

#69-F-44

W.P. 122-65-1

HWY. #402 AND MODELAND

ROAD INTERCHANGE AND

HWY. #402 AND C.N.R.

OVERHEAD.

MEMORANDUM

To: Mr. B. R. Davis,
Bridge Engineer,
Bridge Office,
Admin. Bldg.,

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

ATTENTION: Mr. S. McCombie

DATE: August 29, 1969.

OUR FILE REF:

IN REPLY TO

SEP 10 1969

SUBJECT:

PRELIMINARY

FOUNDATION INVESTIGATION REPORT

For

Proposed Interchange at the Crossing
of Hwy. 402 and Modeland Road and -
Overhead at the Crossing of Hwy. 402
And the C.N. R. Track some 3/4 mi. West
District No. 1 (Chatham)
W.J. 69-F-44 --- W.P. 112-65-1
122-

Enclosed please find our preliminary foundation investigation report for the above mentioned project. We believe that the information contained in the report will be sufficient for your immediate purposes. The main conclusions are that subsoil conditions are similar at the investigated sites to those at sites nearby where structures have been built and are performing satisfactorily. Hence there is little to be gained by constructing the approach fills well in advance of the bridges.

If further information is required, please contact this office.

AGS/ia
Attach.

cc: Messrs. B. R. Davis (2)
H. A. Tregaskes
D. W. Farren
W. Zonnenberg
F. C. Brown
A. P. Watt
J. Roy
B. A. Singh

A. E. Stermac
A. E. Stermac
PRINCIPAL FOUNDATION ENGINEER

Foundation Files
General Files

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PRELIMINARY
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District No. 1 (Chatham)
W.J. 69-F-44 -- W.P. 112-65-1

1. INTRODUCTION:

A request for a preliminary foundation investigation at the above mentioned sites with regard to possible future settlement problems was received from Mr. A. Watt, Regional Bridge Location Engineer in a memo dated June 10th, 1969.

A field investigation was subsequently carried out by this section to determine the subsoil conditions existing at the location of the proposed structures. Presented in this report are the results of this investigation.

2. DESCRIPTION OF THE SITE:

At the first site, farmland lies to the West of Modeland Road while a single row of houses lie along the East side of Modeland Road.

At the second site the surrounding area is farmland. The topography at both sites is flat.

3. FIELD INVESTIGATION PROCEDURE:

A total of 2 borcholes and 2 dynamic core penetration tests was carried out during the course of the field work.

Boring was achieved by means of a Diamond Drill adapted for soil sampling purposes. Undisturbed samples were recovered using 2" I.D. Shelby tubes which were pushed into the soil by hand and occasionally driven the last few inches. Disturbed samples were recovered using split-spoon

3. FIELD INVESTIGATION PROCEDURE: (cont'd.)..

samplers which were driven into the soil according to the requirements of the Standard Penetration Test. Where possible field vane tests were carried out at elevations generally 12 inches below sample depths.

Samples were visually examined in the field and subsequently in the laboratory.

The locations and elevations of both boreholes were surveyed in the field by London Region Engineering Surveys Section and are shown in Drawing 69-F-44A which accompanies this report.

4. LABORATORY TESTS:

Laboratory tests were carried out on selected samples to determine Atterberg Limits, natural moisture contents, grain size distribution, bulk density and unconfined shear strength.

The results of tests carried out in the field and laboratory are plotted on the borehole logs which form part of this report.

5. SOIL TYPES & SOIL CONDITIONS:

5.1) General:

The subsoil at both sites consists of a stratum of clayey silt-silty clay with some sand and traces of gravel extending to over a depth of 80 feet in both areas.

5.2) Clayey Silt-Silty Clay with some Sand & traces of Gravel

(1) Site #1 Modeland Road/Hwy. #402

This deposit extends to a depth of over 96 feet. The top 9 feet has an appreciable amount of organic material and is very soft, otherwise the consistency of the deposit is stiff to very stiff.

5. SOIL TYPES & SOIL CONDITIONS: (cont'd.)..

5.2) Site #1 Modeland Road/Hwy. #402 : (cont'd.)

Atterberg limit tests, together with field observation indicate the material to be clayey silt above elevation 546.0 and silty clay below this elevation.

The average properties are summarized below: -

	<u>Clayey Silt</u>		<u>Silty Clay</u>	
Grain Size Distribution	Gravel 1- 5%, Silt 45-55%, Clay 22-34%	Sand 14-28%, Clay 22-34%	Gravel 0- 2%, Silt 43-59%, Clay 40-45%	Sand 1-10%, Clay 40-45%
Liquid Limit %	25 - 33		36 - 43	
Plastic Lmt. %	14 - 17		18 - 21	
Moist. Cont. %	8 - 22		22 - 27	
Bulk Dens. %	133 - 140		126 - 127	

No field vanes were able to be taken but to determine the shear strength of the material unconfined Compression and (quick) Triaxial tests were carried out with the following results: -

Unconfined compression test psf 1,500 - 3000

Triaxial Test psf 900 - 2200

cont'd./4

5. SOIL TYPES & SOIL CONDITIONS: (cont'd.)...

5.2) Clayey Silt-Silty Clay with some Sand & traces of Gravel
(cont'd.)

(11) Site #2 C.N.R. Overpass

This deposit extends to a depth of over 86 feet, the consistency being firm to very stiff.

Atterberg limit tests, together with field observation indicate the material to be clayey silt above elevation 557 and silty clay below this elevation.

The average properties are summarized below: -

	<u>Clayey Silt</u>		<u>Silty Clay</u>	
Grain Size Distribution	Gravel 1%, Silt 51%	Sand 15% Clay 33%	Gravel 0-1%, Silt 44-47%	Sand 1-10% Clay 45-52%
Liquid Limit %	28 - 32		35 - 43	
Plastic Lmt. %	15 - 17		18 - 21	
Moist.Cont. %	16 - 20		21 - 38	
Bulk Dens.psf.	132 - 136		124 - 126	

Field vane psf 1200 - >2000

Sensitivity 2.1 - 3.0

Unconfined compression Test psf 1,000 - 2,200

Triaxial Test psf 1,500 - 1,800

6. GROUNDWATER CONDITIONS:

The water level was established at site No.2 and is recorded in the borehole record. No water level could be obtained at site No. 1.

7. DISCUSSION & RECOMMENDATIONS:

It is proposed to construct an interchange at the intersection of Hwy. #402 and Modeland Road and on overpass at the intersection of Hwy. #402 and the C.N.R. some 3/4 miles west.

The purpose of the investigation was to determine whether any substantial settlement would occur in these areas, upon construction of the aforementioned structures and hence whether advance construction of the fills would be advantageous.

As described earlier the subsoil at both sites consists of a deep deposit of clayey silt-silty clay with some sand and traces of gravel. The consistency of the material varying from firm to very stiff.

Subsoil investigations in the immediate area ie. 69-F-11, 69-F-12 and WP 29-62 gave identical soil conditions to the one under consideration here. In the former three cases embankments up to 30 feet in height were built and settlements in the order of 3-4" were observed. In view of these facts it is not considered advantageous to undertake advance construction of the fills.

8. MISCELLANEOUS:

The field work for this project was carried out between June 26 to July 3rd, 1969.

Equipment used was owned by P.V.K. Ltd.

Supervision of the field work was carried out by Mr. G. Allen, Project Foundation Engineer.

This report was written by Mr. G. Allen and reviewed by Mr. K. Selby, Supervising Foundation Engineer.

September, 1969.

APPENDIX I

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 1

FOUNDATION SECTION

JOB 69-F-44

LOCATION

Sta. 61 + 70 (Modeland Rd. & Hwy. 402)

ORIGINATED BY GA

W.P.

BORING DATE

June 27, 28 & 29, 1969

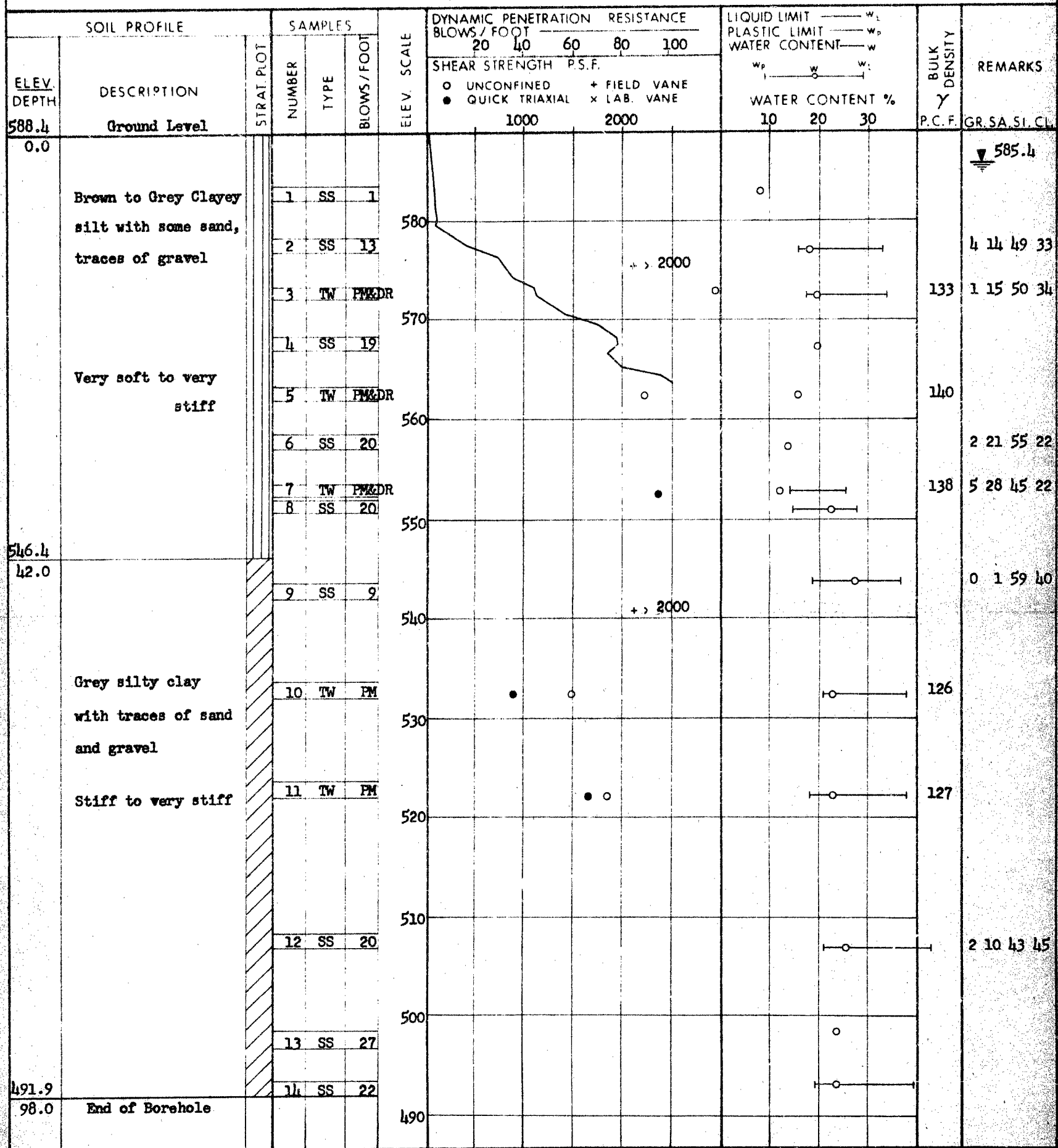
COMPILED BY GA

DATUM

BOREHOLE TYPE

Washboring, NX Casing

CHECKED BY



DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 2

FOUNDATION SECTION

JOB 69-F-44

LOCATION

Sta. 20 + 73 o/s 33' Lt. (C.N.R. O'Pass)

ORIGINATED BY GA

W.P.

BORING DATE

July 2 & 3, 1969

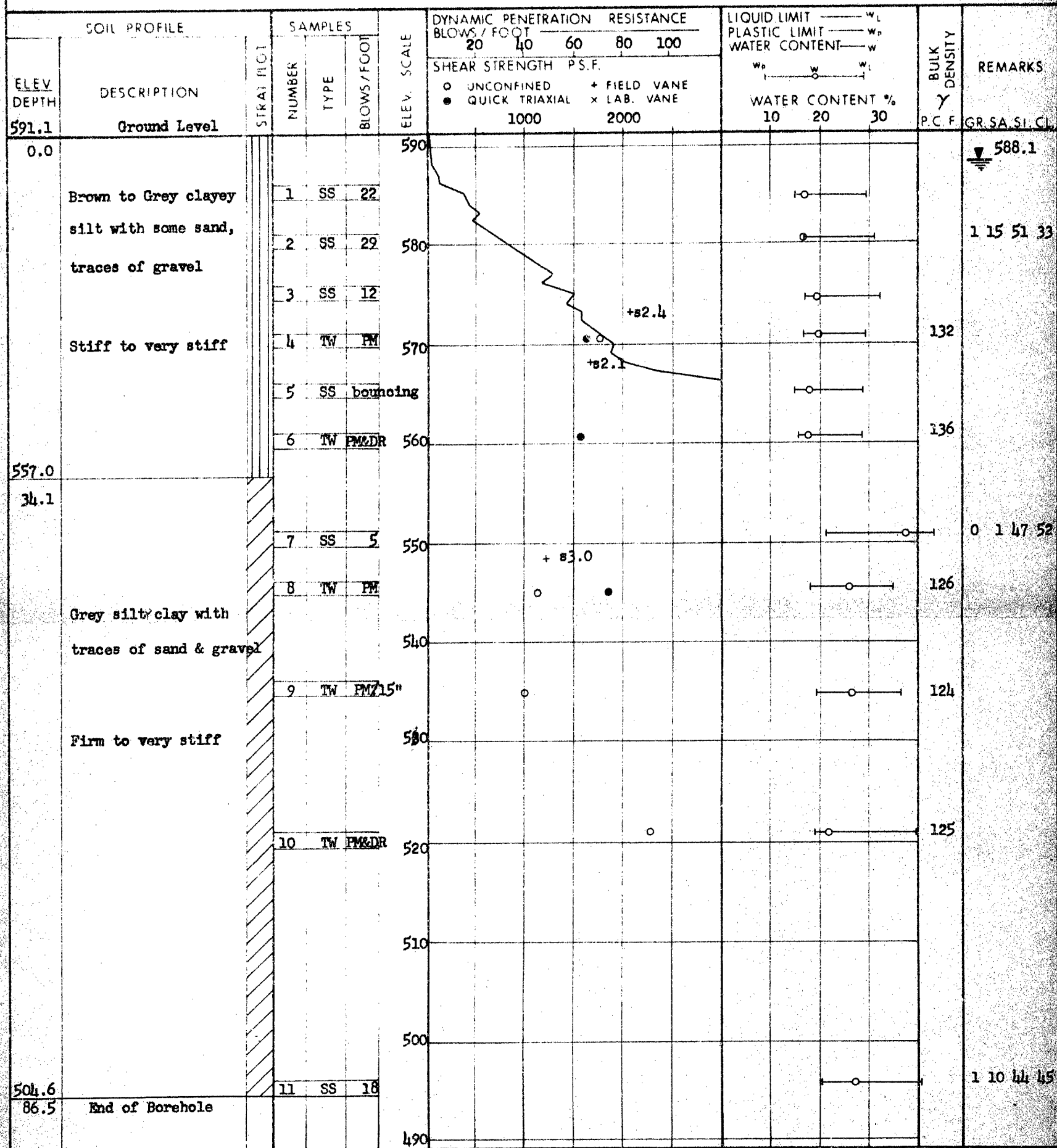
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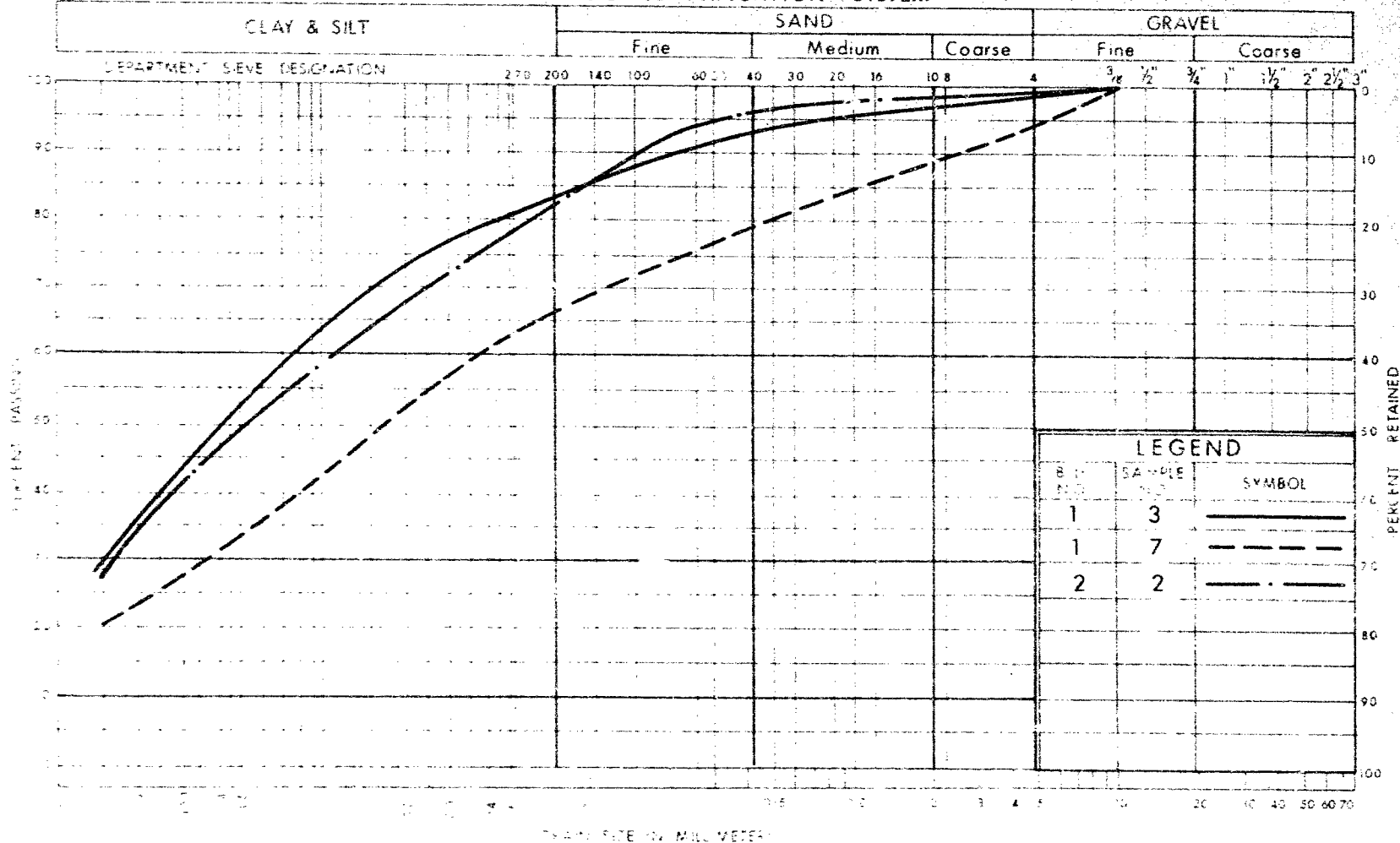
BOREHOLE TYPE

Washboring, NX Casing

CHECKED BY



UNIFIED SOIL CLASSIFICATION SYSTEM



GRAIN SIZE DISTRIBUTION CLAYEY SILT

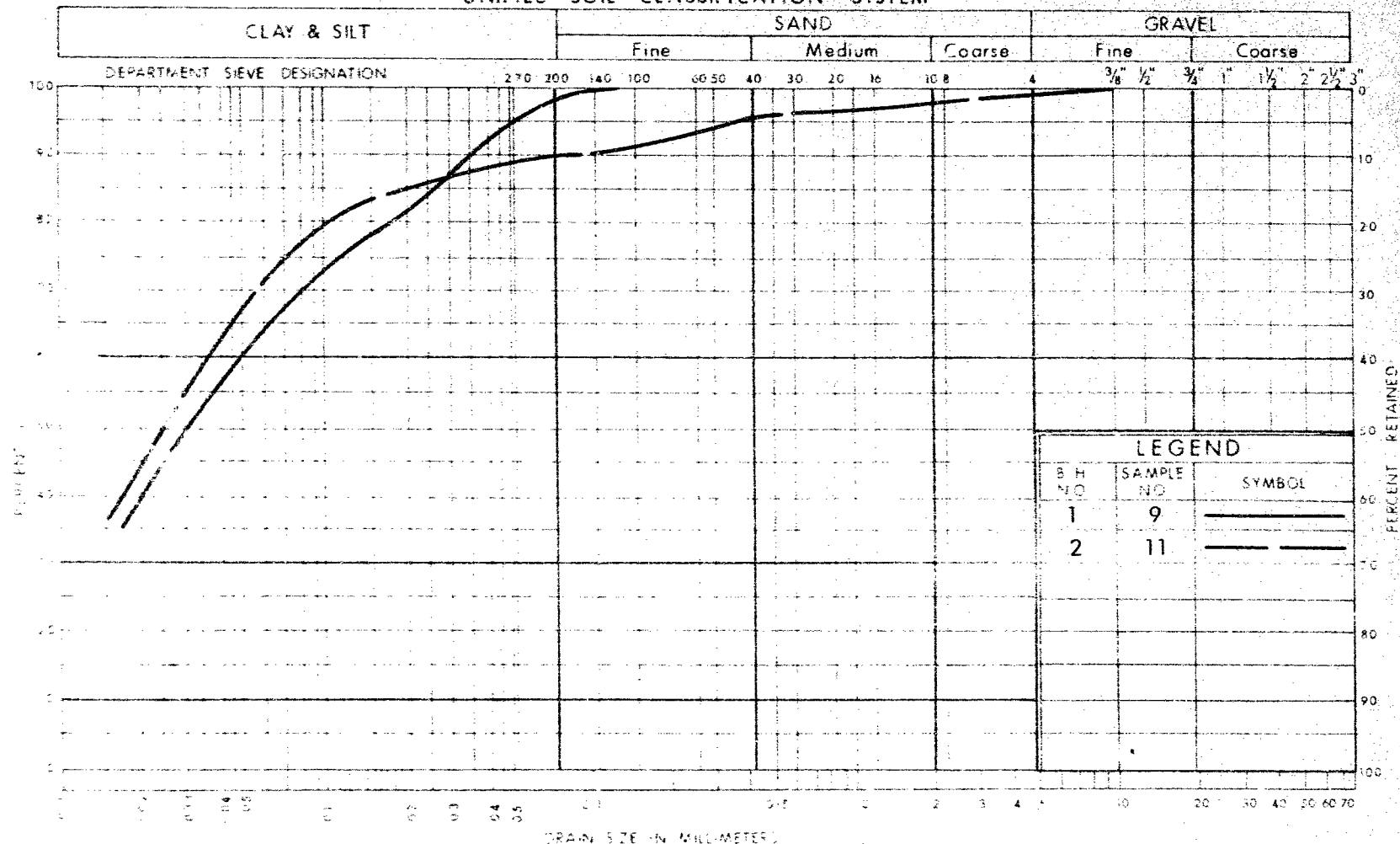
W.P. No. 122-65-1

JOB No. 69-F-44

FIG. NO. 1

DEPARTMENT OF HIGHWAYS
MATERIALS DIVISION
TESTING DIVISION

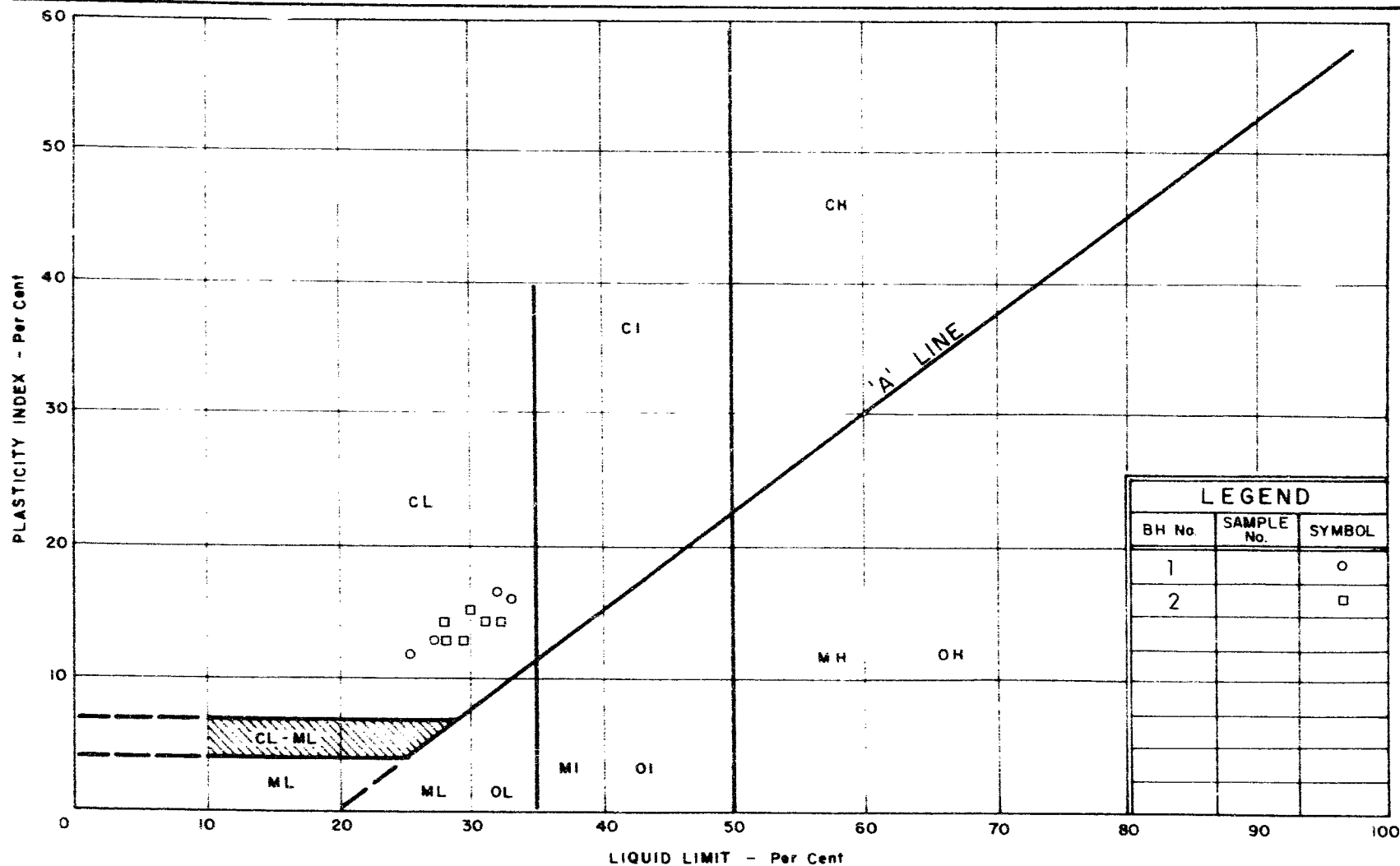
UNIFIED SOIL CLASSIFICATION SYSTEM



DEPARTMENT OF HIGHWAYS
MATERIALS and
TESTING
DIVISION

GRAIN SIZE DISTRIBUTION
SILTY CLAY

WP No. 122-65-1
JOB No. 69-F-44
FIG. NO. 2



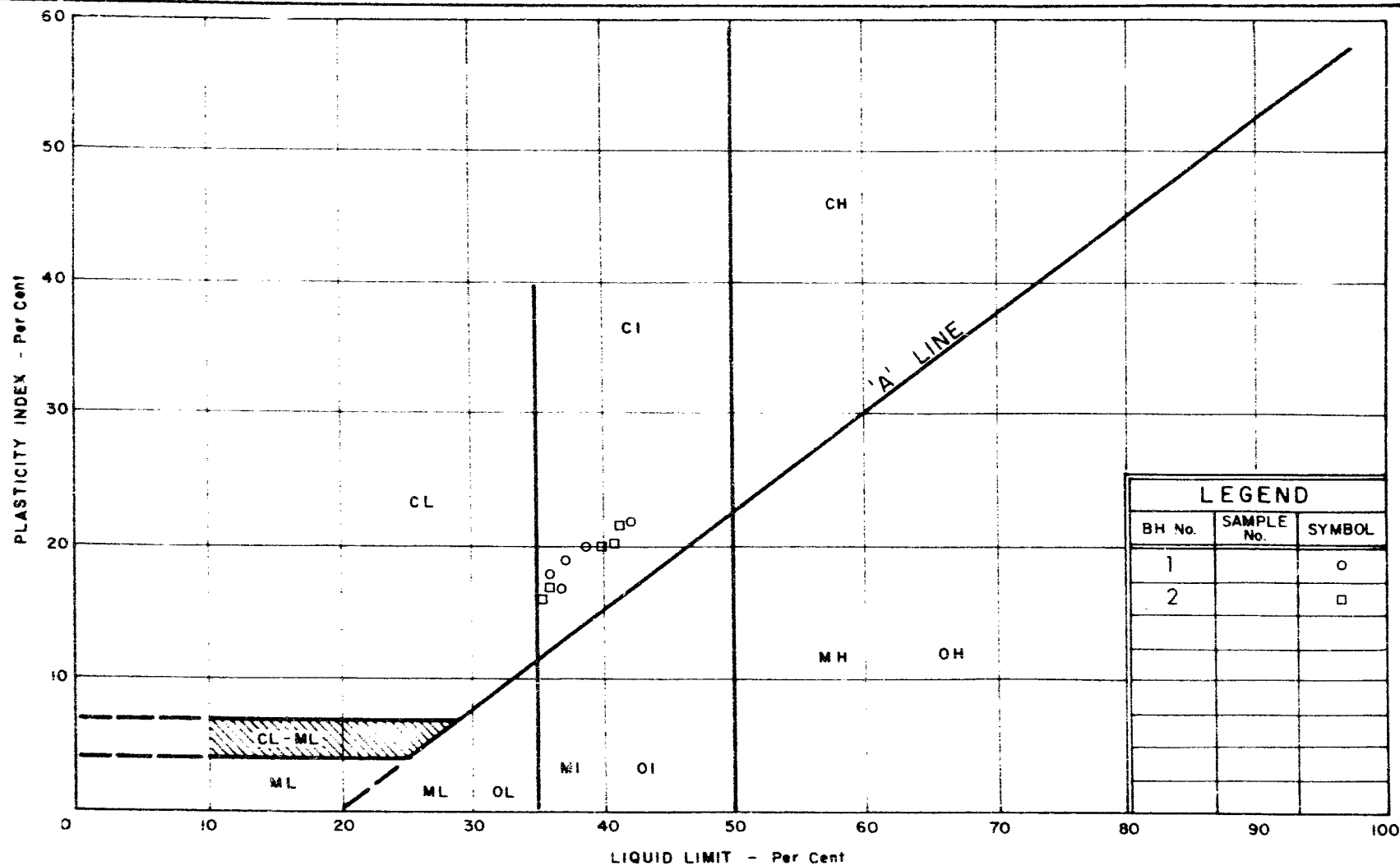
LEGEND		
BH No.	SAMPLE No.	SYMBOL
1		○
2		□



DEPARTMENT OF HIGHWAYS
MATERIALS and
TESTING
DIVISION

PLASTICITY CHART CLAYEY SILT

WP No. 122-65-1
JOB No. 69-F-44
FIG. NO. 3



DEPARTMENT OF HIGHWAYS
MATERIALS and
TESTING
DIVISION

PLASTICITY CHART SILTY CLAY

WP. No. 122 - 65 - 1

JOB No. 69 - F - 44

FIG. NO. 4

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

Q _u	UNCONFINED COMPRESSION	L V	LABORATORY VANE
Q	UNDRAINED TRIAXIAL	F V	FIELD VANE
Q _{cu}	CONSOLIDATED UNDRAINED TRIAXIAL	C	CONSOLIDATION
Q _d	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	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_r	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

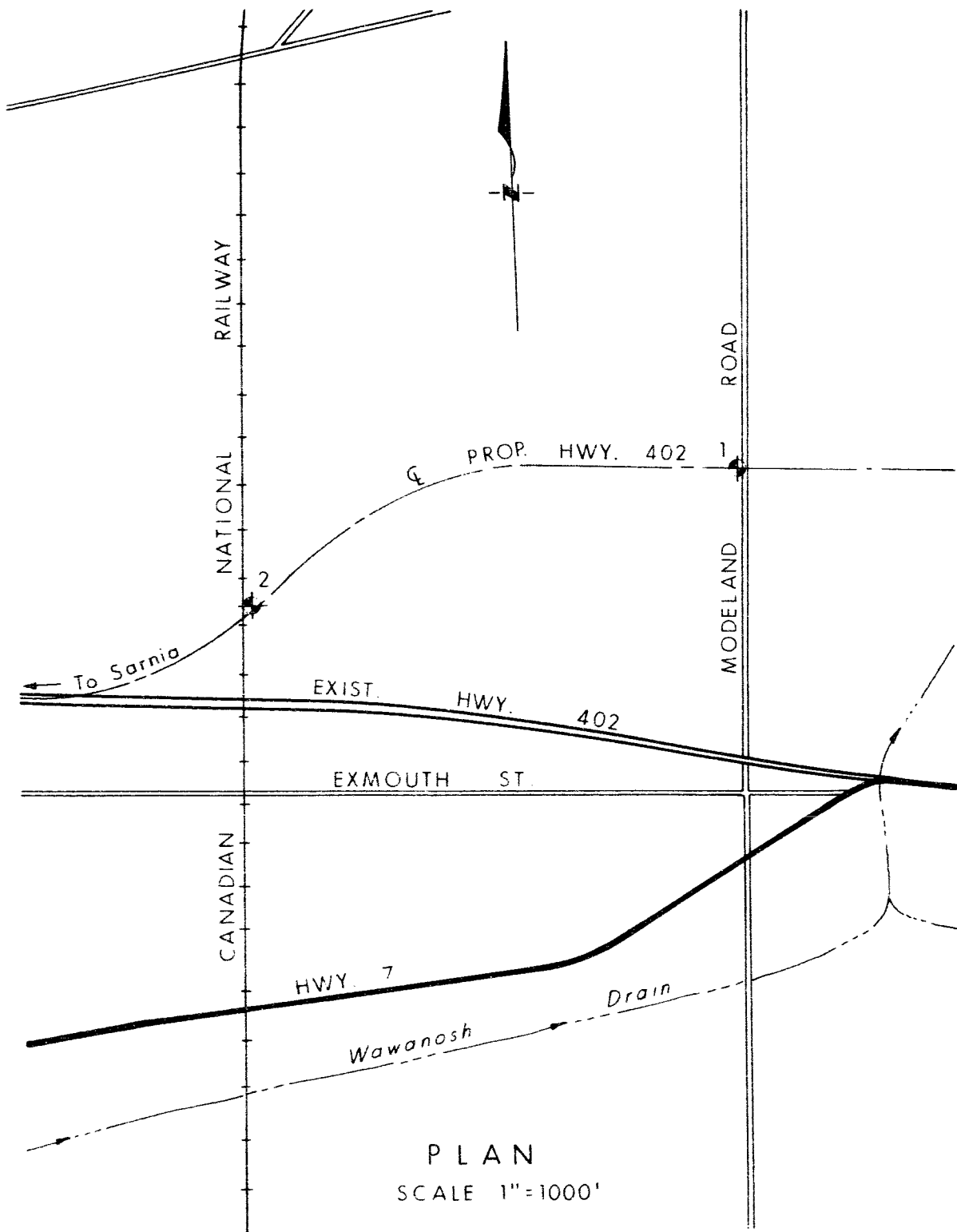
d	DISTANCE FROM TOP OF WALL TO POINT OF APPLICATION OF PRESSURE
δ	ANGLE OF WALL FRICTION
K	DIMENSIONLESS COEFFICIENT TO BE USED WITH VARIOUS SUFFIXES IN EXPRESSIONS REFERRING TO NORMAL STRESS ON WALLS
K_o	COEFFICIENT OF EARTH PRESSURE AT REST

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
β	ANGLE OF SLOPE TO HORIZONTAL



MEMORANDUM

TO: Mr. A. Stermac,
Principal Foundation Engr.,
Room 107, Lab Bldg.,
DOWNSVIEW, Ontario.

FROM: A.P. Watt,
Reg. Br. Loc. Engr.,
London Regional Office.

ATTENTION:

DATE: June 10th, 1969.

OUR FILE REF.

IN REPLY TO

SUBJECT:

W.P. 346-65-01, Site 14-337,
C.N.R. O'Head E.B.L.,
W.P. 346-65-02, C.N.R. O'Head W.B.L.,
0.9 miles West of Modeland Road,
Highway #402,
District #1, Chatham.

Enclosed please find a sketch showing the probable footing locations for the above-mentioned bridge as presently proposed.

A site plan is not available presently; however, a D.H.O. Engineering Surveys party is in the area and will stake the site for you on request.

Please arrange for a preliminary foundation investigation at the C.N.R. Overhead as soon as possible in order to obtain the assistance of the survey party while they are in the area.

Since the apparent final alignment of Highway 402 in the area of the C.N.R. Overhead Bridges, Modeland Road Overpass, Blackwell Sideroad Underpass, Airport Road Underpass and Wawanosh Drain Bridges is being run in the field the preliminary foundation investigation for the above structures could be incorporated in their final Foundation Reports.

S. Jants

S. JANTS
For: A.P. Watt,
Reg. Bridge Location Engineer,
London Regional Office.

SJ/ss

Enclosure: 1 Mosaic, Hwy. 402, 1"=1000'
1 Mosaic, Hwy. 402, 1"=200' (Sarnia Twp.)
and sketches of probable footing locations for each bridge.

c.c. S. McCombie.
R. Fitzgibbon.

5-6-69

Probable Footing Locations

W.P. 346-65-01, -02

C.N.R. Overhead (E & W.B.L.)

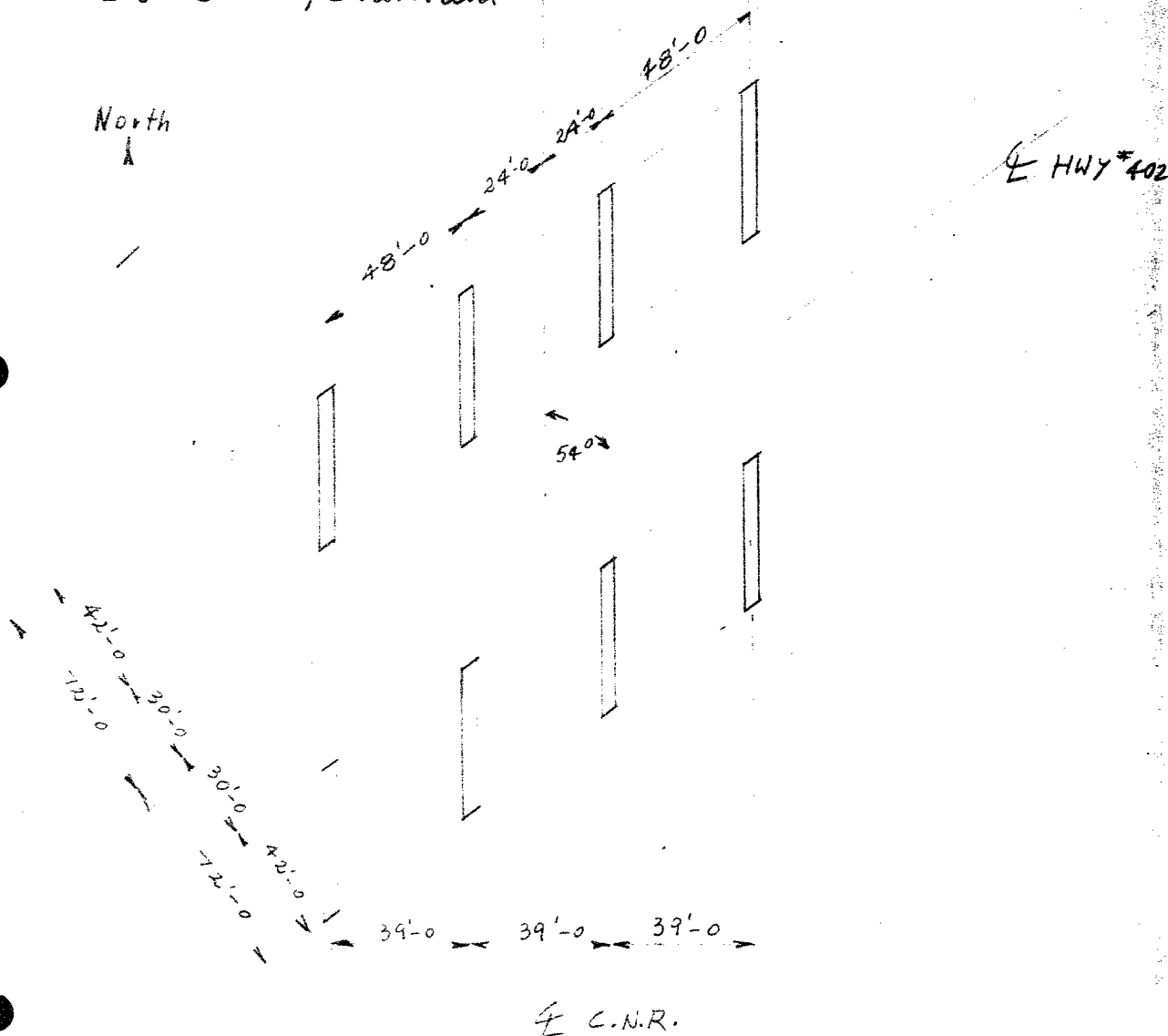
0.9 mile west of Modeland Road

TWP. of nia CTY. of Lambton

Con.: 7 Lot 17 & 18

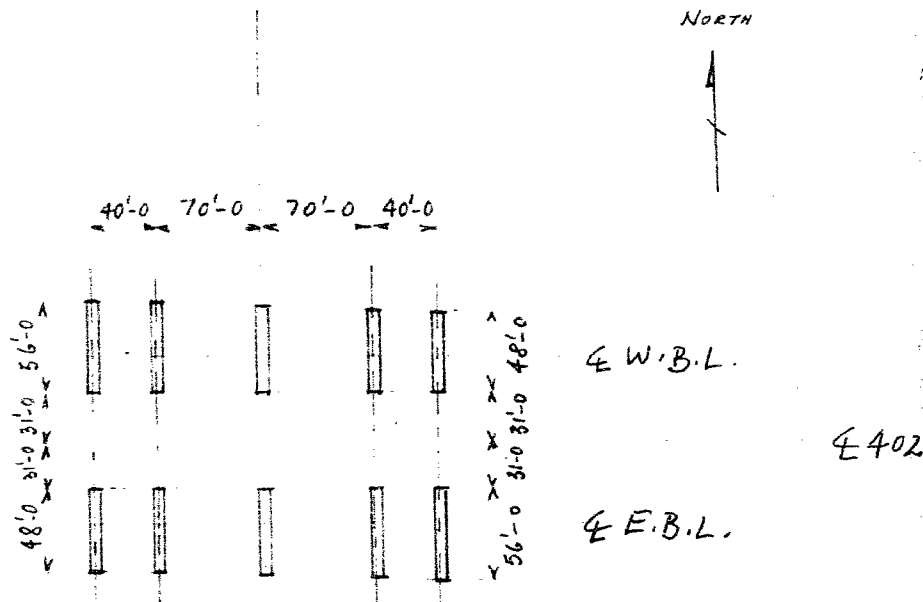
HWY #402

District #1, Chatham



Since the structure is 27.33' long, the total length is estimated 27.33'

Probable Footing Locations
 N.P. 122-65-03, -05
 MODLAND ROAD OVERPASS
 TWP. of Sarnia CTY. of Lambton
 Con.: 7 Lot 15, 16
 HWY # 401
 District # 1, Chatham



Modeland

Probable Footing Locations

W.P. 43-66-01

BLACKWELL SIDE ROAD UNDERPASS

TWP. of Sarnia CTY of Lambton

Con.: 7, Lot 12, 13

HWY #402

District #1, Chatham

North

A

15'-0 15'-0

15'-0

15'-0

15'-0

15'-0

15'-0

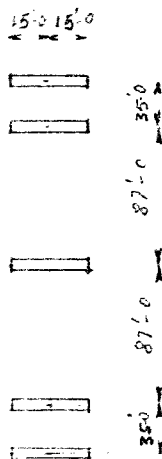
35'-0
75'-0
15'-0
35'-0

E 402

E Blackwell Side Rd.

Releable Footing Locations
W.P. 43-66-01
AIRPORT ROAD UNDERPASS
TWP. of Sarnia CTY. of Lambton
Con. 7, Lot 11
HWY # 402
District #1, Chatham

North
▲



E 402

E Airport Rd.

Mr. A. Watt,
Reg. Bridge Location Engr.

R. Fitzgibbon,
Schedule Co-Ordinator.

June 6, 1969.

W. P. 122-65-1, Modeland Road
Interchange and Associated Structures,
Hwy. 402, District 1

Reference is made to a meeting held on May 7, 1969 in the Regional boardroom concerning the above section of Highway 402, at which time it was mentioned that foundation problems may be encountered within this project. This was mainly due to earlier correspondence pertaining to the Modeland Road structure built in 1968, under W. P. 29-62 which is located approximately 1/2 mile away from the above project.

Following my return, I met with Mr. Ken Selby of the Foundation Section and it was his feeling that as far as he could determine from the functional plan there did not seem to be a problem, however, he emphaasized that this location is approximately a 1/2 mile away from the structure at Hwy. 402. He further stated that if the approach fill at the C.N.R. structures (W. P.'s 346-65-1 & 2) were 30' or more this could cause some problems.

As a result of your discussion with Mr. R. Gascoyne, R. F. P. E., and our meeting with Mr. J. Heffernan, Proj. Planning Engr. on May 28, 1969, a decision was made to proceed with the preliminary foundation investigation. Plans and locations of structures were given to you at that time. Engineering Surveys nas assured you that the line will be staked for this investigation.

Would you please arrange to forward all the necessary plans to Mr. K. Selby by June 11, 1969 as he has informed me that he could start immediately.

Thanking you for your cooperation.

c. c. K. Selby ✓

R. Fitzgibbon,
Schedule Co-Ordinator