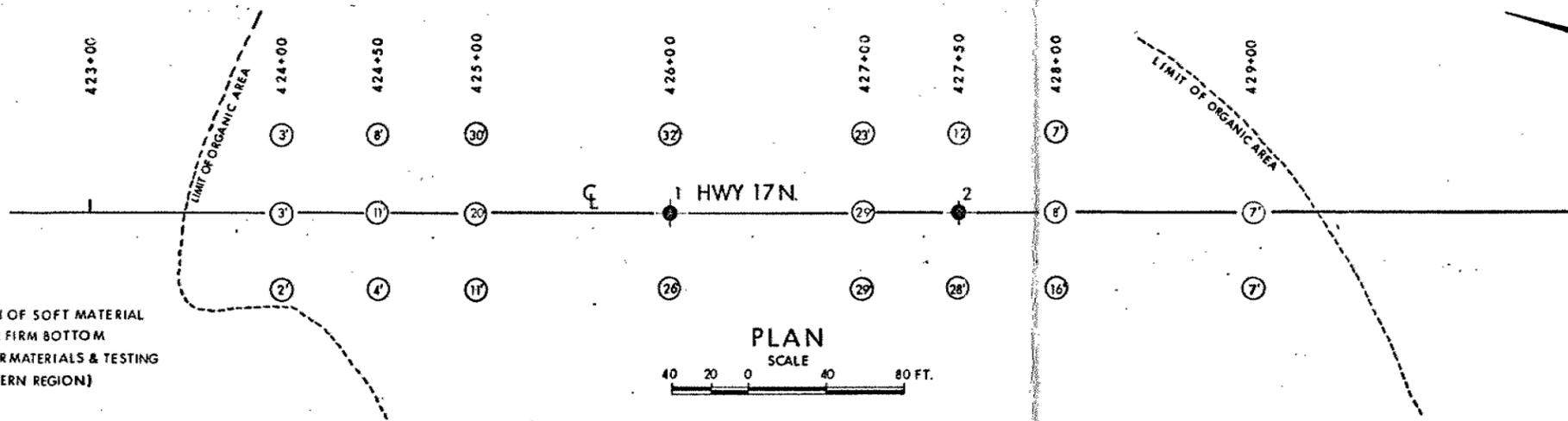
1. As per the Foundation Report "the integrity of 4' to 6' thick surficial mat should be destroyed for a width of approximately 10'0" along the proposed centreline of Highway 17 "New".

Requirement for the breakup of this surficial mat:

- a) Wt. and no of sticks
 - b) Requisite spacing of charges.
2. Charge layout on firm bottom - lateral and longitudinal spacing of charges to obtain a 30'0" width.
 3. Layout of charges for layer of trapped material. Type of explosives required.



NOTE:
 20 DEPTH OF SOFT MATERIAL OVER FIRM BOTTOM AS PER MATERIALS & TESTING (EASTERN REGION)



LEGEND			
	Bore Hole		
	Cone Penetration Test		
	Bore Hole & Cone Test		
	Water Levels established at time of field investigation, Jan 1972		
NO.	ELEVATION	STATION	OFFSET
1	486.5	426+00	℄
2	487.6	427+50	℄

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

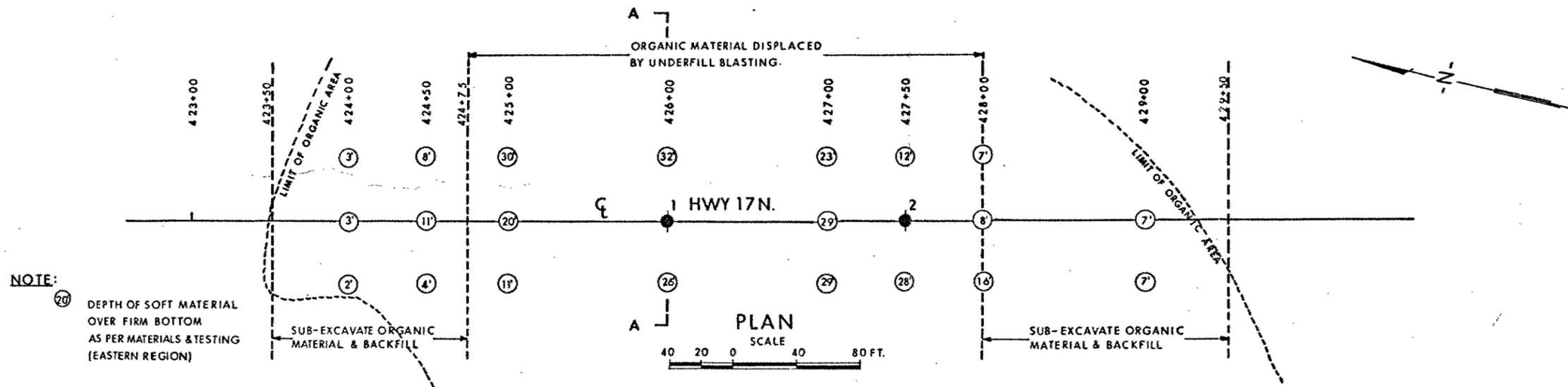
MINISTRY OF TRANSPORTATION & COMMUNICATIONS
 DESIGN SERVICES BRANCH — FOUNDATIONS OFFICE

ORGANIC AREA
 STA. 424+00 TO STA. 429+00

HIGHWAY NO. 17N DIST. NO. 9
 CO. RENFREW
 TWP. PETAWAWA LOT _____ CON. _____

BORE HOLE LOCATIONS & SOIL STRATA

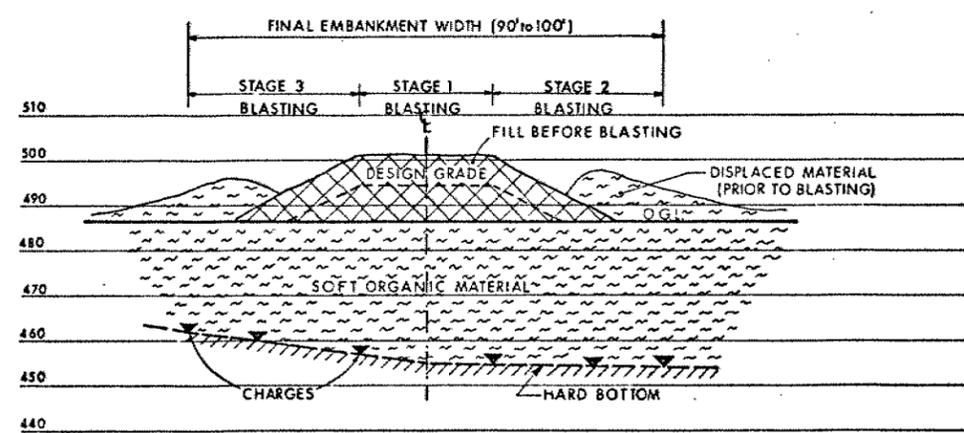
SUBMITTED	CHECKED <input checked="" type="checkbox"/>	WP NO. 3-67-01	DRAWING NO.
DRAWN F.L.	CHECKED	JOB NO 72-11012	72-11012A
DATE JULY 12, 1972	SITE NO.	BRIDGE DRAWING NO.	
APPROVED <i>[Signature]</i>	CONT. NO.		



SEE DRAWING N° 72-11012A

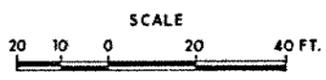
KEY PLAN
SCALE IN MILES

① UNDERFILL BLASTING PROCEDURE (FIRST STAGE)

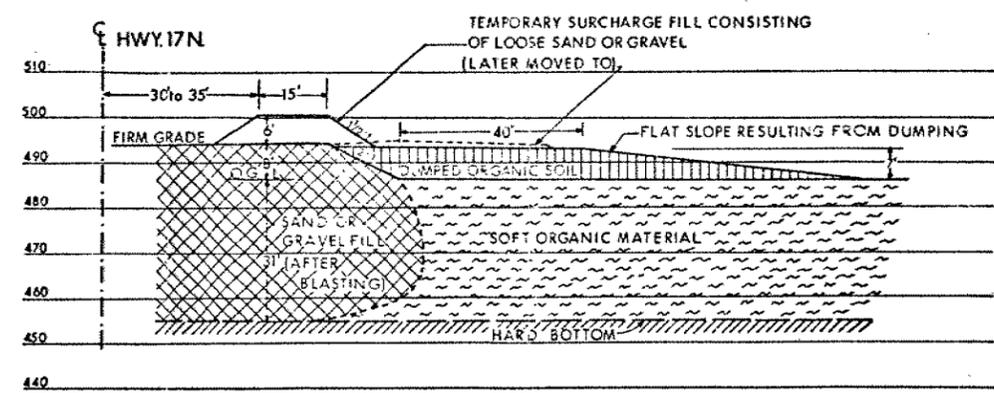


NOTE: RECOMMENDED SPACING BETWEEN THE CHARGES AS WELL AS THE QUANTITY OF DYNAMITE IN EACH CHARGE IS GIVEN IN TABLES V AND VI LOCATED IN APPENDIX II.

SECTION A-A



② RECOMMENDED BERM AND TEMPORARY SURCHARGE (TO BE PLACED FOLLOWING BLASTING OPERATION)



SECTION A-A

LEGEND

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

NO.	ELEVATION	STATION	OFFSET

— 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 & COMMUNICATIONS
DESIGN SERVICES BRANCH — FOUNDATIONS OFFICE

TREATMENT OF ORGANIC AREA
STA. 424+00 TO STA. 429+00

HIGHWAY NO. 17 N. DIST. NO. 9
CO. RENFREW
TWP. PETAWAWA LOT CON.

BORE HOLE LOCATIONS & SOIL STRATA

SUBMD B.T.D. CHECKED	WP NO. 3-67-01	DRAWING NO. 72-11012B
DRAWN P.L. CHECKED	JOB NO 72-11012	BRIDGE DRAWING NO.
DATE AUGUST 10, 1972	SITE NO.	
APPROVED <i>[Signature]</i>	CONT. NO.	

DEPARTMENT OF TRANSPORTATION AND COMMUNICATIONS

RECORD OF BOREHOLE No.1

FOUNDATION SECTION

DESIGN SERVICES BRANCH

JOB 72-11012

LOCATION Sta. 426 + 00 ϕ

ORIGINATED BY B.U.

W.P. 3-67-01

BORING DATE January 25, 1972

COMPILED BY RRB

DATUM Geodetic

BOREHOLE TYPE Washboring NX Casing

CHECKED BY *[Signature]*

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE				LIQUID LIMIT — w_L PLASTIC LIMIT — w_p WATER CONTENT — w			BULK DENSITY γ P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT		SHEAR STRENGTH P.S.F.				WATER CONTENT %				
							○ UNCONFINED	+ FIELD VANE							
							● QUICK TRIAXIAL	x LAB. VANE							
							200	400							
486.5	Ground Level														
0.0	Surficial material	~	1	SS	1	485									
		~	2	SS	1								550	Orgs	
	Soft	~				480		+4						79.5%	
	Peat (occasionally fibrous)	~	3	TW	PM			+2						808	
		~				475		+3							
	Dark Brown	~	4	TW	PM			-2						925	Orgs
		~				470		+1						72%	
		~	5	TW	PM			+2						936	
	Very Soft to Soft	~				465									
463.0	Organic Clay	▨	6	TW	PM			+6							
23.5	Grey	▨				460		+4							
		▨	7	TW	PM										
455.0	Very Soft to Soft	▨				455		-10							
31.5	End of Borehole Hard Bottom														

20
15-5 % STRAIN AT FAILURE

DEPARTMENT OF TRANSPORTATION AND COMMUNICATIONS

RECORD OF BOREHOLE No.2

FOUNDATION SECTION

DESIGN SERVICES BRANCH

JOB 72-11012

LOCATION Sta. 427 + 50 Ø

ORIGINATED BY B.U.

W.P. 3-67-01

BORING DATE January 27, 1972

COMPILED BY RRB

DATUM Geodetic

BOREHOLE TYPE Washboring NX & BX

CHECKED BY *[Signature]*

ELEV. DEPTH	SOIL PROFILE DESCRIPTION	STRAT. PLOT	SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE				LIQUID LIMIT — WL PLASTIC LIMIT — WP WATER CONTENT — W			BULK DENSITY γ	REMARKS
			NUMBER	TYPE	BLOWS/FOOT		SHEAR STRENGTH P.S.F.				WATER CONTENT %				
							○ UNCONFINED	+ FIELD VANE							
							● QUICK TRIAXIAL	x LAB. VANE							
							200	400							
487.6	Ground Level														
0.0	Surficial Material	~	1	SS	2										WL in open BH Jan.27/72
	Soft	~				485									
	Peat (occasional fibrous)	~	2	TW	PM		+4								
		~					+3.5								
	Grey-Brown	~	3	TW	PM	480									
	Very Soft to Soft	~					+2								
475.6	Organic Silt		4	TW	PM	475									
	Grey-Brown						+5								
470.6	Very Soft to Soft						+4								
470.0	Sand with some silt and gravel.	•••	5	SS	127	470									8 78 (14)
467.5	Very Dense	•••	6	SS	100/3"										
20.1	End of Borehole Hard Bottom					465									

20
15-5 % STRAIN AT FAILURE

DOCUMENT MICROFILMING IDENTIFICATION

G.I-30 SEPT. 1976

GEOCRES No. 31F-60

DIST. 9 REGION Eastern

W.P. No. 3-67-01

CONT. No. 76-18

W. O. No. _____

STR. SITE No. _____

HWY. No. _____

LOCATION Hwy 17 - Petawawa
Airport, Line 'A'

OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT.

REMARKS: documents to be unfolded
before microfilming

72-11012

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS, ONTARIO

MEMORANDUM

TO: Mr. A.E. Irving,
Project Design Engineer,
Systems Design Office,
Kingston, Ontario.

FROM: #9, Ottawa.

ATTENTION:

DATE: January 12, 1973.

OUR FILE REF.

IN REPLY TO

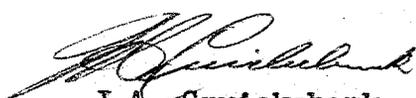
SUBJECT:

Re: W.P. 3-67-01, Hwy. 17N, Co. Rd. 17 W'ly
to W. of Petawawa

On page 3 of the Minutes of the Pre-Contract Review Meeting held December 18, 1972, it is noted in the second last paragraph that no further consideration is to be given to the use of explosives, in conjunction with excavation, for the purposes of pre-contract engineering.

It was my understanding that a decision in this regard was to be reached only after a comparison had been made with "similar" situations previously encountered in Toronto District.

If the information resulting from this comparison is now available, the District would appreciate being advised of the relevant data.


J.A. Cruickshank,
District Construction Engineer.

JAC/ea

c.c. Mr. Devata, Downsview



FOUNDATION INVESTIGATION REPORT
For
Treatment of Organic Terrain
Proposed Hwy. #17 'New'
(Stations 424+00 to 429+00)
Township of Petawawa, County of Renfrew
District No. 9 (Ottawa)
W.O. 72-11012 -- W.P. 3-67-01

1. INTRODUCTION:

Proposed Hwy. #17 "New" is to bypass the Town of Petawawa at a point about 1-1/2 miles south of existing Hwy. #17. Approximately 1,500 feet east of the Petawawa River the new highway will cross an expanse of organic terrain which is about 500 feet in length. It is known that the thickness of the organic material is considerable. Since this is to be a Controlled Access Highway, special measures will have to be initiated in order to ensure proper performance of this localized section. In order to aid in assessing the measures required, the Foundations Office was requested to carry out a subsurface investigation in this area. The request was contained in a memo from Mr. A. M. Batten, Senior Soils Supervisor, Eastern Region, dated January 7, 1972. An investigation was subsequently carried out.

This report presents all the factual results obtained from this investigation, together with recommendations pertaining to the measures deemed necessary to ensure the suitable performance of this highway within this area.

2. DESCRIPTION OF THE SITE AND GEOLOGY:

The area under investigation is located approximately 1,500 feet east of the Petawawa River, at a point about 1-1/2 miles south of existing Hwy. #17. The area is rather flat and

low lying, with the ground surface ranging between elevations 485 and 490. The terrain is covered with light brush growth. The drainage is poor; this had led to the formation of a swamp. The plan limits of this swamp have been defined in a report presented to this Office by Mr. B. Sen Mathur, P. Eng., Airphoto Interpretation Engineer, Ministry of Transportation and Communications (dated January 13, 1972). A shallow (2 to 3 feet deep) creek meanders across this area. The water in the creek is generally not more than 1 foot deep.

Physiographically, the area under investigation is located in the region known as the "Petawawa Sand Plain." The granular overburden deposits encountered here were primarily laid down in a delta built in the Champlain Sea by the Petawawa, Barron, Indian and Ottawa Rivers during the Fossmill stage of Lake Algonquin. In the vicinity of the area under investigation the sand and gravel deposits range from about 5 to 30 feet in thickness. The surficial organic material has been superimposed on this deposit. The overburden is underlain by gneiss bedrock of Precambrian Age.

3. FIELD AND LABORATORY WORK:

Two sampled boreholes were put down during the course of the field investigation. The borings were advanced by means of a conventional diamond drill rig, adapted for soil sampling purposes. In addition, a series of soundings were put down by the Eastern Region Materials Section to define the vertical and lateral extent of the organic material.

Following the sampling and drilling operations a detailed log was made for each of the two borings, this log includes a record of the testing performed as well as the soil types encountered. The locations and elevations of the borings were surveyed by personnel from the Eastern Region Engineering Surveys Section, and are shown on Drawing No. 72-11012A, together with an estimated stratigraphical profile across the site. The

elevations in this report are referenced to a Geodetic datum.

All the samples were subjected to a careful visual examination in the field and subsequently in the laboratory. Following this inspection, laboratory tests were carried out to determine the physical properties of the various soil types; namely,

Natural Moisture Content
Atterberg Limits
Organic Content
Grain-Size Distribution

The results of the laboratory testing are plotted on the Record of Borelog sheets.

4. SUBSOIL CONDITIONS:

4.1) General:

Between Stations 424+00 and 429+00, along the proposed Hwy. #17 'New' alignment, the terrain is swampy. The depth of organic material ranges from 2 feet to 31.5 feet. The organic deposits are underlain by the sand and gravel deposits common to this region.

The soil sequence, encountered at the boring locations, is shown on the borelog sheets, the stratigraphical profile plotted on Drawing No. 72-11012A has been inferred from this data. A brief resume of the stratigraphical sequence from ground surface downward is presented in the subsections to follow.

4.2) Organic Deposits:

In this area the surficial deposit is composed of a dark brown fibrous peat. The thickness of the peat ranges from 2 feet, along the edges of the swamp, to as much as 23.5 feet at B.H. #1, put down near the centre. The natural moisture content of the peat ranges from 550 to 936 percent, while the

organic content was found to vary from 72 to 80 percent by weight. The undrained shear strength of the peat was determined by performing in-situ vane tests; this testing gave values which ranged from 330 p.s.f., in the upper 5 to 7 feet, decreasing to as low as 95 p.s.f. with depth. Based on these results it is estimated that the consistency of the peat is soft, in the upper zone, decreasing to very soft, with depth.

Where the organic terrain is most extensive the peat is underlain by organic material of varying composition. At B.H. #1, for instance, the peat is followed by an 8 feet thick deposit of very soft organic clay, while at B.H. #2 it is underlain by 5 feet of very soft organic silt.

4.3) Lower Inorganic Deposit:

This investigation has indicated that, in the central portion of the swamp, where the organic material is most extensive, the organics are directly underlain by hard bottom (probably bedrock). Elsewhere, however, the organic material is underlain by the dense to very dense sand and gravel deposit common to this region.

5. GROUNDWATER LEVEL CONDITIONS:

Groundwater level observations were carried out during the period of the investigation in the open boreholes. The observations are presented on the individual borelog sheets as well as on Drawing No. 72-11012A. The results indicate that the groundwater level, across this poorly drained area, is at existing ground surface.

6. DISCUSSION AND RECOMMENDATIONS:

6.1) General:

Hwy. #17 'New' is to bypass the Town of Petawawa at a point about 1-1/2 miles south of existing Hwy. #17. Approximately 1,500 feet east of the Petawawa River, namely, between

Stations 424+00 and 429+00 the new highway will cross organic terrain. The depth of organic material ranges from 2 to 31.5 feet. The organic deposits are underlain by a competent sand and gravel deposit. In this area Hwy. #17 'New' will be carried on an embankment varying between 6 and 8 feet in height.

Since this is to be a Controlled Access Highway, special measures will have to be initiated in order to ensure proper performance of this localized section. Specifically, it is proposed to completely remove the organic deposits from beneath the embankment section. Two possible methods of displacing the peaty soils will be discussed in the subsections to follow; namely,

- i) displacement by blasting, and
- ii) displacement by the utilization of a rolling surcharge fill.

6.2) Displacement of Peaty Soil by Blasting:

Dr. L. Casagrande* has outlined the American and German experiences using blasting to displace deep deposits of peaty soils. Four methods were discussed; namely,

- i) toe shooting,
- ii) underfill blasting,
- iii) ditching,
- iv) relief method.

As far as this project is concerned the underfill blasting method, as refined by the Germans, is believed to be the most suitable under the conditions at this site. A proposed construction scheme is shown on Drawing No. W.O. 72-11012B; it will be discussed in the paragraphs to follow.

.....6

*Casagrande, L., "Construction of Embankments Across Peaty Soils." Contributions to Soil Mechanics - Boston Society of Civil Engineers, 1962 to 1964, Pp. 272 - 315.

Where the thickness of the organic material is less extensive (15 feet or less) it can be excavated completely using a conventional technique, such as with draglines. This operation can, therefore, be employed between the following:

Station 423+50 to 424+75

Station 428+00 to 429+50

Following the peat excavation in these areas acceptable granular fill should be placed and brought up to the profile grade of Hwy. #17 'New'. The treatment in these two areas should be completed prior to the operations to be adopted in the central area of the swamp.

Blasting will be required to displace the thick peaty material in the central area (between Stations 424+75 and 428+00). Since the highway embankment will be quite wide (75' to 100' crest to crest) best results will be realized if the blasting operations are carried out in stages. Using this technique a central core of fill, approximately 30 feet wide, should be sunk to firm bottom. Two additional stages then would be required to sink the outer portions of the embankment to firm bottom. During each of these stages the fill should be placed over the full length of the section. The first stage operational sequence is described in the following paragraphs:

- a) The integrity of the 4 to 6 feet thick surficial mat should be destroyed for a width of approximately 10 feet along the proposed centre line of Hwy. #17 'N'. This could be accomplished by pushing or jetting light charges to a depth of several feet below the original ground surface; these charges should be placed on 3 foot centres. This procedure will lessen the danger of cracks developing in the vegetative mat which might lead to sudden sliding during filling operations. Further, it will facilitate a uniform settlement of the fill and prevent the crust from being trapped beneath the fill.
- b) Fill can now be placed to form the central core; it should extend to a height well above the design grade. This is necessary so that the fill will realize a level which is close to the design grade following the blasting operation.

The fill should be composed of granular material with a minimum of coarse gravel sizes.

- c) The dynamite charges should be placed on firm bottom by using the jetting techniques outlined by Dr. Casagrande in his paper. The spacing of the charges, both in a longitudinal and traverse direction, as well as the quantity of dynamite in each charge, are outlined in Tables V and VI of this paper. These tables are presented in Appendix II of this report. A typical cross-sectional charge layout is shown on Drawing No. 72-11012B.
- d) All the charges should be set off simultaneously, thus sinking the central core through the displaced organic material down to hard bottom.

The core could be widened in either direction by placing fill then sinking these extensions down to hard bottom using blasting techniques similar to those discussed for the first stage operation.

In order to ensure the lateral stability of the finalized embankment section, it is recommended that berms be constructed; the berms can be formed of dumped organic soil obtained from the excavation. Recommended berm dimensions for various fill heights and organic depths have been specified by Dr. Casagrande. The berm requirements at a typical section are illustrated on Drawing No. W.O. 72-11012B.

Past experience has indicated that some subsidence and cracking often occur on the shoulder and along the slope of embankments placed in areas where peat has been displaced. This is due to the relative movement between the granular fill and adjacent organic material. Post-construction maintenance, due to these factors, can be minimized by constructing temporary surcharges over the crests of the embankment section in order to accelerate these movements. Typical surcharge details are shown on Drawing 72-11012B. The surcharges should be left in place for a period of at least two months; it then can be removed and used as a top dressing to the berms already in place.

6.3) Displacement of Peaty Soil Using Rolling Surcharge Fill:

As an alternative to the underfill blasting method a rolling surcharge fill could be used.

As discussed in Subsection 6.2) the organic material, where it is less extensive (Stations 423+50 to 424+75 and 428+00 to 429+50) could be excavated using conventional techniques. Between Stations 424+75 and 428+00, however, the peat is too thick (20 to 32 feet) to be economically removed using direct methods. An attempt to displace the organic material in this area could be made by progressively advancing fill composed of coarse granular material. The surcharge should be advanced across the organic terrain by end-dumping granular material over the front face of the fill and by employing bulldozers to push the previously placed surcharge material forward. The forward portion of the fill should be built up to a height considerably above the proposed profile grade, say to a height of 25 to 30 feet. The organic material squeezed out in front of the advancing fill should be removed using draglines.

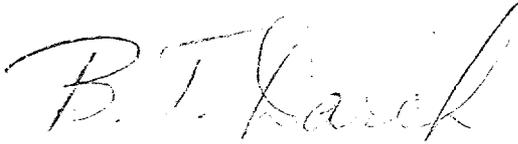
There is a possibility that the rolling surcharge may not be totally effective in displacing all the organic material. Organic soil, trapped beneath the granular fill, would adversely affect the performance of this section of the Hwy. #17 'N' embankment. Under these circumstances the embankment would settle differentially, and thus be a continuing maintenance problem. In this regard, it is recommended that, as soon as the surcharging operation is completed, probes be put down to determine if any organic soil has been trapped beneath the fill. If, in some localized areas a considerable thickness of organic soil is found to be present measures will have to be taken to displace it. The best method would be to employ the underfill blasting technique discussed in detail in Subsection 6.2).

7. MISCELLANEOUS:

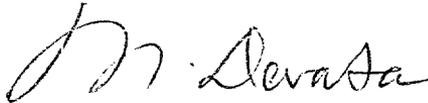
The field work was carried out between the period of January 25 to 27, 1972, under the immediate supervision of Mr. W. V. Uzie, Field Technician.

The equipment used was owned and operated by the F.E. Johnston Drilling Co. Ltd., Ottawa.

This report was written by Mr. B. T. Darch, Senior Foundations Engineer, and reviewed by Mr. M. Devata, Supervising Foundations Engineer.



B. T. Darch, P. Eng.,



M. Devata, P. Eng.

BTD/ao

August 31, 1972.

RECOMMENDED
SPACING AND AMOUNT OF
EXPLOSIVES FOR
DYNAMITE CHARGES

*TABLE V

Thickness H of Peat Deposit	Distance D Between Rows of Charges	Spacing B Between Charges within a Row		
		Below Crest	Below Slopes	Outside Toes
<30 ft.	0.75H	H	0.75H	0.5H
30 to 60 ft.	0.75H	0.5H + 15 ft.	0.5H + 7.5 ft.	0.5H
>60 ft.	45 ft.	45 ft.	38 ft.	30 ft.

*TABLE VI

Thickness H of Peat Deposit - feet	Amount of Explosives W in.lb/charge Along Center Line of Fill	
	For Width of Crest <30 feet	For Width of Crest >30 feet
10	50	60
20	80	100
30	120	150
40	160	200
50	200	250
60	250	300

*Casagrande, L., "Construction of Embankments Across Peaty Soils." Contributions to Soil Mechanics - Boston Society of Civil Engineers, 1962 to 1964. pp. 272-315.

DEPARTMENT OF TRANSPORTATION AND COMMUNICATIONS

RECORD OF BOREHOLE No. 1

FOUNDATION SECTION

DESIGN SERVICES BRANCH

JOB 72-11012

LOCATION Sta. 426 + 00 \emptyset

ORIGINATED BY B.U.

W.P. 3-67-01

BORING DATE January 25, 1972

COMPILED BY RRB

DATUM Geodetic

BOREHOLE TYPE Washboring NX Casing

CHECKED BY *[Signature]*

SOIL PROFILE		STRAT. PLOT	SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE		LIQUID LIMIT			BULK DENSITY	REMARKS
ELEV. DEPTH	DESCRIPTION		NUMBER	TYPE	BLOWS/FOOT		BLOWS / FOOT	SHEAR STRENGTH P.S.F.	W _L	W _P	W		
486.5	Ground Level						200						
0.0	Surficial material	~	1	SS	1	485							
	Soft	~	2	SS	1							550	Orgs 79.5%
	Peat (occasionally fibrous)	~	3	TW	PM	480	+1 +2					808	
	Dark Brown	~	4	TW	PM	475	+3					925	Orgs 72%
	Very Soft to Soft	~	5	TW	PM	470	+1 +2					936	
463.0	Organic Clay Grey	▨	6	TW	PM	465	+6						
23.5		▨	7	TW	PM	460	+4						
455.0	Very Soft to Soft	▨					-10						
31.5	End of Borehole Hard Bottom					455							

DEPARTMENT OF TRANSPORTATION AND COMMUNICATIONS
DESIGN SERVICES BRANCH

RECORD OF BOREHOLE No. 2

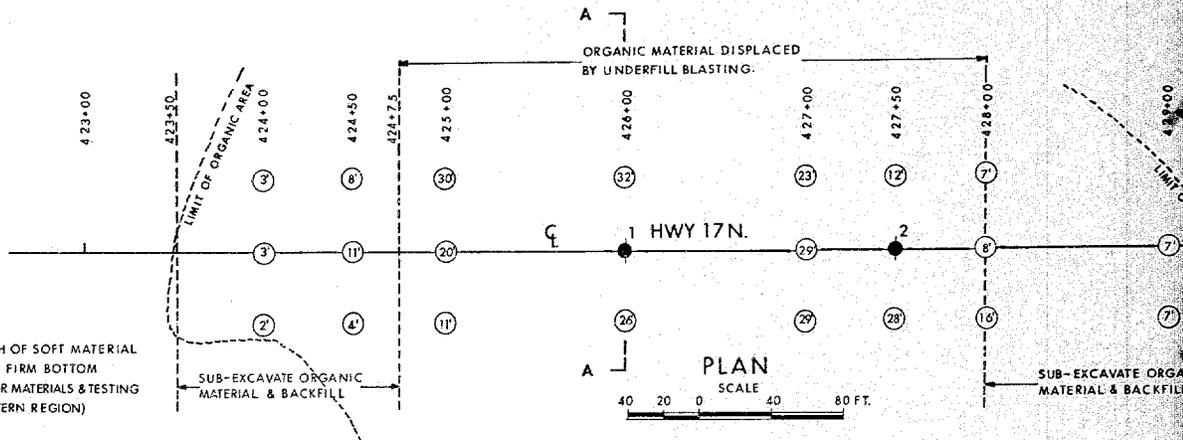
FOUNDATION SECTION

JOB 72-11012 LOCATION Sta. 427 + 50 Ø ORIGINATED BY B.U.
W.P. 3-67-01 BORING DATE January 27, 1972 COMPILED BY RRB
DATUM Geodetic BOREHOLE TYPE Washboring NX & BX CHECKED BY *[Signature]*

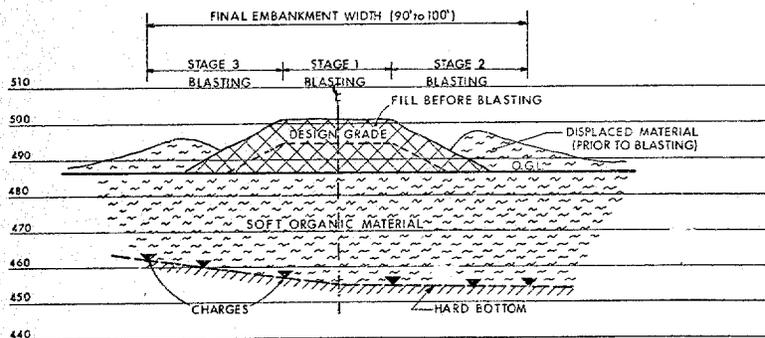
ELEV. DEPTH	SOIL PROFILE DESCRIPTION	STRAT. PLOT	SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE		LIQUID LIMIT			BULK DENSITY	REMARKS
			NUMBER	TYPE	BLOWS/FOOT		BLOWS / FOOT	P.S.F.	W _L	W _P	W		
487.6	Ground Level												
0.0	Surficial Material		1	SS	2								WL in open BH Jan. 27/72
	Soft		2	TW	PM	485							
	Peat (occasional fibrous)						+ 4						
	Grey-Brown		3	TW	PM	480	+ 3.5						
	Very Soft to Soft						+ 2						
475.6	Organic Silt		4	TW	PM	475							
	Grey-Brown					+ 5							
470.6	Very Soft to Soft					+ 4							
17.0	Sand with some silt and gravel.	5	SS	127	470							8 78 (14)	
467.5	Very Dense	6	SS	100/3"									
20.1	End of Borehole Hard Bottom				465								

NOTE:

② DEPTH OF SOFT MATERIAL OVER FIRM BOTTOM AS PER MATERIALS & TESTING (EASTERN REGION)

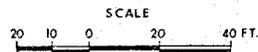


① UNDERFILL BLASTING PROCEDURE (FIRST STAGE)

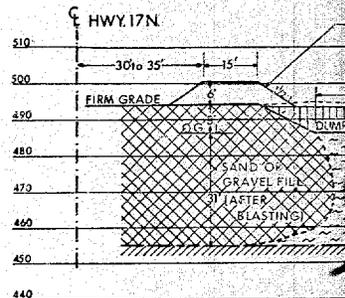


NOTE: RECOMMENDED SPACING BETWEEN THE CHARGES AS WELL AS THE QUANTITY OF DYNAMITE IN EACH CHARGE IS GIVEN IN TABLES V AND VI LOCATED IN APPENDIX II.

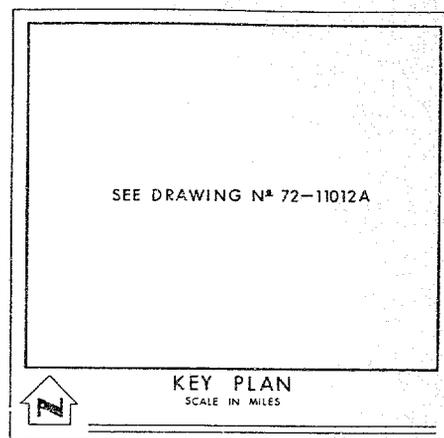
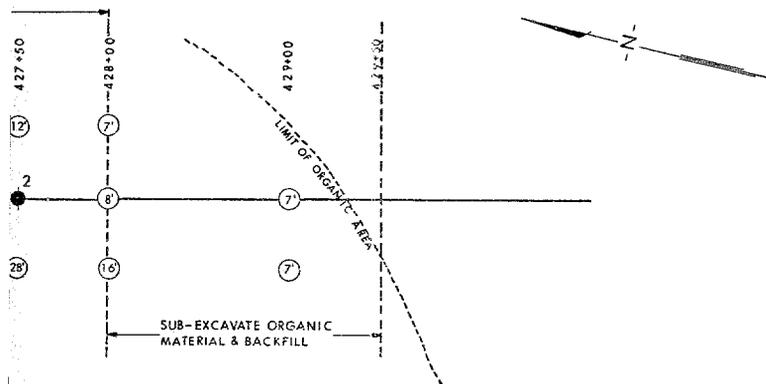
SECTION A-A



② RECOMMENDED BERM TEMPORARY SURCHARGE (TO BE PLACED FOLLOWING B)

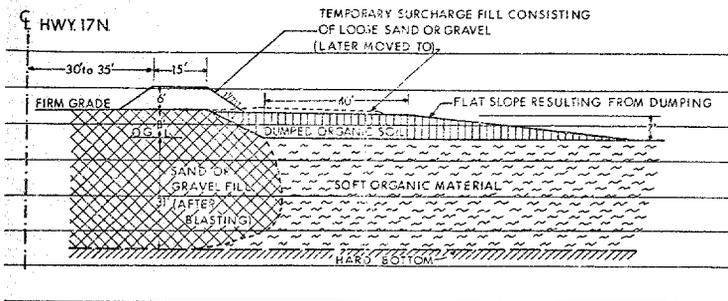


SECTION A-A



RECOMMENDED BERM AND TEMPORARY SURCHARGE

(TO BE PLACED FOLLOWING BLASTING OPERATION)



SECTION A-A

LEGEND

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

NO.	ELEVATION	STATION	OFFSET

— 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

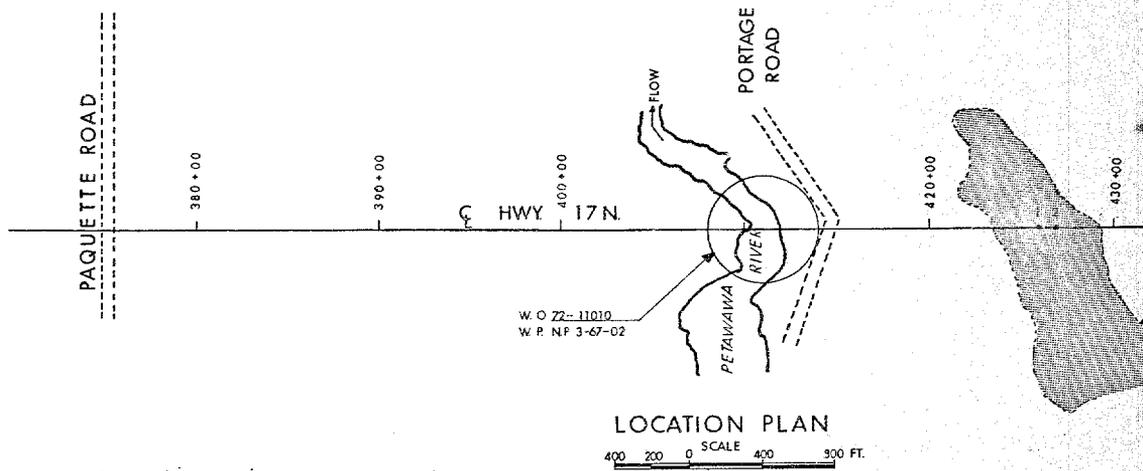
MINISTRY OF TRANSPORTATION & COMMUNICATIONS
DESIGN SERVICES BRANCH — FOUNDATIONS OFFICE

TREATMENT OF ORGANIC AREA
STA. 424+00 TO STA. 429+00

HIGHWAY NO. 17 N. _____ DIST. NO. 9
CO. RENFREW
TWP. PETAWAWA LOT _____ CON. _____

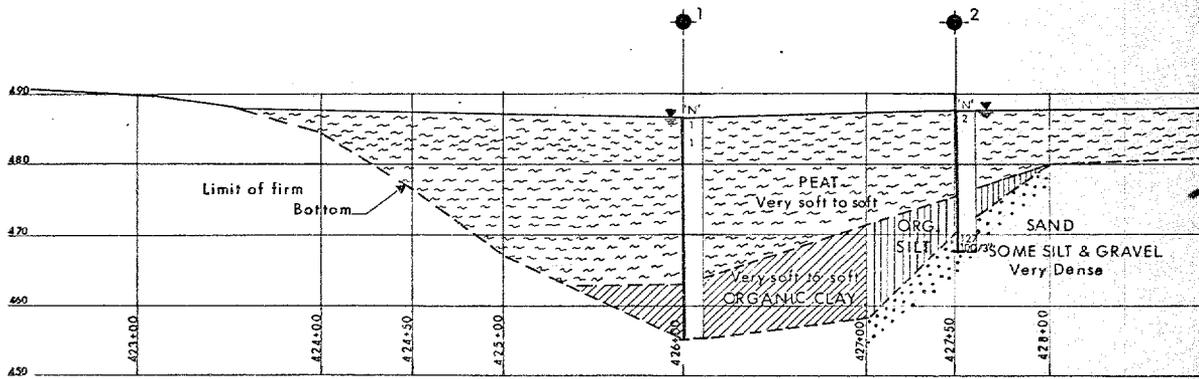
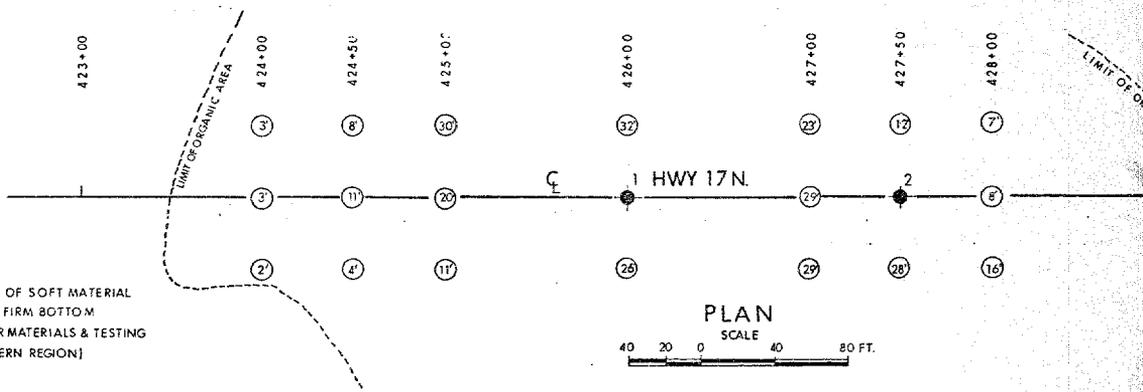
BORE HOLE LOCATIONS & SOIL STRATA

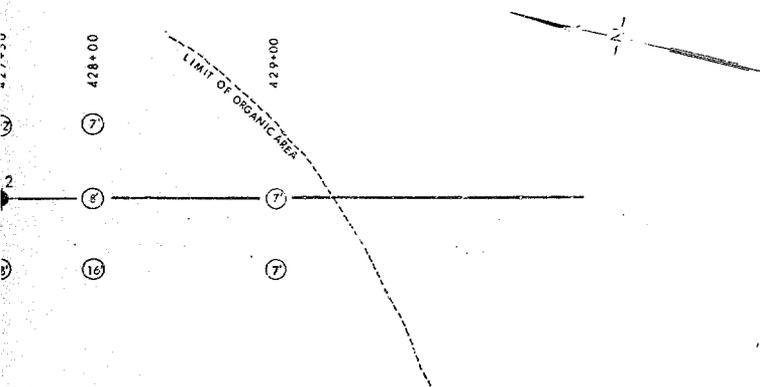
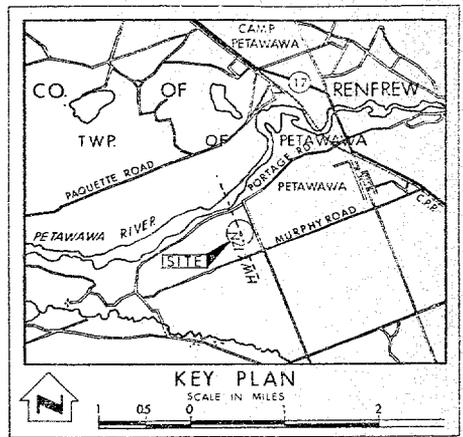
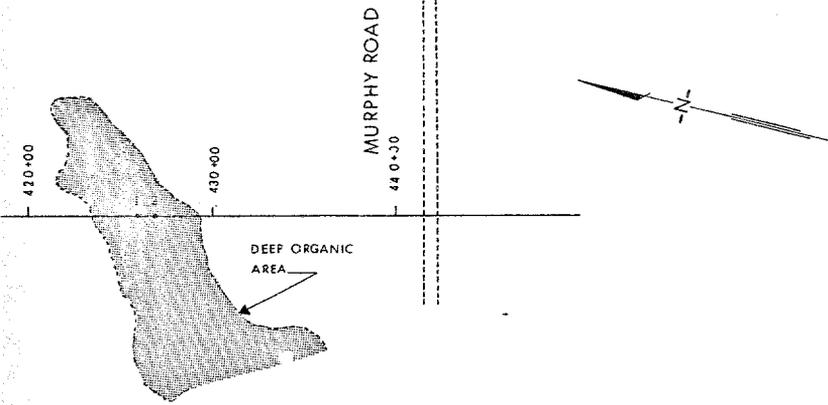
SUBMD. & T.D.	CHECKED <input checked="" type="checkbox"/>	W.P. NO. 3-67-01	DRAWING NO.
DRAWN F.L.	CHECKED <input checked="" type="checkbox"/>	JOB NO. 72-11012	72-11012B
DATE	AUGUST 10, 1972	SITE NO.	BRIDGE DRAWING NO.
APPROVED		CONT. NO.	
FRANCIS	ENGINEER		



NOTE:

② DEPTH OF SOFT MATERIAL
OVER FIRM BOTTOM
AS PER MATERIALS & TESTING
(EASTERN REGION)

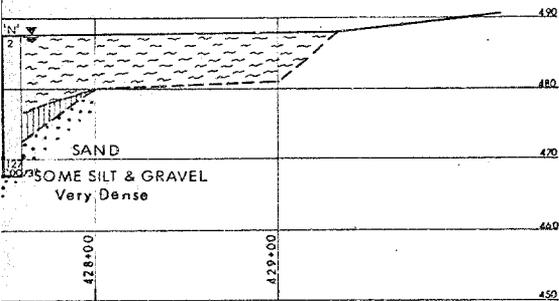




LEGEND			
	Bore Hole		
	Cone Penetration Test		
	Bore Hole & Cone Test		
	Water Levels established at time of field investigation, Jan 1972		
NO.	ELEVATION	STATION	OFFSET
1	486.5	426+00	4
2	487.6	427+50	4

— 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 & COMMUNICATIONS
DESIGN SERVICES BRANCH — FOUNDATIONS OFFICE

ORGANIC AREA
STA. 424+00 TO STA. 429+00

HIGHWAY NO. 17 N. DIST. NO. 9
CO. RENFREW
TWP. PETAWAWA LOT _____ CON _____

BORE HOLE LOCATIONS & SOIL STRATA

SUSHD B.T.D. CHECKED <input checked="" type="checkbox"/>	W.P. NO. 3-67-01	DRAWING NO.
DRAWN F.L. CHECKED <input checked="" type="checkbox"/>	JOB NO 72-11012	72-11012A
DATE JULY 12, 1972	SITE NO.	BRIDGE DRAWING NO.
APPROVED <i>[Signature]</i>	CONT. NO.	

FOUNDATION INVESTIGATION REPORT

For

Hwy. 17N, Organic Terrain, Sta. 424+00 to 429+00

W.P. 3-67-01

INTRODUCTION

This report contains results of a foundation investigation carried out at the following site:

W.P. 3-67-01

Organic terrain, Sta. 424+00 to 429+00

SITE DESCRIPTION AND GEOLOGY

The site is located approximately 1,500 ft. east of the Petawawa River, at a point about 1-1/2 miles south of existing Hwy. #17. The area is rather flat and low lying, with the ground surface ranging between elevations 485 and 490. The terrain is covered with light brush growth. The drainage is poor, this had led to the formation of a swamp. A shallow (2 to 3 feet deep) creek meanders across this area. The water in the creek is generally not more than 1 foot deep.

Physiographically, the area under investigation is located in the region known as the "Petawawa Sand Plain." The granular overburden deposits encountered here were primarily laid down in a delta built in the Champlain Sea by the Petawawa, Barron, Indian and Ottawa Rivers during the Fossmill stage of Lake Algonquin. In the vicinity of the area under investigation the sand and gravel deposits range from about 5 to 30 ft. in thickness. The surficial organic material has been superimposed on this deposit. The overburden is underlain by gneiss bedrock of Precambrian Age.

SUBSURFACE CONDITIONS

General

In this area the terrain is swampy. The depth of organic material ranges from 2 ft. to 32 ft. The organic deposits are underlain by the sand and

gravel deposits common to this region.

The boundaries of the various deposits, as determined in the boreholes, are shown on the Record of Borehole Sheets which are contained in the Appendix to this report. The locations and elevations are shown on Sheet No. 23A of the Contract Drawings. Estimated stratigraphical profiles and sections are shown also. A description of soil types encountered is as follows:

Organic Deposits

In this area the surficial deposit is composed of a dark brown fibrous peat. The thickness of the peat ranges from 2 ft., along the edges of the swamp, to as much as 24 ft. near the centre. The natural moisture content of the peat ranges from 550 to 936 percent, while the organic content varies from 72 to 80 percent by weight. The undrained shear strength of the peat as determined by in-situ vane tests ranges from 330 p.s.f., in the upper 5 to 7 ft., decreasing to as low as 95 p.s.f. with depth. Based on these results it is estimated that the consistency of the peat is soft, in the upper zone, decreasing to very soft, with depth.

Where the organic terrain is most extensive the peat is underlain by organic material of varying composition. In the middle for instance, the peat is followed by an 8 ft. thick deposit of very soft organic clay, half way between the edge and the centre while it is underlain by 5 ft. of very soft organic silt.

Lower Inorganic Deposit

In the central portion of the swamp, where the organic material is most extensive, the organics are directly underlain by firm bottom. Elsewhere, however, the organic material is underlain by the dense to very dense sand and gravel deposit common to this region.

Groundwater Level Conditions

Groundwater level observations were carried out during the period of the investigation in the open boreholes. The observations are presented on the Record of Borehole Sheets as well as on Contract Sheet No. 23A.

The results indicate that the groundwater level, across this poorly drained area, is at existing ground surface.

M. Devata

M. Devata, P. Eng.
Supervising Engineer



MD/bp
June, 1976

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS-ONTARIO
ENGINEERING SERVICES BRANCH-GEOTECHNICAL OFFICE-SOIL MECHANICS SECTION

RECORD OF BOREHOLE NO 1

WP 3-67-01 LOCATION Sta. 426 + 00 @ Hwy. 17N ORIGINATED BY WU
 DIST 9 HWY 17N BORING DATE January 25, 1972 COMPILED BY RRB
 DATUM Geodetic BOREHOLE TYPE Washboring, NX Casing CHECKED BY [Signature]

SOIL PROFILE		STRAT. PLOT	SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT w_l PLASTIC LIMIT w_p WATER CONTENT w			UNIT WEIGHT γ	REMARKS % GR SA SI CL
ELEV DEPTH	DESCRIPTION		NUMBER	TYPE	N' VALUES		20	40	60	80	100	w_p	w	w_l		
486.5	Ground Level															
0.0	Surficial Material Soft	[Wavy pattern]	1	SS	1									550		
			2	SS	1										808	79.5% Orgs.
	PEAT (occasionally fibrous)		3	TW	PM											
			4	TW	PM										925	72% Orgs.
	Dark Brown Very Soft to Soft		5	TW	PM										936	
463.0	Organic Clay Grey	[Diagonal hatching]	6	TW	PM											
23.5	Very Soft to Soft		7	TW	PM											
455.0	End of Borehole Hard Bottom															
31.5																

ENGINEERING SERVICES BRANCH-GEOTECHNICAL OFFICE-SOIL MECHANICS SECTION

RECORD OF BOREHOLE NO 2

WP 3-67-01 LOCATION Sta. 427 + 50 @ Hwy. 17N ORIGINATED BY WU
 DIST 9 HWY 17N BORING DATE January 27, 1972 COMPILED BY RRB
 DATUM Geodetic BOREHOLE TYPE Washboring NX & BX CHECKED BY [Signature]

SOIL PROFILE			SAMPLES			ELEV GROUND WATER	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT — w_L PLASTIC LIMIT — w_p WATER CONTENT — w			UNIT WEIGHT γ	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		20	40	60	80	100	w_p	w	w_L		
487.6	Ground Level															
0.0	Surficial Material Soft		1	SS	2											
	PEAT (occasional fibrous) Grey-Brown		2	TW	PM											
475.6	Very Soft to Soft		3	TW	PM	480										
12.0	Organic Silt Grey-Brown		4	TW	PM											
470.6	Very Soft to Soft															
17.0	Sand with some silt &		5	SS	127	470										
467.5	gravel. Very Dense														8 78 (14)	
20.1	End of Borehole Hard Bottom		6	SS	100, 3"											
						460										

DESIGN SERVICES BRANCH

FOUNDATIONS OFFICE

RECORD OF BOREHOLE - SITE NO 1

JOB 71-11056

LOCATION Hwy. 17 - Petawawa Airport Line 'A'

ORIGINATED BY AED

W.P. 3-67-01

BORING DATE June 18, 21, 22, 23, 1971

COMPILED BY BTB

DATUM Geodetic

BOREHOLE TYPE Washboring, BX Casing

CHECKED BY 

SOIL PROFILE		SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT	LIQUID LIMIT W_L PLASTIC LIMIT W_P WATER CONTENT W	SHEAR STRENGTH P.S.F. ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE	WATER CONTENT % W_P W W_L 20 40 60	BULK DENSITY γ P.C.F.	REMARKS	
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE								BLOWS/FOOT
500.7	Ground Level		1	SS	8							
	Topsoil		2	SS	19							
1.0	Sand (medium to fine) trace of gravel.		3	SS	28							
			4	SS	26							6.92 (2)
			5	SS	35							
			6	SS	51							
			7	SS	42							
			8	SS	32							
			9	SS	43							
			10	SS	96							
			11	SS	43							
			12	SS	69							
			13	SS	81							
			14	SS	109							
			15	SS	61							
			16	SS	44							
			17	SS	38							
			18	Wash	-							
			19	SS	48							
			20	SS	65							
			Compact to Very Dense									
400.7												
100.0	Silty sand		21	SS	54							
	Very Dense										0.71 27 2	

Continued

20
15 ϕ 5 % STRAIN AT FAILURE
10

OFFICE REPORT ON SOIL EXPLORATION

DESIGN SERVICES BRANCH

FOUNDATIONS OFFICE

RECORD OF BOREHOLE - SITE No 1 Cont.

JOB 71-11056 LOCATION Hwy. 17 - Petawawa Airport Line 'A' ORIGINATED BY AED
 W.P. 3-67-01 BORING DATE June 18, 21, 22, 23, 1971 COMPILED BY BTD
 DATUM Geodetic BOREHOLE TYPE Washboring, BX Casing CHECKED BY [Signature]

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT	LIQUID LIMIT W_L PLASTIC LIMIT W_P WATER CONTENT W W_p — W — W_L	WATER CONTENT % 20 40 60	BULK DENSITY γ P.C.F.	REMARKS GR.SA.SI.CL.
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS/FOOT						
387.2	Silty sand. Very Dense	[Strat. Plot]	22	SS	74	390					
113.5	End of Borehole					380					

OFFICE REPORT ON SOIL EXPLORATION

DESIGN SERVICES BRANCH

FOUNDATIONS OFFICE

RECORD OF BOREHOLE - SITE NO 2

JOB 71-1.056

LOCATION Paquette Rd. @ Camp Petawawa Line 'A'

ORIGINATED BY AED

W.P. 3-67-01

BORING DATE June 12 & 14, 1971

COMPILED BY HT

DATUM Geodetic

BOREHOLE TYPE NX, BX Casing, BX, AXT Rock Core

CHECKED BY [Signature]

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT					LIQUID LIMIT W_L PLASTIC LIMIT W_P WATER CONTENT W			BULK DENSITY γ	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS/FOOT		SHEAR STRENGTH P.S.F.					WATER CONTENT %				
						○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE 400 800 1200 1600 2000					W_P W W_L 20 40 60			P.C.F.	GR.SA.SI.CL.	
464.2	Ground Level		1	SS	11											
0.0	Sand (medium to fine)		2	SS	13	460										
			3	SS	17											
	Compact to Dense		4	SS	35										1 96 (3)	
451.6			5	SS	11											
12.6	Irregularly layered silt, sand and clayey silt.		6	TW	105	450										
			7	SS	15											
			8	TW	PM					2520					129 0 23 58 19	
			9	SS	7	440									440.6 June 15/71	
	Loose to Compact or Stiff to Very Stiff		10	SS	26											
			11	SS	9	430										
			12	SS	24										0 37 58 5	
			13	SS	9	420										
			14	TW	PM											
409.7			15	BX	90%	410										
54.5	Gneiss Bedrock		16	RC AXT	87%											
			17	RC AXT	99%											
398.7	Sound					400										
65.5	End of Borehole															
						390										

OFFICE REPORT ON SOIL EXPLORATION

DESIGN SERVICES BRANCH

FOUNDATIONS OFFICE

RECORD OF BOREHOLE NO 1-SITE NO 3

JOB 71-11056

LOCATION Petawawa River - West Bank Line 'A'

ORIGINATED BY AED

W.P. 3-67-01

BORING DATE June 23 - 25, 1971

COMPILED BY HT

DATUM Geodetic

BOREHOLE TYPE NX, BX, AXT Casing, AXT, BX Rock Core

CHECKED BY [Signature]

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT	LIQUID LIMIT —WL PLASTIC LIMIT —WP WATER CONTENT —w Wp — w — WL	BULK DENSITY Y	REMARKS	
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS/FOOT						
480.5	Ground Level										
0.0	Sand and gravel (numerous 6" to 10" boulders throughout)	[Strat. Plot]	1	SS	48	480					
			1A	BX	52%						
			2	SS	10						
			3	SS	13		470				82 17 (1)
			4	SS	28						
			5	SS	124		460				
			6	SS	19						
			7	SS	97 7/8"		450				447.6 June 28/71
			7A	RC BX	14%						
			8	SS	99		440				44 48 (8)
			8A	BX	30%						
	9	SS	65 7/8"								
	10	SS BX	40%								
429.0	Fractured Sound Biotite Gneiss Bedrock	[Strat. Plot]	11	SS	60 1/2"	430					
51.5			12	AXT	83%						
			13	AXT	80%		420				
415.5			14	AXT	99%						
65.0	End of Borehole					410					

OFFICE REPORT ON SOIL EXPLORATION

DESIGN SERVICES BRANCH

FOUNDATIONS OFFICE

RECORD OF BOREHOLE NO 2 - SITE NO 3

JOB 71-11056 LOCATION Portage Road River Crossing Line 'A' ORIGINATED BY AED
 W.P. 3-67-01 BORING DATE June 21, 22, 1971 COMPILED BY HT
 DATUM Geodetic BOREHOLE TYPE NX, EX Casing CHECKED BY [Signature]

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT	LIQUID LIMIT W_L PLASTIC LIMIT W_P WATER CONTENT W W_P — W — W_L WATER CONTENT % 20 40 60	BULK DENSITY γ P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS/FOOT					
1180.2	Ground Level									
0.0	Sand and gravel, Trace of silt, clay with numerous boulders		1	SS	51	480				477.3 June 22/71 27 60 (13)
			2	SS	79					
468.7	Very Dense		3	SS	65	470				
11.5	Fractured		4	EX	75%					
	Biotite Gneiss Bedrock		5	EX	85%	460				
456.1	Sound		6	EX	80%					
24.1	End of Borehole					450				

OFFICE REPORT ON SOIL EXPLORATION

DESIGN SERVICES BRANCH

FOUNDATIONS OFFICE

RECORD OF BOREHOLE NO 3 - SITE NO 3

JOB 71-11056

LOCATION Top W. Bank Petawawa River at Portage Rd. Line 'A'

ORIGINATED BY AED

W.P. 3-67-01

BORING DATE June 16 & 17, 1971

COMPILED BY HT

DATUM Geodetic

BOREHOLE TYPE AX, BX Casing; BX Rock Core

CHECKED BY *[Signature]*

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE			LIQUID LIMIT			BULK DENSITY	REMARKS	
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS/FOOT		BLOWS / FOOT	PLASTIC LIMIT	WATER CONTENT	W _p	W	W _L			WATER CONTENT %
164.5	Ground Level														
0.0	Sand and gravel (numerous 6" to 8" boulders throughout) Compact to Very Dense	<i>[Strat. Plot]</i>	1	SS	52										
			2	SS	14	460									
			3	SS	54										
			3A	BX	33%										
			4	SS	21	450									
			5	SS	30										
140.5	Biotite Gneiss Bedrock Fractured	<i>[Strat. Plot]</i>	6	SS	103	440									
24.0			7	AXT	79%										
			8	AXT	38%	430									
			9	AXT	28%										
124.5															
10.0	End of Borehole					420									

OFFICE REPORT ON SOIL EXPLORATION

56 h1 (3)
▼ 450.1
June 17/71

DESIGN SERVICES BRANCH

FOUNDATIONS OFFICE

RECORD OF BOREHOLE NO 1- SITE NO 4

JOB 71-11056

LOCATION Top W. Bank Petawawa River at Portage Rd. Line 'B'

ORIGINATED BY AED

W.P. 3-67-01

BORING DATE June 15, 1971

COMPILED BY HT

DATUM Geodetic

BOREHOLE TYPE NX, BX Casing, RX Rock Core

CHECKED BY

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE			LIQUID LIMIT			BULK DENSITY	REMARKS	
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS/FOOT		BLOWS / FOOT	SHEAR STRENGTH P.S.F.		W _L	W _P	W			W _L
							○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE		WATER CONTENT % W _P — W — W _L 20 40 60						
458.8	Ground Level														
0.0	Sand and gravel (numerous 7" to 10" boulders)		1	SS	16	450								Hole caved June 16/71	
448.3	Compact to Very Dense		2	SS	114										55 32 (13)
10.5	Biotite Gneiss Bedrock		3	BX	29%										
			4	SS	80%										
			5	BX	88%										
			6	BX	87%										
			7	BX	81%										
			8	BX	99%		440								
			9	BX	99%										
438.0	Sound														
20.8	End of Borehole					430									

OFFICE REPORT ON SOIL EXPLORATION

DESIGN SERVICES BRANCH

FOUNDATIONS OFFICE

RECORD OF BOREHOLE NO 2- SITE NO 4

JOB 71-11056 LOCATION Portage Rd. Line 'B' ORIGINATED BY AED
 W.P. 3-67-01 BORING DATE June 17, 1971 COMPILED BY HT
 DATUM Geodetic BOREHOLE TYPE NX, BX Casing CHECKED BY [Signature]

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT			LIQUID LIMIT W_L PLASTIC LIMIT W_P WATER CONTENT W			BULK DENSITY γ P.C.F.	REMARKS GR. SA. SI. CL.
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS/FOOT		SHEAR STRENGTH P.S.F. ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE			WATER CONTENT % W_P W W_L 20 40 60				
178.8	Ground Level													
0.0	Sand and gravel (numerous 6" to 8" boulders throughout)		1	SS	72	470								26 56 (18) ▼ 468.3 June 21/71
			2	SS	103									
			3	SS	88									
165.8			Very Dense	4	SS		63							
13.0	Biotite Gneiss Bedrock		5	BX	97%	460								
154.8			Sound	6	BX		96%							
24.0	End of Borehole					450								

OFFICE REPORT ON SOIL EXPLORATION

DESIGN SERVICES BRANCH

FOUNDATIONS OFFICE

RECORD OF BOREHOLE - SITE NO 5

JOB 71-11056

LOCATION County Rd. 17 Line 'A'

ORIGINATED BY AED

W.P. 3-67-01

BORING DATE June 11, 1971

COMPILED BY HT

DATUM Geodetic

BOREHOLE TYPE NX Casing

CHECKED BY [Signature]

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT	LIQUID LIMIT W_L PLASTIC LIMIT W_P WATER CONTENT W	BULK DENSITY γ	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS/FOOT					
440.7	Ground Level									
1.0	Topsoil		1	SS	5					
	Clay to silty clay		2	TW	PM					
	Grey		3	TW	PM					
	Very Stiff		4	TW	PM					
443.7			5	TW	PM					
17.0	Het. mix. of sand, silt & gravel, trace of clay (Glacial Till)		6	TW	PM					
	Dense		7	SS	32					
435.7	Bouldery Zone (boulders up to 6" in size)		8	EX	40%					
25.0	Granite Gneiss Bedrock		9	EX	95%					
428.7	Sound		10	EX	100%					
32.0	End of Borehole									

OFFICE REPORT ON SOIL EXPLORATION

DESIGN SERVICES BRANCH

FOUNDATIONS OFFICE

RECORD OF BOREHOLE - SITE NO 6

JOB 71-11056

LOCATION Baelstadt Rd. Line 'A'

ORIGINATED BY AED

W.P. 3-67-01

BORING DATE June 24, 25 & 26, 1971

COMPILED BY HT

DATUM Geodetic

BOREHOLE TYPE NX, BX Casing

CHECKED BY [Signature]

SOIL PROFILE		SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE				LIQUID LIMIT — W _L			BULK DENSITY	REMARKS	
ELEV. DEPTH	DESCRIPTION	NUMBER	TYPE	BLOWS/FOOT		BLOWS / FOOT				PLASTIC LIMIT — W _p					
					SHEAR STRENGTH P.S.F.				WATER CONTENT — W						
					○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL X LAB VANE 400 800 1200 1600 2000				W _p — W — W _L WATER CONTENT % 20 40 60			P.C.F.	GR. SA. SI. CL.		
484.0	Ground Level														
0.0	Sand, trace of silt and gravel	1	SS	9											
		2	SS	30	480										
		3	SS	30											
		4	SS	23											
		5	SS	19	470										
		6	SS	15											
		7	SS	24	460										
		8	SS	20											
		9	SS	33	450										
		10	SS	20											
		11	SS	14	440										
		12	SS	12											
		13	SS	16	430										
		Loose to Dense	14	SS	27										
419.0	Sandy silt with some clay (thin seams) and some gravel	15	SS	40	420									0 92 (8)	
65.0		16	SS	66										0 26 72 2	
		17	SS	16	410										3 25 53 19
		18	SS	16	400										
	Glacial Till	19	SS	31											
	Compact to Very Dense	20	SS	31	390										
		21	SS	31	380										

OFFICE REPORT ON SOIL EXPLORATION

Continued

20
15-5 % STRAIN AT FAILURE
10

DESIGN SERVICES BRANCH

RECORD OF BOREHOLE - SITE NO 7

FOUNDATIONS OFFICE

JOB 71-11056

LOCATION County Rd. 26 Line 'A'

ORIGINATED BY AED

W.P. 3-67-01

BORING DATE June 16 & 17, 1971

COMPILED BY HT

DATUM Geodetic

BOREHOLE TYPE AX, BX, NX Casing: AXT Rock Core

CHECKED BY [Signature]

SOIL PROFILE		SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT					LIQUID LIMIT — W _L PLASTIC LIMIT — W _P WATER CONTENT — W			BULK DENSITY γ	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE		BLOWS/FOOT	SHEAR STRENGTH P.S.F.					WATER CONTENT %			
						○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE					W _P — W — W _L 20 40 60				
523.2	Ground Level														
0.0	Sand, trace of clay, silt and gravel. Loose to Very Dense	[Strat. Plot]	1	SS	21	520									520.9 June 18/71 8 81 (11) 4 19 55 22
			2	SS	72										
			3	SS	59										
			4	SS	31										
			5	SS	8										
511.2	Silty clay, some sand, trace of gravel. Firm to Stiff	[Strat. Plot]	6	SS	3	510									
12.0															
506.2	Granite Gneiss Bedrock (Biotite Layers)	[Strat. Plot]	7	AXT	100%	500									
17.0			8	AXT	100%										
			9	AXT	100%										
495.2	Sound														
28.0	End of Borehole					490									

OFFICE REPORT ON SOIL EXPLORATION

DESIGN SERVICES BRANCH

FOUNDATIONS OFFICE

RECORD OF BOREHOLE NO 1 - SITE NO 8

JOB 71-11056 LOCATION North Side Alice-Petawawa Twp. Boundary Rd., Line 'A'
 W.P. 3-67-01 BORING DATE June 29, 1971 ORIGINATED BY VK
 DATUM Geodetic BOREHOLE TYPE Wash & bore with NX & BX Casing COMPILED BY VK
 CHECKED BY *[Signature]*

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT	LIQUID LIMIT —WL PLASTIC LIMIT —Wp WATER CONTENT —w Wp — W — WL WATER CONTENT % 20 40 60	BULK DENSITY Y	REMARKS	
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS/FOOT						
487.4	Ground Level										
1.5	Silt with sand and trace of clay.		1	SS	11						
			2	SS	27						
			3	SS	34						
478.4	Compact to Dense		4	SS	34	480					
9.0	Clay to silty clay.		5	TW	PM						
			6	TW	PM		• x +20 + 8			103	
			7	TW	PM	470	+ 44 + 12				
			8	SS	-		+ 34				
	Grey		9	TW	PM	460	+ 24 x •			103.5	
	Firm to Stiff		10	SS	-		+ 28 +				
450.4	Granite Gneiss Bedrock					450	+ 44				
37.0			11	BX RC	100%						
	Sound		12	BX RC	100%						
437.4						440					
50.0	End of Borehole					430					

OFFICE REPORT ON SOIL EXPLORATION

P.C.F. (GR SA SI CL)
 481.9
 Jul. 8/71
 0 37 (63)
 eo=2.12
 Pc=1.45tsf
 Cc=1.30

DESIGN SERVICES BRANCH

FOUNDATIONS OFFICE

RECORD OF BOREHOLE NO 2-SITE NO 8

JOB 71-11056

LOCATION South Side Alice-Petawawa Twp. Boundary Rd. Line 'A'

ORIGINATED BY VK

W.P. 3-67-01

BORING DATE June 28, 1971

COMPILED BY ECP

DATUM Geodetic

BOREHOLE TYPE Wash and bore with NX Casing

CHECKED BY [Signature]

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT	LIQUID LIMIT W_L PLASTIC LIMIT W_p WATER CONTENT w $W_p \quad w \quad W_L$	BULK DENSITY γ	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS/FOOT					
487.4	Ground Level									
0.0	Sandy silt with trace of clay.		1	SS	42					
			2	SS	26					
			3	SS	26					
			4	SS	5					
471.4	Loose to Dense									
16.0	Clay to silty clay. Grey		5	TW	PM				103	0 27 49 24 Pc=2.3tsf Cc=1.91 eo=1.822
465.6	Firm to Stiff									
21.8	Het. mix. sand, gravel, silt, clay (Glec. fill) dense		6	SS	38					
462.7										
24.7	Granite Gneiss Bedrock		7	AXT	100%					
457.9	Sound									
29.5	End of Borehole									

OFFICE REPORT ON SOIL EXPLORATION

DESIGN SERVICES BRANCH

FOUNDATIONS OFFICE

RECORD OF BOREHOLE - SITE NO 10

JOB 71-11056

LOCATION Hwy. 62 Line 'A'

ORIGINATED BY VK

W.P. 3-67-01

BORING DATE July 2, 1971

COMPILED BY ECB

DATUM Geodetic

BOREHOLE TYPE Wash & Bore with NX & BX Casing

CHECKED BY *[Signature]*

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT	LIQUID LIMIT W_L PLASTIC LIMIT W_p WATER CONTENT w $W_p \quad w \quad W_L$	BULK DENSITY γ	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS/FOOT					
469.5	Ground Level									
0.0	Sand, trace of gravel									
466.5	(Roadway Fill)									
3.0	Clayey silt to silty clay. Grey Very Stiff		1	SS	19	460				July 8/71 462.5 0 12 63 25
			2	SS	17					
			3	TW	PM					
			4	TW	PM					
			5	SS	8					
450.0	Het. mix. of silt, sand & gravel, some clay (Glacial Till) (boulders up to 12" in size throughout)		6	SS	57	450				0 9 70 21
19.5			7	SS	63/0"					
			8	SS	92					
439.0	Granite Bedrock		9	RC AXT	71%	430				19 59 20 2
30.5			10	RC AXT	100%					
426.6	Sound					420				
42.9	End of Borehole									

OFFICE REPORT ON SOIL EXPLORATION

DESIGN SERVICES BRANCH

FOUNDATIONS OFFICE

RECORD OF BOREHOLE - SITE NO 11

JOB 71-11056

LOCATION C.N.R. - East of Co. Rd. #15 Line 'A'

ORIGINATED BY VK

W.P. 3-67-01

BORING DATE July 8, 1971

COMPILED BY EGB

DATUM Geodetic

BOREHOLE TYPE Wash & Bore with NX & BX Casing

CHECKED BY *[Signature]*

SOIL PROFILE		SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT				LIQUID LIMIT w_L PLASTIC LIMIT w_p WATER CONTENT w			BULK DENSITY γ	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE		BLOWS/FOOT	SHEAR STRENGTH P.S.F.				WATER CONTENT %			
						○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE 400 800 1200 1600 2000				w_p w w_L 20 40 60			P.C.F.	GR. SA. SI. CL.
468.4	Ground Level													
466.4	Topsoil		1	SS	17									
2.0	some sand		2	SS	11									
	Clayey silt to silty clay, trace of sand.		3	TW	PM									
			4	TW	PM									
			5	TW	PM									
			6	TW	PM									
			7	TW	PM									
	Grey		8	TW	PM									
	Firm to Very Stiff		8	TW	PM									
438.4														
30.0	Het. mix. sand & gravel with silt & clay (boulders up to 2.5' in size throughout) (Glacial Till)		8A	BX	84%									
	Dense to Very Dense		9	SS	37									
425.6														
42.8	Granite Gneiss Bedrock		11	BX	100%									
	Sound		12	BX	70%									
414.2														
54.2	End of Borehole													

OFFICE REPORT ON SOIL EXPLORATION

DESIGN SERVICES BRANCH

FOUNDATIONS OFFICE

RECORD OF BOREHOLE - SITE NO 12

JOB 71-11056 LOCATION Co. Rd. #15 Line 'A' ORIGINATED BY VK
 W.P. 3-67-01 BORING DATE June 30, 1971 COMPILED BY ECB
 DATUM Geodetic BOREHOLE TYPE Wash & Bore with NX & BX Casing CHECKED BY [Signature]

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT	LIQUID LIMIT W_L PLASTIC LIMIT W_P WATER CONTENT W $W_P \quad W \quad W_L$	BULK DENSITY γ	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS/FOOT					
488.7	Ground Level									
0.0	Topsoil		1	SS	11					
1.5	Sand, gravel, silt, clay (with boulders up to 10" throughout) (Glacial Till)	[Strat. Plot]	2	SS	24					487.7 July 1/71
			3	SS	32					
477.5			Compact to Dense	4	AXT	38%	480			
11.2	fractured	[Strat. Plot]	5	AXT	94%	470				
	Granite Gneiss Bedrock		6	AXT	100%					
467.2	Sound									
21.5	End of Borehole					460				

OFFICE REPORT ON SOIL EXPLORATION

DESIGN SERVICES BRANCH

FOUNDATIONS OFFICE

RECORD OF BOREHOLE - SITE No 13

JOB 71-11056 LOCATION Biesenthal Rd. - Line 'A' ORIGINATED BY VK
 W.P. 3-67-01 BORING DATE June 29, 1971 COMPILED BY ECB
 DATUM Geodetic BOREHOLE TYPE Wash & Bore with NX & BX Casing CHECKED BY _____

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT	LIQUID LIMIT W_L PLASTIC LIMIT W_p WATER CONTENT w $W_p \quad w \quad W_L$	BULK DENSITY γ	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS/FOOT					
473.3	Ground Level									
0.0	Topsoil		1	SS	6					
469.3	Clayey silt with some sand - Stiff		2	SS	14	470				
4.0	Clay to silty clay		3	TW	PM					
462.7	Grey Firm to Very Stiff		4	TW	PM		10 7			
10.6	Granite Gneiss		5	AXT	100%	460				
457.5	Bedrock Sound									
15.8	End of Borehole					450				

OFFICE REPORT ON SOIL EXPLORATION

DESIGN SERVICES BRANCH

FOUNDATIONS OFFICE

RECORD OF BOREHOLE - SITE NO 15

JOB 71-11056
 W.P. 3-67-01
 DATUM Geodetic

LOCATION Black Bay Rd. Line 'A'
 BORING DATE July 2, 1971
 BOREHOLE TYPE Wash & Bore with BX & NX Casing

ORIGINATED BY VK
 COMPILED BY ECB
 CHECKED BY *[Signature]*

SOIL PROFILE		SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT					LIQUID LIMIT W_L PLASTIC LIMIT W_P WATER CONTENT W			BULK DENSITY γ	REMARKS	
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE		BLOWS/FOOT	SHEAR STRENGTH P.S.F.					WATER CONTENT %				
						○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE 400 800 1200 1600 2000					W_P — W — W_L 20 40 60					
531.5	Ground Level															
0.0	Silty sand to sandy silt, with a trace to some gravel.		1	SS	25											
	Compact to Very Dense		2	SS	40											
			3	SS	85											
			4	SS	136											
			5	SS	52											
506.5			6	SS	133											
25.0	Het. mix. of sand, silt and some gravel (Glacial Till)		7	TW	PM											
	(boulders up to 12" in size throughout)		8	SS	120											
			8A	AXT	30%											
			9	SS	43											
			10	SS	21											
			10A	EX	55%											
			11	SS	120.7"											
			12	SS	150.7"											
			13	EX	100%											
			13A	SS	120.7"											
	14	SS	174.6"													
461.3			15	SS	150.2"											
70.2	Biotite Gneiss Bedrock (some weathering.)		16	EX	72%											
456.2	Sound															
75.3	End of Borehole															

OFFICE REPORT ON SOIL EXPLORATION

DESIGN SERVICES BRANCH

FOUNDATIONS OFFICE

RECORD OF BOREHOLE - SITE NO 16

JOB 71-11056

LOCATION Murray Rd. - Petawawa Line 'A'

ORIGINATED BY VK

W.P. 3-67-01

BORING DATE June 29, 1971

COMPILED BY ECB

DATUM Geodetic

BOREHOLE TYPE Wash & Bore with NX & BX Casing

CHECKED BY [Signature]

SOIL PROFILE			SAMPLES			DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT					LIQUID LIMIT W_L PLASTIC LIMIT W_P WATER CONTENT W			BULK DENSITY γ	REMARKS	
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS/FOOT	ELEV. SCALE	SHEAR STRENGTH P.S.F.					WATER CONTENT %				
							O UNCONFINED + FIELD VANE ● QUICK TRIAXIAL X LAB VANE					W_p — W — W_L 20 40 60			P.C.F.	GR. SA. SI. CL.
512.0	Ground Level															
0.0	Sand, some gravel, trace of silt.	[Dotted Pattern]	1	SS	24	450									No W.L. on June 30/71	
			2	SS	28	460										8 85 (7)
			3	SS	35	470										
			4	SS	48	480										
			5	SS	58	490										25 67 (8)
492.0	Compact to Very Dense															
20.0	Silty clay with some sand.	[Diagonal Hatching]	6	TW	PM	490										
			7	TW	PM	485										
			8	TW	PM	480										108
			9	TW	PM	475										
			10	TW	PM	470										109
			11	TW	PM	465										
			12	TW	PM	460										
457.0	Stiff to Very Stiff															
55.0	Sand, silt, clay, gravel		13	SS	110	450									2 52 31 15	
155.0	(Glac. Till). V. Dense															
57.0	Biotite Gneiss		14	AXT	90%	450										
451.6	Bedrock. Sound															
60.4	End of Borehole					450										

OFFICE REPORT ON SOIL EXPLORATION

DESIGN SERVICES BRANCH

FOUNDATIONS OFFICE

RECORD OF BOREHOLE - SITE No 17

JOB 71-11056
 W.P. 3-67-01
 DATUM Geodetic

LOCATION County Rd.#17 & Hales Cre.
 BORING DATE July 7, 1971
 BOREHOLE TYPE Wash & Bore with NX & BX Casing

ORIGINATED BY VK
 COMPILED BY ECB
 CHECKED BY [Signature]

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT	LIQUID LIMIT W_L PLASTIC LIMIT W_P WATER CONTENT W $W_p \quad W \quad W_L$ WATER CONTENT %	BULK DENSITY γ	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS/FOOT					
390.8	Ground Level									
0.0	Clayey silt with some sand.		1	SS	7	390				
387.8	Stiff									
3.0	Grav. with sand (boulder)		2	SS	11.75"					▼ 387.5
3.3	Granite Gneiss Bedrock		3	BX	100%					July 8/71
			4	BX	100%	380				
377.0	Sound									
13.8	End of Borehole					370				

OFFICE REPORT ON SOIL EXPLORATION

DESIGN SERVICES BRANCH

FOUNDATIONS OFFICE

RECORD OF BOREHOLE NO 1-SITE NO 18

JOB 71-11056

LOCATION Petawawa River - East Bank Line 'C'

ORIGINATED BY VK

W.P. 3-67-01

BORING DATE Sept. 15, 1971

COMPILED BY ECB

DATUM Geodetic

BOREHOLE TYPE Wash & Bore with NX & BX Casing

CHECKED BY *[Signature]*

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT	LIQUID LIMIT w_L PLASTIC LIMIT w_p WATER CONTENT w	BULK DENSITY γ	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS/FOOT					
471.4	Ground Level									
0.0	Sand and Gravel		1	SS	100	3" 470				
			2	SS	199					
458.4	Very Dense		3	SS	150	460				
13.0	Silty clay with trace of sand & gravel.		4	SS	4		+ 8		105	
			5	TW	PM					
446.4	Firm to Stiff		6	TW	PM	450	+ 5.5		102	
25.0	Glac. Till. Very Dense		7	SS	90					
26.3	Sand (boulders up to 10" in size throughout)		8	AXT	23%					
439.4	Very Dense		9	AXT	17%	440				
32.0	End of Borehole					430				

▼ 461.9
Sept. 30/71

OFFICE REPORT ON SOIL EXPLORATION

DESIGN SERVICES BRANCH

FOUNDATIONS OFFICE

RECORD OF BOREHOLE NO 2 - SITE NO 18

JOB 71-11056 LOCATION Petawawa River - West Bank Line 'C' ORIGINATED BY VK
 W.P. 3-67-01 BORING DATE Sept. 21, 1971 COMPILED BY ECB
 DATUM Geodetic BOREHOLE TYPE Wash & Bore with BX Casing CHECKED BY [Signature]

SOIL PROFILE		SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT	LIQUID LIMIT W_L PLASTIC LIMIT W_P WATER CONTENT W W_P — W — W_L WATER CONTENT %	BULK DENSITY γ	REMARKS	
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE						BLOWS / FOOT
456.2	Ground Level									
0.0	Sand and Gravel (boulders up to 10" in size throughout)		1	SS	100%	450				
			2	SS	100%					
	Very Dense		3	SS	100%					
441.7	Fine Sand Layers									
44.5	Granite Bedrock (biotite gneiss inclusions)		4	AXT	93%	440				
	Sound		5	AXT	95%					
431.7										
24.5	End of Borehole					430				

OFFICE REPORT ON SOIL EXPLORATION

DESIGN SERVICES BRANCH

FOUNDATIONS OFFICE

RECORD OF BOREHOLE NO 4-SITE NO 18

JOB 71-11056

LOCATION Petawawa River Line 'C'

ORIGINATED BY VK

W.P. 3-67-01

BORING DATE Sept. 2, 1971

COMPILED BY EGB

DATUM Geodetic

BOREHOLE TYPE Wash & Bore with NX & BX Casing

CHECKED BY [Signature]

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT					LIQUID LIMIT — W _L PLASTIC LIMIT — W _P WATER CONTENT — W			BULK DENSITY Y P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS/FOOT		SHEAR STRENGTH P.S.F.					W _p	W	W _L		
467.2	Ground Level															
0.0	Sand & gravel to gravelly sand (occasional boulders throughout)	0.0	1	SS	125	460										
	Compact to Very Dense	0.0	2	SS	20										33 61 (6)	
453.2		0.0														
14.0	Silty clay, trace of sand.	0.0	3	TW	PM	450									114	
		0.0	4	TW	PM											
		0.0	5	TW	PM	440										
437.2	Firm to Stiff	0.0														
30.0	Silty sand.	0.0	6	SS	23											
431.2	Compact	0.0														
36.0	Clayey silt with some sand & gravel (Glacial Till)	0.0	7	SS	6	430									A- 0 81 (19) B- 0 17 60 23	
		0.0	8	SS	45											
420.7	Firm to Hard	0.0				420										
46.5	Granite Bedrock	0.0														
415.7	Sound	0.0	9	AXT	100%											
51.5	End of Borehole	0.0				410										

OFFICE REPORT ON SOIL EXPLORATION

DESIGN SERVICES BRANCH

FOUNDATIONS OFFICE

RECORD OF BOREHOLE - SITE NO 19

JOB 71-11056 LOCATION Murphy Rd. Line 'C' ORIGINATED BY VK
 W.P. 3-67-01 BORING DATE Sept. 28, 1971 COMPILED BY ECB
 DATUM Geodetic BOREHOLE TYPE Wash & Bore with NX & BX Casing CHECKED BY [Signature]

ELEV. DEPTH	SO. PROFILE DESCRIPTION	STRAT. PLOT	SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT	LIQUID LIMIT —WL PLASTIC LIMIT —WP WATER CONTENT —W WP — W — WL WATER CONTENT % 20 40 60	BULK DENSITY Y P.C.F.	REMARKS
			NUMBER	TYPE	BLOWS/FOOT					
505.2	Ground Level									
0.0	Silty Sand		1	SS	25	500				503.2 Sept. 30/71
			2	SS	20					1 84 (15)
			3	SS	20	490				
	Compact		4	SS	18					
481.2										
24.0	Het. mix. of sand, silt, gravel (Glacial Till) Very Dense		5	SS	64	480				34 53 (13)
	Bouldery Zone (boulders up to 10" in size)		6	AXT	50%					
470.0						470				
35.2	End of Borehole					460				

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE - SITE No 20

JOB 71-11056

LOCATION Co. Rd. #26 & Line 'C'

ORIGINATED BY VK

W.P. 3-67-01

BORING DATE Sept. 30, 1971

COMPILED BY ECB

DATUM Geodetic

BOREHOLE TYPE Wash & Bore with NX & BX Casing

CHECKED BY J.

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT					LIQUID LIMIT — W_L PLASTIC LIMIT — W_P WATER CONTENT — W			BULK DENSITY γ	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS/FOOT		SHEAR STRENGTH P.S.F.					WATER CONTENT %				
515.2	Ground Level					400	800	1200	1600	2000	W_p	W	W_L	P.C.F.	GR. SA. SI. CL.	
0.0	Silty Sand		1	SS	50											
	Dense to Very Dense		2	SS	32											
500.2																
15.0	Silty Clay		3	TW	PM									106		
	Grey		4	TW	PM											
490.2	Firm to Stiff		5	SS	19											
25.0	Irregularly layered silt, clayey silt and silty clay, trace of sand throughout.		6	TW	PM											
			7	TW	PM									120		
			8	TW	PM											
			9	SS	12										0 18 63 19	
			10	SS	12											
	Loose to Compact or Firm to Very Stiff		11	SS	10											
			12	SS	8										0 17 59 24	
			13	TW	PM											
			14	TW	PM											
			15	TW	PM											
			16	TW	PM											
			17	TW	PM											
			18	TW	PM											
			19	TW	PM											
118.2																
97.0	Sand		20	SS	40											
	Dense															

OFFICE REPORT ON SOIL EXPLORATION

Continued

20
15-0-5 % STRAIN AT FAILURE
10

DESIGN SERVICES BRANCH

FOUNDATIONS OFFICE

RECORD OF BOREHOLE - SITE N^o 20 Cont.

JOB 71-11056 LOCATION Co. Rd. #26 & Line 'C' ORIGINATED BY VK
 W.P. 3-67-01 BORING DATE Sept. 30, 1971 COMPILED BY EGB
 DATUM Geodetic BOREHOLE TYPE Wash & Bore with NX & BX Casing CHECKED BY [Signature]

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT					LIQUID LIMIT <u>W_L</u> PLASTIC LIMIT <u>W_P</u> WATER CONTENT <u>W</u>			BULK DENSITY <u>γ</u>	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT		SHEAR STRENGTH P.S.F.					WATER CONTENT %				
							○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE 400 800 1200 1600 2000					W _P — W — W _L 20 40 60				
110.0						410										
105.0	Sand & gravel & silt (Glacial Till)		21	SS	84											
104.7	Very Dense Boulder															
110.5	End of Borehole															
						400										

OFFICE REPORT ON SOIL EXPLORATION

DESIGN SERVICES BRANCH

FOUNDATIONS OFFICE

RECORD OF BOREHOLE NO 1-SITE NO 21

JOB 71-11056
 W.P. 3-67-01
 DATUM Geodetic

LOCATION Hales Creek-West Branch Line 'C'
 BORING DATE Oct. 7/71
 BOREHOLE TYPE Wash & Bore with NX & BX Casing

ORIGINATED BY VK
 COMPILED BY EGB
 CHECKED BY *[Signature]*

SOIL PROFILE		STRAT. PLOT	SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT					LIQUID LIMIT —WL PLASTIC LIMIT —Wp WATER CONTENT —w			BULK DENSITY γ	REMARKS	
ELEV. DEPTH	DESCRIPTION		NUMBER	TYPE	BLOWS/FOOT		SHEAR STRENGTH P.S.F.					Wp — w — WL					
179.2	Ground Level																
0.0	Topsoil																
1.0	Clayey silt to silty clay. Grey Very Stiff to Firm		1	SS	23												
			2	SS	20	470											
			3	TW	PM												
			4	TW	PM	460											
455.1			5	SS	100	455.1											
24.1	End of Borehole																
						450											

OFFICE REPORT ON SOIL EXPLORATION

DESIGN SERVICES BRANCH

FOUNDATIONS OFFICE

RECORD OF BOREHOLE NO 2-SITE NO 21

JOB 71-11056 LOCATION Hales Creek-West Branch Line 'C' ORIGINATED BY VK
 W.P. 3-67-01 BORING DATE Oct. 6, 1971 COMPILED BY EGB
 DATUM Geodetic BOREHOLE TYPE Wash & Bore with NX & BX Casing CHECKED BY [Signature]

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT					LIQUID LIMIT — W _L PLASTIC LIMIT — W _P WATER CONTENT — W			BULK DENSITY γ	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PICT	NUMBER	TYPE	BLOWS/FOOT		SHEAR STRENGTH P.S.F.					WATER CONTENT %				
						400	800	1200	1600	2000	W _P	W	W _L	P.C.F.	GR.SA.SI.CL.	
465.4	Ground Level															
0.0	Sandy silt.															
462.4	Compact															
3.0	Clayey silt to silty clay.		1	TW	PM	460										
456.4	Firm															
9.0	Silty sand (seams of clay throughout)		2	SS	25											
450.4	Compact															
15.0	Het. mix. of sand, silt & gravel (Glacial Till)		3	SS	39	450										
			4	SS	63											
440.9	Dense to Very Dense															
24.5	Biotite Granite Gneiss Bedrock (fractured layers above el. 4,2.5)		5	AXT	80%	440										
430.9	Sound		6	AXT	100%											
34.5	End of Borehole					430										

OFFICE REPORT ON SOIL EXPLORATION

DESIGN SERVICES BRANCH

FOUNDATIONS OFFICE

RECORD OF BOREHOLE - SITE NO 22

JOB 71-11056 LOCATION County Rd. #17 Line 'C' ORIGINATED BY VK
 W.P. 3-67-01 BORING DATE Oct. 4, 1971 COMPILED BY ECB
 DATUM Geodetic BOREHOLE TYPE Wash & Bore with NX & BX Casing CHECKED BY [Signature]

SOIL PROFILE		STRAT. PLOT	SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT					LIQUID LIMIT — WL PLASTIC LIMIT — WP WATER CONTENT — W			BULK DENSITY Y	REMARKS
ELEV. DEPTH	DESCRIPTION		NUMBER	TYPE	BLOWS/FOOT		SHEAR STRENGTH P.S.F.					Wp — W — WL				
						○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 400 800 1200 1600 2000					WATER CONTENT %			P.C.F.	GR. SA. SI. CL.	
481.0	Ground Level															
0.0	Silty Sand				480											
473.5	Dense		1	SS	32											
7.5	Clayey silt to silty clay.		2	TW	PM	470										
	Grey		3	TW	PM											
			4	TW	PM	460										
452.5	Firm		5	TW	PM											
28.5	Het. mix. of sand, silt, and gravel, trace of clay (Glacial Till) (boulders up to 8" in size throughout)		6	SS	100	450										
			7	SS	150/2"											
437.0	Very Dense					440										
44.0	End of Borehole					430										

OFFICE REPORT ON SOIL EXPLORATION

DESIGN SERVICES BRANCH

FOUNDATIONS OFFICE

RECORD OF BOREHOLE NO 1- SITE NO 23

JOB 71-11056 LOCATION S-E Murphy Rd. Line 'C' ORIGINATED BY VK
 W.P. 3-67-01 BORING DATE Sept. 29/71 COMPILED BY ECB
 DATUM Geodetic BOREHOLE TYPE Wash & Bore NX & BX Casing CHECKED BY [Signature]

SOIL PROFILE		SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT	LIQUID LIMIT W_L PLASTIC LIMIT W_P WATER CONTENT W	BULK DENSITY γ	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE					
502.8	Ground Level								
0.0	Sand, gravel, ash, trash (Garbage Dump)	[X]	1	SS	4	500			
			2	SS	17				
			3	SS	8				
495.8	Very Loose to Compact	[X]	4	SS	14	490			
7.0			5	SS	19				
	Sand and gravel	[X]	6	SS	24	480			
			7	SS	29				
478.8	Compact to Very Dense	[X]	8	SS	59	470			
			9	SS	100/20"				
24.0	End of Borehole								

498.6
Sept. 30/71

OFFICE REPORT ON SOIL EXPLORATION

DESIGN SERVICES BRANCH

FOUNDATIONS OFFICE

RECORD OF BOREHOLE NO 2-SITE NO 23

JOB 71-11056

LOCATION S-E of Murphy Rd. Line 'C'

ORIGINATED BY VK

W.P. 3-67-01

BORING DATE Sept. 29/71

COMPILED BY ECB

DATUM Geodetic

BOREHOLE TYPE Wash & Bore with NX & BX Casing

CHECKED BY *[Signature]*

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT	LIQUID LIMIT W_L PLASTIC LIMIT W_P WATER CONTENT W $W_P \quad W \quad W_L$ WATER CONTENT %	BULK DENSITY γ	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS/FOOT					
505.8	Ground Level									
0.0	Sand, gravel, clayey silt, ash, trash, nails etc. (Garbage Dump) Compact to Very Dense	X	1	SS	22	500				
			2	SS	14					
			3	SS	15					
			4	SS	47					
			5	SS	185					
			6	SS	23					
489.3										
16.5	Sand and gravel.	X	7	SS	115	490				
180.8	Very Dense		8	SS	100	0"				
19.0	End of Borehole									
						480				

P.C.F. GR.SA.SI.CL

502.0
Sept, 30/71

,2000

OFFICE REPORT ON SOIL EXPLORATION

DESIGN SERVICES BRANCH

FOUNDATIONS OFFICE

RECORD OF BOREHOLE - SITE NO 24

JOB 71-11056

LOCATION Paquette Rd.-Canadian Forces Base Line 'C'

ORIGINATED BY VK

W.P. 3-67-01

BORING DATE Sept. 24, 1971

COMPILED BY VK

DATUM Geodetic

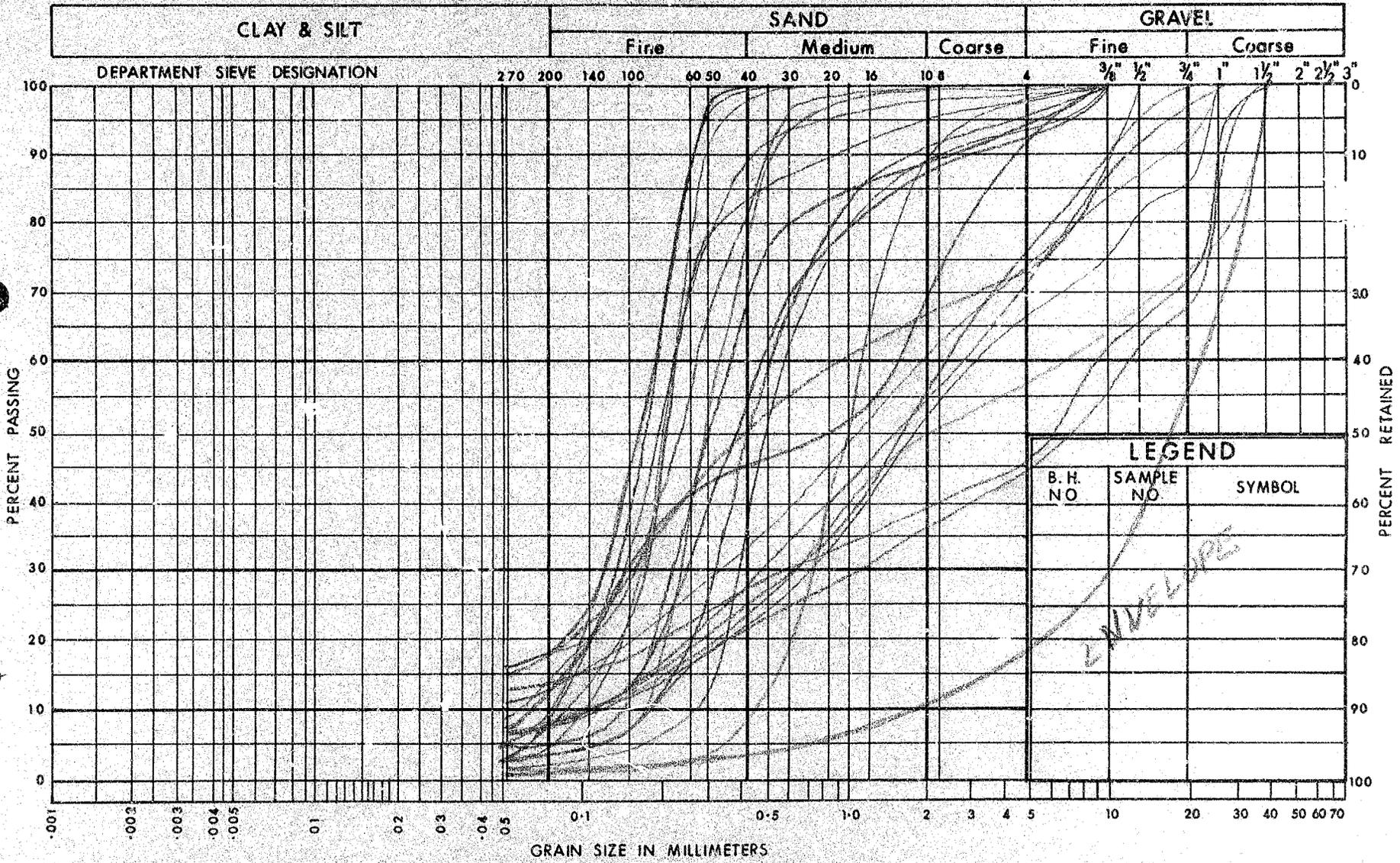
BOREHOLE TYPE Wash & Bore with NX & BX Casing

CHECKED BY

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT	LIQUID LIMIT —WL PLASTIC LIMIT —WP WATER CONTENT —W WP — W — WL 20 40 60	BULK DENSITY γ P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS/FOOT					
465.6	Ground Level									
0.0	Sand and gravel and some silt (Fill)		1	SS	18	460				0 82 (18)
457.6	Compact		2	SS	94					
8.0	Sand with gravel, trace silt, clay (boulders up to 10" in size throughout)		3	SS	100/6"	450				
	(Glacial Till)		4	SS	100/6"					
	Very Dense		5	SS	225	440				25 69 (6)
			6	SS	100/3"					
431.4			7	SS	100/3"					
34.2	End of Borehole					430				

OFFICE REPORT ON SOIL EXPLORATION

UNIFIED SOIL CLASSIFICATION SYSTEM



PERCENT PASSING

PERCENT RETAINED

GRAIN SIZE IN MILLIMETERS

DEPARTMENT
OF
TRANSPORTATION AND COMMUNICATIONS

DESIGN SERVICES
BRANCH

GRAIN SIZE DISTRIBUTION

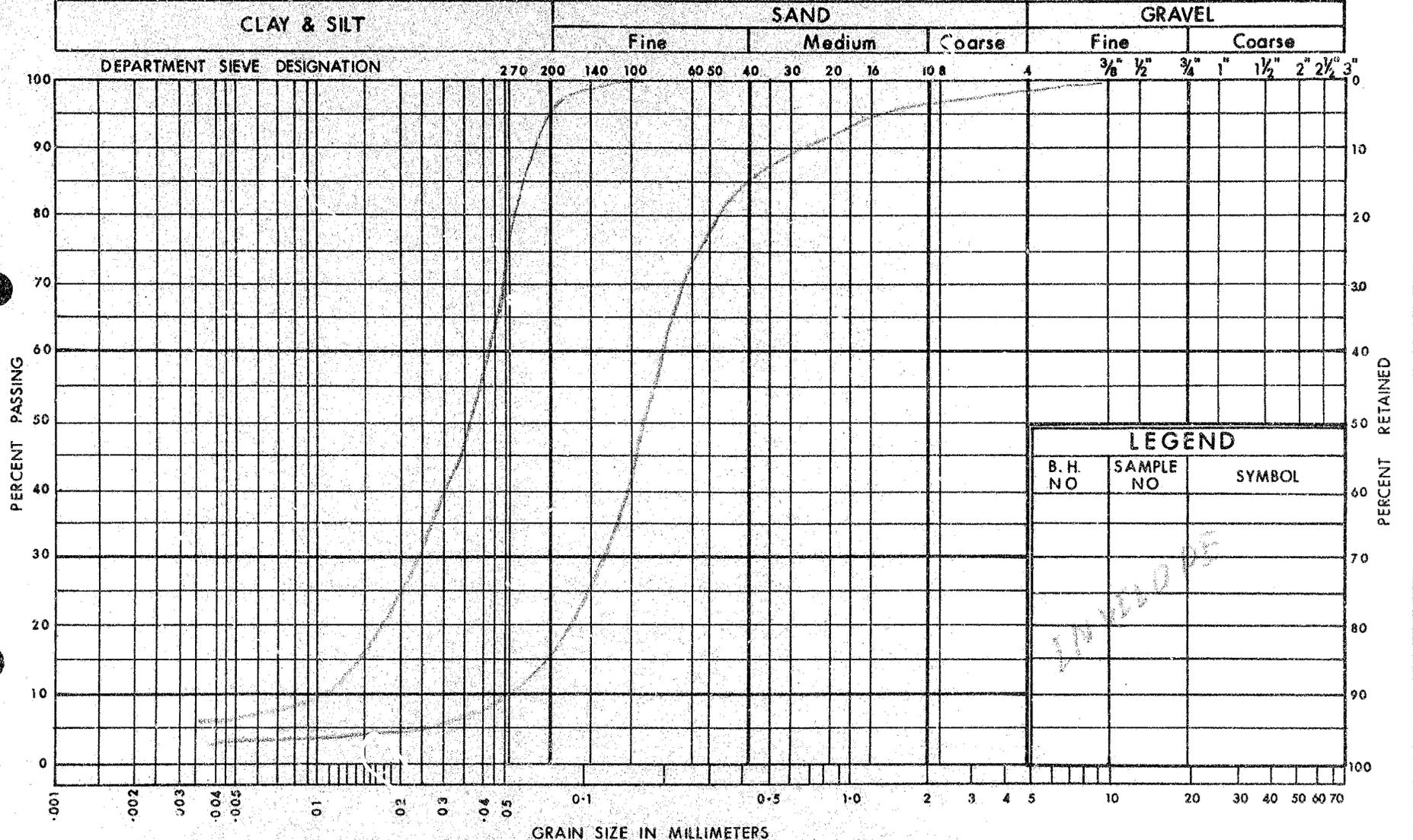
Sand and gravel (upper deposit)

W.P. No. _____

JOB No. *71-11056*

Fig. 1

UNIFIED SOIL CLASSIFICATION SYSTEM



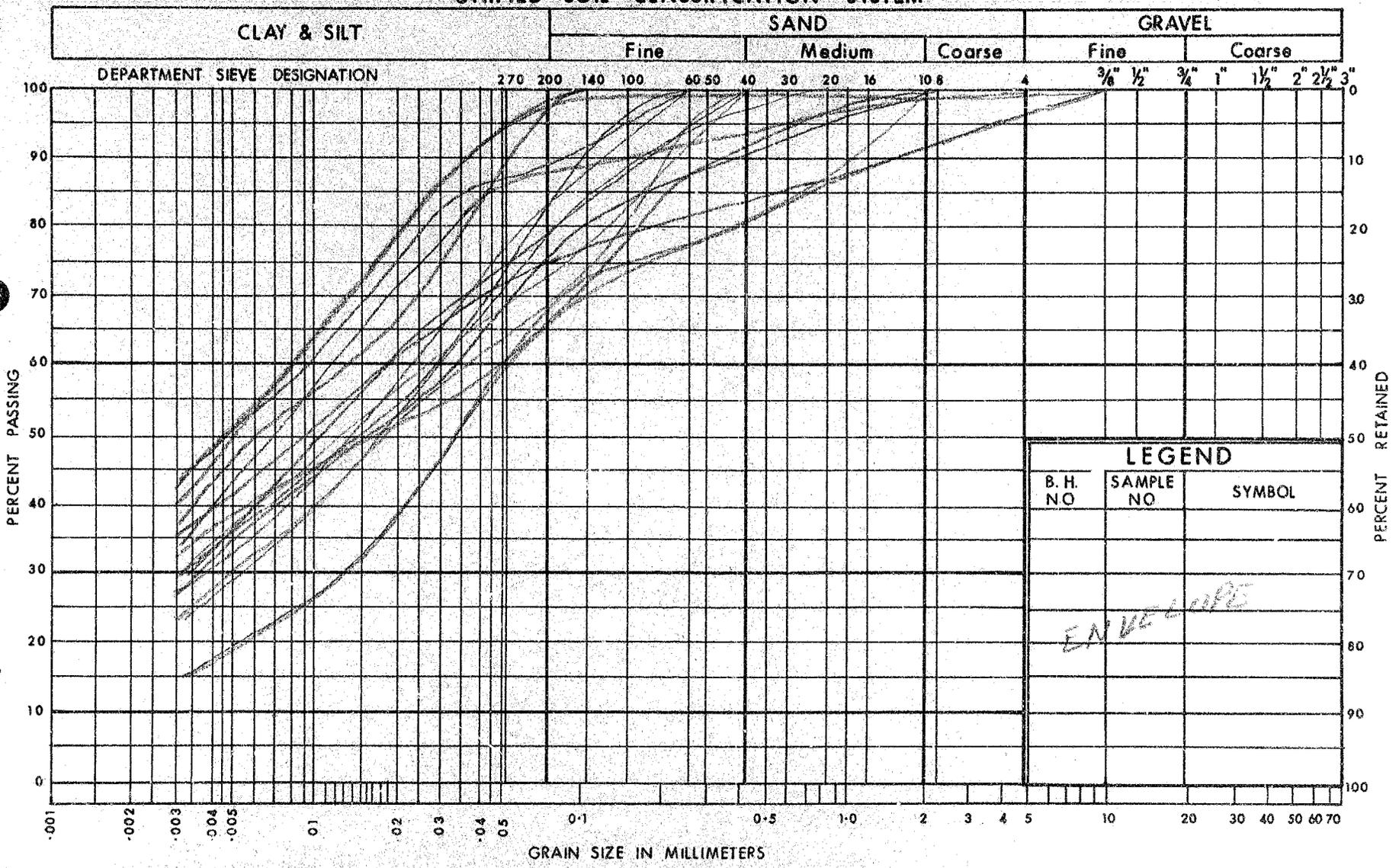
LEGEND		
B. H. NO	SAMPLE NO	SYMBOL

DEPARTMENT OF TRANSPORTATION AND COMMUNICATIONS
DESIGN SERVICES BRANCH
ONTARIO

GRAIN SIZE DISTRIBUTION
Silty sand (upper deposit)

W.P. No.
JOB No. 71-11056
Fig. 2

UNIFIED SOIL CLASSIFICATION SYSTEM



DEPARTMENT OF
TRANSPORTATION AND COMMUNICATIONS



DESIGN SERVICES
BRANCH

GRAIN SIZE DISTRIBUTION

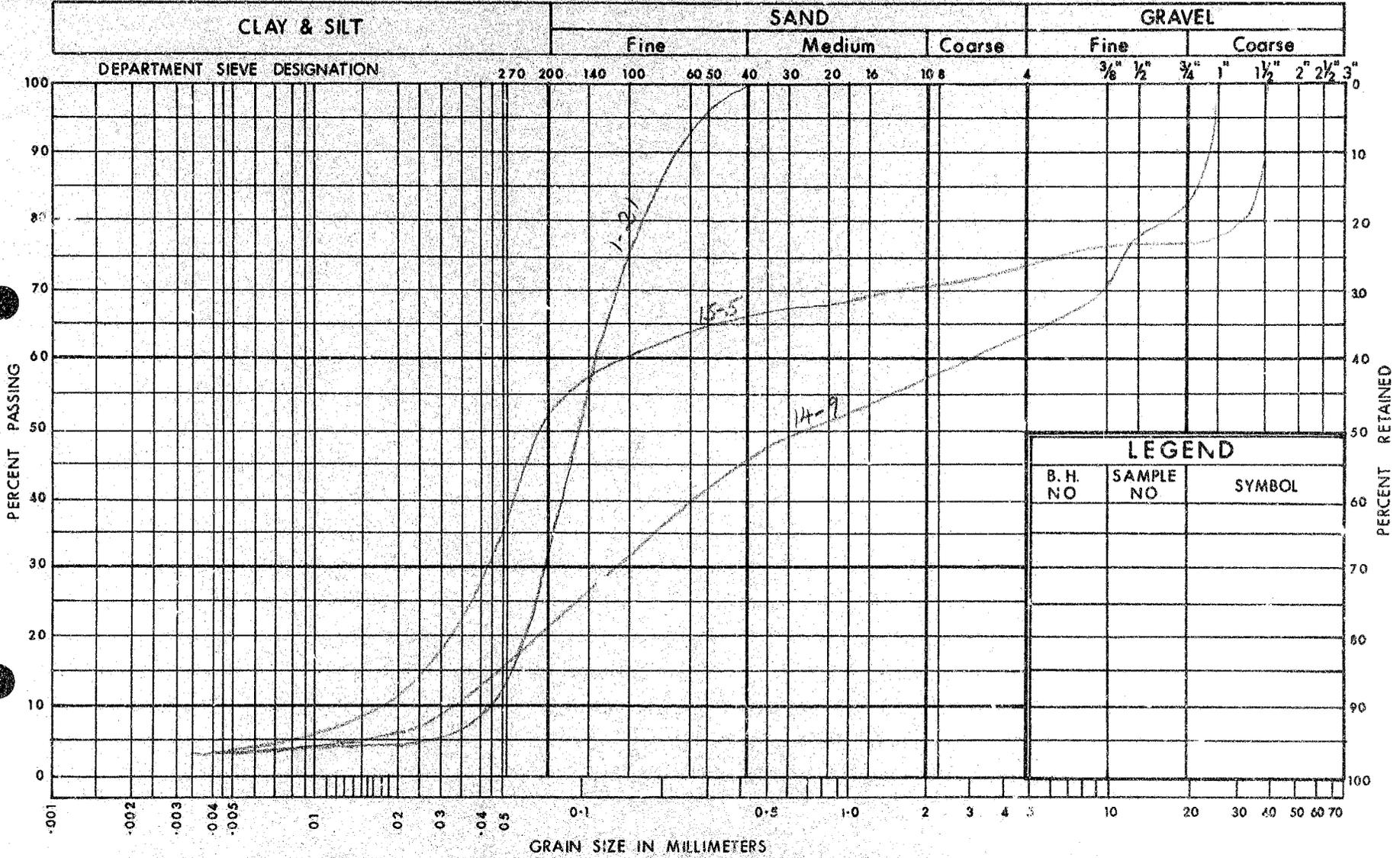
Clay to clayey silt

W.P. No.

JOB No. 71-11056

Fig. 3

UNIFIED SOIL CLASSIFICATION SYSTEM



LEGEND		
B. H. NO	SAMPLE NO	SYMBOL

DEPARTMENT OF TRANSPORTATION AND COMMUNICATIONS
DESIGN SERVICES BRANCH

GRAIN SIZE DISTRIBUTION
Sand and Gravel to Silty Sand (Lower deposit)

W.P. No.
JOB No. 71-1105
Fig. 5

