

MEMORANDUM

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

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

Attention: Mr. S. McCombie

DATE: July 9, 1968

OUR FILE REF.

IN REPLY TO

SUBJECT:

FOUNDATION INVESTIGATION REPORT
For
The Proposed New Structure
At the Crossing of Muskrat River
And Highway #17
Twp. of Westmeath -- Co. of Renfrew
District No. 9 (Ottawa)
W.J. 68-F-39 -- W.P. 46-65

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/MdeF
Attach.

cc: Messrs. B. R. Davis (2)
H. A. Tregaskes
D. W. Farren
S. J. Markiewicz
C. R. Robertson
G. Scott
J. E. Gruspler
B. A. Singh

Foundations Files
Gen. Files

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

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FOUNDATION INVESTIGATION REPORT

For

The Proposed New Structure
At the Crossing of Muskrat River
And Highway #17

Twp. of Westmeath -- Co. of Renfrew
District No. 9 (Ottawa)

W.J. 68-P-39 -- W.P. 46-65

1. INTRODUCTION:

A request, dated April 11, 1968, to carry out a foundation investigation at the present crossing of Hwy. #17 and the Muskrat River, approximately 8 miles south of the Town of Pembroke, was received from Mr. G. Scott, Regional Bridge Location Engineer, Bridge Division, Kingston.

At this location the existing single-span structure will be demolished and replaced with a new, wider single-span structure.

Subsequently, a foundation investigation was carried out at the proposed site to determine subsoil conditions. Field and laboratory test results, together with discussions and recommendations for the bridge foundations and approach embankments, are presented in this report.

2. DESCRIPTION OF THE SITE AND GEOLOGY:

The site is located about 8 miles south of the Town of Pembroke where Hwy. #17 crosses the Muskrat River which flows westerly into Mud Lake. During construction of the existing bridge and road embankment, the river was relocated through a man-made channel about 60 ft. wide with 2:1 side slopes and about 5 to 6 ft. deep. The old river bed which lies north of the existing structure has been covered with a swamp. When fill was placed on the former river bed, mud waves were produced on both sides of the road embankment, and there is still noticeable embankment settlement and associated cracks in the asphalt opposite these mud waves.

Hwy. #17 is a two-lane paved highway, 22 ft. wide. The embankment has 2:1 side slopes and sand berms have been constructed where the road embankment crosses the swampy area.

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

On the west side of the embankment the berm starts at about Station 413+75 and continues northerly. The berm is about 20 ft. wide and about 2 ft. above swamp water level. On the east side the berm starts just north of the bridge and runs northerly. The top of this berm is level with or slightly below the water level.

The land to the south rises gradually to a limestone outcrop about 1000 ft. south of the present bridge. The area is generally clear with a rolling terrain and is used as pastureland. The general area north of the site is swampy with a 200-ft. high escarpment of Precambrian rocks about 600 ft. north of the bridge.

Physiographically, the site is situated in a small limestone plain in the Ottawa Valley Clay Plains. Based on available geological information, it is known that the site lies in a section of a preglacial river valley excavated along an old fault line called the Muskrat Fault. This fault has produced a break in the Ottawa-Bonnechere 'graben', a large block 35 miles in width, that has been down-dropped. At this fault a south-facing escarpment in Precambrian rocks has been formed bounding the down-dropped block which is tilted towards the north thereby preserving the Palaeozoic limestone on its northern flank.

3. FIELD AND LABORATORY WORK:

Using conventional diamond drilling equipment adapted for soil sampling purposes, four sampled boreholes and seven dynamic penetration cone tests were carried out. A driving energy of 350 ft.-lbs. per blow was used for the cone tests as specified in the Standard Penetration Test.

In cohesive materials, 2-inch I.D. Shelby tube samples were obtained at required depths by pushing the tubes into the soil manually, if possible. Otherwise, samples of cohesive and non-cohesive

cont'd. /3 ...

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

materials were obtained using a 2-inch O.D. split-spoon sampler driven according to the specifications of the Standard Penetration Test. In-situ shear strength tests were carried out, where possible, with a field vane.

The locations and elevations of all borings were surveyed in the field by personnel from the Foundation Section and are shown on Drawing 68-F-39A, together with the estimated stratigraphical profile. All elevations in the report are referenced to a Geodetic datum.

Samples were visually examined and identified in the field and subsequently in the laboratory. Laboratory tests were conducted on selected representative samples to determine:

- i) Natural Moisture Contents
- ii) Bulk Densities
- iii) Atterberg Limits
- iv) Grain-Size Distributions
- v) Undrained Shear Strengths
- vi) Consolidation Characteristics
- vii) Organic Contents

Results of the laboratory and field tests, together with locations and elevations of the boreholes, are presented in the Appendix of this report.

4. SUBSOIL CONDITIONS:

4.1) General:

Subsoil at the site generally consists of a 8 to 20 ft. thick silty clay to clayey silt stratum followed by an extensive glacial till deposit at least 51 ft. thick, composed primarily of a hard or dense to very dense heterogeneous mixture of clay, silt, sand, and gravel. In the immediate area of the site the subsoil is overlain by 7 to 15 ft. of highway fills. North of the existing

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

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

structure a 4 to 6 ft. layer of organic silt was encountered between the fill material and the silty clay to clayey silt stratum.

The boundaries between the various soil strata, as determined in the boreholes, are shown on the accompanying borehole log sheets. The stratigraphical profile, shown on Drawing 68-F-39A, is inferred from this data.

4.2) Fill Material:

Overlying the immediate area of the site, up to 15 ft. of highway fill material has been placed during construction of the existing Hwy. #17. This material is predominantly a clayey silt with some sand and gravel. Grain-size distribution curves for samples of the fill are shown on Figure 1 in Appendix I. Atterberg limit tests carried out on representative samples of the deposit are summarized on the Plasticity Chart shown on Figure 3. The Moisture Content ranged from 17% to 27%, Liquid Limit ranged from 25% to 26%, and the Plastic Limit ranged from 15% to 17%. 'N' values ranged from 3 to 10 blows per foot.

In B.H. #4 north of the existing bridge, the fill material consists of a 10-ft. layer of sand with traces of silt and gravel. It appears that the granular material was used for construction of the berm along the highway embankment beyond Sta. 413+75.

Standard Penetration Resistance tests carried out within this layer ranged from 2 to 21 blows per foot, indicating a relative density of very loose to compact.

4.3) Organic Silt:

This material was encountered in boreholes #1 and #4 only, immediately beneath the fill material. The deposit is 4 ft. to 6 ft. thick and is found in the region north of the bridge site, extending south to the north bank of Muskrat River. The material in this deposit is mainly composed of a mixture of silt and organics of variable proportions. The consistency of the organic silt was

cont'd. /5 ...

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

4.3) Organic Silt: (cont'd.) ...

generally soft to firm, with undrained shear strength ranging from 480 to 580 p.s.f. Atterberg limit tests, carried out on representative samples of the deposit, are summarized on the Plasticity Chart shown on Figure 4. The Liquid Limit ranged from 23.2% to 58.1%, the Plastic Limit from 19.8% to 54.3%, and Moisture Content from 10.6% to 27.3%.

4.4) Silty Clay to Clayey Silt:

The surficial deposits are underlain by a stratum of silty clay to clayey silt. The thickness of this deposit ranges from 8 to 20 ft. In B.H.'s #1 and #2 this cohesive deposit contains distinct clay layers with Liquid Limit of 60 - 69%, Plastic Limit of 22 - 28%, and Moisture Content of 62 - 80%. The stratum contains numerous silt seams ranging from 1/2" to 6" in thickness which occur from elevation 404.0 downwards.

The physical properties of the silty clay to clayey silt stratum as determined by field and laboratory testing, are summarized in the Plasticity Chart on Figure 4, the Consolidation Plots on Figure 6, and in the Table which follows:

cont'd. /6 ...

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

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

		<u>Range</u>	<u>Average</u>
Bulk Density (p.c.f.)	(γ)	96 - 104	100
Liquid Limit (%)	(W_L)	26 - 39	33
Plastic Limit (%)	(W_P)	15 - 21	18
Natural Moisture Content (%)	(W)	17 - 54	36
Liquidity Index	(I_L)	0.2 - 1.8	1.2
Initial Void Ratio	(e_o)	1.1 - 1.5	
Compression Index	(C_c)	0.3 - 0.6	

Undrained Shear Strength (C_u) (p.s.f.)	<u>Range</u>
i) Field Vanes	440 - 720
ii) Lab. Vanes	440 - 560
iii) Lab. Testing	330 - 340
Sensitivity	2 - 6
'N' Values (Blows per foot)	5 - 8

Based on these results, it is estimated that the consistency of the stratum varies from soft to firm.

cont'd. /7 ...

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

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

Underlying the silty clay to clayey silt stratum, an extensive deposit of glacial till was encountered. This material was generally a heterogeneous mixture of clay, silt, sand and gravel; however, in B.H. #1 the deposit is more cohesive and could be classified as a clayey silt with sand and gravel. In B.H.'s #1 and #2 the top 9 to 11 ft. of the till deposit appears to be in a reworked condition with 'N' values ranging from 9 to 17 blows per foot, indicating a stiff to very stiff consistency. The 'N' values for the remaining portion of the glacial till deposit ranged from 28 blows per foot to 100 blows for 6 inches. Within this deposit occasional boulders up to 3 ft. in diameter were encountered below elevation 368. In B.H. #1 a distinct layer 4 ft. thick, of fine sand to silt, was found at approximate elev. 364.

Physical properties of the glacial till as determined from the laboratory tests, are:

Moisture Content	(W)	:	8 - 11%
Liquid Limit	(W _L)	:	16 - 17%
Plastic Limit	(W _p)	:	11 - 13%

Grain-Size Distribution -

- Gravel	:	4 - 13%
- Sand	:	51 - 64%
- Silt	:	15 - 33%
- Clay	:	5 - 12%

cont'd. /3 ...

5. GROUNDWATER CONDITIONS:

Groundwater level observations were carried out during the period of investigation in the open boreholes. These observations, which are summarized on Drawing No. 68-F-39A, indicate that the groundwater level in the surficial deposits ranges from elevation 404 near the Muskrat River to elev. 408 about 100 yds. north and south of the river.

6. EXISTING STRUCTURE:

The existing highway bridge, which was built in the 1920's, is in a sound condition. It is 75 feet long, has a 22-ft. width of paved roadway over a concrete deck and is approximately 14 ft. above water level. Two 12" timber curbs have been placed on the deck along both sides of the bridge. The bridge deck rests on a steel truss on two concrete abutments with associated wing walls. There is no noticeable differential settlement or movement of the abutments; however, there is a considerable amount of weathering of the concrete on the wing walls and, also, at the edges of the deck. The slope under the bridge is gradual and is held in place by old timber sheeting.

7. DISCUSSION AND RECOMMENDATIONS:

7.1) General:

It is proposed to construct a new single-span structure to replace the existing bridge at the crossing of Hwy. #17 and Muskrat River. This new structure will be about 45 ft. wide, having a clear span of 70 ft. The proposed structure will have the same grade and alignment as the existing bridge.

The subsoil below the fill material at the site generally consists of a 8 to 20 ft. layer of silty clay to clayey silt underlain by an extensive cohesive glacial till deposit extending at least 79 ft. below existing ground surface. In certain areas the silty clay to clayey silt stratum is overlain by a 4 to 6 ft. layer of organic silt.

cont'd. /c ...

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

7.2) Structure Foundations:

Due to the presence of soft to firm compressible cohesive deposits in the upper portion of the subsoil, adequate bearing capacity cannot be achieved for an economical spread footing design. The new structure should, therefore, be supported on end-bearing piles driven to practical refusal into the glacial till deposit. For estimating purposes, it can be assumed that the piles will meet refusal at approximate tip elev. 360.

Design loads to be used are dependent on the pile section selected and may be 90 tons per pile as in the case of a 12 BF 74 steel H-pile. Footing bases should be founded on a 12" granular pad or suitable working slab. Pile caps should be founded at a sufficient depth below finished grade so as to ensure adequate frost protection.

7.3) Approach Fills:

The proposed approach fills will have the same grade as the existing highway except that the new roadway will be wider than the existing one. No stability problems are anticipated for the proposed widening provided that all soft organic silt or any organic materials in the swampy area of the northern approach are sub-excavated and backfilled prior to the construction of the approach embankments. The sub-excavation and backfilling operations should be as per current D.H.O. Standard DD-406. The extent of the sub-excavation of the organic material for the north approach should be defined by the Regional Materials and Testing Section of the Kingston Region. The slopes of the existing embankments should be stripped of all topsoil before placement of the new fill.

In no case should any attempt be made to trim the slopes of the river bank any steeper than the existing ones at the proposed crossing.

Settlement computations carried out for the widening of the embankment, indicate that the differential settlement between the existing highway embankment and the widened portion will be in the order of 1 to 2 inches.

cont'd. /13 ...

8. SUMMARY:

A new 40-ft. wide, 70-ft. single-span structure is proposed to replace the existing bridge at the crossing of Muskrat River and Hwy. #17.

The subsoil at the site mainly consists of organic silt, silty clay to clayey silt and glacial till.

It is recommended that the new structure be supported on end-bearing piles driven to practical refusal. A safe load of 90 tons/pile may be used for design purposes in the case of 12 BP 74 steel H-piles.

Standard 2:1 side slopes may be used for approach fills provided that certain measures are taken as recommended in Section 7.

9. MISCELLANEOUS:

The field work, performed during the period May 10 to May 16, 1968, was undertaken by Mr. W. Hutton, Project Foundation Engineer and Mr. T. Card.

The report was prepared by Mr. T. Card and Mr. W. Hutton. The investigation was carried out under the general supervision of Mr. A. Devata, Supervising Foundation Engineer, who reviewed this report.

Equipment used was owned and operated by Master Soil Investigation Ltd., Toronto.

July, 1968.

APPENDIX I

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO. 1

FOUNDATION SECTION

JOB 68-F-39 LOCATION Sta. 412 + 69 @ Hwy. #17 o/s 18' Lt. ORIGINATED BY WH
 W.P. 46-65 BORING DATE May 10-13, 1968 COMPILED BY TC
 DATUM Geodetic BOREHOLE TYPE Washboring - Diamond Drill CHECKED BY LD

SOIL PROFILE			SAMPLES		ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE					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	20	40	60	80	100	W _P	W _L		
416.5	Ground Level														
0.0	Fine sand - brown (loose)														
413.3	Fill Material														
3.2	(Clayey silt with sand and some gravel - grey to brown. Soft to firm)		2.2A	SS		6									
			3	2"TW	PM										
401.5			4	SS		3									
15.0	Organic silt - grey		5A	SS		2									
396.0	Soft to firm.		6	2"TW	PM										
20.5	Clay Grey		7	2"TW	PM										
388.3	Soft to firm		8	2"TW	PM										
28.2	Clayey silt with sand and some gravel. Stiff to Hard.		9	SS		15									
			10	SS		17									
			11	SS		9									
	Grey (Glacial Till)		12	SS		41									
	Reworked till above elev. 376.5		13	SS		69									
364.4	3' boulder at El. 367.5		14	SS		100									
52.1	Fine sand to silt. Very dense. Grey.		15	SS		66									
360.2			16	SS		84/10"									
56.3			17	SS		135/11"									
			18	SS		107/11"									
	Limestone & gneiss Boulders below elev. 343.2		20	BX RC		35									
337.5			21	BX RC		No Rec									
79.0	End of Borehole														

DEFECTS IN NEGATIVE DUE TO
CONDITION OF ORIGINAL DOCUMENT

DEFECTS IN NEGATIVE DUE TO
CONDITION OF ORIGINAL DOCUMENT

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO 2

FOUNDATION SECTION

JOB 68-F-39

LOCATION Sta. 411 + 40 O Hwy. #17 o/s 17' Rt.

ORIGINATED BY WH

W P 46-65

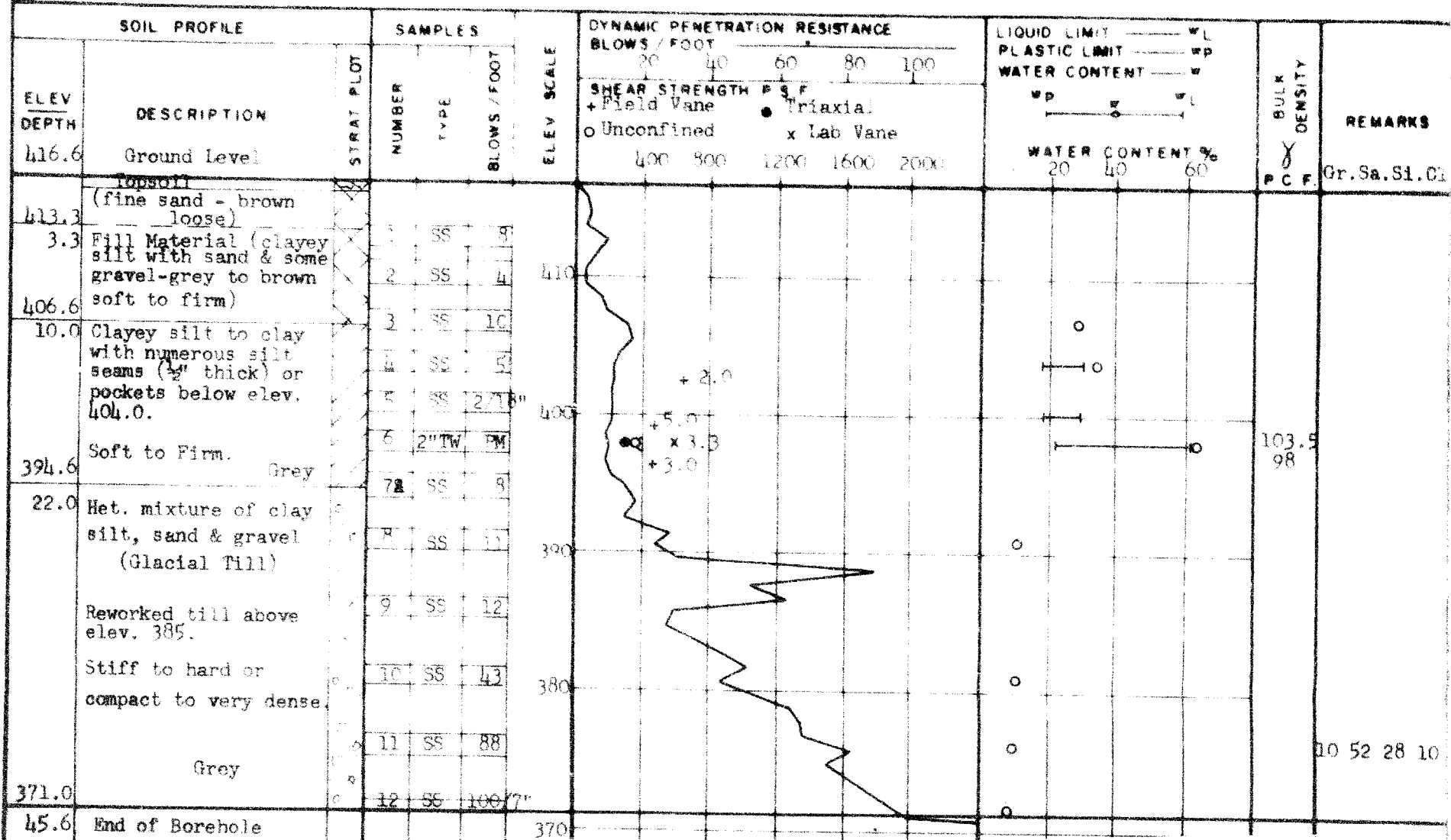
BORING DATE May 13, 14, 1968

COMPILED BY TC

DATUM Geodetic

BOREHOLE TYPE Washboring

CHECKED BY



DEFECTS IN NEGATIVE DUE TO
CONDITION OF ORIGINAL DOCUMENT

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO. 3

FOUNDATION SECTION

JOB 68-F-39

LOCATION Sta. 410 + 74 R Hwy. #17 o/s 27' Lt.

ORIGINATED BY WH

W.P. 16-65

BORING DATE May 14, 1968

COMPILED BY TC

DATUM Geodetic

BOREHOLE TYPE Washboring

CHECKED BY

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE					LIQUID LIMIT — WL PLASTIC LIMIT — WP WATER CONTENT — W WATER CONTENT %	BULK DENSITY PCF	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT		BLOWS / FOOT	20	40	60	80	100		
415.2	Ground Level							400	600	1200	1600	2000		
0.5	Topsoil													
408.7	Clayey silt with sand & trace of gravel. Fill material. Hard. Brown		1	SS	34	410								
6.5	Het. mix. of clay, silt, sand & gravel (gl. till)		2	SS	42									
402.9	Hard or dense to very dense. Grey.		3	SS	81									
12.3	End of Borehole		4	SS	75/76"	400								
						300								

FOUNDATION SECTION

CHECKED BY

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CONDITION OF ORIGINAL DOCUMENT

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

JOB 68-F-39

W. P. 46-65

DATUM Geodetic

LOCATION

Sta. 412 + 62 @ Hwy. #17 o/s 77.5" Lt.

BORING DATE

May 16, 1968

BORE HOLE TYPE

Dynamic Cone Penetration Test

ORIGINATED BY

WH

COMPILED BY

WH

CHECKED BY

FOUNDATION SECTION

[illegible]

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO. 6

FOUNDATION SECTION

JOB 68-F-39

LOCATION Sta. 411 + 54 @ Hwy.#17 o/s 55.4' Lt.

ORIGINATED BY WH

W P 46-65

BORING DATE May 16, 1968

COMPILED BY _____ WH

DATUM Geodetic

BOREHOLE TYPE Dynamic Cone Penetration Test

CHECKED BY _____

SOIL PROFILE			SAMPLES		DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT		LIQUID LIMIT ——— W _L PLASTIC LIMIT ——— W _P WATER CONTENT ——— W		BULK DENSITY γ P C F	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	BLOWS / FOOT	ELEV SCALE	SHEAR STRENGTH P S F	W _P ——— W _L WATER CONTENT %		
111.8 0.0	Ground Level									
386.5										
28.3	End of Cone Test (Practical refusal)									

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MATERIALS & TESTING DIVISION

JOB 68-F-39

LOCATION

Sta. 411 + 15 @ Hwy.#17 o/s 20' Rt.

FOUNDATION SECTION

ORIGINATED BY WH

W # 46-65

BORING DATE

May 16, 1968

COMPILED BY WH

DATUM Geodetic

CORE HOLE TYPE Dynamic Cone Penetration Test

CHECKED BY

[illegible]

CLAY & SILT	SAND			GRAVEL	
	Fine	Medium	Coarse	Fine	Coarse

SAND

GRAVEL

Fine

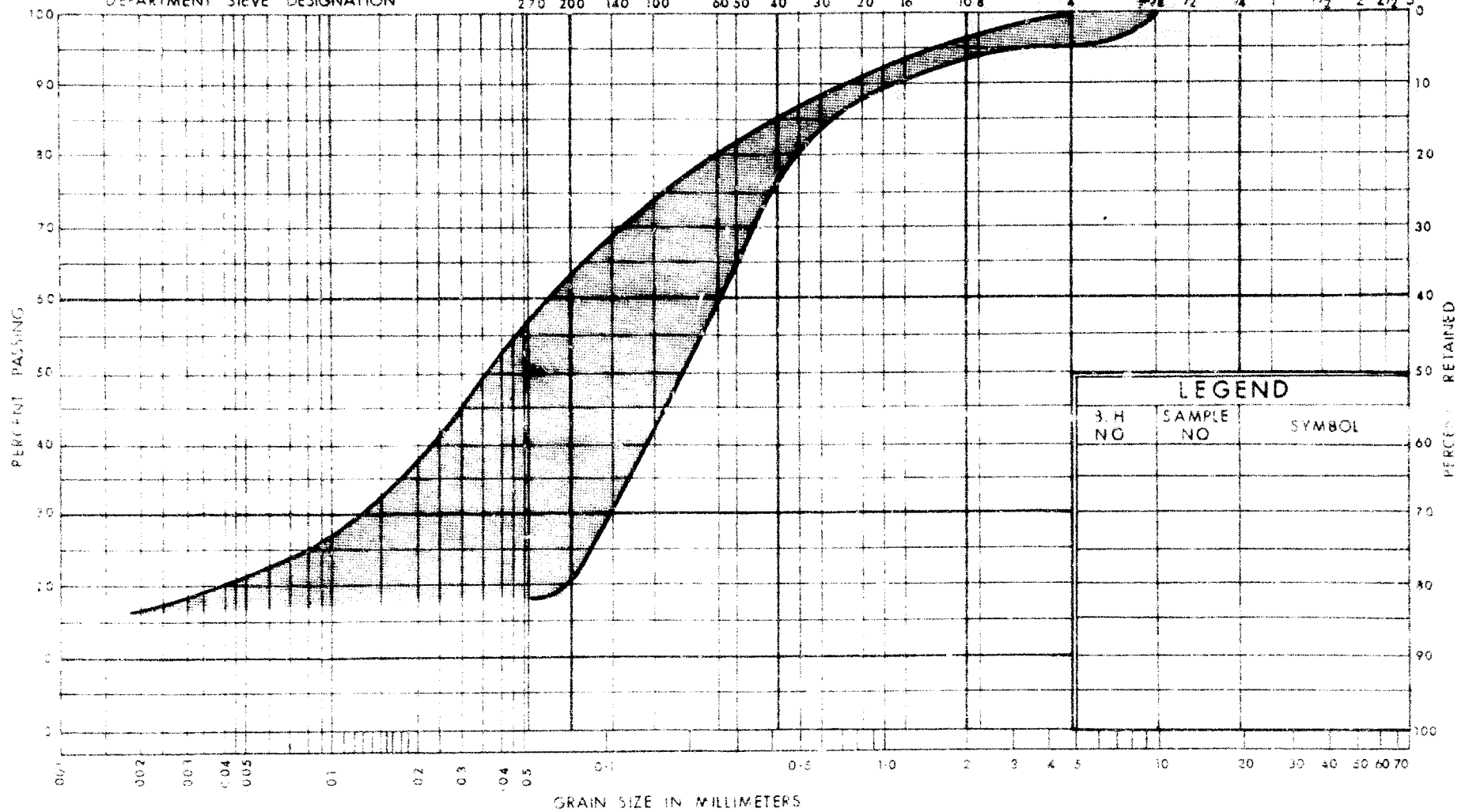
Medium

Coarse

Fine

Coarse

270 200 140 100 60 50 40 30 20 16 10 8 4 1/2 1/2 1/4 1 1 1/2 2 2 1/2 3



DEPARTMENT OF HIGHWAYS
MATERIALS and
TESTING
DIVISION

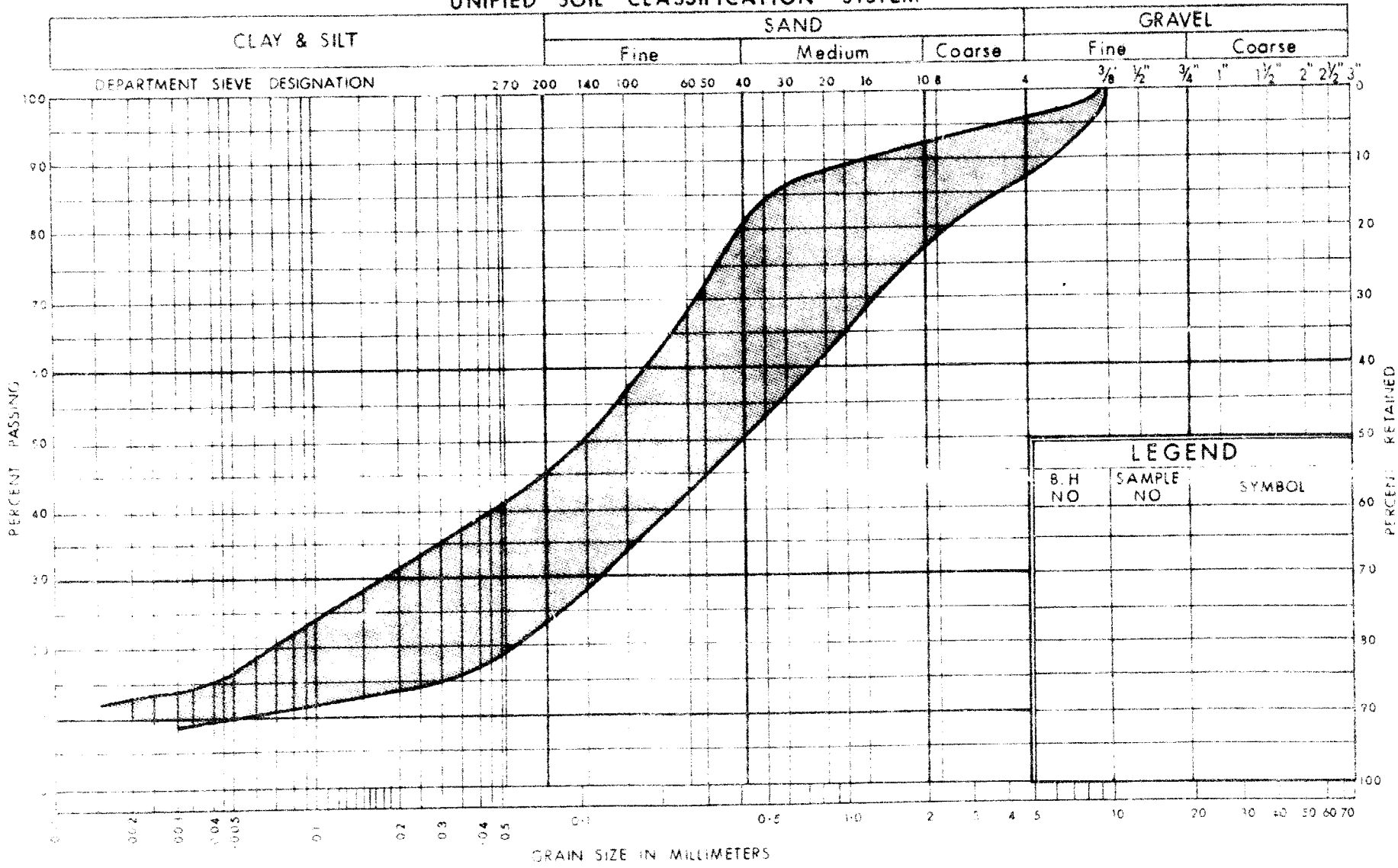
GRAIN SIZE DISTRIBUTION
FILL MATERIAL

W.P. No. 46-65

JOB No. 68-F-39

FIG. 1

UNIFIED SOIL CLASSIFICATION SYSTEM



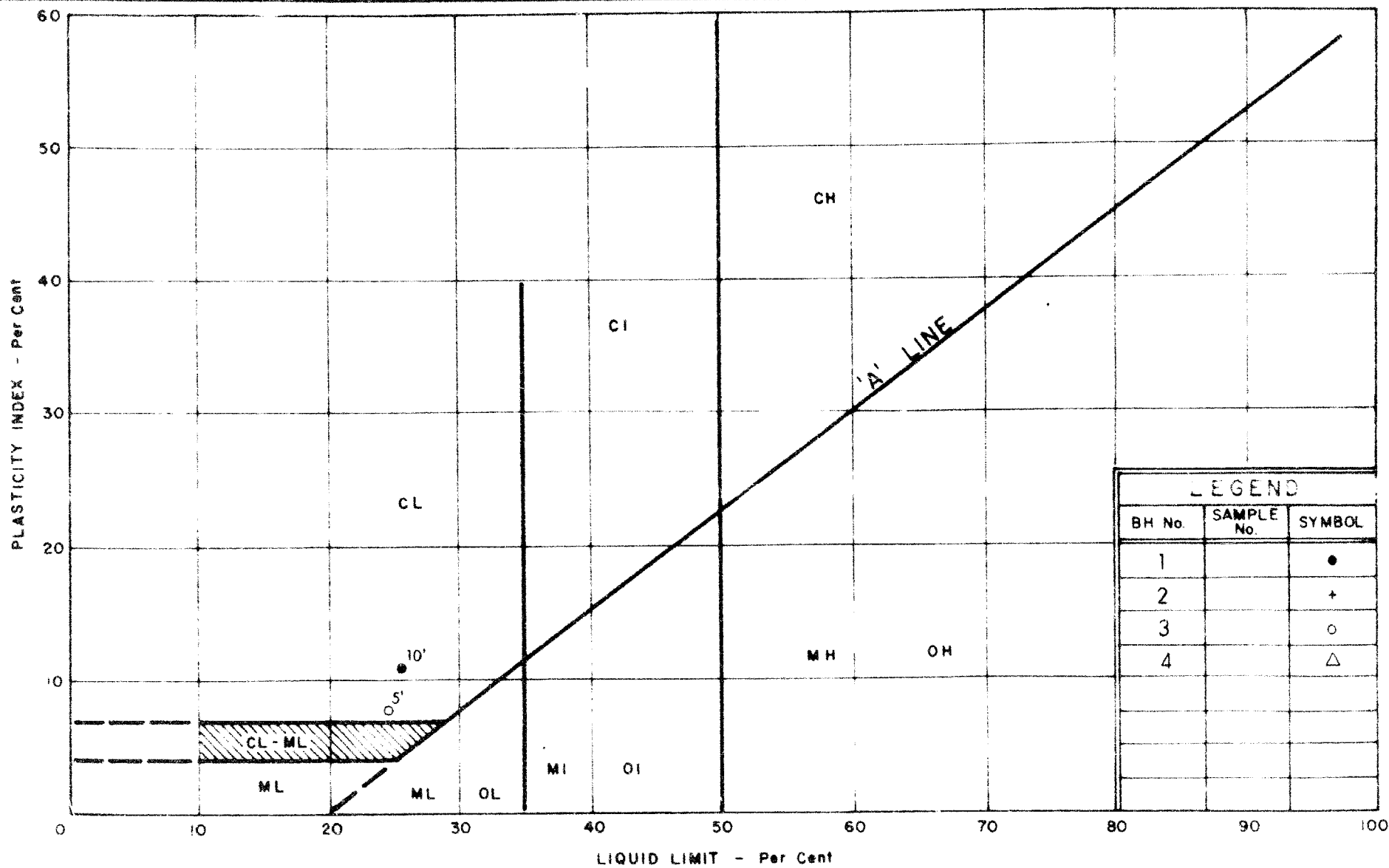
LEGEND		
B. H. NO.	SAMPLE NO.	SYMBOL



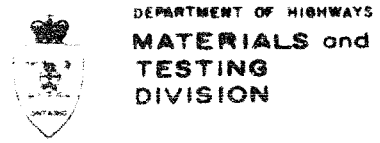
DEPARTMENT OF HIGHWAYS
MATERIALS and
TESTING
DIVISION

GRAIN SIZE DISTRIBUTION GLACIAL TILL

W.P. No. 46-65
JOB No. 68-F-39
FIG. 2

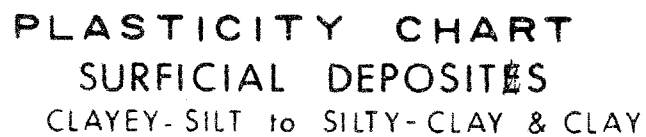


LEGEND		
BH No.	SAMPLE No.	SYMBOL
1		•
2		+
3		o
4		△

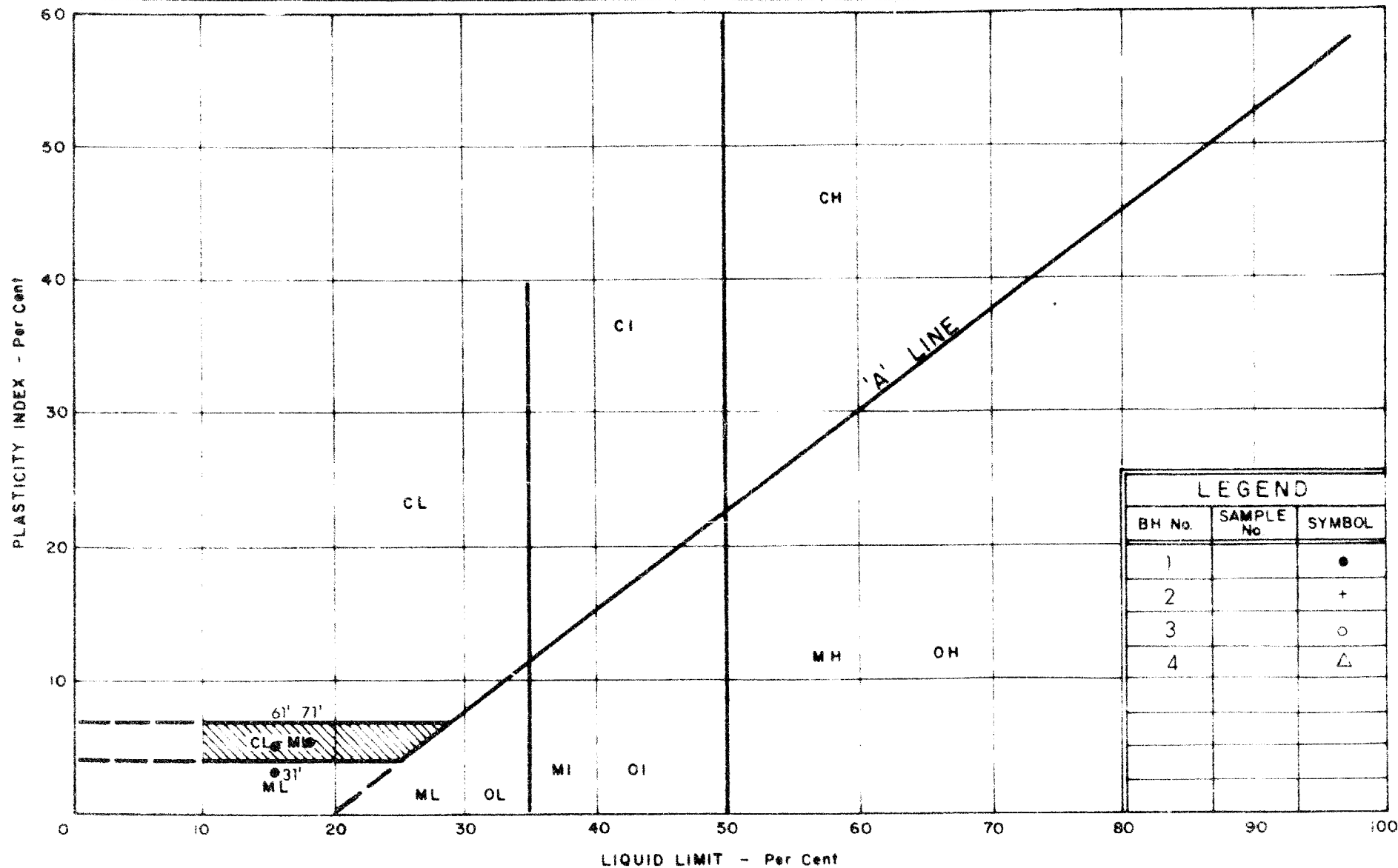


DEPARTMENT OF HIGHWAYS MATERIALS and TESTING DIVISION PLASTICITY CHART FILL

WP. No.	46-65
JOB No.	68-F-39
FIG. 3	



W.P. No.	46-65
JOB No.	68-F-39
FIG. 4	



LEGEND		
BH No.	SAMPLE No.	SYMBOL
1		•
2		+
3		○
4		△



DEPARTMENT OF HIGHWAYS
MATERIALS and
TESTING
DIVISION

PLASTICITY CHART GLACIAL TILL

WP No. 46-65

JOB No. 68-F-39

FIG. 5

VOID RATIO - PRESSURE CURVES

JOB NO. 68-F-39

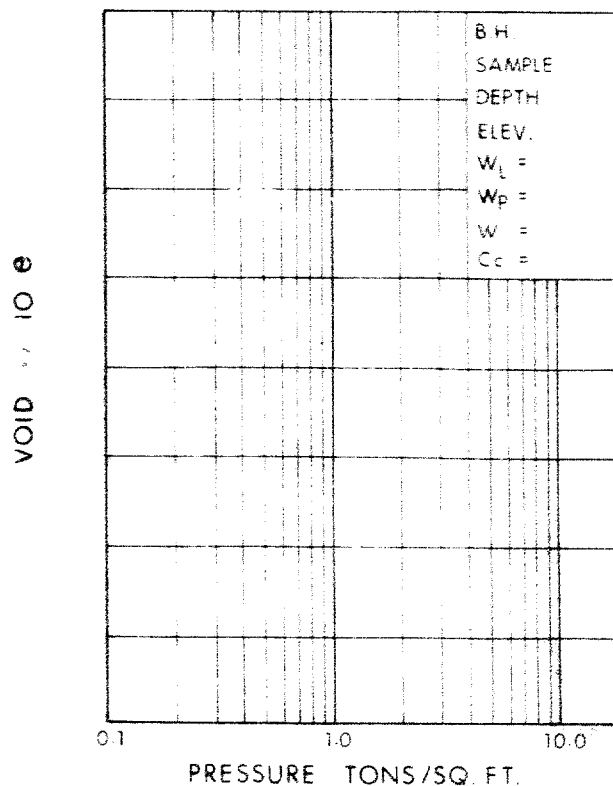
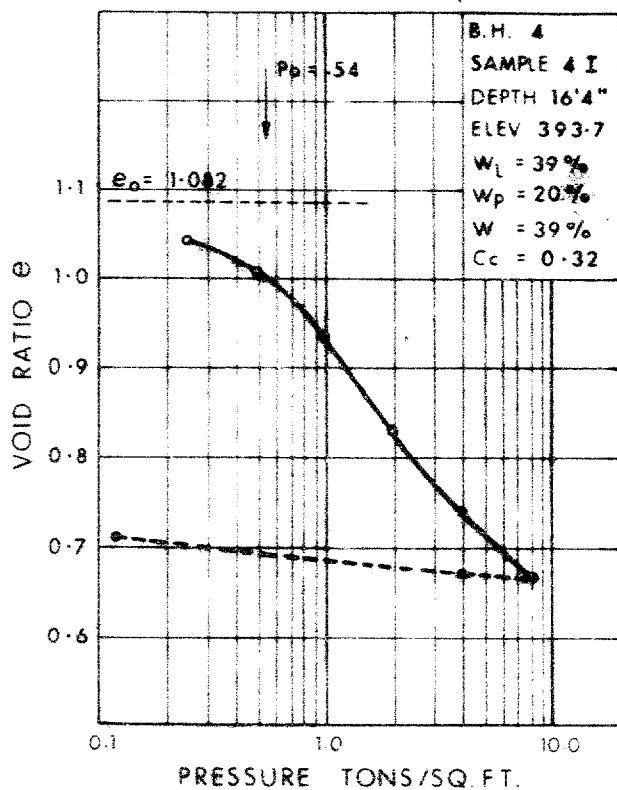
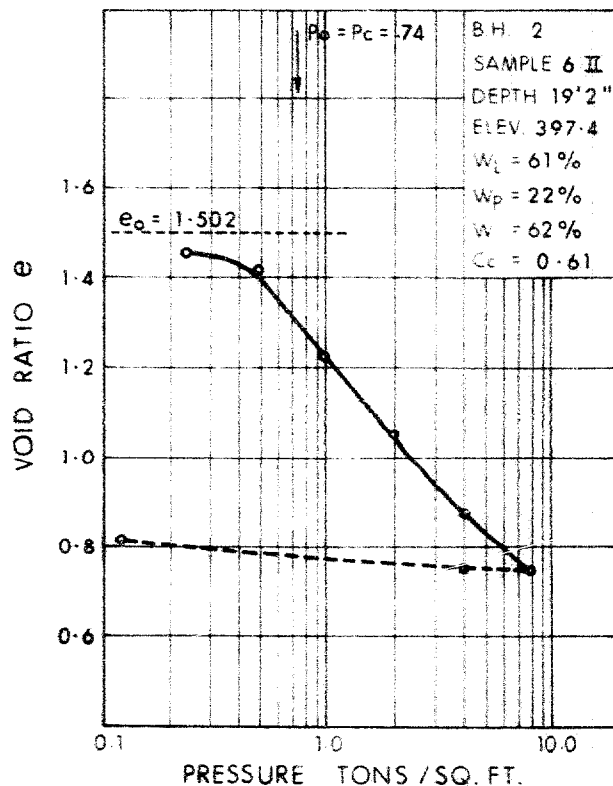
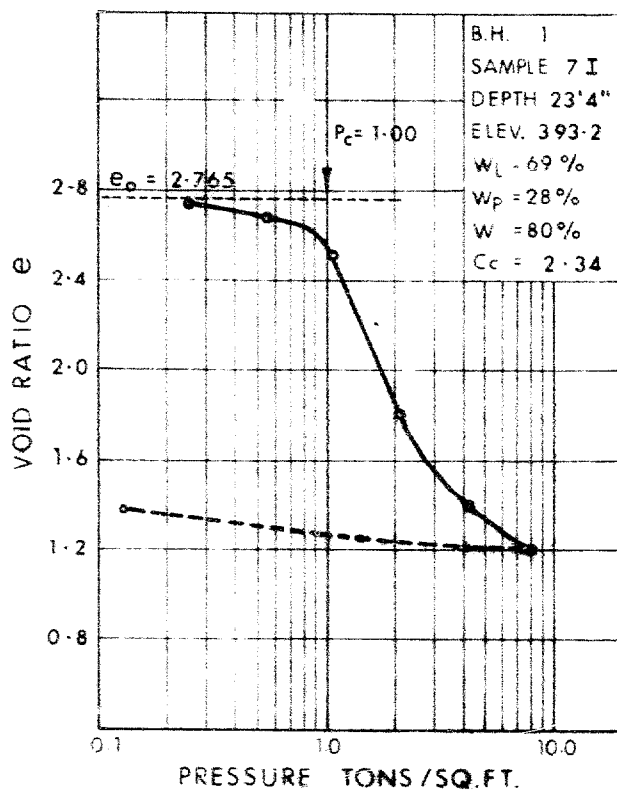
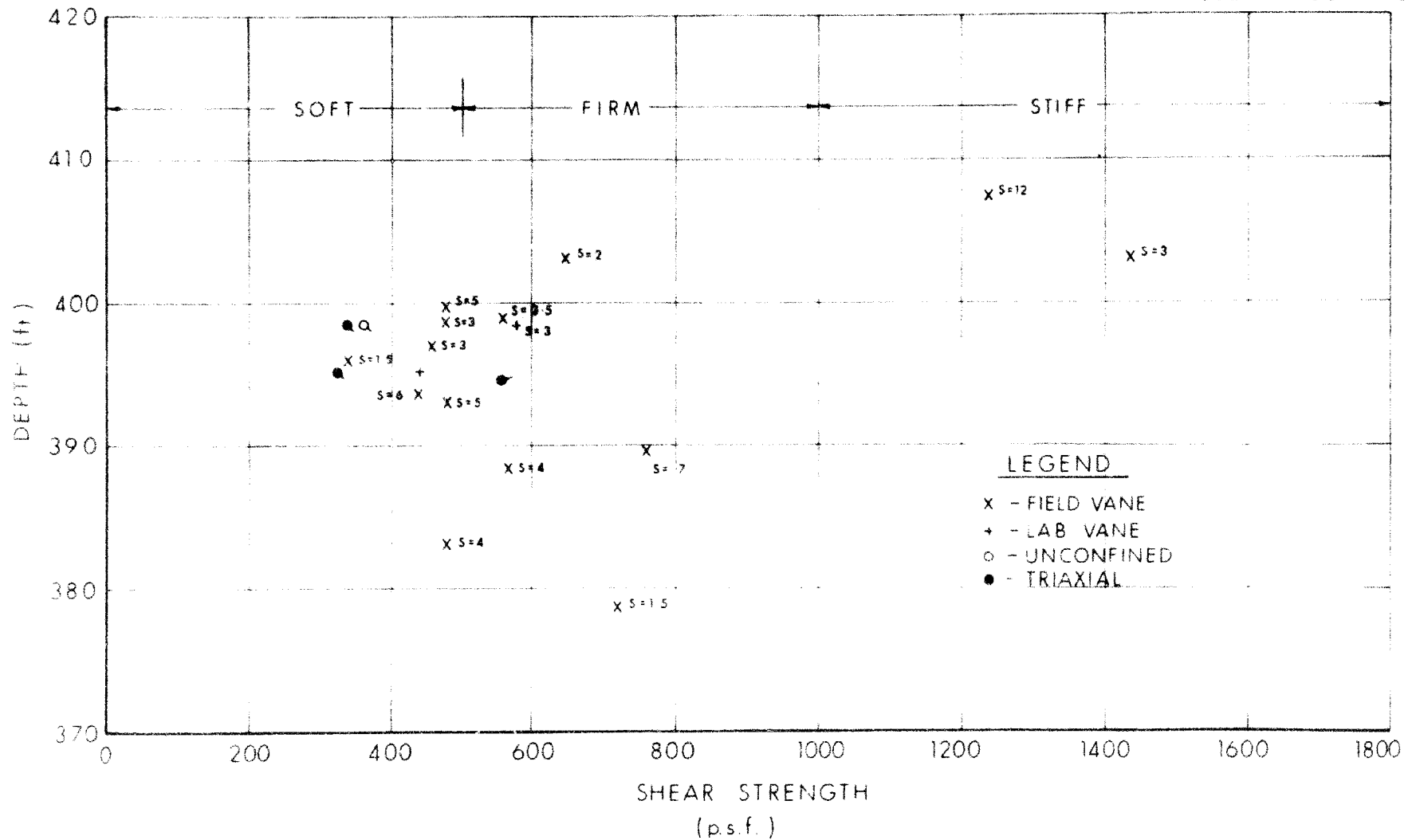


FIG. 6

JOB NO 68 - F - 39



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

SS	SPLIT SPOON	TW	THINWALL OPEN
WS	WASHED SAMPLE	TP	THINWALL PISTON
SB	SCRAPER BUCKET SAMPLE	OS	OESTERBERG SAMPLE
AS	AUGER SAMPLE	FS	FOIL SAMPLE
CS	CHUNK SAMPLE	RC	ROCK CORE
ST	SLOTTED TUBE SAMPLE		
	PH	SAMPLE ADVANCED HYDRAULICALLY	
	PM	SAMPLE ADVANCED MANUALLY	

SOIL TESTS

Qu	UNCONFINED COMPRESSION	LV	LABORATORY VANE
Q	UNDRAINED TRIAXIAL	FV	FIELD VANE
Qcu	CONSOLIDATED UNDRAINED TRIAXIAL	C	CONSOLIDATION
Qd	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_f	SHEAR STRENGTH
c'	EFFECTIVE COHESION INTERCEPT
ϕ'	EFFECTIVE ANGLE OF SHEARING RESISTANCE, OR FRICTION
c_u	APPARENT COHESION
ϕ_u	APPARENT ANGLE OF SHEARING RESISTANCE, OR FRICTION
μ	COEFFICIENT OF FRICTION
S_t	SENSITIVITY

GENERAL

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

STRESS AND STRAIN

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

EARTH PRESSURE

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

FOUNDATIONS

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

SLOPES

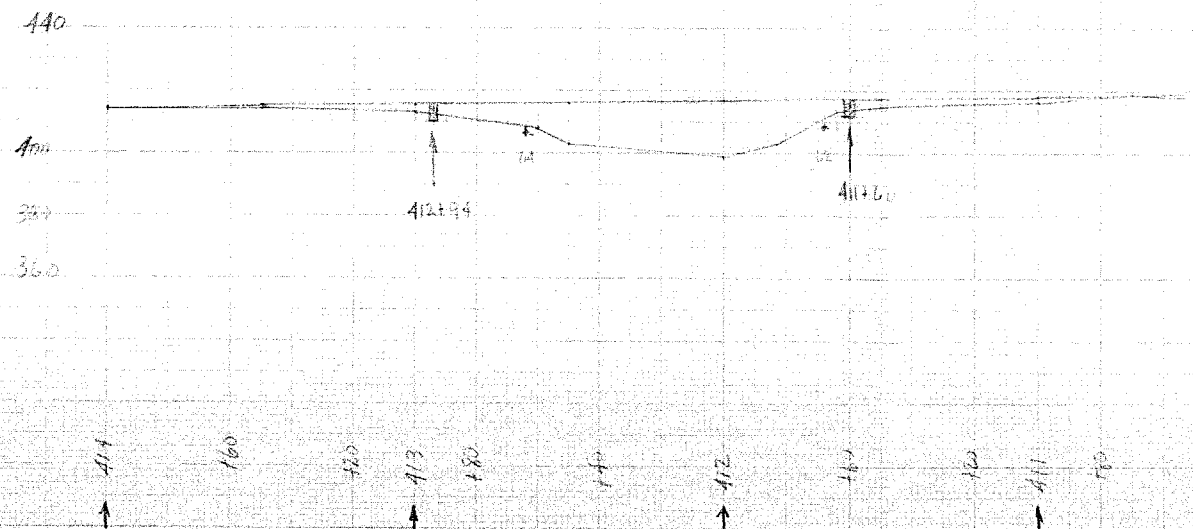
H	VERTICAL HEIGHT OF SLOPE
D	DEPTH BELOW TOE OF SLOPE TO HARD STRATUM
β	ANGLE OF SLOPE TO HORIZONTAL

MILWAUKEE R. DETOUR

11-2-77

SUNBELT BRIDGE

REPORT ON TRAIL BLAZES STA 411+60 to STA 412+75



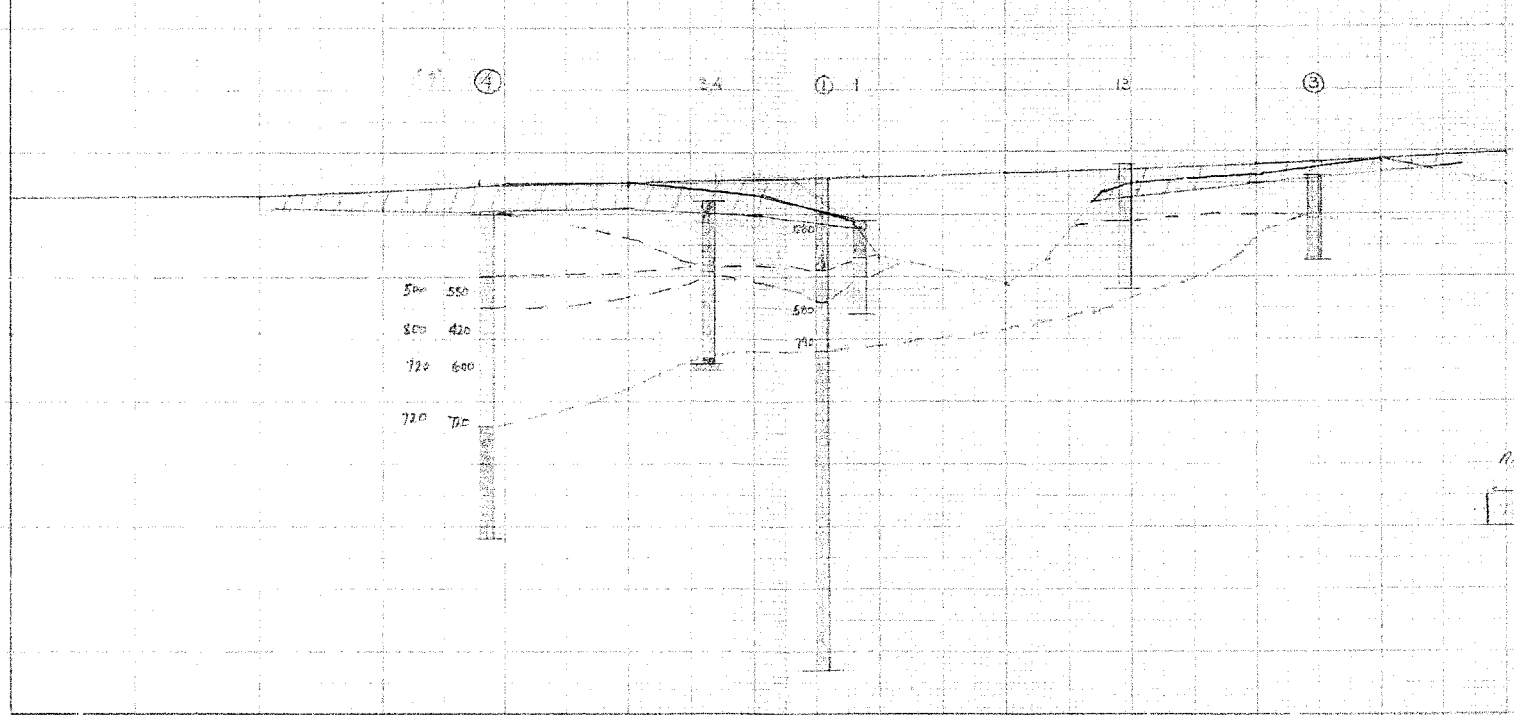
FIELD
JULY 28, 1968

2 PROFILE - PROPOSED DETOUR FOR HWY #17 63-E-39



LEGEND	
FILL	————
SAND FILL	————
ORGANIC SILT	————
SILTY CLAY TO CLAYEY SILT	————
FILL	————

ELEV
440
420
400
380
360
340



$A = 13'$
 $B = 15'$
 $R_1 = \frac{B}{12} = 2.2$
 $R_2 = 2500 \text{ feet}$

416+00 417+00 418+00 419+00
STATIONS

MEMORANDUM

TO: Mr. L.M. Peverett,
Dist. Const. Engineer,
District #9, Ottawa.

FROM: Rankin, Ontario.

ATTENTION:

DATE: November 20, 1970.

OUR FILE REF.

IN REPLY TO

SUBJECT:

POST CONTRACT REVIEW CONTRACT 69-220 W.P. 46-65 68-F-39

(1) Contract documents were essentially complete, easily understood and readily followed. During construction the Bridge Office recommended that a four inch working slab be placed under the east abutment footing. The slab was necessary as the bottom of the footing excavation was a mess of sloppy clay, which resulted from the removal of the old wood piles and the pumping action caused by the driving of the 'H' piles. The working slab would have been unnecessary had the Design Section followed the Soils Report recommendation to place a granular pad under the footings. One possible oversight in the Design Process or Pre-Contract Review Meeting was to eliminate Form 9.10.02 restricting the use of explosives. It would have been virtually impossible to remove the old footings, which were 8' thick and below water level, without the use of explosives.

(2) Ten of the forty-seven Items on Contract 69-220 varied by greater than 20% of the tender quantity. Six of the Items were overruns and the remaining four were underruns. Nine of the Items involved were in the Grading portion and the remaining one in the structure section. None of the Items involved were major items and as a result the overruns and underruns only changed the tender by minus \$106.00. The total tender price was \$129,507.35; The Final Cost subject to audit checking is \$129,816.68

ITEM #1 Earth Excavation

Tender 4,450 CY
Final 5,378 CY

This Item overran when it was possible to obtain extra material from the cut on the detour to be used as fill. An additional

Cont'd ...

338 cy was the result of removing a soft spot in the detour.

ITEM #2 Earth Borrow

Tender 1,000 CY
Final 661 CY

The underrun in this item was a result of being able to obtain extra material from the detour cut. The borrow quantity was also reduced when D.H.O. forces placed a berm Lt. of Sta 413 - 415+00 prior to construction.

ITEM #5 Application of Water

Tender 74 MG
Final 93.5 MG

The additional water was used on the sand cushion which was used to backfill the structure. The sand was extremely dry and required large quantities of water to obtain compaction by a hand operated compaction unit.

ITEM #6 Sand Cushion

Tender 3,100 Tons
Final 2,336 Tons

This item is under tender quantity as it was not possible to place sand cushion full width due to the close proximity of the Bailey Bridge and detour.

ITEM #8 Granular "A"

Tender 1,950 Tons
Final 2,475 Tons

Additional granular was required to shape up the shoulders within the limits of the Contract but outside the limits of grading as called for on the Plan.

Cont'd ...

ITEM #9 Calcium Chloride

Tender 6 Tons
Final 1.5 Tons

Only a small amount of calcium was required as the detour was paved before it was opened to traffic. Between the time Gran 'A' was placed on the grade (Sta 410 - 416) and the pavement being laid, showers were frequent and therefore dust control was a minor problem.

ITEM #20 Removing Fence

Tender 6 rods
Final 13 rods

A short fence, which was completely on D.H.O. property and served no useful purpose, was removed in its entirety because of its poor condition.

ITEM #26 Placing Topsoil

Tender 120 CY
Final 201 CY

All topsoil that had been stripped during the construction of the detour was available and was required to adequately cover the slopes when the detour was removed.

ITEM #27 Random Rip Rap

Tender 140 CY
Final 98 CY

This item is under tender quantity as the Rip Rap was placed to an elevation above high water level but not to the bottom of the curb over wingwall as it would serve no useful purpose. The pieces of Rip Rap were placed individually by a clam or backhoe and thereby eliminated loss in placing.

ITEM #32 Earth Excavation for Struct. Fdn.

Tender 68 CY
Final 94 CY

Cont'd ...

The quantity in this item increased when Mr. W. Hashizume, Bridge Const. Engineer, deemed it necessary to place a 4" working slab under the east abutment. D.H.O. forces had placed a berm west of the river and this increased the amount of excavation required to place the Bailey Bridge grillages.

(3) Estimated Engineering Costs on this Contract are \$9,000.00 This figure represent 6.9% of the tender value. The Project Supvr. was in charge of both Contract 69-179 and Contract 69-220. The Inspector did the layout and office work. Chainmen and Rodmen were obtained from Contract 69-179 when required.

(4) The only Force Account on the job was for the unloading of 'H' piles. The Special Provisions stated that the piles would be delivered to the site before the Contract was let. The piles did not arrive until the contractor had a crane on the site and the Department therefore made a saving in Float Time.

(5) No problems were involved with property or utilities. All utilities were moved well in advance of construction. During construction the only utility involved was the C.P.R. and the co-operation was very good.

CC/mk

C. Quick
C. Quick,
Proj. Supvr.

MEMORANDUM

To: Mr. S.J. Markiewicz,
Reg. Road Design Engr.
Kingston.

FROM: District #9, Ottawa.

ATTENTION:

DATE: September 19th, 1969.

OUR FILE REF.

IN REPLY TO

SUBJECT: W.P. 46-65-00, Muskrat River Bridge, 8.0 Miles S. of
Pembroke South Limits, Highway No. 17

68-F-39

The pre contract review meeting for the above was held in the Kingston Regional Office Boardroom on Thursday September 18th, 1969 at 11:00 AM with the following persons present:

K. Westerby	District Construction Engineer
R.N. McPhail	Construction Supervisor
R. Wert	Engineering Office Supervisor
M. Stoyanoff	Bridge Contract Engineer
T. Kingsland	Regional Bridge Office
R. Ashby	Regional Engineering Audit Office
R. Molaro	Regional Road Design Office
R. Bennett	Regional Road Design Office
J. Gruspier	Regional Materials Engineer
E. Pritchard	Regional Road Design Office
M. Devata	Foundations Section

It was the recommendation of the Committee that all asphalt be H.L.3.

Road Design will check to determine if the boat launching ramp is to be eliminated, bearing in mind the history of its establishment.

Surcharge: The District is to arrange to place a uniform depth of 2' of fill as a temporary surcharge 6 months before contract award. Any additional fill placed during construction need only be removed to the level of the top of surcharge existing at the time of removal.

Considerable discussion took place regarding payment for excavation in the structure foundation area since as it stands now there is not a clearly defined line of division between structure excavation and common excavation. Road Design is to prepare a Special Provision to clarify this point. The initial excavation in the area of station 742+76 is to be earth excavation, and after driving the piles the second excavation will be by Structure Excavation. It was recommended that reference to standard DD-405 be removed from the detail on sheet 6 of the contract drawings and road bed width indicated.

The Sundry Items were reviewed. Road Design Office will check to determine source of Bailey Bridge material.

A Special Provision is to be included that no vibratory equipment will be permitted on the north side of the river for construction of the detour.

On the Special Provision for Item #1 Earth Excavation for Grading at the end of the last sentence add "at his expense".

It was recommended that this contract be awarded early in the fiscal year so that it may be completed during the one construction season with 100 working days being allotted.

Meeting adjourned at 3:00 p.m.



R. Wert,
Engineering Office Supvr.

RW/amcp

MEMORANDUM

68-F-39

To: Mr. M. Devata,
Supervising Foundation Engineer,
DOWNSVIEW, Ontario.

FROM: Road Design Division,
KINGSTON, Ontario.

ATTENTION:

DATE: August 18, 1969.

OUR FILE REF.

IN REPLY TO

SUBJECT: W.P. 46-65 - Hwy. #17 - Muskrat River Bridge

Further to our telephone conversation of this date, attached herewith are sketches of the north approach to the Muskrat River Bridge on which is indicated in brown the limits of the sub-excavation of the layer of soft organic silt. Sketch No. 1 shows the limit of excavation starting at elevation 39625' from the north abutment and tapering up to the existing pavement at a 2:1 slope. Sketch No. 2 shows the same condition but with a 1:1 taper.

You will note that the excavation based on a 2:1 taper will undermine the timber mat that is required for the bailey bridge, but a 1:1 taper is clear of the mat.

I would appreciate receiving your recommendations as to the acceptability of a 1:1 slope rather than 2:1 as previously recommended

If you require additional information regarding this matter please contact this office.



C. E. Pritchard,
SR. PROJECT DESIGN ENGINEER.

CEP/mac

c.c. - J. Gruspier
W. D. Birch

702 11117

KING DOWN 1 AUG 22/69 11.20A VR
E MARKIEWICZ REG RD DESIGN ENGR

ATTN C R PRITCHARD

CC J E GRUSPIER REG MAT ENGR

CC W D BIRCH BRIDGE YTCF ENGR D/832

PE MUSKPAT RIVER BRIDGE HWY 17 WP46-65 WJ68-5-30

FURTHER TO YOUR MEMO OF AUG 18/69 WE HAVE REVIEWED THE SUBSOIL CONDITIONS
AND A 1 TO 1 BACK SLOPE IS ACCEPTABLE FOR SUBEXCAVATION .

Y DEVATA SUPERVISING FOUNDSTION ENGR FOR

A G STERMAC ENCLPL FOUNDATION ENGR

M & T OFFC

T
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L
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P
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DEPARTMENT OF HIGHWAYS ONTARIO

MEMORANDUM

To: Mr. W. D. Birch,
Bridge Maintenance Engineer,
Maintenance Office,
Admin. Bldg.

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

ATTENTION: Mr. E. Van Bellen,
Bridge Inspection Engineer

DATE: June 11, 1969

OUR FILE REF: IN REPLY TO

SUBJECT: Muskrat River Bridge, 29-55
Highway 17, District 9 (Ottawa)
-- W.P. 46-65 --

This is to confirm our discussion of June 11, 1969, regarding the foundations of the Bailey bridge for the temporary detour at the above mentioned site:

- (1) Because of poor ground conditions, the length of the Bailey bridge should be 160 ft.
- (2) Cribs can be used for bridge supports with bearing pressures of the order of 600 lbs./sq.ft.
- (3) Detour fills should be kept as low as possible.
- (4) Care should be taken when the subexcavation at the location of the north abutment of the new bridge is being carried out. This operation, if too close or carried out without the necessary precautions, could endanger the Bailey bridge.

AGS/MdeF

cc: Mr. J. Cruickshank

Foundations Files
Gen. Files

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

Department of Highways Ontario
Copy for the information of

Foundation Section

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

C.S. Grebski,
Bridge Office

May 21, 1969

Muskrat River Bridge
8.0 Miles S. of Pembroke
W.P. 35-65, Site 29-55
Highway 17, District 9

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

Kindly give us your comments at your earliest
convenience.

CSG:rd

C.S. Grebski,
Bridge Design Engineer

Attach.

c.c. Foundation Section

*Advised Gus Radowsky on May 26/69 to change
the forward slopes of the east abutment to 2:1.*

*On. Swata
May 21/69.*

SEP 10 1968 09:25

OK

MX DOWN SEPT 10/68 917A VR

OTTA 1 C E ROBERTSON DIST ENGR ATTN K WESTERBY CONSTRUCTION ENGR
COPIES TO

KINR 3 J GRUSPIER RGN MAT ENGR

S MARKIEWICZ RGN ROAD DESIGN

RE PROPOSED TEMPORARY DETOUR AT THE CROSSING OF MUSKRAT RIVER AND

KWY 17 TWP OF WESTMEATH COUNTY OF RENFREW WJ68-F-39 WP46-65

WE ARE IN FULL AGREEMENT WITH YOUR SUGGESTION OF A SUITABLE GRANULAR
PAD FOR PILE DRIVING EQUIPMENT TO WORK ON PARTICULARLY ON THE NORTH
APPROACH LOCATION.

M DEVATA FOR A G STERMAC MAT AND TEST DIV

T
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P
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MEMORANDUM

To: Mr. S. J. Markiewicz,
Regional Road Design Engineer,
A.D.O., Kingston.

From: Materials & Testing Division,
Kingston.

Date: February 14th, 1968.

Our File Ref.

In Reply To

SUBJECT:

Re: Hwy. 17, W.P. 46-65,
Muskrat River Bridge,
District 9, Ottawa.

68-F-30

Further to our memo of July 19, 1967, please be advised that a preliminary soils investigation has been carried out at this site. A site plan indicating the location of the borings and vane tests, along with logs of the borings and vane test results, are attached.

Based on the results of our investigation, it is recommended that the existing alignment be maintained with work on the existing approaches limited to asphalt padding and resurfacing only.

The best location for a detour during construction of the new bridge would be to the left of the existing structure. In order to stay on the berm with the detour fill, the length of the detour on the north side of the river should be as short as possible and as close to the existing road as possible. It would be desirable to limit the profile grade of the detour over the north side to an elevation of 412.5 which will provide 2.5' over the H.W.L. It is realized however that the grade at the bailey bridge may have to be somewhat higher.

When a profile and x-sections are available for the detour, we will review then with the thought of stage loading for the portion north of the river. Fill to a maximum depth of 3' over the existing berm could be tolerated as a first stage of construction. The material should consist of an acceptable non-plastic earth fill. It is suggested that this could be placed by the District maintenance forces or by using day labour.

Cont'd.....

The use of crib type abutments for the bailey bridge could be considered, similar to that used for the detour at the Snake River bridge several years ago. The stability of the cribs, if used, should be checked by the Foundation Section.

H. Meyer
H. Meyer

for J. E. Gruspier,
Regional Materials Engineer.

HAM/jk

c.c. J. L. Forster
C. R. Robertson
G. Scott
G. A. Wrong
A. G. Stermac ✓

LOG OF BORINGS

W.P. 46-65

Hwy. 17

Muskrat River Bridge

Hole No. 1

Station 412+60

45' Lt. E (-7')

0 - 2"
2 - 18"
18" - 15'

Dk. Br. Sa. Tops
Br. Si. F. Sa.
Br. Si. Cl. Moist Firm to 8' Wet 8'+
Traces Org. @ 5'

68-LA 25 'E' CL.

Sa.	-	12	L.L.	-	33.9
Si.	-	47	P.L.	-	16.5
Cl.	-	41	P.I.	-	17.4
V. F. Sa. Si.	-	57	F M/C	-	32.2

Station 412+60

75' Lt. E (-7')

Hole No. 2

0 - 8"
8" - 15"

Dk. Br. Cl. Tops
Br. Si. Cl. Moist Firm to 8' Soft 8'+
Numerous Stks. Si. F. Sa. to 8'

68-LA 26 'E' CL.

Sa.	-	19	L.L.	-	32.7
Si.	-	46	P.L.	-	17.1
Cl.	-	35	P.I.	-	15.6
V. F. Sa. Si.	-	56	F M/C	-	27.3

Station 413+15

30' Lt. E (-3')

Hole No. 3

0 - 24"
24 - 9'
9' - 10'
10 - 15'

Frozen
Br. S. Cl. Firm
Bl. Org.
Br. Si. CL. Soft

Station 413+15

60' Lt. E (-3')

Hole No. 4

0 - 2"
2" - 20"
20' - 27'

27'

Dk. Br. Sa. Tops
Br. Si. F. Sa.
Br. Si. CL. Firm to 11' Stks. of Org. @ 6'
Soft 11'+
NFP - Bldrs.
Numerous Stks. Sa. 11'+

Station 415+95

27' Lt. E (-7')

Hole No. 5

0 - 2"
2" - 6 1/2'
6 1/2' - 13 1/2'

Dk. Br. Sa. Tops
Br. Si. F. Sa. Gravly
Bl. Org. (Amorph Gran.) 13 1/2' - 15' Br. Marl.

Station 415+00

30' Lt. E (-7')

Vane Test

Hole No. 6

0 - 9'

Br. Si. F. Sa. Gravly

Depth

Undist/Remould

11' $\frac{1}{2}$	920/280
13' $\frac{1}{2}$	800/360
15' $\frac{1}{2}$	960/480
17' $\frac{1}{2}$	960/520
19' $\frac{1}{2}$	880/520
21' $\frac{1}{2}$	800/500
23' $\frac{1}{2}$	760/520
23' $\frac{1}{2}$	N.F.P. 3 men

Station 414+00

30' Lt. E (-7')

Vane Test

Hole No. 7

0 - 8 $\frac{1}{2}$ '

Br. Si. F. Sa. Gravly

Depth

Undist/Remould

11' $\frac{1}{2}$	500/120
13' $\frac{1}{2}$	800/240
15' $\frac{1}{2}$	680/280
17' $\frac{1}{2}$	720/320
19' $\frac{1}{2}$	640/360
21' $\frac{1}{2}$	800/360
23' $\frac{1}{2}$	720/360
25' $\frac{1}{2}$	880/480
27' $\frac{1}{2}$	720/360
29' $\frac{1}{2}$	720/320
31' $\frac{1}{2}$	640/280
33' $\frac{1}{2}$	680/300
34' $\frac{1}{2}$	N.F.P. Bldr.

W.P. 46-65Station 414+00

55' Lt. E (-9')

Vane Test

Hole No. 8

<u>Depth</u>	<u>Undist/Remould</u>
18'	760/80
3 1/4'	1200/220
5 1/4'	800/260
7 1/4'	520/220
9 1/4'	560/200
11 1/4'	600/180
13 1/4'	320/180
15 1/4'	400/180
17 1/4'	680/180
19 1/4'	400/180
21 1/4'	560/160
23 1/4'	400/160
25 1/4'	440/120
27 1/4'	400/110
29 1/4'	1120/160
29 1/2'	N.F.P.

Station 415+00

55' Lt. E (-9')

Vane Test

Hole No. 9

0 - 12"

Ice

<u>Depth</u>	<u>Undist/Remould</u>
3 1/4"	440/140
5 1/4"	640/140
7 1/4"	400/120
9 1/4"	480/140
11 1/4"	420/160
13 1/4"	/130
15 1/4"	420/160
17 1/4"	440/200
19 1/4"	320/160
21 1/4"	340/180
23 1/4"	360/140
25 1/4"	460/160
27 1/4"	360/140
29 1/4"	420/240
31 1/4"	600/180
33 1/4"	520/130
35 1/4"	600/130
37 1/4"	600/160
37 1/2"	N.F.P.

Station 415+95 55' Lt. E (-9') Vane Test Hole No. 10

0	-	3½'	Muck
3½'	-	11'	Marl.
11'	-	48'	Soft Clay Sa. layer @ 28' & 38'

Stations 414+10 35' - 40' Rt. Hole No. 11

414+60
415+60

N.F.P. @ 11' unable to push vane
(Tried several holes at each location)

Station 411+60 30' Lt. E (-3') Hole No. 12

0	-	24"	Frozen (approx. 4' tops)
24"	-	7½'	Br. Si. Cl. (Strks. Sa. few St. Traces Org.)
		7½'	N.F.P. Bldrs.

Station 411+50 60' Lt. E (-3') Hole No. 13

0	-	16"	Frozen (Approx. 6" Tops)
16	-	9'	Br. Si. Cl. Stny. Firm
			<u>68-LA 27 'E' CL.</u>

	Sa. -	30	L.L. -	29.1
	Si. -	34	P.L. -	16.9
	Cl. -	36	P.I. -	12.2
V. F. Sa.	Si. -	40 F	M/C -	28.5

9' - 15' Br. Cl. Si. Firm

Station 411+00 40' Lt. E (-1') Hole No. 14

0	-	18"	Frozen (Approx. 6" Tops)
18"	-	8'	Br. Cl. Si. Firm Hyd, P.I. M. @ 5'
			<u>68-LA 28 'E' CL.</u>

	Sa. -	14	L.L. -	29.1
	Si. -	56	P.L. -	18.9
	Cl. -	30	P.I. -	10.2
V. F. Sa.	Si. -	60 F	M/C -	21.4

Station 410+40 25' Lt. E (-1')

0	-	18"	Frozen (Appr. 4" Tops)
18"	-	8'	Br. Si. Cl. Firm

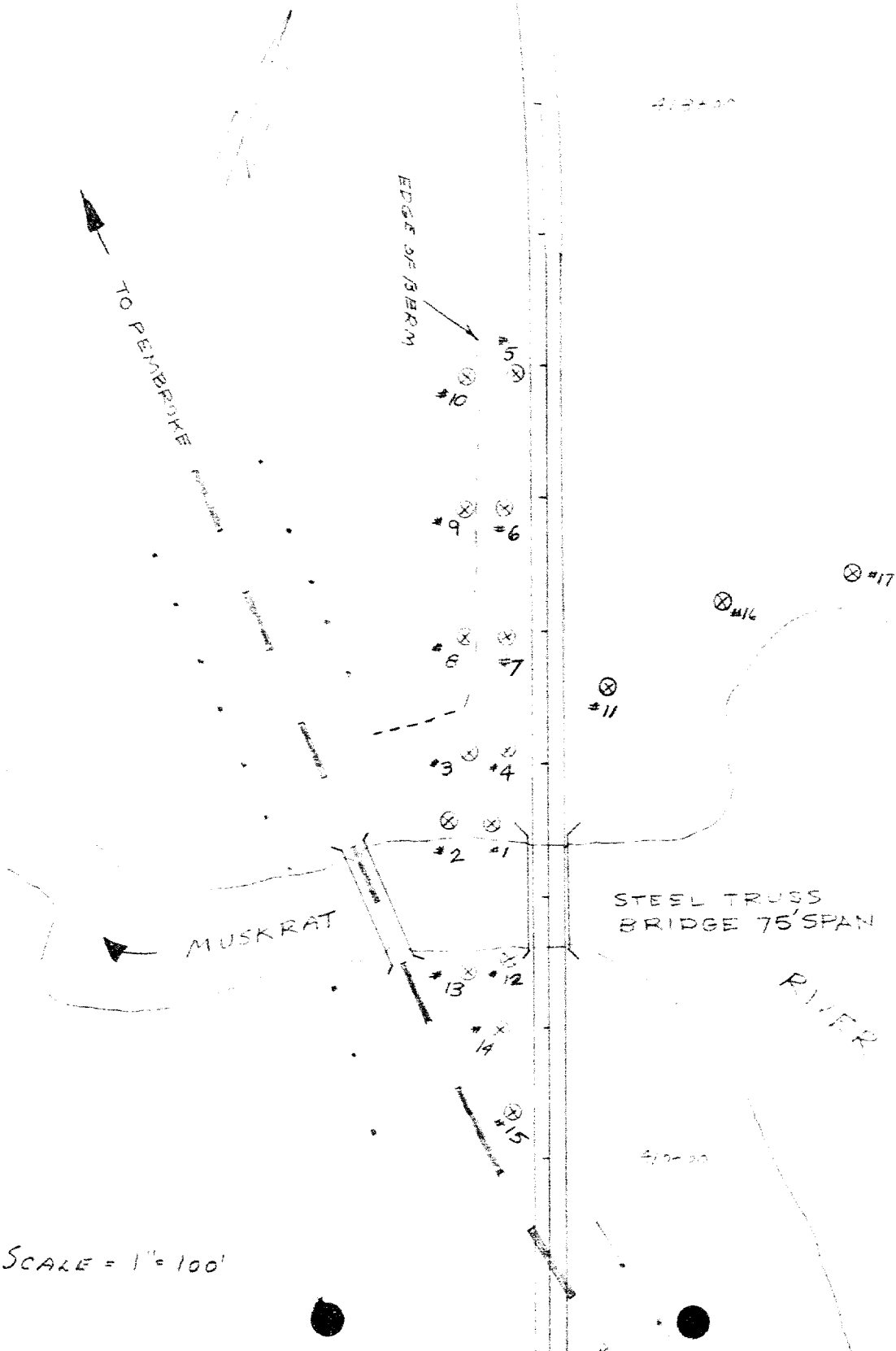
Station 414+20 120' Rt. £ (-10') Hole No. 16 (Peat Sampler)

0" - 3'	Water
3' - 4'	Blk. Org.
4' - 12'	Marl.
12' - 40'	Ga. S. Cl. Soft.
- 40'	Sa. Bottom

Station 414+30 230' Rt. £ (-10') Hole No. 17 (Peat Sampler)

0" - 8"	Ice
8" - 12'	Blk. Org.
12' - 54'+	Gr. Si. Cl. Soft to 48' Soft to Firm 48'+

LIMIT OF M.P. 46-65



MEMORANDUM

To: Mr. J. E. Gruspier,
Regional Materials Engineer,
Regional Office,
KINGSTON, Ontario.

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

DATE: August 2, 1968

OUR FILE REF.

IN REPLY TO

SUBJECT:

PROPOSED TEMPORARY DETOUR
At the Crossing of Muskrat River
And Highway #17
Twp. of Westneath - Co. of Renfrew
District No. 9 (Ottawa)
W.J. 68-F-39 -- W.P. 46-65

1. INTRODUCTION:

A foundation investigation for the above structure crossing was carried out in May, 1968, with the detailed engineering report submitted on July 19, 1968. The temporary detour required during the construction of this structure is to be provided by either a single Bailey or, alternatively, twin Bailey bridge structures located to the south of the existing structure.

In a memo from Mr. J. E. Gruspier, Regional Materials Engineer, dated July 19, 1968, this Section was requested to make recommendations regarding the feasibility of such a scheme, particularly with respect to stability and settlement of the approach fills and foundations. We have studied the data provided a) in the above report, and b) by the Regional Materials Division. This memo presents our comments and recommendations regarding the temporary detour.

2. STABILITY AND SETTLEMENT OF APPROACH EMBANKMENTS FOR DETOUR:

The detour will cross the berm located on the north-west side of the existing structure. To form the north approach to the Bailey bridge structure, this berm will be widened to the west.

cont'd. /2 ...

August 2, 1968

2. STABILITY AND SETTLEMENT OF APPROACH EMBANKMENTS FOR DETOUR: -
(cont'd.) ...

The maximum amount of fill required above ground level, in this the transverse direction, will be of the order of 6 feet. In the longitudinal direction the crest of the embankment is a maximum of 19 feet above creek bottom. Lower fills will be required to form the south approach. These fills are underlain by 10 to 20 feet of soft to firm cohesive deposits. Stability analyses were, therefore, carried out. These analyses indicate that the stability in the transverse and longitudinal direction is satisfactory (Factor of Safety ≥ 1.3), providing the overall slope of the creek banks are not allowed to stand any steeper than 2 horizontal to 1 vertical. Consolidation settlement of the soft foundation subsoil will occur due to the surcharge loading of the detour fill. Computations carried out indicate that, for the maximum height of fill contemplated (of the order of 6 feet), the settlement should not exceed 4 to 6 inches. Settlement of this order of magnitude should not present any major problems.

3. DETOUR STRUCTURE:

Because of the soft compressible cohesive deposits underlying the site, it is recommended that the Bailey structure(s) be founded on end-bearing timber piles driven to practical refusal within the competent glacial till. For estimating purposes, it can be assumed that practical refusal would occur at about elevation 375. An allowable capacity of 20 tons/pile could be used in design, for piles driven to this elevation. Pile driving should be controlled by the Hiley Dynamic Pile Driving formula.

Due to the competent nature of the glacial till at and below pile tip elevation, settlement of the pile bents should be negligible.

cont'd. /3 ...

Mr. J. E. Gruspier,
Regional Materials Engr.,
Kingston, Ont.

3.

August 2, 1968

3. DETOUR STRUCTURE: (cont'd.) ...

It is recommended that the detour structure(s) span be from about Station 411+60 to 412+94 - i.e., be about 134 feet in length.

We trust that this memo contains all the information required. If you have any further queries, or if any of the foregoing requires clarification, please do not hesitate to call us.

MD/MdeF

for *B. T. Darch,*
M. Devata,
SUPERVISING FOUNDATION ENGR.
For:
A. G. Stermac,
PRINCIPAL FOUNDATION ENGR.

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

H. A. Tregaskes

D. W. Farren

S. J. Markiewicz

~~E. A. Cash~~

G. Scott

W. D. Birch

Foundations Files ✓

Gen. Files

C. R. ROBERTSON

MEMORANDUM

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

FROM: Bridge Division,
Kingston, Ontario.

ATTENTION: Mr. M. Devata, P. Eng.

DATE: June 24, 1968.

OUR FILE REF:

IN REPLY TO

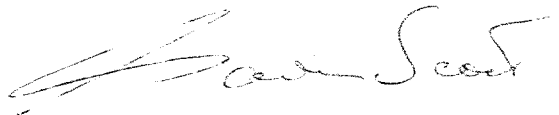
SUBJECT: W. P. 46-65, Site 29-55, Muskrat River Bridge
(Proposed Temporary Detour) Highway 17,
District 9

Herewith please find copy of letter dated June 24, 1968, from Road Design together with portion plan and profile prints for the following schemes:

- A - Utilizing a single lane Bailey
- B - Utilizing Twin Baileys

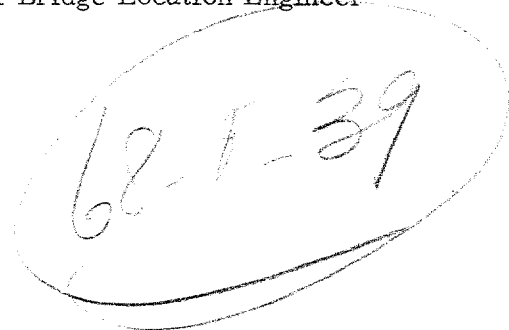
A roll of cross sections is being sent to you under separate cover.

We would be pleased if you will inform us as to the limits of the proposed temporary detour approach embankments, and comment on the stability of the material underlying the approach fills.



Gavin Scott, P. Eng.
Regional Bridge Location Engineer

GS/hl
Encls.
c.c. (w.o. encls.)
Bridge Office Files Section



MEMORANDUM

To: Mr. G. Scott,
Regional Bridge Location Engineer,
KINGSTON, Ontario.

From: Road Design Division,
KINGSTON, Ontario.

Attention:

Date: June 24, 1968.

Our File No.:

IN REPLY TO

Subject: W. P. 46-63-Hwy. #17- Muskrat River Bridge, 8.0 miles south from
Southeastly limits of Pembroke.

We are forwarding the plan, profile and cross sections of two proposed schemes for the temporary detours required in the above noted W. P.

Could you please make recommendations as to the length of Bailey Bridge required and comment on the stability of material underlying the approach fills.

D. B. Thomas,
FOR: E. M. Bartie,
SR. Project Design Engineer,

DBT/EMB/sgb

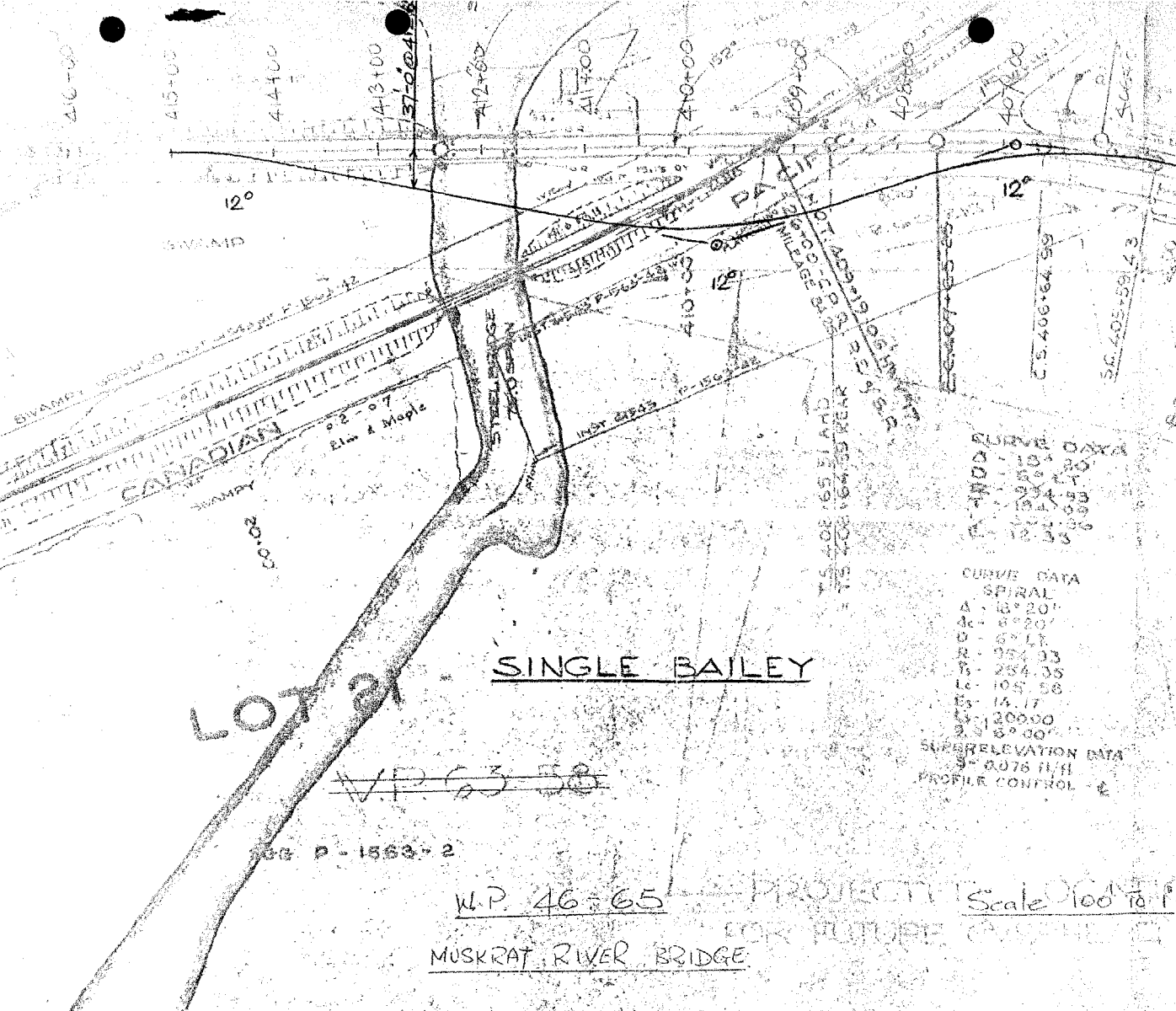
RECEIVED

JUN 24 1968

BRIDGE
OFFICE

DEFECTS IN NEGATIVE DUE TO
CONDITION OF ORIGINAL DOCUMENT

DATA
 HAL
 5922
 5035
 5000
 1145.32
 242.23
 132.23
 11.36
 175.00
 4022.30
 ELEVATION DATA
 0.070 H/H
 CONTROL - 4



CURVE DATA

A	18.20'
L	5.50'
R	954.03
T	254.35
E	105.58
S	14.17

CURVE DATA
 SPIRAL

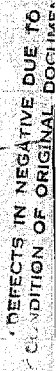
A	18.20'
L	5.50'
R	954.03
T	254.35
E	105.58
S	14.17
L	1200.00
S	8.00'

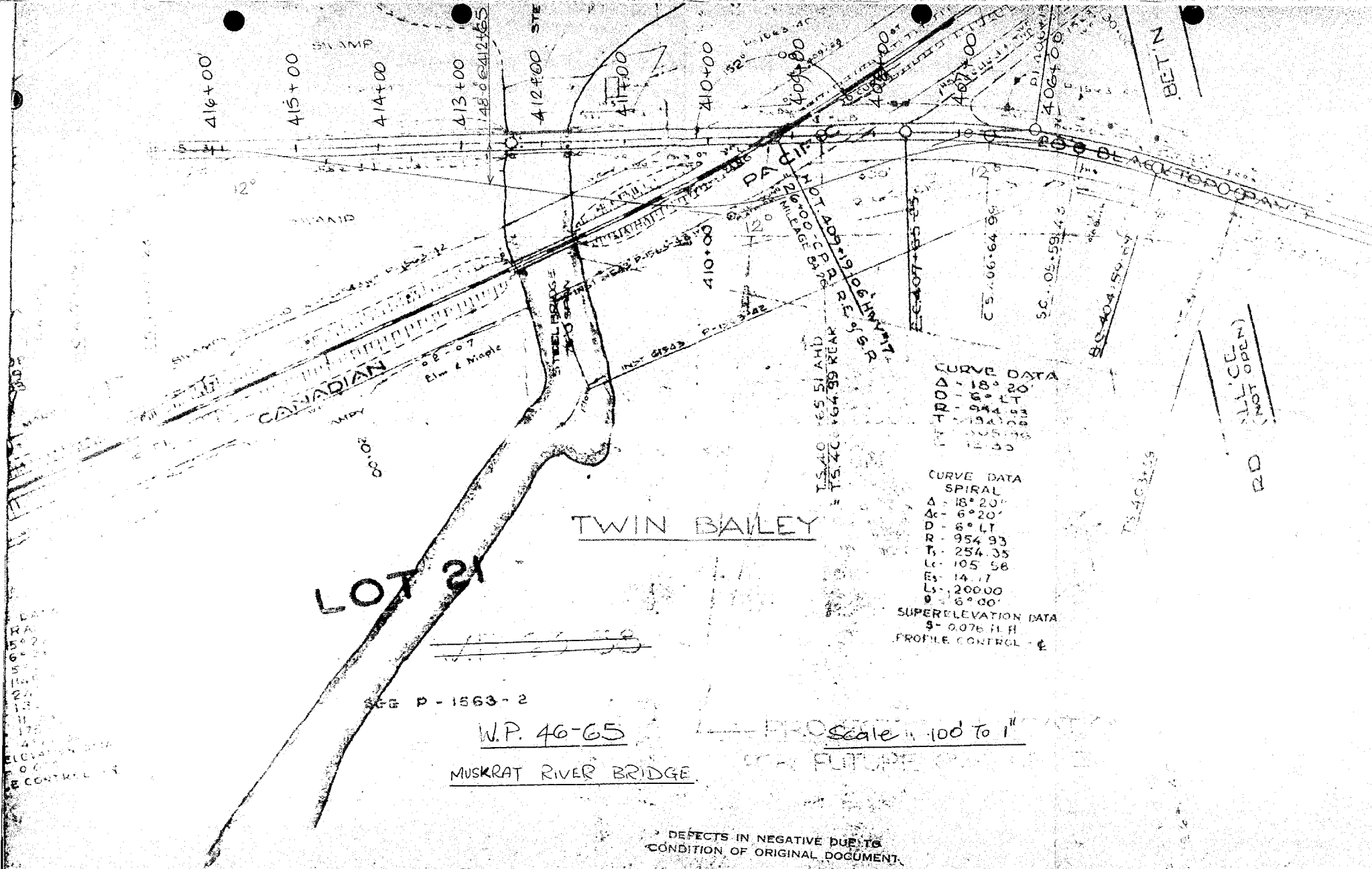
SUPERELEVATION DATA
 S = 0.076 H/H
 PROFILE CONTROL - 2

W.P. 46-65
 MUSKRAT RIVER BRIDGE

PROJECT Scale 100 to 1
 FOR FUTURE CONSTRUCTION

SINGLE BAILEY SCHEME

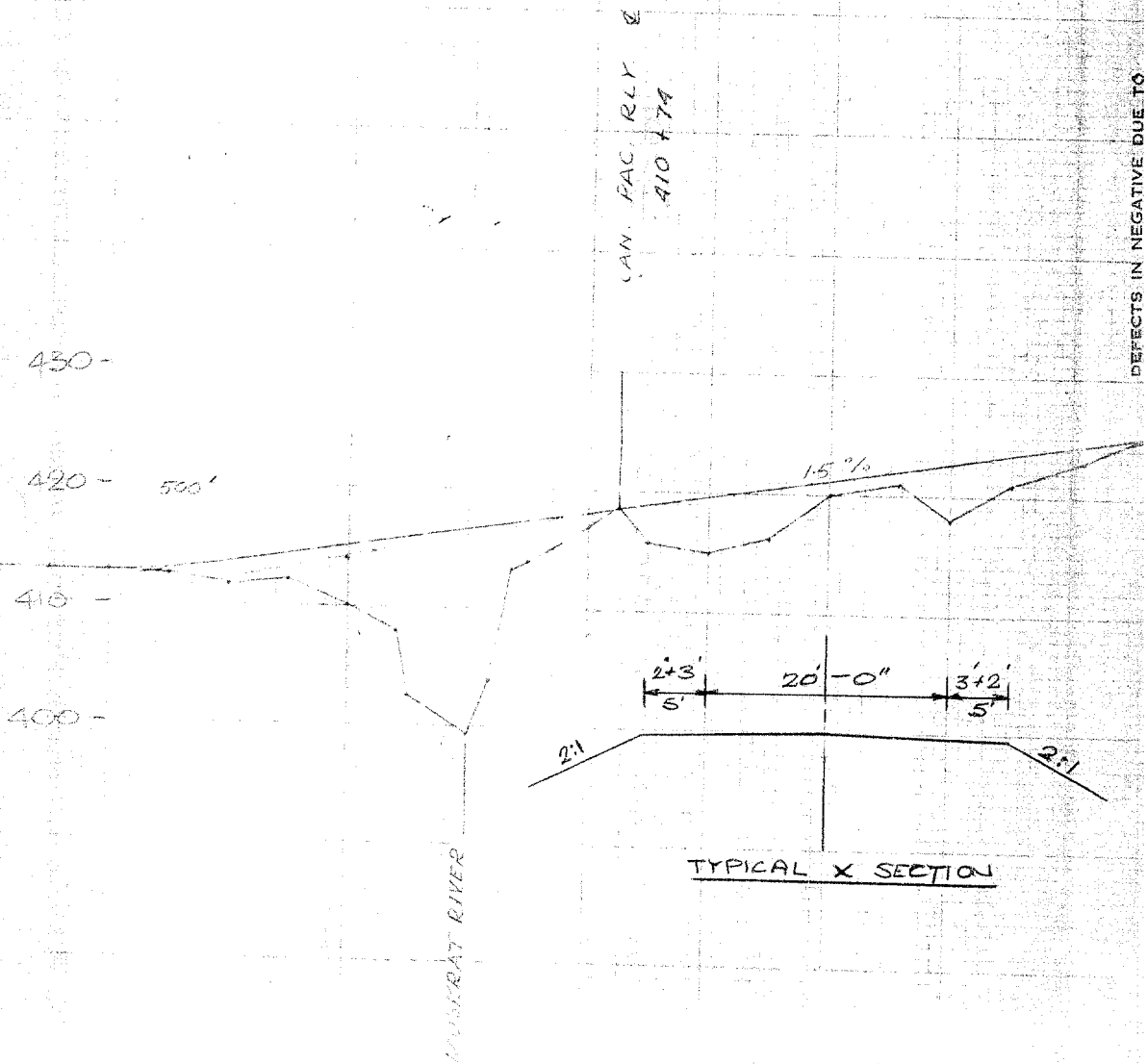




DEFECTS IN NEGATIVE DUE TO
CONDITION OF ORIGINAL DOCUMENT

TWIN BAILEY SCHEME

DEFECTS IN NEGATIVE DUE TO



W.P. 46-65

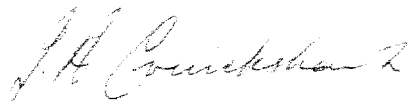
MURRAT RIVER BRIDGE

maintaining the stability of the highway embankment, although they have settled appreciably in the meantime. It seems probable that more serious failure of the present embankment would have occurred in the absence of these berms, and it would be desirable to restore the berm fills to their original height of 4' under this project. Stage loading should be considered. Consideration can be given to utilizing the restored berms for the detour which will be required during replacement of the Muskrat River structure. It is recommended, at this time, that the project be extended westerly to Sta. 419, to include resurfacing of the existing pavement, which is cracked and distorted as a result of the failure at Sta. 418+ left of centreline.

Although the final recommendations for the structure foundations will depend upon a foundation investigation, it appears likely that piles driven to bedrock will be required. The same treatment may be required for any Bailey Bridge structure for the detour, although it may be possible to provide floating crib-type abutments in this case.

Sandy earth borrow suitable for construction of the berms and detour should be available within a reasonable haul distance. Granular materials will likely be obtained from commercial sources and may have to be hauled from as far away as Renfrew or Petawawa.

At the time of the foundation investigation consideration should be given to investigating the proposed detour and its location over the berm area.



J. A. Cruickshank

for: J. E. Crispier
Regional Materials Engineer

JAC:mgm

cc: A. G. Stermac ✓
G. A. Wong

68-F-39

Mr. J. L. Forster
Regional Functional Planning Engr.,
Functional Planning, Kingston

M. & T. Division
Kingston

Attention: Mr. L. P. Shorr

July 19, 1967

Re: W.P. 46-65, Hwy. 17
Muskrat River Bridge
District No. 9

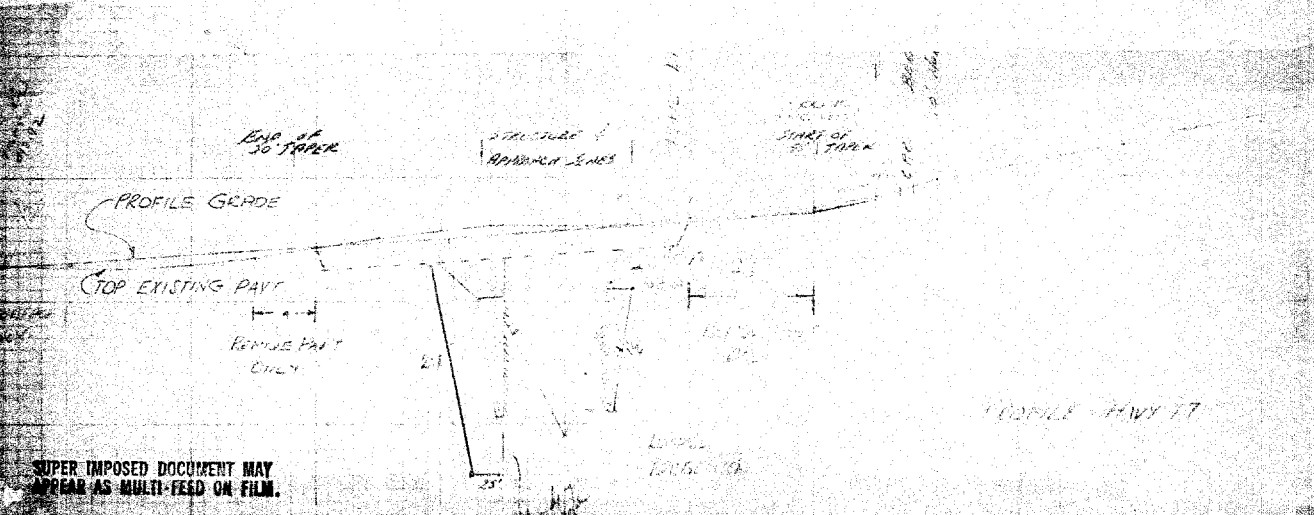
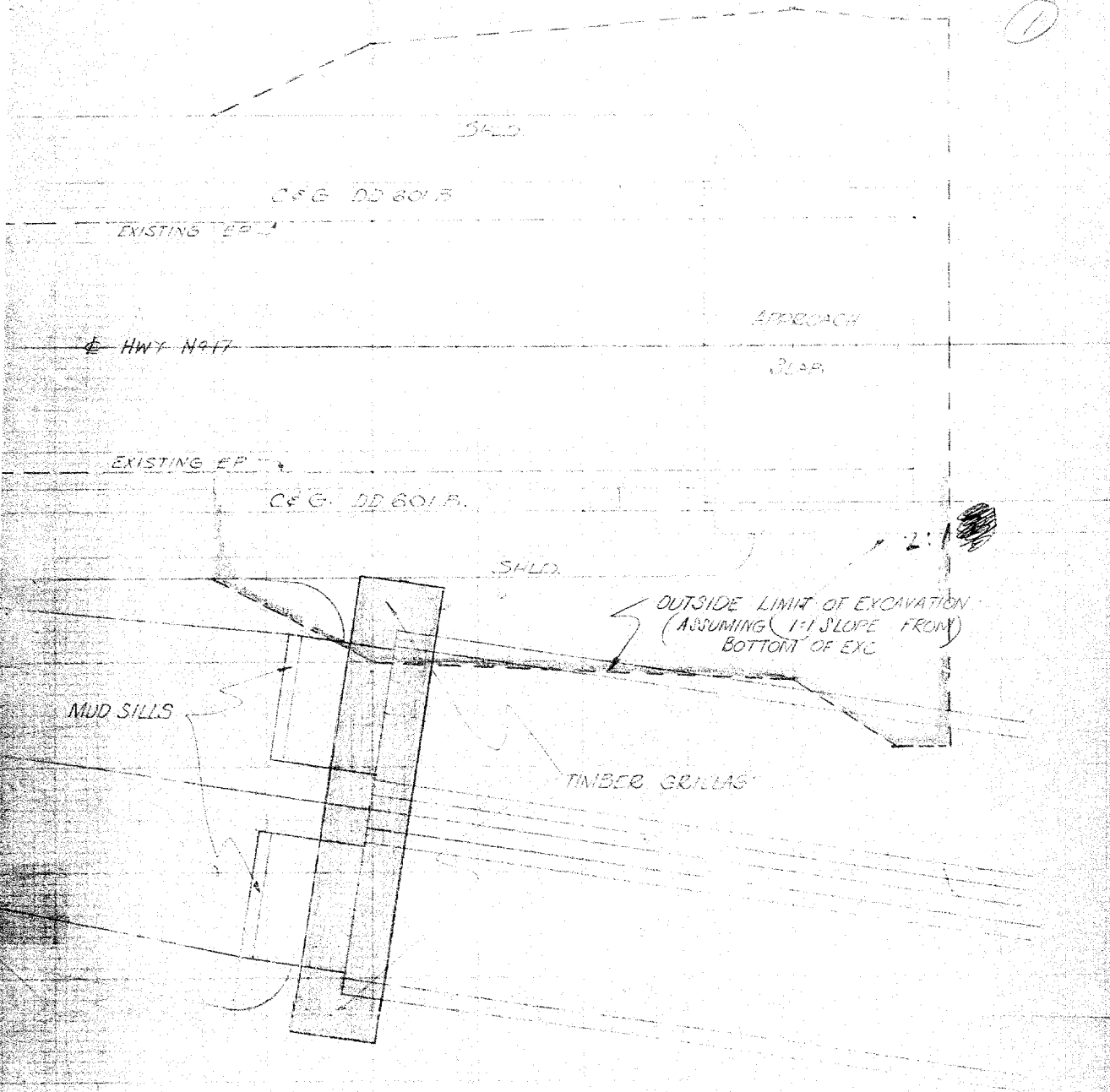
The above site was inspected by the undersigned on July 6, 1967. At that time, surface water in the swamp at Sta. 416+ was at an elevation of approximately 407.

During a previous soils investigation at this site under W.P. 198-59, it was established that the swamp deposits consisted of muskeg over soft clay and marl, with firm bottom at depths from 23' to 43'. Proposals called for a grade raise of 1' - 2' over the existing pavement, and it was recommended that the muskeg be ridden on the widening, with 4' x 25' berms.

Since construction was completed on this section of Hwy. 17 in 1963, appreciable settlement and distortion of the pavement has occurred to the west of the Muskrat River structure. Slight slip failures of the existing embankment have occurred at Sta. 415+ right of centreline, and at Sta. 418+ left of centreline. With the exception of short sections adjacent to the structure, the berms were not visible above the surface of the water in the swamp at the time of the inspection. Low muck waves were evident on both sides of the embankment, about 30' from the toe of the embankment slopes.

Functional Planning proposals call for some asphalt padding east of the structure, and a granular lift of up to 1', to the west of the structure, in order to improve the vertical alignment at the structure approaches. In view of the potentially unstable condition of the present embankment, it would be desirable to reduce to an absolute minimum, the proposed grade raise and widening of the existing embankment between Sta. 413 and Sta. 417. Since the muck waves have occurred outside the limits of the existing berms, it would appear that these berms have at least partially succeeded in

①



2

SHLD.

C & G DE GMB

EXISTING E.P.

CHITAWAY #17

APPROACH
SLAB

EXISTING E.P.

SHLD.

OUTSIDE LIMIT OF EXCAVATION
(ASSUMING 1:1 SLOPE)
FROM BOTTOM OF EXC

MUD SILLS

TIMBER GRILLAGE

E-DEFENSE

END OF
TO TRAIL

STRUCTURE &
APPROACH SLAB

EDGE
OF
THICK

REMOVE PART
ONLY

1:1

WATER
PILLAGE ON

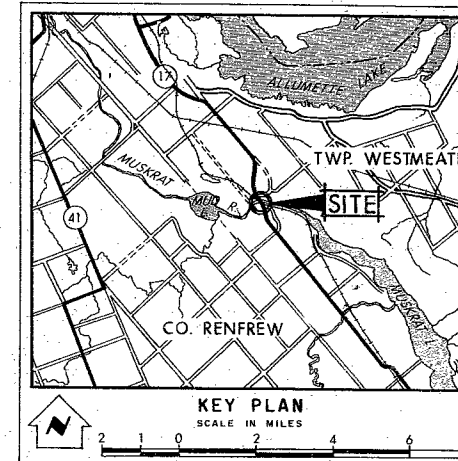
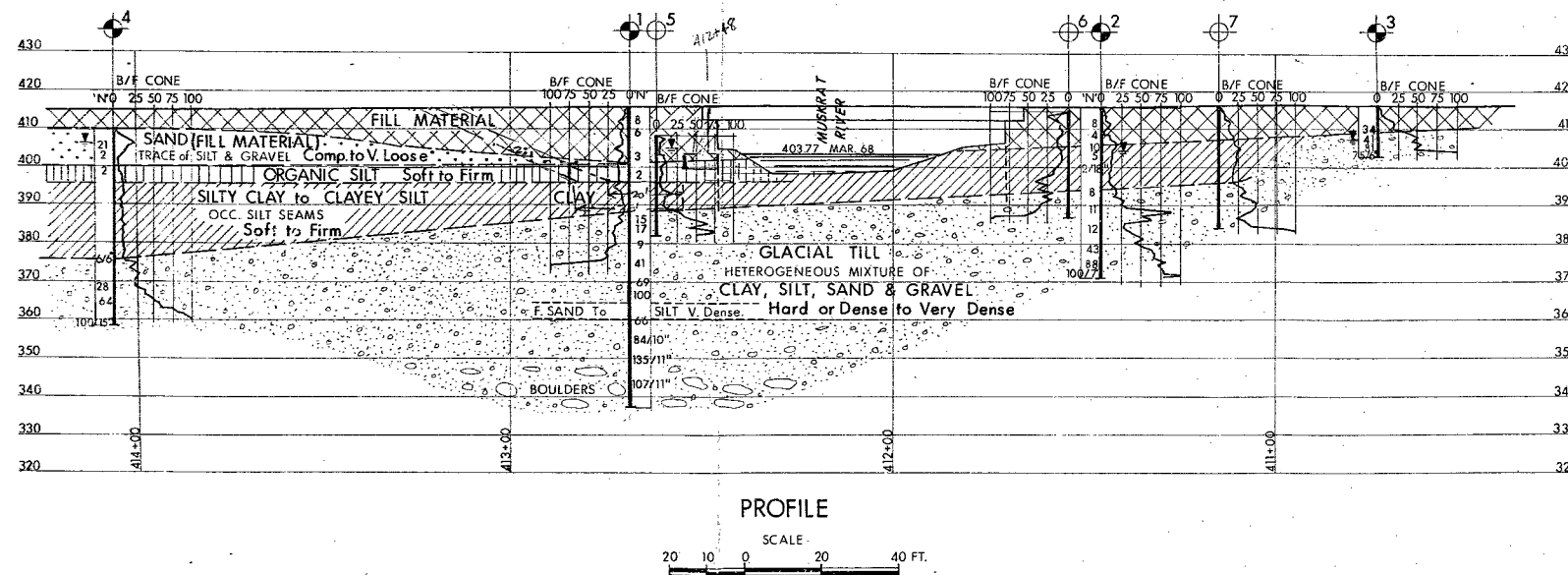
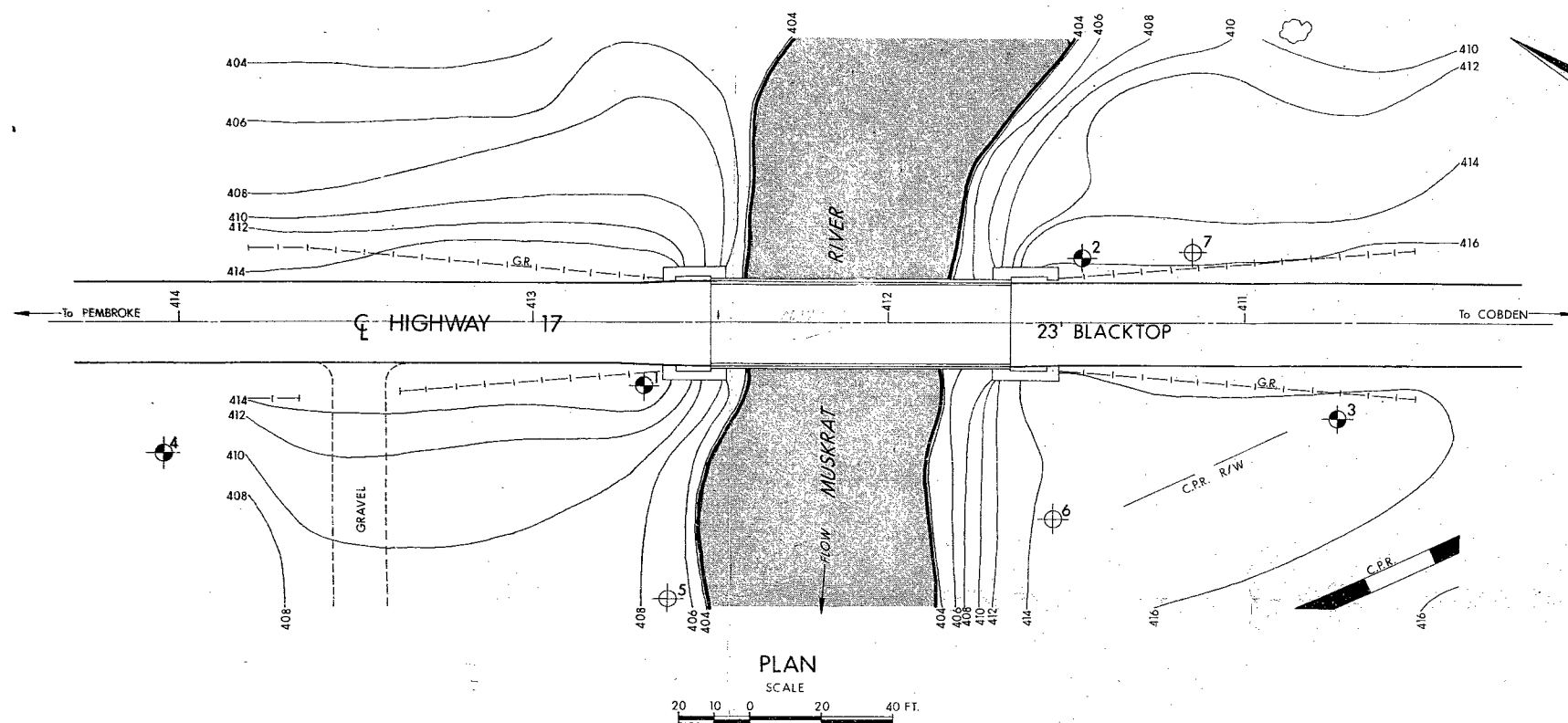
PROFILE HWY 17

#68-F-39

WP #46-65

Hwy #17

MUSKRAT R.



LEGEND			
	Bore Hole		
	Cone Penetration Hole		
	Bore & Cone Penetration Hole		
	Water Levels established at time of field investigation, MAY, 1968.		
NO.	ELEVATION	STATION	OFFSET
1	416.5	69	18.0' LT.
2	416.6	66	17
3	415.2	4	27.0' LT.
4	410.0	4	36.5' RT.
5	408.2	412+62	77.5' LT.
6	414.8	411+54	55.4' LT.
7	416.5	411+15	20.0' RT.

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

REVISIONS	DATE	BY	DESCRIPTION

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

MUSKRAT RIVER

KING'S HIGHWAY NO. 17 DIST. NO. 9
CO. RENFREW
TWP. WESTMEATH LOT 21 CON. 2 WML

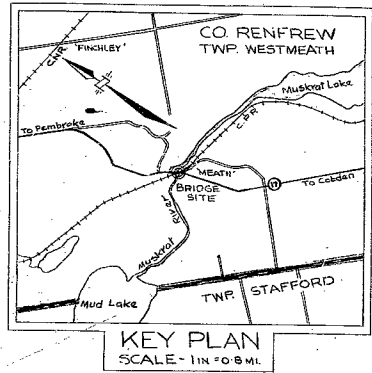
BORE HOLE LOCATIONS & SOIL STRATA

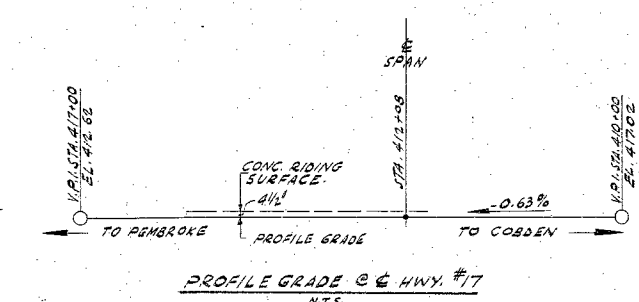
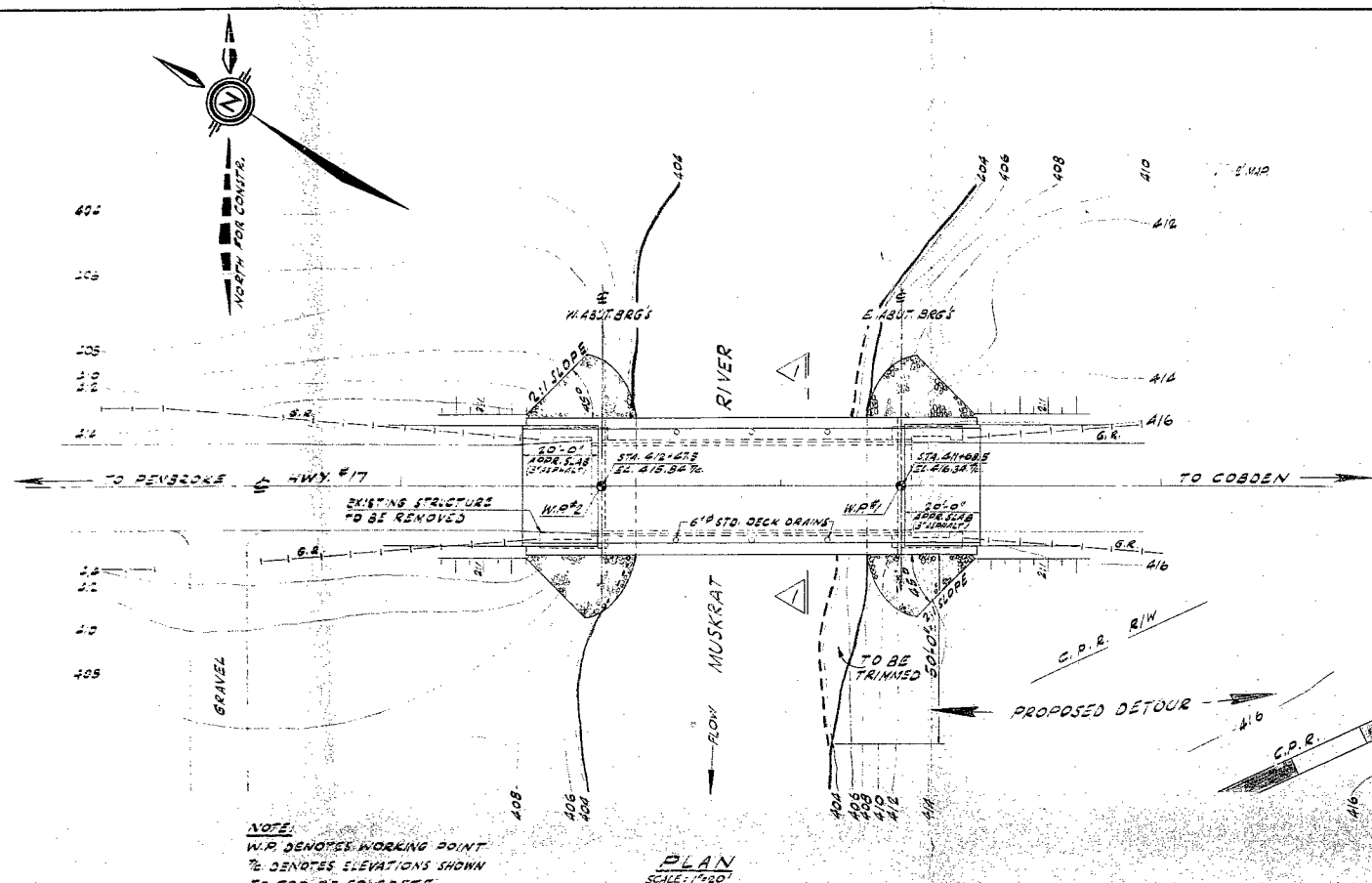
SUBM'D. W. H. CHECKED *[initials]* W.P. NO. 46-65 M.B.T. DRAWING NO.
DRAWN D.M. CHECKED *[initials]* JOB NO. 68-F-39 68-F-39A
DATE: JULY 4, 1968 SITE NO. BRIDGE DRAWING NO.
APPROVED *[signature]* CONT. NO.

REF. NO. E-4660-1

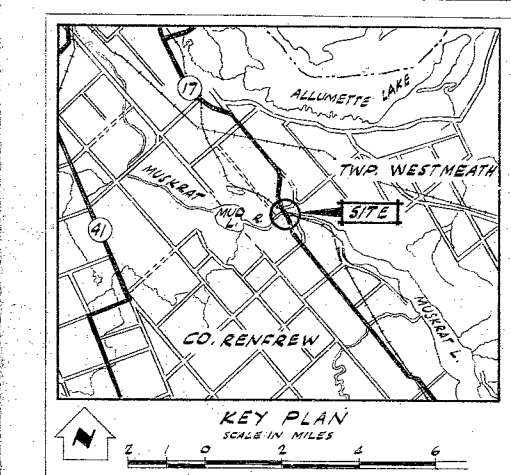
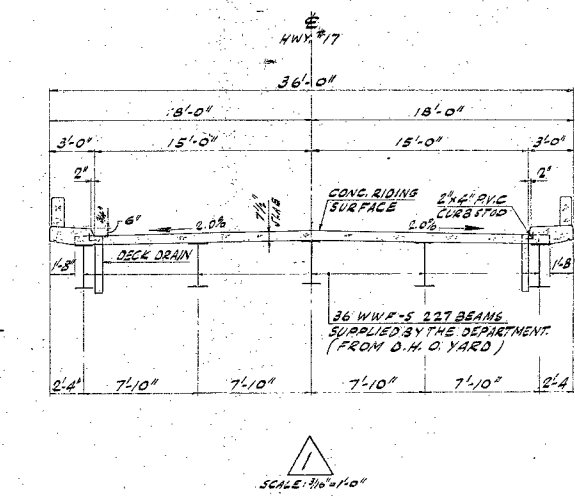
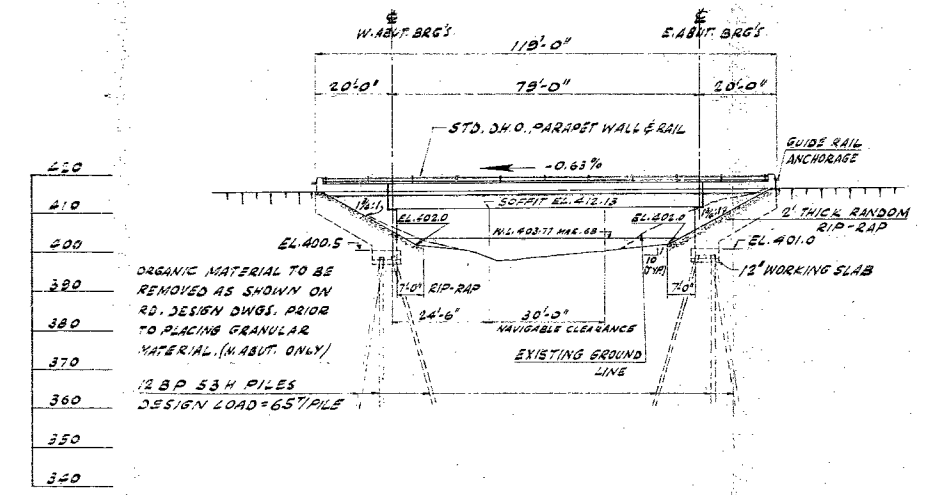
1041

11-0004-1





- LIST OF DRAWINGS**
- D-6536 - 1 GENERAL LAYOUT
 - 1 - 2 BOREHOLE LOCATIONS & SOIL STRATA
 - 1 - 3 FOUNDATION LAYOUT
 - 1 - 4 ABUTMENTS & DETAILS
 - 1 - 5 BEAMS BEARINGS & DETAILS
 - 1 - 6 DECK DETAILS
 - 1 - 7 PARAPET WALL DETAILS
 - 1 - 8 APPROACH SLABS
 - 1 - 9 STANDARD STEEL PARAPET RAIL
 - 1 - 10 STANDARD DETAILS



GENERAL NOTES

CLASS OF CONCRETE
DECK AND CURBS 4000 P.S.I.
REMAINDER 3000 P.S.I.

CLEAR COVER ON REINFORCING STEEL

FOOTINGS 3"
ABUTMENTS 3"
DECK 10" TOP & 1" BOTTOM
CURBS 3"
AND/OR AS NOTED ON DRAWINGS
ALL EXPOSED CONCRETE CORNERS SHALL BE CHAMFERED 3/4"

CONSTRUCTION NOTES

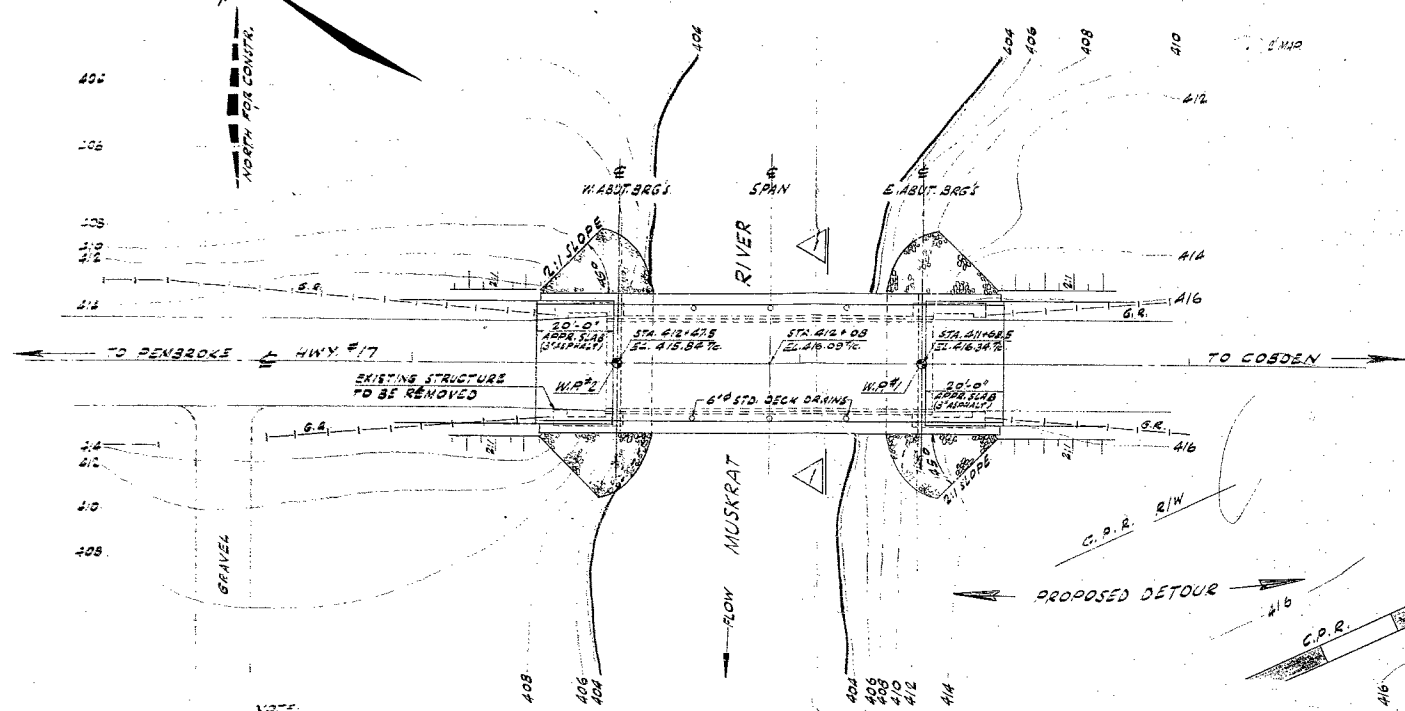
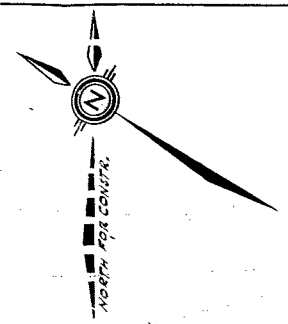
THE CONTRACTOR IS RESPONSIBLE FOR FINISHING BEARING SEATS TO THE SPECIFIED ELEVATIONS WITH A TOLERANCE OF $\pm 1/8"$.
NO CONCRETE IS TO BE PLACED ABOVE BEARING SEATS UNTIL DECK SLAB IS PLACED.

PRINT RECORD		
No.	FOR	DATE

REVISIONS	
DATE	DESCRIPTION
DEPARTMENT OF HIGHWAYS ONTARIO BRIDGE DIVISION	
68 F-39	
MUSKRAT RIVER BRIDGE (8.0 MI. S. OF PEMBROKE)	
KING'S HIGHWAY No. 17	DIST. No. 2
CO. RENFREW	
TWP. WESTMEATH	LOT 21 CON. 2 W.M.L.
GENERAL LAYOUT	
APPROVED	SITE No. 29-55 W.P. No. 46-65
DESIGN A.K.	CHECK V.F.B.
DRAWING A.V.	CHECK A.K.
DATE MAY/69	LOADING H.S.20-44
DRAWING No. D-6536-1	

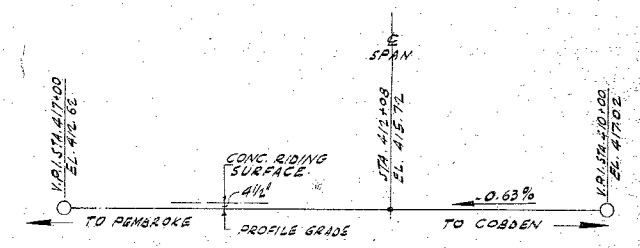
B.M. EL. 417.03
GEODETIC DATUM
CUT CROSS ON N.E. CORNER C.P.R. CONC
ABUTMENT 100' W. OF STA. 411+60



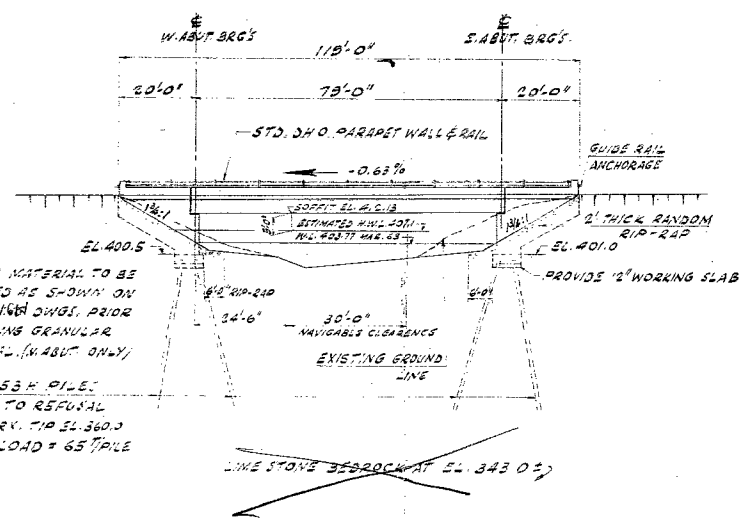
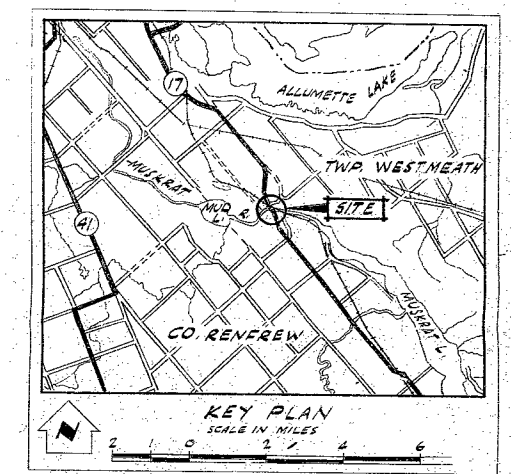


NOTE:
W.P. DENOTES WORKING POINT
TO DENOTES ELEVATIONS SHOWN
TO TOP OF CONCRETE.

PLAN
SCALE: 1"=50'



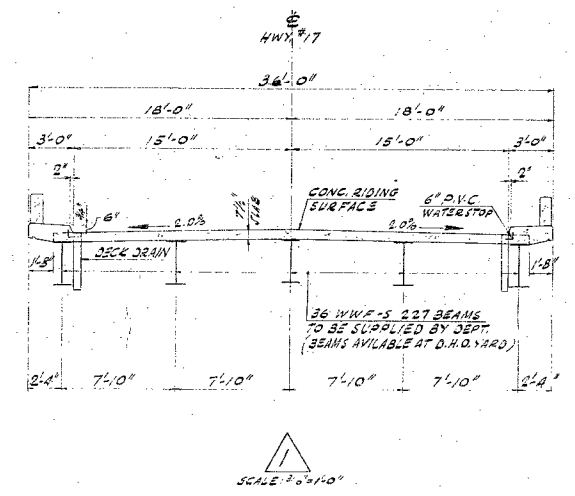
PROFILE GRADE @ HWY. #17
N.T.S.



- 425
- 410
- 400
- 380
- 370
- 360
- 350
- 340

ORGANIC MATERIAL TO BE
REMOVED AS SHOWN ON
RD. DESIGN DWGS. PRIOR
TO PLACING GRANULAR
MATERIAL (W/ABUT ONLY)
2" BP 53 K PILE
DRIVEN TO REFUSAL
AT APPROX. TIP EL. 360.0
DESIGN LOAD = 65 TONS

LIME STONE BEDROCK AT EL. 343.0



SCALE: 1"=10'

B.V. EL. 417.03
GEODETIC DATUM
CUT CROSS ON N.E. EDGE C.P.R. CONC
ABUTMENT 104' LT. OF STA. 711+60

PRINT RECORD		
No.	FOR	DATE

REVISIONS		
DATE	BY	DESCRIPTION

DEPARTMENT OF HIGHWAYS ONTARIO	
BRIDGE DIVISION	
68-F-39	
MUSKRAT RIVER BRIDGE	
(30 M.S. OF PEMBROKE)	
KING'S HIGHWAY No. 17	DIST. No. 9
CO. RENFREW	
TWP. WESTMEATH	LOT 21 CON. 2 WML
PRELIMINARY	
APPROVED	SITE No. 29-55 W.P. No. 46-65
DESIGN A-4	CHECK
DRAWING 4-1	CHECK
DATE MARCH 69	LOADING #520-44
CONTRACT No. J-6536-P2	

