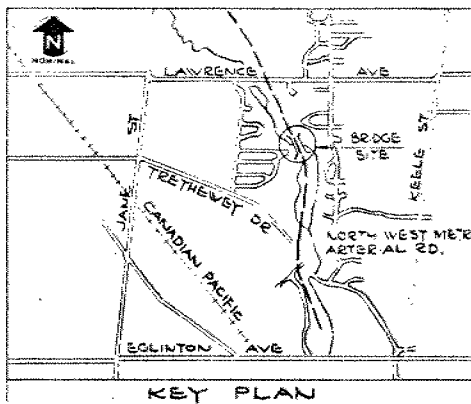
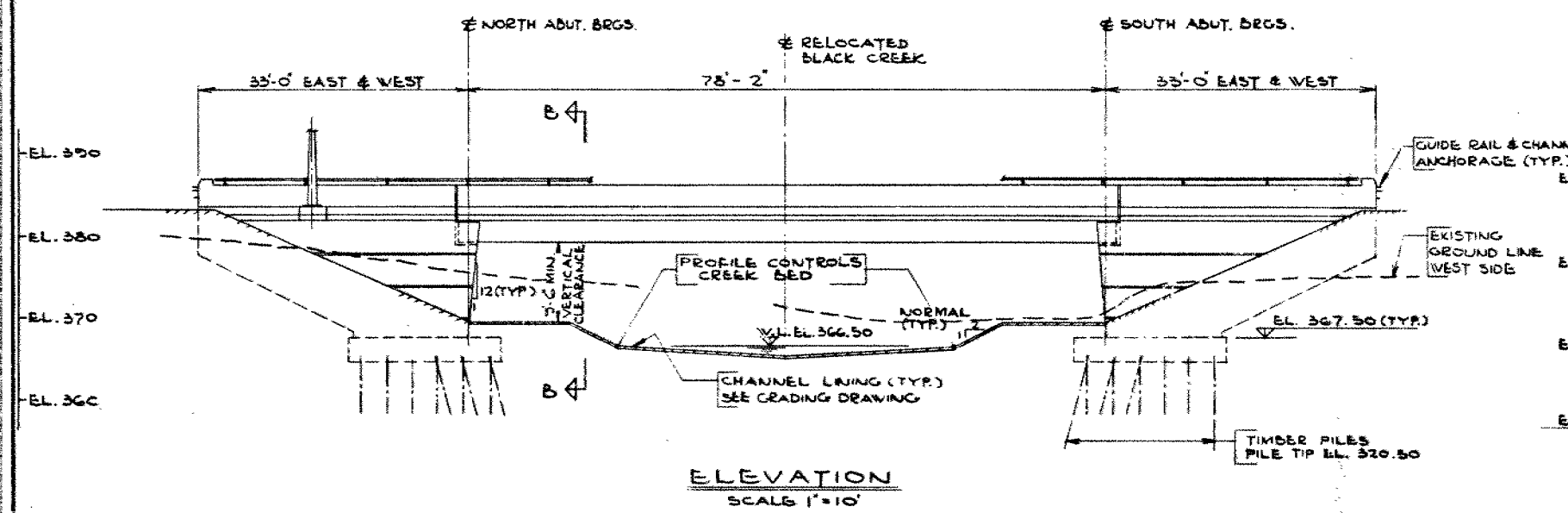
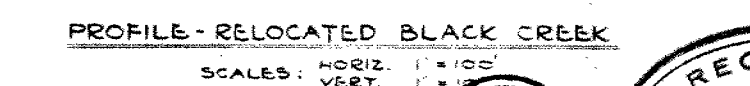
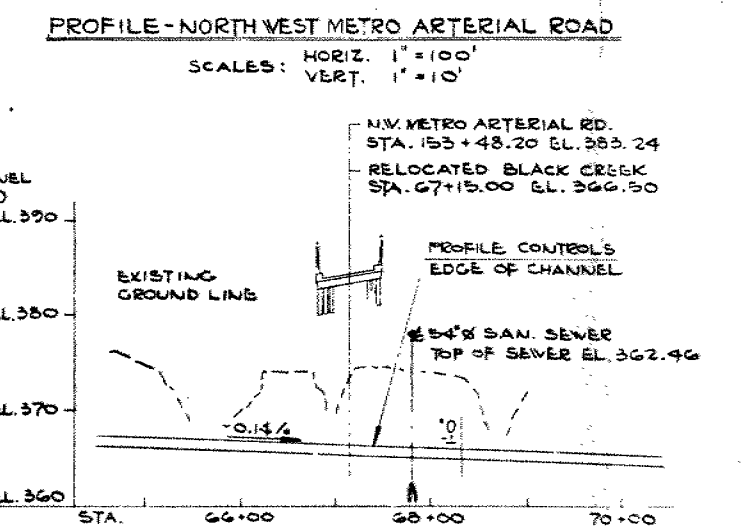
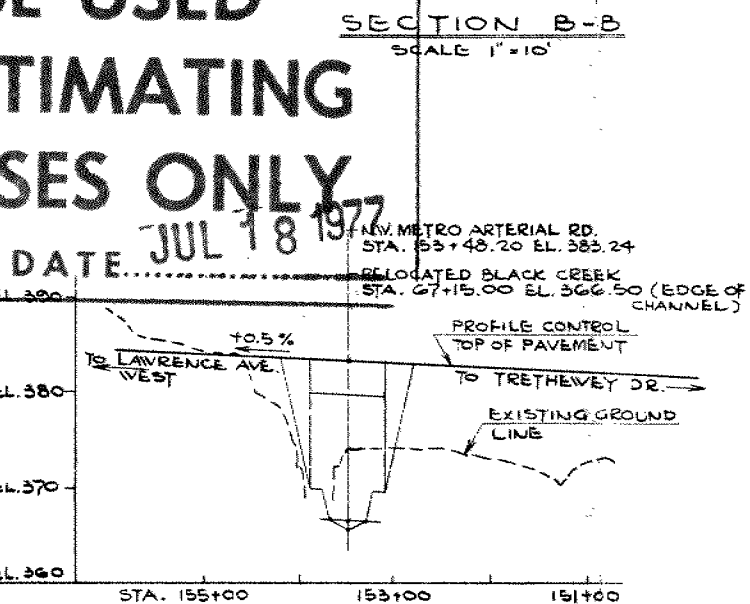
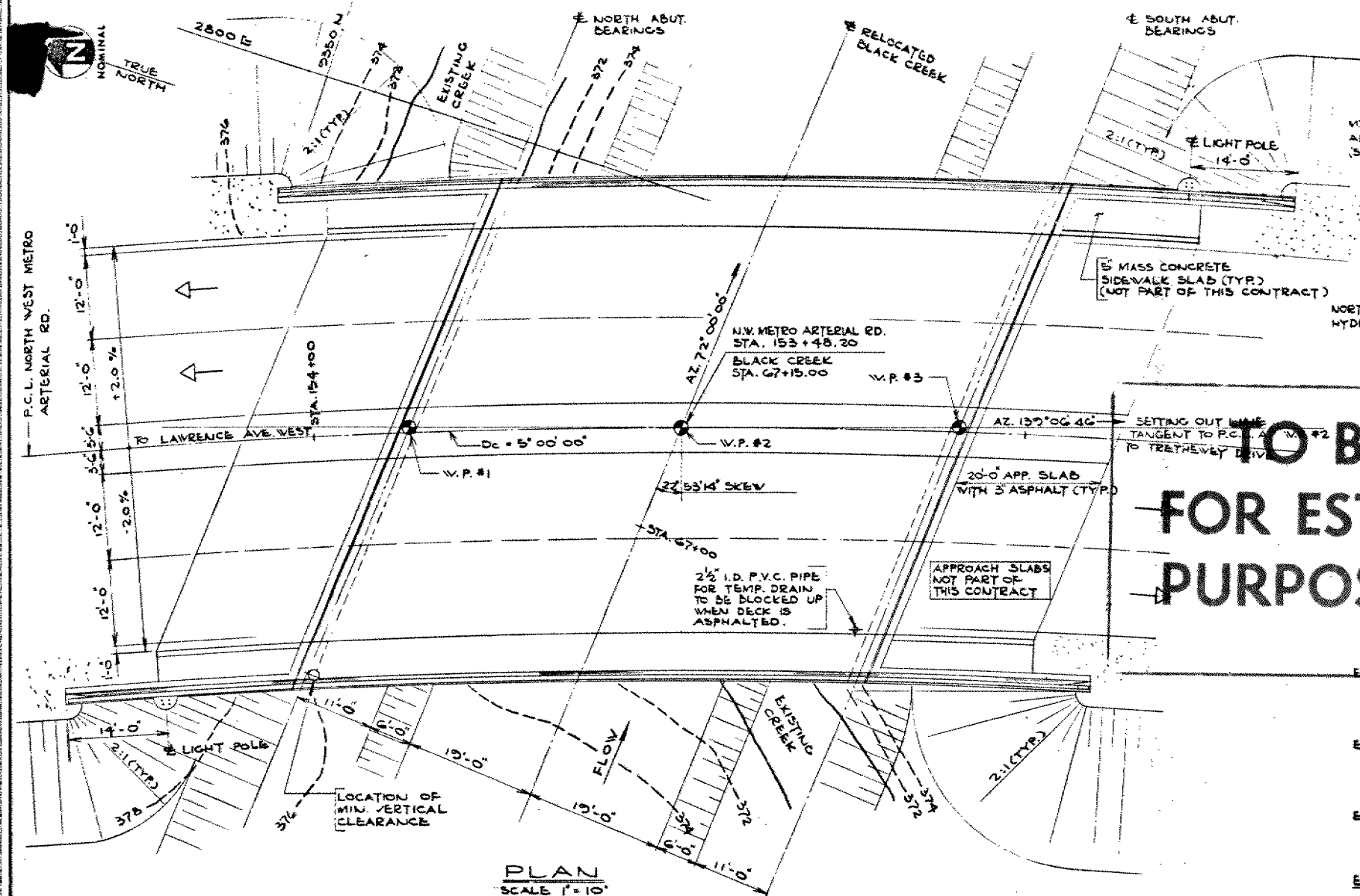


REMARKS: _____



**TO BE USED
FOR ESTIMATING
PURPOSES ONLY**

DATE JUL 18 1977



CONCRETE QUANTITIES LISTED BELOW FOR THE
APPLICABLE LUMP SUM TENDOR ITEMS

ABUTMENT AND WINGWALLS	602 CY	5,000 P.S.I.
DECK, SIDEWALKS AND DIAPHRAGMS	138 CY	4,000 P.S.I.
BARRIER WALLS	22 CY	4,000 P.S.I.

GENERAL NOTES

CLASS OF CONCRETE

PRESTRESSED BOX GIRDERS SEE DWG. No 8.
DECK CURBS AND BARRIER WALLS 4000 P.S.I.
ALL OTHER INCLUDING APPROACH SLABS 3000 P.S.I.

GRADE OF REINFORCING STEEL

REINFORCING STEEL SHALL BE C.S.A. G30 SERIES GRADE 2.

CLEAR COVER TO REINFORCING STEEL

FOUNDATIONS AND SURFACES IN CONTACT WITH EARTH 3"
DECK SLAB TOP* 2"
DECK SLAB BOTTOM 1 1/2"
CURBS, BARRIER WALL AND DIAPHRAGMS 1 1/2"
ALL OTHER 2"

* TO ACHIEVE THE MIN. CLEAR COVER OF 2" SPECIFIED, THE TOP LAYER SHALL BE PLACED PRIOR TO CONCRETING WITH A CLEAR COVER OF 2 1/2" TOLERANCE.

CONSTRUCTION NOTES

THE CONTRACTOR IS RESPONSIBLE FOR FINISHING THE BEARING SEATS DEAD LEVEL TO THE SPECIFIED ELEVATIONS WITH A TOLERANCE OF 1/8".

NO CONCRETE SHALL BE PLACED ABOVE THE BEARING SEATS UNTIL THE CONCRETE IN THE DECK SLAB HAS BEEN PLACED.

PRESTRESSING NOTES

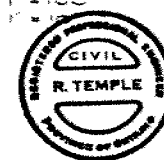
FOR PRESTRESSING NOTES SEE DWG. No 8.

LOADING

H-20-44 OR SCRAPER.
MAXIMUM GROSS WEIGHT = 172 KIPS (SEE DWG. No 15)

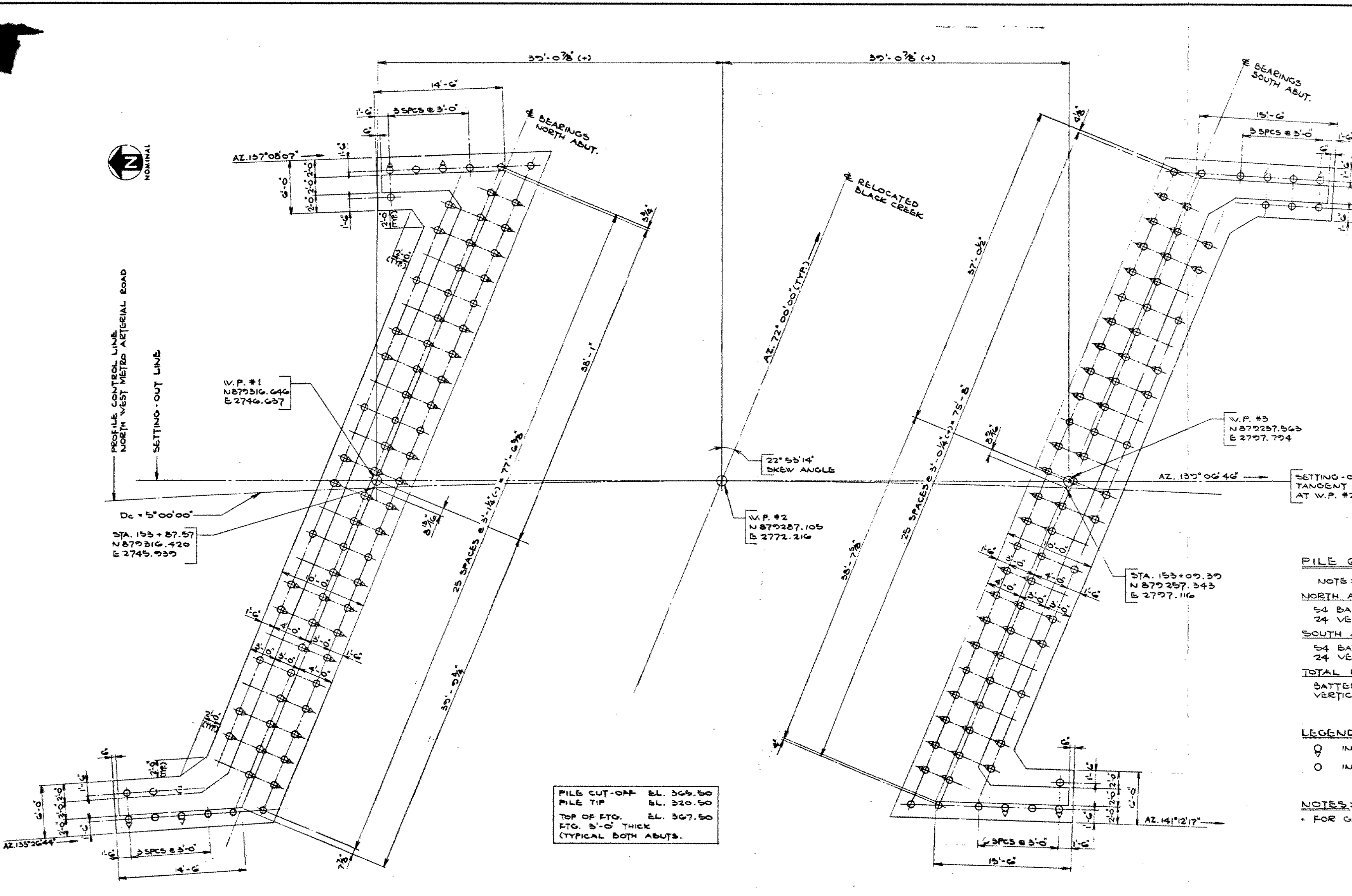
LIST OF DRAWINGS

1. GENERAL ARRANGEMENT
2. BORSHOLE LOCATION AND SOIL STRATA.
3. FOUNDATION LAYOUT
4. NORTH ABUTMENT - PLANS
5. NORTH ABUTMENT - ELEVATIONS AND SECTIONS
6. SOUTH ABUTMENT - PLANS
7. SOUTH ABUTMENT - ELEVATIONS AND SECTIONS
8. PRESTRESSED BOX GIRDERS
9. DECK
10. BARRIER WALL
11. HAND RAIL - SINGLE TUBE
12. APPROACH SLABS.
13. AS CONSTRUCTED.
14. MISCELLANEOUS DETAILS - I
15. MISCELLANEOUS DETAILS - II
16. ELECTRICAL EMBEDDED WORK
17. ELECTRICAL EMBEDDED WORK DETAILS
18. ELECTRICAL CONSTRUCTION STANDARDS



DATE BY	DESCRIPTION
DESIGN	CHECKED
DRAWING	CHECKED
DATE	DATE
FILE NO	FILE NO
DWG	DWG

FENCO No 6755-1K-1



PILE QUANTITIES

NOTE:- ALL PILES ARE TREATED #14 TIMBER PILES.

NORTH ABUTMENT

54 BATTER PILES 3:1
24 VERTICAL PILES

SOUTH ABUTMENT

54 BATTER PILES 3:1
24 VERTICAL PILES

TOTAL LENGTH OF PILES

BATTER 108 x 48 = 5,184 L.F.
VERTICAL 48 x 45 = 2,160 L.F.
7,344 L.F.

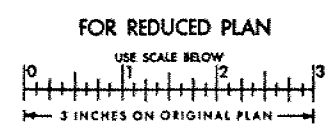
LEGEND

⊙ INDICATES BATTER PILE
○ INDICATES VERTICAL PILE

NOTES:-

• FOR GENERAL NOTES SEE DWG. 1.

FOUNDATION LAYOUT
SCALE 3/16" = 1'-0"



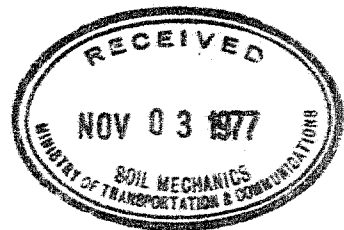
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DESIGN	10/5	CHECKED	LOADING
DRAWING	10/5	CHECKED	PRISITE No 57-060 DWG 5

FOUNDATION INVESTIGATION REPORT

CONTRACT NO. 77-125



Ministry of
Transportation and
Communications



INDEX

<u>Page No.</u>	<u>Description</u>
1	Index
2	Abbreviations & Symbols
3-	Foundation Investigation Report Black Creek Bridge W.P. 33-76-06

NOTE For 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

'N' VALUE: AN INDICATOR OF SOIL QUALITY. IT IS OBTAINED FROM THE STANDARD PENETRATION TEST (ASTM D1586). SPT 'N' VALUE IS THE NUMBER OF BLOWS REQUIRED TO PENETRATE A STANDARD 2 INCH O.D. SPLIT BARREL (ADAPTER TO PENETRA) 12 INCHES INTO UNDISTURBED GROUND IN A BOREHOLE WHEN DRIVEN BY A HAMMER WEIGHING 140 POUNDS, FALLING FREELY A DISTANCE OF 30 INCHES. FOR PENETRATIONS OF LESS THAN 12 INCHES 'N' VALUES ARE INDICATED AS THE NUMBER OF BLOWS FOR THE PENETRATION ACHIEVED. 'N' VALUES CORRECTED FOR OVERBURDEN PRESSURE ARE DENOTED THIS M.

DYNAMIC CONE PENETRATION TEST (ASTM D1586): CONTINUOUS PENETRATION OF A CONICAL STEEL POINT (2" O.D., 60 CONE ANGLE) DRIVEN BY 350 FT-LB IMPACTS ON "A" SIZE DRILL RODS. THE RESISTANCE TO CONE PENETRATION IS MEASURED AS THE NUMBER OF BLOWS FOR EACH 12 INCH ADVANCE OF THE CONICAL POINT INTO THE UNDISTURBED GROUND.

SOIL QUALITY: SOILS ARE DESCRIBED BY THEIR COMPOSITION AND CONSISTENCY OR DENSITY.

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

S_u (PSF)	0 - 250	250 - 500	500 - 1000	1000 - 2000	2000 - 4000	> 4000
	VERY SOFT	SOFT	FIRM	STIFF	VERY STIFF	HARD

DENSITY: COHESIONLESS SOILS ARE DESCRIBED ON THE BASIS OF SPT 'N' VALUES AS FOLLOWS:

'N' (BLOW/FT)	0 - 5	5 - 10	10 - 30	30 - 50	> 50
	VERY LOOSE	LOOSE	MODERATE	DENSE	VERY DENSE

ROCK QUALITY: 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 DRILLED IN THAT CORING RUN.

MODIFIED RECOVERY: SUM OF THOSE NATURALLY FRACTURED CORE PIECES, 4" 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	2"	2" - 12"	1' - 3'	3' - 10'	> 10'
JOINTING	VERY CLOSE	CLOSE	MOD. CLOSE	WIDE	VERY WIDE
BEDDING	VERY FINE	THIN	MEDIUM	THICK	VERY THICK

ABBREVIATIONS & SYMBOLS

LABORATORY TESTING

TRIAXIAL TESTS ARE DESCRIBED IN TERMS OF WHETHER THEY ARE CONSOLIDATED (C) OR NOT (U) ISOTROPICALLY (I) OR NOT (A) AND SHEARED DRAINED (D) OR UNDRAINED (U) WITH PORE PRESSURE MEASUREMENTS (BAR OVER SYMBOLS) EG, $\bar{C}IU$ = CONSOLIDATED ISOTROPIC UNDRAINED TRIAXIAL WITH PORE PRESSURE MEASUREMENT UNLESS OTHERWISE SPECIFIED IN REPORT ALL TESTS ARE IN COMPRESSION

FIELD SAMPLING

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

EARTH PRESSURE TERMS

μ COEFFICIENT OF FRICTION
 δ ANGLE OF WALL FRICTION
 k_o COEFFICIENT OF EARTH PRESSURE AT REST
 k_A COEFFICIENT OF ACTIVE EARTH PRESSURE
 k_P COEFFICIENT OF PASSIVE EARTH PRESSURE
 i ANGLE OF INCLINATION OF SURCHARGE
 w SLOPE ANGLE-BACKFACE OF WALL
 β ANGLE OF SLOPE
 N_1, N_2, N_3 BEARING CAPACITY FACTORS
 D_f DEPTH OF FOOTING
 B, L FOOTING DIMENSIONS

INDEX PROPERTIES

γ UNIT WEIGHT OF SOIL (BULK DENSITY)
 γ_w UNIT WEIGHT OF WATER
 γ_d UNIT DRY WEIGHT OF SOIL (DRY DENSITY)
 γ' UNIT WEIGHT OF SUBMERGED SOIL
 G_s SPECIFIC GRAVITY OF SOLIDS
 e VOID RATIO
 e_o INITIAL VOID RATIO
 e_{max} e IN LOOSEST STATE
 e_{min} e IN DENSEST STATE
 D_r RELATIVE DENSITY = $\frac{e_{max} - e}{e_{max} - e_{min}}$
 n POROSITY
 w WATER CONTENT
 w_L LIQUID LIMIT
 w_P PLASTIC LIMIT
 w_S SHRINKAGE LIMIT
 I_P PLASTICITY INDEX = $w_L - w_P$
 I_L LIQUIDITY INDEX = $\frac{w - w_P}{w_L - w_P}$
 I_c CONSISTENCY INDEX = $\frac{w_L - w_P}{w_L - w_{min}}$
 A_c ACTIVITY = $\frac{I_P}{I_c}$
 O_m ORGANIC MATTER CONTENT
 S_r DEGREE OF SATURATION
 S SENSITIVITY = $\frac{S_u(\text{undisturbed})}{S_u(\text{remoulded})}$

STRENGTH PARAMETERS

ϕ ANGLE OF SHEARING RESISTANCE
 τ_f PEAK SHEAR STRENGTH
 τ_R RESIDUAL SHEAR STRENGTH
 c COHESION INTERCEPT
 σ_1, σ_3 NORMAL PRINCIPAL STRESSES
 u PORE WATER PRESSURE
 u_p EXCESS u
 u_v PORE PRESSURE RATIO
 q_u UNCONFINED COMPRESSIVE STRENGTH
 s_u UNDRAINED SHEAR STRENGTH
 ϵ LINEAR STRAIN
 γ SHEAR STRAIN
 ν POISSON'S RATIO
 E MODULUS OF ELASTICITY
 G MODULUS OF SHEAR DEFORMATION
 k_v MODULUS OF SUBGRADE REACTION
 m, n STABILITY COEFFICIENTS
 A, B PORE PRESSURE COEFFICIENTS
NOTES: EFFECTIVE STRESS PARAMETERS ARE DENOTED BY USE OF APOSTROPHE ABOVE THE SYMBOL, THUS:
 σ' = EFFECTIVE ANGLE OF SHEARING RESISTANCE
 σ' = EFFECTIVE NORMAL STRESS

HYDRAULIC TERMS

h HYDRAULIC HEAD OR POTENTIAL
 q RATE OF DISCHARGE
 v VELOCITY OF FLOW
 i HYDRAULIC GRADIENT
 J SEEPAGE FORCE PER UNIT VOLUME
 η COEFFICIENT OF VISCOSITY
 k COEFFICIENT OF HYDRAULIC CONDUCTIVITY
 k_h k IN HORIZONTAL DIRECTION
 k_v k IN VERTICAL DIRECTION
 m_v COEFFICIENT OF VOLUME CHANGE
 c_v COEFFICIENT OF CONSOLIDATION
 C_c COMPRESSION INDEX
 C_r RECOMPRESSION INDEX
 d DRAINAGE PATH DISTANCE
 T_v TIME FACTOR
 U DEGREE OF CONSOLIDATION
 O_r OVERCONSOLIDATION RATIO (OCR)

FOUNDATION INVESTIGATION REPORT

For

Black Creek Bridge
W.P. 33-76-06, Site 37-1040
Northwest Metro Arterial Rd.
Dist. 6, Toronto

INTRODUCTION

This report contains the results of a foundation investigation carried out at the site of the revised location of the relocated Black Creek channel and Northwest Metro Arterial Hwy. 400 extension. The fieldwork was carried out during the period of April 18 to April 20, 1977. In addition, field data obtained during February 18, 1965 and December 16, 1976 for preliminary investigation purposes is also included. The field work consisted of 6 boreholes (4 boreholes for the recent investigation and 2 boreholes for the previous preliminary investigations) to depths ranging from 35 to 132 ft. below the ground surface. The boreholes were carried out utilizing diamond drilling equipment or by the use of a continuous flight auger machine equipped with 4 inch O.D. solid augers or 3¼ inch I.D. hollow stem augers. Bedrock was proven in one location by obtaining 10 ft. of rock core.

SITE DESCRIPTION AND GEOLOGY

The site is located 1 mile south of Lawrence Ave. West between Keele St. and Jane St. in Metropolitan Toronto. In this Area Black Creek meanders in a southerly direction. At this location the Black Creek valley is generally flat to undulating. The surrounding area is generally used for residential purposes.

The proposed site is within the upper reaches of glacial Lake Iroquois. Black Creek runs in a relatively recent valley, cut into the Lake Iroquois deposits. Below the Lake Iroquois or recent floodplain deposits of Black Creek, the general soil stratigraphy consists of a succession of glacial till and interglacial deposits of the Pleistocene period, extending to bedrock.

SUBSURFACE CONDITIONS

General

Subsoil consists of about 1 ft. thick layer of topsoil, followed by a 8 to 12 ft. thick surficial alluvial deposit of sandy silt to silty sand with occasional intrusions of organics, underlain by an extensive stratum of clayey silt, with some sand and occasional gravel ranging in thickness from 48 to 62 ft. This cohesive deposit is underlain by a granular stratum of silty sand to sandy silt with occasional gravel. This granular deposit was only penetrated about 5 ft. at most of the locations, however, it has been explored to its full depth at one location (B.H. 8) and found to be 45 ft. in thickness. At this location the granular deposit is underlain by shaley dolomite and limestone bedrock.

Boundaries between different deposits are shown on the Record of Borehole Sheets which are contained in the Appendix of this report. The locations and elevations of the borings are shown on Drawing No. 2, Sheet No. 78 of the contract drawings, together with the estimated stratigraphical profile and section. A description of the soil types encountered in the borings is as follows.

Surficial Alluvial Deposit - (Silty Sand to Sandy Silt With Intrusions of Clay and Organics)

Underlying a surficial layer of topsoil is a surficial alluvial deposit of silty sand to sandy silt with intrusions (max. 6") of clay and organics. This 8 to 12 foot thick deposit is very loose to compact having 'N' value range of 2 to 18 blows per foot.

Clayey Silt With Some Sand and Occasional Gravel

Underlying the surficial alluvial deposit is a cohesive stratum of clayey silt with some sand and occasional gravel. The thickness of this cohesive layer at the site was found to vary from 48 to 62 feet.

The engineering properties of the stratum as determined by field and laboratory testing are presented in tabular form as follows:

		<u>Range</u>
Bulk Density	(γ)	121-146 pcf
Liquid Limit	(W_L) %	21 - 28
Plastic Limit	(W_p) %	13 - 17
Natural Moisture Content	(W) %	13 - 22
Undrained Shear Strength (C_u)	psf	
a) Field vanes		750 - 2200 psf
b) Lab vanes		850 - 2500 psf

Standard Penetration resistance or 'N' values 7 - 40 blows/ft.

The Atterberg limit tests, summarized above are also plotted on the Plasticity Chart, Fig. 1. These results indicate that in general, the cohesive deposit is inorganic and of low plasticity, with natural moisture content generally well below the liquid limit. Based on the field and laboratory results obtained, it is estimated that the consistency of the cohesive stratum in the upper 10 ft. of the crust varies from very stiff to firm and below, this portion the consistency varies from firm to hard generally increasing with depth.

Grain-size distribution curves for samples of the clayey silt stratum are shown on Fig. 4.

Lower Granular Deposit - (Silty Sand to Sandy Silt With Occasional Gravel)

Underlying the cohesive clayey silt stratum is a deposit of silty sand to sandy silt with occasional gravel. This granular stratum was proven only to a depth of 5 feet in many locations. However, at one location the total depth of this deposit was fully explored and found to be 46 feet. At this location the granular stratum is underlain by shaley dolomite and limestone bedrock. Typical grain size distribution curves of this granular stratum are shown on Figs. 2 and 3.

The Standard Penetration resistance or 'N' values range from a low of 10 blows/foot to as high as over 100 blows/foot. Based on these values, it is estimated that the relative density of this lower granular stratum varies from compact to very dense with depth.

Bedrock

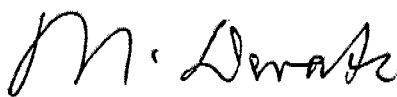
The bedrock was found to be at elevation 250 i.e. about 122 feet below the existing ground surface.

The bedrock is composed of grey shaley dolomite with interbedded limestone zones. The upper 3 feet of the bedrock is somewhat fractured and below this the bedrock is generally sound.

GROUNDWATER CONDITIONS

Groundwater level observations were carried out during the period of the investigation by measuring the water levels in the open boreholes. The results of the measurements indicate that the groundwater level varies from 3 to 4 feet below ground surface which corresponds to the water level in the creek (April, 1977).


V. Korlu, P. Eng.
Project Engineer


M. Devata, P. Eng.
Supervising Engineer



MD/VK/gs
October, 1977

APPENDIX

HIGHWAY ENGINEERING DIVISION - ENGINEERING MATERIALS OFFICE - SOIL MECHANICS SECTION

RECORD OF BOREHOLE NO 1

WP 33-76-06

LOCATION Co-ords. N 15 879 317 E 1 002 788

ORIGINATED BY CTJ

DIST 6 HWY NWMA

BORING DATE April 20, 1977

COMPILED BY CTJ

DATUM Geodetic

BOREHOLE TYPE 3 1/2" Hollow Stem Auger

CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT — w_L PLASTIC LIMIT — w_p WATER CONTENT — w			UNIT WEIGHT γ PCF	REMARKS
FLEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	N' VALUES		20	40	60	80	100	w_p	w	w_L		
374.0	Ground Level															
0.0	Topsoil															
365.0	Silty sand with traces of gravel & organics occ. seams of clayey silt in the upper portion. (loose)		1	SS	5										Org. 1.1%	
			2	SS	3										1.32	9 57 25 9
9.0	Clayey silt with some sand and occasional gravel		3	SS	11											
			4	TW	PH										124	
			5	TW	PH										129	
			6	TW	PH										135	2 20 57 21
			7	TW	PH											
	Stiff to very stiff		8	TW	PH											
			9	SS	14											
317.0																
57.0	Silty sand to sandy silt, trace of clay (dense)		10	SS	30											
312.5																
61.5	End of Borehole															

OFFICE REPORT ON SOIL EXPLORATION

HIGHWAY ENGINEERING DIVISION - ENGINEERING MATERIALS OFFICE - SOIL MECHANICS SECTION

RECORD OF BOREHOLE NO 4

WP 33-76-06 LOCATION Co-ords. N 15 879 239 E 1 002 772 ORIGINATED BY CTJ
 DIST 6 HWY NWMA BORING DATE April 18 & 19, 1977 COMPILED BY CTJ
 DATUM Geodetic BOREHOLE TYPE 3/4" Hollow Stem Auger CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT W_L PLASTIC LIMIT W_P WATER CONTENT W			UNIT WEIGHT γ PCF	REMARKS % GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	N' VALUES		20	40	60	80	100	W_P	W	W_L		
375.0	Ground Level															
0.0	Topsoil		1	SS	4										Org. 1.5%	0 36 51 13
367.0	Silty sand with traces of organics & gravel (loose)		2	SS	2											
8.0	Clayey silt with some sand and occasional gravel.		3	SS	9											
			4	SS	7											
			5	TW	PH											
			6	TW	PH										122	0 1 48 51
			7	TW	PH											
			8	SS	18										138	$e_o=0.433$ $C_c=0.177$
			9	TW	PH											
			10	SS	34											
	Firm to stiff		11	SS	24											
			12	SS	12											5 28 50 17
318.0																
57.0	Silty sand to sandy silt & trace of clay (loose)		13	SS	10											0 35 59 6
313.0																
62.0	End of Borehole															

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 8 (W.O. 65-F-40)

WP 33 - 76 - 06

LOCATION Co-ords. N 15 879 262 E 1 002 679

ORIGINATED BY R.M.

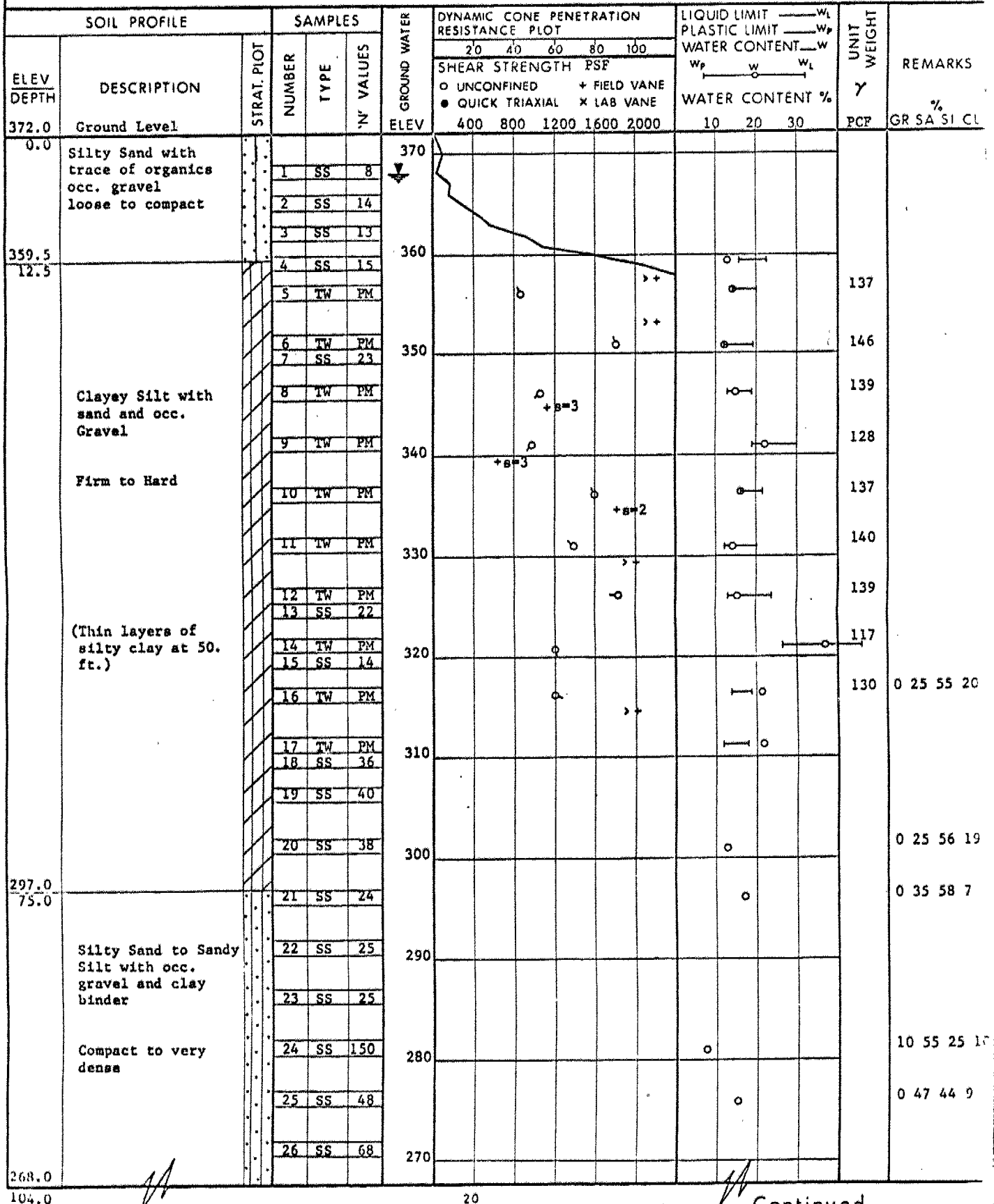
DIST 6 HWY NWMA

BORING DATE February 18, 1965

COMPILED BY H.S.

DATUM Geodetic

BOREHOLE TYPE Washboring, Rock Core & Cone Test

CHECKED BY *CP*

Continued

RECORD OF BOREHOLE NO 8 Continued

(W.O. 65-F-40)

WP 33 - 76 - 06

LOCATION Co-ords. N 15 879 262 E 1 002 679

ORIGINATED BY R.M.

DIST 6 HWY NWMA

BORING DATE February 18, 1965

COMPILED BY H.S.

DATUM Geodetic

BOREHOLE TYPE Washboring, Rock Core & Cone Test

CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT w_L PLASTIC LIMIT w_p WATER CONTENT w			UNIT WEIGHT γ PCF	REMARKS % GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		20	40	60	80	100	w_p	w	w_L		
268.0	Continued															
104.0			27	SS	83											0 36 45 19
	Silty sand to Sandy silt with occ. gravel and clay binder		28	SS	41	260										
	Compact to very Dense		29	SS	65											0 55 33 12
250.2			30	SS	164	250										19 22 48 11
121.8	Shaley Dolomite and Limestone Bedrock		31	RC	60% REC											
			32	RC	60% REC											
240.2																
131.8	End of Borehole															

RECORD OF BOREHOLE NO A

WP 33 - 76 - 06

LOCATION Co-ords. N 15 879 196 E 1 002 850

ORIGINATED BY V.K.

DIST 6 HWY NWMA

BORING DATE December 15, 1976

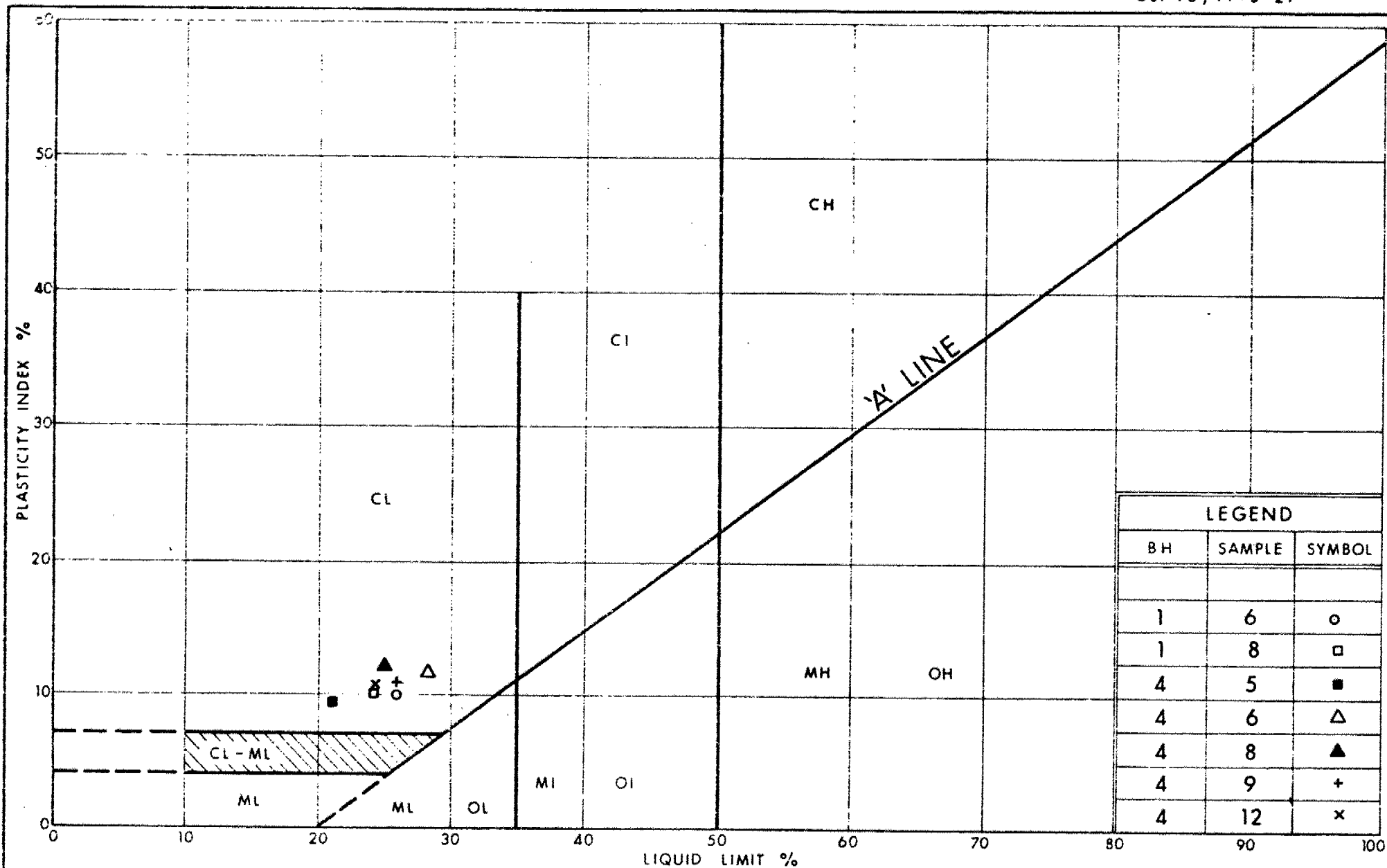
COMPILED BY V.K.

DATUM Geodetic

BOREHOLE TYPE 3 1/4" Hollow Stem Augers

CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT w_L PLASTIC LIMIT w_p WATER CONTENT w			UNIT WEIGHT γ	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		20	40	60	80	100	w_p	w	w_L		
373.4	Ground Level															
0.0	Silty sand with traces of organics and gravel Compact		1	SS	12	370									Org. 0.53%	42-45-(13)
364.4	Silt with traces of organics and some gravel Compact		2	SS	18										Org. 0.59%	11-0-84-5
9.0			3	SS	14											
			4	TW	PH											
			5	TW	PH											
			6	TW	PH											
			7	TW	PH											
	Clayey silt with some sand and occ. gravel		8	SS	16											
			9	SS	15											
			10	SS	19											
	Stiff to very stiff		11	SS	12											
315.4																
58.0	Silty sand Compact		12	SS	11											
311.9																
61.5	End of Borehole															



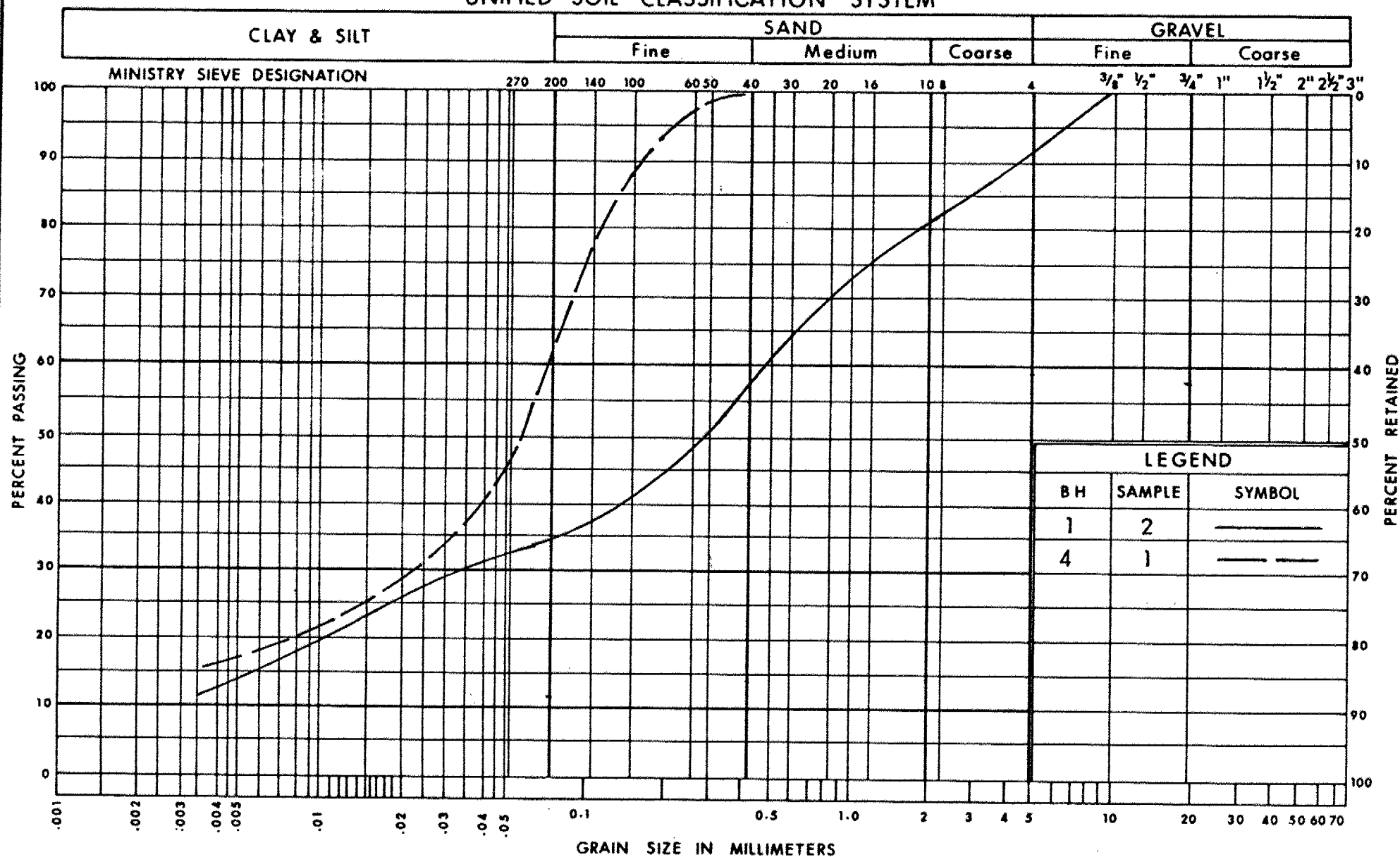
Ministry of
Transportation and
Communications

PLASTICITY CHART CLAYEY SILT

FIG No 1

W P 33-76-06

UNIFIED SOIL CLASSIFICATION SYSTEM



Ontario
ENGINEERING SERVICES BRANCH

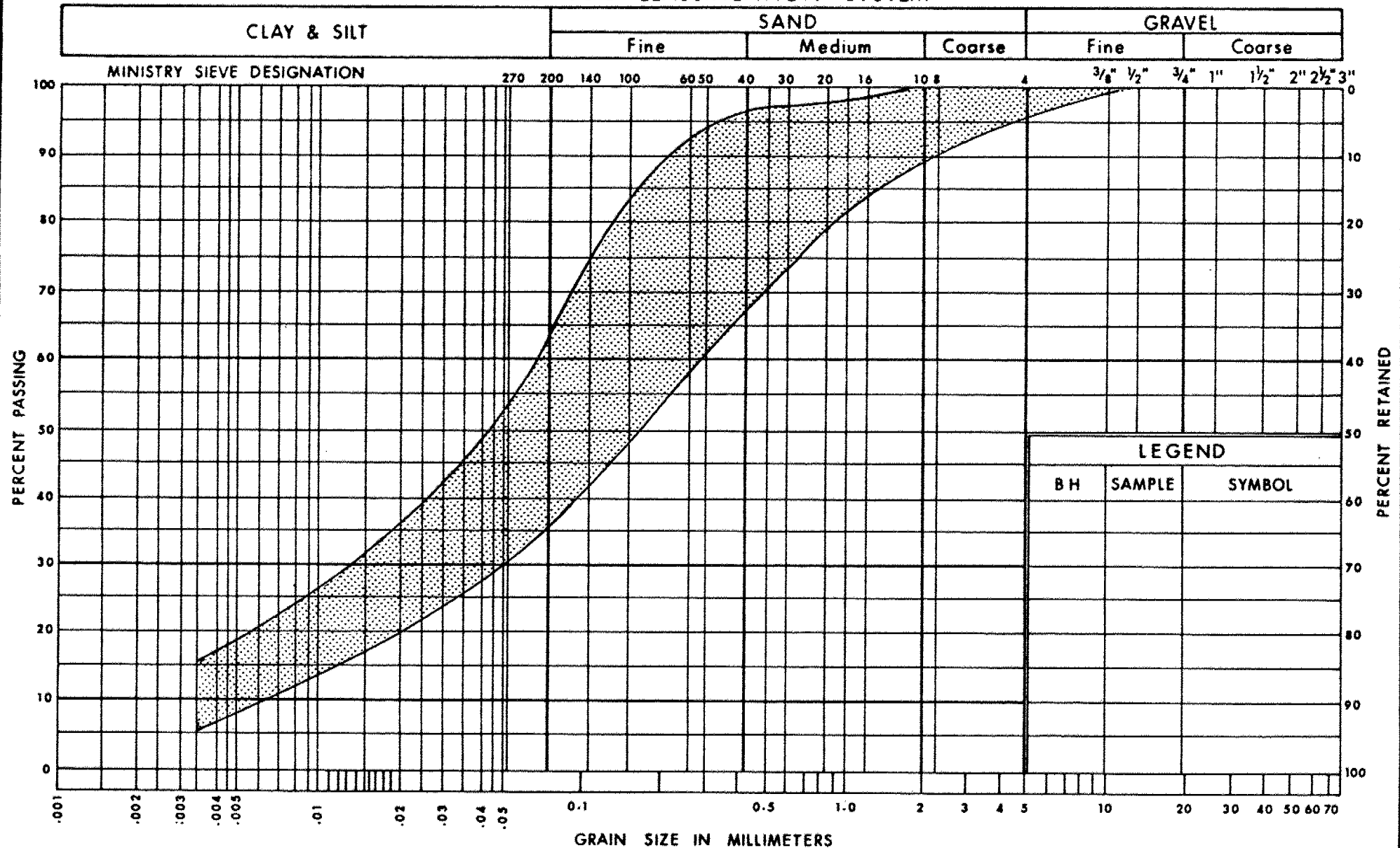
Ministry of
Transportation and
Communications

GRAIN SIZE DISTRIBUTION
SILTY SAND (UPPER)
ALLUVIAL DEPOSIT

FIG No 2

W P 33-76-06

UNIFIED SOIL CLASSIFICATION SYSTEM



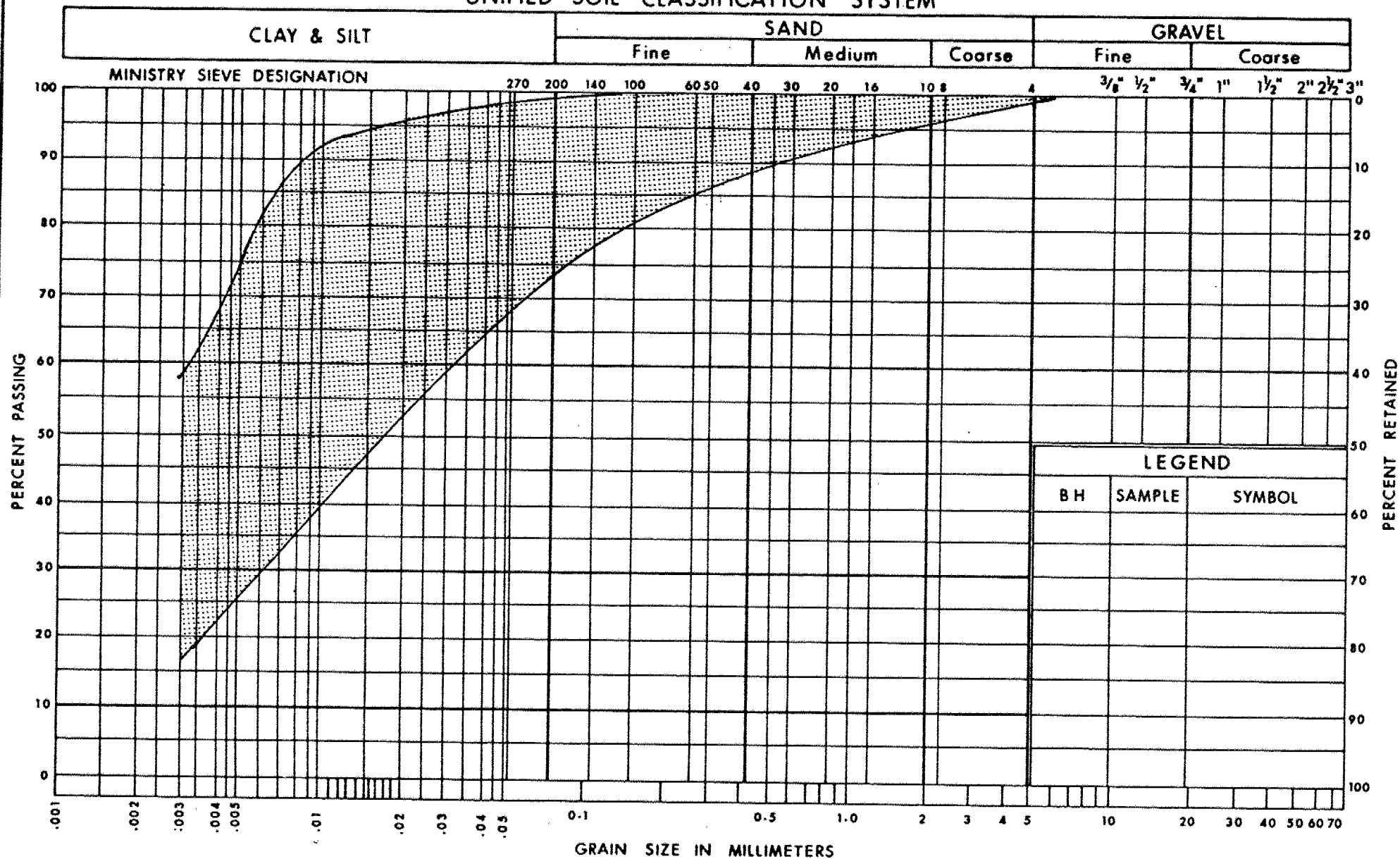
 Ministry of
Transportation and
Communications
Ontario
ENGINEERING SERVICES BRANCH

GRAIN SIZE DISTRIBUTION SILTY SAND (LOWER)

FIG No 3

W P 33-76-06

UNIFIED SOIL CLASSIFICATION SYSTEM

Ministry of
Transportation and
Communications

Ontario

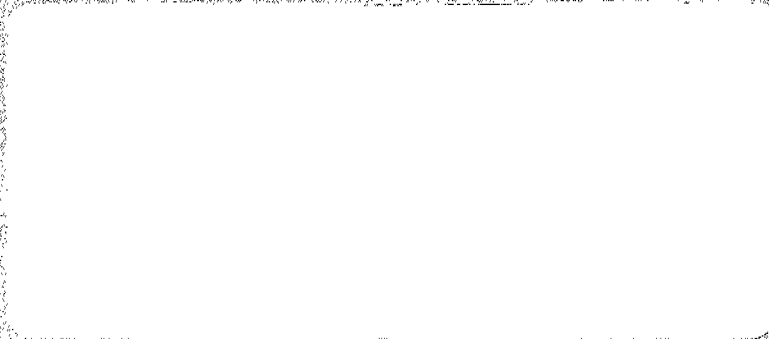
ENGINEERING SERVICES BRANCH

GRAIN SIZE DISTRIBUTION CLAYEY SILT

FIG No 4

W P 33-76-06

FOUNDATION
INVESTIGATION & DESIGN
REPORT



SOIL MECHANICS SECTION

ENGINEERING SERVICES BRANCH
GEOTECHNICAL OFFICE



Ministry of
Transportation and
Communications



FOUNDATION INVESTIGATION & DESIGN REPORT

W.P. 33-76-06

DIST. 6

HWY.

STR. SITE 37-1040

North West Metro Arterial
Black Creek Bridge

DISTRIBUTION

R.S. Pillar
C.S. Grebski
B.J. Giroux
G.A. Wrong
M.R. Ernesaks
R.D. Gunter
H. Greenland

SAMPLE DISPOSITION NOTICE		
TYPE	DISCARD AFTER	RECOMM. BY
JARS	June 15/77	M.D.
TUBES	"	M.D.
ROCK CORES	—	—

R. Hore

J. Anderson)
R. Fitzgibbon) cover only
G. Sloan)
Files J

GEOCRE'S

30 M 11-170
GEOCRE'S No.

DATE JAN 28 1977



Memorandum

To: Mr. G.C.E. Burkhardt (3)
Regional Structural Planning Engineer
Central Region
3501 Dufferin Street, Downsview

Attention:

Mr. W. Kulmattickas

Our File Ref.

From: Soil Mechanics Section
Engineering Materials Office
West Building, Downsview

Date: January 26, 1977

In Reply to

Subject: Re: Northwest Metro Arterial
Black Creek Bridge
W.P. 33-76-06, Site 37-1040
District 6, Toronto

It is understood that the above mentioned project will be considered as a rush project and in order to meet the scheduling requirements a meeting was held in the Central Region on November 18, 1976. At this meeting the Regional Structural Planning Section informed that a request for the foundation investigation for a new structure over Black Creek at Westview Park will be made immediately. This Section agreed to provide preliminary recommendations so that the preliminary design can be developed without any further delay. In order to facilitate the design process of the structure at this meeting we informed Mr. C.F. Farrell of your section that the data contained in our foundation report W.P. 65-F-40 submitted on February 18, 1965 will be considered adequate for preliminary design purposes. Since the new location of the structure will not be the same as that of our preliminary report W.O. 65-F-40, this Section agreed to carry out some investigation after receiving a request from the Regional Structural Planning Section with a sketch showing the approximate location of the proposed structure. This Section received the request on December 6, 1976 without E plans but containing a sketch of the proposed location.

A preliminary field investigation was carried out immediately in order to assess the subsurface conditions at the location shown on the sketch of your memorandum dated December 6, 1976. During the first week of January we were informed by Mr. W. Kulmattickas of your Section that the proposed location of the structure indicated in your memorandum of December 6, 1976, is no longer applicable because of the existence of a 54" ϕ sanitary sewer at the structure site. This was further confirmed in a memorandum dated January 18, 1977, to our Section and also showing the approximate location of the new structure site. Due to the urgency of this project, we are of the opinion that no further investigation should be carried out for the new location at this stage. However, a detailed investigation will be carried out after the structure configuration is finalized at which time the E plans may also be available.

In order to carry out the preliminary design of the structure we suggest that the following information may be used for design purposes.

As mentioned elsewhere, information from our preliminary investigation report W.O. 65-F-40 (Ref. B.H. #8) for Hwy. 400 extension and recent additional information from a preliminary field study consisting of one borehole (Ref. B.H. #A) carried out during December 16, 1976, reveals that the subsurface conditions

cont'd.....

are generally uniform in this area. A sketch is also attached showing the location of the structure proposed as per your memorandum of December 6, 1976 and also the revised location of the structure as per your memorandum of January 18, 1977. On this sketch the above mentioned two borehole locations are also shown.

The subsoil was found to be 9 to 12 feet of loose to compact granular deposit of silty sand and gravel changing with depth to silt with some gravel and traces of organics. This upper granular deposit is underlain by a firm to hard cohesive stratum of clayey silt with some sand and occasional gravel, ranging in thickness from 58 feet (B.H. A) to 75 feet (B.H. 8). This cohesive layer is followed by a compact to very dense lower granular deposit of silty sand to sandy silt with occasional gravel. This granular stratum was explored to its full depth in B.H. 8 and found to be 45 feet in thickness. The granular deposit is underlain by bedrock which has been identified as shaley dolomite and limestone.

The groundwater level observed at this site is about 3.5 feet below the ground surface, which corresponds to the water level in the creek (Dec. 1976).

According to the available data the proposed North-West Metro Arterial roadway will be at the same elevation as the crossing of the relocated Black Creek. The proposed 70 foot long single span structure can be supported on spread footings placed approximately 5 feet below the ground level with a safe bearing pressure of 1.5 t.s.f. Alternatively, the proposed abutments for the single span structure can be supported on timber piles driven into the cohesive stratum. For example, No. 14 timber piles driven 45 feet into the subsoil can provide a safe load of 25 tons per pile.

The footing base elevation will be below the observed groundwater level in the upper granular stratum. A dewatering scheme for the construction of footing excavations may be required. For preliminary purposes no stability is envisaged for approaches constructed with 2:1 slopes.

The recommendations given in this memorandum are to be regarded as conditional only and as such are subject to revision at a later date when and if new information becomes available.

Attached are:

1. Site plan showing the location of proposed structures and two boreholes.
2. Two borehole logsheets.


V. Korlu
Project Engineer

For: M. Devata
Supervising Engineer

MD/VK/gs

Attach.

cc: R.S. Pillar
C.S. Grebski
B.J. Giroux
G.A. Wrong
M.R. Ernesaks
H. Greenland

R.D. Gunter
R. Hore
Files
Record Services



ABBREVIATIONS & SYMBOLS USED IN THIS REPORT

PENETRATION RESISTANCE

N=STANDARD PENETRATION RESISTANCE THE NUMBER OF BLOWS REQUIRED TO ADVANCE A STANDARD SPLIT SPOON SAMPLER 12 INCHES INTO THE SUBSOIL, DRIVEN BY MEANS OF A 140 POUND HAMMER FALLING FREELY A DISTANCE OF 30 INCHES

DYNAMIC PENETRATION RESISTANCE THE NUMBER OF BLOWS REQUIRED TO ADVANCE A 2 INCH, 60 DEGREE CONE, FITTED TO THE END OF DRILL RODS, 12 INCHES INTO THE SUBSOIL, THE DRIVING ENERGY BEING 350 FOOT POUNDS PER BLOW

DESCRIPTION OF SOIL

THE CONSISTENCY OF COHESIVE SOILS AND THE RELATIVE DENSITY OR DENSENESS OF COHESIONLESS SOILS ARE DESCRIBED IN THE FOLLOWING TERMS:-

<u>CONSISTENCY</u>	<u>c LB/SQ FT</u>	<u>DENSENESS</u>	<u>N' BLOWS / FT</u>
VERY SOFT	0 - 250	VERY LOOSE	0 - 4
SOFT	250 - 500	LOOSE	4 - 10
FIRM	500 - 1000	COMPACT	10 - 30
STIFF	1000 - 2000	DENSE	30 - 50
VERY STIFF	2000 - 4000	VERY DENSE	> 50
HARD	> 4000		

TERMS TO BE USED IN DESCRIBING SOILS

TRACE - 10% , SOME 10-25% , WITH 25-40% , > 40% SHY, SANDY, GRAVELLY, CLAYEY ETC

TYPE OF SAMPLE

SS	SPLIT SPOON	TW	THINWALL OPEN
WS	WASHED SAMPLE	TP	THINWALL PISTON
ST	SLOTTED TUBE SAMPLE	OS	OESTERBERG SAMPLE
AS	AUGER SAMPLE	FS	FOIL SAMPLE
CS	CHUNK SAMPLE	RC	ROCK CORE

PH SAMPLE ADVANCED HYDRAULICALLY

PM SAMPLE ADVANCED MANUALLY

SOIL TESTS

U	UNCONFINED COMPRESSION	LV	LABORATORY VANE
UU	UNCONSOLIDATED UNDRAINED TRIAXIAL	FV	FIELD VANE
CU	CONSOLIDATED ISOTROPIC UNDRAINED TRIAXIAL	C	CONSOLIDATION
CID	" " DRAINED "	S	SENSITIVITY
CAU	" " ANISOTROPIC UNDRAINED "		
CAD	" " DRAINED "		

ABBREVIATIONS & SYMBOLS USED IN THIS REPORT

SOIL PROPERTIES

γ	UNIT WEIGHT OF SOIL (BULK DENSITY)
γ_s	UNIT WEIGHT OF SOLID PARTICLES
γ_w	UNIT WEIGHT OF WATER
γ_d	UNIT DRY WEIGHT OF SOIL (DRY DENSITY)
γ'	UNIT WEIGHT OF SUBMERGED SOIL
G	SPECIFIC GRAVITY OF SOLID PARTICLES $G = \frac{\gamma_s}{\gamma_w}$
e	VOID RATIO
n	POROSITY
w	WATER CONTENT
S_r	DEGREE OF SATURATION
w_L	LIQUID LIMIT
w_p	PLASTIC LIMIT
I_p	PLASTICITY INDEX
w_s	SHRINKAGE LIMIT
I_L	LIQUIDITY INDEX = $\frac{w - w_p}{I_p}$
I_C	CONSISTENCY INDEX = $\frac{w_L - w}{I_p}$
e_{max}	VOID RATIO IN LOOSEST STATE
e_{min}	VOID RATIO IN DENSEST STATE
I_D	DENSITY INDEX = $\frac{e_{max} - e}{e_{max} - e_{min}}$
	RELATIVE DENSITY D_r IS ALSO USED
h	HYDRAULIC HEAD OR POTENTIAL
q	RATE OF DISCHARGE
v	VELOCITY OF FLOW
i	HYDRAULIC GRADIENT
k	COEFFICIENT OF PERMEABILITY
j	SEEPAGE FORCE PER UNIT VOLUME
m_v	COEFFICIENT OF VOLUME CHANGE = $\frac{-\Delta e}{(1+e)\Delta\sigma}$
c_v	COEFFICIENT OF CONSOLIDATION
C_c	COMPRESSION INDEX = $\frac{\Delta e}{\Delta \log_{10} \sigma}$
T_v	TIME FACTOR = $\frac{c_v t}{d^2}$ (d, DRAINAGE PATH)
U	DEGREE OF CONSOLIDATION
τ_f	SHEAR STRENGTH
c'	EFFECTIVE COHESION INTERCEPT
ϕ'	EFFECTIVE ANGLE OF SHEARING RESISTANCE, OR FRICTION
c_u	APPARENT COHESION
ϕ_u	APPARENT ANGLE OF SHEARING RESISTANCE, OR FRICTION
μ	COEFFICIENT OF FRICTION
S_t	SENSITIVITY

GENERAL

π	= 3.1416
e	BASE OF NATURAL LOGARITHMS 2.7183
$\log_e a$ or $\ln a$	NATURAL LOGARITHM OF a
$\log_{10} a$ or $\log a$	LOGARITHM OF a TO BASE 10
t	TIME
g	ACCELERATION DUE TO GRAVITY
V	VOLUME
W	WEIGHT
M	MOMENT
F	FACTOR OF SAFETY

STRESS AND STRAIN

u	PORE PRESSURE
σ	NORMAL STRESS
σ'	NORMAL EFFECTIVE STRESS ($\bar{\sigma}$ IS ALSO USED)
τ	SHEAR STRESS
ϵ	LINEAR STRAIN
γ	SHEAR STRAIN
ν	POISSON'S RATIO (μ IS ALSO USED)
E	MODULUS OF LINEAR DEFORMATION (YOUNG'S MODULUS)
G	MODULUS OF SHEAR DEFORMATION
K	MODULUS OF COMPRESSIBILITY
η	COEFFICIENT OF VISCOSITY

EARTH PRESSURE

d	DISTANCE FROM TOP OF WALL TO POINT OF APPLICATION OF PRESSURE
δ	ANGLE OF WALL FRICTION
K	DIMENSIONLESS COEFFICIENT TO BE USED WITH VARIOUS SUFFIXES IN EXPRESSIONS REFERRING TO NORMAL STRESS ON WALLS
K_0	COEFFICIENT OF EARTH PRESSURE AT REST

FOUNDATIONS

B	BREADTH OF FOUNDATION
L	LENGTH OF FOUNDATION
D	DEPTH OF FOUNDATION BENEATH GROUND
N	DIMENSIONLESS COEFFICIENT USED WITH A SUFFIX APPLYING TO SPECIFIC GRAVITY, DEPTH AND COHESION ETC. IN THE FORMULA FOR BEARING CAPACITY
k_s	MODULUS OF SUBGRADE REACTION

SLOPES

H	VERTICAL HEIGHT OF SLOPE
D	DEPTH BELOW TOE OF SLOPE TO HARD STRATUM
β	ANGLE OF SLOPE TO HORIZONTAL

RECORD OF BOREHOLE NO A

WP 33 - 76 - 06

LOCATION Sta. 152 + 28 o/s 5' RT of Hwy. 400 Extension

ORIGINATED BY V.K.

DIST 6 HWY 400 Ext'n

BORING DATE December 15, 1976

COMPILED BY V.K.

DATUM Geodetic

BOREHOLE TYPE 3 1/4" Hollow Stem Augers

CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT — W _L PLASTIC LIMIT — W _P WATER CONTENT — W			UNIT WEIGHT γ	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	N' VALUES		20	40	60	80	100	W _P	W	W _L		
373.4	Ground Level					ELEV	400	800	1200	1600	2000	10	20	30	P.C.F.	% GR SA SI CL
0.0	Silty sand with traces of organics and gravel Compact		1	SS	12	370									Org. 0.53%	42-45-(13)
364.4	Silt with traces of organics and some gravel Compact		2	SS	18										Org. 0.59%	11-0-84-5
9.0			3	SS	14											
			4	TW	PH	360				+2.5					131	
			5	TW	PH					+2					121	
			6	TW	PH										129	
			7	TW	PH						2500				125	
						350										
	Clayey silt with some sand and occ. gravel		8	SS	16											
			9	SS	15											2-24-51-23
						340										
			10	SS	19											
						330										
			11	SS	12											0-8-52-40
	Stiff to very stiff					320										
315.4																
58.0	Silty sand Compact															0-70-25-5
311.9			12	SS	11											
61.5	End of Borehole															

RECORD OF BOREHOLE No 8 (W.O. 65-F-40)

WP 33 - 76 - 06 LOCATION Sta. 153 + 94 o/s 85' LT. 6 Hwy. 400 Ext'n ORIGINATED BY R.M.
 DIST 6 HWY 400 Ext'n BORING DATE February 18, 1865 COMPILED BY H.S.
 DATUM Geodetic BOREHOLE TYPE Washboring, Rock Core & Cone Test CHECKED BY

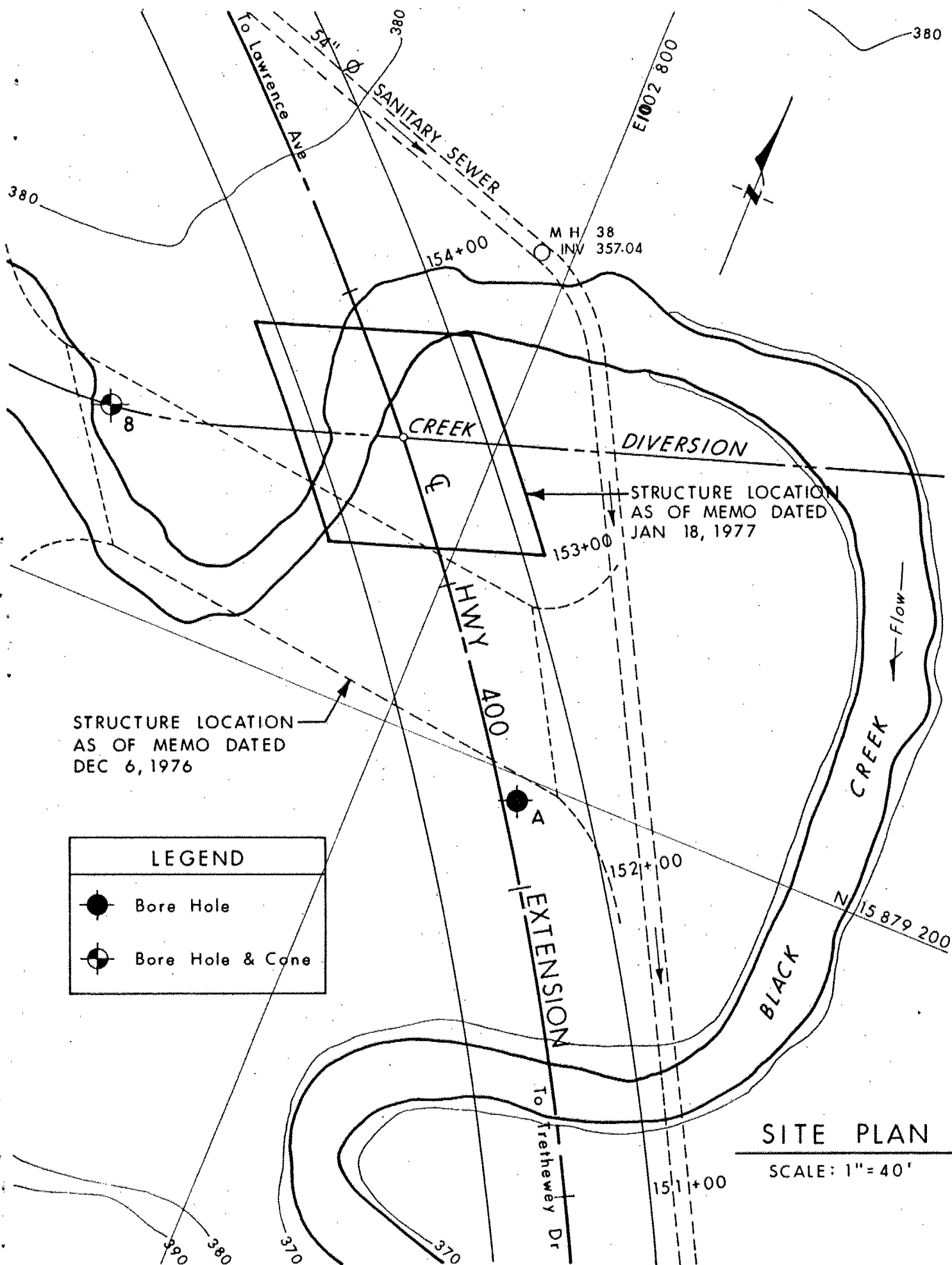
SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT — w_L PLASTIC LIMIT — w_P WATER CONTENT — w			UNIT WEIGHT γ PCF	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		20	40	60	80	100	w_p	w	w_L		
372.0	Ground Level															
0.0	Silty Sand with trace of organics occ. gravel loose to compact		1	SS	8	370										
			2	SS	14											
			3	SS	13											
359.5			4	SS	15	360										
12.5			5	TW	PM											
			6	TW	PM											
			7	SS	23	350										
	Clayey Silt with sand and occ. Gravel		8	TW	PM											
			9	TW	PM											
	Firm to Hard		10	TW	PM	340										
			11	TW	PM											
			12	TW	PM	330										
			13	SS	22											
	(Thin layers of silty clay at 50. ft.)		14	TW	PM	320										
			15	SS	14											
			16	TW	PM											
			17	TW	PM	310										
			18	SS	36											
			19	SS	40											
			20	SS	38	300										
297.0			21	SS	24											
75.0			22	SS	25	290										
	Silty Sand to Sandy Silt with occ. gravel and clay binder		23	SS	25											
			24	SS	150	280										
	Compact to very dense		25	SS	48											
			26	SS	68	270										
268.0																
104.0																

RECORD OF BOREHOLE No 8 Continued
(W.O. 65-F-40)

WP 33 - 76 - 06 LOCATION Sta. 153 + 94 o/s 85' LT & Hwy. 400 Ext'n
DIST 6 HWY 400 Ext'n BORING DATE February 18, 1965
DATUM Geodetic BOREHOLE TYPE Washboring, Rock Core & Cone Test

ORIGINATED BY R.M.
COMPILED BY H.S.
CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT —WL PLASTIC LIMIT —WP WATER CONTENT —W			UNIT WEIGHT γ PCF	REMARKS % GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		20	40	60	80	100	Wp	W	WL		
268.0	Continued															
104.0	Silty sand to Sandy silt with occ. gravel and clay binder Compact to very Dense		27	SS	83	260							o			0 36 45 19
			28	SS	41											
			29	SS	65								o			0 55 33 12
250.2			30	SS	164	250							o			19 22 48 11
121.8	Shaley Dolomite and Limestone Bedrock		31	RC	60% REC											
240.2			32	RC	60% REC											
131.8	End of Borehole															



W P 33-76-06



Memorandum

To: Mr. G.C.E. Burkhardt
Head, Structural Section
Central Region
3501 Dufferin Street, Downsview

From: Soil Mechanics Section
Engineering Materials Office
West Building, Downsview

Attention: Mr. W. Kulmatickas

Date: 77 11 10

Our File Ref.

In Reply to

Subject: Re: Northwest Metro Arterial and
Queen's Drive New Structure
W.P. 33-76-06, Site 37-1061
District 6, Toronto

At the request of the Structural Section, Central Region, by memorandum dated September 27, 1977, a foundation investigation was carried out at the above mentioned site. This investigation consisted of three sampled boreholes advanced by means of a C.M.E.-75 auger machine adapted for soil sampling. An additional borehole from a previous preliminary investigation (formerly B.H. 11, Feb. 9, 1965) at this site has also been incorporated as B.H. 4.

Due to the urgency of this project we have been requested to provide necessary recommendations immediately upon completion of the fieldwork to facilitate finalizing the preliminary bridge drawings. A detailed foundation report will be submitted after the completion of drafting work and borehole log sheets.

Information from our preliminary investigation report W.O. 65-F-40 (Ref. B.H. 11) for Hwy. 400 extension and recent additional information from our field study consisting of 3 boreholes carried out during October 24 and 25, 1977, reveals that the subsurface conditions are quite uniform in this area.

A surficial deposit consisting of 3 feet of silty sand in B.H. 4 (formerly B.H. 11) and 4 to 7 feet of fill material (clayey silt with trace of organics) in B.H. 1, 2 and 3 is underlain by a deep stratum of clayey silt with sand and occasional gravel extending to 91 feet. In-situ shear strength measurements in this cohesive deposit ranged from 1200 to 1800 psf. The 'N' values ranged from 14 to 55 blows/foot. From these results the consistency of the cohesive stratum is estimated as stiff to hard. In B.H. 4, within this cohesive deposit, two distinct layers of silt (elev. 362 to elev. 348 and elev. 345 to elev. 339) were encountered. The relative density of these noncohesive layers varied from dense to very dense. The clayey silt stratum in B.H. 4 is followed by a deposit of silty sand to sandy silt at a depth of 91 feet below the ground surface. This borehole was terminated within this stratum at a depth of 134 feet. The 'N' values in this granular deposit ranged from 14 to over 100 blows per foot, indicating a relative density of compact to very dense.

The groundwater level as observed in the recent boreholes (B.H. 1, 2 and 3) was measured at 2.5 to 6.0 feet below ground surface (elev. 416 to elev. 411.5). However, the groundwater level in B.H. 4 taken on February 9, 1965, was measured at 17.5 feet below ground surface (elev. 389.5).

cont'd.....

According to the available data a single span underpass structure is proposed at this crossing of N.W.A.R. and Queen's Drive. The structure can be supported either on spread footings or large displacement friction piles. For spread footings placed at about elevation 410.0 or lower, a safe design load of $1\frac{1}{2}$ t.s.f. may be used. Provide for 4 foot frost protection coverage over all footings and pile caps. For #14 timber piles driven at least 45 feet into the subsoil, a safe design load of 25 tons per pile may be used. No approach fill or cut stability problems are anticipated if standard 2:1 side slopes are used.

We trust this preliminary soil information will suffice in order to proceed with the preliminary design of the proposed structure. A complete foundation report will be submitted after the submission of the preliminary design drawings from the Structural Office.



For

V. Korlu
Project Engineer

For: M. Devata
Supervising Engineer

VK/gs

cc: R.D. Gunter
M.R. Ernesaks
D.E. Thrasher
C. Grebski
G.A. Wrong
B.J. Giroux
R.S. Pillar

R. Hore
Files ✓

Mr. C.S. Grebski
Structural Design Engineer
Structural Design Section
West Building, Downsview
Mr. W. Lin

Soil Mechanics Section
Engineering Materials Office
West Building, Downsview

77 08 05

Black Creek Bridge
W.P. 33-76-06, Site 37-1040
Metro Arterial Road, District 6

According to your letter dated July 19, 1977, it is planned to widen by 7 feet, the above mentioned structure.

We have reviewed the new design drawings included in the attached copies of Materials and Tender forms. We believe that the proposed 7 feet widening of the structure will not alter the foundation recommendations as submitted in our report dated June 21, 1977. (W.P. 33-76-06). We have no further comments at present.

V. Korlu

for:

N. Devata

VK/MD/kr

cc: Files
C.G. Burkhardt

✓