Water Levels in the Yucca Mountain Area, Nevada, 1997–98

By Robert P. Graves

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CONTENTS

FIGURES

TABLES

CONVERSION FACTORS AND VERTICAL DATUM

Multiply	By	To obtain
meter (m)	3.281	foot
millimeter (mm)	0.03937	inch
kilometer (km)	0.6214	mile
square kilometer (km^2)	0.3861	square mile
kilogram (kg)	2.205	pound avoirdupois
liter (L)	0.03531	cubic foot

Sea level: In this report "sea level" refers to the National Geodetic Vertical Datum of 1929 (NGVD of 1929)—a geodetic datum derived from a general adjustment of the first-order level nets of both the United States and Canada, formerly called Sea Level Datum of 1929.

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ABSTRACT

Water levels were monitored in 24 wells in the Yucca Mountain area, Nevada, during 1997 and 26 wells during 1998. These wells, which represented 31 depth intervals during 1997 and 33 depth intervals during 1998, were monitored periodically. All wells monitor water levels in volcanic rocks of Tertiary age except one that monitors water levels in carbonate rocks of Paleozoic age.

Mean water-level altitudes in the Tertiary volcanic rocks ranged from 727.87 to 1,034.57 meters above sea level during 1997 and from 727.86 to 1,034.76 meters above sea level during 1998. The mean water-level altitude in the well monitoring the Paleozoic carbonate rocks was 752.71 and 752.87 meters above sea level during 1997 and 1998, respectively.

During 1997–98, water levels in the Yucca Mountain area could have been affected by long-term pumping at the C-hole complex that began on May 8, 1996, and continued through November 12, 1997. Other ground-water pumpage in the Yucca Mountain area included annual pumpage from water-supply wells UE-25 J-12 and UE-25 J-13.

INTRODUCTION

The Yucca Mountain area is being evaluated by the U.S. Department of Energy for suitability to store high-level radioactive waste in a mined, underground repository. A 150-km^2 area located about 150 km northwest of Las Vegas in southern Nevada is being studied extensively (fig. 1). Water levels in selected wells have been measured periodically since 1981. The purpose of the water-level monitoring program is to gain a better understanding of the ground-water flow system in the area. The water-level data can be used to determine the direction and rate of ground-water flow and to estimate hydraulic parameters of the flow system. In the Yucca Mountain area, the water table is in air-fall and ash-flow tuffs of Tertiary age (fig. 2). Saturated carbonate rocks of Paleozoic age underlie the Tertiary volcanic rocks. The geology and description of stratigraphic units in the study area have been defined by Winograd and Thordarson (1975), Byers and others (1976), Carr and others (1986), and Carr (1988). The nomenclature for stratigraphic units in the study area was revised by Sawyer and others (1994, p. 1305), and this report uses the revised geologic nomenclature.

This report presents the 1997–98 water-level data and describes the equipment and methods used to collect and process the water-level data. The water-level network during 1997 included 24 wells representing 31 depth intervals and during 1998 included 26 wells representing 33 depth intervals. All 1997–98 water levels included in this report were collected periodically by means of manual measurements (fig. 1, tables 1 and 2). All wells monitor water levels in the various Tertiary-volcanic rocks that underlie the Yucca Mountain area except well UE-25 p#1, which monitors water levels in the Paleozoic carbonate rocks.

This report is a companion and supplement to other reports that present water levels in the Yucca Mountain area (Robison and others, 1988; Gemmell, 1990; O'Brien, 1991; Boucher, 1994b; Luckey and others, 1993; Lobmeyer and others, 1995; O'Brien and others, 1995; Tucci, O'Brien, and Burkhardt, 1996; Tucci, Goemaat, and Burkhardt, 1996; Graves and others, 1996; Graves and others, 1997; Graves and Goemaat, 1998; and Graves, 1998).

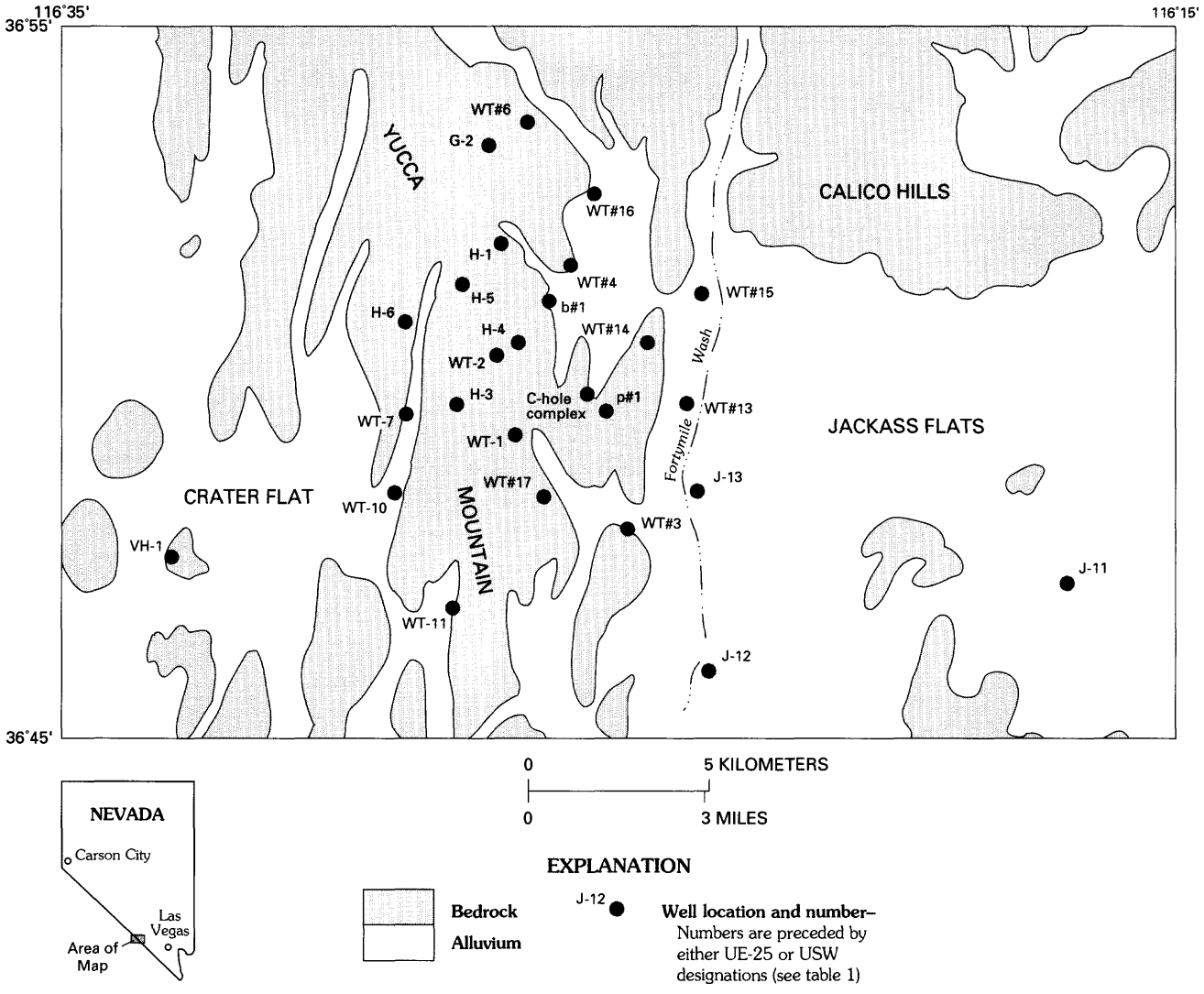

Figure 1. Location of Yucca Mountain area and location of wells.

The water-level data were collected as part of the Yucca Mountain Project of the U.S. Department of Energy. The Yucca Mountain Project is described by a Site Characterization Plan (U.S. Department of Energy, 1988). The data in this study were collected by the U.S. Geological Survey and its contractors in cooperation with the U.S. Department of Energy under Interagency Agreement DE–AI08–97NV12033.

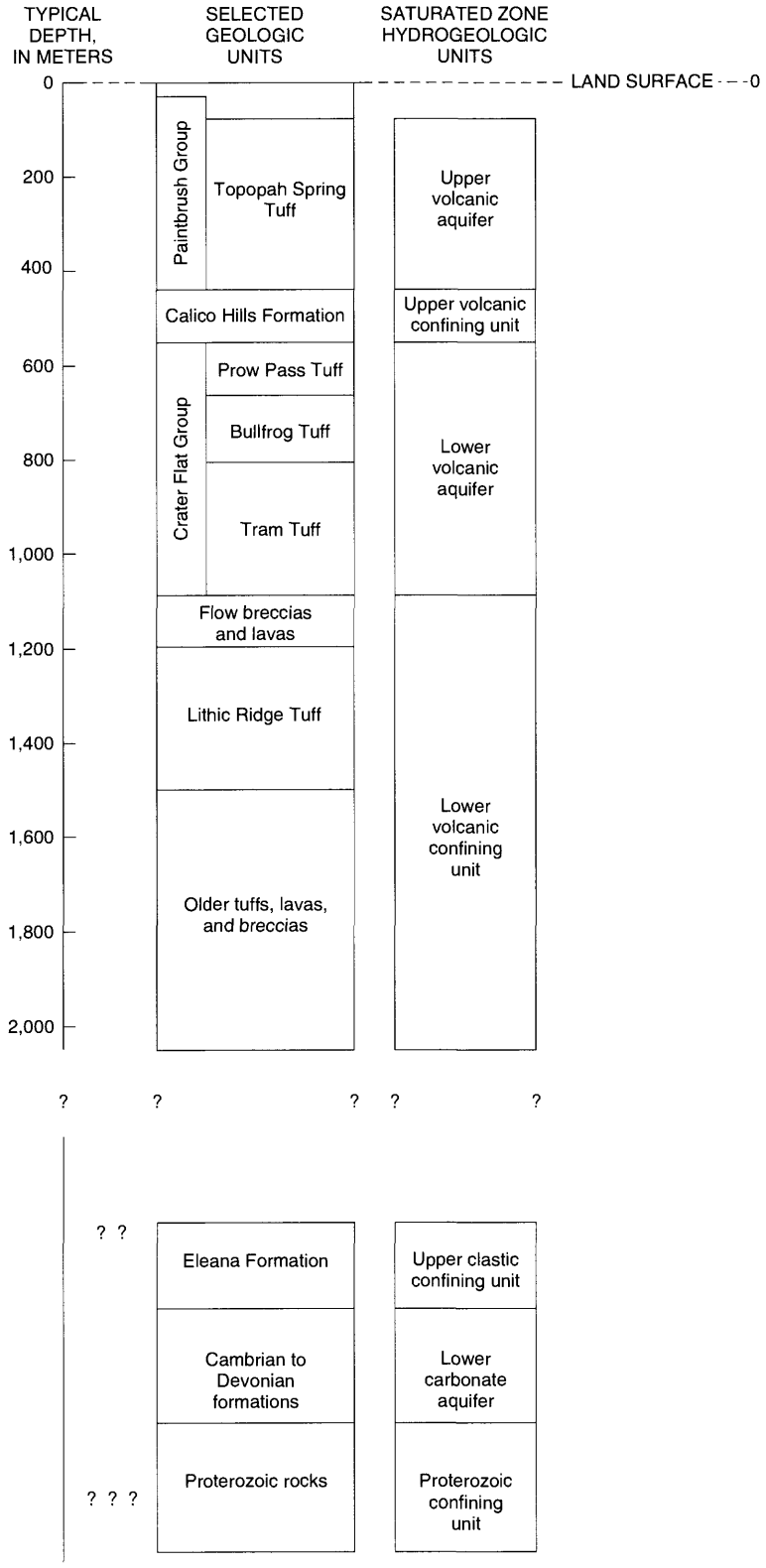

Figure 2. Selected geologic and hydrogeologic units at Yucca Mountain.

Table 1. Summary of wells monitored periodically for water levels, 1997

Well name	Drilled depth (meters)	Depth below land surface of bottom of access tube[1] (meters)	Date completed (month/year)	Water level	
				Mean, 1997, depth below reference point (meters)	Mean, 1997, altitude (meters)
USW WT-1	514.81	507.49	5/83	471.07	730.04
USW WT-2	627.89	621.79	7/83	570.84	730.29
UE-25 WT#3	348.08	342.90	5/83	300.62	729.49
UE-25 WT#4	481.58	477.62	6/83	438.67	730.54
UE-25 WT#6	382.98	372.16	6/83	280.21	1,034.57
USW WT-7	491.00	481.28	7/83	420.94	775.94
USW WT-10	430.68	426.52	8/83	347.36	776.04
USW WT-11	440.74	416.05	8/83	363.63	730.48
UE-25 WT#13	353.57	346.25	7/83	303.42	729.09
UE-25 WT#14	399.29	397.15	9/83	346.61	729.44
UE-25 WT#15	414.53	406.91	11/83	353.75	729.19
UE-25 WT#16	521.21	513.89	11/83	472.49	738.14
UE-25 b#1	1,219.81	Not Applicable	9/81	Not Applicable	Not Applicable
upper interval	Not Applicable	488.00	Not Applicable	470.41	730.32
UE-25 p#1	1,805.33	[2]417.88/?	5/83	361.50	752.71
USW VH-1	762.30	205.40	2/81	183.76	779.47
USW G-2	1,831.00	[3]582.01, 578.75, 582.26	10/81	534.43	1,019.43
USW H-1	1,828.80	Not Applicable	1/81	Not Applicable	Not Applicable
Tube 1	Not Applicable	1,805.90	Not Applicable	517.04	786.06
Tube 2	Not Applicable	1,114.65	Not Applicable	567.70	735.40
Tube 3	Not Applicable	741.11	Not Applicable	572.66	730.44
Tube 4	Not Applicable	640.08	Not Applicable	572.51	730.59
USW H-3	1,219.20	Not Applicable	3/82	Not Applicable	Not Applicable
upper interval	Not Applicable	762.00	Not Applicable	Not Available	Not Available
lower interval	Not Applicable	1,061.00	Not Applicable	Not Available	Not Available
USW H-4	1,219.20	Not Applicable	6/82	Not Applicable	Not Applicable
upper interval	Not Applicable	525.78	Not Applicable	518.66	730.08
lower interval	Not Applicable	1,187.50	Not Applicable	518.54	730.20
USW H-5	1,219.20	Not Applicable	8/82	Not Applicable	Not Applicable
upper interval	Not Applicable	708.61	Not Applicable	703.49	775.45
lower interval	Not Applicable	846.75	Not Applicable	703.16	775.78
USW H-6	1,219.81	Not Applicable	10/82	Not Applicable	Not Applicable
upper interval	Not Applicable	533.86	Not Applicable	525.97	776.09
lower interval	Not Applicable	752.25	Not Applicable	526.11	775.95

Table 1. Summary of wells monitored periodically for water levels, 1997--Continued

Well name	Drilled depth (meters)	Depth below land surface of bottom of access tube[1] (meters)	Date completed (month/year)	Water level	
				Mean, 1997, depth below reference point (meters)	Mean, 1997, altitude (meters)
UE-25 J-11	405.38	(4)	7/57	317.21	732.24
UE-25 J-12	[5] 347.00	(6)	8/68	226.67	727.87
UE-25 J-13	1,063.14	(7)	1/63	283.12	728.35

[1]Screen in access tube set at bottom of tube.

[2]Well is constructed so that the hydraulic head in the Paleozoic carbonate rocks located 1,244 meters below land surface is monitored. Access tube removed and replaced during October and November 1997. Prior to removal, depth of access tube was 417.88 m. After access tube was replaced, the exact depth of replacement was not reported.

[3]Bottom of access tube at 582.01 m below land surface until July 1997. Tube removed and replaced with two new tubes during September 1997. Bottom of new tubes 578.75 meters and 582.26 meters below land surface.

[4]Well measured through open casing. Well is cased to bottom of well. Casing is perforated from 328.3 to 334.4 meters below land surface and from 379.2 to 396.2 meters below land surface.

[5]Original drilled depth 271 meters in 1957; well deepened to present depth in 1968.

[6] Access tube is 54-millimeter-outside-diameter tube, which is installed so measuring equipment can bypass pump that is in the well. Depth of bottom of access tube not known.

[7] Access tube is 50.8-millimeter-outside-diameter tube, which is installed so measuring equipment can bypass pump that is in the well. Depth of bottom of access tube not known.

Table 2. Summary of wells monitored periodically for water levels, 1998

Well name	Drilled depth (meters)	Depth below land surface of bottom of access tube[1] (meters)	Date completed (month/year)	Water level	
				Mean, 1998, depth below reference point (meters)	Mean, 1998, altitude (meters)
USW WT-1	514.81	507.49	5/83	470.89	730.22
USW WT-2	627.89	621.79	7/83	570.63	730.50
UE-25 WT#3	348.08	331.13	5/83	Not Available	Not Available
UE-25 WT#4	481.58	477.62	6/83	438.46	730.75
UE-25 WT#6	382.98	372.16	6/83	280.02	1,034.76
USW WT-7	491.00	481.28	7/83	420.94	775.94
USW WT-10	430.68	426.52	8/83	347.33	776.07
USW WT-11	440.74	416.05	8/83	363.57	730.54
UE-25 WT#12	398.68	389.26	8/83	345.39	729.35
UE-25 WT#13	353.57	346.25	7/83	303.38	729.13
UE-25 WT#14	399.29	397.15	9/83	346.48	729.57
UE-25 WT#15	414.53	406.91	11/83	353.69	729.25
UE-25 WT#16	521.21	513.89	11/83	472.35	738.28
UE-25 WT#17	442.87	416.47	10/83	Not Available	Not Available
UE-25 b#1	1,219.81	Not Applicable	9/81	Not Applicable	Not Applicable
upper interval	Not Applicable	488.00	Not Applicable	470.19	730.54
UE-25 p#1	1,805.33	[2]?	5/83	361.35	752.86
USW VH-1	762.30	205.40	2/81	183.72	779.51
USW G-2	1,831.00	[3]578.75, 582.26	10/81	534.38	1,019.48
USW H-1	1,828.80	Not Applicable	1/81	Not Applicable	Not Applicable
Tube 1	Not Applicable	1,805.90	Not Applicable	516.96	786.14
Tube 2	Not Applicable	1,114.65	Not Applicable	567.95	735.15
Tube 3	Not Applicable	741.11	Not Applicable	572.48	730.62
Tube 4	Not Applicable	640.08	Not Applicable	572.30	730.80

Table 2. Summary of wells monitored periodically for water levels, 1998--Continued

Well name	Drilled depth (meters)	Depth below land surface of bottom of access tube[1] (meters)	Date completed (month/year)	Water level	
				Mean, 1998, depth below reference point (meters)	Mean, 1998, altitude (meters)
USW H-3	1,219.20	Not Applicable	3/82	Not Applicable	Not Applicable
upper interval	Not Applicable	762.00	Not Applicable	Not Available	Not Available
lower interval	Not Applicable	1,061.00	Not Applicable	Not Available	Not Available
USW H-4	1,219.20	Not Applicable	6/82	Not Applicable	Not Applicable
upper interval	Not Applicable	525.78	Not Applicable	518.44	730.30
lower interval	Not Applicable	1,187.50	Not Applicable	518.31	730.43
USW H-5	1,219.20	Not Applicable	8/82	Not Applicable	Not Applicable
upper interval	Not Applicable	708.61	Not Applicable	703.51	775.43
lower interval	Not Applicable	846.75	Not Applicable	703.13	775.81
USW H-6	1,219.81	Not Applicable	10/82	Not Applicable	Not Applicable
upper interval	Not Applicable	533.86	Not Applicable	525.96	776.10
lower interval	Not Applicable	752.25	Not Applicable	526.08	775.98
UE-25 J-11	405.38	(4)	7/57	317.21	732.24
UE-25 J-12	[5] 347.00	(6)	8/68	226.68	727.86
UE-25 J-13	1,063.14	(7)	1/63	283.11	728.36

[1]Screen in access tube set at bottom of tube.

[2]Well is constructed so that the hydraulic head in the Paleozoic carbonate rocks located 1,244 meters below land surface is monitored. Access tube removed and replaced during October and November 1997. After access tube was replaced, the exact depth of replacement was not reported.

[3]Two tubes in borehole, one at 578.75 meters and the second at 582.26 meters below land surface.

[4]Well measured through open casing. Well is cased to bottom of well. Casing is perforated from 328.3 to 334.4 meters below land surface and from 379.2 to 396.2 meters below land surface.

[5]Original drilled depth 271 meters in 1957; well deepened to present depth in 1968.

[6] Access tube is 54-millimeter-outside-diameter tube, which is installed so measuring equipment can bypass pump that is in the well. Depth of bottom of access tube not known.

[7] Access tube is 50.8-millimeter-outside-diameter tube, which is installed so measuring equipment can bypass pump that is in the well. Depth of bottom of access tube not known.

WELL DESIGNATIONS

Each well used in the study of the Yucca Mountain area has a unique name or number. Wells on the Nevada Test Site (NTS) use an NTS designation, whereas wells off the NTS use a slightly different designation. Wells on the NTS begin with UE (for Underground Exploratory), followed by the NTS area number (always 25 in this report). This designation—UE-25—commonly is followed by one or more letters signifying the purpose of the well or simply by a sequential letter, followed by a sequence number. Wells off the NTS begin with the letters USW (for Underground, Southern Nevada, Waste). The designation—USW—is followed by one or more letters signifying the primary purpose of the well followed by a sequence number. The letters signifying purpose that are used in this report are G (collection of geologic data), H (collection of hydrologic data), p (collection of data on rocks of Paleozoic age), VH (collection of hydrologic and geologic data on volcanic rocks), and WT (collection of water-table data). Wells discussed in this report that do not have letters of designation for primary purpose of the well are wells UE-25 J-11, UE-25 J-12, and UE-25 J-13, which were drilled as water-supply wells, and wells UE-25 b#1 and UE-25 c#1, which were named in order of drilling (b or c) but without a letter indicating primary purpose of the well.

Nevada State Plane North American Datum of 1927 (NAD 27) Coordinates are used to identify the location of wells cited in this report. These coordinates are for the central zone of Nevada and are based on a Transverse Mercator projection. The origin of this projection for the central zone of Nevada is latitude 34°45'N., and the central meridian is at longitude 116°40'W. The Nevada State Plane NAD 27 Coordinates are in meters north of the baseline and in meters, plus 152,400, east of the central meridian (Luckey and others, 1993, p. 3). The Nevada State Plane NAD 27 Coordinate locations for the wells were resurveyed during 1997–98 (U.S. Department of Energy, written commun., 1999, MO9907YMP99025.001). Latitude and longitude values for the wells used in this report were calculated from these 1997–98 Nevada State Plane NAD 27 Coordinates. Because well locations were resurveyed during 1997–98, the Nevada State Plane NAD 27 Coordinates and latitude and longitude values in this report may be different from previous reports.

Each well has a Site ID number that is used as a unique identification number of the well in the U.S. Geological Survey's National Water Information System data base. The Site ID is generated by combining the original designations of the latitude and longitude with a two-digit sequence number. The Site ID is for convenience of identification only and should not be used as an actual location number because the original designations of latitude and longitude may be inaccurate.

DATA-COLLECTION SYSTEM

During 1997 and 1998, water-level data were collected periodically by means of manual measurements using either a multiconductor cable unit or a steel tape.[1] All manual water-level measurements collected during 1997–98 were reviewed, and it was decided that only those measurements made with a steel tape would be used in this report.

Periodic Manual Measurements

Periodic manual water-level measurements at wells require visits by trained personnel, who perform specific operations and record the results. Operational plans for 1997–98 called for measurements at least

[1]Continuous collection of water-level data did occur during 1997–98 in support of hydraulic testing at the C-hole complex; however, the continuous data are not presented in this report.

every 3 months (once a quarter). However, when project personnel were available, an attempt was made to measure wells every month.

Periodic measurements during 1997–98 were made primarily with Chain #3, which is a specially constructed reeled steel tape that is 7.9 mm wide and 792 m long. Measurements were also made with the 2,800-foot reference steel tape, a specially constructed reeled steel tape that is 6.4 mm wide and 853 m long. Detailed descriptions of the 2,800-foot reference steel tape are given by O'Brien (1991, p. 8) and are not repeated here. O'Brien (1991, p. 9) also describes Chain #2 (not used to measure water levels during 1997–98). Because of the similarities between Chain #2 and Chain #3, the detailed description of Chain #2 given by O'Brien (1991, p. 9) is considered to be the same for Chain #3 and is not repeated here.

Corrections to Manual Measurements

Mechanical stretch, thermal expansion, and borehole deviation affect the accuracy of manual water-level measurements and are considered in the process of determining an accurate depth below land surface and water-level altitude. All measurements in this report were made with a steel tape. The correction factors applied to steel-tape measurements for each well are discussed in detail in later sections and are summarized in table 3. The corrected depth to water is calculated by applying the mechanical stretch, thermal expansion, and borehole deviation corrections to the apparent depth to water from periodic measurements. All measurements, except those at wells UE-25 J-11, UE-25 J-12, and UE-25 J-13, are corrected for borehole deviation from vertical (in this report, borehole and well are considered synonymous and are used interchangeably). Borehole-deviation information is not available for wells UE-25 J-11, UE-25 J-12, and UE-25 J-13. All measurements are referenced to sea-level datum.

Mechanical Stretch Correction

Mechanical stretch is associated with the weight of the suspended steel tape and attached plumb bob (Garber and Koopman, 1968, p. 3–6; Robison and others, 1988, p. 9–11). The calculated adjustment for the steel tapes used during 1997–98, based on stretch coefficients and an approximate weight of 0.45 kg for the plumb bob used with Chain #3 and the 2,800-foot reference steel tape, ranged from –0.044 to +0.017 m (table 3) for water levels measured in the vicinity of Yucca Mountain.

The correction for mechanical stretch of the tape is given by:

$$C = (L^2WS)/2 + PLS - KLS \quad (1)$$

where

C is the correction, in meters;
L is the apparent length of tape, in meters;
W is the unit weight of the tape, in kilograms per meter;
S is the stretch coefficient, in meters per (meter kilogram);
P is the weight of the plumb bob, in kilograms; and
K is reference tension during manufacture, in kilograms.

Values for L correspond to the depth to water below a reference point in each well. Values for W were determined at a calibration laboratory at the Nevada Test Site. Values for S were determined by the U.S. Geological Survey and are estimated to be accurate to 7 percent (Tucci, O'Brien, and Burkhardt, 1996, p. 7). Values for K are provided by the manufacturer at the time of purchase.

Table 3. Corrections applicable to the 2,800-foot steel tape and Chain #3 during 1997–98

[--, not applicable; m, meters]

Well name (superscript is tube number or interval)	Assumed average air temperature in well (degrees Celsius)	Correction for 2,800-foot reference steel tape (meters)			Correction for Chain #3 (meters)			Correction for hole deviation from vertical (meters)	Measuring point (meters above reference point)	Reference point (meters above sea level)
		Mechanical stretch	Thermal expansion	Total[1]	Mechanical stretch	Thermal expansion	Total[1]			
USW WT-1	25.0	–0.043	0.027	–0.016	–0.019	0.027	0.008	–0.326	0.314	1,201.11
USW WT-2	24.4	–0.038	0.029	–0.009	–0.010	0.029	0.019	–0.445	0.311	1,301.13
UE-25 WT#3	26.1	–0.041	0.021	–0.020	–0.024	0.021	–0.002	–0.271	[2]0.155/ 0.448	1,030.11
UE-25 WT#4	25.0	–0.044	0.025	–0.019	–0.021	0.025	0.004	–0.454	0.311	1,169.21
UE-25 WT#6	23.3	–0.040	0.011	–0.029	–0.023	0.011	–0.012	–0.204	0.463	1,314.78
USW WT-7	27.8	–0.044	0.038	–0.006	–0.022	0.038	0.016	–0.034	0.302	1,196.88
USW WT-10	29.4	–0.043	0.038	–0.005	–0.024	0.038	0.014	–0.030	0.390	1,123.40
USW WT-11	28.3	–0.044	0.035	–0.009	–0.023	0.035	0.012	–0.116	0.311	1,094.11
UE-25 WT#12	27.2	–0.043	0.029	–0.014	–0.024	0.029	0.005	–0.183	0.171	1,074.74
UE-25 WT#13	24.4	–0.041	0.015	–0.026	–0.024	0.015	–0.008	–0.012	0.305	1,032.51
UE-25 WT#14	24.4	–0.043	0.018	–0.025	–0.024	0.018	–0.006	–0.085	0.311	1,076.05
UE-25 WT#15	23.9	–0.043	0.016	–0.027	–0.024	0.016	–0.008	–0.189	0.314	1,082.94
UE-25 WT#16	26.1	–0.043	0.033	–0.010	–0.019	0.033	0.015	–0.064	0.314	1,210.63
UE-25 WT#17	25.0	–0.044	0.023	–0.021	–0.023	0.023	0.000	–0.482	[3]0.158/ 0.408	1,124.06
UE-25 b#1 upper interval	25.6	–0.043	0.031	–0.013	–0.019	0.031	0.012	–0.244	0.302	1,200.73
UE-25 b#1 lower interval	25.6	–0.043	0.031	–0.013	–0.019	0.031	0.012	–0.244	0.134	1,200.73
UE-25 p#1	25.6	–0.044	0.024	–0.020	–0.023	0.023	0.000	–0.021	[4]0.158/ 0.182	1,114.21
USW VH-1	23.9	–0.031	0.008	–0.022	–0.019	0.008	–0.011	–0.049	0.631	963.23
USW G-2	22.8	–0.041	0.017	–0.024	–0.015	0.017	0.002	–0.192	[5]0.560/0.27, 0.23	1,553.86
USW H-1, tube 1	25.0	–0.042	0.030	–0.012	–0.015	0.030	0.015	–0.143	0.311	1,303.10
USW H-1, tube 2	25.0	–0.038	0.033	–0.005	–0.011	0.033	0.022	–0.171	0.311	1,303.10
USW H-1, tubes 3 and 4	25.0	–0.038	0.033	–0.005	–0.010	0.033	0.023	–0.174	0.311	1,303.10

Table 3. Corrections applicable to the 2,800-foot steel tape and Chain #3 during 1997–98—Continued

[--, not applicable; m, meters]

Well name (superscript is tube number or interval)	Assumed average air temperature in well (degrees Celsius)	Correction for 2,800-foot reference steel tape (meters)			Correction for Chain #3 (meters)			Correction for hole deviation from vertical (meters)	Measuring point (meters above reference point)	Reference point (meters above sea level)
		Mechanical stretch	Thermal expansion	Total[1]	Mechanical stretch	Thermal expansion	Total[1]			
USW H--3 upper interval	26.1	–0.015	0.053	0.038	0.017	0.053	0.070	–0.079	0.174	1,483.47
USW H--3 lower interval	26.1	–0.019	0.052	0.033	0.013	0.052	0.064	–0.058	0.201	1,483.47
USW H-4 upper interval	24.4	–0.042	0.026	–0.015	–0.015	0.026	0.011	–0.064	0.597	1,248.74
USW H-4 lower interval	24.4	–0.042	0.026	–0.015	–0.015	0.026	0.011	–0.064	0.308	1,248.74
USW H-5 upper interval	23.9	–0.023	0.032	0.009	0.008	0.032	0.040	–0.079	0.329	1,478.94
USW H-5 lower interval	23.9	–0.023	0.032	0.009	0.008	0.032	0.040	–0.079	0.235	1,478.94
USW H-6 upper interval	25.0	–0.041	0.031	–0.011	–0.015	0.031	0.016	–0.052	0.207	1,302.06
USW H-6 lower interval	25.0	–0.041	0.031	–0.011	–0.015	0.031	0.016	–0.052	0.235	1,302.06
UE-25 J-11	25.0	–0.042	0.018	–0.023	–0.024	0.018	–0.005	unknown	0.555	1,049.45
UE-25 J-12	25.0	–0.035	0.013	–0.022	–0.022	0.013	–0.008	unknown	0.195	954.54
UE-25 J-13	25.0	–0.040	0.016	–0.023	–0.023	0.016	–0.007	unknown	0.165	1,011.47

[1]Total correction may not equal sum of mechanical stretch and thermal expansion due to rounding.

[2]Measuring point 0.155 m through 12–22–97. Monitoring tube removed for Eh-pH sampling. Monitoring tube replaced on 07–22–98. After 07–22–98, measuring point is 0.448 m.

[3]Measuring point 0.158 m through 12–22–97. Monitoring tube removed for Eh-pH sampling. Monitoring tube replaced on 07–21–98. After 07–21–98, measuring point is 0.408 m.

[4]Measuring point 0.158 m through 10–31–97. Monitoring tube removed for borehole seismic tests. Monitoring tube replaced on 11–26–97. After 11–26–97, measuring point 0.182 m.

[5]Measuring point 0.560 m through July 1997. Monitoring tube removed during July 1997, and two new tubes placed back in well during September 1997. Both tubes monitor the same borehole interval. One tube has a measuring point of 0.27 m and the other tube has a measuring point of 0.23 m. Either tube might have been used for water-level measurements.

Thermal Expansion Correction

Thermal expansion of a steel tape occurs because of temperature changes. The calculated correction for thermal expansion for steel tapes is based on manufacturer specifications for thermal expansion coefficients and on average borehole air temperatures calculated from temperature profiles in wells at Yucca Mountain (Garber and Koopman, 1968, p. 3–6; Sass and Lachenbruch, 1982, Robison and others, 1988, p. 8 and 14; Tucci, O'Brien, and Burkhardt, 1996, p. 6). The correction ranged from +0.008 to +0.053 m (table 3).

Correction for thermal expansion of the tape is given by:

$$E = (D - R)\ TL, \tag{2}$$

where

E is the correction, in meters;
D is the assumed average air temperature in the well, in degrees Celsius;
R is the reference temperature during manufacture, in degrees Celsius;
T is the thermal expansion coefficient, in meters per meter-degree Celsius; and
L is the apparent length of the tape, in meters.

Equation 2 differs from that of Garber and Koopman (1968, p. 4). The correction for thermal expansion in their report was subtracted from the measured depth to water when it should have been added (J.H. Robison, U.S. Geological Survey, written commun., 1985).

The tape corrections, which include mechanical stretch and thermal expansion, and average air temperature in the well, are given in table 3. Approximate depth to water below reference point is analogous to apparent length of the tape, L, in equations 1 and 2. The tape-dependent variables for equations 1 and 2 are defined for each tape in table 4.

Borehole-Deviation Correction

In addition to the corrections for mechanical stretch and thermal expansion, corrections must also be made for boreholes that are not vertical (borehole deviation). Gyroscopic surveys were made in all measured wells except wells UE-25 J-11, UE-25 J-12, and UE-25 J-13. The gyroscopic survey is a subsurface borehole survey that measures borehole deviation from vertical. The difference between measured depth and true vertical depth is the borehole deviation, or borehole correction. Corrections range from –0.012 to –0.482 m (table 3). Corrections generally increase with increasing well depth.

Table 4. Mechanical stretch and thermal expansion equation variable values for the 2,800-foot reference steel tape and Chain #3

Variable	2,800-foot reference steel tape	Chain #3
W is the unit weight of the tape, in kilograms per meter	2.08×10^{-2}	2.65×10^{-2}
S is the stretch coefficient, in meters per (meter kilogram)	2.48×10^{-5}	1.69×10^{-5}
P is the weight of plumb bob, in kilograms	0.45	0.45
K is the reference tension during manufacture, in kilograms	9.07	9.07
R is the reference temperature during manufacture, in degrees Celsius	20	20
T is the thermal expansion coefficient in meters per meter-degree Celsius	1.16×10^{-5}	1.16×10^{-5}

Water-Level Altitudes

Water-level altitudes are calculated by subtracting the corrected depth to water from the altitude of the reference point. The reference point generally is a metal tag on the well casing located near land surface. The measuring point for the wells, at the top of the access tube (monitoring tube), is at some distance above the reference point, and the height of the measuring point is subtracted from the apparent depth to water as part of the process to calculate the corrected depth to water. Reference-point and measuring-point values for all wells are listed in table 3 and are described in the individual well sections. Water-level altitudes in this report for all wells except USW VH-1, UE-25 J-11, and UE-25 J-12, are based on a survey of the water-level monitoring network reference points made in late 1984 by the U.S. Geological Survey National Mapping Division (Merle E. Southern, U.S. Geological Survey, written commun., 1985). The survey for USW VH-1 was completed during 1986 (Holmes & Narver, Inc., March 3, 1986), and the surveys for UE-25 J-11 and UE-25 J-12 were completed during 1993, (Boucher, 1994b, p. 5 and 6).

Example Calculations

An example measurement for well USW WT-1 for May 21, 1998, is presented to illustrate a calculation made to derive the altitude of the water level with a steel tape. The units of measurement for a steel tape are feet. All water-level measurements are recorded to the nearest 0.01 foot and later converted to meters. The calculated altitude is the value reported in the section "Well Data and Water Levels."

At least two measurements of the water level are made and averaged during each visit to the well, and the appropriate corrections are applied after averaging the water-level measurements. Additional measurements are made only if the two measured depths differ by more than 1 part in 10,000 for measurements of more than 1,000 feet, or more than 0.1 foot for measurements less than 1,000 feet.

Example:

The water-level measurement on May 21, 1998, at USW WT-1 was made with Chain #3. The HELD is the indicated footage on the tape when it is held at the measuring point during a measurement, and CUT is the footage of tape that is wetted during its submersion in the water. The difference between HELD and CUT is the apparent depth to water below the measuring point.

The measurements and corrections for USW WT-1 on May 21, 1998, were:
[ft, foot; m, meter]

Reading	Measurement 1	Measurement 2	
HELD (ft)	1,549.00	1,550.00	
CUT (ft)	−1.88	−2.88	
Apparent depth to water (ft)	1,547.12	1,547.12	
Average of two apparent depths to water (ft)			1,547.12
Apparent depth to water (1,547.12 feet × 0.3048 meter per foot) (m)			471.56
Measuring point (m) (table 3)			−0.314
Tape correction (m) (table 3)			+0.008
Correction for borehole deviation from vertical (m) (table 3)			−0.326
Corrected depth below reference point (m)			470.93
Determination of water-level altitude:			
Altitude of reference point (m) (table 3)			1,201.11
Corrected depth (m)			−470.93
Altitude of water level (m)			730.18

Precision and Accuracy

An analysis of precision and accuracy of field data was conducted for manual water-level measurements, which included all periodic measurements obtained during 1988–90 (Boucher, 1994a). The mean precision range of the 2,800-foot reference steel tape, based on 31 measurements, was 0.026 ft (Boucher, 1994a, p. 13) (because of changes in accuracy due to conversion to metric units and rounding of conversions, this discussion of precision and accuracy is in the units of the referenced report). The precision of Chain #3 is not known but probably is the same or nearly the same as that of Chain #2 because each chain has nearly the same physical characteristics and because they were identically constructed. The mean precision range of Chain #2, based on 341 measurements, was 0.014 ft (Boucher, 1994a, p. 13). Ninety-seven percent of all measurements obtained with the steel tapes were precise to within 0.05 ft during 1988–90 (Boucher, 1994a, p. 17).

The overall accuracy of the computed water-level altitude depends on the individual accuracies of its computational components such as: (1) water-level measurement, (2) borehole correction, (3) height of the measuring point, (4) altitude of the reference point, and (5) the precision of the calibrated steel tapes. The total accuracy of measurements made with the steel tapes during 1988–90 was estimated to be 0.36 ft, neglecting the accuracy of the borehole correction factors (Boucher, 1994a, p. 17). Accuracy of the borehole correction factors is indeterminate because documentation of the borehole-deviation surveys was inadequate to assess their accuracy and because no borehole-deviation data are available for wells UE-25 J-11, UE-25 J-12, and UE-25 J-13. The unknown accuracy of the borehole corrections poses a problem in the calculation of overall accuracy values (Tucci, O'Brien, and Burkhardt, 1996, p. 9).

Quality Assurance

Water-level data for Yucca Mountain and vicinity may be used to assess the expected performance of a potential high-level radioactive-waste repository, and confidence in the reliability of the data used in such an assessment is required. A quality-assurance program has been implemented by the U.S. Geological Survey for the Yucca Mountain Project to support the reliability of the data and interpretations of the data.

Onsite Procedures

The quality-assurance program requires that water-level measurements be obtained by methods described by formal technical procedures. The technical procedures include calibrations to the equipment to ensure that the equipment is operating properly and that expected precision and accuracy are attained.

Data are recorded in logbooks at the well site. Data recorded include time and date of the visit, names of operators making the visit, identification of specific equipment used, and water-level measurement data. In addition, the entry in the logbooks may include comments concerning factors that may be relevant to the collected data, such as discussion of problems with equipment or weather conditions during the water-level measurement.

Office Processing and Review

The original field-note records were maintained throughout each calendar year at the onsite operations headquarters on the Nevada Test Site. The records were reviewed for completeness. The field-note records are transferred to water-level worksheets, and any needed adjustments not done during onsite operations, such as tape and borehole-deviation corrections, are made at this time. The water-level worksheets are completed at the operations headquarters on the Nevada Test Site. After independent data review and any needed adjustments, the field-note records and water-level worksheets are transferred to a Yucca Mountain Project archive.

Qualified and Unqualified Data

Data used by the Yucca Mountain Project are classified as either "qualified" or "unqualified." Qualified data are defined as data acquired or developed for the Yucca Mountain Project under a Nuclear Regulatory Commission-accepted quality-assurance plan or qualified in accordance with appropriate Yucca Mountain Project proce-

dures. Depth-to-water measurements collected at Yucca Mountain after 1989 are made in accordance with approved Yucca Mountain Project quality-assurance procedures. However, measuring point altitudes and information used to calculate correction factors, such as borehole-deviation information, were obtained before the implementation of the accepted Yucca Mountain Project quality-assurance program in 1989. Therefore, the calculated water-level altitudes presented in this report are classified as unqualified data.

WELL DATA AND WATER LEVELS

This section contains information and data for all wells monitored as part of the Yucca Mountain water-level project during 1997–98. Information for each well includes location and identification, drilling and casing information, description of access tube and interval for measuring water levels, information for calculation of water-level altitude, and measured water-level altitude for 1997–98.

Hydrographs of water-level altitudes are also presented for each well. During 1996, drawdown was observed in several wells due to pumpage at the C-hole complex (Graves, 1998, p. 17). Because of this and the continuation of pumpage at the C-hole complex until November 12, 1997, the 1996 water-level data are included in most hydrographs so that possible trends from the C-hole complex pumpage can be observed. The water-level data collected during each calendar year are connected by dashed lines. The dashed lines are used because of the uncertainty of water-level change that could occur between measurements. There are no lines connecting water-level data from one calendar year to the next.

With the exception of well USW G-2 and USW H-3, lower interval, all hydrographs are uniformly plotted with a y-axis (water-level) span of 2.5 m. The y-axis span for well USW G-2 is 5 m; this is due to the drawdown and slow recovery following completion of hydraulic testing at well USW G-2 during 1996. The y-axis span for well USW H-3, lower interval, is 35 meters; this is due to water-level changes after the packer separating the upper and lower intervals in well USW H-3 failed during 1997.

The mean water-level altitude for 1997 and 1998 is given for each well measured. The mean water-level altitude is calculated only from measurements presented in this report and only represents the mean of these available data. Comparisons of these mean water-level altitudes to each other and to the 1996 and 1985–95 mean water-level altitudes are shown in table 5.

During 1997, water levels in the Yucca Mountain area could have been affected by long-term pumping from well UE-25 c#3 at the C-hole complex (fig. 1), which began on May 8, 1996, and continued until November 12, 1997. Through December 31, 1996, about 196 million liters were pumped from the C-hole complex (Graves, 1998, p. 17). From January 1 through November 12, 1997, about 236 million liters were pumped from well UE-25 c#3 (John Earle, U.S. Geological Survey, written commun., 1999). During 1996, wells that had the most distinct decline in water levels, which probably resulted from the pumpage from UE-25 c#3, were USW WT-1, UE-25 WT#4, UE-25 WT#14, UE-25 b#1, upper interval, and USW H-4, upper and lower intervals (Graves, 1998, p. 17). Other wells where water-level declines during 1996 were not as great, but which were also probably affected by the C-hole complex pumpage, are UE-25 WT#3, USW WT-11, and UE-25 WT#15 (Graves, 1998, p. 17). The ground water that was pumped from borehole UE-25 c#3 was discharged into Fortymile Wash adjacent to borehole UE-25 J-13 (fig. 1); however, there was no observed rise in water levels in boreholes UE-25 J-12 and UE-25 J-13, the two boreholes that are downgradient from the point of discharge.

Other ground-water pumpage in the Yucca Mountain area includes pumpage from water-supply wells UE-25 J-12 and UE-25 J-13. During 1997, about 64 and 123 million liters were pumped from wells UE-25 J-12 and UE-25 J-13, respectively; and during 1998 (through September 1998), about 15 and 114 million liters were pumped from each well, respectively (Bonner and others, 1998, p. 606; Preissler and others, 1999, p. 573). Wells UE-25 J-12 and UE-25 J-13 were drilled during 1957 and 1963, respectively (Young, 1972, p. 10), to be used as water-supply wells. Graves and others (1997, p. 41, 42, and 69) stated that from 1985 to 1995, water-level declines due to pumpage from these two wells were not observed in wells in the Yucca Mountain area. However, it is not known if the water-level declines attributed to pumpage from the C-hole complex are due solely to the discharge from well UE-25 c#3 or if the declines could be an accumulative effect from the pumpage from wells UE-25 J-12, UE-25 J-13, and UE-25 c#3.

Table 5. Mean water-level altitudes for wells and well intervals monitored in the Yucca Mountain area, 1985–95, 1996, 1997, and 1998[1]

Well name	1985–95 Mean water-level altitude (meters)	1996 Mean water-level altitude (meters)	1997 Mean water-level altitude (meters)	1998 Mean water-level altitude (meters)
USW WT-1	730.35	730.17	730.04	730.22
USW WT-2	730.65	730.52	730.29	730.50
UE-25 WT#3	729.64	729.63	729.49	Data Not Available
UE-25 WT#4	730.78	730.66	730.54	730.75
UE-25 WT#6	1,034.60	1,034.58	1,034.57	1,034.76
USW WT-7	775.83	775.96	775.94	775.94
USW WT-10	776.00	776.11	776.04	776.07
USW WT-11	730.66	730.58	730.48	730.54
UE-25 WT#12	729.47	Data Not Available	Data Not Available	729.35
UE-25 WT#13	729.11	729.11	729.09	729.13
UE-25 WT#14	729.68	729.58	729.44	729.57
UE-25 WT#15	729.22	729.18	729.19	729.25
UE-25 WT#16	738.27	738.21	738.14	738.28
UE-25 WT#17	729.70	Data Not Available	Data Not Available	Data Not Available
UE-25 b#1				
Upper interval	730.65	730.44	730.32	730.54
UE-25 p#1	752.44	752.65	752.71	752.86
USW VH-1	779.44	779.49	779.47	779.51
USW G-2	1,020.17 (Mean for 1992–95)	Data Not Available	1,019.43	1,019.48
USW H-1				
Tube 1	785.49	786.00	786.06	786.14
Tube 2	735.97	735.55	735.40	735.15
Tube 3	730.60	730.61	730.44	730.62
Tube 4	730.85	730.78	730.59	730.80
USW H-3				
Upper interval	731.52	731.19	Data Not Available	Data Not Available
Lower interval	755.91	760.07	Data Not Available	Data Not Available
USW H-4				
Upper interval	730.40	730.28	730.08	730.30
Lower interval	730.51	730.39	730.20	730.43
USW H-5				
Upper interval	775.46	775.46	775.45	775.43
Lower interval	775.62	775.65	775.78	775.81
USW H-6				
Upper interval	776.02	776.12	776.09	776.10
Lower interval	775.94	776.00	775.95	775.98
UE-25 J-11	732.21	732.25	732.24	732.24
UE-25 J-12	727.93	727.86	727.87	727.86
UE-25 J-13	728.44	728.36	728.35	728.36

[1] 1985–95 and 1996 water-level data from Graves and others (1997) and Graves (1998).

Well USW WT-1

Well specifications

1. Location and identification:

   Nevada State Plane North American Datum of 1927 Central Zone Coordinates (meters): N 229,802; E 171,828. (U.S. Department of Energy, written commun., 1999, MO9907YMP99025.001)

   Latitude and longitude: 36°49'16"N.; 116°26'56"W. (Converted from Nevada State Plane North American Datum of 1927 Central Zone Coordinates)

   U.S. Geological Survey Site ID: 364916116265601.

2. Drilling and casing information:

   Well started: April 28, 1983 (Fenix & Scisson, Inc., 1986a, p. 69).

   Well completed: May 18, 1983 (Fenix & Scisson, Inc., 1986a, p. 69).

   Drilling method: Rotary, using rock bits and air, water, and soap-circulating medium; core obtained from bottom of the borehole (Robison, and others, 1988, p. 21).

   Bit diameter, below land surface: 0 to 10.21 m, 660.4 mm; 10.21 to 514.81 m, 222.25 mm (Fenix & Scisson, Inc., 1986a, p. 69).

   Casing, below land surface: Only surface casing in borehole, to a depth of 9.91 m (Fenix & Scisson, Inc., 1986a, p. 69).

   Total drilled depth: 514.81 m (Fenix & Scisson, Inc., 1986a, p. 69).

3. Description of access tube and depth interval for measuring water levels:

   62-mm-inside-diameter tubing (Robison and others, 1988, p. 21) that has a 3.66-m-long well screen on the bottom; tubing and attached screen extend from land surface to a depth of 507.49 m (Fenix & Scisson, Inc., 1986a, p. 69); saturated interval of the borehole is within the Calico Hills Formation and Bullfrog Tuff of the Crater Flat Group (Robison and others, 1988, p. 21). Stratigraphic nomenclature presented by Robison revised to agree with stratigraphic nomenclature in Sawyer and others (1994, p. 1305).

4. Information for calculating water-level altitude:

   Reference point: Top of metal tag on well casing, altitude 1,201.11 m (surveyed by U.S. Geological Survey in 1984; Merle E. Southern, National Mapping Division, U.S. Geological Survey, written commun., 1985).

   Measuring point: Top of access tube, 0.314 m above reference point.

   Depth correction for borehole deviation from vertical: 0.326 m, based on approximate depth to water of 471 m (1990 data).

Well USW WT-1 was measured periodically during 1997–98, with the lowest water level during this period being 730.02 m above sea level (02–03–97) and the highest water level being 730.25 m above sea level (09–23–98) (table 6). The mean water-level altitude of the 1997 data was 730.04 m above sea level. The mean water-level altitude of the 1998 data was 730.22 m above sea level. Comparisons to 1996 and 1985–95 mean water-level altitudes (Graves, 1998, p. 18 and 19) are shown in table 5, and 1996 water-level data are included in figure 3.

During 1996, lower water levels in well USW WT-1 were attributed to pumpage at the C-hole complex (Graves, 1998, p. 18). Trends seen in figure 3 indicate that these lower water levels continued into 1997. Pumpage was discontinued at the C-hole complex on November 12, 1997. During 1998, there was a rise in water levels. Though no data were collected in well USW WT-1 from September 1997 until May 1998, this rise in water level is probably water-level recovery following the discontinuation of pumpage at the C-hole complex.

Table 6. Measured water-level altitudes, 1997–98, for well USW WT-1

Date	Measured water-level altitude (meters above sea level)	Equipment used to measure water level
01-21-97	730.05	Chain #3
02-03-97	730.02	Chain #3
03-03-97	730.07	Chain #3
04-07-97	730.04	Chain #3
08-07-97	730.04	Chain #3
05-21-98	730.18	Chain #3
06-17-98	730.20	Chain #3
07-21-98	730.24	Chain #3
08-12-98	730.22	Chain #3
09-23-98	730.25	Chain #3
10-06-98	730.24	Chain #3
12-21-98	730.21	Chain #3

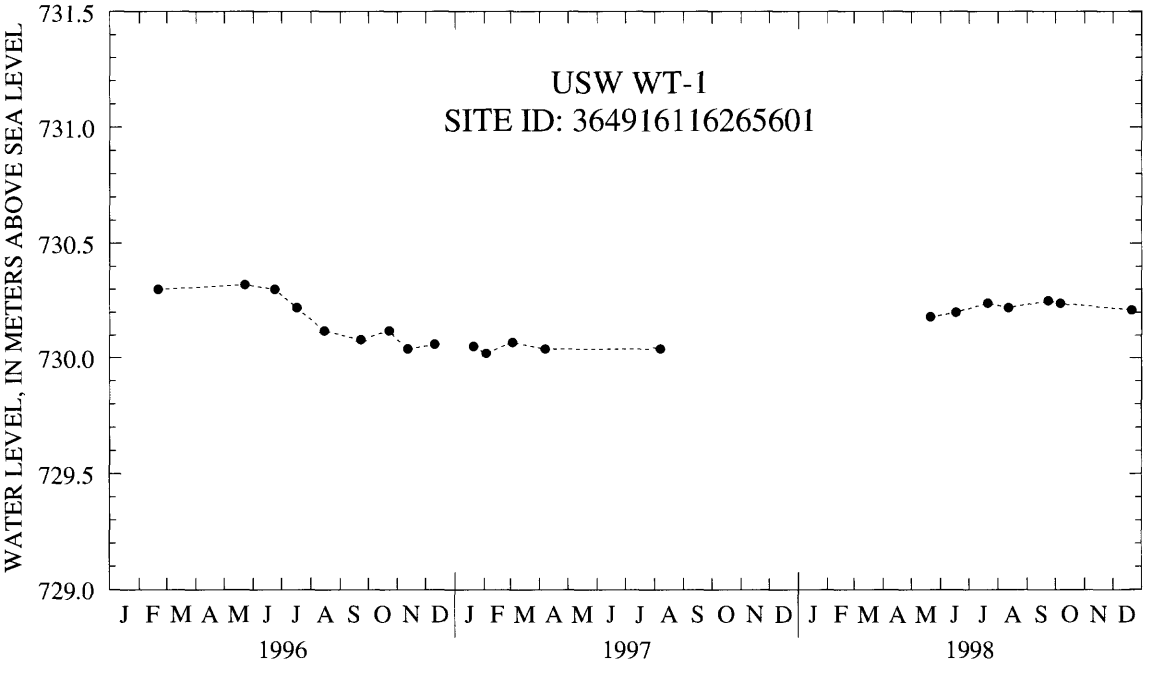

Figure 3. Water-level altitudes, 1996–98, for well USW WT-1.

Well USW WT-2

Well specifications

1. Location and identification:

   Nevada State Plane North American Datum of 1927 Central Zone Coordinates (meters): N 231,850; E 171,275 (U.S. Department of Energy, written commun., 1999, MO9907YMP99025.001.)

   Latitude and longitude: 36°50'23"N.; 116°27'18"W. (Converted from Nevada State Plane North American Datum of 1927 Central Zone Coordinates)

   U.S. Geological Survey Site ID: 365023116271801.

2. Drilling and casing information:

   Well started: July 8, 1983 (Fenix & Scisson, Inc., 1986a, p. 75).

   Well completed: July 16, 1983 (Fenix & Scisson, Inc., 1986a, p. 75).

   Drilling method: Rotary, using rock bits and air-foam circulating medium; core obtained from bottom of the borehole (Robison and others, 1988, p. 25).

   Bit diameter, below land surface: 0 to 17.68 m, 374.65 mm; 17.68 m to 627.89 m, 222.25 mm (Fenix & Scisson, Inc., 1986a, p. 75).

   Casing, below land surface: Only surface casing in borehole, to a depth of 17.68 m (Fenix & Scisson, Inc., 1986a, p. 75).

   Total drilled depth: 627.89 m (Fenix & Scisson, Inc., 1986a, p. 75).

3. Description of access tube and depth interval for measuring water levels:

   62-mm-inside-diameter tubing (Robison and others, 1988, p. 25) that has a 3.66-m-long well screen on bottom, extending from land surface to a depth of 621.79 m (Fenix & Scisson, Inc., 1986a, p. 75); saturated interval of the borehole is within the Prow Pass Tuff of the Crater Flat Group (Robison and others, 1988, p. 25). Stratigraphic nomenclature presented by Robison revised to agree with stratigraphic nomenclature in Sawyer and others (1994, p. 1305).

4. Information for calculating water-level altitude:

   Reference point: Top of metal tag on well casing; altitude 1,301.13 m (surveyed by U.S. Geological Survey in 1984; Merle E. Southern, National Mapping Division, U.S. Geological Survey, written commun., 1985).

   Measuring point: Top of access tube, 0.305 m above reference point after December 8, 1993, 0.146 m above reference point between September 9, 1993, and December 8, 1993, and 0.311 m above reference point prior to September 9, 1993.

   Depth correction for borehole deviation from vertical: 0.445 m after December 8, 1993, and 0.533 m prior to December 8, 1993, based on approximate depth to water of 571 m.

Well USW WT-2 was measured periodically during 1997–98, with the lowest water level during this period being 730.26 m above sea level (01–07–97) and the highest water level being 730.59 m above sea level (10–15–98) (table 7, fig. 4). The mean water-level altitude of the 1997 data was 730.29 m above sea level. The mean water-level altitude of the 1998 data was 730.50 m above sea level. Comparisons to 1996 and 1985–95 mean water-level altitudes (Graves, 1998, p. 20 and 21) are shown in table 5, and 1996 water-level data are included in figure 4.

Table 7. Measured water-level altitudes, 1997–98, for well USW WT-2

Date	Measured water-level altitude (meters above sea level)	Equipment used to measure water level
01-07-97	730.26	Chain #3
02-03-97	730.29	Chain #3
03-03-97	730.33	Chain #3
04-07-97	730.29	Chain #3
08-07-97	730.27	Chain #3
04-08-98	730.39	Chain #3
05-19-98	730.48	Chain #3
06-22-98	730.47	Chain #3
07-13-98	730.49	Chain #3
08-13-98	730.49	Chain #3
09-22-98	730.50	Chain #3
10-15-98	730.59	Chain #3
12-17-98	730.57	Chain #3

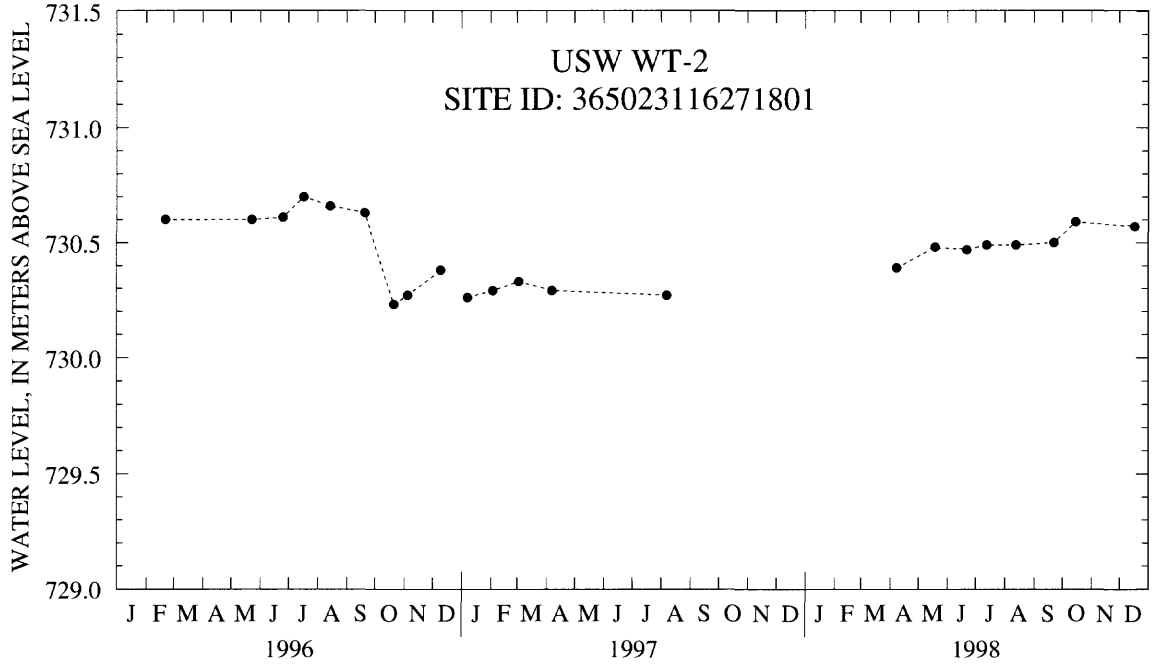

Figure 4. Water-level altitudes, 1996–98, for well USW WT-2.

Well UE-25 WT#3

Well specifications

1. Location and identification:

   Nevada State Plane North American Datum of 1927 Central Zone Coordinates (meters): N 227,380; E 174,768. (U.S. Department of Energy, written commun., 1999, MO9907YMP99025.001.)

   Latitude and longitude: 36°47'57"N.; 116°24'58"W. (Converted from Nevada State Plane North American Datum of 1927 Central Zone Coordinates)

   U.S. Geological Survey Site ID: 364757116245801.

2. Drilling and casing information:

   Well started: April 29, 1983 (Fenix & Scisson, Inc., 1986a, p. 3).

   Well completed: May 25, 1983 (Fenix & Scisson, Inc., 1986a, p. 3).

   Drilling method: Rotary, using rock bits and air-foam circulating medium; core obtained from bottom of the borehole (Robison and others, 1988, p. 28).

   Bit diameter, below land surface: 0 to 4.11 m, 1,219.2 mm; 4.11 to 12.50 m, 374.65 mm; 12.50 m to 348.08 m, 222.25 mm (Fenix & Scisson, Inc., 1986a, p. 3).

   Casing, below land surface: Only surface casing in borehole, to a depth of 12.19 m (Fenix & Scisson, Inc., 1986a, p. 3).

   Total drilled depth: 348.08 m (Fenix & Scisson, Inc., 1986a, p. 3).

3. Description of access tube and depth interval for measuring water levels:

   January 1, 1997–December 22, 1997: 62-mm-inside-diameter tubing (Robison and others, 1988, p. 28) that has a 3.66-m-long well screen on bottom, extending from land surface to a depth of 342.90 m (Fenix & Scisson, Inc., 1986a, p. 3).

   December 22, 1997–July 22, 1998: Workover on well so water-quality sampling could be completed. Access tube removed from well and replaced during workover.

   July 22, 1998: Access tube replaced in well: 61.7-mm-inside-diameter fiberglass tubing from 293.09 to 331.13 m below land surface. Fiberglass tubing slotted (screened) from 326.56 to 331.13 m below land surface. Bottom of fiberglass tubing is capped. Two drain holes are drilled into the cap. From 293.09 m to land surface access tube is 62.0-mm-inside-diameter pipe tubing (U.S. Department of Energy, written commun., 1998 MOL.19980930.0313).

   Saturated interval of the borehole is within the Bullfrog Tuff of the Crater Flat Group (Robison and others, 1988, p. 28). Stratigraphic nomenclature presented by Robison revised to agree with stratigraphic nomenclature in Sawyer and others (1994, p. 1305).

4. Information for calculating water-level altitude:

   Reference point: Top of metal tag on well casing; altitude 1,030.11 m (surveyed by U.S. Geological Survey in 1984; Merle E. Southern, National Mapping Division, U.S. Geological Survey, written commun., 1985).

   Measuring point: Top of access tubing, January 1, 1997–December 22, 1997, 0.155 m above reference point. Top of access tubing, July 22, 1998–December 31, 1998, 0.448 m above reference point.

   Depth correction for borehole deviation from vertical: 0.271 m, based on approximate depth to water of 300 m (1990 data).

   Well UE-25 WT#3 was measured periodically[2] during 1997–98, with the lowest manually measured water level during this period being 729.49 m above sea level (07–02–97 and 09–16–97) and the highest manually

measured water level being 729.60 m above sea level (12–23–98) (table 8, fig. 5). The mean water-level altitude of the 1997 manual measurements was 729.49 m above sea level. Because only one water-level measurement for 1998 is included in this report, the 1998 mean water-level altitude is not estimated. Comparisons to 1996 and 1985–95 mean water-level altitudes (Graves, 1998, p. 22 and 23) are shown in table 5, and 1996 water-level data are included in figure 5.

During 1996, lower water levels in well UE-25 WT#3 were attributed to pumpage at the C-hole complex (Graves, 1998, p. 22). Trends seen in figure 5 indicate that these lower water levels continued into 1997. Insufficient data are available in well UE-25 WT#3 to determine if the rise in water level between September 1997 and December 1998 is due to water-level recovery following the discontinuation of pumpage at the C-hole complex.

Table 8. Measured water-level altitudes, 1997–98, for well UE-25 WT#3

Date	Measured water-level altitude (meters above sea level)	Equipment used to measure water level
03-26-97	729.50	Chain #3
07-02-97	729.49	Chain #3
09-16-97	729.49	Chain #3
12-23-98	729.60	Chain #3

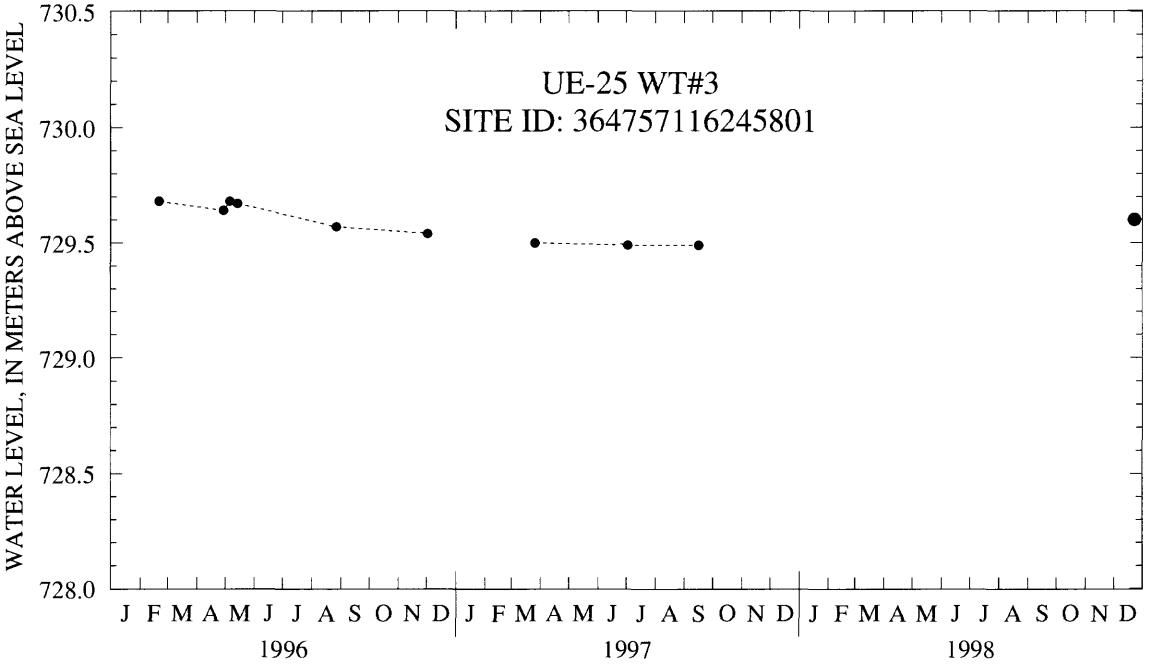

Figure 5. Water-level altitudes, 1996–98, for well UE-25 WT#3.

[2]Well UE-25 WT#3 was monitored continuously January 1 through July 2, 1997, in support of the hydraulic testing at the C-hole complex. The continuous data are not presented in this report.

Well UE-25 WT#4

Well specifications

1. Location and identification:

   Nevada State Plane North American Datum of 1927 Central Zone Coordinates (meters): N 234,243; E 173,138. (U.S. Department of Energy, written commun., 1999, MO9907YMP99025.001.)

   Latitude and longitude: 36°51'40"N.; 116°26'03"W. (Converted from Nevada State Plane North American Datum of 1927 Central Zone Coordinates)

   U.S. Geological Survey Site ID: 365140116260301.

2. Drilling and casing information:

   Well started: May 28, 1983 (Fenix & Scisson, Inc., 1986a, p. 9).

   Well completed: June 6, 1983 (Fenix & Scisson, Inc., 1986a, p. 9).

   Drilling method: Rotary, using rock bits and air-foam circulating medium; core obtained from bottom of the borehole (Robison and others, 1988, p. 31).

   Bit diameter, below land surface: 0 to 15.24 m, 374.65 mm; 15.24 m to 481.58 m, 222.25 mm (Fenix & Scisson, Inc., 1986a, p. 9).

   Casing, below land surface: Only surface casing in borehole, to a depth of 14.63 m (Fenix & Scisson, Inc., 1986a, p. 9).

   Total drilled depth: 481.58 m (Fenix & Scisson, Inc., 1986a, p. 9).

3. Description of access tube and depth interval for measuring water levels:

   62-mm-inside-diameter tubing (Robison and others, 1988, p. 31) that has a 3.66-m-long well screen on the bottom; tubing and attached screen extend from land surface to a depth of 477.62 m (Fenix & Scisson, Inc., 1986a, p. 9); saturated interval of the borehole is within the Calico Hills Formation (Robison and others, 1988, p. 31). Stratigraphic nomenclature presented by Robison revised to agree with stratigraphic nomenclature in Sawyer and others (1994, p. 1305).

4. Information for calculating water-level altitude:

   Reference point: Top of metal tag on well casing, altitude 1,169.21 m (surveyed by U.S. Geological Survey in 1984; Merle E. Southern, National Mapping Division, U.S. Geological Survey, written commun., 1985).

   Measuring point: Top of access tube, 0.311 m above reference point.

   Depth correction for borehole deviation from vertical: 0.454 m, based on approximate depth to water of 438 m (1990 data).

Well UE-25 WT#4 was measured periodically during 1997–98, with the lowest water level during this period being 730.51 m above sea level (03–04–97) and the highest water level being 730.84 m above sea level (10–13–98) (table 9, fig. 6). The mean water-level altitude of the 1997 data was 730.54 m above sea level. The mean water-level altitude of the 1998 data was 730.75 m above sea level. Comparisons to 1996 and 1985–95 mean water-level altitudes (Graves, 1998, p. 24 and 25) are shown in table 5, and 1996 water-level data are included in figure 6.

During 1996, lower water levels in well UE-25 WT#4 were attributed to pumpage at the C-hole complex (Graves, 1998, p. 24). Trends seen in figure 6 indicate that these lower water levels continued into 1997. Pumpage was discontinued at the C-hole complex on November 12, 1997. During 1998, there was a rise in water levels. Though no data were collected in well UE-25 WT#4 from August through December 1997, this rise in water level is believed to be water-level recovery following the discontinuation of pumpage at the C-hole complex.

Table 9. Measured water-level altitudes, 1997–98, for well UE-25 WT#4

Date	Measured water-level altitude (meters above sea level)	Equipment used to measure water level
01-14-97	730.53	Chain #3
02-04-97	730.59	Chain #3
03-04-97	730.51	Chain #3
04-07-97	730.56	Chain #3
07-15-97	730.52	Chain #3
01-22-98	730.61	Chain #3
04-15-98	730.72	Chain #3
05-20-98	730.72	Chain #3
06-11-98	730.79	Chain #3
07-09-98	730.78	Chain #3
08-12-98	730.78	Chain #3
09-21-98	730.78	Chain #3
10-13-98	730.84	Chain #3

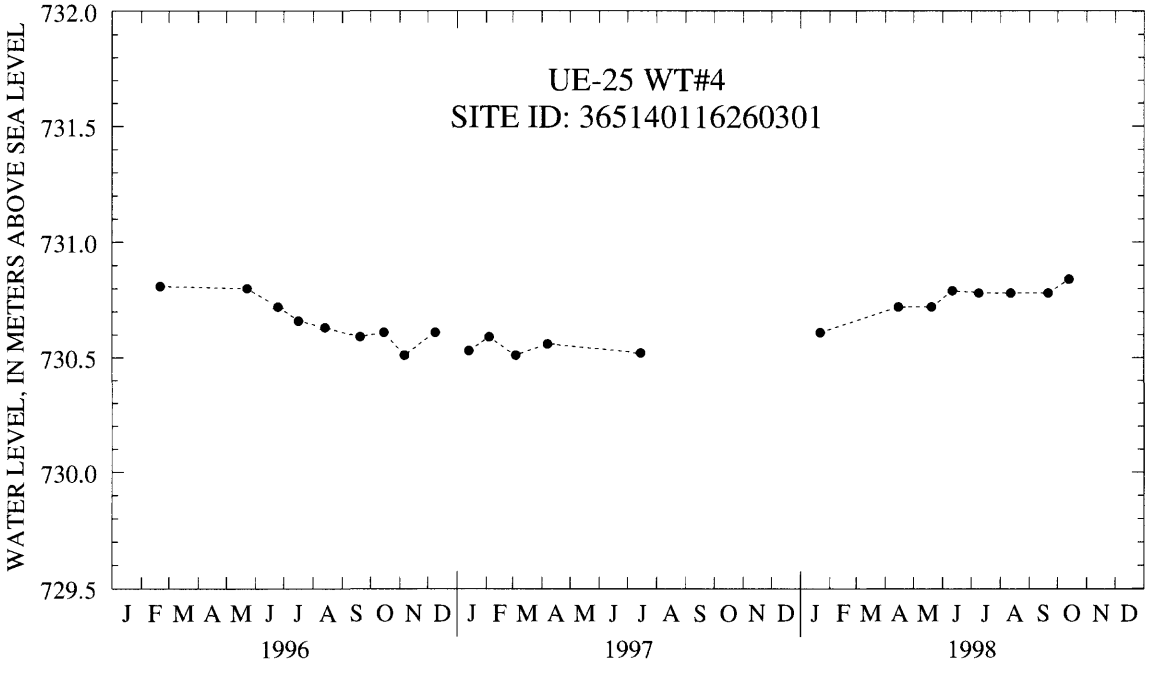

Figure 6. Water-level altitudes, 1996–98, for well UE-25 WT#4.

Well UE-25 WT#6

Well specifications

1. Location and identification:

   Nevada State Plane North American Datum of 1927 Central Zone Coordinates (meters): N 237,920; E 172,067. (U.S. Department of Energy, written commun., 1999, MO9907YMP99025.001.)

   Latitude and longitude: 36°53'40"N.; 116°26'46"W. (Converted from Nevada State Plane North American Datum of 1927 Central Zone Coordinates)

   U.S. Geological Survey Site ID: 365340116264601.

2. Drilling and casing information:

   Well started: June 20, 1983 (Fenix & Scisson, Inc., 1986a, p. 21).

   Well completed: June 29, 1983 (Fenix & Scisson, Inc., 1986a, p. 21).

   Drilling method: Rotary, using rock bits and air-foam circulating medium; core obtained from bottom of the borehole (Robison and others, 1988, p. 35).

   Bit diameter, below land surface: 0 to 21.03 m, 374.65 mm; 21.03 to 76.2 m, 250.82 mm; 76.2 to 381 m, 171.45 mm; 381 to 382.98, 158.75 mm (Fenix & Scisson, Inc., 1986a, p. 21).

   Casing, below land surface: Only surface casing in borehole, to a depth of 76.50 m. (Fenix & Scisson, Inc., 1986a, p. 21)

   Total drilled depth: 382.98 m (Fenix & Scisson, Inc., 1986a, p. 21).

3. Description of access tube and depth interval for measuring water levels:

   62-mm-inside-diameter tubing (Robison and others, 1988, p. 35) that has a 3.75-m-long well screen on bottom, extending from land surface to a depth of 372.16 m (Fenix & Scisson, Inc., 1986a, p. 21); saturated interval of the borehole is within the Calico Hills Formation (Robison and others, 1988, p. 35). Stratigraphic nomenclature presented by Robison revised to agree with stratigraphic nomenclature in Sawyer and others (1994, p. 1305).

4. Information for calculating water-level altitude:

   Reference point: Top of metal tag on well casing; altitude 1,314.78 m (surveyed by U.S. Geological Survey in 1984; Merle E. Southern, National Mapping Division, U.S. Geological Survey, written commun., 1985).

   Measuring point: Top of access tube, 0.463 m above reference point.

   Depth correction for borehole deviation from vertical: 0.204 m, based on approximate depth to water of 280 m (1990 data).

Well UE-25 WT#6 was measured periodically during 1997–98, with the lowest water level during this period being 1,034.54 m above sea level (03–10–97) and the highest water level being 1,034.79 m above sea level (02–24–98, 05–13–98, and 09–15–98) (table 10, fig. 7). The mean water-level altitude of the 1997 data was 1,034.57 m above sea level. The mean water-level altitude of the 1998 data was 1,034.76 m above sea level. Comparisons to 1996 and 1985–95 mean water-level altitudes (Graves, 1998, p. 26 and 27) are shown in table 5, and 1996 water-level data are included in figure 7.

Table 10. Measured water-level altitudes, 1997–98, for well UE-25 WT#6

Date	Measured water-level altitude (meters above sea level)	Equipment used to measure water level
01-16-97	1,034.56	Chain #3
02-06-97	1,034.57	Chain #3
03-10-97	1,034.54	Chain #3
04-02-97	1,034.60	Chain #3
07-14-97	1,034.57	Chain #3
09-18-97	1,034.60	2,800-Foot Reference Steel Tape
02-24-98	1,034.79	Chain #3
04-08-98	1,034.69	Chain #3
04-22-98	1,034.72	Chain #3
05-13-98	1,034.79	Chain #3
09-15-98	1,034.79	Chain #3

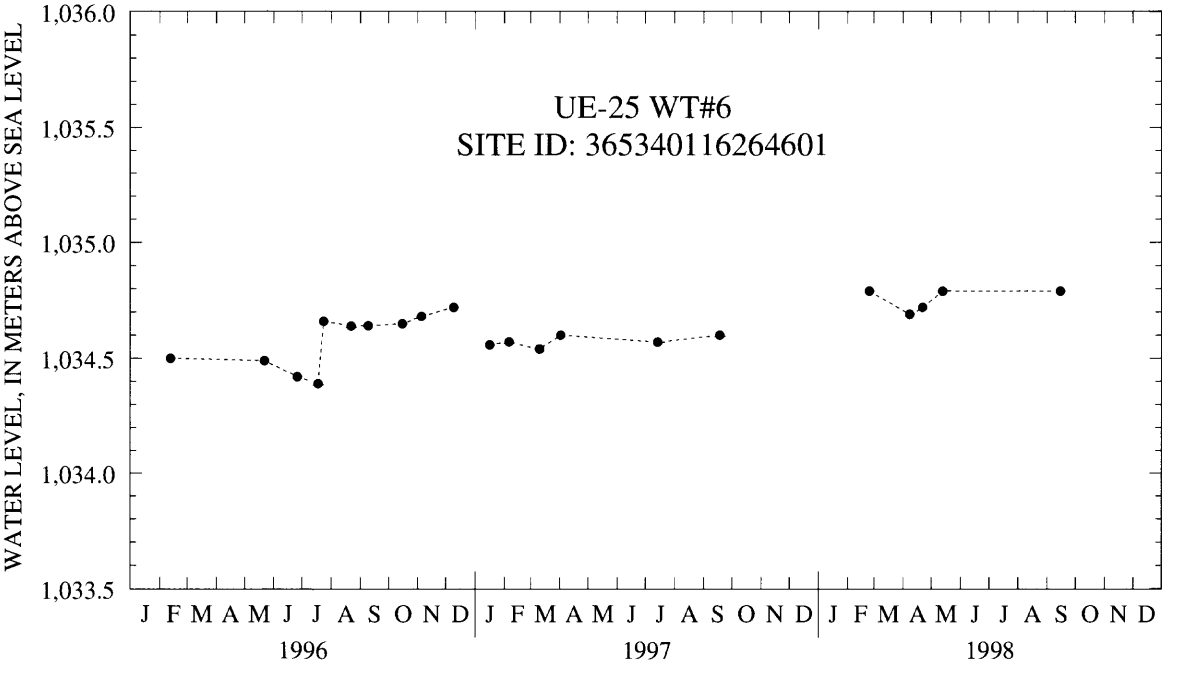

Figure 7. Water-level altitudes, 1996–98, for well UE-25 WT#6.

Well USW WT-7

Well specifications

1. Location and identification:

   Nevada State Plane North American Datum of 1927 Central Zone Coordinates (meters): N 230,298; E 168,827. (U.S. Department of Energy, written commun., 1999, MO9907YMP99025.001.)

   Latitude and longitude: 36°49'33"N.; 116°28'57"W. (Converted from Nevada State Plane North American Datum of 1927 Central Zone Coordinates)

   U.S. Geological Survey Site ID: 364933116285701.

2. Drilling and casing information:

   Well started: July 19, 1983 (Fenix & Scisson, Inc., 1986a, p. 81).

   Well completed: July 26, 1983 (Fenix & Scisson, Inc., 1986a, p. 81).

   Drilling method: Rotary, using rock bits and air-foam circulating medium; core obtained from bottom of the borehole (Robison and others, 1988, p. 38).

   Bit diameter, below land surface: 222 mm (Fenix & Scisson, Inc., 1986a, p. 81).

   Casing, below land surface: Only surface casing in borehole, to a depth of 15.8 m (Fenix & Scisson, Inc., 1986a, p. 81).

   Total drilled depth: 491.00 m (Fenix & Scisson, Inc., 1986a, p. 81).

3. Description of access tube and depth interval for measuring water levels:

   62-mm-inside-diameter tubing (Robison and others, 1988, p. 38) that has a 3.66-m-long well screen on the bottom; tubing and attached screen extend from land surface to a depth of 481.28 m (Fenix & Scisson, Inc., 1986a, p. 81); saturated interval of the borehole is within the Topopah Spring Tuff of the Paintbrush Group to the Prow Pass Tuff of the Crater Flat Group (Robison and others, 1988, p. 38). Stratigraphic nomenclature presented by Robison revised to agree with stratigraphic nomenclature in Sawyer and others (1994, p. 1305).

4. Information for calculating water-level altitude:

   Reference point: Top of metal tag on well casing, altitude 1,196.88 m (surveyed by U.S. Geological Survey in 1984; Merle E. Southern, National Mapping Division, U.S. Geological Survey, written commun., 1985).

   Measuring point: Top of access tube, 0.302 m above reference point.

   Depth correction for borehole deviation from vertical: 0.034 m, based on approximate depth to water of 421 m (1990 data).

Well USW WT-7 was measured periodically during 1997–98, with the lowest water level being 775.84 m above sea level (03–18–97) and the highest water level being 775.99 m above sea level (09–03–98) (table 11, fig. 8). The mean water-level altitude of the 1997 data and the 1998 data was 775.94 m above sea level. Comparisons to 1996 and 1985–95 mean water-level altitudes (Graves, 1998, p. 28 and 29) are shown in table 5, and 1996 water-level data are included in figure 8.

Table 11. Measured water-level altitudes, 1997–98, for well USW WT-7

Date	Measured water-level altitude (meters above sea level)	Equipment used to measure water level
01-22-97	775.97	Chain #3
02-25-97	775.98	Chain #3
03-18-97	775.84	Chain #3
04-15-97	775.93	Chain #3
07-17-97	775.97	Chain #3
04-09-98	775.91	Chain #3
05-28-98	775.93	Chain #3
06-25-98	775.96	Chain #3
07-28-98	775.96	Chain #3
09-03-98	775.99	Chain #3
09-30-98	775.96	Chain #3
10-22-98	775.90	Chain #3
12-15-98	775.93	Chain #3

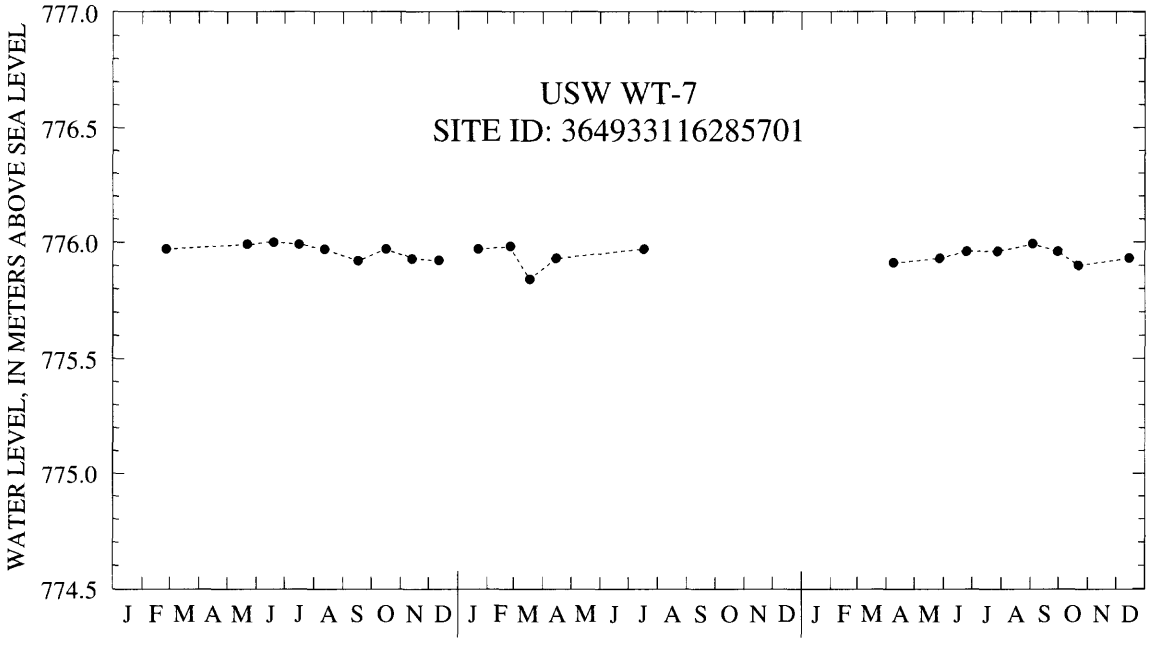

Figure 8. Water-level altitudes, 1996–98, for well USW WT-7.

Well USW WT-10

Well specifications

1. Location and identification:

   Nevada State Plane North American Datum of 1927 Central Zone Coordinates (meters): N 228,226; E 168,647. (U.S. Department of Energy, written commun., 1999, MO9907YMP99025.001.)

   Latitude and longitude: 36°48'25"N.; 116°29'05"W. (Converted from Nevada State Plane North American Datum of 1927 Central Zone Coordinates)

   U.S. Geological Survey Site ID: 364825116290501.

2. Drilling and casing information:

   Well started: July 26, 1983 (Fenix & Scisson, Inc., 1986a, p. 87).

   Well completed: August 2, 1983 (Fenix & Scisson, Inc., 1986a, p. 87).

   Drilling method: Rotary, using rock bits and air-foam circulating medium; core obtained from bottom of the borehole (Robison and others, 1988, p. 42).

   Bit diameter, below land surface: 0 to 35.36 m, 374.65 mm; 35.36 to 430.68 m, 222.25 mm (Fenix & Scisson, Inc., 1986a, p. 87).

   Casing, below land surface: Only surface casing in borehole, to a depth of 34.75 m (Fenix & Scisson, Inc., 1986a, p. 87).

   Total drilled depth: 430.68 m (Fenix & Scisson, Inc., 1986a, p. 87).

3. Description of access tube and depth interval for measuring water levels:

   62.0-mm-inside-diameter tubing that is capped with a well screen on the bottom. Bottom of tubing is at 426.52 m below land surface (U.S. Department of Energy, written commun., 1995, DRC.19960905.0053; U.S. Department of Energy, written commun., 1996, DRC.19960905.0054). The screen length is not reported. Two additional tubes are in borehole USW WT-10. The first tube is capped on the bottom with a 2.44-m-long well screen above the cap. The inside diameter of the tube is not reported. Bottom of tubing is at 424.63 m below land surface. The second tube is a sealed tube, capped top and bottom and filled with water. The tube is installed in the well to allow access for temperature logging. The bottom of the tube is at 427.59 m below land surface. The inside diameter of the tube is not reported (U.S. Department of Energy, written commun., 1996, DRC.19960905.0055). Only the tube designated as the access tube placed at 426.52 m below land surface was used to measure water levels during 1997 and 1998.

   Saturated interval of the borehole is within the Topopah Spring Tuff of the Paintbrush Group (Robison and others, 1988, p. 42). Stratigraphic nomenclature presented by Robison revised to agree with stratigraphic nomenclature in Sawyer and others (1994, p. 1305).

4. Information for calculating water-level altitude:

   Reference point: Top of metal tag on well casing, altitude 1,123.40 m (surveyed by U.S. Geological Survey in 1984; Merle E. Southern, National Mapping Division, U.S. Geological Survey, written commun., 1985).

   Measuring point: Top of access tube, 0.390 m above reference point.

   Depth correction for borehole deviation from vertical: 0.030 m, based on approximate depth to water of 347 m (1990 data).

Well USW WT-10 was measured periodically during 1997–98, with the lowest water level being 775.91 m above sea level (03–18–97) and the highest water level being 776.12 m above sea level (09–03–98) (table 12, fig. 9). The mean water-level altitude of the 1997 data was 776.04 m above sea level. The mean water-level altitude of the 1998 data was 776.07 m above sea level. Comparisons to 1996 and 1985–95 mean water-level altitudes (Graves, 1998, p. 30 and 31) are shown in table 5, and 1996 water-level data are included in figure 9.

Table 12. Measured water-level altitudes, 1997–98, for well USW WT-10

Date	Measured water-level altitude (meters above sea level)	Equipment used to measure water level
01-22-97	776.10	Chain #3
02-25-97	776.10	Chain #3
03-18-97	775.91	Chain #3
04-15-97	776.03	Chain #3
07-16-97	776.07	Chain #3
04-09-98	776.03	Chain #3
05-28-98	776.05	Chain #3
06-25-98	776.09	Chain #3
07-28-98	776.10	Chain #3
09-03-98	776.12	Chain #3
09-30-98	776.09	Chain #3
10-22-98	776.02	Chain #3
12-15-98	776.04	Chain #3

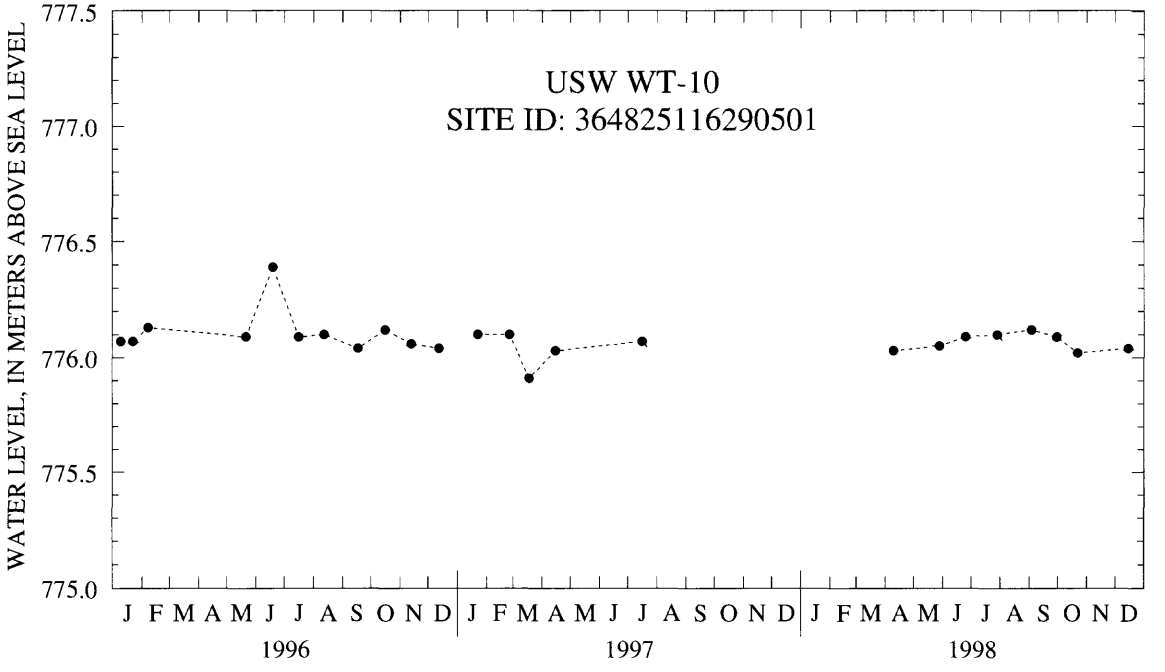

Figure 9. Water-level altitudes, 1996–98, for well USW WT-10.

Well USW WT-11

Well specifications

1. Location and identification:

   Nevada State Plane North American Datum of 1927 Central Zone Coordinates (meters): N 225,269; E 170,194. (U.S. Department of Energy, written commun., 1999, MO9907YMP99025.001.)

   Latitude and longitude: 36°46'49"N.; 116°28'02"W. (Converted from Nevada State Plane North American Datum of 1927 Central Zone Coordinates)

   U.S. Geological Survey Site ID: 364649116280201.

2. Drilling and casing information:

   Well started: August 3, 1983 (Fenix & Scisson, Inc., 1986a, p. 91).

   Well completed: August 9, 1983 (Fenix & Scisson, Inc., 1986a, p. 91).

   Drilling method: Rotary, using rock bits and air-foam circulating medium; core obtained from bottom of the borehole (Robison and others, 1988, p. 46).

   Bit diameter, below land surface: 0 to 13.72 m, 273.05mm; 13.72 to 440.74 m, 222.25 mm (Fenix & Scisson, Inc., 1986a, p. 91).

   Casing, below land surface: Only surface casing in borehole, to a depth of 13.56 m (Fenix & Scisson, Inc., 1986a, p. 91).

   Total drilled depth: 440.74 m (Fenix & Scisson, Inc., 1986a, p. 91).

3. Description of access tube and depth interval for measuring water levels:

   62-mm-inside-diameter tubing (Robison and others, 1988, p. 46) that has a 3.66-m-long well screen on bottom, extending from land surface to a depth of 416.05 m (Fenix & Scisson, Inc., 1986a, p. 91); saturated interval of the borehole is within the Topopah Spring Tuff of the Paintbrush Group and the Calico Hills Formation (Robison and others, 1988, p. 46). Stratigraphic nomenclature presented by Robison revised to agree with stratigraphic nomenclature in Sawyer and others (1994, p. 1305).

4. Information for calculating water-level altitude:

   Reference point: Top of metal tag on well casing; altitude 1,094.11 m (surveyed by U.S. Geological Survey in 1984; Merle E. Southern, National Mapping Division, U.S. Geological Survey, written commun., 1985).

   Measuring point: Top of access tube, 0.311 m above reference point.

   Depth correction for borehole deviation from vertical: 0.116 m, based on approximate depth to water of 363 m (1990 data).

Well USW WT-11 was measured periodically during 1997–98, with the lowest water level being 730.42 m above sea level (03–18–97) and the highest water level being 730.61 m above sea level (06–25–98) (table 13, fig. 10). The mean water-level altitude of the 1997 data was 730.48 m above sea level. The mean water-level altitude of the 1998 data was 730.54 m above sea level. Comparisons to 1996 and 1985–95 mean water-level altitudes (Graves, 1998, p. 32 and 33) are shown in table 5, and 1996 water-level data are included in figure 10.

During 1996, lower water levels in well USW WT-11 were attributed to pumpage at the C-hole complex (Graves, 1998, p. 32). However, the increase in water level during January 1997 and the dropping of water levels from July 1997 through April 1998 (fig. 10) could be evidence that the lower water levels during 1996 were only coincidental and not due to the pumpage at the C-hole complex.

Water-level measurements were discontinued in well USW WT-11 after July 1998 because of blockage in the access tube.

Table 13. Measured water-level altitudes, 1997–98, for well USW WT-11

Date	Measured water-level altitude (meters above sea level)	Equipment used to measure water level
01-22-97	730.56	Chain #3
02-25-97	730.46	Chain #3
03-18-97	730.42	Chain #3
04-15-97	730.51	Chain #3
07-16-97	730.47	Chain #3
04-09-98	730.45	Chain #3
05-28-98	730.54	Chain #3
06-25-98	730.61	Chain #3
07-28-98	730.58	Chain #3

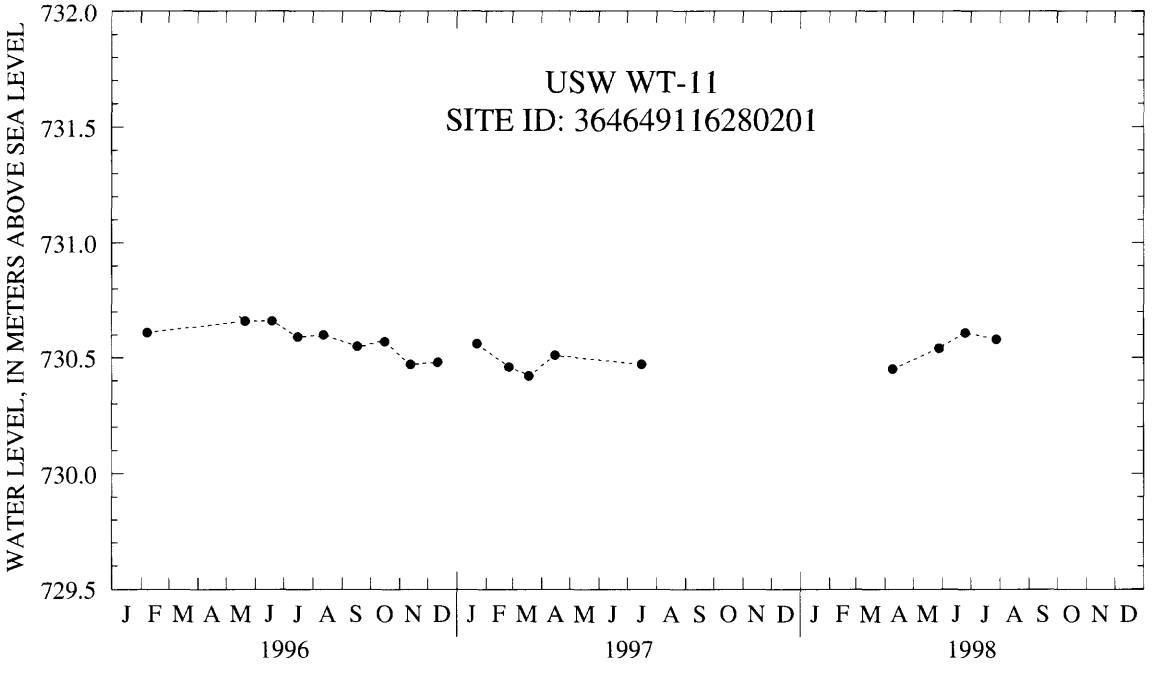

Figure 10. Water-level altitudes, 1996–98, for well USW WT-11.

Well UE-25 WT#12

Well specifications

1. Location and identification:

   Nevada State Plane North American Datum of 1927 Central Zone Coordinates (meters): N 225,469; E 172,826. (U.S. Department of Energy, written commun., 1999, MO9907YMP99025.001.)

   Latitude and longitude: 36°46'56"N.; 116°26'16"W. (Converted from Nevada State Plane North American Datum of 1927 Central Zone Coordinates)

   U.S. Geological Survey Site ID: 364656116261601.

2. Drilling and casing information:

   Well started: August 11, 1983 (Fenix & Scisson, Inc., 1986a, p. 27).

   Well completed: August 16, 1983 (Fenix & Scisson, Inc., 1986a, p. 27).

   Drilling method: Rotary, using rock bits and air-foam circulating medium; core obtained from bottom of the borehole (Robison and others, 1988, p. 49).

   Bit diameter, below land surface: 0 to 22.86 m, 381 mm; 22.86 m to 398.68 m, 222.25 mm (Fenix & Scisson, Inc., 1986a, p. 27).

   Casing, below land surface: Only surface casing in borehole, to a depth of 21.34 m (Fenix & Scisson, Inc., 1986a, p. 27).

   Total drilled depth: 398.68 m (Fenix & Scisson, Inc., 1986a, p. 27).

3. Description of access tube and depth interval for measuring water levels:

   Access tube is capped on the bottom with a well screen above the cap. The bottom of the tube is at 389.26 m below land surface. The length of screen and inside diameter of the tubing are not reported (U.S. Department of Energy, written commun., 1995, DRC.19960905.0024). Two additional tubes are in borehole UE-25 WT#12. One is a 60.3-mm-inside-diameter tubing that is capped on the bottom with a screen above the cap (U.S. Department of Energy, written commun., 1995, DRC.19960905.0027). Accurate information on screen length and depth of tube is not available. The second tube is a 48.42-mm-inside-diameter sealed tube, capped top and bottom and filled with water. The tube is installed in the well to allow access for temperature logging (U.S. Department of Energy, written commun., 1995, DRC.19960905.0027). Accurate information on length of tube below land surface is not available. Only the tube designated as the access tube placed at 389.26 m below land surface was used to measure water levels during 1998.

   The saturated interval of the borehole is within the Topopah Spring Tuff of the Paintbrush Group and the Calico Hills Formation (Robison and others, 1988, p. 49). Stratigraphic nomenclature presented by Robison revised to agree with stratigraphic nomenclature in Sawyer and others (1994, p. 1305).

4. Information for calculating water-level altitude:

   Reference point: Top of metal tag on well casing, altitude 1,074.74 m (surveyed by U.S. Geological Survey in 1984; Merle E. Southern, National Mapping Division, U.S. Geological Survey, written commun., 1985).

   Measuring point: Top of access tube, 0.171 m above reference point.

   Depth correction for borehole deviation from vertical: 0.183 m, based on approximate depth to water of 345 m (1990 data).

Well UE-25 WT#12 was measured periodically during 1998, with the lowest water level being 729.27 m above sea level (04–16–98) and the highest water level being 729.38 m above sea level (12–16–98) (table 14, fig. 11). The mean water-level altitude of the 1998 data was 729.35 m above sea level. No water-level measurements were collected during 1996 and 1997 in well UE-25 WT#12 because the road to the well was inaccessible during this time. Comparisons to 1985–95 mean water-level altitudes (Graves and others, 1997, p. 4) are shown in table 5.

Table 14. Measured water-level altitudes, 1998, for well UE-25 WT#12

Date	Measured water-level altitude (meters above sea level)	Equipment used to measure water level
04-16-98	729.27	Chain #3
05-19-98	729.35	Chain #3
06-10-98	729.36	Chain #3
07-01-98	729.36	Chain #3
08-25-98	729.36	Chain #3
09-23-98	729.35	Chain #3
10-20-98	729.37	Chain #3
12-16-98	729.38	Chain #3

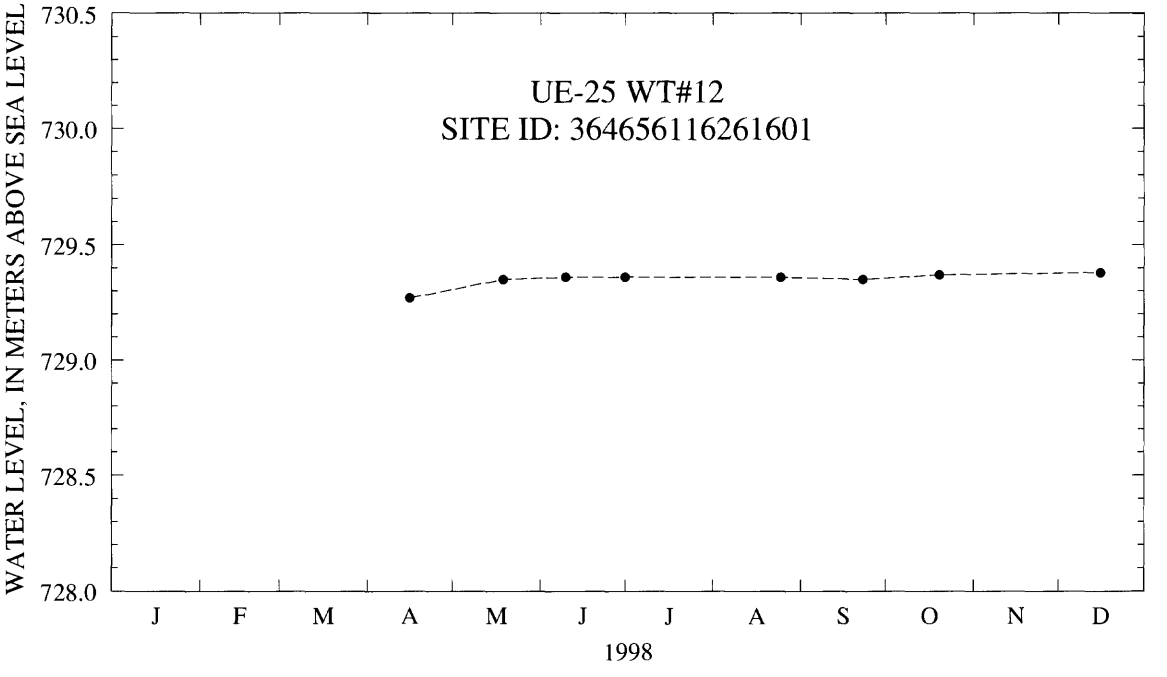

Figure 11. Water-level altitudes, 1998, for well UE-25 WT#12.

Well UE-25 WT#13

Well specifications

1. Location and identification:

   Nevada State Plane North American Datum of 1927 Central Zone Coordinates (meters): N 230,699; E 176,431. (U.S. Department of Energy, written commun., 1999, MO9907YMP99025.001.)

   Latitude and longitude: 36°49'45"N.; 116°23'50"W. (Converted from Nevada State Plane North American Datum of 1927 Central Zone Coordinates)

   U.S. Geological Survey Site ID: 364945116235001.

2. Drilling and casing information:

   Well started: June 29, 1983 (Fenix & Scisson, Inc., 1986a, p. 33).

   Well completed: July 7, 1983 (Fenix & Scisson, Inc., 1986a, p. 33).

   Drilling method: Rotary, using rock bits and air-foam circulating medium; core obtained from bottom of the borehole (Robison and others, 1988, p. 53).

   Bit diameter, below land surface: 0 to 14.78 m, 381 mm; 14.78 to 68.28 m, 374.65 mm; 68.28 to 350.52 m, 222.25 mm; 350.52 to 353.57 m, 204.79 mm (Fenix & Scisson, Inc., 1986a, p. 33).

   Casing, below land surface: Only surface casing in borehole, to a depth of 67.67 m (Fenix & Scisson, Inc., 1986a, p. 33).

   Total drilled depth: 353.57 m (Fenix & Scisson, Inc., 1986a, p. 33).

3. Description of access tube and depth interval for measuring water levels:

   62-mm-inside-diameter tubing (Robison and others, 1988, p. 53) that has a 3.66-m-long well screen on bottom, extending from land surface to a depth of 346.25 m (Fenix & Scisson, Inc., 1986a, p. 33); saturated interval of the borehole is within the Topopah Spring Tuff of the Paintbrush Group (Robison and others, 1988, p. 53). Stratigraphic nomenclature presented by Robison revised to agree with stratigraphic nomenclature in Sawyer and others (1994, p. 1305).

4. Information for calculating water-level altitude:

   Reference point: Top of metal tag on well casing; altitude 1,032.51 m (surveyed by U.S. Geological Survey in 1984; Merle E. Southern, National Mapping Division, U.S. Geological Survey, written commun., 1985).

   Measuring point: Top of access tube, 0.305 m above reference point.

   Depth correction for borehole deviation from vertical: 0.012 m, based on approximate depth to water of 304 m (1990 data).

Well UE-25 WT#13 was measured periodically during 1997–98, with the lowest water level during this period being 729.02 m above sea level (04–08–98) and the highest water level being 729.27 m above sea level (10–15–98) (table 15, fig. 12). The mean water-level altitude of the 1997 data was 729.09 m above sea level. The mean water-level altitude of the 1998 data was 729.13 m above sea level. Comparisons to 1996 and 1985–95 mean water-level altitudes (Graves, 1998, p. 34 and 35) are shown in table 5, and 1996 water-level data are included in figure 12.

Table 15. Measured water-level altitudes, 1997–98, for well UE-25 WT#13

Date	Measured water-level altitude (meters above sea level)	Equipment used to measure water level
01-14-97	729.08	Chain #3
02-13-97	729.05	Chain #3
03-11-97	729.11	Chain #3
04-02-97	729.20	Chain #3
07-15-97	729.03	Chain #3
01-22-98	729.05	Chain #3
04-08-98	729.02	Chain #3
04-23-98	729.14	Chain #3
05-27-98	729.12	Chain #3
06-10-98	729.16	Chain #3
07-01-98	729.15	Chain #3
07-09-98	729.10	Chain #3
08-12-98	729.11	Chain #3
09-22-98	729.12	Chain #3
10-15-98	729.27	Chain #3
12-14-98	729.24	Chain #3

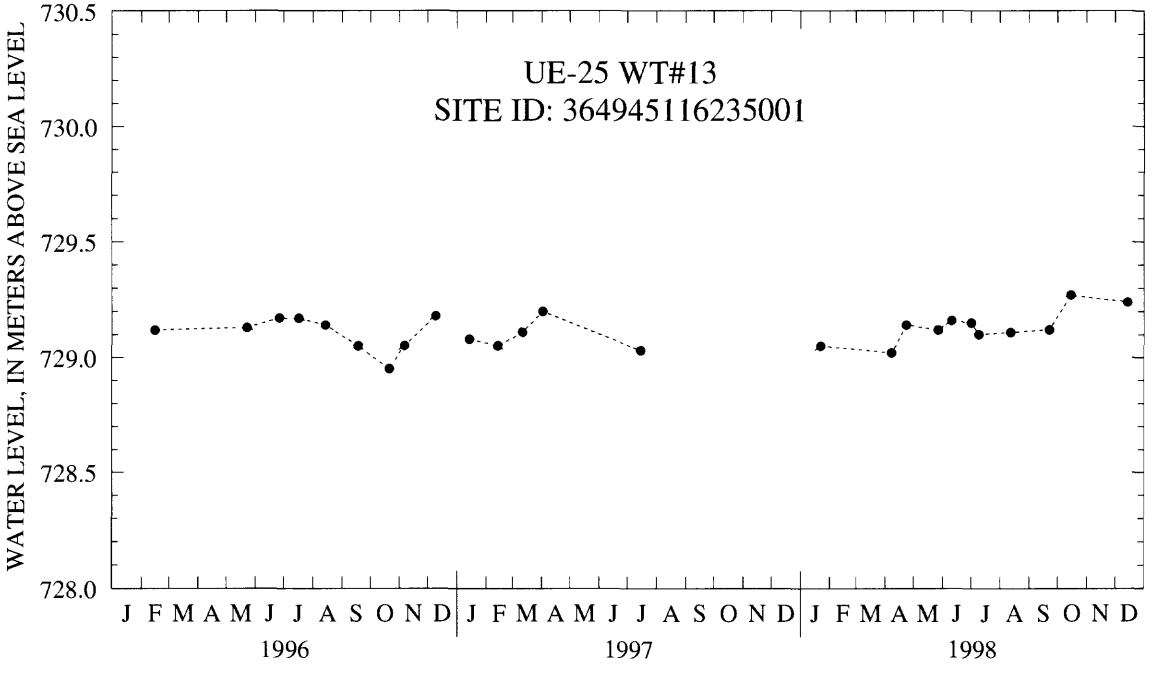

Figure 12. Water-level altitudes, 1996–98, for well UE-25 WT#13.

Well UE-25 WT#14

Well specifications

1. Location and identification:

   Nevada State Plane North American Datum of 1927 Central Zone Coordinates (meters): N 232,152; E 175,324. (U.S. Department of Energy, written commun., 1999, MO9907YMP99025.001.)

   Latitude and longitude: 36°50'32"N.; 116°24'35"W. (Converted from Nevada State Plane North American Datum of 1927 Central Zone Coordinates)

   U.S. Geological Survey Site ID: 365032116243501.

2. Drilling and casing information:

   Well started: August 17, 1983 (Fenix & Scisson, Inc., 1986a, p. 39).

   Well completed: September 30, 1983 (Fenix & Scisson, Inc., 1986a, p. 39).

   Drilling method: Rotary, using rock bits and air-foam circulating medium; core obtained from bottom of the borehole (Robison and others, 1988, p. 56).

   Bit diameter, below land surface: 0 to 38.25 m, 381 mm; 38.25 to 399.29 m, 222.25 mm (Fenix & Scisson, Inc., 1986a, p. 39).

   Casing, below land surface: Surface casing only, to a depth of 36.58 m (Fenix & Scisson, Inc., 1986a, p. 39).

   Total drilled depth: 399.29 m (Fenix & Scisson, Inc., 1986a, p. 39).

3. Description of access tube and depth interval for measuring water levels:

   62-mm-inside-diameter tubing (Robison and others, 1988, p. 56) that has a 3.66-m-long well screen on the bottom; tubing and attached screen extend from land surface to a depth of 397.15 m (Fenix & Scisson, Inc., 1986a, p. 39); saturated interval of the borehole is within the Topopah Spring Tuff of the Paintbrush Group and the Calico Hills Formation (Robison and others, 1988, p. 56). Stratigraphic nomenclature presented by Robison revised to agree with stratigraphic nomenclature in Sawyer and others (1994, p. 1305).

4. Information for calculating water-level altitude:

   Reference point: Top of metal tag on well casing, altitude 1,076.05 m (surveyed by U.S. Geological Survey in 1984; Merle E. Southern, National Mapping Division, U.S. Geological Survey, written commun., 1985).

   Measuring point: Top of access tube, 0.311 m above reference point.

   Depth correction for borehole deviation from vertical: 0.085 m, based on approximate depth to water of 346 m (1990 data).

Well UE-25 WT#14 was measured periodically[3] during 1997–98, with the lowest manually measured water level during this period being 729.44 m above sea level (10–01–97) and the highest water level being 729.62 m above sea level (07–29–98) (table 16, fig. 5). Based on manually measured water levels, the mean water-level altitude for 1997 was 729.44 m above sea level, and for 1998 the mean water-level altitude was 729.57 m above sea level. Comparisons to 1996 and 1985–95 mean water-level altitudes (Graves, 1998, p. 22 and 23) are shown in table 5, and 1996 water-level data are included in figure 13.

During 1996, lower water levels in borehole UE-25 WT#14 were attributed to pumpage at the C-hole complex (Graves, 1998, p. 36). Trends seen in figure 13 indicate that these lower water levels continued into 1997. Pumpage was discontinued at the C-hole complex on November 12, 1997. During 1998, there was a rise in water levels. Though no manual measurements were collected from November 1997 until January 1998, this rise in water level is believed to be water-level recovery following the discontinuation of pumpage at the C-hole complex.

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[3]Well UE-25 WT#14 was monitored continuously during 1997 and 1998, in support of the hydraulic testing at the C-hole complex. The continuous data are not presented in this report.

Table 16. Measured water-level altitudes, 1997–98, for well UE-25 WT#14

Date	Measured water-level altitude (meters above sea level)	Equipment used to measure water level
03-26-97	729.45	Chain #3
10-01-97	729.44	Chain #3
02-25-98	729.51	Chain #3
07-16-98	729.59	Chain #3
07-29-98	729.62	Chain #3

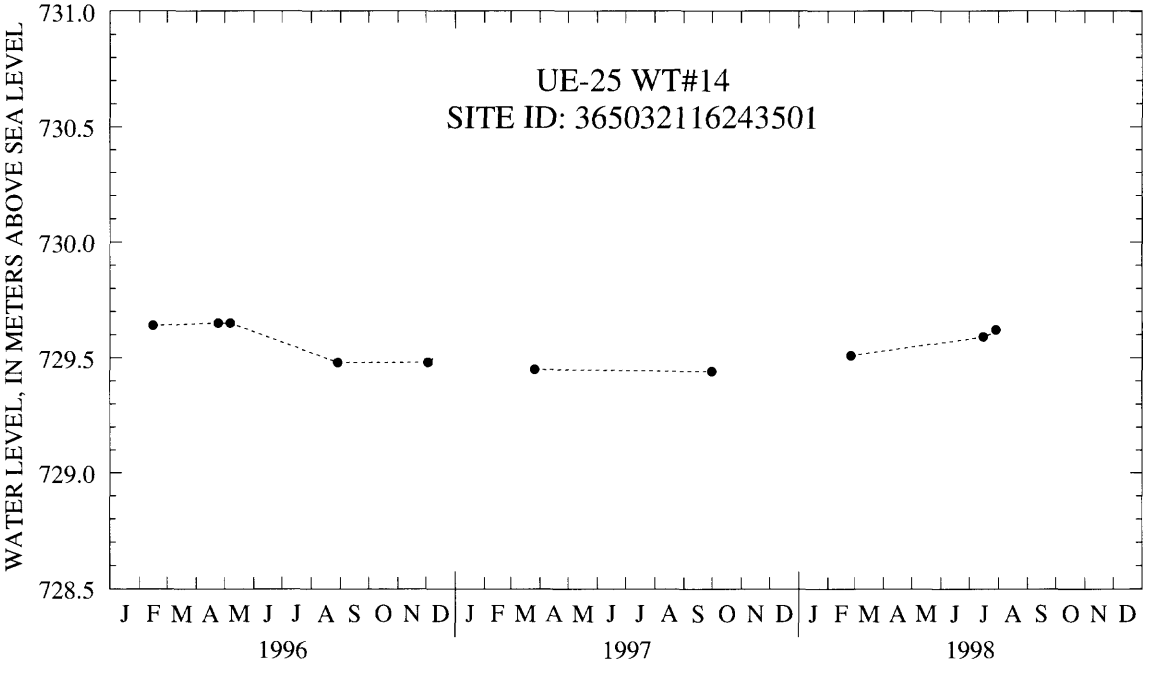

Figure 13. Water-level altitudes, 1996–98, for well UE-25 WT#14.

Well UE-25 WT#15

Well specifications

1. Location and identification:

   Nevada State Plane North American Datum of 1927 Central Zone Coordinates (meters): N 233,513; E 176,725. (U.S. Department of Energy, written commun., 1999, MO9907YMP99025.001.)

   Latitude and longitude: 36°51'16"N.; 116°23'38"W. (Converted from Nevada State Plane North American Datum of 1927 Central Zone Coordinates)

   U.S. Geological Survey Site ID: 365116116233801.

2. Drilling and casing information:

   Well started: November 12, 1983 (Fenix & Scisson, Inc., 1986a, p. 45).

   Well completed: November 22, 1983 (Fenix & Scisson, Inc., 1986a, p. 45).

   Drilling method: Rotary, using rock bits and air-foam circulating medium; core obtained from bottom of the borehole (Robison and others, 1988, p. 60).

   Bit diameter, below land surface: 0 to 39.62 m, 374.65 mm; 39.62 to 414.53 m, 222.25 mm (Fenix & Scisson, Inc., 1986a, p. 45).

   Casing, below land surface: Surface casing only, to a depth of 38.71 m (Fenix & Scisson, Inc., 1986a, p. 45).

   Total drilled depth: 414.53 m (Fenix & Scisson, Inc., 1986a, p. 45).

3. Description of access tube and depth interval for measuring water levels:

   62-mm-inside-diameter tubing (Robison and others, 1988, p. 60) that has a 3.66-m-long well screen on the bottom; tubing and attached screen extend from land surface to a depth of 406.91 m (Fenix & Scisson, Inc., 1986a, p. 45); saturated interval of the borehole is within the Topopah Spring Tuff of the Paintbrush Group (Robison and others, 1988, p. 60). Stratigraphic nomenclature presented by Robison revised to agree with stratigraphic nomenclature in Sawyer and others (1994, p. 1305).

4. Information for calculating water-level altitude:

   Reference point: Top of metal tag on well casing, altitude 1,082.94 m (surveyed by U.S. Geological Survey in 1984; Merle E. Southern, National Mapping Division, U.S. Geological Survey, written commun., 1985).

   Measuring point: Top of access tube, 0.314 m above reference point.

   Depth correction for borehole deviation from vertical: 0.189 m, based on approximate depth to water of 354 m (1990 data).

Well UE-25 WT#15 was measured periodically during 1997–98, with the lowest water level during this period being 729.11 m above sea level (02–13–97) and the highest water level being 729.33 m above sea level (10–15–98) (table 17, fig. 14). The mean water-level altitude of the 1997 data was 729.19 m above sea level. The mean water-level altitude of the 1998 data was 729.25 m above sea level. Comparisons to 1996 and 1985–95 mean water-level altitudes (Graves, 1998, p. 38 and 39) are shown in table 5, and 1996 water-level data are included in figure 14.

During 1996, lower water levels in well UE-25 WT#15 were attributed to pumpage at the C-hole complex (Graves, 1998, p. 38). However, trends seen in figure 14 indicate a rise in water levels during 1997 prior to the discontinuation of pumpage at the C-hole complex on November 12, 1997. Because of the rise in water levels, it is now suspected that the declines in water level during 1996 were not due to the pumpage at the C-hole complex, but represented a natural decline in water levels.

Table 17. Measured water-level altitudes, 1997–98, for well UE-25 WT#15

Date	Measured water-level altitude (meters above sea level)	Equipment used to measure water level
01-14-97	729.18	Chain #3
02-13-97	729.11	Chain #3
03-11-97	729.23	Chain #3
04-02-97	729.27	Chain #3
07-15-97	729.18	Chain #3
01-22-98	729.16	Chain #3
02-24-98	729.32	Chain #3
04-07-98	729.20	Chain #3
04-22-98	729.21	Chain #3
05-27-98	729.21	Chain #3
06-22-98	729.24	Chain #3
07-09-98	729.23	Chain #3
08-13-98	729.23	Chain #3
09-21-98	729.31	Chain #3
10-15-98	729.33	Chain #3
12-14-98	729.30	Chain #3

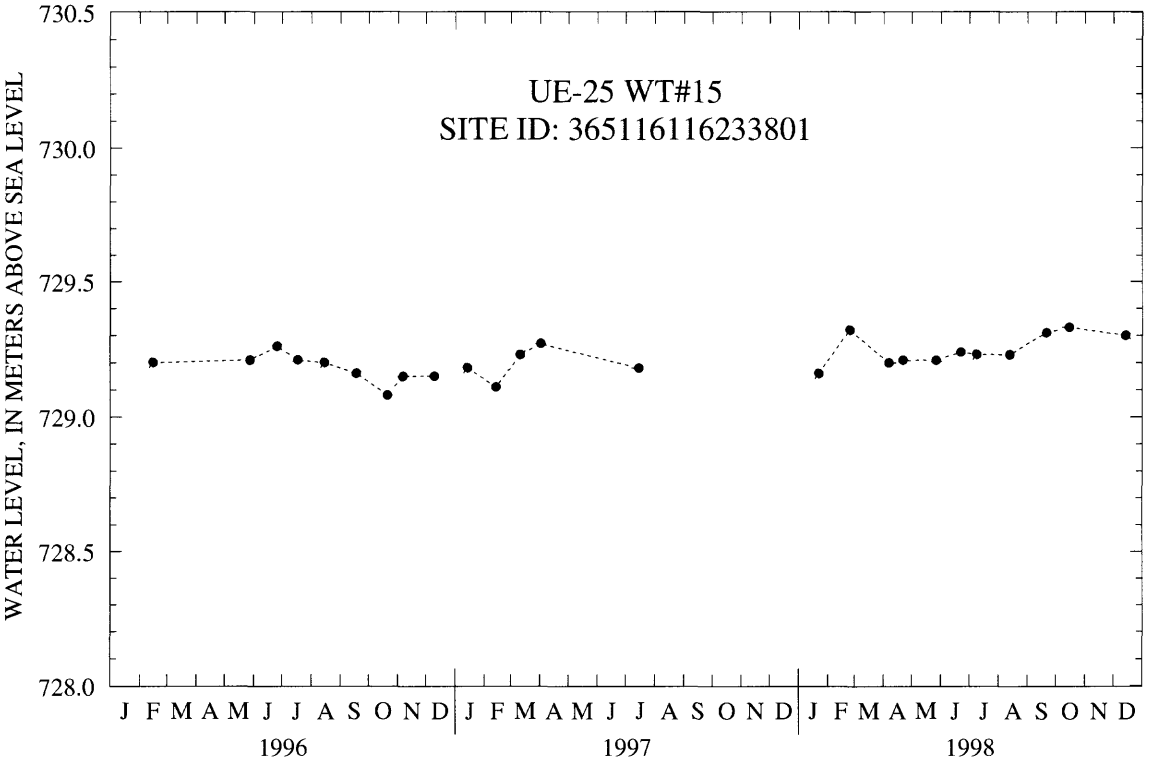

Figure 14. Water-level altitudes, 1996–98, for well UE-25 WT#15.

Well UE-25 WT#16

Well specifications

1. Location and identification:

   Nevada State Plane North American Datum of 1927 Central Zone Coordinates (meters): N 236,044; E 173,857. (U.S. Department of Energy, written commun., 1999, MO9907YMP99025.001.)

   Latitude and longitude: 36°52'39"N.; 116°25'34"W. (Converted from Nevada State Plane North American Datum of 1927 Central Zone Coordinates)

   U.S. Geological Survey Site ID: 365239116253401.

2. Drilling and casing information:

   Well started: November 2, 1983 (Fenix & Scisson, Inc., 1986a, p. 51).

   Well completed: November 10, 1983 (Fenix & Scisson, Inc., 1986a, p. 51).

   Drilling method: Rotary, using rock bits and air-foam circulating medium; core obtained from bottom of the core hole (Robison and others, 1988, p. 64).

   Bit diameter, below land surface: 0 to 32.92 m, 374.65 mm; 32.92 to 521.21 m, 222.25 mm (Fenix & Scisson, Inc., 1986a, p. 51).

   Casing, below land surface: Surface casing only, to a depth of 31.09 m (Fenix & Scisson, Inc., 1986a, p. 51).

   Total drilled depth: 521.21 m (Fenix & Scisson, Inc., 1986a, p. 51).

3. Description of access tube and depth interval for measuring water levels:

   62-mm-inside-diameter tubing (Robison and others, 1988, p. 64) that has a 3.66-m-long well screen on bottom, extending from land surface to a depth of 513.89 m (Fenix & Scisson, Inc., 1986a, p. 51); saturated interval of borehole is within the Calico Hills Formation (Robison and others, 1988, p. 64). Stratigraphic nomenclature presented by Robison revised to agree with stratigraphic nomenclature in Sawyer and others (1994, p. 1305).

4. Information for calculating water-level altitude:

   Reference point: Top of metal tag on well casing; altitude 1,210.63 m (surveyed by U.S. Geological Survey in 1984; Merle E. Southern, National Mapping Division, U.S. Geological Survey, written commun., 1985).

   Measuring point: Top of access tube, 0.314 m above reference point.

   Depth correction for borehole deviation from vertical: 0.064 m, based on approximate depth to water of 473 m (1990 data).

Well UE-25 WT#16 was measured periodically during 1997–98, with the lowest water level during this period being 738.06 m above sea level (01–16–97) and the highest water level being 738.35 m above sea level (09–21–98 and 10–14–98) (table 18, fig. 15). The mean water-level altitude of the 1997 data was 738.14 m above sea level. The mean water-level altitude of the 1998 data was 738.28 m above sea level. Comparisons to 1996 and 1985–95 mean water-level altitudes (Graves, 1998, p. 40 and 41) are shown in table 5, and 1996 water-level data are included in figure 15.

Table 18. Measured water-level altitudes, 1997–98, for well UE-25 WT#16

Date	Measured water-level altitude (meters above sea level)	Equipment used to measure water level
01-16-97	738.06	Chain #3
02-06-97	738.12	Chain #3
03-10-97	738.09	Chain #3
04-02-97	738.17	Chain #3
07-14-97	738.15	Chain #3
09-17-97	738.19	2,800-Foot Reference Steel Tape
09-23-97	738.18	2,800-Foot Reference Steel Tape
02-24-98	738.31	Chain #3
04-08-98	738.23	Chain #3
04-22-98	738.23	Chain #3
05-27-98	738.28	Chain #3
06-22-98	738.28	Chain #3
07-08-98	738.27	Chain #3
08-13-98	738.28	Chain #3
09-21-98	738.35	Chain #3
10-14-98	738.35	Chain #3
12-09-98	738.27	Chain #3

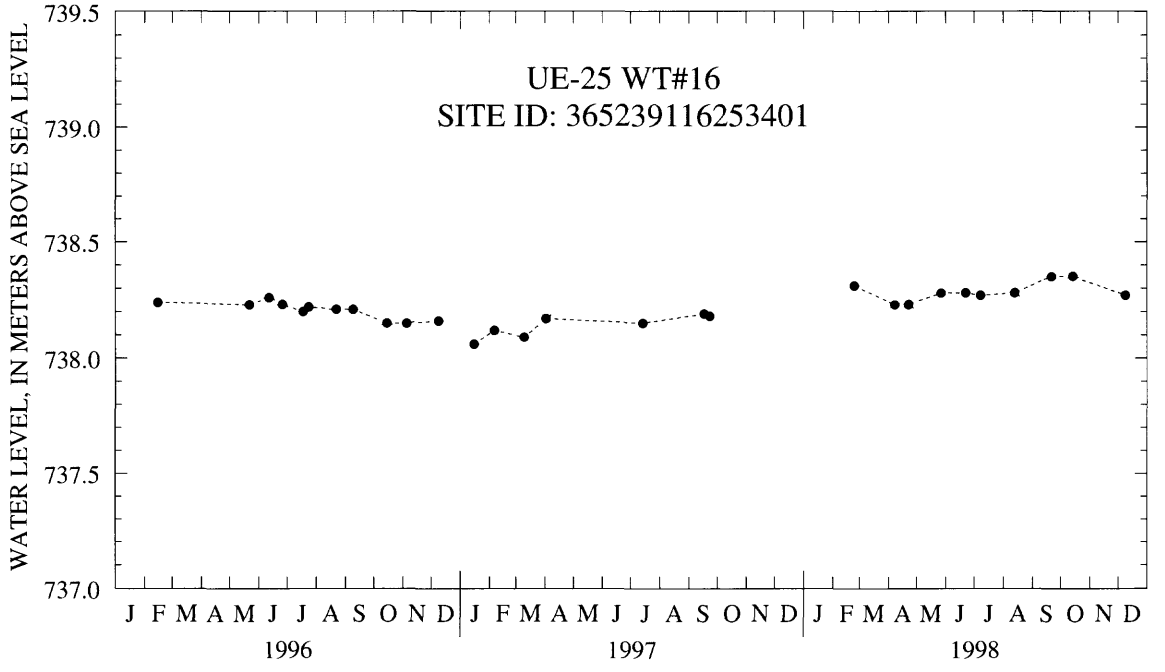

Figure 15. Water-level altitudes, 1996–98, for well UE-25 WT#16.

Well UE-25 WT#17

Well specifications

1. Location and identification:

   Nevada State Plane North American Datum of 1927 Central Zone Coordinates (meters): N 228,119; E 172,582. (U.S. Department of Energy, written commun., 1999, MO9907YMP99025.001.)

   Latitude and longitude: 36°48'22"N.; 116°26'26"W. (Converted from Nevada State Plane North American Datum of 1927 Central Zone Coordinates)

   U.S. Geological Survey Site ID: 364822116262601.

2. Drilling and casing information:

   Well started: October 20, 1983 (Fenix & Scisson, Inc., 1986a, p. 57).

   Well completed: October 30, 1983 (Fenix & Scisson, Inc., 1986a, p. 57).

   Drilling method: Rotary, using rock bits and air-foam circulating medium; attempt to obtain bottom-hole core unsuccessful, core not obtained from bottom of borehole (Robison and others, 1988, p. 67).

   Bit diameter, below land surface: 0 to 16.76 m, 374.65 mm; 16.76 to 442.87 m, 222.25 mm (Fenix & Scisson, Inc., 1986a, p. 57).

   Casing, below land surface: Surface casing only, to a depth of 16.76 m (Fenix & Scisson, Inc., 1986a, p. 57).

   Total drilled depth: 442.87 m (Fenix & Scisson, Inc., 1986a, p. 57).

3. Description of access tube and depth interval for measuring water levels:

   January 1, 1997–December 22, 1997: 62-mm-inside-diameter tubing (Robison and others, 1988, p. 67) that has a 3.66-m-long well screen on the bottom; tubing and attached screen extend from land surface to a depth of 419.40 m (Fenix & Scisson, Inc., 1986a, p. 57).

   December 22, 1997–July 21, 1998: Workover on well so water-quality sampling could be completed. Access tube removed from well and replaced during workover.

   July 21, 1998: Access tube replaced in well: 61.7-mm-inside-diameter fiberglass tubing from 378.43 to 416.47 m below land surface. Fiberglass tubing slotted (screened) from 411.90 to 416.47 m below land surface. Bottom of fiberglass tubing is capped. Two drain holes are drilled into the cap. 62.0-mm-inside-diameter pipe tubing from 378.43 m to land surface (U.S. Department of Energy, written commun., 1998, MOL19980930.0310).

   Saturated interval of borehole is within the Prow Pass Tuff of the Crater Flat Group (Robison and others, 1988, p. 67). Stratigraphic nomenclature presented by Robison revised to agree with stratigraphic nomenclature in Sawyer and others (1994, p. 1305).

4. Information for calculating water-level altitude:

   Reference point: Top of metal tag on well casing, altitude 1,124.06 m (surveyed by U.S. Geological Survey in 1984; Merle E. Southern, National Mapping Division, U.S. Geological Survey, written commun., 1985).

   Measuring point: Top of access tubing, January 1, 1997–December 22, 1997, 0.158 m above reference point. Top of access tubing, July 21, 1998–December 31, 1998, 0.408 m above reference point.

   Depth correction for borehole deviation from vertical: 0.482 m, based on approximate depth to water of 394 m (1990 data).

Well UE-25 WT#17 was not measured during 1997 and only once during 1998 (table 19, fig. 16). Because this measurement does not reflect annual water-level fluctuations, a discussion of water-level ranges or mean values and comparisons to other years for well UE-25 WT#17 is not presented in this report. Well UE-25 WT#17 was not measured during 1996, 1997, and most of 1998 because of partial blockage in the access tube. A work-over of the well during 1998 included cleaning and replacing the access tube.

Table 19. Measured water-level altitude, 1998, for well UE-25 WT#17

Date	Measured water-level altitude (meters above sea level)	Equipment used to measure water level
12-22-98	729.62	Chain #3

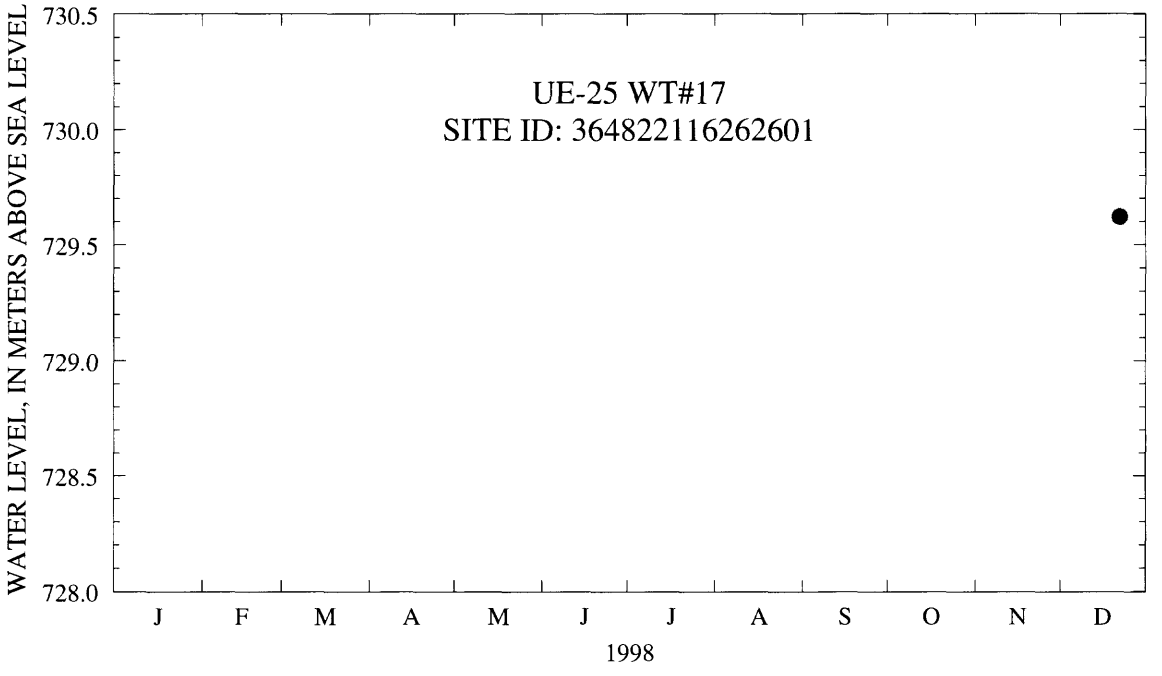

Figure 16. Water-level altitude, 1998, for well UE-25 WT#17.

Well UE-25 b#1

Well specifications

1. Location and identification:

   Nevada State Plane North American Datum of 1927 Central Zone Coordinates (meters): N 233,247; E 172,644. (U.S. Department of Energy, written commun., 1999, MO9907YMP99025.001.)

   Latitude and longitude: 36°51'08"N.; 116°26'23"W. (Converted from Nevada State Plane North American Datum of 1927 Central Zone Coordinates)

   U.S. Geological Survey Site ID: 365108116262301.

2. Drilling and casing information:

   Well started: April 3, 1981 (Fenix & Scisson, Inc., 1986b, p. 3).

   Well completed: September 22, 1981 (Fenix & Scisson, Inc., 1986b, p. 3).

   Drilling method: Rotary, using rock bits and air-foam circulating medium; cores obtained from selected intervals (Robison and others, 1988, p. 74).

   Bit diameter, below land surface: 0 to 10.67 m, 914.40 mm; 10.67 to 96.62 m, 469.90 mm; 96.62 to 96.93 m, 381.00; 96.93 to 519.68 m, 311.15 mm; 519.68 to 649.53 m, 222.25 mm; 649.53 to 1,219.81 m, 215.90 mm (Fenix & Scisson, Inc., 1986b, p. 3).

   Casing, below land surface: 0 to 10.36 m, 508.00-mm inside diameter; 51.21 to 89.00 m, 381.25-mm inside diameter; 0 to 518.16 m, 226.59-mm inside diameter (Fenix & Scisson, Inc., 1986b, p. 3); 226.59-mm-inside-diameter casing perforated with two shots per 0.3048 m from 476.71 to 501.09 m below land surface (Fenix & Scisson, Inc., 1986b, p. 14)

   Total drilled depth: 1,219.81 m (Fenix & Scisson, Inc., 1986b, p. 3).

3. Description of access tube and depth interval for measuring water levels:

   Upper interval:

   48-mm-inside-diameter tubing, open ended, to depth of about 488.00 m; upper interval of borehole, from near water table to top of inflatable packer, is within the Calico Hills Formation and the Prow Pass, Bullfrog, and upper Tram Tuffs of the Crater Flat Group (Robison and others, 1988, p. 74). Stratigraphic nomenclature presented by Robison revised to agree with stratigraphic nomenclature in Sawyer and others (1994, p. 1305).

   Lower interval:

   62-mm-inside-diameter tubing that has an inflatable packer on bottom end, to depth of 1,199 m; lower interval of borehole, from below packer to bottom of well, is within the lower Tram Tuff of the Crater Flat Group and Lithic Ridge Tuff (Robison and others, 1988, p. 74). Stratigraphic nomenclature presented by Robison revised to agree with stratigraphic nomenclature in Sawyer and others (1994, p. 1305).

4. Information for calculating water-level altitude:

   Reference point: Top of metal tag on well casing; altitude 1,200.73 m (surveyed by U.S. Geological Survey in 1984; Merle E. Southern, National Mapping Division, U.S. Geological Survey, written commun., 1985).

   Measuring point: Top of access tubes, 0.302 m above reference point, upper interval; 0.134 m above reference point, lower interval.

   Depth correction for borehole deviation from vertical: 0.244 m, based on approximate depth to water of 470 m (1990 data).

5. Other information:

   Water-level measurements for 1997–98 were made only in the upper interval of borehole UE-25 b#1. The monitoring tube in the lower interval of borehole UE-25 b#1 is damaged making access difficult; subsequently, water-level measurements were not made in the lower interval.

Well UE-25 b#1, upper interval, was measured periodically during 1997–98, with the lowest water level during this period being 730.28 m above sea level (03–04–97) and the highest water level being 730.55 m above sea level (05–20–98 and 06–11–98) (table 20, fig. 17). The mean water-level altitude of the 1997 data was 730.32 m above sea level. The mean water-level altitude of the 1998 data was 730.54 m above sea level. Comparisons to 1996 and 1985–95 mean water-level altitudes (Graves, 1998, p. 42 and 43) are shown in table 5, and 1996 water-level data are included in figure 17.

During 1996, lower water levels in well UE-25 b#1, upper interval, were attributed to pumpage at the C-hole complex (Graves, 1998, p. 43). Trends seen in figure 17 indicate that these lower water levels continued into 1997. Pumpage was discontinued at the C-hole complex on November 12, 1997. During 1998, there was a rise in water levels. Though no data were collected in well UE-25 b#1, upper interval, from September 1997 until April 1998, this rise in water levels is believed to be water-level recovery following the discontinuation of pumpage at the C-hole complex.

No water-level measurements were made in well UE-25 b#1 after June 1998 because the access tube was damaged at land surface, limiting access to the well.

Table 20. Measured water-level altitudes, 1997–98, for well UE-25 b#1, upper interval

Date	Measured water-level altitude (meters above sea level)	Equipment used to measure water level
01-07-97	730.31	Chain #3
02-04-97	730.38	Chain #3
03-04-97	730.28	Chain #3
04-07-97	730.31	Chain #3
08-06-97	730.33	Chain #3
04-15-98	730.53	Chain #3
05-20-98	730.55	Chain #3
06-11-98	730.55	Chain #3

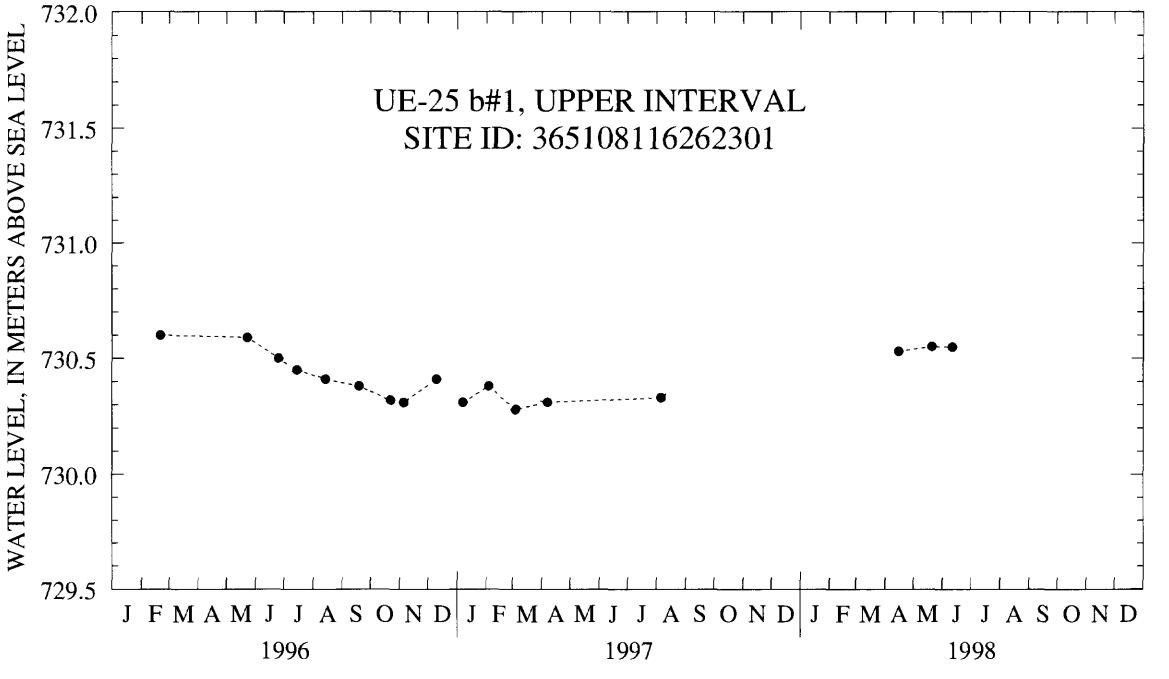

Figure 17. Water-level altitudes, 1996–98, for well UE-25 b#1, upper interval.

Well UE-25 p#1

Well specifications

1. Location and identification:

   Nevada State Plane North American Datum of 1927 Central Zone Coordinates (meters): N 230,482; E 174,189. (U.S. Department of Energy, written commun., 1999, MO9907YMP99025.001.)

   Latitude and longitude: 36°49'38"N.; 116°25'21"W. (Converted from Nevada State Plane North American Datum of 1927 Central Zone Coordinates)

   U.S. Geological Survey Site ID: 364938116252102.

2. Drilling and casing information:

   Well started: November 13, 1982 (Fenix & Scisson, Inc., 1986c, p. 3).

   Well completed: May 24, 1983 (Fenix & Scisson, Inc., 1986c, p. 3).

   Drilling method: Rotary, using rock bits and air-foam circulating medium; cores obtained from selected intervals (Robison and others, 1988, p. 82).

   Bit diameter, below land surface: 0 to 12.80 m, 762.00 mm; 12.80 to 103.02 m, 558.80 mm; 103.02 to 103.94 m, 444.50 mm; 103.94 to 487.07 m, 374.65 mm; 487.07 to 1,304.24 m, 250.83 mm; 1,304.24 to 1,317.35 m, 174.63 mm; 1,317.35 to 1,798.32 m, 171.45 mm; 1,798.32 to 1,805.33 m, 155.58 mm (Fenix & Scisson, Inc., 1986c, p. 3).

   Casing, below land surface: 0 to 10.97 m, 590.5-mm inside diameter; 0 to 99.06 m, 384.18-mm inside diameter; 0 to 476.71 m, 255.27-mm inside diameter; 453.24 to 1,297.23 m, 177.01-mm inside diameter (Fenix & Scisson, Inc., 1986c, p. 3).

   Total drilled depth: 1,805.33 m (Fenix & Scisson, Inc., 1986c, p. 3).

3. Description of access tube and depth interval for measuring water levels:

   January 1–October 31, 1997; a 38-mm-inside-diameter tubing (Robison and others, 1988, p. 82), open ended, to depth of 417.88 m (Fenix & Scisson, Inc., 1986c, p. 3). Well construction is such that water level in the tuffs of Tertiary age is cased off and not monitored. Only the water level in the underlying carbonate rocks of Paleozoic age is measured. Tertiary-Paleozoic contact is at 1,244 m (Robison and others, 1988, p. 82).

   January 1–October 31, 1997; a 38-mm-inside-diameter tubing, closed end, filled with water, set to a depth of 413 m below land surface also is installed in the well to allow access for temperature logging (Robison and others, 1988, p. 82).

   After October 31, 1997, a workover was completed on borehole UE-25 p#1 and both tubes were removed from the borehole. The same tubes were placed back in the borehole during November 1997. The exact depth of each tube after November 1997 is not reported; however, because the same tubes were placed back in the borehole, UE-25 p#1 still monitors only the water level in the carbonate rocks of Paleozoic age.

4. Information for calculating water-level altitude:

   Reference point: Top of metal tag on well casing; altitude 1,114.21 m (surveyed by U.S. Geological Survey in 1984; Merle E. Southern, National Mapping Division, U.S. Geological Survey, written commun., 1985).

   Measuring point: Top of access tube, January 1–October 21, 1997, 0.158 m above reference point. Top of access tube, November 25, 1997–December 31, 1998, 0.182 m above reference point. Access tube removed and replaced during October–November 1997.

   Depth correction for borehole deviation from vertical: 0.021 m, based on approximate depth to water of 362 m (1990 data).

Well UE-25 p#1 was measured periodically during 1997–98, with the lowest water level during this period being 752.68 m above sea level (02–20–97) and the highest water level being 752.95 m above sea level (9–21–98) (table 21, fig. 18). The mean water-level altitude of the 1997 data was 752.71 m above sea level. The mean water-level altitude of the 1998 data was 752.86 m above sea level. Comparisons to 1996 and 1985–95 mean water-level altitudes (Graves, 1998, p. 44 and 45) are shown in table 5, and 1996 water-level data are included in figure 18.

Table 21. Measured water-level altitudes, 1997–98, for well UE-25 p#1

Date	Measured water-level altitude (meters above sea level)	Equipment used to measure water level
02-20-97	752.68	Chain #3
03-26-97	752.70	Chain #3
10-02-97	752.69	Chain #3
10-28-97	752.78	Chain #3
04-07-98	752.85	Chain #3
04-23-98	752.83	Chain #3
05-27-98	752.82	Chain #3
06-10-98	752.82	Chain #3
07-01-98	752.88	Chain #3
08-12-98	752.84	Chain #3
09-21-98	752.95	Chain #3
10-15-98	752.93	Chain #3

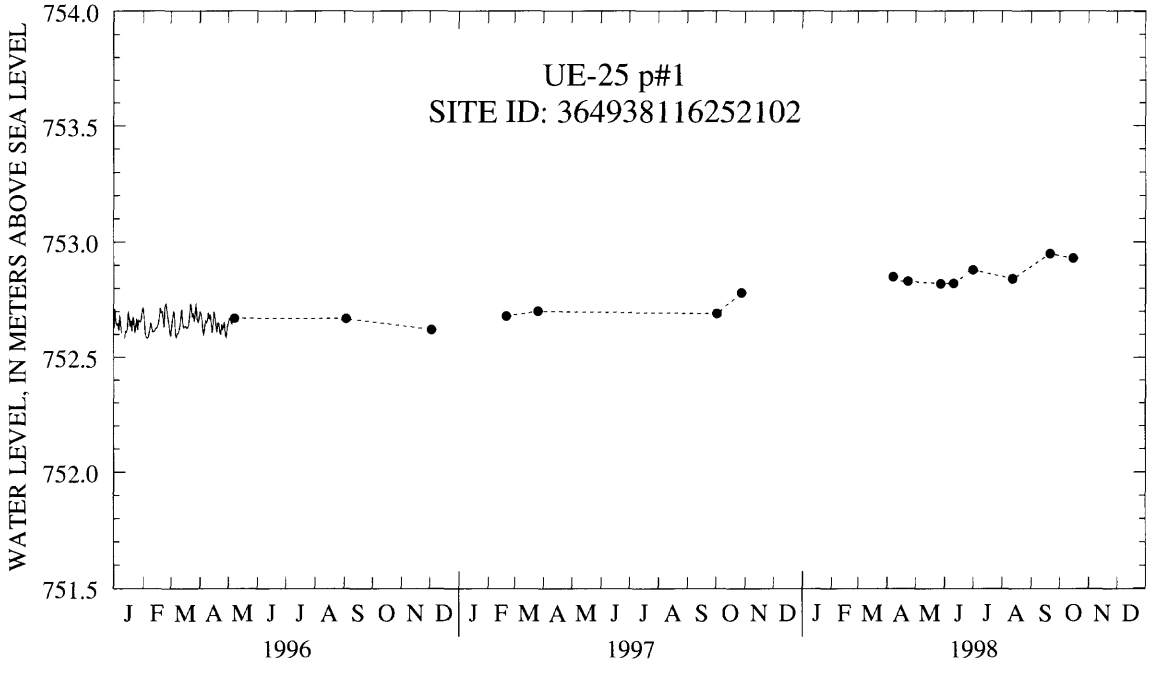

Figure 18. Water-level altitudes, 1996–98, for well UE-25 p#1.

USW VH-1

Well specifications

1. Location and identification:

   Nevada State Plane North American Datum of 1927 Central Zone Coordinates (meters): N 226,575; E 162,649. (U.S. Department of Energy, written commun., 1999, MO9907YMP99025.001.)

   Latitude and longitude: 36°47'32"N.; 116°33'07"W. (Converted from Nevada State Plane North American Datum of 1927 Central Zone Coordinates)

   U.S. Geological Survey Site ID: 364732116330701.

2. Drilling and casing information:

   Well started: October 28, 1980 (Fenix & Scisson, Inc., 1986d, p. 3).

   Well completed: February 18, 1981 (Fenix & Scisson, Inc., 1986d, p. 3).

   Drilling method: Rotary, using rock bits and an air-foam and polymer circulating medium (Robison and others, 1988, p. 125).

   Bit diameter, below land surface: 0 to 15.85 m, 311.15 mm; 15.85 to 277.98 m, 222.25 mm; 277.98 to 762.30 m, 158.75 mm (Fenix & Scisson, Inc., 1986d, p. 3).

   Casing, below land surface: 0 to 14.63 m, 226.59-mm inside diameter; 0 to 277.54 m, 177.01-mm inside diameter (Fenix & Scisson, Inc., 1986d p. 3).

   Total drilled depth: 762.30 m (Fenix & Scisson, Inc., 1986d, p. 3).

3. Description of access tube and depth interval for measuring water levels:

   48-mm-inside-diameter tubing, open ended (Robison and others, 1988, p. 125) from land surface to 205.40 m (Fenix & Scisson, Inc., 1986d, p. 3); saturated interval of the well is within the Tiva Canyon and Topopah Spring Tuffs of the Paintbrush Group and the Prow Pass and Bullfrog Tuffs of the Crater Flat Group (Robison and others, 1988, p. 125). Stratigraphic nomenclature presented by Robison revised to agree with stratigraphic nomenclature in Sawyer and others (1994, p. 1305).

   A pump was installed in the well on July 8, 1982, at a depth of 211.84 m (Fenix & Scisson, Inc., 1986d, p. 3).

4. Information for calculating water-level altitude:

   Reference point: Top of metal tag on well casing, altitude 963.23 m (surveyed by Holmes & Narver, Inc., March 3, 1986).

   Measuring point: Top of access tube, 0.631 m above reference point.

   Depth correction for borehole deviation from vertical: 0.049 m, based on approximate depth to water of 184 m (1990 data).

Well USW VH-1 was measured periodically during 1997–98, with the lowest water level during this period being 779.40 m above sea level (01–15–97) and the highest water level being 779.53 m above sea level (09–03–98) (table 22, fig. 19). The mean water-level altitude of the 1997 data was 779.47 m above sea level. The mean water-level altitude of the 1998 data was 779.51 m above sea level. Comparisons to 1996 and 1985–95 mean water-level altitudes (Graves, 1998, p. 47 and 48) are shown in table 5, and 1996 water-level data are included in figure 19.

Table 22. Measured water-level altitudes, 1997–98, for well USW VH-1

Date	Measured water-level altitude (meters above sea level)	Equipment used to measure water level
01-15-97	779.40	Chain #3
02-25-97	779.53	Chain #3
03-18-97	779.42	Chain #3
04-15-97	779.49	Chain #3
07-16-97	779.52	Chain #3
04-09-98	779.48	Chain #3
05-28-98	779.50	Chain #3
06-25-98	779.51	Chain #3
07-08-98	779.51	Chain #3
07-27-98	779.52	Chain #3
09-03-98	779.53	Chain #3
09-30-98	779.52	Chain #3
10-08-98	779.52	2,800-Foot Reference Steel Tape
12-15-98	779.48	Chain #3

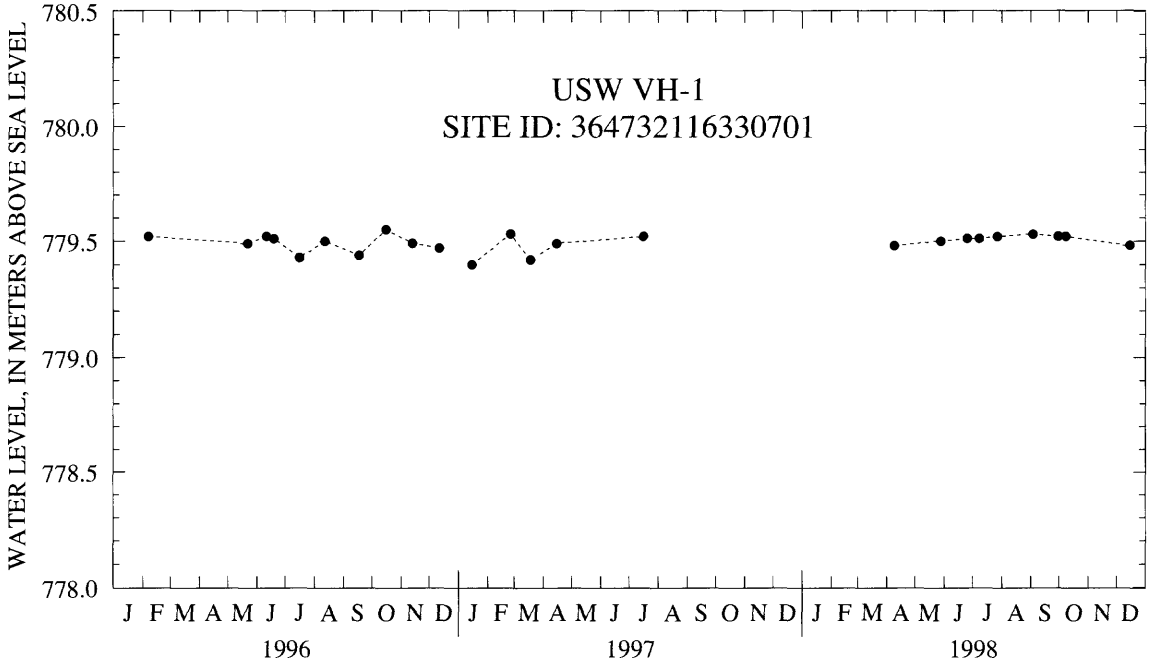

Figure 19. Water-level altitudes, 1996–98, for well USW VH-1.

Well USW G-2

Well specifications

1. Location and identification:

   Nevada State Plane North American Datum of 1927 Central Zone Coordinates (meters): N 237,387; E 170,842. (U.S. Department of Energy, written commun., 1999, MO9907YMP99025.001.)

   Latitude and longitude: 36°53'22"N.; 116°27'35"W. (Converted from Nevada State Plane North American Datum of 1927 Central Zone Coordinates)

   U.S. Geological Survey Site ID: 365322116273501.

2. Drilling and casing information:

   Well started: March 25, 1981 (Robison and others, 1988, p. 85).

   Well completed: October 24, 1981 (Robison and others, 1988, p. 85).

   Drilling method: Rotary, using rock bits with polymer mud to 88 m; cored and reamed from 88 m to total depth; polymer mud and air foam used as needed to total depth (Robison and others, 1988, p. 85).

   Bit diameter, below land surface: 222 mm to 814 m; 159 mm from 814 m to 947 m;

   156 mm from 947 to 1,439 m; 76 mm from 1,439 m to total depth (Robison and others, 1988, p. 85).

   Casing: Surface casing only, 320-mm inside diameter, 0 to 85 m, and 276-mm inside diameter, 0 to 242 m (Robison and others, 1988, p. 85).

   Total drilled depth: 1,831.00 m (Robison and others, 1988, p. 85).

3. Description of access tube and depth interval for measuring water levels:

   An inflatable packer was set at a depth of 792 m below land surface on September 28, 1995. The packer was set to isolate a bridge plug previously set in the well at 808 m below land surface (O'Brien, 1998, p. 7).

   During October 1995, a 60.33-mm-inside-diameter access tube extending from land surface to 582.01 m below land surface was installed in well USW G-2. The bottom of the tube was capped with a 3.28-m-long well screen above the cap (U.S. Department of Energy, written commun., 1995, MOL.19971007.0615). This access tube was removed from well USW G-2 during July 1997 so a pump that was in the well could be removed. Two new access tubes were installed in the well on September 4 and 5, 1997. One access tube is capped and extends to 578.75 m below land surface with a 2.93-m-long slotted pipe (well screen) above the cap. The inside diameter of the tube is not reported. The second access tube is capped and extends to 582.26 m below land surface with a well screen above the cap. Neither the length of well screen or inside diameter of the tube is reported (U.S. Department of Energy, written commun., 1997, MOL.19980806.0384). Either of these access tubes might have been used for water-level measurements during 1997 and 1998.

   Saturated interval of borehole is within the Topopah Spring Tuff of the Paintbrush Group; the Calico Hills Formation; Prow Pass, Bullfrog, and Tram Tuffs of the Crater Flat Group; Lithic Ridge Tuff; and older flows and tuffs (Robison and others, 1988, p. 85). Stratigraphic nomenclature presented by Robison revised to agree with stratigraphic nomenclature in Sawyer and others (1994, p. 1305).

4. Information for calculating water-level altitude:

   Reference point: Top of metal tag on well casing, altitude 1,553.86 m (surveyed by U.S. Geological Survey in 1984; Merle E. Southern, National Mapping Division, U.S. Geological Survey, written commun., 1985).

   Measuring point: Top of access tube, January 1–July 1997, 0.56 m above reference point. September 4, 1997–December 31, 1998, two new tubes, the measuring point of one is 0.27 m above the reference point, the measuring point of the other is 0.23 m above the reference point.

   Depth correction for borehole deviation from vertical: 0.192 m, based on approximate depth to water of 534 m (1994 data).

Well USW G-2 was measured periodically during 1997–98, with the lowest water level during this period being 1,019.34 m above sea level (01–14–97) and the highest water level being 1,019.57 m above sea level (02–03–98) (table 23, fig. 20). The mean water-level altitude of the 1997 data was 1,019.43 m above sea level. The mean water-level altitude of the 1998 data was 1,019.48 m above sea level. A comparison to the 1992–95 mean water-level altitude (Graves and others, 1997, p. 4) is shown in table 5, and 1996 water-level data are included in figure 20.

Table 23. Measured water-level altitudes, 1997–98, for well USW G-2

Date	Measured water-level altitude (meters above sea level)	Equipment used to measure water level
01-14-97	1,019.34	Chain #3
02-11-97	1,019.42	Chain #3
03-11-97	1,019.47	Chain #3
04-14-97	1,019.47	Chain #3
08-08-97	1,019.41	Chain #3
09-10-97	1,019.45	Chain #3
02-03-98	1,019.57	Chain #3
05-12-98	1,019.52	Chain #3
09-16-98	1,019.39	Chain #3
09-17-98	1,019.44	Chain #3

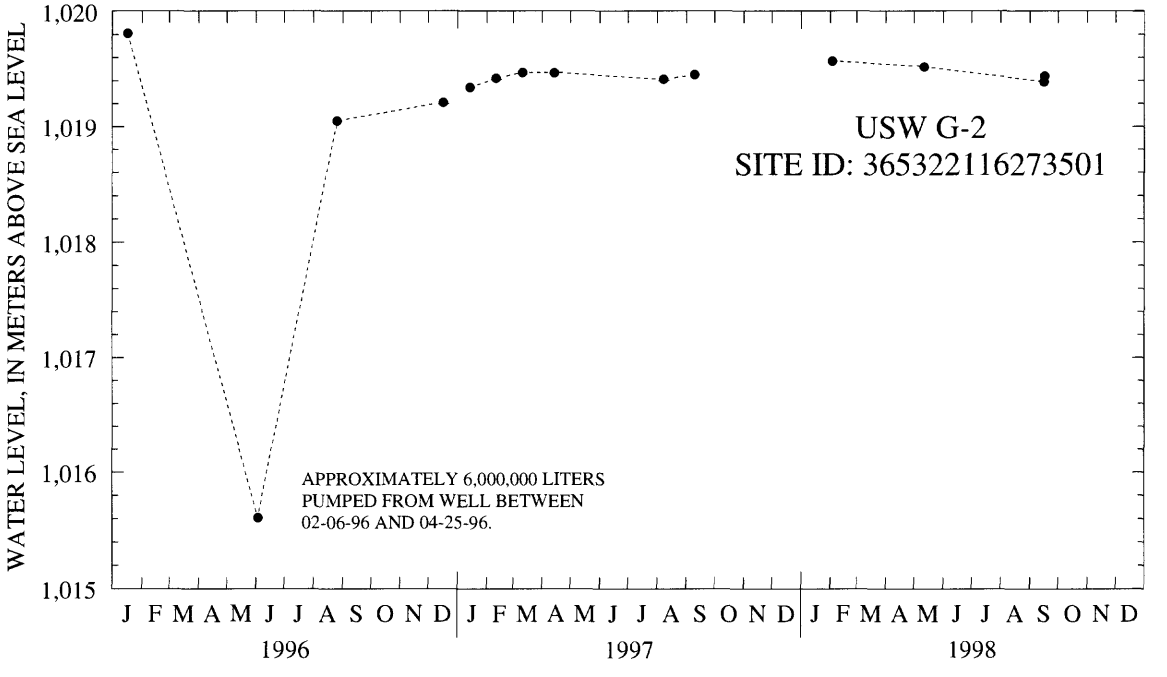

Figure 20. Water-level altitudes, 1996–98, for well USW G-2.

Well USW H-1

Well specifications

1. Location and identification:

   Nevada State Plane North American Datum of 1927 Central Zone Coordinates (meters): N 234,774; E 171,416. (U.S. Department of Energy, written commun., 1999, MO9907YMP99025.001.)

   Latitude and longitude: 36°51'58"N.; 116°27'12"W. (Converted from Nevada State Plane North American Datum of 1927 Central Zone Coordinates)

   U.S. Geological Survey Site ID: 365157116271201.

2. Drilling and casing information:

   Well started: September 3, 1980 (Fenix & Scisson, Inc., 1987, p. 3).

   Well completed: January 25, 1981; borehole completion, but access tubes not installed (Fenix & Scisson, Inc., 1987, p. 3, and 5–14);

   Workover of borehole, four piezometers installed June 21, 1982, to July 6, 1982 (Fenix & Scisson, Inc., 1987, p. 15 and 16).

   Drilling method: Rotary, using rock bits and air-foam circulating medium; cores obtained from selected intervals (Robison and others, 1988, p. 93).

   Bit diameter, below land surface: 0 to 3.05 m, 1,219.20 mm; 3.05 to 12.50 m, 1,181.1 mm; 12.50 to 102.11 m, 508 mm; 102.11 to 117.04 m, 381 mm; 117.04 to 530.35 m, 336.55 mm; 530.35 to 687.93 m, 311.15 mm; 687.93 to 1,828.8 m, 222.25 mm (Fenix & Scisson, Inc., 1987, p. 3).

   Casing: 0 to 687.32 m (Fenix & Scisson, Inc., 1987, p. 3).
   Total drilled depth: 1,828.80 m (Fenix & Scisson, Inc., 1987, p. 3).

3. Description of access tube and depth interval for measuring water levels:

   Tube 1:

   44-mm-inside-diameter tubing (Robison and others, 1988, p. 93), extending from land surface to a depth of 1,805.90 m with a screen of 3.72 m in length on the bottom (Fenix & Scisson, Inc., 1987, p. 15). Tube monitors a depth interval of 1,783 to 1,814 m within older flows and tuffs beneath the Lithic Ridge Tuff (Robison and others, 1988, p. 93). Stratigraphic nomenclature presented by Robison revised to agree with stratigraphic nomenclature in Sawyer and others (1994, p. 1305).

   Tube 2:

   44-mm-inside-diameter tubing (Robison and others, 1988, p. 93), extending from land surface to a depth of 1,114.65 m with a screen of 3.72 m in length on the bottom (Fenix & Scisson, Inc., 1987, p. 15 and 16). Tube monitors a depth interval of 1,097 to 1,123 m within the Tram Tuff of the Crater Flat Group and lava flow and flow breccia beneath the Tram Tuff (Robison and others, 1988, p. 93). Stratigraphic nomenclature presented by Robison revised to agree with stratigraphic nomenclature in Sawyer and others (1994, p. 1305).

   Tube 3:

   44-mm-inside-diameter tubing (Robison and others, 1988, p. 93), extending from land surface to a depth of 741.11 m with a screen of 3.72 m in length on the bottom (Fenix & Scisson, Inc., 1987, p. 15 and 16). Tube monitors a depth interval of 716 to 765 m within the Bullfrog Tuff of the Crater Flat Group (Robison and others, 1988, p. 93). Stratigraphic nomenclature presented by Robison revised to agree with stratigraphic nomenclature in Sawyer and others (1994, p. 1305).

   Tube 4:

   62-mm-inside-diameter tubing (Robison and others, 1988, p. 93), extending from land surface to depth of 640.08 m; tubing is open ended (Fenix & Scisson, Inc., 1987, p. 16). Tube monitors a depth interval of 572 to

673 m within the Prow Pass Tuff of the Crater Flat Group (Robison and others, 1988, p. 93). Stratigraphic nomenclature presented by Robison revised to agree with stratigraphic nomenclature in Sawyer and others (1994, p. 1305).

Note: During the June 21, 1982, to July 6, 1982 borehole workover, a gravel pack was placed in the vicinity of the well screens for tubes 1, 2, and 3; other intervals were grouted with cement to ensure that the tubes are hydraulically isolated from each other (Fenix & Scisson, Inc., 1987, p. 15 and 16).

4. Information for calculating water-level altitude:

Reference point: Top of metal tag on well casing; altitude 1,303.10 m (surveyed by U.S. Geological Survey in 1984; Merle E. Southern, National Mapping Division, U.S. Geological Survey, written commun., 1985).

Measuring point: Top of access tubes, 0.311 m above reference point, all intervals.

Depth correction for borehole deviation from vertical: 0.143 m in tube 1, based on approximate depth to water of 518 m (1990 data); 0.171 m in tube 2, based on approximate depth to water of 567 m (1993 data); 0.174 m in tubes 3 and 4, based on approximate depths to water of 572 m (1990 data).

Tube 1:

Well USW H-1, tube 1, was measured periodically during 1997–98, with the lowest water level during this period being 786.02 m above sea level (02–05–97, 03–05–97, and 04–08–97) and the highest water level being 786.22 m above sea level (05–20–98) (table 24, fig. 21). The mean water-level altitude of the 1997 data was 786.06 m above sea level. The mean water-level altitude of the 1998 data was 786.14 m above sea level. Comparisons to 1996 and 1985–95 mean water-level altitudes (Graves, 1998, p. 53 and 54) are shown in table 5, and 1996 water-level data are included in figure 21.

Tube 2:

Well USW H-1, tube 2, was measured periodically during 1997–98, with the lowest water level during this period being 735.09 m above sea level (12–17–98) and the highest water level being 735.47 m above sea level (01–08–97) (table 25, fig. 22). The mean water-level altitude of the 1997 data was 735.40 m above sea level. The mean water-level altitude of the 1998 data was 735.15 m above sea level. Comparisons to 1996 and 1985–95 mean water-level altitudes (Graves, 1998, p. 54 and 55) are shown in table 5, and 1996 water-level data are included in figure 22.

Tube 3:

Well USW H-1, tube 3, was measured periodically during 1997–98, with the lowest water level during this period being 730.36 m above sea level (03–05–97) and the highest water level being 730.68 m above sea level (09–02–98) (table 26, fig. 23). The mean water-level altitude of the 1997 data was 730.44 m above sea level. The mean water-level altitude of the 1998 data was 730.62 m above sea level. Comparisons to 1996 and 1985–95 mean water-level altitudes (Graves, 1998, p. 55 and 56) are shown in table 5, and 1996 water-level data are included in figure 23.

Tube 4:

Well USW H-1, tube 4, was measured periodically during 1997–98, with the lowest water level during this period being 730.53 m above sea level (03–05–97) and the highest water level being 730.85 m above sea level (09–02–98 and 12–17–98) (table 27, fig. 24). The mean water-level altitude of the 1997 data was 730.59 m above sea level. The mean water-level altitude of the 1998 data was 730.80 m above sea level. Comparisons to 1996 and 1985–95 mean water-level altitudes (Graves, 1998, p. 55 and 57) are shown in table 5, and 1996 water-level data are included in figure 24.

Table 24. Measured water-level altitudes, 1997–98, for well USW H-1, tube 1

Date	Measured water-level altitude (meters above sea level)	Equipment used to measure water level
01-08-97	786.10	Chain #3
02-05-97	786.02	Chain #3
03-05-97	786.02	Chain #3
04-08-97	786.02	Chain #3
08-06-97	786.16	Chain #3
04-13-98	786.14	Chain #3
05-20-98	786.22	Chain #3
06-15-98	786.11	Chain #3
07-06-98	786.12	Chain #3
09-02-98	786.11	Chain #3
09-22-98	786.12	Chain #3
10-19-98	786.13	Chain #3
12-17-98	786.13	Chain #3

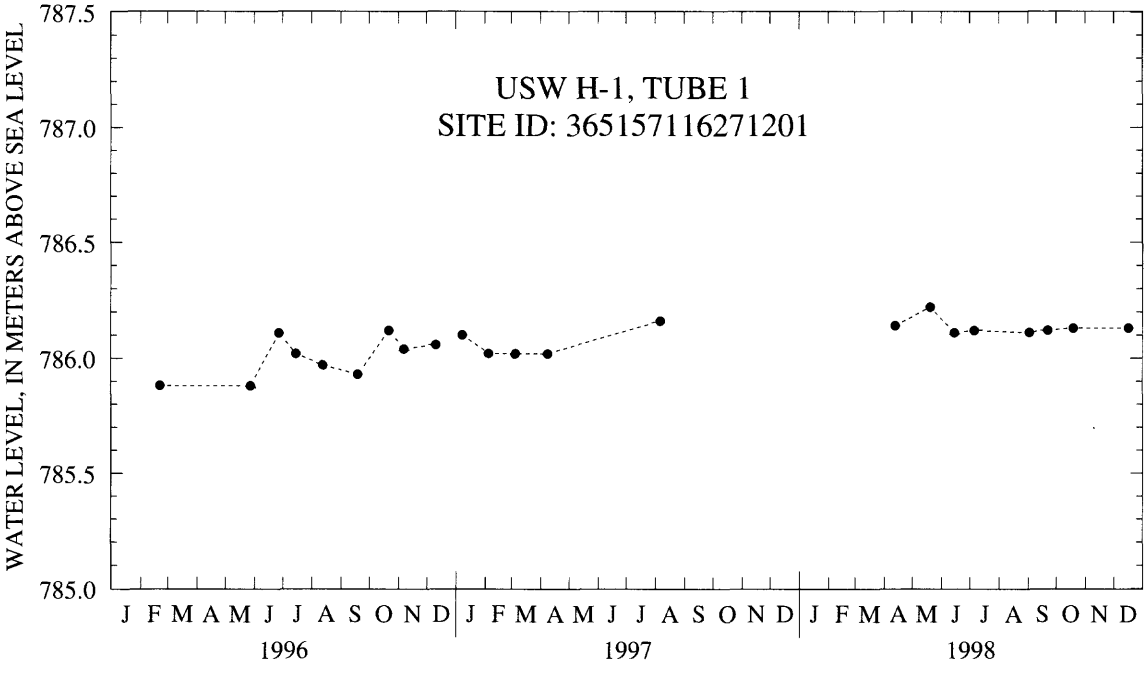

Figure 21. Water-level altitudes, 1996–98, for well USW H-1, tube 1.

Table 25. Measured water-level altitudes, 1997–98, for well USW H-1, tube 2

Date	Measured water-level altitude (meters above sea level)	Equipment used to measure water level
01-08-97	735.47	Chain #3
02-05-97	735.43	Chain #3
03-05-97	735.38	Chain #3
04-08-97	735.36	Chain #3
08-06-97	735.35	Chain #3
04-13-98	735.19	Chain #3
05-20-98	735.15	Chain #3
06-15-98	735.17	Chain #3
07-06-98	735.17	Chain #3
09-02-98	735.16	Chain #3
09-22-98	735.14	Chain #3
10-19-98	735.10	Chain #3
12-17-98	735.09	Chain #3

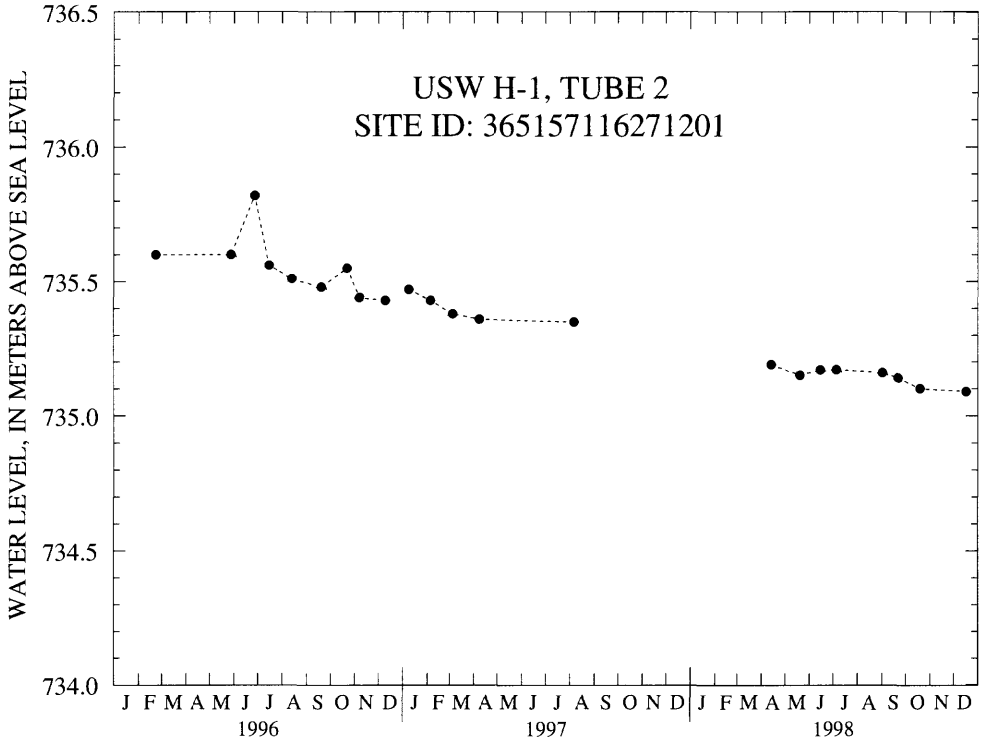

Figure 22. Water-level altitudes, 1996–98, for well USW H-1, tube 2.

Table 26. Measured water-level altitudes, 1997–98, for well USW H-1, tube 3

Date	Measured water-level altitude (meters above sea level)	Equipment used to measure water level
01-08-97	730.48	Chain #3
02-05-97	730.52	Chain #3
03-05-97	730.36	Chain #3
04-08-97	730.47	Chain #3
08-06-97	730.38	Chain #3
04-13-98	730.63	Chain #3
05-20-98	730.62	Chain #3
06-15-98	730.62	Chain #3
07-06-98	730.54	Chain #3
09-02-98	730.68	Chain #3
09-22-98	730.63	Chain #3
10-19-98	730.59	Chain #3
12-17-98	730.64	Chain #3

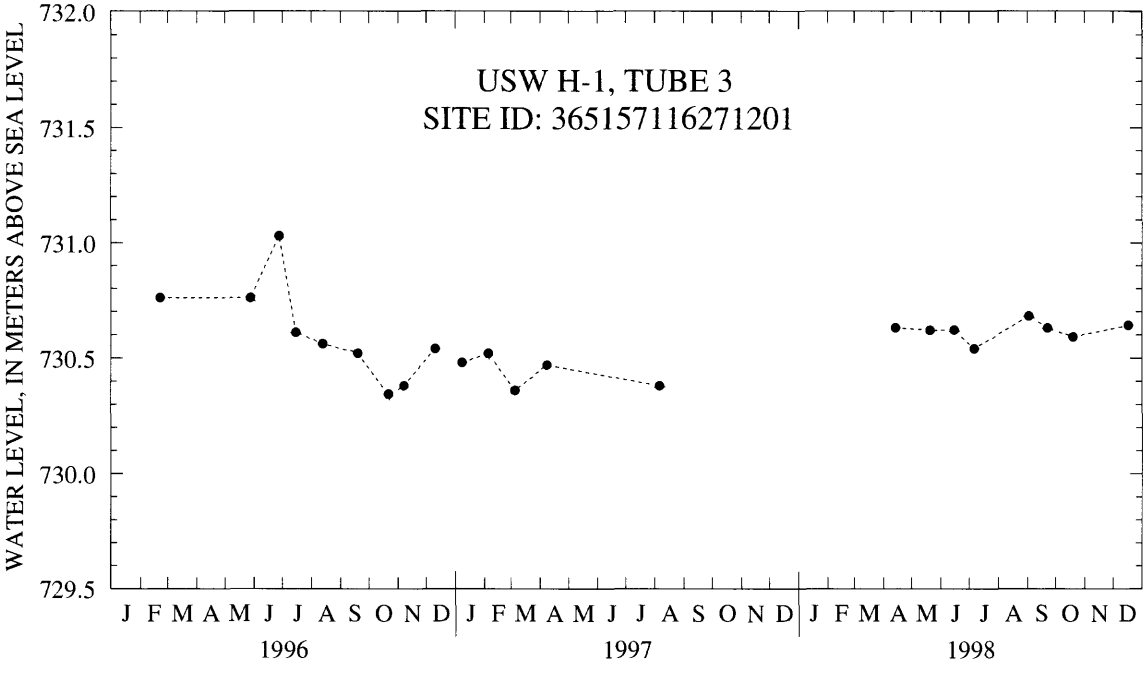

Figure 23. Water-level altitudes, 1996–98, for well USW H-1, tube 3.

Table 27. Measured water-level altitudes, 1997–98, for well USW H-1, tube 4

Date	Measured water-level altitude (meters above sea level)	Equipment used to measure water level
01-08-97	730.59	Chain #3
02-05-97	730.64	Chain #3
03-05-97	730.53	Chain #3
04-08-97	730.63	Chain #3
08-06-97	730.57	Chain #3
04-13-98	730.77	Chain #3
05-20-98	730.77	Chain #3
06-15-98	730.79	Chain #3
07-06-98	730.74	Chain #3
09-02-98	730.85	Chain #3
09-22-98	730.82	Chain #3
10-19-98	730.82	Chain #3
12-17-98	730.85	Chain #3

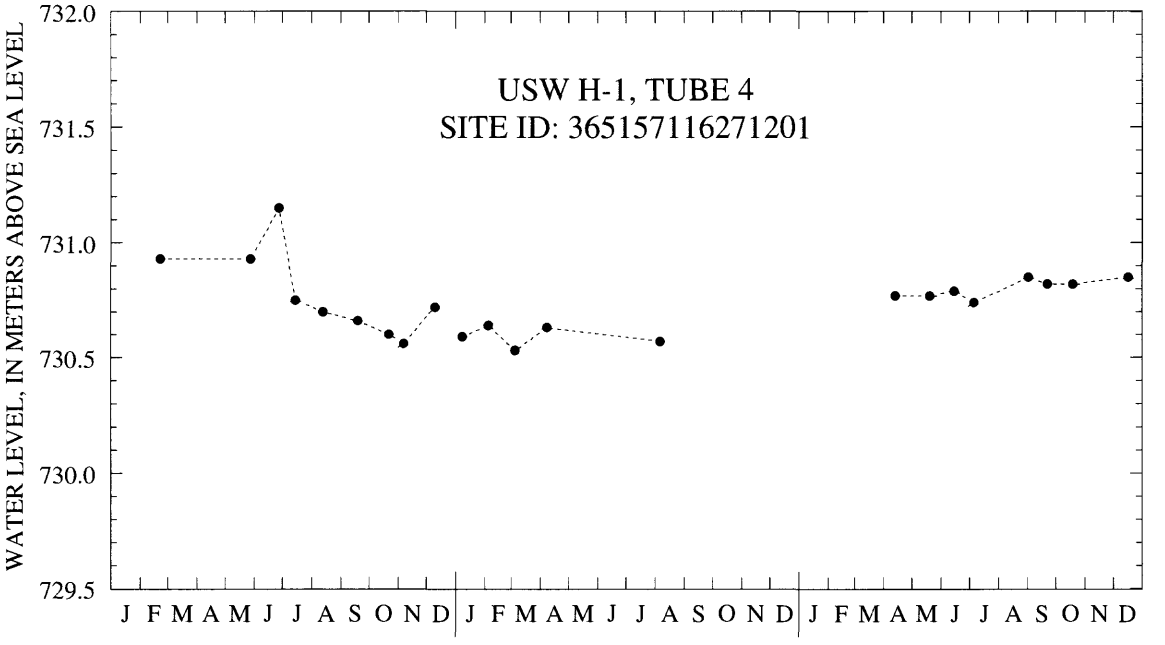

Figure 24. Water-level altitudes, 1996–98, for well USW H-1, tube 4.

Well USW H-3

Well specifications

1. Location and identification:

   Nevada State Plane North American Datum of 1927 Central Zone Coordinates (meters): N 230,594; E 170,216. (U.S. Department of Energy, written commun., 1999, MO9907YMP99025.001.)

   Latitude and longitude: 36°49'42"N.; 116°28'01"W. (Converted from Nevada State Plane North American Datum of 1927 Central Zone Coordinates)

   U.S. Geological Survey Site ID: 364942116280001.

2. Drilling and casing information:

   Well started: January 27, 1982 (Fenix & Scisson, Inc., 1987, p. 21).

   Well completed: March 19, 1982 (Fenix & Scisson, Inc., 1987, p. 21).

   Drilling method: Rotary, using rock bits and air, soap circulating medium (Robison and others, 1988, p. 104).

   Bit diameter, below land surface: 0 to 8.84 m, 914.40 mm; 8.84 to 39.62 m, 660.4 mm; 39.62 to 807.72 m, 374.65 mm; 807.72 to 1,219.20 m, 222.25 mm (Fenix & Scisson, Inc., 1987, p. 21).

   Casing, below land surface: 0 to 8.84 m, 762.00-mm inside diameter; 0 to 38.40 m, 381.25-mm inside diameter; 0 to 792.48 m, 252.73 mm (Fenix & Scisson, Inc., 1987, p. 21).

   Total drilled depth: 1,219.20 m (Fenix & Scisson, Inc., 1987, p. 21).

3. Description of access tube and depth intervals for measuring water levels:

   Inflatable packer installed February 1983, center of packer at a depth of 1,190.40 m below land surface. The packer was removed November 1983 so hydraulic testing could be conducted. During May 1984 a straddle packer was installed with a 4.27-m spacing between center of packers. Location of top and bottom of packers is not clear; however, packers set to test a zone from 1,117.09 m to 1,121.36 m below land surface (Fenix & Scisson, Inc., 1987, p. 28, 29, 35, and 36). In December 1990, the straddle packer was removed for maintenance. Inspection of the packer revealed that the tube through the straddle packer had been plugged since the 1994 installation (Tucci, O'Brien, and Burkhardt, 1996, p. 86). Following maintenance, the straddle packer was replaced in the borehole on December 14, 1990, with the bottom of the straddle packer at 1,061 m below land surface (Tucci, O'Brien, and Burkhardt, 1996, p. 83).

   Upper interval:

   41-mm-inside-diameter open-ended tubing, extending from land surface to depth of about 762.00 m. Tube monitors upper interval of well USW H-3, from the water table to top of inflatable packer. Interval monitored is within bedded tuff and the Tram Tuff of the Crater Flat Group (Robison and others, 1988, p. 104). Stratigraphic nomenclature presented by Robison revised to agree with stratigraphic nomenclature in Sawyer and others (1994, p. 1305).

   Lower interval:

   62-mm-inside-diameter tubing that has an inflatable packer on bottom end extending from land surface to 1,061.00 m. Tube monitors lower interval of well USW H-3, from the bottom of the packer to the bottom of well. Interval monitored is within the Tram Member of the Crater Flat Tuff and the Lithic Ridge Tuff (Tucci, O'Brien, and Burkhardt, 1996, p. 83).

4. Information for calculating water-level altitude:

Reference point: Top of metal tag on well casing; altitude 1483.47 m (surveyed by U.S. Geological Survey in 1984; Merle E. Southern, National Mapping Division, U.S. Geological Survey, written commun., 1985).

Measuring point: Top of access tubes, 0.174 m, upper interval; 0.201 m, lower interval. Each measuring point above reference point.

Depth correction for borehole deviation from vertical: 0.079 m, upper interval, based on approximate depth to water of 752 m (1990 data); 0.058 m, lower interval, based on approximate depth to water of 728 m (1990 data).

Well USW H-3, upper interval, was measured periodically during 1997–98, with the lowest water level during this period being 731.12 m above sea level (02–19–97) and the highest water level being 731.82 m above sea level (09–23–98) (table 28, fig. 25). Well USW H-3, lower interval, was measured periodically during 1997–98, with the lowest water level during this period being 732.54 m above sea level (07–22–98 and 08–11–98) and the highest water level being 760.41 m above sea level (01–23–97) (table 29, fig. 26).

The packer in well USW H-3 that separates the upper and lower intervals is believed to have failed during March/April 1997. Since that time, the water level in the lower interval of well USW H-3 has been declining. The water levels for 1997–98 in the lower interval of USW H-3 no longer represent a true isolated water level of the lower interval. Because the altitude of the water surface in the upper interval of USW H-3 is lower than the altitude of the water surface in the lower interval, water in the lower interval is believed to be moving into the upper interval. Subsequently, the water level in the upper interval of USW H-3 also no longer represents a true isolated water level of the upper interval, though the change in water level in the upper interval since April 1997 is not as significant as the change in the lower interval. Because of the failed packer in well USW H-3, mean water levels for 1997 and 1998 are not presented in this report. Also, to show the change in water-level trend in well USW H-3, 1996 water-level data (Graves, 1998, p. 59, 60, and 61) are included in figures 25 and 26.

Table 28. Measured water-level altitudes, 1997–98, for well USW H-3, upper interval

Date	Measured water-level altitude (meters above sea level)	Equipment used to measure water level
01-23-97	731.20	Chain #3
02-19-97	731.12	Chain #3
03-12-97	731.17	Chain #3
04-09-97	731.27	Chain #3
04-14-97	731.20	Chain #3
04-17-97	731.17	Chain #3
04-24-97	731.28	Chain #3
08-07-97	731.47	Chain #3
04-02-98	731.69	Chain #3
05-26-98	731.80	Chain #3
06-17-98	731.75	Chain #3
07-22-98	731.79	Chain #3
08-11-98	731.79	Chain #3
09-23-98	731.82	Chain #3
10-06-98	731.77	Chain #3

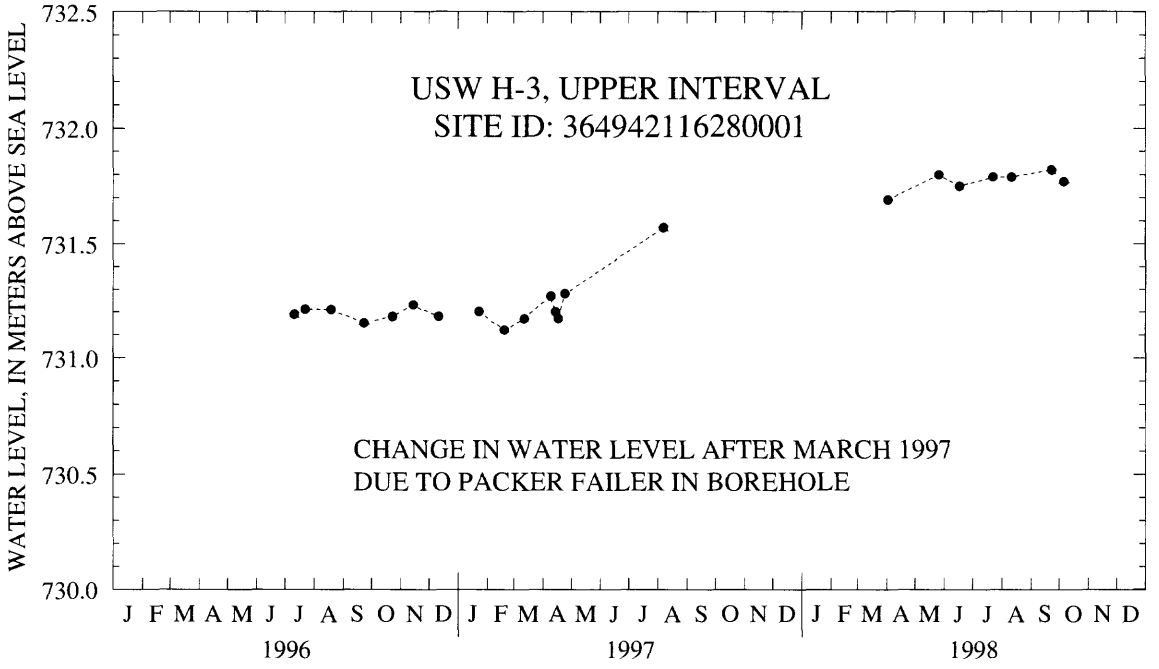

Figure 25. Water-level altitudes, 1996–98, for well USW H-3, upper interval.

Table 29. Measured water-level altitudes, 1997–98, for well USW H-3, lower interval

Date	Measured water-level altitude (meters above sea level)	Equipment used to measure water level
01-23-97	760.41	Chain #3
02-19-97	759.97	Chain #3
03-12-97	760.00	Chain #3
04-09-97	757.58	Chain #3
04-10-97	757.50	Chain #3
04-14-97	757.32	Chain #3
04-17-97	757.16	Chain #3
04-24-97	756.78	Chain #3
02-26-98	733.95	Chain #3
04-02-98	733.94	Chain #3
05-26-98	733.83	Chain #3
06-17-98	733.79	Chain #3
07-22-98	732.54	Chain #3
08-04-98	732.58	2,800-Foot Reference Steel Tape
08-11-98	732.54	Chain #3
09-23-98	732.64	Chain #3
10-06-98	732.63	2,800-Foot Reference Steel Tape

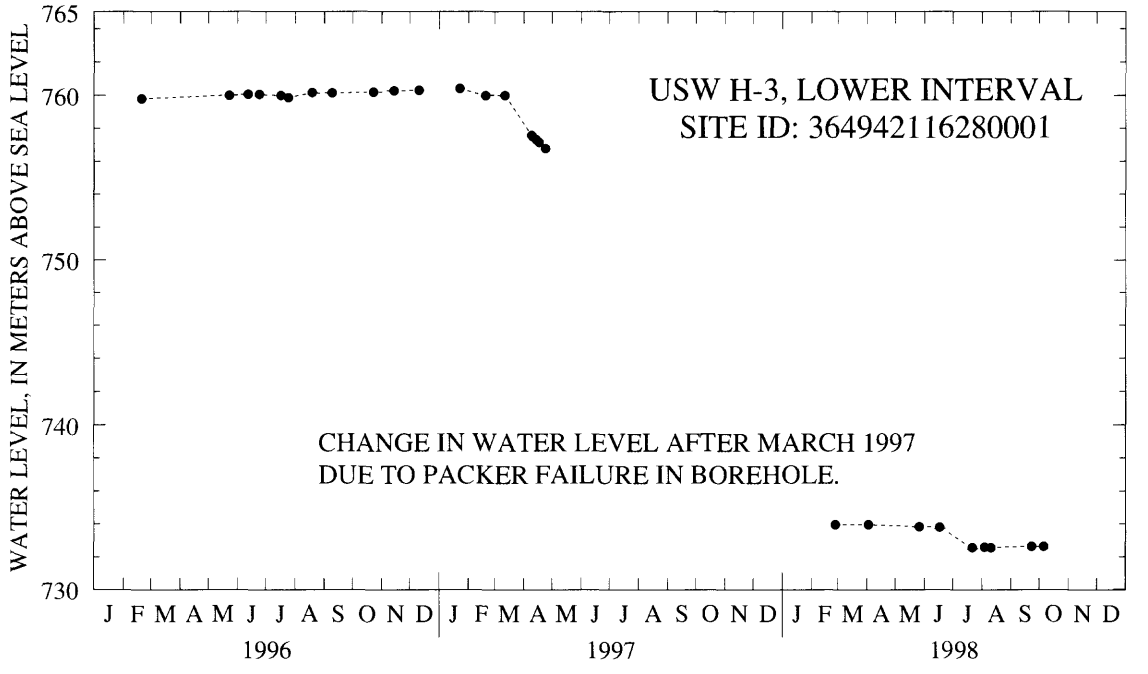

Figure 26. Water-level altitudes, 1996–98, for well USW H-3, lower interval.

Well USW H-4

Well specifications

1. Location and identification:

   Nevada State Plane North American Datum of 1927 Central Zone Coordinates (meters): N 232,150; E 171,881. (U.S. Department of Energy, written commun., 1999, MO9907YMP99025.001.)

   Latitude and longitude: 36°50'32"N.; 116°26'54"W. (Converted from Nevada State Plane North American Datum of 1927 Central Zone Coordinates)

   U.S. Geological Survey Site ID: 365032116265401.

2. Drilling and casing information:

   Well started: March 22, 1982 (Fenix & Scisson, Inc., 1987, p. 39).

   Well completed: June 7, 1982 (Fenix & Scisson, Inc., 1987, p. 39).

   Drilling method: Rotary, using rock bits and air-foam circulating medium; cores obtained from selected intervals (Robison and others, 1988, p. 111).

   Bit diameter, below land surface: 0 to 10.67 m, 914.40 mm; 10.67 to 46.63 m, 660.40 mm; 46.63 to 96.32 m, 508.00 mm; 96.32 to 563.88 m, 374.65 mm; 563.88 to 1,219.20 m, 222.25 mm (Fenix & Scisson, Inc., 1987, p. 39).

   Casing, below land surface: 0 to 10.67 m, 742.95-mm inside diameter; 0 to 94.79 m, 381.25-mm inside diameter; 0 to 560.53 m, 252.73-mm inside diameter. 381.25-mm-inside-diameter casing perforated from 533.40 to 539.50 m at two shots per 0.3048 m (Fenix & Scisson, Inc., 1987, p. 39).

   Total drilled depth: 1,219.20 m (Fenix & Scisson, Inc., 1987, p. 39).

3. Description of access tube and depth interval for measuring water levels:

   Packer placed in borehole. Bottom of packer at 1,181.40 m below land surface (Fenix & Scisson, Inc., 1987, p. 50).

   Upper interval:

   48-mm-inside-diameter open-ended tubing (Robison and others, 1988, p. 111), extending from land surface to depth of 525.78 m (Fenix & Scisson, Inc., 1987, p. 39). Tube monitors upper interval of well USW H-4, from the water table to the top of the inflatable packer. Interval monitored is within the Prow Pass, Bullfrog, and Tram Tuffs of the Crater Flat Group, bedded tuff, and upper Lithic Ridge Tuff (Robison and others, 1988, p. 111). Stratigraphic nomenclature presented by Robison revised to agree with stratigraphic nomenclature in Sawyer and others (1994, p. 1305).

   Lower interval:

   62-mm-inside-diameter tubing with inflatable packer on bottom end (Robison and others, 1988, p. 111). Bottom of packer at 1,181.40 m below land surface, with slotted and bull nose tail pipe extending from bottom of packer to 1,187.50 m below land surface (Fenix & Scisson, Inc., 1987, p. 50). Tube monitors lower interval of USW H-4, from the bottom of the packer to the bottom of the well. Interval monitored is within the Lithic Ridge Tuff (Robison and others, 1988, p. 111). Stratigraphic nomenclature presented by Robison revised to agree with stratigraphic nomenclature in Sawyer and others (1994, p. 1305).

4. Information for calculating water-level altitude:

Reference point: Top of metal tag on well casing; altitude 1,248.74 m (surveyed by U.S. Geological Survey in 1984; Merle E. Southern, National Mapping Division, U.S. Geological Survey, written commun., 1985).

Measuring point: Top of access tubes, 0.597 m, upper interval; 0.308 m, lower interval. Both measuring points above reference point.

Depth correction for borehole deviation from vertical: 0.064 m, based on approximate depth to water of 518 m (1990 data).

Well USW H-4, upper interval, was measured periodically[4] during 1997–98, with the lowest manually measured water level during this period being 730.08 m above sea level (03–25–97 and 09–26–97) and the highest water level being 730.35 m above sea level (07–29–98) (table 30, fig. 27). Based on manually measured water levels, the mean water-level altitude for 1997 was 730.08 m above sea level, and for 1998, the mean water-level altitude was 730.30 m above sea level. Comparisons to 1996 and 1985–95 mean water-level altitudes (Graves, 1998, p. 63) are shown in table 5, and 1996 water-level data are included in figure 27.

Well USW H-4, lower interval, was measured periodically during 1997–98, with the lowest periodic water level during this period being 730.19 m above sea level (03–25–97) and the highest water level being 730.53 m above sea level (10–26–98) (table 31, fig. 28). The mean periodic water-level altitude of the 1997 data was 730.20 m above sea level. The mean periodic water-level altitude of the 1998 data was 730.43 m above sea level. Comparisons to 1996 and 1985–95 mean water-level altitudes (Graves, 1998, p. 64) are shown in table 5, and 1996 water-level data are included in figure 28.

Lower water levels in well USW H-4, upper and lower intervals, during 1996 were suspected of being due to long-term pumpage at the C-hole complex (Graves, 1998, p. 63 and 64). The continued slight decline in water levels in both intervals during 1997 could be due to the C-hole pumpage, which continued through November 12, 1997. During 1998, there was a rise in water levels. Though no data were collected in USW H-4, upper interval, from October 1997 until February 1998, and in USW H-4, lower interval, from September 1997 until March 1998, the rises in water levels during 1998 are suspected of being due to water-level recovery after the discontinuation of pumping at the C-hole complex.

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[4]Well USW H-4, upper interval, was monitored continuously during 1997 and 1998, in support of the hydraulic testing at the C-hole complex. The continuous data are not presented in this report.

Table 30. Measured water-level altitudes, 1997–98, for well USW H-4, upper interval

Date	Measured water-level altitude (meters above sea level)	Equipment used to measure water level
03-25-97	730.08	Chain #3
09-26-97	730.08	Chain #3
02-25-98	730.26	Chain #3
02-26-98	730.26	Chain #3
07-16-98	730.31	Chain #3
07-29-98	730.35	Chain #3

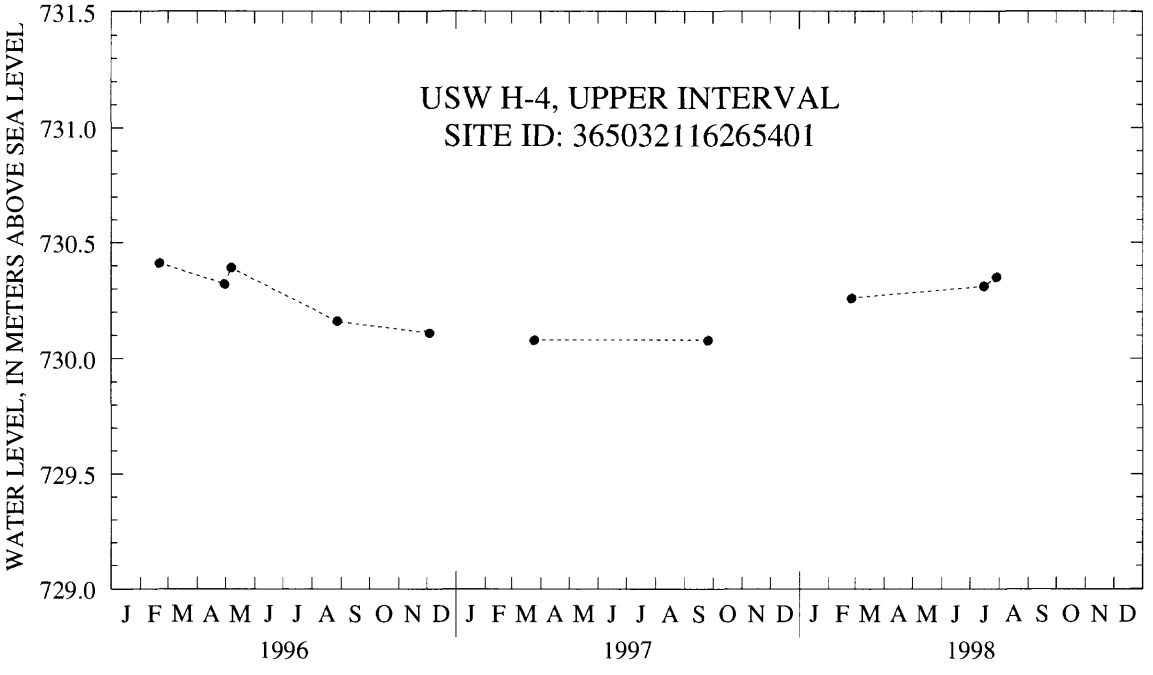

Figure 27. Water-level altitudes, 1996–98, for well USW H-4, upper interval.

Table 31. Measured water-level altitudes, 1997–98, for well USW H-4, lower interval

Date	Measured water-level altitude (meters above sea level)	Equipment used to measure water level
03-25-97	730.19	Chain #3
04-16-97	730.21	Chain #3
08-06-97	730.21	Chain #3
04-15-98	730.38	Chain #3
05-19-98	730.40	Chain #3
06-22-98	730.35	Chain #3
07-13-98	730.39	Chain #3
08-05-98	730.42	2,800-Foot Reference Steel Tape
09-22-98	730.44	Chain #3
10-07-98	730.46	2,800-Foot Reference Steel Tape
10-26-98	730.53	2,800-Foot Reference Steel Tape
12-17-98	730.49	Chain #3

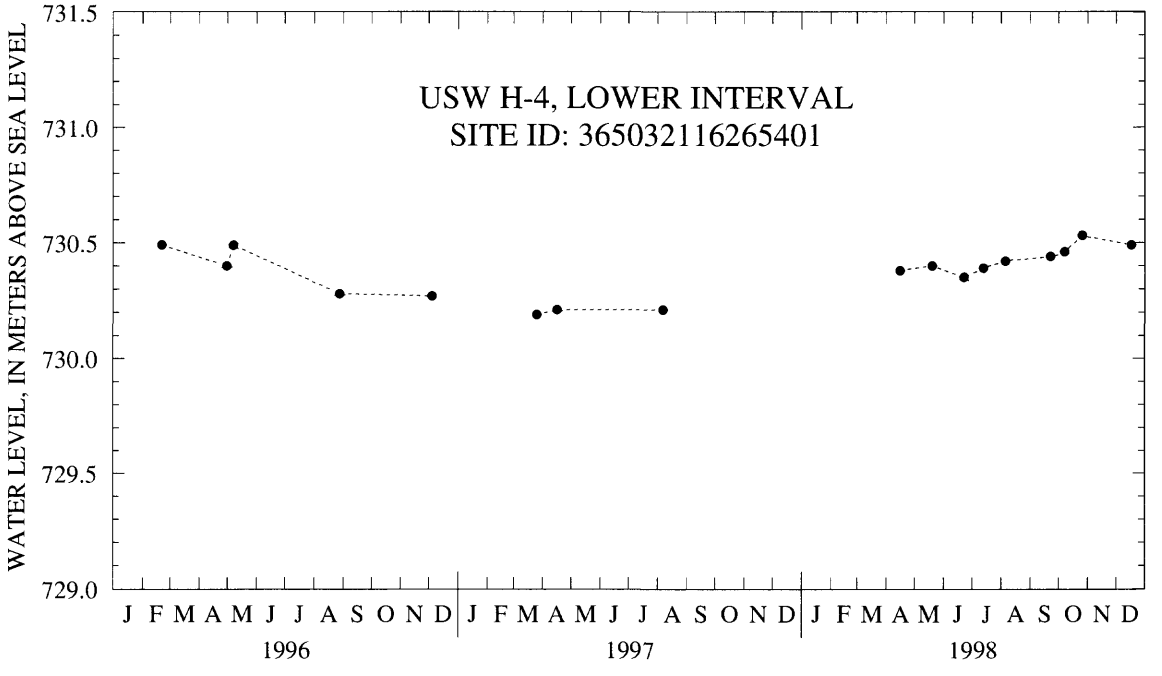

Figure 28. Water-level altitudes, 1996–98, for well USW H-4, lower interval.

Well USW H-5

Well specifications

1. Location and identification:

   Nevada State Plane North American Datum of 1927 Central Zone Coordinates (meters): N 233,671; E 170,356. (U.S. Department of Energy, written commun., 1999, MO9907YMP99025.001.)

   Latitude and longitude: 36°51'22"N.; 116°27'55"W. (Converted from Nevada State Plane North American Datum of 1927 Central Zone Coordinates)

   U.S. Geological Survey Site ID: 365122116275502.

2. Drilling and casing information:

   Well started: May 19, 1982 (Fenix & Scisson, Inc., 1987, p. 51).

   Well completed: August 1, 1982 (Fenix & Scisson, Inc., 1987, p. 51).

   Drilling method: Rotary, using rock bits and air-foam circulating medium; cores obtained from selected intervals (Robison and others, 1988, p. 116).

   Bit diameter, below land surface: 0 to 11.58 m, 914.40 mm; 11.58 to 94.79 m, 508.00 mm; 94.79 to 792.18 m, 374.65 mm; 792.18 to 1,219.20 m, 222.25 mm (Fenix & Scisson, Inc., 1987, p. 51).

   Casing, below land surface: 0 to 11.58 m, 742.95-mm inside diameter; 0 to 94.79 m, 381.00-mm inside diameter; 0 to 787.91 m, 255.27-mm inside diameter. 255.27-mm-inside-diameter casing perforated at two holes per 0.3048 m from 707.14 to 711.71, 731.52 to 736.09, and 768.10 to 772.67, m below land surface and with 360 holes from 717.80 to 731.52, 736.09 to 768.10, and 772.67 to 781.81 m below land surface (Fenix & Scisson, Inc., 1987, p. 51).

   Total drilled depth: 1,219.20 m (Fenix & Scisson, Inc., 1987, p. 51).

3. Description of access tube and depth interval for measuring water levels:

   Packer placed in borehole during 1983 (Robison and others, 1988, p. 117). Bottom of packer at 1,091.18 m below land surface (Fenix & Scisson, Inc., 1987, p. 61)

   Upper interval:

   48-mm-inside-diameter open-ended tubing (Robison and others, 1988, p. 116), extending from land surface to a depth of 708.39 m 1982 to March 1993 (Fenix & Scisson, Inc., 1987, p. 51), and 708.61 m March 1993 to present (G.M. O'Brien, U.S. Geological Survey, written commun., 1993). Tube monitors upper interval of well USW H-5, from the water table to the top of the inflatable packer (bottom of packer at 1,091.18 m below land surface, depth of top of packer not known). Interval monitored is within the Bullfrog Tuff of the Crater Flat Group (Robison and others, 1988, p. 116). Stratigraphic nomenclature presented by Robison revised to agree with stratigraphic nomenclature in Sawyer and others (1994, p. 1305).

   Lower interval:

   62-mm-inside-diameter tubing (Robison and others, 1988, p. 116) that has an inflatable packer on bottom end. Tube extends from land surface to the bottom of the packer. Bottom of the packer at 1,091.18 m below land surface with 3.96 m slotted tubing with bull nose tail pipe attached to bottom of packer (Fenix & Scisson, Inc., 1987, p. 51) 1982 to March 1993. Packer removed and replaced March 1993 (G.M. O'Brien, U.S. Geological Survey, written commun., 1993). Bottom of packer March 1993 to present is 843.09 m, with a 3.66 m slotted caped pipe attached to the bottom of the packer. Tube monitors the lower interval of well USW H-5, from the bottom of the packer to the bottom of the well. Interval monitored is within the Bullfrog and Tram Tuffs of the Crater Flat Group and an unnamed tuff between the Bullfrog and Tram Tuffs (Robison and others, 1988, p. 116). Stratigraphic nomenclature presented by Robison revised to agree with stratigraphic nomenclature in Sawyer and others (1994, p. 1305).

4. Information for calculating water-level altitude:

Reference point: Top of metal tag on well casing; altitude 1,478.94 m (surveyed by U.S. Geological Survey in 1984; Merle E. Southern, National Mapping Division, U.S. Geological Survey, written commun., 1985).

Measuring point: Top of access tubes, 0.329 m, upper interval; 0.235 m, lower interval. Both measuring points above the reference point.

Depth correction for borehole deviation from vertical: 0.079 m, based on approximate depth to water of 703 m (1990 data).

Well USW H-5, upper interval, was measured periodically during 1997–98, with the lowest periodic water level during this period being 775.39 m above sea level (08–12–98) and the highest water level being 775.49 m above sea level (04–10–97) (table 32, fig. 29). The mean periodic water-level altitude of the 1997 data was 775.45 m above sea level. The mean periodic water-level altitude of the 1998 data was 775.43 m above sea level. Comparisons to 1996 and 1985–95 mean water-level altitudes (Graves, 1998, p. 66 and 67) are shown in table 5, and 1996 water-level data are included in figure 29.

Well USW H-5, lower interval, was measured periodically during 1997–98, with the lowest periodic water level during this period being 775.72 m above sea level (02–19–97) and the highest water level being 775.84 m above sea level (09–24–98) (table 33, fig. 30). The mean periodic water-level altitude of the 1997 data was 775.78 m above sea level. The mean periodic water-level altitude of the 1998 data was 775.81 m above sea level. Comparisons to 1996 and 1985–95 mean water-level altitudes (Graves, 1998, p. 68 and 69) are shown in table 5, and 1996 water-level data are included in figure 30.

Table 32. Measured water-level altitudes, 1997–98, for well USW H-5, upper interval

Date	Measured water-level altitude (meters above sea level)	Equipment used to measure water level
01-23-97	775.46	Chain #3
02-19-97	775.42	Chain #3
03-12-97	775.46	Chain #3
04-10-97	775.49	Chain #3
07-18-97	775.43	Chain #3
04-16-98	775.43	Chain #3
05-21-98	775.45	Chain #3
06-17-98	775.43	Chain #3
07-21-98	775.43	Chain #3
08-12-98	775.39	Chain #3
09-24-98	775.47	Chain #3
10-20-98	775.43	Chain #3

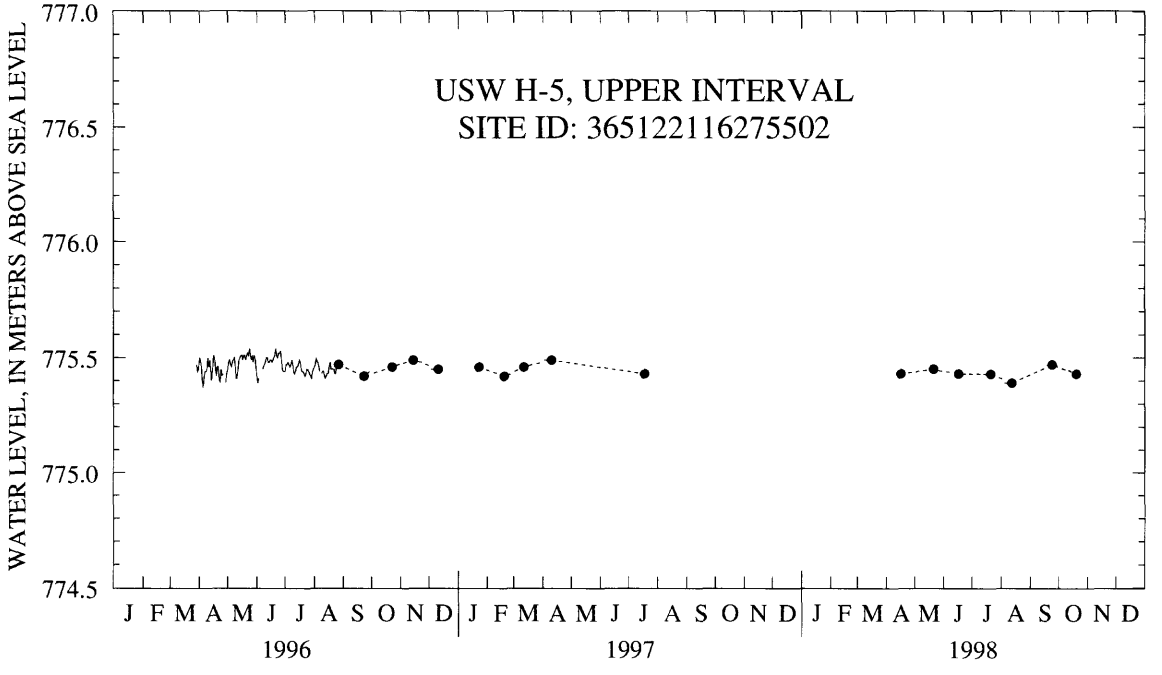

Figure 29. Water-level altitudes, 1996–98, for well USW H-5, upper interval.

Table 33. Measured water-level altitudes, 1997–98, for well USW H-5, lower interval

Date	Measured water-level altitude (meters above sea level)	Equipment used to measure water level
01-23-97	775.78	Chain #3
02-19-97	775.72	Chain #3
03-12-97	775.78	Chain #3
04-10-97	775.81	Chain #3
07-18-97	775.74	Chain #3
09-17-97	775.82	2,800-Foot Reference Steel Tape
04-16-98	775.80	Chain #3
05-21-98	775.83	Chain #3
06-17-98	775.81	Chain #3
07-21-98	775.78	Chain #3
08-11-98	775.78	Chain #3
09-24-98	775.84	Chain #3
10-20-98	775.80	Chain #3

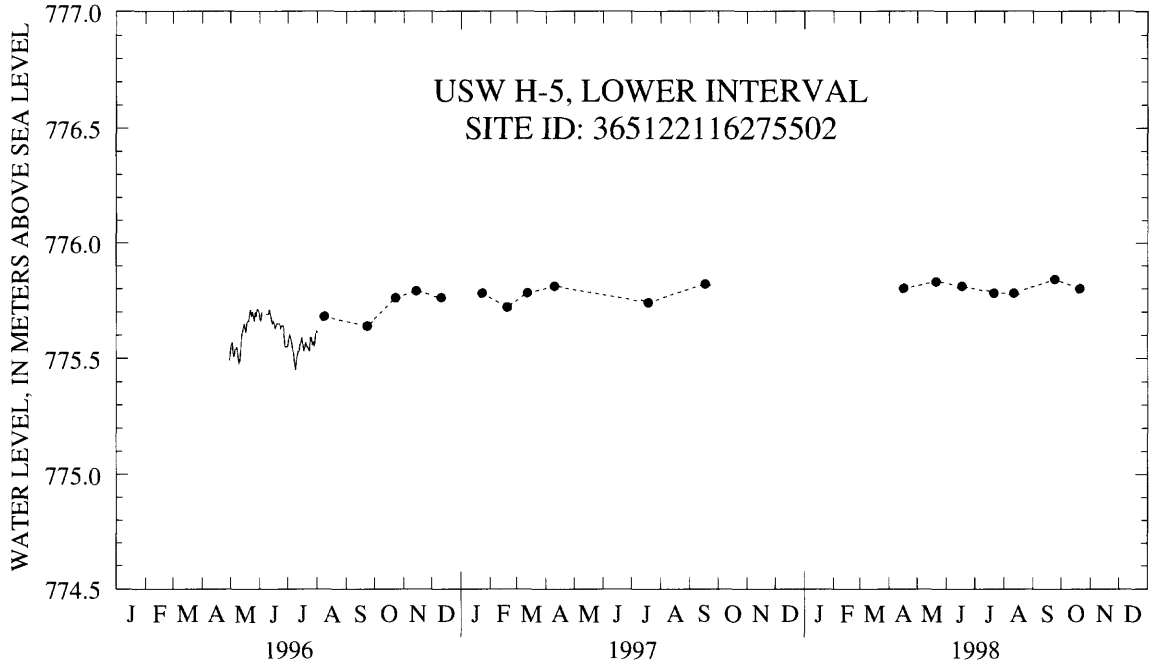

Figure 30. Water-level altitudes, 1996–98, for well USW H-5, lower interval.

Well USW H-6

Well specifications

1. Location and identification:

   Nevada State Plane North American Datum of 1927 Central Zone Coordinates (meters): N 232,654; E 168,882. (U.S. Department of Energy, written commun., 1999, MO9907YMP99025.001.)

   Latitude and longitude: 36°50'49"N.; 116°28'55"W. (Converted from Nevada State Plane North American Datum of 1927 Central Zone Coordinates)

   U.S. Geological Survey Site ID: 365049116285501.

2. Drilling and casing information:

   Well started: August 7, 1982 (Fenix & Scisson, Inc., 1987, p. 63).

   Well completed: October 28, 1982 (Fenix & Scisson, Inc., 1987, p. 63).

   Drilling method: Rotary, using rock bits and air-foam circulating medium; cores obtained from selected intervals (Robison and others, 1988, p. 121).

   Bit diameter, below land surface: 0 to 10.05 m, 914.4 mm; 10.05 to 102.11 m, 558.8 mm; 102.11 to 582.78 m, 374.65 mm; 582.78 to 1,216.15 m, 222.25 mm; 1,216.15 to 1,219.81 m, 155.58 mm (Fenix & Scisson, Inc., 1987, p. 63).

   Casing, below land surface: 0 to 9.45 m, 746.15-mm inside diameter; 0 to 94.79 m, 381.25-mm inside diameter; 0 to 580.95 m, 250.19-mm inside diameter (Fenix & Scisson, Inc., 1987, p. 63).

   Total drilled depth: 1,219.81 m (Fenix & Scisson, Inc., 1987, p. 63).

3. Description of access tube and depth interval for measuring water levels:

   Packer placed in borehole. Bottom of packer at 752.25 m below land surface (Fenix & Scisson, Inc., 1987, p. 79)

   Upper interval:

   48-mm-inside-diameter open-ended tubing (Robison and others, 1988, p. 121), extending from land surface to 533.86 m (Fenix & Scisson, Inc., 1987, p. 63). Tube monitors upper interval of well USW H-6, from the water table to the top of the inflatable packer. Interval monitored is within the Prow Pass, Bullfrog, and Tram Tuffs of the Crater Flat Group, and bedded tuff (Robison and others, 1988, p. 121). Stratigraphic nomenclature presented by Robison revised to agree with stratigraphic nomenclature in Sawyer and others (1994, p. 1305).

   Lower interval:

   62-mm-inside-diameter tubing (Robison and others, 1988, p. 121) with inflatable packer on bottom end. Tubing extends from land surface to bottom of packer and is open at the bottom of the packer. Bottom of packer is set at 752.25 m below land surface. Tube monitors lower interval from the bottom of the packer to the bottom of the well. Interval monitored is within the Tram Tuff of the Crater Flat Group, bedded tuff, an unnamed lava between the Tram Tuff and Lithic Ridge Tuff (Carr, 1988, p. 37; Sawyer and others, 1994, p. 1305), and the Lithic Ridge Tuff (Robison and others, 1988, p. 121). Stratigraphic nomenclature presented by Robison revised to agree with stratigraphic nomenclature in Sawyer and others (1994, p. 1305).

4. Information for calculating water-level altitude:

Reference point: Top of metal tag on well casing; altitude 1,302.06 m (surveyed by U.S. Geological Survey in 1984; Merle E. Southern, National Mapping Division, U.S. Geological Survey, written commun., 1985).

Measuring point: Top of access tubes, 0.207 m above reference point, upper interval; 0.235 m above reference point, lower interval.

Depth correction for borehole deviation from vertical: 0.052 m, based on approximate depth to water of 526 m (1990 data).

Well USW H-6, upper interval, was measured periodically during 1997–98, with the lowest periodic water level during this period being 776.00 m above sea level (03–18–97) and the highest water level being 776.14 m above sea level (09–03–98) (table 34, fig. 31). The mean periodic water-level altitude of the 1997 data was 776.09 m above sea level. The mean periodic water-level altitude of the 1998 data was 776.10 m above sea level. Comparisons to 1996 and 1985–95 mean water-level altitudes (Graves, 1998, p. 71) are shown in table 5, and 1996 water-level data are included in figure 31.

Well USW H-6, lower interval, was measured periodically during 1997–98, with the lowest periodic water level during this period being 775.85 m above sea level (03–18–97) and the highest water level being 776.01 m above sea level (01–22–97 and 09–03–98) (table 35, fig. 32). The mean periodic water-level altitude of the 1997 data was 775.95 m above sea level. The mean periodic water-level altitude of the 1998 data was 775.98 m above sea level. Comparisons to 1996 and 1985–95 mean water-level altitudes (Graves, 1998, p. 72) are shown in table 5, and 1996 water-level data are included in figure 32.

Table 34. Measured water-level altitudes, 1997–98, for well USW H-6, upper interval

Date	Measured water-level altitude (meters above sea level)	Equipment used to measure water level
01-22-97	776.13	Chain #3
02-25-97	776.12	Chain #3
03-18-97	776.00	Chain #3
04-15-97	776.06	Chain #3
07-16-97	776.12	Chain #3
04-09-98	776.07	Chain #3
05-28-98	776.08	Chain #3
06-25-98	776.13	Chain #3
07-27-98	776.12	Chain #3
09-03-98	776.14	Chain #3
09-30-98	776.12	Chain #3
10-22-98	776.05	Chain #3
12-15-98	776.07	Chain #3

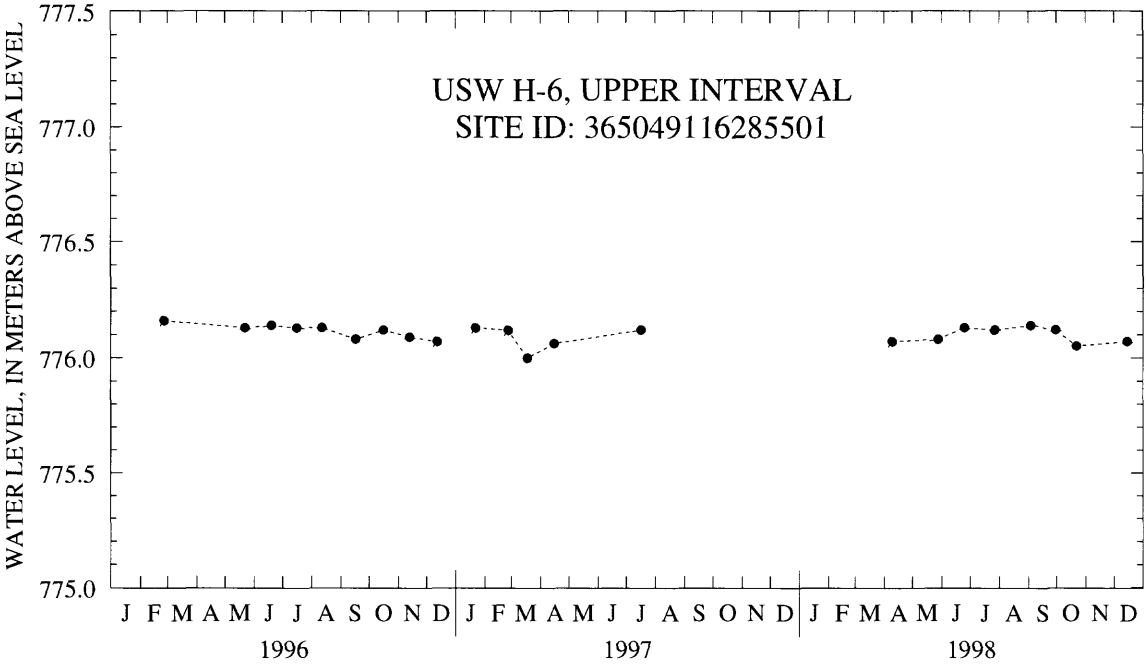

Figure 31. Water-level altitudes, 1996–98, for well USW H-6, upper interval.

Table 35. Measured water-level altitudes, 1997–98, for well USW H-6, lower interval

Date	Measured water-level altitude (meters above sea level)	Equipment used to measure water level
01-22-97	776.01	Chain #3
02-25-97	775.96	Chain #3
03-18-97	775.85	Chain #3
04-15-97	775.94	Chain #3
07-16-97	776.00	Chain #3
04-09-98	775.97	Chain #3
05-28-98	775.96	Chain #3
06-25-98	776.00	Chain #3
07-27-98	776.00	Chain #3
09-03-98	776.01	Chain #3
09-30-98	775.99	Chain #3
10-22-98	775.91	Chain #3
12-15-98	775.96	Chain #3

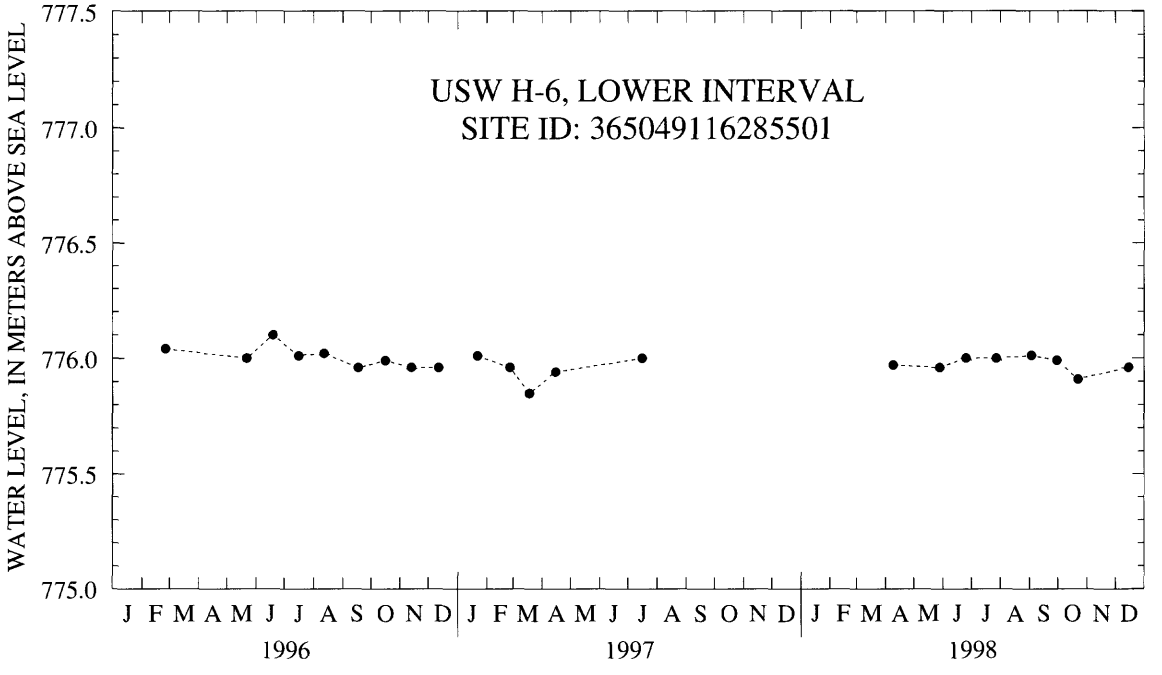

Figure 32. Water-level altitudes, 1996–98, for well USW H-6, lower interval.

Well UE-25 J-11

Well specifications

1. Location and identification:

   Nevada State Plane North American Datum of 1927 Central Zone Coordinates (meters): N 225,848; E 186,467. (U.S. Department of Energy, written commun., 1999, MO9907YMP99025.001.)

   Latitude and longitude: 36°47'06"N.; 116°17'06"W. (Converted from Nevada State Plane North American Datum of 1927 Central Zone Coordinates)

   U.S. Geological Survey Site ID: 364706116170601.

2. Drilling and casing information:

   Well started: June 4, 1957 (Young, 1972, p. 10).

   Well completed: July 19, 1957 (Young, 1972, p. 10).

   Drilling method: Cable-tool (Young, 1972, p. 10).

   Bit diameter, below land surface: 400 mm (Boucher, 1994b, p. 5).

   Casing, below land surface extending below water level: 308-mm-inside-diameter casing extends from land surface to 404.5 m (Boucher, 1994b, p. 5).

   Total drilled depth: 405.38 m (Young, 1972, p. 10).

3. Description of access tube and depth interval for measuring water levels:

   308-mm-inside-diameter casing; the casing is perforated from 328.3 to 334.4 m and from 379.2 to 396.2 m. The well produces water from the basalt of Kiwi Mesa and from the welded-tuff aquifer located within the Topopah Spring Tuff of the Paintbrush Group (Boucher, 1994b, p. 5). Stratigraphic nomenclature presented by Boucher revised to agree with stratigraphic nomenclature in Sawyer and others (1994, p. 1305).

4. Information for calculating water-level altitude:

   Reference point: Chiseled "X" in concrete pad near well; altitude 1,049.45 m (surveyed by U.S. Geological Survey in 1993) (Boucher, 1994b, p. 5).

   Measuring point: Top of casing, even with top of concrete block, 0.555 m above reference point.

   Depth correction for borehole deviation from vertical is not available.

Well UE-25 J-11 was measured periodically during 1997–98, with the lowest periodic water level during this period being 732.18 m above sea level (12–16–98) and the highest water level being 732.30 m above sea level (06–10–98) (table 36, fig. 33). The mean periodic water-level altitude of the 1997 and 1998 data was 732.24 m above sea level. Comparisons to 1996 and 1985–95 mean water-level altitudes (Graves, 1998, p. 73 and 74) are shown in table 5, and 1996 water-level data are included in figure 33.

Table 36. Measured water-level altitudes, 1997–98, for well UE-25 J-11

Date	Measured water-level altitude (meters above sea level)	Equipment used to measure water level
01-15-97	732.19	Chain #3
02-11-97	732.29	Chain #3
03-06-97	732.25	Chain #3
04-07-97	732.24	Chain #3
06-10-98	732.30	Chain #3
07-21-98	732.25	Chain #3
08-03-98	732.22	2,800-Foot Reference Steel Tape
09-24-98	732.27	Chain #3
10-07-98	732.23	2,800-Foot Reference Steel Tape
12-16-98	732.18	Chain #3

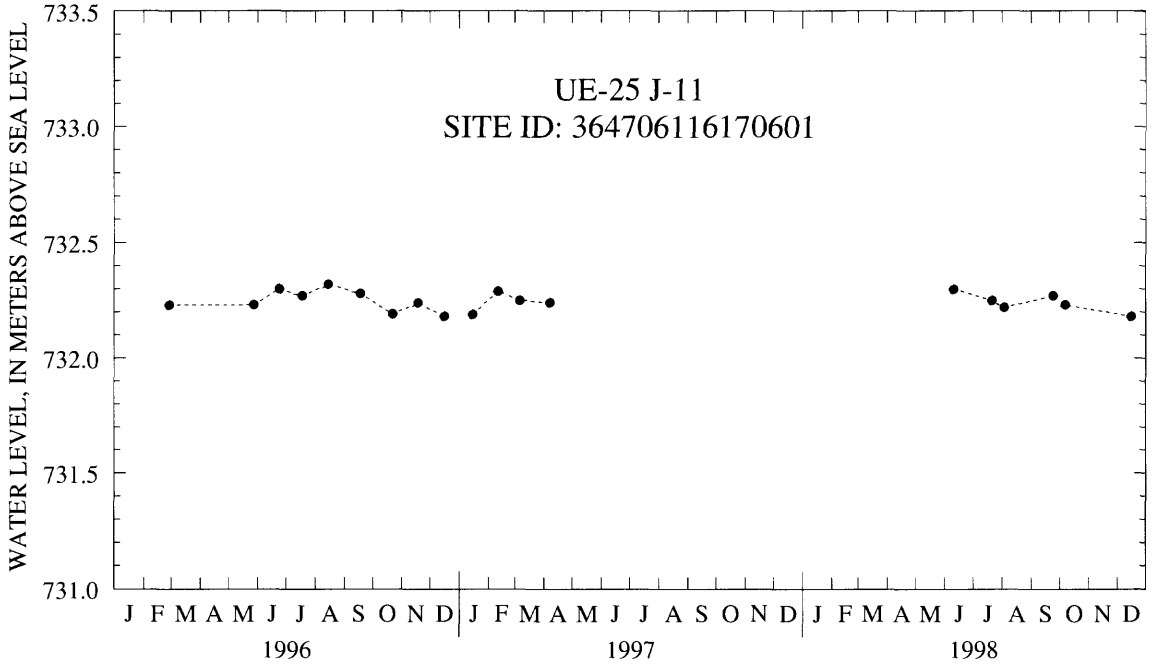

Figure 33. Water-level altitudes, 1996–98, for well UE-25 J-11.

Well UE-25 J-12

Well specifications

1. Location and identification:

   Nevada State Plane North American Datum of 1927 Central Zone Coordinates (meters): N 223,574; E 177,093. (U.S. Department of Energy, written commun., 1999, MO9907YMP99025.001.)

   Latitude and longitude: 36°45'54"N.; 116°23'24"W. (Converted from Nevada State Plane North American Datum of 1927 Central Zone Coordinates)

   U.S. Geological Survey Site ID: 364554116232401.

2. Drilling and casing information:

   Well started: August 4, 1957 (Young, 1972, p. 10).

   Well completed: October 9, 1957 (Young, 1972, p. 10); well was deepened in August 1968 (Boucher, 1994b, p. 6).

   Drilling method: Cable-tool (1957) (Young, 1972, p. 10); unknown (1968) (Boucher, 1994b, p. 6).

   Bit diameter, below land surface: 400 mm to 271 m; 298 mm to 347 m (Boucher, 1994b, p. 6).

   Casing, below land surface extending below water level: 308-mm-inside-diameter casing extending from land surface to 271 m (Boucher, 1994b, p. 6).

   Total drilled depth: 270.36 m (1957) (Young, 1972, p. 10); 347.00 m after the deepening in 1968 (Boucher, 1994b, p. 6).

3. Description of access tube and depth interval for measuring water levels:

   308-mm-inside-diameter casing; the casing is perforated between 241 and 264 m; the hole is open from 271 m to 347 m; access tube is 54-mm outside diameter. The well produces water from the welded-tuff aquifer, located within the Topopah Spring Tuff of the Paintbrush Group (Boucher, 1994b, p. 6). Stratigraphic nomenclature presented by Boucher revised to agree with stratigraphic nomenclature in Sawyer and others (1994, p. 1305).

4. Information for calculating water-level altitude:

   Reference point: Top of well collar, altitude 954.54 m (surveyed by U.S. Geological Survey in 1993) (Boucher, 1994b, p. 6).

   Measuring point: Top of the 54-mm-outside-diameter access tube, 0.195 m above reference point.

   Depth correction for borehole deviation from vertical is not available.

5. The amount of water pumped from well UE-25 J-12 in 1997 was approximately 64 million liters, and from January to September 1998 approximately 15 million liters (Bonner and others, 1998, p. 606; Preissler and others, 1999, p. 573).

Well UE-25 J-12 was measured periodically during 1997–98, with the lowest periodic water level during this period being 727.80 m above sea level (04–08–98) and the highest water level being 727.99 m above sea level (01–13–97) (table 37, fig. 34). The mean periodic water-level altitude of the 1997 data was 727.87 m above sea level. The mean periodic water-level altitude of the 1998 data was 727.86 m above sea level. Comparisons to 1996 and 1985–95 mean water-level altitudes (Graves, 1998, p. 75 and 76) are shown in table 5, and 1996 water-level data are included in figure 34.

Table 37. Measured water-level altitudes, 1997–98, for well UE-25 J-12

Date	Measured water-level altitude (meters above sea level)	Equipment used to measure water level
01-13-97	727.99	Chain #3
02-10-97	727.87	Chain #3
03-06-97	727.84	Chain #3
04-07-97	727.85	Chain #3
07-15-97	727.82	Chain #3
01-22-98	727.82	Chain #3
04-08-98	727.80	Chain #3
04-28-98	727.87	Chain #3
06-10-98	727.88	Chain #3
07-01-98	727.88	Chain #3
07-09-98	727.90	Chain #3
08-25-98	727.89	Chain #3
09-23-98	727.85	Chain #3
10-20-98	727.87	Chain #3
12-16-98	727.86	Chain #3

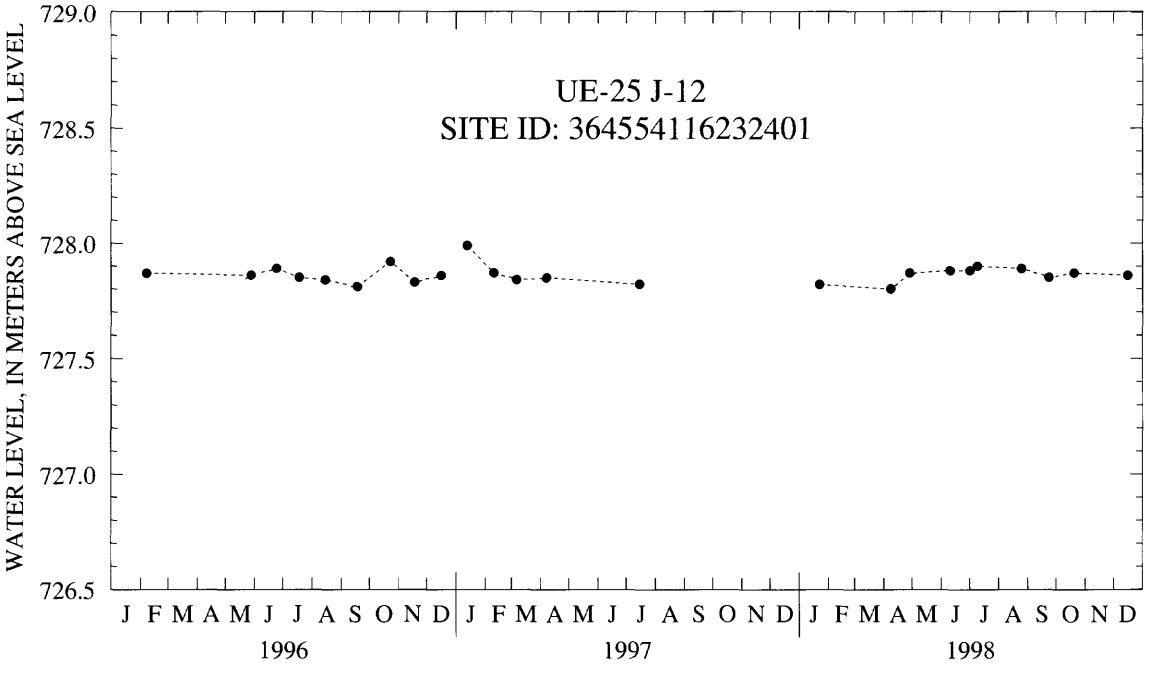

Figure 34. Water-level altitudes, 1996–98, for well UE-25 J-12.

Well UE-25 J-13

Well specifications

1. Location and identification:

   Nevada State Plane North American Datum of 1927 Central Zone Coordinates (meters): N 228,357; E 176,677. (U.S. Department of Energy, written commun., 1999, MO9907YMP99025.001.)

   Latitude and longitude: 36°48'28"N.; 116°23'40"W. (Converted from Nevada State Plane North American Datum of 1927 Central Zone Coordinates)

   U.S. Geological Survey Site ID: 364828116234001.

2. Drilling and casing information:

   Well started: September 1962 (Young, 1972, p. 10).

   Well completed: January 1963 (Young, 1972, p. 10).

   Drilling method: Rotary air (Young, 1972, p. 10).

   Bit diameter, below land surface: 438 mm to 402 m; 380 mm from 402 m to 471 m; 194 mm from 471 m to total depth (Robison and others, 1988, p. 128).

   Casing, below land surface extending below water level: 323-mm inside diameter, from land surface to 396.5 m; 282-mm inside diameter from 396.5 to 471.2 m; 126-mm inside diameter from 452.3 to 1,031.7 m; casing perforated from 303.6 to 423.7 m is within the Topopah Spring Tuff of the Paintbrush Group and from 819.9 to 1,009.5 m is within the Tram Tuff of the Crater Flat Group and upper part of the Lithic Ridge Tuff (Robison and others, 1988, p. 128). Stratigraphic nomenclature presented by Robison revised to agree with stratigraphic nomenclature in Sawyer and others (1994, p. 1305).

   Total drilled depth: 1,063.14 m (Young, 1972, p. 10).

3. Description of access tube and depth interval for measuring water levels:

   50.8-mm-inside-diameter access tube, installed in 1986, in order for measuring equipment to bypass pump assembly.

4. Information for calculating water-level altitude:

   Reference point: Chiseled square on concrete well collar, altitude 1,011.47 m above reference point (surveyed by U.S. Geological Survey in 1984; Merle E. Southern, National Mapping Division, U.S. Geological Survey, written commun., 1985).

   Measuring point: Top of access tube, 0.165 m.

   Depth correction for borehole deviation from vertical is not available.

5. The amount of water pumped from well UE-25 J-13 in 1997 was approximately 123 million liters, and from January to September 1998, approximately 114 million liters (Bonner and others, 1998, p. 606; Preissler and others, 1999, p. 573).

Well UE-25 J-13 was measured periodically during 1997–98, with the lowest periodic water level during this period being 728.30 m above sea level (04–08–98) and the highest water level being 728.41 m above sea level (08–25–98) (table 38, fig. 35). The mean periodic water-level altitude of the 1997 data was 728.35 m above sea level. The mean periodic water-level altitude of the 1998 data was 728.36 m above sea level. Comparisons to 1996 and 1985–95 mean water-level altitudes (Graves, 1998, p. 75 and 76) are shown in table 5, and 1996 water-level data are included in figure 35.

Table 38. Measured water-level altitudes, 1997–98, for well UE-25 J-13

Date	Measured water-level altitude (meters above sea level)	Equipment used to measure water level
01-22-97	728.33	Chain #3
02-10-97	728.37	Chain #3
03-06-97	728.33	Chain #3
04-07-97	728.35	Chain #3
08-08-97	728.36	Chain #3
04-08-98	728.30	Chain #3
05-21-98	728.37	Chain #3
06-23-98	728.40	Chain #3
07-01-98	728.37	Chain #3
08-25-98	728.41	Chain #3
09-23-98	728.35	Chain #3
10-20-98	728.35	Chain #3
12-17-98	728.37	Chain #3

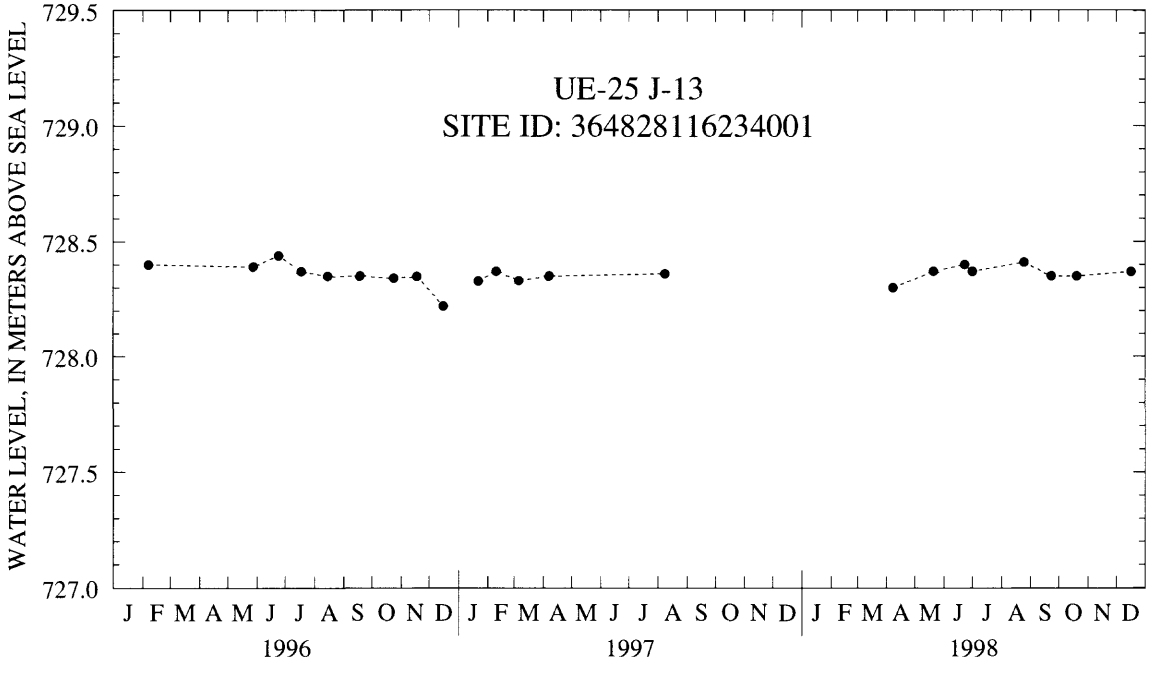

Figure 35. Water-level altitudes, 1996–98, for well UE-25 J-13.

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