

(200)
R290
no. 70-103

OFFICIAL USE ONLY

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

TECHNICAL LETTER: CENTRAL NEVADA-7

HYDRAULIC TESTING AND SAMPLING OF
HOLE Ue-1, IN CENTRAL NEVADA

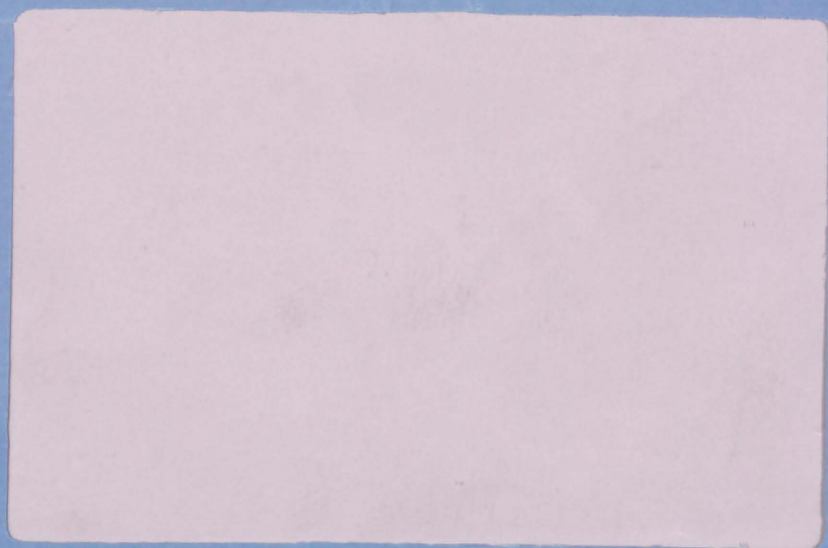
by

George A. Dinwiddie

These data are preliminary and should
not be quoted without permission.

Prepared by the Geological
Survey for the U. S. Atomic
Energy Commission.

OFFICIAL USE ONLY



(200)
R290
no. 70-103

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

Federal Center, Denver, Colorado 80225

In reply refer to:

Technical Letter
Central Nevada-7

August 4, 1967

Mr. James E. Reeves, Manager
Nevada Operations Office
U. S. Atomic Energy Commission
P. O. Box 1676
Las Vegas, Nevada 89101

Dear Mr. Reeves:

Transmitted herewith is one copy of:

TECHNICAL LETTER: CENTRAL NEVADA-7

HYDRAULIC TESTING AND SAMPLING OF
HOLE Ue-1, IN CENTRAL NEVADA

by

George A. Dinwiddie

Additional copies have been distributed as indicated on the attached
sheet.

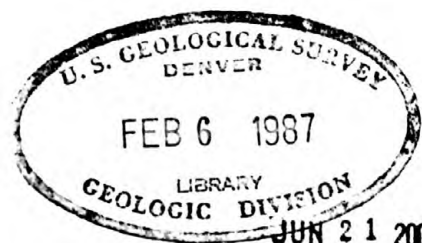
Sincerely yours,

Sam W. West

S. W. West
Research Hydrologist

Enclosure

Attachment



JUN 21 2000
FEB 10 1987

Technical Letter
Central Nevada-7

Distribution:

NVOO--W. Allaire
D. Edwards (2)
R. Emens, Mercury
R. Miller
W. Smith
SAN-- J. Philip
DTIE--Oak Ridge
DMA-- Director
DASA--Director, Attn: Blast and Shock Division
TC-DASA--Commander, Attn: TCDT
Attn: TCDP for B. Grote (2)
Attn: TCNB-TE, Mercury (2)
LASL--R. Blossom, Los Alamos
R. Blossom, Mercury
R. Campbell
R. Newman
W. Ogle
LRL-- R. Goeckermann
R. McArthur, Mercury
M. Nordyke
J. Skrove, Mercury
C. Williams
SC-- P. Schroeder, Mercury (2)
C. Selvage, Attn: R. Statler, 7263
W. Vollendorf (2)
W. Weart
ERC-- Las Vegas
Virginia (8)
F&S-- G. Bruesch, Mercury (3)
M. May, Las Vegas
H&N-- Engineering Mgr., Las Vegas
Advance Planning, Las Vegas
Resident Eng., Mercury
HNSC--Palo Alto (2)
WES-- W. Steinriede, Jr.
DRI-- G. Maxey
USGS--D. Lemmon
W. Pecora
Military Geology Branch
Chief Hydrologist, WRD, Attn: Radiohydrology Section
WRD, Las Vegas (5)
Geologic Data Center, Mercury (15)

CONTENTS

	Page
Abstract	1
Introduction	1
Lithologic log	2
Testing and sampling	3
Composite water level	3
Technique of testing and sampling	4
Conditions affecting testing and sampling	4
Intervals tested and sampled	5
Zone 1	5
Zone 2	10
Zone 3	13
Zone 4	15
Zone 5	18
Summary	24
Reference	25

ILLUSTRATIONS

- Figure 1. Injection test of zone 1 (1,710 feet to total depth),
hole Ue-1, STS central Nevada, January 31, 1967 . . . 6
2. Recovery test 1 of zone 1 (1,710 feet to total depth),
after first swabbing, hole Ue-1, STS central Nevada,
February 1, 1967 8

Figure 3. Recovery test 2 of zone 1 (1,710 feet to total depth), after second swabbing, hole Ue-1, STS central Nevada, February 1, 1967	9
4. Injection test of zone 2 (1,508 to 1,706 feet), hole Ue-1, STS central Nevada, February 1, 1967 . . .	11
5. Recovery test 1 of zone 2 (1,508 to 1,706 feet), after first swabbing, hole Ue-1, STS central Nevada, February 1, 1967	12
6. Recovery test 2 of zone 2 (1,508 to 1,706 feet), after second swabbing, hole Ue-1, STS central Nevada, February 2, 1967	14
7. Injection test of zone 3 (1,266 to 1,464 feet), hole Ue-1, STS central Nevada, February 10, 1967 . . .	16
8. Recovery test 1 of zone 3 (1,266 to 1,464 feet), after first swabbing, hole Ue-1, STS central Nevada, February 10, 1967	17
9. Recovery test of zone 4 (788 to 986 feet), after swabbing, hole Ue-1, STS central Nevada, February 12, 1967	19
10. Injection test 1 of zone 5 (400 to 598 feet), before swabbing, hole Ue-1, STS central Nevada, February 12, 1967	21
11. Recovery test 1 of zone 5 (400 to 598 feet), after swabbing, hole Ue-1, STS central Nevada, February 13, 1967	22

Figure 12. Injection test 2 of zone 5 (400 to 598 feet), after swabbing, hole Ue-1, STS central Nevada, February 13, 1967	23
---	----

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

Federal Center, Denver, Colorado 80225

In reply refer to:
Technical Letter
Central Nevada-7
August 4, 1967

HYDRAULIC TESTING AND SAMPLING OF
HOLE Ue-1, IN CENTRAL NEVADA

by

George A. Dinwiddie

ABSTRACT

Hydraulic testing and sampling of hole Ue-1 began on January 31, 1967, and ended on February 13, 1967. Depth intervals tested and sampled were: zone 1, 1,710 feet to total depth; zone 2, 1,508 to 1,706 feet; zone 3, 1,266 to 1,464 feet; zone 4, 788 to 986 feet; and zone 5, 400 to 598 feet.

Injection and recovery tests were run on each depth interval. Relative specific capacities calculated from injection data were much smaller than those calculated from recovery data. More mud and lost circulation material in the hole and in the formation during the injection test account for the different relative specific capacities.

Comparative composite hydrostatic heads before and after the injection and recovery tests were 211.5 feet below lsd (land-surface datum) and 218.0 feet below lsd. The difference may be due to differences in the conditions of the measurements.

Of the five zones tested, only zone 5 did not have at least partial communication around the bottom packer.

INTRODUCTION

The U. S. Atomic Energy Commission is considering central Nevada (approximately the area defined by Tps. 1 to 21 N., Rs. 41 to 57 E.) as a site for underground nuclear testing. Among the criteria for

nuclear test sites are certain geologic and hydrologic conditions. Exploratory holes are being drilled in the central Nevada area to obtain data that will help to define the geologic and hydrologic conditions of that area. This report describes the hydraulic testing and sampling of the first of these holes, hole Ue-1.

Hole Ue-1, at N. 1,395,000 and E. 429,400, Nevada coordinate system, central zone, Nye County, Nevada, was spudded in on November 25, 1966, and had reached a depth of 2,000 feet when released to the Hydrologic Task Force for hydraulic testing and sampling on January 31, 1967. Its casing record is as follows:

9 $\frac{5}{8}$ -inch OD from ground level to 406 feet (cemented)

2 $\frac{3}{8}$ -inch OD from ground level to 1,999.9 feet (cemented)

LITHOLOGIC LOG

The following lithologic log for hole Ue-1 is from Technical Letter: Central Nevada-3, by D. L. Hoover.

Elevation: 7,050+50 feet

Static water level: 211.5 feet below lsd (before testing)

218.0 feet below lsd (after testing)

Depth (feet)	Rock type
0 - 340	Alluvium of weathered granite
340 - 380	Granite, weathered, friable
380 - 2,000	Granite, very light gray, medium-grained, accessory biotite

Argillized granite zones:

460 - 468
700.8- 701
725.8- 726
728 - 728.5
851.5- 852
857 - 864

Depth (feet)	Rock type
-----------------	-----------

Argillized granite zones (continued):

925 - 929
 949 - 951
 1,004 -1,013
 1,017 -1,031
 1,078 -1,078.5
 1,222.4-1,223.4
 1,332.8-1,333.2
 1,342 -1,352
 1,372 -1,373
 1,404 -1,407
 1,438 -1,444
 1,534 -1,542
 1,557 -1,602
 1,648 -1,650
 1,654.5-1,656
 1,694 -1,694.7
 1,805 -1,812
 1,822 -1,827
 1,843.5-1,844
 1,848 -1,853.5
 1,895 -1,915
 1,923.5-1,924
 1,931.5-1,933
 1,945 -1,947.5
 1,959 -1,961
 1,963 -1,966

TESTING AND SAMPLING

Composite water level

The composite water level was measured with the deep-well measuring device ("iron horse") both before and after testing in the hole. The measurement before testing indicated that the water level was 211.5 feet below lsd (land-surface datum). The measurement after testing indicated that the water level was 218.0 feet below lsd. This difference

can possibly be explained by the difference between the conditions of the measurements. After testing, the borehole and formation probably were cleaner because of the swabbing; and a zone of significantly greater permeability and lower hydrostatic head may not have been open to the borehole before testing but may have been open to the borehole after testing.

Technique of testing and sampling

Specific intervals of the hole were tested by using inflatable straddle packers. After the packers were set, the tubing was filled with water. During release (injection) of this water into the formation, the rate of decline of the water level was measured. When possible, static conditions were attained before continuing to the next step. Then samples of formation water were swabbed from the tested interval until reasonably stable conditions of temperature, pH, specific conductance, and appearance were attained. The amount of water swabbed was recorded. After the swabbing, the rate of rise (recovery) of the water level was measured.

Conditions affecting testing and sampling

According to Fenix & Scisson, Inc., a reasonable degree of cuttings return during drilling was not achieved until drilling mud and some lost-circulation material were added to the hole. Although clean liquid was circulated in the well before testing, most of the foreign material remained in the fractures and proved to be a handicap to proper testing and sampling in the hole. Organic material

remaining in the formation would have made water samples for C^{14} analysis virtually worthless; therefore, no such samples were taken.

Intervals tested and sampled

<u>Zone</u>	<u>Depth</u>
Zone 1	1,710 feet to total depth
Zone 2	1,508 to 1,706 feet
Zone 3	1,266 to 1,464 feet
Zone 4	788 to 986 feet
Zone 5	400 to 598 feet

Zone 1

Static water level was not measured either after injection or after swabbing zone 1 because of the extremely long time involved. The apparent permeability of this part of the formation is low.

Relative specific capacity is computed from injection and recovery data and an assumed static level of 211.5 feet below lsd. The relative specific capacity computed from injection data is much less than that computed from recovery data because of more mud in the hole and in the formation before swabbing.

Relative specific capacity calculated using the time interval from the 3rd to the 4th minute of the injection test data (fig. 1) follows:

$$\text{Head loss} = 130.5 - 130.4 = 0.1 \text{ foot per minute}$$

$$Q = (0.162)(0.1) = 0.0162 \text{ gallons per minute (gpm)}$$

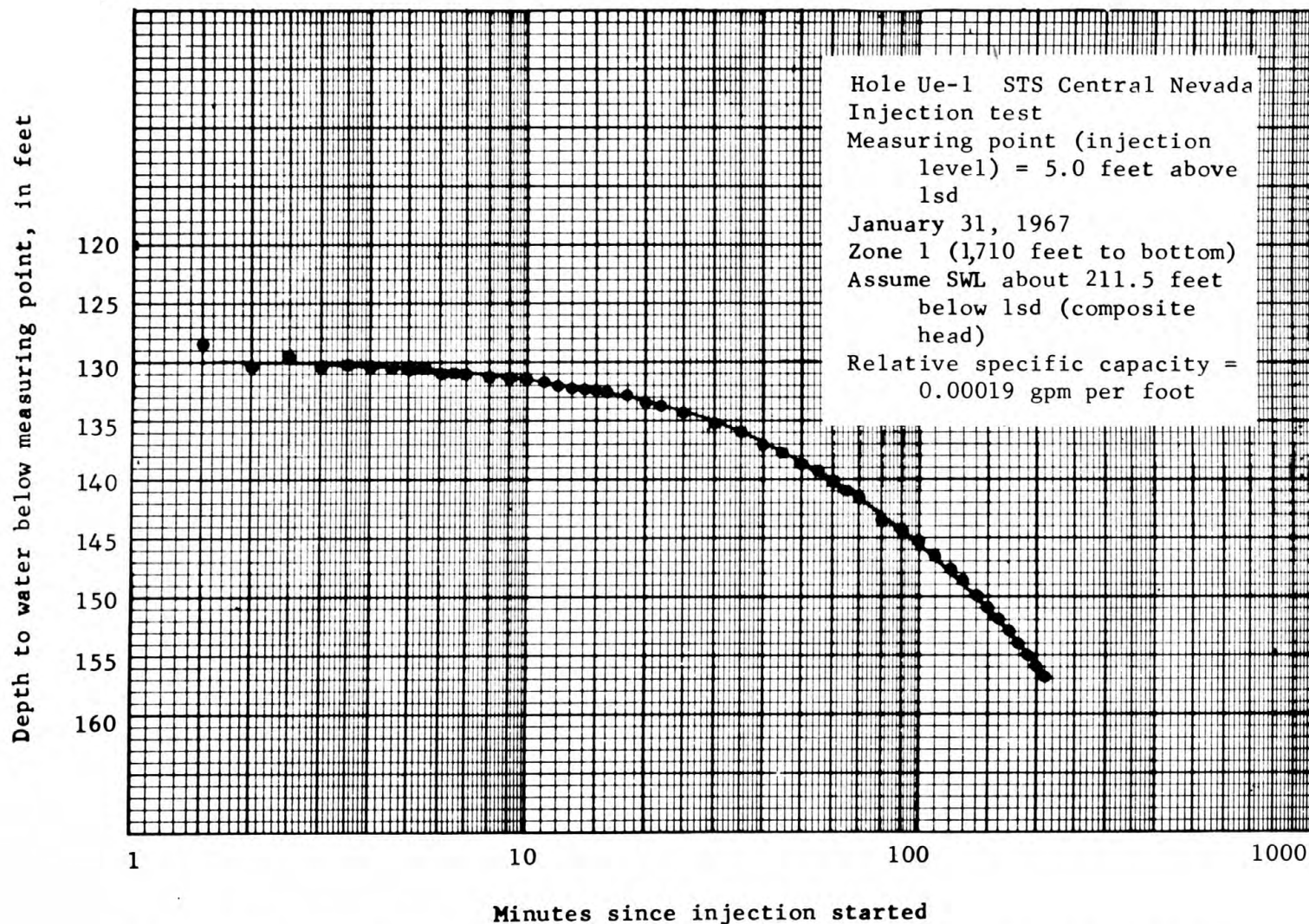


Figure 1.--Injection test of zone 1 (1,710 feet to total depth), hole Ue-1, STS central Nevada, January 31, 1967.

$$\text{Drawdown} = 211.5 - 125.45 = 86.05 \text{ feet}$$

$$\text{Relative specific capacity} = 0.0162/86.05 = 0.00019 \text{ gpm per foot}$$

Relative specific capacity calculated using the time interval from the 12th to the 13th minute of the recovery test 1 data (fig. 2) follows:

$$\text{Head loss} = 765.3 - 753.6 = 11.7 \text{ feet per minute}$$

$$Q = (0.162)(11.7) = 1.90 \text{ gpm}$$

$$\text{Drawdown} = 755.0 - 211.5 = 543.5 \text{ feet}$$

$$\text{Relative specific capacity} = 1.90/543.5 = 0.0035 \text{ gpm per foot}$$

Swabbing was resumed after the first recovery test, and relative specific capacity was computed from data obtained during the second recovery. The second relative specific capacity is greater than the first, which probably indicates further removal of mud from the formation.

Relative specific capacity calculated using the time interval from the 6th to the 7th minute of the recovery test 2 data (fig. 3) follows:

$$\text{Head loss} = 1,107.9 - 1,076.9 = 31.0 \text{ feet per minute}$$

$$Q = (0.162)(31.0) = 5.02 \text{ gpm}$$

$$\text{Drawdown} = 1,086.8 - 211.5 = 875.3 \text{ feet}$$

$$\text{Relative specific capacity} = 5.02/875.3 = 0.0057 \text{ gpm per foot}$$

The above figures for relative specific capacity probably are low because of foreign material in the formation.

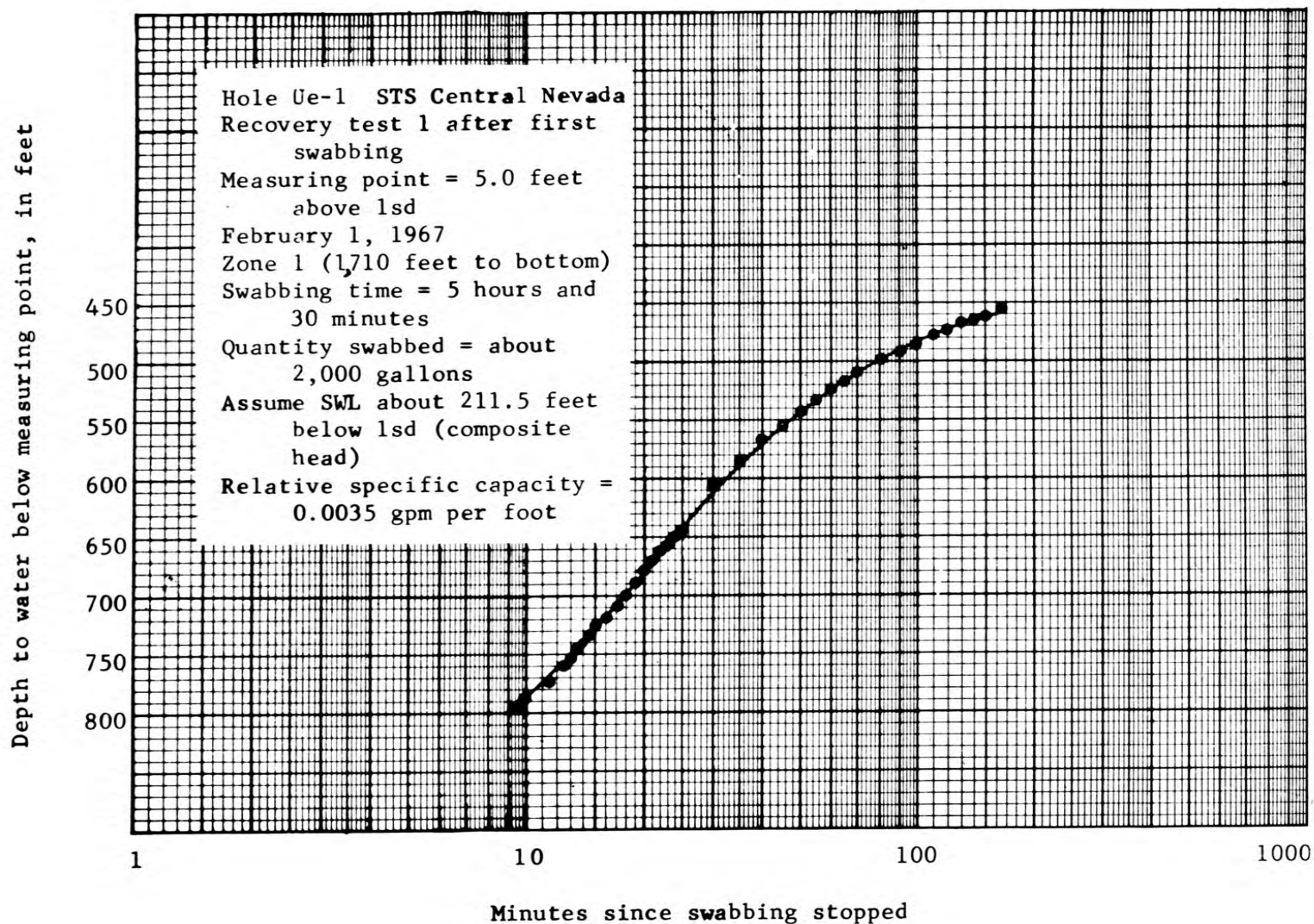


Figure 2.--Recovery test 1 of zone 1 (1,710 feet to total depth), after first swabbing,
 hole Ue-1, STS central Nevada, February 1, 1967.

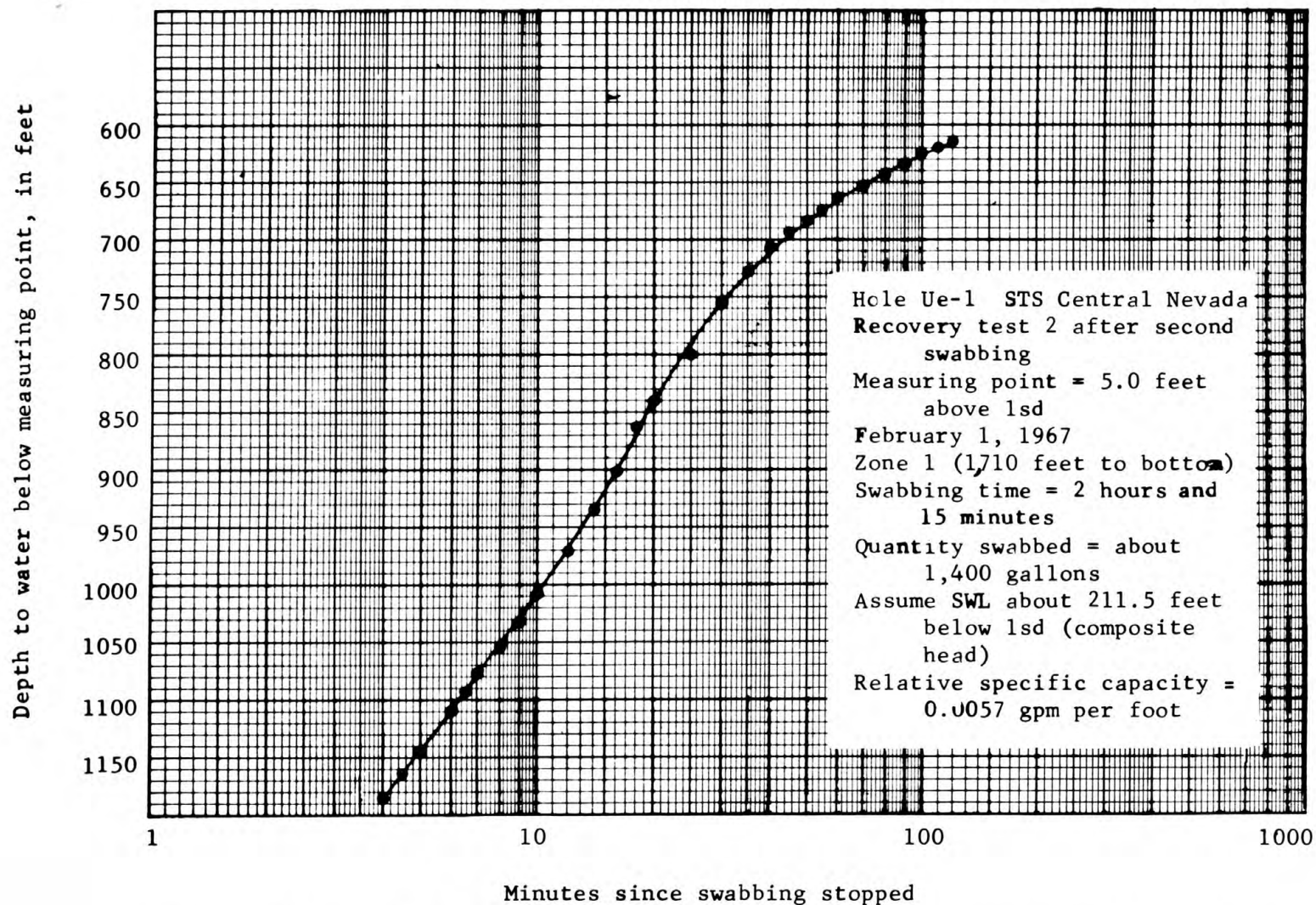


Figure 3.--Recovery test 2 of zone 1 (1,710 feet to total depth), after second swabbing, hole Ue-1, STS central Nevada, February 1, 1967.

Zone 2

Static water level was not measured either after injection or after swabbing because of the extremely long time involved. The apparent permeability of this part of the formation is low.

Relative specific capacity is computed from injection and recovery data and an assumed static level of 211.5 feet below lsd. The relative specific capacity computed from injection data is much less than that computed from recovery data because of more mud in the hole and in the formation.

Relative specific capacity calculated using the time interval from the 4th to the 5th minute of the injection test data (fig. 4) follows:

$$\text{Head loss} = 1.2 - 0.9 = 0.3 \text{ foot per minute}$$

$$Q = (0.162)(0.3) = 0.049 \text{ gpm}$$

$$\text{Drawdown} = 211.5 + 5.63 - 1.0 = 216.13 \text{ feet}$$

$$\text{Relative specific capacity} = 0.049/216.13 = 0.00023 \text{ gpm per foot}$$

Relative specific capacity calculated using the time interval from the 7th to the 8th minute of the recovery test 1 data (fig. 5) follows:

$$\text{Head loss} = 1,014.3 - 991.4 = 22.9 \text{ feet per minute}$$

$$Q = (0.162)(22.9) = 3.71 \text{ gpm}$$

$$\text{Drawdown} = 998.57 - 211.5 = 787.07 \text{ feet}$$

$$\text{Relative specific capacity} = 3.71/787.07 = 0.0047 \text{ gpm per foot}$$

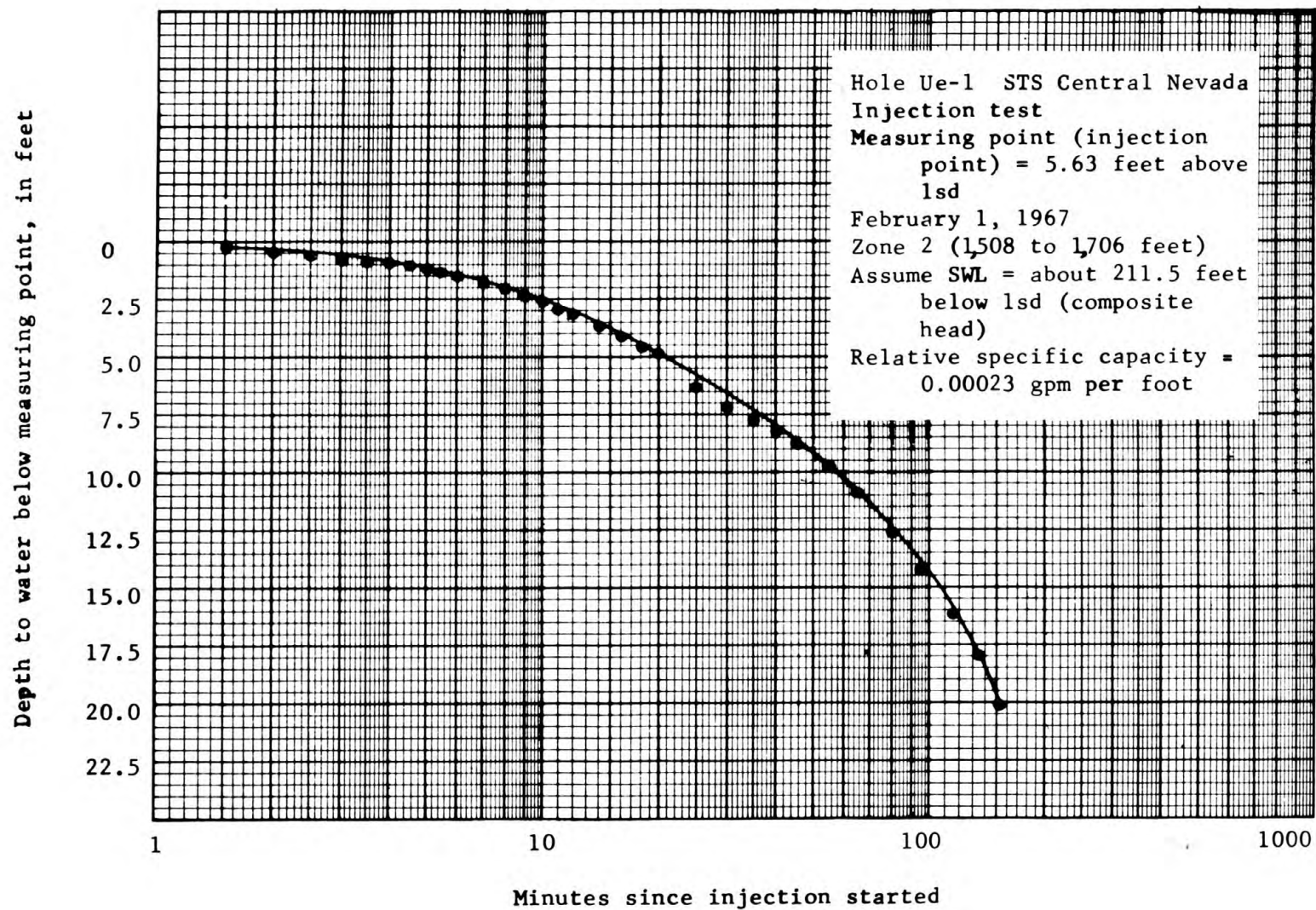


Figure 4.--Injection test of zone 2 (1,508 to 1,706 feet), hole Ue-1, STS central Nevada, February 1, 1967.

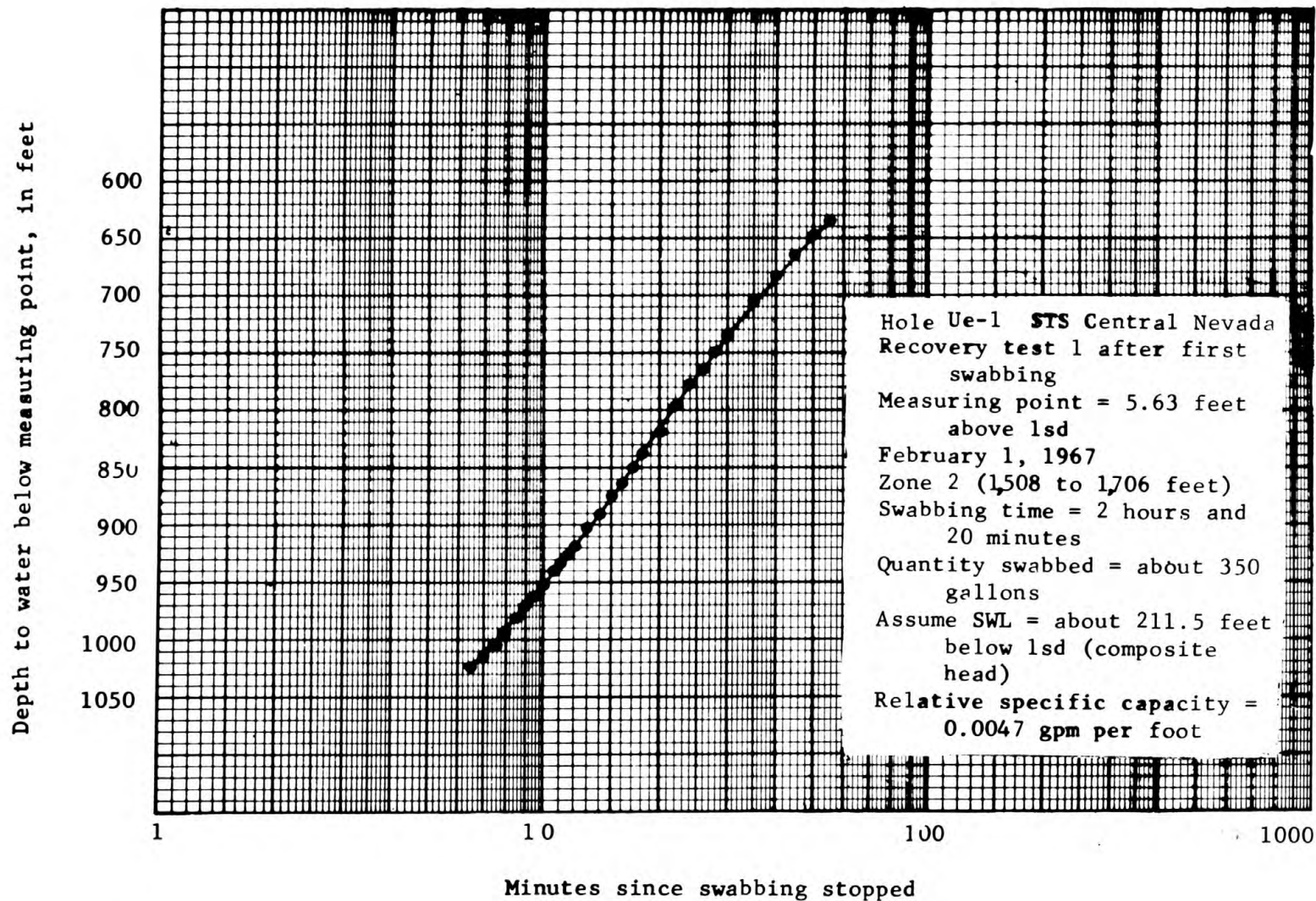


Figure 5.--Recovery test 1 of zone 2 (1,508 to 1,706 feet), after first swabbing,
 hole Ue-1, **STS** central Nevada, February 1, 1967.

Swabbing was resumed after the first recovery test, and relative specific capacity was computed from data obtained during the second recovery.

Relative specific capacity calculated using the time interval from the 7th to the 8th minute of the recovery test 2 data (fig. 6) follows:

$$\text{Head loss} = 1,188.8 - 1,166.6 = 22.2 \text{ feet per minute}$$

$$Q = (0.162)(22.2) = 3.6 \text{ gpm}$$

$$\text{Drawdown} = 1,172.07 - 211.5 = 960.57 \text{ feet}$$

$$\text{Relative specific capacity} = 3.6/960.57 = 0.0037 \text{ gpm per foot}$$

The above figures for relative specific capacity probably are low because of foreign material in the formation.

Zone 3

Static water level was not measured after injection because water was being injected against drilling mud in the fractures of the formation, and to reach static conditions would have required an extremely long time. After recovery from swabbing, static water level apparently was attained at about 285 feet below lsd. This measurement indicates a hydrostatic head of about 75 feet less than the composite hydrostatic head that was measured in the open hole preceding testing. There is no reason to believe that this difference is not real; and even though there was at least partial communication around the bottom packer, a definite head difference is indicated.

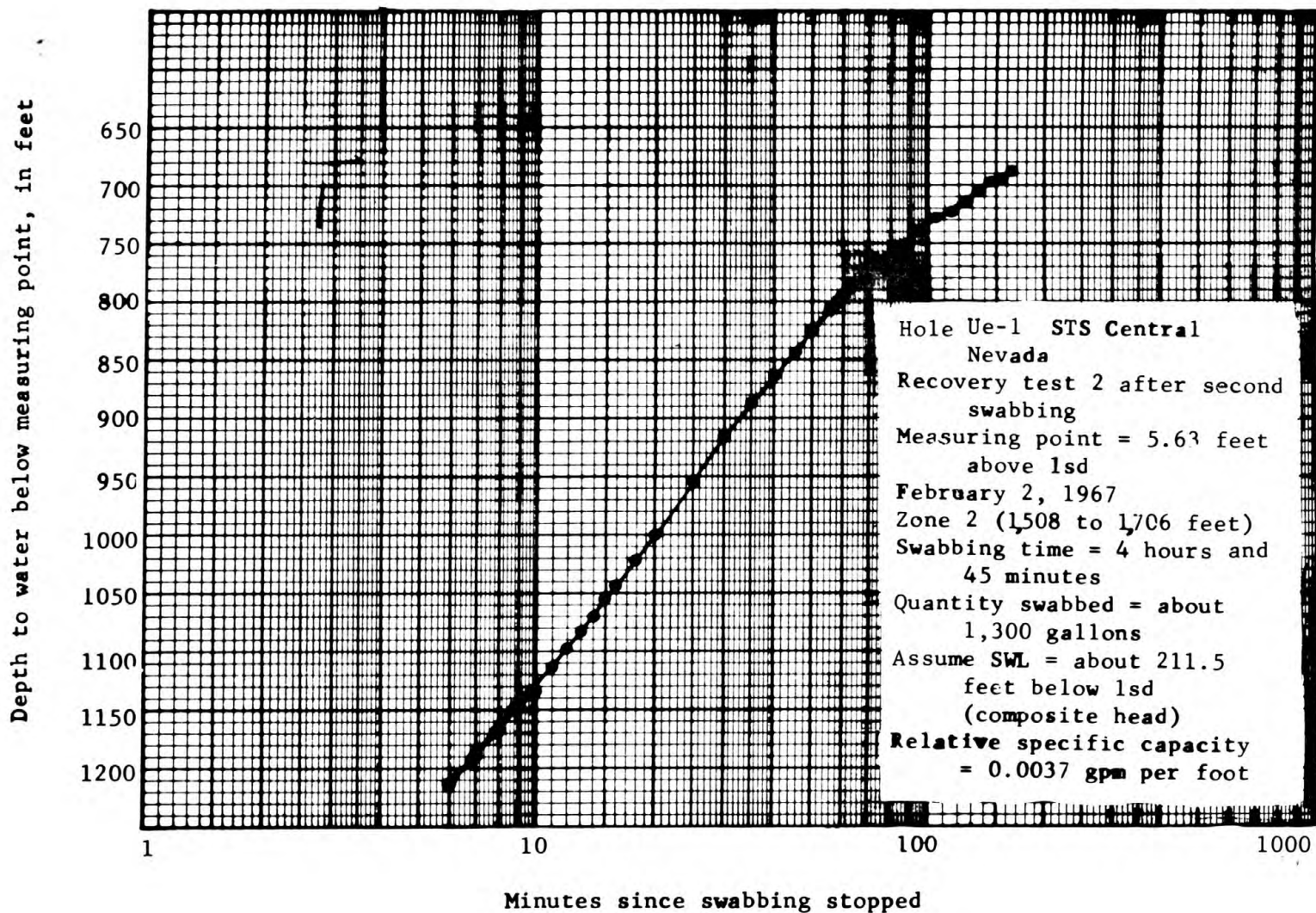


Figure 6.--Recovery test 2 of zone 2 (1,508 to 1,706 feet), after second swabbing, hole Ue-1, STS central Nevada, February 2, 1967.

Relative specific capacity calculated using the time interval from the 8th to the 9th minute of the injection test data (fig. 7) follows:

$$\text{Head loss} = 1.4 - 1.2 = 0.2 \text{ foot per minute}$$

$$Q = (0.162)(0.2) = 0.032 \text{ gpm}$$

$$\text{Drawdown} = 211.5 + 5.6 - 1.3 = 215.8 \text{ feet}$$

$$\text{Relative specific capacity} = 0.032/215.8 = 0.00015 \text{ gpm per foot}$$

Relative specific capacity calculated using the time interval from the 8th to the 9th minute of the recovery test data (fig. 8) follows:

$$\text{Head loss} = 784.2 - 758.0 = 26.2 \text{ feet per minute}$$

$$Q = (0.162)(26.2) = 4.24 \text{ gpm}$$

$$\text{Drawdown} = 765.5 - 285.0 = 480.5 \text{ feet}$$

$$\text{Relative specific capacity} = 4.24/480.5 = 0.0088 \text{ gpm per foot}$$

Relative specific capacity from injection data is much lower because of more drilling mud in the formation; however, both figures probably are low.

Zone 4

An injection test was not successful in this zone because drilling mud in the borehole and in the fractures of the formation did not allow the water level to decline. This lack of decline was not a formation factor because the recovery test after swabbing was successful and the water level reached an apparently stable condition

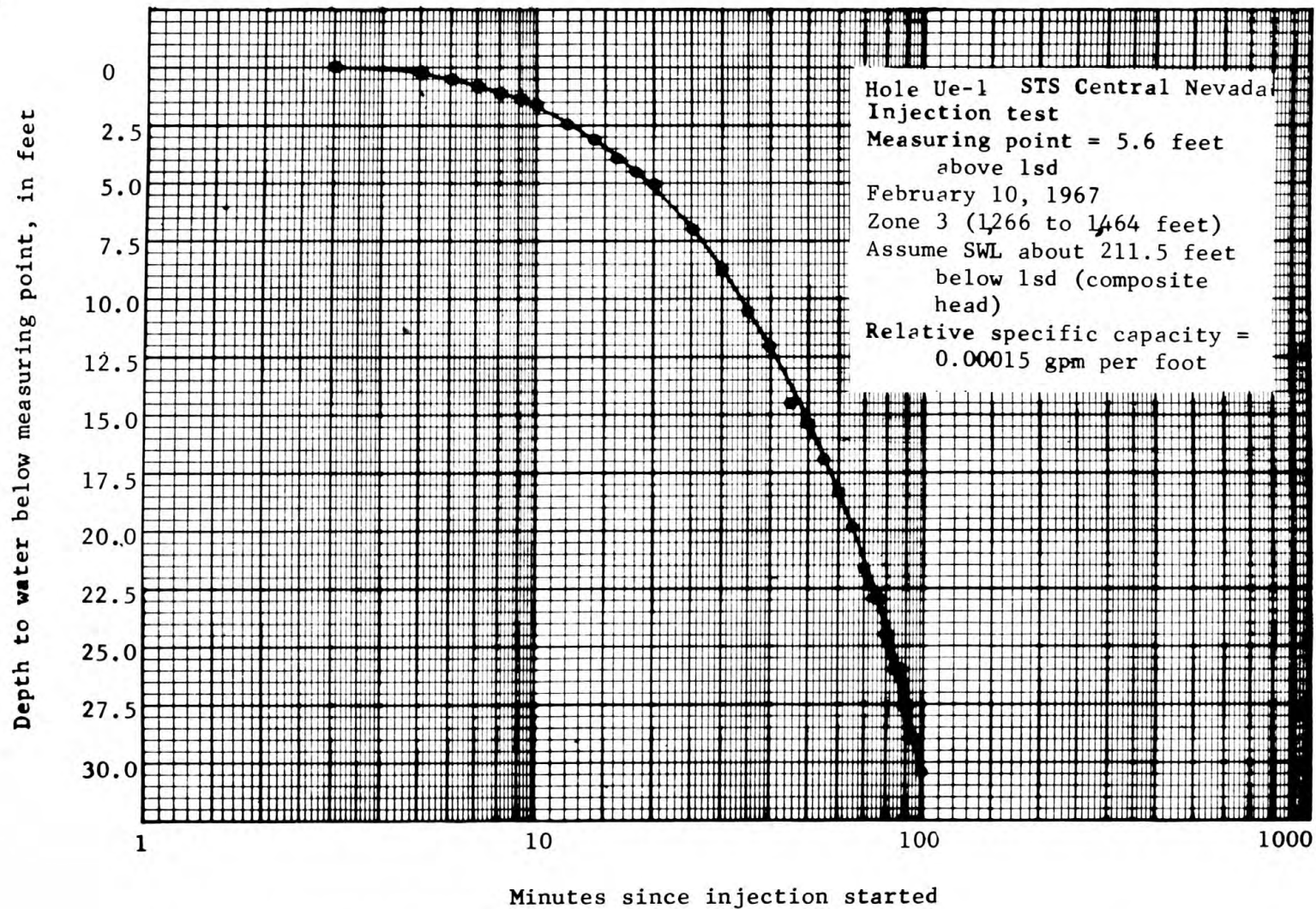


Figure 7.--Injection test of zone 3 (1,266 to 1,464 feet), hole Ue-1, STS central Nevada, February 10, 1967.

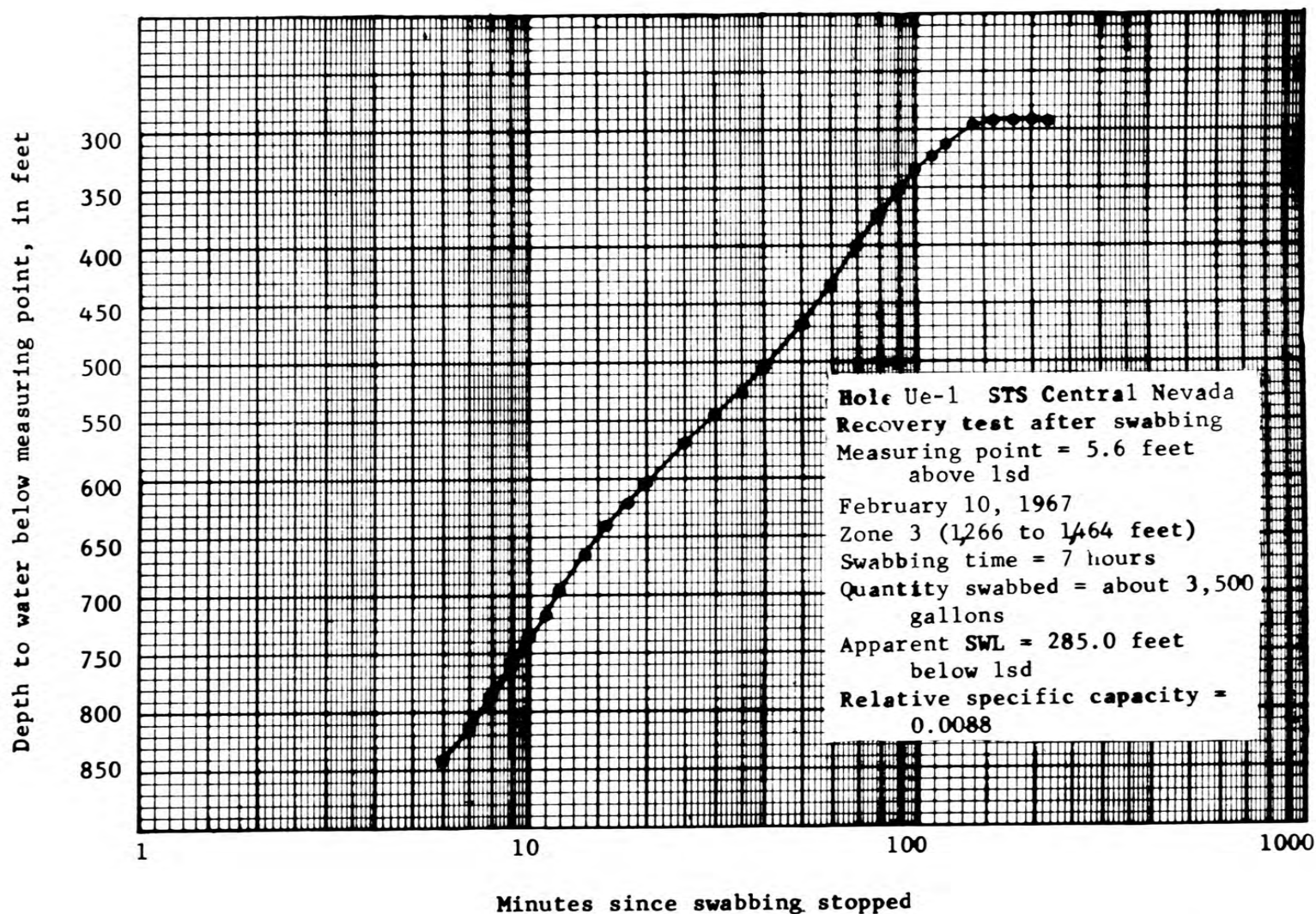


Figure 8.--Recovery test 1 of zone 3 (1,266 to 1,464 feet), after first swabbing, hole Ue-1, STS central Nevada, February 10, 1967.

at about 230 feet below lsd, a decrease from the composite hydrostatic head of about 20 feet.

Relative specific capacity calculated using the time interval from the 5th to the 6th minute of the recovery test data (fig. 9) follows:

$$\text{Head loss} = 360.2 - 341.2 = 19.0 \text{ feet per minute}$$

$$Q = (0.162)(19.0) = 3.08 \text{ gpm}$$

$$\text{Drawdown} = 344.4 - 230 = 114.4 \text{ feet}$$

$$\text{Relative specific capacity} = 3.08/114.4 = 0.027 \text{ gpm per foot}$$

The above figure for relative specific capacity may be low because of foreign material in the formation.

Zone 5

Both packers held during testing of zone 5. In this zone two injection tests, one before swabbing and one after swabbing, were made to determine the effect of drilling mud on test results. Static conditions projected from the recovery curve and from the second injection curve indicate that the hydrostatic head in this zone is very near the composite hydrostatic head measured before the tests began. Zone 5 is the only zone that did not have at least partial communication around the bottom packer.

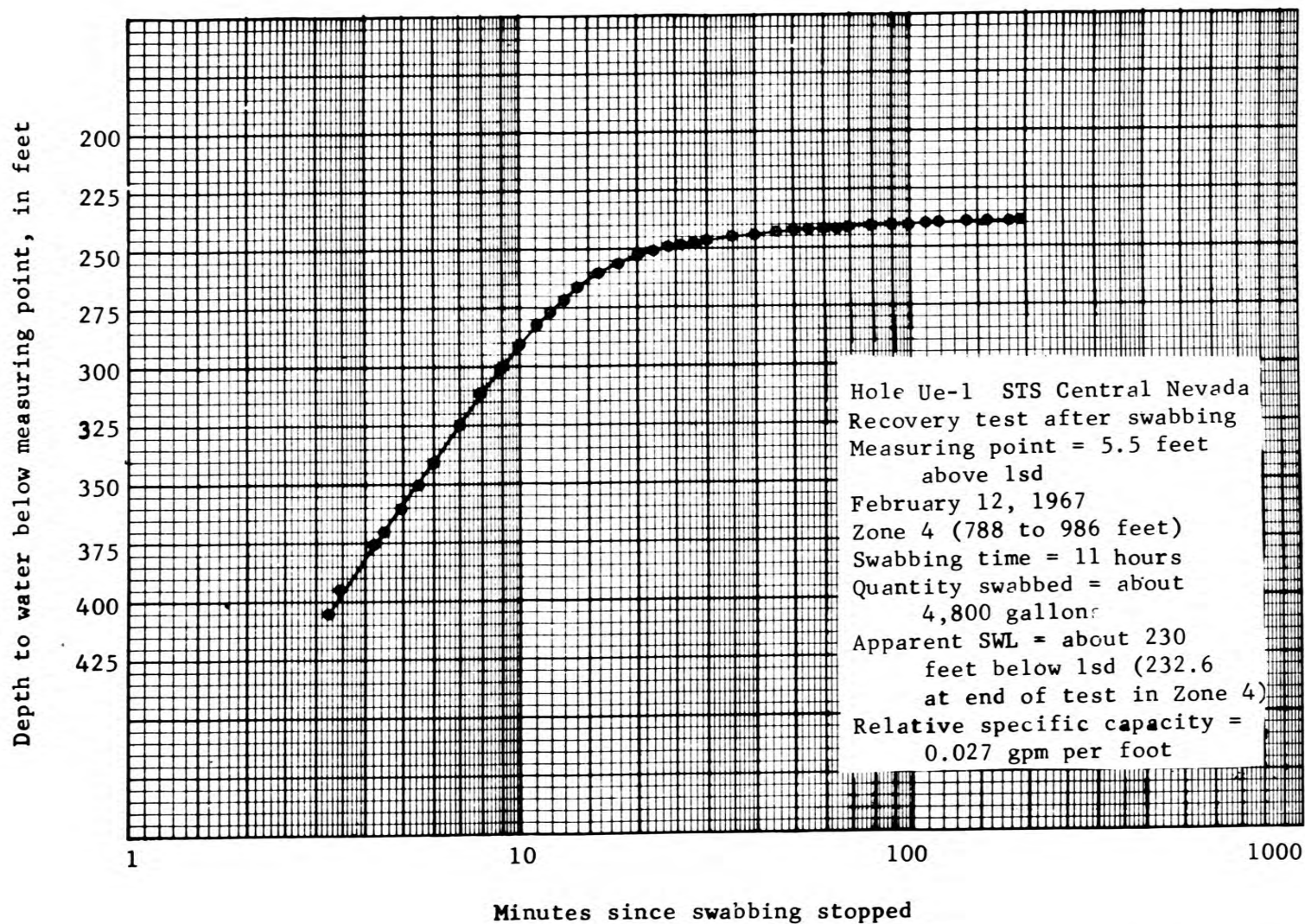


Figure 9.--Recovery test of zone 4 (788 to 986 feet), after swabbing, hole Ue-1, STS central Nevada, February 12, 1967.

Relative specific capacity calculated using the time interval from the 3rd to the 4th minute of the injection test 1 data (fig. 10) follows:

$$\text{Head loss} = 2.2 - 1.4 = 0.8 \text{ foot per minute}$$

$$Q = (0.162)(0.8) = 0.13 \text{ gpm}$$

$$\text{Drawdown} = 211.5 + 5.3 - 1.8 = 215.0 \text{ feet}$$

$$\text{Relative specific capacity} = 0.13/215.0 = 0.0006 \text{ gpm per foot}$$

Relative specific capacity calculated using the time interval from the 3rd to the 4th minute of the recovery test data (fig. 11) follows:

$$\text{Head loss} = 237.8 - 236.7 = 1.1 \text{ feet per minute}$$

$$Q = (0.162)(1.1) = 0.18 \text{ gpm}$$

$$\text{Drawdown} = 231.9 - 211.6 = 20.3 \text{ feet}$$

$$\text{Relative specific capacity} = 0.18/20.3 = 0.0089 \text{ gpm per foot}$$

Relative specific capacity calculated using the time interval from the 5th to the 6th minute of the injection test 2 data (fig. 12) follows:

$$\text{Head loss} = 208.7 - 207.7 = 1.0 \text{ foot per minute}$$

$$Q = (0.162)(1.0) = 0.162 \text{ gpm}$$

$$\text{Drawdown} = 211.5 - 202.7 = 8.8 \text{ feet}$$

$$\text{Relative specific capacity} = 0.162/8.8 = 0.018 \text{ gpm per foot}$$

The composite water level measured in the open hole after testing was 218.0 feet below lsd. This is 6.5 feet lower than was measured

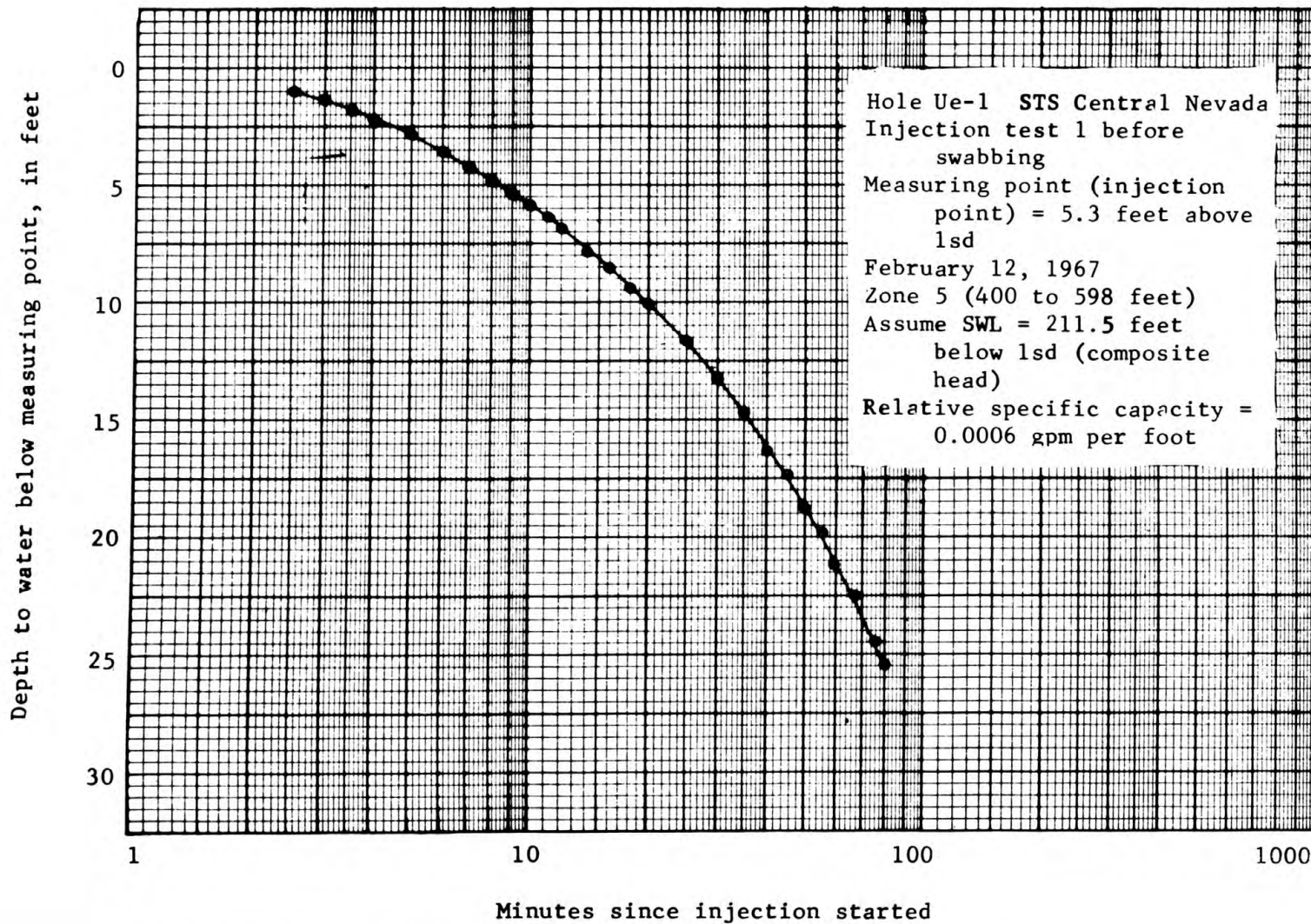


Figure 10.--Injection test 1 of zone 5 (400 to 598 feet), before swabbing, hole Ue-1, STS central Nevada, February 12, 1967.

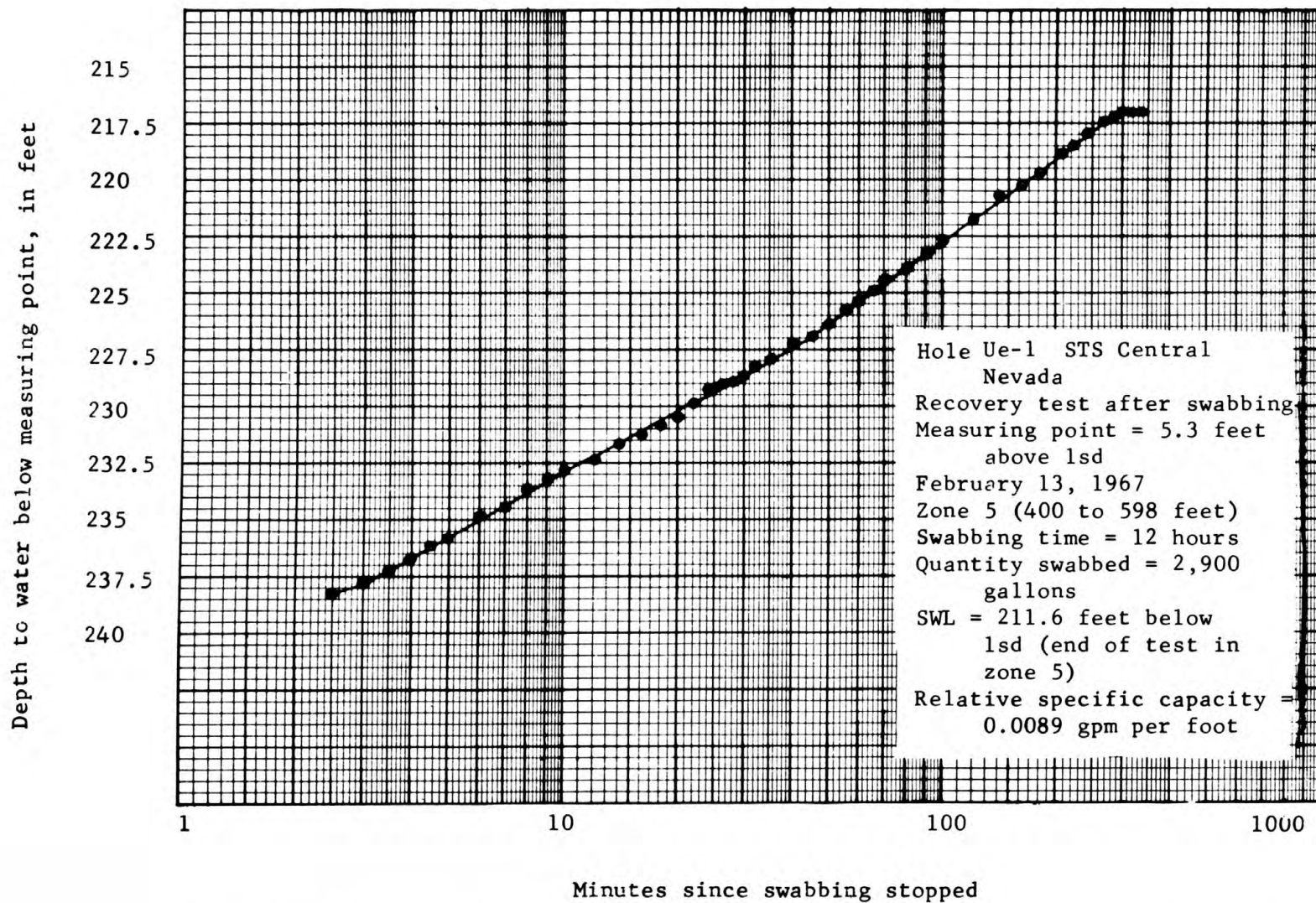


Figure 11.--Recovery test 1 of zone 5 (400 to 598 feet), after swabbing, hole Ue-1, STS central Nevada, February 13, 1967.

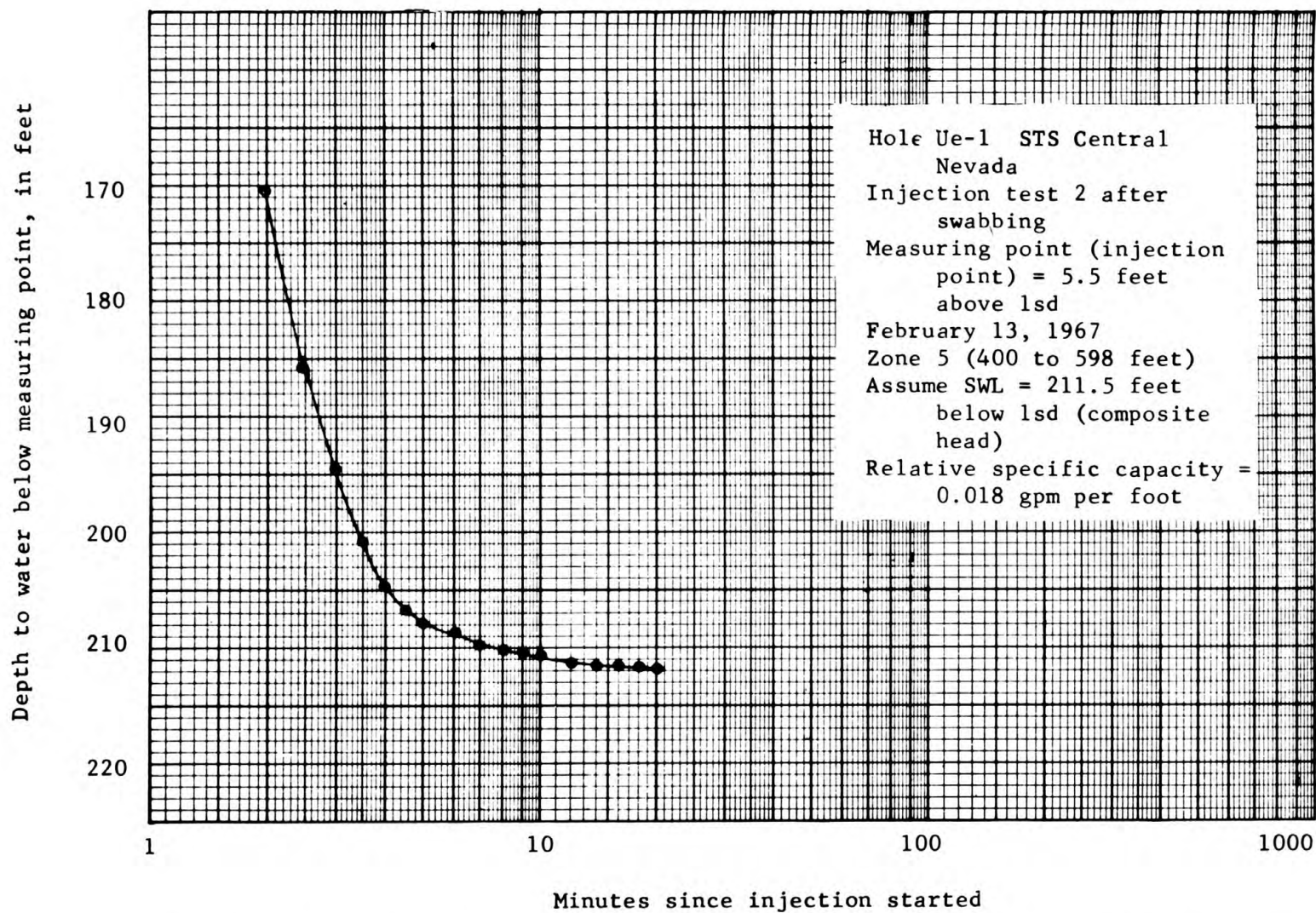


Figure 12.--Injection test 2 of zone 5 (400 to 598 feet), after swabbing, hole Ue-1, STS central Nevada, February 13, 1967.

before testing and may indicate that zones of greater permeability and lower head are now open to the borehole.

SUMMARY

The hydrologic data obtained in hole Ue-1 are summarized in the following table:

Zone	Test	Head loss (ft/min)	Q (gpm)	Drawdown (feet)	Relative specific capacity (gpm/ft)
1	Injection	0.1	0.0162	86.05	0.00019
	Recovery 1	11.7	1.90	543.5	.0035
	Recovery 2	31.0	5.02	875.3	.0057
2	Injection	.3	.049	216.13	.00023
	Recovery 1	22.9	3.71	787.07	.0047
	Recovery 2	22.2	3.6	960.57	.0037
3	Injection	.2	.032	215.8	.00015
	Recovery 1	26.2	4.24	480.5	.0088
4	Injection	-	--	-	---
	Recovery	19.0	3.08	114.4	.027
5	Injection 1	.8	.13	215.0	.0006
	Injection 2	1.0	.162	8.8	.018
	Recovery 1	1.1	.18	20.3	.0089

REFERENCE

Hoover, D. L., 1967, Report of exploration progress, central Nevada,
November 1, 1966 - June 1, 1967: U. S. Geol. Survey Tech.
Letter: Central Nevada-3, 15 p.

USGS LIBRARY - DENVER



3 1819 00415811 5