

DOCUMENT MICROFILMING IDENTIFICATION

GEOCRES No. 30 M 13-85

DIST. 6 REGION                     

W.P. No. 112-87-01

CONT. No. 91-59

W. O. No.                     

STR. SITE No. 37-682

HWY. No. 7

LOCATION CNR Overhead  
(MacMillan Yard)

No. of PAGES - Retaining Walls

                      
                      
OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT.                     

REMARKS:

METRIC

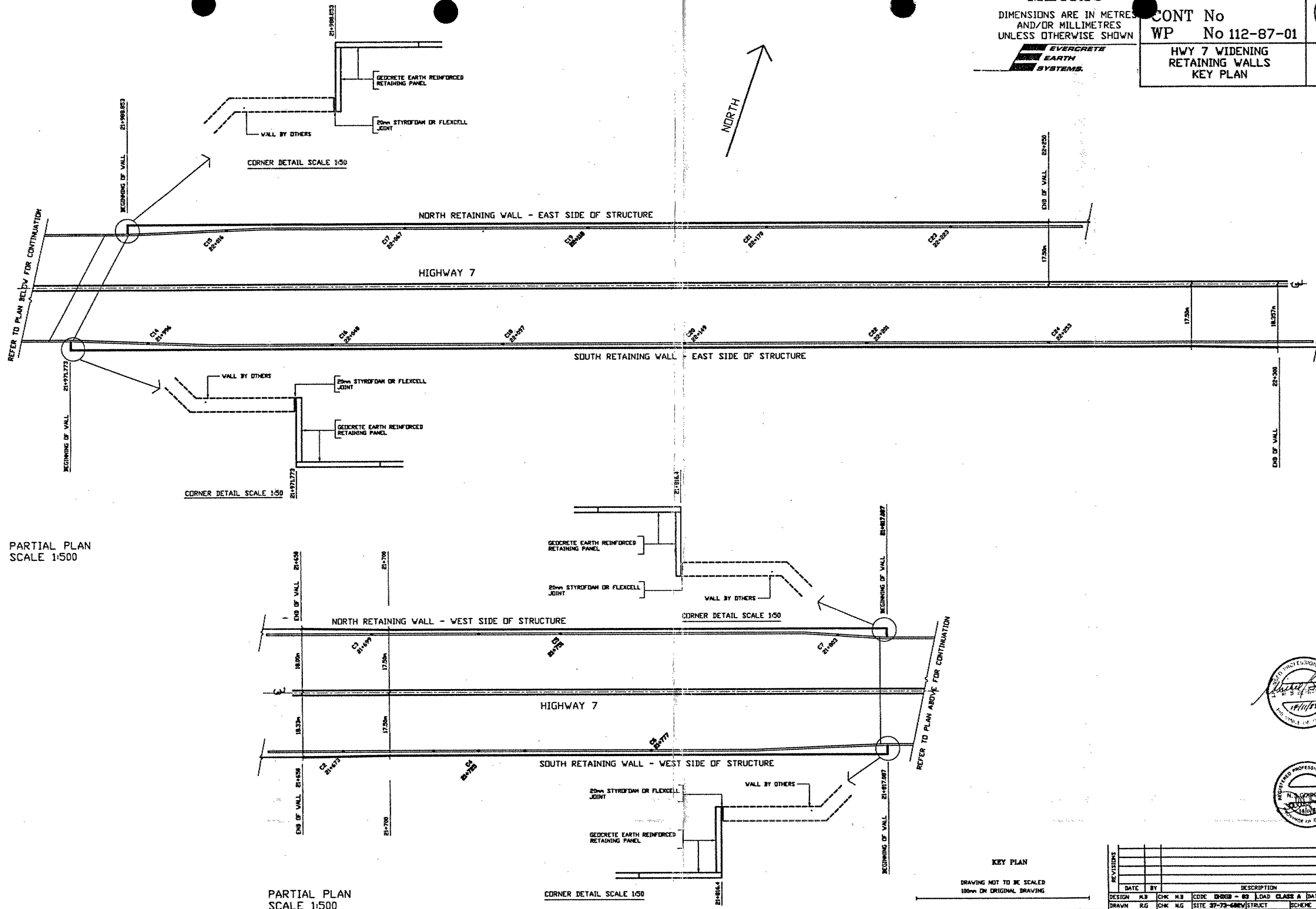
DIMENSIONS ARE IN METRES  
AND/OR MILLIMETRES  
UNLESS OTHERWISE SHOWN

EVERCRETE  
EARTH  
SYSTEMS

CONT No  
WP No 112-87-01

HWY 7 WIDENING  
RETAINING WALLS  
KEY PLAN

SHEET



PARTIAL PLAN  
SCALE 1:500

PARTIAL PLAN  
SCALE 1:500

CORNER DETAIL SCALE 1:50

KEY PLAN

DRAWING NOT TO BE SCALED  
100mm ON ORIGINAL DRAWING



REVISIONS	DATE	BY	DESCRIPTION
DESIGN	M.B.	CHK. M.B.	CODE: BRIDGE - 82 LOAD CLASS A DATE: NOVEMBER 89
DRAWN	R.G.	CHK. M.G.	SITE: 37-73-606V1 STRUCT. SCHEME DWG. 1



Ministry  
of  
Transportation

CONT 91-59

---

## **FOUNDATION DESIGN SECTION**

**foundation  
investigation and  
design report**

ENGINEERING MATERIALS OFFICE  
FOUNDATION DESIGN SECTION

WP 112-87-01 DIST 6  
HWY 7 STR SITE 37-682

CNR OVERHEAD (MACMILLAN YARD) APPROACHES

*CONT 91-59*

DISTRIBUTION

G.C.E. Burkhardt (3)  
G. Cautillo  
J. Smrcka (2)  
A. Wittenberg (2)  
K. Bassi  
D. Aspinwall  
T. Yakutchuk ✓  
G. Szekreny  
B. Steeves (Cover Only)  
M. MacLean (Cover Only)  
File

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.

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 (F111)

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 <sub>L</sub> )	17.0-41.5%	28.4%	29.8%
Plastic Limit (w <sub>p</sub> )	11.5-20.5%	15.3%	14.8%
Plasticity Index (I <sub>p</sub> )	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 <sub>L</sub> )	17.5-39.5%	24.4%	21.0%
Plastic Limit (w <sub>p</sub> )	10.5-20.5%	14.5%	13.0%
Plasticity Index (I <sub>p</sub> )	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.

## DISCUSSION AND RECOMMENDATIONS

It is proposed to widen the existing approach embankments by up to 4± m on both the north and south sides. This widening is in conjunction with the proposed widening of the CNR overhead structure. Embankment height within the study area are estimated to range from 3 m to 9 m.

The embankment widening can be accomplished by either building conventional 2H:1V slopes or by constructing retaining walls along all four quadrants of the site.

### Conventional 2H:1V Embankments

The widening of the approaches could be accomplished by constructing conventional 2H:1V embankments to the required geometry. This will require more space in the transverse direction, and consequently may require the acquisition of property and the relocation of existing underground and surface utilities. Benching of the slopes will be required in accordance with OPSD-208.01.

### Retaining Walls

Alternatively, the widening could be accomplished by constructing retaining walls either at the toe or the crest of the embankment. The advantages of this approach are that it would allow the existing toe of slope to be maintained and thus eliminate requirements for additional property.

By locating the wall at the crest of the embankment, both the fill and utility relocation requirements could be minimized in comparison with the conventional 2H:1V embankment widening or toe wall options. The crest wall approach would also permit superior compaction control. In addition, earth pressures would be minimized resulting in a more cost-effective design than a toe wall.

Due to the potential for differential settlements and the minimal bearing capacity conditions, conventional cantilever walls on spread footings are not as economical for crest walls as earth reinforcement structures. Consequently, it is recommended that an earth reinforcement retaining wall should be constructed at the crest of the embankment.

Earth reinforcement walls are proprietary products with the design, supply and construction supervision provided by the proprietor. In this arrangement the proprietor accepts full responsibility for the integrity and internal stability of the wall, while the Ministry assumes responsibility for the overall stability of the slope.

Until recently, earth reinforcement walls had been considered as a patented proprietary product of the Reinforced Earth Company Ltd. However, new earth reinforcement wall systems have recently become available, and as the New Products Committee custodial office for these products, it is our recommendation that one of these new systems - Geo-Crete Retaining Wall System, from Evercrete Earth Systems, should be demonstrated at this project. The project is considered to be a reasonable size for a demonstration, and the results may permit this technology to be utilized with greater confidence at future projects.

During our preliminary discussions with Evercrete Earth Systems, it was agreed that should MTO adopt the Geo-Crete Retaining Wall System, Evercrete will undertake:

- 1) to provide a letter of confirmation of their ability to perform this project.
- 2) to accept responsibility for the integrity and internal stability of the wall system.
- 3) to prepare drawings, and contract documents consisting of a non-standard special provision, detailing all requirements for the design, supply and construction of the wall.
- 4) to retain a geotechnical consultant of mutual acceptability to propose and execute a mutually agreed upon monitoring program on the Geo-Crete Retaining Wall System at no cost to the Ministry.
- 5) to accept the cost of any repairs that result from the unsatisfactory performance of the retaining wall system, for a period of 5 years.

6) to disclose to the satisfaction of the Ministry all technical information relating to the design of the proposed wall.

The foundation design for this project will be carried out under the technical supervision of the Foundation Design Section.

Following are recommendations related to the Geo-Crete Wall.

#### Bearing Capacity

The following O.H.B.D.C. bearing capacities are recommended for foundations within the embankment material.

Factored Bearing Capacity at U.L.S. = 75 kPa

Bearing Capacity at S.L.S. Type II = 50 kPa

From our discussions with the proprietor, it is our understanding that these capacities are sufficient for the design of the wall.

#### Sliding Resistance

An unfactored  $\phi$  value of  $28^\circ$  may be assumed for calculation of sliding resistance between the wall system and the existing embankment fill.

#### Slope Stability

The stability of the embankment, incorporating the proposed wall, has been verified in both total stress and effective stress with the aid of Bishop's Simplified method. A summary of the design assumptions and the results of the analyses are illustrated in Figure 5. Based on these results, there is an acceptable factor of safety for slope stability external to the wall. As previously stated, the proprietor is responsible for ensuring the internal stability of the wall system.

Temporary (during construction) slopes up to 2 m high may be constructed at 1H:1V or flatter. Permanent slopes should be at 2H:1V or flatter.

### Construction Considerations

It will probably be required to locate utility poles and guard rails within the reinforcing zone behind the wall face. From our discussions with the proprietor, it is our understanding that penetration of the reinforcing grid by the poles, will not adversely affect the performance of the wall. Since it is anticipated that only 60% of the area behind the wall will be reinforced, in some instances it may be possible to locate poles in the non-reinforced zones. In any cases, there will probably be some restriction as to how close the poles can be located to the wall face. The proprietor should consider any additional loads imposed by the poles in the design of the wall.

Any sewers or underground utilities should be located 1 m outside the wall reinforcement zone. Based on a preliminary assessment, it should be possible to locate sewers or underground utilities below or through the wall system.

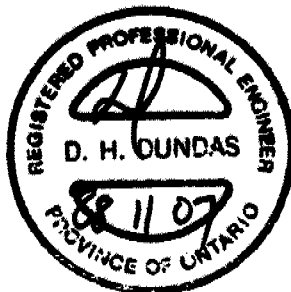
Considerations should be given to the connection of the Geo-Crete wall and the proposed widened abutments for the structure.

### 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. Foundations Engineer, and reviewed by M. Devata, Chief Foundations Engineer.

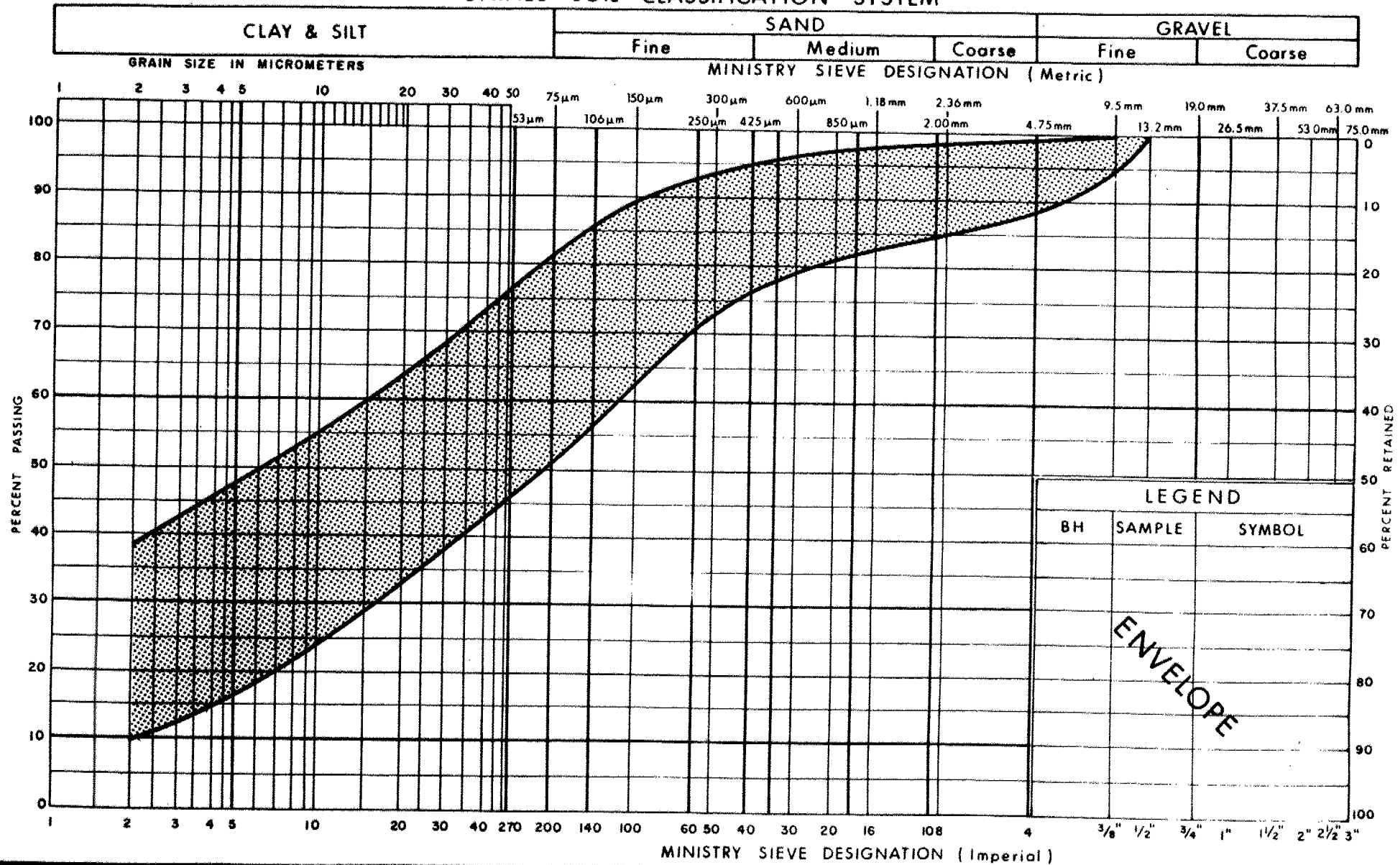


*D. H. Dundas*  
D.H. Dundas, P.Eng.  
Sr. Foundations Engineer

*M. Devata*  
M. Devata, P.Eng.  
Chief Foundations Engineer

**A P P E N D I X**

# UNIFIED SOIL CLASSIFICATION SYSTEM



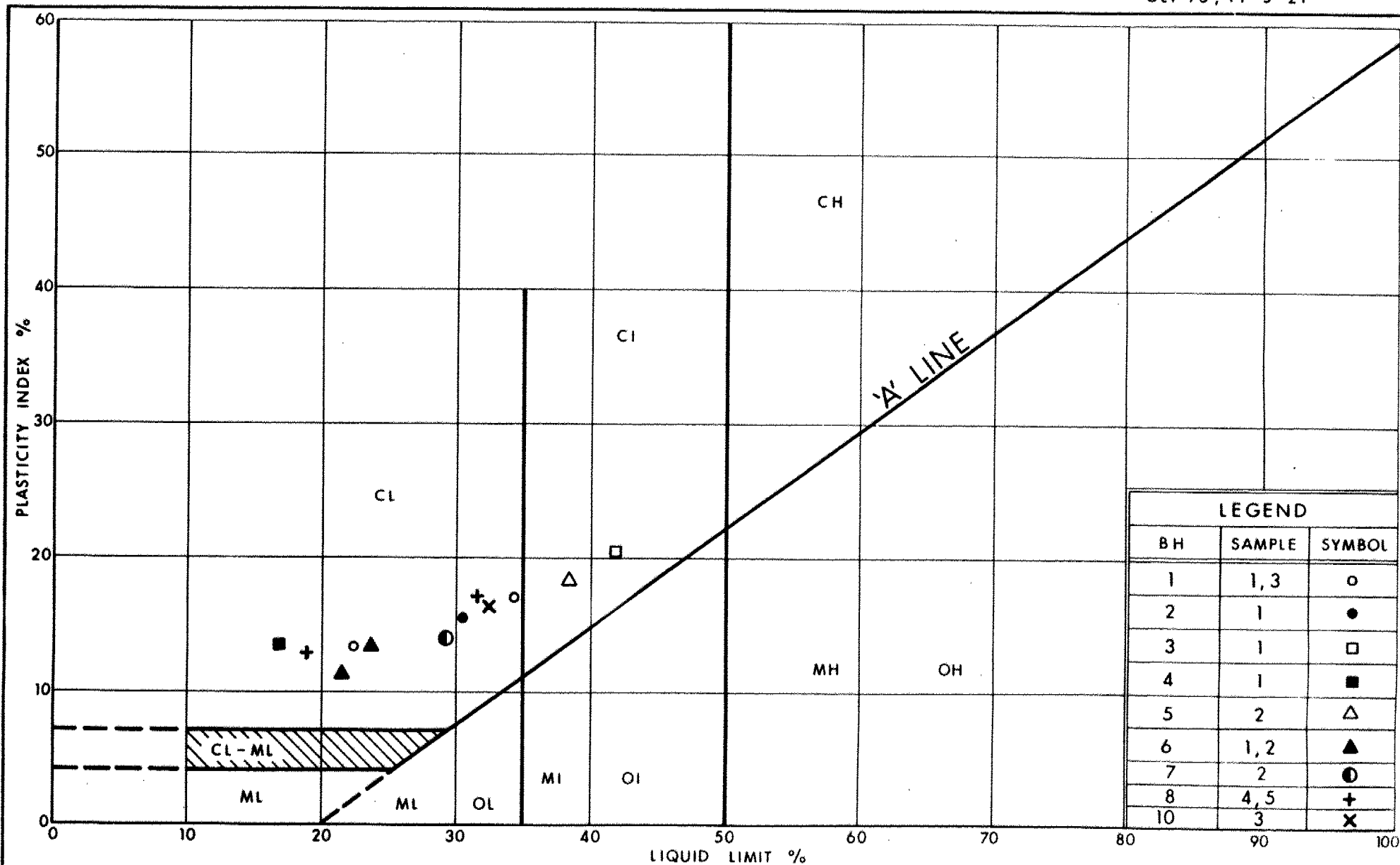
## Ontario

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

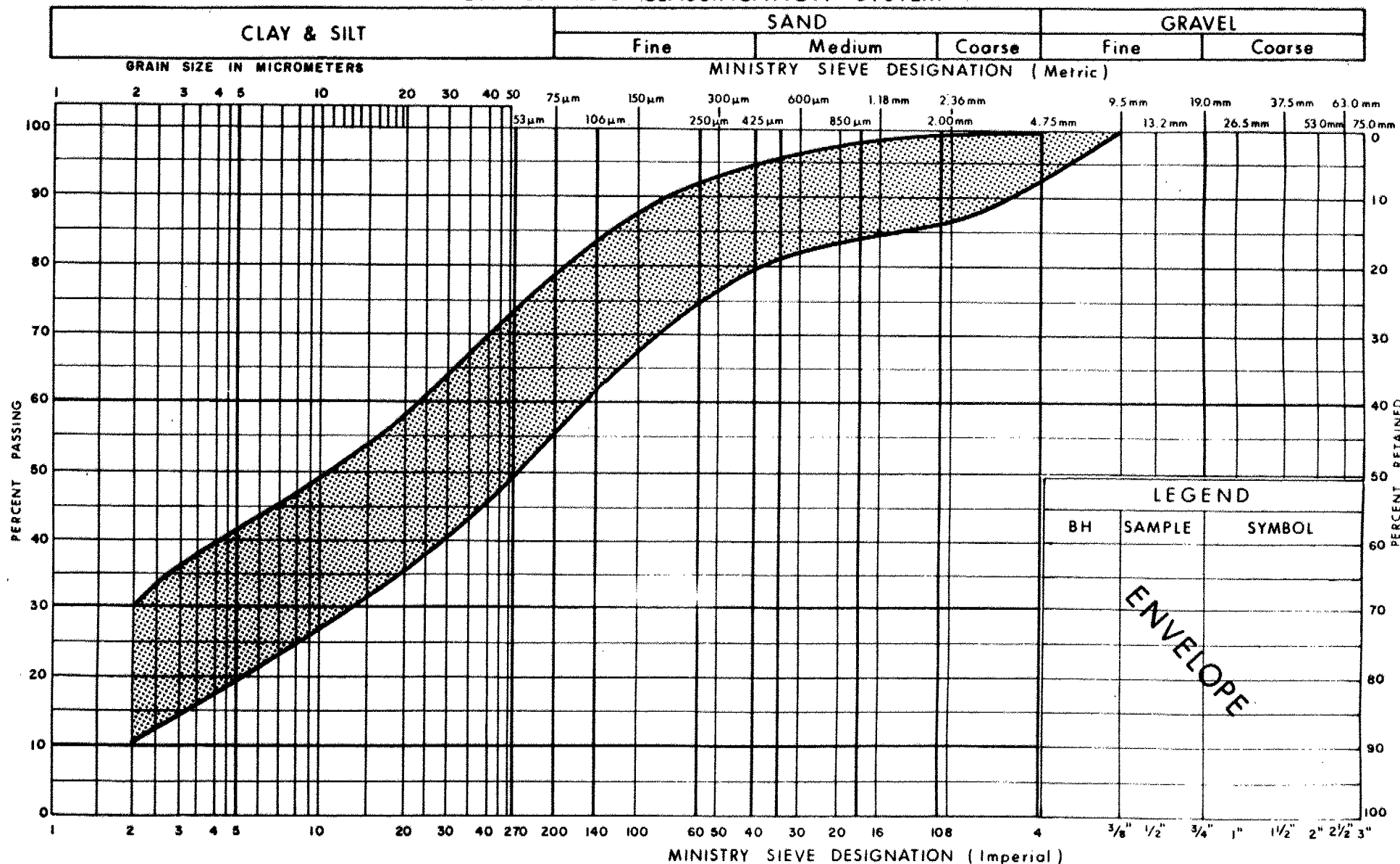
# PLASTICITY CHART HET MIXTURE OF CLAYEY SILT, WITH SAND TRACE GRAVEL (Fill)

FIG No 2

W P 112-87-01



## UNIFIED SOIL CLASSIFICATION SYSTEM

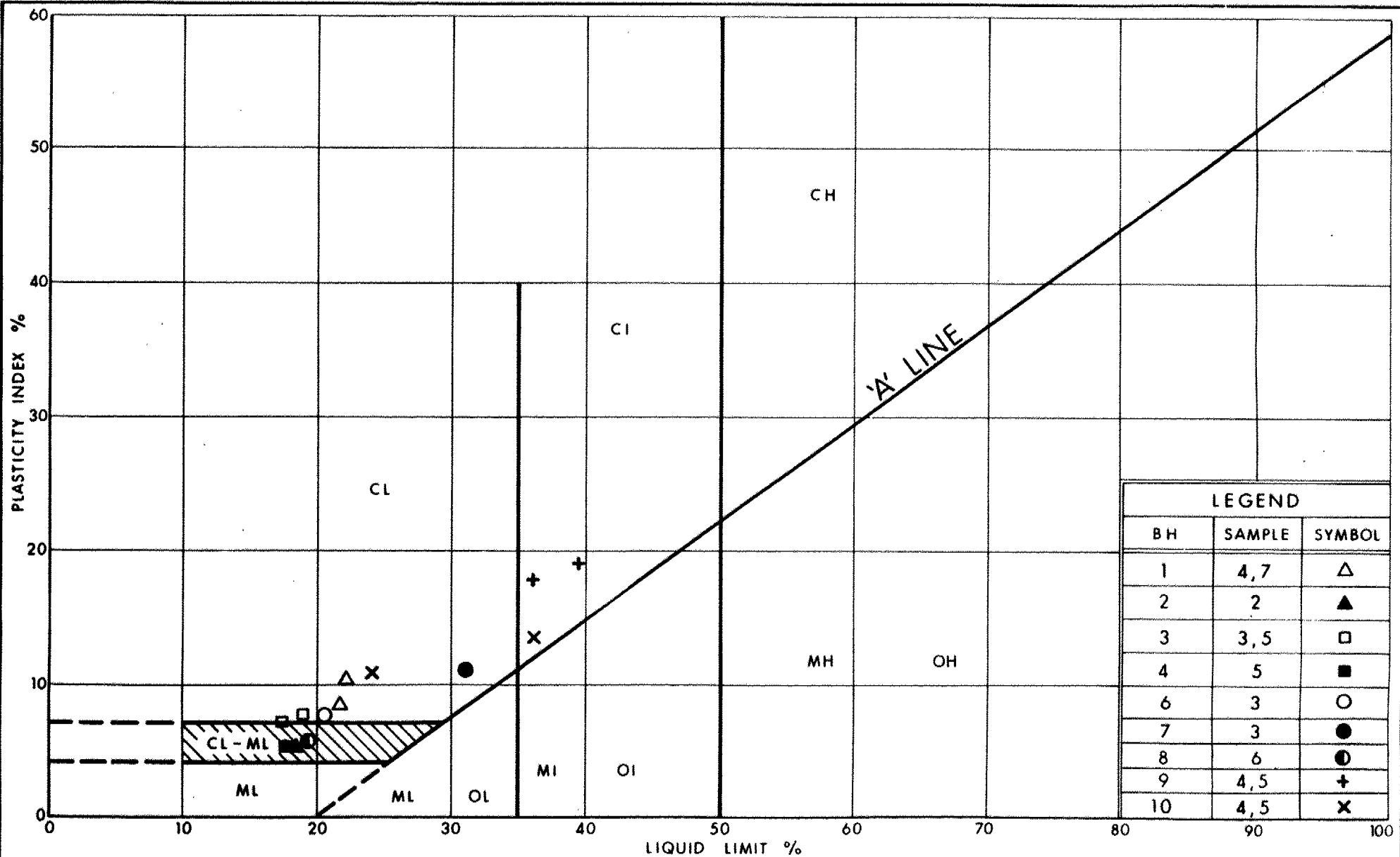


Ministry of  
Transportation

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

FIG No 3

W P 112-87-01

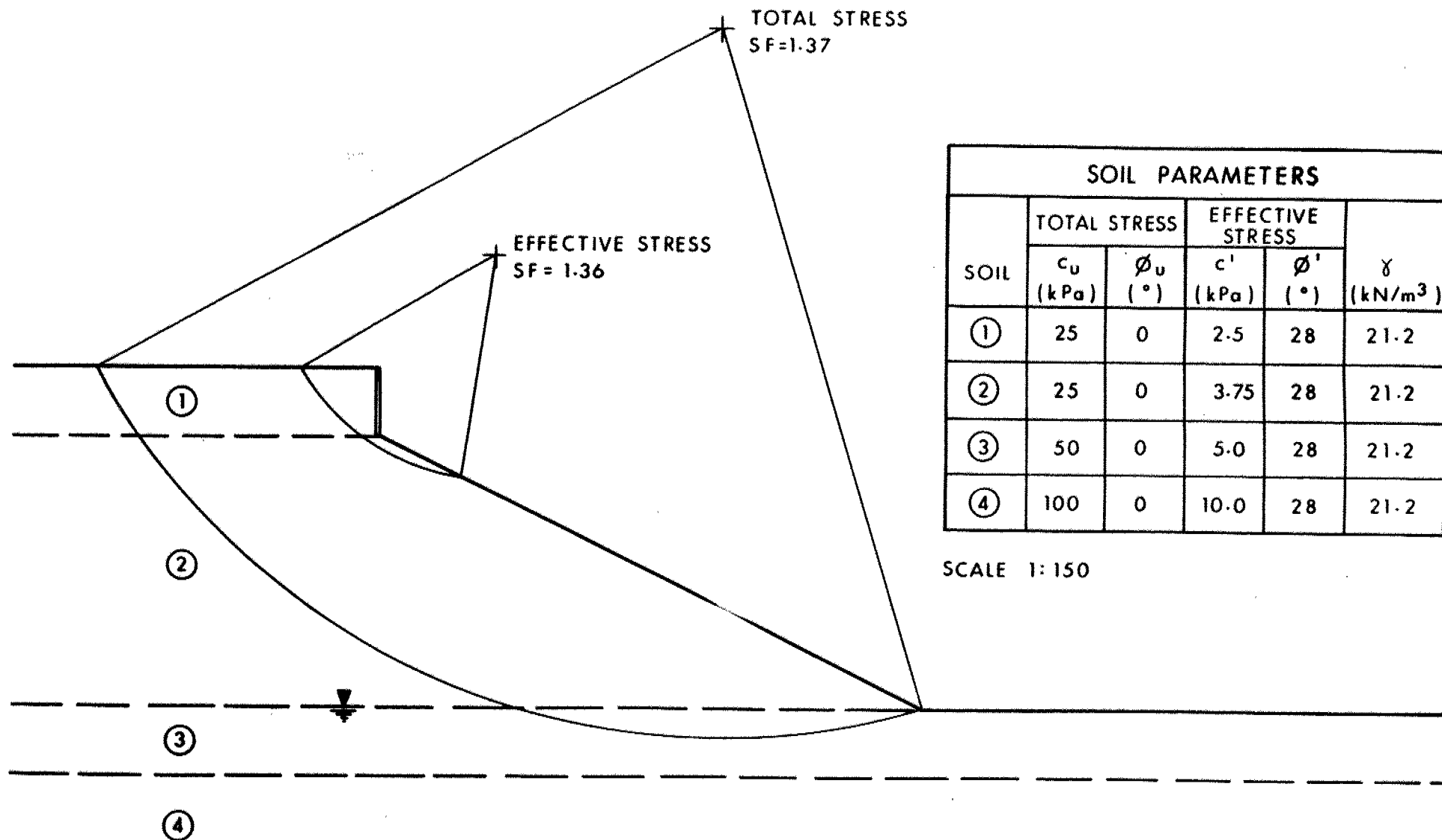


Ministry of  
Transportation  
Ontario

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

FIG No 4

W P 112-87-01



TOTAL AND EFFECTIVE STRESS ANALYSES

## 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

### MECHANICAL PROPERTIES OF SOIL

$m_v$	kPa	COEFFICIENT OF VOLUME CHANGE
$C_c$	1	COMPRESSION INDEX
$C_s$	1	SWELLING INDEX
$C_a$	1	RATE OF SECONDARY CONSOLIDATION
$c_v$	m <sup>2</sup> /s	COEFFICIENT OF CONSOLIDATION
H	m	DRAINAGE PATH
$T_v$	1	TIME FACTOR
U	%	DEGREE OF CONSOLIDATION
$\sigma'_{vo}$	kPa	EFFECTIVE OVERBURDEN PRESSURE
$\sigma'_p$	kPa	PRECONSOLIDATION PRESSURE
$\tau_f$	kPa	SHEAR STRENGTH
$c'$	kPa	EFFECTIVE COHESION INTERCEPT
$\phi'$	-°	EFFECTIVE ANGLE OF INTERNAL FRICTION
$c_u$	kPa	APPARENT COHESION INTERCEPT
$\phi_u$	-°	APPARENT ANGLE OF INTERNAL FRICTION
$\tau_R$	kPa	RESIDUAL SHEAR STRENGTH
$\tau_r$	kPa	REMOULDED SHEAR STRENGTH
$S_t$	1	SENSITIVITY = $\frac{c_u}{\tau_r}$

### STRESS AND STRAIN

$u_w$	kPa	PORE WATER PRESSURE
$r_u$	1	PORE PRESSURE RATIO
$\sigma$	kPa	TOTAL NORMAL STRESS
$\sigma'$	kPa	EFFECTIVE NORMAL STRESS
$\tau$	kPa	SHEAR STRESS
$\sigma_1, \sigma_2, \sigma_3$	kPa	PRINCIPAL STRESSES
$\epsilon$	%	LINEAR STRAIN
$\epsilon_1, \epsilon_2, \epsilon_3$	%	PRINCIPAL STRAINS
E	kPa	MODULUS OF LINEAR DEFORMATION
G	kPa	MODULUS OF SHEAR DEFORMATION
$\mu$	1	COEFFICIENT OF FRICTION

### PHYSICAL PROPERTIES OF SOIL

$\rho_s$	kg/m <sup>3</sup>	DENSITY OF SOLID PARTICLES	e	1, %	VOID RATIO	$e_{min}$	1, %	VOID RATIO IN DENSEST STATE
$\gamma_s$	kn/m <sup>3</sup>	UNIT WEIGHT OF SOLID PARTICLES	n	1, %	POROSITY	$I_D$	1	DENSITY INDEX = $\frac{e_{max} - e}{e_{max} - e_{min}}$
$\rho_w$	kg/m <sup>3</sup>	DENSITY OF WATER	w	1, %	WATER CONTENT	D	mm	GRAIN DIAMETER
$\gamma_w$	kn/m <sup>3</sup>	UNIT WEIGHT OF WATER	$S_r$	%	DEGREE OF SATURATION	$D_n$	mm	n PERCENT - DIAMETER
P	kg/m <sup>3</sup>	DENSITY OF SOIL	$w_L$	%	LIQUID LIMIT	$C_u$	1	UNIFORMITY COEFFICIENT
$\gamma$	kn/m <sup>3</sup>	UNIT WEIGHT OF SOIL	$w_p$	%	PLASTIC LIMIT	h	m	HYDRAULIC HEAD OR POTENTIAL
$\rho_d$	kg/m <sup>3</sup>	DENSITY OF DRY SOIL	$w_s$	%	SHRINKAGE LIMIT	q	m <sup>3</sup> /s	RATE OF DISCHARGE
$\gamma_d$	kn/m <sup>3</sup>	UNIT WEIGHT OF DRY SOIL	$I_p$	%	PLASTICITY INDEX = $w_L - w_p$	v	m/s	DISCHARGE VELOCITY
$\rho_{sat}$	kg/m <sup>3</sup>	DENSITY OF SATURATED SOIL	$I_L$	1	LIQUIDITY INDEX = $\frac{w - w_p}{I_p}$	i	1	HYDRAULIC GRADIENT
$\gamma_{sat}$	kn/m <sup>3</sup>	UNIT WEIGHT OF SATURATED SOIL	$I_C$	1	CONSISTENCY INDEX = $\frac{w_L - w}{I_p}$	k	m/s	HYDRAULIC CONDUCTIVITY
$\rho'$	kg/m <sup>3</sup>	DENSITY OF SUBMERGED SOIL	$e_{max}$	1, %	VOID RATIO IN LOOSEST STATE	j	kn/m <sup>3</sup>	SEEPAGE FORCE
$\gamma'$	kn/m <sup>3</sup>	UNIT WEIGHT OF SUBMERGED SOIL						

# RECORD OF BOREHOLE No 1

METRIC

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

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100				
206.6 0.0	Ground Level															
	Het. Mixture Clayey Silt with Sand Trace Gravel Trace Organics Occ. Silty Clay Zones Stiff to Very Stiff (Fill)		1	SS	9		206									1 15 44 40
203.7 2.9			2	SS	19		204									12 28 48 12
			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		202									
			6	SS	15		200									
			7	SS	11		198									6 23 43 28
			8	SS	39											
195.5 11.1	End of Borehole		9	SS	36		196									

# RECORD OF BOREHOLE No 2

METRIC

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

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT	SHEAR STRENGTH kPa	WATER CONTENT (%)	UNIT WEIGHT	REMARKS & GRAIN SIZE DISTRIBUTION (%)
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. Occ. Silty Clay Zones Firm to Very Stiff (Fill)		1	SS	6							3 34 43 20
204.5			2	SS	17							5 37 38 20
1.8			3	SS	19							
	Het. Mixture Clayey Silt with Sand Trace Gravel Occ. Silt and Sand Zones Occ. Boulders Stiff to Very Stiff (Glacial Till)		4	SS	22							
			5	SS	15							
			6	SS	10							
			7	SS	25							
197.8												
8.5	Sandy Silt to Silty Sand											
196.7			8	SS	24							
9.6	End of Borehole											
	* Trace Gravel Trace Clay Occ. Clayey Silt Zones Compact (Lacustrine)											

OFFICE REPORT ON SOIL EXPLORATION

# 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			PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT Y	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 x LAB VANE						
204.5	Ground Level														GR SA SI CL
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			3	SS	19		200								
	Het. Mixture Clayey Silt with Sand Trace Gravel Occ. Silt and Sand Zones Occ. Boulders Firm to Hard (Glacial Till)		4	SS	25		200								
			5	SS	11		198								4 35 44 17
			6	SS	6										
196.4			7	SS	97										
8.1	End of Borehole														

# 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 <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100				
204.1	Ground Level															
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	Het. Mixture Clayey Silt with Sand Trace Gravel Occ. Silt and Sand Zones Occ. Boulders Very Stiff to Hard (Glacial Till)		3	SS	43		200									
			4	SS	31		200									
			5	SS	120	25 cm	198									1 20 63 16
196.0			6	SS	120											
8.1	End of Borehole															

OFFICE REPORT ON SOIL EXPLORATION



# 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			UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100	PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	
204.5	Ground Level											
0.0	Het. Mixture Clayey Silt with Sand Trace Gravel <u>Asphalt</u> Trace Organics Occ. Silty Clay Zones Very Stiff (Fill)		1	SS	109		204					2 17 43 38
			2	SS	15		202					
201.6			3	SS	19							
2.9			4	SS	20							
	Het. Mixture Clayey Silt with Sand Trace Gravel Occ. Silt and Sand Zones Occ. Boulders Very Stiff to Hard (Glacial Till)		5	SS	25		200					
			6	SS	20		198					
			7	SS	17		196					
194.9			8	SS	48							
9.6	End of Borehole											

# 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 20 40 60 80 100	SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE	PLASTIC LIMIT W <sub>p</sub> NATURAL MOISTURE CONTENT W LIQUID LIMIT W <sub>L</sub> WATER CONTENT (%) 10 20 30	UNIT WEIGHT γ	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 with Sand Trace Gravel Trace Organics		1	SS	12							6 44 32 18
202.3	Occ. Silty Clay Zones Stiff (Fill)		2	SS	10							6 30 50 14
2.1	Het. Mixture Clayey Silt with Sand Trace Gravel Occ. Silt and Sand Zones		3	SS	15							3 36 45 16
	Occ. Boulders Very Stiff to Hard (Glacial Till)		4	SS	22							
			5	SS	56							
			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 W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT Y	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100				
210.2	Ground Level															
0.0	Het. Mixture Clayey Silt with Sand Trace Gravel Trace Organics Occ. Silty Clay Zones Very Stiff (Fill)		1	SS	20	*	210									
			2	SS	18		208									1 22 47 30
206.2			3	SS	21		206									3 37 44 16
4.0	Trace Organics															
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)															

+3, x5: 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 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 W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	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 x LAB VANE					
212.3	Ground Level					*	212							
0.0	Het. Mixture Clayey Silt with Sand Trace Gravel Trace Organics Occ. Silty Clay Zones Soft to Very Stiff (Fill)		1	SS	6		210							
			2	SS	3		208							
			3	SS	22		206							
			4	SS	19		204							
204.4			5	SS	21		202							
7.9	Trace Organics		6	SS	28									
	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



Ministry  
of  
Transportation  
Ontario

# 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

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100				
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															

+3, x5: Numbers refer to  
Sensitivity

20  
15  
10  
5 (%) STRAIN AT FAILURE

OFFICE REPORT ON SOIL EXPLORATION

# RECORD OF BOREHOLE No 10

METRIC

W P 112-87-01 LOCATION Co-ords. N 4 850 768.6; E 304 368.5 ORIGINATED BY KZ  
 DIST 6 HWY 7 BOREHOLE TYPE Hollow Stem Auger COMPILED BY KZ  
 DATUM Geodetic DATE 88 05 02 CHECKED BY \_\_\_\_\_

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT Y	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100				
209.7	Ground Level															
0.0	Het. Mixture Clayey Silt with Sand		1	SS	26	*	208									
	Trace Gravel															
	Trace Organics															
	Occ. Silty Clay Zones		2	SS	17		206									
	Stiff to Very Stiff (Fill)		3	SS	13											3 33 35 29
204.2							204									
5.5	Trace Organics		4	SS	24											4 37 40 19
	Het. Mixt. Clayey Silt with Sand															
	Trace Gravel															
	Occ. Silt & Sand Zones		5	SS	27		202									3 32 40 25
	Occ. Boulders															
	Very Stiff to Hard (Glacial Till)		6	SS	36											
200.1																
9.6	End of Borehole															
	* Water Level not Established															

+<sup>3</sup>, x<sup>5</sup>: Numbers refer to Sensitivity

20  
15  
10  
5 (%) STRAIN AT FAILURE

# 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		PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	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 ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE	WATER CONTENT (%) 10 20 30
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									1 45 40 14		
10.2	Het. Mixture Clayey Silt (CL to CL-ML)		8	SS	21											
200.9	**															
12.6	End of Borehole															
	** with Sand Trace Gravel Occ. Silt and Sand Zones Occ. Boulders Very Stiff (Glacial Till)															
	* Water Level not Established															

OFFICE REPORT ON SOIL EXPLORATION

# 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 ORIGINATED BY KZ  
 DIST 6 HWY 7 BOREHOLE TYPE Hollow Stem Auger COMPILED BY JBF  
 DATUM Geodetic DATE 88 05 04 CHECKED BY

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 (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100	W <sub>p</sub>	W	W <sub>L</sub>	WATER CONTENT (%)		
213.5	Groud Level										10 20 30		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		212							
			2	SS	6		210							
	Clayey Silt		3	SS	22		208					2 36 45 17		
			4	SS	5									
	Clayey Silt		5	SS	6		206					7 32 44 17		
			6	SS	7		204							
203.4	Trace Organics		7	SS	13		202							
10.1	Het. Mixt. 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)													

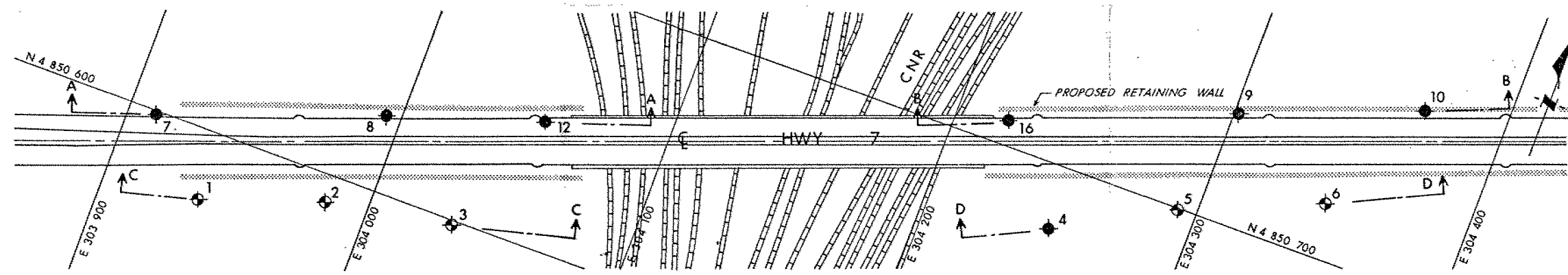


**METRIC**  
DIMENSIONS ARE IN METRES  
AND/OR MILLIMETRES UNLESS  
OTHERWISE SHOWN. STATIONS  
IN KILOMETRES + METRES.

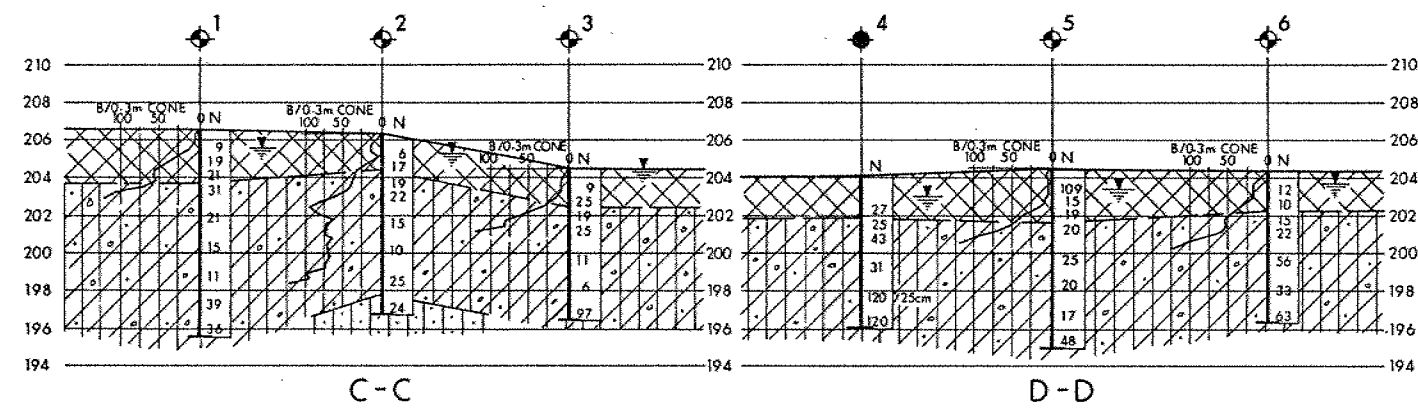
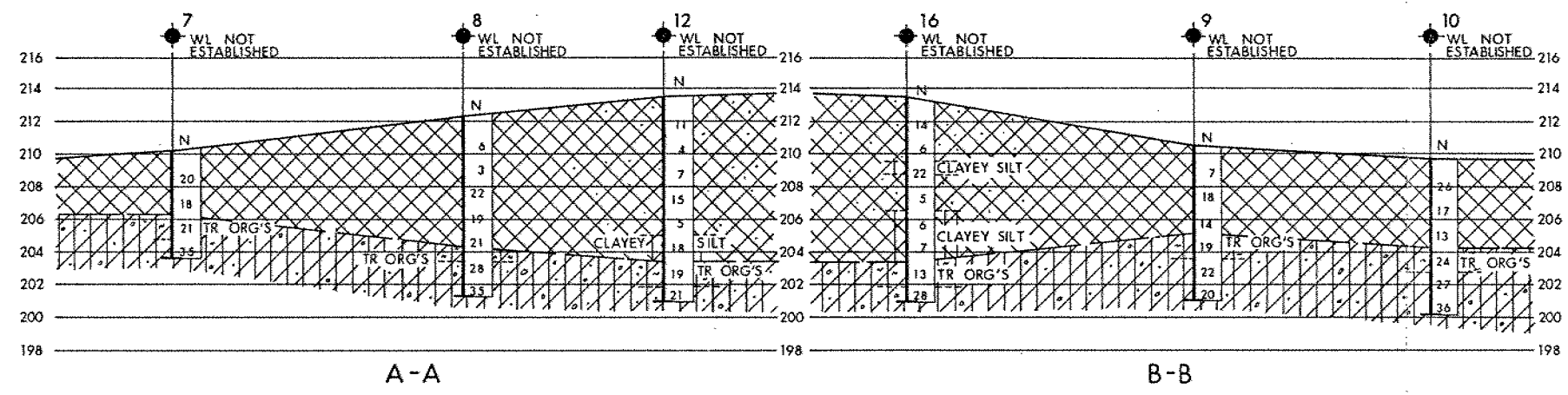
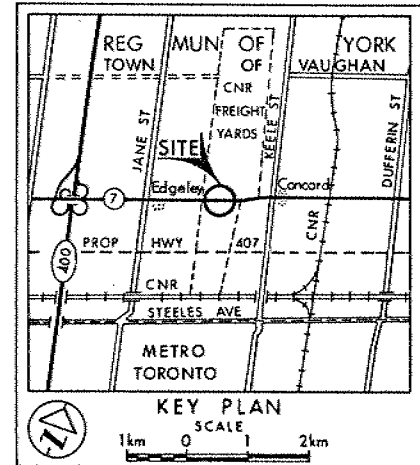
CONT No  
WP No 112-87-01

CNR RETAINING WALLS

BORE HOLE LOCATIONS & SOIL STRATA



PLAN  
SCALE  
20m 10 0 20m



SECTIONS  
SCALE  
20m 10 0 20m Hor  
4m 2 0 4m Vert

**SOIL STRATIGRAPHY LEGEND**

- HETEROGENEOUS MIXTURE  
CLAYEY SILT  
WITH SAND, TRACE GRAVEL  
TRACE ORGANICS  
OCCASIONAL SILTY CLAY ZONES  
Soft to Very Stiff  
(FILL)
- HETEROGENEOUS MIXTURE  
CLAYEY SILT  
WITH SAND, TRACE GRAVEL  
OCCASIONAL SILT AND SAND ZONES  
OCCASIONAL BOULDERS  
Firm to Hard  
(GLACIAL TILL)
- SANDY SILT TO SILTY SAND  
TRACE GRAVEL, TRACE CLAY  
OCCASIONAL CLAYEY SILT ZONES  
Compact  
(LACUSTRINE)

LEGEND			
	Bore Hole		
	Dynamic Cone Penetration Test (Cone)		
	Bore Hole & Cone		
N	Blows/0.3m (3rd Pen Test, 475 J/blow)		
CONE	Blows/0.3m (60° Cone, 475 J/blow)		
	WL at time of investigation 88 04 and 88 05		

No	ELEVATION	CO-ORDINATES NORTH	EAST
1	206.6	4 850 573.1	303 937.2
2	206.3	4 850 589.1	303 983.4
3	204.5	4 850 598.3	304 032.3
4	204.1	4 850 675.6	304 248.3
5	204.5	4 850 699.9	304 292.8
6	204.4	4 850 721.8	304 345.8
7	210.2	4 850 598.0	303 910.5
8	212.3	4 850 628.6	303 993.8
9	210.6	4 850 742.9	304 301.2
10	209.7	4 850 768.6	304 368.5
12	213.5	4 850 647.7	304 052.1
16	213.5	4 850 709.8	304 218.8

**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 30M13-85

HWY No 7	DIST 6
SUBMD DD [CHECKED]	DATE 88 07 21
DRAWN DT [CHECKED]	SITE 37-682
	DWG 1128701-A