

Dist. 28-1

AN INVESTIGATION INTO THE PERFORMANCE
OF GRAVEL SHEETING AT THE
BIG PIC RIVER APPROACHES
DISTRICT #19. HWY. #17 TCH

DEPARTMENT OF HIGHWAYS, ONTARIO
MATERIALS AND RESEARCH
FORT WILLIAM REGION

DECEMBER, 1961.

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1. INTRODUCTION

A detailed investigation was carried out on the cut approaches to the Big Pic River Bridge to investigate the performance of granular blankets which had been placed on the cut back slopes.

The bridge is located on Highway #17 TCH, about 5 miles east of Marathon.

This report is a compilation of data pertaining to the site, before, during and after construction of the cut slopes and the gravel sheeting.

All pertinent laboratory data on samples taken during the investigation will be summarized in this report.

No conclusions or recommendations have been formed in this report. The data presented here will be compared with data from gravel sheeting projects over the whole province in order to establish future techniques in treating wet cuts. This is being undertaken by the Foundation Section.

2. CUT CONSTRUCTION FEATURES

The approach cuts were excavated (approximately 10 feet deep) during the summer and fall of 1955 under Contract 55-49. Reports on this contract indicate that the cuts were very unstable due to the presence of saturated very fine sand, silt, and very plastic clay layers, and, hence, considerable difficulty was experienced during construction operations.

In 1957, Contract 57-194 was awarded to Hacquoil Construction Company. The purpose of this contract was to lower the approaches to

2. (Cont'd.)

the Big Pic River, since the foundation materials for the proposed structure were found to be unstable in their natural state.

A system of underdrainage was also included in this contract.

Work commenced on the east cut during the summer of 1957, and on the west cut in the fall of 1957. The final trimming of the slopes in both cuts was completed in the spring of 1958.

The east approach cut, especially the north side, was appreciably more difficult to excavate than the west approach cut, due to thin water bearing sand strata bedded throughout the varved clay and silt stratum.

The cut back slopes were unstable in that the material repeatedly 'flowed' down the slopes, filling up the ditches. Extensive sloughing occurred on the slopes.

The contractor periodically maintained the slopes by bulldozing the embankment material down from the top of the slope.

The north west slope was terraced where the depth of the cut exceeded 20 feet, in accordance with the recommendation contained in the report prepared by Geocon Ltd. on the Big Pic River Project. This report was not available to the writer.

The cut back slopes were graded generally between 3 to 4 horizontal to 1 vertical.

(Figures 1 to 6 inclusive illustrate the west approach cut during construction. No photographs are available of the east approach cut.)

3. GRAVEL SHEETING CONSTRUCTION FEATURES

Under Contract 57-194 a coarse pit run gravel was placed on the slopes of both approaches during the summer of 1958, in order to intercept the seepage zones in the sides of the cuts.

This blanketing was done by the use of draglines and the final shaping (according to progress reports) was very satisfactory.

The granular blanket was placed over the full length of both approaches to an average depth of 2.0 feet, (measured vertically) except for the exterior limits where the sheeting was gradually thinned out over 100 feet to original ground.

The source of material for the gravel sheeting was a gravel pit known locally as "Hill 14", located approximately 1 mile west of the Big Pic River Bridge.

4. INVESTIGATION

An investigation of the site was carried out on October 9, and 10, 1961.

Test pits were excavated through the gravel to undisturbed material at regular intervals down the slope on a line at right angles to the centreline of the highway.

This line was located at the approximate centre of the cut (i.e. at the deepest part).

Boreholes were then drilled using a hand auger, as deep as possible, in the bottom of the test pits.

4. (Cont'd.)

A complete log for each borehole was then recorded from ground level to the bottom of the augered hole.

Only one side of each approach cut was investigated, that being the side which was considered to have maximum seepage conditions, hence, providing the most adverse conditions for the performance of the granular sheeting.

The soil stratigraphy on the opposite side of the cut was assumed to be the same, since these deposits are a sedimentary type (fluvio-glacial origin).

Cross-sections were taken on the line of the test holes in order to tie down the drilling data, and also to determine the present grade on the slope.

Difficulty was encountered during drilling operations due to gravel from the granular blanket falling in the auger hole. In some cases, no material could be brought up on the auger due to gravel lodged in the sides of the auger hole.

5. PRESENT SITE CONDITIONS

At the time of the investigation no erosion was evident, and except for a few 'pressure waves' (Figure 7) on the north west slope, the cut back slopes were in excellent condition. (Figures 8 to 15)

As can be seen from the photographs, the slopes at the time of the investigation were partially covered with snow, and frost had

5. (Cont'd.)

penetrated some 6 to 12 inches into the ground.

These conditions hindered observations to some extent, however, one 'wet area' was noticed on the south east slope just above the ditchline (Figure 16).

Drilling in this area revealed 2 feet of coarse gravel, over a saturated varved clay and silt.

The gravel on the slopes is covered by 3 inches of topsoil, and straw mulch. This would account for the absence of erosion on the slopes.

6. SOIL TYPES ENCOUNTERED

The soil stratigraphy for each approach cut has been detailed on a sketch accompanying this report.

Reference to the borehole logs and the above-mentioned sketch indicate that the site at the west approach cut is underlain by 15 feet of varved clay containing approximately 40% silt and 60% clay.

This material is underlain by two thin layers (approximately 12 inches each) of fine to very fine dense sand and very stiff silty clay respectively.

Beneath these strata, there exists a layer of fine to very fine sand to an undetermined depth.

6. (Cont'd.)

The soil conditions at the east approach are considerably more complicated. The site is underlain by 13 feet of varved clay, similar in nature to that in the west approach. This material overlies a series of layers of silt, sand and possibly gravel, ranging in thickness from 1 to 3 feet.

Beneath these strata is a relatively impermeable layer of very stiff clayey silt to an undetermined depth.

The sand and gravel layers appear to be water bearing, and this would account for the 1-foot layer of wash material (sand and silt) over this slope (Refer to section B-B on the attached sketch).

The gravel sheeting on both approaches consists of a very coarse clean brown gravel as previously mentioned, varying in depth from 20 inches to 48 inches.

7. SAMPLES

Samples for moisture testing were taken in each stratum where possible. In the thicker deposits, several samples were taken at various intervals.

In some cases, sufficient material was recovered from the auger to carry out sieve and hydrometer analyses.

Samples were also taken from the granular blanket in the top and bottom portions of a designated test hole in order to detect any differences in moisture content. Sufficient material was taken from the granular blanket for gradation analysis with special emphasis on the passing #200 sieve percentage.

7. (Cont'd.)

This was done in order to determine to what extent piping of the natural embankment material had clogged the granular blanket.

Samples were also taken from the source of the granular material used for the gravel sheeting for comparison with material on the slopes.

8. GROUND WATER OBSERVATIONS

The original Soil Survey notes covering the approach cuts do not indicate the presence of free water.

In the west approach cut, free water was noted in borehole #8 at a depth of 3 feet. The fine to very fine sand stratum is saturated below this point. A sample of this material showed 26.8% moisture content at a depth of 4 feet.

The thin sand layer beneath the varved clay strata is possibly water bearing and tests show 15.3% moisture content.

In the east approach cut, free water was noticed during drilling in borehole #4 at a depth of 18 inches.

Three possible layers of water bearing sand and gravel strata were encountered at the depths shown on the sketch attached.

This assumption appears to be substantiated by the fact that free water was noticed in borehole #4, directly below these layers.

9. SUMMARY OF FIELD AND LABORATORY RESULTS

A plan view of the site (N.T.S.) and the cross-sections taken on the line of the test holes were plotted on a sketch attached to this report. The soil stratigraphy for each section has been detailed on the cross-section (to scale). The results of a sieve analysis on the granular material used for the gravel sheeting have been plotted on grading charts for purposes of comparison.

The results of moisture, hydrometer and sieve samples on the subsoil embankment material were listed in tabular form on summary sheets which are attached to this report.

R.S. Pillar

Report prepared by: R. S. PILLAR,
Project Soils Engineer.

A P P E N D I X

SUMMARY OF FIELD & LABORATORY TESTS

Job Big Pic River
W.D. Research

HOLE NO.	SAMP NO.	SAMPLE DEPTH (FEET)	MATERIAL DESCRIPTION	MOIST. CONT. %	% PASS NO. 200 SIEVE	% MED. COARSE SAND	% FINE SAND	% SILT	% CLAY	REMARKS
1	30	28" - 40"	Light Grey Silt and Sand	13.2	-	16	24	24	29	Possible Wash Mat'l
	30A	40"-8'-0"	Varved Grey Silt & Lt. Br. Clay	26.6	-	2	4	36	57	Soft to firm, wet
2	31	2' - 0"	Very Coarse Clean Br. Gravel	5.3	-	-	-	-	-	Sampled for Moisture only
	32	3' - 6"	" " " " "	6.7	-	-	-	-	-	Sampled for Moisture only
	1032	2' - 0"	" " " " "	-	2.6	-	-	-	-	} Sampled for Gradation especially Pass #200 sieve
	1033	3' - 6"	" " " " "	-	2.8	-	-	-	-	
	33	54"- 6'0"	Light Brown Sandy Silt	21.7	-	-	-	-	-	Moist, Very Stiff
3	34	28" - 48"	Light Brown Clayey Silt	18.2	-	2	6	54	35	Moist, Mottled at 40"
	35	48" - 58"	Medium Sand and Grey Silt	17.3	-	-	-	-	-	Wet
4	36	12"	Very Coarse Clean Brown Gravel	5.4	-	-	-	-	-	Sampled for Moisture only
	37	20"	" " " " "	9.6	-	-	-	-	-	Sampled for Moisture only
	38	30"	Coarse Sand & Gry Silt Mixt.	17.5	-	19	16	32	26	Possible Wash Mat'l.
	39	40"	Light Brown Clayey Silt	27.1	-	-	-	-	-	Very Stiff

SUMMARY OF FIELD & LABORATORY TESTS

JOB BIG PIC RIVER
W.P. RESEARCH

HOLE NO.	SAMP. NO.	SAMPLE DEPTH (FEET)	MATERIAL DESCRIPTION	MOIST. CONT. %	% PASS NO. 200 SIEVE	% MED. COARSE SAND	% F.V.F. SAND	% SILT	% CLAY	REMARKS
5	48	30" - 38"	Varved Grey Silt & Lt. Br. Clay	23.3	-	-	4	38	58	Pushed Shelby Tube only 8" recovery Firm, moist
	40	6' - 0"	" " " " " " "	25.3	-	-	5	39	56	
6	41	4" - 14"	Very Coarse Clean Brown Gravel	4.4	-	-	-	-	-	Sampled for Moisture only
	42	14" - 24"	" " " " "	4.7	-	-	-	-	-	Sampled for Moisture only
	1034	4" - 14"	" " " " "	-	2.2	-	-	-	-	Sampled for gradation with emphasis on the pass #200 sieve.
	1035	14" - 24"	" " " " "	-	2.1	-	-	-	-	
	49	24" - 42"	Varved Gry. Silt & Lt. Br. Clay	26.9	-	-	8	37	55	Pushed Shelby Tube Good recovery 18".
7	43	25" - 30"	Dark Grey Silty Clay	19.7	-	-	3	46	51	Very Stiff, moist Wet
	44	40" - 6'0"	Light Brown F. to V.F. Sand	15.3	-	5	90	5	-	
8	45	3" - 12"	Very Coarse Clean Br. Gravel	8.4	-	-	-	-	-	Sampled for Moisture only Sampled for Moisture only Wet to saturated
	46	12" - 20"	" " " " "	6.5	-	-	-	-	-	
	47	4' - 0"	Light Grey Br. F. to V.F. Sand	26.8	-	5	92	3	-	
-	1036	-	Very Coarse Clean Br. Gravel	-	3.6	-	-	-	-	Sample Taken from Wet Area on S.E. Slope
	1037	-	Very Coarse Clean Br. Gravel	-	1.9	-	-	-	-	Source of material for Granular Blanket
	1038	-	" " " " "	-	2.2	-	-	-	-	

GRADATION OF GRANULAR BLANKET

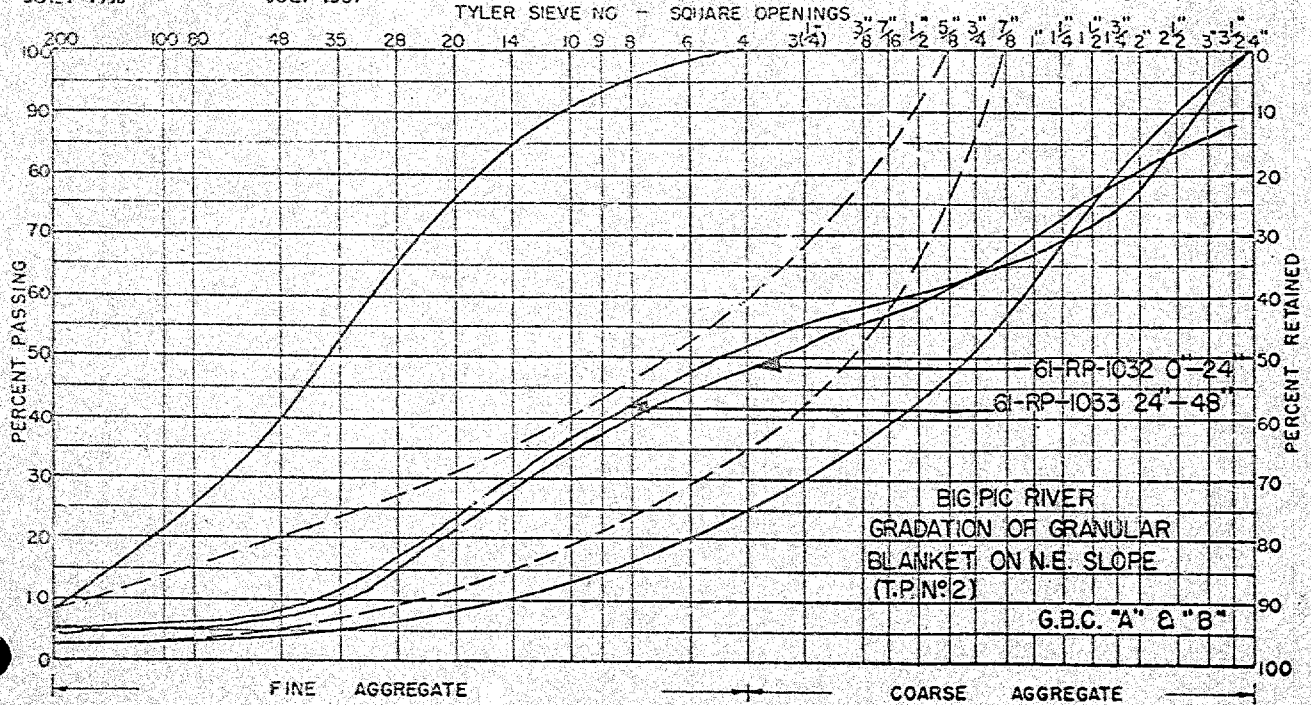
FORM OB-ML-148

JULY 1958

JULY 1957

SEMI-LOG GRADING CHART
TYLER SIEVE NO - SQUARE OPENINGS

CHART A



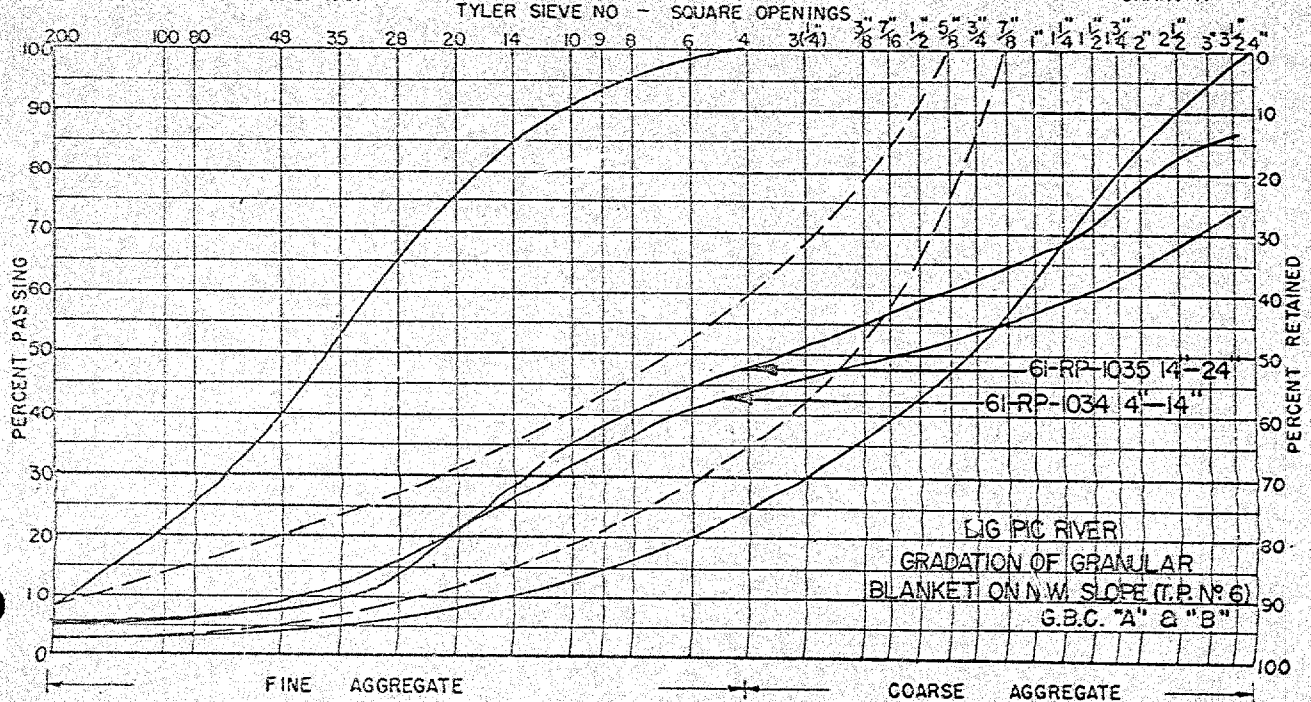
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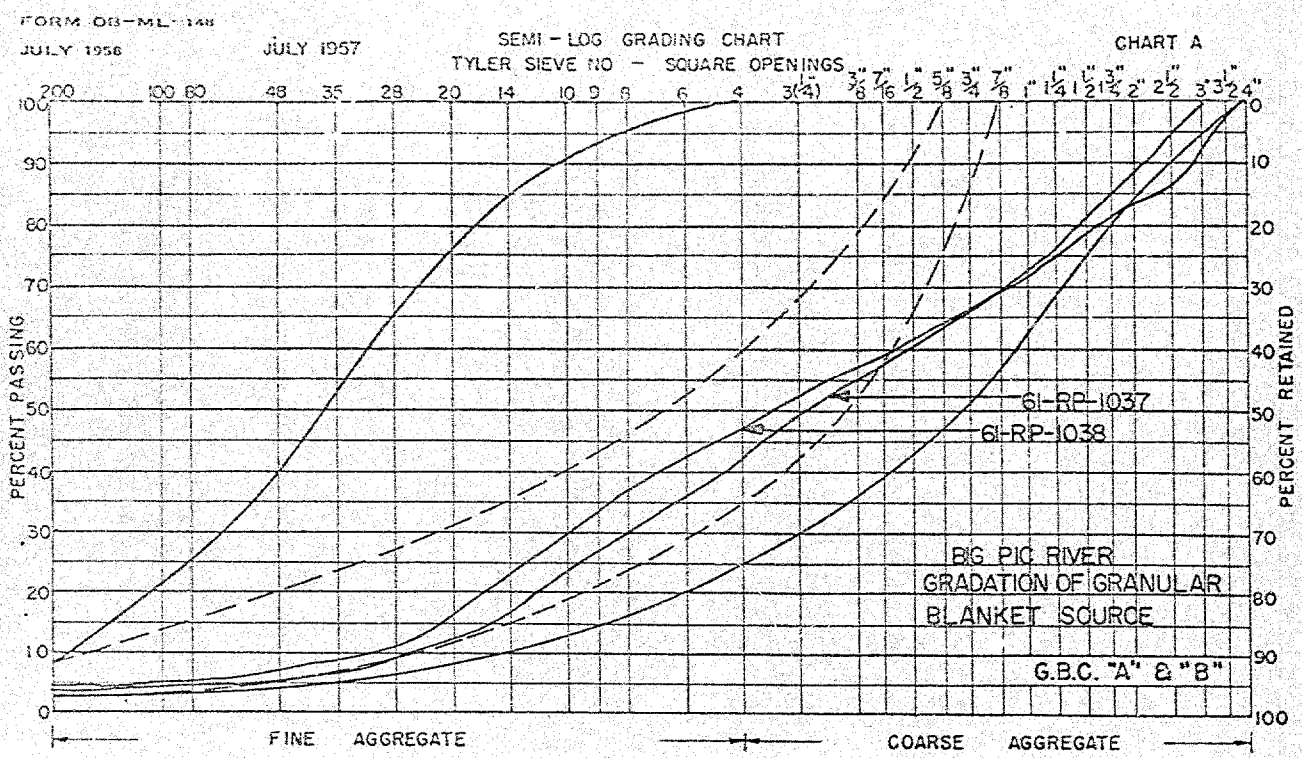
JULY 1957

SEMI-LOG GRADING CHART
TYLER SIEVE NO - SQUARE OPENINGS

CHART A



GRADATION OF GRANULAR BLANKET SOURCE



DATE October 9/61

BIG PIC RIVER APPROACHESN. E. SLOPET.P. #1

Dug out (0" - 2" - Topsoil
 by hand (2" - 28" - V. Co. Clean Br. Gravel - Moist to wet
 28" - 40" - Lt. Gry Silt and Sand - Moist (61-RP-30)
 40" - 8'0" - Varved Lt. Br. Clay & Lt. Gry Silt, soft to firm,
 Wet, (61-RP-30A)

Noticing water in borehole now, stone fell in hole
 unable to measure water level.

T.P. #2

Dug out (0" - 2" - Topsoil
 by hand (2" - 48" - Very Co. Clean Br. Gravel - moist to wet
 2' 0" (61-RP-31) Moist (61-RP-32) Grading Sampl
 3' 6" (61-RP-32) Samples (61-RP-33) Grading Sampl
 48" - 54" - Lt. Gry Silt and sand (mixed), Moist
 54" - 6'0" - Lt. Brown sandy silt, moist, very stiff (61-RP-33)
 6'0" - 7'0" - Presumed sand by sound and feel of rod, unable to
 bring up sample due to stiff silt layer above.
 Water appearing in borehole after this stratum
 was encountered.
 7'-0" - Possibly clay or silt - stiff

Unable to recover auger head, as pipe untreaded at
 the first knuckle.

T.P. #3

Dug out (0" - 3" - Topsoil
 by hand (3" - 26" - V. Co. Clean Br. Gravel - Moist then wet at 20"
 (26" - 28" - Mixture of Lt. Grey Silt and Sand - Moist
 28" - 48" - Lt. Brown Clayey Silt, moist, rottled at 40"
 (61-RP-34)
 48" - 58" - Med. sand and gry. silt, wet, (61-RP-35)
 58" - - NFP -Stone - 3 attempts failed to penetrate this
 layer.

DATE Oct. 9/61

N. E. SLOPETP #4

Dug out (0" - 3" - Topsoil
 by hand (3" - 27" - V. Co. Br. Gravel, Wet to sat. at 18", hole
 sloughing in slightly.

(12" - 61-RP-36)

() Moisture samples

(20" - 61-RP-37)

27" - 40" - Coarse Sand and grey silt mixture, wet
 could be wash material on slope.

(61-RP-38 @ 30")

40" - 48" - Light Brown Clayey Silt - very stiff
 NFP - too stiff

(61-RP-39 @ 40")

This hole was drilled at 5:30 P.M. Oct. 9th

W. L. Reading 2:00 P.M. Oct. 10th was 18"

PAGE NO.

TWP.

DATE Oct. 10th/61

N. W. SLOPETP #5

Dug out (0" - 3" - Topsoil
 by hand (3" - 27" - V. Co. Clean Br. Gravel, moist to wet (Natural
 27" - 9'0" - Varved Lt. Br. clay & grey silt - some mottling
 near surface, stiff to firm, moist to wet.
 (61-RP-48) Shelby Tube #1 pushed 30"-38"
 Poor recovery
 (61-RP-40 @ 6'0")
 Moist

TP #6

Dug out (0" - 4" - Topsoil
 by hand (4" - 24" - V. Co. Br. Clean Gravel - moist
 4" - 14" - 61-RP-41) Moist & 61-RP-1034) Gradation Sample
 14" - 24" - 61-RP-42) Samples 61-RP-1035) " "
 Shelby Tube #2 (24" - 36" - Stiff varved Lt. Br. Clay & Lt. Gray Silt-m
 pushed from (36" - 6'8" - Soft to stiff varved lt. br. clay & lt. gr
 24" to 42" (silt - Mottled - NFP
 (ST#2)
 Good Recovery Seemed to hit a change in material at 6'-8"
 Very stiff (possibly silt)
 (61-RP-49) No samples recovered here since gravel fell in borehole.

TP #7

0" - 3" - Topsoil
 3" - 22" - V. Co. Clean Br. Gravel - Moist
 22" - 25" - Lt. Br. V. F. to F. sand - Moist
 25" - 30" - Dk. Grey, V. Stiff Silty Clay - Moist (61-RP-4
 30" - 40" - Lt. Br. V.F. to F. Sand, Mottled orange (oxidiz
 40" - 6'0" - Lt. Br. V.F. to F. sand - Moist (61-RP-4

Some pressure ridges are noticeable on this slope took a
 photograph of these, however, might not be too evident.

DATE Oct. 10th/61

N. W. SLOPE (CONT'D)TP #8

0" - 3" - Topsoil
3" - 20" - V. Co. Clean Br. Gravel - Moist to wet in last 8"

3"-12" - 61-RP-45 Moist Sample
12"-20" - 61-RP-46 Moist Sample

20" - 6'-0" - Light Grey Brown very fine to fine sand, wet

Water appearing in borehole at 3'-0"

Material saturated from this depth.

(61-RP-47 @ 4'-0")



FIG. 1

Sloughing of embankment material
on N.W. slope during construction.

FIG. 2

N.W. slope during excavation
procedures. Note the soft
consistency of the clay material.



FIG. 3

View of the west approach cut
after excavation procedures
were completed.





FIG. 4

West Approach cut viewed from the west

The Big Pic River can be seen in the centre of the photograph.

FIG. 5

A dragline subexcavating the roadbed through the west approach cut. Note the excessive water conditions in this cut.



FIG. 6

Erosion in the ditchline of the west approach cut.

The photographs as enumerated by Figs. 7 to 16 were taken during the investigation.

P 20

FIG. 7

A few minor 'pressure waves' are noticeable on the N.W. slope as illustrated by this photograph.



FIG. 8

View of the N.W. slope just west of the Big Pic River structure.



FIG. 9

Similar to Fig. 8 but viewed from the opposite side of the cut. This slope is in excellent condition.





FIG. 10

View of the S.W. slope just west of the
Big Pic River structure.



FIG. 11

Similar to Fig. 10, but further west along
the cut. This slope is also in excellent
condition.



FIG. 12

Partial view of the N.E. slope. Both slopes in the east approach cut are in very good condition.

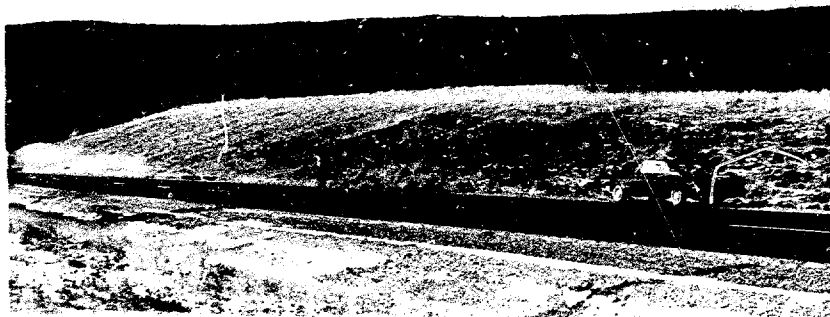


FIG. 13

Similar to Fig 12, but viewed from the opposite side of the cut.



FIG. 14

S.E. slope looking east. (Refer to Fig 16)

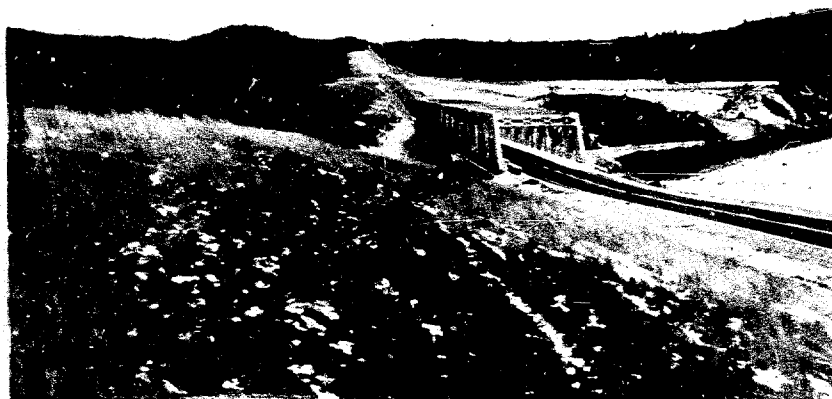


FIG. 15

Overall view of the site as observed from the N.W. slope.



FIG. 16

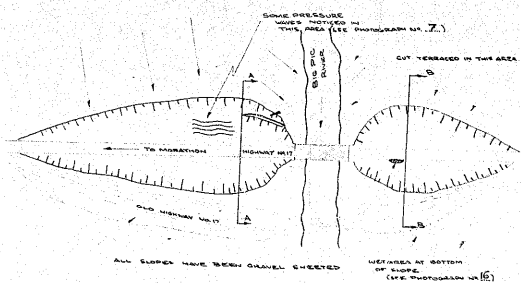
Free water, emanating from the S.E. slope, has frozen in the ditch-line, as illustrated by this photograph.

#61-F-128

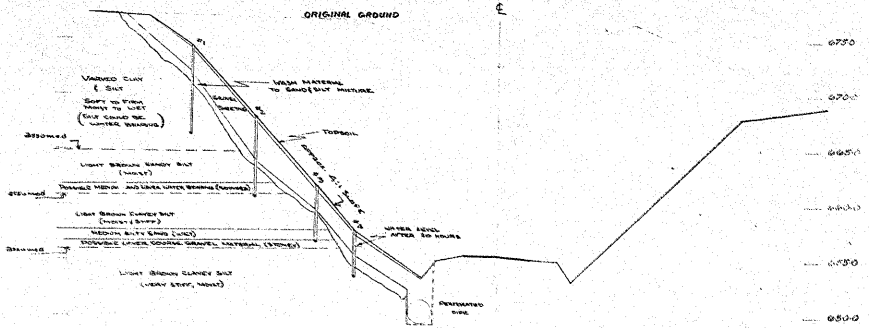
HWY. NO. #17

BIG PIC

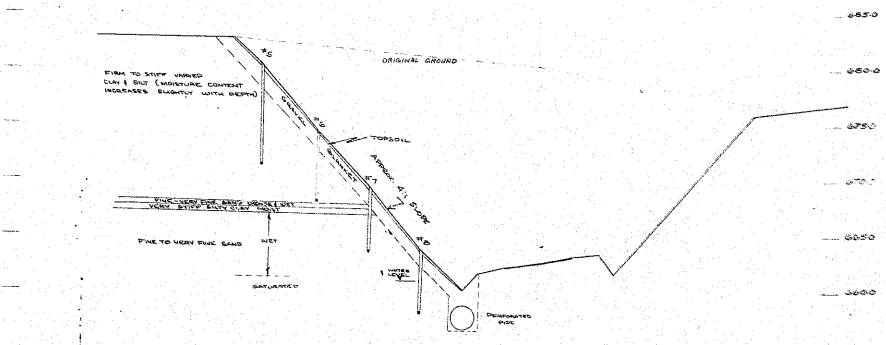
RIVER



PLAN VIEW: BIG PIC RIVER SITE
H.T.S.



SECTION BB
SCALE 1 IN = 5 FT. VERTICAL
1 IN = 50 FT. HORIZONTAL



SECTION AA
SCALE 1 IN = 5 FT. VERTICAL
1 IN = 50 FT. HORIZONTAL

DEPARTMENT OF HIGHWAYS - ONTARIO MATERIALS & RESEARCH SECTION		
BIG PIC RIVER SITE HWY. NO. 17		
DISTRICT 19	COUNTY THUNDER BAY	TOWNSHIP PIC
DATE DEC 29/81	SCALE AS SHOWN	DRAWING NO.