DOCUMENT MICROFILMING IDENTIFICATION

G.I.-30 SEPT. 1976

GEOCRES No. 31L-21

DIST. 13 REGION

W.P. No. 365-62-50

CONT. No.

W. O. No.

STR. SITE No. 43-166

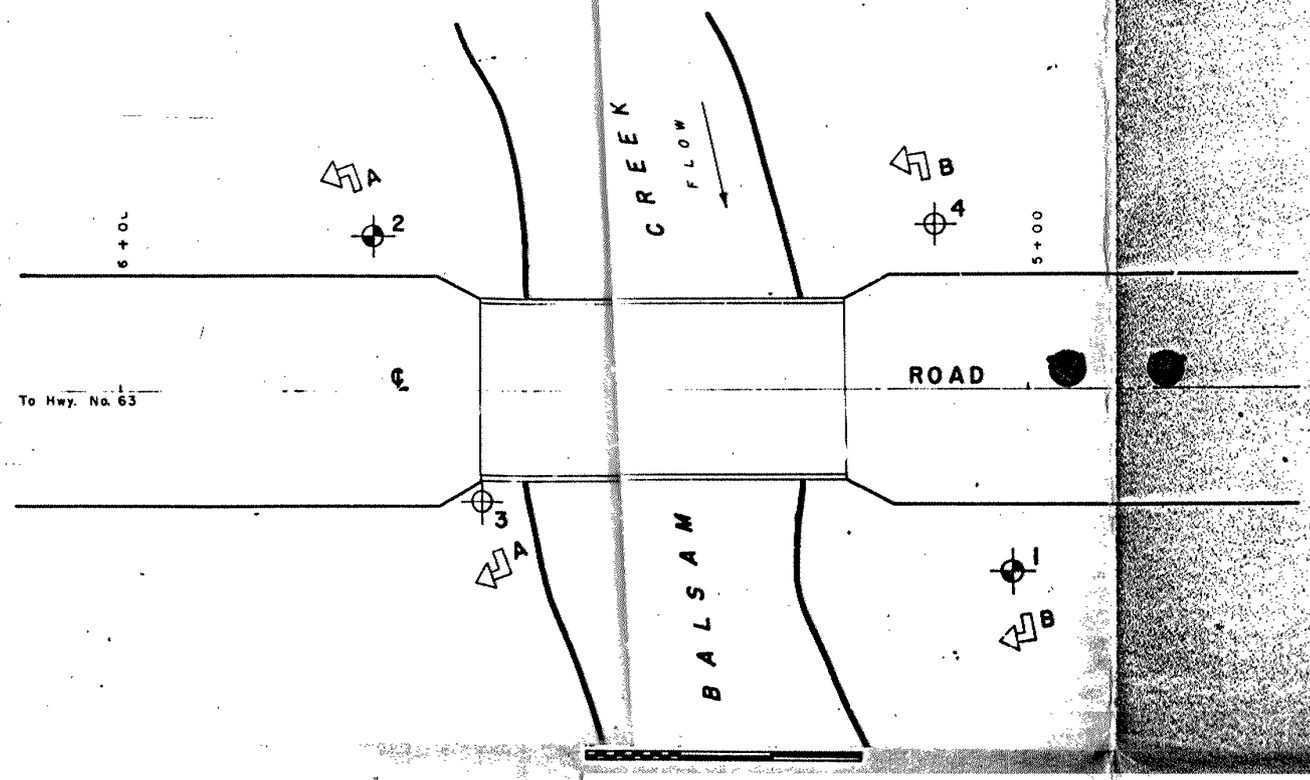
HWY. No.

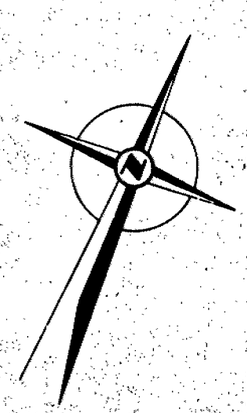
LOCATION BALSAM CREEK

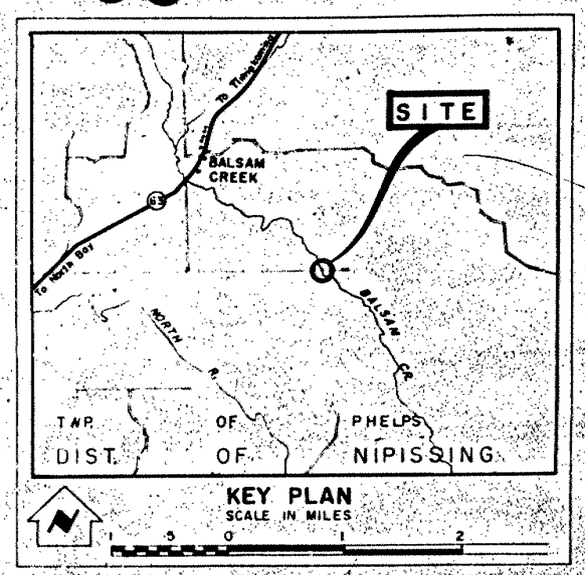
No OF PAGES - 1

OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT.

REMARKS:





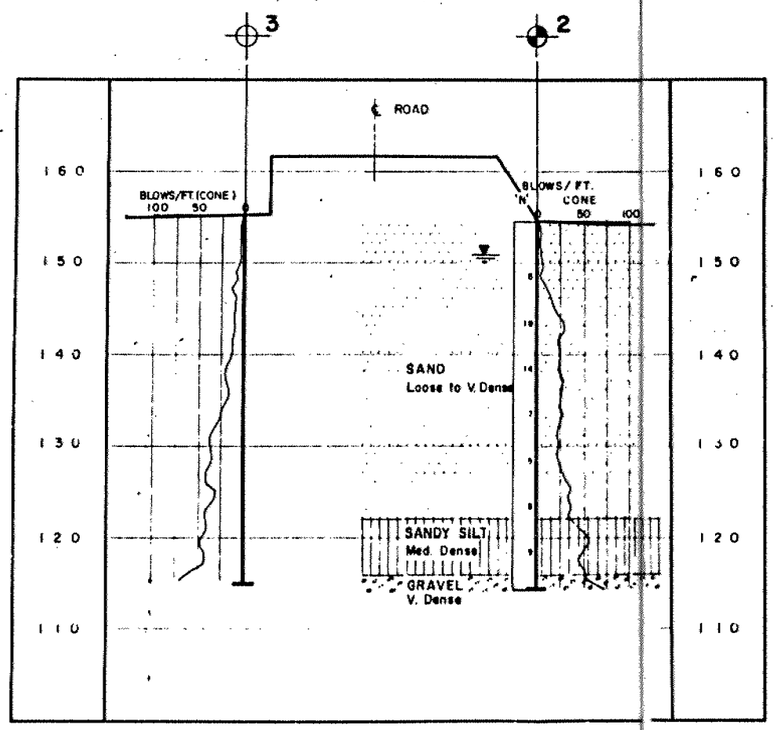


FILE

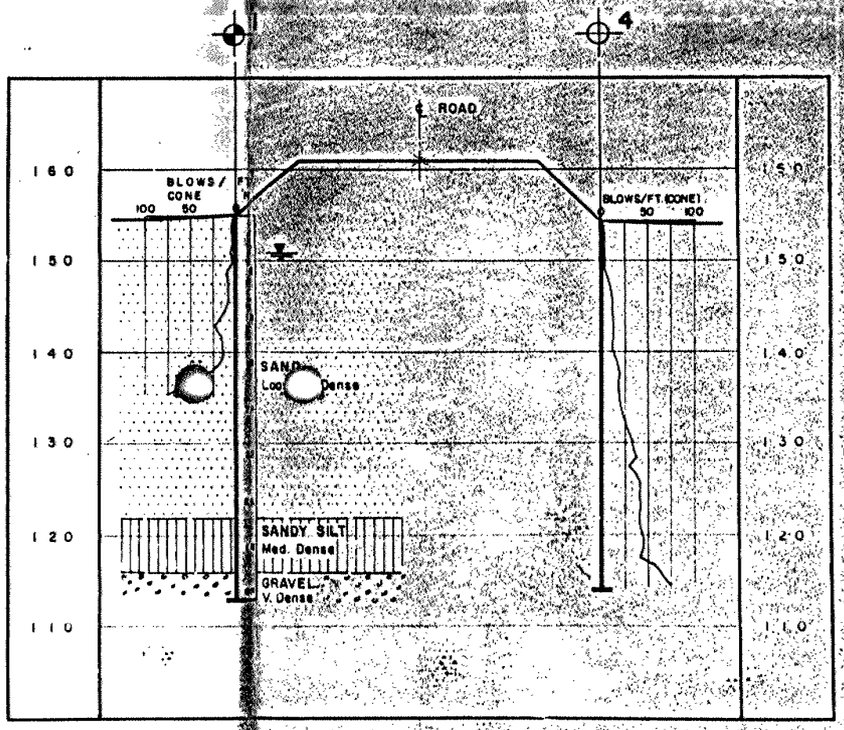
LEGEND

- Bore Hole
- Cone Penetration Hole
- Bore & Cone Penetration Hole

NO.	ELEVATION	STATION	OFFSET
1	155.0	5+02	20' LT.
2	154.8	5+72	17' RT.
3	155.2	5+60	12' LT.
4	154.2	5+10	18' RT.



A - A



B - B

SECTIONS
SCALE IN FEET
10 5 0 10 20

- 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.

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & RESEARCH SECTION

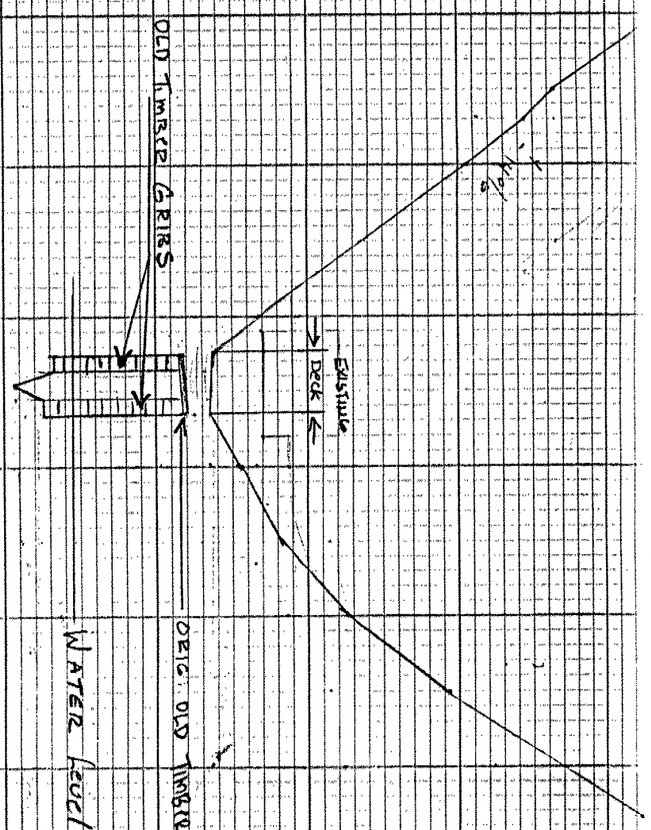
BALSAM CREEK BRIDGE
NIPISSING DISTRICT
PHELPS TWP. LOT 10 CON. III & IV

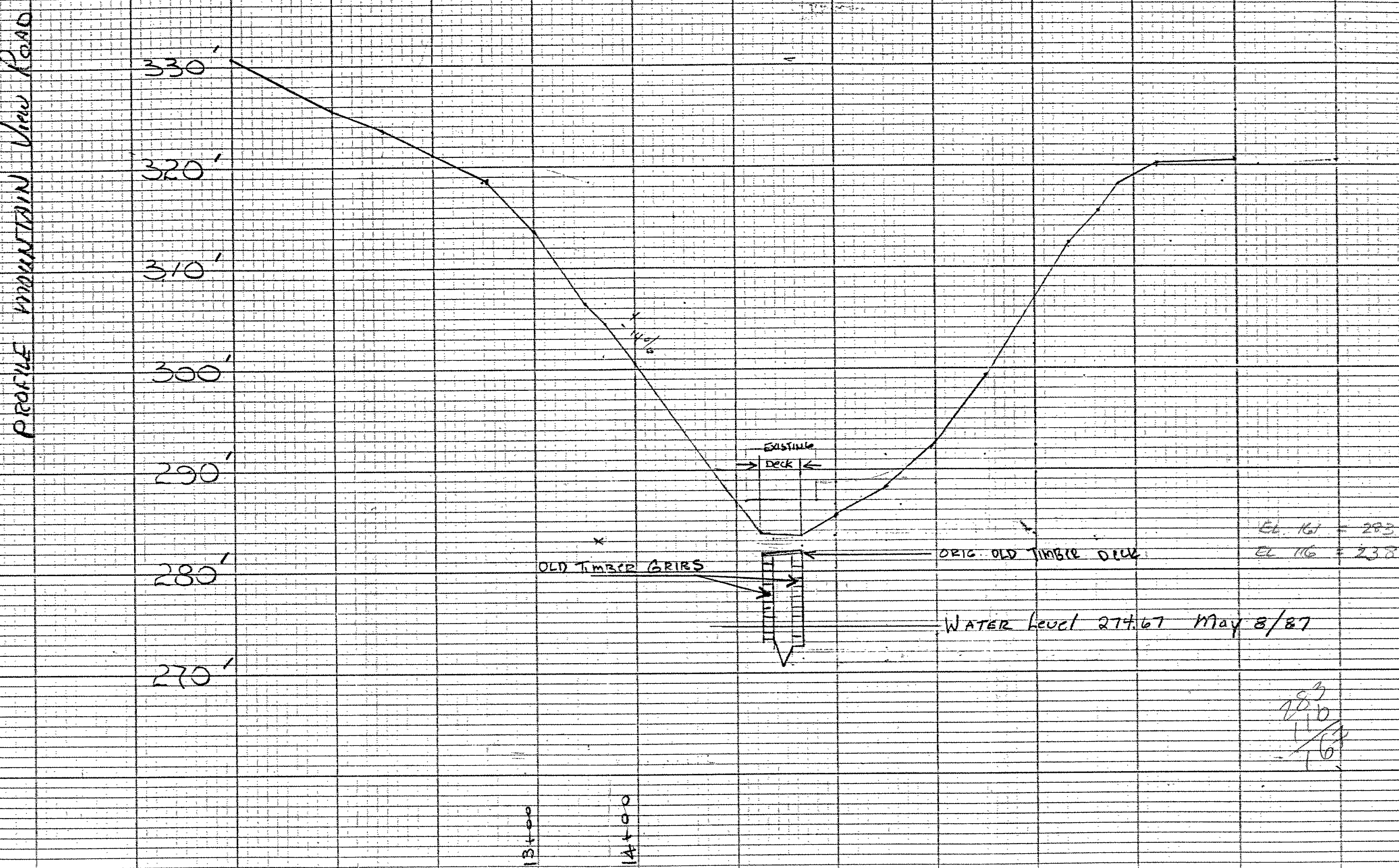
ORIGINATED W. KULMATICKAS	DISTRICT NO. 13	DATE 11 OCT. 1962
DRAWN D. MUMFORD	W.P. NO. —	JOB NO. 62-F-97
CHECKED	CONT. NO.	DRAWING NO. 62-F-97-A
APPROVED		

BRITISH MADE

PROFILE

10	10+00	330.81	(UNDEFINED)
11	11+00	325.46	
	11+50	323.52	
12			
	12+55	318.27	
13	13+00	313.48	
	13+50	306.40	
	13+70	304.46	
14	14+00	300.59	
15	15+00	286.75	
	15+26	283.92	EXISTING DECK
	15+36	281.44	OLD ORIG. DECK
	15+55	281.82	OLD ORIG. DECK
	15+65	283.40	EXISTING DECK
16	16+00	285.53	
	16+50	288.32	
17	17+00	292.62	
	17+50	299.05	
	18+36	312.37	
	18+66	315.39	
19	18+86	318.14	
	19+22	320.11	
20	20+00	320.57	




PROFILE MOUNTAIN VIEW ROAD
330'
320'
310'
300'
290'
280'
270'
14%
EXISTING
DECK
OLD TIMBER GRIRS
ORIG. OLD TIMBER DECK
WATER Level 274.67 May 8/87
13+00
14+00

memorandum

Ontario

235-3731 EXT. 7095

To: Mr. J. C. McAllister
Sr. Structural Engineer
Structural Section
Northern Region

Date: 1987 05 28

From: Foundation Design Section
Room 315, Central Building
Downsview

Re: Site 43-166 - Balsam Creek (WJ62-F-97)
Phelps Township LRB
District 13, North Bay

A foundation investigation was carried out at the above mentioned site in 1962, and foundation recommendations for a structure were generated in a report dated October 1962. The structure has not yet been constructed.

Due to recent development in the area, it is now proposed to proceed with replacement of the existing timber structure.

As per your request of 05 14 87, the following recommendations have been generated with regards to the three foundation schemes you mentioned in your letter. These recommendations are for planning and estimating purposes only and a foundation investigation is required to provide finalized recommendations.

Since the footing locations were not specified, assumptions have been made as to their depth and size in order to estimate the bearing capacity of the soil.

General Recommendations (Applicable to all alternatives)

Earth Pressure Calculations:

Backfill to the structure should consist of granular material in accordance with MTC Standard Special Provision #121 (83 10). Computation of earth pressures should be in accordance with Section 6-6.1.2 of the O.H.B.D.C. For design purposes, the physical properties of the backfill are as follows:

Material	ϕ	γ
Granular 'A'	35°	22.0 kN/m^3
Rock fill	40°	19.5 kN/m^3

...../2

Lateral Resistance

Sliding resistance between the base of concrete footings and the underlying material should be calculated in accordance with section 6-7.3.3 of the O.H.B.D.C. assuming an unfactored 0 value of 28°.

The horizontal component of the battered piles may be used to resist lateral forces.

Settlement

Settlement is not anticipated to be a problem as most of any settlement that does occur will occur during construction of the structure.

Stability

Assuming a level grade on the bridge at elevation 88.4 m (290'), the proposed structure grade is only 2 m higher than the existing grade and thus stability problems are not anticipated.

Dewatering

Assuming pile caps and footings are located at an elevation of 86.4 m (283'), 2 m below the proposed grade, dewatering problems are not anticipated. However, since the non-cohesive soil at this site is susceptible to boiling under conditions of unbalanced hydrostatic head, any excavation performed below the water table will require extensive dewatering or tremie concreting techniques.

Frost Protection

A minimum of 2.0 metres of earth cover, or equivalent is required for frost protection.

Structure Recommendations

a) A single span trestle with grade at approximate elevation 88.4 m (290')

The bridge can be placed on end bearing piles driven into the gravel stratum. 310X110 Steel H piles should be driven in accordance with the Hiley formula and MTC Standards SS103-10 or SS103-11 using an ultimate capacity of 3450 kN per pile. Based on preliminary information, piles must be driven below an estimated elevation of 72.5 m (238'). The estimated refusal elevation is 69.5 m (228'). The following O.H.B.D.C. design loads are recommended for piles driven in accordance with the above noted recommendations.

...../3

Pile Type	Factored Axial Capacity @ U.L.S.	Capacity @ S.L.S. Type II
310X110 HP	1650 kN	1150 kN

During the previous foundation investigation (W.O. 365-62-50), bedrock was not encountered. However, bedrock may be encountered at an elevation higher than the estimated refusal elevation of 69.5 m.

Any fill material placed in the vicinity of the abutments should be restricted to a maximum particle size of 75 mm to facilitate pile driving.

If this scheme is selected, further investigation would be warranted to determine the extent of the gravel stratum.

b) Single span bailey bridge (21-24 m; 70-80') with grade at elevation ±88.4 m (± 290') founded on timber cribs.

In addition to the timber crib option, we also recommend the consideration of gabions for the support of the bailey bridge. For more information on gabions, please contact this office.

To determine the applicability of this alternative, further investigation, or at least a site visit, is required. Subject to verification, the following bearing capacity recommendations apply:

Factored Bearing Capacity at U.L.S.:	240 kPa
Bearing Capacity at S.L.S. Type II :	100 kPa

c) A soil/steel installation in the order of 6 m x 3.5 m (20' x 11'6") SPPA with invert elevation @ 82.3 m (270').

The proposed invert elevation of the culvert is below the water table elevation. An extensive dewatering scheme is required to prevent boiling of the non-cohesive soil. The creek will have to be temporarily diverted and the ground water elevation will have to be lowered to allow for the bedding and backfill to be placed in the dry. Lowering the ground water elevation can be achieved by sheeting, driven to a depth twice the prevailing head, or by well points.

...../4

The pipe should be surrounded with granular material as per OPSD 802.02 and 803.03. Proper compaction of the backfill is important to prevent buckling at the haunches of the culvert.

Precautions should be taken to seal the upstream end against seepage under and around the pipe. To prevent scour at the inlet, a headwall of corrigated steel sheeting, gabions, or clay soil can be constructed.

To prevent erosion at the outlet, 0.23 m thick gabion mats or 0.46 m thick gabions should be placed for a distance estimated at 10 m (subject to verification).

If this alternative is selected, a foundation investigation is required to determine the grain size distribution and properties of the granular material.

Calculations based on values from the previous investigation indicate the soil has the bearing capacity to support alternative (b) or (c). However, a further foundation investigation is probably required. Please advise us when you have completed your cost comparison of the various alternatives you proposed and selected a scheme for this structure so that we can schedule the foundation investigations that may be required. Please contact Mary Lou Pauly of this office if further information is required.

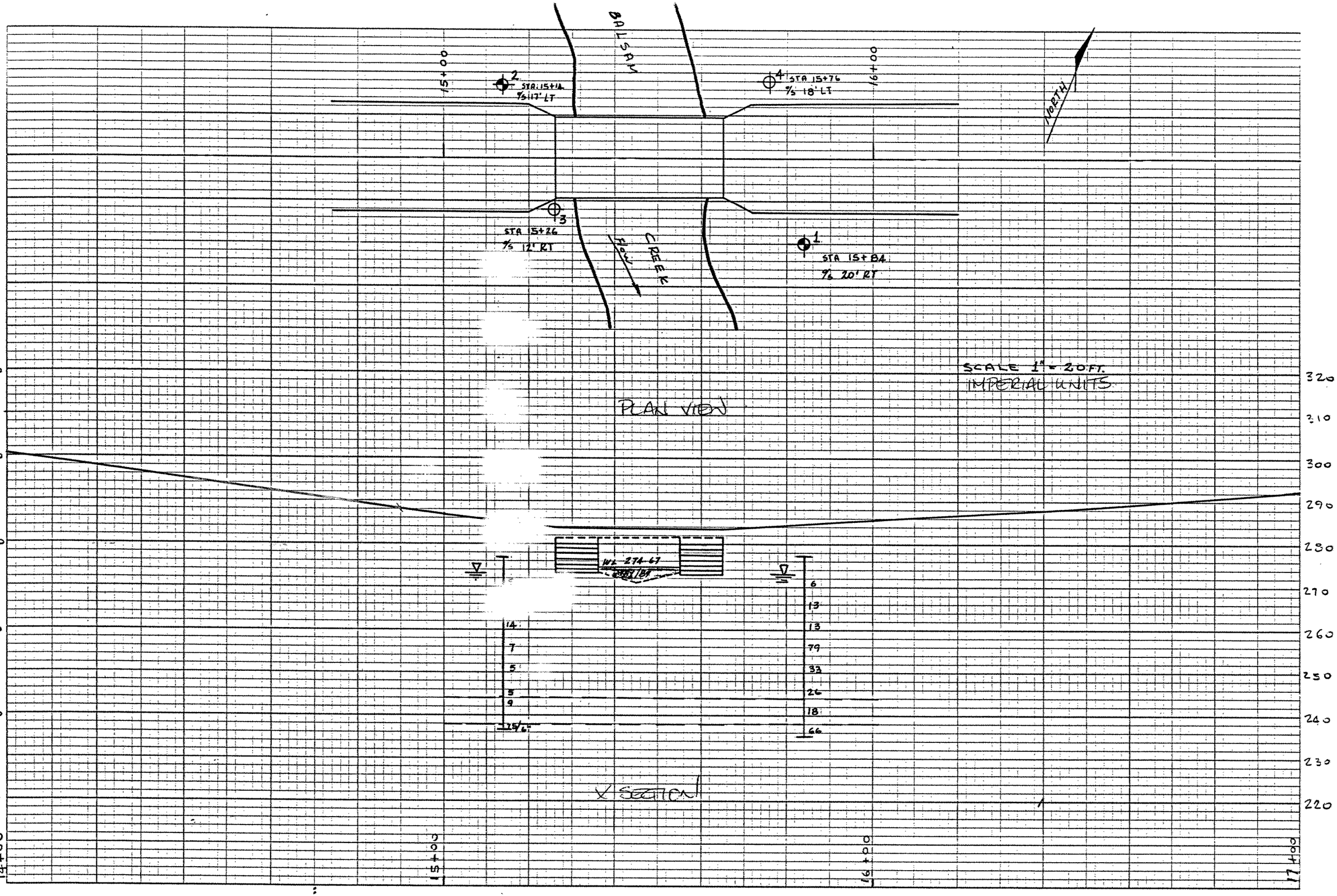
Mary Lou Pauly
Foundation Engineer

for

M. Devata, P. Eng.
Chief Foundation Engineer (East)

MLP/MD/nd

Attachment



memorandum

To: M. Devata
Foundation Design Section
Central Building
Downsview

Date: May 14, 1987

705 - 472-7900

Site 43-166 - Balsam Creek (WJ62-F-97)
Phelps Township LRB
District 13 - North Bay

A foundation investigation was carried out at the above crossing in 1962 by your Section under WO 365-62-50. A report dated 9th October 1962 was submitted giving recommendations for a pile bent structure. High cost/low use postponed construction of a bridge, however recent development east of the crossing is forcing us to again consider construction.

In order to find the most economical solution, I am requesting you to consider the following schemes and let me have your recommendations appropriate to each:

a) A single span or trestle with grade at approximate el. 290.0.

b) A single span bailey (70' to 80') with grade at el. ±290.0, founded on timber cribs.

c) A soil/steel installation in the order 20' x 11'6" SPPA with invert el. 270.0.

For your convenience I am enclosing a copy of the original foundation report and a profile of the crossing. As the District hopes to build this year; an early reply would be appreciated.

J. C. McAllister
Sr. Structural Engineer
Structural Section
Northern Region

JCM:pld
cc: F. Ditullio

Loc 58-13.

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

Attn: Mr. K.L. Kleinsteiber,
Municipal Bridge Liaison
Engr.

Mr. A. G. Stermac,
Principal Foundation Engr.,
Foundation Section,
Materials & Research Division.

October 9, 1962.

Re: D.H.O. FOUNDATION INVESTIGATION REPORT -
Proposed New Bridge over Balsam Creek on
Phelps Twp. Road, Between Conc. III & IV,
Lot 10, Chainage 5+40, Dist. of Nipissing,
W.J. 62-F-97 -- W.O. 365-62-50
District #13.

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

We believe you will find the factual data and recommendations contained therein, adequate for your future design work. Should there be any queries concerning this project, please do not hesitate to contact our Office.

KYL/MdeF
Attach.

K. Y. Lo,
SUPERVISING FOUNDATION ENGR.
For:

A. G. Stermac,
PRINCIPAL FOUNDATION ENGR.

cc: Messrs. A. M. Toye (3)
J. P. Howard
J. H. Cook
E. R. Saint
A. Watt

Foundations Office
Gen. Files.

TABLE OF CONTENTS

FOUNDATION INVESTIGATION

For

Proposed New Bridge over Balsam Creek on
Phelps Twp. Road, Between Conc. III&IV
Lot 10, Chainage 5+40, District of Nipissing
W.J. 62-F-97 -- W.O. 365-62-50
District #13.

1. INTRODUCTION:

A request for a bridge foundation investigation, on the Phelps Twp. Road, between Conc. III & IV Lot 10 Chainage 5+40, was received from the Bridge Planning Engineer Mr. S. McCombie, dated Sept. 4, 1962.

It is proposed to erect a new bridge to carry Phelps Twp. Road between Conc. III & IV over the Balsam Creek. The site of the proposed bridge is located in the District of Nipissing, Twp. of Phelps, approx. 16 miles east of the town of North Bay.

In order to determine the soil properties and decide on the type of foundations, an investigation, was carried out by this Section. Results and the discussion of the field and laboratory investigations, as well as conclusions and recommendations for the future design work, are contained in the following paragraphs of this report.

2. DESCRIPTION OF SITE:

The area in which the structure is located is hilly.

cont'd. /2 ...

2. DESCRIPTION OF SITE: (Cont'd.) ...

Physiographically, the site is located on the extreme outskirts of the Petawawa Sand Plains.

3. FIELD AND LABORATORY WORK:

In order to obtain sufficient information on the type and properties of the subsoil two sampled boreholes and four dynamic cone penetration tests, were carried out at this site.

Split-spoon samples were taken at various depth intervals. Samples recovered in the split-spoon were used to determine the following physical properties.

1. Natural Moisture Content.
2. Grain Size Distribution.

4. SUBSOIL CONDITIONS:

4.1 General:

The stratigraphy of the soil at the site was found to be generally uniform. A detailed description of various soil types encountered during the investigation, is shown in Appendix I of this report, and is also given in subsequent paragraphs. The estimated stratigraphical profile shown on Dwg. No. 62-F-97A is based upon this information.

4.2 Loose to Very Dense, Fine to Medium Coarse Sand:

This stratum, which extends to approx. 122.0 for a depth of about 32'-0" to 33'-0", was found at the surface.

cont'd. /3 ...

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

4.2 Loose to Very Dense, Fine to Medium Coarse Sand; Its density varies from loose at the upper part to very dense at the lower parts. The average "N" value is 30 blows/foot.

4.3 Medium Dense Sandy Silt:

Underlying the stratum of loose to very dense fine to medium coarse sand is a layer of medium dense sandy silt. This layer extends to approx. elev. 116.0 for a depth of 5'-0" to 6'-0". It may be classified as medium dense with an average "N" value of 15 blows/foot.

4.4 Very Dense Gravel:

Following the layer of medium dense sandy silt is an extensive stratum of very dense gravel, with an average "N" value in excess of 150 blows/foot.

5. GROUND WATER CONDITIONS:

The ground water level, at the time of the investigation, was found to be at the level of the creek water surface, approx. 3'-9" to 4'-9" below existing ground elevations. No artesian water conditions were encountered.

6. DISCUSSION AND RECOMMENDATIONS:

As can be seen from the previously described soil stratigraphy, the soil consists of loose to very dense fine to medium coarse sand, followed by medium dense sandy silt,

cont'd. /4 ...

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

underlain by very dense gravel. The investigation has revealed that within the upper 20'-0" of the subsoil the properties are such that adequate support for spread footings can not be obtained. The most suitable structure would be a trestle bridge erected on end-bearing piles. Treated timber piles would be best suited for this purpose and an allowable load of 15 to 25 tons per pile could be obtained. To determine more correctly the bearing capacity, a pile loading test would be required. It is estimated that the piles should reach practical refusal at or below elev. 116.0, within two or three feet.

7. SUMMARY:

1. The stratification of the soil is quite uniform. The relative density of the materials encountered varies from loose to very dense.
2. Because of the loose density of the upper layers, a pile trestle bridge is recommended. Treated end-bearing timber piles driven down to elev. 116.0 are suggested.
3. The design load should be 15 to 25 tons per pile. To determine more correctly the bearing capacity a pile load test would be required.

8. MISCELLANEOUS:

The field work, performed during the period from

cont'd. /5 ...

9. MISCELLANEOUS: (cont'd.) ...

Sept. 17 to Sept. 20, 1962, together with the preparation of this report, was undertaken by Mr. W. W. Kulmatickas. The investigation was carried out under the general supervision of Mr. K. G. Selby, who also reviewed this report. The equipment used was owned and operated by Canadian Longyear Limited.

October, 1962.

APPENDIX I.

FORM 08-ML-126 REV 961
4-4391

OFFICE REPORT ON SOIL EXPLORATION

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & RESEARCH DIVISION

RECORD OF BOREHOLE NO. 1

FOUNDATION SECTION

JOB 62-F-97 LOCATION Sta. 5+02, 20' Lt. ORIGINATED BY W.W.K.

W.P. W.O. 365-62-50 BORING DATE Sept. 17, 1962. COMPILED BY W.W.K.

DATUM 155.0 BOREHOLE TYPE Washboring - BX Casing. CHECKED BY

ELEV. / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/FOOT	ELEV SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS/FOOT 20 40 60 80 100 / SHEAR STRENGTH P.S.F.	LIQUID LIMIT w_L / PLASTIC LIMIT w_P / WATER CONTENT w / w_P w w_L / WATER CONTENT %	BULK DENSITY γ P.C.F.	REMARKS
155.0	Ground Elevation.									wl elev.
0.0										▽ 151.0
	Loose to very dense.		1	SS	6	150.0				Observed in casing.
	Fine to med. coarse sand.		2	SS	13					
			3	SS	13	140.0	74 for 9"			
			4	SS	79					
			5	SS	33	130.0				
			6	SS	26					
122.0										
33.0	Med. dense Sandy silt.		7	SS	18	120.0				
116.0										
39.0										
113.0	Very dense gravel.		8	SS	66					
42.0	End of borehole.					110.0				
						100.0				

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & RESEARCH DIVISION

RECORD OF BOREHOLE NO. 2

FOUNDATION SECTION

JOB 62-F-97 LOCATION Sta. 5+75, 17' Rt. ORIGINATED BY W.W.K.
W.P. W.O. 365-62-50 BORING DATE Sept. 18, 1962. COMPILED BY W.W.K.
DATUM 154.8 BOREHOLE TYPE Washboring - BX Casing. CHECKED BY

ELEV. / DEPTH	DESCRIPTION	STRAT. PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS / FOOT	ELEV SCALE
154.8 / 0.0	Groundlevel					
	Loose to dense. Fine to med. sand.		1	SS	5	150
			2	SS	18	
			3	SS	14	140
			4	SS	7	
			5	SS	5	130
122.1 / 32.7	Med. dense sandy silt.		6	SS	5	
			7	SS	9	120
115.8 / 39.0	Very dense gravel.		8	SS	75 for 6"	
114.3 / 40.5	End of borehole.					110
						100

DYNAMIC PENETRATION RESISTANCE
BLOWS / FOOT 20 40 60 80 100
SHEAR STRENGTH P.S.F.

7.2

LIQUID LIMIT ——— w_L
PLASTIC LIMIT ——— w_P
WATER CONTENT ——— w
w_P w w_L
WATER CONTENT %

BULK DENSITY P.C.F.

REMARKS

▽ W.l. elev. 151.0 Observed in casing.

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & RESEARCH DIVISION

RECORD OF BOREHOLE NO. 3

FOUNDATION SECTION

JOB 62-F-97 LOCATION Sta. 5+60, 12' Lt. ORIGINATED BY W.W.K.
W.P W.O.365-62-50 BORING DATE Sept. 14, 1962. COMPILED BY W.W.K.
DATUM 155.2 BOREHOLE TYPE Penetration Only. CHECKED BY AE

SOIL PROFILE		SAMPLES				ELEV SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT 20 40 60 80 100 SHEAR STRENGTH P.S.F.	LIQUID LIMIT w_L PLASTIC LIMIT w_P WATER CONTENT w w_P w w_L WATER CONTENT %	BULK DENSITY P.C.F.	REMARKS
ELEV. / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	BLOWS / FOOT					
155.2	Ground Elevation.									
0.0						150.0				
						140.0				
	PENETRATION ONLY.					130.0				
						120.0	70			
115.0										
40.2	End of Penetration.					110.0				
	Assumed Very dense gravel.					100.0				

FORM 08 - ML - 126 REV. 1961 — OFFICE REPORT ON SOIL EXPLORATION

61-4391

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & RESEARCH DIVISION

RECORD OF BOREHOLE NO. 4

FOUNDATION SECTION

JOB 62-F-97 — LOCATION Sta. 5+10, 18' Rt. — ORIGINATED BY W.W.K.

W.P No. 365-62-50 — BORING DATE Sept. 19, 1962. — COMPILED BY W.W.K.

DATUM 154.2 — BOREHOLE TYPE Penetration Only. — CHECKED BY MK

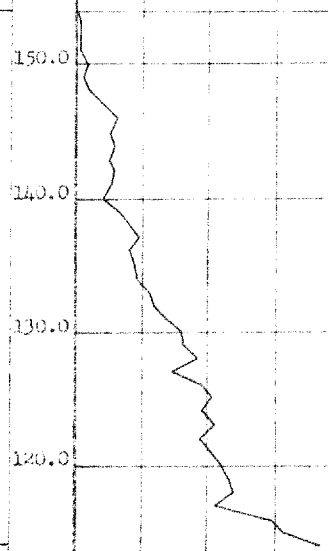
ELEV / DEPTH	DESCRIPTION
154.2	Ground Elevation
0.0	
	PENETRATION ONLY.
114.0	
40.2	End of Penetration.
	Assumed very dense gravel.

SOIL PROFILE — STRAT PLOT — SAMPLES: NUMBER, TYPE, BLOWS/FOOT — ELEV SCALE

DYNAMIC PENETRATION RESISTANCE
BLOWS / FOOT
20 40 60 80 100
SHEAR STRENGTH P.S.F

LIQUID LIMIT ——— w_L
PLASTIC LIMIT ——— w_P
WATER CONTENT ——— w
w_P w w_L
WATER CONTENT %

BULK DENSITY γ_d P.C.F. — REMARKS



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 :-

CONSISTENCY	'N' BLOWS / FT.	c LB. / SQ. FT.	DENSENESS	'N' BLOWS / FT.
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

Qu	UNCONFINED COMPRESSION	L.V.	LABORATORY VANE
Q	UNDRAINED TRIAXIAL	F.V.	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
	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
$\log_e \sigma$ OR $\ln \sigma$	NATURAL LOGARITHM OF σ
$\log_{10} \sigma$ OR $\log \sigma$	LOGARITHM OF σ 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 (YOUNGS 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

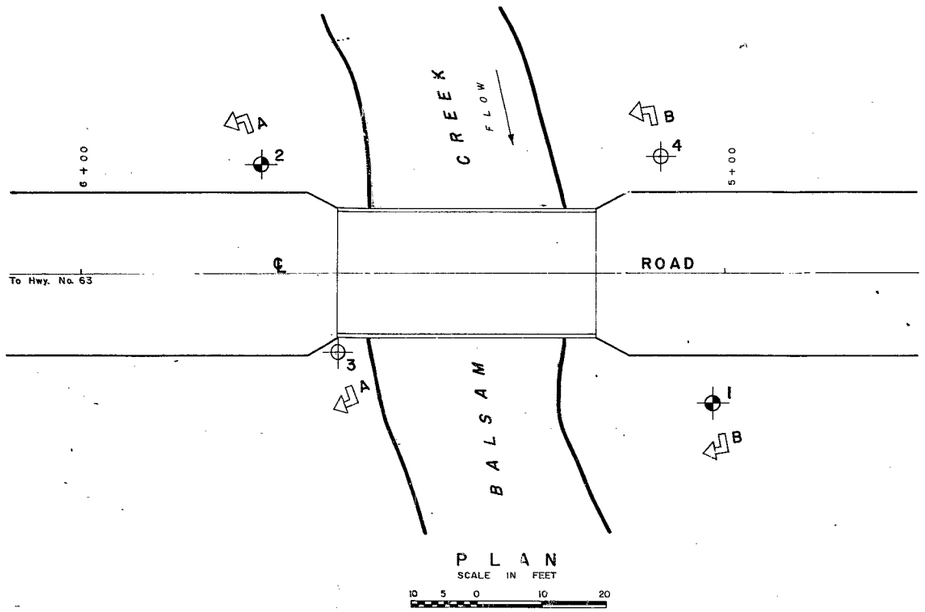
H	VERTICAL HEIGHT OF SLOPE
D	DEPTH BELOW TOE OF SLOPE TO HARD STRATUM
β	ANGLE OF SLOPE TO HORIZONTAL

#62-F-97

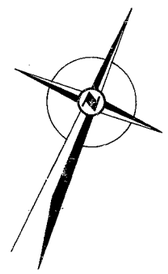
BALSAM

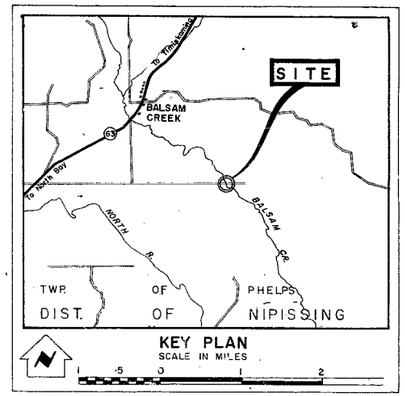
CREEK

BRIDGE



PLAN
SCALE IN FEET
10 5 0 10 20





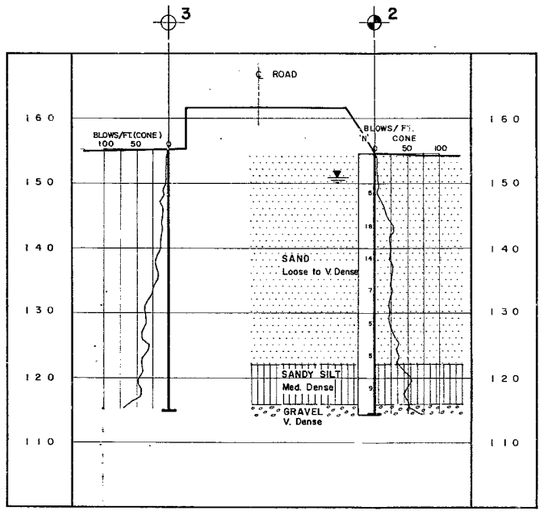
KEY PLAN
SCALE IN MILES
1 .5 0 1 2

71L6E
E. 699750
N. 2514450
2.17

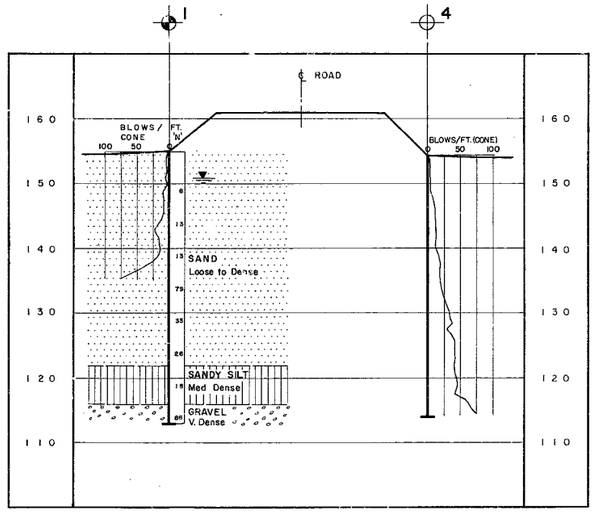
LEGEND

- Bore Hole
- Cone Penetration Hole
- Bore & Cone Penetration Hole
- Water Levels established at time of field investigation. Aug. 1962

NO.	ELEVATION	STATION	OFFSET
1	155.0	5+02	20' LT.
2	154.8	5+72	17' RT.
3	155.2	5+60	12' LT.
4	154.2	5+10	18' RT



A – A



B – B

SECTIONS
SCALE IN FEET
10 5 0 10 20

- 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.

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & RESEARCH SECTION

BALSAM CREEK BRIDGE

NIPISSING DISTRICT

PHELPS TWP. LOT 10 CON. III & IV

ORIGINATED W. KULMATICKAS	DISTRICT NO. 13	DATE 11 [illegible] 62
DRAWN D. MUMFORD	W.P. NO. ——	JOB NO. 1
CHECKED [signature]	CONT. NO.	DRAWG. 62 A
APPROVED [signature]		