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GEOCRES No. 41J-58

DIST. 18 REGION

W.P. No. 14-74-07

CONT. No.

W. O. No.

STR. SITE No. 385-13

HWY. No. 129

LOCATION PROPOSED CREEK AT
RAPID RIVER

No OF PAGES - —

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OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT.

REMARKS:



DOMINION SOIL INVESTIGATION INC.

CONSULTING SOIL & FOUNDATION ENGINEERS

104 CROCKFORD BLVD., SCARBOROUGH, ONTARIO, CANADA, M1R 3C6

(416) 751-6565

41J-58

GEOCRES No.

FOUNDATION INVESTIGATION

PROPOSED CROSSING

RAPID RIVER - KINGS HIGHWAY #129

W.P. 14-74-07, SITE #38S-13

DISTRICT 18, SAULT STE. MARIE

Ref. No. 77-5-16

July 1977

Prepared For:

Ministry of Transportation & Communications
Downsview, Ontario

DISTRIBUTION:

15 Copies - Ministry of Transportation & Communications

2 Copies - Dominion Soil Investigation Inc.

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1.0 INTRODUCTION

The Ministry of Transportation & Communications is planning the replacement of an existing Bailey Bridge on Highway #129 over the Rapid River near Thessalon, Ontario.

At the request of the Engineering Materials Office of the Ministry, Dominion Soil Investigation Inc. has carried out a foundation investigation with the purpose of determining the subsurface conditions at the site of the proposed structure. The investigation in the field was completed in June 1977 and the findings are presented in this report.

.../...

2.0 SITE & GEOLOGY

The site is located in the Township of Sturgeon in the District of Sault Ste. Marie on Highway 129 approximately 45 miles north of Thessalon.

Geologically the site is located on the Canadian Shield and the bedrock in the area consists of intrusive rocks such as granite, gneiss, granitized sedimentary or volcanic rocks belonging to the Archean Era. During the last ice age the area has been invaded by continental glaciers which eroded much of the bedrock and deposited a shallow mantle of glacial debris. The surface of these glacial till sheets have been further modified by post-glacial streams, which have cut valleys into the tills and deposited alluvial soils on the surface.

The region surrounding the bridge site is characterized by undulating, hilly topography with ground surface elevations ranging from 1000 to about 1600 feet above sea level. In the immediate area of the crossing the topography is relatively flat as the highway follows the valley of the Mississagi River. The Rapid River flows from a more mountainous region to the east and discharges into the Mississagi River a short distance to the west of the site. The valley of the Rapid River is boulder-strewn throughout its entire course. Some of the boulders measure up to 7 feet in diameter. On the east side of Highway 129 the ground is covered by dense bush consisting of a mixture of mature elm, maple and evergreen trees. The west side of the highway and extending to the banks of the Mississagi River the ground is sparsely treed and is boulder paved. The site conditions described above are illustrated on photographs 1 to 8 inclusive in the Appendix of this report.



3.0 METHOD OF INVESTIGATION

3.1 Field Work

The work in the field consisted of putting down two boreholes at the locations shown on Drawing No. 147407-A.

The borings were carried out on June 5, 6 and 7, 1977 using both augering and wash-boring techniques. Due to the many boulders present, considerable difficulties were encountered during drilling. The boreholes were advanced by augering to a level where refusal was met. Below this the boreholes were advanced by breaking up the obstructions with a tri-cone and drilling in 'N'-size casing. The cuttings inside the casing were removed by the wash water. The testing in the field consisting of recovering disturbed soil samples by means of a 2-inch outside diameter split-spoon sampler driven into the ground with 350 ft/pound energy. The records of the borings are shown on Enclosures 1 and 2.

The field work was carried out under the supervision of a soils technician who also laid out the boreholes in the field using the centre line stakes established by the surveyors of M.T.C. as a reference. Ground surface elevations were referred to the local benchmark shown on M.T.C. Drawing No. E-5179-1.

3.2 Laboratory Testing

All soil samples were shipped in airtight jars to the laboratory of Dominion Soil Investigation Inc. for examination and testing. Representative soil samples were selected for sieve and hydrometer analyses. The laboratory test results are presented on Enclosures 3 and 4.

.../...



4.0 SUBSOIL CONDITIONS

4.1 General

Based on the results of the two boreholes and the visual examination of surface exposures the subsoil can be divided into two main strata:

1. loose BOULDERS, with sand filler
2. dense to very dense SAND and GRAVEL

4.2 Boulders

The uppermost deposit encountered in the boreholes and exposed in the river bed is a stratum of loosely packed boulders with sand filler. The size of the boulders range from 6-inches to several feet and boulders as large as 7 feet in diameter are exposed in the river bed. Photograph 3 illustrates the composition of this deposit very well. In Borehole 1 the voids between the boulders were filled with peat. In Boreholes 1 and 2 this boulder deposit extends to Elevation 1047.3 and 1042.4 feet respectively.

Because of its open grade structure, this deposit is quite pervious and it is expected that below the river level it will yield considerable amounts of water and due to the loosely packed and often rounded particles, it will be stable only on relatively flat slopes.

.../...

4.3 Sand and Gravel

Below the surficial boulder layer the subsoil is a sand and gravel deposit with numerous boulders and a trace of silt. The surface of this stratum was encountered between about Elevation 1047 and 1042 feet and is known to extend to at least Elevation 1019₊ feet where the boreholes were terminated. The grain size distribution characteristics of the deposit are shown on Enclosures 3 and 4. As shown, the stratum consists of 7 to 48% gravel, 42 to 89% sand, and 4 to 18% soil fines (predominantly silt). In addition, numerous boulders were also encountered, especially near the surface of this deposit.

The Standard Penetration resistances or 'N'-values range between 30 and over 100 blows per foot. From this the relative density of the deposit is inferred to be dense to very dense and generally in the very dense range. Some of the high penetration resistances, however, are undoubtedly due to the large gravel to boulder size particles present in the deposit. Below Elevation 1030₊ feet the particles are slightly cemented and as a result of this the deposit exhibits some apparent cohesion.

The stratum is expected to be quite pervious and to yield considerable amounts of water. As the upper zone of the deposit lacks any cohesion it is also expected that excavations extending below the water level will be unstable and will require either flat side slopes or support.

.../...



5.0 GROUNDWATER

The position of the groundwater table in the boreholes was measured upon completion of the borings. In Borehole 1 before withdrawing the casing the water level was recorded at Elevation 1042.5 feet. After the casing was withdrawn the hole caved-in at Elevation 1048 feet. In Borehole 2 a free-standing water level in the uncased borehole was measured at Elevation 1045.5 feet which level corresponds to the water level in the river at the time of the investigation.

Due to the pervious nature of the soil deposits, the water level is expected to be controlled by the water level in the river.

.../...

6.0 DISCUSSION OF THE RESULTS

6.1 General

The centre line of the proposed crossing is located approximately 70 feet upstream of the existing single-span Bailey Bridge. The proposed structure will have a single, approximately 40 feet (12.2 m) long span, supported on closed abutments. The vertical alignment of the road will also be improved and the grade will be raised by about 5 feet (1.5 m).

On the proposed centre line of the crossing the river is completely covered with boulders (Photographs 5 and 6) and many large boulders are found also in the area of the two proposed abutments (Photographs 7 and 8). The river is fast flowing with numerous rapids. There is a drop of about 1 foot (0.30 m) in the water level in the approximately 30 foot (9.15 m) distance between the upstream and downstream ends of the proposed abutments.

The borings have indicated that underlying a surficial deposit of loose boulders the site of the structure is underlain by dense to very dense sand and gravel.

6.2 Foundations

The very dense sand and gravel stratum is suitable to carry the foundations of the proposed structure. The foundations should be located at a safe depth below the river bed to assure that the footings will not be undermined by scour. As the upper

zone of the sand and gravel stratum contains numerous cobbles and boulders, it is considered to be moderately susceptible to scour and it is estimated that a foundation depths of 5 to 7 feet (1.5 to 2.1 m) below the river bed will be sufficient. This, however, should be confirmed by a study of the hydraulics of the river.

The foundations can be designed for an allowable bearing pressure of 10 k.s.f. (478 kN/m^2). Under a uniformly distributed line load of 25 k.l.f. (365 kN/m) on the foundations of the abutments, the maximum total settlement was estimated to be 0.6-inches (15 mm) and differential settlements less than half of this value are expected. All settlements will take place shortly after the load was applied.

The abutment should be designed to resist the horizontal earth pressure exerted by the approach embankments behind them. The coefficient of friction between the foundation and the sand and gravel subgrade can be taken to be 0.55. The design should incorporate a safety factor of not less than 1.75. The back-fill behind the abutment should be well drained or else the water pressure behind the abutment should be included in the calculation of the horizontal forces acting on the abutment.

6.3 Approach Fills

There are no stability problems foreseen for the proposed 5 to 10 foot (1.5 to 3.0 m) approach fills. Depending on the

type of fill material used the side slopes could range between 1.5 and 2 horizontal in 1 vertical. The approach fill should be constructed in accordance with the current M.T.C. specifications and standards. The face of the approach fill where exposed to the river flow should be adequately protected against scour and erosion by rip-rap or other suitable means.

6.4 Construction

The excavations for the footings of the abutments will extend through the loose bouldery material and the upper bouldery zone of the sand and gravel stratum.

The removal of the large boulders found in the creek bed and the sand and gravel deposit may present problems. Below the water level the sides of the excavation in these deposits will probably be stable only at 1.5 to 1 or 2 to 1 side slopes.

Dewatering problems are also foreseen. Significant amounts of flow can be expected through the boulder and also the sand and gravel deposits. Because of the dense and bouldery nature of the overburden, a coffer-dam consisting of steel sheet piles driven around the perimeter of the excavations does not appear to be feasible and, therefore, alternative measures will have to be considered. The rate of flow into the excavation could probably be decreased by placing an earth dyke around the excavation. If a relatively impervious material can be found in the area and this is placed on the stream bed .../...

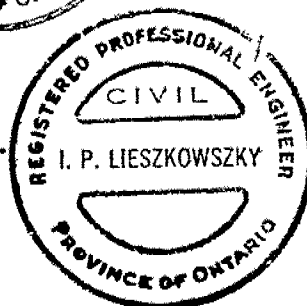
and the earth dyke then it may be possible to reduce the flow sufficiently to keep the excavation dewatered by large capacity sump pumps. However, if dewatering by pumping proves to be inadequate, or results in unsafe caving conditions, then consideration may have to be given to pouring the footings by the tremie method.

DOMINION SOIL INVESTIGATION INC.


I. Rainu, P. Eng.




I.P. Lieszkowszky, P. Eng.



/jn

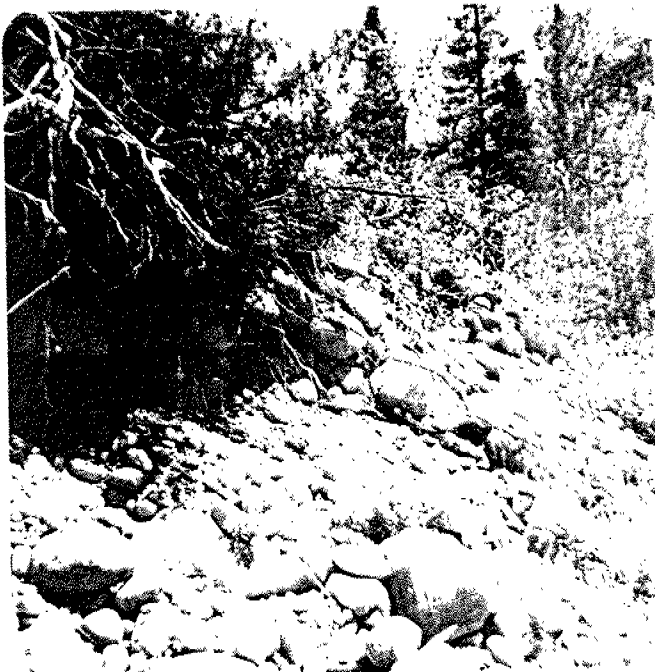
A P P E N D I X



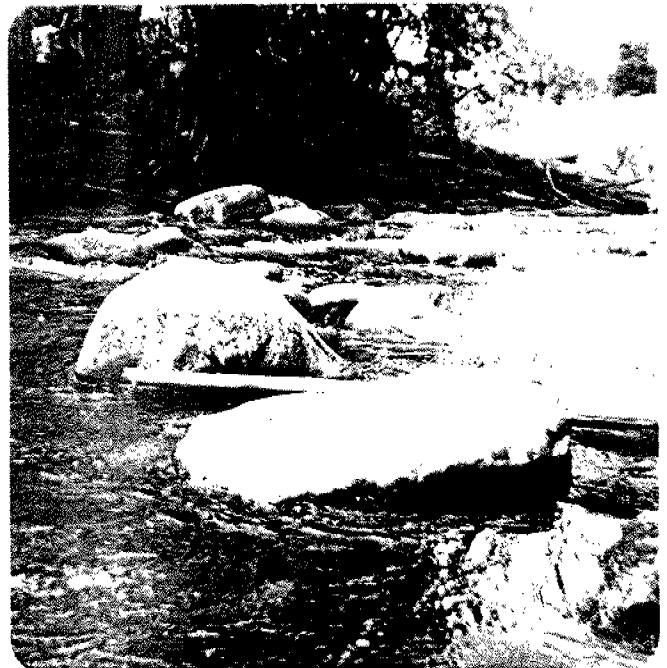
1
EXISTING BRIDGE FROM UPSTREAM



2
LOOKING UPSTREAM FROM EXISTING
BRIDGE



3
RIVER BANK DOWNSTREAM FROM EXISTING
BRIDGE



4
CREEK BED ON $\frac{1}{2}$ OF PROPOSED BRIDGE



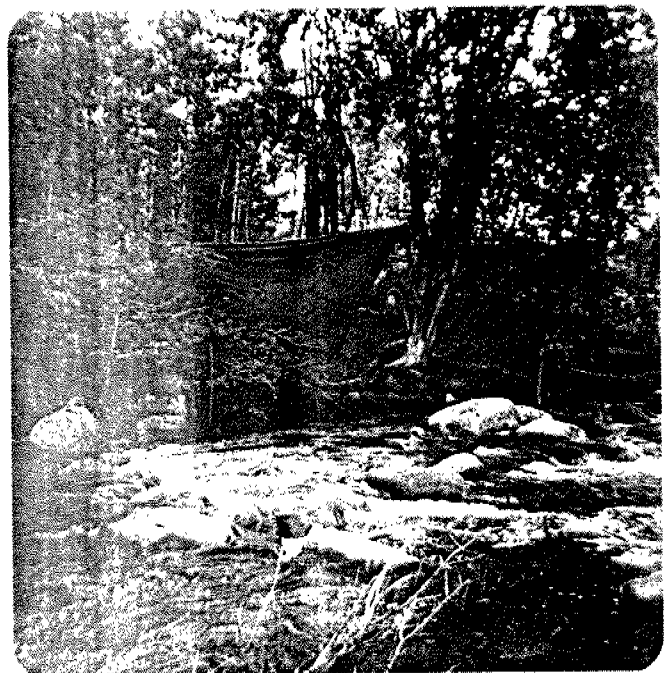
5
PROPOSED £ LOOKING NORTH



6
PROPOSED £ LOOKING SOUTH



7
NORTH ABUTMENT



8
SOUTH ABUTMENT

ENCLOSURES

CONT No
WP No 14-74-07

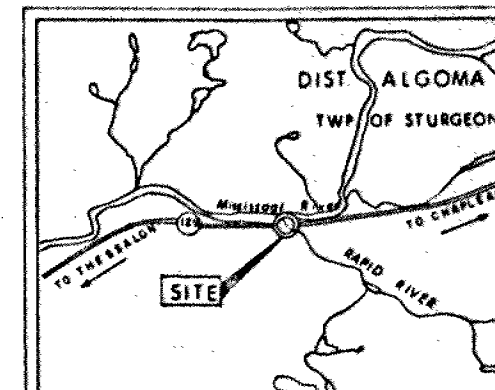


RAPID RIVER

SHEET

BORE HOLE LOCATIONS & SOIL STRATA

DOMINION SOIL INVESTIGATION INC



0.8 0.4 0 0.4 0.8 Miles

LEGEND

- Bore Hole
- ⊕ Dynamic Cone Penetration Test (Cone)
- ⊕ Bore Hole & Cone
- 'N' Blows/ft (Std Pen Test 350 ft lbs energy)
- CONE Blows/ft (60° Cone, 350 ft lbs energy)
- W.L. at time of investigation June 1977

No	ELEVATION	STATION	OFFSET
1	1049.3	259+90	5' LT.
2	1052.4	260+84	18' LT.

-NOTE-

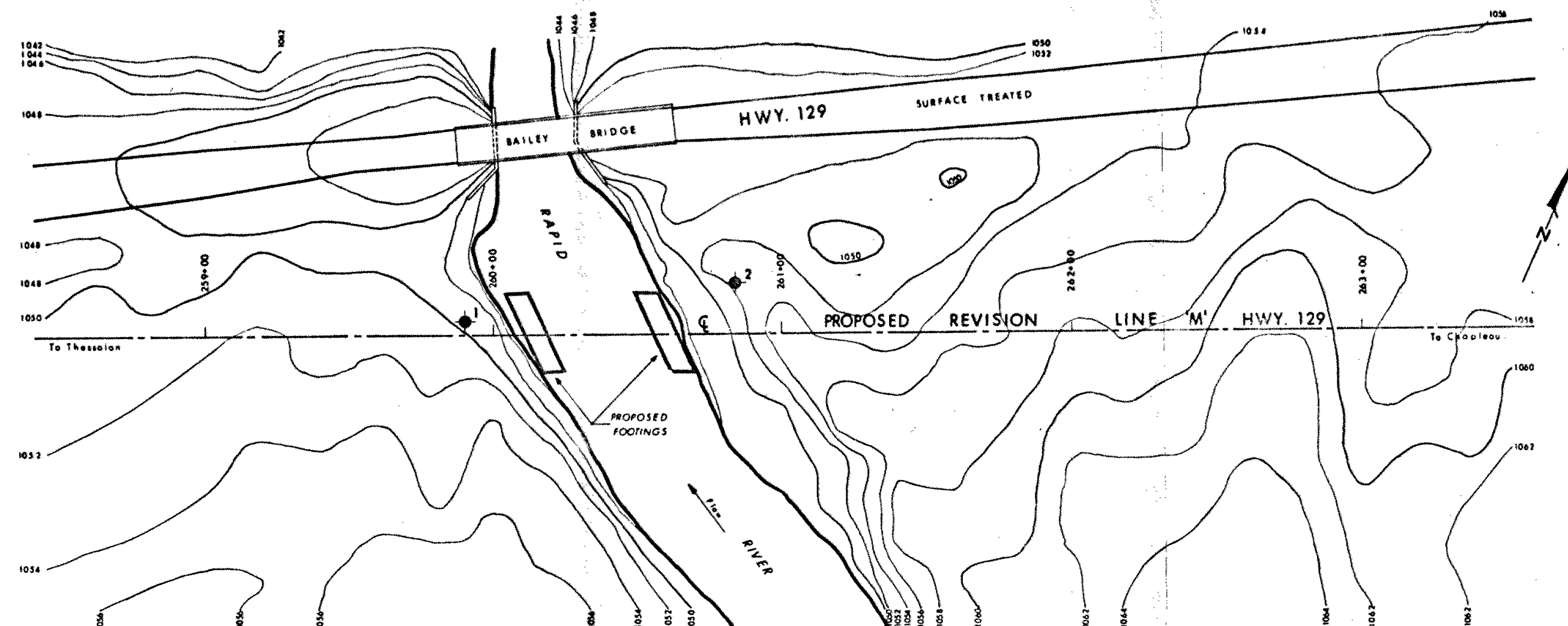
The boundaries between soil strata have been established only at Bore Hole locations. Between Bore Holes the boundaries are assumed from geological evidence.

REVISIONS	DATE	BY	DESCRIPTION

GEOCRES # 415-58
HWY No 129 LINE 'M' REVISION DIST 18
SUBWD LPL CHECKED DATE JUNE 12, 1977 SITE 385-13
DRAWN F.L. CHECKED APPROVED DWG 147407-A

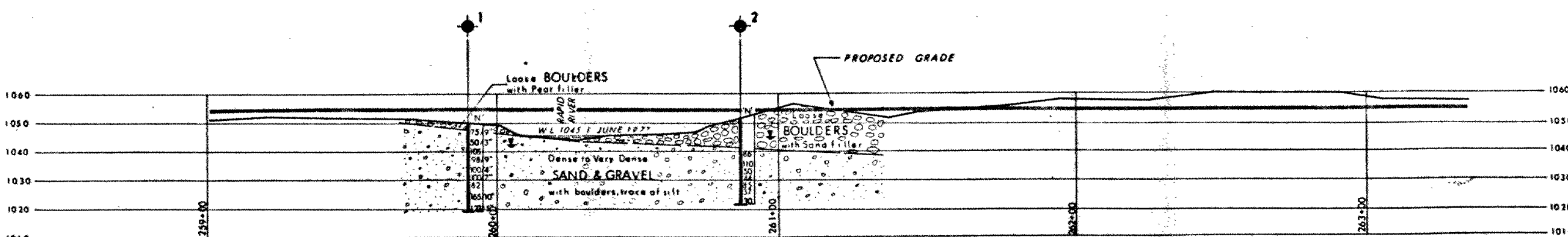


REF. No E-5179-1; NOV. 19, 1975



PLAN

SCALE 20 10 0 20 40 FT.



PROFILE LINE 'M'

SCALE 20 10 0 20 40 FT.

DOMINION SOIL INVESTIGATION INC.

RECORD OF BOREHOLE NO 1

WP 14-74-07 LOCATION Station 259 + 90, 5' LT. E Line 'M' ORIGINATED BY N. McC.
 DIST 18 HWY 129 BORING DATE June 5 and 6, 1977 COMPILED BY I.R.
 DATUM Geodetic BOREHOLE TYPE Augering and Washboring (N-size) CHECKED BY I.P.L.

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT W_L PLASTIC LIMIT W_P WATER CONTENT W			UNIT WEIGHT γ	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		20	40	60	80	100	W_P	W	W_L		
1049.3	Ground Surface															GR SA SI CL
0	Loose Boulders with Peat Filler															Hole Caved- in at E1. 1048. after casing withdrawn
1047.3																
2.0	Very Dense Sand and Gravel with numerous Boulders and a trace to some Silt		1	SS	75	9"										
			2	SS	50	3"										
			3	SS	105											12, 23, 5- 40, 42, 18-
			4	SS	98	9"										augering washboring
			5	SS	100	4"										drilling with NX casing & tri-cone
			6	SS	100	7"										
						1030										45, 43, 12-
	cemented		7	SS	82											
			8	SS	165	10"										35, 52, 13-
						1020										
1018.8			9	SS	127	5"										30, 52, 18-
30.5	END OF BOREHOLE															

DOMINION SOIL INVESTIGATION INC.

RECORD OF BOREHOLE NO 2

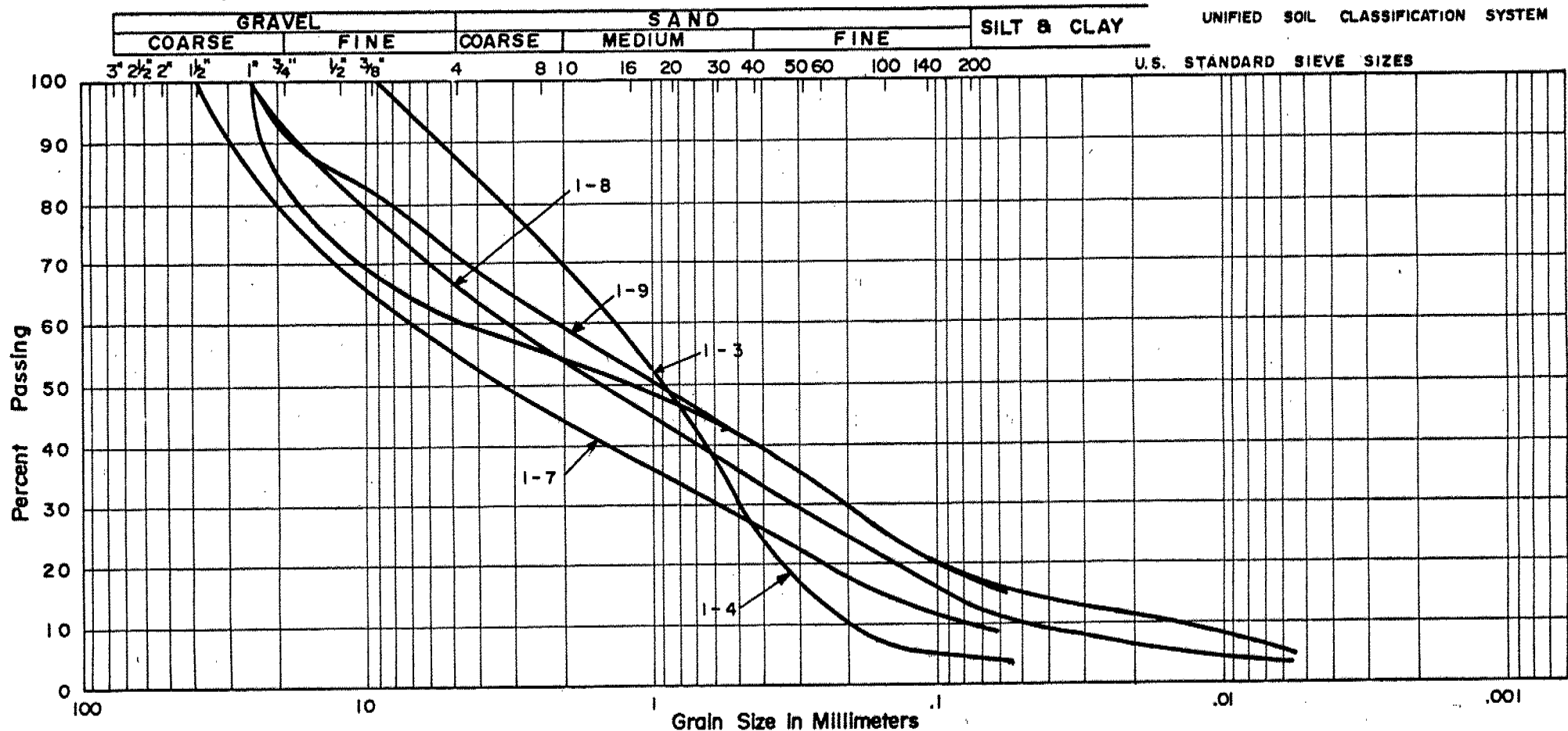
WP 14-74-07LOCATION Station 260 + 84, 18' LT.ORIGINATED BY N. McC.DIST 18 HWY 129BORING DATE June 6 and 7, 1977COMPILED BY I.R.DATUM GeodeticBOREHOLE TYPE Augering and Washboring (N-size)CHECKED BY I.P.L.

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT W_L PLASTIC LIMIT W_P WATER CONTENT W			UNIT WEIGHT γ	REMARKS	
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		20	40	60	80	100	SHEAR STRENGTH ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL X LAB VANE					WATER CONTENT %
1052.4	Ground Surface																
0	LOOSE BOULDERS with Sand filler					1050											↑ augering ↓ washboring drilling with NX casing and tri-cone 42, 54, 4- 15, 78, 7- 7, 89, 4- 18, 74, 8- 48, 42, 10-
1042.4																	
10	Dense to Very Dense SAND AND GRAVEL with Boulders and a trace of Silt Gravel content decreases with depth slightly cemented		1	SS	86	1040											
			2	SS	110												
			3	SS	50												
			4	SS	44												
			5	SS	85	1030											
			6	SS	37												
1021.9			7	SS	30												
30.5	END OF BOREHOLE																

DOMINION SOIL INVESTIGATION LIMITED

GRAIN SIZE DISTRIBUTION

OUR REFERENCE N^o 77-5-16



PROJECT: BRIDGE OVER RAPID RIVER.
 LOCATION: HWY. 129.
 BOREHOLE N^o: 1 1 1 1 1
 SAMPLE N^o: 3 4 7 8 9
 DEPTH: 8.5' 11' 21' 25' 30'
 ELEVATION: 1041' 1038' 1028' 1024' 1019'

COEFFICIENT OF UNIFORMITY: 7.5 - 100
 COEFFICIENT OF CURVATURE:

Classification of Sample and Group Symbol:
SAND & GRAVEL
 with a trace to some silt.

PLASTIC PROPERTIES

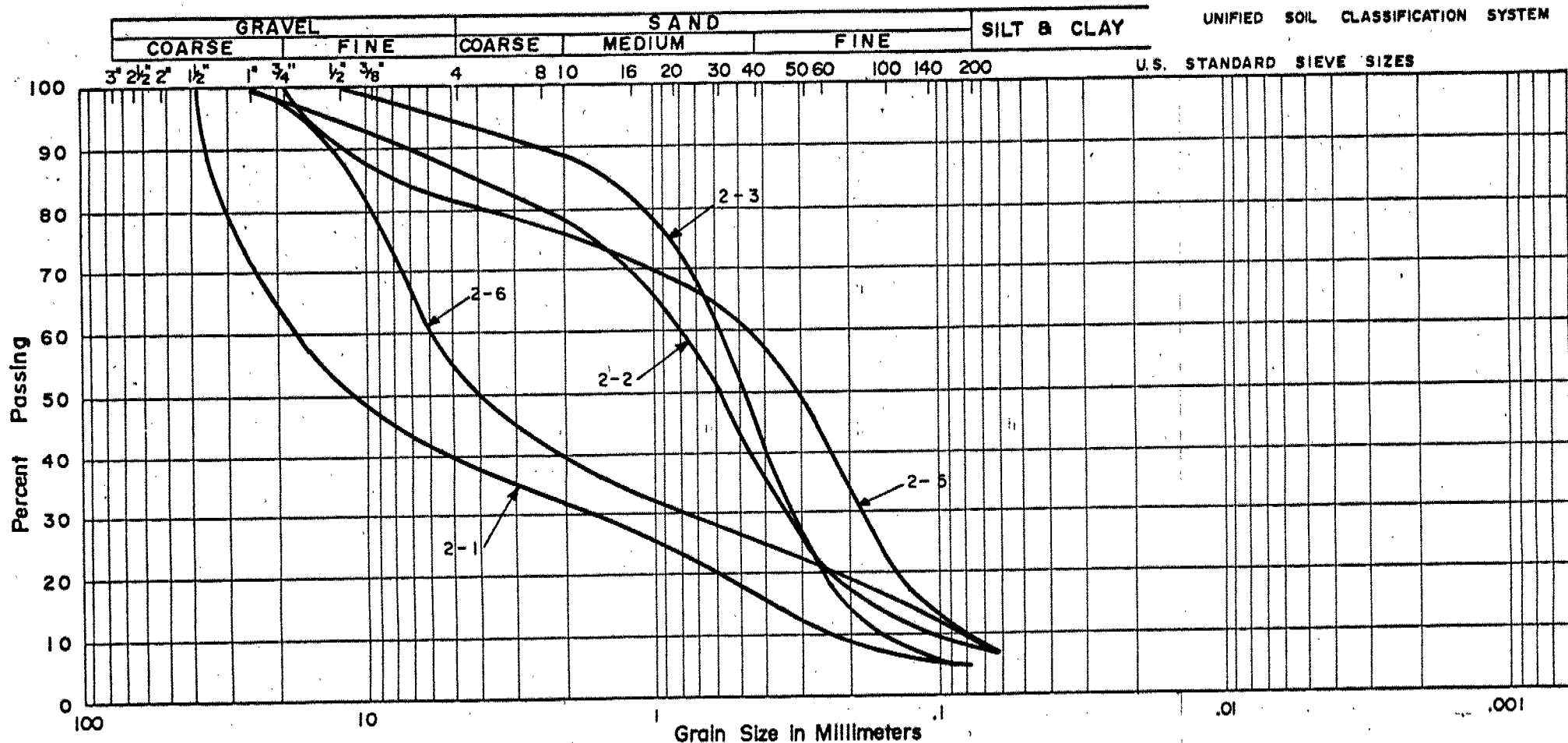
LIQUID LIMIT	% =	N/A.
PLASTIC LIMIT	% =	
PLASTICITY INDEX	% =	
MOISTURE CONTENT	% =	

ENCLOSURE N^o 3

DOMINION SOIL INVESTIGATION LIMITED

GRAIN SIZE DISTRIBUTION

OUR REFERENCE N^o 77-5-16



PROJECT: BRIDGE OVER RAPID RIVER.
 LOCATION: HWY. 129.
 BOREHOLE N^o: 2 2 2 2 2
 SAMPLE N^o: 1 2 3 5 6
 DEPTH: 125' 16' 19' 23.5' 26'
 ELEVATION: 1040' 1036' 1033' 1029' 1026'

COEFFICIENT OF UNIFORMITY: 4 - 75
 COEFFICIENT OF CURVATURE:

Classification of Sample and Group Symbol:
SAND & GRAVEL
 with a trace to some silt.

PLASTIC PROPERTIES
 LIQUID LIMIT % ■ N/A
 PLASTIC LIMIT % ■
 PLASTICITY INDEX % ■
 MOISTURE CONTENT % ■

ENCLOSURE N^o 4

Mr. E. Van Beilen, Head
Northern and NW Section
Structural Office
West Building, Downsview

Soil Mechanics Section
Engineering Materials Office
West Building, Downsview

78 01 31

Mr. A. Radkowski

Re: Rapid River Bridge
W.P. 14-74-07, Site 38S-13
Hwy. 129 (Line 'M'), District 18, Sault Ste. Marie

We have reviewed the Preliminary Bridge Plan Drawing 38S-13-P1 and found the footing design to be satisfactory. However, we would like to bring it to your attention that since the underside of the footings is situated below the water level in a granular subsoil, a dewatering scheme will be required in order to place concrete in the dry.

The Bridge Plan Drawing shows that the footings are founded at a great depth below the river bed. We believe this is to prevent the footings from being undermined by scouring.

B. Ly

B. Ly
Senior Engineer

For: M. Devata
Supervising Engineer

MD/BL/gs

cc: J. Harris
Files ✓

Mr. W. Lees
Manager, Engineering and Right-of-Way
Northwestern Region
Thunder Bay, Ontario
Mr. B McKenna

Soil Mechanics Section
Engineering Materials Office
West Building, Downsview

77 07 26

Foundation Investigation
Proposed Crossing
Rapid River - Relocated Hwy. 129 (Line 'M')
District #18, Sault Ste. Marie
W.P. 14-74-07, Site 385-13

Dominion Soil Investigation Inc., Consulting Soil and Foundation Engineers, were retained by the Ministry to carry out subsurface investigation at the above mentioned structure site. The Soil Mechanics Section recently received the completed report prepared by the Geotechnical consultants and after a careful review of this report, our comments are as follows:

1. The proposed simple span structure abutments can be founded on spread footings as indicated in the report. The founding elevation should be based on the hydrological requirements. This aspect should be reviewed by the Hydrology Section of the Ministry.
2. Dewatering problems during construction are also foreseen. In view of this, a dewatering scheme will be necessary during construction of the footings.

We believe that the aforementioned comments together with the enclosed foundation report submitted by the Geotechnical consultants will be adequate for your immediate requirements. Should you have any other queries please contact our office.

M. Devata
Supervising Engineer

MD/kr

Attach.

cc: B.J. Giroux
C.M. Smith
D.A. Jarvis (2)
W.A. Stewart (2)
A. Radkowski
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R.S. Pillar

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G. Sloan
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J.D. Harris