

G.I.-30 SEPT. 1976

GEOCRES No. 40 P15-30DIST. 2 REGION W.P. No. 565-91-01CONT. No. 96-77W. O. No. STR. SITE No. 35-77HWY. No. 6LOCATION Hwy 6 & Bells CreekNo of PAGES -=====OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT. REMARKS:



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Stan Bonca
DOMINION SOL.

New WP 565 - 91 - 01

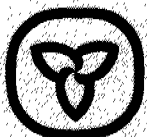
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FOUNDATION INVESTIGATION REPORT

CONTRACT NO. 96-77



Ontario

**Ministry of
Transportation**

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	Foundation Investigation Report for
3 - 18	Bell's Creek Bridge W.P.565-91-01, Site 35-77 Hwy. 6, District 31, London

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

EXPLANATION OF TERMS USED IN REPORT

2

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

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

SOILS ARE DESCRIBED BY THEIR COMPOSITION AND CONSISTENCY OR DENSENESS.

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

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

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

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

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

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

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

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

JOINTING AND BEDDING:

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

ABBREVIATIONS AND SYMBOLS

FIELD SAMPLING

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

STRESS AND STRAIN

u_w	kPa	PORE WATER PRESSURE
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_t	1	SENSITIVITY = $\frac{c_u}{\tau_r}$

PHYSICAL PROPERTIES OF SOIL

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

FOUNDATION INVESTIGATION REPORT

For

Bell's Creek Bridge

W.P. 565-91-01; Site 35-77

Highway 6, District 2, LondonINTRODUCTION

This report contains the results of a foundation investigation carried out at the above mentioned site. The field work was carried out between 1992 12 08 and 1992 12 11, and comprised of three sampled boreholes and Dynamic Cone Penetration Test adjacent to two of these holes. In addition, Dynamic Cone Penetration Test was carried out at two locations.

Boreholes were advanced to a maximum depth of 16.9 m (E1: 413.4 m) below the existing ground level using a 82 mm I.D. continuous flight hollow stem auger.

SITE DESCRIPTION

The site under investigation is located at the crossing of Highway 6 and Bell's Creek in the Township of Arthur, County of Wellington.

The topography of the site, with the exception of the existing crossing (approach fill), is generally flat to gently undulating. The site was modified to the present condition by the construction of the existing bridge and during the construction of this structure, the creek was diverted to the present location. Physiographically, the area is located in the region known as the "Dundalk Till Plain".

SUBSURFACE CONDITIONS

The underlying subsoil at this site consists of 1.3 m to 2.5 m compact to dense granular fill underlain by 0.8 m to 1.9 m compact to dense gravelly sand, with varying proportions of silt. The gravelly sand is underlain by 4.6 m to 5.8 m compact to dense sand to silty sand which overlies very dense heterogeneous mixture of silt, sand and gravel (glacial till). For classification purposes, the soils encountered at this site can be divided into four different zones.

- a) Silty Sand, With Gravel (Fill)
- b) Gravelly Sand, Some Silt
- c) Sand to Silty Sand, Trace Gravel
- d) Heterogeneous Mixture of Silt, Sand and Gravel (Glacial Till)

The soils encountered during the course of the investigation, together with the field and laboratory test results are shown on the Record of Borehole sheets contained in the Appendix of this report. A stratigraphical section is shown on Drawing No. 5659101-A.* This drawing also shows the locations and elevations of the borings. Description of the strata encountered are given below.

Silty Sand, With Gravel (Fill)

This fill which was placed to raise the finished grade of Highway 6, consists of silty sand with gravel. The thickness of the fill varies from 1.3 m to 2.5 m and extends to elevation 427.8 m to 426.6 m. The Standard Penetration Test results indicate that this fill is in compact to dense state of denseness ('N' values 9 blows/0.3 m to 35 blows/0.3 m).

* Dwg No 2, (Sheet 74-1) of the Contract Drawings.

Gravelly Sand, Some Silt

This gravelly sand deposit was encountered immediately below the fill. The thickness of this deposit varies from 0.8 m to 1.9 m and extends to elevation 426.0 m to 425.3 m. The results of the Gradation Test carried out on a representative soil sample is shown on Figure 1. The Standard Penetration Test results in this deposit (22 blows/0.3 m to 44 blows/0.3 m) indicate compact to dense state of denseness.

Sand To Silty Sand, Trace Gravel

The gravelly sand deposit is underlain by this sand to silty sand layer. The thickness of this layer varies from a minimum of 4.6 m to a maximum of 5.8 m and extends to elevation 420.7 to 420.2 m. In this stratum, occasional clayey silt layers varying in thickness from a few millimetres to a maximum of 400 mm were encountered. The Atterberg Limit Test result is shown on Figure 2. The Gradation Test results are shown on Figure 3 in an envelope form. These test results indicate that this deposit is predominantly composed of sand (57% to 71%). The Standard Penetration Test results in this stratum varies over a wide range (13 blows/0.3 m to 48 blows/0.3 m) and indicate compact to dense state of denseness.

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

The upper boundary of this deposit was encountered between El: 420.7 m and El: 420.2 m. The Gradation Test carried out on representative soil samples are shown on Figure 4. These results indicate 10% to 20% gravel, 29% to 34% sand and 51% to 56% silt. The Standard Penetration Test results indicate very dense state of denseness ('N' values over 100 blows/0.3 m). The full extent of this deposit was not proven below El: 413.4 m.

Groundwater Conditions

The groundwater level measurements were taken in open boreholes during the investigation and was observed between El: 428.3 m and El: 427.3 m. Seasonal fluctuation of the groundwater level may be expected due to the influence of the creek. The groundwater level at each borehole location is as follows:

<u>Borehole No.</u>	<u>Elevation</u>
1	428.3 m
3	427.3 m
4	427.8 m

MISCELLANEOUS

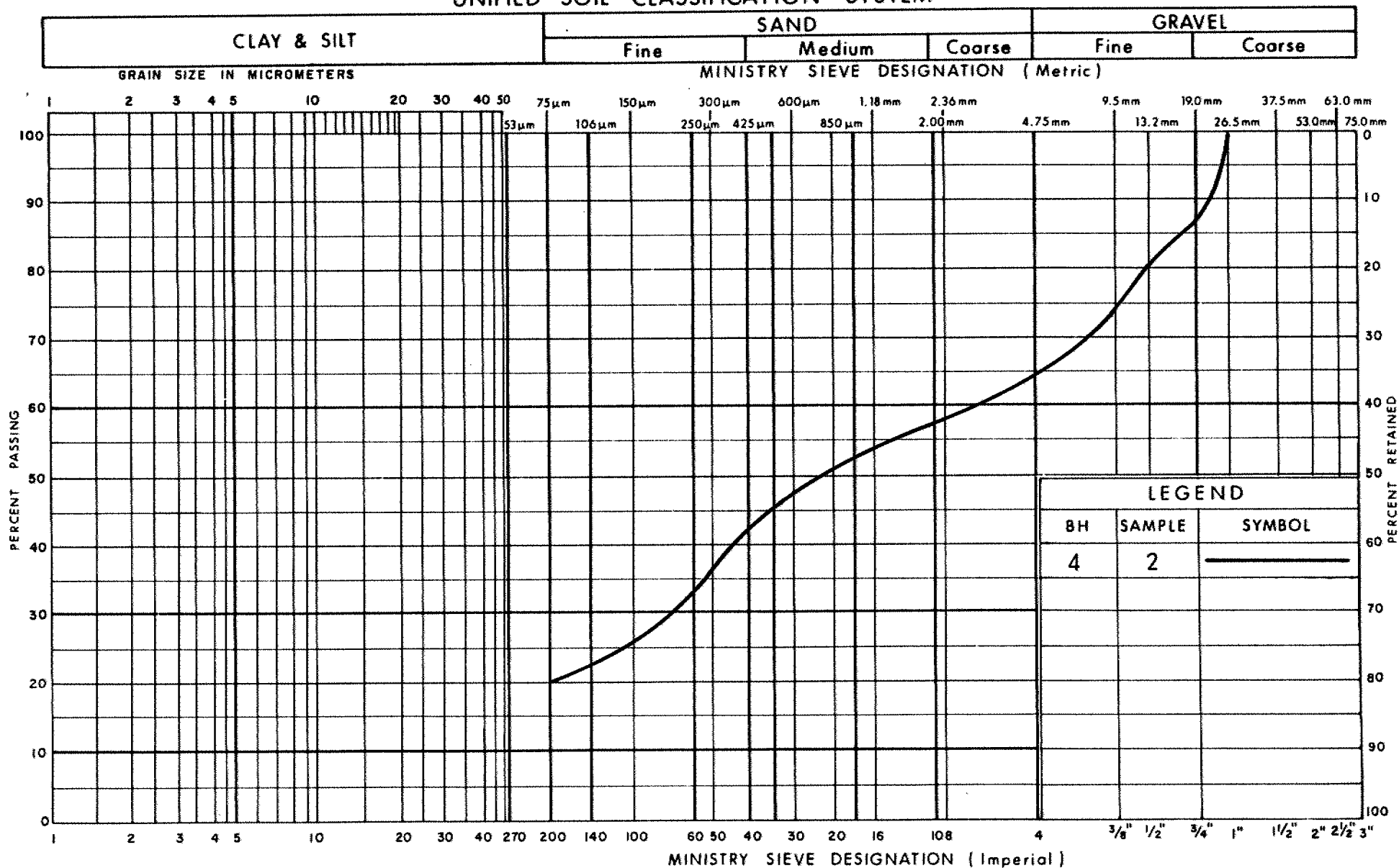
The field work for this investigation was carried out under the supervision of M. Vasavithasan. The equipment used was owned and operated by Dominion Soil Investigation Inc. This report was prepared by M. Vasavithasan, Foundation Engineer and reviewed by P. Payer, Senior Foundation Engineer and approved by M. Devata, Chief Foundation Engineer.



Tae Chul Kim
T.C. Kim, P. Eng.
Senior Foundation Engineer

APPENDIX

UNIFIED SOIL CLASSIFICATION SYSTEM

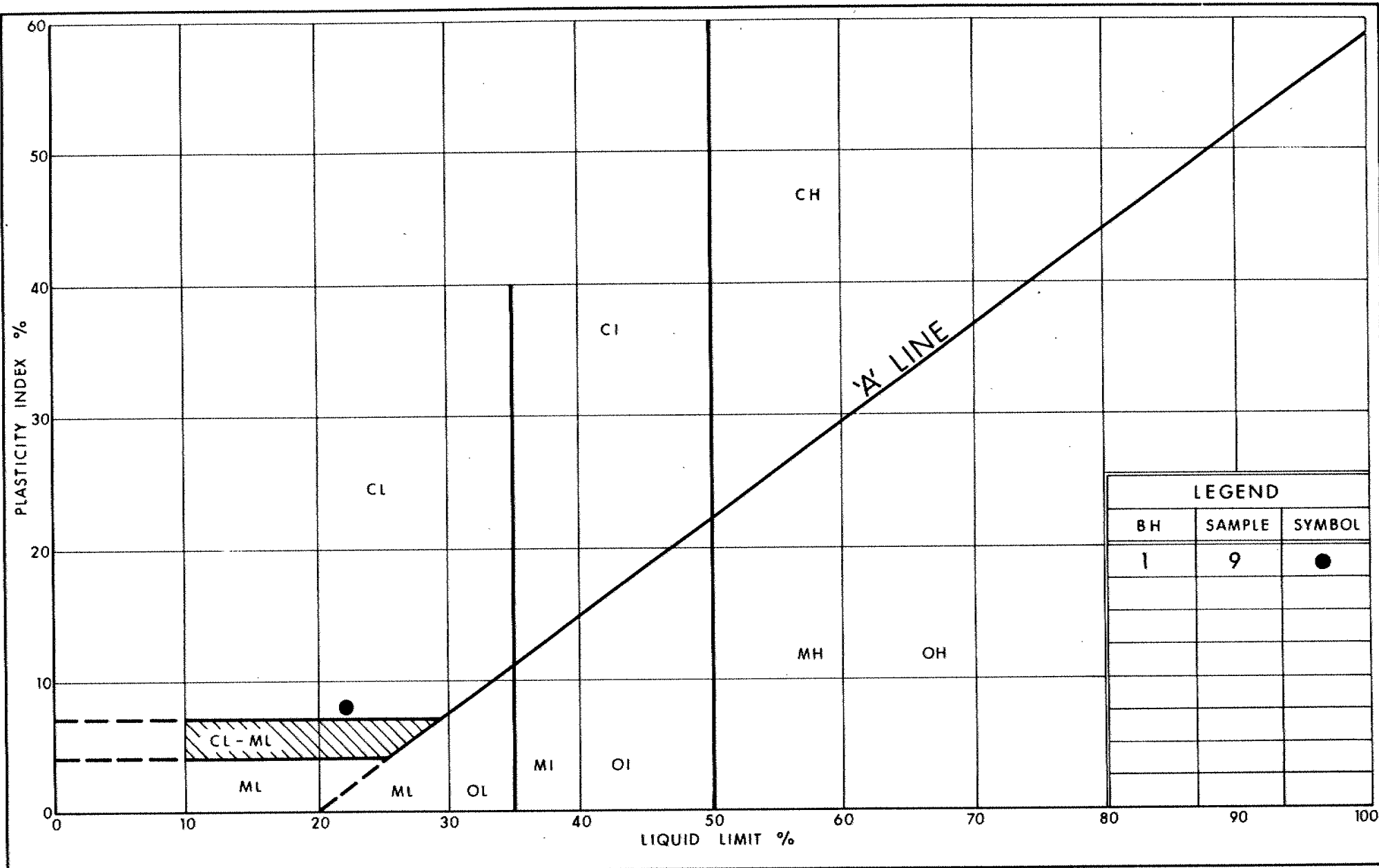


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GRAIN SIZE DISTRIBUTION
GRAVELLY SAND, SOME SILT

FIG No 1

W P 565 - 91 - 01



LEGEND		
BH	SAMPLE	SYMBOL
1	9	●



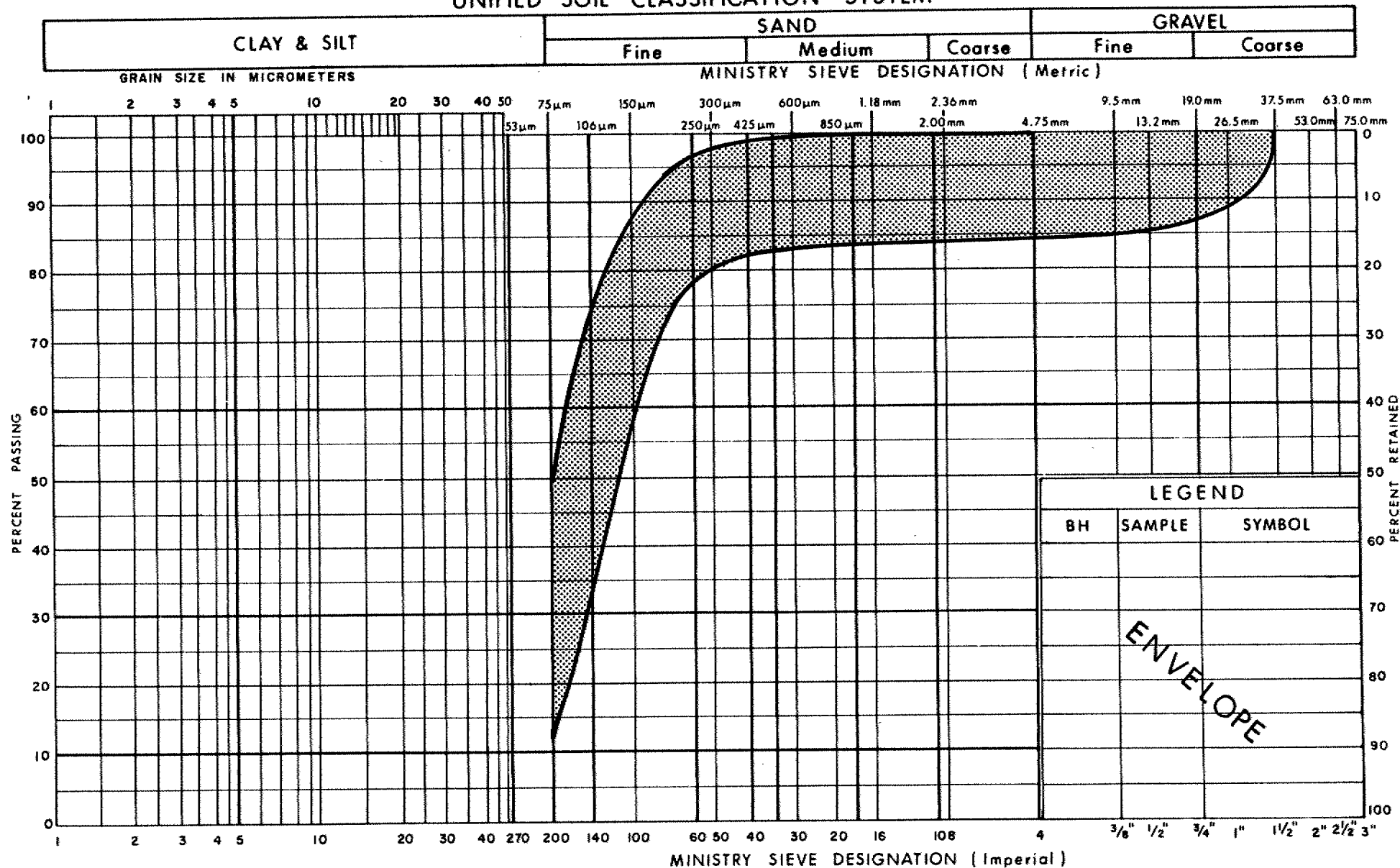
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PLASTICITY CHART CLAYEY SILT, TRACE OF SAND

FIG No 2

W P 565-91-01

UNIFIED SOIL CLASSIFICATION SYSTEM



Ontario

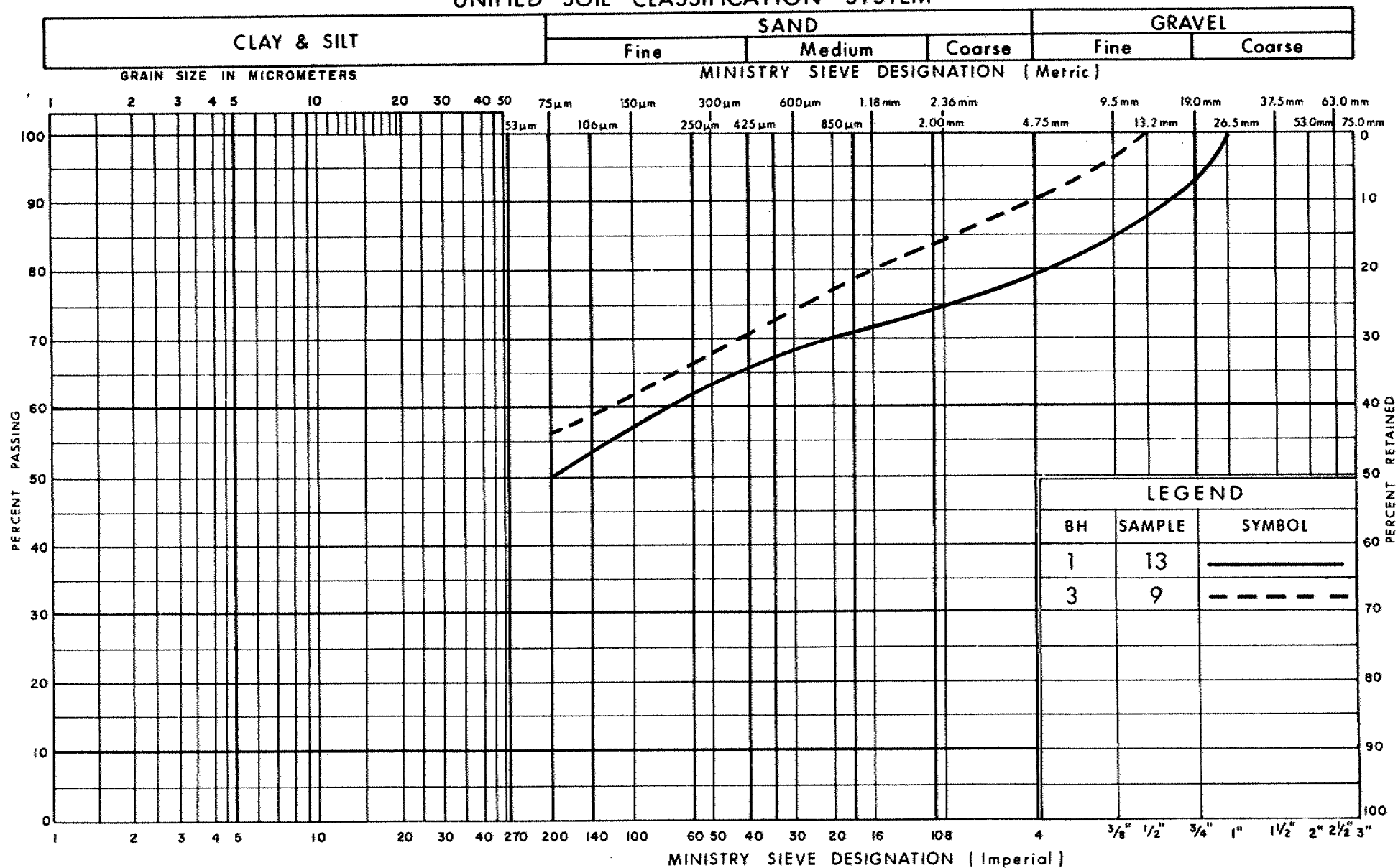
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GRAIN SIZE DISTRIBUTION
SAND TO SILTY SAND
 TRACE OF GRAVEL

FIG No 3

W P 565 - 91-01

UNIFIED SOIL CLASSIFICATION SYSTEM



GRAIN SIZE DISTRIBUTION
 HET MIXTURE OF
 GRAVEL, SAND & SILT (Glacial Till)

FIG No 4

W P 565-91-01



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RECORD OF BOREHOLE No 1

1 OF 2

METRIC

W.P. 565 - 91 - 01 LOCATION Co-ords: N 4 866 023.4; E 210 287.7 ORIGINATED BY M V
DIST 2 HWY 6 BOREHOLE TYPE HOLLOW STEM AUGER, WASHBORING & CONE TEST COMPILED BY M V
DATUM GEODETIC DATE 92 12 08 & 09 CHECKED BY P P

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES		20 40 60 80 100	20 40 60 80 100					
430.3	Ground Surface												
0.0													
	SILTY SAND, With Gravel, Compact, (Fill)		1	SS	28								40 41 (19)
			2	SS	30								
427.8			3	SS	14								
2.5	GRAVELLY SAND, Some Silt, Dense to Compact		4	SS	40								
			5	SS	22								
426.0			6	SS	15								
4.3	SAND to SILTY SAND, Trace of Gravel, Occasional Clayey Silt Layers, Compact to Very Dense		7	SS	18								
			8	SS	13								4 58 (38)
	Clayey Silt, Tr. of Sand		9	SS	28								
			10	SS	100	/11cm							
420.2			11	SS	70	/15cm							
10.1			12	SS	100	/14cm							
	Heterogeneous Mixture of SILT, SAND and GRAVEL, Very Dense (Glacial Till)		13	SS	100	/11cm							20 29 (51)
415.1													

15.2

Continued .

+3, x5 : Numbers refer to
Sensitivity

20
15-5 (x) STRAIN AT FAILURE
10

Continued

RECORD OF BOREHOLE No 1

2 OF 2

METRIC

W.P. 565 - 91 - 01 LOCATION Co-ords: N 4 866 023.4; E 210 287.7 ORIGINATED BY M.V.
DIST 2 HWY 6 BOREHOLE TYPE HOLLOW STEM AUGER, WASHBORING & CONE TEST COMPILED BY M.V.
DATUM GEODETIC DATE 92 12 08 & 09 CHECKED BY P.P.

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ 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					
415.1	Continued															
15.2	Heterogeneous Mixture of SILT, SAND and GRAVEL, Very Dense (Glacial Till)					415										
413.4						414										
16.9	End of Borehole															

RECORD OF BOREHOLE No 2

1 OF 1

METRIC

W.P. 565 - 91 - 01 LOCATION Co-ords: N 4 866 003.9; E 210 323.0 ORIGINATED BY M.V.
DIST 2 HWY 6 BOREHOLE TYPE CONE TEST COMPILED BY M.V.
DATUM GEODETIC DATE 92 12 10 CHECKED BY P.P.

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			20 40 60 80 100	20 40 60 80 100	W _P W W _L	WATER CONTENT (%) 10 20 30			
429.3	Ground Surface													
0.0	Probable SILTY SAND, With Gravel, (Fill)													
427.9														
1.4	Probable GRAVELLY SAND, Some Silt,													
425.7														
3.6	Probable SAND to SILTY SAND, Trace of Gravel, Occasional Clayey Silt Layers													
420.8														
8.5	Probable Heterogeneous Mixture of SILT, SAND and GRAVEL, (Glacial Till)													
419.5														
9.8	End of Cone Test													

RECORD OF BOREHOLE No 3

1 OF 1

METRIC

W.P. 565 - 91 - 01 LOCATION Co-ords: N 4 865 985.7; E 210 321.5 ORIGINATED BY M V
 DIST 2 HWY 6 BOREHOLE TYPE HOLLOW STEM AUGER, WASHBORING & CONE TEST COMPILED BY M V
 DATUM GEODETIC DATE 92 12 10 & 11 CHECKED BY P P

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
428.7	Ground Surface																
0.0	SILTY SAND, With Gravel, Compact to Dense (FIII)		1	SS	23		428										
426.6			2	SS	35		427										
2.1	GRAVELLY SAND, Some Silt, Dense		3	SS	44		426										
425.8			4	SS	48		425										
2.9	SAND to SILTY SAND, Trace of Gravel, Occasional Clayey Silt Layers, Compact to Dense	Clayey Silt	5	SS	21		424										0 89 (31)
			6	SS	19		423										
			7	SS	15		422										
			8	SS	35		421										
420.7	Heterogeneous Mixture of SILT, SAND and GRAVEL, Very Dense (Glacial Till)		9	SS	72	/15cm	420										10 34 (56)
8.0			10	SS	76		419										
416.3	End of Borehole					/5cm	418										
12.4							417										

RECORD OF BOREHOLE No 4

1 OF 1

METRIC

W.P. 565 - 91 - 01 LOCATION Co-ords: N 4 865 995.0; E 210 305.7 ORIGINATED BY M V
DIST 2 HWY 6 BOREHOLE TYPE CONTINUOUS FLIGHT HOLLOW STEM AUGER COMPILED BY M V
DATUM GEODETIC DATE 92 12 11 CHECKED BY P P

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	WATER CONTENT (%) 7	UNIT WEIGHT kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100						
428.5	Ground Surface																	
0.0	SILTY SAND, Trace of Gravel, Organics, Loose, (Fill)		1	SS	9		428											7 43 (50)
427.2			2	SS	40		427											38 44 (20)
1.3	GRAVELLY SAND, Some Silt, Dense		3	SS	32		426											
425.3			4	SS	37		425											
3.2	Clayey Silt		5	SS	24		424											15 71 (14)
	SAND to SILTY SAND, Trace of Gravel, Occasional Clayey Silt Layers, Compact		6	SS	22		423											0 57 (43)
			7	SS	16		422											
			8	SS	21		421											
420.7			9	SS	59													
420.4	Het.Mix of SILT, SAND & GRAVEL, (Glacial Till) Very Dense																	
8.1	End of Borehole																	

RECORD OF BOREHOLE No 5

1 OF 1

METRIC

W.P. 565 - 91 - 01 LOCATION Co-ords: N 4 886 000.5; E 210 290.4 ORIGINATED BY M V
DIST 2 HWY 6 BOREHOLE TYPE CONE TEST COMPILED BY M V
DATUM GEODETIC DATE 92 12 11 CHECKED BY P P

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 × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	WATER CONTENT (%) 10 20 30	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES									
428.6	Ground Surface													
0.0	Probable SILTY SAND, With Gravel, (Fill)													
427.3														
1.3	Probable GRAVELLY SAND, Some Silt													
425.7														
2.9	Probable SAND to SILTY SAND, Trace of Gravel, Occasional Clayey Silt Layers													
422.5														
6.1	End of Cone Test													

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FOUNDATION DESIGN SECTION

**foundation
investigation and
design report**

File

ENGINEERING MATERIALS OFFICE
FOUNDATION DESIGN SECTION

WP 565-91-01

DIST 2

HWY 6

STR SITE 35-77

Bell's Creek Bridge

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FOUNDATION INVESTIGATION REPORT

For

Bell's Creek Bridge

W.P. 565-91-01; Site 35-77

Highway 6, District 2, London

INTRODUCTION

This report contains the results of a foundation investigation carried out at the above mentioned site. The field work was carried out between 1992 12 08 and 1992 12 11, and comprised of three sampled boreholes and Dynamic Cone Penetration Test adjacent to two of these holes. In addition, Dynamic Cone Penetration Test was carried out at two locations.

Boreholes were advanced to a maximum depth of 16.9 m (El: 413.4 m) below the existing ground level using a 82 mm I.D. continuous flight hollow stem auger.

SITE DESCRIPTION

The site under investigation is located at the crossing of Highway 6 and Bell's Creek in the Township of Arthur, County of Wellington.

The topography of the site, with the exception of the existing crossing (approach fill), is generally flat to gently undulating. The site was modified to the present condition by the construction of the existing bridge and during the construction of this structure, the creek was diverted to the present location. Physiographically, the area is located in the region known as the "Dundalk Till Plain".

SUBSURFACE CONDITIONS

The underlying subsoil at this site consists of 1.3 m to 2.5 m compact to dense granular fill underlain by 0.8 m to 1.9 m compact to dense gravelly sand, with varying proportions of silt. The gravelly sand is underlain by 4.6 m to 5.8 m compact to dense sand to silty sand which overlies very dense heterogeneous mixture of silt, sand and gravel (glacial till). For classification purposes, the soils encountered at this site can be divided into four different zones.

- a) Silty Sand, With Gravel (Fill)
- b) Gravelly Sand, Some Silt
- c) Sand to Silty Sand, Trace Gravel
- d) Heterogeneous Mixture of Silt, Sand and Gravel (Glacial Till)

The soils encountered during the course of the investigation, together with the field and laboratory test results are shown on the Record of Borehole sheets contained in the Appendix of this report. A stratigraphical section is shown on Drawing No. 5659101-A. This drawing also shows the locations and elevations of the borings. Description of the strata encountered are given below.

Silty Sand, With Gravel (Fill)

This fill which was placed to raise the finished grade of Highway 6, consists of silty sand with gravel. The thickness of the fill varies from 1.3 m to 2.5 m and extends to elevation 427.8 m to 426.6 m. The Standard Penetration Test results indicate that this fill is in compact to dense state of denseness ('N' values 9 blows/0.3 m to 35 blows/0.3 m).

Gravelly Sand, Some Silt

This gravelly sand deposit was encountered immediately below the fill. The thickness of this deposit varies from 0.8 m to 1.9 m and extends to elevation 426.0 m to 425.3 m. The results of the Gradation Test carried out on a representative soil sample is shown on Figure 1. The Standard Penetration Test results in this deposit (22 blows/0.3 m to 44 blows/0.3 m) indicate compact to dense state of denseness.

Sand To Silty Sand, Trace Gravel

The gravelly sand deposit is underlain by this sand to silty sand layer. The thickness of this layer varies from a minimum of 4.6 m to a maximum of 5.8 m and extends to elevation 420.7 to 420.2 m. In this stratum, occasional clayey silt layers varying in thickness from a few millimetres to a maximum of 400 mm were encountered. The Atterberg Limit Test result is shown on Figure 2. The Gradation Test results are shown on Figure 3 in an envelope form. These test results indicate that this deposit is predominantly composed of sand (57% to 71%). The Standard Penetration Test results in this stratum varies over a wide range (13 blows/0.3 m to 48 blows/0.3 m) and indicate compact to dense state of denseness.

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

The upper boundary of this deposit was encountered between El: 420.7 m and El: 420.2 m. The Gradation Test carried out on representative soil samples are shown on Figure 4. These results indicate 10% to 20% gravel, 29% to 34% sand and 51% to 56% silt. The Standard Penetration Test results indicate very dense state of denseness ('N' values over 100 blows/0.3 m). The full extent of this deposit was not proven below El: 413.4 m.

Groundwater Conditions

The groundwater level measurements were taken in open boreholes during the investigation and was observed between El: 428.3 m and El: 427.3 m. Seasonal fluctuation of the groundwater level may be expected due to the influence of the creek. The groundwater level at each borehole location is as follows:

<u>Borehole No.</u>	<u>Elevation</u>
1	428.3 m
3	427.3 m
4	427.8 m

DISCUSSION AND RECOMMENDATIONS

General

The CPR line at the crossing of Highway 6 and Bell's Creek is no longer in use and it is proposed to replace the existing overpass to lower the vertical alignment of Highway 6. The replacement bridge will be a single span rigid frame or beam type structure. In both alternatives, the clear span between the face of the abutments will be about 12.0 m. The proposed finished grade of Highway 6 is set at El: 435 m± which is about 5.0 m lower than the existing grade.

It is understood that the approach fill at the inlet and outlet of the bridge will be protected by short wing walls and about 5.0 m high gabion walls.

The approach embankments as well as the bridge deck and the abutments appear in very good condition. However, minor cracks have been noticed on the grade beam of the centre piers.

Based on the information available in this office, the existing structure is supported on 273 mm O.D., 5 mm thick, closed-end steel tube piles filled with concrete. The piles are founded approximately at El: 417.0 m±.

Structure Foundations

Considering the subsoil conditions at this site and the scouring properties of the soil encountered, it is recommended that the abutments be supported on piles driven to about El: 418.0 m±. The following bearing capacity values are recommended for the design of the pile foundation.

	<u>HP310x110</u>	<u>HP310x79</u>
Factored Axial Capacity at U.L.S.	1600 kN	1150 kN
Axial Capacity at S.L.S.	1150 kN	900 kN

Driving of piles shall be carefully monitored and controlled employing the Hiley Dynamic Pile Driving formula driven in accordance with MTO Standards SS103-10 or SS103-11 assuming an ultimate capacity as follows:

<u>Pile Type</u>	<u>Ultimate Capacity (kN)</u>
HP310x110	3450
HP310x79	2700

The gabions at both inlet and outlet of the bridge may be placed at about elevation 426.5 and designed assuming the following bearing capacity values, provided that the width of the gabion is not less than 3.0 m and the base of the gabion is protected from erosion.

Factored Bearing Capacity at U.L.S.	= 225 kPa
Bearing Capacity at S.L.S.	= 175 kPa

The sliding resistance may be estimated using an unfactored coefficient of friction value of $\tan 28^\circ$.

A properly designed filter should be provided at the back as well as underlying gabion to prevent loss of fines from the fill.

Earth pressure should be computed as per Section 6.7.4.5 of the Code and an unyielding foundation condition may be assumed for the computations. The granular "A" or "B" backfill should be in accordance with the Special Provision No. 109F03. The following parameters are recommended for the granular backfill.

	<u>Granular 'A'</u>	<u>Granular 'B'</u>
Angle of Internal Friction	$\phi = 35^\circ$	$\phi = 30^\circ$
Unit Weight (kN/m ³)	$\gamma = 22.8$	$\gamma = 21.2$

Approach Embankment

The proposed finished grade of Highway 6 is set at El: 435 m which is about 5.0 m lower than the existing grade. However, the maximum height of approach fill is expected to be about 6.5 m. No major stability problems are anticipated for the approach embankments constructed with 2 horizontal to 1 vertical side slopes. The fill should consist of well compacted acceptable material. The topsoil as well as any spongy or soft areas observed within the base width of the embankment should be removed before placing the fill.

Other Considerations

The pile caps should have a minimum of 1.5 m earth cover for the frost protection.

The pile caps will have to be constructed below creek water level and a dewatering scheme will be required. The dewatering may be readily handled by pumping from the sump.

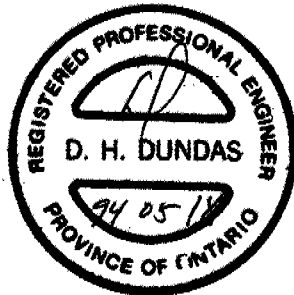
MISCELLANEOUS

The field work for this investigation was carried out under the supervision of M. Vasavithasan. The equipment used was owned and operated by Dominion Soil Investigation Inc.. This report was prepared by M. Vasavithasan, Foundation Engineer and reviewed by P. Payer, Senior Foundation Engineer and approved by M. Devata, Chief Foundation Engineer.



M. Vasavithasan

M. Vasavithasan, P.Eng.
Foundation Engineer

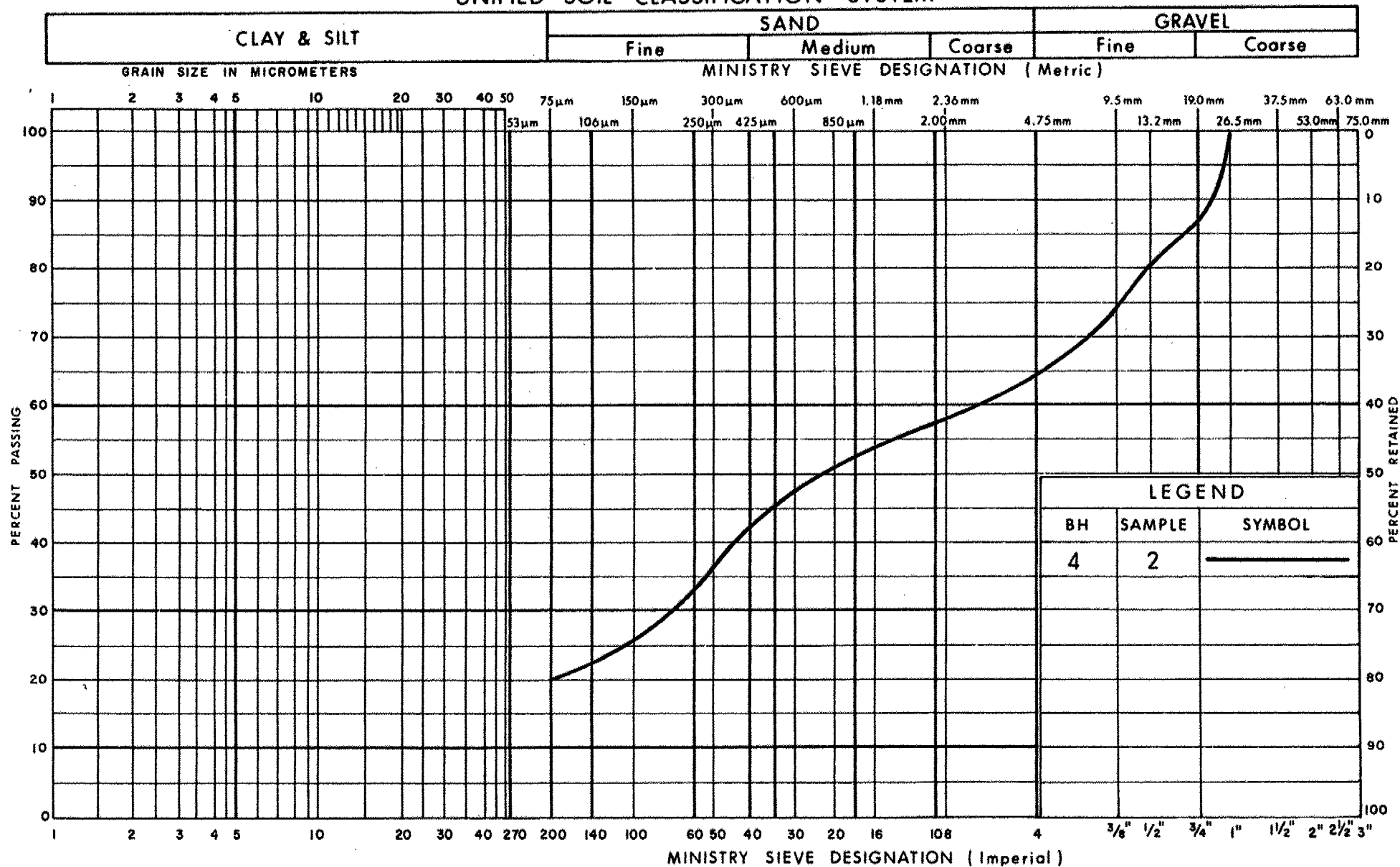


D. Dundas

M. Devata, P.Eng.
Chief Foundation Engineer

APPENDIX

UNIFIED SOIL CLASSIFICATION SYSTEM

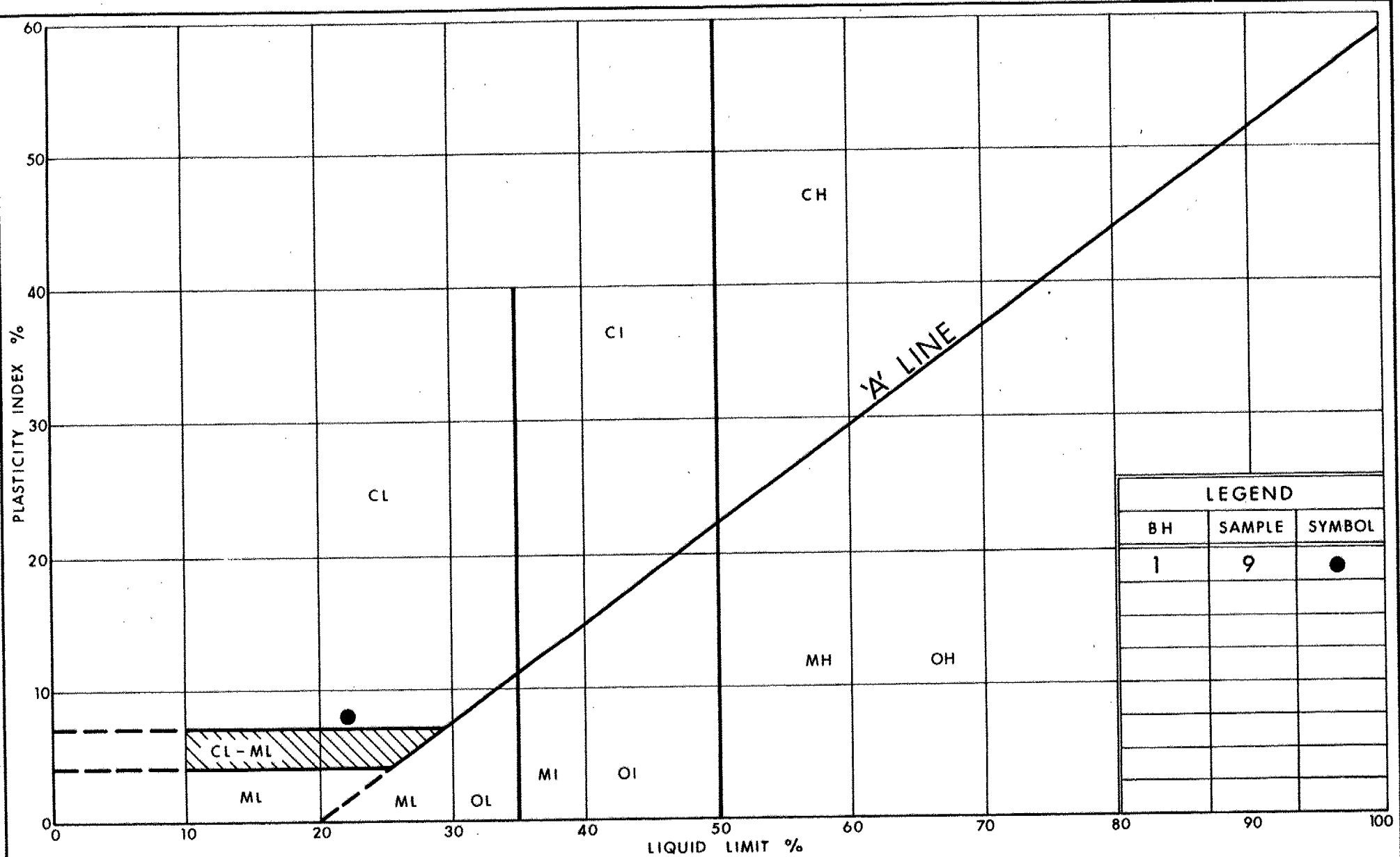


Ministry of
Transportation

GRAIN SIZE DISTRIBUTION
GRAVELLY SAND, SOME SILT

FIG No 1

W P 565-91-01



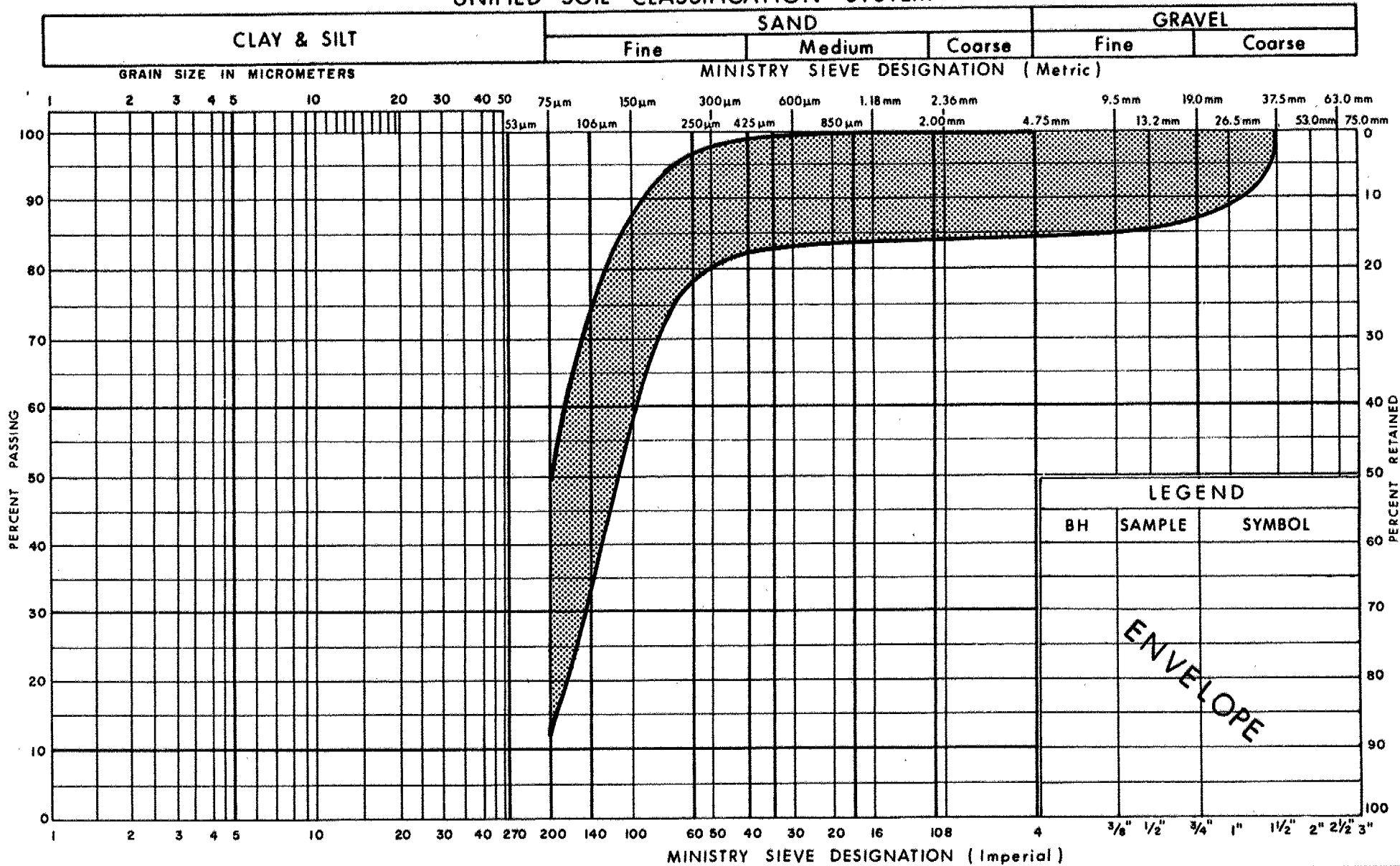
Ministry of
Transportation
Ontario

PLASTICITY CHART CLAYEY SILT, TRACE OF SAND

FIG No 2

W P 565-91-01

UNIFIED SOIL CLASSIFICATION SYSTEM



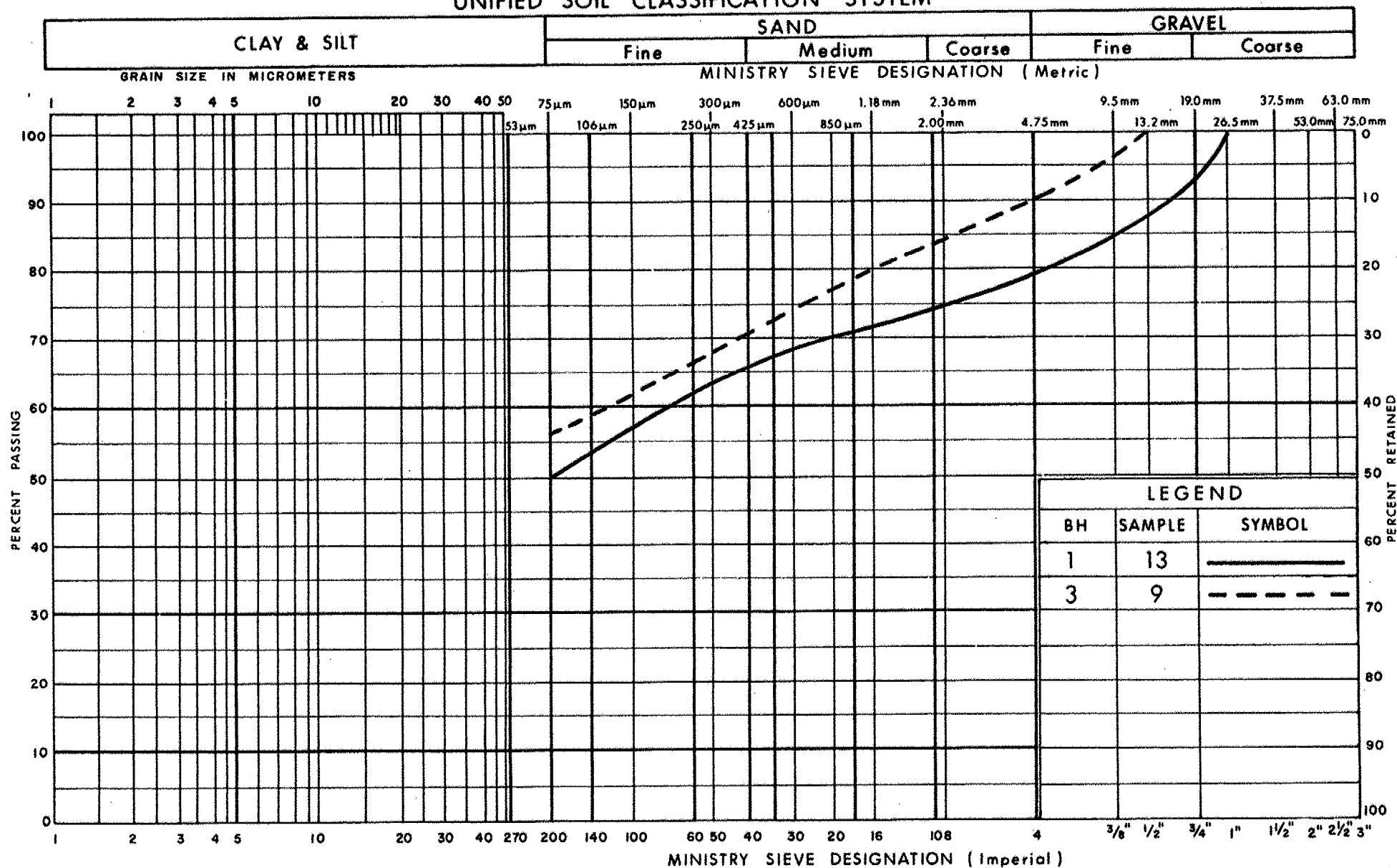
Ministry of
Transportation

GRAIN SIZE DISTRIBUTION
SAND TO SILTY SAND
TRACE OF GRAVEL

FIG No 3

W P 565 - 91-01

UNIFIED SOIL CLASSIFICATION SYSTEM



Ministry of
Transportation

GRAIN SIZE DISTRIBUTION

HET MIXTURE OF

GRAVEL, SAND & SILT (Glacial Till)

FIG No 4

W P 565 - 91 - 01

EXPLANATION OF TERMS USED IN REPORT

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

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

SOILS ARE DESCRIBED BY THEIR COMPOSITION AND CONSISTENCY OR DENSENESS.

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

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

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

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

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

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

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

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

JOINTING AND BEDDING:

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

ABBREVIATIONS AND SYMBOLS

FIELD SAMPLING

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

STRESS AND STRAIN

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

MECHANICAL PROPERTIES OF SOIL

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

PHYSICAL PROPERTIES OF SOIL

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

RECORD OF BOREHOLE No 1

1 OF 2

METRIC

W.P. 565 - 91 - 01 LOCATION Co-ords: N 4 866 023.4; E 210 287.7 ORIGINATED BY M V
DIST 2 HWY 6 BOREHOLE TYPE HOLLOW STEM AUGER, WASHBORING & CONE TEST COMPILED BY M V
DATUM GEODETIC DATE 92 12 08 & 09 CHECKED BY P P

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			UNIT WEIGHT γ 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	PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	
430.3	Ground Surface							SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	WATER CONTENT (%) 10 20 30			
0.0	SILTY SAND, With Gravel, Compact, (Fill)		1	SS	28		430					40 41 (19)
			2	SS	30		429					
427.8			3	SS	14		428					
2.5	GRAVELLY SAND, Some Silt, Dense to Compact		4	SS	40		427					4 58 (38)
			5	SS	22		426					
426.0			6	SS	15		425					
4.3	SAND to SILTY SAND, Trace of Gravel, Occasional Clayey Silt Layers, Compact to Very Dense Clayey Silt, Tr. of Sand		7	SS	18		424					20 29 (51)
			8	SS	13		423					
			9	SS	28		422					
			10	SS	100		421	120 / 28cm				
420.2			11	SS	70		420					
10.1	Heterogeneous Mixture of SILT, SAND and GRAVEL, Very Dense (Glacial Till)		12	SS	100		419					
			13	SS	100		418					
			14	SS	100		417					
415.1			15	SS	100		416					

Continued

Continued

+3, x 5: Numbers refer to
Sensitivity
20
15-5 (X) STRAIN AT FAILURE
10

RECORD OF BOREHOLE No 1

2 OF 2

METRIC

W.P. 565 - 91 - 01 LOCATION Co-ords: N 4 866 023.4; E 210 287.7 ORIGINATED BY M V
 DIST 2 HWY 6 BOREHOLE TYPE HOLLOW STEM AUGER, WASHBORING & CONE TEST COMPILED BY M V
 DATUM GEODETIC DATE 92 12 08 & 09 CHECKED BY P P

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	W _p	W		
415.1	Continued															
15.2	Heterogeneous Mixture of SILT, SAND and GRAVEL, Very Dense (Glacial Till)					415										
413.4			14	SS	100	414										
16.9	End of Borehole															

METRIC

[illegible]

RECORD OF BOREHOLE No 3

1 OF 1

METRIC

W.P. 565 - 91 - 01 LOCATION Co-ords: N 4 865 985.7; E 210 321.5 ORIGINATED BY M V
DIST 2 HWY 6 BOREHOLE TYPE HOLLOW STEM AUGER, WASHBORING & CONE TEST COMPILED BY M V
DATUM GEODETIC DATE 92 12 10 & 11 CHECKED BY P P

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			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	PLASTIC LIMIT W _P	NATURAL MOISTURE CONTENT W		
428.7	Ground Surface							20 40 60 80 100				
0.0	SILTY SAND, With Gravel, Compact to Dense (Fill)		1	SS	23		428					
426.6			2	SS	35		427					
2.1	GRAVELLY SAND, Some Silt, Dense		3	SS	44		426					
425.8			4	SS	48		425					
2.9	SAND to SILTY SAND, Trace of Gravel, Occasional Clayey Silt Layers, Compact to Dense	Clayey Silt	5	SS	21		424					
			6	SS	19		423					
		Clayey Silt	7	SS	15		422					
			8	SS	35		421					
420.7			9	SS	72	/15cm	420					
8.0	Heterogeneous Mixture of SILT, SAND and GRAVEL, Very Dense (Glacial Till)						419					
							418					
							417					
416.3			10	SS	76	/5cm						
12.4	End of Borehole											

RECORD OF BOREHOLE No 4

1 OF 1

METRIC

W.P. 565 - 91 - 01 LOCATION Co-ords: N 4 865 995.0; E 210 305.7 ORIGINATED BY M V
DIST 2 HWY 6 BOREHOLE TYPE CONTINUOUS FLIGHT HOLLOW STEM AUGER COMPILED BY M V
DATUM GEODETIC DATE 92 12 11 CHECKED BY P P

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
428.5	Ground Surface																
0.0	SILTY SAND, Trace of Gravel, Organics, Loose, (Fill)		1	SS	9		428										7 43 (50)
427.2			2	SS	40		427										38 44 (20)
1.3	GRAVELLY SAND, Some Silt, Dense		3	SS	32		426										
425.3			4	SS	37		425										
3.2	Clayey Silt		5	SS	24		424										15 71 (14)
	SAND to SILTY SAND, Trace of Gravel, Occasional Clayey Silt Layers, Compact		6	SS	22		423										0 57 (43)
			7	SS	16		422										
			8	SS	21		421										
420.7			9	SS	58												
420.4	Het.Mix of SILT, SAND & GRAVEL, (Glacial Till) Very Dense																
8.1	End of Borehole																

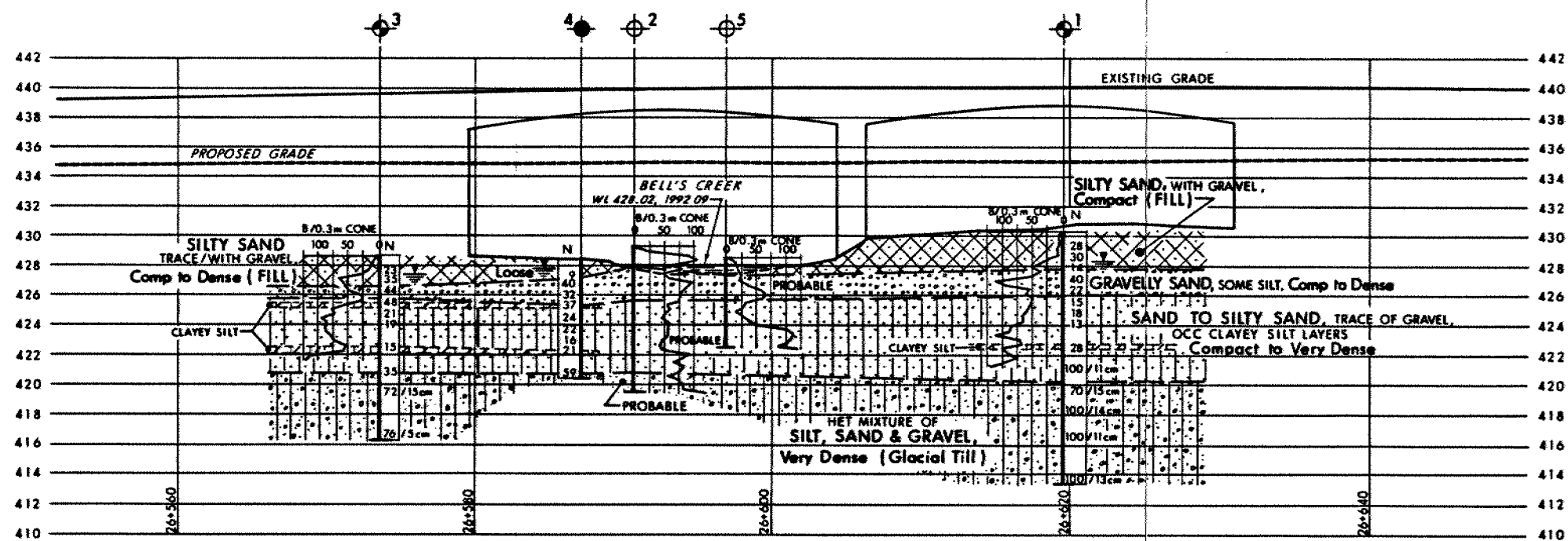
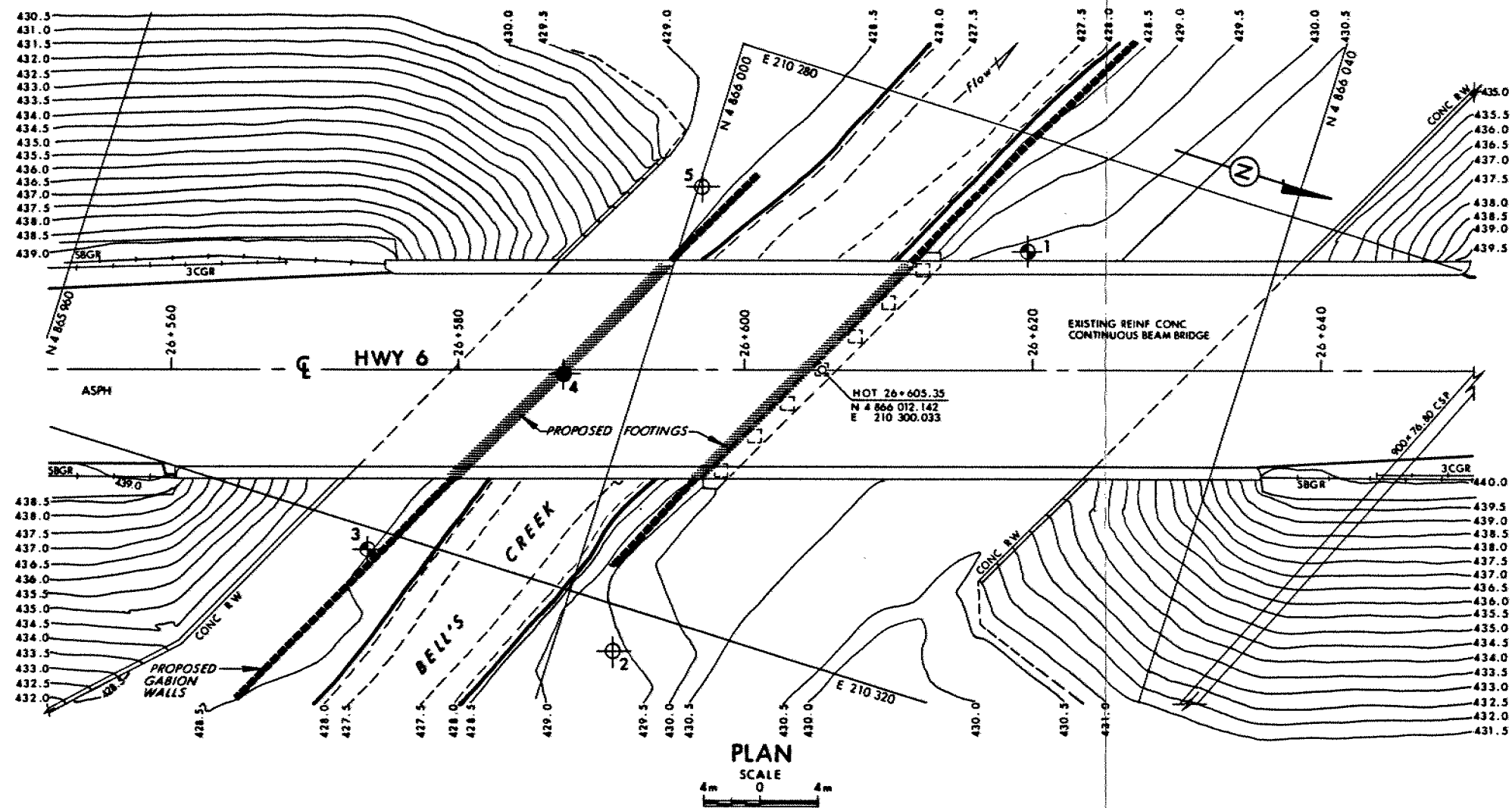
RECORD OF BOREHOLE No 5

1 OF 1

METRIC

W.P. 565 - 91 - 01 LOCATION Co-ords: N 4 866 000.5; E 210 290.4 ORIGINATED BY M.V.
 DIST 2 HWY 6 BOREHOLE TYPE CONE TEST COMPILED BY M.V.
 DATUM GEODETIC DATE 92 12 11 CHECKED BY P.P.

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	20 40 60 80 100					
428.8	Ground Surface													
0.0	Probable SILTY SAND, With Gravel, (Fill)													
427.3														
1.3	Probable GRAVELLY SAND, Some Silt													
425.7														
2.8	Probable SAND to SILTY SAND, Trace of Gravel, Occasional Clayey Silt Layers													
422.5														
6.1	End of Cone Test									120/13cm				



PROFILE HWY 6

METRIC

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

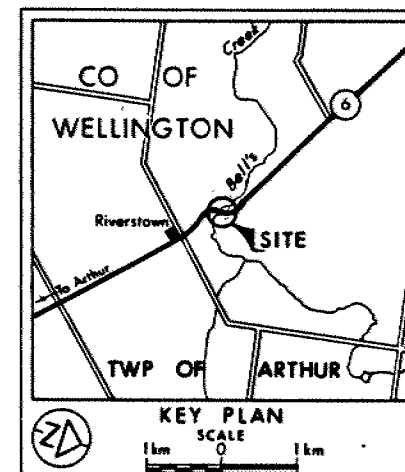
CONT No
WP No 565-91-01

BELL'S CREEK

BORE HOLE LOCATIONS & SOIL STRATA



SHEET



LEGEND

- Bore Hole
- ⊕ Dynamic Cone Penetration Test (Cone)
- ⊕ Bore Hole & Cone
- N Blows/0.3m (Std Pen Test, 475 J/blow)
- CONE Blows/0.3m (60° Cone, 475 J/blow)
- W.L. at time of investigation 1992 12

No	ELEVATION	CO-ORDINATES NORTH	EAST
1	430.3	4866 023.4	210 287.7
2	429.3	4866 003.9	210 323.0
3	428.7	4865 985.7	210 321.5
4	428.5	4865 995.0	210 305.7
5	428.6	4866 000.5	210 290.4

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 included in accordance with the conditions of Section GC 2.01 of OPS Gen. Cond.

REV.	DATE	BY	DESCRIPTION
1			
2			
3			
4			
5			

Geocres No 40P15-30
HWY No 6
SUBMD MV CHECKED DATE 1994 03 24 SITE 35-77
DRAWN RS CHECKED APPROVED DWG 5659101-A



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

DIST. 3 HWY. 6
CONT NO
WP NO 565-91-01



BELLS CREEK AND
C.P.R. OVERPASS
GENERAL ARRANGEMENT

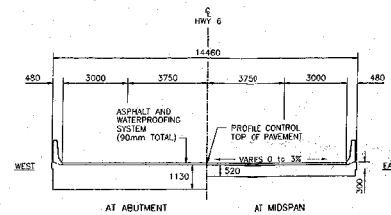
SHEET

GENERAL NOTES

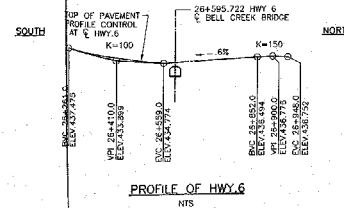
- CLASS OF CONCRETE 30 MPa
- CLEAR COVER TO REINFORCING STEEL
FOOTINGS 100 ±25mm
DECK TOP 70 ±20mm
DECK BOTTOM 50 ±10mm
REMAINERS (UNLESS OTHERWISE NOTED) 70 ±20mm
- REINFORCING STEEL SHALL BE GRADE 400 UNLESS OTHERWISE SPECIFIED. BAR MARKS WITH SUFFIX 'C' INDICATE COATED BARS.
- WP DENOTES WORKING POINT
T/A DENOTES TOP OF ASPHALT

CONSTRUCTION NOTES

- FALSEWORK SUPPORTING WINGWALLS TO REMAIN IN PLACE UNTIL CONCRETE IN DECK SLAB HAS REACHED 20 MPa COMPRESSIVE STRENGTH.
- NO BACKFILL BEHIND ABUTMENT SHALL BE PLACED UNTIL AFTER DECK SLAB HAS REACHED 20 MPa COMPRESSIVE STRENGTH.
- PLACE BACKFILL SIMULTANEOUSLY BEHIND BOTH ABUTMENTS KEEPING HEIGHTS OF BACKFILL WITHIN 500mm DIFFERENTIAL BEHIND BOTH ABUTMENTS.



DECK SECTION
1:100



PROFILE OF HWY.6
NTS

CONSTRUCTION NOTES

- GENERAL ARRANGEMENT
- BORE HOLE LOCATIONS AND SOIL STRATA
- FOOTINGS
- RIGID FRAME
- WINGWALLS
- BARRIER WALLS
- ROADWAY APPROACH SLAB
- STANDARD DETAILS
- QUANTITIES

REVISIONS	DATE	BY	DESCRIPTION

DRAWING NOT TO BE SCALED
100 mm ON ORIGINAL DRAWING