#66-F-226-C

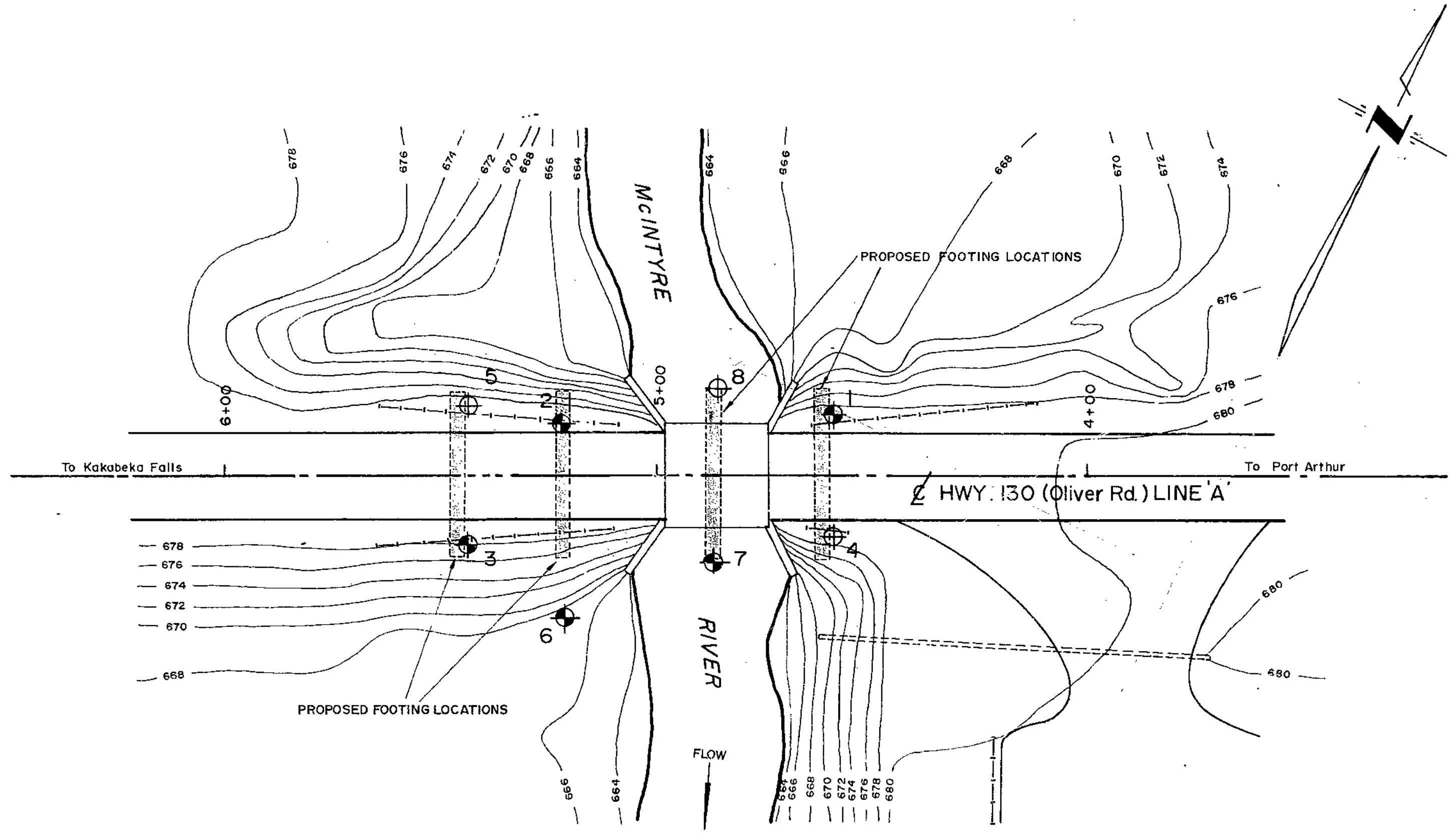
W.P. #227-65

HWY. #130 &

McINTYRE

RIVER BRIDGE

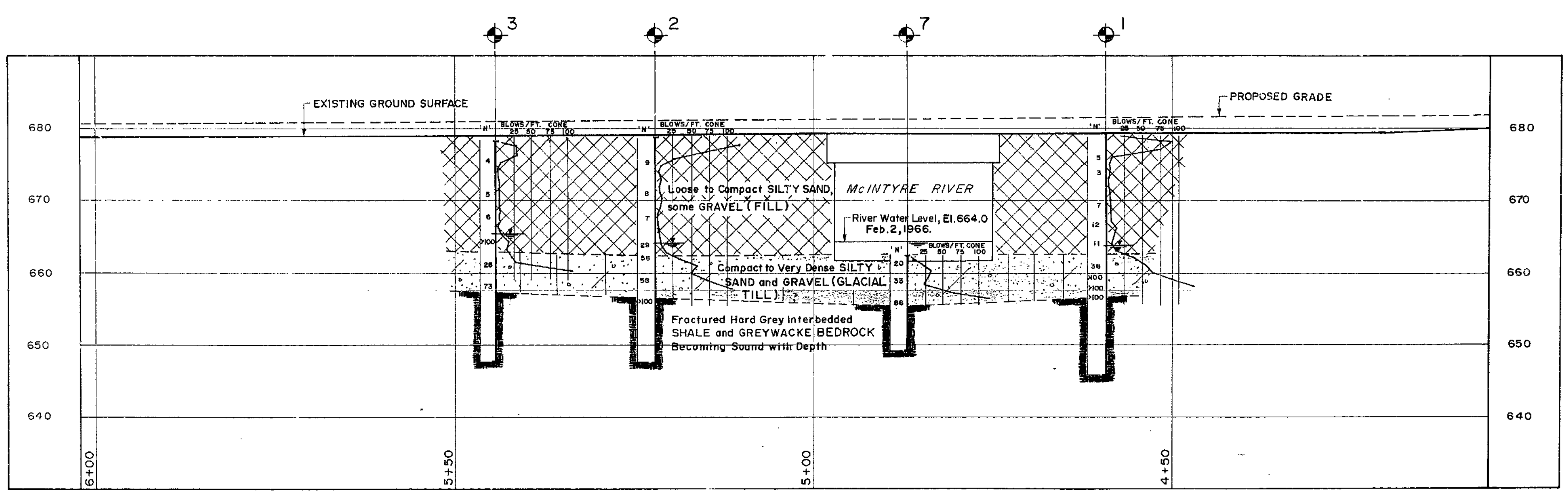
REPLACEMENT



PLAN

SCALE — FEET

20 0 20 40 60 80 100

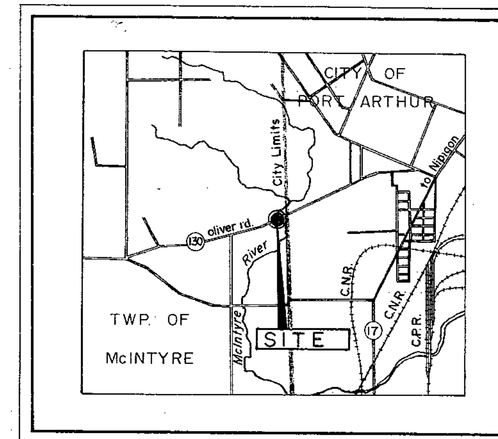


SCHEMATIC SECTION ALONG CENTRELINE HIGHWAY 130

SCALE — FEET

10 0 10 20 30 40 50

REF. No. E- 4539-I



KEY PLAN

SCALE IN MILES

1/2 0 1 2 3

LEGEND

- Bore Hole
- Cone Penetration Hole
- Bore & Cone Penetration Hole
- Water Levels established at time of field investigation. (FEB. 16/66)

NO.	ELEVATION	STATION	OFFSET
1	679.3	4+59	14' RIGHT
2	679.0	5+22	12' RIGHT
3	678.2	5+44	16' LEFT
4	679.1	4+59	14' LEFT
5	678.5	5+44	16' RIGHT
6	667.1	5+21	33' LEFT
7	664.0	4+87	20' LEFT
8	664.0	4+86	20' RIGHT

– 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.

REVISIONS	DATE	BY	DESCRIPTION

H.Q. GOLDER AND ASSOCIATES LTD.

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION - FOUNDATION SECTION

McINTYRE RIVER

KING'S HIGHWAY NO. 130, LINE 'A' DIST. NO. 19

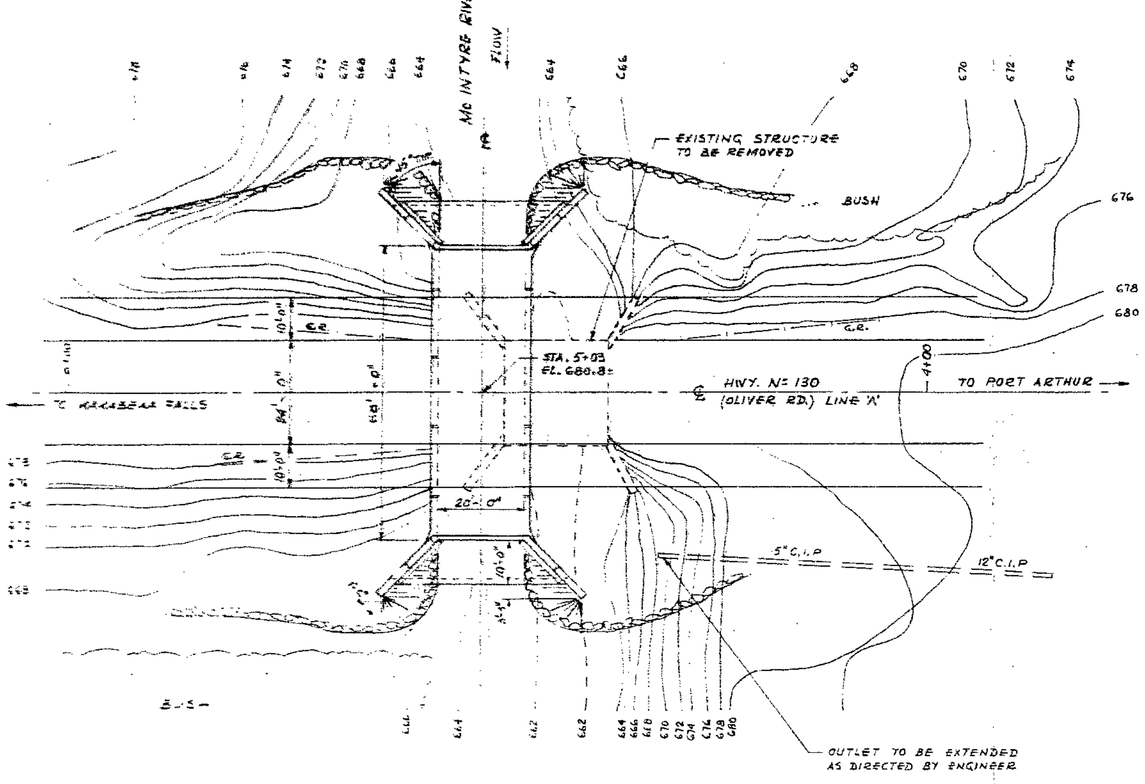
DISTRICT OF THUNDER BAY NEAR PORT ARTHUR

TWP. OF McINTYRE LOT N.W. 1/4 SEC. 50

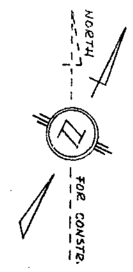
BORING PLAN AND SOIL STRATIGRAPHY SECTION

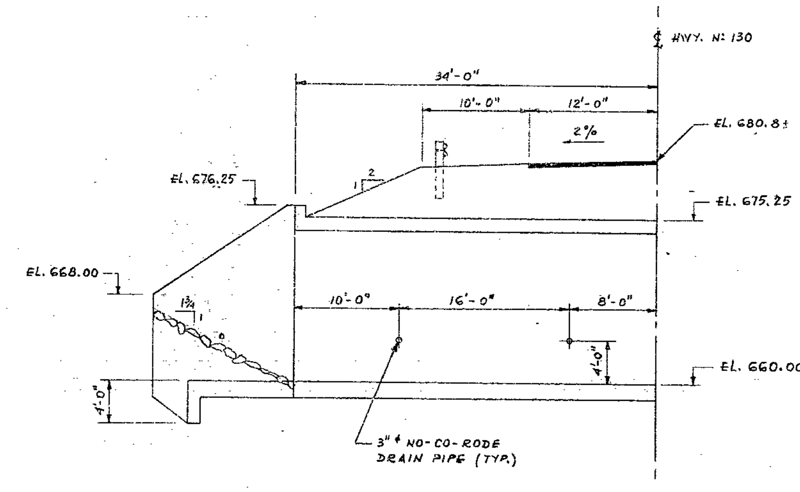
SUBM'D.	CHECKED	W.P. NO. 227-65	DRAWING NO. 1
DRAWN M.W.	CHECKED	JOB NO. 66012	
DATE FEB. 10, 1966		SITE NO. 48C-71	BRIDGE DRAWING NO.
APPROVED PRINCIPAL FOUNDATION ENGINEER		CONT. NO.	

NT RECORD	
FOR	DATE



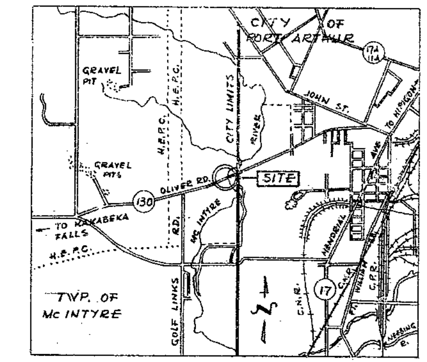
PLAN





HALF LONGITUDINAL SECTION

SCALE: 1/8" = 1'-0"



KEY PLAN

SCALE: 1¼" = 1 MI.

NOTES:

B.M. ELEV. 681.24 GEODETIC DATUM
ROCK RIVET IN N.E. CORNER OF BRIDGE 11.0 RT. OF STA. 4+76

CLASS OF CONCRETE

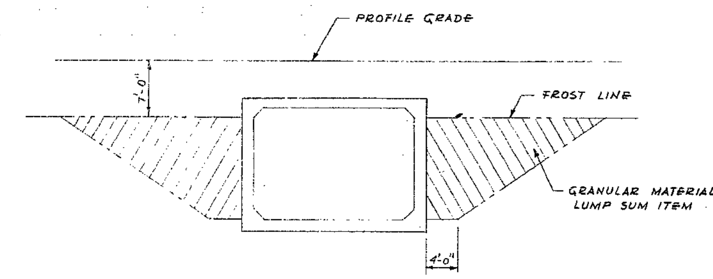
3000 P.S.I.

CLEAR COVER ON REINFORCING STEEL

3" EXCEPT AS NOTED

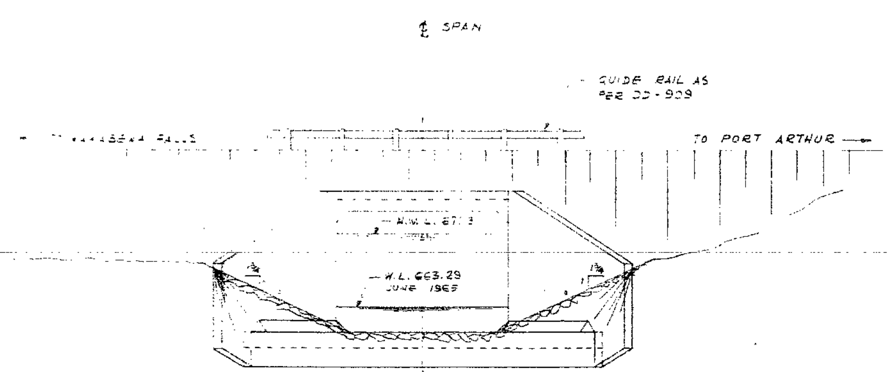
CONSTRUCTION NOTES

ALL EXPOSED EDGES TO BE CHAMFERED 1"x1" EXCEPT AS NOTED



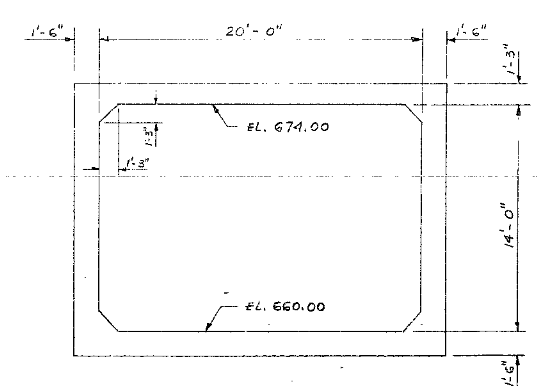
DETAIL OF MINIMUM GRANULAR BACKFILL REQUIREMENT

SCALE: 3/32" = 1'-0"



ELEVATION

SCALE: 1" = 10'-0"



TYPICAL CROSS SECTION

SCALE: 3/16" = 1'-0"

PRINT RECORD

REVISIONS	DATE	BY	DESCRIPTION

D. S. MEDER — REGISTERED PROFESSIONAL ENGINEER — PROVINCE OF ONTARIO

DEPARTMENT OF HIGHWAYS ONTARIO
BRIDGE DIVISION

Mc INTYRE RIVER BRIDGE
0.1 MI. WEST OF PORT ARTHUR W. LIMITS

KING'S HIGHWAY No. 130 — DIST. No. 19
DIST. OF THUNDER BAY
TWP. Mc INTYRE — LOT — CON.

PRELIMINARY

APPROVED	BRIDGE ENGINEER			SITE No. 48C-71	W.P. No. 227-65
DESIGN	D.S.M.	CHECK	W.T.H.	CONTRACT Nos.	
DRAWING	P.K.	CHECK	W.T.H.	DRAWING No.	D-5915-P
DATE	NOV. 1966	LOADING	H20-S16		

66F226C

H. Q. GOLDER & ASSOCIATES LTD.

CONSULTING CIVIL ENGINEERS

H. Q. GOLDER
V. MILLIGAN
L. G. SODERMAN
J. L. SEYCHUK

2444 BLOOR STREET WEST
TORONTO 9, ONTARIO
763-4103
767-9201

W.P. 227-65

REPORT

TO

DEPARTMENT OF HIGHWAYS, ONTARIO

ON

SOIL CONDITIONS AND FOUNDATIONS

PROPOSED McINTYRE RIVER BRIDGE REPLACEMENT

HIGHWAY 130 LINE "A"

NEAR PORT ARTHUR ONTARIO

Distribution:

11 copies - Department of Highways, Ontario, Toronto, Ontario.

2 copies - H. Q. Golder & Associates Ltd., Toronto, Ontario.

March, 1966 66012

TABLE OF CONTENTS

ABSTRACT

The results of an investigation to determine the subsoil conditions at the site of a proposed bridge replacement on Highway 130 over the McIntyre River near Port Arthur, Ontario, are reported and recommendations are made for the foundation design of the proposed structure and approach embankments.

It was found that interbedded shale and greywacke bedrock underlies the site, some 20 to 25 feet below existing roadway grade, at the proposed pier and abutment locations. A stratum of compact to very dense sandy glacial till, some 6 to 7 feet thick, forms the existing river bed and overlies the bedrock. A 5 foot thick surficial cover of very loose to loose sandy silt overlies the till adjacent to the river channel outside the existing roadway approach fill. The groundwater level in the subsoil was found to be within about one foot of the river water level.

The proposed bridge structure may be founded on spread footings or cased large diameter piles placed in the bedrock using a bearing pressure of up to 20 tons/sq.ft. As an alternative, the abutment footings may be founded on piles driven through the approach fill to the underlying bedrock.

There should be no stability problem with the approach embankments if the recent alluvium above the till is removed and if the side slopes are protected against erosion scour as discussed in the report.

INTRODUCTION

H. Q. Golder & Associates Ltd. have been retained by the Department of Highways, Ontario, to carry out a soil investigation for the proposed bridge replacement over the McIntyre River on Highway 130 immediately west of the City of Port Arthur, Ontario. The purpose of this investigation was to determine the subsurface conditions at the site and to provide information for the foundation design and construction of the new bridge structure.

PROCEDURE

The field work for this investigation was carried out during the period January 24 to February 3, 1966. A total of 5 boreholes were put down using a diamond machine drillrig supplied and operated by Canadian Longyear Limited, under the supervision of an engineer from our staff. Dynamic penetration tests were carried out adjacent to each of the borehole locations as well as at three other locations, as shown on Figure 1. Borings 1, 2 and 3, which were put down from the shoulder of the existing roadway embankment, were taken to depths of from about 30 to 33 feet below existing roadway surface. Boring 7, which was carried out from the river ice surface, was taken to a depth of 13 feet below the river bed. In order to determine the characteristics of the natural surface deposits adjacent to the river, borehole 6 was put down at the toe of the existing roadway fill. A sealed stand-pipe was installed in 2 of the borings to determine the ground-water level.

Detailed logs of each boring are given on the Records of Boreholes following the text of this report. The locations of the borings and the dynamic penetration tests, together with a section of the inferred soil stratigraphy across the site, are shown on Figure 1 located in a pocket following the Records of Boreholes.

Samples obtained during the investigation were shipped to our laboratory for detailed examination and testing. The results of the tests carried out are shown on the Records of Boreholes and on Figures 2 to 5, inclusive.

The elevations in this report were provided by the Department of Highways, Ontario, and are referred to the following bench mark: rock rivet in NE corner of bridge, 11 feet right of station 4+76 having elevation 681.24, Geodetic datum.

SITE AND GEOLOGY

The site is located at the crossing of Highway 130 over the McIntyre River approximately 0.1 miles west of the City of Port Arthur west city limits. The McIntyre River flows in a southerly direction at the site and is some 25 feet wide at the proposed crossing location. The terrain surrounding the river valley is some 15 to 20 feet above the valley floor and rises gently to the east and west.

Available geological information indicates that the overburden in this locality consists of silts and fine sands mainly of lacustrine and deltaic origin underlain by glacial till. Bedrock in this area consists mainly of shale, conglomerate or greywacke of the Animike series of Precambrian time with occasional occurrences of diabase sills.

SUBSURFACE CONDITIONS

The detailed stratigraphy encountered in each borehole is given on the Records of Boreholes. Following is a summarized account of the subsurface conditions at the site of the proposed bridge.

Borings 1, 2 and 3 put down through the roadway embankments, show that the fill at the approaches to the existing bridge is some 15 to 17 feet thick. The fill is comprised essentially of silty sand with some gravel and occasional pieces of wood. Several grain size distribution curves obtained from samples of the fill material are shown on Figure 2. Based on the standard penetration resistance tests, the results of which are given on the Records of Boreholes, the relative density of the fill ranges from very loose to compact and is generally loose.

Underlying a thin cover of topsoil at borehole 6, which was put down on the west bank of the river at the toe of the existing embankment fill, there is a 5 foot thick deposit of recent alluvium comprised of brown silt and sand with a trace of clay and containing small roots and twigs. A grain size distribution curve obtained from a sample of the silt and sand deposit is shown on Figure 3. The standard penetration resistance tests, which gave "N" values ranging from 2 to 4 blows/foot, indicate a very loose to loose relative density.

A stratum of glacial till forms the river bed at borehole 7 and underlies the roadway fill or recent alluvium in the remaining borings. The till is some 6 to 7 feet thick and consists essentially of dark grey silty sand and gravel with a trace of clay. Typical grading curves for samples of the till, obtained using 1½ inch I.D. sampling equipment, are shown on Figures 4 and 5. Based on the penetration test results, the fill is compact to very dense with depth.

Hard grey interbedded shale and greywacke bedrock was encountered below the glacial till and was proved by core drilling in AXT size for depths of 6 to 11 feet in boreholes 1, 2, 3 and 7. The upper 2 to 3 feet of the bedrock contains numerous thin soft shale seams and horizontal fractures. Below this depth the rock is in a generally sound condition. The surface of the bedrock is fairly uniform in elevation at the four borehole locations, ranging between 655 and 657.

Standpipes were installed in boreholes 1 and 2, following completion of sampling, to determine the piezometric water level. Details of these installations are given on the Records of Boreholes. Periodic water level readings were taken in the standpipes during the course of the field work and the latest results obtained are given on the Records of Boreholes and on Figure 1.

The piezometric groundwater level, as measured in the borings after completion of the field work, was found to be within about 1 foot of the river water level which was at elevation 664 at the time of the investigation.

DISCUSSION

General

It is understood that the existing bridge over the McIntyre River is to be replaced by a new three span structure to be located along the existing Highway 130 alignment. The existing structure consists of a single 22 foot span concrete bridge. Structural details for the new bridge are not available at this time, but it is understood that tentatively the end spans are 25 feet in length with the central span about 35 feet long. The proposed pier and abutment locations are as shown on Figure 1. It is not known whether the proposed abutments will be closed or of the spill-through type. The proposed grade will be raised about 2 feet above the existing roadway level and the new roadway will consist of two 11 to 12 foot wide lanes with 8 to 10 foot wide shoulders.

Foundations

The bedrock which underlies the site at a relatively shallow depth, is a competent foundation stratum for the support of the proposed bridge structure and it is recommended that the piers be founded on spread footings placed in the bedrock. The pier footings may also be placed in the overlying till stratum. In this case, however, there would probably be insufficient scour protection.

If the proposed bridge is to be a rigid frame structure with closed-end abutments, the abutments should be founded on spread footings placed in the bedrock.

Considering the presence of soft shale seams and fracturing in the upper portion of the bedrock, it is suggested that the excavations for the pier and abutment foundations be carried down at least 1 foot into bedrock. For spread footings placed in the sound portion of the bedrock, an allowable bearing pressure of up to 20 tons/sq.ft. may be used in design.

Backfill for the closed-end abutments consisting of free-draining and non-frost-susceptible granular material is recommended. The granular backfill should extend at least 6 feet horizontally behind the abutment walls and provision for drainage from this material should be made to ensure that no hydrostatic or ice pressures build up behind the walls. With full effective drainage provided, it is recommended that a coefficient of earth pressure at rest, K_o, of 0.4 and a total unit weight, γ , = 135 lb/cu.ft. be used for the compacted granular backfill in design of the walls.

If spill through abutments are to be used for the structure, it may be more economical to use stub abutments placed within the roadway fill and founded on piles driven through the fill to the underlying bedrock rather than placing the abutments on spread footings taken down to the till or bedrock. For 12BP74 steel "H" piles driven through the roadway fill to practical refusal in bedrock, an allowable design load of 70 tons per pile may be used.

The pile cap for stub abutments should be placed at a depth such that a minimum of 6 feet of earth cover is maintained in all directions for frost protection purposes.

Footing Excavations

Excavations for spread footing foundations to bedrock will have to be carried down through some 6 to 7 feet of compact to very dense sandy till. With the river water level several feet above the upper surface of the till, it will be necessary to construct a steel sheeted cofferdam driven to bedrock to control the inflow of water into the excavations.

A possible alternative design which avoids the use of a cofferdam and dewatering problems, would be to use large diameter (6 to 10 feet) steel casing bored into rock and filled with concrete tremied through water. If the lateral forces are large and the depth bored into rock is small, steel dowels may be required.

Approach Embankments

The approach fill to the proposed structure will be some 19 feet above the present river bed level which is underlain by the glacial till stratum. Boreholes 1, 2 and 3, which were put down through the existing embankments, show that the recent alluvium deposit encountered in borehole 6 had been removed prior to placing the existing fill directly on the glacial till stratum.

Provided that all topsoil and loose alluvial silts are removed beneath the full base width of the proposed embankment prior to placement of additional fill, properly compacted in place, there should be no overall stability problem with the approach fills using 2 horizontal to 1 vertical side slopes.

To prevent surface water erosion and gullying of the embankment slopes, provision should be made for sodding or seeding and mulching them as soon as possible following construction. The embankment side and end slopes in the abutment areas should be covered with rip-rap extending from river bottom to at least 3 feet above the river high water level to prevent undermining by erosion of the fill.

REGISTERED PROFESSIONAL ENGINEER
LEO R. LAHTI
PROVINCE OF ONTARIO

L. R. Lahti, P.Eng.

H. Q. Golder, P.Eng.

LRL:hdg
66012
March 16, 1966.

LIST OF ABBREVIATIONS

The abbreviations commonly employed on each "Record of Borehole," on the figures and in the text of the report, are as follows:

I. SAMPLE TYPES

AS	auger sample
CS	chunk sample
DO	drive open
DS	Denison type sample
FS	foil sample
RC	rock core
ST	slotted tube
TO	thin-walled, open
TP	thin-walled, piston
WS	wash sample

II. PENETRATION RESISTANCES

Dynamic Penetration Resistance: The number of blows by a 140-pound hammer dropped 30 inches required to drive a 2-inch diameter, 60 degree cone one foot, where the cone is attached to 'A' size drill rods and casing is not used.

Standard Penetration Resistance, *N*: The number of blows by a 140-pound hammer dropped 30 inches required to drive a 2-inch drive open sampler one foot.

WH sampler advanced by static weight—weight, hammer

PH sampler advanced by pressure—pressure, hydraulic

PM sampler advanced by pressure—pressure, manual

III. SOIL DESCRIPTION

(a) *Cohesionless Soils*

Relative Density	*N, blows/ft.*
Very loose	0 to 4
Loose	4 to 10
Compact	10 to 30
Dense	30 to 50
Very dense	over 50

(b) *Cohesive Soils*

Consistency	c_u, *lb./sq. ft.*
Very soft	Less than 250
Soft	250 to 500
Firm	500 to 1,000
Stiff	1,000 to 2,000
Very stiff	2,000 to 4,000
Hard	over 4,000

IV. SOIL TESTS

C	consolidation test
H	hydrometer analysis
M	sieve analysis
MH	combined analysis, sieve and hydrometer[1]
Q	undrained triaxial[2]
R	consolidated undrained triaxial[2]
S	drained triaxial
U	unconfined compression
V	field vane test

NOTES:

[1]Combined analyses when 5 to 95 per cent of the material passes the No. 200 sieve.

[2]Undrained triaxial tests in which pore pressures are measured are shown as $\bar{Q}$ or $\bar{R}$.

LIST OF SYMBOLS

I. 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

II. STRESS AND STRAIN

- u pore pressure
- σ normal stress
- σ' normal effective stress ($\bar{\sigma}$ is also used)
- τ shear stress
- ϵ linear strain
- ϵ_{xy} 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

III. SOIL PROPERTIES

(a) *Unit weight*

- 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_s specific gravity of solid particles $G_s = \gamma_s/\gamma_w$
- e void ratio
- n porosity
- w water content
- S_r degree of saturation

(b) *Consistency*

- w_L liquid limit
- w_P plastic limit
- I_P plasticity index
- w_S shrinkage limit
- I_L liquidity index $= (w - w_P)/I_P$
- I_C consistency index $= (w_L - w)/I_P$
- e_{max} void ratio in loosest state
- e_{min} void ratio in densest state
- D_r relative density $= (e_{max} - e)/(e_{max} - e_{min})$

(c) *Permeability*

- 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

(d) *Consolidation (one-dimensional)*

- m_v coefficient of volume change $= -\Delta e/(1+e)\Delta\sigma'$
- C_c compression index $= -\Delta e/\Delta \log_{10} \sigma'$
- c_v coefficient of consolidation
- T_v time factor $= c_v t/d^2$ (d, drainage path)
- U degree of consolidation

(e) *Shear strength*

- τ_f shear strength
- c' effective cohesion intercept; ϕ' effective angle of shearing resistance, or friction — in terms of effective stress $\tau_f = c' + \sigma' \tan \phi'$
- c_u apparent cohesion*; ϕ_u apparent angle of shearing resistance, or friction — in terms of total stress $\tau_f = c_u + \sigma \tan \phi_u$
- μ coefficient of friction
- S_t sensitivity

*For the case of a saturated cohesive soil, $\phi_u = 0$ and the undrained shear strength $\tau_f = c_u$ is taken as half the undrained compressive strength.

PROJECT No. 66012

RECORD OF BOREHOLE 1

LOCATION See Figure 1 — BORING DATE JAN. 24-26, 1966 — DATUM GEODETIC

BOREHOLE TYPE WASH BORING — BOREHOLE DIAMETER NX, AX CASING

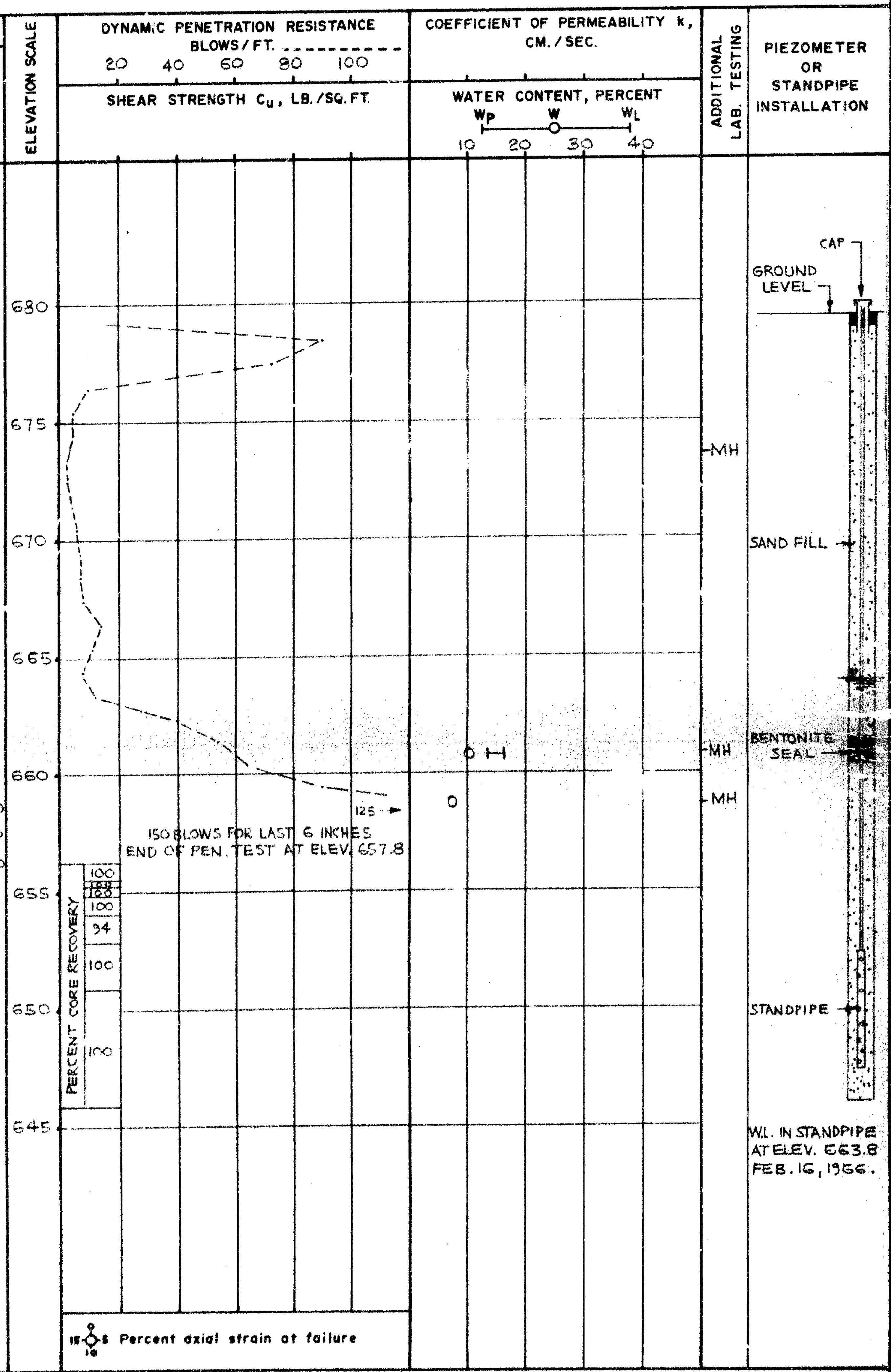
SAMPLER HAMMER WEIGHT 140 LB. DROP 30 INCHES — PEN. TEST HAMMER WEIGHT 140 LB. DROP 30 INCHES

SOIL PROFILE

ELEVN. / DEPTH	DESCRIPTION
679.3	GROUND LEVEL
0.0	LOOSE TO COMPACT SILTY SAND WITH TRACE TO SOME GRAVEL, OCCASIONAL PIECES OF WOOD (FILL)
662.3 / 17.0	DENSE TO VERY DENSE DARK GREY SILTY SAND AND GRAVEL, TRACE CLAY (GLACIAL TILL)
656.3 / 23.0	FRACTURED HARD GREY INTERBEDDED SHALE AND GREYWACKE WITH NUMEROUS THIN SOFT SHALE SEAMS, BECOMING SOUND BELOW ELEV. 653.
645.7 / 33.6	END OF HOLE

SAMPLES

NUMBER	TYPE	BLOWS / FT.
1	2" D.O.	5
2	"	3
3	"	7
4	"	12
5	"	11
6	"	38
[illegible]	"	>100
[illegible]	"	>100
[illegible]	"	>100
10	AX	—
[illegible]	"	—
[illegible]	"	—
15	"	—
16	"	—



VERTICAL SCALE 1 INCH TO 5'-0"

GOLDER & ASSOCIATES

DRAWN ... CHECKED ...

PROJECT No. 66012

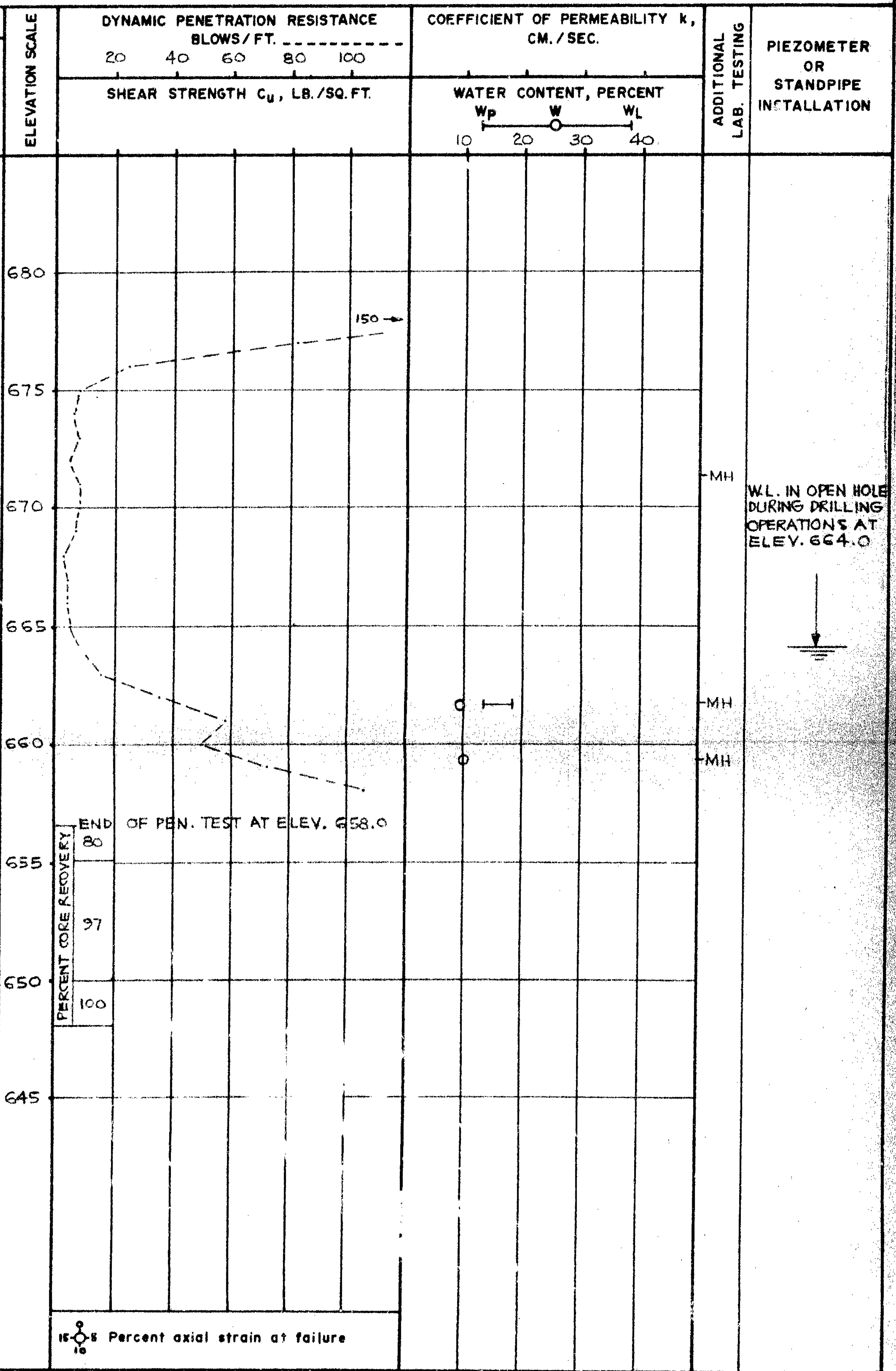
RECORD OF BOREHOLE 2

LOCATION See Figure 1 BORING DATE JAN. 26-30, 1966 DATUM GEODETIC

BOREHOLE TYPE WASH BORING BOREHOLE DIAMETER NX, AX CASING

SAMPLER HAMMER WEIGHT 140 LB. DROP 30 INCHES PEN. TEST HAMMER WEIGHT 140 LB. DROP 30 INCHES

ELEVN. / DEPTH	DESCRIPTION	SAMPLE NUMBER	TYPE	BLOWS/FT.
679.0	GROUND LEVEL			
0.0	LOOSE TO COMPACT BROWN SILTY SAND WITH SOME GRAVEL (FILL)	1	2" D.O.	9
		2	"	8
		3	"	7
		4	"	29
662.5 / 16.5	VERY DENSE DARK GREY SILTY SAND AND GRAVEL, TRACE CLAY (GLACIAL TILL)	5	T.O.	56
		6	D.O.	58
			"	>100
656.6 / 22.4	SOUND GREY INTERBEDDED SHALE AND GREYWACKE WITH SEVERAL SOFT SHALE SEAMS TO ELEV. 655, OCCASIONAL HORIZONTAL FRACTURES THROUGHOUT.	8	AXT RC	–
		9	"	–
		10	"	–
648.0 / 31.0	END OF HOLE			



VERTICAL SCALE
1 INCH TO 5'-0"

GOLDER & ASSOCIATES

DRAWN M.W.
CHECKED

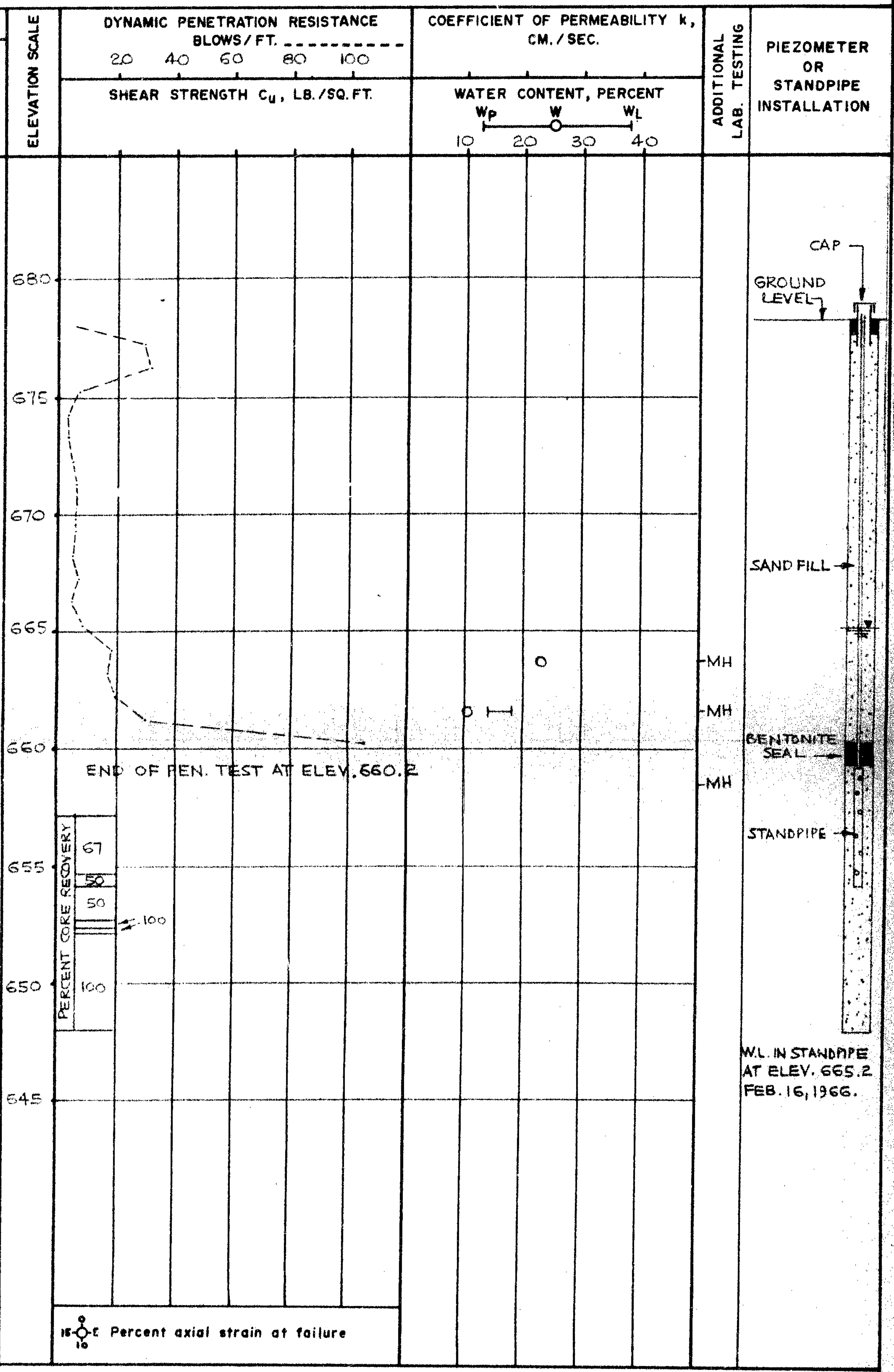
RECORD OF BOREHOLE 3

LOCATION See Figure 1 BORING DATE JAN. 30-31, 1966 DATUM GEODETIC

BOREHOLE TYPE WASH BORING BOREHOLE DIAMETER NX, AX CASING

SAMPLER HAMMER WEIGHT 140 LB. DROP 30 INCHES PEN. TEST HAMMER WEIGHT 140 LB. DROP 30 INCHES

ELEVN. / DEPTH	DESCRIPTION	SAMPLE NUMBER	TYPE	BLOWS / FT.	ADDITIONAL LAB. TESTING
678.2	GROUND LEVEL				
0.0	LOOSE TO COMPACT BROWN SILTY SAND WITH SOME GRAVEL (FILL)	1	2" D.O.	4	
		2	"	5	
		3	"	6	
		4	"	>100	MH
662.7 / 15.5	COMPACT DARK GREY **SANDY SILT**, SOME GRAVEL, TRACE CLAY BECOMING VERY DENSE DARK GREY **SILTY SAND** AND **GRAVEL**, TRACE CLAY (**GLACIAL TILL**)	5	"	28	MH
		6	"	73	MH
657.2 / 21.0	FRACTURED HARD GREY INTERBEDDED **SHALE** AND **GREYWACKE** WITH NUMEROUS THIN SOFT SHALE SEAMS BECOMING SOUND AT ELEV. 652.	7	AXT RC	–	
		8	"	–	
		9	"	–	
		10	"	–	
		11	"	–	
		12	"	–	
648.0 / 30.2	END OF HOLE				



15 ○ 10 Percent axial strain at failure

VERTICAL SCALE
1 INCH TO 5'-0"

GOLDER & ASSOCIATES

DRAWN M.W.
CHECKED

PROJECT No. 66012

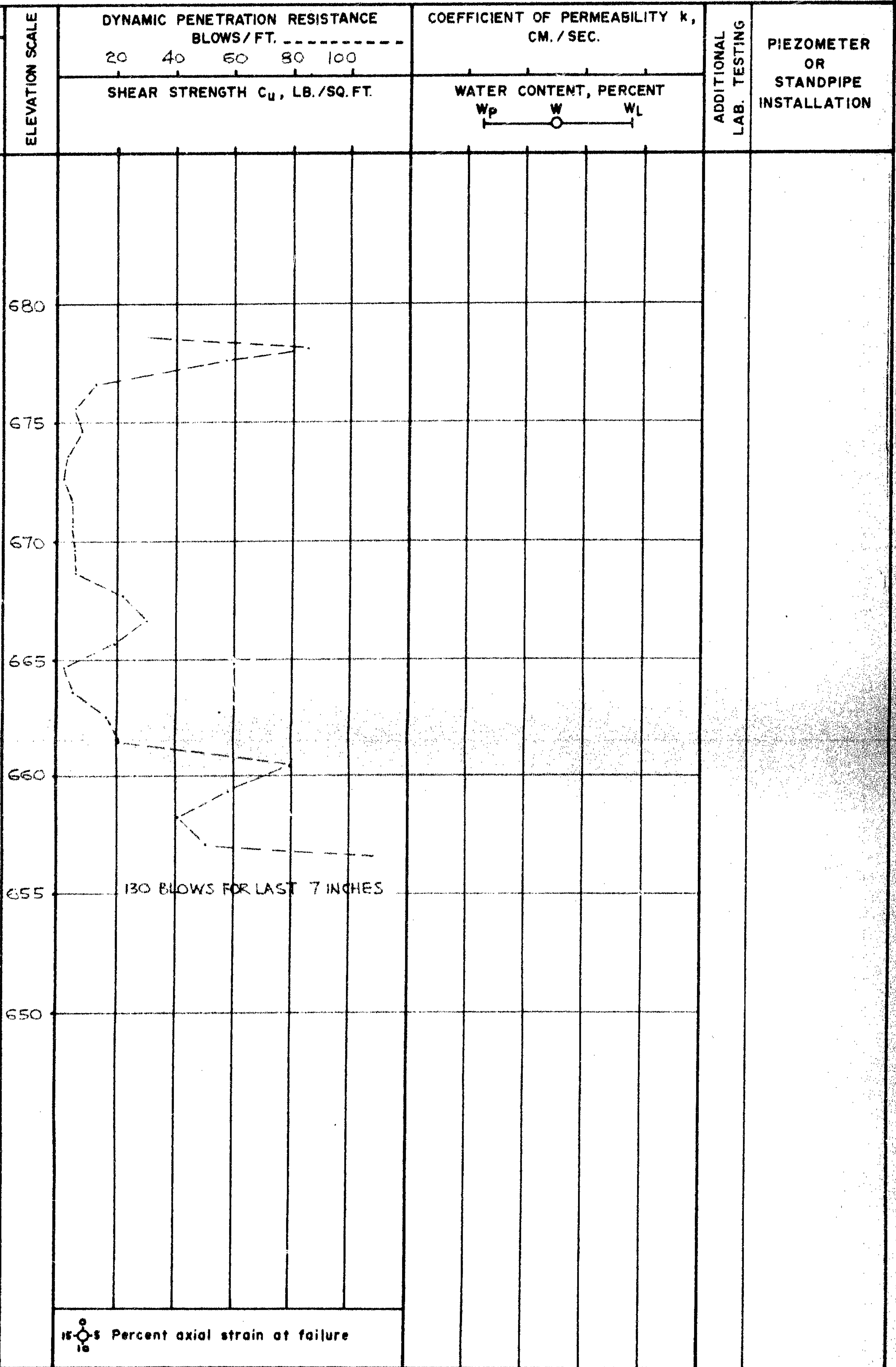
RECORD OF PENETRATION TEST 4

LOCATION See Figure 1 BORING DATE FEB. 1, 1966 DATUM GEODETIC

BOREHOLE TYPE PEN. TEST BOREHOLE DIAMETER —

SAMPLER HAMMER WEIGHT — LB. DROP — INCHES PEN. TEST HAMMER WEIGHT 140 LB. DROP 30 INCHES

ELEVN. / DEPTH	DESCRIPTION	STRAT. PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/FT.
679.1	GROUND LEVEL				
0.0	PROBABLY LOOSE SILTY SAND, SOME GRAVEL (FILL)				
662.1 / 17.0	PROBABLY DENSE TO VERY DENSE SILTY SAND AND GRAVEL (GLACIAL TILL)				
656.5 / 22.6	END OF PEN. TEST				



VERTICAL SCALE 1 INCH TO 5'-0"

GOLDER & ASSOCIATES

DRAWN MW

CHECKED [illegible]

PROJECT No. 66012

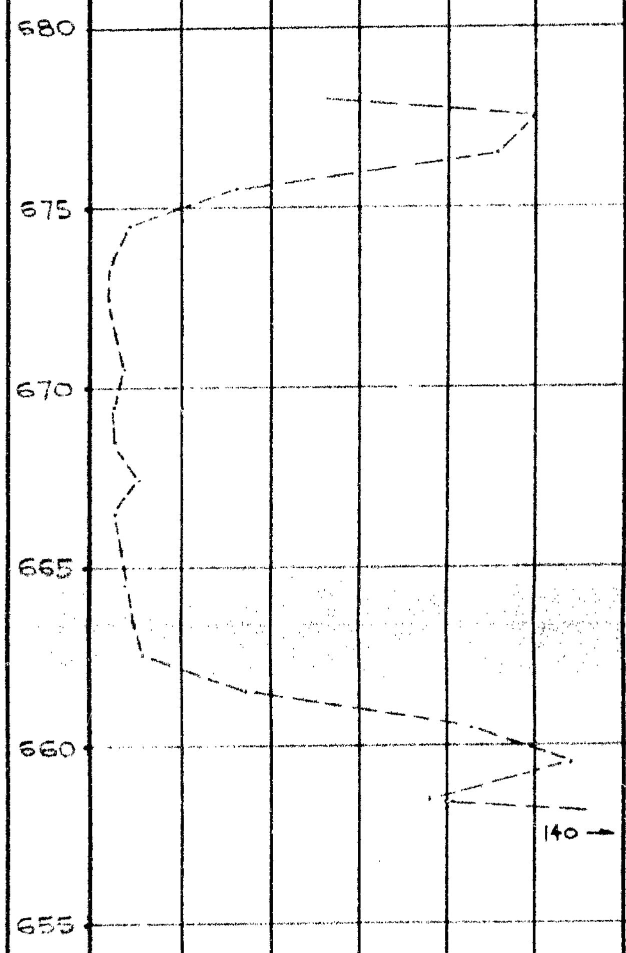
RECORD OF PENETRATION TEST 5

LOCATION See Figure 1 BORING DATE FEB. 1, 1966 DATUM GEODETIC

BOREHOLE TYPE PEN. TEST BOREHOLE DIAMETER —

SAMPLER HAMMER WEIGHT — LB. DROP — INCHES PEN. TEST HAMMER WEIGHT 140 LB. DROP 30 INCHES

SOIL PROFILE			SAMPLES			ELEVATION SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FT. (20 40 60 80 100) / SHEAR STRENGTH C_u, LB./SQ.FT.	COEFFICIENT OF PERMEABILITY k, CM./SEC. / WATER CONTENT, PERCENT W_P W W_L	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
ELEVN. / DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FT.					
678.5	GROUND LEVEL									
0.0	PROBABLY LOOSE SILTY SAND WITH SOME GRAVEL (FILL)									
662.5 / 16.0	PROBABLY VERY DENSE SILTY SAND AND GRAVEL (GLACIAL TILL)									
657.5 / 21.0	END OF PEN. TEST									



15 ○ 5 Percent axial strain at failure (10)

VERTICAL SCALE 1 INCH TO 5'-0"

GOLDER & ASSOCIATES

DRAWN MW

CHECKED

PROJECT No. 66012

RECORD OF BOREHOLES 6, 7 & PEN. TEST 8

LOCATION See Figure 1 | BORING DATE FEB. 1-2, 1966 | DATUM GEODETIC

BOREHOLE TYPE WASH BORINGS & PEN. TEST | BOREHOLE DIAMETER NX CASING

SAMPLER HAMMER WEIGHT 140 LB. DROP 30 INCHES | PEN. TEST HAMMER WEIGHT 140 LB. DROP 30 INCHES

Columns: SOIL PROFILE (ELEVN. / DEPTH, DESCRIPTION, STRAT. PLOT) | SAMPLES (NUMBER, TYPE, BLOWS / FT.) | ELEVATION SCALE | DYNAMIC PENETRATION RESISTANCE BLOWS / FT. (20, 40, 60, 80, 100) / SHEAR STRENGTH C_u, LB./SQ.FT. | COEFFICIENT OF PERMEABILITY k, CM./SEC. / WATER CONTENT, PERCENT W_P W W_L (10, 20, 30, 40) | ADDITIONAL LAB. TESTING | PIEZOMETER OR STANDPIPE INSTALLATION

6

ELEVN. / DEPTH	DESCRIPTION	NUMBER	TYPE	BLOWS / FT.	ADDITIONAL LAB. TESTING
667.1	GROUND LEVEL				
0.0	TOPSOIL	1	2" D.O.	2	
0.5	VERY LOOSE TO LOOSE BROWN **SANDY SILT**, TRACE CLAY, SMALL ROOTS (**RECENT ALLUVIUM**).	2	"	2	MH
		3	"	4	
662.1 / 5.0	COMPACT TO DENSE DARK GREY **SILTY SAND AND GRAVEL** TRACE CLAY (**GLACIAL TILL**)	4	"	21	
		5	"	31	
659.6 / 7.5	END OF HOLE				

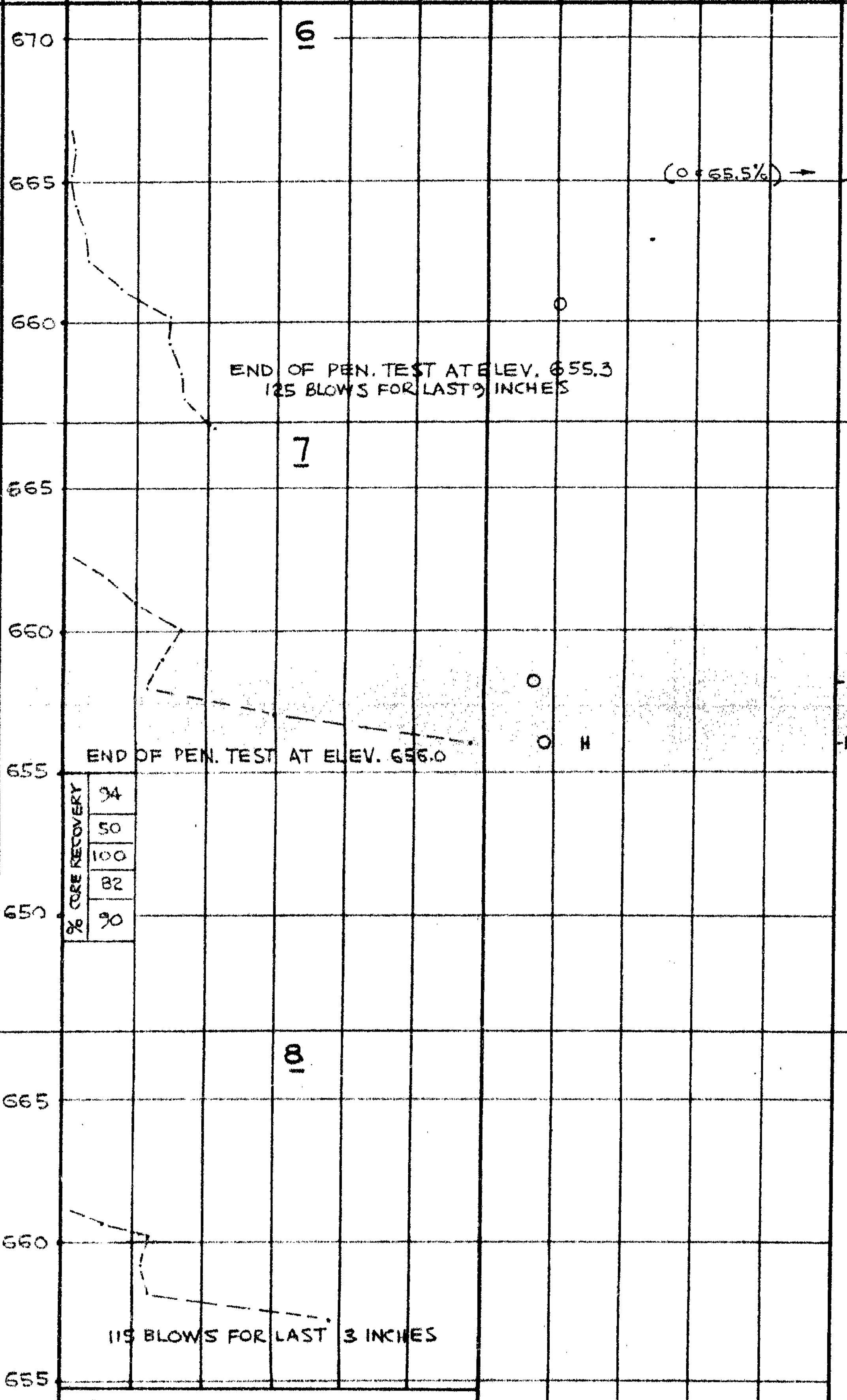
7

ELEVN. / DEPTH	DESCRIPTION	NUMBER	TYPE	BLOWS / FT.	ADDITIONAL LAB. TESTING
664.0	RIVER LEVEL				
0.0	WATER				
662.0 / 2.0	RIVER BOTTOM				
	COMPACT TO VERY DENSE DARK GREY **SILTY SAND AND GRAVEL**, TRACE CLAY (**GLACIAL TILL**)	1	2" D.O.	20	
		2	T.O.	33	MH
		3	D.O.	86	MH
655.0 / 9.0	FRACTURED HARD GREY INTERBEDDED **SHALE** AND **GREYWACKE** WITH SEVERAL THIN SOFT SHALE SEAMS	4	AXT RC	—	
		5	"	—	
		6	"	—	
		7	"	—	
		8	"	—	
649.0 / 15.0	END OF HOLE				

% CORE RECOVERY: 94, 50, 100, 82, 90

8

ELEVN. / DEPTH	DESCRIPTION
664.0	RIVER LEVEL
0.0	WATER
661.5 / 2.5	RIVER BOTTOM
	PROBABLY COMPACT TO VERY DENSE SILTY SAND AND GRAVEL, TRACE CLAY (GLACIAL TILL)
656.8 / 7.2	END OF PEN. TEST



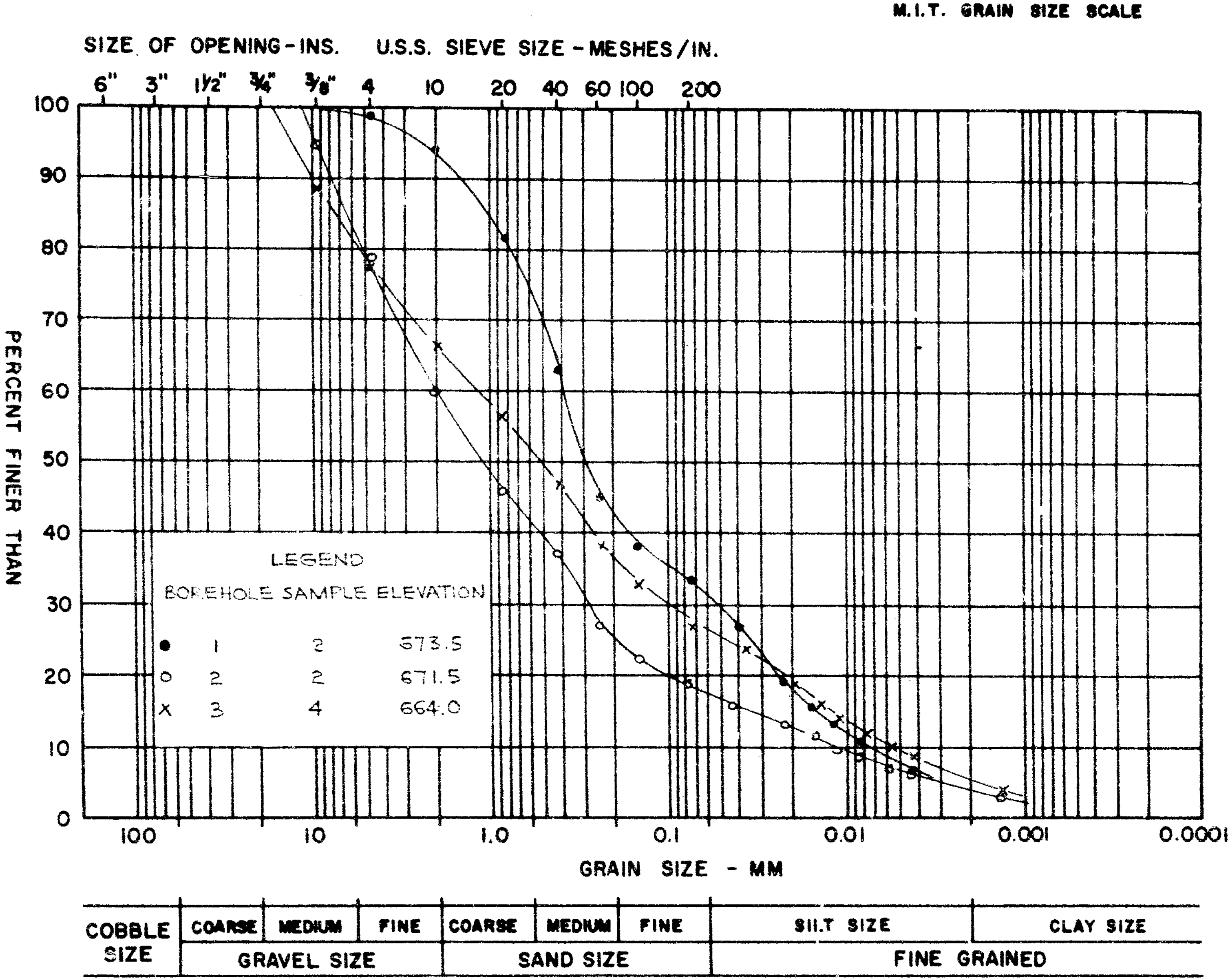
15 -○- 5 Percent axial strain at failure (10)

VERTICAL SCALE 1 INCH TO 5'-0"

GOLDER & ASSOCIATES

DRAWN M.W. | CHECKED

PROJECT No. 66012



GOLDER & ASSOCIATES

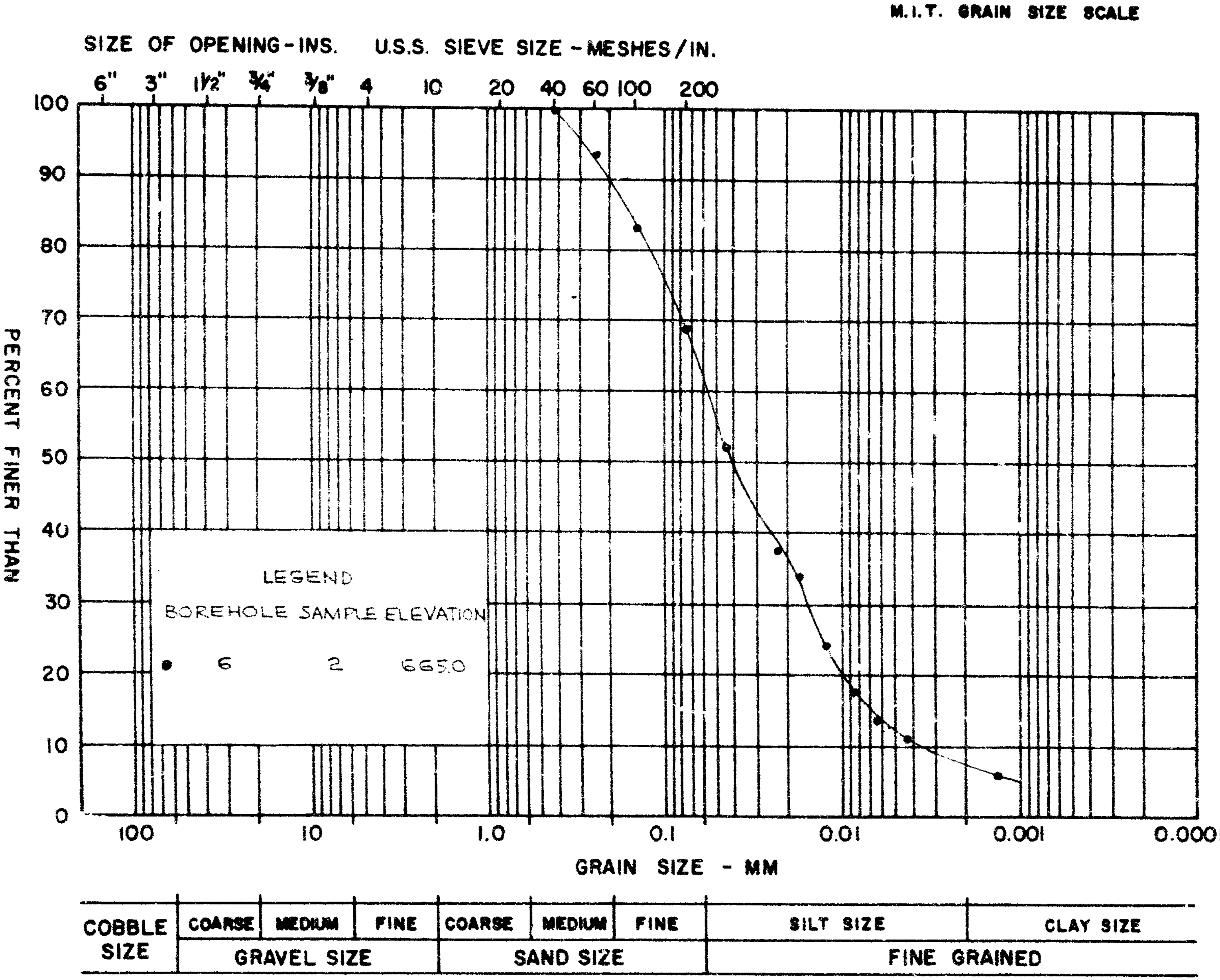
GRAIN SIZE DISTRIBUTION (FILL)

FIGURE 2

PROJECT No. 66012

GRAIN SIZE DISTRIBUTION

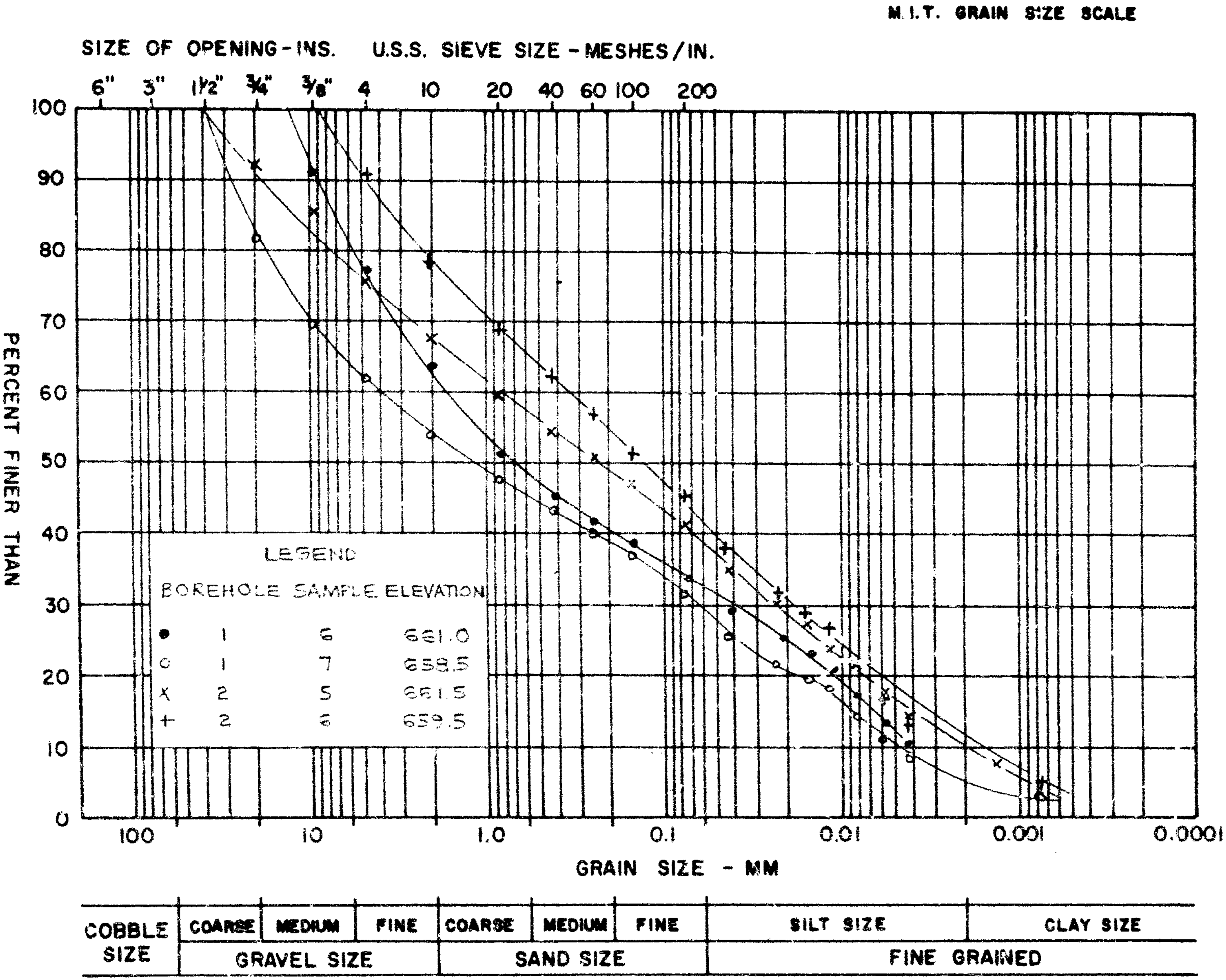
SANDY SILT (RECENT ALLUVIUM)



GOLDER & ASSOCIATES

FIGURE 3

PROJECT No. 66012



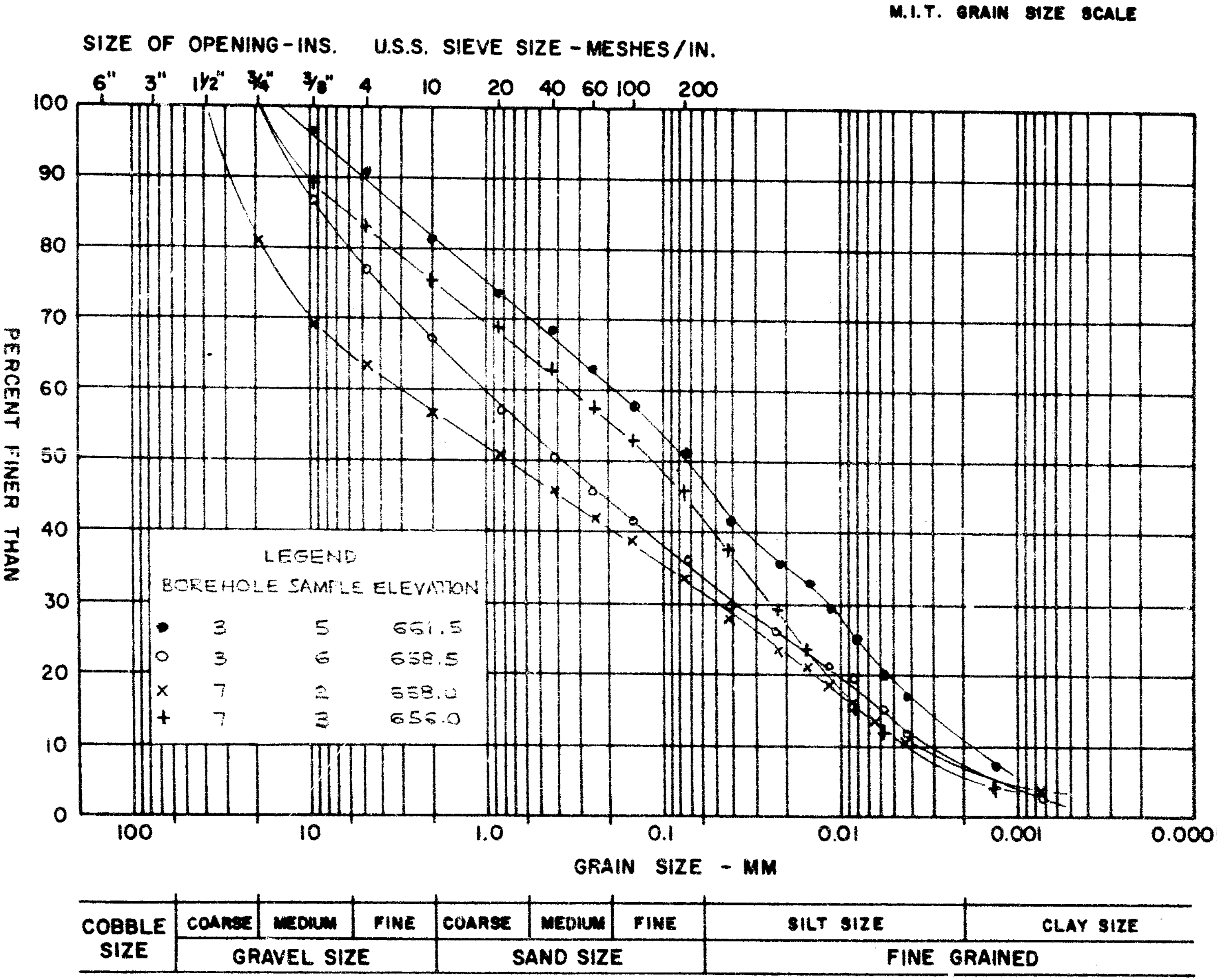
GOLDER & ASSOCIATES

GRAIN SIZE DISTRIBUTION

(GLACIAL TILL)

FIGURE 4

PROJECT No. 66012



GOLDER & ASSOCIATES

GRAIN SIZE DISTRIBUTION (GLACIAL TILL)

FIGURE 5

Hwy. 401 & Keele St.,
Downsview, Ontario.

January 14, 1966

Materials and Testing Division

H. G. Golder and Associates Ltd.,
2444 Bloor Street West,
Toronto, Ontario.

<u>Attention: Mr. J. L. Seronuk</u>

Re: W.P. 227-65, Site 48-71,
McIntyre River, 0.1 Mi. West of
Port Arthur West Limits, Hwy. 130,
<u>District 19 (Fort William).</u>

Dear Sir:

Please consider this your authority to carry out the foundation investigation for the above-mentioned site.

Enclosed, find one print of the Plan K-33y-1, showing the tentative footing layout. A copy of this drawing will be given to your representative, Mr. L. Lahti, who is presently in the Lakehead.

You are requested to advise Mr. Lahti to discuss the details of this investigation with Messrs. P. De Visser, Regional Bridge Location Engineer, and F. Norman, Regional Materials Engineer.

Because the starting date of the field investigation is not known, the fixing of the completion date is impractical. However, it will be appreciated if you would give this job your earliest attention. Eleven (11) copies of the completed report will be required. Previous requirements as to preliminary borehole information and laboratory testing program, should be followed.

Since the drawing accompanying the foundation report, showing the location of borings, the inferred subsoil conditions, etc., is to become a contract drawing, you are requested to prepare it in accordance with the D.H.O. standards. To enable you to do this, we are supplying you with a sample drawing with all the necessary explanations, together with a linen sheet for your drawing. You are also requested to provide us with a Transflex copy of the drawing.

cont'd. /2 ......

Charges for the work performed will be in accordance with your Schedule of Rates, dated October 1, 1965, and invoice to be addressed to the attention of the undersigned.

We are attaching Purchase Order # 34804, covering the purchase of any new material required for this work, in order that you may use this as a basis for exemption from the Federal Tax for such purchases. The Exemption Certificate is printed thereon.

Yours very truly,

A. Rutka

A. Rutka,
MATERIALS & TESTING ENGINEER

AGR/Hle7
Attach.

cc: Messrs. S. McCombie
E. Burrell
V. A. Snell
F. Norman
F. De Visser
E. Konings
Mrs. I. Steinberg
A. Crowley
E. Szymanski (2)
Foundations Office
Gen. Files (2)

cc: Foundations Office (Rm. 110)

Mr. B. E. Davis,
Bridge Engineer,
Bridge Division.

Attention: Mr. G. McCombie

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

March 17, 1966

MAR 18 1966

FOUNDATION INVESTIGATION REPORT BY: H. Q. Golder and Associates Limited - W.P. 227-65, Site 48C-71 - Proposed McIntyre River Bridge Replacement, Highway 130, near Port Arthur - District No. 19 (Port William).

Attached, we are sending you the above mentioned report submitted by the consultant, H. Q. Golder and Associates Limited.

We have reviewed the report and have found the factual information adequate and well presented. In general, we are also in agreement with the consultant's recommendations. However, there are two minor items which, in our opinion, require some comments:

1) A safe load of 100 T/pile rather than 70 T/pile, can be used for a 12 BP 74 steel H-pile driven to practical refusal.

2) Regarding the footing excavations (p. 9), it appears to us that refusal to driving steel sheeting could be encountered within the dense till stratum - i.e., prior to reaching bedrock. In such a case, the flow of water into the excavation would not be prevented and the sheeting may prove to be ineffective. In case the footings are placed on bedrock - and this appears to be the best solution for the piers anyway - we are of the opinion that any amount of water entering the excavation can be handled by pumping from sumps or low-lying areas within the excavation.

We believe that you will now have adequate information for your design work. Should there, however, be any additional questions that you would like to discuss, please feel free to call on our Office.

[illegible]
[illegible]

AGS/Mdef
Attach.
cc: Messrs. B. E. Davis (2)
E. A. Tregaskes
D. A. Farren
W. A. Burrell
J. A. Snell
F. Norman
F. De Visser
A. Watt
Foundations Office
Gen. Files

Foundation Files H.Q. Golder /65

Mr. F. DeVisser
Regional Bridge Location Engr.
Bridge Division
777 Memorial Ave.
Port Arthur, Ontario

Foundation Section
Materials & Testing Division
Downsview

January 6, 1967

Site 48C-71, W.P. 227-65
McIntyre River Bridge
0.1 Mi. W. of Port Arthur Limits
Highway 130, District #19

We have reviewed the above-mentioned Preliminary Plan with regard to the foundation design. We note that the designer has complied with the recommendations contained in the foundation report.

MD:mt

M. Devata
M. Devata
Supervising Foundation Engineer
for: A. G. Stermac
Principal Foundation Engineer

DEPARTMENT OF HIGHWAYS ONTARIO

MEMORANDUM

To: Mr. A. Stermac,
Principal Foundation Engineer,
Laboratory Building,
Downsview, Ontario.

From: Bridge Division,
777 Memorial Avenue,
P. O. Box 1170,
Port Arthur, Ontario,

Date: December 19, 1966.

Our File Ref.

In reply to

Subject: Site 48C-71, W. P. 227-65,
McIntyre River Bridge,
0.1 Mi. W. of Port Arthur Limits,
Highway 130, District 19.

Attached is one print of the preliminary plan for the subject structure. If you have any comments, please let me know before December 30, 1966.

F. DeVisser

F. DeVISSER,
Regional Bridge Location Eng.

FDV/mcr

Enc.

no comments.
M. Alevato
Dec 21/66