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GEOCRES No. 3165-92

DIST. 9 REGION EASTERN

W.P. No. 10-69-18

CONT. No. 76-23

W. O. No. 73-P-78

STR. SITE No. _____

HWY. No. _____

LOCATION BASELINE RD. AND

BORTHWICK CK.

OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT. _____

REMARKS: _____

| | | | |
|---------|----------|-----------------------------|-------------|
| 73-F-78 | 10-69-18 | BASLINE RD. & BORTHWICK CK. | 3105-92 |
| W.O. | W.P. | LOCATION | GEOCRES NO. |

● DATA ON FILE IN SOIL MECHANICS SECTION

REFER TO: W.P. FILE *See cont # 76-23*

REMARKS

GEOCRES

INDEXING CARD FOR REPORTS NOT MICROFILMED

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MINISTRY OF TRANSPORTATION AND COMMUNICATIONS, ONTARIO

MEMORANDUM

TO: Mr. A. G. Stermac,
Principal Foundations Engineer,
Downsview, Ontario.

FROM: Structural Planning Office,
Kingston, Ontario.

ATTENTION: Mr. M. Devata

DATE: 18 September 1973.

OUR FILE REF.

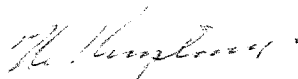
IN REPLY TO

SUBJECT: W.P. 10-69-18 - Borthwick Creek Culvert
at Baseline Road, District 9 - Ottawa

With reference to the discussions in this office today between Messrs. E. R. Saint and H. Meyer, Regional Materials and Testing, Mr. Devata of your office and myself, I confirm that we should like you to carry out a foundation investigation at the site of the above-mentioned culvert and in the fills on each side.

We shall be glad to receive recommendations in due course both with regard to the culvert type suitable for use from a foundations viewpoint and also, with regard to any stability and settlement problems in the fills on each side of the culvert. The plan and profile was handed to you by our Regional Materials and Testing office.

Your office has previously carried out a foundation investigation on Borthwick Creek a short distance downstream at its inception with the Walkley Road Extension (see your Report W.O. 72-11146 dated March 9, 1973). The predominant stratum at the Walkley Road site consisted of loose to compact sand underlain by glacial till. However, preliminary borings carried out by Materials and Testing Section at the Baseline Road site indicate that the subsoil is composed of soft clay at least 15 ft. in thickness.



T. C. Kingsland
Regional Structural Planning Engineer

TCK/hl

c.c. E. R. Saint
A. J. Percy
C. S. Grebski - Att. K. Bassi

O.D.D. Nov. 7/73



MINISTRY OF TRANSPORTATION AND COMMUNICATIONS, ONTARIO

Copy for the information of

M. Devata

Estimating Office
Downsview

Systems Design Office
Kingston

Mr. S. Giroux

September 19, 1973

W.P. 10-69, -18, -19 & -20, Baseline Road, District 9,
Ottawa; From Ridge Road to Walkley Road and C.N.R.
Overhead

Attached are estimates for 3 alternatives for which we would like to have priced for cost comparison purposes.

The problem arises as a result of wet clays to depths from 15 to 20 feet requiring either excavation or the use of bents.

The location is adjacent to Highway 417 in the Ramsayville area.

The estimates were prepared by a Consultant, M.M. Dillon. The Consultant has shown unit prices but I suggest you ignore these as they are probably obsolete. If you require additional information you can obtain it from Mr. M. Devata of the Foundation Section who is familiar with the problem.


S.J. Markiewicz
Senior Project Design Engineer

SJM:sl

Attach.

c.c. S.R. Saint
M. Devata



Mr. H. Meyer,
Regional Materials and Testing ,
Eastern Region,
Kingston, Ontario.

73-11-078

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

September 21, 1973.

W.P. 10-69-18 - Borthwick Creek Culvert
at Baseline Rd., District #9 - Ottawa

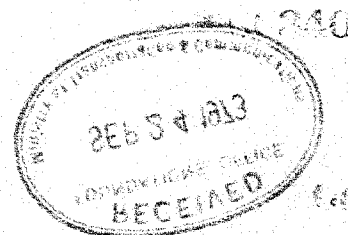
Attached herewith are prints of Borthwick Creek Culvert
Drawings No.'s C-56-417-8 and B-56-417-6 which we are
returning to you.

JTB/ao
Attch.

For: J. T. Bangs,
Project Foundations Engineer,
M. Devata,
Supervising Foundations Eng.

RECEIVED 21 00 3:43

OK



MX DOWN SEPT 21/73 3.35 PM VR

OTTA 4 W A STUART D N E

KINR 6 CC T C KINGSLAND REG STRUC PLAN ENGR

CC E R SAINT REG MATLS ENGR

RE WP-10-59-18, WO-73-11078, DIST. 9,

BASE LINE ROAD AND WALKLEY ROAD.

THIS IS TO ADVISE THAT THE FIELD INVESTIGATION WORK FOR
THE ABOVE MENTIONED PROJECT WILL COMMENCE ON SEPT. 26/73
UNDER THE SUPERVISION OF MR JIM BANKS PROJECT FOUNDATIONS
ENGR., THE ESTIMATED DURATION OF THE FIELD WORK WILL BE
3 DAYS.

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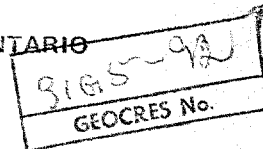
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MEMORANDUM



TO: Mr. T. C. Kingsland, (2)
Regional Structural Planning Eng.,
Eastern Region,
Kingston, Ontario.

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

ATTENTION: DATE: October 25, 1973.

OUR FILE REF. IN REPLY TO OCT 31 1973

SUBJECT:

3165-92

FOUNDATION INVESTIGATION

For

The Proposed Culvert and Associated Approaches at
The Crossing of Baseline Rd. and Borthwick Creek
Twp. of Gloucester, Reg. Mun. of Ottawa-Carleton
District No: 9, Site --

W.O. 73-11078 - W.P. 10-69-18

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

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

AGS/ao
Atch.

A. G. Stermac
A. G. Stermac,
PRINCIPAL FOUNDATIONS ENGINEER.

c.c. E. J. Orr
B. R. Davis
A. Rutka
A. J. Percy
J. M. Childs
B. J. Giroux
E. R. Saint
G. A. Wrong
B. A. Singh
M. M. Lillian (Atch.)
Foundations Files
Documents

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-

FOUNDATION INVESTIGATION
For
The Proposed Culvert and Associated Approaches at
The Crossing of Baseline Rd. and Borthwick Creek
Twp. of Gloucester, Reg. Mun. of Ottawa-Carleton
District No. 9, Site --
W.O. 73-11078 - W.P. 10-69-18

1. INTRODUCTION:

The Foundations Office was requested to carry out a subsurface investigation at the crossing of Baseline Rd. and Borthwick Creek. The request was contained in a memo from the Eastern Region, Structural Planning Office (Mr. T. C. Kingsland, Regional Structural Planning Engineer) dated September 18, 1973. An investigation was subsequently carried out by the Foundation Office to determine the subsoil, bedrock and groundwater conditions at the site.

This report contains the results of the investigation, together with recommendations pertaining to the foundations of the proposed culvert as well as the stability and settlement of the approach embankments.

2. DESCRIPTION OF THE SITE AND GEOLOGY:

The site is located at the crossing of Baseline Rd. and Borthwick Creek in the Township of Gloucester, Regional Municipality of Ottawa-Carleton. The terrain is flat to gently undulating in relief. The land is being used for farming purposes.

The site is situated in the physiographic region known as "Ottawa Valley Clay Plains." In this region, extensive clay deposits are interrupted by ridges of sand and/or bedrock.

The sensitive marine clay, which was deposited in the geologic past in the Champlain Sea, varies markedly in thickness over the region. In the vicinity of the site, it was found to be less than 10 ft. thick. The clay is generally underlain by a granular deposit in turn by shale bedrock.

3. FIELD & LABORATORY INVESTIGATION:

Six sampled boreholes, four of which accompanied by a dynamic cone penetration test, were put down during the course of the field investigation. The borings were advanced by means of a Penn Drill adapted for soil sampling purposes.

Samples of the granular deposits were obtained in a 2" O.D. split spoon sampler, which was hammered into the soil in accordance with the specifications for the Standard Penetration Test. The dynamic cone penetration tests were advanced using the same method. Samples of the cohesive stratum were obtained in 2" I.D. Shelby tubes which were manually pushed into the soil. In-situ vane tests were also carried out within this zone to determine the undrained shear strength and the sensitivity of the clay.

The groundwater level conditions across the site were determined by recording the water levels in the open boreholes during the course of the investigation.

The locations and elevations of all boreholes are shown on Drawing No. 73-11078A. An estimated stratigraphical profile is also presented on the same drawing. The surveying was carried out by personnel from Kingston Region, Engineering Surveys Office. All elevations are referenced to a Geodetic datum.

All samples were subjected to careful visual examination both in the field and in the laboratory. Laboratory tests were performed on selected samples to determine the engineering properties of the various soil types; namely,

- Natural Moisture Contents
- Grain-Size Distributions
- Atterberg Limits
- Undrained Shear Strengths
- Consolidation Characteristics

The results of the laboratory testing are plotted on the "Record of Borehole" sheets and summarized on Figures No. 1 to 4, all of which are contained in Appendix I of this report.

4. SURSOIL AND BEDROCK CONDITIONS:

4.1) General:

The predominant stratum across the site is a soft to stiff silty clay to clay, with traces of sand. The thickness of this stratum varies from 3 to 14 ft. Underlying this cohesive stratum is a deposit of sand, with grave and silt up to 7 feet thick, which is believed to be underlain by bedrock (shale). At all boring locations, the cohesive stratum is covered by fill material composed mainly of sand and gravel. This stratum ranges in thickness from 4 to 5.5 feet.

The boundaries of the various deposits, as determined in the boreholes, are shown on the individual Record of Borehole sheets. The stratigraphical profile, shown on Drawing 73-11078A has been inferred from this data. From ground surface downward, the various soil types encountered are described in the subsections to follow.

4.2) Fill Material:

At all boring locations, fill material consisting of sand and gravel is present, the thickness of which varies from 4 ft. (B.H.'s #1, #2 & #6) to 5.5 ft. (B.H.'s #3, #4 & #5). Standard penetration testing carried out within this deposit gave 'N' values which vary from 4 to 10 blows per foot. Based on these results, it is estimated that the fill material has been poorly compacted.

4.3) Silty Clay to Clay, Trace of Sand:

Directly beneath the fill material is a 3 (B.H. #1) to 14 ft. (B.H. #6) thick silty clay to clay with a trace of sand. However, in B.H.'s #1 and #2, the cohesive deposit contains a trace of organics.

Grain-size distribution testing was carried out on several samples of this stratum and the results are shown on the Record of Borehole sheets and are plotted on Figure No. 3.

The engineering properties of the deposit, as determined by field and laboratory testing, are presented in the following table.

| <u>Identity Tests</u> | <u>Range</u> | <u>Average</u> |
|---|---------------|----------------|
| Bulk Density (γ) p.c.f. | 106 - 120 | 113 |
| Liquid Limit (W_L) % | 27 - 67 | 50 |
| Plastic Limit (W_p) % | 21 - 28 | 24 |
| Natural Moisture Content (W) % | 22 - 52 | 34 |
| <u>Compressibility Characteristics</u> | | |
| Initial Void Ratio (e_o) | 1.45 - 1.60 | } 2 Tests |
| Compression Index (C_c) | 0.78 - 0.94 | |
| Degree of Preconsolidation (p.s.f.) ($P_c - P_o'$) | 6,600 - 7,800 | |
| <u>Undrained Shear Strength (C_u) p.s.f.</u> | | |
| In Situ Field Vane Test | 720 - 1840 | |
| Laboratory Tests | 375 - 1145 | |

The Atterberg limit test results, given in the table, are also summarized on the Plasticity Chart, Figure No. 1. Testing indicates that the cohesive soil is inorganic with the plasticity in the intermediate to high range.

The field and laboratory undrained shear strength results are plotted on the Record of Borehole sheets. The results indicate that the consistency of the cohesive deposit varies randomly from soft to stiff.

The consolidation characteristics of the stratum were determined by carrying out laboratory tests; the results are shown on Figure No. 4 as Void Ratio vs. Log of Pressure Plots. This testing indicates that the silty clay stratum is preconsolidated by 6,600 to 7,800 p.s.f. in excess of the existing overburden pressure.

4.4) Silty Sand, Some Gravel:

Immediately below the cohesive deposit except in B.H. #6 is a stratum of silty sand, some gravel; the thickness of which varies from 1 ft. (B.H. #4) to 2.5 ft. (B.H. #1). Standard penetration testing carried out within this deposit gave 'N' values which vary from 7 to 18 blows per foot. Based on these results, it is estimated that the relative density of the granular deposit varies from loose to compact. It is believed that this granular deposit is underlain by shale bedrock. No attempt was made to prove the bedrock by obtaining rock core samples. However, it is assumed that the bedrock surface is at the level where the auger met refusal.

5. GROUNDWATER CONDITIONS:

Groundwater level observations were carried out during the course of the field investigation by recording the water level in the open boreholes. The observations are recorded on the Record of Borehole sheets and summarized on Drawing No. 73-11078A. The results of the observation indicate that the groundwater level, within the overburden deposits, ranges from 3 ft. to 6 ft. below the existing ground surface which corresponds to elevations from 205 to 212.

6. DISCUSSION AND RECOMMENDATIONS:

6.1) General:

It is proposed to realign the Baseline Road in conjunction with the construction of Hwy. 417 in this area. A new culvert is proposed at the crossing of Baseline Rd. and Borthwick Creek, Township of Gloucester, Regional Municipality of Ottawa-Carleton. In the vicinity of this site, it is understood that the present alignment of Baseline Road will be maintained.

The proposed profile grade of Baseline Rd. in the vicinity of Borthwick Creek will be at elevation 218. However, between Stations 100+00 and 125+00, the proposed grade ranges from

elev. 220 to 260. To reach these grades, fills up to 14 feet (north approach) and 20 feet (south approach) above the original ground surface will be required. In addition, cuts up to 6 feet will be necessary between Stations 119+00 and 122+50.

The subsoil at the site consists of 4 to 5.5 ft. of fill material (sand and gravel) followed by a soft to stiff deposit of silty clay to clay up to 14 feet thick. Immediately below the cohesive stratum is a deposit of silty sand which is believed to be underlain by shale bedrock.

Recommendations pertaining to the foundation design of the culvert (two schemes), as well as the stability and settlement considerations associated with the approach embankments and cuts are presented in the subsections to follow.

6.2) Culvert Foundations:

6.2.1) Scheme I: Rigid Frame Concrete Culvert:

At the time of the preparation of this report, the invert elevation of the proposed culvert has not been finalized. However, according to the information obtained from the Structural Planning Office, Eastern Region, the new invert elevation will be very close to the existing one; i.e., approximately at elevation 203.

The rigid frame concrete culvert may be supported on spread footings, founded at or below elevation 199 in order to fulfill the frost protection requirements. At this elevation, the footings will be located within the granular deposit. A safe bearing pressure of up to 2.5 t.s.f. may be used in designing the footings.

Two boreholes (B.H.'s #2 and #3) put down in the vicinity of the proposed culvert location revealed that the power auger met refusal at elevations 198.9 (B.H. #2) and 198.3 (B.H. #3) which is probably the shale bedrock surface. It is, therefore, recommended that alternatively the footings may be founded on the shale bedrock using an allowable bearing pressure of up to 10 t.s.f. In both cases, the settlement of the culvert footings will be negligible.

The foundation excavation will be made through the cohesive silty clay to clay stratum into the underlying granular deposit. The prevailing groundwater level at the time of the field investigation was up to 8 feet above the base of excavation. A temporary dewatering scheme may be required.

In designing the wall sections of the rigid frame concrete culvert, a coefficient of earth pressure of 0.5 should be assumed for the granular backfill behind the walls. In addition, the design should incorporate the full effect of the surcharge located above the top of the walls.

In order to relieve the buildup of excess hydrostatic pressure behind the walls, suitable drainage measures should be provided in accordance with the current M.T.C. standards.

6.2.2) Scheme II: Multi-Plate Pipe Arch Culvert:

As an alternative a multi-plate pipe arch could be employed at this site. No major complications are envisaged with regard to the placement and performance of the culvert. The bedding and backfilling for the culvert should be carried out in accordance with current M.T.C. practices No. DD-808-B (Bedding) and No. DD-813 (Backfilling).

The cohesive subsoil below the culvert invert should be completely subexcavated from within the plan limits of the proposed pipe arch. The slope of the sub-excavation should be 1:1.

The sub-excavation so formed should be backfilled with a granular type of material (Granular 'A') to the pipe arch base. All current M.T.C. specifications relating to pipe arch installation should be applied here.

The bedding should be placed in a relatively dry condition. In order to achieve this, a temporary dewatering scheme may be required.

6.3) Approaches:

6.3.1) Stability Considerations:

It is proposed to revise the grade in the vicinity of Borthwic

Creek by 4 to 14 feet, above the existing profile grade. The presence of the sensitive cohesive stratum proves to be the critical condition for stability of an embankment. This being the case, a total stress analysis provides a suitable means of assessing the stability of the embankment sections. In this method of analysis, stability is governed by the applied loads and by the stress-strain and undrained shear strength characteristics of the foundation and embankment soils.

Analyses have been carried out by the use of the electronic computer to determine the stability of the approaches, using the following assumptions:

Geometry of Embankment:

| | |
|----------------|-----------|
| Maximum Height | - 20 feet |
| Side Slopes | - 2:1 |
| Top Width | - 44 feet |

Fill Material:

| | |
|--|-------------------|
| Unit Weight (γ) | - 130 p.c.f. |
| Apparent Angle of Shearing Resistance (ϕ) | - 30° |
| Tension Crack | - 1/3 Fill Height |

Silty Clay to Clay:

| | |
|------------------------------------|--------------|
| Unit Weight (γ) | - 110 p.c.f. |
| Undrained Shear Strength (C_u) | - 600 p.s.f. |

The results of the analyses revealed that fills up to 16 feet in height will be stable. For fills in excess of 16 feet high, mid-height berm will be necessary. The length of the mid-height berm for various fill heights are presented in the following table.

| <u>Fill Height (feet)</u> | <u>Berm Length (feet)</u> |
|---------------------------|---------------------------|
| 18 | 5 |
| 20 | 10 |

It should be noted that the above computations were based on the results obtained from the boreholes put down at the shoulders of the existing Baseline Road. The future approach embankments will, however, be much wider. It is, therefore,

suggested that the Regional Materials Office carry out shallow borings within the proposed plan limits of the approaches, to determine the characteristics of the surficial deposit. Any loose/soft material or organics found should be completely removed since they will affect the stability of the overall embankments.

As mentioned elsewhere, cuts up to 6 feet deep will be necessary between Stations 119+00 and 122+50. No stability problems are anticipated provided that the cuts are constructed with 2:1 slopes and protected as per current M.T.C. Standards.

6.3.2) Settlement Considerations:

The silty clay stratum will undergo settlements due to consolidation, over a period of time, under the embankment loadings. Settlement computations were, therefore, carried out.

It is estimated that the settlement of the 20-foot embankments could be of the order of 3 to 4 inches. The total amount of the predicted settlement, at both approaches, should take place within a period of 2 years. About 50% should, however, occur within 6 months.

Since the major portion of the predicted settlements will occur in a relatively short period of time it may be advantageous to delay final paving operations in order to minimize post-construction maintenance. If scheduling permits, a period of at least 6 months should be provided for this purpose.

7. MISCELLANEOUS:

The field work was carried out between September 26, 1973, and September 28, 1973, under the supervision of Mr. J. T. Bangs, Project Foundations Engineer.

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

This report was written by Mr. J. T. Bangs, Project Foundations Engineer, who was assisted by Mr. C. S. Poon, Project Foundations Engineer.

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

J. T. Bangs
J. T. Bangs, P. Eng.

M. Devata
M. Devata, P. Eng.

JTB/ao

Oct. 25, 1973.



APPENDIX I

DESIGN SERVICES BRANCH

FOUNDATIONS OFFICE

RECORD OF BOREHOLE NO 1

JOB 73-11078

LOCATION Sta. 108 + 09 1h' Rt.

ORIGINATED BY JB

W.P. 10-69-18

BORING DATE Sept. 26, 1973

COMPILED BY VK

DATUM Geodetic

BOREHOLE TYPE Auger

CHECKED BY *JK*

| SOIL PROFILE | | | SAMPLES | | | ELEV. SCALE | DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT 20 40 60 80 100 | LIQUID LIMIT w_L PLASTIC LIMIT w_p WATER CONTENT w w_p — w — w_L | BULK DENSITY γ P.C.F. | REMARKS |
|--------------|--------------------------------|------------|---------|------|------------|-------------|---|---|------------------------------------|-----------|
| ELEV. DEPTH | DESCRIPTION | STRAT. PLT | NUMBER | TYPE | BLOWS/FOOT | | | | | |
| 209.9 | Ground Level | | | | | | | | | |
| 0.0 | Fill Material | | | | | | | | | |
| 205.9 | Sand with organics | | 1 | SS | 4 | | | | | 205.9 |
| 5.0 | Silty clay with organics. Soft | | 2 | SS | 10 | | | | | 0.48 (52) |
| 202.9 | | | 3 | SS | 10 | | | | | |
| 7.0 | Silty sand | | 4 | SS | 7 | | | | | |
| | Loose to Compact | | | | | | | | | |
| 195.4 | Grey | | | | | | | | | |
| 14.5 | End of Borehole | | | | | | | | | |

DESIGN SERVICES BRANCH

FOUNDATIONS OFFICE

RECORD OF BOREHOLE NO 2

JOB 73-11078

LOCATION Sta. 110 + 14 13' Rt.

ORIGINATED BY JB

W.P. 10-89-18

BORING DATE Sept. 26, 1973

COMPILED BY VR

DATUM Geodetic

BOREHOLE TYPE Auger

CHECKED BY

| SOIL PROFILE | | | SAMPLES | | | DYNAMIC PENETRATION RESISTANCE | | | LIQUID LIMIT | | | BULK DENSITY | REMARKS |
|--------------|---|------------|---------|------|------------|--------------------------------|--------------|----------------|----------------|---|----------------|--------------|---------|
| ELEV. DEPTH | DESCRIPTION | STRAT. PLT | NUMBER | TYPE | BLOWS/FOOT | ELEV. SCALE | BLOWS / FOOT | W _p | W _L | W | W _p | | |
| 210.4 | Ground level | | | | | | | | | | | | |
| 0.0 | Fill material | | | | | 210 | | | | | | | |
| 206.4 | Sand and gravel. Brown | | 1 | SS | 5 | | | | | | | | |
| 4.0 | Silty clay, trace of organics. | | 2 | TM | DM | | | | | | | | |
| | | | 3 | TM | DM | | | | | | | | |
| 200.9 | Firm Grey | | 4 | TM | DM | | | | | | | | |
| 198.9 | Sandy silt, trace of clay & clay. Grey. Loose | | 5 | SS | 9 | | | | | | | | |
| 11.5 | End of Borehole | | | | | | | | | | | | |
| | Probable Bedrock | | | | | | | | | | | | |
| | | | | | | 190 | | | | | | | |

OFFICE REPORT ON SOIL EXPLORATION

DESIGN SERVICES BRANCH

FOUNDATIONS OFFICE

RECORD OF BOREHOLE NO 3

JOB 73-11078

LOCATION Sta. 109 + 91 14' Lt.

ORIGINATED BY JB

W.P. 10-69-18

BORING DATE Sept. 26, 1973

COMPILED BY VK

DATUM Geodetic

BOREHOLE TYPE Auger

CHECKED BY

| SOIL PROFILE | | | SAMPLES | | | ELEV. SCALE | DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT | | | | | LIQUID LIMIT — w_L | | | BULK DENSITY | REMARKS |
|--------------|--------------------------------------|------------|---------|------|------------|-------------|--|----|----|----|-----|-----------------------|---------------------|--|--------------|---------|
| ELEV. DEPTH | DESCRIPTION | STRAT. PLT | NUMBER | TYPE | BLOWS/FOOT | | 20 | 40 | 60 | 80 | 100 | PLASTIC LIMIT — w_p | WATER CONTENT — w | | | |
| 210.1 | Ground Level | | | | | | | | | | | | | | | |
| 0.0 | Fill material sand and gravel. | | | | | 210 | | | | | | | | | | |
| 204.6 | Loose Brown | | 1 | SS | 6 | | | | | | | | | | | |
| 5.5 | Silty clay | | 2 | FW | PM | | | | | | | | | | | |
| 200.6 | Soft to Firm Grey | | | | | 200 | | | | | | | | | | |
| 198.3 | Silty sand, some grav. & clay. Loose | | 3 | SS | 8 | | | | | | | | | | | |
| 11.8 | End of Borehole Probable Bedrock | | | | | 190 | | | | | | | | | | |

RECORD OF BOREHOLE NO 4

JOB 73-11078

LOCATION Sta. 112 + 66 10' Rt.

ORIGINATED BY JP

W.P 10-69-18

BORING DATE Sept. 26, 1973

COMPILED BY VK

DATUM Geodetic

BOREHOLE TYPE Auger

CHECKED BY

[illegible]

15 ϕ 5 % STRAIN AT FAILURE

OFFICE REPORT ON SOIL EXPLORATION

DESIGN SERVICES BRANCH

RECORD OF BOREHOLE NO 5

FOUNDATIONS OFFICE

JOB 73-11078

LOCATION Sta. 116 + 00 17' Lt.

ORIGINATED BY JB

W.P. 10-69-18

BORING DATE Sept. 26, 1973

COMPILED BY VE

DATUM Geodetic

BOREHOLE TYPE Auger

CHECKED BY

| SOIL PROFILE | | | SAMPLES | | | DYNAMIC PENETRATION RESISTANCE | | | LIQUID LIMIT ——— w _L | | | BULK DENSITY Y | REMARKS | |
|---------------|--|------------|---------|------|------------|--------------------------------|-----------------------------|------|---------------------------------|---|-----|-----------------------|-----------------|-------------------|
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | BLOWS/FOOT | ELEV SCALE | BLOWS / FOOT | | | PLASTIC LIMIT ——— w _p | | | | |
| | | | | | | | 20 | 40 | 60 | 80 | 100 | | | WATER CONTENT — w |
| | | | | | | | SHEAR STRENGTH P.S.F. | | | w _p ——— w ——— w _L | | | WATER CONTENT % | |
| | | | | | | | ○ UNCONFINED + FIELD VANE | | | | | | | |
| | | | | | | | ● QUICK TRIAXIAL x LAB VANE | | | | | | | |
| 218.5 | Ground Level | | | | | | 800 | 1600 | | 25 | 50 | 75 | P.C.F. | GR SA, SI, CL |
| 0.0 | Fill Material (Sand) | ◇ | | | | | | | | | | | | |
| 213.0 | Loose Brown | ◇ | 1 | SS | 8 | | | | | | | | | 212.5 |
| 5.5 | Silty clay to clay, trace of sand. | ▨ | 2 | SS | 6 | 210 | | | | | | | 109 | 0 2 46 5 |
| | | ▨ | 3 | SS | 6 | | | | | | | | | |
| | Soft to Firm | ▨ | 4 | SS | 3 | | | | | | | | 114 | |
| 200.5 | Grey | ▨ | 5 | SS | 18 | 200 | | | | | | | | 32 45 (23) |
| 18.0 | Sand, with gravel & clay, Compact Grey | ▨ | 6 | SS | 18 | | | | | | | | | |
| 198.0 | | ▨ | | | | | | | | | | | | |
| 20.5 | End of Borehole Probable Bedrock | ▨ | | | | 190 | | | | | | | | |

OFFICE REPORT SOIL EXPLORATION

DESIGN SERVICES BRANCH

FOUNDATIONS OFFICE

RECORD OF BOREHOLE NO 6

JOB 73-11078

LOCATION Sta. 11h + 80 1h' Lt.

ORIGINATED BY JB

W.P. 10-69-18

BORING DATE Sept. 27, 1973

COMPILED BY VK

DATUM Geodetic

BOREHOLE TYPE Auger

CHECKED BY *SK*

| 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 | | 20 | 40 | 60 | 80 | 100 | w_p | | | w | w_L |
| | | | | | | | SHEAR STRENGTH P.S.F. | | | | | | | | | |
| | | | | | | | ○ UNCONFINED + FIELD VANE | | | | | | | | | |
| | | | | | | | ● QUICK TRIAXIAL x LAB VANE | | | | | | | | | |
| | | | | | | | 800 | | | 1600 | | | 25 50 75 | | | |
| 215.0 | Ground Level | | | | | | | | | | | | | | P.C.F. | GR SA, SI, CL |
| 0.0 | Fill material sand & gravel | | | | | | | | | | | | | | | |
| 211.0 | Loose Brown | | 1 | SS | 10 | 210 | | | | | | | | | | 209.7 |
| 4.0 | Silty clay to clay, trace of sand. | | 2 | SS | 9 | | | | | | | | | | | 0 5 46 42 |
| | | | 3 | SS | 7 | | | | | | | | | | | 0 0 44 52 |
| | | | 4 | TM | 11 | | | | | | | | | | | |
| | Soft to Firm | | 5 | TM | 11 | | | | | | | | | | | |
| 197.0 | Gray | | 6 | SS | 1 | 200 | | | | | | | | | | 0 2 68 30 |
| 18.0 | End of Borehole Probable Bedrock | | | | | 190 | | | | | | | | | | |

OFFICE REPORT ON SOIL EXPLORATION

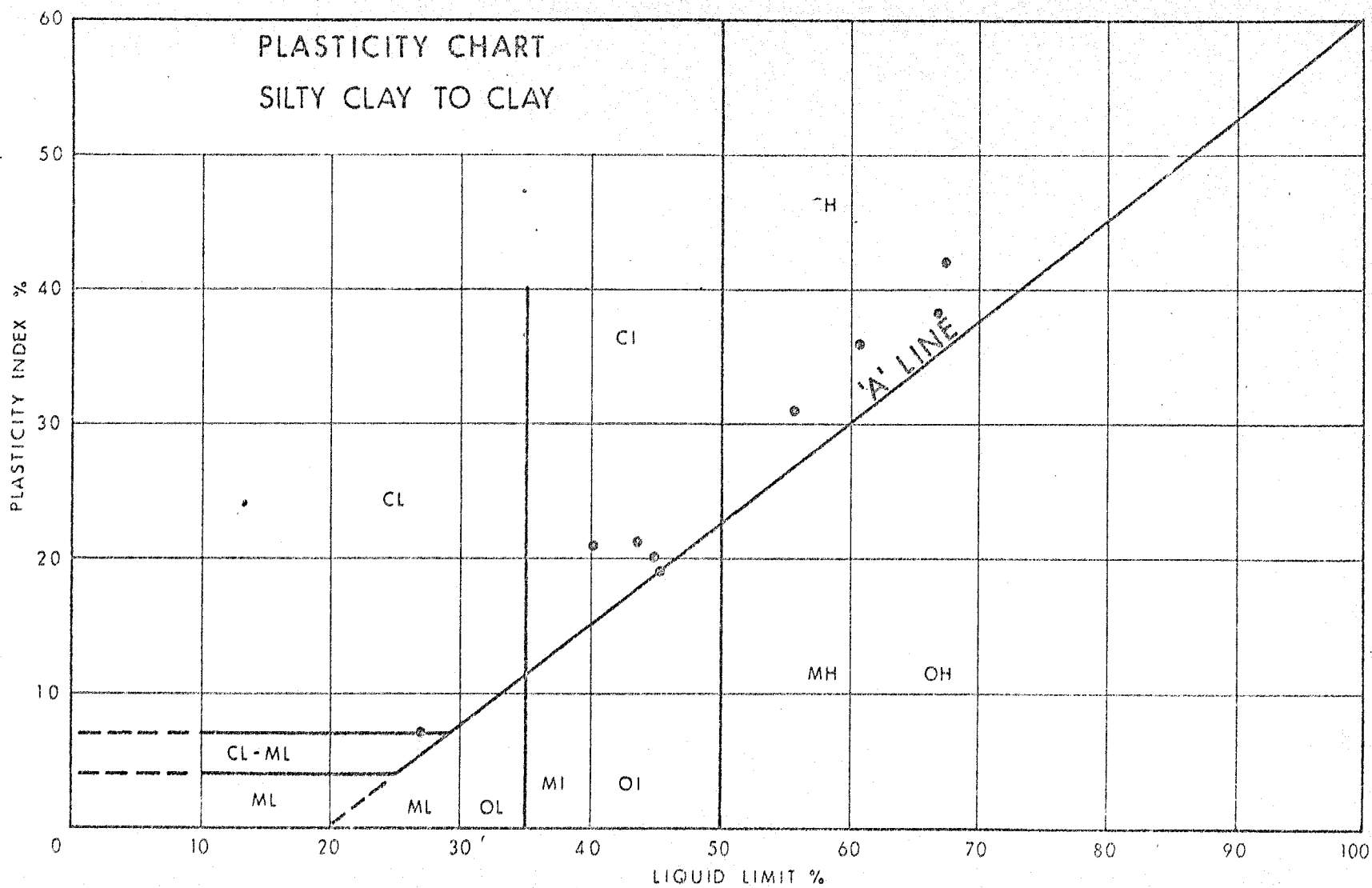
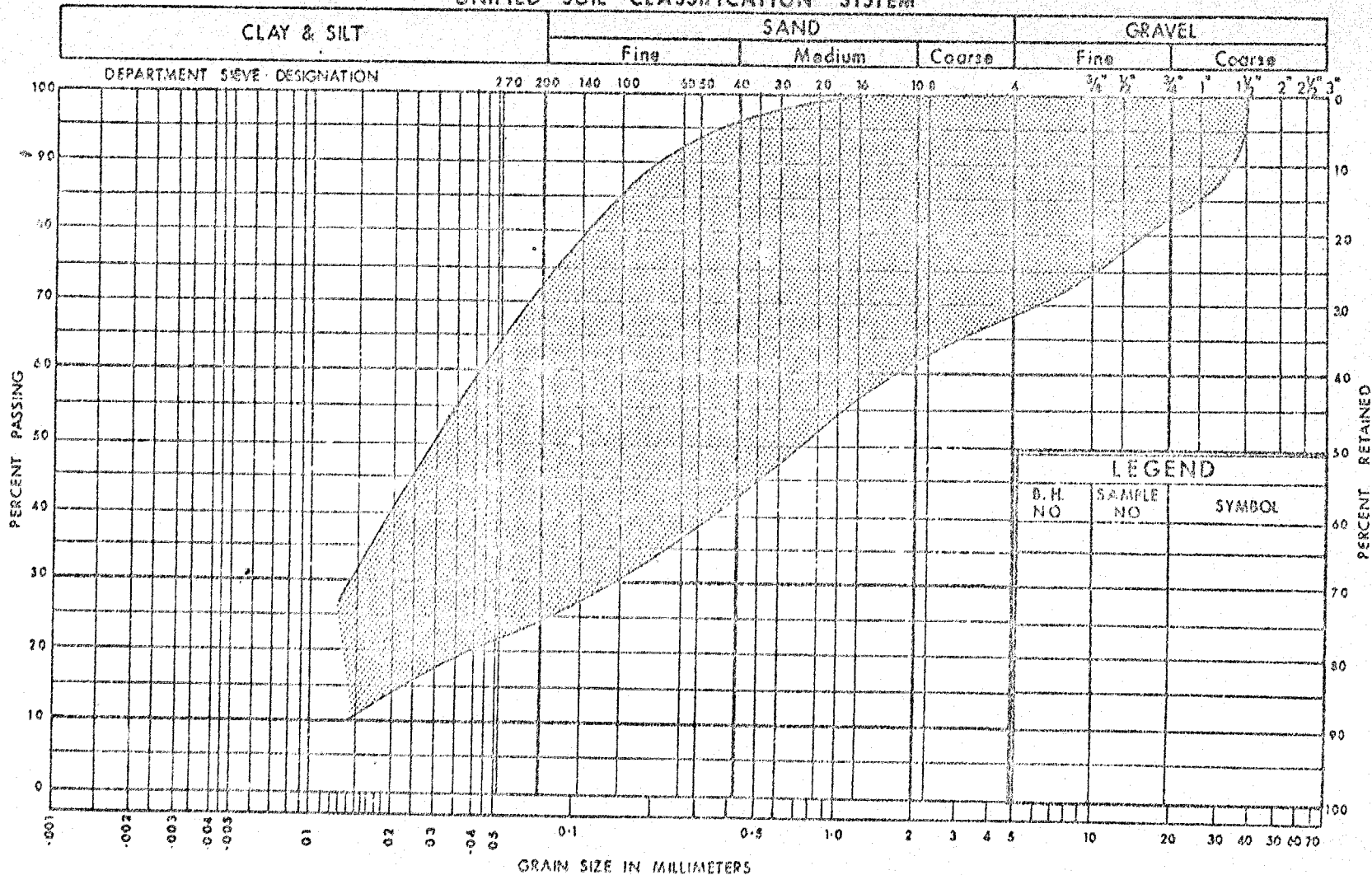


FIG. 1

UNIFIED SOIL CLASSIFICATION SYSTEM



LEGEND

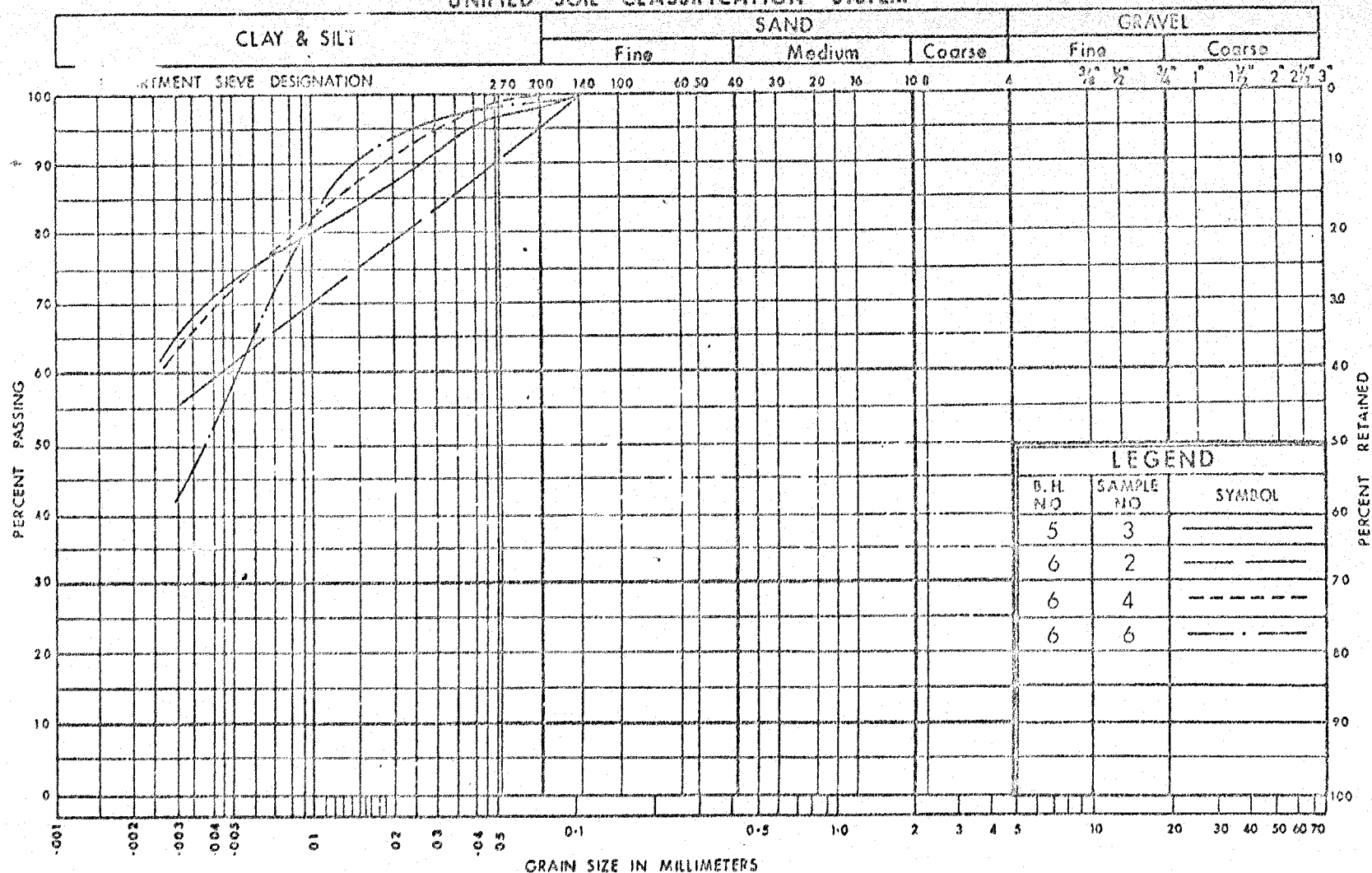
| D.H. NO | SAMPLE NO | SYMBOL |
|---------|-----------|--------|
| | | |

GRAIN SIZE DISTRIBUTION
SILTY SAND
WITH GRAVEL

| | |
|----------|----------|
| W.P. No. | 10-69-18 |
| JOB No. | 73-11078 |
| FIG. 2 | |

DEPARTMENT
OF
TRANSPORTATION AND COMMUNICATIONS
DESIGN SERVICES
BRANCH

UNIFIED SOIL CLASSIFICATION SYSTEM



DEPARTMENT
OF
TRANSPORTATION AND COMMUNICATIONS
DESIGN SERVICES
BRANCH

GRAIN SIZE DISTRIBUTION
SILTY CLAY TO CLAY
TRACE OF SAND

W.P. No. 10-69-18
JOS. No. 73-11078
FIG. 3

VOID RATIO - PRESSURE CURVES

JOB NO. 73-11078

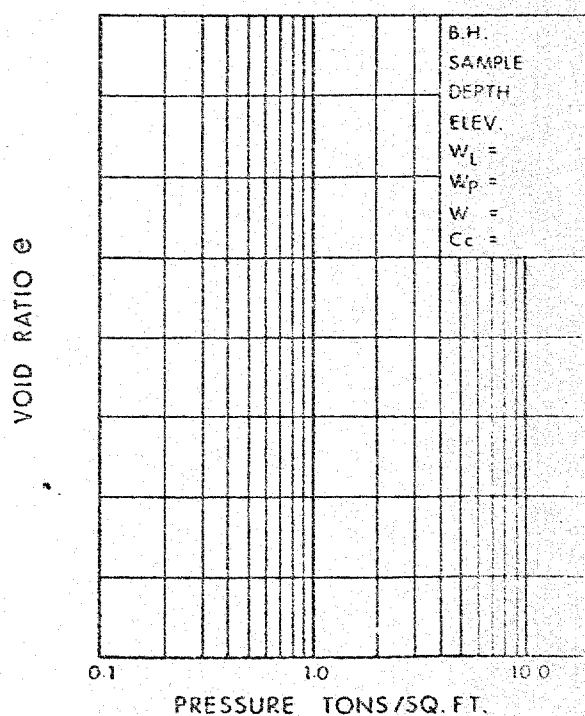
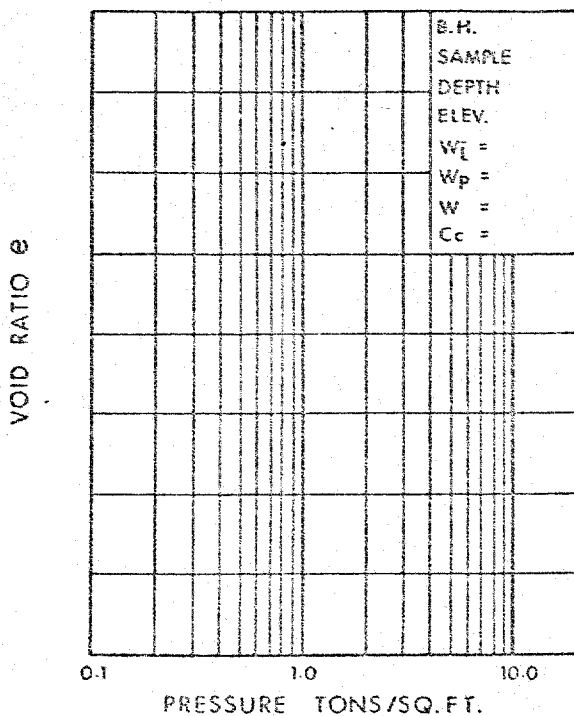
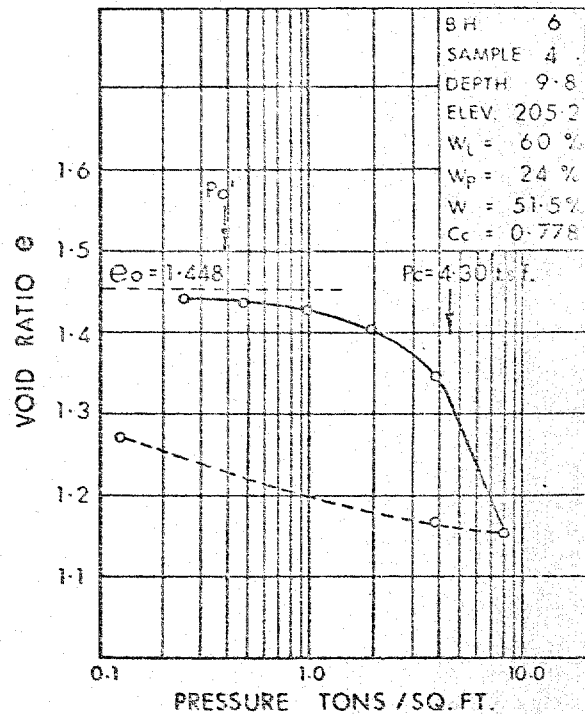
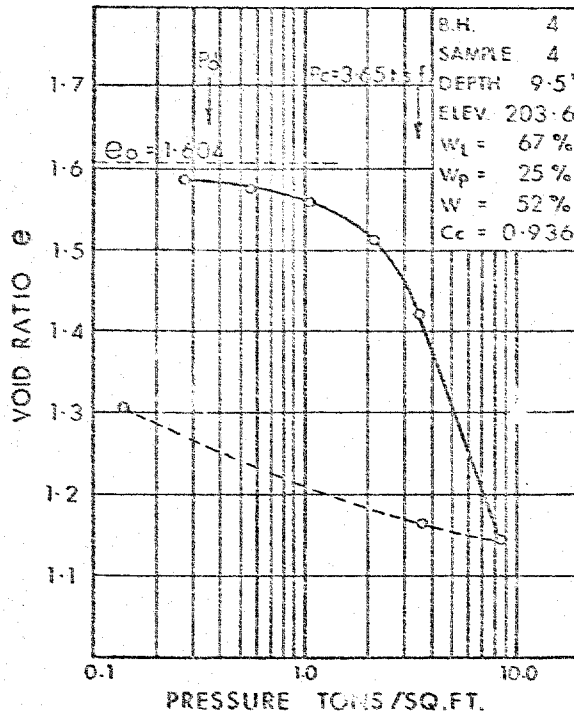


FIG. 4

FD-90 (Rev. Jan 73)

ABBREVIATIONS & SYMBOLS USED IN THIS REPORT

PENETRATION 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 |
| CU | 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 |
| 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_i | SENSITIVITY |

GENERAL

| | |
|-------------------------------------|-----------------------------------|
| π | = 3.1416 |
| e | BASE OF NATURAL LOGARITHMS 2.7183 |
| $\log_e \sigma$ OR $\ln \sigma$ | NATURAL LOGARITHM OF σ |
| $\log_{10} \sigma$ OR $\log \sigma$ | LOGARITHM OF σ TO BASE 10 |
| t | TIME |
| g | ACCELERATION DUE TO GRAVITY |
| V | VOLUME |
| W | WEIGHT |
| M | MOMENT |
| F | FACTOR OF SAFETY |

STRESS AND STRAIN

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

EARTH PRESSURE

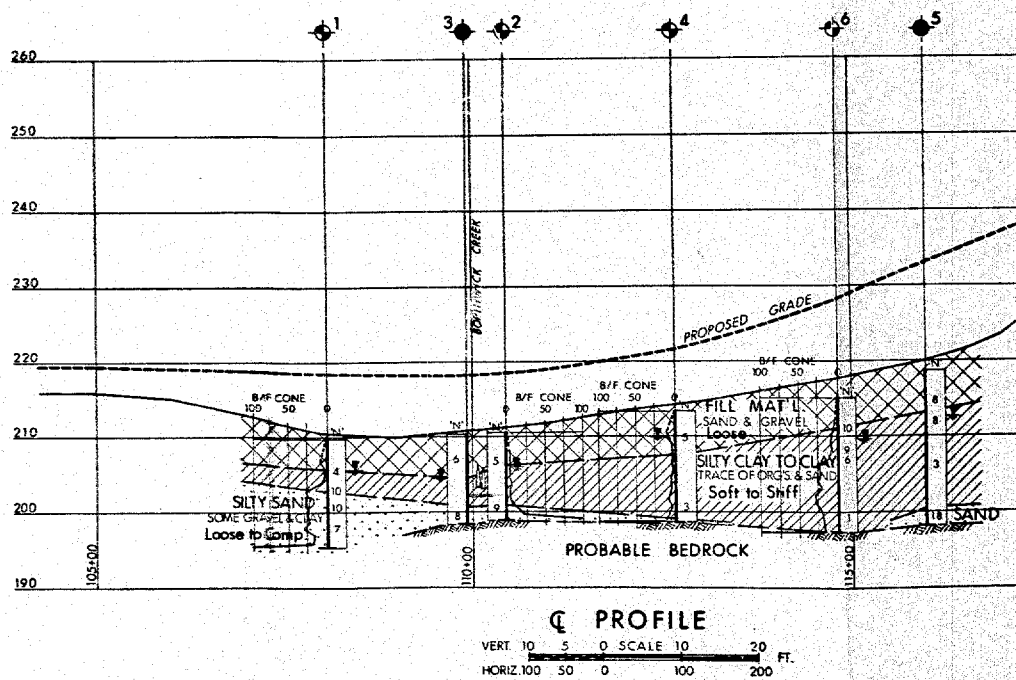
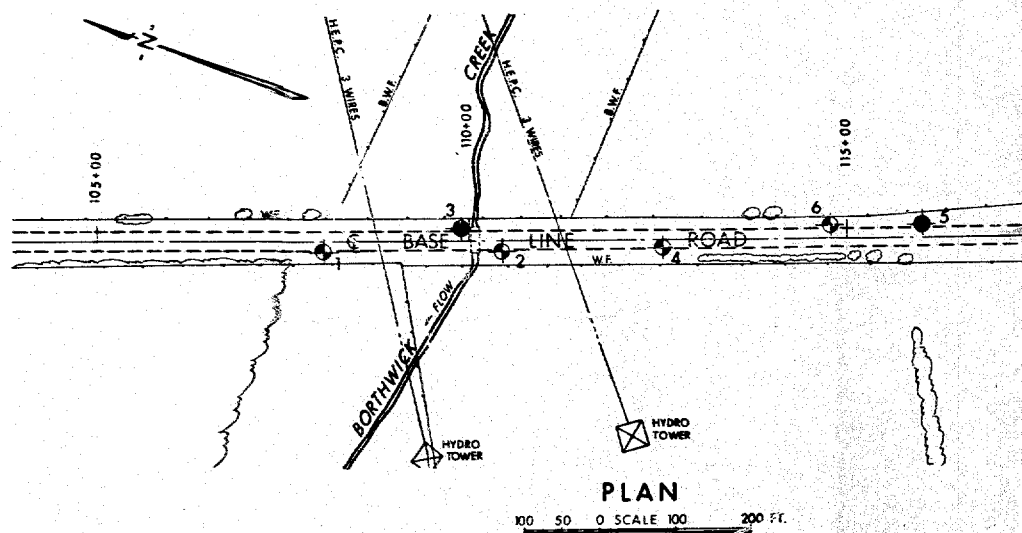
| | |
|----------|---|
| d | DISTANCE FROM TOP OF WALL TO POINT OF APPLICATION OF PRESSURE |
| δ | ANGLE OF WALL FRICTION |
| K | DIMENSIONLESS COEFFICIENT TO BE USED WITH VARIOUS SUFFIXES IN EXPRESSIONS REFERRING TO NORMAL STRESS ON WALLS |
| K_o | COEFFICIENT OF EARTH PRESSURE AT REST |

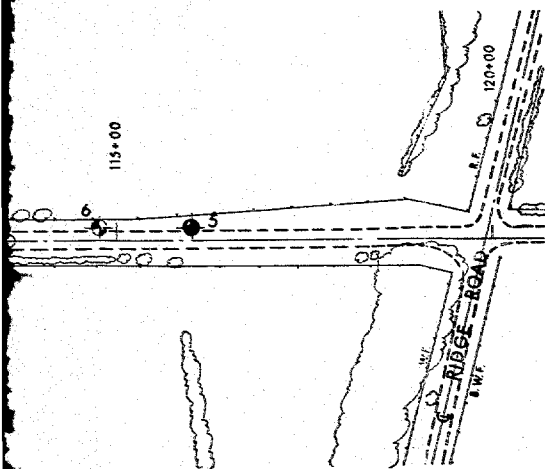
FOUNDATIONS

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

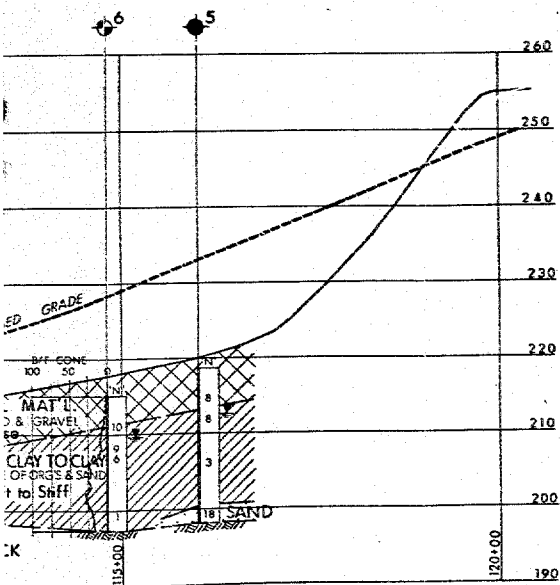
SLOPES

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





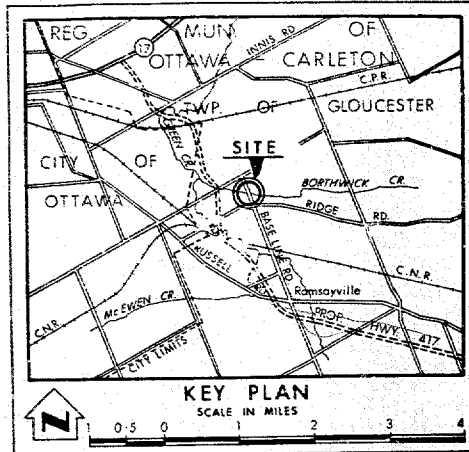
200 FT.



20
200

NOTE FOR CONTRACT DOCUMENT

The complete foundation investigation report for this structure may be examined at the Structural Office and Foundations Office, Downsview, and at the OTTAWA District Office.



LEGEND

- Bore Hole
- ⊕ Cone Penetration Test
- ⊕ Bore Hole & Cone Test
- ≡ Water Levels established at time of field investigation, SEPT. 1973

| NO. | ELEVATION | STATION | OFFSET |
|-----|-----------|---------|---------|
| 1 | 209.9 | 108+09 | 14' RT. |
| 2 | 210.4 | 110+44 | 13' RT. |
| 3 | 210.1 | 109+91 | 14' LT. |
| 4 | 213.1 | 112+66 | 10' RT. |
| 5 | 218.5 | 116+00 | 17' LT. |
| 6 | 215.0 | 114+80 | 14' LT. |

— NOTE —

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

| REVISIONS | DATE | BY | DESCRIPTION |
|-----------|------|----|-------------|
| | | | |
| | | | |
| | | | |

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

PROPOSED CULVERT BASE LINE RD. & BORTHWICK CR.

HIGHWAY NO. _____ DIST. NO. 9
REG. MUN. OF OTTAWA - CARLETON
TWP. GLOUCESTER LOT _____ CON. _____

BORE HOLE LOCATIONS & SOIL STRATA

| | | | |
|-------------------------------|---|-------------------|--------------------|
| SUBMD. J.B. | CHECKED <input checked="" type="checkbox"/> | WF NO. 10-69-18 | DRAWING NO. |
| DRAWN S.O. | CHECKED <input checked="" type="checkbox"/> | W.O. NO. 73-11078 | 73-11078 A |
| DATE 23 OCT 1973 | | SITE NO. | BRIDGE DRAWING NO. |
| APPROVED <i>[Signature]</i> | | CCNT. NO. | |
| PRINCIPAL FOUNDATION ENGINEER | | | |

PRIORITY

NOV 2 11 2:30
73-11078

DOWN KINR 4 NOV 2/ 73 2:30 URGENT

M DEVATA, FOUNDATIONS OFFICE

COPY TO KINR:

A J PERCY, SYSTEMS DESIGN

RE: W P 10-69-13, BASE LINE ROAD

BORTHUICK CREEK CROSSING INO-73-11078

A 130 P.C.F. FILL WEIGHT HAS BEEN ASSUMED FOR

FOUNDATION STABILITY AND SETTLEMENT CONSIDERATION ON

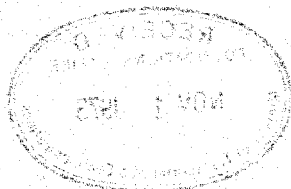
THE ABOVE NOTED PROJECT. IT IS QUITE PROBABLE THAT A FILL

MATERIAL WITH 140 P.C.F. DENSITY WILL BE USED. PLEASE ADVISE

ON FILLS WITH THIS LATER DENSITY.

A M BATTEN, M AND T

VF



MINISTRY OF TRANSPORTATION AND COMMUNICATIONS, ONTARIO

MEMORANDUM

TO: E. R. Saint,
Regional Materials Engineer,
Eastern Region, Kingston.

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

ATTENTION: M. Batten,
Senior Soils Supervisor.

DATE: November 12, 1973.

OUR FILE REF.

IN REPLY TO NOV 14 1973

SUBJECT: Proposed Culvert & Associated Approaches at
Crossing of Baseline Rd. & Borthwick Creek
Regional Municipality of Ottawa - Carleton
District #9
W.O. 73-11078 W.P. 10-69-18

With reference to your teletype dated November 1, 1973, it informed us stating that fill material (shale) with a bulk density of 140 p.c.f. material will be used instead of earth material.

Computations using the revised density of 140 p.c.f. for the fill material have been carried out and the results conclude that fills up to 14 feet in height will be stable with 2:1 slopes. For fills in excess of 14 feet in height, mid-height berms will be necessary. The length of mid-height berm for various fill heights are presented in the following table.

| <u>Fill Height (feet)</u> | <u>Berm Length (feet)</u> |
|---------------------------|---------------------------|
| 16 | 5 |
| 18 | 10 |
| 20 | 15 |

In addition, settlements of the silty clay stratum can be anticipated due to the increased density of the fill material. It is estimated that the settlement for a 20 feet embankment with berms could be in the order of 4 to 5 inches. The major portion of predicted settlement will occur in a relatively short period of time (approximately 6 months). It may prove advantageous to delay final paving operations in order to minimize post-construction maintenance. If scheduling permits, a period of at least 6 months would prove adequate for this purpose.

If you have any further queries regarding this matter, please do not hesitate to contact our Office.

JTB/ji

c.c. E. J. Orr
B. R. Davis
A. Rutka
A. J. Percy
J. M. Childs
B. J. Giroux
T. C. Kingsland
G. A. Wrong
B. A. Singh
M. M. Dillon (Ottawa)
Foundation Files
Documents

J. T. Bangs
J. T. Bangs,
Project Foundations Engineer,
For: M. Devata,
Supervising Foundations Engineer.

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS, ONTARIO

MEMORANDUM

TO: Mr. M. Devata,
Supervising Foundations Engineer,
Soils Mechanics Section,
Downsview, Ontario.

FROM: Structural Planning Office,
Kingston, Ontario.

ATTENTION:

DATE: 6 May 1974.

OUR FILE REF.

IN REPLY TO

SUBJECT: W.P. 10-69-18 - W.O. 73-11078
Borthwick Creek Culvert at Base Line Road
District 9 - Ottawa

With reference to the above-mentioned culvert, please find enclosed copies of correspondence from Mr. S. J. Markiewicz, Regional Systems Design office, and M. M. Dillon Limited.

I shall be glad to receive any comments you may have in respect to the queries in the correspondence regarding the possible substitution of a circular pipe culvert for either a rigid frame concrete culvert or a multi plate pipe arch and also concerning the bedding material to be used for a circular pipe.

T. C. Kingsland

T. C. Kingsland
Regional Structural Planning Engineer

TCK/hl
encls.

c.c. C. S. Grebski - Att. K. Bassi

*TCK to supply finalized
culvert level.*
cl/Port May 10/74

ele. 202.5



MINISTRY OF TRANSPORTATION AND COMMUNICATIONS, ONTARIO

MEMORANDUM



TO: Mr. T. C. Kingsland
Regional Structural Planning Engineer
Kingston

FROM: Systems Design Office
Kingston

ATTENTION:

DATE: May 1, 1974

OUR FILE REF.

IN REPLY TO

SUBJECT:

W. P. 10-69-18
Baseline Road. District 9 - Ottawa
From Blake Road to Walkley Road

Attached for your information is a copy of a letter received from M. M. Dillon in which they recommend an 8 foot diameter multi-plate pipe on Baseline Road for Borthwick Creek.

The Foundation Report for the site suggests either a Rigid Frame Concrete Culvert or a Multi-Plate Pipe Arch.

I would appreciate any comments you may have and in particular the bedding requirements for a circular pipe.


S. J. Markiewicz
Sr. Project Design Engineer

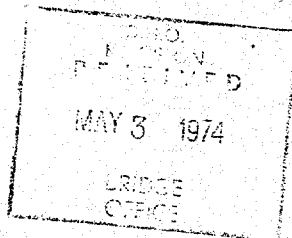
SJM/jeb

att:

c. c. E. Saint
J. M. Childs

Copies made for: (TCK: 6/5/74)

✓ M. Devata
C. S. Grebski - Att. K. Bassi



M. M. DILLON LIMITED

consulting engineers and planners

280 METCALFE STREET, OTTAWA, ONTARIO, K2P 1R7 • 613-236-9589

OUR FILE: 6830-18

YOUR FILE:

25 April 1974

Ministry of Transportation
and Communications
Postal Bag 4000
Kingston, Ontario

Attention: Mr. S.J. Markiewicz, P.Eng.

Base Line Road
W.P. 10-69-18

Dear Sirs:

With reference to the foundation investigation report for the crossing of Base Line Road and Borthwick Creek, W.O. 73-11078, we request an update to the recommendations. The two culverts considered are a rigid frame and multi-plate pipe arch. Our design is now for an 8 foot plate pipe culvert. We would appreciate recommendations from the Foundations Office with regards to bedding and backfill requirements for this circular culvert.

If there are any questions, please call us.

Yours truly,

M. M. DILLON LIMITED

J.A. Seaborn
J.A. Seaborn, P.Eng.
Project Engineer

JAS:ls

Mr. T.C. Kingsland,
Reg. Structural Planning Engineer,
Eastern Region, Kingston.

Soil Mechanics Section,
Geotechnical Office,
West Building, Downsview.

May 13th, 1974.

RE: Borthwick Creek Culvert at Baseline Road,
Twp. of Gloucester, Regional Municipality
of Ottawa-Carleton, District #9, Ottawa,
W.O. 73-11078 W.P. 10-69-18.

It is understood that an 8-foot diameter plate pipe culvert will be employed at the crossing of Base Line Road and Borthwick Creek. The bottom of the circular pipe culvert will be at elevation 202.5. At this elevation the subsoil is a soft to firm silty clay which is underlain by a granular deposit. Type 1 bedding as specified in M.T.C. Standard No. DD-808-A may be used. The backfill should be carried out in accordance with M.T.C. Standard No. DD-813-A.

The excavation for the culvert will be carried out within the cohesive silty clay. The bottom of excavation will be some 4 feet (1.2 m) below the groundwater level recorded during the field investigation (September, 1973) and the distance between bottom of excavation and the upper boundary of the granular deposit is approximately 2 feet (0.6 m). It is possible that the base of the excavation may heave due to the unbalanced hydrostatic head existing within the granular deposit. This may be overcome by continuously pumping from sumps which should extend into the granular deposit by at least one foot (0.3 m) at both sides of the excavation, provided that the following procedures are used.

- i) Excavate a section of no more than 25 feet (7.6 m) long.
- ii) Install the culvert and complete the backfilling to grade prior to excavating the next section.

May 13th, 1974.

Mr. T.C. Kingsland - RE: W.O. 73-11078.

Should you require additional information, or further clarification of any aspect of the foregoing, please contact this Office.

C.S. Poon,
Project Engineer,
For: M. Devata,
Supervising Engineer.

CSP/mj
c.c. J.M. Childs,
K. Bassi,
S.J. Markiewicz,
M.M. Dillon Ltd., Ottawa.
(ATTN: J.A. Seaborn)

Files
Documents