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W.P. No. 49-71-05 & 06

CONT. No. 82-51

W. O. No.

STR. SITE No. 37-633

HWY. No. 427

LOCATION West Humbler River

No of PAGES -

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OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT.

REMARKS:

ENGINEERING MATERIALS OFFICE
PAVEMENT & FOUNDATION DESIGN SECTION

WP 49-71-05 & 06 DIST 6
HWY 427 STR SITE 37-633

Structures Over The West Humber River

CONT 82-51

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Supplemental
to
Foundation Investigation Report
for
Structure over the West Humber River
S.B.L. W.P. 49-71-06 NR
Site 37-633
Hwy. 427, Dist. 6, Toronto

A foundation investigation was carried out in August, 1979 for the above project and the results are contained in the Foundation Investigation Report for Structures Over the West Humber River, W.P. 49-71-05 and 06 issued on November 8, 1979. The scope of the investigation was based on the assumption that the structure would be founded on spread footings or end bearing piles. Since the report was issued, the founding scheme has been revised to 36"Ø tube piles concrete filled and socketted into the bedrock as a result of the Conservation Authorities' Hydrological requirements. The revised scheme required an additional boring in the area of the south abutment to confirm the subsurface and bedrock conditions.

The additional borehole was carried out on 80-05-21 and is appended as BH 14 for your information. Subsurface groundwater and bedrock conditions revealed in BH 14 are similar to those encountered in the boreholes previously carried out. A brief description of the encountered subsurface conditions in BH 14

are as follows.

From the ground surface extending to a depth of 10 feet is a cohesive deposit of clayey silt with some sand. The 'N' values of 7 and 29 blows per foot indicate the deposit has a hard consistency. Based on the topography and surrounding subsurface conditions, it is inferred that this surficial stratum is fill material. Immediately below this surficial cohesive material is a granular deposit some 6 feet thick, composed of sandy silt to a sandy gravel. Based on S.P.T. 'N' values of 10 and 32 blows per foot, the relative density is described as compact to dense. This granular strata is in turn, underlain by up to 12 feet of hard silty clay which contains occasional sand seams. A second granular zone some 10 feet thick was encountered immediately below the silty clay deposit. This granular zone exhibited a wide range in grain size distribution from a sand with gravel and a trace of silt to a sandy silt with a trace of clay. The Standard Penetration Test 'N' values ranged from 65 to over 100 blows per foot indicating a very dense relative density. This lower granular zone is underlain by a shale bedrock which was encountered at a depth of 38 feet below ground surface. The shale bedrock was proven by augering through 8 feet of shale. The shale may be described as fine textured, fissile and weathered.

The groundwater level was measured to be 10 feet below ground surface which corresponds to elevation 325. This groundwater level is some 5 feet higher than the Humber River water level

at the time of investigation.

The recommendation contained in our original Foundation Investigation Report and subsequent memorandum will not be altered in view of the subsurface conditions revealed in BH 14; however some adjustment in quantities (ie. steel pipe quantities, etc.) may be necessary in the area of BH 14 depending on the original assumptions.

If you have any further comments please do not hesitate to call us.

M. MacLean

M. MacLean

for

M. Devata
Senior Foundations Engineer

RECORD OF BOREHOLE No 14

W P 49-71-06 LOCATION N 15, 891, 877.5; E 966, 109.4 ORIGINATED BY B.T.
 DIST 6 HWY 427 BOREHOLE TYPE Hollow Stem Auger and Cone Test COMPILED BY B.T.
 DATUM Geodetic DATE May 21, 1980 CHECKED BY _____

| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | | | | PLASTIC LIMIT W _p | NATURAL MOISTURE CONTENT W | LIQUID LIMIT W _L | UNIT WEIGHT Y | REMARKS & GRAIN SIZE DISTRIBUTION (%) |
|---------------|---|------------|---------|------|------------|----------------------------|-----------------|---|----|----|----|-----|------------------------------------|-------------------------------------|-----------------------------------|---------------------|---|
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | 'N' VALUES | | | 20 | 40 | 60 | 80 | 100 | | | | | |
| 534.7 | Ground Surface | | 1 | SS | 7 | | | | | | | | | | | | GR SA SI CL |
| 0.0 | Clayey Silt Some Sand Hard (Probable Fill Material) | | 2 | SS | 29 | | 530 | | | | | | | | | | 2 33 40 2 |
| 524.7 | Sandy Organics | | 3 | SS | 10 | | | | | | | | | | | | 0 25 64 1 |
| 10.0 | Silt Compact | | | | | | | | | | | | | | | | |
| 520.7 | Sandy Gravel | | 4 | SS | 32 | | 520 | | | | | | | | | | 47 35 17 1 |
| 14.0 | Dense | | | | | | | | | | | | | | | | |
| 517.7 | Silty Clay | | 5 | SS | 68 | | | | | | | | | | | | |
| 17.0 | Occasional Sand Seams | | 6 | SS | 100 | | 510 | | | | | | | | | | |
| 506.7 | Hard | | | | | | | | | | | | | | | | |
| 28.0 | Sand with Gravel to Sandy Silt, Trace of Clay | | 7 | SS | 100 | 3" | 500 | | | | | | | | | | 31 59 10 |
| 496.7 | Very Dense | | 8 | SS | 65 | | | | | | | | | | | | 0 29 60 1 |
| 38.0 | Shale Bedrock | | 9 | SS | 100 | 4" | 490 | | | | | | | | | | |
| 488.2 | | | 10 | SS | 100 | 3" | | | | | | | | | | | |
| 46.5 | End of Borehole | | | | | | | | | | | | | | | | |

OFFICE REPORT ON SOIL EXPLORATION



Ministry of
Transportation and
Communications

foundation investigation and design report

| SAMPLE DISPOSITION NOTICE | | |
|---------------------------|---------------------|------------|
| TYPE | DISCARD AFTER | RECOMM. BY |
| JARS | 79 11 30 | m d |
| TUBES | — | — |
| ROCK CORES | the mwpd 14 cont | m d |

ENGINEERING MATERIALS OFFICE
PAVEMENT & FOUNDATION DESIGN SECTION

WP 49-71-05 & 06 DIST 6
HWY 427 STR SITE 37-633

Structures Over The West Humber River
CONT 82-51

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FOUNDATION INVESTIGATION REPORT

For

Structures Over The West Humber River

N.B.L., W.P. 49-71-05

S.B.L., W.P. 49-71-06

Site 37-633

Hwy. 427, District 6, Toronto

INTRODUCTION

This report presents the results of a foundation investigation carried out at this site from August 13 to August 27, 1979 by the Pavement and Foundation Design Section. The fieldwork consisted of augering nine samples boreholes, four of which were accompanied by a dynamic cone penetration test. The depth of boring ranged between 26 and 42 feet below the ground surface.

SITE AND GEOLOGY

The site is at the present crossing of Indian Line and the West Humber River, about 1½ miles north of Rexdale Blvd., in the Borough of Etobicoke, Metro Toronto.

The surrounding terrain is gently undulating, but generally sloping down towards the West Humber River. Most of the adjoining land is an open field, except the area in the southeastern quadrant of the site where it is thickly covered with mixed mature trees. The West Humber River, which is about 50 feet wide and 2 feet deep, flows gently in an easterly direction from a reservoir in the Claireville Conservation area which is located about 1000 feet upstream of the site. The riverbed is strewn with cobbles and boulders. Indian Line traverses the West Humber River by means of a two span single lane Bailey Bridge. The pier of the bridge is supported by steel 'H' section piles; whereas the abutments are supported by timber sills placed within the shallow approach fills. While the site is relatively well drained, the forward slope of the north approach embankment and its immediate neighboring area

are wet, showing signs of seepage.

Geologically, the site is located in a physiographic region generally referred to as the 'Peel plain'. The till plains in this region are often covered with a thin mantle of clay which was left over when this region was inundated during the Peel ponding period. The underlying bedrock is a grey shale of the Dundas-Meaford formation.

SUBSURFACE CONDITIONS

The location and elevation of the boreholes are shown in Drawing No. 497105/06-A, which also contains two estimated subsoil stratigraphy profiles. The subsurface conditions at this site are rather complex, consisting of recent alluvial, glacial, and interglacial deposits. In view of this, reference should be made to the individual borehole record sheets for the factual data about the subsurface conditions. A brief description of the various subsoil strata and bedrock encountered in our investigation is as follows.

Alluvial Deposits

A surficial alluvial deposit was encountered in the south riverbank as well as in one location in the north riverbank. This deposit has a thickness of up to 9.5 feet and is composed of sandy silt to sand and gravel. At some places, the alluvial deposit also contains trace of clay or organics. A typical grain size distribution curve of the alluvium which is composed of sand and gravel is shown in Figure 1. Based on the 'N' values which ranged from 12 to 41 blows per foot, it is inferred that the relative density of the alluvial deposit is compact to dense.

Clayey Silt with Sand and Gravel (Glacial Till)

This deposit was encountered in the high ground north of the river. It extends immediately below the ground surface and

at one location has a thickness of about 9.5 feet. The glacial till is a heterogeneous mixture of clay, silt, sand and gravel. Its matrix has a low plasticity, with a liquid limit of about 23% and a plastic limit of about 13% (Figure 2). The material in the upper 7 feet or so of the glacial till stratum is brown and very stiff; below that it is grey. In one isolated zone, the glacial till is firm, having an undrained shear strength measured by in-situ vane test in the order of 640 psf.

Silty Sand with Gravel (Glacial Till)

This is the predominant deposit at this site. It was encountered either immediately beneath the ground surface or beneath the above mentioned surficial deposits of alluvium or the cohesive glacial till. This basically non-cohesive glacial till stratum has a thickness ranging from 13 to 22 feet and is composed of a heterogeneous mixture predominantly of silt, sand and gravel. Typical grain size distribution characteristics of the granular glacial till are shown in Figure 3 in an envelope form. Within the granular glacial till stratum, there are occasional layers or zones of silty clay, sandy silt or sand with gravel. The Atterberg limits of the material in the cohesive inclusions are shown in Figure 2 and the grain size distribution curves of the material in the non-cohesive inclusions are shown in Figure 4 and 5. The 'N' values of the overall stratum of the glacial till ranged from occasional low values of 16 and 28 blows per foot in the upper portion of the stratum to generally in excess of 100 blows per foot. Accordingly, the relative density of the granular glacial till is occasionally compact in the upper portion of the deposit but generally very dense.

Silty Clay

The above granular glacial till deposit is underlain throughout the site by a stratum of reddish silty clay with some sand and trace of gravel. A typical grain size distribution

curve for the silty clay is shown in Figure 6. This stratum of cohesive subsoil generally extends down to bedrock surface for a thickness of about 8 to 16 feet. The silty clay was also found to contain occasional layers, or pockets, of sand or sand and gravel. In some places, these granular inclusions are sandwiched between the silty clay and the bedrock. The silty clay has the following identity indices:

| | | |
|------------------|--------------------|----------|
| Moisture content | (w%) | 7 to 16 |
| Plastic limit | (w _P %) | 10 to 22 |
| Liquid limit | (w _L %) | 16 to 28 |

These results, when plotted on a plasticity chart (Figure 2), fall mostly in the CL zone, with only occasional points in the CL-ML zone. Therefore, the silty clay generally has a low plasticity; but occasionally it may only be slightly plastic. The 'N' values in the silty clay deposit are overwhelmingly in excess of 100 blows per foot. Based on these, the consistency of the cohesive subsoil is defined as hard.

Shale Bedrock

The bedrock surface is gently undulating, varying between elevation 490 and elevation 496. Bedrock is a grey shale of the Dundas-Meadford formation. The shale is soft, fine textured and fissile. It was found to be weathered within the depths of our borings.

Groundwater Conditions

The groundwater level in the south riverbank was found to exist at elevation 519 \pm , closely corresponding to the prevailing river water level. The groundwater level in the area north of the river was found to be almost at the ground surface, except for one location in the high ground where the groundwater level was found at a depth of about 6 feet below the ground surface, corresponding to elevation 524 \pm . Because of the very high groundwater table in the north river bank, the ground adjacent to the forward slope of the existing north approach embankment has become very wet.

DISCUSSIONS AND RECOMMENDATIONS

It has been proposed to construct two three span structures to carry the SBL and the NBL of Hwy. 427 over the West Humber River. These two structures would have a span arrangement of 75' - 85' - 75' and would require approach fills up to 30 feet high. In addition, the West Humber River would be rechannelized. The bottom of the realigned channel would be about 46 feet wide. Our recommendations for the structure foundations, the approaches and the channel diversion are as follows.

Structure Foundations

Abutments

Considering the proposed height of the approach fills, we recommend that perched types abutment be adopted. Such abutments can be supported either by spread footings placed on a well compacted granular 'A' pad or by end-bearing piles driven into the competent subsoil.

In the scheme of spread footings on compacted granular 'A' pad, an allowable bearing pressure of up to 2.5 tsf for vertical loads and a coefficient of friction equal to 0.65 for resistance against lateral loads can be assumed for design purposes. The granular 'A' pads however, should be constructed on competent natural ground. Therefore, all the existing approach fill material and organic contaminated surficial subsoil or topsoil within the plane limits of the granular 'A' pads should be completely removed.

In the scheme of end-bearing piles, we recommend that steel 'H' section piles should be used because hard driving conditions are anticipated. These piles can be designed for their maximum allowable structural capacity. To ensure that the piles develop their design bearing capacity, pile driving should be controlled by M.T.C. Hiley formula. It's our opinion that the piles would

develop the design capacity when they are driven to approximate tip elevations of 514 - 510. In the areas where piles are to be driven, the fill material should not contain cobbles and boulders. In addition, all existing surficial cobbles and boulders in these areas should be removed prior to driving the piles.

The underside of the footings or the pile caps should have a minimum of 4 feet of earth cover for frost protection purposes. If the abutment spread footings or the pile caps are located as recommended, they will be above the groundwater table and no major dewatering problems are foreseen during their construction.

Piers

The piers can be supported on spread footings founded in the competent silty sand till stratum. The founding levels for the various pier footings should be at or below the following elevations.

| <u>Footing Location</u> | <u>Ref. Boreholes</u> | <u>Founding Elevation</u> |
|-------------------------|-----------------------|---------------------------|
| SBL South Pier | 5 | 518 |
| SBL North Pier | 6 | 518 |
| NBL South Pier | 9 | 511 |
| NBL North Pier | 10 | 518 |

If it is desired to found the south pier footings of the NBL structure at approximately the same elevation as the other pier footings, this can be achieved by bringing up the excavation with concrete. The underside of the various pier footings should be situated below the frost penetration depth or below the probable scour depth, whichever is the deeper. The pier footings, if founded as recommended above, can be designed for a bearing pressure of up to 4 tsf.

Since the excavation for the pier footings will be carried out below the groundwater level and the silty sand till,

because of the lack of sufficient clay binder in it, would behave essentially as a granular soil, a positive dewatering scheme will be required for the construction of the pier footings. Dewatering can be achieved by means of the method of oversized excavation which incorporates a perimeter intercepting ditch and an impervious earth dyke to exclude the river water. Alternatively, instead of constructing the pier footings 'in the dry', the method of 'flooded excavation' can be adopted, with the footings poured using 'tremie concrete' method.

Approaches

The subsoil is competent; therefore, the required 30 foot high approach fills can be constructed with forward slopes and side slopes of 2:1. The approach fills should be protected against scouring with rip-rap up to the high water level. ✓


Channel Diversion

The sides of the channel should be maintained at not steeper than 2:1. Because of the lack of sufficient clay binder in it, the silty sand till is considered susceptible to erosion and scouring. In view of this, the side and the bottom of the channel should be protected either with concrete linings or with rip-rap. ✓

Other Considerations

Backfill to the abutments should be composed of free draining granular type of material which should be kept drained by means of weep holes. To estimate the lateral earth pressure exerted on the wall by the weight of the granular backfill, a coefficient of lateral earth pressure (K) equal to 0.4 and a unit weight of the backfill material (γ) equal to 135 pcf should be used. It should be noted that the use of heavy ✓

vibrating compacting equipment in the vicinity of the abutment walls should be restricted as per current M.T.C. practice.



B. Ly

B. Ly, P. Eng.
Foundation Engineer.

M. Devata

M. Devata, P. Eng.
Senior Foundation Engineer.

October, 1979.

APPENDIX

RECORD OF BOREHOLE No 5

W P 49-71-05/06 LOCATION Co-ords. N 15,891,951; E 966,084 ORIGINATED BY BRL
 DIST 6 HWY 427 BOREHOLE TYPE 3 1/2" Diameter HSA COMPILED BY BL
 DATUM Geodetic DATE August 22, 1979 CHECKED BY RS

| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | | | | PLASTIC LIMIT W _p | NATURAL MOISTURE CONTENT W | LIQUID LIMIT W _L | UNIT WEIGHT γ | REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL |
|---------------|---|------------|---------|------|------------|----------------------------|-----------------|--|--|--|--|--|------------------------------------|-------------------------------------|-----------------------------------|---------------------|--|
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | 'N' VALUES | | | 20 40 60 80 100 | | | | | | | | | |
| | | | | | | | | SHEAR STRENGTH ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE | | | | | | | | | |
| 525.0 | Ground Level | | | | | | | | | | | | | | | | |
| 0.0 | Sandy silt, brown, dense | | 1 | SS | 41 | | 520 | | | | | | | | | 28 41 (31) | |
| 520.5 | | | 2 | SS | 47 | | | | | | | | | | | | |
| 4.5 | Glacial Till, Silty sand, some gravel, grey, very dense | | 3 | SS | 80 | | | | | | | | | | | | |
| | | 4 | SS | 100/ | 6" | | | | | | | | | | | | |
| | | 5 | SS | 100/ | 4" | | | | | | | | | | | | |
| | | 6 | SS | 128/ | 10" | | | | | | | | | | | | |
| | | | 7 | SS | 69 | | 510 | | | | | | | | | | |
| 501.0 | | | | | | | | | | | | | | | | 26 53 (21) | |
| 24.0 | Silty clay, some sand, reddish, hard | | 8 | SS | 100/ | 5 " | 500 | | | | | | | | | | |
| 494.0 | | | 9 | SS | 131/ | 10" | | | | | | | | | | | |
| 31.0 | Shale bedrock, weathered | | | | | | | | | | | | | | | | |
| 489.5 | | | 10 | SS | 100/ | 3" | 490 | | | | | | | | | | |
| 35.5 | End of Borehole | | | | | | | | | | | | | | | | |

RECORD OF BOREHOLE No 6

W P 49-71-05/06 LOCATION Co-ords. N 15,892,042; E 966,097 ORIGINATED BY BRL
 DIST 6 HWY 427 BOREHOLE TYPE 3 1/2" Diameter HSA and Cone Test COMPILED BY BL
 DATUM Geodetic DATE August 17, 1979 CHECKED BY RS

| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | | | | UNIT WEIGHT Y | REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL |
|---------------|---|------------|---------|------|------------|----------------------------|--------------------|---|----|----|----|-----|---------------------|--|
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | 'N' VALUES | | | 20 | 40 | 60 | 80 | 100 | | |
| 520.3 | Ground Level | | | | | | | SHEAR STRENGTH | | | | | | |
| | | | | | | | | O UNCONFINED + FIELD VANE | | | | | | |
| | | | | | | | | ● QUICK TRIAXIAL x LAB VANE | | | | | | |
| | | | | | | | | WATER CONTENT (%) | | | | | | |
| | | | | | | | | 10 20 30 | | | | | | |
| 0.0 | Glacial Till Silty sand, some gravel, grey, very dense | | 1 | SS | 43 | | 520 | | | | | | | |
| | | | 2 | SS | 115 | 6" | | | | | | | | |
| | | | 3 | SS | 151 | | | | | | | | | |
| | | | 4 | SS | 100 | 3" | | | | | | | | |
| | | | 5 | SS | 185 | 8" | | | | | | | | |
| 504.8 | | | 6 | SS | 173 | | | | | | | | | |
| 15.5 | Silty clay, some sand reddish brown, hard | | 7 | SS | 150 | | | | | | | | | |
| 499.8 | | | 8 | SS | 119 | | | | | | | | | |
| 20.5 | Gravelly sand, very dense | | 9 | SS | 133 | | | | | | | | | |
| 496.8 | | | 10 | SS | 164 | | | | | | | | | |
| 23.5 | Shale bedrock, fine textured and fissile, weathered | | 11 | SS | 100 | 5" | | | | | | | | |
| 487.8 | | | 12 | SS | 120 | 5" | | | | | | | | |
| 32.5 | End of Borehole | | | | | | | | | | | | | |

RECORD OF BOREHOLE No 7

W P 49-71-05/06 LOCATION Co-ords. N 15,892,121; E 966,093 ORIGINATED BY BRL
 DIST 6 HWY 427 BOREHOLE TYPE 3 1/2" Diameter HSA and Cone Test COMPILED BY BL
 DATUM Geodetic DATE August 16, 1979 CHECKED BY ES

| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | | | | PLASTIC LIMIT W _p | NATURAL MOISTURE CONTENT W | LIQUID LIMIT W _L | UNIT WEIGHT γ | REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL |
|--------------|---|------------|---------|------|------------|-------------------------|-----------------|--|----|----|----|-----|---------------------------------|-------------------------------|--------------------------------|------------------|--|
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | 'N' VALUES | | | 20 | 40 | 60 | 80 | 100 | | | | | |
| 530.0 | Ground Level | | | | | | | | | | | | | | | | |
| 0.0 | Glacial Till Clayey silt, trace of gravel, brown, very stiff | | 1 | SS | 36 | | | | | | | | | | | | |
| | | | 2 | SS | 17 | | | | | | | | | | | | |
| 520.5 | firm, grey | | 3 | SS | 2 | | | | | | | | | | | | |
| 9.5 | Glacial Till Silty sand, some gravel, grey, very dense | | 4 | SS | 100/ | 3" | 520 | | | | | | | | | | 12 64 (24) |
| | | | 5 | SS | 114 | | | | | | | | | | | | |
| | | | 6 | SS | 100/ | 5" | | | | | | | | | | | |
| | silty clay | | 7 | SS | 100/ | 5" | | | | | | | | | | | |
| | | | 8 | SS | 100/ | 4" | 510 | | | | | | | | | | 33 52 (15) |
| 24.5 | Silty clay, reddish | | 9 | SS | 100/ | 5" | | | | | | | | | | | |
| | | | 10 | SS | 122 | | | | | | | | | | | | |
| 27.0 | End of Borehole | | | | | | | | | | | | | | | | |

+3, x5 : Numbers refer to Sensitivity

20
15
10
5 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 8

W P 49-71-05/06 LOCATION Co-ords. N 15,891,803; E 966,240 ORIGINATED BY BRL
 DIST 6 HWY 427 BOREHOLE TYPE 3 1/2" Diameter and Cone Test COMPILED BY BL
 DATUM Geodetic DATE August 23, 1979 CHECKED BY RS

| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | | | | UNIT WEIGHT γ | REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL |
|---------------|---|------------|---------|------|------------|----------------------------|-----------------|---|----|----|----|-----|----------------------------|--|
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | 'N' VALUES | | | 20 | 40 | 60 | 80 | 100 | | |
| 522.0 | Ground Level | | | | | | 520 | SHEAR STRENGTH | | | | | | |
| 0.0 | Sand, trace of clay and gravel, compact | | 1 | SS | 19 | | | O UNCONFINED + FIELD VANE | | | | | | |
| 517.5 | | | 2 | SS | 28 | | | ● QUICK TRIAXIAL x LAB VANE | | | | | | |
| 4.5 | Glacial Till | | 3 | SS | 153 | 9" | | WATER CONTENT (%) | | | | | | |
| | Silty sand, trace to some gravel, compact to very dense | | 4 | SS | 114 | 10" | | Wp W WL | | | | | | |
| | silty clay | | 5 | SS | 185 | | | 10 20 30 | | | | | | |
| 505.0 | | | 6 | SS | 90 | | | | | | | | | |
| 17.0 | Silty clay, reddish, hard | | 7 | SS | 125 | | | | | | | | | |
| 498.0 | some gravel | | 8 | SS | 112 | | | | | | | | | |
| 24.0 | Gravelly sand, very dense | | 9 | SS | 145 | 11" | | | | | | | | |
| 494.0 | | | 10 | SS | 110 | 5" | | | | | | | | |
| 28.0 | Shale bedrock, fine textured and fissile, weathered | | 11 | SS | 110 | 3" | | | | | | | | |
| 486.5 | | | | | | | | | | | | | | |
| 35.5 | End of Borehole | | | | | | | | | | | | | |

+3, x5: Numbers refer to
Sensitivity

20
15 \pm 5 (%) STRAIN AT FAILURE
10

RECORD OF BOREHOLE No 9

W P 49-71-05/06 LOCATION Co-ords. N 15,891,895; E 966,208 ORIGINATED BY BRL
 DIST 6 HWY 427 BOREHOLE TYPE 3 1/2" Diameter HSA COMPILED BY BL
 DATUM Geodetic DATE August 23, 1979 CHECKED BY RS

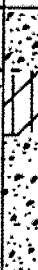


| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | | | | UNIT WEIGHT γ | REMARKS & GRAIN SIZE DISTRIBUTION (%) |
|--------------|---|------------|---------|------|------------|-------------------------|-----------------|--|----|----|----|-----|------------------|---------------------------------------|
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | 'N' VALUES | | | 20 | 40 | 60 | 80 | 100 | | |
| 522.1 | Ground Level | | | | | | | | | | | | | |
| 0.0 | Sand to sand trace of and gravel organics | | 1 | SS | 12 | | 520 | | | | | | | |
| | | | 2 | SS | 15 | | | | | | | | | |
| 512.6 | | | 3 | SS | 27 | | | | | | | | | 46 40 (14) |
| 9.5 | Glacial Till | | 4 | SS | 160 | | | | | | | | | |
| | Silty sand, some gravel, grey, very dense | | 5 | SS | 123/10" | | 510 | | | | | | | 9 35 (56) |
| | | | 6 | SS | 72 | | | | | | | | | |
| | | | 7 | SS | 76 | | | | | | | | | |
| 498.1 | | | 8 | SS | 159 | | 500 | | | | | | | 26 57 (17) |
| 24.0 | Silty clay, some sand, reddish, hard | | 9 | SS | 113/9" | | | | | | | | | |
| 490.1 | gravelly | | 10 | SS | 144/9" | | 490 | | | | | | | |
| 32.0 | Shale bedrock, weathered | | 11 | SS | 100/3" | | | | | | | | | |
| 486.6 | | | | | | | | | | | | | | |
| 35.5 | End of Borehole | | | | | | | | | | | | | |

+3, x5: Numbers refer to Sensitivity

20
15
10
5
5 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 10

W P 49-71-05/06 LOCATION Co-ords. N 15,891,989; E 966,213 ORIGINATED BY BRL
 DIST 6 HWY 427 BOREHOLE TYPE 3 1/2" Diameter RSA and Cone Test COMPILED BY BL
 DATUM Geodetic DATE August 24, 1979 CHECKED BY RS

| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | PLASTIC LIMIT W _p | NATURAL MOISTURE CONTENT W | LIQUID LIMIT W _L | UNIT WEIGHT γ | REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL |
|---------------|--|---|---------|------|------------|----------------------------|-----------------|--|--|------------------------------------|-------------------------------------|-----------------------------------|---------------------|--|
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | 'N' VALUES | | | SHEAR STRENGTH ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE | | | | | | |
| 522.6 | Ground Level | | | | | | | 20 40 60 80 100 | | 10 20 30 | | | | |
| 0.0 | Glacial Till Silty sand, grey trace to some gravel, very dense |  | 1 | SS | 58 | | | | | | | | | |
| | | | 2 | SS | 54 | | | | | | | | | |
| | | | 3 | SS | 100 | 4" | | | | | | | | 45 18 (37) |
| | | | 4 | SS | 104 | | | | | | | | | |
| | | | 5 | SS | 94 | 6" | | | | | | | | 4 43 (53) |
| | | | 6 | SS | 100 | 5" | | | | | | | | |
| 503.6 | | | 7 | SS | 118 | | | | | | | | | |
| 19.0 | Silty clay, trace of sand, reddish, hard |  | 8 | SS | 133 | 10" | | | | | | | | |
| | | | 9 | SS | 135 | 8" | | | | | | | | |
| 493.6 | Silty sand | | | | | | | | | | | | | |
| 29.0 | Shale bedrock, fissile and weathered |  | 10 | SS | 125 | 5" | | | | | | | | |
| 486.1 | | | 11 | SS | 125 | 2" | | | | | | | | |
| 36.5 | End of Borehole | | | | | | | | | | | | | |

+3, x5: Numbers refer to
Sensitivity

20
15 5 (%) STRAIN AT FAILURE
10



RECORD OF BOREHOLE No 11

W P 49-71-05/06 LOCATION Co-ords. N 15,892,042; E 966,254 ORIGINATED BY BRL
DIST 6 HWY 427 BOREHOLE TYPE 3 1/2" Diameter HSA COMPILED BY BL
DATUM Geodetic DATE August 13, 1979 CHECKED BY RS

| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | | | | UNIT WEIGHT γ | REMARKS & GRAIN SIZE DISTRIBUTION (%) | | | |
|---------------|--|------------|---------|------|------------|----------------------------|-----------------|--|--|--|--|--|---------------------|---|---|-------------------------------------|-----------------------------------|
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | 'N' VALUES | | | 20 40 60 80 100 | | | | | | | PLASTIC LIMIT W _p | NATURAL MOISTURE CONTENT W | LIQUID LIMIT W _L |
| | | | | | | | | SHEAR STRENGTH ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE | | | | | | | WATER CONTENT (%) 10 20 30 | | |
| 530.6 | Ground Level | | | | | | | | | | | | | | GR SA SI CL | | |
| 0.0 | Glacial Till Silty sand, some gravel, dense | | 1 | SS | 35 | | 530 | | | | | | | | 50 40 (10) 1 24 (75) 51 21 (28) | | |
| | | | 2 | SS | 39 | | 520 | | | | | | | | | | |
| | | | 3 | SS | 49 | | | | | | | | | | | | |
| | | | 4 | SS | 35 | | | | | | | | | | | | |
| | | | 5 | SS | 110 | | | | | | | | | | | | |
| | | | 6 | SS | 123 | | | | | | | | | | | | |
| | | | 7 | SS | 183 | | 11" | 510 | | | | | | | | | |
| | | | 8 | SS | 147 | | 11" | | | | | | | | | | |
| 508.6 | | | 9 | SS | 143 | | 6" | | | | | | | | | | |
| 22.0 | Silty clay, some sand, reddish, hard | | 10 | SS | 109 | | | | | | | | | | | | |
| | | | 11 | SS | 70 | | | | | | | | | | | | |
| | | | 12 | SS | 140 | | 9" | 500 | | | | | | | | | |
| | | | 13 | SS | 100 | | 4" | | | | | | | | | | |
| | | | 14 | SS | 143 | | 10" | | | | | | | | | | |
| 492.6 | | | | | | | | | | | | | | | | | |
| 38.0 | Shale bedrock, weathered | | 15 | SS | 105 | 6" | 490 | | | | | | | | | | |
| 489.1 | | | | | | | | | | | | | | | | | |
| 41.5 | End of Borehole | | | | | | | | | | | | | | | | |

RECORD OF BOREHOLE No 12

W P 49-71-05/06 LOCATION Co-ords. N 15,892,091; E 966,135 ORIGINATED BY BL
 DIST 6 HWY 427 BOREHOLE TYPE 3 1/2" Diameter RSA COMPILED BY BL
 DATUM Geodetic DATE August 27, 1979 CHECKED BY RS

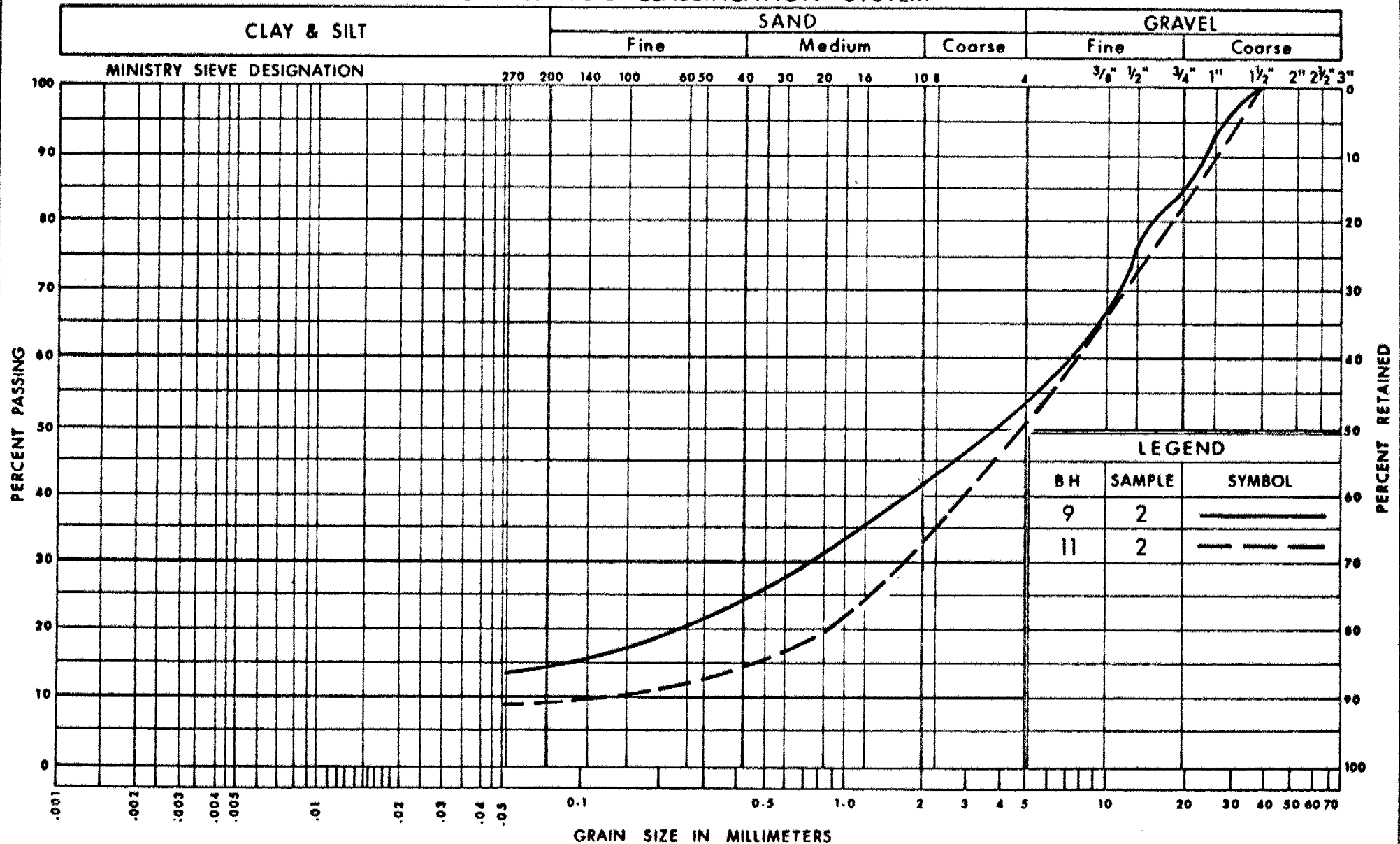
| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | | | | PLASTIC LIMIT W _p | NATURAL MOISTURE CONTENT W | LIQUID LIMIT W _L | UNIT WEIGHT Y | REMARKS & GRAIN SIZE DISTRIBUTION (%) |
|---------------|--|------------|---------|------|------------|----------------------------|-----------------|---|----|----|----|-----|------------------------------------|-------------------------------------|-----------------------------------|---------------------|---|
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | 'N' VALUES | | | 20 | 40 | 60 | 80 | 100 | | | | | |
| 524.0 | Ground Level | | | | | | | | | | | | | | | | |
| 0.0 | Glacial Till Silty sand, some gravel, grey compact to generally very dense | Organics | 1 | SS | 16 | | 520 | | | | | | | | | | |
| | | | 2 | SS | 120/11" | | | | | | | | | | | | |
| | | | 3 | SS | 52 | | | | | | | | | | | | |
| | Silty clay | | 4 | SS | 73 | | | | | | | | | | | | |
| | | | 5 | SS | 90/5" | | 510 | | | | | | | | | | |
| 505.0 | | | | | | | | | | | | | | | | | |
| 19.0 | Silty clay, some sand, reddish, hard | | 6 | SS | 100/8" | | | | | | | | | | | | 0 42 (58) |
| 498.0 | | | | | | | | | | | | | | | | | |
| 497.0 | Probable bedrock | | 7 | SS | Bouncing | | 500 | | | | | | | | | | |
| 27.0 | End of Borehole | | | | | | | | | | | | | | | | |
| | Note: Augering met refusal at 27 feet | | | | | | | | | | | | | | | | |

RECORD OF BOREHOLE No 13

W P 49-71-05/06 LOCATION Co-ords. N 15,892,047; E 966,157 ORIGINATED BY BL
 DIST 6 HWY 427 BOREHOLE TYPE 3 1/2" Diameter HSA COMPILED BY BL
 DATUM Geodetic DATE August 27, 1979 CHECKED BY RS

| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | | | | PLASTIC LIMIT W _p | NATURAL MOISTURE CONTENT W | LIQUID LIMIT W _L | UNIT WEIGHT γ | REMARKS & GRAIN SIZE DISTRIBUTION (%) |
|---------------|--|------------|---------|------|------------|----------------------------|--------------------|---|----|----|----|-----|------------------------------------|-------------------------------------|-----------------------------------|---------------------|---|
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | 'N' VALUES | | | 20 | 40 | 60 | 80 | 100 | | | | | |
| 523.0 | Ground Level | | | | | | | | | | | | | | | | |
| 0.0 | Fine sand with gravel | Organic | | | | | 520 | | | | | | | | | | |
| 517.0 | Very dense | | 1 | SS | 55 | | | | | | | | | | | | |
| 6.0 | Silty clay, some sand seams, trace of gravel | | 2 | SS | 102 | 10" | 510 | | | | | | | | | | |
| | Glacial Till | | | | | | | | | | | | | | | | |
| | Silty sand, some gravel, very dense | | 3 | SS | 57 | | | | | | | | | | | | |
| | | | 4 | SS | 96 | 11" | 500 | | | | | | | | | | |
| | Sand with gravel, very dense | | | | | | | | | | | | | | | | |
| 496.5 | | | 5 | SS | 128 | 11" | | | | | | | | | | | 29 51 (20) |
| 26.5 | End of Borehole | | | | | | | | | | | | | | | | |

UNIFIED SOIL CLASSIFICATION SYSTEM

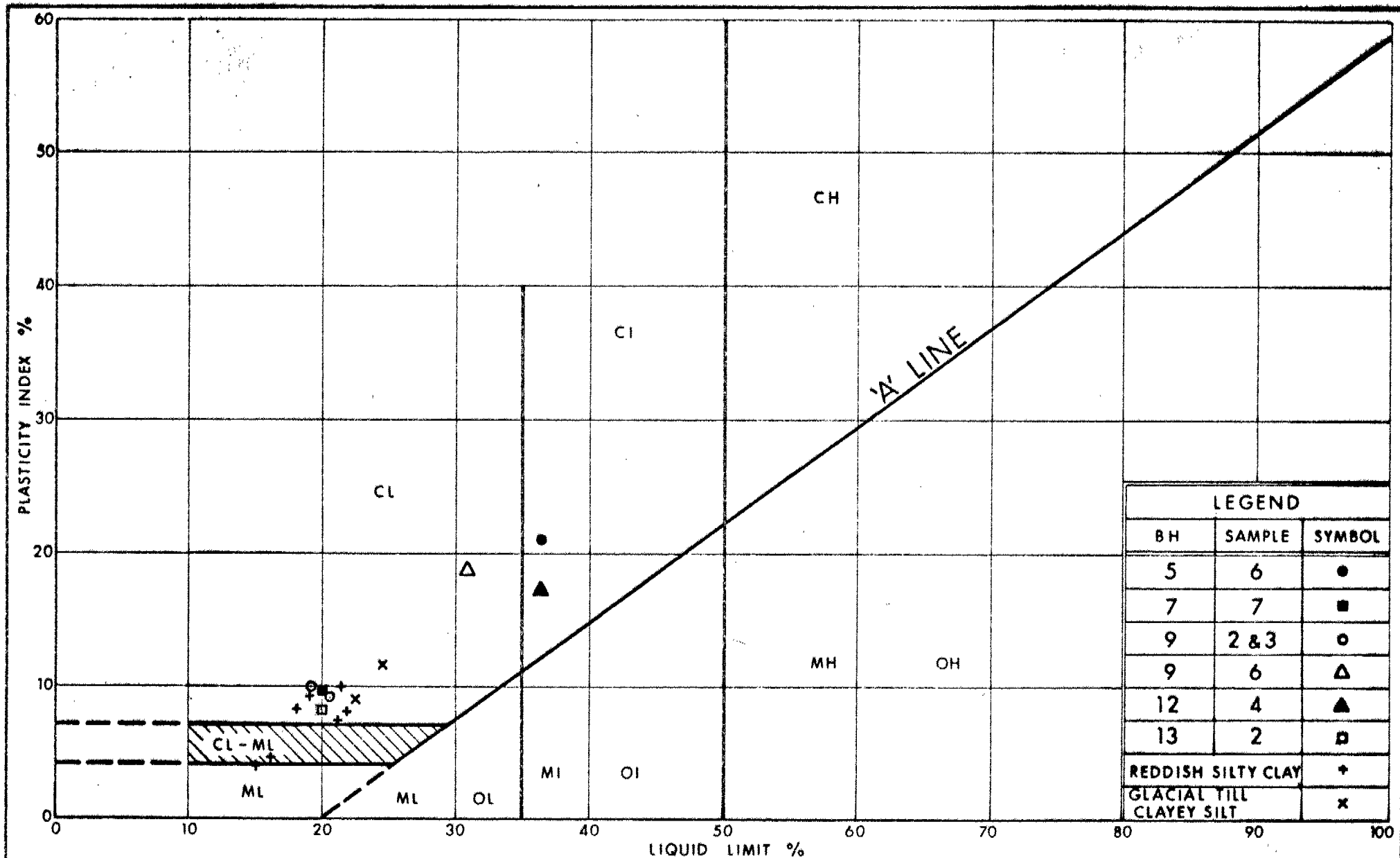


Ministry of
Transportation and
Communications

GRAIN SIZE DISTRIBUTION SAND & GRAVEL

FIG No 1

W P 49 - 71 - 05 & 06

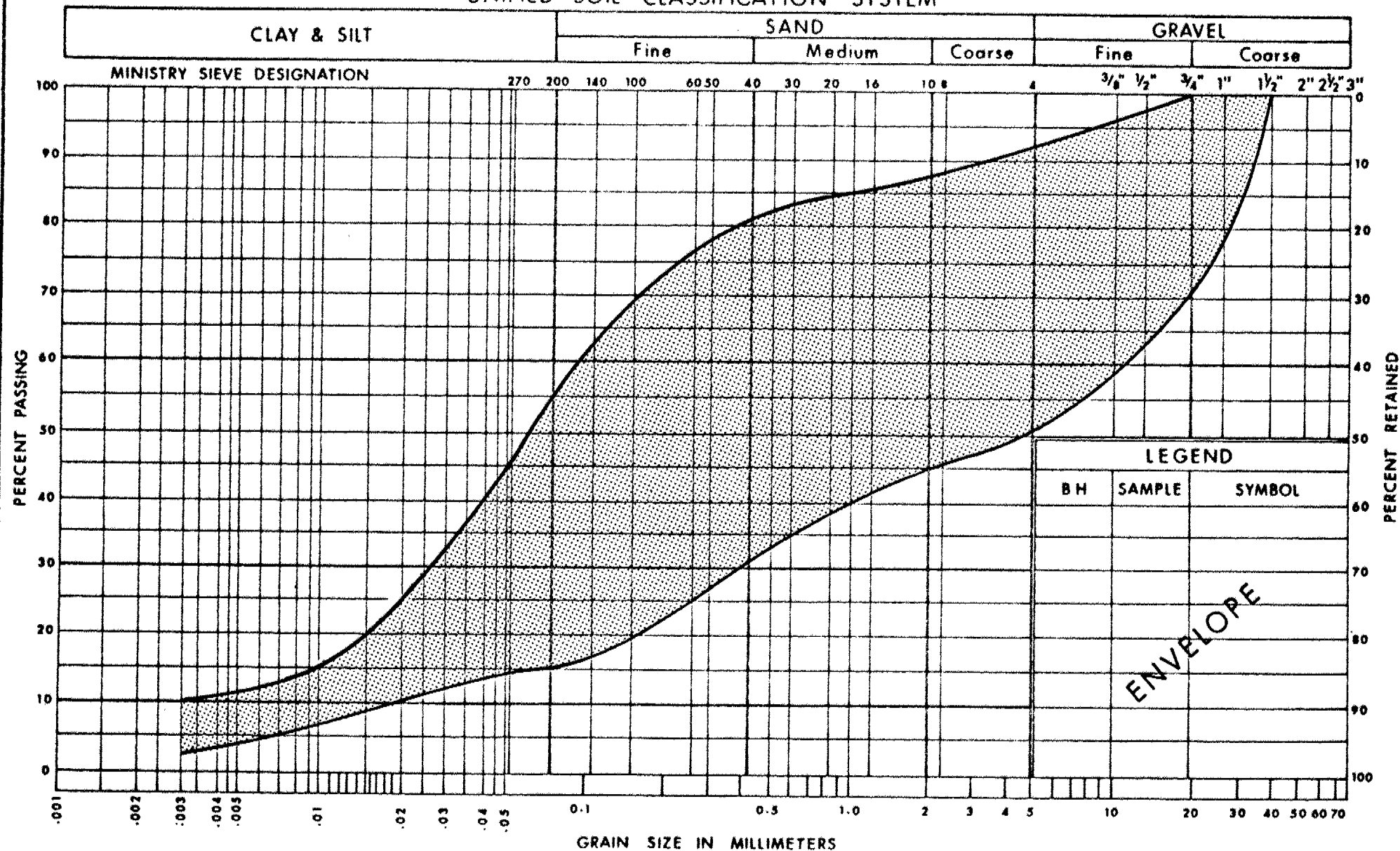


Ministry of
Transportation and
Communications

PLASTICITY CHART

FIG No 2

W P 49-71-05 & 06



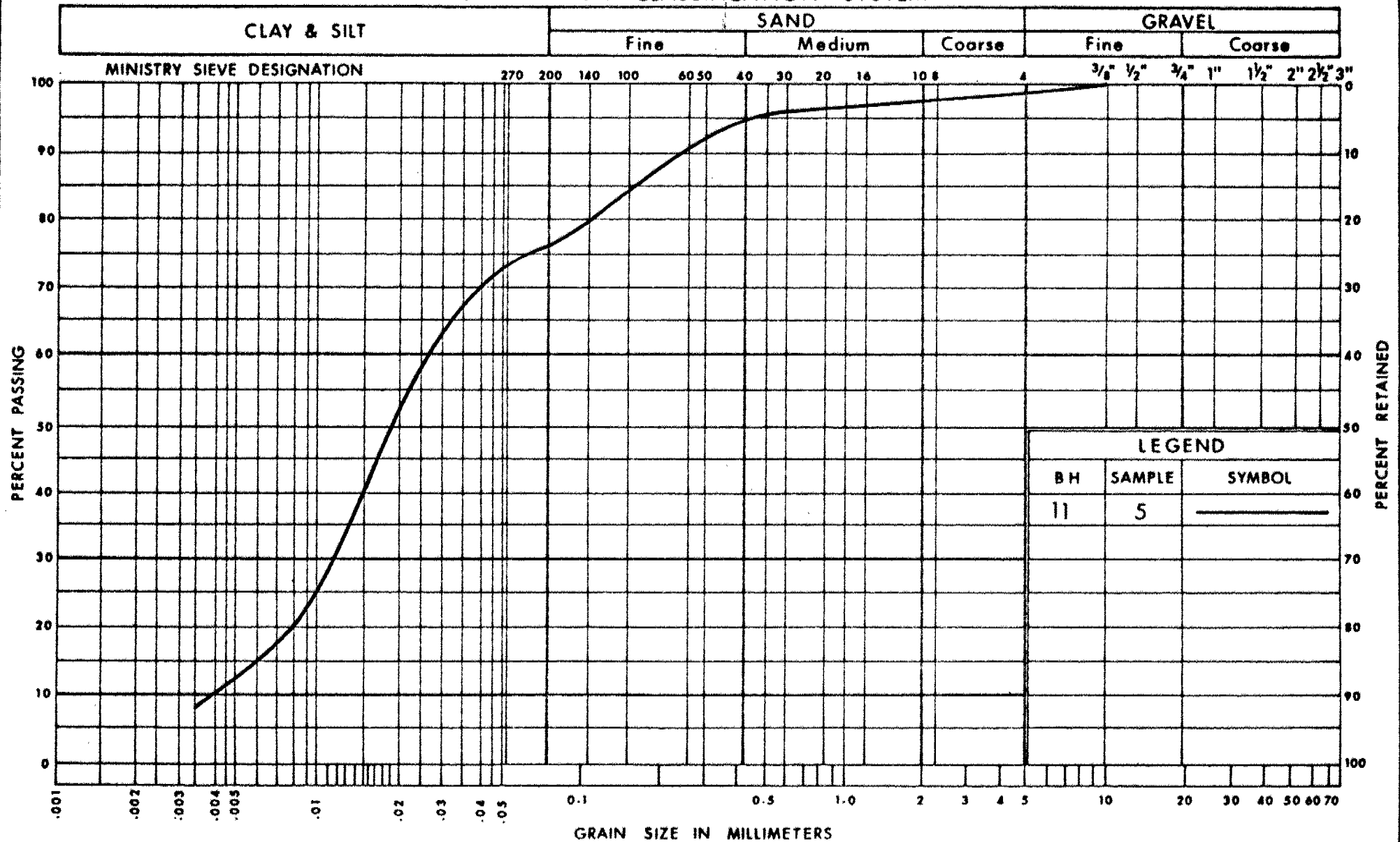
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Transportation and
Communications**

GRAIN SIZE DISTRIBUTION
GLACIAL TILL
SILTY SAND WITH GRAVEL

FIG No 3

W P 49-71-05 & 06

UNIFIED SOIL CLASSIFICATION SYSTEM



Ministry of
Transportation and
Communications

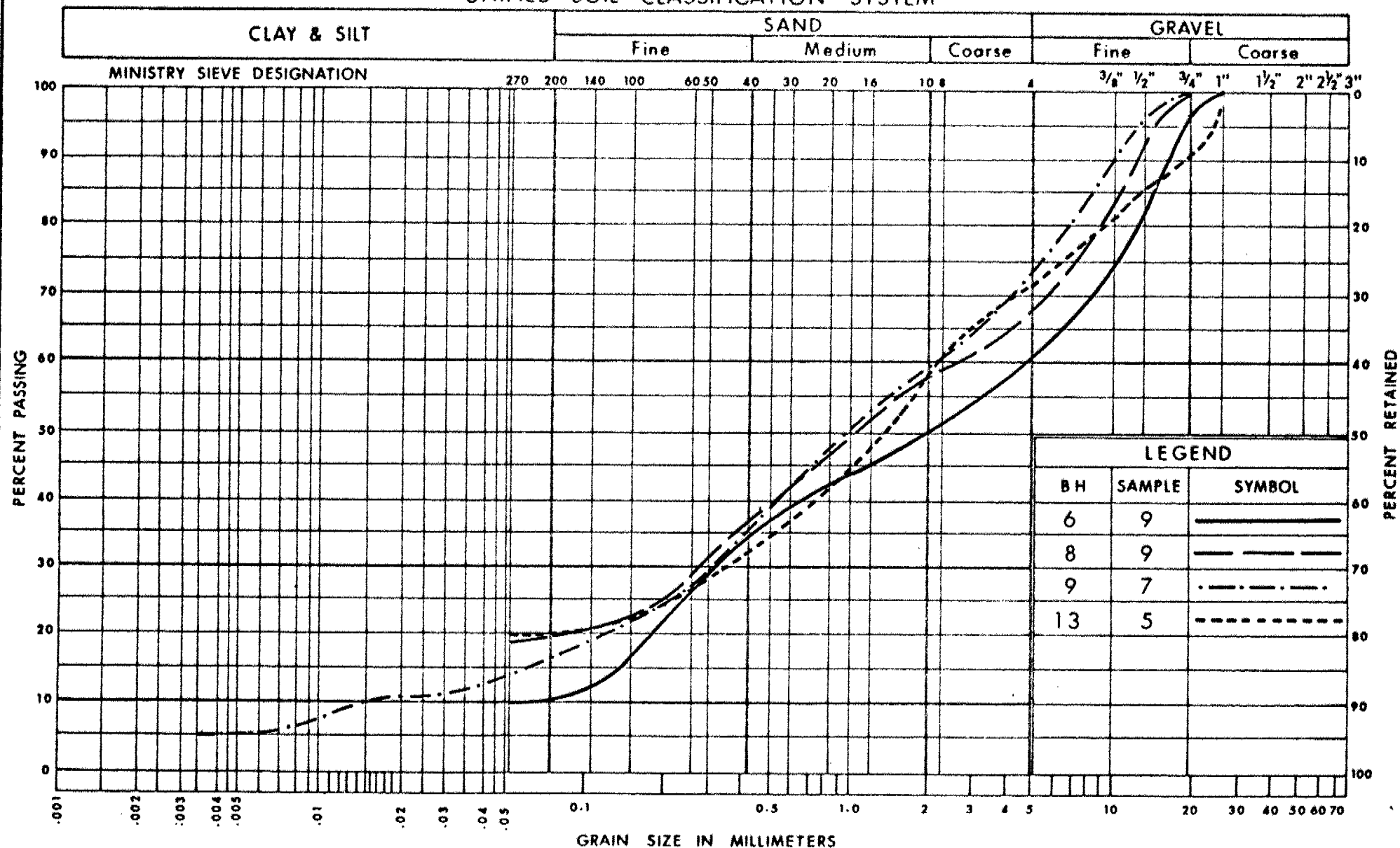
GRAIN SIZE DISTRIBUTION

SANDY SILT

FIG No 4

W P 49-71-05 & 06

UNIFIED SOIL CLASSIFICATION SYSTEM



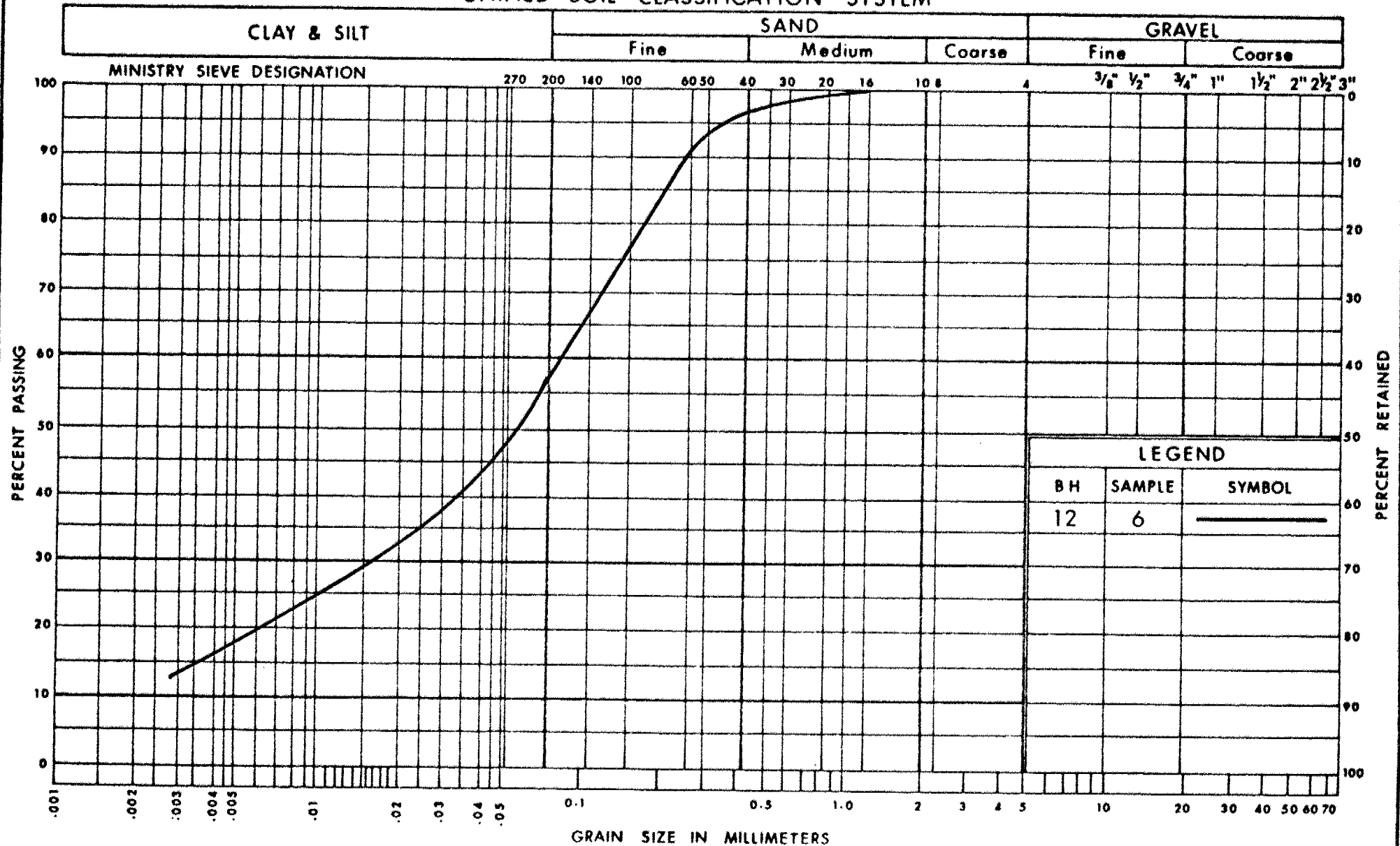
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GRAIN SIZE DISTRIBUTION
GRAVELLY SAND

FIG No 5

W P 49-71-05 & 06

UNIFIED SOIL CLASSIFICATION SYSTEM



Ministry of
Transportation and
Communications

GRAIN SIZE DISTRIBUTION
SILTY CLAY
SOME SAND

FIG No 6

W P 49-71-05 & 06

EXPLANATION OF TERMS USED IN REPORT

'N' VALUE: AN INDICATOR OF SUBSOIL QUALITY. IT IS OBTAINED FROM THE STANDARD PENETRATION TEST (CSA STD. A119.1). SPT 'N' VALUE IS THE NUMBER OF BLOWS REQUIRED TO CAUSE A STANDARD 2 INCH O.D. SPLIT-BARREL SAMPLER TO PENETRATE 12 INCHES INTO UNDISTURBED GROUND IN A BOREHOLE WHEN DRIVEN BY A HAMMER WEIGHING 140 POUNDS, FALLING FREELY A DISTANCE OF 30 INCHES. FOR PENETRATIONS OF LESS THAN 12 INCHES 'N' VALUES ARE INDICATED AS THE NUMBER OF BLOWS FOR THE PENETRATION ACHIEVED. 'N' VALUES CORRECTED FOR OVERBURDEN PRESSURE ARE DENOTED THUS N_c .

DYNAMIC CONE PENETRATION TEST (CSA STD. A119.3): CONTINUOUS PENETRATION OF A CONICAL STEEL POINT (2" O.D. 60 CONE ANGLE) DRIVEN BY 350 FT-LB IMPACTS ON "A" SIZE DRILL RODS. THE RESISTANCE TO CONE PENETRATION IS MEASURED AS THE NUMBER OF BLOWS FOR EACH 12 INCH ADVANCE OF THE CONICAL POINT INTO THE UNDISTURBED GROUND.

SOIL QUALITY: SOILS ARE DESCRIBED BY THEIR COMPOSITION AND CONSISTENCY OR DENSITY.

CONSISTENCY: COHESIVE SOILS ARE DESCRIBED ON THE BASIS OF THEIR UNDRAINED SHEAR STRENGTH AS FOLLOWS:

| S_u (PSF) | 0 - 250 | 250 - 500 | 500 - 1000 | 1000 - 2000 | 2000 - 4000 | > 4000 |
|-------------|-----------|-----------|------------|-------------|-------------|--------|
| | VERY SOFT | SOFT | FIRM | STIFF | VERY STIFF | HARD |

DENSENESS: COHESIONLESS SOILS ARE DESCRIBED ON THE BASIS OF SPT 'N' VALUES AS FOLLOWS:

| 'N' (BLOW/FT) | 0 - 5 | 5 - 10 | 10 - 30 | 30 - 50 | > 50 |
|---------------|------------|--------|---------|---------|------------|
| | VERY LOOSE | LOOSE | COMPACT | DENSE | VERY DENSE |

ROCK QUALITY: ROCKS ARE DESCRIBED BY THEIR COMPOSITION AND STRUCTURAL FEATURES AND/OR STRENGTH.

RECOVERY: SUM OF ALL RECOVERED ROCK CORE PIECES FROM A CORING RUN EXPRESSED AS A PERCENT OF THE TOTAL LENGTH DRILLED IN THAT CORING RUN.

MODIFIED RECOVERY: SUM OF THOSE NATURALLY FRACTURED CORE PIECES, 4" IN LENGTH EXPRESSED AS A PERCENT OF THE LENGTH OF THE CORING RUN. THE ROCK QUALITY DESIGNATION (RQD), FOR MODIFIED RECOVERY, IS:

| RQD (%) | 0 - 25 | 25 - 50 | 50 - 75 | 75 - 90 | 90 - 100 |
|---------|-----------|---------|---------|---------|-----------|
| | VERY POOR | POOR | FAIR | GOOD | EXCELLENT |

JOINTING AND BEDDING:

| SPACING | 2" | 2" - 12" | 1' - 3' | 3' - 10' | > 10' |
|----------|------------|----------|------------|----------|------------|
| JOINTING | VERY CLOSE | CLOSE | MOD. CLOSE | WIDE | VERY WIDE |
| BEDDING | VERY THIN | THIN | MEDIUM | THICK | VERY THICK |

ABBREVIATIONS & SYMBOLS

LABORATORY TESTING

TRIAXIAL TESTS ARE DESCRIBED IN TERMS OF WHETHER THEY ARE CONSOLIDATED (C) OR NOT (U) ISOTROPICALLY (I) OR NOT (A) AND SHEARED DRAINED (D) OR UNDRAINED (U) WITH PORE PRESSURE MEASUREMENTS (BAR OVER SYMBOLS) EG. $\bar{C}IU$ = CONSOLIDATED ISOTROPIC UNDRAINED TRIAXIAL WITH PORE PRESSURE MEASUREMENT UNLESS OTHERWISE SPECIFIED IN REPORT ALL TESTS ARE IN COMPRESSION

FIELD SAMPLING

S S SPLIT SPOON
W S WASH SAMPLE
S T SLOTTED TUBE SAMPLE
B S BLOCK SAMPLE
C S CHUNK SAMPLE
T W THINWALL OPEN
T P THINWALL PISTON
O S OSTERBERG SAMPLE
F S FOIL SAMPLE
R C ROCK CORE
P H T.W. ADVANCED HYDRAULICALLY
P M T.W. ADVANCED MANUALLY

EARTH PRESSURE TERMS

μ COEFFICIENT OF FRICTION
 δ ANGLE OF WALL FRICTION
 k_o COEFFICIENT OF EARTH PRESSURE AT REST
 k_A COEFFICIENT OF ACTIVE EARTH PRESSURE
 k_P COEFFICIENT OF PASSIVE EARTH PRESSURE
 i ANGLE OF INCLINATION OF SURCHARGE
 w SLOPE ANGLE-BACKFACE OF WALL
 β ANGLE OF SLOPE
 N_q, N_c BEARING CAPACITY FACTORS
 D_f DEPTH OF FOOTING
 B, L FOOTING DIMENSIONS

INDEX PROPERTIES

γ UNIT WEIGHT OF SOIL (BULK DENSITY)
 γ_w UNIT WEIGHT OF WATER
 γ_d UNIT DRY WEIGHT OF SOIL (DRY DENSITY)
 γ' UNIT WEIGHT OF SUBMERGED SOIL
 G_s SPECIFIC GRAVITY OF SOLIDS
 e VOIDS RATIO
 e_o INITIAL VOIDS RATIO
 e_{max} e IN LOOSEST STATE
 e_{min} e IN DENSEST STATE
 D_r RELATIVE DENSITY = $\frac{e_{max} - e}{e_{max} - e_{min}}$
 n POROSITY
 w WATER CONTENT
 w_L LIQUID LIMIT
 w_P PLASTIC LIMIT
 w_S SHRINKAGE LIMIT
 I_P PLASTICITY INDEX = $w_L - w_P$
 I_L LIQUIDITY INDEX = $\frac{w - w_P}{I_P}$
 I_c CONSISTENCY INDEX = $\frac{w_L - w}{I_P}$
 A_c ACTIVITY = $\frac{I_P \text{ of soil}}{I_P \text{ of } 2\mu m \text{ Soil Fraction}}$
 Om ORGANIC MATTER CONTENT
 S_r DEGREE OF SATURATION
 S SENSITIVITY = $\frac{S_u \text{ (undisturbed)}}{S_u \text{ (remoulded)}}$

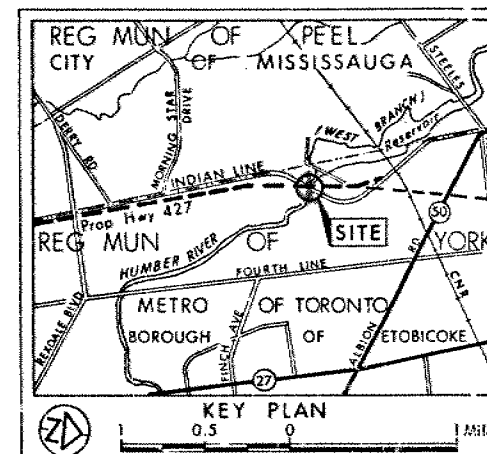
STRENGTH PARAMETERS

ϕ ANGLE OF SHEARING RESISTANCE
 τ_f PEAK SHEAR STRENGTH
 τ_R RESIDUAL SHEAR STRENGTH
 c COHESION INTERCEPT
 $\sigma_1, \sigma_2, \sigma_3$ NORMAL PRINCIPAL STRESSES
 u PORE WATER PRESSURE
 u_e EXCESS u
 r_u PORE PRESSURE RATIO
 q_u UNCONFINED COMPRESSIVE STRENGTH
 s_u UNDRAINED SHEAR STRENGTH
 ϵ LINEAR STRAIN
 γ SHEAR STRAIN
 ν POISSON'S RATIO
 E MODULUS OF ELASTICITY
 G MODULUS OF SHEAR DEFORMATION
 k_s MODULUS OF SUBGRADE REACTION
 m, n STABILITY COEFFICIENTS
 A, B PORE PRESSURE COEFFICIENTS

HYDRAULIC TERMS

h HYDRAULIC HEAD OR POTENTIAL
 q RATE OF DISCHARGE
 v VELOCITY OF FLOW
 i HYDRAULIC GRADIENT
 j SEEPAGE FORCE PER UNIT VOLUME
 η COEFFICIENT OF VISCOSITY
 k COEFFICIENT OF HYDRAULIC CONDUCTIVITY
 k_h k IN HORIZONTAL DIRECTION
 k_v k IN VERTICAL DIRECTION
 m_v COEFFICIENT OF VOLUME CHANGE
 c_v COEFFICIENT OF CONSOLIDATION
 C_c COMPRESSION INDEX
 C_r RECOMPRESSION INDEX
 d DRAINAGE PATH DISTANCE
 T_v TIME FACTOR
 U DEGREE OF CONSOLIDATION
 O_r OVERCONSOLIDATION RATIO (OCR)

NOTE: EFFECTIVE STRESS PARAMETERS ARE DENOTED BY USE OF APOSTROPHE ABOVE THE SYMBOL, THUS:
 ϕ' = EFFECTIVE ANGLE OF SHEARING RESISTANCE;
 σ' = EFFECTIVE NORMAL STRESS



LEGEND

- Bore Hole
- ⊕ Dynamic Cone Penetration Test (Cone)
- ⊕ Bore Hole & Cone
- 'N' Blows/ft (Std Pen Test 350ft lbs energy)
- CONE Blows/ft (60° Cone, 350ft lbs energy)
- W at time of investigation Aug 1979

| No | ELEVATION | CO-ORDINATES NORTH | EAST |
|----|-----------|-----------------------|---------|
| 1 | 528.0 | 15 891 900 | 966 035 |
| 2 | 526.3 | 15 891 975 | 966 042 |
| 3 | 527.4 | 15 892 066 | 966 032 |
| 4 | 530.2 | 15 892 142 | 966 033 |
| 5 | 525.0 | 15 891 951 | 966 084 |
| 6 | 520.3 | 15 892 042 | 966 097 |
| 7 | 530.0 | 15 892 121 | 966 093 |
| 8 | 522.0 | 15 891 803 | 966 240 |
| 9 | 522.1 | 15 891 895 | 966 208 |
| 10 | 522.6 | 15 891 989 | 966 213 |
| 11 | 530.6 | 15 892 042 | 966 234 |
| 12 | 524.0 | 15 892 091 | 966 135 |
| 13 | 523.0 | 15 892 047 | 966 157 |

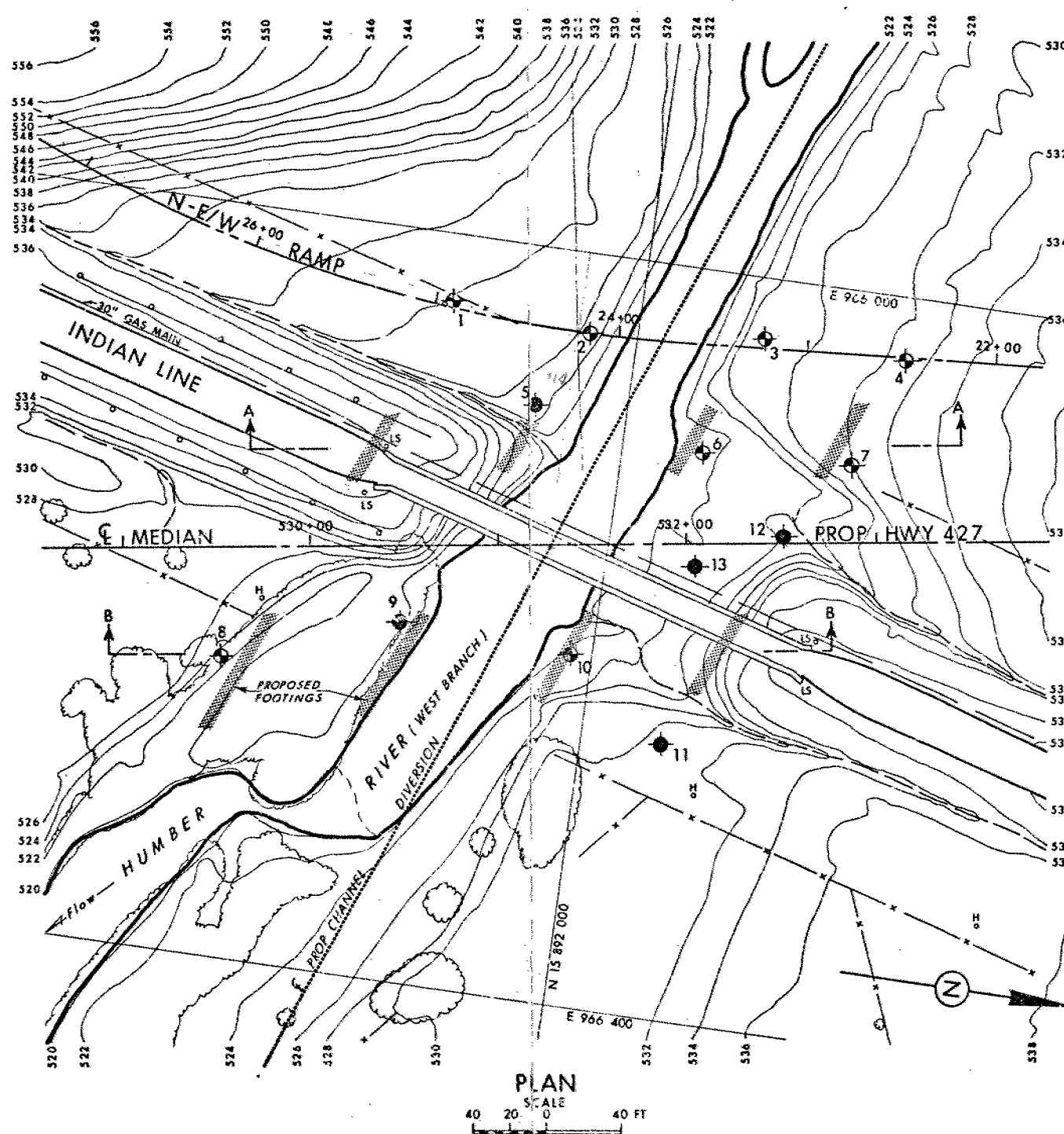
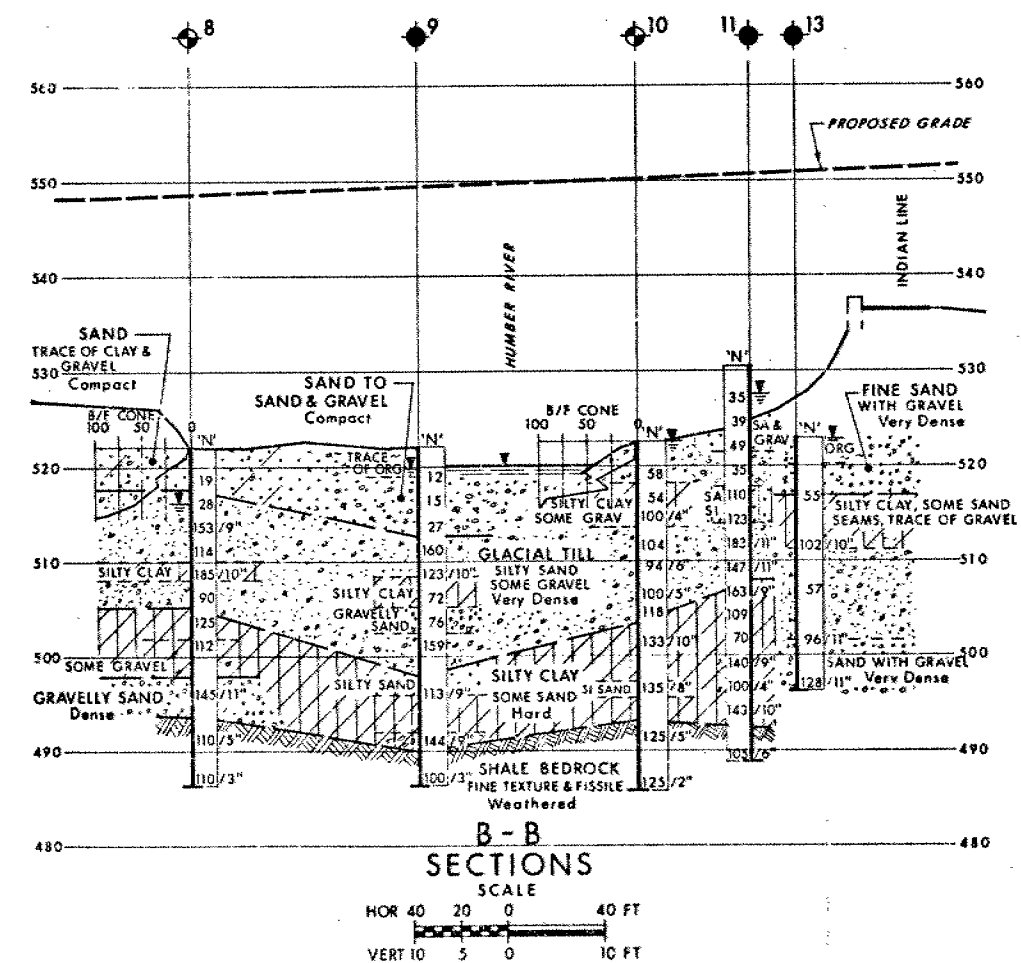
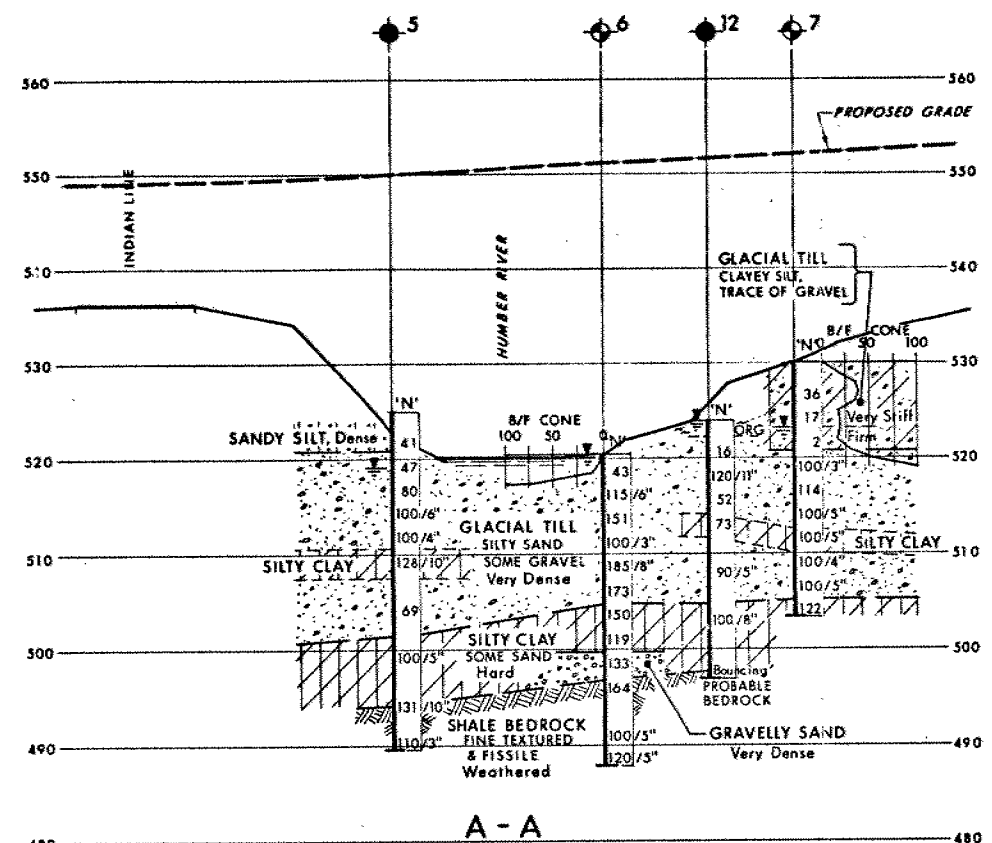
NOTE

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

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

GEOCRE No 30M12-144

HWY No 427 (NBL & SBL) DATE 5
SUBMITTED FOR CIRCULAR 31, 1979 SITE 37-633
DRAWN R S CHECKED DATE 12/1/79 DWG 49710506-A



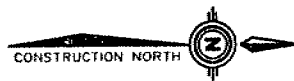
NOTE:
FOR BORE HOLES 1, 2, 3 & 4
SEE REPORT WP 49-71-07

G.I.-30 SEPT. 1976

GEOCRES No. 30M12-144DIST. 6 REGION W.P. No. 661-93-01CONT. No. 98-35W. O. No. STR. SITE No. 37-0633HWY. No. 427LOCATION Humber River BridgeNBL & SBLNo. of PAGES -

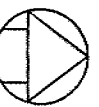
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OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT. REMARKS:



METRIC
DIMENSIONS ARE IN METRES
AND/OR MILLIMETRES
UNLESS OTHERWISE SHOWN

DISTRICT No. 6
CONT No
WP. No 661-93-01
HUMBER RIVER BRIDGE (N.B.L.)
HWY. 427 WIDENING
GENERAL ARRANGEMENT



SHEET

totten sims hubicki associates
ENGINEERS ARCHITECTS AND PLANNERS

GENERAL NOTES

CLASS OF CONCRETE

- PRESTRESSED GIRDERS 40MPa
- REMAINDER 30MPa
- UNLESS OTHERWISE NOTED

CLEAR COVER TO REINFORCING STEEL

- FOOTINGS 100 ±25mm
- DECK TOP 70 ±20mm
- DECK BOTTOM 40 ±10mm
- REMAINDER (UNLESS OTHERWISE NOTED) 70 ±20mm

REINFORCING STEEL

- REINFORCING STEEL SHALL BE GRADE 400 UNLESS NOTED OTHERWISE. BAR MARKS WITH PREFIX "C" DENOTE COATED BARS.

CONSTRUCTION NOTES

- THE CONTRACTOR SHALL ESTABLISH THE BEARING SEAT ELEVATIONS BY DEDUCTING THE ACTUAL BEARING THICKNESSES FROM THE TOP OF BEARING ELEVATIONS. IF THE ACTUAL BEARING THICKNESSES ARE DIFFERENT FROM THOSE GIVEN WITH THE BEARING DESIGN DATA, THE CONTRACTOR SHALL ADJUST THE REINFORCING STEEL TO SUIT.
- CONTRACTOR TO CHECK ALL RELEVANT EXISTING STRUCTURE DIMENSIONS AND ELEVATIONS SHOWN ON THE DRAWINGS AND ADJUST DIMENSIONS AND ELEVATIONS AS REQUIRED TO MATCH EXISTING STRUCTURE AS APPROVED BY THE ENGINEER.

REFERENCE DRAWINGS

- DETAILS OF THE EXISTING STRUCTURES HAVE BEEN OBTAINED FROM DRAWINGS OF THE HUMBER RIVER BRIDGE (WEST BRANCH) AT HWY. 427 NORTHBOUND LANES PREPARED BY THE MINISTRY OF TRANSPORTATION ONTARIO DATED 1980.

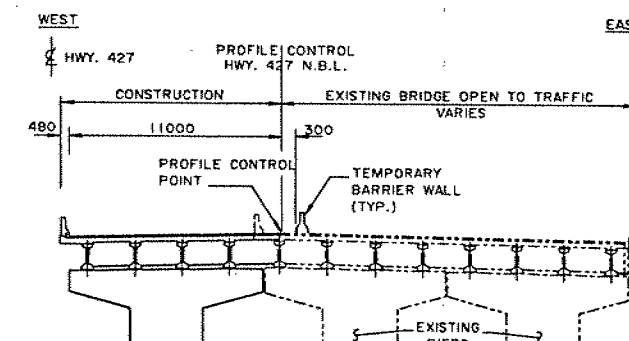
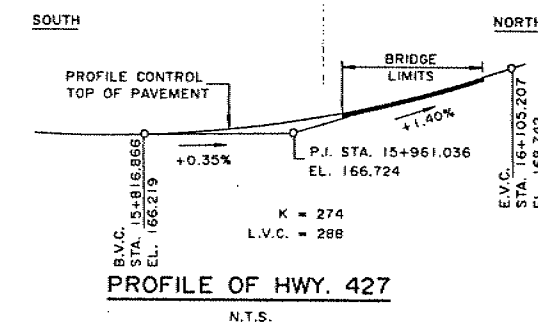
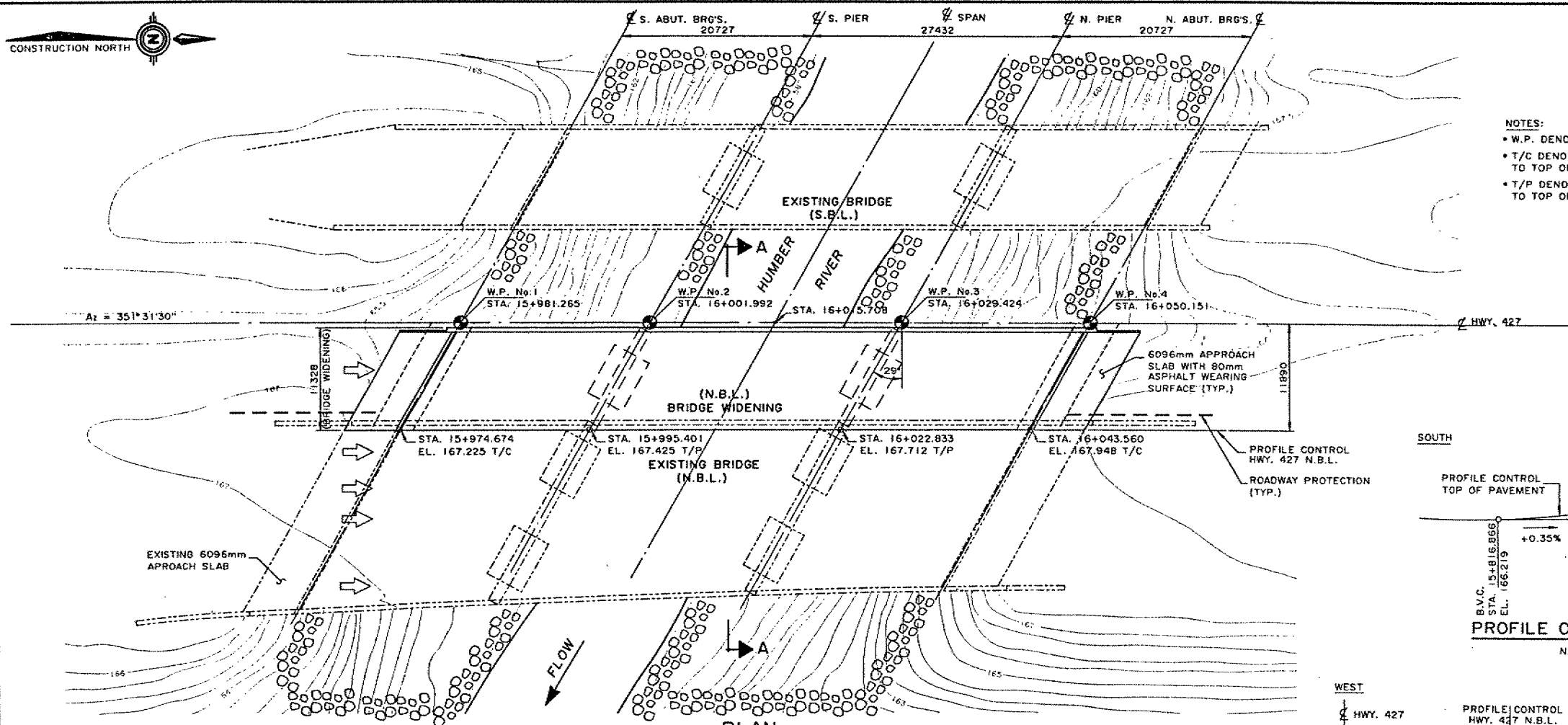
LIST OF DRAWINGS

- GENERAL ARRANGEMENT
- BOREHOLE DATA & SOIL STRATA
- REMOVALS
- FOOTING LAYOUT
- FOOTING REINFORCEMENT
- SOUTH ABUTMENT
- NORTH ABUTMENT
- PIER DETAILS
- PRESTRESSED GIRDERS
- DECK DETAILS
- DECK REINFORCEMENT
- JOINT ANCHORAGE & ARMOURING
- BARRIER WALLS
- 6000mm APPROACH SLABS
- STANDARD DETAILS
- ELECTRICAL EMBEDDED WORK
- QUANTITIES STRUCTURE 1
- QUANTITIES STRUCTURE 11

APPLICABLE STANDARD DRAWINGS

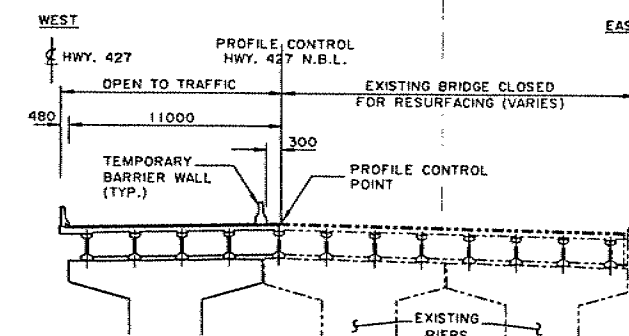
- OPSD 3501.00 MINIMUM GRANULAR BACKFILL REQUIREMENTS
- OPSD 4010.00 GUIDERAIL & CHANNEL ANCHORAGE

NOTES:
• W.P. DENOTES WORKING POINT.
• T/C DENOTES ELEVATION GIVEN TO TOP OF CONCRETE DAM
• T/P DENOTES ELEVATIONS GIVEN TO TOP OF PAVEMENT.



FIRST STAGE

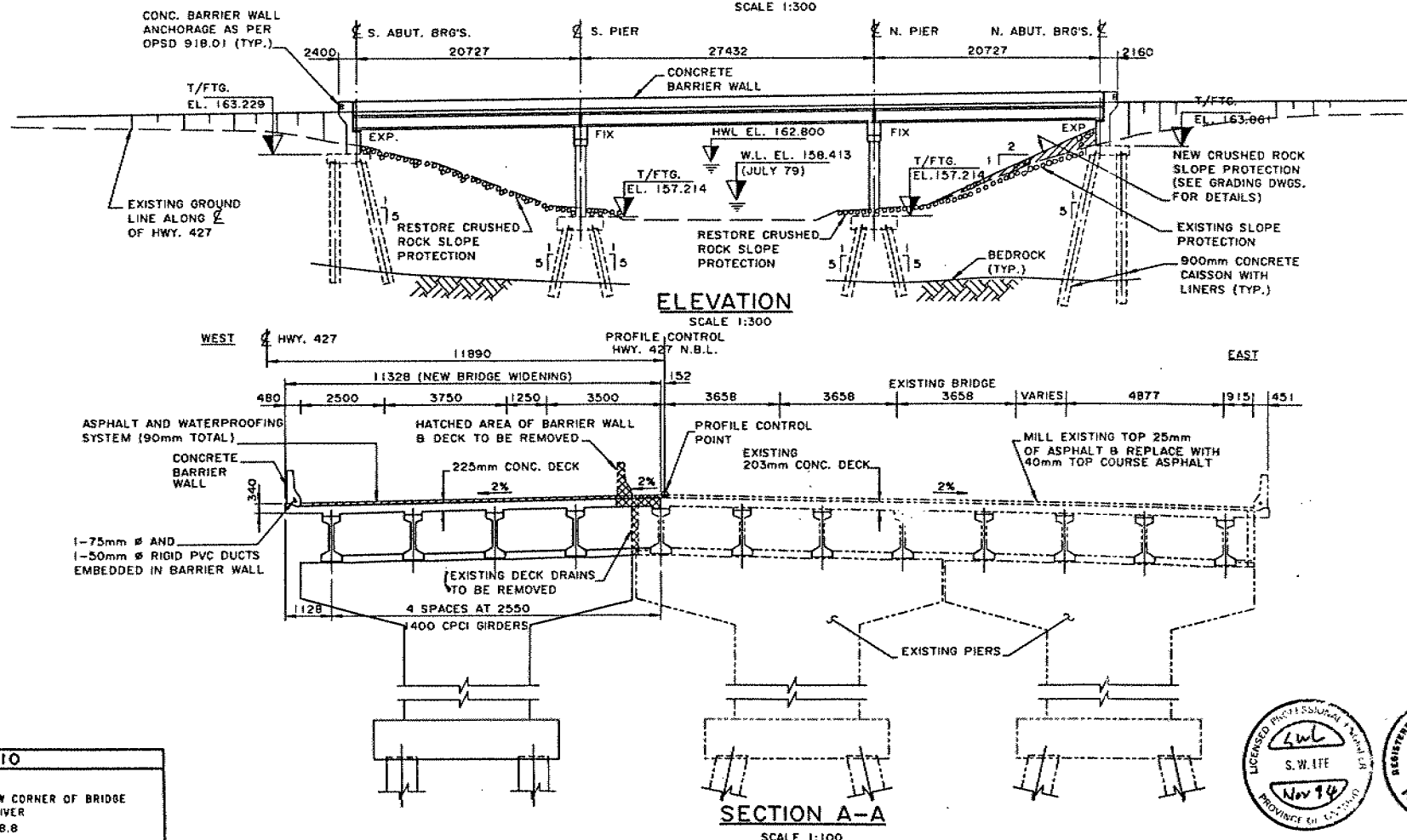
SCALE 1:200



SECOND STAGE

SCALE 1:200

CONSTRUCTION STAGING



SECTION A-A

SCALE 1:100



DRAWING NOT TO BE SCALED
100 mm ON ORIGINAL DRAWING

B.M. 167.410

GEODETIC DATUM
TOP OF BOLT SW CORNER OF BRIDGE
OVER HUMBER RIVER
21.4 LT 15+988.8

| REVISIONS | DATE | BY | DESCRIPTION |
|-----------|---------|--------------|--------------------------------|
| 1 | NOV. 94 | CHK S.W.I. | CODE CHBDC-91 (LOAD) |
| 2 | | DRAWN P.J.W. | CHK G.L.A. SITE 3/-0633/STRUCT |
| 3 | | | SCHEME DWG 1 |

FOUNDATION INVESTIGATION REPORT

CONTRACT NO. 98-35



**Ministry of
Transportation**

Ontario

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| <u>Page No:</u> | <u>DESCRIPTION</u> |
|-----------------|---|
| 1 | Index |
| 2 | Abbreviations & Symbols |
| 3 - 25 | Foundation Investigation Report for Hwy. 427 Widening Humber River Bridges NBL and SBL W.P. 661-93-01/02, Site 37-0633 Hwy. 427, Central Region |

Note: For purposes of the contract, this report supersedes all other Foundation Reports prepared by, or for the Ministry in connection with the above mentioned project.

EXPLANATION OF TERMS USED IN REPORT

N VALUE: THE STANDARD PENETRATION TEST (SPT) N VALUE IS THE NUMBER OF BLOWS REQUIRED TO CAUSE A STANDARD 51mm O.D. SPLIT BARREL SAMPLER TO PENETRATE 0.3m INTO UNDISTURBED GROUND IN A BOREHOLE WHEN DRIVEN BY A HAMMER WITH A MASS OF 63.5kg, FALLING FREELY A DISTANCE OF 0.76m. FOR PENETRATIONS OF LESS THAN 0.3m, N VALUES ARE NOTED AS THE NUMBER OF BLOWS FOR THE PENETRATION ACHIEVED. AVERAGE N VALUE IS DENOTED THUS \bar{N} .

DYNAMIC CONE PENETRATION TEST: CONTINUOUS PENETRATION OF A CONICAL STEEL POINT (51mm O.D., 60° TAPER ANGLE) DRIVEN BY 475 J IMPACT ENERGY ON 1A SIZE DRILL RODS. THE RESISTANCE TO CONE PENETRATION IS MEASURED AS THE NUMBER OF BLOWS FOR EACH 0.3m ADVANCE OF THE CONICAL POINT INTO THE UNDISTURBED GROUND.

SOILS ARE DESCRIBED BY THEIR COMPOSITION AND CONSISTENCY OR DENSENESS.

CONSISTENCY: COHESIVE SOILS ARE DESCRIBED ON THE BASIS OF THEIR UNDRAINED SHEAR STRENGTH (c_u) AS FOLLOWS:

| c_u (kPa) | 0 - 12 | 12 - 25 | 25 - 50 | 50 - 100 | 100 - 200 | >200 |
|-------------|-----------|---------|---------|----------|------------|------|
| | VERY SOFT | SOFT | FIRM | STIFF | VERY STIFF | HARD |

DENSENESS: COHESIONLESS SOILS ARE DESCRIBED ON THE BASIS OF DENSENESS AS INDICATED BY SPT N VALUES AS FOLLOWS:

| N (BLOWS/0.3m) | 0 - 5 | 5 - 10 | 10 - 30 | 30 - 50 | >50 |
|----------------|------------|--------|---------|---------|------------|
| | VERY LOOSE | LOOSE | COMPACT | DENSE | VERY DENSE |

ROCKS ARE DESCRIBED BY THEIR COMPOSITION AND STRUCTURAL FEATURES AND/OR STRENGTH.

RECOVERY: SUM OF ALL RECOVERED ROCK CORE PIECES FROM A CORING RUN EXPRESSED AS A PERCENT OF THE TOTAL LENGTH OF THE CORING RUN.

MODIFIED RECOVERY: SUM OF THOSE INTACT CORE PIECES, 100mm+ IN LENGTH EXPRESSED AS A PERCENT OF THE LENGTH OF THE CORING RUN. THE ROCK QUALITY DESIGNATION (RQD), FOR MODIFIED RECOVERY, IS:

| RQD (%) | 0 - 25 | 25 - 50 | 50 - 75 | 75 - 90 | 90 - 100 |
|---------|-----------|---------|---------|---------|-----------|
| | VERY POOR | POOR | FAIR | GOOD | EXCELLENT |

JOINTING AND BEDDING:

| SPACING | 50mm | 50 - 300mm | 0.3m - 1m | 1m - 3m | >3m |
|----------|------------|------------|------------|---------|------------|
| JOINTING | VERY CLOSE | CLOSE | MOD. CLOSE | WIDE | VERY WIDE |
| BEDDING | VERY THIN | THIN | MEDIUM | THICK | VERY THICK |

ABBREVIATIONS AND SYMBOLS

FIELD SAMPLING

| | |
|--------------------------|----------------------------------|
| S.S. SPLIT SPOON | T.P. THINWALL PISTON |
| W.S. WASH SAMPLE | O.S. OSTERBERG SAMPLE |
| S.T. SLOTTED TUBE SAMPLE | R.C. ROCK CORE |
| B.S. BLOCK SAMPLE | P.H. T.W. ADVANCED HYDRAULICALLY |
| C.S. CHUNK SAMPLE | P.M. T.W. ADVANCED MANUALLY |
| T.W. THINWALL OPEN | F.S. FOIL SAMPLE |

STRESS AND STRAIN

| | | |
|--------------------------------------|-----|-------------------------------|
| u_w | kPa | PORE WATER PRESSURE |
| r_u | - | PORE PRESSURE RATIO |
| σ | kPa | TOTAL NORMAL STRESS |
| σ' | kPa | EFFECTIVE NORMAL STRESS |
| τ | kPa | SHEAR STRESS |
| $\sigma_1, \sigma_2, \sigma_3$ | kPa | PRINCIPAL STRESSES |
| ϵ | % | LINEAR STRAIN |
| $\epsilon_1, \epsilon_2, \epsilon_3$ | % | PRINCIPAL STRAINS |
| E | kPa | MODULUS OF LINEAR DEFORMATION |
| G | kPa | MODULUS OF SHEAR DEFORMATION |
| μ | - | COEFFICIENT OF FRICTION |

MECHANICAL PROPERTIES OF SOIL

| | | |
|----------------|-------------------|--------------------------------------|
| m_v | kPa ⁻¹ | COEFFICIENT OF VOLUME CHANGE |
| c_c | - | COMPRESSION INDEX |
| c_s | - | SWELLING INDEX |
| C_α | - | RATE OF SECONDARY CONSOLIDATION |
| c_v | m ² /s | COEFFICIENT OF CONSOLIDATION |
| H | m | DRAINAGE PATH |
| T_v | - | TIME FACTOR |
| U | % | DEGREE OF CONSOLIDATION |
| σ'_{vo} | kPa | EFFECTIVE OVERBURDEN PRESSURE |
| σ'_p | kPa | PRECONSOLIDATION PRESSURE |
| τ_f | kPa | SHEAR STRENGTH |
| c' | kPa | EFFECTIVE COHESION INTERCEPT |
| ϕ' | -° | EFFECTIVE ANGLE OF INTERNAL FRICTION |
| c_u | kPa | APPARENT COHESION INTERCEPT |
| ϕ_u | -° | APPARENT ANGLE OF INTERNAL FRICTION |
| τ_R | kPa | RESIDUAL SHEAR STRENGTH |
| τ_i | kPa | REMOULDED SHEAR STRENGTH |
| S_f | - | SENSITIVITY = $\frac{c_u}{\tau_i}$ |

PHYSICAL PROPERTIES OF SOIL

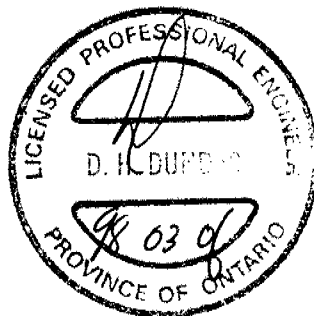
| | | | | | | | | |
|----------------|-------------------|--------------------------------|-----------|------|---|-----------|---------------------|---|
| ρ_s | kg/m ³ | DENSITY OF SOLID PARTICLES | e | 1, % | VOID RATIO | e_{min} | 1, % | VOID RATIO IN DENSEST STATE |
| γ_s | kn/m ³ | UNIT WEIGHT OF SOLID PARTICLES | n | 1, % | POROSITY | I_D | - | DENSITY INDEX = $\frac{e_{max} - e}{e_{max} - e_{min}}$ |
| ρ_w | kg/m ³ | DENSITY OF WATER | w | 1, % | WATER CONTENT | D | mm | GRAIN DIAMETER |
| γ_w | kn/m ³ | UNIT WEIGHT OF WATER | S_r | % | DEGREE OF SATURATION | D_n | mm | n PERCENT - DIAMETER |
| ρ | kg/m ³ | DENSITY OF SOIL | w_L | % | LIQUID LIMIT | C_u | - | UNIFORMITY COEFFICIENT |
| γ | kn/m ³ | UNIT WEIGHT OF SOIL | w_p | % | PLASTIC LIMIT | h | m | HYDRAULIC HEAD OR POTENTIAL |
| ρ_d | kg/m ³ | DENSITY OF DRY SOIL | w_s | % | SHRINKAGE LIMIT | q | m ^{1/2} /s | RATE OF DISCHARGE |
| γ_d | kn/m ³ | UNIT WEIGHT OF DRY SOIL | I_p | % | PLASTICITY INDEX = $w_L - w_p$ | v | m/s | DISCHARGE VELOCITY |
| ρ_{sat} | kg/m ³ | DENSITY OF SATURATED SOIL | I_L | - | LIQUIDITY INDEX = $\frac{w - w_p}{I_p}$ | i | - | HYDRAULIC GRADIENT |
| γ_{sat} | kn/m ³ | UNIT WEIGHT OF SATURATED SOIL | I_C | - | CONSISTENCY INDEX = $\frac{w_L - w}{I_p}$ | k | m/s | HYDRAULIC CONDUCTIVITY |
| ρ' | kg/m ³ | DENSITY OF SUBMERGED SOIL | e_{max} | 1, % | VOID RATIO IN LOOSEST STATE | J | kn/m ³ | SEEPAGE FORCE |
| γ' | kn/m ³ | UNIT WEIGHT OF SUBMERGED SOIL | | | | | | |

Foundation Investigation Report
for
Highway 427 Widening
Humber River Bridges NBL and SBL
W.P. 661-93-01/02, Site 37-0633
Central Region

The following report is a copy of the factual information from the Foundation Investigation and Design Report for WP 49-71-05/06, Contract 82-51. The foundation investigation report was prepared for the existing structures by MTO Foundations Unit and represents the subsurface conditions for the proposed widening of the existing Highway 427 structures over the West Humber River.

Imperial units of measure are used in the report and on the Record of Borehole sheets. The original ground elevations shown on the borehole logs may differ from present day elevations as a result of the construction of the existing structures.

This report contains the detailed subsurface conditions, the Record of Borehole sheets, and the location of the borings in plan.



D. Dundas
D. Dundas, P.Eng.
Sr. Foundation Engineer

For

Structures Over The West Humber River

N.B.L., W.P. 49-71-05, Site 37-633A

S.B.L., W.P. 49-71-06, Site 37-633B

Hwy. 427, District 6, TorontoINTRODUCTION:

This report contains the results of a foundation investigation carried out at this site from August 13 to August 27, 1979 and on May 21, 1980 by the Pavement and Foundation Design Section. The fieldwork consisted of augering ten sampled boreholes, five of which were accompanied by a dynamic cone penetration test. The depth of borings ranged from 26 and 46.5 feet below the ground surface.

SITE AND GEOLOGY

The site is at the present crossing of Indian Line and the West Humber River, about 1.25 miles north of Rexdale Blvd., in the Borough of Etobicoke, Metro Toronto.

The surrounding terrain is gently undulating, but generally sloping down towards the West Humber River. Most of the adjoining land is an open field, except the area in the southeastern quadrant of the site where it is thickly covered with mixed mature trees. The West Humber River, which is about 50 feet wide and 2 feet deep, flows gently in an easterly direction from a reservoir in the Claireville Conservation area which is located about 1000 feet upstream of the site. The riverbed is strewn with cobbles and boulders. Indian Line traverses the West Humber River by means of a two span single lane Bailey Bridge. The pier of the bridge is supported by steel 'H' section piles; whereas the abutments are supported by timber sills placed within the shallow approach fills. While the site is relatively well drained, the forward slope of the north approach embankment and its immediate neighboring areas are wet, showing signs of seepage.

Geologically, the site is located in a physiographic region generally referred to as the 'Peel Plain'. The till plains in this region are often covered with a thin mantle of clay which was left over when this

region was inundated during the Peel ponding period. The underlying bedrock is a grey shale of the Dundas-Meaford formation.

SUBSURFACE CONDITIONS

The location and elevation of the boreholes for both sites are shown on Drawings No. 2,* each of which contains an estimated subsoil stratigraphy profile. The subsurface conditions at this site are rather complex, consisting of recent alluvial, glacial, and interglacial deposits. In view of this, reference should be made to the individual borehole record sheets for the factual data about the subsurface conditions. A brief description of the various subsoil strata and bedrock encountered in our investigation is as follows.

Fill Materials

At the south approach embankment location, the fill material was found to consist of a silt clay of low plasticity with some sand. Based on S.P.T. 'N' values ranging from 7 to 29 blows per foot, this fill material has undergone a moderate degree of compactive effect.

Alluvial Deposits

A surficial alluvial deposit was encountered in the south riverbank as well as in one location in the north riverbank. This deposit has a thickness of up to 9.5 feet and is composed of sandy silt to sand and gravel. At some places, the alluvial deposit also contains a trace of clay or organics. A typical grain size distribution curve of the alluvium which is composed of sand and gravel is shown in Figure 1. Based on the 'N' values which ranged from 12 to 41 blows per foot, it is inferred that the relative density of the alluvial deposit is compact to dense.

Silty Clay with Sand and Gravel (Glacial Till)

This deposit was encountered in the high ground north of the river. It extends immediately below the ground surface and at one location has a thickness of about 9.5 feet. The glacial till is a heterogeneous mixture

* Page No 25 in the Appendix of this Contract.

of clay, silt, sand and gravel. Its matrix has a low plasticity, with a liquid limit of about 23% and a plastic limit of about 13% (Figure 2). The material in the upper 7 feet or so of the glacial till stratum is brown and very stiff; below that it is grey. In one isolated zone, the glacial till is firm, having an undrained shear strength measured by in-situ vane test in the order of 640 psf.

Silty Sand with Gravel (Glacial Till)

This is the predominant deposit at this site. It was encountered either immediately beneath the ground surface or beneath the above mentioned surficial deposits of alluvium or the cohesive glacial till. This basically non-cohesive glacial till stratum has a thickness ranging from 13 to 22 feet and is composed of a heterogeneous mixture predominantly of silt, sand and gravel. Typical grain size distribution characteristics of the granular glacial till are shown in Figure 3 in an envelope form. Within the granular glacial till stratum, there are occasional layers or zones of silty clay, sandy silt or sand with gravel. The Atterberg limits of the material in the cohesive inclusions are shown in Figure 2 and the grain size distribution curves of the material in the non-cohesive inclusions are shown in Figure 4 and 5. The 'N' values of the overall stratum of the glacial till ranged from occasional low values of 16 and 28 blows per foot in the upper portion of the stratum to generally in excess of 100 blows per foot. Accordingly, the relative density of the granular glacial till is occasionally compact in the upper portion of the deposit but generally very dense.

Silty Clay

The previously mentioned granular glacial till deposit is underlain through out the site by a stratum of reddish silty clay with some sand and trace of gravel. A typical grain size distribution curve for the silty clay is shown in Figure 6. This stratum of cohesive subsoil generally extends down to bedrock surface for a thickness of about 8 to 16 feet. The silty clay was also found to contain occasional layers, or pockets, of sand or sand and gravel. In some places, these granular inclusions are sandwiched between the silty clay and the bedrock. The silty clay has the following identity indices:

| | |
|----------------------------------|----------|
| Moisture Content (w%) | 7 to 16 |
| Plastic Limit (w _p %) | 10 to 22 |
| Liquid Limit (w _L %) | 16 to 28 |

These results, when plotted on a plasticity chart (Figure 2), fall mostly in the CL zone, with only occasional points in the CL-ML zone. Therefore, the silty clay generally has a low plasticity; but occasionally it may only be slightly plastic. The 'N' values in the silty clay deposit are overwhelmingly in excess of 100 blows per foot. Based on these, the consistency of the cohesive subsoil is defined as hard.

Shale Bedrock

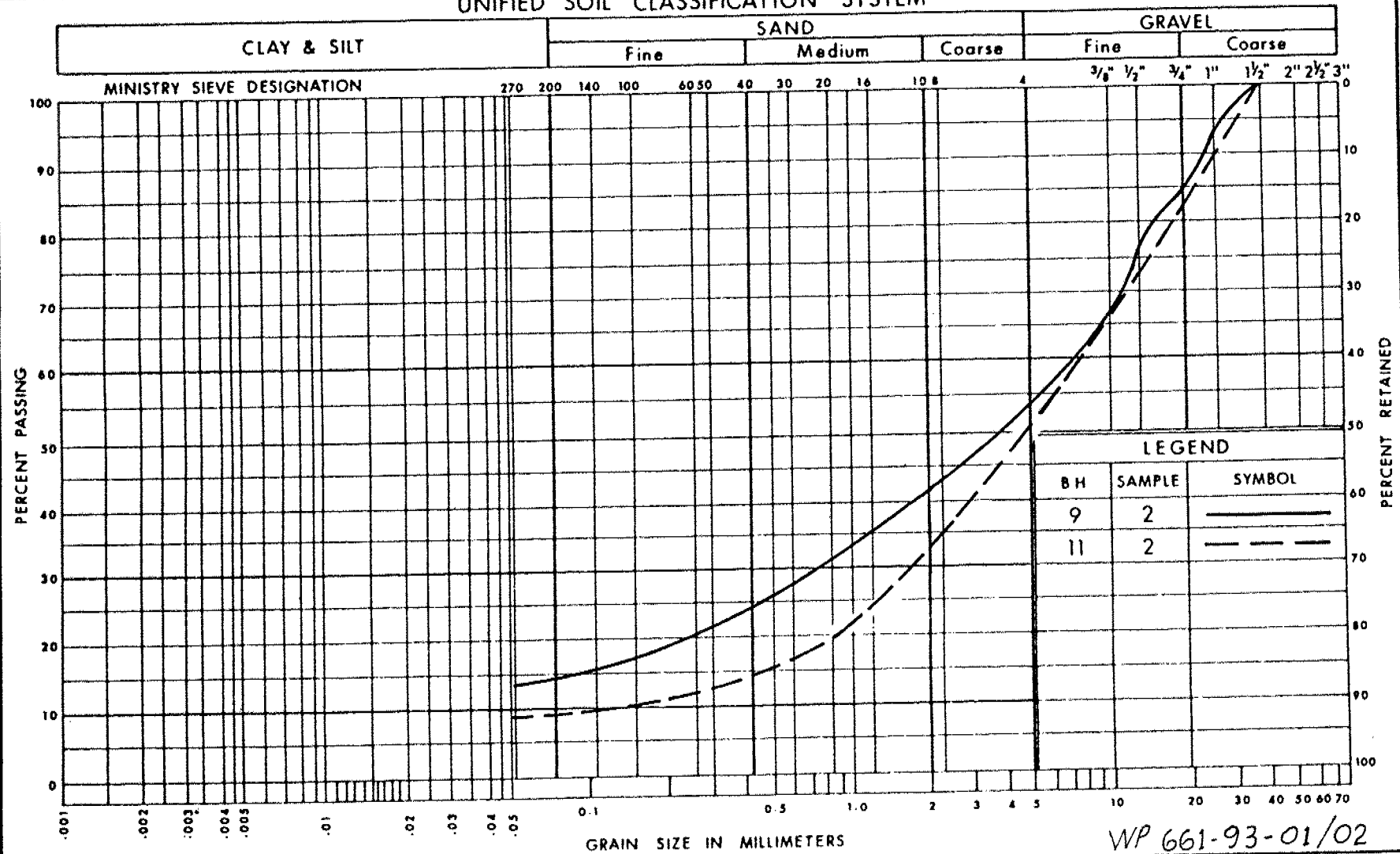
The bedrock surface is gently undulating, varying between elevation 490 and elevation 496.7. Bedrock is a grey shale of the Dundas-Meadford formation. The shale is soft, fine textured and fissile. It was found to be weathered within the depths of our borings.

Groundwater Conditions

The groundwater level in the south riverbank was found to exist at elevation 519 ±, closely corresponding to the prevailing river water level. Groundwater was encountered at elevation 325 within the south approach fill, some 5 feet higher than river water level at the time of the investigation. The groundwater level in the area north of the river was found to be almost at the ground surface, except for one location in the high ground where the groundwater level was found at a depth of about 6 feet below the ground surface, corresponding to elevation 524±. Because of the very high groundwater table in the north river bank, the ground adjacent to the forward slope of the existing north approach embankment has become very wet.

APPENDIX

UNIFIED SOIL CLASSIFICATION SYSTEM



WP 661-93-01/02

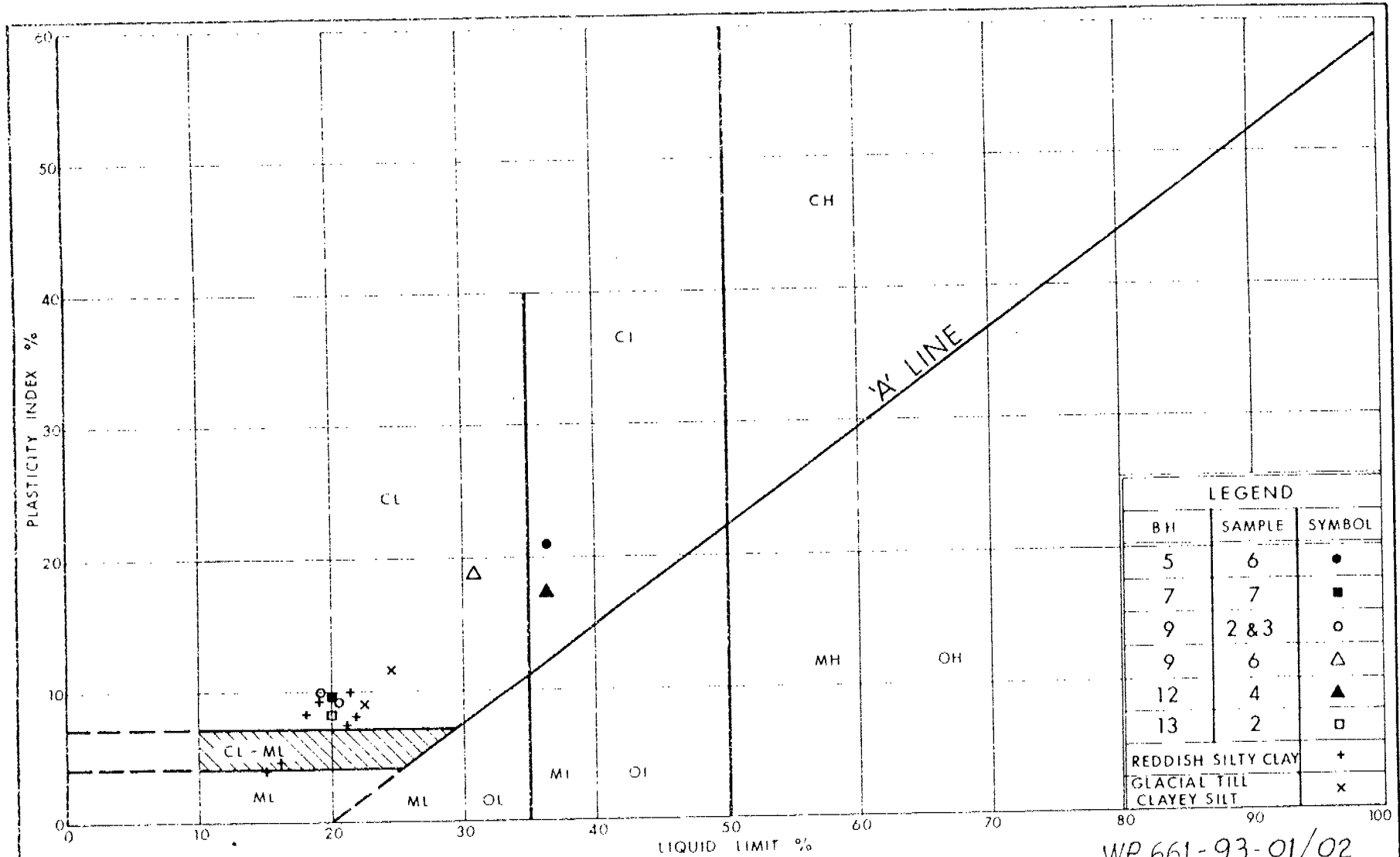


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GRAIN SIZE DISTRIBUTION SAND & GRAVEL

FIG No 1

WP 49-71-05 & 06



WP 661-93-01/02

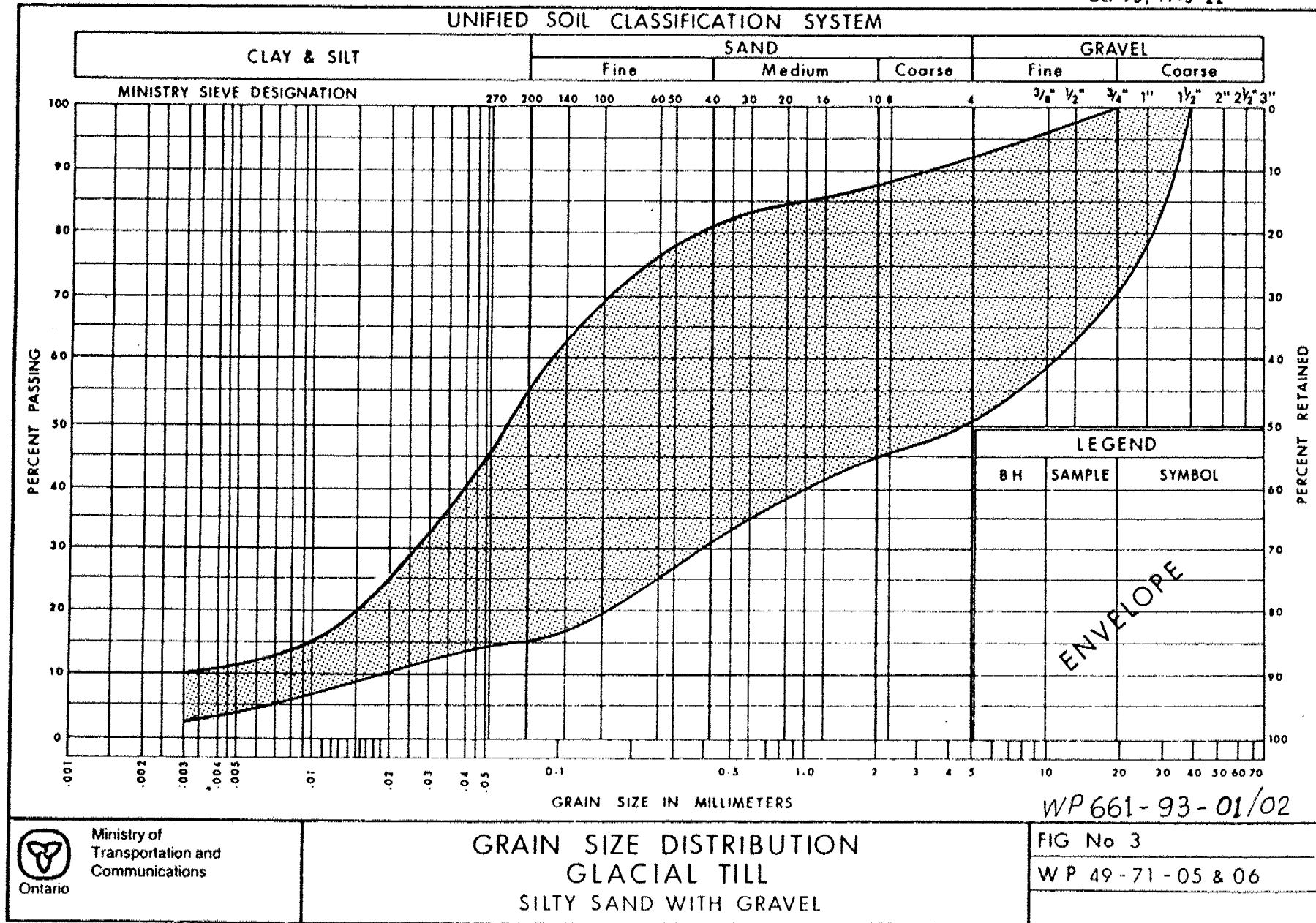


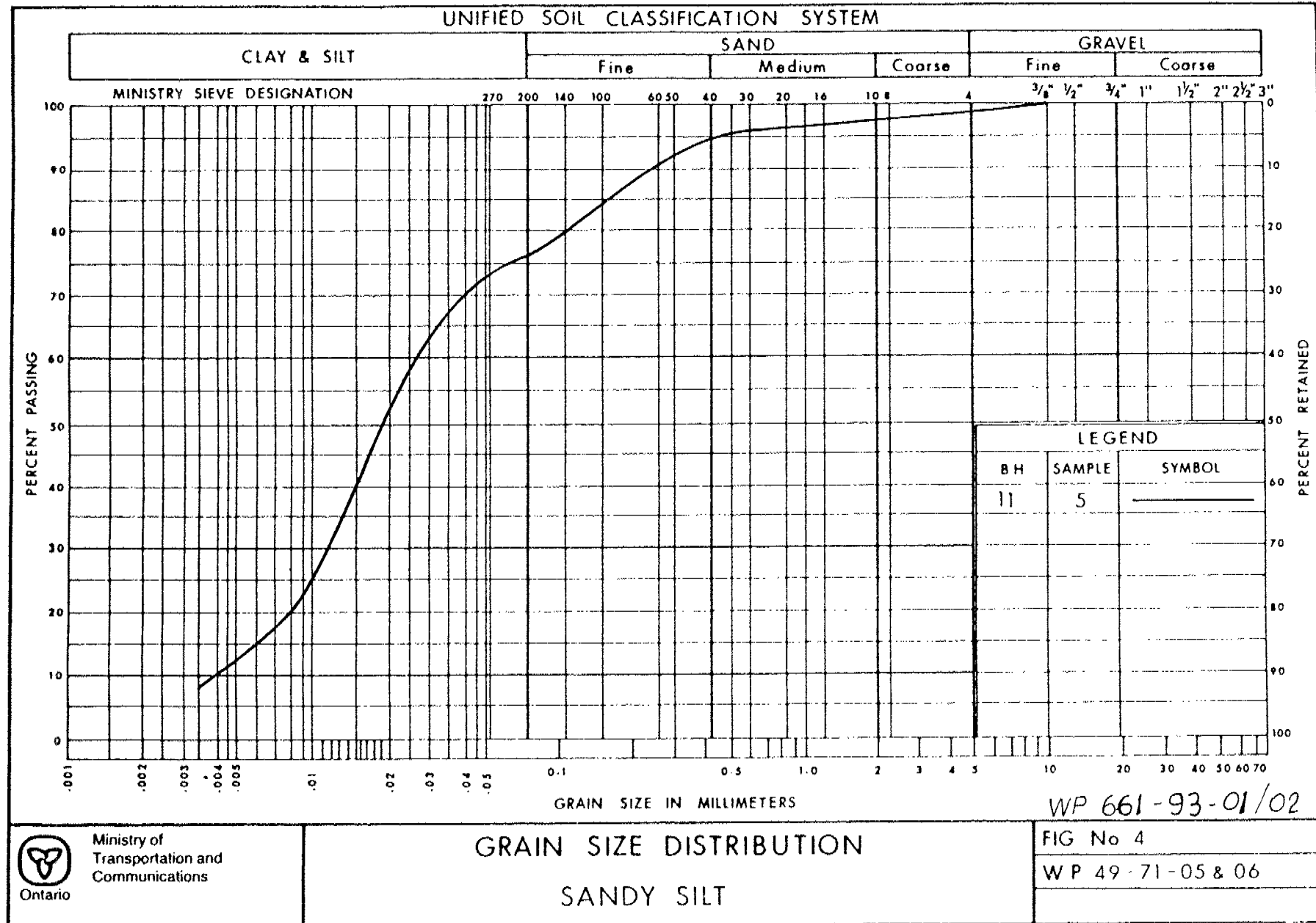
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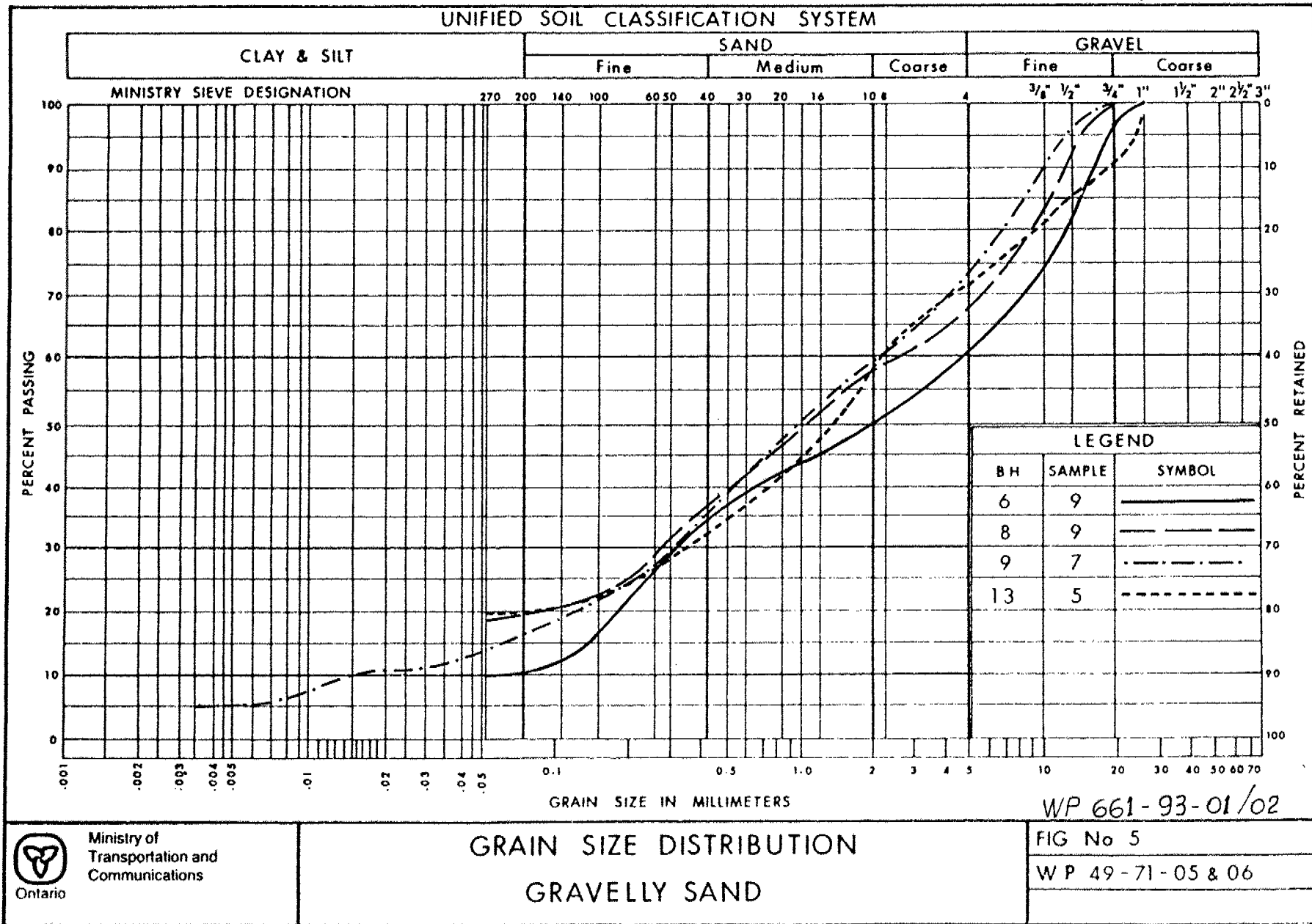
PLASTICITY CHART

FIG No 2

W P 49-71-05 & 06

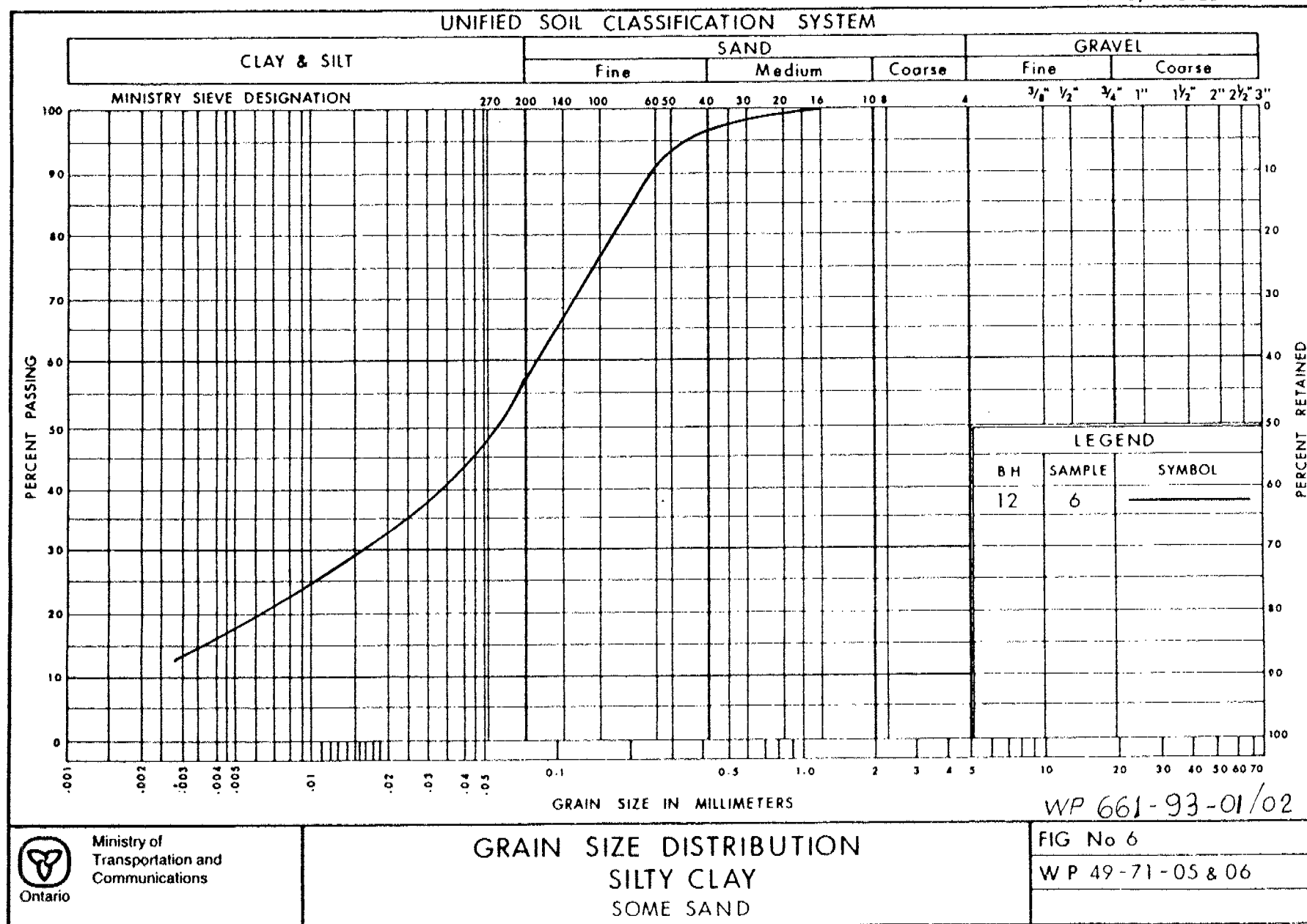






Ontario

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WP 661-93-01/02

RECORD OF BOREHOLE No 5

IMPERIAL

W P 49-71-05/06 LOCATION Co-ords. N 15,891,951; E 966,084 ORIGINATED BY BRL
DIST 6 HWY 427 BOREHOLE TYPE 3 1/2" Diameter HSA COMPILED BY BL
DATUM Geodetic DATE August 22, 1979 CHECKED BY

| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | | | | PLASTIC LIMIT W _p | NATURAL MOISTURE CONTENT W | LIQUID LIMIT W _L | UNIT WEIGHT Y | REMARKS & GRAIN SIZE DISTRIBUTION (%) |
|---------------|---|------------|---------|------|------------|----------------------------|--------------------|---|----|----|----|-----|------------------------------------|-------------------------------------|-----------------------------------|---------------------|---|
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | 'N' VALUES | | | 20 | 40 | 60 | 80 | 100 | | | | | |
| 525.0 | Ground Level | | | | | | | | | | | | | | | | GR SA SI CL |
| 0.0 | Sandy silt, brown, dense | | 1 | SS | 41 | | 520 | | | | | | | | | | |
| 520.5 | | | 2 | SS | 47 | | | | | | | | | | | | |
| 4.5 | Glacial Till, Silty sand, some gravel, grey, very dense | | 3 | SS | 80 | | | | | | | | | | | | |
| | | | 4 | SS | 100/ | 6" | | | | | | | | | | | |
| | | | 5 | SS | 100/ | 4" | | | | | | | | | | | |
| | silty clay | | 6 | SS | 128/ | 10" | | | | | | | | | | | |
| | | | 7 | SS | 69 | | | | | | | | | | | | |
| 501.0 | | | | | | | | | | | | | | | | | |
| 24.0 | Silty clay, some sand, reddish, hard | | 8 | SS | 100/ | 5" | 500 | | | | | | | | | | |
| 494.0 | | | | | | | | | | | | | | | | | |
| 31.0 | Shale bedrock, weathered | | 9 | SS | 131/ | 10" | | | | | | | | | | | |
| 489.5 | | | | | | | | | | | | | | | | | |
| 35.5 | End of Borehole | | 10 | SS | 100/ | 3" | 490 | | | | | | | | | | |

+3, x5: Numbers refer to Sensitivity

20
15
10
5 (%) STRAIN AT FAILURE



| WP 661-93-01/02 | | RECORD OF BOREHOLE No 6 | | IMPERIAL | | | | | | | |
|-----------------|---|---|--------|--|------------|---|-----------------|-----------------|---------|---------------------------------------|-------------|
| W P 49-71-05/06 | | LOCATION Co-ords. N 15,892,042; E 966,097 | | ORIGINATED BY BRL | | | | | | | |
| DIST 6 HWY 427 | | BOREHOLE TYPE 3 1/2" Diameter HSA and Cone Test | | COMPILED BY BL | | | | | | | |
| DATUM Geodetic | | DATE August 17, 1979 | | CHECKED BY | | | | | | | |
| SOIL PROFILE* | | SAMPLES | | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT | | UNIT WEIGHT | | REMARKS & GRAIN SIZE DISTRIBUTION (%) | |
| ELEV. / DEPTH | DESCRIPTION | STRAT. PLOT | NUMBER | TYPE | 'N' VALUES | GROUND WATER CONDITIONS | ELEVATION SCALE | 20 40 60 80 100 | Wp W WL | WATER CONTENT (%) | GR SA SI CL |
| 520.3 | Ground Level | | | | | | | | | | |
| 0.0 | Glacial Till | | 1 | SS | 43 | | 520 | | | | |
| | Silty sand, some gravel, grey, very dense | | 2 | SS | 115/6" | | | | | | |
| | | | 3 | SS | 151 | | | | | | |
| | | | 4 | SS | 100/3" | | | | | | |
| | | | 5 | SS | 185/8" | | | | | | |
| 504.8 | | | 6 | SS | 173 | | 510 | | | | |
| 15.5 | Silty clay, some sand; reddish brown, hard | | 7 | SS | 150 | | | | | | |
| 499.8 | | | 8 | SS | 119 | | | | | | |
| 20.5 | Gravelly sand, very dense | | 9 | SS | 133 | | 500 | | | | |
| 496.8 | | | 10 | SS | 164 | | | | | | |
| 23.5 | Shale bedrock, fine textured and fissile, weathered | | 11 | SS | 100/5" | | | | | | |
| 487.8 | | | 12 | SS | 120/5" | | 490 | | | | |
| 32.5 | End of Borehole | | | | | | | | | | |

+3, x5: Numbers refer to Sensitivity

20
15 5 (%) STRAIN AT FAILURE
10



WP 661-93-01/02

RECORD OF BOREHOLE No 7

IMPERIAL

W P 49-71-05/06 LOCATION Co-ords. N 15,892,121; E 966,093 ORIGINATED BY BRL
DIST 6 HWY 427 BOREHOLE TYPE 3 1/2" Diameter HSA and Cone Test COMPILED BY BL
DATUM Geodetic DATE August 16, 1979 CHECKED BY

| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 | PLASTIC LIMIT W _p | NATURAL MOISTURE CONTENT W | LIQUID LIMIT W _L | UNIT WEIGHT γ | REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL |
|---------------|-----------------------|------------|---------|------|------------|----------------------------|-----------------|--|------------------------------------|-------------------------------------|-----------------------------------|---------------------|--|
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | 'N' VALUES | | | | | | | | |
| 530.0 | Ground Level | | | | | | | | | | | | |
| 0.0 | Glacial Till | | 1 | SS | 36 | | | | | | | | |
| | Clayey silt, trace of | | 2 | SS | 17 | | | | | | | | |
| | gravel, brown, | | 3 | SS | 2 | | | | | | | | |
| 520.5 | firm, grey | | 4 | SS | 100/3" | | | | | | | | |
| 9.5 | Glacial Till | | 5 | SS | 114 | | | | | | | | |
| | Silty sand, some | | 6 | SS | 100/5" | | | | | | | | 12 64 (24) |
| | gravel, grey, | | 7 | SS | 100/5" | | | | | | | | |
| | very dense | | 8 | SS | 100/4" | | | | | | | | |
| | silty clay | | 9 | SS | 100/5" | | | | | | | | 33 52 (15) |
| 505.5 | | | 10 | SS | 122 | | | | | | | | |
| 24.5 | Silty clay, reddish | | | | | | | | | | | | |
| 27.0 | End of Borehole | | | | | | | | | | | | |

*3, x5: Numbers refer to
Sensitivity

20
15 5 (%) STRAIN AT FAILURE
10



Ministry of
Transportation and
Highways

HIGHWAY ENGINEERING DIVISION-ENGINEERING MATERIALS OFFICE-SOIL MECHANICS SECTION

18

WP 661-93-01/02

RECORD OF BOREHOLE No 8

IMPERIAL

W P 49-71-05/06 LOCATION Co-ords. N 15,891,803; E 966,240 ORIGINATED BY BRL
DIST 6 HWY 427 BOREHOLE TYPE 3 1/2" Diameter and Cone Test COMPILED BY BL
DATUM Geodetic DATE August 23, 1979 CHECKED BY

| SOIL PROFILE * | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | | PLASTIC LIMIT W _p | NATURAL MOISTURE CONTENT W | LIQUID LIMIT W _L | UNIT WEIGHT γ | REMARKS & GRAIN SIZE DISTRIBUTION (%) |
|----------------|---|-------------|---------|------|------------|----------------------------|-----------------|---|--|--|------------------------------------|-------------------------------------|-----------------------------------|---------------------|---|
| ELEV. DEPTH | DESCRIPTION | STRAT. PLOT | NUMBER | TYPE | 'N' VALUES | | | 20 40 60 80 100 | SHEAR STRENGTH | | | | | | |
| | | | | | | | | | ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE | | | | | | |
| 522.0 | Ground Level | | | | | | | | | | | | | | GR SA SI CL |
| 0.0 | Sand, trace of clay and gravel, compact | | 1 | SS | 19 | | 520 | | | | | | | | |
| 517.5 | | | 2 | SS | 28 | | | | | | | | | | |
| 4.5 | Glacial Till | | 3 | SS | 153 | 9" | | | | | | | | | 28 33 (39) |
| | Silty sand, trace to some gravel, compact to very dense | | 4 | SS | 114 | | | | | | | | | | |
| | silty clay | | 5 | SS | 185 | 10" | | | | | | | | | |
| 505.0 | | | 6 | SS | 90 | | | | | | | | | | 2 51 (47) |
| 17.0 | Silty clay, reddish, hard | | 7 | SS | 125 | | | | | | | | | | |
| | some gravel | | 8 | SS | 112 | | | | | | | | | | |
| 498.0 | | | | | | | | | | | | | | | |
| 24.0 | Gravelly sand, very dense | | 9 | SS | 145 | 11" | | | | | | | | | 32 48 (20) |
| 494.0 | | | | | | | | | | | | | | | |
| 28.0 | Shale bedrock, fine textured and fissile, weathered | | 10 | SS | 110 | 5" | 490 | | | | | | | | |
| 486.5 | | | 11 | SS | 110 | 3" | | | | | | | | | |
| 35.5 | End of Borehole | | | | | | | | | | | | | | |

+3, x5: Numbers refer to
Sensitivity

20
15-5 (%) STRAIN AT FAILURE
10



Highway Engineering Division
Engineering Materials Office - Soil Mechanics Section

HIGHWAY ENGINEERING DIVISION-ENGINEERING MATERIALS OFFICE-SOIL MECHANICS SECTION

19

WP 661-93-01/02

RECORD OF BOREHOLE No 9

IMPERIAL

W P 49-71-05/06 LOCATION Co-ords. N 15,891,895; E 966,208 ORIGINATED BY BRL

DIST 6 HWY 427 BOREHOLE TYPE 3 1/2" Diameter HSA COMPILED BY BL

DATUM Geodetic DATE August 23, 1979 CHECKED BY

| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | | | | PLASTIC LIMIT W _p | NATURAL MOISTURE CONTENT W | LIQUID LIMIT W _L | UNIT WEIGHT γ | REMARKS & GRAIN SIZE DISTRIBUTION (%) |
|---------------|--|------------|---------|------|------------|----------------------------|--------------------|---|----|----|----|-----|------------------------------------|-------------------------------------|-----------------------------------|---------------------|---|
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | 'N' VALUES | | | 20 | 40 | 60 | 80 | 100 | | | | | |
| 522.1 | Ground Level | | | | | | | | | | | | | | | | GR SA SI CL |
| 0.0 | Sand to sand trace of and gravel organics | | 1 | SS | 12 | | 520 | | | | | | | | | | 46 40 (14) |
| | | | 2 | SS | 15 | | | | | | | | | | | | |
| 512.6 | | | 3 | SS | 27 | | | | | | | | | | | | |
| 9.5 | Glacial Till | | 4 | SS | 160 | | 510 | | | | | | | | | | 9 35 (56) |
| | Silty sand, some gravel, grey, very dense | | 5 | SS | 123/10" | | | | | | | | | | | | |
| | | | 6 | SS | 72 | | | | | | | | | | | | |
| | | | 7 | SS | 76 | | | | | | | | | | | | |
| | | | 8 | SS | 159 | | 500 | | | | | | | | | | 26 57 (17) |
| 498.1 | | | | | | | | | | | | | | | | | |
| 24.0 | Silty silty sand, clay, some sand, reddish, hard | | 9 | SS | 113/9" | | | | | | | | | | | | |
| 490.1 | | | 10 | SS | 144/9" | | 490 | | | | | | | | | | |
| 32.8 | Shale bedrock, weathered | | 11 | SS | 100/3" | | | | | | | | | | | | |
| 486.6 | | | | | | | | | | | | | | | | | |
| 35.5 | End of Borehole | | | | | | | | | | | | | | | | |

+3, x5: Numbers refer to
Sensitivity

20
15 5 (%) STRAIN AT FAILURE
10

OFFICE REPORT ON SOIL EXPLORATION



Highway Engineering Division
Engineering Materials Office - Soil Mechanics Section

WP 661-93-01/02

RECORD OF BOREHOLE No 10

IMPERIAL

W P 49-71-05/06 LOCATION Co-ords. N 15,891,989; E 966,213 ORIGINATED BY BRL
DIST 6 HWY 427 BOREHOLE TYPE 3L" Diameter HSA and Cone Test COMPILED BY BL
DATUM Geodetic DATE August 24, 1979 CHECKED BY

| SOIL PROFILE | | SAMPLES | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | PLASTIC LIMIT W _p | NATURAL MOISTURE CONTENT W | LIQUID LIMIT W _L | UNIT WEIGHT Y | REMARKS & GRAIN SIZE DISTRIBUTION (%) |
|--------------|---|-------------|--------|-------------------------|-----------------|--|----|---------------------------------|-------------------------------|--------------------------------|------------------|---------------------------------------|
| ELEV. DEPTH | DESCRIPTION | STRAT. PLOT | NUMBER | TYPE | | 20 | 40 | 60 | 80 | 100 | | |
| 522.6 | Ground Level | | | | | | | | | | | |
| 0.0 | Glacial Till Silty sand, grey trace to some gravel, very dense | | 1 | SS | 58 | | | | | | | |
| | | | 2 | SS | 54 | | | | | | | |
| | | | 3 | SS | 100 | | | | | | | |
| | | | 4 | SS | 104 | | | | | | | |
| | | | 5 | SS | 94 | | | | | | | |
| | | | 6 | SS | 100 | | | | | | | |
| 503.6 | | | 7 | SS | 118 | | | | | | | |
| 19.0 | Silty clay, trace of sand, reddish, hard | | 8 | SS | 133 | | | | | | | |
| | Silty sand | | 9 | SS | 135 | | | | | | | |
| 493.6 | | | 10 | SS | 125 | | | | | | | |
| 29.0 | Shale bedrock, fissile and weathered | | 11 | SS | 125 | | | | | | | |
| 486.1 | | | | | | | | | | | | |
| 36.5 | End of Borehole | | | | | | | | | | | |

+3, x5: Numbers refer to Sensitivity

20
15 5 (%) STRAIN AT FAILURE
10



Highway Engineering Division
Engineering Materials Office - Soil Mechanics Section

HIGHWAY ENGINEERING DIVISION-ENGINEERING MATERIALS OFFICE-SOIL MECHANICS SECTION

21

WP 661-93-01/02

RECORD OF BOREHOLE No 11

IMPERIAL

W P 49-71-05/06 LOCATION Co-ords. N 15,892,042; E 966,254 ORIGINATED BY BRL
DIST 6 HWY 427 BOREHOLE TYPE 3 1/2" Diameter HSA COMPILED BY BL
DATUM Geodetic DATE August 13, 1979 CHECKED BY

| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | | | | PLASTIC LIMIT W _p | NATURAL MOISTURE CONTENT W | LIQUID LIMIT W _L | UNIT WEIGHT γ | REMARKS & GRAIN SIZE DISTRIBUTION (%) |
|---------------|--|------------|---------|------|------------|----------------------------|-----------------|---|----|----|----|-----|------------------------------------|-------------------------------------|-----------------------------------|---------------------|---|
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | 'N' VALUES | | | 20 | 40 | 60 | 80 | 100 | | | | | |
| 530.6 | Ground Level | | | | | | | | | | | | | | | | GR SA SI CL |
| 0.0 | Glacial Till Silty sand, some gravel, dense | | 1 | SS | 35 | | 530 | | | | | | | | | | 50 40 (10) |
| | | | 2 | SS | 39 | | | | | | | | | | | | |
| | | | 3 | SS | 49 | | | | | | | | | | | | |
| | | | 4 | SS | 35 | | 520 | | | | | | | | | | |
| | | | 5 | SS | 110 | | | | | | | | | | | | |
| | | | 6 | SS | 123 | | | | | | | | | | | | |
| | | | 7 | SS | 183 | 11" | | | | | | | | | | | |
| | | | 8 | SS | 147 | 11" | 510 | | | | | | | | | | |
| 508.6 | | | 9 | SS | 163 | 9" | | | | | | | | | | | |
| 22.0 | Silty clay, some sand, reddish, hard | | 10 | SS | 109 | | | | | | | | | | | | |
| | | | 11 | SS | 70 | | | | | | | | | | | | |
| | | | 12 | SS | 140 | 9" | 500 | | | | | | | | | | |
| | | | 13 | SS | 100 | 4" | | | | | | | | | | | |
| | | | 14 | SS | 143 | 10" | | | | | | | | | | | |
| 492.6 | | | | | | | | | | | | | | | | | |
| 38.0 | Shale bedrock, weathered | | 15 | SS | 105 | 6" | 490 | | | | | | | | | | |
| 489.1 | | | | | | | | | | | | | | | | | |
| 41.5 | End of Borehole | | | | | | | | | | | | | | | | |

+3, x5: Numbers refer to
Sensitivity

20
15 5 (%) STRAIN AT FAILURE
10



Highway Engineering Division
Engineering Materials Office - Soil Mechanics Section

| WP 661-93-01/02 | | RECORD OF BOREHOLE No 12 | | IMPERIAL | | | | | | | |
|-----------------|---|---|--------|-------------------------|-----------------|---|---------------------------------|-------------------------------|--------------------------------|------------------|--|
| W P 49-71-05/06 | | LOCATION Co-ords. N 15,892,091; E 966,135 | | ORIGINATED BY BL | | | | | | | |
| DIST 6 HWY 427 | | BOREHOLE TYPE 31" Diameter HSA | | COMPILED BY BL | | | | | | | |
| DATUM Geodetic | | DATE August 27, 1979 | | CHECKED BY | | | | | | | |
| SOIL PROFILE | | SAMPLES | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 | PLASTIC LIMIT W _p | NATURAL MOISTURE CONTENT W | LIQUID LIMIT W _L | UNIT WEIGHT γ | REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL |
| ELEV. DEPTH | DESCRIPTION | STRAT. PLOT | NUMBER | | | | | | | | |
| 524.0 | Ground Level | | | | | | | | | | |
| 0.0 | Glacial Till Silty sand, some gravel, grey compact to generally very dense | Organics | 1 | SS | 16 | | | | | | |
| | | | 2 | SS | 120/11" | | | | | | |
| | | | 3 | SS | 52 | | | | | | |
| | Silty clay | | 4 | SS | 73 | | | | | | |
| | | | 5 | SS | 90/5" | | | | | | |
| 505.0 | | | | | | | | | | | |
| 19.0 | Silty clay, some sand, reddish, hard | | 6 | SS | 100/8" | | | | | | 0 42 (58) |
| 498.0 | | | | | | | | | | | |
| 497.0 | Probable bedrock | | 7 | SS | Bouncing | | | | | | |
| 27.0 | End of Borehole | | | | | | | | | | |
| | Note: Augering met refusal at 27 feet | | | | | | | | | | |

OFFICE REPORT ON SOIL EXPLORATION

+3, x5: Numbers refer to Sensitivity

20
15 5 (%) STRAIN AT FAILURE
10



Division of
Highway Engineering and
Construction

WP 661-93-01/02

RECORD OF BOREHOLE No 13

IMPERIAL

W P 49-71-05/06 LOCATION Co-ords. N 15,892,047; E 966,157 ORIGINATED BY BL
DIST 6 HWY 427 BOREHOLE TYPE 3 1/2" Diameter HSA COMPILED BY BL
DATUM Geodetic DATE August 27, 1979 CHECKED BY

| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | PLASTIC LIMIT W _p | NATURAL MOISTURE CONTENT W | LIQUID LIMIT W _L | UNIT WEIGHT Y | REMARKS & GRAIN SIZE DISTRIBUTION (%) |
|---------------|---|------------|---------|------|------------|----------------------------|-----------------|---|----------------|------------------------------------|-------------------------------------|-----------------------------------|---------------------|---|
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | 'N' VALUES | | | 20 40 60 80 100 | SHEAR STRENGTH | | | | | |
| 523.0 | Ground Level | | | | | | | | | | | | | GR SA SI CL |
| 0.0 | Fine sand with gravel Organic Very dense | | | | | | 520 | | | | | | | |
| 517.0 | | | 1 | SS | 55 | | | | | | | | | |
| 6.0 | Silty clay, some sand seams, trace of gravel Glacial Till Silty sand, some gravel, very dense | | 2 | SS | 102 | 10" | 510 | | | | | | | |
| | | | 3 | SS | 57 | | | | | | | | | |
| | | | 4 | SS | 96 | 11" | | | | | | | | |
| 496.5 | Sand with gravel, very dense | | 5 | SS | 128 | 11" | 500 | | | | | | | 29 51 (20) |
| 26.5 | End of Borehole | | | | | | | | | | | | | |

OFFICE REPORT ON SOIL EXPLORATION

+3, x5: Numbers refer to
Sensitivity

20
15 10 5 (%) STRAIN AT FAILURE
10

WP 661-93-01/02

RECORD OF BOREHOLE No 14

IMPERIAL

W P 49-71-06 LOCATION N 15, 891, 877.5; E 966, 109.4 ORIGINATED BY B.T.
DIST 6 HWY 427 BOREHOLE TYPE Hollow Stem Auger and Cone Test COMPILED BY B.T.
DATUM Geodetic DATE May 21, 1980 CHECKED BY

| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | PLASTIC LIMIT | NATURAL MOISTURE CONTENT | LIQUID LIMIT | UNIT WEIGHT γ | REMARKS & GRAIN SIZE DISTRIBUTION (%) |
|----------------|---|-------------|---------|------|------------|----------------------------|----------------------------------|---|------------------|--------------------------------|-----------------|----------------------------|---|
| ELEV. DEPTH | DESCRIPTION | STRAT. PLOT | NUMBER | TYPE | 'N' VALUES | | | 20 40 60 80 100 | W _p | W | W _L | | |
| | | | | | | | | SHEAR STRENGTH | | | | | |
| | | | | | | | ○ UNCONFINED ● QUICK TRIAXIAL | + FIELD VANE x LAB VANE | | | | | |
| 534.7 | Ground Surface | | | | | | | | 10 20 30 | | | | GR SA SI CL |
| 0.0 | Clayey Silt Some Sand Hard | | 1 | SS | 7 | | 530 | | | | | | 2 33 40 25 |
| 524.7 | (Probable Fill Material) | | 2 | SS | 29 | | | | | | | | |
| 10.0 | Sandy Organics | | 3 | SS | 10 | | | | | | | | 0 25 64 11 |
| 520.7 | Silt Compact | | | | | | | | | | | | |
| 14.0 | Sandy Gravel | | 4 | SS | 32 | | 520 | | | | | | 47 35 17 1 |
| 517.7 | Dense (Glacial Till) | | | | | | | | | | | | |
| 17.0 | Silty Clay | | 5 | SS | 68 | | | | | | | | |
| | Occasional Sand Seams | | 6 | SS | 100 | | 510 | | | | | | |
| 506.7 | Hard | | | | | | | | | | | | |
| 28.0 | Sand with Gravel to Sandy Silt, Trace of Clay | | 7 | SS | 100/3" | | 500 | | | | | | 31 59 10 |
| 496.7 | Very Dense (Glacial Till) | | 8 | SS | 65 | | | | | | | | 0 29 60 11 |
| 38.0 | Shale Bedrock Fine Textured & Fissile Weathered | | 9 | SS | 100/4" | | 490 | | | | | | |
| 488.2 | | | 10 | SS | 100/3" | | | | | | | | |
| 46.5 | End of Borehole | | | | | | | | | | | | |

OFFICE REPORT ON SOIL EXPLORATION

207.

SHEET
115

REG MUN OF PEEL CITY OF MISSISSAUGA

INDIAN LINE

HUMBER RIVER

METRO BOROUGH OF TORONTO

STONICOME

SITE

KEY PLAN

0.5 0 1 Mile

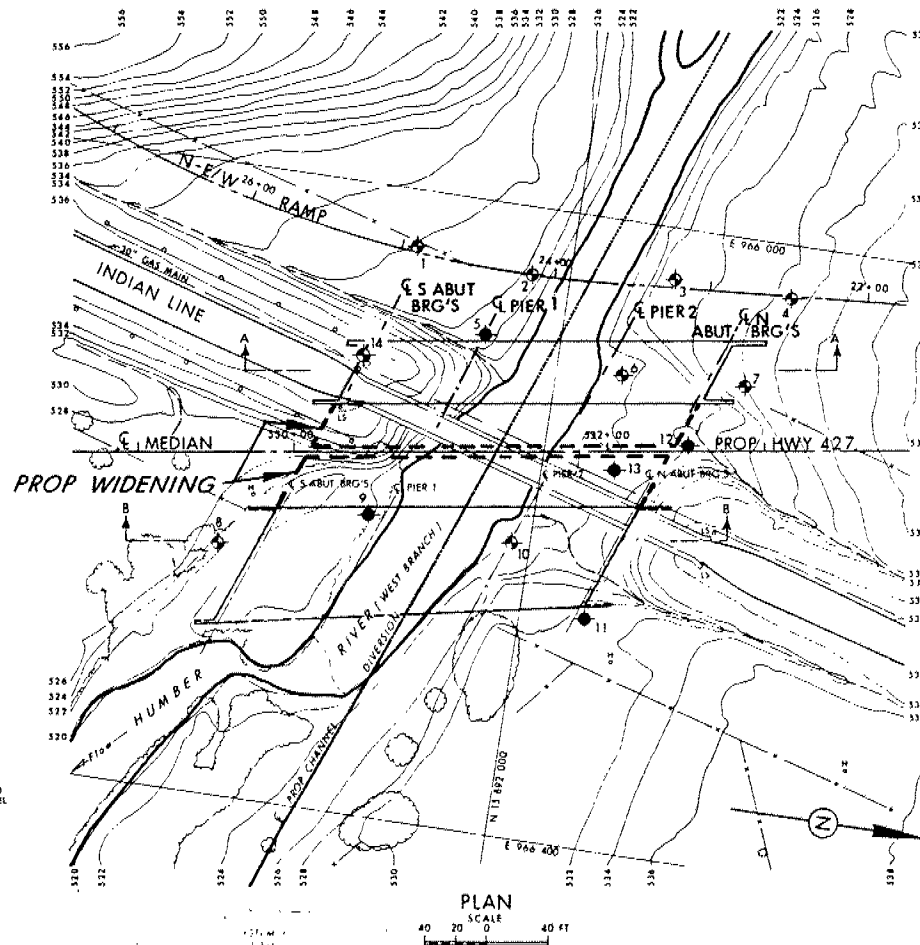
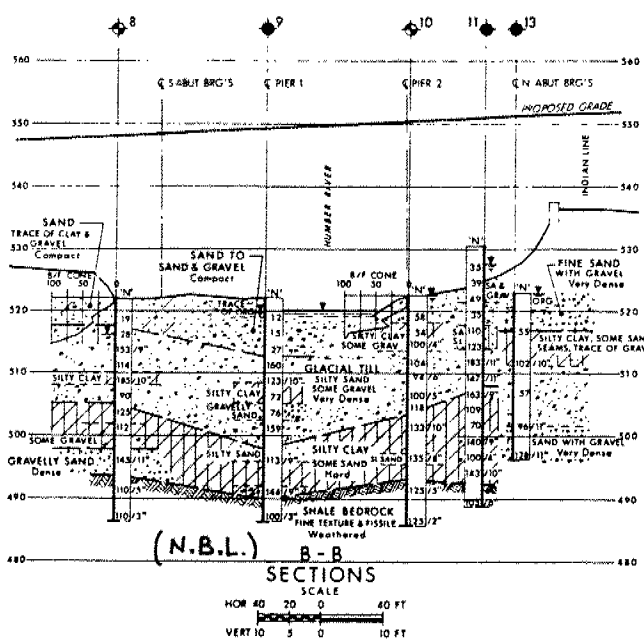
- Bore Hole
- ⊕ Dynamic Cone Penetration Test (Cone)
- ⊗ Bore Hole & Cone
- W Blows/ft (Std Pen Test, 350 ft lbs energy)
- CONE Blows/ft (60° Cone, 350 ft lbs energy)
- ⬇ WL of time of investigation Aug 1970

| No. | ELEVATION | CO-ORDINATES | |
|-----|-----------|--------------|---------|
| | | NORTH | EAST |
| 1 | 528.0 | 15 891 700 | 966 035 |
| 2 | 526.3 | 15 891 975 | 966 042 |
| 3 | 527.4 | 15 892 066 | 966 032 |
| 4 | 520.2 | 15 892 142 | 966 033 |
| 5 | 525.0 | 15 891 051 | 966 084 |
| 6 | 520.3 | 15 892 042 | 966 097 |
| 7 | 530.0 | 15 892 121 | 966 093 |
| 8 | 522.0 | 15 891 803 | 966 240 |
| 9 | 522.1 | 15 891 895 | 966 208 |
| 10 | 522.6 | 15 891 899 | 966 213 |
| 11 | 530.6 | 15 892 042 | 966 254 |
| 12 | 524.0 | 15 892 091 | 966 135 |
| 13 | 523.0 | 15 892 042 | 966 157 |
| 14 | 524.7 | 15 891 877 | 966 109 |

The boundaries between corals have been established only at Bare Hole locations. Between Bare Holes the boundaries are assumed from geological evidence.



| | | | |
|------------|------------|------------------|--------------|
| HWT No 427 | | INB 15811 | Dist 6 |
| SUBNOB 11 | CHECKED MA | DATE Oct 31 1979 | SITE 17-633A |
| DRWBY 85 | CHECKED #3 | WJG | 2 |



PLAN
SCALE
40 20 0 40

REF No X-78462-G11; Sept 1979 PROCTOR & KROFFEN LIMITED