

DOCUMENT MICROFILMING IDENTIFICATION

GEOCRES No. 30M4-17

DIST. 4 REGION

W.P. No. 318-89-00

CONT. No. 91-83

W. O. No. _____

STR. SITE No. _____

HWY. No. Q.E.W.

LOCATION Q.E.W. - Hwy 20 to Pineland Ave

No. of PAGES - 1

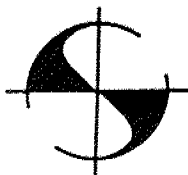
OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT. _____

REMARKS: _____

© 2006 The Authors
Journal compilation © 2006 Blackwell Publishing Ltd

[illegible]

© 2006 The Authors
Journal compilation © 2006 Blackwell Publishing Ltd



STRATA ENGINEERING CORP.

RESEARCH . ENGINEERING . SCIENCE

Tel.: (416) 441-2560
Fax: (416) 441-4161

Suite 410, 170 The Donway West,
Don Mills, Ontario, Canada M3C 2G3

PAVEMENT DESIGN REPORT

W.P. 318-89-00, Q.E.W., 2.4km

From Hwy. 20 to Pineland's Ave.

District 4, Burlington

Proposed Grading, Drainage, Widening

Resurfacing and Structures

Strata Project: S-89-279

Report Issue Date: 1990 07 30

Report Distribution:

**MTO Central Region Geotechnical Section
Strata File: S-89-279**

**14 copies
1 copy**

TABLE OF CONTENTS

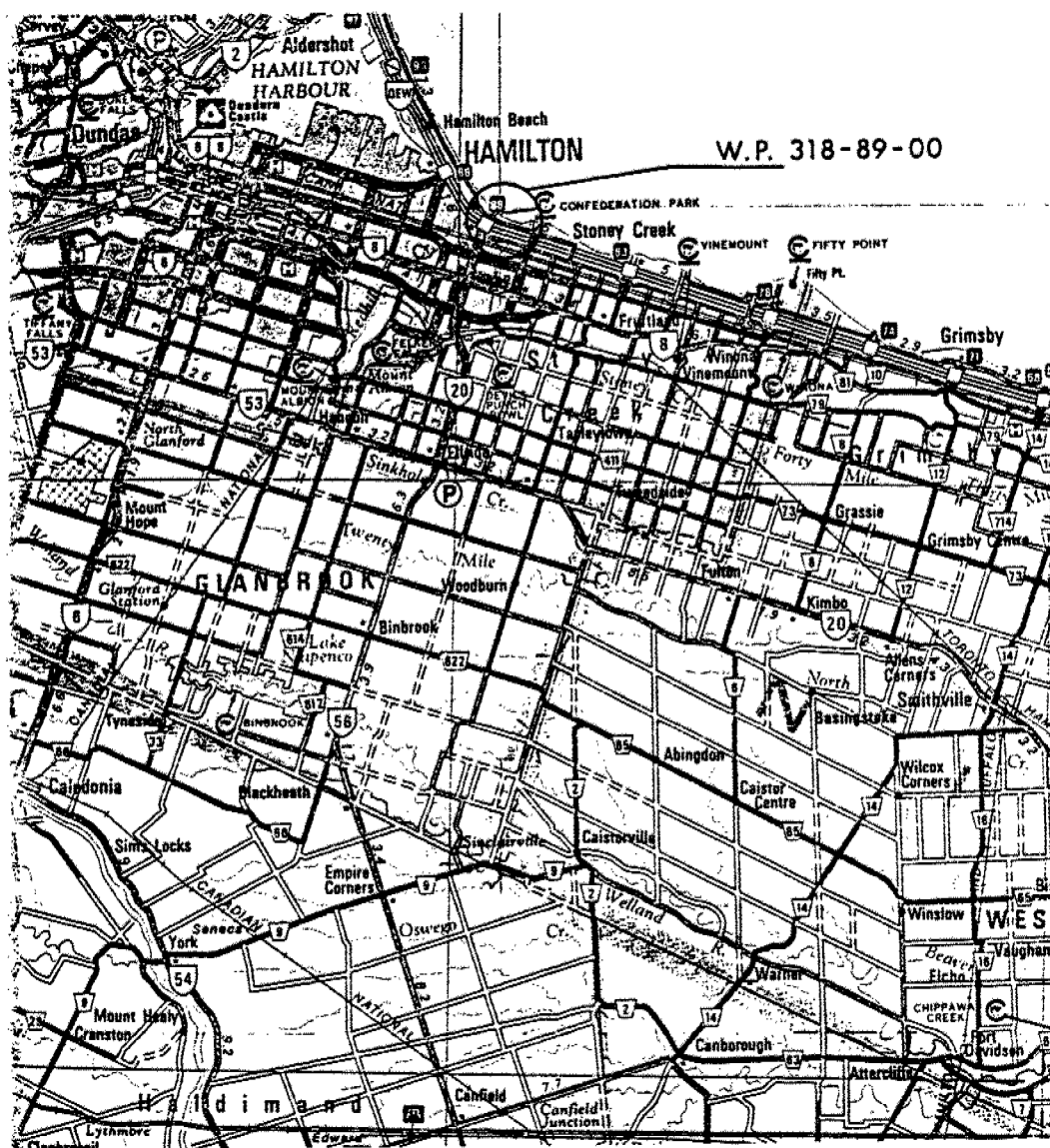
KEY PLAN

PROJECT DESIGN SUMMARY

APPENDIX

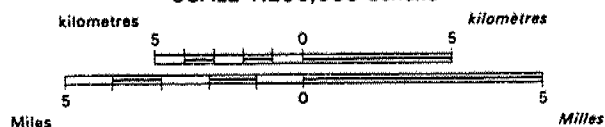
| | | |
|-------|---|---|
| 1.0 | GENERAL | 1 |
| 2.0 | PROJECT LIMITS AND SCOPE | 2 |
| 3.0 | DESIGN CRITERIA | 3 |
| 4.0 | EXISTING PAVEMENT STRUCTURE AND PERFORMANCE | 3 |
| 5.0 | FIELD INVESTIGATION AND SOILS DATA | 4 |
| 5.1 | General | 4 |
| 5.2 | Soils Data | 5 |
| 5.2.1 | Q.E.W. Eastbound and Westbound | 5 |
| 5.2.2 | Service Roads and Interchange Ramps | 6 |
| 5.2.3 | Organic and Low Wet Areas | 6 |
| 5.2.4 | Topsoil Under Existing Roadway | 6 |
| 6.0 | PHYSIOGRAPHY AND TOPOGRAPHY | 7 |
| 7.0 | GROUNDWATER CONDITIONS | 7 |
| 8.0 | DRAINAGE | 7 |
| 9.0 | GRADE LINE | 7 |
| 10.0 | GRANULAR MATERIALS | 8 |
| 11.0 | EARTH BORROW | 8 |
| 12.0 | DESIGN AND CONSTRUCTION FEATURES | 8 |
| 12.1 | Cut Sections | 8 |
| 12.2 | Fill Sections | 8 |
| 12.3 | Organic Deposits | 9 |
| 12.4 | Use of Excavated Materials From the Proposed Widening and Storm Sewers | 9 |
| 12.5 | Existing Embankment and Fill Widening | 9 |
| 12.6 | Hot Mix Types | 9 |

| | |
|---|----|
| 13.0 RECOMMENDATIONS | 10 |
| 13.1 Types of Granular Materials | 10 |
| 13.2 Width of Granular Materials | 10 |
| 13.3 Conversion Factors | 10 |
| 13.4 Pavement Structure | 10 |
| 13.4.1 Q.E.W. Existing | 10 |
| 13.4.2 Q.E.W. Proposed Widening | 11 |
| 13.4.3 Westbound and Eastbound Collectors | 11 |
| 13.4.4 Interchange Ramps and North and South Service Roads | 12 |
| 13.4.5 Highway 20 | 12 |
| 13.4.6 Confederation Drive | 12 |
| 13.4.7 Paved Shoulders | 13 |
| 13.4.8 Raised Islands | 13 |
| 13.4.9 Commercial Entrances | 13 |
| 14.0 CULVERT AND STRUCTURE BACKFILL | 13 |
| 15.0 CULVERTS | 13 |
| 16.0 SUBDRAINS | 13 |
| 17.0 FROST DEPTH | 14 |
| 18.0 PAVEMENT REMOVAL | 14 |
| 19.0 VOLUME ADJUSTMENT FACTOR | 14 |
| 20.0 TOPSOIL DEPTHS | 14 |
| 21.0 STORM SEWERS | 15 |
| 22.0 DRAINAGE DITCHES AND DRAINAGE OUTLETS | 15 |
| 23.0 LOGS OF BORE HOLES | 15 |
| 24.0 DISPOSAL OF MATERIALS | 15 |
| 25.0 SLOPE PROTECTION | 15 |
| 26.0 TREATMENT OF ORGANIC SECTIONS | 16 |
| 27.0 BACKFILL TO ORGANIC EXCAVATIONS | 16 |
| 28.0 PROPOSED ROADWAY RESTORATION AT STORM SEWER CROSSINGS | 16 |
| 29.0 SOILS DATA AND SAMPLE TEST RESULTS | 17 |
| 30.0 CLOSURE | 18 |



PROJECT LOCATION Q.E.W

SCALE 1:250,000 Échelle



KEY PLAN

PROJECT DESIGN SUMMARY

The main purpose of this Project is to improve the very low level of service now being experienced on this section of the Queen Elizabeth Way, by carrying out a major widening scheme of the existing east and west bound lanes, construction of east and west bound collectors, improvement to interchange ramps at Highway 20, and revisions to the north and south service roads. The installation of median barriers and a storm sewer system will also be carried out.

The Project lies within the "Iroquois Plain" Physiographic Region. The inorganic soils are predominantly silty clays and silty sands, with moisture contents at or slightly above optimum. Deep deposits of organic materials, which may be environmentally sensitive, are present mainly on the north service road and Ramp NSR-W alignments, and are underlain by firm silty clay.

Sources of granular materials suitable for base are located in the Stoney Creek, Vineland and St. Catharines areas. The hot mix types will predominantly be Dense Friction Course (for the surface course) and Heavy Duty Binder (for the binder courses).

Due to an acceleration of the Project time table, it is anticipated that geotechnical revisions will be required on an on-going basis after the submission of this report. Such revisions will be handled by Addenda as necessary.

A P P E N D I X

| | |
|------------|---|
| I | Organic Deposits |
| II | Profile Corrections |
| III | Typical Section |
| IV | Gradation Curves |
| V | Abbreviations for Boring and Test Data |

Geotechnical Survey Data

| | |
|-------------------------|---------|
| Eastbound Lanes | pp. 1-6 |
| Westbound Lanes | 7-12 |
| Eastbound Collector | 13-15 |
| Westbound Collector | 16-17 |
| Cores - Eastbound Lanes | 18 |
| Cores - Westbound Lanes | 19 |
| Median | 20 |
| Ramps S E | 21 |
| Ramps E-NSR and NSR-W | 22 |
| North Service Road | 23-26 |
| Sample Test Results | |
| Eastbound Lane | 27-28 |
| Westbound Lane | 29-30 |
| Eastbound Collector | 31 |
| Median | 32 |
| Ramps | 33 |
| North Service Road | 34 |
| Culverts | 35 |

PAVEMENT DESIGN REPORT

W.P. 318-89-00, Q.E.W., 2.4km

From Highway 20 to Pineland's Avenue

District 4, Burlington

Proposed Grading, Drainage, Widening, Resurfacing
and Structures

1.0 GENERAL

By Consultant Agreement Number 4212-2589-572, the Geotechnical Section of the Ministry of Transportation, Ontario (Central Region) has authorized Strata Engineering Corporation to carry out a soils investigation and to provide detailed design recommendations for the construction of the proposed major widening of the Q.E.W., Interchange Ramps, and associated Secondary Roads.

This section of the Q.E.W. is located within the Town of Stoney Creek and the Regional Municipality of Hamilton - Wentworth.

The Highway is classified as R.F.O. -130. Its primary function is to connect the Toronto - Hamilton area with the Niagara Peninsula - Western New York area, while its secondary function is to accommodate local agricultural and industrial traffic.

From various reports the existing four lane facility is presently operating at a "D" level of service with major capacity deficiencies.

Under Group Work Project 80-76-00, the Queen Elizabeth Way will be upgraded to a basic 6-lane facility with provision for an 8-lane ultimate scheme. Generally, the proposed widening will be carried out on the outside of the existing roadway.

The recommended staging of the various projects under this Group Work Project, by design year, are as follows:

DESIGN YEAR 1990

- Project "A" - from Highway 20 to Pineland's Avenue
- Project "B" - from Pineland's Avenue to Fifty Road

- Project "C" - from Jordan Road to Highway 406
- Project "D" - from Victoria Avenue to Jordan Road

DESIGN YEAR 1991

- Project "E" - Fifty Road to Bartlett Avenue
- Project "F" - Bartlett Avenue to Victoria Avenue

Under Work Project 318-89-00, this Pavement Design Report addresses Project "A", from Highway 20 easterly to Pineland's Avenue, which includes the widening of the Q.E.W., Westbound and Eastbound Collectors, revisions to existing Interchange Ramps, and Service Roads.

The Q.E.W. was originally constructed prior to 1940. At that time, the pavement design consisted of 9" (225mm) of concrete, both reinforced and unreinforced, placed on a very shallow depth of granular materials. Most of the intersecting roads were level crossings. Since then grade separations have been built. Service roads were also constructed on both the north and south sides of the Q.E.W..

Our field investigations did not include the new alignment of the South Service Road due to inaccessibility to private property. The results of the completed field investigation and recommendations for this section will be forwarded as soon as they are available.

2.0 PROJECT LIMITS AND SCOPE

The project is approximately 2.4km in length and involves a detailed soils investigation, coring of existing pavement, pertinent soils recommendations, and recommended pavement structure designs for the proposed widening of the existing Q.E.W., Service and Collector Roads, and Interchange Ramps within the project limits.

The project scope was discussed and reviewed in the field with staff from the Geotechnical Section, Central Region, Ministry of Transportation, Ontario.

Under this project it is proposed to carry out the following operations:

1. Widening of the existing Q.E.W. to six lanes with a median barrier and storm sewers.
2. Construction of Eastbound and Westbound Collectors.
3. Realignment and construction of the North and South Service Roads and Confederation Park Road.
4. Realignment and reconstruction of Interchange Ramps at Highway 20.

3.0 DESIGN CRITERIA

The Design Criteria for this project has not been issued. However, the existing Q.E.W. within the project limits was constructed as a four lane divided freeway with a cross section of two 3.5m (11.5 ft.) lanes and fully paved 3.0m shoulders.

4.0 EXISTING PAVEMENT STRUCTURE AND PERFORMANCE

The original pavement on this section of highway consisted of approximately 225mm of reinforced concrete over varying shallow thicknesses of granular materials. However, as traffic volumes increased in the late 1940's, the pavement started to deteriorate, with various degrees of cracking becoming quite prevalent. Remedial measures, consisting of hot mix patching, had to be carried out. In the mid-1950's and early 1960's, hot mix resurfacing contracts were set up to rehabilitate the old pavement. Basically, these contracts consisted of placing a Binder Course and a Surface Course.

The test borings placed at the edge of pavement on both the Eastbound and Westbound Lanes indicate that there is now 80mm to 300mm of hot mix over the concrete pavement. Test holes placed on the existing fully paved shoulders show that they were constructed with 80mm to 270mm of hot mix over 100mm to 630mm of crushed gravel (Granular A).

Briefly, the existing pavement exhibits the following distress manifestations:

- existing pavement is in good condition;
- slight to moderate centre line cracks throughout;
- intermittent, moderate transverse cracks;
- slight to moderate longitudinal cracking between the Ramps and main lanes;

- slight to moderate longitudinal cracks between main lanes and fully paved shoulders;
- slight wheel track rutting more pronounced in the westbound lanes;
- moderate to severe ravelling at the transverse cracks;
- westbound lanes exhibit more distress than the eastbound lanes;
- visually, and from the field investigation, no pavement structure failures (blow-ups) were encountered;

The Service Roads and Interchange Ramps are in good condition, and exhibit the following distress:

- slight to moderate transverse and longitudinal cracks throughout;
- occasional pavement edge cracking;
- some slight to moderate alligatored sections;

The field investigation indicates that the pavement structure of the existing service roads consists of:

90mm to 270mm of asphalt over
110mm to 630mm of crushed gravel (Granular A) over
a moist to wet silty clay and or silty sand.

The existing Interchange Ramps at Highway 20 and the Q.E.W. consist of

220mm to 340mm of asphalt over
110mm to 680mm crushed gravel (Granular A) over
silty clays and occasional areas of sandy gravel.

5.0 FIELD INVESTIGATION AND SOILS DATA

5.1 General

During the months of May and June, 1990, a soils investigation covering the Eastbound and Westbound Lanes, Interchange Ramps, and other secondary roads, was carried out within the limits of the project.

The investigation was carried out with the use of a truck mounted earth boring auger, augmented by the use of a hand auger and a pavement coring machine.

The investigation determined existing subsoil conditions and existing pavement structure. Borings were also placed in all low lying and organic areas to ascertain the thickness and consistency of the organic materials and to establish firm subsoil.

Pavement depths, thicknesses, and types of existing granular materials, plus subsoil types and moisture conditions, were ascertained in coincidental alignment areas. The boreholes were placed along the alignment of all proposed roadway facilities. Test holes were placed at the edge of existing pavements and within the existing fully paved shoulders to determine pavement depths, granular widths, depths, and subsoil types and conditions.

The numerous test holes placed were extended to competent materials.

The various materials encountered were sampled to determine, from laboratory analysis, the field and optimum moisture contents, gradation, classification, and Atterberg Limits. The data accumulated provided the information required to determine the treatments for the various soil conditions.

The results of the test borings indicate the main soils encountered are predominantly silty clays and sandy clays. These materials, for the most part, are at or about optimum moisture content. The organic areas are fairly deep with underlying firm clay. Soft clays were encountered within close proximity to the Highway 20/Q.E.W. Interchange.

5.2 Soils Data

A review of the soils data obtained from the field investigation gives the following information.

5.2.1 Q.E.W. Eastbound and Westbound

The subsoils within the project limits and within the existing right-of-way consist predominantly of moist to wet silty clays with a firm consistency, and moist to wet silty sands.

However, soft to firm clays ranging in depth from 750mm - 1.4m below existing pavement, Station 21+500 to Station 22+000, were encountered.

Seepage was observed at depths of 530mm to 840mm below the existing pavement.

A subdrain system was encountered during the investigation, located some 900mm below the pavement.

5.2.2 Service Roads and Interchange Ramps

Materials encountered during the field investigation along these alignments are similar to those found within the Q.E.W. right-of-way.

However, materials encountered along the new alignment of the North Service Road, Station 14+775 to Station 15+100, comprise man-made fill, consisting of a sandy clay mixed with topsoil, and occasional boulders and having a moisture content at or slightly above optimum.

5.2.3 Organic and Low Wet Areas

During the field investigation organic materials consisting of organic clay and/or black ooze were encountered at the following locations: (see Appendix 1)

Station 15+120± to Station 15+145±)
) North Service Road
 Station 15+310± to Station 15+320±)

The materials consist of 900mm to 4.3m of black ooze and 300mm to 1.3m of black organic clay over a firm silty clay.

Station 10+100± to Station 10+135± Ramp NSR - W

Materials encountered consist of 600mm water over 2.7m of soft to firm organic clay underlain by firm silty clay and silty clay till.

5.2.4 Topsoil Under Existing Roadway

During the field investigation topsoil consisting of clay and/or sand was encountered at depths ranging from 500mm to 1.9m below the existing main lanes and below the existing fully paved shoulders. For locations and depths, refer to the logs of test holes.

6.0 PHYSIOGRAPHY AND TOPOGRAPHY

The Q.E.W. follows the shoreline of Lake Ontario and lies mainly in the "Iroquois Plain" Physiographic Region. However, the Highway also traverses the "Haldimand Clay Plain" in the Niagara Falls area. A small section of the Highway at Highway 405 crosses the Niagara Escarpment.

The Iroquois Plain comprises fairly shallow sandy materials deposited in the bed of Lake Iroquois. The area is also referred to as the Niagara Fruit Belt.

The Haldimand Clay Plain was an area once submerged by Lake Warren. The soils are generally stratified clays with some till near the surface. The overburden is less than 20.0m thick, and overlies dolomitic bedrock. The area drains through several streams but due to the clay soil and general flatness, perched water is often a problem.

The Niagara Escarpment separates the Haldimand Clay Plain and the Peel Plain Physiographic Regions. The Escarpment consists of a dolomite cap over shale in the Niagara Peninsula. In the Niagara Peninsula the Escarpment is covered with boulder clay.

7.0 GROUNDWATER CONDITIONS

The results of the test borings show that the inorganic soils are predominantly above optimum moisture content. Seepage zones were observed at shallow depths below existing ground level (540mm to 850mm). No groundwater was encountered within the proposed cut sections at the time of this investigation.

8.0 DRAINAGE

The surface drainage within the project limits is primarily controlled by Stoney Creek which is fed by open ditches, culverts and storm sewer systems. It outlets into Lake Ontario.

9.0 GRADE LINE

From a geotechnical point-of-view, the proposed grades for the various alignments under this Work Project are acceptable.

However, some modifications may be required to minimize extensive removal of existing asphalt over the concrete on the main lanes of the Q.E.W..

The shallow wet and soft areas encountered, especially on the existing right-of-way of the Q.E.W., should be excavated to firm ground before any material is placed for the proposed embankment construction.

12.3 Organic Deposits

The proposed North Service Road and Ramp NSR-W (Station 15+320± to Station 15+145±, Station 15+310± to Station 15+320± and Station 10+100± to Station 10+135±) traverses organic deposits varying in thickness from 300mm to 4.3m, over a wet silt clay of firm consistency.

The results of this field investigation indicate that the underlying clay is competent and no major construction problems are anticipated provided all the organic and deleterious materials are removed to firm ground before placing any fill material for the proposed embankment construction.

12.4 Use of Excavated Materials From The Proposed Widening and Storm Sewers

The earth materials excavated for the proposed widening and storm sewers of the Q.E.W. are acceptable for use as fill in embankment construction.

12.5 Existing Embankment and Fill Widening

During the field investigation it was identified that the existing embankment fills are in stable condition, with no visible signs of erosion or failure.

12.6 Hot Mix Types

As discussed and agreed upon, with the Central Region Geotechnical Section, the following hot mix types will apply for the project.

Q.E.W. Main Lanes, Highway 20 and Interchange Ramps

The hot mix types will be D.F.C. (Dense Friction Course) Surface Course over H.D.B. (Heavy Duty Binder) Binder Courses.

North and South Service Roads

The hot mix types will be as those for the Q.E.W. (as warranted by traffic volume data supplied).

Confederation Park Drive

The hot mix will be H.L.3 Surface Course and H.L.8 Binder Course.

13.0 RECOMMENDATIONS

13.1 Types of Granular Materials

It is recommended that Granular "A" be used to the widths and depths as specified hereunder.

13.2 Width of Granular Materials

Granular materials should be placed full width unless otherwise specified.

13.3 Conversion Factors

For design purposes, use the following conversion factor:

Granular "A" - 2.4 t/m^3

13.4 Pavement Structure

13.4.1 Q.E.W. Existing (Appendix II)

(a) Partial Pavement Removal

- Remove the existing fully paved shoulders full depth.
- Starting from the outside edge of the existing pavement remove the upper 40mm inwards for the full width of the existing pavement. This will be required where a 2% cross fall is to be achieved.
- When the above has been completed resurface with one 40mm D.F.C. (Dense Friction Course) Surface Course and one 50mm H.D.B. (Heavy Duty Binder) Binder Course.

(b) Padding

Where padding is required for cross-fall correction, the Heavy Duty Binder should be used. This is required where the existing pavement over the concrete, after partial pavement removal, is less than 90mm in thickness.

13.4.2 Q.E.W. Proposed Widening (Appendix III)

As per the attached typical section for the proposed widening (see Appendix III), excavate starting from the edge of the existing pavement to provide for the following:

40mm D.F.C. Surface Course
 100mm Heavy Duty Binder (50mm + 60mm Binder Courses)
 110mm H.L.8 (50mm + 60mm) Binder Courses
 150mm Granular "A" (min)
 100mm O.G.D.L. (Open Graded Drainage Layer)
 225mm Granular "A"

The O.G.D.L. with a separator (geotextile between the Granular "A" and the O.G.D.L.) should be void of A/C and must be placed starting approximately 50mm from the bottom of the concrete downwards to meet with the underlying Granular "A".

The upper 100mm of the Binder Course should be keyed into the existing asphalt pavement using the following criteria:

- Where the existing asphalt over the concrete after partial removal is 90mm or less, then the asphalt should be removed down to the concrete.
- The longitudinal joint between the concrete and the new asphalt should be taped before the overlay is placed.

13.4.3 Westbound and Eastbound Collectors

Excavate to provide for the same design as for the Q.E.W. main lanes widening.

13.4.4 Interchange Ramps and North and South Service Roads

Provide for:

40mm D.F.C. Surface Course
100mm H.D.B. (50mm + 50mm) Binder Courses over
500mm Granular "A"

13.4.5 Highway 20**(a) Proposed New Alignment, Station 9+700± to Station 9+800**

- Remove the existing concrete median and curb and gutter.
- Remove the existing pavement full depth to provide for the following:

40mm D.F.C. Surface Course
100mm H.D.B. (50mm + 50mm) Binder Course over
Granular "A"

In the removal of the existing pavement, full depth concrete may be encountered.

(b) Existing Pavement

- Remove the existing pavement to a depth of 50mm full width by cold planing.
- When the above has been completed resurface with 50mm H.D.B. and 40mm D.F.C..

13.4.6 Confederation Drive**(a) Station 14+850 to Station 15+000 (new alignment)**

Provide for:

40mm H.L.3
60mm H.L.8 over
450mm Granular "A"

(b) Existing Pavement

- Remove the upper 40mm of the existing pavement by cold planing.
- When completed, resurface with 40mm H.L.3.

13.4.7 Paved Shoulders

Provide for 90mm hot mix consisting of

40mm D.F.C.
50mm H.L.8.

13.4.8 Raised Islands

Provide for 40mm H.L.3.

13.4.9 Commercial Entrances

Provide for 90mm hot mix consisting of

40mm H.L.3
50mm H.L.8 over
450mm Granular "A"

14.0 CULVERT AND STRUCTURE BACKFILL

Use Granular "A" for culvert and structure backfill.

15.0 CULVERTS

Types and locations of all culverts have not been determined at the time of compiling this report. Test borings were placed adjacent to the existing culverts. The results of these borings indicate that proposed culverts and extensions to the existing culverts will be founded on firm to stiff silty clays. Hence, no major construction problems are anticipated.

For the installation of any rigid or flexible type culverts, should it be required, specific sites will be investigated on a request basis.

16.0 SUBDRAINS

Where proposed, it is recommended that subdrains consisting of 150mm diameter perforated plastic pipes wrapped with a geotextile sleeve be provided. For bedding and backfill to the subdrains the following will apply:

- provide for clear stone which is to be placed as shown on the contract drawings;

- the clear stone shall conform to the physical requirements for Granular "A" as per OPSS 1010, Table 1, and shall conform to the gradation requirements for H.L.8 coarse aggregate as per OPSS 1003, Table 3.

17.0 FROST DEPTH

For the purposes of this project, the frost penetration depth is 1.2m.

18.0 PAVEMENT REMOVAL

Pavement thicknesses in the removal areas are as follows:

Highway 20

150mm to 165mm asphalt over possible 175mm unreinforced concrete.

Service Roads

200mm average (maximum 300mm)

Confederation Drive

150mm average (maximum 250mm)

Note: Not all of the above pavement depths were verified in the field. Some pavement thicknesses were obtained from past data.

19.0 VOLUME ADJUSTMENT FACTOR

Where earth cut materials are to be used as fill material, a shrinkage factor of 8% should be allowed. This does not include any construction factors.

20.0 TOPSOIL DEPTHS

For estimating purposes the following topsoil depths can be used:

Q.E.W. Eastbound and Westbound Collectors

240mm average (maximum 320mm)

Service Roads

200mm average (maximum 300mm)

Confederation Drive

150mm average (maximum 250mm)

21.0 STORM SEWERS

When the sewer profiles are available, it will be determined whether further field investigation will be required.

Native backfill should be used as backfill for sewers where practical. The bedding should be Class B1 using 19mm clear stone as per OPSD -802.3.

22.0 DRAINAGE DITCHES AND DRAINAGE OUTLETS

In the rural sections and where open ditches are proposed, flat bottom ditches are recommended. Rip-rap, where proposed at or within the drainage outlets or ditches should be placed on top of a geotextile. The geotextile should meet the requirements of OPSS 1860 Material Specifications for Geotextiles Class 1 Geotextile with FOS of 150 μ m to 200 μ m, non-woven, and with a minimum thickness of 1mm.

23.0 LOGS OF BORE HOLES

Typed logs of the boreholes have been produced and have been forwarded to the Central Region Geotechnical Section.

24.0 DISPOSAL OF MATERIALS

Due to the high moisture content observed at some locations within the project limits, it is recommended that these materials not be used as fill in embankment construction.

However, these materials can be utilized to flatten the various fill slopes provided drainage is not obstructed.

25.0 SLOPE PROTECTION

From the results of the field investigation and visual surveys, the existing slopes are in good condition, showing no visible signs of erosion or slope failure.

All new slopes should be seeded, mulched and/or sodded at an early stage. Cut slopes should not be left unprotected during the winter months.

Earth cut embankment slopes should be constructed with slopes no steeper than the standard 2 hor : 1 vert.

26.0 TREATMENT OF ORGANIC SECTIONS

- Station 15+120± to Station 15+145±)
- Station 15+310± to Station 15+320±) North Service Road
- Station 10+100± to Station 10+135± Ramp NSR - W

The attached plan Appendix I shows the extent of the organic areas. These areas, ranging in thickness from 300mm to 4.3m, are underlain by a stiff to firm silty clay.

All organic matter should be excavated to firm base and for the full width of the proposed embankment before any fill material is placed.

Organic materials that will be encountered within Station 15+120± to Station 15+145± North Service Road and Station 10+100± to Station 10+135± Ramp NSR-W consist of a black ooze of very soft consistency. This material could prove to be environmentally sensitive.

27.0 BACKFILL TO ORGANIC EXCAVATIONS

Backfill to the sections where organic materials will be excavated should consist of Granular "B" Type 1 or Granular "A", whichever is more cost effective.

28.0 PROPOSED ROADWAY RESTORATION AT STORM SEWER CROSSINGS

- | | | | |
|-----|-----------------|---|---------------------|
| (1) | Station 21+165± |) | Westbound Collector |
| (2) | Station 21+240± |) | |
| (3) | Station 21+310± |) | Eastbound Collector |
| (4) | Station 21+560± |) | |

The above storm sewer locations in an open cut design will cross, for the most part, existing bituminous asphaltic pavement varying in thickness from 90mm to 270mm over 110mm to 600mm of crushed gravel (Granular "A") underlain by a moist to wet silty clay and/or silty sand. For restoring the existing pavement structure, the following will apply:

- The sewer trench should not be less than 600mm wide.
- Replace the granular materials, using Granular "A", compacted to Ministry's standards and specifications, to the original thickness below the asphalt.
- Replace the asphalt using H.D.B. to its original depth.

(5) Station 22+545 Eastbound and Westbound Lanes.

The above storm sewer location crosses the existing Q.E.W. roadway with a pavement structure consisting of 200mm of asphalt over 230mm of unreinforced concrete.

To restore the existing pavement structure the following will apply:

- Provide for Granular "A" placed and compacted to 80mm from the bottom of the concrete.
- Replace the remainder of the open trench with asphalt consisting of H.D.B. placed flush with the existing pavement.

The above installations should be carried out prior to the cold planning operation.

29.0 SOILS DATA AND SAMPLE TEST RESULTS

A soil profile will not be issued.

Copies of the logs of boreholes and sample test results are appended. Results for hydrometer analyses and Atterberg Limits will be issued at a later date and should be incorporated in this Report.

30.0 CLOSURE

The field work for this investigation was carried out by Mr. Michael Percy, P.Eng., assisted by Messrs J. Duncan and Mark Percy.

Drilling services for this investigation were provided by Jim's Earth Drilling Company of Fenelon Falls, Ontario.

The pavement coring was performed by M. Nasiruddin & Associates Ltd. of Scarborough, Ontario.

This report was written by Mr. Don A. Mullett and reviewed by Messrs. R. Dale Gunter and C. Mirza, P.Eng., Principals of the Firm.

Details of the investigation and the recommendations given in this report are considered to be complete. However, should any questions arise please do not hesitate to call.

Respectfully submitted:
STRATA ENGINEERING CORPORATION


D. A. Mullett
Associate



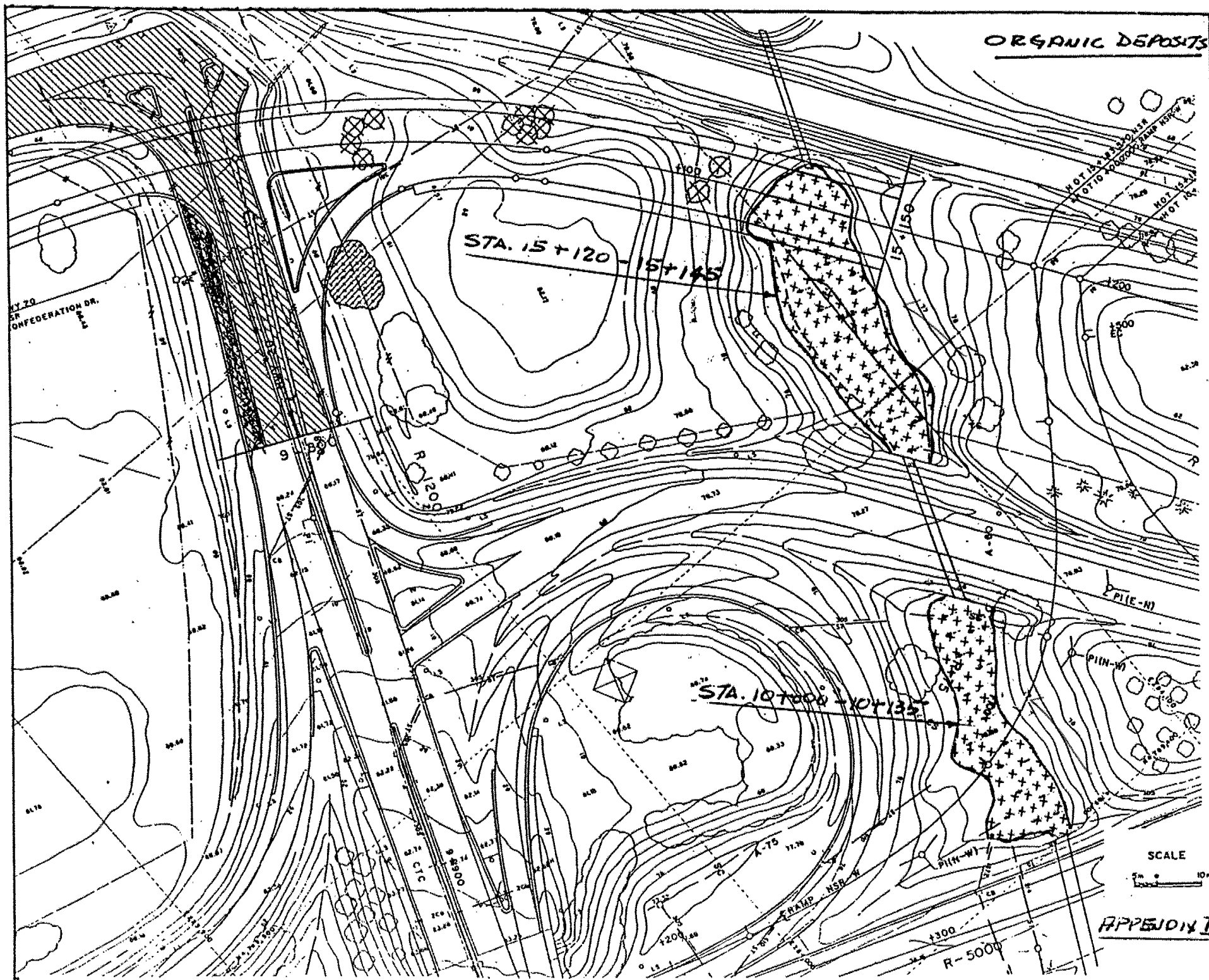
Report Distribution:

| | |
|---|-----------|
| MTO Geotechnical Section, Central Region: | 14 copies |
| Strata File S-89-279: | 1 copy |

A P P E N D I X

| | |
|------------|---|
| I | Organic Deposits |
| II | Profile Corrections |
| III | Typical Section |
| IV | Gradation Curves |
| V | Abbreviations for Boring and Test Data |
| | Geotechnical Survey Data |

| | |
|-------------------------|---------|
| Eastbound Lanes | pp. 1-6 |
| Westbound Lanes | 7-12 |
| Eastbound Collector | 13-15 |
| Westbound Collector | 16-17 |
| Cores - Eastbound Lanes | 18 |
| Cores - Westbound Lanes | 19 |
| Median | 20 |
| Ramps S E | 21 |
| Ramps E-NSR and NSR-W | 22 |
| North Service Road | 23-26 |
| Sample Test Results | |
| Eastbound Lane | 27-28 |
| Westbound Lane | 29-30 |
| Eastbound Collector | 31 |
| Median | 32 |
| Ramps | 33 |
| North Service Road | 34 |
| Culverts | 35 |



ORGANIC DEPOSITS

NY 79
CONFEDERATION DR.

STA. 15+120-15+145

STA. 10+100-10+135

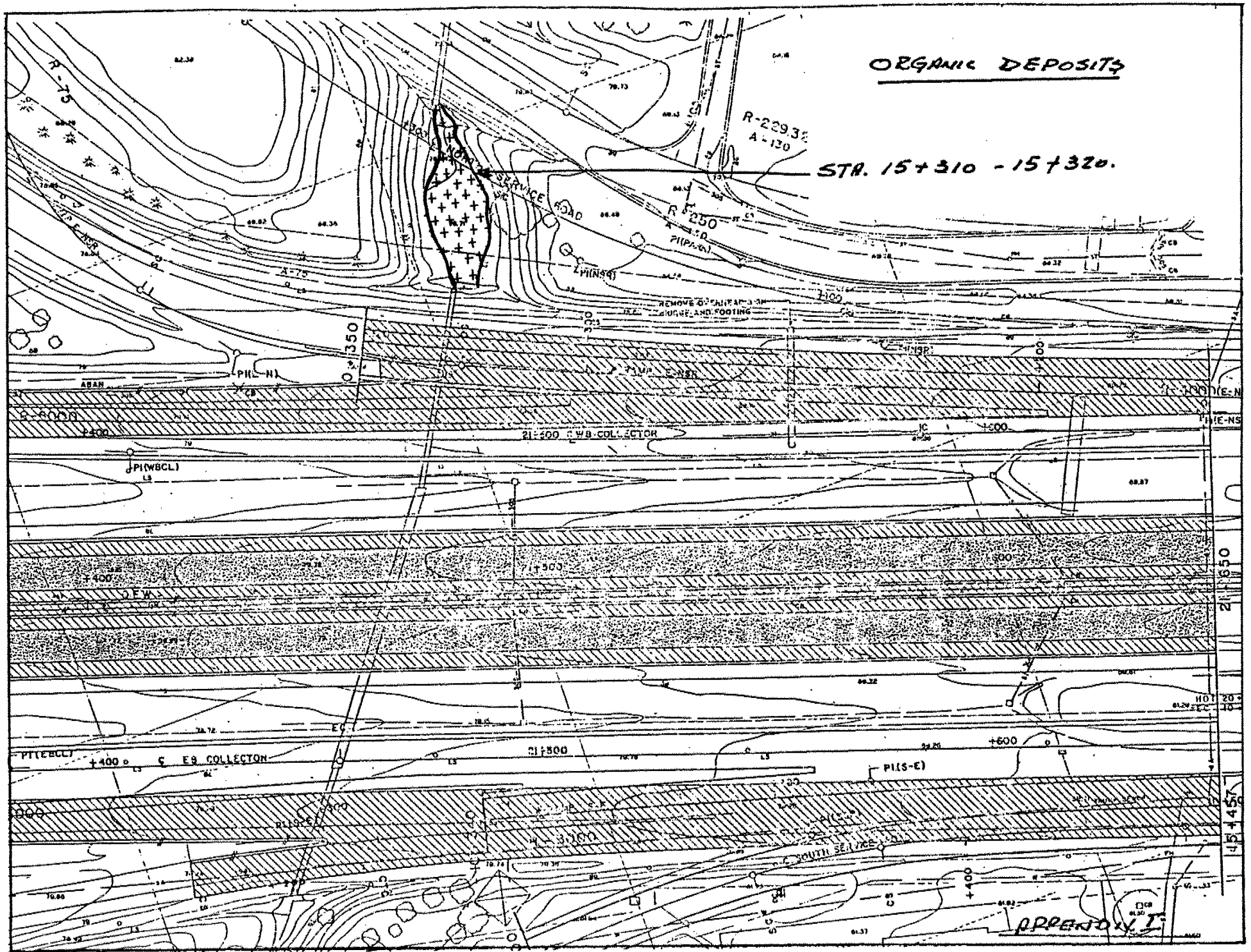
SCALE

1000

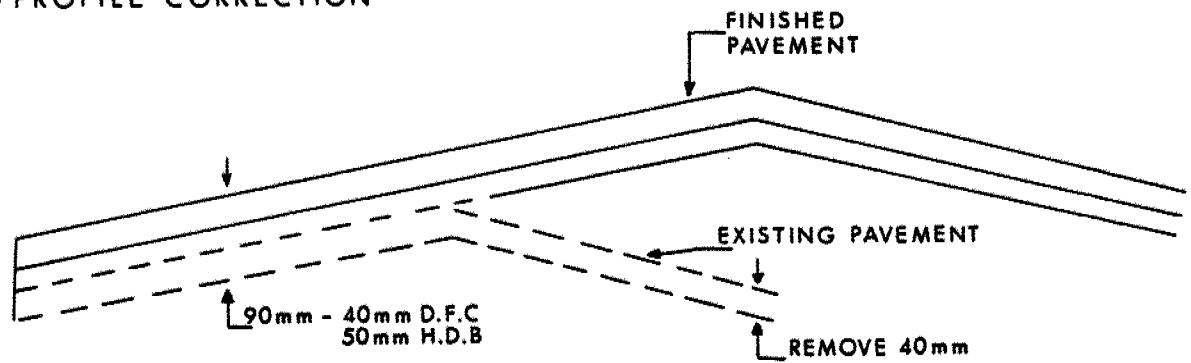
APPENDIX I

ORGANIC DEPOSITS

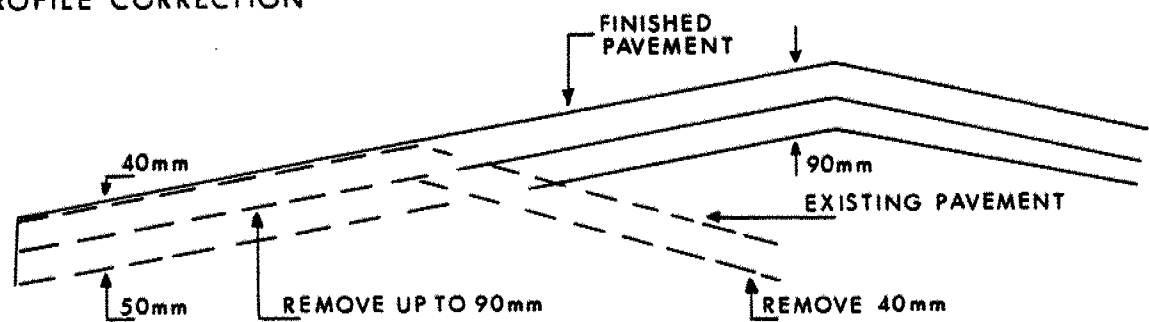
STA. 15+310 - 15+320.



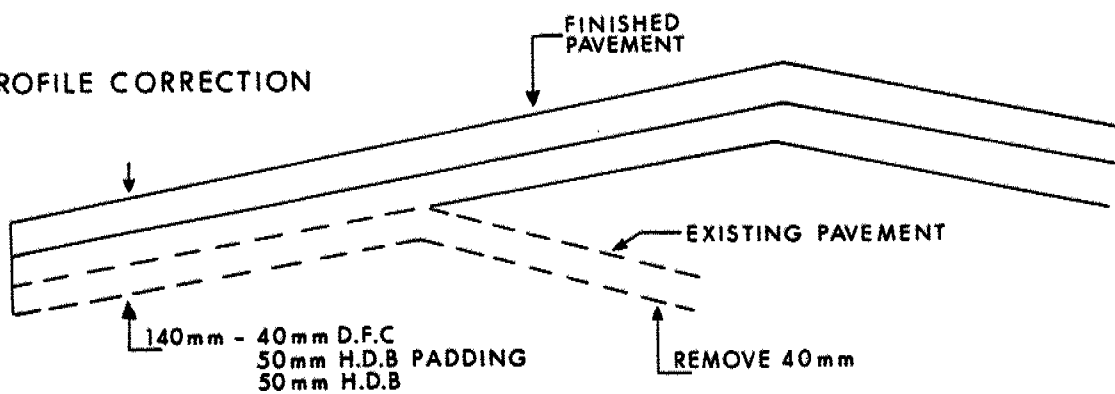
1. NO PROFILE CORRECTION

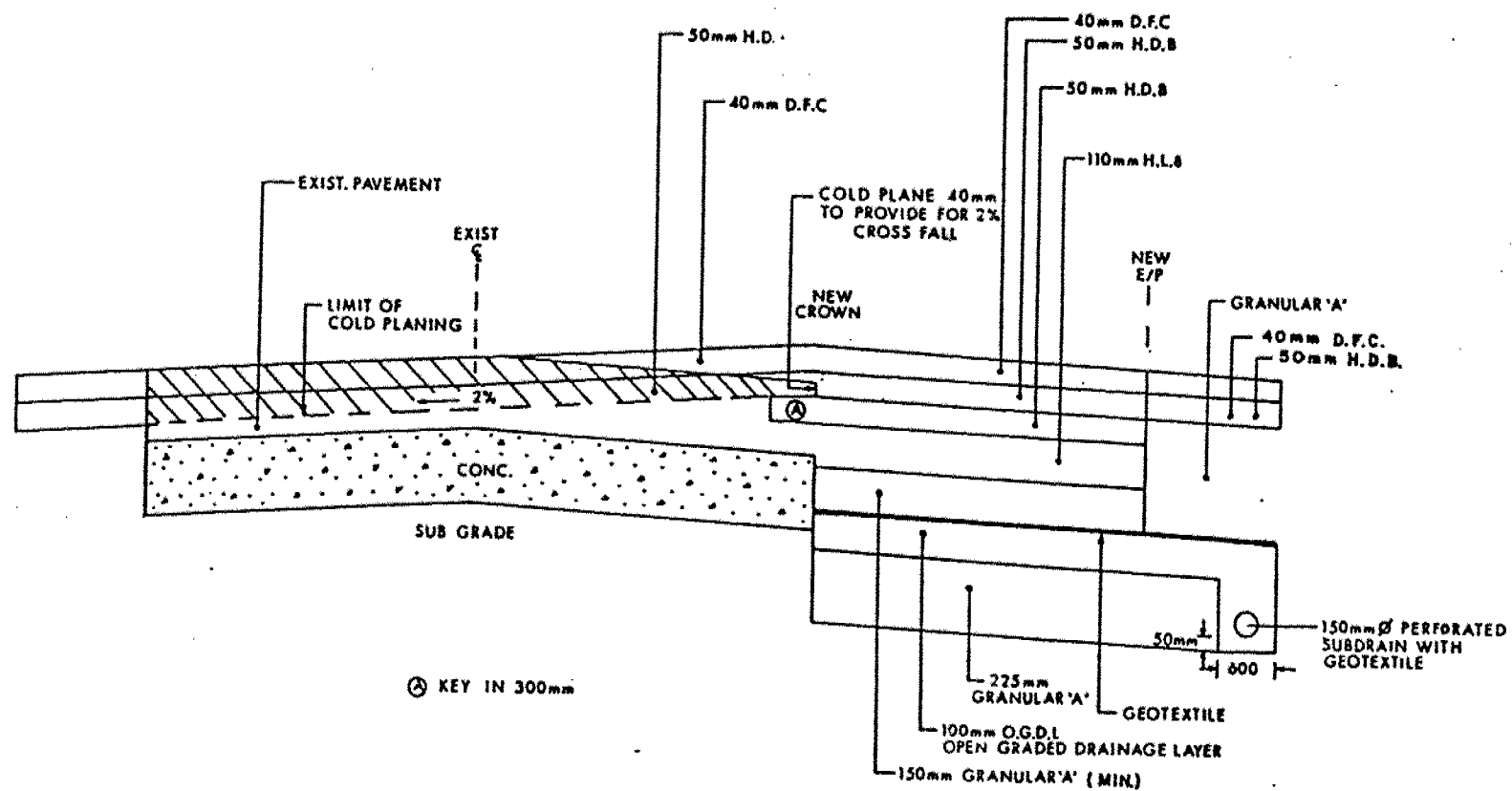


2. PROFILE CORRECTION



3. PROFILE CORRECTION



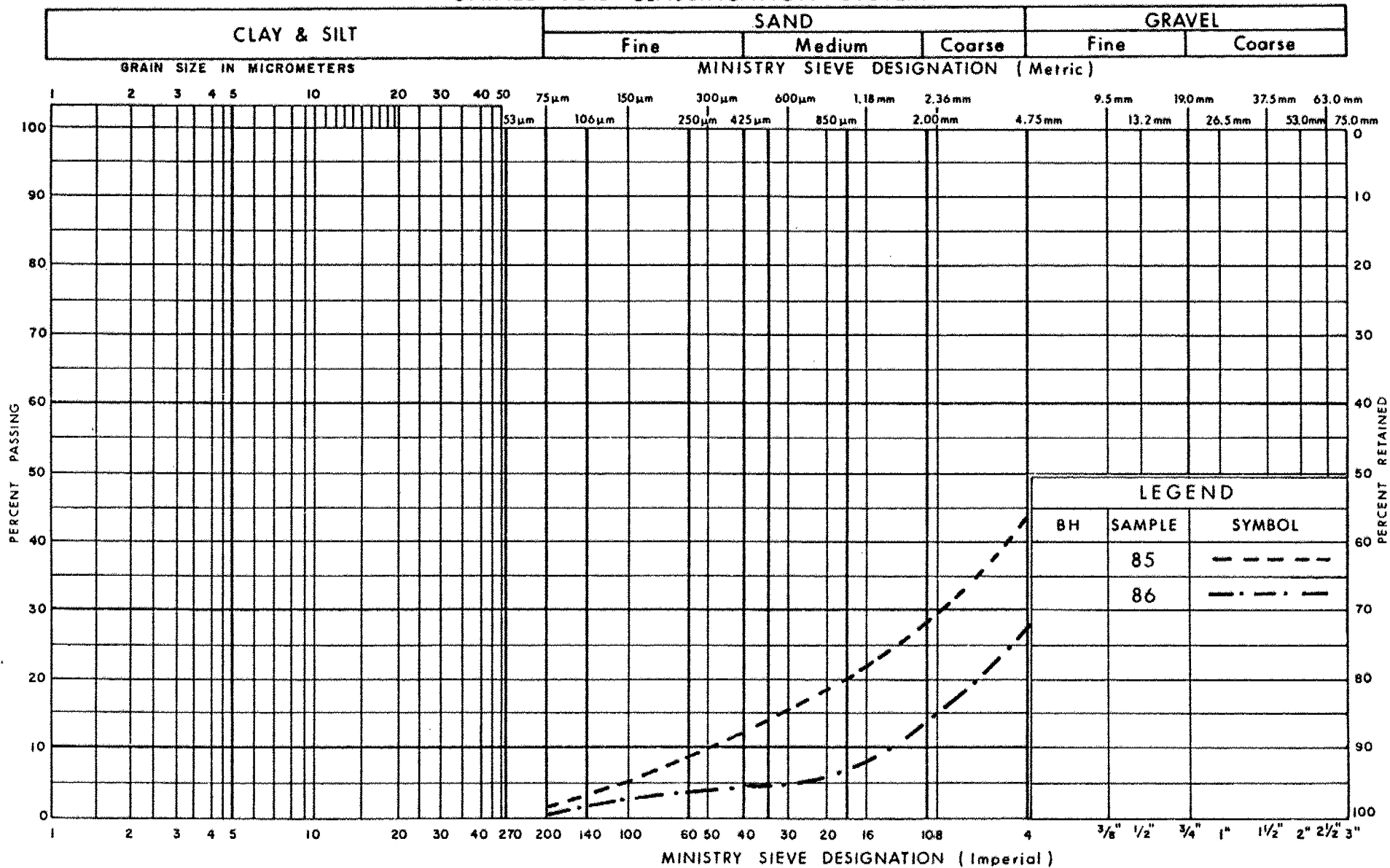


TYPICAL SECTION

Q.E.W.
W.P. 318-89-00
DISTRICT 4, BURLINGTON

APPENDIX III

UNIFIED SOIL CLASSIFICATION SYSTEM



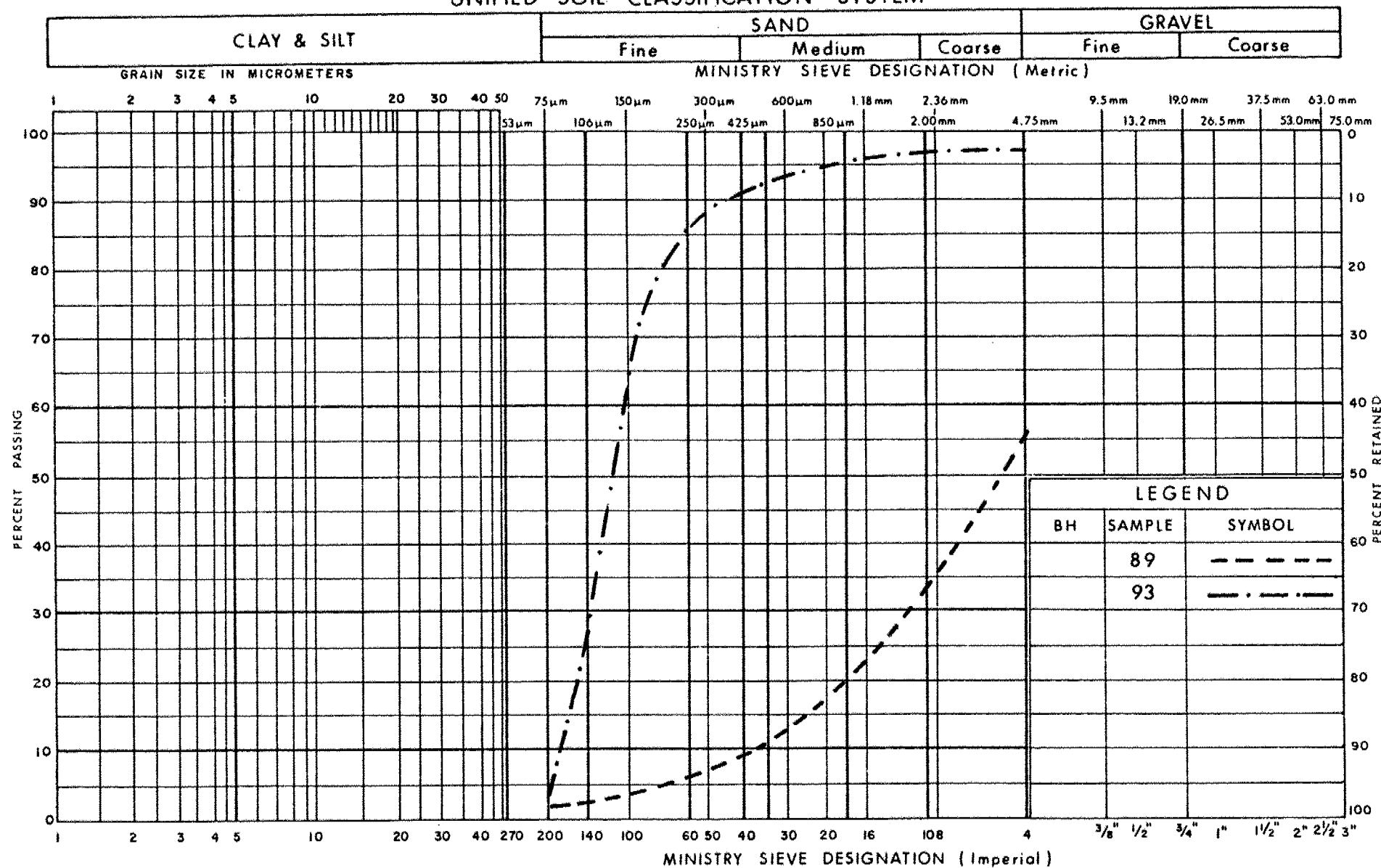
Ministry of
Transportation

GRAIN SIZE DISTRIBUTION

FIG No

W P APPENDIX IV

UNIFIED SOIL CLASSIFICATION SYSTEM



Ministry of
Transportation

Ontario

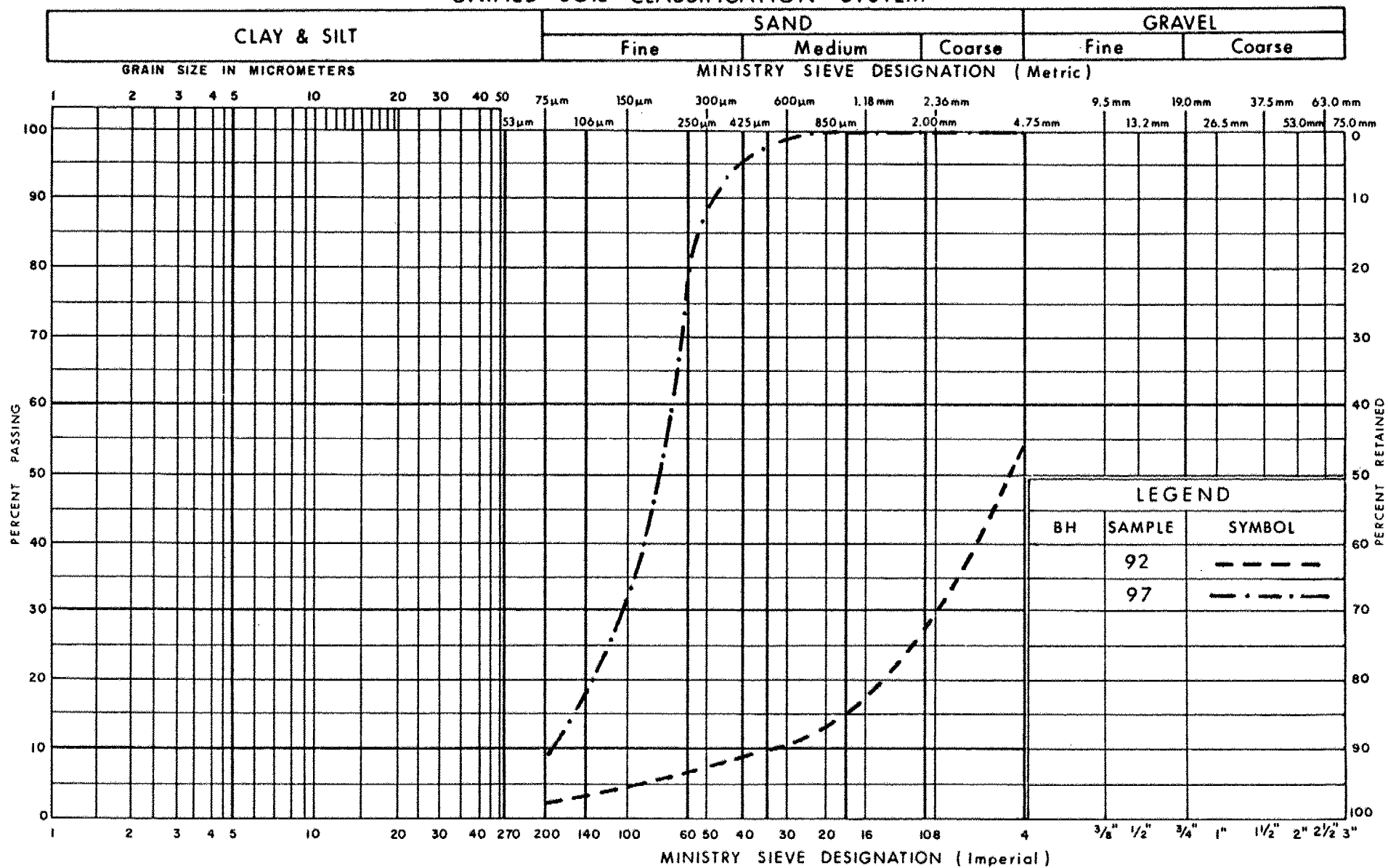
GRAIN SIZE DISTRIBUTION

FIG No

W P

APPENDIX IV

UNIFIED SOIL CLASSIFICATION SYSTEM



Ministry of
Transportation

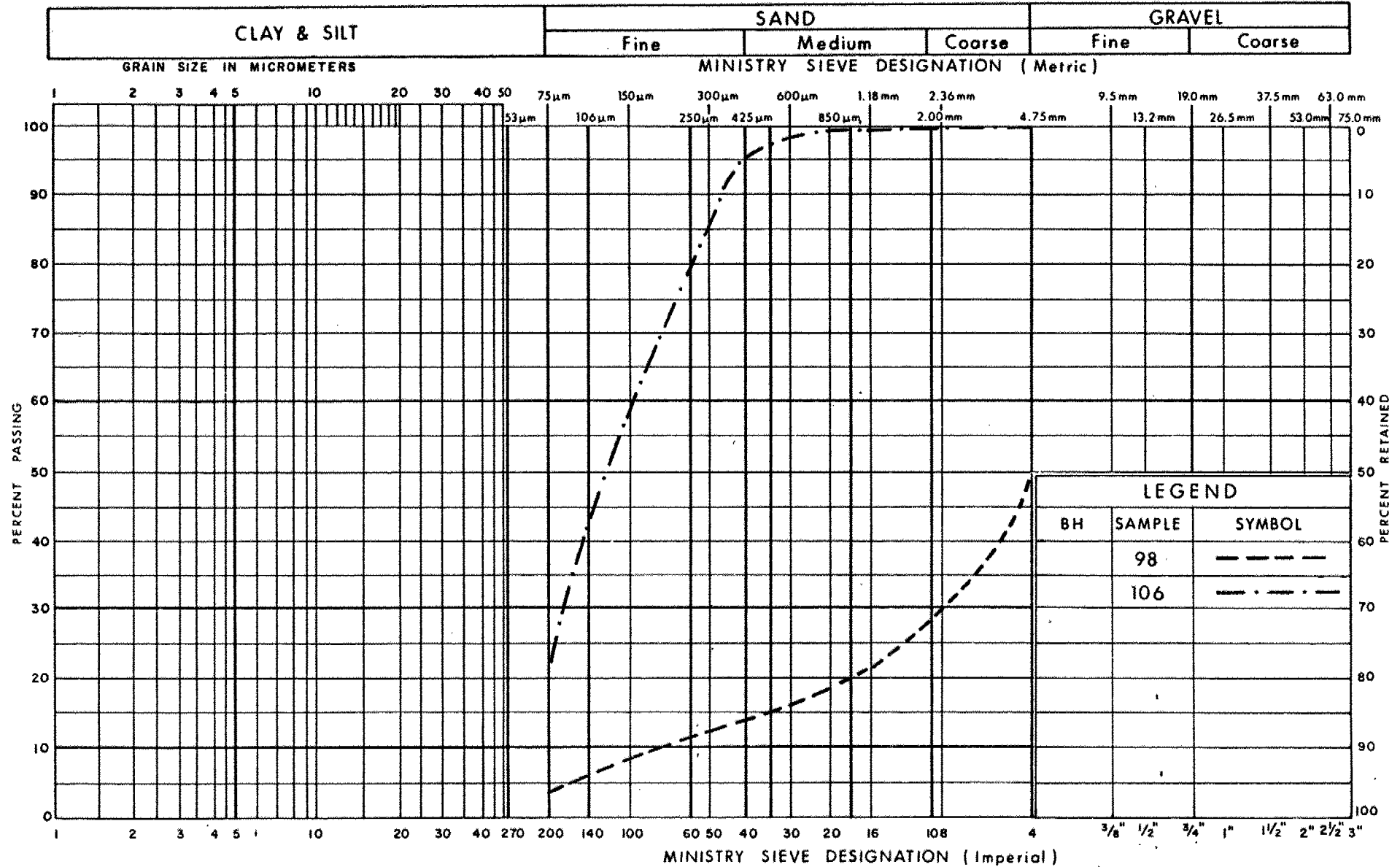
GRAIN SIZE DISTRIBUTION

FIG No

W P

APPENDIX IV

UNIFIED SOIL CLASSIFICATION SYSTEM



Ministry of
Transportation

Ontario

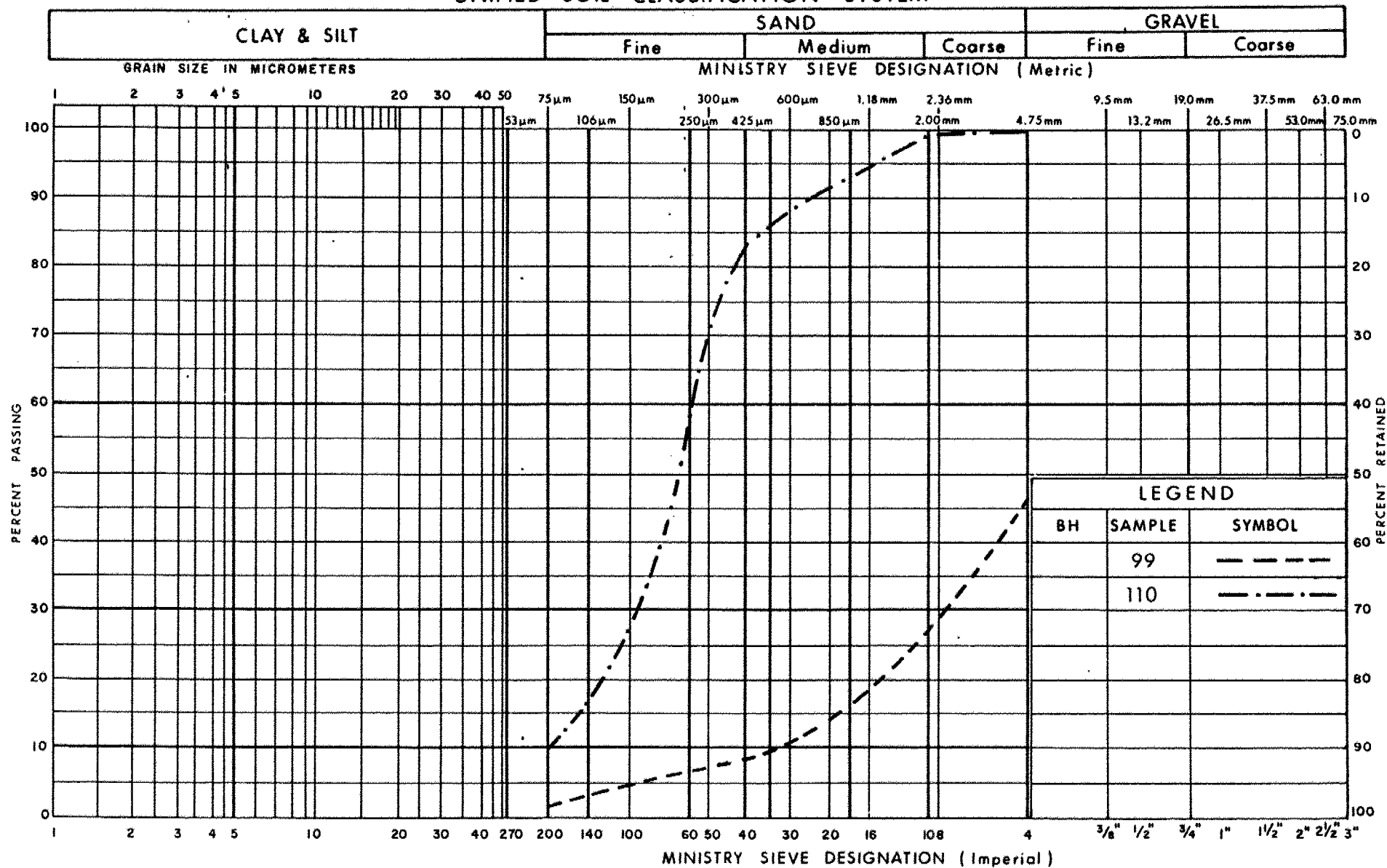
GRAIN SIZE DISTRIBUTION

FIG No

W P

APPENDIX IV

UNIFIED SOIL CLASSIFICATION SYSTEM



Ministry of
Transportation

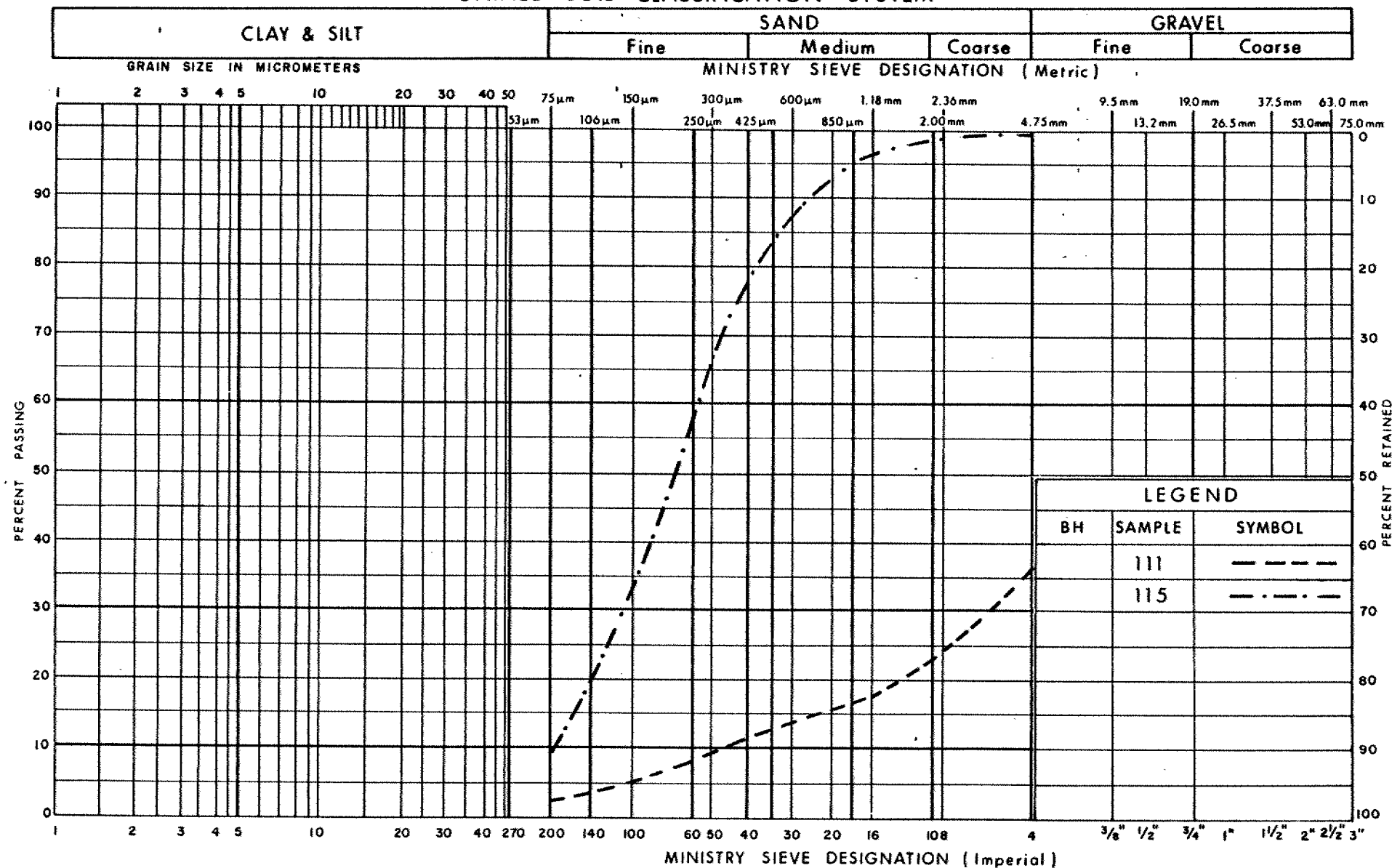
GRAIN SIZE DISTRIBUTION

FIG No

W P

APPENDIX IV

UNIFIED SOIL CLASSIFICATION SYSTEM



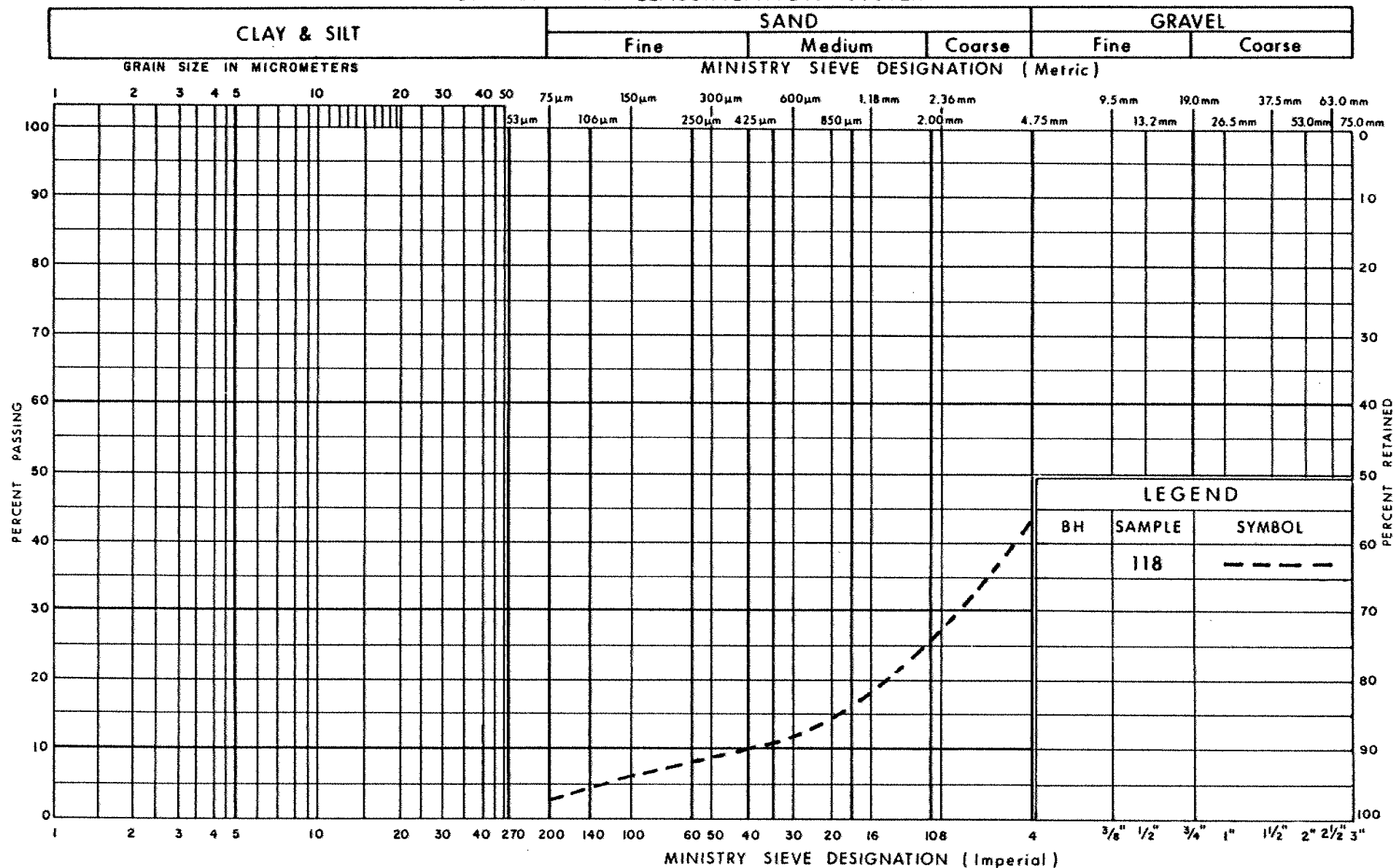
Ministry of
Transportation

GRAIN SIZE DISTRIBUTION

FIG No

W P APPENDIX IV

UNIFIED SOIL CLASSIFICATION SYSTEM



Ontario

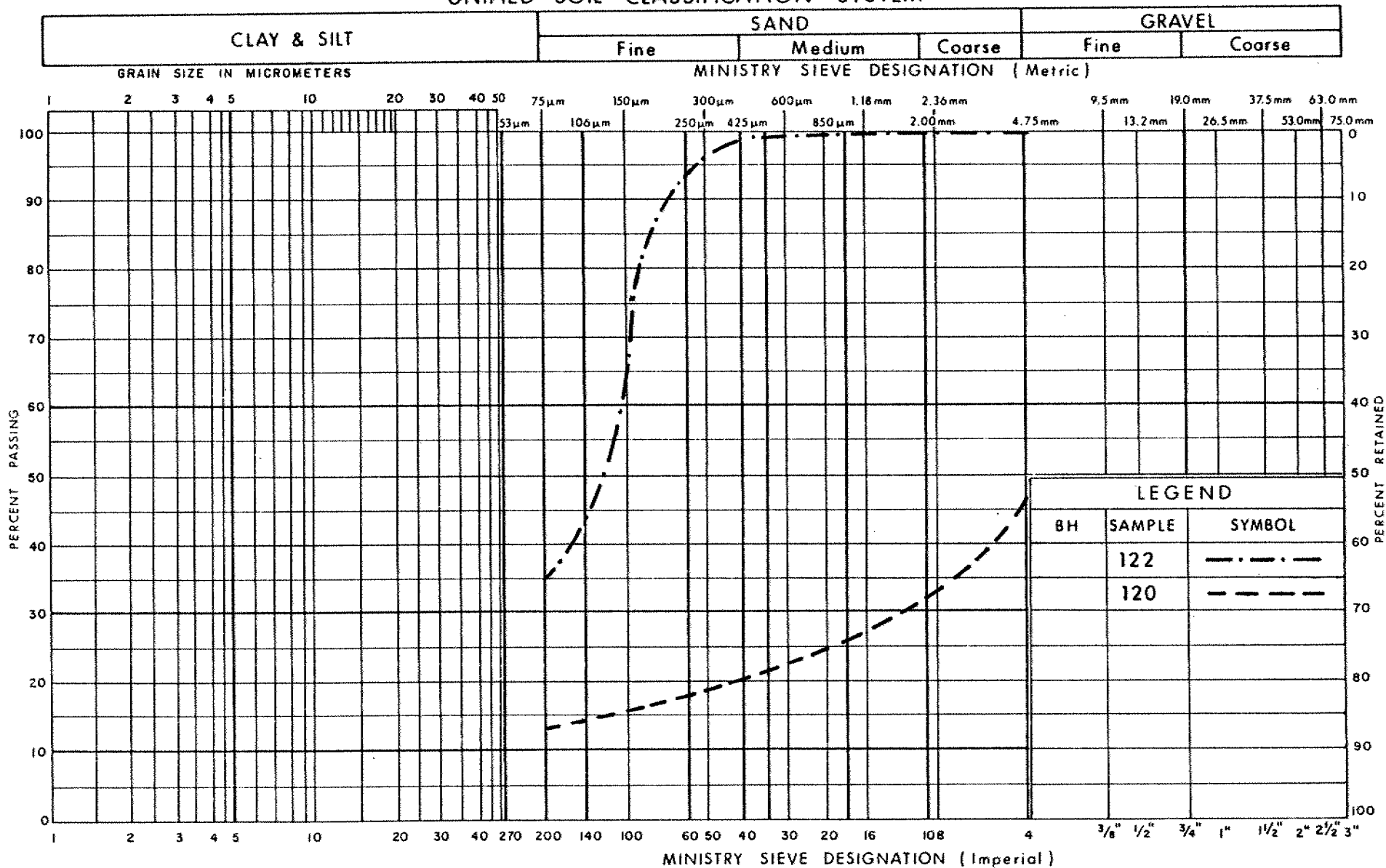
Ministry of
Transportation

GRAIN SIZE DISTRIBUTION

FIG No

W P APPENDIX IV

UNIFIED SOIL CLASSIFICATION SYSTEM



Ministry of
Transportation

GRAIN SIZE DISTRIBUTION

FIG No

W P APPENDIX IV

ABBREVIATIONS FOR BORING AND TEST DATA

| | | | | | |
|---------|------------------------|------------|--------------------------------|---------|----------------------------|
| Accp | Acceptable | Gry | Grey | Psty | Polystyrene |
| Agg | Aggregate | H | Heavy | Poss | Possible |
| Amor | Amorphous | Hi | Highly | PST | Prime & Surface Treated |
| Asph | Asphalt | HP | High Plasticity | Quant | Quantity |
| BR | Bedrock | HM | Hot Mix | Reinf | Reinforced |
| Blk | Black | Lt | Light | RSS | Remoulded Shear Strength |
| Bl | Blue | Liq | Liquid | RF | Rock Fill |
| BH | Borehole | WL | Liquid Limit | Sa | Sand |
| Bld (y) | Boulder (y) | Lo | Loam | Sat | Saturated |
| Blds | Boulders | L | Loose | SH | Shale |
| BU | Break Up | Mrl | Marl | St | Sensitivity |
| Br | Brown | Matl | Material | SSM | Select Subgrade Material |
| CF | Channel Face | Max | Maximum | Sh Rk | Shot Rock |
| Cl | Clay | MDD | Maximum Dry Density | Sl (y) | Silt (y) |
| Co | Coarse | MWD | Maximum Wet Density | Sl (y) | Slight (ly) |
| Cob | Cobbles | Med | Medium | SP | Slight Plasticity |
| Comp | Compact | MP | Medium Plasticity | Stn (y) | Stoney |
| Conc | Concrete | Mod | Moderate | DR | Relative Density |
| Contam | Contaminated | Mott | Mottled | Stks | Streaks |
| Cord | Corduroy | Mul | Mulch | Surf | Surface |
| Cr | Crushed | NFP | No Further Progress | Temp | Temperature |
| Dk | Dark | NFP (Blds) | No Further Progress (Boulders) | TH | Test Hole |
| Decomp | Decomposed | Num | Numerous | TP | Test Pit |
| D | Dense | OCC | Occasional | Tps | Topsoll |
| E | Earth | Wopt | Optimum Moisture Content | Tr | Trace |
| Fib | Fibrous | Ora | Orange | USS | Undisturbed Shear Strength |
| w | Field Moisture Content | Org | Organic | Unreinf | Unreinforced |
| F | Fine | Org M | Organic Matter | Varv | Varved |
| Fr Wat | Free Water | Ob | Overburden | VF | Very Fine |
| FB | Frost Boil | Pavt | Pavement | WT | Water Table |
| FH | Frost Heave | Pedo | Pedological | Weath | Weathered |
| Gran | Granular | Pen Mac | Penetration Macadam | W | With |
| Gr | Gravel (ly) | Wp | Plastic Limit | Wd (y) | Wood (y) |
| Grn | Green | Ip | Plasticity Index | Yel | Yellow |

*most
firm
wet*

ONTARIO PROVINCIAL STANDARD DRAWING

ABBREVIATIONS GEOTECHNICAL

SUSCEPTIBILITY TO FROST HEAVING

HSFH - High
MSFH - Medium
LSFH - Low

Date | 1986 07 18 | Rev |

Date _____

OPSD - 100.06

GEOTECHINICAL SURVEY DATA

| DATE OF SURVEY | TYPE OF SURVEY |
|----------------|---|
| May, 1990 | Power Auger Core Drill Hand Auger |

NOTES

1. Conditions and pavement depths apply only to the date of the survey.
2. The boundaries between the strata have been established only at core/borehole locations. Between cores/boreholes the boundaries are assumed and may be subject to error.
3. Soils are described according to the MTC Soils Classification System.
4. Pavement core locations were established using random numbers.
5. Abbreviations for boring and test data conform to OPSD 100.06
6. Dimension are in metres and/or millimetres unless otherwise shown.
Stations in kilometres + metres.

STONE CREEK

EASTBOUND LANES

| | | | |
|-----------------|-------------------------------------|-----------------|-----------------------|
| 21 + 250 | E/P | 21 + 350 | 3.0m Rt E/P |
| 0 - 90mm | Asph | 0 - 130mm | Asph |
| 90 - 270 | Conc. | 130 - 460 | Cr Gr <u>90-DM-86</u> |
| 270 - 1.0m | Cr Gr | 460 - 1.3m | Dk Gry Cl Tps |
| 1.0 - 1.2 | Br Si Cl Moist | 1.3 - 1.5 | Br Si Cl Moist |
| 1.2 - 1.3 | Dk Cl Tps | | |
| 1.3 - 1.6 | Br Si Cl Moist <u>90-DM-84</u> | 21 + 450 | E/P |
| 21 + 250 | 3.0m E/P | 0 - 100mm | Asph |
| 0 - 130mm | Asph | 100 - 320 | Conc. |
| 130 - 500 | Cr Gr (300-500 Si(Y)) | 320 - 750 | Cr Gr |
| 500 - 750 | Br Si Cl Moist | 750 - 850 | Br Sa Cl |
| 750 - 900 | Dk Gry Tps & Cl Mix | 850 - 1.5m | Br Si Cl Moist |
| 900 - 1.5m | Br Si Cl Moist Stiff Firm | 21 + 450 | 3.0m Rt E/P |
| 21 + 250 | 6.0m Rt E/P | 0 - 100mm | Asph |
| 0 - 150mm | Tps | 100 - 680 | Cr Gr |
| 150 - 670 | Br Cl Si Moist | 680 - 780 | Gry Cl Tps |
| 670 - 1.5m | Si Cl (Si Bands) Moist | 780 - 1.5m | Br Sa Cl Moist |
| 21 + 350 | E/P | 21 + 450 | 6.0m Rt E/P |
| 0 - 80mm | Asph | 0 - 200mm | Tps |
| 80 - 290 | Conc. | 200 - 1.5m | Br Sa Cl Moist |
| 290 - 620 | Cr Gr (Wet 430-620) <u>90-DM-85</u> | | <u>90-DM-87</u> |
| 620 - 900 | Br Si Cl & Gr Mix Wet | 21 + 575 | E/P |
| 900 - 1.2m | Dk Gry Tps | 0 - 120mm | Asph |
| 1.2 - 1.5 | Br Si Cl Moist | 120 - 300 | Conc. |
| | | 300 - 900 | Cr Gr |
| | | 900 - 1.5m | Red Br Si Sa Wet |
| | | | <u>90-DM-88</u> |

STONEY CREEK

EASTBOUND LANES

| | | | | | | | |
|-----------------|---|--------------------|---|-----------------|---|--------------------|-------------------------------------|
| 21 + 575 | | 3.0m Rt E/P | | 21 + 750 | | 3.0m Rt E/P | |
| 0 | - | 120mm | Asph | 0 | - | 130mm | Asph |
| 120 | - | 540 | Cr Gr | 130 | - | 380 | Cr Gr |
| 540 | - | 1.5m | Br Si F Sa Moist-Wet | 380 | - | 1.5m | Si Cl Till Moist <u>90-DM-91</u> |
| 21 + 650 | | E/P | | 21 + 850 | | E/P | |
| 0 | - | 80mm | Asph | 0 | - | 70mm | Asph |
| 80 | - | 320 | Conc. | 70 | - | 280 | Conc. |
| 320 | - | 750 | Cr Gr <u>90-DM-89</u> | 280 | - | 900 | Cr Gr <u>90-DM-92</u> |
| 750 | - | 1.2m | Cl & Gr Mix Wet | 900mm+ | | | NFP Poss C.S.P |
| 1.2 | - | 1.5 | Br Si Sa Moist-Wet | | | | |
| 21 + 650 | | 3.0m Rt E/P | | 21 + 850 | | 1.5m Rt E/P | |
| 0 | - | 80mm | Asph | 0 | - | 140mm | Asph |
| 80 | - | 710 | Cr Gr | 140 | - | 800 | Cr Gr |
| 710 | - | 1.2m | Br Si F Sa Wet (Sat1.0m-1.2m) | 800 | - | 1.2m | Br Si Sa Moist |
| 1.2 | - | 1.5 | Gr Si Cl (Si Bands) Wet <u>90-DM-90</u> | 1.2 | - | 1.5 | Gry Br Si Cl Moist |
| 21 + 650 | | 6.0m Rt E/P | | 21 + 850 | | 6.0m Rt E/P | |
| 0 | - | 150mm | Tps | 0 | - | 170mm | Tps |
| 150 | - | 540 | Cl & Gr Mix | 170 | - | 540 | Cr Gr |
| 540 | - | 1.2m | Gry Br Si - Si Sa | 540 | - | 1.2m | Br Si Sa |
| 1.2 | - | 1.5 | Gry Si Cl | 1.2 | - | 1.5 | Gry Br Si Cl Moist Stiff-Firm |
| 21 + 750 | | E/P | | | | | |
| 0 | - | 40mm | Asph | | | | |
| 40 | - | 270 | Conc. | | | | |
| 270 | - | 900 | Cr Gr | | | | |
| 900mm+ | | | NFP Poss C.S.P | | | | |

STONEY CREEK

EASTBOUND LANES

| | | | | |
|-----------------|----------------------|--|-----------------|--------------------|
| 21 + 950 | E/P | | 22 + 050 | 6.0m Rt E/P |
| 0 - 300mm | Asph | | 0 - 250mm | Tps |
| 300 - 500 | Conc. | | 250 - 1.0m | Cr Gr |
| 500 - 1.4m | Br Si Sa Moist-Wet | | 1.0 - 1.9 | Tps |
| | <u>90-DM-93</u> | | 1.9 - 2.1 | Br Si Cl Moist-Wet |
| 1.4 - 1.5 | Gry Si Cl Moist-Wet | | | |
| 21 + 950 | 3.0m Rt E/P | | 22 + 175 | E/P |
| 0 - 270mm | Asph | | 0 - 200mm | Asph |
| 270 - 570 | Cr Gr | | 200 - 480 | Conc. |
| 570 - 1.6m | Br Si F Sa Moist-Wet | | 480 - 900 | Cr St & Cl Mixed |
| 1.6 - 1.8 | Gry Si - Si Sa Moist | | 900 - 1.5m | Gry Br Si Cl Stiff |
| 1.8m+ | Gry Si Cl Moist-Wet | | | Wet Firm |
| 22 + 050 | E/P | | 22 + 175 | 3.0m Rt E/P |
| 0 - 230mm | Asph | | 0 - 100mm | Asph |
| 230 - 450 | Conc. | | 100 - 300 | Cr Gr |
| 450 - 700 | Br Si Cl | | 300 - 750 | Cl & Tps Mixed |
| 700 - 2.1m | Dk Gry Tps | | 750 - 1.5m | Br Si Cl Moist-Wet |
| 2.1 - 2.4 | Gry Si Cl Moist | | | <u>90-DM-94</u> |
| 22 + 050 | 3.0m Rt E/P | | 22 + 225 | E/P |
| 0 - 200mm | Asph | | 0 - 130mm | Asph |
| 200 - 400 | Cr Gr | | 130 - 450 | Cr Gr |
| 400 - 540 | Br Si Cl Moist-Wet | | 450 - 550 | Old Pavt |
| 540 - 1.9m | Dk Gry Tps | | 550 - 670 | Conc. |
| 1.9 - 2.1 | Gry Si Cl Moist | | | |

STONEY CREEK

EASTBOUND LANES

| | | | | | |
|-----------------|---------------------------------------|--|--|-----------------|---------------------------|
| 22 + 275 | E/P | | | 22 + 450 | E/P |
| 0 - 270mm | Asph | | | 0 - 300mm | Asph |
| 270 - 500 | Cr Gr with Cl | | | 300 - 530 | Conc. |
| 500 - 670 | Old Pavt | | | 530 - 1.5m | Cr St & Cl Mixed |
| 670 - 750 | Cl Tps | | | | |
| 750 - 1.5m | Br Si Cl (Fill) Moist | | | 22 + 450 | 3.5m Rt E/P |
| 22 + 275 | 3.0m Rt E/P | | | 0 - 130mm | Asph |
| 0 - 140mm | Asph | | | 130 - 300 | Cr Gr |
| 140 - 300 | Cr Gr | | | 300 - 900 | Br Si Cl Moist-Wet |
| 300 - 520 | Gr & Tps Mixed | | | 900 - 1.2m | Br Si - Si Sa |
| 520 - 1.2m | Gry Cl Tps | | | | Moist-Wet |
| 1.2 - 1.5 | Gry Br Si Cl Wet-Sat | | | 1.2 - 1.5 | Gry Si Cl Wet |
| 22 + 350 | E/P | | | 22 + 525 | E/P |
| 0 - 260mm | Asph | | | 0 - 150mm | Asph |
| 260 - 450 | Cr Gr & Cl Mixed | | | 150mm+ | NFP Conc. |
| 450 - 600 | Old Pavt | | | 22 + 550 | E/P |
| 600 - 900 | Cr Stones & Cl Mix (seepage@840mm) | | | 0 - 190mm | Asph |
| 900 - 1.5m | Br Si Cl Wet | | | 190 - 460 | Conc. |
| 22 + 350 | 3.0m Rt E/P | | | 460 - 1.0m | Si Cl Wet <u>90-DM-95</u> |
| 0 - 130mm | Asph | | | 1.0 - 1.5 | Cr St & Cl |
| 130 - 240 | Cr Gr | | | | Mixed Wet |
| 240 - 550 | Gry Si Cl (seepage@530mm) | | | | (Cl tile@1.2m) |
| 550 - 1.6m | Br Si Cl (Fill) Wet | | | | |

STONE CREEK

EASTBOUND LANES

| | | | |
|-----------------|----------------------------------|-----------------|--|
| 22 + 550 | 3.0m Rt E/P | 22 + 750 | E/P |
| 0 - 100mm | Asph | 0 - 180mm | Asph |
| 100 - 300 | Cr Gr (Cl Mixed) | 180 - 460 | Conc. |
| 300 - 1.2m | Si - Si Sa with Cl layers | 460 - 630 | Cr St & Mixed |
| | Cl <u>90-DM-96</u> | | Wet |
| 1.2 - 1.5 | Br Si Cl Moist | 630 - 1.2m | Si Sa (Cl tile @1.2m) |
| | | 1.2 - 1.5 | Br Si Cl Moist-Wet |
| 22 + 650 | E/P | 22 + 750 | 3.0m Rt E/P |
| 0 - 230mm | Asph | 0 - 90mm | Asph |
| 230 - 430 | Conc. | 90 - 390 | Cr Gr |
| 430 - 840 | Si Cl Moist | 390 - 1.5m | Br Si Cl Moist |
| 840 - 1.4m | Cr St & Cl Mix (1.0m Cl tile) | | |
| 1.4 - 1.5 | Br Si Cl Moist-Wet | 22 + 850 | E/P |
| 22 + 650 | 3.0m Rt E/P | 0 - 200mm | Asph |
| 0 - 110mm | Asph | 200 - 490 | Conc. |
| 110 - 360 | Cr Gr with Cl | 490 - 1.5m | Cr St & Cl Mixed (Cl tile@1.2m) (Wet 1.0-1.5m) |
| 360 - 1.5m | Si Sa Moist-Wet | | |
| 22 + 650 | 6.0m Rt E/P (D + 300) | 22 + 850 | 3.0m Rt E/P |
| 0 - 130mm | Tps | 0 - 110mm | Asph |
| 130 - 1.2m | Si Sa Moist <u>90-DM-97</u> | 110 - 210 | Cr Gr |
| 1.2 - 1.7 | Br Si Cl with Sa Seams Moist-Wet | 210 - 470 | Cr Gr & Cl Mixed |
| | | 470 - 1.5m | Si Cl Moist Stiff-Firm |

STONE CREEK

EASTBOUND LANES

23 + 000 **E/P**

0 - 220mm Asph
220 - 460 Conc.
460 - 1.2m Cr St & Cl Mix
 (tile drain@1.2m)
1.2 - 16 Br Si Cl Wet Stiff
 Firm

23 + 000 **5.0m Rt E/P**

0 - 200mm Asph
200 - 660 Cr Gr
660 - 1.5m Gry Br Si Cl Moist Firm

23 + 000 **8.0m Rt E/P**

0 - 150mm Asph
150 - 700 Cr Gr
700 - 1.5m Br Si Cl Moist-Wet Firm

23 + 100 **E/P**

0 - 180mm Asph
180 - 420 Conc.
420 - 700 Cr Gr & Cl Mix
700 - 1.5m Br Si Cl Moist

23 + 100 **4.5m Rt E/P**

0 - 230mm Asph
230 - 750 Cr Gr 90-DM-98
750 - 900 Br Si Cl
900 - 1.2m Dk Gry Tps
1.2 - 3.3 Dk Gry Si Cl
3.3 - 3.6 Gry Si Cl Wet
 Stiff

23 + 200 **E/P**

0 - 280mm Asph
280 - 480 Conc.
480 - 1.5m Cr St
 Tile Drain@1.2m

23 + 200 **7.0m Rt E/P**

0 - 100mm Asph
100 - 620 Cr Gr
620 - 1.5m Br Si Cl Moist

STONEY CREEK**WESTBOUND LANES****23 + 200**

| | | | |
|-----|---|-------|------------------|
| 0 | - | 270mm | Asph |
| 270 | - | 450 | Conc. |
| 450 | - | 700 | Cr Gr & Cl Mixed |
| 700 | - | 920 | Si Sa |
| 920 | - | 1.5m | Br Si Cl Moist |

23 + 200

| | | | |
|-------|---|-------|-----------------------|
| 0 | - | 130mm | Asph |
| 130 | - | 1.2m | Cr Gr <u>90-DM-99</u> |
| 1.2m+ | | | NFP CSP |

23 + 200

| | | | |
|-----|---|-------|-------------------------------------|
| 0 | - | 240mm | Tps |
| 240 | - | 830 | Sa Cl Wet <u>90-DM-100</u> |
| 830 | - | 1.5m | Gry Br Si Cl Moist <u>90-DM-101</u> |

23 + 100

| | | | |
|-----|---|-------|--------------------|
| 0 | - | 240mm | Asph |
| 240 | - | 440 | Conc. |
| 440 | - | 720 | Cr Gr & Cl Mixed |
| 720 | - | 1.5m | Gry Br Si Cl Moist |

23 + 100

| | | | |
|-----|---|-------|--------------------|
| 0 | - | 200mm | Asph |
| 260 | - | 780 | Cr Gr |
| 780 | - | 1.5m | Gry Br Si Cl Moist |

E/P**5.0m Lt E/P****8.0m Lt E/P****E/P****400mm Lt E/P****23 + 100**

| | | | |
|-----|---|-------|---------------------------------|
| 0 | - | 140mm | Asph |
| 140 | - | 420 | Cr Gr |
| 420 | - | 1.5m | Br Si Cl Moist <u>90-DM-102</u> |

23 + 025

| | | | |
|-----|---|-------|----------------|
| 0 | - | 270mm | Asph |
| 270 | - | 495 | Conc. |
| 495 | - | 1.5m | Br Si Cl Moist |

23 + 025

| | | | |
|-----|---|-------|----------------|
| 0 | - | 280mm | Asph |
| 280 | - | 650 | Cr Gr |
| 650 | - | 1.5m | Br Si Cl Moist |

23 + 025

| | | | |
|-----|---|-------|----------------|
| 0 | - | 160mm | Asph |
| 160 | - | 420 | Cr Gr |
| 420 | - | 1.5m | Br Si Cl Moist |

23 + 025

| | | | |
|-----|---|-------|---------------------|
| 0 | - | 200mm | Tps |
| 200 | - | 1.5m | Br Si Cl Moist Firm |

7.0m Lt E/P**E/P****400mm Lt E/P****7.0m Lt E/P****10.5m Lt E/P (D + 400)**

STONEY CREEK

WESTBOUND LANES

22 + 825

E/P

| | | | |
|-----|---|-------|----------------|
| 0 | - | 180mm | Asph |
| 180 | - | 420 | Conc. |
| 420 | - | 900 | Si Sa Wet |
| 900 | - | 1.5m | Br Si Cl Moist |

22 + 825

3.3m Lt E/P

| | | | |
|-----|---|-------|---|
| 0 | - | 100mm | Asph |
| 100 | - | 460 | Cr Gr |
| 460 | - | 1.5m | Si Cl with Sa Seams Moist <u>90-DM-103</u> |

22 + 725

E/P

| | | | |
|-----|---|-------|-------------------------------|
| 0 | - | 190mm | Asph |
| 190 | - | 450 | Conc. |
| 450 | - | 780 | Br Si Cl Moist-Wet |
| 780 | - | 1.5m | Br Si Sa Wet <u>90-DM-104</u> |

22 + 725

3.3m Lt E/P

| | | | |
|-----|---|-------|----------------|
| 0 | - | 100mm | Asph |
| 100 | - | 420 | Cr Gr |
| 420 | - | 1.5m | Br Si Cl Moist |

22 + 725

2.6m Lt E/P

| | | | |
|-----|---|-------|----------------|
| 0 | - | 320mm | Tps & Sa Mixed |
| 320 | - | 1.5m | Br Si Cl Moist |

22 + 625

E/P

| | | | |
|-----|---|-------|----------------|
| 0 | - | 180mm | Asph |
| 180 | - | 400 | Conc. |
| 400 | - | 1.5m | Br Si Cl Moist |

22 + 625

3.2m Lt E/P

| | | | |
|-----|---|------|--------------|
| 0 | - | 90mm | Asph |
| 90 | - | 300 | Cr Gr |
| 300 | - | 1.5m | Br Si Cl Wet |

22 + 525

E/P

| | | | |
|-----|---|-------|----------------|
| 0 | - | 200mm | Asph |
| 200 | - | 440 | Conc. |
| 440 | - | 1.2m | Br Si Cl Moist |
| 1.2 | - | 1.5 | Gry Cl Wet HP |

22 + 525

3.5m Lt E/P

| | | | |
|-----|---|-------|-----------------------------|
| 0 | - | 130mm | Asph |
| 130 | - | 470 | Cr Gr |
| 470 | - | 1.2m | Br Si Cl Moist-Wet |
| 1.2 | - | 1.5 | Gry Cl Wet <u>90-DM-105</u> |

22 + 525

10.0m Lt E/P (D + 800)

| | | | |
|-----|---|-------|------------------------|
| 0 | - | 150mm | Tps |
| 150 | - | 2.0m | Si Sa <u>90-DM-106</u> |
| 2.0 | - | 2.8 | Gry Si Cl Wet Stiff |

STONE CREEK**WESTBOUND LANES****22 + 400**

| | | | |
|-----|---|-------|---------------------|
| 0 | - | 330mm | Asph |
| 330 | - | 520 | Conc. |
| 520 | - | 880 | Dk Gry Cl Tps |
| 880 | - | 1.5m | Gry Si Cl Moist-Wet |

22 + 400**3.2m Lt E/P**

| | | | |
|-----|---|------|---------------------|
| 0 | - | 80mm | Asph |
| 80 | - | 500 | Cr Gr & Cl Mix |
| 500 | - | 750 | Dk Gry Cl Tps Mix |
| 750 | - | 1.5m | Gry Si Cl Moist-Wet |

22 + 300**E/P**

| | | | |
|-----|---|-------|---------------------|
| 0 | - | 200mm | Asph |
| 200 | - | 380 | Cr Gr |
| 380 | - | 600 | Old Pavt |
| 600 | - | 780 | Conc. |
| 780 | - | 900 | Sa Cl |
| 900 | - | 1.5m | Gry Si Cl Moist-Wet |

22 + 300**3.2m Lt E/P**

| | | | |
|-----|---|-------|-----------------------------|
| 0 | - | 100mm | Asph |
| 100 | - | 480 | Cr Gr (some Cl) |
| 480 | - | 600 | Br Sa Cl Moist |
| 600 | - | 1.5m | Gry Br Si Cl Moist-Wet Firm |

22 + 300

| | | |
|-----|---|------|
| 0 | - | 200m |
| 200 | - | 600 |
| 600 | - | 1.6m |

8.0m Lt E/P (D - 1.0m)

Tps
Br Si Cl - Sa Cl Moist
Wet
Gry Br Si Cl Wet
90-DM-107

22 + 200**E/P**

| | | |
|-----|---|-------|
| 0 | - | 260mm |
| 260 | - | 500 |
| 500 | - | 1.5m |

Asph
Conc.
Br Si Cl Wet Stiff Firm

22 + 200**3.0m Lt E/P**

| | | |
|-----|---|------|
| 0 | - | 80mm |
| 80 | - | 300 |
| 300 | - | 450 |
| 450 | - | 1.5m |

Asph
Cr Gr
Cr Gr & Cl Mix
Br Si Cl Wet
90-DM-108

22 + 125**E/P**

| | | |
|-----|---|-------|
| 0 | - | 230mm |
| 230 | - | 440 |
| 440 | - | 1.6m |

Asph
Conc.
Gry Si Cl Wet Soft-Firm
90-DM-109

22 + 125**3.0m Lt E/P**

| | | |
|-----|---|-------|
| 0 | - | 100mm |
| 100 | - | 380 |
| 380 | - | 1.5m |

Asph
Cr Gr
Gry Si Cl Wet Firm

STONE CREEKWESTBOUND LANES**22 + 125**

0 - 150mm
150 - 300
300 - 1.5m

10.0m Lt E/P

Tps
Br Si - Si Cl Moist
Gry Si Cl Wet Stiff Firm

22 + 000

0 - 200mm
200 - 480
480 - 600
600 - 1.2m
1.2 - 1.5

E/P

Asph
Conc.
Br Si Cl
Gry Br Si Sa
Gry Sa Si Moist-Wet

22 + 000

0 - 100mm
100 - 350
350 - 450
450 - 750
750 - 4.5m

3.0m Lt E/P

Asph
Cr Gr
Tps
Br Si Sa
Gry Si Cl Wet
(2.4m-4.5m soft)

21 + 900

0 - 200mm
200 - 400
400 - 1.8m

E/P

Asph
Conc.
Si F Sa Sat from 1.2m

21 + 900

0 - 90mm
90 - 300
300 - 1.2m
1.2 - 1.5

3.0m Lt E/P

Asph
Cr Gr
Si Sa
Gry Si Cl Wet

21 + 900

0 - 630mm
630 - 1.9m
1.9 - 2.0

9.0m Lt E/P (D + 500)

Tps
Si Sa 90-DM-110
Gry Si Cl Moist

21 + 800

0 - 180
180 - 340
340 - 1.2m
1.2m+

E/P

Asph
Conc.
Cr Gr
NFP CSP

21 + 800

0 - 100mm
100 - 700
700 - 1.5m

3.0m Lt E/P

Asph
Cr Gr
Br Si F Sa Wet-Sat

21 + 700

0 - 120mm
120 - 300
300 - 1.2m

E/P

Asph
Conc.
Cr Gr 90-DM-111

21 + 700

0 - 90mm
90 - 600
600 - 1.4m
1.4 - 1.5

3.0m Lt E/P

Asph
Cr Gr
Si Sa Wet-Sat
Gry Si Cl

STONE CREEKWESTBOUND LANES**21 + 700 7.0m Lt E/P (D + 300)**

| | | | |
|-----|---|-------|-----------------|
| 0 | - | 500mm | Tps |
| 500 | - | 1.4m | Si Sa Sat |
| | | | (Seepage@900mm) |
| 1.4 | - | 1.6 | Gry Si Cl Sat |

21 + 600 E/P

| | | | |
|-------|---|-------|---------|
| 0 | - | 130mm | Asph |
| 130 | - | 300 | Conc. |
| 300 | - | 1.2m | Cr Gr |
| 1.2m+ | | | NFP CSP |

21 + 600 3.0m Lt E/P

| | | | |
|-----|---|-------|----------------|
| 0 | - | 100mm | Asph |
| 100 | - | 280 | Cr Gr |
| 280 | - | 1.5m | Br Si Cl Moist |

21 + 500 E/P

| | | | |
|-----|---|-------|-------|
| 0 | - | 120mm | Asph |
| 120 | - | 310 | Conc. |
| 310 | - | 1.2m | Cr Gr |

21 + 500 3.0m Lt E/P

| | | | |
|-----|---|-------|----------------|
| 0 | - | 100mm | Asph |
| 100 | - | 300 | Cr Gr |
| 300 | - | 500 | Cr Gr Cl Mix |
| 500 | - | 1.5m | Br Si Cl Moist |

21 + 500 7.5 Lt E/P

| | | | |
|-----|---|-------|--------------------|
| 0 | - | 250mm | Tps |
| 250 | - | 1.5m | Br Si Cl Moist-Wet |

21 + 400 E/P

| | | | |
|-----|---|-------|-----------------------|
| 0 | - | 130mm | Asph |
| 130 | - | 350 | Conc. |
| 350 | - | 620 | Cr Gr |
| 620 | - | 1.5m | Br Si Cl Till (Moist) |
| 1.5 | - | 1.6 | Gry Si Cl Moist |

21 + 400 3.0m Lt E/P

| | | | |
|-----|---|-------|-----------------|
| 0 | - | 100mm | Asph |
| 100 | - | 400 | Cr Gr |
| 400 | - | 1.4m | Br Si Cl Till |
| 1.4 | - | 1.5 | Gry Si Cl Moist |

21 + 300 E/P

| | | | |
|-----|---|-------|---------------|
| 0 | - | 100mm | Asph |
| 100 | - | 270 | Conc. |
| 270 | - | 370 | Cr Gr |
| 370 | - | 1.5m | Br Si Cl Wet |
| | | | (Water@750mm) |

21 + 300 3.0m Lt E/P

| | | | |
|-----|---|-------|--------------------|
| 0 | - | 120mm | Asph |
| 120 | - | 320 | Cr Gr |
| 320 | - | 1.5m | Br Si Cl Moist-Wet |

STONEY CREEK

WESTBOUND LANES

21 + 300

7.0m Lt E/P

| | | | |
|-----|---|-------|---------------------|
| 0 | - | 300mm | Tps |
| 300 | - | 1.4m | Br Si Cl Moist-Wet |
| 1.4 | - | 1.5 | Gry Si Cl Moist-Wet |

21 + 225

E/P

| | | | |
|-----|---|-------|-------------------------------|
| 0 | - | 100mm | Asph |
| 100 | - | 320 | Conc. |
| 320 | - | 800 | Cr Gr |
| 800 | - | 1.8m | Gry Si Cl Wet Firm to 1.5m |

21 + 225

3.0m Lt E/P

| | | | |
|-----|---|-------|-------------------------------|
| 0 | - | 100mm | Asph |
| 100 | - | 420 | Cr Gr |
| 420 | - | 1.5m | Gry Si Cl Wet Firm to 1.4m |

EASTBOUND COLLECTOR

| | | | | | |
|-----------------|-------------------------|--|--|-----------------|------------------------------|
| 21 + 250 | E/P | | | 21 + 450 | 5.0m Lt E/P |
| 0 - 90mm | Asph | | | 0 - 250mm | Tps |
| 90 - 200 | Cr Gr | | | 250 - 1.3m | Br Si Cl St (Fill) |
| 200 - 280 | Old Pavt | | | | Moist-Wet Firm |
| 280 - 780 | Cr Gr | | | 1.3 - 1.5 | Br Si Cl Moist Wet Firm |
| 780 - 1.2m | Br Si Cl Moist-Wet | | | | |
| 21 + 250 | 5.0m Lt E/P | | | 21 + 550 | E/P |
| 0 - 250mm | Tps | | | 0 - 270mm | Asph |
| 250 - 1.2m | Br Si Cl Moist-Wet | | | 270 - 700 | Cr Gr |
| | | | | 700 - 1.5m | Br Si Cl St |
| | | | | 1.5 - 1.7 | Cr Si Cl <u>90-DM-121</u> |
| 21 + 350 | E/P | | | 21 + 550 | 3.5m Lt E/P |
| 0 - 250mm | Asph | | | 0 - 250mm | Tps |
| 250 - 760 | Cr Gr | | | 250 - 1.2m | Br Si Cl Moist |
| 760 - 860 | Br Si Cl Till Moist-Wet | | | | |
| 860 - 1.2m | Br Si Cl Moist | | | 21 + 650 | E/P |
| 21 + 350 | 5.0m Lt E/P | | | 0 - 260mm | Asph |
| 0 - 260mm | Tps | | | 260 - 650 | Cr Gr |
| 260 - 1.2m | Br Si Cl Moist-Wet | | | 650 - 1.2m | Br Si Cl & Gr (Fill) |
| | | | | | Moist-Wet |
| 21 + 450 | E/P | | | 1.2 - 1.5 | Br Si-Si Sa Dry-Moist |
| 0 - 90mm | Asph | | | 1.5 - 1.6 | Gry Si Cl Moist |
| 90 - 200 | Cr Gr <u>90-DM-120</u> | | | 21 + 650 | 4.0M Lt E/P (D - 300) |
| 200 - 330 | Asph Old Pavt | | | 0 - 250mm | Tps |
| 330 - 690 | Cr Gr | | | 250 - 900 | Br Si Cl |
| 690 - 1.2m | Br Si Cl Till Wet | | | 900 - 1.5m | Gry Si Cl Moist |
| 1.2 - 1.5 | Sa Gr Wet | | | | |

EASTBOUND COLLECTOR

21 + 650 11.0m Lt E/P (D + 1.0m)

| | | | |
|-----|---|-------|--|
| 0 | - | 250mm | Tps |
| 250 | - | 2.5m | Br Si Cl with Brick (Fill) Moist (Wet From 1.2m) |
| 2.5 | - | 2.6 | Gry Si Cl Wet Stiff |

21 + 750 E/P

| | | | |
|-----|---|-------|-------------------|
| 0 | - | 240mm | Asph |
| 240 | - | 900 | Cr Gr |
| 900 | - | 1.8m | Br Si Sa & Gr Wet |
| 1.8 | - | 1.9 | Br Si Cl Wet |

21 + 750 10.0m Lt E/P (D + 900)

| | | | |
|-----------------|---|-------|-----------------|
| 0 | - | 350mm | Tps |
| 350 | - | 1.9m | Br Si Sa Gr Sat |
| (seepage@900mm) | | | |
| 1.9 | - | 2.0 | Gry Si Cl Wet |

21 + 850 E/P

| | | | |
|-----|---|-------|------------------------------------|
| 0 | - | 200mm | Asph |
| 200 | - | 740 | Cr Gr |
| 740 | - | 2.0m | Br Si Sa Moist-Wet (Sat from 1.2m) |
| 2.0 | - | 2.1 | Gry Si Cl Wet |

21 + 850 5.0m Lt E/P

| | | | |
|-----|---|-------|-----------------------|
| 0 | - | 300mm | Tps |
| 300 | - | 900 | Br Si Sa Moist-Wet |
| 900 | - | 1.2m | Br Si Sa & Gr Wet-Sat |
| 1.2 | - | 1.6 | Br Si Sa Moist-Wet |

90-DM-122

21 + 950

| | | | |
|-----|---|-------|------------------|
| 0 | - | 250mm | Asph |
| 250 | - | 750 | Cr Gr |
| 750 | - | 1.6m | Br Si Sa Wet-Sat |

21 + 950 4.0m Lt E/P

| | | | |
|-----|---|-------|-----------------|
| 0 | - | 200mm | Tps |
| 200 | - | 1.4m | Br Si Sa Wet |
| 1.4 | - | 1.5 | Gry Si Cl Moist |

22 + 025 E/P

| | | | |
|-----|---|-------|------------------------------|
| 0 | - | 230mm | Asph |
| 230 | - | 630 | Cr Gr |
| 630 | - | 1.0m | Dk Gry Sa & Tps Mixed (Fill) |
| 1.0 | - | 1.3 | Dk Gry Si Cl (Fill) |
| 1.3 | - | 1.8 | Br Si Cl Moist |

22 + 125 E/P

| | | | |
|-----|---|-------|---------------------------------|
| 0 | - | 270mm | Asph |
| 270 | - | 700 | Cr Gr |
| 700 | - | 900 | Cl & Gr Mixed Wet (Seepage@700) |
| 900 | - | 1.3m | Br Si Cl Wet |

22 + 125 3.0m Lt E/P

| | | | |
|-----|---|-------|---------------------------------|
| 0 | - | 340mm | Tps |
| 340 | - | 370 | Gr Cl Mixed Sat (seepage@350mm) |
| 370 | - | 1.5m | Gry Si Cl Wet |

EASTBOUND COLLECTOR

22 + 225

E/P

| | | | |
|-----|---|-------|-------------------------------|
| 0 | - | 400mm | Asph |
| 400 | - | 500 | Cr Gr |
| 500 | - | 900 | Si Cl & Gr Mixed (Fill) |
| 900 | - | 1.2m | Dk Gry Cl & Tps Mix (Fill) |
| 1.2 | - | 1.5 | Gry Br Si Cl Moist |

22 + 225

3.0m Lt E/P

| | | | |
|-----|---|-------|------------------------------------|
| 0 | - | 200mm | Tps |
| 200 | - | 900 | Br Si Cl |
| 900 | - | 1.9m | Dk Gry Tps & Cl Mixed Moist-Wet |
| 1.9 | - | 2.0 | Gry Si Cl Moist-Wet Firm |

WESTBOUND COLLECTOR

21 + 500

E/P

| | | | |
|-----|---|-------|----------------|
| 0 | - | 260mm | Asph |
| 260 | - | 800 | Cr Gr |
| 800 | - | 1.5m | Br Si Cl Moist |

21 + 500

4.0m Lt

| | | | |
|-----|---|-------|------------------|
| 0 | - | 150mm | Tps |
| 150 | - | 900 | Br Si Cl Wet-Sat |
| 900 | - | 1.2m | Br Si Cl Wet |

21 + 400

E/P

| | | | |
|-----|---|-------|--|
| 0 | - | 250mm | Asph |
| 250 | - | 800 | Cr Gr |
| 800 | - | 1.2m | Br Si Cl Moist Stiff- Firm <u>90-DM-119</u> |

21 + 300

E/P

| | | | |
|--------|---|-------|---------|
| 0 | - | 260mm | Asph |
| 260 | - | 900 | Cr Gr |
| 900mm+ | | | NFP CSP |

WESTBOUND COLLECTOR

22 + 200 10.0m Lt (D + 1.2m)
 0 - 140mm Asph
 140 - 680 Cr Gr
 680 - 1.2m Br Si Cl & Gr Mixed
 1.2 - 3.3 Br Si Cl Moist Stiff Firm

22 + 125 8.0m Lt (D + 700mm)
 0 - 280mm Asph
 280 - 1.5m Br Si Cl Moist
 1.5 - 2.4 Gry Si Cl Wet Stiff
90-DM-117

22 + 125 7.6m Lt (D + 700mm)
 0 - 500mm Cr Gr
 500 - 1.5m Br Si Cl Moist
 1.5 - 2.4 Gry Si Cl Wet Stiff

22 + 050 4.0m Lt (D + 600mm)
 0 - 230mm Asph
 230 - 800 Cr Gr
 800 - 940 Sa Gr (Old Rd)
 940 - 1.5m Br Si Sa
 1.5 - 1.6 Br Si Cl Moist
 1.6 - 2.0 Br Si to Si Sa Moist

21 + 975 3.0m Lt (D + 300mm)
 0 - 250mm Asph
 250 - 1.0m Cr Gr (seepage@900mm)
 1.0 - 1.4 Br Si Cl Moist
 1.4 - 1.5 Br Si Sa Moist

21 + 975 CL
 0 - 150mm Tps
 150 - 800 Cr Gr
 800 - 1.7m Br Si Sa Wet
 1.7 - 1.8 Gry Br Si Cl Wet

21 + 900 E/P
 0 - 230mm Asph
 230 - 670 Cr Gr
 670 - 1.3m Br Si F Sa Moist
 1.3 - 1.5 Br Si-Si Sa

21 + 800 E/P
 0 - 180mm Asph
 180 - 750 Cr Gr Wet
 (seepage@750mm)
 750 - 900 Tps Cl Mix Moist
 900 - 1.2m Br Si Cl Moist
 1.2 - 1.5 Br Si Sa Moist

21 + 700 E/P
 0 - 350mm Asph
 350 - 1.0m Cr Gr 90-DM-118
 1.0 - 1.2 Br Si Sa Moist
 1.2 - 1.4 Br F Med Sa Sat
 1.4 - 1.5 Br Si Cl Moist-Wet Firm

21 + 600 E/P
 0 - 260mm Asph
 260 - 780 Cr Gr Wet
 780 - 1.5m Si Cl

STONE CREEKPAVEMENT CORESEASTBOUND LANES**21 + 270 1.5m Rt CL EBL**

| | | | |
|----|---|------|--------------|
| 0 | - | 90mm | Asph |
| 90 | - | 290 | Conc.(Reinf) |

21 + 550 1.5m Rt CL EBL

| | | | |
|----|---|------|--------------|
| 0 | - | 90mm | Asph |
| 90 | - | 285 | Conc.(Reinf) |

21 + 825 1.5m Rt CL EBL

| | | | |
|----|---|------|--------------|
| 0 | - | 80mm | Asph |
| 80 | - | 310 | Conc.(Reinf) |

22 + 225 1.5m Rt CL EBL

| | | | |
|------|---|-------|-------|
| 0 | - | 325mm | Asph |
| 325+ | | | Cr Gr |

22 + 081 1.5m Rt CL EBL

| | | | |
|-----|---|-------|-------|
| 0 | - | 210mm | Asph |
| 210 | - | 400 | Conc. |

22 + 390 1.5m Rt CL EBL

| | | | |
|------|---|-------|-------|
| 0 | - | 250mm | Asph |
| 250+ | | | Cr Gr |

22 + 575 1.5m Rt CL EBL

| | | | |
|-----|---|-------|-------|
| 0 | - | 212mm | Asph |
| 212 | - | 442 | Conc. |

22 + 750 1.5m Rt CL EBL

| | | | |
|-----|---|-------|-------|
| 0 | - | 195mm | Asph |
| 195 | - | 230 | Conc. |

22 + 942 0.5m Rt CL EBL

| | | | |
|------|---|-------|-------|
| 0 | - | 180mm | Asph |
| 180+ | | | Cr Gr |

23 + 025 1.5m Rt CL EBL

| | | | |
|-----|---|-------|-----------------|
| 0 | - | 200mm | Asph |
| 200 | - | 400 | Conc. (UnReinf) |

23 + 250 1.5m Rt CL EBL

| | | | |
|-----|---|-------|-----------------|
| 0 | - | 220mm | Asph |
| 220 | - | 440 | Conc. (UnReinf) |

STONE CREEK

PAVEMENT CORES

WESTBOUND LANES

| | | | |
|-----------------|-----------------------|-----------------|-----------------------|
| 23 + 200 | 1.5m Lt CL WBL | 21 + 750 | 1.5m Lt CL WBL |
| 0 - 230mm | Asph | 0 - 80mm | Asph |
| 230 - 470 | Conc. (UnReinf) | 80 - 285 | Conc. (Reinf) |
| 23 + 038 | 1.5m Lt CL WBL | 21 + 550 | 1.5m Lt CL WBL |
| 0 - 220mm | Asph | 0 - 110mm | Asph |
| 220 - 445 | Conc. (UnReinf) | 110 - 330 | Conc. (Reinf) |
| 22 + 752 | 1.5m Lt CL WBL | 21 + 250 | 1.5m Lt CL WBL |
| 0 - 230mm | Asph | 0 - 90mm | Asph |
| 230 - 460 | Conc. (UnReinf) | 90 - 310 | Conc. |
| 22 + 500 | 1.5m Lt CL WBL | 21 + 050 | 1.5m Lt CL WBL |
| 0 - 225mm | Asph | 0 - 100mm | Asph |
| 225 - 445 | Conc. (UnReinf) | 100 - 290 | Conc. (Reinf) |
| 22 + 275 | 1.5m Lt CL WBL | 20 + 875 | 1.5m Lt CL WBL |
| 0 - 230mm | Asph | 0 - 90mm | Asph |
| 230+ | Cr Gr | 90 - 295 | Conc. |
| 22 + 025 | 1.5m Lt CL WBL | | |
| 0 - 210mm | Asph | | |
| 210 - 225 | Conc. (UnReinf) | | |

STONEY CREEK

MEDIAN

23 + 150

3.0m Lt Median CL

| | | | |
|------------------|---|-------|--------------------|
| 0 | - | 120mm | Asph |
| 120 | - | 600 | Cr Gr |
| 600 | - | 3.6m | Br Si Cl Till Hard |
| <u>90-DM-112</u> | | | |

22 + 850

3.0m Lt Median CL

| | | | |
|-----|---|-------|--------------------------|
| 0 | - | 120mm | Asph |
| 120 | - | 700 | Cr Gr |
| 700 | - | 2.7m | Br Si Cl Till Moist-Wet |
| 2.7 | - | 3.5 | Gry Si Cl Till Moist-Wet |

22 + 550

3.0m Lt Median CL

| | | | |
|-----|---|-------|--------------------|
| 0 | - | 150mm | Asph |
| 150 | - | 550 | Cr Gr |
| 550 | - | 1.4m | Br Si Sa |
| 1.4 | - | 3.1 | Gry Si Cl Firm Wet |

22 + 250

3.0m Lt Median CL

| | | | |
|-----|---|-------|----------------------|
| 0 | - | 150mm | Asph |
| 150 | - | 550 | Cr Gr |
| 550 | - | 1.5m | Br Si Cl Till (Fill) |
| 1.5 | - | 2.4 | Dk Gry Sa Cl Tr Org |
| 2.4 | - | 2.7 | Gry Si Sa |
| 2.7 | - | 2.8 | Br Si Sa Wet |
| 2.8 | - | 3.0 | Gry Si Cl Moist |

RAMPS

| 10 + 050 | | | CL Ramps S-E | 10 + 400 | | | E/P Ramp S-E |
|-----------------|---|-------|----------------------------------|-----------------|---|-------|--|
| 0 | - | 200mm | Tps | 0 | - | 250mm | Asph |
| 200 | - | 1.2m | Si Cl Fill Dry-Moist | 250 | - | 380 | Cr Gr |
| 1.2 | - | 1.5 | Gry Si Cl Moist | 380 | - | 840 | Br Si Cl & Gr Mix (Wet-Sat@840) |
| 10 + 085 | | | CL Ramp S-E | 840 | - | 1.5m | Gry Br Si Cl |
| 0 | - | 300mm | Tps | 10 + 500 | | | E/P Ramp S-E |
| 300 | - | 1.5m | Br Si Cl (Fill) Moist | 0 | - | 230mm | Asph |
| 10 + 125 | | | 3.0m Rt CL Ramp S-E | 230 | - | 390 | Cr Gr |
| 0 | - | 340mm | Asph | 390 | - | 630 | Br Si Cl & Gr Mix |
| 340 | - | 750 | Cr Gr | 630 | - | 1.4m | Br Si - Cl Si Moist |
| 750 | - | 1.5m | Dk Gry Tps Cl & Gr Mix (Fill) | 1.4 | - | 1.5+ | <u>90-DM-123</u> Gry Br Si Cl Moist |
| 1.5 | - | 1.6 | Br Si Cl (Fill) Moist Firm | 10 + 600 | | | E/P Ramp S-E |
| 10 + 175 | | | 2.0m Rt Cl Ramp S-E | 0 | - | 220mm | Asph |
| 0 | - | 300mm | Asph | 220 | - | 520 | Cr Gr |
| 300 | - | 700 | Cr Gr | 520 | - | 915 | Si Cl & Gr Mix |
| 700 | - | 1.5m | Tps Cl & Gr Mixed (Fill) | 915 | - | 1.5m | Co Sa Si(y) Wet (Sat@1.5) |
| 1.5 | - | 1.6 | Br Si Cl & Gr Mixed (Fill) | 1.5+ | | | Br Si Cl Moist |
| 10 + 225 | | | CL Ramp S-E | 10 + 700 | | | E/P Ramp S-E |
| 0 | - | 100mm | Tps | 0 | - | 220mm | Asph |
| 100 | - | 350 | Cr Gr | 220 | - | 900 | Cr Gr |
| 350 | - | 1.2m | Br Si Cl (Fill) | 900 | - | 1.1m | Br Med Sa |
| 1.2 | - | 1.5 | Dk Gry Si Cl & Tps (Fill) | 1.1 | - | 1.2 | Br Sa Si Gr Mix |
| 1.5 | - | 1.7 | Br Si Cl Moist-Wet | 1.2 | - | 1.8 | Br F-Med Sa Wet |

RAMPS**10 + 500**

0 - 200mm
 200 - 1.8m
 1.8 - 2.4

CL Ramp E-NSR

Tps
 Br Si Sa (Fill) Moist
 Br Si Cl Moist
 (Fill)

10 + 475

0 - 200mm
 200 - 1.8m
 1.8 - 2.1
 2.1 - 2.5

CL Ramp E-NSR

Tps
 Br Si Sa Moist (Fill)
 Br Sa Cl Sat (Fill)
 Br Si Cl Sat (Fill)

10 + 390

0 - 150mm
 150 - 750
 750 - 2.1m

4.0m Lt E-NSR

Asph
 Cr Gr
 Br Si Cl Moist-Wet

10 + 350

0 - 150
 150 - 700
 700 - 1.3m
 1.3 - 1.5

5.0m Rt CL E-NSR

Asph
 Cr Gr
 Br Sa Cl Moist
 Gry Si Cl Moist-Wet

10 + 300

0 - 180mm
 180 - 600
 600 - 1.5m

4.0m Rt CL E-NSR

Asph
 Cr Gr
 Br Si Cl Moist-Wet

10 + 025

0 - 150mm
 150 - 2.4m

CL Ramp NSR-W

Tps
 Br Si Cl Moist 90-DM-116

10 + 082

0 - 800mm
 800 - 1.3m
 1.3 - 1.5

CL Ramp NSR-W

Tps With St
 Br Si Cl
 Gry Si Cl Moist-Wet

10 + 100

0 - 1.0m
 1.0 - 2.7m
 2.7 - 3.3

CL Ramp NSR-W

Tps & Cl Mix
 Blk Org Cl Wet
 Br Org Wd(y) Fib Moist-
 Wet

10 + 125

0 - 150mm
 1.0 - 1.8m
 1.8 - 2.3
 2.3 - 2.5

CL Ramp NSR-W

Tps
 Dk Gry Org Cl Wet
 Gry Si Cl Wet Soft-Firm
 Br Si Cl Wet 90-DM-119

10 + 132

0 - 300mm
 300 - 2.7m
 2.7 - 3.0
 3.0 - 3.7

CL Ramp NSR-W

Tps & Cl Mix
 Dk Gry Org Cl
 (Water@1.2m)
 Gry Si Cl Wet Stiff Firm
 Gry Br Si Cl Till Wet
 Firm

10 + 150

0 - 200mm
 200 - 1.5m

CL Ramp NSR-W

Tps
 Br Si Cl With St Moist

STONEY CREEKNORTH SERVICE ROAD

| | | | | |
|-----------------|--------------------------|---------------------------------|--------------------------|-----------|
| 14 + 850 | | 3.6m Rt CL (Exist. Road) | 15 + 050 | CL |
| 0 - 80mm | Asph | 0 - 200mm | Tps | |
| 80 - 600 | Cr Gr | 200 - 1.5m | Br Si Cl with Sa (Fill) | |
| 600 - 1.2m | Br Sa Gr & Cl Mix | | Moist <u>90-DM-113</u> | |
| | Moist Firm | 1.5 - 2.2 | Gry Br Si Cl Wet | |
| | | 2.2 - 3.0 | Tps & Sa Gr Mix (Fill) | |
| | | | Wet | |
| 14 + 900 | CL | 15 + 075 | CL | |
| 0 - 250mm | Tps | 0 - 150mm | Tps | |
| 250 - 700 | Br Sa Cl Moist-Wet | 150 - 1.0 | Br Si Cl with Sa | |
| 700 - 1.2m | Br Si Sa Wet-Sat Firm | 1.0 - 1.5m | Gry Si Cl Moist-Wet | |
| | | 1.5 - 2.2 | Br Si Cl with Sa Moist | |
| | | 2.2 - 3.0 | Br Si Sa Moist | |
| 14 + 950 | CL | 15 + 135 | CL | |
| 0 - 200mm | Tps | 0 - 900mm | Water | |
| 200 - 1.2m | Br Si Sa OCC Stones | 900 - 4.3m | Blk OOZE Soft | |
| | Moist (Wet-Sat 900-1.2m) | | (Stoney 4.0-4.3) | |
| | Firm | 4.3 - 4.5 | Gry Si Cl Wet Fairly | |
| | | | Firm | |
| 14 + 975 | CL | 15 + 150 | CL | |
| 0 - 200mm | Sa Cl Tps Wet | 0 - 200mm | Tps | |
| 200 - 500 | Br Si Sa Wet Sat | 200 - 1.3m | Br Sa Cl Wet-Sat | |
| | (Water@500mm) | 1.3 - 3.3 | Blk Org Cl Soft to 3.3m | |
| 500 - 1.2m | Br Si - Si Cl Moist-Wet | | Wet | |
| | Firm | 3.3 - 3.6 | Dk Br Org Cl Wd(y) Wet | |
| | | 3.6 - 3.8 | Gry Si Cl Wet Stiff Firm | |
| 15 + 025 | CL | | | |
| 0 - 150mm | Tps | | | |
| 150 - 1.2m | Sa Cl & Gr Mixed (Fill) | | | |
| | Moist | | | |
| 1.2m+ | NFP Conc. | | | |

STONE CREEKNORTH SERVICE ROAD**15 + 175**

0 - 325
 325 - 1.0m
 1.0 - 2.3

CL

Tps
 Br Si Sa (Fill) Moist
 Br Si Cl & Sa (Fill)
 Moist

15 + 200

0 - 150mm
 150 - 1.2m
 1.2 - 1.4
 1.4 - 2.4
 2.4 - 3.2

CL

Tps
 Gry Si Cl (Fill) Wet
 Br Sa Cl (Fill)
 Br Si Cl (Fill) Wet
90-DM-114
 Br Si Sa Wet Firm

15 + 225

0 - 150mm
 150 - 660
 660 - 2.7m
 2.7 - 3.3

CL

Tps
 Br Si Sa Moist
 Gry Br Si Cl (Fill)
 Moist-Wet
 Br Si Sa (Fill) Moist

15 + 250

0 - 160mm
 160 - 750
 750 - 2.3m
 2.3 - 3.3

CL

Tps
 Br Si Sa Moist
90-DM-115
 Gry Br Si Cl (Fill)
 Moist-Wet
 Br Si Sa Moist

15 + 275

0 - 150mm
 150 - 1.5m
 1.5 - 3.3

CL

Tps
 Gry Br Si Sa & Sa Cl Mix
 (Fill) Moist
 Br Sa Cl (Fill) Wet -
 Sat

15 + 295

0 - 150mm
 150 - 1.2m
 1.2 - 1.8

CL

Tps
 Sa Gr & Tps Mix Moist
 Br Sa Cl Moist - Wet

15 + 315

0 - 1.3m
 1.3 - 1.6

CL

Dk Gry Si Cl & Org Mix
 Wet (seepage@600mm)
 Gry Si Cl Wet Stiff Firm

15 + 335

0 - 250mm
 250 - 1.8m

CL

Tps
 Br Si Cl with Sa Wet

15 + 375

0 - 360mm
 360 - 1.5m
 1.5 - 2.0

CL

Tps
 Sa Cl Moist
 Br Si Sa Wet-Sat

STONE CREEKNORTH SERVICE ROAD

| | | | |
|-----------------|-----------------------------|-----------------|-------------------------|
| 15 + 400 | CL | 15 + 600 | 3.5m Lt CL |
| 0 - 150mm | Tps | 0 - 240mm | Tps |
| 150 - 1.6m | Br Si Sa Moist | 240mm+ | Br Si Cl with Sa Moist- |
| 1.6 - 1.8 | Gry Br Si Cl Moist | | Wet |
| 15 + 450 | 2m Rt CL | 15 + 650 | 1.5m Rt CL |
| 0 - 180mm | Tps | 0 - 120mm | Asph |
| 180 - 420 | Br Si Sa Moist-Wet | 120 - 670 | Cr Gr |
| 420 - 1.3m | Gry Br Si Cl Wet Stiff-Firm | 670 - 900 | Br Si Sa |
| | | 900 - 1.1m | Dk Gry Tps & Org Moist |
| | | 1.1 - 1.5 | Br Si Sa |
| 15 + 500 | CL | 15 + 700 | CL |
| 0 - 180mm | Tps | 0 - 100mm | Tps & Gr Mixed |
| 180 - 900 | Br Si Sa Wet-Sat | 100 - 700 | Cr Gr |
| 900 - 1.2m | Br Si Cl Moist | 700 - 900 | Br Sa Cl |
| | | 900 - 1.2m | Br Si Sa Moist |
| 15 + 550 | CL | 15 + 700 | 4.0m Lt CL |
| 0 - 200mm | Tps | 0 - 200 | Tps |
| 200 - 900 | Br Si Cl Till Moist | 200+ | Br Si Sa Moist |
| 900 - 1.2m | Br Sa Cl Till Moist-Wet | | |
| 15 + 600 | 2.0m Rt CL | 15 + 750 | CL |
| 0 - 120mm | Asph | 0 - 100 | Tps & Gr Mixed |
| 120 - 800 | Cr Gr | 100 - 700 | Cr Gr |
| 800 - 1.1m | Br Si Cl with Sa Moist-Wet | 700 - 1.2m | Br F Si Sa Moist |
| 1.1 - 1.2 | Br Si Sa Moist | | |

STONEY CREEK

NORTH SERVICE ROAD

15 + 800

CL

| | | | |
|-----|---|-------|---------------|
| 0 | - | 110mm | Asph |
| 110 | - | 800 | Cr Gr |
| 800 | - | 1.2m | F Si Sa Moist |

**W.P. 318-89-00 SAMPLE TEST RESULTS
EASTBOUND LANE**

90-DM-84 21+250

Water Content 18.0%
 L.L. 47.1%
 P.L. 22.0%
 P.I. 25.1%

90-DM-85 21+350

Water Content 3.6%
 % Passing 4.75mm 43.2%
 % Passing 75µm 1.7%

90-DM-86 21+350 3.0m Rt E/P

Water Content 5.2%
 % Passing 4.75mm 27.1%
 % Passing 75µm 0.9%

90-DM-87 21+450

Water Content 17.1%
 L.L. 21.2%
 P.L. 13.9%
 P.I. 7.3%

90-DM-88 21+575

Water Content 13.6%
 Non Plastic

90-DM-89 21+650 E/P

Water Content 4.0%
 % Passing 4.75mm 55.4%
 % Passing 75µm 1.9%

90-DM-90 21+650 3.0m Rt E/P

Water Content 20.8%
 L.L. 21.8%
 P.L. 12.0%
 P.I. 9.8%

90-DM-91 21+750 3.0m Rt E/P

Water Content 20.1%
 L.L. 31.1%
 P.L. 13.5%
 P.I. 17.6%

90-DM-92 21+850 E/P

Water Content 4.5%
 % Passing 4.75mm 53.3%
 % Passing 75µm 2.6%

90-DM-93 21+950 E/P

Water Content 17.2%
 % Passing 4.75mm 97.1%
 % Passing 75µm 27.4%

90-DM-94 22+175 5.0m Rt E/P

| | |
|---------------|-------|
| Water Content | 21.2% |
| L.L. | 27.0% |
| P.L. | 12.0% |

90-DM-95 22+550 E/P

| | |
|---------------|-------|
| Water Content | 12.1% |
| L.L. | 20.1% |
| P.L. | 11.5% |
| P.I | 8.6% |

90-DM-96 22+550 3.0m Rt E/P

| | |
|---------------|-------|
| Water Content | 17.0% |
| Non Plastic | |

90-DM-97 22+650 6.0m Rt E/P

| | |
|------------------|--------|
| Water Content | 19.9% |
| % Passing 4.75mm | 100.0% |
| % Passing 75µm | 9.1% |

90-DM-98 23+000 4.5m Rt E/P

| | |
|------------------|-------|
| Water Content | 5.5% |
| % Passing 4.75mm | 49.2% |
| % Passing 75µm | 3.8% |

**W.P. 318-89-00 SAMPLE TEST RESULTS
WESTBOUND LANE**

| | | | | | |
|----------------------|---------------|-----------------------------|----------------------|---------------|--------------|
| <u>90-DM-99</u> | <u>23+200</u> | 5.0m Lt E/P | <u>90-DM-103</u> | <u>22+825</u> | 3.3m Lt E/P |
| Water Content | 6.1% | | Water Content | 30.6% | |
| % Passing 4.75mm | 45.6% | | L.L. | 37.1% | |
| % Passing 75 μ m | 2.1% | | P.L. | 29.0% | |
| | | | P.I. | 8.1% | |
| <u>90-DM-100</u> | <u>23+200</u> | 8.0m Lt E/P (240-830mm) | <u>90-DM-104</u> | <u>22+725</u> | E/P |
| Water Content | 19.0% | | Water Content | 17.5% | |
| L.L. | 20.4% | | | | |
| P.L. | 13.0% | | | | |
| P.I. | 7.4% | | | | |
| <u>90-DM-101</u> | <u>32+200</u> | 8.0m Lt E/P (830mm-1.5m) | <u>90-DM-105</u> | <u>22+525</u> | 3.5m Lt E/P |
| Water Content | 19.3% | | Water Content | 23.5% | |
| L.L. | 31.1% | | L.L. | 31.9% | |
| P.L. | 17.0% | | P.L. | 15.3% | |
| P.I. | 14.1% | | P.I. | 16.6% | |
| <u>90-DM-102</u> | <u>23+100</u> | 7.0m Lt E/P | <u>90-DM-106</u> | <u>22+525</u> | 10.0m Lt E/P |
| Water Content | 14.9% | | Water Content | 19.7% | |
| L.L. | 32.9% | | % Passing 4.75mm | 0.0% | |
| P.L. | 14.0% | | % Passing 75 μ m | 22.3% | |
| P.I. | 18.9% | | | | |

| | | |
|------------------|---------------|-------------|
| <u>90-DM-107</u> | <u>22+300</u> | 8.0m Lt E/P |
| Water Content | 23.6% | |
| L.L. | 31.2% | |
| P.L. | 17.0% | |
| P.I. | 14.2% | |

| | | |
|----------------------|---------------|-----|
| <u>90-DM-111</u> | <u>21+700</u> | E/P |
| Water Content | 2.6% | |
| % Passing 4.75mm | 36.5% | |
| % Passing 75 μ m | 2.4% | |

| | | |
|------------------|---------------|-------------|
| <u>90-DM-108</u> | <u>22+200</u> | 3.0m Lt E/P |
| Water Content | 27.6% | |
| L.L. | 39.2% | |
| P.L. | 20.4% | |
| P.I. | 18.8% | |

| | | |
|------------------|---------------|-----|
| <u>90-DM-109</u> | <u>22+125</u> | E/P |
| Water Content | 19.5% | |
| L.L. | 21.5% | |
| P.L. | 16.3% | |
| P.I. | 5.2% | |

| | | |
|----------------------|---------------|-------------|
| <u>90-DM-110</u> | <u>21+900</u> | 9.0m Lt E/P |
| Water Content | 16.0% | |
| % Passing 4.75mm | 0.0% | |
| % Passing 75 μ m | 10.0% | |

**W.P. 318-89-00 SAMPLE TEST RESULTS
EASTBOUND COLLECTOR**

90-DM-120 21+450

Water Content 4.7%
% Passing 4.75mm 45.7%
% Passing 75µm 12.9%

90-DM-121 21+550

Water Content 20.7%
L.L. 40.6%
P.L. 19.5%
P.I. 21.1%

90-DM-122 21+850 5.0m Lt E/P

Water Content 17.1%
% Passing 4.75mm 99.9%
% Passing 75µm 34.9%

90-DM-117 22+125 8.0m Lt E/P

Water Content 28.7%
L.L. 32.2%
P.L. 18.0%
P.I. 14.2%

90-DM-118 21+700

Water Content 4.7%
% Passing 4.75mm 43.1%
% Passing 75µm 2.6%

90-DM-119 21+700

Water Content 24.5%
L.L. 37.1%
P.L. 19.0%
P.I. 18.1%

W.P. 318-89-00 SAMPLE TEST RESULTS
MEDIAN

| <u>90-DM-112</u> | <u>23+150</u> |
|------------------|---------------|
| Water Content | 18.5% |
| L.L. | 30.2% |
| P.L. | 14.0% |
| P.I. | 16.2% |

**W.P. 318-89-00 SAMPLE TEST RESULTS
RAMPS**

90-DM-116 10+025 CL NSR-W

| | |
|---------------|-------|
| Water Content | 18.1% |
| L.L. | 25.0% |
| P.L. | 13.0% |
| P.I. | 12.0% |

90-DM-119 10+125 CL NSR-W

| | |
|---------------|-------|
| Water Content | 24.5% |
| L.L. | 37.1% |
| P.L. | 19.0% |
| P.I. | 18.1% |

90-DM-123 10+500 S-E

| | |
|---------------|-------|
| Water Content | 15.2% |
| L.L. | 26.6% |
| P.L. | 15.3% |
| P.I. | 11.3% |

W.P. 318-89-00 SAMPLE TEST RESULTS
NORTH SERVICE ROAD

90-DM-113 15+050

| | |
|---------------|-------|
| Water Content | 17.7% |
| L.L. | 23.4% |
| P.L. | 12.5% |
| P.I. | 10.9% |

90-DM-114 15+200

| | |
|---------------|-------|
| Water Content | 18.2% |
| L.L. | 28.3% |
| P.L. | 13.0% |
| P.I. | 15.3% |

90-DM-115 15+250

| | |
|----------------------|-------|
| Water Content | 19.2% |
| % Passing 4.75mm | 99.6% |
| % Passing 75 μ m | 9.3% |

W.P. 318-89-00 SAMPLE TEST RESULTS
CULVERTS

| <u>90-DM-1</u> | <u>22+400</u> |
|----------------|---------------|
| Water Content | 20.0% |
| L.L. | 24.6% |
| P.L. | 14.0% |
| P.I. | 10.6% |

memorandum



To: V.F. Boehnke
Head, Structural Section
Central Region
4th Floor, Atrium Tower

Date: 1991 12 13

Attn: K. Wong


From: Foundation Design Office
Room 315, Central Bldg.

Re: Berm Length Revision
North Abutment Hwy. #20 Underpass
Q.E.W. Site No. 36-144
W.P. 318-89-00 (Former W.P. 10-57-02)
District #4, (Burlington)

The foundation investigation report (issued on May 12, 1972) recommended the construction of a 15 ft. (4.57 m) wide berm in the longitudinal direction (north abutment) which was carried out under Contract 74-110. Presently it is proposed to construct an additional lane in front of the north abutment which will reduce the berm width to 11.7 ft. (3.57 m). The results of the stability analyses for the revised geometry indicate that the factor of safety against failure is adequate. These analyses were based on the assumption that the undrained shear strength of the subsoil has increased since the original construction.

It is pointed out however any further encroachment may create unstable conditions.

Should additional information be required, please contact our office.


P. Payer, P. Eng.
Sr. Foundation Engineer

PP/mmj

c.c. - L. Politano

69 - F - 71

W.P. 10-57-02

Q.E.W. AND H.W.Y. #20

RECONSTRUCTION

STONEY CREEK

UNDERPASS STRUCTURE

MEMORANDUM

To: Mr. B. H. Davis,
Bridge Engineer,
Bridge Office,
Admin. Bldg.

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

ATTENTION: Mr. S. McCombie

DATE: November 10, 1969

OUR FILE REF.

IN REPLY TO

NOV 12 1969

SUBJECT:

FOUNDATION INVESTIGATION REPORT
For

Proposed Underpass Structure at
The Crossing of the Reconstructed
Q.E.W. & Hwy. #20, Stoney Creek
Traffic Circle, County of Wentworth
District No. 4 (Hamilton)
W.J. 69-P-71 -- W.P. 10-57-02

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

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

ACS/W3eF
Attach.

cc: Messrs. B. R. Davis (2)
H. A. Tregaskes
D. W. Farren
G. K. Hunter (2)
H. Greenland
W. S. Melinyshyn
T. J. Kovich
B. A. Singh

Foundations Files
Gen. Files

A. G. Stermac
-vr A. G. Stermac
PRINCIPAL FOUNDATION ENGINEER

TABLE OF CONTENTS

1. INTRODUCTION.
 2. DESCRIPTION OF THE SITE AND GEOLOGY.
 3. FIELD AND LABORATORY WORK.
 4. SUBSOIL AND BEDROCK CONDITIONS:
 - 4.1) General.
 - 4.2) Surficial Deposits:
 - 4.2.1) Fill Material.
 - 4.2.2) Silty Sand to Silt.
 - 4.3) Clayey Silt to Silty Clay.
 - 4.4) Clayey Silt with Sand and Gravel - (Glacial Till).
 - 4.5) Shale Bedrock.
 5. GROUNDWATER CONDITIONS.
 6. DISCUSSION AND RECOMMENDATIONS:
 - 6.1) General.
 - 6.2) Approach Embankments:
 - 6.2.1) Stability Considerations.
 - 6.2.2) Settlement Considerations.
 - 6.3) Structure Foundations:
 - 6.3.1) Pier Foundations.
 - 6.3.2) Abutment Foundations.
 - 6.3.3) Foundations in Close Proximity to Buried Utilities.
 7. MISCELLANEOUS.
-

FOUNDATION INVESTIGATION REPORT
For
Proposed Underpass Structure at
The Crossing of the Reconstructed
Q.E.W. & Hwy. #20, Stoney Creek
Traffic Circle, County of Wentworth
District No. 4 (Hamilton)
W.J. 69-F-71 -- W.P. 10-57-02

1. INTRODUCTION:

Major reconstruction is proposed for the Q.E.W., Hwy.#20 complex at a location about 2 miles north of Stoney Creek, Ontario. The main purpose of this reconstruction is to eliminate the existing Stoney Creek Traffic Circle. In conjunction with this project the Foundation Section was requested to carry out an investigation at the location of the aforementioned structure. The request for this foundation investigation was contained in a memo from Mr.W.S.Melinyshyn, Regional Bridge Location Engineer, Central Region, dated August 12, 1969. An investigation was subsequently carried out by this Section to determine the subsoil, bedrock and groundwater conditions at the structure site.

This report contains all the factual data obtained from this investigation, together with recommendations pertaining to the foundations for the structure, as well as the stability and settlement of the approach embankments.

The foundation investigation for the two proposed C.N.R. overhead structures, which will cross the Q.E.W. and Hwy.#20, respectively, will be discussed in a separate report (W.J.#69-F-70, W.P.'s. No.10-57-03 and -04).

2. DESCRIPTION OF THE SITE AND GEOLOGY:

The proposed structure sites are located in the immediate vicinity of the Q.E.W. - Hwy.#20, Stoney Creek Traffic Circle, which is east of Hamilton, Ontario. Q.E.W. and Hwy.#20 have two paved traffic lanes in both travelled directions; these lanes are separated by a median of variable width. The existing highways are in cuts which extend approximately 12 to 14 feet below the surrounding terrain; the existing side slopes are standing at approximately $2\frac{1}{2}$:1 to 3:1. The terrain, which supports light vegetation such as grass and brush cover, is gently undulating in relief between about elevations 264 and 267. The sites are located in a non-built-up area. Just west of the Traffic Circle, along Hwy.#20, however, some light industry exists.

The existing Canadian National Railway(C.N.R.) track traverses across the Traffic Circle in a north-south direction. It is carried on an embankment 6 to 7 feet high. Single span (51.5 feet long) rigid frame steel and concrete overhead structures carry the C.N.R. over the E.B. and W.B. legs of the Q.E.W. The heights of the associated approaches, in the foreward direction, are approximately 18 to 19 feet.

Physiographically the sites are situated in the "Iroquois Plain", specifically in the "Niagara Fruit Belt" sub-section. This area was inundated in the late Pleistocene times by a body of water known as Lake Iroquois. The overburden deposits were laid down in this lake. In the "Niagara Fruit Belt" sub-section the upper most stratum is composed of a silty clay of lacustrine origin; the thickness of this cohesive subsoil generally varies between 25 and 45 feet.

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

The silty clay is underlain by glacial till which, in turn, is followed by red shale bedrock of the Queenston formation, Ordovician Period.

3. FIELD AND LABORATORY WORK:

A total of 13 boreholes, all of which were accompanied by a dynamic cone penetration test, was put down during the period of the investigation. The borings were advanced by either a conventional diamond drill rig or a pendrill (power auger machine), both of which were adapted for soil sampling purposes.

Samples of the fill and overburden were recovered, at required depths, in a 2" O.D. split-spoon sampler, which was hammered into the soil in accordance with the specifications for carrying out the Standard Penetration Test. The same method was used to advance the dynamic cone penetration tests. Wherever possible, these samples were supplemented by obtaining 2" I.D. Shelby tube samples, which were manually pushed into the silty clay stratum. In addition, in situ vane tests were carried out within the softer, more compressible portions of this stratum. Bedrock was proven in 3 of the borings, by obtaining BXL size rock core samples.

The groundwater level conditions across the site, at the time of the investigation, were determined by recording the water levels in all the open boreholes.

The location and elevation of all borings were surveyed by personnel from the Central Region Engineering Surveys Section. The borings are shown in plan on Drawing No. 69-P-71A, together with an estimated stratigraphical profile along the proposed centre line of Hwy. #20.

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

Additional strategic stratigraphic sections are shown on Drawing No.69-F-71B. All elevations in this report are referenced to a Geodetic datum.

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

Bulk Densities

Natural Moisture Contents

Grain-size Distributions

Atterberg Limit Tests

Undrained Shear Strengths

Consolidation Characteristics

The results of the testing are plotted on the Record of Borelog sheets and summarized on Figures 2 to 6 , inclusive , all contained in Appendix I of this report.

4. SUBSOIL AND BEDROCK CONDITIONS:

4.1) General:

The predominant stratum across the site is composed of a clayey silt to silty clay with a trace of sand and gravel, the overall thickness of which varies from 14.5 to 44 feet. At some of the boring locations the upper 3.5 to 10 feet of this stratum had been desiccated forming a hard crust. The cohesive deposit is underlain by a hard cohesive glacial till which is between 24 and 44 feet thick. The glacial till is followed, in turn, by shale bedrock, at a depth of between 74 and 86 feet below the original ground surface.

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

4.1) General: (cont'd.)

At a few random locations, in the vicinity of the existing Traffic Circle, up to 5.5 feet of fill of variable composition, was encountered. At other locations the clayey silt stratum was overlain by as much as 10.5 feet of silty sand to silt.

The boundaries of the various deposits, as determined in the boreholes, are shown on the accompanying borelog sheets. The stratigraphical sections, plotted on Drawings No.69-F-71A and B have been inferred from this data.

From ground surface downwards, the various subsoil types encountered are as follows:

4.2) Surficial Deposits:

4.2.1) Fill Material:

Some fill was placed, at random locations, in conjunction with the original construction of the Stoney Creek Traffic Circle. The depth of this material, where encountered varies from 4.5 to 5.5 feet. The composition of the fill is variable. At some locations it is composed of a stiff to very stiff ('N' values 8 to 24 blows/ft.) clayey silt to silty clay with some sand and gravel, and a trace of organic matter. Elsewhere, however, it is granular in nature being composed of a dense silty sand with a trace of clay and gravel.

4.2.2) Silty Sand to Silt:

At some isolated locations the surficial deposit is composed of a compact to dense ('N' values 14 to 78 blows/ft.) silty sand to silt with a trace of gravel and organic matter.

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

4.2.2) Silty Sand to Silt: (cont'd.)

The thickness of this deposit varies between 3 and 6 feet. Occasional seams and partings of clayey silt, up to 1/4 inch thick were encountered randomly throughout the granular subsoil. Grain-size distribution curves for samples from this deposit, as well as the cohesive fill discussed in sub-section 4.2.1), are plotted on Figure #2.

4.3) Clayey Silt to Silty Clay:

Directly underlying the surficial cover is the predominant overburden stratum across the site, composed of a grey silty clay to clayey silt with a trace of sand and gravel. The overall thickness of the stratum varies from 14.5 at B.H.#12A to 44 feet at B.H.#3, being typically in the 30 to 40 foot range. At some locations the upper 3.5 to 10 feet of the stratum has been desiccated; this crust zone can easily be differentiated from the underlying subsoil by its characteristic brown colour. Numerous random seams and layers of sandy silt, varying anywhere from a fraction of an inch up to 2 inches, are present throughout the deposit. These granular layers were not found to be continuous across the area, it is inferred, therefore, that they are localized pockets. Grain-size distribution curves for samples of the clayey silt to silty clay, are plotted on Figure #3.

The engineering properties of the stratum, as determined by field and laboratory testing, are presented in tabular form;

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

4.3) Clayey Silt to Silty Clay: (cont'd.) ...

| <u>Identity Tests</u> | | <u>Overall Stratum (Excluding More Compressible Zone)</u> | Relatively More Compressible Zone Encountered North of Sta. 103 + 50 (Between Elev's. 255 and 240) |
|--|--------------|---|---|
| | | | <u>Range(Average)</u> |
| Bulk Density (p.c.f.) | (γ) | 130 - 132 | 121 - 129 (124) |
| Liquid Limit % | (W_L) | 23 - 37 (32) | 25 - 47 (34) |
| Plastic Limit % | (W_p) | 15 - 20 (17) | 13 - 22 (18) |
| Natural Moisture Content | (W) | 14 - 23 (18) | 17 - 42 (26) |
| Liquidity Index | (I_L) | -0.2 -0.5 (0.1) | 0.3 - 1.0 (0.8) |
| <u>Consolidation Characteristics</u> | | | |
| Initial Void Ratio (e_o) | | (1 Test) 0.67 | (1 Test) 0.96 |
| Compression Index (C_c) | | 0.20 | 0.23 |
| Degree of Preconsolidation (p.s.f.) ($P_c - P'_o$) | | 6,000 | 1,600 |
| <u>Undrained Shear Strength (C_u)</u> (p.s.f.) | | | |
| 1) Field Vanes | | - > 2,000 | 550 - 1,500 |
| 2) Lab. Tests | | 1,200 - > 2,000 | 450 - 1,000 |
| <u>Standard Penetration Tests 'N'</u> | | | |
| (Blows / ft.) | | 14 - 64 (35) | up to 6 |

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

4.3) Clayey Silt to Silty Clay: (cont'd.) ...

The resumé of engineering properties, presented in the table, conclusively indicates the presence of a relatively soft compressible zone within the cohesive deposit, north of Station 103+50 (Hwy. #20 chainage). The significance of this compressible zone, with regard to foundation design, will be discussed throughout this report.

The Atterberg Limit tests, summarized above, are also plotted on the Plasticity Chart, Figure #5. These results indicate that the cohesive stratum is inorganic with a plasticity in the low to intermediate range. In the overall deposit the natural moisture content ranges from a few percent below to a few percent above the plastic limit. In the compressible zone, however, the natural moisture content exceeds the plastic limit by a considerable degree, as represented by liquidity indices between 0.3 and 1.0.

The undrained shear strength testing carried out gave values which vary from 1,200 p.s.f. to greater than 2,000 p.s.f., throughout the overall deposit. In the more compressible zone, encountered north of Station 103+50, however, the values range from 450 p.s.f., increasing with depth, to 1,500 p.s.f. Based on these results, it is estimated that the consistency of the majority of the stratum varies from stiff to hard, being typically in the very stiff range. The consistency of the compressible zone, however, varies from soft to stiff. The aforementioned patterns were corroborated by the standard penetration testing carried out within the cohesive deposit.

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

4.3) Clayey Silt to Silty Clay: (cont'd.) ...

The sensitivity of the stratum, as determined by the field and laboratory testing, was found to vary between 2 and 10, being, on the average, about 4.

The consolidation characteristics of the stratum were determined by carrying out two laboratory consolidation tests, the results of which are shown as Void Ratio vs. Pressure plots on Figure #6. The results of these tests indicate that the clayey silt to silty clay subsoil, located within the relatively compressible zone, is preconsolidated by about 1,600 p.s.f. in excess of the existing overburden pressure (result of 1 test). The remainder of the stratum, however, is preconsolidated by approximately 6,000 p.s.f. The values for the initial void ratio (e_0) and the Compression Index (C_c) are within the normal range for cohesive deposits encountered in this area.

4.4) Clayey Silt with Sand and Gravel - (Glacial Till):

Underlying the cohesive stratum is a reddish-brown glacial till, composed primarily of clayey silt with sand and gravel. The total thickness of the deposit, where penetrated, was found to vary from 24 feet (B.H. #3) to 44 feet (B.H. #11). Occasional random granular zones are present throughout the glacial till; in these areas the subsoil is composed of silt and sand binding gravel. Grain-size distribution curves, for samples of the glacial till, obtained with 2" O.D. sampling equipment, are shown on Figure #4.

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

4.4) Clayey Silt with Sand and Gravel - (Glacial Till:) (cont'd.)

Atterberg Limit tests were carried out on samples from the deposit, the results are plotted on the Plasticity Chart, Figure # 5 . This testing gave values for the liquid and plastic limits which range from 23 to 31 and 11 to 17, respectively. The corresponding natural moisture content varies from 2 percent above to 5 percent below the plastic limit.

The Standard Penetration Tests, carried out in this deposit, gave 'N' values which range from 29 blows/ft. to 100 blows/3 inches, being typically greater than 100 blows/ft. Based on these results, it is estimated that the consistency of the basically cohesive glacial till is hard.

4.5) Shale Bedrock

The glacial till is directly underlain by bedrock which was proven in three of the borings, by obtaining from 5 to 10 feet of BXL size rock core samples. Over the area under investigation the surface of the bedrock was found to vary between elevations 180 and 192.

The bedrock is composed of a reddish brown horizontally bedded shale. In general, bedrock is sound throughout; however, some signs of fracturing and weathering were observed in the upper 2 to 5 feet, at some of the boring locations.

5. GROUNDWATER CONDITIONS:

Groundwater level observations have been carried out, during the period of the investigation, in the open holes. The observations are recorded on the borelog sheets and summarized on Drawings No. 69-F-71A, and 69-F-71B.

5. GROUNDWATER CONDITIONS: (cont'd.) ...

The recorded observations indicate that the groundwater level in the overburden deposits generally varies between elevations 225 and 249. The lower elevations were encountered in some of the borings put down with the Pendrill(power auger) i.e. the borings were carried out in a dry state. The subsoil is relatively impervious. This being the case it is inferred that the water levels, recorded in these open holes, did not have sufficient time, during the period of the investigation, to reach their true piezometric equilibrium level. It is believed, therefore, that the piezometric groundwater level across the site probably varies between elevations 238 and 249.

Recent observations, carried out on November 5, 1969, indicate that the water levels in the borings advanced by the Pendrill, have risen. These observations confirm the aforementioned elevation range.

At B.H.'s #3,4, and 11, the groundwater level was encountered at elevations between 258 and 263. These levels are indicative of a 'perched condition' existing in the surficial deposits underlain by the relatively impervious clayey silt stratum.

6. DISCUSSION AND RECOMMENDATIONS:

6.1) General:

It is proposed to construct an underpass structure at the crossing of the Q.E.W. and Hwy.#20; this site will be in an area presently occupied by the western leg of the Stoney Creek Traffic Circle.

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

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

The proposed scheme for this particular structure is given on Drawing No. 6465-01-R2, dated, August, 1969; this drawing was prepared by M.M.Dillon Limited, Consulting Engineers.

In the vicinity of the structure, the Q.E.W. will have four 12 foot wide paved lanes in both the E.B. and W.B. directions; there will also be associated ramps. In addition there will be North and South Collector Roads in this complex. The profile grade of the Q.E.W. complex will vary from elevation 254 at the North Collector Road increasing to elevation 263 at the South Collector Road, i.e. ranges from 12 feet to 3 feet respectively, below the original ground surface in the area. Hwy.#20, however, will have two 12 foot wide paved lanes in either direction with a variable median. The profile grade of Hwy.#20 varies from elevation 277 to elevation 286 at the north and south ends of the structure, respectively - i.e. ranges from 11 to 18 feet, respectively, above the original ground level.

The structure scheme proposed, calls for four spans (115' - 115' - 125' - 120' approx.), incorporating three piers and abutments. It is understood that the abutments will be 'perched' within the approach fills. The bridge deck will be about 108 feet wide.

An existing east-west trending, 78" diameter sanitary sewer, as well as a 33" diameter sanitary sewer, are located within 25 to 30 feet of the proposed location of the south abutment.

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

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

The predominant deposit across the site is a 14.5 to 44 foot thick clayey silt to silty clay stratum, which is underlain by a hard glacial till deposit, followed by shale bedrock. The major portion of the clayey silt stratum is competent. North of Station 103+50, between elevations 255 and 240, however, a relatively compressible zone was encountered within this subsoil. The presence of this zone is of primary importance as far as foundation design is concerned, since it will be necessary to ensure that it is not 'overstressed' by either the structure element or approach fill surcharge loadings. This being the case, the structure elements must be supported on piled foundations. Further, it is imperative that the stability of the approaches be ensured. These will be discussed in the sub-sections to follow.

6.2) Approach Embankments:

6.2.1) Stability Considerations:

The critical condition for stability of an embankment on slightly overconsolidated cohesive subsoils, as in the case at this site, generally occurs during or immediately after construction. This being the case, a total stress analysis ($\phi = 0$) 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, therefore, in terms of total stresses, both manually and by the use of the electronic computer, to determine the stability of the approaches.

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

6.2) Approach Embankments:(cont'd.) ...

6.2.1) Stability Considerations:(cont'd.) ...

The geometric sections at the approaches, and the soil properties for the fill and subsoil, assumed for computation purposes, are presented on Figure 1, in Appendix I of this report. The results of the analyses, presented on the aforementioned figure, are summarized in the following paragraphs.

The critical spill-through type approach, as far as stability is concerned, is the north. Here the height of the embankment will be 21 and 11 feet in the longitudinal and transverse directions, respectively. The compressible zone, underlying this approach at a shallow depth, has an average undrained shear strength of 750 p.s.f. The computations carried out indicate that this approach will be stable with standard 2:1 slopes. The minimum factor of safety will be of the order of 1.7 (in the longitudinal direction).

The south approach is inherently more stable since

i) the relatively compressible zone is thinner and has a slightly higher average undrained shear strength

($c_u = 800$ p.s.f.), and

ii) the height of the approach in the longitudinal direction is comparable to that along the north approach.

At approximately Station 104 + 25 (200 feet south of the south abutment), in the vicinity of the existing Q.E.W - Hwy.#20 cut, the maximum height of fill will be in the order of 30 feet.

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

6.2) Approach Embankments:(cont'd.) ...

6.2.1) Stability Considerations: (cont'd.) ...

This will not create a stability problem, however, since it is believed that the existing cut will be backfilled to the surrounding natural ground surface, prior to the construction of the approach fills.

6.2.2) Settlement Considerations:

The underlying more compressible zone within the clayey silt stratum will undergo settlement due to consolidation, over a period of time, under the weight of the approach embankments. In addition recompression settlement will occur within the remaining highly overconsolidated portion of the stratum for similar reasons. Settlement computations were, therefore, carried out, the results of which are summarized on Figure #1. The maximum consolidation settlement will occur under the centre line of the south approach, where the height of fill will be of the order of 18 feet above ground surface. The computations indicate that the settlement at this location could be of the order of 3 to 5 inches. Beneath the north approach, where the height of fill is approximately 11 feet, the consolidation settlement should be within 2 inches.

The total amount of the consolidation settlements predicted will take place over a period of from 2½ to 3 years. However, about 50% of the consolidation settlement should occur within 6 months (refer to graph on Figure #1).

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

6.3) Structure Foundations:

As discussed previously the existence of a relatively compressible zone, at a shallow depth below original ground precludes the economic use of spread footings for the support of structure elements. Pile foundations should, therefore, be employed.

6.3.1) Pier Foundations:

The piers can be supported on end-bearing piles driven to practical refusal into the competent glacial till deposit. For estimating purposes, it can be assumed that the pile tips will be at about elevation 205. The piles can be designed for the maximum allowable load for the respective pile section selected (e.g. 12 BP 74 steel H. piles may be designed for 90 tons/pile).

No major dewatering problems are anticipated for the construction of the pile caps, in view of the relatively impermeable nature of the cohesive subsoil. Any minor seepage or surface run-off occurring in the excavations could be handled by employing conventional techniques, such as pumping from sumps.

6.3.2) Abutment Foundations:

The abutments may be 'perched' within the approach fills; they can be supported on end-bearing piles driven to practical refusal within the glacial till deposit, as discussed in sub-section 6.3.1).

No bouldery or rock fill should be used in areas in which piles are to be driven.

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

6.3.3) Foundations in Close Proximity to Buried Utilities:

As discussed previously, the proposed south 'perched' abutment will likely be within close proximity of two existing sanitary sewers. Further, it is understood that there is a possibility that additional utilities may be placed within the area prior to construction of this complex.

Where piles are to be driven adjacent to existing utilities, special precautions must be taken to ensure that no damage results. We suggest that the following procedure be adopted:

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

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

The above procedure was followed in Contracts 63 - 182 and 68 - 24 with satisfactory results.

7. MISCELLANEOUS:

The field work was carried out during the period September 24 to October, 21, 1969, under the supervision of Mr.V.Korlu, Project Foundation Engineer.

The equipment was owned by Dominion Soil Investigation Ltd., Toronto, Ontario.

7. MISCELLANEOUS: (cont'd.) ...

This report was prepared by Mr. B.T. Darch, Senior Foundation Engineer, assisted by Mr. V. Korlu. This project was carried out under the general supervision of Mr. M. Devata, Supervising Foundation Engineer, who also reviewed this report.

November 1969.

APPENDIX 1

FOUNDATION SECTION

ORIGINATED BY VK

COMPILED BY VK

CHECKED BY

[illegible]

FOUNDATION SECTION

ORIGINATED BY VK

COMPILED BY **VR**

CHECKED BY

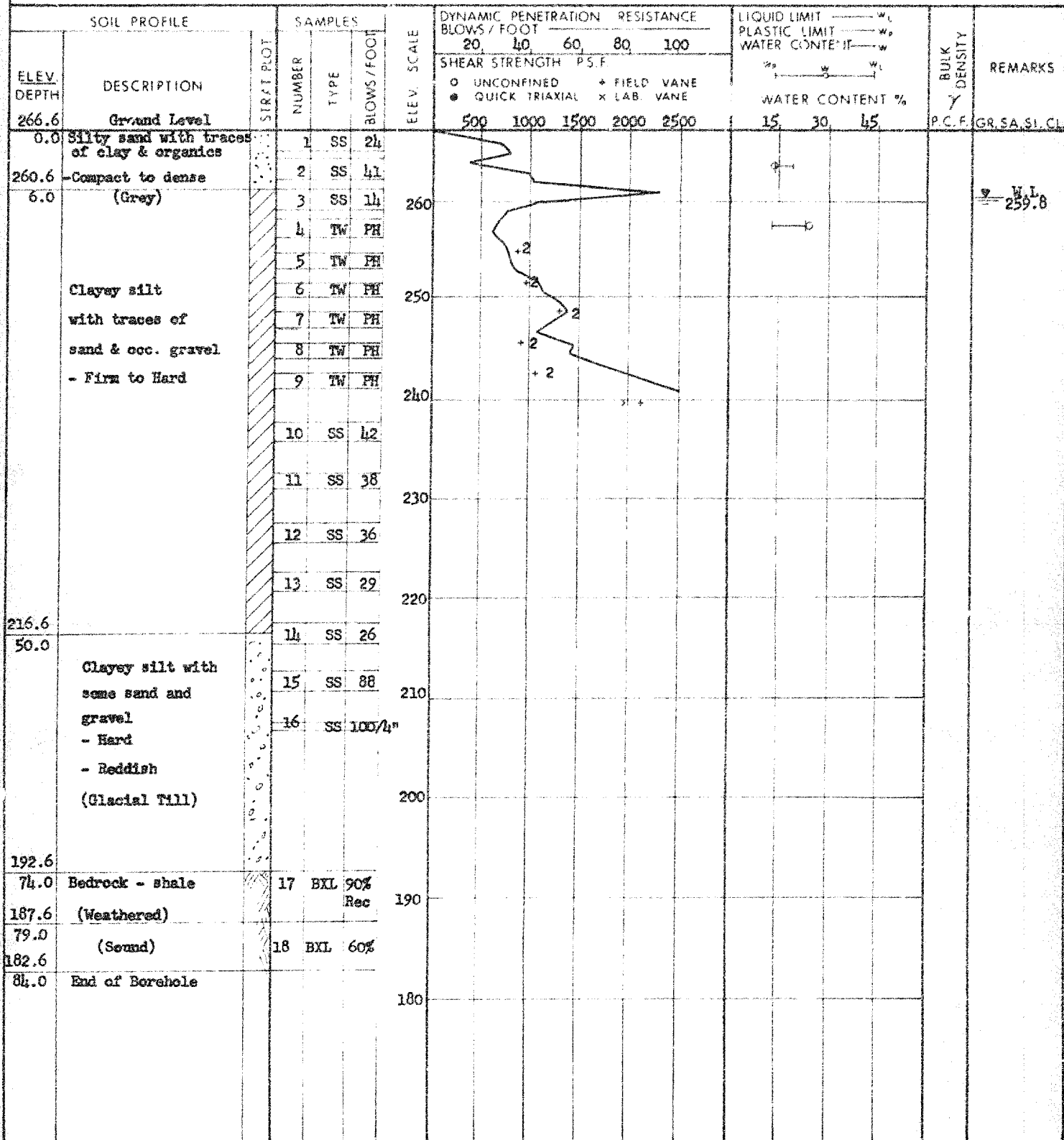
[illegible]

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 3

FOUNDATION SECTION

JOB 69-F-71 LOCATION O.B.W. & Hwy. 20, N15, 713, 585 8931, 257 ORIGINATED BY VK
 W.P. 10-57-02 BORING DATE September 25, 1969 COMPILED BY VK
 DATUM Geodetic BOREHOLE TYPE Pen-drill, Washboring, BX Casing, BXL Rock Core CHECKED BY




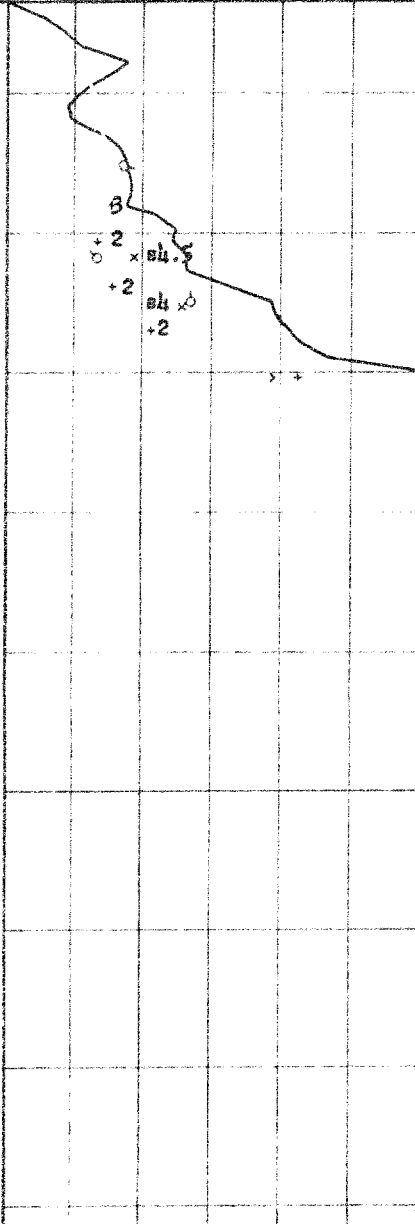

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 4 &

FOUNDATION SECTION

JOB 69-P-71 LOCATION Q.E.W. & Hwy. 20, N15, 713, 507 E931, 108 ORIGINATED BY VK
 W.P. 10-57-02 BORING DATE October 3, 1969 COMPILED BY VK
 DATUM Geodetic BOREHOLE TYPE Pen-drill, Wash boring, BX Casing, BXL Rock CHECKED BY *h*

Core

| SOIL PROFILE | | | SAMPLES | | | ELEV. SCALE | DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT | | | | | LIQUID LIMIT — w_L PLASTIC LIMIT — w_p WATER CONTENT — w | | | BULK DENSITY γ P.C.F. | REMARKS | | | |
|--------------|---|---|---------|--------|--------------|---|---|----|----|-----|----------|--|--|--|---|---------|-----|-----|--|
| ELEV. DEPTH | DESCRIPTION | STRAT. PLOT | NUMBER | TYPE | BLOWS / FOOT | | SHEAR STRENGTH P.S.F. | | | | | WATER CONTENT % | | | | | | | |
| | | | | | | | ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB. VANE | | | | | w_p — w — w_L | | | | | | | |
| | | | | | | 20 | 40 | 60 | 80 | 100 | 15 30 45 | | | | | | | | |
| 266.4 | Ground Level | | | | | | | | | | | | | | | | | | |
| 0.0 | Silty sand to silt with traces of clay |  | 1 | SS | 21 |  | | | | | | | | | 0-61-32-7 0-29-59-12 257.8' 0-23-69-8 0-23-70-7 0-20-60-20 0-23-65-12 | | | | |
| | - Compact to V. Dense - Brown | | 2 | SS | 25 | | | | | | | | | | | | | | |
| | | | 3 | SS | 78 | | 260 | | | | | | | | | | | | |
| 255.9 | | | 4 | SS | 60 | | | | | | | | | | | | | | |
| 10.5 | Clayey silt with traces of sand and occ. gravel - Firm to Hard (Grey) | | 5 | TW | PH | | | | | | | | | | | | 120 | | |
| | | | 6 | TW | PH | | | | | | | | | | | | | | |
| | | | 7 | TW | PH | | 250 | | | | | | | | | | | 119 | |
| | | | 8 | TW | PH | | | | | | | | | | | | | 129 | |
| | | | 9 | TW | PH | | 240 | | | | | | | | | | | | |
| | | | 10 | SS | 42 | | | | | | | | | | | | | | |
| | | | 11 | SS | - | | | | | | | | | | | | | | |
| | | | 12 | SS | 27 | | 230 | | | | | | | | | | | | |
| | | | 13 | SS | 22 | | | | | | | | | | | | | | |
| | | | 14 | SS | 18 | | 220 | | | | | | | | | | | | |
| 217.4 | Clayey silt with some sand and gravel - Hard - Reddish (Glacial Till) | 15 | SS | 44 | | | | | | | | | | | | | | | |
| 149.0 | | 16 | SS | 90 | 210 | | | | | | | | | | | | | | |
| | | 17 | SS | 100/5" | | | | | | | | | | | | | | | |
| | | 18 | SS | 126 | 200 | | | | | | | | | | | | | | |
| 188.4 | | | | | 190 | | | | | | | | | | | | | | |
| 78.0 | Bedrock - Shale |  | 19 | BXL | 100% Rec | | | | | | | | | | | | | | |
| 183.4 | Sound | | | | | | | | | | | | | | | | | | |
| 83.0 | End of Borehole | | | | | 180 | | | | | | | | | | | | | |

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 5

FOUNDATION SECTION

JOB 69-F-71 LOCATION Q.E.W. & Hwy. 20, N15, 713, 462, E931, 198
 W.P. 10-57-02 BORING DATE October 3, 1969
 DATUM Geodetic BOREHOLE TYPE Pen-drill (Power Auger)

ORIGINATED BY VK

COMPILED BY VK

CHECKED BY

| SOIL PROFILE | | SAMPLES | | | ELEV SCALE | DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT | | | | | LIQUID LIMIT ——— w_L PLASTIC LIMIT ——— w_p WATER CONTENT ——— w | | | BULK DENSITY γ P.C.F. | REMARKS |
|--------------|----------------------|---------|------|--------------|------------|--|------|------|------|------|--|-----|-------|------------------------------------|-------------|
| ELEV DEPTH | DESCRIPTION | NUMBER | TYPE | BLOWS / FOOT | | 20 | 40 | 60 | 80 | 100 | w_p | w | w_L | | |
| 254.1 | Ground Level | | | | | 500 | 1000 | 1500 | 2000 | 2500 | 15 | 30 | 45 | | GR SA SI CL |
| 0.0 | | 1 | SS | 20 | | | | | | | | | | | |
| 249.6 | (Brown) | 2 | SS | 5 | 250 | | | | | | | | | | |
| 4.5 | (Grey) | 3 | TW | PH | | | | | | | | | | | |
| | Clayey silt | 4 | TW | PH | | | | | | | | | | | |
| | with traces of | 5 | SS | 26 | 240 | | | | | | | | | | |
| | sand and occ. gravel | 6 | SS | 37 | | | | | | | | | | | |
| | - Soft to Hard | 7 | SS | 41 | 230 | | | | | | | | | | |
| 223.1 | | 8 | SS | 40 | | | | | | | | | | | |
| 31.0 | End of Borehole | | | | 220 | | | | | | | | | | |

123

W.L.
230.8

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 6

FOUNDATION SECTION

JOB 69-F-71

LOCATION Q.E.W & Hwy. 20, N15, 713, 400 E931, 102

ORIGINATED BY VK

W.P. 10-57-02

BORING DATE October 6, 1969

COMPILED BY VK

DATUM Geodetic

BOREHOLE TYPE Pen-drill (Power Auger)

CHECKED BY

| SOIL PROFILE | | | SAMPLES | | | ELEV SCALE | DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT | | | | | LIQUID LIMIT — W _L PLASTIC LIMIT — W _P WATER CONTENT — W | | | BULK DENSITY Y | REMARKS |
|---------------|---|------------|---------|------|--------------|---------------|--|------|------|------|------|--|----------------|----|----------------------|-----------------|
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | BLOWS / FOOT | | 20 | 40 | 60 | 80 | 100 | W _p | W _L | W | | |
| 254.2 | Ground Level | | | | | | 500 | 1000 | 1500 | 2000 | 2500 | 15 | 30 | 45 | P.C.F. | GR. SA. SI. CL. |
| 249.7 | Clayey silt to silty clay with trace of org. Prob fill mtl. (Brown) | | 1 | SS | 24 | 250 | | | | | | | | | | |
| 4.5 | (Grey) | | 2 | SS | 8 | | | | | | | | | | | |
| | | | 3 | TW | PH | | | | | | | | | | | |
| | Clayey silt to | | 4 | TW | PH | | | | | | | | | | | |
| | to silty clay | | 5 | SS | 27 | 240 | | | | | | | | | | |
| | with traces of | | 6 | SS | 34 | | | | | | | | | | | |
| | sand and | | | | | | | | | | | | | | | |
| | occ. gravel | | 7 | SS | 47 | 230 | | | | | | | | | | |
| | - Firm to Hard | | | | | | | | | | | | | | | |
| 223.2 | | | 8 | SS | 32 | | | | | | | | | | | |
| 31.0 | End of Borehole | | | | | 220 | | | | | | | | | | |

W.L.
227.2'

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 7

FOUNDATION SECTION

JOB 69-F-71

LOCATION Q.E.W. & HWY 20, N15, 713, 361, E931, 183

ORIGINATED BY VK

W.P. 10-57-02

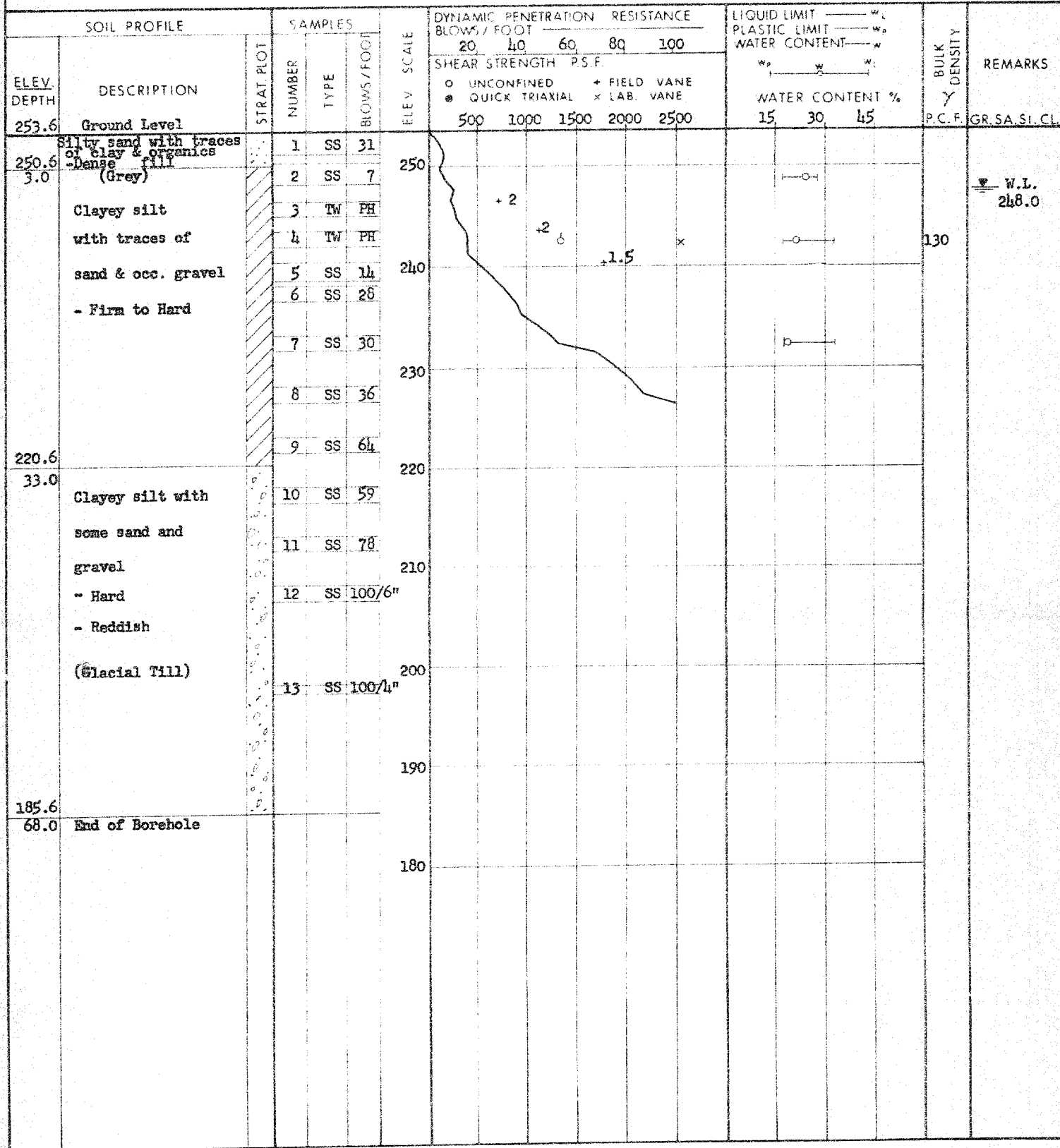
BORING DATE October 6, 1969

COMPILED BY VK

DATUM Geodetic

BOREHOLE TYPE Washboring - BX casing

CHECKED BY



| DEPARTMENT OF HIGHWAYS - ONTARIO MATERIALS & TESTING OFFICE | | | RECORD OF BOREHOLE No. 8 | | | | | FOUNDATION SECTION | | | | | | | | |
|--|---|---|--------------------------|------|------------------|--|----|--------------------|----|-----|--|----|----|------------------------------------|---------|--|
| JOB 69-F-71 | | LOCATION Q.E.W. & HWY. 20, N15, 713, 282, E931, 065 | | | ORIGINATED BY VK | | | | | | | | | | | |
| W.P. 10-57-02 | | BORING DATE October 17, 1969 | | | COMPILED BY VK | | | | | | | | | | | |
| DATUM Geodetic | | BOREHOLE TYPE Wash boring - BX casing - BXL Rock Core | | | CHECKED BY | | | | | | | | | | | |
| ELEV. DEPTH | SOIL PROFILE DESCRIPTION | STRAT. PLOT | SAMPLES | | ELEV. SCALE | DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT | | | | | LIQUID LIMIT — w_L PLASTIC LIMIT — w_p WATER CONTENT — w | | | BULK DENSITY γ P.C.F. | REMARKS | |
| | | | NUMBER | TYPE | | 20 | 40 | 60 | 80 | 100 | 15 | 30 | 45 | | | |
| 255.1 | Ground Level | | 1 | SS | 24 | | | | | | | | | | | |
| 249.6 | (Brown) | | 2 | SS | 25 | | | | | | | | | | | |
| 5.5 | (Grey) | | 3 | SS | 7 | | | | | | | | | | | |
| | Clayey Silt with traces of sand and occ. gravel - Firm to Hard | | 4 | TW | PH | | | | | | | | | | | |
| | | | 5 | SS | 18 | | | | | | | | | | | |
| | | | 6 | SS | 22 | | | | | | | | | | | |
| | | | 7 | SS | 20 | | | | | | | | | | | |
| | | | 8 | SS | 26 | | | | | | | | | | | |
| | | | 9 | SS | 31 | | | | | | | | | | | |
| 220.1 | | | 10 | SS | 48 | | | | | | | | | | | |
| 35.0 | Clayey silt with some sand and gravel - Hard - Reddish (Glacial Till) | | 11 | SS | 59 | | | | | | | | | | | |
| | | | 12 | SS | 100/6" | | | | | | | | | | | |
| | | | 13 | SS | 100/3" | | | | | | | | | | | |
| 180.1 | | | | | | | | | | | | | | | | |
| 75.0 | Bedrock (shale weathered) | | | | | | | | | | | | | | | |
| 77.0 | (sound) | | | | | | | | | | | | | | | |
| 175.1 | | | | | | | | | | | | | | | | |
| 80.0 | End of Borehole | | | | | | | | | | | | | | | |

DEPARTMENT OF HIGHWAYS- ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 9

FOUNDATION SECTION

JOB 69-F-71

LOCATION Q.E.W. & HWY 20, N15, 713, 222 E931, 185

ORIGINATED BY VK

W.P. 10-57-02

BORING DATE October 6, 1969

COMPILED BY VK

DATUM Geodetic

BOREHOLE TYPE Pen-Drill (Power Auger)

CHECKED BY

| SOIL PROFILE | | | SAMPLES | | | ELEV. SCALE | DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT | | | | | LIQUID LIMIT ——— w_L PLASTIC LIMIT ——— w_p WATER CONTENT ——— w | | | BULK DENSITY γ P.C.F. | REMARKS |
|---------------------|---|-------------|---------|------|--------------|-------------|---|------|------|------|-----|--|-----|-------|------------------------------------|---------|
| ELEV. DEPTH | DESCRIPTION | STRAT. PLOT | NUMBER | TYPE | BLOWS / FOOT | | 20 | 40 | 60 | 80 | 100 | w_p | w | w_L | | |
| | | | | | | | SHEAR STRENGTH P.S.F. | | | | | | | | | |
| | | | | | | | ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB. VANE | | | | | | | | | |
| 268.2 | Ground Level | | | | | 500 | 1000 | 1500 | 2000 | 2500 | 15 | 30 | 45 | | | |
| 0.0 265.2 3.0 | Silty sand, trace of clay - compact - | | 1 | SS | 14 | | | | | | | | | | | |
| | | | 2 | SS | 44 | | | | | | | | | | | |
| | | | 3 | SS | 45 | | | | | | | | | | | |
| 256.7 11.5 | (Brown) (Grey) Clayey Silt to Silty clay with traces of sand & occ. gravel - Firm to Hard | | 4 | SS | 15 | | | | | | | | | | | |
| | | | 5 | TW | PH | | | | | | | | | | | |
| | | | 6 | TW | PH | | | | | | | | | | | |
| | | | 7 | TW | PH | | | | | | | | | | | |
| | | | 8 | TW | PH | | | | | | | | | | | |
| | | | 9 | SS | 41 | | | | | | | | | | | |
| | | | 10 | SS | 48 | | | | | | | | | | | |
| | | | 11 | SS | 53 | | | | | | | | | | | |
| 227.2 41.0 | End of Borehole | | 12 | SS | 50 | | | | | | | | | | | |

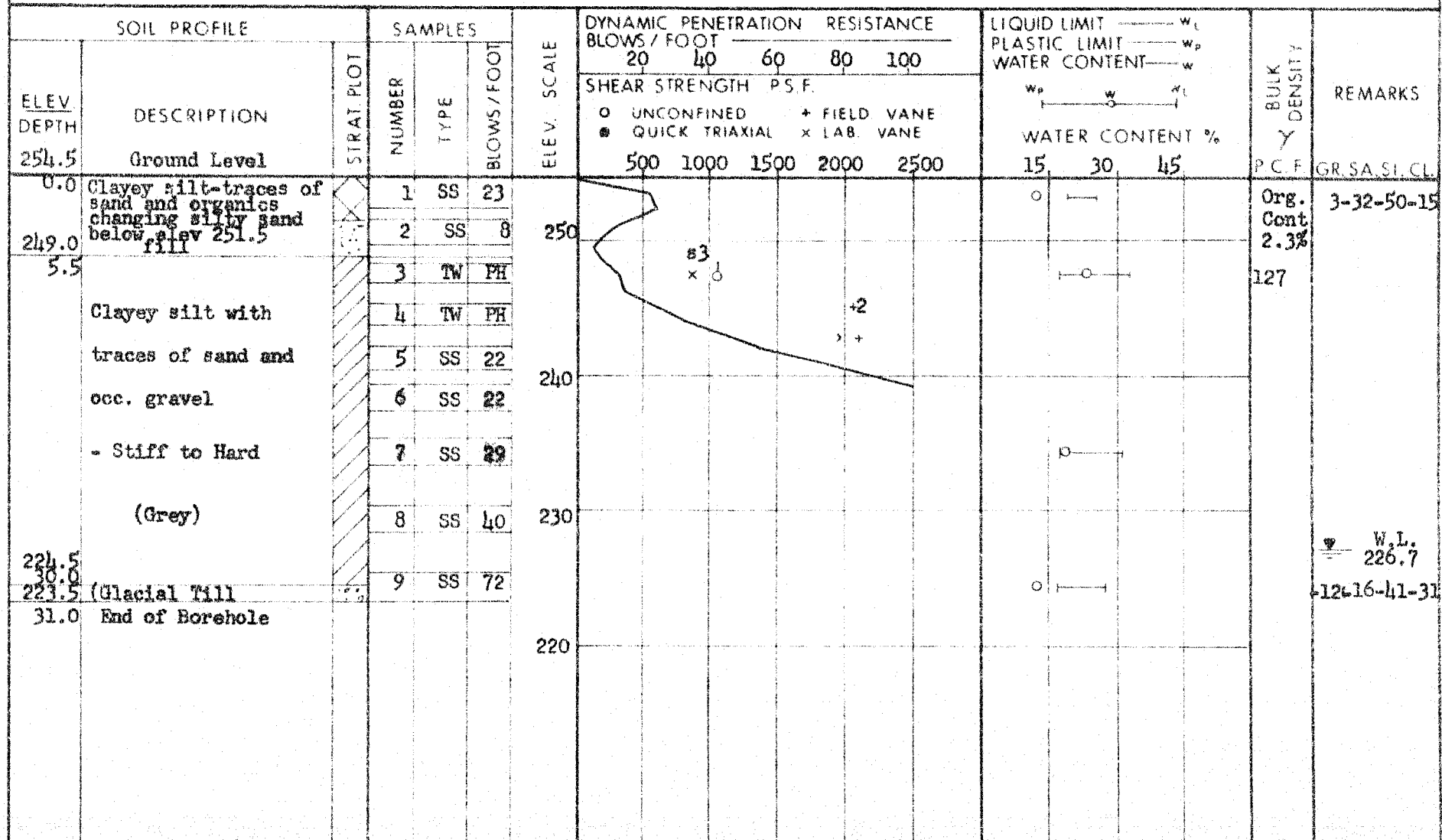
W.L.
240.2
2-16-44-38

DEPARTMENT OF HIGHWAYS- ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 10

FOUNDATION SECTION

JOB 69-F-71 LOCATION Q.E.W. & Hwy. 20 N15, 713, 135 E931, 082 ORIGINATED BY VK
 W.P. 10-57-02 BORING DATE October 7, 1969 COMPILED BY VK
 DATUM Geodetic BOREHOLE TYPE Pen-drill (Power Auger) CHECKED BY



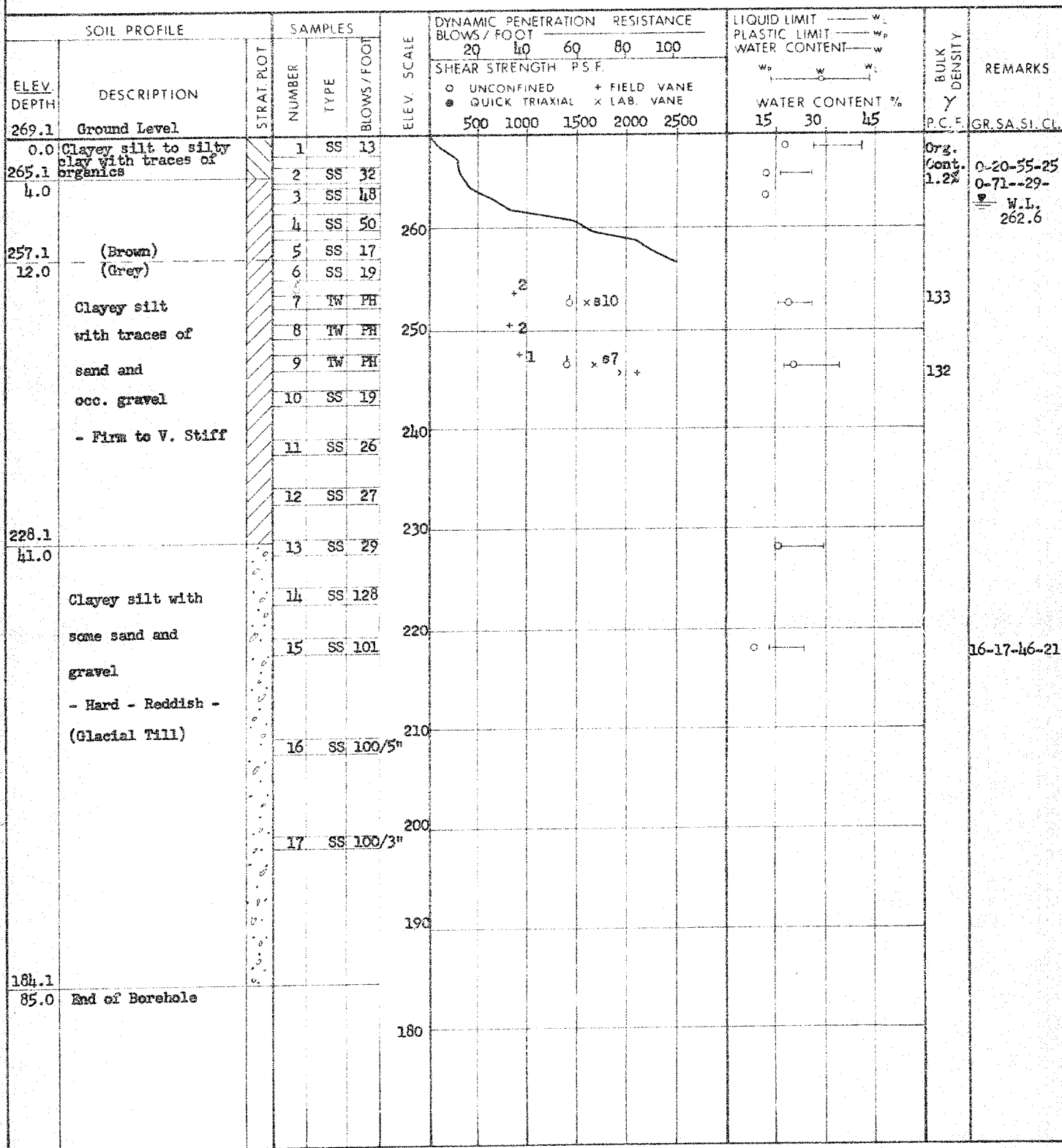
DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 11

FOUNDATION SECTION

JOB 69-F-71 LOCATION Q.E.W. & Hwy. 20, N15, 713, 113 E931, 166
 W.P. 10-57-02 BORING DATE October 9, 1969
 DATUM Geodetic BOREHOLE TYPE Washboring - BX Casing

ORIGINATED BY VK
 COMPILED BY VK
 CHECKED BY



16-17-46-21

DEPARTMENT OF HIGHWAYS- ONTARIO

MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 12

FOUNDATION SECTION

JOB 69-F-71

LOCATION Q. & Hwy. 20, N15, 712, 956 E931, 123

ORIGINATED BY VK

W.P. 10-57-02

BORING DATE October 7, 1969

COMPILED BY VK

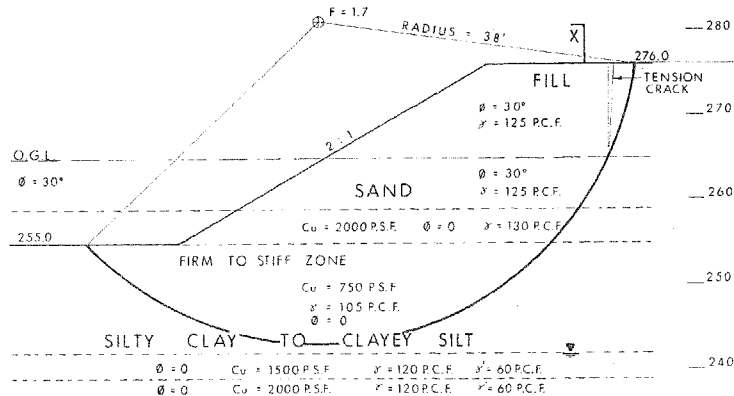
DATUM Geodetic

BOREHOLE TYPE Pen-drill (Power Auger)

CHECKED BY

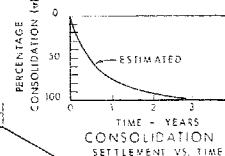
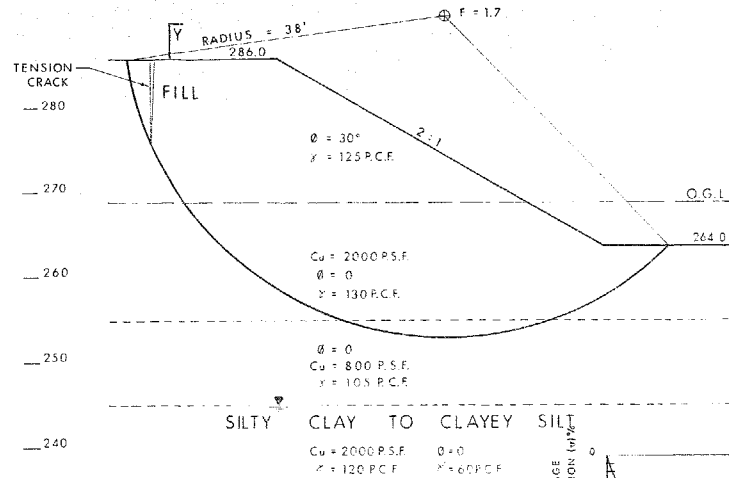
| SOIL PROFILE | | | SAMPLES | | | ELEV SCALE | DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT | | | | | LIQUID LIMIT ——— w_L PLASTIC LIMIT ——— w_P WATER CONTENT ——— w w_p ——— w ——— w_L WATER CONTENT % | BULK DENSITY γ P.C.F. | REMARKS |
|--------------|---|------------|---------|------|--------------|------------|--|------|------|------|------|--|------------------------------------|---------|
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | BLOWS / FOOT | | 20 | 40 | 60 | 80 | 100 | | | |
| 255.1 | Ground Level | | | | | | 500 | 1000 | 1500 | 2000 | 2500 | 15 | 30 | 45 |
| 0.0 | Clayey silt with trace organic occ layers of sand | | 1 | SS | 47 | | | | | | | | | |
| 249.6 | (Probable Fill) | | 2 | SS | 12 | 250 | | | | | | | | |
| 5.5 | (Grey) | | 3 | TW | PH | | | | | | | | | |
| | Clayey silt | | 4 | TW | PH | | | | | | | | | |
| | with traces of sand & occ. gravel | | 5 | SS | 27 | | | | | | | | | |
| | - Stiff to Hard | | 6 | SS | 24 | | | | | | | | | |
| | | | 7 | SS | 42 | | | | | | | | | |
| | | | 8 | SS | 22 | | | | | | | | | |
| 225.1 | | | 9 | SS | 60 | | | | | | | | | |
| 30.0 | Clayey silt with some sand & gravel | | 10 | SS | 104 | | | | | | | | | |
| 219.6 | -Hard (Glacial Till) | | | | | | | | | | | | | |
| 35.5 | End of Borehole | | | | | | | | | | | | | |

W.L.
225.1



LEGEND

- H - HEIGHT OF FILL (FT.)
- F - FACTOR OF SAFETY
- \oplus - CENTRE OF CRITICAL CIRCLE
- R - RADIUS OF CIRCLE (FT.)
- ∇ - ASSUMED WATER ELEV.



DEPARTMENT OF HIGHWAYS
MATERIALS and
TESTING
DIVISION

SUMMARIZED RESULTS OF
STABILITY & SETTLEMENT ANALYSES
(APPROACH EMBANKMENTS)

W.P. 10-57-02 DIST. 4 JOB 69-F-71

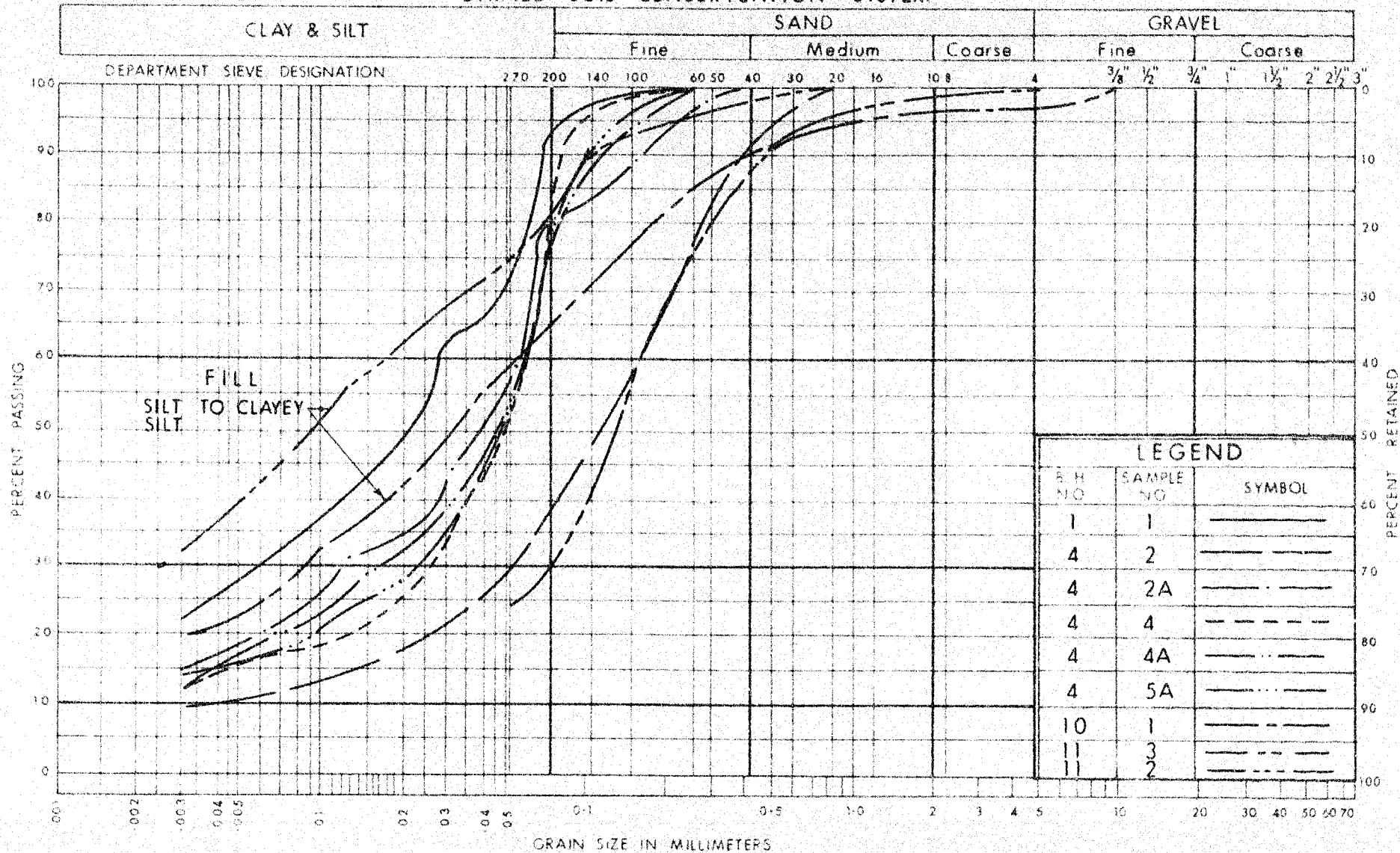
DATE NOV. 7, 1969

APPROVED

FIGURE NO.

1

UNIFIED SOIL CLASSIFICATION SYSTEM



DEPARTMENT OF HIGHWAYS
MATERIALS and
TESTING
DIVISION

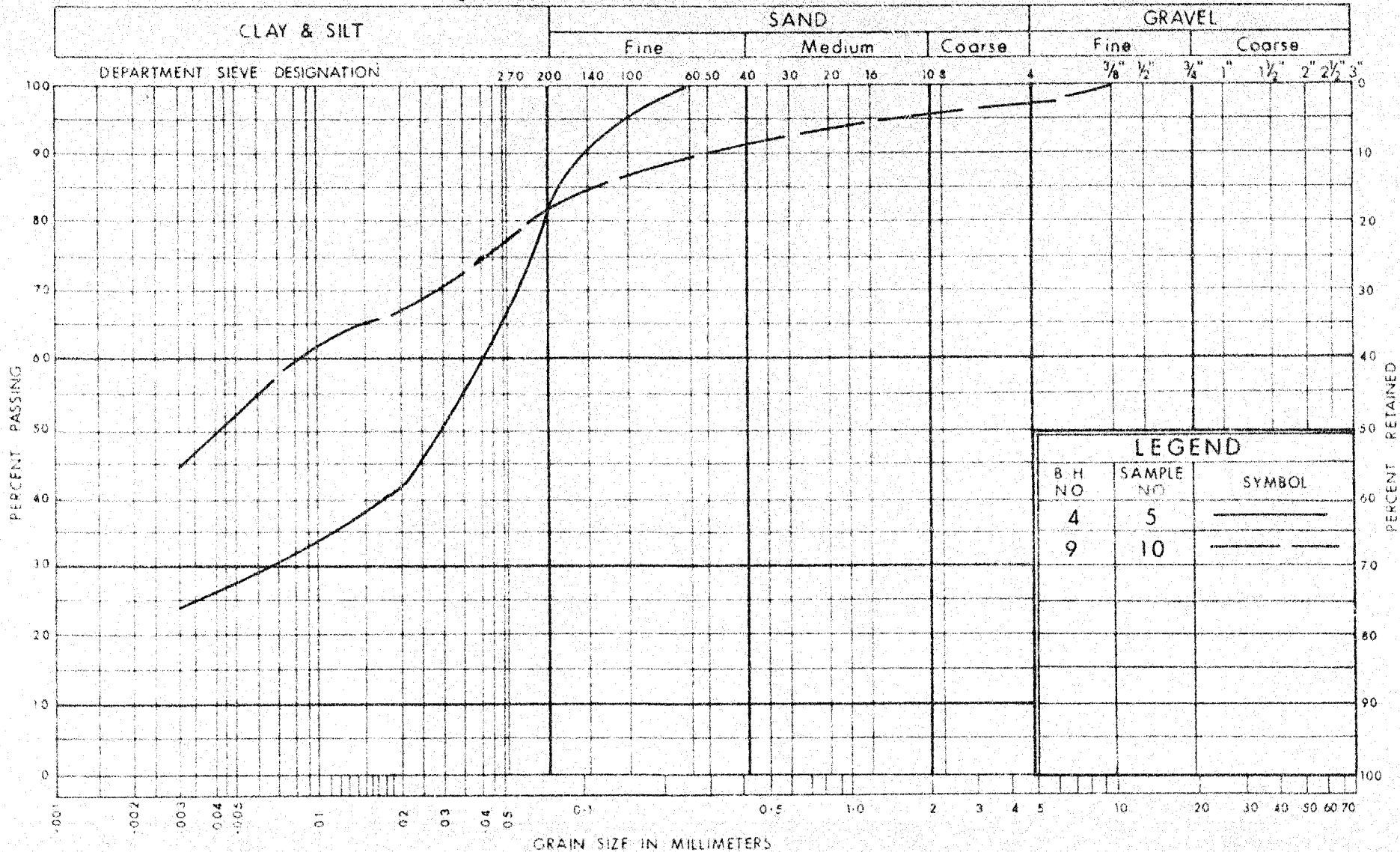
GRAIN SIZE DISTRIBUTION
SILTY SAND TO SILT
(SURFICIAL DEPOSIT)

WP No. 10 - 57 - 2

JOB No. 69 - F - 71

FIG. 2

UNIFIED SOIL CLASSIFICATION SYSTEM



DEPARTMENT OF HIGHWAYS
MATERIALS and
TESTING
DIVISION

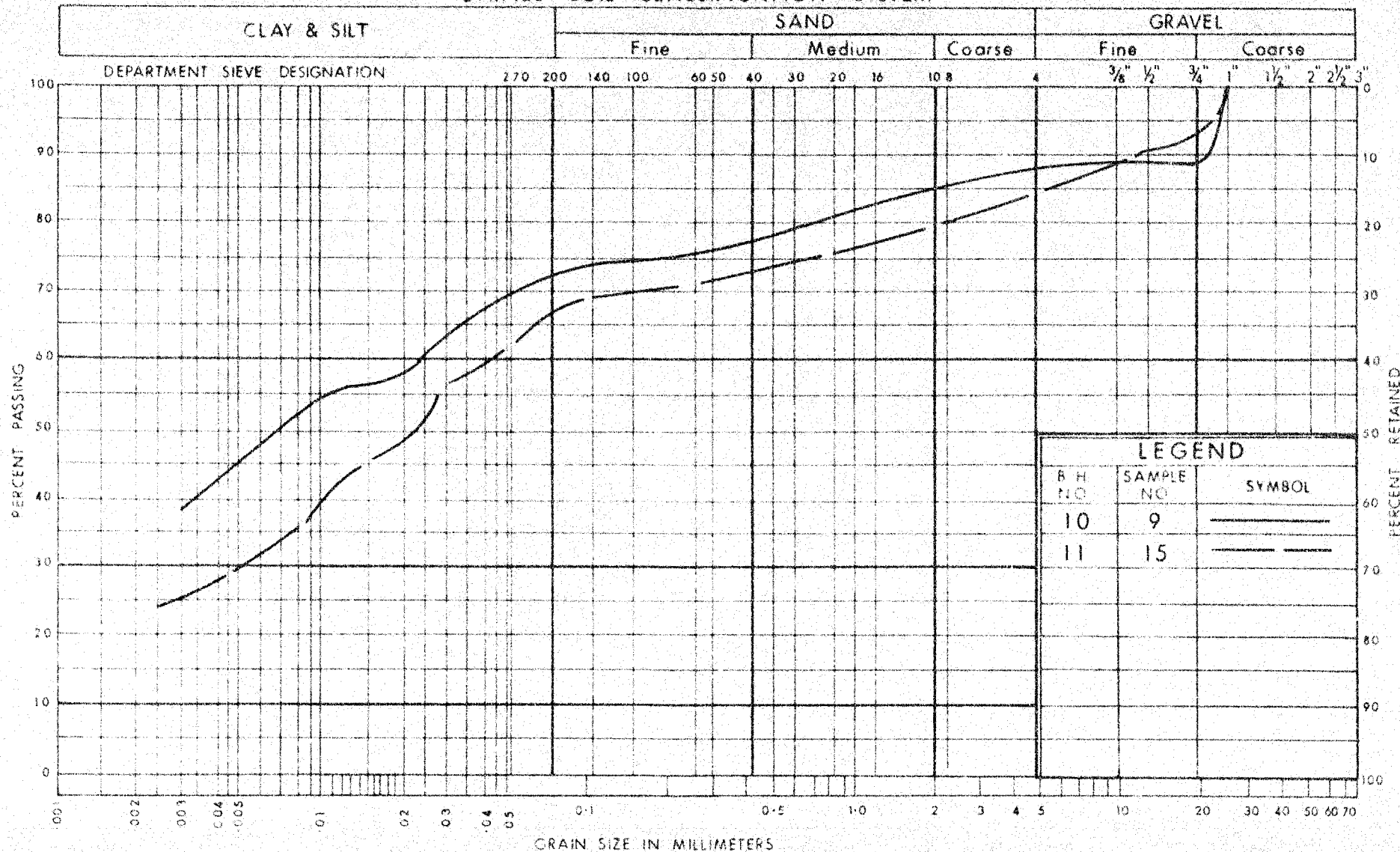
GRAIN SIZE DISTRIBUTION
CLAYEY SILT TO SILTY CLAY

W.P. No. 10 - 57 - 2

JOB No. 69 - F - 71

FIG. 3

UNIFIED SOIL CLASSIFICATION SYSTEM



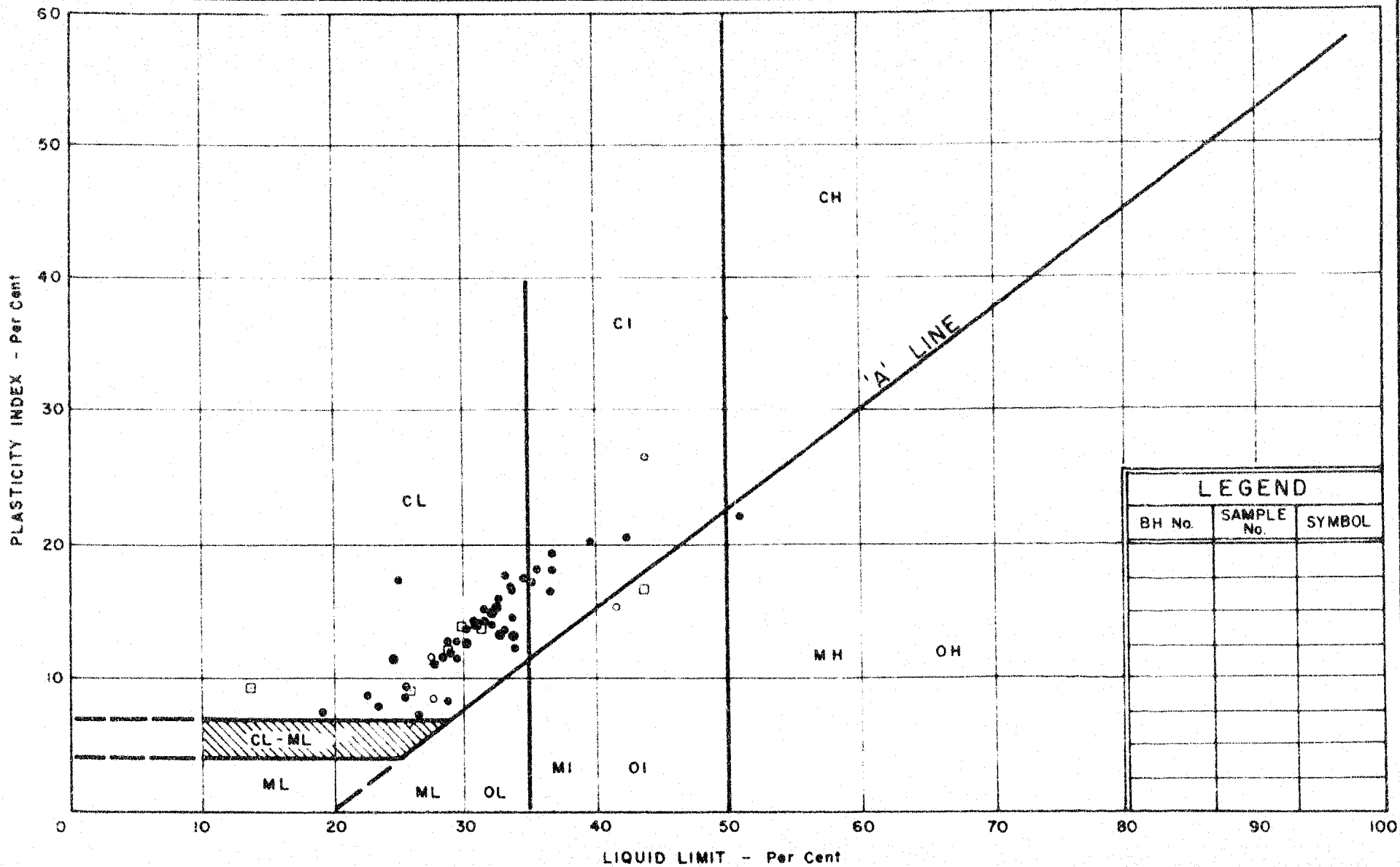
| LEGEND | | |
|----------|------------|-----------|
| B.H. NO. | SAMPLE NO. | SYMBOL |
| 10 | 9 | ————— |
| 11 | 15 | - - - - - |



DEPARTMENT OF HIGHWAYS
MATERIALS and
TESTING
DIVISION

GRAIN SIZE DISTRIBUTION
CLAYEY SILT
WITH SOME SAND & GRAVEL
(GLACIAL TILL)

W.P. No. 10 - 57 - 2
JOB No. 69 - F - 71
FIG. 4



PLASTICITY CHART

CLAY • FILL ○ GLACIAL TILL □

W.P. No. 10 - 57 - 2

JOB No. 69 - F - 71

FIG. 5

VOID RATIO - PRESSURE CURVES

JOB NO. 69 - F - 71

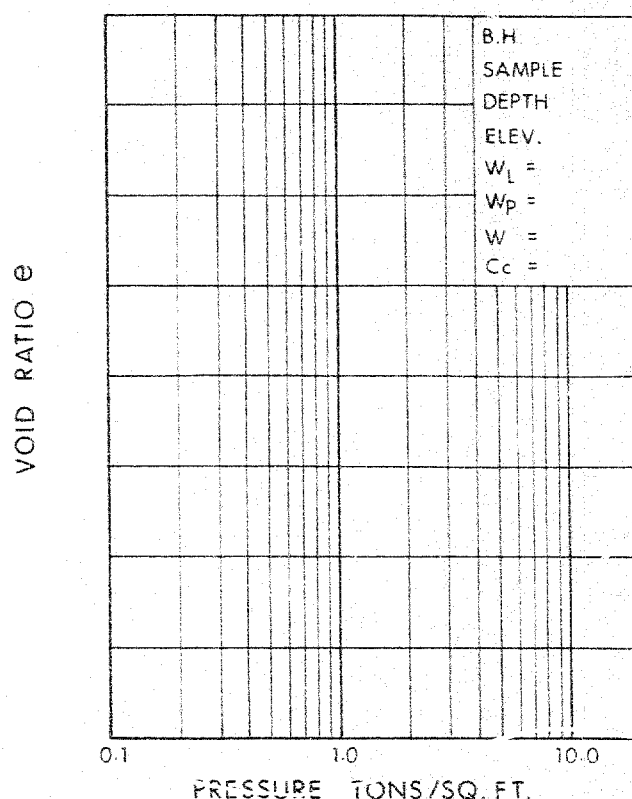
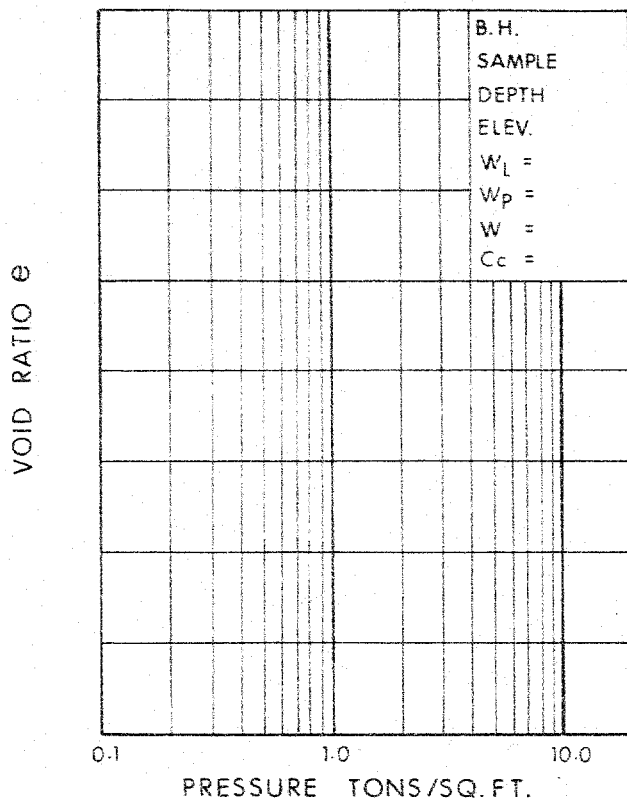
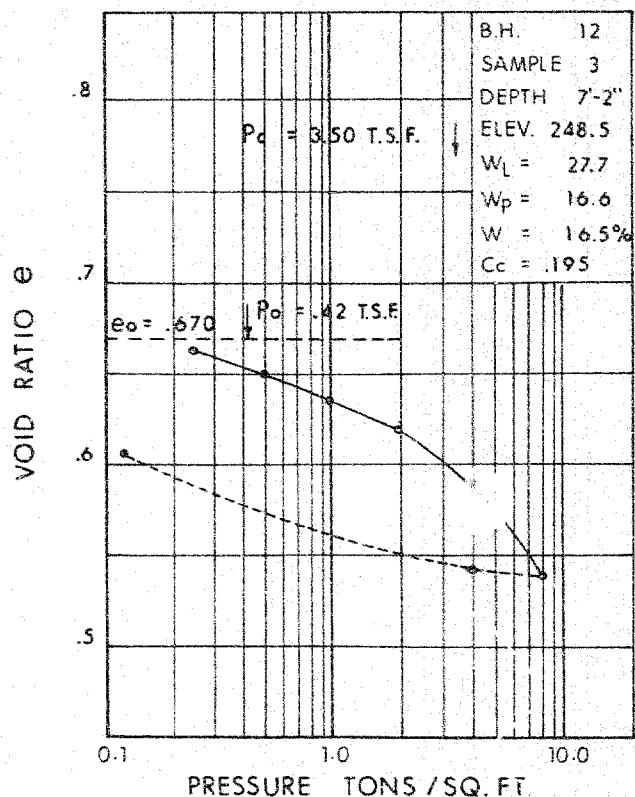
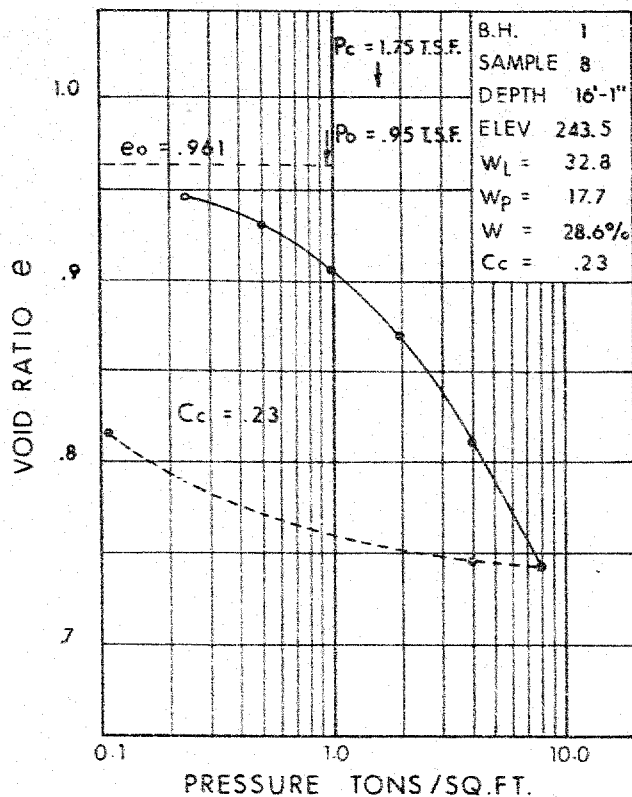


FIG. 6

ABBREVIATIONS USED IN THIS REPORT

PENETRATION RESISTANCE

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

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

DESCRIPTION OF SOIL

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

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

TYPE OF SAMPLE

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

SOIL TESTS

| | | | |
|-----------------|---------------------------------|------|-----------------|
| Q _u | UNCONFINED COMPRESSION | L.V. | LABORATORY VANE |
| Q | UNDRAINED TRIAXIAL | F.V. | FIELD VANE |
| Q _{cu} | CONSOLIDATED UNDRAINED TRIAXIAL | C | CONSOLIDATION |
| Q _d | DRAINED TRIAXIAL | S | SENSITIVITY |

ABBREVIATIONS USED IN THIS REPORT

SOIL PROPERTIES

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

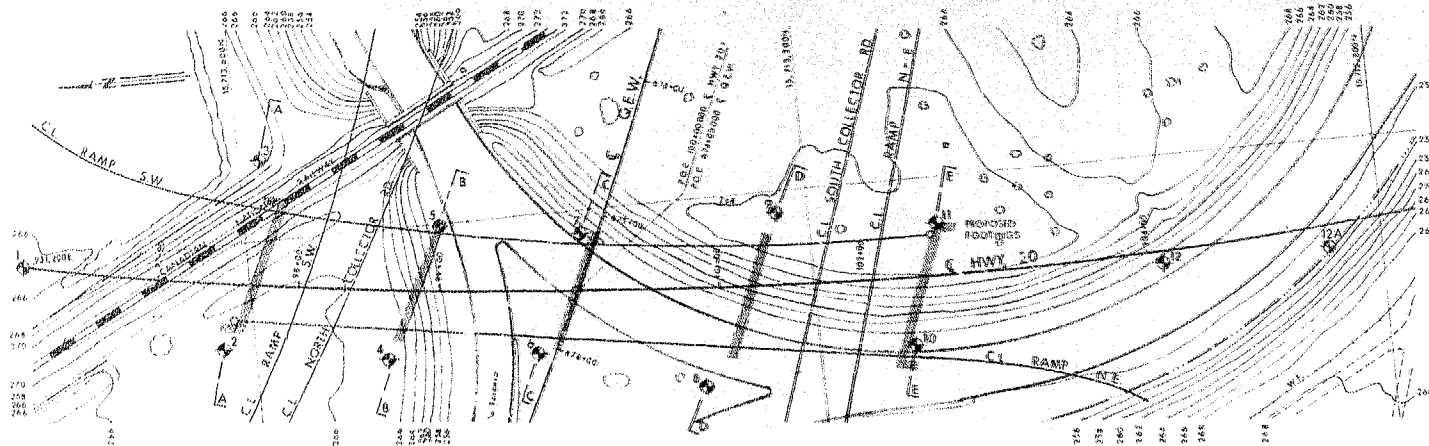
| | |
|----------|---|
| d | DISTANCE FROM TOP OF WALL TO POINT OF APPLICATION OF PRESSURE |
| δ | ANGLE OF WALL FRICTION |
| K | DIMENSIONLESS COEFFICIENT TO BE USED WITH VARIOUS SUFFIXES IN EXPRESSIONS REFERRING TO NORMAL STRESS ON WALLS |
| K_0 | COEFFICIENT OF EARTH PRESSURE AT REST |

FOUNDATIONS

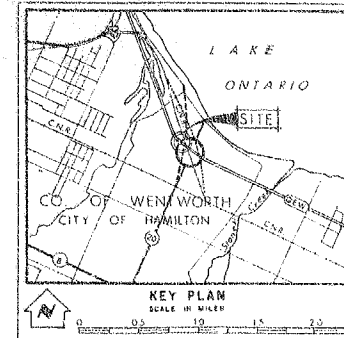
| | |
|-------|--|
| B | BREADTH OF FOUNDATION |
| L | LENGTH OF FOUNDATION |
| D | DEPTH OF FOUNDATION BENEATH GROUND |
| N | DIMENSIONLESS COEFFICIENT USED WITH A SUFFIX APPLYING TO SPECIFIC GRAVITY, DEPTH AND COHESION ETC. IN THE FORMULA FOR BEARING CAPACITY |
| k_s | MODULUS OF SUBGRADE REACTION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

SLOPES

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



PLAN
SCALE



LEGEND

- ◆ Bore Hole
- ⊕ Cone Penetration Hole
- ⊙ Bore & Cone Penetration Hole
- ~ Water Levels established at time of field investigation, OCT 1969

| NO. | ELEVATION | COORDINATES | |
|-----|-----------|-------------|---------|
| | | NORTH | EAST |
| 1 | 264.8 | 15,713.767 | 931.198 |
| 2 | 264.9 | = 622 | = 125 |
| 3 | 266.6 | = 585 | = 257 |
| 4 | 266.8 | = 507 | = 108 |
| 5 | 254.1 | = 463 | = 198 |
| 6 | 254.2 | = 400 | = 102 |
| 7 | 253.8 | = 361 | = 183 |
| 8 | 253.1 | = 282 | = 085 |
| 9 | 266.7 | = 227 | = 181 |
| 10 | 254.5 | = 135 | = 084 |
| 11 | 266.1 | = 113 | = 164 |
| 12 | 253.1 | 15,712.856 | 125 |
| 12A | 254.4 | = 838 | = 124 |

NOTE

The boundaries between soil strata have been established only at Bore Hole locations. Between Bore Holes the boundaries are assumed from geological evidence and may be subject to considerable error.

| DATE | BY | REVISION |
|------|----|----------|
| | | |
| | | |
| | | |

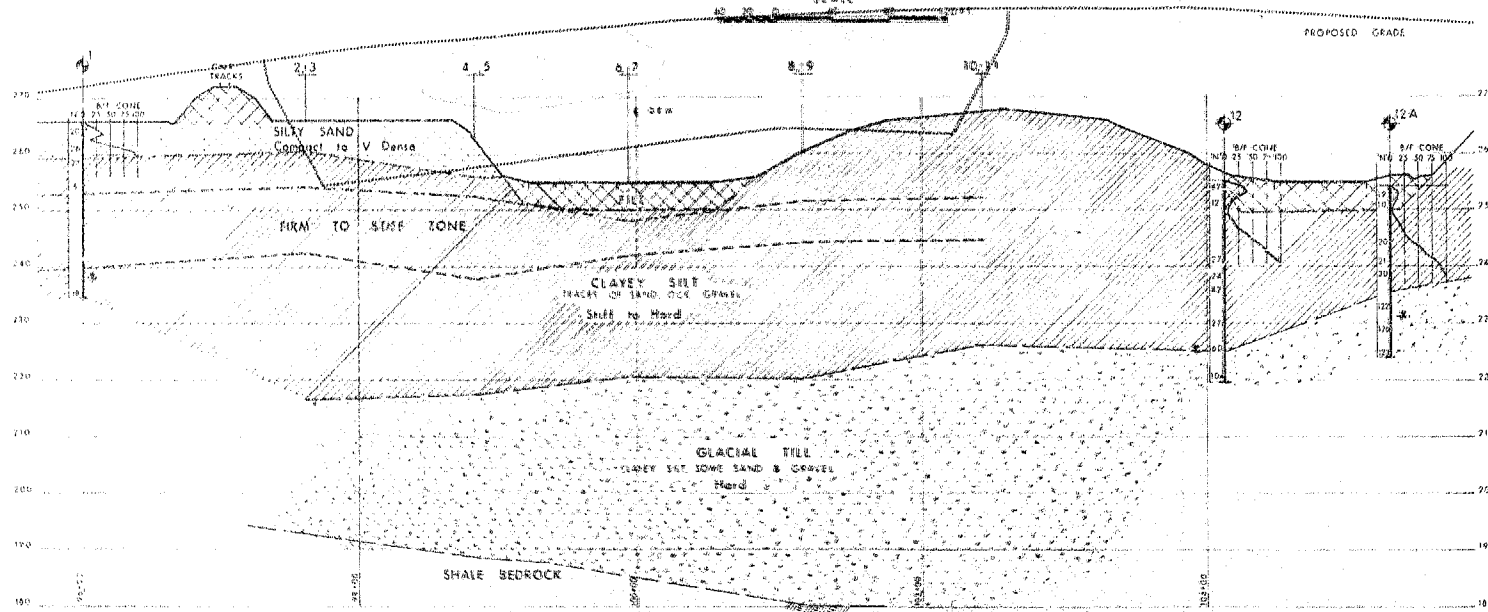
DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING OFFICE - FOUNDATION SECTION

HIGHWAY 20 RELOCATION

KING'S HIGHWAY NO. 20 RECONSTR. DIST. NO. 4
CO. WENTWORTH CITY OF HAMILTON
TWP. LOT. CON.

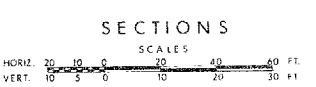
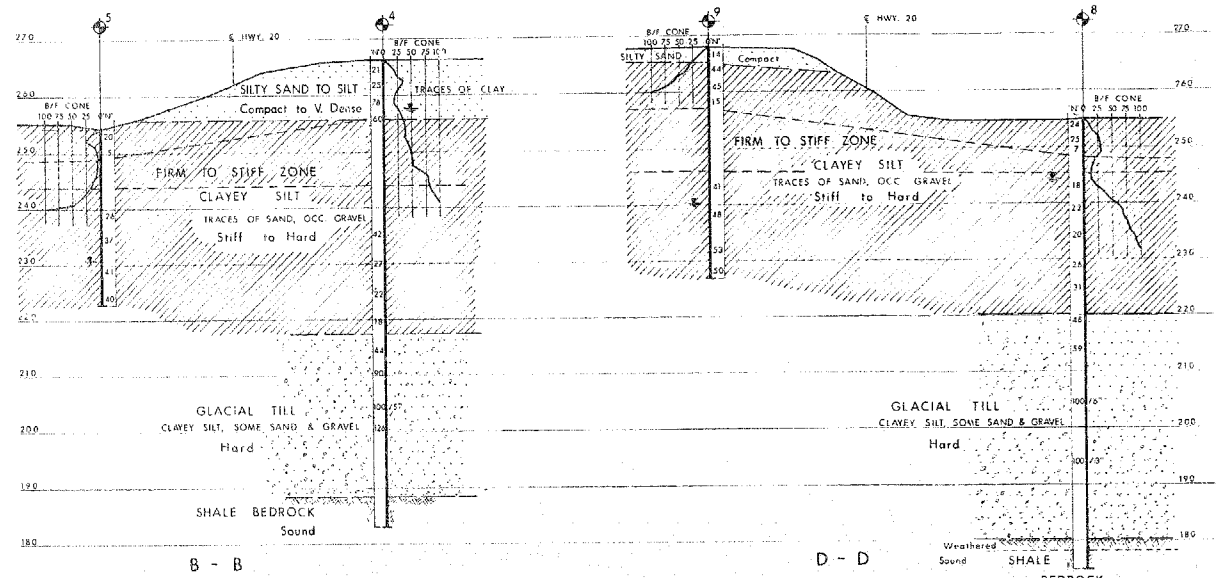
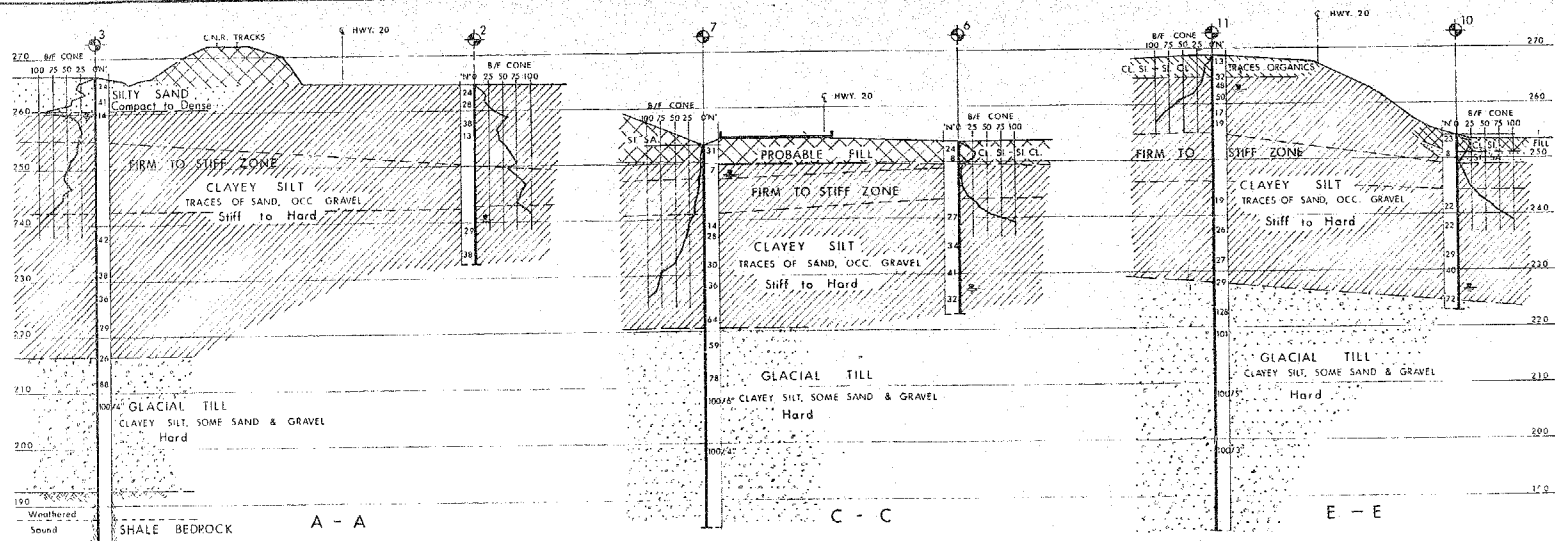
BORE HOLE LOCATIONS & SOIL STRATA

SHEET NO. 69 OF 71
DATE 11/01/69
APPROVED [Signature]
DRAWN [Signature]
CHECKED [Signature]
TEST. DRAWING NO. 69-P-71



E PROFILE PROPOSED HWY. 20 RELOCATION





SEE DRAWING 69-F-71A

KEY PLAN

SCALE IN MILES

LEGEND

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

| NO. | ELEVATION | STATION | OFFSET |
|-----|-----------|---------|--------|
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |

NOTE

The boundaries between soil strata have been established only at Bore Hole locations. Between Bore Holes the boundaries are assumed from geological evidence and may be subject to considerable error.

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

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING OFFICE - FUNDATION SECTION

HIGHWAY 20 RELOCATION

KING'S HIGHWAY NO. Q.E.W. RECONSTRUCT DIST. NO. 4

CO. WENTWORTH CITY OF HAMILTON

TWP. LOT CON.

SECTIONS & SOIL STRATA

SUBMITTED V.R. CHECKED 2/7/73 REF. NO. 10-57-2

DRAWN A.N. CHECKED 1/1/73 JOB NO. 69-F-71

DATE NOV. 4, 1969 SITE NO. 69-F-71B

APPROVED [Signature] CONT. NO. [Blank]

WAST DRAWING NO. [Blank]

BRIDGE DRAWING NO. [Blank]

Department of Highways Ontario
Copy for the information of

Mr. M. Devata

Mr. C. S. Grebski,
Structural Design Engineer,
West Building.

G. C. E. Burkhardt,
Structural Planning Office,
90 Floral Parkway.

A. Radkowski

April 21, 1972.

Hwy. 20 Underpass at Stoney Creek,
W.P. 10-57-02, Site 36-144,
Q.E.W., District 4.

69-F-71

Following the recent receipt of the recommendations from the Foundation Section, a meeting was held April 12 at which the following points were agreed to:

- a) Since the grade to grade distance at the north abutment was less than 19', there would be no berm required in the forward direction. A berm would however be required in the lateral direction.
- b) Structural Planning would confirm the location of the existing sanitary sewer at the south abutment.
- c) Structural Design could provide six prints of the revised span arrangement, by means of the General Arrangement drawing rather than re-issuing a preliminary.
- d) The representatives of the Program Office agreed that the Structural Design Office could extend their completion date by two months.
- e) The Program Office was to ascertain the status of the Snake Road and Spring Gardens Road projects and their connection and correlation with this work. They are also to attempt to obtain information on the schedule for closing the railway at the Stoney Creek location.

A subsequent meeting was held on April 17th, at which time the writer confirmed the location of the sewer as requested. A drawing, showing the sewer, as supplied by the City of Hamilton was given to your designer, and we also supplied the following two co-ordinate points which will define the alignment of the centreline of the sewer.

1. On the west side of the structure

N. 15,713,340

E. 930,722

2. On the east side of the structure

N. 15,712,960

E. 931,605

The south abutment should be located such that the battered piles will not cause any damage to this facility. The distance of the pile from the sewer as it passes should be decided by you in conjunction with the Foundation Office.

The Structural Office had proposed inserting a short curve in the horizontal alignment on the west side, to remove a 'kink' which would be visible in the parapet rail. Since the 'kink' is occasioned by the definitive nature of the alignment, which will align the existing motorist with his ramp, it is not desirable to remove this feature on the roadway, and Systems Design do not wish to do so. Should the Structural Office, however, still desire to curve the parapet wall and the fascia (outside vertical face) of the sidewalk there are no objections, provided the extra width is added to the sidewalk. The control line and the roadway face of the sidewalk are to follow the 'kink' alignment.

This memorandum will also confirm your statement that provision is being made in the structure for the six Hydro and four Bell Canada ducts as requested by these utility companies.

J. F. Walshe

JFW:lc

J. F. Walshe,
STRUCTURAL PLANNING SUPERVISOR,
for:
G. C. E. Burkhardt,
REC. STRUCTURAL PLANNING ENG.

c.c. M. Devata
P. Kinnear
E. Cross
R. Fitzgibbon

MEMORANDUM

TO: Mr. G. C. E. Burkhardt,
Regional Bridge Planning Engineer,
90 Floral Parkway,
Central Region.

FROM: M. Devata,
Foundations Office,
Central Bldg., Downsview.

ATTENTION: Mr. J. F. Walshe

DATE: September 20, 1971.

OUR FILE REF. (2497)

IN REPLY TO

SUBJECT: Hwy. #20, Overpass at Stoney Creek Traffic Circle,
W.P. 10-57-02, Site 36-144, Q.E.W., District No. 4,
(Hamilton).

69-F-71

The original foundation investigation was carried out for a scheme incorporating an underpass structure at the crossing of the Q.E.W. and revised Hwy. #20 in an area presently occupied by the western leg of the Stoney Creek Traffic Circle. In addition, two separate structures will be required in this scheme where C.N.R. tracks cross the Q.E.W. and revised Hwy. #20 respectively. According to the recent information there will be only one overpass structure at the middle of the traffic circle where Hwy. #20 (reconstructed) crosses the Q.E.W.

The Foundations Office was recently requested by your Section to provide recommendations for preliminary design purposes of the new location of the overpass structure based on the available subsoil information obtained from the previous investigations in this area of the traffic circle.

We have reviewed all the available data and our comments with regard to the preliminary design requirements are as follows:

Approach Embankments:

Fills of the north approach embankment will not be stable with standard 2:1 slopes in view of the presence of soft to firm silty clay to clayey silt stratum at a relatively shallow depth beneath the original ground surface. In order to ensure the stability of the north approach fill, a mid-height berm of 25 ft. in length will be required for the proposed 23 ft. embankment in the longitudinal as well as in the transverse direction (south side only).

Stability problems are not anticipated for the south approach embankment with standard 2:1 slopes.

Structure Foundations:

The presence of a relatively compressible zone at a shallow depth precludes the economic use of spread footings for the support of structure elements. The new overpass structure should, therefore, be supported on end bearing steel 'H' piles driven into the competent glacial till stratum. It is estimated that these piles can attain the maximum allowable loads at the following tip elevations.

Northern portion of the structure - Elev. 210.

Southern portion of the structure - Elev. 215.

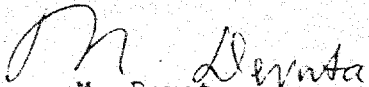
Settlement Considerations:

The maximum settlements will occur beneath the north approach fill due to the embankment loading on the compressible zone of natural subsoil. The preliminary computations indicate that the settlement, at this location, could be of the order of 5 inches.

The various recommendations outlined in this memo are for preliminary design purposes based on available data obtained for various structure elsewhere in this traffic circle. It will be necessary to carry out borings at the appropriate locations of the proposed footings and approach embankments when the final design details are available. Recommendations given in this memo are, therefore, to be regarded as conditional only, and as such are subject to revision at a later date when and if new information becomes available.

If you have any further queries, or if any of the foregoing requires clarification, please contact our Office.

MD/ao


M. Devata,
SUPERVISING FOUNDATION ENGINEER.

cc: Messrs. C. S. Grebski
G. K. Hunter
W. S. Friedmann
T. J. Kovich
A. Rutka
R. S. Pillar

Foundations Files ✓
Documents

MEMORANDUM

To: Mr. A. G. Stermac,
Principal Foundation Engineer,
Room 107, Lab. Building.

From: G. C. E. Burkhardt,
Bridge Planning Section,
90 Floral Parkway.

ATTENTION: M. Devata

DATE: September 2, 1971.

OUR FILE REF.

IN REPLY TO

SUBJECT: Highway 20 Overpass,
W.P. 10-57-02, Site 36-144,
Q.E.W., District 4.

Attached hereto is one print of the 200':1" plan and the profiles for the 'ultimate scheme' at this interchange.

Since several foundation investigations have been made in this area (see W.J. 69-F-71, W.J. 69-F-70 & W.O. 70-11035) we would suggest that, rather than making further investigations at this time, it would be safe to proceed with the preliminary bridge design on the basis of the recommendations in these reports.

The schedule however would be so arranged that time would be available to your section following receipt of the preliminary. It would then be possible to make further borings at the actual locations of piers and abutments.

Since this project is urgently required your comments and acquiescence are requested.

Please return the drawings to us as they are the only copy we have at this time. We will forward to you the 40:1 plans as they become available.

JFW:lc
Encl.

J. F. Walshe

J. F. Walshe,
REG. BRIDGE PLANNING SUPERVISOR,
for:
G. C. E. Burkhardt,
REG. BRIDGE PLANNING ENGINEER.

c.c. R. Fitzgibbon
C. S. Grebski
W. S. Friedmann

MEMORANDUM

Telephone: 248-3097

To: Mr. A. Stermac,
Principal Foundation Engineer,
Room 107,
Lab. Building.

FROM: W.S. Melinyshyn,
Bridge Office,
Central Region.

ATTENTION: Mr. M. Devata.

DATE: January 2nd, 1970.

OUR FILE REF.

IN REPLY TO

SUBJECT: Hwy. 20 Underpass,
W.P. 10-57-02, Site 36-144,
C.N.R. Subway, *69-F-71*
W.P. 10-57-03, Site 36-228,
Stoney Creek Traffic Circle,
Q.E.W., District No. 4.

As previously discussed, an existing 78" diameter sanitary sewer crosses the above two sites running parallel to proposed pier or abutment locations. Piled foundations will be used to support the structures and it is essential to locate the sewer limits within the areas indicated below (refer to attached drawings).

Hwy. #20 and relocated Q.E.W.

Sta. 673 + 50 to Sta. 675 + 50
South Collector Road

Sewer Invert Elev. 215.6 (approx.
50' below original ground).

C.N.R. and Q.E.W.

Sta. 680 + 50 to Sta. 682 + 00
South Collector Road

Sewer invert Elev. 216.3 (approx.
38' below original ground).

Would you please undertake a boring program to accurately locate the utility within the limits stated. Assistance in locating the sewer and co-ordinating the boring probes will be provided by Mr. F. Sobolak, of M.M. Dillon Limited, (Tel. No. HU 1-6886).

WSM/cew

cc D. Barr
F. Sobolak
W. Friedmann

W.S. Melinyshyn
W.S. Melinyshyn,
REGIONAL BRIDGE PLANNING ENGINEER.

ITEM

ACTION BY

6. An accurate location of the existing 78 inch Sanitary Sewer on the south side of Q.E.W. is required. M. M. Dillon Limited will prepare a cost estimate of locating the sanitary sewer. Mr. W. C. Friedmann suggested that Mr. D. Thrasher of District 4 would provide forces for locating the sewer. M. M. Dillon Limited will provide plans and supervision.

MMD

7. Minutes of 18 November 1969 meeting with C.N.R. were reviewed.

M. Devata has examined M. M. Dillon's proposal for bridge arrangement at North abutment as outlined in Item 4 of C.N.R. meeting minutes. Factor of safety for the new proposal is within allowable limits. M. M. Dillon Limited will adjust bridge spans using new information and submit proposals to Mr. W. Melinyshyn.

MMD
DHO

8. Department of Highways Functional Planning Office will determine status of communication with Canadian Transport Commission and take appropriate action.

DHO

9. City of Hamilton plans for drainage of Interchange area south of Q.E.W. are required. M. M. Dillon Limited cannot proceed with drainage design until this information is available.

DHO
MMD

IH:mab

I. Hausmanis

DISTRIBUTION: All Present

c.c. J. Bonsall
P. Weber
H. Adams
G. McMillan
B. Strain