

#58-F-222-C

OTTAWA,

QUEENSWAY

& CARLING AVE.

BA 713

# MCROSTIE & ASSOCIATES

CONSULTING ENGINEERS AND SURVEYORS

OTTAWA 1  
CANADA

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58-F-222C

## Foundation Report - Structure No. 2

### 1. FIELD WORK

Four boreholes were completed at the site in the locations shown on Plate One. At some of these locations it was necessary to make several attempts to get below boulders. Where the boulders were encountered above 15 feet, new holes were attempted, below this, drilling through or blasting was required. Two inch split barrel samples were recovered for visual classification and standard penetration tests were performed in the boreholes. Two inch thin walled tube samples were taken in the cohesive soil layers. The underlying rock was diamond drilled, cores recovered for inspection, and a record kept of core recovery percentages. A careful watch was kept for drops or discontinuities in the rock during drilling.

Groundwater levels were observed during the programme and an observation well was installed in Hole No. 3 so that groundwater conditions up to and immediately preceding construction could be readily observed.

### 2. OBSERVATIONS

Soil conditions at the site consist of several layers of different types. At the surface is a layer of sand about 3 to 5 feet thick. Next is a clay layer, stiff to medium soft, down to depths of 15 to 21 feet. Under this is a loose till layer 1 to 5 feet thick and under this is dense till with boulders to rock at about 35 feet. The rock is a shaley limestone of the Ottawa formation, the upper surface of which is weathered and broken and shale interbedding occurs in the upper 5 feet. No drops were detected during drilling but the highest shale beds were sufficiently weathered to produce a considerable reduction in drilling pressures required for progress.

The high number of blows recorded for the standard penetration test in the till soils should be regarded with caution. The presence of stones would have the effect of increasing the blow count and the resistance of piles on or through tills of the Ottawa area has been found, on occasion, to be lower than might be inferred from the high blow count.

Groundwater levels varied between 4 and 8 feet, but these should be considered to be near the seasonal low value. During wet seasons, levels would likely rise nearly to the ground surface, due to the present lack of storm drainage and the existence of adjacent higher land with a pervious layer likely connecting this land and site.

### 3. RECOMMENDATIONS

#### 3.1 Soil Strengths

Bearing values can be recommended as follows:

Clay at El. 241 - 2000 pounds per square foot  
to El. 236

El. 236 to El. 222 - difficult to develop suitable support with footings

Below El. 222 - 6000 pounds per square foot  
but groundwater control required.

#### 3.2 Soil Compressibility

The clay layer from El. 240 to El. 235 would produce consolidation settlements from the load of any structure supported on it and also from the load of the approach fills.

The upper few feet of the stiff clay can be considered incompressible but at least 10 feet of the lower layer will be somewhat compressible, despite its preconsolidation. The consolidation properties of a similar clay from the same geological deposit were studied and results related to this site. From these results the estimated settlements under an

abutment footing and under the approach fill were calculated. The estimated settlement under a footing 10 feet wide, with a load of 2000 pounds per square foot is 0.1 feet and the estimated settlement under the centre of an approach fill approximately 20 feet high is 0.3 feet. For an abutment, these would be cumulative but for a centre pier the settlements would be independent of each other.

The timing of settlements is difficult to establish due to unknowns in the continuity of drainage patterns within and below the deposit but the settlements can be expected to occur within the first year after loading.

### 3.3 Foundation Type

If spread footings are considered for support of the structure, the effect of the consolidation settlements of footings and embankment must be considered. In view of these settlements, and the differential amounts associated with them, it is unlikely that any structure sensitive to movement would be feasible.

If pile supported foundations are considered, allowance should be made for the probability that piles will penetrate a few feet into the weathered and interbedded rock and payment clauses made sufficiently flexible to cover variations which may be encountered.

### 3.4 Pile Loads

In addition to the design loads on piles, it should be recognized that the incompressible consolidation of the soft clay layer due to the weight of the adjacent approach embankment will produce a load on the piles by negative friction. The load will, of course, be distributed across the depth of the clay layer and will develop over the same period as that estimated for consolidation settlements. The estimated maximum value of the load due to negative friction is approximately 20 tons for a 14 inch diameter pile. Other maximum values can be estimated by multiplying the pile surface area in compressible clay by the shear strength of the

clay itself but considerable judgment must be exercised in evaluating the modifying factors of pile spacing, strength regain of the clay, and disturbance due to driving.

#### 4. CONSTRUCTION PRECAUTIONS

##### 4.1 Soil Protection

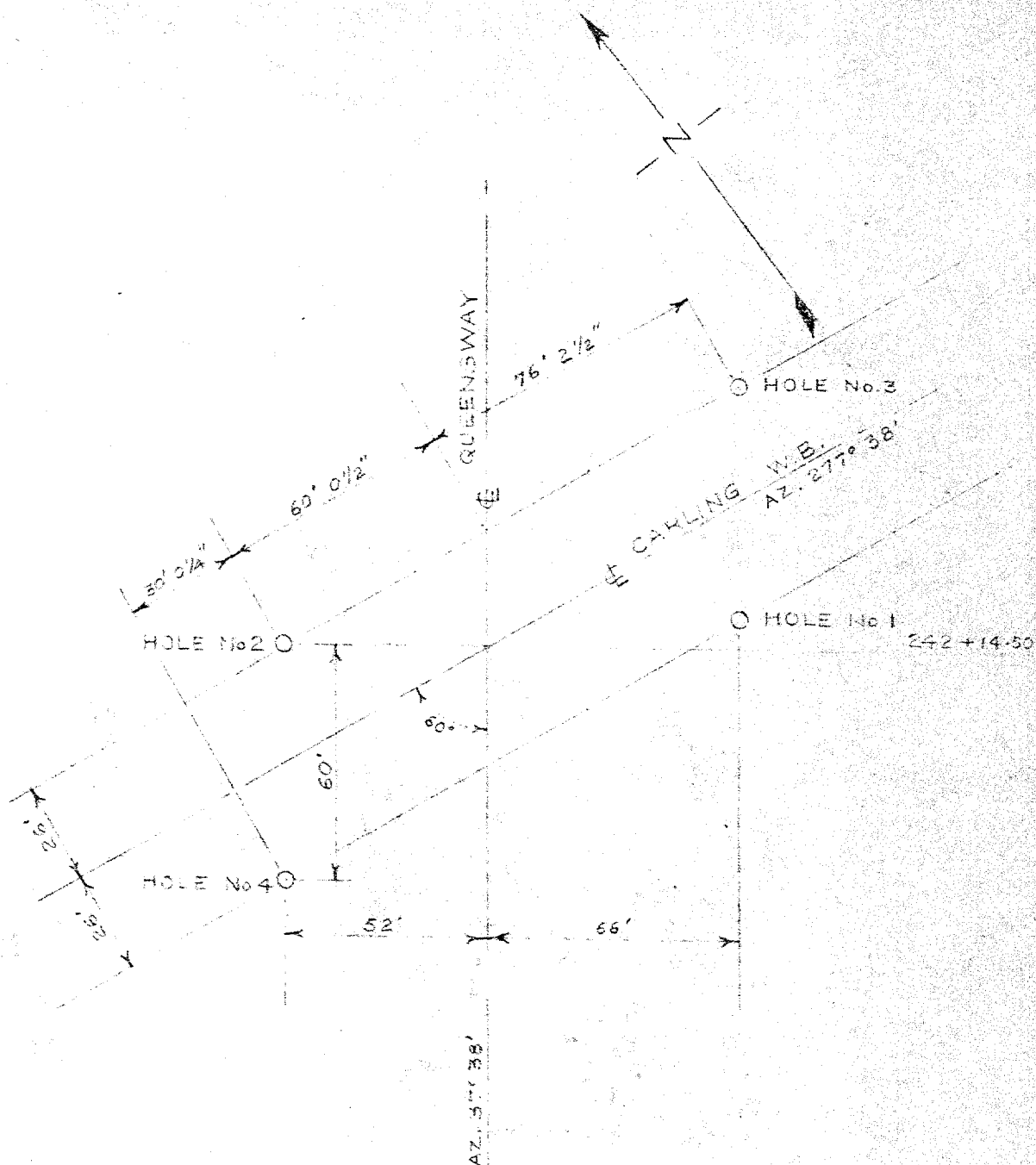
If the clay soils at El. 256 are used for support of all or part of the structure, these soils are sensitive and must be protected from disturbance during construction. A protection layer of lean concrete or crushed stone placed immediately after excavation would serve the purpose.

##### 4.2 Gr.ewater

Pumping from an excavation in the clay will be a practical method of handling groundwater. A flow of water may be met at the top of the clay surface and under the sand; it may be desirable to remove the sand layer for some distance around an excavation to prevent its sloughing into the excavation with a flow of groundwater.

#### 5. COORDINATION

We would be pleased to discuss any points arising from the report or supply any extra information that we have available.



**McROSTIE & ASSOCIATES**  
CONSULTING ENGINEERS

**BOREHOLE LOCATIONS**  
QUEENSWAY AT CARLING WEST B.  
BRIDGE No. 7

SCALE 1" = 40 FT.

PLATE 1



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### OTTAWA CANADA

#### SOIL PROFILE AND SUMMARY OF LABORATORY TESTS

Queensway Carling (Westbound)  
Bridge #7

ELEVATION OF GROUND SURFACE (ZERO DEPTH) 2422 (Geodetic Datum)  
REMARKS Ref. B.M. #11-11 el. 246.1 Top M.H. 20' S. of CARLING INTER. of CARLING

HOLE NO.

2

DATE Feb. 158

UNCONFINED COMPRESSIVE STRENGTH KIPS/FT. <sup>2</sup>	SMALL SCALE PENETROMETER KIPS/FT. <sup>2</sup>	STANDARD PENETRATION BLOWS/FT.	SAMPLE NUMBER	DESCRIPTION OF SOIL	DEPTH IN FEET	ELEVATION	PENETRATION TEST	
							LB. HAMMER INCH DROP	NO CASING INCH DIA. ROD
				GROUND SURFACE	0	2422	BLOWS PER FOOT	
				Top Soil	0	2422		
		6 for 6 15	2-1	Medium Dense Fine Sand	10	2467		
				Loose Fine Sand	40	2437	Over Night Water Level - 4.0'	
	58	5 for 6 3 for 6	2-2	Very Stiff Brownish Gray Clay	60	2417		
2.0	3, 2.8 22, 3.1		2-3	Stiff Fissured Brownish Gray Clay	75	2402		
1.7	14.11 14.12		2-4	Medium Soft	100	2377		
1.5	17.18 10, 12		2-5	Fissured Gray Clay	110	2327		
1.5	17.18 12, 18		2-6	Medium Soft Fissured Gray Clay with some silt	125	2302		
1.0	19.16 15, 15		2-7	Medium Soft Fissured Silty Gray Clay				
1.3	15		2-8	Medium Soft Fissured Silty Gray Clay with layers of well-sorted Sand				
	55 for 6 13 for 6		2-9	Loose Sandy Till	222	2246		
	130 for 6		2-10	Dense Sandy Till	282	2215		
				Boulders in Dense Sandy Till	285	2192		
	58		2-11	Dense Fine Sand with some coarse sand & a few stones				
	20 for 6 140		2-12	Weathered Gray Limestone	350	2127		
				Shaley Limestone interbedded shale CORE RECOVERY - 84%	374	2107		
				Shaley Limestone CORE RECOVERY - 88%	425	2057		
				Shaley Limestone CORE RECOVERY - 100%	458	2018		
				Bottom of Hole	473	1999		
							% WATER CONTENT	
							PLATE 3	



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#### SOIL PROFILE AND SUMMARY OF LABORATORY TESTS

QUEENSWAY CARLING (Westbound)  
Bridge #7

ELEVATION OF GROUND SURFACE (ZERO DEPTH) 2450' (Geodetic Datum)

REMARKS Ref. B.M. #11-11 at 2461' Top 12 H. 20 S. of CARLING INTER. of CARLING

HOLE NO.

3

DATE Feb 1/58

UNCONFINED COMPRESSIVE STRENGTH KIPS/FT. <sup>2</sup>		SMALL SCALE PENETROMETER KIPS/FT. <sup>2</sup>	STANDARD PENETRATION BLOWS/FT.	SAMPLE NUMBER	DESCRIPTION OF SOIL	DEPTH IN FEET	ELEVATION	PENETRATION TEST	
								LB. HAMMER	NO CASING
								INCH DROP	INCH DIA. ROD
GROUND SURFACE								BLOWS PER FOOT	
					Topsoil	0	2450		
						10	2440		
			8	3-1	Loose Fine Sand	4.0	2440		
2.1	45.45		3-2	Very Stiff Fissured Brownish Gray Clay	7.5	2375			
10	15.16		3-3	Medium Soft Fissured Gray Clay	10.0	2350			
1.8	15.15		3-4	Medium Soft Fissured					
1.5	12.20		3-5	Silty Gray Clay					
	15.17		3-6		15.0	2300			
		5 ft. 20	3-7	Loose Till					
		6	3-8		20.0	2250			
		25 ft. 20	3-9	Boulders in					
		125	3-10	Dense Sandy Till					
		27 ft. 20	3-11						
		68							
		28 ft. 20							
					Shaley Limestone + interbedded shale CORE RECOVERY - 57%	32.5	2125		
					Shaley Limestone CORE RECOVERY - 91%	37.5	2075		
					Shaley Limestone CORE RECOVERY - 80%	43.0	2020		
					Bottom of hole	48.0	1970		
								% WATER CONTENT	
								PLATE	
								4	

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### OTTAWA CANADA

#### SOIL PROFILE AND SUMMARY OF LABORATORY TESTS

Queensway Carling (Westbound)  
Bridge #7

ELEVATION OF GROUND SURFACE (ZERO DEPTH) 242.5 (Geodetic DATUM)  
REMARKS Ref. B.M. #11-11 el. 246.1' Top M.H. 20'S. of CARLING INTER. of CARLING  
Rly.  
DATE Feb 1/58

HOLE NO.  
4

UNCONFINED COMPRESSIVE STRENGTH KIPS/FT. <sup>2</sup>	SMALL SCALE PENETROMETER KIPS/FT. <sup>2</sup>	STANDARD PENETRATION BLOWS/FT.	SAMPLE NUMBER	DESCRIPTION OF SOIL	DEPTH IN FEET	ELEVATION	PENETRATION TEST			
							LB. HAMMER		NO CASING	
							INCH DROP		INCH DIA. ROD	
							BLOWS PER FOOT			
				GROUND SURFACE						
				Top Soil	5'	247.5				
				Loose Fine Sand	10'	246.5				
		4 fms 15'	4-1	Medium Dense Fine Sand	30'	244.5				
	33	12 fms 6"	4-2	Stiff Fissured	60'	241.5				
15	23.30 24.30		4-3	Brownish Gray Clay	100'	237.5				
10	14.11 15.13		4-4	Medium Soft Fissured						
17	16.16 16.10		4-5	Gray Clay						
15	20.18 21.20		4-6	Medium Soft Slightly Fissured Silty Gray Clay	150'	232.5				
15	18.16 17.11		4-7	Medium Soft Fissured Silty Gray Clay with a few sand grains	175'	230.0				
08	13		4-8	Loose Till	210'	226.5				
	25.26 18		4-9	Medium Dense Sandy Till	230'	224.5				
	26.26 193		4-10	Dense Fine Sand with some Coarse Sand & a few stones	250'	222.5				
	51.50 59		4-11	Backlogs	275'	220.0				
				in						
	140		4-12	Dense Sandy Till						
	102		4-13	Shaly Limestone	361'	211.4				
				Core recovery - 34% Mfr. drilled down	385'	209.0				
				Shaly Limestone						
				Core recovery - 92%	435'	204.0				
				Shaly Limestone						
				Core recovery - 93%	465'	199.0				
				Bottom of Hole						
							% WATER CONTENT			
							PLATE 5			

Actual Measured  
0.1 MPa