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DIST. 18 REGION

W.P. No. 52-86-01

CONT. No.

W. O. No.

STR. SITE No. 38S-340

HWY. No. 556

LOCATION AUBINADONG RIVER

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OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT.

REMARKS:



Ministry of
Transportation and
Communications

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FOUNDATION DESIGN SECTION

**foundation
investigation and
design report**

ENGINEERING MATERIALS OFFICE
FOUNDATION DESIGN SECTION

WP 52-86-01

DIST 18

HWY 556

STR SITE No. 38S-340

AUBINADONG RIVER BRIDGE

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FOUNDATION INVESTIGATION REPORT

For

W.P. 52-86-01, Site #38S-340

AUBINADONG RIVER BRIDGE

Sec. Hwy #556, District 18, Saulte Ste. Marie

As per your request in the letter dated March 14, 1986, we are submitting the results of a foundation investigation carried out at the above site, together with our recommendations.

The field work for the investigation was conducted during the period from 86-04-07 to 86-04-09 utilizing a diamond drill equipped with N and B casing, and a B core barrel. Wash boring techniques were employed where necessary.

The field work consisted of two sampled boreholes located at either end of the timber deck, adjacent to the timber crib abutments. Diamond drilling techniques were carried out at both locations for the purpose of providing bedrock details. Mr. F. Saccon and Mr. D. Protulipac supervised the operation. The attached Figure 1 shows the location of the two boreholes along with a stratigraphical profile. The Record of Borehole Sheets (BH #1 to BH #2) illustrate the subsurface conditions at the borehole locations.

SUBSURFACE CONDITIONS

In order to facilitate drilling operations, drilling was carried out from the bridge deck. Since no geodetic information was available for this bridge site, an assumed top of bridge deck elevation of 100.0 m was introduced.

The river water level at the time of drilling was found to be at elevation 96.0 m. The depth of the water varied from 0.8 m at the west location, to 1.4 m at the east. Beneath the river bottom a dense to very dense layer of sand and gravel was encountered. At the east location, this layer is 2.8 m thick and overlies sound, granitic bedrock. At the west location this layer contains numerous boulders, 15-30 cm in diameter. Diamond drilling techniques were necessary to penetrate through the boulders. The borehole was advanced 5.9 m into this deposit but could not be advanced further due to the numerous boulders. As a result, the bedrock elevation here was not determined.

DISCUSSION & RECOMMENDATIONS

It is proposed to design and construct a support system to be placed in front of each abutment at the Aubinadong River Bridge. It is understood that considerable deterioration of the cribs has occurred resulting in crushing of some of the members, and that some undermining is suspected. Two alternatives are being contemplated: pile bents, and mud sills.

Driving of piles to an end bearing stratum at the site will be virtually impossible due to the presence of numerous boulders as evidenced in BH #2. In order to penetrate piles to bedrock, the boulders would have to be pre-augered. This would involve very expensive rock coring techniques. Consequently, for the above reasons, we have not provided design values for piles at this time.

The use of mudsills would appear to be the more feasible solution, given the subsurface conditions. The dense to very dense sand and gravel found at the river bottom is a competent material, and footings can be designed for a value of 700 kPa at factored capacity at the U.L.S.. Rip-rap should be placed on the river bottom enclosing the area where the mudsill is to be placed. In order to avoid any expensive de-watering schemes, tremie concrete techniques should be employed to build up the sill, using the rip-rap enclosure as the formwork. Undermining of the sill will be held to a minimum due to the presence of the rip-rap. The height and width of the rip-rap protection should be designed to meet hydrological requirements.

Should further information be required, please do not hesitate to contact this section.



F. Saccon
Project Foundations Engineer



M. S. Devata
Chief foundations Engineer
(East)

EXPLANATION OF TERMS USED IN REPORT

N VALUE: THE STANDARD PENETRATION TEST (SPT) N VALUE IS THE NUMBER OF BLOWS REQUIRED TO CAUSE A STANDARD 51mm O.D. SPLIT BARREL SAMPLER TO PENETRATE 0.3m INTO UNDISTURBED GROUND IN A BOREHOLE WHEN DRIVEN BY A HAMMER WITH A MASS OF 63.5kg, FALLING FREELY A DISTANCE OF 0.76m. FOR PENETRATIONS OF LESS THAN 0.3m N VALUES ARE INDICATED AS THE NUMBER OF BLOWS FOR THE PENETRATION ACHIEVED. AVERAGE N VALUE IS DENOTED THUS \bar{N} .

DYNAMIC CONE PENETRATION TEST: CONTINUOUS PENETRATION OF A CONICAL STEEL POINT (51mm O.D. 60° CONE ANGLE) DRIVEN BY 475 J IMPACT ENERGY ON 'A' SIZE DRILL RODS. THE RESISTANCE TO CONE PENETRATION IS MEASURED AS THE NUMBER OF BLOWS FOR EACH 0.3m ADVANCE OF THE CONICAL POINT INTO THE UNDISTURBED GROUND.

SOILS ARE DESCRIBED BY THEIR COMPOSITION AND CONSISTENCY OR DENSENESS.

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

| c_u (kPa) | 0 - 12 | 12 - 25 | 25 - 50 | 50 - 100 | 100 - 200 | >200 |
|-------------|-----------|---------|---------|----------|------------|------|
| | VERY SOFT | SOFT | FIRM | STIFF | VERY STIFF | HARD |

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

| N (BLOWS/0.3m) | 0 - 5 | 5 - 10 | 10 - 30 | 30 - 50 | >50 |
|----------------|------------|--------|---------|---------|------------|
| | VERY LOOSE | LOOSE | COMPACT | DENSE | VERY DENSE |

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 OF THE CORING RUN.

MODIFIED RECOVERY: SUM OF THOSE INTACT CORE PIECES, 100mm+ 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 | 50mm | 50 - 300mm | 0.3m - 1m | 1m - 3m | >3m |
|----------|------------|------------|------------|---------|------------|
| JOINTING | VERY CLOSE | CLOSE | MOD. CLOSE | WIDE | VERY WIDE |
| BEDDING | VERY THIN | THIN | MEDIUM | THICK | VERY THICK |

ABBREVIATIONS AND SYMBOLS

FIELD SAMPLING

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

MECHANICAL PROPERTIES OF SOIL

| | | |
|----------------|------------|--------------------------------------|
| m_v | kPa^{-1} | COEFFICIENT OF VOLUME CHANGE |
| C_c | 1 | COMPRESSION INDEX |
| C_s | 1 | SWELLING INDEX |
| C_α | 1 | RATE OF SECONDARY CONSOLIDATION |
| c_v | m^2/s | COEFFICIENT OF CONSOLIDATION |
| H | m | DRAINAGE PATH |
| T_v | 1 | TIME FACTOR |
| U | % | DEGREE OF CONSOLIDATION |
| σ'_{vo} | kPa | EFFECTIVE OVERBURDEN PRESSURE |
| σ'_p | kPa | PRECONSOLIDATION PRESSURE |
| τ_f | kPa | SHEAR STRENGTH |
| c' | kPa | EFFECTIVE COHESION INTERCEPT |
| ϕ' | -° | EFFECTIVE ANGLE OF INTERNAL FRICTION |
| c_u | kPa | APPARENT COHESION INTERCEPT |
| ϕ_u | -° | APPARENT ANGLE OF INTERNAL FRICTION |
| τ_R | kPa | RESIDUAL SHEAR STRENGTH |
| τ_r | kPa | REMOULDED SHEAR STRENGTH |
| S_t | 1 | SENSITIVITY = $\frac{c_u}{\tau_r}$ |

STRESS AND STRAIN

| | | |
|--------------------------------------|-----|-------------------------------|
| u_w | kPa | PORE WATER PRESSURE |
| r_u | 1 | PORE PRESSURE RATIO |
| σ | kPa | TOTAL NORMAL STRESS |
| σ' | kPa | EFFECTIVE NORMAL STRESS |
| τ | kPa | SHEAR STRESS |
| $\sigma_1, \sigma_2, \sigma_3$ | kPa | PRINCIPAL STRESSES |
| ϵ | % | LINEAR STRAIN |
| $\epsilon_1, \epsilon_2, \epsilon_3$ | % | PRINCIPAL STRAINS |
| E | kPa | MODULUS OF LINEAR DEFORMATION |
| G | kPa | MODULUS OF SHEAR DEFORMATION |
| μ | 1 | COEFFICIENT OF FRICTION |

PHYSICAL PROPERTIES OF SOIL

| | | | | | | | | |
|----------------|----------|--------------------------------|-----------|------|---|-----------|----------|---|
| ρ_s | kg/m^3 | DENSITY OF SOLID PARTICLES | e | 1, % | VOID RATIO | e_{min} | 1, % | VOID RATIO IN DENSEST STATE |
| γ_s | kn/m^3 | UNIT WEIGHT OF SOLID PARTICLES | n | 1, % | POROSITY | I_D | 1 | DENSITY INDEX = $\frac{e_{max} - e}{e_{max} - e_{min}}$ |
| ρ_w | kg/m^3 | DENSITY OF WATER | w | 1, % | WATER CONTENT | D | mm | GRAIN DIAMETER |
| γ_w | kn/m^3 | UNIT WEIGHT OF WATER | S_r | % | DEGREE OF SATURATION | D_n | mm | n PERCENT - DIAMETER |
| P | kg/m^3 | DENSITY OF SOIL | w_L | % | LIQUID LIMIT | C_u | 1 | UNIFORMITY COEFFICIENT |
| γ | kn/m^3 | UNIT WEIGHT OF SOIL | w_p | % | PLASTIC LIMIT | h | m | HYDRAULIC HEAD OR POTENTIAL |
| ρ_d | kg/m^3 | DENSITY OF DRY SOIL | w_s | % | SHRINKAGE LIMIT | q | m^3/s | RATE OF DISCHARGE |
| γ_d | kn/m^3 | UNIT WEIGHT OF DRY SOIL | I_p | % | PLASTICITY INDEX = $w_L - w_p$ | v | m/s | DISCHARGE VELOCITY |
| ρ_{sat} | kg/m^3 | DENSITY OF SATURATED SOIL | I_L | 1 | LIQUIDITY INDEX = $\frac{w - w_p}{I_p}$ | i | 1 | HYDRAULIC GRADIENT |
| γ_{sat} | kn/m^3 | UNIT WEIGHT OF SATURATED SOIL | I_C | 1 | CONSISTENCY INDEX = $\frac{w_L - w}{I_p}$ | k | m/s | HYDRAULIC CONDUCTIVITY |
| ρ' | kg/m^3 | DENSITY OF SUBMERGED SOIL | e_{max} | 1, % | VOID RATIO IN LOOSEST STATE | j | kn/m^3 | SEEPAGE FORCE |
| γ' | kn/m^3 | UNIT WEIGHT OF SUBMERGED SOIL | | | | | | |



RECORD OF BOREHOLE No 1

METRIC

W P 52-86-01 LOCATION Hwy. 556 and Aubinadong River North East Corner of Bridge ORIGINATED BY FS & DP
DIST 18 HWY 556 BOREHOLE TYPE Washboring, NW-Casing and BW Rock Core Deck COMPILED BY F.S.
DATUM Assumed DATE 86 04 07 CHECKED BY _____

| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | | | | UNIT WEIGHT γ | REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL |
|---------------|-------------------------------------|------------|---------|----------|------------|----------------------------|-----------------|---|----|----|----|-----|----------------------------|--|
| ELEV DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | 'N' VALUES | | | 20 | 40 | 60 | 80 | 100 | | |
| 100.0 | Bridge Deck | | | | | | | | | | | | | |
| 0.0 | Timber Deck | | | | | | | | | | | | | |
| 99.5 | | | | | | | | | | | | | | |
| 0.5 | | | | | | | | | | | | | | |
| | | | | | | | 99 | | | | | | | |
| | | | | | | | 98 | | | | | | | |
| | | | | | | | 97 | | | | | | | |
| 96.0 | River Water Level | | | | | | 96 | | | | | | | |
| 4.0 | Water | | | | | | 95 | | | | | | | |
| 94.6 | River Bottom | | | | | | 94 | | | | | | | |
| 5.4 | Medium to Coarse Sand and Gravel | | 1 | SS | 59 | | 93 | | | | | | | |
| | Very Dense | | | | | | 92 | | | | | | | |
| 91.8 | | | 2 | SS | 55 | | 91 | | | | | | | |
| 8.2 | Bedrock | | 3 | BW RC | REC 97% | | 90 | | | | | | | |
| | Granite | | 4 | BW RC | REC 95% | | 89 | | | | | | | |
| | Sound | | | | | | | | | | | | | |
| 88.9 | | | | | | | | | | | | | | |
| 11.1 | End of Borehole | | | | | | | | | | | | | |

+3, x⁵: Numbers refer to
Sensitivity

20
15 ϕ 5 (%) STRAIN AT FAILURE
10

RECORD OF BOREHOLE No 2

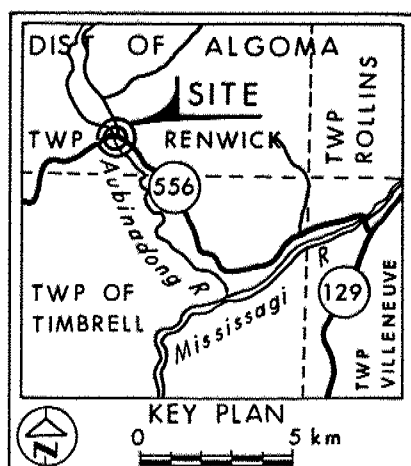
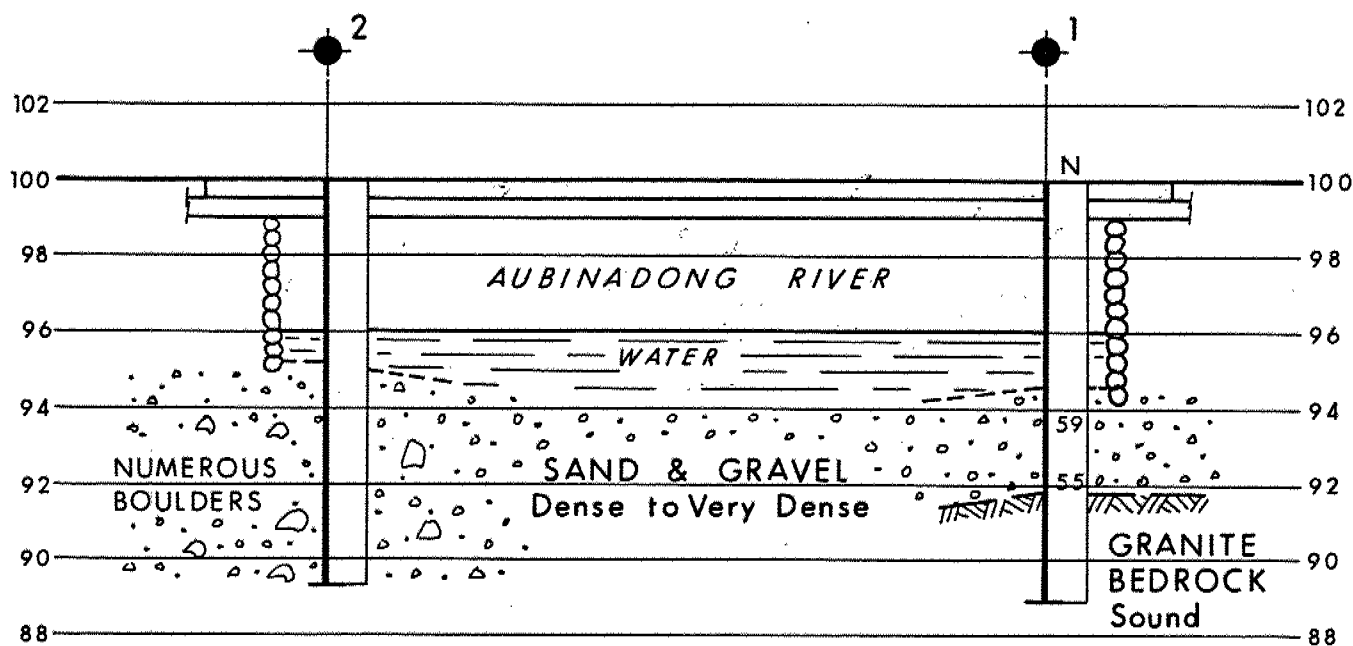
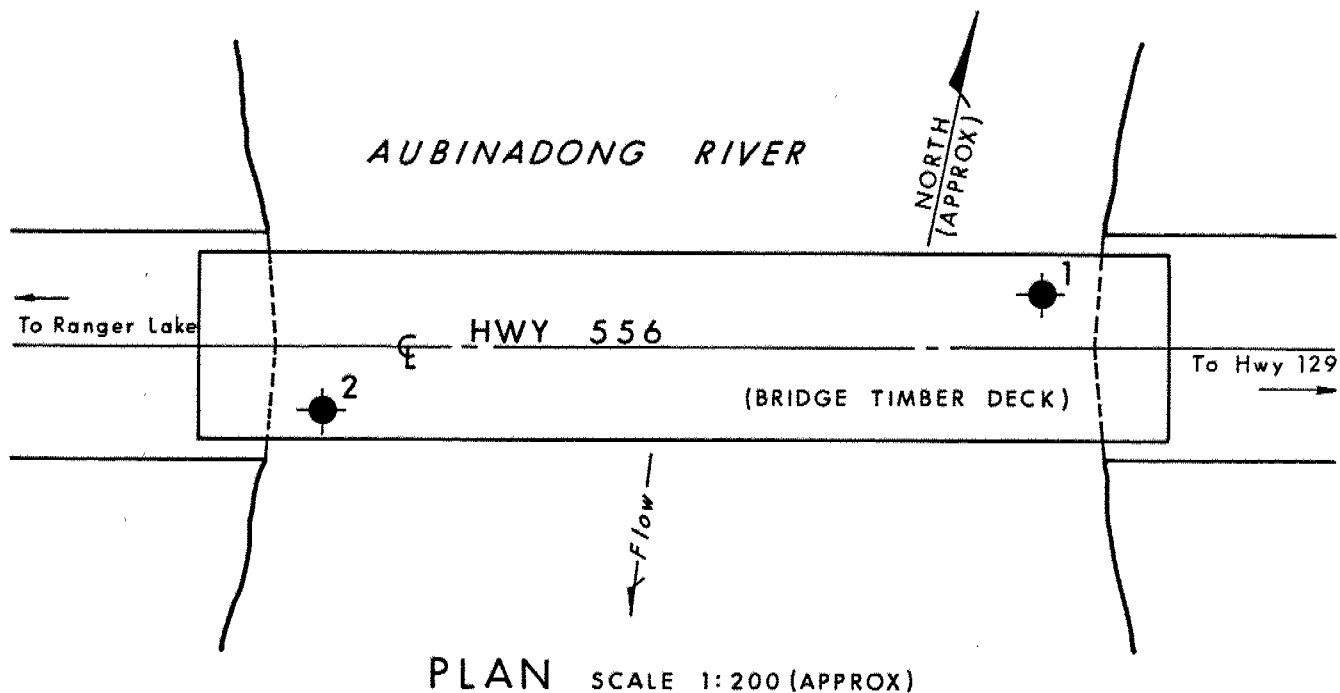
METRIC

W P 52-86-01 LOCATION Hwy. 556 and Aubinadong River South West Corner of Bridge ORIGINATED BY D.P.
DIST 18 HWY 556 BOREHOLE TYPE Washboring, NW-Casing BW Rock Core Deck COMPILED BY F.S.
DATUM Assumed DATE 86 04 08 CHECKED BY _____

[illegible]

+3, x5 : Numbers refer to Sensitivity

20
15 ϕ 5 (%) STRAIN AT FAILURE
10



W P 52-86-01
 SITE No 385-340
 HWY 556
 DIST 18
 Geocres No 41J-46

AUBINADONG RIVER
 (12.9 km West of Hwy 129)

FIG No 1

ANBINADDONG RIVER BRIDGE
SITE # 385-390, HWY. 556



SIDE ELEVATION LOOKING EAST



SIDE ELEVATION LOOKING WEST