

#60-F-232

W.P. #904-57

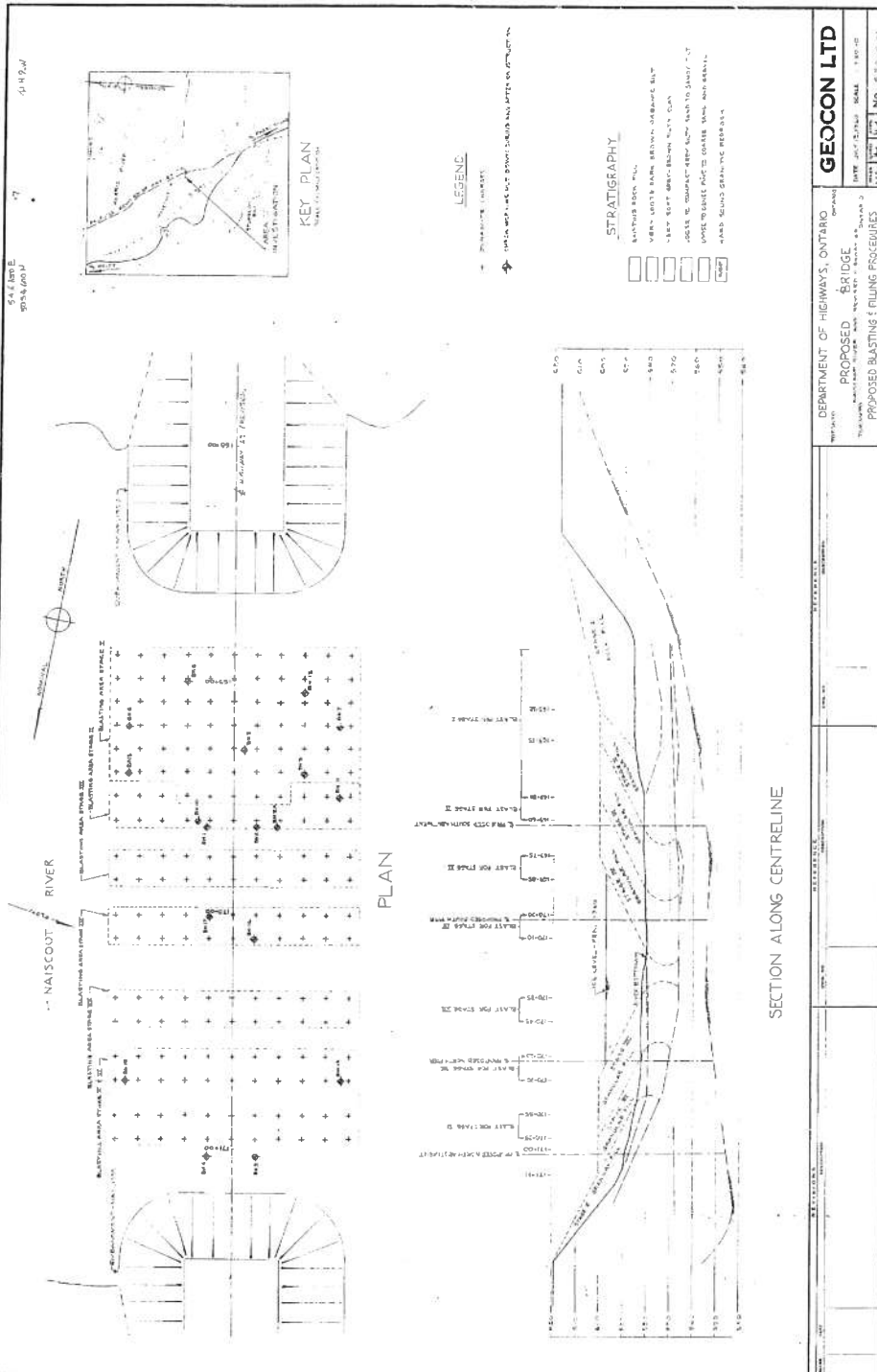
HWY #69

NAISCOOT RIVER

BRIDGE

APPROACH

EMBANKMENT



BH. 2A DOES NOT COINCIDE WITH THE SOUNDING

BLASTING DATES

I	MARCH 28
II	APRIL 12
III	APRIL 22
IV	APRIL 26
V	MAY 31
VI	MAY 31
VII	APRIL 20

BORE HOLE DATES

1	APRIL 2	} AFTER BLAST I
2	"	
2A	"	
3	APRIL 5	
4	"	
5	APRIL 8	
6	"	
7	APRIL 9	
8	"	
9	"	
10	APRIL 13	} AFTER BLAST I, II & III.
11	"	
12	MAY 4	
13	"	
14	"	
15	MAY 4	
16	"	
17	"	

SOUNDING DATE

MARCH 29 - AFTER BLAST I

May 4. 170+10 9' west

BH¹⁶

0-15 water

15-20 clay

20-23 rock

the sand

BH¹⁷ - 0-10 water 170+02 10' east

10-15 clay

15-20 rock

BH¹⁸ - No change about level

Summary 168480 to 169490

started Mar 28 completed Mar 29

DEFECTS IN NEGATIVE DUE TO
CONDITION OF ORIGINAL DOCUMENT

Mr. A. M. Toye,
Bridge Engineer.
Materials & Research Section.

March 7, 1960.

FOUNDATION REPORT -- by
Geoccon, Limited.

Attention: Mr. S. McCombie.

Re: -- NAISCOOT RIVER BRIDGE --
Hwy. No. 69 - Contract No. 59-05
District No. 17

Enclosed herewith, is the report on the
Naiscoot River Subsoil Investigation, submitted by Geoccon,
Limited.

The remedial construction programme necessitated
by the rock slide which occurred, has been discussed in detail,
with Mr. H. A. Tregaskes and the Bridge Design Engineer,
Mr. B. Davis.

This report is forwarded for your records.

LGS/MdEF
Attach.

L. G. Soderman
L. G. Soderman,
PRINCIPAL SOILS & FOUNDATIONS ENGINEER

cc: Messrs. A. M. Toye (2)
H. A. Tregaskes
H. D. McMillan
C. K. Hunter
E. A. Cash
L. Eadie
E. H. Saint
Foundations Office ✓
Gen. Files.

GEOCON LTD

HEAD OFFICE
180 VALLÉE ST., MONTREAL 18, QUEBEC
TELEPHONE UN. 6-7632

DISTRICT OFFICES

14 HAAS ROAD
REXDALE, TORONTO, ONT.
TEL. CH. 4-8641

1425 WEST PENDER ST.
VANCOUVER 5, B.C.
TEL. MU. 1-8926

W.P. 904-57

Rexdale, Ontario,
October 5th, 1960.

Department of Highways, Ontario,
Materials and Research Section,
Downsview, Ontario.

Attention: Mr. A. Rutka, P. Eng.,
Acting Materials and Research Engineer.

Re: Construction Procedure - Approach Embankments,
Naiscoot River Bridge,
Township of Harrison, Ontario.

Dear Sirs:

This letter accompanies our detailed report on the construction procedures adopted for the approach embankments at the Naiscoot River Bridge, Township of Harrison, Ontario.

It is felt that the control blasting procedure, which was evolved in cooperation with your staff, is unique. Consequently detailed records of the efficiency of the blasting and filling operation were kept and are presented in this report together with other pertinent data.

Yours very truly,

GEOCON LTD

V. Milligan

V. Milligan, P. Eng.,
Assistant Chief Engineer.

VM/dw
S7064

S7064
REPORT
TO
DEPARTMENT OF HIGHWAYS, ONTARIO
ON
CONSTRUCTION PROCEDURE - APPROACH EMBANKMENTS
NAISCOOT RIVER BRIDGE
TOWNSHIP OF HARRISON ONTARIO

Distribution:

- 10 copies - Department of Highways, Ontario,
Downsview, Ontario.
- 2 copies - Geocon Ltd,
Rexdale, Ontario.

GEOCON

INDEX

	<u>Page</u>
Introduction	1
Site	1
History	1
Procedure	2
Results	
Stage 1	3
Stages V and VI	4
Stages II, VII, III and IV	5
Additional Blasting	6
Personnel	7
Appendix I	
Recommended Blasting Patterns	
Appendix II	
Blasting Procedures Used	

INTRODUCTION

Geocon Ltd has been retained by the Department of Highways, Ontario, by verbal agreement, to provide supervisory service during the construction of the approach embankments for the Naiscoot River bridge in the Township of Harrison, District of Parry Sound, Ontario.

The purpose of the supervision was to control the remoulding and displacement of soft silty clay beneath the existing portion of the south approach embankment and to control the removal and/or remoulding of clay in front of successive advances of the approach embankments.

SITE

The site is located in the Township of Harrison, District of Parry Sound and about 2 miles north of Pointe au Baril where the re-alignment of Highway 69 crosses the Naiscoot River.

HISTORY

The original bridge design, as shown on D.H.O. drawing D4011-1, consisted of a simply supported 3-span steel beam superstructure, founded on caissons driven to bedrock. The total length of the structure was to be 140 feet. The south and north approach embankments were to be constructed of rock fill about 40 feet wide at grade level and about 135 and 85 feet long respectively. It is understood that the dimensions of the river channel were based on hydrologic considerations and on requirements set forth by the Navigable Waters Act.

During the construction of the south approach embankment in May, 1959, several subsidences occurred, and it was noticed that the toe

HISTORY (continued)

2.

of the embankment had slid into the river for a distance of about 70 feet. The operations were subsequently stopped. Geocon Ltd carried out a site investigation in February, 1960 and the results are contained in our report S 7045, dated February 22nd, 1960. It was found that the toe of the south approach embankment had slid into a layer of very soft silty clay, about 20 feet in thickness. It was further found that about 5 to 10 feet of this material were entrapped between the subsided portion of the embankment and the underlying sand and gravel stratum.

When it was known that the rock fill slide had covered the area of the proposed south abutment, it was decided to move the proposed bridge towards the north for a distance of about 25 feet. It was further decided to displace the clay entrapped beneath the embankment by blasting and to construct the remainder of the embankments of granular fill, using stage construction and pre-removal or remoulding of the clay.

A drawing showing the revised positions of the piers and abutments and a schematic outline of suggested stage construction, together with the recommended blasting patterns were submitted in our report S 7045, dated February 22nd, 1960 and are reproduced in this report on Drawing S 7064-1 and in Appendix I, respectively. The blasting procedures adopted are given in detail in Appendix II.

PROCEDURE

The work was commenced on March 15th, 1960 and completed, except for final grading and widening of the embankment, on May 5th, 1960.

PROCEDURE (continued)

3.

The charges in Stage II were placed on April 11th and 12th and blasted on April 12th. Cross-sections after blasting are shown on Drawing S 7064-2.

The charges in Stage VII were placed on April 19th and April 20th and blasted on April 20th. The charges in Stage III were placed on April 21st and blasted on April 22nd.

The charges in Stage IV were placed on April 25th and blasted on April 26th. Sections over the check borings put down after blasting are shown on Drawing S 7064-2.

One additional line of charges at chainage 170+05 was fired on April 29th, and at chainage 170+02 on May 4th to make the toes of the north and south approach embankments meet.

Geocon Ltd left the site on May 5th. At that time final grading and widening of the embankment was still in progress.

A detailed procedure of the blasting operations is given in Appendix II to this report.

RESULTS

The various construction Stages will be discussed separately in order of construction progress.

Stage I

The results of soundings taken after blasting in this Stage are shown on Drawing S 7064-2 and indicated the presence of rock fill and scattered boulders north of the row of caissons for the south abutment planned at chainage 169+62. They further indicated the presence of clay

RESULTS (continued)

4.

Stage I (continued)

overlying rock fill north of chainage 169+20. This chainage corresponds to that where the clay stratum underlying rock fill before blasting increased in thickness.

At a subsequent meeting with the Department of Highways, it was decided to check, by putting down test borings, the extent of rock fill north of chainage 169+50 and to carefully check the progress of the advancing south approach embankment by soundings, ensuring that no rock fill would advance north of chainage 169+50.

Stages V and VI

Based on the experience obtained in Stage I, it was decided to place a granular berm at the toe of the north approach embankment, prior to blasting to prevent the embankment from sliding over the location of the proposed north abutment at chainage 171+02.

About 700 cubic yards of granular fill was used for the construction of the toe-berm extending to about chainage 170+90.

Stages V and VI were fired together. As a result of the blast the granular berm together with part of the rock fill embankment subsided. The results of soundings taken subsequently are shown on Drawing S 7064-2 and indicated the presence of rock fill at the location of the proposed north abutment and extending south from it to about chainage 170+80.

A second meeting with the Department of Highways was then held and it was decided to depart from the initial bridge design. It was proposed to maintain the planned blasting program and filling operations

Stages V and VI (continued)

using rock fill instead of granular fill. The embankment was to be constructed at temporary grade elevation 600 to chainages 169+68 and 170+42 at the south and north sides respectively, thereby maintaining a navigable channel about 70 feet wide. The above chainages were based on the approach embankments meeting each other at the toes at chainage 170+05 under a natural slope of 1 vertical to 1-1/4 horizontal. It was further decided to blast and fill symmetrically in relation to chainage 170+05. The embankment was to be advanced under a wedge-shaped front in order to ensure the maximum displacement of clay. With the embankments completed, a simple span would be put across the opening, supported on spread footings within the rock fill. To allow for probable settlement within the rock fill, a temporary crossing of the Bailey bridge type would be used before placing the final structure.

Stages II, VII, III and IV

As construction proceeded, the blasts in Stages II, VII, III and IV were set off individually and in that order. Soundings were taken regularly at the toes of the advancing embankments and the displacement of clay was found generally to be satisfactory. Due partly to the frozen condition of the rock fill stock piles which made blasting of the stock piles necessary, and partly to lack of sufficient equipment to handle the rock fill, the embankments could not be advanced at full width at elevation 600. During construction the width of the approach embankment was generally 40 to 60 feet. It was found that a mud wave was formed at the

Stages II, VII, III and IV (continued)

toe of the embankment, about 10 feet long and 4 to 5 feet high over the full width of the embankment. It was further found that the natural slope of the rock fill by end dumping was about 1 to 1. Several borings were put down through the rock fill to check the degree of displacement of the clay. The results were generally satisfactory and wherever clay was found entrapped between the rock fill and the underlying sand and gravel stratum, dynamite charges were put down the hole and fired. On re-drilling such holes, the clay invariably had been displaced and replaced by rock.

Additional Blasting

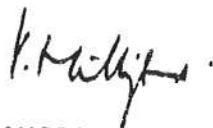
After each blast the rock fill embankment end slopes generally subsided as shown on Drawing S 7064-3. The positions of the embankment before and after the blast in Stage IV are shown. The toes were found to be still 15 to 20 feet apart after blasting. It was then decided to blast another row of charges at chainage 170+05. Previous to this blast the embankments were advanced 2 feet beyond the desired positions and overloaded at the edge of the end slope. After the blast the toes had met in several places. One final blast together with overloading of the end slopes was then set off at chainage 170+02 with the result that the toes met completely over the width of the embankment. About 4 to 5 feet of remoulded clay covered the rock fill where the toes met.

PERSONNEL

7.

The field work was carried out by Mr. A. Tilk and Mr. A. Prior.
The report was written by Messrs. Tilk and Prior and reviewed by Mr.
V. Milligan.

VM/dw
S7064


V. Milligan, P. Eng.

GEOCON

APPENDIX I

RECOMMENDED BLASTING PATTERNS

GEOCON

Recommended Procedures
for
Remolding River Bed Clay
and Granular Approach Fill

A. South Approach:

- (1) (a) Between chainages 168+79 and 169+50 (i.e., area where rock fill overlies clay) boreholes shall be drilled at 10' centres to a depth sufficient to contact the sand stratum underlying the clay. The limits of the grid of borings to the left and right of centreline between the above chainages shall be determined by the intersection of a 1:1 side slope from profile grade with the upper horizon of the clay layer.
- (b) In each of the holes drilled, a 40 lb. charge of C.I.L. ditching dynamite (i.e., 50% Forcite - 1-1/4" x 8" lg. sticks) shall be placed at the base of the clay layer where the thickness of the stratum is less than 8 feet or above the base of clay layer equal to 1/3 the clay layer thickness where it is in excess of 8 feet.
- (c) Every fourth charge in one row of loaded holes shall be positively fired; propagation firing may be used for intermediate charges. The entire pattern may be fired as one shot.

A. South Approach: (continued)

- (2) Immediately after the above blasting has been carried out, probings should be made to determine whether or not rock fill has moved in a longitudinal direction beyond Station 169+50. If rock is encountered beyond this chainage, this rock will have to be excavated for the entire width of area blasted before proceeding with step (3).
- (3) Rock fill can be advanced to chainage 169+12 at elevation 600.0'. This chainage point corresponds to centreline chainage at the intersection point of the "as dumped" slope of rock with horizontal line at elevation 600.0'.
- (4) Wash and load holes at 10' centres on two lines at chainages 169+50 and 169+60. Blast these two rows as one shot. Limits of grid of holes to the right and left of centreline should be as defined in 1(a); charge per hole to be as defined in 1(b).
- (5) Advance approved granular fill (not rock fill) to chainage 169+25 at Elev. 600.0'. Definition of chainage as given in (3).
- (6) Wash and load holes at 10' spacing in two rows 10 feet apart. Rows located at chainages 169+75, and 169+85. Fire both rows as one blast.
- (7) Advance approved granular fill to chainage 169+50 at Elev. 600.0'.

A. South Approach: (continued)

- (8) Wash and load holes at 10' spacing in two rows. Rows located at chainages 170+00, and 170+10. Fire both rows as one blast.
- (9) Advance approved granular fill to Station 169+75, at Elev. 600.0'.

B. North Approach:

- (1) (a) Underlying the North approach fill, the thickness of the clay is less than at the South approach location. The number of pounds of powder per hole can be varied where the clay is less than 8 feet thick. A powder factor of one should be maintained - (i.e., 1 lb. of dynamite per cu.yd. of clay to be remolded). The depth at which the charge should be placed is defined in 1(b).
- (b) Wash and load holes spaced at 10' centres in two rows 10 feet apart. Row chainages at 170+85, and 170+95. Limits of rows right and left of road centreline to be determined using intersection of 1:1 side slopes, with upper horizon of clay stratum as for South approach fill. Fire both rows as one blast.
- (2) Advance approved granular fill to chainage 171+11 at elevation 600.0'.

B. North Approach: (continued)

- (3) Wash and load holes at 10' centres in two rows 10 feet apart. Row chainages at 170+70, and 170+60. Fire both rows as one blast.
- (4) Advance approved granular fill to chainage 170+95, with top of fill at elevation 600.0'.
- (5) Wash and load holes at 10' centres in two rows 10 feet apart. Row chainages at 170+45, and 170+35. Fire both rows as one blast.
- (6) Advance approved granular fill to chainage 170+70, with top of fill at elevation 600.0'.
- (7) Piling for caissons can now be driven. A protective layer of at least four feet of rock fill should be placed on the side and end slopes of the approach fill granular core. The maximum dimension of individual rock sizes should be 2'.

C. Pump Specifications:

The washing of holes in which the charges of dynamite are to be placed, requires the provision of a pump with the following specifications:-

Capacity	1,000 gallons/min.
Discharge Pressure	150 - 200 p.s.i.
Discharge Orifice	2" Diameter.

C. Pump Specifications: (continued)

Also required is the provision of a total footage of 50' of 2" O.D. standard pipe supplied in 5' lengths, each length threaded at both ends; couplings, 1 tee pipe section, 1 valve and 1 end cap to be provided.

D. The above blasting and filling procedures are illustrated on Drawing S7064-1.

Prepared by: L. G. Soderman,
Department of Highways,

V. Milligan,
Geocon Ltd.

S7064

GEOCON

APPENDIX II

BLASTING PROCEDURES USED

APPENDIX II

BLASTING PROCEDURES USED

The blast holes in Stage I were put down through the rock fill using standard machine drillrigs. In view of the number of holes to be drilled in Stage I and the time limit on explosives under water, three drillrigs were employed in this stage each working 24 hours per day in two 12-hour shifts. The holes in the remaining stages were jetted, using one drillrig and one day shift only.

The explosive used was C.I.L. 50 per cent Ditching Dynamite with a velocity of 17,500 feet per second. The maximum allowable lag between placing and detonating was 12 days and preferably not in excess of 10 days. The blast holes were loaded either through AX or BX casing. To jet the charges in place, a Jaeger pump was employed with a rated capacity of 500 gallons per minute at a discharge pressure of 150 pounds per square inch. Each blast hole was loaded with about 40 to 50 pounds of dynamite or about ninety 1-1/4 by 8 inch sticks.

Initially, the holes were loaded 5 sticks at a time, then gradually increased to 10 to 15 sticks at a time. It was found by experiment that a jetting pressure of 130 pounds per square inch was required for BX casing and 135 pounds per square inch for AX casing to properly deposit the charge in the clay stratum. In this way an average of 12 to 15 holes were loaded in a 12-hour shift.

Detailed layouts of the charges are given on Drawing S 7064-4. The holes to be fired positively were primed with 4 sticks attached to

plastic wrapped Primacord. The Primacord was then attached to stakes driven into the ice or poles driven into the clay. When all holes were loaded 1 or 2 electric detonator caps together with 1 extra primer stick were connected to the Primacord and all caps were hooked up into a circuit of connecting wire. A sketch showing this arrangement is given on Drawing S 7064-4. The circuit was tested by passing a small electrical current through it. The primed charges were then detonated by closing the circuit through a 1200 Series Blasting Machine with a rated voltage of 480. Non-primed charges were detonated by propogation.

Part of Stage II was fired simultaneously with Stage I as shown on Drawing S 7064-4. The purpose of firing the extra line was to effect a counterforce limiting the trend of the rock fill embankment to slide. A similar consideration was incorporated in the lay-out of primed charges in Stages V and VI.

Two additional blasts were set off along chainage 170+05 and 170+02 to let the toes of the approach embankments meet. The second of these blasts was effected by using "bombs" consisting of whole cases of ditching powder put down by their own weight in the already remoulded clay and set off by using electric caps and connecting wire only.

The materials used for blasting are summarized in the following table.

<u>Stage</u>	<u>50% Ditching Dynamite Pounds</u>	<u>Plastic Wrapped Primacord feet</u>	<u>Detonator Caps No. 8</u>	<u>Connecting Wire feet</u>	<u>75% Forcite pounds</u>
I	2900	1200	40	850	-
II	800	140	4	900	-
III	1125	380	10	850	-
IV	1300	392	11	400	-
V, VI	1765	490	14	800	-
VII	1120	275	8	850	50
170+05	550	70	6	900	200
170+02	700	-	7	650	-
	<hr/>	<hr/>	<hr/>	<hr/>	<hr/>
Total	10260	2947	100	6200	250

NOTE: Part of connecting wire salvaged after each blast and re-used.

GEOCON

LEGEND

- BOREHOLE IN ELEVATION S TOG 4
- BOREHOLE IN ELEVATION S TO 45
- ROCK SURFACE, SOUNDINGS AFTER BLASTING
- CLAY SURFACE, SOUNDINGS AFTER BLASTING

STRATIGRAPHY

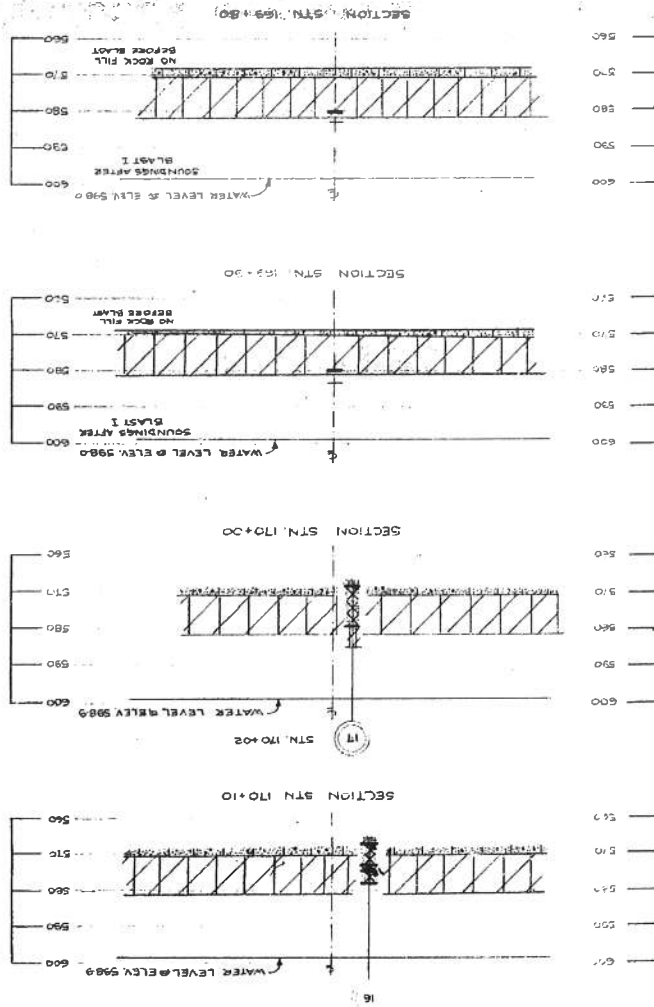
- ROCK FILL
- VERY SORTY GREY - BROWN SILTY CLAY
- LOOSE TO COMPACT GREY SILTY SAND TO SANDY SILT
- LOOSE TO DENSE FINE TO COARSE SAND AND GRAVEL

NOTES: 1. ANY CORRECTIONS TO THIS DRAWING MUST BE MADE AT THE TIME OF THE SURVEY. 2. THE DRAWING IS NOT TO BE USED FOR ANY OTHER PURPOSES WITHOUT THE WRITTEN PERMISSION OF GEOCON LTD. 3. THE DRAWING IS NOT TO BE USED FOR ANY OTHER PURPOSES WITHOUT THE WRITTEN PERMISSION OF GEOCON LTD.

GEOCON LTD
DATE: SEPT. 1960
SCALE: 1" = 20'
No. S TOG 4-2A

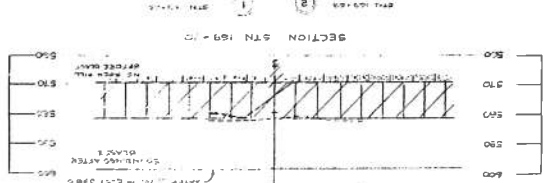
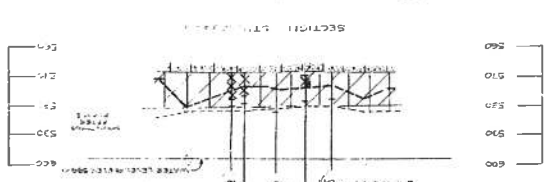
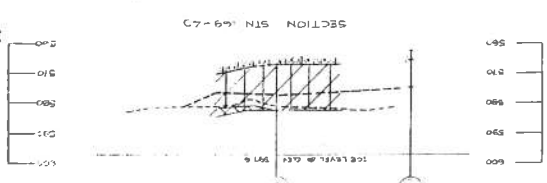
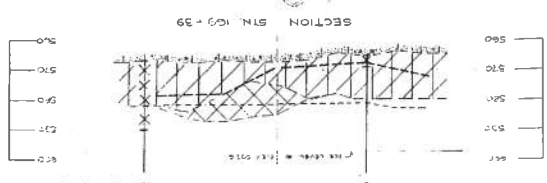
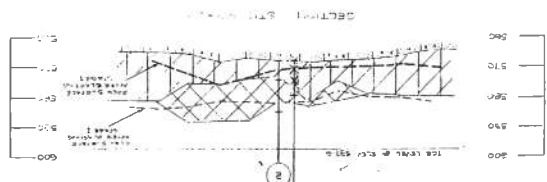
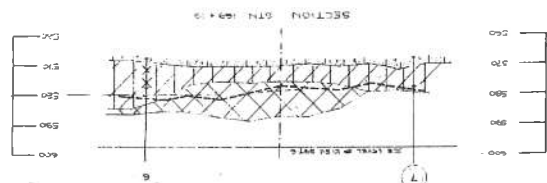
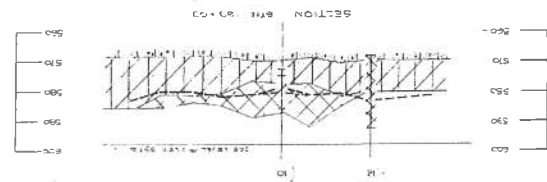
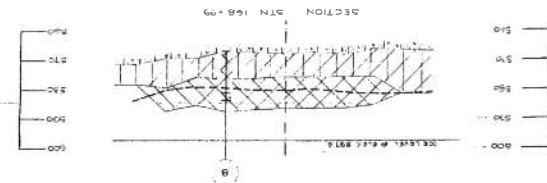
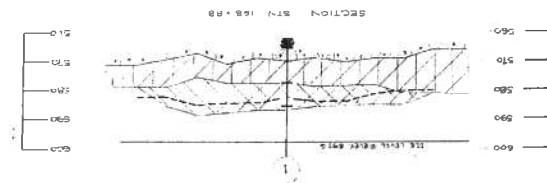
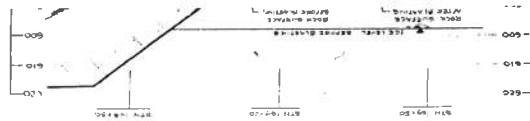
DRAWING FROM
STN. 169+80 TO 171+05

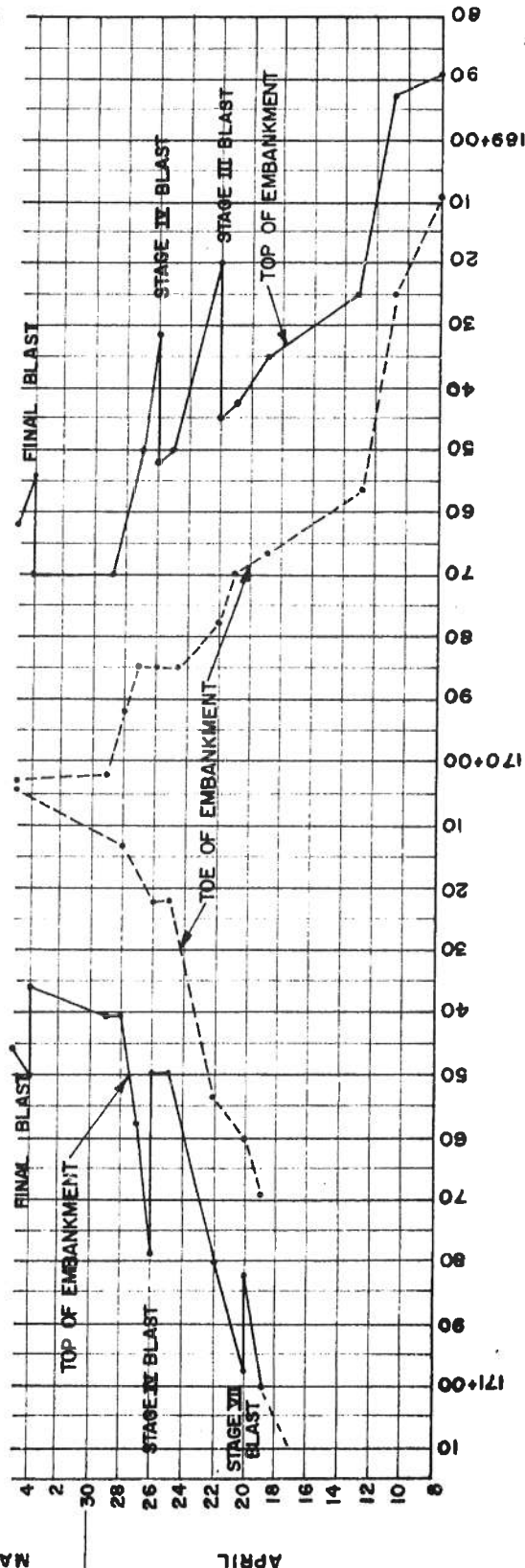
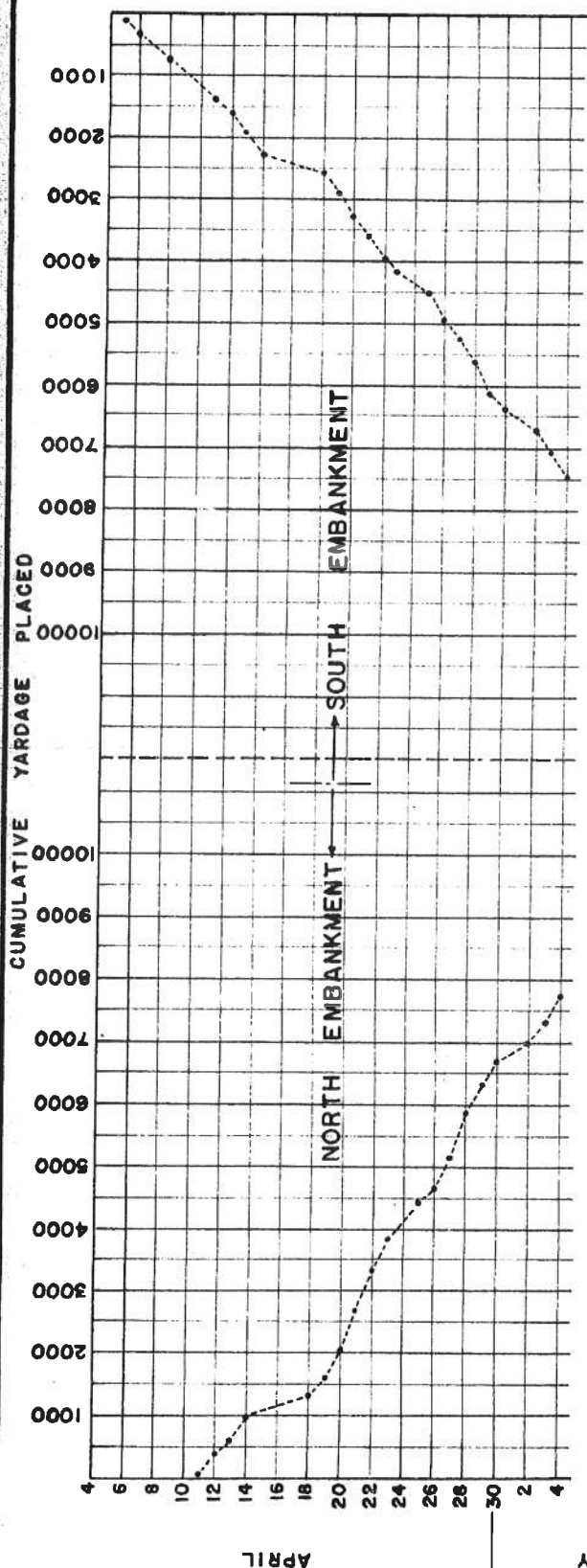
DEPARTMENT OF HIGHWAYS, ONTARIO
TORONTO
NAISCOOT RIVER BRIDGE
SOIL STRATIGRAPHY BEFORE BLASTING
SOUNDINGS AND CHECK BORINGS AFTER BLASTING



FOR AREA STN 170+10 - 170+45
SOUNDINGS & BORINGS FOR LVS 1/2

SECTION STN 170+45

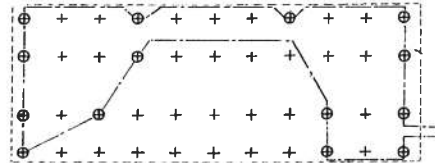




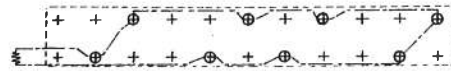
DEPARTMENT OF HIGHWAYS, ONTARIO		GEOCON LTD	
TORONTO		ONTARIO	
NAISCOOT RIVER BRIDGE		DATE SEPT. 16/60 SCALE —	
TOWNSHIP OF HARRISON		MADE CHKD. APPD. No. S 7064 - 3	
PROGRESS OF EMBANKMENT VS TIME			



BLASTING AREA
STAGE I



BLASTING AREA
STAGE II



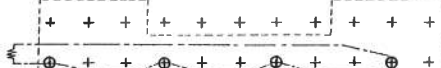
BLASTING AREA
STAGE III



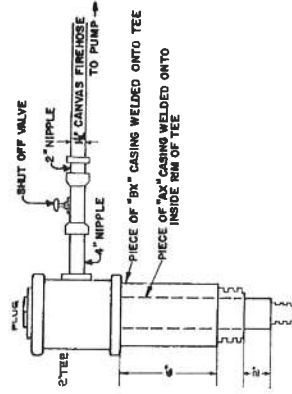
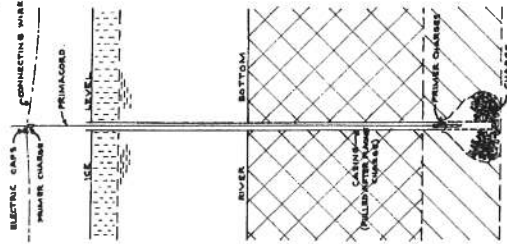
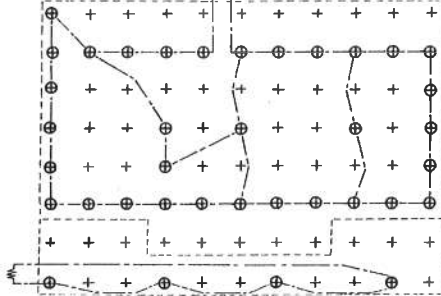
BLASTING AREA
STAGE IV



BLASTING AREA
STAGE V



BLASTING AREA
STAGE VI



JETTING TEE FOR 8" X 8" CASING

LEGEND

- ⊕ CHARGE PRIMED AND POSITIVELY FIRED
- + CHARGE, FIRED BY PROPAGATION
- TO BLASTING MACHINE

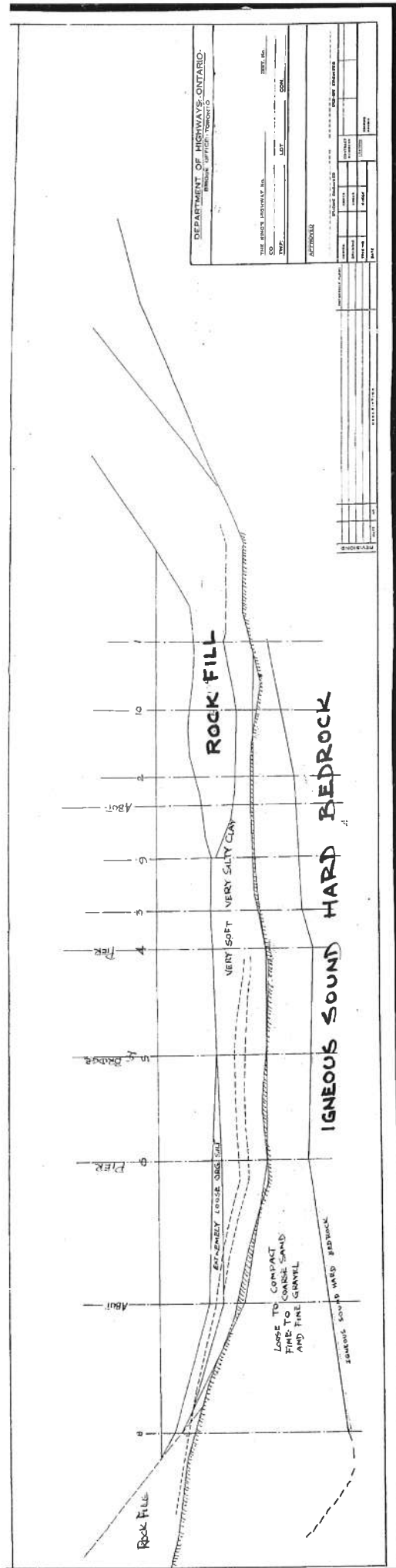
TYPICAL DIAGRAM

OF POSITIVELY FIRED CHARGE

PLAN SHOWING LAYOUT OF CHARGES

SCALE 1"=20'-0"

DEPARTMENT OF HIGHWAYS, ONTARIO		GEOCON LTD	
TORONTO		DATE SEPT. 19/60 SCALE AS SHOWN	
NAISCOOT RIVER BRIDGE		TOWNSHIP OF HARRISON	
DETAILS OF BLASTING PROGRAMME		NO. S 7064-4	



DEPARTMENT OF HIGHWAYS, ONTARIO
BRIDGE OFFICE, TORONTO

THE BRIDGE, BETWEEN R.R. AND HIGHWAY 101
TWP. 10 N. 10 W. 10 E. CO. 10

APPENDIX

NO.	DESCRIPTION	DATE	BY	CHECKED	DATE	BY
1	REVISION					
2	REVISION					
3	REVISION					
4	REVISION					
5	REVISION					
6	REVISION					
7	REVISION					
8	REVISION					
9	REVISION					
10	REVISION					

NO.	DESCRIPTION	DATE	BY	CHECKED	DATE	BY
1	REVISION					
2	REVISION					
3	REVISION					
4	REVISION					
5	REVISION					
6	REVISION					
7	REVISION					
8	REVISION					
9	REVISION					
10	REVISION					

PLANNING NOTES

641.

2-7064 NAISCOOT BRIDGE SITE BLANK

PRINC:

EXPERIMENTS

SKETCH OF TEST PROBINGS

