

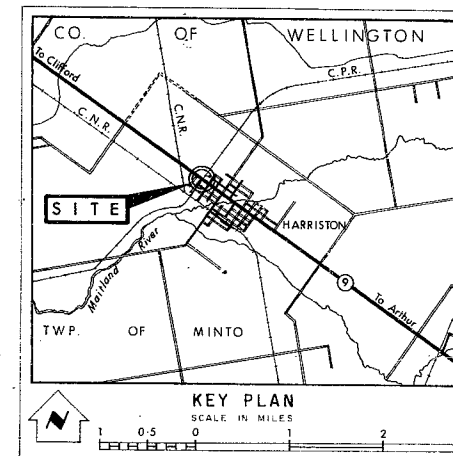
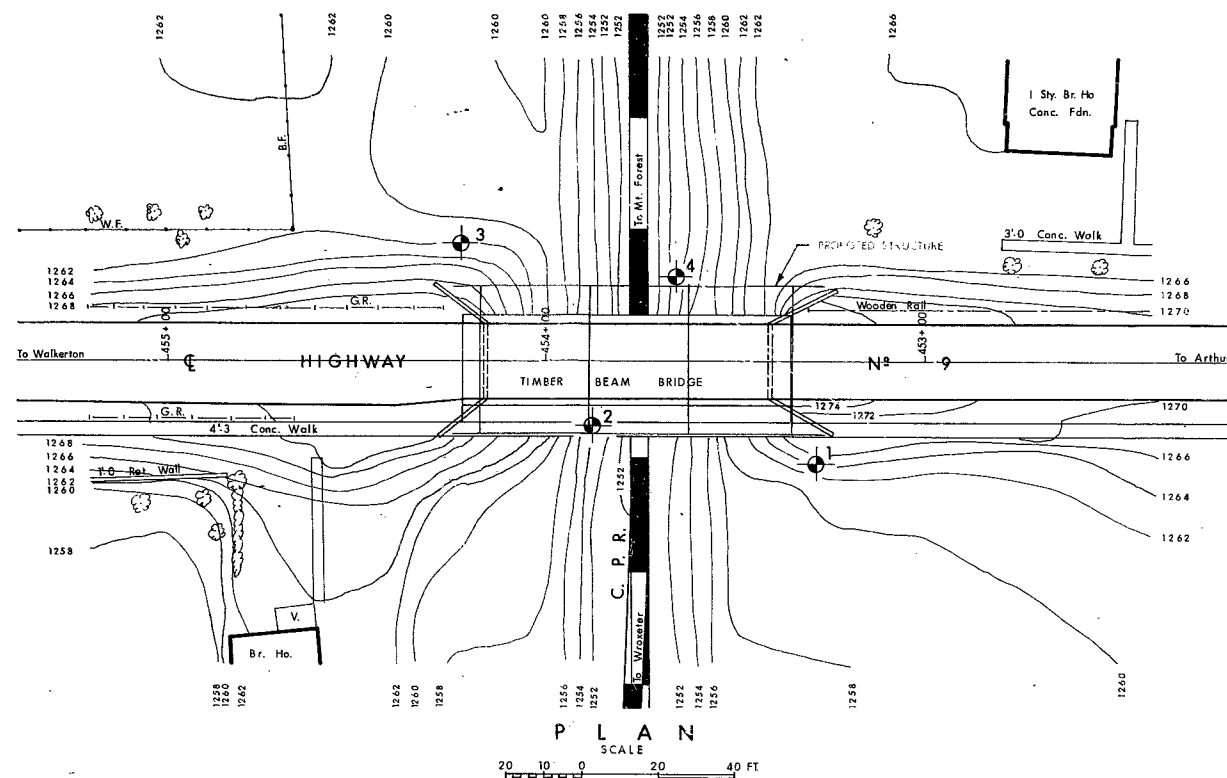
#64-F-93

W.P. # 18-62

Hwy. #9 E'

Prop. C.P.R. Br.

509 950 E.
4862 350N
40 P15 W



LEGEND			
	Bore Hole		
	Cone Penetration Hole		
	Bore & Cone Penetration Hole		
	Water Levels established at time of field investigation (Oct. 1964)		
NO.	ELEVATION	STATION	OFFSET
1	1261.8	453+29	27' LT.
2	1253.0	453+88	17' LT.
3	1260.7	454+22	31' RT.
4	1253.6	453+66	22' 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 & RESEARCH DIVISION - FOUNDATION SECTION			
CANADIAN PACIFIC RAILWAY			
KING'S HIGHWAY NO. 9		DIST. NO. 3	
CO. WELLINGTON		TOWN OF HARRISTON	
TWP. MINTO		LOT CON.	
BORE HOLE LOCATIONS & SOIL STRATA			
SUBM'D. P. M. CHECKED	W.P. NO. 18-62	M&R DRAWING NO.	
DRAWN D.A.M. CHECKED	JOB NO. 64-F-93	64-F-93 A	
DATE 9 DECEMBER 1964	SITE NO.	BRIDGE DRAWING NO.	
APPROVED	CONT. NO.		

REF. N° E-4178-1

MEMORANDUM

TO: Mr. A. M. Toye,
Bridge Engineer,
Bridge Division.

FROM: Foundation Section,
Materials and Research Div.,
Room 107, Lab. Bldg.

Attention: Mr. S. McCombie

DATE: November 19, 1964.

OUR FILE REF.

IN REPLY TO

SUBJECT:

FOUNDATION INVESTIGATION REPORT

For
Proposed New Bridge over the
Canadian Pacific Railroad line on
Hwy. #9, Harriston, Ontario
District #3
W.J. 64-F-93 W.P. 18-62

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

We believe that you will find the factual data and recommendations contained therein, adequate for your future design work. Should you require additional information, please do not hesitate to contact our Office.

PM/pb
Attach.

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

cc: Messrs. A. M. Toye (2)
H. A. Tregaskes
H. D. McMillan
A. Gater
J. D. Tillcock
J. Roy
A. Watt

Foundations Office
Gen. Files. ✓

TABLE OF CONTENTS

1. INTRODUCTION.
 2. DESCRIPTION OF SITE.
 3. FIELD INVESTIGATION PROCEDURES.
 4. LABORATORY TESTS
 5. SUBSOIL CONDITIONS
 - 5.1) General
 - 5.2) Fill Material
 - 5.3) Silt to Sandy-Silt
 - 5.4) Clayey-Silt with Sand and some Gravel
 6. GROUNDWATER CONDITIONS.
 7. DISCUSSION & RECOMMENDATIONS.
 8. SUMMARY.
 9. MISCELLANEOUS.
-

FOUNDATION INVESTIGATION REPORT

For

Proposed New Bridge over the Canadian
Pacific Railroad line on Hwy. #9,
Harriston, Ontario, District #3
W.J. 64-F-93 W.P. 18-62

1. INTRODUCTION:

A request for a foundation investigation at the site of the proposed Hwy. 9 & C.P.R. Overhead was received from the Bridge Office in a memo dated October 5th, 1964.

A field investigation was subsequently carried out by this Section to determine the subsoil conditions existing at the site of the proposed Overhead. Presented in this report are the results of this investigation, together with our recommendations pertaining to the design of the proposed foundations and approach embankments.

2. DESCRIPTION OF SITE:

The site is located at the north-west end of Harriston, Ontario at the crossing of Hwy. 9 and the C.P.R. line. The existing structure is a 74 ft. span timber-beam overhead bridge in a generally poor condition, spanning a single-track C.P.R. line.

The area in the immediate vicinity of the site is generally gently undulating farmland pasture.

cont'd /2...

3. FIELD INVESTIGATION PROCEDURES:

A total of 4 boreholes, with dynamic cone penetration tests adjacent to each bore hole, was carried out during the field investigation. Boring was achieved by means of a conventional diamond drill adapted for soil sampling purposes (namely a Longyear Junior diamond drill).

Disturbed samples were obtained by means of either 2 inch I.D. shelby tubes or a standard 2 inch O.D. split-spoon sampler.

The shelby tubes, dynamic penetration cones and split-spoon were all advanced into the soil by means of a 140 lb. hammer falling freely for 30 inches, (thereby imparting a driving energy of 350 ft. lb. per blow).

Samples were visually examined in the field before being transported to the laboratory.

The locations of all boreholes were surveyed by the D.H.O. Engineering Surveys Section. Elevations of borings are referred to top of rail of C.P.R. line Sta. 453+73.08 & of Hwy. 9 - elev. 1252.7. The locations and elevations of all borings are shown on the accompanying Dwg. 64-F-93A.

4. LABORATORY TESTS:

A detailed visual observation and classification was carried out on each sample in the laboratory. Tests were then carried out on a selection of samples to determine the following physical properties.

cont'd /3...

4. LABORATORY TESTS: (Cont'd)...

- (a) Grain size Distribution.
- (b) Atterberg Limits.
- (c) Natural Moisture Content.

The results of these tests are contained in the Appendix of this report.

5. SUBSOIL CONDITIONS:

5.1) General

Generally, uniform subsoil conditions exist over the site area. Subsoil consists of a granular type fill material followed by a deposit of glacial till also of a basically granular nature. A detailed description of the different deposits is given in the record of the boreholes contained in the Appendix of this report. The estimated stratigraphical profile shown in Drawing #64-F-93A is based upon this information. From ground level downwards the different soil deposits are as follows:

5.2) Fill Material

This material consists mainly of silt to sandy-silt with traces of gravel and clay and is the material contained in the existing embankment and railway cutting sides. The relative density may be described as loose to compact with 'N' values ranging from 8 to 25 blows per foot.

Cont'd /4...

5.3) Silt to Sandy-Silt (Glacial Till)

This material underlies the fill material and is similar in composition to it. It exists however, in a much denser state with 'N' values ranging from 11 to more than 100 blows per foot. The depth of the deposit ranges from 5 ft. in B.H. #3 to 8 ft. in B.H. #1.

5.4) Clayey Silt with Sand & some Gravel (Glacial Till)

This material underlies the silt to sandy-silt material and extends for a minimum depth of 18 ft. to elevation 1230 which was the maximum depth tested.

It consists of a heterogeneous mixture varying from sandy-silt to clayey-silt with gravel. Also encountered occasionally were erratic boulders in size up to about 12 inches. The relative density of the overall stratum may be classified as very dense, with the 'N' values ranging from 70 to a maximum of over 100 blows per foot.

The mean grain size distribution was in the region of: gravel 18%, sand 25%, silt 46% and clay 11%, with the coarser elements increasing with depth.

The mean plastic limit of the matrix material was about 9% and the mean liquid limit about 20%.

The material moisture content of this material was generally just below the plastic limit.

6. GROUND WATER CONDITIONS:

The water level in the boreholes was found to be about 2 ft. above the surface of the very dense portion of the glacial till deposit at approximate ... 1251.0

Cont'd /5...

7. DISCUSSION AND RECOMMENDATIONS:

It is proposed to erect a new structure at this site. The new center line will coincide with the center line of the existing structure.

The main subsoil at this site consists of a very dense deposit of clayey-silt with sand and some gravel which is competent to provide spread footing support in its upper layers. At the locations of the pier foundations it is recommended that spread footings founded within this stratum be used. It is believed that a depth of 6 ft. below track level would suffice, giving the base of these footings an elevation at or below 1247. Conforming with these conditions a net allowable pressure of 3.5 tons per square foot may be assumed for design purposes.

For the abutment foundations the dense material is some 12 ft. below present ground level at the borehole locations and consequently two types of foundations merit consideration, spread footings and piled footings.

For both abutments it is recommended that either spread footings with bases at or below elevation 1251 and a design load of 3.5 tons per square foot be used or, alternatively, steel tubular piles of dimensions 12 3/4" x 1/4" driven to approximate elevation 1245, where it is estimated that a design load of 60 tons per pile will be achieved.

Cont'd /6...

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

It is anticipated that dewatering will be required during construction of spread footings, since the base of the excavation would be below ground water level. However, the excavation would probably be relatively shallow, and it is not expected that any serious problems due to water seepage will occur. Any seepage water should easily be handled by conventional pumping methods.

No stability problems are anticipated with regard to the proposed approach embankments, provided standard 2:1 slopes are constructed.

8. SUMMARY:

A foundation investigation at the site of the proposed overhead at Hwy. 9 and C.P.R. is reported.

Subsoil at the site consists of approximately 5 ft. of fill material overlying a minimum of 25 ft. of compact to very dense glacial till.

It is recommended that the bridge piers be founded on spread footings and the abutments be founded on either spread footings or steel tubular piles. Further details are given in the main body of the report.

No major dewatering problems are anticipated.

No stability problems are anticipated.

9. MISCELLANEOUS:

The field work, performed during the period October 13 to October 20, 1964, together with the preparation of this report was carried out under the supervision of Mr. P.M.A. McGlone, Project Foundation Engineer. The report was reviewed by Mr. K. Selby, Senior Foundation Engineer.

The drilling equipment was owned and operated by Canadian Longyear Ltd.

November, 1964.

APPENDIX I.

RECORD OF BOREHOLE NO. 1

FOUNDATION SECTION

MATERIALS & TESTING DIVISION

JOB 64-F-93

LOCATION Sta. 453/29 Hwy. #9, 27' Lt.

ORIGINATED BY P.Mc

W.F. 18-62

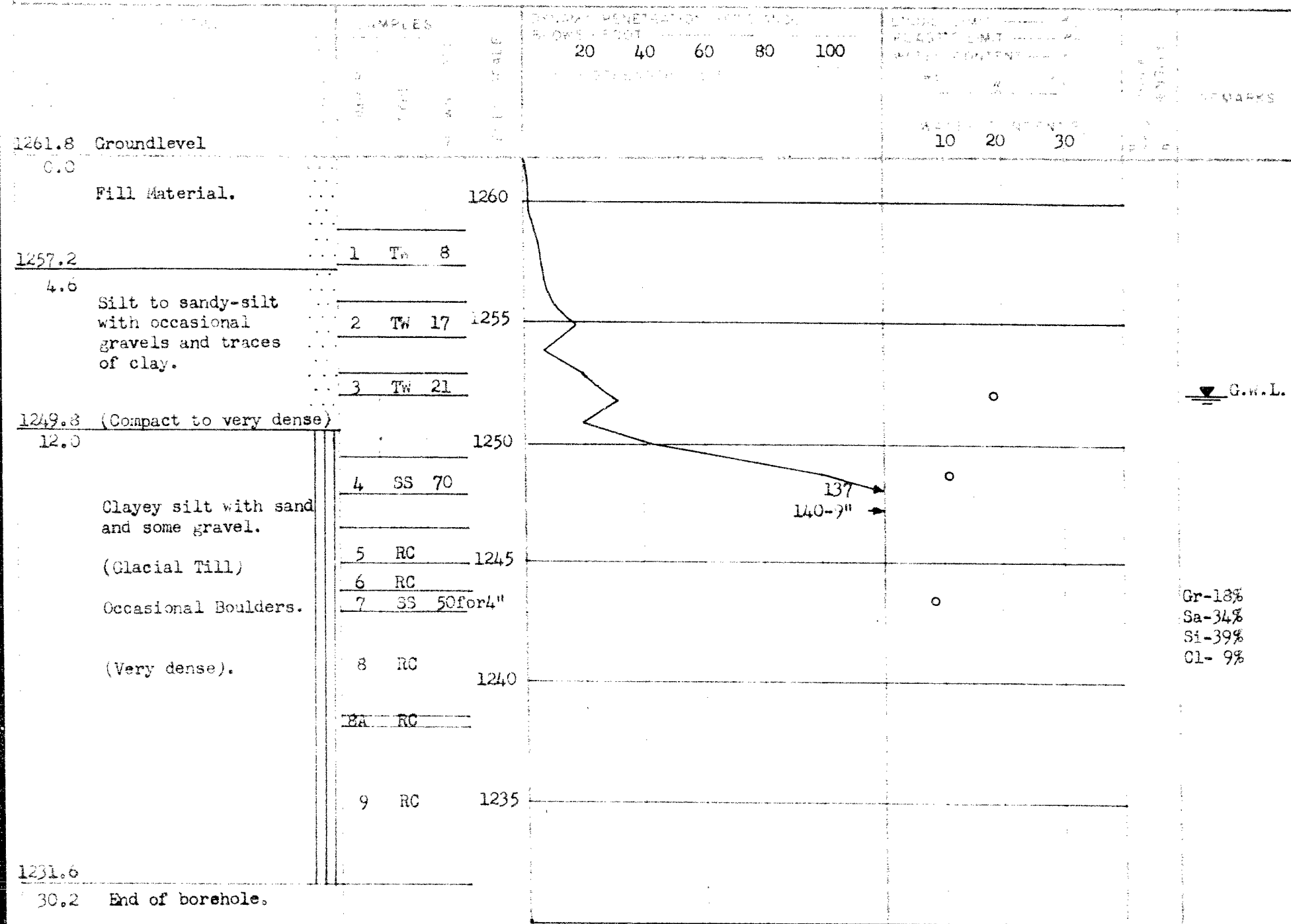
BORING DATE Oct. 15, 1964.

COMPILED BY P.Mc

BATHY T/R C.P.R. - 1252.7

BOREHOLE TYPE Washboring NX Casing & Diamond Drill-BX Casing.

CHECKED BY H.S.



MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO. 2

FOUNDATION SECTION

JOB 64-F-93LOCATION Sta. 453+88 Hwy. #9, 17' Lt.ORIGINATED BY P. McW P 18-62BORING DATE Oct. 19, 1964.COMPILED BY P. McDATUM T/R C.P.R.-1252.7BOREHOLE TYPE Washboring - BX Casing.CHECKED BY H.S.

DEPTH FEET	SAMPLES NUMBER	TYPE	REMARKS	DYNAMIC PENETRATION TEST (P.S.F.)					LIND. LIMIT		WATER CONTENT %	REMARKS
				20	40	60	80	100	20	40		
1253.0			Groundlevel									
1252.0			Fill Material									
			Silt to sandy silt with occasional gravels & traces of clay. (Compact to v. dense).									
1248.4	1	SS 25										
4.6												
	2	SS 36										
			Clayey silt with sand and some gravel.									
	3	SS 52 for 6"										
			(Glacial Till).									
	4	SS 50 for 4"										
			Occasional boulders. (Very dense)									
	5	SS 50 for 4"										
1234.1	6	SS 45 for 4"										
13.9			End of borehole.									

REMARKS

G.W.L.

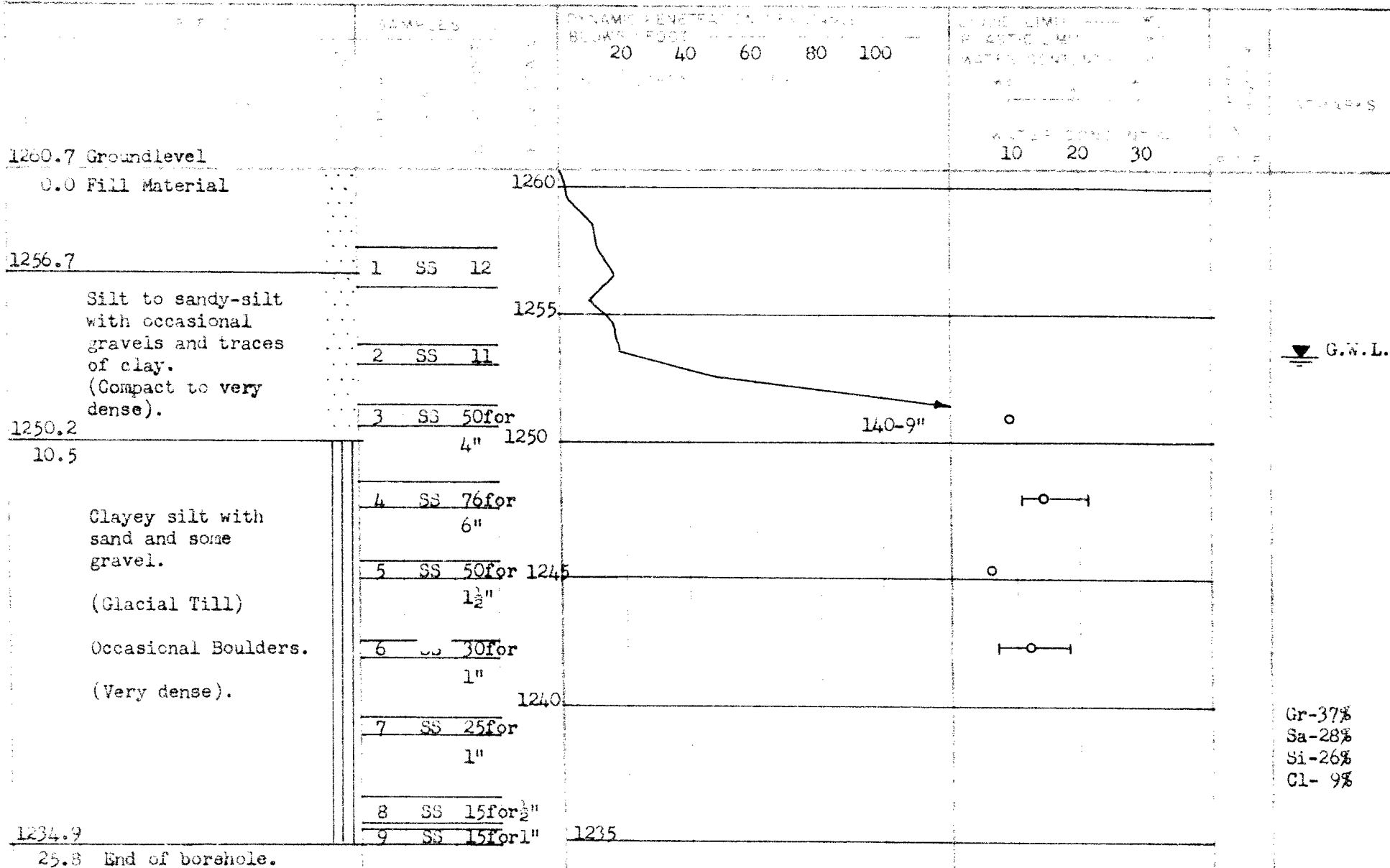
Gr- 3%
Sa-30%
Si-52%
Cl-15%

RECORD OF BOREHOLE NO. 3

FOUNDATION SECTION

MATERIALS & TESTING DIVISION

JOB 64-F-93 LOCATION Sta. 454+22 Hwy. #9, 31' Rt. ORIGINATED BY P. Mc
 W.P. 18-62 BORING DATE Oct. 13, 1964. COMPILED BY P. Mc
 DATUM T/R C.P.R. - 1252.7 BOREHOLE TYPE Washboring - BX Casing. CHECKED BY H.S.



DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO. 4

FOUNDATION SECTION

JOB 64-F-93 LOCATION Sta. 453+66 Hwy. #9, 22' Rt. ORIGINATED BY P. Mc
 W. F. 18-62 BORING DATE Oct. 20, 1964. COMPILED BY P. Mc
 DRAWN T/R C.P.R. - 1252.7 BOREHOLE TYPE Washboring - BX Casing. CHECKED BY H.S.

DEPTH (FEET)	SOIL DESCRIPTION	SAMPLE NUMBER	TYPE	PEN. (FEET)	PIV. SCALE	DYNAMIC PENETRATION - RESISTANCE BLOWS / FOOT				WATER CONTENT (%)	PLASTIC LIMIT (%)	REMARKS
						20	40	60	100			
1253.6	Groundlevel											
1252.7	Fill Material											
0.9	Silt to sandy-silt with occasional gravels and traces of clay.	1	CS									
		2	CS									
1249.1	Compact to v. dense.	3	SS	50 for 1250								
4.5	Clayey silt with sand and some gravel. (Glacial Till) Occasional Boulders (Very dense)			6"								
		4	SS	65 for 1245								
				5"								
		5	SS	57 for 1240								
				6"								
1241.0		6	SS	50 for 1240								
12.6	End of borehole.			6"								

Gr-13%
Sa- 8%
Si-69%
Cl-10%

UNIFIED SOIL CLASSIFICATION SYSTEM

Clay & Silt

Sand

Gravel

Fine

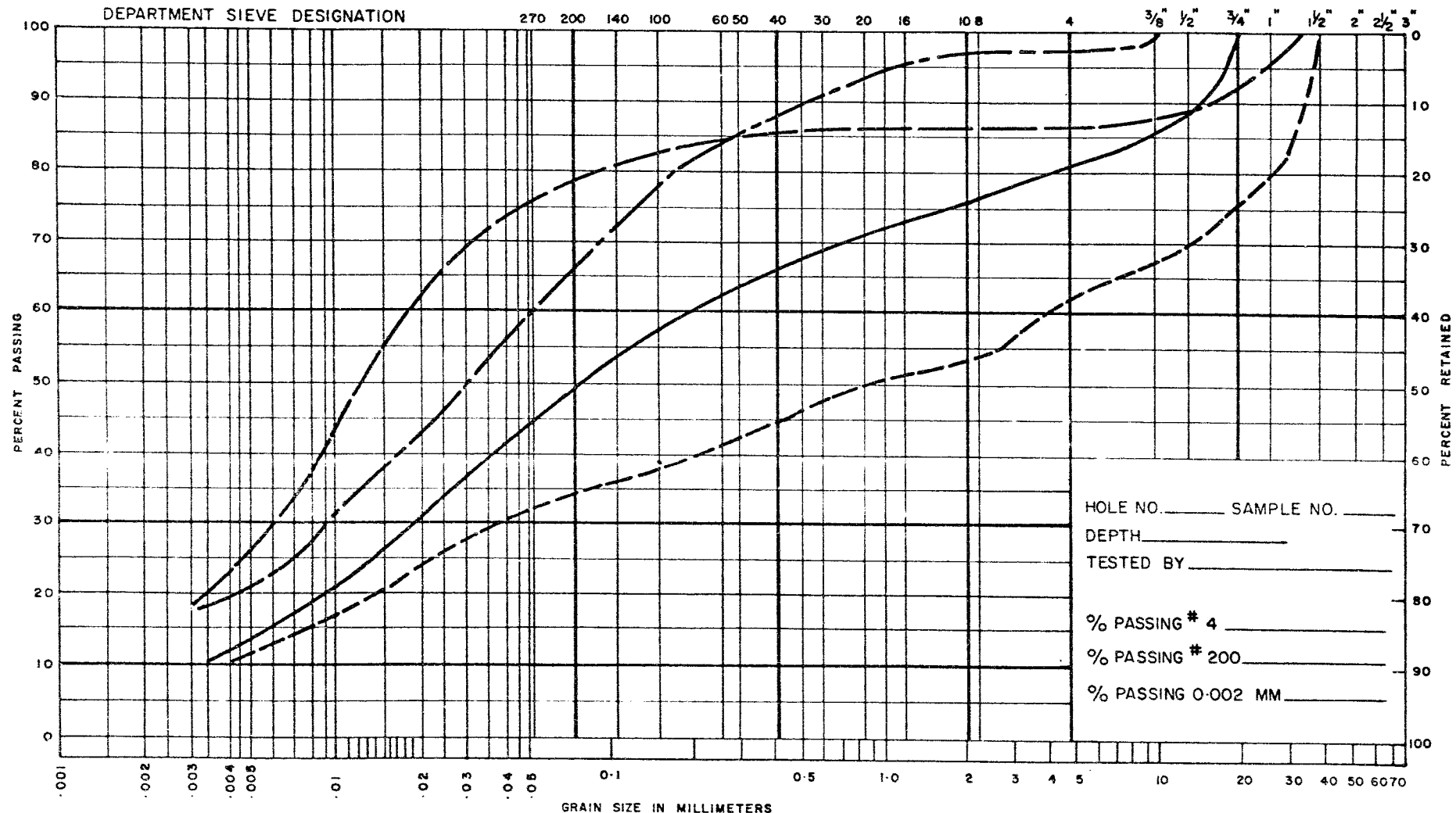
Medium

Coarse

Fine

Coarse

DEPARTMENT SIEVE DESIGNATION



NOTES TYPICAL EXAMPLES OF GLACIAL TILL

B.H. N° 1, SAMPLE N° 7

B.H. N° 2, SAMPLE N° 4

B.H. N° 3, SAMPLE N° 7

B.H. N° 4, SAMPLE N° 4

DEPARTMENT OF HIGHWAYS — ONTARIO
MATERIALS & TESTING DIVISION

GRAIN SIZE DISTRIBUTION

JOB NO. 64 - F - 93 W.P. NO. 18 - 62

LOCATION HWY. N° 9 & C.P.R. TOWN OF HARRISTON

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_f	SHEAR STRENGTH
c'	EFFECTIVE COHESION INTERCEPT
ϕ'	EFFECTIVE ANGLE OF SHEARING RESISTANCE, OR FRICTION
	IN TERMS OF EFFECTIVE STRESS $\tau_f = c' + \sigma' \tan \phi'$
c_u	APPARENT COHESION
ϕ_u	APPARENT ANGLE OF SHEARING RESISTANCE, OR FRICTION
	IN TERMS OF TOTAL STRESS $\tau_f = c_u + \sigma \tan \phi$
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

DEPARTMENT OF HIGHWAYS ONTARIO

MEMORANDUM

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

FROM: Bridge Division,
Downsview, Ontario.

DATE: July 19, 1965.

OUR FILE REF.

IN REPLY TO

SUBJECT: W.P. 18-62, Site No. 35-47,
O.P.R. Overhead at Harriston,
 Hwy. 9, Dist. 1.

We are sending to you herewith one print of Preliminary Plan D 5046-P1 of the above structure.

Would you please let us have your written comments.

N. Zolnay

NZ/ag
c.c. C. McCombie
G. Scott
M. D. Shaw

N. Zolnay,
Bridge Location Engineer.

Mr. S. McCombie,
Bridge Planning Engr.,
Bridge Division.

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

Attn: Mr. L. Zoltay,
Bridge Location Engr.

August 5, 1965

✓ W.P. 13-62 - C.P.R. Overhead, Hwy. #9, Harriston.
W.P. 131-64 - Sandwich C. Twp. Rd. Concession XI U'Pass.
W.P. 132-64 - Essex County Rd. No. 27 U'Pass.

We have reviewed the Preliminary Plans D-5646-P1,
D-5722-P1, and D-5723-P1 for the above-mentioned proposed
structures with respect to the foundation design.

In all cases, the designer appears to have followed
the recommendations contained in our foundation reports.

K. G. Selby

KGS/KGF

cc: Foundations Office
Gen. Files

K. G. Selby,
SENIOR FOUNDATION ENGINEER
For:
A. G. Stermac,
PRINCIPAL FOUNDATION ENGINEER

MEMORANDUM

64-F-93

TO: Mr. K. Selby,
Senior Foundations Engineer,
Materials and Testing Section,
DOWNSVIEW.

FROM: Mr. F.E. Loscombe,
Reg. Super't of Eng. Surveys,
S.W. REGION.

DATE: November 10, 1964.

OUR FILE REF.


IN REPLY TO

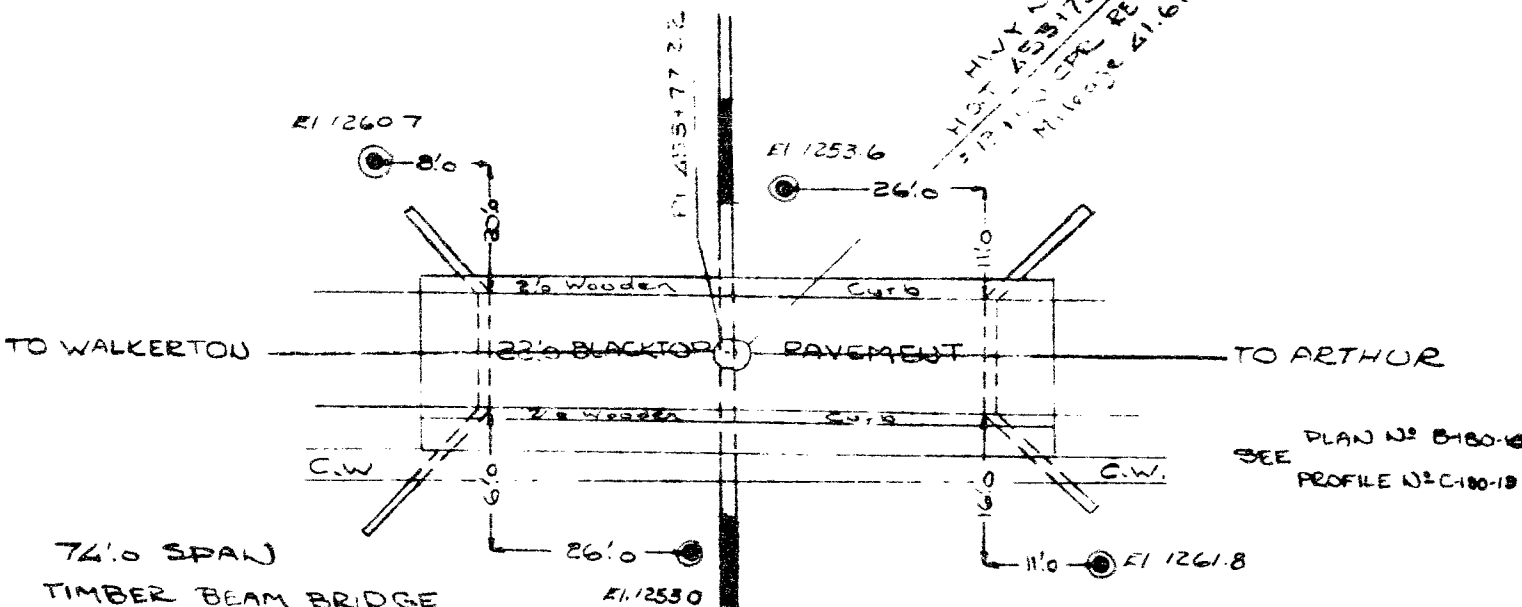
SUBJECT:

Re: Elevation Bore Holes - C.P.R. O'Head Harriston
W.P. 18-62

As per your request enclosed find O/G elevations of bore holes
as indicated.

FEL:maj


F.E. Loscombe,
Reg. Super't of Eng. Surveys.



● - THIS INDICATES A BORE HOLE WITH THE ACCOMPANYING ORIGINAL GROUND ELEVATION AS SHOWN, BASED ON ELEV. OF TIR. OF FIRST RAIL.

CROSSING
AT
THE CANADIAN PACIFIC RAILWAY
AND
THE KING'S HIGHWAY NO 9
TOWN OF HARRISTON
TWP OF MINTO
CO OF WELLINGTON
W.P. NO 18-62

IN REPLY TO

64-F-93

C. Johnson

N. Zoltay,
for G. Scott,
Regional Bridge Location Engineer.

17th Sept 1882

Mr. D. PORTER

No Coats CPR