

GEOCRES No. 41I-84

DIST. _____ REGION _____

W.P. No. _____

CONT. No. _____

W. O. No. 74-30687STR. SITE No. 46-30HWY. No. 805LOCATION SILVER CREEK BRIDGENo of PAGES -

OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT. _____

REMARKS: _____

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS, ONTARIO

MEMORANDUM

41I-84

GEOCRES No.

TO: Mr. J. McAllister, (2) FROM: Soil Mechanics Section,
Reg. Structural Planning Geotechnical Office,
Engineer, West Bldg., Downsview.
Northern Region, North Bay.

ATTENTION: DATE: October 1st, 1974.

OUR FILE REF.

IN REPLY TO OCT 15 1974

SUBJECT: FOUNDATION INVESTIGATION REPORT
For
Silver Creek Bridge, 12.4 Miles
North of Sec. Hwy. 539A,
District #13, North Bay.
W.O. 74-30687, Site 46-30.

Attached we are forwarding to you our detailed foundation investigation report on the subsoil conditions existing at the abovementioned 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.

K.G. Selby

K.G. Selby,
Supervising Engineer.

KGS/mj

c.c. E.J. Orr
B.R. Davis
H. McArthur
M.J. Bernhardt
B.J. Giroux
J.E. Gruspier
G.A. Wrong
P. Lewycky
S. McCombie

Files
Documents

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FOUNDATION INVESTIGATION REPORT
For
Silver Creek Bridge, 12.4 Miles
North of Sec. Hwy. 539A,
District #13, North Bay.
W.O. 74-30687, Site 46-30.

1. INTRODUCTION:

A foundation investigation has been carried out at the abovementioned site to determine the existing subsoil and groundwater conditions. A request for this investigation was received in a memorandum from Mr. J.C. McAllister, Regional Structural Planning Engineer for Northern Region, dated June 14th, 1974.

This Report contains the results of the field and laboratory investigations, together with recommendations for the foundations.

2. DESCRIPTION OF SITE:

The project site is located at Tertiary Road 805 and Silver Creek, 16 miles north from the Village of River Valley. The creek has created a 10-ft. (3.1 m) depression at this location and is about 20 ft. (6.1 m) wide and 2 to 3 feet (.6 to .9 m) deep. The existing single-span timber structure is 23 feet (7.0m) long and 16 feet (4.9 m) wide.

The surrounding area is flat to rolling and is well forested.

3. FIELD AND LABORATORY WORK:

The field work consisted of 2 sampled boreholes, placed at diagonal ends of the proposed new culvert and creek diversion, and 4 cone penetration tests. The boreholes were advanced using a skid-mounted Diamond Drill, adapted for soil sampling purposes. Disturbed samples were obtained by driving a split-spoon sampler 18 inches deep into the subsoil using a driving energy of 350 ft.-lbs. per blow. Undisturbed samples

4.2) Sand, Some Silty Clay, Organics.

Sand, some silty clay, and wood in various stages of decay was found in B.H.#1 only from groundlevel (elev. 90.0 ft., 27.4 m) to a depth of 9 feet (elev. 81.0 ft., 24.7 m).

The Standard Penetration 'N' values ranged from 2 to 3 blows/foot, the average being 2 blows/foot.

The physical properties as determined by the laboratory results are as follows:

Natural Moisture Content	58%
Liquid Limit	45%
Plastic Limit	38%

4.3) Clayey Silt, Traces of Sand.

Clayey silt, traces of sand was found in B.H.#1 only, from a depth of 9 ft. (elev. 81.0 ft., 24.7 m) to a depth of 16 ft. (elev. 74.0 ft., 22.6 m).

The Standard Penetration 'N' values were 1 blow/foot.

The field vane tests showed the soil shear strength to be 720 p.s.f.

The physical properties as determined by the laboratory results are as follows:

Natural Moisture Content	40.5%
Liquid Limit	31%
Plastic Limit	19%

4.7) Silt, Traces of Clay.

Silt, traces of clay was encountered in B.H.#4 only from elevation 73.8 ft. (22.5 m) to the bottom of the borehole at elevation 47.3 ft. (14.4 m).

The Standard Penetration 'N' values ranged from 14 to 33 blows/ft., the average being 21 blows/foot.

The physical properties as determined by the laboratory results are as follows:

Natural Moisture Content	21.5% - 27.5%
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5. GROUNDWATER CONDITIONS:

Groundwater levels at the site were observed during the course of the investigations.

B.H.#1 elev. 88.0 ft. (26.8 m)

B.H.#4 elev. 86.3 ft. (26.3 m)

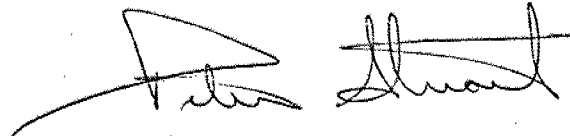
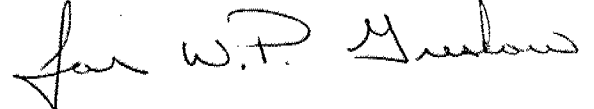
6. DISCUSSION AND RECOMMENDATIONS:

6.1) General.

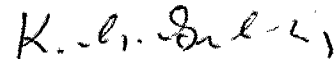
The proposal at this site is to replace the existing single span timber structure with one large 14 ft.-Ø structural steel pipe or two smaller 10 ft.-Ø structural steel pipes at a new location approximately 40 feet west of the existing bridge. This will require a stream diversion for about 100 feet north and south of the pipe extremities.

The new pipe(s) will have a skew angle of about 21.5°. A road grade raise of about 5 feet at the deepest point is proposed on a new alignment. This new alignment is to run adjacent to and north of the existing bridge.

This Report was written by W.P. Greskow,
and reviewed by Mr. K.G. Selby, Supervising Engineer.

W.P. Greskow,
Student Technician.



K.G. Selby,
Supervising Engineer.

WPG/mj
October, 1974.

A P P E N D I X , I

FOUNDATIONS OFFICE

ORIGINATED BY ^{WG}

COMPILED BY WG

CHECKED BY

[illegible]

15 $\overset{20}{\circ}$ 5 % STRAIN AT FAILURE
10

DESIGN SERVICES BRANCH

FOUNDATIONS OFFICE

RECORD OF BOREHOLE NO 4

JOB W.O. 74-30687

LOCATION 45.0' Rt. of Sta. 2 + 93 Tertiary Road 805

ORIGINATED BY WG

W.P.

BORING DATE August 16 - 17, 1974

COMPILED BY WG

DATUM Assumed

BOREHOLE TYPE Washbore and Cone Test

CHECKED BY

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE					LIQUID LIMIT — w_L			BULK DENSITY γ P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS/FOOT		BLOWS / FOOT					PLASTIC LIMIT — w_p				
							20	40	60	80	100	WATER CONTENT — w				
												w_p	w	w_L		
SHEAR STRENGTH P.S.F.						UNCONFINED			FIELD VANE			WATER CONTENT %				
						○			+			20 40 60				
						●			x							

88.8	Ground Level															GR. SA. SI. CL.
0.0	Silty (fine) sand, traces of clay and gravel, wood in diff. stages of decay. Grey Loose to Very Loose		1	SS	5											86.3
			2	SS	1											3 58 35 4
			3	SS	1											0 51 48 1
			4	SS	1											
			5	SS	1											
73.8			6	SS	14											
15.0	Silt, trace of clay Grey Compact		7	SS	15											2 2 92 4
			8	SS	18											
			9	SS	18											
			10	SS	23											
			11	SS	27											
47.3			12	SS	33											0 0 96 4
41.5	End of Borehole															
28.8																
60.0	End of Cone Test															

PENETRATION RESISTANCE

'N' STANDARD PENETRATION RESISTANCE : - 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>c LB./SQ. FT.</u>	<u>DENSENESS</u>	<u>'N' BLOWS / FT.</u>
VERY SOFT	0 - 250	VERY LOOSE	0 - 4
SOFT	250 - 500	LOOSE	4 - 10
FIRM	500 - 1000	COMPACT	10 - 30
STIFF	1000 - 2000	DENSE	30 - 50
VERY STIFF	2000 - 4000	VERY DENSE	> 50
HARD	> 4000		

TERMS TO BE USED IN DESCRIBING SOILS:-

TRACE < 10% , SOME 10-25% , WITH 25-40% , > 40% SILTY, SANDY, GRAVELLY, CLAYEY ETC.

TYPE OF SAMPLE

S.S.	SPLIT SPOON	T.W.	THINWALL OPEN
W.S.	WASHED SAMPLE	T.P.	THINWALL PISTON
S.T.	SLOTTED TUBE SAMPLE	O.S.	OESTERBERG SAMPLE
A.S.	AUGER SAMPLE	F.S.	FOIL SAMPLE
C.S.	CHUNK SAMPLE	R.C.	ROCK CORE

P.H. SAMPLE ADVANCED HYDRAULICALLY

P.M. SAMPLE ADVANCED MANUALLY

SOIL TESTS

U	UNCONFINED COMPRESSION	L.V.	LABORATORY VANE
UU	UNCONSOLIDATED UNDRAINED TRIAXIAL	F.V.	FIELD VANE
CIU	CONSOLIDATED ISOTROPIC UNDRAINED TRIAXIAL	C	CONSOLIDATION
CID	" " DRAINED "	S	SENSITIVITY
CAU	" ANISOTROPIC UNDRAINED "		
CAD	" " DRAINED "		

ABBREVIATIONS & SYMBOLS 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
w_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_i	SENSITIVITY

IN TERMS OF
EFFECTIVE STRESS
 $\tau_f = c' + \sigma' \tan \phi'$

IN TERMS OF
TOTAL STRESS
 $\tau_f = c_u + \sigma \tan \phi$

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

