

DEPARTMENT OF HIGHWAYS ONTARIO

MEMORANDUM

To: Mr. B. R. Davis,
Bridge Engineer,
Bridge Division.

Attention: Mr. S. McCombie

FROM: Foundation Section,
Materials & Testing Div.,
Room 107, Lab. Bldg.

DATE: March 17, 1966

OUR FILE REF.

IN REPLY TO

MAR 18 1966

SUBJECT:

FOUNDATION INVESTIGATION REPORT
For
Proposed Retaining Walls on Q.E.W.,
(Kipling Ave. - Wickman Rd. Vicinity)
Metro. Toronto, Twp. of Etobicoke
District #6 (Toronto)
W.J. 66-F-8 -- W.P. 47-65-1

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

We believe that you will find the factual data and recommendations contained therein, adequate for your design requirements. Should additional information be required, please feel free to contact our Office.

AGS/MdeF
Attach.

cc: Messrs. B. R. Davis (2)
H. A. Tregaskes
D. W. Farren
G. K. Hunter (2)
J. C. Thatcher
T. J. Kovich
A. Watt

Foundations Office
Gen. Files

A. G. Stermac
A. G. Stermac,
PRINCIPAL FOUNDATION ENGINEER

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FOUNDATION INVESTIGATION REPORT
For
Proposed Retaining Walls on Q.E.W.,
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Metro. Toronto, Twp. of Etobicoke
District #6 (Toronto)
W.J. 66-F-8 -- W.P. 47-65-1

1. INTRODUCTION:

The Foundation Section was requested to carry out an investigation for the proposed retaining walls in the vicinity of Kipling Ave. and Wickman Rd. on the Q.E.W. in Metropolitan Toronto. The request was contained in a memo from the Bridge Location Section, dated January 17, 1966. An investigation was subsequently carried out by this Section to determine the subsoil conditions existing at the site. This report contains the results of our investigation, together with recommendations pertaining to the foundations of the proposed retaining structures.

The area in the immediate vicinity of the site is heavily built of light industry and residential buildings. The topography may be described as flat to gently undulating. Physiographically, the area is situated in the low-lying part of the region referred to as the Iroquois Plain which was formed during the late Pleistocene period by the body of water since designated Lake Iroquois. Soils in that part of the region are mainly heavy- textured shale and limestone tills.

2. SUBSOIL CONDITIONS:

2.1) General:

A total of 30 boreholes was carried out during the course of the field work. These borings revealed that the subsoil over the site area consists generally of deposits of silty sand or clayey silt followed by shale bedrock. The bedrock contact ranges between elev. 361 and elev. 354, having a maximum depth of 12.7 ft. in B.H. #21 and a minimum depth of 2.5 ft. in B.H. #7. The boundaries between the

cont'd. /2

2. SUBSOIL CONDITIONS: (cont'd.) ...

2.1) General: (cont'd.) ...

different deposits are shown on the borelog sheets contained in the Appendix. The estimated stratigraphical profiles shown on Dwg. 66-F-8A, are based upon this information. A description of various soil types follows:

2.2) Silty Sand:

This deposit was observed only in a limited number of boreholes, as can be seen from the soil stratigraphical profile. The thickness of the stratum ranges from 3 to 13 ft., and its denseness, based on 'N' values of 9 to 130 blows/ft., is compact to very dense.

2.3) Clayey Silt:

This deposit was observed in the majority of the boreholes and extends down to the shale bedrock. The laboratory tests indicated that the liquid limits of this material ranged from 18% to 35%, and the plastic limits ranged from 14% to 25%. The moisture content was found to vary between 8% and 17%. The consistency of the deposit is essentially very stiff to hard, with 'N' values ranging from 12 to 123 blows/ft.

2.4) Shale Bedrock:

In most cases, the bedrock contact was established by drilling with a Penn. auger to refusal. Boreholes (B.H.'s #1, #2, #3 and #4) which were carried out under W.J. 65-F-38 at the Wickman Rd. and Q.E.W. crossing, indicated that the upper 6 to 18 inches of shale bedrock has been subjected to extensive weathering. Below this, the shale bedrock is generally sound. The above mentioned borings were also incorporated in this project.

3. WATER CONDITIONS:

Ground water levels ranged from 1 to 7 feet below the ground surface. The exact water levels observed during the time of the field investigation, are shown on the enclosed drawing as well as borehole logs.

cont'd. /3

4. DISCUSSION AND RECOMMENDATIONS:

Retaining Wall #1 -

Spread footings may be founded on sound shale bedrock assuming a design load of 10 t.s.f. In the vicinity of B.H.'s #20, #21 and #22, the depth of excavation to bedrock may be in the order of 12 ft. In such a case, spread footings may be constructed within the sand stratum at or below elev. 360 with a safe bearing pressure of 2.5 t.s.f. Footings located in the sand may require a dewatering scheme, since excavations will be carried out in the fine-grained granular material below the water level. It is recommended that an expansion joint be provided between the retaining structures founded on rock and sand, in order to accommodate any possible differential settlements.

Retaining Structure #2 -

At this location the shale bedrock is generally 4 to 6.5 ft. below the ground surface. Spread footings may be founded on shale bedrock assuming a design load of 10 t.s.f. No major dewatering problems are anticipated; however, any seepage from the side slopes can be controlled by ordinary pumping methods.

Retaining Structures #3 and #4 -

In this portion the retaining structures can be supported on shale bedrock with a safe design load of 10 t.s.f. In the vicinity of B.H.'s #1, #2 and #9, the footings can be constructed as high as possible in the very stiff to hard clayey silt stratum. The structures founded on rock and clayey silt should be constructed independently in order to accommodate any possible differential settlements. No major dewatering problems are anticipated for the proposed footing excavations.

cont'd. /4

5. MISCELLANEOUS:

The field work for this project was carried out during the period January 24 - February 1 , 1966, by Mr. R. Magi, Project Foundation Engineer, under the general supervision of Mr. M. Devata, Senior Foundation Engineer, who also prepared this report.

Equipment used was owned by Dominion Soil Investigation Ltd.

March 1966

APPENDIX I

DEPARTMENT OF HIGHWAYS - ONTARIO		RECORD OF BOREHOLE NO. 1, 2, & 3		FOUNDATION SECTION	
MATERIALS & TESTING DIVISION					
JOB <u>66/F-8</u>	LOCATION <u>See Below</u>	ORIGINATED BY <u>R.M.</u>			
W. P. <u>47-65-1</u>	BORING DATE <u>Jan. 25/66</u>	COMPILED BY <u>R.M.</u>			
DATUM _____	BOREHOLE TYPE <u>Pennndrill</u>	CHECKED BY <u>LM</u>			

[illegible]

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

JO8 66-F-8

LOCATION See Below

ORIGINATED BY R.M.

W.P. 47-65-1

BORING DATE Jan. 24, 1966

COMPILED BY R.M.

DATUM

BOREHOLE TYPE Penndrill

CHECKED BY

[illegible]

FOUNDATION SECTION

CHECKED BY

[illegible]

DEPARTMENT OF HIGHWAYS - ONTARIO

RECORD OF BOREHOLE NO. 10, 11 & 12

FOUNDATION SECTION

MATERIALS & TESTING DIVISION

10a 66-F-8

LOCATION See Below

ORIGINATED BY R.M.

W.P. 47-65-1

BORING DATE Jan. 26, 1966

COMPILED BY R.M.

DATUM

BOREHOLE TYPE Penndrill

CHECKED BY _____

[illegible]

FOUNDATION SECTION

CHECKED BY

[illegible]

FOUNDATION SECTION

ORIGINATED BY R.M.

COMPILED BY R.M.

CHECKED BY

[illegible]

DEPARTMENT OF HIGHWAYS - ONTARIO

RECORD OF BOREHOLE NO. 19, 20 & 21

FOUNDATION SECTION

MATERIALS & TESTING DIVISION

JOB 66-F-8 LOCATION See Below ORIGINATED BY R.M.
W.P. 47-65-1 BORING DATE Jan. 27, 1966. COMPILED BY R.M.
DATUM _____ BOREHOLE TYPE Penndrill CHECKED BY RL

SOIL PROFILE		SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE		LIQUID LIMIT — w _L PLASTIC LIMIT — w _P WATER CONTENT — w			BULK DENSITY P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE		BLOWS / FOOT	SHEAR STRENGTH P.S.F.	w _P	w	w _L		
												WATER CONTENT % 10 20 30
BH #19 Sta. 161/65 140' Rt.												
366.5	Groundlevel											
0	Sandy silt.		1	SS	20							
360.0	Compact.											
6.5	Shale Bedrock		2	SS	100							
7.5	End of borehole.											
BH#20 Sta. 152/55 240' Rt.												
363.0	Groundlevel											
0	Silty sand.		1	SS	16							
			2	SS	58							
354.5	Compact to v. dense											
3.5	Shale Bedrock		3	SS	3076"							
9.5	End of borehole											
BH #21 Sta. 151/82 385' Rt.												
366.5	Groundlevel											
0	Silty sand.		1	SS	11							
			2	SS	32							
			3	SS	54							
354.0	Compact to v. dense.											
353.8	Shale Bedrock		4	SS	3072"							
12.7	End of borehole.											

▼ WL 5-8'

▼ WL 7-5'

[illegible]

FOUNDATION SECTION

JOB 66-F-8 LOCATION See Below ORIGINATED BY R.M.
 W.P. 47-65-1 BORING DATE Jan. 31, 1966 COMPILED BY R.M.
 DATUM _____ BOREHOLE TYPE Penndrill CHECKED BY sk

SOIL PROFILE			SAMPLES			DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT			LIQUID LIMIT ——— WL PLASTIC LIMIT ——— WP WATER CONTENT ——— W			BULK DENSITY $\rho_{\text{c.f.}}$	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT	ELEV. SCALE	SHEAR STRENGTH P.S.F.			WATER CONTENT % 10 20 30			
<u>BH #25</u> Sta. 175+40 100' Rt.													
363.0	Groundlevel												
0	Clayey silt.												
358.7			1	SS	109								
4.3	Shale Bedrock End of borehole.												
<u>BH #26</u> Sta. 173+40 100' Rt.													
363.5	Groundlevel												
0	Clayey silt.												
359.2			1	SS	66								
4.3	Shale Bedrock End of borehole.												
<u>BH #27</u> Sta. 171+40 100' Rt.													
364.5	Groundlevel												
0	Clayey silt.												
359.5	Hard.		1	SS	138								
5	Shale Bedrock End of borehole.												

FOUNDATION SECTION

CHECKED BY

[illegible]

DEPARTMENT OF HIGHWAYS - ONTARIO

RECORD OF BOREHOLE NO. 31 & 32

FOUNDATION SECTION

MATERIALS & TESTING DIVISION

JOB 66/F-8

LOCATION See Below

ORIGINATED BY R.M.

W.P. 47-65-1

BORING DATE Feb. 1, 1966

COMPILED BY R.M.

DATUM

BOREHOLE TYPE Penndrill

CHECKED BY

[illegible]

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
	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
	IN TERMS OF EFFECTIVE STRESS $\tau_f = c' + \sigma' \tan \phi'$
c_u	APPARENT COHESION
ϕ_u	APPARENT ANGLE OF SHEARING RESISTANCE, OR FRICTION
	IN TERMS OF TOTAL STRESS $\tau_f = c_u + \sigma \tan \phi$
μ	COEFFICIENT OF FRICTION
S_r	SENSITIVITY

GENERAL

π	= 3.1416
e	BASE OF NATURAL LOGARITHMS 2.7183
$\log_e \sigma$ OR $\ln \sigma$	NATURAL LOGARITHM OF σ
$\log_{10} \sigma$ OR $\log \sigma$	LOGARITHM OF σ 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

67-5-8

DEPARTMENT OF HIGHWAYS ONTARIO

MEMORANDUM

To: Mr. A. G. Stermac,
Principal Foundations Engineer,
Materials and Testing Division,
Downsview.

From: Materials and Testing,
London.

Date: January 3, 1967.

Our File Ref.

In Reply To

Subject: - W. P. 152-63, Proposed Little Ausable River Bridge,
Highway #4, 4.3 Miles Northwest of Highway #7.

While carrying out the soils power auger investigation for the proposed reconstruction from Lucan to Clandeboye it was not possible to penetrate to subgrade in the cut section south of the proposed structure between Station 220 and Station 222. The power auger penetrated to approximately 10' below ground level where either a layer of boulders or a seam of rock seems to exist in view of the fact that the existing road cut on the east side of the revision is excavated lower than this seam. No visible signs of the rock layer are present on the existing cut slope.

We would appreciate it if you would place an approximate 20' deep hole in the centre of this area when carrying out the foundation investigation for the forementioned proposed structure in order that a core of the rock layer can be obtained.

If the Project Engineer will contact this office, we will locate the borehole and examine the core when the investigation is carried out.

A. M. Batten
A. M. BATTEN,

AMB:hp.

FOR: J. R. ROY,
REGIONAL MATERIALS ENGINEER.

C.C. - File.

Mr. A. Sternac,
Principal Foundation Engineer,
Room 107, Lab. Bldg.

Bridge Division,
Downsview, Ontario.

January 13, 1966.

Retaining Walls at Q.E.W. and
Wickman Road Overpass,
W.P. 4/-65-1, District 6.

In order to keep the scheduled award date (June 29, 1966)
a foundation investigation of utmost urgency would be
required for the four retaining walls adjacent to above
mentioned structure.

The bridge design section is prepared to go ahead
immediately after the receipt of the final geometrics for
these walls. We would appreciate it very much if you could
arrange for some preliminary, possibly verbal information
at your earliest convenience.

A plan showing all retaining walls on the Q.E.W. west
of Hwy. 27 was handed to Mr. Devata this morning. The
top priority exists only for the four walls mentioned
above. However, a foundation report for all walls shown on
the plan will be required eventually.

FBU, S.

J. D. Curtis,
Regional Bridge Location Engineer.

66-F-8

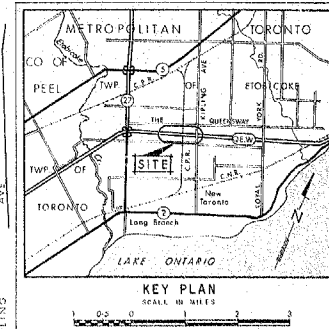
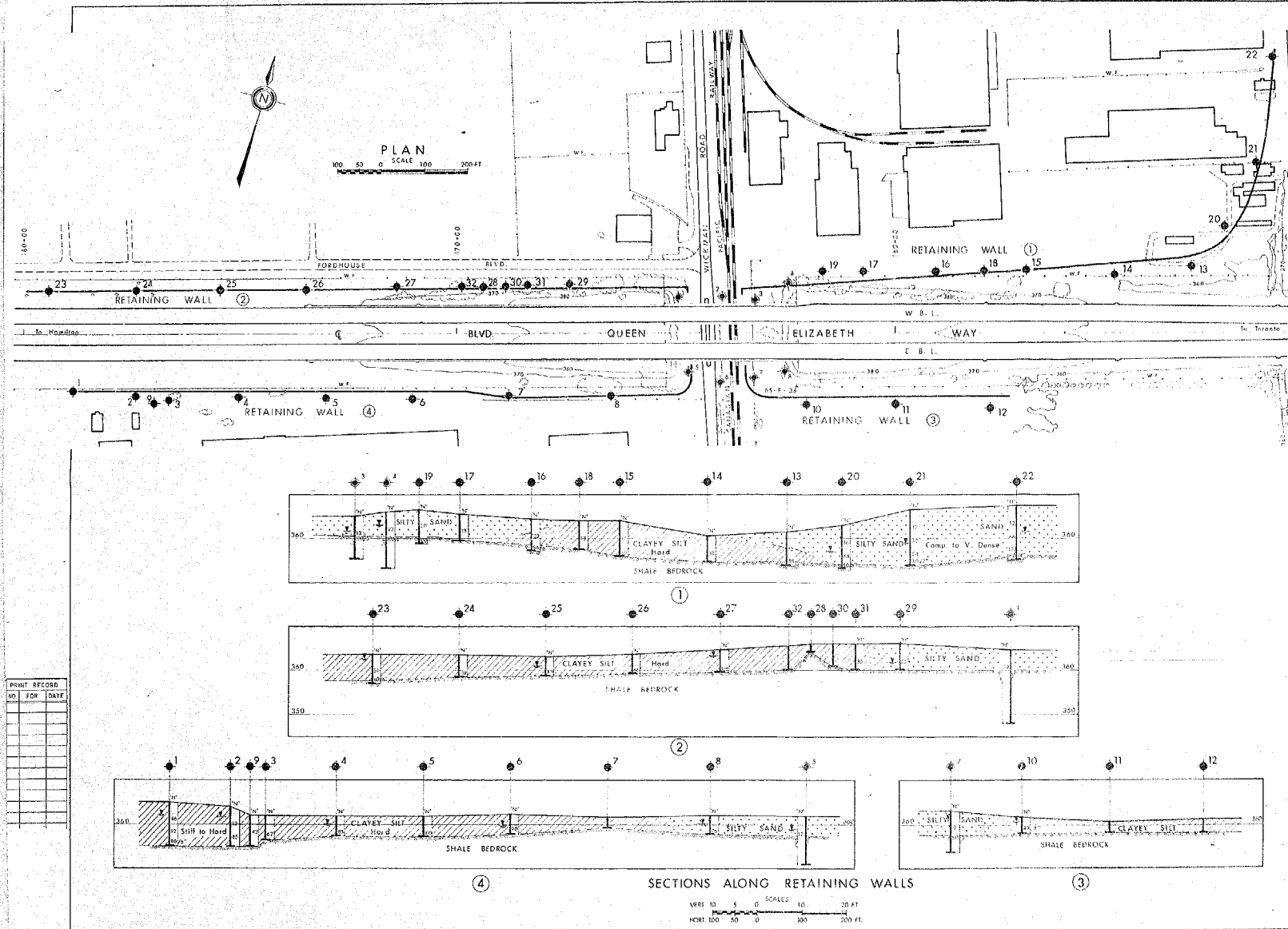
W.P. # 47-65-1

Q.E.W. ε'

KIPLING AVE.

-WICKMAN RD.

VICINITY



LEGEND

- Bore Hole
- Core Penetration Hole
- Core Penetration Hole
- Water Levels established at time of field investigation, FEB 21, 1966
- Bore Holes done for previous job, C.S. - F-38

NO.	ELEVATION	STATION	OFFSET
1	305.5-0	178+90	130' RT.
2	305.5-0	177+45	130' RT.
3	305.5-0	176+55	150' RT.
4	305.5-0	176+00	151' RT.
5	302.0-0	174+00	158' RT.
6	302.0-0	173+00	158' RT.
7	302.0-0	168+40	140' RT.
8	302.0-0	167+45	140' RT.
9	302.0-0	177+00	153' RT.
10	302.0-0	167+00	153' RT.
11	301.0-0	160+00	160' RT.
12	301.0-0	157+45	170' RT.
13	301.0-0	153+30	150' RT.
14	301.0-0	151+05	140' RT.
15	301.0-0	150+05	140' RT.
16	301.0-0	150+05	140' RT.
17	301.0-0	150+05	140' RT.
18	301.0-0	150+05	140' RT.
19	301.0-0	150+05	140' RT.
20	301.0-0	150+05	140' RT.
21	301.0-0	150+05	140' RT.
22	301.0-0	150+05	140' RT.
23	301.0-0	150+05	140' RT.
24	301.0-0	150+05	140' RT.
25	301.0-0	150+05	140' RT.
26	301.0-0	150+05	140' RT.
27	301.0-0	150+05	140' RT.
28	301.0-0	150+05	140' RT.
29	301.0-0	150+05	140' RT.
30	301.0-0	150+05	140' RT.
31	301.0-0	150+05	140' RT.
32	301.0-0	150+05	140' RT.

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING DIVISION - FOUNDATION SECTION

RETAINING WALLS
(KIPLING AVE - WICKMAN RD. VICINITY)

KING'S HIGHWAY NO. Q.E.W. DIST. NO. 6
CO. METROPOLITAN TORONTO
TWP. ETOBICOKE LOT. CON.

BORE HOLE LOCATIONS & SOIL STRATA

BORED H.M. 47-65-1 DATE DRAWING NO. 66-F-8A
DRAWN S.O. 47-65-1 JOB NO. 66-F-8
DATE 10 FEB 1966 SITE NO. 66-F-8
APPROVED [Signature] CONT. NO. 66-F-8A