Annual Water-Resources Review, White Sands Missile Range, New Mexico, 1988

By Robert G. Myers and Steven C. Sharp

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CONVERSION FACTORS AND VERTICAL DATUM

Multiply	By	To obtain
inch	25.40	millimeter
foot	0.3048	meter
acre	4,047	square meter
mile	1.609	kilometer
gallon	3.785	liter

Temperatures can be converted by the equations:

$$°F = (1.8 \times °C) + 32$$

$$°C = (°F - 32)/1.8$$

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

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ABSTRACT

Hydrologic data were collected at White Sands Missile Range in 1988. The total ground-water withdrawal in 1988 was 628,525,100 gallons. The 11 water-supply wells in the Post Headquarters well field produced 582,653,000 gallons, or about 92 percent of the total ground-water withdrawal. The seven Range area water-supply wells produced 45,872,100 gallons. The total ground-water withdrawal, excluding 207,500 gallons from Rhodes Canyon, was 7,825,600 gallons more in 1988 than in 1987.

Water samples from the Hardin Ranch well and Pine Spring were collected for chemical analysis of major ions, selected minor ions, and trace elements in 1988. One sample was analyzed from a wet-fall/dry-fall precipitation collector for selected chemical constituents.

Twenty-seven water samples were collected from 25 other wells throughout the Range area for specific-conductance measurements in 1988. The specific conductance ranged from 245 microsiemens per centimeter at 25 degrees Celsius in water from test well T-17 to 1,840 microsiemens per centimeter at 25 degrees Celsius in water from test well T-14.

INTRODUCTION

This report presents water-resources data that were collected at White Sands Missile Range and adjacent areas (fig. 1) during 1988 by personnel of the U.S. Geological Survey and White Sands Missile Range. Ground-water withdrawals, water-level measurements, chemical analyses, precipitation data, and sewage-influent data summarized in this report were obtained as a result of the continuing water-resources hydrologic-data-collection program sponsored by the Engineering, Housing, and Logistics Directorate, White Sands Missile Range.

This report is the 20th water-resources review prepared for the White Sands Missile Range. Previous reports are available for inspection at the District Office of the U.S. Geological Survey, Water Resources Division, Albuquerque, New Mexico, or the Subdistrict Office in Las Cruces, New Mexico.

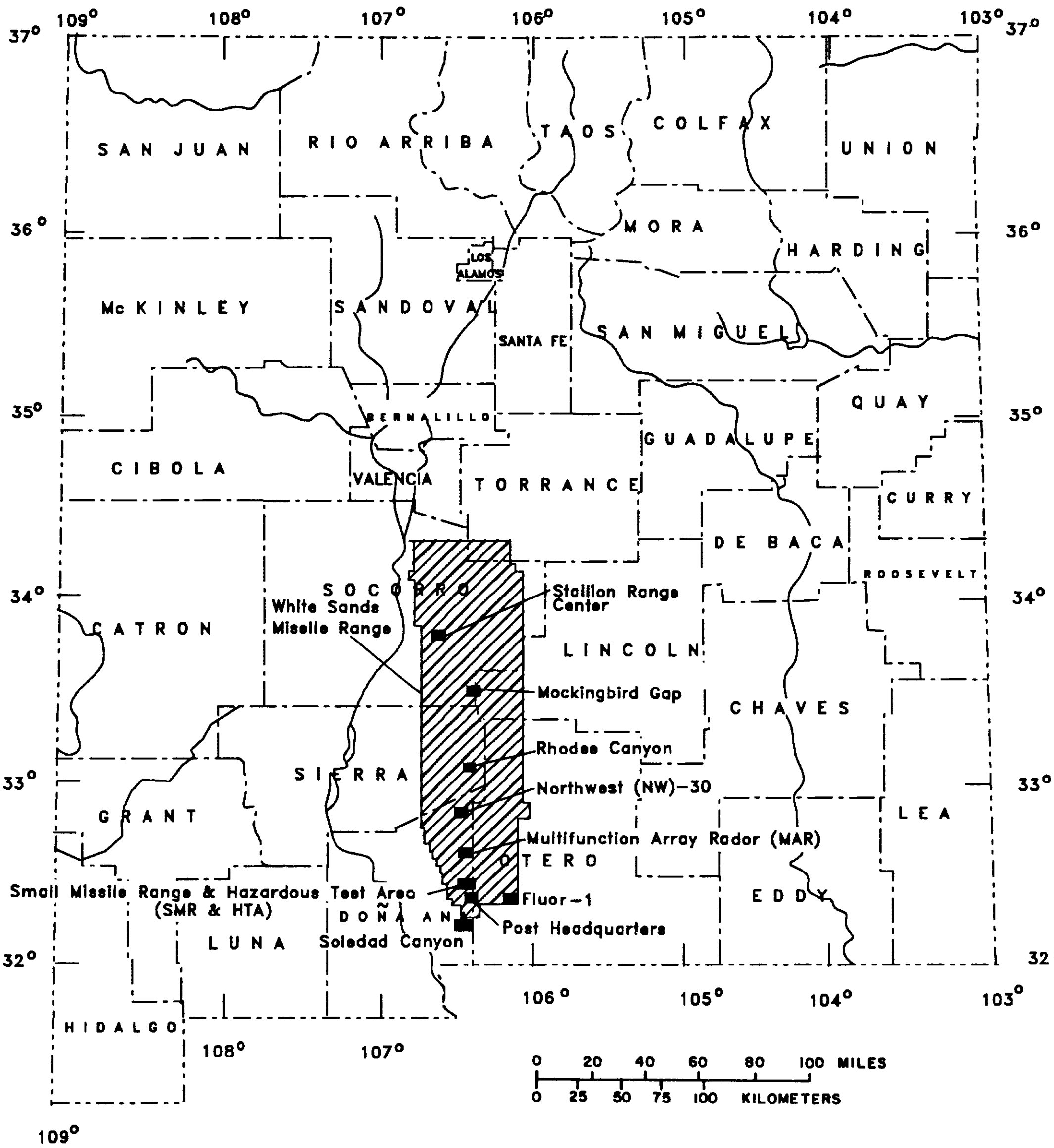


Figure 1.--Location of White Sands Missile Range, New Mexico, and areas of hydrologic observations.

WELL-NUMBERING SYSTEM

Wells are located according to the system of common subdivision of sectionized land used throughout the State by the U.S. Geological Survey. The number of each well consists of four segments separated by periods and locates the well's position to the nearest 10-acre tract of land. The segments denote, respectively, the township south of the New Mexico base line, the range east of the New Mexico principal meridian, the section, and the particular 10-acre tract within the section.

The fourth segment of the number consists of three digits denoting, respectively, the quarter section or approximate 160-acre tract, the quadrant (approximately 40 acres) of the quarter section, and the quadrant (approximately 10 acres) of the 40-acre tract in which the well is located. The system of quarter sections and quadrants, which are numbered in reading order, as well as the usual numbering of sections within a township is shown below. For example, well 22S.4E.1.431 (fig. 2) is located in the NW1/4 of the SW1/4 of the SE1/4, section 1, Township 22 South, Range 4 East. If more than one well has the same location number, the letter "a" is assigned to the second well, the letter "b" to the third well, and so on.

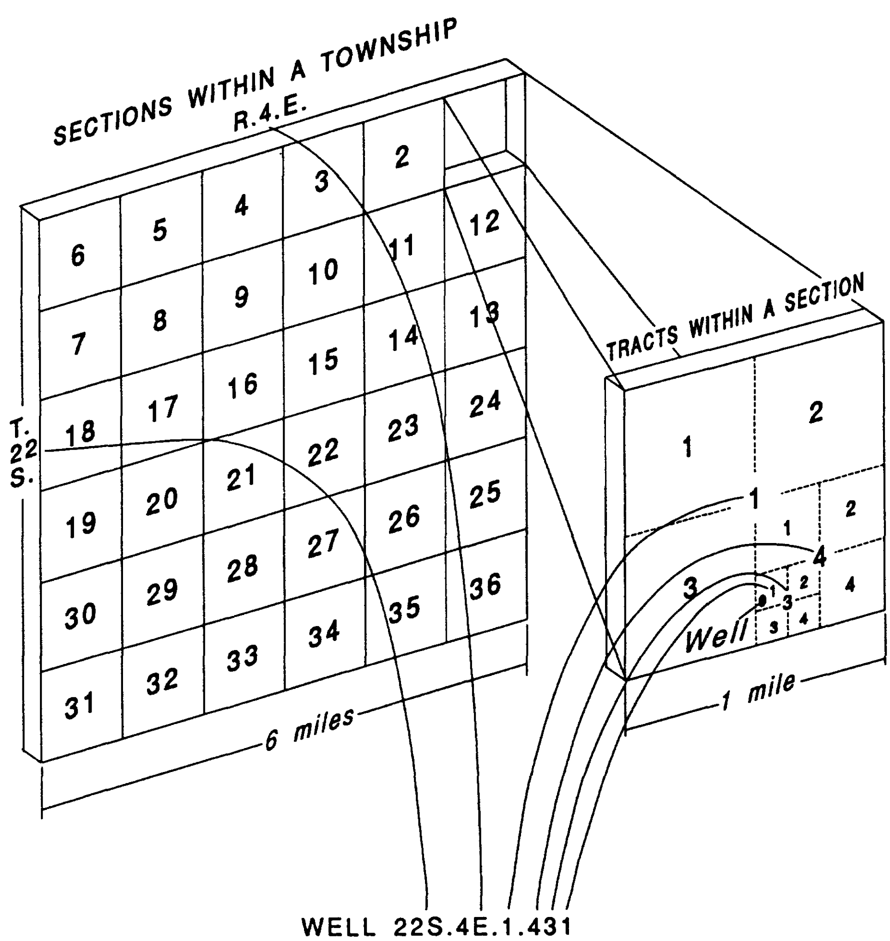


Figure 2.--Well-numbering system.

WATER-RESOURCES HYDROLOGIC-DATA-COLLECTION PROGRAM

The program of hydrologic-data collection at White Sands Missile Range has been continuous since 1953. The original program consisted of water-level measurements in five wells in the Post Headquarters area. The hydrologic-data-collection program has expanded over the years in response to expansion of the White Sands Missile Range facilities. Currently, the program consists of depth-to-water measurements in 99 wells, specific-conductance measurements of water samples from 25 wells, and compilation of ground-water withdrawals from 18 wells in the Post Headquarters and Range areas (figs. 3-7). Precipitation data at C-Station (22S.05E.36.224) and Post Headquarters sewage-influent data for 1988 are shown in tables 1 and 2, respectively (tables are in the back of the report).

Ground-Water Withdrawals

Total ground-water withdrawal at White Sands Missile Range in 1988 was 628,525,100 gallons (table 3), of which the Post Headquarters well field produced 582,653,000 gallons. Water levels in test well T-8 from 1966 to 1988 and yearly ground-water withdrawal from the Post Headquarters well field from 1961 to 1988 are shown in figure 8. In the Range area, the Multifunction Array Radar wells (MAR-1 and MAR-2), Small Missile Range well (SMR-1), Hazardous Test Area well (HTA-1), Stallion Range Center wells (SRC-1 and SRC-2), and Rhodes Canyon well (RC-4) (13S.4E.11.334) produced 45,872,100 gallons or 8 percent of the total withdrawal in 1988. Total ground-water pumpage, excluding 207,500 gallons from test well RC-4, was 7,825,600 gallons more in 1988 than in 1987.

Water-Level Measurements in Water-Supply Wells

Depth to water was measured in eight wells in the Post Headquarters area and six wells in the Range area (table 4). The greatest seasonal water-level fluctuation was 9.14 feet in water-supply well SW-22. Hydrographs of long-term water-level measurements for 10 water-supply wells in the Post Headquarters area are shown in figure 9. The 1988 water-level measurements from these wells indicated seasonal fluctuations as well as long-term declines, except for water levels in wells 10A, 21, and 22, which have risen in the past 2 years.

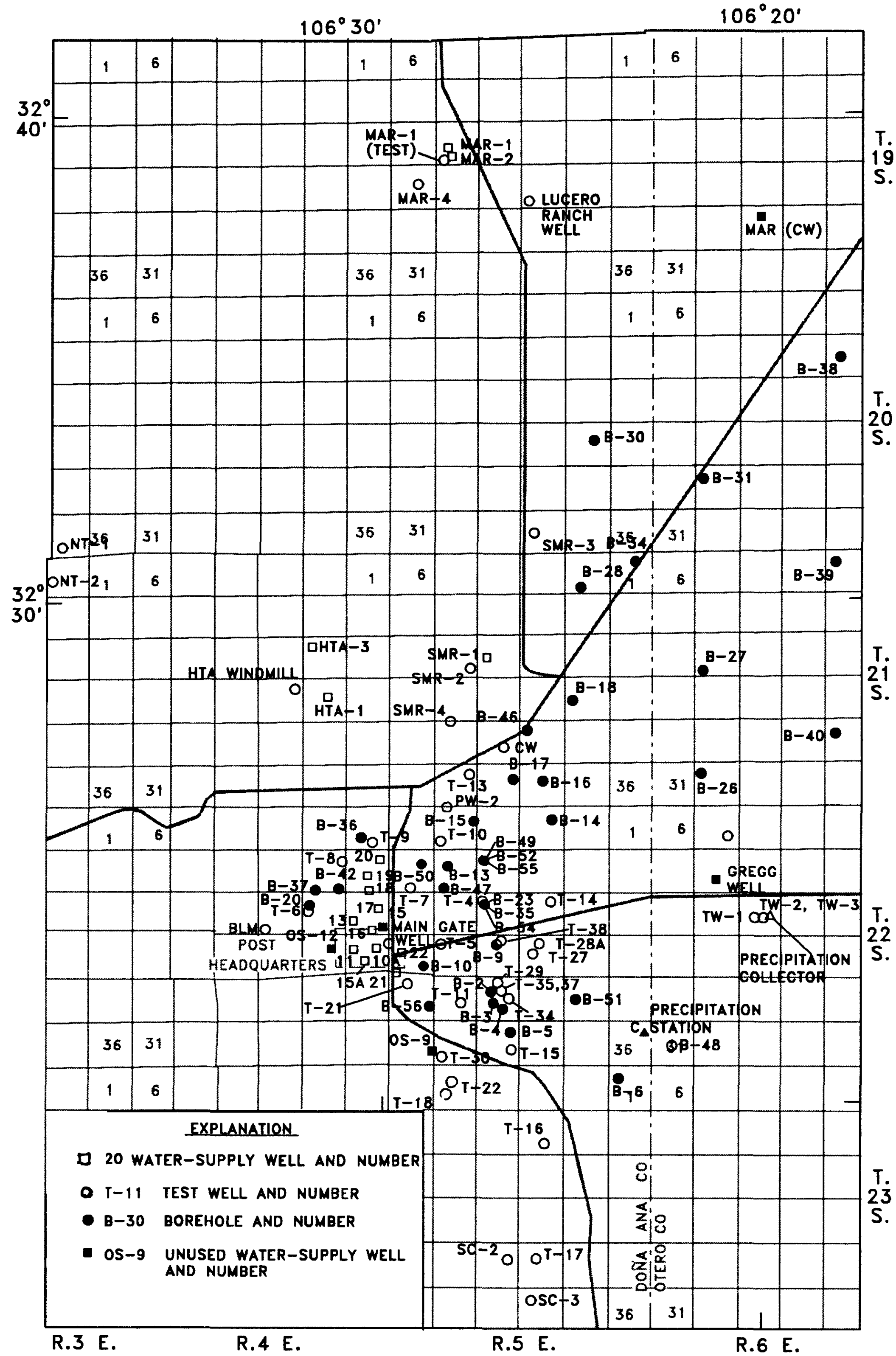


Figure 3.--Water-supply wells, test wells, boreholes, unused water-supply wells, and precipitation stations in the Post Headquarters and adjacent areas.

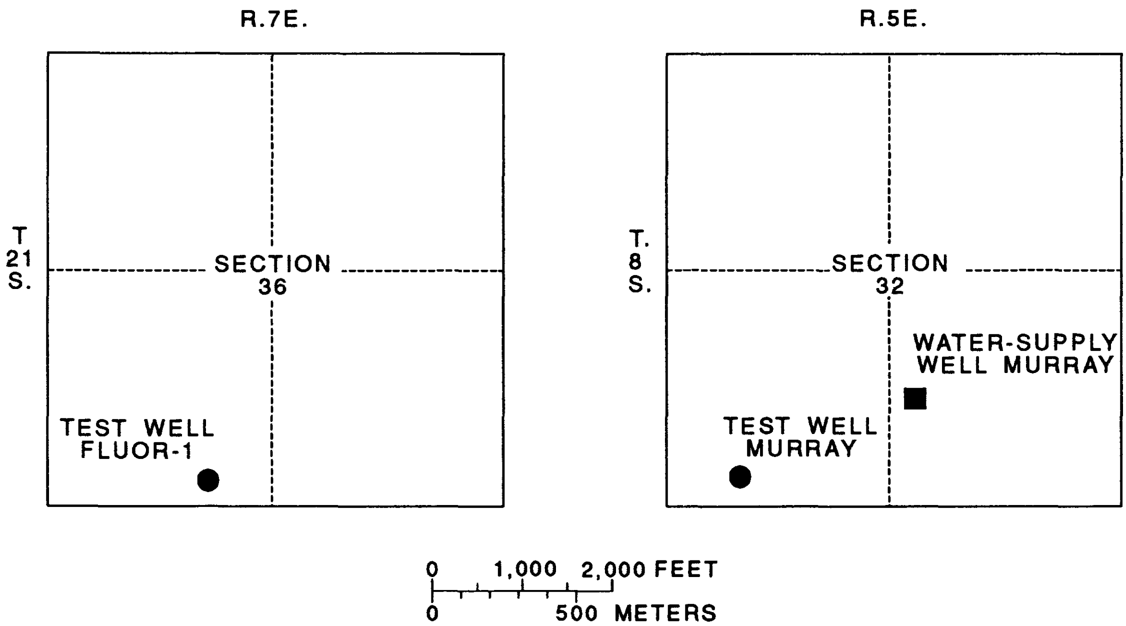


Figure 4.--Fluor-1 and Mockingbird Gap wells.

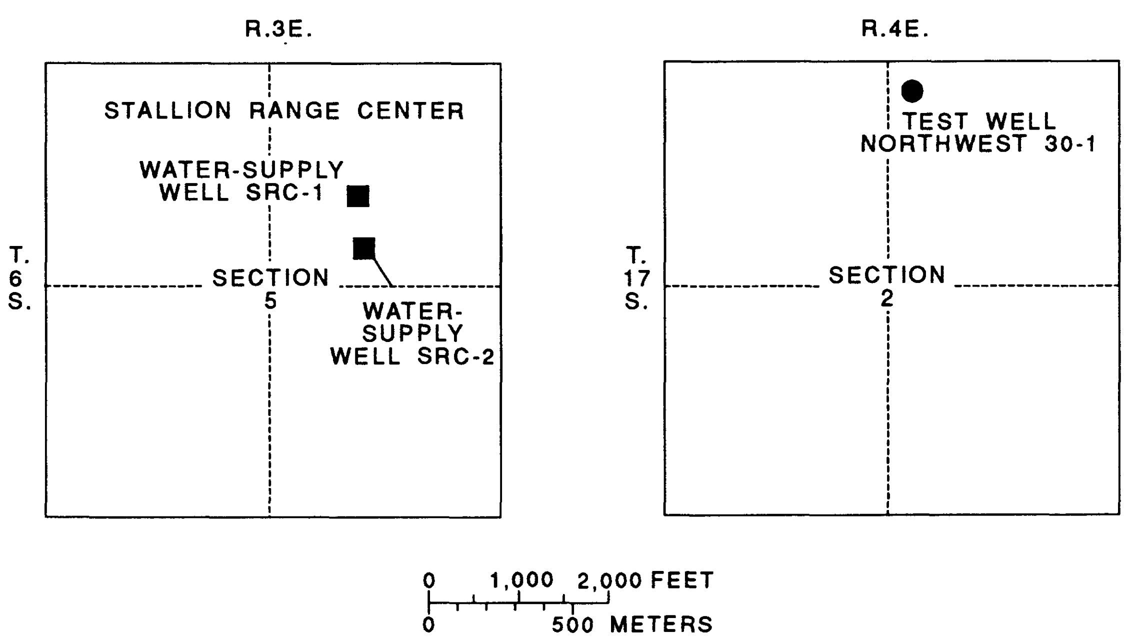


Figure 5.--Wells in the Stallion Range Center and Northwest-30 areas.

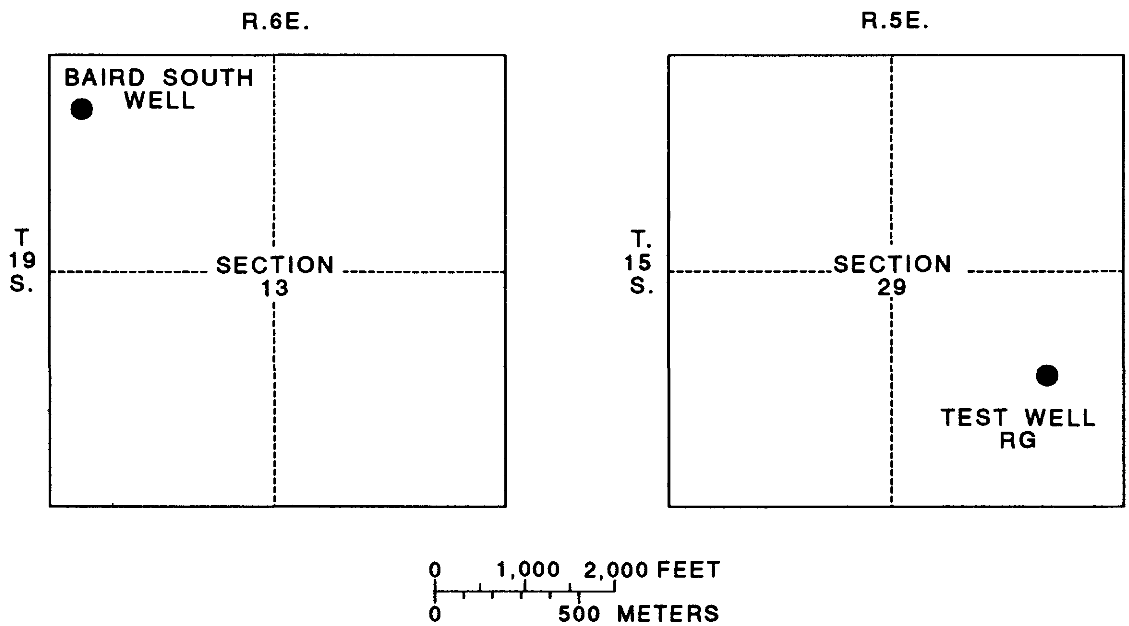


Figure 6.--Baird South well and test well RG.

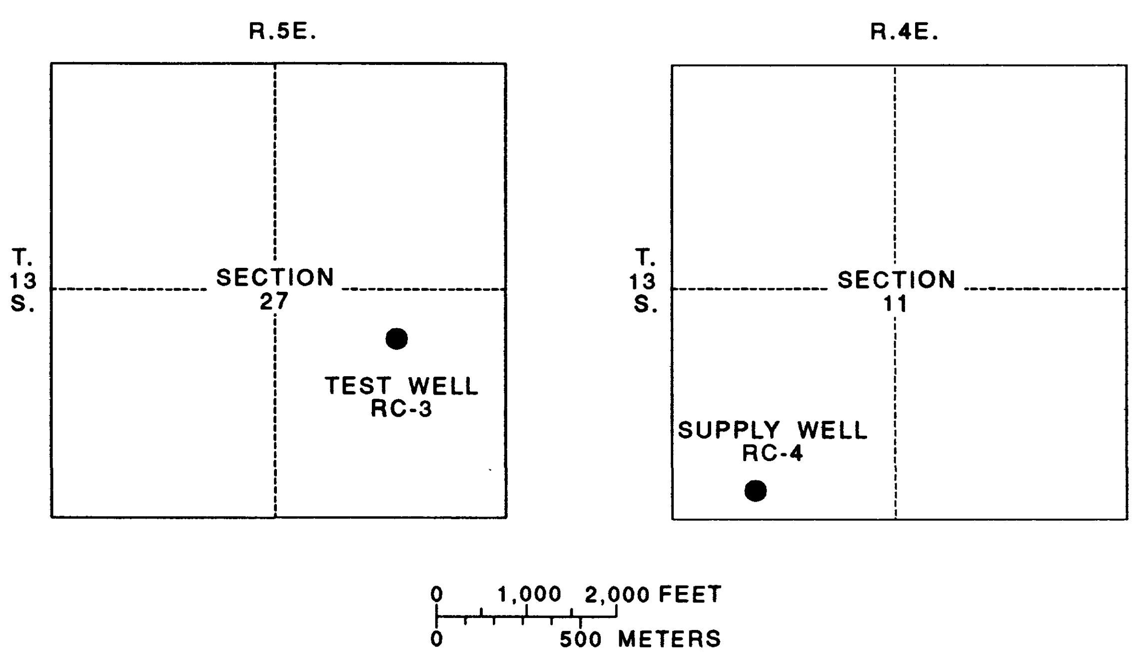
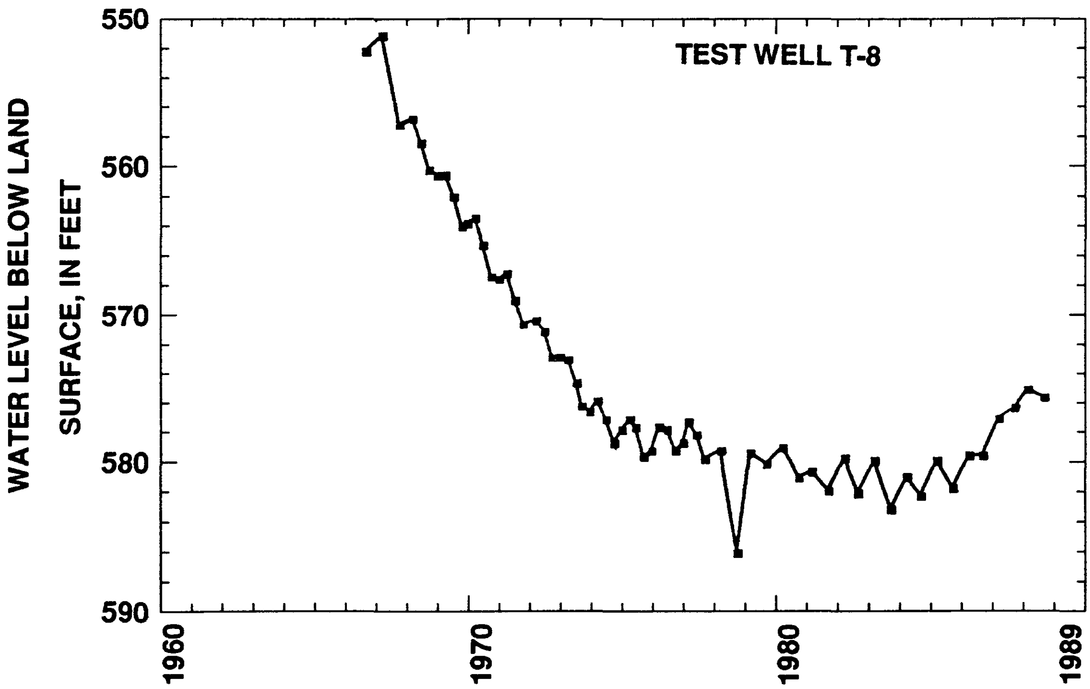


Figure 7.--Rhodes Canyon test and supply wells.



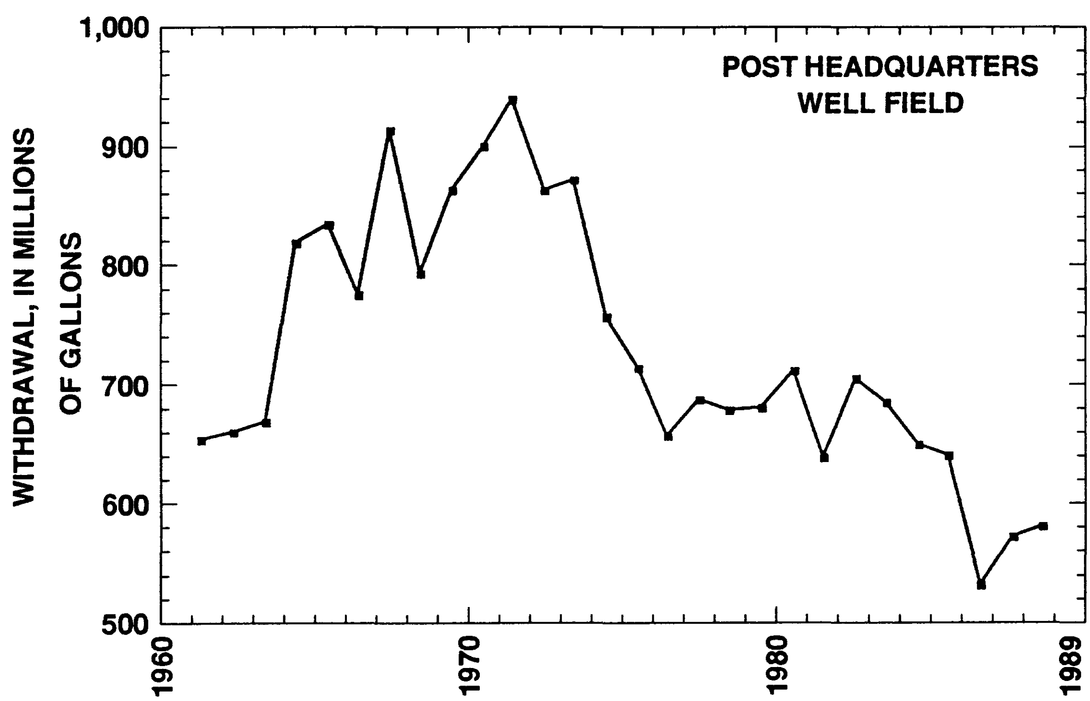


Figure 8.--Water levels in test well T-8 and yearly ground-water withdrawal from the Post Headquarters well field, 1961-88.

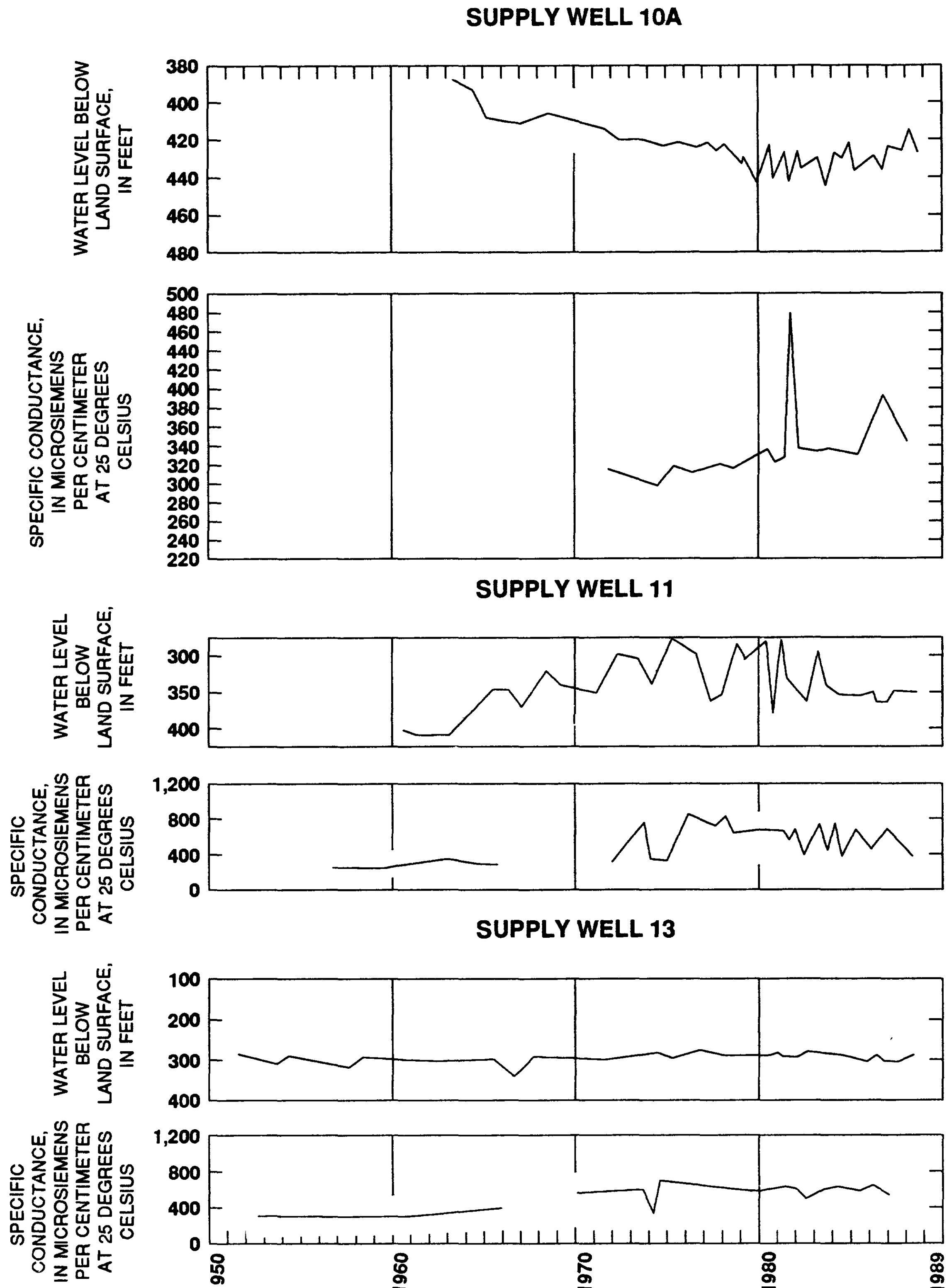


Figure 9.--Water levels and specific conductance for period of record available in selected water-supply wells, Post Headquarters area.

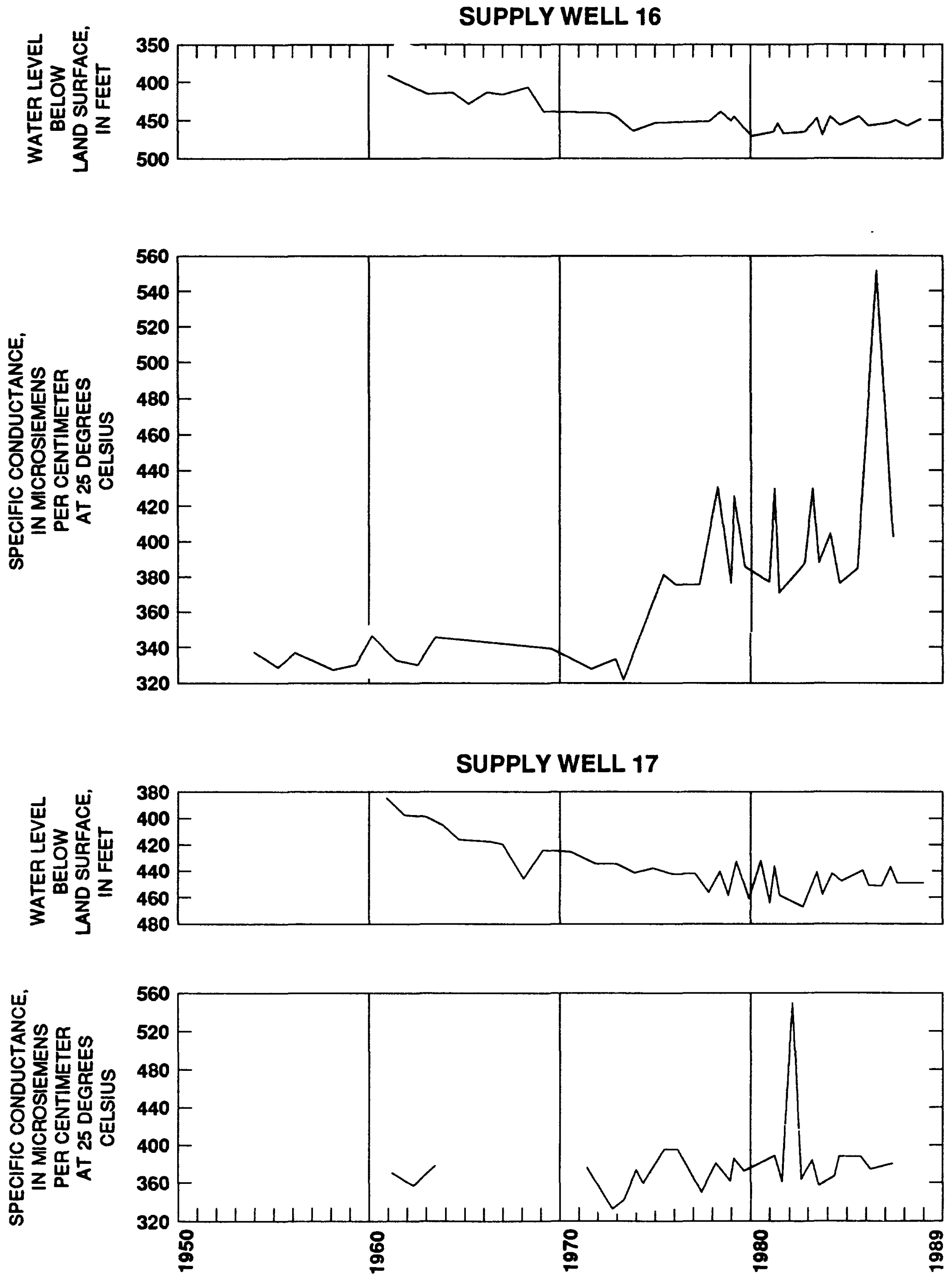


Figure 9.--Water levels and specific conductance for period of record available in selected water-supply wells, Post Headquarters area - Continued.

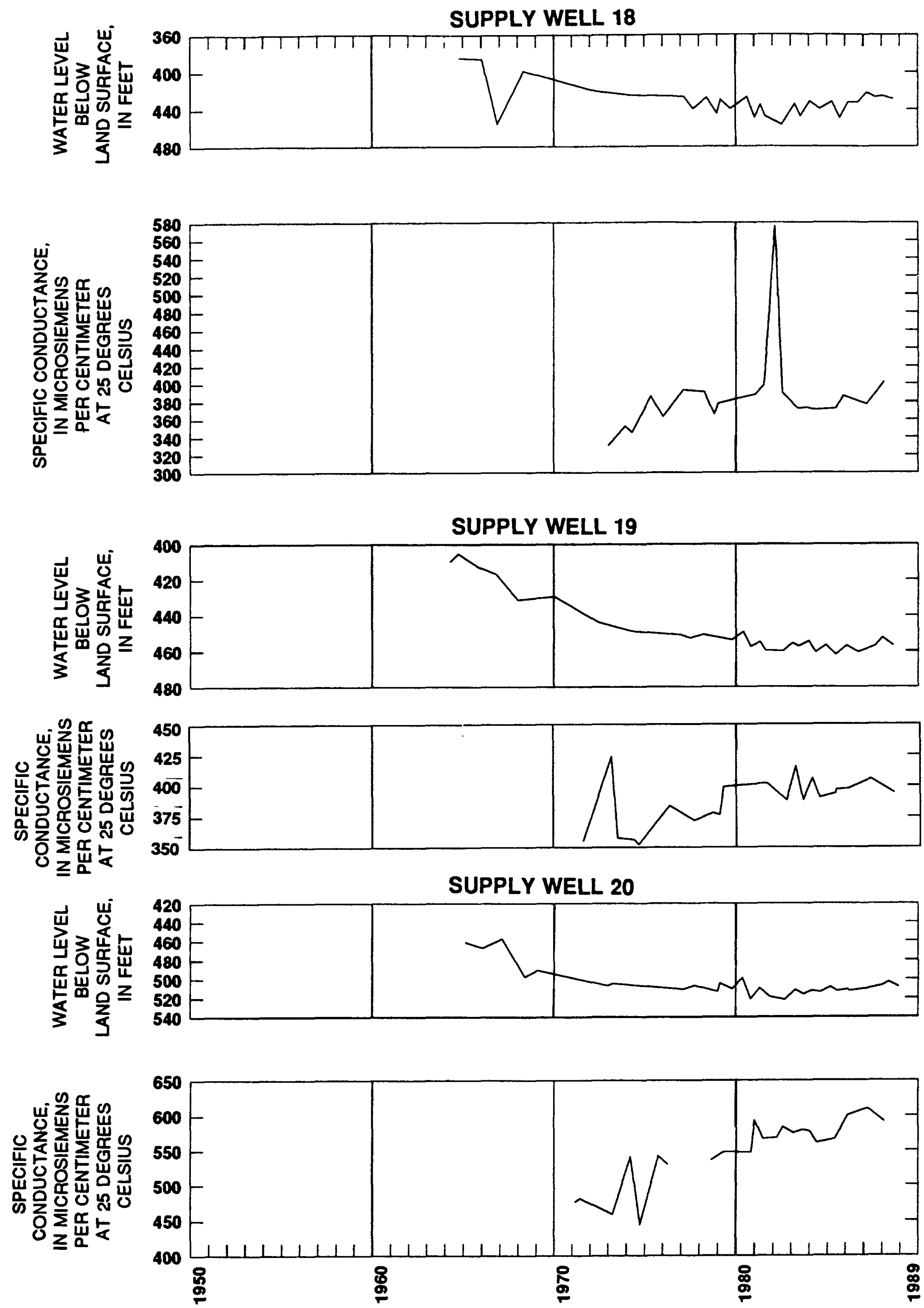


Figure 9.--Water levels and specific conductance for period of record available in selected water-supply wells, Post Headquarters area - Continued.

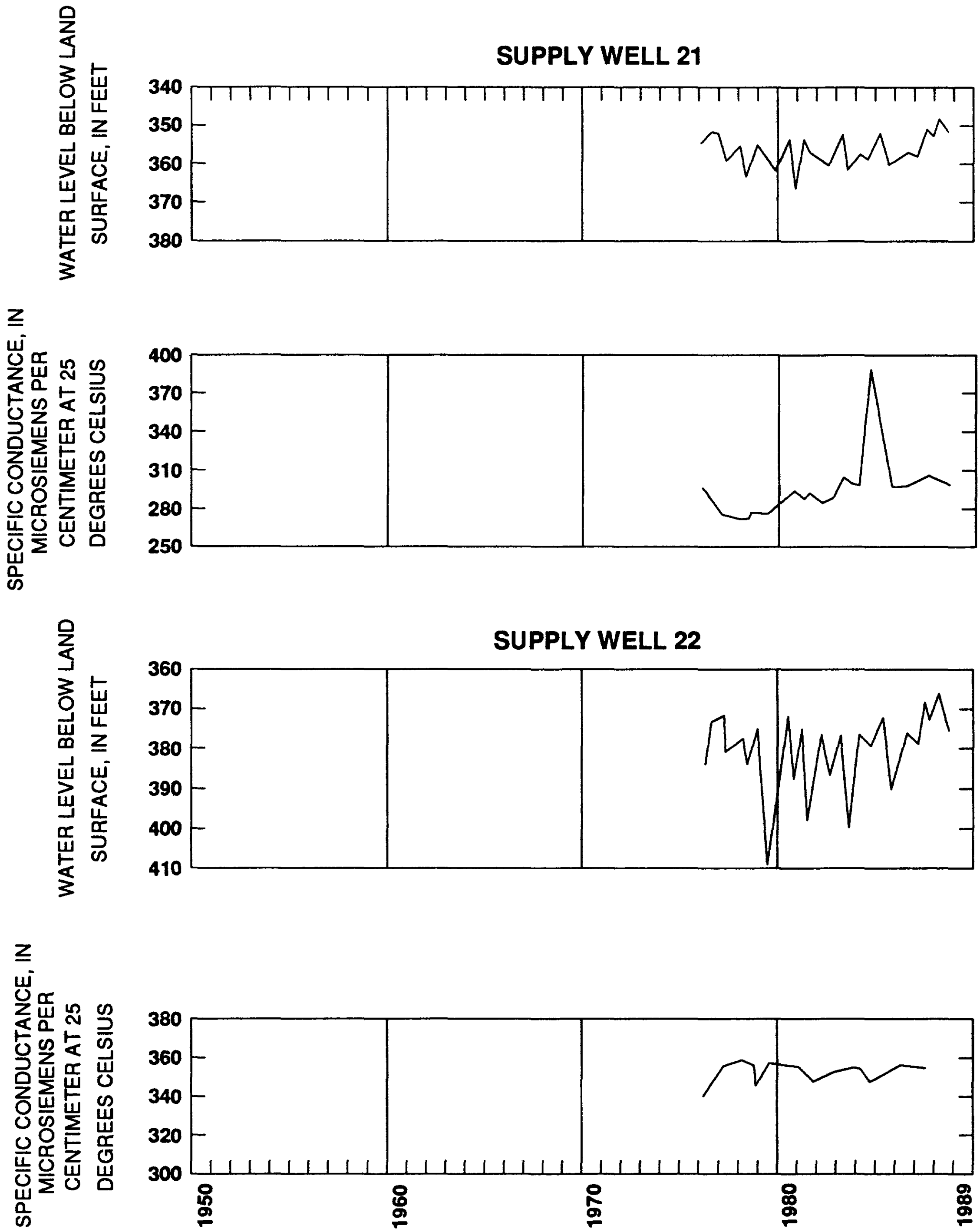


Figure 9.--Water levels and specific conductance for period of record available in selected water-supply wells, Post Headquarters area - Concluded.

Water-Level Measurements in Test Wells, Observation Wells, and Boreholes

Depth to water was measured in 49 test and observation wells and 36 boreholes in 1988 (tables 5 and 6). Eighteen of the test and observation wells had seasonal water-level declines and 26 wells had seasonal water-level rises (table 5). The greatest water-level decline in the test and observation wells was 7.92 feet in test well T-7; the greatest water-level rise was 3.33 feet in test well SMR-3. Test well T-10 continued to have a small water-level decline in 1988 (fig. 10), whereas the water level in test well T-11 declined for the first time in several years (fig. 10). The water level in test well T-8 continued to rise slightly in 1988 (fig. 10), whereas the water level in test well T-7 was about the same (fig. 10).

Twelve of the 36 boreholes measured had seasonal water-level rises, 23 had water-level declines, and one had no seasonal water-level change (table 6). The greatest seasonal water-level rise was 3.21 feet in boreholes B-37 and B-42, which are west of the Post Headquarters well field (fig. 3). The greatest seasonal water-level decline was 1.37 feet in borehole B-10, which is east of the Post Headquarters well field (fig. 3).

Chemical Analyses

One water sample was collected from a well at Hardin Ranch (12S.02E.27.211a) and one sample was collected from Pine Spring (23S.04E.15.221) for chemical analysis of major and selected minor ions and trace elements (table 7). One wet-fall/dry-fall sample was collected from a precipitation collector (22S.06E.16.233a) for selected chemical-constituent analysis (table 7). The sample collection period for the collector was November 4 to December 15, 1988.

Twenty-seven water samples--17 from Post Headquarters area test and observation wells, 6 from Post Headquarters area water-supply wells, and 4 from Range area water-supply wells--were collected from 25 wells for specific-conductance analyses in 1988 (table 8). The long-term specific conductance of water samples collected from 10 water-supply wells in the Post Headquarters area is shown in figure 9. In 1988, the specific conductance ranged from 245 microsiemens (microsiemens per centimeter at 25 degrees Celsius) in water from test well T-17 to 1,840 microsiemens in water from test well T-14 in the Post Headquarters area. The pH ranged from 7.30 in water from supply well OS-12 to 8.81 in water from test well T-14 in the Post Headquarters area. The specific conductance for four Range area wells ranged from 740 microsiemens in water from supply well SMR-1 to 1,800 microsiemens in water from supply well MAR-2.

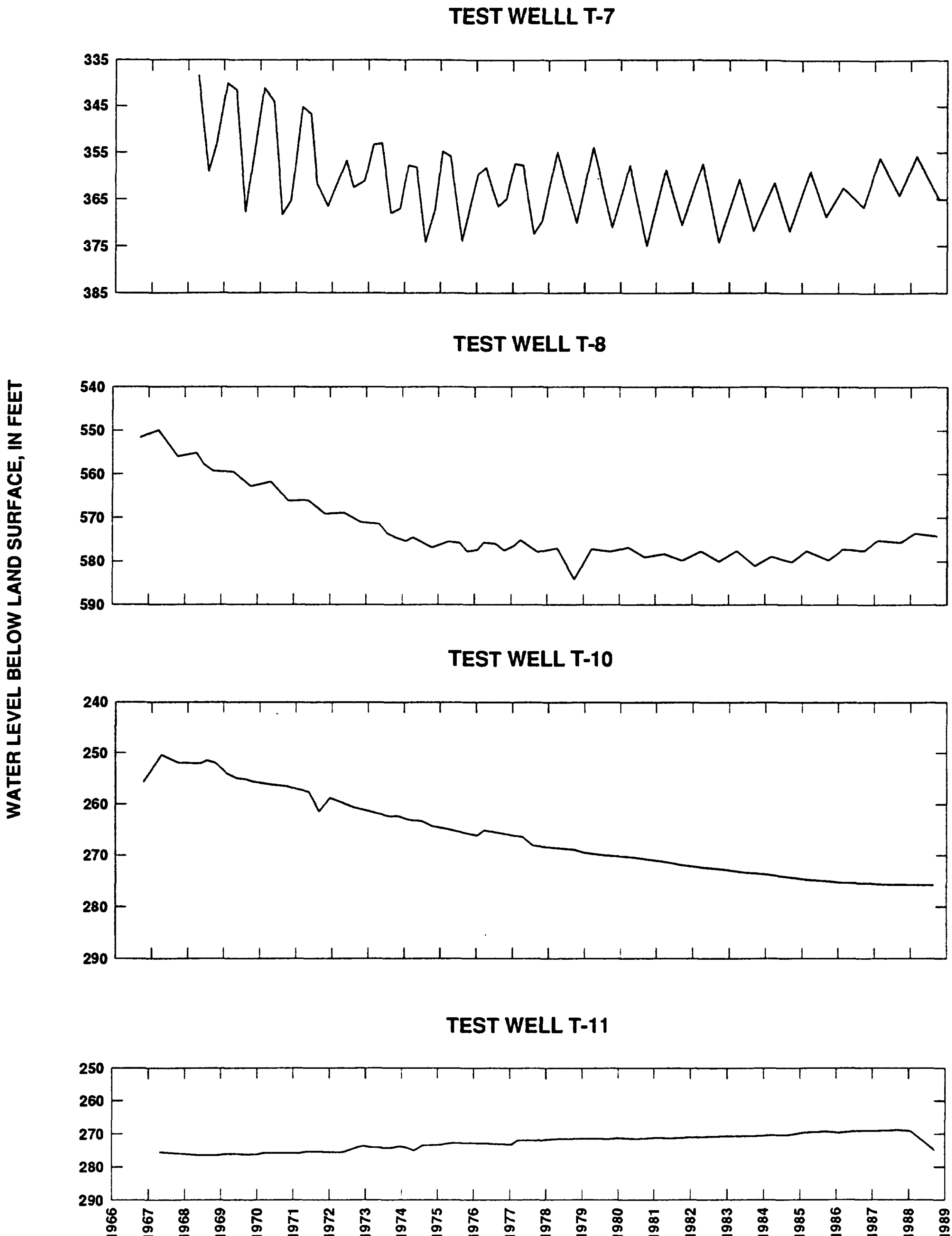


Figure 10.--Water levels in test wells T-7, T-8, T-10, and T-11, 1966-88.

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Table 1.--Monthly precipitation, in inches, at C-Station (22S.05E.36.224), White Sands Missile Range, 1988

Month	1988
January	0.23
February	2.07
March	0.02
April	0.39
May	0.04
June	1.39
July	3.73
August	6.59
September	0.67
October	0.45
November	0.87
December	1.60
Total	18.05

Table 2.--Monthly sewage-influent data for Post Headquarters, 1988

Month	Gallons
January	16,116,600
February	14,159,800
March	16,031,800
April	15,807,500
May	17,359,900
June	16,671,100
July	16,978,000
August	17,963,500
September	17,644,000
October	17,660,000
November	15,630,000
December	15,940,700
Total	197,962,900

Table 3.--Total ground-water withdrawal from water-supply wells, Post Headquarters and Range areas, 1988

[Location of wells SRC-1 and SRC-2 is shown in figure 5; location of well RC-4 is shown in figure 7. All other well locations are shown in figure 3]

	Ground-water withdrawal from wells in Post Headquarters area (in thousands of gallons)											
Month	Well SW-10A	Well SW-11	Well SW-13	Well SW-15A	Well SW-16	Well SW-17	Well SW-18	Well SW-19	Well SW-20	Well SW-21	Well SW-22	Totals
January	4,500	3,110	(1)		4,453	(1)	1,849	4,082	626	909	2,338	21,867
February	4,603	2,389	(1)		3,528	(1)	2,720	5,287	1,400	76	2,994	22,997
March	6,707	2,879	(1)		8,341	(1)	6,071	13,224	2,808	496	6,100	46,626
April	7,571	1,230	(1)		9,609	(1)	5,224	15,095	8,705	2,837	12,341	62,612
May	13,038	(1)	(1)	(1)	11,826	(1)	9,735	21,034	13,389	3,706	9,077	81,805
June	10,369	(1)	(1)	(1)	10,704	2,865	7,217	24,170	17,804	3,868	11,479	88,476
July	11,563	(1)	(1)	(1)	11,399	(1)	6,317	20,940	17,208	3,262	1,768	72,457
August	10,596	(1)	(1)	(1)	7,322	(1)	6,991	10,902	13,486	3,029	1,495	53,821
September	6,715	(1)	(1)	(1)	6,390	(1)	7,314	11,249	4,873	2,187	5,135	43,863
October	5,110	(1)	(1)	(1)	2,941	(1)	3,055	8,313	6,970	2,019	6,298	34,706
November	3,704	(1)	(1)	(1)	3,478	(1)	991	6,386	8,209	2,113	4,699	29,580
December	2,916	(1)	(1)	(1)	2,716	(1)	143	5,679	6,220	2,498	3,671	23,843
Totals	87,392	9,608	0	0	82,707	2,865	57,627	146,361	101,698	27,000	67,395	582,653

	Ground-water withdrawal from wells in Range area (in thousands of gallons)							
Month	Well MAR-1	Well MAR-2	Well SMR-1	Well HTA-1	Well SRC-1	Well SRC-2	Well RC-4	Totals
January	799.9	1,236.9	343.6	4.3	283.0	50.0	14.4	2,732.1
February	1,103.4	673.2	57.0	7.9	566.0	75.0	14.8	2,497.3
March	1,081.6	1,477.8	69.1	8.2	525.0	38.0	10.0	3,209.7
April	913.9	928.6	173.1	6.0	(1)	904.0	8.2	2,933.8
May	1,135.4	1,128.1	230.1	17.4	(1)	687.0	43.1	3,241.1
June	1,063.2	1,243.0	278.2	13.4	(1)	980.0	10.9	3,588.7
July	1,644.7	2,444.9	205.5	14.9	(1)	881.0	13.7	5,204.7
August	2,339.3	1,019.2	1,625.6	15.7	(1)	813.0	18.7	5,831.5
September	2,275.4	180.2	180.0	9.1	(1)	821.0	26.4	3,492.1
October	2,761.7	207.2	163.9	6.9	(1)	575.0	10.5	3,725.2
November	3,756.0	1,169.2	217.1	10.5	(1)	540.0	19.8	5,712.6
December	2,685.7	208.0	208.0	7.6	(1)	577.0	17.0	3,703.3
Totals	21,560.2	11,916.3	3,751.2	121.9	1,374.0	6,941.0	207.5	45,872.1

[1] Not operational because of equipment malfunction

Table 4.--**Depth-to-water measurements from water-supply wells, Post Headquarters and Range areas, 1988**

[Location of wells SRC-1 and SRC-2 are shown in figure 5; all other well locations are shown in figure 3]

Well number	Location	Winter 1988 (feet below land surface)	Summer 1988 (feet below land surface)
	Post Headquarters area		
SW-10A	22S.4E.24.212a	416.92	423.40
SW-11	22S.4E.24.112	(1)	(1)
SW-13	22S.4E.13.311	[2]300	(1)
SW-16	22S.4E.13.432	[2]454	(1)
SW-17	22S.4E.13.241	(1)	(1)
SW-18	22S.4E.12.434	426.38	432.24
SW-19	22S.4E.12.414	451.99	456.85
SW-20	22S.4E.12.214	514.26	520.12
SW-21	22S.5E.19.323	348.21	352.71
SW-22	22S.5E.19.141	366.98	376.12
	Range area		
HTA-1	21S.4E.23.233	61.29	(3)
HTA-3	21S.4E.14.114	48.19	50.89
MAR-1	19S.5E.17.331	211.64	Pumping
MAR-2	19S.5E.17.334	218.19	Pumping
SRC-1	6S.3E.05.232	214.00	(1)
SRC-2	6S.3E.05.234	207.00	207.00

[1]Unable to measure (equipment malfunction)
[2]Air-line reading
[3]Area road blocks

Table 5.--Depth-to-water measurements from test and observation wells, Post Headquarters and Range areas, 1988

[Location of wells is shown in figures 3-7]

Well number	Location	Winter 1988 (feet below land surface)	Summer 1988 (feet below land surface)
T-4	22S.5E.16.111	227.15	227.07
T-5	22S.5E.20.111	277.31	277.50
T-6	22S.4E.14.133	188.03	187.45
T-7	22S.5E.07.342	356.00	363.92
T-8	22S.4E.11.224	575.95	576.45
T-9	22S.4E.01.431	369.57	368.53
T-10	22S.5E.05.313	275.04	274.97
T-11	22S.5E.29.412	271.78	275.74
T-13	21S.5E.32.222	214.08	214.04
T-14	22S.5E.15.221	132.55	132.48
T-15	22S.5E.33.244	179.70	179.19
T-16	23S.5E.10.413	182.48	181.16
T-17	23S.5E.27.142	242.19	242.25
T-18	23S.5E.05.321	235.72	234.95
T-21	22S.5E.30.122	312.39	312.05
T-22	23S.5E.05.144	188.32	188.28
T-27	22S.5E.22.141	162.34	162.21
T-28A	22S.5E.22.122a	155.15	154.98
T-29	22S.5E.28.122	185.92	187.56
T-30	22S.5E.32.334	208.14	207.73
T-34	22S.5E.28.234	188.29	190.04
T-35	22S.5E.28.142a	189.30	191.37
T-37	22S.5E.28.142b	207.24	208.14
T-38	22S.5E.21.211a	214.41	214.22
OS-9	22S.5E.31.424	237.40	237.23
OS-12	22S.4E.23.214	223.63	224.35
TW-1	22S.6E.16.233	229.32	229.33
TW-2	22S.6E.16.234	235.73	235.72
TW-3	22S.6E.16.234a	234.52	234.78
NT-1	20S.3E.35.341	127.97	129.46

Table 5.--Depth-to-water measurements from test and observation wells, Post Headquarters and Range areas, 1988--Concluded

Well number	Location	Winter 1988 (feet below land surface)	Summer 1988 (feet below land surface)
NT-2	21S.3E.02.311	176.46	176.34
Gregg	22S.6E.08.414	214.32	214.28
HTA (windmill)	21S.4E.22.222	39.90	([1])
SMR-2	21S.5E.17.424	321.15	321.00
SMR-3	20S.5E.34.133	300.32	296.99
SMR-4	21S.5E.20.344	290.43	290.39
MAR-1 (test)	19S.5E.17.333	218.52	218.66
MAR-4	19S.5E.19.231	300.94	([1])
NW30-1	17S.4E.02.211	212.30	211.77
Murray	8S.5E.32.334	177.26	176.97
Lucero Ranch	19S.5E.22.334	171.03	171.23
CW	21S.5E.28.411	153.72	153.85
BLM	22S.4E.15.331	58.83	60.35
RC-3	13S.5E.27.421	35.61	35.21
RG	15S.5E.29.423	28.50	27.72
Baird South	19S.6E.13.113	([1])	68.67
Fluor-1	21S.7E.36.344	311.91	312.41
SC-2	23S.5E.28.223	([1])	180.24
SC-3	23S.5E.34.114	([1])	261.32

[1]Were not in data-collection network at this time.

Table 6.--Depth-to-water measurements from boreholes, Post Headquarters and adjacent areas, 1988

[Location of boreholes is shown in figure 3]

Borehole number	Location	Winter 1988 (feet below land surface)	Summer 1988 (feet below land surface)
B-2	22S.5E.28.124	196.32	195.68
B-3	22S.5E.28.142	202.58	203.41
B-4	22S.5E.28.233	197.28	198.43
B-5	22S.5E.33.223	187.08	187.38
B-6	23S.5E.01.113	133.66	133.69
B-9	22S.5E.21.211	224.99	224.86
B-10	22S.5E.19.414	301.20	302.57
B-13	22S.5E.08.141	246.30	246.70
B-14	22S.5E.03.221	112.90	112.93
B-15	22S.5E.05.242	176.16	176.28
B-16	21S.5E.34.213	110.09	110.05
B-17	21S.5E.33.242	112.34	112.44
B-18	21S.5E.23.134	104.99	105.06
B-20	22S.4E.14.134	347.38	344.94
B-23	22S.5E.16.111	225.60	225.61
B-26	21S.6E.32.114	141.35	141.33
B-27	21S.6E.17.314	119.96	119.98
B-28	21S.5E.02.341	140.43	140.56
B-30	20S.5E.23.213	89.72	89.71
B-31	20S.6E.29.123	123.40	123.40
B-34	21S.5E.01.221	126.39	126.53
B-36	22S.4E.01.323	211.26	211.39
B-37	22S.4E.11.344	370.65	367.44
B-38	20S.6E.11.234	129.81	129.84
B-39	21S.6E.02.142	156.43	156.28
B-40	21S.6E.26.142	188.69	188.67
B-42	22S.4E.11.444	361.21	358.00
B-46	21S.5E.27.113	136.61	136.66
B-47	22S.5E.08.334	274.49	274.63
B-48	22S.6E.31.322	204.65	204.68
B-50	22S.5E.07.242	308.37	308.53
B-51	22S.5E.26.312	146.19	146.24
B-52	22S.5E.09.113	211.40	211.64
B-54	22S.5E.16.111	230.28	230.19
B-55	22S.5E.09.113	215.19	215.21
B-56	22S.5E.30.424	271.89	270.88

Table 7.—Chemical-constituent analyses of water from miscellaneous selected sites, 1988

[deg C, degrees Celsius; uS/cm, microsiemens per centimeter at 25 degrees Celsius; mg/L, milligrams per liter; --, no data; <, less than; ug/L, micrograms per liter]

Location	Name	Date of sample	Elevation of land-surface datum (feet above sea level)	Specific conductance (uS/cm)	Specific conductance, lab (uS/cm)	Solids, residue at 180 deg C (dissolved) (mg/L)	pH, lab (standard units)	Temperature, water (deg C)	Calcium, dissolved (mg/L as Ca)	Magnesium, dissolved (mg/L as Mg)	Sodium, dissolved (mg/L as Na)	Potassium, dissolved (mg/L as K)
22S.06E.16.233a	WSMR-HWDF[1]	12-15-88	--	--	--	--	7.68	--	--	--	--	--
12S.02E.27.211a	Hardin Ranch well	09-09-88	6,430	--	1,080	738	8.10	18.5	100	72	43	2.9
23S.04E.15.221	Pine Spring	07-07-88	5,830	490	522	353	7.50	21.5	75	11	19	1.6

Name	Date of sample	Alkalinity, lab (mg/L as $CaCO_3$)	Chloride, dissolved (mg/L as Cl)	Sulfate, dissolved (mg/L as SO_4)	Fluoride, dissolved (mg/L as F)	Bromide, dissolved (mg/L as Br)	Silica, dissolved (mg/L as SiO_2)	Nitrogen, nitrate, dissolved (mg/L as N)	Nitrogen, NO_2+NO_3, dissolved (mg/L as N)	Phosphorus ortho, dissolved (mg/L as P)	Arsenic, dissolved (ug/L as As)	Barium, dissolved (ug/L as Ba)	Boron, dissolved (ug/L as B)
WSMR-HWDF[1]	12-15-88	--	0.93	6.3	0.12	<0.01	--	0.67	--	<0.01	--	--	--
Hardin Ranch well	09-09-88	301	42	220	0.40	0.28	35	--	1.3	--	1	27	60
Pine Spring	07-07-88	138	12	110	0.60	--	32	--	<0.1	--	--	--	10

Name	Date of sample	Cadmium, dissolved (ug/L as Cd)	Chromium, dissolved (ug/L as Cr)	Copper, dissolved (ug/L as Cu)	Iron, dissolved (ug/L as Fe)	Lead, dissolved (ug/L as Pb)	Lithium, dissolved (ug/L as Li)	Manganese, dissolved (ug/L as Mn)	Mercury, dissolved (ug/L as Hg)	Selenium, dissolved (ug/L as Se)	Silver, dissolved (ug/L as Ag)	Strontium, dissolved (ug/L as Sr)	Zinc, dissolved (ug/L as Zn)
WSMR-HWDF[1]	12-15-88	--	--	--	--	--	--	--	--	--	--	--	--
Hardin Ranch well	09-09-88	<1	1	2	<3	<5	34	5	0.1	7	<1	930	71
Pine Spring	07-07-88	--	--	--	4	--	11	--	--	--	--	390	--

[1] Wet-fall/dry-fall sample from precipitation collector; sample collection period was 11-04-88 to 12-15-88

Table 8.--Specific conductance and pH of water samples collected from test and water-supply wells in the Post Headquarters and Range areas, summer 1988

[Location of wells is shown in figure 3. µS/cm, microsiemens per centimeter at 25 degrees Celsius]

Well number	Sampling depth (feet below land surface)	Specific conductance, lab (µS/cm)	pH (lab)
	Post Headquarters area		
Test wells			
T-4	325	310	7.96
T-5	330	378	8.01
T-6	350	442	7.55
T-7	440	357	7.88
T-7	960	580	8.22
T-8	650	670	7.64
T-8	915	620	7.89
T-9	550	830	7.53
T-10	513	329	8.00
T-11	570	257	8.25
OS-12	350	469	7.30
T-13	320	487	7.72
T-14	250	1,840	8.81
T-15	448	280	8.12
T-16	480	322	7.96
T-17	440	245	7.74
T-18	635	720	8.10
Supply wells			
SW-10A	Pumping	350	([1])
SW-11	do.	430	([1])
SW-18	do.	400	([1])
SW-19	do.	395	([1])
SW-20	do.	590	([1])
SW-21	do.	300	([1])
	Range area		
Supply wells			
SMR-1	Pumping	740	([1])
HTA-1	Pumping	750	([1])
MAR-1	Pumping	860	([1])
MAR-2	Pumping	1,800	([1])

[1]Undetermined

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