

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: October 10, 1969

OUR FILE REF.

IN REPLY TO

OCT 17 1969

SUBJECT:

FOUNDATION INVESTIGATION REPORT

For

Proposed Structure at the Crossing of
The South Nation River and Hwy. #31
(Revision Line 'A')

Cass Bridge -- Winchester Township
District No. 9 (Ottawa)

W.J. 69-F-57

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W.P. 33-66-00

Attached, we are forwarding to you, our detailed
foundation investigation report on the subsoil conditions
existing at the above structure site.

We believe that the factual data and recommendations
contained therein, will prove adequate for your design
requirements. Should additional information be required,
please do not hesitate to contact our Office.

AGS/WdsF

Attach.

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

H. A. Tregaskes

D. W. Farren

S. J. Markiewicz

C. R. Robertson

T. C. Kingsland (2)

J. E. Gruspier

B. A. Singh

Foundations Files

Gen. Files

A. G. Sternac
A. G. Sternac
PRINCIPAL FOUNDATION ENGINEER

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FOUNDATION INVESTIGATION REPORT
For
Proposed Structure at the Crossing of
The South Nation River and Hwy. #31
(Revision Line 'A')
Cass Bridge -- Winchester Township
District No. 9 (Ottawa)
W.J. 69-F-57 -- W.P. 33-66-00

1. INTRODUCTION:

It is proposed to realign Hwy. #31 in the vicinity of the South Nation River, near the Village of Cass Bridge. In conjunction with this project, the Foundation Section was requested to carry out an investigation at the proposed bridge crossing of the South Nation River and Hwy. #31 (Rev'n. Line 'A'), in the Township of Winchester, County of Dundas. The request was contained in a memo from the Kingston Bridge Location Section - (Mr. T. C. Kingsland, Regional Bridge Location Engineer), dated July 10, 1969. An investigation was subsequently carried out by this Section to determine the subsoil and groundwater conditions at this site.

This report contains the results of the investigation, together with recommendations pertaining to the foundations of the proposed structure, as well as the stability and settlement of the approach embankments.

2. DESCRIPTION OF THE SITE AND GEOLOGY:

The site is located at Cass Bridge, a small village on Hwy. #31, approximately 2-1/2 miles south of Winchester.

In the vicinity of the crossing, the South Nation River is approximately 320 feet wide from crest to crest, and 17 to 18 feet deep. The banks of the river are standing slopes of between 4:1 and 6:1; the river water level, at the time of the investigation, was at about elevation 224.5. The surrounding terrain, which supports light vegetation and is being used as pasture land, is

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

flat to gently undulating in relief between elevations 232 and 234. A 5-span, 312 feet long, bridge structure presently crosses the South Nation River. The approaches to this structure extend approximately 10 feet above the surrounding terrain.

Physiographically, the site is situated in the "Winchester Clay Plains" region. In general, the predominant stratum in this area is composed of a sensitive marine clay deposited, in the geologic past, by the Champlain Sea. The clay, which is encountered at a relatively shallow depth below ground surface, varies anywhere from 10 to 40 feet in thickness. The cohesive stratum is underlain by competent glacial till deposits. The glacial till is, in turn, underlain by sandstone bedrock of the Beekmantown formation, Ordovician Period.

3. FIELD AND LABORATORY WORK:

Nine sampled boreholes, 6 of which were accompanied by a dynamic cone penetration test, were put down during the course of the recent field investigation. In addition, two vane borings were put down to complement the aforementioned. The borings were advanced by means of conventional diamond drill rigs adapted for soil sampling purposes. One of the drill rigs was mounted on a drum raft in order to put down the two borings located in the South Nation River.

Samples of the upper desiccated portion of the cohesive stratum, as well as the lower glacial till deposit, were obtained in a 2" O.D. 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 lower portion of the clay stratum were obtained in 2" I.D. Shelby tubes, which were manually pushed into the material. Further, in situ vane testing was carried out within this zone to determine the undrained shear strength of the subsoil. Bedrock was proven in six of the borings

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

by obtaining either AXT or BXT size rock core samples.

The groundwater level conditions across the site were determined by installing sealed piezometers in three of the boreholes. This information was supplemented by recording the water level in the open holes during the course of the investigation. The artesian conditions encountered in B.H.'s #4 and #5, were completely sealed during the period of the drilling operations.

The locations and elevations of all the borings were surveyed in the field by personnel from the Kingston Regional Engineering Survey Section. They are shown on Drawing No. 69-F-57A, together with the estimated stratigraphical profile across the site. All elevations were referenced to a geodetic datum.

All the samples were subjected to a careful visual examination in the field and subsequently in the laboratory. Following this inspection, laboratory tests were performed on selected samples to determine the engineering properties of the various soil types, namely:

- Natural Moisture Contents
- Grain-Size Distributions
- Atterberg Limits
- Undrained Shear Strength Testing
- Consolidation Testing

The results of the laboratory testing are plotted on the Record of Borelog sheets and summarized on Figures 1 to 5, all of which are contained in Appendix I of this report.

4. SUBSOIL AND BEDROCK CONDITIONS:

4.1) General:

A stratum of very stiff to soft silty clay to clayey silt is present beneath a surficial topsoil cover across the site.

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

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

The thickness of this cohesive stratum varies from 8.5 feet, beneath the river bed, to 22.5 feet on the river banks. The clay is underlain by a very dense (or hard) glacial till which ranges from 11 to 22 feet in thickness. The glacial till is, in turn, underlain by sandstone bedrock.

The boundaries of the various deposits, as determined in the boreholes, are shown on the accompanying borehole sheets. The stratigraphical profile, shown on Drawing No. 69-P-57A, is inferred from this boring data.

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

4.2) Silty Clay to Clayey Silt:

Directly underlying the surficial mantle of topsoil is a stratum composed of a grey to grey-brown silty clay to clayey silt with random zones of clay. The overall thickness of this stratum varies from 8.5 feet, immediately below the river bed, to 22.5 feet along the river banks. Along the river banks, outside of the river valley proper, the upper 5 to 9 feet of this stratum has been desiccated forming a crust. Numerous pockets of sand and silt, varying anywhere from a fraction of an inch to up to 2 inches in thickness, are present randomly throughout the stratum. Grain-size distribution curves for samples of the cohesive subsoil are shown on Figure #2, located in the Appendix of this report.

The engineering properties of the stratum, as determined by field and laboratory testing, are summarized on Figure #1. A brief resumé, presented in tabular form, follows:

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

4.2) Silty Clay to Clayey Silt: (cont'd.) ...

<u>Identity Tests</u>		<u>Desiccated Zone</u> Range (Average)	<u>Lower Zone</u> Range (Average)
Bulk Density (p.c.f.)	(γ)	-	99 - 133 (115)
Liquid Limit	(W_L)	40 - 61 (55)	21 - 79 (36)
Plastic Limit	(W_P)	25 - 34 (29)	16 - 27 (21)
Natural Moisture Content (%)	(W)	29 - 48 (40)	23 - 74 (48)
Liquidity Index	(I_L)	0 - 0.9 (0.3)	0.7 - 1.3 (1.1)

Consolidation Characteristics

Initial Void Ratio (e_0)	1.33	One Test	1.02 and 1.36	Two Tests
Compression Index (C_c)	0.71		0.25 and 0.66	
Degree of Preconsolidation (t.s.f.) ($P_c - P'_0$)	4.5		0.75 and 1.0	

Undrained Shear Strength (C_u)
(p.s.f.)

1) Field Vanes	> 2,000	400* - 1,200
2) Lab. Vanes	-	600 - 1,300
3) Lab. Tests	1,000 - 1,400	400* - 1,300

*These low values were obtained in the clay stratum located below the river bed; elsewhere, the minimum undrained shear strength is about 600 p.s.f.

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

4.2) Silty Clay to Clayey Silt: (cont'd.) ...

The Atterberg limit tests, summarized on the foregoing page, are also plotted on the Plasticity Chart, Figure #4. These results indicate that the plasticity of the inorganic cohesive stratum varies generally from low to intermediate; there are random zones, however, where the plasticity is in the high range. The natural moisture content of the stratum is generally at, or slightly above, the plastic limit in the upper desiccated zone; in the lower portion, however, the moisture content consistently exceeds the liquid limits.

The consistency of the stratum varies from very stiff, in the upper desiccated zone, decreasing with depth to firm. This pattern is interrupted beneath the river bed; in this area the consistency ranges from soft to firm.

The consolidation characteristics of the stratum were determined by carrying out three laboratory consolidation tests, the results of which are shown as Void Ratio vs. Pressure plots, on Figure #5. The results of this testing indicate that the majority of the clay stratum is preconsolidated by about 1,500 to 2,000 p.s.f. in excess of existing overburden pressure. In the upper desiccated zone, however, it is preconsolidated by approximately 3,000 to 9,000 p.s.f. The values for the initial void ratio (e_0) and the compression index (C_c) are within the normal range for cohesive deposits encountered in this area.

4.3) Heterogeneous Mixture of Clay, Silt, Sand and Gravel - (Glacial Till):

The cohesive stratum is underlain by a glacial till deposit, whose composition is heterogeneous in nature. The thickness of this deposit varies from 11 feet at B.H. #6 to 22 feet at B.H. #2. The upper 2 to 3 feet of the glacial till is in a 'reworked' condition - i.e., it is a transition zone

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

4.3) Heterogeneous Mixture of Clay, Silt, Sand and Gravel - (Glacial Till): (cont'd.) ...

between the overlying clay and till. The major portion of the glacial till is granular in nature - i.e., composed of silt, sand and gravel with a trace of clay. There are random zones throughout, however, where the deposit is cohesive in nature; in these areas the matrix is composed of a clayey silt binding sand and gravel. Occasional seams of sand and gravel are present throughout the glacial till. Grain-size distribution curves, obtained on samples of the overall deposit, using 2" O.D. sampling equipment, are plotted on Figure #3.

A few Atterberg limit tests were carried out on samples from the more cohesive portions of the glacial till; these are summarized on Figure #4. The results of this testing indicate that the subsoil, in these zones, is inorganic and of low plasticity.

The standard penetration tests, carried out within the deposit, are plotted on the Record of Borelog sheets, as well as on Figure #1. This testing gave 'N' values which range from 63 blows/ft. to 150 blows/1 inch, being typically greater than 100 blows/ft. In the upper 'reworked' zone, however, the 'N' values range from 6 to 13 blows/ft. Based on these values, it is estimated that the granular zones of the deposit have a very dense relative density, while the cohesive zones have a consistency in the hard range. In the 'reworked' zone, however, the relative density and consistency is inferred to be compact and stiff, respectively.

4.4) Sandstone Bedrock:

The glacial till is directly underlain by bedrock, which was proven in boreholes #1 to 6, inclusive, by obtaining from 8 to 11 feet of either BXT or AXT size rock core samples. Over the site the bedrock surface was found to vary between elevations 191 and 198.

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

4.4) Sandstone Bedrock: (cont'd.) ...

The bedrock is composed of a grey sandstone with minor shaly carbonate inclusions. In general, bedrock is sound throughout; however, some signs of fracturing and jointing were observed in the upper 2 to 3 feet, at some of the boring locations.

5. GROUNDWATER CONDITIONS:

Groundwater level observations have been carried out during the period of the investigation in: i) sealed piezometers installed in some of the boreholes, and ii) the open holes at the remaining locations. The observations are recorded on the borelog sheets and summarized on Drawing No. 69-F-57A.

The recorded observations indicate that, along the banks approaching the South Nation River, the groundwater level in the overburden deposits is between 3 and 5 feet below existing ground surface. These depths correspond to elevations between 228 and 230.

An artesian condition was encountered at one of the boreholes put down through the river bed (B.H. #4), as well as at borehole #5, put down on the south bank of the river. This artesian groundwater condition occurred once the boreholes penetrated into the underlying, more pervious glacial till deposit; specifically it was encountered between elevations 202 and 203. Once this zone was tapped, the groundwater rose instantaneously in the casing; the artesian head stabilized itself somewhere between elevations 227 and 228. This elevation corresponds to a head of water approximately 2 to 3 feet above the river level. It is inferred that this zone is relatively pervious in nature and, as such, can be considered to be a confined aquifer. This aquifer is being charged with groundwater from the surrounding terrain, which is at a higher elevation. The artesian condition exists only within the confines of the South Nation River proper.

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

6.1) General:

It is proposed to construct a 34-foot wide, 5-span structure (57'-80'-83'-80'-64') at the crossing of realigned Hwy. #31 (Rev'n. Line 'A') and the South Nation River, near the Village of Cass Bridge. At this location, the center of the revised highway will be approximately 50 feet east of the existing centre-line. At this location the proposed profile grade of Hwy. #31 (Rev'n. Line 'A') will be between elevations 245 and 247. The associated approach fills will have a maximum height of the order of 13 feet above the existing ground surface in both the longitudinal and transverse directions.

A stratum of very stiff, changing to soft with depth, silty clay to clayey silt, between 8.5 (beneath the river bed) and 22.5 feet (along the banks) is encountered beneath the thin surficial cover. The cohesive stratum is underlain by a competent glacial till deposit, ranging from 11 to 22 ft. in thickness; the glacial till is directly followed by sandstone bedrock, the surface of which was encountered between elevations 191 and 198.

The presence of the relatively firm to soft, compressible cohesive stratum at the proposed footing locations precludes the economic use of spread footings. Therefore, the structure elements will have to be pile-supported, as discussed in Section 6.2), which follows.

6.2) Structure Foundations:

6.2.1) Pier Foundations -

The piers can be supported on end-bearing piles driven to practical refusal into the lower portion of the competent glacial till deposit. For estimating purposes, it can be assumed that the pile tip elevations will be between elevations 200 and 205. The piles can be designed for the maximum allowable load for the respective pile section selected (e.g., 12 BP 74 steel H-piles may be designed for 90 tons/pile). Since the glacial till is granular

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

6.2) Structure Foundations: (cont'd.) ...

6.2.1) Pier Foundations - (cont'd.) ...

in nature, it is recommended that the pile driving, during construction, be controlled by employing the Hiley Dynamic Pile Driving formula (D.H.O. Standards DD 1218 and DD 1219).

The centre piers will be located within the confines of the South Nation River (refer to B.H.'s #3 and 4). If pile caps are to be located below the river water level, a temporary dewatering scheme will be required. This can be achieved by temporarily diverting the river, or alternatively, by carrying out the excavation from within a sheeted cofferdam. The pile caps should be protected against any possible river scour action.

No major dewatering problems are anticipated when carrying out the excavations for the pile caps at the end pier locations (refer to B.H.'s #2 and 5).

6.2.2) Abutment Foundations (Refer to B.H.'s #1 & 6) -

The abutments may be 'perched' within the approach fills; they can be supported on end-bearing piles driven to practical refusal within the glacial till deposit, as discussed in Section 6.2.1).

No bouldery or rock fill should be used in areas in which piles are to be driven.

6.3) Approach Embankments:

The approach fills will have a maximum height of about 13 feet. No stability problems are anticipated for embankments of this height, if constructed of properly compacted fill with standard 2:1 slopes.

The cohesive foundation subsoil will undergo consolidation settlement due to the surcharge loading of the approach fills.

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

6.3) Approach Embankments: (cont'd.) ...

The magnitude of the induced loading will be approximately the preconsolidation pressure of the compressible stratum. This being the case, the settlement will be of a recompression nature - i.e., take place during or immediately following placement of the fill. Based on computations carried out, it is estimated that the settlement will be of the order of 2 to 3 inches.

7. MISCELLANEOUS:

The field work, performed during the period of August 14 to 27, 1969, was supervised by Mr. D. Phelps, Project Foundation Engineer.

The preparation of this report was undertaken by Mr. B. T. Darch, Senior Foundation Engineer.

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

Equipment used was owned and operated by F. E. Johnston Drilling Co. Ltd.

October 1969

APPENDIX I.

CHECKED BY

FOUNDATION SECTION

[illegible]

FOUNDATION SECTION

JOB	59-F-57	LOCATION	Sta. 77 + 64 o/s 19' Rt. 2	ORIGINATED BY	DP
W.P.	33-66-00	BORING DATE	Aug. 21, 1969	COMPILED BY	DP
DATUM	Geodetic	BOREHOLE TYPE	Washboring-NX Casing	CHECKED BY	<i>[Signature]</i>

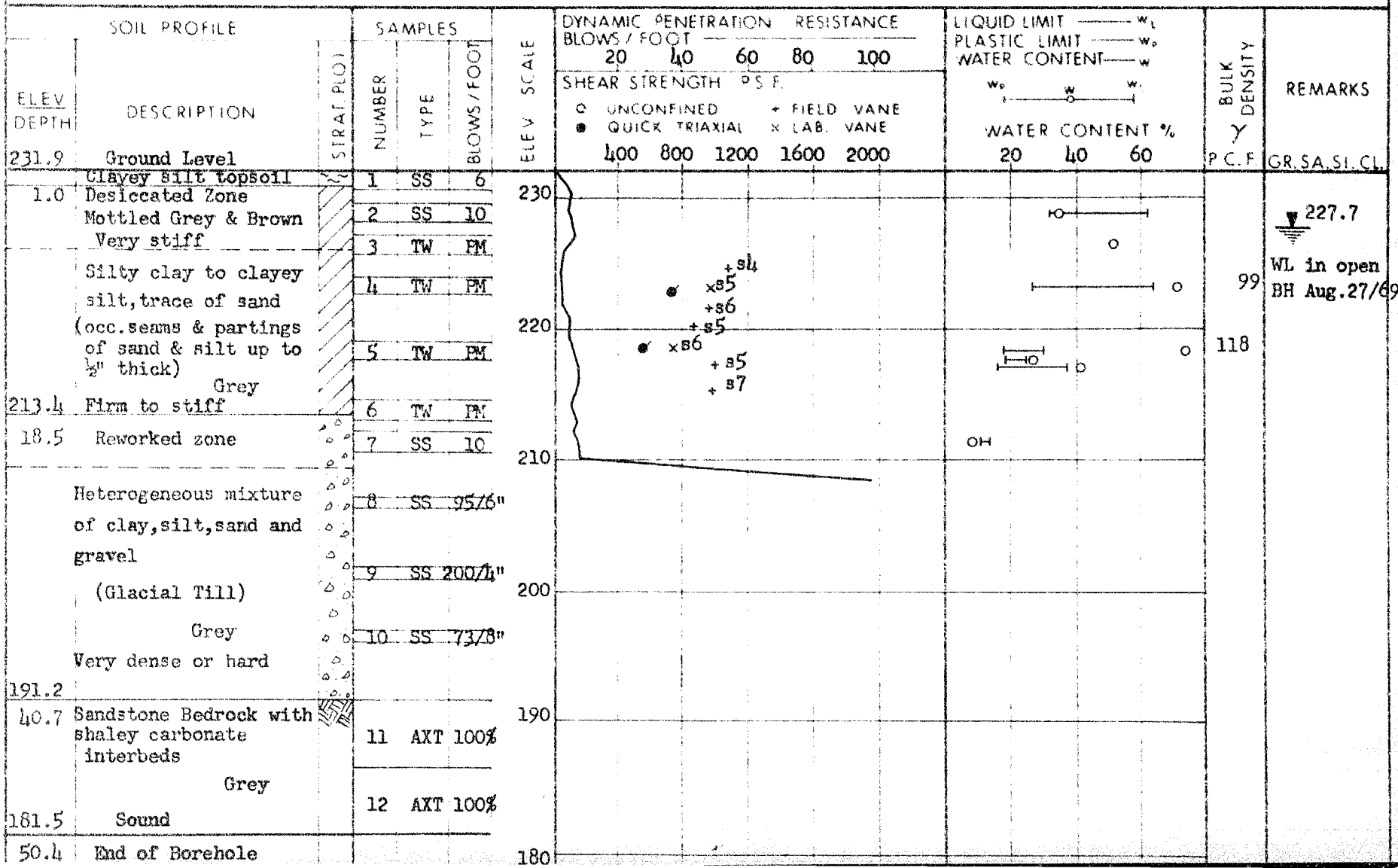
SOIL PROFILE			SAMPLES			DYNAMIC PENETRATION RESISTANCE		LIQUID LIMIT — w_L		BULK DENSITY	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	BLOWS / FOOT	ELEV SCALE	BLOWS / FOOT	PLASTIC LIMIT — w_p	WATER CONTENT — w		
234.1	Ground Level										
	Clayey silt topsoil										
	Desiccated Zone					230					
	Mottled Grey & Brown										
	Very stiff										
	Silty clay to clayey silt, trace of sand					220					
	Grey										
223.1	Firm to stiff										
21.0	End of Vane Hole					210					

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 2

FOUNDATION SECTION

JOB 69-7-57 LOCATION Sta. 77 + 09 o/s 3' Rt. 4
W.P. 33-66-00 BORING DATE August 21, 22, 25, 1969
DATUM Geodetic BOREHOLE TYPE Washboring NX,BX,AX; AXT Rock Core
ORIGINATED BY DP
COMPILED BY DP
CHECKED BY



DEPARTMENT OF HIGHWAYS- ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 3

FOUNDATION SECTION

JOB 69-F-57 LOCATION Sta. 76 + 23 o/s 16' Rt. 4
 W.P. 33-66-00 BORING DATE August 20, 21 & 22, 1969
 DATUM Geodetic BOREHOLE TYPE Washboring NX,BX Casing; AXT Rock Core
 ORIGINATED BY DP
 COMPILED BY DP
 CHECKED BY

ELEV DEPTH	SOIL PROFILE DESCRIPTION	STRAT PLOT	SAMPLES			ELEV SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT					LIQUID LIMIT w_L PLASTIC LIMIT w_p WATER CONTENT w	BULK DENSITY Y P C F	REMARKS
			NUMBER	TYPE	BLOWS/FOOT		20	40	60	80	100			
224.5	River Level													
0.0	Water													
218.5						220								
6.0	Silty clay to clayey silt, trace of sand (occ. seams & layers of sand & silt throughout)		1	TW	PM								121	
209.5	Firm Grey		2	TW	PM								133	
15.0	Reworked Zone		3	SS	8	210								
	Het. mix. of clay, silt, sand & gravel (Glacial Till)		4	SS	11 1/4									
	Grey		5	SS	150/2"									
			6	SS	150/1"									
195.4	Very dense or hard					200								
29.1	Fractured Sandstone Bedrock with shaley carbonate inclusions. Grey		7	AXT	99%	190								
185.2	Sound		8	AXT	82%									
39.3	End of Borehole					180								

220

210

200

190

180

s5

+s5

+s3

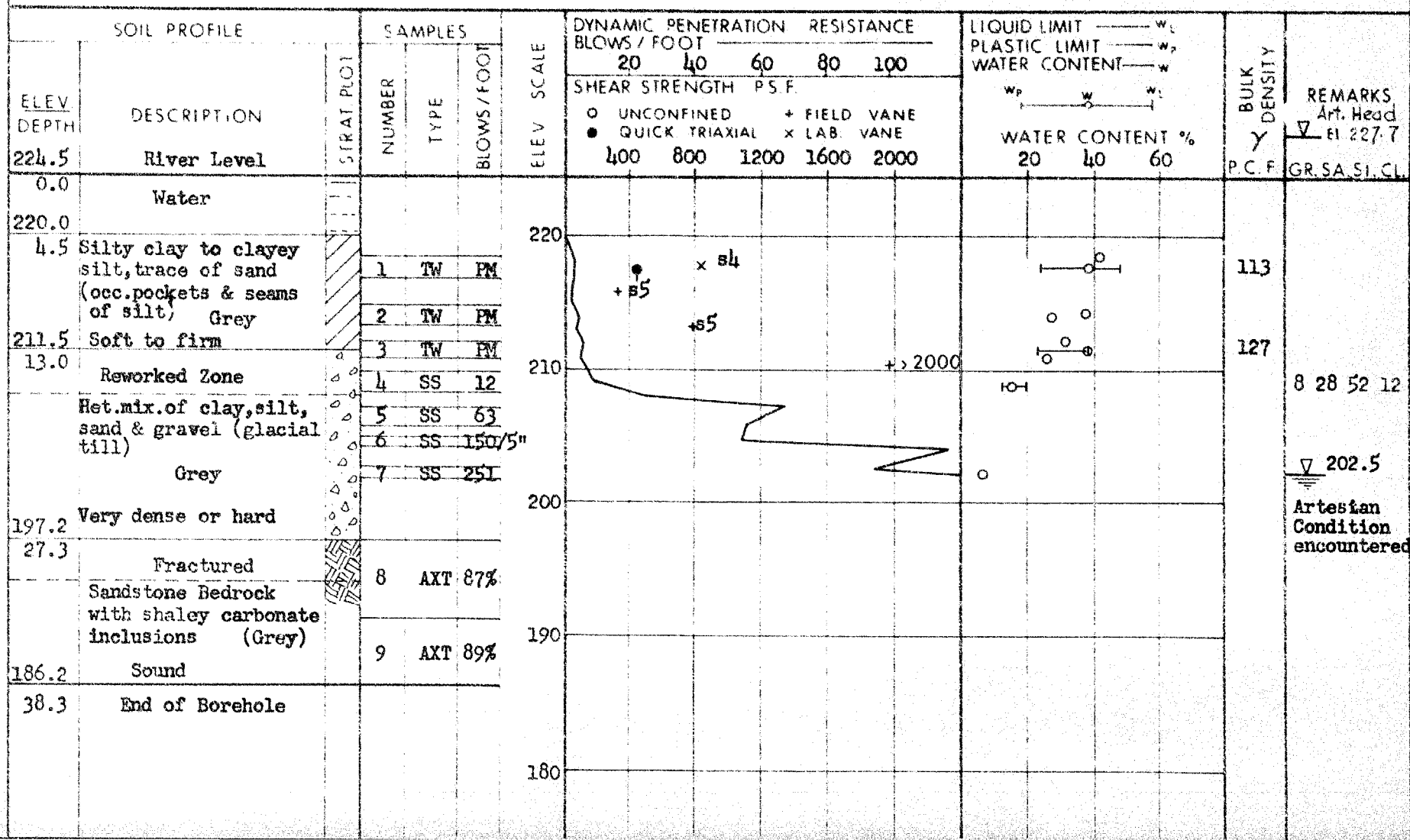
39 47 (14)

DEPARTMENT OF HIGHWAYS- ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 4

FOUNDATION SECTION

JOB 69-F-57 LOCATION Sta. 75 + 42 o/s 16' Lt. # ORIGINATED BY DP
 W.P. 33-66-00 BORING DATE August 18, 19, 20, 1969 COMPILED BY DP
 DATUM Geodetic BOREHOLE TYPE Washboring NX,BX Casing; AXT Rock Core CHECKED BY *ME*

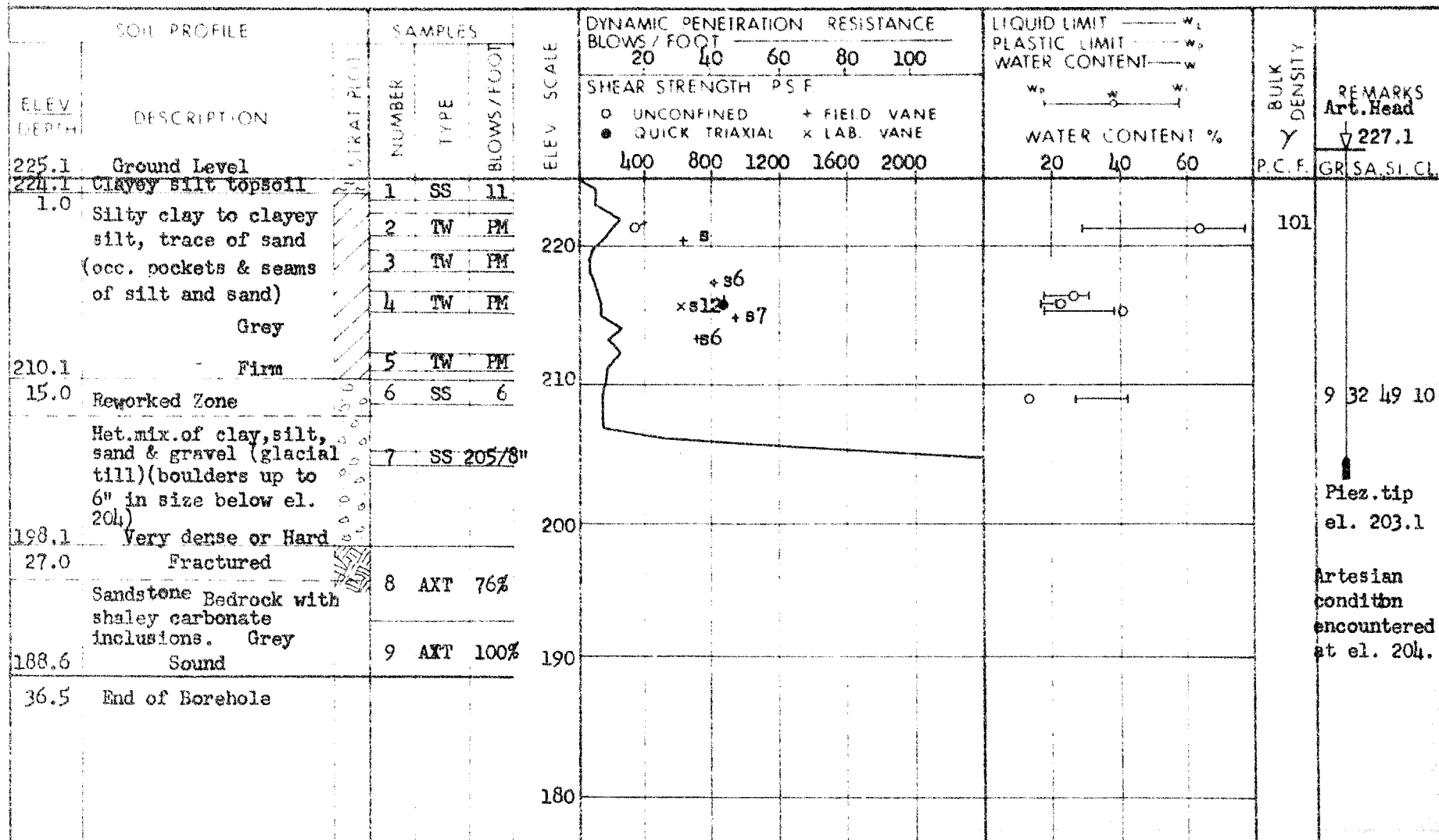


DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 5

FOUNDATION SECTION

JOB 69-F-57 LOCATION Sta. 74 + 60 on Ø ORIGINATED BY DP
 W P 33-66-00 BORING DATE August 24, 25, 1969 COMPILED BY DP
 DATUM Geodetic BOREHOLE TYPE Washboring NX,BX Casing; Axt Rock Core CHECKED BY *JK*



CHECKED BY

Piez.#1
Tip.el.
197.9

WL in piez'
Aug.27/69

CHECKED BY

FOUNDATION SECTION

[illegible]

FOUNDATION SECTION

ORIGINATED BY DP

COMPILED BY DP

CHECKED BY

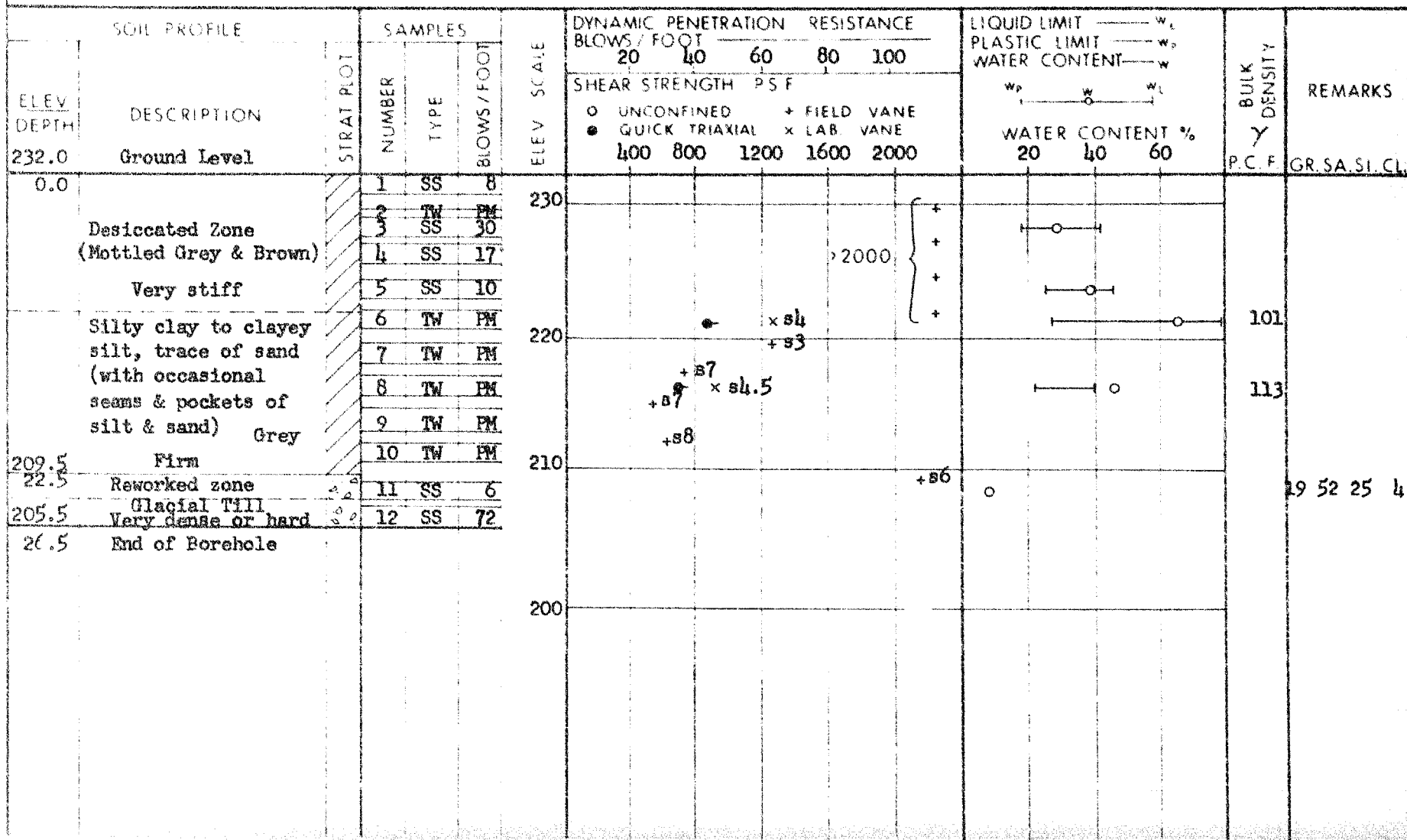
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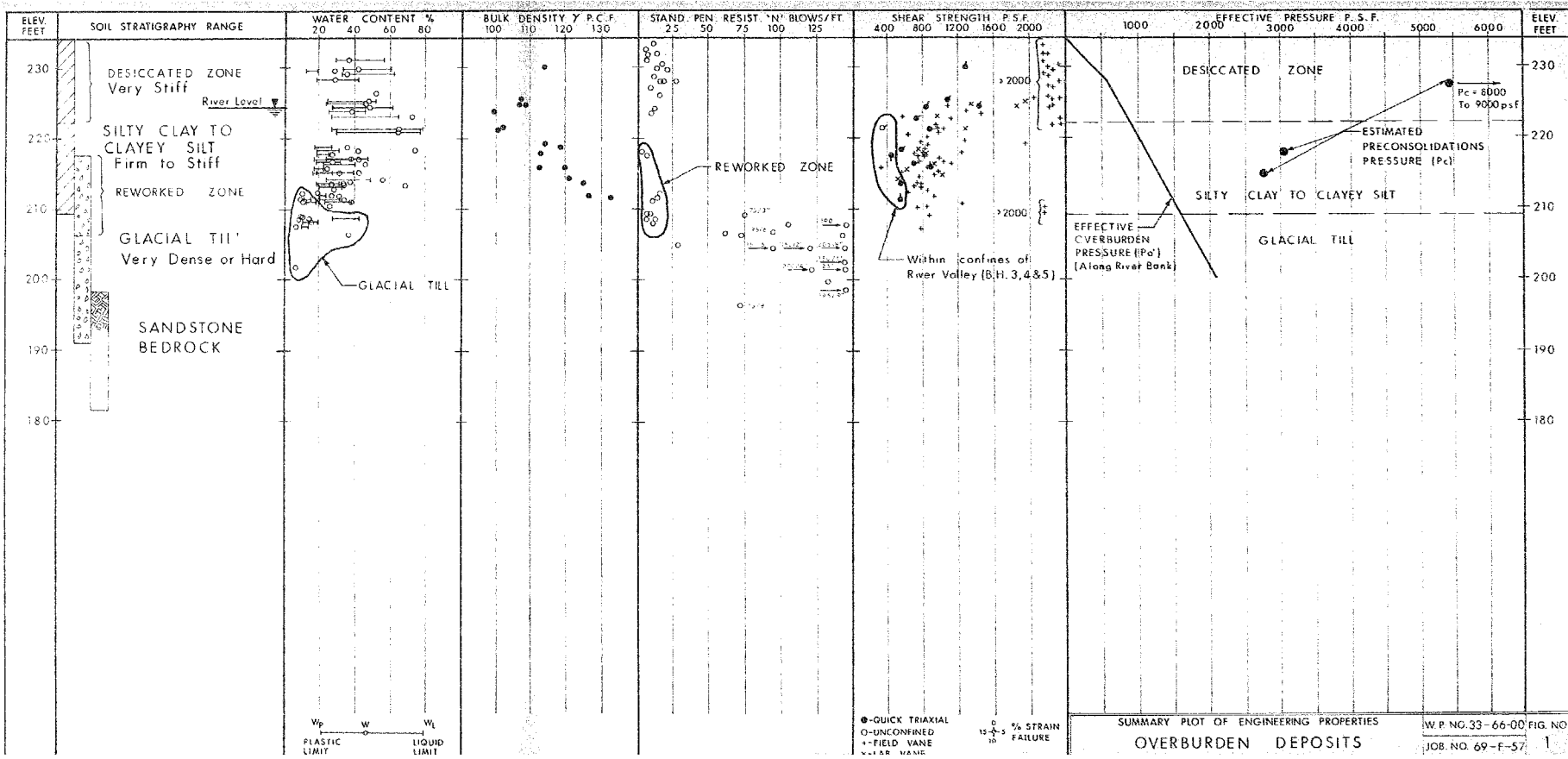
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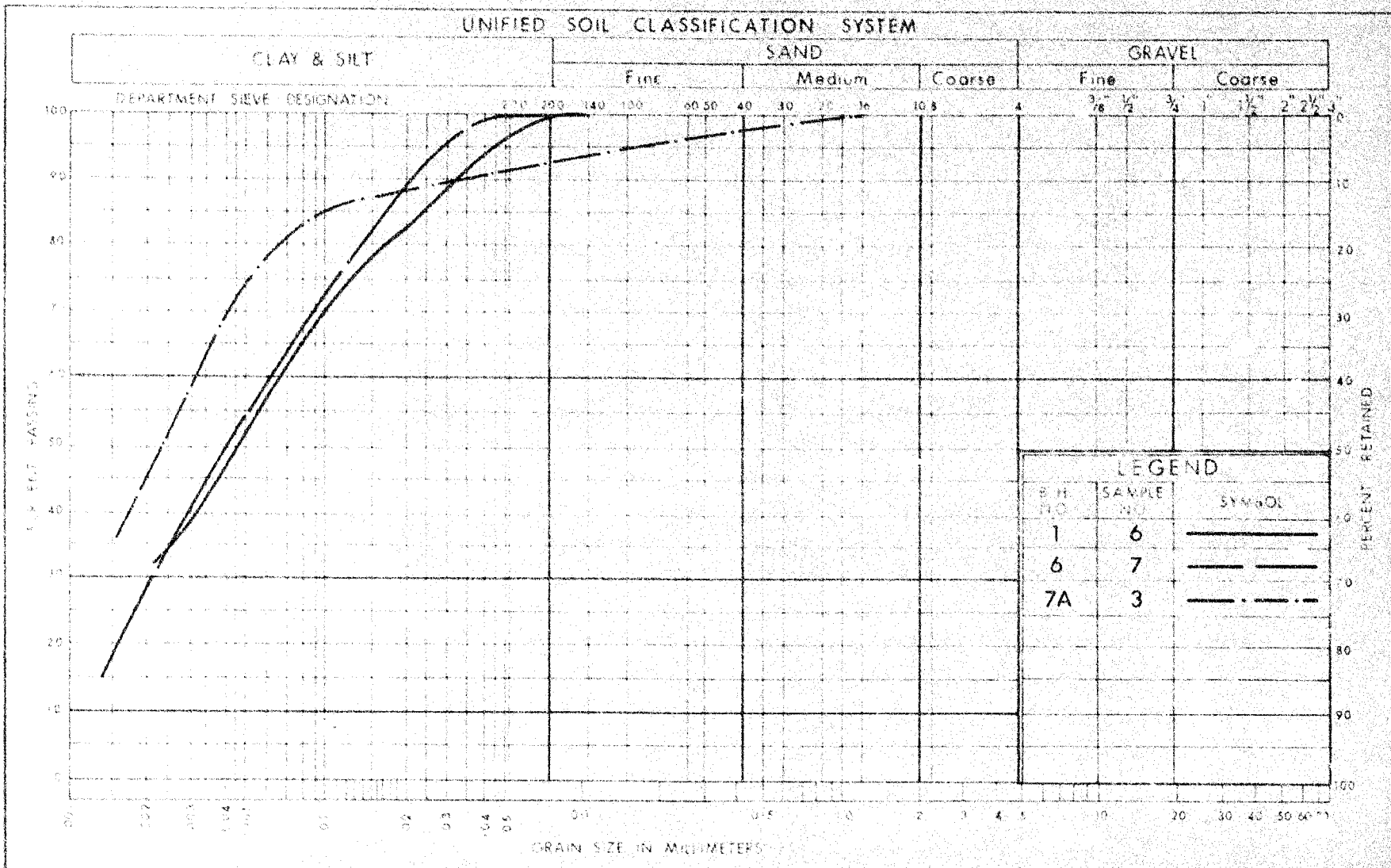
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FOUNDATION SECTION

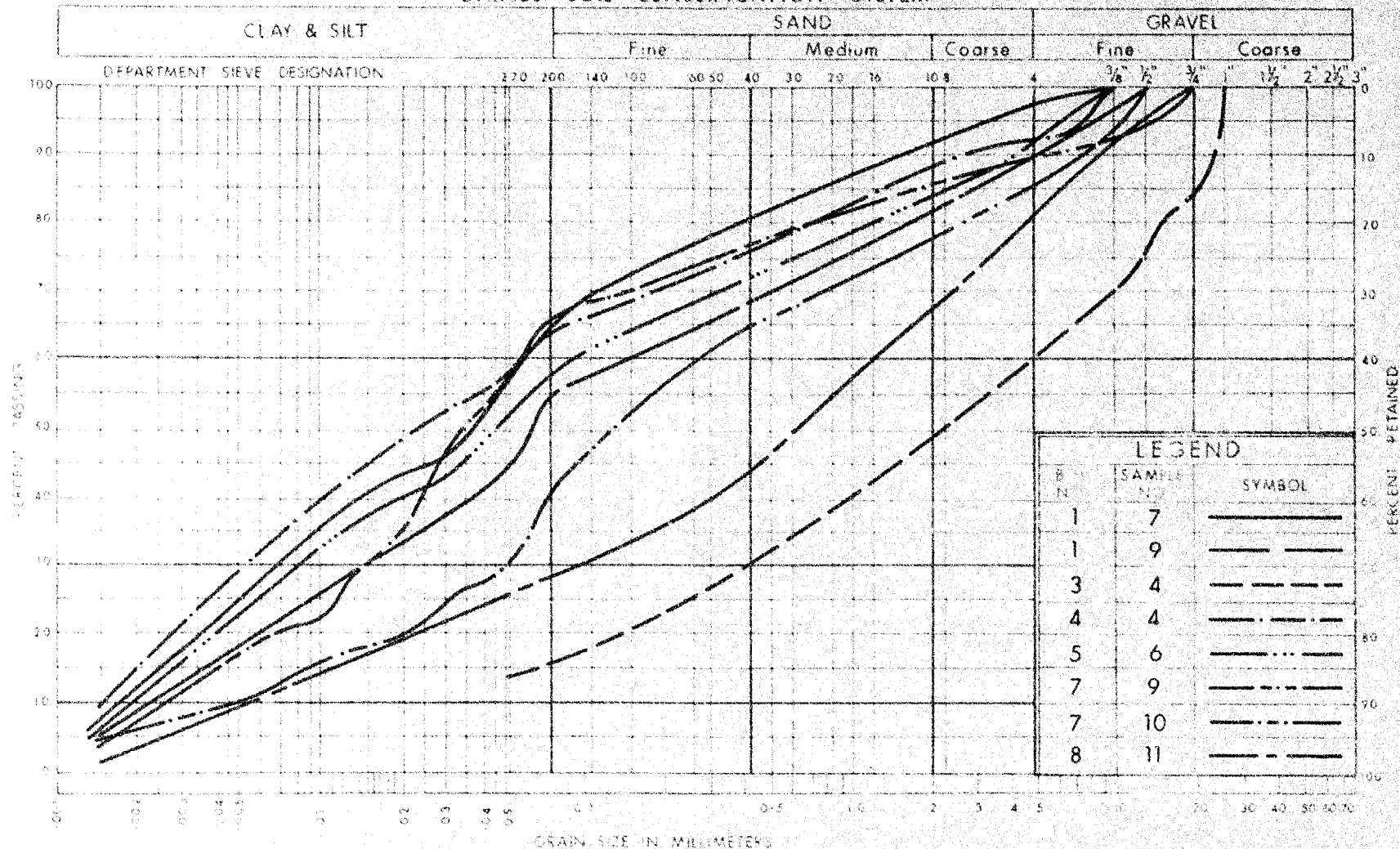
JOB 69-F-57 LOCATION Sta. 72 + 45 on Ø ORIGINATED BY DP
 W P 33-66-00 BORING DATE August 26, 27, 1969 COMPILED BY DP
 DATUM Geodetic BOREHOLE TYPE Washboring NX Casing CHECKED BY *4R*







UNIFIED SOIL CLASSIFICATION SYSTEM

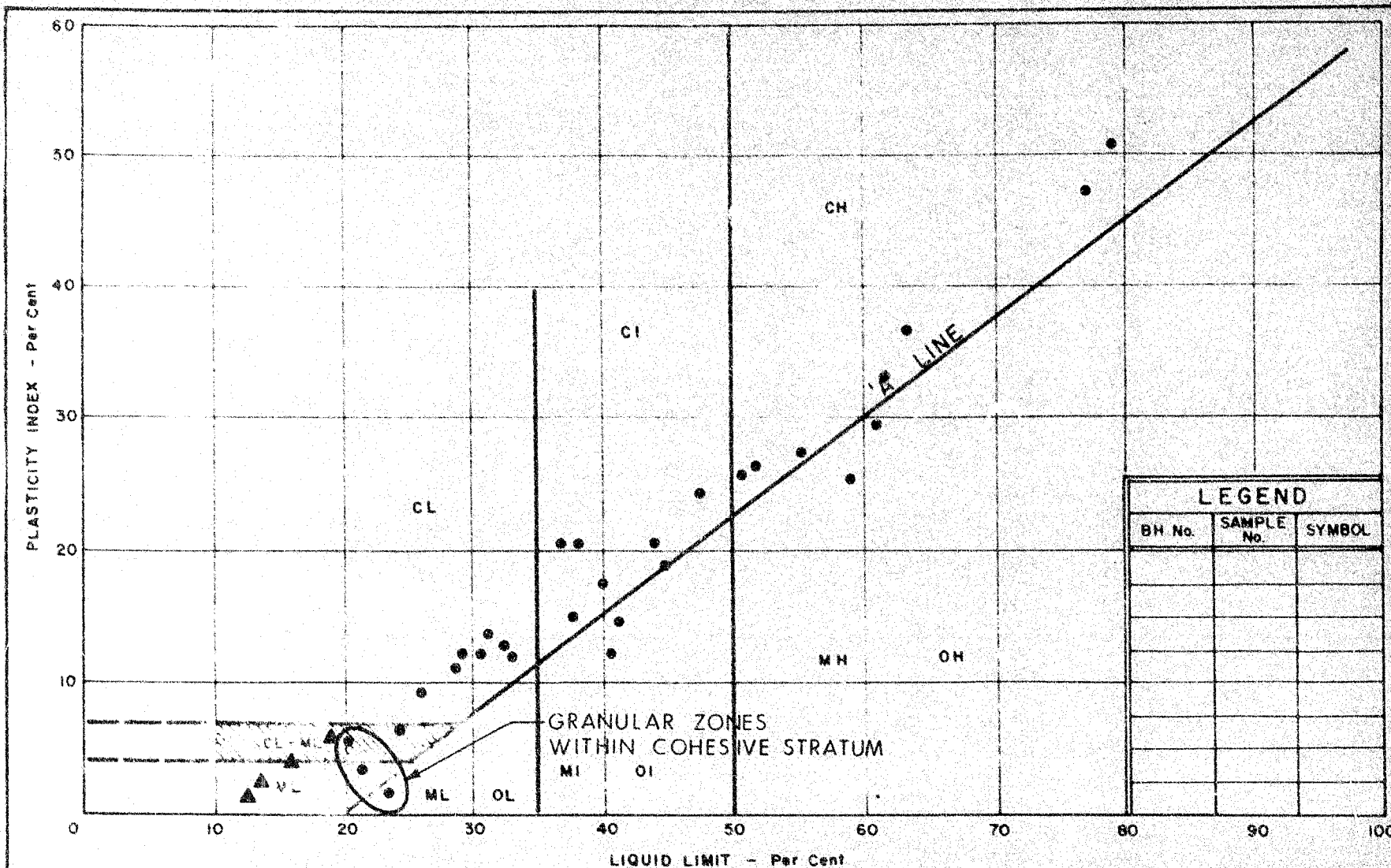


DEPARTMENT OF HIGHWAYS
MATERIALS and
TESTING
DIVISION

GRAIN SIZE DISTRIBUTION
GLACIAL TILL
HET. MIXTURE OF CLAY, SILT, SAND & GRAVEL FIG. NO. 3

W.P. No. 33-66-00

JOB No. 69-F-57



DEPARTMENT OF HIGHWAYS
MATERIALS and
TESTING
DIVISION

PLASTICITY CHART

- - SILTY CLAY TO CLAYEY SILT Stratum
- ▲ - GLACIAL TILL Deposit

WP No. 33-66-00

JOB No. 69-F-57

FIG. NO 4

VOID RATIO - PRESSURE CURVES

JOB NO. 69-F-57

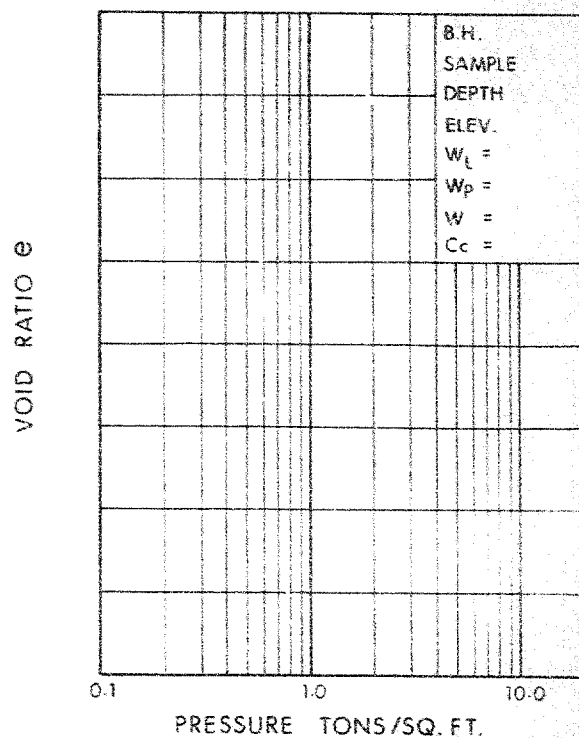
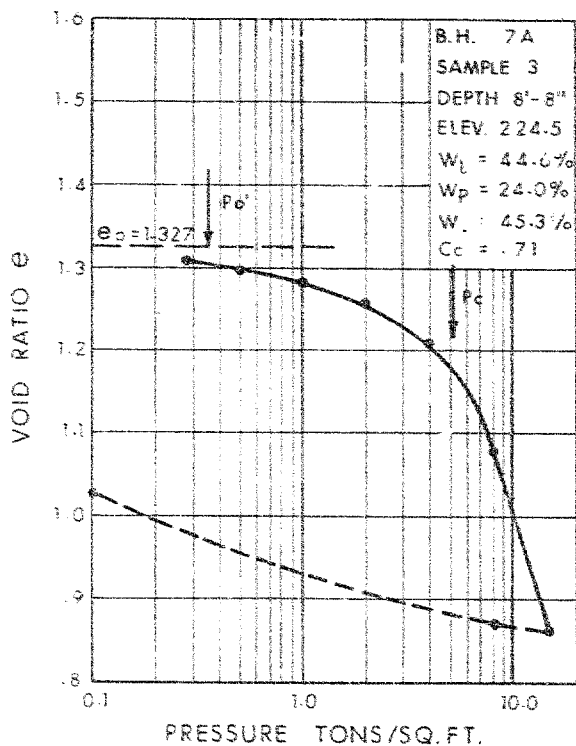
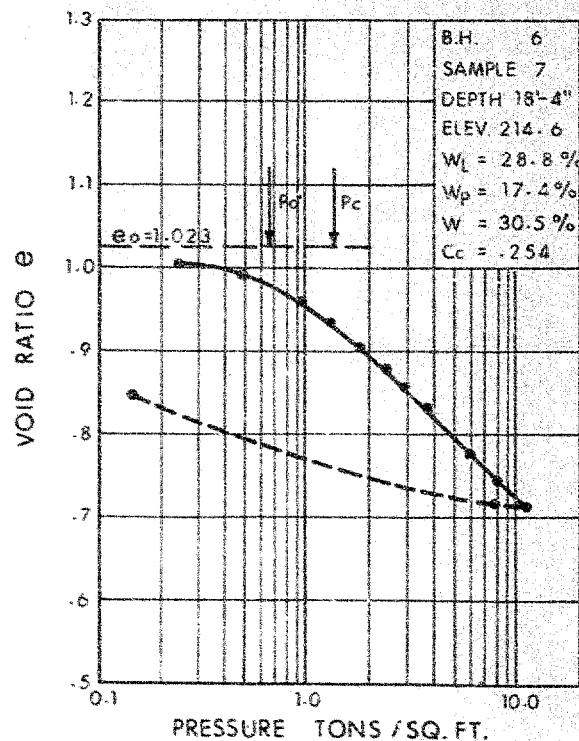
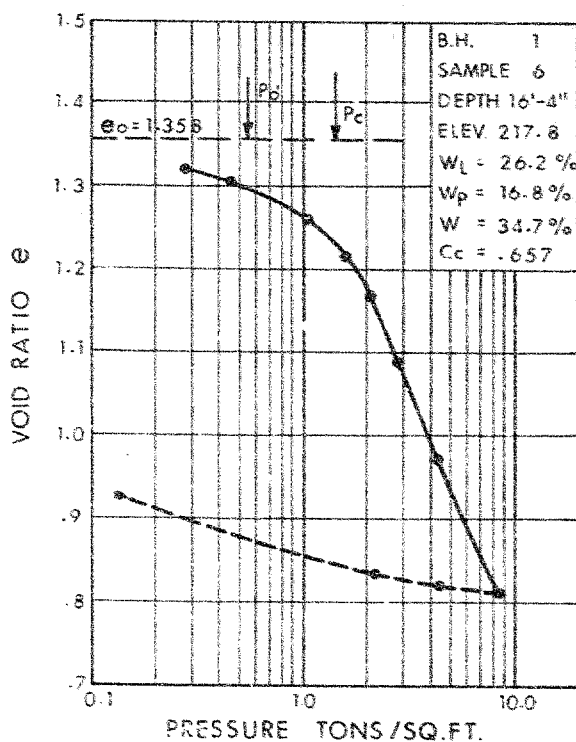


FIG. 5

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
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

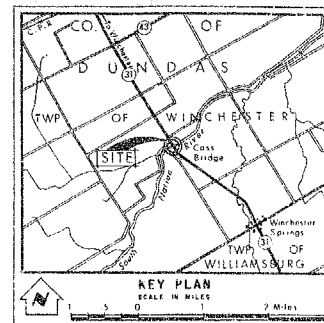
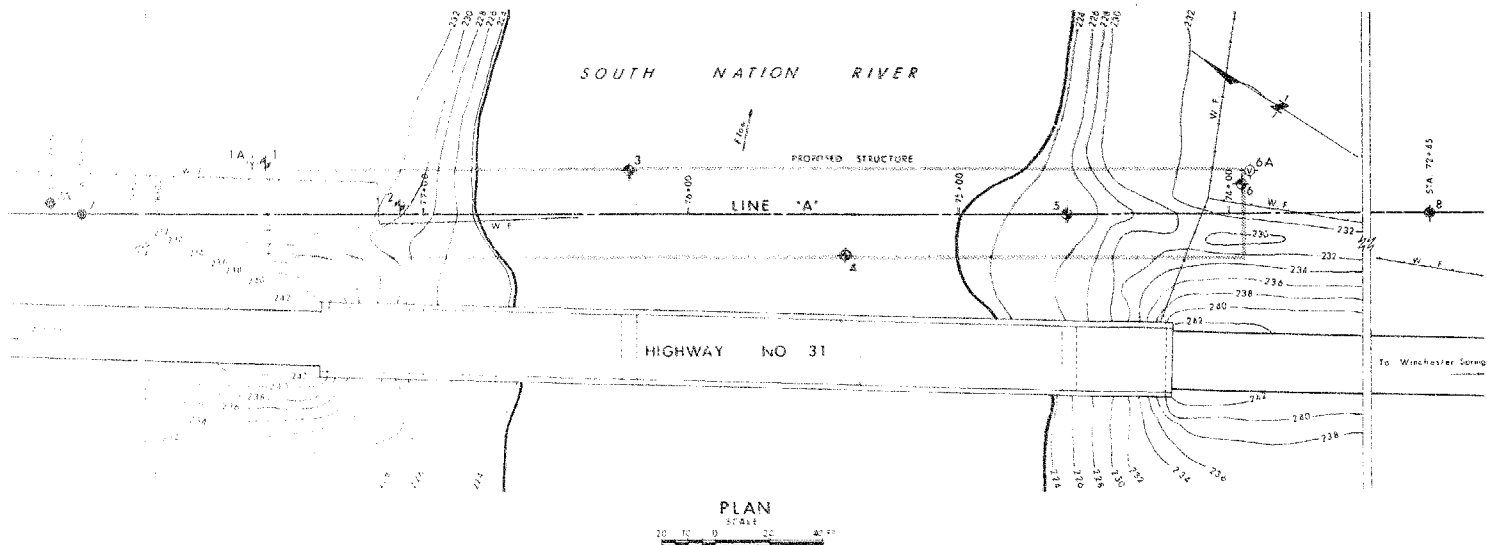
d	DISTANCE FROM TOP OF WALL TO POINT OF APPLICATION OF PRESSURE
δ	ANGLE OF WALL FRICTION
K	DIMENSIONLESS COEFFICIENT TO BE USED WITH VARIOUS SUFFIXES IN EXPRESSIONS REFERRING TO NORMAL STRESS ON WALLS
K_o	COEFFICIENT OF EARTH PRESSURE AT REST

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



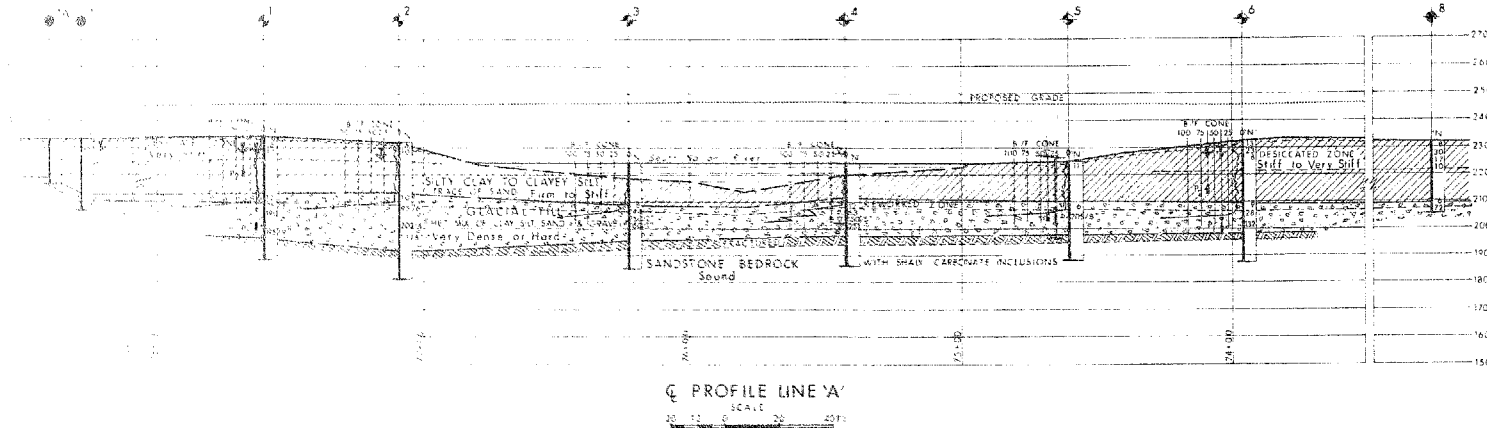
LEGEND

- Bore Hole
- Cone Penetration Hole
- Bore B Cone Penetration Hole
- Water Levels established at time of field investigation Aug. 1969
- Piezometer
- HEAD
- Artesian Condition
- ENCOUNTERED

NO.	ELEVATION	STATION	OFFBY
1	234.1	77+60	10' RT
1A	234.1	77+64	10' RT
2	231.9	77+09	3' RT
3	224.5	76+73	16' RT
4	226.5	75+42	16' LT
5	225.1	74+60	Q
6	232.9	73+95	11' RT
6A	232.9	73+92	16' RT
7	233.1	70+19	Q
7A	233.0	70+32	4' RT
8	242.0	72+45	Q

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.



DATE	BY	DESCRIPTION

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING OFFICE - FOUNDATION SECTION

SOUTH NATION RIVER
(CASS BRIDGE)

KING'S HIGHWAY NO 31 REV'N LINE 'A' DIST NO 9
CO. DUNDAS
TWP. WINCHESTER LOT 4 COR. II

BORE HOLE LOCATIONS & SOIL STRATA

BORE HOLE NO. 101222 H.P. NO. 32-66-00 M.B.T. CHARGING NO.
DRAWN G. R. CHECKED J. R. JOE NO. 65-F-37 69-F-57A
DATE Oct. 1, 1969 SITE NO. UNLESS DRAWING NO.
APPROVED [Signature] DIST NO. 71-113

SUMMARY OF PILE DRIVING RECORDS

W.O. 69-11057 W.P. 33-66 CONT. 71-10 DIST. 9

SITE CASS BRIDGE OVER SOUTH NATION RIVER

DATE DRIVEN JUNE 2/71 WEIGHT OF ANVIL 1100 LB

HAMMER TYPE PORTING HAMMER WEIGHT 6800 lb ENERGY 40800 FT/LB
R-225

[illegible]

OVER

Form OS-MT-285

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS AND TESTING OFFICE
FOUNDATION SECTION

6.000
40.320

BRIDGE CONSTRUCTION - PILE DRIVING RECORD

DISTRICT NO. 9 CONTRACT NO. 71-10 STRUCTURE CASS RIVER BRIDGE
CONTRACTOR CORNWALL GRAVEL CO. LTD. DESIGN LOAD OF PILE 70 TONS
HAMMER DETAILS TYPE BERMINGHAM CO. LTD. WEIGHT 6,800 HEIGHT OF FALL OR ENERGY 6'
TYPE OF ANVIL OR CAP B225 WEIGHT OF ANVIL OR CAP 1,100 lbs
PILE DETAILS 12 B P 53 STEEL "H" PILING (24') HAD TO SPLICED
PILE NO. 18 LOCATION SOUTH ABUTMENT FOOTINGS DATE DRIVEN JUNE 2 1971

TOTAL LENGTH BEING DRIVEN	LENGTH IN GROUND	PENETRATION BLOWS / FT.	TOTAL LENGTH BEING DRIVEN	LENGTH IN GROUND	PENETRATION BLOWS / FT.	TOTAL LENGTH BEING DRIVEN	LENGTH IN GROUND	PENETRATION BLOWS / FT.	TOTAL LENGTH BEING DRIVEN	LENGTH IN GROUND	PENETRATION BLOWS / FT.
	1			26	4		61			76	
	2			27	20		52			77	
	3			28	54		53			78	
	4			29	72		54			79	
	5			30			55			80	
	6			31			56			81	
	7			32			57			82	
	8			33			58			83	
	9			34			59			84	
	10			35			60			85	
	11			36			61			86	
	12			37			62			87	
	13			38			63			88	
	14			39			64			89	
	15			40			65			90	
	16			41			66			91	
	17			42			67			92	
	18			43			68			93	
	19			44			69			94	
	20			45			70			95	
	21			46			71			96	
	22			47			72			97	
	23			48			73			98	
SPLICE	24	↓		49			74			99	
	25	4		50			75			100	

DETAILS FOR FINAL SIX INCHES OF PENETRATION	1	2	3	4	5	6
BLOWS PER INCH				12-14	8	6
MEASURED REBOUND IN INCHES				1/8	1/16	1/16
FINAL LENGTH OF PILE <u>29' 10"</u>	FINAL CUT OFF ELEVATION <u>226.9</u>					

REPORT TO BE SENT TO: - PRINCIPAL FOUNDATION ENGINEER
MATERIALS & TESTING DIVISION
DEPARTMENT OF HIGHWAYS
DOWNSVIEW, ONTARIO

SIGNED Gerald Simpson
NAME (PRINT) GERALD SIMPSON

DATE JUNE 2 - 1971

ATTACH SKETCH OF PILE NUMBERING SYSTEM

MR. BILL NASHIZUME
ON PROJECT WHILE
DRIVING

226.0
19.8
198.2

Notes:-

In general this form should be completed for every tenth pile in a group, but at least one is required for every pier and abutment.

Piles driven vertically should be selected where possible.

Pile Details must include type, dimensions and weight per foot, details of shoe, and slope of batter: e.g. 12 $\frac{3}{4}$ " O.D. steel tube x 0.251" @ 33 lbs. per ft. Vertical. 12 $\frac{3}{4}$ " x $\frac{1}{2}$ " steel plate shoe.

Details for the final six inches of penetration must be completed for all piles except in the case of an end bearing pile driven to bedrock. Final length of pile, and final cut off elevation must always be given.

The total length being driven is the full length of the pile and remains unchanged until a length is cut off or spliced on.

The penetration in blows per foot must be recorded for every foot of penetration of the pile.

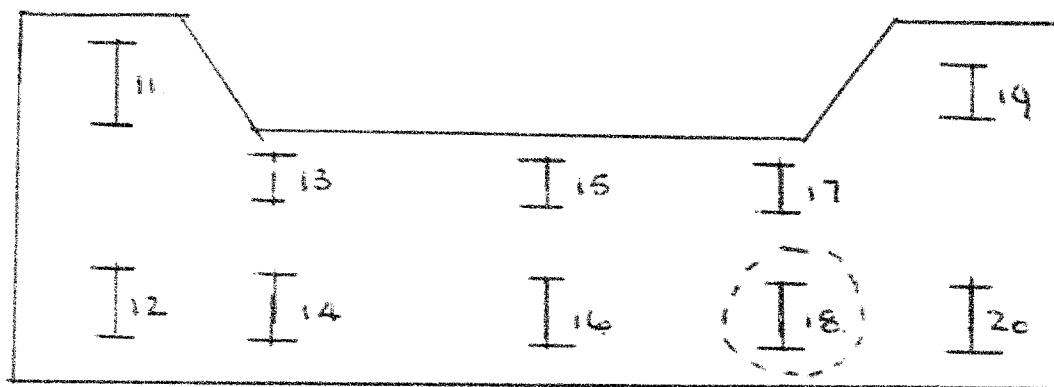
Measured rebounds recorded on this form must be the average for each individual inch for the final six inches of penetration.

SOUTH NATION CASS RIVER BRIDGE

CONTRACT T1-10 WINCHESTER HWY "31

OTTAWA "9 DISTRICT.

4
SOUTH



TEST PILE NO 18 12 B P 53. PILE 24' 0" SPACE

5' 10" TOTAL LENGTH 29' 10"

Gerald Simpson
Inspector.

MEMORANDUM

TO: G. Martens
Asst. Construction Engineer

FROM: A. G. Stermac
Principal Foundation Engineer

ATTENTION

DATE: December 6, 1971

OUR FILE REF.

IN REPLY TO

SUBJECT: Contract 71-10

With respect to your letter of October 8, 1971 and our discussion of December 6, 1971, regarding the above subject, please find below our views and opinions for your use and guidance:

1. Boreholes No. 3 and 4 show basically the same materials and similar stratigraphy. The material described as glacial till is extremely dense as evidenced by the very high blow counts on the Standard Penetration Test.
2. In neither of these two boreholes were boulders encountered, and consequently were not reported or shown on either the borelogs or the stratigraphical profile.
3. In Borehole No.5, which was situated approximately in the middle of the south abutment, boulders up to 6" in diameter, below elevation 204, were encountered and recorded on the appropriate borehole log.
4. The information contained in foundation reports is true only for the very locations at which boreholes are actually put down. The type of material and the stratigraphy between these locations is only inferred. Consequently it should not be surprising that conditions on a site could vary somewhat from those which are inferred from a limited number of investigated locations. This is in particular valid for glacial tills which are composed of all sorts of materials moved and deposited by glaciers in a most random way.
5. In view of what is said under (4), it is entirely possible that the Contractor has encountered different conditions at the south and north piers respectively, although the two boreholes (No.3 & 4) covering this area failed to indicate such a difference.

6. The design called for the 4 ft. dia. caissons to be socketted into the underlying dolomitic limestone and sandstone. In order to accomplish this the contractor had to resort (we believe) to a chopping and crushing procedure using some heavy equipment. In view of this we have difficulty in understanding that such heavy equipment was unable to remove the obstacles (boulders) encountered in the overburden and that men had to be lowered down the caissons and use air breakers. However, not having been witness to this operation we would suggest that the views and opinions of our District staff be taken as guides in deciding on this aspect of the problem.

Should you wish to discuss the problem further please feel free to contact this office.



A. G. Stermac
PRINCIPAL FOUNDATION ENGINEER

AGS:mt

DEPARTMENT OF TRANSPORTATION AND COMMUNICATIONS

MEMORANDUM

TO: Mr. A. G. Stermac,
Principal Foundation Engineer,
Foundation Office,
Design Services Branch.

FROM: G. Martens

ATTENTION:

DATE: October 8, 1971

OUR FILE REF.

IN REPLY TO

SUBJECT: Contract 71-10

DP 33-66-01 Y12

I am enclosing for review and comment copies of the caisson sub-contractor's claim and the District's report. Please note the contractor's reference to difference in the subsoil between that found and that shown on the foundation drawings.



G. Martens,
Asst. Construction Engineer

for: P. G. Allen, Director,
Construction Branch.

GM:gn
Encl.

MEMORANDUM

To: P.G. Allen
Director of Construction Br.
DOWNSVIEW

From: District #9 Ottawa

ATTENTION: Mr. J. Martens

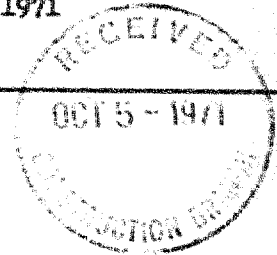
DATE: October 5th, 1971

OUR FILE REF.

IN REPLY TO

SUBJECT:

CONTRACT 71-10



Further to our conversation of Friday, October 1st, 1971, concerning the intent to claim which was submitted by Cornwall Gravel Co. Limited, concerning the additional cost of driving caissons on the Cass Bridge. We also attach a detailed report which has been compiled by H. Alguire, Construction Supervisor.

Also enclosed with this report are charts noting the progress of the driving in both the north and south piers.

Attached are the following:

- 1) Letter from Bermingham Construction Limited dated August 20/71 to Looby Construction Limited.
- 2) Letter and invoice dated August 20/71 from Looby Construction Ltd. to Cornwall Gravel Co. Limited.
- 3) Invoice from Cornwall Gravel Co. Limited dated August 31/71 together with copies of #1 and #2 above.

I trust the attached is in order and that we are correct in forwarding these invoices to your office. Should any additional information be required from the District, please advise.

A handwritten signature in cursive script, appearing to read 'R. R. Wert'.

R. R. Wert
Engineering Office Supervisor

RW:ds
Att.

c.c. J.W. MacDougall, Claims Engineer

MEMORANDUM

To: L.M. Peverett
Dist. Construction Engineer
District #9 Ottawa

From: District #9 Ottawa

Attention:

Date: September/1971

Our File Ref.

In Reply To

Subject:

RE: CORNWALL GRAVEL SUB-CONSTRUCTORS, BIRMINGHAM CONSTRUCTION
71-10 - CLAIM FOR ADDITIONAL COSTS INCURRED RESULTING FROM
CAISSONS INSTALLATION BEING PERFORMED IN SOIL CONDITIONS SUB-
STANTIALLY DIFFERENT FROM CONDITIONS INDICATED ON DRAWINGS.

In reply to the above noted claim, it is my interpretation of the Foundations Investigation Report that results from boreholes #3 and #4 in general alignment of the piers indicates soils conditions are relatively the same.

Three distinct layers are described in the report.

The first layer immediately beneath the stream bed approximately 8.5' in thickness consists of Silty Clay to Clayey Silt with numerous pockets of sand and silt. This layer as indicated in attached report did not present a problem in placing the Caissons.


A second layer described as Glacial Till made up of Heterogeneous Mixture of Clay, Silt, Sand and Gravel, approximately 12' or 13' in depth seemed to interfere with the progress in placing of the Caissons in the north pier. Boulders up to one foot were encountered thus having the contractor change to other equipment.

It would seem that boulders of the dimensions noted above were not adequately covered in the report.

The third layer referred to in the report was fractured rock and solid rock. All was as expected.

However, in closing, I would like to refer you to the note on Contract drawings sheet number D-6755-2 which says - THE BOUNDARIES BETWEEN SOIL STRATA HAVE BEEN ESTABLISHED ONLY AT BOREHOLE LOCATION. BETWEEN BOREHOLES THE BOUNDARIES ARE ASSUMED FROM GEOLOGICAL EVIDENCE AND MAY BE SUBJECT TO CONSIDERABLE ERROR.

HA;ds

H. Alguire 
Construction Supervisor

MISCELLANEOUS DETAIL SHEET

(DO NOT USE FOR GRADING QUANTITIES, ETC.
OR FOR SCRATCH PAD USE)

SHEET NO. _____ OF _____ DATE _____

WORK PROJECT NO. _____ CONTRACT NO. 71-10 ITEM NO. _____LOCATION OF MATERIAL, ETC. PROGRESS CHART FOR CAISSONS LOCATION - SOUTH PIER

FEET DOWN FROM CUT-OFF ELEV ELEV 226.00	RESULTS AS PER FOUNDATION REPORT	ELEV 226.00 CUT-OFF ELEV	EAST CAISSON		WEST CAISSON		REMARKS	UNIT
			DAILY PROGRESS		DAILY PROGRESS			
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								
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35								

DETAILED BY _____

CHECKED BY _____

MISCELLANEOUS DETAIL SHEET

(DO NOT USE FOR GRADING QUANTITIES, ETC.)
(A FOR SCRATCH PAD USE)

SHEET NO. _____ OF _____ DATE _____

WORK PROJECT NO. _____ CONTR. LT. NO. 71-10 ITEM NO. _____

LOCATION OF MATERIAL, ETC. PROGRESS CHART FOR CAISSONS (LOCATION-NORTH PIER)

FEET DOWN FROM CUT-OFF ELEV. 226.00			RESULTS AS PER FOUNDATION REPORT		ELEV. 226.00 CUT-OFF ELEV.		EAST CAISSON	WEST CAISSON	REMARKS	UNIT
							DAILY PROGRESS	DAILY PROGRESS		
1										
2										
3										
4										
5										
6										
7						ELEV 219.0	JUNE 21/71 FREE FALL	JUNE 21/71 FREE-FALL		
8										
9										
10										
11										
12										
13										
14										
15										
16										
17										
18						ELEV 209.0	JUNE 28/71 JUNE 27, 28, 29, 30 VED. SLOW PROGRESS ENCOUNTERED WATER IN CAISSON WATER IN CAISSON	JUNE 28/71 JUNE 28, 29, 30 VED. SLOW PROGRESS ENCOUNTERED WATER IN CAISSON WATER IN CAISSON		
19										
20										
21										
22										
23										
24										
25										
26										
27										
28										
29										
30						ELEV 196.0	JUNE 24/71 VED. CLOS. PROGRESS	JUNE 24/71 VED. CLOS. PROGRESS		
31										
32										
33										
34						ELEV 192.0	JULY 7/71 VED. CLOS. PROGRESS	JULY 7/71 VED. CLOS. PROGRESS		
35										

CORNWALL GRAVEL COMPANY LIMITED

FOR READY MIX CONCRETE PHONE - GRANT READY MIX LIMITED

P.O. BOX 67
390 - 11TH ST. W.
CORNWALL, ONT.
PHONE 932-2512

PHONE - 932-2512
MANAGERS - IVAN & LONEL GRANT

Caund

INVOICE NO.
D 000122

District Engineer
Dept. of Transportation & Communication
530 Tremblay Road
Ottawa, Ontario
Contract 71-10

DATE 01/71

PLEASE RETURN ONE COPY OF INVOICE WITH PAYMENT

ORDER OR JOB NUMBER

TERMS:

1% PER MONTH CARRYING CHARGE AFTER 30 DAYS

INVOICE DATE	CODE	DELIVERY SLIP NUMBER	QUANTITY	PRICE	AMOUNT	TOTAL
RE: D.H.C. CONTRACT 71-10						
Claim Invoice Leoby Construction Ltd.					\$	7,890.27
5% General Contractor					\$	394.52
Total					\$	<u>7,761.06</u>

RECEIVED
JAN 8 1971

CODE TO KINDS OF MATERIAL AND EQUIPMENT RENTALS

EQUIPMENT RENTALS

FT - FLOAT
 SH - SHOVEL
 BS - BS BULLDOZER
 DT - DT BULLDOZER
 955 - CAT 955 LOADER
 944 - CAT 944 LOADER
 T - TRUCKING
 CAT - MICHIGAN LOADER

MATERIAL

GS - DRIVEWAY GRAVEL
 PR - PIT RUN GRAVEL
 CS - CRUSHED STONE
 CG - CONCRETE GRAVEL
 SD - STONE DUST
 S - SAND
 F - FILL
 B - BRIDGE TOLL

LOOBY BUILDERS (DUBLIN) LIMITED

P.O. BOX 67 • DUBLIN, ONTARIO • 519-341-2800 2800

CONTRACT	DATE OF ORDER
DEVELOPER	DEVELOPER'S NAME
WORKSHOP	DEVELOPER'S ADDRESS
SERVICES	DEVELOPER'S PHONE

Cornwall Gravel Co.Ltd.,
Box 67,
CORNWALL, Ontario.

20th August, 1971

CLAIM INVOICE

Contract: D.H.O. 72-10, Case Bridge on Hwy. #31 at 1.6 Mi. S. of WINCHESTER By Pass.

Details: "NOTICE of INTENT TO CLAIM" dated 13th July, 1971 for additional costs incurred resulting from the caissons installation being performed in soil conditions substantially different from the soil conditions indicated on the Contract Drawings.

Prime Contractors: Cornwall Gravel Co. Limited:
Structure Sub-Contractors: Looby Builders(Dublin) Limited:
Piling & Caissons work: Birmingham Construction Limited:

1 9 7 1

JULY 1-9th

Per Invoice #8273 dated 10th August, 1971 from
Birmingham Construction Limited (att.) \$ 7,044.07

Add: Structure Sub-Contractor's own costs: 5% \$ 352.00

NET CLAIM: \$ 7,396.27

Attached: Detailed explanation of above cost per attached letter from Birmingham Constr.Ltd.



BERMINGHAM

CONSTRUCTION LIMITED

WILLIAMSON STREET MARINE TERMINAL

HAMILTON 71, ONTARIO

Established 1897

Invoice 5-7924

TORONTO
AM 4-2270

TO LOOBY BUILDERS (DUBLIN) LIMITED,
P.O. BOX 69,
DUBLIN ONTARIO

Date 10TH AUGUST, 1971

No. 827J

WINCHESTER
D.H.O. 71-10

EXTRA RE: ADDITIONAL TIME REQUIRED FOR 2 NORTH CAISSONS

4 DAYS AT 11 HOURS PER DAY - TOTAL 44

ALL WORK DONE BETWEEN JUNE 1 AND JULY 9, 1971

LABOUR:

FOREMAN	44 HOURS	@ \$7.78 / HR.	\$ 342.32
OPERATOR	44 HOURS	@ 6.32 / HR.	278.08
PILE DRIVER	44 HOURS	@ 6.32 / HR.	278.08
WELDER BURNER	44 HOURS	@ 6.32 / HR.	278.08

\$1,176.56

PLUS 17% PAYROLL BURDEN

200.00

\$1,376.56

TOTAL \$1,376.56 @ 135%

\$1,858.77

EQUIPMENT: 44 HOURS EACH - RATE / HOUR

CRANE (60TON)	\$33.30	1,465.20
VERTICAL TRAVEL LEADS,		
HYD. OPERATOR	13.05	574.20
MATS (SET OF 7 - 25FT x 4FT)	10.00 / DAY	40.00
CHURN DRILLING EQUIPMENT		
INTERNAL CAISSON DROP HAMMER		
(7,000 LB.)	5.00	220.00
2 - CHURN DIGGING BUCKETS	5.00	220.00
INTERNAL CAISSON BREAKER	10.00	440.00
COMPRESSOR (600 C.F.M.)	11.70	514.80
JET PUMP (5 C.P.H.)	5.00	220.00
ROTARY DRILLING EQUIPMENT		
POWER PAC	15.00	660.00
KELLY BAR & BITS	10.00	440.00
WATER PUMP (2" ELECT.)	.50	22.00
GENERATOR (5 K.W.)	1.25	55.00
WELDER (300 AMP)	1.75	77.00
CUTTING TORCH	3.70	162.80
PICK-UP TRUCK	1.70	74.80

\$1,185.80

\$7,044.07

BERMINGHAM

CONSTRUCTION LIMITED

WELLINGTON STREET MARINE TERMINAL

HAMILTON 21, ONTARIO

HAMILTON
JACKSON 4-7
TORONTO
LA 5-0771

10th August, 1971.

Looby Construction Limited,
P.O. Box 69,
DUBLIN ONTARIO

South Nation River Bridge
D.H.O. 71-10 Winchester

Dear Sirs,

We are submitting the attached claim for additional work on the above project on the basis that the soil conditions encountered in the North pier when installing the two Caissons were substantially different from those indicated on D.H.O. drawing No. D-6755-2.

When installing the Caissons in the South pier the soil strata was found to be exactly as shown in Bore Hole 4 that is approximately 8' of silty clay and then 15' of glacial till (silt, clay, sand and gravel) over lying the rock. No boulders were encountered and a total of eight days was required to complete the two caissons.

Bore Hole 3 which is on the axis of the North pier indicates exactly the same soil strata as those shown in Bore Hole 4 on the axis of the South Pier. When installing the Caissons in the North pier many boulders (hardheads) were encountered, which made it impossible to advance the Caissons by normal machine methods and we had to resort to putting men down inside the Caissons to break the boulders with air breakers. The work on this pier took twelve days to complete.

Cont'd.

Stamp: 1971

In view of the fact that no boulders were shown on the soil report. We are claiming recompense for the additional four days required to complete the North Pier.

Yours very truly,
BERMINGHAM CONSTRUCTION LIMITED

JPM:ph



J. F. McDougall
Vice President.

DIP

900

PROPERTY South Nation River Crossing
LOCATION Rwy. #31
Cass Bridge
69-F-57
LATITUDE _____
DEPARTURE _____
BEARING _____

TOTAL FOOTAGE 45' 8"

ELEV. COLLAR _____
 DATUM _____
 DATE STARTED _____
 DATE COMPLETED _____
 DRILLED BY _____
 LOGGED BY _____
 B.K. Glassford

[illegible]

DATE OF EXAMINATION _____

DATE OF EXAMINATION _____

JANUARY 1970

DIAMOND DRILL RECORD

HOLE NO. 3 SHEET NO. 1

□ □ □

900

TOTAL FOOTAGE 38' 9"

ELEV. COLLAR

DATUM

DATE STARTED

DATE COMPLETED

DELETED

LOADED BY

B.K. Glassford

PROPERTY	
LOCATION	
LATITUDE	
DEPARTURE	
BEARING	

[illegible]

DATE OF EXAMINATION _____

2025-26

PROPERTY	
LOCATION	
LATITUDE	
DÉPARTURE	
BELONGING	

TOTAL FOOTAGE 31 64

ELEV. COLLAR
DATUM
DATE STARTED
DATE COMPLETED
DRILLED BY
LOGGED BY
R. K. Glassford

[illegible]

DATE OF EXAMINATION _____

JANUARY 1970

DEPARTMENT OF HIGHWAYS ONTARIO

DIAMOND DRILL RECORD

HOLE NO. 5 SHEET NO. 1

DOI: 10.1002/for

PROPERTY	
LOCATION	
LATITUDE	
DEPARTURE	
BEARING	

TOTAL FOOTAGE 40' 9"

ELEV. COLLAR _____
 DATUM _____
 DATE STARTED _____
 DATE COMPLETED _____
 DRILLED BY _____
 LOGGED BY _____
 B.K. Glassford

[illegible]

DATE OF EXAMINATION _____

FORM 08-MT-113
JANUARY 1970

ROLL NO. 6 SHEET NO. 1

90

PROPERTY	
LOCATION	
LATITUDE	
DEPARTURE	
HOURS	

TOTAL FOOTAGE 1118 1054

LOGGED BY

B. K. Glassford

[illegible]

DATE OF EXAMINATION _____

June 2
4:00 p.m.

Phone call from Bill Hashizume -
(Call from Contractor's Field Office
Ottawa - Winchester 774-5815)

Re: South Nation River Job -
Our Report 69-7-57

The Contractor drove H-piling
for South Abutment - length of Piling
approx. 30 ft. to refusal to bedrock
- (We recommended 24 ft.)

Wants to know: What length of piling
should they be using on North Abutmen
based on the experience at South
Abutment?

When we have the answer, Bill will
be waiting for our call at the
above number.

6/2

NOTE FOR FILES :

W.P. 33-66-00 W.O. 69-F-57
SOUTH WATLOU RIVER @ LLOY 31

MESSAGE FROM SITE BY BILL HASHIZUMI

AT SOUTH ABUTMENT (BH 5) PILES EASILY
REACHED BEDROCK ; 4 BLOWS/FOOT
BERNARDHAMMER 225 (D-22)

Q: IN VIEW OF THE ABOVE FACT WHAT LENGTH
OF PILES IS TO BE CHOSEN FOR THE NORTH
ABUTMENT (BH 2) ?

A: IT IS REASONABLE TO ASSUME THAT HERE
TWO PILES WILL BE ABLE TO REACH
BEDROCK AND THIS ^{SHOULD} DETERMINE
THE PILE LENGTH.
HOWEVER, IF PILES DO NOT REACH
BEDROCK BECAUSE REFUSAL WAS REACHED
AT A HIGHER ELEVATION, THIS SHOULD
SURPRISE NOBODY.

A.S.

JULY 2, 1971

MEMORANDUM

Gordon Costello.

To: Mr. A. G. Stermac,
Principal Foundation Engineer,
Laboratory Building,
Downsview, Ontario.

FROM: Bridge Section,
Kingston, Ontario.

DATE: July 10, 1969.

ATTENTION:

OUR FILE REF.

IN REPLY TO

SUBJECT:

W.P. 33-66-00, Site 31-85,
Cass Bridge (South Nation River),
(1.7 Miles South of South Jct. Hwy. 43),
Highway 31, District 9

69-F-57

We are sending to you herewith two prints of Bridge Site Plan E-4675-1 on which we have marked the proposed location of the subject structure. Also enclosed are two copies of your Field Reconnaissance Report.

We would be pleased if you will make arrangements for the necessary foundation investigation and to have your report, the scheduled date for which is October 1, 1969.

T. C. Kingsland

T. C. Kingsland
Regional Bridge Planning Engineer

TCK/hl
Encls.
c.c. (with encl.)
Bridge Office Files Section

MEMORANDUM

To: Mr. A. Stermac,
Principal Foundation Engineer,
Room 107, Lab. Building

From: C.S. Grebski,
Bridge Office

ATTENTION:

DATE: April 29, 1970

Our File Ref.

IN REPLY TO

SUBJECT: Cass Bridge over South Nation River
1.6 Mi. South of Winchester By-Pass
W.P. 33-66-02, Site 31-85
Highway 31, District No. 9

69-F-57

Attached herewith we are submitting the final bridge drawings which show the foundation design for this structure.

Kindly give us your comments at your earliest convenience.

CSG:rd

C.S. Grebski
C.S. Grebski,
Bridge Design Engineer

Attach.

c.c. Foundation Office

M. Levent
May 14th 1970

No Comments
BTD
May
14/70

SL

Copy for the information of

Mr. A.O. Stermac, Principal Foundation Engineer,
Room 107, Lab. Building

Mr. T.C. Kingsland,
Reg. Bridge Planning Engineer,
Kingston Regional Office,
Kingston, Ontario

Bridge Office,
Downsview

July 22, 1970

Cass Bridge over S. Nation River
W.P. 33-66-02, Site 31-85
Highway 31, District #9 - Ottawa
Cattle Pass under S. Span

Enclosed are two prints of revised Drawing D-6755-1 showing the layout of the cattle pass under the South span of the proposed structure. It is understood that the Regional Road Design Office will detail the walkway and the fence on their drawings.

If Regional Road Design Office feel that further revisions to our drawing are necessary, would you please arrange for the changes to be marked on one of the prints and return it to us and we will revise our tracings to suit.


K.G. Bassi,
Regional Bridge Design Engineer

KGB:rd

Encls.

c.c. M. Stoyanoff
A.O. Stermac

no comment

M. Stoyanoff
22 Aug 70

no comment

RD

22 Aug 70

MEMORANDUM

To: Mr. J. E. Callaghan,
District Engineer,
OTAWA, Ontario.

From: Road Design Section,
KIMESION, Ontario.

Attention: M. Povey

Date: November 20th, 1970.

C. File Ref.

IN REPLY TO

Subject:

CONTRACT REVIEW MEETINGS

Further to this morning's telephone conversation I confirm the following revised arrangements for Pre-Contract Review meetings.

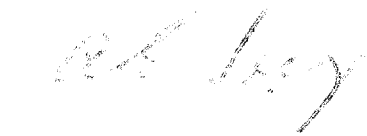
- 1) U.P. 148-66-01 & -02 - Highway #63 - Chesterville Diversion
L/22' CD CB & Structure

This job is to be reviewed on Wednesday December 2nd starting at 10:30 a.m. in Regional Board Room #2.

- 2) U.P. 33-66-01 & -02 - Highway #31 - Cass Bridge - CD CB & Structure
L/22'

This job is to be reviewed on Friday December 4th starting at 1:30 p.m. in Regional Board Room #1.

These arrangements supersede those issued previously in my letter of November 19th, 1970.



A. E. Irving,
SR. PROJECT DESIGN ENGINEER.

AEI/bac

- c.c. - P. Billings
J. Graspier
B. McKay
T. Kingsland
M. Ennisaks
J. Trow
G. Sternac

*Discussed with T. Kingsland on Nov 25th
and agreed that our position may not be
revised. If anything develops, to make
contact with M. Ennisaks*

Ontario
Department of Transportation and Communications
~~XXXXXXXXXXXXXXXXXXXX~~

MEMORANDUM

TO: B.T. Darch,
Senior Foundation Engineer

FROM: G. Woda

ATTENTION:

DATE: June 15, 1971

OUR FILE REF.

IN REPLY TO

SUBJECT:

Proposed Structure Crossing of
The South Nation River and Hwy. #3
(Revision Line 'A')
Cass Bridge ----- Windsor Township
District No. 9 (Ottawa)
W.O. 69-11057 W.P. 33-66-00

Re: Bedrock Description

The examined five (5) diamond cores are represented by carbonates: mostly dolomite and dolomitic limestone, which are fine-grained, and dark-gray in colour.

This carbonate varies considerably in chemical composition and in amounts of clastic material: clay, silt, and sand particles. Concentrations of the first two produce shaly seams, which are usually irregular and interbedded. In some instances a significant accumulation of them form a typical calcareous shale. In the latter case, they might be admixed with carbonates making them arenaceous, or just forms of impure sandstone lenses (they usually appear mottled).

Such variation in composition is typical for the Chazy formation, though this carbonate is mostly dolomitic and possibly, at least in part, might belong to the Beekmantown formation.

G. Woda

#69-F-57

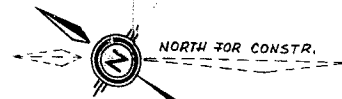
W.P. 33-66-00

H.W.Y. #31

REV'N LINE 'A'

SOUTH NATION

BRIDGE (CASS BRIDGE)



-
- CO. DUNDAS
TWP. WINCHESTER
- 43
- 4 3 2 1
- DOMINION
- TO MORRISBURG
- TO WINCHESTER
- 31
- CASS ABRIDGE
- SITE
- WINCHESTER BRANCH
- CO. RD. 5
- CL. RD. 34
- RD. 5
- TWP. MOUNTAIN
- KEY PLAN
- SCALE : 1 INCH = 1 MI.

NOTES:

CLASS OF CONCRETE

DECK, CURBS & CONCRETE ABOVE CURBS - 4000 P.S.I.

PRESTRESSED CONC. GIRDERS - 5000 P.S.I.

PIER COLUMNS - 4000 P.S.I. REMAINDER - 3000 P.S.I.

CLEAR COVER ON REINF. STEEL

FOOTINGS & ABUTMENTS - 3"

TOP OF DECK - 1½", BOTT. - 1", DIAPHRAGMS - 1½"

CURBS & APPR. SLABS - 2"

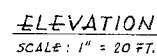
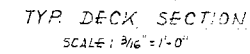
PARAPET WALLS - 1½"

PIERS - AS NOTED

CONSTRUCTION NOTES

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

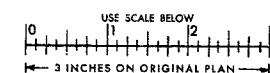
NO CONCRETE SHALL BE PLACED ABOVE THE ABUTMENT BEARING SEATS UNTIL THE CONCRETE IN THE DECK HAS BEEN PLACED




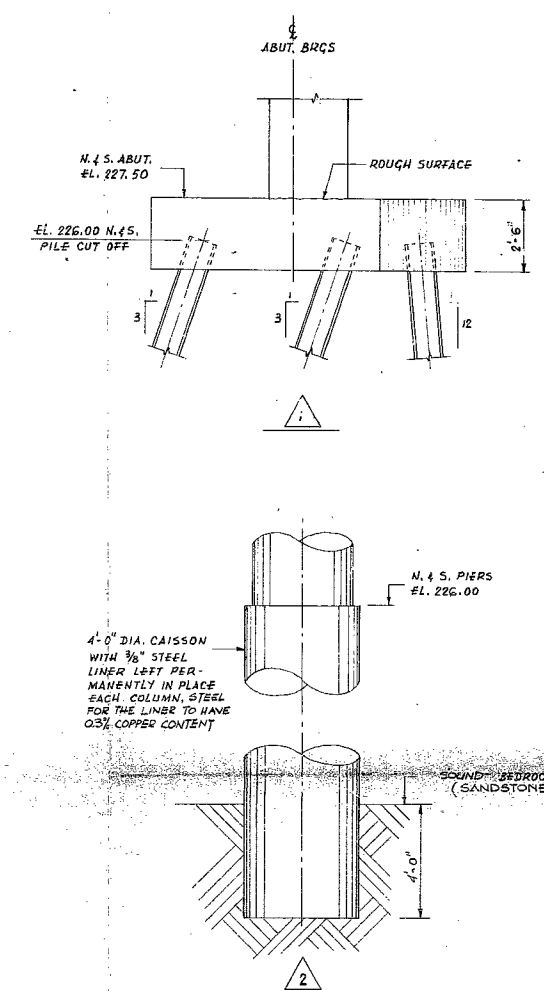
76420



FOR REDUCED PLAN



REVISIONS									
DATE	BY	DESCRIPTION							
<p align="center">DEPARTMENT OF HIGHWAYS ONTARIO BRIDGE DIVISION</p>									
<p align="center"><u>CASS BRIDGE OVER SOUTH NATION RIVER</u> 1.6 MI. SOUTH OF WINCHESTER BY-PASS</p>									
<u>KING'S HIGHWAY No. 31</u>						<u>SITE No. 9</u>			
<u>CO. DUNDAS</u>									
<u>TWP. WINCHESTER</u>						<u>LOT 4</u>		<u>CON. 2</u>	
<p align="center">GENERAL LAYOUT</p>									
APPROVED 					SITE No. <u>31-85</u>		W.P. No. <u>33-66-02</u>		
BRIDGE ENGINEER					CONTRACT No.				
DESIGN	ING. V.S.	CHECK	R.S.R.						
DRAWING	R.K.	CHECK	R.S.R.						
DATE	APRIL 1970	LOADING	HS 20-44			DRAWING No.		D-6755-1	



NOTES:

- PILE SPACING TO BE MEASURED AT UNDERSIDE OF FOOTING.
- PILES TO BE DRIVEN TO REFUSAL IN ACCORDANCE WITH STD DD-1219 (SEE D-6755-12)

[illegible]

DEPARTMENT OF HIGHWAYS ONTARIO
BRIDGE DIVISION

CASS BRIDGE OVER SOUTH NATION RIVER
1.6 MI. S. OF WINCHESTER BY-PASS

KING'S HIGHWAY No. 31 DIST. No. 9
CO. DUNDAS
TWP. WINCHESTER LOT 4 CON. 2

FOOTING LAYOUT

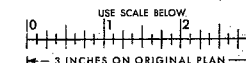
APPROVED _____		MIDDLE ENGINEER		CONTRACT No.			
DESIGN	ING. V. S.	CHECK	R. S. R.	DRAWING No.	D-6755-3		
DRAWING	P. K.	CHECK	MAV. S.				
DATE	APRIL 1970	LOADING	45 20-44				

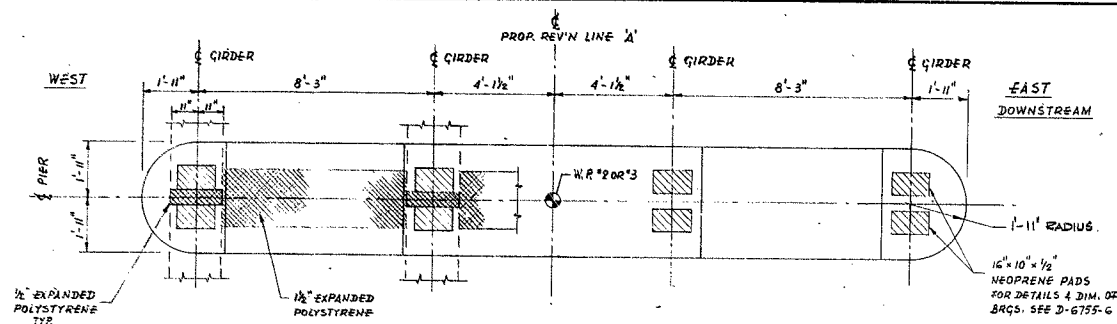
LOCATION	QUANTITY	LENGTH	TYPE	DESIGN LOAD
NORTH ABUT.	10	24'-0" ✓	12 BP 53	70 TONS/PILE
SOUTH ABUT.	10	24'-0" ✓	4" PILES	

LOCATION	DIA.	QUANTITY	STEEL LINER THICKNESS	DESIGN LOAD
NORTH PIER	4'-0"	2	3/8"	280 TONS/CAISSON
SOUTH PIER		2		

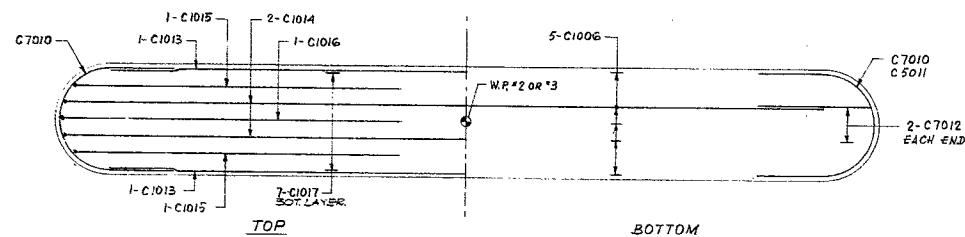
SCALE: $\frac{3}{8}'' = 1'-0''$

FOR REDUCED PLAN

[illegible]

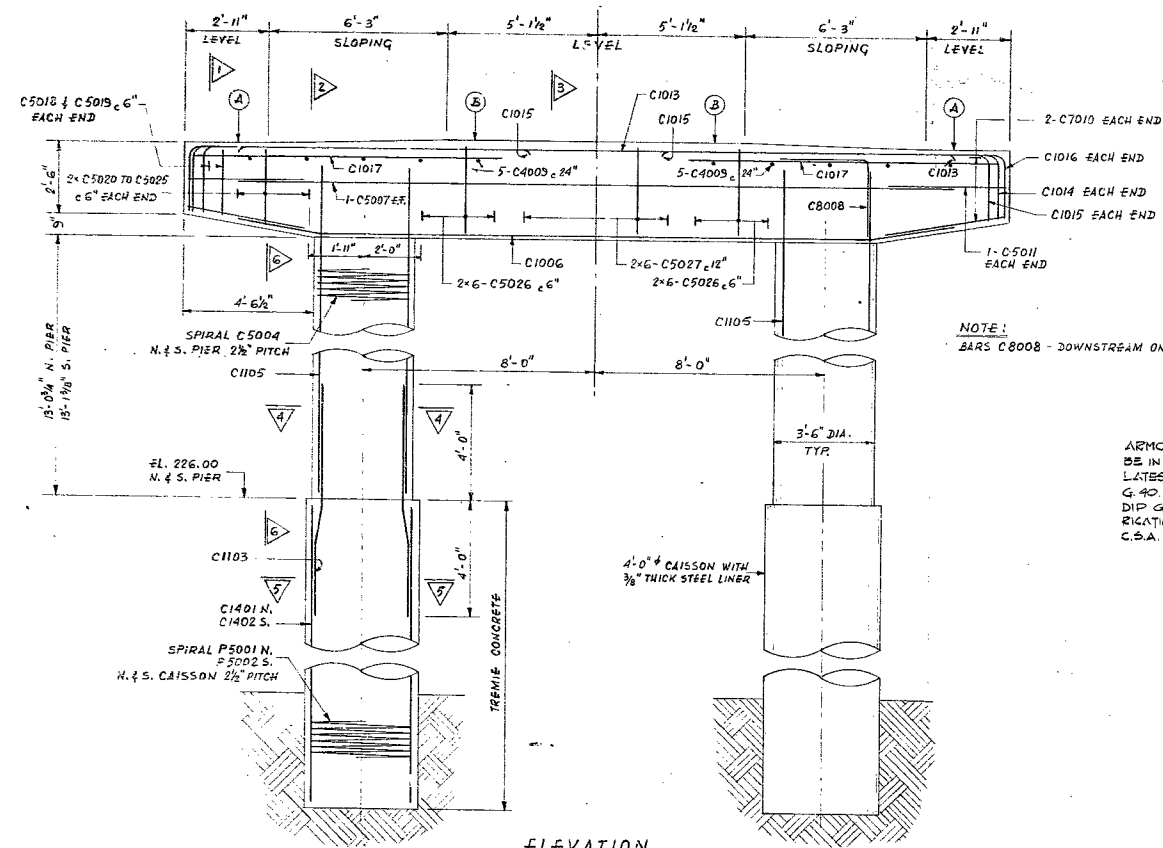


PIER CAP PLAN
SCALE: 3/8" = 1'-0"



PIER CAP PLAN
(REINFORCEMENT SHOWN)
SCALE: 3/8" = 1'-0"

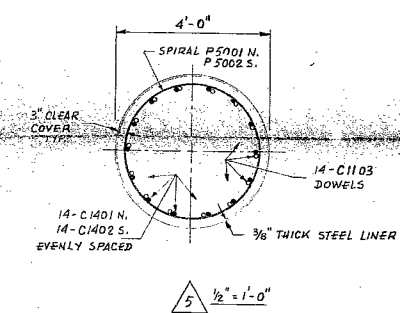
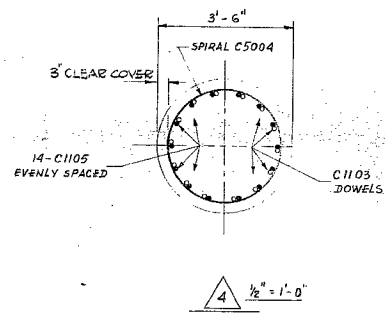
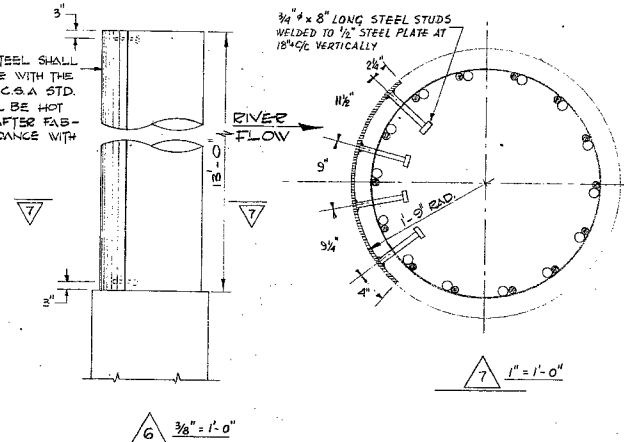
NOTE:
CAP AND REINFORCEMENT
TYPICAL FOR EACH PIER



PIER CAP ELEV.
SCALE: 3/8" = 1'-0"

NOTE:
BARS C8008 - DOWNSTREAM ONLY

ARMOUR PLATE STEEL SHALL
BE IN ACCORDANCE WITH THE
LATEST ISSUE OF C.S.A. STD.
G-40.14 AND SHALL BE HOT
DIP GALVANIZED AFTER FAB-
RICATION IN ACCORDANCE WITH
C.S.A. STD. G164.



REVISIONS			
NO.	DATE	BY	DESCRIPTION

DEPARTMENT OF HIGHWAYS ONTARIO BRIDGE DIVISION			
69-F-57			
CASS BRIDGE OVER SOUTH NATION RIVER 1.6 MI. S. OF WINCHESTER BY-PASS			
KING'S HIGHWAY No. 31		DIST. No. 9	
CO. DUNDAS		TWP. WINCHESTER	
LOT 4		CON. 2	
PIERS			
APPROVED		SITE No. 31-85	
DESIGN INC. V.S.		W.P. No. 33-66-02	
CHECK P.K.		CONTRACT No.	
DATE APRIL 1970		DRAWING No. D-6755-5	

FOR REDUCED PLAN
USE SCALE BELOW
10 1 2 3
3 INCHES ON ORIGINAL PLAN