

G.I.-30 SEPT. 1976

GEOCRES No. 30M11-147DIST. 6 REGION W.P. No. 314-65-17CONT. No. 72-97W. O. No. STR. SITE No. HWY. No. Q.E.W.LOCATION Prop. Relocation of  
Q.E.W. Lions MonumentNo. of PAGES - =====  
OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT. REMARKS:

## MINISTRY OF TRANSPORTATION AND COMMUNICATIONS, ONTARIO

## MEMORANDUM

TO: Mr. W. C. Friedmann, (2)  
Regional Expressway Design Eng.,  
Central Region,  
3501 Dufferin St., Downsview.

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

ATTENTION:

DATE:

September 13, 1973.

OUR FILE REF.

IN REPLY TO

SEP 20 1973

SUBJECT:

FOUNDATION INVESTIGATION REPORT  
For  
Proposed Relocation of Q.E.W. Lions Monument  
Borough of Etobicoke, Metropolitan Toronto  
District No. 6, Toronto  
W.O. 73-11047 -- W.P. 314-65-17

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.

AGS/ao  
Attch.

c.c. E. J. Orr  
R. S. Pillar  
A. Rutka  
H. Greenland  
G.C.E. Burkhardt  
B. J. Giroux  
C. Mirza  
G. A. Wrong  
B. A. Singh  
R. S. Adachi (Fenco)

Foundations Files  
Documents

*A. G. Stermac*  
A. G. Stermac,  
PRINCIPAL FOUNDATIONS ENGINEER.

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FOUNDATION INVESTIGATION REPORT  
For  
Proposed Relocation of Q.E.W. Lions Monument  
Borough of Etobicoke, Metropolitan Toronto  
District No. 6, Toronto  
W.O. 73-11047 - W.P. 314-65-17

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1. INTRODUCTION:

The Foundations Office received a request for a foundation investigation, at the proposed site for the relocation of the Q.E.W. Lions Monument, from Mr. W.C. Friedmann, Regional Expressway Engineer in a memo dated August 9, 1973.

Subsequently, a field investigation was carried out by this office to determine the subsoil and groundwater conditions prevailing at the proposed relocation site. Presented in this report are the results of the investigation together with our recommendations pertaining to the foundations of the monument.

2. DESCRIPTION OF THE SITE AND GEOLOGY:

It is proposed to relocate the Q.E.W. Lions Monument in the Sir Casimir Gzowski Park at a point some 400 ft. east of the mouth of the Humber River and some 200 ft. south of Lakeshore Boulevard in the Borough of Etobicoke, Metropolitan Toronto.

Topographically, the area surrounding the site is flat grass-covered parkland containing a number of small trees. To the west the Humber River flows into Lake Ontario, which is

immediately south of the site. To the north the area is bounded by Lakeshore Boulevard.

Physiographically the site is located within the region referred to as the Iroquois Plain.

### 3. FIELD AND LABORATORY INVESTIGATIONS:

One sampled borehole and three dynamic cone penetration tests were put down during the course of the field work. The borehole was advanced by wash boring techniques. Disturbed soil samples were obtained using a 2-inch O.D. split spoon sampler driven according to the specifications for the Standard Penetration Test. A rock core sample was obtained at the bottom of the borehole with BXL rock coring equipment.

One cone test was put down adjacent to the borehole, with the remaining two cone tests being put down at the northwest and southeast corners of the proposed monument footing location.

Driving energy to advance the cones was 350 ft.-lb. per blow.

Samples were examined visually in the field and again in the laboratory. Tests were performed on selected samples to determine the following physical properties:

- (1) Natural Moisture Content
- (2) Atterberg Limits
- (3) Grain-Size Distribution

The results of the field and laboratory tests are given on the Record of Borehole Sheets and Figures 1 and 2 which are contained in the Appendix of this report.

The locations and elevations of the borehole and cone tests, together with the estimated stratigraphical profile are given on Drawing 73-11047A which is also contained in the Appendix to this report. The borehole location and elevation was surveyed in the field by personnel from Central Region Engineering Surveys Office, Toronto.

4. SUBSOIL CONDITIONS:

4.1 General:

The subsoil encountered at the site consists of a 4 to 5 ft. thick surficial fill underlain by alternating layers of fine sand, and silt to clayey silt. The sand layers varied in thickness from approximately 2.5 to 5.5 ft. and are parted by silt to clayey silt layers of from 2 to 5.5 ft. in thickness. Underlying the lower silt to clayey silt layer is a 11 to 12 ft. thick deposit of clayey silt which in turn is underlain by some 6 to 8 inches of weathered shale bedrock overlying sound black shale bedrock with occasional limestone interbeds.

The boundaries between the various soil types and layers are shown on the Record of Borehole Sheet contained in the Appendix of this report. The estimated stratigraphical profile shown on Drawing 73-11047A is based on this information.

From ground level downward, the various soil strata are described in some detail with regard to soil types and physical properties as follows:

#### 4.2 Fill Material: Silt, Some Sand and Clay:

This surficial deposit is some 4.5 ft. thick and is a fill material consisting of silt with some sand and gravel. It is mottled brown in colour and contains numerous seams of black decayed organic material, roots and bits of decayed wood.

The material has a natural water content of 15% and liquid and plastic limits of 20% and 17% respectively as determined by laboratory tests. A single grain size analysis indicated the following distribution: gravel 0%, sand 12%, silt 77%, clay 11%. An 'N' value of 10 obtained within the stratum indicates the material to be of a loose to compact relative density.

#### 4.3 Sand, With Traces of Gravel and Some Silt and Clay:

Three sand layers were intersected by the borehole. These strata consisted of fine uniform sand with traces of gravel and some silt and clay. Occasional thin seams (1/16" - 1/8") of clayey silt and decayed black organic material were also discovered within these layers as well as occasional chunks of decayed wood.

The natural moisture contents of this material as determined by laboratory tests vary between 15% to 22% with an average of 18%. Grain size analyses performed on samples from each sand layer indicate the following distributions and are plotted on figure 1:

			<u>Average</u>
Gravel	%	0-3	1
Sand	%	59-88	74
Silt & Clay	%	9-41	24

Standard penetration test 'N' values obtained within these layers ranged from 26-43 blows/foot suggesting a compact to dense relative density.

4.4 Silt to Clayey Silt, Traces of Sand and Gravel:

Three layers of silt to clayey silt containing traces of sand and gravel were intersected by the borehole. These layers parted the sand layers and were from 2.5 to 5.5 ft. in thickness.

Physical properties of the material as determined from laboratory tests are as follows and are plotted on figure 2:

Natural Moisture Content	%	17-22
Liquid Limit	%	17-22
Plastic Limit	%	15-18

Grain size analyses performed on samples of this material indicate the following distributions and are plotted on figure 1:

			<u>Average</u>
Gravel	%	0-1	1
Sand	%	0-17	8
Silt	%	71-81	76
Clay	%	11-19	15

Standard penetration test 'N' values within these strata ranged from 28-36 blows/foot indicating a compact to dense relative density for the material.



#### 4.5 Clayey Silt, Traces of Sand and Gravel:

An 11 to 12 ft. thick deposit of clayey silt containing traces of sand and gravel was intersected by the borehole beneath the lowermost silt to clayey silt layer at a depth of 28 ft. (El. 223.5) below the ground surface.

A single standard penetration test performed within this deposit yielded an 'N' value of 21 blows/foot suggesting an undrained shear strength of greater than 2000 psf for the material.

#### 4.6 Shale Bedrock, Sound:

Shale bedrock was proven at the boring location by obtaining a 5 foot BXL core sample (100% Recovery). The upper 6 to 8 inch zone of the bedrock appears to be moderately weathered. The sound bedrock beneath this weathered zone is composed of black shale with thin light grey limestone interbeds occurring at 10 to 12 in. intervals. The bedrock elevation is 212<sup>±</sup>.

### 5. GROUNDWATER CONDITIONS:

At the time of the field investigation, the ground water level determined in the open borehole was at elevation 247 or some 4.5 ft. below the ground surface.

### 6. DISCUSSION AND RECOMMENDATIONS:

#### 6.1 General:

It is proposed to relocate the Q.E.W. Lions Monument from its present location along the Q.E.W. to the Sir Casimir Gzowski Park just east of the mouth of the Humber River between Lake Ontario and Lakeshore Boulevard.

Presented in this report are our recommendations pertaining to the proposed new foundation for Lions Monument.

6.2 Monument Foundation:

In view of the subsoil existing at the relocation site and the relatively large loads the monument will impose on its foundations, it is recommended that the monument be supported on end bearing piles driven to bedrock (El. 212<sup>±</sup>). In this case, the maximum allowable capacity for the particular pile chosen may be assumed.

A minimum earth cover of 4.0 ft. above the bottom of the pile cap must be provided for frost protection purposes. If the finished grade after construction conforms to the existing ground level (El. 251.5<sup>±</sup>), the bottom of the pile cap (El. 247.5<sup>±</sup>) will be above the natural ground water table (El. 247<sup>±</sup>). Thus no major dewatering problems are anticipated. As a precaution, any very soft material at the bottom of the excavation should be removed and replaced with suitable granular material.

7. MISCELLANEOUS:

The field investigation was carried out during the period from August 16 - 17, 1973, under the supervision of Mr. L.J. Hodge, Project Foundations Engineer, who also prepared this report.

Equipment used was owned and operated by Canadian  
Longyear Ltd., Toronto.

This report was reviewed by Mr. K.G. Selby, Supervising  
Foundations Engineer.

*L.J. Hodge*

L.J. Hodge,

*K.G. Selby*

K.G. Selby, P. Eng.

LJH/zh  
September 10, 1973.

APPENDIX I

ORIGINATED BY LJH

COMPILED BY LJH.

CHECKED BY AS

15  $\frac{20}{5}$  % STRAIN AT FAILURE  
10

DESIGN SERVICES BRANCH

FOUNDATIONS OFFICE

## RECORD OF BOREHOLE NO 2

JOB 73-11047

LOCATION Co-ords. 185,602 N; 230,240 E.

ORIGINATED BY LJH

W.P. 314-65-17

BORING DATE August 17, 1973

COMPILED BY LJH

DATUM Geodetic

BOREHOLE TYPE Cone Test

 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 $\gamma$	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS/FOOT					
251.5 0.0	Ground Level									
						250				
						240				
234.0 17.5	End of Cone Test					230				

FOUNDATIONS OFFICE

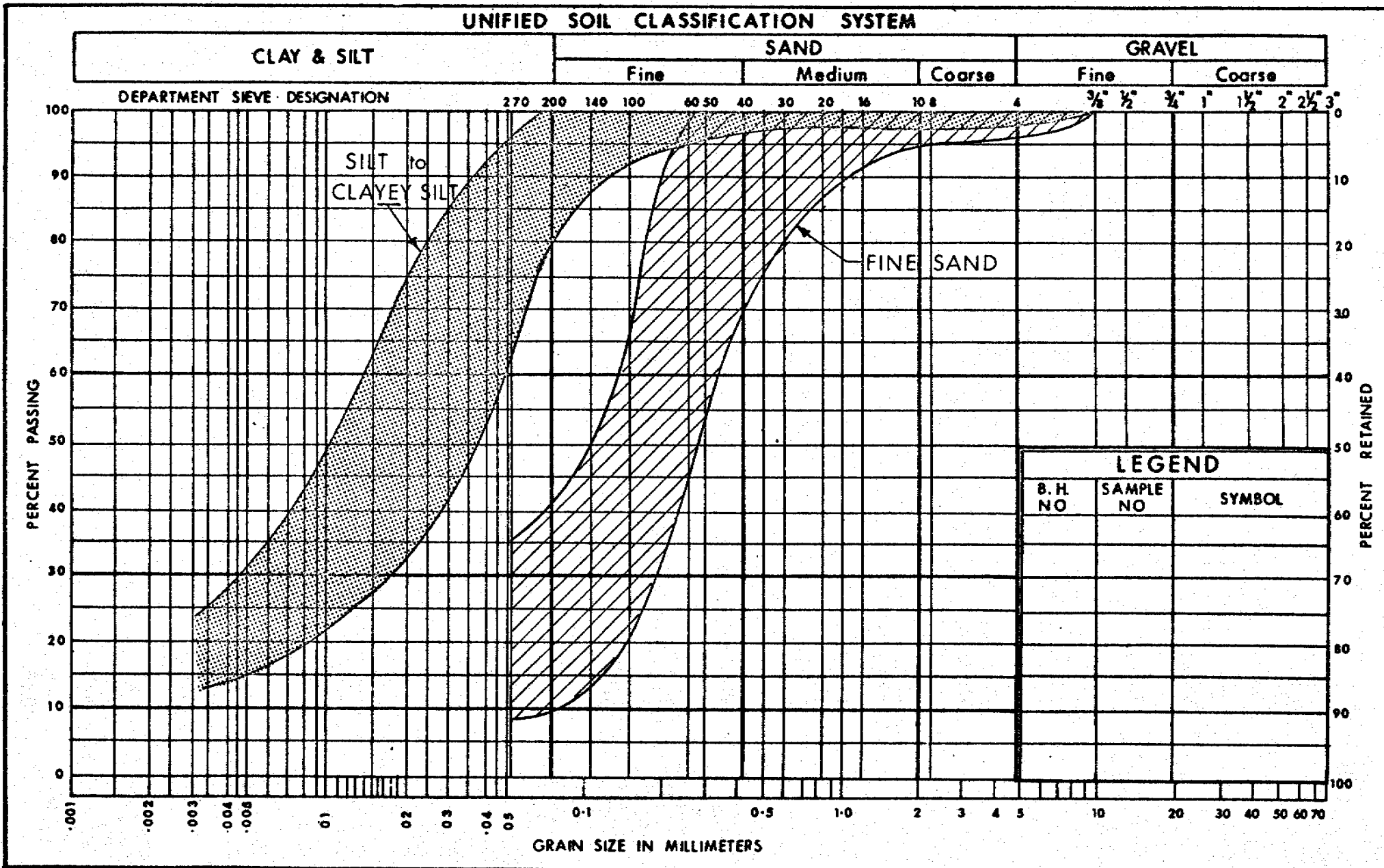
ORIGINATED BY LJH

COMPILED BY LJH

CHECKED BY CE

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 $\gamma$ P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE					
251.5 0.0	Ground Level								
234.5 17.0	End of Cone Test								

15  $\frac{20}{10}$  5 % STRAIN AT FAILURE



DEPARTMENT  
OF  
TRANSPORTATION AND COMMUNICATIONS

 DESIGN SERVICES  
BRANCH

**GRAIN SIZE DISTRIBUTION**  
FINE SAND: Envelope  
SILT to CLAYEY SILT: Envelope

W.P. No. 314 - 65 - 17

**JOB No. 73-11047**

FIG. 1



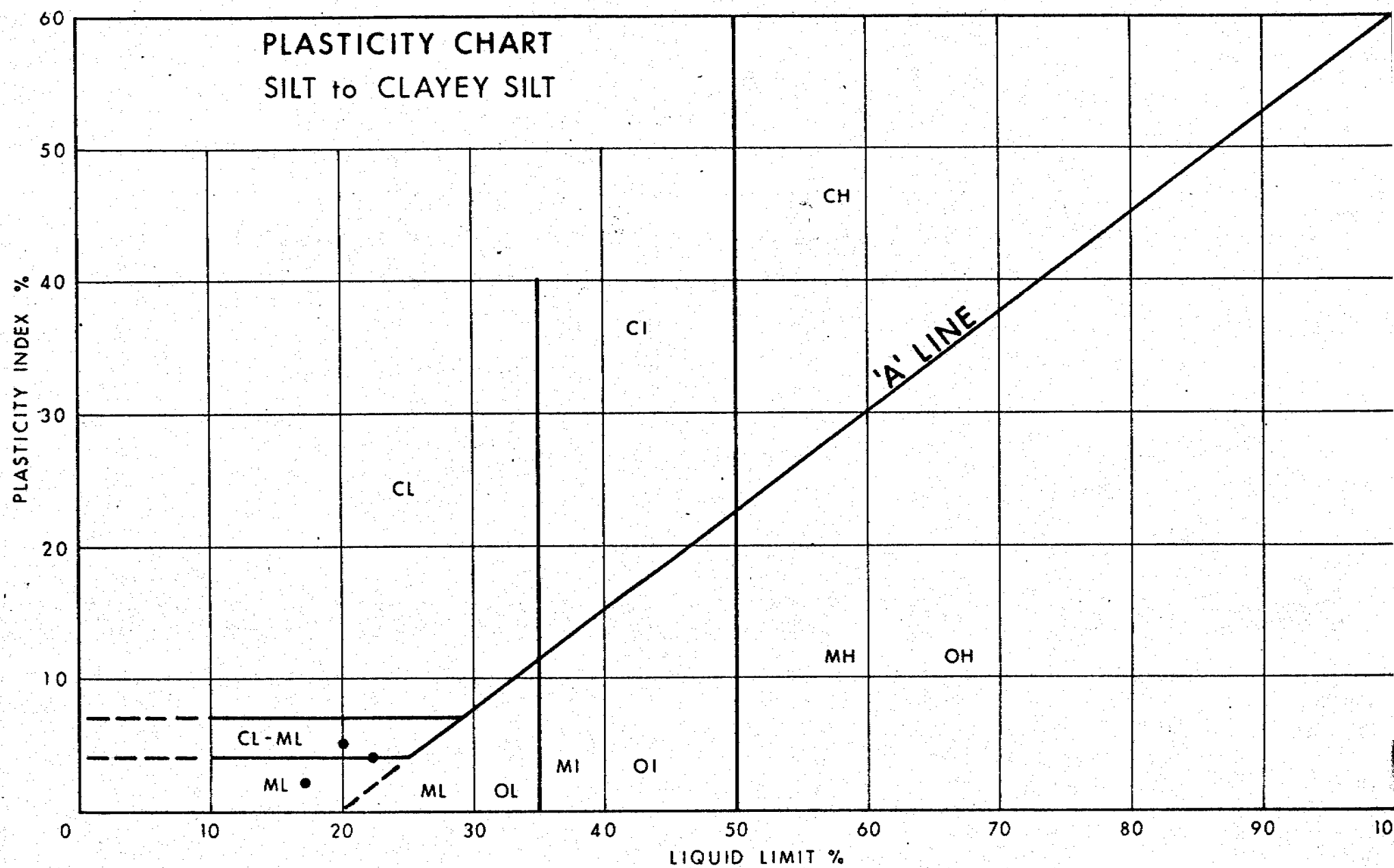


FIG. 2

ABBREVIATIONS & SYMBOLS USED IN THIS REPORTPENETRATION RESISTANCE

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

TERMS TO BE USED IN DESCRIBING SOILS:-

TRACE < 10% , SOME 10-25% , WITH 25-40% , > 40% SILTY, SANDY, GRAVELLY, CLAYEY ETC.

TYPE OF SAMPLE

S.S.	SPLIT SPOON	T.W.	THINWALL OPEN
W.S.	WASHED SAMPLE	T.P.	THINWALL PISTON
S.T.	SLOTTED TUBE SAMPLE	O.S.	OESTERBERG SAMPLE
A.S.	AUGER SAMPLE	F.S.	FOIL SAMPLE
C.S.	CHUNK SAMPLE	R.C.	ROCK CORE

P.H. SAMPLE ADVANCED HYDRAULICALLY

P.M. SAMPLE ADVANCED MANUALLY

SOIL TESTS

U	UNCONFINED COMPRESSION	L.V.	LABORATORY VANE
UU	UNCONSOLIDATED UNDRAINED TRIAXIAL	F.V.	FIELD VANE
CIU	CONSOLIDATED ISOTROPIC UNDRAINED TRIAXIAL	C	CONSOLIDATION
CID	" " DRAINED "	S	SENSITIVITY
CAU	" " ANISOTROPIC UNDRAINED "		
CAD	" " DRAINED "		

# ABBREVIATIONS & SYMBOLS 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
$w_s$	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
$C_\alpha$	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
$c_u$	APPARENT COHESION
$\phi_u$	APPARENT ANGLE OF SHEARING RESISTANCE, OR FRICTION
$\mu$	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
$\bar{\sigma}$	NORMAL EFFECTIVE STRESS ( $\bar{\sigma}$ IS ALSO USED)
$\tau$	SHEAR STRESS
$\epsilon$	LINEAR STRAIN
$\gamma$	SHEAR STRAIN
$\nu$	POISSON'S RATIO ( $\mu$ IS ALSO USED)
E	MODULUS OF LINEAR DEFORMATION (YOUNG'S MODULUS)
G	MODULUS OF SHEAR DEFORMATION
K	MODULUS OF COMPRESSIBILITY
$\eta$	COEFFICIENT OF VISCOSITY

## EARTH PRESSURE

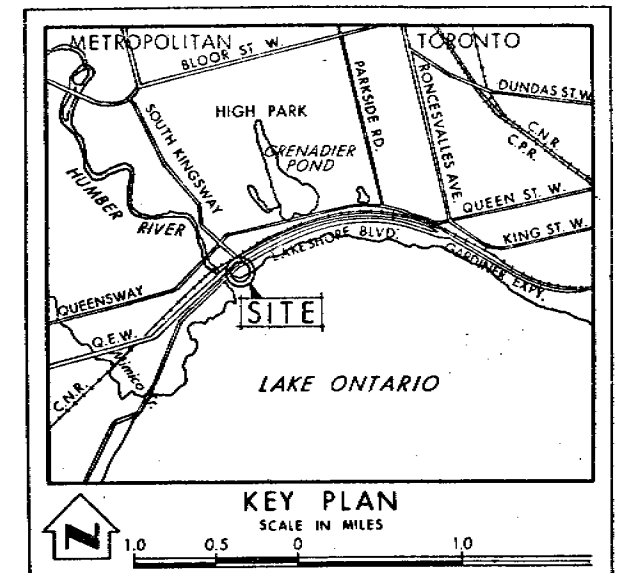
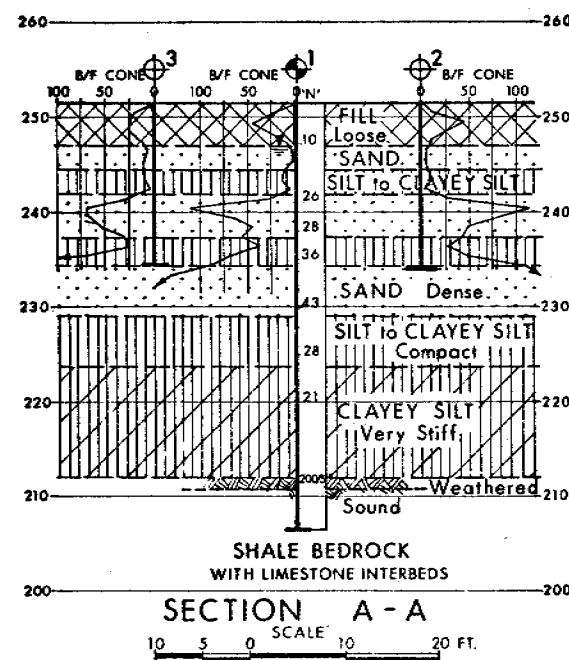
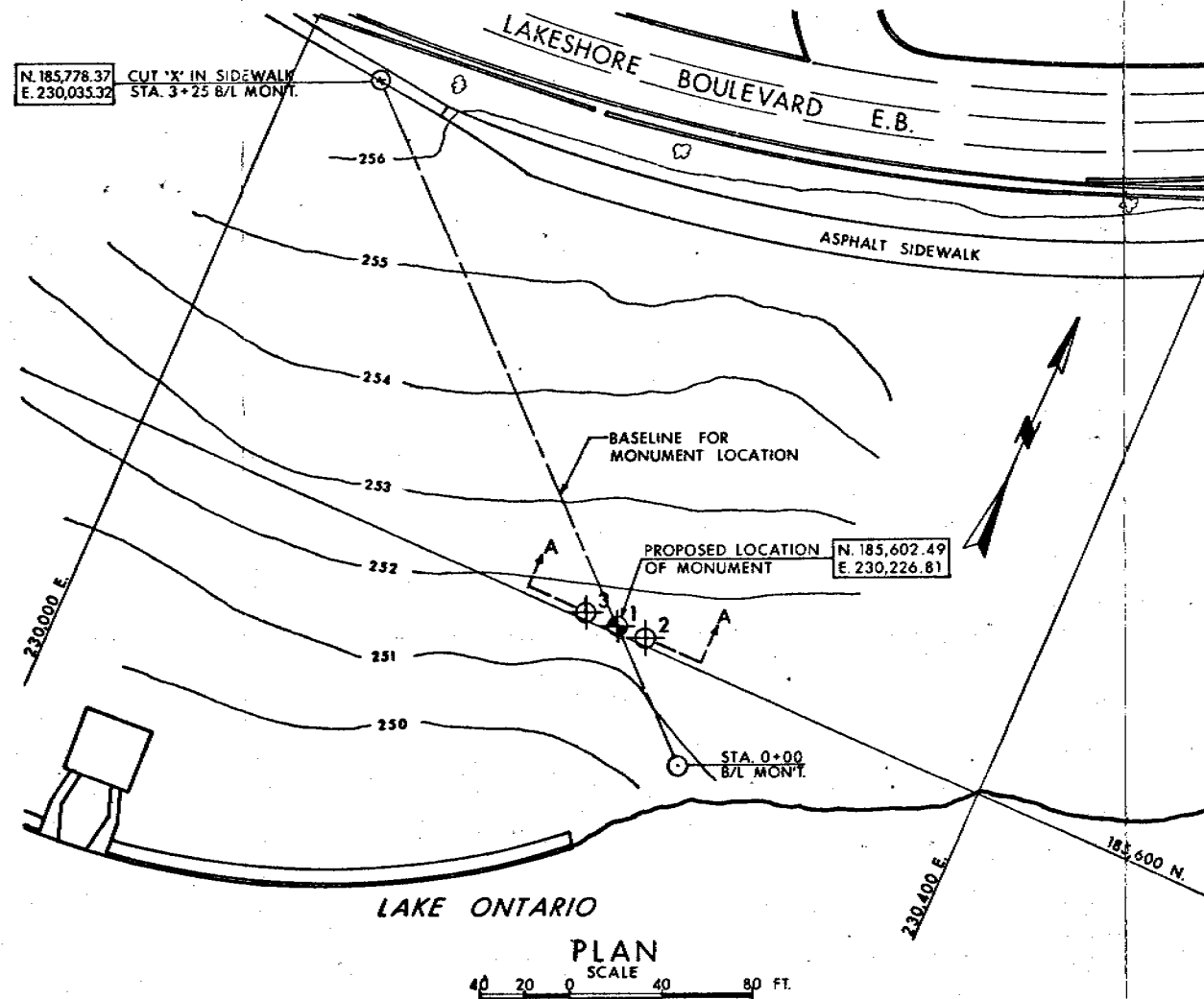
d	DISTANCE FROM TOP OF WALL TO POINT OF APPLICATION OF PRESSURE
$\delta$	ANGLE OF WALL FRICTION
K	DIMENSIONLESS COEFFICIENT TO BE USED WITH VARIOUS SUFFIXES IN EXPRESSIONS REFERRING TO NORMAL STRESS ON WALLS
$K_0$	COEFFICIENT OF EARTH PRESSURE AT REST

## 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
$\beta$	ANGLE OF SLOPE TO HORIZONTAL



LEGEND			
	Bore Hole		
	Cone Penetration Test		
	Bore Hole & Cone Test		
	Water Levels established at time of field investigation, AUG. 1973.		
NO.	ELEVATION	CO-ORDINATES NORTH	EAST
1	251.5	185,602	230,227
2	251.5	185,602	230,240
3	251.5	185,602	230,212

#### NOTE

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

#### CONTRACT DOCUMENT NOTE

The complete soil investigation report for this structure may be examined at the Structural and the Foundations Office, Downsview, and at the Toronto District Office.

DATE	BY	DESCRIPTION

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS—ONTARIO  
DESIGN SERVICES BRANCH—FOUNDATIONS OFFICE

#### Q.E.W. MONUMENT RELOCATION

HIGHWAY NO. \_\_\_\_\_ DIST. NO. 6  
 METROPOLITAN TORONTO  
 TWP. \_\_\_\_\_ LOT \_\_\_\_\_ CON. \_\_\_\_\_

#### BORE HOLE LOCATIONS & SOIL STRATA

SUBMD. L.J.H.	CHECKED <input checked="" type="checkbox"/>	W.P. NO. 314-65-17	DRAWING NO. <u>73-11047A</u>
DRAWN M.S.	CHECKED <input checked="" type="checkbox"/>	W.O. NO. 73-11047	
DATE SEPT. 6, 1973		SITE NO.	BRIDGE DRAWING NO.
APPROVED		CONT. NO.	

REF. NO. FENCO 3671-4H-1