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W. O. No.

STR. SITE No. 37-1314

HWY. No. 407

LOCATION Jane N/S - W Ramp over
407E - 400 N/S Ramp

No of PAGES - (West Bound Basketweave)

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OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT.

REMARKS:

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FOUNDATION DESIGN SECTION

**foundation
investigation and
design report**

ENGINEERING MATERIALS OFFICE
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CONT. 93-86

WP 140-87-02 (R) DIST 6

HWY 407 STR SITE 37-1314

Jane Street N/S-W Ramp over 407 E-400 N/S Ramp
(Westbound Basketweave)

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FOUNDATION INVESTIGATION REPORT

For

Jane Street N/S-W Ramp over 407 E-400 N/S Ramp
(Westbound Basketweave)

W.P. 140-87-02 (R), Site 37-1314

Highway 407, District 6, Toronto

INTRODUCTION

This report summarizes the results of a foundation investigation carried out at the aforementioned site. It is proposed to construct a three (3) span structure that carries the Jane Street N/S-W ramp over the Hwy. 407E-Hwy.400N/S ramp. This report describes the subsurface conditions at the site and provides detailed recommendations pertaining to structure foundations and related earthworks.

SITE DESCRIPTION

The site is located in a sector of land situated approximately midway between the existing Jane Street and Hwy. 400, approximately 0.5 km south of existing Hwy. 7 and immediately north of the proposed Hwy. 407 in the Town of Vaughan, Regional Municipality of York. A drainage channel approximately 5 m in depth is located approximately 250-300 m west of the site. The site can be accessed via an existing gravel road located off of Jane Street.

The terrain at the site is generally flat but slopes gently upward in an easterly direction. Ground surface elevations ranged from 194.3 m to 196.7 m from the western to the eastern boundary limits of the site.

The land at the site is used primarily as agricultural farmland. A paved parking lot which is located southeast of the site serves as a temporary storage area for construction equipment and materials. A residential home also exists east of the site and immediately west of existing Jane Street.

Physiographically, the site lies in the geological domain known as the Bolton Area, an area that covers approximately 1200 square kilometres located at the northwestern border of the Municipality of Metropolitan Toronto. The Bolton area has drumlins, till plains, moraines and numerous other features associated

with deglaciation. The area was covered with the Wisconsin glacier of the Pleistocene period that advanced into the region approximately 50,000 years ago and retreated approximately 15,000 years ago.

The overburden deposits at the site consist of moraine tills of the Halton Till Formation underlain by glaciolacustrine sediments deposited by Lake Peel, a body of water impounded between lobes of projecting ice. The Halton Till is primarily a silt till composed of varying percentages of clay, silt, sand and gravel. The glaciolacustrine deposits generally consist of stratified silt, clayey silt and/or silty clay.

The surficial deposits of the Cenozoic era are underlain by bedrock of the Paleozoic era. Bedrock consists of grey, thinly bedded shales with interbedded limestone from the Dundas Meaford Formation. Bedrock topographical maps reveal that the bedrock exists at depths approximately 70-80 m below the natural ground surface at the site location.

INVESTIGATION PROCEDURES

Soil data and inherent properties were obtained by in situ and laboratory testing conducted. The procedures employed are discussed below.

Field Investigation

The fieldwork for the investigation was carried out within two separate time periods. The original fieldwork was carried out between 90 02 07 and 90 02 12 and consisted of 8 sampled boreholes advanced to depths ranging from 7.0 m to 15.7 m below the ground surface. Two of the boreholes were accompanied by dynamic cone tests advanced to depths of 2.6 m to 5.1 m. The subsequent investigation, conducted to obtain additional soils information, was carried out on 90 07 30 and consisted of two sampled boreholes advanced to depths of 12.6 m.

Track mounted CME 55 equipment employing hollow stem augering techniques was used to advance the boreholes in the overburden. In general, disturbed subsoil samples were retrieved at 0.7 m for the surficial 6 m and 1.5 m intervals thereafter. Sample retrieval was conducted in accordance with the Standard

Penetration Test (ASTM D1586). All samples were identified in the field and then returned to the laboratory for applicable testing.

Groundwater levels were obtained by monitoring the levels in the open boreholes throughout the duration of the field investigation. All open boreholes were backfilled at the completion of the fieldwork.

Survey information related to the location and elevation of boreholes was provided by Central Region Surveys and Plans.

Laboratory Analyses

To identify the behaviour, gradation and pertinent properties and characteristics of the soil, various laboratory tests were performed. These tests included:

- 1) Atterberg Limits
- 2) Grain Size Distributions
- 3) Unit Weights
- 4) Natural Moisture Contents

Laboratory test results have been summarized in the subsequent section of this report entitled "Subsurface Conditions", and are illustrated on corresponding figures and boreholes included in the attached Appendix.

SUBSURFACE CONDITIONS

At the site, the elevation of the ground surface increases in an easterly direction from 194.3 m to 196.7 m. The subsoil stratigraphy at the site consists of a surficial veneer of topsoil, brown in colour and of thickness equivalent to approximately 0.5 m. The topsoil is underlain by a glacial till deposit consisting of a heterogeneous mixture of clayey silt, sand and gravel. The host material of the deposit is the cohesive clayey silt that binds the other grain sizes into a matrix. The thickness of this deposit is in the order of magnitude of 2.5 to 3.5 m. The deposit generally has a stiff to hard consistency.

The cohesive till deposit is underlain by a second till deposit consisting of a heterogeneous mixture of silt, sand and gravel. The host material of the deposit is primarily silt and consequently the deposit exhibits a cohesionless behaviour. The thickness of the deposit across the site generally ranges from approximately 1.5 to 4.6 m. However, at BH 57 this deposit was explored for a thickness of 9.1 m. The full extent of the deposit was not ascertained at this location. The deposit is in a dense to very dense state of condition.

Underlying the cohesionless till deposit exists a glaciolacustrine cohesive stratum consisting of a silty clay. This stratum can be categorized as having a hard consistency. The extent of this deposit was not determined in the investigation.

The boundaries between the various soil types, in situ and laboratory test results as well as groundwater levels established at the time of investigation, are shown on the attached Record of Borehole sheets in the Appendix. A plan of the site illustrating the locations and elevations of the boreholes and subsoil stratigraphical sections are provided on Dwg. 1408702R-A.

A detailed description of the subsurface conditions encountered is given below.

Topsoil

A thin veneer of topsoil that is brown in colour, moist and contains a rich, earthy odour is spread across the site. The thickness of this veneer is approximately 0.5 m.

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

The surficial topsoil is underlain by a unstratified glacial till deposit consisting of a heterogeneous mixture of clayey silt, sand and gravel. Occasional random sand seams are also present in the deposit. The thickness of the cohesive deposit ranges from 2.5 to 3.5 m extending to an elevation ranging from 190.8 to 193.7 m. The deposit has been generally oxidized throughout its full thickness and consequently brown in colour, although at some locations the lower metre or so is unoxidized and hence grey in colour.

A grain size distribution envelope for this deposit as determined by mechanical sieve and hydrometer analysis is given in Figure 1 in the Appendix. The envelope illustrates that the grain sizes range from gravel to clay with a range of 56 to 75% of the material being fine grained (<75 micrometre). Although not encountered during the field investigation, boulders and cobbles are also characteristic components of till deposits and hence can exist in this deposit.

Atterberg Limit tests were carried out to define the behaviour and plasticity of the fine grained portion of the soil and the results are plotted in Figure 2. A summary of the indices is provided in Table 1 below.

Table 1 - Het. Mix. of Clayey Silt,
and Gravel (Glacial Till)

	<u>Range</u>	<u># of Tests</u>
Natural Moisture Content (w%)	12-18	6
Liquid Limit (W _L %)	21-28	6
Plasticity Index (I _p %)	9-20	6
Unit Weight (kN/m ³)	19-21.6	6
SPT 'N' values (blows/0.3 m)	1-120/5 cm	32

The test results reveal that the fine grained portion of the deposit is of low plasticity and hence can be categorized as a clayey silt.

Standard Penetration tests carried out in this deposit revealed 'N' values ranging from 1 blow/0.3 m to 120 blows/0.05 m. In general, however, the 'N' values exceed 15 blows/0.3 m in the lower 1-1.5 m of the deposit. The weaker material generally occurs within the upper 2 m of the deposit. Consequently, the deposit can be categorized as having a firm to stiff consistency for the upper 1-1.5 m and a very stiff to hard consistency for the lower thickness.

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

Underlying the cohesive till deposit exists a cohesionless till deposit composed of a heterogeneous mixture of silt, sand and gravel. Traces of clay are also present in the deposit. Boulders and cobbles are also present in this deposit

as evidenced by frequent auger grinding during borehole advancement in this deposit and auger refusal as encountered at BH 56.

The thickness of the deposit generally ranges from approximately 1.5 m to 4.6 m. However, at BH 57 the thickness of the deposit was explored to a depth of 9.1 m. (The full extent of the deposit was not penetrated at this location).

A grain size distribution envelope for this deposit as determined by mechanical sieve and hydrometer analysis is given in Figure 3 in the Appendix. The envelope illustrates the wide range of grain sizes typically inherent of till deposits. Silt, the main component of the deposit, comprises approximately 46 to 62% of the material.

Atterberg Limit tests were carried out to define the behaviour and plasticity of the fine grained portion of the soil and the results are plotted on Figure 4. A summary of the indices is provided in Table 2 below.

Table 2 - Het. Mix. of Silt, Sand
Gravel (Glacial Till)

	<u>Range</u>	<u># of Tests</u>
Natural Moisture Content (w%)	7-12	8
Liquid Limit (W_L %)	16-19	8
Plasticity Index (I_p %)	3-6	8
Unit Weight (kN/m^3)	21.8-23.3	5
SPT 'N' values (blows/0.3 m)	11->120	35

The test results reveal that the fine grained portion of the deposit behaves as a plastic silt.

Standard Penetration tests carried out in this deposit reveal 'N' values ranging from 11 blows/0.3 m to 120 blows/0.2 m. However, in general 'N' values exceed 30 blows/0.3 m and hence the deposit can be categorized as dense to very dense.

Silty Clay (Lacustrine)

The cohesionless till deposit is in turn underlain by a glaciolacustrine deposit consisting of a grey silty clay. The surface of this stratum is generally at an elevation ranging from 188.2 m to 190.7 m. The extent of the deposit was not determined during the investigation.

A grain size distribution envelope for this deposit as determined by hydrometer and sieve analysis is given in Figure 5 in the Appendix. The envelope illustrates that clay and silt percentages in the deposit range from 55-65% and 33-43% respectively.

Atterberg Limit tests were carried out to define the behaviour and plasticity of the soil and the results are plotted in Figure 6. A summary of the indices is provided in Table 3 below.

Table 3 - Silty Clay (Lacustrine)

	<u>Range</u>	<u># of Tests</u>
Natural Moisture Content (w%)	17-23	5
Liquid Limit (W_L %)	39-47	5
Plasticity Index (I_p %)	20-28	5
Unit Weight (kN/m^3)	20.3-21.8	6
SPT 'N' values (blows/0.3 m)	15->142	31

The test results reveal that the stratum is of intermediate plasticity and consequently can be categorized as a silty clay.

Standard Penetration tests carried out in this deposit revealed 'N' values ranging from 15 blows/0.3 m to 142 blows/.25 m as tabulated in Table 3. However, in general 'N' values exceed 30 blows/0.3 m and consequently this stratum has a hard consistency.

GROUNDWATER CONDITIONS

Observation of the groundwater level was carried out by measuring the water level in the open boreholes. Groundwater levels determined at the time of investigation ranged from 1 to 3.7 m below ground surface (El. 194 to 192.1 m).

Groundwater levels, in general, are subject to seasonal fluctuations and hence can vary from the values given in this report.

DISCUSSION AND RECOMMENDATIONS

A three (3) span structure is proposed to carry the Jane Street N/S-W Ramp over the westbound 407 E-400 N/S Ramp. The structure is one of five structures associated with the Jane Street/Hwy. 407 interchange. The structure is located north of the Hwy. 407 right of way. The proposed profile grades of the Jane St. N/S-W and 407 E-400 N/S ramps are $202\pm$ m and $195\pm$ m respectively.

The proposed structure has outer span lengths of approximately 35 m and a middle span of approximately 50 m. The proposed structure width is approximately 9.5 m. Approach fills in the order of magnitude of 6.5 m will be required in conjunction with the structure. A shallow excavation cut of 1 to 1.5 m is required for the east approach of the 407 E-400 N/S Ramp.

Recommendations pertaining to the following foundation and geotechnical considerations are included in the scope of this report.

- 1) Structure Foundations
- 2) Approach Embankments
- 3) Backfill Suitability of Excavated Material

1) Structure Foundations

In view of the sound, competent nature of the lower thickness of the surficial cohesive clayey silt till and the underlying silt till and silty clay, the structure can be supported on a shallow foundation. The conventional spread footings can be designed and constructed as discussed below. The most economical and technically feasible method or combination thereof shall be selected.

a) Compacted Granular 'A'

In view of the weaker nature of the surficial thickness of the surficial cohesive till deposit, it is recommended that this material be subexcavated and replaced with a compacted Granular 'A' material. The abutments can then be designed as closed-type or alternatively perched above the natural ground surface as illustrated in Figure 7 in the Appendix. The elevation for

subexcavation and the bearing capacity recommended for purposes of the O.H.B.D.C. are summarized in Table 4 below.

Table 4 - Abutments Footings on Granular 'A'

<u>Structure</u>	<u>Subexcavation Elevation (m)</u>	<u>Bearing Capacity at S.L.S Type II (kPa)</u>	<u>Factored Capacity at U.L.S. (kPa)</u>
W.Abutment	191.6	350	900
E.Abutment	194.2	350	900

The subexcavation shall be of sufficient width that enables the Granular 'A' pad to be constructed at 1H:1V slopes with the crest of the pad set a minimum one (1) metre from the top of the concrete footing. All founding soil shall be protected against frost penetration. Consequently, the footings must have 1.2 m earth cover. These requirements are illustrated on the aforementioned Figure 7 in the Appendix. The Granular 'A' pad shall have a minimum thickness of 2.0 m.

The Granular 'A' material must be placed and compacted to achieve 100% of the Proctor maximum dry density as outlined in OPSS 501.08.02 (Method A). Quality control in the form of material inspection and field density measurements shall be conducted.

The material at the elevations tabulated in Table 4 shall be inspected to confirm the extent of the weaker surficial material. Any softened/loosened material at the footing foundation elevation shall be removed.

Settlement of the foundation subsoil as a result of the applied footing pressure will be elastic in nature and consequently is expected to take place during or immediately following the construction period. The magnitude of this settlement is anticipated to be within 25 mm, provided the subsoil/granular material is not softened/loosened by construction or related activities.

Should the superstructure have the flexibility to tolerate greater settlements, larger bearing pressures are possible. For structures that can withstand

differential settlements up to 37.5 mm, the abutment foundations, as discussed above, can be designed using a bearing capacity at S.L.S. Type II of 450 kPa. The anticipated settlements will be the result of the recompression of the native soil and hence should be realized during and immediately following construction.

Reduction for inclinations of loads acting on a shallow foundation shall be carried out in accordance with Section 6-7.3.3.5 of the O.H.B.D.C. The bearing capacities tabulated in Table 4 shall therefore be modified accordingly for the granular soil.

The computation of the sliding resistance of the foundation shall be computed in accordance with Section 6-7.3.3.2 of the O.H.B.D.C. An unfactored friction angle of 35° can be used between the concrete footing and the Granular 'A' material. If additional sliding resistance is required, consideration can be given to employing shear keys beneath the footing. The passive resistance developed by the shear key can be computed using the parameters of the granular material tabulated in Table 6 (see "Lateral Earth Pressures on Structure" in subsequent section of the report).

No major difficulties are anticipated for the footing excavation. Conventional excavation equipment (backhoes, dozers, etc) can be used to excavate the surficial topsoil and till. Large boulders, however, may impede the excavation productivity. No dewatering problems are anticipated in view of the relatively impervious nature of the till material. Any groundwater seepage or surface runoff that occurs during excavation can be easily discharged using conventional sump pumping techniques with perimeter ditches.

Temporary slopes to facilitate the footing excavation can be constructed at 1.5H:1V.

b) Spread Footings on Native Soil

Alternatively, all footings can be founded on spread footings on the native soil. The bearing capacities at or below the founding elevations are summarized in Table 5 below.

Table 5 - Spread Footings on Native Soil

<u>Structure</u>	<u>Founding Elevation (m)</u>	<u>Bearing Capacity at S.L.S Type II (kPa)</u>		<u>Factored Capacity at U.L.S. (kPa)</u>
		<u>25 mm</u>	<u>37.5 mm</u>	
W.Abutment	191.6	400	500	900
W.Pier	192	350	450	900
E.Pier	192	350	450	900
E.Abutment	194.2	400	500	900

Settlement of the foundation subsoil as a result of the applied footing pressure will be due to the recompression of the subsoil and hence elastic and immediate in nature. Bearing pressures at S.L.S. Type II that will produce 25 mm and 37.5 mm total or differential settlement have been given. The flexibility of the superstructure need be considered in selecting the applicable bearing capacities at S.L.S. Type II.

Reduction for inclination of load acting on a shallow foundation shall be carried out in accordance with Section 6-7.3.3.5 of the O.H.B.D.C. The bearing capacities given in Table 5 shall be modified accordingly. The reduction factors corresponding to the granular soil shall be applied because the cohesionless heterogeneous mixture of silt, sand and gravel is considered as the founding soil.

An unfactored friction angle of 30° can be used between the concrete footing and the native soil in the computation of the sliding resistance of the foundation.

If additional sliding resistance is required, consideration can be given to employing shear keys beneath the footing. The above mentioned unfactored friction angle of 30° and a saturated unit weight of 20 kN/m^3 can be used in the determination of the passive resistance of the shear key.

All loosened/softened material at the footing founding elevation shall be removed and replaced with a granular material and/or mass concrete.

Frost depth criteria and the construction considerations discussed previously in conjunction with the spread footings on compacted Granular 'A' material alternative are equally applicable for the spread footings on the native soil.

2. Approach Embankments

Approach fills in the order of magnitude of 6.5 m will be required in advance of the proposed structure for the Jane Street N/S-Hwy. 407W ramp. Shallow excavation cuts in the order of 1 to 1.5 m will be required to facilitate the advancement of the proposed Hwy. 407E-Hwy. 400N/S ramp. Discussion of the lateral earth pressures on the abutment walls at the approaches, stability, settlement and construction of the approach embankments are provided below.

Lateral Earth Pressure on Structure

Free draining material such as Granular 'A' or Granular 'B' shall be used within a wedge behind the abutments and retaining walls bounded by a plane rising at 60° to the horizontal as shown in Figure 6-9.6.1 of the O.H.B.D.C. The application of granular material combined with weep holes in the abutment walls to drain any accumulation of water in the backfill will prevent hydrostatic pressure build-up. Design parameters of the soil are given in Table 6 below.

Table 6 - Backfill Properties

	<u>Granular 'A'</u>	<u>Granular 'B'</u>
Angle of Internal Friction (ϕ) (unfactored)	35°	30°
Unit Weight (kN/m ³)	22.8	21.2
*Coefficient of Active Earth Pressure (K _a)		
- S.L.S.	0.27	0.33
- U.L.S.	0.33	0.4
*Coefficient of Earth Pressure at Rest (K _o)		
- S.L.S.	0.43	0.5
- U.L.S.	0.5	0.58

*Horizontal surface backfill only. Appropriate consideration must be given to sloping surface backfill.

For a rigid and unyielding structure, the earth pressure coefficient at rest is to be used in computing lateral earth pressure.

The backfill beyond the granular wedge as illustrated on OPSD 803 series can consist of acceptable borrow material as defined in OPSS 212.05.

Stability/Settlement

In view of the competent nature of the subsoil, no deep-seated stability problems are anticipated for the proposed embankment fill heights of 6.5 m, for transverse and longitudinal slopes constructed at 2H:1V.

In addition, internal (surficial) stability of the embankment fill can be effectively controlled by providing an adequate surface erosion protection scheme, such as sodding, on the exposed slopes.

The shallow excavation cuts at the east approach of the 407 E-400 N/S Ramp can be constructed with 2H:1V slopes. To assure the stability of these slopes a granular blanket is recommended for surface erosion protection and also to facilitate drainage of the slope, a toe drain should be placed at the toe of the slope.

Settlements in the order of magnitude of 50 mm attributable to the elastic recompression of the native subsoil and settlement within the fills under its own weight are anticipated. It is predicted that the majority of the settlements will be realized during or immediately following the construction of the embankment.

Embankment Construction

In the construction of the embankment fills, all softened and/or organic material should be excavated for their full depth within the plan limits prior

to fill placement. The embankment fill shall be placed and compacted to achieve the target maximum dry density as outlined in OPSS 501 series.

Heavy compaction equipment should not be used behind the abutment/retaining walls within a lateral distance equal to the current height of fill above the wall footing in order to avoid imposing damage or deflection to the wall during the fill placement.

3) Backfill Suitability of Excavated Material

Excavation to facilitate the construction of the shallow foundations at the site will require the removal of the surficial topsoil and cohesive clayey silt till. The applicability of utilizing these materials as backfill is discussed below.

Topsoil

The brown topsoil CAN be used as a blanket in conjunction with natural vegetation cover as a form of surficial erosion protection.

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

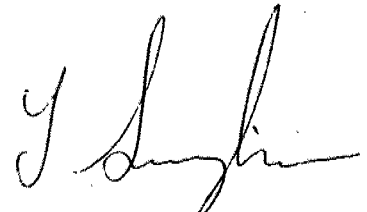
Optimum moisture contents for this type of material are generally in the 11-12% range as based on standard proctor tests conducted on similar material. In situ moisture contents for this material is generally in the 17-18% range. Hence this material has moisture contents that exceed the range that will produce 95% of the maximum dry density as specified in OPSS 501.08.02.

In view of the cohesive nature of the clayey silt matrix reducing the water content to acceptable levels can become difficult, time consuming and in our opinion not practicable. Furthermore, this stratum has silt percentages in the 37% to 48% range and hence the soil has borderline frost susceptible characteristics. Consequently, for these reasons this material is considered unsuitable for backfill application.

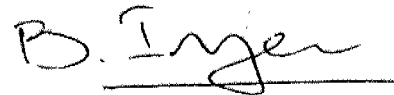
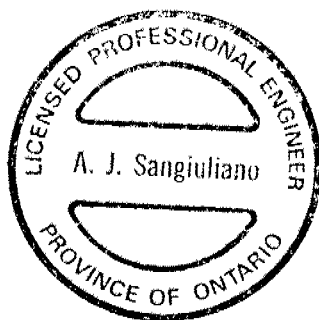
MISCELLANEOUS

The initial fieldwork for this investigation conducted between 90 02 07 to 90 02 12, was carried out under the supervision of T. Sangiuliano, Foundation Engineer and B. Cung, Engineering Trainee, utilizing equipment owned and operated by Marathon Drilling and Master Soils Investigation. The subsequent fieldwork conducted on 90 07 30 was carried out under the supervision of M. Iampietro, Engineering Student, utilizing equipment owned and operated by Master Soils Investigation.

The project was carried out by T. Sangiuliano under the general supervision of Dr. B. Iyer, Senior Foundation Engineer. The report was written by T. Sangiuliano, reviewed by Dr. B. Iyer and approved by Mr. M.S. Devata, Chief Foundation Engineer.



T. Sangiuliano, P.Eng.
Foundation Engineer



for

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

APPENDIX

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

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

STRESS AND STRAIN

u_w	kPa	PORE WATER PRESSURE
r_u	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

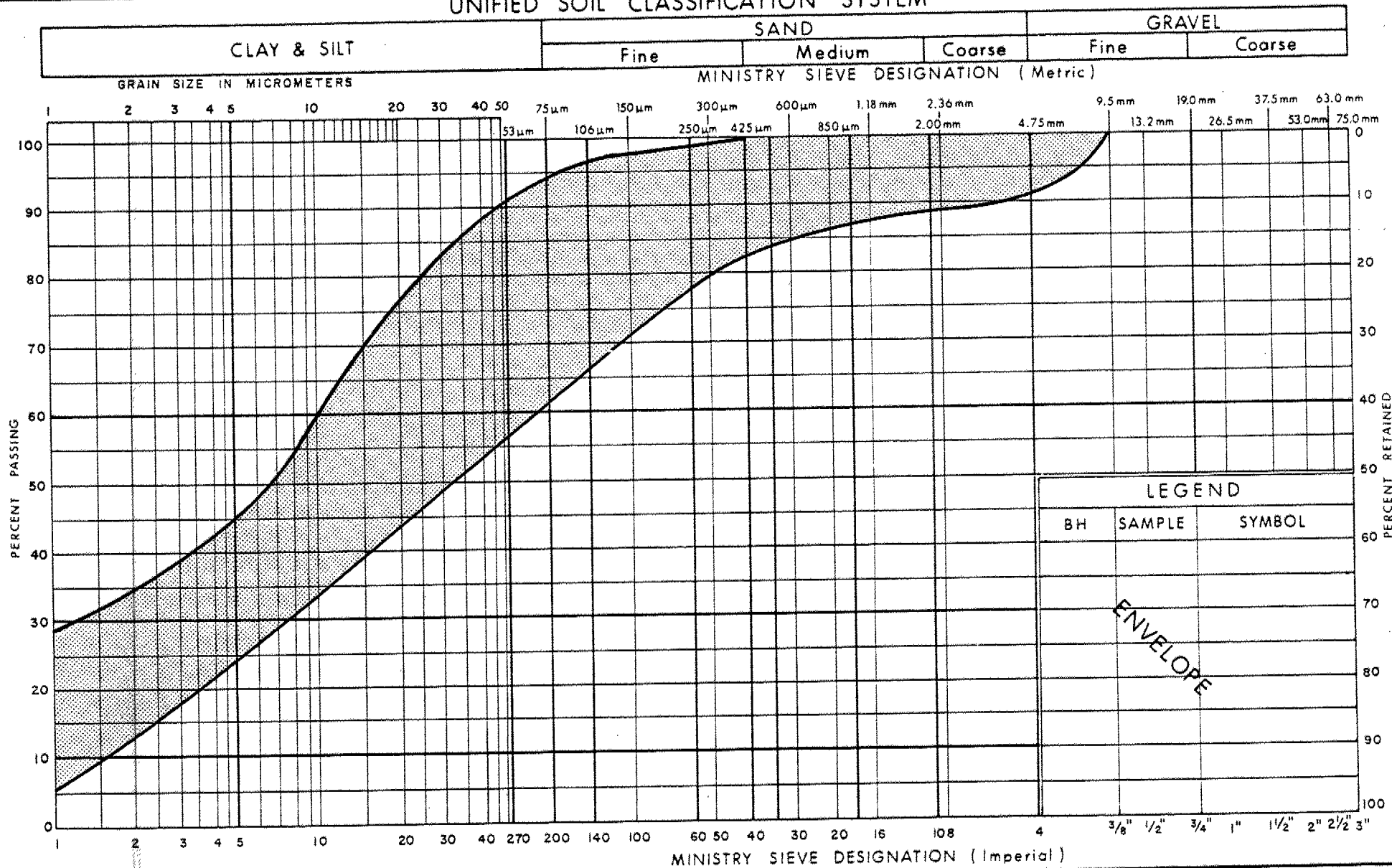
MECHANICAL PROPERTIES OF SOIL

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_f	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						

UNIFIED SOIL CLASSIFICATION SYSTEM



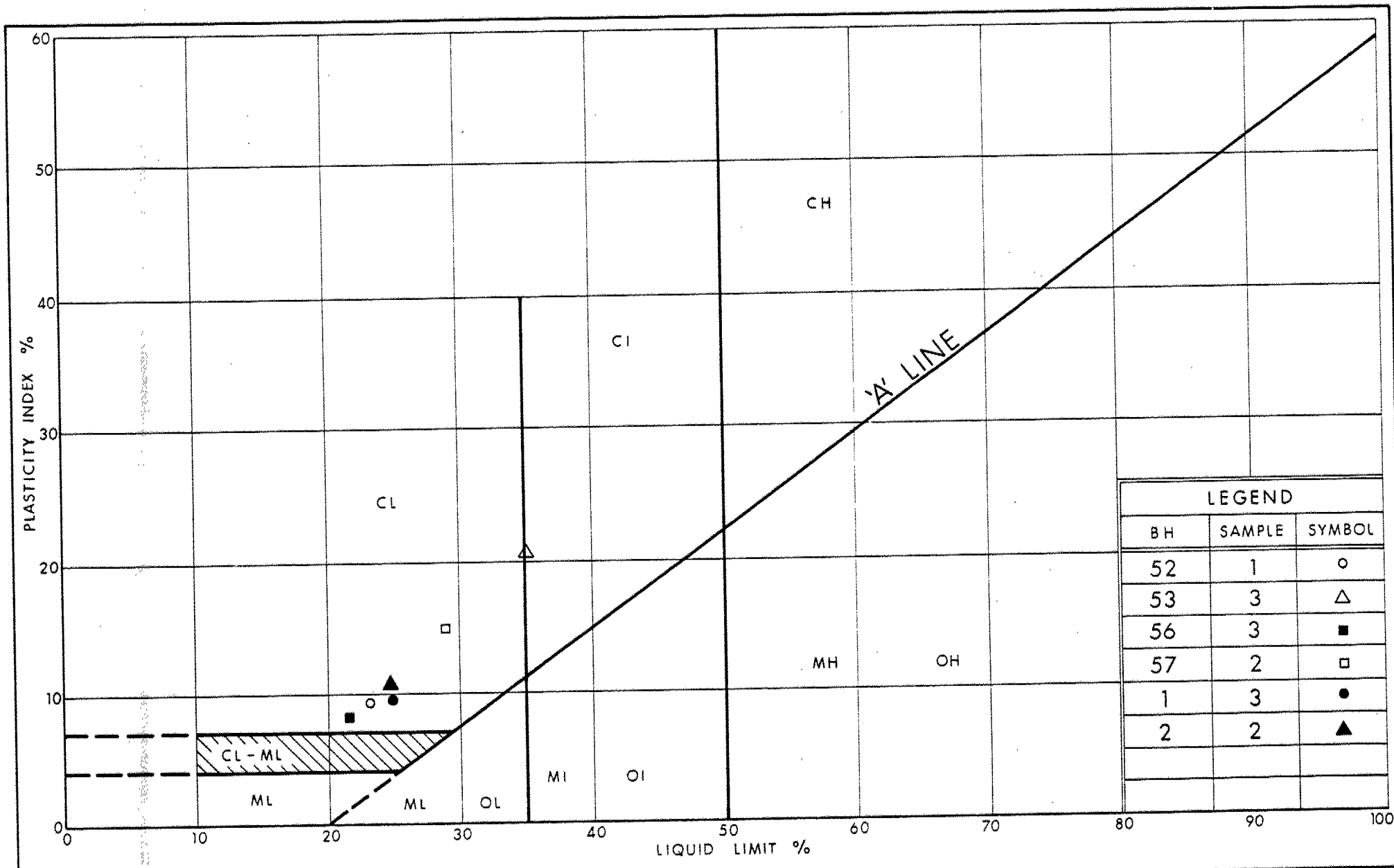
Ontario

Ministry of
Transportation

GRAIN SIZE DISTRIBUTION
HET MIXTURE OF CLAYEY SILT, SAND & GRAVEL
(GLACIAL TILL)

FIG No 1

W P 140-87-02 R



Ministry of
Transportation

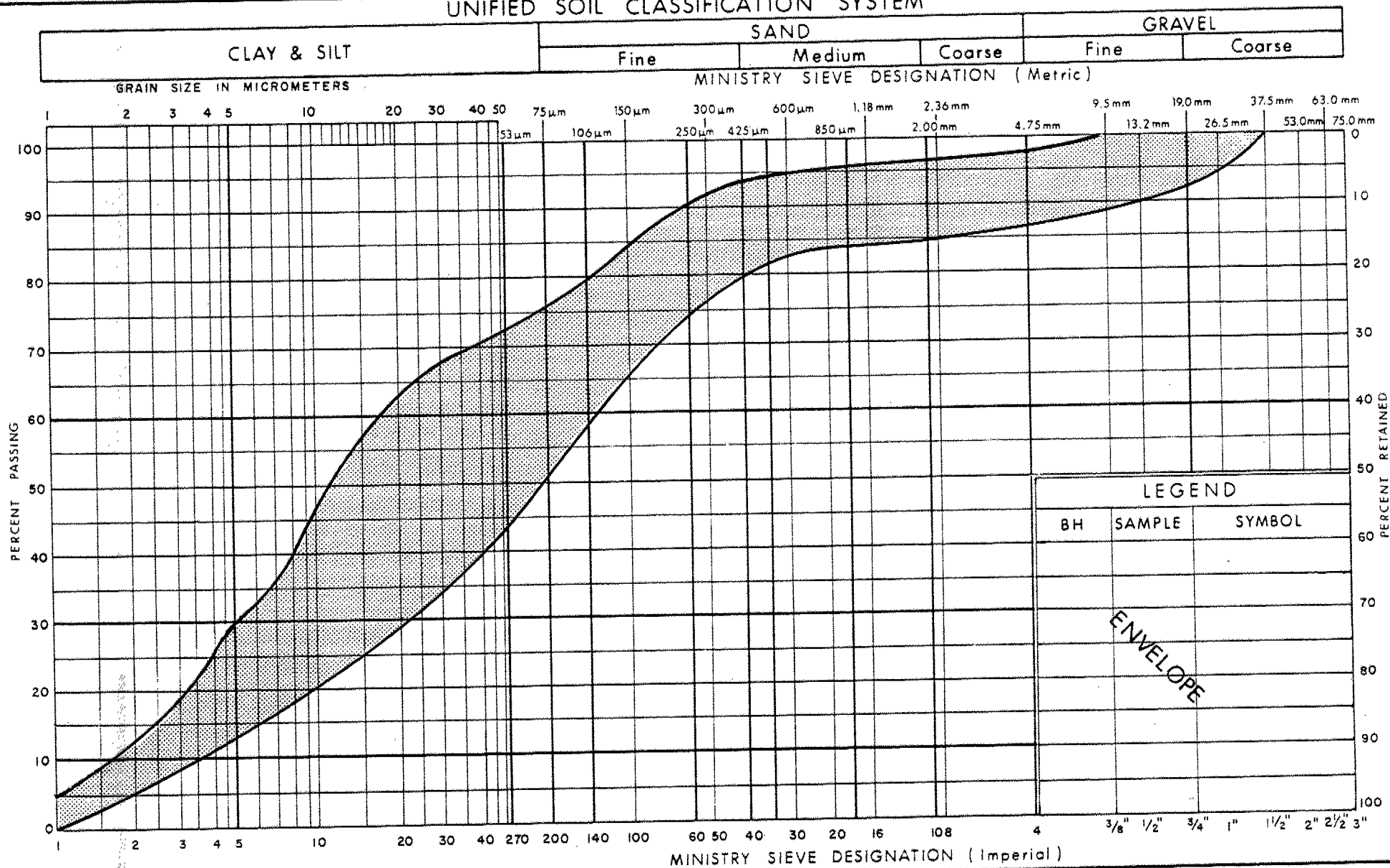
Ontario

PLASTICITY CHART
HET MIXTURE OF CLAYEY SILT, SAND & GRAVEL
(GLACIAL TILL)

FIG No 2

W P 140-87-02 R

UNIFIED SOIL CLASSIFICATION SYSTEM



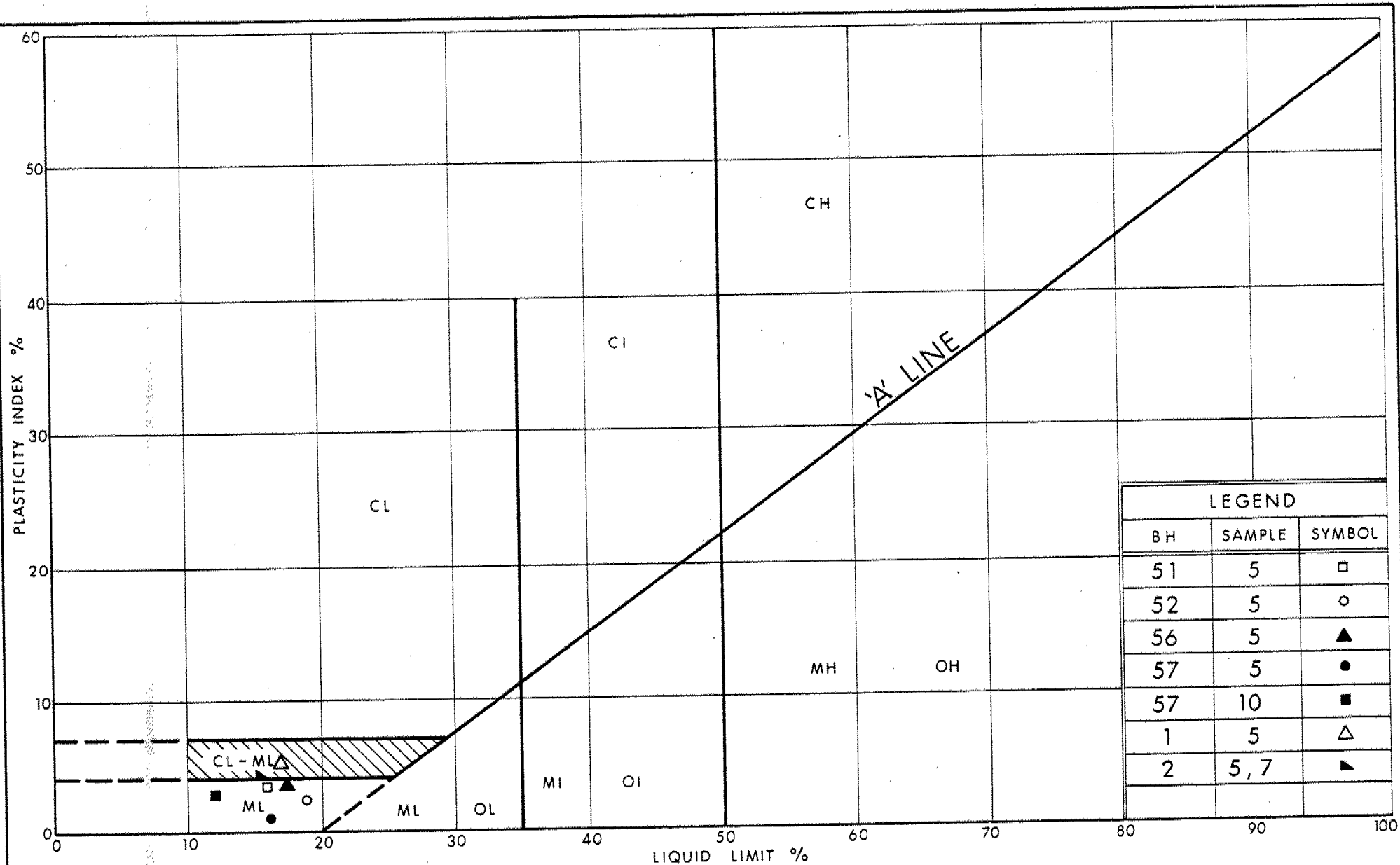
Ontario

Ministry of
Transportation

GRAIN SIZE DISTRIBUTION
HET MIXTURE OF SILT, SAND & GRAVEL
 (GLACIAL TILL)

FIG No 3

W P 140-87-02 R



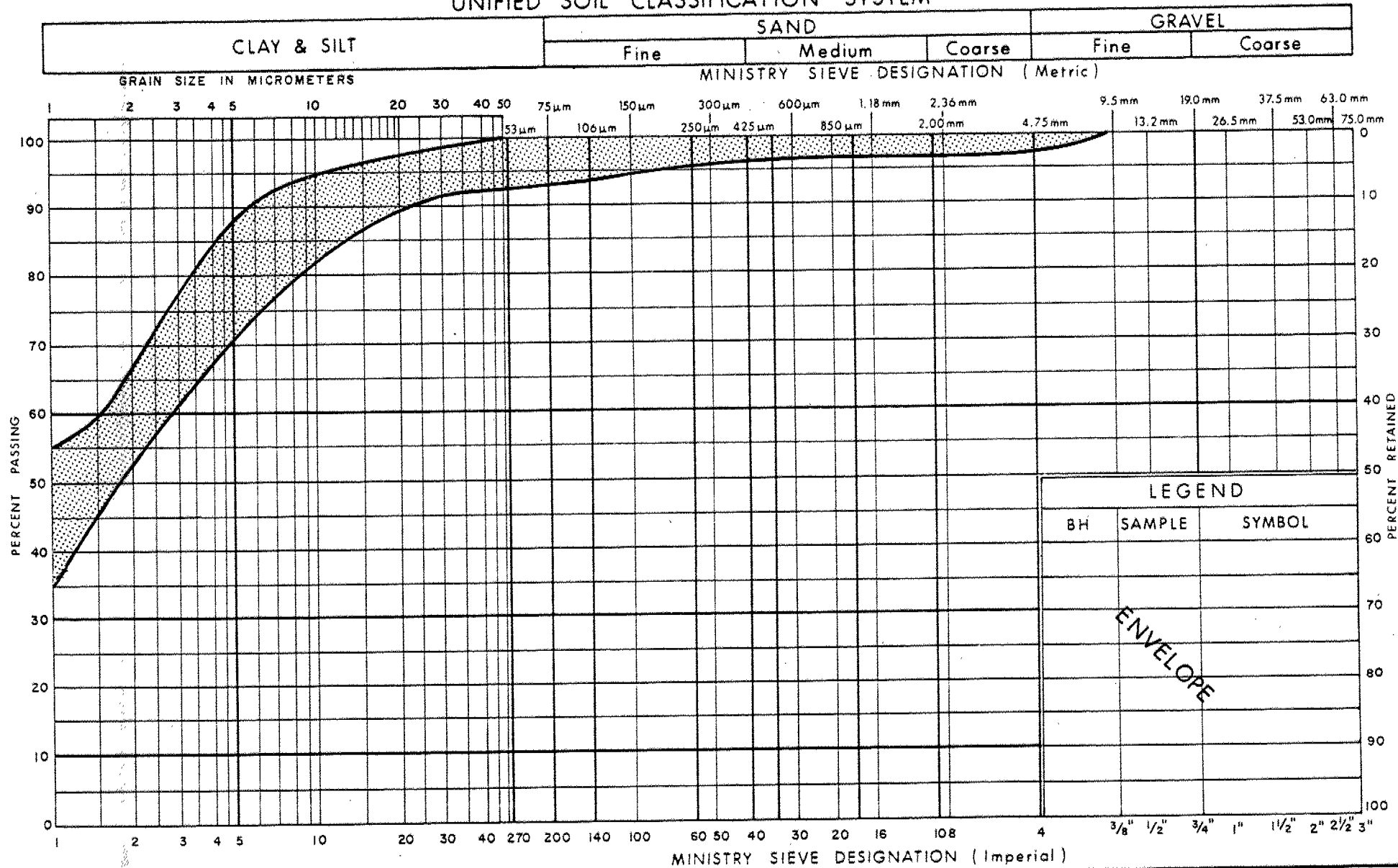
Ministry of
Transportation

PLASTICITY CHART
HET MIXTURE OF SILT, SAND & GRAVEL
(GLACIAL TILL)

FIG No 4

W P 140-87-02 R

UNIFIED SOIL CLASSIFICATION SYSTEM

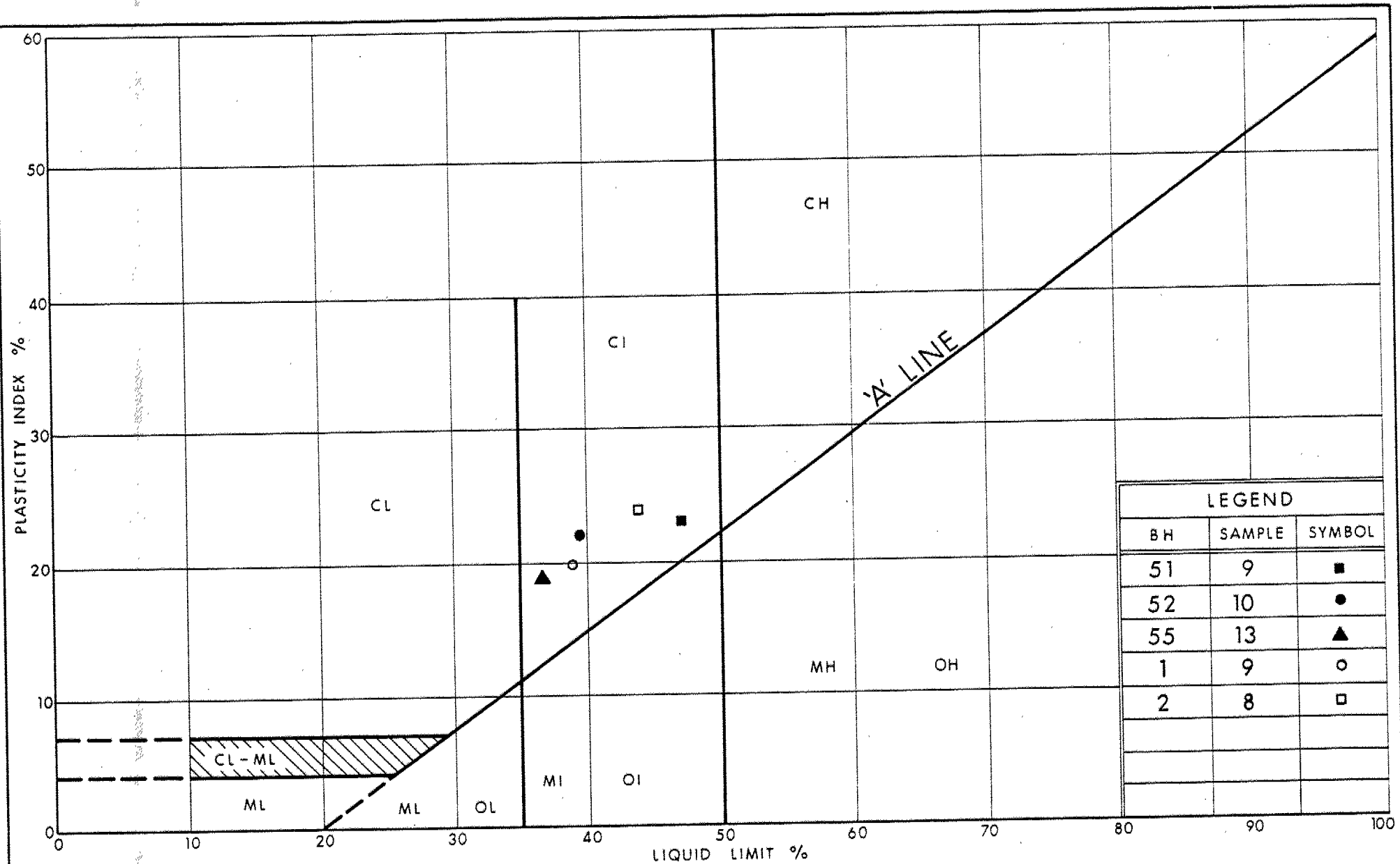


Ministry of
Transportation

GRAIN SIZE DISTRIBUTION
SILTY CLAY (LACUSTRINE)

FIG No 5

W P 140-87-02 R



Ministry of
Transportation

PLASTICITY CHART SILTY CLAY (LACUSTRINE)

FIG No 6

W P 140-87-02 R

RECORD OF BOREHOLE No 1

1 OF 1

METRIC

W.P. 140-87-02R LOCATION Co-ords: N 4 849 297.3 ; E 302 442.3 ORIGINATED BY MI
DIST 6 HWY 407 BOREHOLE TYPE HS Auger COMPILED BY MI
DATUM Geodetic DATE 90 07 30 CHECKED BY TS

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 7 kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
194.3	Ground Surface																
0.0	Topsoil		1	SS	16		194										
	Heterogeneous mixture of Clayey Silt, Sand and Gravel (Glacial Till)		2	SS	17												
	Brown, Stiff to Hard		3	SS	13		192									21.6	0 6 73 21
190.6			4	SS	70												
3.7	Heterogeneous mixture of Silt, Sand and Gravel (Glacial Till)		5	SS	80		190										4 40 46 10
188.8	Grey, Very Dense		6	SS	53												
5.5			7	SS	66		188										
	Silty Clay (Lacustrine)		8	SS	72		186										
	Grey, Hard		9	SS	96											21.8	2 5 33 60
			10	SS	82		184										
181.7			11	SS	74		182										
12.6	End of Borehole																
	* GWL TAKEN ON 90 07 31																

RECORD OF BOREHOLE No 2

1 OF 1

METRIC

W.P. 140-87-02R LOCATION Co-ords: N 4 849 360.9 ; E 302 544.3 ORIGINATED BY MI
DIST 6 HWY 407 BOREHOLE TYPE HS Auger COMPILED BY MI
DATUM Geodetic DATE 90 07 30 CHECKED BY TS

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 7 kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
196.5	Ground Surface																
0.0	Topsoil		1	SS	16		196										
	Heterogeneous mixture of Clayey Silt, Sand and Gravel (Glacial Till)		2	SS	157											19.7	7 28 40 25
	Brown, Very Stiff to Hard		3	SS	36		194										
192.8			4	SS	120	5cm											
3.7			5	SS	50	15cm											2 28 60 10
	Heterogeneous mixture of Silt, Sand and Gravel (Glacial Till)		6	SS	65		192										
	Grey, Very Dense		7	SS	120	28cm	190										3 27 62 8
189.5			8	SS	50												
7.0			9	SS	43		188										0 0 35 65
	Silty Clay (Locustrine)		10	SS	48		186										
	Grey, Hard		11	SS	55		184										
183.9																	
12.6	End of Borehole																
	* GWL TAKEN ON 90 07 31																

RECORD OF BOREHOLE No 50

1 OF 1

METRIC

W.P. 140-87-02R LOCATION Co-ords: N 4 849 331 ; E 302 466 ORIGINATED BY BC
DIST 6 HWY 407 BOREHOLE TYPE HS AUGER COMPILED BY TS
DATUM GEODETIC DATE 90 02 07-08 CHECKED BY TS

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT 7 kN/m ³	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 80 100	W _p	W	W _L		
195.0	GROUND SURFACE													
194.5	Topsoil													
0.5	Hel. mixture of Clayey Silt, Sand and Gravel (Glacial Till)		1	SS	7		194							
192.7	Brown, Firm to V. Stiff		2	SS	17									
2.3	Brown		3	SS	118									
	Grey		4	SS	120									
	Hel. mixture of Silt, Sand and Gravel (Glacial Till)		5	SS	96									
189.7	Very Dense		6	SS	81									
5.3			7	SS	39									
			8	SS	58									
			9	SS	42									
	Silty Clay (Locustrine)		10	SS	34									
	Grey, Hard		11	SS	47									
182.4			12	SS	57									
12.6	End of Borehole													

RECORD OF BOREHOLE No 51

1 OF 1

METRIC

W.P. 140-87-02R LOCATION Co-ords: N 4 849 336 ; E 302 497 ORIGINATED BY BC
DIST 6 HWY 407 BOREHOLE TYPE HS AUGER COMPILED BY TS
DATUM GEODETIC DATE 90 02 08 CHECKED BY JP

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 7 kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
195.9	GROUND SURFACE																
195.4	Topsoil																
0.5	Het. mixture of Clayey Silt, Sand and Gravel (Glacial Till)		1	SS	13												
			2	SS	25												
	Brown, Stiff to Hard		3	SS	33												
192.9			4	SS	103												
3.0	Het. mixture of Silt, Sand and Gravel (Glacial Till)		5	SS	125	/25cm											
	Grey, Very Dense		6	SS	120	/20cm											
			7	SS	130												
189.3			8	SS	60												
6.6	Silty Clay (Lacustrine)		9	SS	142	/25cm											
	Grey, Hard		10	SS	95												
184.8			11	SS	57												
11.1	End of Borehole																

RECORD OF BOREHOLE No 52

1 OF 1

METRIC

W.P. 140-87-02R LOCATION Co-ords: N 4 849 340 ; E 302 528 ORIGINATED BY TS
DIST 6 HWY 407 BOREHOLE TYPE HS AUGER COMPILED BY TS
DATUM GEODETIC DATE 90 02 09 CHECKED BY JP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					NATURAL MOISTURE CONTENT			UNIT WEIGHT 7 kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100	W _P	W	W _L		
196.2	GROUND SURFACE																
195.7	Topsoil																
0.5	Hel. mixture of Clayey Silt, Sand and Gravel (Glacial Till)		1	SS	7												3 33 37 27
	Firm to Stiff		2	SS	6												
193.2	Grey		3	SS	20		194									19.0	
3.0	Compact		4	SS	11												
	Dense		5	SS	40		192										2 21 54 23
190.9	Hel. mixture of Silt, Sand and Gravel (Glacial Till)		6	SS	38											21.8	
	Grey		7	SS	30												
5.3			8	SS	36		190										
			9	SS	27												
	Silty Clay (Locustrine)						188										
	Grey, Very Stiff to Hard		10	SS	15											20.6	0 5 34 61
			11	SS	38		186										
183.6			12	SS	30		184										
12.6	End of Borehole																

RECORD OF BOREHOLE No 53

1 OF 1 METRIC

W.P. 140-87-02R LOCATION Co-ords: N 4 849 344 ; E 302 562 ORIGINATED BY TS
 DIST 6 HWY 407 BOREHOLE TYPE HS AUGER COMPILED BY TS
 DATUM GEODETIC DATE 90 02 09 - 12 CHECKED BY BC

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL * LAB VANE 20 40 60 80 100					WATER CONTENT (%) w _p w w _L 10 20 30				
196.7	GROUND SURFACE																
196.2	Topsoil																
0.5	Het. mixture of Clayey Silt, Sand and Gravel (Glacial Till) Brown, Stiff to Hard		1	SS	13												
			2	SS	18												
193.7			3	SS	35												
3.0			4	SS	45												
	Het. mixture of Silt, Sand and Gravel (Glacial Till) Grey, Very Dense		5	SS	100												
			6	SS	104												
			7	SS	80												
189.1			8	SS	130												
7.6	Silty Clay (Locustrine) Grey, Hard																
187.1			9	SS	79												
9.6	End of Borehole																

RECORD OF BOREHOLE No 54

1 OF 1

METRIC

W.P. 140-87-02R LOCATION Co-ords: N 4 849 307 ; E 302 433 ORIGINATED BY PM/TS
 DIST 6 HWY 407 BOREHOLE TYPE HS AUGER COMPILED BY TS
 DATUM GEODETIC DATE 90 02 07 CHECKED BY BC

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 7 kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			SHEAR STRENGTH kPa						
							20 40 60 80 100		10 20 30					
194.3	GROUND SURFACE													
193.8	Topsoil													
0.5	Het. mixture of Clayey Silt, Sand and Gravel (Glacial Till)	Brown	1	SS	1									
			2	SS	15									
191.3	Stiff	Grey	3	SS	14									
3.0	Het. mixture of Silt, Sand and Gravel (Glacial Till)		4	SS	51									
	Very Dense		5	SS	56									
			6	SS	64									
188.2			7	SS	120	25cm								
6.1			8	SS	86									
			9	SS	87									
	Silty Clay (Locustrine)		10	SS	39									
	Grey, Hard		11	SS	60									
181.7			12	SS	58									
12.6	End of Borehole													

RECORD OF BOREHOLE No 55

1 of 1

METRIC

W.P. 140-87-02R LOCATION Co-ords: N 4 849 313 ; E 302 467 ORIGINATED BY TS
DIST 6 HWY 407 BOREHOLE TYPE HS AUGER COMPILED BY TS
DATUM GEODETIC DATE 90 02 08 CHECKED BY BC

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 7 kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
194.9	GROUND SURFACE																
194.4	Topsoil																
0.5	Het. mixture of Clayey Silt, Sand and Gravel (Glacial Till)		1	SS	10												
	Brown, Stiff to Very Stiff		2	SS	12												
191.9			3	SS	29												
3.0	Het. mixture of Silt, Sand and Gravel (Glacial Till)		4	SS	78												
190.3	Grey, Very Dense		5	SS	65												
4.6			6	SS	38												
			7	SS	54												
			8	SS	40												
			9	SS	40												
			10	SS	37												
	Silty Clay (Locustrine)		11	SS	31												
	Grey, Hard		12	SS	32												
			13	SS	42												
179.2			14	SS	24												
15.7	End of Borehole																

+3, x5: Numbers refer to
Sensitivity

20
15-5 (x) STRAIN AT FAILURE
10

RECORD OF BOREHOLE No 56

1 OF 1 METRIC

W.P. 140-87-02R LOCATION Co-ords: N 4 849 318 ; E 302 498 ORIGINATED BY TS
 DIST 6 HWY 407 BOREHOLE TYPE HS AUGER COMPILED BY TS
 DATUM GEODETIC DATE 90 02 08 - 09 CHECKED BY BC

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT 7 kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			SHEAR STRENGTH kPa					WATER CONTENT (%)				
								20 40 60 80 100					w _p w w _L				
195.6	GROUND SURFACE																
195.1	Topsoil																
0.5	Het. mixture of Clayey Silt, Sand and Gravel (Glacial Till)		1	SS	2		194								19.8	8 28 48 16	
	Brown, Stiff		2	SS	10												
192.6			3	SS	16												
3.0			4	SS	48		192										
	Het. mixture of Silt, Sand and Gravel (Glacial Till)		5	SS	120	/28cm											
	Grey, Very Dense		6	SS	80	/15cm									23.0	14 17 60 9	
			7	SS	75		190										
			8	SS	72												
188.6																	
7.0	End of Borehole Auger Refusal (Probable Boulder)																

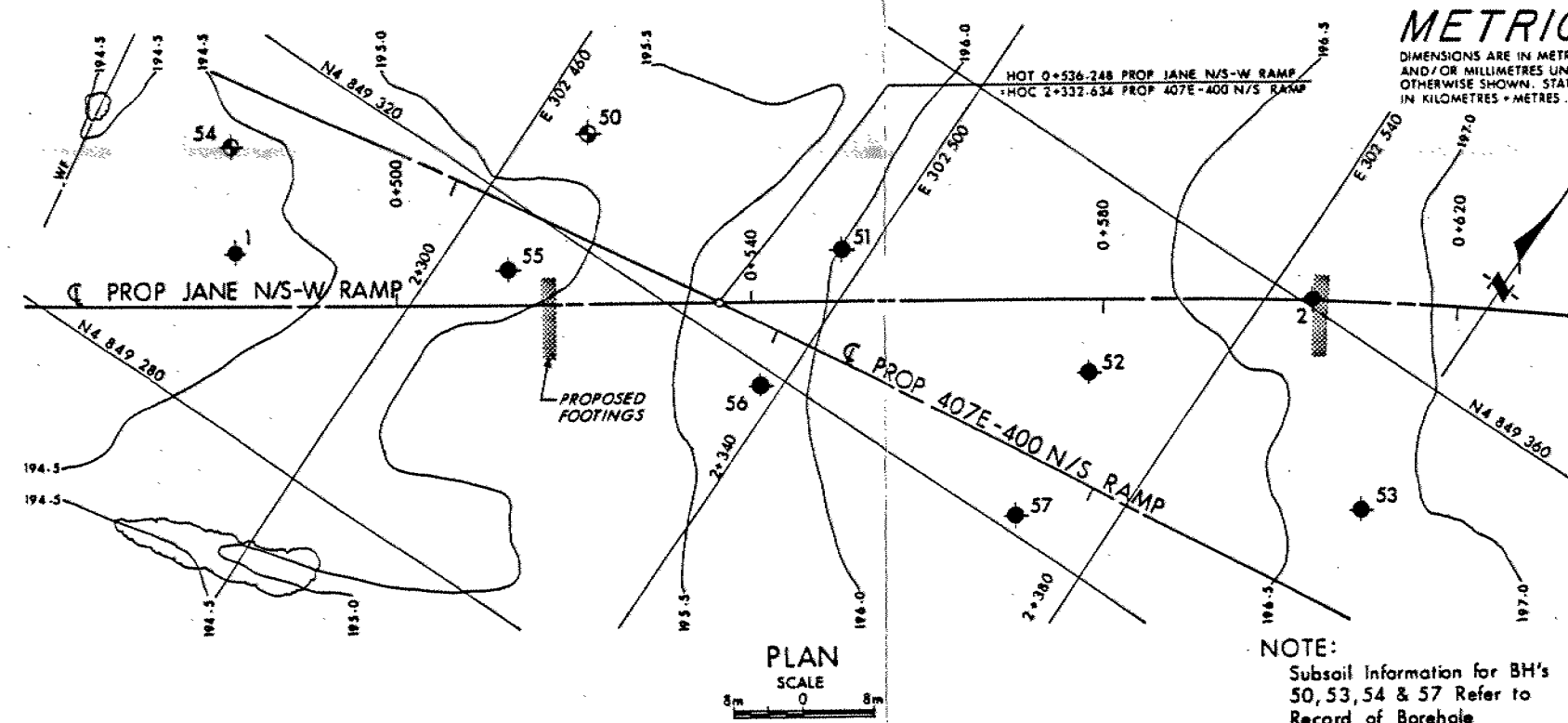
RECORD OF BOREHOLE No 57

1 OF 1

METRIC

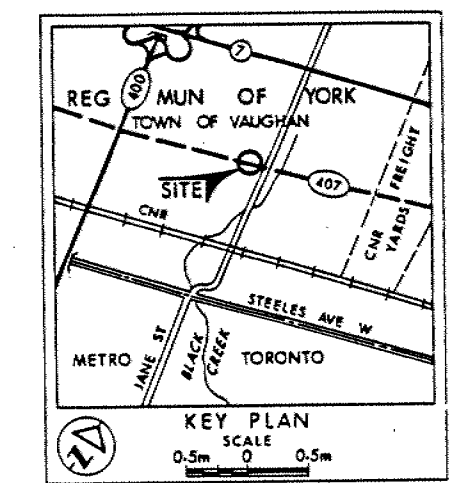
W.P. 140-87-02R LOCATION Co-ords: N 4 849 322 ; E 302 530 ORIGINATED BY TS
DIST 6 HWY 407 BOREHOLE TYPE HS AUGER COMPILED BY TS
DATUM GEODETIC DATE 90 02 09 CHECKED BY BC

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100	W _p	W	W _L		
196.2	GROUND SURFACE																
195.7	Topsoil																
0.5	Het. mixture of Clayey Silt, Sand and Gravel (Glacial Till)		1	SS	9												
	Stiff to V. Stiff		2	SS	14												
			3	SS	25												
192.7			4	SS	20												
3.5			5	SS	45												
			6	SS	47												
			7	SS	32												
			8	SS	30												
			9	SS	72												
			10	SS	109												
			11	SS	136												
			12	SS	125												
183.6																	
12.6	End of Borehole																



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

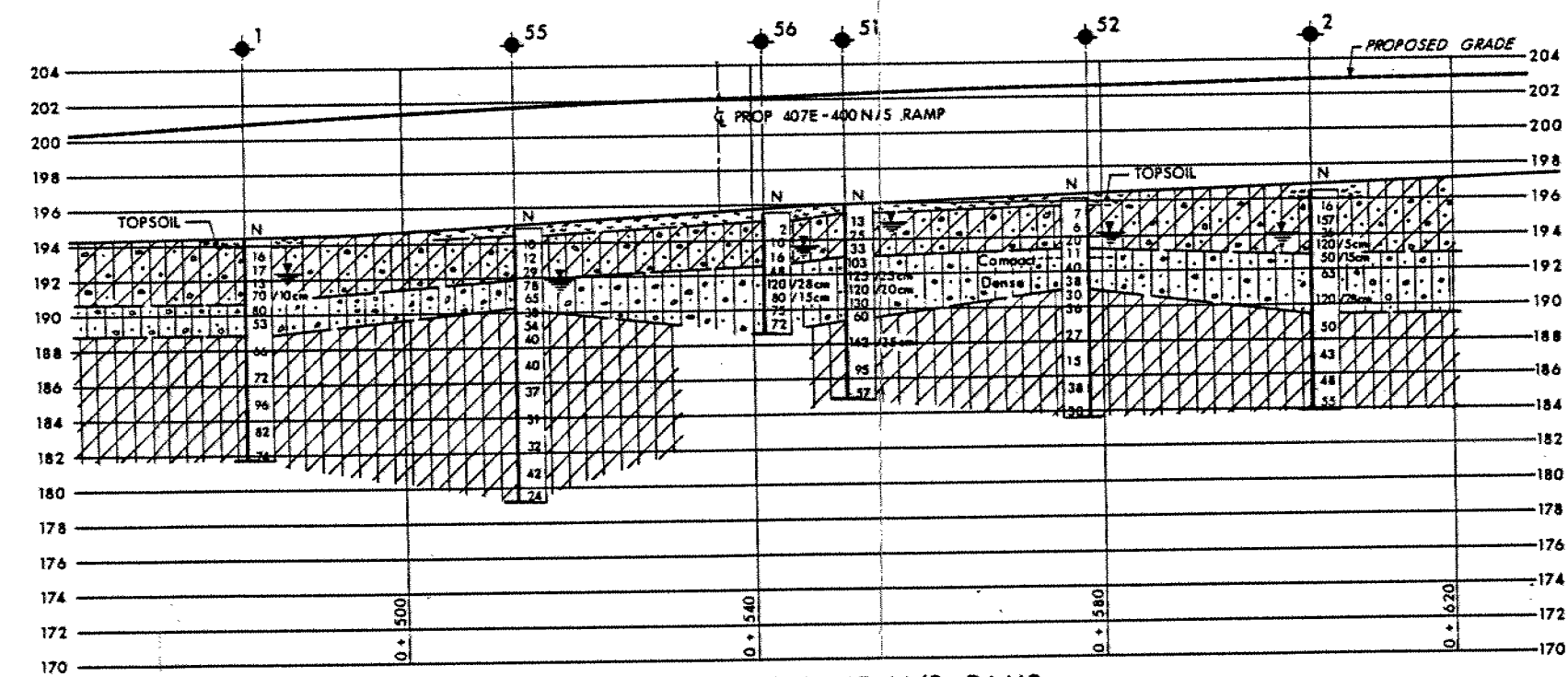
CONT No WP No 140-87-02R		SHEET
JANE N/S-W RAMP OVER 407E-400 N/S RAMP (WESTBOUND BASKETWEAVE) BORE HOLE LOCATIONS & SOIL STRATA		



NOTE:
Subsoil Information for BH's
50, 53, 54 & 57 Refer to
Record of Borehole

SOIL STRATIGRAPHY LEGEND

- HETEROGENEOUS MIXTURE OF
CLAYEY SILT, SAND & GRAVEL
Firm to Hard
(GLACIAL TILL)
- HETEROGENEOUS MIXTURE OF
SILT, SAND & GRAVEL
(GLACIAL TILL)
Very Dense
- SILTY CLAY
(LACUSTRINE)
Very Stiff to Hard



Q PROFILE PROP JANE N/S RAMP

SCALE
8m 0 8m Hor
4m 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)
- WL at time of investigation
90 02 and 90 07

No	ELEVATION	CO-ORDINATES	
		NORTH	EAST
50	195.0	4 849 331.0	302 466.0
51	195.9	4 849 336.0	302 497.0
52	196.2	4 849 340.0	302 528.0
53	196.7	4 849 344.0	302 562.0
54	194.3	4 849 307.0	302 433.0
55	194.9	4 849 313.0	302 467.0
56	195.6	4 849 318.0	302 498.0
57	196.2	4 849 322.0	302 530.0
90 07	1	194.3	4 849 297.3 302 442.3
	2	196.5	4 849 360.9 302 544.3

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 30M13-105

HWY No 407	DIST 6
SUBMD T5	CHECKED DATE 90 05 08 SITE 37-1314
DRAWN DT	CHECKED DWG 1408702R-A

MEMORANDUM

(416) 235-3731

To: K.G. Bassi
Head, Design Section
Central Region

1990 12 14

Attn: G. Al-Bazi
Design Engineer

From: Foundation Design Section
Room 315, Central Region, Downsview, Ontario
Central Region

Re: Final Drawing Review
Jane N/S-W Ramp over 407 E-400 N/S Ramp
W.P. 140-87-02, Site 37-1314
Highway 407, District 6, Toronto

The final design drawing and documents for the above-mentioned structure has been reviewed by this office and were found to be in conformance with our design requirements.

Should you have any further questions, please advise.



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

For

M. Devata, P. Eng.
Chief Foundation Engineer

memorandum

Tel: (416) 235-5655



To: M. Devata
Chief Foundation Engineer
Foundation Design Section


Date: 90 08 13

Re: Bearing Capacity
Ramp Jane N/S-W over Ramp 407E to 400N/S
W.P. 140-87-02, Site 37-1314, District 6

With reference to our meeting on July 19, 1990 and our subsequent discussion on August 2, 1990, I confirm our agreement that the following bearing capacities can go up from 400 kPa to 450 kPa.

	<u>Founding Elevation (m)</u>	<u>Bearing Capacity at S.L.S. Type II (kPa)</u>
W. Pier	193 to 189.5	450) 37.5 mm
E. Pier	193 to 190	450) settlement

If you feel differently, please advise me as soon as possible.


E. Chan
Project Engineer
Structural Office

EC/sl

c.c. G. Al-Bazi
V. Boehnke



memorandum



Fax. No: 235-5240

Tel. No: 235-3731

To: Mr. K. G. Bassi
Head
Design Section
Structural Office

Date: 1990 07 26

Attn: G. Al-Bazi
Design Engineer

From: Foundation Design Section
Room 315, Central Building

Subject: General Arrangement Drawing Review
Ramp Jane N/S-W over Ramp 407 E to 400 N/S
W.P. 140-87-02, Site 37-1314
District 6, Toronto

The original proposed rigid frame structure at the aforementioned site has been recently revised to a three span bridge. Although the soils data and information procured for the original proposed rigid frame structure can be applied to the proposed new pier foundations, additional subsurface investigation will be required to assess the soils conditions at the abutment foundation locations and adjacent approach fills. In the interim, the revised General Arrangement drawing reflecting the proposed new three span structure has been reviewed and the following comments are provided.

Structure Foundations

Abutments

Based on extrapolation of existing soils data, a weaker surficial veneer of a cohesive clayey silt is anticipated at the proposed abutment locations. Consequently, it is recommended that this material be subexcavated and the abutment foundations be founded on a compacted Granular 'A' pad. The extent of subexcavation and bearing capacity recommended for purposes of the O.H.B.D.C. are summarized in Table 1 below.

Table 1 - Abutments on Granular 'A' Pad

Structure	Subexcavation Elevation (m)	Bearing Capacity at S.L.S. Type II	Factored Capacity at U.L.S.
		(kPa)	(kPa)
W. Abutment	192.5	350	900
E. Abutment	193.5	350	900

The Granular 'A' pad shall be placed and compacted in accordance with OPSS 501 series and shall be a minimum 2 m thickness.

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Total and differential settlements under the recommended loadings are anticipated to be within 25 mm. Should the superstructure have the flexibility to tolerate greater settlements, larger bearing pressures are possible. For structures that can withstand differential settlements up to 37.5 mm, the abutment foundations, as discussed above, can be designed using a bearing capacity at S.L.S. Type II of 450 kPa. The anticipated settlements will be the results of the recompression of the native soil and hence should be realized during and immediately following construction.

The drawing reflects the aforementioned perched abutment design. However, it is recommended that the elevation of subexcavation be defined on the drawing.

Piers

The pier foundations can be founded on conventional spread footings supported by the native soil as identified on the General Arrangement Drawing. For purposes of the O.H.B.D.C., the following bearing capacities are provided.

Table 1 - Abutments on Granular 'A' Pad

<u>Structure</u>	<u>Founding * Elevation (m)</u>	<u>Bearing Capacity at S.L.S. Type II (kPa)</u>		<u>Factored Capacity at U.L.S. (kPa)</u>
		<u>25 mm</u>	<u>37.5 mm</u>	
W. Pier	193 to 189.5	300	400	900
	<189.5	450	500	675
E. Pier	193 to 190	300	400	900
	<190	400	450	600

* All footings shall be protected against frost penetration equivalent to 1.2 m.

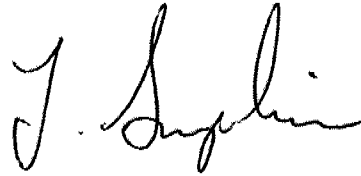
Approach Embankments

Approach embankments in the order of magnitude of 6.5 m have been proposed in advance of the structure. There are no deep seated nor internal slope instabilities anticipated for fills constructed at a slope of 2H:1V as identified on the drawing.

Settlements in the order of magnitude of 50 mm attributable to the elastic recompression of the native subsoil and settlement within the fills under its own weight are anticipated. It is predicted that the majority of the settlements will be realized during or immediately following the construction of the embankment.

191.5 + 1.50

If you have any queries regarding the above comments or require additional information, please do not hesitate to contact this office.

A handwritten signature in dark ink, appearing to read 'T. Sangiuliano', written in a cursive style.

T. Sangiuliano, P.Eng.
Foundation Engineer

for

M. Devata, P.Eng.
Chief Foundation Engineer

TS/ms

c.c.: Mr. V. Boehnke
Head,
Structural Section
Central Region

memorandum



To: V. Boehnke
Head, Structural Section
Central Region

Atten: N. Garland
Structural Engineer

From: Foundation Design Section
Room 315, Central Building

Re: General Arrangement Drawing Review
Jane N/S-W Ramp over 407 E - 400 N/S Ramp
W.P. 140-87-02, Site 37-1314
Highway 407, District 6, Toronto

Date: 1990 05 22


The General Arrangement drawing for the aforementioned structure has been reviewed by this office and the following comments are provided.

STRUCTURE FOUNDATIONS

a) South Abutment/Retaining Wall

The founding elevations of the spread footings on the native soil as illustrated on the drawings (south abutment) are not in accordance with the founding elevations recommended in the foundation report. The founding elevations shall be corrected to reflect the elevations tabulated in Table 5 (pg. 11) of the foundation report.

All other foundation and geotechnical aspects of the General Drawing are in accordance with our recommendations.



T. Sangiuliano, P. Eng.
Foundation Engineer

for

BI/TS/jb

Dr. B. Iyer, P. Eng.
Sr. Foundation Engineer

WESTBOUND BASKETWEAVE AT
HWY 407/JANE ST INTERCHANGE
SITE 37-1314



LOOKING NORTH



LOOKING SOUTH

WESTBOUND BASKETWEAVE AT
HWY 407/JANE ST INTERCHANGE
SITE 37-1314



LOOKING EAST



LOOKING WEST