

DEPARTMENT OF HIGHWAYS ONTARIO

MEMORANDUM

Just 28-14.

Re: Mr. C. S. Moose,
Manager,
Special Services Section,
Admin. Bldg.

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

Date: June 21, 1965

Our File Ref.

IN REPLY TO

Subject:

FOUNDATION INVESTIGATION REPORT

For

Proposed D.H.O. Maintenance Yard in
The Town of Larder Lake, Township of
Hearst, District #14 (New Liskeard).

W.J. 65-B-46 -- W.P. (Nil)

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

We believe that the factual information and
recommendations contained therein, will prove adequate
for your design requirements.

Should additional information be required, please
do not hesitate to contact our Office.

KYL/MaeF

Attach.

cc: Messrs. C. S. Moose (4)
E. J. Orr
D. W. Parren
G. M. Sinclair
E. R. Saint
A. Watt

K. V. Lo.
K. V. Lo.
SUPERVISING FOUNDATION ENGINEER

Foundations Office
Gen. Files

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FOUNDATION INVESTIGATION REPORT

For

Proposed D.H.O. Maintenance Yard in
The Town of Larder Lake, Township of
Hearst, District #14 (New Liskeard).

W.J. 65-F-48 -- W.P. (Nil)

1. INTRODUCTION:

A request from the Services Branch, dated March 11, 1965, was received by this Section, asking for a foundation investigation at the site of the proposed maintenance yard in Larder Lake.

Accordingly, a field and subsequent laboratory soil study was carried out, supervised by the Foundation Section.

The results of the investigation are presented in this report, as well as recommendations concerning the footings of the proposed building.

2. DISCUSSION:

2.1) The site is located at the south side of Larder Lake, right beside the still unopened section of Manitoba Street. The area is moderately undulating, the difference between lowest and highest elevations inside the proposed fence being 15 - 20 ft. The larger part of the site is covered with bush.

After heavy rainfall, water stands in the depressions: at the locations where no vegetation exists, the ground is very soft. The high degree of dilatancy of the surface soil is easily noticeable.

2. DISCUSSION: (cont'd.) ...

2.1) (cont'd.) ...

The vicinity is partly built up, partly hilly woodland.

2.2) The subsoil exploration consisted of 4 sampled boreholes and 4 dynamic cone penetration tests. The locations and elevations of the boreholes may be seen on Drawing No. 65-F-48A, contained in the Appendix of this report. The equipment used for the boreholes was a conventional diamond drill, adapted for soil sampling purposes. Sampling and field testing (Standard Penetration and Field Vane tests) was carried out in accordance with D.H.C. standards. A short discussion of the soils, revealed by the borings, is given below:

2.3) Beneath the silty topsoil varved clay was observed in various thicknesses, being somewhat shallower at the west side of the area (13.0 ft.), while extending to a depth of 20 - 25 ft. at the east. The consistency of the deposit is firm to stiff, the estimated undrained shear strength at the site of the proposed garage ranging between 760 - 1100 p.s.f. Underlying the varved clay, silt and sand layers are found. At the west side the deposit consists mainly of sand-size particles, becoming more of a silty nature toward the east. The relative density varies randomly between loose and dense.

2.4) Ground water level observations were carried out in the boreholes, except in B.H. #4 which caved in after removal of the casing. Free water level was found to be high only in B.H. #2 - situated some 500 ft. from Larder Lake, where the water was

cont'd. /3 ...

2. DISCUSSION: (cont'd.) ...

2.4) (cont'd.) ...

established at 1 ft. below ground, elevation 957.00 ft. In B.H. #1 no free water was found; in B.H. #3 it was estimated to be at El. 942.00 ft., some 20 ft. below ground surface.

Hemlock Lake which supplies the town with domestic water, is situated some 500 ft. west of the proposed site. The water is actually pumped from a well 80 ft. in depth, some 200 ft. of the Lake proper. The watermain (10 in. diam. pipe), runs along the south side of the proposed yard, at 8 ft. below ground.

3. RECOMMENDATIONS:

From the standpoint of soil conditions, the proposed site seems to be acceptable.

The garage, at its suggested location, can be supported on continuous strip footings, at a depth right below the frost penetration level. A safe soil pressure of 1400 p.s.f. may be utilized for the design. A compacted sand cushion of approximately 6" - 12" thickness should be placed under the footings, the breadth of the cushion being 1 ft. larger than that of the footings. Concentrated loads should not be employed inside the structure, in order to avoid differential settlements. The highly dilatant silty soil is sensitive to vibrations. It is therefore recommended that if foundations for machinery - causing vibrations - are contemplated, they should be separated from the footings and floor of the building. For machinery foundations, the value of the allowable bearing pressure

cont'd. /4 ...

3. RECOMMENDATIONS: (cont'd.) ...

shall be reduced by half. No dewatering problems are anticipated at the site of the garage for the excavations. The proposed site of the sand pile is considered suitable since the ground water is fairly deep in that location. No stability problem will arise provided that the height of the sand pile will not exceed 14 ft.

With regard to future paved and gravelled areas, the recommendations given by Mr. E. R. Saint, Regional Materials Engineer, are as follows:

- 1.) Prior to placing any granular base, all topsoil should be removed within 4 feet of finished grade. The average thickness of topsoil is 7 inches.
- 2.) On all driveways, parking areas and sand pile pads, provide for 24 inches of sand cushion and 6 inches of G.B.C. Class 'A'.
- 3.) The paving should consist of 2 inches of HL-4 binder course and $1\frac{1}{2}$ inches of HL-4 surface course.

4. MISCELLANEOUS:

The field work and the preparation of this report was the task of Mr. A. K. Barsvary, Project Foundation Engineer, under the general supervision of Mr. K. G. Selby, Senior Foundation Engineer.

June 1965.

APPENDIX I.

FOUNDATION SECTION

ORIGINATED BY A.B.

COMPILED BY A.B.

CHECKED BY

SOIL PROFILE			SAMPLES			DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT		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	10 20 30 40 50	10 20 30 40 50	20 40 60		
968.5	Groundlevel										
0.0											
	Varved clay. Stiff Brown		1	SS	10						
			2	TW	14	960					
955.5											
13.0	Silty sand becoming sand. Dense to loose Grey		3	SS	35						
			4	SS	16	950					
			5	SS	16						
			6	SS	7	940					
937.0											
31.5	End of borehole.					930					
							Penetration ends at El 908.5 No values greater than 38 blows/ft. or less than 30 blows/ft.				

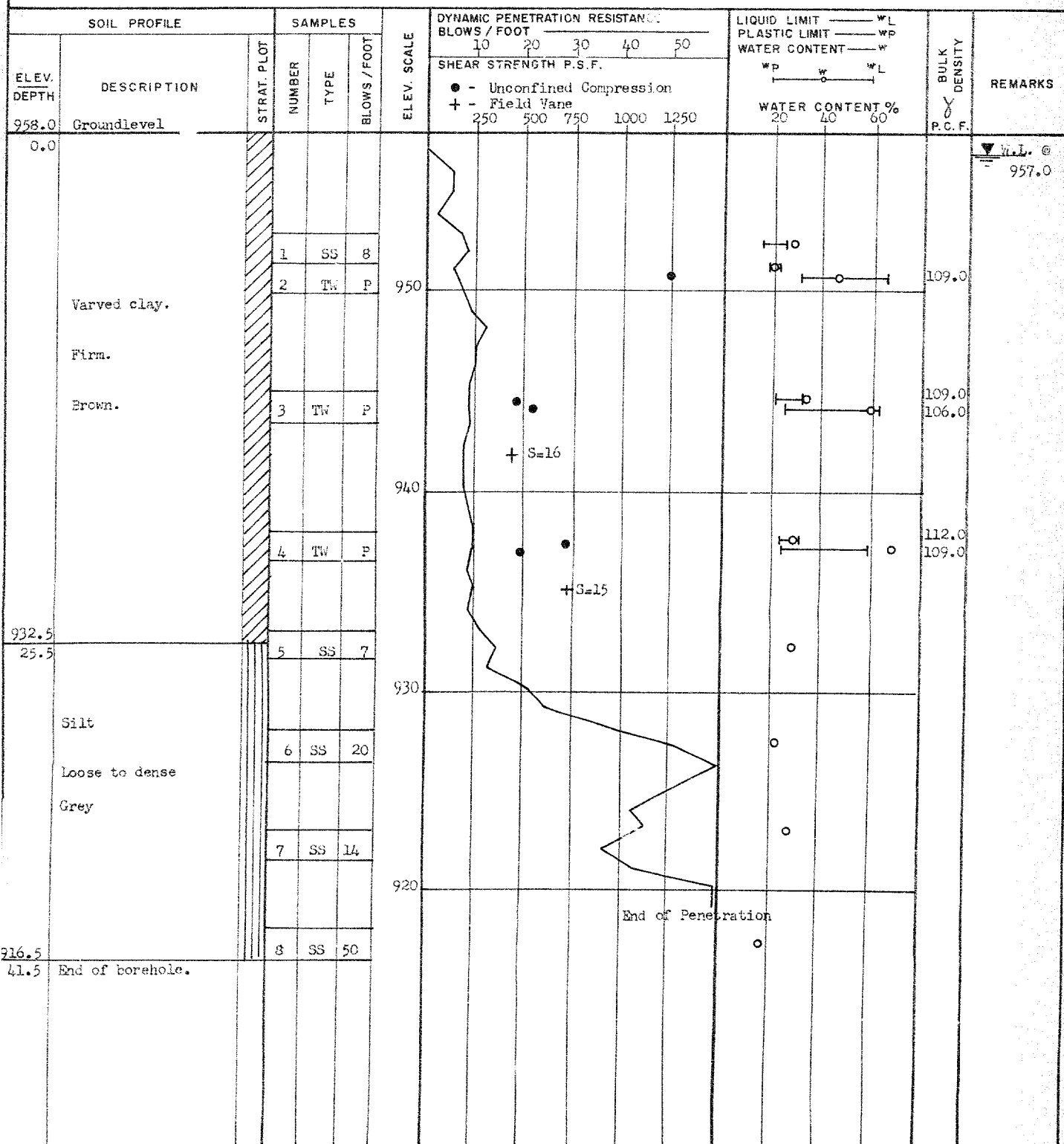
DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO. 2

FOUNDATION SECTION

JOB 65-F-48 LOCATION 100' W & 12' N of SE Corner of Proposed Fence. ORIGINATED BY A.B.
W.P. BORING DATE May 18, 1965. COMPILED BY A.B.
DATUM Geodetic BOREHOLE TYPE Washboring, NX Casing. CHECKED BY



DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO. 3

FOUNDATION SECTION

JOB 65-F-48

LOCATION 50' W & 50' S of NE Corner of Proposed Fence

ORIGINATED BY A.B.

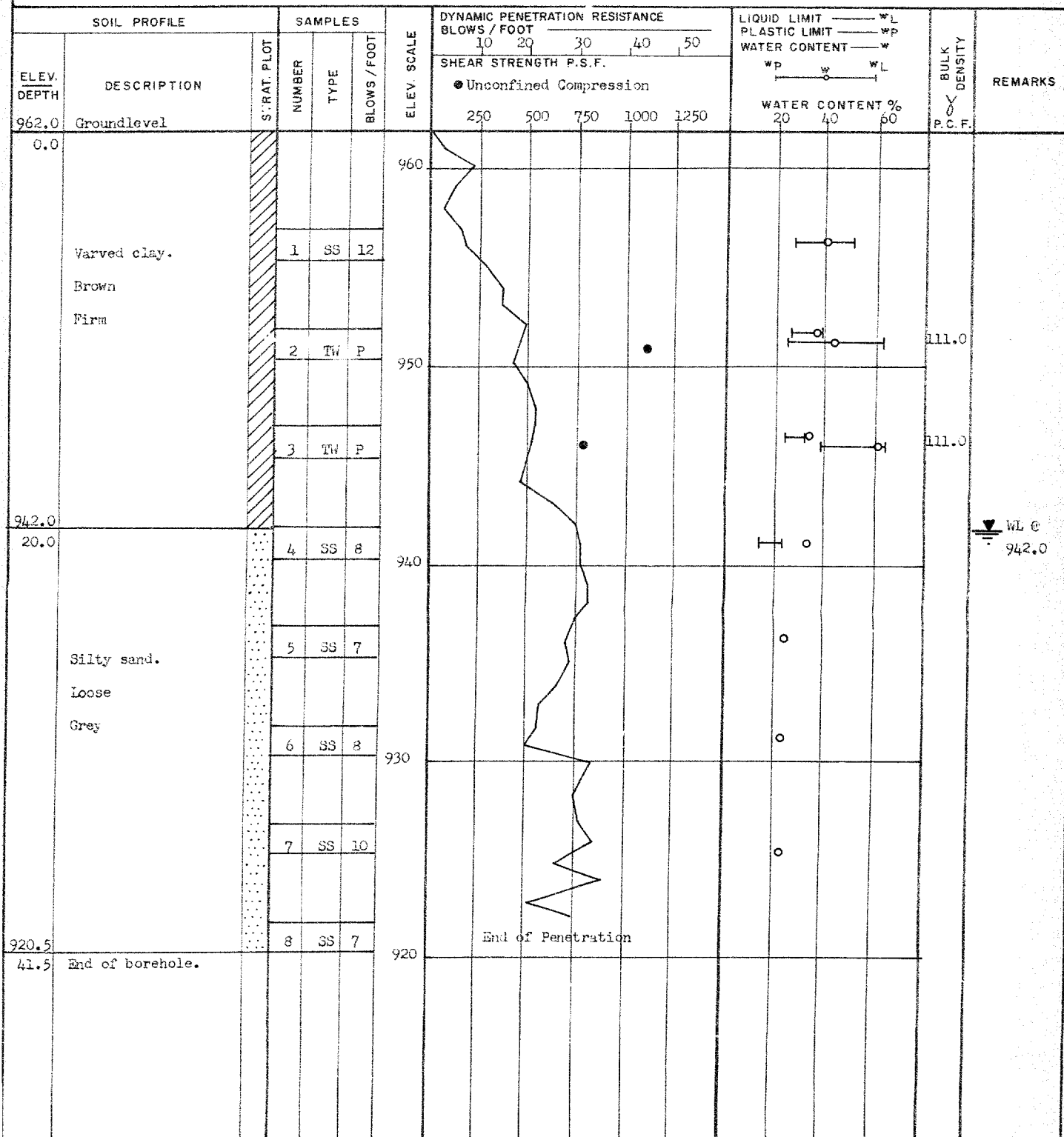
W.P.

BORING DATE May 19, 1965.

COMPILED BY A.B.

DATUM Geodetic

BOREHOLE TYPE Washboring, MN Casing.

CHECKED BY *AL*

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO. 4

FOUNDATION SECTION

JOB 65-F-48

LOCATION 200' E & 160' N of SW Corner of Proposed Fence

ORIGINATED BY A.B.

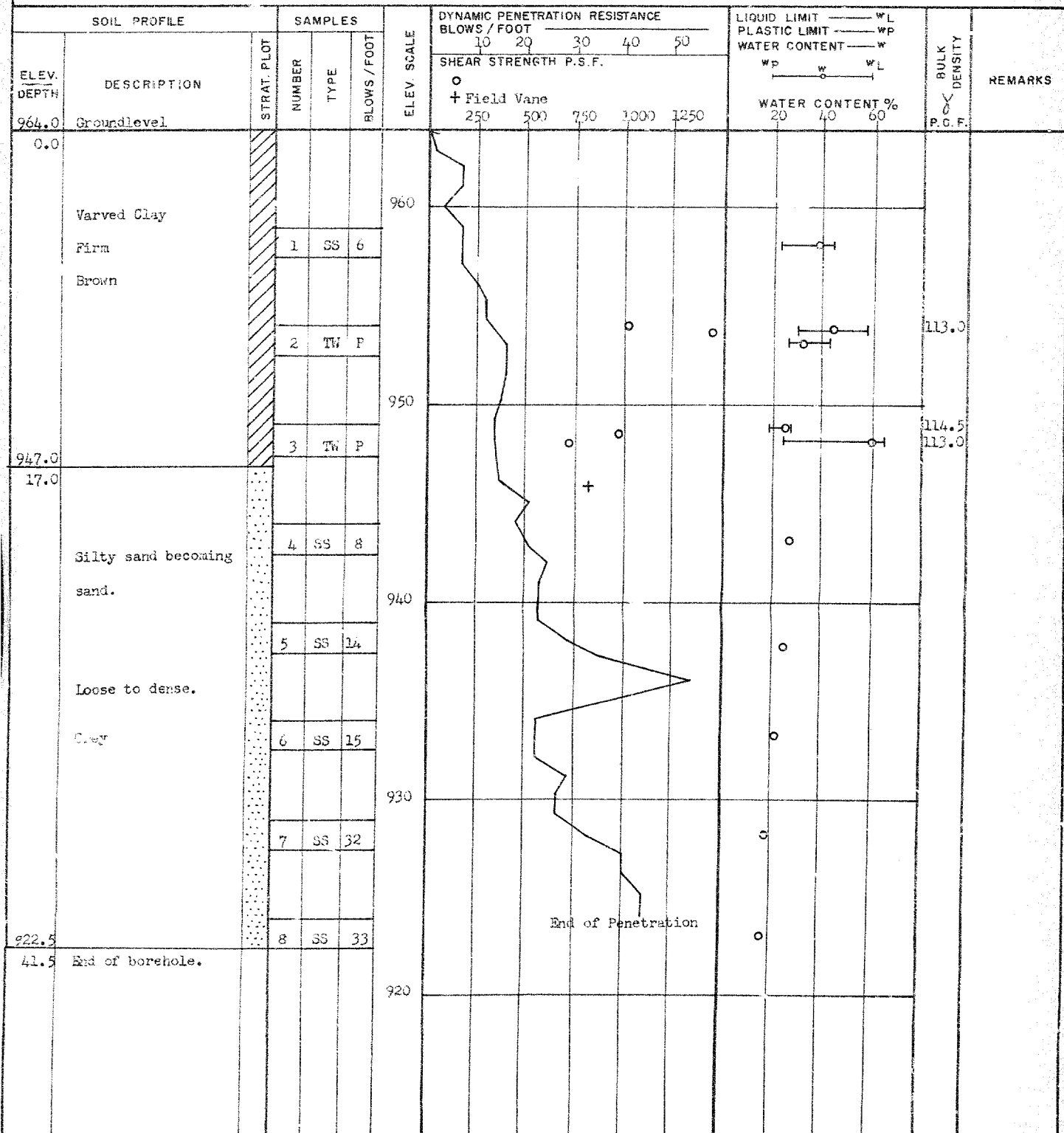
W.P.

BORING DATE May 19, 1965.

COMPILED BY A.B.

DATUM Geodetic

BOREHOLE TYPE Washboring, NX Casing.

CHECKED BY *AB*

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
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
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_t	SENSITIVITY

GENERAL

π	= 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
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

MEMORANDUM

FOUNDATIONS
OFFICE
RM 110

To: Mr. A.G. Stermac
Principal Foundations Eng.
Materials & Testing
Downsview

FROM: Materials & Testing
Northern Region

DATE: June 17, 1965

OUR FILE REF.

IN REPLY TO

SUBJECT:

Re: Soils Investigation on Proposed Maintenance Yard,
Part of Parcel 10615, Unsubdivided Township of
Hearst, Hwy. #624, New Liskeard District

A soils investigation was carried out on the above noted site in June 1965 using hand equipment. The proposed yard is situated on a deposit of very fine sand and silt which was found to be firm. The terrain at the site slopes gently to the south-east.

Recommendations:

- 1.) Prior to placing any granular base, all topsoil should be removed within 4 feet of finished grade. The average thickness of topsoil is 7 inches.
- 2.) On all driveways, parking areas and sand pile pads, provide for 24 inches of sand cushion and 6 inches of G.B.C. Class "A".
- 3.) The paving should consist of 2 inches of HL4 binder course and 1½ inches of HL4 surface course.

K.L.H.

K.L. Howe

for: E.R. Saint
Regional Materials Engineer

KLH/ef
c.c. N.D. Smith
File

MEMORANDUM

To: Mr. E. R. Saint,
Regional Materials Engr.,
Regional Office,
NORTE BAY, Ont.

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

ATTENTION:

DATE: October 2, 1970

OUR FILE REF.

IN REPLY TO

SUBJECT:

Larder Lake Patrol Yard - Sand Pile
District No. 14 (New Liskeard)

65-F-48

As requested by you, we have reviewed our Foundation Report 65-11048 with regard to recommendations relating to the safe height of the sand storage pile. In the light of your new information, the following assumptions have been made:

- (1) The sand pile location will be between B.H.'s 1 and 4 - (Drawing 65-F-48A).
- (2) The site will be covered with 4 ft. of compacted granular fill.
- (3) The sand pile will be 100 ft. diameter at the base.
- (4) Subsoil consists of 17 ft. of firm to stiff varved clay with an average undrained shear strength of 750 p.s.f., followed by a deep deposit of loose to dense silty sand.
- (5) Part of the new sand pile location has been covered with winter sand, up to 20 ft. high for about 3 years.

Our recommendations are as follows:

The proposed sand pile may be constructed to a height of 40 ft. without danger of base failure. Insofar as the construction of the future enclosure is concerned, there is a possibility that differential settlement will occur between the part of the proposed storage area, which has been loaded before, and the part which has not. Therefore, it would be advantageous to ensure that this 'unloaded' part of the area is used for the sand storage in the future for as long a period as possible before constructing the enclosure.

XGS/MdeP

cc: Messrs. E. J. Orr
T. A. Sharpe
J. R. Carr

Foundations Files ✓
Gen. Files

K. G. Selby
SUPERVISING FOUNDATION ENGR.
For:
A. G. Stermac
PRINCIPAL FOUNDATION ENGR.

#65-F-48

Hwy. #624

LARDER LAKE T.

D.H.O. MTCE.

YARD

HEARST

