

J. D. Paterson BSc. P.Eng.
L. Bredeson BSc. P.Eng.
S. de la Roche Mech. Eng.

JOHN D. PATERSON & ASSOCIATES LTD.
Consulting Engineers & Geologists
Soil Investigations
Inspection & Testing Services
Damage Claims

Offices & Laboratory
1479 Laperriere Ave.
Ottawa 3, Canada
Telephone (613) 728-3505

316-178

GEOCRES No.

REPORT OF SOIL INVESTIGATION
PROPOSED BRIDGE REPLACEMENT
LOT 14, CONC. I & II
LANCASTER TOWNSHIP, CLENGARRY COUNTY

FOR
TOWNSHIP OF LANCASTER

ALEX J. GRAHAM
CONSULTING ENGINEER
OTTAWA

REPORT NO. S430-65
MAY 12, 1965.



INTRODUCTION

At the request of Mr. Alex. Graham, P.Eng., Consulting Engineer, on behalf of the Township of Lancaster, in the County of Glengarry, a soils investigation was conducted at the site of a proposed bridge replacement.

The existing bridge crosses Sutherland Creek on the Concession Road between Concessions I and II on Lot 14, Lancaster Township.

It was requested by Mr. Graham that the program consist of three test holes, two near the existing structure and one about 20 feet from a hydro pole which is on the line of flow of high water level.

FIELD WORK PROCEDURE

Three bore holes were put down at the locations shown on the Test Boring Plan. Core probes were driven to refusal in conjunction with bore holes 1 and 3. (Since the cone probe driven in conjunction with bore hole 3 is some distance away from it, it has been identified as Hole No. 4)

At Hole No. 1, the casing was drilled into position and the soils sampled. In Hole No's. 2 and 3, the casing was advanced by driving and the soils sampled.

At Hole No. 4, a cone probe was driven to provide soils information should the new bridge be repositioned to the west.

A standard drilling rig operated by a crew of two was supervised and directed in the field at all times by a soils technician from our staff.

SAMPLING AND TESTING

Samples of the various soils were taken in the bore holes by means of Shelby thin-walled tubes (for cohesive soils) and by means of split spoon sampler (for granular soils).

Split spoon samples SS1, SS7 and SS17, recovered from clay above any possible footing level, were taken for classification purposes only. The Standard Penetration Test was conducted on all split spoon samples and the results are recorded as "N" values. The split spoon samples were retained in plastic bags.

The Shelby tubes were taken to the laboratory where the samples were extruded and tested for unconfined compressive strength. A moisture test was conducted on a representative sample of the clay.

OBSERVATIONS

(a) Soil Types

It was observed that the soil profile on one side of the creek is considerably different from the other side. Only a thin layer of clay was found to overlie the glacial till on the east side of the creek, whereas on the west side, the clay layer is considerably thicker and increases in thickness as far west as Hole No. 4 (the limit of the investigation).

In Hole No. 1 the following soil profile occurs:

- 0 - 0.5 Topsoil
- 0.5 - 5 Stiff, brownish grey, silty clay with traces of small roots.
- 5 - 17 Medium dense, grey, saturated, gravelly glacial till with a few boulders below 10 feet.
- 17 - 20 Dense, gravelly, glacial till with boulders.

In Hole No. 2 the following soil profile occurs:

- 0 - 0.5 Topsoil
- 0.5 - 4.5 Clayey silt fill.
- 4.5 - 5.5 Topsoil.
- 5.5 - 8 Loose, brownish grey, clayey silt with red mottling. Minor organic (roots).
- 8 - 18 Soft, interbanded, light grey, dark grey (fissured) and pinkish silty clay with a few pebbles and isolated small hard clay lumps. Some black mottling.
- 18 - 24.6 Medium dense, saturated, gravelly glacial till. Boulder drilled at 20'.
- 24.6 - Dense glacial till.

In Hole No. 3 the following soil profile occurs:

- 0 - 0.5 Topsoil.
- 0.5 - 8 Medium stiff, brownish grey, silty clay, with traces of small roots.
- 8 - 24 Soft, interbanded, light grey, dark grey, (fissured) and pinkish silty clay with isolated inclusions of small hard clay lumps. Interbanded silt layers below 18'.
- 24 - 30 Dense, gravelly glacial till with boulders.

An interpretation of Hole No. 4, based on cone blows per foot and associated Bore Hole No. 3, as well as the details of all the holes, are shown on the Soil Profile sheets.

(b) Ground Water

The ground water levels were recorded at the completion of the field work at each of the bore holes. The results were as follows:

<u>Hole No.</u>	<u>Depth Below Ground Surface</u>	<u>Elevation - Ground Water</u>
1	4.3'	154.8
2	5.5'	154.8
3	2.0'	156.3

(c) Test Results

The Standard Penetration Tests on the glacial till indicate that a medium dense layer of glacial till underlies the clay and overlies a dense layer of till.

The unconfined compressive strength tests conducted on the clay by conventional equipment and by means of pocket penetrometer indicate that the clay at possible footing levels is soft.

Cont'd.../4

CONCLUSIONS AND RECOMMENDATIONS

Because the soil profile at the same elevation differs across the creek, it is possible to consider different supports for footings on either side of the river.

East Side Creek

The medium dense glacial till below elevation 149 is suitable material on which to place footings for support of the structure. An allowable loading of 3000 pounds per square foot can be used and for a loading that might slightly exceed this, the effective weight of the surcharge to the top of the fill on the stream side can be added.

Below or at elevation 149, sufficient soil cover is provided for frost protection. Since the footings will be placed below the ground water level (elevation 154 \pm) provision should be made for pumps to keep the excavation dry until the footings are in place, since glacial till loses considerable strength when saturated and disturbed.

West Side Creek

The clay is unsuitable material on which to place spread footings for support of the structure. It is recommended, therefore, that the new structure be supported on piles driven to refusal or 10 feet into the dense glacial till. Suitable for this, will be creosoted timber or steel H piles which will easily penetrate the clay layer. However, they may encounter boulders in the glacial till and meet with refusal at various depths.

Some realignment of the creek would appear to be advantageous in order to reduce scour on the east bank. If this is done then the new bridge will be completely west of the existing bridge with the east abutment in the vicinity of Hole No. 2 and the west abutment in the vicinity of Hole No. 3. At these locations the soft clay is 18 and 24 feet deep respectively and piles, driven to refusal in the glacial till, would have to be used. Assuming a cut-off elevation of 150, the expected length of the piles for the east abutment would be approximately 13 feet and for the west abutment 20 feet. Timber piles should be spaced at least 2 feet apart in order to prevent possible "boiling up" of the clay when it is remolded by the displacement of soil.

The creek bank upstream and at the new east abutment should be rip-rapped to prevent scour of the clay.

When final grades are established for the bridge deck and approaches, the stability of the approaches should be analysed because of the soft clay layer which underlies this site.

L. Bredeson

L. Bredeson, P. Eng.

SOIL PROFILES AND LABORATORY TESTS

CANADA

LOCATION: Sutherland Creek
Concession 1 & 2
Lancaster Twp.

Sheet No: 1 of 4

Remarks: Cone probe to refusal and test boring hole to 20 feet.

20 feet.

Loggings By: F. E. Johnston Drilling Co. Date: Mar. 31 & Apr. 1

Hole No:

[illegible]

SOIL PROFILE AND LABORATORY TESTS

CANADA

Sutherland Creek

Concession 1 & 2

Lancaster Twp.

Elevation (Zero Depth) B.M. El. 161.6 West end of bridge deck

Remarks: Test boring hole to 24.6'. P.P. = Pocket Penetrometer

Sheet No: 2 of 4

Boxings By: F. E. Johnston Drilling Co

Date: April 2, 1965

Hole No: 2

[illegible]

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CARRODA

Sutherland Creek

LOCATION: Concession 1 & 2
Lancaster Twp.

Remarks: Test boring hole to 30'
P.P. = Pocket penetrometer.

Sheet No:3 of 4

Spring: F.E. Johnston Drilling Co.

Date: April 1, 1965. Hole No: 3

File No: 3

Blows per Foot	Soil Description	Samples		N	Depth in Feet	Elev.	Moisture Content Per Cent.				
		Type	No. sq.ft.				30	40	50	60	70
	Ground Surface										
	Topsoil 0.5				0	158.3					
	Medium stiff, brownish-grey, silty clay with traces of small roots.				3						
		SS	7	7	6	152.3					
					9						
		SS	8	1	12	146.3					
	Soft, interbanded, light grey, dark grey, (fissured) and pinkish silty clay with isolated inclusions of small hard clay lumps. Interbanded silt layers below 18'.	TW	9	0.34	15						
		TW	10	0.30	18	140.3					
		TW	11	0.37	21						
					24	134.3					
	Dense, gravelly glacial till with boulders.	SS	12	41	27						
		SS	13	50 for 0.3'	30	128.3					
					33						
					36						

2000

LOCATION: Sutherland Creek
Concession 1 & 2
Lancaster Twp.

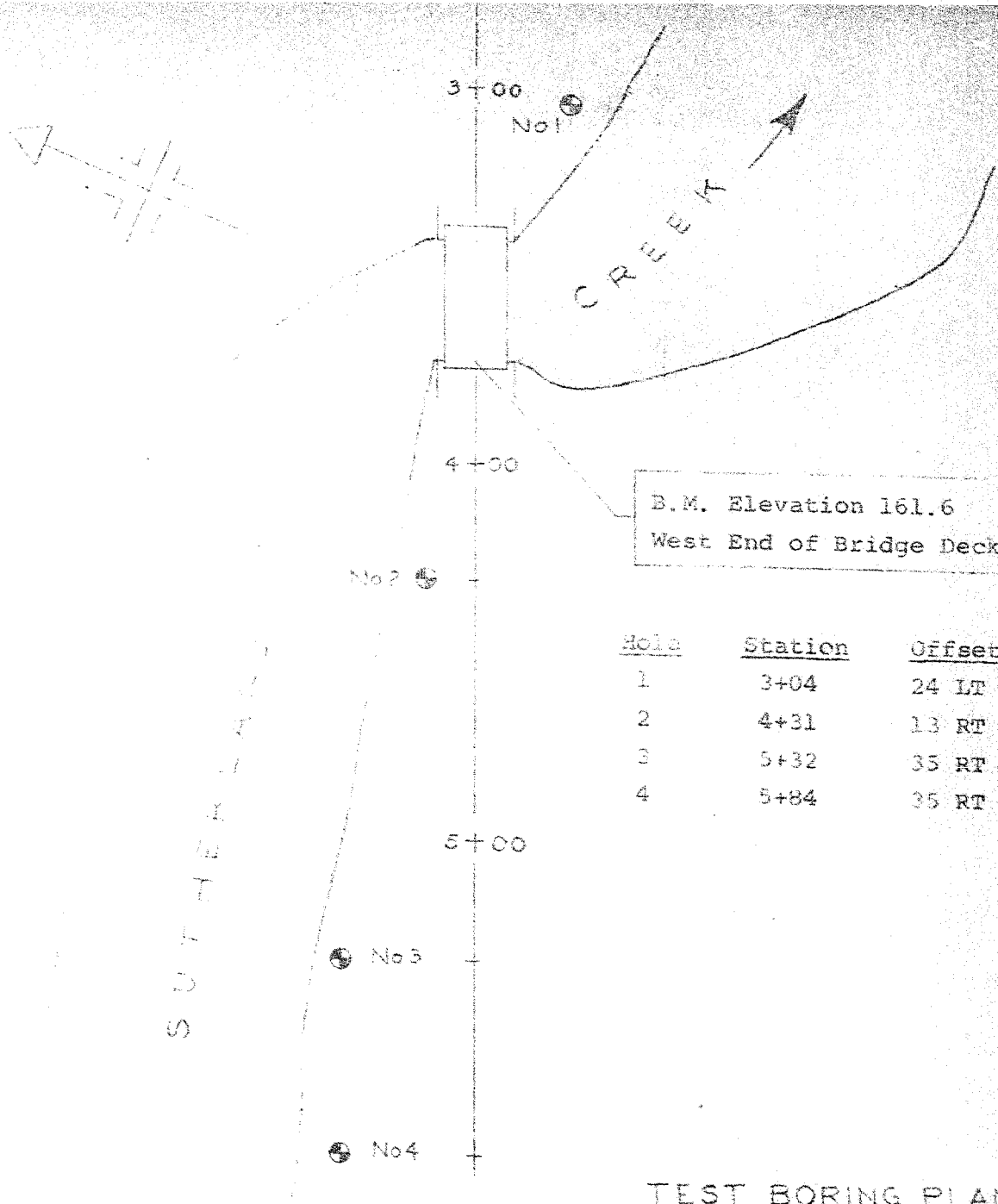
Remarks: cone probe to refusal. Interpretation based on
 borings at: F. F. Johnston Drilling Co. borings 2 & 3

Sheet No.4 of 4

Drillings By: F.E. Johnston Drilling Co. Date: April 1, 1965

Date: April 1, 1965. Hole No: 4

[illegible]



Hole	Station	Offset	El.
1	3+04	24 LT	159.1
2	4+31	13 RT	160.3
3	5+32	35 RT	158.3
4	5+84	35 RT	158.8

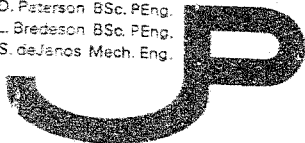
TEST BORING PLAN
PROPOSED BRIDGE
LOT 14 CON I & II
LANCASTER TWP.

SCALE 1"=40'

MAY 1965

JOHN G. PATERSON & ASSOCIATES LTD.
Consulting Engineers and Geologists
1475 WARDEN AVE. OTTAWA 1, CANADA

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REPORT OF SOIL INVESTIGATION
PROPOSED BRIDGE REPLACEMENT
LOT 14 CONCESSION 1 AND 2
LANCASTER TWP. GLENGARRY COUNTY

FOR
TOWNSHIP OF LANCASTER

ALEX J. GRAHAM
CONSULTING ENGINEER
OTTAWA

REPORT NO. S457-65
AUGUST 4, 1965.

(Previous Report No. S430-65 May 1965 same site)



INTRODUCTION

At the request of Mr. Alex J. Graham, P. Eng., Consulting Engineer, on behalf of the Township of Lancaster, in the County of Glengarry, an additional soils investigation was conducted at Sutherland Creek to supplement a previous investigation at this site (Our Report No. S430-65).

The investigation was made necessary when a stability analysis of the proposed approach fills at the existing bridge site indicated a factor of safety against failure of only 1.02.

The proposed bridge has been relocated to the east to allow a realignment of the stream and to take advantage of higher ground to reduce the amount of fill in the approaches.

FIELD WORK PROCEDURE

Two test holes were put down at the locations shown on the Test Boring Plan. The holes have been numbered consecutively 5 and 6 to avoid confusion with the previous holes put down at this site.

At Hole No. 5 a cone probe was driven to refusal, casing was driven and the soils sampled to 33 feet. A cone probe was driven to refusal at Hole No. 6 to check the uniformity of the soils.

A standard drilling rig fully equipped for soils testing and manned by a crew of two was supervised and directed in the field at all times by an engineer from our staff.

SAMPLING AND TESTING

Samples of the granular soils and soil above the water level of the creek were recovered by the split spoon sampler. During the recovery of each split spoon sample, the Standard Penetration test was conducted and the results are recorded as "N" values. These samples were retained in plastic bags.

Samples of the cohesive soils were recovered by means of Shelby thin-walled tubes. The tube samples were extruded at the laboratory and tested for unconfined compressive strength.

OBSERVATIONS

(a) Soil Types

In Hole No. 5 the following soil profile occurs:

- | | | | |
|-----|---|-----|---|
| 0 | - | 0.5 | Topsoil (loam) |
| 0.5 | - | 2.5 | Loose loam (silty) with organic content in the form of small roots. |
| 2.5 | - | 6.5 | Very stiff brownish-grey (oxidized) clay with very thin white silt seams. |
| 6.5 | - | 24 | Soft, grey, silty clay with isolated bands of pink silty clay, fissured silty clay, and black organic mottling. |
| 24 | - | 29 | Interbanded, medium stiff, grey, fissured silty clay and soft grey silty clay. |
| 29 | - | 33 | Dense stony grey glacial till. |

The details of bore hole No. 5 and an interpretation of hole No. 6, based on cone blows per foot, are shown on the Soil Profile sheets.

Along the right of way of the road, the thick band of soft clay increases gradually in thickness from 15 feet at the bridge to 35 feet at Hole No. 6. The clay overlies glacial till of undetermined depth.

(b) Ground Water

At the completion of the bore hole an attempt was made to pump the hole dry to eliminate wash water used in drilling. Water was unexpectedly pumped from the hole at the rate of approximately 25 gallons per minute for five minutes without appreciably altering the water level. It appears that the interface between the clay and till is a water bearing horizon.

The ground water level was recorded at 6.5 feet (elevation 154.5) which is approximately the water level in Sutherland Creek.

(c) Test Results

The results of the unconfined compressive strength tests and pocket penetrometer tests on the clay indicate that it is (except for a thin stiff upper crust) soft in consistency. The average shearing strength is 430 pounds per square foot compared to 330 pounds per square foot determined for the clay to the west.

The Standard Penetration tests on the glacial till indicate that its density increases with depth from medium dense to very dense.

CONCLUSIONS AND RECOMMENDATIONS

Bridge Foundations

The clay is unsuitable material on which to place footings for support of the proposed bridge.

It is recommended that the bridge be supported by piles driven to refusal into the glacial till. If timber piles are used maximum penetration into the till is expected to be 10 feet.

Assuming the cut-off point of the piles to be 4 feet below the existing stream bed (el. 150) the pile length will vary from 25 to 35 feet. The longer piles will be concentrated on the north side of the road.

Stability Analysis - Approach Fills

The approach fills of the relocated bridge have been calculated to have a Factor of Safety against failure of 1.6. It has been assumed in the calculation that the new bridge deck will be at elevation 168 and that the granular fill and clay have the following properties.

Density of the granular fill = 125 pounds per cubic foot.
Density of the clay = 100 pounds per cubic foot.
Clay ϕ = 0°
c = 430 pounds per square foot

The side slopes of the approach fill are assumed to be 2 horizontal to 1 vertical. The fill is considered as having no shear strength.

L. Bredeson

L. Bredeson, P. Eng.

JOHN D. PATERSON & ASSOCIATES CONSULTING ENGINEERS		SOIL PROFILE AND LABORATORY TESTS	
OFFICE: CANADA		LOCATION: Sutherland Creek Concessions 1 & 2 Lancaster Township	
Elevation (Zero Depth): B.M. El. 161.6 W. end of bridge deck			Sheet No: 1 of 2
Remarks: Cone probe to refusal (29.5')			
Sample hole to 32' P.P. = Pocket Penetrometer			
Borings By: F.E. Johnston Drilling Co. Date: July 21, 1965			Hole No: 5

Blows per Foot	Soil Description	Sample Type	Qu Tons/ sq. ft.	N	Depth in Feet	Elev.	Moisture Content Per Cent.				
							30	40	50	60	70
	Ground Surface				0	161.0					
7	Topsoil (Loam) 0.5	ss	1	6							
8	Loose loam with root										
18	inclusions 2.5										
12	Very stiff brownish-	ss	2	21	3						
8	grey clay with thin										
5	white silt seams.	ss	3	21							
	6.5				6	155.0					
5											
3		Tw	4	0.52	9						
4											
7											
7											
6	Soft, grey, silty clay	Tw	5	0.44	PP	12	149.0				
6	with isolated bands of										
6	pink silty clay,										
5	fissured silty clay,										
5	and black organic	Tw	6	0.39		15					
4	mottling.										
4						18	143.0				
7											
6											
7		Tw	7	0.39	pp	21					
7											
7	24					24	137.0				
8	Interbanded, medium										
9	stiff, grey, fissured	Tw	8	0.41	pp	27					
9	silty clay and soft										
9 for .5'	grey silty clay										
	29										
	Dense stony					30	131.0				
	glacial till										
	33	ss	9	41		33	128.0				

Ground Water
Level 6.5 feet
July 21, 1965

Bottom of Creek
at bridge el.
149.8

JOHN D. PATERSON & ASSOCIATES CONSULTING ENGINEERS OTTAWA CANADA		SOIL PROFILE AND LABORATORY TESTS Sutherland Creek LOCATION: Concessions 1 and 2 Lancaster Township	
Elevation (Zero Depth): 161.6 W. end of bridge deck Remarks: cone probe to refusal (40.5') Borings By: F.E. Johnston Drilling Co.		Date: July 21, 1965 Sheet No: 2 of 2 Hole No: 6	

Blows per Foot	Soil Description	Sample Type	Qu Tons/ cu ft.	N	Depth in Feet	Elev.	Moisture Content Per Cent.				
							30	40	50	60	70
	Ground Surface				0	161.4					
7	Topsoil underlain by										
9	loose loam	2									
13	Very stiff clay	4			3						
10											
8											
7											
7	Soft, grey, silty clay				6	155.4					
7					9						
8											
7					12	149.4					
5											
7					15						
7											
5					18	143.4					
4											
4					21						
5											
4					24	137.4					
11	Interbanded medium stiff fissured clay, and soft silty clay										
12					27						
11											
12					30	131.4					
11											
13					33						
13											
11					36	125.4					
12											
10					39						
12	Medium dense glacial till										
12					42	119.4					
12											
19											
24											
31	Very dense glacial till										
50 for											
0.5'											

Note:
 Interpretation
 based on cone
 blows per foot
 and associated
 bore hole No. 5

GJ-50 SEPT. 1976

DOCUMENT MICROFILMING IDENTIFICATION.

GEOCRES No. 316-178

DIST. 9 REGION EASTERN

W.P. No. _____

CONT. No. _____

W. O. No. _____

STR. SITE No. _____

HWY. No. _____

LOCATION LOT 14 CONCESSION

1 & 2 LANCASTER TWP.

OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT. 1

REMARKS: _____

