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GEOCRES No. 31M-37

DIST. 14 REGION

W.P. No. 130-72-01

CONT. No.

W. O. No.

STR. SITE No.

HWY. No. 558

LOCATION PROPOSED CROSSING AT MONTREAL RIVER

No of PAGES - 1

OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT.

REMARKS:

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS, ONTARIO

31M-37

MEMORANDUM

TO: Mr. J. C. McAllister, (2)
Reg. Structural Planning Supervisor,
Northern Region,
North Bay, Ontario.

FROM: Foundations Office,
Design Services Branch,
West Bldg., Downsview.

ATTENTION:

DATE: January 18, 1973.

OUR FILE REF.

IN REPLY TO JAN 2 4 1973

SUBJECT:

PRELIMINARY
FOUNDATION INVESTIGATION REPORT
For
Proposed Crossing at
Montreal River and Sec. Hwy. #558
Twp. of Barr, District of Timiskaming
District #14 (New Liskeard)
W.O. 72-11140 --- W.P. 130-72-01

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

We believe that the information contained therein will prove adequate for your immediate use. Should you require additional information, please feel free to contact this Office.

A. G. Stermac,
PRINCIPAL FOUNDATIONS ENGINEER.

AGS/ao
Attch.
cc: E. J. Orr
B. R. Davis
A. Rutka
H. McArthur
T. A. Sharpe
B. J. Giroux
J. E. Gruspier
G. A. Wrong
B. A. Singh

Foundations Files ✓
Documents

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PRELIMINARY
FOUNDATION INVESTIGATION REPORT
For
Proposed Crossing at
Montreal River and Sec. Hwy. #558
Twp. of Barr, District of Timiskaming
District #14 (New Liskeard)
W.O. 72-11140 --- W.P. 130-72-01

1. *INTRODUCTION:*

A request for a preliminary foundation investigation at the crossing of secondary Hwy. #558 and the Montreal River was received from Mr. J. C. McAllister, Regional Structural Planning Supervisor. The request was made verbally on December 7, 1972.

A field investigation has been carried out by the Foundations Office to determine the subsoil conditions at this site. This report contains the results of the field investigation and our recommendations pertaining to the preliminary design.

2. *DESCRIPTION OF THE SITE:*

The site of the proposed structure is situated at Mowat Landing about 16.5 miles west of Haileybury, approximately 12.5 miles west of Hwy. 11. The secondary Hwy. 558 ends on the east side of the Montreal River.

The surrounding area on the east side of the river is undulating and covered with trees. On the west side immediately near the west bank of the river the land is covered with brush or small trees. As the land rises away from the river bank the ground cover is mainly grass with some coniferous trees. Beyond this grass-covered zone the site is undulating and tree covered.

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3. *FIELD AND LABORATORY WORK:*

The field work consisted of six sampled boreholes, three on each side of the river. The boreholes on the east side of the river were advanced with diamond drilling equipment modified for soil sampling purposes. Because the ice on the river was too thin to carry the diamond drill rig, the three boreholes on the west side of the river were advanced manually with a shovel and sledge hammer. Disturbed samples were obtained using a 2-inch O.D. split spoon sampler driven according to the specifications for the standard penetration test with the diamond drill rig or driven by hand with the sledge hammer. BX rock cores were obtained in some boreholes.

The locations and elevations of the sampled boreholes are marked on Drawing #72-11140A accompanying this report.

Samples were examined visually in the field and again in the laboratory. Tests were performed on selected samples to determine natural moisture contents, Atterberg limits, and grain-size distribution. The results of the field and laboratory tests are given in the Record of Borehole sheets which are contained in the Appendix of this report.

4. *SUBSOIL CONDITIONS:*

4.1) *General:*

In general, the subsoil consists of granular deposits. The deposits in any one hole increase in grain size with depth. A geotechnical analysis of the bridge site and its vicinity was conducted by Mr. B. S. Mathur, Remote Sensing Engineer, M.T.C., from the aerial photographs of this area. His findings are included in the Appendix to this report.

The boundaries between the various soil types are shown on the attached Record of Borehole sheets and on Drawing No. 72-11140A. The different soil deposits are described as follows:

4.2) *Silt to Clayey Silt:*

This material was found in Borehole 5 from ground level

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to a depth of 5 ft., and consists of silt to clayey silt with some sand and traces of organics. The Atterberg Limits tests indicate the material to be slightly plastic because of the presence of organics. This borehole was put down using rods, split spoon and a sledge hammer. Therefore, it was not possible to determine its consistency; however, it is estimated that the consistency varies from very soft at the top to firm at the bottom of the layer.

Two grain size analyses indicate the following ranges of distribution and are plotted on Fig. 1,

Sand	(%)	5 - 18
Silt and Clay	(%)	82 - 95

Atterberg Limits tests indicate the following physical properties:

Liquid Limit	(%)	27 - 29
Plastic Limit	(%)	18 - 20
Natural Moisture Content	(%)	24 - 28

4.3) Silt:

This deposit was found in Boreholes 3 and 4 for a depth of 13.2 and 8.8 ft. below the ground level. Material in Borehole 4 contained small amounts of organics as reflected in the relatively high values for natural moisture content. The material consists of silt with traces of clay and sand. The relative density varies from very loose to compact.

Grain size analyses indicate the following distributions and are plotted on Fig. 1.

Sand	(%)	1 - 4
Silt	(%)	84 - 89
Clay	(%)	7 - 15

Physical properties of the deposit as determined from laboratory tests are as follows:

		B.H.#3	B.H.#4
Liquid Limit	(%)	18 - 23	34 - 38
Plastic Limit	(%)	17 - 21	31 - 34
Natural Moisture Content	(%)	20 - 42	43 - 56

4.4) Silt to Sandy Silt:

This material was encountered in Borehole 4 at a depth of 8.8 ft. The borehole was terminated in this material which consists of silt to sandy silt with traces of clay. The relative density is estimated to be compact. Two grain size analyses indicate the following distributions and are plotted on Fig. 1.

Sand	(%)	3 - 31
Silt	(%)	58 - 87
Clay	(%)	10 - 11

4.5) Sandy Silt:

This deposit was intersected at the bottom of Borehole 5 and in Borehole 2 from ground level to a depth of 12.5 ft. The material consists of sandy silt with traces of clay, gravel and organics. The relative density as indicated by N values varies from loose to compact.

Two grain size analyses indicate the following distributions and are plotted on Fig. 1.

Sand	(%)	18 - 27
Silt	(%)	71 - 75
Clay	(%)	2 - 7

4.6) Silty Sand:

This material was found in Borehole 6, which was a 2.5 ft. deep test hole dug manually, and in the bottom of Borehole 3 at a depth of 19.0 ft. below the ice level. In Borehole 6 the material consists of silty sand with traces of clay and is estimated to be compact in denseness. In Borehole 3 the material may be described as very dense silty sand with gravel and occasional boulders. The boulders became more numerous with the depth.

4.7) Sandy Gravel to Gravelly Sand:

This stratum was encountered in Borehole 2 from 12.5 ft. to 21.8 ft. The material consists of sandy gravel to gravelly sand, with some silt. N values varied from 100 blows for 6 to 9

.....5

inches indicating a very dense relative density.

Two grain size analyses indicate the following distributions and are plotted on Fig. 1.

Gravel	(%)	33 - 45
Sand	(%)	19 - 60
Silt & Clay	(%)	7 - 36

4.8) Gravel:

This deposit was found in Borehole 1 from ground level to a depth of 8.5 ft. and in Borehole 2 from a depth of 21.8 ft. downwards to the termination of the hole. The material consists of gravel, some sand and boulders. The relative density was very dense and frequently the boulders were penetrated by drilling through it.

4.9) Boulders or Possible Bedrock:

This material was found in Borehole 1 from a depth of 8.5 ft. to 28.9 ft., where the hole was terminated. A careful examination of the rock cores recovered indicates that either it is a very bouldery stratum with almost continuous boulders or fractured bedrock. The rock type is a combination of sandstone and dolomite and is described as sandy dolomite.

5. GROUNDWATER CONDITIONS:

The ice level in the Montreal River at the time of investigation was at elevation 908.64 and water levels in all boreholes were at approximate elevation 909.0.

6. DISCUSSION AND RECOMMENDATIONS:

It is proposed to construct a bridge to carry secondary Hwy. #558 over the Montreal River. At present, Hwy. 558 ends at the east bank of the Montreal River. Three alternative lines have been suggested. The southmost alignment, i.e., Line #3, passes through a burial ground on the west side of the river;

therefore, it is likely to be changed. Line #1 crosses the river at its narrowest point and the length of bridge at this location will be about 400 ft. Line #2 will require a longer structure, approximately 600 ft. long. No decision has been made regarding the final grade.

As already mentioned the subsoil, in general, consists of non-cohesive deposits. It was not possible to drive casing below elevation 889 because of the presence of boulders. Below this level casing was advanced by drilling through the overburden. The lowest point in the river bottom is at about elevation 885 as shown on the profiles supplied by North Bay Regional Office.

The subsoil in the upper regions is relatively loose and not competent to support spread footing type foundations; therefore, it is recommended that the abutments of the proposed structure be supported on steel H-piles driven to practical refusal. It is espected that refusal will be met at approximate elevation 880. Maximum allowable load for the particular section adopted may be used for design purposes.

The piers of the proposed bridge may be supported on 20 inch O.D. and 3/4" thick walled steel tube piles. These piles should be driven open ended to refusal and should extend at least 15 ft. below the possible scour level. If these piles meet refusal earlier than the level mentioned above, then a churn drill should be employed to churn the material from inside and below the piles and the piles should be advanced by hammering. This process should be repeated till the required penetration is achieved. The piles should be filled with tremie concrete. A maximum allowable load of 250 tons per pile may be used for design purposes.

Because the final grade is not yet decided upon no stability calculations were performed. However, no stability problems are anticipated for fills up to 20 ft. high, provided all surficial organic deposit is removed.

All foundation and pile caps should be protected against frost action by at least 7 ft. of earth cover.

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The topsoil and the soft material containing organics should be removed in accordance with the pertinent M.T.C. standards within the construction area.

7. *MISCELLANEOUS:*

The field investigation was carried out during the period of December 13, 1972, to January 3, 1973, under the supervision of Mr. E. A. Wood, Project Foundations Engineer. This report was prepared by Mr. A. Prakash, Senior Foundations Engineer, and reviewed by Mr. K. G. Selby, Supervising Foundations Engineer.

Equipment was owned and operated by Canadian Longyear Ltd.

A Prakash

A. Prakash, P. Eng.

K. G. Selby

K. G. Selby, P. Eng.

AP/ao
Jan. 17, 1973.

APPENDIX I

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS – ONTARIO

DESIGN SERVICES BRANCH — FOUNDATIONS OFFICE

RECORD OF BOREHOLE No 1

JOB 72-1114O — LOCATION Sta. 215 + 70 Ø Line 2 — ORIGINATED BY EW

W.P. 130-72-01 — BORING DATE December 13, 1972 — COMPILED BY JT

DATUM Geodetic — BOREHOLE TYPE Washboring, NW & HW Casing & BX Core — CHECKED BY

SOIL PROFILE ELEV./DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	TYPE	BLOWS/FOOT	ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT; SHEAR STRENGTH P.S.F. ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE	LIQUID LIMIT W_L PLASTIC LIMIT W_P WATER CONTENT W — WATER CONTENT %	BULK DENSITY γ P.C.F.	REMARKS GR.SA.SI.CL.
916.3	Ground Level									
0.0	Gravel, some sand and boulders. Very Dense		1	BX RC	30%	910				▼909.0
907.8			2	SS	57					
8.5	Boulders or possible bedrock (Sandy dolomite)		3	BX RC	65%					
			4	BX RC	80%					
			5	BX RC	60%	900				
			6	BX RC	70%					
			7	BX RC	85%					
			8	BX RC	35%	890				
887.4										
28.9	End of Borehole									

OFFICE REPORT — SOIL EXPLORATION

20
15 ◇ 5 % STRAIN AT FAILURE
10

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS – ONTARIO

DESIGN SERVICES BRANCH — FOUNDATIONS OFFICE

RECORD OF BOREHOLE Nº 2

JOB 72-11140 — LOCATION Sta. 111 + 89 2' Rt. ℄ Line 1 — ORIGINATED BY EW

W.P. 130-72-01 — BORING DATE December 16, 1972 — COMPILED BY JT

DATUM Geodetic — BOREHOLE TYPE Washboring, NW, BW Casing & BX Core — CHECKED BY

ELEV. / DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS/FOOT	ELEV. SCALE
910.9	Ground Level					
0.0	Sandy silt, traces of clay, gravel and organics					910
	Compact		1	SS	11	
	Some sand Compact		2	SS	12	
	Loose		3	SS	7	900
898.4						
12.5	Sandy gravel to gravelly sand, with some silt.		4	SS	100/6"	
			5	SS	100/3"	
	Very Dense		6	SS	100/9"	890
889.1						
21.8			7	BX,Rc	80%	
	Gravel with sand and boulders.		8	BX RC	12%	
			9	BX RC	3%	
	Very Dense		10	BX RC	10%	880
877.9			11	SS	140/6"	
			10	BX	10%	
33.0	End of Borehole					

DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT

SHEAR STRENGTH P.S.F.
o UNCONFINED + FIELD VANE
● QUICK TRIAXIAL × LAB VANE

LIQUID LIMIT w_L
PLASTIC LIMIT w_P
WATER CONTENT w
w_P — w — w_L
WATER CONTENT % 20 40 60

BULK DENSITY γ P.C.F.

REMARKS	GR. SA. SI. CL.
▼ 909.0	
	0 27 71 2
	0 18 75 7
	45 19 31 5
	33 60 (7)

20
15 ⊹ 5 % STRAIN AT FAILURE
10

OFFICE REPORT ON SOIL EXPLORATION

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS – ONTARIO

DESIGN SERVICES BRANCH — FOUNDATIONS OFFICE

RECORD OF BOREHOLE Nº 3

JOB 72-11140 — LOCATION Sta. 212 + 57 28' Rt. Ø Line 2 — ORIGINATED BY EW

W.P. 130-72-01 — BORING DATE Dec. 19,1972 — COMPILED BY JT

DATUM Geodetic — BOREHOLE TYPE Washboring, NW, BW Casing & BX Core — CHECKED BY [illegible]

SOIL PROFILE ELEV./DEPTH	DESCRIPTION	STRAT. PLOT	SAMPLES NUMBER	TYPE	BLOWS/FOOT	ELEV. SCALE
908.7	Ice Level					
902.9	Ice and Water					
5.8	Very Loose		1	SS	1	
	Compact		2	SS	11	
	Loose					900
	Silt, traces of clay and sand.		3	SS	7	
			4	SS	5	
			5	SS	5	
889.7						890
19.0	Silty sand with gravel and occasional boulders.		6	SS	100/2"	
	Very Dense		7	BX RC	40%	
880.7			8	BX RC	15%	
28.0	End of Borehole					

DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT

SHEAR STRENGTH P.S.F.
○ UNCONFINED + FIELD VANE
● QUICK TRIAXIAL × LAB VANE

LIQUID LIMIT W_L — PLASTIC LIMIT W_P — WATER CONTENT W

WATER CONTENT % 20 40 60

BULK DENSITY γ P.C.F.

REMARKS GR.	SA.	SI.	CL.
0	1	87	12
0	4	89	7
0	1	84	15

20
15 ⊹ 5 % STRAIN AT FAILURE
10

OFFICE REPORT — SOIL EXPLORATION

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS - ONTARIO

DESIGN SERVICES BRANCH — FOUNDATIONS OFFICE

RECORD OF BOREHOLE No 4

JOB 72-111140 — LOCATION Sta. 205 + 00 Ø Line 2 — ORIGINATED BY EW

W.P. 130-72-01 — BORING DATE January 3, 1973 — COMPILED BY EW

DATUM Geodetic — BOREHOLE TYPE Advanced Manually — CHECKED BY

SOIL PROFILE ELEV./DEPTH	DESCRIPTION	STRAT. PLOT	SAMPLES NUMBER	TYPE	BLOWS/FOOT	ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS/FOOT / SHEAR STRENGTH P.S.F. (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE)	LIQUID LIMIT W_L / PLASTIC LIMIT W_P / WATER CONTENT W — WATER CONTENT % (20 40 60)	BULK DENSITY γ P.C.F.	REMARKS GR.SA.SI.CL.
909.4	Ground Level									
0.0	Silt, traces of clay, sand and organics		1	SS	-					
			2	SS	-					
	Brown		3	SS	-					
	Loose to Compact or									
900.6	Soft to Firm									
8.8	Silt to sandy silt, traces of clay		4	SS	-	900				0 31 58 11
897.1	Grey Compact		5	SS	-					0 3 87 10
12.3	End of Borehole									

OFFICE REPORT — SOIL EXPLORATION

20 / 15 / 10 — 5 % STRAIN AT FAILURE

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS – ONTARIO

DESIGN SERVICES BRANCH — FOUNDATIONS OFFICE

RECORD OF BOREHOLE No 5

JOB 72-11140 — LOCATION Sta. 203 + 00 ℄ Line 2 — ORIGINATED BY EW

W.P. 130-72-01 — BORING DATE January 3, 1973 — COMPILED BY EW

DATUM Geodetic — BOREHOLE TYPE Advances Manually — CHECKED BY

SOIL PROFILE ELEV./DEPTH	DESCRIPTION	STRAT. PLOT	SAMPLES NUMBER	TYPE	BLOWS/FOOT	ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS/FOOT / SHEAR STRENGTH P.S.F. (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE)	LIQUID LIMIT W_L / PLASTIC LIMIT W_P / WATER CONTENT W — WATER CONTENT % (20 40 60)	BULK DENSITY γ P.C.F.	REMARKS GR. SA. SI. CL.
911.7	Ground Level									
0.0	Silt to clayey silt, some sand, traces of organics.		1	SS	-	910				0 18 65 17
906.7	Very Soft to Firm		2	SS	-					▼ 0 5 (95)
906.2	Sandy silt, traces of clay.		3	SS	-					0 39 53 8
5.5	End of Borehole									

OFFICE REPORT — SOIL EXPLORATION

15 20 10 5 % STRAIN AT FAILURE

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS – ONTARIO

DESIGN SERVICES BRANCH — FOUNDATIONS OFFICE

RECORD OF BOREHOLE Nº 6

JOB 72-11140 — LOCATION Sta. 201 + 00 Ø Line 2 — ORIGINATED BY EW

W.P. 130-72-01 — BORING DATE January 3, 1972 — COMPILED BY EW

DATUM Geodetic — BOREHOLE TYPE Advances Manually — CHECKED BY [illegible]

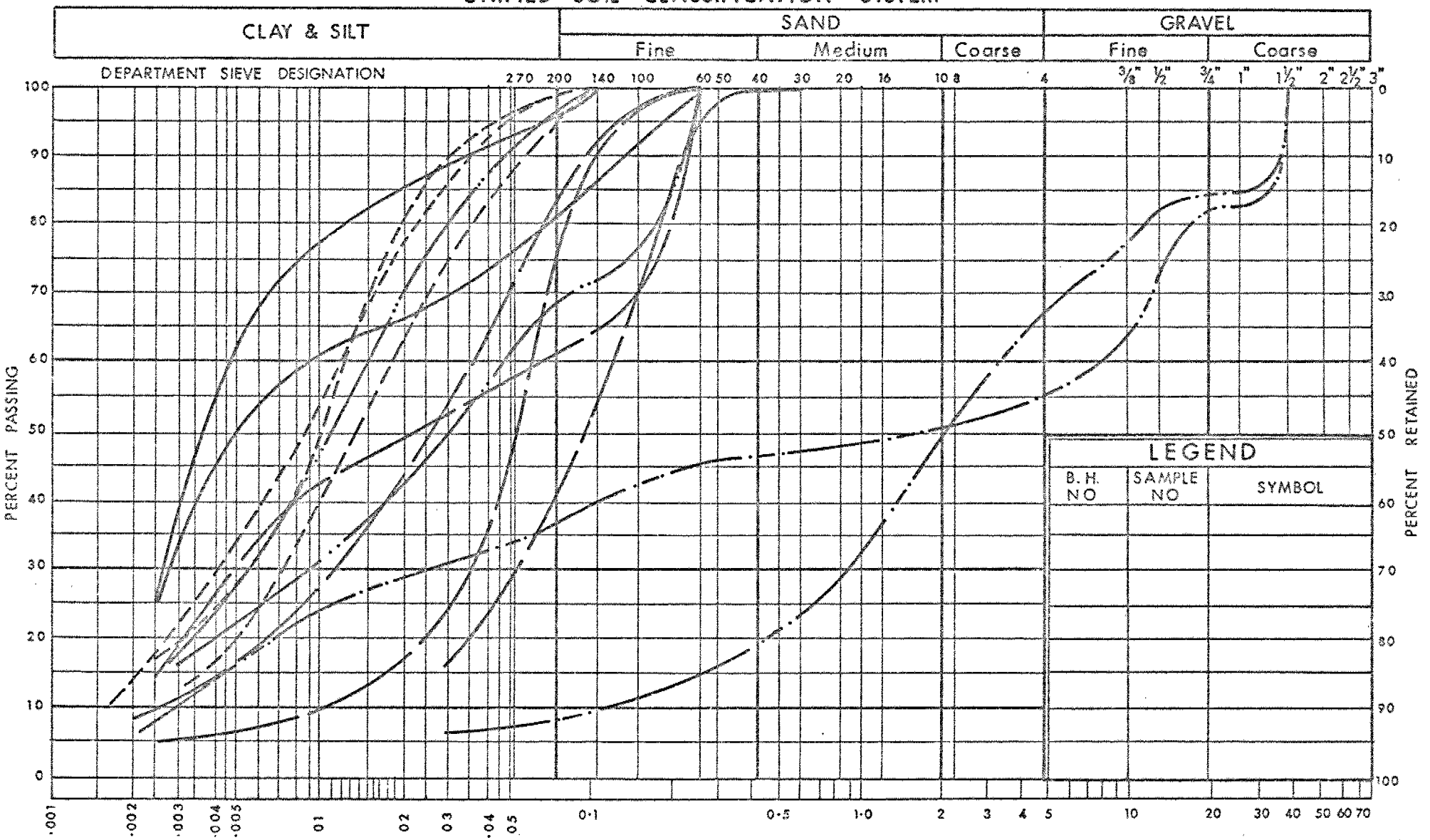
SOIL PROFILE			SAMPLES				DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT	LIQUID LIMIT w_L / PLASTIC LIMIT w_P / WATER CONTENT w	BULK DENSITY	REMARKS
ELEV. / DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS/FOOT	ELEV. SCALE	SHEAR STRENGTH P.S.F. ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE	w_P — w — w_L WATER CONTENT % 20 40 60	γ P.C.F.	GR. SA. SI. CL.
919.9	Ground Level									
0.0	Silty sand, traces of clay.									
917.6	Compact		1	SS	-			o		0 61 (39)
2.3	End of Borehole									

OFFICE REPORT ON SOIL EXPLORATION

15 20 10 ◇ 5 % STRAIN AT FAILURE

FORM OD-MT-17
REV. AUG. 1971

UNIFIED SOIL CLASSIFICATION SYSTEM



DEPARTMENT OF TRANSPORTATION AND COMMUNICATIONS
ONTARIO
DESIGN SERVICES BRANCH

GRAIN SIZE DISTRIBUTION

——— SILT TO CLAYEY SILT
– – – – SILT
—·—·— SILT TO SANDY SILT
— — — SILTY SAND
—·—·— SANDY GRAVEL TO GRAVELY SAND

W.P. No. 130-72-01
JOB No. 72-11140
FIG. Nº 1

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
$\log_e a$ 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 (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

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS, ONTARIO

MEMORANDUM

TO: Mr. A. Prakash,
Sr. Foundation Engineer,
Foundations Office,
West Building.

ATTENTION:

FROM: Soils Office,
Design Services Branch,
1st Floor, West Building,

DATE: January 9, 1972.

OUR FILE REF.

IN REPLY TO

SUBJECT: Bridge Site Investigations
Hwy. #558, Montreal River

Further to our recent conversation, I am attaching a detailed geotechnical analysis of the above bridge site. This study was conducted from the Ministry of Natural Resources photography taken at a scale of 1" = 1, 320'.

Please feel free to let us know if we can be of any further assistance in this matter.

B. Sen Mathur,
Remote Sensing Engineer.

BSM/sd
Attached

Bridge Site Investigations
Hwy. #558 & Montreal River
District #14, New Liskeard

LOCATION

The site under investigation lies in the Township of Barr in the vicinity of Mowat Landing, District of Timiskaming.

GENERAL GEOLOGY

The area under investigation is primarily underlain by Precambrian rock formations of igneous and metamorphic origin.

During the Wisconsin glaciation, various types of surface materials were deposited. Some of these materials are found in the vicinity of the study area (see photo enlargement).

ENGINEERING SOILS

The inorganic soils developed in the area vary from silty sand to gravelly sand. These soils are primarily associated with outwash deposits. At places these soils are masked by the organic materials in varying thicknesses.

Some of the important engineering properties of these soils are shown in tabular form (Table 1).

The soil conditions encountered by the three proposed bridge sites are shown on the attached plan and profiles of Lines 1, 2, & 3.

CONCLUSIONS

1. The general area in the vicinity of the three proposed bridge sites seems to be quite suitable. All three proposed sites

Bridge Site Investigations
Hwy. #558 & Montreal River
District #14, New Liskeard

have about the same rating. Line #3 passes through a cemetery and hence cannot be recommended.

2. Erosion is not a problem and should not pose any problem in the foreseeable future.

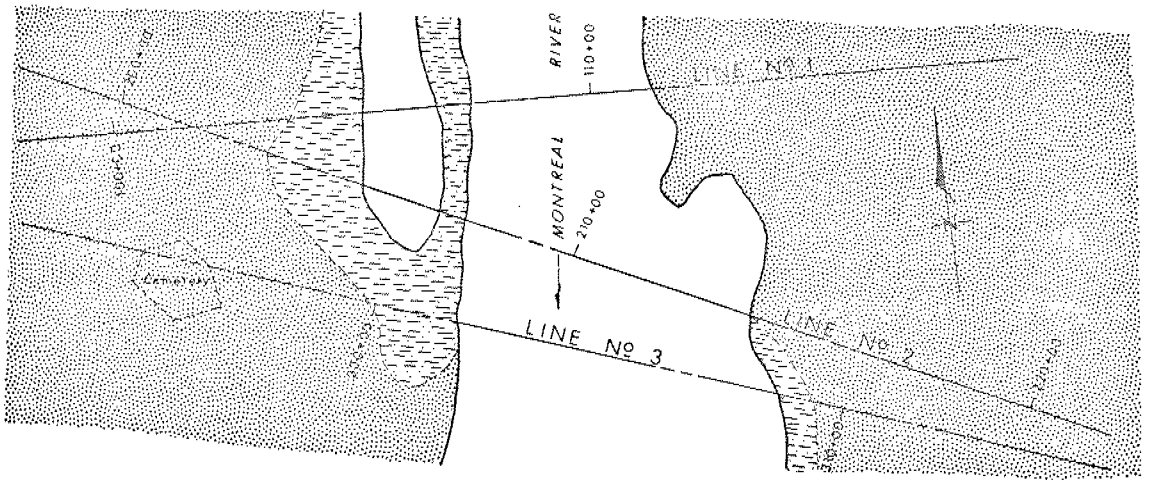
3. The drainage in general is fair to good except in the organic deposit on the west bank of the river through which all three lines pass.

4. The site is accessible by Highway #558.

5. There is no scarcity of natural aggregate in the area for the construction of the proposed structure.

B. Sen Mathur,
Remote Sensing Engineer.

	Engineering Properties	Silty Sand with Occasional Gravel	Si. Sa. with Occasional Gravel Overlain by Shallow Organic	Organic
1	Compaction	fair to good	fair to poor	poor
2	Water Seepage	often common in cuts	common	very common
3	Bearing Capacities	usually good	fair to poor	very poor
4	Drainage	fair to good internal drainage	fair to poor	very poor
5	Erosion	generally along slopes, and profile eroded to typical sections of those formed in fine sands	practically no erosion because of high water table	no erosion because of high water table
6	Instabilities	generally very stable except along the slopes where undercutting by stream is effective	settlement can be a problem	settlement can be a problem
7	Ground Water	water table can fluctuate thus affecting earth pressure calculations	water table often fluctuates	water table often fluctuates



PLAN

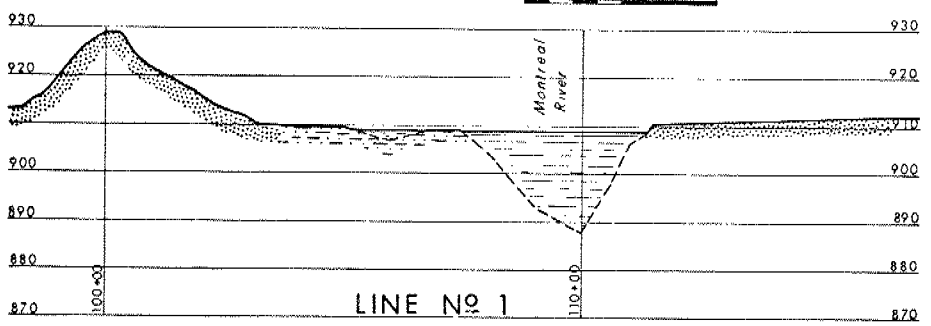
SCALE

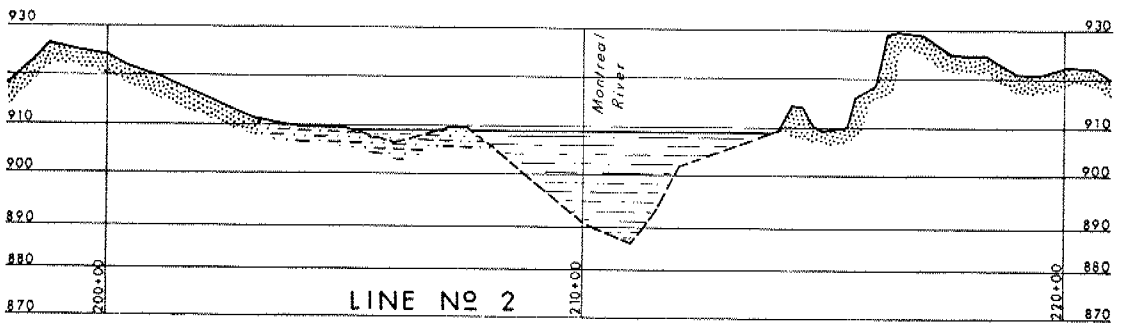
200 100 0 200 FT.

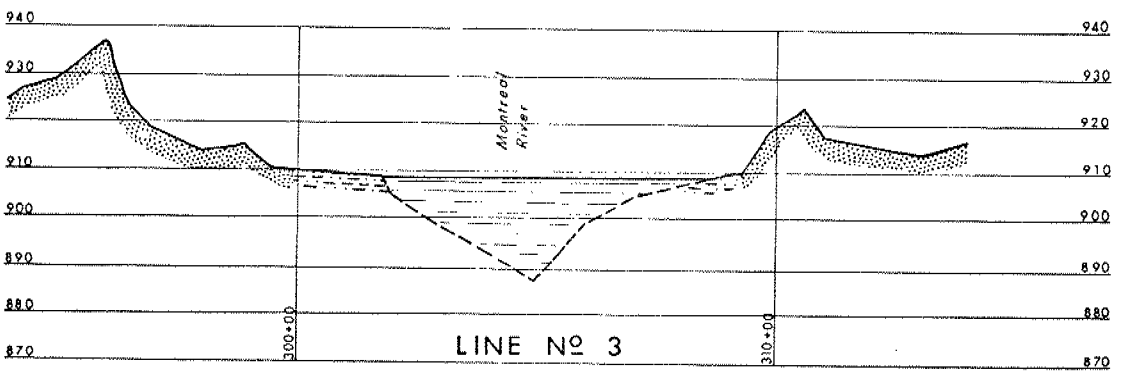
—LEGEND—

ORGANIC

SILTY SAND WITH OCC. GRAVEL







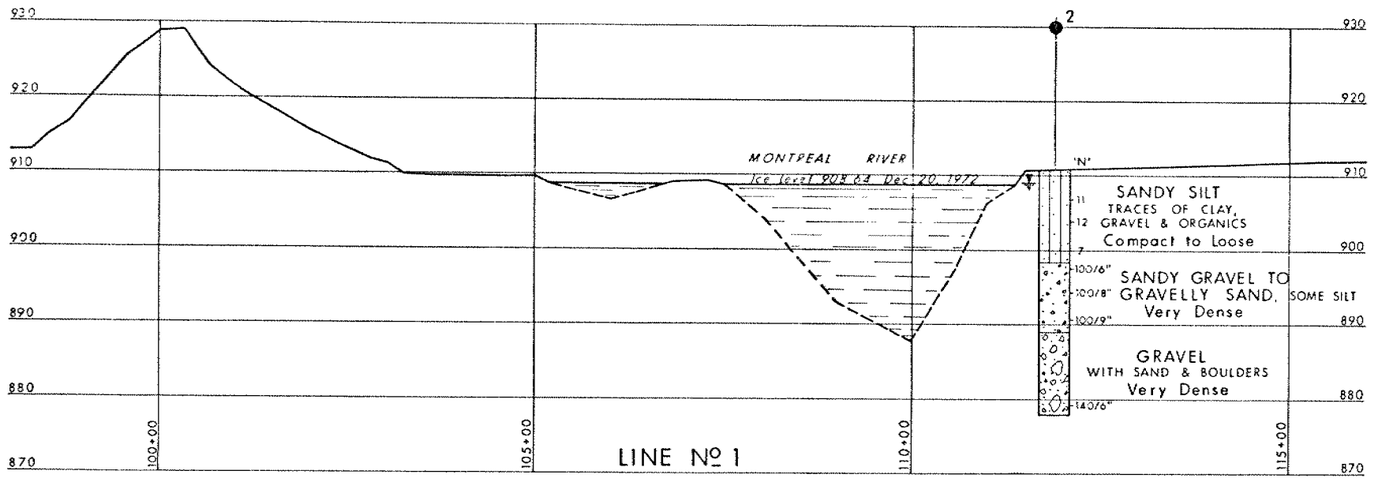
PROFILES

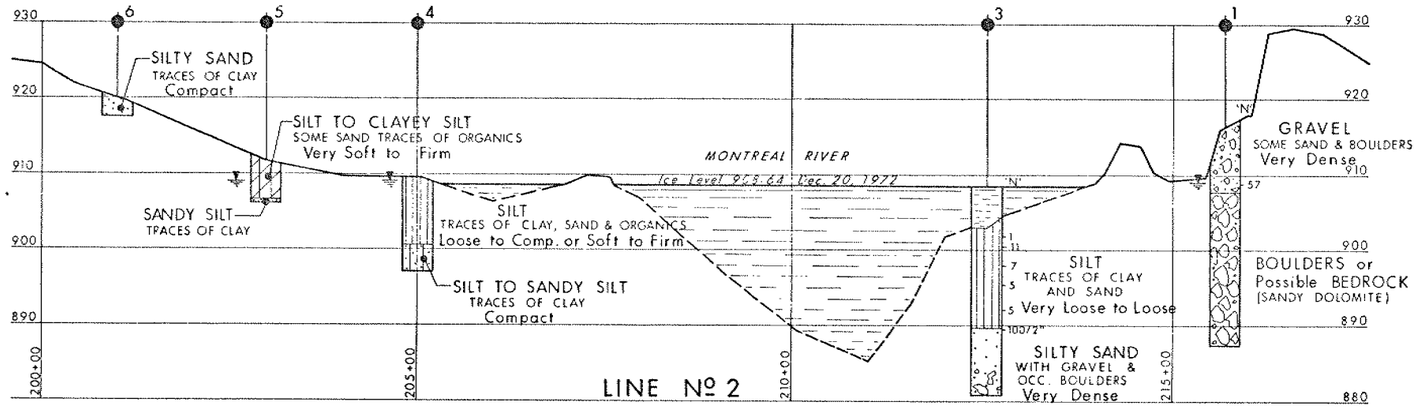
SCALE

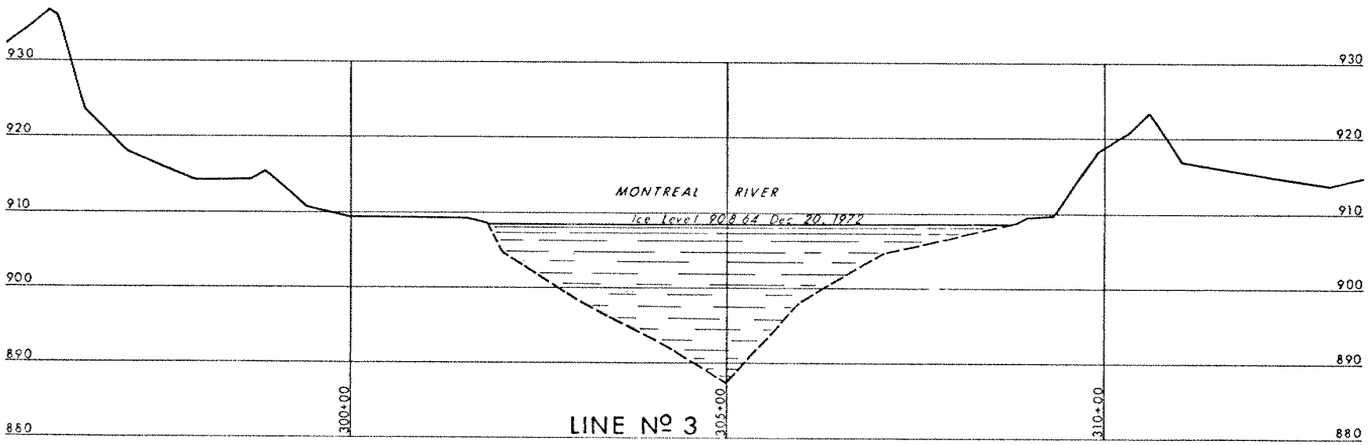
HORIZ. 200 100 0 200 FT.

VERT. 20 10 0 20 FT.

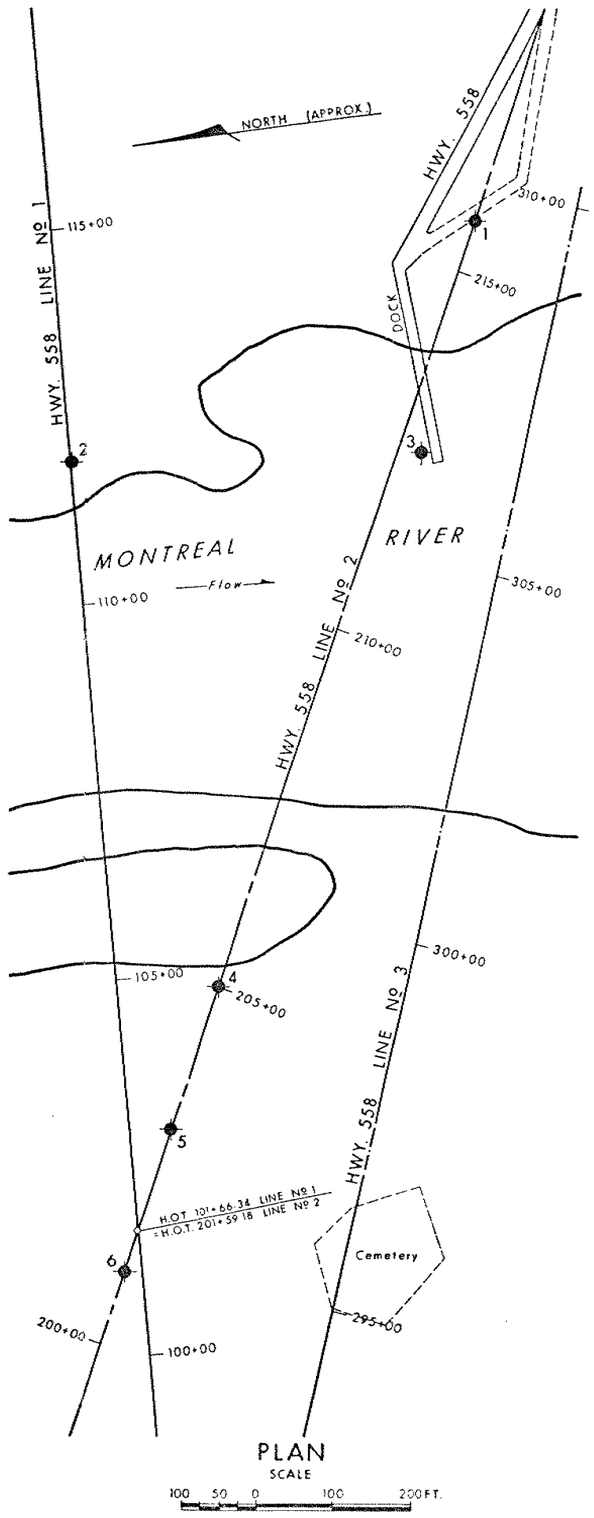

MONTREAL
RIVER
LINE '1'
LINE '2'
LINE '3'
N
① – BEDROCK (Igneous & Metamorphic)
② – SILTY SAND . Occasional Gravel
③ – SILTY SAND Occasional Gravel
Overlain by shallow ORGANIC
④ – ORGANIC



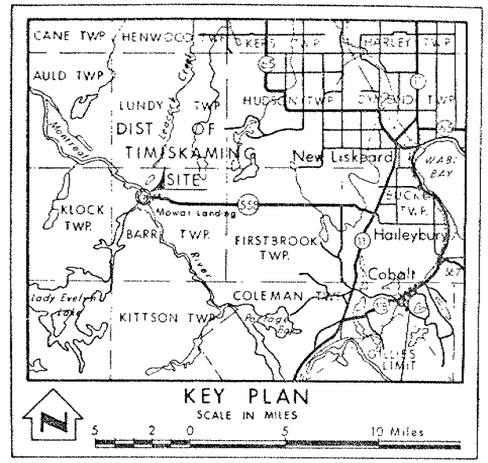




℄ PROFILES
SCALE
HORIZ. 100 50 0 100 200 FT.
VERT. 10 5 0 10 20 FT.



PLAN
SCALE
100 50 0 100 200 FT.



KEY PLAN
SCALE IN MILES
5 2 0 5 10 Miles

LEGEND

- Bore Hole
- Cone Penetration Test
- Bore Hole & Cone Test
- Water Levels established at time of field investigation Dec. 1972 & Jan. 1973

NO.	ELEVATION	STATION	OFFSET	LINE
1	916.3	215+70	℄	2
2	910.9	111+89	2' RT.	1
3	908.7	212+57	28' RT.	2
4	909.4	205+00	℄	2
5	911.7	203+00	℄	2
6	919.9	201+00	℄	2

— NOTE —
The boundaries between soil strata have been established only at Bore Hole locations. Between Bore Holes the boundaries are assumed from geological evidence

REVISIONS		
DATE	BY	DESCRIPTION

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS—ONTARIO
DESIGN SERVICES BRANCH—FOUNDATIONS OFFICE

MONTREAL RIVER

HIGHWAY NO 558 LINES 1, 2 & 3 DIST NO. 14
Dist TIMISKAMING
TWP BARR LOT 9 CON V

BORE HOLE LOCATIONS & SOIL STRATA

SUBMD E.A.W.	CHECKED A.M.	W.P.NO 130-72-01	DRAWING NO 72-11140A
DRAWN	CHECKED	W.O. NO 72-11140	
DATE Jan 12, 1973		SITE NO	BRIDGE DRAWING NO
APPROVED PRINCIPAL FOUNDATION ENGINEER		CONT NO	

BMD-TRACE 300-H-72