

MEMORANDUM

To: Mr. B. R. Davis,
Bridge Engineer,
Bridge Office,
Admin. Bldg.

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

Attention: Mr. S. McCombie

Date: December 30, 1968

Our File Ref.

In Reply To

JAN 3 1969

SUBJECT:

FOUNDATION INVESTIGATION REPORT

For

Feasibility Study - Proposed Hwy. #417

Vars to Quebec Border

Alternate Alignments (Lines A, B, C, & D)

District No. 9 (Ottawa)

W.J. 68-F-85

--

W.P. (~~W.P.~~)

35-66

36-66

37-66

Attached, we are forwarding to you our preliminary subsoil information to aid the Regional Functional Planning Section in carrying out a feasibility study for the alternate alignments proposed for the eastern portion of Hwy. #417 between Vars and the Quebec border.

The report outlines the subsoil conditions existing at the various alternate alignments, together with our general comments pertaining to the stability of the approaches at various crossings.

We believe that the information contained in this report, will prove adequate for your immediate use. Should you have any queries, please do not hesitate to contact our Office.

AGS/MdeF

Attach.

cc: Messrs. B. R. Davis (2)

H. A. Tregaskes

D. W. Farren

S. J. Markiewicz

I. C. Campbell

J. L. Forster

C. R. Robertson

G. Scott

J. E. Grusnier

B. A. Singh

Foundations Files

Gen. Files

Afternoon
A. G. Sternac
PRINCIPAL FOUNDATION ENGINEER

TABLE OF CONTENTS

1. INTRODUCTION.
 2. DESCRIPTION OF THE AREA AND GEOLOGY.
 3. FIELD AND LABORATORY WORK.
 4. SUBSOIL CONDITIONS:
 - 4.1) General.
 - 4.2) Surficial Deposits (Silty Sand and Organic Matter).
 - 4.3) Clay to Silty Clay.
 - 4.3.1) Strength and Compressibility Characteristics.
 - 4.4) Glacial Till.
 - 4.5) Bedrock.
 5. FOUNDATION PROBLEMS ASSOCIATED WITH THE APPROVED ALIGNMENT - HWY. #417 (Ramsayville Easterly 7.5 Miles).
 6. DISCUSSION & CONCLUSIONS - FEASIBILITY OF ALTERNATE ALIGNMENTS - HWY. #417 (Vars to Quebec Border).
 7. MISCELLANEOUS.
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FOUNDATION INVESTIGATION REPORT
For
Feasibility Study - Proposed Hwy. #417
Vars to Quebec Border
Alternate Alignments (Lines A, B, C, & D)
District No. 9 (Ottawa)
W.J. 68-F-85 --. W.P. (Nil)

1. INTRODUCTION:

The Foundation Section was requested to provide preliminary subsoil information to aid the Functional Planning Section in carrying out a feasibility study for the alternate alignments proposed for the eastern portion of Hwy. #417, between Vars and the Quebec border; this portion of the highway is approximately 52 miles in length. The investigation was verbally requested, on November 11, 1968, by Mr. J. L. Forster, Regional Functional Planning Engineer (Eastern Region). An investigation was subsequently carried out by this Section to determine the subsoil conditions along four possible alignments, designated Lines 'A' (most northerly), 'B', 'C' and 'D' (most southerly).

This report contains the factual data obtained from the investigation, together with an assessment of the feasibility of the various alignments with respect to foundation considerations.

The alignment along the western portion of the proposed highway, namely, between Ramsayville easterly about 7.5 miles to the eastern limits of Carleton County, has been approved. The Foundation Section has already submitted final foundation reports on the majority of the structure and creek crossings in this section.

2. DESCRIPTION OF THE AREA AND GEOLOGY:

The alternate alignments of the eastern portion of Hwy. #417 start at Vars and cross through the Counties of Russell, Prescott, Stormont and Glengarry, terminating at the Quebec border. The terrain is flat to gently undulating in relief, between about elevation 200 and 275. The land is being basically utilized for farming purposes; there are, however, localized timbered areas. The majority of the drainage in the area is provided by two rivers and their tributaries, namely, the South Nation and Rigaud. In addition to these major rivers, numerous smaller rivers, creeks and gullies have dissected steep-sided valleys within the overburden.

Geologically, the alignments are located in the following physiographic regions* - The "Russell and Prescott Sand Plains", "Winchester Clay Plains", and the "Glengarry Till Plains". The approximate limits of the respective regions are shown on Drawing 68-P-85A. A brief description of the subsoil, characteristic to each of these regions, follows.

The western and north-eastern portion of the area encompassing the alignments, are located in the "Russell and Prescott Sand Plains". In this area a mantle or cap of sand overlies extensive deposits of clay. The sand is of deltaic origin formed by the Ottawa River and its northern tributaries. The thickness of the surficial granular deposits range from 20 to 30 feet in the northern parts of the region to 10 to 15 feet in the central and southern portions. The gradation of the granular mantle varies from fine sand and silt, south of the Castor River, to coarse sands and gravels to the north.

The deep stratum of marine clay, known locally as "Leda Clay", was deposited by the Champlain Sea, which inundated the area during the post-glacial period following the Wisconsin Glacial Age. The thickness of the clay varies from 40 feet to

* Chapman, L. J. and Putnam, D. F., "The Physiography of Southern Ontario", University of Toronto Press, 1966.

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

180 feet; in general, the deposit decreases in thickness to the south and east, within the limits of the alignments investigated. The clay stratum is underlain by a glacial till, which is in turn, followed by grey and black shale and limestone bedrock of the Lorraine formation, Ordovician Period. An exception to this trend occurs in the Vars area where glacial till protrudes within a few feet of ground surface.

The "Winchester Clay Plains" are bounded on the north by the "Russell and Prescott Sand Plains", and on the South by the "Glengarry Till Plains"; portions of Lines 'C' and 'D' traverse this region. The predominant stratum throughout the "Winchester Clay Plains" is composed of the marine clay deposited by the Champlain Sea. The clay, which is encountered at a relatively shallow depth below ground surface, is quite variable in thickness; it is, however, not nearly as extensive a deposit as that encountered in the "Russell and Prescott Sand Plains" region. In many localized areas, throughout this region, the underlying glacial till is present at or slightly below ground surface. Further, large sections are poorly drained; this poor drainage has led to the formation of numerous swamps of considerable extent.

The eastern part of Line 'D' extends into the "Glengarry Till Plains" section. This area is characterized by drumlinized ridges with the intervening flats floored with clay, and in some cases, swamp deposits. The glacial till is stoney in texture and generally less than 25 feet in thickness. The till is underlain by shale and limestone bedrock.

3. FIELD AND LABORATORY WORK:

Four sampled boreholes (Sites 4, 80, 81 and 83), two of which were accompanied by a dynamic cone penetration test, were put down during the course of the investigation, using a conventional diamond drill rig adapted for soil sampling purposes. In addition, a cone penetration test was carried out to practical refusal at 13 prospective structure sites.

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

Samples of the surficial granular deposits and glacial till were obtained using a split-spoon sampler, which was hammered into the soil in accordance with the specifications for the Standard Penetration Test. The same method was used to advance the dynamic cone penetration tests. Samples of the cohesive portions of the overburden were recorded, at required depths, in 2" I.D. Shelby tubes, which were manually pushed into the soil. Field vane tests were also carried out in the cohesive stratum, to determine the undrained shear strength of the deposit.

The locations of the borings and cone tests, shown on Drawing No. 68-F-684, were referenced to geographic land marks, such as County Roads, etc., as shown on County Militia maps (scale 1:50,000). The elevations given in the report are referenced to the ground surface contours given on the maps, and thus are approximate only (contour interval 25 feet).

All samples were subjected to a careful visual examination in the field and subsequently in the laboratory. Following this examination, laboratory testing was carried out on selected representative samples to determine the following engineering properties of the overburden:

- Natural Moisture Contents
- Bulk Densities
- Atterberg Limits
- Grain-Size Distributions
- Undrained Shear Strengths
- Consolidation Characteristics

The results of this testing are plotted on the Record of Borelog sheets and are summarized on the Figures in Appendix I of this report.

4. SUBSOIL CONDITIONS:

4.1) General:

The area is generally covered by deposits of silty sand varying in thickness from a few feet to up to 30 feet. There are also a few localized swamps in areas where the surface drainage is poor. The surficial deposits are underlain by a compressible "Leda Clay" of irregular thickness. The clay is underlain by glacial till which, in turn, overlies bedrock.

An exception to the pattern discussed above, occurs in the south-eastern portion of the area encompassing the alignments; in this region the glacial till extends to within a few feet of ground surface.

The boundaries between the various soil strata, as determined by this investigation, are shown on the accompanying Borehole Log sheets. Two stratigraphical sections, shown on Drawing 68-F-85B, are inferred from this data.

A brief resume' of the subsoil conditions is given in the following paragraphs.

4.2) Surficial Deposits (Silty Sand and Organic Matter):

The sites located in the "Russell and Prescott Sand Plains", namely, Sites #4, 9, 12, 20, 35, 37 and 80, are surficially covered with a deposit of compact to dense silty fine sand. The thickness of the deposit, where encountered, varies from 14 to 30 feet, being greater in the northern areas (Sites #35, 37, and 20, etc.), becoming negligible to the south where the "Sand Plains" butt against the "Winchester Clay Plains". Two grain-size distribution curves, carried out on samples of the sand deposit, are shown on Figure #1 in the Appendix of the report.

As discussed in Section 2, swamps have been formed in poorly drained areas, located within the "Winchester Clay Plains". Three of the sites investigated, namely, Sites #83, 84 and 52, were located in such areas. At Sites #83 and 84, between 3 and 4 feet of soft peat or organic silt surficially cover the terrain. At Site #52, it is inferred (cone test only) that the organic deposit may extend for depths of up to 25 feet.

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

4.3) Clay to Silty Clay:

Underlying the granular deposits in the "Russell and Prescott Sand Plains" and at a shallow depth below ground surface in the "Winchester Clay Plains" is a stratum of sensitive grey clay to silty clay, with a trace of sand. The thickness of the cohesive stratum varies anywhere from 10 feet to greater than 100 feet. In general, it is quite deep in the northern areas encompassing the alignments ("Sand Plains"), being thinnest in that portion immediately east of Casselman ("Clay Plains"). Occasional silt seams and partings, ranging from a fraction of an inch up to 1 foot, were randomly encountered throughout the stratum. Grain-size distribution curves for samples of the clay are shown on Figure #2 in Appendix I.

Atterberg limit tests, summarized on the Plasticity Chart shown on Figure #3, indicate that the clay is inorganic and of intermediate to high plasticity. The corresponding liquidity indices vary from about 0.7 to 1.3.

4.3.1) Strength and Compressibility Characteristics:

A limited number of laboratory and field undrained shear strength tests were carried out at Sites #4, 80, 81 and 83. The testing carried out at Sites 4, 80 and 82 gave values, for the undrained shear strength, varying from 700 to 1500 p.s.f., indicating that the consistency of the stratum, at these locations, varies from firm to stiff. The undrained shear strength of the clay stratum at Site #83, as determined by the testing, varies from 450 to 900 p.s.f., indicating a consistency in the soft to firm range.

The consistency of the stratum at the remaining sites, where only dynamic cone penetration tests were performed, could only be inferred by correlation with the results from the more detailed borings. It is considered, however, that the consistency of the clay stratum, at the majority of the sites, is within the firm to stiff range, with the exception of the sites situated in swampy areas. At Sites #83, 84 and 52, located in such areas, it is

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

4.3) Clay to Silty Clay: (cont'd.) ...

4.3.1) Strength and Compressibility Characteristics: -
(cont'd.) ...

~~it is~~ estimated that the consistency is probably in the soft to firm range.

The consolidation characteristics of the stratum were determined by carrying out three laboratory tests, the results of which are shown on the Borehole Log sheets. This testing indicates that, at the majority of the sites, the clay is probably pre-consolidated by something of the order of 1 to 1.5 t.s.f. in excess of existing overburden pressure. The relatively high values given for the initial void ratio (e_0) and the compression index (C_c) are within the normal range for such values, obtained from laboratory testing on sensitive "Leda Clay".

4.4) Glacial Till:

A competent glacial till deposit i) underlies the clay stratum encountered in the physiographic regions discussed above, or ii) is encountered at a shallow depth below ground surface in the south-eastern portion of Line 'D', which is located in the physiographic region known as the "Glengarry Till Plain". In addition, in the immediate vicinity of Vars, a hummock, composed of glacial till protrudes through the surrounding "Clay Plains". The glacial till is composed of a clayey silt to silt with sand and gravel. Typical grain-size distribution curves, obtained from samples of the deposit, are shown on Figure #4.

It should be noted that this investigation provides subsoil information to a point just east of St. Isidore de Prescott. Our subsurface data is being supplemented by the Regional Materials Section. Their terms of reference, therefore, include that portion of the alignment which traverses the "Glengarry Till Plains".

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

4.5) Bedrock:

Bedrock was not positively proven at any of the boring locations; it is known, however, that limestone and/or shale bedrock underlies the glacial till.

Bedrock was inferred at a few sites; at these locations the elevation of the bedrock surface was assumed at the point where the cone test met practical refusal. It should be noted that at Site #85 bedrock was encountered between 3 and 6 feet below ground surface.

5. FOUNDATION PROBLEMS ASSOCIATED WITH THE APPROVED ALIGNMENT - HWY. #417 (Ramsayville Easterly 7.5 Miles):

In the portion of Hwy. #417 previously investigated - i.e., between Ramsayville and Vars, the original proposal called for structures of the underpass type, with associated approach embankments between 15 and 22 feet in height. These proposed structure sites are located in the "Russell and Prescott Sand Plains". The subsurface investigations carried out indicated that the subsoil at the sites is composed of a mantle of sand, some 10 to 15 feet thick, overlying an extensive deposit of "Leda Clay", whose minimum undrained shear strength is typically in the 350 to 500 p.s.f. range.

The presence of the soft compressible clay at a relatively shallow depth below ground surface was the controlling factor in determining the type of foundations and structures that could be employed. In order to ensure the stability of the embankments and reduce the magnitude of the consolidation settlement of the foundation subsoil, drastic measures were often warranted. In many instances the fill heights were limited in order to keep the settlement within a tolerable range. Such measures, however, make it necessary to increase the span length of the structure considerably.

5. FOUNDATION PROBLEMS ASSOCIATED WITH THE APPROVED ALIGNMENT -
HWY. #417 (Ramsayville Easterly 7.5 Miles): (cont'd.) ...

The thickness and strength-compressibility characteristics of the clay stratum vary from site to site and, therefore, the measures recommended to improve the stability and control settlements also varied. It can be stated, however, that the measures required became more drastic as:

- i) the consistency of the clay decreases; and
- ii) the thickness of the deposit increases.

6. DISCUSSION & CONCLUSIONS - FEASIBILITY OF ALTERNATE ALIGNMENTS
HWY. #417 (Vars to Quebec Border):

It is understood that the majority of the proposed structure crossings in this section will probably be underpass types, with the fill heights of the order of 15 to 25 feet. As indicated in the previous section, the presence of an extensive clay stratum at a relatively shallow depth below ground surface will require that measures be taken to:

- i) ensure the stability of the approach embankments; and
- ii) limit the settlement of the subsoil within a tolerable range.

From a foundation point of view, it would, therefore, be advantageous to select the alignment along which i) the overall thickness of the compressible clay is least, and ii) the strength-compressibility characteristics of the clay deposit are as favourable as possible.

The results of this investigation indicates that the majority of Lines 'A', 'B' and 'C' are located in the "Russell and Prescott Sand Plains", an area in which extensive thicknesses (up to 150 feet) of compressible clay are present.

The western portion of Line 'D' is located within this region as well, however, the eastern portion (east of the South Nation River), traverses the "Winchester Clay Plains", then enters

6. DISCUSSION & CONCLUSIONS - FEASIBILITY OF ALTERNATE ALIGNMENTS
HWY. #417 (Vars to Quebec Border): (Cont'd.) ...

the "Glengarry Till Plains". The thickness of the clay in the "Winchester Clay Plains" is typically between 10 and 25 feet - i.e., considerably less than to the north. Further, the glacial till encountered in the "Glengarry Till Plains" should be competent and thus provide favourable foundation conditions with regard to structure foundations and associated approach fills.

Based on the available subsoil information, it is concluded that Line 'D' is the most favourable alignment from a foundation point of view.

If Line 'D' is adopted, the majority of the foundation problems will probably be confined to the following areas:

a) West of the South Nation River

With the exception of Sites #1 and 2, an extensive deposit of compressible clay is present in this region. It may, therefore, be necessary to

i) provide berms to ensure the stability of the approach fills, or

ii) limit the height of fill to keep the consolidation settlement within a tolerable range.

The "Sand Plains" extend for a considerable distance in all directions from Line 'D'. The clay deposit, is therefore, probably quite extensive in the vicinity of this alignment. Based on this it is quite unlikely that, anything less than a major re-alignment of Line 'D', would have a beneficial effect, as far as foundation considerations are concerned.

6. DISCUSSION & CONCLUSIONS - FEASIBILITY OF ALTERNATE ALIGNMENTS
HWY. #417 (Vars to Quebec Border): (cont'd.) ...

b) Swamp Areas (Sites #83 and 84, etc.)

Where sites, such as those noted, are located in swampy areas, it may be necessary to sub-excavate the surficial organic matter present. Alternatively, it may be possible to re-align Line 'D' slightly, such that the organic terrain is avoided; and

c) Hwy. #17 (Sites #29, 30, 31 and 38)

Detailed subsoil conditions, along Hwy. #17, are not known at this time. According to available information, however, some embankment failures have occurred on this highway, east of Hawksbury. Taking into consideration these case histories some of the sites aforementioned may require remedial measures in order to ensure the stability of the approach fills and limit the consolidation settlement.

7. MISCELLANEOUS:

The field work for this project was carried out during the period of November 14 to 21, 1968, under the supervision of Mr. B. T. Darch, Senior Foundation Engineer, assisted by Mr. S. Wilson, Project Foundation Engineer.

The equipment was owned and operated by F. E. Johnston Drilling Company Limited.

This report was written by Mr. Darch and reviewed by Mr. M. Devata, Supervising Foundation Engineer.

December 1968.

APPENDIX I

LINE 'D'
BOREHOLES

LINES 'A', 'B' & 'C'

BOREHOLES

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

68-F-85

W.P. _____

DATUM _____ Geodetic

RECORD OF BOREHOLE NO. Site #4

LINE 'C' & 'D'

LOCATION West Side Russel Co. Rd. 5, Conc. 3, Cumberland Twp.

BOHRING DATE Nov. 15, 1968

BOREHOLE TYPE Washboring - BX Casing

FOUNDATION SECTION

ORIGINATED BY S.G.W.

COMPILED BY SGW

CHECKED BY 25

SOIL PROFILE			SAMPLES		ELEV SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT	LIQUID LIMIT — W _L PLASTIC LIMIT — W _P WATER CONTENT — W			BULK DENSITY P C F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE		BLOWS / FOOT	SHEAR STRENGTH P.S.F. + Field Vane	WATER CONTENT % 20 40 60			
225.0	Ground Surface					500 1000 1500 2000 2500					Gr. Sa. Si. Cl.
0.0	Silty fine sand (irregularly stratified) (Grey)		1	SS	19	220					0 85 (15)
			2	SS	23	210					
			3	SS	19	210					
199.0	Compact to very dense.		4	SS	61	200					0 1 41 58
26.0	Clay to silty clay, with a trace of sand (occasional seams of silt from a fraction of an inch up to 1 foot in thickness) (sensitive) (grey) Firm to stiff.		5	SS	7	190					
						180	+ s=7 + s=6 + s=5				
			6	TW	PM	170	+ s=2	s=10			
						160					
						150					
						140					
						130					
					120						
					110						
105.0	End of Borehole				100						
120.0	(Clay probably extends below this depth)										

DEPARTMENT OF HIGHWAYS - ONTARIO			CONE PENETRATION TEST			RECORD OF _____ SITE NO. 20			FOUNDATION SECTION						
MATERIALS & TESTING DIVISION			LINE 'C'												
JOB	68-F-85		LOCATION Co. Rd. 9, ½ mile north of St. Isidore de Prescott			ORIGINATED BY			BTD						
W.P.			BORING DATE Nov. 19, 1968			COMPILED BY			SW						
DATUM	Geodetic		BOREHOLE TYPE Dynamic Cone Penetration Test			CHECKED BY			<i>[Signature]</i>						
SOIL PROFILE		SAMPLES			DYNAMIC PENETRATION RESISTANCE			LIQUID LIMIT ——— WL PLASTIC LIMIT ——— WP WATER CONTENT ——— W			BULK DENSITY P.C.F.		REMARKS		
ELEV. DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	BLOWS / FOOT	ELEV SCALE	SHEAR STRENGTH P.S.F.	WATER CONTENT % ————— W ———							
210.0	Ground Level														
208.0	Roadway Fill	X													
2.0	Probably silty sand	[Pattern]													
185.0															
25.0	Probably clay to silty clay	[Pattern]													
118.0															
92.0	Probably competent deposits (sand & gravel)	[Pattern]													
113.0	glacial till	[Pattern]													
97.0	End of Cone Test														

The graph plots 'BLOWS / FOOT' against 'ELEV SCALE'. The y-axis ranges from 110 to 210.0. The x-axis represents shear strength in P.S.F. with markings at 20, 40, 60, 80, and 100. A jagged line represents the test results, showing varying soil resistance with depth.

DEPARTMENT OF HIGHWAYS - ONTARIO

RECORD OF ~~BOREHOLE NO.~~ CONE PENETRATION TEST Site 32

FOUNDATION SECTION

MATERIALS & TESTING DIVISION

JOB 68-F-85

LOCATION Conc. 5, Cumberland Twp. Co. Rd. 17 Line 'A' & 'B'

ORIGINATED BY SW

W.P.

BORING DATE November 14, 1968

COMPILED BY _____ SW

DATUM Geodetic

BOREHOLE TYPE Dynamic Cone Penetration

CHECKED BY [Signature]

SOIL PROFILE			SAMPLES			DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT	LIQUID LIMIT ——— W _L PLASTIC LIMIT ——— W _P WATER CONTENT ——— W	BULK DENSITY P C F	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	BLOWS / FOOT	SHEAR STRENGTH P.S.F.	W _P ——— W _L WATER CONTENT %		
250.0	Ground Surface								
245.0	Roadway Fill	X X X							
5.0	Competent deposits (Sand & gravel and/or glacial till)	X X X							
240.0									
10.0	End of Cone Test (Probably bedrock)	X X X							

DEPARTMENT OF HIGHWAYS - ONTARIO

RECORD OF CONE PENETRATION TEST BOREHOLE NO. Site 35

FOUNDATION SECTION

MATERIALS & TESTING DIVISION

68-F-85

LOCATION Russel Co.Rd.5, 1½ mi. North of Limoges, Line 'A' & 'B'

ORIGINATED BY SW

4. P.

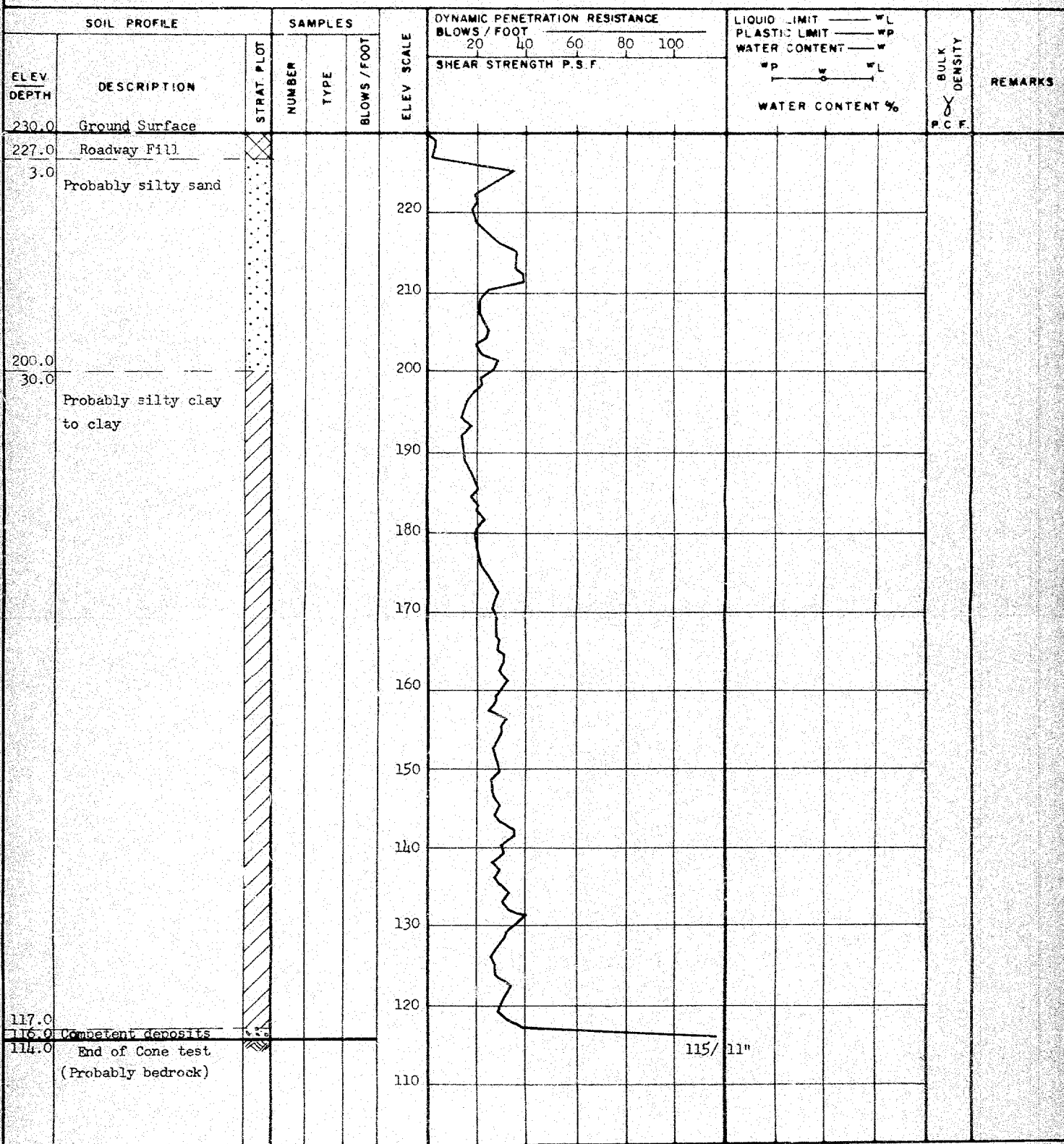
BORING DATE November 20, 1968

COMPILED BY SW

DATUM Geodetic

BOREHOLE TYPE Dynamic Cone Penetration Test

CHECKED BY



DEPARTMENT OF HIGHWAYS - ONTARIO

CONE PENETRATION TEST

MATERIALS & TESTING DIVISION

RECORD OF ~~BOREHOLE NO.~~ Site 52

FOUNDATION SECTION

JOB 68-F-85

LOCATION 0.7 mile south of St. Bernardin

Line 'A'

ORIGINATED BY BTD

W. P. BORING DATE November 12, 1968

COMPILED BY SW

DATUM Geodetic

BOREHOLE TYPE Dynamic Cone Penetration Test

CHECKED BY

SOIL PROFILE			SAMPLES			DYNAMIC PENETRATION RESISTANCE					LIQUID LIMIT — WL PLASTIC LIMIT — WP WATER CONTENT — W		BULK DENSITY P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLT	NUMBER	TYPE	BLOWS / FOOT	ELEV. SCALE	BLOWS / FOOT	20	40	60	80	100		
210.0	Ground Surface													
206.0	Roadway Fill													
185.0	Probably organic silt with sand													
185.0	Probably clay to silty clay													
106.0	Probably competent deposits (sand & gravel and/or glacial till)													
100.0	End of Cone Test													

NOTE: Delay in probe test over night - higher values probably due to build up of skin friction on the 'A' rods

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO. Site 80

FOUNDATION SECTION

JOB 68-F-85

LOCATION South Nation River, Conc.7, Cumberland Twp. LINE 'D'

ORIGINATED BY SW

W.P.

BORING DATE Nov. 19, 1968

COMPILED BY SW

DATUM Geodetic

BOREHOLE TYPE Washboring - NX Casing

CHECKED BY *HL*

SOIL PROFILE			SAMPLES			DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT		LIQUID LIMIT — W _L PLASTIC LIMIT — W _P WATER CONTENT — W		BULK DENSITY P.C.F.	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLT	NUMBER	TYPE	BLOWS / FOOT	ELEV SCALE	SHEAR STRENGTH P.S.F. + Field Vane • Undrained Triaxial x Lab Vane o Unconfined		WATER CONTENT % 20 40 60		
200.0	Ground Level										
192.0	Roadway Fill										
191.0	Silty clay.										
193.0	(Brown) Stiff										
5.0											
	Silty clay to clay with a trace of sand (occasional silt seams from a fraction of an inch up to 3" in thickness)		1	TW	RM		190	+s=2 +s=3		105	
	Sensitive (Grey with random reddish brown lamin- ations)		2	TW	PM		170	+s=2 +s=1		103 99	0 5 45 50
	Firm to stiff						160				
152.0											
48.0	Silty fine sand.		3	SS	42		150				0 75 (25)
147.0	(Grey) Dense										
53.0	Clayey silt with sand & gravel (Glacial Till)										
140.5	(Grey) Hard										
59.5	End of borehole. (Probably bedrock)										

NOTE: Consolidation Test - Sa.#2 Depth 31'
 Preconsolidation Pressure (P_c) 1.9 t.s.f.
 Effective Overburden Pressure (P_o) 0.85 t.s.f.
 Initial Void Ratio (e_o) 2.1
 Compression Index (C_c) 1.1

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

JOB 68-F-85

LOCATION Russel Co. Rd. 7, 4000' south of Casselman, Line 'D'

FOUNDATION SECTION

W.P.

BORING DATE Nov. 14/68

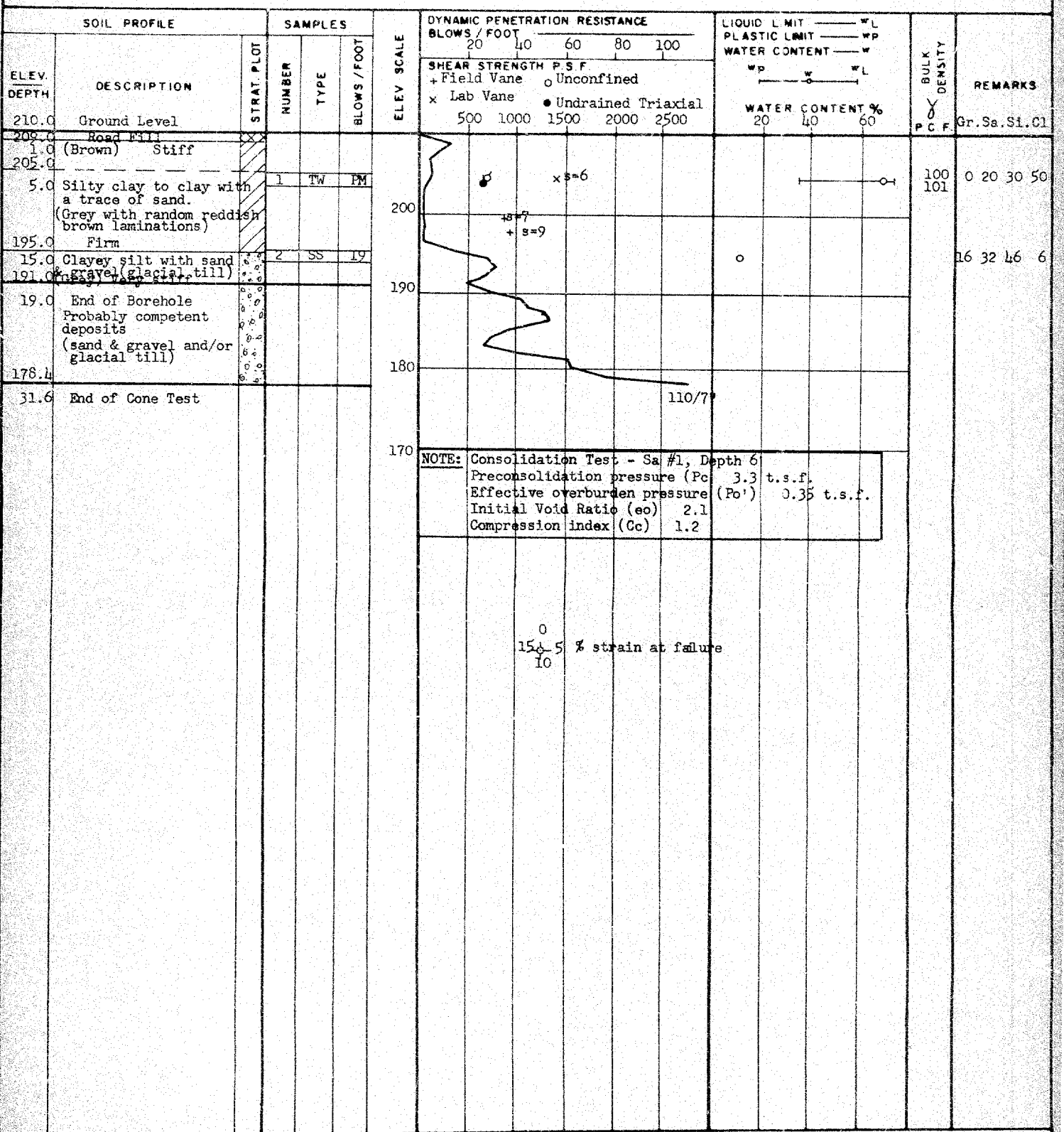
ORIGINATED BY SW

DATUM Geodetic

BOREHOLE TYPE Washboring - NX Casing

COMPILED BY SW

CHECKED BY



[illegible]

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO. Site 83

FOUNDATION SECTION

JOB 68-F-85

LOCATION Stormont Co. Rd. 3A, Line 'D'

ORIGINATED BY BTD

W. P.

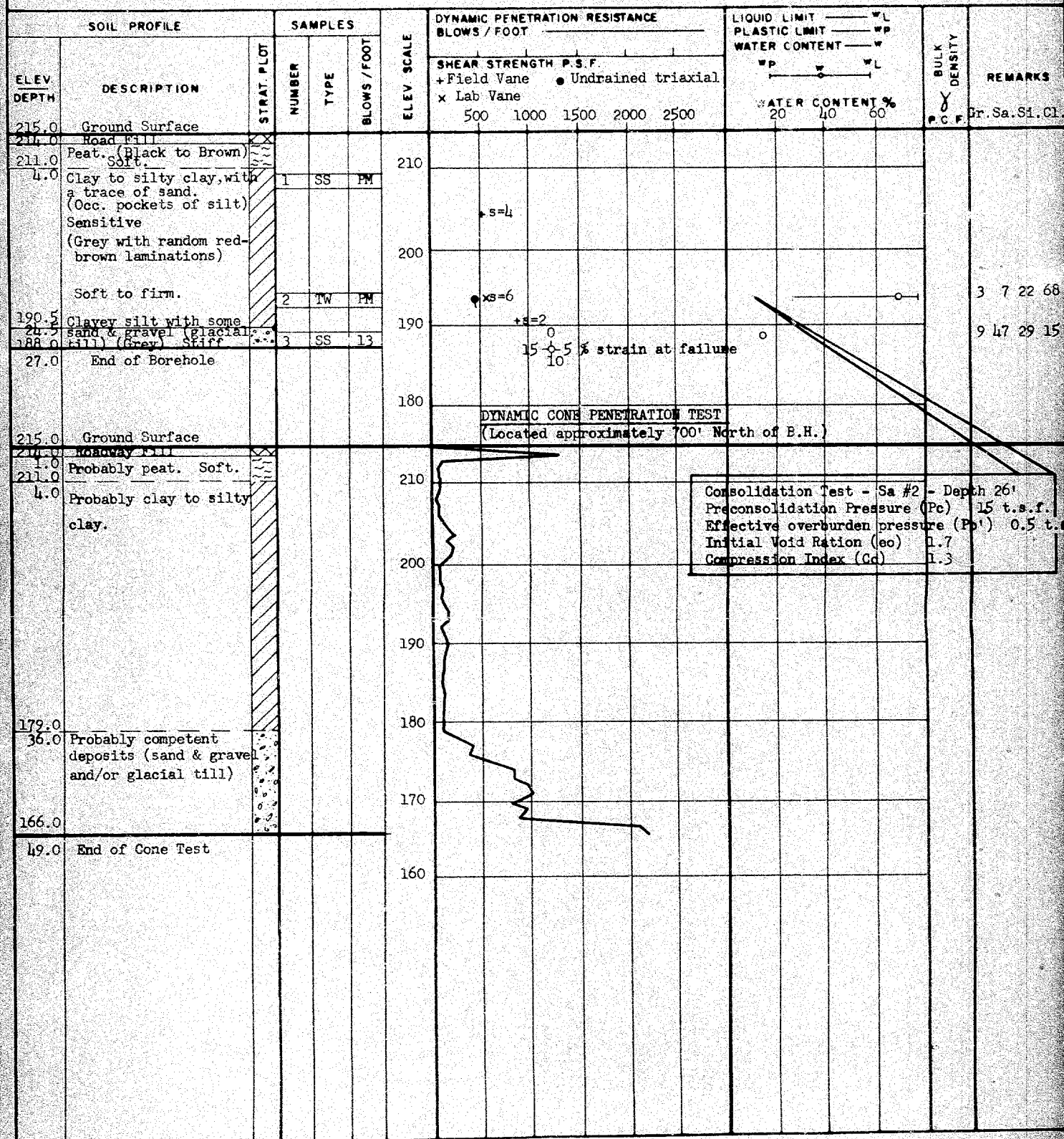
BORING DATE November 15, 1968

COMPILED BY SW

DATUM Geodetic

BOREHOLE TYPE Washboring - BX Casing & Dynamic Cone Test

CHECKED BY



DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

JOB 68-F-85

LOCATION South Plantagenet Twp., Conc.XX Line 'D'

Site 85

FOUNDATION SECTION

W.P. _____ BORING DATE November 20, 1968

ORIGINATED BY BTD

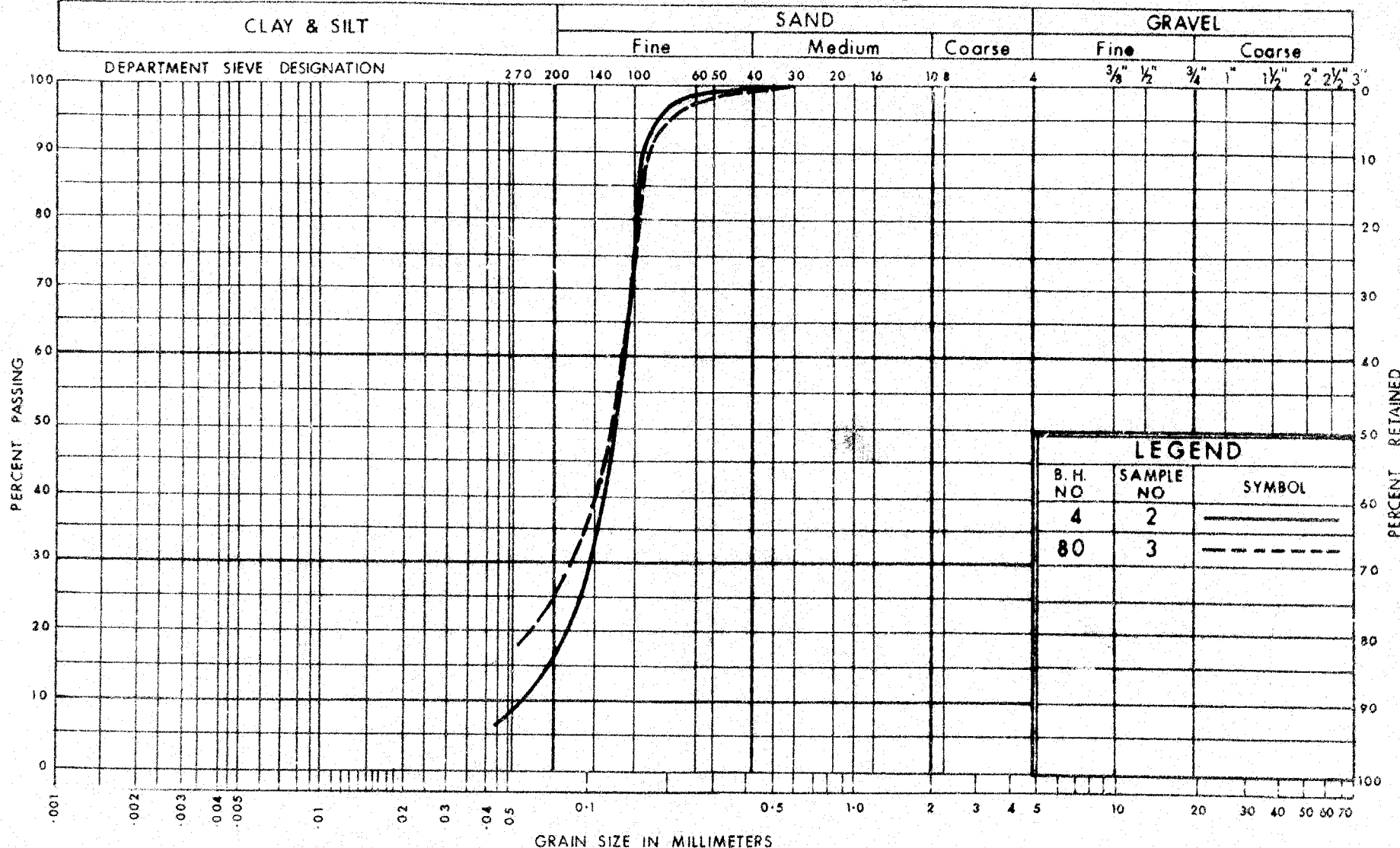
COMPILED BY SW

DATUM Geodetic BOREHOLE TYPE Dynamic Cone Penetration Test

CHECKED BY LEE CK

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT 20 40 60 80 100 SHEAR STRENGTH P.S.F.	LIQUID LIMIT — w _L PLASTIC LIMIT — w _p WATER CONTENT — w w _p — w _L WATER CONTENT %	BULK DENSITY P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT					
220.0	Ground Surface									
217.0	Roadway Fill - clayey silt deposit.									
3.0	End of Cone test (Probably Bedrock)									
						210				
<p><u>NOTE:</u></p> <p>Additional cone penetration tests (4) in the area indicate that the probable bedrock surface varies from 2 to 6 feet below ground surface.</p>										

UNIFIED SOIL CLASSIFICATION SYSTEM



DEPARTMENT OF HIGHWAYS
MATERIALS and
TESTING
DIVISION

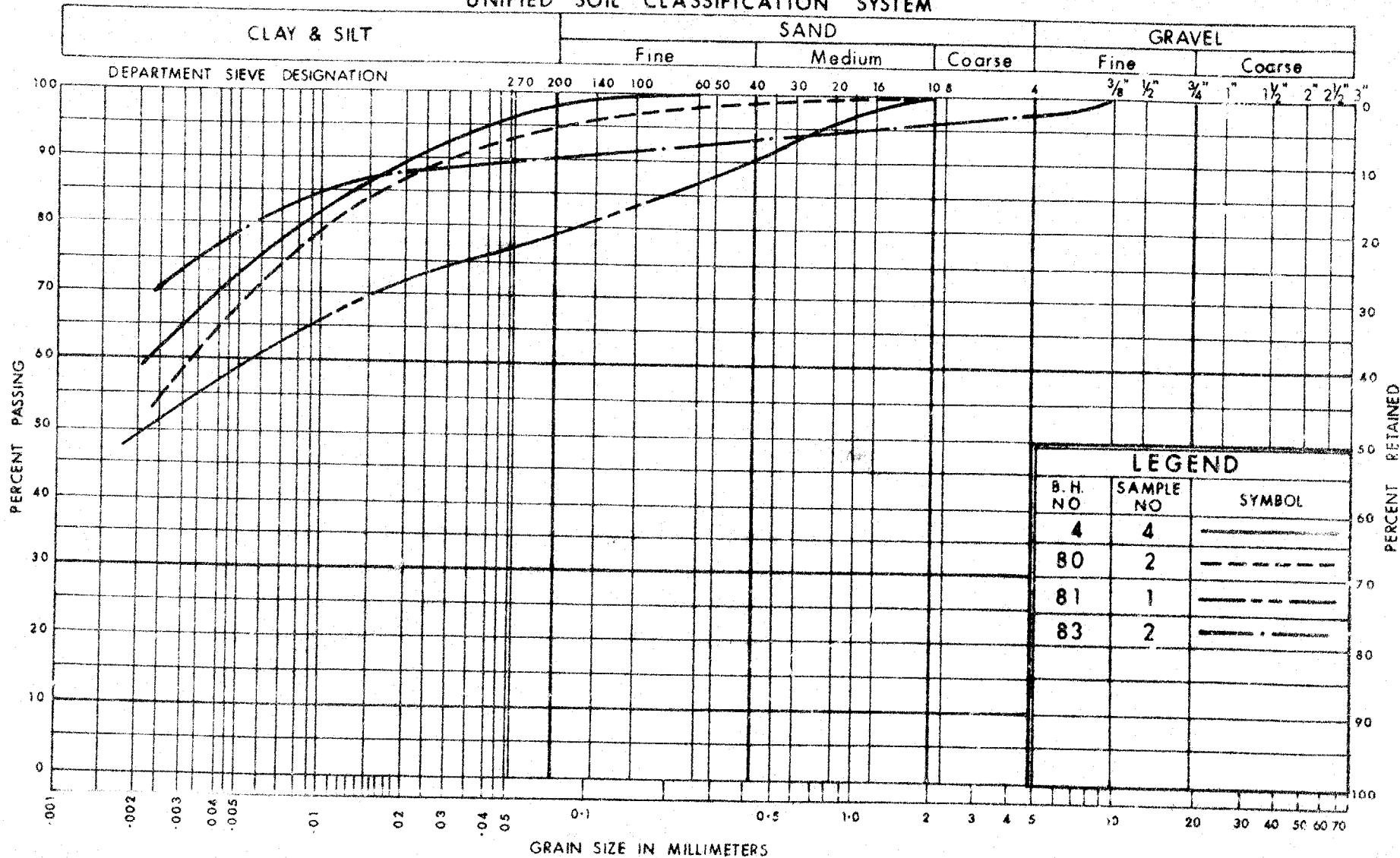
GRAIN SIZE DISTRIBUTION SILTY FINE SAND

W.P. No.

JOB No. 68-F-85

FIG. No. 1

UNIFIED SOIL CLASSIFICATION SYSTEM



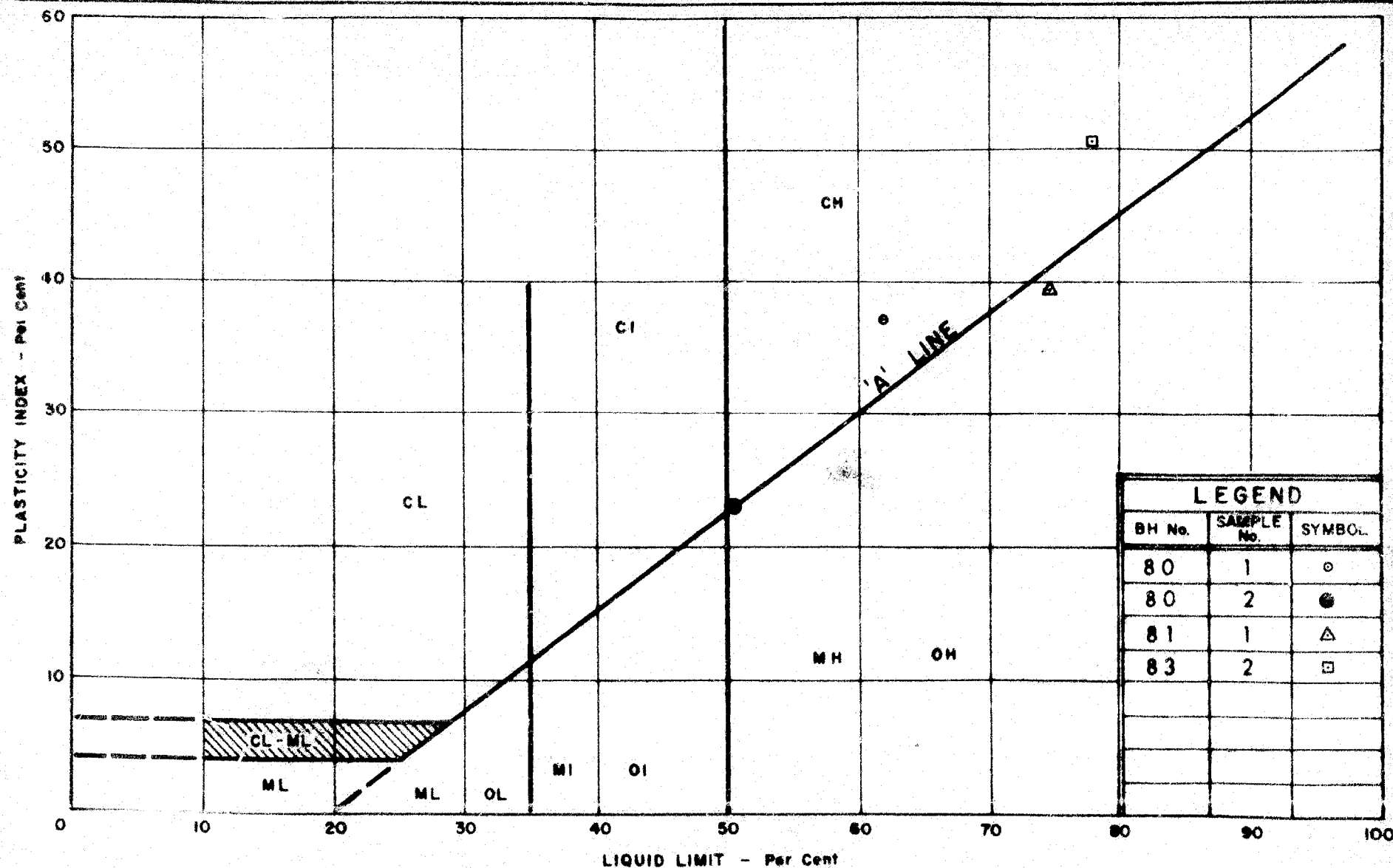
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MATERIALS and
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DIVISION

GRAIN SIZE DISTRIBUTION SILTY CLAY TO CLAY STRATUM

W.P. No.

JOB No. 68-F-85

FIG. No. 2



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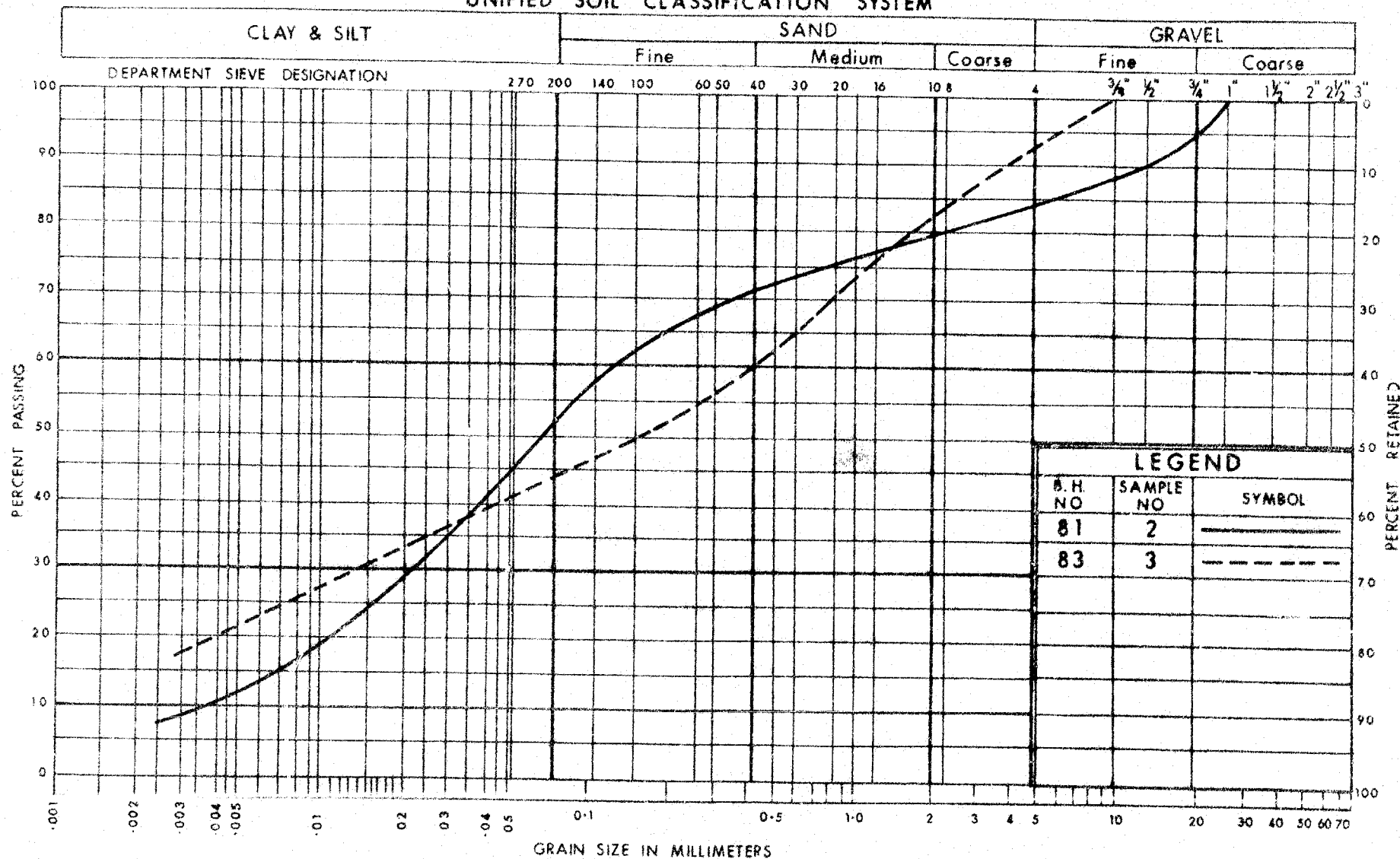
PLASTICITY CHART SILTY CLAY TO CLAY STRATUM

W.P. No.

JOB No. 68-F-85

FIG. No. 3

UNIFIED SOIL CLASSIFICATION SYSTEM



DEPARTMENT OF HIGHWAYS
MATERIALS and
TESTING
DIVISION

GRAIN SIZE DISTRIBUTION
CLAYEY SILT WITH SAND & GRAVEL
(GLACIAL TILL)

W.P. No.

JOB No. 68-F-85

FIG. No. 4

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 _u	UNCONFINED COMPRESSION	L V	LABORATORY VANE
Q	UNDRAINED TRIAXIAL	F V	FIELD VANE
Q _{cu}	CONSOLIDATED UNDRAINED TRIAXIAL	C	CONSOLIDATION
Q _d	DRAINED TRIAXIAL	S	SENSITIVITY

ABBREVIATIONS 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
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	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_r	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

Mr. J. L. Forster,
Regional Functional Planning
Engineer,
Functional Planning Section,
Kingston, Ontario.

Foundation Section,
Materials & Testing Office,
Lab. Bldg., Downsview.

January 7, 1969

W.P. 35-66 to 37-66, Hwy. 417, Vars to Quebec Border
District 9 - Ottawa

With respect to your memorandum of January 3, 1969, regarding the formation of a co-ordinating committee, we wish to inform you that this seems to us to be an excellent idea, and we will gladly co-operate as and when required.

AGS/RdeP


A. G. Stermac
PRINCIPAL FOUNDATION ENGINEER

cc: Foundations Files
Gen. Files

Mr. H. Aron
Mr. A. G. Boucher
Mr. J. E. Graspier
Mr. S. J. Markiewicz
Mr. C. R. Robertson

DEPARTMENT OF HIGHWAYS ONTARIO

MEMORANDUM

To: Mr. G. Scott
Mr. A. Stermac
Mr. L. Timson

FROM: Functional Planning Section
Kingston, Ontario.

ATTN: Mr. W. Wigle
Mr. K. Williams
OUR FILE REF.

DATE: January 3, 1969.

IN REPLY TO

SUBJECT: W.P. 35-66 to 37-66, Hwy. 417, Vars to Quebec Border,
District 9 - Ottawa

Recently, several instances have been noted where a misunderstanding or conflict has arisen between different groups working on the above projects. Although this is minor in scope, at the moment, it could develop into a more serious problem.

It would seem that in order to prevent a deterioration in co-operation within the Region and also to prevent any delays in the projects, it would be advisable to have regular co-ordinating meetings, possibly once a month or sooner if necessary, between preselected representatives from the various sections. Since the scheduling of the projects has or will be speeded up, this is even more critical. The various groups could then be kept up-to-date with the different aspects of the projects and also provide vital information.

A representative of this office could act as chairman, call the meetings and set up the agenda, giving sufficient time for the participants to prepare any necessary information.

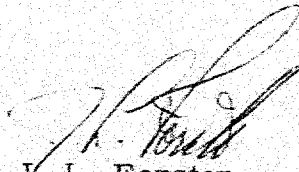
The committee could be composed of a representative from each of the following sections.

Functional Planning	
Road Design	
Materials and Testing	
Bridge	
Photogrammetry	(When considered necessary)
Right-of-Way	(When considered necessary)
District	(When considered necessary)
Programming	(When considered necessary)
Engineering Surveys	(When considered necessary)
Traffic	(When considered necessary)
Foundation	(When considered necessary)

The first four representatives would form the basic committee and the remainder could be advised of the meeting dates and agenda and participate if they or the chairman feel it is necessary. It would be desirable to keep the committee to as small a unit as possible.

If it is desirable to keep the committee in operation after the planning stage, the representative from Road Design could assume the roll of chairman.

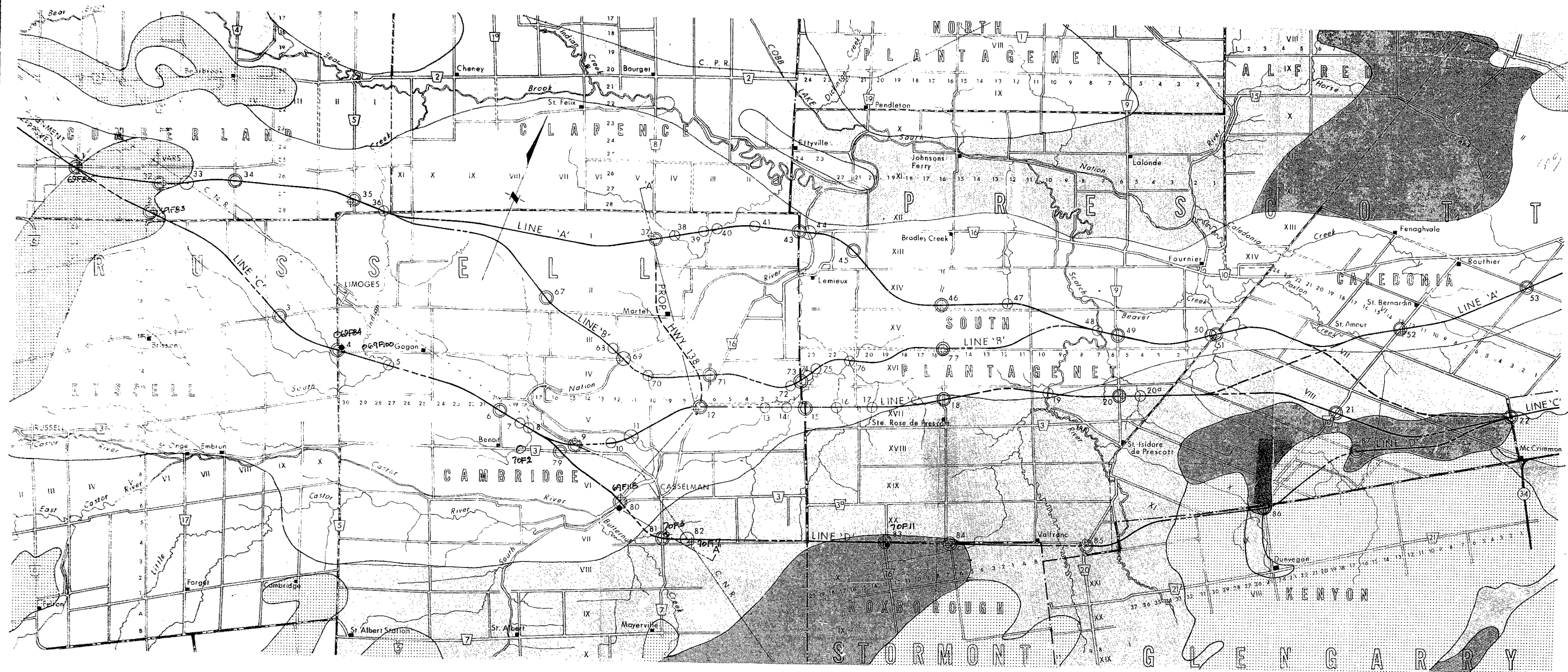
Your comments on the above would be appreciated.

A handwritten signature in dark ink, appearing to read 'J. L. Forster', with a stylized flourish at the end.

J. L. Forster,
Regional Functional Planning Engineer.

JLF/mjh

#68-F-85
WP #35-66
#36-66, #37-66
HWY #417
VARS TO
QUEBEC BORDER



LEGEND

- Bore Hole
- ⊕ Cone Penetration Hole
- ⊕ Bore and Cone Penetration Hole
- Proposed Structure and Intersection
- Proposed Structure
- Highway
- County Road
- County Boundaries
- Township Boundaries

— Roads.

PLAN



PHYSIOGRAPHIC REGIONS

- RUSSELL & PRESCOTT SAND PLAINS 10' - 30' OF SAND OVERLYING EXTENSIVE DEPOSIT OF MARINE CLAY
- WINCHESTER CLAY PLAINS 10' - 25' OF MARINE CLAY OVERLYING GLACIAL TILL - SOUTH OF RUSSELL & PRESCOTT SAND PLAINS
- SWAMP VARIABLE THICKNESS OF ORGANIC MATTER
- GLENGARRY TILL PLAINS 10' - 25' OF GLACIAL TILL OVERLYING BEDROCK

REVISIONS	DATE	BY	DESCRIPTION

DEPARTMENT OF HIGHWAYS - ONTARIO			
MATERIALS & TESTING DIVISION - FOUNDATION SECTION			
PRELIMINARY INVESTIGATION			
VARS TO ST. ISIDORE DE PRESCOTT			
KING'S HIGHWAY NO. 417 LINE 'A' 'B' 'C' 'D' DIST NO. 9			
CO. RUSSELL		& PRESCOTT	
TWP.	LOT	CON.	
PROPOSED ALIGNMENTS & STRUCTURE LOCATIONS			
SUBMD B.T.D. CHECKED	W.P. NO.	M.B.T. DRAWING NO.	
DRAWN G.F. CHECKED	JOB NO 68-F-85	68-F-85A	
DATE Dec 5, 1968	SITE NO.	BRIDGE DRAWING NO.	
APPROVED <i>[Signature]</i>	CONT. NO.		

PHYSIOGRAPHY - CHAPMAN & PUTNAM
REF NO. COUNTY MAPS P&R52, P&R W52

