

GEOCRES No. 310-174DIST. 7 REGION W.P. No. CONT. No. W. O. No. 73-11208MSTR. SITE No. 32-151HWY. No. LOCALLOCATION PIGEON RIVER CROSSINGCON IX & IX COUNTY OF VICTORIANo of PAGES - =====OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT. REMARKS:

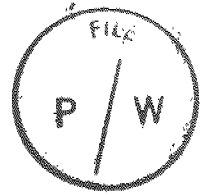
31D-174

TOTTEN SIMS HUBICKI ASSOCIATES LTD.

1500 HOPKINS STREET

P. O. BOX 149

WHITBY, ONTARIO



73-F-208 M.

REPORT ON SOIL CONDITIONS

PIGION RIVER CROSSING

AT CONCESSIONS IX & X

OPS TOWNSHIP, COUNTY OF VICTORIA

STRUCTURE SITE No. 32-151

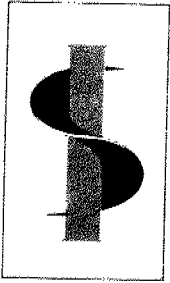
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STRUCTURAL  
OFFICE

JOB #633A (Supersedes #633 report  
dated September 1972)

FEBRUARY 1973



SITE INVESTIGATION SERVICES  
LIMITED

677 CROWN DRIVE PETERBOROUGH, ONT. PHONE 743-6850

February 16, 1973

Totten Sims Hubicki Associates Limited  
1500 Hopkins Street  
P. O. Box 149  
Whitby, Ontario

Attention: Mr. G. Aleong

Re: Soils Report - Pigeon River Crossing

Dear Sir:

We are pleased to submit 4 copies of our report on subsurface soil conditions for the above project. This report supersedes our earlier report on the project, dated September 1972 and includes all relevant data from that report.

I trust that you will find the information straightforward, but if there are any further questions about the site or the report, please do not hesitate to contact me at your convenience.

Yours very truly,

R. Marttila, P. Eng.

RM/jc

for SITE INVESTIGATION SERVICES LIMITED

# SOILS REPORT - PIGEON RIVER CROSSING

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REPORT ON SOIL CONDITIONS - PIGEON RIVER CROSSING

INTRODUCTION

A subsurface soils investigation has been completed at the proposed Pigeon River Crossing at Concessions IX and X of Ops Township, County of Victoria. Results of boreholes drilled on the north abutment in September 1972 were discussed in our earlier report dated September 1972. This report also includes information from boreholes drilled at the south abutment in February 1973. This report supersedes the 1972 report and includes all relevant data from that report.

The boreholes on the north abutment were advanced from the surface of a partially completed approach fill which crosses a broad, flat, marshy river flood plain. The south abutment holes were drilled from the ice surface.

The site is underlain by a few feet of organic soils over medium to stiff clay. The clay extends down to a thin layer of glacial till which in turn rests on bedrock near elevation 50 to 52, roughly 24 to 26 feet below the proposed bridge level.

Conditions are suitable for a pile-supported structure.

REPORT ON SOIL CONDITIONS - PIGEON RIVER CROSSING

BACKGROUND INFORMATION

Authorizing Agency: County of Victoria

Design Engineers: Totten Sims Hubicki Associates Limited

Enclosed Data: Location plan, inferred soil stratigraphy, summaries of borehole and cone probe data, and an explanation of soil symbols and terminology.

FIELD WORK INFORMATION

Drilling Period: September 15, 1972 and February 12, 1973

Number of Boreholes: Three boreholes and one dynamic cone probe located as shown on Figure 1.

Sampling and Testing: Split spoon sampling, with measurement of standard penetration values, dynamic cone probe test, field vane shear tests and Shelby tube sampling.

Drilling Equipment: A truck-mounted power drill equipped with hollow stem augers was used at the north abutment and a power drill mounted on a track vehicle and equipped with hollow stem augers was used for the south abutment holes.

REPORT ON SOIL CONDITIONS - PIGEON RIVER CROSSING

SOIL CONDITIONS

The bridge site is located within a broad flood plain of the Pigeon River and most of the flood plain is covered with water or is wet and marshy in appearance. The high water level in the site area is maintained by a small dam located about 1500 feet downstream of the bridge site.

Access to the bridge site was provided by a partially constructed approach embankment which extends from the north river bank, across the flood plain to the proposed bridge site. Holes off the embankment were drilled from the ice surface.

The approach fill is composed of stoney and cobbly silty sand fill. This material is relatively loose as indicated by penetration resistances of 2 to 3 blows per foot.

The upper few feet of natural soil consists of organic soils or silty sand. These soils are underlain by 12 or 13 feet of layered silty clay to clayey silt which extends to elevation 54. The clay-silt is in turn underlain by 3 or 4 feet of silty sandy clay till which rests on bedrock. Each of the main soils types is described in more detail as follows.

## REPORT ON SOIL CONDITIONS - PIGEON RIVER CROSSING

SOIL CONDITIONS (Cont.)Organic Soils

Organic silt and peat soils occur in the upper 2 to 3.8 feet at boreholes 3 and 4 but they do not exist below the fill at borehole one and the cone probe blow counts suggest that little or no organic soils exist at cone probe 2. These recent organic soils are very soft and contain frequent small wood fragments.

Clay-Silt

At borehole 1 the highly fissured and layered silty clay to clayey silt stratum is stiff in the upper several feet, as indicated by standard penetration values of 7 to 13 blows per foot; however, it is relatively soft in the lower 2 feet where the penetration value was 2 blows per foot. At borehole 3 field tests and observations suggest that the clay-silt zone is of medium consistency in the upper few feet and stiff below elevation 70 with shear strengths in the order of 1.8 ksf.

Cone penetration resistances at hole 2 increase substantially near elevation 55.5 and the contact between the clay-silt and the underlying till soils is probably at or above this level.

The clay is moderately sensitive to disturbance, as indicated by a remoulded shear strength  $\frac{1}{4}$  of the undisturbed shear strength.



## REPORT ON SOIL CONDITIONS - PIGEON RIVER CROSSING

SOIL CONDITIONS (Cont.)

The more silty layers are also very susceptible to disturbance in excavations.

Till

The glacial till is generally well graded stoney silty sandy clay soil but a less stoney zone was noted in borehole 3. Standard penetration resistances of 24 to 53 blows per foot at borehole 1 are indicative of hard compact soils. The lower blow count of 13 in borehole 3 is probably due to disturbance from water inflow into the cased borehole. Dynamic cone penetration resistances at hole 2 suggest that a similar soil exists below elevation 55.5 at that location.

Bedrock

Borehole 1 and borehole 3 met refusal on bedrock at elevations 50.0 and 51.3 feet respectively. Refusal of the cone probe at location 2 was at elevation 54.2 feet and this is probably the bedrock level at that location. Bedrock in this area is primarily competent limestone.

The bedrock surface elevations are within a range of a few feet and significant variations in elevations at intermediate points are unlikely.

## REPORT ON SOIL CONDITIONS - PIGEON RIVER CROSSING

SOIL CONDITIONS (Cont.)Ground Water

Ground water levels are generally controlled by the level of the river which, at the bridge site, corresponds to the level of the reservoir formed by the downstream dam. A slight flow of artesian water was noted near the bedrock contact in borehole 3.

DESIGN AND CONSTRUCTION CONSIDERATIONSAbutment Support

The site is not well suited for conventional type footings because allowable loads in the clay-silt zone could not exceed 3000 psf. In addition, significant disturbance could occur in the siltier layers during construction.

The site is well suited for a pile supported structure and, provided the bridge span is acceptable, a composite timber type structure could be considered. Piles should extend to the underlying bedrock, roughly 25 to 30 feet below road grade at the abutments, and no significant driving problems can be envisaged. Creosote treated timber, steel tube or steel H piles could all develop full structural capacities.

## REPORT ON SOIL CONDITIONS - PIGEON RIVER CROSSING

DESIGN AND CONSTRUCTION CONSIDERATIONS (Cont.)

Closely spaced piles should be checked for rebound and be redriven if necessary. In this regard some rebound of displacement piles may occur since the thickness of the underlying dense glacial till may not be sufficient to fix the piles against uplift forces developed by displacement of the overlying clay.

Pile lengths may be selected on the assumption that the bedrock surface will not be significantly different than the levels determined at the actual borehole locations. An allowance of 2 or 3 feet of excess length should be more than adequate to cover possible variations.

The pile tips will be embedded in a few feet of till soil at the rock contact. In view of the very gentle rock slopes indicated by the boreholes, we consider this embedment to be more than adequate to prevent pile tips from sliding down the rock slope during driving.

Embankments

We understand that the Township of Ops will complete the approach fill prior to construction of the bridge structure.

## REPORT ON SOIL CONDITIONS - PIGEON RIVER CROSSING

DESIGN AND CONSTRUCTION CONSIDERATIONS (Cont.)North Approach

No highly compressible soils were found in borehole 1 and none was indicated by cone probe 2. Consequently no significant settlement problems are anticipated due to compression of the underlying subsoils. Completion of the approach fill in advance of bridge construction would minimize post construction settlements.

The embankment fill on the north bank has been placed in a relatively loose condition, as indicated by penetration values of 2 to 3 blows per foot. Some settlement can therefore be expected from compression of the fill. The influence of this settlement can be neutralized by replacing the fill, and any organic soils, within 10 feet of the abutment with compacted granular fill as per M.T.C. DD-415. A 5 (horizontal) to 1 (vertical) transition slope would provide an appropriate transition and the replacement fill should extend to at least elevation 66 feet.

No stability problems will arise for the 8 foot high embankment with conventional 2 to 1 side slopes.

## REPORT ON SOIL CONDITIONS - PIGEON RIVER CROSSING

DESIGN AND CONSTRUCTION CONSIDERATIONS (Cont.)South Approach

Two to 4 feet of soft organic soils exist below much of the south approach fill. It is preferable to sub-excavate these soft soils and replace them with inorganic fill. However, this is only a necessity near the actual bridge structure. At this latter location the M.T.C. DD-415 procedure suggested for the north approach fill should be used if the organic soils are sub-excavated below the adjacent embankment. Otherwise organic soils within 20 feet of the abutment should be removed and a transition slope of 10 horizontal to 1 vertical should be provided. The replacement will be required above elevation 64.

If the remainder of the approach fill is placed without removal of the organic soils, it should be done with the understanding that some displacement of the organic soils will occur during placement and that a few inches of differential settlement may occur over the first few years as the organic soils compress.

Scour Protection

The clayey subsoils are not highly erodable but the fill, organic soils and the thin sand zone above the clay can be easily eroded by flow velocities and wave action.

## REPORT ON SOIL CONDITIONS - PIGEON RIVER CROSSING

DESIGN AND CONSTRUCTION CONSIDERATIONS (Cont.)

At the abutment zone, unless flood flows are severely restricted to gain bridge economies, we would expect that the normal 12 inches of random riprap would be adequate. Since some wave action can be expected, the riprap should be underlain by at least 8 inches of coarse gravel bedding within the zone of wave action.

Some form of slope protection will be required to protect the causeway embankment. Both the fetch and water depth are small so consideration could be given to using a flattened slope of coarse gravel and cobbles, rather than riprap, to prevent wave erosion within the range of reservoir fluctuation.

Road Base

For an unpaved approach road we would suggest that the embankment fills be covered with a granular base consisting of 4 inches of granular "A" and 8 inches of granular "B". The subgrade material within 3 feet of profile grade should consist of well-compacted acceptable earth. In addition, approach fills could be built wider than normal so that the granular thickness could be increased should the road be paved in the future.

Submitted by:

SITE INVESTIGATION SERVICES LIMITED

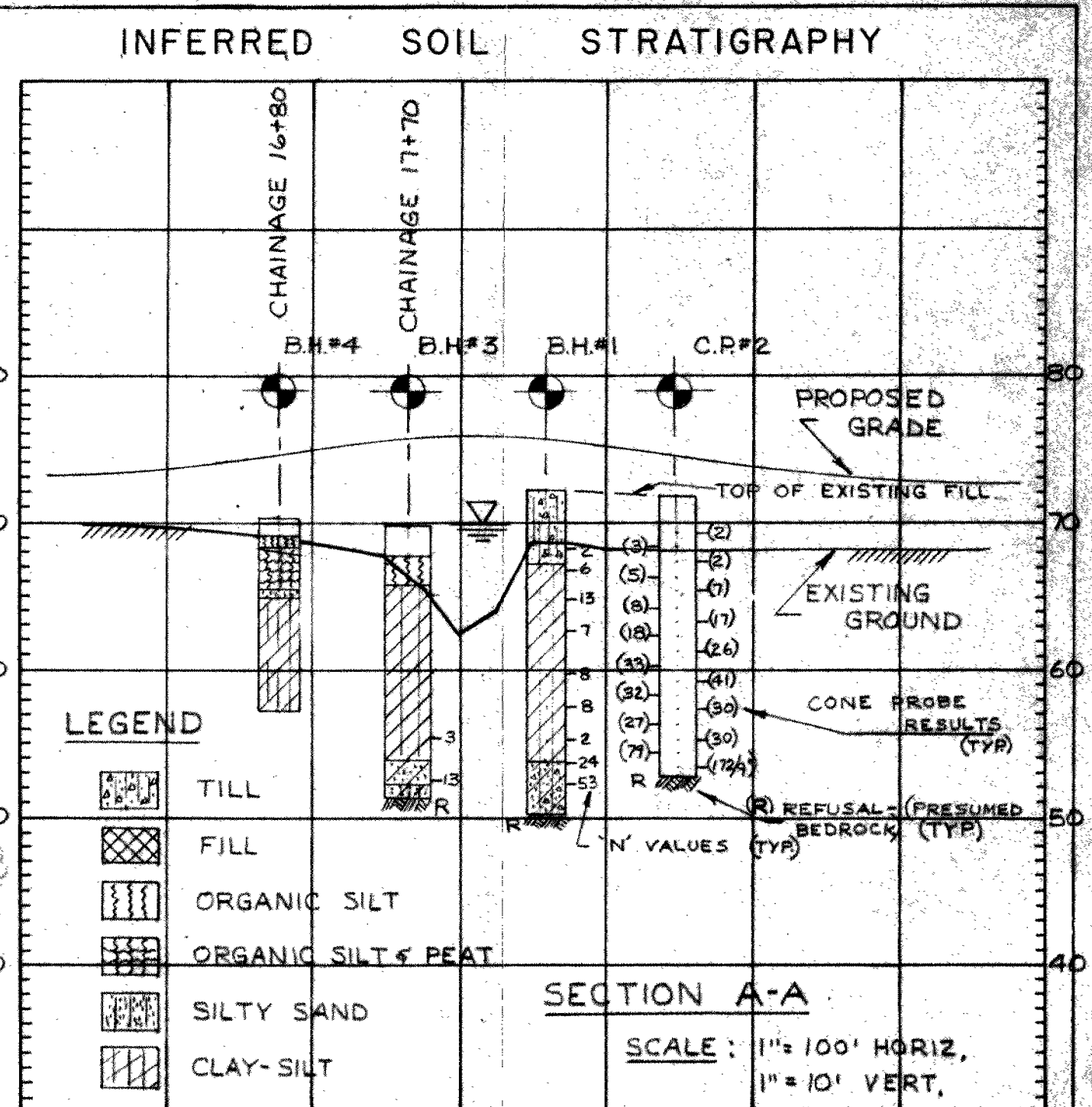
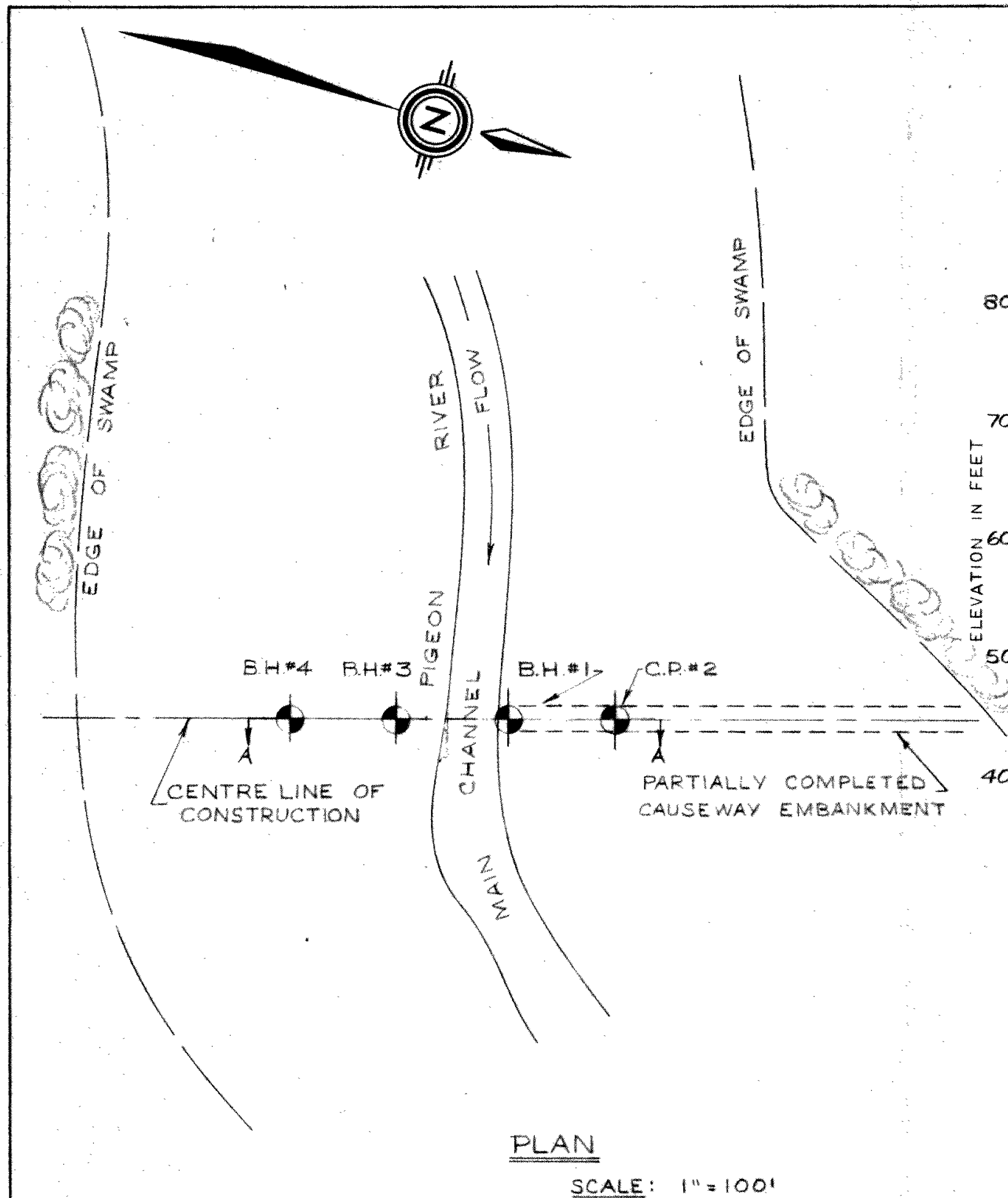
per

*R. Marttila*

R. Marttila, P. Eng.

RM/jc





NOTE - SOILS DATA APPLIES ONLY TO THE ACTUAL BOREHOLE LOCATION. CONDITIONS MAY BE DIFFERENT AT OTHER PARTS OF THE SITE.

#633 <b>SITE INVESTIGATION SERVICES LIMITED</b>			
<b>PIGEON RIVER CROSSING</b> <b>CONC IX &amp; X TWP OF OPS.</b>			
SCALE AS SHOWN	DWN. BY D.W.N	DATE FEB. '73	FIGURE # 1

# BOREHOLE DATA and TEST SUMMARY

SITE INVESTIGATION SERVICES Ltd.  JOB No: 633  BOREHOLE No: 1  FIGURE No: 2	Project - <u>PIGEON RIVER CROSSING</u> Location - <u>CONC. IX &amp; X OPS TOWNSHIP</u> Hole Location - <u>STATION 18+60 (C)</u>			Date - <u>SEPTEMBER 15, 1972.</u> Elevation Datum - <u>T.S.H. SURVEY</u> Type of Drill - <u>HOLLOW STEM AUGER</u>			<b>LEGEND</b> Penetration Tests      Moisture Contents 2" O.D. Split Spoon —○— In-Situ      ○ 2" O.D. Cone —●—●—●— Liquid Limit      — — Plastic Limit      — — (See Appendix "A" for Other Symbols)		
	SOIL DESCRIPTION	SOIL SYMBOL	ELEVATION IN FEET	DEPTH IN FEET	MOISTURE CONTENT and ATTERBERG LIMITS (%) <div style="display: flex; justify-content: space-around; width: 100%;"> <span>20</span> <span>40</span> </div>	SAMPLE TYPE AND NUMBER	PENETRATION RESISTANCE (Blows/Ft) <div style="display: flex; justify-content: space-around; width: 100%;"> <span>10</span> <span>20</span> <span>30</span> <span>40</span> <span>50</span> <span>60</span> </div> SHEAR STRENGTH (Kips/Ft <sup>2</sup> )		
	FILL - Stoney and cobbly silty sand fill - Light grey fine sand at 5'		72.5	0		DS 1			
	SILTY CLAY - Grey silty clay - Wet and softer at 8 3/4' - Saturated at 16 3/4' - Frequent clayey silt seams.		67.5	5		DS 2			
				10		DS 3			
			15		DS 4				
			20		DS 5				
CLAY TILL - Grey gravelly silty sandy clay till		50.0	25		DS 6				
NO FURTHER PROGRESS (PRESUMED BEDROCK)					DS 7				



# BOREHOLE DATA and TEST SUMMARY

SITE INVESTIGATION SERVICES Ltd.  JOB No: 633  BOREHOLE No: 2  FIGURE No: 3	Project - <u>PIGEON RIVER CROSSING</u> Location - <u>CONC. IX &amp; X OPS TOWNSHIP</u> Hole Location - <u>STATION 19+50 (b)</u>			Date - <u>SEPTEMBER 15, 1972</u> Elevation Datum - <u>T.S.H. SURVEY</u> Type of Drill - <u>CONE PROBE</u>			<b>LEGEND</b> Penetration Tests 2" O.D. Split Spoon —○— In-Situ ○ 2" O.D. Cone —●—●—●— Liquid Limit — — Plastic Limit — — (See Appendix "A" for Other Symbols)		
	SOIL DESCRIPTION	SOIL SYMBOL	ELEVATION IN FEET 72.0±	DEPTH IN FEET	MOISTURE CONTENT and ATTERBERG LIMITS (%)	SAMPLE TYPE AND NUMBER	PENETRATION RESISTANCE (Blows/Ft) 10    20    30    40    50    60 SHEAR STRENGTH (Kips/Ft <sup>2</sup> )		
END OF CONE PROBE  NO FURTHER PROGRESS (PRESUMED BEDROCK)			5						
			10						
			15						
			20						
			25						
			30						
			35						
			40						
			45						
			50						

# BOREHOLE DATA and TEST SUMMARY

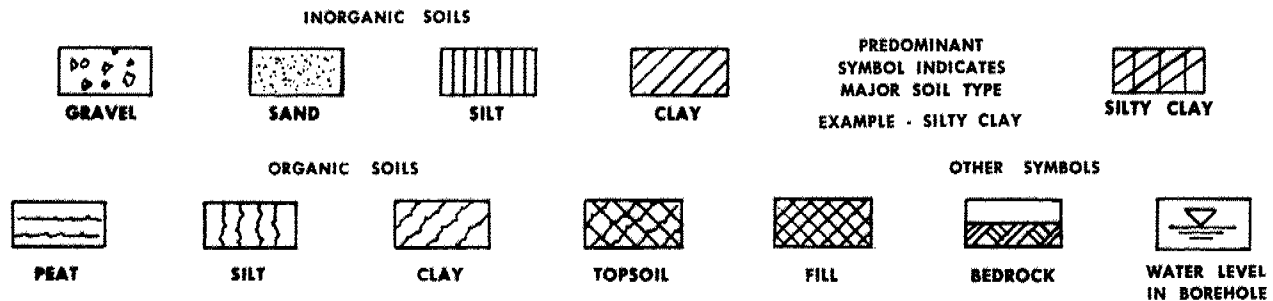
SITE INVESTIGATION SERVICES Ltd.  JOB No: 633A  BOREHOLE No: 3  FIGURE No: 4	Project - <u>PIGEON RIVER CROSSING</u> Location - <u>CONC. IX &amp; X OPS TOWNSHIP</u> Hole Location - <u>SEE PLAN</u>			Date - <u>FEBRUARY 13, 1973</u> Elevation Datum - <u>T.S.H.</u> Type of Drill - <u>HOLLOW STEM AUGER</u>			JOB No: <u>633A</u> BOREHOLE No: <u>3</u>										
	<b>SOIL DESCRIPTION</b>  ICE and WATER  ORGANIC SILT - Grey organic silt, frequent wood fragments.  SILTY CLAY - Grey silty clay to clayey silt. - Highly fissured. - Medium stiff to 8 feet, then stiff to very stiff.  SANDY CLAY TILL (Grey) STONEY SILTY SANDY CLAY TILL (Brown)  NO FURTHER PROGRESS (PRESUMED BEDROCK)  NOTE: Small flow of artesian water noted at 18' depth.			SOIL SYMBOL	ELEVATION IN FEET 69.8	DEPTH IN FEET	<b>MOISTURE CONTENT and ATTERBERG LIMITS (%)</b> Plastic Limit      Moisture Content      Liquid Limit 10                      20                      30			LAB. TESTS	SAMPLE TYPE AND NUMBER	<b>LEGEND</b> Gravel  Sand  Clay (See Appendix "A" for Other Symbols)					
							<b>PENETRATION RESISTANCE (Blows/Ft)</b> 2" O.D. Split Spoon ——— 2" O.D. Cone ——— 10      20      30      40      50										
							<b>SHEAR STRENGTH (Kips/Ft²)</b> Field Vane - X      Unconfined Compression - □ 1.0      2.0      3.0      4.0      5.0										
<div style="position: absolute; top: 10px; left: 10px; font-size: small;">                         MOISTURE CONTENT 251 %                     </div> <div style="position: absolute; top: 450px; left: 750px; font-size: small;">                         REMOULDED UNDISTURBED                     </div> Data points for Moisture Content and Penetration Resistance <div style="position: absolute; top: 350px; left: 450px;">                         5 10 15 20                     </div> <div style="position: absolute; top: 350px; left: 650px;">                         1 2 3 4                     </div>																	

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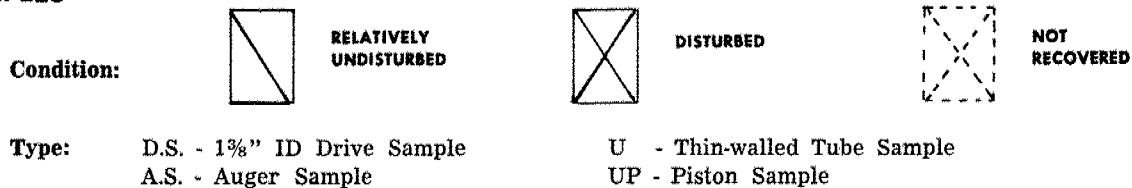
# EXPLANATION OF SYMBOLS AND TEST DATA

## SOIL DESCRIPTION

A description of visible characteristics of the soil as determined in the field and altered, if necessary, on the basis of laboratory classification tests.



## SAMPLES



## PENETRATION RESISTANCE:

(N) Indicates number of blows, of a 140-lb. hammer falling 30 inches, required to drive a 2" OD Drive Sampler a distance of 1 foot into the soil. This resistance is used to assess the relative density of cohesionless soils and the relative consistency of cohesive soils.

## OTHER TESTS

- M - Grain size analysis using sieves or hydrometer or both - plotted graphically on a separate sheet.
- V<sub>1</sub> - laboratory vane tests.
- γ<sub>d</sub> - dry unit weight.
- C - consolidation test - results on separate sheet.
- T - triaxial compression test - results on a separate sheet.
- P - proctor compaction test.
- K - laboratory permeability test.

## SOILS PROFILES:

Where soil profiles are shown on drawings the soil profile applies only to the borehole location and may be different at intermediate locations on the site.

## GROUND WATER:

Ground Water levels are generally measured in the open boreholes and apply to conditions at the time of drilling. Seasonal ground water fluctuations should be expected at most sites.