

DOCUMENT MICROFILMING IDENTIFICATION

G.I.-30 SEPT. 1976

GEOCRES No. 41 F - 37

DIST. 18 REGION

W.P. No. 14-74-10

CONT. No. 81-210

W. O. No.

STR. SITE No. 38S - 11

HWY. No. 129

LOCATION Gravel River
Sault Ste. Marie

No of PAGES -

=====

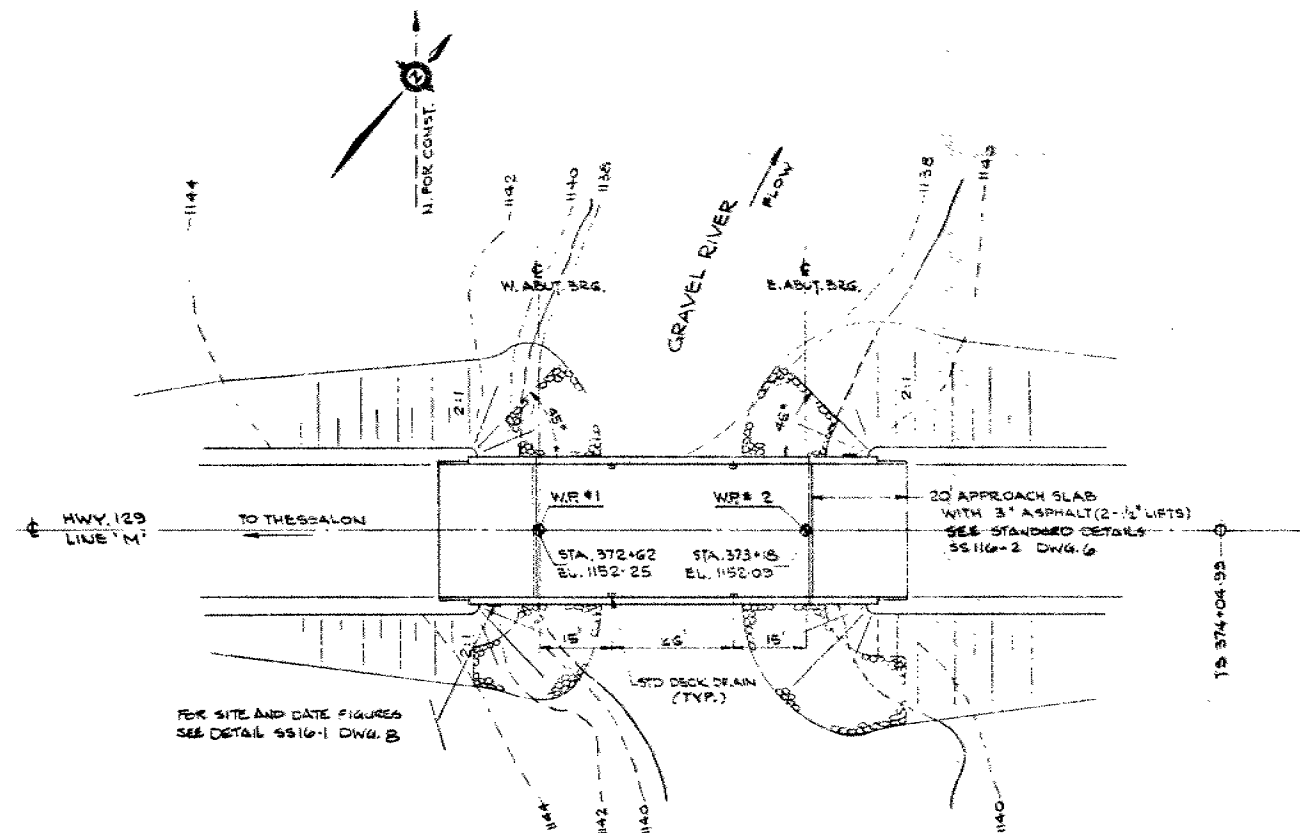
OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT.

REMARKS:

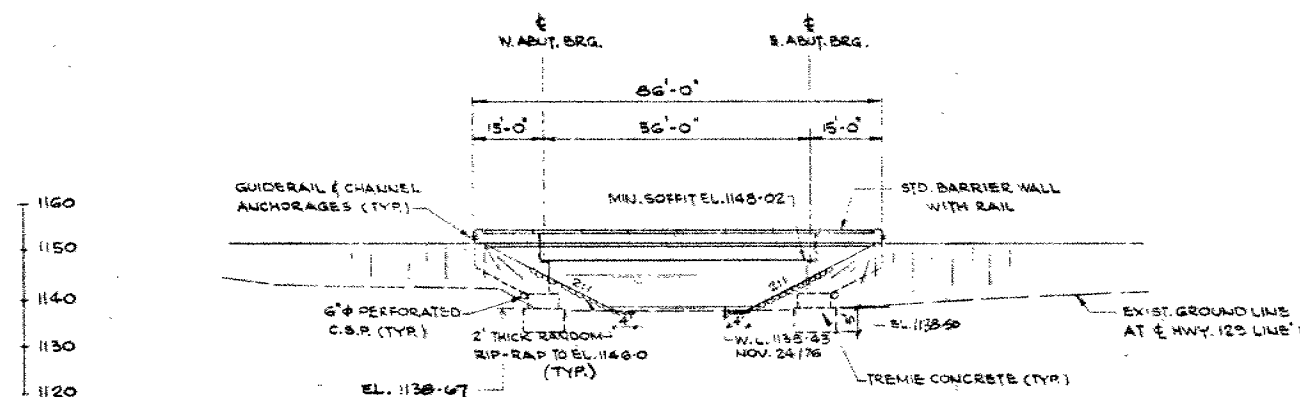


DIST. 18	
CONT No	WP No 14-74-10
GRAVEL RIVER BRIDGE # 3	
3.7 MI. NORTH OF HWY. 554	
SHEET	

DESIGN ENGINEERS	
WRIGHT & BARKER CO. LTD.	
CONSULTING ENGINEERS	
SAULT STE MARIE ONTARIO	
BRIDGE PLAN AND ROAD SECTIONS	
PROJECT 2535	OWNER: ONTARIO MINISTRY OF TRANSPORTATION AND COMMUNICATIONS



PLAN
1" = 20'



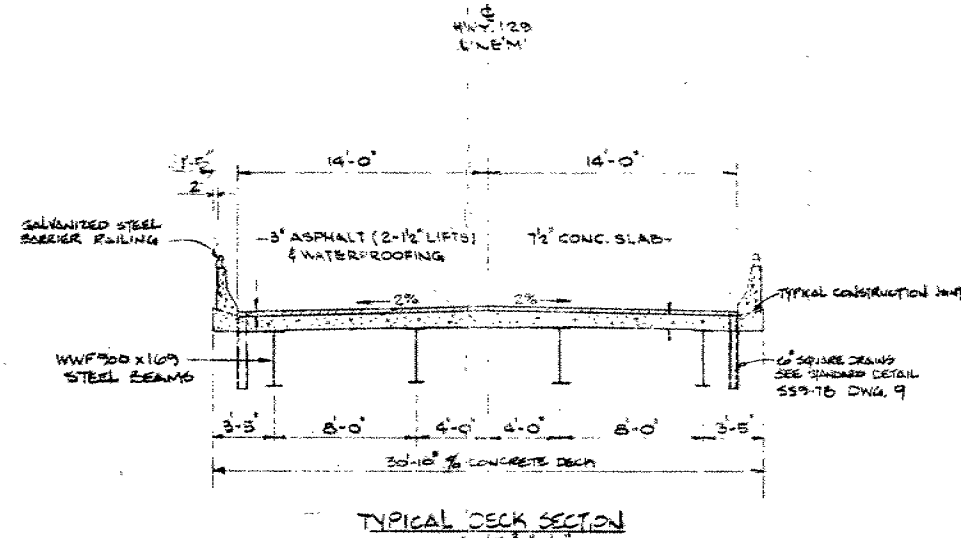
ELEVATION
1" = 20'

MAIN QUANTITIES

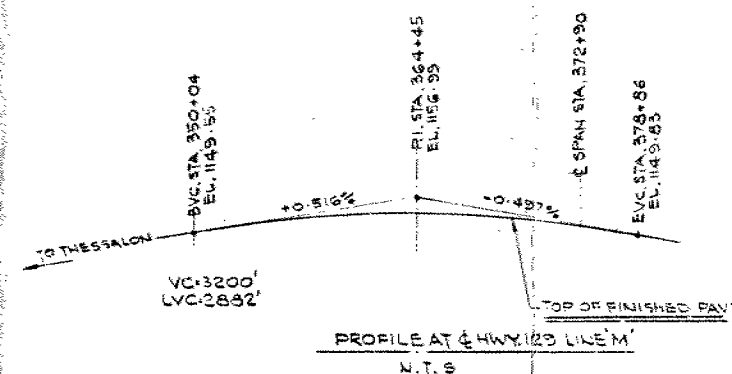
STRUCTURAL STEEL 16 TONS

CONCRETE FOR LUMP SUMP TENDER ITEMS

ABUTMENTS + WING WALLS	85	CY YDS
DECK	44	CY YDS
BARRIER WALLS	15	CY YDS
APPROACH SLABS	35	CY YDS



TYPICAL DECK SECTION
SCALE 3/4" = 1'-0"



BM 1141.86
1/4" IN ROOT 1-7 CEDAR
38' LT. 374+05

LIST OF DRAWINGS

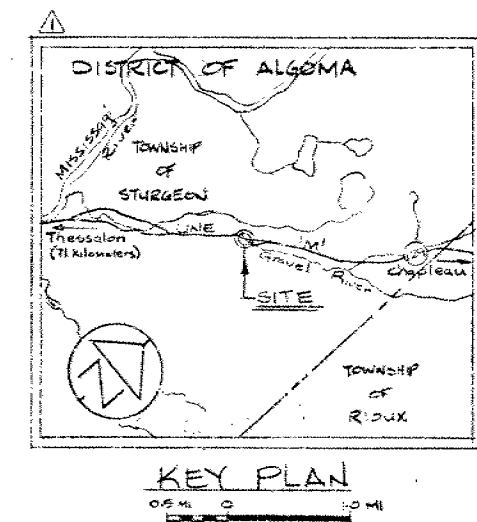
- 1 - BRIDGE PLAN AND ROAD SECTIONS
- 2 - SCORE HOLE LOCATIONS AND SOIL STRATA
- 3 - FOOTING AND ABUTMENT DETAILS
- 4 - ABUTMENT AND BRIDGE DECK DETAILS
- 5 - STRUCTURAL STEEL DETAILS
- 6 - 20 FT. APPROACH SLAB
- 7 - AS CONSTRUCTED ELEV. 4 DIM.
- 8 - STANDARD DETAILS - I
- 9 - " " - II
- 10 - " " - III
- 11 - BARRIER WALL
- 12 - STEEL RAILING (SINGLE TUBE)

NOTES:
REINFORCING STEEL
GRADE 400
REINFORCING BARS WITH THE DESIGNATION 'C' AT THE END OF BAR MARKS SHALL BE COATED BARS

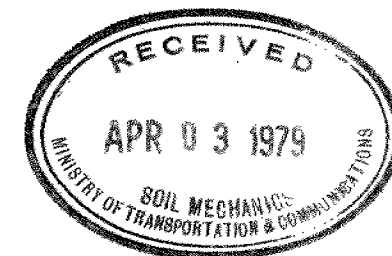
CLASS OF CONCRETE
DECK AND BARRIER WALLS 4000 PSI
REMAINDER 3000 PSI

CONSTRUCTION NOTES
THE CONTRACTOR IS RESPONSIBLE FOR FINISHING THE BEARING SEATS DEAD LEVEL TO THE SPECIFIED ELEVATIONS WITH A TOLERANCE OF $\pm 1/8"$.
NO CONCRETE SHALL BE PLACED ABOVE THE ABUTMENT BEARING SEATS UNTIL CONCRETE IN DECK HAS BEEN PLACED.
TO ACHIEVE THE MINIMUM CLEAR COVER OF 2" SPECIFIED, THE TOP LAYER OF REINFORCEMENT SHALL BE PLACED, PRIOR TO CONCRETING, WITH A CLEAR COVER OF $2 1/2" \pm 1/2"$ TOLERANCE.
FORMWORK FOR THE BALLAST WALL (e.g. EXPANDED POLYSTYRENE) NEXT TO END OF DIAPHRAGMS SHALL BE REMOVED.

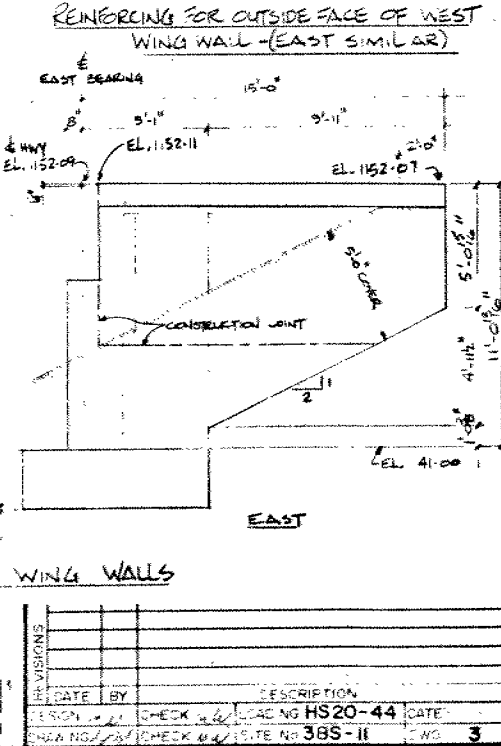
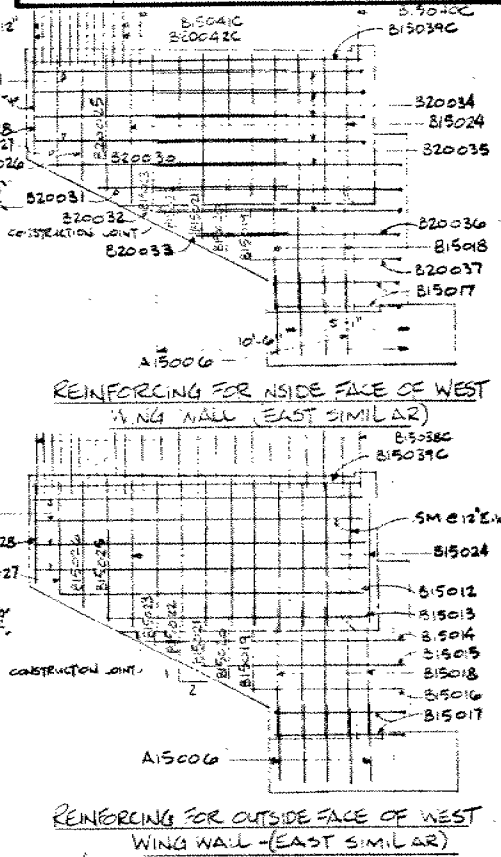
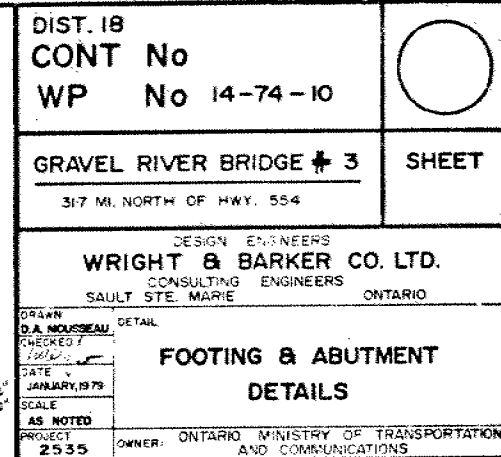
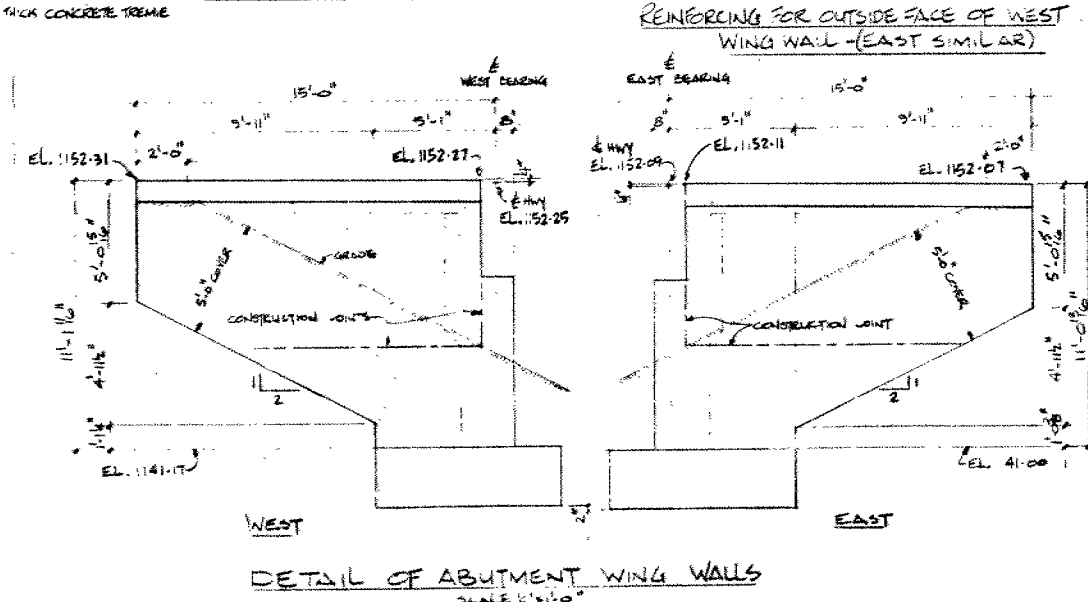
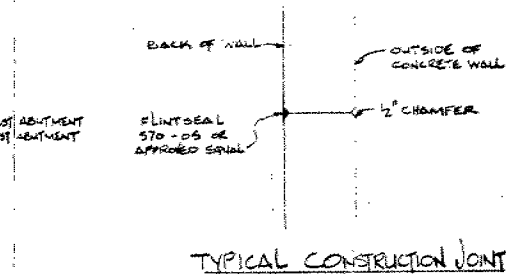
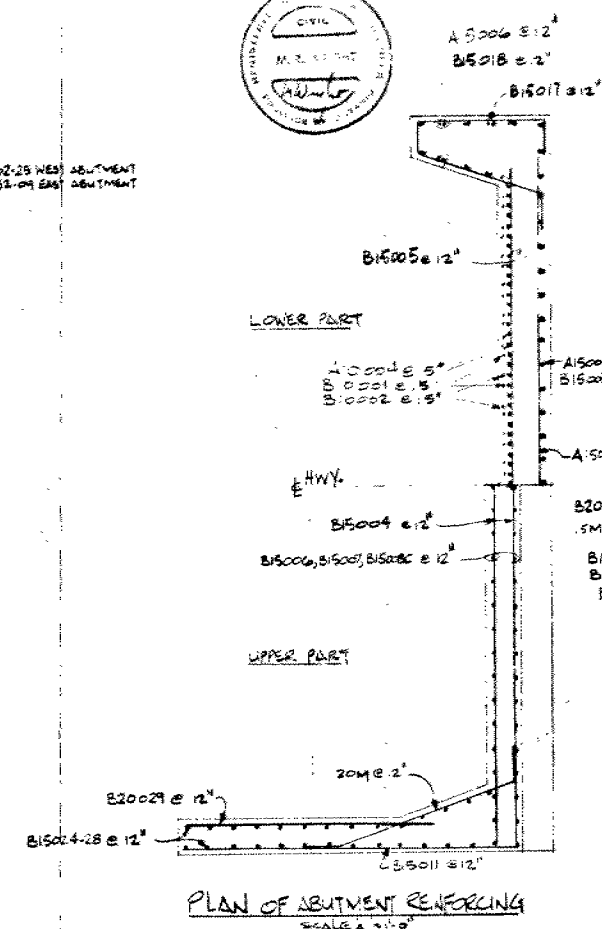
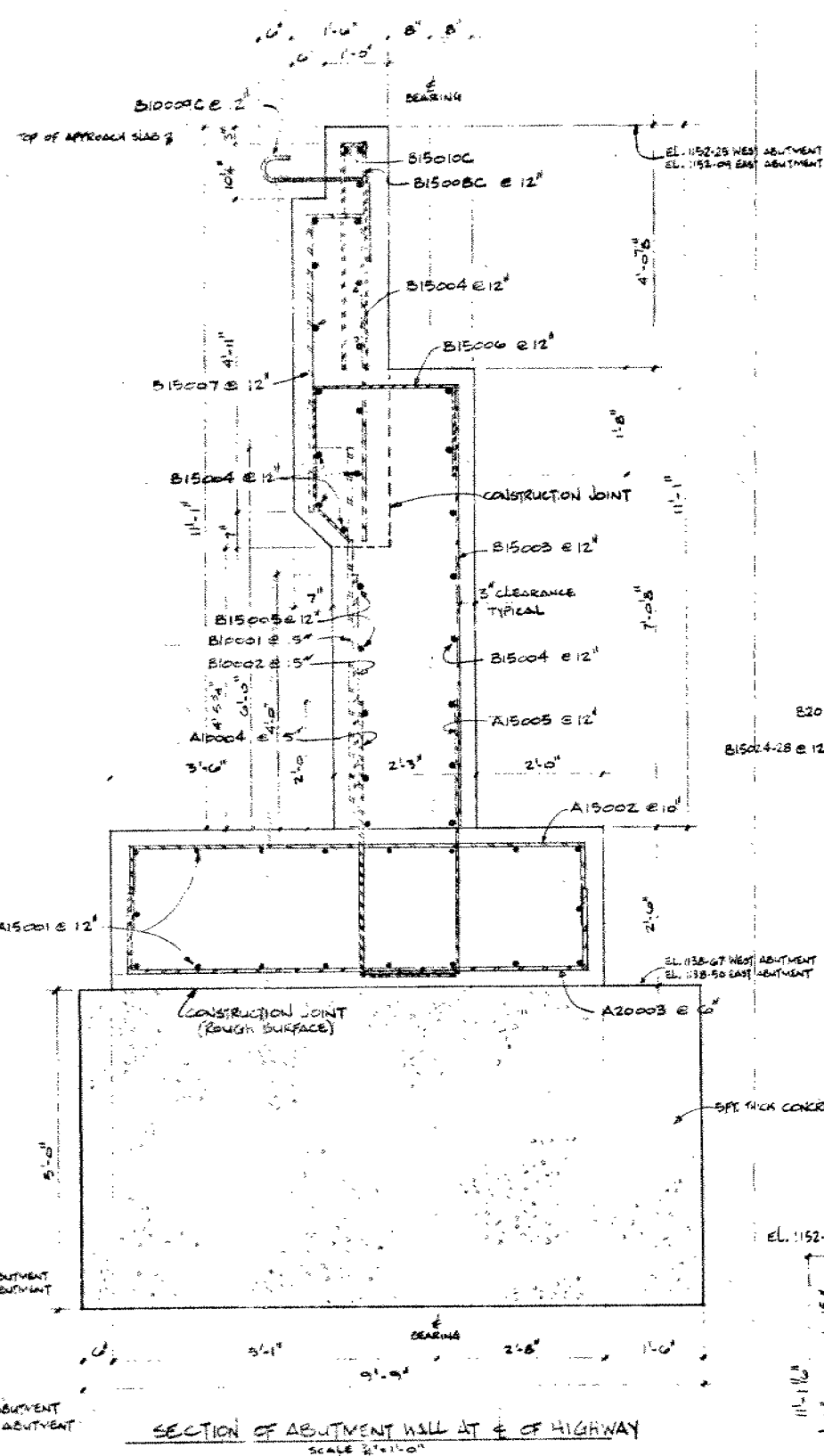
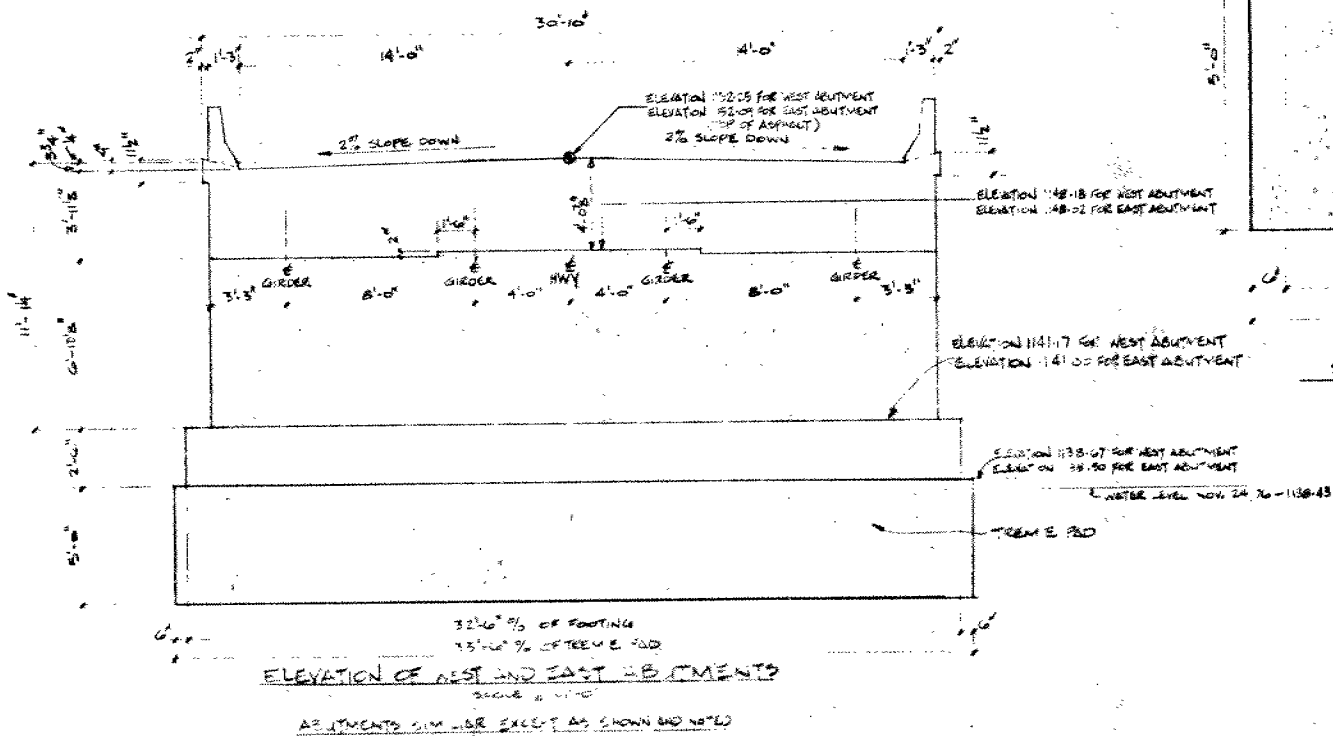
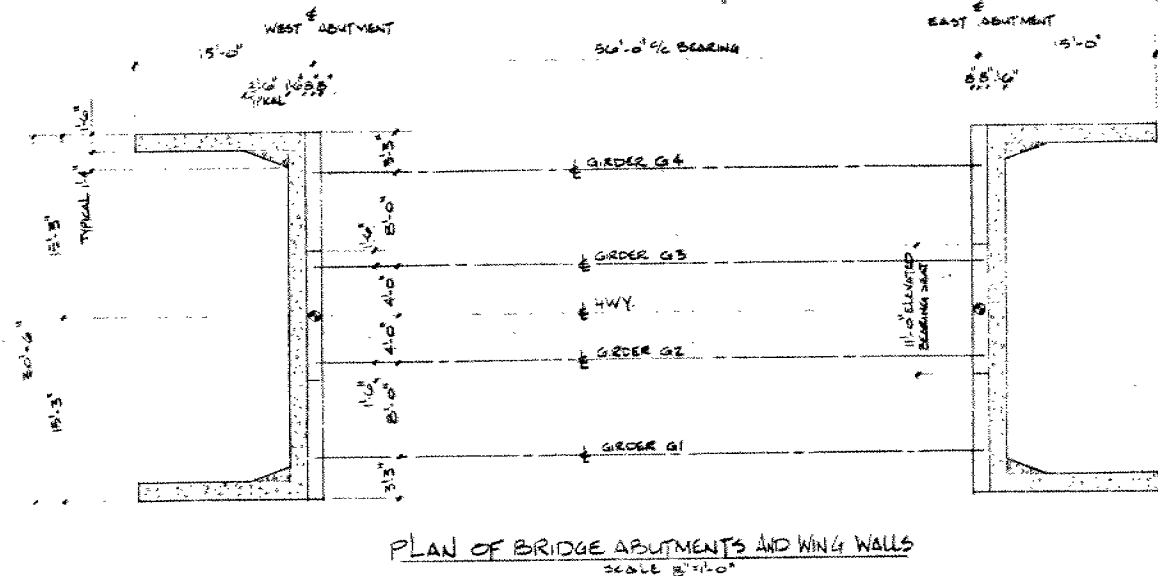
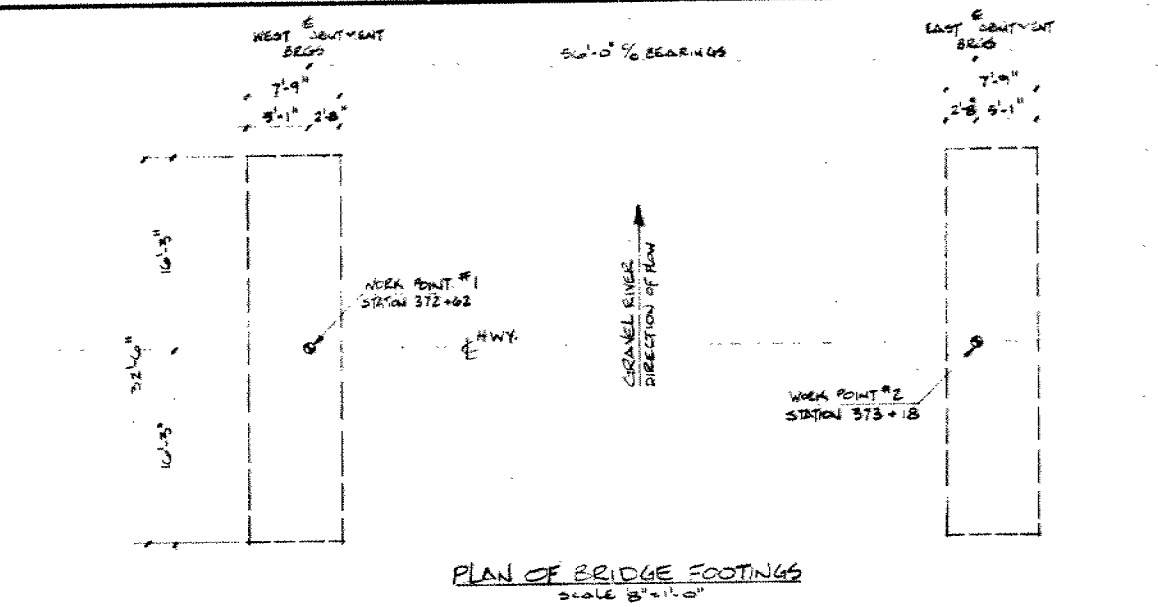
CLEAR COVER ON REINFORCING STEEL
FOOTINGS & ABUTMENTS 3"
DECK, TOP 2", BOTTOM 1 1/2"



KEY PLAN
0.5 MI. 0 1.0 MI.



FOR REDUCED PLAN	
USE SCALE BELOW	
10 1 2 3	
1" = 3 INCHES ON ORIGINAL PLAN	
REVISIONS	DATE BY DESCRIPTION
DESIGN	CHECK
DRAWING	LOADING HS20-44 DATE NOV. 78
CHECK	POL SITE No. 365-11 DWG. 1



INDEX

<u>Page No.</u>	<u>Description</u>
1	Index
2	Abbreviations & Symbols
3- 13	Foundation Investigation Report for: Gravel River - Highway #129 W.P. 14-74-10, Site 38S-17

NOTE: For purposes of the contract these reports
supercede all other foundation reports prepared
by or for the Ministry in connection with the
above mentioned projects.

'N' VALUE: AN INDICATOR OF SUBSOIL QUALITY. IT IS OBTAINED FROM THE STANDARD PENETRATION TEST (CSA STD. A119.1). SPT 'N' VALUE IS THE NUMBER OF BLOWS REQUIRED TO CAUSE A STANDARD 2 INCH O.D. SPLIT-BARREL SAMPLER TO PENETRATE 12 INCHES INTO UNDISTURBED GROUND IN A BOREHOLE WHEN DRIVEN BY A HAMMER WEIGHING 140 POUNDS, FALLING FREELY A DISTANCE OF 30 INCHES. FOR PENETRATIONS OF LESS THAN 12 INCHES 'N' VALUES ARE INDICATED AS THE NUMBER OF BLOWS FOR THE PENETRATION ACHIEVED. 'N' VALUES CORRECTED FOR OVERBURDEN PRESSURE ARE DENOTED THUS N_c .

DYNAMIC CONE PENETRATION TEST (CSA STD. A119.3): CONTINUOUS PENETRATION OF A CONICAL STEEL POINT (2" O.D. 60 CONE ANGLE) DRIVEN BY 350 FT-LB IMPACTS ON "A" SIZE DRILL RODS. THE RESISTANCE TO CONE PENETRATION IS MEASURED AS THE NUMBER OF BLOWS FOR EACH 12 INCH ADVANCE OF THE CONICAL POINT INTO THE UNDISTURBED GROUND.

SOIL QUALITY: SOILS ARE DESCRIBED BY THEIR COMPOSITION AND CONSISTENCY OR DENSITY.

CONSISTENCY: COHESIVE SOILS ARE DESCRIBED ON THE BASIS OF THEIR UNDRAINED SHEAR STRENGTH AS FOLLOWS:

S_u (PSF)	0 - 250	250 - 500	500 - 1000	1000 - 2000	2000 - 4000	> 4000
	VERY SOFT	SOFT	FIRM	STIFF	VERY STIFF	HARD

DENSENESS: COHESIONLESS SOILS ARE DESCRIBED ON THE BASIS OF SPT 'N' VALUES AS FOLLOWS:

'N' (BLOW/FT)	0 - 5	5 - 10	10 - 30	30 - 50	> 50
	VERY LOOSE	LOOSE	COMPACT	DENSE	VERY DENSE

ROCK QUALITY: ROCKS ARE DESCRIBED BY THEIR COMPOSITION AND STRUCTURAL FEATURES AND/OR STRENGTH.

RECOVERY: SUM OF ALL RECOVERED ROCK CORE PIECES FROM A CORING RUN EXPRESSED AS A PERCENT OF THE TOTAL LENGTH DRILLED IN THAT CORING RUN.

MODIFIED RECOVERY: SUM OF THOSE NATURALLY FRACTURED CORE PIECES, 4" IN LENGTH EXPRESSED AS A PERCENT OF THE LENGTH OF THE CORING RUN. THE ROCK QUALITY DESIGNATION (RQD), FOR MODIFIED RECOVERY, IS:

RQD (%)	0 - 25	25 - 50	50 - 75	75 - 90	90 - 100
	VERY POOR	POOR	FAIR	GOOD	EXCELLENT

JOINTING AND BEDDING:

SPACING	2"	2" - 12"	1' - 3'	3' - 10'	> 10'
JOINTING	VERY CLOSE	CLOSE	MOD. CLOSE	WIDE	VERY WIDE
BEDDING	VERY THIN	THIN	MEDIUM	THICK	VERY THICK

ABBREVIATIONS & SYMBOLS

LABORATORY TESTING

TRIAXIAL TESTS ARE DESCRIBED IN TERMS OF WHETHER THEY ARE CONSOLIDATED (C) OR NOT (U) ISOTROPICALLY (I) OR NOT (A) AND SHEARED DRAINED (D) OR UNDRAINED (U) WITH PORE PRESSURE MEASUREMENTS (BAR OVER SYMBOLS) EG. \bar{C}_{IU} = CONSOLIDATED ISOTROPIC UNDRAINED TRIAXIAL WITH PORE PRESSURE MEASUREMENT UNLESS OTHERWISE SPECIFIED IN REPORT ALL TESTS ARE IN COMPRESSION

FIELD SAMPLING

S S SPLIT SPOON
W S WASH SAMPLE
S T SLOTTED TUBE SAMPLE
B S BLOCK SAMPLE
C S CHUNK SAMPLE
T W THINWALL OPEN
T P THINWALL PISTON
O S OSTERBERG SAMPLE
F S FOIL SAMPLE
R C ROCK CORE
P H T.W. ADVANCED HYDRAULICALLY
P M T.W. ADVANCED MANUALLY

EARTH PRESSURE TERMS

μ COEFFICIENT OF FRICTION
 δ ANGLE OF WALL FRICTION
 k_0 COEFFICIENT OF EARTH PRESSURE AT REST
 k_A COEFFICIENT OF ACTIVE EARTH PRESSURE
 k_P COEFFICIENT OF PASSIVE EARTH PRESSURE
 i ANGLE OF INCLINATION OF SURCHARGE
 w SLOPE ANGLE-BACKFACE OF WALL
 β ANGLE OF SLOPE
 N, N_q, N_c BEARING CAPACITY FACTORS
 D_f DEPTH OF FOOTING
 B, L FOOTING DIMENSIONS

INDEX PROPERTIES

γ UNIT WEIGHT OF SOIL (BULK DENSITY)
 γ_w UNIT WEIGHT OF WATER
 γ_d UNIT DRY WEIGHT OF SOIL (DRY DENSITY)
 γ' UNIT WEIGHT OF SUBMERGED SOIL
 C_s SPECIFIC GRAVITY OF SOLIDS
 e VOIDS RATIO
 e_0 INITIAL VOIDS RATIO
 e_{max} e IN LOOSEST STATE
 e_{min} e IN DENSEST STATE
 D_r RELATIVE DENSITY = $\frac{e_{max} - e}{e_{max} - e_{min}}$
 n POROSITY
 w WATER CONTENT
 w_L LIQUID LIMIT
 w_p PLASTIC LIMIT
 w_s SHRINKAGE LIMIT
 I_p PLASTICITY INDEX = $w_L - w_p$
 I_L LIQUIDITY INDEX = $\frac{w - w_p}{p}$
 I_c CONSISTENCY INDEX = $\frac{w_L - w}{I_p}$
 A_c ACTIVITY = $\frac{I_p \text{ of soil}}{I_p \text{ of } \mu m \text{ Soil Fraction}}$
 O_m ORGANIC MATTER CONTENT
 S_r DEGREE OF SATURATION
 S SENSITIVITY = $\frac{S_u \text{ (undisturbed)}}{S_u \text{ (remoulded)}}$

STRENGTH PARAMETERS

ϕ ANGLE OF SHEARING RESISTANCE
 τ_f PEAK SHEAR STRENGTH
 τ_R RESIDUAL SHEAR STRENGTH
 c COHESION INTERCEPT
 $\sigma_1, \sigma_2, \sigma_3$ NORMAL PRINCIPAL STRESSES
 u PORE WATER PRESSURE
 u_e EXCESS u
 r_u PORE PRESSURE RATIO
 q_u UNCONFINED COMPRESSIVE STRENGTH
 s_u UNDRAINED SHEAR STRENGTH
 ϵ LINEAR STRAIN
 γ SHEAR STRAIN
 ν POISSON'S RATIO
 E MODULUS OF ELASTICITY
 G MODULUS OF SHEAR DEFORMATION
 k_s MODULUS OF SUBGRADE REACTION
 m, n STABILITY COEFFICIENTS
 A, B PORE PRESSURE COEFFICIENTS

NOTE: EFFECTIVE STRESS PARAMETERS ARE DENOTED BY USE OF APOSTROPHE ABOVE THE SYMBOL, THUS:
 ϕ' = EFFECTIVE ANGLE OF SHEARING RESISTANCE;
 σ' = EFFECTIVE NORMAL STRESS

HYDRAULIC TERMS

h HYDRAULIC HEAD OR POTENTIAL
 q RATE OF DISCHARGE
 v VELOCITY OF FLOW
 i HYDRAULIC GRADIENT
 j SEEPAGE FORCE PER UNIT VOLUME
 η COEFFICIENT OF VISCOSITY
 k COEFFICIENT OF HYDRAULIC CONDUCTIVITY
 k_h k IN HORIZONTAL DIRECTION
 k_v k IN VERTICAL DIRECTION
 α_v COEFFICIENT OF VOLUME CHANGE
 c_v COEFFICIENT OF CONSOLIDATION
 C_c COMPRESSION INDEX
 C_r RECOMPRESSION INDEX
 d DRAINAGE PATH DISTANCE
 T_v TIME FACTOR
 U DEGREE OF CONSOLIDATION
 O_r OVERCONSOLIDATION RATIO (OCR)

FOUNDATION INVESTIGATION REPORT
For
Gravel River - Highway # 129
W.P. 14-74-10, Site No. 38S-1
District 18, Sault Ste. Marie

INTRODUCTION

This report describes the results of a geotechnical investigation carried out at the site of the proposed crossing of Highway # 129 over the Gravel River. The Ministry of Transportation and Communication retained Dominion Soil Investigation Inc. to carry out the above mentioned investigation. The object of the investigation was to determine the subsoil and groundwater conditions at the site; to establish the engineering properties of the subsoil; and to make recommendations for the foundation design and construction of the proposed bridge structure.

The field work was carried out between August 15 and 18, 1978 and consisted of two boreholes to a depth of 35 to 45 ft. below ground surface. The locations of the boreholes are shown on Drawing No. 2. The boreholes were drilled with a BOA-8M machine, mounted on an all terrain vehicle. Due to the many cobbles and boulders present at and below the ground surface, the boreholes were advanced by diamond drilling and washboring technique.

DESCRIPTION OF THE SITE

The site is located in the Township of Sturgeon on Highway 129, approximately 47 miles north of Thessalon. The crossing is proposed approximately 750 ft. downstream of the existing one lane Bailey Bridge. The Gravel River in the area of the crossing is fairly narrow, 60 to 90 ft. wide, and shallow. At the time of the investigation (August 1978), the water in the river was only 0.5 to 2 ft. deep and the water level was at Elevation 1138.6 ft. At the point of the crossing, the river makes a slight bend and flows in a generally northerly direction. The velocity of the stream was estimated to be between 1 and 1.5 ft. per second. The bottom of the river is covered with gravel, cobbles and small boulders. The boulders are generally less than 2 ft. in diameter. There is very little evidence of scour and the river banks are very shallow and flat. There are no visible rock outcrops in the immediate area and the few road cuts in the area showed a gravelly boulder deposit. The land surrounding the bridge site is heavily tree covered with mature pine and birch trees.

REGIONAL GEOLOGY

The site is situated in a deep valley within the pre-cambrian rocks which in this area consist mainly of granite and other intrusive rocks. 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 further been modified by post-glacial streams which have cut valleys into the tills and deposited alluvial soils on the surface.

SUBSOIL CONDITIONS

The two exploratory boreholes put down on the opposite side of the river indicated similar conditions. Both boreholes encountered a surficial layer of boulders and cobbles with some gravel and sand in the voids. This stratum ranges in thickness from 11 ft. to 15 ft. It is underlain by a compact to very dense sand deposit which contains occasional gravelly or bouldery zones.

Details of the subsurface conditions are shown on the Record of Boreholes (Enclosures 1 and 2) and also on the inferred soil profile shown on Drawing No. 2. The relevant index and engineering properties of the principal soil strata are described briefly below.

BOULDERS AND COBBLES

The uppermost deposit encountered in the boreholes and exposed in the river bed is a stratum of boulders and cobbles with sand and gravel filler. The cobble and boulder sizes range from

4-inches to approximately 2 ft. in diameter. Although larger particles were not encountered, the presence of large diameter boulders cannot be excluded as they are evident in other sections of the river and in some of the road cuts in the area.

Judging from the difficulty encountered during the drilling and the fact that the boulders could not be displaced by a powerful large diameter auger, it is believed that the particles of this deposit are tightly packed. The stratum is considered to be very pervious and it is expected that below the river level it will yield considerable amount of water.

The boulder stratum ranged in thickness from 11.5 ft. on the west bank to 15 ft. on the east bank. The underside of the stratum is at Elevation 1131.2 ft. and 1125.6 ft. at these locations respectively.

GRAVELLY SAND

On the east bank, a 5 ft. thick layer of gravelly sand with a trace of silt was encountered. Typical grain size distribution curves of this stratum are shown on Enclosure 4. These indicate a well graded deposit consisting of about 26% gravel, 71 to 73% fine to coarse sand and 1 to 3% silt.

Standard Penetration tests gave 'N'-values between 48 and 51 blows per foot, indicating that the stratum is dense.

MEDIUM TO FINE SAND

In both boreholes the above deposits are underlain by medium to fine sand with a trace to some silt. The grain size distribution curves of representative samples are shown on Enclosure 3. These indicate a generally uniformly graded material consisting of mainly medium or fine sand particles. The amount of soil fines are generally less than 5%.

The top 8 to 9 ft. of the stratum is compact as inferred from Standard Penetration resistances or 'N'-values of 10 to 21 blows per foot. Below this, the deposit is dense to very dense ('N' = 30 to over 100 blows per foot).

The stratum is expected to be quite pervious and to yield considerable amount of water. As the deposit lacks any cohesion, it is also expected that excavations extending into this deposit will be unstable and will require full support below the water table.

GROUNDWATER CONDITIONS

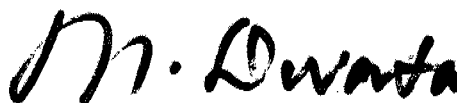
Water levels in the boreholes were recorded before the casing was withdrawn. In both boreholes, the water level was observed

at Elevation 1138.4 ft. which corresponds closely to the water level in the river at the time of the investigation. After the casing was withdrawn, the boreholes caved in at about Elevation 1139 ft.

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



T.J. Kazmierowski, P. Eng.
Foundations Engineer



M. Devata, P. Eng.
Senior, Foundations Engineer

APPENDIX

RECORD OF BOREHOLE No 1

10

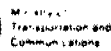
W P 14-74-10 LOCATION Sta. 372+40.5 16.1 ft. Lt. Hwy. 129 Line 'M' ORIGINATED BY D.C.
 DIST 18 HWY 129 BOREHOLE TYPE Washboring and Diamond Drilling (BX and NX) COMPILED BY D.C.
 DATUM Geodetic DATE August 16, 1978 CHECKED BY I.P.L.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100	SHEAR STRENGTH ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE						PLASTIC LIMIT W _p NATURAL MOISTURE CONTENT W LIQUID LIMIT W _L WATER CONTENT (%) 20 40 60
1142.7	GROUND LEVEL														
0.0	BOULDERS and COBBLES, some sand and gravel		1	SS	1007	0"	1140								
			2	SS	1007	0"									
			3	SS	1007	0"									
1132.2			4	SS	1007	0"									
11.5	compact very dense		5	SS	15		1130								
			6	SS	20										1 96 3 0
			7	SS	21										0 95 5 0
			8	SS	897	10"	1120								2 95 3 0
			9	SS	50										
			10	SS	507										
			11	SS	67		1110								0 97 3 0
			12	SS	507	3"									
1107.2			13	SS	31										
35.5	END OF BOREHOLE														

3, 5: Numbers refer to
Sensitivity

20
15 5 (%) STRAIN AT FAILURE
10

OFFICE REPORT ON SOIL EXPLORATION



RECORD OF BOREHOLE No 2

11

W P 14-74-10 LOCATION Sta. 373+54, 12 ft. Rt. Hwy. 129 Line 'M' ORIGINATED BY D.C.
DIST 18 HWY 129 BOREHOLE TYPE Washboring and Diamond Drilling (BX and NX) COMPILED BY D.C.
DATUM Geodetic DATE August 18, 1978 CHECKED BY I.P.L.

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)				
ELEV DEPTH	DESCRIPTION	STRAT	PLOT NUMBER	TYPE			'N' VALUES	20						40	60	80	100
							SHEAR STRENGTH							WATER CONTENT (%)			
							○ UNCONFINED + FIELD VANE										
							● QUICK TRIAXIAL x LAB VANE										
												20		40		60	
1140.6	GROUND LEVEL												GR SA SI CL				
0.0	BOULDERS and COBBLES, some sand and gravel						50/ 2"	W.L.	E.I.	1138	4 ft		Drilled NX casing to 15.0 ft. and cleaned out with bi-cone				
125.6																	
15.0	Dense Gravelly SAND, trace of silt		1	SS	SI								26 73 1 0				
120.6			2	SS	48								26 71 3 0				
20.0	Grey FINE SAND, some silt		3	SS	10												
			4	SS	17												
	compact dense to very dense		5	SS	30												
105.1			6	SS	50/ 6"												
35.5	END OF BOREHOLE																
1095.8																	
44.8	END OF CONE TEST									100/ 10"							

OFFICE REPORT ON SOIL EXPLORATION

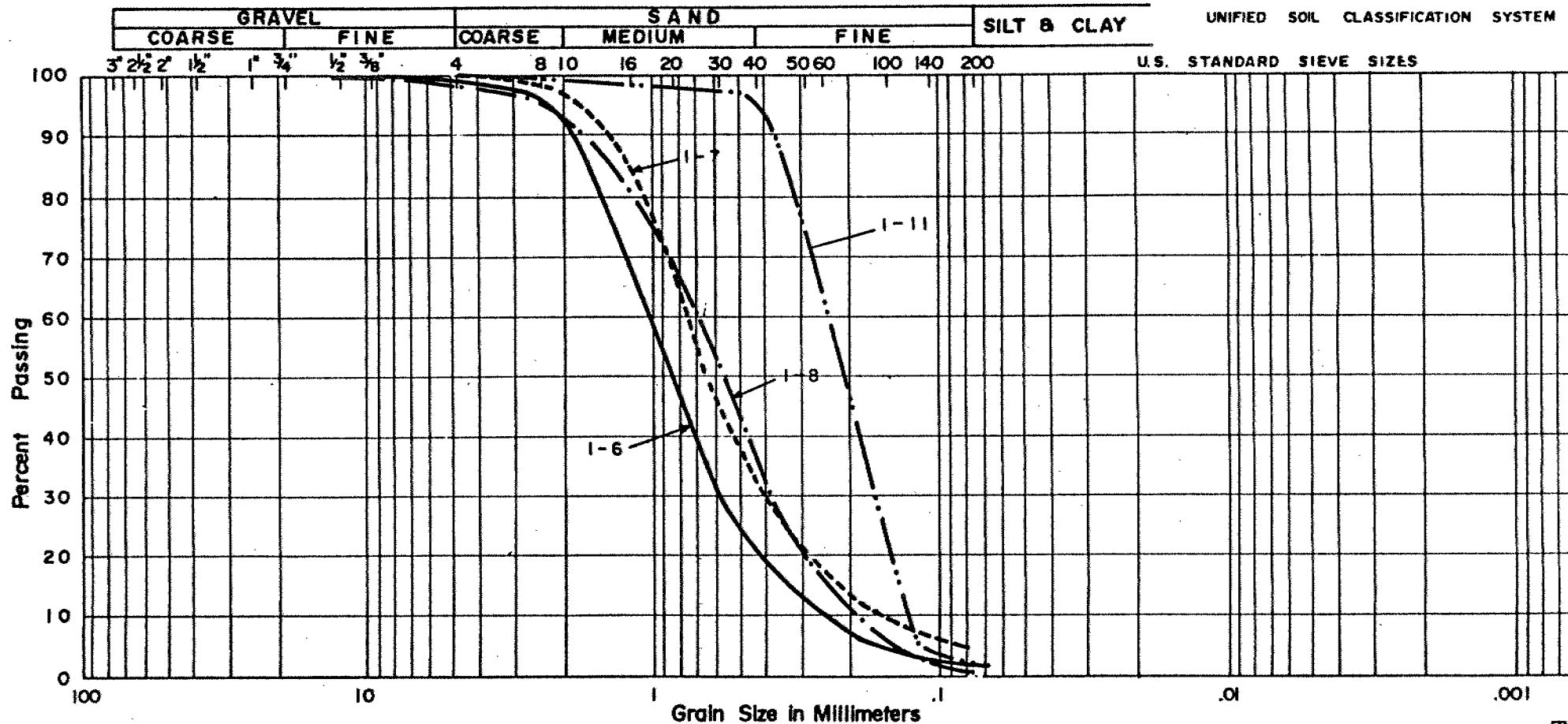
• 3, x3 : Numbers refer to Sensitivity

15 \pm 3 (%) STRAIN AT FAILURE

DOMINION SOIL INVESTIGATION INC.

GRAIN SIZE DISTRIBUTION

OUR REFERENCE Nº 7.8-8-9



PROJECT: PROPOSED BRIDGE
 LOCATION: HWY. 129 & GRAVEL RIVER.
 BOREHOLE Nº: 1 1 1 1
 SAMPLE Nº: 6 7 8 11
 DEPTH: 17' 18' 21' 31'
 ELEVATION: 1123.6' 1122.6' 1119.6' 1109.6'

COEFFICIENT OF UNIFORMITY: _____
 COEFFICIENT OF CURVATURE: _____

Classification of Sample and Group Symbol:

SAND
 trace of silt.

ENCL. 3

PLASTIC PROPERTIES

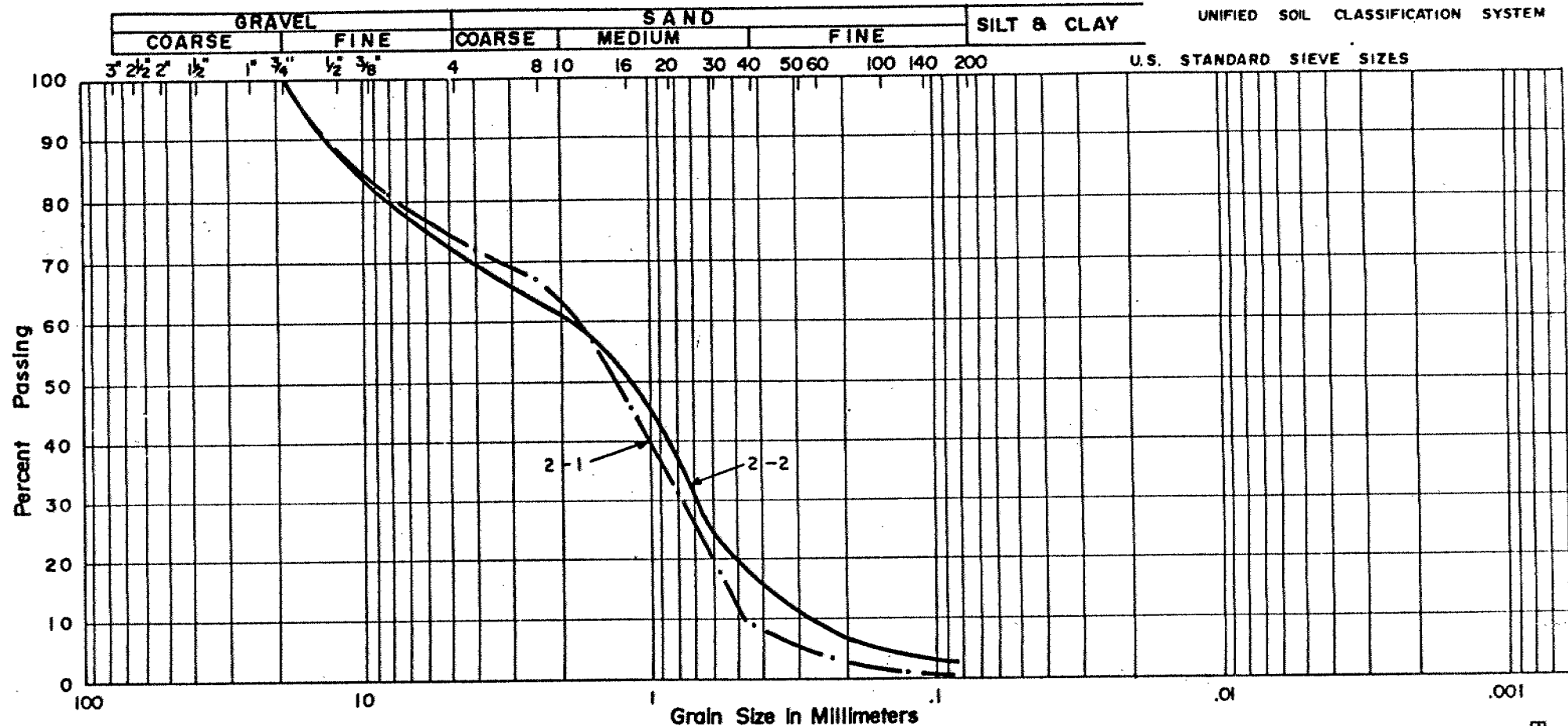
LIQUID LIMIT	% =
PLASTIC LIMIT	% =
PLASTICITY INDEX	% =
MOISTURE CONTENT	% = 15.6 - 18.4

DOMINION SOIL INVESTIGATION INC.

GRAIN SIZE DISTRIBUTION

OUR REFERENCE NO 78-8-2

UNIFIED SOIL CLASSIFICATION SYSTEM



PROJECT: PROPOSED BRIDGE
 LOCATION: HWY. 129 AND GRAVEL RIVER
 BOREHOLE NO: 2 2
 SAMPLE NO: 1 2
 DEPTH: 16' 18'
 ELEVATION: 1126.7' 1124.7'

COEFFICIENT OF UNIFORMITY:
 COEFFICIENT OF CURVATURE:

Classification of Sample and Group Symbol:
GRAVELLY SAND
 trace of silt.

PLASTIC PROPERTIES

LIQUID LIMIT	% =
PLASTIC LIMIT	% =
PLASTICITY INDEX	% =
MOISTURE CONTENT	% = 13.7 - 15.2

ENCL. 4

13



DOMINION SOIL INVESTIGATION INC.

CONSULTING SOIL & FOUNDATION ENGINEERS

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

(416) 751-6565

GEORES No 41J-37

CONT. 81-210

FOUNDATION INVESTIGATION

PROPOSED STRUCTURE

GRAVEL RIVER - KING'S HIGHWAY NO. 129

WP14-74-10, SITE NO. 38S-11

DISTRICT 18, SAULT STE. MARIE, ONTARIO

Ref. No. 78-8-9

September 1978

Prepared for:

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS
DOWNSVIEW, ONTARIO

DISTRIBUTION:

- 15 copies - Ministry of Transportation and Communications
- 2 copies - Dominion Soil Investigation Inc., Toronto
- 1 copy - Dominion Soil Investigation Inc., Thunder Bay

C O N T E N T S

	<u>Page No.</u>
1.0 INTRODUCTION	1
2.0 DESCRIPTION OF THE SITE	2
3.0 REGIONAL GEOLOGY	2
4.0 SUBSOIL CONDITIONS	3
4.1 Boulders and Cobbles	3&4
4.2 Gravelly Sand	4
4.3 Medium to Fine Sand	4&5
5.0 GROUNDWATER CONDITIONS	5
6.0 DISCUSSION OF THE RESULTS	6
6.1 General	6
6.2 Foundations	6&7
6.3 Earth Pressures	7&8
6.4 Approach Fill	8
6.5 Construction	9
7.0 STATEMENT OF LIMITATION	10

A P P E N D I C E S

APPENDIX 'A', PHOTOGRAPHS 1, 2, 3 & 4
APPENDIX 'B', ABBREVIATIONS & SYMBOLS
APPENDIX 'C', FIELD WORK & LABORATORY TESTING.
APPENDIX 'D', STATEMENT OF LIMITATION

E N C L O S U R E S

BOREHOLE LOCATION PLAN	Drawing 1
BOREHOLE LOGS	Enclosures 1&2
GRAIN SIZE DISTRIBUTION CURVES	Enclosures 3&4

1.0 INTRODUCTION

This report describes the results of a geotechnical investigation carried out at the site of the proposed crossing of Highway # 129 over the Gravel River. The investigation was requested by the Ministry of Transportation and Communications and authorization to carry out the work was received from the Engineering Materials Office of the Ministry.

The object of the investigation was to determine the subsoil and ground-water conditions at the site; to establish the engineering properties of the subsoil; and to make recommendations for the foundation design and construction of the proposed bridge structure.

The investigation in the field was completed in August 1978 and consisted of two boreholes. The locations of the boreholes are shown on Drawing No. 147410-A, and the subsurface conditions found in the boreholes are presented on the Record of the Boreholes.

2.0 DESCRIPTION OF THE SITE

The site is located in the Township of Sturgeon on Highway 129, approximately 47 miles north of Thessalon. The crossing is proposed approximately 750 ft. downstream of the existing one lane Bailey Bridge. The Gravel River in the area of the crossing is fairly narrow, 60 to 90 ft. wide, and shallow. At the time of the investigation (August 1978), the water in the river was only 0.5 to 2 ft. deep and the water level was at Elevation 1138.6 ft. At the point of the crossing, the river makes a slight bend and flows in a generally northerly direction. The velocity of the stream was estimated to be between 1 and 1.5 ft. per second. The bottom of the river is covered with gravel, cobbles and small boulders. The boulders are generally less than 2 ft. in diameter. There is very little evidence of scour and the river banks are very shallow and flat. There are no visible rock outcrops in the immediate area and the few road cuts in the area showed a gravelly boulder deposit. The land surrounding the bridge site is heavily tree covered with mature pine and birch trees.

3.0 REGIONAL GEOLOGY

The site is situated in a deep valley within the pre-cambrian rocks which in this area consist mainly of granite and other intrusive rocks. 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 further been modified by post-glacial streams which have cut valleys into the tills and deposited alluvial soils on the surface.

.../...

4.0 SUBSOIL CONDITIONS

The two exploratory boreholes put down on the opposite side of the river indicated similar conditions. Both boreholes encountered a surficial layer of boulders and cobbles with some gravel and sand in the voids. This stratum is about 11 ft. thick in Borehole 1 and about 15 ft. in Borehole 2. It is underlain by a compact to very dense sand deposit which contains occasional gravelly or bouldery zones.

Details of the subsurface conditions are shown on the Record of Boreholes (Enclosures 1 and 2) and also on the inferred soil profile shown on Drawing No. 147410-A. The relevant index and engineering properties of the principal soil strata are described briefly below.

4.1 Boulders and Cobbles

The uppermost deposit encountered in the boreholes and exposed in the river bed is a stratum of boulders and cobbles with sand and gravel filler. The cobble and boulder sizes range from 4-inches to approximately 2 ft. in diameter. Although larger particles were not encountered, the presence of large diameter boulders cannot be excluded as they are evident in other sections of the river and in some of the road cuts in the area. Photographs 1 and 2 illustrate the composition of this stratum and the river bed quite well.

Judging from the difficulty encountered during the drilling and the fact that the boulders could not be displaced by a powerful large diameter auger, it is believed that the particles of this deposit are tightly

.../...

packed. The stratum is considered to be very pervious and it is expected that below the river level it will yield considerable amount of water.

The boulder stratum is 11.5 ft. thick in Borehole 1 and 15 ft. in Borehole 2. The underside of the stratum is at Elevation 1131.2 ft. and 1125.6 ft. in Boreholes 1 and 2 respectively.

4.2 Gravelly Sand

In Borehole 2, a 5 ft. thick layer of gravelly sand with a trace of silt was encountered. Typical grain size distribution curves of this stratum are shown on Enclosure 4. These indicate a well graded deposit consisting of about 26% gravel, 71 to 73% fine to coarse sand and 1 to 3% silt.

Standard Penetration tests gave 'N'-values between 48 and 51 blows per foot, indicating that the stratum is dense.

4.3 Medium to Fine Sand

In both boreholes the above deposits are underlain by medium to fine sand with a trace to some silt. The grain size distribution curves of representative samples are shown on Enclosure 3. These indicate a generally uniformly graded material consisting mainly of medium or fine sand particles. The amount of soil fines are generally less than 5%.

.../...

The top 8 to 9 ft. of the stratum is compact as inferred from Standard Penetration resistances or 'N'-values of 10 to 21 blows per foot. Below this, the deposit is dense to very dense ('N' = 30 to over 100 blows per foot).

The stratum is expected to be quite pervious and to yield considerable amount of water. As the deposit lacks any cohesion, it is also expected that excavations extending into this deposit will be unstable and will require full support below the water table.

5.0 GROUNDWATER CONDITIONS

Water levels in the boreholes were recorded before the casing was withdrawn. In both boreholes, the water level was observed at Elevation 1138.4 ft. which corresponds closely to the water level in the river at the time of the investigation. After the casing was withdrawn, the boreholes caved in at about Elevation 1139 ft.

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

.../...



6.0 DISCUSSION OF THE RESULTS

6.1 General

The centre line of the proposed crossing on Line 'M' is located approximately 750 ft. downstream of the existing single span Bailey Bridge.

The proposed structure will be a 50 ft. single span structure supported on closed abutments. The proposed grade will be at about Elevation 1152 ft., i.e. about 10 ft. above present grade.

On the line of the proposed crossing, the river is narrow, about 60 ft. wide, and flows inside shallow banks. The river bed is covered by cobbles and boulders and at the time of the investigation a large amount of drift wood was piled up on the line of the crossing (see Photographs 3 and 4).

The borings have indicated that to a depth of about 9 to 12 ft. below the river bed the site is underlain by boulders and cobbles, followed by compact to dense fine to medium sand, extending to a depth at least 40 ft. below the river bed.

6.2 Foundations

The very dense boulder and cobble stratum and the underlying sand deposit are suitable to carry the load of 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 stratum consists mainly of cobble and boulder size particles, the river bed is considered to be only moderately susceptible to scour. It is estimated, therefore, that a foundation depth of 5 to 7 ft. below the .../...

river bed will be sufficient, however, this should be confirmed by the Hydrology Section of the Ministry.

Foundations placed between Elevation 1133 and 1131 ft. can be designed for an allowable bearing pressure of 3 t.s.f. Assuming a uniformly distributed line load of 25 K.L.F. on the foundations of the abutments, the maximum total settlement was estimated to be 1.25-inches under the west abutment and about 0.5-inches under the east abutment. Differential settlements of about 0.75-inches can, therefore, be expected. All settlements will take place shortly after the load is applied.

Since the excavation for the abutments will have to be carried out below the river level in granular subsoil, some form of dewatering scheme will be required. Dewatering problems could be minimized if the structure would be supported on rock filled timber or steel cribs, although these too should be protected against scour.

6.3 Earth Pressures

The abutments should be designed to resist the horizontal earth pressure exerted by the approach embankments behind them.

The earth pressure on the abutments can be assumed to be distributed in accordance with the following formula:

.../...

$$p = K_o (\gamma \cdot d + q) \quad \text{where}$$

p = horizontal earth pressure at depth "d" (p.s.f.)

K_o = coefficient of earth pressure at rest = 0.43

γ = unit weight of soil = 135 pounds per cubic foot

d = distance from top of wall to point of application of pressure (ft.)

q = unit surcharge load applied at ground surface (p.s.f.)

The backfill 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.

The coefficient of friction (μ) between the foundation and the subgrade can be taken to be 0.6. The design should incorporate a safety factor of not less than 1.75. Additional resistance could be obtained from the passive resistance of the soil in front of the foundations. The coefficient of passive earth resistance (K_p) can be taken to be 4.0. The passive resistance in front of the footings within the frost or scour penetration depth (approximately 5 to 7 ft.) should be neglected.

6.4 Approach Fill

There are no stability problems foreseen for the proposed approximately 10 ft. high approach fills. The approach embankment could be constructed in accordance with the current M.T.C. Specifications and Standards using 2 to 1 side slopes. That portion of the embankment which is below the high water level in the river should be protected against scour by rip-rap or other suitable means.

.../...



6.5 Construction

The excavation for the footings of the abutments will extend through the bouldery stratum. Since very large size boulders were not encountered in the boreholes, nor were such seen exposed in the creek bed, no major excavation problems other than difficult digging conditions are expected. Below the water level, the sides of the excavation in the boulder deposit will probably be stable only at 1.5 horizontal to 1 vertical or 2 : 1 side slopes.

Dewatering problems are also foreseen. The rate of flow through the boulder and the underlying sand deposit is expected to be significant. Because of the dense and bouldery nature of the overburden, a cofferdam 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 reduced 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. Dewatering problems could possibly be minimized by supporting the structure on rock filled timber or steel cribs.

.../...

Si


7.0 STATEMENT OF LIMITATION

The Statement of Limitation, as quoted in Appendix 'D', is an integral part of this report.

DOMINION SOIL INVESTIGATION INC.


I. Rainu, P.Eng.




I.P. Lieszkowsky, P.Eng.
IR/IPL:esp



A P P E N D I C E S

CROSSING OF
GRAVEL RIVER - HWY. 129
W.P. 14-74-10



PHOTOGRAPH 1
EXISTING BAILEY BRIDGE
LOOKING FROM DOWN-STREAM



PHOTOGRAPH 2
LOOKING DOWN-STREAM
FROM EXISTING BRIDGE

CROSSING OF
GRAVEL RIVER - HWY. 129
W.P. 14-74-10



PHOTOGRAPH 3
CENTRE LINE OF PROPOSED CROSSING
LINE 'M'



PHOTOGRAPH 4
LINE OF PROPOSED CROSSING
LOOKING UPSTREAM

ABBREVIATIONS & SYMBOLS USED IN THIS REPORTSOIL 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_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
$\bar{\sigma}$	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

ABBREVIATIONS & SYMBOLS USED IN THIS REPORTPENETRATION 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 "		

Ref. No. 78-8-9

- 1 -

Si

FIELD WORK

The field work was carried out between August 15 and 18, 1978 and consisted of two boreholes to a depth of 35 to 45 ft. below ground surface. The locations of the boreholes are shown on Drawing No. 147410-A. The boreholes were drilled with a BOA-8M machine, mounted on an all terrain vehicle. Due to the many cobbles and boulders present at and below the ground surface, the boreholes were advanced by diamond drilling and washboring technique.

The sampling of the overburden was carried out at 2.5 ft. intervals to a depth of 20 ft. and at 5 ft. intervals below. Samples were taken by the Standard Penetration test method. This method, which consists of driving a 2-inch outside diameter split-spoon sampler into the undisturbed ground with 350 ft.-lb. energy, provides representative soil samples from any level below the ground surface. The number of blows required to advance the sampler into the undisturbed ground are recorded as the Standard Penetration Resistance or 'N'-value, from which the relative density of the soil can be inferred. The relationship between penetration resistance and relative density is given in the Appendix 'B'. Adjacent to the boreholes, a dynamic cone penetration test was performed from the ground surface and in Borehole No. 2, also from the bottom of the borehole. In the cone penetration tests the same driving energy was used as in the Standard Penetration test. The results of the borings and penetration tests are shown on the Record of Boreholes, presented on Enclosures 1 and 2.

.../...

Ref. No. 78-8-9

- 2 -

The field work was supervised by a soil engineer who also determined the ground elevations at the borehole locations and of the river bed at the crossing. The elevations of the boreholes were referred to an M.T.C. datum. This geodetic datum, Elevation 1141.86 ft., was located on the top of a nail and washer driven in the root of a 1.7 ft. diameter cedar tree, 88 ft. left of Station 374 + 05.

LABORATORY TESTING

All soil samples were shipped in air tight jars to the laboratory of Dominion Soil Investigation Inc. for examination and testing. Representative soil samples were selected for sieve analysis and the natural moisture content was also determined. The laboratory test results are presented on Enclosures 1 and 2 and the Grain Size Distribution Curves are plotted on Enclosures 3 and 4.

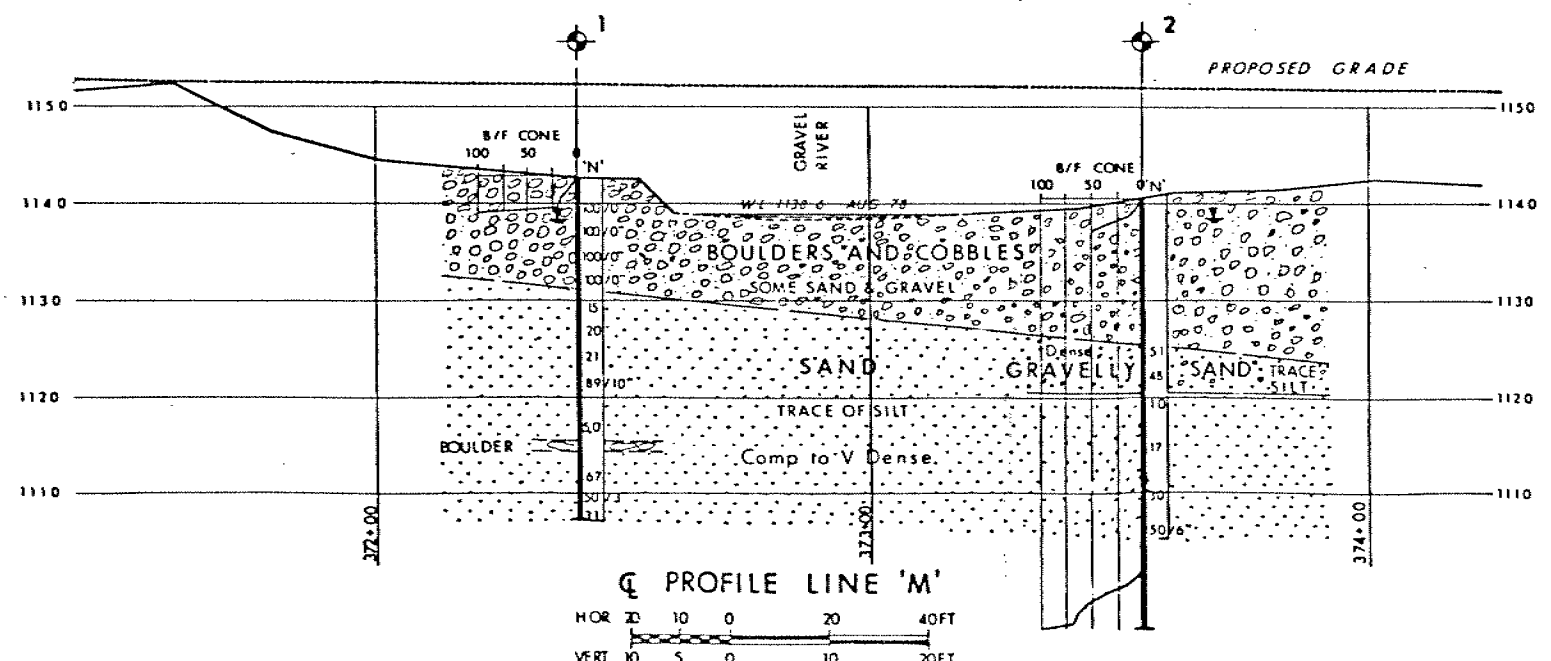
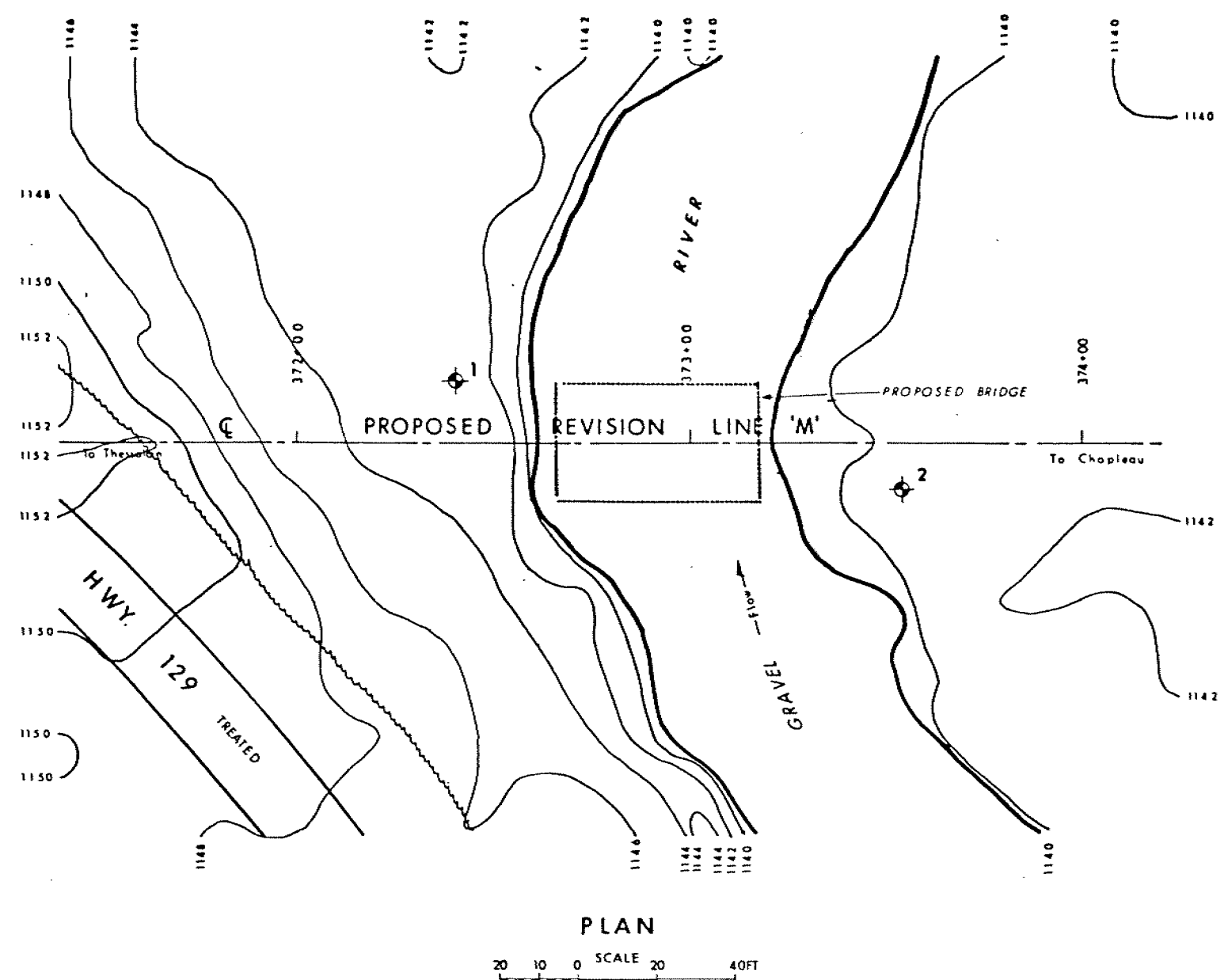
APPENDIX 'D'STATEMENT OF LIMITATION

The conclusions and recommendations in this report are based on information determined at the borehole locations and on geological data of a general nature which may be available for the area investigated. Soil and groundwater conditions between and beyond the boreholes may differ from those encountered at the borehole locations and conditons may become apparent during construction which could not be detected or anticipated at the time of the soil investigation.

We recommend that we be retained to ensure that all necessary stripping, subgrade preparation and compaction requirements are met, and to confirm that the soil conditions do not deviate materially from those encountered in the boreholes. In cases where this recommendation is not followed, the company's responsibility is limited to interpreting accurately the information encountered at the boreholes.

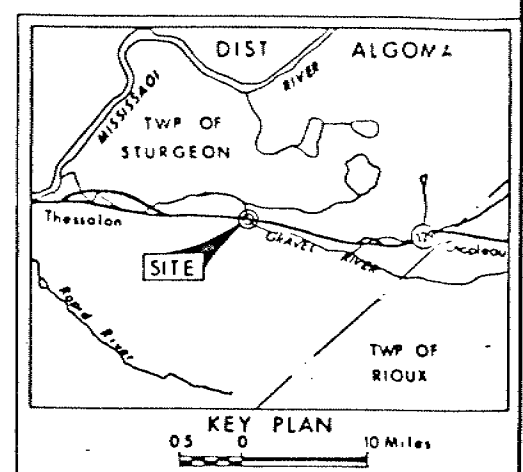
This report is applicable only to the project described in the introduction, constructed substantially in accordance with details of alignment and elevations quoted in the text.

ENCLOSURES



CONT No WP No 14-74-10	
GRAVEL RIVER	SHEET
BORE HOLE LOCATIONS & SOIL STRATA	

DOMINION SOIL INVESTIGATION INC.



- LEGEND**
- Bore Hole
 - Dynamic Cone Penetration Test (Cone)
 - Bore Hole & Cone
 - Blows/ft (Std Pen Test 350ft lbs energy)
 - CONE Blows/ft (60° Cone, 350ft lbs energy)
 - WL at time of investigation AUG 1978

No	ELEVATION	STATION	OFFSET
1	1142.7	372+40.5	16' L
2	1140.6	373+54	12' R

-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

415-37

HWY No 129 DIST 18

SUBMIT DC CHECKED DC DATE Aug 30 1978 SITE 385-11

DRAWN FL CHECKED FL DATE 10/1/78 DWG 1474-C-A

HIGHWAY ENGINEERING DIVISION-ENGINEERING MATERIALS OFFICE-SOIL MECHANICS SECTION

RECORD OF BOREHOLE No 1

W P 14-74-10 LOCATION Sta. 372+40.5 16.1 ft. Lt. Hwy. 129 Line 'M' ORIGINATED BY D.C.
DIST 18 HWY 129 BOREHOLE TYPE Washboring and Diamond Drilling (BX and NX) COMPILED BY D.C.
DATUM Geodetic DATE August 16, 1978 CHECKED BY I.P.L.

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT Y	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			20 40 60 80 100						
1142.7	GROUND LEVEL												
0.0													
	BOULDERS and COBBLES, some sand and gravel		1	SS	1007	0"							
			2	SS	1007	0"							
			3	SS	1007	0"							
1132.2			4	SS	1007	0"							
11.5			5	SS	15								
	compact very dense		6	SS	20								
			7	SS	21								
			8	SS	897	10"							
			9	SS	50								
	SAND medium to fine, trace of silt		10	RC	50%								
			11	SS	67								
1107.2			12	SS	507	3"							
35.5	END OF BOREHOLE		13	SS	31								

+3, x5 : Numbers refer to
Sensitivity

20
15
10

5 (%) STRAIN AT FAILURE

OFFICE REPORT ON SOIL EXPLORATION



RECORD OF BOREHOLE No 2

W P 14-74-10 LOCATION Sta. 373+54, 12 ft. Rt. Hwy. 129 Line 'M' ORIGINATED BY D.C.
DIST 18 HWY 129 BOREHOLE TYPE Washboring and Diamond Drilling (BX and NX) COMPILED BY D.C.
DATUM Geodetic DATE August 18, 1978 CHECKED BY I.P.L.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100	Wp	W	W _L	WATER CONTENT (%)	20 40 60				
1140.6	GROUND LEVEL																
0.0	BOULDERS and COBBLES, some sand and gravel																
1125.6																	
15.0	Dense Gravelly SAND, trace of silt		1	SS	51												
1120.6			2	SS	48												
20.0	Grey FINE SAND, some silt		3	SS	10												
			4	SS	17												
	compact dense to very dense		5	SS	30												
1105.1			6	SS	50/6"												
35.5	END OF BOREHOLE																
1095.8																	
44.8	END OF CONE TEST																

+3, x5 : Numbers refer to
Sensitivity

20
15
10

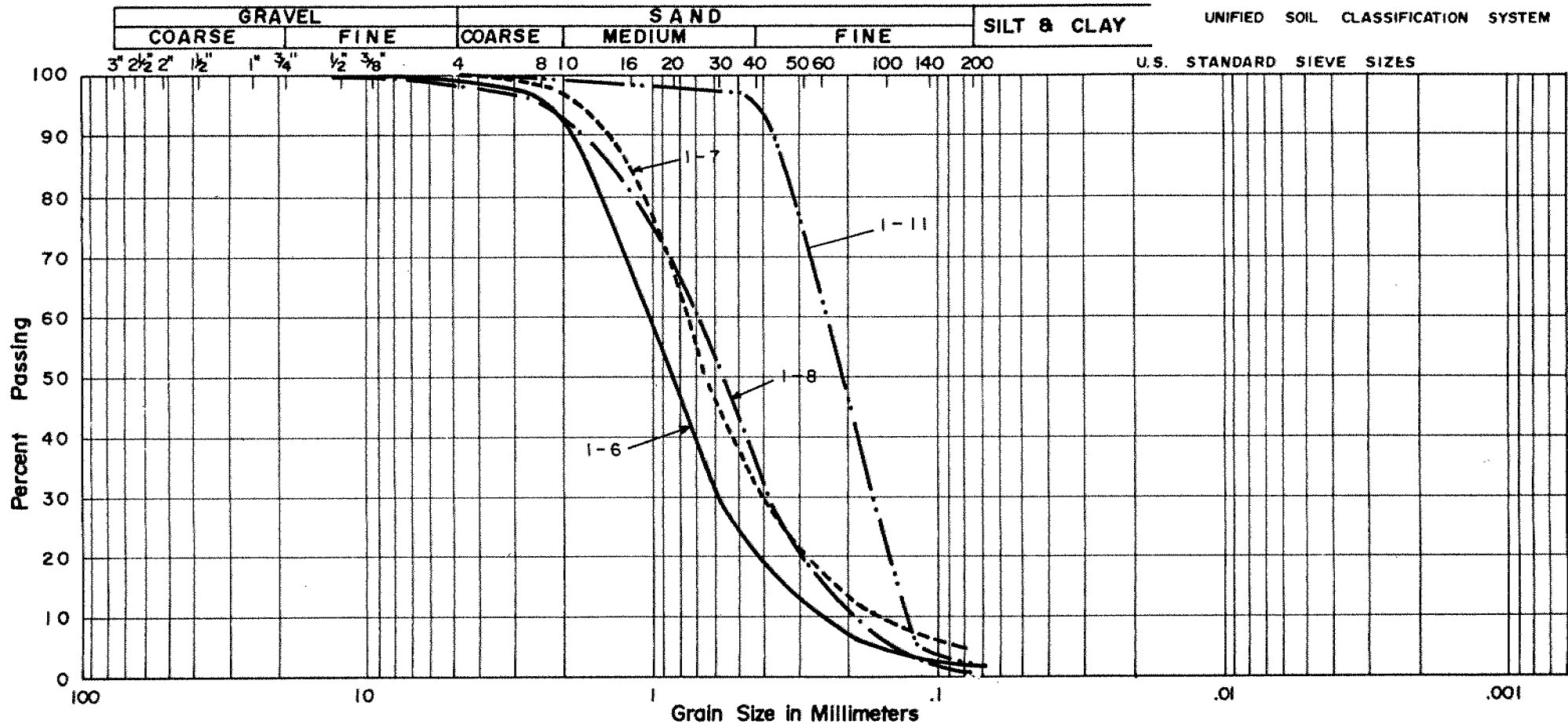
(%) STRAIN AT FAILURE

OFFICE REPORT ON SOIL EXPLORATION

DOMINION SOIL INVESTIGATION INC.

GRAIN SIZE DISTRIBUTION

OUR REFERENCE N^o 7.8-8-9.



PROJECT: PROPOSED BRIDGE
 LOCATION: HWY. 129 & GRAVEL RIVER.
 BOREHOLE N^o: 1 1 1 1
 SAMPLE N^o: 6 7 8 11
 DEPTH: 17' 18' 21' 31'
 ELEVATION: 1123.6' 1122.6' 1119.6' 1109.6'

COEFFICIENT OF UNIFORMITY :
 COEFFICIENT OF CURVATURE :

Classification of Sample and Group Symbol:

SAND
 trace of silt.

PLASTIC PROPERTIES

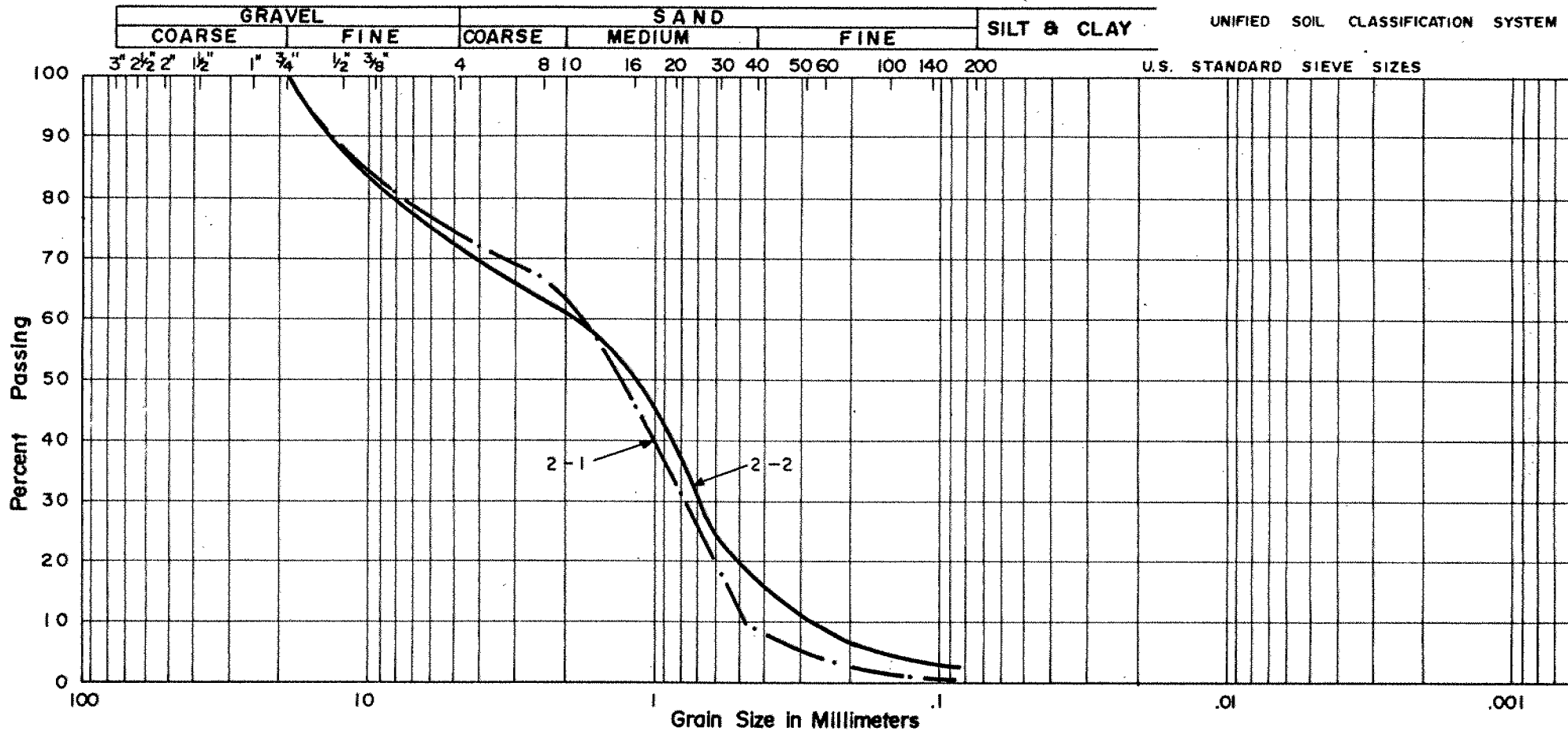
LIQUID LIMIT	% =
PLASTIC LIMIT	% =
PLASTICITY INDEX	% =
MOISTURE CONTENT	% = 15.6 - 18.4

ENCLOSURE N^o 3.

DOMINION SOIL INVESTIGATION INC.

GRAIN SIZE DISTRIBUTION

OUR REFERENCE No 78-8-9



PROJECT: PROPOSED BRIDGE
 LOCATION: HWY. 129 AND GRAVEL RIVER
 BOREHOLE No: 2 2
 SAMPLE No: 1 2
 DEPTH: 16' 18'
 ELEVATION: 1126.7' 1124.7'

COEFFICIENT OF UNIFORMITY:
 COEFFICIENT OF CURVATURE:

Classification of Sample and Group Symbol:
GRAVELLY SAND
 trace of silt.

PLASTIC PROPERTIES
 LIQUID LIMIT % =
 PLASTIC LIMIT % =
 PLASTICITY INDEX % =
 MOISTURE CONTENT % = 13.7 - 15.2

ENCLOSURE No. 4

Mr. E. Van Beilen
Head, Northern and NW Section
Structural Office
2nd Floor, West Building

Mr. A. Radkowski

Soil Mechanics Section
Engineering Materials Office
Room 315, Central Building

78 11 23

Re: Gravel River Bridge #3
W.P. 14-74-10, Site 38S-11
Hwy. 129, District #18, Sault Ste. Marie

Further to your request of 78 11 06 we have reviewed the preliminary structural drawings and have the following comments to make.

In the foundation investigation report it was assumed that the footing founding level would be at elevation 1133 to 1131 based on scour depths of 5 to 7 feet. According to the preliminary structural drawing, the founding level is located at elevation 1136.5. At this founding level the footings can be designed for an allowable bearing pressure of 3 tsf. Estimates of settlements were accordingly re-evaluated and it is expected that the maximum settlements would be in the order of 1 inch for the south abutment and 1/2 inch for the north abutment. These settlements would occur during or immediately after construction and are not expected to be detrimental to the performance of the type of structure contemplated.

In order to avoid the requirement for an unwatering item in the contract it will be necessary to carry tremie concrete to an elevation above the river water level at the time of construction.

M. MacLean
Project Engineer

For: M. Devata
Supervising Engineer

MM/MD/gs

cc: Files ✓



Memorandum

To: Mr. B.T. Darch
Manager
Engineering and Right of Way
Northwestern Region, Thunder Bay

Attention:

Mr. W. Kulmattickas

Our File Ref.

From: Soil Mechanics Section
Engineering Materials Office
Room 315, Central Building

Date: 78 09 21

In Reply to

Subject:

Re: Foundation Investigation Report
W.P. 14-74-10, Gravel River, Hwy. 129
Structure Site No. 38S-11
District 18, Sault Ste. Marie

Attached is a copy of the final Foundation Investigation Report prepared by the geotechnical consultants Dominion Soil Investigation Inc. A preliminary copy of this report was submitted to your office on 78 09 14 in order to meet your planning deadline for this project.

Our comments pertaining to this project are as follows.

In the report two alternatives are suggested for the foundation support of the proposed 50 foot single span structure. In our opinion a third alternative should also be considered. In this alternative the abutments for the single span structure can be supported on spread footings founded on granular fill using a safe bearing pressure of 3 t.s.f. The fill material below the tops of the footing should consist of well compacted Granular 'A' material and should extend for a horizontal distance of at least 10 feet from the footing edges as shown on the enclosed sketch. It should be noted that this alternative may eliminate the dewatering requirements of the structure footing construction since the structure elements will be located above the creek water level.

We believe that the aforementioned comments, together with the factual data and recommendations contained in the enclosed report will be adequate for your planning and design requirements.

M. Devata
Supervising Engineer

MD/gs

Enclosures

cc:	C.M. Smith	G.A. Wrong	N. Maluzinsky)
	D.A. Jarvis (2)	B.J. Giroux	J. Anderson) memo only
	W.A. Stewart (2)	R.S. Pillar	G. Sloan)
	E. Van Beilen	R. Hore	Files/

GRAVEL RIVER

38S - 11

May 22, 1975

