

Mr. A. M. Teye,  
Bridge Engineer.  
Materials & Research Division,  
(Foundations Section)

November 8, 1961.

FOUNDATION INVESTIGATION REPORT  
By: W.A. Trow & Associates, Ltd.

Attention: Mr. J. McCombie.

Re: W.P. 189-40,  
Sutherland Creek Crossing,  
Rwy. #2, near Quebec City,  
District #9.

We have reviewed the Consultants' report for the above structure, and are of the opinion that it contains sufficient information for your future design work in connection with this project.

If further assistance is required, please do not hesitate to contact our Office.

MSB/MSF  
Attach.

cc: Messrs. A. M. Teye (2)  
H. A. Trogaskes  
H. D. McMillan  
J. Ford  
L. E. Walker  
J. E. Graspier  
T. J. Kovich  
J. Roy  
R. H. Saint  
F. Moran  
A. Watt  
Foundations Office  
Gen. Files.

A. S. Sterner,  
PRINCIPAL FOUNDATION ENGR.  
Per:

*K. G. Selby*  
(K. G. Selby,  
CH. PROJECT FOUNDATION ENGR.)

Bridge Division,  
September 11, 1961.

MEMORANDUM TO:

Mr. A. Stermac,  
Principal Foundation Eng.,  
Department of Highways,  
Room 107,  
Downsview, Ontario.

Attn.: Mr. M. DeVatta

RE: W.P. 189-60  
Proposed Service Road  
Hwy. 401 (Exist. #2)  
at Sutherland Creek

Enclosed find site plan E 4019-1 and print  
of the existing structure at the above location.  
As we discussed would you kindly have a foundation  
investigation carried out here at your earliest con-  
venience.

A handwritten signature in dark ink, appearing to be 'J. Curtis', with a large, sweeping loop at the end.

JC/bm

J. Curtis,  
Bridge Location Engineer.

c.c. N.D. Smith

OFFICE LOCATION -  
DOWNSVIEW AVE.,  
KEELE ST. - HIGHWAY 401  
TORONTO, ONTARIO.



ONTARIO

DEPARTMENT OF HIGHWAYS

POSTAL ADDRESS -  
DEPARTMENT OF HIGHWAYS  
PARLIAMENT BUILDINGS,  
TORONTO 5, ONTARIO.

Bridge Division,  
December 1, 1961.

MEMORANDUM TO:

Mr. A. G. Stermac,  
Principal Foundation Eng.,  
Department of Highways,  
Room 107, Lab. Bldg.,  
DOWNSVIEW, Ontario.


RE: W.P. 189-60  
Hwy. 401 Service Rd. at  
Sutherland Ck., 2.3 Mi.  
W. of Quebec Boundary  
Dist. No. 9

Enclosed find one print (D4962-P) of the preliminary plan for the subject structure.

The designer has used steel H-piles contrary to the recommendations of the foundation report. The reason we have chosen this type of pile was because of the strong possibility that this structure would be awarded to the same contractor to whom the upstream structures are awarded. In this case we are likely to get a very low unit price for piling.

Would you kindly let us have any comments you might like to make.

JBC/ea  
cc. D. Smith

  
J. B. Curtis,  
Bridge Location Engineer.

NO COMMENT

WILLIAM A. TROW AND ASSOCIATES LTD.

SITE INVESTIGATIONS  
LABORATORY TESTING  
SOIL MECHANICS CONSULTATION

23-62-82

W. A. TROW, M.A.S.C., M.E.I.C., P.ENG.

1850 JANE ST.,  
WESTON, ONT.  
CH. 1-4644

W.P. 189-60

Project: J 542B

October 28, 1961.

Mr. A. Rutka,  
Acting Materials and Research Engineer,  
Department of Highways of Ontario,  
Parliament Buildings,  
Toronto, Ont.

Attention: Mr. N. D. Stermac, P. Eng.,  
Principal Soils & Foundations Engineer

WP 118-59

Foundation Conditions  
Bridge Replacement  
Hwy. 2, Sutherland Creek

Dear Sirs:

The enclosed report describes the foundation conditions existing at this bridge site.

The predominating soil type was found to be a deposit of dense gravelly sandy silt till. Although it is possible to found the replacement bridge on this material just below creek bed level, the problems associated with excavation and construction well below the river surface may cause this alternative to be uneconomic.

Support on timber piles, end bearing about 22 feet below the creek surface, therefore, has been recommended. A capacity of 20 tons should be developed in each pile at this depth. Because the upper levels of till are somewhat denser than the conditions prevailing for the Hwy. 401 structure just upstream, the contractor should be advised that jetting of some of the piles may be required in order to reach this refusal depth.

Steel H piles driven to bedrock, which occurs about 10 feet lower down than the timber pile refusal depth, also have been considered. Since the lower levels of till contains boulders up to 2 feet in thickness some distortion of H piles should be anticipated during driving to bedrock.

WILLIAM A. TROW AND ASSOCIATES LTD.

We shall be pleased to discuss any queries that may occur to you after you have reviewed the contents of this report.

Yours very truly,

*W. Trow*

William A. Trow (P. Eng.)

WAT/lt  
Encl.

DEPARTMENT OF HIGHWAYS OF ONTARIO  
MATERIALS AND RESEARCH DIVISION  
PARLIAMENT BUILDINGS, TORONTO, ONT.

FOUNDATION INVESTIGATION  
BRIDGE REPLACEMENT, HWY. NO. 2  
SUTHERLAND CREEK

Project: J 542 B

William A. Trow & Associates Ltd.

October 28, 1961.

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Appendix A - Field Investigation Methods

ENCLOSURES

Borehole Location and Estimated Stratigraphy	Dwg. 1
Borehole Profiles, Holes 1 and 2	2 & 3
Photographs of Site.	

FOUNDATION INVESTIGATION  
BRIDGE REPLACEMENT  
HWY. 2, OVER SUTHERLAND CREEK, ONT.

Project

The proposed construction of Highway 401 in this area incorporates the realignment of Hwy. 2 to the north of the present location.

The existing route of Hwy. 2 is to be improved for use as a service road for Hwy. 401. Consequently, replacement of the existing bridge with a 40 foot span structure is proposed. The existing approaches will be utilized for this new construction.

This report presents the results of the field investigation at this site, and discusses the foundation requirements. This field investigation was carried out simultaneously with a similar survey for the proposed upstream structures carrying Hwys. 2 and 401. The results of this latter investigation are presented in a separate report, reference to which is made in this presentation.

Site Description

At this site, Sutherland Creek is a slow moving stream about 140 feet wide. A considerable swamp growth of reeds and rushes extends for some distance from each bank.

At the bridge site, however, the west approaches have been extended, for a distance of about 90 feet, towards the 37 foot span bridge. Immediately upstream and downstream of this embankment fill, the water is about 5 feet deep over 6 to 12 inches of organic muck.

As mentioned in the report on the proposed upstream structures, the surrounding surface topography indicates a glacial till soil on the west bank. Similarly, a lake bed, or marine deposit, is indicated to the east of the stream.

Water level in the creek remained relatively constant during the investigation at about Elev. 152.6 feet.

Soil Types Encountered

Two borings were put down at this site in the positions shown in Dwg. 1. Dynamic cones were driven beside each boring. The results of these holes are shown in the borehole logs, presented as Dwgs. 2 and 3 of this report. The relevant data from these logs is summarized in the estimated stratigraphical profile on Dwg. 1.



Reference to these drawings show the soil conditions to be essentially similar to those encountered at the upstream site. The principal foundation material is again a sandy silt gravel till, but it exists in a denser state in the upper levels than farther upstream.

Between Elev. 126 and 128 feet, the till becomes very dense with frequent cobbles and boulders. A 2-foot thick boulder was cored in borehole 2 on the west bank. Limestone bedrock was encountered and proved at Elev. 118 to 120 feet, or about 5 feet higher than the upstream site.

A surface crust of stiff marine clay was encountered on the east bank, but the existence of this soil is of no practical consequence. On the western approach, the till was encountered at about Elev. 147 feet, under 12 feet of embankment fill. Hard bottom in the creek bed is indicated on Plan E-4019-1, immediately north and south of the approach at a similar level.

Laboratory testing of these foundation soils was not considered necessary.

#### Discussion of Foundation Requirements

The choice of the most suitable type of bridge support represents the only foundation problem at this site. Embankment stability is not a factor here.

Since the natural till below Elev. 147 feet at this site is somewhat denser than at the Hwy. 401 crossing, footings could be founded in it about 4 feet below creek bed level, utilizing a net bearing pressure of 4000 p.s.f. However, excavation to this depth will involve work well below the water table, and the problems associated with this construction condition. As pile driving equipment will be on the site, it is assumed that either steel H piles or end-bearing timber piles will be more economic.

As mentioned in the report on the proposed Highways 401 and 2 structures, it is considered that potential long term yielding and settlement of individual H-piles is possible due to the effects of distortion and damage suffered when driving through the dense boulder till. Hence, it is recommended that the alternative of end-bearing timber piles be used. Timber piles should encounter refusal at approximate Elev. 130 ft., or about 22 feet below the surface of the creek. Refusal should be designated as 8 blows per inch penetration under a driving energy of 8750 ft.lbs. per blow. Since there is about 3 to 5 feet of dense till over the boulder deposit, positive end support should be obtainable. It is considered that the piles should be fitted with steel shoes for driving into this gravel till. A design load of 20 Tons per pile is recommended.

However, the use of 60 Ton capacity H-piles for this and the upstream project may be preferred for economic reasons. If the decision is made for this type of pile, they should be driven to a resistance of 12 to 15 blows per inch penetration, under a driving energy of 15,000 ft. lbs. per blow. It is quite possible that refusal may be encountered in the dense boulder till some distance above bedrock. A heavy section pile should be used to minimize any distortion and buckling that may occur. It would be desirable to design the pile cap to adequately distribute loads to other piles if any one pile yields, as recommended for the upstream project.

A load test would be desirable on piles meeting refusal in the till.

### Conclusions and Recommendations

- 1) Medium dense to dense sandy silt gravel till underlies the site to a depth of about 33 feet below creek level. The lower 6 to 8 feet is very dense with a high concentration of boulders. This dense stratum covers limestone bedrock at Elev. 118 to Elev. 120 feet. Silty clay in the natural state or as fill was encountered just below ground surface.
- 2) Timber piles with steel shoes are recommended for support of the proposed structure. A capacity of 20 Tons is suggested.
- 3) Some objections to the use of steel H-piles, presented in the submission on the upstream project, are summarized in this report. Nevertheless, considerable economy may be achieved by the use of these piles for the combined projects. Certain precautions and recommendations covering the use of these piles are again reiterated in this report.
- 4) There is no embankment stability problem.

PI/lt  
Oct. 28/64



A handwritten signature in dark ink, appearing to read "P.G.M. Imrie".

Peter G.M. Imrie (P.Eng.)

APPENDIX A

Field Investigation Methods

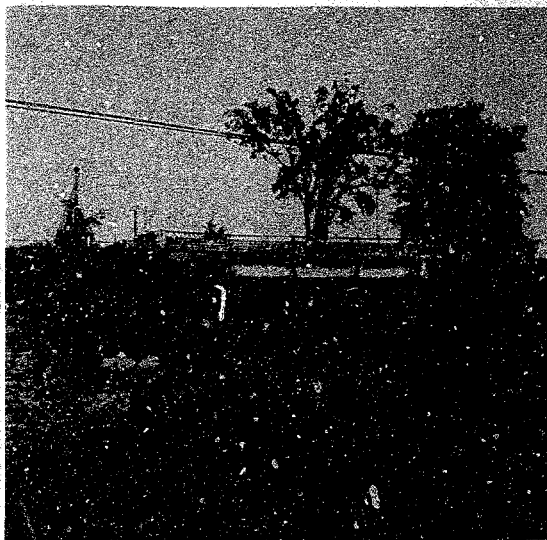
The two borings at this site were put down in conjunction with the investigation of the upstream Highways 2 and 401 crossings, utilizing two conventional diamond drills equipped for soil sampling purposes. Both holes were taken to bedrock, which was proved by recovery of AX core. Progress through the boulders overlying bedrock was very slow and was achieved by alternately drilling ahead with AX core barrel and BX casing. Dynamic cones were driven adjacent to the borings.

Disturbed samples of the various soil strata were obtained by driving a standard 2 inch outside diameter split spoon sampler into the soil ahead of the boring. The number of 350 ft.lb. hammer blows required to extend the penetration of the split spoon from 6 inches to 18 inches was recorded as the penetration resistance of the soil. Upon recovery, the samples were inspected, and retained in moisture proof plastic bags.

Undisturbed samples of the clay deposit were obtained by pressing a 2-inch inside diameter shelby tube sampler into the soil ahead of the boring. Upon recovery, the tubes were sealed with low melting point wax for transportation to the laboratory.

In view of the relatively straightforward soil conditions encountered, laboratory testing of the recovered samples was considered unnecessary.

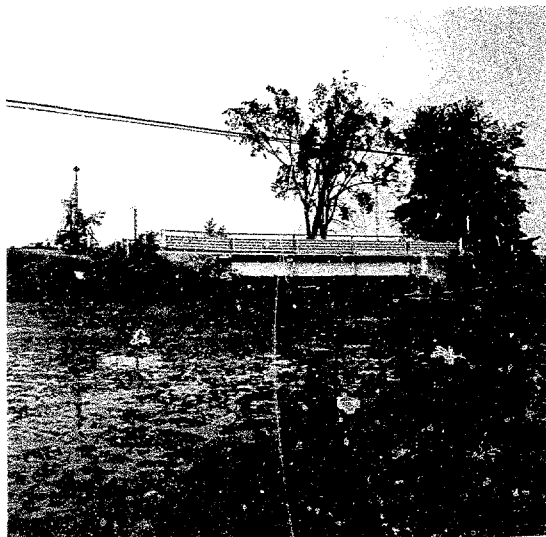
The elevation of the borings was referred to a bench mark in a maple tree on the east bank. The level of this bench mark was taken as Elev. 159.03 feet.



View looking North (Upstream)  
Drill on BH 2



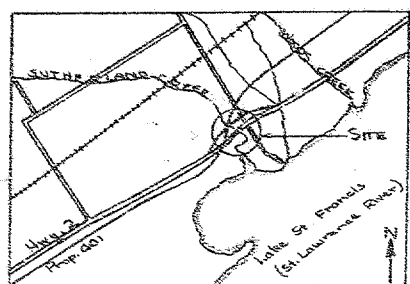
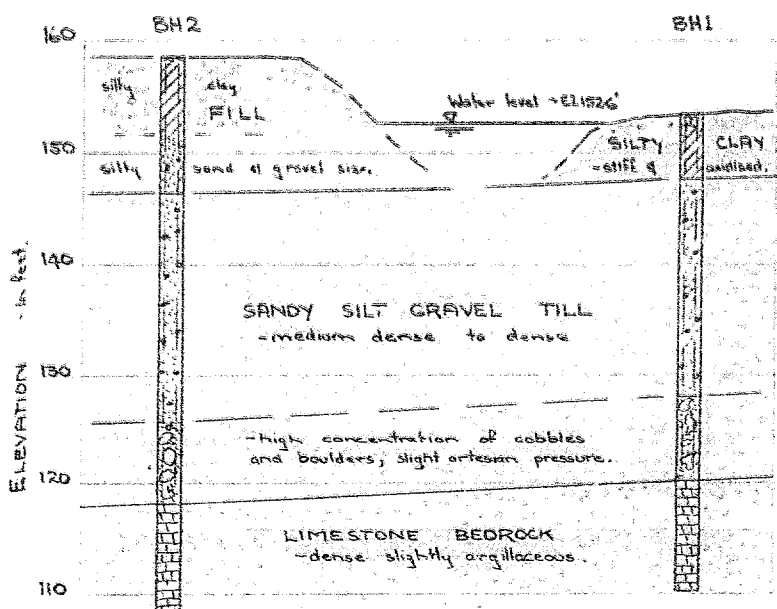
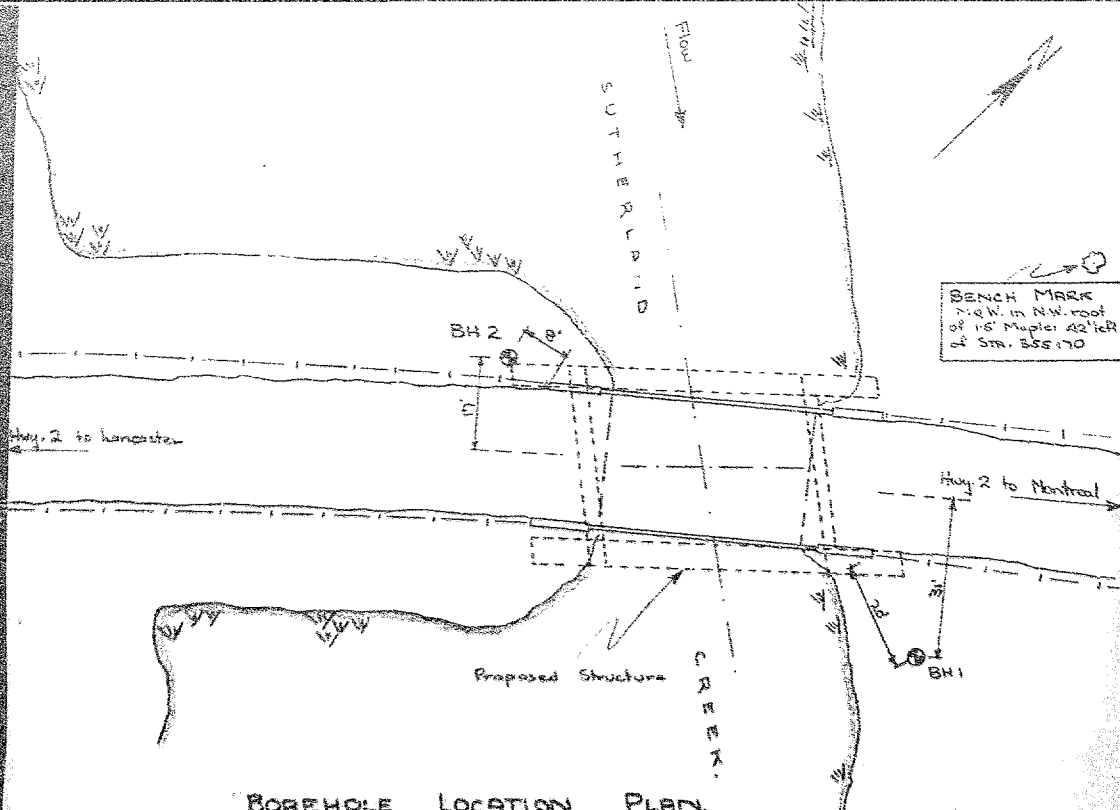
View looking Southeast (Downstream)  
Drill on BH 2



View looking North (Upstream)  
Drill on BH 2



View looking Southeast (Downstream)  
Drill on BH 2



# FOUNDATION INVESTIGATION BRIDGE REPLACEMENT

Hwy. 2, over SUTHERLAND CREEK

WILLIAM A. TROW & ASSOCIATES LTD  
J5428 DWG. 1

BRIDGE NO. 1  
PROJECT: Bridge Replacement,  
Sutherland Creek, Lancaster, Ont.  
DATE: See Drg. 1.  
HOLE LOCATION: 153.3 ft.  
HOLE ELEVATION: See Drg. 1.  
DRAIN: See Drg. 1.

## PENETRATION RESISTANCE

2" O.D. SPLIT TUBE  $\bigcirc - \bigcirc - \bigcirc$   
1" O.D. SHELBY TUBE  $\rightarrow - \rightarrow - \rightarrow$   
3" O.D. CONE  $\text{---}$

## SHEAR STRENGTH

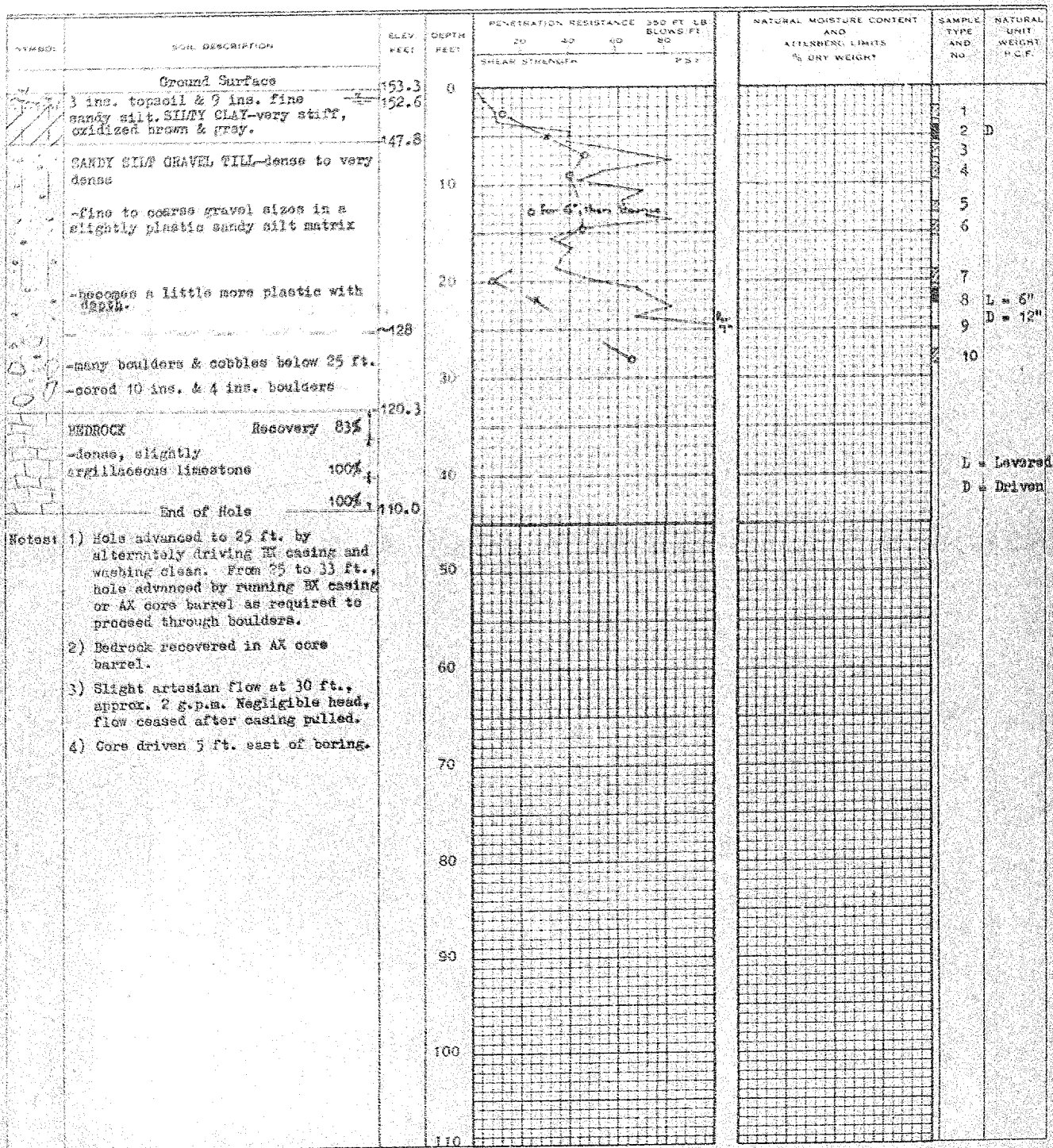
UNDRAINED TRIAXIAL  
AT OVERBURDEN PRESSURE  $\oplus$   
UNCONFINED COMPRESSION  $\otimes$   
VANE TEST AND DENSIVITY  $\pm, \frac{1}{5}$

NATURAL MOISTURE CONTENT  
AND LIQUIDITY INDEX

## ATTERBERG LIMITS

LIQUID LIMIT  $\bigcirc$ PLASTIC LIMIT  $\text{---}$ 

## SAMPLE TYPE

2" O.D. SPLIT TUBE  $\text{---}$ 2" O.D. SHELBY TUBE  $\text{---}$ 3" O.D. SHELBY TUBE  $\text{---}$ 

## LEGEND

## PENETRATION RESISTANCE

2" O.D. SPLIT TUBE —○—○—  
 2" I.D. SHELBY TUBE —\*—\*—\*—  
 2" DIA. CONE ————

## SHEAR STRENGTH

UNDRAINED TRIAXIAL  
 AT OVERBURDEN PRESSURE ⊕  
 UNCONFINED COMPRESSION ⊙  
 VANE TEST AND SENSITIVITY  $\frac{1}{s}$

## NATURAL MOISTURE CONTENT

AND LIQUIDITY INDEX

## ATTERBERG LIMITS

LIQUID LIMIT —○—

PLASTIC LIMIT ———

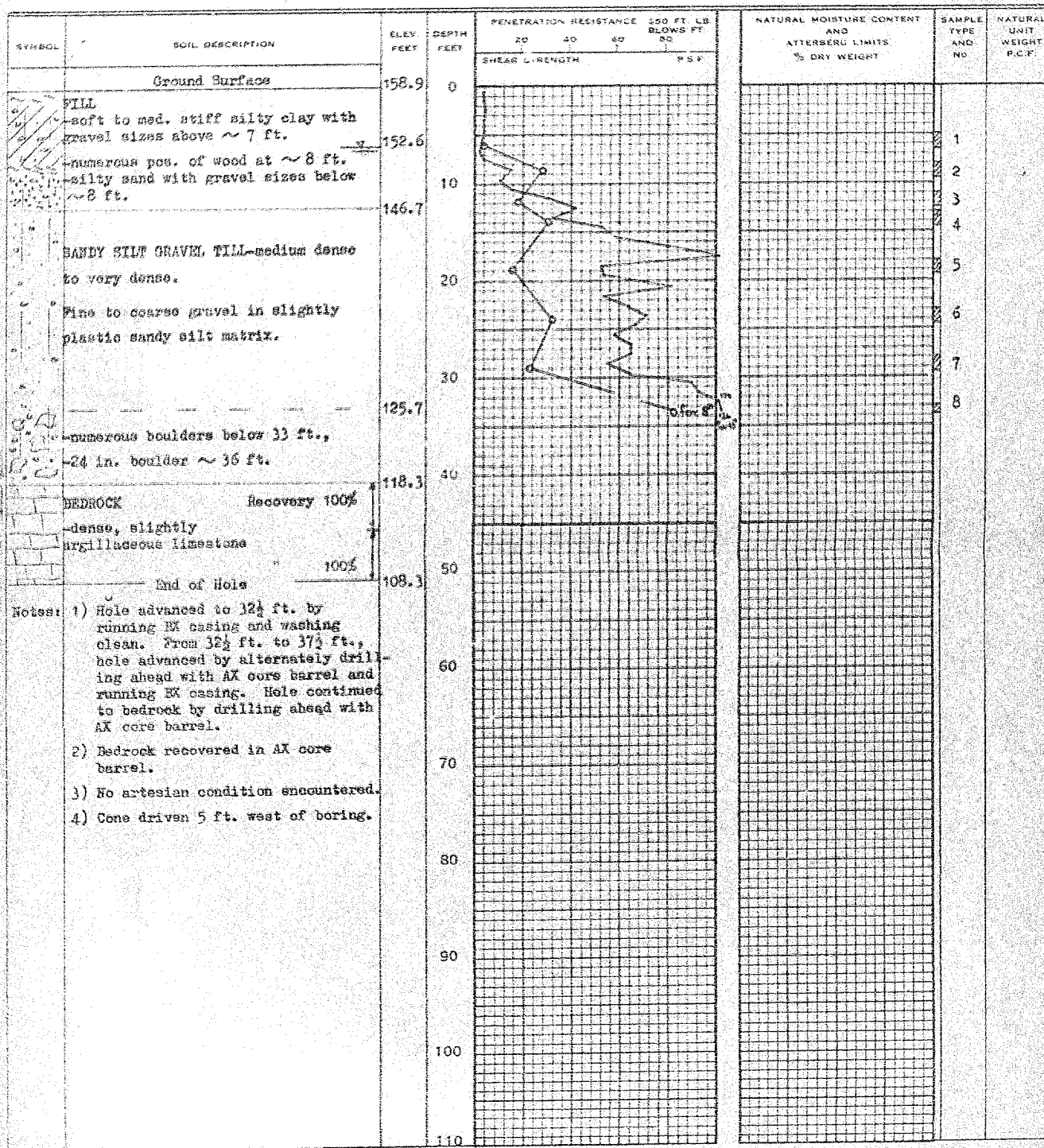
## SAMPLE TYPE

2" O.D. SPLIT TUBE ———

2" I.D. SHELBY TUBE ———

3" O.D. SHELBY TUBE ———

BOREHOLE NO. 2  
 PROJECT Bridge Replacement,  
 LOCATION Sutherland Creek, Lancaster, Ont.  
 HOLE LOCATION See Dwg. 5  
 HOLE ELEVATION 158.9 ft.  
 DATUM See Dwg. 5.





#61-F-203-C

W.P.#189-60

HWY.#2

SUTHERLAND

CREEK CROSSING

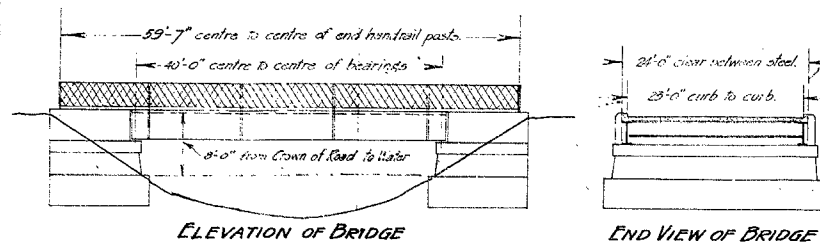

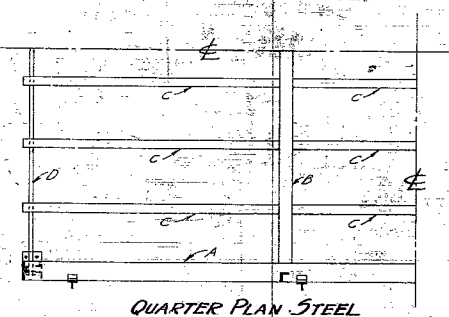
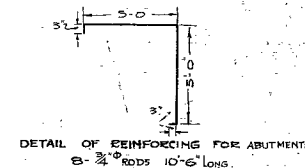
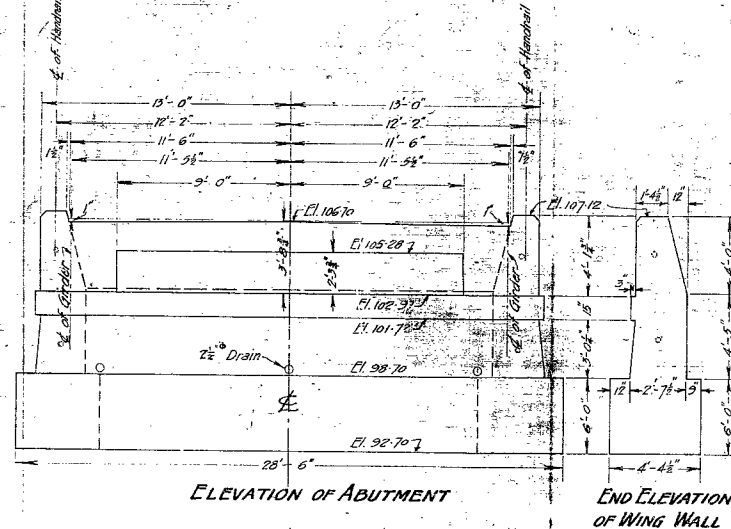
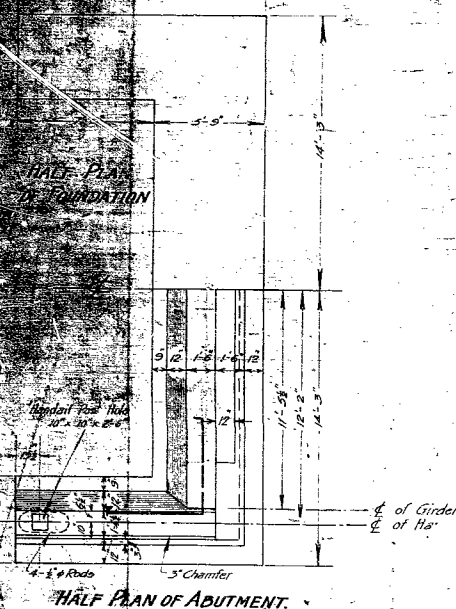
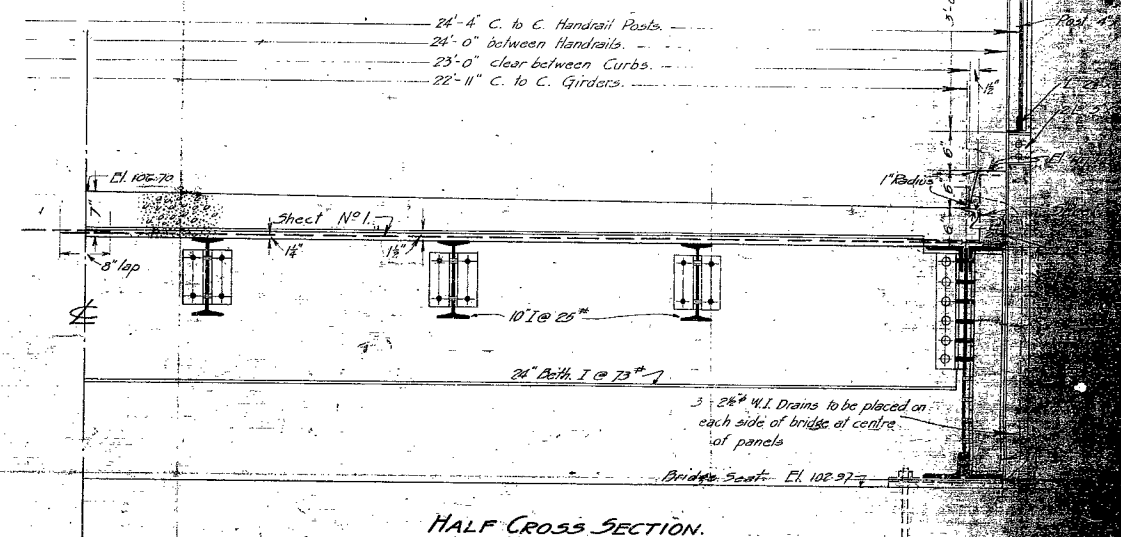
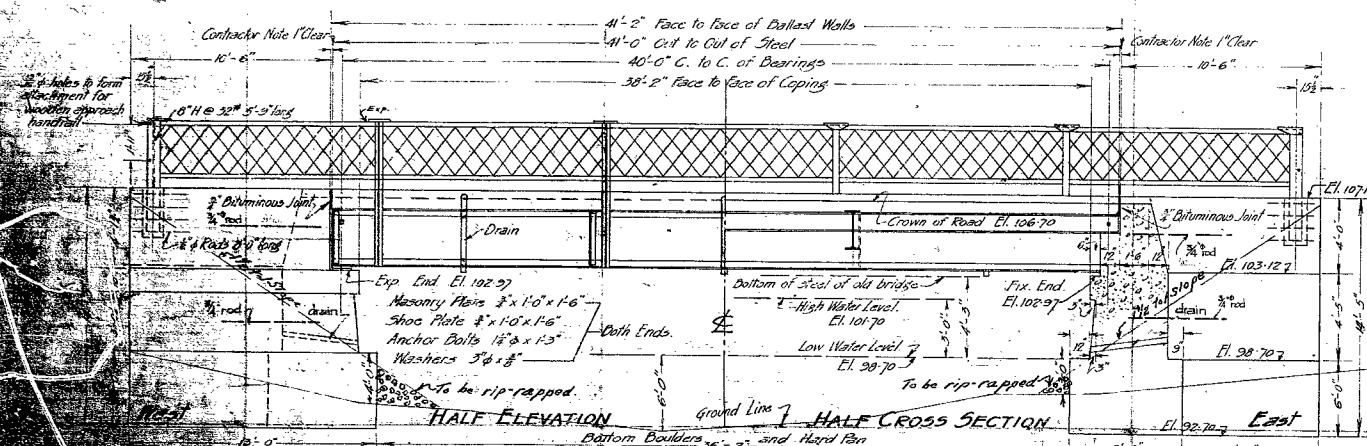


Table of Reinforcement for Floor				
Mark	Size	Designation	Quantity	Detail
N <sup>o</sup> 1.	5'9" x 12'0"	3 : 9 : 35	16	Straight
N <sup>o</sup> 2.	5'9" x 2'0"	3 : 9 : 35	16	

length of diamond - 8" - must be placed at right angles to stringers in all cases  
Curbs to be poured at same time as floor.

Use standard beam connections  
Rivets  $\frac{3}{4}$ "  $\phi$ , open holes  $\frac{13}{16}$ "  $\phi$ , except  $\frac{3}{4}$ " rivets  
in handrail lattice bars.  
Concrete in Abutments 174 cu. yds.  
Concrete in Floor 109.5 sq. yds.  
Depth of Foundations subject to revision by Engineer  
3 - 2"  $\phi$  Drains to be placed in face of each abutment  
4 - 2"  $\phi$  Rods to be lapped round each handrail  
post hole as reinforcement.



A. Plate Girder - Pl.  $36 \times \frac{1}{2}$ " and 4 L $6 \times 4 \times \frac{3}{8}$ " Stiffeners L $25 \times 3 \times \frac{3}{8}$   
 B. Floor Beam - 24" Beth. I @ 73"  
 C. Stringer - 10" I @ 25"  
 D.  $\frac{3}{4}$ "  $\phi$  Rod and W.I. Pipe Separators.

PROPOSED BRIDGE  
OVER  
SUTHERLAND'S CREEK  
Township of Lancaster  
Lot 10  
Provincial Highway - Johnstown  
to East Boundary.

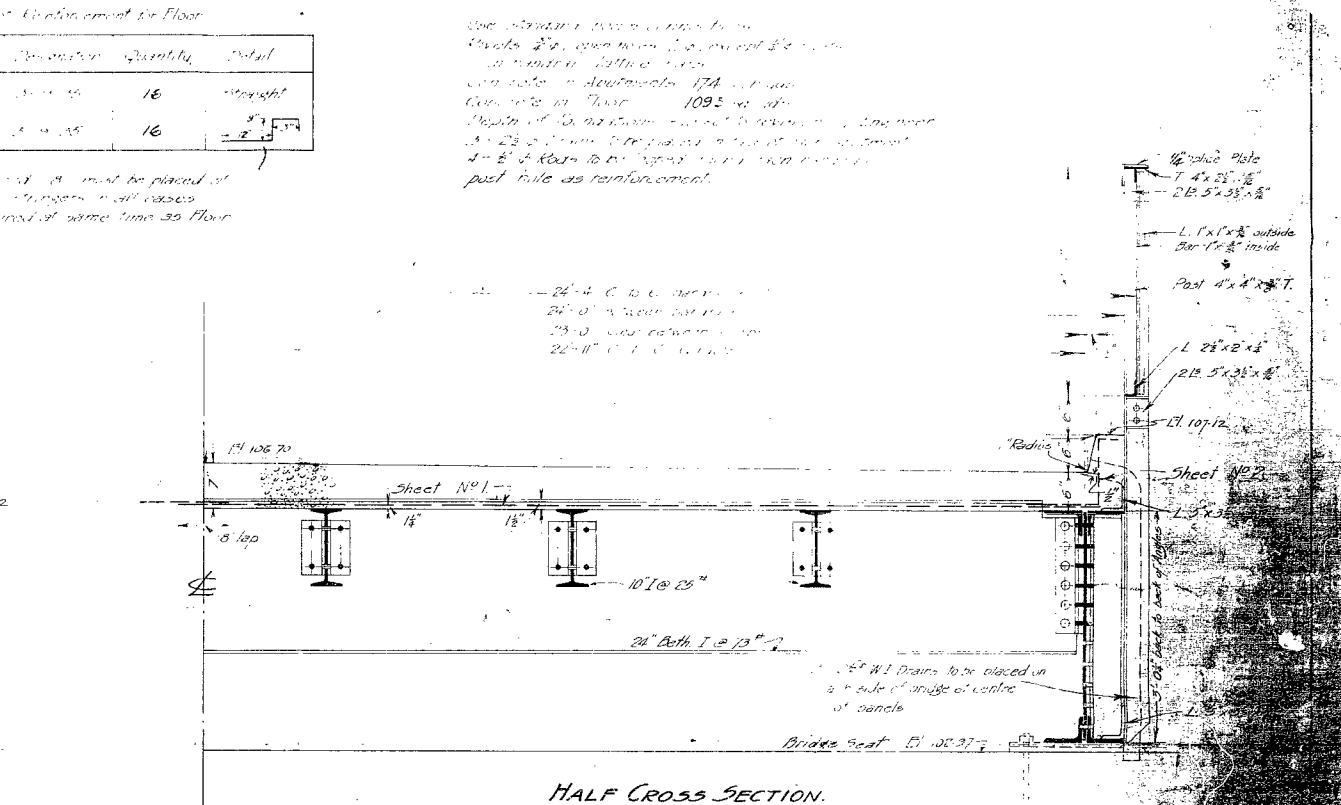
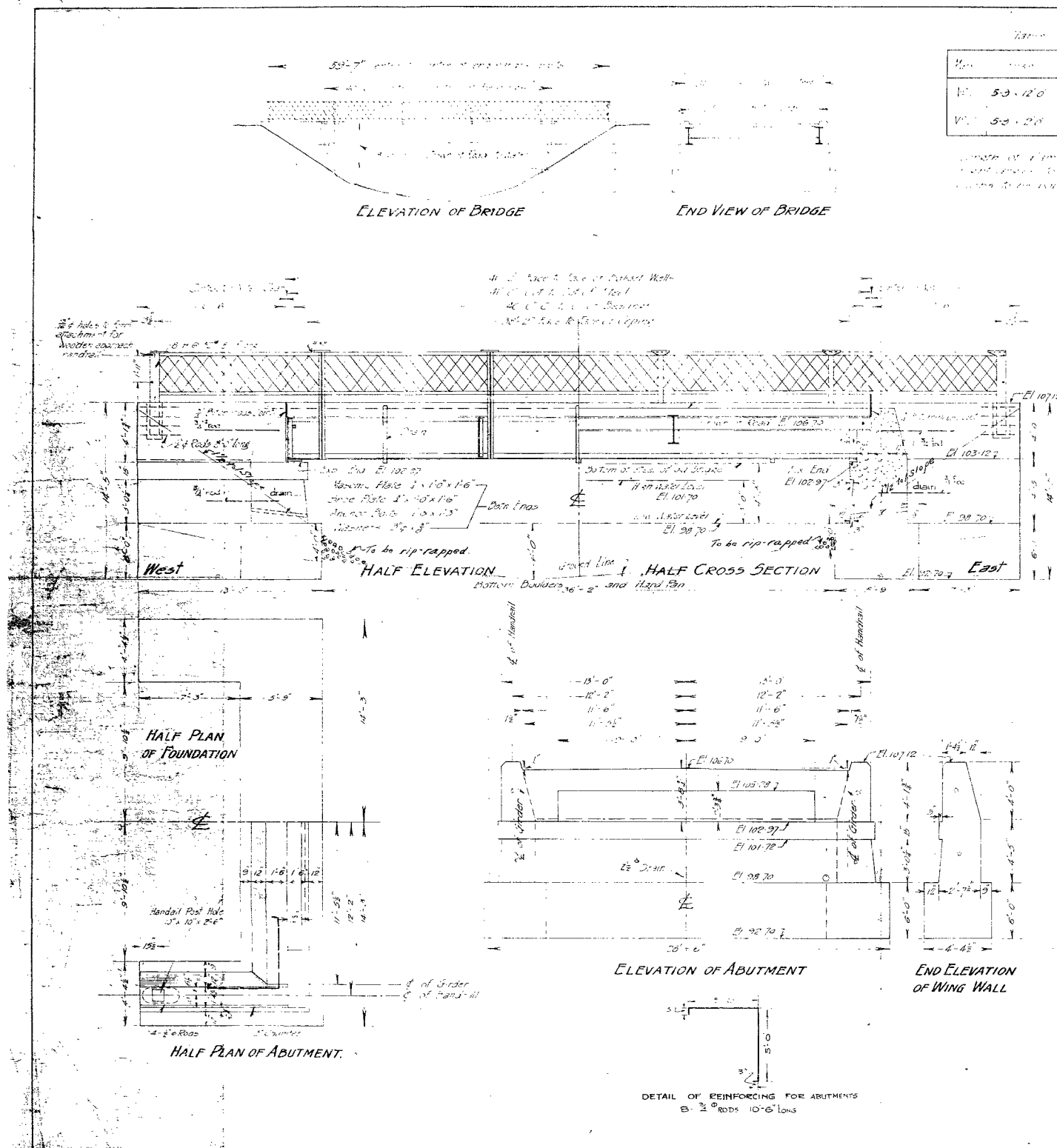
Scales:- Concrete - 1 in. = 4 ft.  
Steel Details - 1 in. = 1 ft.

Approved

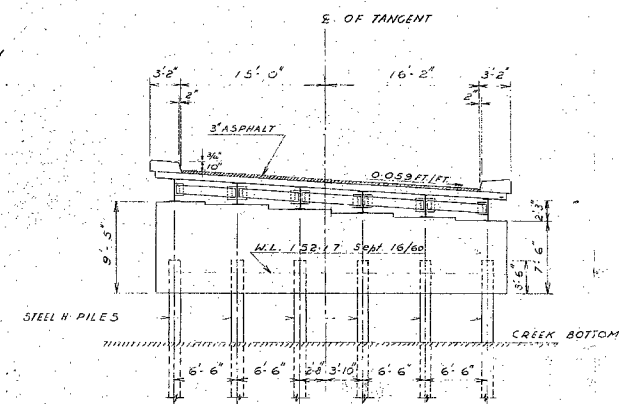
*Geo. Hogarth* *Beauchamp*  
Chief Engineer Deputy Minister

Department of Public Highways, Ontario.  
May 2<sup>nd</sup> 1928  
Toronto, ~~October 22nd 1929~~

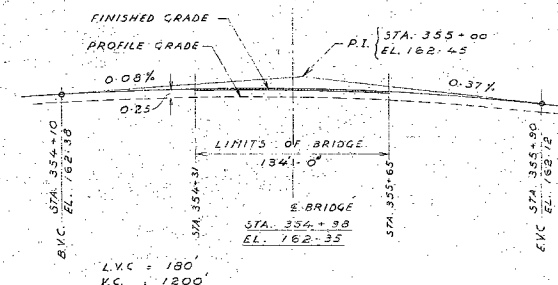
Structure No 17  
Project No 5.



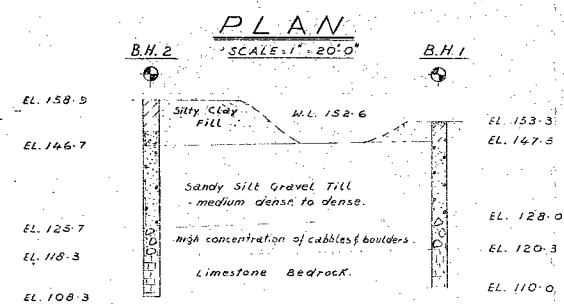




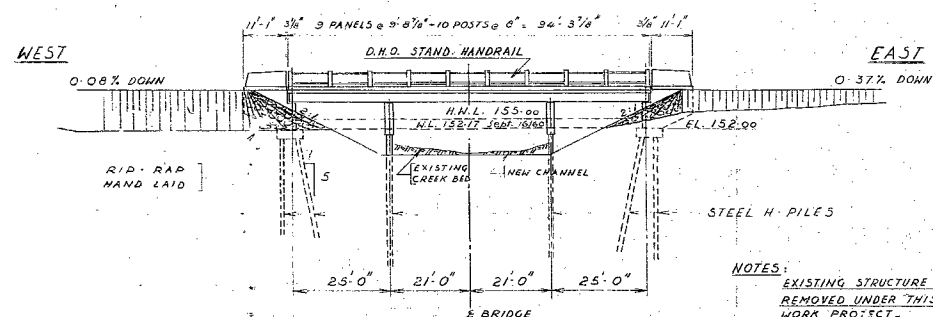
SECTION A-A  
SCALE 1/8" = 1'-0"



PROFILE OF SERVICE ROAD  
(NOT TO SCALE)



### SECTION OF BOREHOLES

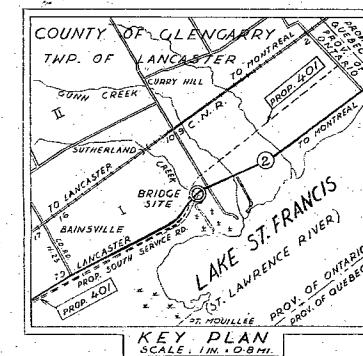


SOUTH ELEVATION  
SCALE: 1" = 20'-0"

NOTES:  
EXISTING STRUCTURE TO BE  
REMOVED UNDER THIS  
WORK PROJECT.

[illegible]

SHEET No.	TOTAL SHEET



THE GENERAL CONTRACTOR IS RESPONSIBLE FOR FINISHING THE BRIDGE SEATS DECK LEVEL TO THE SPECIFIED ELEVATIONS WITH A TOLERANCE OF PLUS OR MINUS 1/8 INCH. IF THEY ARE CAST TOO THIN, THEY SHALL BE RUSH HAMMERED DOWN BY THE GENERAL CONTRACTOR. IF THEY ARE CAST TOO LOW, THE GENERAL CONTRACTOR SHALL PROVIDE FULL BEARING SHIM TO BRING THEM UP TO THE CORRECT ELEVATIONS. THE USE OF GROUT IS PROHIBITED. THE GENERAL CONTRACTOR SHALL BE RESPONSIBLE FOR ENSURING THAT THE FINAL DECK ELEVATIONS CONFORM WITH THE ELEVATIONS SHOWN. NO CONCRETE SHALL BE PLACED ABOVE BRIDGE SEAT UNTIL CONCRETE IN DECK HAS BEEN PLACED.

[illegible]

DEPARTMENT OF HIGHWAYS ONTARIO			
BRIDGE DIVISION			
Hwy. 401 SERVICE RD. AT SUTHERLAND CK. (2.3 MI. WEST OF QUEBEC BDRY.)			
KING'S HIGHWAY No. 401 SERVICE RD.		DIST. No. 9	
CO. GLENGARRY			
TWP. LANCASTER	LOT 10	CON. 1	
PRELIMINARY			
APPROVED _____		SITE No. _____	
BRIDGE ENGINEER		W.F. No. 189-6	
DESIGN _____	CHECK _____	CONTRACT No. _____	
DRAWING _____	CHECK _____		
DATE _____	LOADING _____	DRAWING No. D-4962-A	