

MEMORANDUM

CC: GEN. FILES

*Dist. 28-1*

18. Mr. C. S. Moase,  
Manager,  
Special Services Section,  
Admin. Bldg.

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

DATE: **DEC 12 1965**

OUR FILE REF.

IN REPLY TO

SUBJECT:

FOUNDATION INVESTIGATION REPORT  
For  
Alvinston Patrol Yard  
Lot 18, Conc. 5, County of Lambton,  
Hwy. #79, District #1 (Chatham)  
W.J. 65-F(R)-66 -- W.P. (Nil)

Attached, we are forwarding to you, our 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 further information be required, please feel free to contact our Office.

KYL/M6eF  
Attach.

cc: Messrs. C. S. Moase (4)  
E. J. Orr  
D. W. Farren  
F. C. Brown  
J. Roy  
A. Watt

*KYL*  
K. Y. Lo,  
SUPERVISING FOUNDATION ENGR.  
For  
A. G. Stermac,  
PRINCIPAL FOUNDATION ENGR.

Foundations Office  
Gen. Files ✓

# FOUNDATION INVESTIGATION REPORT

For

ALVINSTON PATROL YARD  
Lot 18, Conc. 5, County of Lambton,  
Hwy. #79, District #1 (Chatham)  
W.J. 65-F(R)-66 -- W.P. (Nil).

A request for a foundation investigation at the site of the proposed D.H.O. Patrol Yard at Alvinston, was received from Special Services Section, during April 1965.

A field investigation was subsequently carried out by this Section to determine the subsoil conditions existing at the site. Following are the results of this investigation, together with our recommendations pertaining to the proposed buildings and sand pile.

The field investigation consisted of four sampled boreholes. The locations and elevations of these boreholes are shown on Dwg. 65-F(R)-66A. The elevations were determined from a temporary bench mark (D.H.O. monument) located at the South-West corner of the site. The elevation of this temporary bench mark is: 100.0'.

The upper portion of the subsoil at the site was found to differ from borehole to borehole. From ground level downward, the following deposits were encountered:

A silty sand to sand with traces of gravel stratum was observed in boreholes No. 2, 3, & 4, to an average depth of 9 ft. The relative density may be described as loose to compact.

In borehole No. 1, a firm clayey silt with some sand and gravel was encountered from ground level to El. 94.

Beneath this deposit, a highly organic, very soft material (muck) was found between El. 94 and El. 90.

A compact gravelly sand stratum was observed in boreholes No. 1 and No. 4 underlying the muck and sand deposits, respectively. The thickness varied from 5 ft. to 8 ft.

The clayey silt with traces of sand and gravel deposit was found to underlie the above-described deposits at the following depths: El. 85.5, El. 91.4, El. 91.4, and El. 93.3 in boreholes No. 1, No. 3, No. 4 and No. 2, respectively. The colour of the material is grey.

The consistency varied randomly with depth and ranged from firm to very stiff.

Physical properties of the clayey silt material as determined from field and laboratory tests, are as follows:

Natural Moisture Content	:	18 - 26%
Plastic Limit	:	16 - 19%
Liquid Limit	:	31 - 35%
Unconfined Shear Strength	:	906 - 3,880 p.s.f.
'N' Value	:	9 - 19 blows per foot

The average proportions of the different grain sizes

are:	Gravel	:	2%
	Sand	:	4%
	Silt	:	55%
	Clay	:	39%

The vicinity of the proposed 3-bay garage is covered by swamp and was inaccessible for drilling operations. This highly

cont'd. /3 ...

organic soft material was also observed in B.H. #1, and it is underlain by a gravelly sand deposit below Elev. 90.0'.

In view of the foregoing, it is recommended that the proposed garage be relocated, or that the soft organic material be removed for its full depth and replaced by well-compacted granular material. The proposed garage may then be built on spread footings placed on the granular material below frost penetration level. 1.0 t.s.f. is recommended for design purposes. No stability problems are anticipated for the proposed sand pile.

Recommendations for the future paved and gravelled areas will be reported by the Regional Materials Engineer at a later date.

The field work was carried out during the period of June 16 to 18, 1965, under the direction of Mr. P. Payer, Project Foundation Engineer, who also prepared this report under the general supervision of Mr. K. G. Selby, Senior Foundation Engineer.

October 1965

APPENDIX I

\*\*\*\*\*

## FOUNDATION SECTION

CHECKED BY K.G.S.

[illegible]

CHECKED BY K.G.S. *AK*

[illegible]

DEPARTMENT OF HIGHWAYS - ONTARIO

## RECORD OF BOREHOLE NO. 3

FOUNDATION SECTION

MATERIALS &amp; TESTING DIVISION

JOB 65-(R)F-66

LOCATION As shown on Plan.

ORIGINATED BY P.P.

W.P. Nil

BORING DATE June 17 & 18, 1965.

COMPILED BY P.P.

DATUM T.B.M.

BOREHOLE TYPE Washbore - NX Casing.

CHECKED BY K.G.S.

[illegible]



DEPARTMENT OF HIGHWAYS - ONTARIO

## RECORD OF BOREHOLE NO. 4

FOUNDATION SECTION

MATERIALS &amp; TESTING DIVISION

JOB 65-(R)F-66

LOCATION As shown on Plan.

ORIGINATED BY P.P.

W.P. Nil

BORING DATE June 16, 1965.

COMPILED BY P.P.

DATUM T.B.M.

BOREHOLE TYPE Washbore - BX Casing.

CHECKED BY K.G.S. *HL*

SOIL PROFILE			SAMPLES			DYNAMIC PENETRATION RESISTANCE		LIQUID LIMIT — WL PLASTIC LIMIT — WP WATER CONTENT — W		BULK DENSITY P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT	ELEV. SCALE	BLOWS / FOOT 25 50 75 100 125	SHEAR STRENGTH P.S.F.	WATER CONTENT % 10 20 30		
104.9	Groundlevel										
0.0	Medium sand Dark brown Loose		1	SS	6	100					
97.9	7.0 Gravelly sand with silt and clay. Dark brown Compact		2	SS	25						
91.4	13.5 Clayey silt with traces of sand. Grey. Firm to stiff.		3	SS	19	90					
			4	SS	10						
78.4	26.5 End of borehole.		5	SS	9	80		End of cone test			
						70					

W.L.  
El. 97.4  
Gr 28%  
Sa 50%  
Si 22%  
Cl 1%  
Gr 0%  
Sa 5%  
Si 51%  
Cl 44%

## 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.	SCRAPE 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

$\gamma$	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
$c_u$	APPARENT COHESION
$\phi_u$	APPARENT ANGLE OF SHEARING RESISTANCE, OR FRICTION
$\mu$	COEFFICIENT OF FRICTION
$S_r$	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
$\epsilon$	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

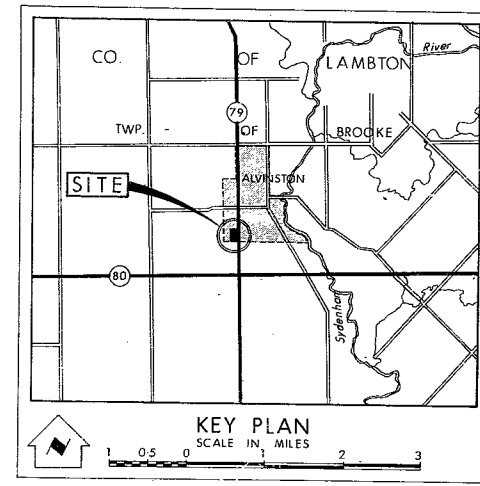
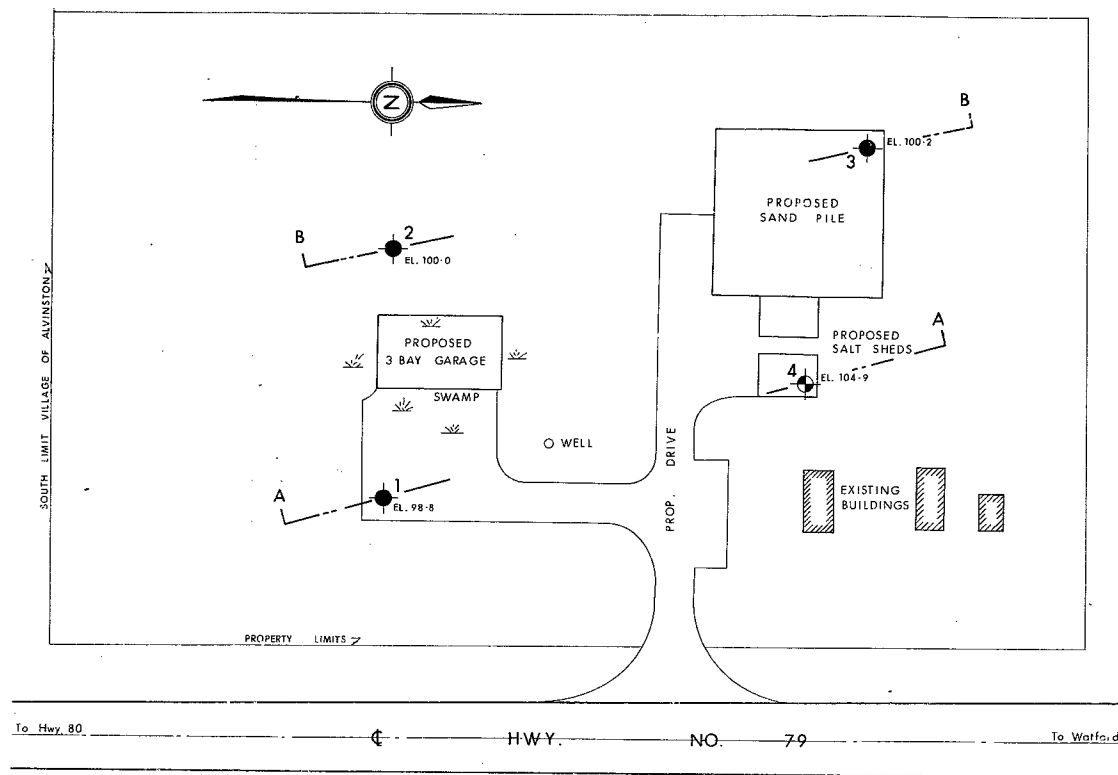
### FOUNDATIONS

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

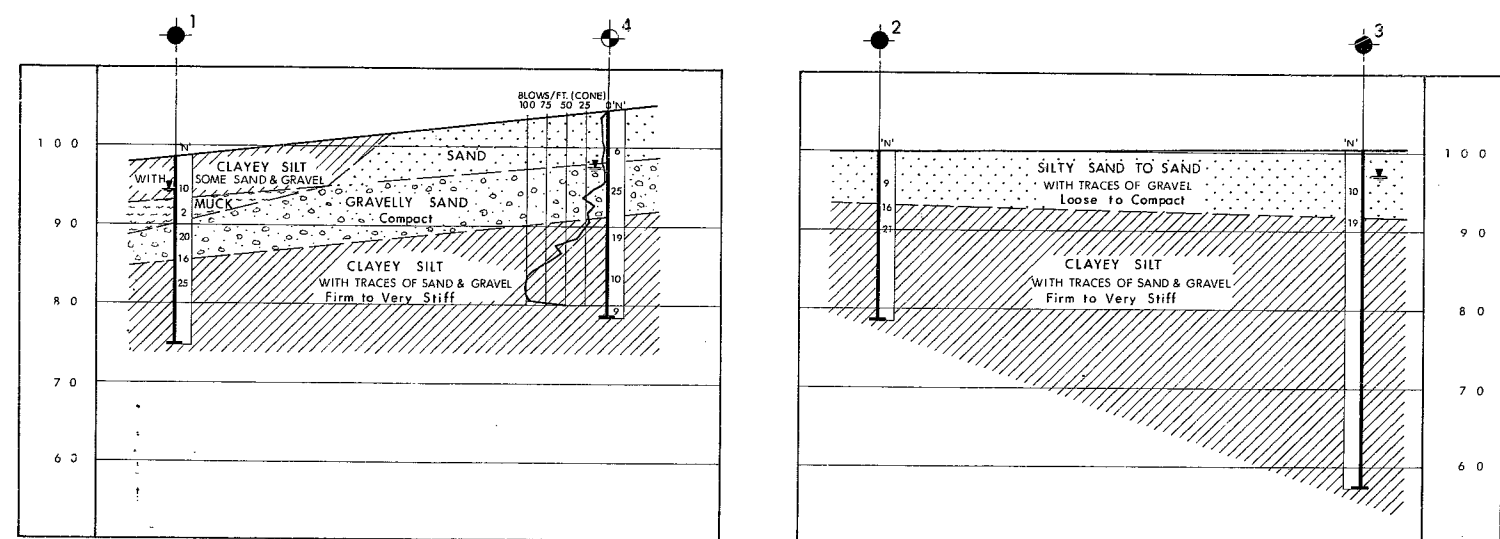
#65-F(R)-66  
HWY. #79  
ALVINSTON  
PATROL YARD



**LEGEND**

- Bore Hole
- ⊙ Bore & Cone Penetration Hole
- ≡ Water Level (18 June 1965)

**PLAN**  
SCALE 1" = 100 FEET



**SECTIONS**  
SCALE 1" = 100 FEET  
HORIZ. 50 25 0 50 100 FEET  
VERT. 10 5 0 10 20 FEET

**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.

DEPARTMENT OF HIGHWAYS - ONTARIO			
MATERIALS & RESEARCH SECTION			
PROPOSED ALVINSTON PATROL YARD			
ORIGINATED P. P.	DISTRICT NO. 1	DATE 10 JULY 1965	
DRAWN S. O.	W.P. NO.	JOB NO. 65-F(R)-66	
CHECKED K. L. 3.2.67	SCALE AS SHOWN	DRAWING NO. 65-F(R)-66A	
APPROVED			