

MEMORANDUM

W.P. 114-63

23-65-239

TO: Mr. B. R. Davis,
Bridge Design Engr.,
Bridge Division.

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

Attention: Mr. J. Keen

DATE: May 29, 1964

OUR FILE REF.

IN REPLY TO

SUBJECT:

FOUNDATION INVESTIGATION REPORT

For

Black Creek Structure on Ramp from
Jane St. North to W.B. Hwy. No. 400.
District No. 6

W.J. 64-F-29 -- W.P. 343-64

As requested by you in your memo dated April 16, 1964, we have carried out two borings and four dynamic cone penetration tests at the above-mentioned site for the purpose of determining the most suitable type of foundations.

Subsoil at the site generally consists of 21 to 28 ft. of soft to stiff clayey silt to silty clay with some sand and fine gravel. This deposit on the west side of the Black Creek is overlain by 11 ft. of loose to compact sandy silt with organic material, whereas on the east side it is overlain by 11 ft. of firm to stiff clayey silt with sand and organics. A dense stratum of silt was encountered immediately below the deposit of clayey silt to silty clay. The boundaries of these layers, together with their properties, are shown on the borehole log sheets which are included in this report. The estimated stratigraphical profile is shown on Dwg. No. 64-F-29A.

cont'd. /2

Structure Foundations:

The presence of soft to stiff clayey silt to clayey silt some 5.0 ft. below the proposed footing elevation raises the problem of low bearing capacity and large settlements. For these reasons, it is recommended that the proposed abutments of the single span structure be supported on end-bearing piles. It is believed that a 12 $\frac{1}{2}$ " O.D. steel tube pile driven to practical refusal in the silt should provide a safe design load of 50 tons. However, the driving of piles in the silt during construction should be controlled by the use of the Hiley Formula as per current D.H.O. Standards DD 1217 & DD 1218.

A closed end abutment type structure with a single span about 100 ft. in length is proposed at this location. The full height of the abutments would be in the order of 20 feet. If a closed end abutment of this height is adopted, there may be some lateral movement of the abutments due to the horizontal strain in the subsoil. In a rigid frame structure, a negligible amount of movement would take place but additional stresses may set up in the frame. It is suggested that consideration be given to an open abutment type structure with end slopes of 2 horizontal to 1 vertical. This type of construction would ensure the overall stability of the embankment in a longitudinal direction and limit any possible lateral movements of the structure.

Approach Fills:

The maximum height of the approach embankments will be in the order of 20 ft. Total stress circular arc analysis was carried

Approach Fills: (cont'd.) ...

out for the proposed embankment section and indicated that the factor of safety at the end of construction was about 1.25.

If you have any further queries regarding this matter, please contact this Office.

MD/MdeF
Attach.

M. Devata
M. Devata,
SR. FOUNDATION ENGR.
For:
A. G. Stermac,
PRINCIPAL FOUNDATION ENGR.

cc: Messrs. H. A. Tregaskes
H. D. McMillan
G. K. Hunter (2)
C. Fraser
T. J. Kovich
A. Watt

Foundations Office
Gen. Files

APPENDIX I.

FOUNDATION SECTION

OWEN, JAMES E. H.S.

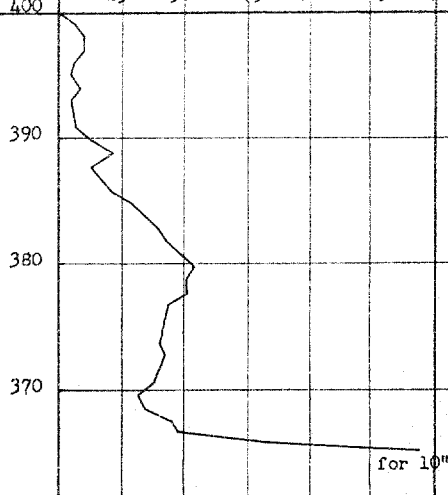
... .. H₂O

WITNESSED BY _____ M.D.

DEPTH	SOIL DESCRIPTION	SPT BLOW COUNT	SPT TYPE	BLOW SCALE	DYNAMIC PENETRATION RESISTANCE					WATER CONTENT			BULK DENSITY	REMARKS
					25	50	75	100	125	150	WATER LIMIT	PLASTIC LIMIT		
					SHEAR STRENGTH P.S.F.									
					O - Unconfined Compr. Strength									
					+ - Field Vane Test									
					500 1000 1500 2000 2500					WATER CONTENT %				
										10 20 30				
399.8	Groundlevel			400										
0.0	Clayey silt with sand and some organic. Firm to stiff.													W.L. @ 397.8
		1	SS	7										From observation in borehole
		2	SS	7										Gr 4% 2.78%
888.8		3	SS	16										Sa 44% Organic
11.0	Clayey silt to silty clay with some sand and fine gravel.	4	SS	9										Si 52% Matte
		5	TM	P										
		6	TM	P										
		7	TM	P										
367.8	Firm to stiff.	8	TM	P										
32.0	Silt-Grey	9	SS	89										Sa 4%
		10	SS	81										Si 87%
358.3	Very dense.													Cl 96%
41.5	End of borehole.													

JOB 64-F-29 LOCATION Black Creek, Hwy. 400 Ramp N-W ORIGINATED BY H.S.
W.P. 343-64 BORING DATE April 20, 1964. COMPILED BY H.S.
DATUM G.S.C. BOREHOLE TYPE Dynamic Penetration Test Only. CHECKED BY M.D.

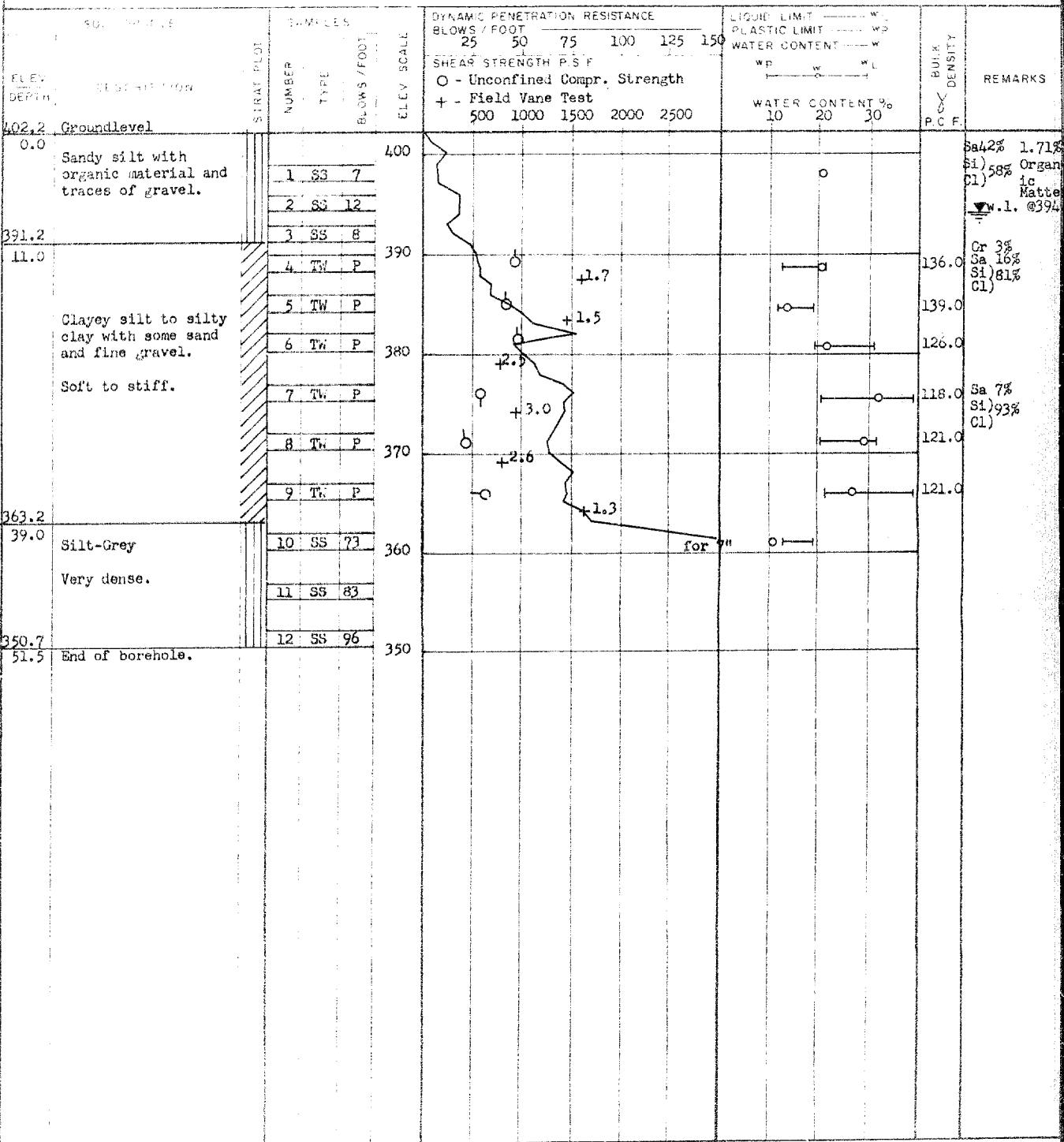
SOIL PROFILE		SAMPLES		ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT		LIQUID LIMIT ———— W _L PLASTIC LIMIT ———— W _P WATER CONTENT ———— W		BULK DENSITY P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER		TYPE	SHEAR STRENGTH P.S.F.		W _P ———— W _L WATER CONTENT %		
399.8 0.0	Groundlevel				400	25 50 75 100 125 150				
					390					
					380					
					370					
365.0 34.8	End of Penetration Test				360					



RECORD OF BOREHOLE NO. 3

FOUNDATION SECTION

NO. 64-F-29 LOCATION Black Creek Hwy. 400 Ramp N-W ORIGINATED BY H.S.
 W.C. 343-64 BORING DATE April 23, 1964. COMPILED BY H.S.
 DATUM U.S.C. BORING TYPE Washboring CHECKED BY H.D.



DEFECTS IN NEGATIVE DUE TO
CONDITION OF ORIGINAL DOCUMENT

$$64 - 4 = 24$$

Black Creek, Hwy. 400 Ramp N-W

H.3

343-64

April 22, 1964.

H.5

C.C.C.

Dynamic Cone Penetration Test Only.

H. U

STATION	NUMBER	TYPE	BLOWS / FOOT	ELEV. FEET	ANVIL PENETRATION RESISTANCE						WATER CONTENT %	BULK DENSITY P.C.F.	REMARKS	
					BLOWS / FOOT	25	50	75	100	125				150
002.4		Ground level		0.0										
384.0		End of Penetration Test		39.6										

400

390

380

370

360

For 7"

6000

7000

6200

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
WS	WASHED SAMPLE	T.P.	THINWALL PISTON
SB	SCRAPER BUCKET SAMPLE	DS	DESTERBERG SAMPLE
AS	AUGER SAMPLE	FS	FOIL SAMPLE
CS	CHUNK SAMPLE	RC	ROCK CORE
ST	SLOTTED TUBE SAMPLE		
	PH	SAMPLE ADVANCED HYDRAULICALLY	
	PM	SAMPLE ADVANCED MANUALLY	

SOIL TESTS

CU	UNCONFINED COMPRESSION	LV	LABORATORY VANE
Q	UNDRAINED TRIAXIAL	FV	FIELD VANE
CUU	CONSOLIDATED UNDRAINED TRIAXIAL	C	CONSOLIDATION
QU	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_v	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

Mr. B. Davis,
Bridge Design Engr.,
Bridge Division.

Foundation Section,
Materials & Research Div.,
Rm. 107, Lab. Bldg.

Attention: Mr. J. L. Keen

June 1, 1964.

Your Memo May 28, 1964

Jane St. Overpass, W.P. 113-63 and
Black Creek Bridge on Ramp from
Jane St. N. to W.B. Hwy. 400, W.P. 343-64
District #6.

We have received your Preliminary Plans for the above-mentioned structures and herewith submit our comments for your consideration:

At the Jane Street Overpass (W.P. 113-63), two areas seem to be critical with respect to possible damage from pile driving. One is where the 36" Metro W.M. encased in a 5' x 5' concrete box on piles passes between the bridge and retaining wall footing, and the other where the 12" sanitary sewer passes under the west bridge abutment footing. At these two locations the piles seem to be quite close to the existing mentioned structures and damage could conceivably be caused to the structures by the material being displaced by the piles. It is therefore our recommendation that preboring be carried out for seven piles at the first, and four piles at the second mentioned location. Due to the granular nature of the uppermost layer, the boreholes may not stay open, but it is believed that enough loosening of the material will be achieved to account for the lateral displacing when the pile is inserted into the ground. Preboring should be carried out down to the invert elevations of the two existing structures.

Some difficulty may be encountered in connection with the predrilling of inclined holes for the battered piles, but we feel that this is easily surmountable provided the proper equipment is used. In any case, we feel that even some soil removal should be very beneficial because the upper soil layer is rather loose anyway, and the predrilling could be considered as only a precautionary measure rather than an absolutely necessary one.

At the Black Creek bridge on ramp from Jane Street to W.B. Hwy. 400 (W.P. 343-64), the smallest distance between the battered pile and the 6' C.D. sewer seems to be in the order of 7 feet. It is our opinion that this is an adequate distance and no special precautions are necessary. However, we would like

cont'd. /2 ...

Mr. B. R. Davis
Attn: Mr. J. L. Keon

- 2 -

June 1, 1964

to emphasize the importance of checking all the distances prior to pile driving, because should they differ from those indicated on the drawings, preboring may become necessary.

AGS/MdeF

cc: Foundations Office (2)
Gen. Files

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

To: A. G. Stermac, P. Eng.,
Principal Foundation Engineer,
Room 107, Lab. Bldg.

FROM: Bridge Division,
Downsview, Ontario.

Att.: M. Devata, P. Eng.

DATE: May 26, 1964.

OUR FILE REF.

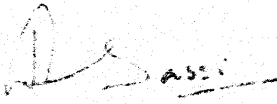
IN REPLY TO

SUBJECT: Jane St. Overpass W.P. 113-61 and
Black Creek Bridge on Ramp from
Jane St. N. to W. B. Hwy. 400 W.P. 343-64
District #6.

Enclosed herewith are Foundation and File Layout
Plans for the above structures. The location of the
various utilities has been indicated on these plans.

Would you please investigate the effect of File
Driving on these utilities and let us know what
precautions (if any) should be taken to prevent them
from being damaged.

RGB:gc
c.c. J. Curtis
M. Stoyanoff


K. G. Bissi, P. Eng.,
Bridge Project Engineer,
for J. L. Keen, P. Eng.,
Sr. Bridge Project Engineer.

Copy for the information of
M. Devata, Senior Foundation Eng.,
Room 107, Lab. Building.
Mr. J. C. Thatcher,
District Engineer,
Central Building.

Bridge Division,
Downsview, Ontario.

June 30, 1965.

Minutes of Review Meeting,
Hwy. 400 & Jane St.,
District 6 Boardroom,
Friday, June 25, 1965.

64-F-29

I would like to clarify the last paragraph on page one of the minutes for the review meeting held on Friday, June 25, 1965, in the District 6 Boardroom in connection with the work of Hwy. 400 and Jane St.

The first part of the paragraph recorded as "The Bridge Office stated that the piling was definitely not bearing piles but tube piles" should be clarified as there is a possible ambiguity in the use of the word "bearing". I believe that the word "bearing" has been used here to mean H-piles, usually used when the pile derives most of its load capacity from end bearing on a hard lower stratum. The discussion referred to the ramp structure west of Jane St., and at this location the piles will be concrete filled steel tube piles. These piles may be described as "bearing", but only because they will derive practically all their load capacity through end bearing at the pile tip.

The last part of the paragraph, "guaranteed that damage would not occur to the channel lining" is incorrect. At the time I stated that we did not believe that damage would result to the existing channel lining from the driving of the tube piles (ramp structure west of Jane St.) and that we had not called for pre-drilling holes for the tube piles on the strength of the Foundations Report, the writer of which seemed confident this would not occur. I do not believe the minutes are correct to refer to this as our "guarantee". As mentioned at the time of discussion, we have reviewed this matter with the Foundations Section, who confirm their previous recommendations. However as the only way to be absolutely 100% sure that there will be no effect on the channel lining is to pre-drill at least the first row of piles and accordingly we have shown this on our plans. Pre-drilling will now be used on the front row of piles for both abutments.

JCA/lc
C.C. M. Devata

J. L. Keen, P. Eng.,
Sr. Bridge Project Engineer.

115

To: Mr. A. Stermac,
Principal Foundations Engineer,
Room 107, Lab. Bldg.,
Downsview, Ontario.

FROM: Bridge Division,
Downsview, Ontario.

DATE: April 16, 1964.

OUR FILE REF.

IN REPLY TO

SUBJECT: Black Creek Bridge
on Ramp N-W from Jane St. W.P. 343-64,
Hwy. 400 Extension at Jane St.,
District #6.

This memorandum is to confirm our request for foundation investigation for the above bridge site, as requested by your Mr. M. Devata during a meeting with Messrs. Devata, Bassi and Keen at your offices on Wednesday April 15, 1964.

This additional work has been made necessary because of the recently revised arrangement of the interchange at Hwy. 400 and Jane St. to include a ramp in the north-west quadrant and that this ramp has been added since the completion of your field work.

JLK:go
c.c. J. Curtis
K. Bassi

J. L. Keen
J. L. Keen,
for B. Davis,
Bridge Design Engineer.

#64-F-29

W.P. #343-64

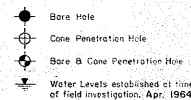
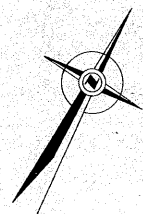
HWY. #400

BLACK CREEK

STRUCTURE ON

RAMP. JANE ST.

NORTH



NO.	ELEVATION	STATION	OFFSET
1	399.8	604+19	20' RT.
2	399.7	604+13	10' LT.
3	402.2	603+08	10' LT.
4	402.3	603+25	20' RT.

- NOTE -

The boundaries between soil strata have been established only at Bore Hole locations. Between Bore Holes the boundaries are assumed from geological evidence and may be subject to considerable error.

[illegible]

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

BLACK CREEK

KING'S HIGHWAY NO. 400 RAMP N-W DIST. NO. 6

CO. METROPOLITAN TORONTO
TWP. NORTH YORK LOT CON.

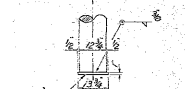
BORE HOLE LOCATIONS & SOIL STRATA	
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SUBMIT H.S.	CHECKED <i>fr</i>	W.P. NO. 343-64	M.B.R. DRAWING NO.
DRAWN D.M.	CHECKED <i>fr</i>	J.G.B. NO. 64-F-29	64-F-29 A
DATE 15 MAY 1964		SITE NO.	BRIDGE DRAWING NO.

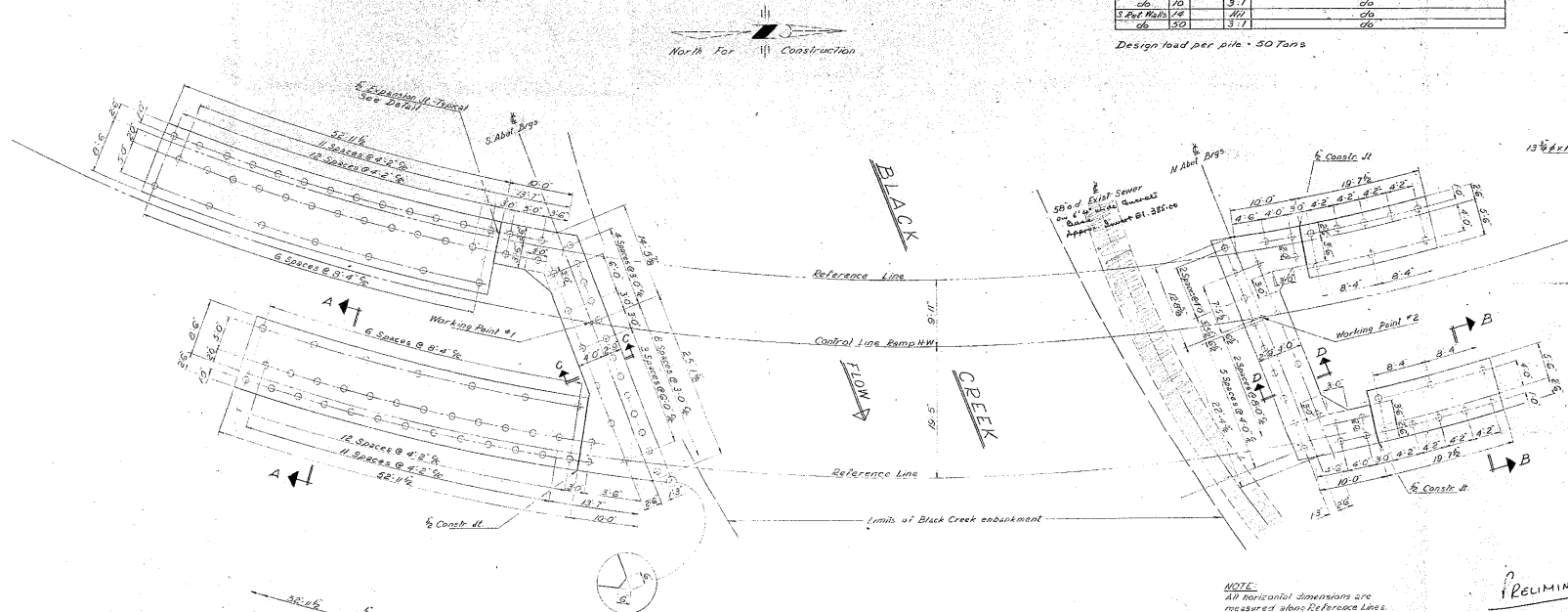
[illegible]

Location	#	Length	Bar #	Type
N Abut	1	N/A	N/A	12" w/ 4 # 0.25 Wall Thickness Steel Tube Pile
do	9		4-1	do
N Abut	12	N/A	N/A	do
do	13		3-1	do
N Ret Walls	6	N/A	N/A	do
do	10		3-1	do
S Ret Walls	14	N/A	N/A	do
do	20		3-1	do

PILE SPLICE DETAIL



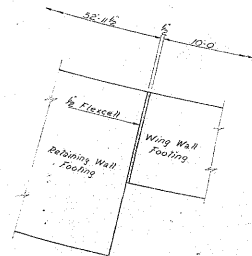
PILE SHOE DETAIL



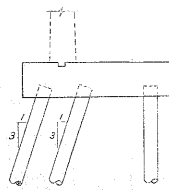
NOTE:
All horizontal dimensions are
measured along Reference Lines

PRELIMINARY

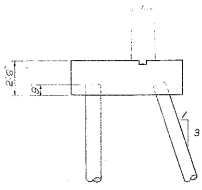
Scale: $\frac{1}{2}$ in. = 1 ft.



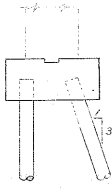
(Typical at All Four Ret. Walls)
H.T.S.



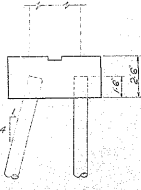
Typical S. Ret. Walls
Scale: $\frac{1}{4}'' = 1'-0''$



Typical N. Ret. Walls
Scale: $\frac{1}{4}" = 1'-0"$



Scale: $\frac{1}{4}$ " = 1'-0"



Scale: $\frac{1}{4} = 1.0$

[illegible]

BLACK CREEK BRIDGE

On Ramp From Jane St North to W.B. Hwy. N° 400

KING'S HIGHWAY No. 400 DIST. No. 6

CO. York

TWP. North York LOT CON.

FOUNDATION PLAN

SITE No.	38-668	W.P. No.	343-6
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APPROVED	BRIDGE ENGINEER	CONTRACT		
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DESIGN	B. C.	CHECK		POST.			
DRAWING	E. 161	CHECK		DRAWING	D. 5122		

DATE	LOADING	W20-S16	No.	D-3413
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D-5473-