

DOCUMENT MICROFILMING IDENTIFICATION

G.I.-30 SEPT. 1976

GEOCRES No. 30M3-204

DIST. 4 REGION

W.P. No. 392-85-01

CONT. No. 94-83

W. O. No.

STR. SITE No. N/A

HWY. No. Q.E.W.

LOCATION Q.E.W. @ JORDAN RD.

=====

OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT.

REMARKS:



**Ministry of  
Transportation and  
Communications**

**FILE No.** WP 333-89-005 **DATE** June 16 th / 94

REMARKS

# OVERSIZE DRAWING

# memorandum

235-3731



To: V. Boehnke  
Head, Structural Section  
Central Region

Date: 94 06 16

Attn: K. Wong  
Senior Structural Engineer

WP 392-85-01

GEOGRES No 30M3-204

From: Foundation Design Section  
Room 315, Central Building

SUBJECT: Foundation Investigation - Temporary Shoring  
QEW Widening from Victoria Street to Jordan Road  
Station 12+705 to Station 12+804  
District 4, Burlington

## INTRODUCTION

Further to your request for foundation recommendations to facilitate the design and construction of the temporary shoring wall within the median of the QEW east of Jordan Road between Stations 12+705 and 12+804, our office has undertaken and completed a foundation investigation planned to acquire additional subsurface information at the site. This fieldwork was carried out on June 16, 1994 and consisted of two sampled boreholes advanced to depths of 14.6 m and 15.7 (see attached plan and borehole logs S1, S2). Subsoil samples were retrieved using a 50 mm diameter split spoon sampler driven in accordance with the Standard Penetration Test (ASTM D1586) at 1.5 m intervals. In situ vane tests were conducted in cohesive soils of weaker consistency in accordance with ASTM D2573 employing the Standard MTO 'N' vane. The samples were examined in the field, placed in sample jars to preserve moisture contents and then transported to the laboratory for further examination and classification. Physical property testing including Atterberg Limit testing, grain size distribution testing, unit weight determination

.../2

and moisture content determination were then conducted in the laboratory. Groundwater levels were obtained by measurement in the open boreholes at the time of the investigation. All boreholes were backfilled upon completion.

A description of the subsurface conditions encountered at the site is given below. Laboratory test results will be forwarded upon completion at which time the borehole logs attached to this memorandum can be updated to reflect these results. Recommendations for the design and construction of the shoring wall are thereafter provided.

#### SUBSURFACE CONDITIONS

The existing ground surface at the site varies between approximately 88 m and 82.3 m. Jordan Road, located at the eastern limit of the proposed shoring is situated primarily in an excavation cut with side slopes approximately 2H:1V.

The subsurface conditions at the site consists of a surficial fill material comprised of a brown sand and gravel. This material which is in a compact state of denseness and serves as a base for QEW, has a thickness of approximately 0.9 m.

The sand and gravel fill material is underlain by a native stratum of Silt to Sandy Silt that contains random interbedded layers of Clayey Silt and has a thickness ranging between 7 m and 8.2 m. The silt material ranges from a plastic silt to a non-plastic silt depending on the composition. The Clayey Silt layers have a thickness ranging from 25 mm to 500 mm. This stratum has been oxidized at some locations and is brown for the surficial 2.0 m or so at BH S2. The stratum is grey below the surficial oxidized material. Standard Penetration Test 'N' values ranged from 4 blows/0.3 m to 34 blows/0.3 m indicating a very loose to dense state of denseness. In general, however, the stratum is in a compact state of denseness. The interbedded layers of Clayey Silt can be considered as stiff.

A layer of a grey, stiff cohesive Clayey Silt underlies the Silt to Sandy Silt with random interbedded layers of Clayey Silt. This layer has a thickness ranging from approximately 0.9 m to 1.6 m.

A heterogeneous mixture of Clayey Silt, Sand and Gravel of glacial till origin in turn underlies the clayey silt layer at an Elevation ranging between 77.1 m and 78.4 m. The thickness of this deposit was not determined during this investigation but previous investigations (64-F-13) indicate that this deposit has a thickness of approximately 21 to 24 m. 'N' values in this deposit ranged between 1 blow/0.3 m to 9 blows/0.3 m. In Situ Vane Tests revealed undrained shear strengths ranging from 76 kPa to in excess of 120 kPa indicating a stiff to very stiff consistency.

Groundwater levels measured in the open boreholes at the time of the investigation ranged from 3 to 4 m below the ground surface (Elevation 84.8 to 84.1). Groundwater levels, however are subject to seasonal fluctuation.

## DISCUSSION AND RECOMMENDATIONS

### GENERAL

It is proposed to construct a temporary shoring wall that will extend westerly from Jordan Road from Station 12+804 to Station 12+705 to facilitate a median access road for construction purposes. The shoring wall will be designed to support the QEW WB and EB traffic enabling a 4.5 m access road with a profile grade rising at 8% from Elevation 82 m to Elevation 87.5 m.

Recommendations pertaining to the design and construction of the temporary shoring wall are summarized below.

## DESIGN

### Type of Shoring Wall

It is recommended that an anchored soldier pile-timber lagging wall be employed for this project. Details of this shoring wall scheme are described below. The Contractor shall submit working drawings three weeks prior to construction as outlined in OPSS 902.04.

### Shoring Design

The shoring system shall be designed to resist the appropriate earth pressures computed in accordance with Section 6-7.4 of the O.H.B.D.C. Surcharge loadings shall be incorporated in the design in accordance with Section 6-7.5 of the O.H.B.D.C. The shoring system can be considered as free draining and therefore hydrostatic pressures will NOT be exerted against the wall.

Table 1 below contains the relevant soil parameters required to compute the lateral earth pressures. Buoyant unit weights ( $\gamma$ ) shall be used below the groundwater table. The groundwater table at the time of the investigation was approximately at Elevation 84 m. Active earth pressure coefficients and a triangular earth pressure distribution can be used to compute the lateral thrust on the wall.

| Table 1 - Shoring Design Parameters                     |               |  |  |  |   |
|---|---------------|--|--|--|---|
| Soil  | Elevation (m) | Bulk Unit Weight ( $\gamma$ ) (kN/m <sup>3</sup> ) | Angle of Internal Friction ( $\phi$ )(°) | Coefficient of Active Earth Pressure ( $K_a$ ) | Coefficient of Passive Earth Pressure ( $K_p$ ) |
| Fill Material   | 88-87         | 20   | 30                                       | 0.33   | 3   |
| Silt to Sandy Silt (interbedded Clayey Silt)            | 87-80         | 20   | 30                                       | 0.33   | 3   |
| Clayey Silt   | 80-78.5       | 18   | 28                                       | 0.36   | 2.8   |
| Het. Mixt. of Clayey Silt, Sand & Gravel (Glacial Till) | 78.5-57.5     | 20   | 30                                       | 0.33   | 3   |

The shoring system must be designed to satisfy earth pressure equilibrium. In view of the depths of excavation proposed at the site, it is recommended that soil anchors with bond zones within the heterogeneous mixture of clayey silt, sand and gravel (glacial till) at or below an Elevation of 77 m be employed. Soil anchors can be designed using a bond stress of 75 kPa at the grouted anchor/soil interface. Typically, soil anchors in practice are in the order of 300 mm in diameter.

## DESIGN

### General

It is recommended that a NSSP be included in the Contract Documents outlining the specifications pertaining to the installation of the soldier piles and the soil anchors. These specifications that include contractor responsibilities, materials, equipment, installation procedures and production anchor stressing and testing can be obtained from our office.

The overburden at the site consists of a surficial stratum of cohesionless silts to Sandy Silts which are susceptible to disturbance, sloughing and boiling under conditions of unbalanced hydrostatic head. In addition, boulders and cobbles are characteristic components of Glacial Till deposits and hence can exist at the site. The Contractor shall be alerted of these conditions and address these conditions accordingly in the construction proposal.

The construction of the protection scheme shall comply with OPSS 902.07.01 and OPSS 538 and 539 series.

### Soldier Pile Installation

Soldier piles can be installed in preaugered holes or alternatively driven to the design tip elevation. In the case of installation in



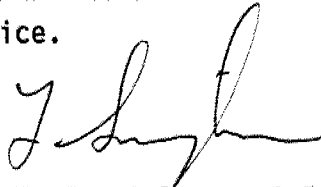
preaugered holes, soil cave-in and boiling conditions must be controlled during construction. These types of conditions will arise within cohesionless soils submerged below the groundwater table which is the case for the surficial native stratum at the site. One method of controlling this condition is to construct the caisson within a temporary liner installed to the full depth of the submerged cohesionless soils. Alternatively, mud drilling techniques can also be used to control the unbalanced head condition.

Concrete soldier pile toes shall be placed in the dry or alternatively placed using tremie techniques.

#### Anchor Installation

Soil anchors shall also be installed such that no soil loss is experienced during the process. Hollow stem augering techniques can be used to install the soil anchors without soil cave-in.

We trust the above comments satisfy your current requirements. If you have any questions or require additional information, please do not hesitate to contact this office.



T. Sangiuliano, P.Eng.  
Foundation Engineer

for

P. Payer, P.Eng.  
Senior Foundation Engineer

TS/mr

LIMIT OF SHORING  
S/12+705

MEDIAN ACCESS ROAD

S/8

LIMIT OF SHORING  
2+80.4

A

009.1

A



# RECORD OF BOREHOLE No S 1

1 OF 1

METRIC

W.P. 392-85-01 LOCATION Co - ord: N 4 782 084.4 : E 315 945.9 \*\* ORIGINATED BY I.S.  
DIST 4 HWY QEW BOREHOLE TYPE HS Auger COMPILED BY I.B.  
DATUM Geodetic DATE 94 06 16 CHECKED BY P.P.

| SOIL PROFILE  |  | SAMPLES    |        |      | GROUND WATER<br>CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION<br>RESISTANCE PLOT |    |    |    |     | PLASTIC LIMIT<br>NATURAL MOISTURE<br>CONTENT |   |                | UNIT<br>WEIGHT<br>$\gamma$<br>KN/m <sup>3</sup> | REMARKS<br>&<br>GRAIN SIZE<br>DISTRIBUTION<br>(%) |
|---------------|--|------------|--------|------|----------------------------|-----------------|---|----|----|----|-----|--|---|----------------|---|---|
| ELEV<br>DEPTH | DESCRIPTION  | STRAT PLOT | NUMBER | TYPE | N° VALUES                  |                 | 20  | 40 | 60 | 80 | 100 | W <sub>p</sub>                               | W | W <sub>L</sub> |   |   |
| 87.8          | Ground Surface   |            |        |      |                            |                 |   |    |    |    |     |  |   |                |   |   |
| 0.0           | SAND and GRAVEL<br>(Fill Material)   |            |        |      |                            |                 |   |    |    |    |     |  |   |                |   |   |
| 86.9          |  |            |        |      |                            |                 |   |    |    |    |     |  |   |                |   |   |
| 0.9           |  |            |        |      |                            |                 |   |    |    |    |     |  |   |                |   |   |
|               |  |            | 1      | SS   | 24                         |                 |   |    |    |    |     |  |   |                |   |   |
|               |  |            | 2      | SS   | 34                         |                 |   |    |    |    |     |  |   |                |   |   |
|               | SILT to SANDY SILT,<br>with Random Interbeds of<br>Clayey Silt             |            |        |      |                            |                 |   |    |    |    |     |  |   |                |   |   |
|               | Grey, Compact to Dense/Stiff   |            | 3      | SS   | 12                         |                 |   |    |    |    |     |  |   |                | 18.9  | 0 2 58 42   |
|               |  |            | 4      | SS   | 22                         |                 |   |    |    |    |     |  |   |                |   |   |
|               |  |            | 5      | SS   | 13                         |                 |   |    |    |    |     |  |   |                |   |   |
|               |  |            | 6      | SS   | 1                          |                 |   |    |    |    |     |  |   |                |   |   |
| 78.7          | CLAYEY SILT,<br>Grey, Stiff  |            |        |      |                            |                 |   |    |    |    |     |  |   |                |   |   |
| 9.1           |  |            | 7      | SS   | 1                          |                 |   |    |    |    |     |  |   |                |   |   |
| 77.1          |  |            | 8      | SS   | 3                          |                 |   |    |    |    |     |  |   |                | 22.4  | 1 6 66 27   |
| 10.7          | Heterogeneous Mixture of<br>CLAYEY SILT, Sand and Gravel<br>(Glacial Till) |            |        |      |                            |                 |   |    |    |    |     |  |   |                |   |   |
|               | Grey, Stiff  |            | 9      | SS   | 6                          |                 |   |    |    |    |     |  |   |                |   |   |
| 73.2          |  |            |        |      |                            |                 |   |    |    |    |     |  |   |                |   |   |
| 14.6          | End of Borehole * 94 06 16<br>** Sta. 12+705,<br>o/s 3m RL @ Median QEW    |            |        |      |                            |                 |   |    |    |    |     |  |   |                |   |   |

+3, +5. Numbers refer to  
Sensitivity

20  
15-5 (%) STRAIN AT FAILURE  
10

# RECORD OF BOREHOLE No S 2

1 OF 2

METRIC

W.P. 392-85-01 LOCATION Co - Ords: N 4 782 076.2 ; E 315 992.2 \*\* ORIGINATED BY T.B.  
DIST 4 HWY QEW BOREHOLE TYPE HS Auger COMPILED BY T.B.  
DATUM Geodetic DATE 94.06.16 CHECKED BY P.P.

| SOIL PROFILE  |  |            | SAMPLES |      |            | GROUND WATER<br>CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION<br>RESISTANCE PLOT |                 |                 |                 |                 | UNIT<br>WEIGHT<br>$\gamma$<br>kN/m <sup>3</sup> | REMARKS<br>&<br>GRAIN SIZE<br>DISTRIBUTION<br>(%)<br>GR SA SI CL |
|---------------|--|------------|---------|------|------------|----------------------------|-----------------|---|-----------------|-----------------|-----------------|-----------------|---|--|
| ELEV<br>DEPTH | DESCRIPTION  | STRAT PLOT | NUMBER  | TYPE | 'N' VALUES |                            |                 | 20 40 60 80 100                             | 20 40 60 80 100 | 20 40 60 80 100 | 20 40 60 80 100 | 20 40 60 80 100 |   |  |
| 88.1          | Ground Surface   |            |         |      |            |                            | 88              |   |                 |                 |                 |                 |   |  |
| 0.0           | SAND and GRAVEL<br>(Fill Material)   |            |         |      |            |                            |                 |   |                 |                 |                 |                 |   |  |
| 87.2          |  |            |         |      |            |                            |                 |   |                 |                 |                 |                 |   |  |
| 0.9           | SILT to SANDY SILT,<br>with Random Interbeds of<br>Clayey Silt,<br><br>Very Loose to Compact/Stiff<br><br>Brown<br>-----<br>Grey |            | 1       | SS   | 4          |                            | 86              |   |                 |                 |                 |                 | 21.3  | 0 11 69 20   |
|               |  |            | 2       | SS   | 14         |                            | 84              |   |                 |                 |                 |                 |   | 0 11 (89)  |
|               |  |            | 3       | SS   | 29         |                            |                 |   |                 |                 |                 |                 |   |  |
|               |  |            | 4       | SS   | 7          |                            | 82              |   |                 |                 |                 |                 |   |  |
| 80.2          |  |            | 5       | SS   | 4          |                            | 80              |   |                 |                 |                 |                 |   |  |
| 7.9           | CLAYEY SILT,<br>Grey, Stiff  |            | 6       | SS   | 2          |                            |                 |   |                 |                 |                 |                 |   | 5 1 50 44  |
| 78.3          |  |            |         |      |            |                            | 78              |   |                 |                 |                 |                 |   |  |
| 9.8           |  |            | 7       | SS   | 7          |                            |                 |   |                 |                 |                 |                 |   |  |
|               |  |            |         |      |            |                            | 76              |   |                 |                 |                 |                 |   |  |
|               | Heterogeneous Mixture of<br>CLAYEY SILT, Sand and Gravel<br>(Glacial Till)<br><br>Grey, Stiff to Very Stiff                      |            | 8       | SS   | 7          |                            |                 |   |                 |                 |                 |                 |   |  |
|               |  |            | 9       | SS   | 7          |                            | 74              |   |                 |                 |                 |                 | 20.3  | 1 14 57 28   |
| 72.9          |  |            |         |      |            |                            |                 |   |                 |                 |                 |                 |   |  |

15.2 Continued

+3, x5: Numbers refer to  
Sensitivity

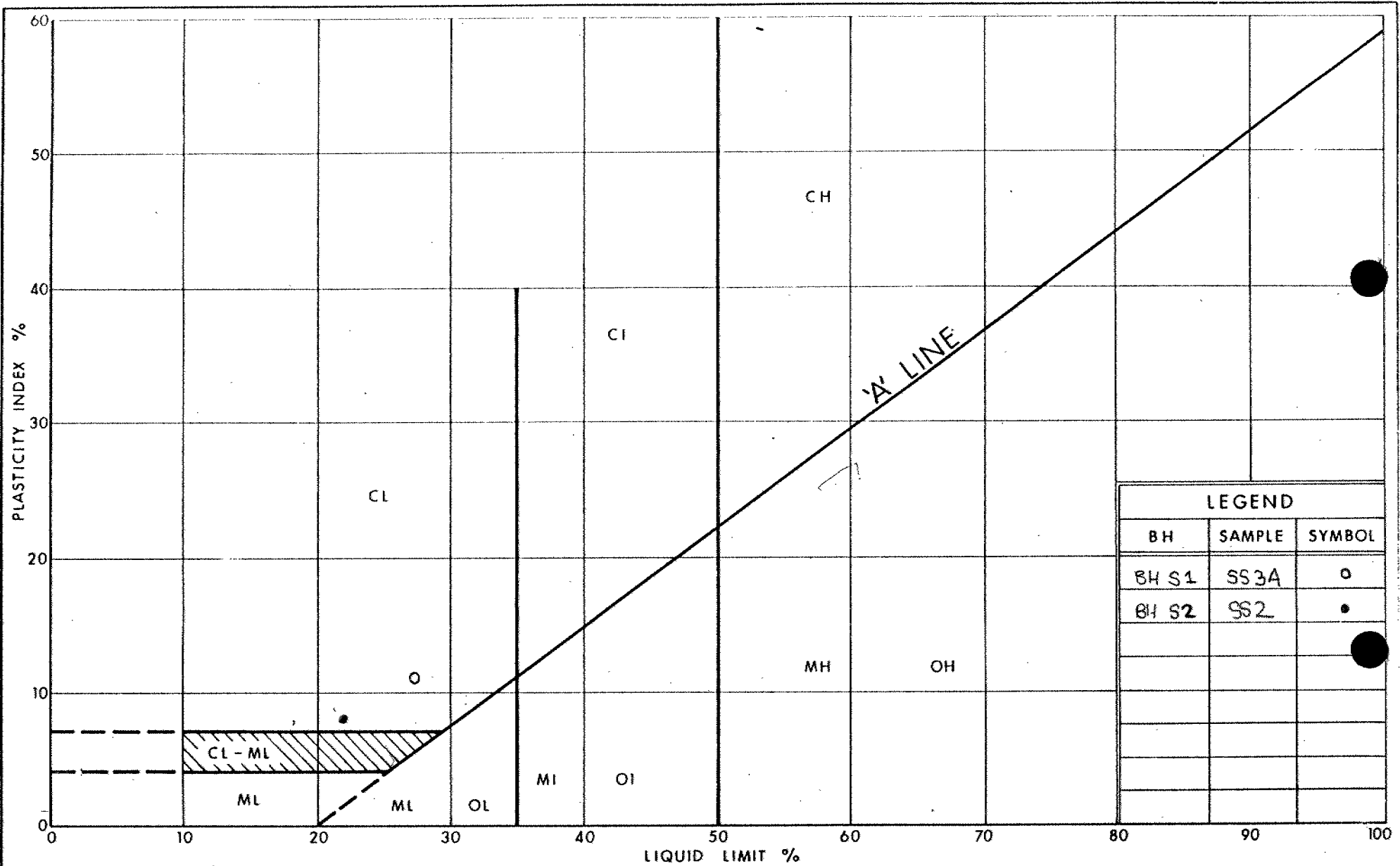
20  
15-5 (%) STRAIN AT FAILURE  
10

Continued

# RECORD OF BOREHOLE No S 2 2 OF 2 METRIC

W.P. 392-85-01 LOCATION Co - Ords: N 4 782 076.2 : E 315 992.2 \*\* ORIGINATED BY T.B.  
 DIST 4 HWY QEW BOREHOLE TYPE HS Auger COMPILED BY T.B.  
 DATUM Geodetic DATE 94 06 16 CHECKED BY P.P.

| SOIL PROFILE  |                        | SAMPLES    |        |      | GROUND WATER<br>CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION<br>RESISTANCE PLOT |    |    |    |    | PLASTIC<br>LIMIT<br>w <sub>p</sub> | NATURAL<br>MOISTURE<br>CONTENT<br>w | LIQUID<br>LIMIT<br>w <sub>L</sub> | UNIT<br>WEIGHT<br>γ<br>kN/m <sup>3</sup> | REMARKS<br>&<br>GRAIN SIZE<br>DISTRIBUTION<br>(%)<br>GR SA SI CL |
|---------------|------------------------|------------|--------|------|----------------------------|-----------------|---|----|----|----|----|------------------------------------|-------------------------------------|-----------------------------------|--|--|
| ELEV<br>DEPTH | DESCRIPTION            | STRAT PLOT | NUMBER | TYPE |                            |                 | 'N' VALUES                                  | 20 | 40 | 60 | 80 |                                    |                                     |                                   |  |  |
| 72.9          | Continued              |            |        |      |                            |                 |   |    |    |    |    |                                    |                                     |                                   |  |  |
| 15.2          |                        |            | 10     | SS   | 9                          |                 |   |    |    |    |    |                                    |                                     |                                   |  |  |
| 72.4          |                        |            |        |      |                            |                 |   |    |    |    |    |                                    |                                     |                                   |  |  |
| 15.7          | End of Borehole        |            |        |      |                            |                 |   |    |    |    |    |                                    |                                     |                                   |  |  |
|               | • 94 06 16             |            |        |      |                            |                 |   |    |    |    |    |                                    |                                     |                                   |  |  |
|               | ** Sta. 21+755,        |            |        |      |                            |                 |   |    |    |    |    |                                    |                                     |                                   |  |  |
|               | o/s 3m Rt C Median QEW |            |        |      |                            |                 |   |    |    |    |    |                                    |                                     |                                   |  |  |



Ministry of  
Transportation  
Ontario

**PLASTICITY CHART**  
SILT to Sandy SILT with Random  
Interbeds of Clayey SILT

FIG No

W P 333-89 - 005

## UNIFIED SOIL CLASSIFICATION SYSTEM

CLAY &amp; SILT

SAND

GRAVEL

Fine

Medium

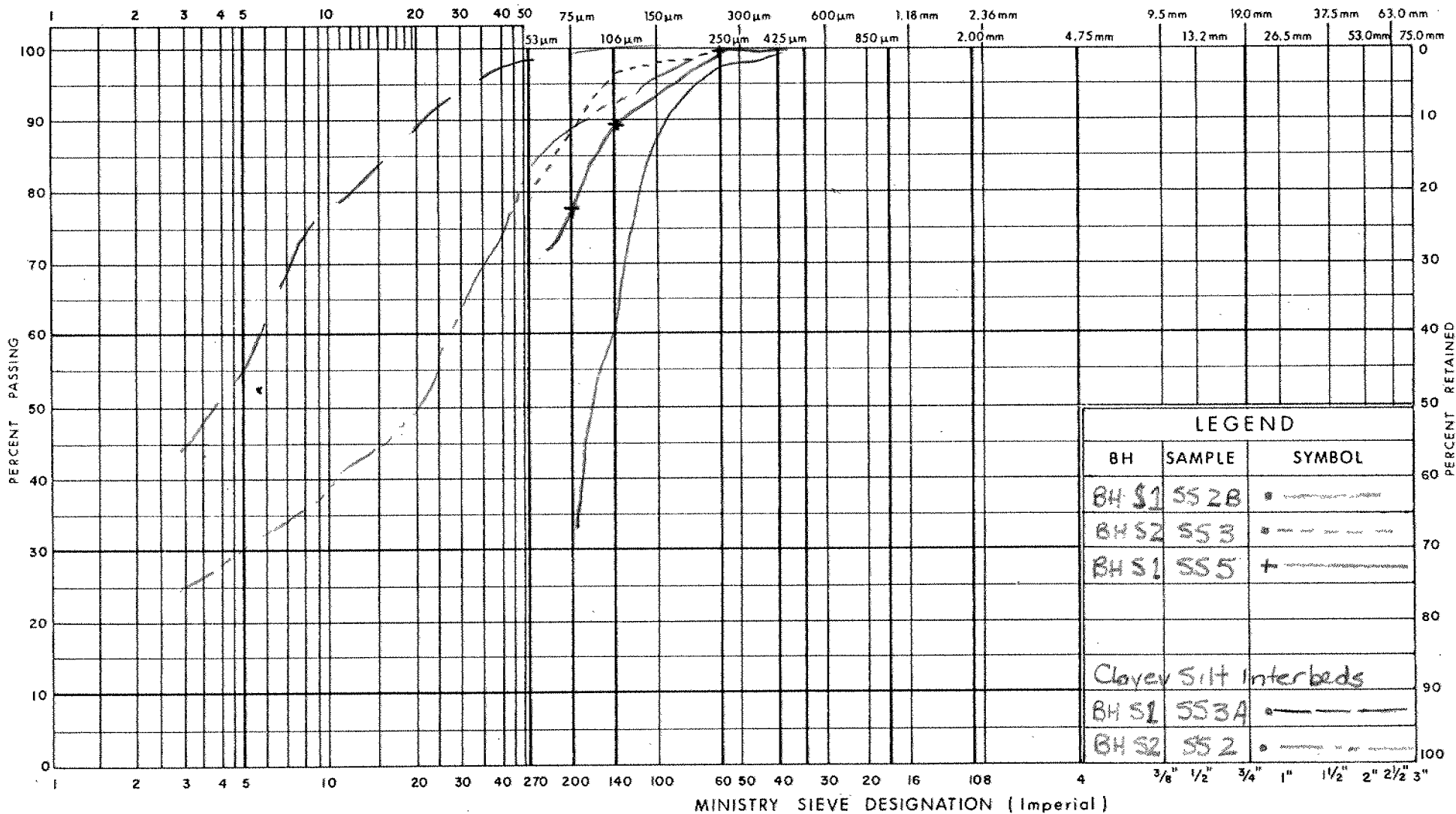
Coarse

Fine

Coarse

GRAIN SIZE IN MICROMETERS

MINISTRY SIEVE DESIGNATION (Metric)



MINISTRY SIEVE DESIGNATION (Imperial)

Ministry of  
Transportation

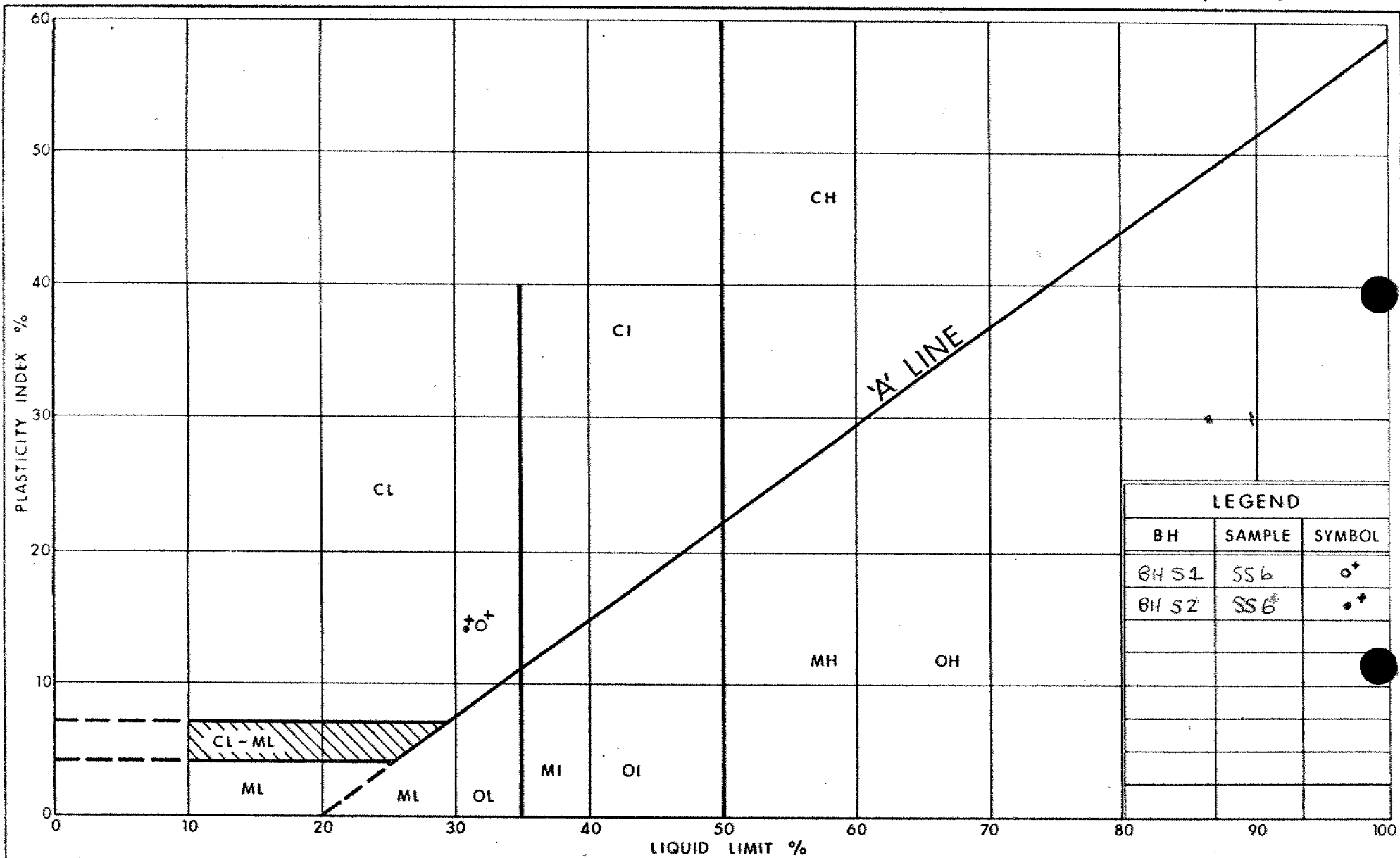
Ontario

## GRAIN SIZE DISTRIBUTION

SILT to Sandy Silt with Random  
Interbeds of Clayey Silt

FIG No

W P 333 89-005



Ministry of  
Transportation

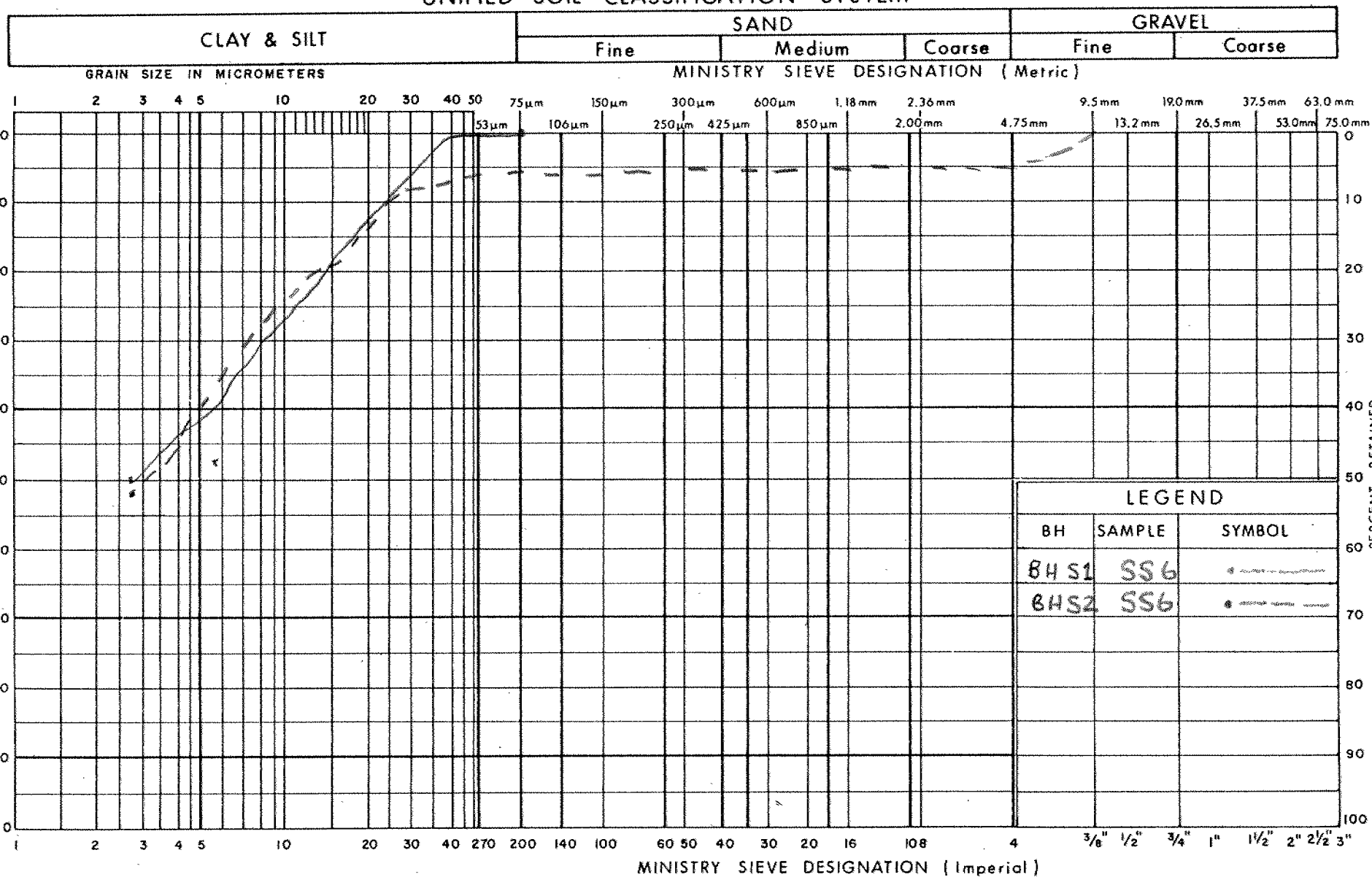
# PLASTICITY CHART CLAYEY SILT

FIG No

W P 333-89-005



## UNIFIED SOIL CLASSIFICATION SYSTEM

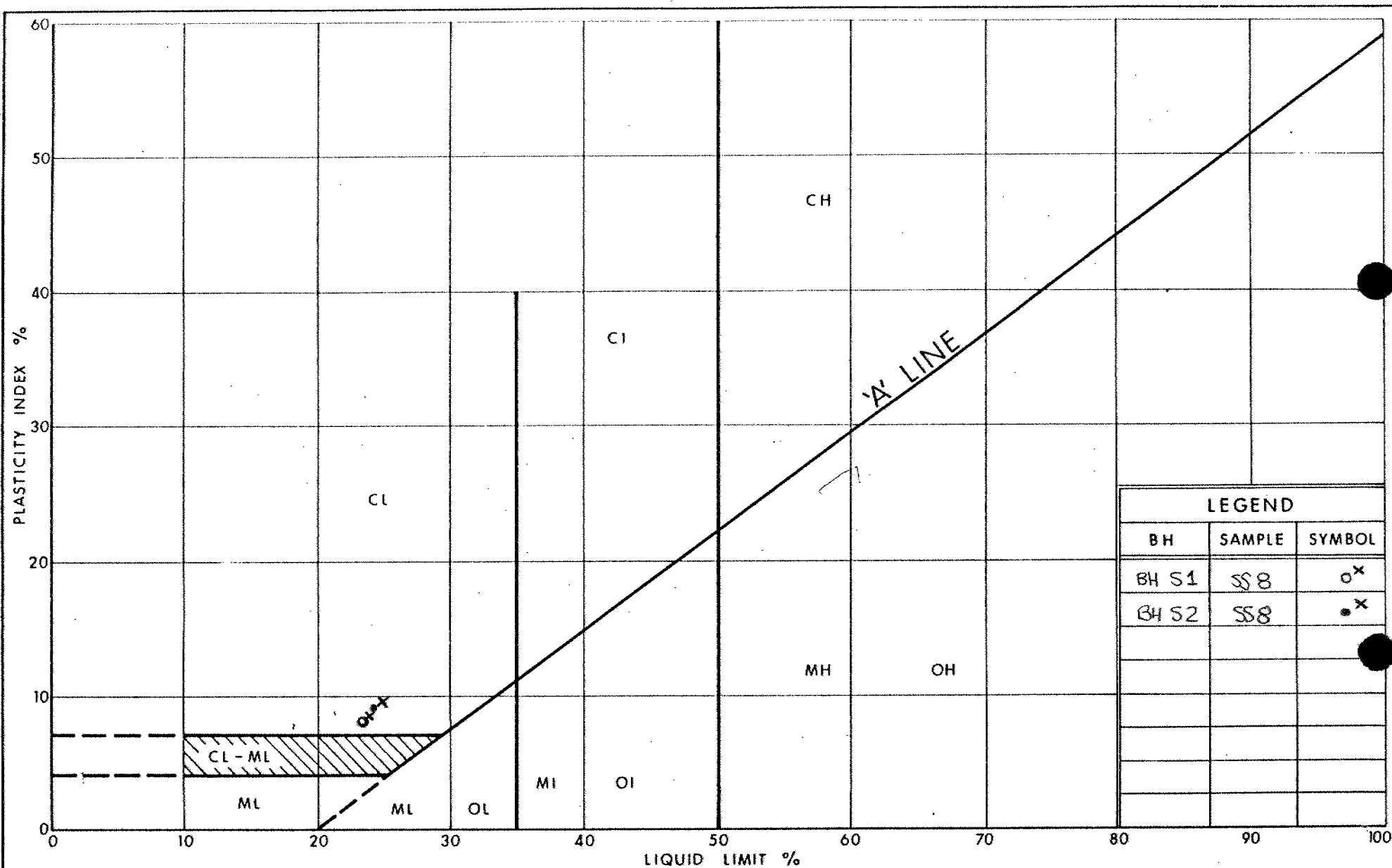


Ministry of  
Transportation

GRAIN SIZE DISTRIBUTION  
CLAYEY SILT

FIG No

W P 333-89-005



Ministry of  
Transportation  
Ontario

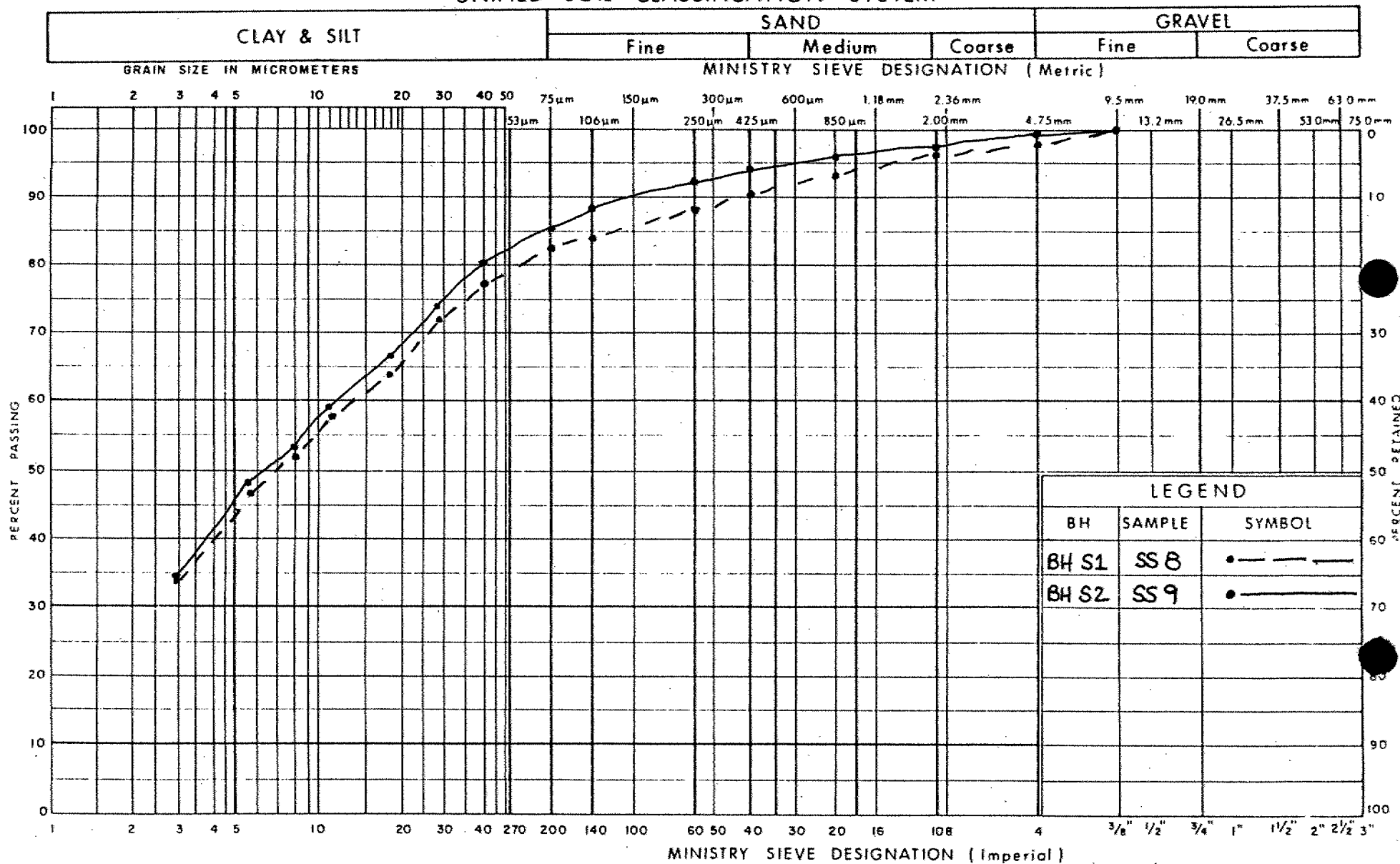
# PLASTICITY CHART

Heterogeneous Mixture of Clayey Silt,  
Sand and Gravel (Glacial Till)

FIG No

W P 333-89-005

## UNIFIED SOIL CLASSIFICATION SYSTEM



Ontario

Ministry of  
Transportation

GRAIN SIZE DISTRIBUTION  
Heterogeneous Mixture of  
CLAYEY SILT, Sand and  
Gravel (Glacial Till)

FIG No

W P 333-89-00S

METRIC

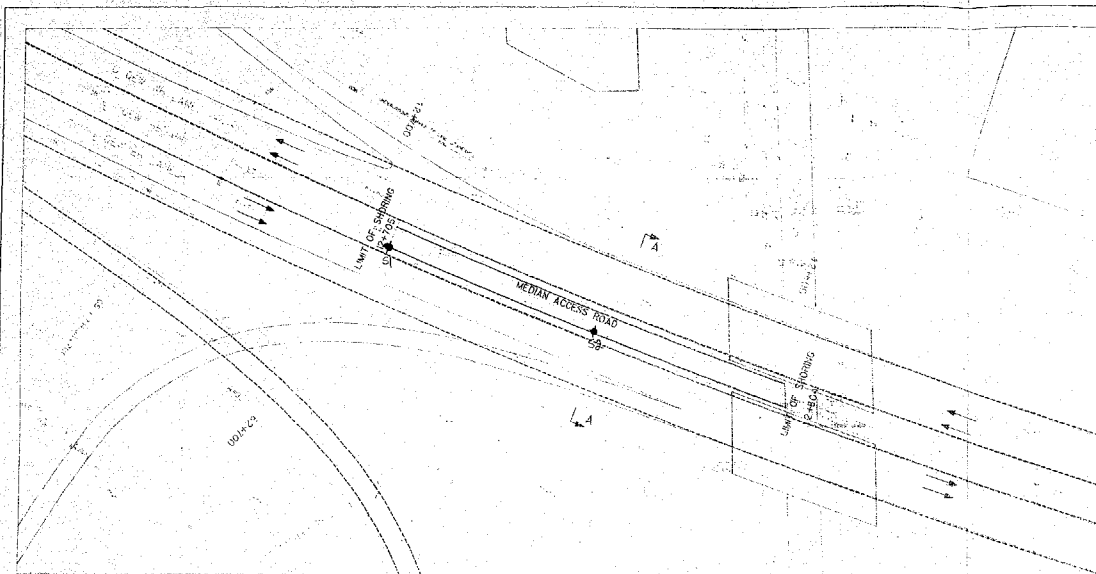
PLATE No

CONT No

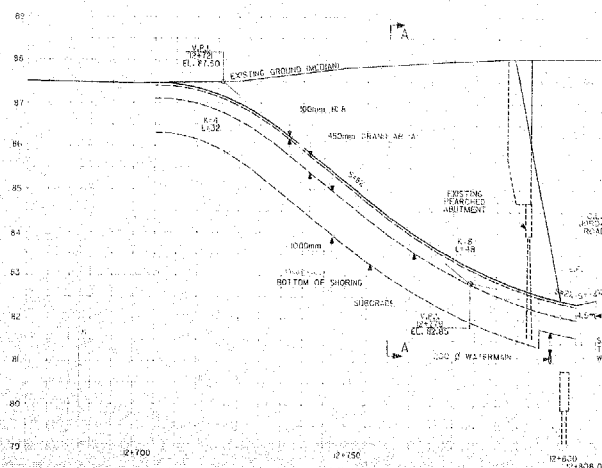
WP No 333-89-00

SHEET

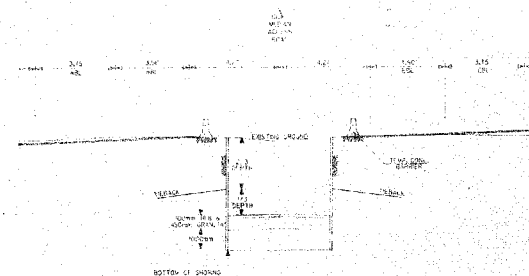
STA TO STA



PROPOSED MEDIAN ACCESS ROAD  
PLAN



PROPOSED MEDIAN ACCESS ROAD  
PROFILE



SECTION A-A

