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GEOCRES No. 30M13-81

DIST. 6 REGION

W.P. No. 181-86-01

CONT. No. 91-59

W. O. No.

STR. SITE No. 37-682

HWY. No. 7

LOCATION CNR Overhead
MacMillan Yard

No of PAGES -

=====

OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT.

REMARKS:

FOUNDATION INVESTIGATION REPORT

CONTRACT NO 91-59



Ministry of
Transportation

INDEX

| <u>Page No.</u> | <u>DESCRIPTION</u> |
|-----------------|---|
| 1 | Index |
| 2 | Abbreviations and Symbols |
| | Foundation Investigation Reports for |
| 3 - 54 | C.N.R. Overhead at MacMillan Yard W.P. 181-86-01; Site 37-682 Hwy. 7, District 6, Toronto |
| | C.N.R. Overhead (MacMillan Yard) Approaches W.P. 112-87-01; Site 37-682 Hwy. 7, District 6, Toronto |

Note: For purposes of the contract, these reports supercede all other Foundation Reports prepared by, or for the Ministry in connection with the above-mentioned project.

EXPLANATION OF TERMS USED IN REPORT

2

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 INDICATED 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° CONE ANGLE) DRIVEN BY 475 J IMPACT ENERGY ON 'A' 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 |
| u | 1 | 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 | 1 | COEFFICIENT OF FRICTION |

MECHANICAL PROPERTIES OF SOIL

| | | |
|----------------|-----------------------|--------------------------------------|
| m_v | kPa^{-1} | COEFFICIENT OF VOLUME CHANGE |
| C_c | 1 | COMPRESSION INDEX |
| C_s | 1 | SWELLING INDEX |
| C_α | 1 | RATE OF SECONDARY CONSOLIDATION |
| c_v | m^2/s | COEFFICIENT OF CONSOLIDATION |
| H | m | DRAINAGE PATH |
| T_v | 1 | 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_r | kPa | REMOULDED SHEAR STRENGTH |
| S_t | 1 | SENSITIVITY = $\frac{c_u}{\tau_r}$ |

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 | 1 | 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 | 1 | 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^3/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 | 1 | LIQUIDITY INDEX = $\frac{w - w_p}{I_p}$ | i | 1 | HYDRAULIC GRADIENT |
| γ_{sat} | KN/m^3 | UNIT WEIGHT OF SATURATED SOIL | I_C | 1 | 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^2 | SEEPAGE FORCE |
| γ' | KN/m^3 | UNIT WEIGHT OF SUBMERGED SOIL | | | | | | |

FOUNDATION INVESTIGATION REPORT
FOR
CNR Overhead at MacMillan Yard
W.P. 181-86-01, Site 37-682
Hwy. 7, District 6, Toronto

INTRODUCTION

The report summarizes the foundation investigation for the proposed bridge widening at this site.

The investigation is applicable to the proposed structure widening within 10 m of the existing structure.

SITE DESCRIPTION

The site is located at the existing crossing of Hwy. 7 over the CNR tracks, which is between Jane Street and Keele Street in the Town of Vaughan.

The immediate area is a yard for the CNR.

The area is basically a glacial till plain, with low local relief except for the existing Hwy. 7 embankments.

INVESTIGATION PROCEDURES

A foundation investigation for this project was conducted between 88 04 05 and 88 05 04. The drilling equipment consisted of 82 mm I.D. hollow-stem augers and N casing were used.

The investigation consisted of 15 boreholes, 13 of which were accompanied by dynamic cone penetration tests. Piezometers were installed in 4 boreholes in order to verify groundwater measurements in open boreholes.

The boreholes have been identified as #1-S, 3-N, 3-S, 6-N, 6-S, 7-N, 8-S, 9-N, 10-S, 11, 12, 14, 15, 16 and 18. They extended for depths ranging from 12.6 to 24.8 m. All boreholes were terminated in overburden.

Survey details were provided by the Central Region Surveys and Plans Section.

The sampling program consisted of split spoon samples collected at 0.8 m to 3.0 m intervals. They provided Standard Penetration Test (N) values for assessment of the in situ state of compaction of the non-cohesive materials, and for an indication of shear strengths of cohesive materials. These samples also provided material for identification purposes.

The laboratory testing program for representative samples consisted of:

- grain size analyses
- natural moisture content determinations
- Atterberg Limit determinations

SUBSURFACE CONDITIONS

The Record of Borehole Sheets in the Appendix illustrate the subsurface conditions at the borehole locations. The locations and elevations of the boreholes, along with stratigraphical profiles based on the borehole data are shown on Drawing No. 1818601A & B. **

The approaches to the structure consist of essentially sand fill extending from elev. 214± m to 203± m. The fill is underlain by clayey silt till containing traces of organics in the upper 1± m.

Within the limits of the structure, the overburden consists of the following generalized layers, in sequence, from the surface down:

| <u>Elevation (m)</u> | | <u>Material</u> |
|----------------------|-----------|--------------------------|
| <u>From</u> | <u>To</u> | |
| 205± | 201± | Clayey Silt (Fill) |
| 201± | 194± | Clayey Silt (Upper Till) |
| <u>West Side</u> | | |
| 194± | below 180 | Sandy Silt to Silty Sand |
| <u>East Side</u> | | |
| 194± | 188± | Sandy Silt to Silty Sand |
| 188± | 184± | Clayey Silt (Lower Till) |
| 184± | below 180 | Silty Clay |

**NOTE: REFER TO DWG. # 2 and 3 OF THE CONTRACT DRAWINGS.

Following are detailed descriptions of the soil strata encountered.

Sand (Fill)

This non-cohesive material is fill for the immediate approaches to the existing structure. It has been described as a heterogeneous mixture of sand, with gravel, traces of silt and clay containing occasional clayey silt zones. The bottom 2± m is clayey silt.

It was encountered at BH #12 and BH #16, where it extended for thicknesses of 10.1 m and 10.2 m respectively.

Based on the results of Standard Penetration Tests (N = 4 to 22), the material is in a loose to compact state.

The results of one test indicate a natural water content of 3.5% and a grain size distribution as follows:

| | |
|--------|-------|
| Gravel | 17% |
| Sand | 68% |
| Silt | 14.5% |
| Clay | 0.5% |

Clayey Silt (Fill)

This cohesive material is fill for the CNR track bed and also underlies the embankment fill. It has been described as a heterogeneous mixture of clayey silt (CL), with sand, traces of gravel and organics, containing occasional silty clay zones.

It was encountered at all boreholes within the limits of the bridge and beneath the sand fill at the approach embankments, where it extended for thicknesses ranging from 1.7 to 4.4 m.

Based on the results of Standard Penetration Test (N = 4 to 100+) the material is in a firm to hard, but generally firm to very stiff state.

Typical properties of the material, as determined by laboratory tests, are summarized as follows:

| | <u>Range</u> | <u>Average</u> | <u>Median</u> |
|----------------------------|--------------|----------------|---------------|
| Water Content (w) | 12.0-26.0% | 20.8% | 22.8% |
| Liquid Limit (w_L) | 20.0-37.5% | 28.8% | 28.5% |
| Plastic Limit (w_p) | 13.5-18.0% | 15.8% | 16.0% |
| Plasticity Index (I_p) | 6.0-20.0% | 13.0% | 13.0% |

Figure 1 illustrates a typical plasticity range for this material.

Figure 2 illustrates a typical grain size distribution for this material.

Clayey Silt (Upper Till)

This cohesive material directly underlies the fill across the entire site. It has been described as a heterogeneous mixture of clayey silt (CL to CL-ML), with sand, traces of gravel, containing occasional sand zones and occasional boulders.

It was encountered at all boreholes. Its thickness ranged from 6.3± m to 9.6± m, at these locations.

Based on the results of Standard Penetration Tests ($N = 6$ to 100+), the material is in a firm to hard, but generally very stiff to hard state.

Typical properties of the material, as determined by laboratory tests, are summarized as follows:

| | <u>Range</u> | <u>Average</u> | <u>Median</u> |
|----------------------------|--------------|----------------|---------------|
| Water Content (w) | 7.0-22.0% | 12.2% | 11.3% |
| Liquid Limit (w_L) | 16.0-39.0% | 21.3% | 20.3% |
| Plastic Limit (w_p) | 11.0-24.0% | 13.4% | 12.5% |
| Plasticity Index (I_p) | 3.0-20.5% | 7.9% | 7.3% |

Figure 3 illustrates a typical plasticity envelope for this material.

Figure 4 illustrates a typical grain size distribution for the cohesive portion of this material.

There are zones of silt and sand within the overburden which are water bearing and exhibit a tendency to flow or boil under conditions of unbalanced hydrostatic head.

The presence of boulders within this strata is noted.

Sandy Silt to Silty Sand

This non-cohesive material directly underlies the clayey silt till across the entire site. It has been described as sandy silt to silty sand, with traces of gravel and clay, and occasional clayey silt zones.

The surface of this stratum is relatively level. However the elevation of the base of the stratum is irregular, as it extends for thicknesses in excess of 14.5 m at west portion of the site while the thicknesses at the east portion of the site range from 4± to 6± m.

Based on the results of Standard Penetration Test (N = 3 to 100+) the material is in a very loose to very dense, but generally compact to very dense state.

Typical properties of the material, as determined by laboratory tests, are summarized as follows:

| | <u>Range</u> | <u>Average</u> | <u>Median</u> |
|----------------------------|--------------|----------------|---------------|
| Water Content (w) | 5.5-25.5% | 17.4% | 18.8% |
| Liquid Limit (w_L) | 0-22.0% | N/A | N/A |
| Plastic Limit (w_P) | 0-16.5% | N/A | N/A |
| Plasticity Index (I_P) | 0- 6.5% | N/A | N/A |

Figure 5 illustrates a typical grain size distribution for this material.

Clayey Silt (Lower Till)

This cohesive material was encountered directly beneath the sandy silt to silty sand stratum at the east portion of the site. Boreholes at the west portion of the site did not penetrate to this stratum. It has been described as a heterogeneous mixture of clayey silt (CL to CL-ML), with sand, traces of gravel and containing occasional silt and sand zones and occasional boulders.

It was encountered at boreholes #3-N, #3-S, #6-S, #15, #16 and #18 where its thickness ranges from an estimated 2.3 to 6.0 m. The elevation of the surface of the deposit is irregular, sloping down from east to west.

Based on the results of Standard Penetration Tests (N = 13 to 100+), the material is in a stiff to hard, but generally hard state.

Typical properties of the material, as determined by laboratory tests, are summarized as follows:

| | <u>Range</u> | <u>Average</u> | <u>Median</u> |
|----------------------------|--------------|----------------|---------------|
| Water Content (w) | 8.0-22.5% | 13.0% | 11.0% |
| Liquid Limit (w_L) | 14.0-26.5% | 18.7% | 16.0% |
| Plastic Limit (w_p) | 9.5-17.5% | 12.5% | 11.0% |
| Plasticity Index (I_p) | 3.0- 9.0% | 6.2% | 5.5% |

Figure 6 illustrates a typical grain size distribution for this material.

Silty Clay

This cohesive material was encountered directly beneath the clayey silt (lower till) stratum at the east portion of the site. It has been described as silty clay (CI), containing occasional silt zones.

It was encountered at boreholes #3-N, #3-S, #15 and #18 where its full extent was not explored. At these locations it is over 5± m thick. The elevation of the surface of the deposit is irregular, sloping down from east to west.

Based on the results of Standard Penetration Tests (N = 68 to 100+) the material is in a hard state.

Typical properties of the material, as determined by laboratory tests, are summarized as follows:

| | <u>Range</u> | <u>Average</u> | <u>Median</u> |
|----------------------------|--------------|----------------|---------------|
| Water Content (w) | 19.0-21.0% | 20.0% | 20.0% |
| Liquid Limit (w_L) | 42.0-48.5% | 43.9% | 42.5% |
| Plastic Limit (w_P) | 19.0-22.0% | 20.3% | 20.0% |
| Plasticity Index (I_P) | 21.5-26.5% | 23.6% | 23.3% |

Figure 7 illustrates a typical grain size distribution for this material.

Groundwater

At the time of the field investigation, the groundwater elevation was generally within 1 m of the ground surface. Reference is made to the Record of Borehole Sheets for specific groundwater elevations.

MISCELLANEOUS

The field work for this project was carried out under the supervision of K. Zasitko, Foundation Technician.

The equipment used was owned and operated by Malone's Soils Samples and Master Soil Investigation Ltd.

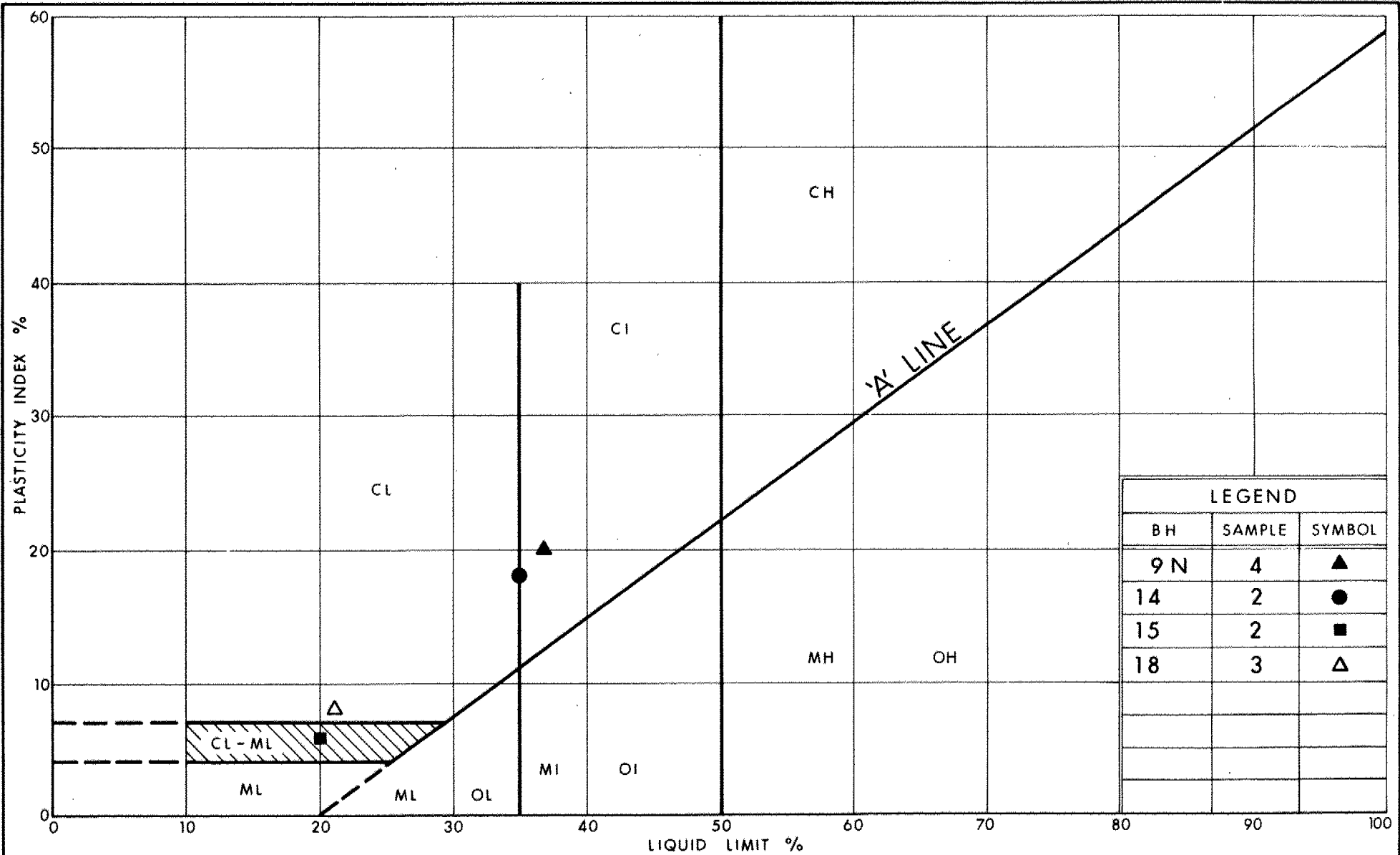
The report was written by D. Dundas, Sr. Foundation Engineer, and reviewed by M. Devata, Chief Foundation Engineer.



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

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

APPENDIX



| LEGEND | | |
|--------|--------|--------|
| BH | SAMPLE | SYMBOL |
| 9 N | 4 | ▲ |
| 14 | 2 | ● |
| 15 | 2 | ■ |
| 18 | 3 | △ |
| | | |
| | | |
| | | |
| | | |



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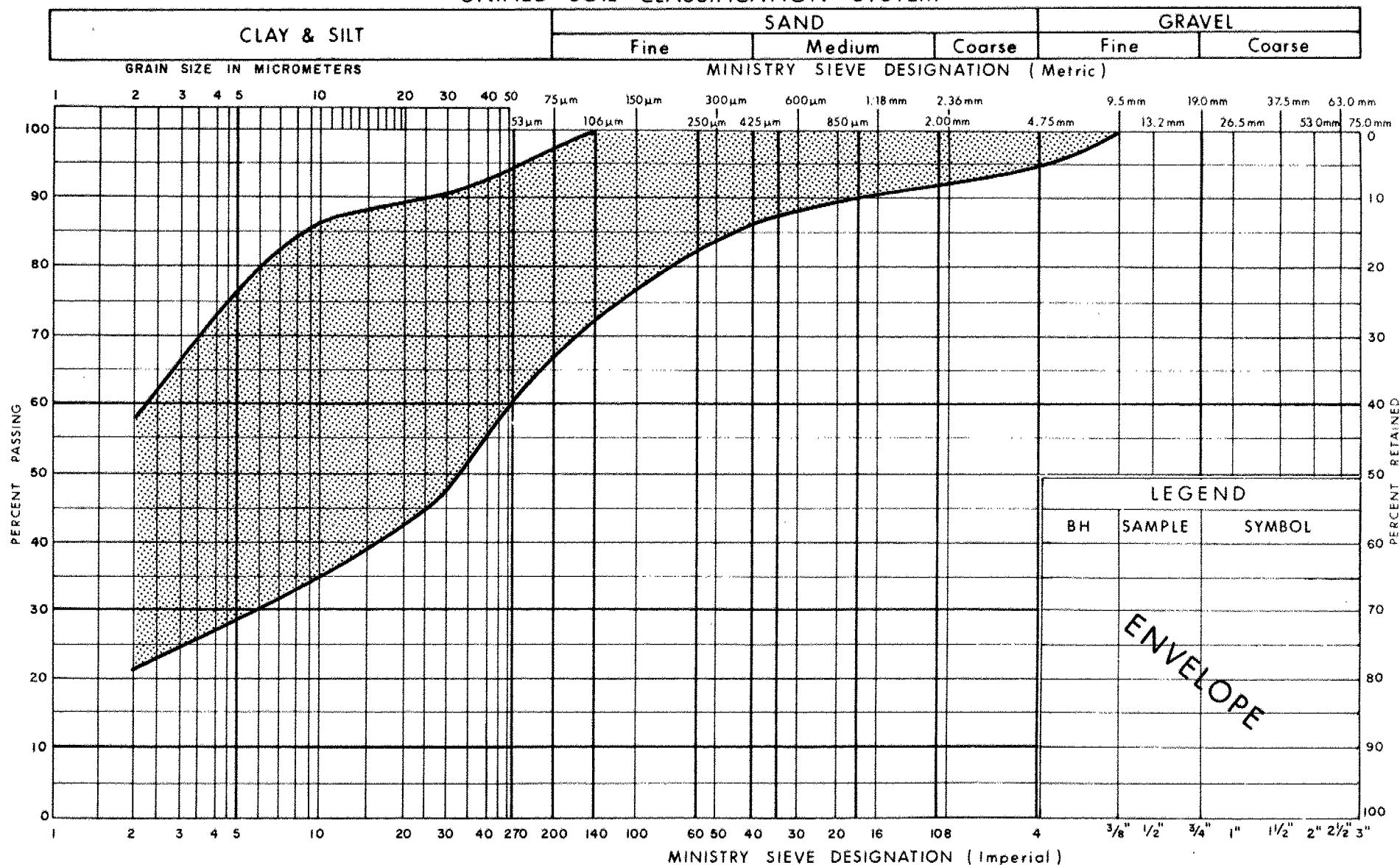
Ontario

PLASTICITY CHART CLAYEY SILT (FILL)

FIG No 1

W P 181-86-01

UNIFIED SOIL CLASSIFICATION SYSTEM

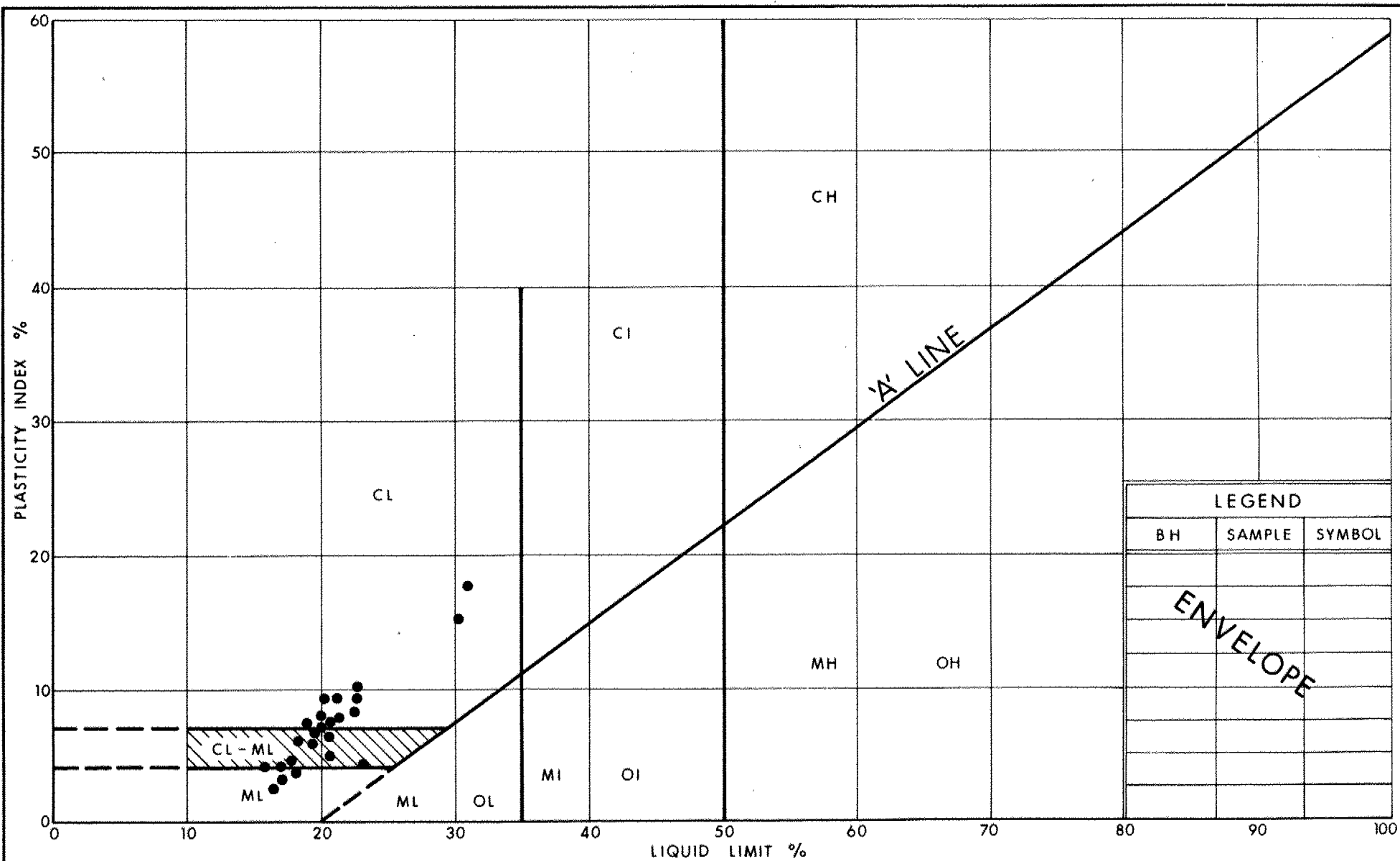


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Transportation

GRAIN SIZE DISTRIBUTION CLAYEY SILT (FILL)

FIG No 2

W P 181-86-01



Ministry of
Transportation

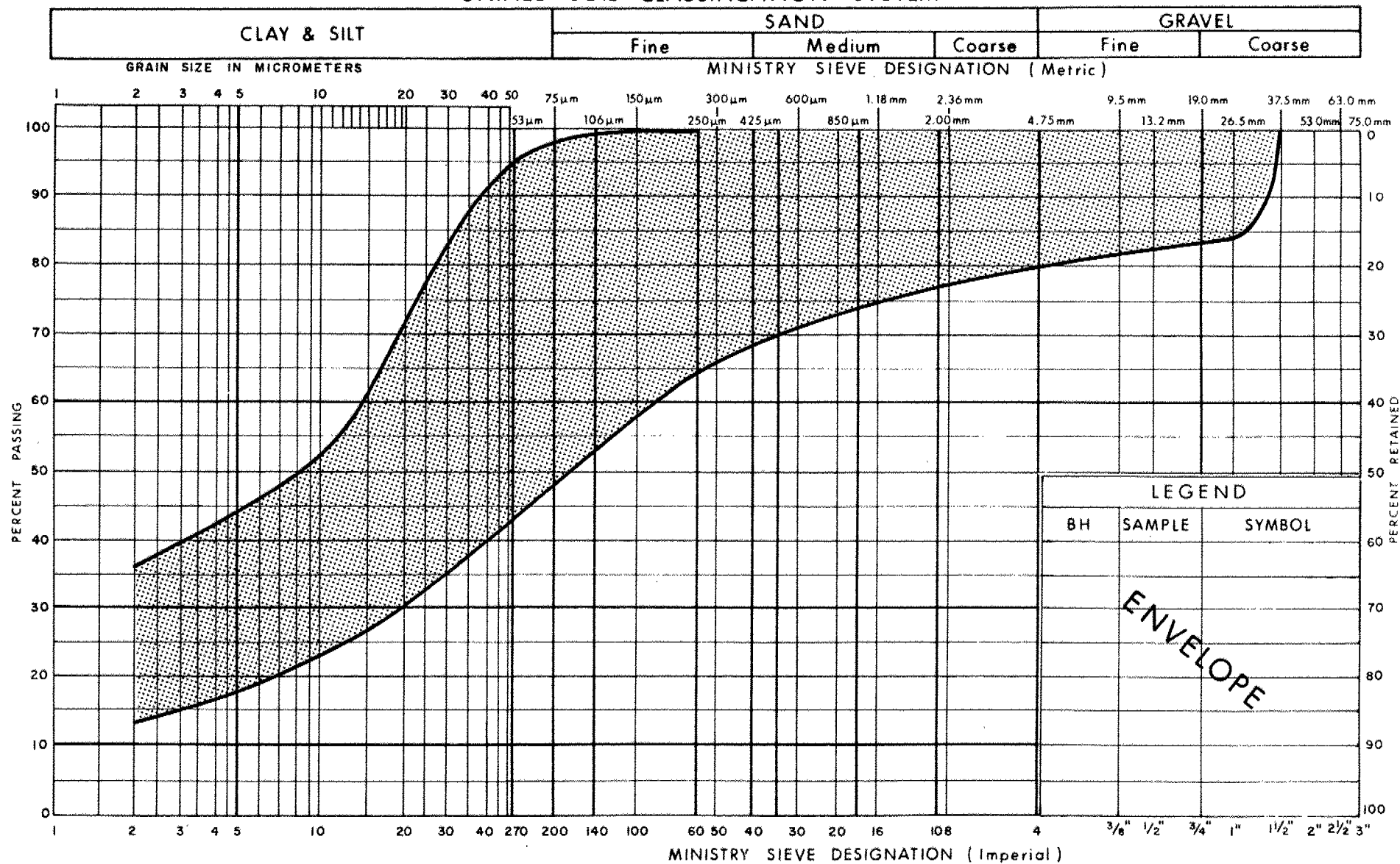
Ontario

PLASTICITY CHART CLAYEY SILT (Upper Glacial Till)

FIG No 3

W P 181-86-01

UNIFIED SOIL CLASSIFICATION SYSTEM


 Ministry of
Transportation

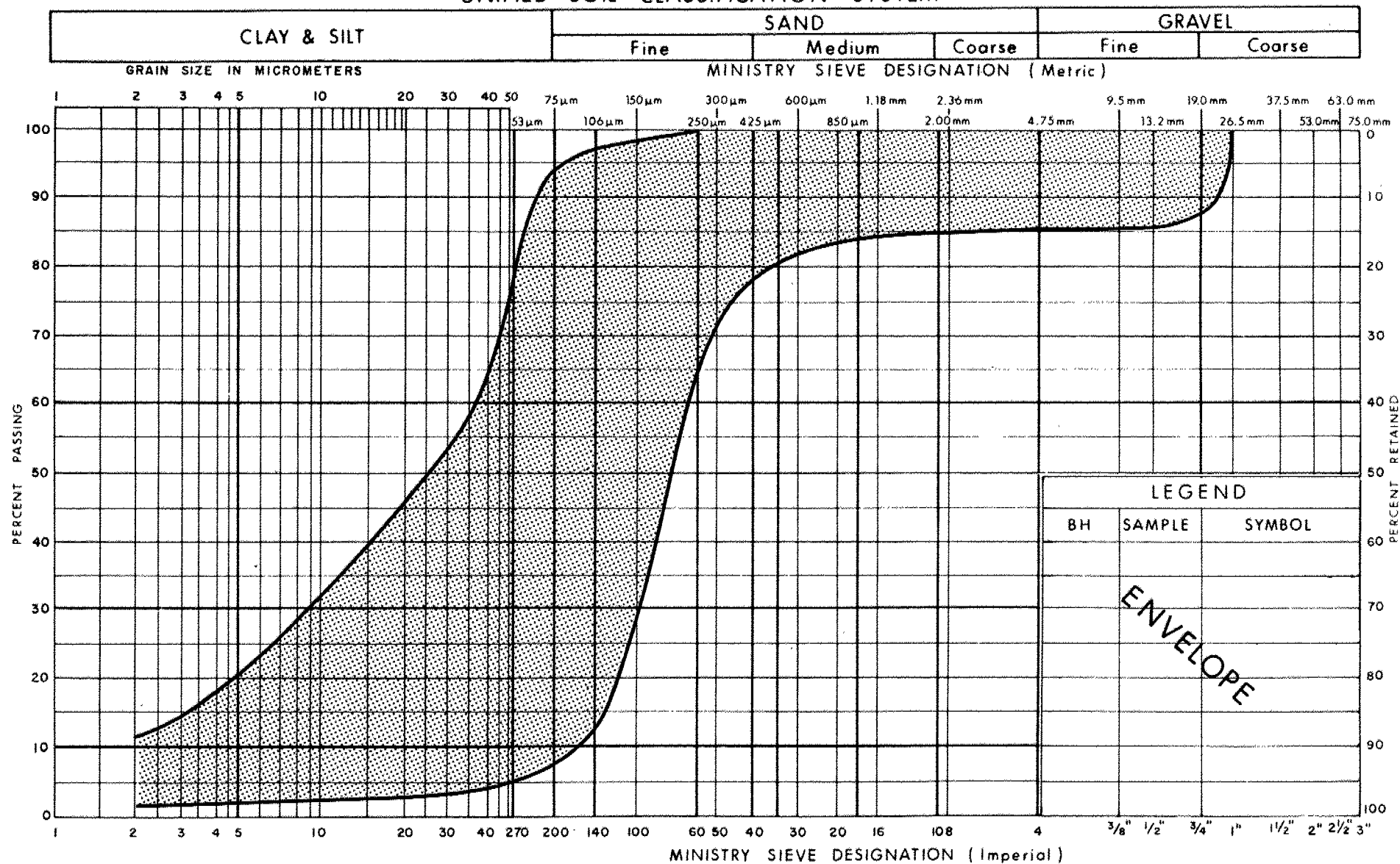
GRAIN SIZE DISTRIBUTION

CLAYEY SILT (Upper Glacial Till)

FIG No 4

WP 181-86-01

UNIFIED SOIL CLASSIFICATION SYSTEM

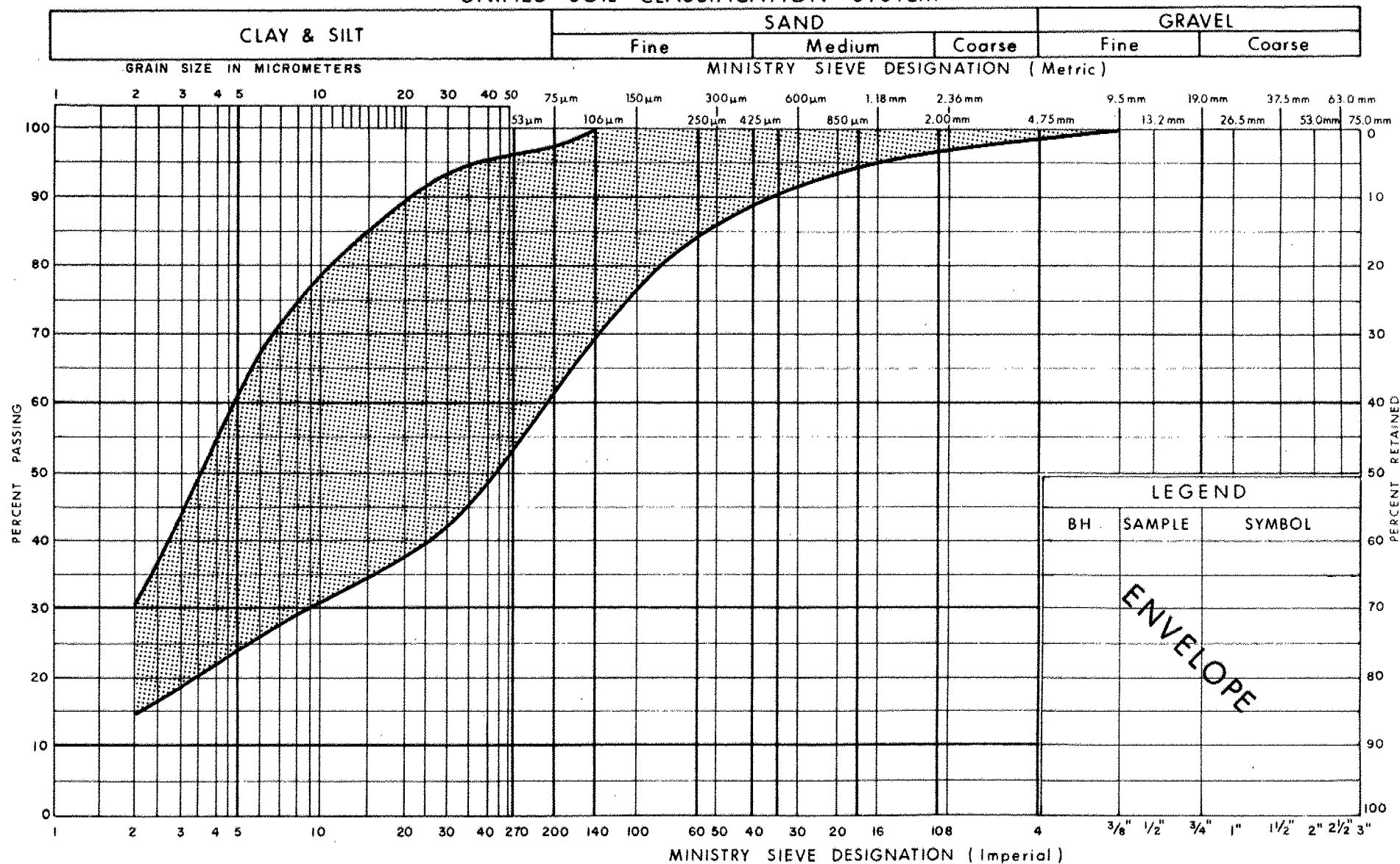

 Ministry of
Transportation

 GRAIN SIZE DISTRIBUTION
SANDY SILT TO SILTY SAND

FIG No 5

WP 181-86-01

UNIFIED SOIL CLASSIFICATION SYSTEM



Ministry of
Transportation

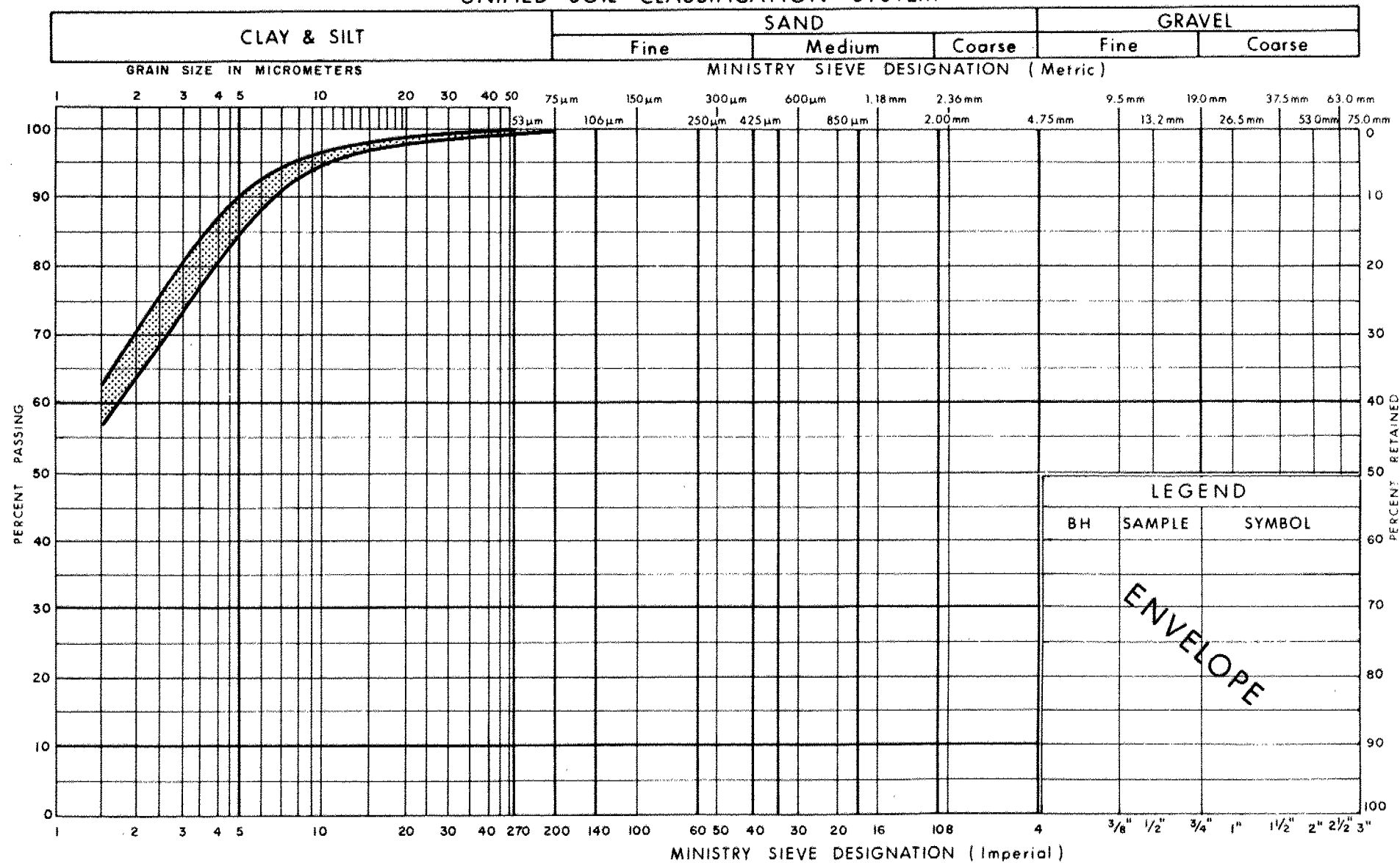
GRAIN SIZE DISTRIBUTION

CLAYEY SILT (Lower Glacial Till)

FIG No 6

WP 181-86-01

UNIFIED SOIL CLASSIFICATION SYSTEM



Ministry of
Transportation

GRAIN SIZE DISTRIBUTION
SILTY CLAY

FIG No 7

WP 181-86-01

RECORD OF BOREHOLE No 15

METRIC

W P 181-86-01 LOCATION Co-ords N 4 850 679.8; E 304 202.6 ORIGINATED BY KZ
 DIST 6 HWY 7 BOREHOLE TYPE Hollow Stem Auger & Cone Test COMPILED BY JBF
 DATUM Geodetic DATE 88 04 12 CHECKED BY

OFFICE REPORT ON SOIL EXPLORATION

| 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 | WATER CONTENT (%) | 20 40 60 | | | | | |
| 204.9 | Ground Level | | | | | | | | | | | | | | |
| 0.0 | Het. Mixture Clayey Silt with Sand Tr. Gravel, Organics Occ. Silty Clay Zones Stiff (Fill) | | 1 | SS | 13 | | | | | | | | | | |
| 202.8 | | | 2 | SS | 9 | | | | | | | | | | |
| 2.1 | Het. Mixture Clayey Silt (CL to CL-ML) with Sand | | 3 | SS | 21 | | | | | | | | | | |
| | Tr. Gravel Boulders | | 4 | SS | 21 | | | | | | | | | | |
| | Occ. Silt and Sand Zones | | 5 | SS | 27 | | | | | | | | | | |
| | Occ. Boulders Firm to Hard (Glacial Till) | | 6 | SS | 33 | | | | | | | | | | |
| | | | 7 | SS | 22 | | | | | | | | | | |
| | | | 8 | SS | 7 | | | | | | | | | | |
| | | | 9 | SS | 104 | | | | | | | | | | |
| | | | 10 | SS | 100/ | 15 cm | | | | | | | | | |
| | | | 11 | SS | 67 | | | | | | | | | | |
| 193.2 | | | | | | | | | | | | | | | |
| 11.7 | Sandy Silt to Silty Sand * | | | | | | | | | | | | | | |
| 192.2 | | | 12 | SS | 14 | | | | | | | | | | |
| 12.7 | End of Borehole | | | | | | | | | | | | | | |
| | * Trace Gravel Trace Clay Occ. Clayey Silt Zones Compact (Lacustrine) | | | | | | | | | | | | | | |

RECORD OF BOREHOLE No 3N

METRIC

W P 181-86-01 LOCATION Co-ords. N 4 850 702.9; E 304 178.8 ORIGINATED BY KZ
 DIST 6 HWY 7 BOREHOLE TYPE Hollow Stem Auger, Washbore & Cone Test COMPILED BY JBF
 DATUM Geodetic DATE 88 04 13 - 14 CHECKED BY

OFFICE REPORT ON SOIL EXPLORATION

| 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 | | | 20 40 60 80 100 | PLASTIC LIMIT W _p | NATURAL MOISTURE CONTENT W | | |
| 204.7 | Ground Level | | | | | | | | | | |
| 0.0 | Het. Mixture Clayey Silt with Sand Tr. Gravel, Organics Occ. Silty Clay Zones Stiff to V. Stiff (Fill) | | 1 | SS | 26 | | | | | | 1 39 43 17 |
| 202.6 | | | 2 | SS | 15 | | | | | | |
| 2.1 | Het. Mixture Clayey Silt(CL to CL-ML) with Sand Trace Gravel Occ. Silt and Sand Zones Occ. Boulders Stiff to Hard (Glacial Till) | | 3 | SS | 29 | | | | | | |
| | | | 4 | SS | 25 | | | | | | |
| | | | 5 | SS | 30 | | | | | | 9 32 40 19 |
| | | | 6 | SS | 19 | | | | | | 6 34 42 18 |
| | | | 7 | SS | 10 | | | | | | |
| | | | 8 | SS | 15 | | | | | | 6 34 46 14 |
| | | | 9 | SS | 130/ | 25 cm | | | | | |
| | | | 10 | SS | 120/ | 28 cm | | | | | 5 31 48 16 |
| 194.0 | | | | | | | | | | | |
| 10.7 | Sandy Silt to Silty Sand Trace Gravel Trace Clay Occ. Clayey Silt Zones Compact to V. Dense (Lacustrine) | | 11 | SS | 66 | | | | | | |
| | | | 12 | SS | 12 | | | | | | |
| | | | 13 | SS | 100 | | | | | | 0 6 90 4 |
| 190.0 | | | | | | | | | | | |
| 14.7 | Het. Mixture Clayey Silt(CL to CL-ML) with Sand Trace Gravel Occ. Silt and Sand Zones Occ. Boulders Hard (Glacial Till) | | 14 | SS | 112 | | | | | | |
| | | | 15 | SS | 39 | | | | | | 2 34 49 15 |
| | | | 16 | SS | 63 | | | | | | |
| 184.1 | | | | | | | | | | | |
| 20.6 | Silty Clay (CI) Occ. Silt Zones Hard (Lacustrine) | | 17 | SS | 86 | | | | | | 0 0 33 67 |
| | | | | | | | | | | | |
| 179.9 | | | 18 | SS | 68 | | | | | | |
| 24.8 | End of Borehole | | | | | | | | | | |

+³, x⁵: Numbers refer to
Sensitivity

20
15
10

5 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 35

METRIC

W P 181-86-01 LOCATION Co-ords. N 4 850 667.9; E 304 170.6 ORIGINATED BY KZ
 DIST 6 HWY 7 BOREHOLE TYPE Hollow Stem Auger, Washbore & Cone Test COMPILED BY JBF
 DATUM Geodetic DATE 88 04 11 - 13 CHECKED BY

OFFICE REPORT ON SOIL EXPLORATION

| 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 | | | | | |
| 204.5 | Ground Level | | | | | | | | | | | | |
| 0.0 | Het. Mixture Clayey Silt (CL) with Sand Trace Gravel Trace Organics Occ. Silty Clay Zones Stiff to V. Stiff (Fill) | | 1 | SS | 18 | | | | | | | | |
| | | | 2 | SS | 9 | | | | | | | | |
| 201.6 | | | 3 | SS | 18 | | | | | | | | |
| 2.9 | | | 4 | SS | 30 | | | | | | | | |
| | Het. Mixture Clayey Silt (CL to CL-ML) with Sand Trace Gravel Occ. Silt and Sand Zones Occ. Boulders Stiff to Hard (Glacial Till) | | 5 | SS | 40 | | | | | | | | |
| | | | 6 | SS | 38 | | | | | | | | |
| | | | 7 | SS | 25 | | | | | | | | |
| | | | 8 | SS | 10 | | | | | | | | |
| | | | 9 | SS | 100 | | | | | | | | |
| | | | 10 | SS | 126/25 | cm | | | | | | | |
| | | | 11 | SS | 43 | | | | | | | | |
| 192.8 | | | | | | | | | | | | | |
| 11.7 | Sandy Silt to Silty Sand Trace Gravel Trace Clay Occ. Clayey Silt Zones Compact to V. Dense (Lacustrine) | | 12 | SS | 32 | | | | | | | | |
| | | | 13 | SS | 13 | | | | | | | | |
| | | | 14 | SS | 55 | | | | | | | | |
| 187.5 | | | | | | | | | | | | | |
| 17.0 | Het. Mixture Clayey Silt (CL to CL-ML) with Sand Trace Gravel Occ. Silt & Sand Zones Occ. Boulders Very Stiff to Hard (Glacial Till) | | 15 | SS | 26 | | | | | | | | |
| | Silty Sand | | 16 | SS | 60/10 | cm | | | | | | | 12 42 37 9 |
| 181.5 | | | | | | | | | | | | | |
| 23.0 | Silty Clay (CI) Occ. Silt Zones | | | | | | | | | | | | |
| 179.7 | Hard (Lacustrine) | | 17 | SS | 101 | | | | | | | | 0 0 38 62 |
| 24.8 | End of Borehole | | | | | | | | | | | | |

| RECORD OF BOREHOLE No 6N | | | | | | | | | | METRIC | | | | |
|--------------------------|--|------------|---------------|------|------------|------------------------------------|-----------------|--|--------------------|---------------------------------|-------------------------------|--------------------------------|------------------|--|
| W P 181-86-01 | | | LOCATION | | | Co-ords N 4 850 685.8; E 304 132.9 | | | ORIGINATED BY KZ | | | | | |
| DIST 6 HWY 7 | | | BOREHOLE TYPE | | | Hollow Stem Auger & Cone Test | | | COMPILED BY JBF | | | | | |
| DATUM Geodetic | | | DATE | | | 88 04 11 | | | 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 (%) GR SA SI CL |
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | 'N' VALUES | | | 20 40 60 80 100 | SHEAR STRENGTH kPa | | | | | |
| 203.9 | Ground Level | | | | | | | | | | | | | |
| 0.0 | Het. Mixture Clayey Silt (CL) with Sand, Tr. Gravel Tr. Organics | | 1 | SS | 25 | | | | | | | | | |
| | Occ. Silty Clay Zones | | 2 | SS | 13 | | | | | | | | | |
| 201.0 | Stiff to Very Stiff (Fill) | | 3 | SS | 25 | | | | | | | | | |
| 2.9 | Het. Mixture Clayey Silt (CL to CL-ML) with Sand | | 4 | SS | 36 | | | | | | | | | |
| | Trace Gravel | | 5 | SS | 43 | | | | | | | | | |
| | Occ. Silt & Sand Zones | | 6 | SS | 13 | | | | | | | | | |
| | Occ. Boulders | | 7 | SS | 9 | | | | | | | | | |
| | Stiff to Hard (Glacial Till) | | 8 | SS | 13 | | | | | | | | | |
| | Boulders | | 9 | SS | 100/15 cm | | | | | | | | | |
| | | | 10 | SS | 100/10 cm | | | | | | | | | |
| 192.9 | | | 11 | SS | 87 | | | | | | | | | |
| 11.0 | Sandy Silt to Silty Sand, Tr. Gravel | | | | | | | | | | | | | |
| 191.3 | Trace Clay | | 12 | SS | 4 | | | | | | | | | |
| 12.6 | End of Borehole | | | | | | | | | | | | | |
| | * Occ. Clayey Silt Zones Loose (Lacustrine) | | | | | | | | | | | | | |

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 6S

METRIC

W P 181-86-01 LOCATION Co-ords N 4 850 655.4; E 304 137.0 ORIGINATED BY KZ
 DIST 6 HWY 7 BOREHOLE TYPE Hollow Stem Auger & Cone Test COMPILED BY JBF
 DATUM Geodetic DATE 88 04 06 CHECKED BY

OFFICE REPORT ON SOIL EXPLORATION

| 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 | |
| 204.0 | Ground Level | | | | | | | | | | | |
| 0.0 | Het. Mixture Clayey Silt (CL) with Sand, Tr. Gravel Trace Organics Occ. Silty Clay Zones Firm to Stiff (Fill) | | 1 | SS | 13 | | 202 | | | | | 0 15 40 45 |
| 201.1 | | | 2 | SS | 12 | | | | | | | 7 35 40 18 |
| 2.9 | Het. Mixture Clayey Silt (CL to CL-ML) with Sand | | 3 | SS | 6 | | | | | | | |
| | | | 4 | SS | 37 | | 200 | | | | | |
| | | | 5 | SS | 46 | | | | | | | |
| | Boulders | | 6 | SS | 25 | | | | | | | 2 29 46 23 |
| | Silty Clay | | 7 | SS | 11 | | 198 | | | | | 1 15 38 46 |
| | | | 8 | SS | 12 | | | | | | | 8 37 40 15 |
| | Trace Gravel Occ. Silt & Sand Zones Occ. Boulders Stiff to Hard (Glacial Till) | | 9 | SS | 100 | 13 cm | 196 | | | | | 1 19 67 13 |
| | | | 10 | SS | 120 | 25 cm | | | | | | |
| 193.9 | | | | | | | 194 | | | | | |
| 10.1 | Sandy Silt to Silty Sand Trace Gravel Trace Clay Occ. Clayey Silt Zones Compact to Very Dense (Lacustrine) | | 11 | SS | 36 | | 192 | | | | | 0 29 69 2 |
| | | | 12 | SS | 31 | | | | | | | |
| | | | 13 | SS | 41 | | 190 | | | | | |
| | | | 14 | SS | 59 | | 188 | | | | | |
| | | | 15 | SS | 28 | | 186 | | | | | |
| 186.2 | | | | | | | | | | | | |
| 17.8 | Het. Mixture Clayey Silt (CL to CL-ML) | | 16 | SS | 22 | | | | | | | 0 4 66 30 |
| 185.3 | | | | | | | | | | | | |
| 18.7 | End of Borehole | | | | | | | | | | | |
| | * With Sand Trace Gravel Occ. Silt and Sand Zones Occ. Boulders Very Stiff (Glacial Till) | | | | | | | | | | | |

+3, x5: Numbers refer to
Sensitivity

20
15
10

5 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 7N

METRIC

W P 181-86-01 LOCATION Co-ords N 4 850 678.8; E 304 113.9 ORIGINATED BY KZ
 DIST 6 HWY 7 BOREHOLE TYPE Hollow Stem Auger, Washbore & Cone Test COMPILED BY JBF
 DATUM Geodetic DATE 88 04 22 - 25 CHECKED BY

OFFICE REPORT ON SOIL EXPLORATION

| 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 (%) GR SA SI CL |
|---------------|--|------------|---------|------|------------|----------------------------|-----------------|---|----------|------------------------------------|-------------------------------------|-----------------------------------|---------------------|--|
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | 'N' VALUES | | | 20 40 60 80 100 | 20 40 60 | | | | | |
| 203.9 | Ground Level | | | | | | | | | | | | | |
| 0.0 | Het. Mixture Clayey Silt (CL) with Sand, Tr. Gravel Trace Organics Occ. Silty Clay Zones Firm to Stiff (Fill) | | 1 | SS | 12 | | | | | | | | | |
| | | | 2 | SS | 13 | | | | | | | | | |
| 201.0 | | | 3 | SS | 6 | | | | | | | | | |
| 2.9 | Het. Mixture Clayey Silt (CL to CL-ML) with Sand Trace Gravel Occ Silt & Sand Zones Occ. Boulders Firm to Hard (Glacial Till) | | 4 | SS | 28 | | | | | | | | | |
| | | | 5 | SS | 39 | | | | | | | | | |
| | | | 6 | SS | 21 | | | | | | | | | |
| | | | 7 | SS | 10 | | | | | | | | | |
| | | | 8 | SS | 6 | | | | | | | | | |
| | | | 9 | SS | 100/15cm | | | | | | | | | |
| | | | 10 | SS | 76 | | | | | | | | | |
| 193.8 | | | | | | | | | | | | | | |
| 10.1 | Sandy Silt to Silty Sand Trace Gravel Trace Clay Occ. Clayey Silt Zones Compact to Very Dense (Lacustrine) | | 11 | SS | 33 | | | | | | | | | |
| | | | 12 | SS | 50 | | | | | | | | | |
| | | | 13 | SS | 15 | | | | | | | | | |
| | | | 14 | SS | 40 | | | | | | | | | |
| | | | 15 | SS | 60 | | | | | | | | | |
| | | | 16 | SS | 51 | | | | | | | | | |
| | Clayey Silt | | 17 | SS | 70 | | | | | | | | | |
| | | | 18 | SS | 100/13 cm | | | | | | | | | |
| | | | 19 | SS | 100/10 cm | | | | | | | | | |
| 179.3 | | | | | | | | | | | | | | |
| 24.6 | End of Borehole | | | | | | | | | | | | | |

RECORD OF BOREHOLE No 85

METRIC

W P 181-86-01 LOCATION Co-ords N 4 850 645.8; E 304 111.3 ORIGINATED BY KZ
 DIST 6 HWY 7 BOREHOLE TYPE Hollow Stem Auger & Cone Test COMPILED BY JBF
 DATUM Geodetic DATE 88 04 25 CHECKED BY

OFFICE REPORT ON SOIL EXPLORATION

| 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 | 20 40 60 | | | | | |
| 204.1 | Ground Level | | | | | | | | | | | | | |
| 0.0 | Het Mixture Clayey Silt (CL) with Sand, Tr. Gravel Trace Organics Occ. Silty Clay Zones Firm to Stiff (Fill) | | 1 | SS | 15 | | | | | | | | | |
| | | | 2 | SS | 5 | | | | | | | | | |
| 201.2 | | | 3 | SS | 8 | | | | | | | | | |
| 2.9 | Het. Mixture Clayey Silt (CL to CL-ML) with Sand Trace Gravel Occ. Silt & Sand Zones Occ. Boulders Firm to Hard (Glacial Till) | | 4 | SS | 19 | | | | | | | | | |
| | | | 5 | SS | 23 | | | | | | | | | |
| | | | 6 | SS | 24 | | | | | | | | | |
| | | | 7 | SS | 11 | | | | | | | | | |
| | | | 8 | SS | 7 | | | | | | | | | |
| | Sandy Silt | | 9 | SS | 100 | 10 cm | | | | | | | | |
| | | | 10 | SS | 118 | 25 cm | | | | | | | | |
| | | | 11 | SS | 61 | | | | | | | | | |
| 192.4 | | | | | | | | | | | | | | |
| 11.7 | Sandy Silt to Silty Sand, Tr. Gravel Trace Clay Occ. Clayey Silt Zones Very Dense (Lacustrine) | | 12 | SS | 63 | | | | | | | | | |
| 189.9 | | | 13 | SS | 42 | | | | | | | | | |
| 14.2 | End of Borehole | | | | | | | | | | | | | |
| | * Water Level not Established | | | | | | | | | | | | | |

+3, x5: Numbers refer to
Sensitivity

20
15
10
5 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 9N

METRIC

W P 181-86-01 LOCATION Co-ords N 4 850 669.6; E 304 089.3
 DIST 6 HWY 7 BOREHOLE TYPE Hollow Stem Augers & Cone Test ORIGINATED BY KZ
 DATUM Geodetic DATE 88 04 06 COMPILED BY JBF
 CHECKED BY

OFFICE REPORT ON SOIL EXPLORATION

| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE | PLASTIC LIMIT Wp NATURAL MOISTURE CONTENT W LIQUID LIMIT Wl WATER CONTENT (%) 20 40 60 | UNIT WEIGHT Y | REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL | |
|---------------|--|------------|---------|------|------------|----------------------------|--------------------|--|---|---------------------|--|--|
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | 'N' VALUES | | | | | | | |
| 204.4 | Ground Level | | | | | | | | | | | |
| 0.0 | Het. Mixture Clayey Silt (CL) with Sand, Tr. Gravel Trace Organics Occ. Silty Clay Zones Stiff to Very Stiff (Fill) | | 1 | SS | 16 | | | | | | | |
| | | | 2 | SS | 18 | | | | | | | |
| | | | 3 | SS | 12 | | | | | | | |
| | | | 4 | SS | 16 | | | | | | | |
| 200.7 | Het. Mixture Clayey Silt (CL to CL-ML) with Sand Trace Gravel Occ. Silt & Sand Zones Occ. Boulders Stiff to Hard Boulders (Glacial Till) | | 5 | SS | 26 | | | | | | | |
| 3.7 | | | 6 | SS | 28 | | | | | | | |
| | | | 7 | SS | 52 | | | | | | | |
| | | | 8 | SS | 11 | | | | | | | |
| | | | 9 | SS | 100 | 10 cm | | | | | | |
| | | | 10 | SS | 100 | 15 cm | | | | | | |
| | | | 11 | SS | 103 | | | | | | | |
| 193.3 | End of Borehole | | | | | | | | | | | |
| 11.1 | | | | | | | | | | | | |

RECORD OF BOREHOLE No 10S

METRIC

W P 181-86-01 LOCATION Co-ords. N 4 850 635.7; E 304 084.2 ORIGINATED BY KZ
 DIST 6 HWY 7 BOREHOLE TYPE Hollow Stem, Washbore, Penetration Test COMPILED BY JBF
 DATUM Geodetic DATE 88 04 09 CHECKED BY

OFFICE REPORT ON SOIL EXPLORATION

| 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 | | | | | |
| 204.8 | Ground Level | | | | | | | | | | | | | |
| 0.0 | Het. Mixture Clayey Silt (CL) with Sand, Tr. Gravel Trace Organics Occ. Silty Clay Zones Firm to Hard (Fill) | | 1 | SS | 100 | 3 cm | 204 | | | | | | | |
| | | | 2 | SS | 17 | | | | | | | | | |
| | | | 3 | SS | 4 | | | | | | | | | |
| | | | 4 | SS | 16 | | | | | | | | | |
| 200.4 | | | 5 | SS | 25 | | | | | | | | | |
| 4.4 | Het. Mixture Clayey Silt (CL to CL-ML) with Sand Trace Gravel Occ. Silt & Sand Zones Occ. Boulders Stiff to Hard (Glacial Till) | | 6 | SS | 39 | | 200 | | | | | | | |
| | | | 7 | SS | 30 | | | | | | | | | |
| | | | 8 | SS | 20 | | | | | | | | | |
| | | | 9 | SS | 8 | | 198 | | | | | | | |
| | | | 10 | SS | 104 | 25cm | 196 | | | | | | | |
| | | | 11 | SS | 116 | 25cm | 194 | | | | | | | |
| | | | 12 | SS | 58 | | 192 | | | | | | | |
| 191.6 | | | 13 | SS | 19 | | 190 | | | | | | | |
| 13.2 | Sandy Silt to Silty Sand Trace Gravel Trace Clay Occ. Clayey Silt Zones Loose to Compact (Lacustrine) | | 14 | SS | 8 | | 188 | | | | | | | |
| | | | 15 | SS | 16 | | 186 | | | | | | | |
| | | | 16 | SS | 25 | | 184 | | | | | | | |
| | | | | | | | 182 | | | | | | | |
| 180.4 | | | | | | | | | | | | | | |
| 24.4 | End of Borehole | | | | | | | | | | | | | |

RECORD OF BOREHOLE No 11

METRIC

W P 181-86-01 LOCATION Co-ords. N 4 850 665.7; E 304 059.9 ORIGINATED BY KZ
 DIST 6 HWY 7 BOREHOLE TYPE Hollow Stem Auger, Washbore & Cone Test COMPILED BY JBF
 DATUM Geodetic DATE 88 04 20 - 21 CHECKED BY

OFFICE REPORT ON SOIL EXPLORATION

| 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 (%) GR SA SI CL |
|---------------|--|------------|---------|------|------------|----------------------------|--------------------|---|----------|------------------------------------|-------------------------------------|-----------------------------------|---------------------|--|
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | 'N' VALUES | | | 20 40 60 80 100 | 20 40 60 | | | | | |
| 204.5 | Ground Level | | | | | | | | | | | | | |
| 0.0 | Het. Mixture Clayey Silt (CL) with Sand, Tr. Gravel Trace Organics Occ. Silty Clay Zones Firm to Very Stiff (Fill) | | 1 | SS | 10 | | | | | | | | | |
| | | | 2 | SS | 15 | | | | | | | | | |
| | | | 3 | SS | 6 | | | | | | | | | |
| 200.8 | | | 4 | SS | 24 | | | | | | | | | |
| 3.7 | Het. Mixture Clayey Silt (CL to CL-ML) with Sand, Tr. Gravel Occ. Silt & Sand Zones Occ. Boulders Stiff to Hard | | 5 | SS | 15 | | | | | | | | | |
| | | | 6 | SS | 25 | | | | | | | | | |
| | | | 7 | SS | 25 | | | | | | | | | |
| | | | 8 | SS | 10 | | | | | | | | | |
| | Boulders | | | | | | | | | | | | | |
| | | | 9 | SS | 116 | | | | | | | | | |
| | (Glacial Till) | | 10 | SS | 100 | 13 cm | | | | | | | | |
| 194.5 | | | | | | | | | | | | | | |
| 10.0 | Sandy Silt to Silty Sand Trace Gravel Trace Clay Occ. Clayey Silt Zones Compact to Very Dense (Lacustrine) | | 11 | SS | 54 | | | | | | | | | |
| | | | 12 | SS | 15 | | | | | | | | | 0 11 84 5 |
| | | | 13 | SS | 70 | | | | | | | | | |
| | | | 14 | SS | 51 | | | | | | | | | 5 87 6 2 |
| | | | 15 | SS | 76 | | | | | | | | | |
| | | | | | | | | | | | | | | |
| | | | 16 | SS | 36 | | | | | | | | | 16 18 56 10 |
| | Clayey Silt | | | | | | | | | | | | | |
| 182.7 | | | 17 | SS | 49 | | | | | | | | | |
| 21.8 | End of Borehole | | | | | | | | | | | | | |

RECORD OF BOREHOLE No 12

METRIC

W P 181-86-01 LOCATION Co-ords N 4 850 647.7; E 304 052.1 ORIGINATED BY KZ
 DIST 6 HWY 7 BOREHOLE TYPE Hollow Stem Auger COMPILED BY JBF
 DATUM Geodetic DATE 88 05 03 CHECKED BY

OFFICE REPORT ON SOIL EXPLORATION

| 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 | | | 20 | 40 | 60 | 80 | 100 | | |
| 213.5 | Ground Level | | | | | | | | | | | | |
| 0.0 | Het. Mixture Sand with Gravel Trace Silt Trace Clay Occ. Clayey Silt Zones Loose to Compact (Fill) | | | | * | | | | | | | | |
| | | | 1 | SS | 11 | 212 | | | | | | | |
| | | | 2 | SS | 4 | 210 | | | | | | | |
| | | | 3 | SS | 7 | | | | | | | | |
| | | | 4 | SS | 15 | 208 | | | | | | | |
| | | | 5 | SS | 5 | 206 | | | | | | | |
| | | | 6 | SS | 18 | 204 | | | | | | | |
| 203.3 | Clayey Silt | | | | | | | | | | | | |
| 10.2 | Trace Organics | | 7 | SS | 19 | | | | | | | | |
| | Het. Mixt. | | | | | 202 | | | | | | | |
| 200.9 | Clayey Silt(CL to CL-ML) | | 8 | SS | 21 | | | | | | | | |
| 12.6 | End of Borehole | | | | | | | | | | | | |
| | * Water Level not Established | | | | | | | | | | | | |
| | ** with Sand Trace Gravel Occ. Silt and Sand Zones Occ. Boulders Very Stiff (Glacial Till) | | | | | | | | | | | | |

+3, x5: Numbers refer to
Sensitivity

20
15 5 (%) STRAIN AT FAILURE
10

RECORD OF BOREHOLE No 14

METRIC

W.P. 181-86-01 LOCATION Co-ords. N 4 850 624.2; E 304 071.6 ORIGINATED BY KZ
 DIST 6 HWY 7 BOREHOLE TYPE Solid Stem Auger, Washbore & Cone Test COMPILED BY JBF
 DATUM Geodetic DATE 88 04 05 - 06 CHECKED BY

OFFICE REPORT ON SOIL EXPLORATION

| 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 | | | SHEAR STRENGTH kPa | | | | | | | |
| 204.4 | Ground Level | | | | | | | 20 40 60 80 100 | | | | | | | GR SA SI CL |
| 0.0 | Het. Mixture Clayey Silt (CL) with Sand, Tr. Gravel Trace Organics Occ. Silty Clay Zones Stiff to Very Stiff (Fill) | | 1 | SS | 14 | | 204 | | | | | | | | 6 26 38 30 |
| | | | 2 | SS | 10 | | 202 | | | | | | | | |
| 201.5 | | | 3 | SS | 23 | | | | | | | | | | |
| 2.9 | Het. Mixture Clayey Silt (CL to CL-ML) with Sand, Tr. Gravel Occ. Silt & Sand Zones Occ. Boulders Stiff to Hard (Glacial Till) | | 4 | SS | 18 | | | | | | | | | | 3 37 46 14 |
| | | | 5 | SS | 33 | | 200 | | | | | | | | 2 36 47 15 |
| | | | 6 | SS | 20 | | | | | | | | | | 20 30 35 15 |
| | | | 7 | SS | 12 | | 198 | | | | | | | | 4 21 38 37 |
| | | | 8 | SS | 9 | | | | | | | | | | |
| | | | 9 | SS | 100/5 cm | | | | | | | | | | 6 32 44 18 |
| | Boulders | | 10 | SS | 115 | | 196 | | | | | | | | |
| 194.3 | | | | | | | 194 | | | | | | | | |
| 10.1 | Sandy Silt to Silty Sand Trace Gravel Trace Clay Occ. Clayey Silt Zones Very Loose to Very Dense (Lacustrine) | | 11 | SS | 20 | | 192 | | | | | | | | 0 29 68 3 |
| | | | 12 | SS | 3 | | | | | | | | | | |
| | | | 13 | SS | 15 | | 190 | | | | | | | | |
| | | | 14 | SS | 14 | | 188 | | | | | | | | |
| | | | 15 | SS | 16 | | | | | | | | | | |
| | | | 16 | SS | 7 | | 186 | | | | | | | | 1 16 56 27 |
| | Clayey Silt | | 17 | SS | 15 | | 184 | | | | | | | | |
| | | | 18 | SS | 147/20 cm | | 182 | | | | | | | | 5 16 70 9 |
| | | | 19 | SS | 105/28 cm | | | | | | | | | | 0 60 36 4 |
| 179.8 | | | 20 | SS | 60/5 cm | | 180 | | | | | | | | |
| 24.6 | End of Borehole | | | | | | | | | | | | | | |

+3, x5: Numbers refer to
Sensitivity

20
15
10
5 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 15

METRIC

W P 181-86-01 LOCATION Co-ords N 4 850 728.3; E 304 212.5 ORIGINATED BY KZ
 DIST 6 HWY 7 BOREHOLE TYPE Hollow Stem Auger & Cone Test COMPILED BY JBF
 DATUM Geodetic DATE 88 04 19 - 20 CHECKED BY

OFFICE REPORT ON SOIL EXPLORATION

| SOIL PROFILE | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | | UNIT WEIGHT Y | REMARKS & GRAIN SIZE DISTRIBUTION (%) |
|---------------|--|---------------|--------|------|----------------------------|--------------------|---|----|---|---------------------|---|
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | | | 20 40 60 80 100 | Wp | W | | |
| 205.2 | Ground Level | | | | | | | | | | |
| 0.0 | Het. Mixture Clayey Silt (CL) with Sand, Tr. Gravel Trace Organics Occ. Silty Clay Zones Stiff (Fill) | | 1 | SS | 12 | | | | | | 0 30 49 21 |
| | | | 2 | SS | 11 | | | | | | 1 22 45 32 |
| 202.3 | | | 3 | SS | 14 | | | | | | |
| 2.9 | Het. Mixture Clayey Silt (CL to CL-ML) with Sand Trace Gravel Occ. Silt & Sand Zones Occ. Boulders Stiff to Hard (Glacial Till) | | 4 | SS | 16 | | | | | | 4 32 39 25 |
| | | | 5 | SS | 39 | | | | | | |
| | | | 6 | SS | 36 | | | | | | |
| | | | 7 | SS | 19 | | | | | | |
| | | | 8 | SS | 12 | | | | | | |
| | | | 9 | SS | 113 | | | | | | |
| | Boulders | | 10 | SS | 128 | | | | | | 2 34 53 11 |
| | | | 11 | SS | 53 | | | | | | |
| 193.5 | | | | | | | | | | | |
| 11.7 | Sandy Silt to Silty Sand Trace Gravel Trace Clay Occ. Clayey Silt Zones Very Dense (Lacustrine) | | 12 | SS | 61 | | | | | | 1 89 9 1 |
| | | | 13 | SS | 57 | | | | | | |
| | | | 14 | SS | 118 | | | | | | |
| 189.0 | | | | | | | | | | | |
| 16.2 | Het. Mixture Clayey Silt (CL to CL-ML) with Sand Trace Gravel | | 15 | SS | 19 | | | | | | 0 23 63 14 |
| 186.7 * | | | | | | | | | | | |
| 18.5 | Silty Clay (CI) Occ. Silt Zones Hard (Lacustrine) | | 16 | SS | 92 | | | | | | |
| 181.9 | | | 17 | SS | 78 | | | | | | 0 1 35 64 |
| 23.3 | End of Borehole | | | | | | | | | | |
| | * Occ. Silt & Sand Zones Occ. Boulders Very Stiff (Glacial Till) | | | | | | | | | | |

RECORD OF BOREHOLE No 16

METRIC

W P 181-86-01 LOCATION Co-ords N 4 850 709.8; E 304 218.8 ORIGINATED BY KZ
 DIST 6 HWY 7 BOREHOLE TYPE Hollow Stem Auger COMPILED BY JBF
 DATUM Geodetic DATE 88 05 04 CHECKED BY

OFFICE REPORT ON SOIL EXPLORATION

| 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 (%) GR SA SI CL |
|---------------|---|------------|---------|------|------------|----------------------------|-----------------|---|----|----|----|-----|------------------------------------|-------------------------------------|-----------------------------------|---------------------|--|
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | 'N' VALUES | | | 20 | 40 | 60 | 80 | 100 | | | | | |
| 213.5 | Ground Level | | | | | | | | | | | | | | | | |
| 0.0 | Het. Mixture Sand with Gravel Trace Silt Trace Clay Occ. Clayey Silt Zones Loose to Compact (Fill) | | | | | * | | | | | | | | | | | |
| | | | 1 | SS | 14 | | 212 | | | | | | | | | | |
| | | | 2 | SS | 6 | | 210 | | | | | | | | | | |
| | Clayey Silt | | 3 | SS | 22 | | 208 | | | | | | 10 | | | | 2 36 45 17 |
| | | | 4 | SS | 5 | | 206 | | | | | | | | | | |
| | Clayey Silt | | 5 | SS | 6 | | 204 | | | | | | 10 | | | | 7 32 44 17 |
| 203.4 | | | 6 | SS | 7 | | 202 | | | | | | | | | | |
| 10.1 | Trace Organics | | 7 | SS | 13 | | | | | | | | | | | | |
| 200.9 | Het. Mixture Clayey Silt (CL to CL-ML) | | 8 | SS | 28 | | | | | | | | 0 | | | | 2 32 42 24 |
| 12.6 | End of Borehole | | | | | | | | | | | | | | | | |
| | * Water Level not Established | | | | | | | | | | | | | | | | |
| | ** With Sand Trace Gravel Occ. Silt and Sand Zones Occ. Boulders Very Stiff (Glacial Till) | | | | | | | | | | | | | | | | |

+3, x5: Numbers refer to
Sensitivity

20
15 5 (%) STRAIN AT FAILURE
10

RECORD OF BOREHOLE No 18

METRIC

W P 181-86-01 LOCATION Co-ords N 4 850 668.0; E 304 216.0 ORIGINATED BY KZ
 DIST 6 HWY 7 BOREHOLE TYPE Hollow Stem Auger & Cone Test COMPILED BY JBF
 DATUM Geodetic DATE 88 04 18 - 19 CHECKED BY

OFFICE REPORT ON SOIL EXPLORATION

| 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 | W _p W W _L | WATER CONTENT (%) | | |
| 204.6 | Ground Level | | | | | | | | | | | GR SA SI CL |
| 0.0 | Het. Mixture Clayey Silt (CL) with Sand, Tr. Gravel Trace Organics Occ. Silty Clay Zones | | 1 | SS | 16 | | 204 | | | | | |
| | | | 2 | SS | 16 | | 202 | | | | | 5 31 40 24 |
| 201.7 | Very Stiff (Fill) | | 3 | SS | 29 | | 200 | | | | | 1 32 43 24 |
| 2.9 | Het. Mixture Clayey Silt (CL to CL-ML) with Sand Trace Gravel | | 4 | SS | 30 | | 198 | | | | | |
| | | | 5 | SS | 42 | | 196 | | | | | |
| | Boulders | | 6 | SS | 27 | | 194 | | | | | |
| | Occ. Silt and Sand Zones | | 7 | SS | 17 | | 192 | | | | | |
| | Occ. Boulders | | 8 | SS | 74 | | 190 | | | | | |
| | Very Stiff to Hard (Glacial Till) | | 9 | SS | 122 | | 188 | | | | | 3 26 55 16 |
| | | | 10 | SS | 77 | | 186 | | | | | |
| 193.9 | Boulders | | | | | | 184 | | | | | 0 18 78 4 |
| 10.7 | Sandy Silt to Silty Sand Trace Gravel Trace Clay Occ. Clayey Silt Zones Compact to Very Dense (Lacustrine) | | 11 | SS | 14 | | 182 | | | | | |
| | | | 12 | SS | 73 | | 180 | | | | | |
| | | | 13 | SS | 110 | 28 cm | | | | | | |
| 189.2 | | | 14 | SS | 46 | | | | | | | 0 2 88 10 |
| 15.4 | Het. Mixture Clayey Silt (CL to CL-ML) with Sand Trace Gravel Occ. Silt and Sand Zones Occ. Boulders Hard (Glacial Till) | | 15 | SS | 82 | | | | | | | 3 34 50 13 |
| 184.6 | | | | | | | | | | | | |
| 20.0 | Silty Clay (CI) Occ. Silt Zones Hard (Lacustrine) | | 16 | SS | 85 | | | | | | | 0 0 34 66 |
| 179.8 | | | 17 | SS | 83 | | | | | | | |
| 24.8 | End of Borehole | | | | | | | | | | | |

FOUNDATION INVESTIGATION REPORT
FOR
CNR Overhead (MacMillan Yard) Approaches
W.P. 112-87-01, Site 37-682
Hwy. 7, District 6, Toronto

INTRODUCTION

The report summarizes the foundation investigation for the proposed widening of the approaches to the CNR Overhead at MacMillan Yard.

The report is applicable to the proposed approach widening from Sta. 21 + 600 to Sta. 22 + 200, within 50 m of the Hwy. 7 centre-line.

SITE DESCRIPTION

The site is located at the existing crossing of Hwy. 7 over the CNR tracks, which is between Jane Street and Keele Street in the Town of Vaughan.

The immediate area is a yard for the CNR.

The area is basically a glacial till plain, with low local relief except for the existing Hwy. 7 embankments. Within the proposed retaining wall site, the existing fill heights range from an estimated 3 m to 9 m with slopes varying from 2H:1V to 3H:1V but generally from 2H:1V to 2.5H:1V.

INVESTIGATION PROCEDURES

A foundation investigation for this project was conducted between 88 04 26 and 88 05 04. The drilling equipment used consisted of an auger machine equipped with 82 mm I.D. hollow-stem augers.

The investigation consisted of 12 boreholes, 5 of which were accompanied by dynamic cone penetration tests. These boreholes have been identified as BH #1 to BH #10 inclusive, BH #12 and BH #16. They extended for depths ranging from 6.6 m to 12.6 m. All boreholes were terminated in overburden. Survey details of borehole locations were provided by the Central Region Surveys and Plans Section.

The sampling program consisted of split spoon samples collected at 0.8 m to 1.5 m intervals. They provided Standard Penetration Test (N) values for assessment of the in situ state of compaction of the non-cohesive materials, and for an indication of shear strengths of cohesive materials. These samples also provided material for identification purposes.

The laboratory testing program for representative samples consisted of:

- grain size analyses
- natural moisture content determinations
- Atterberg Limit determinations

SUBSURFACE CONDITIONS

The Record of Borehole Sheets in the Appendix illustrate the subsurface conditions at the borehole locations. The locations and elevations of the boreholes, along with stratigraphical profiles based on the borehole data are shown on Drawing No. 1128701-A. **

The immediate approaches to the structure consist essentially of sand fill extending from elevation 214± m to elevation 203± m. The remainder of the approach fills consist essentially of clayey silt fill. The fill is underlain by clayey silt till, containing traces of organics in the upper 1± m at several locations. Sandy silt to silty sand was encountered below elev. 197.8 at BH #2.

Following are detailed descriptions of the soil strata encountered.

Sand (Fill)

This non-cohesive material is fill for the immediate approaches to the existing structure. It has been described as a heterogeneous mixture of sand, with gravel, traces of silt and clay containing occasional clayey silt zones. The bottom 2± m is clayey silt.

It was encountered at BH #12 and BH #16, where it extended for thicknesses of 10.1 m and 10.2 m respectively.

** NOTE: Refer to Sheet No 178-1 of the Contract Drawings.

Based on the results of Standard Penetration Tests (N = 4 to 22), the material is in a loose to compact state.

The results of one test indicate a natural water content of 3.5% and a grain size distribution as follows:

| | |
|--------|-------|
| Gravel | 17% |
| Sand | 68% |
| Silt | 14.5% |
| Clay | 0.5% |

Clayey Silt (Fill)

This cohesive material is the fill for the approach embankments except for the immediate approaches to the CNR structure. It has been described as a heterogeneous mixture of clayey silt (CL), with sand, traces of gravel and organics, containing occasional silty clay zones.

At BH #1 to BH #6 inclusive, along the south toe of slope of the existing embankment, the clayey silt fill extended from the surface for depths ranging from 1.8 to 2.9 m. At BH #7 to BH #10 inclusive it extended from the road surface for depths ranging from 4.0 m to 7.9 m. At BH #12 and BH #16, at the immediate approaches to the structure, it is essentially the lower 1.7 m to 4.4 m of the previously described sand fill.

Based on the results of Standard Penetration Test (N = 3 to 27) the material is in a soft to very stiff but generally firm to very stiff state.

Typical properties of the material, as determined by laboratory tests, are summarized as follows:

| | <u>Range</u> | <u>Average</u> | <u>Median</u> |
|----------------------------|--------------|----------------|---------------|
| Water Content (w) | 11.0-22.5% | 16.1% | 15.5% |
| Liquid Limit (w_L) | 17.0-41.5% | 28.4% | 29.8% |
| Plastic Limit (w_p) | 11.5-20.5% | 15.3% | 14.8% |
| Plasticity Index (I_p) | 9.0-21.0% | 14.6% | 15.0% |

Figure 1 illustrates a typical grain size distribution for this material.
Figure 2 illustrates a typical plasticity distribution for this material.

Clayey Silt (Till)

This cohesive material directly underlies the fill across the entire site. It has been described as a heterogeneous mixture of clayey silt (CL to CL-ML), with sand, traces of gravel, and containing occasional sand zones and occasional boulders.

It was encountered at all borehole locations. All boreholes except BH #2 were terminated in this deposit so that its thickness can only be estimated to range from 6.7 m to over 8± m.

Based on the results of Standard Penetration Tests ($N = 6$ to 100+), the material is in a firm to hard, but generally very stiff to hard state.

Typical properties of the material, as determined by laboratory tests, are summarized as follows:

| | <u>Range</u> | <u>Average</u> | <u>Median</u> |
|----------------------------|--------------|----------------|---------------|
| Water Content (w) | 8.0-21.0% | 14.0% | 12.5% |
| Liquid Limit (w_L) | 17.5-39.5% | 24.4% | 21.0% |
| Plastic Limit (w_p) | 10.5-20.5% | 14.5% | 13.0% |
| Plasticity Index (I_p) | 5.0-19.0% | 9.9% | 8.5% |

Figure 3 illustrates a typical grain size distribution for this material.
Figure 4 illustrates a typical plasticity distribution for this material.

There are zones of silt and sand within this deposit which are water bearing and exhibit a tendency to flow or boil under conditions of unbalanced hydrostatic head.

The presence of boulders within this strata is also noted.

Sandy Silt to Silty Sand

This non-cohesive material was encountered directly below the clayey silt till at BH #2. It has been described as sandy silt to silty sand, traces of gravel and clay containing occasional clayey silt zones.

The extent of this deposit was explored for only 1.1 m and the results of one Standard Penetration Test (N = 24) indicates that it is in a compact state.

GROUNDWATER

At the time of the field investigation the groundwater was generally within 1 m of the surface at the toe of the embankments.

MISCELLANEOUS

The Field investigation for this project was carried out under the supervision of K. Zasitko, Foundation Technician.

The equipment used was owned and operated by Master Soil Investigation Ltd.

The report was written by D. Dundas, Sr. Foundation Engineer, and reviewed by M. Devata, Chief Foundation Engineer.

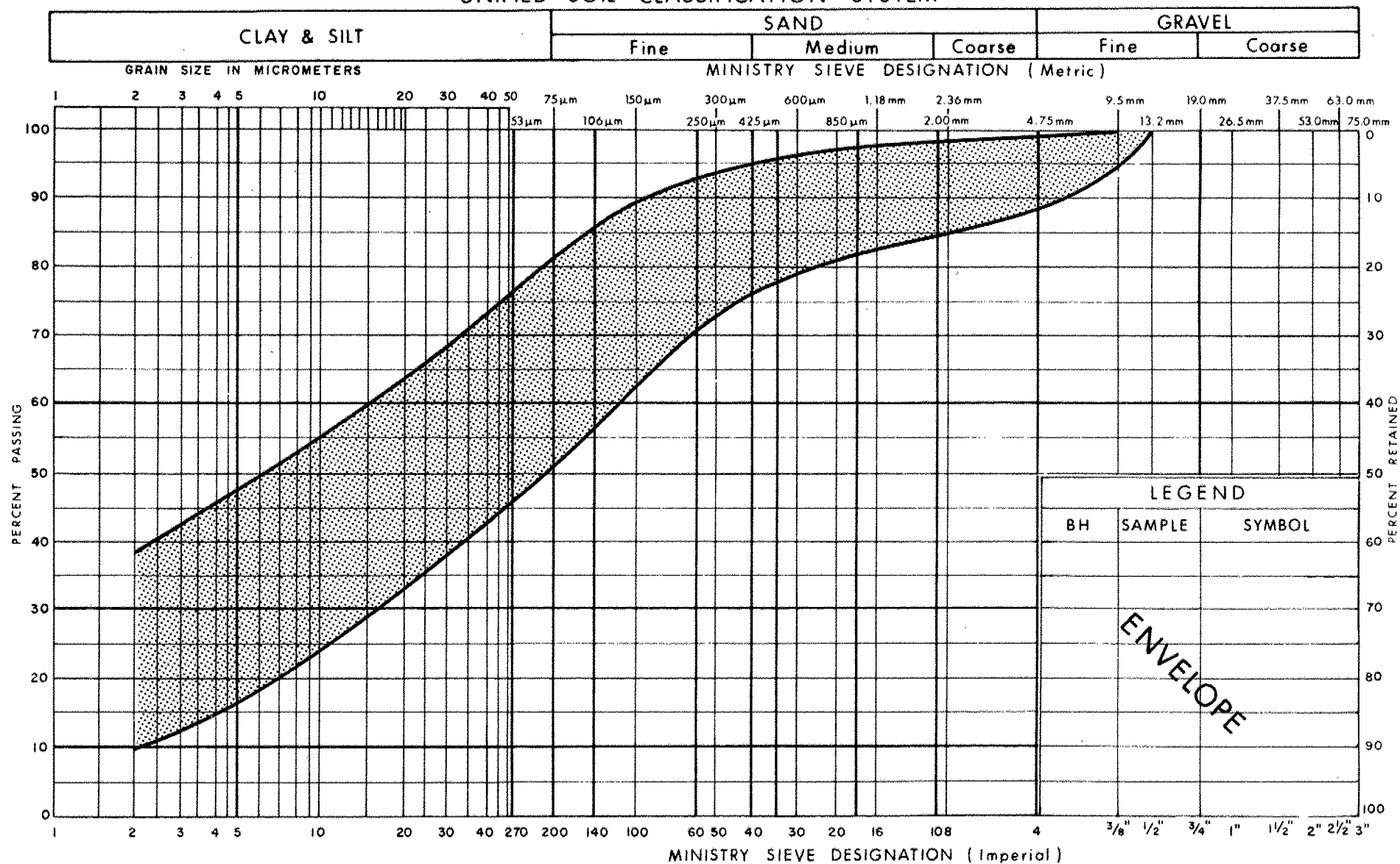


D. Dundas
D. Dundas, P. Eng.
Sr. Foundation Engineer

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

A P P E N D I X

UNIFIED SOIL CLASSIFICATION SYSTEM



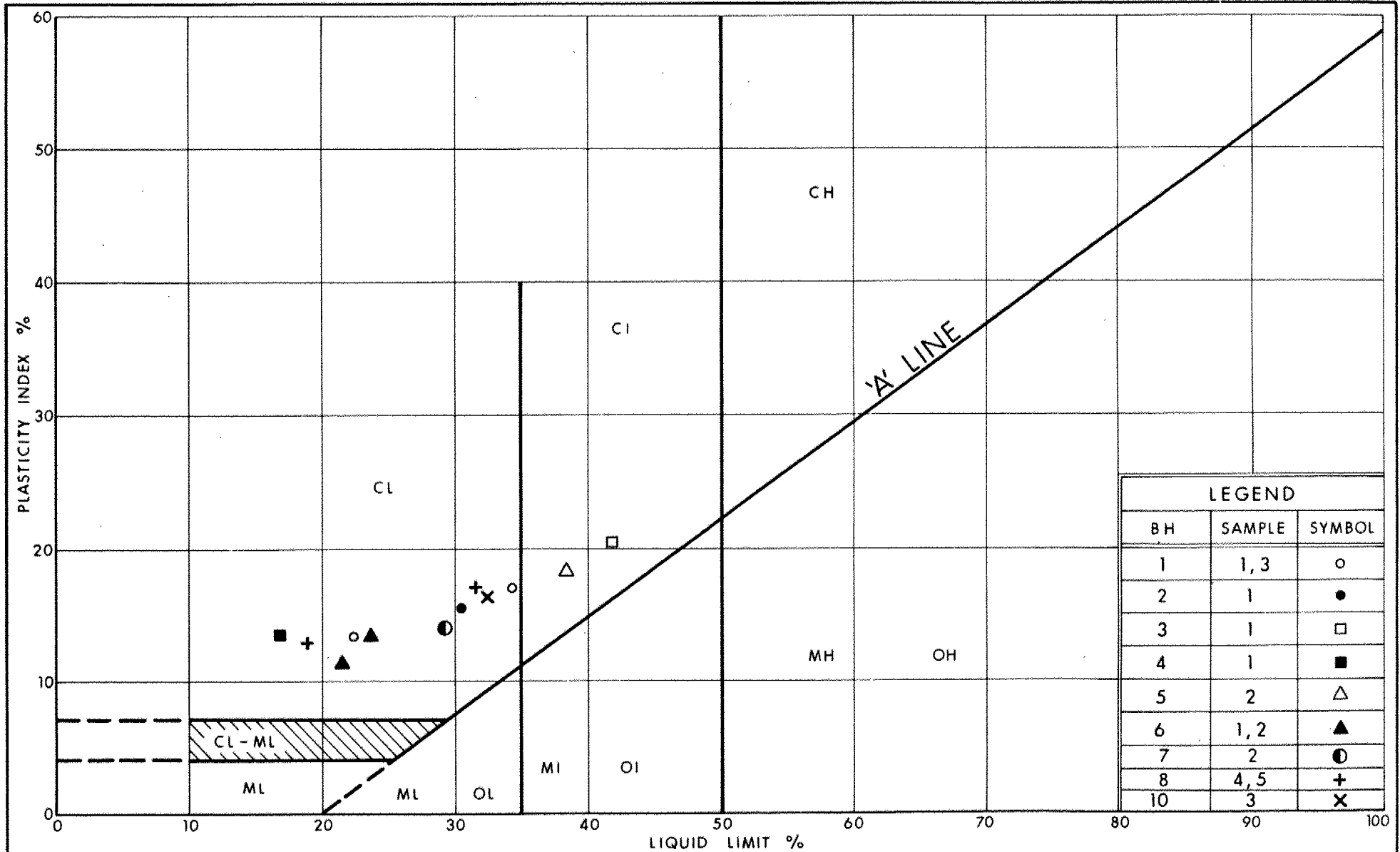
Ontario

Ministry of
Transportation

GRAIN SIZE DISTRIBUTION
HET MIXTURE OF
CLAYEY SILT, WITH SAND TRACE GRAVEL (Fill)

FIG No 1

W P 112-87-01



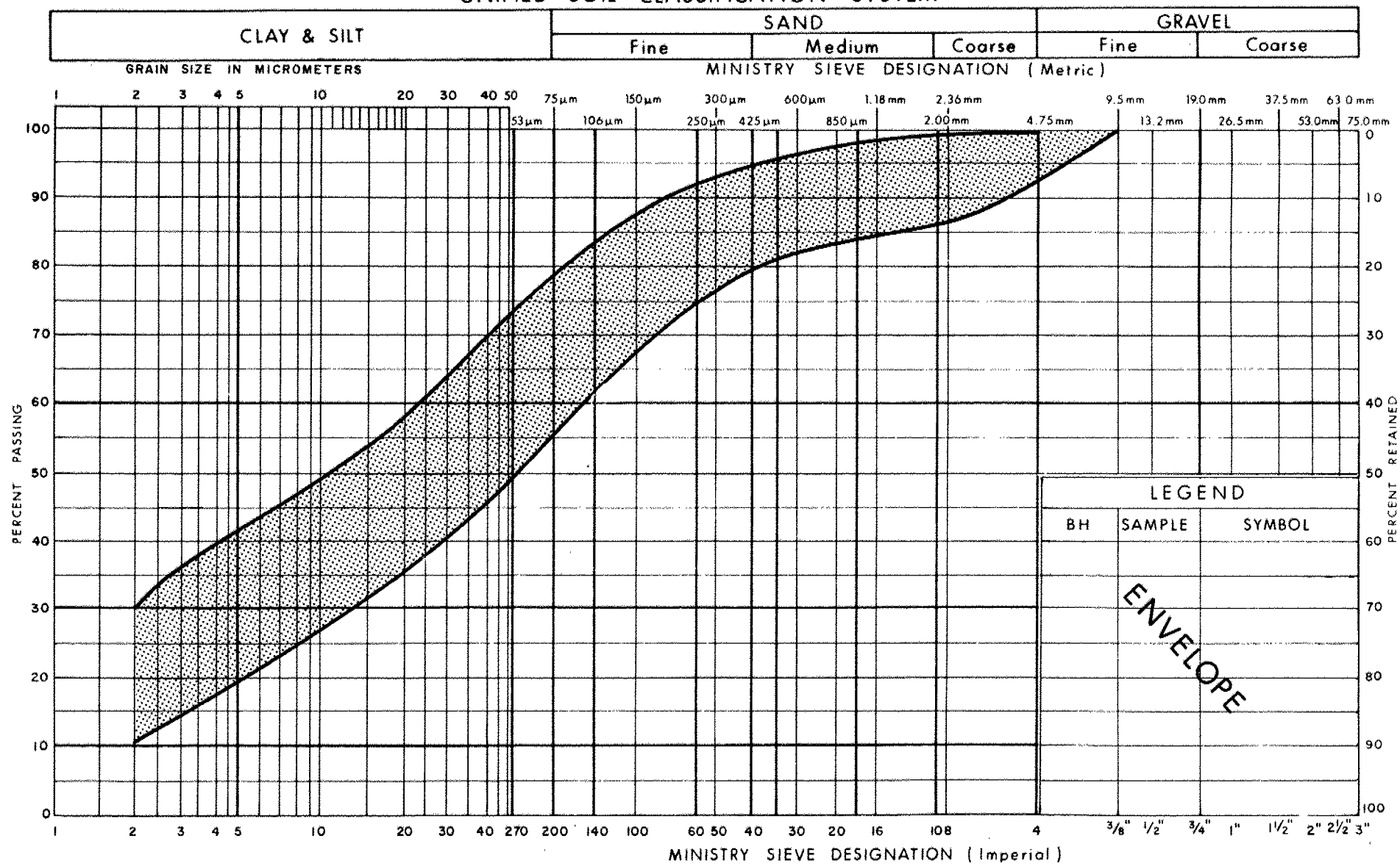
Ministry of
Transportation
Ontario

PLASTICITY CHART
HET MIXTURE OF
CLAYEY SILT, WITH SAND TRACE GRAVEL (Fill)

FIG No 2

W P 112-87-01

UNIFIED SOIL CLASSIFICATION SYSTEM



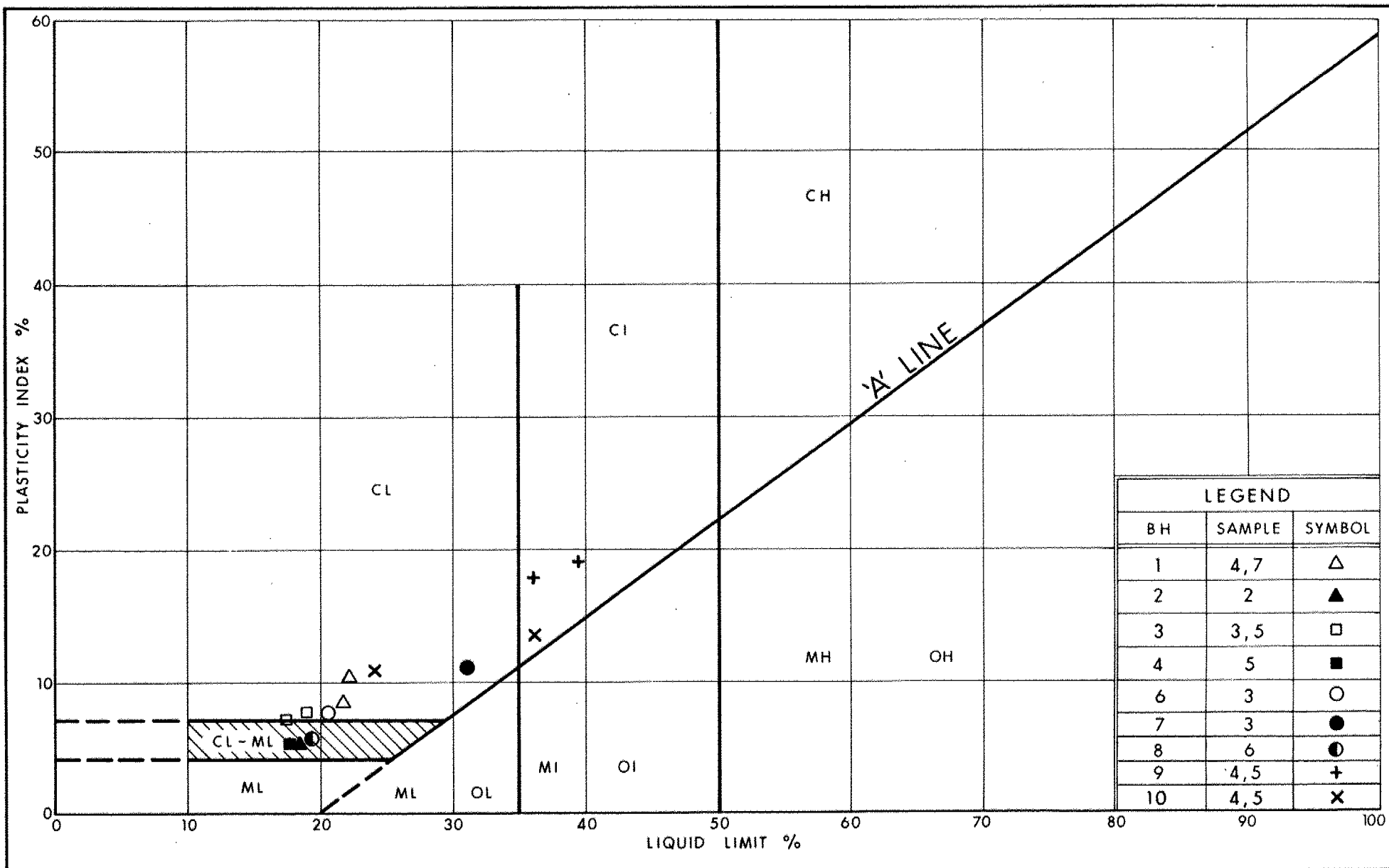
Ontario

Ministry of
Transportation

GRAIN SIZE DISTRIBUTION
HET MIXTURE OF
CLAYEY SILT, WITH SAND TRACE GRAVEL (Glacial Till)

FIG No 3

W P 112-87-01



Ministry of
Transportation

Ontario

PLASTICITY CHART
HET MIXTURE OF
CLAYEY SILT, WITH SAND TRACE GRAVEL (Glacial Till)

FIG No 4

W P 112-87-01

RECORD OF BOREHOLE No 1

METRIC

W P 112-87-01 LOCATION Co-ords. N 4 850 573.1; E 303 937.2
 DIST 6 HWY 7 BOREHOLE TYPE Hollow Stem Auger & Cone Test
 DATUM Geodetic DATE 88 04 26
 ORIGINATED BY KZ
 COMPILED BY KZ
 CHECKED BY

| SOIL PROFILE | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | NATURAL MOISTURE CONTENT LIMIT | UNIT WEIGHT Y | REMARKS & GRAIN SIZE DISTRIBUTION (%) |
|----------------|---|-------------|--------|------|----------------------------|-----------------|---|---------|---|---------------------|---|
| ELEV. DEPTH | DESCRIPTION | STRAT. PLOT | NUMBER | TYPE | | | 20 40 60 80 100 | Wp W WL | | | |
| 206.6 | Ground Level | | | | | | | | | | |
| 0.0 | Het. Mixture Clayey Silt with Sand Trace Gravel Trace Organics Occ. Silty Clay Zones Stiff to Very Stiff (Fill) | | 1 | SS | 9 | | | | | | 1 15 44 40 |
| 203.7 | | | 2 | SS | 19 | | | | | | 12 28 48 12 |
| 2.9 | | | 3 | SS | 21 | | | | | | 5 35 46 14 |
| | | | 4 | SS | 31 | | | | | | |
| | Het. Mixture Clayey Silt with Sand Trace Gravel Occ. Silt and Sand Zones Occ. Boulders Stiff to Hard (Glacial Till) | | 5 | SS | 21 | | | | | | |
| | | | 6 | SS | 15 | | | | | | |
| | | | 7 | SS | 11 | | | | | | 6 23 43 28 |
| | | | 8 | SS | 39 | | | | | | |
| 195.5 | | | 9 | SS | 36 | | | | | | |
| 11.1 | End of Borehole | | | | | | | | | | |

OFFICE REPORT ON SOIL EXPLORATION

+3, x5: Numbers refer to
Sensitivity

20
15 5 (%) STRAIN AT FAILURE
10

RECORD OF BOREHOLE No 2

METRIC

W P 112-87-01 LOCATION Co-ords. N 4 850 589.1; E 303 983.4
 DIST 6 HWY 7 BOREHOLE TYPE Hollow Stem Auger & Cone Test
 DATUM Geodetic DATE 88 04 26
 ORIGINATED BY KZ
 COMPILED BY KZ
 CHECKED BY

OFFICE REPORT ON SOIL EXPLORATION

| SOIL PROFILE | | SAMPLES | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 | PLASTICITY NATURAL MOISTURE CONTENT (%) Wp W WL | UNIT WEIGHT Y | REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL |
|--------------|--|------------|------------------------|-------------------------|-----------------|---|--|------------------|--|
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER TYPE 'N' VALUES | | | | | | |
| 206.3 | Ground Level | | | | | | | | |
| 0.0 | Het. Mixture Clayey Silt with Sand Tr. Gravel, Tr. Organ. | | 1 SS 6 | | 206 | | | | 3 34 43 20 |
| 204.5 | Occ. Silty Clay Zones Firm to Very Stiff (Fill) | | 2 SS 17 | | 204 | | | | 5 37 38 20 |
| 1.8 | Het. Mixture Clayey Silt with Sand Trace Gravel | | 3 SS 19 | | 202 | | | | |
| | Occ. Silt and Sand Zones | | 4 SS 22 | | 200 | | | | |
| | Occ. Boulders Stiff to Very Stiff (Glacial Till) | | 5 SS 15 | | 198 | | | | |
| | | | 6 SS 10 | | | | | | |
| 197.8 | | | 7 SS 25 | | | | | | |
| 8.5 | Sandy Silt to Silty Sand | | 8 SS 24 | | | | | | |
| 196.7 | | | | | | | | | |
| 9.6 | End of Borehole | | | | | | | | |
| | * Trace Gravel Trace Clay Occ. Clayey Silt Zones Compact (Lacustrine) | | | | | | | | |

+3, x5: Numbers refer to Sensitivity
 20 15 10 (% STRAIN AT FAILURE)

RECORD OF BOREHOLE No 3

METRIC

W P 112-87-01 LOCATION Co-ords. N 4 850 598.3; E 304 032.3
 DIST 6 HWY 7 BOREHOLE TYPE Hollow Stem Auger & Cone Test
 DATUM Geodetic DATE 88 04 26 - 27
 ORIGINATED BY KZ
 COMPILED BY KZ
 CHECKED BY


| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 SHEAR STRENGTH $\times P_0$ ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE | PLASTIC LIMIT W _p NATURAL MOISTURE CONTENT W LIQUID LIMIT W _L WATER CONTENT (%) 10 20 30 | UNIT WEIGHT Y | REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL |
|----------------|--|-------------|---------|------|------------|----------------------------|--------------------|---|---|---------------------|--|
| ELEV. DEPTH | DESCRIPTION | STRAT. PLOT | NUMBER | TYPE | 'N' VALUES | | | | | | |
| 204.5 | Ground Level | | | | | | | | | | |
| 0.0 | Het. Mixture Clayey Silt with Sand Tr. Gravel, Tr. Organ. Occ. Silty Clay Zones Stiff to Very Stiff (Fill) | | 1 | SS | 9 | | 204 | | | | 3 36 44 17 |
| 202.4 | | | 2 | SS | 25 | | 202 | | | | 2 41 47 10 |
| 2.1 | Het. Mixture Clayey Silt with Sand Trace Gravel Occ. Silt and Sand Zones Occ. Boulders Firm to Hard (Glacial Till) | | 3 | SS | 19 | | 200 | | | | 4 35 44 17 |
| | | | 4 | SS | 25 | | 198 | | | | |
| | | | 5 | SS | 11 | | | | | | |
| | | | 6 | SS | 6 | | | | | | |
| 196.4 | | | 7 | SS | 97 | | | | | | |
| 8.1 | End of Borehole | | | | | | | | | | |

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 4

METRIC

W P 112-87-01 LOCATION Co-ords. N 4 850 675.6; E 304 248.3 ORIGINATED BY KZ
 DIST 6 HWY 7 BOREHOLE TYPE Hollow Stem Auger COMPILED BY KZ
 DATUM Geodetic DATE 88 04 28 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 kPa | | | | | |
| 204.1 | Ground Level | | | | | | | ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE | 10 20 30 | | | | | GR SA SI CL |
| 0.0 | Het. Mixture Clayey Silt with Sand Tr. Gravel, Tr. Organ. Occ. Silty Clay Zones Very Stiff (Fill) | | 1 | SS | 27 |  | 204 | | | | | | | 5 42 44 9 |
| 202.0 | | | 2 | SS | 25 | | 202 | | | | | | | |
| 2.1 | | | 3 | SS | 43 | | | | | | | | | |
| | Het. Mixture Clayey Silt with Sand Trace Gravel Occ. Silt and Sand Zones Occ. Boulders Very Stiff to Hard (Glacial Till) | | 4 | SS | 31 | | 200 | | | | | | | |
| | | | 5 | SS | 120 | | 198 | | | | | | | 1 20 63 16 |
| 196.0 | | | 6 | SS | 120 | | | | | | | | | |
| 8.1 | End of Borehole | | | | | | | | | | | | | |

OFFICE REPORT ON SOIL EXPLORATION

+3, x5: Numbers refer to
Sensitivity

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

RECORD OF BOREHOLE No 5

METRIC

W P 112-87-01 LOCATION Co-ords. N 4 850 699.9; E 304 292.8 ORIGINATED BY KZ
DIST 6 HWY 7 BOREHOLE TYPE Hollow Stem Auger & Cone Test COMPILED BY KZ
DATUM Geodetic DATE 88 04 28 CHECKED BY

| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE | PLASTIC LIMIT W _p NATURAL MOISTURE CONTENT W LIQUID LIMIT W _L WATER CONTENT (%) 10 20 30 | UNIT WEIGHT Y | REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL |
|---------------|--|------------|---------|------|------------|----------------------------|-----------------|--|---|---------------------|--|
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | 'N' VALUES | | | | | | |
| 204.5 | Ground Level | | | | | | | | | | |
| 0.0 | Het. Mixture Clayey Silt with Sand Trace Gravel Trace Organics Occ. Silty Clay Zones Very Stiff (Fill) | | 1 | SS | 109 | | | | | | 2 17 43 38 |
| 201.6 | | | 2 | SS | 15 | | | | | | |
| 2.9 | | | 3 | SS | 19 | | | | | | |
| | Het. Mixture Clayey Silt with Sand Trace Gravel Occ. Silt and Sand Zones Occ. Boulders Very Stiff to Hard (Glacial Till) | | 4 | SS | 20 | | | | | | |
| | | | 5 | SS | 25 | | | | | | |
| | | | 6 | SS | 20 | | | | | | |
| | | | 7 | SS | 17 | | | | | | |
| 194.9 | | | 8 | SS | 48 | | | | | | |
| 9.6 | End of Borehole | | | | | | | | | | |

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 6

METRIC

W P 112-87-01 LOCATION Co-ords. N 4 850 721.8; E 304 345.8 ORIGINATED BY KZ
 DIST 6 HWY 7 BOREHOLE TYPE Hollow Stem Auger & Cone Test COMPILED BY KZ
 DATUM Geodetic DATE 88 04 27 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 | | | | | |
| 204.4 | Ground Level | | | | | | | | | | | | |
| 0.0 | Het. Mixture Clayey Silt with Sand Trace Gravel Trace Organics | | 1 | SS | 12 | | | | | | | | 6 44 32 18 |
| 202.3 | Occ. Silty Clay Zones | | 2 | SS | 10 | | | | | | | | 6 30 50 14 |
| 2.1 | Stiff (Fill) | | 3 | SS | 15 | | | | | | | | 3 36 45 16 |
| | Het. Mixture Clayey Silt with Sand Trace Gravel | | 4 | SS | 22 | | | | | | | | |
| | Occ. Silt and Sand Zones | | 5 | SS | 56 | | | | | | | | |
| | Occ. Boulders Very Stiff to Hard (Glacial Till) | | 6 | SS | 33 | | | | | | | | |
| 196.3 | | | 7 | SS | 63 | | | | | | | | |
| 8.1 | End of Borehole | | | | | | | | | | | | |

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 7

METRIC

W P 112-87-01 LOCATION Co-ords. N 4 850 598.0; E 303 910.5 ORIGINATED BY KZ
 DIST 6 HWY 7 BOREHOLE TYPE Hollow Stem Auger COMPILED BY KZ
 DATUM Geodetic DATE 88 05 03 CHECKED BY

| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | PLASTIC LIMIT LIMIT | | NATURAL MOISTURE CONTENT | LIQUID LIMIT | UNIT WEIGHT Y | REMARKS & GRAIN SIZE DISTRIBUTION (%) |
|---------------|--|------------|---------|------|------------|----------------------------|-----------------|---|--|------------------------|--|--------------------------------|-------------------|-------------------------|---|
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | 'N' VALUES | | | 20 40 60 80 100 | | | | | | | |
| | | | | | | | | SHEAR STRENGTH $\times P_0$ | | | | | WATER CONTENT (%) | | |
| | | | | | | | | | | | | | | | |
| 210.2 | Ground Level | | | | | | | | | | | | | | |
| 0.0 | Het. Mixture Clayey Silt with Sand Trace Gravel Trace Organics Occ. Silty Clay Zones Very Stiff (Fill) | | | | | * | 210 | | | | | | | | |
| | | | 1 | SS | 20 | | 208 | | | | | | | | 1 22 47 30 |
| 206.2 | | | 2 | SS | 18 | | | | | | | | | | |
| 4.0 | Trace Organics | | 3 | SS | 21 | | 206 | | | | | | | | 3 37 44 16 |
| 203.6 | Het. Mixture Clayey Silt | | 4 | SS | 35 | | 204 | | | | | | | | |
| 6.6 | End of Borehole | | | | | | | | | | | | | | |
| | * Water Level not Established | | | | | | | | | | | | | | |
| | ** with Sand Trace Gravel Occ. Silt and Sand Zones Occ. Boulders Very Stiff to Hard (Glacial Till) | | | | | | | | | | | | | | |

OFFICE REPORT ON SOIL EXPLORATION

*3, *5: Numbers refer to Sensitivity

20
15 → 5 (%) STRAIN AT FAILURE
10

RECORD OF BOREHOLE No 8

METRIC

W P 112-87-01 LOCATION Co-ords. N 4 850 628.6; E 303 993.8
 DIST 6 HWY 7 BOREHOLE TYPE Hollow Stem Auger ORIGINATED BY KZ
 DATUM Geodetic DATE 88 05 03 COMPILED BY KZ
 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 (%) GR SA SI CL |
|---------------|--|------------|---------|------|------------|----------------------------|-----------------|--|--------------------|------------------------------------|-------------------------------------|-----------------------------------|---------------------|--|
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | 'N' VALUES | | | 20 40 60 80 100 | SHEAR STRENGTH kPa | | | | | |
| 212.3 | Ground Level | | | | | | | ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE | | | | | | |
| 0.0 | Het. Mixture Clayey Silt with Sand Trace Gravel Trace Organics Occ. Silty Clay Zones Soft to Very Stiff (Fill) | | 1 | SS | 6 | * | 212 | | | | | | | |
| | | | 2 | SS | 3 | | 210 | | | | | | | |
| | | | 3 | SS | 22 | | 208 | | | | | | | |
| | | | 4 | SS | 19 | | 206 | | | | | | | 3 38 44 15 |
| 204.4 | | | 5 | SS | 21 | | 204 | | | | | | | 2 28 44 26 |
| 7.9 | Trace Organics | | 6 | SS | 28 | | 202 | | | | | | | 5 34 46 15 |
| | Het. Mixture Clayey Silt with Sand Trace Gravel Occ. Silt & Sand Zones | | 7 | SS | 35 | | | | | | | | | |
| 201.2 | ** | | | | | | | | | | | | | |
| 11.1 | End of Borehole | | | | | | | | | | | | | |
| | ** Occ. Boulders Very Stiff to Hard (Glacial Till) | | | | | | | | | | | | | |
| | * Water Level not Established | | | | | | | | | | | | | |

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 9

METRIC

W P 112-87-01 LOCATION Co-ords. N 4 850 742.9; E 304 301.2 ORIGINATED BY KZ
 DIST 6 HWY 7 BOREHOLE TYPE Hollow Stem Auger COMPILED BY KZ
 DATUM Geodetic DATE 88 05 02 CHECKED BY

OFFICE REPORT ON SOIL EXPLORATION

| 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 Y | REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL |
|--------------|---|------------|---------|------|------------|-------------------------|-----------------|---|---------------------------------|-------------------------------|--------------------------------|------------------|--|
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | 'N' VALUES | | | | | | | | |
| 210.6 | Ground Level | | | | | | | | | | | | |
| 0.0 | Het. Mixture Clayey Silt with Sand Trace Gravel Trace Organics Occ. silty Clay Zones Stiff to Very Stiff (Fill) | | 1 | SS | 7 | | 210 | | | | | | |
| | | | 2 | SS | 18 | | 208 | | | | | | |
| | | | 3 | SS | 14 | | 206 | | | | | | |
| 205.1 | | | 4 | SS | 19 | | 204 | | | | | | 1 31 42 26 |
| 5.5 | Trace Organics | | 5 | SS | 22 | | 202 | | | | | | 3 23 52 22 |
| | Het. Mixture Clayey Silt with Sand Trace Gravel Occ. Silt & Sand Zones Occ. Boul. V. Stiff (Glacial Till) | | 6 | SS | 20 | | | | | | | | |
| 201.0 | | | | | | | | | | | | | |
| 9.6 | End of Borehole | | | | | | | | | | | | |
| | * Water Level not Established | | | | | | | | | | | | |

RECORD OF BOREHOLE No 10

METRIC

W P 112-87-01 LOCATION Co-ords. N 4 850 768.6; E 304 368.5
 DIST 6 HWY 7 BOREHOLE TYPE Hollow Stem Auger
 DATUM Geodetic DATE 88 05 02
 ORIGINATED BY KZ
 COMPILED BY KZ
 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 (%) GR SA SI CL |
|---------------|--|------------|---------|------|------------|----------------------------|-----------------|---|--|------------------------------------|-------------------------------------|-----------------------------------|---------------------|--|
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | 'N' VALUES | | | 20 40 60 80 100 | | | | | | |
| | | | | | | | | SHEAR STRENGTH kPo | | | | | | |
| | | | | | | ○ UNCONFINED | + FIELD VANE | | | WATER CONTENT (%) | | | | |
| | | | | | | ● QUICK TRIAXIAL | x LAB VANE | | | 10 20 30 | | | | |
| 209.7 | Ground Level | | | | | | | | | | | | | |
| 0.0 | Het. Mixture Clayey Silt with Sand Trace Gravel Trace Organics Occ. Silty Clay Zones Stiff to Very Stiff (Fill) | | 1 | SS | 26 | * | | | | | | | | |
| | | | 2 | SS | 17 | | | | | | | | | |
| 204.2 | | | 3 | SS | 13 | | | | | | | | | 3 33 35 29 |
| 5.5 | Trace Organics | | 4 | SS | 24 | | | | | | | | | 4 37 40 19 |
| | Het. Mixt. Clayey Silt with Sand Trace Gravel Occ. Silt & Sand Zones Occ. Boulders Very Stiff to Hard (Glacial Till) | | 5 | SS | 27 | | | | | | | | | 3 32 40 25 |
| 200.1 | | | 6 | SS | 36 | | | | | | | | | |
| 9.6 | End of Borehole | | | | | | | | | | | | | |
| | * Water Level not Established | | | | | | | | | | | | | |

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 12 (Formerly WP 181-86-01) METRIC

W P 112-87-01 LOCATION Co-ords. N 4 850 647.7; E 304 052.1 ORIGINATED BY KZ
DIST 6 HWY 7 BOREHOLE TYPE Hollow Stem Auger COMPILED BY JBF
DATUM Geodetic DATE 88 05 03 CHECKED BY

| 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 | |
| 213.5 | Ground Level | | | | | | | | | | | |
| 0.0 | Het. Mixture Sand with Gravel Trace Silt Trace Clay Occ. Clayey Silt Zones Loose to Compact (Fill) | | 1 | SS | 11 | | 212 | | | | | |
| | | | 2 | SS | 4 | | 210 | | | | | |
| | | | 3 | SS | 7 | | 208 | | | | | |
| | | | 4 | SS | 15 | | 206 | | | | | 17 68 14 1 |
| | | | 5 | SS | 5 | | 204 | | | | | |
| | Clayey Silt | | 6 | SS | 18 | | 202 | | | | | 0 48 38 14 |
| 203.3 | Trace Organics | | 7 | SS | 19 | | | | | | | |
| 10.2 | Het. Mixture Clayey Silt (CL to CL-ML) | | 8 | SS | 21 | | | | | | | 1 45 40 14 |
| 200.9 | End of Borehole | | | | | | | | | | | |
| 12.6 | ** with Sand Trace Gravel Occ. Silt and Sand Zones Occ. Boulders Very Stiff (Glacial Till) * Water Level not Established | | | | | | | | | | | |

OFFICE REPORT ON SOIL EXPLORATION

+3, x5: Numbers refer to
Sensitivity

20
15 5 (%) STRAIN AT FAILURE
10

RECORD OF BOREHOLE No 16 (FORMERLY WP 181-86-01) METRIC

W P 112-87-01 LOCATION Co-ords. N 4 850 709.8; E 304 218.8
DIST 6 HWY 7 BOREHOLE TYPE Hollow Stem Auger ORIGINATED BY KZ
DATUM Geodetic DATE 88 05 04 COMPILED BY JBF
CHECKED BY

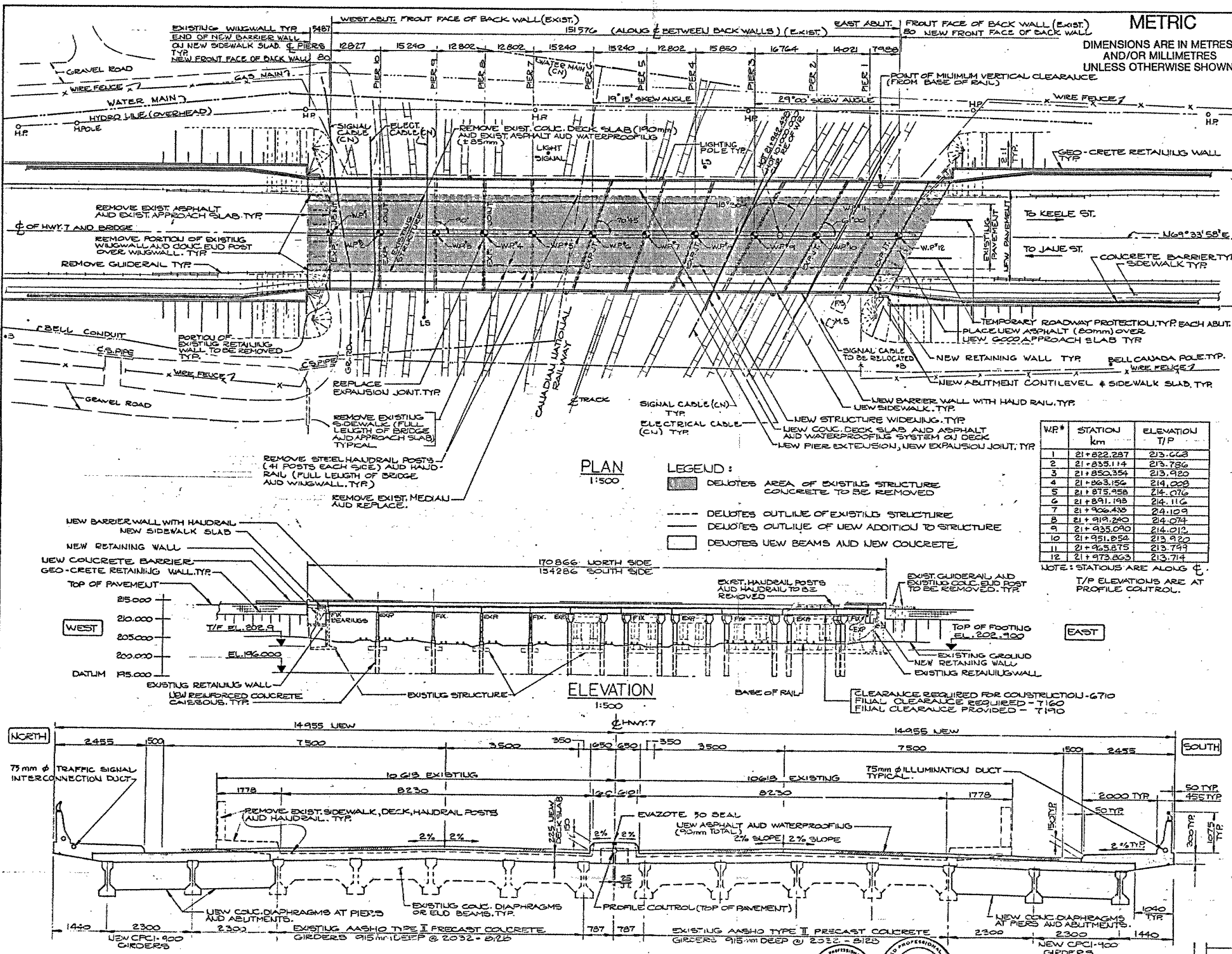
OFFICE REPORT ON SOIL EXPLORATION

| 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 (%) GR SA SI CL |
|---------------|---|------------|---------|------|----------------------------|-----------------|---|----|------------------------------------|-------------------------------------|-----------------------------------|---------------------|--|
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | | | 'N' VALUES | 20 | | | | | |
| 213.5 | Ground Level | | | | | | | | | | | | |
| 0.0 | Het. Mixture Sand with Gravel Trace Silt Trace Clay Occ. Clayey Silt Zones Loose to Compact (Fill) | | 1 | SS | 14 | | | | | | | | |
| | Clayey Silt | | 2 | SS | 6 | | | | | | | | |
| | | | 3 | SS | 22 | | | | | | | | |
| | | | 4 | SS | 5 | | | | | | | | |
| | Clayey Silt | | 5 | SS | 6 | | | | | | | | |
| | | | 6 | SS | 7 | | | | | | | | |
| 203.4 | | | | | | | | | | | | | |
| 10.1 | Trace Organics | | 7 | SS | 13 | | | | | | | | |
| | Het. Mixt. | | | | | | | | | | | | |
| 200.9 | Clayey Silt (CL to CL-ML) | | | | | | | | | | | | |
| 12.6 | End of Borehole | | 8 | SS | 28 | | | | | | | | |
| | * Water Level not Established | | | | | | | | | | | | |
| | ** with Sand Trace Gravel Occ. Silt and Sand Zones Occ. Boulders Very Stiff (Glacial Till) | | | | | | | | | | | | |

+3, x5: Numbers refer to
Sensitivity

20
15
10

5 (%) STRAIN AT FAILURE



CONCORD PBM 243-66
EL 213.585

TABLET SET HOR IN S FACE OF W
CONC ABUT OF BRIDGE 2.93 E OF S
CORNER 0.3 BELOW TOP OF DECK
10.55 RT 21 + 819.8
ROUTE 22

DECK CROSS SECTION
1:50

DRAWING NOT TO BE SCALED
100 mm ON ORIGINAL DRAWING

| | | | | | | | |
|--------------------|------------------|--------------------|--|--|--|-------------|--|
| REVISIONS | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| DATE | BY | DESCRIPTION | | | | | |
| DESIGN C <u>SL</u> | CHECK R <u>T</u> | LOADING 24200-A-22 | | | | DATE AUG 89 | |
| DRAWING 13 | CHECK E <u>F</u> | SITE No 3T-032731 | | | | DWG 1 | |

CONT No
WP No 181-86-01

HWY. 7 / CNR OVERHEAD
REHABILITATION
GENERAL ARRANGEMENT

CS COLE,
SHERMAN

GENERAL NOTES

- | | | |
|----|-----------------------------------|--------------------------------|
| 1. | Class of Concrete: | |
| | Prestressed Girders | 33 MPa |
| | Remainder | 30 MPa |
| 2. | Clear cover to reinforcing steel: | |
| | Footing | 100 ± 25 |
| | Abutments, wingwalls: | |
| | Front Face | 80 ± 20 |
| | Back Face | 70 ± 20 |
| | Piers | 80 ± 20 |
| | Deck Top | 70 ± 20 |
| | Bottom | 40 ± 10 |
| | Remainder | 70 ± 20 unless otherwise noted |

REINFORCING STEEL

- Reinforcing steel shall be grade 400 unless otherwise noted.
- Bar marks with suffix "C" denote coated bars.

CONSTRUCTION NOTED

- All surfaces of existing concrete that are to be in contact with new concrete are to be prepared by abrasive blast-cleaning and applying cement paste prior to placing of new concrete.
 - The Contractor shall field check and verify all conditions and measurements associated with the work to be done and report any discrepancies to the Engineer before proceeding with the work.
 - For scope of repair work see staging diagrams and construction and traffic sequence notes on Drawing No. 2.
- W.P. denotes working point.
T/P denotes top of pavement.

LIST OF DRAWINGS

1. General Arrangement
2. Construction clearance and sequence.
3. Temporary deck Stage 1.
4. Caissons.
5. Piers.
6. Removal West abutment.
7. Removal East abutment.
8. West abutment.
9. East abutment.
10. Retaining walls.
11. Prestressed girders and bearings.
12. Prestressed girders and bearings.
13. Prestressed girders and bearings.
14. Prestressed girders and bearings.
15. Prestressed girders and bearings.
16. Prestressed girders and bearings.
17. Prestressed girders and bearings.
18. Prestressed girders and bearings.
19. Prestressed girders and bearings.
20. Prestressed girders and bearings.
21. Prestressed girders and bearings.
22. Prestressed girders and bearings.
23. Deck - Sht. 1.
24. Deck - Sht. 2
25. Deck - Sht. 3
26. Deck - Sht. 4
27. Deck sections and details.
28. Scream elevations.
29. 6000 mm West approach slab.
30. 6000 mm East approach slab.
31. South barrier wall.
32. North barrier wall.
33. Railing for barrier wall North.
34. Railing for barrier wall South.
35. Joint anchorage and armourings.
36. As constructed elev. and dim. Sht. 1.
37. As constructed elev. and dim. Sht. 2.
38. Bridge date and site number data.
39. Miscellaneous details.
40. Standard details.
41. Clearance diagram.
42. Electrical embedded work.
43. Beam and Diaphragm repairs.

LIST OF STANDARD DRAWINGS

OPSD - 508 .02 Bridge Deck Water Proofing.

DD-3501 Minimum Granular Backfill Requirements
(Final Surface Above Original Ground).



Ministry
of
Transportation

CONT. 91-59

FOUNDATION DESIGN SECTION

**foundation
investigation and
design report**

ENGINEERING MATERIALS OFFICE
FOUNDATION DESIGN SECTION

WP 181-86-01

DIST 6

HWY 7

STR SITE 37-682

CNR Overhead at MacMillan Yard

CONT 91-59

DISTRIBUTION

G.C.E. Burkhardt (3)
G. Cautillo
J. Smrcka (2)
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K. Bassi
J.H. Peer
T. Yakutchuk
G. Szekreny
B. Steeves (Cover Only)
M. MacLean (Cover Only)
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GEOCRES 30M13-81

DATE *SEPT 22/88*

FOUNDATION INVESTIGATION REPORT
FOR

CNR Overhead at MacMillan Yard

W.P. 181-86-01, Site 37-682

Hwy. 7, District 6, Toronto

INTRODUCTION

The report summarizes the foundation investigation for the proposed bridge widening at this site.

The investigation is applicable to the proposed structure widening within 10 m of the existing structure.

SITE DESCRIPTION

The site is located at the existing crossing of Hwy. 7 over the CNR tracks, which is between Jane Street and Keele Street in the Town of Vaughan.

The immediate area is a yard for the CNR.

The area is basically a glacial till plain, with low local relief except for the existing Hwy. 7 embankments.

INVESTIGATION PROCEDURES

A foundation investigation for this project was conducted between 88 04 05 and 88 05 04. The drilling equipment consisted of 82 mm I.D. hollow-stem augers and N casing were used.

The investigation consisted of 15 boreholes, 13 of which were accompanied by dynamic cone penetration tests. Piezometers were installed in 4 boreholes in order to verify groundwater measurements in open boreholes.

The boreholes have been identified as #1-S, 3-N, 3-S, 6-N, 6-S, 7-N, 8-S, 9-N, 10-S, 11, 12, 14, 15, 16 and 18. They extended for depths ranging from 12.6 to 24.8 m. All boreholes were terminated in overburden.

Survey details were provided by the Central Region Surveys and Plans Section.

The sampling program consisted of split spoon samples collected at 0.8 m to 3.0 m intervals. They provided Standard Penetration Test (N) values for assessment of the in situ state of compaction of the non-cohesive materials, and for an indication of shear strengths of cohesive materials. These samples also provided material for identification purposes.

The laboratory testing program for representative samples consisted of:

- grain size analyses
- natural moisture content determinations
- Atterberg Limit determinations

SUBSURFACE CONDITIONS

The Record of Borehole Sheets in the Appendix illustrate the subsurface conditions at the borehole locations. The locations and elevations of the boreholes, along with stratigraphical profiles based on the borehole data are shown on Drawing No. 1818601A.

The approaches to the structure consist of essentially sand fill extending from elev. 214± m to 203± m. The fill is underlain by clayey silt till containing traces of organics in the upper 1± m.

Within the limits of the structure, the overburden consists of the following generalized layers, in sequence, from the surface down:

| <u>Elevation (m)</u> | | <u>Material</u> |
|----------------------|-----------|--------------------------|
| <u>From</u> | <u>To</u> | |
| 205± | 201± | Clayey Silt (Fill) |
| 201± | 194± | Clayey Silt (Upper Till) |
| <u>West Side</u> | | |
| 194± | below 180 | Sandy Silt to Silty Sand |
| <u>East Side</u> | | |
| 194± | 188± | Sandy Silt to Silty Sand |
| 188± | 184± | Clayey Silt (Lower Till) |
| 184± | below 180 | Silty Clay |

Following are detailed descriptions of the soil strata encountered.

Sand (Fill)

This non-cohesive material is fill for the immediate approaches to the existing structure. It has been described as a heterogeneous mixture of sand, with gravel, traces of silt and clay containing occasional clayey silt zones. The bottom 2± m is clayey silt.

It was encountered at BH #12 and BH #16, where it extended for thicknesses of 10.1 m and 10.2 m respectively.

Based on the results of Standard Penetration Tests (N = 4 to 22), the material is in a loose to compact state.

The results of one test indicate a natural water content of 3.5% and a grain size distribution as follows:

| | |
|--------|-------|
| Gravel | 17% |
| Sand | 68% |
| Silt | 14.5% |
| Clay | 0.5% |

Clayey Silt (Fill)

This cohesive material is fill for the CNR track bed and also underlies the embankment fill. It has been described as a heterogeneous mixture of clayey silt (CL), with sand, traces of gravel and organics, containing occasional silty clay zones.

It was encountered at all boreholes within the limits of the bridge and beneath the sand fill at the approach embankments, where it extended for thicknesses ranging from 1.7 to 4.4 m.

Based on the results of Standard Penetration Test (N = 4 to 100+) the material is in a firm to hard, but generally firm to very stiff state.

Typical properties of the material, as determined by laboratory tests, are summarized as follows:

| | <u>Range</u> | <u>Average</u> | <u>Median</u> |
|----------------------------|--------------|----------------|---------------|
| Water Content (w) | 12.0-26.0% | 20.8% | 22.8% |
| Liquid Limit (w_L) | 20.0-37.5% | 28.8% | 28.5% |
| Plastic Limit (w_p) | 13.5-18.0% | 15.8% | 16.0% |
| Plasticity Index (I_p) | 6.0-20.0% | 13.0% | 13.0% |

Figure 1 illustrates a typical plasticity range for this material.

Figure 2 illustrates a typical grain size distribution for this material.

Clayey Silt (Upper Till)

This cohesive material directly underlies the fill across the entire site. It has been described as a heterogeneous mixture of clayey silt (CL to CL-ML), with sand, traces of gravel, containing occasional sand zones and occasional boulders.

It was encountered at all boreholes. Its thickness ranged from 6.3± m to 9.6± m, at these locations.

Based on the results of Standard Penetration Tests ($N = 6$ to 100+), the material is in a firm to hard, but generally very stiff to hard state.

Typical properties of the material, as determined by laboratory tests, are summarized as follows:

| | <u>Range</u> | <u>Average</u> | <u>Median</u> |
|----------------------------|--------------|----------------|---------------|
| Water Content (w) | 7.0-22.0% | 12.2% | 11.3% |
| Liquid Limit (w_L) | 16.0-39.0% | 21.3% | 20.3% |
| Plastic Limit (w_p) | 11.0-24.0% | 13.4% | 12.5% |
| Plasticity Index (I_p) | 3.0-20.5% | 7.9% | 7.3% |

Figure 3 illustrates a typical plasticity envelope for this material.

Figure 4 illustrates a typical grain size distribution for the cohesive portion of this material.

There are zones of silt and sand within the overburden which are water bearing and exhibit a tendency to flow or boil under conditions of unbalanced hydrostatic head.

The presence of boulders within this strata is noted.

Sandy Silt to Silty Sand

This non-cohesive material directly underlies the clayey silt till across the entire site. It has been described as sandy silt to silty sand, with traces of gravel and clay, and occasional clayey silt zones.

The surface of this stratum is relatively level. However the elevation of the base of the stratum is irregular, as it extends for thicknesses in excess of 14.5 m at west portion of the site while the thicknesses at the east portion of the site range from 4± to 6± m.

Based on the results of Standard Penetration Test (N = 3 to 100+) the material is in a very loose to very dense, but generally compact to very dense state.

Typical properties of the material, as determined by laboratory tests, are summarized as follows:

| | <u>Range</u> | <u>Average</u> | <u>Median</u> |
|------------------------------------|--------------|----------------|---------------|
| Water Content (w) | 5.5-25.5% | 17.4% | 18.8% |
| Liquid Limit (w _L) | 0-22.0% | N/A | N/A |
| Plastic Limit (w _p) | 0-16.5% | N/A | N/A |
| Plasticity Index (I _p) | 0- 6.5% | N/A | N/A |

Figure 5 illustrates a typical grain size distribution for this material.

Clayey Silt (Lower Till)

This cohesive material was encountered directly beneath the sandy silt to silty sand stratum at the east portion of the site. Boreholes at the west portion of the site did not penetrate to this stratum. It has been described as a heterogeneous mixture of clayey silt (CL to CL-ML), with sand, traces of gravel and containing occasional silt and sand zones and occasional boulders.

It was encountered at boreholes #3-N, #3-S, #6-S, #15, #16 and #18 where its thickness ranges from an estimated 2.3 to 6.0 m. The elevation of the surface of the deposit is irregular, sloping down from east to west.

Based on the results of Standard Penetration Tests (N = 13 to 100+), the material is in a stiff to hard, but generally hard state.

Typical properties of the material, as determined by laboratory tests, are summarized as follows:

| | <u>Range</u> | <u>Average</u> | <u>Median</u> |
|----------------------------|--------------|----------------|---------------|
| Water Content (w) | 8.0-22.5% | 13.0% | 11.0% |
| Liquid Limit (w_L) | 14.0-26.5% | 18.7% | 16.0% |
| Plastic Limit (w_p) | 9.5-17.5% | 12.5% | 11.0% |
| Plasticity Index (I_p) | 3.0- 9.0% | 6.2% | 5.5% |

Figure 6 illustrates a typical grain size distribution for this material.

Silty Clay

This cohesive material was encountered directly beneath the clayey silt (lower till) stratum at the east portion of the site. It has been described as silty clay (CI), containing occasional silt zones.

It was encountered at boreholes #3-N, #3-S, #15 and #18 where its full extent was not explored. At these locations it is over 5± m thick. The elevation of the surface of the deposit is irregular, sloping down from east to west.

Based on the results of Standard Penetration Tests (N = 68 to 100+) the material is in a hard state.

Typical properties of the material, as determined by laboratory tests, are summarized as follows:

| | <u>Range</u> | <u>Average</u> | <u>Median</u> |
|------------------------------------|--------------|----------------|---------------|
| Water Content (w) | 19.0-21.0% | 20.0% | 20.0% |
| Liquid Limit (w _L) | 42.0-48.5% | 43.9% | 42.5% |
| Plastic Limit (w _p) | 19.0-22.0% | 20.3% | 20.0% |
| Plasticity Index (I _p) | 21.5-26.5% | 23.6% | 23.3% |

Figure 7 illustrates a typical grain size distribution for this material.

Groundwater

At the time of the field investigation, the groundwater elevation was generally within 1 m of the ground surface. Reference is made to the Record of Borehole Sheets for specific groundwater elevations.

RECOMMENDATIONS

It is proposed to widen the existing structure by approximately 3.75 m on either side. The extensions for the abutment and pier footings are to be parallel to the existing footing alignments and there are to be no significant changes to the profile of Hwy. 7.

Structure Foundations

The abutment and pier footing extensions may be founded on reinforced concrete caissons based on hard glacial till at elevation 196.0 m.

By extending the caissons to the underside of the deck, footings could be eliminated. Alternatively, conventional caisson caps could be constructed incorporating any walls that the CNR may require.

The following O.H.B.D.C. capacities are recommended for 0.9 m (36 inch), 1.1 m (42 inch) or 1.2 m (48 inch) diameter caissons.

| <u>Caisson Size</u> | <u>Factored Capacity at U.L.S.</u> | <u>Capacity at S.L.S. Type II</u> |
|-------------------------|--|---------------------------------------|
| 0.9 m (36 inch) | 1920 kN | 1280 kN |
| 1.1 m (42 inch) | 2850 kN | 1900 kN |
| 1.2 m (48 inch) | 3390 kN | 2260 kN |

Track protection, dewatering and the presence of boulders are concerns that require consideration in the installation of caissons.

Due to the proximity of the CNR tracks, it will be necessary to protect the tracks from any disturbance during construction of the foundations. This could be accomplished by advancing a temporary steel liner concurrently with the advancement of the caisson excavation. The liner should support and prevent any caving of the walls of the excavation.

In addition, the base of the excavation should be protected against any disturbance during installation of the caisson. As there is a relatively high water table at this site, and occasional silt and sand seams were encountered above the founding elevation, there is a possibility that seepage zones will be encountered and that instabilities and material flows may occur within these

zones under conditions of unbalanced hydrostatic head. There is also a possibility that these conditions may be encountered at the base of the caisson, which is critical to the caisson capacity. The base of caisson is in close proximity (within 2± m) of the underlying sandy silt to silty sand stratum and therefore the excavation is susceptible to basal heave if excess hydrostatic head is not adequately controlled. These disturbances could be prevented by maintaining a sufficient head in the excavation (with drilling mud) and placing the concrete by the tremie methods.

In any case, the contract should include a special provision indicating the presence of boulders, the potential instabilities, and the dewatering problems. The contractor should address these concerns in his proposal.

Earth Pressure

Backfill to structures should consist of granular material in accordance with Ministry of Transportation Standard Special Provision #121 (83 10).

Computation of earth pressures should be in accordance with Section 6-6.1.2.1 of the O.H.B.D.C. The active condition will govern earth pressure design for the yielding condition while the at-rest condition will govern earth pressure design for the unyielding condition. The following properties for backfill are recommended for design:

| <u>Material</u> | <u>ϕ</u> | <u>γ</u> | <u>$\frac{K}{A}$</u> | <u>$\frac{K}{O}$</u> |
|-----------------|--------------------------|----------------------------|---------------------------------|---------------------------------|
| Granular 'A' | 35° | 22.8 kN/m ³ | 0.27 | 0.43 |
| Granular 'B' | 30° | 21.2 kN/m ³ | 0.33 | 0.50 |

Lateral Resistance

The resistance to lateral load for caissons should be calculated in accordance with Section 6-8.3.8 of the O.H.B.D.C.

Frost Protection

A minimum earth cover of 1.2 m, or equivalent, is required for frost protection.

Slope Stability

Since there will be no change to the grade of Hwy. 7, no deep-seated stability problems are anticipated for this proposal for slopes at 2H:1V.

However, due to property constraints, steeper slopes or retaining structures may be required. These concerns will be addressed in the Foundation Investigation and Design Report for W.P. 112-87-01.

Temporary slopes should be up to 3 m high should be 1H:1V or flatter. Temporary slopes up to 10 m high should be 1.5H:1V or flatter.

Settlement

Total and differential settlements will be negligible for structure foundations and immediate approaches constructed in accordance with the recommendations provided.

MISCELLANEOUS

The field work for this project was carried out under the supervision of K. Zasitko, Foundation Technician.

The equipment used was owned and operated by Malone's Soil Samples and Master Soil Investigation Ltd.

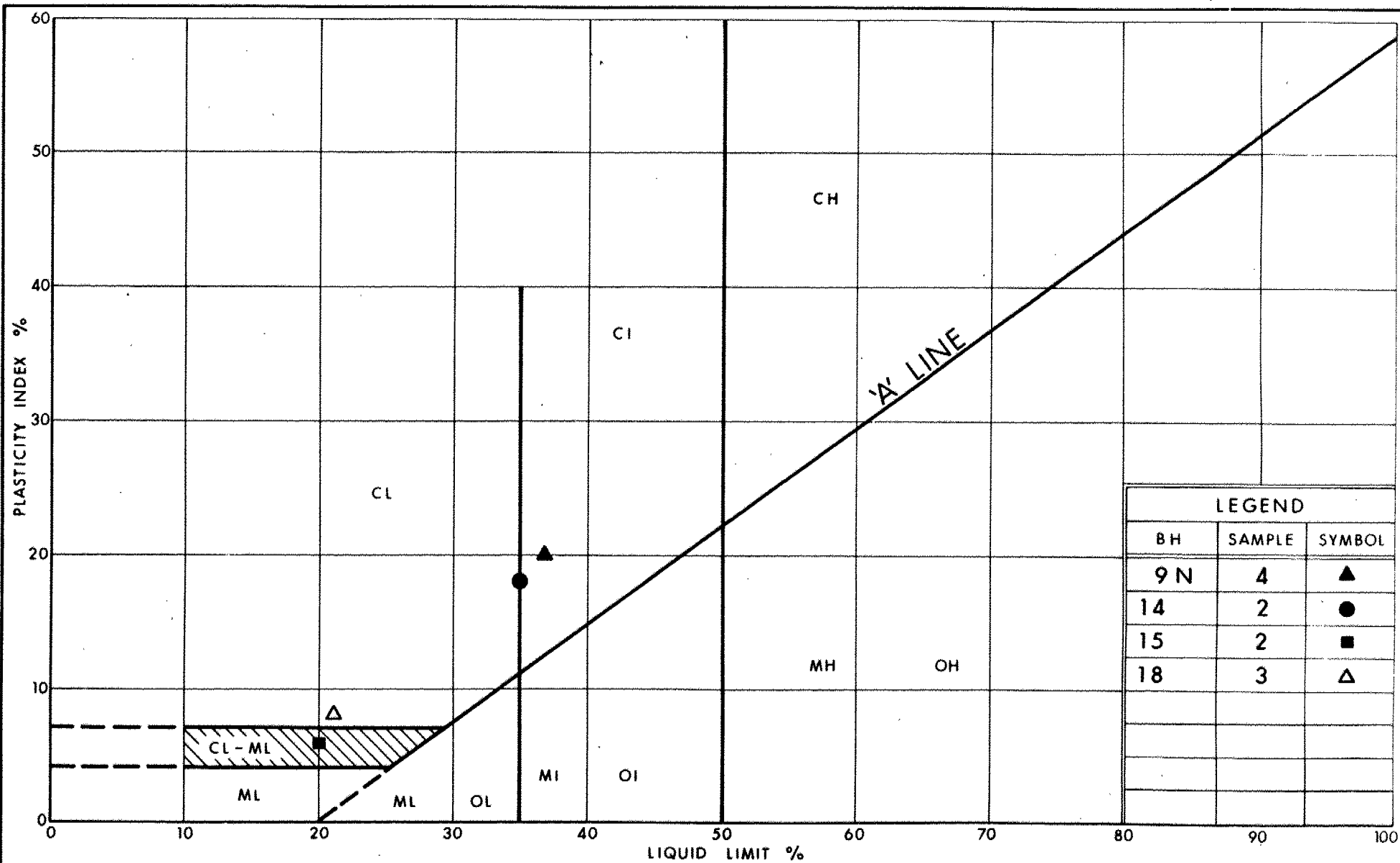
The report was written by D. Dundas, Sr. Foundations Engineer, and reviewed by M. Devata, Chief Foundations Engineer (East).



D. H. Dundas
D.H. Dundas, P.Eng.
Sr. Foundations Engineer

M. Devata
M.S. Devata, P.Eng.
Chief Foundations Engineer
(East)

APPENDIX



Ministry of
Transportation

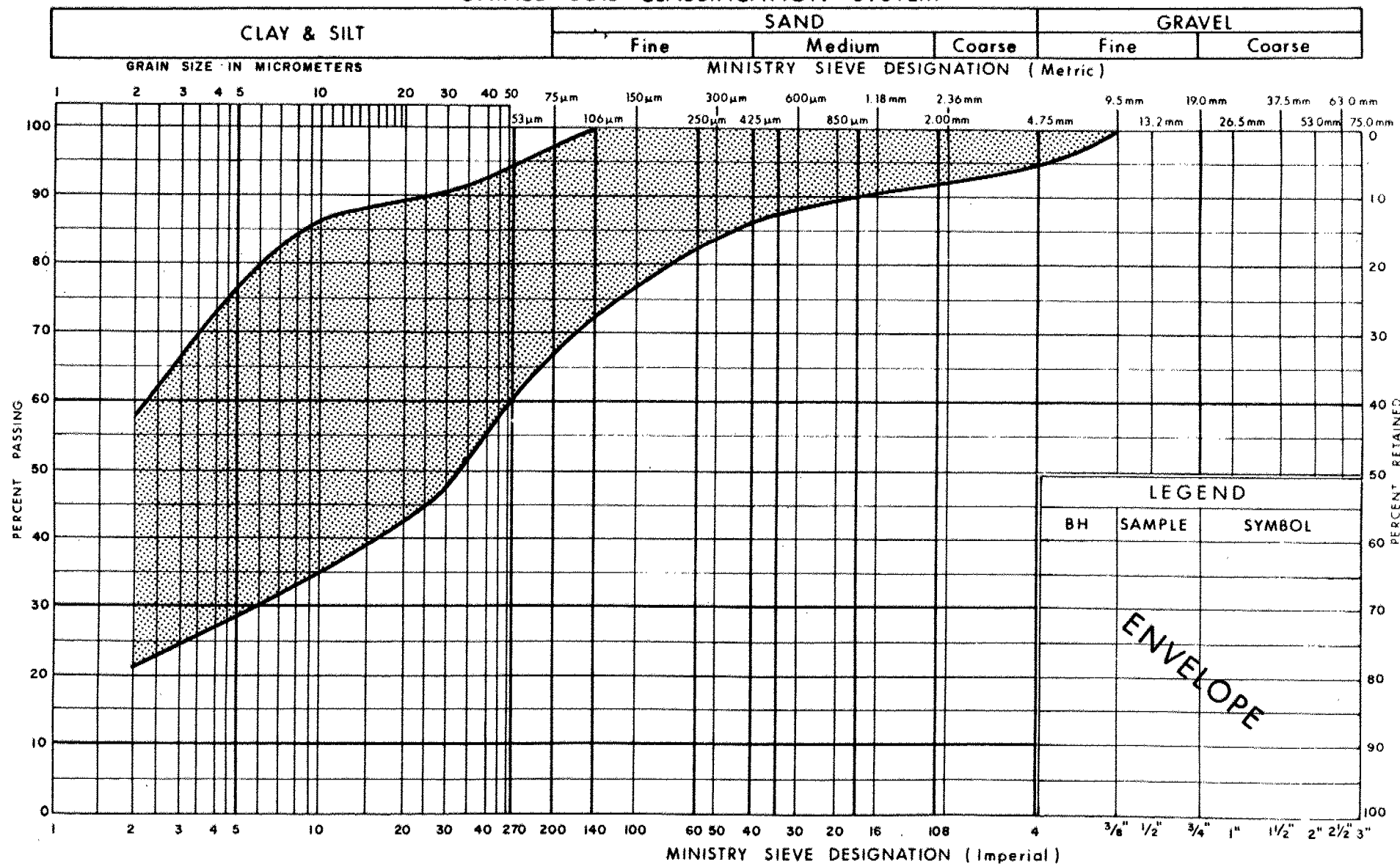
Ontario

PLASTICITY CHART CLAYEY SILT (FILL)

FIG No 1

W P 181-86-01

UNIFIED SOIL CLASSIFICATION SYSTEM

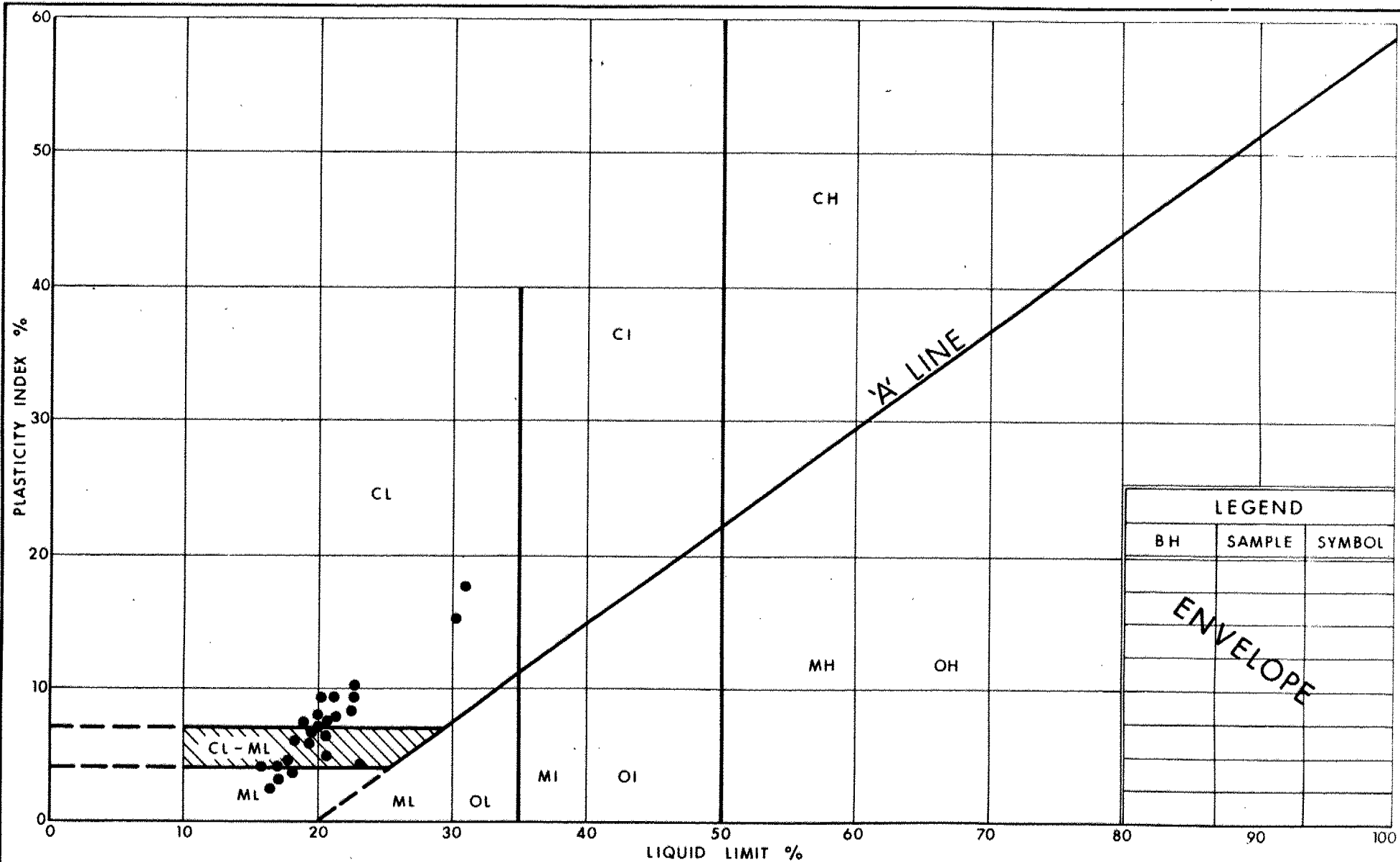

 Ministry of
Transportation

GRAIN SIZE DISTRIBUTION

CLAYEY SILT (FILL)

FIG No 2

W P 181-86-01

Ministry of
Transportation

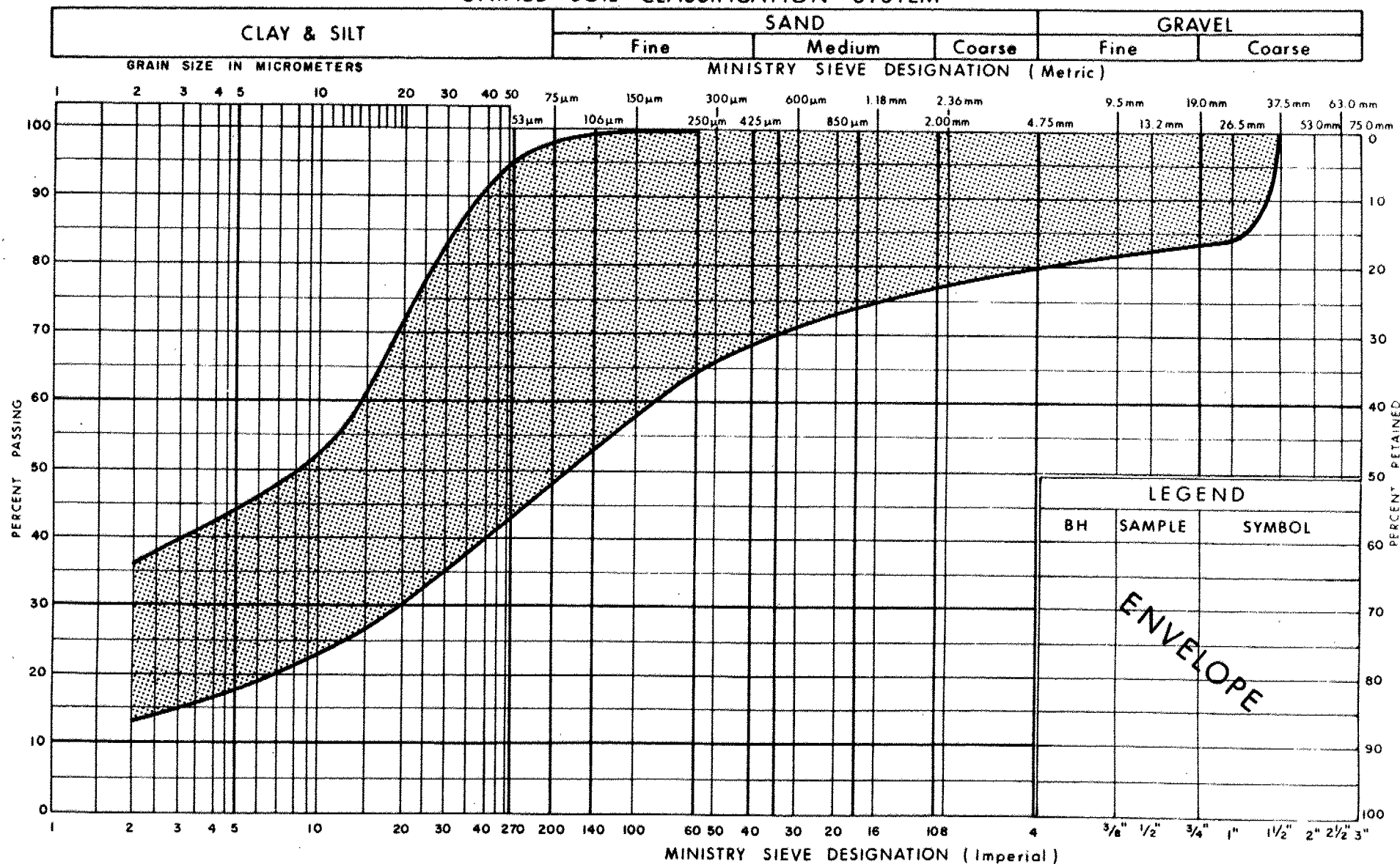
Ontario

PLASTICITY CHART
CLAYEY SILT (Upper Glacial Till)

FIG No 3

W P 181-86-01

UNIFIED SOIL CLASSIFICATION SYSTEM



Ministry of
Transportation

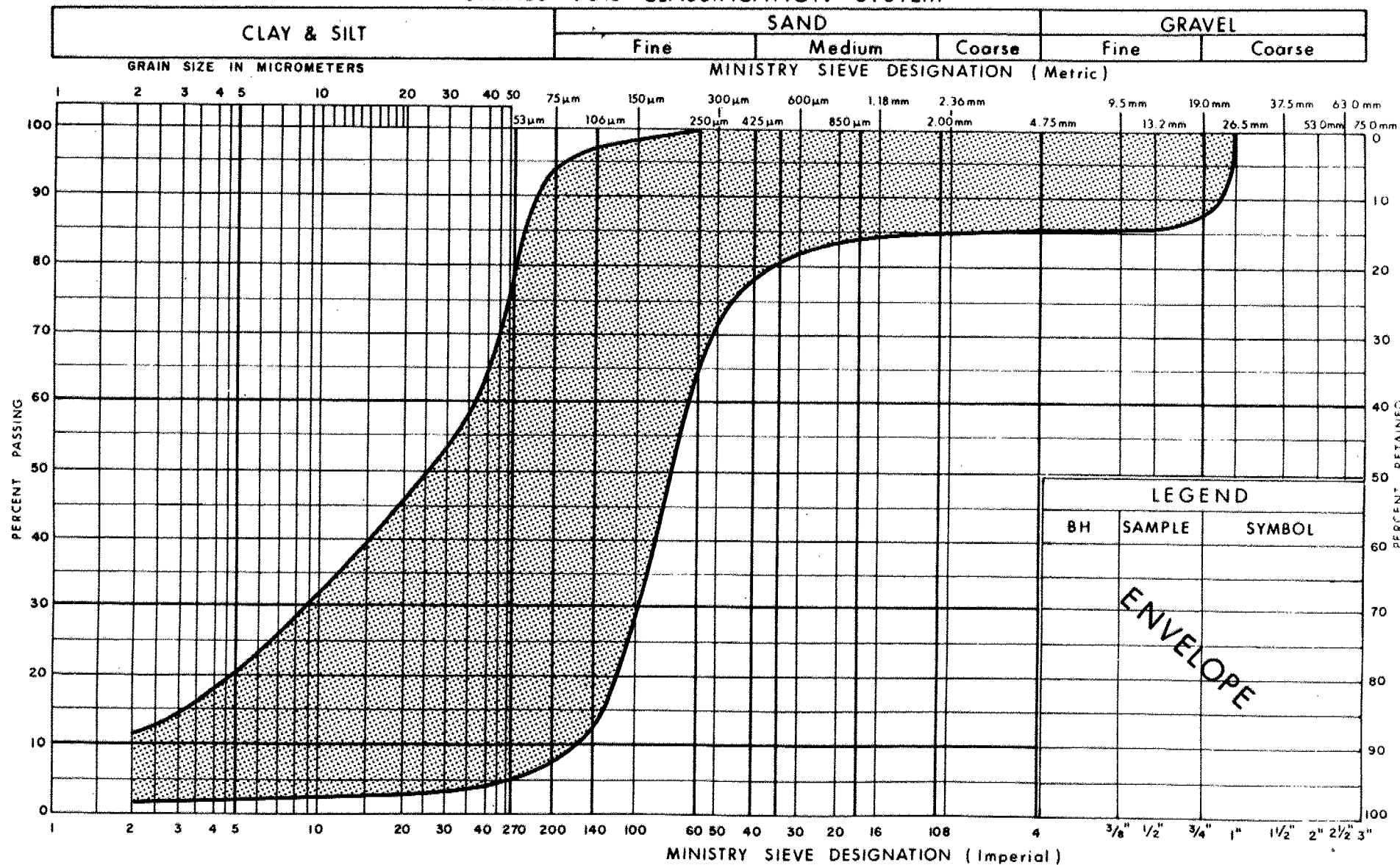
GRAIN SIZE DISTRIBUTION

CLAYEY SILT (Upper Glacial Till)

FIG No 4

W P 181-86-01

UNIFIED SOIL CLASSIFICATION SYSTEM



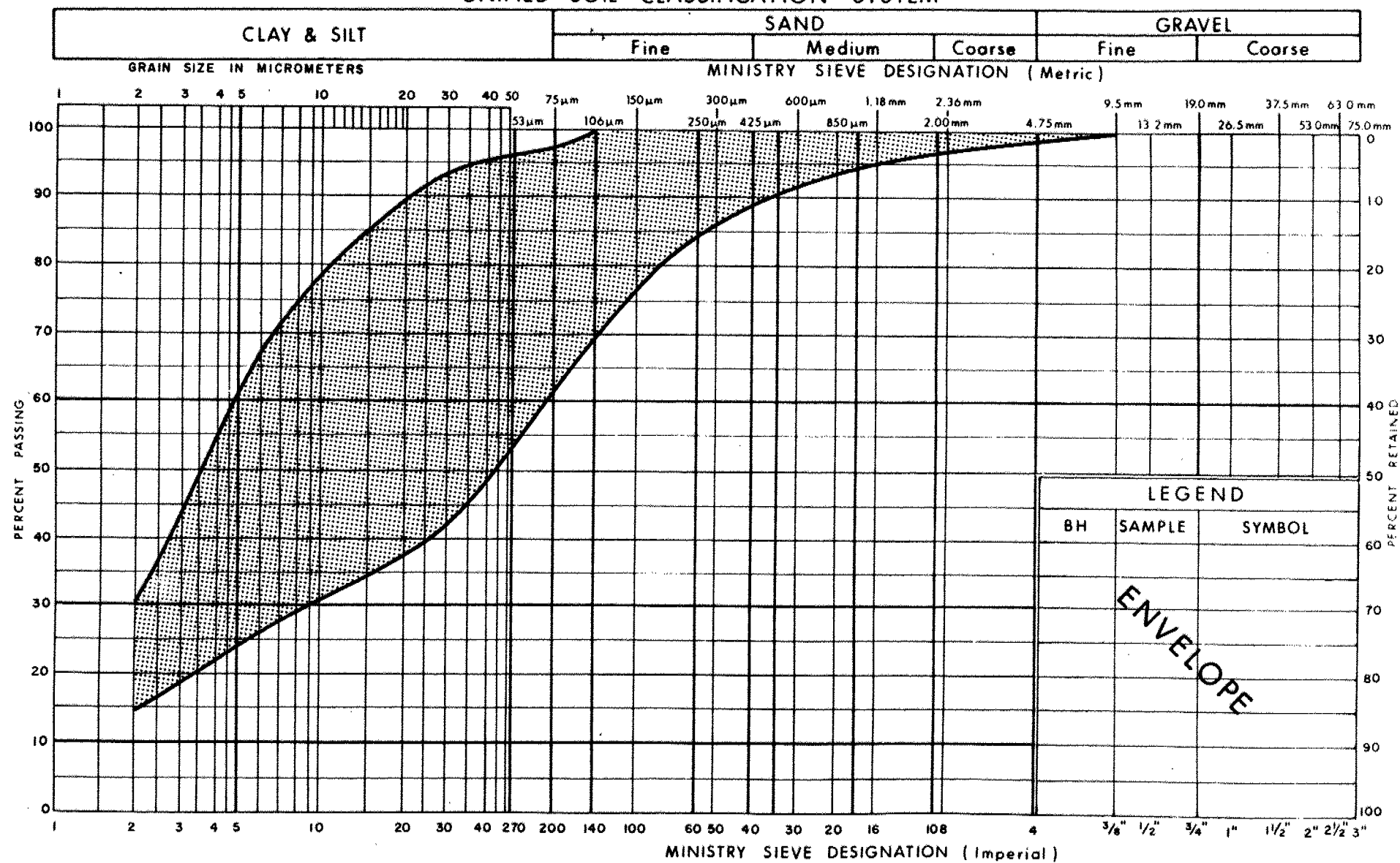
Ministry of
Transportation

GRAIN SIZE DISTRIBUTION
SANDY SILT TO SILTY SAND

FIG No 5

W P 181-86-01

UNIFIED SOIL CLASSIFICATION SYSTEM



Ministry of
Transportation

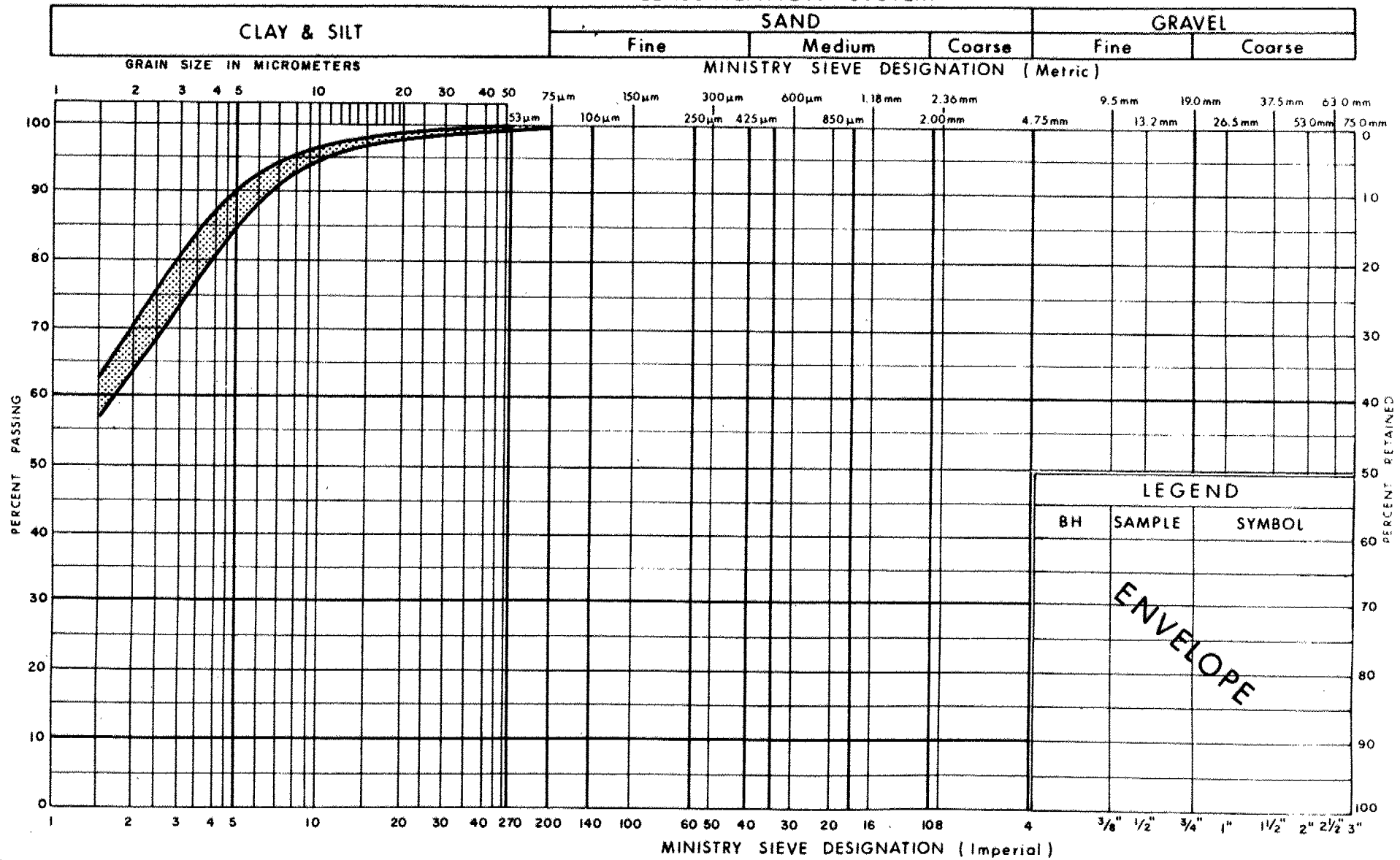
GRAIN SIZE DISTRIBUTION

CLAYEY SILT (Lower Glacial Till)

FIG No 6

WP 181-86-01

UNIFIED SOIL CLASSIFICATION SYSTEM



Ministry of
Transportation

GRAIN SIZE DISTRIBUTION
SILTY CLAY

FIG No 7

W P 181-86-01

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 INDICATED 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° CONE ANGLE) DRIVEN BY 475 J IMPACT ENERGY ON 'A' 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

| | | | |
|----|---------------------|----|-----------------------------|
| SS | SPLIT SPOON | TP | THINWALL PISTON |
| WS | WASH SAMPLE | OS | OSTERBERG SAMPLE |
| ST | SLOTTED TUBE SAMPLE | RC | ROCK CORE |
| BS | BLOCK SAMPLE | PH | T.W. ADVANCED HYDRAULICALLY |
| CS | CHUNK SAMPLE | PM | T.W. ADVANCED MANUALLY |
| TW | THINWALL OPEN | FS | FOIL SAMPLE |

STRESS AND STRAIN

| | | |
|--------------------------------------|-----|-------------------------------|
| u_w | kPa | PORE WATER PRESSURE |
| r_u | 1 | 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 | 1 | COEFFICIENT OF FRICTION |

MECHANICAL PROPERTIES OF SOIL

| | | |
|----------------|-------------------|--------------------------------------|
| m_v | kPa ⁻¹ | COEFFICIENT OF VOLUME CHANGE |
| C_c | 1 | COMPRESSION INDEX |
| C_s | 1 | SWELLING INDEX |
| C_α | 1 | RATE OF SECONDARY CONSOLIDATION |
| c_v | m ² /s | COEFFICIENT OF CONSOLIDATION |
| H | m | DRAINAGE PATH |
| T_v | 1 | 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_r | kPa | REMOULDED SHEAR STRENGTH |
| S_r | 1 | SENSITIVITY = $\frac{c_u}{\tau_r}$ |

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 | 1 | 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 | 1 | 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 ³ /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 | 1 | LIQUIDITY INDEX = $\frac{w - w_p}{I_p}$ | i | 1 | HYDRAULIC GRADIENT |
| γ_{sat} | kn/m ³ | UNIT WEIGHT OF SATURATED SOIL | I_C | 1 | 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 | | | | | | |

RECORD OF BOREHOLE No 15

METRIC

W P 181-86-01 LOCATION Co-ords N 4 850 679.8; E 304 202.6 ORIGINATED BY KZ
 DIST 6 HWY 7 BOREHOLE TYPE Hollow Stem Auger & Cone Test COMPILED BY JBF
 DATUM Geodetic DATE 88 04 12 CHECKED BY

OFFICE REPORT ON SOIL EXPLORATION

| 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 | WATER CONTENT (%) | | |
| | | | | | | | | SHEAR STRENGTH kPa | | | | | | | | 20 | 40 | 60 | | |
| | | | | | | ○ UNCONFINED + FIELD VANE | | | | | | | | | | | | | | |
| | | | | | | ● QUICK TRIAXIAL x LAB VANE | | | | | | | | | | | | | | |
| 204.9 | Ground Level | | | | | | | | | | | | | | GR SA SI CL | | | | | |
| 0.0 | Het. Mixture Clayey Silt with Sand Tr. Gravel, Organics Occ. Silty Clay Zones Stiff (Fill) | | 1 | SS | 13 | | | | | | | | | | | | | | | |
| 202.8 | | | 2 | SS | 9 | | | | | | | | | | | | | | | |
| 2.1 | Het. Mixture Clayey Silt (CL to CL-ML) with Sand | | 3 | SS | 21 | | | | | | | | | | 3 34 44 19 | | | | | |
| | Tr. Gravel | | 4 | SS | 21 | | | | | | | | | | | | | | | |
| | Occ. Silt and Sand | | 5 | SS | 27 | | | | | | | | | | 11 27 40 22 | | | | | |
| | Zones | | 6 | SS | 33 | | | | | | | | | | 18 18 30 34 | | | | | |
| | Occ. Boulders | | 7 | SS | 22 | | | | | | | | | | 6 36 44 14 | | | | | |
| | Firm to Hard (Glacial Till) | | 8 | SS | 7 | | | | | | | | | | | | | | | |
| | | | 9 | SS | 104 | | | | | | | | | | 1 28 54 17 | | | | | |
| | | | 10 | SS | 100/ | 15 cm | | | | | | | | | | | | | | |
| | | | 11 | SS | 67 | | | | | | | | | | | | | | | |
| 193.2 | | | | | | | | | | | | | | | | | | | | |
| 11.7 | Sandy Silt to Silty Sand | | | | | | | | | | | | | | | | | | | |
| 192.2 | * | | 12 | SS | 14 | | | | | | | | | | 0 87 12 1 | | | | | |
| 12.7 | End of Borehole | | | | | | | | | | | | | | | | | | | |
| | * Trace Gravel Trace Clay Occ. Clayey Silt Zones Compact (Lacustrine) | | | | | | | | | | | | | | | | | | | |

RECORD OF BOREHOLE No 3N

METRIC

W P 181-86-01 LOCATION Co-ords. N 4 850 702.9; E 304 178.8
 DIST 6 HWY 7 BOREHOLE TYPE Hollow Stem Auger, Washbore & Cone Test
 DATUM Geodetic DATE 88 04 13 - 14
 ORIGINATED BY KZ
 COMPILED BY JBF
 CHECKED BY

OFFICE REPORT ON SOIL EXPLORATION

| 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 kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE | | | | | | |
| 204.7 | Ground Level | | | | | | | | | | | | | | GR SA SI CL |
| 0.0 | Het. Mixture Clayey Silt with Sand Tr. Gravel, Organics Occ. Silty Clay Zones Stiff to V. Stiff (Fill) | | 1 | SS | 26 | | 204 | | | | | | | | 1 39 43 17 |
| 202.6 | | | 2 | SS | 15 | | 202 | | | | | | | | |
| 2.1 | Het. Mixture Clayey Silt (CL to CL-ML) with Sand Trace Gravel Occ. Silt and Sand Zones Occ. Boulders Stiff to Hard (Glacial Till) | | 3 | SS | 29 | | 202 | | | | | | | | |
| | | | 4 | SS | 25 | | 202 | | | | | | | | |
| | | | 5 | SS | 30 | | 200 | | | | | | | | 9 32 40 19 |
| | | | 6 | SS | 19 | | 200 | | | | | | | | 6 34 42 18 |
| | | | 7 | SS | 10 | | 198 | | | | | | | | |
| | | | 8 | SS | 15 | | 198 | | | | | | | | 6 34 46 14 |
| | | | 9 | SS | 130/ | 25 cm | 196 | | | | | | | | |
| | | | 10 | SS | 120/ | 28 cm | 196 | | | | | | | | 5 31 48 16 |
| 194.0 | | | 11 | SS | 66 | | 194 | | | | | | | | |
| 10.7 | Sandy Silt to Silty Sand Trace Gravel Trace Clay Occ. Clayey Silt Zones Compact to V. Dense (Lacustrine) | | 12 | SS | 12 | | 192 | | | | | | | | |
| | | | 13 | SS | 100 | | 190 | | | | | | | | 0 6 90 4 |
| 190.0 | | | 14 | SS | 112 | | 188 | | | | | | | | |
| 14.7 | Het. Mixture Clayey Silt (CL to CL-ML) with Sand Trace Gravel Occ. Silt and Sand Zones Occ. Boulders Hard (Glacial Till) | | 15 | SS | 39 | | 188 | | | | | | | | 2 34 49 15 |
| | | | 16 | SS | 63 | | 186 | | | | | | | | |
| 184.1 | | | 17 | SS | 86 | | 184 | | | | | | | | 0 0 33 67 |
| 20.6 | Silty Clay (CI) Occ. Silt Zones Hard (Lacustrine) | | | | | | 182 | | | | | | | | |
| 179.9 | | | 18 | SS | 68 | | 180 | | | | | | | | |
| 24.8 | End of Borehole | | | | | | | | | | | | | | |

+3, x5: Numbers refer to Sensitivity
 20
 15 5 (%) STRAIN AT FAILURE
 10

RECORD OF BOREHOLE No 35

METRIC

W P 181-86-01 LOCATION Co-ords. N 4 850 667.9; E 304 170.6 ORIGINATED BY KZ
 DIST 6 HWY 7 BOREHOLE TYPE Hollow Stem Auger, Washbore & Cone Test COMPILED BY JBF
 DATUM Geodetic DATE 88 04 11 - 13 CHECKED BY

OFFICE REPORT ON SOIL EXPLORATION

| 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 | | | 20 40 60 80 100 | | | | | | |
| 204.5 | Ground Level | | | | | | | | | | | | |
| 0.0 | Het. Mixture Clayey Silt (CL) with Sand Trace Gravel Trace Organics Occ. Silty Clay Zones Stiff to V. Stiff (Fill) | | 1 | SS | 18 | | | | | | | | |
| | | | 2 | SS | 9 | | | | | | | | |
| 201.6 | | | 3 | SS | 18 | | | | | | | | |
| 2.9 | | | 4 | SS | 30 | | | | | | | | |
| | Het. Mixture Clayey Silt (CL to CL-ML) with Sand Trace Gravel Occ. Silt and Sand Zones Occ. Boulders Stiff to Hard (Glacial Till) | | 5 | SS | 40 | | | | | | | | |
| | | | 6 | SS | 38 | | | | | | | | |
| | | | 7 | SS | 25 | | | | | | | | |
| | | | 8 | SS | 10 | | | | | | | | |
| | | | 9 | SS | 100 | | | | | | | | |
| | | | 10 | SS | 126/25 | cm | | | | | | | |
| | | | 11 | SS | 43 | | | | | | | | |
| 192.8 | | | | | | | | | | | | | |
| 11.7 | Sandy Silt to Silty Sand Trace Gravel Trace Clay Occ. Clayey Silt Zones Compact to V. Dense (Lacustrine) | | 12 | SS | 32 | | | | | | | | |
| | | | 13 | SS | 13 | | | | | | | | |
| | | | 14 | SS | 55 | | | | | | | | |
| 187.5 | | | | | | | | | | | | | |
| 17.0 | Het. Mixture Clayey Silt (CL to CL-ML) with Sand Trace Gravel Occ. Silt & Sand Zones Occ. Boulders Very Stiff to Hard (Glacial Till) | | 15 | SS | 26 | | | | | | | | |
| | Silty Sand | | 16 | SS | 60/10 | cm | | | | | | | 12 42 37 9 |
| 181.5 | | | | | | | | | | | | | |
| 23.0 | Silty Clay (CI) Occ. Silt Zones | | | | | | | | | | | | |
| 179.7 | Hard (Lacustrine) | | 17 | SS | 101 | | | | | | | | 0 0 38 62 |
| 24.8 | End of Borehole | | | | | | | | | | | | |

+3, x⁵: Numbers refer to
Sensitivity

20
15
10
5 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 6N

METRIC

W.P. 181-86-01 LOCATION Co-ords N 4 850 685.8; E 304 132.9 ORIGINATED BY KZ
 DIST 6 HWY 7 BOREHOLE TYPE Hollow Stem Auger & Cone Test COMPILED BY JBF
 DATUM Geodetic DATE 88 04 11 CHECKED BY

OFFICE REPORT ON SOIL EXPLORATION

| 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 | | | | | |
| 203.9 | Ground Level | | | | | | | | | | | | | |
| 0.0 | Het. Mixture Clayey Silt (CL) with Sand, Tr. Gravels Tr. Organics Occ. Silty Clay Zones Stiff to Very Stiff (Fill) | | 1 | SS | 25 | | | | | | | | | |
| | | | 2 | SS | 13 | | | | | | | | | |
| 201.0 | | | 3 | SS | 25 | | | | | | | | | |
| 2.9 | Het. Mixture Clayey Silt (CL to CL-ML) with Sand Trace Gravels Occ. Silt & Sand Zones Occ. Boulders Stiff to Hard (Glacial Till) | | 4 | SS | 36 | | | | | | | | | |
| | | | 5 | SS | 43 | | | | | | | | | |
| | | | 6 | SS | 13 | | | | | | | | | |
| | | | 7 | SS | 9 | | | | | | | | | |
| | | | 8 | SS | 13 | | | | | | | | | |
| | Boulders | | 9 | SS | 100/15 cm | | | | | | | | | |
| | | | 10 | SS | 100/10 cm | | | | | | | | | |
| 192.9 | | | 11 | SS | 87 | | | | | | | | | |
| 11.0 | Sandy Silt to Silty Sand, Tr. Gravel Trace Clay | | | | | | | | | | | | | |
| 191.3 | | | 12 | SS | 4 | | | | | | | | | |
| 12.6 | End of Borehole | | | | | | | | | | | | | |
| | * Occ. Clayey Silt Zones Loose (Lacustrine) | | | | | | | | | | | | | |

RECORD OF BOREHOLE No 65

METRIC

W P 181-86-01 LOCATION Co-ords N 4 850 655.4; E 304 137.0 ORIGINATED BY KZ
DIST 6 HWY 7 BOREHOLE TYPE Hollow Stem Auger & Cone Test COMPILED BY JBF
DATUM Geodetic DATE 88 04 06 CHECKED BY

OFFICE REPORT ON SOIL EXPLORATION

| 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 | | | | | | | WATER CONTENT (%) | 20 40 60 |
| | | | | | | | | SHEAR STRENGTH kPa | | | | | | | | |
| | | | | | | | | ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE | | | | | | | | |
| 204.0 | Ground Level | | | | | | | | | | | | | GR SA SI CL | | |
| 0.0 | Het. Mixture Clayey Silt (CL) with Sand, Tr. Gravel Trace Organics Occ. Silty Clay Zones Firm to Stiff (Fill) | | 1 | SS | 13 | | 202 | | | | | | | 0 15 40 45 | | |
| 201.1 | | | 2 | SS | 12 | | | | | | | | | 7 35 40 18 | | |
| 2.9 | Het. Mixture Clayey Silt (CL to CL-ML) with Sand | | 3 | SS | 6 | | | | | | | | | | | |
| | | | 4 | SS | 37 | | 200 | | | | | | | | | |
| | | | 5 | SS | 46 | | | | | | | | | | | |
| | Boulders | | 6 | SS | 25 | | | | | | | | | 2 29 46 23 | | |
| | Silty Clay | | 7 | SS | 11 | | 198 | | | | | | | 1 15 38 46 | | |
| | | | 8 | SS | 12 | | | | | | | | | 8 37 40 15 | | |
| | Trace Gravel Occ. Silt & Sand Zones Occ. Boulders Stiff to Hard (Glacial Till) | | 9 | SS | 100 | 13 cm | 196 | | | | | | | 1 19 67 13 | | |
| 193.9 | | | 10 | SS | 120 | 25 cm | | | | | | | | | | |
| 10.1 | Sandy Silt to Silty Sand Trace Gravel Trace Clay Occ. Clayey Silt Zones Compact to Very Dense (Lacustrine) | | 11 | SS | 36 | | 194 | | | | | | | | | |
| | | | 12 | SS | 31 | | 192 | | | | | | | 0 29 69 2 | | |
| | | | 13 | SS | 41 | | 190 | | | | | | | | | |
| | | | 14 | SS | 59 | | 188 | | | | | | | | | |
| | | | 15 | SS | 28 | | 186 | | | | | | | | | |
| 186.2 | | | | | | | | | | | | | | | | |
| 17.8 | Het. Mixture Clayey Silt (CL to CL-ML) | | | | | | | | | | | | | | | |
| 185.3 | * | | 16 | SS | 22 | | | | | | | | | 0 4 66 30 | | |
| 18.7 | End of Borehole | | | | | | | | | | | | | | | |
| | * With Sand Trace Gravel Occ. Silt and Sand Zones Occ. Boulders Very Stiff (Glacial Till) | | | | | | | | | | | | | | | |

+3, x5 : Numbers refer to
Sensitivity

20
15
10
5 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 7 N

METRIC

W P 181-86-01 LOCATION Co-ords N 4 850 678.8; E 304 113.9 ORIGINATED BY KZ
 DIST 6 HWY 7 BOREHOLE TYPE Hollow Stem Auger, Washbore & Cone Test COMPILED BY JBF
 DATUM Geodetic DATE 88 04 22 - 25 CHECKED BY

OFFICE REPORT ON SOIL EXPLORATION

| SOIL PROFILE | | SAMPLES | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT | | | UNIT WEIGHT Y | REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL |
|--------------|---|---------|------|-------------------------|-----------------|--|-----------------|---|-------------------------------|--|------------------|--|
| ELEV DEPTH | DESCRIPTION | NUMBER | TYPE | | | VALUES | 20 40 60 80 100 | Wp W WL | WATER CONTENT (%) 20 40 60 | | | |
| 203.9 | Ground Level | | | | | | | | | | | |
| 0.0 | Het. Mixture Clayey Silt (CL) with Sand, Tr. Gravel Trace Organics Occ. Silty Clay Zones Firm to Stiff (Fill) | 1 | SS | 12 | | | | | | | | |
| | | 2 | SS | 13 | | | | | | | | |
| 201.0 | | 3 | SS | 6 | | | | | | | | |
| 2.9 | Het. Mixture Clayey Silt (CL to CL-ML) with Sand Trace Gravel Occ Silt & Sand Zones Occ. Boulders Firm to Hard (Glacial Till) | 4 | SS | 28 | | | | | | | | |
| | | 5 | SS | 39 | | | | | | | | |
| | | 6 | SS | 21 | | | | | | | | |
| | | 7 | SS | 10 | | | | | | | | |
| | | 8 | SS | 6 | | | | | | | | |
| | | 9 | SS | 100/15cm | | | | | | | | |
| | | 10 | SS | 76 | | | | | | | | |
| 193.8 | | 11 | SS | 33 | | | | | | | | |
| 10.1 | Sandy Silt to Silty Sand Trace Gravel Trace Clay Occ. Clayey Silt Zones Compact to Very Dense (Lacustrine) | 12 | SS | 50 | | | | | | | | |
| | | 13 | SS | 15 | | | | | | | | |
| | | 14 | SS | 40 | | | | | | | | |
| | | 15 | SS | 60 | | | | | | | | |
| | Clayey Silt | 16 | SS | 51 | | | | | | | | |
| | | 17 | SS | 70 | | | | | | | | |
| | | 18 | SS | 100/13 cm | | | | | | | | |
| | | 19 | SS | 100/10 cm | | | | | | | | |
| 179.3 | | | | | | | | | | | | |
| 24.6 | End of Borehole | | | | | | | | | | | |

+3, x5: Numbers refer to Sensitivity

20
15
10
5 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 85

METRIC

W P 181-86-01 LOCATION Co-ords N 4 850 645.8; E 304 111.3 ORIGINATED BY KZ
 DIST 6 HWY 7 BOREHOLE TYPE Hollow Stem Auger & Cone Test COMPILED BY JBF
 DATUM Geodetic DATE 88 04 25 CHECKED BY

OFFICE REPORT ON SOIL EXPLORATION

| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE | 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 | | | | | | | | |
| 204.1 | Ground Level | | | | | | | | | | | | |
| 0.0 | Het. Mixture Clayey Silt (CL) with Sand, Tr. Gravel Trace Organics Occ. Silty Clay Zones Firm to Stiff (Fill) | | 1 | SS | 15 | | 204 | | | | | | |
| 201.2 | | | 2 | SS | 5 | | 202 | | | | | | |
| 2.9 | Het. Mixture Clayey Silt (CL to CL-ML) with Sand Trace Gravel Occ. Silt & Sand Zones Occ. Boulders Firm to Hard (Glacial Till) | | 3 | SS | 8 | | 200 | | | | | | |
| | | | 4 | SS | 19 | | 198 | | | | | | |
| | | | 5 | SS | 23 | | 196 | | | | | | |
| | | | 6 | SS | 24 | | 194 | | | | | | |
| | | | 7 | SS | 11 | | 192 | | | | | | |
| | | | 8 | SS | 7 | | 190 | | | | | | |
| | Sandy Silt | | 9 | SS | 100/ | 10 cm | | | | | | | |
| | | | 10 | SS | 118/ | 25 cm | | | | | | | |
| | | | 11 | SS | 61 | | | | | | | | |
| 192.4 | | | 12 | SS | 63 | | | | | | | | |
| 11.7 | Sandy Silt to Silty Sand, Tr. Gravel Trace Clay Occ. Clayey Silt Zones Very Dense (Lacustrine) | | 13 | SS | 42 | | | | | | | | |
| 189.9 | | | | | | | | | | | | | |
| 14.2 | End of Borehole | | | | | | | | | | | | |
| | * Water Level not Established | | | | | | | | | | | | |

+3, x5: Numbers refer to
Sensitivity

20
15
10
5 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 9N

METRIC

W. P. 181-86-01 LOCATION Co-ords N 4 850 669.6; E 304 089.3 ORIGINATED BY KZ
 DIST 6 HWY 7 BOREHOLE TYPE Hollow Stem Augers & Cone Test COMPILED BY JBF
 DATUM Geodetic DATE 88 04 06 CHECKED BY

OFFICE REPORT ON SOIL EXPLORATION

| SOIL PROFILE | | SAMPLES | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE | PLASTIC LIMIT W _p NATURAL MOISTURE CONTENT W LIQUID LIMIT W _L | WATER CONTENT (%) 20 40 60 | UNIT WEIGHT Y | REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL |
|---------------|--|---------------|---|----------------------------|---------------------------------|--|--|-------------------------------|---------------------|--|
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER TYPE 'N' VALUES | | | | | | | |
| 204.4 | Ground Level | | | | | | | | | |
| 0.0 | Het. Mixture Clayey Silt (CL) with Sand, Tr. Gravel Trace Organics Occ. Silty Clay Zones Stiff to Very Stiff (Fill) | | 1 SS 16 2 SS 18 3 SS 12 4 SS 16 | | 204 | | | | | 3 18 44 35 |
| 200.7 | | | 5 SS 26 6 SS 28 7 SS 52 8 SS 11 9 SS 100/10 cm 10 SS 100/15 cm | | 202 200 198 196 194 | | | | | 0 3 40 57 8 31 43 18 9 32 39 20 5 31 48 16 |
| 3.7 | Het. Mixture Clayey Silt (CL to CL-ML) with Sand Trace Gravel Occ. Silt & Sand Zones Occ. Boulders Stiff to Hard Boulders (Glacial Till) | | 11 SS 103 | | | | | | | |
| 193.3 | End of Borehole | | | | | | | | | |
| 11.1 | | | | | | | | | | |

RECORD OF BOREHOLE No 10S

METRIC

W P 181-86-01 LOCATION Co-ords. N 4 850 635.7; E 304 084.2 ORIGINATED BY KZ
 DIST 6 HWY 7 BOREHOLE TYPE Hollow Stem, Washbore, Penetration Test COMPILED BY JBF
 DATUM Geodetic DATE 88 04 09 CHECKED BY

OFFICE REPORT ON SOIL EXPLORATION

| 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 | VALUES | | | 20 | 40 | | | | | |
| 204.8 | Ground Level | | | | | | | | | | | | | |
| 0.0 | Het. Mixture Clayey Silt (CL) with Sand, Tr. Gravel Trace Organics Occ. Silty Clay Zones Firm to Hard (Fill) | | 1 | SS | 100 | 3 cm | | | | | | | | |
| | | | 2 | SS | 17 | | | | | | | | | |
| | | | 3 | SS | 4 | | | | | | | | | |
| | | | 4 | SS | 16 | | | | | | | | | |
| 200.4 | | | 5 | SS | 25 | | | | | | | | | |
| 4.4 | Het. Mixture Clayey Silt (CL to CL-ML) with Sand Trace Gravel Occ. Silt & Sand Zones Occ. Boulders Stiff to Hard (Glacial Till) | | 6 | SS | 39 | | | | | | | | | |
| | | | 7 | SS | 30 | | | | | | | | | |
| | | | 8 | SS | 20 | | | | | | | | | |
| | | | 9 | SS | 8 | | | | | | | | | |
| | | | 10 | SS | 104 | 25 cm | | | | | | | | |
| | | | 11 | SS | 116 | 25 cm | | | | | | | | |
| | | | 12 | SS | 58 | | | | | | | | | |
| 191.6 | | | 13 | SS | 19 | | | | | | | | | |
| 13.2 | Sandy Silt to Silty Sand Trace Gravel Trace Clay Occ. Clayey Silt Zones Loose to Compact (Lacustrine) | | 14 | SS | 8 | | | | | | | | | |
| | | | 15 | SS | 16 | | | | | | | | | |
| | | | 16 | SS | 25 | | | | | | | | | |
| 180.4 | | | | | | | | | | | | | | |
| 24.4 | End of Borehole | | | | | | | | | | | | | |

+3, x5: Numbers refer to
Sensitivity

20
15
10

5 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 11

METRIC

W P 181-86-01 LOCATION Co-ords. N 4 850 665.7; E 304 059.9 ORIGINATED BY KZ
 DIST 6 HWY 7 BOREHOLE TYPE Hollow Stem Auger, Washbore & Cone Test COMPILED BY JBF
 DATUM Geodetic DATE 88 04 20 - 21 CHECKED BY

OFFICE REPORT ON SOIL EXPLORATION

| 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 | WATER CONTENT (%) | | | | | |
| 204.5 | Ground Level | | | | | | | | | | | | | |
| 0.0 | Het. Mixture Clayey Silt (CL) with Sand, Tr. Gravel Trace Organics Occ. Silty Clay Zones Firm to Very Stiff (Fill) | | 1 | SS | 10 | | | | | | | | | |
| | | | 2 | SS | 15 | | | | | | | | | |
| | | | 3 | SS | 6 | | | | | | | | | |
| 200.8 | | | 4 | SS | 24 | | | | | | | | | |
| 3.7 | Het. Mixture Clayey Silt (CL to CL-ML) with Sand, Tr. Gravel Occ. Silt & Sand Zones Occ. Boulders Stiff to Hard | | 5 | SS | 15 | | | | | | | | | |
| | | | 6 | SS | 25 | | | | | | | | | |
| | | | 7 | SS | 25 | | | | | | | | | |
| | | | 8 | SS | 10 | | | | | | | | | |
| | Boulders | | | | | | | | | | | | | |
| | | | 9 | SS | 116 | | | | | | | | | |
| | (Glacial Till) | | | | | | | | | | | | | |
| 194.5 | | | 10 | SS | 100 | 13 cm | | | | | | | | |
| 10.0 | Sandy Silt to Silty Sand Trace Gravel Trace Clay Occ. Clayey Silt Zones Compact to Very Dense (Lacustrine) | | 11 | SS | 54 | | | | | | | | | |
| | | | 12 | SS | 15 | | | | | | | | | 0 11 84 5 |
| | | | 13 | SS | 70 | | | | | | | | | |
| | | | 14 | SS | 51 | | | | | | | | | 5 87 6 2 |
| | | | 15 | SS | 76 | | | | | | | | | |
| | | | | | | | | | | | | | | |
| | | | 16 | SS | 36 | | | | | | | | | 16 18 56 10 |
| | Clayey Silt | | | | | | | | | | | | | |
| 182.7 | | | 17 | SS | 49 | | | | | | | | | |
| 21.8 | End of Borehole | | | | | | | | | | | | | |

+3, x5: Numbers refer to
Sensitivity

20
15
10
5 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 12

METRIC

W P 181-96-01 LOCATION Co-ords N 4 850 647.7; E 304 052.1
 DIST 6 HWY 7 BOREHOLE TYPE Hollow Stem Auger
 DATUM Geodetic DATE 88 05 03
 ORIGINATED BY KZ
 COMPILED BY JBF
 CHECKED BY

OFFICE REPORT ON SOIL EXPLORATION

| 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 kPa | | | | | |
| 213.5 | Ground Level | | | | | | | ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE | 20 40 60 | | | | | GR SA SI CL |
| 0.0 | Het. Mixture Sand with Gravel Trace Silt Trace Clay Occ. Clayey Silt Zones Loose to Compact (Fill) | | | | | * | | | | | | | | |
| | | | 1 | SS | 11 | | 212 | | | | | | | |
| | | | 2 | SS | 4 | | 210 | | | | | | | |
| | | | 3 | SS | 7 | | 208 | | | | | | | |
| | | | 4 | SS | 15 | | 206 | | | | | | | 17 68 14 1 |
| | | | 5 | SS | 5 | | 204 | | | | | | | |
| | Clayey Silt | | 6 | SS | 18 | | 202 | | | | | | | 0 48 38 14 |
| 203.3 | Trace Organics | | 7 | SS | 19 | | | | | | | | | |
| 10.2 | Het. Mixt. Clayey Silt(CL to CL-ML) | | 8 | SS | 21 | | | | | | | | | 1 45 40 14 |
| 200.9 | ** | | | | | | | | | | | | | |
| 12.6 | End of Borehole | | | | | | | | | | | | | |
| | * Water Level not Established | | | | | | | | | | | | | |
| | ** with Sand Trace Gravel Occ. Silt and Sand Zones Occ. Boulders Very Stiff (Glacial Till) | | | | | | | | | | | | | |

+3, x²: Numbers refer to
Sensitivity

20
15
10
5 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 14

METRIC

W P 181-86-01 LOCATION Co-ords. N 4 850 624.2; E 304 071.6
 DIST 6 HWY 7 BOREHOLE TYPE Solid Stem Auger, Washbore & Cone Test
 DATUM Geodetic DATE 88 04 05 - 06
 ORIGINATED BY KZ
 COMPILED BY JBF
 CHECKED BY

OFFICE REPORT ON SOIL EXPLORATION

| 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 | WATER CONTENT (%) | | | | | |
| 204.4 | Ground Level | | | | | | | | | | | | | GR SA SI CL |
| 0.0 | Het. Mixture Clayey Silt (CL) with Sand, Tr. Gravel Trace Organics Occ. Silty Clay Zones Stiff to Very Stiff (Fill) | | 1 | SS | 14 | | 204 | | | | | | | 6 26 38 30 |
| | | | 2 | SS | 10 | | 202 | | | | | | | 3 37 46 14 |
| 201.5 | | | 3 | SS | 23 | | | | | | | | | |
| 2.9 | Het. Mixture Clayey Silt (CL to CL-ML) with Sand, Tr. Gravel Occ. Silt & Sand Zones Occ. Boulders Stiff to Hard (Glacial Till) | | 4 | SS | 18 | | | | | | | | | |
| | | | 5 | SS | 33 | | 200 | | | | | | | 2 36 47 15 |
| | | | 6 | SS | 20 | | | | | | | | | 20 30 35 15 |
| | | | 7 | SS | 12 | | | | | | | | | 4 21 38 37 |
| | | | 8 | SS | 9 | | 198 | | | | | | | 6 32 44 18 |
| | | | 9 | SS | 100/5 cm | | 196 | | | | | | | |
| | Boulders | | 10 | SS | 115 | | 194 | | | | | | | |
| 194.3 | | | 11 | SS | 20 | | 192 | | | | | | | |
| 10.1 | Sandy Silt to Silty Sand Trace Gravel Trace Clay Occ. Clayey Silt Zones Very Loose to Very Dense (Lacustrine) | | 12 | SS | 3 | | 190 | | | | | | | 0 29 68 3 |
| | | | 13 | SS | 15 | | 188 | | | | | | | |
| | | | 14 | SS | 14 | | 186 | | | | | | | 1 16 56 27 |
| | | | 15 | SS | 16 | | 184 | | | | | | | |
| | | | 16 | SS | 7 | | 182 | | | | | | | 5 16 70 9 |
| | Clayey Silt | | 17 | SS | 15 | | 180 | | | | | | | 0 60 36 4 |
| | | | 18 | SS | 147/20 cm | | | | | | | | | |
| | | | 19 | SS | 105/28 cm | | | | | | | | | |
| 179.8 | | | 20 | SS | 60/5 cm | | | | | | | | | |
| 24.6 | End of Borehole | | | | | | | | | | | | | |

+3, x5: Numbers refer to
Sensitivity

20
15
10
5 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 15

METRIC

W P 181-86-01 LOCATION Co-ords N 4 850 728.3; E 304 212.5
 DIST 6 HWY 7 BOREHOLE TYPE Hollow Stem Auger & Cone Test
 DATUM Geodetic DATE 88 04 19 - 20
 ORIGINATED BY KZ
 COMPILED BY JBF
 CHECKED BY

OFFICE REPORT ON SOIL EXPLORATION

| 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 kPa | | | | | |
| 205.2 | Ground Level | | | | | | | ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE | 20 40 60 | | | | | GR SA SI CL |
| 0.0 | Het. Mixture Clayey Silt (CL) with Sand, Tr. Gravel Trace Organics Occ. Silty Clay Zones Stiff (Fill) | | 1 | SS | 12 | | 204 | | | | | | | 0 30 49 21 |
| 202.3 | | | 2 | SS | 11 | | | | | | | | | 1 22 45 32 |
| 2.9 | Het. Mixture Clayey Silt (CL to CL-ML) with Sand Trace Gravel Occ. Silt & Sand Zones Occ. Boulders Stiff to Hard (Glacial Till) | | 3 | SS | 14 | | 202 | | | | | | | |
| | | | 4 | SS | 16 | | | | | | | | | |
| | | | 5 | SS | 39 | | | | | | | | | |
| | | | 6 | SS | 36 | | 200 | | | | | | | 4 32 39 25 |
| | | | 7 | SS | 19 | | | | | | | | | |
| | | | 8 | SS | 12 | | | | | | | | | |
| | | | 9 | SS | 113 | | 198 | | | | | | | |
| | Boulders | | 10 | SS | 128 | | 196 | | | | | | | 2 34 53 11 |
| | | | 11 | SS | 53 | | 194 | | | | | | | |
| 193.5 | | | 12 | SS | 61 | | 192 | | | | | | | |
| 11.7 | Sandy Silt to Silty Sand Trace Gravel Trace Clay Occ. Clayey Silt Zones Very Dense (Lacustrine) | | 13 | SS | 57 | | 190 | | | | | | | 1 89 9 1 |
| | | | 14 | SS | 118 | | 188 | | | | | | | |
| 189.0 | Het. Mixture Clayey Silt (CL to CL-ML) with Sand Trace Gravel | | 15 | SS | 19 | | 186 | | | | | | | 0 23 63 14 |
| 16.2 | | | 16 | SS | 92 | | 184 | | | | | | | |
| 186.7 * | Silty Clay (CI) Occ. Silt Zones Hard (Lacustrine) | | 17 | SS | 78 | | 182 | | | | | | | 0 1 35 64 |
| 18.5 | | | | | | | | | | | | | | |
| 181.9 | End of Borehole | | | | | | | | | | | | | |
| 23.3 | * Occ. Silt & Sand Zones Occ. Boulders Very Stiff (Glacial Till) | | | | | | | | | | | | | |

+3, x5: Numbers refer to
Sensitivity

20
15
10

5 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 16

METRIC

W P 181-86-01 LOCATION Co-ords N 4 850 709.8; E 304 218.8 ORIGINATED BY KZ
 DIST 6 HWY 7 BOREHOLE TYPE Hollow Stem Auger COMPILED BY JBF
 DATUM Geodetic DATE 88 05 04 CHECKED BY

OFFICE REPORT ON SOIL EXPLORATION

| 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 | | | | | |
| 213.5 | Ground Level | | | | | | | | | | | | | | | GR SA SI CL |
| 0.0 | Het. Mixture Sand with Gravel Trace Silt Trace Clay Occ. Clayey Silt Zones Loose to Compact (Fill) | | 1 | SS | 14 | | | | | | | | | | | |
| | | | 2 | SS | 6 | | | | | | | | | | | |
| | Clayey Silt | | 3 | SS | 22 | | | | | | | | | | | 2 36 45 17 |
| | | | 4 | SS | 5 | | | | | | | | | | | |
| | Clayey Silt | | 5 | SS | 6 | | | | | | | | | | | 7 32 44 17 |
| | | | 6 | SS | 7 | | | | | | | | | | | |
| 203.4 | Trace Organics | | 7 | SS | 13 | | | | | | | | | | | |
| 10.1 | Het. Mixture Clayey Silt (CL to CL-ML) | | 8 | SS | 28 | | | | | | | | | | | 2 32 42 24 |
| 200.9 | | | | | | | | | | | | | | | | |
| 12.6 | End of Borehole | | | | | | | | | | | | | | | |
| | * Water Level not Established | | | | | | | | | | | | | | | |
| | ** With Sand Trace Gravel Occ. Silt and Sand Zones Occ. Boulders Very Stiff (Glacial Till) | | | | | | | | | | | | | | | |

+3, x5: Numbers refer to
Sensitivity

20
15
10
5 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 18

METRIC


W P 181-86-01 LOCATION Co-ords N 4 850 668.0; E 304 216.0 ORIGINATED BY KZ
DIST 6 HWY 7 BOREHOLE TYPE Hollow Stem Auger & Cone Test COMPILED BY JBF
DATUM Geodetic DATE 88 04 18 - 19 CHECKED BY

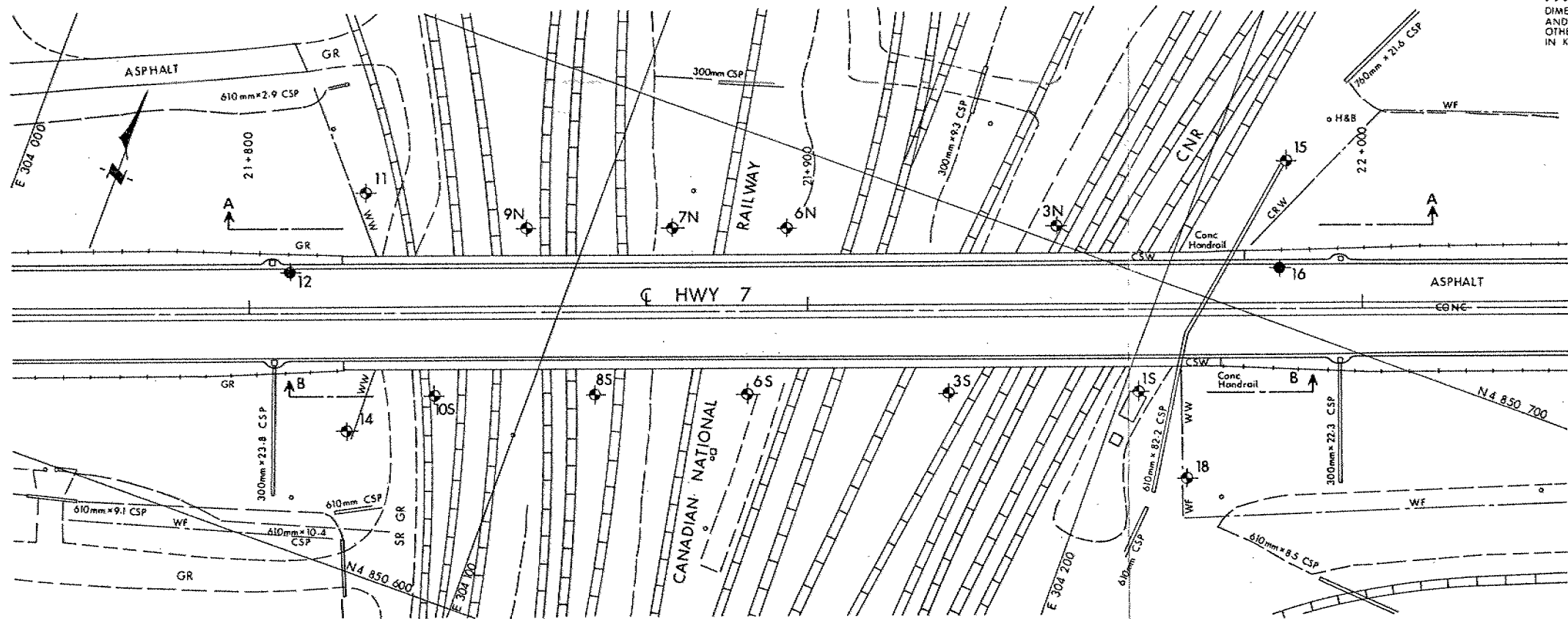
OFFICE REPORT ON SOIL EXPLORATION

| 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 kPa | | | | | | | WATER CONTENT (%) | | |
| | | | | | | | ○ UNCONFINED * FIELD VANE | | | | | | | | | | |
| | | | | | | | ● QUICK TRIAXIAL x LAB VANE | | | | | | | | | | |
| 204.6 | Ground Level | | | | | | | | | | | | | GR SA SI CL | | | |
| 0.0 | Het. Mixture Clayey Silt (CL) with Sand, Tr. Gravel Trace Organics Occ. Silty Clay Zones | | 1 | SS | 16 | | 204 | | | | | | | | | | |
| | | | 2 | SS | 16 | | | | | | | | | | | | |
| 201.7 | Very Stiff (Fill) | | 3 | SS | 29 | | 202 | | | | | | | 5 31 40 24 | | | |
| 2.9 | Het. Mixture Clayey Silt (CL to CL-ML) with Sand Trace Gravel | | 4 | SS | 30 | | | | | | | | | | | | |
| | | | 5 | SS | 42 | | | | | | | | | | | | |
| | | | 6 | SS | 27 | | 200 | | | | | | | 1 32 43 24 | | | |
| | Boulders | | 7 | SS | 17 | | | | | | | | | | | | |
| | Occ. Silt and Sand Zones | | 8 | SS | 74 | | | | | | | | | | | | |
| | Occ. Boulders Very Stiff to Hard (Glacial Till) | | 9 | SS | 122 | | 198 | | | | | | | | | | |
| | | | 10 | SS | 77 | | 196 | | | | | | | 3 26 55 16 | | | |
| 193.9 | Boulders | | | | | | 194 | | | | | | | | | | |
| 10.7 | Sandy Silt to Silty Sand Trace Gravel Trace Clay Occ. Clayey Silt Zones Compact to Very Dense (Lacustrine) | | 11 | SS | 14 | | | | | | | | | 0 18 78 4 | | | |
| | | | 12 | SS | 73 | | 192 | | | | | | | | | | |
| | | | 13 | SS | 110/28 cm | | 190 | | | | | | | | | | |
| 189.2 | | | 14 | SS | 46 | | | | | | | | | | | | |
| 15.4 | Het. Mixture Clayey Silt (CL to CL-ML) with Sand Trace Gravel Occ. Silt and Sand Zones Occ. Boulders Hard (Glacial Till) | | 15 | SS | 82 | | 188 | | | | | | | 0 2 88 10 | | | |
| | | | | | | | 186 | | | | | | | 3 34 50 13 | | | |
| 184.6 | | | | | | | | | | | | | | | | | |
| 20.0 | Silty Clay (CI) Occ. Silt Zones Hard (Lacustrine) | | 16 | SS | 85 | | 184 | | | | | | | 0 0 34 66 | | | |
| | | | | | | | 182 | | | | | | | | | | |
| 179.8 | | | 17 | SS | 83 | | 180 | | | | | | | | | | |
| 24.8 | End of Borehole | | | | | | | | | | | | | | | | |

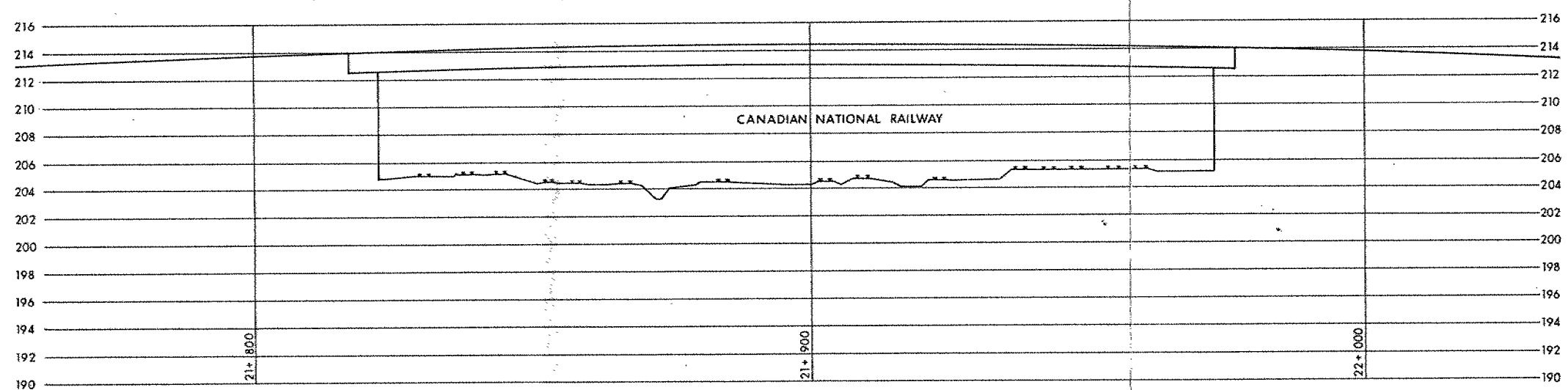
*3, *5: Numbers refer to Sensitivity
20
15 5 (%) STRAIN AT FAILURE
10

METRIC
DIMENSIONS ARE IN METRES
AND/OR MILLIMETRES UNLESS
OTHERWISE SHOWN. STATIONS
IN KILOMETRES + METRES.

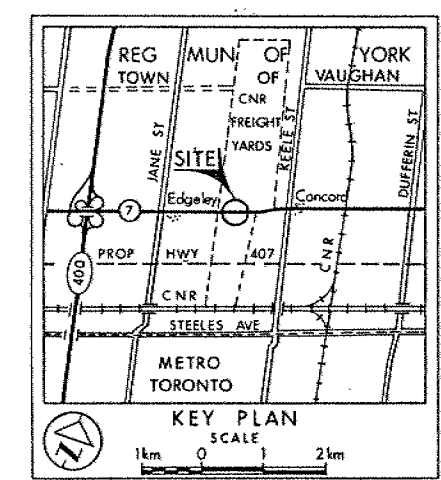
| | |
|--|---|
| CONT No WP No 181-86-01 |  SHEET |
| CNR & HWY 7 BORE HOLE LOCATIONS & SOIL STRATA | |



PLAN
SCALE
10m 5 0 10m



PROFILE HWY 7
SCALE
10m 5 0 10m Hor
4m 2 0 4m Vert



- LEGEND**
- Bore Hole
 - ⊕ Dynamic Cone Penetration Test (Cone)
 - ⊙ Bore Hole & Cone
 - N Blows/0.3m (Std Pen Test, 475 J/blow)
 - CONE Blows/0.3m (60° Cone, 475 J/blow)
 - W.L. at time of investigation 88 04 and 88 05

| No | ELEVATION | CO-ORDINATES | |
|-----|-----------|--------------|-----------|
| | | NORTH | EAST |
| 15 | 204.9 | 4 850 679.8 | 304 202.6 |
| 3N | 204.7 | 4 850 702.9 | 304 178.8 |
| 3S | 204.5 | 4 850 667.9 | 304 170.6 |
| 6N | 203.9 | 4 850 685.8 | 304 132.9 |
| 6S | 204.0 | 4 850 655.4 | 304 137.0 |
| 7N | 203.9 | 4 850 678.8 | 304 113.9 |
| 8S | 204.1 | 4 850 645.8 | 304 111.3 |
| 9N | 204.4 | 4 850 669.6 | 304 089.3 |
| 10S | 204.8 | 4 850 635.7 | 304 084.2 |
| 11 | 204.5 | 4 850 665.7 | 304 059.9 |
| 12 | 213.5 | 4 850 647.7 | 304 052.1 |
| 14 | 204.4 | 4 850 624.2 | 304 071.6 |
| 15 | 205.2 | 4 850 728.3 | 304 212.5 |
| 16 | 213.5 | 4 850 709.8 | 304 218.8 |
| 18 | 204.6 | 4 850 668.0 | 304 216.0 |

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

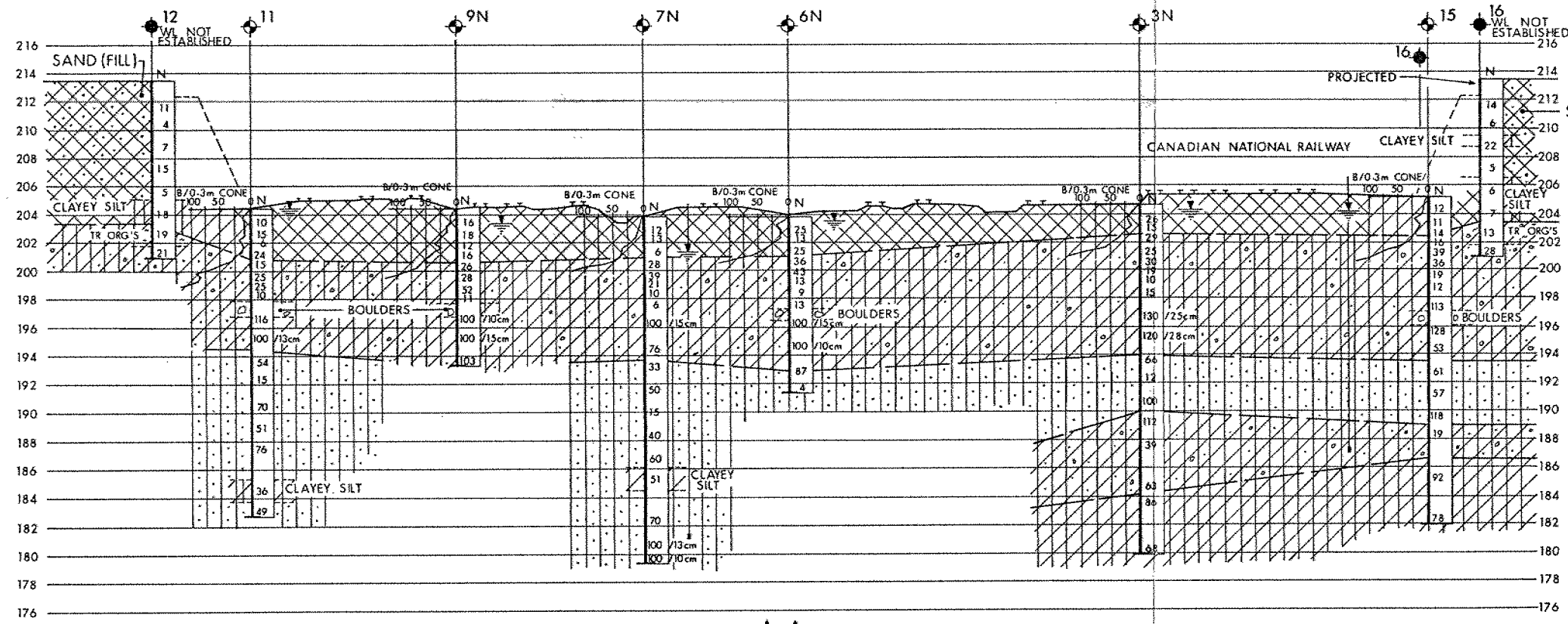
NOTE: The complete foundation investigation and design report for this project and other related documents may be examined at the Engineering Materials Office, Downsview. Information contained in this report and related documents is specifically excluded in accordance with the conditions of Section 102-2 of Form 100.

| REV. | DATE | BY | DESCRIPTION |
|------|------|----|-------------|
| | | | |

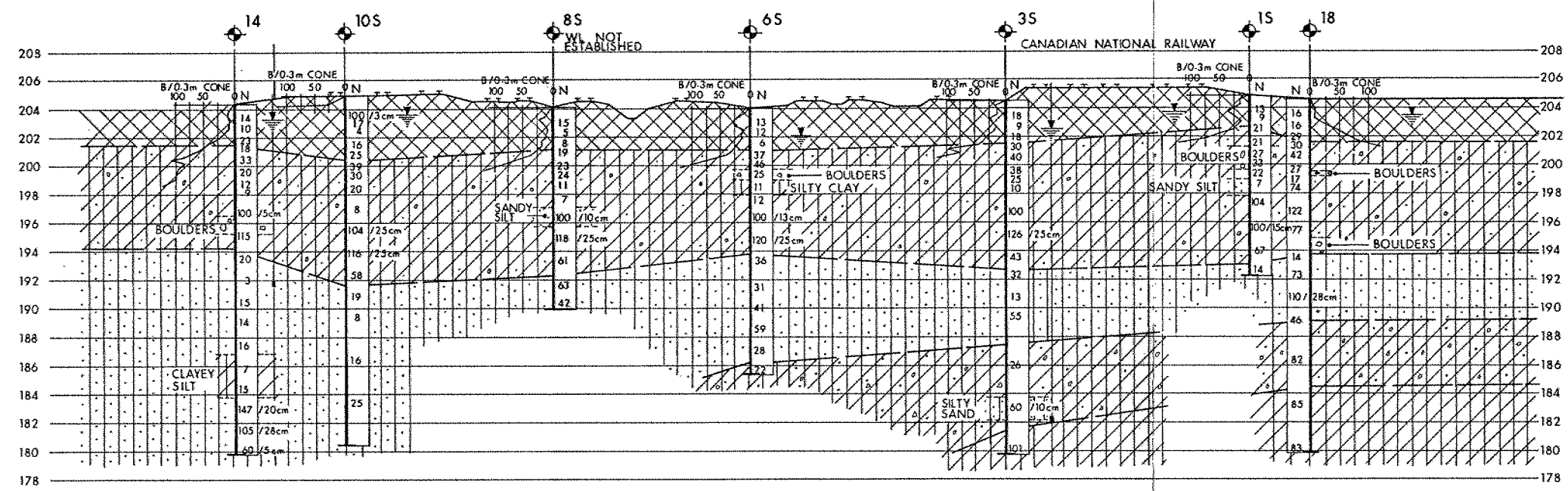
Geocres No 30M13-81

| | |
|-----------|-----------------------------------|
| HWY No 7 | DIST 6 |
| SUBM'D DD | CHECKED DATE 88 06 29 SITE 37-682 |
| DRAWN DT | CHECKED APPROVED DWG 1818601-A |

METRIC
DIMENSIONS ARE IN METRES
AND/OR MILLIMETRES UNLESS
OTHERWISE SHOWN. STATIONS
IN KILOMETRES + METRES.



A-A



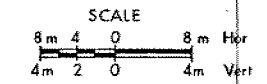
B-B

SOIL STRATIGRAPHY LEGEND

- HETEROGENEOUS MIXTURE CLAYEY SILT WITH SAND TRACE/WITH GRAVEL, TRACE SILT, TRACE CLAY, TRACE ORGANICS, OCCASIONAL SILTY CLAY ZONES, LOOSE TO VERY STIFF (FILL)
- HETEROGENEOUS MIXTURE CLAYEY SILT WITH SAND, TRACE GRAVEL, OCCASIONAL SILT & SAND ZONES, OCCASIONAL BOULDERS, FIRM TO HARD (GLACIAL TILL)

- SANDY SILT TO SILTY SAND TRACE GRAVEL, TRACE CLAY, OCCASIONAL CLAYEY SILT ZONES, LOOSE TO VERY DENSE (LACUSTRINE)
- SILTY CLAY, OCCASIONAL SILT ZONES, HARD (LACUSTRINE)

SECTIONS



LEGEND

- Bore Hole
- Dynamic Cone Penetration Test (Cone)
- Bore Hole & Cone
- Blows/0.3m (5rd Pen Test, 475 J/blow)
- Blows/0.3m (60° Cone, 475 J/blow)
- WL at time of investigation 88 04 & 88 05
- WL in Piezometer
- Piezometer

| No | ELEVATION | CO-ORDINATES | |
|-----|-----------|--------------|-----------|
| | | NORTH | EAST |
| 1S | 204.9 | 4 850 679.8 | 304 202.6 |
| 3N | 204.7 | 4 850 702.9 | 304 178.8 |
| 3S | 204.5 | 4 850 667.9 | 304 170.6 |
| 6N | 203.9 | 4 850 685.8 | 304 132.9 |
| 6S | 204.0 | 4 850 655.4 | 304 137.0 |
| 7N | 203.9 | 4 850 678.8 | 304 113.9 |
| 8S | 204.1 | 4 850 645.8 | 304 111.3 |
| 9N | 204.4 | 4 850 669.6 | 304 089.3 |
| 10S | 204.8 | 4 850 635.7 | 304 084.2 |
| 11 | 204.5 | 4 850 665.7 | 304 059.9 |
| 12 | 213.5 | 4 850 647.7 | 304 052.1 |
| 14 | 204.4 | 4 850 624.2 | 304 071.6 |
| 15 | 205.2 | 4 850 728.3 | 304 212.5 |
| 16 | 213.5 | 4 850 709.8 | 304 218.8 |
| 18 | 204.6 | 4 850 668.0 | 304 216.0 |

NOTE

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

NOTE: The complete foundation investigation and design report for this project and other related documents may be examined at the Engineering Materials Office, Downsview. Information contained in this report and related documents is specifically excluded in accordance with the conditions of Section 102-2 of Form 100.

| REV | DATE | BY | DESCRIPTION |
|---------------------|------|---------------|-------------|
| | | | |
| Geocres No 30M13-81 | | | |
| HWY No 7 | | DIST 6 | |
| SUBMD DD CHECKED | | DATE 88 07 04 | |
| DRAWN DT CHECKED | | SITE 37-682 | |
| | | DWG 1818601-B | |

to be prudent to increase the
footing pressure since we did not
know the existing safety factor.

Also failure would have serious consequences
due to the CNR operation and the fact
that this is an existing bridge.

On April 1989, I contacted Stan Legger of
Cole Sherman and suggested that
the caissons concept would be OK if
we could maintain the same footing
pressure by using lightweight backfill.
He determined that submergation
and backfill of 360 m^3 of each
caisson would maintain the same pressure.
I told him the incremental cost would
be $\$15$ per ton or an estimated $\$10 \text{ K} \pm$ total.

I contacted the Structural Office
on April 6/89 and passed along this
recommendation to T. Huser.

J.H. Douglas
Sr. Febr. 89

HWY. 7/CNR
ABUTMENT WIDENING ALTERNATIVES

| <u>ALTERNATIVE</u> | <u>ADVANTAGE</u> | <u>DISADVANTAGE</u> |
|---|--|--|
| (1) Abutment on spread foundations light weight back-fill | <ul style="list-style-type: none"> o Conventional design o Conventional appearance o Max. horizontal clearance | <ul style="list-style-type: none"> o Extensive road protection and soldier pile walls o Existing w. walls require temporary support o Extensive excavation and back-fill o Concrete removal for 4.5 m portion of walls and footings of existing R. walls o Dewatering required o Tie backs required at base o Most expensive alternative (+ \$250,000) o Longest construction time (+ 4 weeks) |
| (2) Pier cap to support beams | <ul style="list-style-type: none"> o Minimum road protection required o Minimum concrete removal o Existing R. wall left as is o Less new concrete work required o Shorter construction time than (1) o Minimum cost o Support for existing W. wall is not required o minimum dewatering | <ul style="list-style-type: none"> o Reduced clearance for CN road and tracks o Unconventional abutment (column in front of abutment) o Requires partial removal of footing (toe) of R. wall, for caisson installation |
| (3) Beams supported by cantilever from exist abutment | <ul style="list-style-type: none"> o Eliminated column and pier cap o Appearance more acceptable o No removal of footing concrete o Minimum road protection and excavation o Cost and construction time similar to alternative (2) o No dewatering required | <ul style="list-style-type: none"> o Soil pressures under existing abutment increased by 8% o Requires some removal of concrete to upper portions of existing abutment and upper portions of R. walls o The design and construction of the connection of the cantilever to the existing abutment is more complicated than usual due to the physical shape of the existing abutment and the details of the existing reinforcing steel |

memorandum



To: Mr. G. Al-Bazi
Design Engineer
Structural Office

Date: 1989 03 06

From: Foundation Design Section
Room 315, Central Building

RE: C.N.R. Overhead at MacMillan Yard
W.P. 181-86-01, Site 37-682
Hwy. #7, District #6, Toronto

Further to your memo dated February 13, 1989, we have reviewed the preliminary drawings #1 and #2. We have no comments except for the proposal at the abutments which as you are aware are still under consideration.

If there are any questions, please advise.

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

DHD/ms

WP 181-86-01 CNR/J
Meeting at Structural Office

89 02 24

K. Barni

M. Deate

W. Young

S. Lepper

G. Al-Bazi

D. Dondos

V. Brelnke

I. Husein

Cole Sherman

Structural Office

FDS

Structural Section

- ① K. Barni initiated discussion on possibility of spread footing.
The loading values of 200 kPa were provided by M. Deate.

Loading requirements could be reduced with lightweight fill (slag or styrofoam).

- ② D. Dondos indicated that advantages of caisson would be elimination of requirements for temporary shoring & excavation.

The Structural Office indicated that there may be problem locating caisson without having to drill through existing footing.

It may be possible to support on one caisson.

- M. Deate
③ ~~D. Dondos~~ had indicated that caisson machine would not fit into limited space of 4m x 7m at ground level in original proposal.

- ④ Ensuring discussion about structural considerations if single caisson used.

- reduction of earth pressure on existing retaining wall from increased fill height

- styrofoam meshed

- wrapping RE wall around, soil anchor support

- ⑤ D. Dondos pointed out that exposing existing abutment would require support & that soil anchors won't drill through reinforced concrete

remotely

(6) K. Barri pointed out that we needed to evaluate a number of options

- 1) spread footings
- 2) high level caissons
- 3) reinforced earth
- 4) box structure option

(7) Wade Young proposed wallhead slabs & removal of abutment side. However there were concerns due to having to drill through baring base.

(8) Star Leppin inquired if spread footing option would require full height styrofoam & may lead to differential pressures on each side of wall. This could be offset by soil anchors but would require drilling soil anchors through reinforced concrete.

(9) D. Dunder provided parameters for lightweight fill

- styrofoam $\gamma \approx 0$ cost ~ 75 / ~~unit~~ ^{for smaller volume / time}

- slag structural course $\gamma = 60$
 $\phi = 35$

clay

$\$23$ delivered / ~~unit~~ ^{for smaller volume / time}
 $\gamma = 70$
 $\phi = 35$

(10) D. Dunder provided cost for soil anchors
 $\$100 / m$

D. Dunder
Sr. Fdn. Eng.

Re: Soil Anchors.

I discussed soil anchor installation with Victor Kramlich. 669-4952 of Dymally. Soaker well can be drilled but remote drilling through reinforced wall would be extremely difficult. He advised that cased holes are required & that 6" to 9" ϕ are preferred.

Pressure grouting (post grouting) will probably not be required. Some massing can be applied in casing at first grouting. However if soil is softer it may have application.

For 30' bond he feels we can pull 100 tons ultimate per anchor.

$$\begin{aligned} \text{soaker area} &= \pi d \times L \\ &= (\pi)(0.1524)(9.144) \\ &= 4.4 \text{ m}^2 \end{aligned}$$

$$\text{Stress} = \frac{\text{Load}}{\text{Area}} = \frac{890}{4.4} = 200 \text{ kPa}$$

$$\therefore \text{safe load} = 100 \text{ kPa} \\ \text{or } 445 \text{ kN per anchor}$$

D. Dymally
Sr. Est. Eng.



PLEASE TYPE

DATE Feb. 23/89

PAGE 1 OF 2

TO: Birmingham Construction Ltd.
Fax 528-6187
Manny Fine tel 528-7924

FROM: MTO
Foundation Design Section
tel: 235-3731

SUBJECT: Caissons Hwy 7/CNR

Manny

As discussed I am faxing a sketch showing the present proposal to widen the existing bridge at this site.

Since the additions must retain approx. 30' of fill there is a problem with lateral capacity.

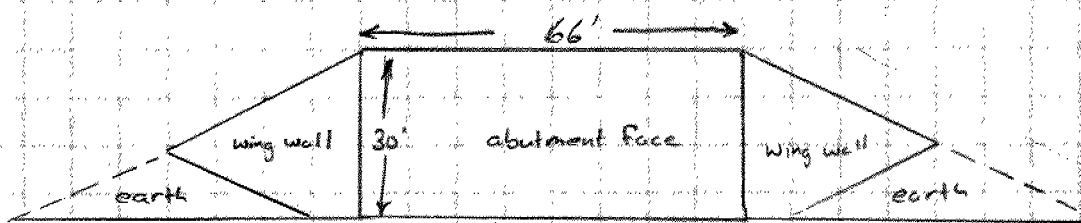
- Can caissons be built at a better, say 10:1 on the forward caissons. (or steeper better)

Also your comments about feasibility of constructing caissons in restricted space.

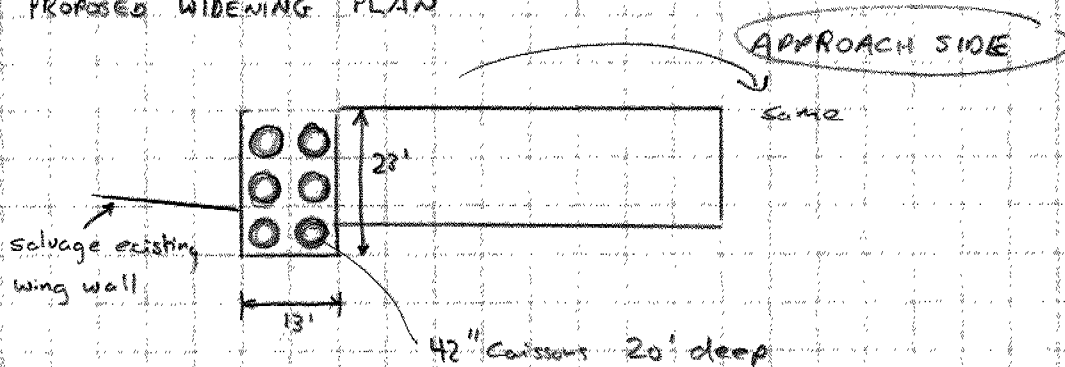
Thanks.

Dave Dundas.

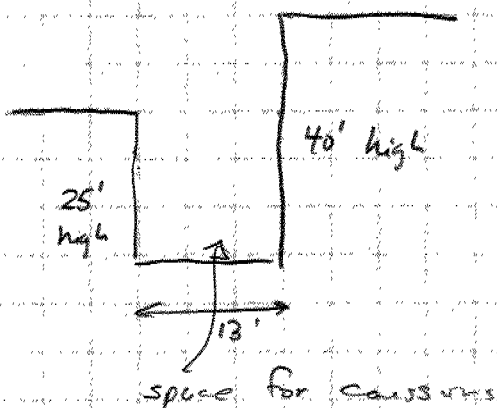
EXISTING ELEVATION (LOOKING AT ABUTMENT)



PROPOSED WIDENING PLAN



Section



89 02 24

Murray Fife advised that
1:6 batter possible but more expensive

13' is probably too tight & we
may have to consider drilling from top

his equipment is truck mounted & 13' + width
even if he could fit in on closure he
can only drill down center line.

D. Dierker

En. Ltn Ely

memorandum



To: G.C.E. Burkhardt
Head
Structural Section

Date: 88 12 07

Attention: W. Young

From: Foundation Design Section
Room #315, Central Building

RE: CNR Overhad at MacMillan Yard
WP 181-86-01, Site 37-682
Hwy 7, District 6, Toronto

Further to your memo dated 88 11 10, this memo provides additional foundation recommendations for the abutments and adjacent retaining walls for the proposed widening.

From our review of as-built drawings (dated 1961) for the existing structure, it is our understanding that the elevations of the footings at the abutments are as follows:

- West abutment 202.1 m with key to 201.7 m
- East abutment 202.3 m with key to 201.8 m

The abutments and adjacent retaining walls could be founded on caissons as recommended in the Foundation Report for this project. For caissons constructed in accordance with the recommendations provided in the Foundation Report the following lateral capacities are recommended:

| <u>Caisson Size</u> | <u>Factored Lateral Capacity at U.L.S.</u> | <u>Lateral Capacity at S.L.S. Type II</u> |
|-------------------------|--|---|
| 0.9 m (36 inch) | 360 kN | 240 kN |
| 1.1 m (42 inch) | 420 kN | 280 kN |
| 1.2 m (48 inch) | 480 kN | 320 kN |

Alternatively the abutments and adjacent retaining walls could be founded on spread footings. The following O.H.B.D.C. bearing capacities are recommended for this alternative.

| <u>Location</u> | <u>Footing Elevation</u> | <u>Bearing Capacity</u> | |
|-----------------|--------------------------|-------------------------|------------------------|
| | | <u>S.L.S Type II</u> | <u>Factored U.L.S.</u> |
| East Abutment | 201.5 m | 200 kPa | 300 kPa |
| | 201 m | 250 kPa | 375 kPa |
| West Abutment | 201.5 m | 200 kPa | 300 kPa |
| | 201 m | 250 kPa | 375 kPa |

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To: G.C.E. Burkhardt

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For calculation of sliding resistance an unfactored ϕ of 28° is recommended between the base of the footing and the foundation soil.

Piles were not considered to be appropriate for this application due to the irregular nature of the subsoil and the difficulty in establishing a suitable end-bearing stratum.

For both the caisson and spread footing alternatives, it will be required to accommodate possible small differential movements between the existing structure and the widening.

In addition, the existing footing should not be disturbed during construction. This definitely will require careful dewatering operations for excavations below the ground water table, and may require shoring to protect the existing footings if excavations extend below their bases. If more details regarding shoring requirements are required, please contact this office.

Additional lateral resistance could be provided by soil anchors. For planning purposes the capacity of each soil anchor could be estimated at 350 kN to 500 kN. If additional details are required for soil anchors, please contact this office.

If there are any further questions, please advise.

DHD:st



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for

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