RESOURCES INVESTIGATIONS 82-19

RESULTS OF HYDROLOGIC TESTS AND WATER-CHEMISTRY ANALYSES, WELLS H-5A, H-5B, AND H-5C, AT THE PROPOSED WASTE ISOLATION PILOT PLANT SITE, SOUTHEASTERN NEW MEXICO

PREPARED BY THE
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Dissolved-solids concentrations in water samples were: (1) Magenta Dolomite Member, 6,090 milligrams per liter; (2) Culebra Dolomite Member, 144,000 milligrams per liter; and (3) Rustler Formation-Salado Formation contact, 412,000 milligrams per liter. The major chemical constituents of water samples from the Magenta Dolomite Member were sodium and sulfate; from the Culebra Dolomite Member, sodium and chloride; and from the Rustler Formation-Salado Formation contact, magnesium and chloride. Radium-226, a naturally occurring radioactive element, was present in samples from all three zones.

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UNITED STATES DEPARTMENT OF THE INTERIOR

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Symbols used in the report

Symbol	Description
Ci	Curie: Unit of radioactivity, the amount of any nuclide that undergoes exactly 3.7×10^{10} radioactive disintegrations per second.
Es	Bulk modulus of elasticity of solid skeleton of an aquifer.
H	Hydraulic head in the well above the initial static hydraulic head at time $t > 0$, in feet.
H_o	Maximum hydraulic head in the well above initial static hydraulic head at time $t > 0$, in feet.
Q	Average discharge or recharge of water from or to the test zone, in cubic feet per day.
S	Storage coefficient: volume of water an aquifer releases from or take into storage per unit surface area of the aquifer per unit change in head (dimensionless unit).
T	Transmissivity: The rate at which water is transmitted through a unit width of an aquifer under a uni hydraulic gradient, in feet squared per day.
V	Volume.
h	Hydraulic head, in feet.
h'	Hydraulic head at time $t > 0$, in feet.
h_i	Static hydraulic head, in feet.
h_o	Hydraulic head at time $t=0$, in feet.
r	Radial distance.
r_c	Radius of tubing in the interval over which water levels fluctuate, in feet.
r_s	Radius of open hole.
t	Time since initial stress of test zone.
t'	Time since shut-in began.

Symbols used in the report

Symbol	Description
α	$(r_s2/r_c2)S$.
Δp	Change in hydraulic head over one log cycle of time.
φ	Density of fluid.
μ	Micro (10^{-6}).
p	Pico (10^{-12}).

CONVERSION FACTORS

In this report, values for measurements except chemical measurements are given in inch-pound units only. The following table contains factors for converting to metric units.

Multiply inch-pound units	By	To obtain metric units
foot	0.3048	meter
foot squared per day	.0929	meter squared per day
cubic foot per day	.02832	cubic meter per day
gallon per minute	3.785	liter per minute
mile	1.609	kilometer
inch	25.40	millimeter
gallon	3.785	liter

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ABSTRACT

Data were collected during hydrologic testing at wells H-5A, H-5B, and H-5C in the northeastern part of the proposed Waste Isolation Pilot Plant site in southeastern New Mexico. The three water-bearing zones tested, the Magenta and Culebra Dolomite Members of the Rustler Formation and the Rustler Formation-Salado Formation contact, yield water to wells at rates less than 0.6 gallon per minute. Throughout the testing, water-pressure response in the tested zone was monitored by a pressure-transducer system. Shut-in and slug tests were conducted to acquire data from which the following values were derived.

Well	Test zone	Calculated transmissivity (foot squared per day)	Estimated storage coefficient
H-5A	Magenta Dolomite Member of the Rustler Formation	0.1	10^{-5}
H-5B	Culebra Dolomite Member of the Rustler Formation	.2	10^{-5}
H-5C	Rustler Formation-Salado Formation contact	.00003	10^{-3}

Dissolved-solids concentrations in water samples were: (1) Magenta Dolomite Member, 6,090 milligrams per liter; (2) Culebra Dolomite Member, 144,000 milligrams per liter; and (3) Rustler Formation-Salado Formation contact, 412,000 milligrams per liter. The major chemical constituents of water samples from the Magenta Dolomite Member were sodium and sulfate; from the Culebra Dolomite Member, sodium and chloride; and from the Rustler Formation-Salado Formation contact, magnesium and chloride. Radium-226, a naturally occurring radioactive element, was present in samples from all three zones.

INTRODUCTION

Purpose

The U.S. Geological Survey, at the request of the U.S. Department of Energy, is investigating the geohydrology of the proposed Waste Isolation Pilot Plant (WIPP) site near Carlsbad, New Mexico (fig. 1). The site is intended as a storage facility for defense-associated transuranic waste. The investigation is designed to supplement the work conducted by Sandia National Laboratory, which is responsible for the technical development of the site. The proposed facility would be constructed in bedded salt of the Permian age Salado Formation.

The purpose of this publication is to report values of transmissivity, estimates of the storage coefficient, and information on water chemistry for several water-bearing zones above the salt section. The data presented here were obtained from wells H-5A, H-5B, and H-5C, located in sec. 15, T. 22 S., R. 31 E., near the northeastern boundary of the site.

Scope

The values given in the report pertain only to the specific location of the H-5 wells. However, in conjunction with measured aquifer characteristics at other locations, onsite as well as offsite, it should be possible to acquire a comprehensive regional representation of the area's hydrology. In turn, a regional knowledge of aquifer characteristics would aid in the prediction for transport of radionuclides to the biosphere via ground-water movement in the event the storage facility is breached.

At the WIPP site, water movement in the water-bearing zones above and below the salt section could potentially move radionuclides offsite. A previous study (Mercer and Orr, 1979) indicates that the water-bearing zones in the Permian Rustler Formation require the most detailed investigation. The three geologic zones tested were the Magenta Dolomite and Culebra Dolomite Members of the Rustler Formation and the Rustler Formation-Salado Formation contact (fig. 2).

The three zones yield water to wells H-5A, H-5B, and H-5C at rates less than 0.6 gallon per minute. For this reason, shut-in tests and slug tests were used in the determination of transmissivities and estimates of the storage coefficients. Special testing procedures were developed to perform these tests. Throughout the testing sequence, water-pressure response in the tested zones was monitored by a pressure-transducer system. The testing procedures, methods of analysis, test results, and results of water-chemistry analyses are described in this report.

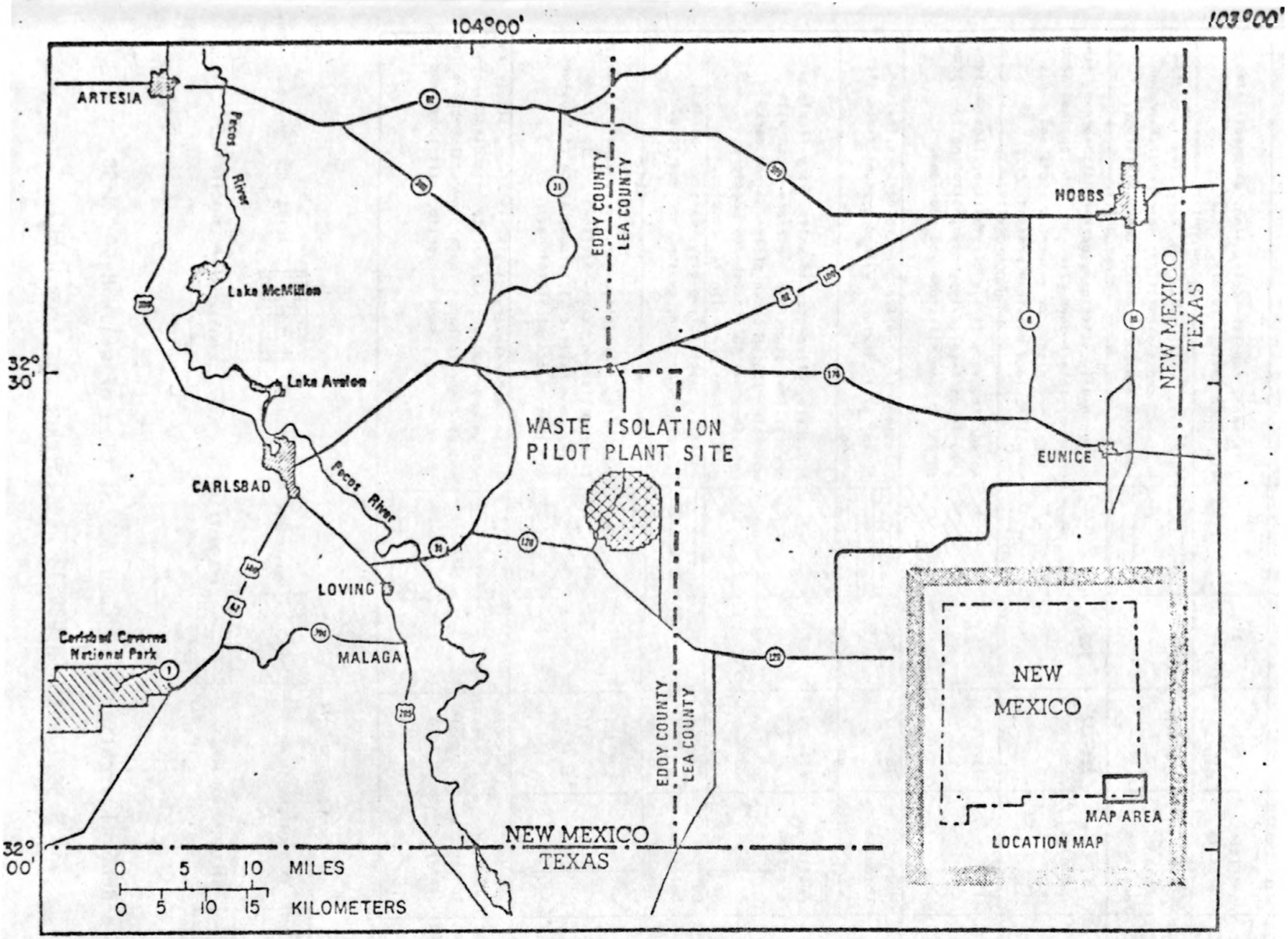

Figure 1.-- General location of the proposed Waste Isolation Pilot Plant site.

Age		Rock unit	Depth interval (feet)	Thickness (feet)	Graphic log	Description
QUATERNARY	Holocene	Surficial deposits	0-8	8		Dune sand, reddish-brown, fine, unconsolidated with some caliche rubble.
						----------UNCONFORMITY----------
TRIASSIC	Late Triassic	Santa Rosa Formation	8-225	217		Sandstone, yellowish-brown, very fine to medium grained, cross-stratified; some reddish-brown mudstone and dark-reddish-brown siltstone.
						----------UNCONFORMITY----------
LATE PERMIAN	Ochoan	Dewey Lake Red Beds	225-732	507		Predominantly siltstone, dark-reddish-brown, fine grained, interbedded with very fine grained sandstone, greenish-gray reduction spots and bands of selenite; some mudstone present.
						----------UNCONFORMITY----------
			732-788	56		Anhydrite, very finely crystalline, light-olive-gray to dark-yellowish-brown, altering to gypsum in part; some siltstone and mudstone.
		Magenta Dolomite Member	788-812	24		Dolomite, light-olive-gray to dark-yellowish-brown, silty texture, veined gypsum; trace siltstone.
		Rustler Formation	812-899	87		Anhydrite, olive-gray to white, very finely crystalline; sandstone, moderate-brown with moderate-reddish-brown siltstone and dark-reddish-brown to grayish-red mudstone; some gypsum; trace light-gray clay.
		Culebra Dolomite Member	899-924	25		Dolomite, light-olive-gray, massive, pitted; trace of siltstone, gypsum, and mudstone.
			924-1041	117		Anhydrite, light-olive-gray, very finely crystalline; siltstone, dark-reddish-brown to olive-gray, some halitic siltstone; trace of mudstone and thin layers of siltstone.
		Salado Formation (upper part)	1041-1076 Total depth 1076	–		Halite, moderate-orange-pink to clear, finely to medium crystalline; polyhalite both disseminated and as discrete bands, moderate-reddish-brown to reddish-orange; some anhydrite, siltstone, and mudstone.

EXPLANATION

SAND OR SANDSTONE

SILTSTONE OR MUDSTONE

ANHYDRITE OR GYPSUM

DOLOMITE

HALITE

POLYHALITE

Figure 2.--General stratigraphic sequence at site of wells H-5A, H-5B, and H-5C (depth intervals and thicknesses from H-5C).

Acknowledgments

The authors wish to thank Robert Statler, Sandia National Laboratory, who was responsible for field operations, and Earl Cunningham, D. L. Bradley, Wayne Laney, and Matthew Wilson of Fenix & Scisson for scheduling and direction of support operation during drilling and testing.

We also wish to thank Paul Davis, who helped establish testing procedures and methods, and James Basler, who was responsible for test instrumentation development (both with the U.S. Geological Survey, Albuquerque office). We would like to express appreciation to R. K. Dewees, U.S. Geological Survey, Carlsbad Office, for collecting data during formation testing.

HYDROLOGIC TESTING

Shut-in tests and slug tests were used to determine transmissivities and estimates of storage coefficients for zones in which H-5A, H-5B, and H-5C are completed. The location of the wells is shown in figure 3. These tests were chosen because the test zones generally yield only small quantities of water to the wells, less than 0.6 gallon per minute. Both methods primarily are restricted to wells that are fully developed and fully penetrate a confined aquifer. In addition, the slug test is restricted to wells completed in aquifers of low transmissivity. In order to perform these tests and obtain optimum results, special testing procedures were devised.

Test procedures

Pretest activities

Special care was taken in the drilling program used to complete each test well. Air, air foam, and brine were used at one time or another as drilling and coring fluids (table 1). Drilling was done in such a way as to avoid contaminating or plugging the test zone, so that optimum test results would be possible.

In order to test the different zones above the repository level, three wells were drilled. Each was completed in a different test zone; Well H-5A in the Magenta Dolomite Member of the Rustler Formation, Well H-5B in the Culebra Dolomite Member of the Rustler Formation, and well H-5C in the Rustler Formation-Salado Formation contact zone. Each well was drilled to a point above the test zone, cased, and the casing cemented up to the land surface. The test zone was then cored.

Upon completion of a well, brine was used to flush the well and then compressed air was used to remove the brine from the well. This action was designed to develop the cored interval as well as guard against any plugging or contamination that might occur. Water levels were monitored until the hydrologic testing began to assure that equilibrium had been reached.

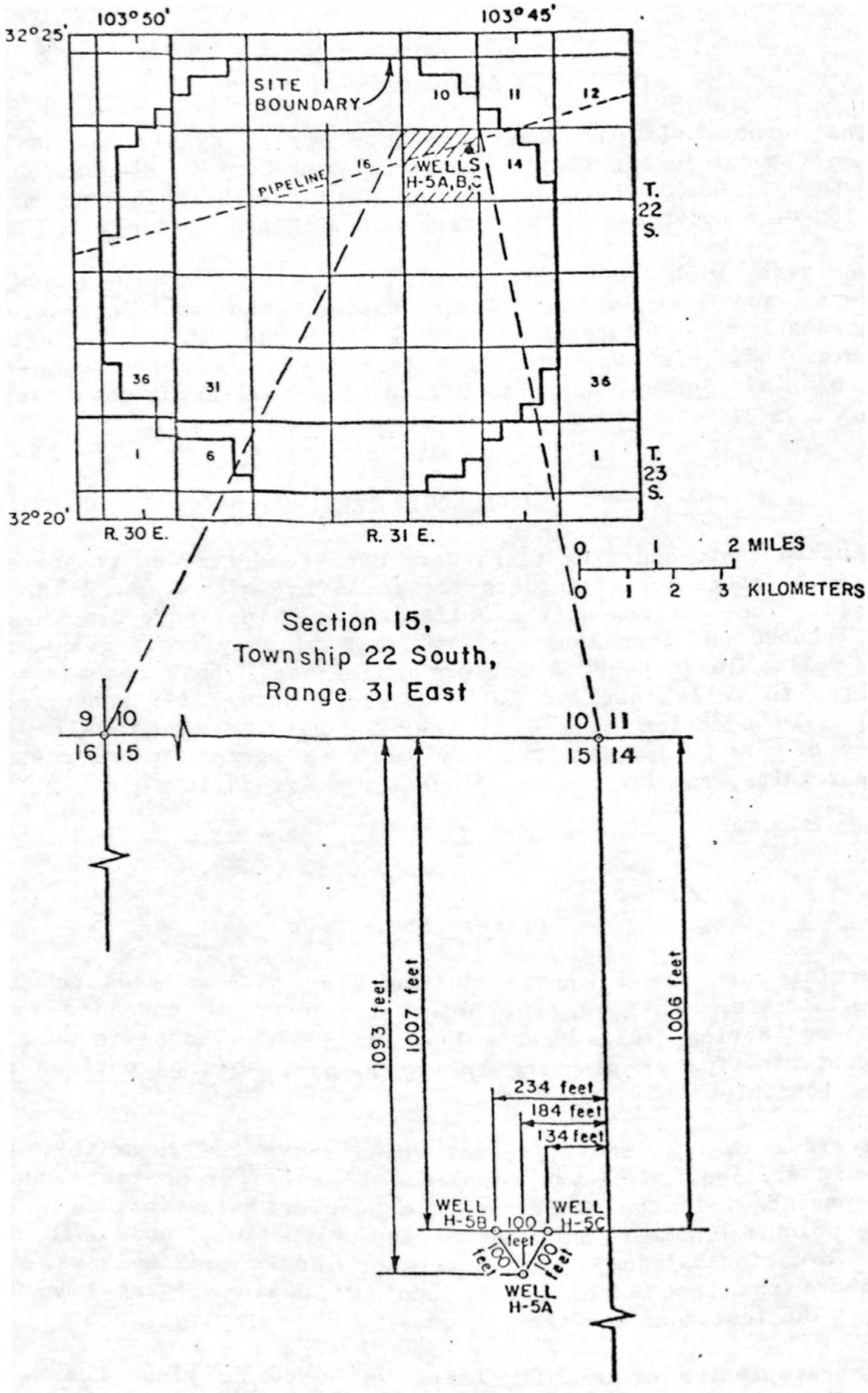

Figure 3.--Location of wells H-5A, H-5B, and H-5C within the proposed site boundary.

Table 1. Construction and testing chronologies of wells H-5A, H-5B, and H-5C

[All measurements adjusted to ground level in feet above National Geodetic Vertical Datum of 1929: H-5A, 3,506.2 feet; H-5B, 3,506.0 feet; H-5C, 3,506.4 feet.]

Well H-5A -- 1,093 feet from north line, 184 feet from east line

05-22-78	Set surface pipe.
06-13-78 to 06-17-78	Spudded and rotary drilled hole with air and air foam to 775 feet. Cleaned hole and set casing at 774 feet. Cemented casing.
06-19-78 to 06-20-78	Drilled out cement and plug, cleaned out to 775 feet. Cut core from 775 feet to a total depth of 824 feet, using brine. Flushed hole with brine and removed brine using compressed air. Hole completed.
06-21-78 to 12-09-78	Monitored water levels.
12-09-78 to 12-12-78	Conducted shut-in tests and slug test.
12-13-78 to present (1981)	Monitored water levels.

Well H-5B -- 1,007 feet from north line, 234 feet from east line

05-22-78	Set surface pipe.
06-05-78 to 06-09-78	Spudded and rotary drilled hole with air and air foam to 882 feet. Cleaned hole and set casing at 881 feet. Cemented casing.
06-12-78 to 06-13-78	Drilled out cement and plug, cleaned out to 882 feet. Cut core from 882 feet to a total depth of 925 feet, using brine. Flushed hole with brine and removed brine using compressed air. Hole completed.
06-14-78 to 12-12-78	Monitored water levels.
12-12-78 to 12-15-78	Conducted shut-in tests and slug test.
12-16-78 to present (1981)	Monitored water levels.

Table 1. Construction and testing chronologies of wells H-5A, H-5B, and H-5C - Concluded

Well H-5C -- 1,006 feet from north line, 134 feet from east line

05-22-78	Set surface pipe.
05-23-78 to 05-31-78	Spudded and rotary drilled hole with air, air foam, and brine to 1,025 feet. Obtained geophysical logs. Cleaned hole and set casing at 1,024 feet. Cemented casing.
06-02-78 to 06-03-78	Drilled out cement and plug, cleaned out to 1,026 feet. Cut core from 1,026 to a total depth of 1,076 feet using air and brine. Flushed hole with brine and removed brine using compressed air. Hole completed.
06-04-78 to 10-03-78	Monitored water levels.
10-03-78 to 11-07-78	Surface-water runoff accidentally drained into well.
12-15-78	Bailed hole dry to evacuate contaminated formation water.
12-16-78 to 05-16-79	Monitored water levels.
05-17-79 to 08-24-79	Added closely matched density water to well in order to set packer. Packer set and pressure recovery monitored until static pressure was reached.
08-24-79 to 06-10-80	Conducted slug (flow-in) test.
06-11-80 to present (1981)	Monitored water levels.

Pressure monitoring system

A downhole pressure transducer was connected to a digital-readout data logger at the surface to monitor the response of the tested zone during shut-in tests and slug tests. This pressure-transducer system has the capability to continuously monitor downhole conditions prior to and throughout the test period, thus insuring proper initiation and completion of the test.

Water pressures recorded at the land surface reflect the pressure head above the measuring point (fig. 4). Presure head plus the elevation head is equal to the hydraulic head. By defining the measuring point to be the datum for the elevation head, the pressure head measured is equivalent to the hydraulic head. Therefore, the terms pressure head and hydraulic head are interchangeable in this report.

First shut-in test

The first step in the test sequence was to bail water from the hole in order to stress the water-bearing zone and provide formation water for the forthcoming slug test. The water level was lowered to a point just above the test zone. Next, a pressure transmitter was lowered on a logging cable into the well to monitor water-level recovery in the open hole. The rise in water level was monitored in order to obtain an estimate for the average discharge (Q) of water from the test zone. After a discharge value was obtained, the transmitter was removed from the hole.

A special inflatable packer was lowered into the well on drill-stem tubing to a point just above the test zone. Modifications made to the inflatable packer allowed for continuous monitoring of downhole conditions at the surface. The modifications (fig. 4) consisted of strapping a transducer housing to the tubing directly above the rubber packer element. Inside the housing, a pressure transducer was installed. A length of steel tubing connected to the housing was inserted beneath the packer element and extended to the bottom of the element where it was exposed to the test zone. This feed-through line allowed the transducer to sense pressure at the test zone after packer inflation. To inflate the packer the drill-stem tubing was filled with water obtained during bailing. Packer inflation effectively sealed off the test zone. The pressure recovery rate increased significantly because the zone no longer had to supply water to the wellbore. The shut-in test was terminated after a static pressure was reached in the test zone. A graphical representation of the water pressure or hydraulic head in the test zone during the shut-in test is shown in figure 5.

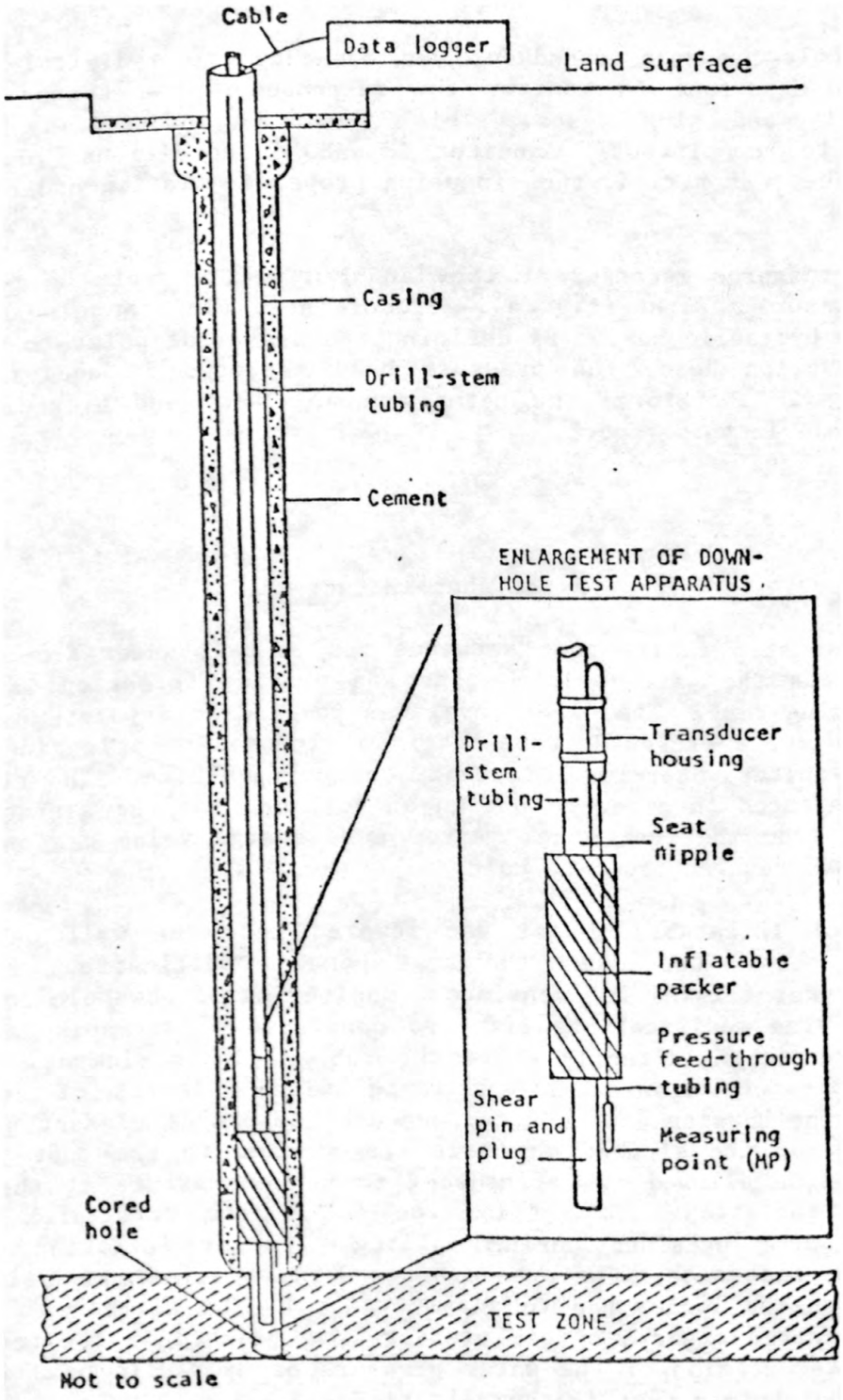

Figure 4.--Typical well-testing configuration for shut-in and slug tests.

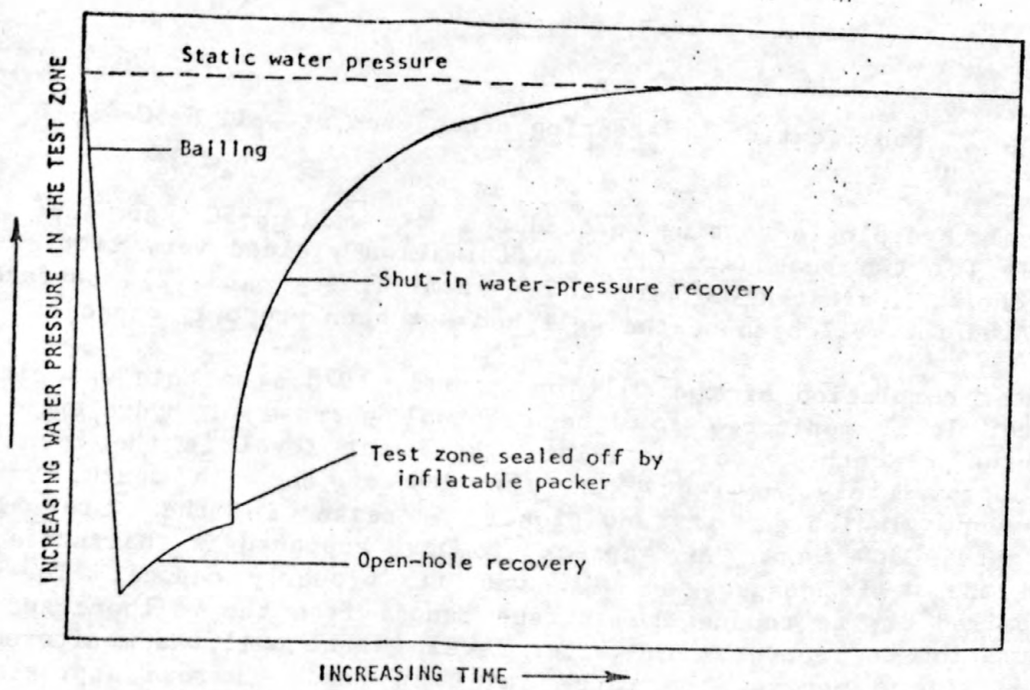

Figure 5.--First shut-in test.

Slug test

The second type of test performed on each test zone was the slug test (Cooper and others, 1967). A slug test is performed by suddenly injecting or removing a known volume or slug of water from a well. At the end of the shut-in test, the test apparatus was in the proper configuration for an injection-type slug test. The tubing above the packer was filled with formation water to just above land surface while the pressure-transducer system was monitoring the formation-water pressure. The plug in the lower part of the packer (fig. 4) was knocked out, causing an instantaneous increase in pressure (slug) to the test zone (fig. 6). The decrease in pressure was then monitored.

Second shut-in test

Because the H-5 wells were among the first to be tested, a second shut-in test was performed in the testing sequence to demonstrate the reproducibility of results. The shut-in test was easily implemented at the end of the slug test, when sufficient information had been obtained to analyze the slug test and the pressure response in the zone was still substantially above the static hydraulic head. This test was accomplished by running a standing valve inside the tubing and into a seat nipple on top of the packer (fig. 4). The test zone was then effectively sealed off from the remaining portion of the slug of water in the tubing. As in the first shut-in test, water no longer was moving in the test zone or the well; therefore, the rate of pressure recovery increased (fig. 6).

Modifications to testing procedures at well H-5C

Usual hydrologic-testing procedures at well H-5C were not possible primarily for two reasons: (1) The formation yielded very little water to the borehole, indicating a very low transmissivity; and (2) surface runoff had entered the well because the well had not been properly capped.

After completion of the well on June 3, 1978, the hole was cleaned and the water level monitored for the eventual purpose of hydrologic testing. During the 3 months after drilling, the water level in the open hole had risen approximately 70 feet. At the end of the 4th month, water-level measurements indicated an additional increase in the water level of approximately 380 feet. What appears to have happened is that surface runoff entered the well because the well was not properly capped. The well was again bailed dry to remove the surface runoff from the wellbore and to allow the formation to recover. The water level in the well was monitored; during the following 5 months, the water level in the well rose approximately 40 feet. From this, it became apparent that the formation could possibly take years to recover to its static level in an open-hole configuration. A decision was made to introduce water that approximated the density of the water in the formation. By raising the water level in the well, a packer could be set and pressure recovery initiated. The rate of recovery to a static level is increased significantly by shutting-in the system. Even with the well in a pressure-recovery configuration, 3 months were necessary for the formation to reach a static level. Then, hydrologic testing could begin and a transmissivity value determined (the water level needs to be at a static level prior to conducting a shut-in or slug test).

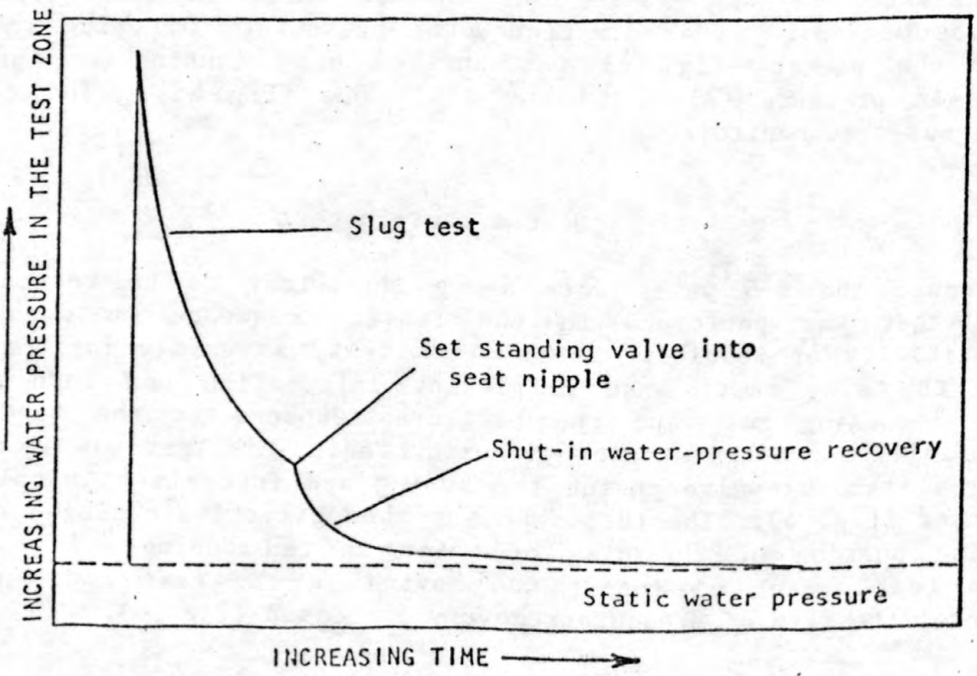

Figure 6.--Slug test followed by second shut-in test.

The water used to inflate the packer had been removed by swabbing when the packer was initially set. The plug in the lower part of the packer (fig. 4) was knocked out, causing an instantaneous decrease of pressure (slug) in the test zone. Because the drill-stem tubing contained no water, formation water began to rise in the tubing once the plug had been knocked out. The slug (flow-in) test was then monitored for formation response.

Test analyses

Shut-in tests

The method used in analyzing the shut-in tests was adapted from the Theis recovery method (Theis, 1935). The following paragraphs describe the use of the method as applied to shut-in tests at WIPP (Dennehy and Davis, 1981).

The time (t) since the initial stress of the test zone is divided by the time (t') since the shut-in test began. The quotient of these two time increments is then plotted on the logarithmic scale of semilogarithmic paper against the hydraulic head in the test zone plotted on the arithmetic scale. Transmissivity is calculated using the following equation:

$$T = \frac{2.30\ Q}{4\pi'\ \Delta p} \qquad (1)$$

where

T = transmissivity, in feet squared per day;

Q = average discharge or recharge of water from or to the test zone, in cubic feet per day; and

Δp = change in hydraulic head over 1 log cycle of time, in feet.

In the above equation, Q may be calculated two different ways depending on how the test zone was stressed prior to the shut-in. When the hole was bailed before the test zone was shut-in, Q was calculated from the water-level recovery in the open hole for the elapsed time between the end of bailing and the beginning of the shut-in. For the shut-in test after a slug test, Q was calculated from the water decline that occurred during the slug test.

Slug tests

Slug tests were analyzed using standard techniques as presented by Cooper and others (1967). The method of analysis is given in the following paragraphs.

The ratio of hydraulic heads, H/H_o, can be calculated by the following equation:

$$H/H_o = \frac{h' - h_i}{h_o - h_i} \qquad (2)$$

where

H = hydraulic head in the well above the initial static hydraulic head at time $t > 0$, in feet;

H_o = maximum hydraulic head in the well above initial static hydraulic head at time $t > 0$, in feet;

h' = hydraulic head at time $t > 0$, in feet;

h_i = static hydraulic head, in feet; and

h_o = hydraulic head at time $t = 0$, in feet.

From measured values of h', values of H/H_o are computed and are plotted on the arithmetic scale of semilogarithmic paper against the time measurement, t, in seconds, on the logarithmic scale. The data curve is then superposed on type curves by standard curve-matching procedures (Papadopulos and others, 1973). The match curve is used to select a value of t.

The transmissivity is then determined by the equation:

$$T = \frac{86{,}400\ r_c^{\,2}}{t} \qquad (3)$$

where

T = transmissivity, in feet squared per day;

r_c = radius of drill-stem tubing in interval over which the water level fluctuates, in feet; and

t = time, at the match line, in seconds.

Storage coefficient is then determined by the equation:

$$S = \frac{r_c^{\,2}}{r_s^{\,2}} \alpha \qquad (4)$$

where

S = storage coefficient, dimensionless;

r_c = radius of drill-stem tubing in interval over which the water level fluctuates, in feet; and

r_s = radius of open hole, in feet;

$\alpha = \frac{r_s^{\,2}}{r_c^{\,2}} S$; value obtained by curve matching, dimensionless.

TEST RESULTS

The specially modified hydrologic testing procedures along with the established methods of analysis discussed in the preceding section produced comparable results for transmissivities (T) and estimates for the coefficient of storage (S) in the test zones of wells H-5A, H-5B, and H-5C. All data collected during onsite operations such as construction detail of wells (fig. 18), and test data used for calculations (table 5) are included in the Supplemental Information section at the end of this report.

Well H-5A

A transmissivity value of 0.1 foot squared per day was calculated from the slug test for the Magenta Dolomite Member of the Rustler Formation at well H-5A. This value is consistent with the results of the two shut-in tests run before and after the slug test (table 2). Data plots of the shut-in test and slug test are presented in figures 7, 8, and 9. The complete history of the hydraulic head during testing of well H-5A is shown in figure 10.

Well H-5B

A transmissivity value of 0.2 foot squared per day was calculated from the slug test for the Culebra Dolomite Member of the Rustler Formation at well H-5B. The calculated value compares very well with the two shut-in tests performed at well H-5B (table 2). Data plots of the shut-in tests and slug test are presented in figures 11, 12, and 13. The complete history of hydraulic head during testing of well H-5B is shown in figure 14.

Table 2. Hydrologic-test results

Well	Test zone	Test method	Date	Calculated transmissivities (foot squared per day)	Estimates of storage coefficient
H-5A	Magenta Dolomite Member of the Rustler Formation	Shut-in	12-09-78	0.2	--
		Slug	12-11-78	.1	10^{-5}
		Shut-in	12-11-78	.4	--
H-5B	Culebra Dolomite Member of the Rustler Formation	Shut-in	12-13-78	.2	--
		Slug	12-14-78	.2	10^{-5}
		Shut-in	12-14-78	.3	--
H-5C	Rustler Formation-Salado Formation contact	Slug	08-24-79	.00003	10^{-3}

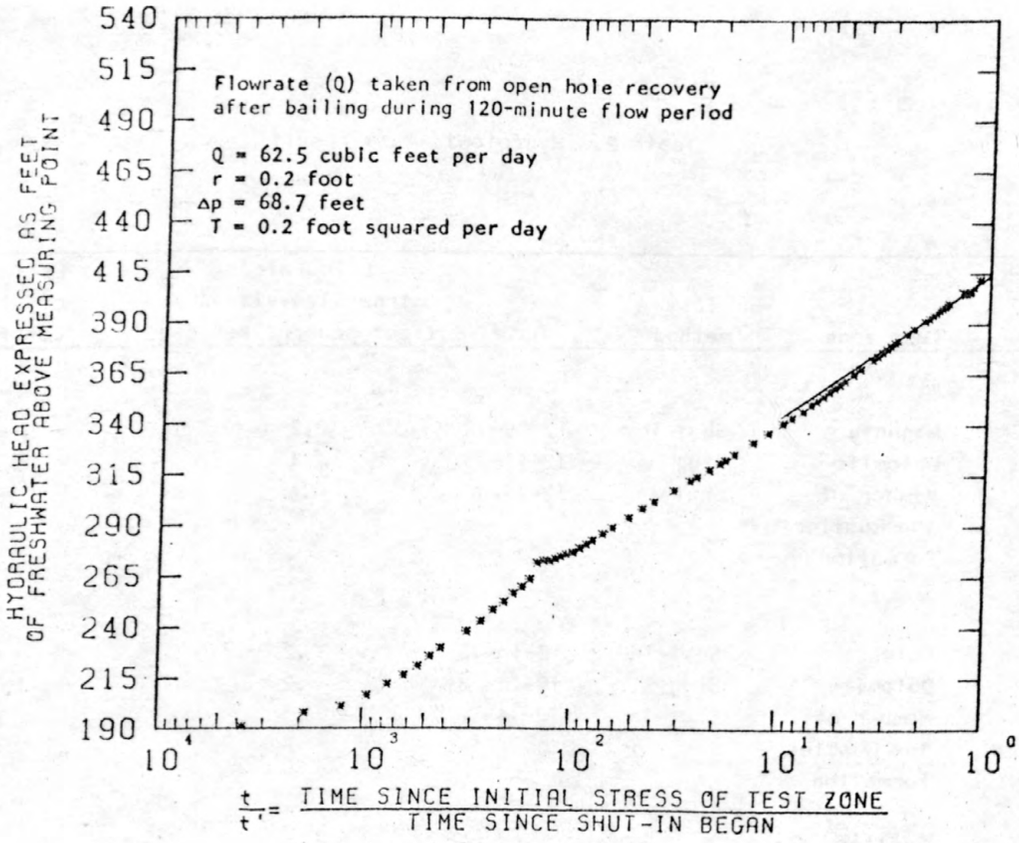

Figure 7.--Results of shut-in test 1 for well H-5A.

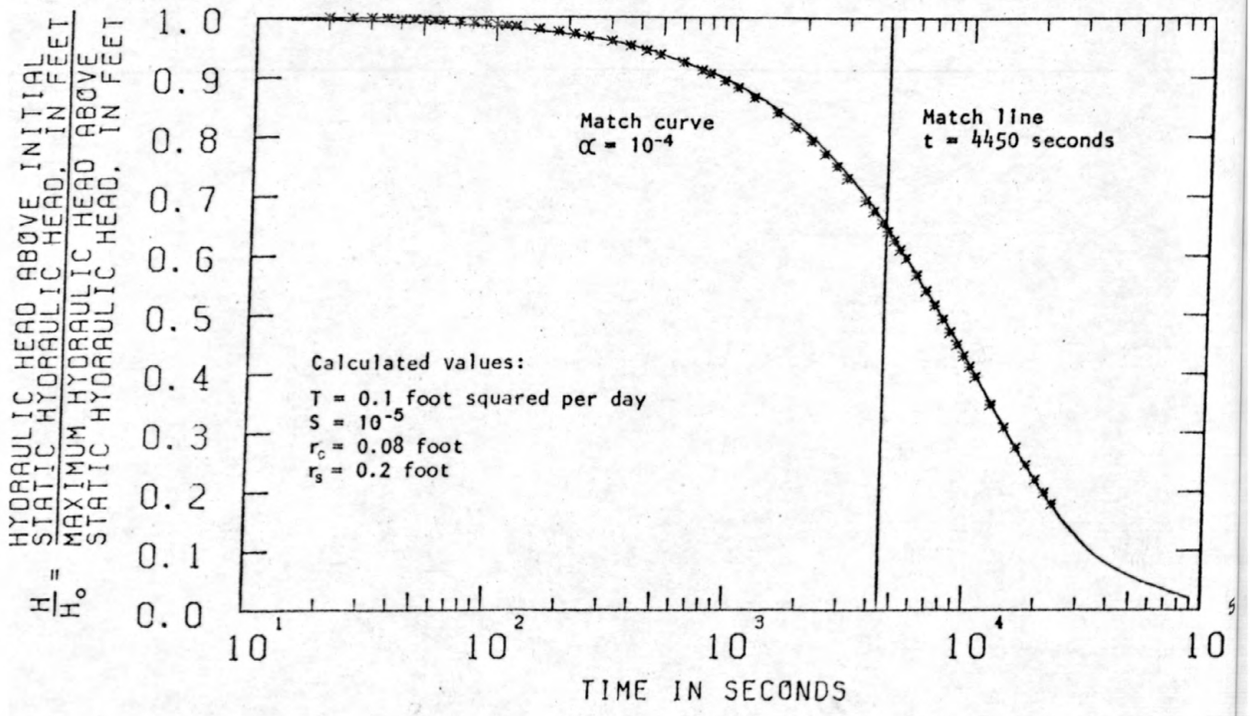

Figure 8.--Results of slug test 1 for well H-5A.

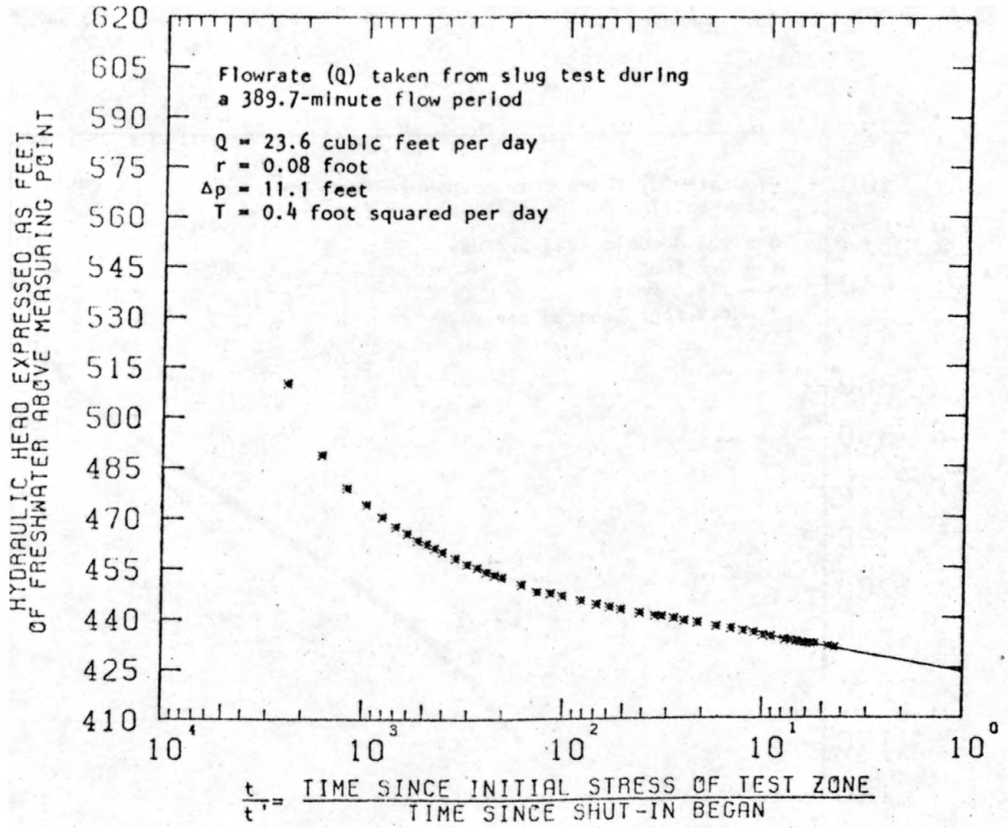

Figure 9.--Results of shut-in test 2 for well H-5A.

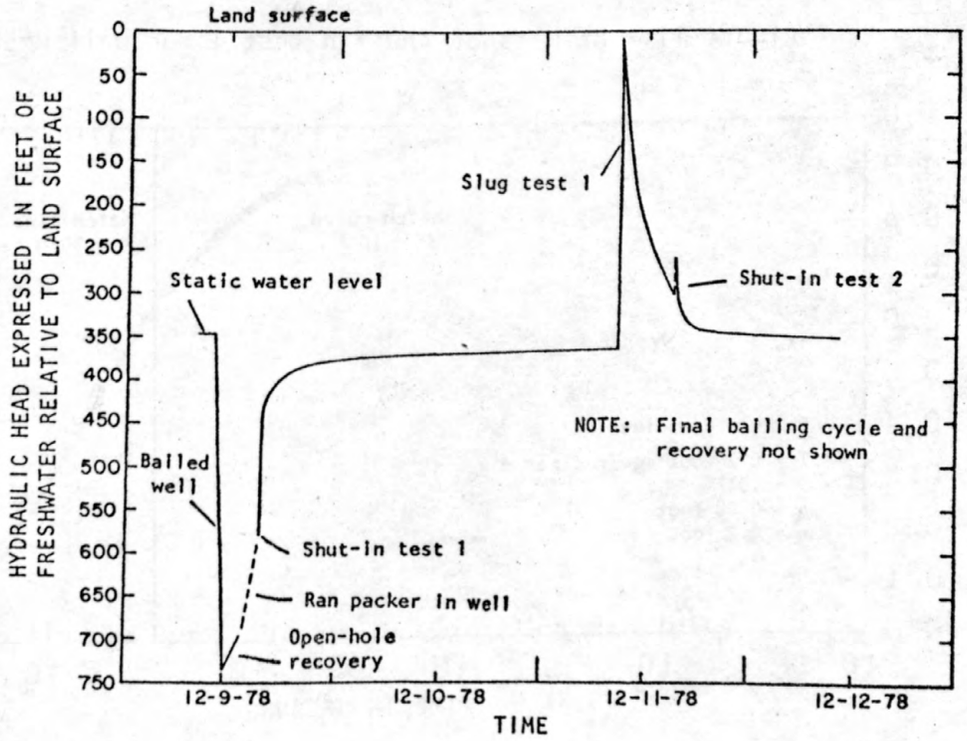

Figure 10.--History of hydraulic head during testing of well H-5A.

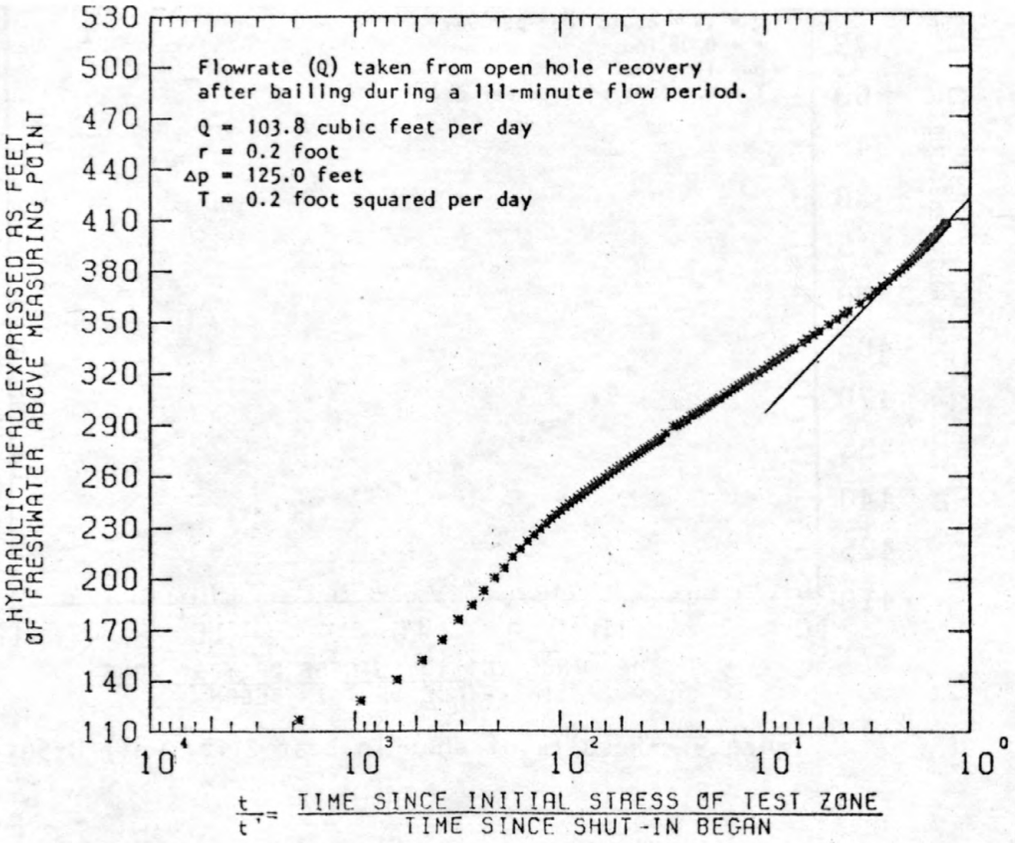

Figure 11.--Results of shut-in test 1 for well H-5B.

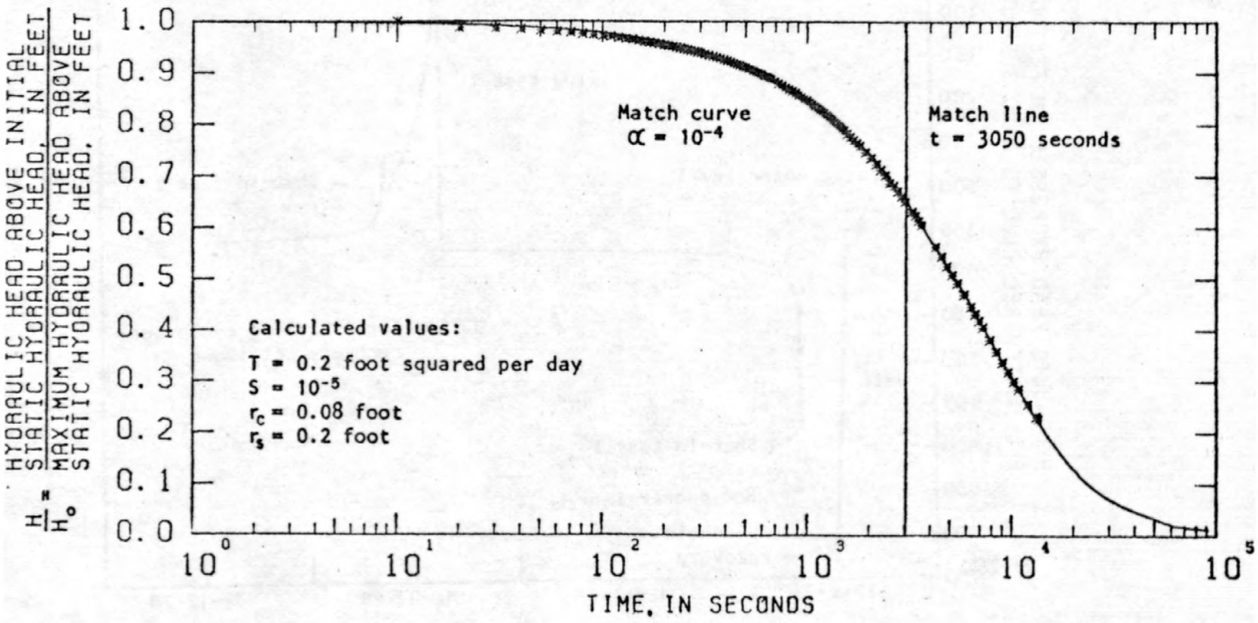

Figure 12.--Results of slug test 1 for well H-5B.

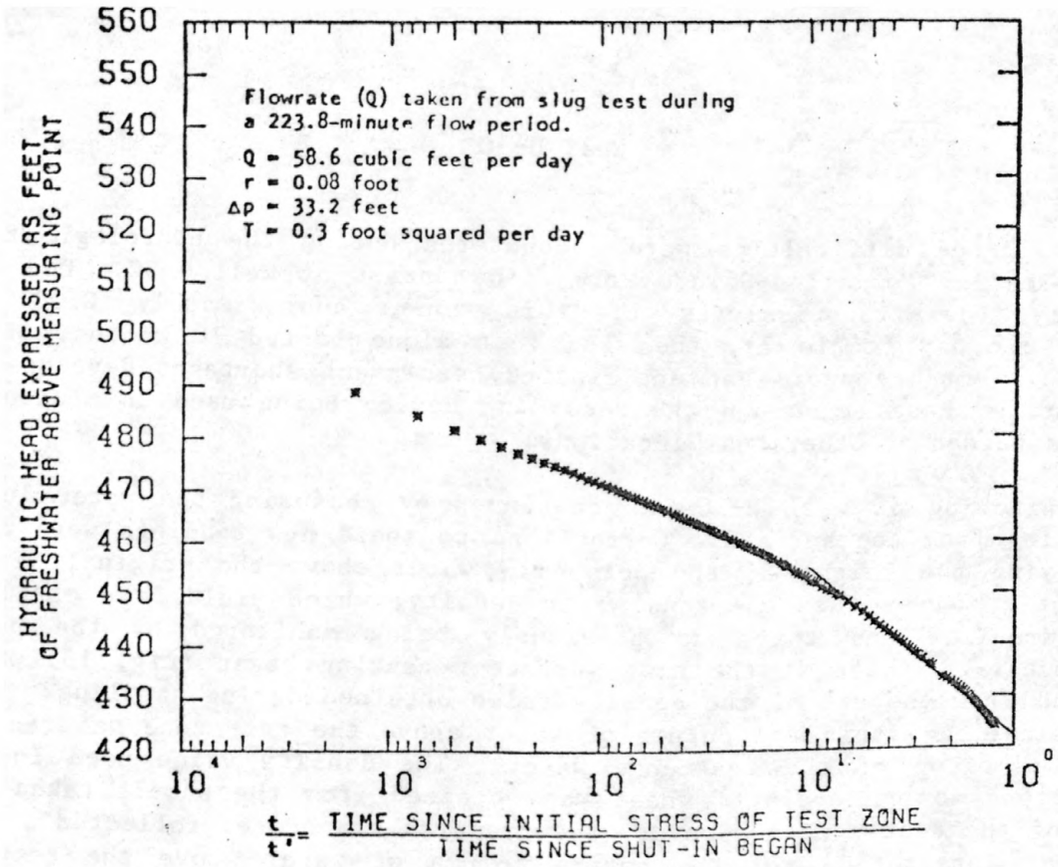

Figure 13.--Results of shut-in test 2 for well H-5B.

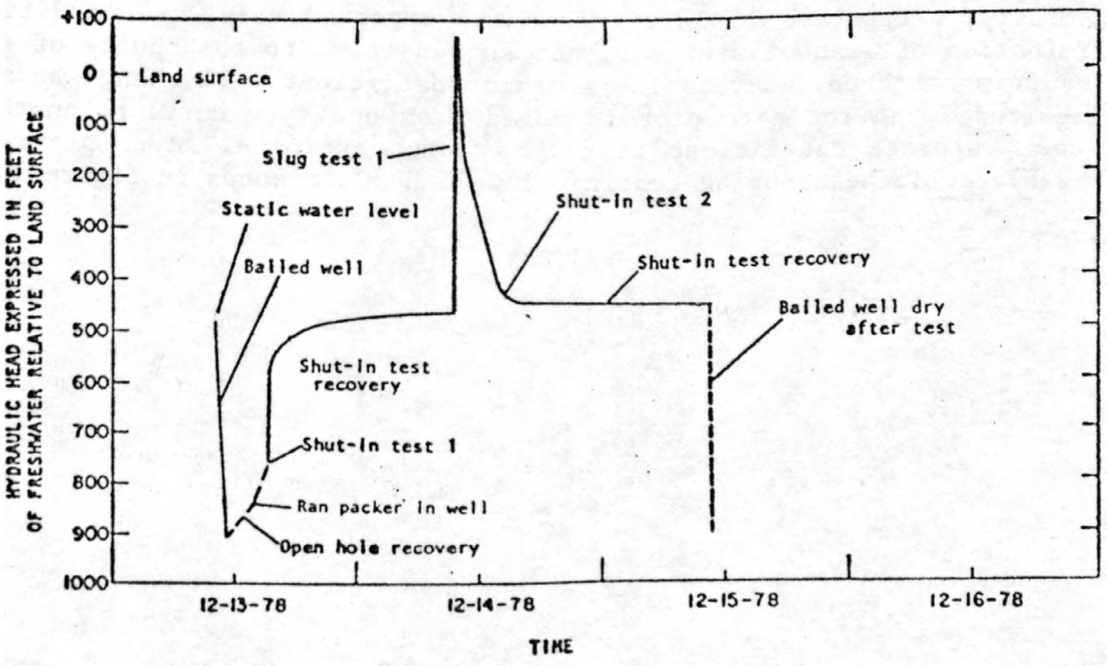

Figure 14.--History of hydraulic head during testing of well H-5B.

Well H-5C

Unexpected difficulties were encountered during the hydrologic testing of the Rustler Formation-Salado Formation contact at well H-5C. Due to the extremely low transmissivity of this zone, approximately 0.00003 foot squared per day (table 2), the slug test alone lasted 10 months. Because testing ran much longer than anticipated, equipment shortages developed as a new testing phase began and the recording device being used to monitor well H-5C was needed at other test locations.

Monitoring at well H-5C was continued by measuring the water level in the tubing from the surface. Corrections to these new readings were made by multiplying the height of the column of water above the original measuring point (fig. 4) by the test-zone water density, which yielded an estimate of the hydraulic head that was previously being monitored by the pressure transducer. A shift at the time surface measuring began (fig. 15) probably resulted from the use of the density value obtained during sampling. Density stratification within the column of water above the test zone was recognized during sampling of the test-zone water. The density value used in making corrections to the hydraulic head was obtained from the sample taken at the level of the test zone. However, the pressure transducer reflected a density that was integrated over the entire column of water above the test zone. Data points plotted in figure 15 show both the corrected and uncorrected values of H/H_o. In attempting to match a type curve to the data points, it was determined that the corrected values gave a better fit. However, because the corrected values of H/H_o are lower than the expected values, the value of transmissivity obtained is larger than the expected value. In addition, the determination of transmissivity is not so sensitive to the choice of the type curves being matched, whereas the storage coefficient will change by an order of magnitude when the data plot is moved from one type curve to another. In any case, storage coefficient is only a rough estimate. A complete history of the hydraulic head during testing of well H-5C is shown in figure 16.

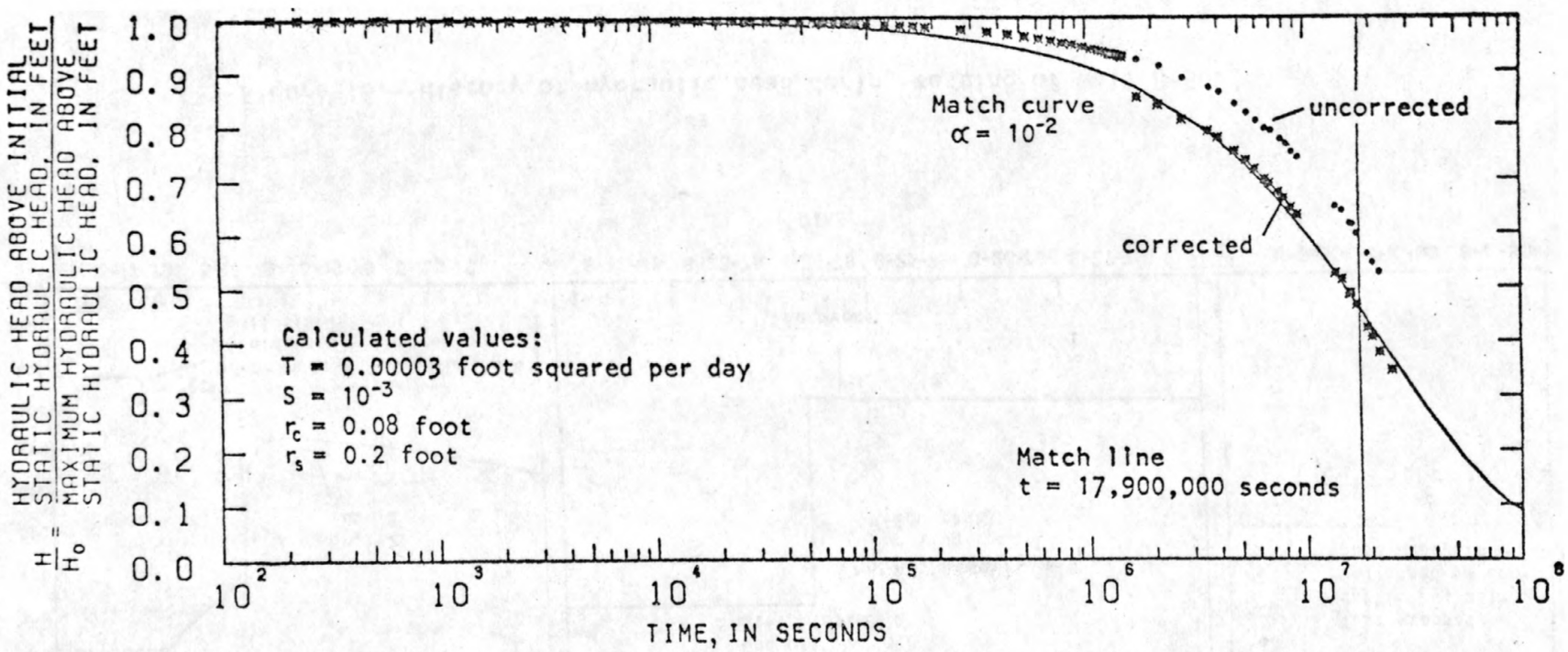

Figure 15.--Results of slug test 1 for well H-5C.

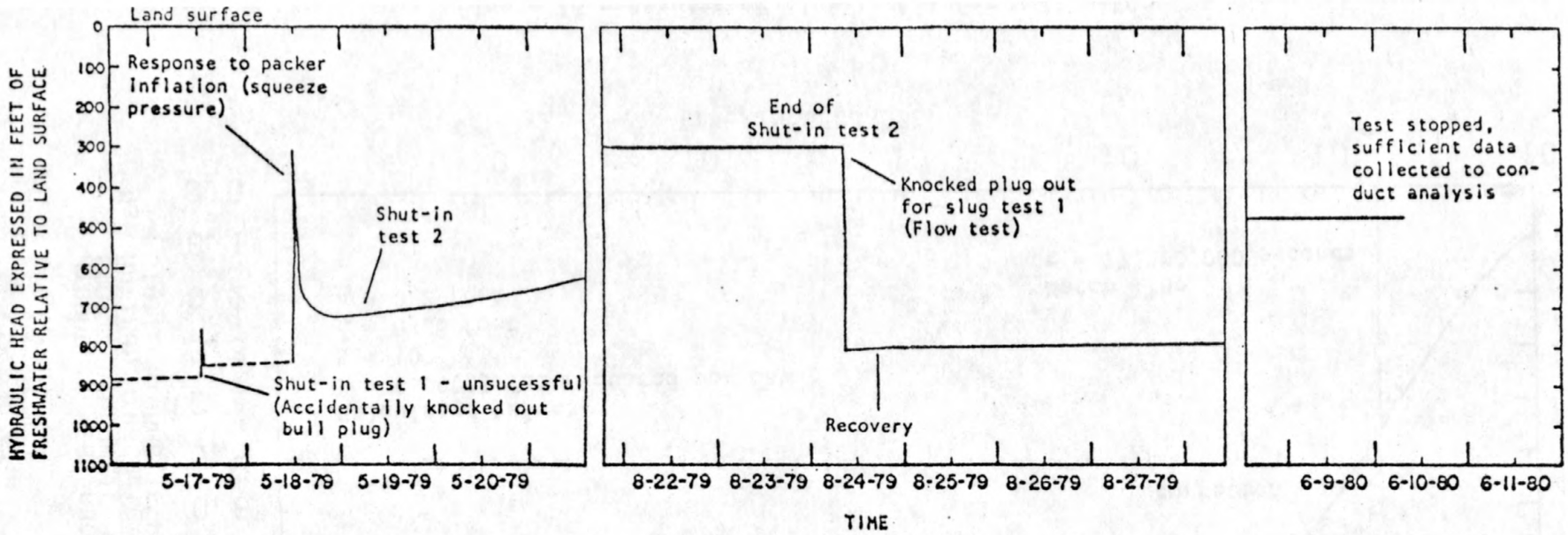

Figure 16.--History of hydraulic head during testing of well H-5C.

Evaluation of test results

Slug tests may give more accurate values for transmissivity than the shut-in tests in zones of low transmissivity. In the case of the shut-in test, it is difficult to fit a straight line to the steep part of the shut-in curve in order to determine the absolute change in pressure over one log cycle (Δp). Slight inflections in the recovery curve at long times make it possible to fit several lines, each yielding a different transmissivity value, through the same curve. In the slug test, the transmissivity value is calculated using a curve-matching procedure, which is not as sensitive to the choice of the curve being matched.

In addition to this difficulty with the shut-in test, technical problems result from the use of an average discharge of water (Q) from the test zone in calculating transmissivity. The discharge from the well is, in fact, continually decreasing after the zone has been stressed (bailed). Although the use of an average discharge is reasonable, the logistics of performing the shut-in test prevented the measurement of discharge throughout the total time from bailing until shut-in. Discharge measurements ended during the first steps of setting the packer in the casing. Due to the depth of the test zones below land surface, the time between the start of the setting of the packer and the actual shut-in was several hours. The continually decreasing discharge during this period of no measurement dictates that the value calculated always would be larger than the actual average discharge for the entire flow period; therefore, the computed transmissivity would be larger than the actual value.

Pressure readings taken at the beginning of the shut-in tests in zones of low transmissivity indicate that early recovery is dominated by well-bore storage effects. Generally, well-bore storage affects a recovery test in two ways: (1) A part of the water discharged from the well is water that is stored in the well bore; and (2) the recovery of hydraulic head is affected by the large storage capacity per unit volume of the well compared to the storage capacity per unit volume of the test zone. These effects apparently caused the initial part of the recovery curve to remain flat; thus, Δp was calculated using only late time recovery data.

Slug tests can provide a rough estimate of the magnitude of the storage coefficient. Storage estimates were obtained by a curve-matching technique described by Cooper, Bredehoft, and Papadopulos (1967). These estimates depend upon the shapes of the type curves, which vary only slightly when alpha (α) differs by an order of magnitude; therefore, storage, which is directly proportional to the value of alpha, is estimated only to the order of magnitude.

Although the slug test has clear advantages over the shut-in test in low transmissive zones, the transmissivity values calculated from the shut-in test data still serve as a useful check for the transmissivities calculated from the slug test. Thus, the shut-in test remains an integral part of the hydrologic-testing procedure.

WATER CHEMISTRY

Ground water in each test zone is mineralized, as indicated by dissolved-solids concentrations of 6,090 milligrams per liter in the Magenta Dolomite Member; 144,000 milligrams per liter in the Culebra Dolomite Member; and 412,000 milligrams per liter in the Rustler Formation-Salado Formation contact. According to categories assigned by the U.S. Geological Survey (Hem, 1970), water in the Magenta Dolomite Member is moderately saline, and water in the Culebra Dolomite Member and Rustler-Salado contact is briny.

Detailed information on the composition of water obtained from the Magenta, Culebra, and Rustler-Salado contact at wells H-5A, H-5B, and H-5C is presented in table 3. The table includes the major dissolved anions and cations, along with radioactive and miscellaneous constituents.

Table 3. Chemical composition of water obtained from well H-5A, Magenta Dolomite Member, and well H-5B, Culebra Dolomite Member of the Rustler Formation; and well H-5C, Rustler Formation-Salado Formation contact

[Chemical analysis in milligrams per liter unless otherwise noted g/mL = grams per milliliter; pCi/L = picocuries per liter; ug/L = micrograms per liter; U-NAT - uranium, natural; CS-137 = cesium-137; SR/YT-90 = strontium-yttrium-90]

Constituent or property	Well H-5A[1/]	Well H-5B[2/]	Well H-5C[3/]
Density, g/mL at 20°Celsius	1.008	1.106	1.193
Alkalinity, as calcium carbonate	41	34	180
Nitrogen, nitrite plus nitrate (NO_2+NO_3), dissolved,	.01	.01	-
Phosphate, ortho, dissolved (PO_4)	.00	.89	-
Phosphorus, ortho, dissolved (P)	.00	.29	-
Carbon, organic, total (C)	.6	2.4	-
Carbon, organic, dissolved (C)	.3	.7	-
Carbon, organic, suspended total (C)	.3	.3	-
Hardness, total ($CaCO_3$)	1,300	8,700	340,000
Hardness, noncarbonate ($CaCO_3$)	1,300	8,700	340,000
Calcium, dissolved (Ca)	240	360	2,100
Magnesium, dissolved (Mg)	170	1,900	82,000
Sodium, dissolved (Na)	1,500	53,000	14,000
Sodium adsorption ratio	18	247	10
Sodium, percent	71	92	8
Potassium, dissolved (K)	53	1,400	21,000
Chloride, dissolved (Cl)	880	86,000	290,000
Sulfate, dissolved (SO_4)	3,200	810	2,000
Fluoride, dissolved (F)	2.8	1.4	0
Bromide, dissolved, catalytic method (Br)	-	-	2,375
Silica, dissolved (SiO_2)	9.0	2.1	1.6

Table 3. Chemical composition of water obtained from well H-5A, Magenta Dolomite Member, and well H-5B, Culebra Dolomite Member of the Rustler Formation; and well H-5C, Rustler Formation-Salado Formation contact - Concluded

Constituent or property	Well H-5A[1/]	Well H-5B[2/]	Well H-5C[3/]
Gross alpha, dissolved (pCi/L as U-NAT)	-	2,700	<13,000
Gross alpha, suspended total (pCi/L as U-NAT)	-	-	.7
Gross beta, dissolved (pCi/L as CS-137)	53	1,100	15,000
Gross beta, suspended total (pCi/L as CS-137)	-	-	.6
Radium 226, dissolved, radon method (pCi/L)	17	290	310
Solids, sum of constituents, dissolved	6,090	144,000	412,000
Uranium, dissolved, extraction (µg/L)	1.0	1.0	<.04
Gross alpha, dissolved (µg/L as U-NAT)	160	4,000	<19,000
Gross alpha, suspended total (µg/L as U-NAT)	-	-	1.1
Gross beta, dissolved (pCi/L as SR/YT-90)	48	1,000	14,000
Gross beta, suspended total (pCi/L as SR/YT-90)	-	-	.6

1/ Sampled 12-14-78, 1420 hours.

2/ Sampled 12-19-78, 1355 hours.

3/ Sampled 05-16-79, 0855 hours.

Sampling methods

Samples for water-chemistry analyses were collected from wells H-5A and H-5B after completion of the hydrologic testing sequence. Each well was bailed prior to sampling to acquire the most representative formation sample possible. A stainless steel sampling tool was used to collect the sample opposite the formation tested. Well H-5C had to be sampled after the well was bailed dry because of the inflow of surface runoff. The well was allowed to recover and a sample was taken just prior to hydrologic testing. Because of the very slow recovery rate of the well, this was the only time a water sample could be taken that would represent actual formation water. A stainless steel sampling tool was used to collect the sample. The samples collected probably were representative of the formation, but the results of the analyses need to be used with discretion.

Analyses of total, suspended, and dissolved metals were made on the water samples but are not reported here because of problems with the sampling technique. Bailing caused vigorous aeration of the water in the well bore, which resulted in precipitation of metals previously in solution. The bailing process also caused flakes of corroding metal to be dislodged from the side of the casing or bailer and suspended in the sample water.

Radiochemistry

Radioactivity present in water from the Magenta Dolomite and Culebra Dolomite Members of the Rustler Formation and the Rustler Formation-Salado Formation contact is due to the natural radioactive decay of uranium, an element widely disseminated throughout the crust of the Earth. In order to establish background conditions, radiochemistry for the aquifers was determined. Concentration of radium-226, in picocuries per liter, in water samples was 17 from the Magenta, 290 from the Culebra, and 310 from the Rustler-Salado contact (table 3).

Chemical composition

Chemical composition of the water from the three zones is represented by a bar graph diagram in figure 17. Vertical bars are used to represent total anions and total cations. The bars are divided by horizontal lines to show the proportional concentrations of the major ions in milliequivalents per liter.

Chemical composition of the water from the three zones also is listed in table 4. Dissolved cations and anions are given in milliequivalents per liter, milligrams per liter, and percentage composition.

The concentration of dissolved ionic constituents in water is greatest at the Rustler-Salado contact and least in the Magenta Dolomite Member. The water at the Rustler-Salado contact and in the Culebra Dolomite Member is very mineralized; however, the percentage composition of dissolved ionic constituents is quite different. Dissolved ionic composition for the brine at the Rustler-Salado contact is predominantly chloride and magnesium, with sodium, potassium, calcium, and sulfate comprising most of the remainder of the dissolved ions. The dissolved composition of the Culebra Dolomite Member brine is predominantly chloride and sodium, with magnesium, calcium, potassium, and sulfate comprising most of the remainder of the dissolved ions. Predominant dissolved ions in the Magenta Dolomite Member are sulfate and sodium, with chloride, magnesium, calcium, and potassium comprising most of the remainder of the dissolved ions. The percentage of calcium in solution decreases with depth, whereas the percentage of chloride increases with depth (table 4).

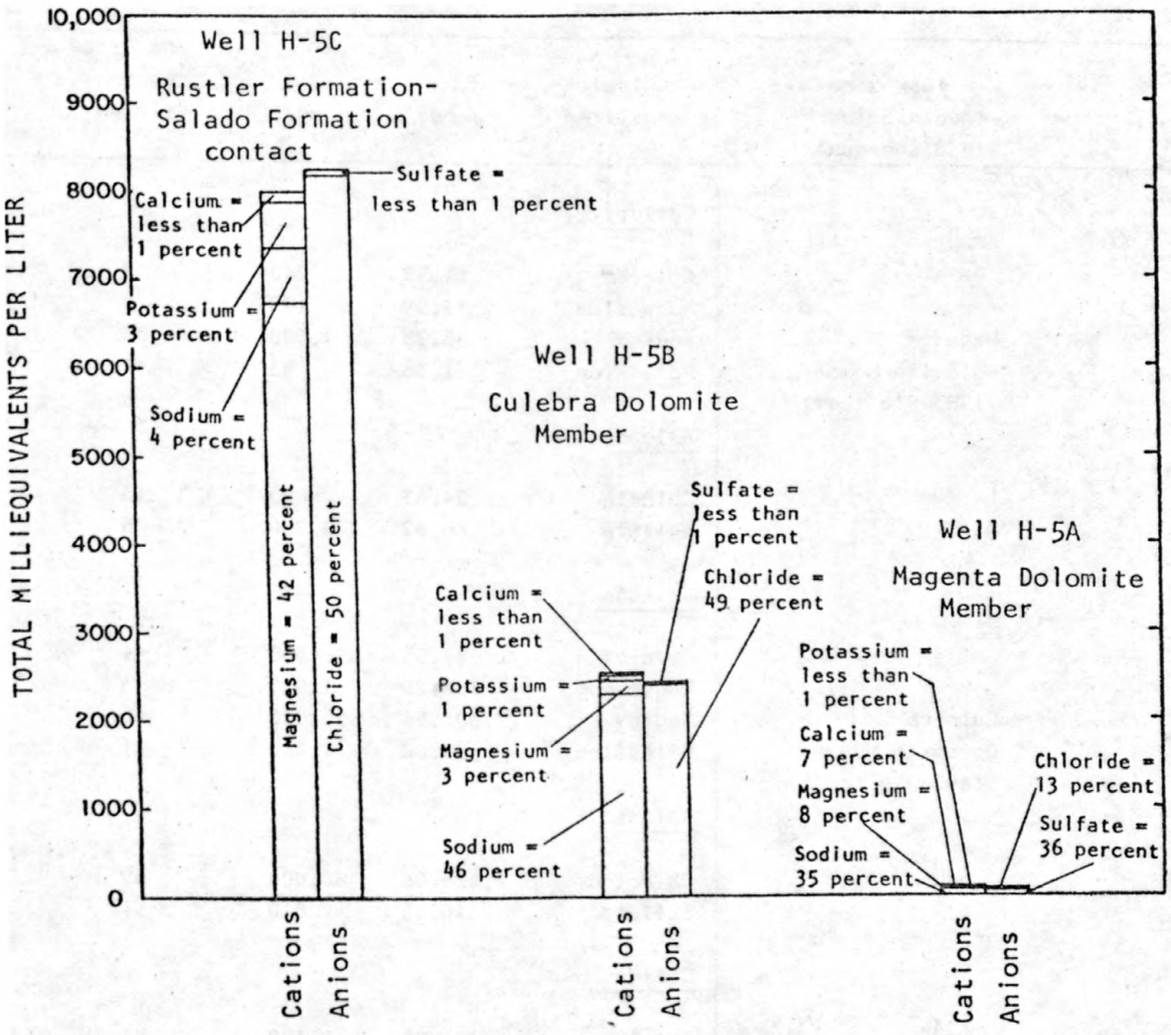

Figure 17.--Percentage composition of water from the Magenta Dolomite and Culebra Dolomite Members of the Rustler Formation, and Rustler Formation-Salado Formation contact.

Table 4. Major cations and anions in water from the Magenta Dolomite and Culebra Dolomite Members of the Rustler Formation and Rustler Formation-Salado Formation contact

[meq/L, milliequivalent per liter; mg/L, milligrams per liter]

Well	Test zone (depth below land surface)	Chemical composition	meq/L	mg/L	Percentage composition
H-5A	Magenta Dolomite Member (783-810 feet)	Cations			
		Calcium	11.99	240	7
		Magnesium	13.99	170	8
		Sodium	65.25	1,500	35
		Potassium	1.36	53	<1
		Anions			
		Chloride	24.83	880	13
		Sulfate	66.62	3,200	36
H-5B	Culebra Dolomite Member (897-920 feet)	Cations			
		Calcium	17.96	360	<1
		Magnesium	156.29	1,900	3
		Sodium	2,305.50	53,000	46
		Potassium	35.80	1,400	1
		Anions			
		Chloride	2,426.06	86,000	49
		Sulfate	16.86	810	<1
H-5C	Rustler Formation-Salado Formation contact (1,041 feet)	Cations			
		Calcium	104.79	2,100	<1
		Magnesium	6,745.32	82,000	42
		Sodium	609.00	14,000	4
		Potassium	536.97	21,000	3
		Anions			
		Chloride	8,180.90	290,000	50
		Sulfate	41.64	2,000	<1

SUMMARY

Wells H-5A, H-5B, and H-5C are located in the northeastern part of the proposed Waste Isolation Pilot Plant site in southeastern New Mexico. Drilling of these wells took place during May 1978. Hydrologic testing and water chemistry investigations were completed by June 1980.

The three test zones under investigation at the proposed repository site yield water to wells at rates less than 0.6 gallon per minute. For this reason, shut-in tests and slug tests were used to calculate transmissivities and estimates for the coefficients of storage. Special testing procedures were developed to perform these tests. A distinct component of the procedure included a pressure-transducer system used throughout the testing sequence to monitor the water-pressure response in the tested zone.

Hydrologic-testing results are as follows:

Well	Test zone	Calculated transmissivity (foot squared per day)	Estimated storage coefficient
H-5A	Magenta Dolomite Member of the Rustler Formation	0.1	10^{-5}
H-5B	Culebra Dolomite Member of the Rustler Formation	.2	10^{-5}
H-5C	Rustler Formation-Salado Formation contact	.00003	10^{-3}

The slug test may give a more accurate value for transmissivity than the shut-in test for the following reasons:

(1) Subjectivity in determining the straight line part of the shut-in curve to be used in acquiring the change in the hydraulic head throughout one log cycle of time (Δp);

(2) Difficulty met in obtaining a sufficient flow time preceding the shut-in to determine an actual average discharge (Q) of water from the test zone; and

(3) Early time readings taken during the shut-in tests were apparently dominated by well-bore storage effects.

In addition, the slug test has the added advantage of providing an estimate of the storage coefficient.

Although the slug test appears to give more reliable results, the shut-in test will continue to be used at the WIPP site because it consists of monitoring test-zone pressures during preparation for the slug test. In addition, should anything go wrong with either test, the remaining test still provides a transmissivity value.

Chemical analysis of water obtained from the Magenta Dolomite Member indicated this water to be moderately saline based on dissolved-solids concentration of 6,090 milligrams per liter. The predominate ions in the water from the Magenta were sodium and sulfate. Chemical analysis of water obtained from the Culebra Dolomite Member and Rustler-Salado contact indicated these waters to be briny based on dissolved-solids concentrations of 144,000 and 412,000 milligrams per liter, respectively. The predominate ions in the water from the Culebra were sodium and chloride, whereas in the water from the Rustler-Salado contact magnesium and chloride were the predominate ions. Radium-226, a naturally occurring radioactive element, is present in the three waters.

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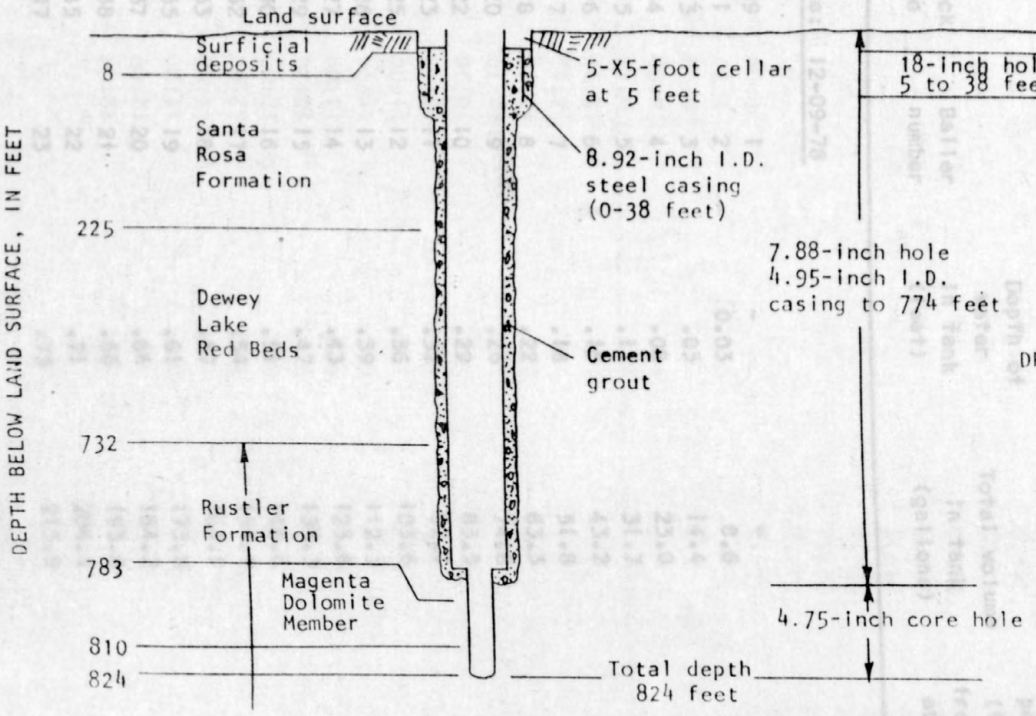
Papadopulos, S. S., Bredehoeft, J. D., and Cooper, H. H., Jr., 1973, On the analysis of "slug test" data: Water Resources Research, v. 9, no. 4, p. 1087-1089.

Theis, C. V., 1935, The relation between the lowering of the piezometric surface and the rate and duration of discharge of a well using ground-water storage: American Geophysical Union Transactions., v. 16, p. 519-524.

SUPPLEMENTAL INFORMATION

This section contains data collected during onsite operations, including construction detail of wells (fig. 18) and test data (table 5) used for the calculations that appear earlier in the text.

WELL H-5A



LOCATION: 1093 feet from north line, 184 feet from east line, section 15, Township 22 South, Range 31 East, Eddy County, New Mexico

ALTITUDE: 3506.2 feet

DEPTH DRILLED: 824 feet

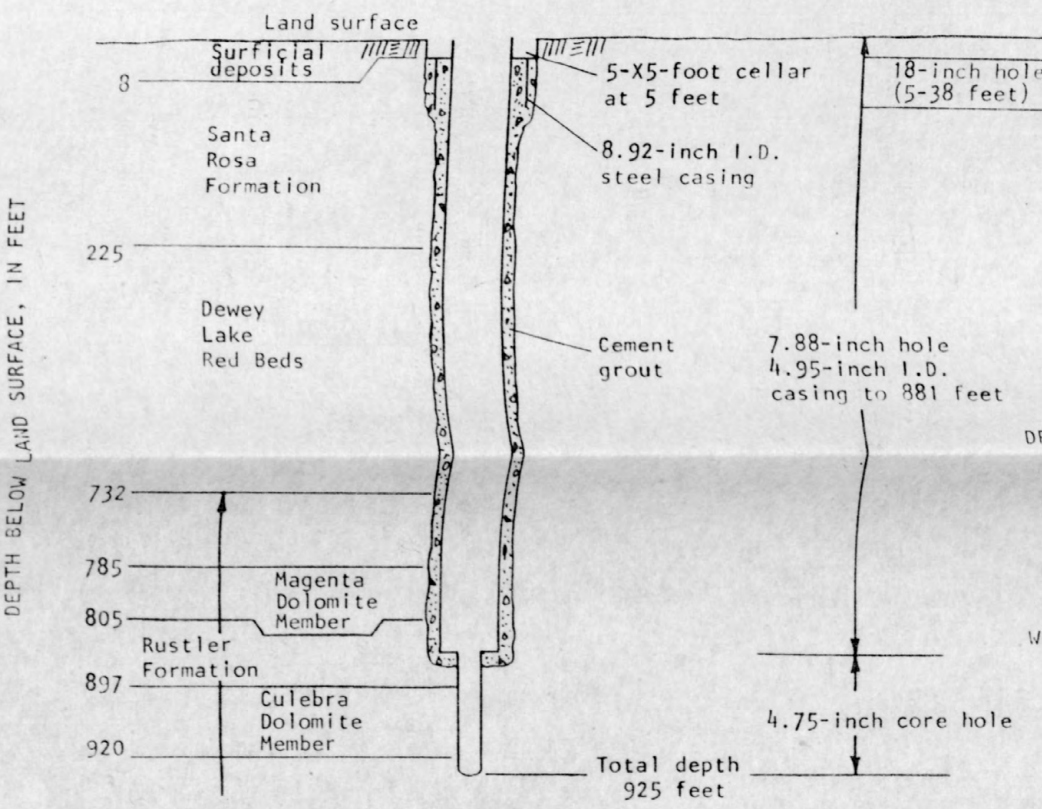
DATE COMPLETED: June 20, 1978

DRILLING CONTRACTOR: Pennsylvania Drilling Company, Carlsbad, New Mexico

DRILLING METHOD: Drilled 18-inch hole using auger (5-38 feet). Rotary drilled 7.88-inch hole with air (38-109 feet), changed to air foam (109-775 feet). Cut 4.75-inch core using brine (775-824 feet).

WELL CASING RECORD: 8.92-inch inside diameter steel casing (0-38 feet). 4.95-inch inside diameter steel casing (0-774 feet).

WELL H-5B



LOCATION: 1007 feet from north line, 234 feet from east line, section 15, Township 22 South, Range 31 East, Eddy County, New Mexico

ALTITUDE: 3506.0 feet

DEPTH DRILLED: 925 feet

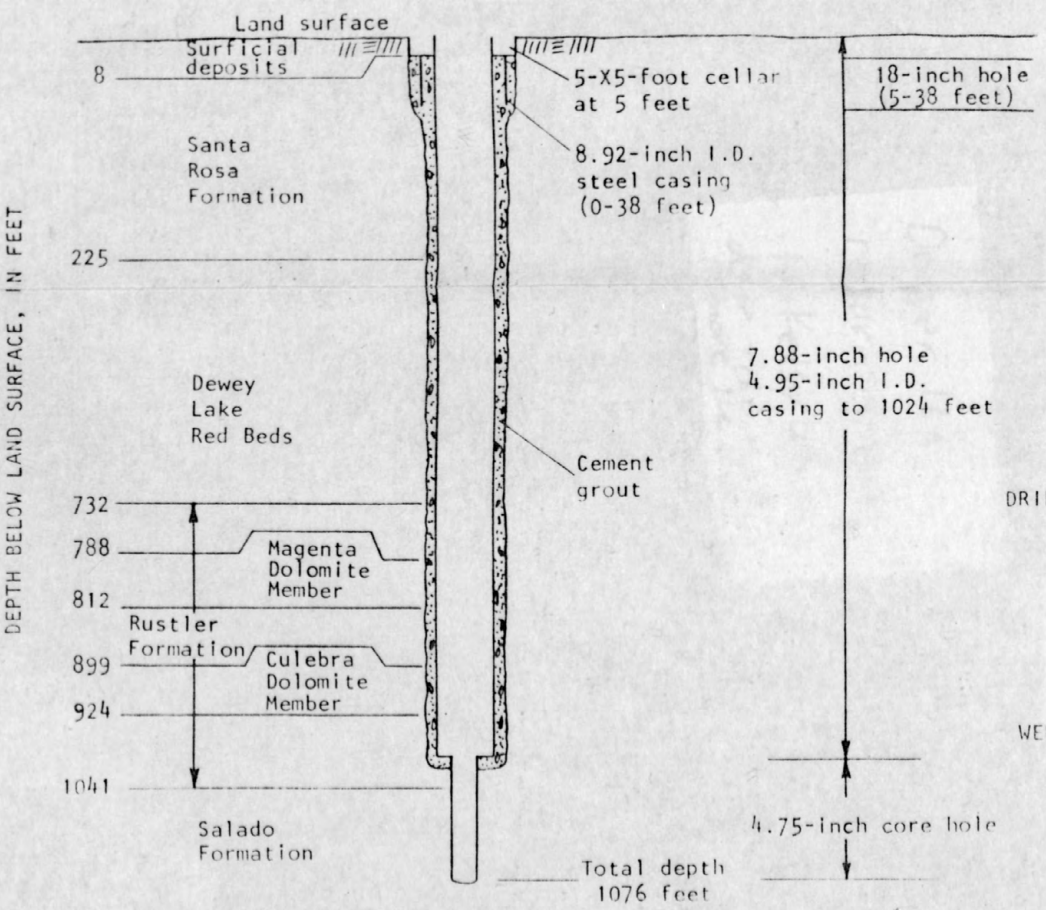
DATE COMPLETED: June 13, 1978

DRILLING CONTRACTOR: Pennsylvania Drilling Company, Carlsbad, New Mexico

DRILLING METHOD: Drilled 18-inch hole using auger (5-38 feet). Rotary drilled 7.88-inch hole with air (38-148 feet),changed to air foam (148-882 feet). Cut 4.75-inch core using brine (882-925 feet).

WELL CASING RECORD: 8.92-inch inside diameter steel casing (0-38 feet). 4.95-inch inside diameter steel casing (0-881 feet).

WELL H-5C



LOCATION: 1006 feet from north line, 134 feet from east line, section 15, Township 22 South, Range 31 East, Eddy County, New Mexico

ALTITUDE: 3506.4 feet

DEPTH DRILLED: 1076 feet

DATE COMPLETED: June 3, 1978

DRILLING CONTRACTOR: Pennsylvania Drilling Company, Carlsbad, New Mexico

DRILLING METHOD: Drilled 18-inch hole using auger (5-38 feet). Rotary drilled 7.88-inch hole with air (38-225 feet), changed to air foam (225-1025 feet). Cut 4.75-inch core using brine (1025-1048 feet), changed to air (1048-1076).

WELL CASING RECORD: 8.92-inch inside diameter steel casing (0-38 feet). 4.95-inch inside diameter steel casing (0-1024 feet).

Figure 18.--Construction detail of wells H-5A, H-5B, and H-5C.

Table 5. Hydrologic-test data for wells H-5A, H-5B, and H-5C

H-5A - Bailing Test 1

Starting date: 12-09-78
Hole depth: 824 feet
Cased interval: 0-774 feet
Tested interval: 744-824 feet
Diameter of tested interval: 4.75 inches
Geologic unit tested: Magenta Dolomite Member of the Rustler Formation

Water levels were measured with a pressure transducer.
Measuring point (MP) for the recovery from bailing was the pressure transducer, which was 732 feet below land surface.
Static water level was 346.5 feet below land surface.

Type of bailer: Dart valve
Length: 19.5 feet
Diameter: 3.5 inches
Capacity: 9.75 gallons

A circular stock tank was used to hold the water removed during bailing.
Diameter of the stock tank: 7 feet.

Clock time	Bailer number	Depth of water in tank (feet)	Total volume in tank (gallons)	Water pressure (feet of freshwater above MP)	Time since bailing stopped (minutes:seconds)
Date: 12-09-78					
1009	1	-	-	-	-
1011	2	0.03	8.6	-	-
1013	3	.05	14.4	-	-
1014	4	.08	23.0	-	-
1015	5	.11	31.7	-	-
1016	6	.15	43.2	-	-
1017	7	.18	51.8	-	-
1018	8	.22	63.3	-	-
1020	9	.26	74.8	-	-
1022	10	.29	83.5	-	-
1023	11	.32	92.1	-	-
1025	12	.36	103.6	-	-
1026	13	.39	112.3	-	-
1027	14	.43	123.8	-	-
1029	15	.47	135.3	-	-
1030	16	.51	146.8	-	-
1032	17	.54	155.4	-	-
1033	18	.57	164.1	-	-
1035	19	.61	175.6	-	-
1037	20	.64	184.2	-	-
1038	21	.68	195.8	-	-
1045	22	.71	204.4	-	-
1047	23	.75	215.9	-	-

Table 5. Hydrologic-test data for wells H-5A, H-5B, and H-5C - Continued

H-5A - Bailing Test 1 - Continued

Clock time	Bailer number	Depth of water in tank (feet)	Total volume in tank (gallons)	Water pressure (feet of freshwater above MP)	Time since bailing stopped (minutes:seconds)
Date: 12-09-78 - Continued					
1049	24	0.78	224.5	-	-
1051	25	.82	236.0	-	-
1052	26	.86	247.6	-	-
1054	27	.90	259.1	-	-
1057	28	.93	267.7	-	-
1100	29	.96	276.4	-	-
1102	30	1.00	287.9	-	-
1103	31	1.04	299.4	-	-
1105	32	1.08	310.9	-	-
1111	33	1.12	322.4	-	-
1112	34	1.15	331.0	-	-
1115	35	1.17	336.8	-	-
1116	36	1.20	345.4	-	-
1118	37	1.23	354.1	-	-
1120	38	1.26	362.7	-	-
1124	39	1.30	374.2	-	-
1125	40	1.33	382.9	-	0:00
1133:20	-	-	-	0.6	8:20
-	-	-	-	.9	8:45
-	-	-	-	1.0	9:00
-	-	-	-	1.2	9:15
-	-	-	-	1.3	9:30
-	-	-	-	1.4	9:45
-	-	-	-	1.5	10:00
-	-	-	-	1.6	10:15
-	-	-	-	1.7	10:30
-	-	-	-	1.7	10:45
-	-	-	-	1.8	11:00
-	-	-	-	2.0	11:30
-	-	-	-	2.2	12:00
-	-	-	-	2.4	12:30
-	-	-	-	2.6	13:00
-	-	-	-	2.8	13:30
-	-	-	-	3.0	14:00
-	-	-	-	3.2	14:30
1140	-	-	-	3.4	15:00
-	-	-	-	3.7	16:00

Table 5. Hydrologic-test data for wells H-5A, H-5B, and H-5C - Continued

H-5A - Bailing Test 1 - Concluded

Clock time	Bailer number	Depth of water in tank (feet)	Total volume in tank (gallons)	Water pressure (feet of freshwater above MP)	Time since bailing stopped (minutes:seconds)
Date: 12-09-78 - Concluded					
-	-	-	-	4.1	17:00
-	-	-	-	4.5	18:00
-	-	-	-	4.9	19:00
-	-	-	-	5.3	20:00
-	-	-	-	6.0	22:00
-	-	-	-	7.1	25:00
-	-	-	-	9.0	30:00
-	-	-	-	10.8	35:00
-	-	-	-	12.6	40:00
-	-	-	-	14.3	45:00
-	-	-	-	16.1	50:00
-	-	-	-	17.8	55:00
-	-	-	-	19.4	60:00
-	-	-	-	22.8	70:00
-	-	-	-	26.0	80:00
-	-	-	-	29.1	90:00
-	-	-	-	32.2	100:00
-	-	-	-	35.2	110:00
1325	-	-	-	38.2	120:00

Table 5. Hydrologic-test data for wells H-5A, H-5B, and H-5C - Continued

H-5A - Shut-in Test 1

Starting date: 12-09-78
Shut in after: Bailing
Hole depth: 824 feet
Cased interval: 0-774 feet
Tested interval: 774-824 feet

Diameter of tested interval: 4.75 inches
Geologic unit tested: Magenta Dolomite Member of the Rustler Formation
Packer type: Lynes PIP**
Diameter: 4.5 inches

Packer set at 769.6 feet below land surface.
Measuring point (MP) was transducer pressure port below the packer, which was 773.3 feet below land surface.
Static water level was 346.5 feet below land surface as measured at 0805 on 12-10-78.

REMARKS: t = time since bailing began (minutes)
t' = time since shut in (minutes)

Clock time	Stop watch time (minutes: seconds)	Water pressure (feet of freshwater above MP)	t/t'	Change in barometric pressure (inches of mercury referenced to 0)	Remarks
Date: 12-09-78					
1525:38	0:0	144.5	-	0	Pretest reading
-	:05	191.1	3800.6	0	Packer set
-	:10	197.8	1900.8	0	-
-	:15	200.9	1267.5	0	-
-	:20	206.2	950.9	0	-
-	:25	211.7	760.9	0	-
-	:30	216.3	634.3	0	-
-	:35	220.9	543.8	0	-
-	:40	225.6	475.9	0	-
-	:45	229.7	423.2	0	-
-	:50	-	-	0	-
-	:55	-	-	0	-
-	1:00	238.0	317.6	0	-
-	1:10	243.0	272.4	0	-
-	1:20	248.6	238.5	0	-
-	1:30	252.5	212.1	0	-
-	1:40	256.7	191.0	0	-
-	1:50	260.1	173.7	0	-
-	2:00	264.0	159.3	0	-
-	2:10	272.0	147.1	0	-

Table 5. Hydrologic-test data for wells H-5A, H-5B, and H-5C - Continued

H-5A - Shut-in Test 1- Continued

Clock time	Stop watch time (minutes: seconds)	Water pressure (feet of freshwater above MP)	t/t'	Change in barometric pressure (inches of mercury referenced to 0)	Remarks
Date: 12-09-78 - Continued					
-	2:20	273.1	136.7	0	-
-	2:30	272.9	127.7	0	-
-	2:40	274.1	119.7	0	-
-	2:50	275.3	112.8	0	-
1528:38	3:00	276.3	106.5	0	-
-	3:15	277.1	98.4	0	-
-	3:30	279.3	91.5	0	-
-	3:45	281.3	85.4	0	-
-	4:00	283.0	80.2	0	-
-	4:30	286.4	71.4	0	-
-	5:00	289.4	64.3	0	-
-	6:00	294.2	53.8	0	-
-	7:00	298.7	46.2	0	-
-	8:00	302.0	40.6	0	-
-	10:00	307.7	32.7	0	-
-	12:00	312.5	27.4	0	-
-	13:00	314.5	25.4	0.01	-
-	15:00	318.0	22.1	.01	-
-	17:00	321.2	19.6	.01	-
-	18:00	322.7	18.6	.01	-
-	20:00	325.5	16.8	.01	-
-	25:00	331.3	13.7	.01	-
-	30:00	335.9	11.6	.01	-
-	36:00	340.8	9.8	.01	-
-	40:00	343.5	8.9	.01	-
-	46:00	346.8	7.9	.01	-
-	51:00	350.1	7.2	.01	-
-	55:00	352.0	6.8	.01	-
-	60:00	354.3	6.3	.01	-
-	65:00	356.5	5.87	.01	-
-	70:00	358.5	5.52	.01	-
-	75:00	360.2	5.22	.01	-
-	80:00	362.0	4.96	.01	-
-	90:00	365.2	4.52	.01	-
-	100:00	368.0	4.17	.02	-
-	111:00	370.6	3.85	.02	-
-	120:00	372.6	3.64	.02	-

Table 5. Hydrologic-test data for wells H-5A, H-5B, and H-5C - Continued

H-5A - Shut-in Test I- Concluded

Clock time	Stop watch time (minutes: seconds)	Water pressure (feet of freshwater above MP)	t/t'	Change in barometric pressure (inches of mercury referenced to 0)	Remarks
Date: 12-09-78 - Concluded					
-	130:00	374.4	3.44	0.02	-
-	140:00	376.2	3.26	.02	-
1755:38	150:00	377.9	3.11	.03	-
-	160:00	379.3	2.98	.03	-
-	171:00	380.9	2.85	.03	-
-	180:00	382.0	2.76	.03	-
-	210:00	385.3	2.51	.03	-
-	240:00	387.9	2.32	.02	-
-	280:00	390.7	2.13	.02	-
-	300:00	391.7	2.06	.01	-
-	330:00	393.0	1.96	.01	-
-	360:00	394.5	1.88	0	-
-	390:00	395.8	1.81	0	-
-	420:00	397.0	1.75	0	-
-	452:00	398.0	1.70	0	-
-	482:00	398.9	1.66	- .02	-
-	510:00	399.8	1.62	- .02	-
Date: 12-10 78					
0025:38	540:00	400.4	1.59	- .03	-
0618	-	405.7	1.35	- .08	-
0655	-	405.9	1.34	- .07	-
0830	-	405.2	1.31	- .07	-
0900	-	404.8	1.30	- .07	-
1126	-	405.6	1.26	- .13	-
1248	-	406.1	1.25	- .17	-
1607	-	408.3	1.21	- .19	-
Date: 12-11-78					
0708	-	411.9	1.13	.20	-
0741	-	411.0	1.13	.21	-
0810	-	410.5	1.13	.22	-

** The use of the trade name is for descriptive purposes only and does not imply endorsement by the U.S. Geological Survey.

Table 5. Hydrologic-test data for wells H-5A, H-5B, and H-5C - Continued

H-5A - Slug Test I

Starting date: 12-11-78
Hole depth: 824 feet
Cased interval: 0-774 feet
Tested interval: 774-824 feet
Diameter of tested interval: 4.75 inches
Inside diameter (ID) of tubing: 2.0 inches
Geologic unit tested: Magenta Dolomite Member of the Rustler Formation
Packer type: Lynes PIP with feed through
Diameter: 4.5 inches

Packer set at 769.9 feet below land surface.
Measuring point (MP) was transducer pressure port below packer which was 773.3 feet below land surface.
Static water level was 346.5 feet below land surface.

REMARKS:

$$H/H^{\circ} = \frac{h-h_I}{h_o-h_I}$$

Clock time	Water pressure (feet of freshwater above MP)	Time (seconds)	H/H_o	Change in barometric pressure (inches of mercury referenced to 0)	Remarks
Date: 12-11-78					
0810	410.5	-	-	0	Pretest reading.
0844	-	0	-	0	Knocked plug out of packer.
-	750.8	5	-	0	-
-	790.3	10	-	0	-
-	765.4	15	-	0	-
-	767.2	20	1.000	0	*
-	767.3	25	1.000	0	-
-	767.0	30	0.999	0	-
-	766.6	35	.998	0	-
-	766.2	40	.997	0	-
-	766.0	45	.997	0	-
-	765.6	50	.996	0	-
-	765.2	55	.994	0	-
-	765.0	60	.994	0	-
-	764.4	70	.992	0	-
-	763.7	80	.990	0	-

Table 5. Hydrologic-test data for wells H-5A, H-5B, and H-5C - Continued

H-5A - Slug Test I- Continued

Clock time	Water pressure (feet of freshwater above MP)	Time (seconds)	H/H_o	Change in barometric pressure (inches of mercury referenced to 0)	Remarks
Date: 12-11-78					
-	763.2	90	0.989	0	-
-	762.6	100	0.987	0	-
-	762.1	110	0.986	0	-
-	761.6	120	0.984	0	-
-	760.0	150	0.980	0	-
-	758.4	180	0.975	0	-
-	757.0	210	0.971	0	-
-	755.5	240	0.967	0	-
-	752.7	300	0.959	0	-
0850	750.1	360	0.952	0	-
-	747.3	420	0.944	0	-
-	744.8	480	0.937	0	-
-	740.1	600	0.924	0	-
-	735.5	720	0.911	0	-
-	733.3	780	0.905	0	-
-	729.1	900	0.893	0	-
-	725.0	1020	0.882	0	-
-	719.0	1200	0.865	0	-
-	709.9	1500	0.839	0	-
-	701.2	1800	0.815	0	-
-	693.1	2100	0.792	.01	-
-	685.4	2400	0.771	.01	-
-	677.9	2700	0.750	.01	-
-	670.8	3000	0.730	.01	-
-	657.3	3600	0.692	.01	-
-	651.0	3900	0.674	.01	-
-	643.7	4260	0.654	0	-
-	638.9	4500	0.640	0	-
-	633.4	4800	0.625	0	-
-	627.9	5100	0.609	0	-
-	622.7	5400	0.595	0	-
-	612.8	6000	0.567	- .01	-

Table 5. Hydrologic-test data for wells H-5A, H-5B, and H-5C - Continued

H-5A - Slug Test 1- Concluded

Clock time	Water pressure (feet of freshwater above MP)	Time (seconds)	H/H_o	Change in barometric pressure (inches of mercury referenced to 0)	Remarks
Date: 12-11-78					
-	603.2	6600	0.540	-0.01	-
-	594.3	7200	.515	- .02	-
-	586.0	7800	.492	- .03	-
-	578.1	8400	.470	- .04	-
-	570.7	9000	.449	- .04	-
-	563.7	9600	.429	- .05	-
-	557.3	10200	.412	- .06	-
-	551.0	10800	.394	- .07	-
-	534.3	12600	.347	- .10	-
1244	520.5	14400	.308	- .11	-
-	508.2	16200	.274	- .13	-
-	497.8	18000	.245	- .14	-
-	488.8	19800	.220	- .14	-
-	481.0	21600	.198	- .14	-
-	474.1	23400	.178	- .14	-

* $\frac{H}{H_o} = \frac{h' - 410.5}{767.2 - 410.5}$

Table 5. Hydrologic-test data for wells H-5A, H-5B, and H-5C - Continued

H-5A - Shut-in Test 2

Starting date: 12-11-78
Shut in after: Slug test
Hole depth: 824 feet
Cased interval: 0-774 feet
Tested interval: 774-824 feet

Diameter of tested interval: 4.75 inches
Geologic unit tested: Magenta Dolomite Member of the Rustler Formation
Packer type: Lynes PIP **
Diameter: 4.5 inches

Packer set at 769.6 feet below land surface.
Measuring point (MP) was transducer pressure port below the packer, which was 773.3 feet below land surface.
Static water level was 346.5 feet below land surface as measured at 0805 on 12-10-78.

REMARKS: t = time since bailing began (minutes)
t' = time since shut in (minutes)

Clock time	Stop watch time (minutes: seconds)	Water pressure (feet of freshwater above MP)	t/t'	Change in barometric pressure (inches of mercury referenced to 0)	Remarks
Date: 12-11-78					
1514	-	474.1	-	0	Pretest.
1528:36	0:0	-	-	0	Set seat nipple.
-	0:10	510.0	2428.6	0	-
-	0:15	488.8	1619.4	0	-
-	0:20	478.9	1214.8	0	-
-	0:25	474.0	972.0	0	-
-	0:30	470.2	810.2	0	-
-	0:35	467.4	694.6	0	-
-	0:40	465.3	607.9	0	-
-	0:45	463.2	540.5	0	-
-	0:50	462.2	486.5	0	-
-	0:55	461.0	442.4	0	-
-	1:00	459.9	405.6	0	-
-	1:10	458.0	347.8	0	-
-	1:20	456.3	304.5	0	-

Table 5. Hydrologic-test data for wells H-5A, H-5B, and H-5C - Continued

H-5A - Shut-in Test 2 - Concluded

Clock time	Stop watch time (minutes: seconds)	Water pressure (feet of freshwater above MP)	t/t'	Change in barometric pressure (inches of mercury referenced to 0)	Remarks
Date: 12-11-78					
-	1:30	455.2	270.7	0	-
-	1:40	453.9	243.8	0	-
-	1:50	453.0	221.7	0	-
-	2:00	452.3	203.3	0	-
-	2:30	450.2	162.8	0	-
-	3:00	448.0	135.9	0	-
-	3:30	447.6	116.6	0	-
-	4:00	446.7	102.2	0	-
1533:36	5:00	445.3	81.9	0	-
-	6:00	444.2	68.4	0	-
-	7:00	443.4	58.8	0	-
-	8:00	442.6	51.6	0	-
-	10:00	441.5	41.5	0	-
-	12:00	440.7	34.7	0	-
-	13:00	440.5	32.1	0	-
-	15:00	439.9	28.0	0	-
-	17:00	439.1	24.8	0	-
-	20:00	438.5	21.2	0	-
-	25:00	437.4	17.2	0	-
-	30:00	436.7	14.5	0	-
-	35:00	436.0	12.6	0	-
-	40:00	435.4	11.1	0	-
-	45:00	434.6	10.0	0	-
-	50:00	434.3	9.1	0	-
-	60:00	433.4	7.7	0	-
-	65:00	433.0	7.2	0	-
-	70:00	432.8	6.8	0	-
-	75:00	432.5	6.4	0	-
-	80:00	432.3	6.1	0	-
-	85:00	432.2	5.8	0	-
-	90:00	432.1	5.5	0	-
-	110:00	431.4	4.7	0	-
1728:36	120:00	430.9	4.4	0	-

Table 5. Hydrologic-test data for wells H-5A, H-5B, and H-5C - Continued

H-5B - Bailing Test 1

Starting date: 12-13-78
Hole depth: 925 feet
Cased interval: 0-881 feet
Tested interval: 881-925 feet
Diameter of tested interval: 4.75 inches
Geologic unit tested: Culebra Dolomite Member of the Rustler Formation

Static water level was 478.7 feet below land surface.

Type of bailer: Dart valve
Length: 19.5 feet
Diameter: 3.5 inches
Capacity: 9.75 gallons

A circular stock tank was used to hold the water removed during bailing.

Diameter of the stock tank: 7 feet.

Clock time	Bailer number	Depth of water in tank (feet)	Total volume in tank (gallons)	Water pressure (feet of freshwater above MP)	Time since bailing stopped (minutes:seconds)	Change in barometric pressure (in. of mercury referenced to 0)	Remarks
Date: 12-13-78							
0830	-	-	-	478.7	-	-	*
1000	1	-	-	-	-	-	-
1003	2	0.1	28.8	-	-	-	-
1004	3	-	-	-	-	-	-
1005	4	.17	48.9	-	-	-	-
1007	5	-	-	-	-	-	-
1008	6	-	-	-	-	-	-
1010	7	.30	86.4	-	-	-	-
1011	8	-	-	-	-	-	-
1014	9	.35	100.8	-	-	-	-
1015	10	.39	112.3	-	-	-	-
1016	11	-	-	-	-	-	-
1018	12	.45	129.6	-	-	-	-
1020	13	-	-	-	-	-	-
1022	14	-	-	-	-	-	-
1023	15	.59	169.9	-	-	-	-
1025	16	-	-	-	-	-	-
1026	17	-	-	-	-	-	-
1028	18	-	-	-	-	-	-
1029	19	.73	210.2	-	-	-	-
1031	20	-	-	-	-	-	-
1032	21	-	-	-	-	-	-
1034	22	.81	233.2	-	-	-	-

Table 5. Hydrologic-test data for wells H-5A, H-5B, and H-5C - Continued

H-5B - Bailing Test 1 - Continued

Clock time	Bailer number	Depth of water in tank (feet)	Total volume in tank (gallons)	Water pressure (feet of freshwater above MP)	Time since bailing stopped (minutes:seconds)	Change in barometric pressure (in. of mercury referenced to 0)	Remarks
Date: 12-13-78							
1036	23	-	-	-	-	-	-
1037	24	-	-	-	-	-	-
1039	25	-	-	-	-	-	-
1042	26	-	-	-	-	-	-
1044	27	1.03	296.5	-	-	-	-
1046	28	-	-	-	-	-	-
1047	29	-	-	-	-	-	-
1049	30	-	-	-	-	-	-
1051	31	-	-	-	-	-	-
1053	32	-	-	-	-	-	-
1055	33	-	-	-	-	-	-
1056	34	-	-	-	-	-	-
1058	35	1.25	359.9	-	-	-	-
1100	36	-	-	-	-	-	-
1102	37	-	-	-	-	-	-
1104	38	-	-	-	-	-	-
1106	39	-	-	-	-	-	-
1108	40	1.45	417.5	-	-	-	-
1110	41	-	-	-	-	-	-
1114	42	-	-	-	-	-	-
1116	43	-	-	-	-	-	-
1118	44	-	-	-	-	-	-
1121	45	1.65	475.0	-	-	-	-
1123	46	-	-	-	-	-	-
1126	47	1.81	521.1	-	0:00	-	-
1131	-	-	-	-	5:00	-	-
-	-	-	-	-	5:30	-	-
-	-	-	-	-	6:00	-	-
-	-	-	-	1.3	6:30	-	-
-	-	-	-	1.7	7:00	-	-
-	-	-	-	2.1	7:30	-	-
1139	-	-	-	2.5	8:00	-	-
1139:30	-	-	-	2.8	8:30	-	-
-	-	-	-	3.2	9:00	-	-
-	-	-	-	3.5	9:30	-	-
-	-	-	-	3.9	10:00	-	-

Table 5. Hydrologic-test data for wells H-5A, H-5B, and H-5C - Continued

H-5B - Bailing Test 1 - Continued

Clock time	Bailer number	Depth of water in tank (feet)	Total volume in tank (gallons)	Water pressure (feet of freshwater above MP)	Time since bailing stopped (minutes:seconds)	Change in barometric pressure (in. of mercury referenced to 0)	Remarks
Date: 12-13-78							
-	-	-	-	4.2	10:30	-	-
-	-	-	-	4.5	11:00	-	-
-	-	-	-	4.9	11:30	-	-
-	-	-	-	5.2	12:00	-	-
-	-	-	-	5.5	12:30	-	-
-	-	-	-	5.8	13:00	-	-
-	-	-	-	6.2	13:30	-	-
-	-	-	-	6.5	14:00	-	-
-	-	-	-	6.8	14:30	-	-
-	-	-	-	7.1	15:00	-	-
-	-	-	-	7.8	16:00	-	-
-	-	-	-	8.4	17:00	-	-
-	-	-	-	9.0	18:00	-	-
-	-	-	-	9.7	19:00	-	-
-	-	-	-	10.3	20:00	-	-
-	-	-	-	11.0	21:00	-	-
-	-	-	-	11.6	22:00	-	-
-	-	-	-	12.3	23:00	-	-
-	-	-	-	12.8	24:00	-	-
-	-	-	-	13.5	25:00	-	-
-	-	-	-	14.7	27:00	-	-
-	-	-	-	15.9	29:00	-	-
-	-	-	-	17.1	31:00	-	-
-	-	-	-	18.3	33:00	-	-
-	-	-	-	19.6	35:00	-	-
-	-	-	-	20.8	37:00	-	-
-	-	-	-	22.0	39:00	-	-
-	-	-	-	23.2	41:00	-	-
-	-	-	-	24.4	43:00	-	-
-	-	-	-	25.6	45:00	-	-
-	-	-	-	26.8	47:00	-	-
-	-	-	-	27.9	49:00	-	-
1222	-	-	-	28.9	51:00	-	-
1224	-	-	-	30.0	53:00	-	-
-	-	-	-	31.2	55:00	-	-
-	-	-	-	32.3	57:00	-	-

Table 5. Hydrologic-test data for wells H-5A, H-5B, and H-5C - Continued

H-5B - Bailing Test 1 - Concluded

Clock time	Bailer number	Depth of water in tank (feet)	Total volume in tank (gallons)	Water pressure (feet of freshwater above MP)	Time since bailing stopped (minutes:seconds)	Change in barometric pressure (in. of mercury referenced to 0)	Remarks
Date: 12-13-78							
-	-	-	-	33.3	59:00	-	-
-	-	-	-	34.1	61:00	-	-
-	-	-	-	35.1	63:00	-	-
-	-	-	-	36.1	65:00	-	-
-	-	-	-	37.1	67:00	-	-
-	-	-	-	38.2	69:00	-	-
-	-	-	-	39.2	71:00	-	-
-	-	-	-	40.3	72:00	-	-
-	-	-	-	41.2	75:00	-	-
-	-	-	-	42.3	77:00	-	-
-	-	-	-	43.3	79:00	-	-
-	-	-	-	44.3	81:00	-	-
-	-	-	-	45.3	83:00	-	-
-	-	-	-	46.3	85:00	-	-
-	-	-	-	47.2	87:00	-	-
-	-	-	-	48.2	89:00	-	-
-	-	-	-	49.2	91:00	-	-
-	-	-	-	50.2	93:00	-	-
-	-	-	-	51.1	95:00	-	-
-	-	-	-	52.1	97:00	-	-
-	-	-	-	53.1	99:00	-	-
-	-	-	-	54.0	101:00	-	-
-	-	-	-	54.9	103:00	-	-
-	-	-	-	55.9	105:00	-	-
-	-	-	-	56.8	107:00	-	-
-	-	-	-	-	109:00	-	-
0122	-	-	-	58.8	111:00	-	**

* Water level below land surface prior to bailing.

** Bailed 5 additional bailers prior to running packer in hole.

Table 5. Hydrologic-test data for wells H-5A, H-5B, and H-5C - Continued

H-5B - Shut-in Test 1

Starting date: 12-13-78
Shut in after: Bailing
Hole depth: 925 feet
Cased interval: 0-881 feet
Tested interval: 881-925 feet

Diameter of tested interval: 4.75 inches
Geologic unit tested: Culebra Dolomite Member of the Rustler Formation
Packer type: Lynes PIP **
Diameter: 4.5 inches

Packer set at 875.0 feet below land surface.
Measuring point (MP) was transducer pressure port below the packer, which was 878.6 feet below land surface.
Static water level was 478.7 feet below land surface as measured at 0830 on 12-13-78.

REMARKS: t = time since bailing began (minutes)
t' = time since shut in (minutes)

Clock time	Stop watch time (minutes: seconds)	Water pressure (feet of freshwater above MP)	t/t'	Change in barometric pressure (inches of mercury referenced to 0)	Remarks
Date: 12-11-78					
1503	-	-	-	0	Pretest readings.
1512:40	0:00	-	0	0	Packer inflated.
-	:10	116.9	1877.0	0	-
-	:20	128.1	939.0	0	-
-	:30	140.5	626.3	0	-
-	:40	151.8	470.0	0	-
-	:50	163.7	376.2	0	-
-	1:00	175.4	313.7	0	-
-	1:10	184.0	269.0	0	-
-	1:20	192.3	235.1	0	-
-	1:30	199.8	209.4	0	-
-	1:40	205.9	188.6	0	-
-	1:50	212.3	171.6	0	-
-	2:00	217.1	157.3	0	-
-	2:10	221.8	145.3	0	-
-	2:20	225.3	135.0	0	-
-	2:30	228.8	126.1	0	-

Table 5. Hydrologic-test data for wells H-5A, H-5B, and H-5C - Continued

H-5B - Shut-in Test 1 - Continued

Clock time	Stop watch time (minutes: seconds)	Water pressure (feet of freshwater above MP)	t/t'	Change in barometric pressure (inches of mercury referenced to 0)	Remarks
Date: 12-13-78					
-	2:40	231.8	118.3	0	-
-	2:50	234.9	111.4	0	-
-	3:00	237.5	105.2	0	-
-	3:10	239.8	99.7	0	-
-	3:20	241.8	94.8	0	-
-	3:30	243.8	90.3	0	-
-	3:40	245.6	86.3	0	-
1516:30	3:50	247.3	82.6	0	-
1516:40	4:00	249.0	79.2	0	-
-	4:10	250.6	76.0	0	-
-	4:20	252.1	73.2	0	-
-	4:30	253.6	70.5	0	-
-	4:40	254.9	68.0	0	-
-	4:50	256.2	65.7	0	-
-	5:00	257.5	63.5	0	-
-	5:15	259.3	60.6	0	-
-	5:30	261.0	57.8	0	-
-	5:45	262.7	55.4	0	-
-	6:00	264.2	53.1	0	-
-	6:15	265.7	51.0	0	-
-	6:30	267.1	49.1	0	-
-	6:45	268.4	47.3	0	-
-	7:00	269.8	45.7	0	-
-	7:15	271.1	44.1	0	-
-	7:30	272.2	42.7	0	-
-	7:45	273.4	41.3	0	-
-	8:00	274.5	40.1	0	-
-	8:15	275.6	38.9	0	-
-	8:30	276.5	37.8	0	-
-	8:45	277.6	36.7	0	-
-	9:00	278.5	35.7	0	-
-	9:15	279.4	34.8	0	-
-	9:30	280.4	33.9	0	-

Table 5. Hydrologic-test data for wells H-5A, H-5B, and H-5C - Continued

H-5B - Shut-in Test 1 - Continued

Clock time	Stop watch time (minutes: seconds)	Water pressure (feet of freshwater above MP)	t/t'	Change in barometric pressure (inches of mercury referenced to 0)	Remarks
Date: 12-13-78					
-	9:45	281.3	33.1	0	-
-	10:00	282.2	32.3	0	-
-	10:30	284.7	30.8	0	-
-	11:00	293.6	29.4	0	Pressured up on packer.
-	11:30	288.8	28.2	0	-
-	12:00	289.4	27.1	0	-
-	12:30	290.3	26.0	0	-
-	13:00	291.5	25.1	0	-
-	13:30	292.7	24.2	0	-
1526:40	14:00	294.8	23.3	0	-
1527:10	14:30	295.3	22.6	0	-
-	15:00	296.3	21.8	0	-
-	15:30	297.2	21.2	0	-
-	16:00	298.2	20.5	0	-
-	16:30	299.2	19.9	0	-
-	17:00	300.1	19.4	0	-
-	17:30	301.0	18.9	0	-
-	18:00	301.9	18.4	0	-
-	18:30	302.8	17.9	0	-
-	19:00	303.7	17.5	0	-
-	19:30	304.5	17.0	0	-
-	20:00	305.4	16.6	-0.01	-
-	21:00	307.0	15.9	- .01	-
-	22:00	308.4	15.2	- .01	-
-	23:00	309.9	14.6	- .01	-
-	24:00	311.2	14.0	- .01	-
-	25:00	312.6	13.5	- .01	-
-	26:00	313.8	13.0	- .01	-
-	27:00	315.0	12.6	- .01	-
-	28:00	316.1	12.2	- .01	-
-	29:00	317.2	11.8	0	-
-	30:00	318.2	11.4	0	-
-	32:00	320.0	10.8	0	-
-	34:00	322.0	10.2	0	-

Table 5. Hydrologic-test data for wells H-5A, H-5B, and H-5C - Continued

H-5B - Shut-in Test 1 - Continued

Clock time	Stop watch time (minutes: seconds)	Water pressure (feet of freshwater above MP)	t/t'	Change in barometric pressure (inches of mercury referenced to 0)	Remarks
Date: 12-13-78					
-	36:00	324.0	9.7	0	-
-	38:00	325.8	9.2	0	-
-	40:00	327.4	8.8	0	-
-	42:00	328.9	8.4	0	-
-	44:00	330.3	8.1	0	-
-	46:00	331.8	7.8	0	-
-	48:00	333.1	7.5	0	-
-	50:00	334.3	7.3	0	-
-	56:00	337.6	6.6	0	-
-	60:00	339.7	6.2	0	-
1617:40	65:00	342.0	5.8	0	-
1622:40	70:00	344.1	5.5	-0.01	-
-	80:00	347.9	4.9	- .01	-
-	90:00	351.2	4.5	0	-
-	100:00	354.2	4.1	.01	-
-	107:00	355.9	3.9	.01	-
-	127:00	360.5	3.5	.01	-
-	147:00	364.3	3.1	.01	-
-	167:00	367.7	2.9	.01	-
-	187:00	370.6	2.7	.01	-
-	207:00	373.4	2.5	.01	-
-	227:00	375.8	2.4	.01	-
-	247:00	378.0	2.3	.03	-
-	267:00	380.0	2.2	.01	-
-	287:00	381.8	2.1	.02	-
-	307:00	383.4	2.02	.02	-
-	327:00	385.0	1.96	.01	-
-	347:00	386.4	0	.01	-
-	367:00	387.7	1.85	.03	-
-	387:00	389.0	1.81	.04	-
-	407:00	390.2	1.77	.01	-
-	427:00	391.2	1.73	.02	-
-	447:00	392.3	1.70	.01	-
-	467:00	393.1	1.67	0	-
-	487:00	394.1	1.64	.01	-
-	507:00	395.0	1.62	- .01	-
-	527:00	395.9	1.59	- .02	-

Table 5. Hydrologic-test data for wells H-5A, H-5B, and H-5C - Continued

H-5B - Shut-in Test 1 - Concluded

Clock time	Stop watch time (minutes: seconds)	Water pressure (feet of freshwater above MP)	t/t'	Change in barometric pressure (inches of mercury referenced to 0)	Remarks
Date: 12-14-78					
-	547:00	396.7	1.57	-0.03	-
-	567:00	397.4	1.55	- .03	-
-	587:00	398.2	1.53	- .04	-
-	607:00	398.8	1.52	- .05	-
-	627:00	399.6	1.50	- .06	-
-	647:00	400.2	1.48	- .06	-
-	667:00	400.8	1.47	- .07	-
-	687:00	401.4	1.46	- .08	-
02:59:40	707:00	401.9	1.44	- .08	-
03:19:40	727:00	402.4	1.43	- .10	-
-	747:00	402.9	1.42	- .10	-
-	767:00	403.4	1.41	- .12	-
-	787:00	403.9	1.40	- .12	-
-	807:00	404.4	1.39	- .12	-
-	827:00	404.8	1.38	- .13	-
-	847:00	405.2	1.37	- .13	-
-	867:00	405.6	1.36	- .13	-
-	887:00	405.9	1.35	- .15	-
06:19:40	907:00	406.3	1.345	- .14	-
-	927:00	406.6	1.337	- .16	-
-	947:00	406.9	1.330	- .16	-
-	967:00	407.2	1.323	- .15	-
-	987:00	407.4	1.317	- .18	-
07:59:40	1007:00	407.5	1.311	- .18	-
-	1019:00	407.6	1.307	- .18	-
08:29:40	1037:00	407.7	1.302	- .17	-
-	1047:00	407.6	1.299	- .19	-
-	1057:00	407.5	1.296	- .18	-
-	1077:00	407.5	1.290	- .21	-
09:19:40	1087:00	407.5	1.288	- .21	-

Table 5. Hydrologic-test data for wells H-5A, H-5B, and H-5C - Continued

H-5B - Slug Test 1

Starting date: 12-14-78
Hole depth: 925 feet
Cased interval: 0-881 feet
Tested interval: 881-925 feet
Diameter of tested interval: 4.75 inches
Inside diameter (ID) of tubing: 2.0 inches
Geologic unit tested: Culebra Dolomite Member of the Rustler Formation
Packer type: Lynes PIP ** with feed through
Diameter: 4.5 inches

Packer set at 875.0 feet below land surface.
Measuring point (MP) was transducer pressure port below packer, which was 878.6 feet below land surface.
Static water level was 478.7 feet below land surface.

REMARKS:

$$H/H_o = \frac{h'-h_i}{h_o-h_i}$$

Clock time	Water pressure (feet of freshwater above MP)	Time (seconds)	H/H_o	Change in barometric pressure (inches of mercury referenced to 0)	Remarks
Date: 12-14-78					
0912	407.4	-	-	0	Pretest reading.
-	946.2	10	1.000	0	*
-	939.8	20	0.988	0	-
-	938.7	30	.986	0	-
-	937.5	40	.984	0	-
-	936.1	50	.981	0	-
-	935.1	60	.979	0	-
-	934.0	70	.977	0	-
-	932.8	80	.975	0	-
-	932.0	90	.974	0	-
-	930.9	100	.972	0	-
-	930.0	110	.970	0	-
-	928.9	120	.968	0	-
-	928.0	130	.966	0	-
-	927.0	140	.964	0	-
-	926.0	150	.963	0	-

Table 5. Hydrologic test data for wells H-5A, H-5B, and H-5C - Continued

H-5B - Slug Test I - Continued

Clock time	Water pressure (feet of freshwater above MP)	Time (seconds)	H/H_o	Change in barometric pressure (inches of mercury referenced to 0)	Remarks
Date: 12-14-78					
-	925.0	160	0.961	0	-
-	924.2	170	.959	0	-
-	923.2	180	.957	0	-
-	922.3	190	.956	0	-
-	921.3	200	.954	0	-
-	920.5	210	.952	0	-
0915:40	919.6	220	.951	0	-
0915:50	918.8	230	.949	0	-
-	917.0	250	.946	0	-
-	916.1	260	.944	0	-
-	915.3	270	.943	0	-
-	914.4	280	.941	0	-
-	913.5	290	.939	0	-
-	912.7	300	.938	0	-
-	911.5	315	.936	0	-
-	910.1	330	.933	0	-
-	908.9	345	.931	0	-
-	907.6	360	.928	0	-
-	906.5	375	.926	0	-
-	905.2	390	.924	0	-
-	904.1	405	.922	0	-
-	902.8	420	.919	0	-
-	901.6	435	.917	0	-
-	900.5	450	.915	0	-
-	899.3	465	.913	0	-
-	898.1	480	.911	0	-
-	897.0	495	.909	0	-
-	895.3	510	.906	0	-
-	894.7	525	.904	0	-
-	893.5	540	.902	0	-
-	892.4	555	.900	0	-
-	891.4	570	.898	0	-
-	890.2	585	.896	0	-
-	889.1	600	.894	0	-
-	888.0	615	.892	0	-
-	887.0	630	.890	0	-

Table 5. Hydrologic test data for wells H-5A, H-5B, and H-5C - Continued

H-5B - Slug Test 1 - Continued

Clock time	Water pressure (feet of freshwater above MP)	Time (seconds)	H/H_o	Change in barometric pressure (inches of mercury referenced to 0)	Remarks
Date: 12-14-78					
-	885.8	645	0.888	0	-
0923	884.8	660	.886	0	-
0923:30	882.6	690	.882	0	-
-	880.6	720	.878	0	-
-	878.4	750	.874	0	-
-	876.4	780	.870	0	-
-	874.4	810	.867	0	-
-	872.4	840	.863	0	-
-	870.4	870	.859	0	-
-	868.3	900	.855	0	-
-	866.3	930	.852	0	-
-	864.5	960	.848	0	-
-	862.6	990	.845	0	-
-	860.7	1020	.841	-0.01	-
-	858.7	1050	.838	- .01	-
-	856.7	1080	.834	- .01	-
-	855.0	1110	.831	- .01	-
-	853.1	1140	.827	- .01	-
-	851.3	1170	.824	- .01	-
-	849.4	1200	.820	- .01	-
-	847.6	1230	.817	- .01	-
-	845.8	1260	.814	- .01	-
-	844.0	1290	.810	- .01	-
-	842.2	1320	.807	- .01	-
-	840.4	1350	.804	- .01	-
-	838.7	1380	.800	- .01	-
-	836.9	1410	.797	- .01	-
-	835.2	1440	.794	- .01	-
-	833.5	1470	.791	- .02	-
-	831.8	1500	.788	- .02	-
-	828.3	1560	.781	- .02	-
-	825.0	1620	.775	- .02	-
-	821.6	1680	.769	- .02	-
0941	818.3	1740	.763	- .02	-
0942	815.2	1800	.757	- .02	-
-	808.8	1920	.754	- .02	-

Table 5. Hydrologic test data for wells H-5A, H-5B, and H-5C - Continued

H-5B - Slug Test 1 - Concluded

Clock time	Water pressure (feet of freshwater above MP)	Time (seconds)	H/H_o	Change in barometric pressure (inches of mercury referenced to 0)	Remarks
Date: 12-14-78					
-	802.5	2040	0.733	-0.02	-
-	796.5	2160	.722	- .02	-
-	790.3	2280	.711	- .02	-
-	784.7	2400	.700	- .02	-
-	776.4	2520	.685	- .02	-
-	773.6	2640	.680	- .02	-
-	768.1	2760	.669	- .02	-
-	762.7	2880	.659	- .02	-
-	757.4	3000	.650	- .02	-
-	746.5	3240	.629	- .02	-
-	742.5	3360	.622	- .03	-
-	737.1	3480	.612	- .03	-
-	732.7	3600	.604	- .03	-
-	709.8	4200	.561	- .03	-
-	699.5	4500	.542	- .03	-
-	689.4	4800	.523	- .03	-
-	680.3	5100	.506	- .05	-
-	671.4	5400	.490	- .05	-
-	659.5	5820	.468	- .05	-
-	646.8	6300	.444	- .06	-
-	639.2	6600	.430	- .06	-
-	632.0	6900	.417	- .07	-
-	625.0	7200	.404	- .07	-
-	611.8	7800	.379	- .08	-
-	599.5	8400	.357	- .09	-
-	588.3	9000	.336	- .10	-
1152	578.1	9600	.317	- .10	-
1202	568.5	10200	.299	- .12	-
-	560.1	10800	.283	- .13	-
-	544.5	12000	.254	- .13	-
-	531.2	13200	.230	- .14	-
1256	528.8	13440	.225	- .14	-

* $H/H_o = \frac{h' - 410.5}{767.2 - 410.5}$

Table 5. Hydrologic-test data for wells H-5A, H-5B, and H-5C - Continued

H-5B - Shut-in Test 2

Starting date: 12-14-78
Shut in after: Slug test
Hole depth: 925 feet
Cased interval: 0-881 feet
Tested interval: 881-925 feet

Diameter of tested interval: 4.75 inches
Geologic unit tested: Culebra Dolomite Member of the Rustler Formation
Packer type: Lynes PIP
Diameter: 4.5 inches

Packer set at 875.0 feet below land surface.
Measuring point (MP) was transducer pressure port below the packer, which was 878.6 feet below land surface.
Static water level was 478.7 feet below land surface as measured at 0830 on 12-13-78.

REMARKS: t = time since bailing began (minutes)
t' = time since shut in (minutes)

Clock time	Stop watch time (minutes: seconds)	Water pressure (feet of freshwater above MP)	t/t'	Change in barometric pressure (inches of mercury referenced to 0)	Remarks
Date: 12-14-78					
1318	0:00	520.4	-	0	Pretest
-	:10	488.6	1477.0	0	-
-	:20	484.1	739.0	0	-
-	:30	481.4	493.0	0	-
-	:40	479.6	370.0	0	-
-	:50	478.3	296.2	0	-
-	1:00	477.1	247.0	0	-
-	1:10	476.2	211.9	0	-
-	1:20	475.4	185.5	0	-
-	1:30	474.7	165.0	0	-
-	1:40	474.0	148.6	0	-
-	1:50	473.4	135.2	0	-
-	2:00	472.8	124.0	0	-
-	2:10	472.2	114.5	0	-
-	2:20	471.8	106.4	0	-
-	2:30	471.3	99.4	0	-
-	2:40	470.9	93.2	0	-
-	2:50	470.5	87.8	0	-
-	3:00	470.1	83.0	0	-

Table 5. Hydrologic-test data for wells H-5A, H-5B, and H-5C - Continued

H-5B - Shut-in Test 2 - Continued

Clock time	Stop watch time (minutes: seconds)	Water pressure (feet of freshwater above MP)	t/t'	Change in barometric pressure (inches of mercury referenced to 0)	Remarks
Date: 12-14-78					
-	3:10	469.7	78.7	0	-
-	3:20	469.3	74.8	0	-
-	3:30	469.0	71.3	0	-
-	3:40	468.7	68.1	0	-
-	3:50	468.4	65.2	0	-
1324	4:00	468.1	62.5	0	-
-	4:10	467.7	60.0	0	-
-	4:20	467.5	57.8	0	-
-	4:30	467.2	55.7	0	-
-	4:40	466.9	53.7	0	-
-	4:50	466.7	51.9	0	-
-	5:00	466.4	50.2	0	-
-	5:15	466.1	47.9	0	-
-	5:30	465.7	45.7	0	-
-	5:45	465.6	43.8	0	-
-	6:00	465.1	42.0	0	-
-	6:15	464.8	40.4	0	-
-	6:30	464.5	38.8	0	-
-	6:45	464.2	37.4	0	-
-	7:00	464.0	36.1	0	-
-	7:15	463.7	34.9	0	-
-	7:30	463.4	33.8	0	-
-	7:45	463.2	32.7	0	-
-	8:00	462.9	31.8	0	-
-	8:15	462.7	30.8	0	-
-	8:30	462.5	29.9	0	-
-	8:45	462.3	29.1	0	-
-	9:00	462.0	28.3	0	-
-	9:15	461.8	27.6	0	-
-	9:30	461.6	26.9	0	-
-	9:45	461.4	26.2	0	-
-	10:00	461.2	25.6	0	-
-	10:30	460.8	24.4	0	-
-	11:00	460.5	23.4	0	-
-	11:30	460.1	22.4	0	-
-	12:00	459.8	21.5	0	-

Table 5. Hydrologic-test data for wells H-5A, H-5B, and H-5C - Continued

H-5B - Shut-in Test 2 - Continued

Clock time	Stop watch time (minutes: seconds)	Water pressure (feet of freshwater above MP)	t/t'	Change in barometric pressure (inches of mercury referenced to 0)	Remarks
Date: 12-14-78					
-	12:30	459.4	20.7	0	-
-	13:00	459.1	19.9	0	-
-	13:30	458.8	19.2	0	-
1332	14:00	458.5	18.6	0	-
1332:30	14:30	458.2	18.0	0	-
-	15:00	458.0	17.4	0	-
-	15:30	457.7	16.9	0	-
-	16:00	457.5	16.4	0	-
-	16:30	457.2	15.9	0	-
-	17:00	457.0	15.5	0	-
-	17:30	456.7	15.1	0	-
-	18:30	456.2	14.3	0	-
-	19:00	456.0	13.9	0	-
-	19:30	455.8	13.6	0	-
-	20:00	455.5	13.3	0	-
-	20:30	455.3	13.0	0	-
-	21:00	455.1	12.7	0	-
-	22:00	454.7	12.2	0	-
-	23:00	454.3	11.7	0	-
-	24:00	453.9	11.2	0	-
-	25:00	453.6	10.8	0	-
-	26:00	453.3	10.5	0	-
-	27:00	452.9	10.1	0	-
-	28:00	452.5	9.79	0	-
-	29:00	452.3	9.48	0	-
-	30:00	452.0	9.20	0	-
-	32:00	451.3	8.69	0	-
-	34:00	450.7	8.24	0	-
-	36:00	450.4	7.83	0	-
-	38:00	449.8	7.47	0	-
-	40:00	449.4	7.15	0	-
-	45:00	448.3	6.47	0	-
-	50:00	447.3	5.92	-0.03	-
-	55:00	446.3	5.47	- .03	-
-	60:00	445.4	5.10	- .01	-

Table 5. Hydrologic-test data for wells H-5A, H-5B, and H-5C - Continued

H-5B - Shut-in Test 2 - Continued

Clock time	Stop watch time (minutes: seconds)	Water pressure (feet of freshwater above MP)	t/t'	Change in barometric pressure (inches of mercury referenced to 0)	Remarks
Date: 12-14-78					
-	65:00	444.4	4.78	-0.02	-
-	70:00	443.6	4.51	- .02	-
1433	75:00	443.0	4.28	- .03	-
1438	80:00	442.4	4.08	- .03	-
-	85:00	441.7	3.89	- .03	-
-	90:00	441.1	3.73	- .03	-
-	95:00	440.7	3.59	- .03	-
-	100:00	440.2	3.46	- .03	-
-	105:00	439.7	3.34	- .03	-
-	110:00	439.3	3.24	- .03	-
-	115:00	438.8	3.14	- .03	-
-	120:00	438.4	3.05	- .03	-
-	125:00	438.0	2.97	- .03	-
-	130:00	437.7	2.89	- .04	-
-	135:00	437.3	2.82	- .04	-
-	140:00	437.2	2.76	- .04	-
-	155:00	436.2	2.59	- .04	-
1603	165:00	435.9	2.49	- .04	-
					Serviced generator.
1638	200:00	433.6	2.23	- .08	-
-	220:00	433.3	2.12	- .07	-
-	240:00	432.7	2.03	- .05	-
-	260:00	432.2	1.95	- .03	-
-	280:00	431.7	1.88	- .03	-
-	280:00	431.7	1.88	- .03	-
-	300:00	431.3	1.82	- .04	-
-	320:00	430.8	1.77	- .03	-
-	340:00	430.4	1.72	- .02	-
-	360:00	429.9	1.68	- .01	-
-	380:00	429.6	1.65	0	-
-	400:00	429.1	1.62	0	-
-	420:00	428.8	1.59	- .03	-
-	440:00	428.5	1.56	0	-
-	460:00	428.2	1.53	0	-
-	480:00	428.0	1.51	0	-
-	500:00	427.8	1.49	0	-

Table 5. Hydrologic-test data for wells H-5A, H-5B, and H-5C - Continued

H-5B - Shut-in Test 2 - Concluded

Clock time	Stop watch time (minutes: seconds)	Water pressure (feet of freshwater above MP)	t/t'	Change in barometric pressure (inches of mercury referenced to 0)	Remarks
Date: 12-14-78					
-	520:00	427.5	1.47	0	-
-	540:00	427.2	1.46	0	-
2238	560:00	426.8	1.44	0	-
-	580:00	426.6	1.43	-0.02	-
-	600:00	426.4	1.41	- .02	-
-	620:00	426.3	1.40	- .06	-
-	640:00	426.1	1.38	- .04	-
Date: 12-15-78					
0018	660:00	425.9	1.37	- .03	-
-	680:00	425.8	1.36	- .03	-
-	700:00	425.6	1.35	- .03	-
-	720:00	425.6	1.34	- .04	-
-	740:00	425.4	1.33	- .03	-
-	760:00	425.2	1.32	- .04	-
-	780:00	425.2	1.32	- .05	-
-	800:00	425.0	1.308	- .04	-
-	820:00	424.9	1.300	- .04	-
-	840:00	424.7	1.293	- .03	-
-	860:00	424.7	1.286	- .02	-
-	880:00	424.7	1.280	- .03	-
-	900:00	424.7	1.273	- .04	-
-	920:00	424.7	1.267	- .05	-
-	940:00	424.5	1.262	- .04	-
-	960:00	424.4	1.256	- .04	-
-	980:00	424.3	1.251	- .04	-
-	1000:00	424.1	1.246	- .04	-
-	1020:00	424.1	1.241	- .04	-
-	1040:00	423.9	1.237	- .03	-
-	1060:00	423.7	1.232	- .04	-
-	1080:00	423.4	1.228	- .04	-
-	1100:00	423.0	1.224	- .05	-
-	1120:00	422.7	1.220	- .05	-
-	1130:00	422.9	1.218	- .04	-
0858	1180:00	422.1	1.208	- .05	-

Table 5. Hydrologic-test data for wells H-5A, H-5B, and H-5C - Continued

H-5B - Bailing Test 2

Starting date: 12-15-78
Hole depth: 925 feet
Cased interval: 0-881 feet
Tested interval: 881-925 feet
Diameter of tested interval: 4.75 inches
Geologic unit tested: Culebra Dolomite Member of the Rustler Formation

Water levels were measured with a pressure transducer.
Measuring point (MP) for the recovery from bailing was the pressure transducer, which was 878.6 feet below land surface.
Static water level was 478.7 feet below land surface.

Type of bailer: Dart valve
Length: 19.5 feet
Diameter: 3.5 inches
Capacity: 9.75 gallons

A circular stock tank was used to hold the water removed during bailing.
Diameter of the stock tank: 7 feet.

Clock time	Bailer number	Depth of water in tank (feet)	Total volume in tank (gallons)	Water pressure (feet of freshwater above MP)	Time since bailing stopped (minutes:seconds)
Date: 12-15-78					
1022	1	0.30	86.4	-	-
1024	2	-	-	-	-
1026	3	-	-	-	-
1028	4	-	-	-	-
1030	5	.46	132.4	-	-
1031	6	-	-	-	-
1033	7	-	-	-	-
1035	8	-	-	-	-
1037	9	-	-	-	-
1038	10	-	-	-	-
1041	11	-	-	-	-
1043	12	-	-	-	-
1045	13	-	-	-	-
1047	14	-	-	-	-
1048	15	.80	230.3	-	-
1051	16	-	-	-	-
1053	17	-	-	-	-
1055	18	.91	262.0	-	-
1057	19	-	-	-	-

Table 5. Hydrologic-test data for wells H-5A, H-5B, and H-5C - Continued

H-5C - Bailing Test 1

Starting date: 12-15-78
Hole depth: 1,075 feet
Cased interval: 0-1,025 feet

Tested interval: 1,025-1,076 feet
Diameter of tested interval: 4.75 inches
Geologic unit tested: Rustler Formation-Salado Formation contact

Water levels were measured with a pressure transducer.

Static water level was unknown at this time.

A circular stock tank was used to hold the water removed during bailing.
Diameter of the stock tank: 7 feet.

Remark: Hole was bailed dry and allowed to recover prior to hydrologic testing.

Clock time	Bailer number	Depth of water in tank (feet)	Total volume in tank (gallons)	Water pressure (feet of freshwater above MP)	Time since bailing stopped (minutes:seconds)
Date: 12-15-78					
1138	1	-	-	-	-
1140	2	-	-	-	-
1142	3	-	-	-	-
1143	4	-	-	-	-
1144	5	-	-	-	-
1146	6	-	-	-	-
1150	7	-	-	-	-
1152	8	-	-	-	-
1153	9	-	-	-	-
1155	10	-	-	-	-
1157	11	-	-	-	-
1159	12	-	-	-	-
1201	13	-	-	-	-
1203	14	-	-	-	-
1205	15	-	-	-	-
1208	16	-	-	-	-
1210	17	-	-	-	-
1212	18	-	-	-	-
1213	19	-	-	-	-
1215	20	-	-	-	-
1219	21	-	-	-	-
1221	22	-	-	-	-
1222	23	-	-	-	-
1224	24	-	-	-	-

Table 5. Hydrologic-test data for wells H-5A, H-5B, and H-5C - Continued

H-5C - Bailing Test 1 - Concluded

Clock time	Bailer number	Depth of water in tank (feet)	Total volume in tank (gallons)	Water pressure (feet of freshwater above MP)	Time since bailing stopped (minutes:seconds)
Date: 12-15-78					
1227	25	-	-	-	-
1229	26	-	-	-	-
1231	27	-	-	-	-
1233	28	-	-	-	-
1235	29	-	-	-	-
1237	30	-	-	-	-
1238	31	-	-	-	-
1240	32	-	-	-	-
1242	33	-	-	-	-
1244	34	-	-	-	-
1246	35	-	-	-	-
1248	36	-	-	-	-
1338	37	-	-	-	-
1341	38	-	-	-	-
1343	39	-	-	-	-
1345	40	-	-	-	-
1348	41	-	-	-	-
1350	42	-	-	-	-
1352	43	-	-	-	-
1355	44	-	-	-	-
1357	45	-	-	-	-
1403	46	-	-	-	-
1406	47	-	-	-	-
1409	48	-	-	-	-
1413	49	-	-	-	-
1416	50	-	-	-	-
1420	51	-	-	-	-
1422	52	-	-	-	-
1425	53	-	-	-	-
1428	54	-	-	-	-

Table 5. Hydrologic-test data for wells H-5A, H-5B, and H-5C - Continued

H-5C - Shut-in Test 2

Starting date: 05-18-79
Shut in after: Addition of about 90 gallons of water with approximately the same density as the formation water.
Tested interval: 1025-1076 feet
Diameter of tested interval: 4.750 inches
Geologic unit tested: Rustler Formation-Salado Formation Contact
Hole depth: 1076 feet
Cased interval: 0-1025 feet
Packer type: Lynes PIP
Diameter: 4.25 inches

Packer set at 959.5 feet below land surface.
Measuring point (MP) was transducer pressure port below the packer, which was 962.7 feet below land surface.
Static water level was unknown at this time

Remarks: This shut-in was performed to determine static head level, not to determine transmissivity. Due to the very low yield of this zone, water had to be added to raise the water level high enough to set the packer. About 90 gallons of water with approximately the same density as the formation water were added to H-5C. The plug was accidentally knocked out at the start of the first shut-in; therefore, the second shut-in was performed.

t = time since bailing began (minutes)
t' = time since shut in (minutes)

Clock time	Stop watch time (minutes: seconds)	Water pressure (feet of freshwater above MP)	t/t'	Change in barometric pressure (inches of mercury referenced to 0)	Remarks
Date: 05-18-79					
1105	-	122.9	-	-	Pretest reading.
1124:03	0:00	-	-	-	Packer set with weight of water in tubing alone.
-	:05	179.0	-	-	-
-	:10	171.2	-	-	-
-	:15	167.1	-	-	-
-	:20	164.9	-	-	-
-	:25	164.4	-	-	-
-	:30	163.7	-	-	-
-	:35	170.1	-	-	-

Table 5. Hydrologic-test data for wells H-5A, H-5B, and H-5C - Continued

H-5C - Shut-In Test 2 - Continued

Clock time	Stop watch time (minutes: seconds)	Water pressure (feet of freshwater above MP)	t/t'	Change in barometric pressure (inches of mercury referenced to 0)	Remarks
Date: 05-18-79					
-	0:40	176.6	-	-	-
-	:45	178.0	-	-	-
-	:50	184.6	-	-	-
-	:55	192.3	-	-	-
-	1:00	200.0	-	-	-
-	1:05	203.5	-	-	-
-	1:10	202.9	-	-	-
-	1:20	220.6	-	-	-
-	1:30	229.3	-	-	-
-	1:40	235.8	-	-	-
-	1:50	244.4	-	-	-
-	2:00	258.5	-	-	-
-	2:10	261.6	-	-	-
-	2:20	276.6	-	-	-
-	2:30	295.0	-	-	-
-	3:00	329.0	-	-	-
-	3:30	351.0	-	-	-
-	4:00	384.0	-	-	-
-	4:30	407.0	-	-	-
-	5:00	424.9	-	-	-
-	5:30	467.0	-	-	-
-	6:00	480.0	-	-	-
-	7:00	502.0	-	-	-
-	8:00	497.4	-	-	-
-	9:00	492.6	-	-	-
-	10:00	656.1	-	-	Inflated packer.
-	12:30	610.0	-	-	-
-	15:00	576.6	-	-	-
-	17:30	548.2	-	-	-
-	20:00	525.3	-	-	-
-	25:00	487.1	-	-	-
-	30:00	456.4	-	-	-
-	35:00	442.3	-	-	-
-	40:00	422.0	-	-	-

Table 5. Hydrologic-test data for wells H-5A, H-5B, and H-5C - Continued

H-5C - Shut-In Test 2 - Continued

Clock time	Stop watch time (minutes: seconds)	Water pressure (feet of freshwater above MP)	t/t'	Change in barometric pressure (inches of mercury referenced to 0)	Remarks
Date: 05-18-79					
-	45	406.5	-	-	-
-	50	393.1	-	-	-
-	55	381.5	-	-	-
-	62	367.5	-	-	-
-	70	354.0	-	-	-
-	80	340.1	-	-	-
1300	-	322.7	-	-	-
1310	-	314.2	-	-	-
1320	-	306.8	-	-	-
1330	-	300.4	-	-	-
1340	-	294.6	-	-	-
1350	-	289.6	-	-	-
1359	-	285.2	-	-	The following data were taken from a data logger and corrected for inaccuracies caused by temperature and power fluctuations.
1429	-	274.2	-	-	-
1458	-	266.1	-	-	-
1528	-	259.8	-	-	-
1557	-	254.9	-	-	-
1627	-	251.0	-	-	-
1656	-	247.9	-	-	-
1755	-	243.4	-	-	-
1854	-	240.5	-	-	-
1953	-	238.6	-	-	-
2052	-	237.5	-	-	-
2151	-	237.1	-	-	-
2250	-	237.1	-	-	-
2349	-	237.4	-	-	-

Table 5. Hydrologic-test data for wells H-5A, H-5B, and H-5C - Continued

H-5C - Shut-in Test 2 - Continued

Clock time	Stop watch time (minutes: seconds)	Water pressure (feet of freshwater above MP)	t/t'	Change in barometric pressure (inches of mercury referenced to 0)	Remarks
Date: 05-19-79					
0048	-	238.0	-	-	-
0147	-	238.8	-	-	-
0246	-	239.8	-	-	-
0345	-	241.0	-	-	-
0444	-	242.2	-	-	-
0543	-	243.5	-	-	-
0642	-	245.0	-	-	-
0741	-	246.6	-	-	-
0840	-	248.1	-	-	-
0940	-	249.8	-	-	-
Date: 05-19-79					
1000	-	250.2	-	-	The following data were taken from direct watch times.
Date: 05-21-79					
0915	-	324.0	-	-	-
Date: 05-24-79					
0925	-	399.7	-	-	-
Date: 05-25-79					
1115	-	419.7	-	-	-
Date: 05-29-79					
0915	-	475.0	-	-	-
Date: 05-31-79					
0920	-	495.1	-	-	-

Table 5. Hydrologic-test data for wells H-5A, H-5B, and H-5C - Continued

H-5C - Shut-in Test 2 - Continued

Clock time	Stop watch time (minutes: seconds)	Water pressure (feet of freshwater above MP)	t/t'	Change in barometric pressure (inches of mercury referenced to 0)	Remarks
Date: 06-01-79					
1000	-	503.5	-	-	-
Date: 06-04-79					
0910	-	525.6	-	-	-
Date: 06-05-79					
1250	-	532.8	-	-	-
Date: 06-06-79					
1050	-	538.0	-	-	-
Date: 06-07-79					
0900	-	542.8	-	-	-
Date: 06-08-79					
0900	-	547.9	-	-	-
Date: 06-11-79					
1250	-	561.8	-	-	-
Date: 06-13-79					
1515	-	569.5	-	-	-
Date: 06-15-79					
1610	-	575.9	-	-	-

Table 5. Hydrologic-test data for wells H-5A, H-5B, and H-5C - Continued

H-5C - Shut-in Test 2 - Continued

Clock time	Stop watch time (minutes: seconds)	Water pressure (feet of freshwater above MP)	t/t'	Change in barometric pressure (inches of mercury referenced to 0)	Remarks
Date: 06-18-79					
1110	-	584.7	-	-	-
Date: 06-20-79					
0940	-	590.0	-	-	-
Date: 06-25-79					
1040	-	601.7	-	-	-
Date: 06-27-79					
0930	-	605.7	-	-	-
Date: 06-29-79					
1050	-	609.4	-	-	-
Date: 07-03-79					
1045	-	616.4	-	-	-
Date: 07-09-79					
1035	-	625.4	-	-	-
Date: 07-13-79					
1015	-	630.8	-	-	-
Date: 07-17-79					
1050	-	635.6	-	-	-

Table 5. Hydrologic-test data for wells H-5A, H-5B, and H-5C - Continued

H-5C - Shut-in Test 2 - Concluded

Clock time	Stop watch time (minutes: seconds)	Water pressure (feet of freshwater above MP)	t/t'	Change in barometric pressure (inches of mercury referenced to 0)	Remarks
Date: 07-20-79					
1150	-	639.2	-	-	-
Date: 07-23-79					
1515	-	642.1	-	-	-
Date: 07-25-79					
1030	-	643.9	-	-	-
Date: 07-27-79					
1110	-	645.6	-	-	-
Date: 07-31-79					
0925	-	649.0	-	-	-
Date: 08-03-79					
0945	-	651.6	-	-	-
Date: 08-06-79					
1015	-	654.0	-	-	-
Date: 08-20-79					
1310	-	663.6	-	-	-
Date: 08-22-79					
1005	-	664.1	-	-	-
Date: 08-24-79					
0820	-	665.8	-	-	Readings stabilized.

Table 5. Hydrologic-test data for wells H-5A, H-5B, and H-5C - Continued

H-5C - Slug Test I

Starting date: 08-24-79
Hole depth: 1076 feet
Cased interval: 0-1025 feet
Tested interval: 1025-1076 feet
Diameter of tested interval: 4.75 inches
Inside diameter (ID) of tubing: 2.0 inches
Geologic unit tested: Rustler Formation-Salado Formation Contact
Packer type: Lynes PIP with feed through

Packer set at 959.5 feet below land surface.
Measuring point (MP) was transducer pressure port below packer, which was 926.7 feet below land surface.
Static water level was 297 feet below land surface.

REMARKS: $H/H_o = \frac{h'-h_i}{h_o-h_i}$

Clock time	Water pressure (feet of freshwater above MP)	Time (seconds)	H/H_o	Change in barometric pressure (inches of mercury referenced to 0)	Remarks
Date: 08-24-79					
0820	665.8	-	-	0	Pretest.
0822	-	0	-	0	Knocked plug out of packer.
-	158.0	60	1.000	0	*
-	158.2	120	1.000	0	-
-	158.3	180	0.999	-0.01	-
-	158.4	240	.999	- .01	-
-	158.4	300	.999	- .01	-
-	158.5	360	.999	- .01	-
-	158.5	420	.999	- .01	-
-	158.5	540	.999	- .01	-
-	158.6	600	.999	- .01	-
-	158.7	900	.999	- .01	-
-	158.9	1200	.998	- .02	-
-	159.0	1500	.998	- .02	-
-	159.1	1800	.998	- .02	-
-	159.2	2280	.998	- .02	-
-	159.3	2880	.997	- .02	-
-	159.5	3480	.997	- .03	-
-	159.4	4080	.997	- .03	-
-	159.5	5880	.997	-	-

Table 5. Hydrologic-test data for wells H-5A, H-5B, and H-5C - Continued

H-5C - Slug Test I - Continued

Clock time	Water pressure (feet of freshwater above MP)	Time (seconds)	H/H_o	Change in barometric pressure (inches of mercury referenced to 0)	Remarks
Date: 08-24-79					
-	159.9	9480	0.996	-	-
-	160.2	13080	.996	-	-
-	160.5	16680	.995	-	-
-	160.7	20280	.995	-	-
-	160.8	23880	.994	-	-
-	161.2	27480	.994	-	-
-	161.0	28080	.994	-	-
-	161.4	34680	.993	-	-
-	161.9	41880	.992	-	-
-	162.1	49080	.992	-	-
-	162.4	56280	.991	-	-
Date: 08-25-79					
-	162.6	63480	.991	-	-
-	162.9	70680	.990	-	-
-	163.1	77880	.990	-	-
-	163.5	85080	.989	-	-
-	163.5	88680	.989	-	-
-	164.3	99480	.988	-	-
-	165.2	121080	.986	-	-
-	165.8	142680	.985	-	-
Date: 08-26-79					
-	166.3	164280	.984	-	-
-	167.3	185880	.982	-	-
Date: 08-27-79					
-	169.8	272280	.977	-	-
Date: 08-28-79					
-	172.0	358680	.972	-	-

Table 5. Hydrologic-test data for wells H-5A, H-5B, and H-5C - Continued

H-5C - Slug Test I - Continued

Clock time	Water pressure (feet of freshwater above MP)	Time (seconds)	H/H_o	Change in barometric pressure (inches of mercury referenced to 0)	Remarks
Date: 08-29-79					
-	174.2	445080	0.968	-	-
Date: 08-30-79					
-	176.4	531480	.964	-	-
Date: 08-31-79					
-	178.5	617880	.960	-	-
Date: 09-01-79					
-	180.4	704280	.956	-	-
Date: 09-02-79					
-	182.4	790680	.952	-	-
Date: 09-03-79					
-	184.0	877080	.949	-	-
Date: 09-04-79					
-	186.1	974280	.945	-	-
-	186.2	977880	.944	-	-
Date: 09-05-79					
-	188.2	1071480	.941	-	-
Date: 09-06-79					
-	188.6	1114680	.940	-	-
-	189.9	1157880	.937	-	-

Table 5. Hydrologic-test data for wells H-5A, H-5B, and H-5C - Continued

H-5C - Slug Test I - Continued

Clock time	Water pressure (feet of freshwater above MP)	Time (seconds)	H/H_o	Change in barometric pressure (inches of mercury referenced to 0)	Remarks
Date: 09-07-79					
-	190.6	1201080	0.936	-	-
-	191.9	1244280	.933	-	-
Date: 09-08-79					
-	192.6	1287480	.932	-	-
-	192.7	1307280	.932	-	-
-	193.0	1330680	.931	-	-
Date: 09-09-79					
-	193.6	1373880	.930	-	-
-	194.8	1417080	.928	-	-
Date: 09-10-79					
-	195.2	1460280	.927	-	-
-	196.0	1480080	.925	-	-
Date: 09-13-79					
-	233.3	1734780	.852	-	The following are water-level measurements taken by logging winch and corrected for density.
Date: 09-18-79					
-	240.4	2164380	.838	-	-
Date: 09-25-79					
-	254.7	2769780	.810	-	-

Table 5. Hydrologic-test data for wells H-5A, H-5B, and H-5C - Continued

H-5C - Slug Test I - Continued

Clock time	Water pressure (feet of freshwater above MP)	Time (seconds)	H/H_o	Change in barometric pressure (inches of mercury referenced to 0)	Remarks
Date: 10-05-79					
-	265.5	3636480	0.788	-	-
Date: 10-10-79					
-	271.4	4065780	.777	-	-
Date: 10-19-79					
-	284.5	4845480	.751	-	-
Date: 10-26-79					
-	292.9	5456280	.734	-	-
Date: 11-01-79					
-	301.2	5977080	.718	-	Adjusted elapsed time to reflect change to Mountain Standard Time
Date: 11-09-79					
-	310.8	6667080	.699	-	-
Date: 11-13-79					
-	314.3	7010580	.692	-	-
Date: 11-21-79					
-	322.7	7696680	.676	-	-
Date: 11-26-79					
-	328.6	8129880	.644	-	-

Table 5. Hydrologic-test data for wells H-5A, H-5B, and H-5C - Continued

H-5C - Slug Test 1 - Continued

Clock time	Water pressure (feet of freshwater above MP)	Time (seconds)	H/H_o	Change in barometric pressure (inches of mercury referenced to 0)	Remarks
Date: 12-03-79					
-	337.0	8733480	0.648	-	-
Date: 12-10-79					
-	344.1	9346080	.634	-	-
Date: 02-01-80					
-	399.0	13930680	.525	-	-
Date: 02-13-80					
-	404.9	14967480	.514	-	-
Date: 02-27-80					
-	418.0	16173780	.488	-	-
Date: 03-02-80					
-	418.0	16518180	.488	-	-
Date: 03-12-80					
-	428.8	17384280	.467	-	-
Date: 04-05-80					
-	450.2	19448880	.425	-	-
Date: 04-16-80					
-	458.6	20397180	.408	-	-

Table 5. Hydrologic-test data for wells H-5A, H-5B, and H-5C - Concluded

H-5C - Slug Test I - Concluded

Clock time	Water pressure (feet of freshwater above MP)	Time (seconds)	H/H_o	Change in barometric pressure (inches of mercury referenced to 0)	Remarks
Date: 05-06-80					
-	472.9	22122480	.380	-	Adjusted elapsed time to reflect change to Daylight Savings Time.
Date: 06-10-80					
-	489.6	25142580	.347	-	-

* $H/H_o = \frac{665.8 - h'}{665.8 - 158.0 \text{ feet}}$