

G.I.-30 SEPT. 1976

GEOCRES No. 30M3-206DIST. 4 REGION W.P. No. 46-74-37CONT. No. 77-02W. O. No. STR. SITE No. 1HWY. No. 406LOCATION Detour & Preloading
Geneva St.No. of PAGES -

OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT. REMARKS:

FOUNDATION INVESTIGATION & DESIGN REPORT

W.P. 46-74-37

DIST. 4

HWY. N/A

STR. SITE

N/A

1. 24" Watermain at Downing St. and Carlisle St.
2. 24" Sanitary Sewer at Downing St. and South Drive

DISTRIBUTION

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Memorandum

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

From: Soil Mechanics Section
Geotechnical Office
West Building, Downsview

Attention:

Date: July 29, 1976

Our File Ref.

In Reply to

Subject:

W.P. 46-74-37
1. 24" Watermain at Downing St. and Carlisle St.
2. 24" Sanitary Sewer at Downing St. and South Drive
District 4, Hamilton

INTRODUCTION

This report contains results of a foundation investigation carried out by this Section at the following sites:

1. 24" Watermain at Downing St. and Carlisle St.
2. 24" Sanitary Sewer at Downing St. and South Drive.

Also contained in this report are recommendations for the foundations of the above mentioned utilities.

SITE DESCRIPTION

The proposed watermain crosses the Geneva-Glenridge Valley, where the Old Welland Canal is located, at approximately 1200 feet east of the Glenridge Fill. The area in concern is bounded to the north by Park St. and to the south by Downing St. At this locale the valley is about 650 feet wide, flanked by moderate slopes of 60 to 70 feet high. The valley, in general, is grass covered but sparsely treed. At this particular area, the old channel of the canal has been filled in and the canal has been relocated to a 3 cell box culvert.

The site of the sanitary sewer is just south of the watermain site and is also in a valley where Downing St. intersects with South Drive. This valley is proposed to be spanned by the future Westchester Crescent, by means of a fill. The slopes of the valley are about 50 to 65 feet high, not steeper than 2.5:1 overall, and at present are covered with trees. Residential developments are the major land use of the areas.

SUBSURFACE CONDITIONS

A total of seven sampled boreholes (No. 1 to 5, and No. 61 to 62 inclusive) were put down during the period of April 13 to April 22, 1976. Results of another four boreholes (No. 13, 14, 115 and 311) previously put down for feasibility study of Hwy. 406 are also incorporated here.

Locations of the boreholes, together with the inferred subsoil stratigraphy, are shown in Dwg. No. 467437-A and B. Details of the borehole results are also presented in the Borehole Record Sheets which are included in the Appendix to this report. A description of the various subsoil types is given below.

In general, subsoil at these sites consists of a thick deposit of clayey silt, underlain by a deposit of silty sand. In the vicinity of the three cell box culvert, the clayey silt is overlain by a layer of mixed fill.

Clayey Silt

The clayey silt is the predominant deposit in the area and is intercepted in all boreholes. This deposit generally exists from ground surface to elev. 247+, except in the neighborhood of the Old Welland Canal where it is overlain by a layer of mixed fill. According to the consolidation test results, the clayey silt is an overly consolidated material. Inferred from the 'N' values of the Standard Penetration Test and undrained shear strengths, this material is classified as stiff to firm in consistency. The Atterberg Limits and moisture contents, as determined by our lab tests, have the following ranges of values:

| | |
|-----------------------------|------------|
| Liquid Limits (LL) | 37% to 50% |
| Plasticity Limits (PL) | 18% to 22% |
| Moisture Contents (w_n) | 25% to 35% |

A plot of the liquid limits and the plasticity indices on the Plasticity Chart shows that the material is medium to low in plasticity. Lab tests have also been carried out to determine the PH values, concentration of SO_3 , and organic contents. This information is for choosing a corrosive resistant material for the watermain. The test results, which are reported in the Borehole Log Sheets, show that the clayey silt is generally slightly basic and contains an SO_3 concentration from 50 ppm to 2750 ppm.

Sandy Silt to Silty Sand

Underneath the clayey silt is a deposit of sandy silt/silty sand, the lower boundary of which, due to the purpose of the present investigation, is not fully determined. In Borehole 311, the silty sand is found to be underlain by a glacial till at elev. 203+. On the basis of the 'N' values, the relative density of this deposit is in the range of compact to very dense. Results of grain size analyses show that this material contains 35% to 60% silt and the sand component is predominantly fine grained. This deposit also contains trace of clay and fine gravel. Typical grain size distribution curves are shown in the Appendix.

Mixed Fill

In the area between Sta. 4+50 and Sta. 8+00, the site is covered with a layer of cohesive fill. Thickness of this material increases towards the Old Welland Canal, extending to elev. 268+ near Sta. 5+50 and Sta. 7+00 for a maximum thickness of about 23 ft. Although it is composed of mainly clayey silt, due to inclusions of organic matters, cinders, etc., its composition is very heterogeneous and its consistency is very non-uniform, ranging from stiff to very soft. Some Atterberg Limits, moisture contents, and chemical contents determined for this material are included in the Borehole Log Sheets.

GROUNDWATER CONDITIONS

Groundwater levels were observed in the open boreholes during our field investigation and they reflected the prevailing conditions at the time of observation. Our observations showed that groundwater generally existed within 5 feet of ground surface at the watermain site and it drained into the three cell box culvert. In the slope of the sewer site, groundwater was observed at 10 to 20 feet below ground surface.

RECOMMENDATIONS

Placement of the Hwy. 406 fill has necessitated the existing underground utilities to be relocated. Because of the presence of the mixed fill in the vicinity of the culvert, concern has been expressed over the large differential settlements anticipated for the mixed fill. Concern has also been expressed over the stability of the existing slope in which the new sewer is to be constructed.

Based on our subsoil information, the following recommendations are given:

- (a) With regard to the effect on the adjacent 50 ft. high slope between Downing St. and South Drive of the new sewer installation, it is our opinion that if the sewer trench incorporates a subdrain - an 8 inch perforated plastic pipe covered by 12 inch minimum Granular 'A' backfill material - the net result will be an increase rather than a decrease in stability. No major construction problems are anticipated for the sewer construction.
- (b) The proposed new watermain will be constructed in areas which are to be backfilled later when construction of Hwy. 406 takes place. This back fill will cause settlements of the watermain which will thereby be subjected to differential movements. Our estimates of these settlements are as follows:

| <u>Station</u> | <u>Estimated Settlements</u> |
|----------------|------------------------------|
| 1 + 00 | 0" |
| 1 + 70 | 3" |
| 2 + 20 | 10" |
| 3 + 30 | 10" |
| 3 + 90 | 4" |
| 5 + 00 | 8" |
| 5 + 50 | 20" |
| 7 + 00 | 20" |
| 7 + 70 | 3" |
| 9 + 30 | 0" |

It will be noted that from Sta. 5 + 50 to Sta. 7 + 00, a large settlement in the order of 20 inches is anticipated. This is due to the presence of about 15 ft. of soft organic soil below the proposed watermain invert. In our view, it would be advisable to excavate this material for a width of 8 ft. and replace to the pipe invert level with Granular 'A' material. This should result in a settlement over this section not exceeding about 2-3 inches.

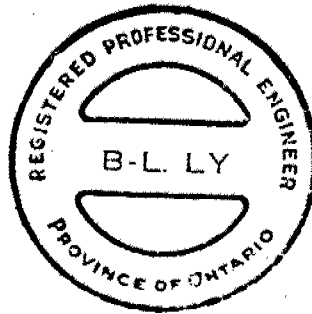
To reduce the magnitude of a possible bump at the surface of the future Hwy. 406 vertically above the watermain, it would be advisable to construct an 'imperfect' trench at least 6 feet in depth (minimum) above the bedding for the watermain.

MISCELLANEOUS

The recent fieldwork was carried out during the period of April 13 to April 22, 1976, under the supervision of Mr. B. Ly. The drilling equipment was owned and operated by Atcost Drilling Company. This report was prepared by Mr. B. Ly and reviewed by Mr. K. Selby, Supervising Engineer.

B. Ly

B. Ly, P. Eng.
Senior Engineer



K.G. Selby

K.G. Selby, P. Eng.
Supervising Engineer

KGS/gs
July, 1976

APPENDIX

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

RECORD OF BOREHOLE NO 1

WP 46-74-37 (A) LOCATION Co-ords. 1,069,226 E.; 15,680,477 N; ORIGINATED BY MK
 DIST 4 HWY 406 BORING DATE April 13, 14, 1976 COMPILED BY MK
 DATUM Geodetic BOREHOLE TYPE NX & BX Casing CHECKED BY _____

| SOIL PROFILE | | | SAMPLES | | | GROUND WATER ELEV | 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 | | |
| 307.1 | Ground Level | | | | | | | | | | | | | | | |
| 0.0 | Clayey silt - low to medium plasticity containing some sand | | 1 | SS | 12 | | | | | | | | | | | |
| | | | 2 | SS | 14 | | | | | | | | | | | |
| | Very stiff, brown and fissured | | 3 | SS | 18 | | | | | | | | | | | |
| | | | 4 | SS | 15 | | | | | | | | | | | |
| | Grey and Firm | | 5 | SS | 5 | | | | | | | | | | | |
| | | | 6 | TW | PM | | | | | | | | | | | |
| | | | 7 | SS | 7 | | | | | | | | | | | |
| | Stiff | | 8 | SS | 7 | | | | | | | | | | | |
| | | | 9 | SS | 16 | | | | | | | | | | | |
| | containing some sand | | | | | | | | | | | | | | | |
| | and fine gravel sizes | | 10 | SS | 23 | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | |
| | | | 11 | SS | 13 | | | | | | | | | | | |
| 239.1 | becoming very sandy | | 12 | SS | 110 | 240 | | | | | | | | | | |
| 68.0 | End of Borehole | | | | | | | | | | | | | | | |
| | Note: ¹ BH open to El. 297.6 April 20/76 | | | | | | | | | | | | | | | |
| | 2. Water level not established | | | | | | | | | | | | | | | |
| | 3. Chemical tests | | | | | | | | | | | | | | | |
| | Sample Organic PH SO_3 | | | | | | | | | | | | | | | |
| | SS-3 -- 8.22 240 ppm | | | | | | | | | | | | | | | |

RECORD OF BOREHOLE NO 2

WP 46-74-37 (A) LOCATION Co-ords. 1,069,170 E; 15,680,710 N. ORIGINATED BY MK
 DIST 4 HWY 406 BORING DATE April 20, 21, 1976 COMPILED BY MK
 DATUM Geodetic BOREHOLE TYPE Hollow Stem Auger CHECKED BY

| SOIL PROFILE | | | SAMPLES | | | GROUND WATER ELEV | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | | | | LIQUID LIMIT w_L PLASTIC LIMIT w_p WATER CONTENT w | | | UNIT WEIGHT γ P.C. FGR SA SI CL | REMARKS |
|---------------|---|-------------|-----------------|------|------------|----------------------|---|-----|------|------|------|--|-----|-------|---|---------|
| ELEV DEPTH | DESCRIPTION | STRAT. PLOT | NUMBER | TYPE | 'N' VALUES | | 20 | 40 | 60 | 80 | 100 | w_p | w | w_L | | |
| 293.1 | Ground Level | | | | | | 400 | 800 | 1200 | 1600 | 2000 | 20 | 40 | 60 | | |
| 0.0 | Fill - heterogeneous mixture of sand, clay & cinder, some organic | | 1 | SS | 10 | 290 | | | | | | | | | | |
| | | | 2 | SS | 9 | | | | | | | | | | | |
| | | | 3 | SS | 3 | | | | | | | | | | | |
| 283.6 | | | 4 | SS | 5 | | | | | | | | | | | |
| 9.5 | Clayey Silt | | 5 | SS | 11 | | | | | | | | | | | |
| | Grey, Firm to Stiff | | 6 | SS | 12 | | | | | | | | | | | |
| | | | 7 | SS | 12 | | | | | | | | | | | |
| | | | 8 | SS | 7 | | | | | | | | | | | |
| | low to medium plasticity, | | 9 | TW | PH | | | | | | | | | | | |
| | traces of sand | | 10 | SS | 4 | | | | | | | | | | | |
| | | | 11 | TW | PH | | | | | | | | | | | |
| | | | 12 | SS | 14 | | | | | | | | | | | |
| | | | 13 | SS | 12 | | | | | | | | | | | |
| 250.1 | | | 14 | SS | 8 | | | | | | | | | | | |
| 43.0 | Silty Sand | | | | | | | | | | | | | | | |
| | Fine | | 15 | SS | 23 | | | | | | | | | | | |
| | Compact to Dense | | | | | | | | | | | | | | | |
| 231.6 | | | 16 | SS | 38 | | | | | | | | | | | |
| 61.5 | End of Borehole | | | | | | | | | | | | | | | |
| | Note: | | | | | | | | | | | | | | | |
| | Chemical test results | | | | | | | | | | | | | | | |
| | Sample Organic PH | | SO ₃ | | | | | | | | | | | | | |
| | SS-2 2.25% 8.25 | | 440 | ppm | | | | | | | | | | | | |
| | SS-4 3.76% 8.15 | | 430 | ppm | | | | | | | | | | | | |

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

RECORD OF BOREHOLE NO 3

WP 46-74-37 (A) LOCATION Co-ords. 1,069,172 E. 15,680,813 N. ORIGINATED BY MK
DIST 4 HWY 406 BORING DATE April 15, 20, 1976 COMPILED BY MK
DATUM Geodetic BOREHOLE TYPE Hollow Stem Auger CHECKED BY

| SOIL PROFILE | | | SAMPLES | | | GROUND WATER ELEV | 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_L | | |
| 289.0 | Ground Level | | | | | | | | | | | | | | |
| 0.0 | Clay Fill | | 1 | SS | 17 | | | | | | | | | | |
| | homogeneous & stiff | | 2 | SS | 13 | | | | | | | | | | |
| 282.0 | | | 3 | SS | 9 | | | | | | | | | | |
| 7.0 | Mixed Fill - mainly | | 4 | SS | 8 | | | | | | | | | | |
| | sand, silt, some clay | | 5 | TW | PH | | | | | | | | | | |
| | and organic, Black | | 6 | TW | PH | | | | | | | | | | |
| 274.0 | | | 7 | SS | 62 | | | | | | | | | | |
| 15.0 | Clay Fill - some sand | | 8 | SS | 12 | | | | | | | | | | |
| | and organic | | 9 | SS | 9 | | | | | | | | | | |
| 268.0 | Soft | | 10 | SS | 9 | | | | | | | | | | |
| | | | 11 | SS | 8 | | | | | | | | | | |
| 21.0 | Clayey silt, grey, | | 12 | SS | 12 | | | | | | | | | | |
| | stiff to firm, with | | 13 | SS | 20 | | | | | | | | | | |
| | traces of sand, low | | 14 | SS | 14 | | | | | | | | | | |
| | to medium plasticity | | 15 | SS | 8 | | | | | | | | | | |
| | becoming more sandy, | | 16 | SS | 7 | | | | | | | | | | |
| 249.0 | some fine gravel | | 17 | SS | 33 | | | | | | | | | | |
| 40.0 | Silty Sand | | 18 | SS | N/A | | | | | | | | | | |
| | Fine and Dense, | | 19 | SS | N/A | | | | | | | | | | |
| | occasional clay seams | | | | | | | | | | | | | | |
| | becoming denser | | | | | | | | | | | | | | |
| 229.0 | | | | | | | | | | | | | | | |
| 60.0 | End of Borehole | | | | | | | | | | | | | | |
| | Note: | | | | | | | | | | | | | | |
| | Chemical test results | | | | | | | | | | | | | | |
| | Sample Organic PH SO ₃ | | | | | | | | | | | | | | |
| | SS-3 2.86% 7.85 550 ppm | | | | | | | | | | | | | | |
| | TW-6 1.04% 8.34 180 ppm | | | | | | | | | | | | | | |
| | SS-8 3.05% 8.05 250 ppm | | | | | | | | | | | | | | |
| | water -- 7.77 22 ppm | | | | | | | | | | | | | | |

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

RECORD OF BOREHOLE NO 4

WP 46-74-37 (A) LOCATION Co-ords. 1,069,155 E; 15,681,013 N; ORIGINATED BY MK
DIST 4 HWY 406 BORING DATE April 14, 1976 COMPILED BY MK
DATUM Geodetic BOREHOLE TYPE Hollow Stem Auger CHECKED BY

| SOIL PROFILE | | | SAMPLES | | | GROUND WATER ELEV | 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 | | |
| 294.4 | Ground Level | | | | | | | | | | | | | | | |
| 0.0 | Fill - mixture of clay & sand with some gravel, some organic | | 1 | SS | 12 | 290 | | | | | | | | | | |
| 285.4 | | | 2 | SS | 10 | | | | | | | | | | | |
| 9.0 | Clayey Silt | | 3 | SS | 7 | | | | | | | | | | | |
| | Very Stiff to Stiff | | 4 | TW | PH | | | | | | | | | | | |
| | fissured, containing traces of sand | | 5 | SS | 21 | | | | | | | | | | | |
| | | | 6 | SS | 13 | | | | | | | | | | | |
| | | | 7 | TW | PH | | | | | | | | | | | |
| | | | 8 | SS | 19 | | | | | | | | | | | |
| | | | 9 | SS | 14 | | | | | | | | | | | |
| | | | 10 | SS | 10 | | | | | | | | | | | |
| | | | 11 | SS | 9 | | | | | | | | | | | |
| | | | 12 | SS | 12 | | | | | | | | | | | |
| | | | 13 | SS | 16 | | | | | | | | | | | |
| 262.9 | | | 14 | SS | 14 | | | | | | | | | | | |
| 31.5 | End of Borehole | | | | | | | | | | | | | | | |
| Note : Chemical Test Results Sample Org. PH S03 SS-2 2.39% 8.08 550 ppm Water - 8.10 375 ppm | | | | | | | | | | | | | | | | |

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

RECORD OF BOREHOLE NO 5

WP 46-74-37 (A) LOCATION Co-ords. 1,069,172 E. 15,680,910 N ORIGINATED BY MK
DIST 4 HWY 406 BORING DATE April 13, 1976 COMPILED BY MK
DATUM Geodetic BOREHOLE TYPE Hollow Stem Auger CHECKED BY

| SOIL PROFILE | | | SAMPLES | | | GROUND WATER ELEV | 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 | | |
| 289.7 | Ground Level | | | | | | | | | | | | | | | |
| 0.0 | Fill | | | | | | | | | | | | | | | |
| | Silty Clay | | 1 | SS | 23 | | | | | | | | | | | |
| | Very Stiff | | 2 | SS | 18 | | | | | | | | | | | |
| 281.7 | | | 3 | SS | 11 | | | | | | | | | | | |
| 8.0 | Fill: clayey, some sand & organic | | 4 | TW | PH | | | | | | | | | | | |
| | Firm to Very Stiff | | 5 | TW | PH | | | | | | | | | | | |
| | | | 6 | SS | 12 | | | | | | | | | | | |
| | | | 7 | TW | PH | | | | | | | | | | | |
| 267.7 | becoming very sandy | | 8 | SS | 15 | | | | | | | | | | | |
| 22.0 | Clayey silt - grey, stiff, low to medium plasticity, some sand and fine gravels | | 9 | SS | 22 | | | | | | | | | | | |
| | | | 10 | SS | 13 | | | | | | | | | | | |
| | | | 11 | SS | 10 | | | | | | | | | | | |
| | | | 12 | SS | 45 | | | | | | | | | | | 11 23 53 13 |
| 243.2 | becoming very sandy | | 13 | SS | 44 | | | | | | | | | | | 1 23 61 15 |
| 46.5 | End of Borehole | | | | | | | | | | | | | | | |
| | Note : | | | | | | | | | | | | | | | |
| | Chemical test results | | | | | | | | | | | | | | | |
| | Sample Organic PH SO_3 | | | | | | | | | | | | | | | |
| | SS-3 0.77% 8.0 | | | | 2750 ppm | | | | | | | | | | | |
| | TW-5 1.66% 8.07 | | | | 130 ppm | | | | | | | | | | | |
| | SS-8 0.38% 8.31 | | | | 40 ppm | | | | | | | | | | | |
| | water -- 8.14 | | | | 70 ppm | | | | | | | | | | | |

OFFICE REPORT ON SOIL EXPLORATION

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

RECORD OF BOREHOLE NO 115

WP 46-74-(A) LOCATION Co-ords. 15,680,606 N; 1,069,219 E. ORIGINATED BY EK
DIST 4 HWY BORING DATE November 3-4, 1971 COMPILED BY AKB
DATUM Geodetic BOREHOLE TYPE Auger CHECKED BY

| SOIL PROFILE | | | SAMPLES | | | GROUND WATER ELEV | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | | | | LIQUID LIMIT w_L PLASTIC LIMIT w_p WATER CONTENT w | | | UNIT WEIGHT γ P.C.F. | REMARKS |
|---------------|--|-------------|---------|------|---------------------|----------------------|---|----|----|----|-----|--|-----|-------|--------------------------------------|------------|
| ELEV DEPTH | DESCRIPTION | STRAT. PLOT | NUMBER | TYPE | 'N' VALUES | | 20 | 40 | 60 | 80 | 100 | w_p | w | w_L | | |
| 299.1 | Ground Level | | | | | | | | | | | | | | | |
| 0.0 | Clayey silt, traces of sand and gravel Very Stiff to Stiff Brown and Grey | | 1 | SS | 15 | | | | | | | | | | | |
| | | | 2 | SS | 15 | | | | | | | | | | | |
| | | | 3 | SS | 10 | 290 | | | | | | | | | 121 | |
| | | | 4 | TW | PH | | | | | | | | | | 119 | |
| | | | 5 | TW | PH | | | | | | | | | | | |
| | | | 6 | TW | PH | 280 | | | | | | | | | 118 | |
| | | | 7 | SS | 19 | | | | | | | | | | | |
| | | | 8 | TW | PH | 270 | | | | | | | | | 130 | |
| | | | 9 | SS | 15 | | | | | | | | | | | |
| | | | 10 | TW | PH | 260 | | | | | | | | | 133 | |
| | | | 11 | TW | PH | | | | | | | | | | 113 | |
| | | | 12 | TW | PH | 250 | | | | | | | | | 123 116 | |
| 242.1 | | | 13 | TW | PH | | | | | | | | | | 135 | |
| 57.0 | Silty sand, some clay. Very Dense | | 14 | SS | 100/10 ⁿ | 240 | | | | | | | | | | 0 31 58 11 |
| | | | 15 | SS | 97 | | | | | | | | | | | |
| | | | 16 | SS | 27 | 230 | | | | | | | | | | 0 64 (36) |
| 227.6 | End of Borehole | | | | | | | | | | | | | | | |
| 71.5 | | | | | | | | | | | | | | | | |

20
15 5 % STRAIN AT FAILURE
10

RECORD OF BOREHOLE NO 311

WP 46-74-37 (A) LOCATION Co-ords. 15,680,844N: 1,069,120 E. ORIGINATED BY Golder
 DIST 4 HWY BORING DATE October 22 - 24, 1963 COMPILED BY NW
 DATUM Geodetic BOREHOLE TYPE Washboring HX & BX Casing CHECKED BY

| SOIL PROFILE | | | SAMPLES | | | GROUND WATER ELEV | 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 | | |
| 288.6 | Ground Level | | | | | | | | | | | | | | | |
| 0.0 | Very stiff brown becoming a mixture of soft to firm silty clay, cinders & pieces of brick and gravel below about 4' depth (Fill) | | 1 | SS | 18 | | | | | | | | | | | WL in pipe @ El. 283. Oct. 25/63 |
| | | | 2 | SS | 6 | | | | | | | | | | | |
| | | | 3 | TW | PM | | | | | | | | | | | |
| | | | 4 | SS | 11 | | | | | | | | | | | |
| 267.6 | | | 5 | SS | 9 | | | | | | | | | | | 127 |
| 21.0 | Firm, brown or grey, brown silty clay with some random sand and gravel size particles few small (generally less than 1/8" size) silt pockets | | 6 | TW | PM | | | | | | | | | | | |
| | | | 7 | TW | PM | | | | | | | | | | | |
| | | | 8 | TW | PM | | | | | | | | | | | |
| | | | 9 | SS | 54 | | | | | | | | | | | |
| 244.1 | becoming very sandy | | | | | | | | | | | | | | | 126 |
| 44.5 | Compact to very dense grey silty sand or sand, trace of silt, with very occasional thin (app. 1/4") silty clay layers | | 10 | SS | 58 | | | | | | | | | | | |
| | | | 11 | SS | 33 | | | | | | | | | | | |
| | | | 12 | SS | 43 | | | | | | | | | | | |
| | | | 13 | SS | 37 | | | | | | | | | | | |
| | | | 14 | SS | 21 | | | | | | | | | | | 136 |
| | | | 15 | SS | 44 | | | | | | | | | | | |
| | | | 16 | SS | 61 | | | | | | | | | | | |
| | | | 17 | SS | 35 | | | | | | | | | | | |
| 202.6 | | | | | | | | | | | | | | | | 126 |
| 86.0 | Dense grey and red silty sand & gravel (Till) | | 18 | SS | 35 | | | | | | | | | | | |
| 197.1 | | | | | | | | | | | | | | | | 126 |
| 91.5 | End of Borehole | | | | | | | | | | | | | | | |

RECORD OF BOREHOLE NO 1

WP 46-74-37 (B) LOCATION Co-ords. 1,069,226 E. 15,680,477 N; ORIGINATED BY BL
 DIST 4 HWY 406 BORING DATE April 13 & 14, 1976 COMPILED BY MK
 DATUM Geodetic BOREHOLE TYPE NX & BX Casing CHECKED BY

| SOIL PROFILE | | | SAMPLES | | | GROUND WATER ELEV | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | | | | LIQUID LIMIT w_L PLASTIC LIMIT w_p WATER CONTENT w | | | UNIT WEIGHT γ P.C.F. | REMARKS % GR SA SI CL |
|---------------|--|-------------|---------|------|-----------|----------------------|---|----|----|----|-----|--|-----|-------|--------------------------------------|-----------------------------|
| ELEV DEPTH | DESCRIPTION | STRAT. PLOT | NUMBER | TYPE | N' VALUES | | 20 | 40 | 60 | 80 | 100 | w_p | w | w_L | | |
| 307.1 | Ground Level | | | | | | | | | | | | | | | |
| 0.0 | Clayey silt: low to medium plasticity containing some sand | | 1 | SS | 12 | | | | | | | | | | | |
| | | | 2 | SS | 14 | 300 | | | | | | | | | | |
| | Very Stiff | | 3 | SS | 18 | | | | | | | | | | | |
| | Brown & fissured | | 4 | SS | 15 | | | | | | | | | | | |
| | | | 5 | SS | 5 | 290 | | | | | | | | | | |
| | Grey & Firm | | 6 | TW | PM | | | | | | | | | | | |
| | | | 7 | SS | 7 | 280 | | | | | | | | | | |
| | | | 8 | SS | 7 | | | | | | | | | | | |
| | Stiff | | 9 | SS | 16 | 270 | | | | | | | | | | |
| | containing some sand | | 10 | SS | 23 | 260 | | | | | | | | | | |
| | and fine gravel sizes | | 11 | SS | 13 | 250 | | | | | | | | | | |
| 239.1 | becoming very sandy | | 12 | SS | 110 | 10" | | | | | | | | | | |
| 68.0 | End of Borehole | | | | | | | | | | | | | | | |
| | Note: 1. BH open to El. 297.6 April 20/76 | | | | | | | | | | | | | | | |
| | 2. WL not able to determine. | | | | | | | | | | | | | | | |
| | 3. Chemical tests | | | | | | | | | | | | | | | |
| | Sample Organic PH SO ₃ | | | | | | | | | | | | | | | |
| | SS-3 -- 8.22 240 ppm | | | | | | | | | | | | | | | |

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

RECORD OF BOREHOLE NO 13

WP 46-74-37 (B) LOCATION Co-ords. 680,499 N; 69,277 E. ORIGINATED BY PK
DIST 4 HWY 406 BORING DATE November 2-3, 1971 COMPILED BY ABK
DATUM Geodetic BOREHOLE TYPE Auger CHECKED BY

| SOIL PROFILE | | | SAMPLES | | | GROUND WATER ELEV | 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 | | |
| 296.1 | Ground Level | | | | | | | | | | | | | | | |
| 0.0 | Fill | | | | | | | | | | | | | | | |
| 289.1 | Cinder, gravel, organics Very Loose | | 1 | SS | 3 | | | | | | | | | | | |
| 7.0 | | | 2 | SS | 7 | | | | | | | | | | | |
| | | | 3 | TW | PH | | | | | | | | | | | |
| | clayey silt, traces | | 4 | SS | 9 | | | | | | | | | | | |
| | | | 5 | TW | PH | | | | | | | | | | | |
| | of sand and gravel | | 6 | TW | PH | | | | | | | | | | | |
| | | | 7 | TW | PH | | | | | | | | | | | |
| | | | 8 | SS | 10 | | | | | | | | | | | |
| | | | 9 | TW | PH | | | | | | | | | | | |
| | Firm to Very Stiff | | 10 | SS | 12 | | | | | | | | | | | |
| | | | 11 | TW | PH | | | | | | | | | | | |
| | | | 12 | TW | PH | | | | | | | | | | | |
| | sand and gravel | | 13 | SS | 100 | | | | | | | | | | | |
| 237.1 | Hard Reddish Brown | | 14 | SS | 100/9" | | | | | | | | | | | |
| 59.0 | Sandy silt with some clay. | | 15 | SS | 88 | | | | | | | | | | | |
| | Very Dense to Dense | | 16 | SS | 37 | | | | | | | | | | | |
| | | | 17 | SS | 16 | | | | | | | | | | | |
| | Grey and Brown | | 18 | SS | 31 | | | | | | | | | | | |
| 214.6 | | | | | | | | | | | | | | | | |
| 81.5 | End of Borehole | | | | | | | | | | | | | | | |

OFFICE REPORT ON SOIL EXPLORATION

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

RECORD OF BOREHOLE NO 14

WP 46-74-37 (B) LOCATION Co-ords. 680,017 N; 69,409 E. ORIGINATED BY DM
DIST 4 HWY 406 BORING DATE November 15, 1971 COMPILED BY AKB
DATUM Geodetic BOREHOLE TYPE Auger CHECKED BY

| SOIL PROFILE | | | SAMPLES | | | GROUND WATER ELEV | 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 | | |
| 309.5 | Ground Level | | | | | | | | | | | | | | | |
| 0.0 | Organic Topsoil | | | | | | | | | | | | | | | |
| 306.0 | | | | | | | | | | | | | | | | |
| 3.5 | | | 1 | TW | PM | | | | | | | | | | 119 | |
| | Clayey silt, random | | | | | | | | | | | | | | | |
| | pockets of silt | | 2 | TW | PM | | | | | | | | | | 118 | |
| | | | 3 | TW | PM | | | | | | | | | | 113 | |
| | Firm to Stiff | | 4 | TW | PM | | | | | | | | | | 118 | |
| | | | 5 | SS | 6 | | | | | | | | | | | |
| | Greyish Brown | | 6 | TW | PM | | | | | | | | | | 115 | |
| | | | 7 | TW | PM | | | | | | | | | | 118 | |
| | | | 8 | TW | PM | | | | | | | | | | 126 | |
| | | | 9 | SS | 15 | | | | | | | | | | | |
| | | | 10 | TW | PM | | | | | | | | | | 131 | |
| | | | 11 | TW | PM | | | | | | | | | | 112 | |
| | | | 12 | TW | PM | | | | | | | | | | | |
| 243.5 | | | 13 | TW | PM | | | | | | | | | | 123 | |
| 66.0 | Silt to silty sand, | | 14 | SS | 50 | | | | | | | | | | | |
| | traces of clay | | 15 | SS | 116 | | | | | | | | | | | |
| | Hard | | 16 | SS | 104 | | | | | | | | | | | |
| | Reddish Brown | | 17 | SS | 91 | | | | | | | | | | | |
| 228.0 | | | | | | | | | | | | | | | | |
| 81.5 | End of Borehole | | | | | | | | | | | | | | | |

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

RECORD OF BOREHOLE NO 61

WP 46-74-37 (B) LOCATION Co-ords. 15,680,430 N; 1,069,097 E. ORIGINATED BY MK
DIST 4 HWY 406 BORING DATE April 22 & 23, 1976 COMPILED BY MK
DATUM Geodetic BOREHOLE TYPE Hollow Stem Auger CHECKED BY _____

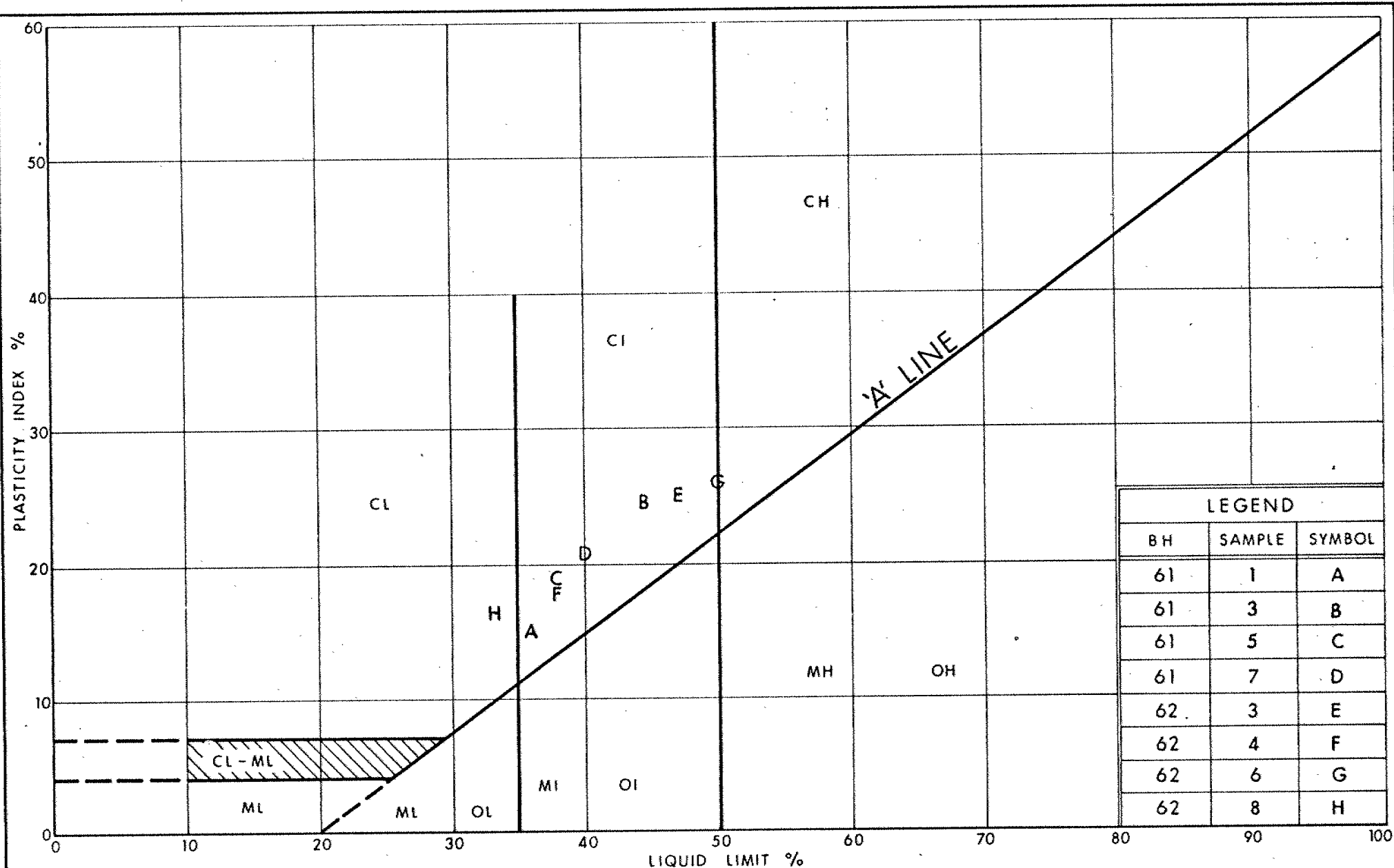
| SOIL PROFILE | | | SAMPLES | | | GROUND WATER ELEV | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | | | | LIQUID LIMIT <u>W_L</u> PLASTIC LIMIT <u>W_P</u> WATER CONTENT <u>W</u> | | | UNIT WEIGHT γ | REMARKS |
|---------------|---------------------------|------------|---------|------|------------|----------------------|---|----|----|----|-----|---|---|----------------|-------------------------|--------------------|
| ELEV DEPTH | DESCRIPTION | STRAT. PLT | NUMBER | TYPE | 'N' VALUES | | 20 | 40 | 60 | 80 | 100 | W _P | W | W _L | | |
| 343.5 | Ground Level | | | | | | | | | | | | | | | GR SA SI CL |
| 0.0 | Clayey silt | | | | | 340 | | | | | | | | | | |
| | Brown, stiff, and | | 1 | SS | 32 | | | | | | | | | | | PH SO ₃ |
| | fissured, medium | | 2 | SS | 27 | | | | | | | | | | | 8.1 1440ppm |
| | plasticity | | 3 | SS | 22 | 330 | | | | | | | | | | |
| | | | 4 | SS | 20 | | | | | | | | | | | PH SO ₃ |
| | Grey, stiff to firm, | | 5 | SS | 22 | 320 | | | | | | | | | | 8.24 1100ppm |
| | medium to low plasti- | | 6 | SS | 15 | | | | | | | | | | | |
| | city | | 7 | SS | 12 | 310 | | | | | | | | | | |
| | containg some sand | | 8 | SS | 12 | | | | | | | | | | | |
| | and fine gravel | | | | | 300 | | | | | | | | | | |
| | | | 9 | SS | 22 | | | | | | | | | | | |
| | | | | | | 290 | | | | | | | | | | |
| | | | 10 | SS | 14 | | | | | | | | | | | |
| | | | | | | 280 | | | | | | | | | | |
| | | | | | | 270 | | | | | | | | | | |
| | | | 11 | SS | 18 | | | | | | | | | | | |
| | | | | | | 260 | | | | | | | | | | |
| | | | | | | 250 | | | | | | | | | | |
| | containing more | | 12 | SS | 36 | | | | | | | | | | | |
| | coarse sand particles | | | | | | | | | | | | | | | |
| 247.0 | | | 13 | SS | 18 | | | | | | | | | | | |
| 96.5 | End of Borehole | | | | | | | | | | | | | | | |
| | Not. W.L. not established | | | | | | | | | | | | | | | |

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

RECORD OF BOREHOLE NO 62

WP 46-74-37 (B) LOCATION Co-ords. 15,680,078 N. 1,069,092 E. ORIGINATED BY BL
DIST 4 HWY 406 BORING DATE April 20-22, 1976 COMPILED BY MK
DATUM Geodetic BOREHOLE TYPE NX & BX Casing CHECKED BY

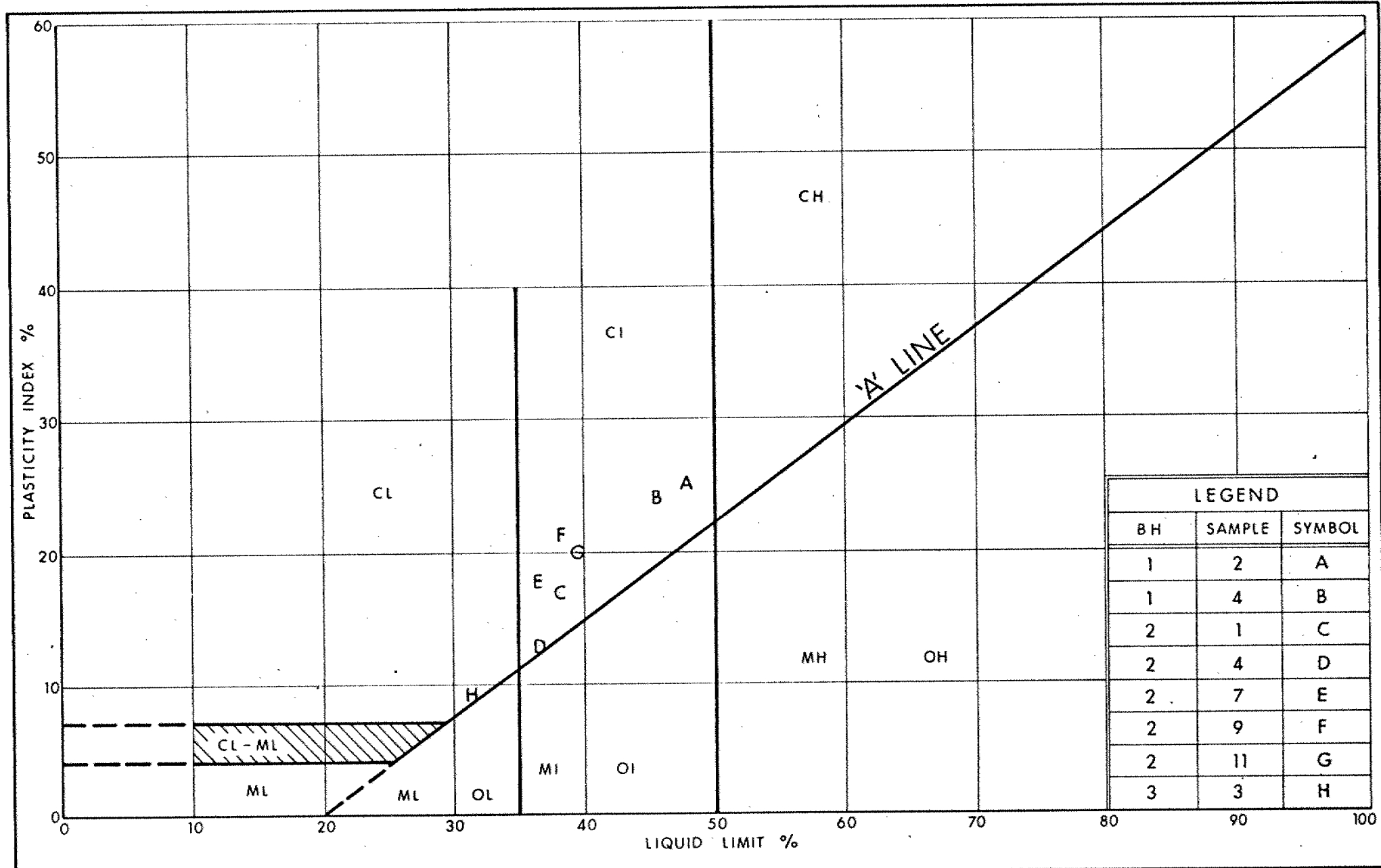
| SOIL PROFILE | | | SAMPLES | | | GROUND WATER ELEV | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | | | | LIQUID LIMIT w_L PLASTIC LIMIT w_p WATER CONTENT w | | | UNIT WEIGHT γ | REMARKS |
|---------------|--|-------------|---------|------|-----------|----------------------|---|-----|------|------|------|--|-----|-------|----------------------------|-----------------------------------|
| ELEV DEPTH | DESCRIPTION | STRAT. PLOT | NUMBER | TYPE | N' VALUES | | 20 | 40 | 60 | 80 | 100 | w_p | w | w_L | | |
| 333.0 | Ground Level | | | | | | 400 | 800 | 1200 | 1600 | 2000 | 20 | 40 | 60 | | GR SA SI CL |
| 0.0 | Clayey Silt Brown, very stiff, oxidized & fissured | | 1 | SS | 21 | 330 | | | | | | | | | | PH 8.34 SO ₃ 120ppm |
| | | | 2 | SS | 31 | | | | | | | | | | | 8.18 680ppm |
| | | | 3 | SS | 29 | | | | | | | | | | | |
| | | | 4 | SS | 23 | | | | | | | | | | | |
| | | | 5 | SS | 26 | 320 | | | | | | | | | | |
| | | | 6 | SS | 22 | | | | | | | | | | | |
| | Grey, stiff to firm | | 7 | SS | 13 | 310 | | | | | | | | | | |
| | | | 8 | SS | 12 | | | | | | | | | | | |
| | low to medium plasti- city, | | 9 | SS | 8 | 300 | | | | | | | | | | |
| | trace of sand | | 10 | SS | 13 | 290 | | | | | | | | | | |
| | | | 11 | SS | 23 | 280 | | | | | | | | | | |
| 261.5 | | | | | | 270 | | | | | | | | | | |
| 71.5 | End of Borehole | | | | | | | | | | | | | | | |



PLASTICITY CHART CLAYEY SILT

FIG No 1

W P 46-74-37 B



| LEGEND | | |
|--------|--------|--------|
| BH | SAMPLE | SYMBOL |
| 1 | 2 | A |
| 1 | 4 | B |
| 2 | 1 | C |
| 2 | 4 | D |
| 2 | 7 | E |
| 2 | 9 | F |
| 2 | 11 | G |
| 3 | 3 | H |



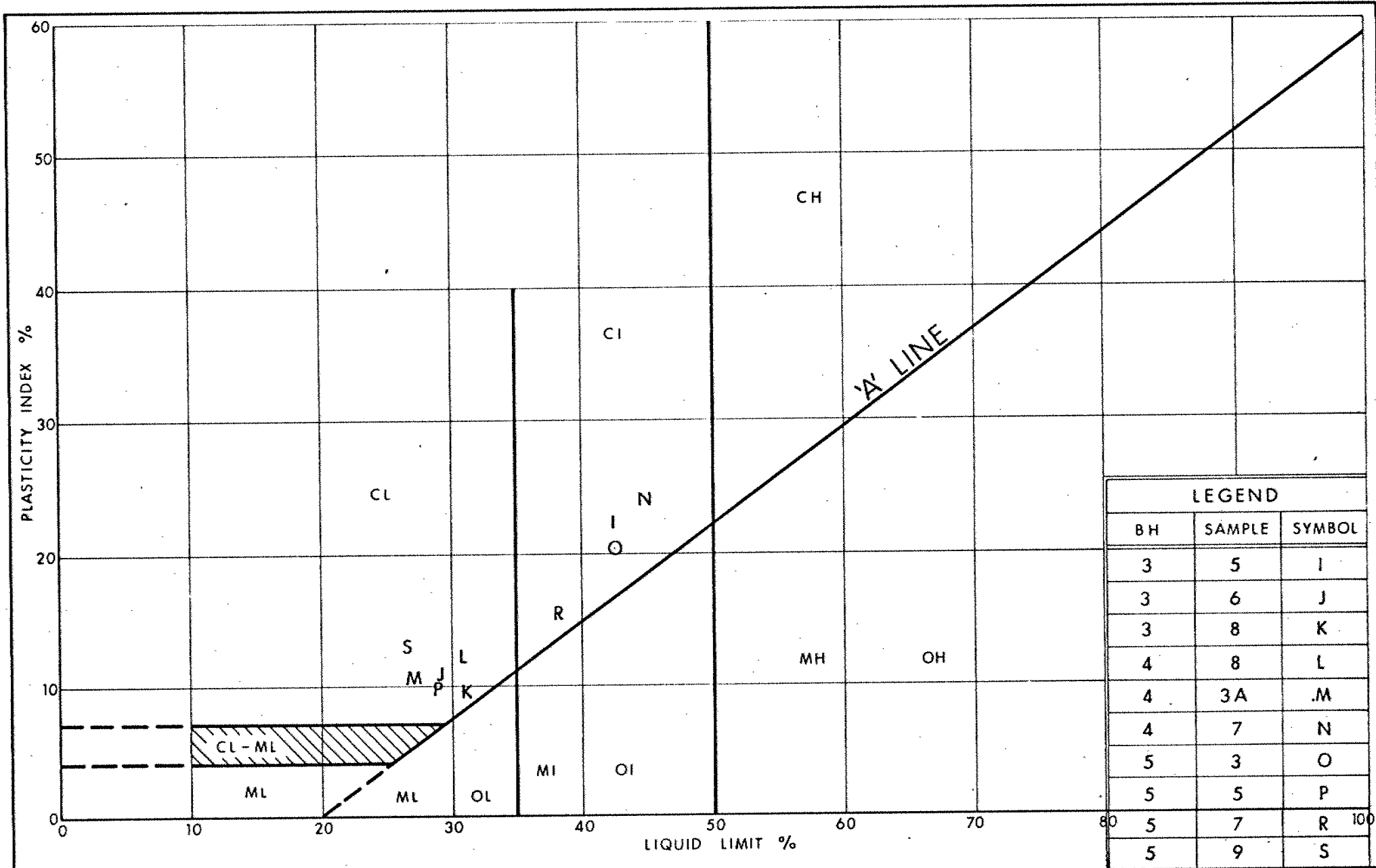
Ministry of
Transportation and
Communications

ENGINEERING SERVICES BRANCH

PLASTICITY CHART CLAYEY SILT

FIG No 1 A

W P 46-74-37 A



Ontario

 Ministry of
Transportation and
Communications

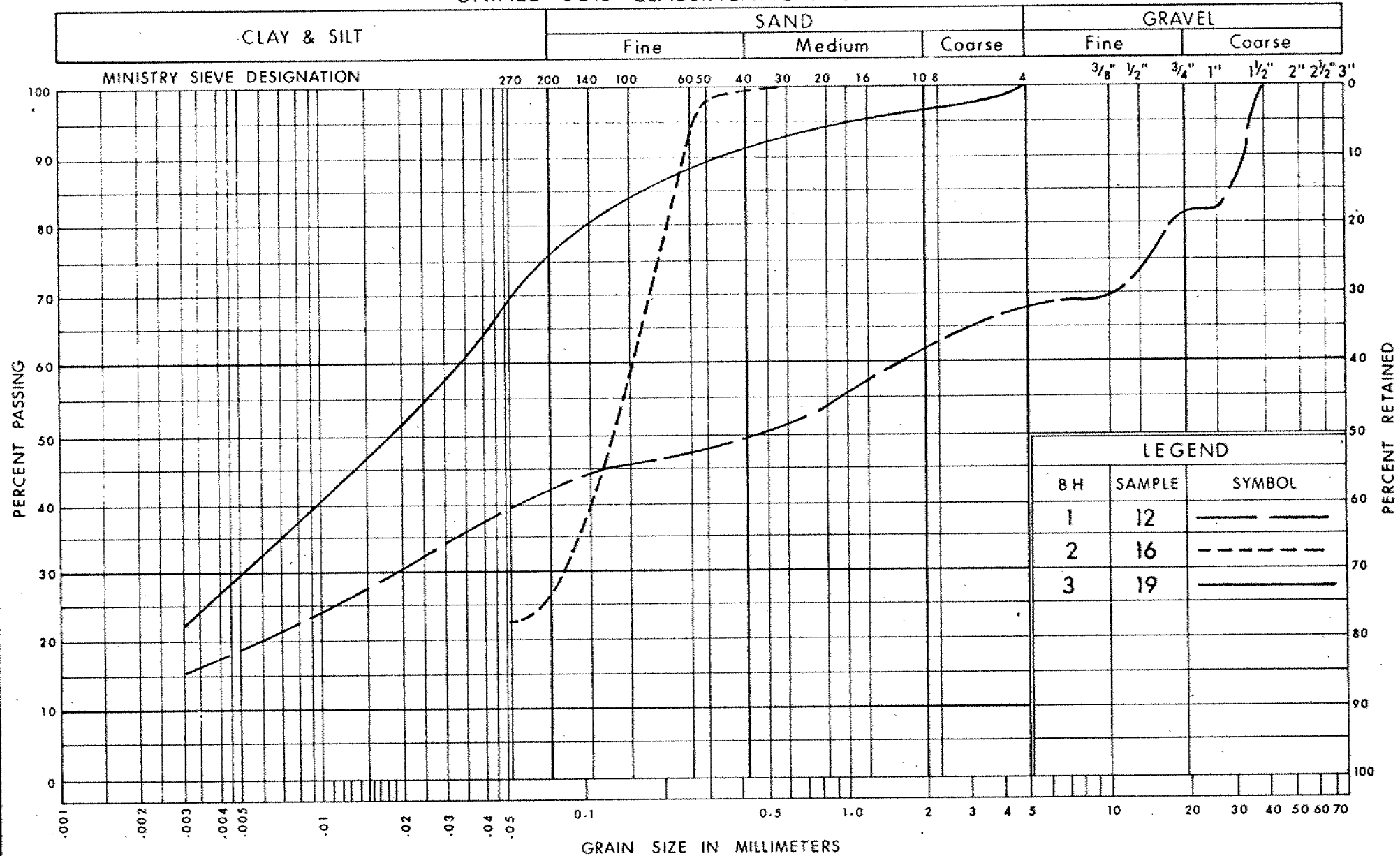
ENGINEERING SERVICES BRANCH

PLASTICITY CHART CLAYEY SILT

FIG No 1B

W P 46-74-37 A

UNIFIED SOIL CLASSIFICATION SYSTEM



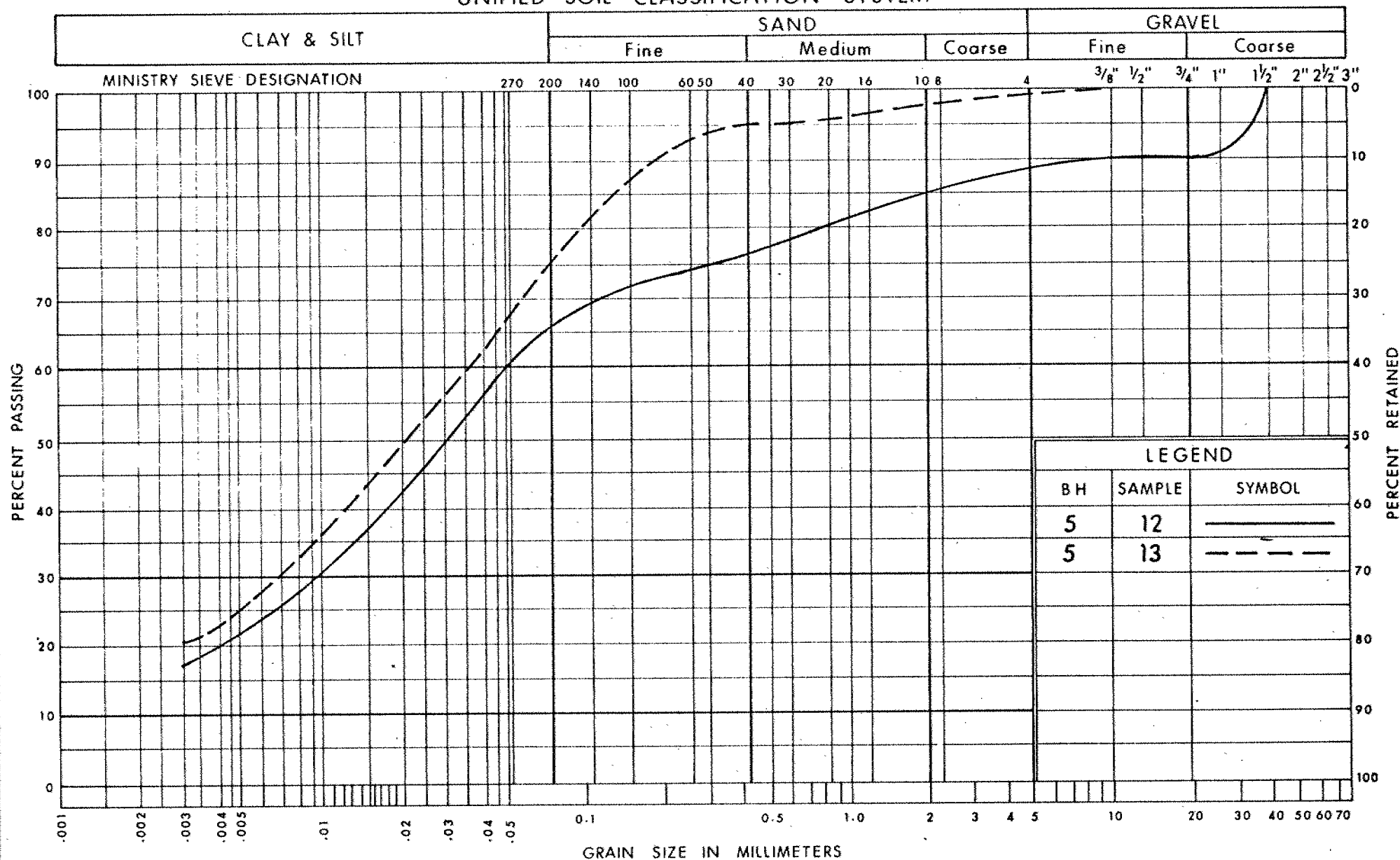
Ministry of
Transportation and
Communications
Ontario
ENGINEERING SERVICES BRANCH

GRAIN SIZE DISTRIBUTION SILTY SAND

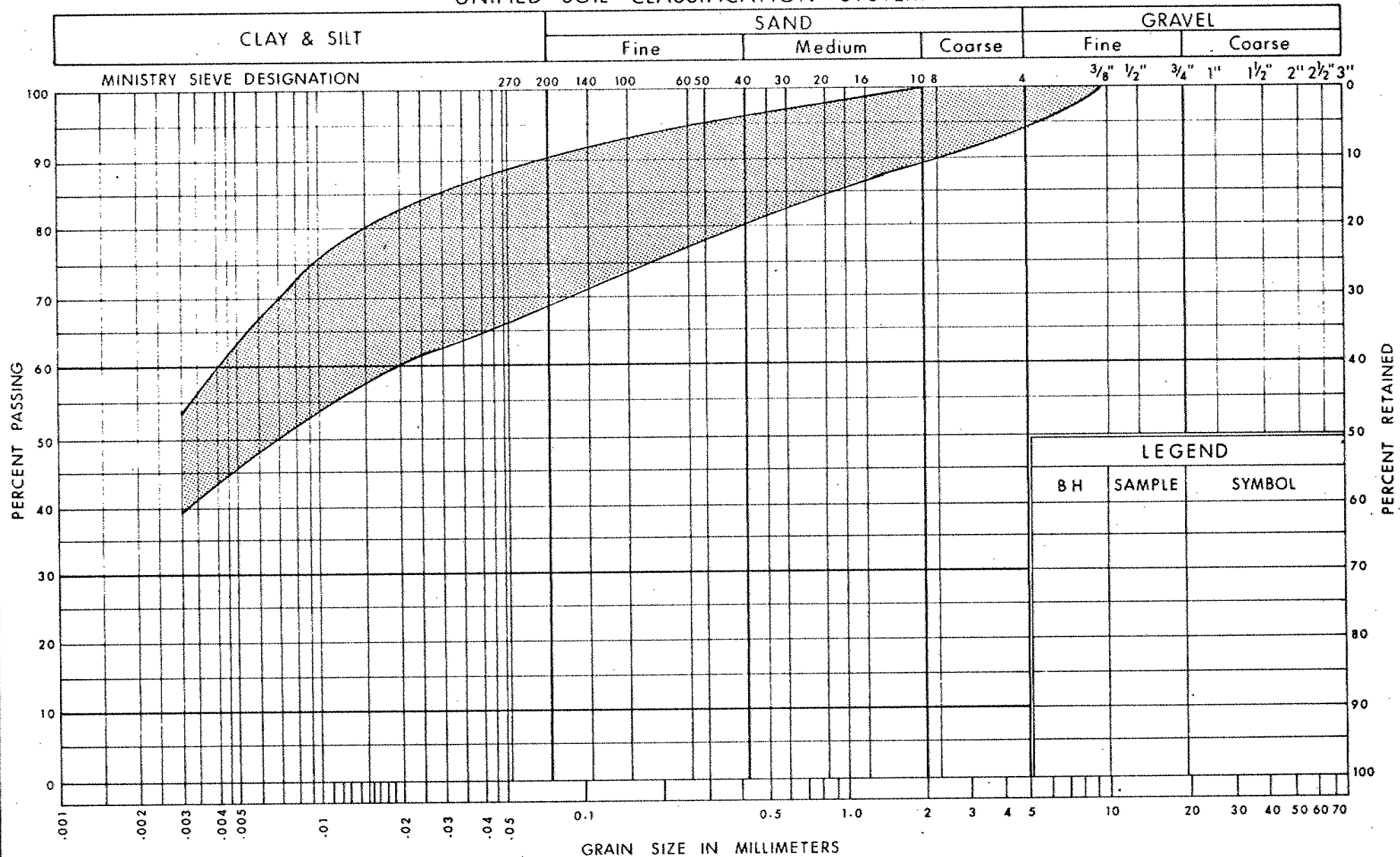
FIG No 2

W P 46-74-37 A

UNIFIED SOIL CLASSIFICATION SYSTEM



UNIFIED SOIL CLASSIFICATION SYSTEM

Ministry of
Transportation and
Communications

Ontario

ENGINEERING SERVICES BRANCH

GRAIN SIZE DISTRIBUTION CLAYEY FILL

FIG No 4

W P 46-74-37 A

VOID RATIO - PRESSURE CURVES

W. P. 46-74-37 A

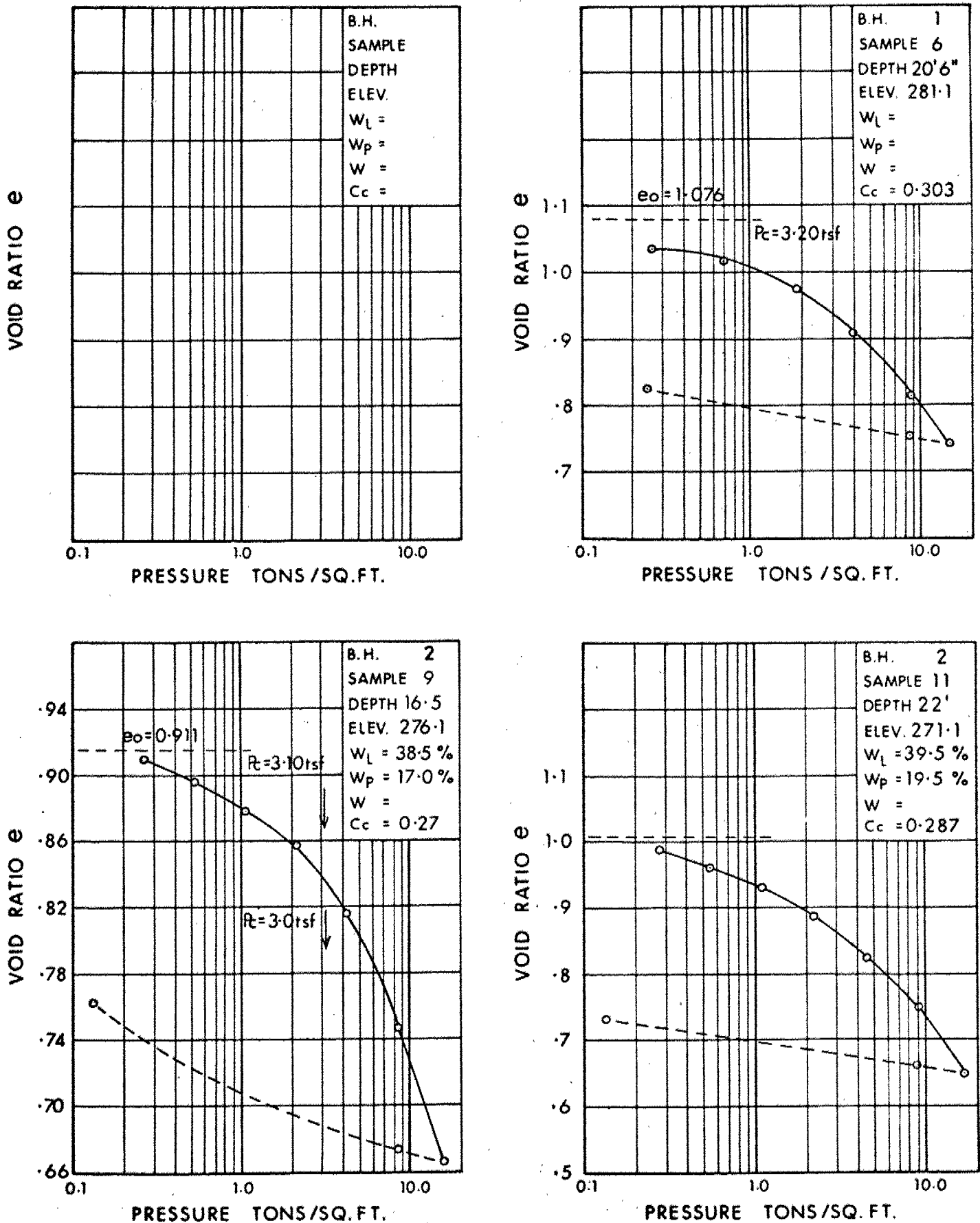
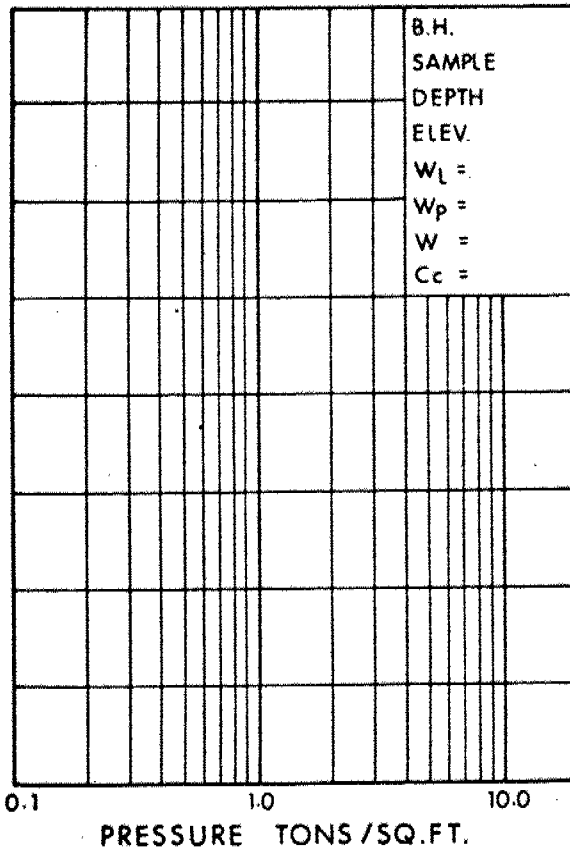


FIG. 5

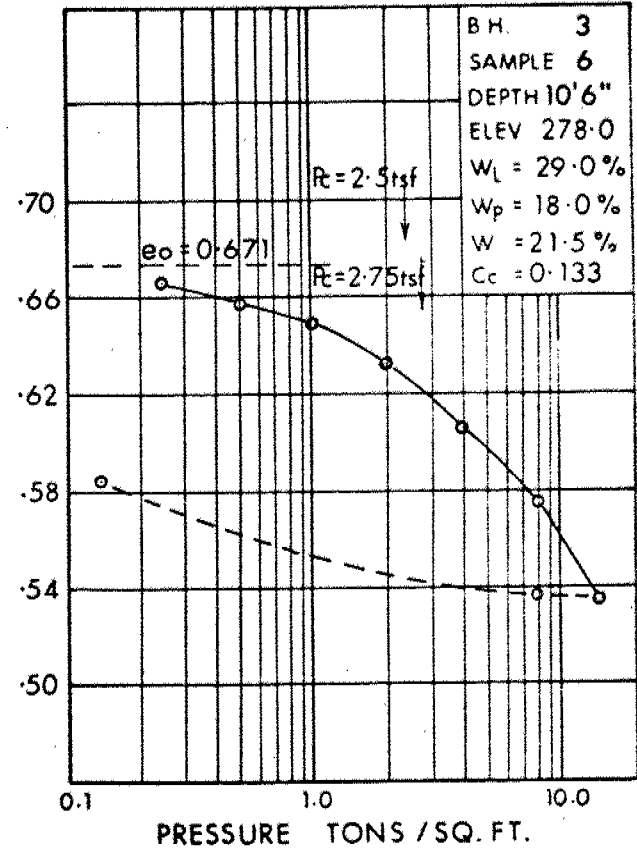
VOID RATIO - PRESSURE CURVES

W.P. 46-74-37 A

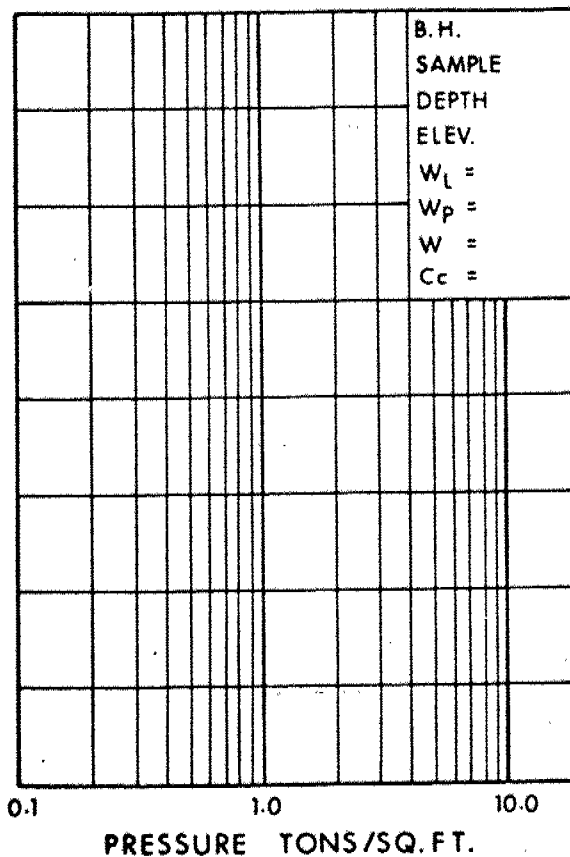
VOID RATIO e



VOID RATIO e



VOID RATIO e



VOID RATIO e

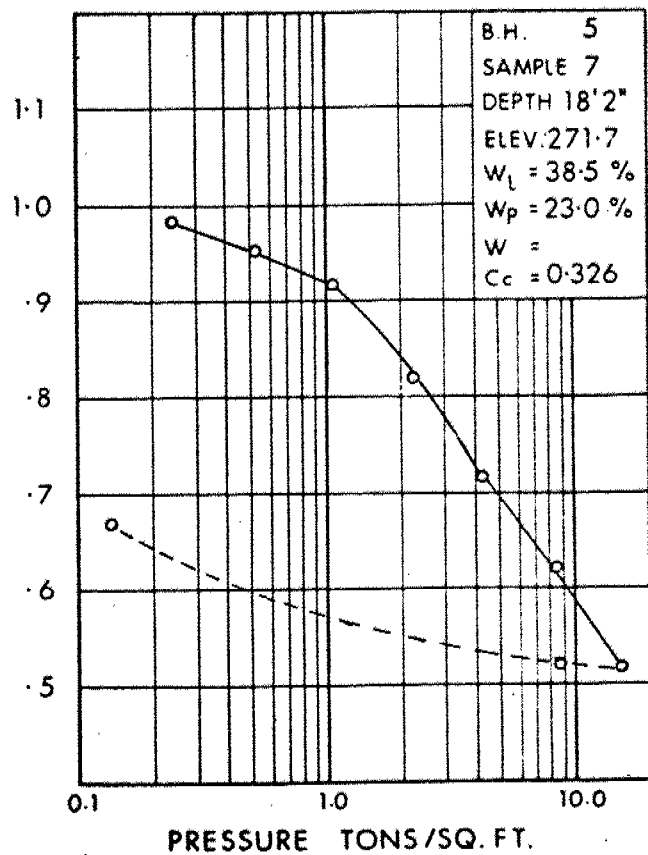


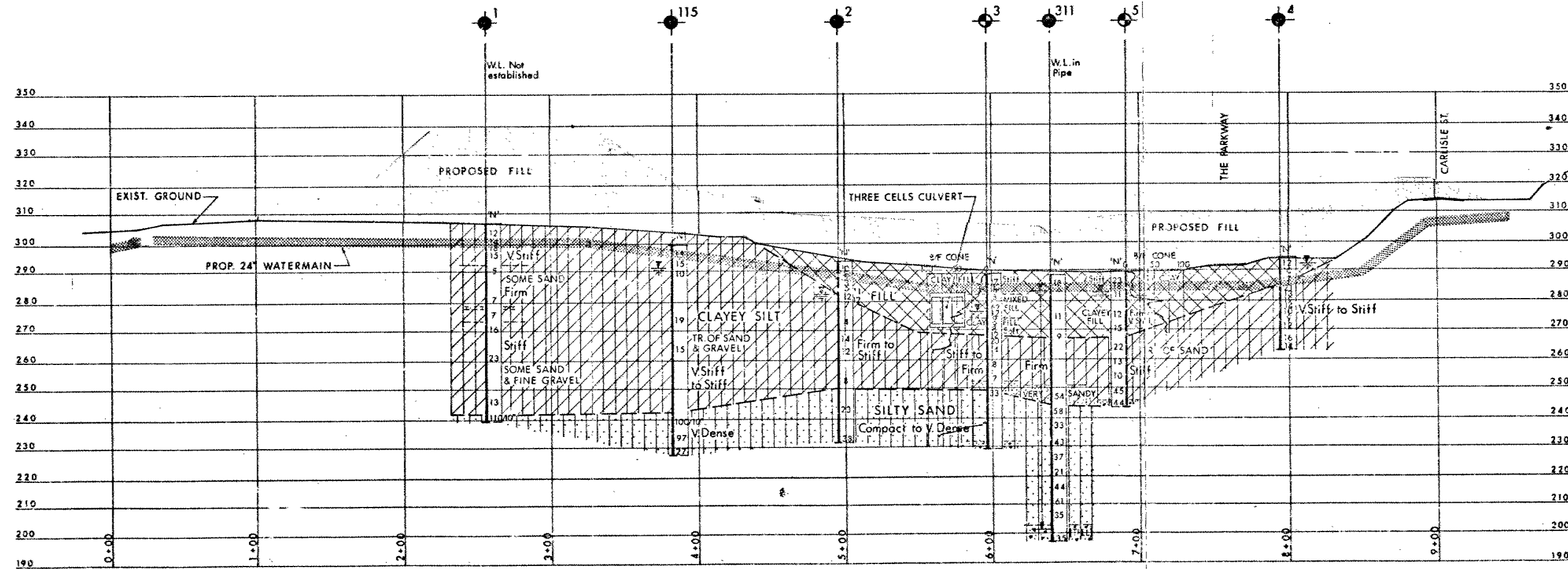
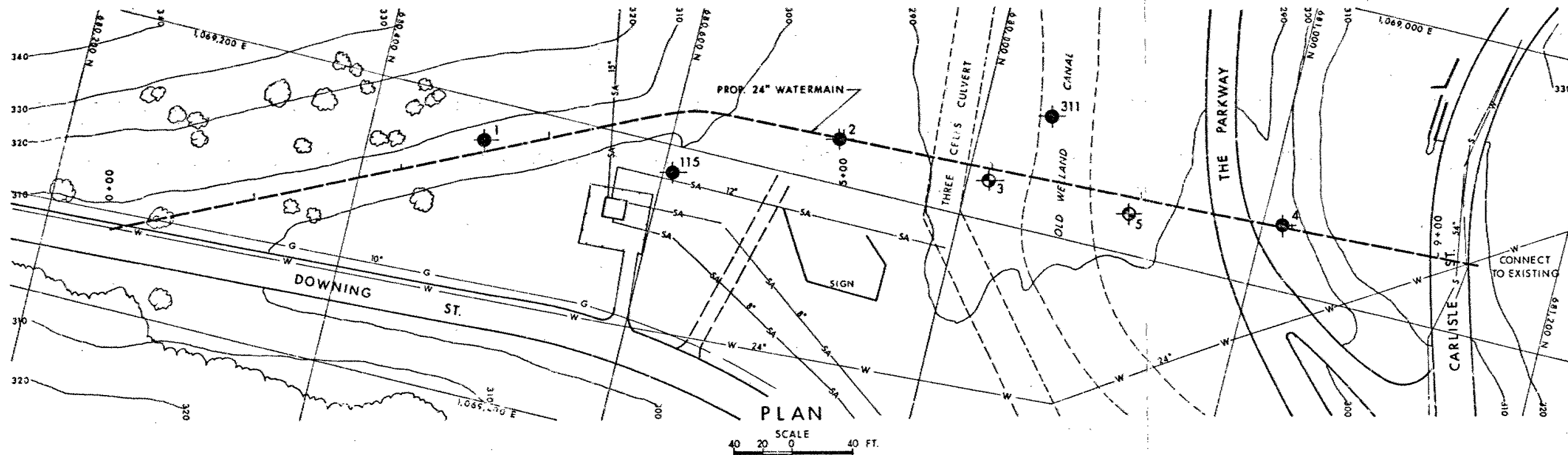
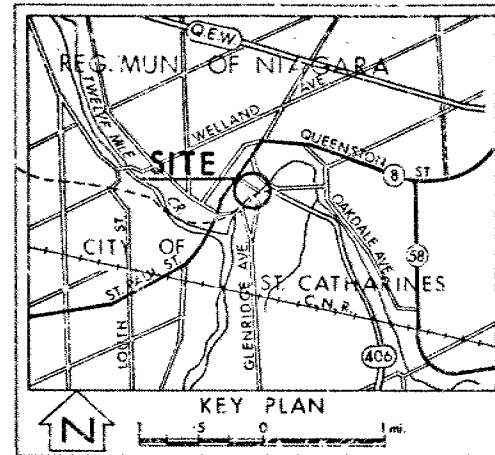
FIG. 6

CONT No
WP No 46-74-37(A)



24" WATER MAIN
BORE HOLE LOCATIONS & SOIL STRATA

SHEET



LEGEND

- Bore Hole
- Dynamic Cone Penetration Test (Cone)
- Bore Hole & Cone
- Blows/ft (Std Pen Test 350ft lbs energy)
- CONE Blows/ft (60° Cone, 350ft lbs energy)
- W.L. at time of investigation
B.H. No. 2, 3, 4 & 5 APR. 1976
B.H. No. 115 NOV. 1971
B.H. No. 311 OCT. 1963

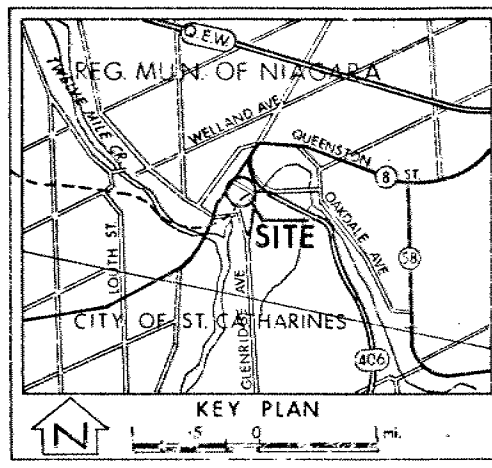
| No | ELEVATION | CO-ORDINATES | |
|-----|-----------|--------------|---------|
| | | NORTH | EAST |
| 1 | 307.1 | 680,477 | 069,226 |
| 2 | 293.1 | 680,710 | 069,170 |
| 3 | 289.0 | 680,813 | 069,172 |
| 4 | 294.4 | 681,013 | 069,153 |
| 5 | 289.7 | 680,910 | 069,172 |
| 115 | 294.1 | 680,606 | 069,219 |
| 311 | 288.6 | 680,844 | 069,120 |





-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 |
|-----------|------|----|-------------|
| | | | |
| | | | |
| | | | |

Drawn by: CITY OF ST. CATHARINES, ONT. 4
Checked by: DATE 17 MAY 76
Drawn by: DATE 17 MAY 76
Checked by: DATE 17 MAY 76

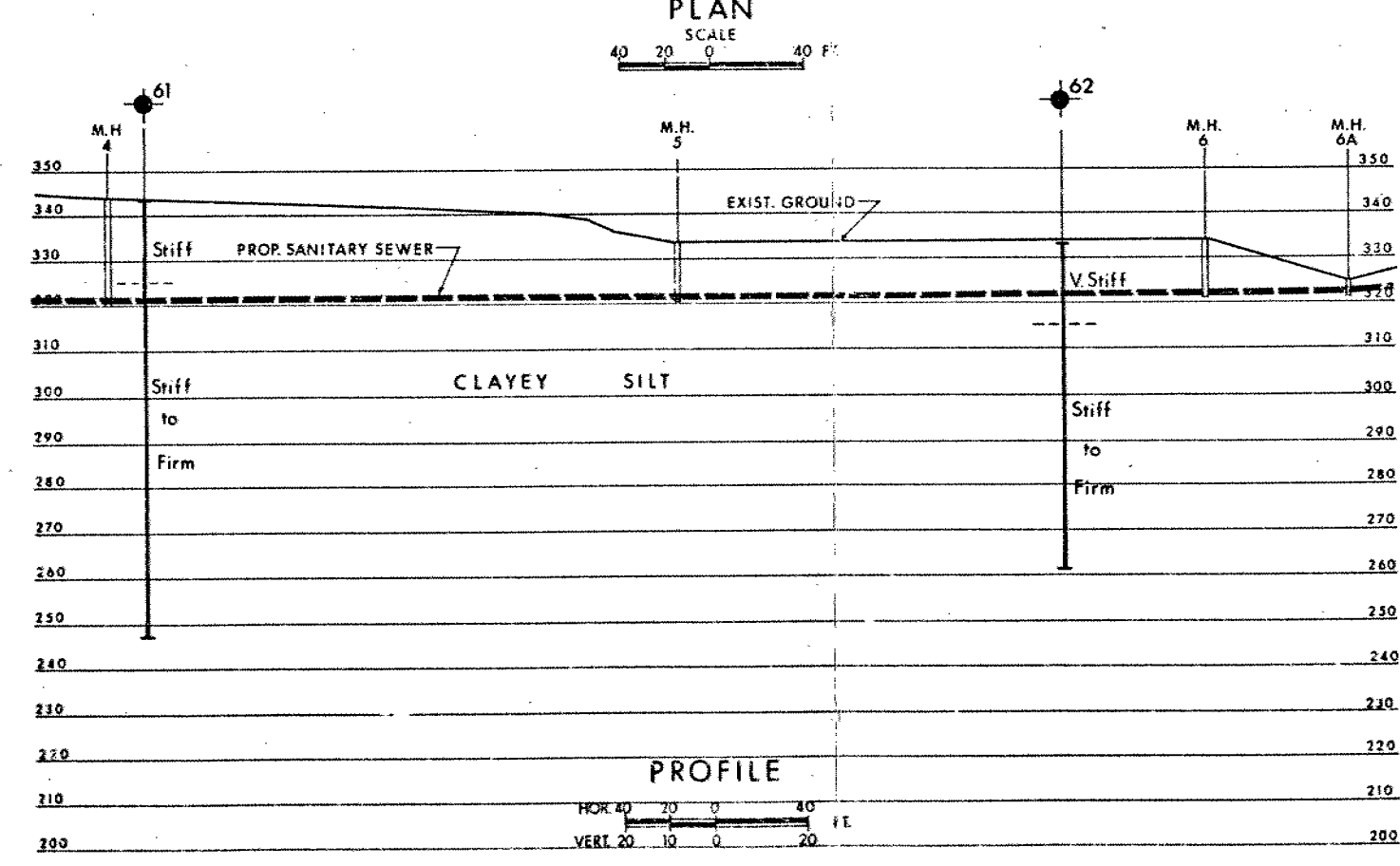
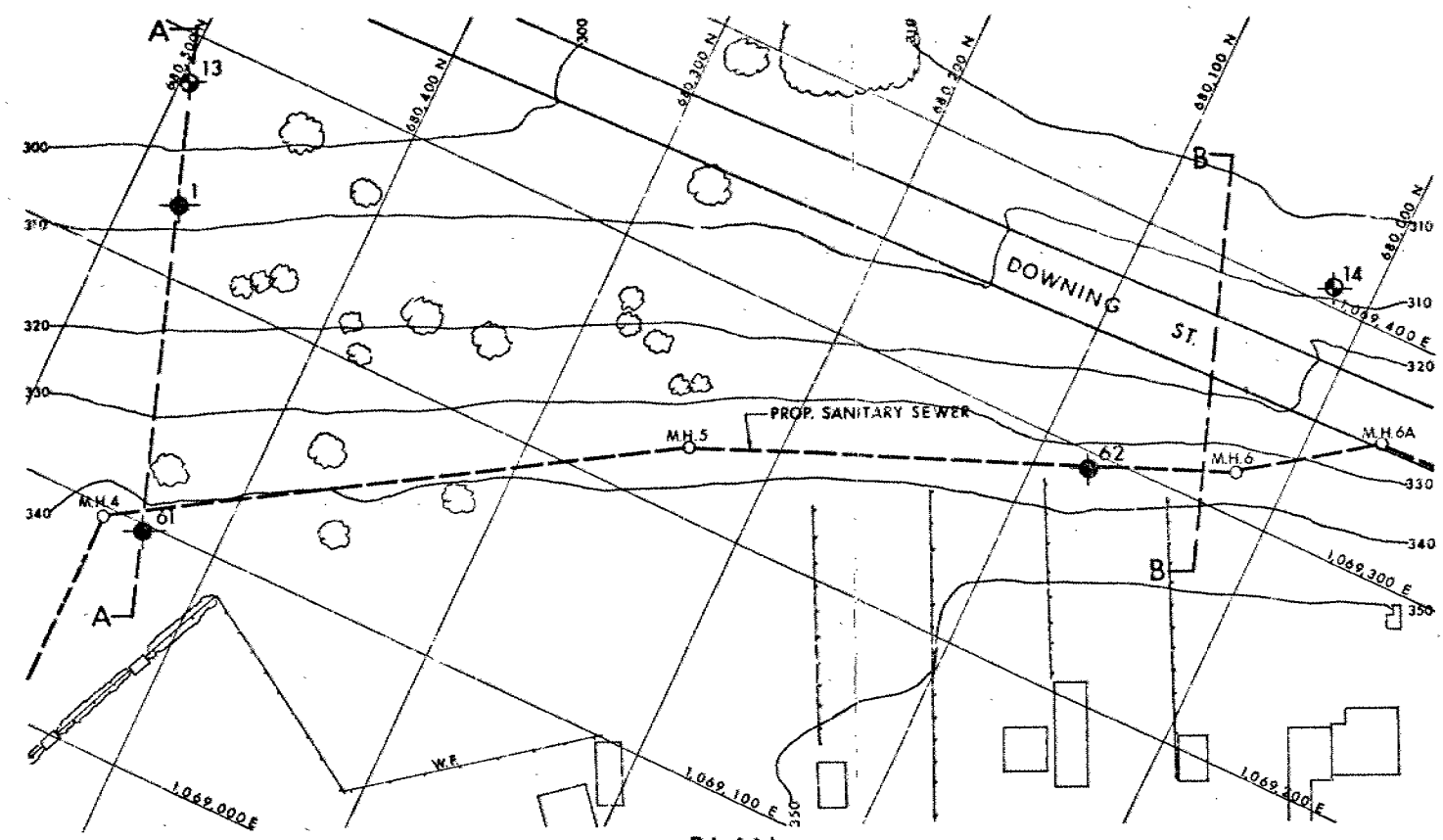
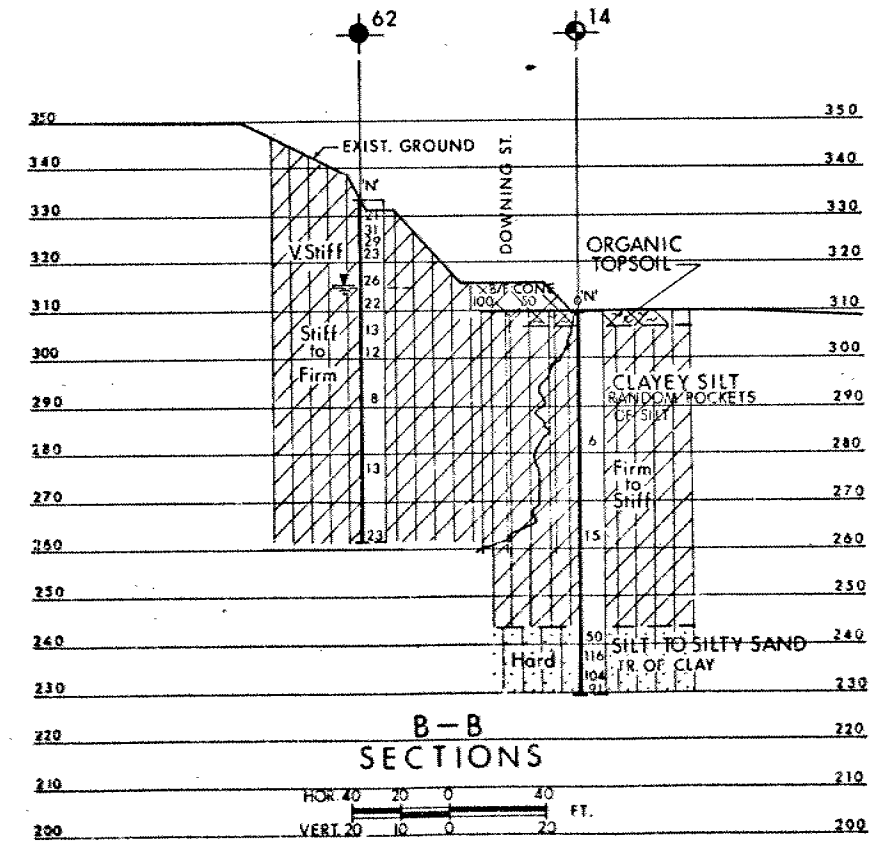
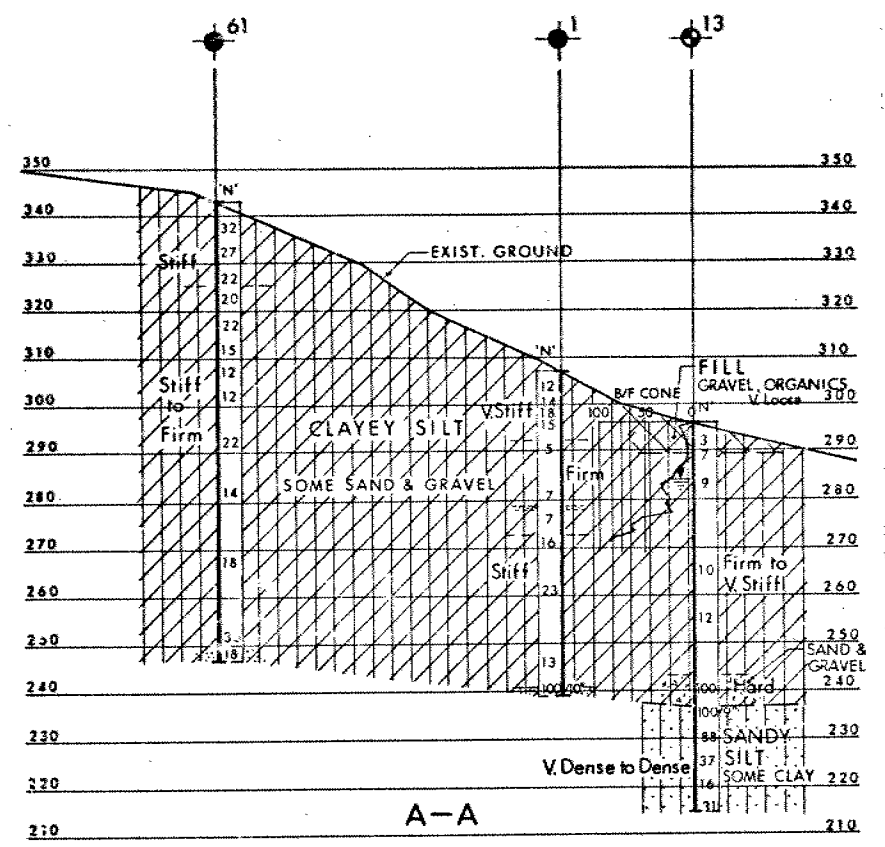


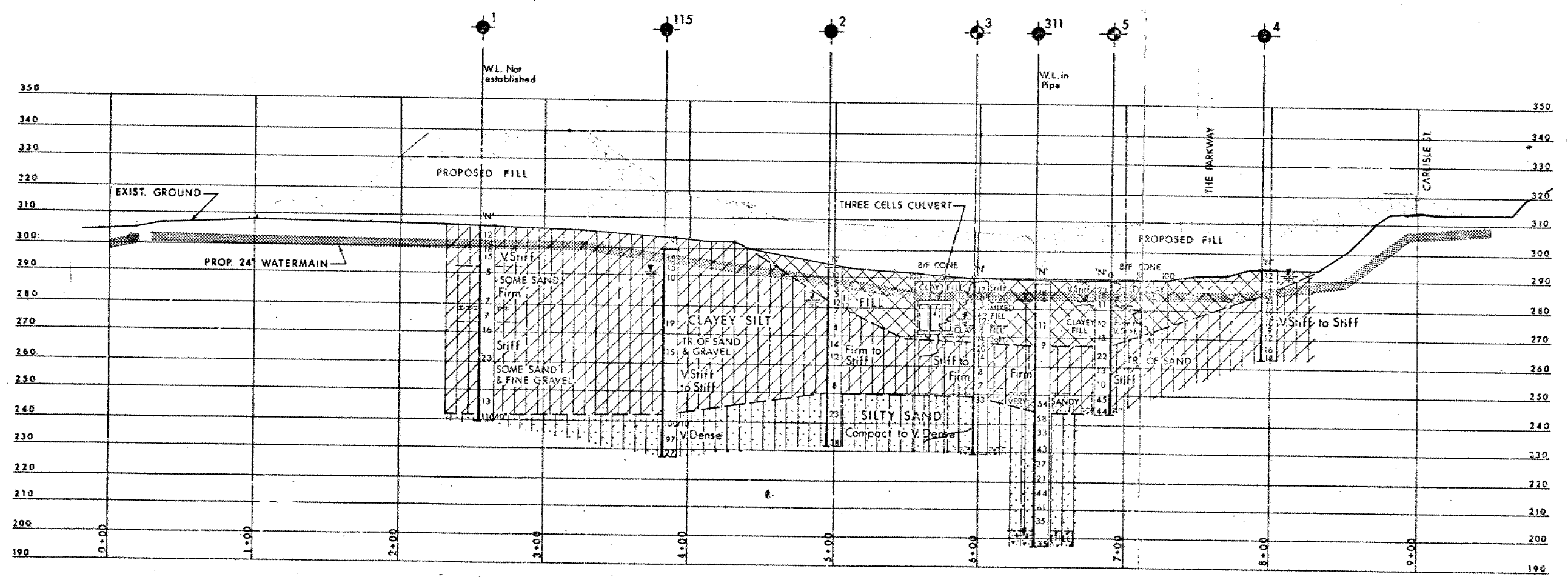
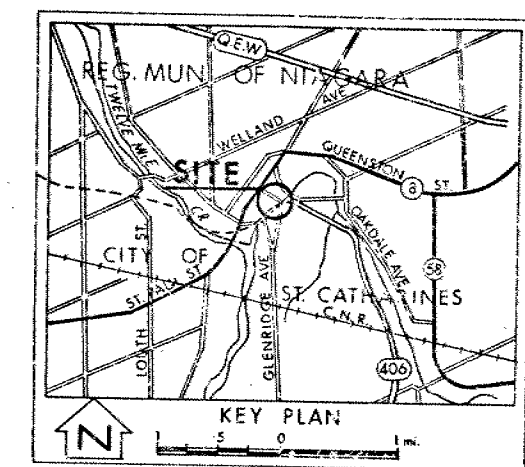
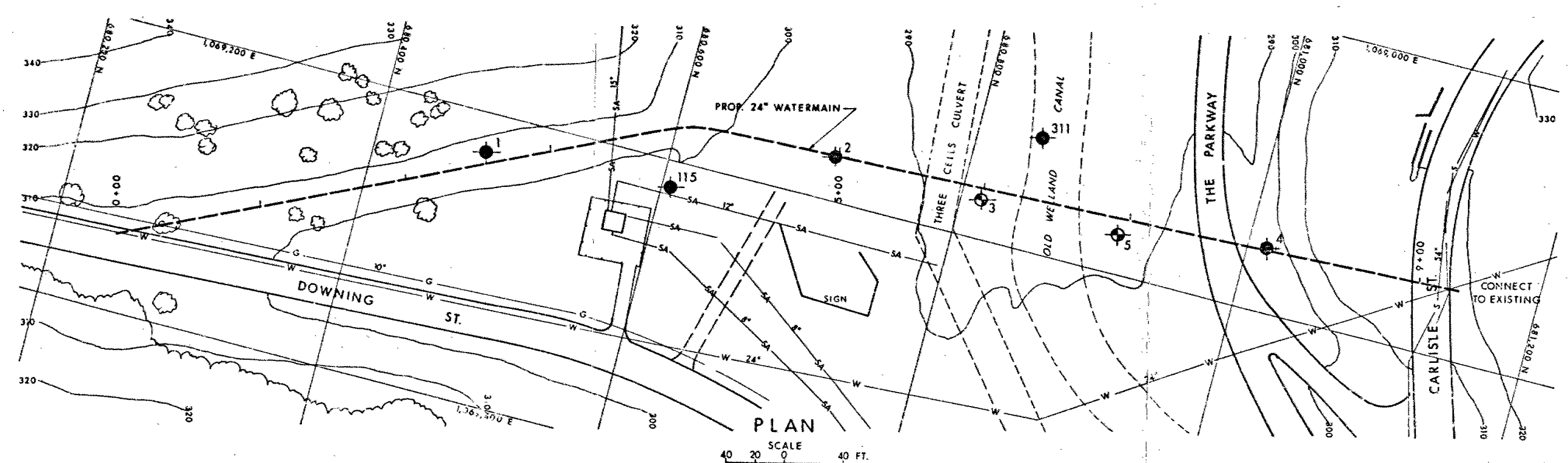
| LEGEND | |
|---|--|
|  | Bore Hole |
|  | Dynamic Cone Penetration Test (Cone) |
|  | Bore Hole & Cone |
| N' | Blows/ft (Std Pen Test 350ft lbs energy) |
| CONE | Blows/ft (60° Cone, 350ft lbs energy) |
|  | W.L at time of investigation |
| B.H. No.13 NOV. 1971 | |
| B.H. No.62 APR. 1976 | |
| NO W.L.established B.H. 1, 61, 14 | |

| No | ELEVATION | CO-ORDINATES | |
|----|-----------|--------------|---------|
| | | NORTH | EAST |
| 1 | 307.1 | 680,477 | 069,226 |
| 13 | 296.1 | 680,499 | 069,277 |
| 14 | 309.5 | 680,017 | 069,409 |
| 61 | 343.5 | 680,430 | 069,097 |
| 62 | 333.0 | 680,078 | 069,052 |

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 |
|-----------|------|----|-------------|
| | | | |
| | | | |
| | | | |





LEGEND

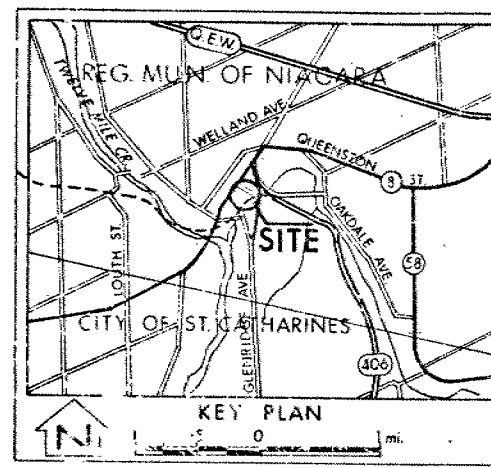
- Bore Hole
- Dynamic Cone Penetration Test (Cone)
- Bore Hole & Cone
- 'N' Blows/ft (Std Pen Test 350 ft lbs energy)
- CONE Blows/ft (60° Cone, 350 ft lbs energy)
- WL at time of investigation
- B.H. No. 2, 3, 4 & 5 APR. 1976
- B.H. No. 115 NOV. 1971
- B.H. No. 311 OCT. 1963

| No | ELEVATION | CO-ORDINATES | |
|-----|-----------|--------------|---------|
| | | NORTH | EAST |
| 1 | 307.1 | 680,477 | 069,226 |
| 2 | 293.1 | 680,710 | 069,170 |
| 3 | 289.0 | 680,813 | 069,172 |
| 4 | 294.4 | 681,013 | 069,155 |
| 5 | 289.7 | 680,910 | 069,172 |
| 115 | 297.1 | 680,606 | 069,219 |
| 311 | 288.6 | 680,844 | 069,120 |

-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



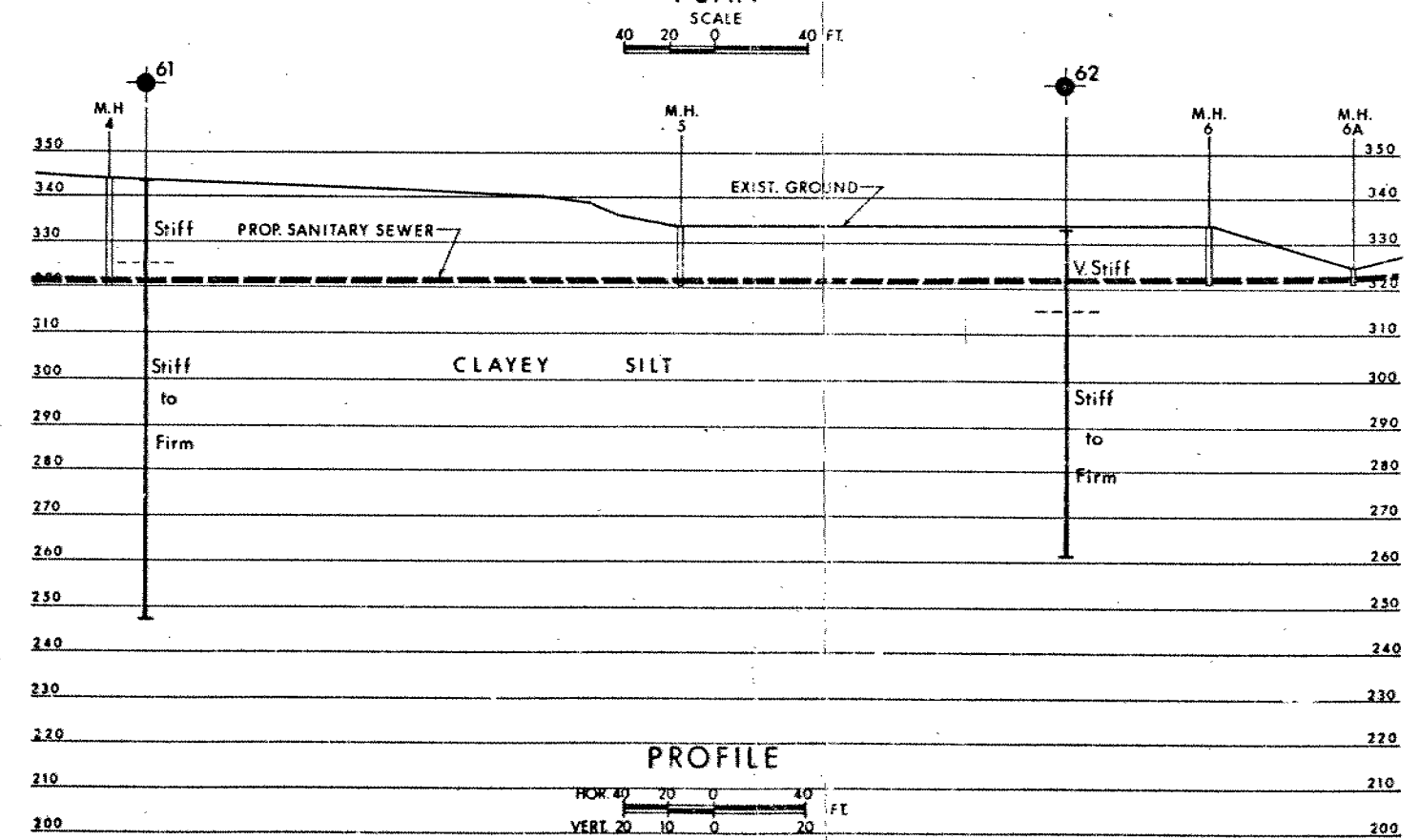
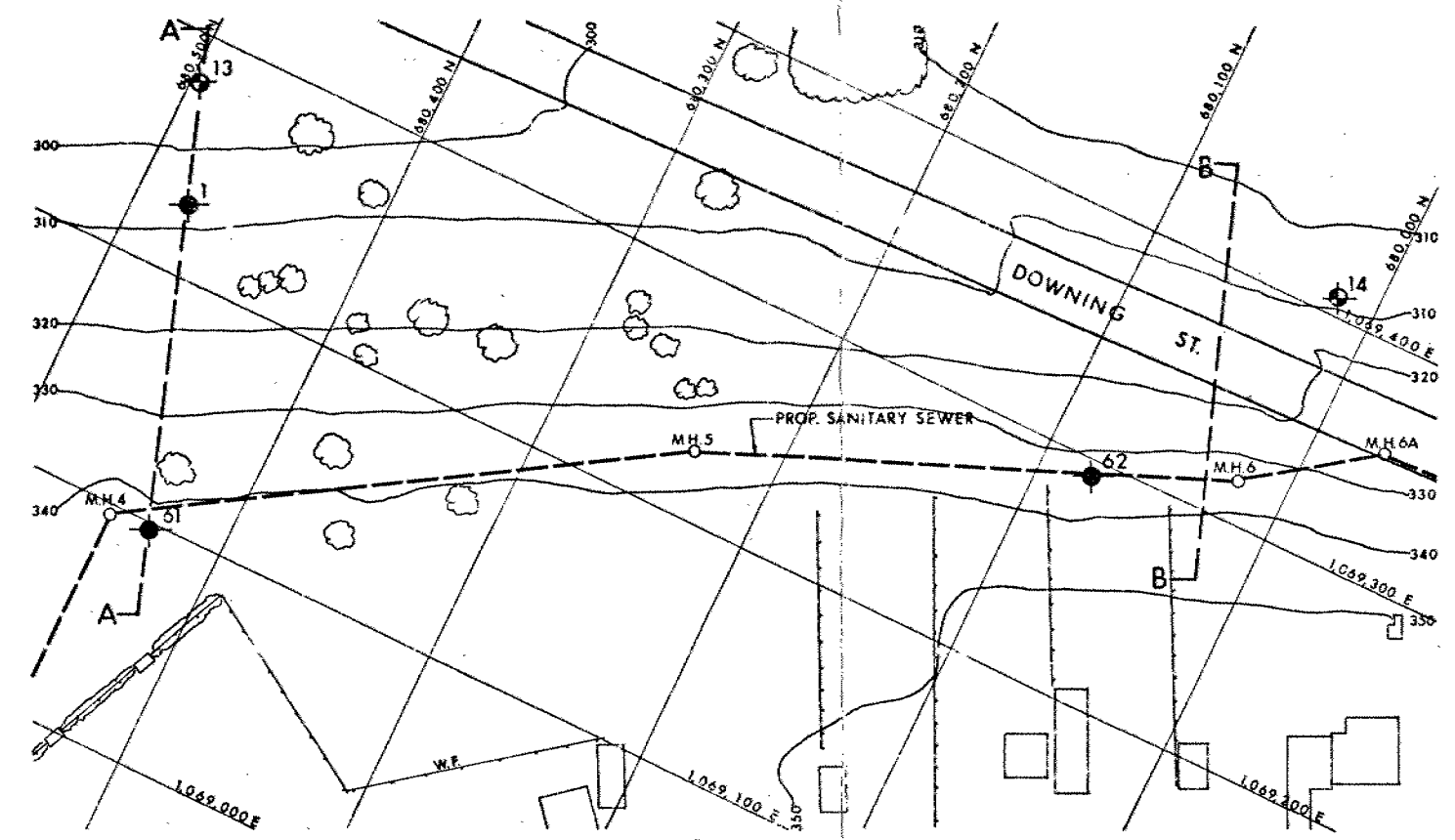
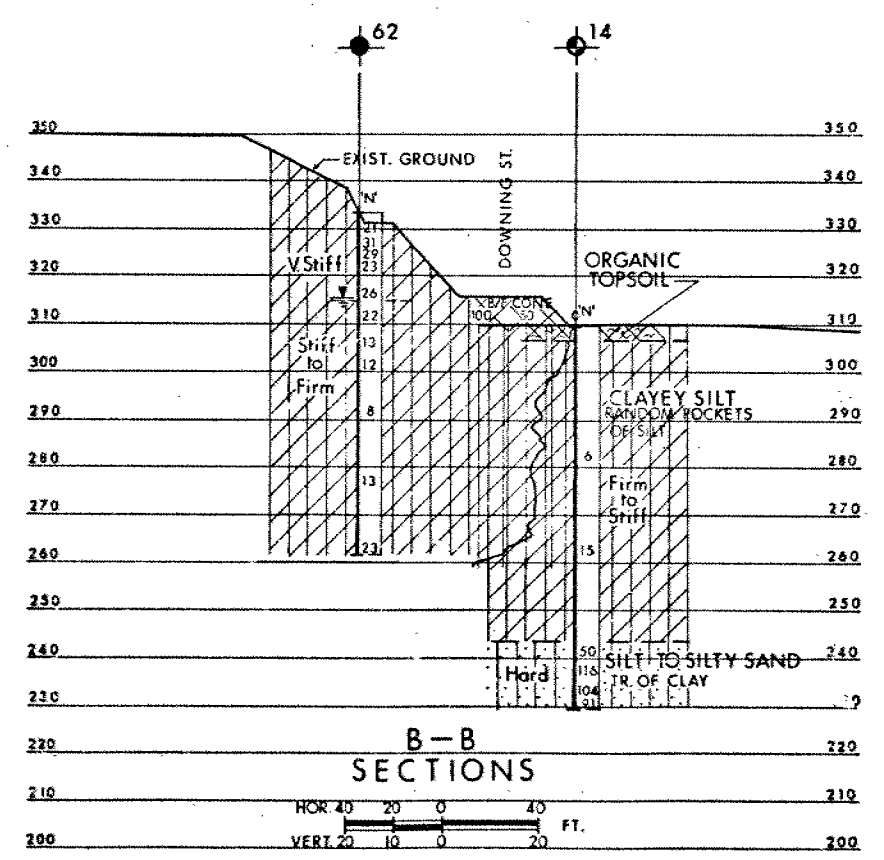
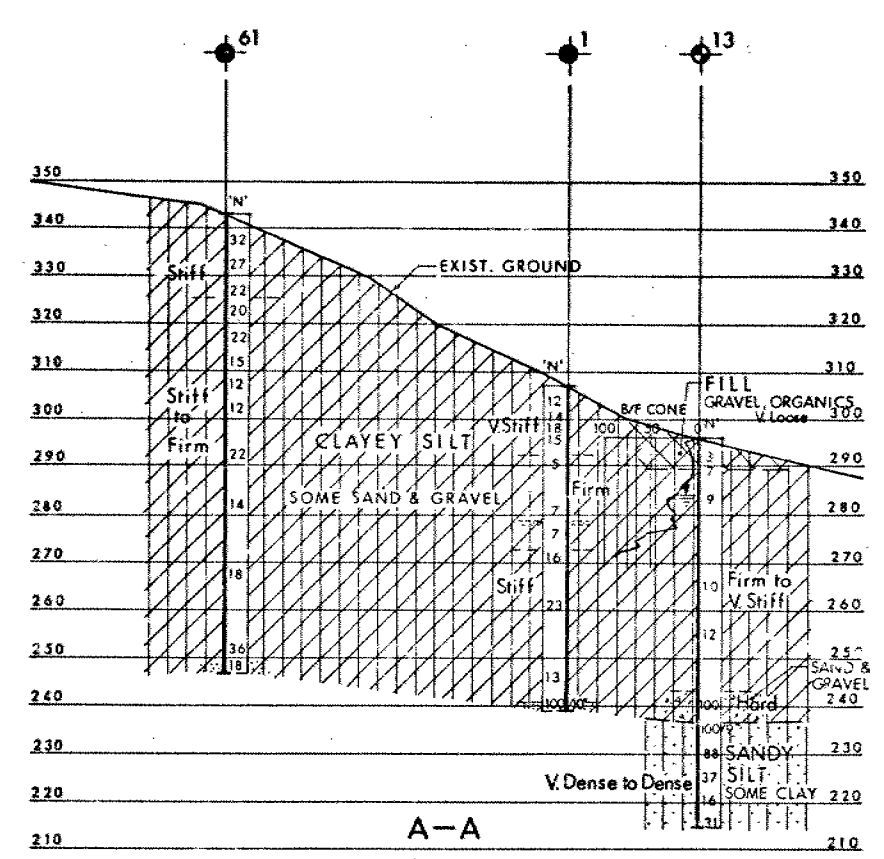
LEGEND

- Bore Hole
- Dynamic Cone Penetration Test (Cone)
- Bore Hole & Cone
- N' Blows/ft (Std Pen Test, 350 ft lbs energy)
- CONE Blows/ft (60° Cone, 350 ft lbs energy)
- W.L. at time of investigation
- S.H. No. 13 NOV. 1971
- B.H. No. 62 APR. 1976
- NO W.L. established B.H. 1, 61, 14

| No | ELEVATION | CO-ORDINATES | |
|----|-----------|--------------|---------|
| | | NORTH | EAST |
| 1 | 307-1 | 680,477 | 069,226 |
| 13 | 296-1 | 680,499 | 069,277 |
| 14 | 309-5 | 680,017 | 069,409 |
| 61 | 343-5 | 680,430 | 069,097 |
| 62 | 333-0 | 680,078 | 069,092 |

-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 |
|-----------|------|----|-------------|
| | | | |
| | | | |
| | | | |



Mr. D.A. Waller
Construction Engineer
District #4, Hamilton

Soil Mechanics Section
Engineering Materials Office
West Building, Downsview


77 06 20

Re: Slope Seepage at North Approach
Fill For Geneva St., St. Catharines
Cont. 77-02, District #4, Hamilton

When the existing slope was benched in preparation for the placing of the north approach fill for the Geneva Street Structure, a seepage zone in the slope was uncovered.

During a visit to the site it was agreed by Mr. J. Castellan, Project Supervisor; Mr. K. Saarits of the Quality Assurance Section, and by the writer, that the following treatment was required.

The slope should be benched normally. A 24 inch thick blanket of free draining granular should then be placed over the seepage area so that any seepage water can drain through the granular to a 6 inch perforated pipe running across the base of the slope and out to a future Highway 406 ditch.



P.J. Stuart
Project Engineer

For: K.G. Selby
Supervising Engineer

PJS/gs

cc: K. Saarits
Files/
Record Services

Soil Mechanics Section
Engineering Materials Office
West Building
1201 Wilson Avenue
Downsview, Ontario
M3M 1J8

Tel: (416) 248-3282

December 8, 1976

Mr. J.A. Patkowski, P. Eng.
Proctor and Redfern
75 Eglinton Avenue East
Toronto, Ontario
M4P 1H3

Dear Sir: Re: The Relocation of the Sanitary Sewer
Between Downing St. and Glenridge Avenue
W.P. 46-74-37

A review of the plan and sections provided for the installation of a sanitary sewer running above the slope between Downing St. and Glenridge Avenue, leads to the following comments:

1. The 10 foot cut to lower the ground surface before excavating for the sewer trench will flatten the slope and thereby improve its stability.
2. The 8 inch diameter perforated pipe being placed in the sanitary sewer excavation to remove seepage water should be extended from MH #15 to MH # 12.
3. The 8 inch perforated pipe should not be outlet onto the slope as this will saturate and soften it and thereby reduce its stability.



P. Stuart
Project Engineer

For: K.G. Selby
Supervising Engineer

KGS/PS/gs

cc: Files
Record Services



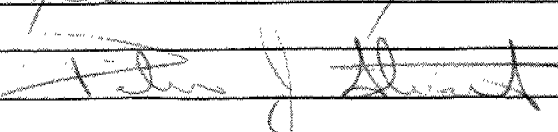
MISCELLANEOUS DETAIL SHEET

(DO NOT USE FOR GRADING QUANTITIES, ETC.)
OR FOR SCRATCH PAD USE

SHEET NO. _____ OF _____ DATE _____

WORK PROJECT NO. _____ CONTRACT NO. _____ ITEM NO. _____

LOCATION OF MATERIAL, ETC. _____

| WT - 46-74-39 | UNIT |
|---|------|
| St Catharines ONT January 6, 1977 | |
| Mr. Dorez Patchy Proctor & Redfern | |
| <p>Dear Sir:</p> <p>A slip failure has developed in the slope below the sanitary sewer excavation, due to the loading of the slope with ^{the} material being excavated. Lateral earth pressures from this moving mass of soil could cause structural damage to the 3-cell culvert buried at the toe of slope. It would therefore be advisable to avoid loading the slope and in this way avoid any possibility of damage to the culvert.</p> | |
| Yours truly,  Peter J. Albert Project ENGR Soil Mechanics Sec Ministry of Trans & Com | |

Mr. N.D. Smith
Central Region
3501 Dufferin Street
Downsview

Soil Mechanics Section
Geotechnical Office
West Building, Downsview

May 18, 1976

Foundation Investigation For

1. 24 Inch Sanitary Sewer - Downing St.
and South Drive, St. Catharines
 2. 24 Inch Watermain - Downing St. -
Carlisle St., St. Catharines
- W.P. 46-74-37, District 4, Hamilton

This is to provide you with a summary of our findings as a result of foundation investigations recently carried out for the above mentioned projects.

Subsoil at the site consists of a thick deposit (from ground surface to elevation 245+) of generally stiff clayey silt overlying a deposit of dense silty sand. In the old canal channel and its vicinity, a mixed fill with organics up to 23 ft. thick is also encountered.

1. With regard to the effect on the adjacent 50 ft. high slope between Downing St. and South Drive of the new sewer installation, it is our opinion that if the sewer trench incorporates a sub-drain - an 8 inch perforated plastic pipe covered by 12 inch minimum Granular 'A' backfill material - the net result will be an increase rather than a decrease in stability. No major construction problems are anticipated for the sewer construction.
2. The proposed new watermain will be constructed in areas which are to be backfilled later when construction of Hwy. 406 takes place. This backfill will cause settlements of the watermain which will thereby be subjected to differential movements. Our estimates of these settlements are as follows:

| <u>Station</u> | <u>Estimated Settlements</u> |
|----------------|------------------------------|
| 1 + 00 | 0" |
| 1 + 70 | 3" |
| 2 + 20 | 10" |
| 3 + 30 | 10" |
| 3 + 90 | 4" |
| 5 + 00 | 8" |
| 5 + 50 | 20" |
| 7 + 00 | 20" |
| 7 + 70 | 3" |
| 9 + 30 | 0" |

cont'd.....

It will be noted that from Sta. 5 + 50 to Sta. 7 + 00, a large settlement in the order of 20 inches is anticipated. This is due to the presence of about 15 ft. of soft organic soil below the proposed watermain invert. In our view, it would be advisable to excavate this material for a width of 8 ft. and replace to the pipe invert level with Granular 'A' material. This should result in a settlement over this section not exceeding about 2-3 inches. To reduce the magnitude of a possible bump at the surface of the future Hwy. 406 vertically above the watermain, it would be advisable to construct an 'imperfect' trench at least 6 feet in depth (minimum) above the bedding for the watermain.

A meeting was held among Messrs. N. Smith, K. Selby, K. Smith, N. Huggins, P. Stuart and B. Ly, on May 11, 1976, in which the above mentioned points were discussed in detail. A complete foundation report will be sent to you in the near future.

B. Ly

B. Ly, P. Eng.
Project Engineer

For: K.G. Selby, P. Eng.
Supervising Engineer

cc: C. Robertson
R.M. Martin
T. Ellerbusch
N. Huggins
K. Smith
Files
Record Services

DOCUMENT MICROFILMING IDENTIFICATION

G.I.-30 SEPT. 1976

GEOCRES No. 30M3-206

DIST. 4 REGION

W.P. No. 46-74-37

CONT. No.

W. O. No.

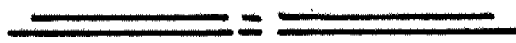
STR. SITE No.

HWY. No. LOC

LOCATION WATERMAIN @ DOWNING ST

± CARLISLE ST. SANITARY SEWER @

NO. 200 - 2000 DOWNING & SOUTH DRIVE
ST CATHARINES



OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT.

REMARKS:

FOUNDATION INVESTIGATION & DESIGN REPORT

30M3-206
GEOCRES No.

W.P. 46-74-37

DIST. 4

HWY. N/A

STR. SITE N/A

1. 24" Watermain at Downing St. and
Carlisle St.
2. 24" Sanitary Sewer at Downing St.
and South Drive

DISTRIBUTION

G.C.E. Burkhardt (3)
R.S. Pillar
C.S. Grebski
B.J. Giroux
G.A. Wrong
M.R. Ernesaks
R.D. Gunter
C.R. Robertson

R. Hore

J. Anderson)
R. Fitzgibbon) cover only
G. Sloan)

Files

GEOCRES 30M3-206

DATE



Memorandum

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

From: Soil Mechanics Section
Geotechnical Office
West Building, Downsview

Attention:

Date: July 29, 1976

Our File Ref.

In Reply to

Subject:

W.P. 46-74-37
1. 24" Watermain at Downing St. and Carlisle St.
2. 24" Sanitary Sewer at Downing St. and South Drive
District 4, Hamilton

INTRODUCTION

This report contains results of a foundation investigation carried out by this Section at the following sites:

1. 24" Watermain at Downing St. and Carlisle St.
2. 24" Sanitary Sewer at Downing St. and South Drive.

Also contained in this report are recommendations for the foundations of the above mentioned utilities.

SITE DESCRIPTION

The proposed watermain crosses the Geneva-Glenridge Valley, where the Old Welland Canal is located, at approximately 1200 feet east of the Glenridge Fill. The area in concern is bounded to the north by Park St. and to the south by Downing St. At this locale the valley is about 650 feet wide, flanked by moderate slopes of 60 to 70 feet high. The valley, in general, is grass covered but sparsely treed. At this particular area, the old channel of the canal has been filled in and the canal has been relocated to a 3 cell box culvert.

The site of the sanitary sewer is just south of the watermain site and is also in a valley where Downing St. intersects with South Drive. This valley is proposed to be spanned by the future Westchester Crescent, by means of a fill. The slopes of the valley are about 50 to 65 feet high, not steeper than 2.5:1 overall, and at present are covered with trees. Residential developments are the major land use of the areas.

SUBSURFACE CONDITIONS

A total of seven sampled boreholes (No. 1 to 5, and No. 61 to 62 inclusive) were put down during the period of April 13 to April 22, 1976. Results of another four boreholes (No. 13, 14, 115 and 311) previously put down for feasibility study of Hwy. 406 are also incorporated here.

Locations of the boreholes, together with the inferred subsoil stratigraphy, are shown in Dwg. No. 467437-A and B. Details of the borehole results are also presented in the Borehole Record Sheets which are included in the Appendix to this report. A description of the various subsoil types is given below.

In general, subsoil at these sites consists of a thick deposit of clayey silt, underlain by a deposit of silty sand. In the vicinity of the three cell box culvert, the clayey silt is overlain by a layer of mixed fill.

Clayey Silt

The clayey silt is the predominant deposit in the area and is intercepted in all boreholes. This deposit generally exists from ground surface to elev. 247+, except in the neighborhood of the Old Welland Canal where it is overlain by a layer of mixed fill. According to the consolidation test results, the clayey silt is an overly consolidated material. Inferred from the 'N' values of the Standard Penetration Test and undrained shear strengths, this material is classified as stiff to firm in consistency. The Atterberg Limits and moisture contents, as determined by our lab tests, have the following ranges of values:

Liquid Limits (LL) 37% to 50%
Plasticity Limits (PL) 18% to 22%
Moisture Contents (W_n) 25% to 35%

A plot of the liquid limits and the plasticity indices on the Plasticity Chart shows that the material is medium to low in plasticity. Lab tests have also been carried out to determine the PH values, concentration of SO_3 , and organic contents. This information is for choosing a corrosive resistant material for the watermain. The test results, which are reported in the Borehole Log Sheets, show that the clayey silt is generally slightly basic and contains an SO_3 concentration from 50 ppm to 2750 ppm.

Sandy Silt to Silty Sand

Underneath the clayey silt is a deposit of sandy silt/silty sand, the lower boundary of which, due to the purpose of the present investigation, is not fully determined. In Borehole 311, the silty sand is found to be underlain by a glacial till at elev. 203+. On the basis of the 'N' values, the relative density of this deposit is in the range of compact to very dense. Results of grain size analyses show that this material contains 35% to 60% silt and the sand component is predominantly fine grained. This deposit also contains trace of clay and fine gravel. Typical grain size distribution curves are shown in the Appendix.

Mixed Fill

In the area between Sta. 4+50 and Sta. 8+00, the site is covered with a layer of cohesive fill. Thickness of this material increases towards the Old Welland Canal, extending to elev. 268+ near Sta. 5+50 and Sta. 7+00 for a maximum thickness of about 23 ft. Although it is composed of mainly clayey silt, due to inclusions of organic matters, cinders, etc., its composition is very heterogeneous and its consistency is very non-uniform, ranging from stiff to very soft. Some Atterberg Limits, moisture contents, and chemical contents determined for this material are included in the Borehole Log Sheets.

GROUNDWATER CONDITIONS

Groundwater levels were observed in the open boreholes during our field investigation and they reflected the prevailing conditions at the time of observation. Our observations showed that groundwater generally existed within 5 feet of ground surface at the watermain site and it drained into the three cell box culvert. In the slope of the sewer site, groundwater was observed at 10 to 20 feet below ground surface.

RECOMMENDATIONS

Placement of the Hwy. 406 fill has necessitated the existing underground utilities to be relocated. Because of the presence of the mixed fill in the vicinity of the culvert, concern has been expressed over the large differential settlements anticipated for the mixed fill. Concern has also been expressed over the stability of the existing slope in which the new sewer is to be constructed.

Based on our subsoil information, the following recommendations are given:.

- (a) With regard to the effect on the adjacent 50 ft. high slope between Downing St. and South Drive of the new sewer installation, it is our opinion that if the sewer trench incorporates a subdrain - an 8 inch perforated plastic pipe covered by 12 inch minimum Granular 'A' backfill material - the net result will be an increase rather than a decrease in stability. No major construction problems are anticipated for the sewer construction.
- (b) The proposed new watermain will be constructed in areas which are to be backfilled later when construction of Hwy. 406 takes place. This back fill will cause settlements of the watermain which will thereby be subjected to differential movements. Our estimates of these settlements are as follows:

| <u>Station</u> | <u>Estimated Settlements</u> |
|----------------|------------------------------|
| 1 + 00 | 0" |
| 1 + 70 | 3" |
| 2 + 20 | 10" |
| 3 + 30 | 10" |
| 3 + 90 | 4" |
| 5 + 00 | 8" |
| 5 + 50 | 20" |
| 7 + 00 | 20" |
| 7 + 70 | 3" |
| 9 + 30 | 0" |

It will be noted that from Sta. 5 + 50 to Sta. 7 + 00, a large settlement in the order of 20 inches is anticipated. This is due to the presence of about 15 ft. of soft organic soil below the proposed watermain invert. In our view, it would be advisable to excavate this material for a width of 8 ft. and replace to the pipe invert level with Granular 'A' material. This should result in a settlement over this section not exceeding about 2-3 inches.

To reduce the magnitude of a possible bump at the surface of the future Hwy. 406 vertically above the watermain, it would be advisable to construct an 'imperfect' trench at least 6 feet in depth (minimum) above the bedding for the watermain.

MISCELLANEOUS

The recent fieldwork was carried out during the period of April 13 to April 22, 1976, under the supervision of Mr. B. Ly. The drilling equipment was owned and operated by Atcost Drilling Company. This report was prepared by Mr. B. Ly and reviewed by Mr. K. Selby, Supervising Engineer.

B. Ly

B. Ly, P. Eng.
Senior Engineer

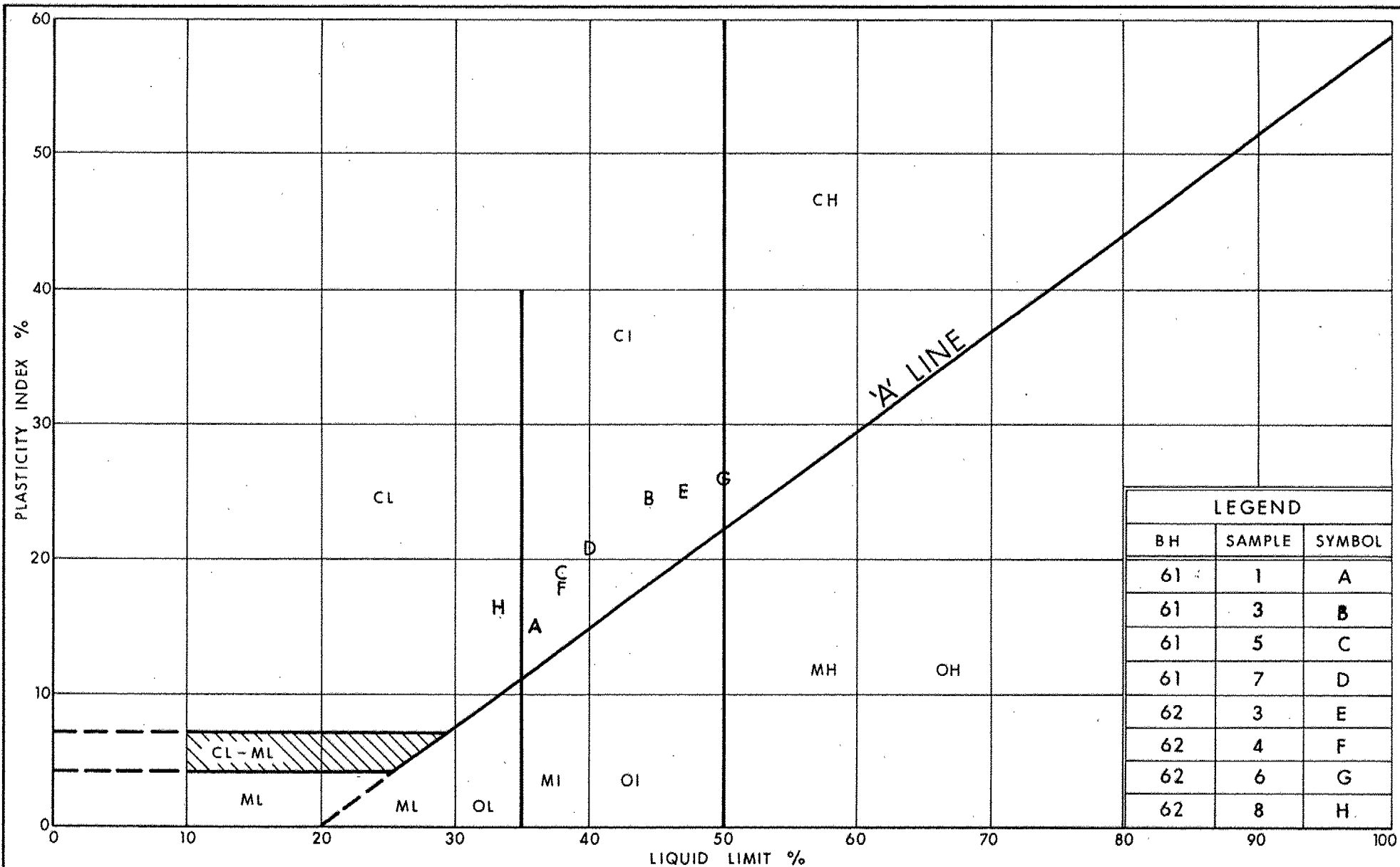


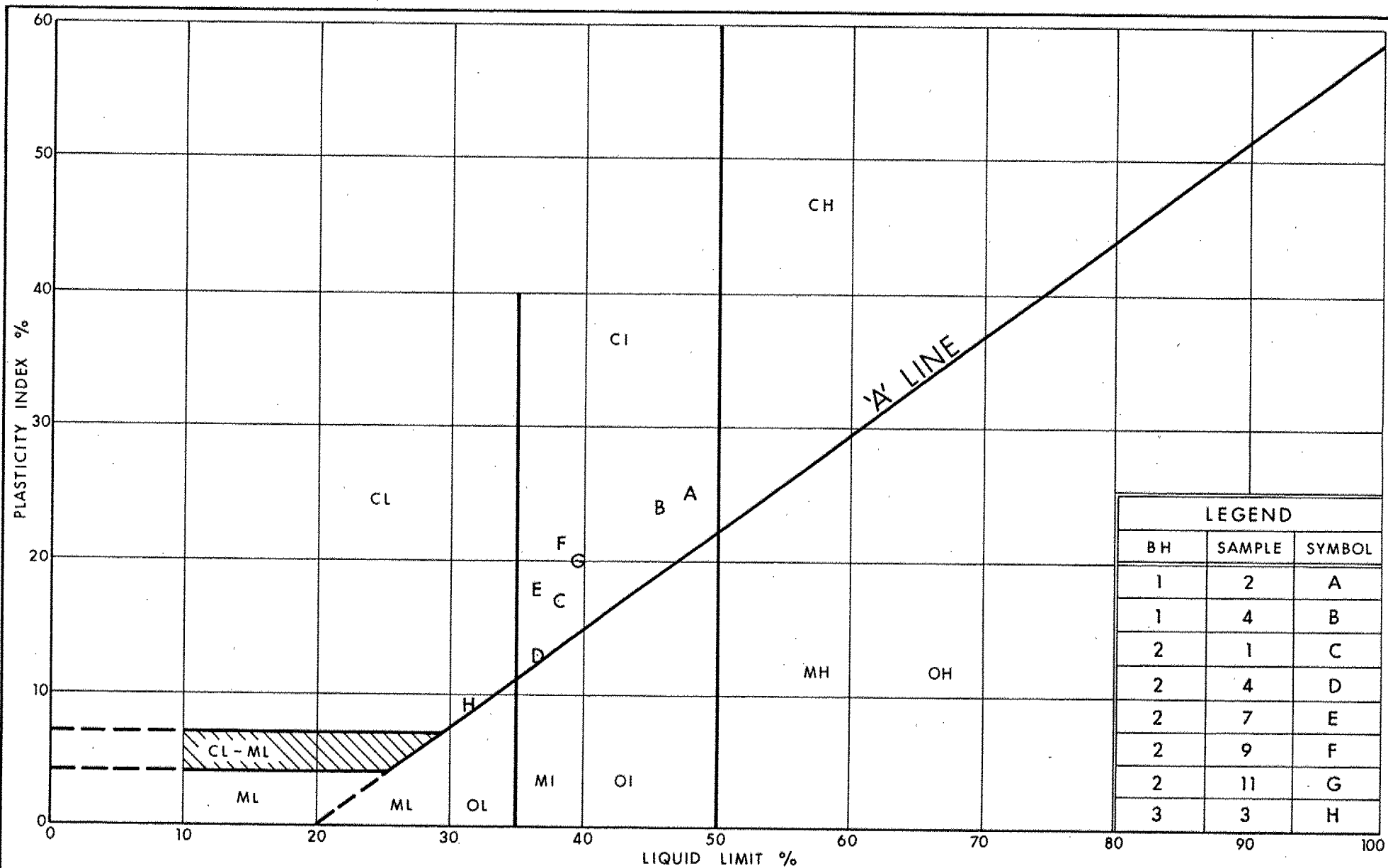
K.G. Selby

K.G. Selby, P. Eng.
Supervising Engineer

KGS/gs
July, 1976

APPENDIX





| LEGEND | | |
|--------|--------|--------|
| BH | SAMPLE | SYMBOL |
| 1 | 2 | A |
| 1 | 4 | B |
| 2 | 1 | C |
| 2 | 4 | D |
| 2 | 7 | E |
| 2 | 9 | F |
| 2 | 11 | G |
| 3 | 3 | H |



Ontario

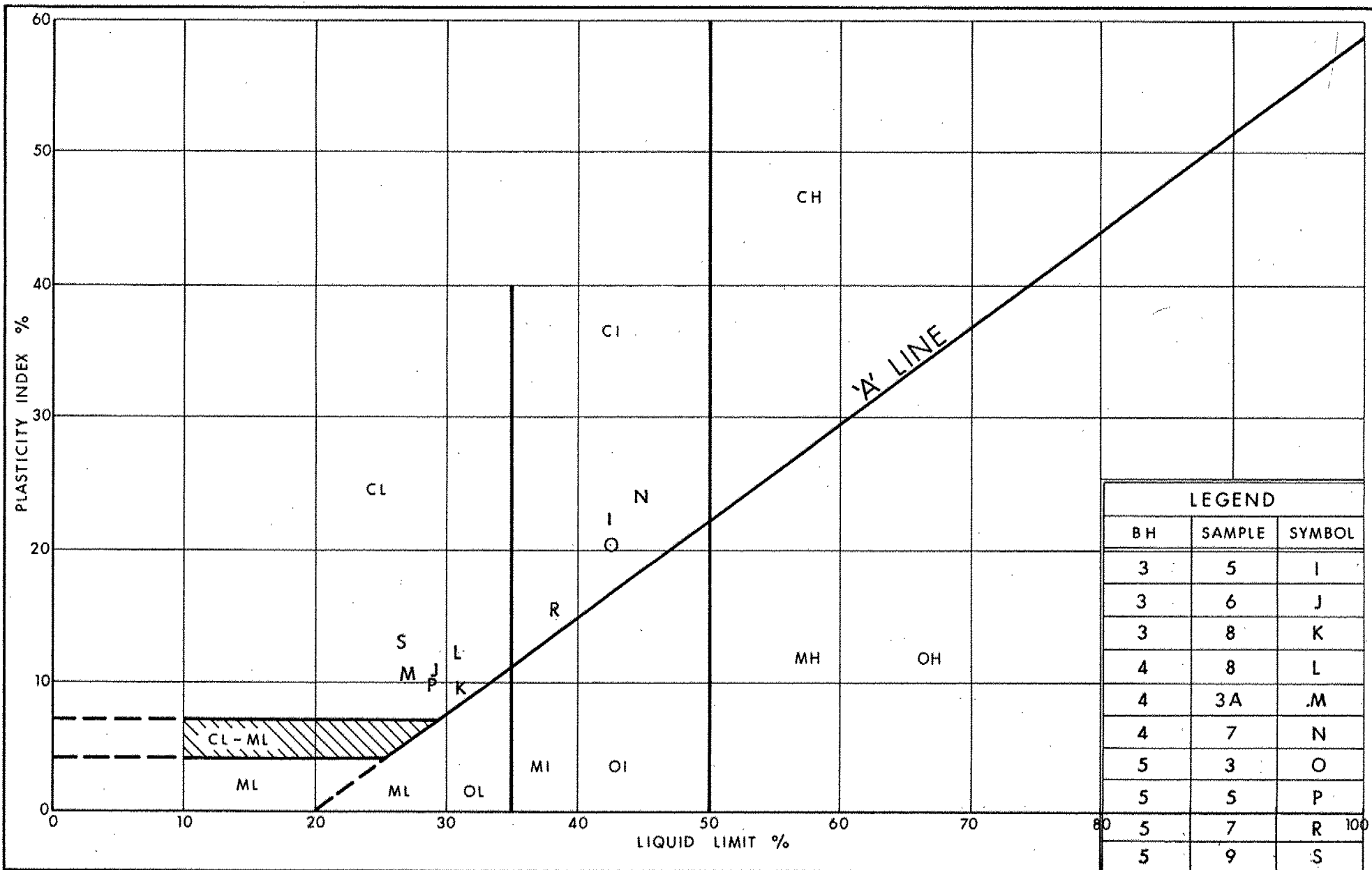
Ministry of
Transportation and
Communications

ENGINEERING SERVICES BRANCH

PLASTICITY CHART CLAYEY SILT

FIG No 1 A

W P 46-74-37 A



Ontario
ENGINEERING SERVICES BRANCH

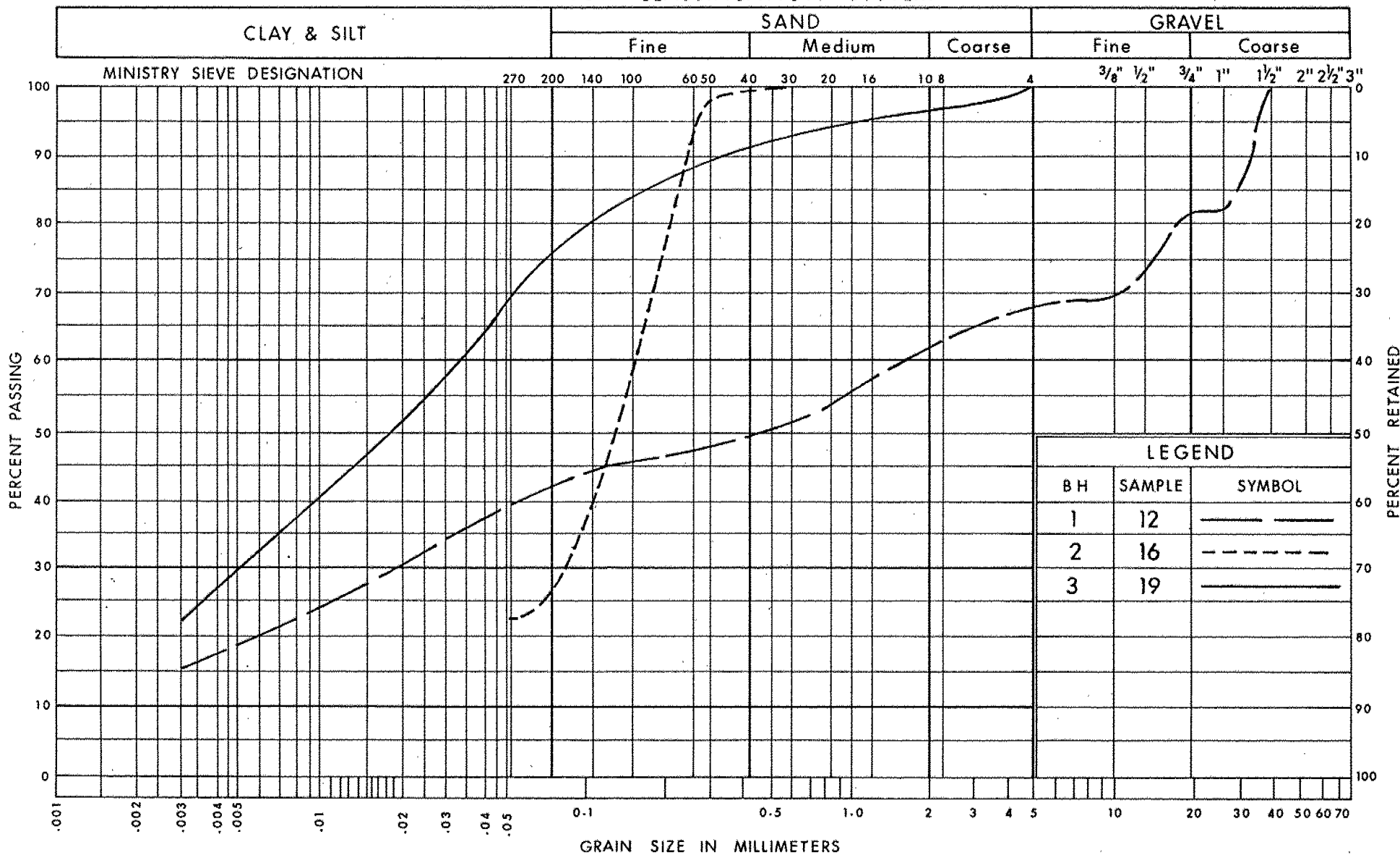
Ministry of
Transportation and
Communications

PLASTICITY CHART CLAYEY SILT

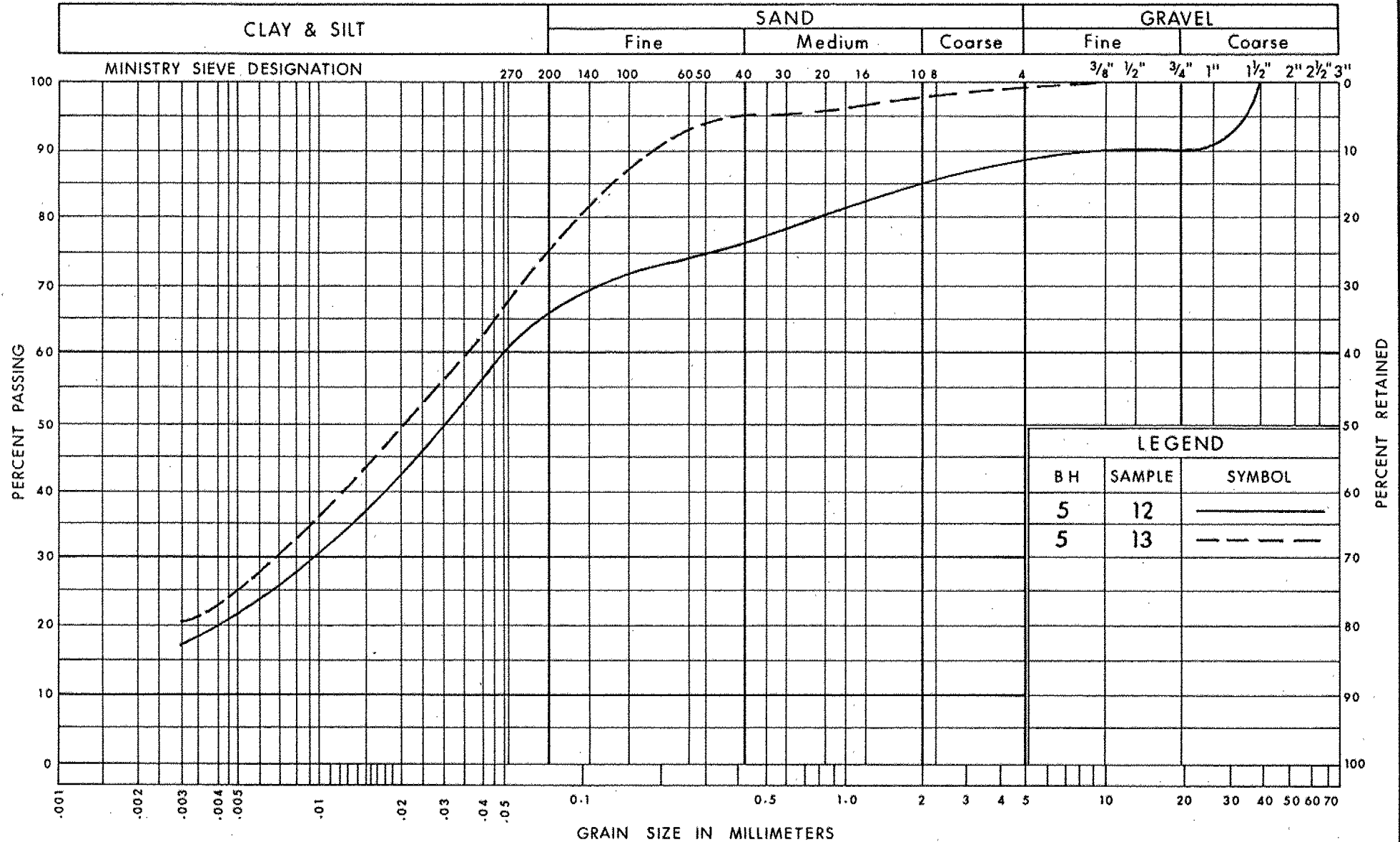
FIG No 1B

W P 46-74-37 A

UNIFIED SOIL CLASSIFICATION SYSTEM



UNIFIED SOIL CLASSIFICATION SYSTEM



Ministry of
Transportation and
Communications

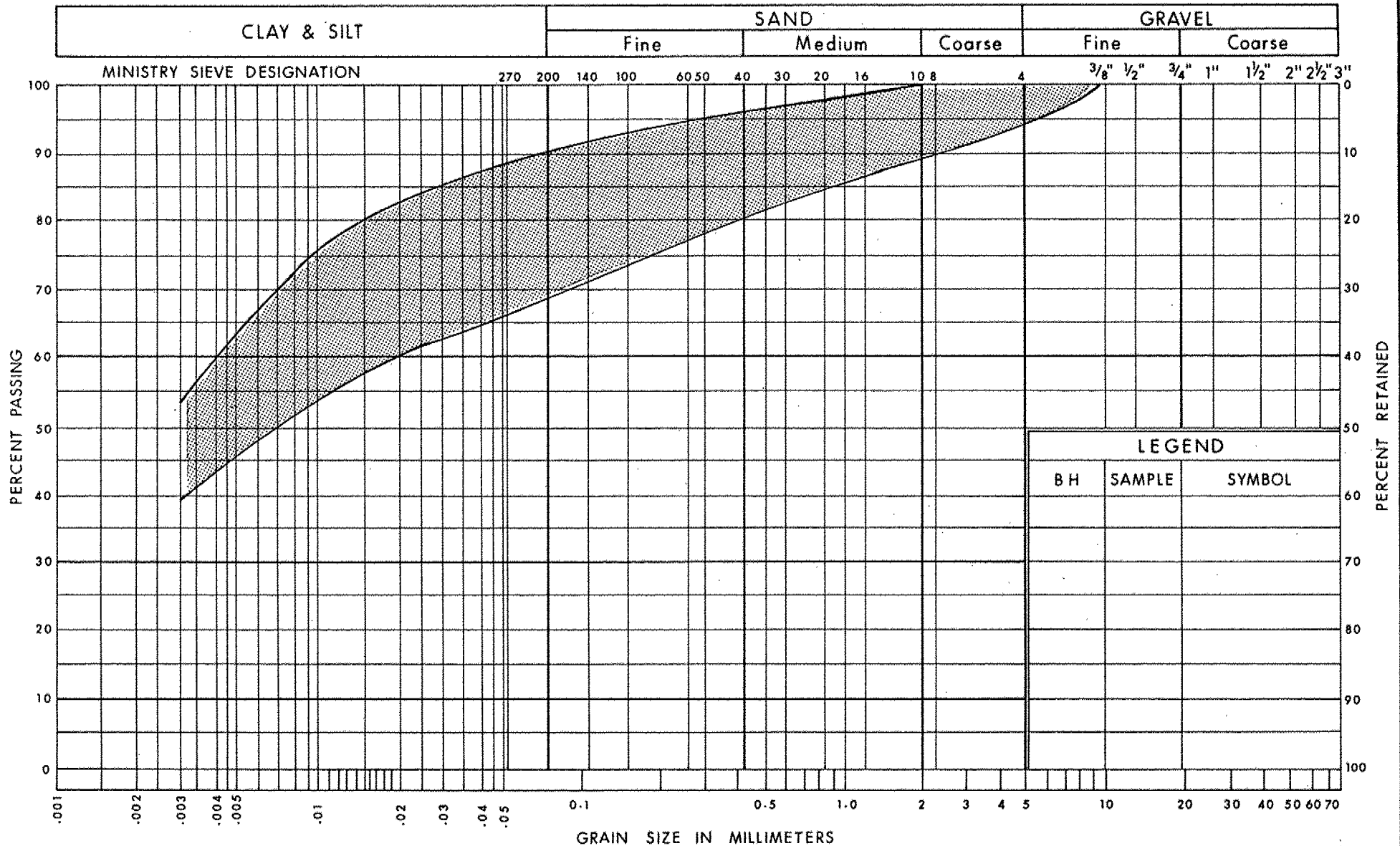
ENGINEERING SERVICES BRANCH

GRAIN SIZE DISTRIBUTION CLAYEY SILT

FIG No 3

W P 46-74-37 A

UNIFIED SOIL CLASSIFICATION SYSTEM

Ministry of
Transportation and
Communications

Ontario

ENGINEERING SERVICES BRANCH

GRAIN SIZE DISTRIBUTION CLAYEY FILL

FIG No 4

W P 46-74-37 A

VOID RATIO - PRESSURE CURVES

W.P. 46-74-37 A

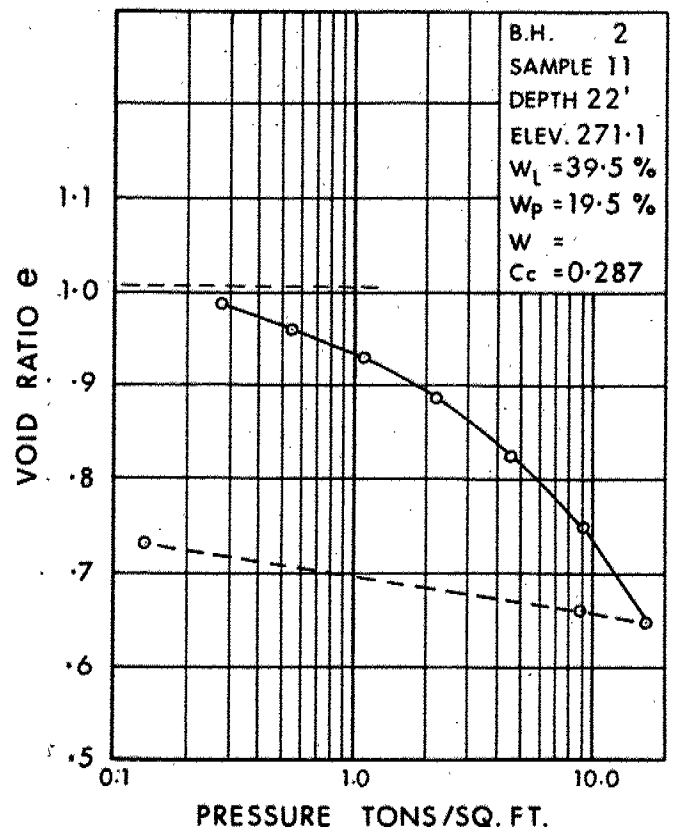
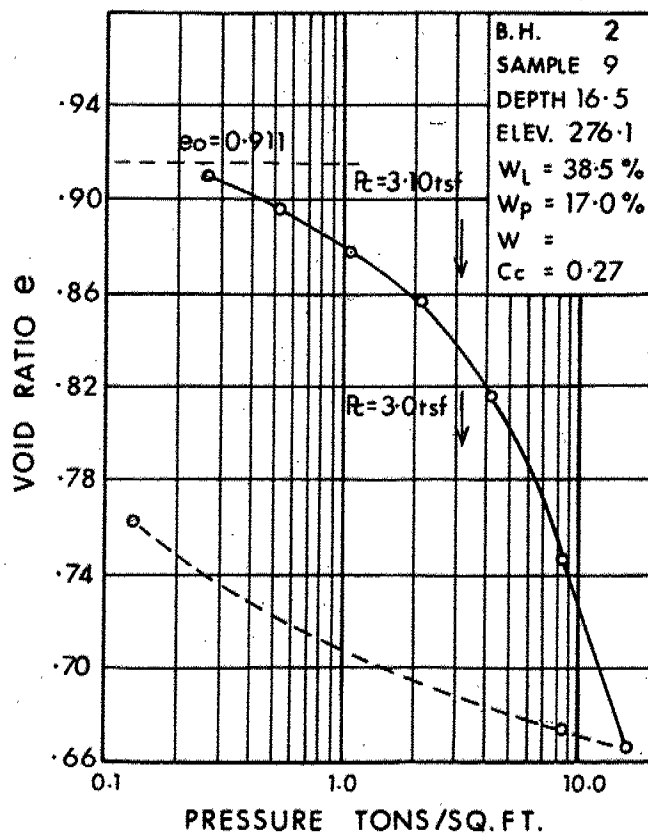
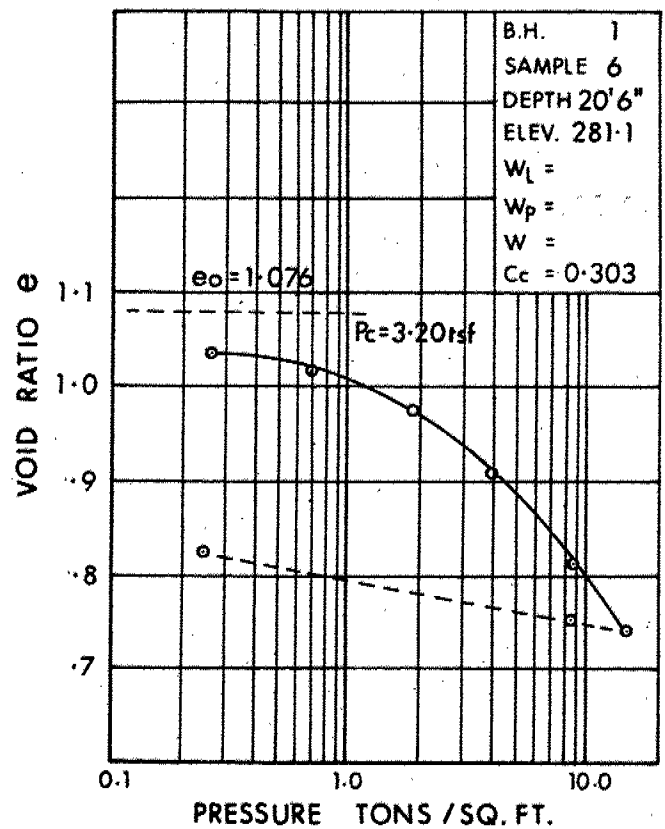
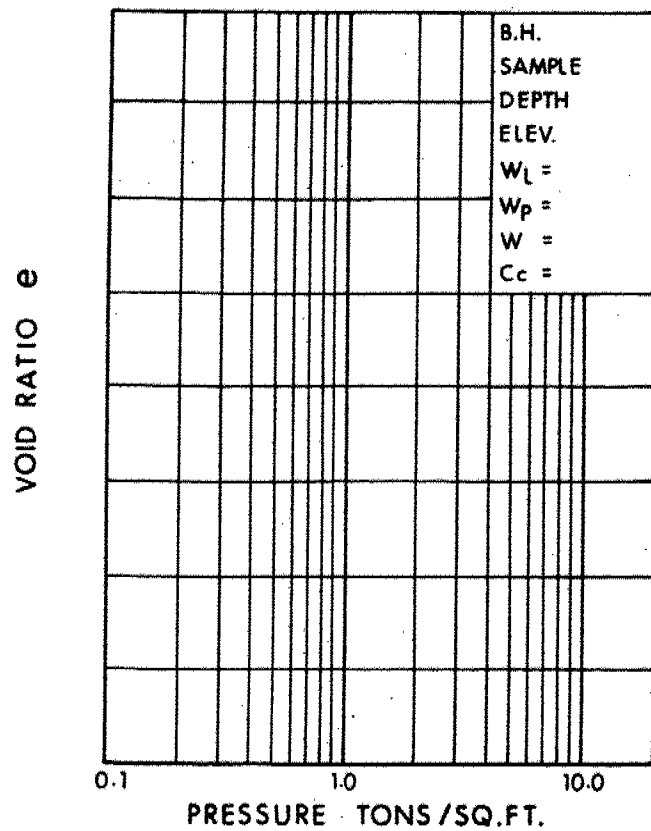
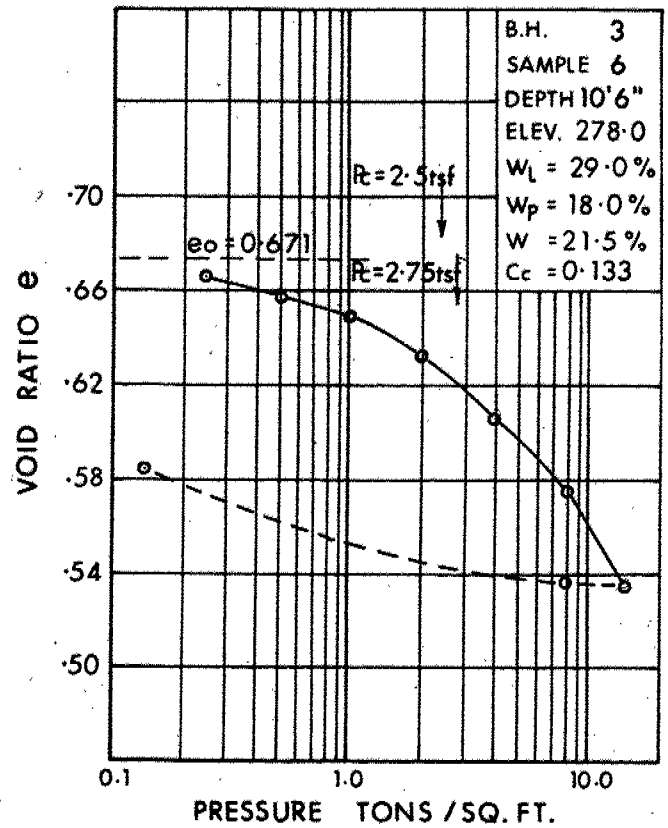
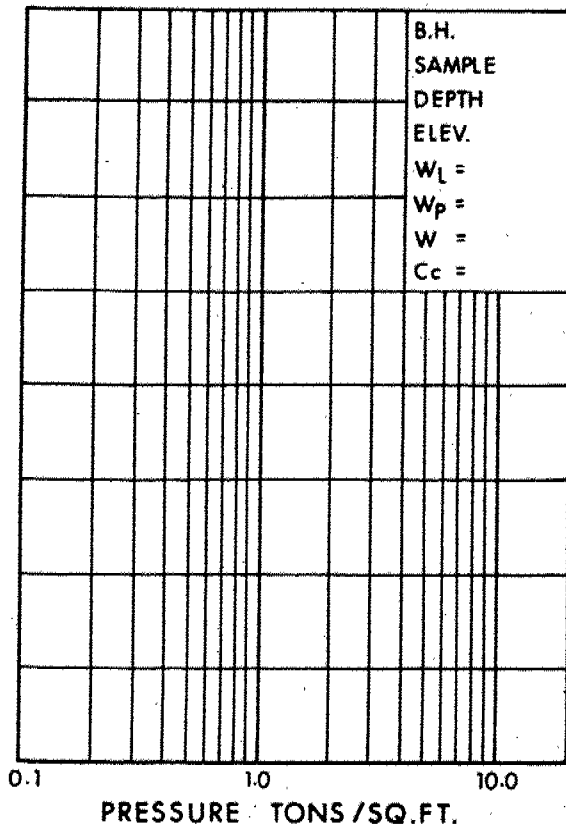


FIG. 5

VOID RATIO - PRESSURE CURVES

W.P. 46-74-37 A

VOID RATIO e



VOID RATIO e

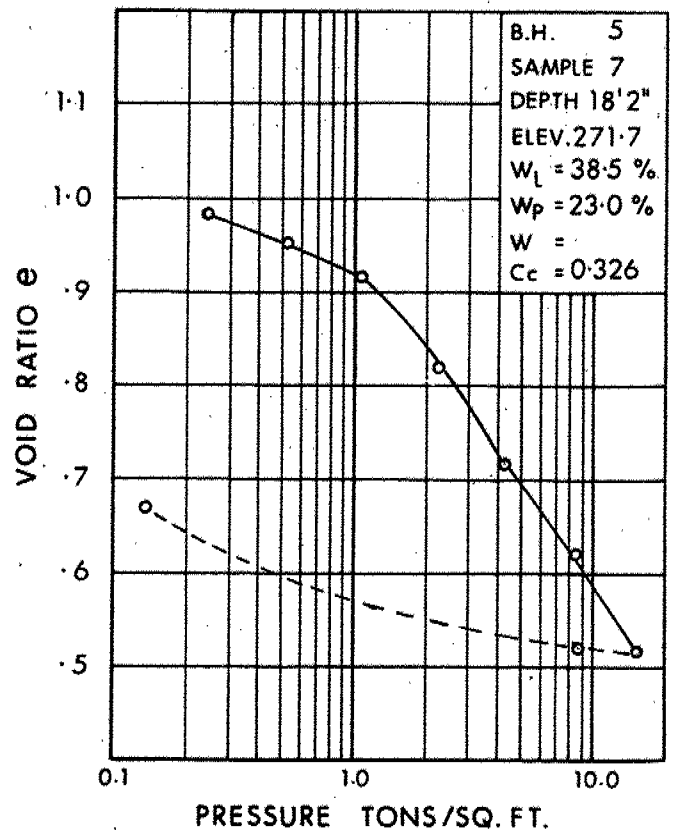
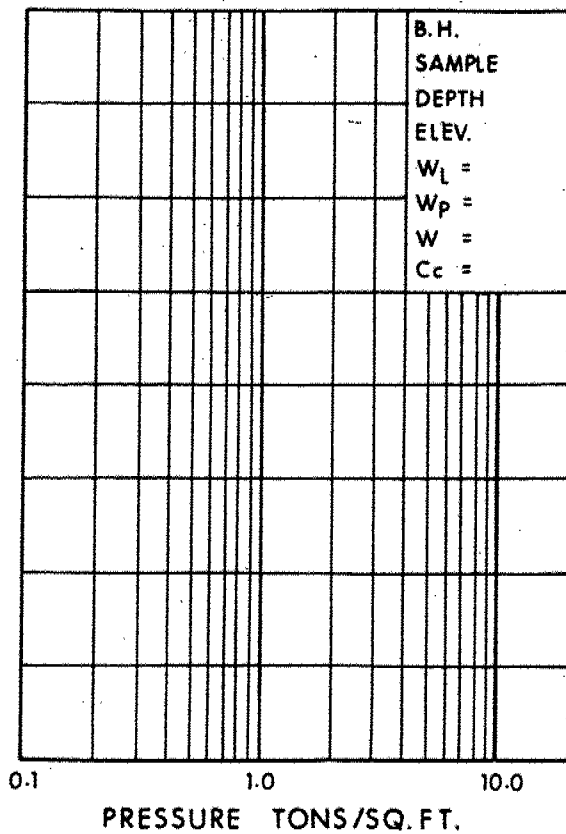


FIG. 6

WP 46-74-37 (A) LOCATION Co-ords. 1,069,226 E.; 15,680,477 N; ORIGINATED BY MK
DIST 4 HWY 406 BORING DATE April 13, 14, 1976 COMPILED BY MK
DATUM Geodetic BOREHOLE TYPE NX & BX Casing CHECKED BY _____

20
15 ϕ 5 % STRAIN AT FAILURE
10

ENGINEERING SERVICES BRANCH-GEOTECHNICAL OFFICE-SOIL MECHANICS SECTION

RECORD OF BOREHOLE NO 2

WP 46-74-37 (A) LOCATION Co-ords. 1,069,170 E; 15,680,710 N. ORIGINATED BY MK
 DIST 4 HWY 406 BORING DATE April 20, 21, 1976 COMPILED BY MK
 DATUM Geodetic BOREHOLE TYPE Hollow Stem Auger CHECKED BY

| SOIL PROFILE | | | SAMPLES | | | GROUND WATER ELEV | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | | | | LIQUID LIMIT <u>W_L</u> PLASTIC LIMIT <u>W_P</u> WATER CONTENT <u>W</u> | | | UNIT WEIGHT <u>γ</u> P.C. | REMARKS |
|---------------|---|-------------|---------|------|-----------------------|----------------------|---|----|----|----|-----|---|---|----------------|------------------------------------|---------|
| ELEV DEPTH | DESCRIPTION | STRAT. PLOT | NUMBER | TYPE | N ^o VALUES | | 20 | 40 | 60 | 80 | 100 | W _P | W | W _L | | |
| 293.1 | Ground Level | | | | | | | | | | | | | | | |
| 0.0 | Fill - heterogeneous mixture of sand, clay & cinder, some organic | | 1 | SS | 10 | 290 | | | | | | | | | | |
| | | | 2 | SS | 9 | | | | | | | | | | | |
| | | | 3 | SS | 3 | | | | | | | | | | | |
| 283.6 | | | 4 | SS | 5 | | | | | | | | | | | |
| 9.5 | Clayey Silt | | 5 | SS | 11 | | | | | | | | | | | |
| | Grey, Firm to Stiff | | 6 | SS | 12 | | | | | | | | | | | |
| | | | 7 | SS | 12 | | | | | | | | | | | |
| | | | 8 | SS | 7 | | | | | | | | | | | |
| | | | 9 | TW | PH | | | | | | | | | | | |
| | low to medium plasticity, | | 10 | SS | 4 | | | | | | | | | | | |
| | traces of sand | | 11 | TW | PH | | | | | | | | | | | |
| | | | 12 | SS | 14 | | | | | | | | | | | |
| | | | 13 | SS | 12 | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | |
| 250.1 | | | 14 | SS | 8 | | | | | | | | | | | |
| 43.0 | Silty Sand | | | | | | | | | | | | | | | |
| | Fine | | 15 | SS | 23 | | | | | | | | | | | |
| | Compact to Dense | | | | | | | | | | | | | | | |
| 231.6 | | | 16 | SS | 38 | | | | | | | | | | | |
| 61.5 | End of Borehole | | | | | | | | | | | | | | | |
| | Note: | | | | | | | | | | | | | | | |
| | Chemical test results | | | | | | | | | | | | | | | |
| | Sample Organic PH | | | | | | | | | | | | | | | |
| | SS-2 2.25% 8.25 | | | | | | | | | | | | | | | |
| | SS-4 3.76% 8.15 | | | | | | | | | | | | | | | |

ENGINEERING SERVICES BRANCH-GEOTECHNICAL OFFICE - SOIL MECHANICS SECTION

RECORD OF BOREHOLE NO 3

WP 46-74-37 (A) LOCATION Co-ords. 1,069,172 E. 15,680,813 N. ORIGINATED BY MK
 DIST 4 HWY 406 BORING DATE April 15, 20, 1976 COMPILED BY MK
 DATUM Geodetic BOREHOLE TYPE Hollow Stem Auger CHECKED BY

| SOIL PROFILE | | | SAMPLES | | | GROUND WATER ELEV | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | | | | LIQUID LIMIT w_L PLASTIC LIMIT w_p WATER CONTENT w w_p — w — w_L WATER CONTENT % 20 40 60 | UNIT WEIGHT γ | REMARKS % GR SA SI CL |
|---------------|-----------------------------------|-------------|---------|------|-----------|----------------------|---|----|----|----|-----|--|----------------------------|---------------------------------|
| ELEV DEPTH | DESCRIPTION | STRAT. PLOT | NUMBER | TYPE | N' VALUES | | 20 | 40 | 60 | 80 | 100 | | | |
| 289.0 | Ground Level | | | | | | | | | | | | | |
| 0.0 | Clay Fill | | | | | | | | | | | | | |
| | homogeneous & stiff | | 1 | SS | 17 | | | | | | | | | |
| | | | 2 | SS | 13 | | | | | | | | | |
| 282.0 | | | 3 | SS | 9 | | | | | | | | | |
| 7.0 | Mixed Fill - mainly | | 4 | SS | 8 | | | | | | | | | |
| | sand, silt, some clay | | 5 | TW | PH | | | | | | | | | |
| | and organic, Black | | 6 | TW | PH | | | | | | | | | |
| 274.0 | | | 7 | SS | 62 | | | | | | | | | |
| | | | 8 | SS | 12 | | | | | | | | | |
| 15.0 | Clay Fill - some sand | | 9 | SS | 9 | | | | | | | | | |
| | and organic | | 10 | SS | 9 | | | | | | | | | |
| 268.0 | Soft | | 11 | SS | 8 | | | | | | | | | |
| | | | 12 | SS | 12 | | | | | | | | | |
| 21.0 | Clayey silt, grey, | | 13 | SS | 20 | | | | | | | | | |
| | stiff to firm, with | | 14 | SS | 14 | | | | | | | | | |
| | traces of sand, low | | | | | | | | | | | | | |
| | to medium plasticity | | 15 | SS | 18 | | | | | | | | | |
| | | | 16 | SS | 7 | | | | | | | | | |
| | becoming more sandy, | | | | | | | | | | | | | |
| 249.0 | some fine gravel | | | | | | | | | | | | | |
| 40.0 | Silty Sand | | 17 | SS | 33 | | | | | | | | | |
| | Fine and Dense, | | | | | | | | | | | | | |
| | occasional clay seams | | 18 | SS | N/A | | | | | | | | | |
| | | | | | | | | | | | | | | |
| | becoming denser | | 19 | SS | N/A | | | | | | | | | |
| 229.0 | | | | | | | | | | | | | | |
| 60.0 | End of Borehole | | | | | | | | | | | | | |
| | Note: | | | | | | | | | | | | | |
| | Chemical test results | | | | | | | | | | | | | |
| | Sample Organic PH SO ₂ | | | | | | | | | | | | | |
| | SS-3 2.86% 7.85 550 ppm | | | | | | | | | | | | | |
| | TW-6 1.04% 8.34 180 ppm | | | | | | | | | | | | | |
| | SS-8 3.05% 8.05 250 ppm | | | | | | | | | | | | | |
| | water -- 7.77 22 ppm | | | | | | | | | | | | | |

ENGINEERING SERVICES BRANCH-GEOTECHNICAL OFFICE-SOIL MECHANICS SECTION

RECORD OF BOREHOLE NO 4

WP 46-74-37 (A) LOCATION Co-ords. 1,069,155 E; 15,681,013 N; ORIGINATED BY MK
 DIST 4 HWY 406 BORING DATE April 14, 1976 COMPILED BY MK
 DATUM Geodetic BOREHOLE TYPE Hollow Stem Auger CHECKED BY

| SOIL PROFILE | | | SAMPLES | | | GROUND WATER ELEV | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | | | | LIQUID LIMIT w_L PLASTIC LIMIT w_p WATER CONTENT w $w_p \quad w \quad w_L$ WATER CONTENT % 20 40 60 | UNIT WEIGHT γ | REMARKS % GR SA SI CL |
|--|--|-------------|---------|------|------------|----------------------|---|----|----|----|-----|--|-------------------------|-----------------------------|
| ELEV DEPTH | DESCRIPTION | STRAT. PLOT | NUMBER | TYPE | 'N' VALUES | | 20 | 40 | 60 | 80 | 100 | | | |
| 294.4 | Ground Level | | | | | | | | | | | | | |
| 0.0 | Fill - mixture of clay & sand with some gravel, some organic | | 1 | SS | 12 | 290 | | | | | | | | |
| 285.4 | | | 2 | SS | 10 | | | | | | | | | |
| 9.0 | Clayey Silt | | 3 | SS | 7 | | | | | | | | | |
| | Very Stiff to Stiff | | 4 | TW | PH | | | | | | | | | |
| | fissured, containing traces of sand | | 5 | SS | 21 | | | | | | | | | |
| | | | 6 | SS | 13 | | | | | | | | | |
| | | | 7 | TW | PH | | | | | | | | | |
| | | | 8 | SS | 19 | | | | | | | | | |
| | | | 9 | SS | 14 | | | | | | | | | |
| | | | 10 | SS | 10 | | | | | | | | | |
| | | | 11 | SS | 9 | | | | | | | | | |
| | | | 12 | SS | 12 | | | | | | | | | |
| 262.9 | | | 13 | SS | 16 | | | | | | | | | |
| 31.5 | End of Borehole | | 14 | SS | 14 | | | | | | | | | |
| Note : Chemical Test Results Sample Org. PH S03 SS-2 2.39% 8.08 550 ppm Water - 8.10 375 ppm | | | | | | | | | | | | | | |

ENGINEERING SERVICES BRANCH-GEOTECHNICAL OFFICE-SOIL MECHANICS SECTION

RECORD OF BOREHOLE NO 5

WP 46-74-37 (A)

LOCATION Co-ords. 1,069,172 E. 15,680,910 N

ORIGINATED BY MK

DIST 4 HWY 406

BORING DATE April 13, 1976

COMPILED BY MK

DATUM Geodetic

BOREHOLE TYPE Hollow Stem Auger

CHECKED BY

| SOIL PROFILE | | | SAMPLES | | | GROUND WATER ELEV | 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 | | |
| 289.7 | Ground Level | | | | | | | | | | | | | | | |
| 0.0 | Fill | | | | | | | | | | | | | | | |
| | Silty Clay | | 1 | SS | 23 | | | | | | | | | | | |
| | Very Stiff | | 2 | SS | 18 | | | | | | | | | | | |
| 281.7 | | | 3 | SS | 11 | | | | | | | | | | | |
| 8.0 | Fill: clayey, some sand & organic | | 4 | TW | PH | | | | | | | | | | | |
| | Firm to Very Stiff | | 5 | TW | PH | | | | | | | | | | | |
| | | | 6 | SS | 12 | | | | | | | | | | | |
| | | | 7 | TW | PH | | | | | | | | | | | |
| 267.7 | becoming very sandy | | 8 | SS | 15 | | | | | | | | | | | |
| 22.0 | Clayey silt - grey, stiff, low to medium plasticity, some sand and fine gravels | | 9 | SS | 22 | | | | | | | | | | | |
| | | | 10 | SS | 13 | | | | | | | | | | | |
| | | | 11 | SS | 10 | | | | | | | | | | | |
| | | | 12 | SS | 45 | | | | | | | | | | | |
| 243.2 | becoming very sandy | | 13 | SS | 44 | | | | | | | | | | | |
| 46.5 | End of Borehole | | | | | | | | | | | | | | | |
| | Note : | | | | | | | | | | | | | | | |
| | Chemical test results | | | | | | | | | | | | | | | |
| | Sample Organic PH SO_3 | | | | | | | | | | | | | | | |
| | SS-3 0.77% 8.0 | | 2750 | ppm | | | | | | | | | | | | |
| | TW-5 1.66% 8.07 | | 130 | ppm | | | | | | | | | | | | |
| | SS-8 0.38% 8.31 | | 40 | ppm | | | | | | | | | | | | |
| | water — 8.14 | | 70 | ppm | | | | | | | | | | | | |

OFFICE REPORT ON SOIL EXPLORATION

ENGINEERING SERVICES BRANCH-GEOTECHNICAL OFFICE-SOIL MECHANICS SECTION

RECORD OF BOREHOLE NO 115

WP 46-74-37(A)

LOCATION Co-ords. 15,680,606 N; 1,069,219 E.

ORIGINATED BY PK

DIST 4 HWY

BORING DATE November 3-4, 1971

COMPILED BY AKB

DATUM Geodetic

BOREHOLE TYPE Auger

CHECKED BY

| SOIL PROFILE | | | SAMPLES | | | GROUND WATER ELEV | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | | | | LIQUID LIMIT ——— w_L PLASTIC LIMIT ——— w_p WATER CONTENT — w | | | UNIT WEIGHT γ P.C.F. | REMARKS |
|---------------|--|-------------|---------|------|------------|----------------------|--|--|--|--|--|--|--|--|--------------------------------------|---------|
| ELEV DEPTH | DESCRIPTION | STRAT. PLOT | NUMBER | TYPE | 'N' VALUES | | 20 40 60 80 100 | | | | | w_p — w — w_L | | | | |
| | | | | | | | SHEAR STRENGTH | | | | | WATER CONTENT % | | | | |
| | | | | | | | ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE | | | | | 400 800 1200 1600 2000 | | | | |
| 299.1 | Ground Level | | | | | ELEV | | | | | | | | | % GR SA SI CL | |
| 0.0 | Clayey silt, traces of sand and gravel Very Stiff to Stiff Brown and Grey | | 1 | SS | 15 | | | | | | | | | | | |
| | | | 2 | SS | 15 | | | | | | | | | | | |
| | | | 3 | SS | 10 | | 290 | | | | | | | | | |
| | | | 4 | TW | PH | | | | | | | | | | | |
| | | | 5 | TW | PH | | | | | | | | | | | |
| | | | 6 | TW | PH | | 280 | | | | | | | | | |
| | | | 7 | SS | 19 | | | | | | | | | | | |
| | | | 8 | TW | PH | | 270 | | | | | | | | | |
| | | | 9 | SS | 15 | | | | | | | | | | | |
| | | | 10 | TW | PH | | 260 | | | | | | | | | |
| | | | 11 | TW | PH | | | | | | | | | | | |
| | | | 12 | TW | PH | | 250 | | | | | | | | | |
| 242.1 | | | | 13 | TW | | PH | | | | | | | | | |
| 57.0 | Silty sand, some clay. Very Dense | | 14 | SS | 100/10 | 240 | | | | | | | | | | |
| | | | 15 | SS | 97 | | | | | | | | | | | |
| 227.6 | | | 16 | SS | 27 | 230 | | | | | | | | | | |
| 71.5 | End of Borehole | | | | | | | | | | | | | | | |

RECORD OF BOREHOLE NO 311

WP 46-74-37 (A) LOCATION Co-ords. 15,680,844N; 1,069,120 E. ORIGINATED BY Golder
 DIST 4 HWY BORING DATE October 22 - 24, 1963 COMPILED BY MW
 DATUM Geodetic BOREHOLE TYPE Washboring HX & BX Casing CHECKED BY

| SOIL PROFILE | | | SAMPLES | | | GROUND WATER ELEV | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | | | | LIQUID LIMIT W_L PLASTIC LIMIT W_P WATER CONTENT W | | | UNIT WEIGHT γ P.C.F. | REMARKS |
|---------------|---|-------------|---------|------|------------|------------------------|--|--|--|--|--|--|--|--|--------------------------------------|---------|
| ELEV DEPTH | DESCRIPTION | STRAT. PLOT | NUMBER | TYPE | 'N' VALUES | | 20 40 60 80 100 | | | | | W_P W W_L | | | | |
| | | | | | | | SHEAR STRENGTH | | | | | | | | | |
| | | | | | | | O UNCONFINED + FIELD VANE ● QUICK TRIAXIAL X LAB VANE | | | | | WATER CONTENT % | | | | |
| | | | | | | 400 800 1200 1600 2000 | 20 40 60 | | | | | | | | | |
| 288.6 | Ground Level | | | | | | | | | | | | | | | |
| 0.0 | Very stiff brown becoming a mixture of soft to firm silty clay, cinders & pieces of brick and gravel below about 4' depth (Fill) | | 1 | SS | 18 | | | | | | | | | | 127 | |
| | | | 2 | SS | 6 | | | | | | | | | | | |
| | | | 3 | TW | PM | | | | | | | | | | | |
| | | | 4 | SS | 11 | | | | | | | | | | | |
| | | | 5 | SS | 9 | | | | | | | | | | | |
| 267.6 | Firm, brown or grey, brown silty clay with some random sand and gravel size particles few small (generally less than 1/8" size) silt pockets becoming very sandy | | 6 | TW | PM | | | | | | | | | | 136 | |
| 21.0 | | | 7 | TW | PM | | | | | | | | | | | |
| | | | 8 | TW | PM | | | | | | | | | | | |
| | | | 9 | SS | 54 | | | | | | | | | | | |
| | | | 10 | SS | 58 | | | | | | | | | | | |
| 244.1 | Compact to very dense grey silty sand or sand, trace of silt, with very occasional thin (app. 1/4") silty clay layers | | 11 | SS | 33 | | | | | | | | | | 126 | |
| 44.5 | | | 12 | SS | 43 | | | | | | | | | | | |
| | | | 13 | SS | 37 | | | | | | | | | | | |
| | | | 14 | SS | 21 | | | | | | | | | | | |
| | | | 15 | SS | 44 | | | | | | | | | | | |
| | | | 16 | SS | 61 | | | | | | | | | | | |
| | | | 17 | SS | 35 | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | |
| 202.6 | Dense grey and red silty sand & gravel (Till) | | 18 | SS | 35 | | | | | | | | | | | |
| 197.1 | | | | | | | | | | | | | | | | |
| 91.5 | End of Borehole | | | | | | | | | | | | | | | |

ENGINEERING SERVICES BRANCH-GEOTECHNICAL OFFICE-SOIL MECHANICS SECTION

RECORD OF BOREHOLE NO 1

WP 46-74-37 (B) LOCATION Co-ords. 1,069,226 E. 15,680,477 N; ORIGINATED BY BL
 DIST 4 HWY 406 BORING DATE April 13 & 14, 1976 COMPILED BY MK
 DATUM Geodetic BOREHOLE TYPE NX & BX Casing CHECKED BY

| SOIL PROFILE | | | SAMPLES | | | GROUND WATER ELEV | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | | | | LIQUID LIMIT w_L PLASTIC LIMIT w_P WATER CONTENT w | | | UNIT WEIGHT γ P.C.F. | REMARKS |
|---------------|--|-------------|---------|------|------------|----------------------|---|----|----|----|-----|--|-----|-------|-----------------------------------|-------------|
| ELEV DEPTH | DESCRIPTION | STRAT. PLOT | NUMBER | TYPE | 'N' VALUES | | 20 | 40 | 60 | 80 | 100 | w_P | w | w_L | | |
| 307.1 | Ground Level | | | | | | | | | | | | | | | |
| 0.0 | Clayey silt: low to medium plasticity containing some sand | | 1 | SS | 12 | | | | | | | | | | | |
| | | | 2 | SS | 14 | | | | | | | | | | | |
| | Very Stiff | | 3 | SS | 18 | | | | | | | | | | | |
| | Brown & fissured | | 4 | SS | 15 | | | | | | | | | | | |
| | | | 5 | SS | 5 | | | | | | | | | | | |
| | Grey & Firm | | 6 | TW | PM | | | | | | | | | | | |
| | | | 7 | SS | 7 | | | | | | | | | | | |
| | | | 8 | SS | 7 | | | | | | | | | | | |
| | Stiff | | 9 | SS | 16 | | | | | | | | | | | |
| | containing some sand | | 10 | SS | 23 | | | | | | | | | | | |
| | and fine gravel sizes | | | | | | | | | | | | | | | |
| | | | 11 | SS | 13 | | | | | | | | | | | |
| 239.1 | becoming very sandy | | 12 | SS | 110 | 10" | | | | | | | | | | 32 26 30 12 |
| 68.0 | End of Borehole | | | | | | | | | | | | | | | |
| | Note: 1. BH open to El. 297.6 April 20/76 | | | | | | | | | | | | | | | |
| | 2. WL not able to determine. | | | | | | | | | | | | | | | |
| | 3. Chemical tests | | | | | | | | | | | | | | | |
| | Sample Organic PH SO ₃ | | | | | | | | | | | | | | | |
| | SS-3 -- 8.22 240 ppm | | | | | | | | | | | | | | | |

ENGINEERING SERVICES BRANCH-GEOTECHNICAL OFFICE-SOIL MECHANICS SECTION

RECORD OF BOREHOLE No 13

WP 46-74-37 (B) LOCATION Co-ords. 680,499 N; 69,277 E. ORIGINATED BY RK
 DIST 4 HWY 406 BORING DATE November 2-3, 1971 COMPILED BY ABK
 DATUM Geodetic BOREHOLE TYPE Auger CHECKED BY

| SOIL PROFILE | | | SAMPLES | | | GROUND WATER ELEV | 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 | | |
| 296.1 | Ground Level | | | | | | | | | | | | | | | |
| 0.0 | Fill | | | | | | | | | | | | | | | |
| | Cinder, gravel, organics | | 1 | SS | 3 | | | | | | | | | | | |
| 289.1 | Very Loose | | 2 | SS | 7 | | | | | | | | | | | |
| 7.0 | | | 3 | TW | PH | | | | | | | | | | | |
| | clayey silt, traces | | 4 | SS | 9 | | | | | | | | | | | |
| | of sand and gravel | | 5 | TW | PH | | | | | | | | | | | |
| | | | 6 | TW | PH | | | | | | | | | | | |
| | | | 7 | TW | PH | | | | | | | | | | | |
| | | | 8 | SS | 10 | | | | | | | | | | | |
| | Firm to Very Stiff | | 9 | TW | PH | | | | | | | | | | | |
| | | | 10 | SS | 12 | | | | | | | | | | | |
| | | | 11 | TW | PH | | | | | | | | | | | |
| | | | 12 | TW | PH | | | | | | | | | | | |
| | sand and gravel | | 13 | SS | 100 | | | | | | | | | | | |
| 237.1 | Hard Reddish Brown | | 14 | SS | 100/9" | | | | | | | | | | | |
| 59.0 | Sandy silt with some clay. | | 15 | SS | 88 | | | | | | | | | | | |
| | Very Dense to Dense | | 16 | SS | 37 | | | | | | | | | | | |
| | Grey and Brown | | 17 | SS | 16 | | | | | | | | | | | |
| 214.6 | | | 18 | SS | 31 | | | | | | | | | | | |
| 81.5 | End of Borehole | | | | | | | | | | | | | | | |

RECORD OF BOREHOLE NO 14

WP 46-74-37 (B) LOCATION Co-ords. 680,017 N; 69,409 E. ORIGINATED BY DM
 DIST 4 HWY 406 BORING DATE November 15, 1971 COMPILED BY AKB
 DATUM Geodetic BOREHOLE TYPE Auger CHECKED BY

| SOIL PROFILE | | | SAMPLES | | | GROUND WATER ELEV | 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 | | |
| 309.5 | Ground Level | | | | | | | | | | | | | | | |
| 0.0 | Organic Topsoil | | | | | | | | | | | | | | | |
| 306.0 | | | | | | | | | | | | | | | | |
| 3.5 | Clayey silt, random pockets of silt | | 1 | TW | PM | | | | | | | | | | 119 | |
| | | | 2 | TW | PM | | | | | | | | | | 118 | |
| | | | 3 | TW | PM | | | | | | | | | | 113 | |
| | | | 4 | TW | PM | | | | | | | | | | 118 | |
| | Firm to Stiff | | 5 | SS | 6 | | | | | | | | | | | |
| | | | 6 | TW | PM | | | | | | | | | | 115 | |
| | | | 7 | TW | PM | | | | | | | | | | 118 | |
| | Greyish Brown | | 8 | TW | PM | | | | | | | | | | 126 | |
| | | | 9 | SS | 15 | | | | | | | | | | | |
| | | | 10 | TW | PM | | | | | | | | | | 131 | |
| | | | 11 | TW | PM | | | | | | | | | | 112 | |
| | | | 12 | TW | PM | | | | | | | | | | | |
| 243.5 | | | 13 | TW | PM | | | | | | | | | | 123 | |
| 66.0 | Silt to silty sand, traces of clay | | 14 | SS | 50 | | | | | | | | | | | |
| | Hard | | 15 | SS | 116 | | | | | | | | | | | |
| | Reddish Brown | | 16 | SS | 104 | | | | | | | | | | | |
| 228.0 | | | 17 | SS | 91 | | | | | | | | | | | |
| 81.5 | End of Borehole | | | | | | | | | | | | | | | |

ENGINEERING SERVICES BRANCH-GEOTECHNICAL OFFICE-SOIL MECHANICS SECTION

RECORD OF BOREHOLE NO 61

WP 46-74-37 (B) LOCATION Co-ords. 15,680,430 N; 1,069,097 E. ORIGINATED BY MK
 DIST 4 HWY 406 BORING DATE April 22 & 23, 1976 COMPILED BY MK
 DATUM Geodetic BOREHOLE TYPE Hollow Stem Auger CHECKED BY

| SOIL PROFILE | | | SAMPLES | | | GROUND WATER ELEV | 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 | | |
| 343.5 | Ground Level | | | | | | | | | | | | | | | |
| 0.0 | Clayey silt | | | | | 340 | | | | | | | | | | |
| | Brown, stiff, and | | 1 | SS | 32 | | | | | | | | | | | |
| | fissured, medium | | 2 | SS | 27 | | | | | | | | | | | |
| | plasticity | | 3 | SS | 22 | 330 | | | | | | | | | | PH SO_3 |
| | | | 4 | SS | 20 | | | | | | | | | | | 8.1 1440ppm |
| | Grey, stiff to firm, | | 5 | SS | 22 | 320 | | | | | | | | | | PH SO_3 |
| | medium to low plasti- | | 6 | SS | 15 | | | | | | | | | | | 8.24 1100ppm |
| | city | | 7 | SS | 12 | 310 | | | | | | | | | | |
| | containing some sand | | 8 | SS | 12 | | | | | | | | | | | |
| | and fine gravel | | 9 | SS | 22 | 300 | | | | | | | | | | |
| | | | 10 | SS | 14 | 290 | | | | | | | | | | |
| | | | 11 | SS | 18 | 280 | | | | | | | | | | |
| | | | 12 | SS | 36 | 270 | | | | | | | | | | |
| | containing more | | 13 | SS | 18 | 260 | | | | | | | | | | |
| | coarse sand particles | | | | | 250 | | | | | | | | | | |
| 247.0 | End of Borehole | | | | | | | | | | | | | | | |
| 96.5 | Not. W.L. not established | | | | | | | | | | | | | | | |

20
15 ϕ 5 % STRAIN AT FAILURE
10

ENGINEERING SERVICES BRANCH-GEOTECHNICAL OFFICE-SOIL MECHANICS SECTION

RECORD OF BOREHOLE No 62

WP 46-74-37 (B)

LOCATION Co-ords. 15,680,078 N. 1,069,092 E.

ORIGINATED BY BL

DIST 4 HWY 406

BORING DATE April 20-22, 1976

COMPILED BY MK

DATUM Geodetic

BOREHOLE TYPE NX & BX Casing

CHECKED BY

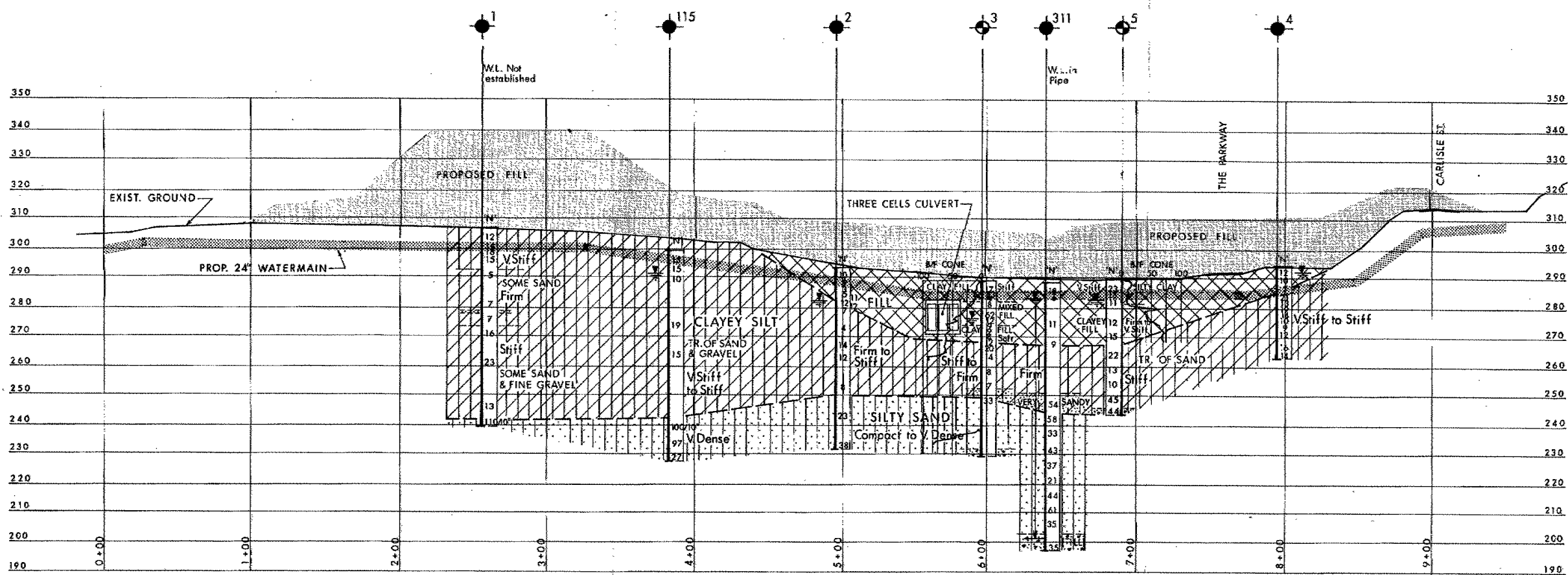
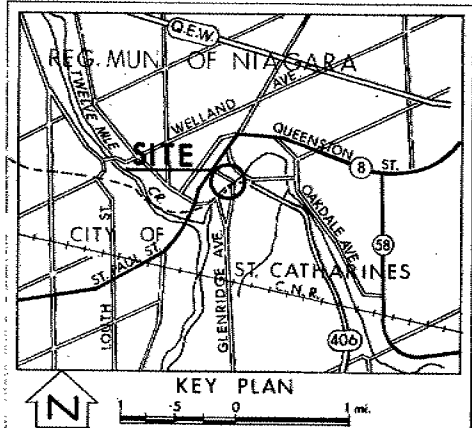
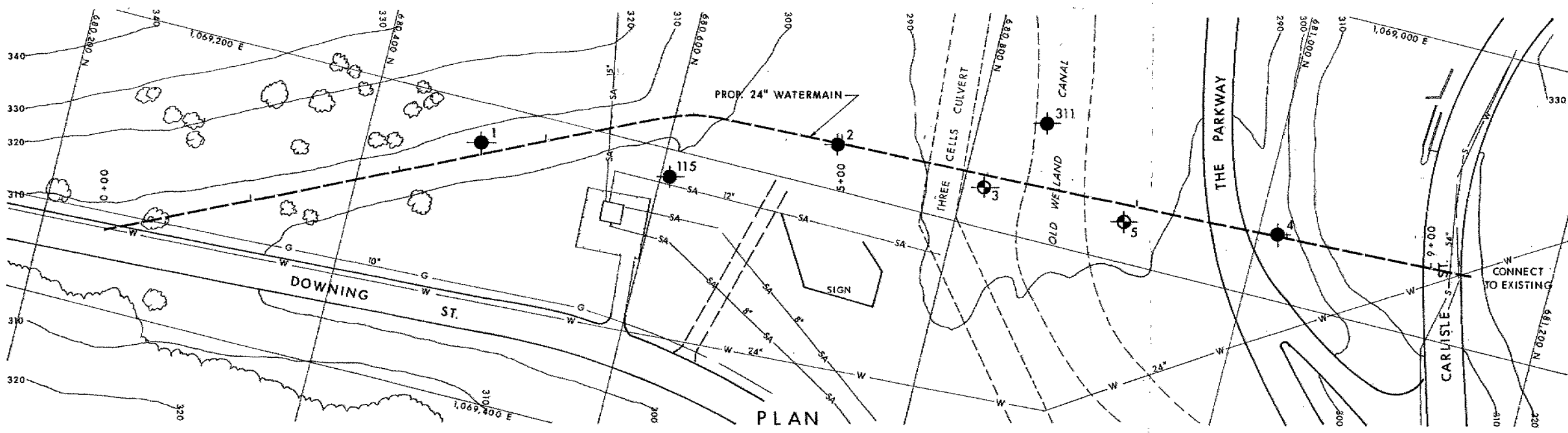
| SOIL PROFILE | | | SAMPLES | | | GROUND WATER ELEV | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | | | | LIQUID LIMIT w_L PLASTIC LIMIT w_p WATER CONTENT w | | | UNIT WEIGHT γ | REMARKS |
|---------------|--|-------------|---------|------|------------|----------------------|---|----|----|----|-----|--|-----|-------|----------------------------|---------|
| ELEV DEPTH | DESCRIPTION | STRAT. PLOT | NUMBER | TYPE | 'N' VALUES | | 20 | 40 | 60 | 80 | 100 | w_p | w | w_L | | |
| 333.0 | Ground Level | | | | | | | | | | | | | | | |
| 0.0 | Clayey Silt Brown, very stiff, oxidized & fissured | | 1 | SS | 21 | 330 | | | | | | | | | | |
| | | | 2 | SS | 31 | | | | | | | | | | | |
| | | | 3 | SS | 29 | | | | | | | | | | | |
| | | | 4 | SS | 23 | | | | | | | | | | | |
| | | | | | | 320 | | | | | | | | | | |
| | | | 5 | SS | 26 | | | | | | | | | | | |
| | Grey, stiff to firm | | 6 | SS | 22 | | | | | | | | | | | |
| | | | 7 | SS | 13 | | | | | | | | | | | |
| | low to medium plasti- city, | | 8 | SS | 12 | | | | | | | | | | | |
| | trace of sand | | | | | 300 | | | | | | | | | | |
| | | | 9 | SS | 8 | | | | | | | | | | | |
| | | | | | | 290 | | | | | | | | | | |
| | | | | | | 280 | | | | | | | | | | |
| | | | 10 | SS | 13 | | | | | | | | | | | |
| | | | | | | 270 | | | | | | | | | | |
| 261.5 | | | 11 | SS | 23 | | | | | | | | | | | |
| 71.5 | End of Borehole | | | | | | | | | | | | | | | |





CONT No
WP No 46-74-37(A)



24" WATER MAIN
BORE HOLE LOCATIONS & SOIL STRATA

SHEET



| LEGEND | | | |
|---|---|--------------|---------|
|  | Bore Hole | | |
|  | Dynamic Cone Penetration Test (Cone) | | |
|  | Bore Hole & Cone | | |
| N' | Blows/ft (Std Pen Test 350 ft lbs energy) | | |
| CONE | Blows/ft (60° Cone, 350 ft lbs energy) | | |
|  | WL at time of investigation | | |
| | B.H. No. 2, 3, 4 & 5 APR. 1976 | | |
| | B.H. No. 115 NOV. 1971 | | |
| | B.H. No. 311 OCT. 1963 | | |
| CO-ORDINATES | | | |
| No | ELEVATION | CO-ORDINATES | |
| | | NORTH | EAST |
| 1 | 307.1 | 680,477 | 069,226 |
| 2 | 293.1 | 680,710 | 069,170 |
| 3 | 289.0 | 680,813 | 069,172 |
| 4 | 294.4 | 681,013 | 069,155 |
| 5 | 289.7 | 680,910 | 069,172 |
| 115 | 299.1 | 680,606 | 069,219 |
| 311 | 288.6 | 680,844 | 069,120 |

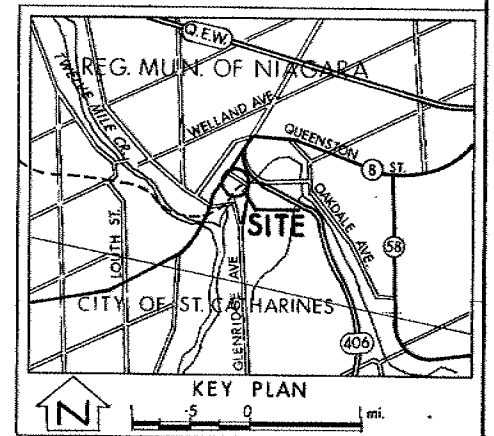
NOTE
The boundaries between soil strata have been established only at Bore Hole locations. Between Bore Holes the boundaries are assumed from geological evidence.

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

HWY No. CITY OF ST. CATHARINES DIST. 4
SUBM'D B. L. CHECKED DATE 17 MAY '76 SITE
DRAWN O.L.J. CHECKED APPROVED DWG 467437 A

CONT No
WP No 46-74-37(B)

SANITARY SEWER
BORE HOLE LOCATIONS & SOIL STRATA



LEGEND

- Bore Hole
- ⊕ Dynamic Cone Penetration Test (Cone)
- Bore Hole & Cone
- 'N' Blows/ft (Std Pen Test 350 ft lbs energy)
- CONE Blows/ft (60° Cone, 350 ft lbs energy)
- W.L. at time of investigation
- B.H. No. 13 NOV. 1971
- B.H. No. 62 APR. 1976
- NO W.L. established B.H. 1, 61, 14

| No | ELEVATION | CO-ORDINATES | |
|----|-----------|--------------|---------|
| | | NORTH | EAST |
| 1 | 307.1 | 680,477 | 069,226 |
| 13 | 296.1 | 680,499 | 069,277 |
| 14 | 309.5 | 680,017 | 069,409 |
| 61 | 343.5 | 680,430 | 069,097 |
| 62 | 333.0 | 680,078 | 069,092 |

-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 |
|-----------|------|----|-------------|
| | | | |
| | | | |

| | | | |
|--------------|------------------------|-----------------|--------------|
| HWY No. | CITY OF ST. CATHARINES | DIST. | 4 |
| SUBMD B.L. | CHECKED | DATE 17 MAY '76 | SITE |
| DRAWN O.L.J. | CHECKED | APPROVED | DWG 467437 B |

