

## MEMORANDUM

Reference: 305-140

TO: Mr. A. Stannas,  
Principal Foundation Engineer,  
Materials & Testing,  
Lab Building.

FROM: G. McMillan,  
Toronto Region Road Design.

ATTENTION: Mr. H. Devata

DATE: April 24, 1970.

30504-018

OUR FILE REF.

IN REPLY TO

SUBJECT: Re: M.P. 10-57-06, Queen Elizabeth Way,  
Stoney Creek Traffic Circle,  
District 4, Hamilton.

70-11035

Further to our meeting this morning, this is to confirm our request for investigation along the line of the proposed trunk sewer on the above project and also at the proposed retaining wall in front of the Pines Motel on Highway 20.

You have received the alignment, invert elevations and grades of the sewer and the profile will be forwarded to you shortly.

G. McMillan  
Consultant Projects Co-Ordinator

For:  
W.C. Friedmann

Expressway Consultant Control Engineer

REGIONAL ROAD DESIGN OFFICE

GM/CR

CENTRAL REGION, DOWNSVIEW

c.c. P. Kovlich  
J. Kozel

## MEMORANDUM

To: Mr. G. K. Hunter,  
Regional Road Design Engineer,  
Central Region (Toronto),  
Central Building.

FROM: Foundation Section,  
Materials & Testing Office,  
Room 107, Lab. Bldg.

ATTENTION:

DATE: July 20, 1970

OUR FILE REF.

IN REPLY TO

JUL 21 1970

SUBJECT:

FOUNDATION INVESTIGATION REPORT  
For  
Proposed Main Storm Trunk Sewer  
Hwy. #20 -- Q.E.W. Interchange  
Twp. of Saltfleet - Co. of Wentworth  
District No. 4 (Hamilton)  
W.O. 70-11035 - W.P. 10-57-06

30m04-018  
GEOCREs No.

Enclosed please find our complete foundation report for the above mentioned project.

We believe that factual information pertaining to subsoil conditions at the site, and recommendations regarding the design and construction of the storm sewer, contained within the report, should be sufficient for your purposes.

If additional information is required, or should the report require further clarification, please contact this Office.

AGS/MaeF  
Attach.

cc: Messrs. H. A. Tregaskes  
B. R. Davis  
D. W. Farren  
G. K. Hunter (2)  
C. R. Robertson (2)  
W. C. Friedmann  
T. J. Kovich  
W. S. Melinyshyn  
M. M. Dillon Ltd. (Toronto)  
B. A. Singh  
Foundations Files  
Gen. Files

*A. G. Stermac*  
A. G. Stermac  
PRINCIPAL FOUNDATION ENGINEER

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FOUNDATION INVESTIGATION REPORT  
For  
Proposed Main Storm Trunk Sewer  
Hwy. #20 -- Q.E.W. Interchange  
Twp. of Saltfleet Co. of Wentworth  
District No. 4 (Hamilton)  
W.O. 70-11035 -- W.P. 10-57-06

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1. INTRODUCTION:

The Foundation Section was requested to carry out a subsurface investigation along the alignment for the proposed sewer. The request was contained in a memo from Mr. G. McMillan, Toronto Regional Road Design, dated April 24, 1970.

Subsequently, an investigation was carried out by this section at the above site in order to determine the subsoil and ground water conditions. This report contains all the factual data, together with our recommendations pertaining to the installation of the main storm trunk sewer.

2. DESCRIPTION OF THE SITE AND GEOLOGY:

The proposed sewer begins at a point just south of the C.N.R. tracks on the east side of Hwy. # 20. It crosses Hwy. #20 about 250 ft. north of the railroad tracks and runs parallel to and just to the west of Hwy. #20 for a distance of about 1100 ft. It then swings north-west and runs approximately parallel to and just west of the Q.E.W. for a distance of about 2400 ft. where it flows out into an open ditch. The existing highway is in cut which extends up to 12 ft.

2. DESCRIPTION OF THE SITE AND GEOLOGY: (cont'd.)...

below the surrounding terrain. The topography of the area is flat to gently undulating and consists of cultivated farmland along the Q.E.W. but changes to slightly residential along Hwy. #20.

Physiographically, this area is known as the "Iroquois Plain". This area was inundated in the late Pleistocene times by Lake Iroquois; the overburden deposits were laid down in this lake. The main deposit is clayey silt to silty clay of lacustrine origin, which is underlain by glacial till.

3. FIELD AND LABORATORY WORK:

A total of 19 sampled boreholes and 18 dynamic cone penetration tests was carried out in close proximity to the proposed storm sewer during the course of the field investigation. These operations were performed using a continuous flight auger machine adapted for soil sampling purposes. Samples were obtained at required depths by means of a Standard split-spoon sampler; the energy used in driving it, conformed to the requirements of the Standard Penetration Test. The same method was used to advance the dynamic cones. Wherever possible, 2" I.D. Shelby tube samples were taken. The tubes were either pushed manually or hydraulically into the soil. In addition in situ field vane tests were carried out within the softer more compressible portion of this stratum.

3. FIELD AND LABORATORY WORK: (cont'd.)...

The ground water levels, in the open borings, were measured and recorded during the period of the investigation.

The samples were visually examined in the field and subsequently in the laboratory. Following this examination, laboratory tests were carried out on selected samples to determine the various physical properties of the subsoil, namely:

- Atterberg Limits
- Natural Moisture Contents
- Bulk Densities
- Undrained Shear Strengths
- Grain-size Distributions

The laboratory test results are plotted on the individual Record of Borelog sheets and summarized on Figures 1 and 2, which are contained in Appendix I of this report.

4. SUBSOIL CONDITIONS:

4.1) General:

Generally uniform conditons were found to prevail across the site. The predominant stratum is composed of firm to hard clayey silt to silty clay with some sand and a trace of gravel. The upper 6 to 12 ft. of this stratum has been desiccated forming a hard crust. The cohesive deposit is underlain by a hard cohesive glacial till. Detailed descriptions of

4. SUBSOIL CONDITIONS: (cont'd.)...

4.1) General: (cont'd.)...

the various soil types encountered in each borehole are given on the Record of Borelog Sheets. The estimated stratigraphical profile, shown on Drawing No. 70-11035A is based upon this information.

From ground level downwards, the various soil types encountered are as follows:

4.2) Surficial Deposit--Silty sand to sandy silt:

A stratum of silty sand to sandy silt, with occasional traces of clay and gravel was periodically encountered beneath a 5" to 12" layer of topsoil. The thickness of the stratum varies from 2 to 8 feet.

The standard penetration tests carried out within the deposit gave 'N' values which range from 4 to 58 blows/ft. Based on these results it is estimated that the relative density varies from loose to very dense being typically in the compact range.

4.3) Silty clay to clayey silt:

Directly underlying the surficial cover is the predominant stratum across the site, composed of a grey clayey silt to silty clay with some sand and a trace of gravel. The upper 3 to 10 ft. of the stratum has been desiccated forming a hard crust. This crust can easily be differentiated from the underlying subsoil by its

4. SUBSOIL CONDITIONS: (cont'd.) ...

4.3) Silty Clay to Clayey Silt: (cont'd.) ...  
characteristic brown colour. Below the crust, between elevation 260 and 239, the stratum is relatively soft and compressible in relation to the remainder; the significance of this will be discussed in the paragraphs to follow. In addition, occasional thin silt and sand seams were encountered in a limited number of the borings put down in this area. Grain-size distribution tests were carried out on typical samples obtained from the subsoil, the range in gradation is shown in envelope form on Figure #2 appended to this report.

The engineering properties of the stratum, as determined by field and laboratory testing, are presented in the following table:

	Overall Stratum (excluding more compressible zone)	Relatively softer more compressible zone (between elev.'s 260 & 239)
Bulk Density (p.c.f.)	127 - 136	119 - 132
Liquid Limit %	21 - 41	21 - 41
Plastic Limit %	13 - 22	15 - 20
Natural Moisture Content %	12 - 26	16 - 32
Undrained Shear Strength(Cu)		
1) Field Vanes (p.s.f.)	1280 -> 2000	480 - 1250
2) Lab. Tests (p.s.f.)	1250 -> 2000	400 - 1150
Standard Penetration Tests		
"N" (Blow/ft.)	8 - 71	up to 6



4. SUBSOIL CONDITIONS: (cont'd.)...

4.3) Silty clay to clayey silt: (cont'd.)...

The Atterberg Limit tests, summarized above, are also plotted on the Plasticity Chart, Fig. #1. These results indicate that the cohesive stratum is inorganic with a plasticity in the low to intermediate range.

Based on the results of the undrained shear strength testing carried out, it is estimated that the consistency of the majority of the stratum varies from stiff to hard. The consistency of the more compressible zone, however, varies from soft to stiff.

4.4) Clayey silt with sand and gravel-(glacial till):

Underlying the cohesive stratum is a reddish brown glacial till. It is composed of clayey silt with sand and gravel. The consistency of the deposit, as determined by the Standard Penetration tests performed ('N' values 64 blows/ft. to 100 blows for 2 inches) is in the hard range. This deposit was not fully penetrated at any of the boring locations; it was, however, proven for a depth of up to 7 ft. (BH #8).

5. GROUNDWATER CONDITIONS:

Groundwater level observations were carried out in the open boreholes, during the time of the investigation.

5. GROUNDWATER CONDITIONS: (cont'd.) ...

The observations are recorded on the borelog sheets and summarized on Drawing No. W.O. 70-11035A.

The recorded observations indicate that the groundwater level in the overburden deposits varies between elevations 255 and 266. These elevations correspond to depths of 2 to 7 ft. below the ground surface.

At B.H.'s #7, 10 and 12 the groundwater level was encountered between elevations 234 and 249. All of the borings were carried out with a Penndrill (power auger) - i.e., the borings were carried out in a dry state. The subsoil is relatively impervious. This being the case, it is inferred that the water levels recorded in the aforementioned borings, did not have sufficient time, during the period of investigation, to reach their true equilibrium level. This was confirmed by a more recent reading taken on June 12, 1970, which indicated that the water level was still rising in these boreholes.

6. DISCUSSION AND RECOMMENDATIONS:

6.1) General:

It is proposed to construct a main storm trunk sewer in conjunction with the proposed reconstruction of the Q.E.W. - Hwy. #20 complex, in the vicinity of the Stoney Creek Traffic

6. DISCUSSION AND RECOMMENDATIONS: (cont'd.)...

6.1) General: (cont'd.)...

Circle. The sewer, which will be approximately 3,800 feet long, has a variable diameter, starting with 42 inches and increasing to 48 inches about 1600 feet from its outfall.

The proposed profile grade of the sewer was provided by M. M. Dillon Ltd., Consulting Engineers. The invert of the sewer which is shown on Dwg. No. 70-11035A will range from elevation 252 at its start, to elevation 245 at its outfall. The sewer is located within the clayey silt to silty clay stratum, 8 to 22 feet below existing ground surface.

The predominant stratum across the site is composed of a firm to hard clayey silt to silty clay with some sand and a trace of gravel. The upper 6 to 12 feet of this stratum has been desiccated forming a hard crust. This deposit is periodically overlain by a surficial deposit of silty sand to sandy silt, and underlain by a hard cohesive glacial till. The prevailing groundwater level, at the time of the investigation ranged from elevation 255 to 266.

At the time of writing this report, it is not known whether the sewer construction will be carried out by open-cut methods or tunneling operations. In view of this, the two methods of construction will be discussed under separate headings in the sub-sections to follow.

6. DISCUSSION AND RECOMMENDATIONS: (cont'd.)...

6.2) Sewer Construction by Open-Cut Methods:

The sewer excavation will extend through the surficial deposit of silty sand to sandy silt and into the cohesive stratum of clayey silt to silty clay. Temporary cuts in this area will be stable against a deep-seated rotational type of failure, providing the cuts (max. depth 22 ft.) are constructed with 1:1 slopes.

If, due to space restrictions, slopes steeper than those specified above are desired, the excavation should be sheeted.

In all cases, the provisions adopted in the designated working areas should comply with the Trench Excavator's Act.

The groundwater level along the sewer alignment varies from about 5 to 15 feet above the invert level. Since the subsoil is generally cohesive and relatively impervious, the groundwater seepage into the excavations should be negligible. Within the stratum, occasional sand and gravel seams were encountered; if such zones are intersected, the inflow could be readily controlled by normal means, such as pumping from sumps.

It is recommended that the pipe bedding on this project adhere to standards currently being used by the Department, specifically for Class 'B' Bedding on a Yielding Foundation (Standard No. SD-840). The bedding must always be placed in a dry trench, and particular attention should be paid to compacting and shaping of the bedding material.

6. DISCUSSION AND RECOMMENDATIONS: (cont'd.)...

6.3) Sewer Construction by Tunneling Through the Overburden:

An alternate scheme of sewer installation is to utilize tunneling methods. In constructing the sewer by tunneling through the overburden, a minimum cover of 10 feet above the sewer obvert will be necessary in order to ensure against caving-in of the tunnel. It will also be necessary to lower the groundwater level below the tunnel base, or alternatively, to construct the tunnel using air pressure greater than the prevailing hydrostatic pressure in order to achieve safe dry working conditions. Contractors, who use air pressure, should be advised that they will be responsible for determining the air pressure that will be used, and also, that they would be responsible for preventing leakage through the boreholes that have been drilled at the site insofar as it affects their operation.

In sinking shafts through the overburden, the fore-mentioned recommendations are also applicable.

6.4) Dewatering Procedures:

Comments and recommendations relating to dewatering and stability of excavations mentioned in the foregoing paragraphs, are based on the assumption that the conditions, encountered during the period of the investigation (April and May, 1970) will apply during construction. This may or may not be the case. It will be the responsibility of the Contractor to determine the conditions which prevail during

6. DISCUSSION AND RECOMMENDATIONS: (cont'd.)...

6.4) Dewatering Procedures: (cont'd.)...

construction, and to take such steps as are necessary to ensure safe dry working conditions. It is believed that if the sewer is constructed continuously from the outfall end in a south-easterly direction, drainage in the critical zones will occur thus alleviating the situation considerably.

As previously mentioned, any groundwater seepage or surface run-off into the excavation could be controlled by normal techniques, such as pumping from sumps.

7. MISCELLANEOUS:

The field work, performed during the period of April 29 to May 26, 1970, was supervised by Mr. H. Szymanski, Foundation Technician. The equipment was owned and operated by P.V.K. Drilling Co.

The preparation of this report was undertaken by Mr. H. Szymanski and Mr. F. A. Patterson, Student Technician (Field).

The investigation was carried out under the general supervision of Mr. M. Devata, Supervising Foundation Engineer, who reviewed this report.

July 1970

APPENDIX I

FOUNDATION SECTION

ORIGINATED BY HS

COMPILED BY HS ,

CHECKED BY                     

[illegible]



FOUNDATION SECTION

JOB 70-11035 LOCATION Co-ords. 15, 711, 807 N 931, 094 E ORIGINATED BY HS  
W.P. 10-57 BORING DATE April 29, 1970 COMPILED BY HS  
DATUM Geodetic BOREHOLE TYPE Pan drill-dynamic cone penetration test CHECKED BY

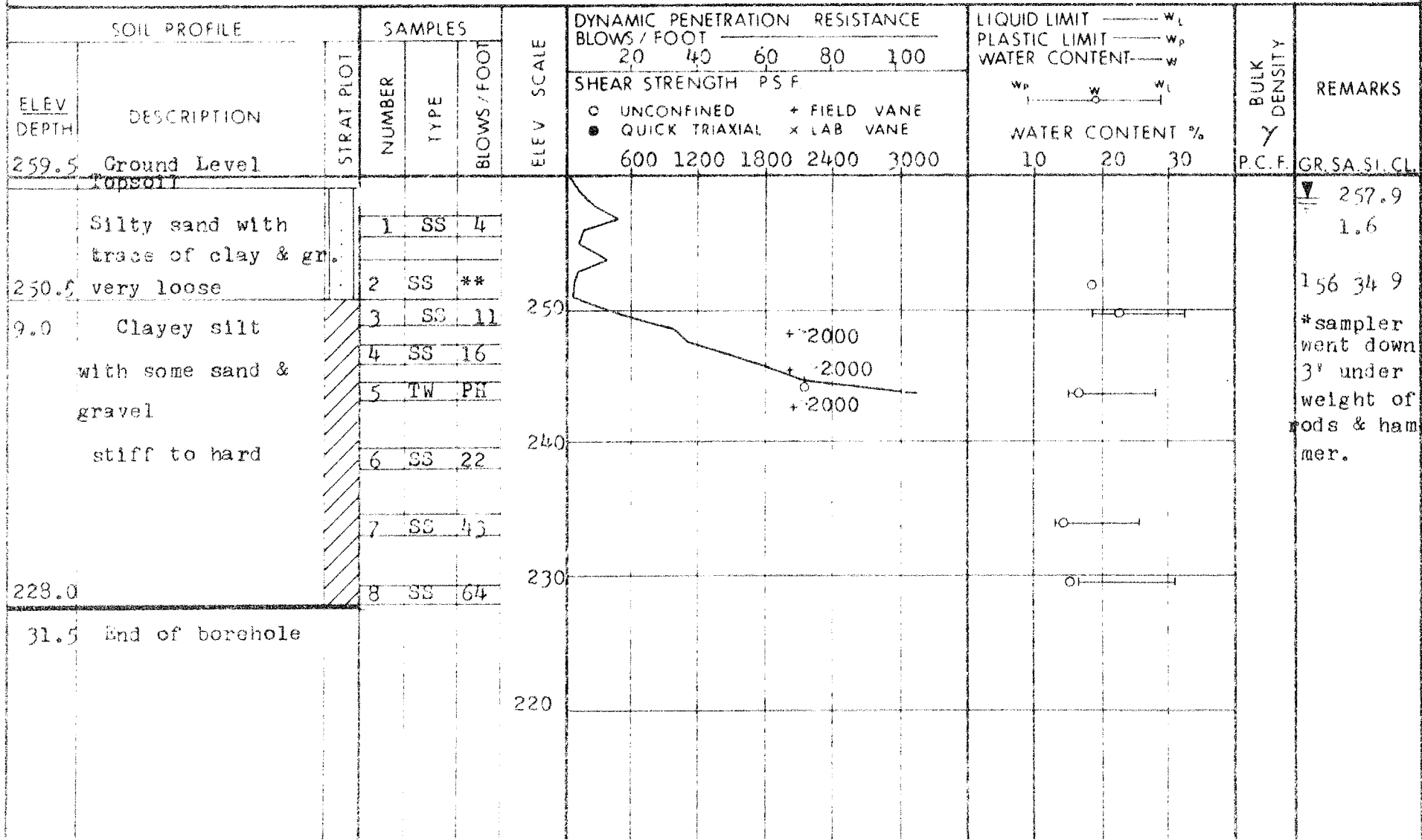
SOIL PROFILE			SAMPLES			ELEV SCALE	DYNAMIC PENETRATION RESISTANCE	LIQUID LIMIT ———— $w_L$	BULK DENSITY	REMARKS	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	BLOWS / FOOT		BLOWS / FOOT	PLASTIC LIMIT ———— $w_p$			WATER CONTENT ———— $w$
							20 40 60 80 100				
							SHEAR STRENGTH PS F	$w_p$ ———— $w$ ———— $w_L$			
							○ UNCONFINED + FIELD VANE	WATER CONTENT %			
							● QUICK TRIAXIAL x LAB. VANE	10 20 30			
							600 1200 1800 2400 3000			P.C.F.	
266.4	Ground Level									GR SA SI CL	
	Topssoil										
			1	SS	5	260				0 6 56 38	
			2	SS	8					257.2	
259.4	Brown		3	SS	19					9.2	
11.0	Grey		4	SS	20						
	Clayey silt to silty clay with some sand & trace of gravel		5	SS	13	250					
			6	Tw PH			○			1 16 48 35	
			7	SS	24		+ 2000				
	firm to hard		8	SS	41	240					
234.9			9	SS	30						
31.5	End of borehole					230					

DEPARTMENT OF HIGHWAYS- ONTARIO  
MATERIALS & TESTING OFFICE

# RECORD OF BOREHOLE No. 3

FOUNDATION SECTION

JOB 70-11035 LOCATION Co-ords. 15,711, 621 N, 931.040 E ORIGINATED BY HS  
W.P. 10-57 BORING DATE May 1, 1970 COMPILED BY HS  
DATUM Geodetic BOREHOLE TYPE Pen Drill--Dynamic Cone Penetration Test CHECKED BY *HS*



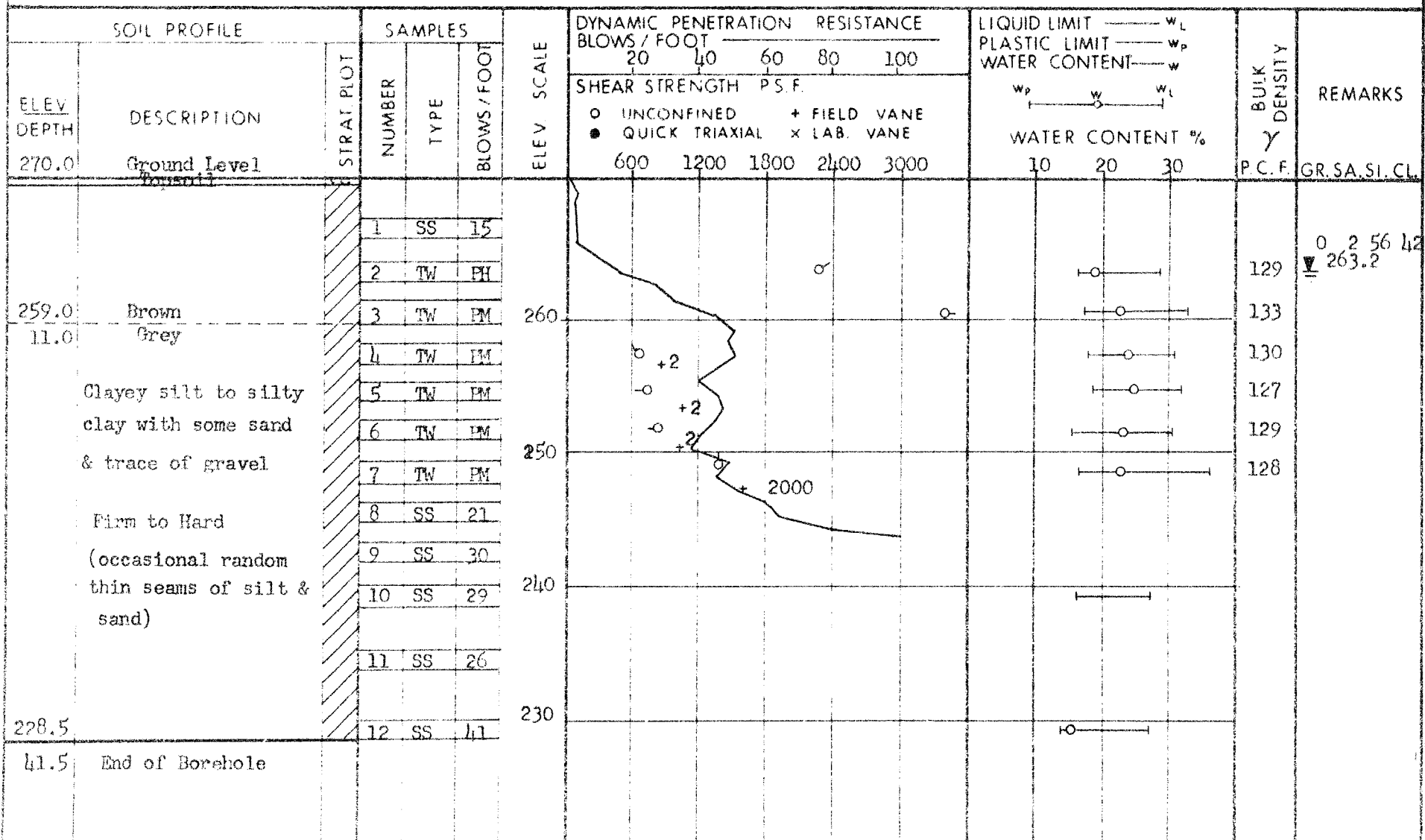


DEPARTMENT OF HIGHWAYS- ONTARIO  
MATERIALS & TESTING OFFICE

## RECORD OF BOREHOLE No. 5

FOUNDATION SECTION

JOB 70-11035 LOCATION Co-ords. 15,712,145 N; 931,118 E. ORIGINATED BY HS  
 W.P. 10-57 BORING DATE May 5, 1970 COMPILED BY HS  
 DATUM Geodetic BOREHOLE TYPE Pendrill; Cone Test CHECKED BY



DEPARTMENT OF HIGHWAYS- ONTARIO  
MATERIALS & TESTING OFFICE

# RECORD OF BOREHOLE No. 6

FOUNDATION SECTION

JOB 70-11035 LOCATION Co-ords. 15,712,350 N; 931,107 E.

ORIGINATED BY HS

W.P. 10-57-06

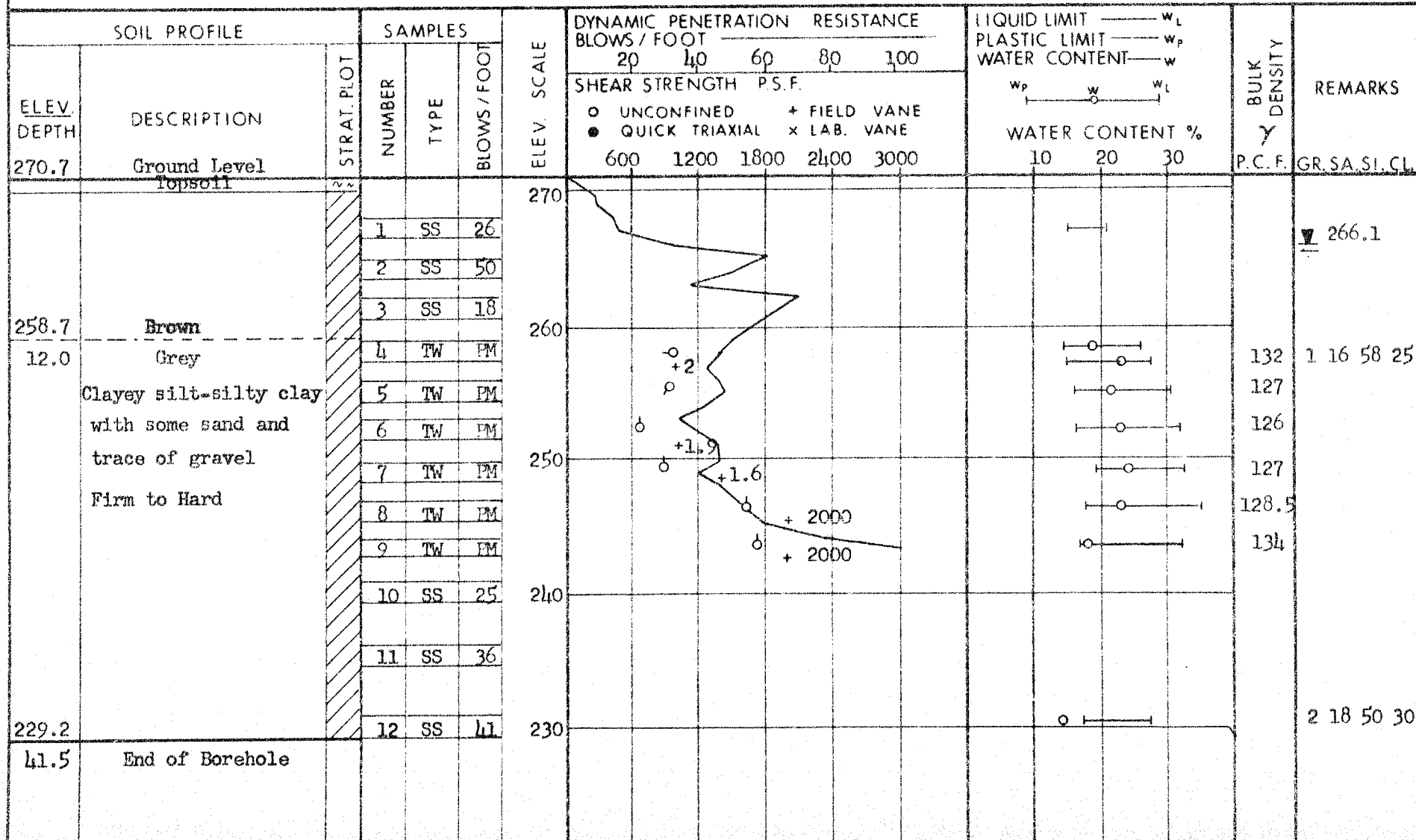
BORING DATE May 6, 1970

COMPILED BY HS

DATUM Geodetic

BOREHOLE TYPE Pendrill; Cone Test

CHECKED BY



DEPARTMENT OF HIGHWAYS- ONTARIO  
MATERIALS & TESTING OFFICE

## RECORD OF BOREHOLE No.7

FOUNDATION SECTION

JOB 70-11035

LOCATION

Co-ords. 15,712,624 N; 931,087 E.

ORIGINATED BY HS

W.P. 10-57-66

BORING DATE

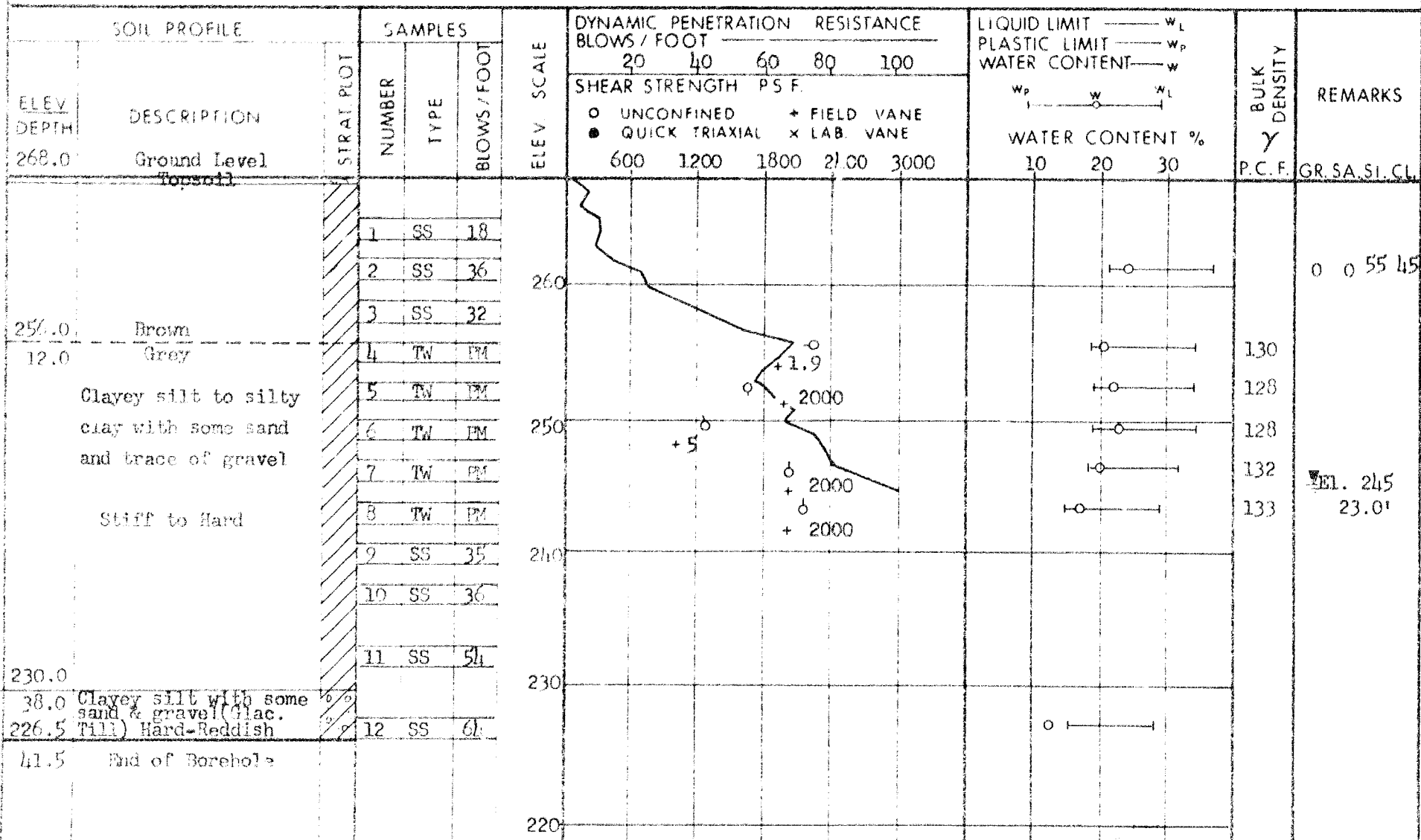
May 7, 1970

COMPILED BY HS

DATUM Geodetic

BOREHOLE TYPE

Pendrill; Cone Test

CHECKED BY *DR*

FOUNDATION SECTION

JOB	70-11035	LOCATION	CoOords. 15,712,811 N; 931,045 E.	ORIGINATED BY	HS
W.P.	10-57-06	BORING DATE	May 7, 1970	COMPILED BY	HS
DATUM	Geodetic	BOREHOLE TYPE	Pendril; Cone Test	CHECKED BY	HS

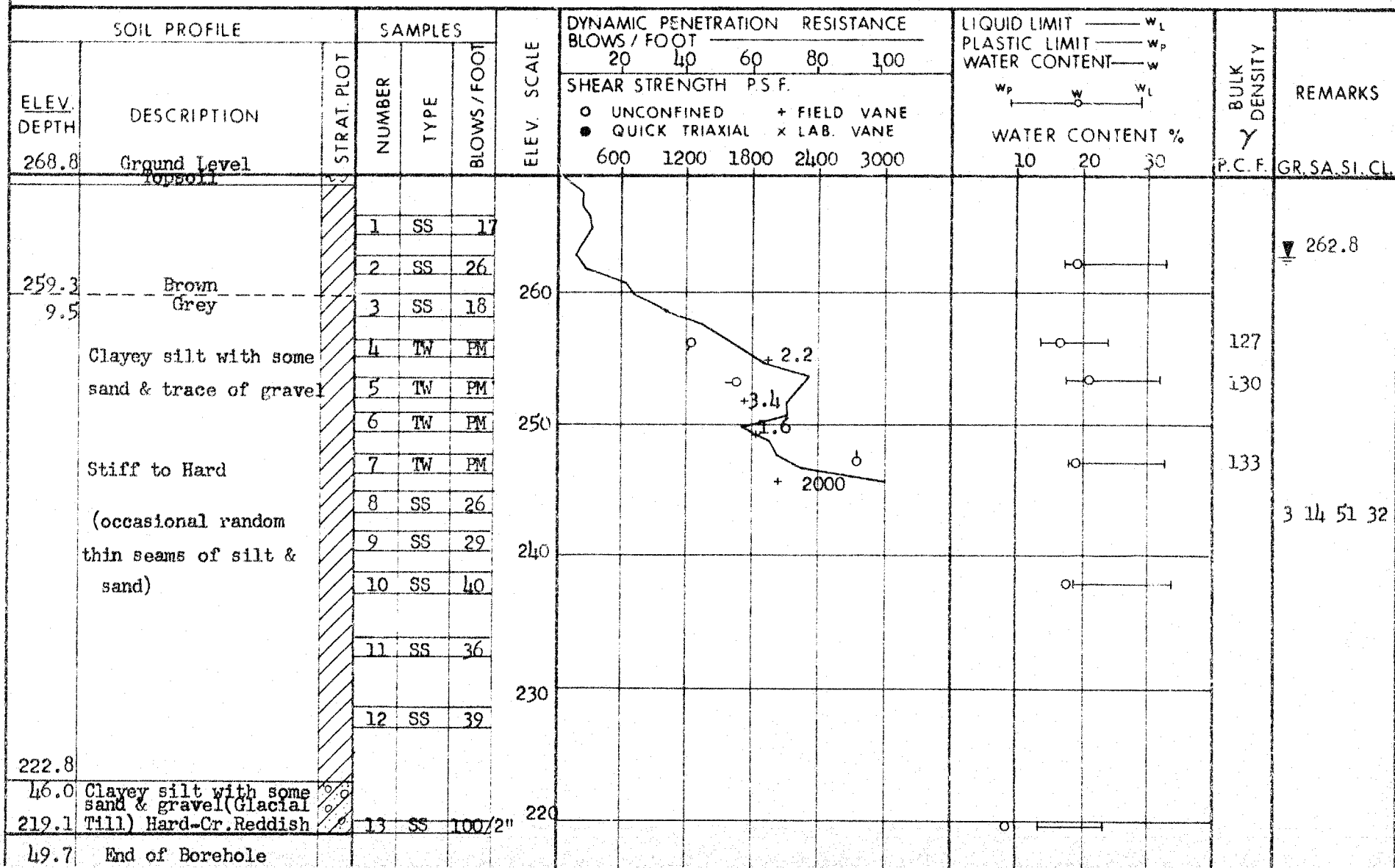
[illegible]

DEPARTMENT OF HIGHWAYS- ONTARIO  
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 9

FOUNDATION SECTION

JOB 70-11035 LOCATION Co-ords. 15,712,961 N; 930,995 E. ORIGINATED BY HS  
W.P. 10-57-06 BORING DATE May 11, 1970 COMPILED BY HS  
DATUM Geodetic BOREHOLE TYPE Pendrill; Cone Test CHECKED BY





DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS &amp; TESTING OFFICE

## RECORD OF BOREHOLE No. 10

FOUNDATION SECTION

JOB 70-11035

LOCATION Co-ords. 15,713,150 N; 930,932 E.

ORIGINATED BY HS

W.P. 10-57-06

BORING DATE May 12, 1970

COMPILED BY HS

DATUM Geodetic

BOREHOLE TYPE Pendrill; Cone Test

CHECKED BY

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE					LIQUID LIMIT ——— $w_L$ PLASTIC LIMIT ——— $w_p$ WATER CONTENT ——— $w$			BULK DENSITY $\gamma$	REMARKS		
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS/FOOT		BLOWS / FOOT					SHEAR STRENGTH P.S.F.					WATER CONTENT %	
							20	40	60	80	100	UNCONFINED		FIELD VANE				
											O QUICK TRIAXIAL		X LAB. VANE					
						600 1200 1800 2400 3000								10 20 30				
269.4	Ground Level Topsoil															P.C.F.	GR. SA. SI. CL	
261.4	Brown		1	SS	29													
8.0	Grey  Clayey silt to silty clay with some sand and trace of gravel  Firm to Hard  (occasional random thin seams of silt & sand)		2	SS	40													
			3	SS	20													
			4	TW	PM													
			5	TW	PM													
			6	TW	PM													
			7	TW	PM													
			8	SS	17													
			9	SS	22													
			10	SS	24													
			11	SS	26													
			12	SS	30													
226.4	Clayey silt with some sand & gravel																	
43.0	Hard (Glacial Till)																	
217.9			13	SS	147													
51.5	End of Borehole																	

1 11 46 39

Elev. 234

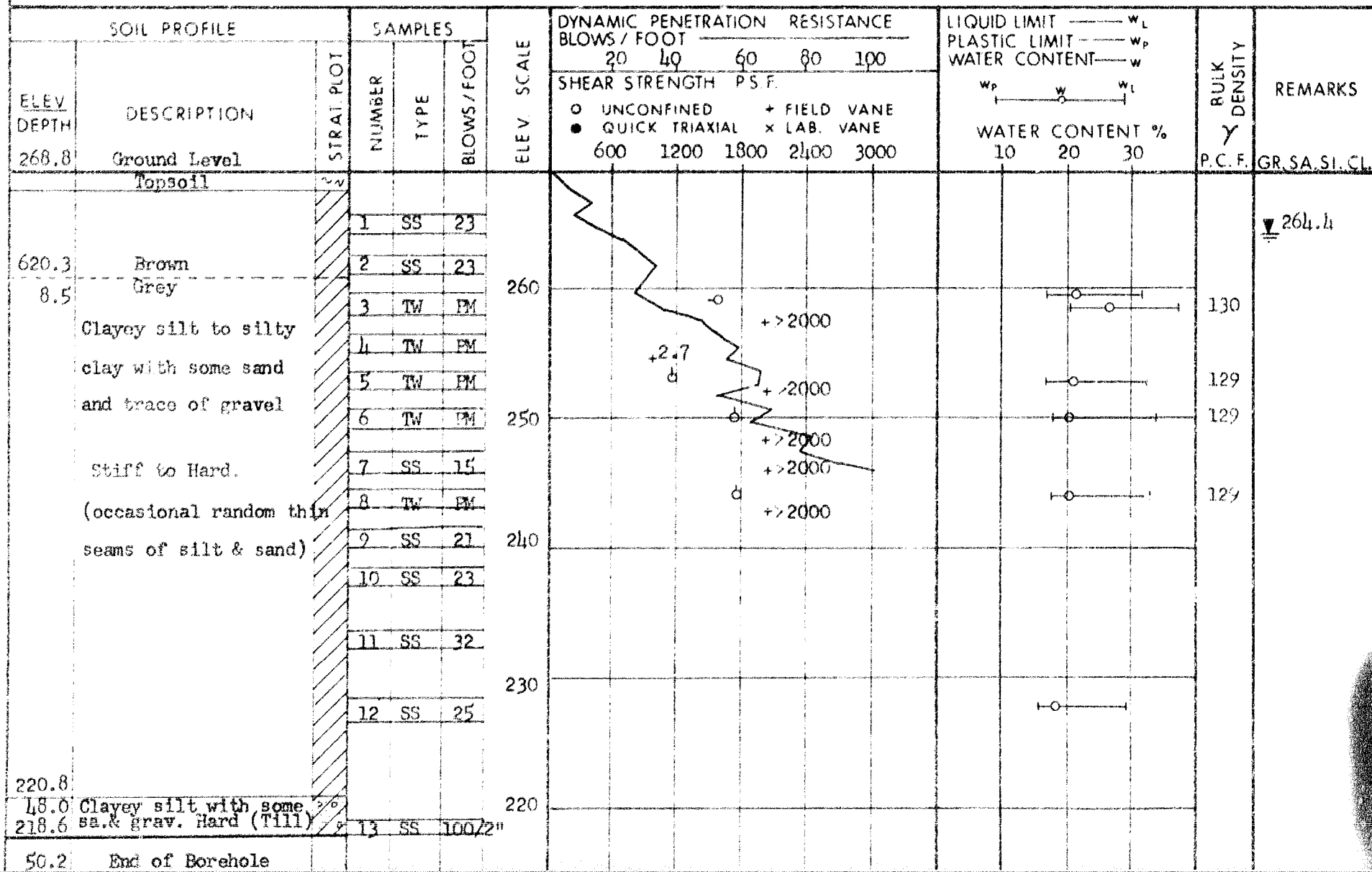
35.7'

DEPARTMENT OF HIGHWAYS - ONTARIO  
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 11

FOUNDATION SECTION

JOB 70-11035 LOCATION Co-ords. 15,713,382 N; 930,827 E. ORIGINATED BY HS  
W.P. 10-57-06 BORING DATE May 13, 1970 COMPILED BY HS  
DATUM Geodetic BOREHOLE TYPE Pendrill; Cone Test CHECKED BY *HS*



DATUM Geodetic

## BOREHOLE TYPE Pen Drill-Dynamic Cone Penetration Test

CHECKED BY *[Signature]*

[illegible]

DEPARTMENT OF HIGHWAYS - ONTARIO  
MATERIALS & TESTING OFFICE

# RECORD OF BOREHOLE No. 13

FOUNDATION SECTION

JOB 70-11035 LOCATION Co-ords. 15,713,669 N; 930,646 E.

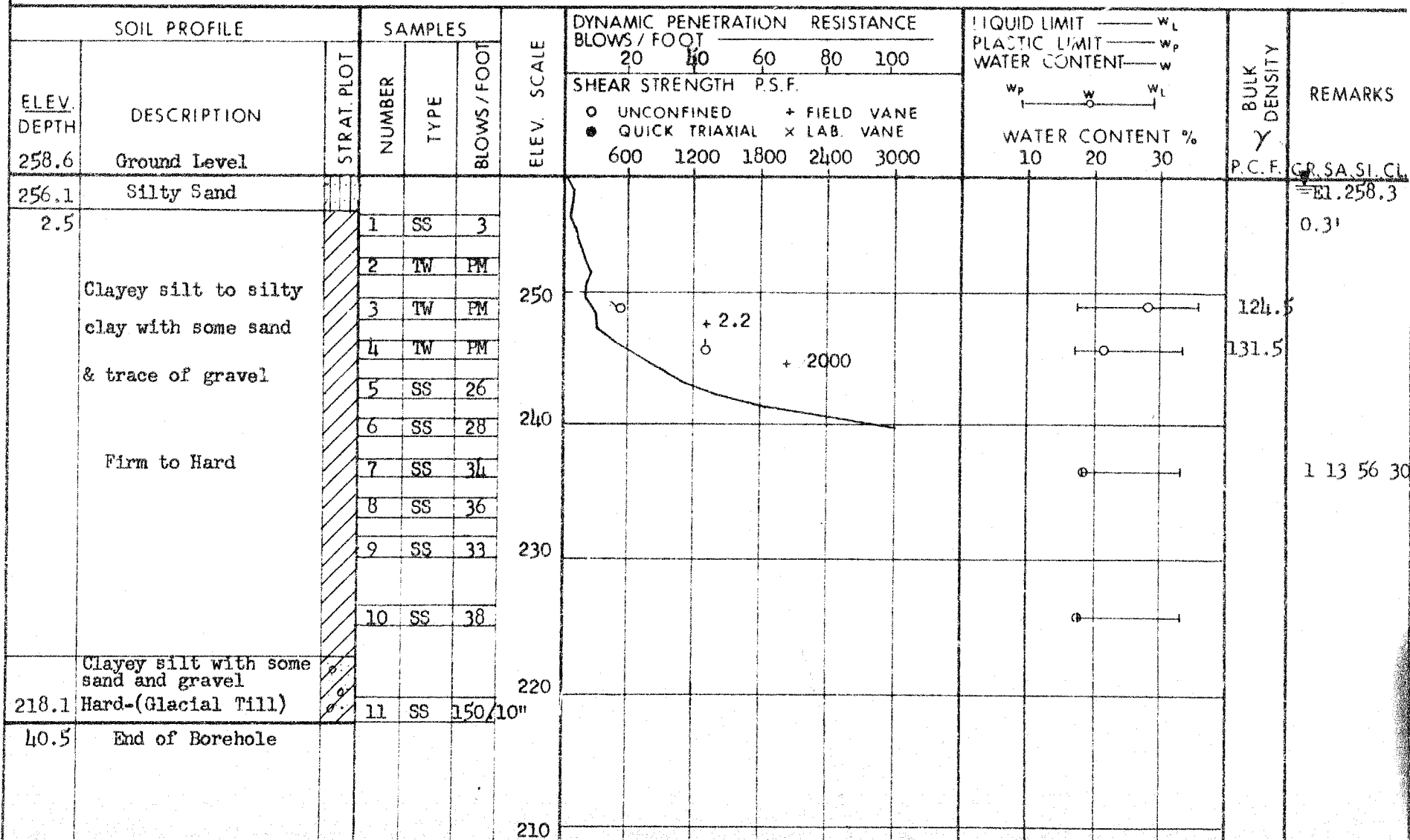
ORIGINATED BY HS

W.P. 10-57-06 BORING DATE May 15, 1970

COMPILED BY HS

DATUM Geodetic BOREHOLE TYPE Pendrill; Cone Test

CHECKED BY

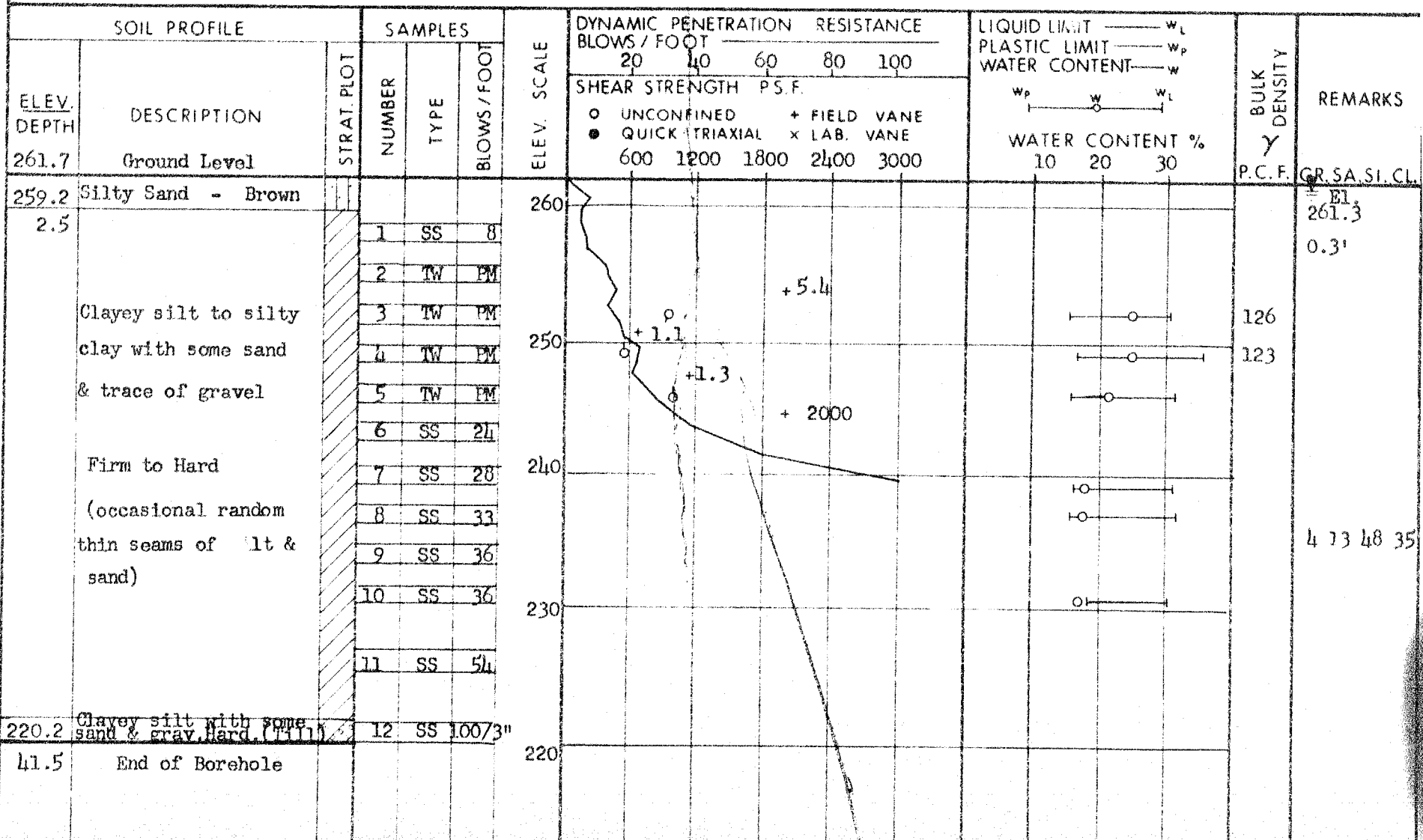


DEPARTMENT OF HIGHWAYS- ONTARIO  
MATERIALS & TESTING OFFICE

## RECORD OF BOREHOLE No. 14

FOUNDATION SECTION

 JOB 70-11035 LOCATION Co-ords. 15,713,827 N; 930,512 E.  
 W.P. 10-57-06 BORING DATE May 19, 1970  
 DATUM Geodetic BOREHOLE TYPE Pendrill; Cone Test

 ORIGINATED BY HS  
 COMPILED BY HS  
 CHECKED BY




FOUNDATION SECTION

ORIGINATED BY HS

COMPILED BY HS

CHECKED BY

[illegible]





FOUNDATION SECTION

BOREHOLE TYPE Pen Drill--Dynamic cone Penetration Test CHECKED BY

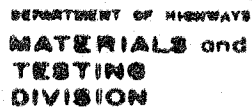
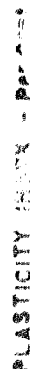
SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE	LIQUID LIMIT ——— W <sub>L</sub> PLASTIC LIMIT ——— W <sub>P</sub> WATER CONTENT ——— W			BULK DENSITY γ P.C.F.	REMARKS	
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT		BLOWS / FOOT						
							20 40 60 80 100						
							SHEAR STRENGTH P.S.F.						
							○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB. VANE						
							600 1200 1800 2400 3000				WATER CONTENT % 10 20 30		
260.8	Ground Level					260							
	Topsoil												
	Fine sandy silt		1	SS	58								
254.3			2	SS	22								
6.5			3	SS	9								
	Clayey silt to silty clay with some sand & traces of gravel		4	TW	PM	250							
			5	TW	PM								
			6	TW	PM								
	firm to hard		7	TW	PM	240							
			8	TW	PM								
	grey		9	SS	39								
229.8			10	SS	110	230							
31.0	Clayey silt with some sa. & gr. Hard reddish (glacial till)		11	SS	100/2"								
226.1													
34.7	End of borehole					220							

FOUNDATION SECTION

COMPILED BY HS

CHECKED BY

[illegible]

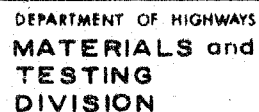
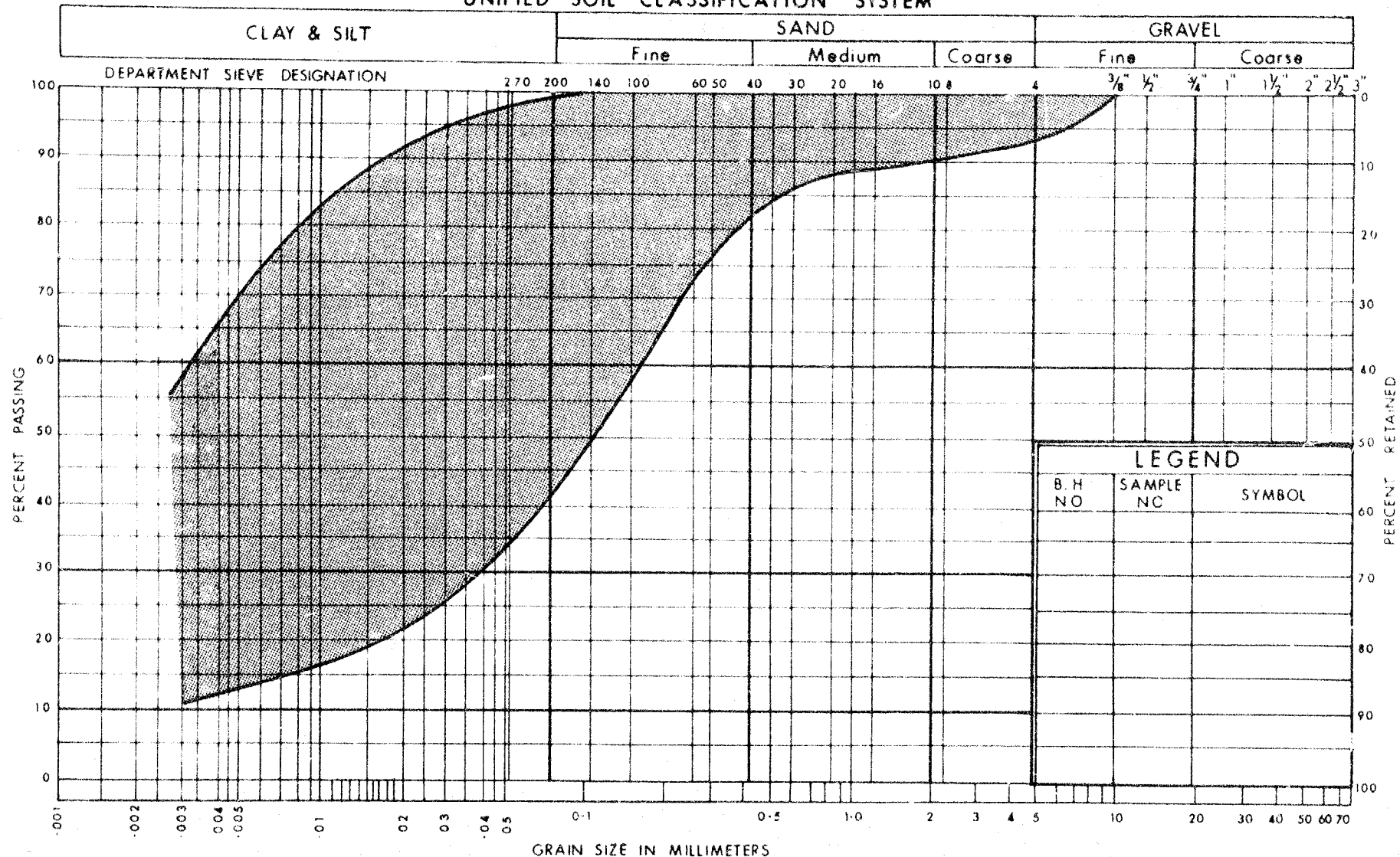


PLASTICITY CHART  
CLAYEY SILT TO SILTY CLAY  
WITH SOME SAND & TRACES OF GRAVEL

WP No. 10-57-06

JOB No. 70-11035

FIG. 1



GRAIN SIZE DISTRIBUTION  
CLAYEY SILT TO SILTY CLAY  
SOME SAND & TRACE OF GRAVEL

JOB No: 70-11035

FIG. 2

## ABBREVIATIONS USED IN THIS REPORT

### PENETRATION RESISTANCE

STANDARD PENETRATION RESISTANCE 'N' - 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>'N' BLOWS / FT.</u>	<u>c LB. / SQ. FT.</u>	<u>DENSENESS</u>	<u>'N' BLOWS / FT.</u>
VERY SOFT	0 - 2	0 - 250	VERY LOOSE	0 - 4
SOFT	2 - 4	250 - 500	LOOSE	4 - 10
FIRM	4 - 8	500 - 1000	COMPACT	10 - 30
STIFF	8 - 15	1000 - 2000	DENSE	30 - 50
VERY STIFF	15 - 30	2000 - 4000	VERY DENSE	> 50
HARD	> 30	> 4000		

### TYPE OF SAMPLE

S.S.	SPLIT SPOON	T.W.	THINWALL OPEN
W.S.	WASHED SAMPLE	T.P.	THINWALL PISTON
S.B.	SCRAPER BUCKET SAMPLE	O.S.	OESTERBERG SAMPLE
A.S.	AUGER SAMPLE	F.S.	FOIL SAMPLE
C.S.	CHUNK SAMPLE	R.C.	ROCK CORE
S.T.	SLOTTED TUBE SAMPLE		
	P.H. SAMPLE ADVANCED HYDRAULICALLY		
	P.M. SAMPLE ADVANCED MANUALLY		

### SOIL TESTS

Q <sub>u</sub>	UNCONFINED COMPRESSION	L.V.	LABORATORY VANE
Q	UNDRAINED TRIAXIAL	F.V.	FIELD VANE
Q <sub>cu</sub>	CONSOLIDATED UNDRAINED TRIAXIAL	C	CONSOLIDATION
Q <sub>d</sub>	DRAINED TRIAXIAL	S	SENSITIVITY

# ABBREVIATIONS USED IN THIS REPORT

## SOIL PROPERTIES

$\gamma$	UNIT WEIGHT OF SOIL (BULK DENSITY)
$\gamma_s$	UNIT WEIGHT OF SOLID PARTICLES
$\gamma_w$	UNIT WEIGHT OF WATER
$\gamma_d$	UNIT DRY WEIGHT OF SOIL (DRY DENSITY)
$\gamma'$	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
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
$\tau_f$	SHEAR STRENGTH
$c'$	EFFECTIVE COHESION INTERCEPT
$\phi'$	EFFECTIVE ANGLE OF SHEARING RESISTANCE, OR FRICTION
$c_u$	APPARENT COHESION
$\phi_u$	APPARENT ANGLE OF SHEARING RESISTANCE, OR FRICTION
$\mu$	COEFFICIENT OF FRICTION
$S_t$	SENSITIVITY

## GENERAL

$\pi$	= 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
$\sigma$	NORMAL STRESS
$\sigma'$	NORMAL EFFECTIVE STRESS ( $\bar{\sigma}$ IS ALSO USED)
$\tau$	SHEAR STRESS
$\epsilon$	LINEAR STRAIN
$\gamma$	SHEAR STRAIN
$\nu$	POISSON'S RATIO ( $\mu$ IS ALSO USED)
E	MODULUS OF LINEAR DEFORMATION (YOUNG'S MODULUS)
G	MODULUS OF SHEAR DEFORMATION
K	MODULUS OF COMPRESSIBILITY
$\eta$	COEFFICIENT OF VISCOSITY

## EARTH PRESSURE

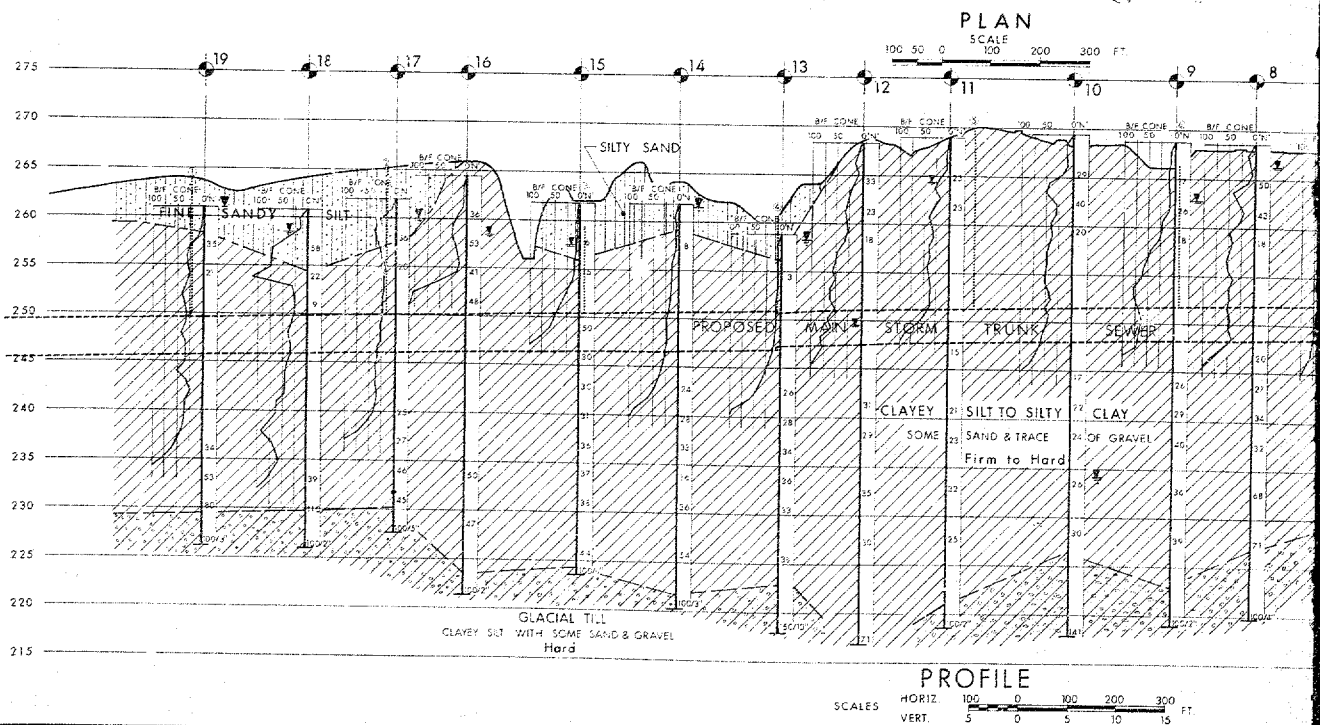
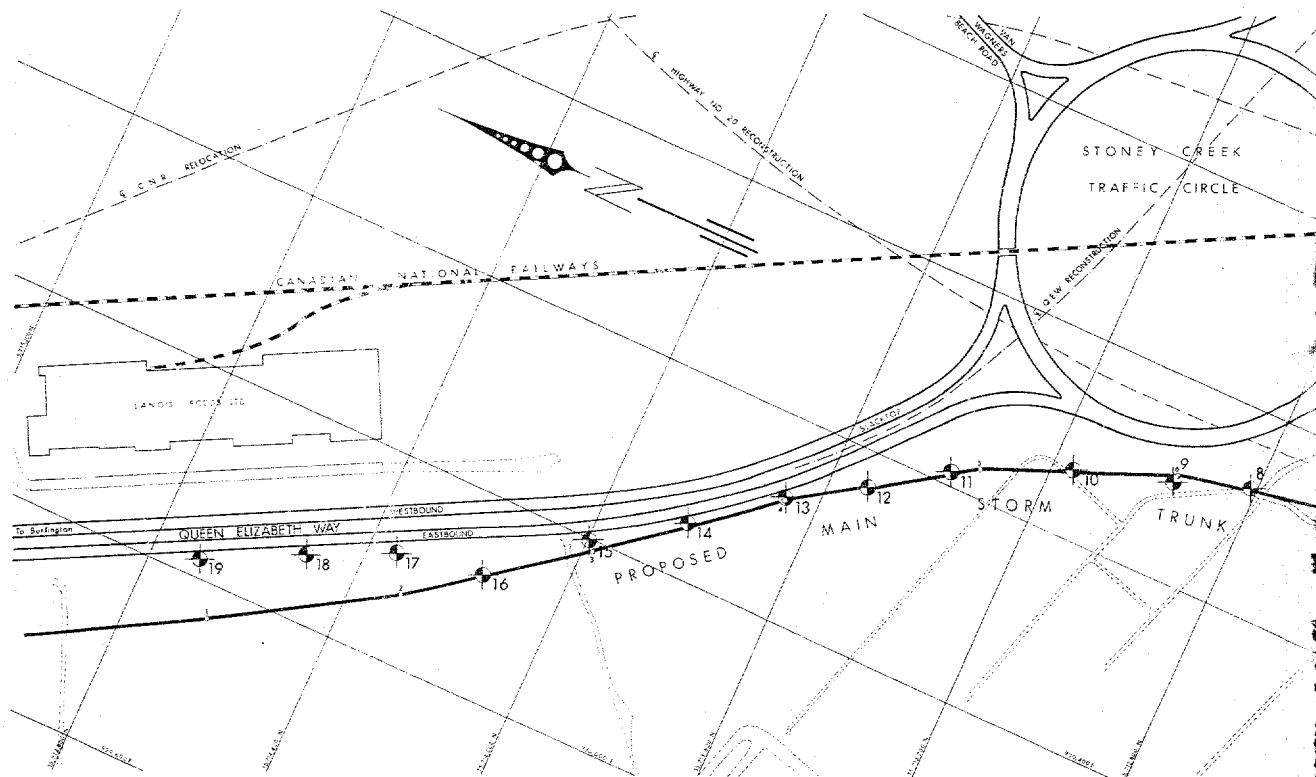
d	DISTANCE FROM TOP OF WALL TO POINT OF APPLICATION OF PRESSURE
$\delta$	ANGLE OF WALL FRICTION
K	DIMENSIONLESS COEFFICIENT TO BE USED WITH VARIOUS SUFFIXES IN EXPRESSIONS REFERRING TO NORMAL STRESS ON WALLS
$K_0$	COEFFICIENT OF EARTH PRESSURE AT REST

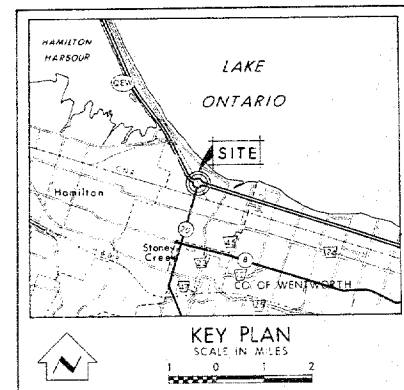
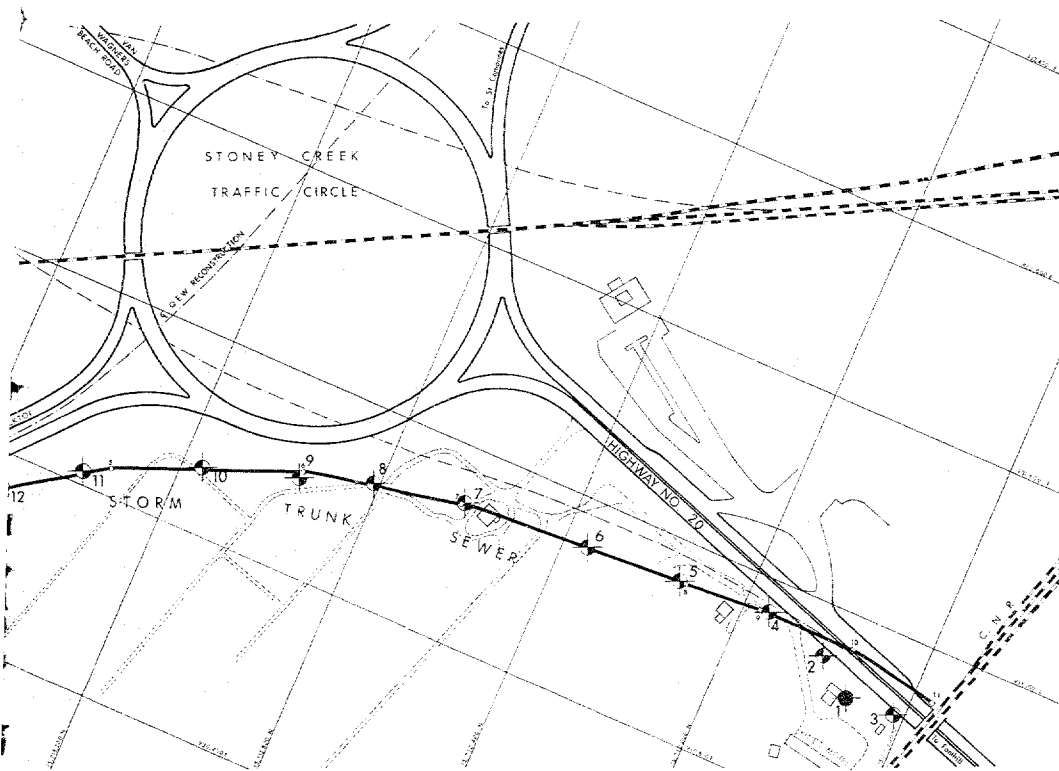
## FOUNDATIONS

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
$\beta$	ANGLE OF SLOPE TO HORIZONTAL



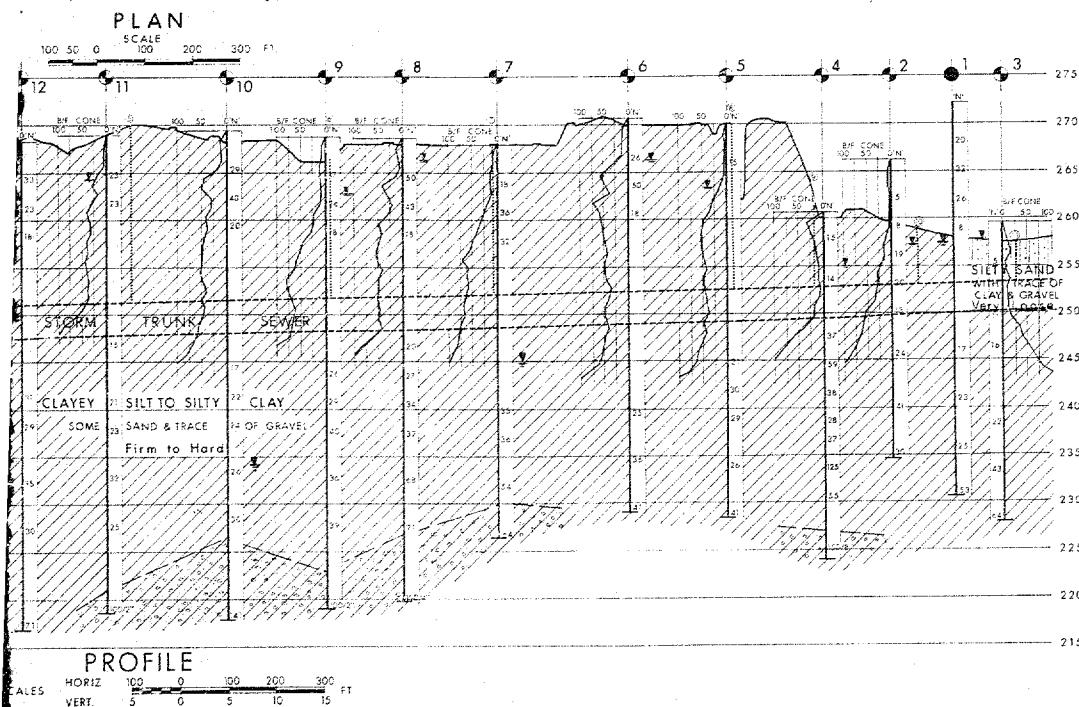


LEGEND			
	Bore Hole		
	Cone Penetration Hole		
	Bore & Cone Penetration Hole		
	Water Levels established at time of field investigation May 1970		
NO.	ELEVATION	CO-ORDINATES	
		NORTH	EAST
1	272.2	15,711,727	931,069
2	266.4	15,711,867	931,094
3	269.5	15,711,621	931,040
4	260.7	15,711,945	931,131
5	270.0	15,712,145	931,118
6	270.7	15,712,350	931,107
7	268.0	15,712,624	931,087
8	268.6	15,712,811	931,045
9	268.8	15,712,961	930,995
10	269.4	15,713,150	930,952
11	268.8	15,713,382	930,827
12	268.4	15,713,525	930,730
13	258.6	15,713,669	930,646
14	261.7	15,713,827	930,512
15	261.8	15,713,990	930,399
16	264.6	15,714,165	930,246
17	262.0	15,714,342	930,217
18	250.8	15,714,509	930,138
19	261.0	15,714,702	930,039

**NOTE**  
The boundaries between soil strata have been established only at Bore Hole locations. Between Bore Holes the boundaries are assumed from geological evidence and may be subject to considerable error.

REVISIONS		
NO.	DATE	DESCRIPTION

DEPARTMENT OF HIGHWAYS - ONTARIO MATERIALS & TESTING DIVISION - FOUNDATION SECTION			
<b>MAIN STORM TRUNK SEWER</b>			
KING'S HIGHWAY NO. 20 & Q.E.W.		DIST. NO. 4	
CO. WENTWORTH		CITY OF HAMILTON	
TWP. _____		LOT _____ CON. _____	
<b>BORE HOLE LOCATIONS &amp; SOIL STRATA</b>			
SUBMD. H.S.	CHECKED <i>SP</i>	WP. NO. 10-57-06	M&T DRAWING NO.
DRAWN M.Y.	CHECKED <i>SP</i>	JOB NO. 70-11035	<b>70-11035A</b>
DATE 26 JUNE 1970	SITE NO.	BRIDGE DRAWING NO.	
APPROVED <i>Optimus</i> FRANCIS BRIDGEMAN, ENGINEER	CONT. NO.		





DOCUMENT MICROFILMING IDENTIFICATION

GEOCRS No. 35004-018

DIST. 4 REGION CENTRAL

W.P. No. 10-57-06

CONT. No. 74-10

W. O. No. 70-1025

STR. SITE No. 36

HWY. No. 30

LOCATION 9.5 km. W. Westville, Sney  
Creek Traffic circle

OVERSIDE DRAWINGS TO BE INCLUDED WITH THIS REPORT. 1

REMARKS: Document to be unfolded

6-108 SEP-68

