

G.I.-30 SEPT. 1976

GEOCRES No. 3165-85DIST. 9 REGION W.P. No. 13-69-09, 10, 11CONT. No. 73-191W. O. No. STR. SITE No. 3-311A
3-311B
3-310HWY. No. 417LOCATION Green Creek CrossingNo. of PAGES -OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT.REMARKS:

DEPARTMENT OF TRANSPORTATION AND COMMUNICATIONS

MEMORANDUM

3165-85

73-191

TO: Mr. T. C. Kingsland, (2)
Regional Structural Planning Eng.,
Eastern Region,
Kingston, Ontario.

FROM: Foundations Office,
Design Services Branch,
West Bldg., Downsview.

ATTENTION:

DATE: August 28, 1972.

OUR FILE REF.

IN REPLY TO

AUG 30 1972

SUBJECT:

FOUNDATION INVESTIGATION REPORT
For

- Proposed Structures at the Crossing of
- i) E.B.L. Hwy. #417 and Green Creek Rechannellization 13-68-09
 - ii) W.B.L. Hwy. #417 and Green Creek Rechannellization 13-68-10
 - iii) Ramp S-EW and Green Creek Rechannellization 13-68-11
- Regional Municipality of Ottawa-Carleton
District #9 (Ottawa)
W.O. 72-11067 -- W.P. 13-68-01

CONT. 73-191

SITES: 3-311B
3-311A
3-310

C. Poon
Jul 28/1973

Attached we are forwarding to you our detailed foundation investigation report on the subsoil conditions existing at the above-mentioned site.

We believe that the factual data and recommendations contained therein will prove adequate for your design requirements. Should additional information be required, please do not hesitate to contact our Office.

A. G. Stermac

A. G. Stermac,
PRINCIPAL FOUNDATIONS ENGINEER.

AGS/ao
Attach.

cc: D. W. Farren
B. R. Davis
A. Rutka
S. J. Markiewicz
J. E. Callaghan
B. J. Giroux
E. R. Saint
G. A. Wrong
B. A. Singh
Deleuw, Cather Co. Ltd., Ottawa (G. Saunders)

Foundations Files
Documents

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FOUNDATION INVESTIGATION REPORT
For

- Proposed Structures at the Crossing of
- i) E.B.L. Hwy. #417 and Green Creek Rechannelization
 - ii) W.B.L. Hwy. #417 and Green Creek Rechannelization
 - iii) Ramp S-EW and Green Creek Rechannelization
- Regional Municipality of Ottawa-Carleton
District #9 (Ottawa)
W.O. 72-11067 --- W.P. 13-68-01
-

1. INTRODUCTION:

The Foundations Office was requested to carry out a subsurface investigation at the proposed crossings of E.B.L. and W.B.L. Hwy. #417 and Ramp S-EW with the Green Creek Rechannelization, in the Regional Municipality of Ottawa-Carleton. The request was contained in a memo from Mr. T. C. Kingsland, Regional Structural Planning Engineer, Eastern Region, dated May 29, 1972. An investigation was subsequently carried out by this Office to determine the subsoil, bedrock and groundwater conditions at this site.

This report contains the factual results obtained from the investigation, together with recommendations pertaining to the foundations of the proposed structures as well as the stability and settlement considerations associated with the approaches.

2. DESCRIPTION OF THE SITE AND GEOLOGY:

The area under investigation is approximately 150 feet south of the existing Innes Road and some 500 feet north of the C.P.R. track, in the Township of Gloucester, Regional Municipality of Ottawa-Carleton. The terrain in the region is flat to gently undulating in relief between about elevations 200 and 212. The Green Creek meanders across the site having an

isolated oxbow east of the site. The land is primarily used for farming purposes with occasional light commercial enterprises and housing.

The present physical features of the region are of varied origins and are the result of erosion and deposition by various agencies. During a long period of time, previous to Pleistocene or Glacial time, the region was above sea-level.* During this time the major features of the bedrock topography were formed by processes of weathering and stream erosion. During Pleistocene time the region was invaded by one or more ice sheets advancing from the north. The pre-Glacial land surface was modified by glacial erosion and by deposition, in places, of material eroded by the ice-sheet. Near the close of Pleistocene time, when the ice sheet began to retire, the area was, in large part, below sea level so that as the ice retired or melted back, the sea entered and overspread the Ottawa Valley to a depth, in places, of several hundred feet. In this arm of the sea, known as the Champlain Sea, thick deposits of sand, silt and clay were laid down. As the ice retired still further, uplift took place, the land gradually emerged from the sea. This area is now commonly called "The Ottawa Valley Clay Plain".** Here extensive sensitive clay deposits are interrupted by ridges of sand and/or bedrock. The clay is generally underlain by glacial till which is in turn followed by Collingwood and Gloucester shale of the Billings Formation, Ordovician period.

3. FIELD AND LABORATORY WORK:

Six sampled boreholes, all accompanied by dynamic cone

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* Johnston, W.A., "Pleistocene and Recent Deposits in the Vicinity of Ottawa, with Description of Soils", Geological Surveys #84, Dept. of Mines.

**Chapman, L.J., and Putnam, D.F., "Physiography of Southern Ontario", University of Toronto Press 1967.

penetration tests, as well as two additional dynamic cone tests, were put down at the site during the field investigation, using conventional diamond drill rig and C.M.E. power auger machine adapted for soil sampling purposes.

Samples of the overburden were obtained by using a 2-inch O.D. split-spoon sampler, which was hammered into the soil in accordance with the specifications for the Standard Penetration Test. The same method was used to advance the dynamic cone penetration tests.

Bedrock was proven in four of the boreholes by obtaining BXL size rock core samples.

The soil, bedrock and groundwater conditions encountered at the boring locations, are presented on the Record of Borehole sheets appended to this report. The locations and elevations of the various boreholes were provided by personnel from the Eastern Region Engineering Surveys Section. The elevations in this report are referenced to a geodetic datum. The boring locations and elevations are shown on Drawing No. 72-11067A. Stratigraphical profiles inferred from the boring data, are also presented on the aforementioned drawing.

All the samples were subjected to a careful visual examination in the field, and subsequently in the laboratory. Following this examination, laboratory testing was carried out on selected representative samples in order to determine the physical properties of the overburden, namely:

- Natural Moisture Content
- Atterberg Limits
- Grain-Size Distribution

The results of this testing are plotted on the Record of Borehole sheets and summarized on Figure No. 1 appended to this report.

4. SUBSOIL AND BEDROCK CONDITIONS:

4.1) General:

The predominant stratum across the site is composed

of a very loose to very dense silty sand to sandy silt with some gravel. The thickness of this deposit varies from 10 feet to 23 feet. This granular deposit is underlain by shale bedrock.

The boundaries of the deposits, as determined in the boreholes, are shown on the accompanying Record of Borehole sheets. From ground surface downward, the various soil and bedrock encountered are as follows:

4.2) Silty Sand to Sandy Silt, With Some Gravel:

Directly beneath the nominal cover of topsoil (3 inch) is a predominant stratum of silty sand to sandy silt with some gravel. The thickness of this granular stratum varies from 10 feet at B.H. #8 to 23 feet at B.H. #9. Occasional seams of clayey silt up to 1 inch thick were encountered throughout the overburden. In certain boreholes a trace of organics was encountered at the upper 1 to 4 feet of the stratum having organic content varying from 0.8 percent to 2.0 percent. Grain-size distribution curves for representative samples of this granular deposit are plotted on Figure No. 1.

The Standard Penetration Tests, carried out within the granular stratum are plotted on the Record of Borehole sheets. This testing gave 'N' values which ranged from 2 blows/ft. to 69 blows/ft. generally increasing with depth. Based on these values it is estimated that the relative density of the deposit ranges from very loose to very dense.

4.3) Shale Bedrock:

The granular overburden is directly underlain by bedrock, which was proven in six of the boreholes by obtaining up to 6 feet of BXL size rock core samples. Over the site the bedrock surface was found to vary between elevations 187 and 193 which corresponds to depths below ground surface of from 10 to 23 feet. The bedrock is composed of a grey calcareous shale, which is in a sound condition as evidenced by the high percentage of core recovered.

The bedrock core samples were examined by Mr. K. Ingham,

Geologist, Ministry of Transportation and Communications.

Mr. K. Ingham presented the result of his bedrock examination in a memo to this Office, dated July 18, 1972, which is appended to this report.

5. GROUNDWATER CONDITIONS:

Groundwater level observations have been carried out during the period of observations in the open boreholes and shown on the Record of Borehole sheets. These observations indicate that the groundwater level varies between elevations 196 and 207, which corresponds to depths of between 2 and 9 feet below ground surface.

Artesian groundwater pressure heads were observed at B.H.'s No. 2 and 7, when the borings penetrated into the lower granular stratum. The water rose instantaneously in the casing stabilizing itself at about elevation 206, which corresponds to a level approximately 2.5 feet above the existing ground surface. This artesian water flow was properly sealed, at the source, following the completion of the boring operations.

6. DISCUSSIONS AND RECOMMENDATIONS:

6.1) General:

The design and construction of the rural portion of Hwy. #417, south-easterly of Ramseyville to Quebec border will be completed by 1974. The Ministry and the Regional Municipality of Ottawa-Carleton have undertaken a study to determine the most appropriate alignment for the urban portion of Hwy. #417 in the Ottawa area. A preliminary Foundation Report W.O. 70-11115, for various corridors of Hwy. #417, from Ramseyville northerly to the Ottawa Queensway (west of Blair Rd.) was submitted on March 23, 1971. The finalized alignment requires interchanges at Hunt Club Road, Walkley Road Extension, Innes Road and Ottawa Queensway. In addition, structures will be required at the crossing of Baseline Road, Canadian National Railway,

Canadian Pacific Railway and Green Creek rechannelization, with the proposed Hwy. #417.

This discussion deals with the proposed structures at the crossing of:

- i) E.B.L. Hwy. #417 and Green Creek Rechannelization
- ii) W.B.L. Hwy. #417 and Green Creek Rechannelization
- iii) Ramp S-EW and Green Creek Rechannelization

Discussions with regard to other structures on this portion of this Freeway will be covered under separate foundation reports.

6.2) E.B.L. and W.B.L. Hwy. #417 and Green Creek Rechannelization Structures:

It is proposed to construct two, single-span structures for the crossing of E.B.L. and W.B.L. Hwy. #417 and Green Creek rechannelization. The E.B.L. structure will have a clear span of 100 feet and a width of 110 feet, in order to accommodate the Ramp W-S. The W.B.L. structure will have a clear space of 105 ft. and a width of 60 ft. The proposed profile grade in the vicinity of the E.B.L. and W.B.L. structures will vary between elevation 218 and 216. The proposed invert elevation of the new channel will be about elevation 197.5. Based on this, the maximum height of approaches (cuts and fills combined) in the longitudinal direction will be in the order of 21 feet. The height of approaches in the transverse direction will be of the order of 15 feet above existing ground surface.

6.2.1) Structure Foundations:

The abutments for both the structures can be perched within the fill and supported on end-bearing piles driven to bedrock. The pile capacities will be dependent on the pile section chosen. For example, a 12 HP 74 steel H-piles may be designed for 95 tons/pile. For estimating purposes the pile tip elevations will be as follows.

<u>Structure</u>	<u>Location</u>	<u>Tip Elevation</u>	<u>Refer to B.H.#</u>
E.B.L. Hwy. #417 <i>PR-9</i>	West Abutment	193 (bedrock)	8
	East Abutment	187 (bedrock)	9
W.B.L. Hwy. #417 <i>B2</i>	West Abutment	189 (bedrock)	10
	East Abutment	190 (bedrock)	7

A minimum cover of 4 feet should be provided to the underside of the abutment footing for frost protection purposes. No rock or bouldery fill should be placed in areas where piles are to be driven.

It should be noted that the prevailing groundwater level in the granular stratum is at approximate elevation 206. In order to avoid any major dewatering problems the respective abutment foundation at this location should be founded well above this elevation. If such considerations are taken into account, no dewatering problems are anticipated since the excavations for the abutments for all the associated structures will be above the prevailing groundwater level.

6.3) Ramp S-EW and Green Creek Rechannelization Structure:

It is proposed to construct a separate structure at the crossing of ramp S-EW and Green Creek. The profile grade of Ramp S-EW in the vicinity of the structure is at approximate elevation 218. The invert elevation of the channelization at the crossing is at elevation 196, which indicates the maximum height of approaches (cuts and fills) is of the order of 22 feet.

6.3.1) Structure Foundations:

The proposed perched abutments for the single-span structure can be supported on end-bearing piles driven to bedrock. The pile capacity will depend on the pile section chosen. For example, a 12 HP 74 steel H-pile can be designed using a safe allowable load for 95 tons/pile. For estimating purposes the pile tip elevation will be about 188.

No rock or bouldery fill should be placed in areas where piles are to be driven. A minimum earth cover of 4 feet should be provided to the underside of the footing for frost protection purposes.

Since the prevailing groundwater elevation is lower than the excavation for the abutment footings, no major dewatering problems are anticipated. Any surface runoff can be readily handled by pumping from sumps.

6.4) Related Considerations:

6.4.1) Design Considerations:

For the design of the abutments of all three structures, the following design values may be used:

Coefficient of Earth Pressure at Rest (K_o) = 0.5 (rigid wall)

Coefficient of Active Earth Pressure (K_a) = 0.33 (some movement at the top of wall permitted)

Coefficient of Passive Earth Pressure (K_p) = 3.0 (in front of the abutment)

Sliding resistance between abutment and subsoil $\tan \phi = 0.577$

6.4.2) Stability of Approach Fills:

As mentioned elsewhere the maximum height of approaches will be of the order of 22 feet. Since the Green Creek meanders in a complex way within the general area, it is possible some localized organic surficial deposits may be present. The stability of the fills will be adversely affected if such pockets are not removed prior to the placement of fills in this area. It is, therefore, suggested that the Regional Materials Section should thoroughly investigate the general area and make specific recommendations with regard to the removal of any surficial organic material. If such measures are complied with, no stability problems are anticipated with regard to proposed approaches constructed with standard 2:1 slopes.

Protection against the scour action of the Green Creek may be necessary to comply with the hydrological requirements.

6.4.3) Settlement Considerations:

The settlements induced by the surcharge loading will

be elastic in nature and negligible in magnitude, occurring during or shortly after the completion of the fills.

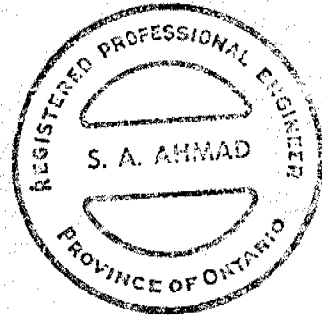
7. MISCELLANEOUS:

The field work, performed during the period of June 12 to 15, 1972, was under the immediate supervision of Mr. S. A. Ahmad, Project Foundations Engineer, who also prepared this report.

This project was under the general supervision of Mr. M. Devata, Supervising Foundations Engineer, who reviewed this report.

Equipment used was owned and operated by F. E. Johnston Drilling Co. Ltd., Ottawa.

S. A. Ahmad
S. A. Ahmad, P. Eng.



M. Devata
M. Devata, P. Eng.

SAA/ao

August 25, 1972.

APPENDIX I

SIGN SERVICES BRANCH

FOUNDATION'S OFFICE

RECORD OF BOREHOLE NO 1

JOB 72-11067

LOCATION Co-ord's 16,504,781 N. 1,229,223 E.

ORIGINATED BY S.A.

W.P. 13-68-01

BORING DATE June 13, 1972

COMPILED BY S.R.

DATUM Geodetic

BOREHOLE TYPE Hollow Stem Auger and Cone Test.

CHECKED BY

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT 20 40 60 80 100	LIQUID LIMIT W_L PLASTIC LIMIT W_P WATER CONTENT W W_P — W — W_L WATER CONTENT % 10 20 30	BULK DENSITY γ P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS/FOOT					
201.0	Ground level.									
0.0	Silty sand, with some gravel. Occ. clayey silt seams. Very loose to compact. Brown - Grey.		1	SS	2					
			2	SS	7					
			3	SS	15					
189.0			4	SS	60/0"					
12.0	Bedrock - Shale Sound - Grey.		5	RCBX	90%					
183.0			6	RC BX	Rec 100%					
18.0	End of borehole.									

W.L. El.
195.5

24 53 18 5

DESIGN SERVICES BRANCH

FOUNDATIONS OFFICE

RECORD OF BOREHOLE NO 2

JOB 72-11067

LOCATION Co-ord's 16,504,561 N. 1,229,300 E.

ORIGINATED BY S.A.

W.P. 13-68-01

BORING DATE June 13, 1972

COMPILED BY S.R.

DATUM Geodetic

BOREHOLE TYPE Hollow Stem Auger and Cone Test.

CHECKED BY *SL*

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT 20 40 60 80 100	LIQUID LIMIT W_L PLASTIC LIMIT W_P WATER CONTENT W $W_P \quad W \quad W_L$	BULK DENSITY γ P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS/FOOT					
202.7	Ground level.									
	Topsoil.									
	Silty sand, with gra.		1	SS	7					W.L. Elev. ∇ 198.5
	Occ. clayey silt		2	SS	12					1.99% org. cont.
	seams, trace of		3	SS	69					W.L. El. ∇ 193.5
	organics. Loose to		4	SS	26					Artesian
188.7	Brown to grey.									27 71 (2)
14.0	Bedrock - Shale.		5	RC	Rec.					
183.7	Sound - Grey.			AXT	90%					
19.0	End of borehole.									

DESIGN SERVICES BRANCH

FOUNDATIONS OFFICE

RECORD OF BOREHOLE NO 3

JOB 72-11067

LOCATION Co-ord's 16,504,391 N. 1,229,240 E.

ORIGINATED BY S.A.

W.P. 13-68-01

BORING DATE June 15, 1972

COMPILED BY S.R.

DATUM Geodetic

BOREHOLE TYPE Cone Test Only.

CHECKED BY *[Signature]*

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT 20 40 60 80 100	LIQUID LIMIT W_L PLASTIC LIMIT W_P WATER CONTENT W W_P — W — W_L	BULK DENSITY γ P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLT	NUMBER	TYPE	BLOWS/FOOT					
203.7 0.0	Ground level.									
189.1	Assumed bedrock.					200				
14.6	End of cone test.					190				
						180				

SIGN SERVICES BRANCH

FOUNDATIONS OFFICE

RECORD OF BOREHOLE NO 4

JOB 72-11067

LOCATION Co-ord's 16,504,355 N. 1,229,128 E.

ORIGINATED BY S.A.

W.P. 13-68-01

BORING DATE June 14, 1972

COMPILED BY S.R.

DATUM Geodetic

BOREHOLE TYPE Cone Test Only.

CHECKED BY *OK*

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT 20 40 60 80 100	LIQUID LIMIT W_L PLASTIC LIMIT W_P WATER CONTENT W W_P — W — W_L	BULK DENSITY γ P.C.F. GR. SA. SI. CL.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT					
203.0	Ground level.									
0.0						200				
192.9	Assumed bedrock.									
10.1	End of cone test.					190				

DESIGN SERVICES BRANCH

FOUNDATIONS OFFICE

RECORD OF BOREHOLE NO 5

JOB 72-11067

LOCATION Co-ord's 16,504,277 N. 1,229,212 E.

ORIGINATED BY S.A.

W.P. 13-68-01

BORING DATE June 15, 1972

COMPILED BY S.R.

DATUM Geodetic

BOREHOLE TYPE Cone Test Only.

 CHECKED BY *[Signature]*

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT 20 40 60 80 100	LIQUID LIMIT W_L PLASTIC LIMIT W_P WATER CONTENT W W_P — W — W_L WATER CONTENT %	BULK DENSITY γ P.C.F. GR. SA. SI. CL.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS/FOOT					
202.1	Ground level.									
0.0										
188.3	Assumed bedrock.									
13.8	End of cone test.									

SIGN SERVICES BRANCH

FOUNDATIONS OFFICE

RECORD OF BOREHOLE NO 6

JOB 72-11067

LOCATION Co-ord's 16,504,200 N. 1,229,087 E.

ORIGINATED BY S.A.

W.P. 13-68-01

BORING DATE June 14, 1972

COMPILED BY S.R.

DATUM Geodetic

BOREHOLE TYPE Cone Test only.

CHECKED BY *[Signature]*

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT 20 40 60 80 100	SHEAR STRENGTH P.S.F. ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE	LIQUID LIMIT — W _L PLASTIC LIMIT — W _P WATER CONTENT — W W _P — W — W _L WATER CONTENT %	BULK DENSITY γ P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS/FOOT						
204.5	Ground level.										
0.0											
192.9	Assumed bedrock.										
11.6	End of cone test.										

SIGN SERVICES BRANCH

FOUNDATIONS OFFICE

RECORD OF BOREHOLE NO 7

JOB 72-11067

LOCATION Co-ord's 16,504,331 N. 1,229,225 E.

ORIGINATED BY S.A.

W.P. 13-68-01

BORING DATE June 15, 1972

COMPILED BY S.R.

DATUM Geodetic

BOREHOLE TYPE Hollow Stem Auger and Cone Test.

CHECKED BY

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT 20 40 60 80 100	LIQUID LIMIT W_L PLASTIC LIMIT W_P WATER CONTENT W W_P — W — W_L WATER CONTENT % 10 20 30	BULK DENSITY γ P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS/FOOT					
202.4	Ground level.									
0.0	Silty sand with some gravel. Loose to dense. Grey.	...	1	SS	4					1.05% org. cont.
		...	2	SS	19					0.77% org. cont.
		...	3	SS	45					14.50 28.8
190.9		...								Elev. 193.4
11.5	Bedrock - Shale		4	RC	Rec.					Artesian
186.4	Sound - Grey.			BX	100%					Water encountered.
16.0	End of borehole.									

DESIGN SERVICES BRANCH

FOUNDATIONS OFFICE

RECORD OF BOREHOLE NO 8

JOB 72-11067

LOCATION Co-ord's 16,504,302 N. 1,229,114 E.

ORIGINATED BY S.A.

W.P. 13-68-01

BORING DATE June 14, 1972

COMPILED BY S.R.

DATUM Geodetic

BOREHOLE TYPE Hollow Stem Auger and Cone Test.

 CHECKED BY *HK*

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT 20 40 60 80 100	SHEAR STRENGTH P.S.F. ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE	LIQUID LIMIT — W _L PLASTIC LIMIT — W _P WATER CONTENT — W W _P — W — W _L WATER CONTENT % 10 20 30	BULK DENSITY γ P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS/FOOT						
202.5	Ground level.										
0.0	Sandy silt with trace of gravel. Occ. clayey silt seams. Loose. Grey.		1	SS	4	200					W _L El. 200.0
			2	SS	8						1 38 49 12
192.2			3	SS	100/10"						0.79% org. cont.
10.3	Bedrock - Shale.		4	RC	Rec.	190					
186.5	Sound - Grey.			BX	100%						
16.0	End of borehole.					180					

DESIGN SERVICES BRANCH

FOUNDATIONS OFFICE

RECORD OF BOREHOLE NO 9

JOB 72-11067

LOCATION Co-ord's 16,504,175 N. 1,229,183 E.

ORIGINATED BY S.A.

W.P. 13-68-01

BORING DATE June 14, 1972

COMPILED BY S.R.

DATUM Geodetic

BOREHOLE TYPE Hollow Stem Auger and Cone Test.

CHECKED BY

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT					LIQUID LIMIT — w_L PLASTIC LIMIT — w_p WATER CONTENT — w			BULK DENSITY γ P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS/FOOT		20	40	60	80	100	w_p — w — w_L				
						SHEAR STRENGTH P.S.F.										
						○ UNCONFINED + FIELD VANE										
						● QUICK TRIAXIAL x LAB VANE										
						WATER CONTENT %										
210.3	Ground level.					210									GR. SA. SI. CL.	
0.0	Topsoil.														W.L. El. 206.8	
	Silty sand with some gravel. Occ. clayey silt seams.		1	SS	24										3 60 32 5	
			2	SS	20											
	Loose to compact.		3	SS	9	200										
	Brown to grey.		4	SS	12											
			5	SS	25										18 71 (11)	
			6	SS	30											
187.3			7	RCBX	100%	190										
23.0	Bedrock - Shale.		8	RC	Rec.											
181.3	Sound - Grey.			BX	100%											
29.0	End of borehole.					180										

DESIGN SERVICES BRANCH

FOUNDATION OFFICE

RECORD OF BOREHOLE NO 10

JOB 72-11067

LOCATION Co-ord's 16,504,415 N. 1,229,143 E.

ORIGINATED BY S.A.

W.P. 13-68-01

BORING DATE June 15, 1972

COMPILED BY S.R.

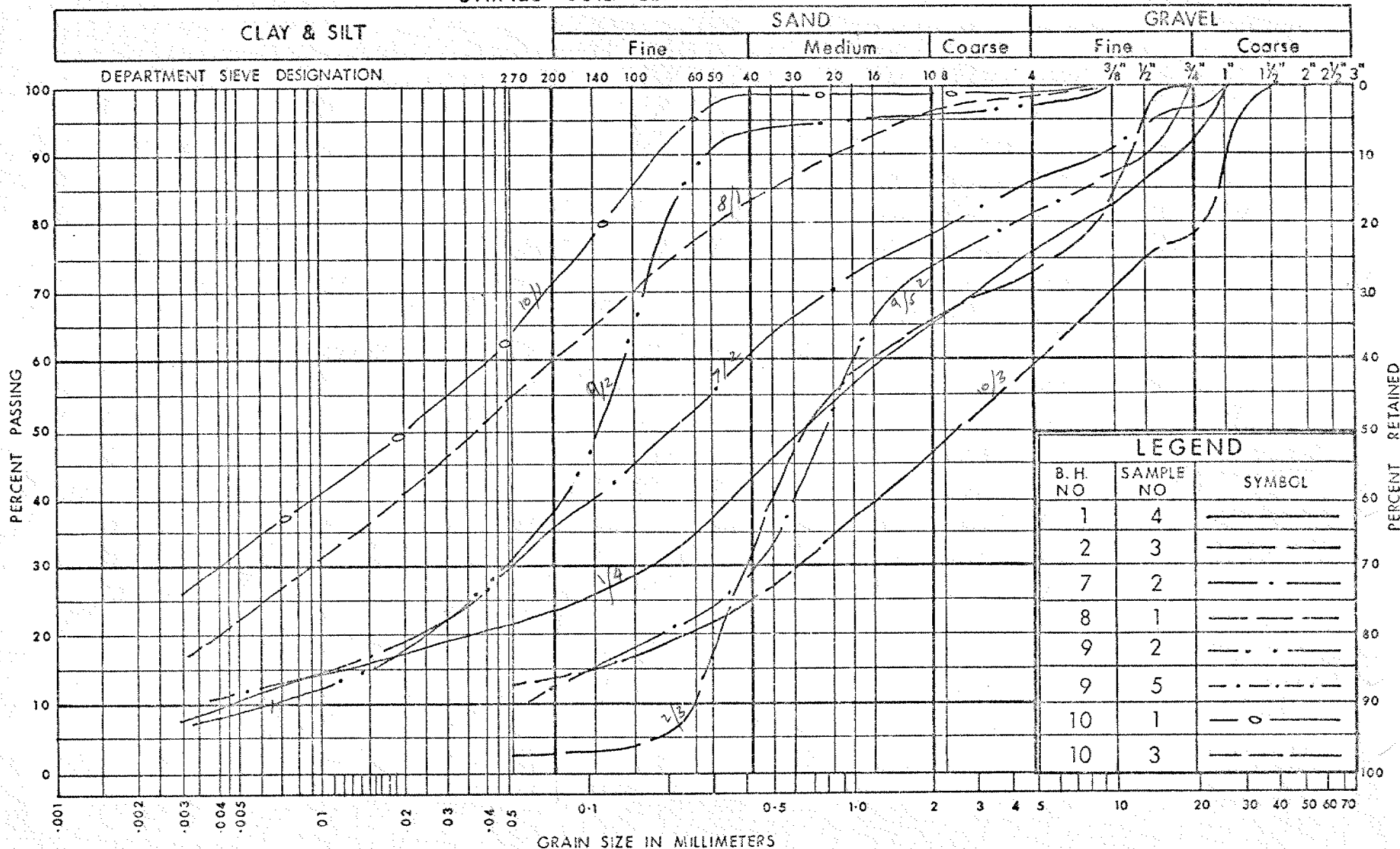
DATUM Geodetic

BOREHOLE TYPE Hollow Stem Auger and Cone Test.

CHECKED BY *ML*

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE					LIQUID LIMIT — w_L			BULK DENSITY	REMARKS	
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS/FOOT		BLOWS / FOOT 20 40 60 80 100					PLASTIC LIMIT — w_p					WATER CONTENT — w
						SHEAR STRENGTH P.S.F.					w_p — w — w_L			WATER CONTENT %			
						○ UNCONFINED + FIELD VANE								10 20 30		P.C.F.	GR.SA.SI.CL.
						● QUICK TRIAXIAL × LAB VANE											
203.4	Ground level.																
	Topsoil.															W.L. El.	
	Silty sand with trace		1	SS	2	200										201.6	
	of gravel. Occ.		2	SS	3											1 27 51 21	
	clayey silt seam.		3	SS	45												
	Very loose to dense.		4	SS	30	190										41 46 (13)	
	Brown to grey.		5	RC	Rec.												
189.9				BX	100%												
13.5	Bedrock. - Shale.																
185.9	Sound.																
17.5	End of borehole.					180											

UNIFIED SOIL CLASSIFICATION SYSTEM



DEPARTMENT
OF
TRANSPORTATION AND COMMUNICATIONS



DESIGN SERVICES
BRANCH

GRAIN SIZE DISTRIBUTION
SILTY SAND TO SANDY SILT, WITH GRAVEL

W.P. No. 13-6801

JOB No. 72-11067

FIG. 1

ABBREVIATIONS USED IN THIS REPORT

PENETRATION RESISTANCE

STANDARD PENETRATION RESISTANCE 'N' - THE NUMBER OF BLOWS REQUIRED TO ADVANCE A STANDARD SPLIT SPOON SAMPLER 12 INCHES INTO THE SUBSOIL, DRIVEN BY MEANS OF A 140 POUND HAMMER FALLING FREELY A DISTANCE OF 30 INCHES.

DYNAMIC PENETRATION RESISTANCE :- THE NUMBER OF BLOWS REQUIRED TO ADVANCE A 2 INCH, 60 DEGREE CONE, FITTED TO THE END OF DRILL RODS, 12 INCHES INTO THE SUBSOIL, THE DRIVING ENERGY BEING 350 FOOT POUNDS PER BLOW.

DESCRIPTION OF SOIL

THE CONSISTENCY OF COHESIVE SOILS AND THE RELATIVE DENSITY OR DENSENESS OF COHESIONLESS SOILS ARE DESCRIBED IN THE FOLLOWING TERMS :-

<u>CONSISTENCY</u>	<u>'N' BLOWS / FT.</u>	<u>c LB. / SQ. FT.</u>	<u>DENSENESS</u>	<u>'N' BLOWS / FT.</u>
VERY SOFT	0 - 2	0 - 250	VERY LOOSE	0 - 4
SOFT	2 - 4	250 - 500	LOOSE	4 - 10
FIRM	4 - 8	500 - 1000	COMPACT	10 - 30
STIFF	8 - 15	1000 - 2000	DENSE	30 - 50
VERY STIFF	15 - 30	2000 - 4000	VERY DENSE	> 50
HARD	> 30	> 4000		

TYPE OF SAMPLE

S.S.	SPLIT SPOON	T.W.	THINWALL OPEN
W.S.	WASHED SAMPLE	T.P.	THINWALL PISTON
S.B.	SCRAPER BUCKET SAMPLE	O.S.	OESTERBERG SAMPLE
A.S.	AUGER SAMPLE	F.S.	FOIL SAMPLE
C.S.	CHUNK SAMPLE	R.C.	ROCK CORE
S.T.	SLOTTED TUBE SAMPLE		
	P.H. SAMPLE ADVANCED HYDRAULICALLY		
	P.M. SAMPLE ADVANCED MANUALLY		

SOIL TESTS

Qu	UNCONFINED COMPRESSION	L.V.	LABORATORY VANE
Q	UNDRAINED TRIAXIAL	F.V.	FIELD VANE
Qcu	CONSOLIDATED UNDRAINED TRIAXIAL	C	CONSOLIDATION
Qd	DRAINED TRIAXIAL	S	SENSITIVITY

ABBREVIATIONS USED IN THIS REPORT

SOIL PROPERTIES

γ	UNIT WEIGHT OF SOIL (BULK DENSITY)
γ_s	UNIT WEIGHT OF SOLID PARTICLES
γ_w	UNIT WEIGHT OF WATER
γ_d	UNIT DRY WEIGHT OF SOIL (DRY DENSITY)
γ'	UNIT WEIGHT OF SUBMERGED SOIL
G	SPECIFIC GRAVITY OF SOLID PARTICLES $G = \frac{\gamma_s}{\gamma_w}$
e	VOID RATIO
n	POROSITY
w	WATER CONTENT
S_r	DEGREE OF SATURATION
w_L	LIQUID LIMIT
w_p	PLASTIC LIMIT
I_p	PLASTICITY INDEX
s	SHRINKAGE LIMIT
I_L	LIQUIDITY INDEX $= \frac{w - w_p}{I_p}$
I_c	CONSISTENCY INDEX $= \frac{w_L - w}{I_p}$
e_{max}	VOID RATIO IN LOOSEST STATE
e_{min}	VOID RATIO IN DENSEST STATE
I_D	DENSITY INDEX $= \frac{e_{max} - e}{e_{max} - e_{min}}$
	RELATIVE DENSITY D_r IS ALSO USED
h	HYDRAULIC HEAD OR POTENTIAL
q	RATE OF DISCHARGE
v	VELOCITY OF FLOW
i	HYDRAULIC GRADIENT
k	COEFFICIENT OF PERMEABILITY
j	SEEPAGE FORCE PER UNIT VOLUME
m_v	COEFFICIENT OF VOLUME CHANGE $= \frac{-\Delta e}{(1+e)\Delta\sigma'}$
c_v	COEFFICIENT OF CONSOLIDATION
C_c	COMPRESSION INDEX $= \frac{\Delta e}{\Delta \log_{10} \sigma'}$
T_v	TIME FACTOR $= \frac{c_v t}{d^2}$ (d, DRAINAGE PATH)
U	DEGREE OF CONSOLIDATION
τ_f	SHEAR STRENGTH
c'	EFFECTIVE COHESION INTERCEPT
ϕ'	EFFECTIVE ANGLE OF SHEARING RESISTANCE, OR FRICTION
c_u	APPARENT COHESION
ϕ_u	APPARENT ANGLE OF SHEARING RESISTANCE, OR FRICTION
μ	COEFFICIENT OF FRICTION
S_t	SENSITIVITY

GENERAL

π	$= 3.1416$
e	BASE OF NATURAL LOGARITHMS 2.7183
$\log_e a$ OR $\ln a$	NATURAL LOGARITHM OF a
$\log_{10} a$ OR $\log a$	LOGARITHM OF a TO BASE 10
t	TIME
g	ACCELERATION DUE TO GRAVITY
V	VOLUME
W	WEIGHT
M	MOMENT
F	FACTOR OF SAFETY

STRESS AND STRAIN

u	PORE PRESSURE
σ	NORMAL STRESS
σ'	NORMAL EFFECTIVE STRESS ($\bar{\sigma}$ IS ALSO USED)
τ	SHEAR STRESS
ϵ	LINEAR STRAIN
γ	SHEAR STRAIN
ν	POISSON'S RATIO (μ IS ALSO USED)
E	MODULUS OF LINEAR DEFORMATION (YOUNG'S MODULUS)
G	MODULUS OF SHEAR DEFORMATION
K	MODULUS OF COMPRESSIBILITY
η	COEFFICIENT OF VISCOSITY

EARTH PRESSURE

d	DISTANCE FROM TOP OF WALL TO POINT OF APPLICATION OF PRESSURE
δ	ANGLE OF WALL FRICTION
K	DIMENSIONLESS COEFFICIENT TO BE USED WITH VARIOUS SUFFIXES IN EXPRESSIONS REFERRING TO NORMAL STRESS ON WALLS
K_0	COEFFICIENT OF EARTH PRESSURE AT REST

FOUNDATIONS

B	BREADTH OF FOUNDATION
L	LENGTH OF FOUNDATION
D	DEPTH OF FOUNDATION BENEATH GROUND
N	DIMENSIONLESS COEFFICIENT USED WITH A SUFFIX APPLYING TO SPECIFIC GRAVITY, DEPTH AND COHESION ETC. IN THE FORMULA FOR BEARING CAPACITY
k_s	MODULUS OF SUBGRADE REACTION

SLOPES

H	VERTICAL HEIGHT OF SLOPE
D	DEPTH BELOW TOE OF SLOPE TO HARD STRATUM
β	ANGLE OF SLOPE TO HORIZONTAL

APPENDIX II

DEPARTMENT OF TRANSPORTATION AND COMMUNICATIONS

MEMORANDUM

TO: Mr. M. Devata,
Sup. Foundation Engineer.

FROM: K. W. Ingham

ATTENTION:

DATE: July 18, 1972

OUR FILE REF.

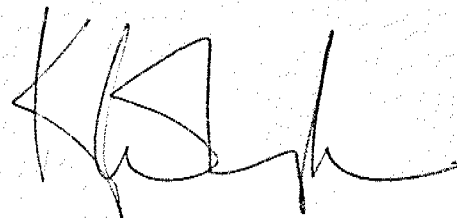
IN REPLY TO

SUBJECT:

Foundation Investigation 72-11067;
Highway 417, Re-Channelization at
Green Creek

Six boreholes drilled to bedrock indicate uniform rock conditions underlying the site. The bedrock is a dark grey calcareous shale with minor bands of limestone and sandstone. The bedrock elevation in each of the holes is given below.

Hole No. 1	Bedrock at	189.0
Hole No. 2	"	188.7
Hole No. 7	"	190.9
Hole No. 8	"	192.2
Hole No. 9	"	187.3
Hole No. 10	"	189.9



K. W. Ingham,
Geologist.

KWI:mv

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS, ONTARIO

MEMORANDUM

TO: Mr. T.C. Kingsland,
Regional Structural Planning Engineer,
Eastern Region, Kingston.

FROM: Soil Mechanics Section,
Geotechnical Office,
West Building, Downsview.

ATTENTION:

DATE: May 1st, 1974.

OUR FILE REF.

IN REPLY TO

SUBJECT: Foundation Investigation at Green Creek
under NB Ramp to Innes Road, Bridge #6
Relocation, Hwy. #417, District #9, Ottawa,
W.O. 72-11067, W.P. 13-68-11, Contract 73-191.

The Soil Mechanics Section was requested to attend an emergency meeting in Ottawa District Office on April 17th, 1974, by the Regional Structural Planning Office to discuss the relocation and new position of Bridge #6 (Northbound ramp) at the above mentioned contract, which was already awarded for construction.

In view of this urgency, this Section immediately carried out a Foundation Investigation and the results of the borings were submitted to the Regional Structural Planning Office and to the Design Consultant, DeLeuw, Cather & Co. Ltd. (Ottawa).

A brief resume of the subsoil conditions together with our comments is as follows:

The subsoil at the revised location was found to consist of a 12 to 14 ft. thick deposit of silty sand with gravel, occasional clayey silt seams and traces of organics, followed by sound shale bedrock at approximate elevation 188.

Artesian condition was encountered in B.H.#13 once the boring penetrated into the bedrock. The water level stabilized itself at elevation 203.4, which is approx. 2.5 ft. above the existing groundlevel.

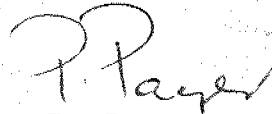
It should be noted that the prevailing conditions are similar to those which are described in the original Foundation Report. Consequently, recommendations of Foundation Report 72-11067 are still applicable and should be followed. For estimating purposes the pile tip elevation will be between 188 and 189.

- 2 - May 1st, 1974.

Mr. T.C. Kingsland - RE: W.O. 72-11067.

The enclosed Record of Borehole Sheets and the Revised Foundation Drawing 72-11067 'A', along with this memorandum should be included in our original Foundation Report 72-11067.

If you have any further queries, please contact our Office.



P. Payer,
Senior Engineer

For: M. Devata,
Supervising Engineer.

PP/mj
Encl*

C.C. E.J. Orr
B.R. Davis
A.J. Percy
J.M. Childs
B.J. Giroux
E.R. Saint
G.A. Wrong
B.A. Singh
DeLeuw, Cather

Files
Documents

DESIGN SERVICES BRANCH

FOUNDATIONS OFFICE

RECORD OF BOREHOLE NO 11

JOB 72-11067

LOCATION Co-ords. 16,504,604 N., 1,229,274 E.

ORIGINATED BY M.L.

W.P. 13-68-10

BORING DATE April 19, 1974

COMPILED BY P.P.

DATUM Geodetic

BOREHOLE TYPE Hollow Stem Auger

CHECKED BY

SOIL PROFILE			SAMPLES			ELEV. SCALE ft./m	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT (0.3 m)				LIQUID LIMIT — w_L PLASTIC LIMIT — w_p WATER CONTENT — w			BULK DENSITY γ P.C.F.	REMARKS
ELEV. DEPTH ft.	DESCRIPTION	STRAT. PLT	NUMBER	TYPE	BLOWS/FOOT		20	40	60	80	100	w_p	w	w_L	
61.5 0.0	Ground Level					200 61.0									
	Silty Sand with Gravel occasional clayey silt seams, trace of organics Loose to very dense		1	SS	10										
			2	SS	15										
			3	SS	8										
			4	SS	10										
57.2 4.3			5	SS	13 1/2	190 57.9									
	Sound		6	RC BX	Rec. 90%										
54.6 6.9	Shale (Grey) Bedrock		7	RC BX	Rec. 98%	180 54.9									
	End of Borehole														
						170 51.8									

OFFICE REPORT SOIL EXPLORATION

DESIGN SERVICES BRANCH

FOUNDATIONS OFFICE

RECORD OF BOREHOLE NO 12

JOB 72-11067

LOCATION Co-ords. 16,504,619 N., 1,229,311 E.

ORIGINATED BY M.L.

W.P. 13-68-10

BORING DATE April 19, 1974

COMPILED BY P.P.

DATUM Geodetic

BOREHOLE TYPE Dynamic Cone Penetration Test

CHECKED BY

		SOIL PROFILE			SAMPLES			DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT (0.3 m)					LIQUID LIMIT — w_L PLASTIC LIMIT — w_p WATER CONTENT — w				BULK DENSITY γ P.C.F.	REMARKS
m		ELEV. DEPTH ft.	DESCRIPTION	STRAT. PLT	NUMBER	TYPE	BLOWS/FOOT	ELEV. SCALE ft./m	SHEAR STRENGTH P.S.F. ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE					w_p — w — w_L WATER CONTENT %				
61.7	0.0	202.4	Ground Level															
			Probable					200										
			Silty Sand					61.0										
57.5		188.8						190										
4.2	13.6		End of Cone Test (Probable Bedrock)					57.9				Refusal	100 7"					
								180										
								54.9										

OFFICE REPORT ON SOIL EXPLORATION

DESIGN SERVICES BRANCH

FOUNDATIONS OFFICE

RECORD OF BOREHOLE NO 13

JOB 72-11067

LOCATION Co-ords. 16,504,545 N., 1,229,364

W.P. 13-68-10

BORING DATE April 18, 1974

ORIGINATED BY M.L.

DATUM Geodetic

BOREHOLE TYPE Hollow Stem Auger

COMPILED BY P.P.

CHECKED BY

SOIL PROFILE			SAMPLES			ELEV. SCALE ft./m	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT (0.3 m)				LIQUID LIMIT — W _L PLASTIC LIMIT — W _P WATER CONTENT — W			BULK DENSITY Y	Art. Head REMARKS elevation (62.0) ∇ GR. SA. SI. CL.
ELEV. DEPTH ft.	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS/FOOT (0.3 m)		20	40	60	80	100	W _P	W	W _L	
61.2	200.9	Ground Level				61.0									
0.0	0.0		1	SS	14										
			2	SS	15										
			3	SS	20	190									
57.5	188.6	Compact	4	SS	20	57.9									
3.7	12.3	Shale	5	RC	Rec										(57.5) ∇
56.0	183.6	Sound Bedrock		BX	100%										Elev. 188.6
5.2	17.3	End of Borehole				180									Art. water
						54.9									encountered

OFFICE REPORT SOIL EXPLORATION

DESIGN SERVICES BRANCH

FOUNDATIONS OFFICE

RECORD OF BOREHOLE NO 14

JOB 72-11067

LOCATION Co-ords. 16,504,531 N., 1,229,332 E.

ORIGINATED BY M.L.

W.P. 13-68-10

BORING DATE April 18, 1974

COMPILED BY P.P.

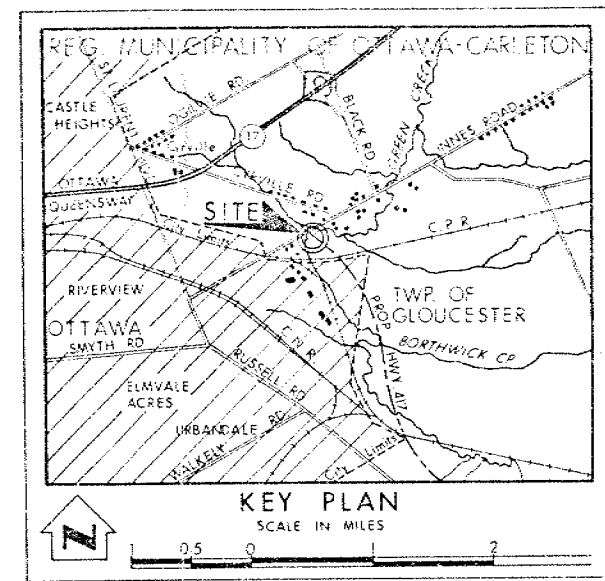
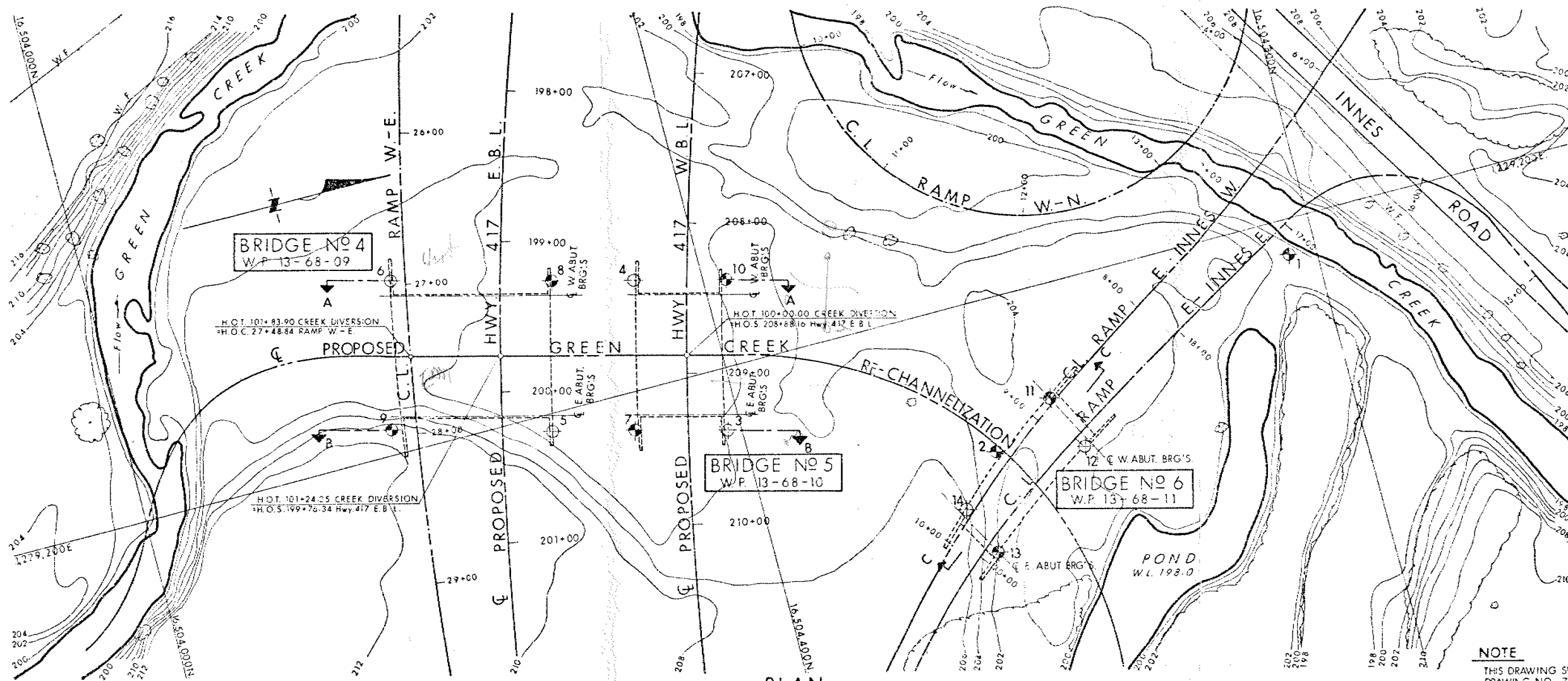
DATUM Geodetic

BOREHOLE TYPE Dynamic Cone Penetration Test

CHECKED BY

SOIL PROFILE			SAMPLES			ELEV. SCALE ft./m	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT (0.3 m)					LIQUID LIMIT — W _L PLASTIC LIMIT — W _P WATER CONTENT — W			BULK DENSITY γ P.C.F.	REMARKS
ELEV. DEPTH ft.	DESCRIPTION	STRAT. PLT	NUMBER	TYPE	BLOWS/FOOT (0.3 m)		20	40	60	80	100	W _P	W	W _L		
62.6 m 0.0	0.0 Ground Level															
	Probable Silty Sand					200 61.0										
						190										
57.3 17.4	188.0 End of Cone Test (Probable Bedrock)					57.9										
5.3											100 Refusal 5"					
						180 54.9										

OFFICE REPORT ON SOIL EXPLORATION

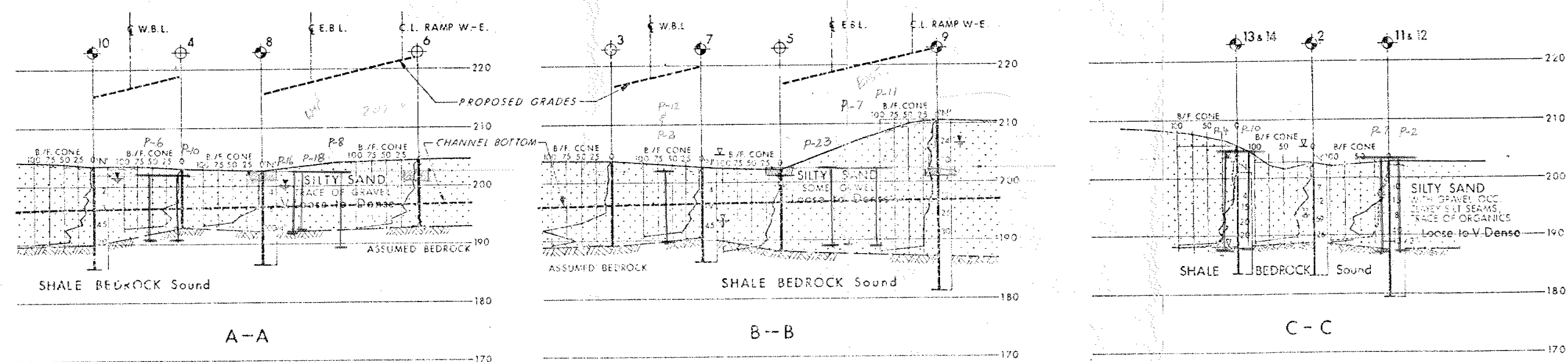


LEGEND

- Bore Hole
- Cone Penetration Test
- Bore Hole & Cone Test
- Water Levels established at time of field investigation, June 1972 & Apr. 1974
- Head
- Artesian Water Levels
- Encountered

NO.	ELEVATION	CO-ORDINATES	
		NORTH	EAST
1	201.0	16,504,781	1,229,223
2	202.7	16,504,561	1,229,300
3	203.7	16,504,391	1,229,240
4	203.0	16,504,355	1,229,128
5	202.1	16,504,277	1,229,212
6	204.5	16,504,200	1,229,087
7	202.4	16,504,331	1,229,225
8	202.5	16,504,302	1,229,114
9	210.3	16,504,175	1,229,183
10	203.4	16,504,415	1,229,143
11	201.9	16,504,604	1,229,274
12	202.4	16,504,619	1,229,311
13	200.9	16,504,545	1,229,364
14	205.4	16,504,531	1,229,332

NOTE
THIS DRAWING SUPERCEDES
DRAWING NO. 72-11067A
DATED JULY 27, 1972



NOTE
The boundaries between soil strata have been established only at Bore Hole locations. Between Bore Holes the boundaries are assumed from geological evidence.

NO.	DATE	DESCRIPTION
1	APR 10 1972	REVISED BRIDGE NO. 6 & ADDED BORE HOLES 11, 12, 13 & 14

MINISTRY OF TRANSPORTATION & COMMUNICATIONS
ENGINEERING SERVICES BRANCH - GEOTECHNICAL OFFICE

GREEN CREEK

HIGHWAY NO. Prop. 417 DIST NO. 9
REG. MUNICIPALITY OF OTTAWA-CARLETON
TWP. GLOUCESTER LOT CON

BORE HOLE LOCATIONS & SOIL STRATA

SURV. 5 A CHECKED BY <u> </u> W.P. NO. <u>13-68-01</u>	DRAWN BY <u> </u>
DRAWN BY <u> </u> JOB NO. <u>72-11067</u>	72-11067A
DATE <u>APR 10 1972</u> SITE NO. <u> </u>	BRIDGE DRAWING NO. <u> </u>
APPROVED <u> </u> CONT NO. <u> </u>	

NOTE:
The complete foundation investigation report for this structure may be examined at the Structural Office and Foundations Office, Downsview, and at the OTTAWA District Office.