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DIST. 11 REGION

W.P. No. 60-86-02

CONT. No. 88-07

W. O. No.

STR. SITE No.

HWY. No. 11

LOCATION Hwy 11 & Maslova Rd 14
Underpass (Fraserburg Rd)

No. of PAGES -

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OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT.

REMARKS:



**Ministry of
Transportation and
Communications**

FILE No. _____ **DATE** _____

REMARKS _____

5-18
6-13

FOUNDATION INVESTIGATION REPORT

CONTRACT NO 88-07



Ministry of
Transportation and
Communications

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Abbreviations and Symbols

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For

Muskoka Road 14 Underpass
W.P. 60-86-02, Site 45-563-189
Hwy. 11, District 11

and

Muskoka Road 14 Embankment
from 10 + 060 to 10 + 160
W.P. 60-86-00
Hwy. 11, District 11

Note: For the purposes of the contract, this report supercedes
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 1" 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^{-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 = $\frac{c_u}{\tau_r}$

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

PHYSICAL PROPERTIES OF SOIL

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

FOUNDATION INVESTIGATION REPORT

For

Muskoka Road 14 Underpass (Fraserburg Road)
W.P. 60-86-02; Site 45-563-189
Highway 11, District #11, Huntsville

INTRODUCTION

This report contains the results of a Foundation Investigation carried out for the proposed underpass structure at the existing junction of Muskoka Road 14 (Fraserburg Road) and Highway 11, during the period from 86 06 05 to 86 06 20. The field work consisted of four sampled boreholes with dynamic cone penetration tests adjacent to each borehole location, and an additional dynamic cone penetration test commencing at the bottom of BH #2. The borings were advanced by hollow stem auger (8.3 cm I.D.) and/or BW casing (5.9 cm O.D.) using a machine mounted on a muskeg vehicle (all terrain vehicle and a bombardier). Size BX rock cores were obtained in BH #3 and 4.

SITE DESCRIPTION

The site is located approximately a kilometre east of Bracebridge at the crossing of Highway 11 and the new proposed alignment for Muskoka Road 14 (Fraserburg Road). The new proposed alignment is over the old Fraserburg Road and will straighten the existing road out again.

The proposed realignment on the east side of Highway 11 goes over an existing high fill next to a 7 to 8 metre gully with a creek running through at the bottom. Vegetation in the above area is grassland and scattered mixed trees.

On the west side of Highway 11 the topography is gently rolling grasslands.

SUBSURFACE CONDITIONS**General**

Five types of overburden material were encountered at the borehole locations. The materials encountered included a fill material (some shoulder granular and sandy silt to silty sand, trace of clay), clay of high plasticity, silty clay of low to medium plasticity, silt to sandy silt, trace of clay, and a

silty sand. The bedrock encountered is classified as granite gneiss.

The plan and location of borings and the stratigraphical profile are shown on drawing No.2 of the contract drawings. The obtained field and laboratory test results are plotted on the Record of Borehole sheets also in the Appendix of this report. A brief description of the different soil types is given below.

Sandy Silt to Silty Sand, Trace of Clay

Below the ground surface (approximate El. 255.3) at BH #3 and below the shoulder granular at BH #4 a very fine sandy silt to a silty very fine sand, trace of clay material was encountered. The lower boundary was found to be 2.1 m below ground level.

The natural moisture content of the deposit was approximately 22%, ranging from 21% to 22.5%. The denseness of the overall deposit ranges from loose to compact.

Clay (CH), Trace of Sand

A 2.5 m to 2.7 m pocket of clay of high plasticity, trace of sand was encountered below the fill and silty sand at BH #4 and at the surface at BH #1.

The physical properties of the material as determined by field and laboratory tests are summarized below:

	<u>Range</u>	
Unit Weight γ	15.8 - 16.5	kN/m ³
Natural Moisture content(w)	60 - 68%	
Liquid Limit (w_L)	57 - 65%	
Plastic Limit (w_p)	23 - 25.5%	
Unconfined Shear Strength	25.7 - 56.34	kPa

The consistency of the deposit was stiff. The grain size distribution consisted of 3 to 4% of sand, 29 to 43% of silt and 54 to 68% of clay.

Figure 1 indicates that the deposit plots as a CH on the Plasticity Chart.

Silty Clay (CI), Layered with CL, Trace of Sand

This stratum was encountered below the above described deposits in BH #1, 3 and 4, and at the ground surface in BH #2. This deposit is 4.5 to 6.3 m in depth.

Physical properties of the material as determined by field and laboratory tests are summarized below:

	Range
Unit Weight γ	16.3 - 17.9 kN/m ³
Unconfined Shear Strength	41.19 - 50.73 kPa
Natural Moisture Content (w)	38 - 61%
Liquid Limit (w_L)	32 - 47%
Plastic Limit (w_p)	18 - 24%
Initial Voids Ratio (e_o)	1.087 - 1.513
Preconsolidation Pressure (P_c)	180 - 289 kPa
Compression Index (C_c)	0.341 - 0.916

This deposit of silty clay was of medium plasticity with thin (approximately 3 mm) layers of silty clay of low plasticity and a few thin (1 mm) seams of very fine sand. The consistency of the overall deposit ranged between firm and stiff.

Figure 2 shows the results of the grain size distribution for this material in envelope form, and Figure 3 indicates the plasticity of the deposit.

Silt to Sandy Silt to Silty Sand, Trace of Clay

In all four boreholes deposits of mixed proportions of silt and sand with traces of clay were found. For boundary elevations of these materials reference should be made to the Record of Boreholes. Generally the deposit ranged from a silt or sandy silt, trace of clay with depth to a silty sand, trace of clay.

The denseness of the deposit ranged from very loose to very dense generally becoming denser with depth.

The natural moisture content ranges from 14.5 to 27%, Figure 4 shows an envelope of the grain size distribution curves for the strata at this location.

Bedrock

Bedrock was encountered below the overburden material at the following elevations:

BH #3	229.1 m
BH #4	213.5 m

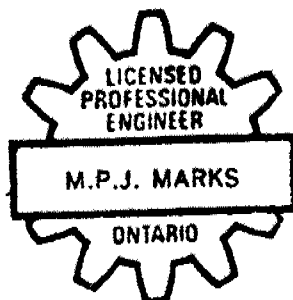
At both locations, bedrock is a sound granite gneiss of Middle Precambrian Age. The rock core samples were examined by Mr. E.R. Magni, MTC Geologist and his description is included in Figure 5 of the Appendix of this report.

GROUNDWATER CONDITIONS

The following groundwater conditions were observed during the field investigation:

<u>Borehole</u>	<u>Elevation (m)</u>
1	245.7
2	242.6
3	252.1
4	243.5

The boreholes indicate the groundwater level to be 3.2 m below the ground level at the approximate elevation 252 m. This level will most likely vary seasonally.



P. Marks

P. Marks, P. Eng.
Project Foundation Engineer

K. G. Selby

K.G. Selby, P. Eng.
Chief Foundation Engineer
(West)

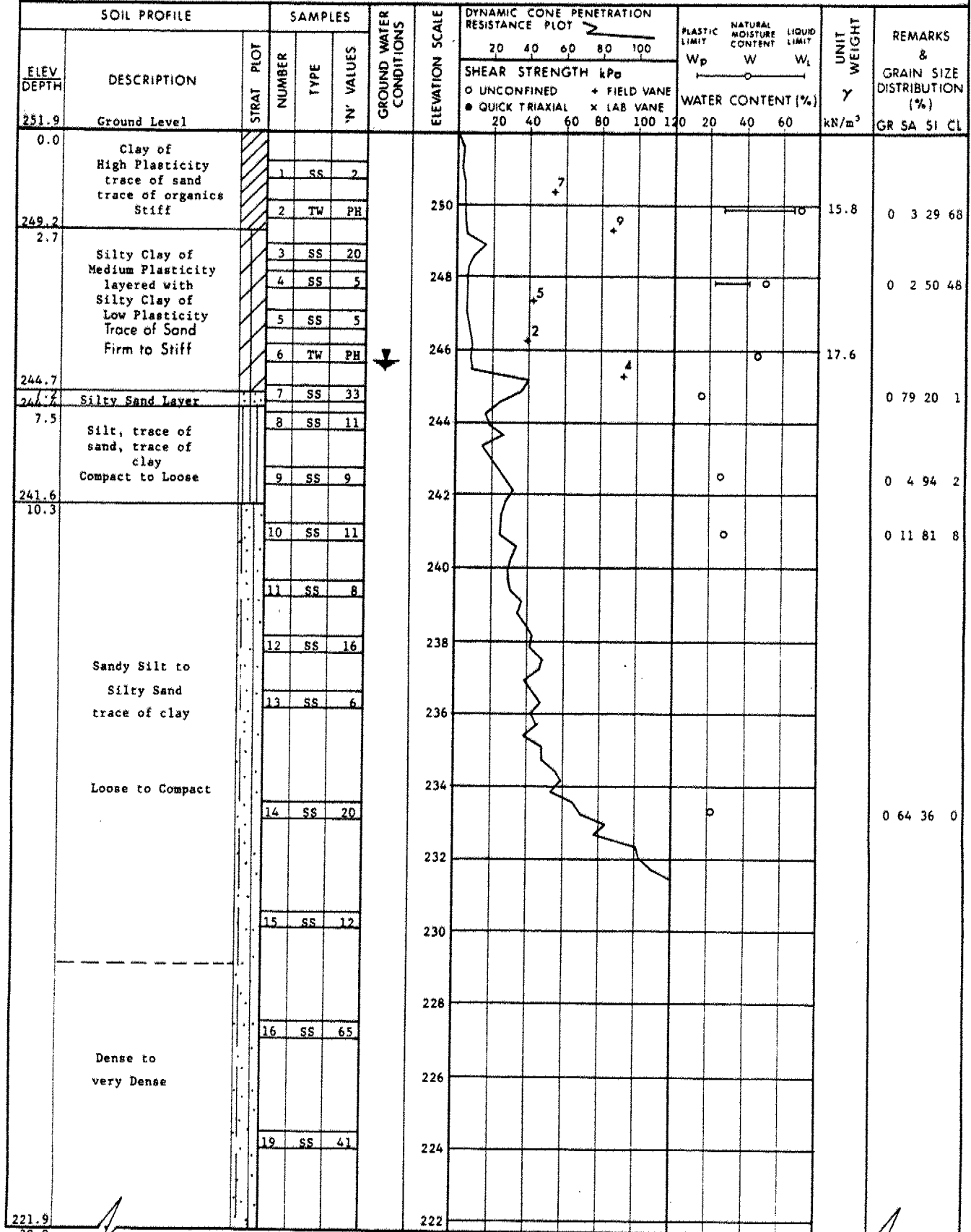
PM/wn

APPENDIX

RECORD OF BOREHOLE No 1

METRIC

W P 60-86-02 LOCATION Sta. 10 + 037 O/S 1.0 m Lt. ORIGINATED BY PM
 DIST 11 HWY 11 BOREHOLE TYPE Cont. Flight Auger (HS) Casing (BW) COMPILED BY _____
 DATUM Geodetic DATE 86 06 05 - 86 06 11 CHECKED BY _____



Continued

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

Continued



RECORD OF BOREHOLE No 1 Continued

METRIC

W P 60-86-02 LOCATION Sta. 10 + 037, O/S 1.0 m Lt. ORIGINATED BY PM
DIST 11 HWY 11 BOREHOLE TYPE Continuous Flight Auger (HS) Casing (BW) COMPILED BY _____
DATUM Geodetic DATE 86 06 05 - 86 06 11 CHECKED BY _____

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 SHEAR STRENGTH ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE	PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES									
221.9 30.0	Continued													
	Sandy Silt to Silty Sand						220							
	trace of clay						218							
	Dense to Very Dense						216							
			24	SS	73		214							
			25	SS	81		212			0				0 17 82 1
							210							
209.0 42.9	End of Borehole		27	SS	53									

OFFICE REPORT ON SOIL EXPLORATION



RECORD OF BOREHOLE No 2

METRIC

W P 60-86-02 LOCATION Sta. 10 + 075, 0/S 1.0 m Lt. ORIGINATED BY PH
DIST 11 HWY 11 BOREHOLE TYPE Cont. Flight Auger (HS) COMPILED BY
DATUM Geodetic DATE 86 06 12 - 86 06 13 CHECKED BY PH

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT Y kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40					
250.6	Ground Level													
0.0	Silty Clay of Medium Plasticity with layers of silty clay of Low Plasticity trace of sand Firm to Stiff		2	SS	8									
			3	SS	3									
			4	SS	2									
			5	TW	PH									
			6	SS	2									
244.3														
6.3	Silty Sand, trace of clay		7	SS	9									
243.6														
7.0	Silt Trace of Sand Trace of Clay Loose to Compact		8	SS	11									
			9	SS	8									
238.8			10	SS	8									
11.8														
	Silt and Sand Trace of Clay Loose to Compact		11	SS	9									
			12	SS	5									
			13	SS	9									
			14	SS	5									
232.4			15	SS	22									
18.2	End of Borehole													
230.1														
20.5	End of Cone Test													
228.6														
22.0	End of Cone Test													

— Cone test originating at ground level
- - Cone test originating at bottom of borehole

RECORD OF BOREHOLE No 3

METRIC

W P 60-86-02 LOCATION Sta. 9 + 959.8, O/S 2.3 m Lt. ORIGINATED BY PM
DIST 11 HWY 11 BOREHOLE TYPE Cont. Flight Auger (HS), Casing (BW) COMPILED BY
DATUM Geodetic DATE 86 06 13 - 86 06 17 CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100	20 40 60 80 100	20 40 60 80 100					
255.3	Ground Level														GR SA SI CL
0.0	Silt, trace of sand trace of clay Fill Material Compact		1	SS	25		254								0 9 83 8
253.2			2	SS	13										
2.1	Silty Clay of Low Plasticity (From Uniform to Layered with Silty Clay of Medium Plasticity) Firm		3	SS	2		252							16.3	
			4	TW	PH										
			5	SS	3		250								0 1 67 32
			6	TW	PH		248							17.9	0 2 66 32
247.1															
8.2	Silt Loose		7	SS	10		246								0 0 100 0
			8	SS	8		244								
243.7															
11.6	Sandy Silt Very Loose to Loose		9	SS	2		242								
			10	SS	8		240								0 25 73 2
			11	SS	8		238								
			12	SS	8		236								
235.2															
20.1	Silty Sand Compact to Dense		13	SS	21		234								
			14	SS	40		232								0 91 9
229.1							230								
26.2	Granite Gneiss Sound Bedrock		15	RC BX	REC 100%		228								
			16	RC BX	REC 100%		226								
226.0															
29.3	End of Borehole														

+3, x5: Numbers refer to
Sensitivity

20
15
10
5 (%) STRAIN AT FAILURE

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 4

METRIC

W P 60-86-02 LOCATION Sta. 10 + 005.4; O/S 4.2 m Lt. ORIGINATED BY PH
DIST 11 HWY 11 BOREHOLE TYPE Cont. Flight Auger (HS); Casing (BW) COMPILED BY
DATUM Geodetic DATE 86 06 18 - 86 06 20 CHECKED BY

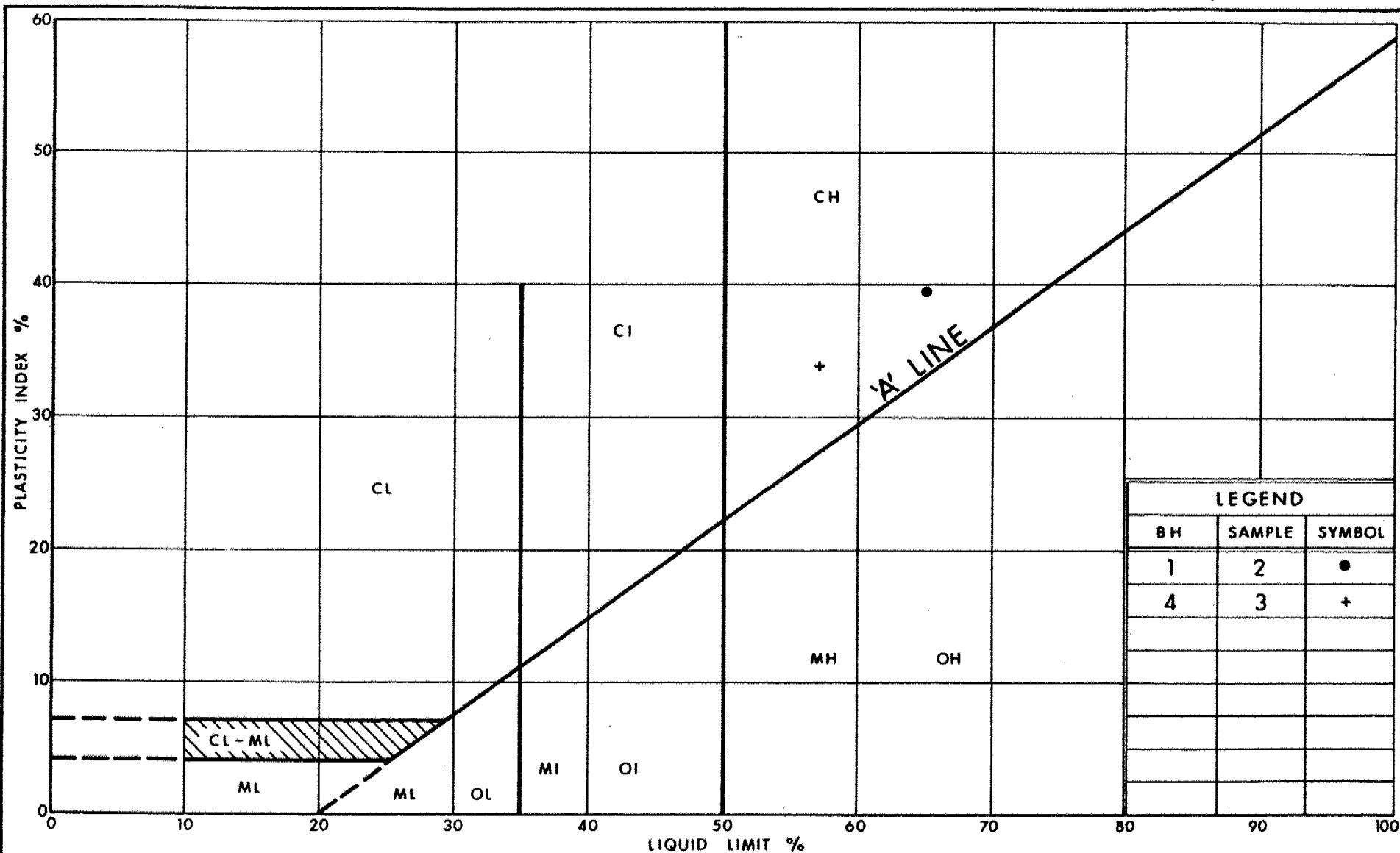
SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES		20 40 60 80 100	20 40 60 80 100	W _p	W	W _L		
254.0	Shoulder Level												GR SA SI CL
0.0	Fill Material												
253.3	Sand and Gravel												
0.7	Silty Sand to Sandy Silt		1	SS	7								0 16 76 8
251.9	trace of clay Loose		2	SS	5								0 3 43 54
2.1	Clay of High Plasticity Stiff		3	SS	2								
249.4			4	TW	PH							16.5	0 4 43 53
4.6	Silty Clay of Low to Medium Plasticity		5	SS	3								
246.2	Firm to Stiff		6	TW	PH							17.9	
7.8	Sandy Silt Occasional Layers of Clay		7	SS	12								0 2 93 5
242.3	Loose to Compact		8	SS	9								
11.7			9	SS	6								0 18 78 4
242.3			10	SS	6								0 27 70 3
			11	SS	1								
	Sandy Silt Very Loose to Loose		12	SS	0								
			13	SS	6								0 33 66 1
233.9													
20.1			14	SS	21								
	Silty Sand		15	SS	33								
	Compact to Dense												
			16	SS	50								0 93 7
224.0	Very Dense												
30.0													

Continued

+3, x5: Numbers refer to
Sensitivity

20
15 5 (%) STRAIN AT FAILURE
10

Continued



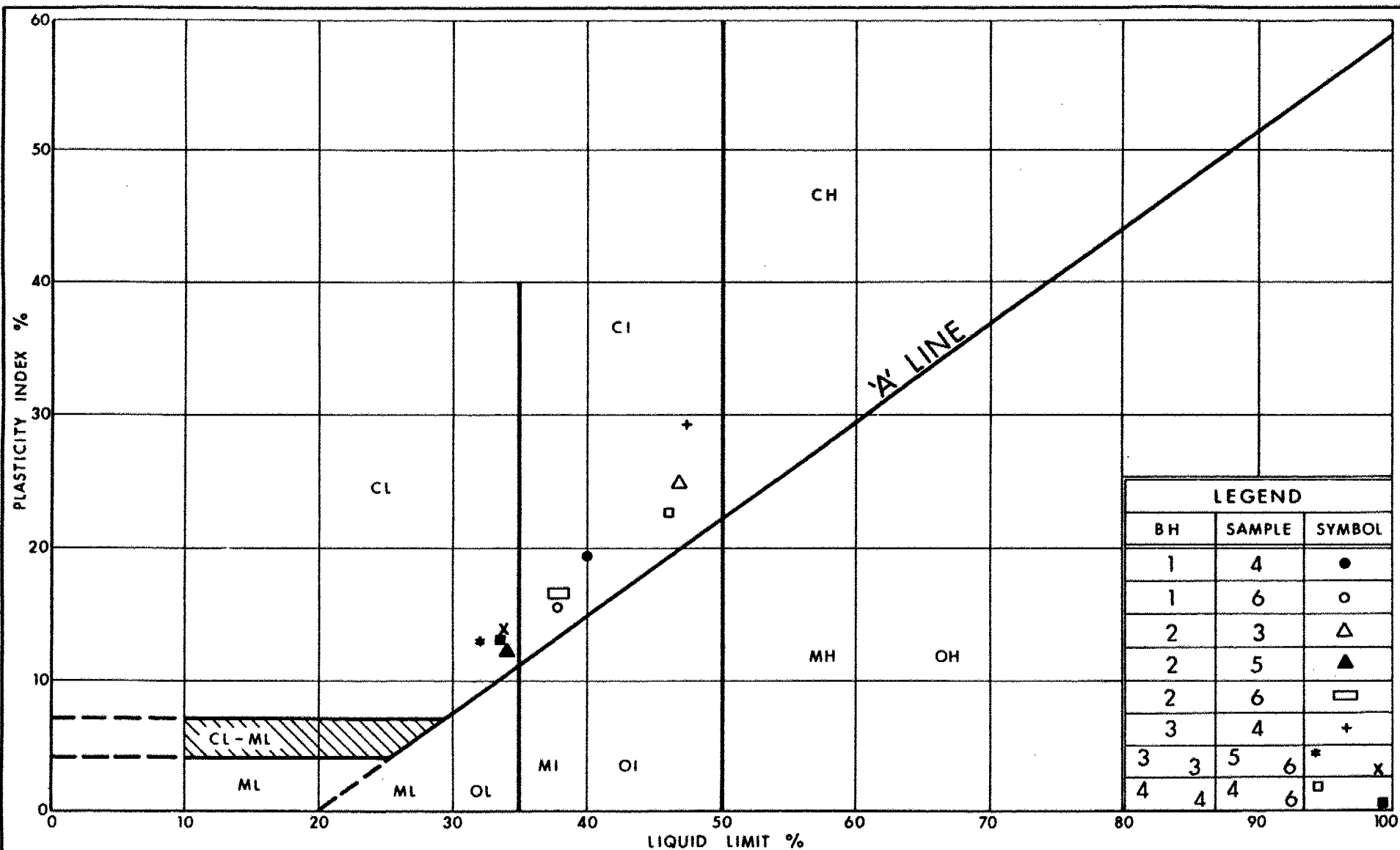
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PLASTICITY CHART

CLAY Trace of sand

FIG No 1

W P 60-86-02



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PLASTICITY CHART SILTY CLAY of low to medium plasticity, trace of sand

FIG No 3

W P 60-86-02

60-86-06

* CR = CORE RECOVERY ; RQD = ROCK QUALITY DESIGNATION

18

FOUNDATION INVESTIGATION REPORT

For

Muskoka Road Embankment
From 10 + 060 to 10 + 160

W.P. 60-86-00

Highway 11, District #11, Huntsville

INTRODUCTION

This report contains the results of a Foundation Investigation carried out for the embankment and culvert extension on the east side of the junction of Muskoka Road 14 (Fraserburg Road) and Highway 11, during the period from 86 12 15 to 86 12 18 and from 87 01 06 to 87 01 13. The fieldwork consisted of nine sampled boreholes with dynamic cone penetration tests adjacent to each borehole. The borings were advanced by hollow stem auger (8.3 cm I.D.) using a machine mounted on a muskeg vehicle and NX casing (8.1 cm I.D.) using a diamond drill on skids.

SITE DESCRIPTION

The site is located approximately a kilometre east of Bracebridge at the crossing of Highway 11 and the new proposed alignment for Muskoka Road 14 (Fraserburg Road). The new proposed alignment is over the old Fraserburg Road and will straighten the existing road out again.

The proposed realignment on the east side of Highway 11 goes over an existing high fill next to a 7 to 8 metre gully with a creek running through at the bottom. Vegetation in the above area is grassland and scattered mixed trees.

On the west side of Highway 11 the topography is gently rolling grasslands.

SUBSURFACE CONDITIONS

General

Several types of overburden material were encountered at the borehole locations. The materials encountered included a fill material (sandy silt to silty sand), clay of high plasticity, silty clay of low to medium plasticity, organic silt to silt, sandy silt and silty sand.

The plan and location of the borings are shown on Sketch 1 in the attached Appendix. The obtained field and laboratory test results are plotted on the Record of Borehole Sheets also in the Appendix of this report. A brief description of the different soil types is given below.

Sandy Silt to Silty Sand (Fill)

Below the ground surface in boreholes 12 and 14 a fill material consisting of silty sand/sandy silt, trace of organics was encountered. The lower boundary was found to be 0.9 to 2.0 m below the ground surface.

The denseness of the material ranged from loose to compact. The natural moisture content is approximately 34.5%.

Clay to Silty Clay

A 3.7 to 7 m thick deposit of clay to silty clay trace to thin layers of sand was encountered at the surface in boreholes 11 and 13 and in boreholes 12 and 14 beneath the fill described above.

The physical properties of the material as determined by field and laboratory tests are summarized below:

	<u>Mean</u>	<u>Range</u>
Unit Weight γ (kN/m ³)	17.4	16.3 - 18.5
Natural Moisture Content (w)	50.4	37.5 - 72.5%
Liquid Limit (w_L)	43.5	30.5 - 67%
Plastic Limit (w_p)	22.7%	
Field Vane Undrained Shear Strength (kPa)	(54.6)	18-80.6
Unconfined Shear Strength (kPa)	(56.9)	47.6-79.5

The consistency of the deposit was soft to very stiff. Figure 6 indicates that the deposit was mainly of medium plasticity.

Organic Silt to Silt, Trace of Sand

In boreholes 22, 23, 24 and 25 (in the gullies) the surface deposit was 2.3 to 2.4 m of an organic silt to silt of low plasticity, trace of sand. In borehole 22 pieces of wood were also found.

Physical properties of the material as determined by field and laboratory tests are summarized below:

	<u>Mean</u>
Unit Weight γ	20.0 kN/m ³
Natural Moisture Content (w)	26.3%
Plastic Limit (w_p)	20.5%
Liquid Limit (w_L)	26.8%

	<u>Range</u>
Field Vane Undrained Shear Strength	32.6 - 92.1 kPa
Unconfined Shear Strength	27.9 - 120 kPa
Organic Content by Weight	(1.32%)

The consistency of the overall deposit ranged from firm to stiff. Figure 7 indicates the plasticity of the deposit as low.

The results from the grain size distribution tests are shown in Figure 8 in envelope form.

Silty Sand (Layer of Silty Clay)

In boreholes 22, 23 and 25 there was a 0.7 m to 1.4 m thick deposit of silty sand and in borehole 25 it contained a thin layer of silty clay. The denseness of the material was compact and it was found 2.3 to 2.4 m below the ground surface under the organic silt.

Sandy Silt

Beneath the above deposits in all the boreholes lies a 0.5+ to 5.9+ m thick deposit of sandy silt of low plasticity .

The natural moisture content of the deposit was approximately 26%, ranging from 21.5 to 29%. The denseness of the overall deposit ranges from loose to compact (to dense).

Silty Sand

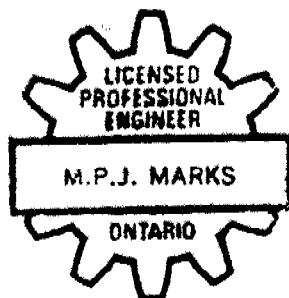
In boreholes 21 and 24 the last deposit encountered was silty sand underlying the deposit above. It ranged in thickness from 0.8+ to 1.5 m +. The denseness of the deposit ranged from loose to compact.

Groundwater Conditions

The following groundwater conditions were observed during the field investigation:

<u>Borehole</u>	<u>Elevation (m)</u>
11	249.0
12	246.8
13	248.4
14	Water Level Not Established
21	244.7
22	Water Level Not Established
23	Water Level Not Established
24	246.2
25	245.1

The water level will most likely vary seasonally.

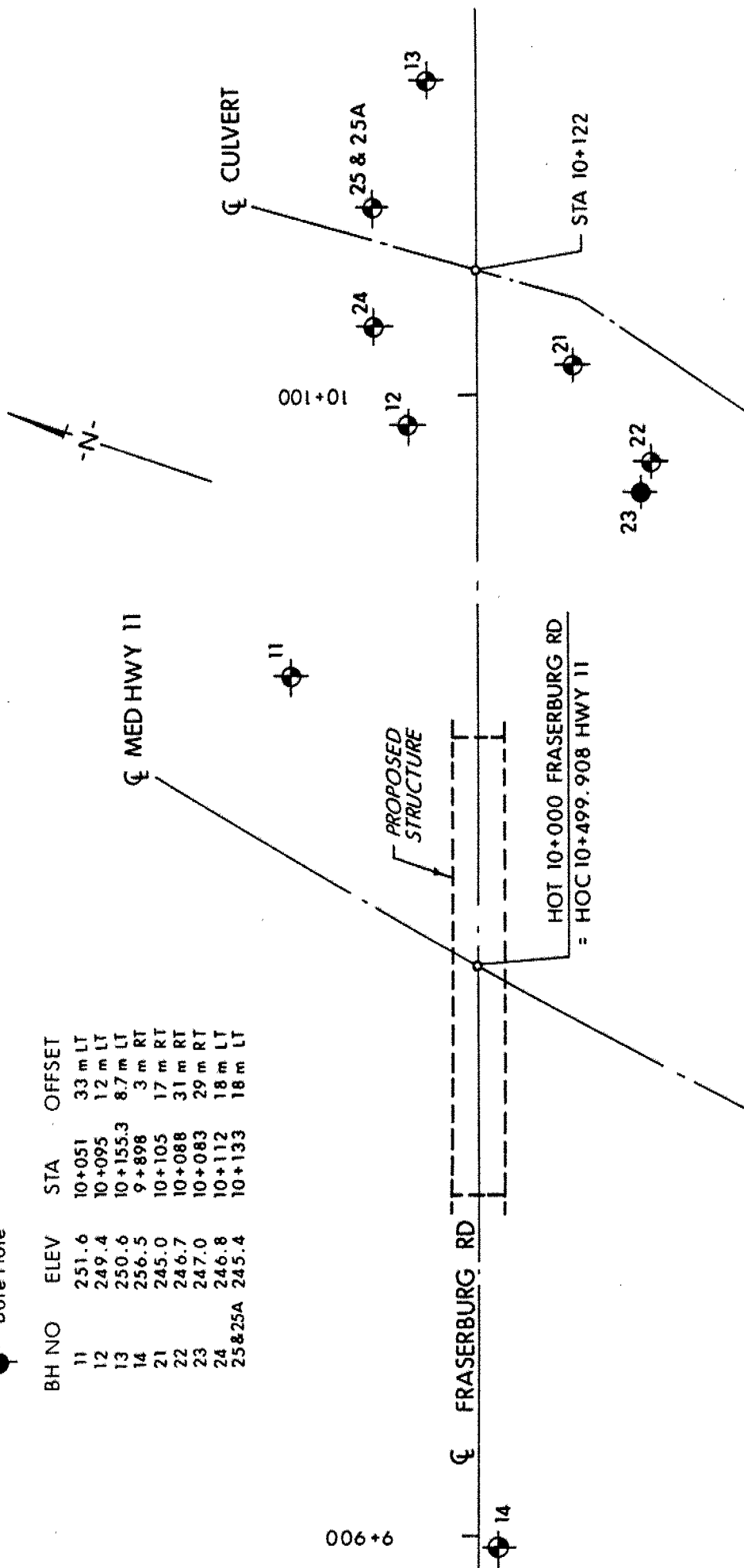


P. Marks
P. Marks, P. Eng.
Foundation Engineer

K.G. Selby
K.G. Selby, P. Eng.
Chief Foundations Engineer
(West)

 Bore Hole & Cone

BH NO	ELEV	STA	OFFSET
11	251.6	10+051	33 m LT
12	249.4	10+095	12 m LT
13	250.6	10+155.3	8.7 m LT
14	256.5	9+898	3 m RT
21	245.0	10+105	17 m RT
22	246.7	10+088	31 m RT
23	247.0	10+083	29 m RT
24	246.8	10+112	18 m LT
25&25A	245.4	10+133	18 m LT



NOTE: FOR SUBSOIL DESCRIPTION REFER TO
RECORD OF BOREHOLE SHEETS

23

WP 60-86-00 DIST 11

SCALE 1:1000

SKETCH 1

RECORD OF BOREHOLE No 11

METRIC

W P 60-86-00 LOCATION Sta. 10 + 051±, Offset 33m Left of C ORIGINATED BY PH
DIST 11 HWY 11 BOREHOLE TYPE Continuous Flight Auger (HS) COMPILED BY PH
DATUM Geodetic DATE 86-12-15 to 86-12-16 CHECKED BY 227

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					NATURAL MOISTURE CONTENT			UNIT WEIGHT Y KN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			20	40	60	80	100	W _p	W	W _L		
251.6 0.0	Ground Level															
	Clay to Silty Clay of Medium Plasticity With layers of Sand Stiff to very Stiff		1	SS	3											
			2	TW	PH											
			3	SS	10											
			4	SS	4											
			5	SS	3											
			6	SS	2											
			7	TW	PH											
			8	SS	3											
244.9 6.7	SANDY SILT LOOSE TO COMPACT		9	SS	19											
			10	SS	5											
			11	SS	13											
			12	SS	9											
239.0 12.6	END OF BOREHOLE															
234.8 16.8	END OF CONE															

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 12

METRIC

W P 60-86-00 LOCATION Sta. 10 + 095; Offset 12 m Left of C ORIGINATED BY PH
 DIST 11 HWY 11 BOREHOLE TYPE Cont. Flight Auger (HS) COMPILED BY PH
 DATUM Geodetic DATE 86-12-16 to 86-12-17 CHECKED BY PH

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					
249.4	Ground Level													
0.0	Sandy Silt						249							0 36 (64)
248.5	Loose		1	SS	8									0 2 (98)
0.9	Silty Clay Of Medium To Low Plasticity Firm to Stiff		2	SS	3		247						17.9	0 1 (99)
			3	TW	PH									
			4	SS	4									
			5	SS	3		245						18.5	0 1 (99)
			6	TW	PH									
244.5	Sandy Silt Compact To Loose		7	SS	12		243							0 1 (99)
4.9			8	SS	19									
			9	SS	14		241							0 1 (99)
			10	SS	12									
			11	SS	5		239							
238.3	End of Borehole						237							
235.4	End of Cone Test													
14.0														

+3, x5: Numbers refer to
Sensitivity

20
15
10
5 (%) STRAIN AT FAILURE

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 13

METRIC

W P 60-86-00 LOCATION Sta.10 + 155.3; O/S 8.7 m Left of C ORIGINATED BY PM
 DIST 11 HWY 11 BOREHOLE TYPE Continuous Flight Auger (H.S.) COMPILED BY PM
 DATUM Geodetic DATE 86-12-17 to 86-12-18 CHECKED BY PM

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 (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			SHEAR STRENGTH kPa							WATER CONTENT (%)
								○ UNCONFINED ● QUICK TRIAXIAL	+ FIELD VANE x LAB VANE						
250.6	Ground Level							20 40 60 80 100	20 40 60					GR SA SI CL	
0.0	Clay To Silty Clay Of Medium Plasticity Trace of Sand Soft to Stiff		1	SS	5		250	+1					16.4	0 2 (98)	
			2	TW	PH		248	+6							
			3	SS	4			+5							
			4	SS	4										
			5	SS	4										
			6	TW	PH		246	+2						18.1	0 1 (99)
			7	SS	4										
			8	SS	4		244								
243.6	Sandy Silt Compact														
7.0			9	SS	13	242								0 1 (99)	
			10	SS	14	240									
239.5			11	SS	14								0 5 (95)		
11.1	End of Borehole						238								
							236								
234.8															
15.8	End of Cone														

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 14

METRIC

W P 60-86-00 LOCATION Sta. 9 + 898; O/S 3 m Right of G ORIGINATED BY PM
 DIST 11 HWY 11 BOREHOLE TYPE Continuous Flight Auger (H.S.) COMPILED BY PM
 DATUM Geodetic DATE 86-12-18 CHECKED BY /

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT Y	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
256.5	Ground Level																
0.0	Silty Sand To Sandy Silt Trace of Organics Compact		1	SS	18	*	256										
254.5			2	SS	15		254										
2.0	Silty Clay Of Medium Plasticity Firm/Stiff		3	SS	5		254										0 7 (93)
			4	TW	PH		254										0 1 (99)
			5	SS	3		252										0 1 (99)
			6	SS	3		252										
250.6			7	SS	3		250										
5.9	Sandy Silt		8	SS	32		250										
			9	SS	26		248										
	Compact/ Dense		10	SS	31		246										
245.4			11	SS	22		246										0 10 (90)
11.1	End of Borehole * W.L. not established						244										
							242										
							240										
239.1	End of Cone Test																
17.4																	

OFFICE REPORT ON SOIL EXPLORATION



RECORD OF BOREHOLE No 21

METRIC

W P 60-86-00 LOCATION Sta. 10+ 105; Offset 17 m Rt. of C ORIGINATED BY PM
 DIST 11 HWY 11 BOREHOLE TYPE Casing (NX) COMPILED BY PM
 DATUM Geodetic DATE 87-01-06 to 87-01-07 CHECKED BY PM

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100	W _p	W	W _L		
245.0	Ground Level																
0.0																	
	Silty Sand With to Trace of Wood Fibres		1	SS	6												
			2	SS	2												
			3	SS	3												
	Very Loose/ Loose		4	SS	6												
			6	SS	7												
239.8			7	SS	6												
5.2	Sandy Silt		8	SS	8												
			9	SS	9												
	Loose																
237.1			10	SS	5												
7.9	Silty Sand																
235.4	Compact		11	SS	12												
9.6	End of Borehole																
234.0																	
11.0	End of Cone																

+3, x⁵: Numbers refer to
Sensitivity

20
15
10
5 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 22

METRIC

W P 60-86-00 LOCATION Sta. 10 + 088; O/S 31 m Rt. of C ORIGINATED BY PM
 DIST 11 HWY 11 BOREHOLE TYPE Casing (NX) COMPILED BY PM
 DATUM Geodetic DATE 87-01-08 CHECKED BY SC

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT Y	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			'N' VALUES	20 40 60 80 100					
246.7	Ground Level												
0.0	Organic Silt of Low Plasticity		1	SS	4								
	Occ. Pieces of Wood Stiff		2	TW	PH								
244.4			3	SS	3								
2.3	Silty Sand		5	SS	9								
243.0	Loose		6	SS	12								
3.7	Sandy Silt		7	SS	13								
	Compact to Loose		8	SS	7								
240.1			9	SS	8								
6.6	End of Borehole												
234.3													
12.4	End of Cone Test												
	* Water Level Not established												

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 23

METRIC

W P 60-86-00 LOCATION Sta. 10 + 083; Offset 29 m Rt. of C ORIGINATED BY PM
 DIST 11 HWY 11 BOREHOLE TYPE Casing (NX) COMPILED BY PM
 DATUM Geodetic DATE 87 01 09 CHECKED BY Lo

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					
247.0	Ground Level																
0.0	Silt to Organic Silt of Low Plasticity		1	SS	4	*	246										
	Firm to Stiff		3	TW	PM				+ 5					140			
244.7	Silty Sand, Occ. Pieces of Wood, Loose		4	SS	5		244			+ 5				140			0 12 77 11
244.0	Sandy Silt		5	SS	13												
243.5	Compact																
3.5	End of Borehole																
	* Water Level Not Established																

OFFICE REPORT ON SOIL EXPLORATION

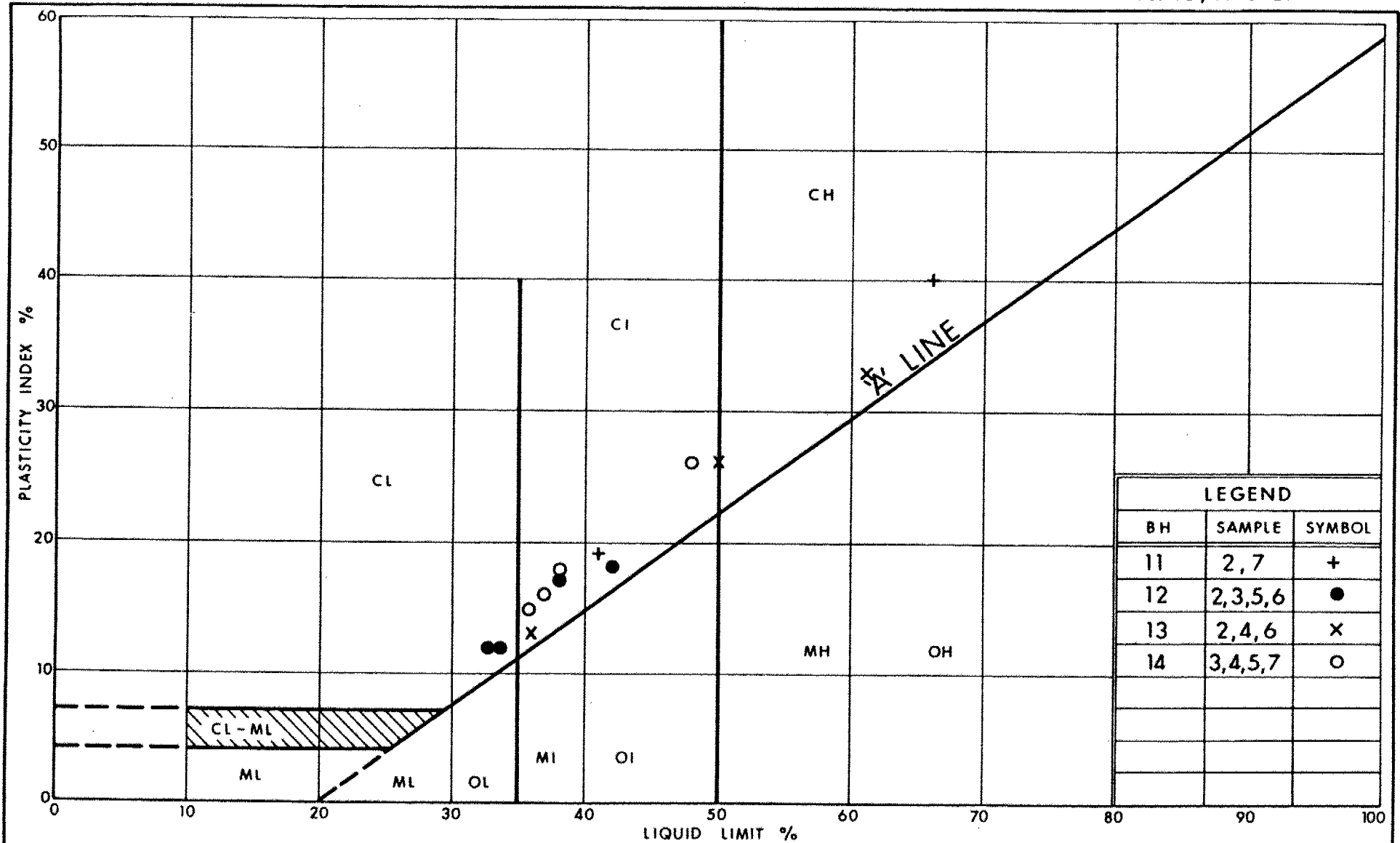
+3, x5: Numbers refer to
Sensitivity

20
15
10
5 (%) STRAIN AT FAILURE

METRIC

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
245.4	Ground Level						SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE						
							20	40	60	80	100		
							WATER CONTENT (%)		20		40	60	
									kN/m ³			GR SA SI	

+3, x5: Numbers refer to Sensitivity

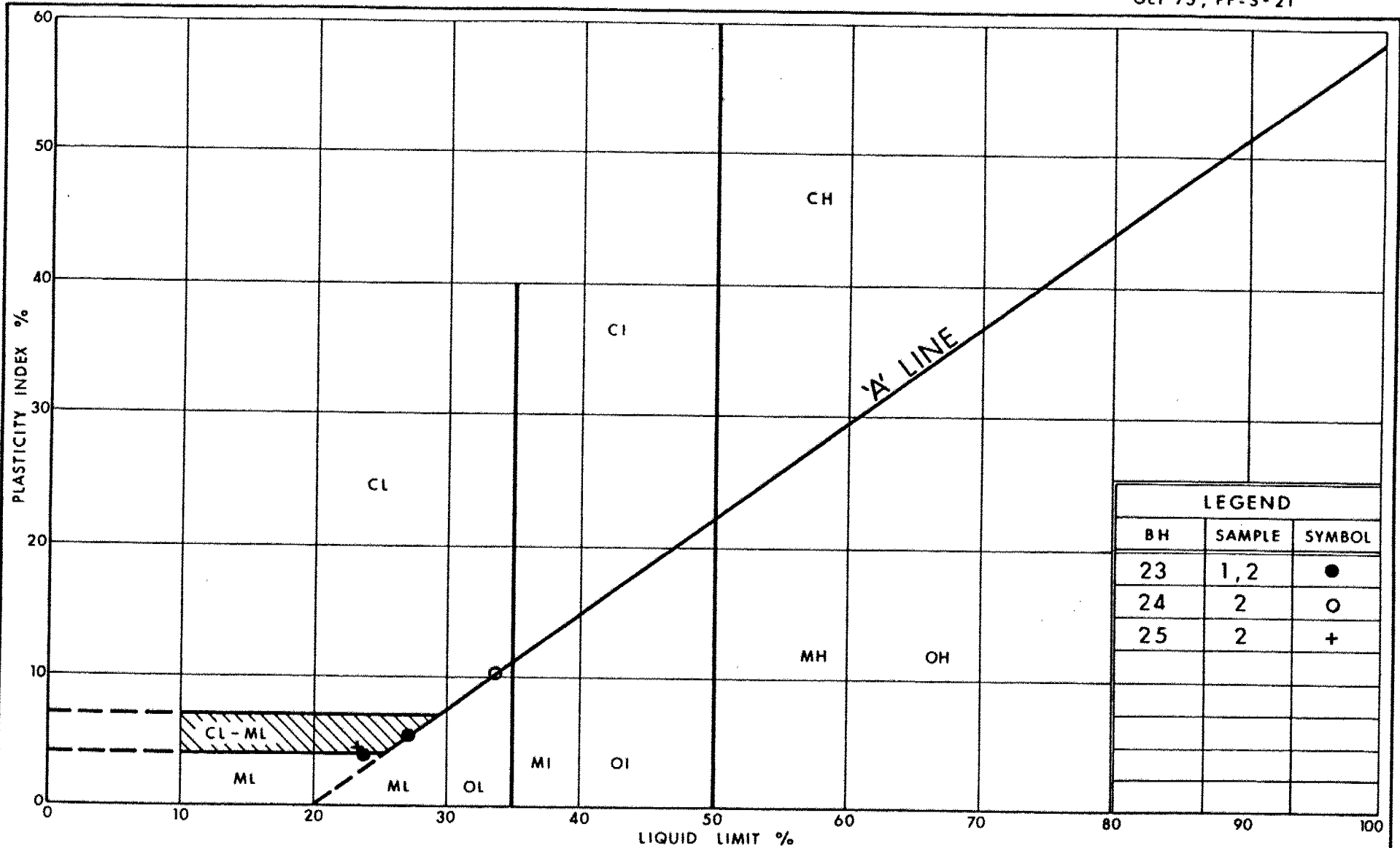


Ministry of
Transportation
Ontario

PLASTICITY CHART
CLAY TO SILTY CLAY
TRACE TO LAYERS OF SAND

FIG No 6

W P 60-86-00



Ministry of
Transportation

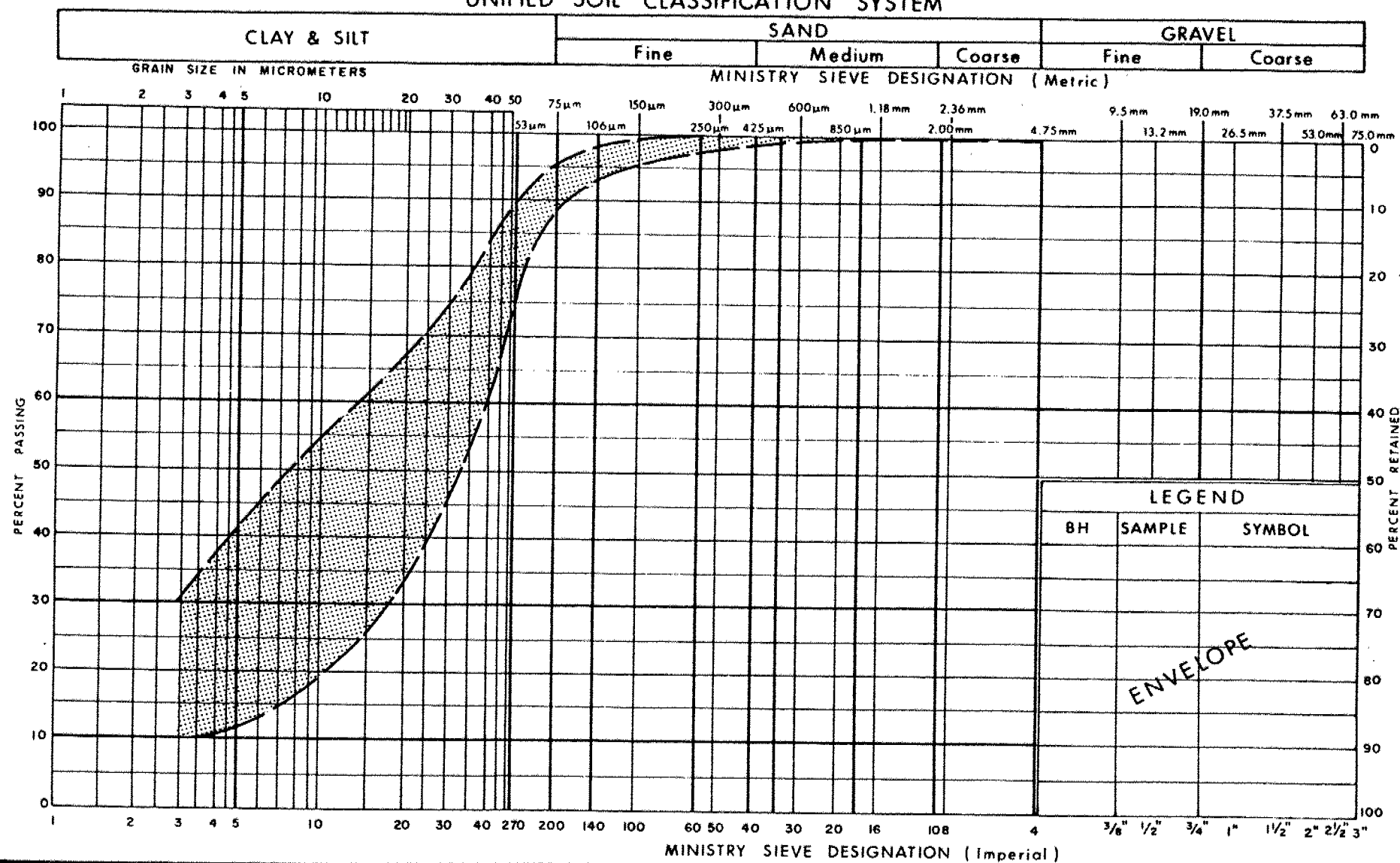
Ontario

PLASTICITY CHART
ORGANIC SILT TO SILT of low plasticity
TRACE OF SAND

FIG No 7

W P 60-86-00

UNIFIED SOIL CLASSIFICATION SYSTEM

Ministry of
Transportation

GRAIN SIZE DISTRIBUTION
ORGANIC SILT TO SILT
TRACE OF SAND

FIG No 8

W P 60-86-00

OVERSIZE DRAWING



Ministry of
Transportation and
Communications

FILE COPY

FOUNDATION DESIGN SECTION

foundation investigation and design report

ENGINEERING MATERIALS OFFICE
FOUNDATION DESIGN SECTION

WP 60-86-⁰²~~00~~

DIST 11

HWY 11

STR SITE N/A

Muskoka Road 14 Underpass (Fraserburg Road)

DISTRIBUTION

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FOUNDATION INVESTIGATION REPORT
For
Muskoka Road 14 Underpass (Fraserburg Road)
W.P. 60-86-00; Site N/A
Highway 11, District #11, Huntsville

INTRODUCTION

This report contains the results of a Foundation Investigation carried out for the proposed underpass structure at the existing junction of Muskoka Road 14 (Fraserburg Road) and Highway 11, during the period from 86 05 to 86 06 20. The field work consisted of four sampled boreholes with dynamic cone penetration tests adjacent to each borehole location, and an additional dynamic cone penetration test commencing at the bottom of BH #2. The borings were advanced by hollow stem auger (8.3 cm I.D.) and/or BW casing (5.9 cm O.D.) using a machine mounted on a muskeg vehicle (all terrain vehicle and a bombardier). Size BXL rock cores were obtained in BH #3 and 4.

SITE DESCRIPTION

The site is located approximately a kilometre east of Bracebridge at the crossing of Highway 11 and the new proposed alignment for Muskoka Road 14 (Fraserburg Road). The new proposed alignment is over the old Fraserburg Road and will straighten the existing road out again.

The proposed realignment on the east side of Highway 11 goes over an existing high fill next to a 7 to 8 metre gully with a creek running through at the bottom. Vegetation in the above area is grassland and scattered mixed trees.

On the west side of Highway 11 the topography is gently rolling grasslands with sand and gravel open pits in the distance.

SUBSURFACE CONDITIONS

General

Five types of overburden material were encountered at the borehole locations. The materials encountered included a fill material (some shoulder granular and sandy silt to silty sand, trace of clay), clay of high plasticity, silty clay of low to medium plasticity, silt to sandy silt, trace of clay, and a silty sand. The bedrock encountered is classified as granite gneiss.

The plan and location of borings and the stratigraphical profile are shown on drawing number 608600-A in the attached Appendix. The obtained field and laboratory test results are plotted on the Record of Borehole sheets also in the Appendix of this report. A brief description of the different soil types is given below.

Sandy Silt to Silty Sand, Trace of Clay

Below the ground surface (approximate EL. 255.2) at BH #3 and below the shoulder granular at BH #4 a very fine sandy silt to a silty very fine sand, trace of clay material was encountered. The lower boundary was found to be 2.1 m below ground level.

The natural moisture content of the deposit was approximately 22%, ranging from 21% to 22.5%. The denseness of the overall deposit ranges from loose to compact.

Clay (CH), Trace of Sand

A 2m to 1m pocket of silty clay of high plasticity, trace of sand was encountered below the fill and silty sand at BH #4 and at the surface at BH #1.

The physical properties of the material as determined by field and laboratory tests are summarized below:

	<u>Range</u>	
Unit Weight	15.8 - 16.5	kN/m ³
Natural Moisture Content (w)	60 - 68%	
Liquid Limit (W _L)	57 - 65%	
Plastic Limit (wp)	23 - 25.5%	
Unconfined Shear Strength	25.7 - 56.34	kPa

The consistency of the deposit was stiff. The grain size distribution consisted of 3 to 4% of sand, 29 to 43% of silt and 54 to 68% of clay.

Figure 1 indicates that the deposit plots as a CH on the Plasticity Chart.

Silty Clay (CI), Layered with CL, Trace of Sand

This stratum was encountered below the above described deposits in BH #1, 3 and 4, and at the ground surface in BH #2. This deposit is 4.5 to 6m in depth.

Physical properties of the material as determined by field and laboratory tests are summarized below:

	<u>Range</u>
Unit Weight	16.3 - 17.9 kN/m ³
Unconfined Shear Strength	41.19- 50.73 kPa
Natural Moisture Content (w)	38 - 61%
Liquid Limit (W _L)	32 - 47%
Plastic Limit (wp)	18 - 24%
Initial Voids Ratio (eo)	1.087- 1.513
Preconsolidation Pressure (Pc)	180 - 289 kPa
Compression Index (Cc)	0.341- 0.916

This deposit of silty clay was of medium plasticity with thin (approximately 3 mm) layers of silty clay of low plasticity and a few thin (1 mm) seams of very fine sand. The consistency of the overall deposit ranged between firm and stiff.

Figure 2 shows the results of the grain size distribution for this material in envelope form, and Figure 3 indicates the plasticity of the deposit.

Silt to Sandy Silt to Silty Sand, Trace of Clay

In all four boreholes deposits of mixed proportions of silt and sand with traces of clay were found. For boundary elevations of these materials reference should be made to the Record of Boreholes. Generally the deposit ranged from a silt or sandy silt, trace of clay with depth to a silty sand, trace of clay.

The denseness of the deposit ranged from very loose to very dense generally be coming denser with depth.

The natural moisture content ranges from 14.5 to 27%, Figure 4 shows an envelope of the grain size distribution curves for the strata at this location.

Bedrock

Bedrock was encountered below the overburden material at the following elevations:

BH #3	229.1 m
BH #4	213.5 m

At both locations, bedrock is a sound granite gneiss of Middle Precambrian Age. The rock core samples were examined by Mr. E. R. Magni, MTC Geologist and his description is included in Figure 5 of the Appendix of this report.

GROUNDWATER CONDITIONS

The following groundwater conditions were observed during the field investigation:

<u>Borehole</u>	<u>Elevation (m)</u>
1	245.7
2	242.6
3	252.1
4	243.5

The boreholes indicate the groundwater level to be 3.2 m below the ground level at the approximate elevation 252 m. This level will most likely vary seasonally.

DISCUSSION AND RECOMMENDATIONS

It is proposed to construct a bridge to carry the proposed re-alignment of the existing Muskoka Road 14 (approximately 30 m south of the existing alignment) over Highway 11. The present intersection is a level crossing. Grade raises of 7 m at the west abutment and 8.5 m at the east abutment locations are proposed to provide for the underpass.

STRUCTURE FOUNDATIONS

In view of the encountered subsurface conditions the following foundation recommendations are being made:

1. The west abutment should be founded on steel H-piles driven to bedrock at approximate elevation 229 m. For HP 310X110 steel 'H' piles, a design load of 1150 kN is recommended. For the purpose of the O.H.B.D.C. the following values are recommended:

Factored Capacity at U.L.S.	1600 kN
Capacity at S.L.S. Type II	1150 kN

2. The centre pier(s) and east abutment should be founded on steel 'H' piles, HP 310X110, driven to approximate EL. 220 m. A design load of 885 kN per pile is recommended. For the purposes of the O.H.B.D.C. the following design values are recommended:

Factored Capacity at U.L.S.	1230 kN
Capacity at S.L.S. Type II	885 kN

The piles should be driven in accordance with MTC standards SS-103-10 and SS-103-11, using an ultimate capacity of 2655 kN per pile.

All piles should be reinforced with pile tips.

Earth pressure should be computed as per Subsection 6.6.1.2.2. of the Code. A yielding foundation condition may be assumed. Backfill to the structure should consist of Granular 'A' or Granular 'B' for which the following properties may be assumed:

Granular 'A'	$\gamma = 22.8 \text{ kN/m}^3$, $\phi = 35^\circ$, $K_a = 0.271$
Granular 'B'	$\gamma = 21.3 \text{ kN/m}^3$, $\phi = 30^\circ$, $K_a = 0.333$

The pile caps should have a minimum of 1.7 m of earth cover for frost protection.

Concrete should be placed in the 'dry'. A dewatering scheme will be required for footing excavations below the prevailing groundwater level.

Differential settlements of the structure constructed in accordance with the for going recommendations should not exceed 25 mm however the structure must be designed to withstand this amount of differential settlement between adjacent pier(s) and abutments.

Approach Embankments

Topsoil and surficial material is to be removed prior to placing any fill. The fill should consist of well compacted acceptable material. Care should be taken to ensure that no bouldery fill is placed within the approaches through which piles have to be driven, and it is recommended that this portion of the fill contain no larger grain sizes than 75 mm.

West of station 10+060 the embankments should be constructed with forward and side slopes not steeper than 2 horizontal to 1 vertical. East of station 10+060 where the effective height of the new fill will be up to 16 m further investigation is required and a separate report will be issued at a later date. For this purpose, we will require cross sections along Fraserburg Road between stations 10+060 and 10+160. These sections should be taken to 50 m right and left of the new proposed centreline of Fraserburg Road.

Settlements will occur due to consolidation of the cohesive soil in the original ground due to the weight of the new approach embankments. Maximum settlement is expected to occur adjacent to the abutments and is estimated to be in the order of 200 to 250 mm of which about 50% should occur in the first six months. To minimize the effect of the settlement, it is recommended that final paving of the Fraserburg Road be delayed for as long a period as possible, after the placement of the fill to its full height in addition suitable approach slabs should also be constructed.

MISCELLANEOUS

The fieldwork for this investigation was carried out under the supervision of Mrs. Pamela Marks, Project Foundation Engineer and Mr. P. Lough, summer student. The equipment was owned and operated by Dominion Soil Investigations. This report was prepared by Mrs. P. Marks and reviewed by Mr. K. Selby.



P. Marks
Project Foundations Engineer



K. G. Selby, P.Eng.
Chief Foundations Engineer (West)

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

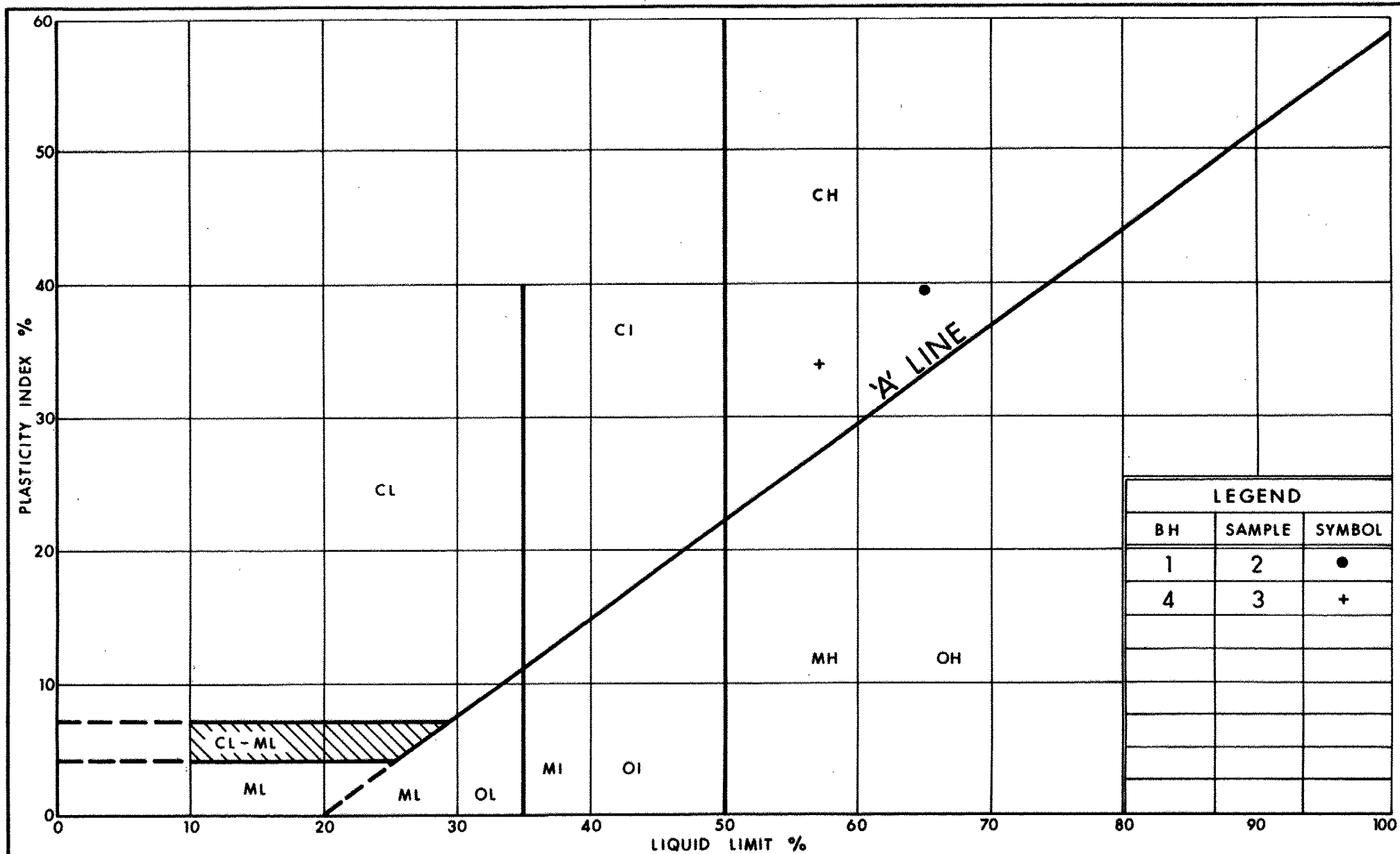
u_w	kPa	PORE WATER PRESSURE
r_u	1	PORE PRESSURE RATIO
σ	kPa	TOTAL NORMAL STRESS
σ'	kPa	EFFECTIVE NORMAL STRESS
τ	kPa	SHEAR STRESS
$\sigma_1, \sigma_2, \sigma_3$	kPa	PRINCIPAL STRESSES
ϵ	%	LINEAR STRAIN
$\epsilon_1, \epsilon_2, \epsilon_3$	%	PRINCIPAL STRAINS
E	kPa	MODULUS OF LINEAR DEFORMATION
G	kPa	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_t	1	SENSITIVITY = $\frac{c_u}{\tau_r}$

PHYSICAL PROPERTIES OF SOIL

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



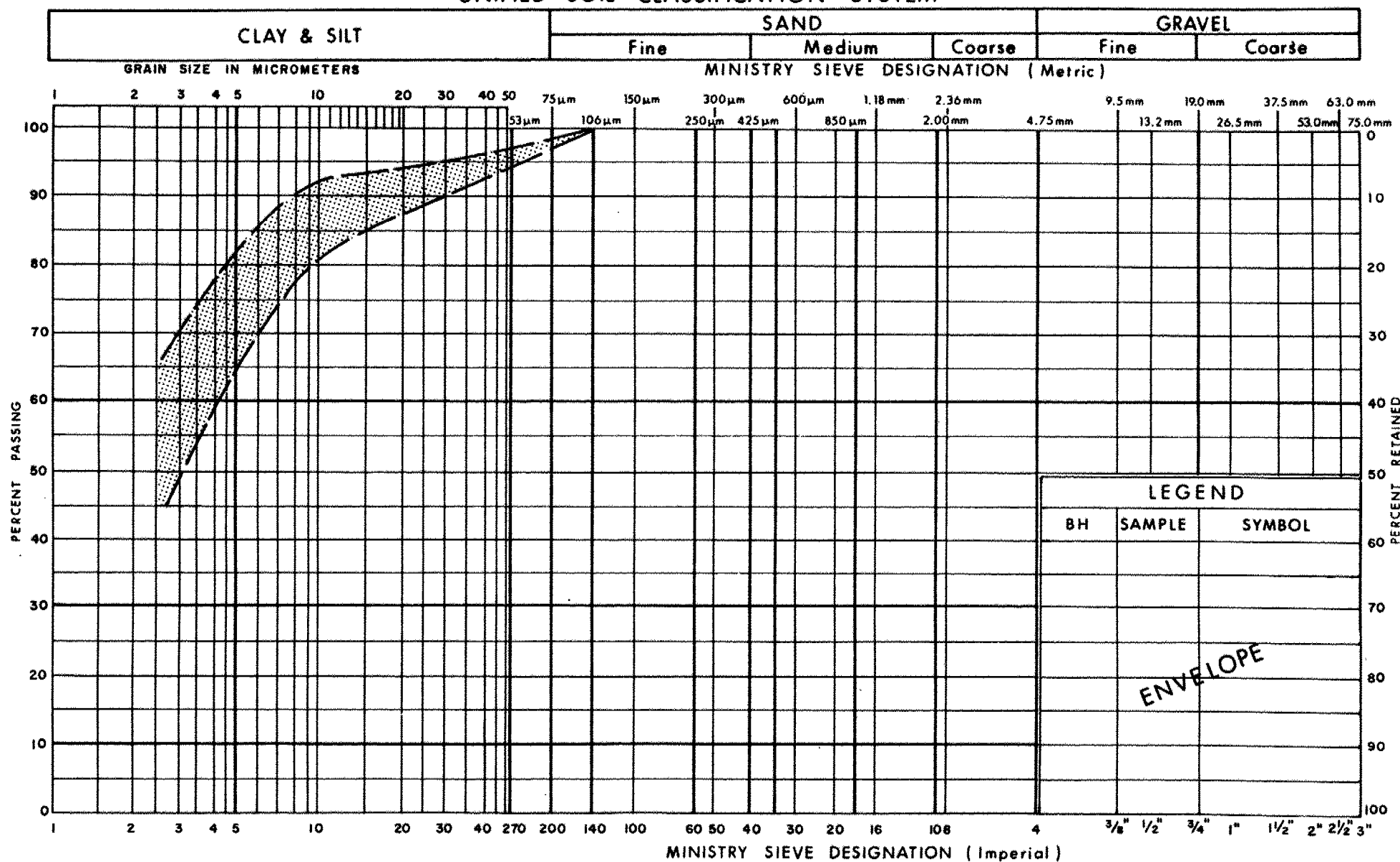
Ministry of
Transportation and
Communications

PLASTICITY CHART
CLAY Trace of sand

FIG No 1

W P 60-86-00

UNIFIED SOIL CLASSIFICATION SYSTEM

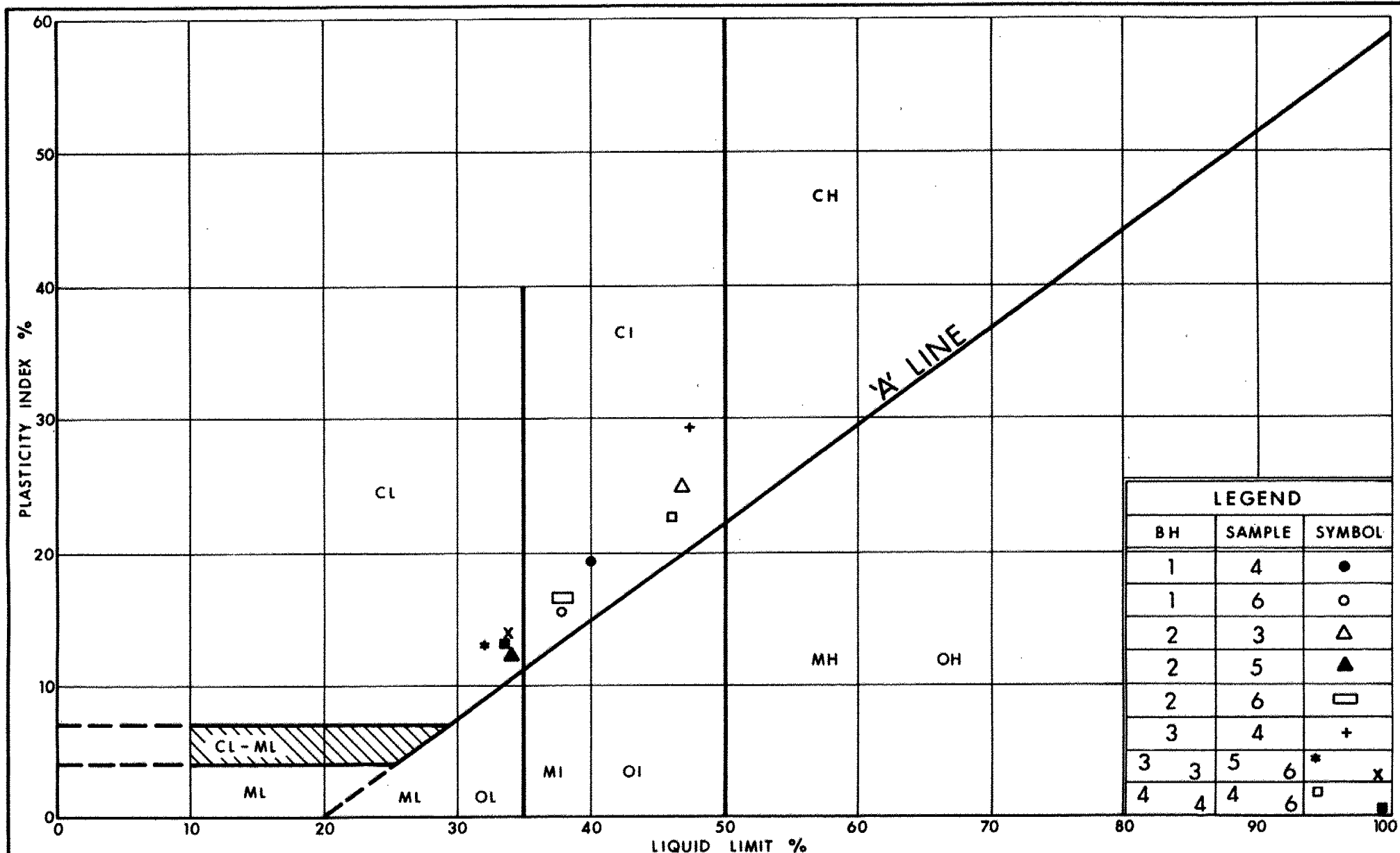
Ministry of
Transportation and
Communications

GRAIN SIZE DISTRIBUTION

SILTY CLAY Layered of medium to low plasticity, trace of sand

FIG No 2

W P 60-86-00



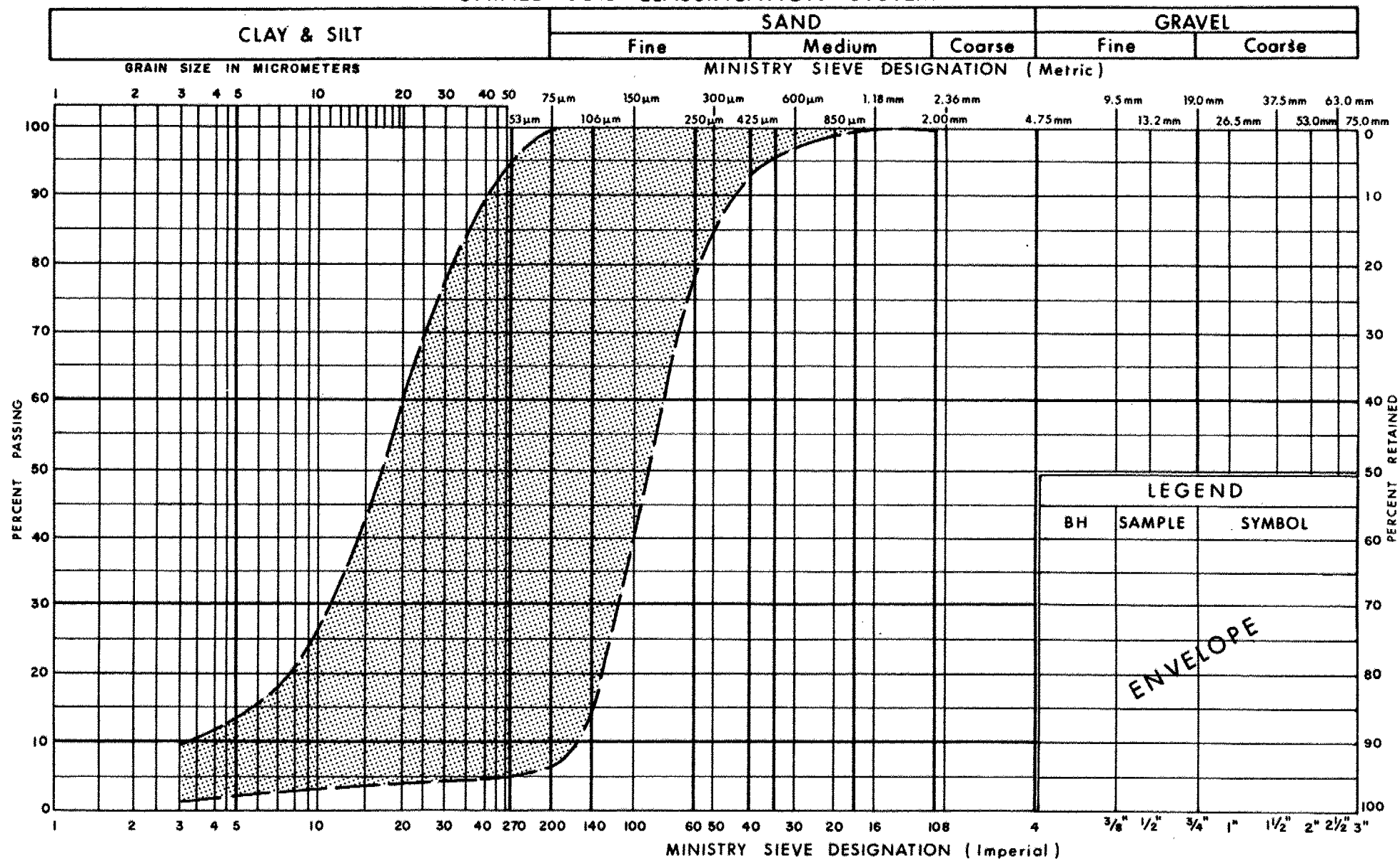
Ministry of
Transportation and
Communications

PLASTICITY CHART
SILTY CLAY of low to medium plasticity, trace of sand

FIG No 3

W P 60-86-00

UNIFIED SOIL CLASSIFICATION SYSTEM



**Ministry of
Transportation and
Communications**

GRAIN SIZE DISTRIBUTION
SILT TO SANDY SILT TO SILTY SAND Trace of clay

FIG No 4

W P 60-86-00

DESCRIPTION OF ROCK CORE - W.P. 60-86-00

BOREHOLE NUMBER				CORE DESCRIPTION	
	DEPTH (m)	% CR *	% RQD *	DEPTH (m)	DESCRIPTION
3	26.21 - 27.74 27.74 - 29.26	100 100	80 100	26.21 - 29.26	GRANITE GNEISS, unweathered, widely to very widely spaced joints
4	40.54 - 42.11	98	85	40.54 - 40.84 40.84 - 42.11	GRANITE GNEISS, slightly weathered, medium spaced joints GRANITE GNEISS, unweathered, widely spaced joints

* CR= CORE RECOVERY ; RQD = ROCK QUALITY DESIGNATION

FIG 5



RECORD OF BOREHOLE No 1

METRIC

W P 60-86-00 LOCATION Sta. 10 + 037 O/S 1.0 m Lt. ORIGINATED BY PM
DIST 11 HWY 11 BOREHOLE TYPE Cont. Flight Auger (HS) Casing (BW) COMPILED BY
DATUM Geodetic DATE 86 06 05 - 86 06 11 CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100	100						WATER CONTENT (%)
251.9	Ground Level														
0.0	Clay of High Plasticity trace of sand trace of organics Stiff		1	SS	2										
249.2			2	TW	PH										
2.7			3	SS	20										
			4	SS	5										
			5	SS	5										
			6	TW	PH										
244.7	Silty Clay of Medium Plasticity layered with Silty Clay of Low Plasticity Trace of Sand Firm to Stiff		7	SS	33										
244.7			8	SS	11										
7.5			9	SS	9										
241.6	Silt, trace of sand, trace of clay Compact to Loose		10	SS	11										
10.3			11	SS	8										
			12	SS	16										
			13	SS	6										
			14	SS	20										
			15	SS	12										
	Sandy Silt to Silty Sand trace of clay		16	SS	65										
			17	SS	12										
			18	SS	12										
			19	SS	41										
	Loose to Compact		20	SS	12										
			21	SS	12										
			22	SS	12										
			23	SS	12										
	Dense to very Dense		24	SS	12										
			25	SS	12										
			26	SS	12										
			27	SS	12										
221.9															

Continued

+3, x5 : Numbers refer to Sensitivity

20 15 10 5 (%) STRAIN AT FAILURE

Continued



RECORD OF BOREHOLE No 1 Continued

METRIC

W P. 60-86-00 LOCATION Sta. 10 + 037, O/S 1.0 m Lt. ORIGINATED BY PM
DIST 11 HWY 11 BOREHOLE TYPE Continuous Flight Auger (HS) Casing (BW) COMPILED BY _____
DATUM Geodetic DATE 86 06 05 - 86 06 11 CHECKED BY JS

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
221.9 30.0	Continued																
							220										
							218										
							216										
							214										
			24	SS	73		212										
			25	SS	81		210										
209.0 42.9	End of Borehole		27	SS	53												

Sandy Silt to
Silty Sand
trace of clay
Dense to
Very Dense

0 17 82 1



RECORD OF BOREHOLE No 2

METRIC

W P 60-86-00 LOCATION Sta. 10 + 075, O/S 1.0 m Lt. ORIGINATED BY PM
DIST 11 HWY 11 BOREHOLE TYPE Cont. Flight Auger (HS) COMPILED BY
DATUM Geodetic DATE 86 06 12 - 86 06 13 CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ 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	x LAB VANE	
250.6	Ground Level						20	40	60	80	100	20	40	60			
0.0	Silty Clay of Medium Plasticity with layers of silty clay of Low Plasticity trace of sand Firm to Stiff		2	SS	8												
			3	SS	3										0 1 38 61		
			4	SS	2												
			5	TW	PH												
			6	SS	2												
244.3																	
6.3	Silty Sand, trace of clay Loose		7	SS	9										0 1 64 35		
243.6			8	SS	11										0 66 29 5		
7.0	Silt Trace of Sand Trace of Clay Loose to Compact		9	SS	8										0 5 90 5		
			10	SS	8												
238.8			11	SS	9										0 12.84 4		
11.8	Silt and Sand Trace of Clay Loose to Compact		12	SS	5										0 40 59 1		
			13	SS	9												
			14	SS	5												
232.4			15	SS	22										0 58 40 2		
18.2	End of Borehole																
230.1																	
20.5	End of Cone Test																
228.6																	
22.0	End of Cone Test																

— Cone test originating at ground level

- - - Cone test originating at bottom of borehole



RECORD OF BOREHOLE No 3

METRIC

W P 60-86-00 LOCATION Sta. 9 + 959.8, O/S 2.3 m Lt. ORIGINATED BY PM
DIST 11 HWY 11 BOREHOLE TYPE Cont. Flight Auger (HS), Casing (BW) COMPILED BY
DATUM Geodetic DATE 86 06 13 - 86 06 17 CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT		UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100	20 40 60 80 100	W _p W W _L	WATER CONTENT (%)		
255.3	Ground Level												
0.0	Silt, trace of sand		1	SS	25		254						0 9 83 8
253.2	trace of clay		2	SS	13		252						
2.1	Fill Material		3	SS	2		250						
	Compact		4	TW	PH		248						
	Silty Clay of		5	SS	3		246						
	Low Plasticity		6	TW	PH		244						
	(From Uniform to						242						
	Layered with Silty						240						
	Clay of Medium						238						
	Plasticity)						236						
	Firm						234						
247.1							232						
8.2	Silt		7	SS	10		230						
	Loose		8	SS	8		228						
243.7			9	SS	2		226						
11.6			10	SS	8		224						
	Sandy Silt		11	SS	8		222						
	Very Loose		12	SS	8		220						
	to Loose						218						
235.2							216						
20.1			13	SS	21		214						
	Silty Sand		14	SS	40		212						
	Compact to						210						
	Dense						208						
229.1							206						
26.2	Granite Gneiss		15	RC	REC		204						
	Sound			BX	100%		202						
	Bedrock		16	RC	REC		200						
				BX	100%		198						
226.0							196						
29.3	End of Borehole						194						

+3, x5: Numbers refer to
Sensitivity

20
15 5 (%) STRAIN AT FAILURE
10



RECORD OF BOREHOLE No 4

METRIC

W P 60-86-00 LOCATION Sta. 10 + 005.4; O/S 4.2 m Lt. ORIGINATED BY PM
DIST 11 HWY 11 BOREHOLE TYPE Cont. Flight Auger (HS); Casing (BW) COMPILED BY
DATUM Geodetic DATE 86 06 18 - 86 06 20 CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100	20 40 60 80 100					
254.0	Shoulder Level													
0.0	Fill Material													
253.3	Sand and Gravel													
0.7	Silty Sand to Sandy Silt trace of clay		1	SS	7									
251.9	Loose		2	SS	5									0 16 76 8
2.1	Clay of High Plasticity Stiff		3	SS	2									0 3 43 54
249.4			4	TW	PH								16.5	0 4 43 53
4.6	Silty Clay of Low to Medium Plasticity		5	SS	3									
246.2	Firm to Stiff		6	TW	PH								17.9	
7.8	Sandy Silt Occasional Layers of Clay		7	SS	12									0 2 93 5
242.3	Loose to Compact		8	SS	9									
11.7			9	SS	6									0 18 78 4
			10	SS	6									0 27 70 3
			11	SS	1									
	Sandy Silt Very Loose to Loose		12	SS	0									
			13	SS	6									0 33 66 1
233.9														
20.1			14	SS	21									
	Silty Sand		15	SS	33									
	Compact to Dense													
			16	SS	50									0 93 7
224.0	Very Dense													
30.0														

Continued

+3, x5: Numbers refer to
Sensitivity

20
15 5 (%) STRAIN AT FAILURE
10

Continued

RECORD OF BOREHOLE No 4 Continued

METRIC

W P 60-86-00

LOCATION Sta. 10 + 005.4; O/S 4.2 m Lt.

ORIGINATED BY PM

DIST 11 HWY 11

BOREHOLE TYPE Cont. Flight Auger (HS); Casing (BW)

COMPILED BY

DATUM Geodetic

DATE 86 06 18 - 86 06 20

CHECKED BY

SOIL PROFILE

SAMPLES

GROUND WATER
CONDITIONS

LEVATION SCALE

DYNAMIC CONE PENETRATION
RESISTANCE PLOT

20 40 60 80 100

SHEAR STRENGTH

○ UNCONFINED + FIELD VANE
● QUICK TRIAXIAL x LAB VANE

PLASTIC
LIMIT
W_D

NATURAL
MOISTURE
CONTENT
W

LIQUID
LIMIT
W.

UNIT	WEIGHT
γ	1

	REMARKS & GRAIN SIZE DISTRIBUTION (%)
GR SA SI CL	

GR SA SI CL

0 76 23 1

Silty Sand

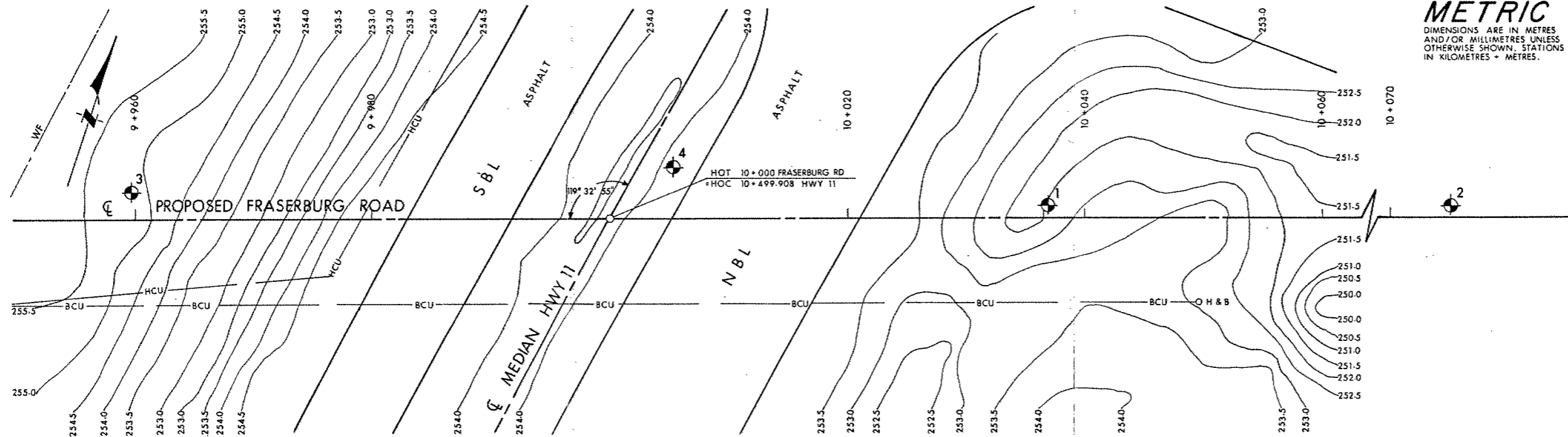
Very Dense

Granite Gneiss
Sound
Bedrock

End of Borehole

+3, x5: Numbers refer to Sensitivity

20
15 ϕ 5 (%) STRAIN AT FAILURE
10

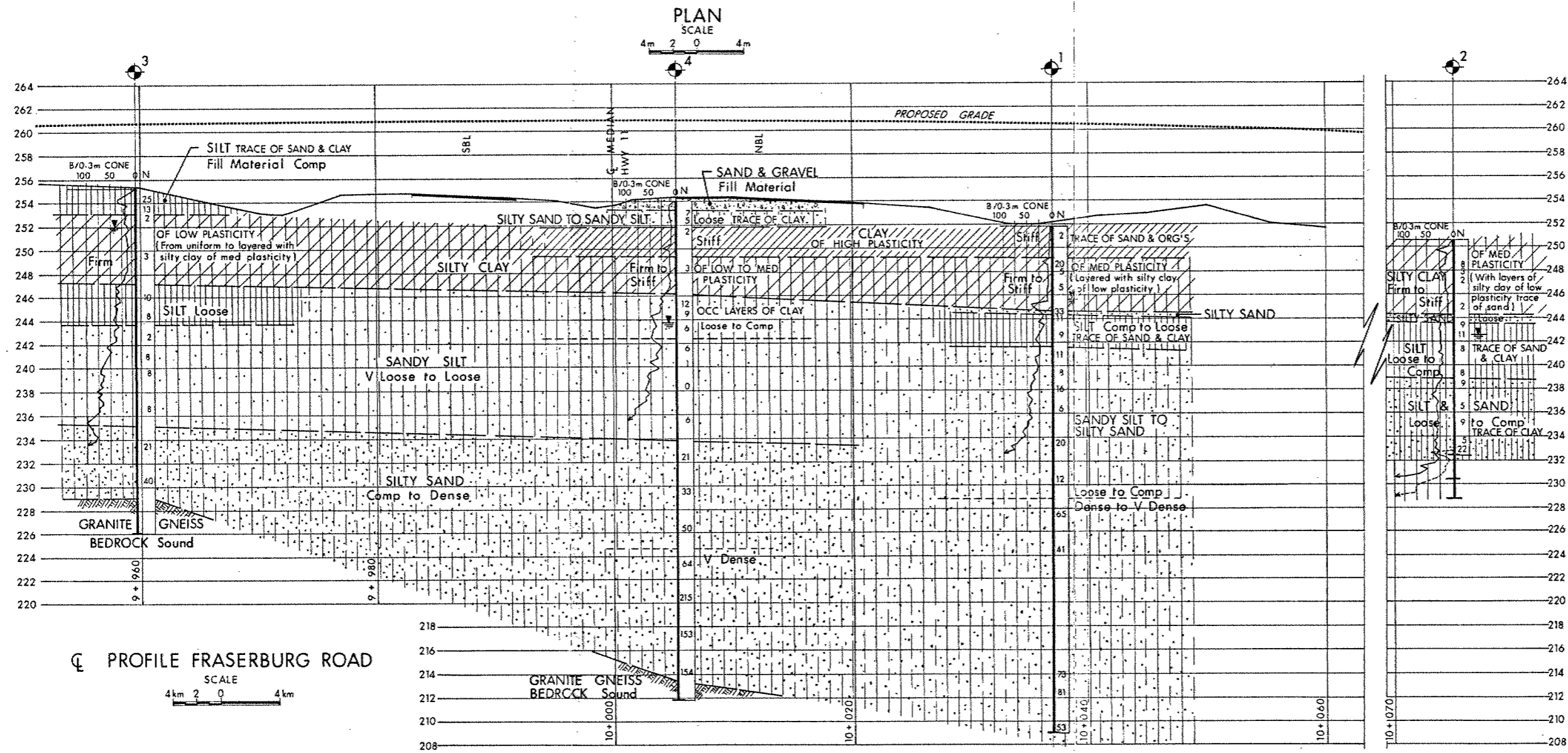
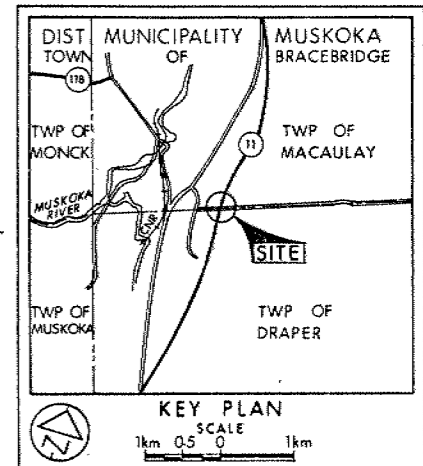


METRIC
DIMENSIONS ARE IN METRES
AND/OR MILLIMETRES UNLESS
OTHERWISE SHOWN. STATIONS
IN KILOMETRES + METRES.

CONT No
WP No 60-86-00
FRASERBURG ROAD
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 86 06

No	ELEVATION	STATION	OFFSET
1	251.9	10+037.0	1.0m Lt
2	250.6	10+075.0	1.0m Lt
3	255.3	9+959.8	2.3m Lt
4	254.0	10+005.4	4.2m Lt

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
1	1986 09 24	DATE	DATE

Geocres No 31E-101

HWY No 11	DIST 11
SUBMD PM [CHECKED]	SITE
DRAWN DT [CHECKED]	DWG 608600-A

memorandum



Tel: 235-3731

To: D. Chretien
Planning & Design
North Bay

From: Foundation Design Section
Room 315, Central Building

RE: Gradings Drawings
Muskoka Road 14, Underpass
W.P. 60-86-02
Hwy. 11, District 11

Date: 1987 12 03

We have reviewed the grading drawings you sent for the above project and have the following comments:

1. The skew angle indicated for the culvert marks a less than 90° angle as 106° , Sheet 1, Layout for Culvert 7.

As discussed in late November 1987,

2. $D/2 + 185 \text{ cm} = 285 \text{ cm}$ is measured from the top of the granular material to the centre of the pipe not the invert level as shown on Sheet 1, Typical Culvert Treatment.
3. The berm width for the South side at station $10 + 070$ should be indicated as 7 m on Sheet 1, Typical Section at Berm Location.

A handwritten signature in cursive script, reading "Pamela Marks".

Pamela Marks, P. Eng.
Project Foundations Engineer

PM/wn

DOCUMENT MICROFILMING IDENTIFICATION

GEOCRES No. 31E-101
101A

DIST. _____ REGION _____

W.P. No. 60-86-00

CONT. No. 88-07

W. O. No. _____

STR. SITE No. _____

HWY. No. 11

LOCATION Muskegon Co. Rd #14.

No of PAGES -

=====

OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT. _____

REMARKS: _____

From: Jim McDougall
To: MTONH.HUNTSVILLE.HinesGeo
Date: 7/7/95 11:58am
Subject: Fraserburg Rd (Musk.Rd. #14) Cont.88-07 WP 60-86-00
-Reply

Howie Pattenden reviewed the approaches this week and is sending you something in the mail.

Tai Kim, and Dave Kwok both of the Foundations Section and I are going to be reviewing Hwy 118 near Haliburton as well as the swamp west of port Carling on Wed july 12th 95. We hope to meet at the District office at 10:30 and head to the Haliburton site first.

If you or or Dan Donner would like to be present that is fine. We will be staying overnight at the Journeys End in Huntsville. On thursday we will look at Hwy 141 and 632 sawdust swamp areas and proceed to the Tensar rock fill down on Hwy 69/Bots job they will continue on south and I'll high tail it back to north bay. FYI and TAA.

Dave Dundas if you are not on Holidays please pass this info on to Tai Kim.

>>> George Hines 6/28/95, 11:30am >>>

This project was constructed with the assumption that the approach fills would consolidate. It was surface treated and was to be Hot Mixed at a later date. The Disrict of Musk. think that it is now time to Hot Mix. Settlements are minimul, the worst being at the east approach slab. Although the District of Musk. are going ahead with the paving of the surface treated sectoin we need to review the sections from the end af the curbs to the expansion joints. Your Recommendations are required so the Ministry can finalize there Commitments. Remedail work at the approach slab could be included in the Musk. #37 contract. If you need more info please call.

CC: MTONH.HUNTSVILLE.DonerDan, MTOHO3.TES.Dundas

memorandum



To: K. Williams
Head, Planning & Design Section
Northern Region
North Bay

Date: 1987 11 25

From: Foundation Design Section
Room 315, Central Building

RE: Fraserburg Road Sta. 10 + 060 - 10 + 160
W.P. 60-86-00; District 11 (Huntsville)

A foundation investigation was carried out by this office at the above-mentioned location in January 1987. The purpose was to determine the appropriate cross sections for the realigned Fraserburg Road. No formal report was prepared by this office, however, a memo containing our recommendations in detail, and copies of borelog sheets (hand-written only) were provided to J. McDougall. In accordance with DD-76-32/OD-76-49 (attached) you are to determine which documents are to be prepared by us for inclusion in contract documents and to provide us with the necessary drawings etc. for this purpose. Please advise us accordingly.

A handwritten signature in cursive script, appearing to read "K.G. Selby".

K.G. Selby, P. Eng.
Chief Foundation Engineer
(West)

KGS/wn

c.c. - J. McDougall

memorandum



Mr. K. Selby

87 03 23

To: Chief Foundations Engineer
Engineering Materials Office
3rd Floor, Central Building
DOWNSVIEW

Date:
Phone 1-705-472-7900
Ext. 286, 7

FROM: Geotechnical Section
Northern Region

Attention: Paul Payer
Senior Foundations Engineer



Culvert Bedding and Backfill Requirements
WP 60-86-00
Muskoka Road # 14, Underpass
District # 11, Huntsville

As discussed by phone on March 3, 1987, Planning & Design Section have now completed the preliminary culvert design with parameters as listed:-

1. Proposed Culvert - 4' x 4' reinforced concrete, box culvert.
2. Location - Station 10+130, Skew No. 125°.
3. Length - 95[±] m.
4. Invert Elevations - Upstream 245.2[±]
- Downstream 243.4[±]

Please analyze the stability requirements of this culvert design and provide recommendations for culvert bedding and backfill requirements.

Attached is the proposed culvert layout sketch.

Ken Crowder
Pavement Design &
Evaluation Officer

KC/ap
Attach:
cc: K. L. Williams
S. McCombie
File (2)

TELEFAX TO:

J. McDougall
Head, Geotechnical Section
Northern Region

Attention: K. Crowder

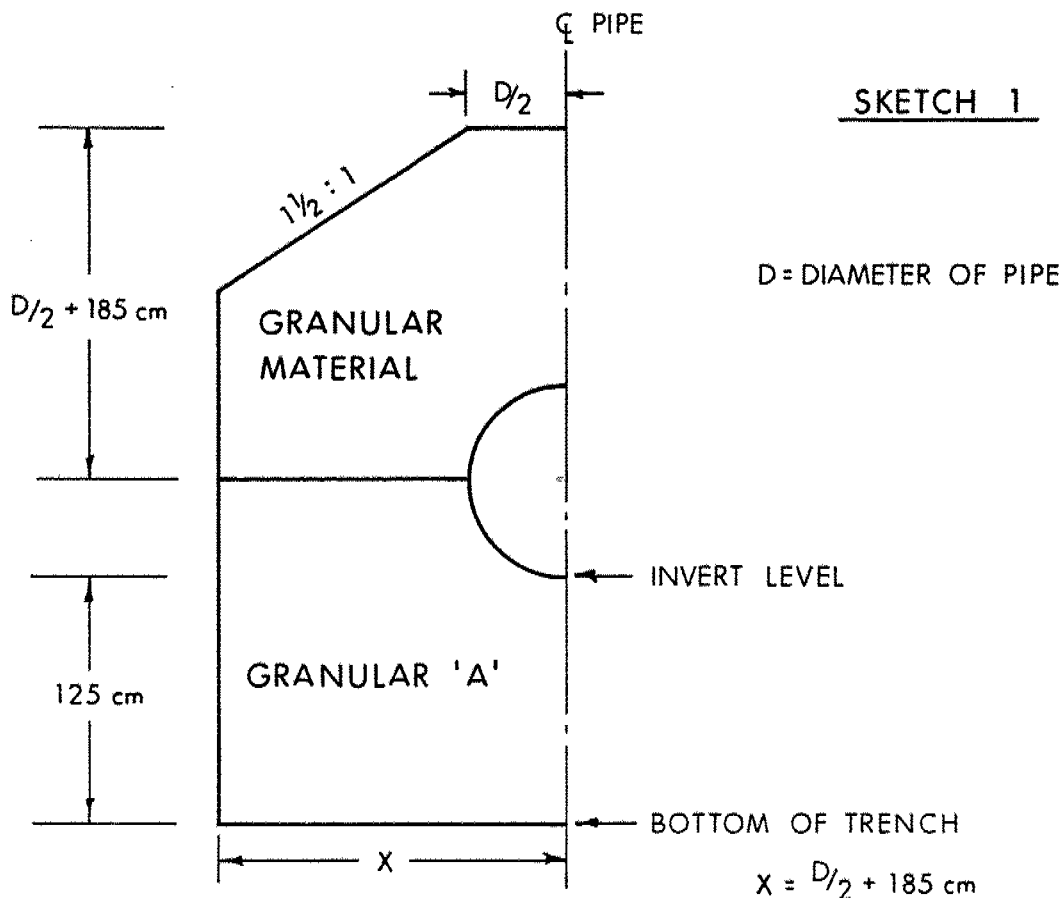
From: Foundation Design Section
Room 315, Central Building

RE: Bedding and Backfill Requirements
Culvert Installation
Muskoka Road #14, Sta: 10 + 130
W.P. 60-86-00
District #11 (Huntsville)

It is proposed to construct a culvert at this location. A flexible type culvert is recommended. The following design details are suggested by the Regional Planning and Design Section:

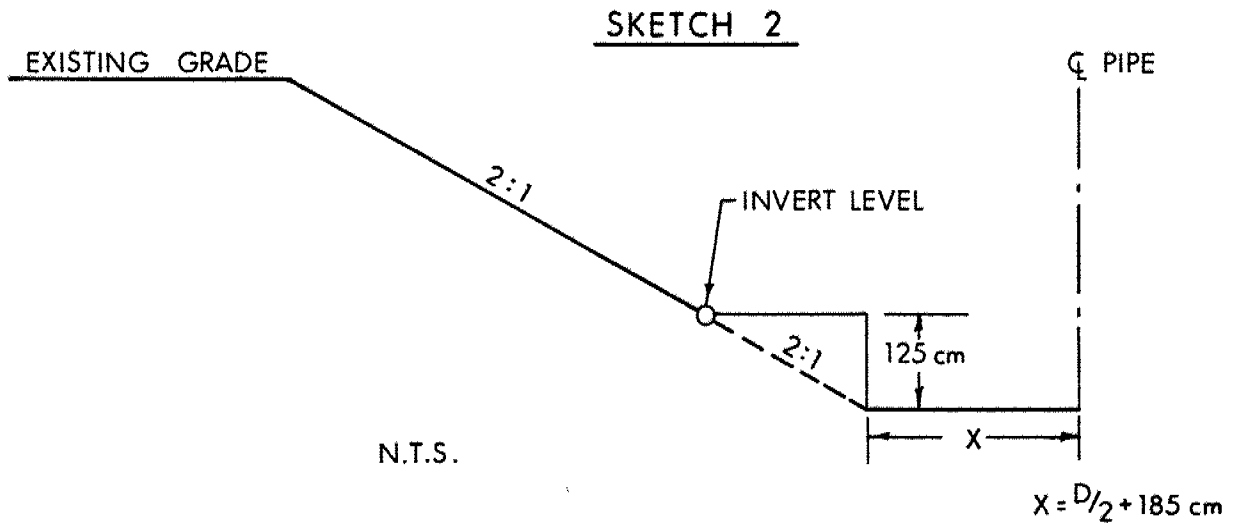
- 1) Diameter: 1500 mm CSP
- 2) Skew: 125°
- 3) Length: $95 \pm$ m
- 4) Invert Levels; Upstream: El. 245.2 \pm
Downstream: El. 243.4 \pm

In order to ensure the integrity and the future performance of the proposed culvert, it is recommended that the pertinent M.T.C. specifications and standards be followed. The bedding for this type of pipe is outlined on Standard Dd-808A, Type 4 (Rev. 6, 1984 08 01). The minimum requirements are as illustrated below.



N.T.S.

In order to place the culvert, excavation of the existing fill and/or the original subsoil will be required to ensure the stability of the existing embankment, stability analyses were carried out. The obtained results have suggested the following geometry for duration of the installation:



The pipe should be constructed with a minimum camber of 15 cm.

The following construction sequence is recommended:

- 1) Excavate existing fill and trench as illustrated on sketch (2)
- 2) Place 125 cm thick granular 'A' at the bottom of trench
- 3) Place bedding in dry and pipe in accordance with Standard DD-808A, Type 4
- 4) Backfill as shown on sketch (1).

The above recommendations in part, were discussed with you on 87 05 25.

P. Payer

P. Payer, P. Eng.
Sr. Foundations Engineer

c.c. K.L. Williams
S. McCombie

memorandum



To: J.I. McDougall
Head, Geotechnical Section
North Bay

Date: 1987 03 04

Atten: K. Crowder

From: Foundation Design Section
Room 315, Central Building

RE: Berm Requirements
Muskoka Rd. #14 Underpass
W.P. 60-86-00
Hwy.#11, District #11

This is to confirm our verbal recommendations of 87 03 02 concerning the berm requirements on Fraserburg Road, East of the proposed underpass structure.

North (Left) Side

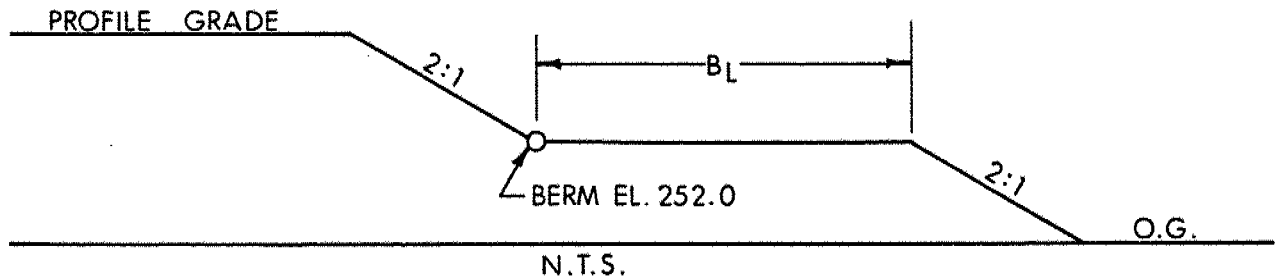
<u>Station</u>	<u>Berm Length (BL)</u>
10 + 100	0 m
10 + 110	8 m
10 + 120	12 m
10 + 130	12 m
10 + 140	12 m
10 + 150	9 m
10 + 160	0 m

South (Right) Side

10 + 060	0 m
10 + 070	7 m
10 + 080	12 m
10 + 090	12 m
10 + 100	12 m
10 + 110	12 m
10 + 120	12 m
10 + 130	12 m
10 + 140	6 m
10 + 150	0 m

Berm Level: El. 252.0

The berms should be constructed as follows:



The material in the embankment (core and berm) should consist of well compact acceptable material and should be placed in accordance with Special Provision No. 120.17.

The berms should be tapered off horizontally and vertically to stations where zero berm lengths are indicated.

The completed Record of Borehole Sheets will be forwarded to you in the near future.

P. Payer, P. Eng.
Senior Foundations Engineer

PP.mmj

c.c. - K. Williams

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

DIST. 11
CONT No
WP No 60-86-02
MUSKOKA ROAD #14
(FRASERSBURG ROAD)
UNDERPASS
GENERAL ARRANGEMENT



NOTES

REINFORCING STEEL
REINFORCING STEEL SHALL BE GRADE 400
UNLESS OTHERWISE SPECIFIED
SAR MARKS WITH SUPPLY 'C' DENOTE
COATED BARS.

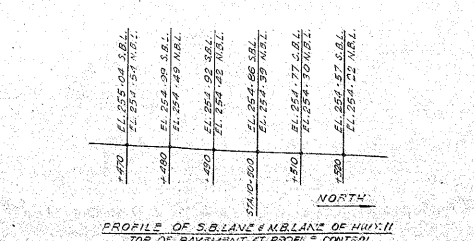
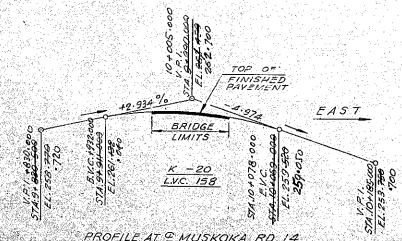
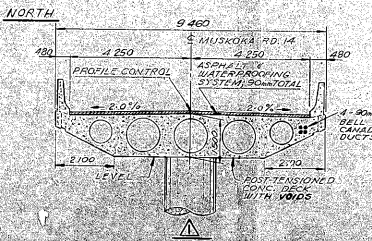
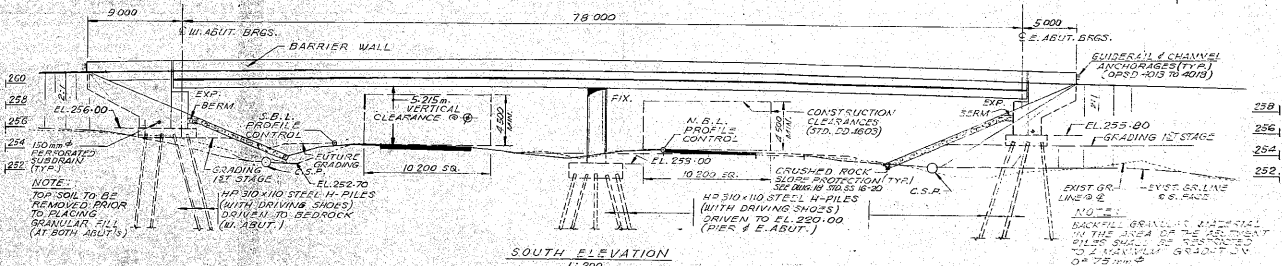
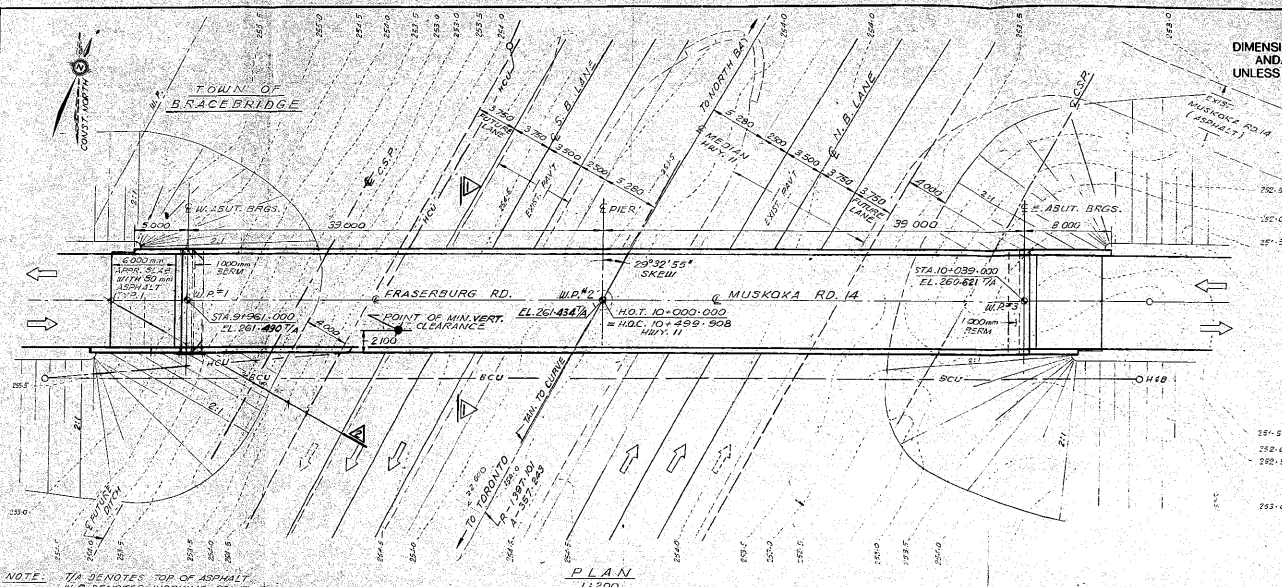
CLASS OF CONCRETE
ABUTMENT FOOTINGS 20 MPa
ABUTMENTS & WINGWALLS 20 MPa
PIER FOOTING 20 MPa
PIER COLUMN & DECK 35 MPa
BARRIER WALLS 30 MPa
APPROACH SLABS 30 MPa
AND AS NOTED

CLEAR COVER TO REINFORCING STEEL
FOOTINGS 100 ± 25 mm
ABUTMENTS & WINGWALLS 100 ± 25 mm
FRONT FACE 90 ± 20 mm
BACK FACE 90 ± 20 mm
PIER COLUMN TOP 80 ± 20 mm
DECK TOP 80 ± 20 mm
BARRIER WALLS BOTTOM 50 ± 10 mm
APPROACH SLABS 80 ± 20 mm
AND AS NOTED

CONSTRUCTION NOTES
THE CONTRACTOR SHALL FINISH BEARING
SEATS DEAD LEVEL TO THE SPECIFIED
ELEVATIONS TO A TOLERANCE OF ± 3 mm.
NO CONCRETE SHALL BE PLACED ABOVE
THE ABUTMENT BEARING SEATS UNTIL THE
CONCRETE IN THE DECK HAS BEEN PLACED,
STRESSED AND JOINTS GROUTED.

LIST OF DRAWINGS

- 20-363-89-1 GENERAL ARRANGEMENT
- 2 BORE HOLE LOCATION & SOIL STRATA
- 3 FOOTINGS
- 4 WEST ABUTMENT
- 5 EAST ABUTMENT
- 6 PIER
- 7 DECK DETAILS
- 8 LONGITUDINAL TENDON DETAILS
- 9 TRANSVERSE TENDON DETAILS
- 10 DECK REINFORCING I
- 11 DECK REINFORCING II
- 12 JOINT ANCHORAGE AND ARMOURING
- 13 BARRIER WALL
- 14 6000mm APPROACH SLAB
- 15 AS CONSTRUCTED ELEV. & DIM.
- 16 PILE DRIVING - STEAM & DIESEL HAMMERS
- 17 BRIDGE DATA & SITE NUMBER DATA
- 18 STANDARD DETAILS
- 19 QUANTITIES - STRUCTURE I
- 20 QUANTITIES - STRUCTURE II



DUO 9M 283-67
EL. 256-843
DESIGNED AND CONSTRUCTED
IN THE CASE OF CONC. RD.
ROUTE 30.

DATE	BY	CHECK	LOADING	DESCRIPTION	DATE	BY	CHECK
2011-02-01	2011-02-01
2011-02-01	2011-02-01

291-50 400
761-84-01