DOCUMENT MICROFILMING IDENTIFICATION

G.I.-30 SEPT. 1976

GEOCRES No. 30M12-171

DIST. 6 REGION

W.P. No. 21-79-01

CONT. No. 84-02

W. O. No.

STR. SITE No. 24-477

HWY. No. 410

LOCATION C.N.R. Overpass

No of PAGES -

OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT.

REMARKS:

FOUNDATION INVESTIGATION REPORT

CONTRACT NO 84-02

Ontario

Ministry of
Transportation and
Communications

I N D E X

Note: For the purpose 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

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
γ_s	kN/m^3	UNIT WEIGHT OF SOLID PARTICLES
ρ_w	kg/m^3	DENSITY OF WATER
γ_w	kN/m^3	UNIT WEIGHT OF WATER
ρ	kg/m^3	DENSITY OF SOIL
γ	kN/m^3	UNIT WEIGHT OF SOIL
ρ_d	kg/m^3	DENSITY OF DRY SOIL
γ_d	kN/m^3	UNIT WEIGHT OF DRY SOIL
ρ_{sat}	kg/m^3	DENSITY OF SATURATED SOIL
γ_{sat}	kN/m^3	UNIT WEIGHT OF SATURATED SOIL
ρ'	kg/m^3	DENSITY OF SUBMERGED SOIL
γ'	kN/m^3	UNIT WEIGHT OF SUBMERGED SOIL

e	1,%	VOID RATIO
n	1,%	POROSITY
w	1,%	WATER CONTENT
S_r	%	DEGREE OF SATURATION
w_L	%	LIQUID LIMIT
w_P	%	PLASTIC LIMIT
w_S	%	SHRINKAGE LIMIT
I_P	%	PLASTICITY INDEX = $w_L - w_P$
I_L	1	LIQUIDITY INDEX = $\frac{w - w_P}{I_P}$
I_C	1	CONSISTENCY INDEX = $\frac{w_L - w}{I_P}$
e_{max}	1,%	VOID RATIO IN LOOSEST STATE

e_{min}	1,%	VOID RATIO IN DENSEST STATE
I_D	1	DENSITY INDEX = $\frac{e_{max} - e}{e_{max} - e_{min}}$
D	mm	GRAIN DIAMETER
D_n	mm	n PERCENT - DIAMETER
C_U	1	UNIFORMITY COEFFICIENT
h	m	HYDRAULIC HEAD OR POTENTIAL
q	m^3/s	RATE OF DISCHARGE
v	m/s	DISCHARGE VELOCITY
i	1	HYDRAULIC GRADIENT
k	m/s	HYDRAULIC CONDUCTIVITY
j	kN/m^3	SEEPAGE FORCE

Foundation Investigation Report
For
Hwy. 410/CNR Overhead
W.P. 21-79-01 Site 24-145-477
District 6, Toronto

INTRODUCTION

This report contains the results of a foundation investigation carried out at the site of the above-mentioned project by Dominion Soil Investigation Inc., Consulting Engineers. The fieldwork was carried out in July and August, 1982 and consisted of eight boreholes to depths ranging between 4.3 and 7.3 m below the existing ground surface.

DESCRIPTION OF THE SITE AND GEOLOGY

The site is located in the Regional Municipality of Peel, in the eastern section of the City of Brampton, where Heart Lake Road crosses the C.N.R. tracks. The proposed structure site is located immediately east of the present level crossing.

The terrain in the area is generally flat, rising gently from south to north at a grade of approximately 10 m in 1 km.

Physiographically, the site is located within the Halton-Peel till plain which occupies the area east of the Niagara Escarpment and north of the Lake Iroquois shoreline. It consists mainly of a bevelled till plain with some fluting. In places, it is overlain by thin varved clay or silty sand. The till takes on the character of the underlying bedrock which generally lies at a shallow depth. At the bridge site, the bedrock is the grey Meaford-Dundas shale and the till is generally grey-brown silty clay with many pebbles and fragments of the shale and silt-stone bedrock.

SUBSOIL CONDITIONS

General

Details of the subsurface conditions encountered in the boreholes are shown on the record of borehole sheets (Enclosures 1 to 8) and on the inferred subsoil profiles presented as Sections A to D inclusive on Drawing 2 of the Contract Drawings. The subsurface conditions can be summarized briefly as follows.

Underlying an approximately 0.15 m thick layer of topsoil, the overburden is a hard silty clay till with some embedded gravel and shale fragments. The shale content increases with depth and at depths ranging between 2.6 and 4.6 m, i.e. between Elevations 206.8 and 205.3 m, the boreholes encountered the surface of the grey weathered shale bedrock. The groundwater table is believed to be near the surface of the rock.

The properties of the two principal substrata will be discussed briefly below.

Silty Clay Till

Covered by up to 0.17 m of organic topsoil, the boreholes encountered a brown to greyish brown coloured glacial till which extends to depths ranging between 2.6 and 4.6 m.

The till is a well graded mixture of fine gravel to clay size particles and the grading curves of the material are shown on Figures 1 and 2. Reference to these curves indicate that the till consists of 1 to 12% gravel, 15 to 35% sand, 37 to 46% silt, and 16 to 38% clay size particles.

The matrix of the soil exhibits considerable cohesion and cementation.

Atterberg tests carried out on the soil fines gave the following results:

Liquid Limit	25 to 31%
Plastic Limit	13 to 18%
Plasticity Index	7 to 15%
Natural Moisture Content	10 to 14%

These test results are indicative of a clay of low plasticity and the fact that the natural moisture content is below the plastic limit of the soil suggests a hard consistency. The results of Atterberg Limit Testing on samples from the Silty Clay till are shown on the Plasticity Chart, Figure 3.

Standard Penetration Tests in the till gave 'N'-values ranging from 19 to over 100 blows/0.3 m from which a very stiff to hard consistency can be inferred.

Laboratory unconfined compression tests carried out on intact split spoon samples recovered from the soil gave undrained shear strength values ranging between 200 and over 500 kPa. Based on these test results, together with the visual examination of the samples and the low moisture contents, it is considered that the till has a generally hard consistency.

The unit weight of the soil was measured to range between 21.1 and 22.3 kN/m^3.

Bedrock

The boreholes encountered refusal at depths ranging between 2.6 and 4.6 m, i.e. between Elevations 206.8 and 205.3 m. It is believed that refusal in the boreholes was encountered on the surface of the bedrock. The rock was proven by diamond coring in Boreholes 1, 2, 4, 5, 6 and 8. At these locations, NXL cores were recovered to depths ranging from 1.5 to 3.0 m below the surface of the rock. Core recovery was 100%, and the examination of the recovered cores indicates that the bedrock to the depths explored, is a weathered, very closely bedded, grey shale which is interlayered with grey beds of hard limestone or calcarious sandstone up to 0.15 m thick. It is estimated that the hard layers make up about 10 to 30% of the shale section. R.Q.D. values ranged from 0 to 30% indicating a rock of poor quality.

Groundwater

Groundwater was not encountered during drilling and the boreholes were extended dry to the surface of the rock. As water was introduced in the hole during the coring of the rock, further groundwater observations were obscured. To facilitate water level readings, piezometers were installed in Boreholes 3 and 7.

The piezometer installed in Borehole 3 was left dry to observe the rate at which water may accumulate in the tubing, whereas the piezometer tubes in Borehole 7 was filled with water in order to observe the rate at which water dissipates and finds its equilibrium position. Due to the low permeability of the subsoil, however, water level readings carried out to date do not show a conclusive picture. From the visual and tactile examination of the soil samples, the generally brown colour of the soil, and the presence of oxidized seams even in soil samples taken near the surface of the rock, it is believed that the permanent groundwater table lies at or below the surface of the rock.

L. Politano
Trainee Engineer

M. Devata, P. Eng.
Sr. Foundations Engineer

APPENDIX

Ministry of Transportation and Communications, Ontario

Ref. No. 82-7-2

Enclosure No. 1

HIGHWAY ENGINEERING DIVISION - ENGINEERING MATERIALS OFFICE - SOIL MECHANICS SECTION

RECORD OF BOREHOLE No. 1

METRIC 8

W P 21-79-01 LOCATION Co-ords 4,839,212 N.; 286,707 E. ORIGINATED BY R.M.

DIST 6 HWY 410 BOREHOLE TYPE Hollow Stem Auger, NXL Rock Core COMPILED BY R.M.

DATUM Geodetic DATE 1982 07 15 CHECKED BY I.P.L.

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES 'N' VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE; 100 300 500)	PLASTIC LIMIT Wp / NATURAL MOISTURE CONTENT W / LIQUID LIMIT WL; WATER CONTENT (%) (10 20 30)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
208.1	GROUND SURFACE						208				
0.0	0.16 m Topsoil										
	Brown hard SILTY CLAY some sand and embedded rock fragments. (Glacial Till)		1	SS	32		207				
			2	SS	36					22.3	
							206				
205.5			3	SS	50/12 cm.						11 15 39 35 Augering / Diamond Drilling
2.6	Grey weathered SHALE very closely bedded, with hard limestone layers.		4	RC NXL RQD	100% 0		205				During drilling steady pressure and water return.
			5	RC NXL RQD	100% 0		204				
			6	RC NXL RQD	100% 38%		203				
202.0											
6.1	END OF BOREHOLE										

$\triangle^3$, $\times^5$: Numbers refer to Sensitivity

$\frac{20}{15 \diamond 5}$ (%) STRAIN AT FAILURE
10

OFFICE REPORT ON SOIL EXPLORATION

Ministry of Transportation and Communications, Ontario

Ref. No. 82-7-2

Enclosure No. 2

HIGHWAY ENGINEERING DIVISION - ENGINEERING MATERIALS OFFICE - SOIL MECHANICS SECTION

RECORD OF BOREHOLE No 2

METRIC 9

W P 21-79-01 LOCATION Co-ords 4,839,230 N.; 286,703 E. ORIGINATED BY R.M.

DIST 6 HWY 410 BOREHOLE TYPE Hollow Stem Auger, Rock Core COMPILED BY R.M.

DATUM Geodetic DATE 1982 08 12 CHECKED BY I.P.L.

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES 'N' VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (o UNCONFINED, + FIELD VANE, ● QUICK TRIAXIAL, × LAB VANE) (100 300 500)	PLASTIC LIMIT Wp / NATURAL MOISTURE CONTENT W / LIQUID LIMIT WL — WATER CONTENT (%) (10 20 30)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
208.5	GROUND SURFACE										
0.0	Brown hard SILTY CLAY some embedded rock fragments. (Glacial Till)		1	SS	42		208				W.L. at 205.5 m after coring
			2	SS	43		207				
			3	SS	40		206				
205.3											Augering
3.2	Grey weathered SHALE with hard limestone layers.		4	RC NXL	92% RQD 26%		205				Diamond Drilling
203.8							204				
4.7	END OF BOREHOLE										

OFFICE REPORT ON SOIL EXPLORATION

+3, x5 : Numbers refer to Sensitivity

15 20 10 5 (%) STRAIN AT FAILURE

Ministry of Transportation and Communications, Ontario

Ref. No. 82-7-2

Enclosure No. 3

HIGHWAY ENGINEERING DIVISION - ENGINEERING MATERIALS OFFICE - SOIL MECHANICS SECTION

RECORD OF BOREHOLE No 3

METRIC 10

W P 21-79-01 LOCATION Co-ords 4,839,255 N.; 286,680 E. ORIGINATED BY R.M.

DIST 6 HWY 410 BOREHOLE TYPE Hollow Stem Auger COMPILED BY R.M.

DATUM Geodetic DATE 1982 07 14 CHECKED BY I.P.L.

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES 'N' VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (o UNCONFINED, • QUICK TRIAXIAL, + FIELD VANE, × LAB VANE) (100 300 500)	PLASTIC LIMIT Wp / NATURAL MOISTURE CONTENT W / LIQUID LIMIT W_L — WATER CONTENT (%) (10 20 30)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
210.1	GROUND SURFACE										
0.0	0.15 m Topsoil						210				
								Bentonite Seal			
											Date W.L. 07-14 Nil 07-15 206.3 08-24 206.9
	Brown hard SILTY CLAY (Glacial Till)		1	SS	36		209				
			2	SS	34						
							208				
			3	SS	25			Bentonite Seal		22.2	1 29 46 24
			4	SS	42		207				
								Piezometer			
206.0	Shale fragments		5	SS	50/10 cm						
4.1	END OF BOREHOLE REFUSAL PROBABLY ON BEDROCK										

OFFICE REPORT ON SOIL EXPLORATION

+³, ×⁵ : Numbers refer to Sensitivity

20 / 15 ◇ 5 / 10 (%) STRAIN AT FAILURE

Ministry of Transportation and Communications, Ontario

Ref. No. 82-7-2

Enclosure No. 4

HIGHWAY ENGINEERING DIVISION - ENGINEERING MATERIALS OFFICE - SOIL MECHANICS SECTION

RECORD OF BOREHOLE No 4

METRIC

W P 21-79-01 LOCATION Co-ords 4,839,268 N.; 286,653 E. ORIGINATED BY R.M.

DIST 6 HWY 410 BOREHOLE TYPE Hollow Stem Auger; NXL Rock Core COMPILED BY R.M.

DATUM Geodetic DATE 1982 07 13 CHECKED BY I.P.L.

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	TYPE	'N' VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE; 100 300 500)	PLASTIC LIMIT Wp / NATURAL MOISTURE CONTENT W / LIQUID LIMIT WL; WATER CONTENT (%) (10 20 30)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
210.3	GROUND SURFACE										
0.0	0.15 m Topsoil						210				Hole dry before coring.
	Brown hard SILTY CLAY some sand embedded rock fragments. (Glacial Till)		1	SS	22					21.1	W.L. at 209.2 m after coring and 24 hrs. later.
			2	SS	41		209				4 27 43 26
			3	SS	26		208			21.3	
			4	SS	64					21.4	Augering
206.8 3.5			5	RC NXL	100% RQD 0		207				Diamond Drilling
	Grey weathered SHALE very closely bedded with hard limestone layers.		6	RC NXL	100% RQD 18%		206				During drilling steady pressure and water return
			7	RC NXL	100% RQD 28%		205				
203.0							204				
7.3	END OF BOREHOLE										

+3, ×5 : Numbers refer to Sensitivity

15 (20 / 10) 5 (%) STRAIN AT FAILURE

OFFICE REPORT ON SOIL EXPLORATION

Ministry of Transportation and Communications, Ontario

Ref. No. 82-7-2

Enclosure No. 5

HIGHWAY ENGINEERING DIVISION - ENGINEERING MATERIALS OFFICE - SOIL MECHANICS SECTION

RECORD OF BOREHOLE No 5

METRIC [12]

W P 21-79-01 LOCATION Co-ords 4,839,232 N.; 286,778 E. ORIGINATED BY R.M.

DIST 6 HWY 410 BOREHOLE TYPE Hollow Stem Auger, NXL Rock Core COMPILED BY R.M.

DATUM Geodetic DATE 1982 07 15 CHECKED BY I.P.L.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) SHEAR STRENGTH kPa (100 300 500) ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE	PLASTIC LIMIT Wp / NATURAL MOISTURE CONTENT W / LIQUID LIMIT WL — WATER CONTENT (%) (10 20 30)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES						GR SA SI CL
207.9 / 0.0	GROUND SURFACE 0.17 m Topsoil										Hole dry before coring. W.L. 206.7m after coring
	Brown hard SILTY CLAY some sand trace gravel (Glacial Till)		1	SS	19		207			21.1	
			2	SS	37		206				12 35 37 16
205.3 / 2.6			3	SS	50/ 10 cm						Augering
	Grey weathered SHALE with hard limestone layers.		4	RC NXL	100% RQD 23%		205				Diamond Drilling
							204				During drilling steady pressure and water return
			5	RC NXL	100% RQD 30%		203				
202.1 / 5.8	END OF BOREHOLE										

+3, ×5 : Numbers refer to Sensitivity

20 / 15 ◇ 5 / 10 (%) STRAIN AT FAILURE

OFFICE REPORT ON SOIL EXPLORATION

Ministry of Transportation and Communications
Ontario

Ref. No. 82-7-2

Enclosure No. 6

HIGHWAY ENGINEERING DIVISION - ENGINEERING MATERIALS OFFICE - SOIL MECHANICS SECTION

RECORD OF BOREHOLE No 6

METRIC 13

W P 21-79-01 LOCATION Co-ords 4,839,243 N.; 286,750 E. ORIGINATED BY R.M.

DIST 6 HWY 410 BOREHOLE TYPE Hollow Stem Auger, NXL Rock Core COMPILED BY R.M.

DATUM Geodetic DATE 1982 08 12 CHECKED BY I.P.L.

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: 'N' VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (o UNCONFINED, • QUICK TRIAXIAL, + FIELD VANE, x LAB VANE; 100 300 500)	PLASTIC LIMIT Wp / NATURAL MOISTURE CONTENT W / LIQUID LIMIT WL — WATER CONTENT (%) (10 20 30)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
208.5	GROUND SURFACE										
0.0							208				W.L. 205.5m after coring.
	Brown hard SILTY CLAY (Glacial Till)		1	SS	46						
			2	SS	41		207				
			3	SS	75		206				
205.4	shale fragments										
3.1	Grey weathered SHALE with hard limestone layers.		4	RC NXL	100% RQD 19%		205				
203.6							204				
4.9	END OF BOREHOLE										

+3, x5 : Numbers refer to Sensitivity

15 20 10 5 (%) STRAIN AT FAILURE

OFFICE REPORT ON SOIL EXPLORATION

Ministry of Transportation and Communications
Ontario

Ref. No. 82-7-2

Enclosure No. 7

HIGHWAY ENGINEERING DIVISION - ENGINEERING MATERIALS OFFICE - SOIL MECHANICS SECTION

RECORD OF BOREHOLE No 7

METRIC 14

W P 21-79-01 LOCATION Co-ords 4,839,268 N.; 286,726 E. ORIGINATED BY R.M.

DIST 6 HWY 410 BOREHOLE TYPE Hollow Stem Auger COMPILED BY R.M.

DATUM Geodetic DATE 1982 07 14 CHECKED BY I.P.L.

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	TYPE	'N' VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE; 100 300 500)	PLASTIC LIMIT Wp / NATURAL MOISTURE CONTENT W / LIQUID LIMIT WL; WATER CONTENT (%) (10 20 30)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
210.1	GROUND SURFACE										
0.0	0.15 m Topsoil						210				Filled piezometer tubing with water. Date W.L. 07-14 209.5; 07-15 208.6; 08-24 208.0
	Hard brown SILTY CLAY some sand and embedded gravel, rock fragments. (Glacial Till)		1	SS	36		209				
			2	SS	38		208			21.4	
			3	SS	31	Bentonite Seal					5 19 38 38
			4	SS	79		207				
			5	SS	50/ 12 cm		206				
205.5						Piezometer					
4.6	END OF BOREHOLE REFUSAL, PROBABLY BEDROCK										

+3, ×5 : Numbers refer to Sensitivity

15 ◇ 5 (%) STRAIN AT FAILURE (20 / 10)

OFFICE REPORT ON SOIL EXPLORATION

Ministry of Transportation and Communications
Ontario

Ref. No. 82-7-2

Enclosure No. 8

HIGHWAY ENGINEERING DIVISION - ENGINEERING MATERIALS OFFICE - SOIL MECHANICS SECTION

RECORD OF BOREHOLE No 8

METRIC

15

W P 21-79-01 LOCATION Co-ords 4,839,287 N.; 286,724 E. ORIGINATED BY R.M.

DIST 6 HWY 410 BOREHOLE TYPE Hollow Stem Auger, NXL Rock Core COMPILED BY R.M.

DATUM Geodetic DATE 1982 07 13 CHECKED BY I.P.L.

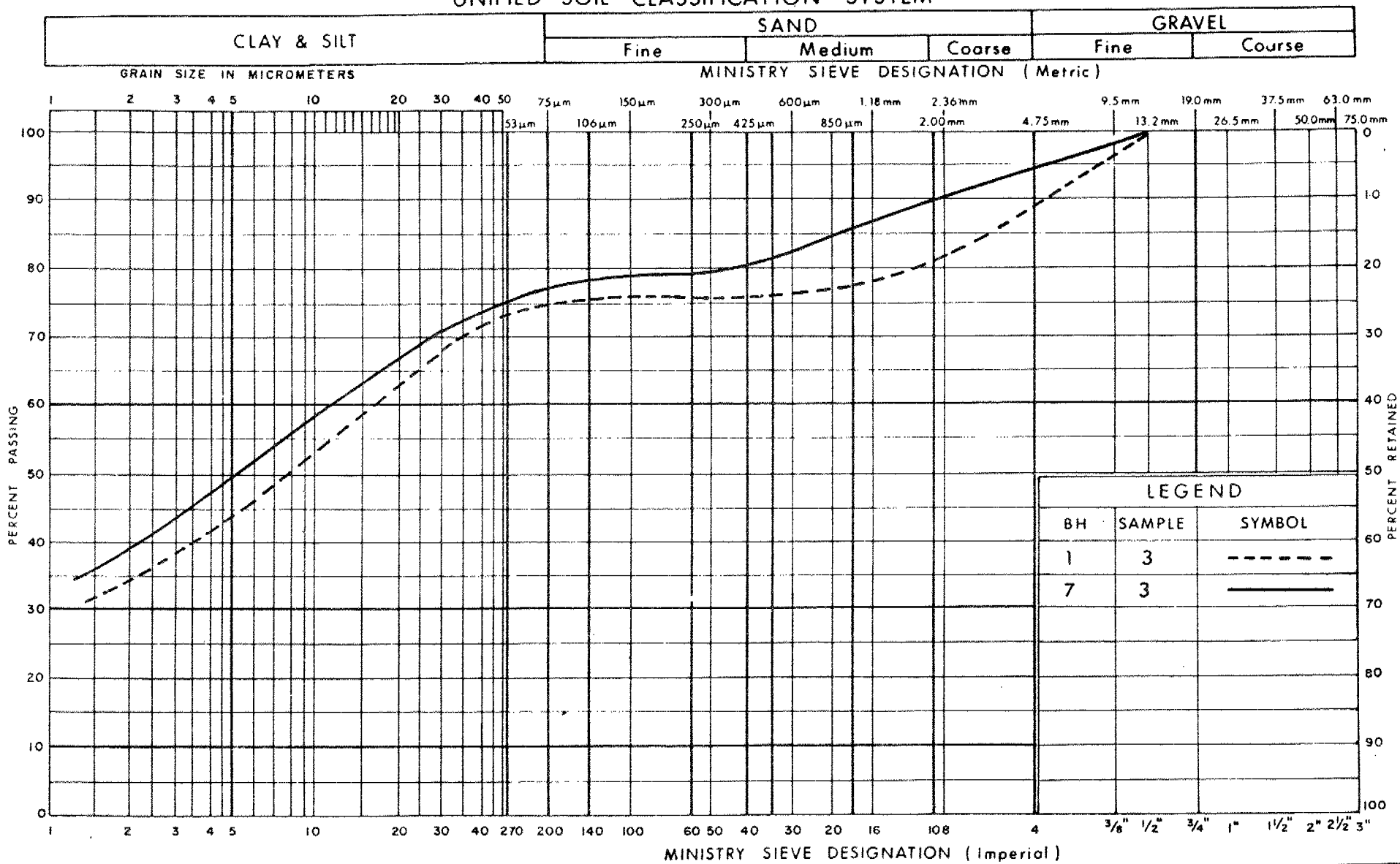
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES 'N' VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (O UNCONFINED, + FIELD VANE, ● QUICK TRIAXIAL, × LAB VANE) (100 300 500)	PLASTIC LIMIT Wp / NATURAL MOISTURE CONTENT W / LIQUID LIMIT WL — WATER CONTENT (%) (10 20 30)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
209.7	GROUND SURFACE										
0.0	0.17 m Topsoil										Hole dry before coring. W.L. at 208.8 m after coring.
	Hard brown SILTY CLAY some sand trace fine gravel (Glacial Till)		1	SS	26		209				
			2	SS	35		208				
206.8			3	SS	72/18 cm		207				
2.9	Grey weathered SHALE with hard limestone layers.		4	RC NXL RQD	100% 0%		206				Augering ↑ Diamond Drilling ↓ During drilling steady pressure and water return
			5	RC NXL RQD	87% 0%		205				
203.8			6	RC NXL RQD	73% 0%		204				
5.9	END OF BOREHOLE										

+3, ×5 : Numbers refer to Sensitivity

20 / 15 ◇ S (%) STRAIN AT FAILURE / 10

OFFICE REPORT ON SOIL EXPLORATION

UNIFIED SOIL CLASSIFICATION SYSTEM



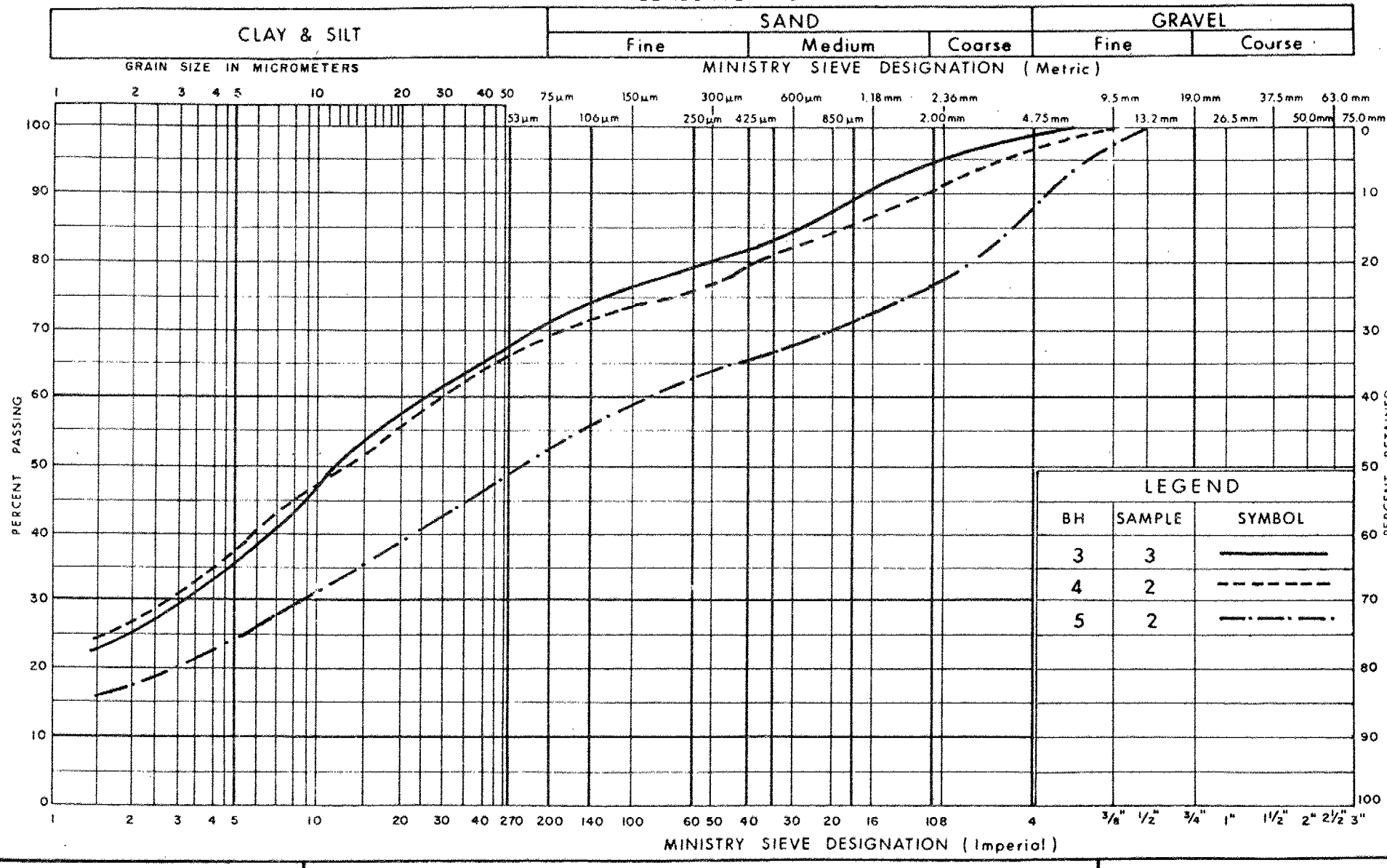
Ministry of Transportation and Communications
Ontario

GRAIN SIZE DISTRIBUTION
SILTY CLAY (GLACIAL TILL)
Some Sand, Trace of Gravel

FIG No 1
W P 29-79-01

16

UNIFIED SOIL CLASSIFICATION SYSTEM



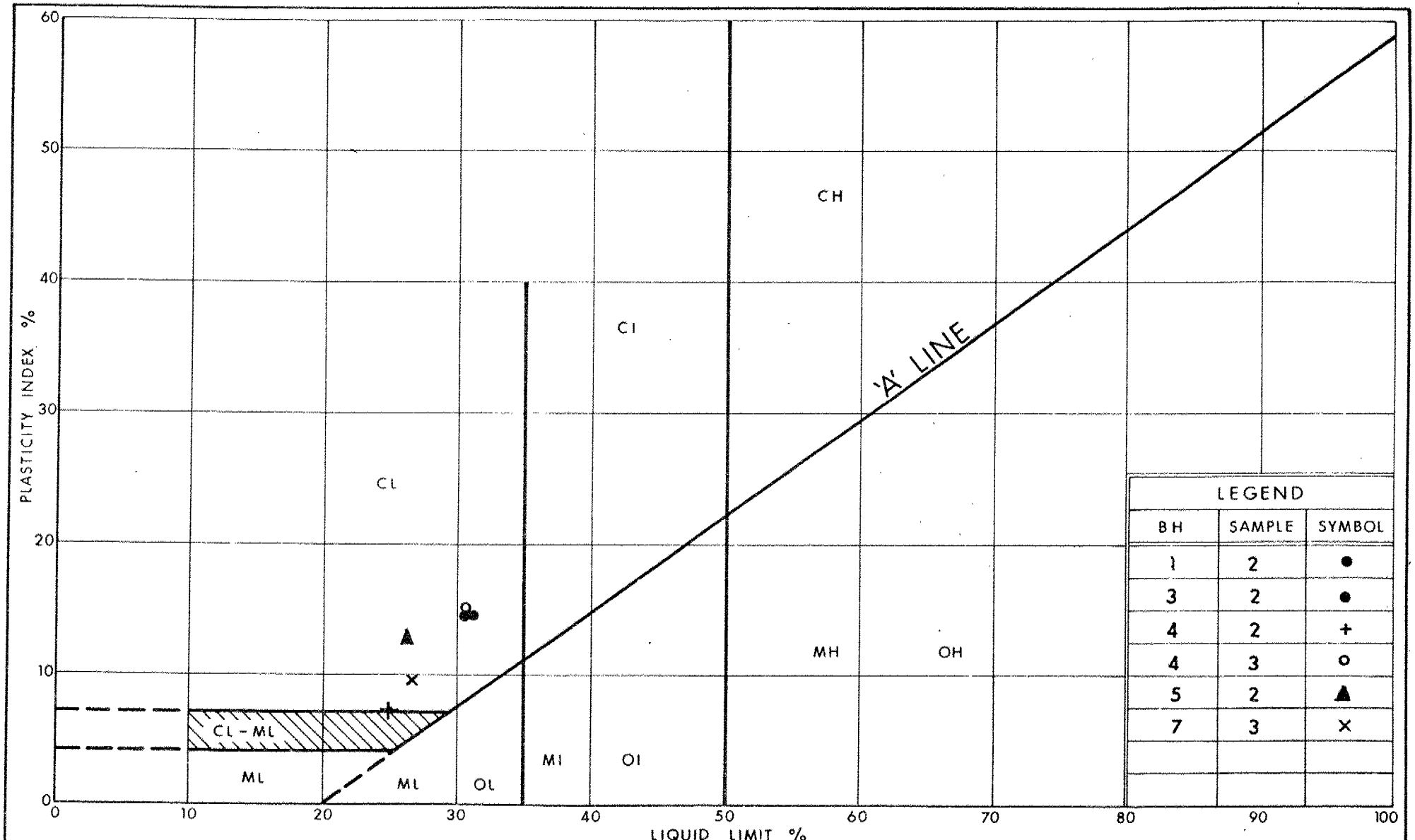
Ministry of Transportation and Communications
Ontario

GRAIN SIZE DISTRIBUTION
SILTY CLAY (GLACIAL TILL)
With Sand, Trace Gravel.

FIG No 2

WP 29-79-01.

17



Ministry of Transportation and Communications
Ontario

PLASTICITY CHART

SILTY CLAY (GLACIAL TILL)

FIG No 3
W P 29-79-01

18

DOMINION SOIL INVESTIGATION INC.
CONSULTING SOIL & FOUNDATION ENGINEERS
104 CROCKFORD BLVD., SCARBOROUGH, ONTARIO, CANADA, M1R 3C6 (416) 751-6565

GEOTECHNICAL INVESTIGATION

C.N.R. OVERPASS

HIGHWAY 410 (BRAMPTON BYPASS)

SITE 24-477, W.P. 21-79-01

DISTRICT 6, TORONTO

Ref. 82-7-2
August 1982

Prepared for:

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS
PAVEMENT AND FOUNDATION DESIGN SECTION

Distribution:

10 copies - Ministry of Transportation & Communications
2 copies - Dominion Soil Investigation Inc.

GEOC. U2 30M12-171

CONTENTS

APPENDIX

ENCLOSURES

1.0 INTRODUCTION

This report describes the results of a subsurface investigation carried out at the site of a proposed twin bridge structure over the C.N.R. tracks in Brampton, Ontario. The structures will carry the future Highway 410.

Authorization to carry out the investigation was received from the Pavement and Foundation Design Section of the Ministry of Transportation and Communications, and was confirmed by Engineering Agreement No. 4242-9082-67 dated July 8, 1982.

The purpose of the investigation was to determine the subsoil and groundwater conditions at the proposed structure site; to establish the engineering properties of the substrata; and to make recommendations for the geotechnical aspects of the design of foundations of the proposed bridge.

The field work was carried out in July and August, 1982, and consisted of drilling eight boreholes to depths ranging between 4.3 and 7.3 m. The locations of the boreholes are shown on Drawing No. 217901-A and the subsurface conditions encountered are presented on the record of borehole sheets.

.../...

2.0 DESCRIPTION OF THE SITE AND GEOLOGY

The site is located in the Regional Municipality of Peel, in the eastern section of the City of Brampton, where Heart Lake Road crosses the C.N.R. tracks. The proposed structure site is located immediately east of the present level crossing.

The terrain in the area is generally flat, rising gently from south to north at a grade of approximately 10 m in 1 km.

Physiographically, the site is located within the Halton-Peel till plain which occupies the area east of the Niagara Escarpment and north of the Lake Iroquois shoreline. It consists mainly of a bevelled till plain with some fluting. In places, it is overlain by thin varved clay or silty sand. The till takes on the character of the underlying bedrock which generally lies at a shallow depth. At the bridge site, the bedrock is the grey Meaford-Dundas shale and the till is generally grey-brown silty clay with many pebbles and fragments of the shale and siltstone bedrock.

.../...

3.0 SUMMARIZED SUBSURFACE CONDITIONS

Details of the subsurface conditions encountered in the boreholes are shown on the record of borehole sheets (Enclosures 1 to 8) and on the inferred subsoil profiles presented as Sections A to D inclusive on Drawing 217901-A. The subsurface conditions can be summarized briefly as follows.

Underlying an approximately 0.15 m thick layer of topsoil, the overburden is a hard silty clay till with some embedded gravel and shale fragments. The shale content increases with depth and at depths ranging between 2.6 and 4.6 m, i.e. between Elevations 206.8 and 205.3 m, the boreholes encountered the surface of the grey weathered shale bedrock. The groundwater table is believed to be near the surface of the rock.

The properties of the two principal substrata will be discussed briefly below.

3.1 Silty Clay Till

Covered by up to 0.17 m of organic topsoil, the boreholes encountered a brown to greyish brown coloured glacial till which extends to depths ranging between 2.6 and 4.6 m.

The till is a well graded mixture of fine gravel to clay size particles and the grading curves of the material are shown on Figures 1 and 2. Reference to these curves indicate that the till consists of 1 to 12% gravel, 15 to 35% sand, 37 to 46% silt, and 16 to 38% clay size particles.

The matrix of the soil exhibits considerable cohesion and cementation.

Atterberg tests carried out on the soil fines gave the following results:

Liquid Limit	25 to 31%
Plastic Limit	13 to 18%
Plasticity Index	7 to 15%
Natural Moisture Content	10 to 14%

These test results are indicative of a clay of low plasticity and the fact that the natural moisture content is below the plastic limit of the soil suggests a hard consistency.

Standard Penetration Tests in the till gave penetration indices, 'N'-values, ranging from 19 to over 100 blows/0.3 m from which a very stiff to hard consistency can be inferred.

Laboratory unconfined compression tests carried out on intact split spoon samples recovered from the soil gave undrained shear strength values ranging between 200 and over 500 kPa. Based on these test results, together with the visual examination of the samples and the low moisture contents, it is considered that the till has a generally hard consistency.

The unit weight of the soil was measured to range between 21.1 and 22.3 kN/m^3.

.../...

3.2 Bedrock

The boreholes encountered refusal at depths ranging between 2.6 and 4.6 m i.e. between Elevations 206.8 and 205.3 m. It is believed that refusal in the boreholes was encountered on the surface of the bedrock. The rock was proven by diamond coring in Boreholes 1, 2, 4, 5, 6 and 8. At these locations, NXL cores were recovered to depths ranging from 1.5 to 3.0 m below the surface of the rock. Core recovery was 100%, and the examination of the recovered cores indicates that the bedrock to the depths explored, is a weathered, very closely bedded, grey shale which is interlayered with grey beds of hard limestone or calcarious sandstone up to 0.15 m thick. It is estimated that the hard layers make up about 10 to 30% of the shale section. R.Q.D. values ranged from 0 to 30% indicating a rock of poor quality.

3.3 Groundwater

Groundwater was not encountered during drilling and the boreholes were extended dry to the surface of the rock. As water was introduced in the hole during the coring of the rock, further groundwater observations were obscured. To facilitate water level readings, piezometers were installed in Boreholes 3 and 7. The piezometer installed in Borehole 3 was left dry to observe the rate at which water may accumulate in the tubing, whereas the piezometer tube in Borehole 7 was filled with water in order to observe the rate at which water dissipates and finds its equilibrium position. Due to the low permeability of the subsoil,

.../...

however, water level readings carried out to date do not show a conclusive picture. From the visual and tactile examination of the soil samples, the generally brown colour of the soil, and the presence of oxidized seams even in soil samples taken near the surface of the rock, it is believed that the permanent groundwater table lies at or below the surface of the rock. Water level readings will be, however, monitored and will be reported to you under separate cover.

.../...

4.0 DISCUSSION OF THE RESULTS

We understand that the construction of a three-span structure is contemplated at the site to carry the proposed Highway 410 over the CNR tracks. The present three tracks will be increased in the future to a total of six tracks and the proposed structure will make allowance both for the present and future tracks. The total length of the structure will be about 76 m with two 21.5 m exterior and one 33.5 m long interior span. The finished grade of the structure and the approach fills will be approximately 9 m above the existing track level, i.e. at about Elevation 218.5$\pm$ m. Preliminary drawings made available to us suggest that probably perched abutments will be used.

The eight exploratory boreholes drilled at the pier and abutment locations indicate that the bridge site is underlain by hard silty clay till and that at the borehole locations the surface of the weathered shale bedrock lies between Elevations 206.8 and 205.3 m. The silty clay till overburden at the site exhibits high undrained shear strengths and is considered to be a competent deposit to carry the proposed structure on normal shallow spread footing foundations.

4.1 Pier Foundations

The footings supporting the piers, or possibly closed end abutments and wing walls, can be placed within the overburden at a depth at least 0.9m

.../...

below the existing ground surface. At this depth the factored bearing capacity of the hard silty clay till at Ultimate Limit State is 570 kPa. The bearing capacity at Servicibility Limit States Type II is 380 kPa. At a depth of 1.5 m below existing ground surface the factored bearing capacity at Ultimate Limit State is 850 kPa; and at Servicibility Limit States Type II is 500 kPa.

Provided that the subsoil is not unduly disturbed during the construction the total and differential settlements corresponding to the Servicibility Limit State are expected to be less than 25 and 15 mm, respectively. Under inclined loading conditions, the bearing capacity at Ultimate Limit State should be reduced in accordance with Clause 6.7.3.3.5 of the Ontario Highway Bridge Design Code, 1979 (OHBDC). For the evaluation of the sliding resistance of the foundation, the ultimate angle of friction between the underside of the foundations and the hard silty clay till can be taken as 26 degrees.

All footings should have at least 1.2 m earth cover for frost protection.

4.2 Perched Abutments

Perched abutments could be supported either on shallow spread footings established within the compacted approach embankments or on piles.

i.) In the case that the footings are placed on engineered fill, all topsoil, organic and other unsuitable materials should be removed to the surface of the inorganic hard silty clay till. The material used for embankment construction under the footings should be well graded, clean granular earth fill (Granular 'A' quality) the width of which at the footing level should be at least twice the width of the footing and should increase in width below this level at an angle of 1.5 horizontal in 1 vertical or flatter. The fill should be placed in 150 mm thick lifts and each lift should be uniformly compacted to at least 100% of its Standard Proctor maximum dry density. The horizontal distance measured from the edge of the footing to the face of the embankment slope should not be less than 1.5 times the width of the footing, and the footing should also have a minimum earth cover of 1.2 m.

For footings meeting the above requirements, the Factored Bearing Capacity at Ultimate Limit States (q_f) is 600 kPa. The Bearing Capacity at Servicibility Limit States Type II is 250 kPa. With this value, the maximum total settlement should be limited to 25 mm.

ii.) Alternatively, end bearing steel H or tube piles could be used to support the perched abutments.

It is estimated that the piles will encounter refusal at or near the surface of the bedrock, i.e. at about El.205 m at the south abutment and El.206.5 m at the north abutment. The piles should be fitted with hardened rock points to get a good seating on the bedrock and to

.../...

avoid damage during driving through the dense fill and the hard overburden.

The estimated pile capacities for some common sizes of steel piles driven to a final set of about 1 blow/1 mm penetration with a hammer capable to deliver an energy of 40 to 70 thousand Joules/blow are tabulated below:

ESTIMATED PILE CAPACITY (kN)

Pile Type	Size	Factored Capacity at Ultimate Limit States (Q_f)	Capacity at Servicibility Limit States Type II (Q_s)
Steel H	HP 310 x 110	1400	980
	HP 310 x 79	1000	690
	HP 250 x 62	750	530
	HP 200 x 54	680	445
Steel Pipe	323 X 9.5	900	650
	273 x 9.3	750	530

It is recommended that the driving of the piles in the field be controlled by a recognized pile driving formula such as the Hiley formula. Unbalanced horizontal forces should be resisted by battered piles and for frost protection, the underside of the pile caps should be established at least 2.1 m below finished grade.

4.3 Lateral Earth Pressures

Assuming that free-draining granular material and adequate drainage is provided behind the abutments and the wing walls (Figure 6.9.6.1

.../...

OHBDC), the lateral earth pressure can be calculated by assuming active earth pressure conditions and using the following equivalent fluid pressures:

- At Ultimate Limit State: 8 kPa/m
- At Servicibility Limit State Type II: 6.5 kPa/m

The rigid walls of the abutments, however, should be designed to withstand the at-rest earth pressures which can be evaluated using the following equivalent fluid pressures:

- At Ultimate Limit State: 10 kPa/m
- At Servicibility Limit States Type II: 8.5 kPa/m

When using the above values, it is assumed that the slope of the backfill behind the retaining structure is approximately level.

Care should be given to avoid the overcompaction of the backfill and the use of heavy compaction equipment behind the retaining walls and abutments. The contractor shall not be permitted to use other than hand operated vibratory type compaction equipment for the compaction of the fill material behind the wing walls and the abutments in an area within a plane extending from the base of the back face of the wall upwards at a slope of 1.5 vertical to 1 horizontal and an area within 1.5 m from the back face of the wall.

.../...

Water accumulation in the backfill behind the retaining structures should be prevented by the use of perforated pipes and weep holes.

4.4 Approach Fills

The design of the approach fills will not be limited by the strength of the foundation materials underlying the site and there are no stability problems foreseen. In the case that the approach fills are constructed from locally available clean earth fills, 2 horizontal in 1 vertical side slopes can be used. The slopes of the embankment should be adequately protected against surface erosion.

In the case of pile supported perched abutments, rockfill should not be used in that part of the embankment through which piles are driven.

4.5 Construction

There are no soil related construction problems foreseen.

Excavations in the hard till will stand unsupported with nearly vertical faces to a depth of 1.2 m. Where deeper excavations are required, the face of the excavation should be flattened to 45 degrees to comply with the provincial safety regulations.

Water should not be allowed to accumulate in the excavations and surface water should be removed by pumping from temporary sumps. Any material

.../...

that might be softened by water ponding in the excavation should be removed by hand before pouring the footings.

5.0 STATEMENT OF LIMITATION

The Statement of Limitation, as quoted in Appendix 'B', is an integral part of this report.

DOMINION SOIL INVESTIGATION INC.

Z.S. Ozden, P. Eng.

I.P. Lieszkowszky, P. Eng.

ZSO:IPL:gr

APPENDICES

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
γ_s	kN/m^3	UNIT WEIGHT OF SOLID PARTICLES
ρ_w	kg/m^3	DENSITY OF WATER
γ_w	kN/m^3	UNIT WEIGHT OF WATER
ρ	kg/m^3	DENSITY OF SOIL
γ	kN/m^3	UNIT WEIGHT OF SOIL
ρ_d	kg/m^3	DENSITY OF DRY SOIL
γ_d	kN/m^3	UNIT WEIGHT OF DRY SOIL
ρ_{sat}	kg/m^3	DENSITY OF SATURATED SOIL
γ_{sat}	kN/m^3	UNIT WEIGHT OF SATURATED SOIL
ρ'	kg/m^3	DENSITY OF SUBMERGED SOIL
γ'	kN/m^3	UNIT WEIGHT OF SUBMERGED SOIL

e	1,%	VOID RATIO
n	1,%	POROSITY
w	1,%	WATER CONTENT
S_r	%	DEGREE OF SATURATION
w_L	%	LIQUID LIMIT
w_P	%	PLASTIC LIMIT
w_S	%	SHRINKAGE LIMIT
I_P	%	PLASTICITY INDEX = $w_L - w_P$
I_L	1	LIQUIDITY INDEX = $\frac{w - w_P}{I_P}$
I_C	1	CONSISTENCY INDEX = $\frac{w_L - w}{I_P}$
e_{max}	1,%	VOID RATIO IN LOOSEST STATE

e_{min}	1,%	VOID RATIO IN DENSEST STATE
I_D	1	DENSITY INDEX = $\frac{e_{max} - e}{e_{max} - e_{min}}$
D	mm	GRAIN DIAMETER
D_n	mm	n PERCENT - DIAMETER
C_U	1	UNIFORMITY COEFFICIENT
h	m	HYDRAULIC HEAD OR POTENTIAL
q	m^3/s	RATE OF DISCHARGE
v	m/s	DISCHARGE VELOCITY
i	1	HYDRAULIC GRADIENT
k	m/s	HYDRAULIC CONDUCTIVITY
j	kN/m^3	SEEPAGE FORCE

APPENDIX 'B'
STATEMENT OF LIMITATION

The conclusions and recommendations in this report are based on information determined at the testhole locations. Subsurface and groundwater conditions between and beyond the testholes may differ from those encountered at the testhole locations, and conditions may become apparent during construction which could not be detected or anticipated at the time of the site investigation.

We recommend that we be retained during construction to confirm that the subsurface conditions throughout the site do not deviate materially from those encountered in the testholes.

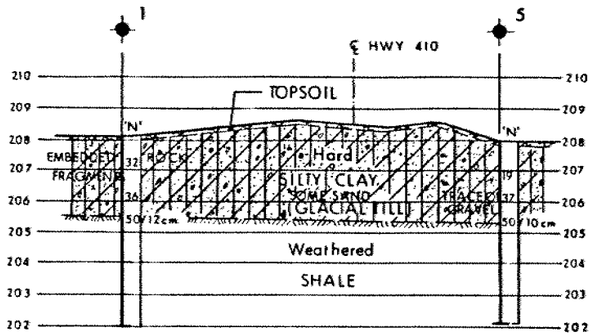
The design recommendations given in this report are applicable only to the project described in the text and then only if constructed substantially in accordance with details of alignment and elevations stated in the report. Since all details of the design may not be known, in our analysis certain assumptions had to be made. The actual conditions may, however, vary from those assumed, in which case changes and modifications may be required to our recommendations.

We recommend, therefore, that we be retained during the final design stage to review the design drawings and to verify that they are consistent with our recommendations or the assumptions made in our analysis.

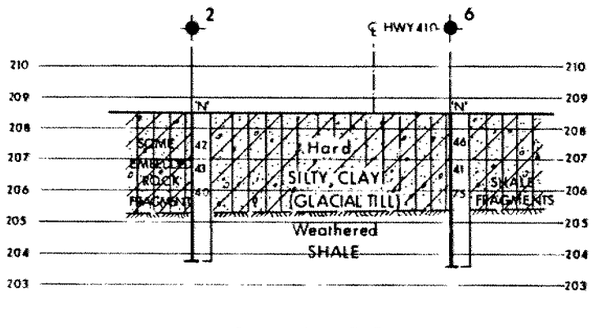
In cases where these recommendations are not followed, the company's responsibility is limited to report accurately the information encountered in the testholes.

The comments given in this report on potential construction problems and possible methods are intended only for the guidance of the designer. The number of boreholes may not be sufficient to determine all the factors thay may affect construction methods and costs. The contractors bidding on this project or undertaking the construction should, therefore, make their own interpretation of the factual information presented and draw their own conclusions as to how the subsurface conditions may affect their work.

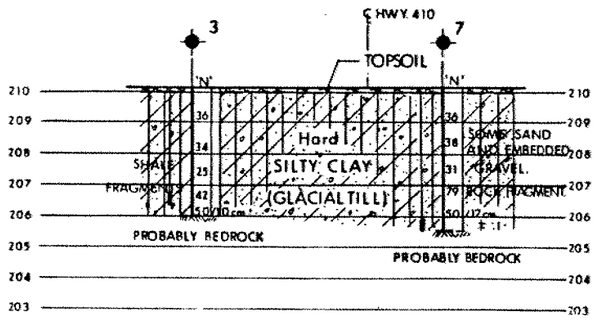
ENCLOSURES



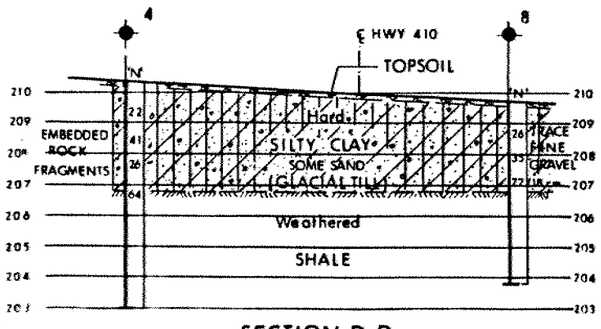
SECTION A-A



SECTION B-B



SECTION C-C

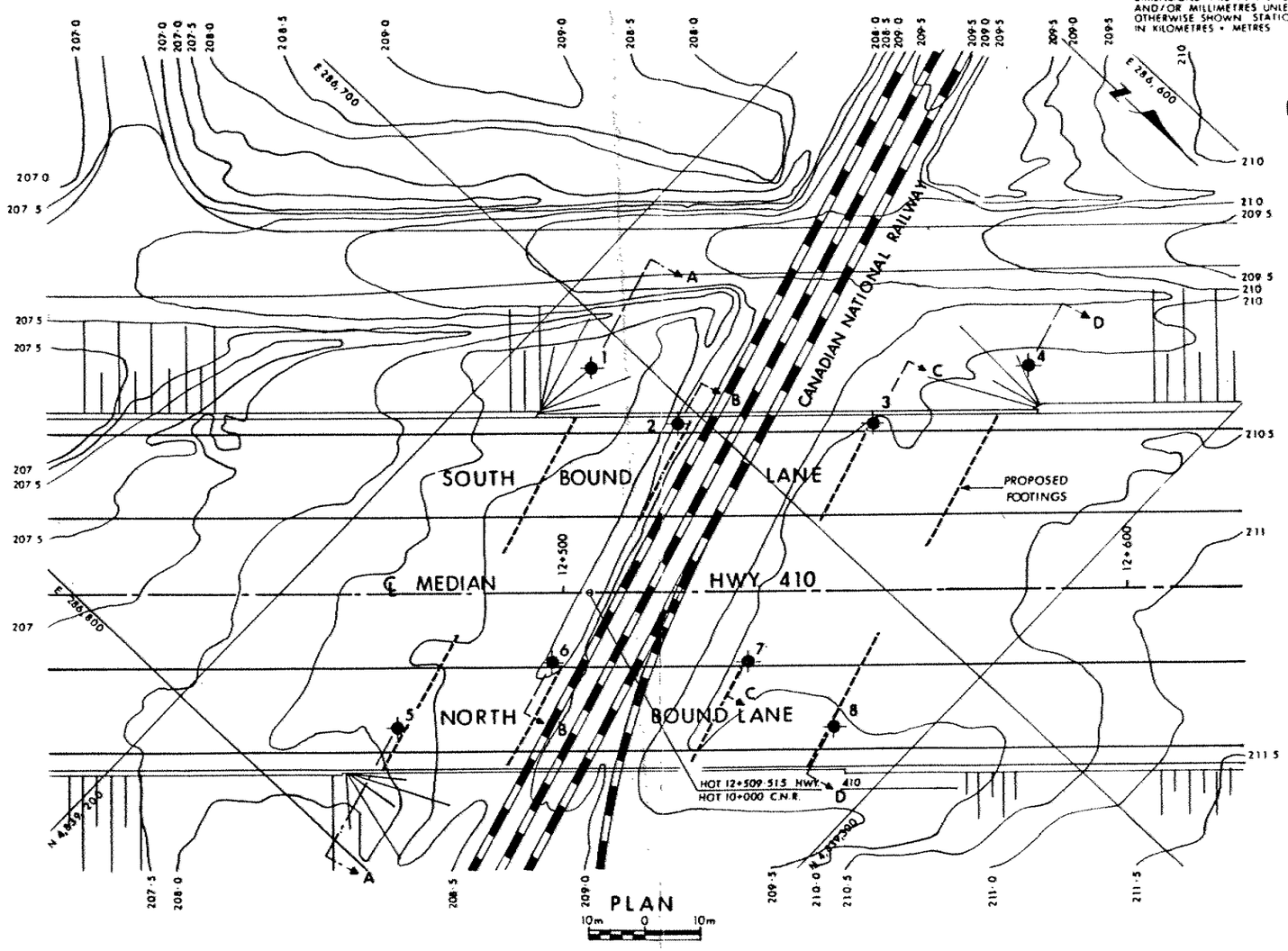


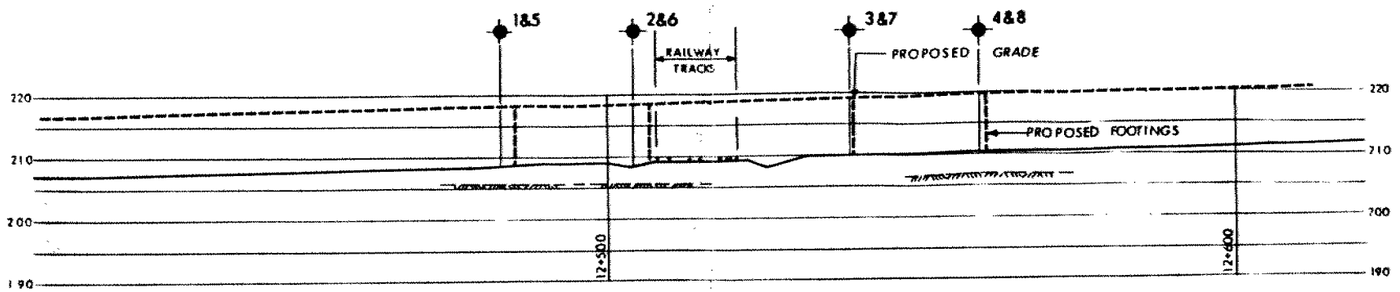
SECTION D-D

SCALE

HOR 10m 0 10m

VER. 2m 0 2m





PROFILE OF HWY. 410 ON ℄ MEDIAN

10m 0 10m

CONT No

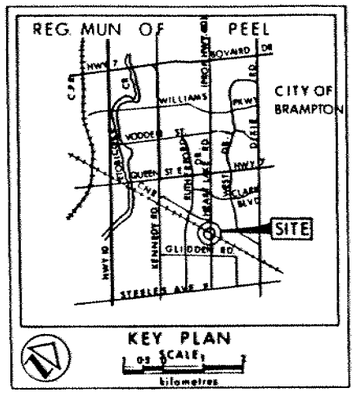
WP No 21-79-01

OVERPASS AT C.N.R AND HWY.410

BORE HOLE LOCATIONS & SOIL STRATA

SHEET

DOMINION SOIL INVESTIGATION INC.



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
- PIEZOMETER

ALL BOREHOLES DRY UPON COMPLETION OF FIELD INVESTIGATION

No	ELEVATION	CO-ORDINATES NORTH	EAST
1	208.1	4,839,212	286,707
2	208.5	4,839,230	286,703
3	210.1	4,839,255	286,680
4	210.3	4,839,268	286,653
5	207.9	4,839,232	286,778
6	208.5	4,839,243	286,750
7	210.1	4,839,268	286,726
8	209.7	4,839,287	286,724

NOTE

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

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

REV.	DATE	BY	DESCRIPTION

Geocres No

HWY No 410			DIST 6
SUBM'D R.M.	RECRED'D P.L.	DATE	SITE 24-145 477
DRAWN F.L.	RECRED'D P.L.	APPROVED	DWG 217901-A

R. P. LIESZKOWSKY — REGISTERED PROFESSIONAL ENGINEER — CIVIL — PROVINCE OF ONTARIO

Ref. No. 82-7-2

Enclosure No. 1

HIGHWAY ENGINEERING DIVISION - ENGINEERING MATERIALS OFFICE - SOIL MECHANICS SECTION

RECORD OF BOREHOLE No. 1

METRIC

W P 21-79-01 LOCATION Co-ords 4,839,212 N.; 286,707 E. ORIGINATED BY R.M.

DIST 6 HWY 410 BOREHOLE TYPE Hollow Stem Auger, NXL Rock Core COMPILED BY R.M.

DATUM Geodetic DATE 1982 07 15 CHECKED BY I.P.L.

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES 'N' VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (o UNCONFINED, + FIELD VANE, • QUICK TRIAXIAL, × LAB VANE; 100 300 500)	PLASTIC LIMIT Wp / NATURAL MOISTURE CONTENT W / LIQUID LIMIT Wl; WATER CONTENT (%) (10 20 30)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
208.1 / 0.0	GROUND SURFACE 0.16 m Topsoil						208				
	Brown hard SILTY CLAY some sand and embedded rock fragments. (Glacial Till)		1	SS	32		207				
			2	SS	36		206	o	o —	22.3	
205.5 / 2.6			3	SS	50/ 12 cm.				•		11 15 39 35 ↑ Augering Diamond Drilling ↓
	Grey weathered SHALE very closely bedded, with hard limestone layers.		4	RC NXL RQD	100% 0		205				During drilling steady pressure and water return
			5	RC NXL RQD	100% 0		204				
			6	RC NXL RQD	100% 38%		203				
202.0 / 6.1	END OF BOREHOLE										

$+^3$, $\times^5$: Numbers refer to Sensitivity

$\frac{20}{15 \diamond 5}$ (%) STRAIN AT FAILURE
10

OFFICE REPORT ON SOIL EXPLORATION

Ref. No. 82-7-2 Enclosure No. 2

Ministry of Transportation and Communications, Ontario

HIGHWAY ENGINEERING DIVISION - ENGINEERING MATERIALS OFFICE - SOIL MECHANICS SECTION

RECORD OF BOREHOLE No 2 METRIC

W P 21-79-01 LOCATION Co-ords 4,839,230 N.; 286,703 E ORIGINATED BY R.M.

DIST 6 HWY 410 BOREHOLE TYPE Hollow Stem Auger, Rock Core COMPILED BY R.M.

DATUM Geodetic DATE 1982 08 12 CHECKED BY I.P.L.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (o UNCONFINED, • QUICK TRIAXIAL, + FIELD VANE, × LAB VANE; 100 300 500)	PLASTIC LIMIT Wp / NATURAL MOISTURE CONTENT W / LIQUID LIMIT W_L; WATER CONTENT (%) 10 20 30	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES						
208.5 0.0	GROUND SURFACE						208				W.L. at 205.5 m after coring
	Brown hard SILTY CLAY some embedded rock fragments. (Glacial Till)		1	SS	42						
			2	SS	43		207				
			3	SS	40		206				Augering
205.3 3.2	Grey weathered SHALE with hard limestone layers.		4	RC NXL RQD	92% 26%		205				Diamond Drilling
203.8 4.7	END OF BOREHOLE						204				

+³, ×⁵ : Numbers refer to Sensitivity

15 ◇ 5 (20 / 10) (%) STRAIN AT FAILURE

OFFICE REPORT ON SOIL EXPLORATION

Ref. No. B2-7-2

Enclosure No. 3

HIGHWAY ENGINEERING DIVISION · ENGINEERING MATERIALS OFFICE · SOIL MECHANICS SECTION

RECORD OF BOREHOLE No 3

METRIC

W P 21-79-01 LOCATION Co-ords 4,839,255 N.; 286,680 E. ORIGINATED BY R.M.

DIST 6 HWY 410 BOREHOLE TYPE Hollow Stem Auger COMPILED BY R.M.

DATUM Geodetic DATE 1982 07 14 CHECKED BY I.P.L.

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES 'N' VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (o UNCONFINED, + FIELD VANE, • QUICK TRIAXIAL, × LAB VANE; 100 300 500)	PLASTIC LIMIT Wp / NATURAL MOISTURE CONTENT W / LIQUID LIMIT WL; WATER CONTENT (%) (10 20 30)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
210.1	GROUND SURFACE										
0.0	0.15 m Topsoil						210				
								Bentonite Seal			Date W.L. 07-14 N11 07-15 206.3 08-24 206.9
	Brown hard SILTY CLAY (Glacial Till)		1	SS	36		209		o		
			2	SS	34				o		
							208				
			3	SS	25			Bentonite Seal	o	22.2	1 29 46 24
							207				
			4	SS	42				o		
								Piezometer			
206.0	Shale fragments		5	SS	50/10 cm				o		
4.1	END OF BOREHOLE REFUSAL PROBABLY ON BEDROCK										

+3, ×5 : Numbers refer to Sensitivity

15 20 10 5 (%) STRAIN AT FAILURE

OFFICE REPORT ON SOIL EXPLORATION

Ref. No. 82-7-2

Enclosure No. 4

HIGHWAY ENGINEERING DIVISION - ENGINEERING MATERIALS OFFICE - SOIL MECHANICS SECTION

RECORD OF BOREHOLE No 4

METRIC

W P 21-79-01 LOCATION Co-ords 4,839,268 N.; 286,653 E. ORIGINATED BY R.M.

DIST 6 HWY 410 BOREHOLE TYPE Hollow Stem Auger; NXL Rock Core COMPILED BY R.M.

DATUM Geodetic DATE 1982 07 13 CHECKED BY I.P.L.

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES 'N' VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (o UNCONFINED, + FIELD VANE, • QUICK TRIAXIAL, × LAB VANE; 100 300 500)	PLASTIC LIMIT Wp / NATURAL MOISTURE CONTENT W / LIQUID LIMIT WL; WATER CONTENT (%) (10 20 30)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
210.3	GROUND SURFACE										
0.0	0.15 m Topsoil						210				Hole dry before coring.
	Brown hard SILTY CLAY some sand embedded rock fragments. (Glacial Till)		1	SS	22			o	o	21.1	W.L. at 209.2 m after coring and 24 hrs. later.
			2	SS	41		209		o ⊢		4 27 43 26
			3	SS	26		208	•	o	21.3	
206.8			4	SS	64		207		o	21.4	Augering
3.5	Grey weathered SHALE very closely bedded with hard limestone layers.		5	RC NXL	100% RQD 0		206				Diamond Drilling. During drilling steady pressure and water return
			6	RC NXL	100% RQD 18%		205				
			7	RC NXL	100% RQD 28%		204				
203.0											
7.3	END OF BOREHOLE										

$+^3$, $\times^5$: Numbers refer to Sensitivity

20 / 15 ◇ 5 / 10 (%) STRAIN AT FAILURE

OFFICE REPORT ON SOIL EXPLORATION

HIGHWAY ENGINEERING DIVISION - ENGINEERING MATERIALS OFFICE - SOIL MECHANICS SECTION

RECORD OF BOREHOLE No 5 METRIC

W P 21-79-01 LOCATION Co-ords 4,839,232 N.; 286,778 E. ORIGINATED BY R.M.

DIST 6 HWY 410 BOREHOLE TYPE Hollow Stem Auger, NXL Rock Core COMPILED BY R.M.

DATUM Geodetic DATE 1982 07 15 CHECKED BY I.P.L.

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES 'N' VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa 100 300 500 (o UNCONFINED, + FIELD VANE, • QUICK TRIAXIAL, × LAB VANE)	PLASTIC LIMIT Wp / NATURAL MOISTURE CONTENT W / LIQUID LIMIT WL / WATER CONTENT (%) 10 20 30	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
207.9	GROUND SURFACE										
0.0	0.17 m Topsoil										
	Brown hard SILTY CLAY some sand trace gravel		1	SS	19		207		o	21.1	
			2	SS	37		206		o⊢		12 35 37 16
	(Glacial Till)										Augering
205.3			3	SS	50/	10 cm					
2.6	Grey weathered SHALE with hard limestone layers.		4	RC NXL	100% RQD 23%		205				Diamond Drilling
							204				During drilling steady pressure and water return
			5	RC NXL	100% RQD 30%		203				
202.1											
5.8	END OF BOREHOLE										

+3, ×5 : Numbers refer to Sensitivity

20 / 15 ◇ 5 / 10 (%) STRAIN AT FAILURE

OFFICE REPORT ON SOIL EXPLORATION

Ref. No. 82-7-2 Enclosure No. 6

HIGHWAY ENGINEERING DIVISION - ENGINEERING MATERIALS OFFICE - SOIL MECHANICS SECTION

RECORD OF BOREHOLE No 6 METRIC

W P 21-79-01 LOCATION Co-ords 4,839,243 N.; 286,750 E. ORIGINATED BY R.M.

DIST 6 HWY 410 BOREHOLE TYPE Hollow Stem Auger, NXL Rock Core COMPILED BY R.M.

DATUM Geodetic DATE 1982 08 12 CHECKED BY I.P.L.

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES 'N' VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (o UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE; 100 300 500)	PLASTIC LIMIT Wp / NATURAL MOISTURE CONTENT W / LIQUID LIMIT WL; WATER CONTENT (%) (10 20 30)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
208.5	GROUND SURFACE										
0.0	Brown hard SILTY CLAY (Glacial Till)		1	SS	46		208				W.L. 205.5m after coring.
			2	SS	41		207				
			3	SS	75		206				
205.4	shale fragments										
3.1	Grey weathered SHALE with hard limestone layers.		4	RC NXL	100% RQD 19%		205 204				
203.6											
4.9	END OF BOREHOLE										

OFFICE REPORT ON SOIL EXPLORATION

+3, ×5 : Numbers refer to Sensitivity

20 / 15 ◇ 5 / 10 (%) STRAIN AT FAILURE

Ref. No. 82-7-2 Enclosure No. 7

HIGHWAY ENGINEERING DIVISION - ENGINEERING MATERIALS OFFICE - SOIL MECHANICS SECTION

RECORD OF BOREHOLE No 7 METRIC

W P 21-79-01 LOCATION Co-ords 4,839,268 N.; 286,726 E. ORIGINATED BY R.M.

DIST 6 HWY 410 BOREHOLE TYPE Hollow Stem Auger COMPILED BY R.M.

DATUM Geodetic DATE 1982 07 14 CHECKED BY I.P.L.

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES 'N' VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (o UNCONFINED, • QUICK TRIAXIAL, + FIELD VANE, × LAB VANE) (100 300 500)	PLASTIC LIMIT Wp / NATURAL MOISTURE CONTENT W / LIQUID LIMIT Wl / WATER CONTENT (%) (10 20 30)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
210.1	GROUND SURFACE										
0.0	0.15 m Topsoil						210				Filled piezometer tubing with water. Date W.L. 07-14 209.5 07-15 208.6 08-24 208.0
	Hard brown SILTY CLAY some sand and embedded gravel, rock fragments.		1	SS	36		209				
			2	SS	38					21.4	
							208				
	(Glacial Till)		3	SS	31	Bentonite Seal					5 19 38 38
							207				
			4	SS	79						
			5	SS	50/12 cm		206				
205.5						Piezometer					
4.6	END OF BOREHOLE REFUSAL, PROBABLY BEDROCK										

+³, ×⁵ ; Numbers refer to Sensitivity

15 20 10 5 (%) STRAIN AT FAILURE

OFFICE REPORT ON SOIL EXPLORATION

Ministry of Transportation and Communications Ontario

Ref. No. 82-7-2

Enclosure No. 8

HIGHWAY ENGINEERING DIVISION-ENGINEERING MATERIALS OFFICE-SOIL MECHANICS SECTION

RECORD OF BOREHOLE No 8

METRIC

W P 21-79-01 LOCATION Co-ords 4,839,287 N.; 286,724 E. ORIGINATED BY R.M.

DIST 6 HWY 410 BOREHOLE TYPE Hollow Stem Auger, NXL Rock Core COMPILED BY R.M.

DATUM Geodetic DATE 1982 07 13 CHECKED BY I.P.L.

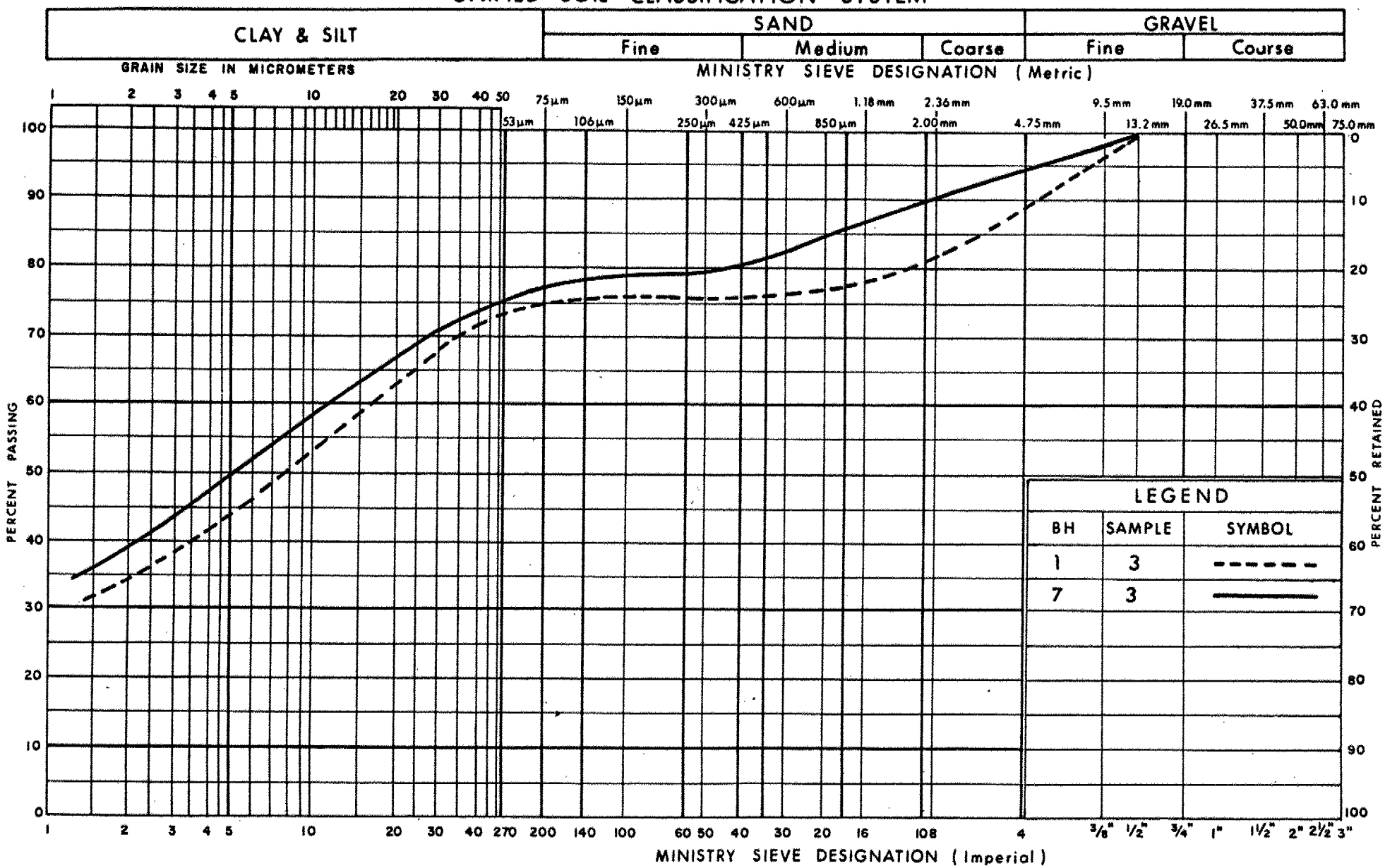
ELEV / DEPTH	SOIL PROFILE: DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	TYPE	'N' VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE; 100 300 500)	PLASTIC LIMIT Wp / NATURAL MOISTURE CONTENT W / LIQUID LIMIT WL; WATER CONTENT (%) (10 20 30)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
209.7	GROUND SURFACE										
0.0	0.17 m Topsoil						209				Hole dry before coring. W.L. at 208.8 m after coring.
	Hard brown SILTY CLAY some sand trace fine gravel (Glacial Till)		1	SS	26						
			2	SS	35		208				
			3	SS	72/18 cm						
206.8							207				Augering ↕ Diamond Drilling
2.9	Grey weathered SHALE with hard limestone layers.		4	RC NXL RQD	100% 0%		206				During drilling steady pressure and water return
			5	RC NXL RQD	87% 0%		205				
			6	RC NXL RQD	73% 0%		204				
203.8											
5.9	END OF BOREHOLE										

+3, ×5 : Numbers refer to Sensitivity

20 / 15 ◇ 5 / 10 (%) STRAIN AT FAILURE

OFFICE REPORT ON SOIL EXPLORATION

UNIFIED SOIL CLASSIFICATION SYSTEM



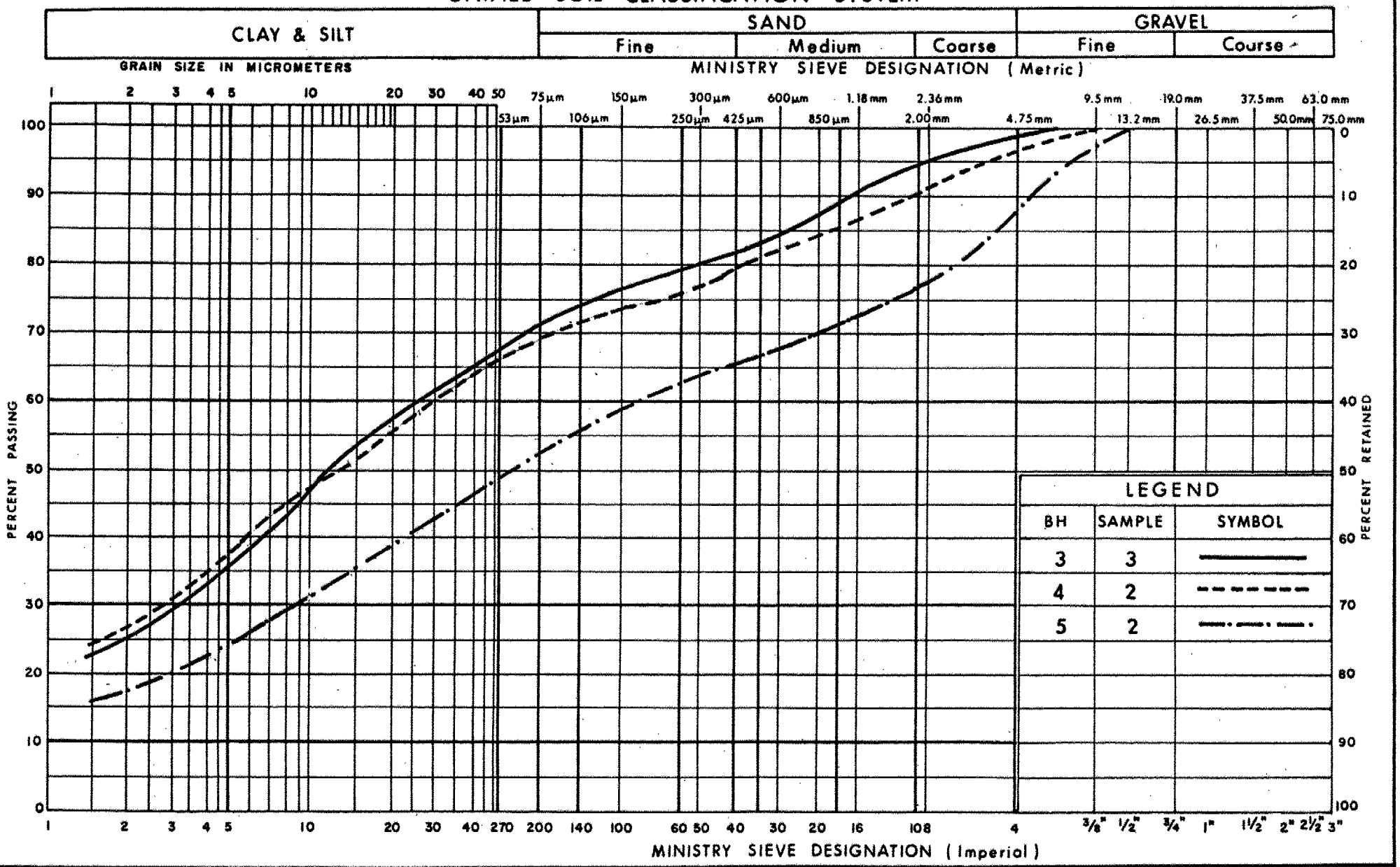
Ministry of Transportation and Communications
Ontario

GRAIN SIZE DISTRIBUTION
SILTY CLAY (GLACIAL TILL)
Some Sand, Trace of Gravel

FIG No 1

WP 29-79-01

UNIFIED SOIL CLASSIFICATION SYSTEM

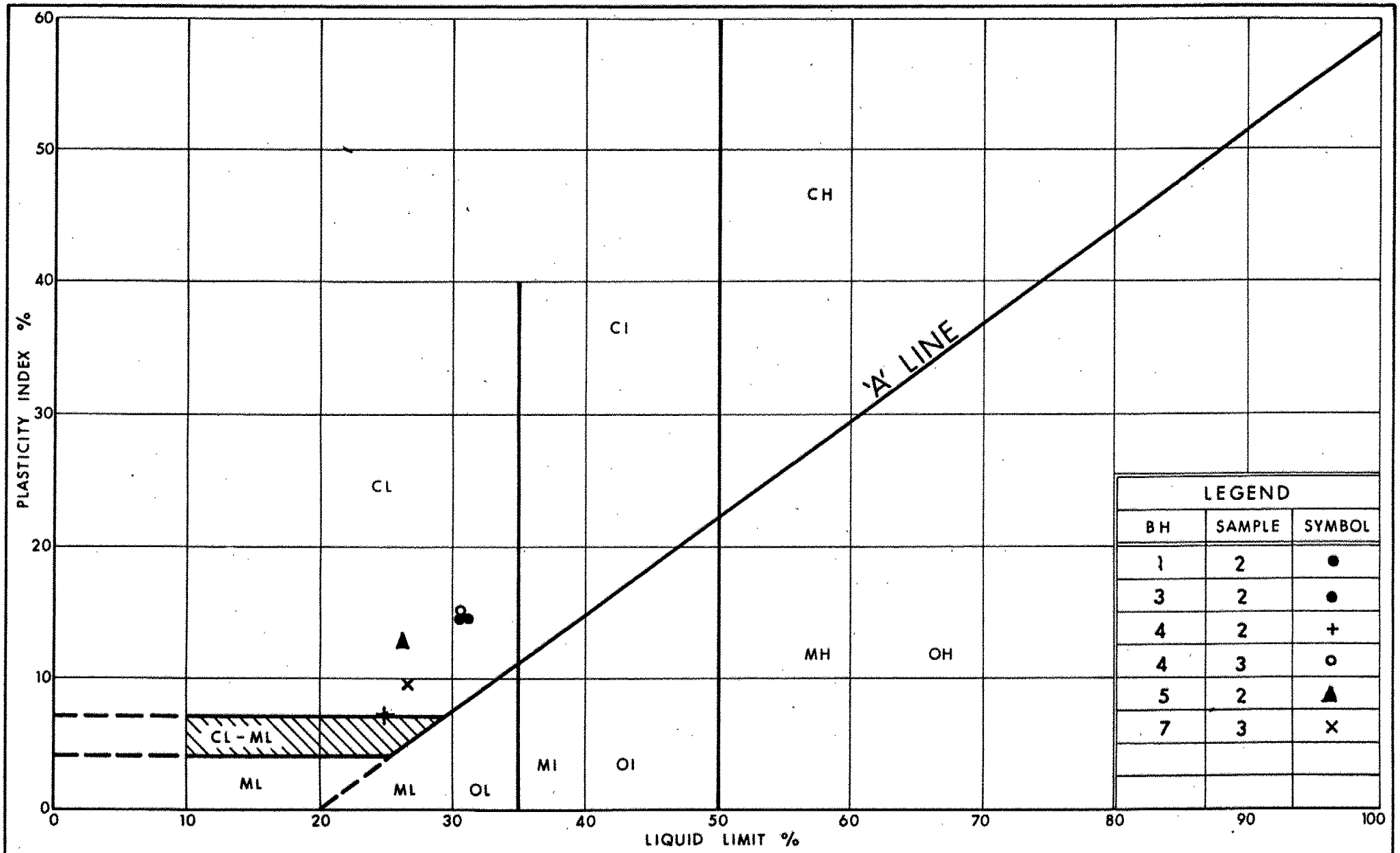


Ministry of Transportation and Communications
Ontario

GRAIN SIZE DISTRIBUTION
SILTY CLAY (GLACIAL TILL)
With Sand, Trace Gravel.

FIG No 2

WP 29-79-01.



Ministry of Transportation and Communications
Ontario

PLASTICITY CHART

SILTY CLAY (GLACIAL TILL)

FIG No 3

W P 29-79-01

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS ONTARIO DB-BR ISM 81-05

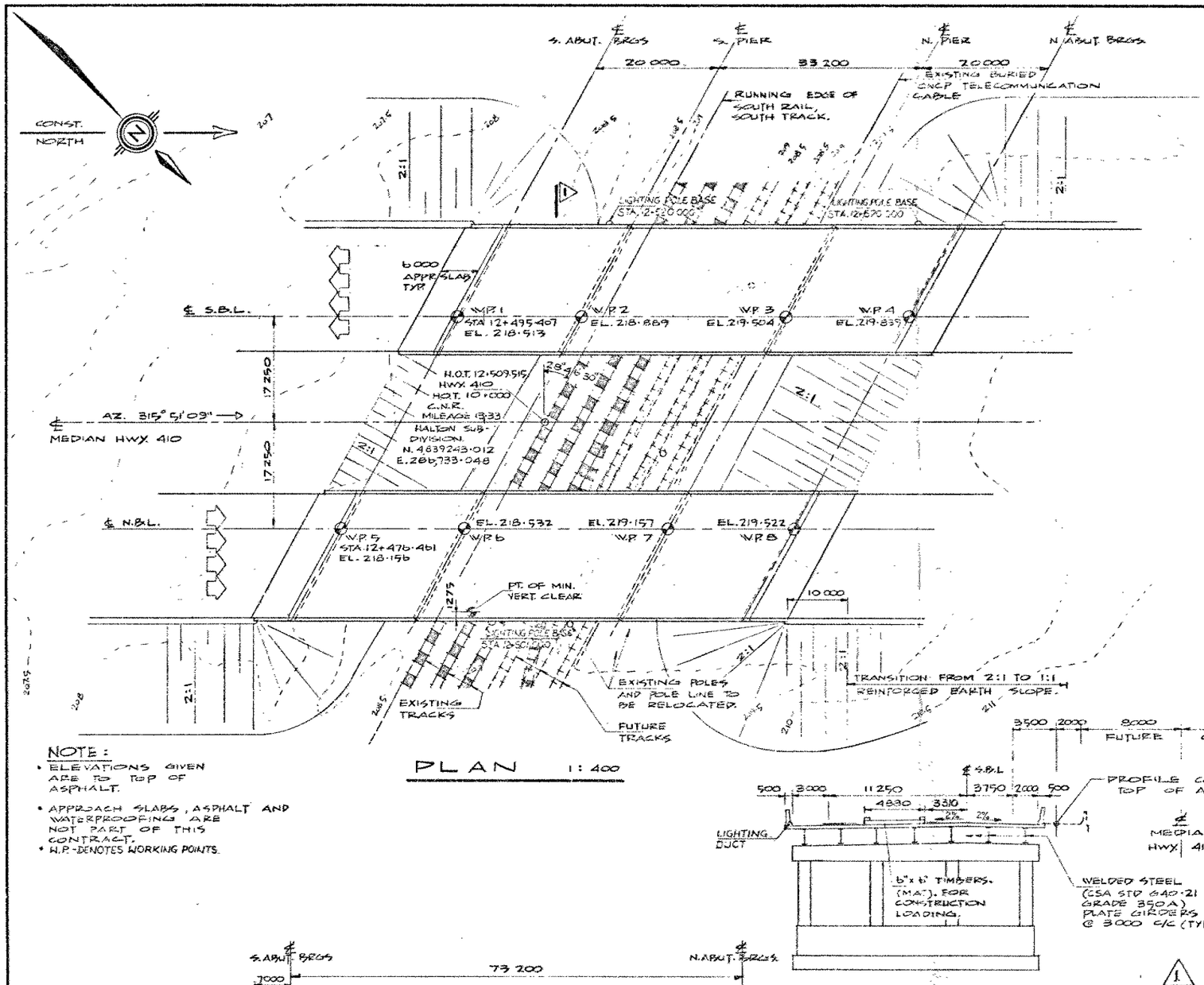
METRIC

DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE SHOWN.
ELEVATIONS, COORDINATES, CURVE AND ALIGNMENT DATA ARE IN METRES.
STATIONS ARE IN KILOMETRES + METRES.

DISTRICT NO 6
CONT No
WP No 21-79-01

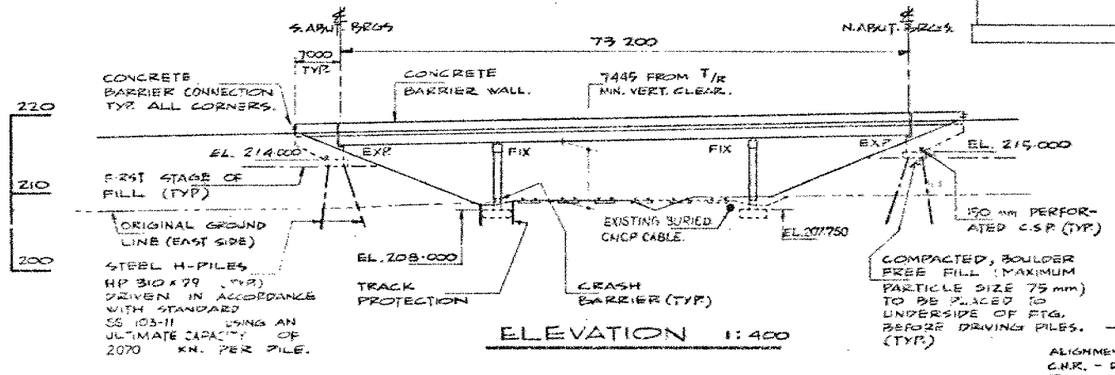
HWY. 410/C.N.R. OVERHEAD
GENERAL ARRANGEMENT

SHEET



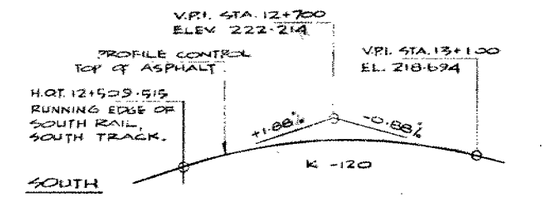
PLAN 1:400

NOTE:
- ELEVATIONS GIVEN ARE TO TOP OF ASPHALT.
- APPROACH SLABS, ASPHALT AND WATERPROOFING ARE NOT PART OF THIS CONTRACT.
- W.P. - DENOTES WORKING POINTS.

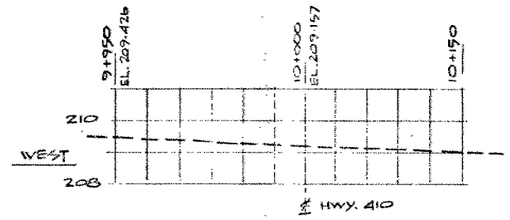


ELEVATION 1:400

BM ELEV 214·051
N.W. CORNER OF CONCRETE SLAB 15·5 m LT OF STA. 12+934·700.



PROFILE HWY 410 N.T.S.



PROFILE C.N.R. (TOP OF RAIL)

(R.E. OF SOUTH RAIL, SOUTH TRACK)
SCALE: HOR. 1:100 ; VER. 1:10.

GENERAL NOTES

CLASS OF CONCRETE

DECK, BARRIER WALLS, PIERS, PIER FTG., ABUTMENTS, WINGWALLS	— 30 MPa
REMAINDER	— 20 MPa

CLEAR COVER TO REINFORCING STEEL

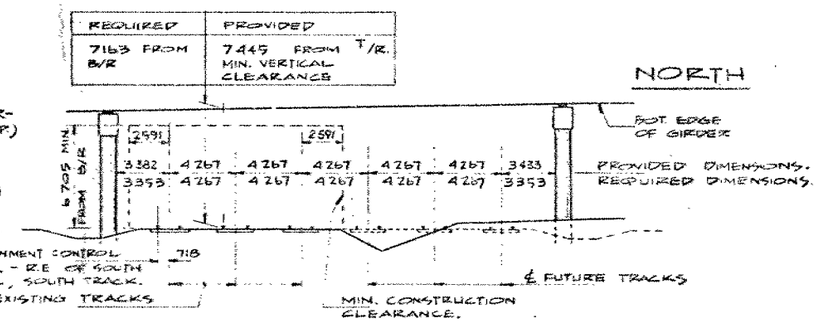
FOOTINGS.		— 100 ± 20 mm
DECK	TOP.	— 70 ± 20 mm
	BOTTOM.	— 40 ± 10 mm
ABUTMENTS, WALLS & PIERS		— 80 ± 20 mm
REMAINDER.		70 ± 20 OR AS NOTED.

REINFORCING STEEL SHALL BE GRADE 400 UNLESS OTHERWISE SPECIFIED. BARS MARKED WITH THE SUFFIX C SHALL BE COATED BARS.

CONSTRUCTION NOTES

- THE CONTRACTOR SHALL FINISH THE BEARING SEATS DEAD LEVEL TO THE SPECIFIED ELEVATIONS TO A TOLERANCE OF ± 3 mm.

1 1:200



C.N.R. CLEARANCE DIAGRAM N.T.S.

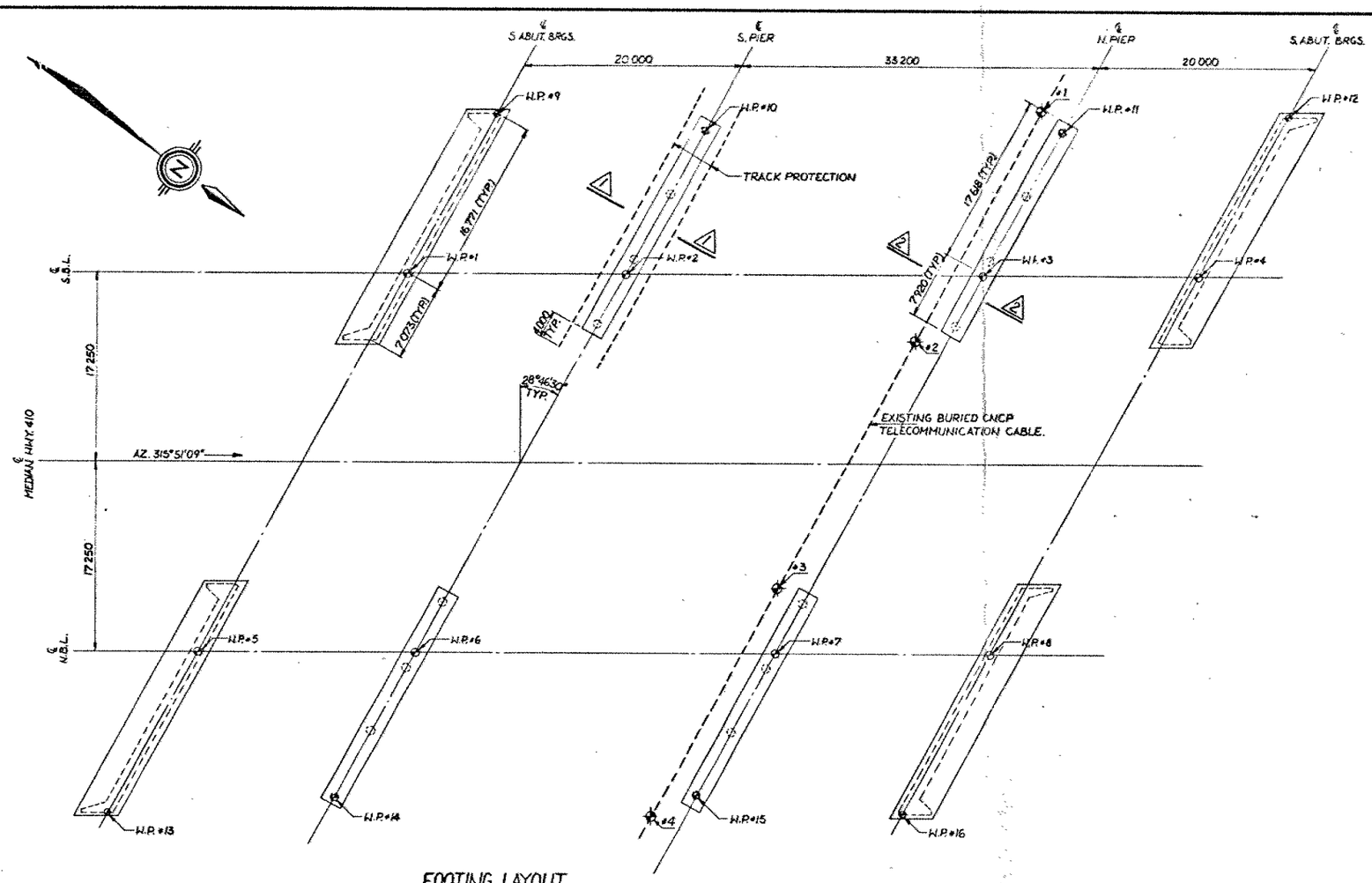
DIMENSIONS ARE PERPENDICULAR TO TRACK

DRAWING NOT TO BE SCALED
100 mm ON ORIGINAL DRAWING

LIST OF DRAWINGS

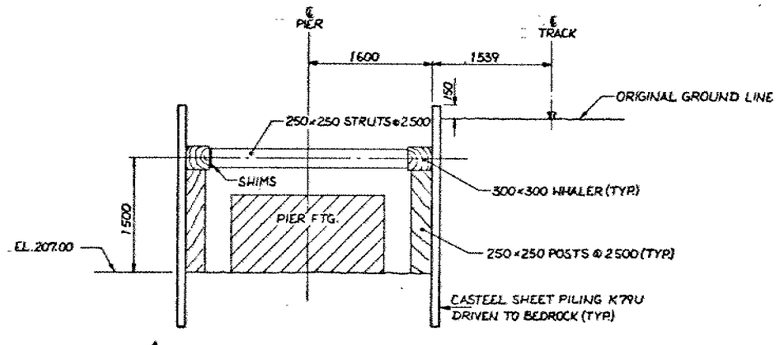
REVISIONS			
DATE	BY	DESCRIPTION	
DESIGN	CHECK	LOADING	DATE SEP '82
DRAWING	CHECK	SITE	DWG

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS ONTARIO DB-BR 1SM 81-06

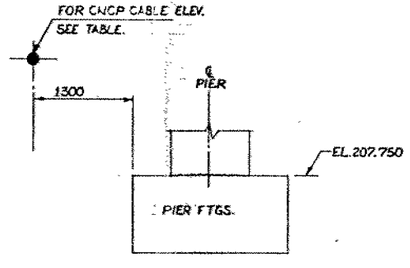


FOOTING LAYOUT
N.T.S.

NOTES: *ALTERNATE SCHEMES FOR TRACK PROTECTION WILL BE CONSIDERED BY THE MINISTRY.
*ALL TIMBER FOR TRACK PROTECTION TO BE CONSTRUCTION GRADE, DOUGLAS FIR (NOT DRESSED).



1 TRACK PROTECTION DETAILS
SCALE 1:40



2 CNCP CABLE LOCATION

CNCP LOCATIONS		
POINT	STATION	ELEVATION
#1	9+963.562	209.265
#2	9+986.880	209.365
#3	10+014.420	209.258
#4	10+037.338	209.248

		CO-ORDINATES	
POINT	STATION	NORTH	EAST
W.P.#1	12+495.407	4839220.874	286730.496
W.P.#2	12+515.407	4839235.225	286716.566
W.P.#3	12+548.607	4839259.048	286693.442
W.P.#4	12+568.607	4839273.399	286679.512
W.P.#5	12+476.461	4839231.309	286768.448
W.P.#6	12+496.461	4839245.660	286754.518
W.P.#7	12+529.661	4839269.482	286731.394
W.P.#8	12+549.661	4839283.833	286717.464
W.P.#9	12+503.480	4839216.428	286714.325
W.P.#10	12+522.684	4839231.217	286701.989
W.P.#11	12+565.824	4839255.040	286678.865
W.P.#12	12+576.680	4839268.953	286663.341
W.P.#13	12+468.388	4839235.755	286784.619
W.P.#14	12+489.184	4839249.668	286769.095
W.P.#15	12+522.384	4839273.490	286745.971
W.P.#16	12+541.588	4839288.279	286733.635

METRIC

DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE SHOWN.
ELEVATIONS, COORDINATES, CURVE AND ALIGNMENT DATA ARE IN METRES.
STATIONS ARE IN KILOMETRES + METRES.

CONT No
WP No 21-79-01

HWY. 410/C.N.R.
OVERHEAD
FOOTING LAYOUT

SHEET

DRAWING NOT TO BE SCALED
100 mm ON ORIGINAL DRAWING

REVISIONS			
DATE	BY	DESCRIPTION	
DESIGN	CHECK	LOADING	DATE
DRAWING	CHECK	SITE	DWG

METRIC

DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN

CONT No

WP No 21-79-01

HWY 410 CNR OVERHEAD

FOOTING DETAILS

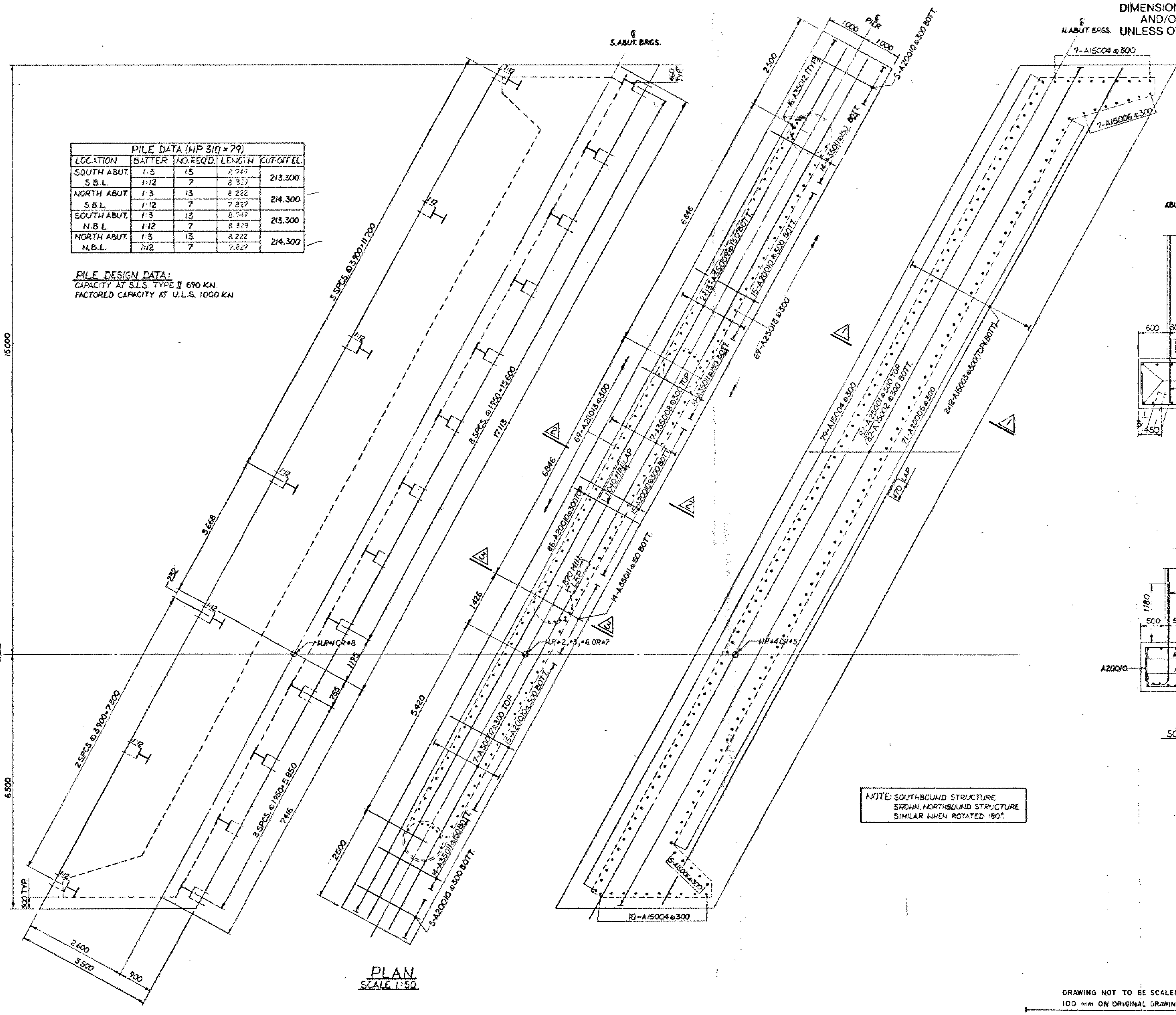
SHEET

PILE DATA (HP 310 × 79)				
LOCATION	BATTER	NO. REQ'D.	LENGTH	CUT-OFF EL.
SOUTH ABUT. S.B.L.	1:3	13	8.749	213.300
	1:12	7	8.329	
NORTH ABUT. S.B.L.	1:3	13	8.222	214.300
	1:12	7	7.827	
SOUTH ABUT. N.B.L.	1:3	13	8.749	213.300
	1:12	7	8.329	
NORTH ABUT. N.B.L.	1:3	13	8.222	214.300
	1:12	7	7.827	

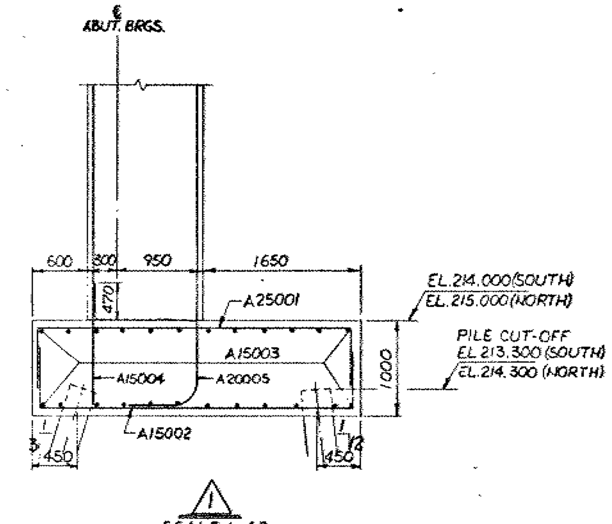
PILE DESIGN DATA:

CAPACITY AT S.L.S. TYPE II 690 KN.

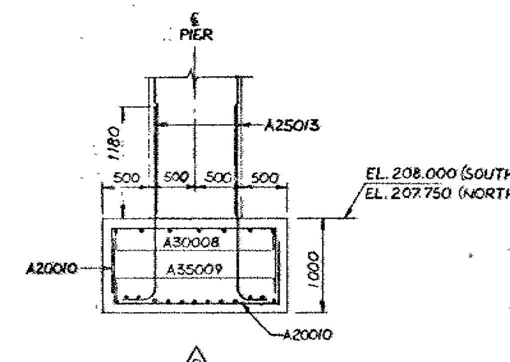
FACTORED CAPACITY AT U.L.S. 1000 KN



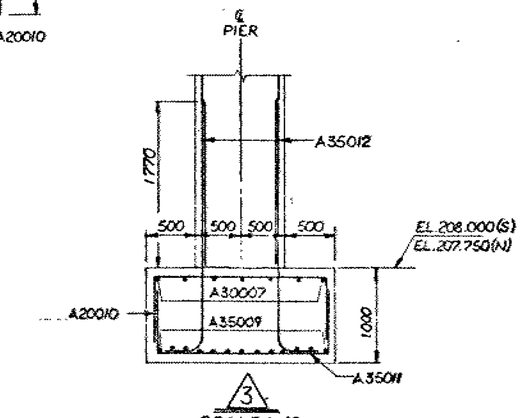
PLAN
SCALE 1:50



SCALE 1:40



SCALE 1:40



SCALE 1:40

NOTE: SOUTHBOUND STRUCTURE SHOWN, NORTHBOUND STRUCTURE SIMILAR WHEN ROTATED 180°.

DRAWING NOT TO BE SCALED
100 mm ON ORIGINAL DRAWING

REVISIONS		
DATE	BY	DESCRIPTION

DESIGN	CHECK	LOADING		DATE	
DRAWING	CHECK	SITE No		DWG	

memorandum

Ontario

To: Mr. W. L. Lin
Design Engineer (Central)
Structural Office
3501 Dufferin St.

Date: 83 04 22

From: Pavement & Foundation Design Section
Room 315, Central Building
Downsview

RE: Hwy 410/CNR Overhead
W.P. 21-79-01, Site 24-145-477
Hwy 410, District 6

We have reviewed the final bridge drawings for the above-mentioned site and provide the following comments:

1. The note regarding the driving of piles should be changed to read "Piles to be driven to bedrock". The use of the above note will require the removal of standard drawing SS103-11 from the contract package.

2. The pile lengths given should be rounded to the nearest 0.3 m.

3. As stated in our memo of 82 11 22, a note should be added necessitating the removal of all topsoil, organic and other unsuitable material prior to placement of the approach fill material.

Brian Ruck

BRIAN RUCK
Trainee Engineer
for

M. DEVATA, P.Eng.
Senior Foundations Engineer

Memorandum

Ontario

To: Mr. W.L. Lin
Design Engineer (Central)
Design Section
Structural Office
3501 Dufferin St., 4th Floor

Date: 82 11 22

From: Pavement & Foundation Design Section
Room 315, Central Bldg.
Downsview

Re: Hwy. 410/CNR Overpass
W.P. No. 21-79-01
Site No. 24-145-477
District No. 6

We have reviewed the general arrangement drawing 24-145-477-P1 for the above-mentioned structure and provide the following comments:

1) Please refer to our comments as of 82 08 30, as we still feel perched abutments founded on a well compacted Granular 'A' core without the need of piles will be satisfactory when designed to a Factored Capacity at U.L.S. of 850 kPa and a Capacity at S.L.S. Type II of 300 kPa.

2) All topsoil, organic and other unsuitable materials should be removed and the site properly graded prior to placement and compaction of Granular 'A' earth fill.

3) Notice should also be given to elevations at the bases of both bridge abutment footings as there appears to be some discrepancy with other elevations of the structure foundations.

K.D. Chak
Trainee Engineer

for: M. Devata, P. Eng.
Senior Foundations Engineer

KDC:syc

C.N.R. O'PASS
SITE 24-477 W.P. 21-79-01

LOOKING SOUTH ALONG 410
ALIGNMENT PAST C.N.R. TRACKS

LOOKING WEST ALONG C.N.R.
PAST 410 ALIGNMENT TOWARDS
HEART LAKE ROAD