DEPARTMENT OF HIGHWAYS ONTARIO

MEMORANDUM

23-65-263.

To: Mr. A. M. Toye,
Bridge Engineer,
Bridge Division.

Attention: Mr. S. McCombie

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

Date: June 22, 1964

Our File Ref.

In reply to

Subject:

FOUNDATION INVESTIGATION REPORT

For

Prop. North-West Ramp Structure at
Islington Ave. & Hwy.401 Interchange,
Twp. of Etobicoke, County of York,
District No. 6, Toronto
W.J. 64-F-36 -- W.P. 608-64

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 future design work. Should you require additional information, please do not hesitate to contact our Office.

A. G. Stermac,
PRINCIPAL FOUNDATION ENGINEER

AGS/MdeF
Attach.
cc: Messrs. A. M. Toye (2)
H. A. Tregaskes
H. D. McMillan
G. K. Hunter (2)
C. Fraser
T. J. Kovich
A. Watt

Foundations Office
Gen. Files

# FOUNDATION INVESTIGATION REPORT

For

Prop. North-West Ramp Structure at
Islington Ave. & Hwy. 401 Interchange,
Twp. of Etobicoke, County of York,
District No. 6, Toronto
W.J. 64-F-36 -- W.P. 608-64

It is proposed to construct an overpass bridge which will take the proposed North-West Ramp over East-West (Belfield) Ramp, Islington and Hwy. 401 Interchange. At the request of the Bridge Location Engineer, Mr. J. Curtis (memo dated April 28, 1964), a foundation investigation was carried out to determine the subsoil conditions existing at the site of the proposed structure.

The field investigation consisted of four sampled boreholes. A dynamic cone penetration test was also carried out adjacent to each borehole. The locations and elevations of the boreholes are shown on the attached drawing No. 64-F-36A.

The subsoil conditions at this site were found to be generally uniform. The subsoil consists of very stiff to hard clayey silt, sand and traces of gravel (glacial till).

The upper 10 - 12 ft. of the clayey silt material is desiccated and brown in colour. The remainder of the deposit is generally grey in colour. The deposit has a consistency ranging from very stiff to hard with 'N' values in the order of 21 to over 100 blows per foot. The other physical properties as determined in the laboratory are as follows:

| | |
|---|---|
| Liquid Limit | 18% - 23% |
| Plastic Limit | 11% - 15% |
| Moisture Content | 10% - 14% |

cont'd. /2 ...

The elevations of the water levels in the boreholes are as follows:

| | | Elev. |
|---|---|---|
| B.H. #1 | - | 511.5 |
| B.H. #2 | - | 487.3 |
| B.H. #3 | - | 487.5 |
| B.H. #4 | - | 487.5 |

The subsoil conditions at this site are favourable for spread footing type foundations. It is recommended that the new structure be founded on spread footings with a safe bearing pressure of 3 T.S.F., approximately 5 ft. below the existing ground surface.

No dewatering problems are anticipated with regard to proposed footing excavations since the subsoil is relatively impermeable.

Stability problems are not anticipated provided standard 2:1 slopes are adopted for the proposed approach fills.

The field work was carried out during May 19 to May 21, 1964, under the supervision of Mr. V. Korlu, Project Foundation Engineer, who also wrote this report. The report was reviewed by Mr. M. Devata, Senior Foundation Engineer. The drilling equipment was supplied by Johnston Drilling Co. of Toronto.

June 1964

# APPENDIX I.

FORM OBM-102
6/382

OFFICE REPORT ON SOIL EXPLORATION

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & RESEARCH DIVISION

# RECORD OF BOREHOLE NO. 1

FOUNDATION SECTION

JOB 64-F-36 LOCATION Hwy. 401 & Islington; N-W Ramp ORIGINATED BY V.K.

W P 608-64 BORING DATE May 19, 1964. COMPILED BY V.K.

DATUM Geodetic BOREHOLE TYPE Penndrill CHECKED BY M.D.

| ELEV / DEPTH | DESCRIPTION | STRAT PLOT | SAMPLES NUMBER | TYPE | BLOWS / FOOT | ELEV SCALE |
|---|---|---|---|---|---|---|
| 514.0 | Groundlevel | | | | | |
| 0.0 | Topsoil | | | | | |
| 1.0 | ▼ W.L. | | | | | |
| 2.5 | Brown clayey silt with sand and occasional gravel. (Glacial till) | | 1 | SS | 50 | 510 |
| | | | 2 | SS | 49 | |
| | | | 3 | SS | 58 | |
| | Changing to grey below elev. 504) | | 4 | SS | 22 | 500 |
| | | | 5 | SS | 21 | |
| | Hard | | 6 | SS | 23 | |
| | | | 7 | SS | 35 | |
| | | | | | | 490 |
| | | | 8 | SS | 50 | |
| | | | 9 | SS | 92 | |
| 480.5 | | | 10 | SS | 100/6" | 480 |
| 33.5 | End of borehole. | | | | | |
| | | | | | | 470 |

DYNAMIC PENETRATION RESISTANCE
BLOWS / FOOT
20 40 60 80 100

SHEAR STRENGTH P.S.F.

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

Gr-2
Sa-30
Si-47
Cl-21

FORM OB-ML-105
63-392

OFFICE REPORT ON SOIL EXPLORATION

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & RESEARCH DIVISION

# RECORD OF BOREHOLE NO. 2

FOUNDATION SECTION

JOB 64-F-36 LOCATION Hwy. 401 & Islington; N-W Ramp ORIGINATED BY V.K.

W P 608-64 BORING DATE May 20, 1964. COMPILED BY V.K.

DATUM Geodetic BOREHOLE TYPE Penndrill CHECKED BY M.D.

| ELEV / DEPTH | DESCRIPTION | STRAT PLOT | SAMPLES NUMBER | TYPE | BLOWS / FOOT | ELEV SCALE |
|---|---|---|---|---|---|---|
| 513.8 | Groundlevel | | | | | |
| 0.0 | Topsoil | | | | | |
| 1.0 | Brown clayey silt, sand and occasional gravel. | | 1 | SS | 29 | 510 |
| | | | 2 | SS | 39 | |
| | (Glacial till) | | 3 | SS | 65 | |
| | (Grey below elev 503.0) | | 4 | SS | 26 | 500 |
| | | | 5 | SS | 29 | |
| | | | 6 | SS | 42 | |
| | V. stiff to hard. | | 7 | SS | 38 | |
| | | | | | | 490 |
| W.L. 26.5 | ▼ | | 8 | SS | 48 | |
| 482.3 | | | 9 | SS | 105 | |
| 31.5 | End of borehole. | | | | | 480 |
| | | | | | | 470 |

DYNAMIC PENETRATION RESISTANCE
BLOWS / FOOT 20 40 60 80 100
SHEAR STRENGTH P.S.F.

LIQUID LIMIT — $w_L$
PLASTIC LIMIT — $w_P$
WATER CONTENT — $w$
$w_P$ $w$ $w_L$
WATER CONTENT % 10 20 30

BULK DENSITY P.C.F.

REMARKS

Gr-0
Sa-30
Si-49
Cl-21

Gr-3
Sa-28
Si-49
Cl-20

OFFICE REPORT ON SOIL EXPLORATION

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & RESEARCH DIVISION

# RECORD OF BOREHOLE NO. 3

FOUNDATION SECTION

JOB 64-F-36 LOCATION Hwy. 401 & Islington; N-W Ramp ORIGINATED BY V.K.

W P 608-64 BORING DATE May 20, 1964. COMPILED BY V.K.

DATUM Geodetic BOREHOLE TYPE Penndrill CHECKED BY M.D.

| ELEV / DEPTH | DESCRIPTION | STRAT PLOT | SAMPLES NUMBER | SAMPLES TYPE | SAMPLES BLOWS / FOOT | ELEV SCALE | DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT 20 40 60 80 100 / SHEAR STRENGTH P.S.F. | LIQUID LIMIT $w_L$ / PLASTIC LIMIT $w_P$ / WATER CONTENT $w$ / WATER CONTENT % 10 20 30 | BULK DENSITY $\gamma$ P.C.F. | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|
| 516.5 | Groundlevel | | | | | | | | | |
| 0.0 | Topsoil | | | | | | | | | |
| 1.0 | Brown clayey silt, sand and occasional gravel. (Glacial till) V. stiff to hard. Changing to grey below elev. 504.0 | | 1 | SS | 50 | 510 | | | | Gr-4 Sa-24 Si-) Cl-) 72 |
| | | | 2 | SS | 71 | | | | | |
| | | | 3 | SS | 73 | | | | | |
| | | | 4 | SS | 36 | | | | | |
| | | | 5 | SS | 34 | 500 | | | | Gr-3 Sa-29 Si-) Cl-) 68 |
| | | | 6 | SS | 28 | | | | | |
| | | | 7 | SS | 45 | | | | | |
| | | | 8 | SS | 68 | 490 | | | | Gr-1 Sa-32 Si-) Cl-) 67 |
| W.L. 29.0 485.8 | | | 9 | SS | 98 | | | | | |
| 31.5 | End of borehole. | | | | | 480 | | | | |
| | | | | | | 470 | | | | |

FORM OBNL-12c

OFFICE REPORT ON SOIL EXPLORATION

DEPARTMENT OF HIGHWAYS ONTARIO
MATERIALS & RESEARCH DIVISION

# RECORD OF BOREHOLE NO. 4

FOUNDATION SECTION

JOB 64-F-36 LOCATION Hwy. 401 & Islington; N-W Ramp. ORIGINATED BY V.K.

W P 608-64 BORING DATE May 21, 1964. COMPILED BY V.K.

DATUM Geodetic BOREHOLE TYPE Penndrill CHECKED BY M.D.

| ELEV / DEPTH | DESCRIPTION | STRAT PLOT | SAMPLES NUMBER | SAMPLES TYPE | SAMPLES BLOWS / FOOT | ELEV SCALE |
|---|---|---|---|---|---|---|
| 516.5 | Groundlevel | | | | | |
| 0.0 | Topsoil | | | | | |
| 1.0 | Brown clayey silt with sand and occasional gravel. (Glacial till) V. stiff to hard. | | 1 | SS | 27 | |
| | | | 2 | SS | 50 | 510 |
| | | | 3 | SS | 55 | |
| 504.0 | | | | | | |
| 12.5 | (changing to grey below Elev. 504.0) | | 4 | SS | 52 | |
| | | | 5 | SS | 37 | 500 |
| | | | 6 | SS | 28 | |
| | | | 7 | SS | 23 | |
| W.L. | | | 8 | SS | 59 | 490 |
| 29.0 | | | | | | |
| 485.0 | | | 9 | SS | 63 | |
| 31.5 | End of borehole. | | | | | 480 |
| | | | | | | 470 |

DYNAMIC PENETRATION RESISTANCE
BLOWS / FOOT
20 40 60 80 100
SHEAR STRENGTH P.S.F.

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

Gr-2
Sa-25
Si-) 73
Cl-)
Gr-1
Sa-22
Si-) 77
Cl-)

# 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 :-

| CONSISTENCY | 'N' BLOWS/FT. | c LB./SQ.FT. | DENSENESS | 'N' BLOWS/FT. |
|---|---|---|---|---|
| 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

| | | | |
|---|---|---|---|
| $Q_u$ | UNCONFINED COMPRESSION | L.V. | LABORATORY VANE |
| Q | UNDRAINED TRIAXIAL | F.V. | FIELD VANE |
| $Q_{cu}$ | CONSOLIDATED UNDRAINED TRIAXIAL | C | CONSOLIDATION |
| $Q_{\bar{d}}$ | DRAINED TRIAXIAL | S | SENSITIVITY |

# ABBREVIATIONS USED IN THIS REPORT

## SOIL PROPERTIES

| | |
|---|---|
| $\gamma$ | UNIT WEIGHT OF SOIL (BULK DENSITY) |
| $\gamma_s$ | UNIT WEIGHT OF SOLID PARTICLES |
| $\gamma_w$ | UNIT WEIGHT OF WATER |
| $\gamma_d$ | UNIT DRY WEIGHT OF SOIL (DRY DENSITY) |
| $\gamma'$ | 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 |
| $\tau_f$ | SHEAR STRENGTH |
| $c'$ | EFFECTIVE COHESION INTERCEPT |
| $\phi'$ | EFFECTIVE ANGLE OF SHEARING RESISTANCE, OR FRICTION |
| | IN TERMS OF EFFECTIVE STRESS $\tau_f = c' + \sigma' \tan \phi'$ |
| $c_u$ | APPARENT COHESION |
| $\phi_u$ | APPARENT ANGLE OF SHEARING RESISTANCE, OR FRICTION |
| | IN TERMS OF TOTAL STRESS $\tau_f = c_u + \sigma \tan \phi$ |
| $\mu$ | COEFFICIENT OF FRICTION |
| $S_t$ | SENSITIVITY |

## GENERAL

| | |
|---|---|
| $\pi$ | = 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 |
| $\sigma$ | NORMAL STRESS |
| $\sigma'$ | NORMAL EFFECTIVE STRESS ($\bar{\sigma}$ IS ALSO USED) |
| $\tau$ | SHEAR STRESS |
| $\varepsilon$ | LINEAR STRAIN |
| $\gamma$ | SHEAR STRAIN |
| $\nu$ | POISSON'S RATIO ($\mu$ IS ALSO USED) |
| E | MODULUS OF LINEAR DEFORMATION (YOUNGS MODULUS) |
| G | MODULUS OF SHEAR DEFORMATION |
| K | MODULUS OF COMPRESSIBILITY |
| $\eta$ | COEFFICIENT OF VISCOSITY |

## EARTH PRESSURE

| | |
|---|---|
| d | DISTANCE FROM TOP OF WALL TO POINT OF APPLICATION OF PRESSURE |
| $\delta$ | ANGLE OF WALL FRICTION |
| K | DIMENSIONLESS COEFFICIENT TO BE USED WITH VARIOUS SUFFIXES IN EXPRESSIONS REFERRING TO NORMAL STRESS ON WALLS |
| $K_o$ | COEFFICIENT OF EARTH PRESSURE AT REST |

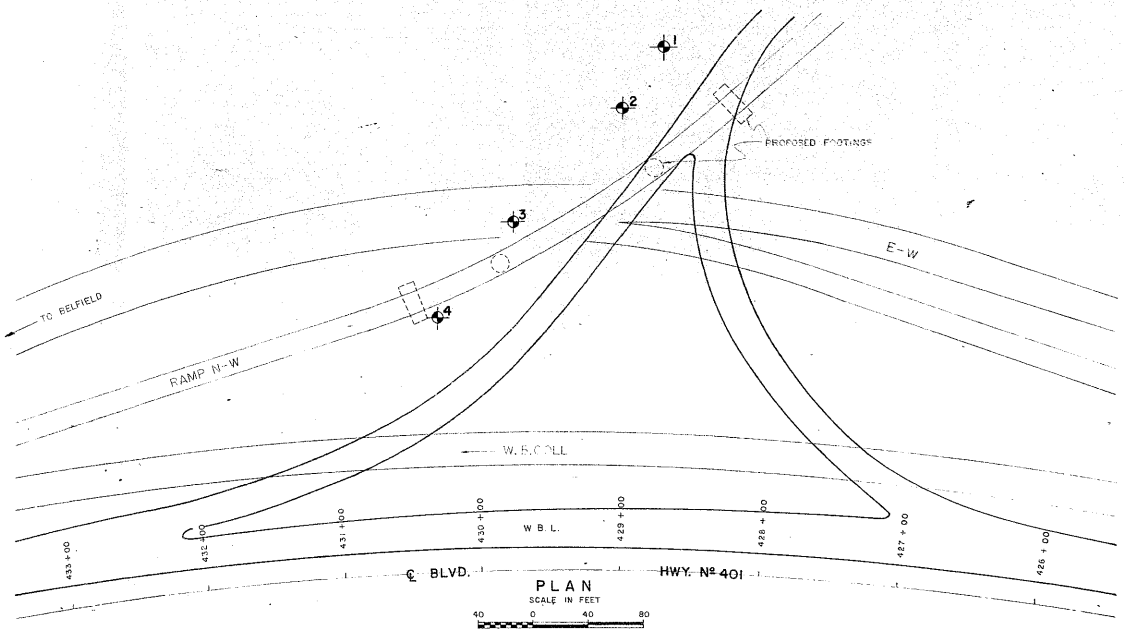
## FOUNDATIONS

| | |
|---|---|
| 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 |

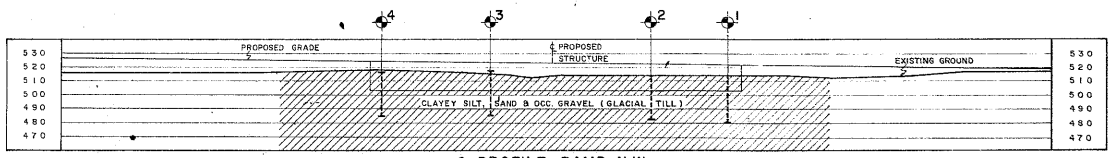
## SLOPES

| | |
|---|---|
| H | VERTICAL HEIGHT OF SLOPE |
| D | DEPTH BELOW TOE OF SLOPE TO HARD STRATUM |
| $\beta$ | ANGLE OF SLOPE TO HORIZONTAL |

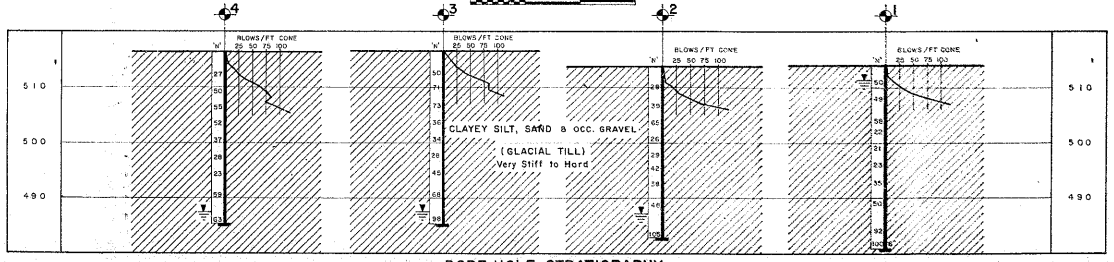
#64-F-36
W.P.# 608-64
HWY. #401 &
PROP. N.W. RAMP
STRUCTURE AT
ISLINGTON, AVE.



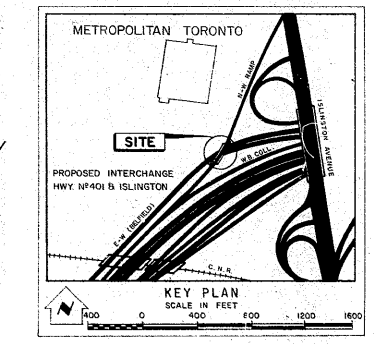

PLAN
SCALE IN FEET
40 0 40 80




℄ PROFILE RAMP N-W
SCALE IN FEET
40 0 40 80




BORE HOLE STRATIGRAPHY
SCALE IN FEET
10 0 10 20




KEY PLAN
SCALE IN FEET

## LEGEND

- Bore Hole
- Cone Penetration Hole
- Bore & Cone Penetration Hole
- Water Levels established at time of field investigation, 20 MAY 1964

| NO. | ELEVATION | STATION | OFFSET |
|---|---|---|---|
| 1 | 514.0 | 428+80 | 379' RT. |
| 2 | 513.8 | 429+05 | 334' RT. |
| 3 | 516.5 | 429+75 | 252' RT. |
| 4 | 516.5 | 430+27 | 184' 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.

| PRINT RECORD | | |
|---|---|---|
| NO. | FOR | DATE |
| | | |

| REVISIONS | | |
|---|---|---|
| DATE | BY | DESCRIPTION |
| | | |

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

# N-W RAMP OVER E-W (BELFIELD)

ISLINGTON INTERCHANGE

KING'S HIGHWAY NO. 401 DIST. NO. 6
CO. YORK METROPOLITAN TORONTO
TWP. ETOBICOKE LOT CON.

BORE HOLE LOCATIONS & SOIL STRATA

| | | | |
|---|---|---|---|
| SUBM'D V.K. | CHECKED D.H. | W.P. NO. 608-64 | M.B.R. DRAWING NO. 64-F-36A |
| DRAWN I.M. | CHECKED J.C. | JOB NO. 64-F-36 | |
| DATE 9 JULY 1964 | | SITE NO. | BRIDGE DRAWING NO. |
| APPROVED A.J. Pettman PROVINCIAL FOUNDATION ENGINEER | | CONT. NO. | |