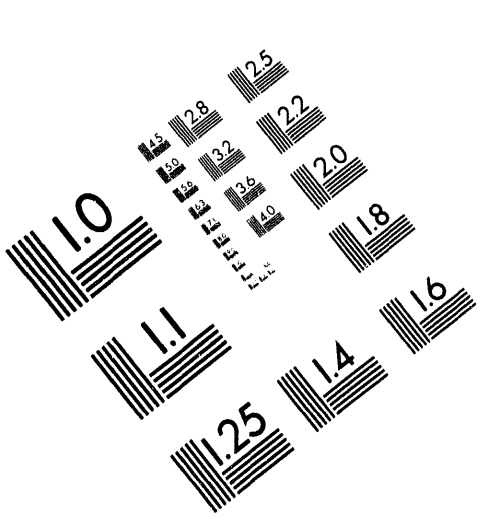

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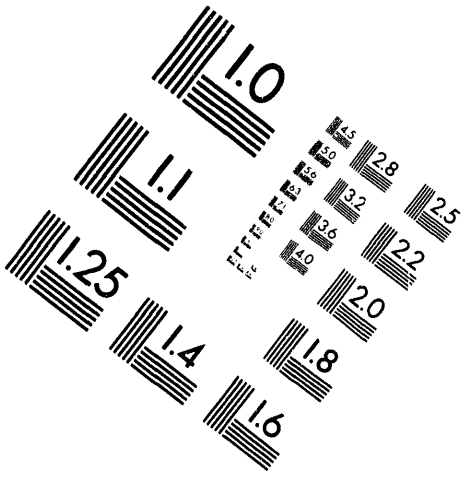

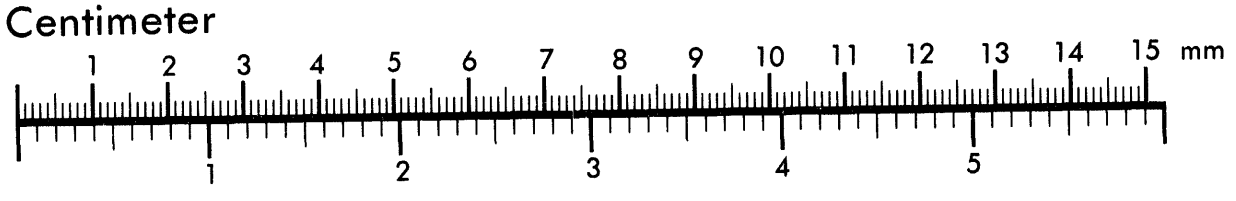

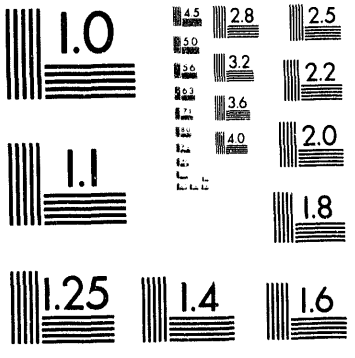

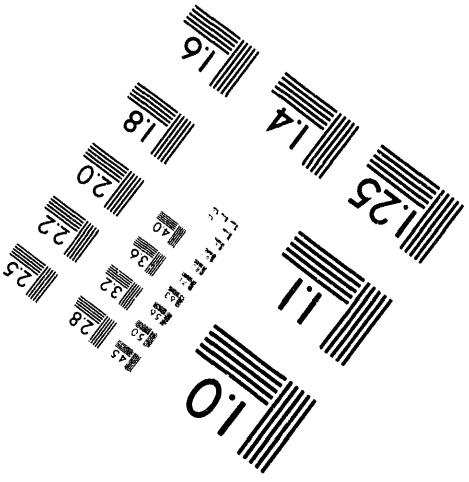

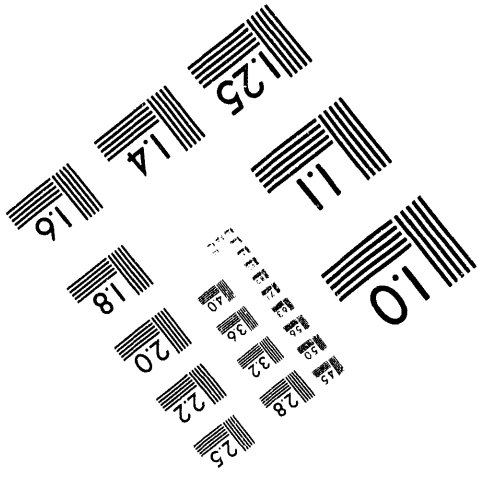

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Water Supply at Los Alamos during 1991

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Los Alamos
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WATER SUPPLY AT LOS ALAMOS DURING 1991

by

W. D. Purtymun, S. G. McLin, A. K. Stoker, and M. N. Maes

ABSTRACT

Municipal potable water supply during 1991 was about 1,448 × 10^6 gallons from wells in three fields. The nonpotable water supply used exclusively for industry was about 12 × 10^6 gallons from the spring gallery in Water Canyon. The nonpotable water used for irrigation was 1.5 × 10^6 gallons from the Guaje Reservoir and 2.4 × 10^6 gallons from the Los Alamos Reservoir. Thus, the total water usage in 1991 was about 1,464 × 10^6 gallons. New wells in the Otowi Well Field were not operational in 1991. Otowi 4 may become operational in the latter part of 1992. Water supply was satisfactory in that production met demand, and water quality in the distribution system was in compliance with state and federal regulations.

I. INTRODUCTION

This report summarizes production and aquifer conditions for water wells in the Los Alamos, Guaje, and Pajarito Well Fields (Fig. 1). The wells supply all of the potable water used for municipal and some industrial purposes in Los Alamos County and the Los Alamos National Laboratory. The spring gallery in Water Canyon supplies nonpotable water for industrial use while the rest of the nonpotable water supply used for irrigation is surface water from the Guaje and Los Alamos Reservoirs. Included is a section on the chemical and radiochemical quality of water from the supply wells, gallery in Water Canyon and the reservoirs in Guaje and Los Alamos Canyons. A section on the quality of water with reference to compliance with state and federal regulations is included in the report.

This report is a joint effort between the Laboratory Environmental Protection Group and the Utilities Department of Johnson Controls World Services Inc. (JCI). The purpose of this report is to ensure a continuing historical record and to provide guidance for management of water resources in long-range planning for the water supply system. We have issued one summary report for the period of 1947–1971 and 20 annual reports that contain the results of our studies of these water supplies.[1-21] An additional report summarized the hydrology of the main aquifer with reference to future development of groundwater supplies.[22] A report was issued in 1988 to examine the current status of wells and future water supply.[23] On the basis of that report, two new supply wells were drilled in 1990.

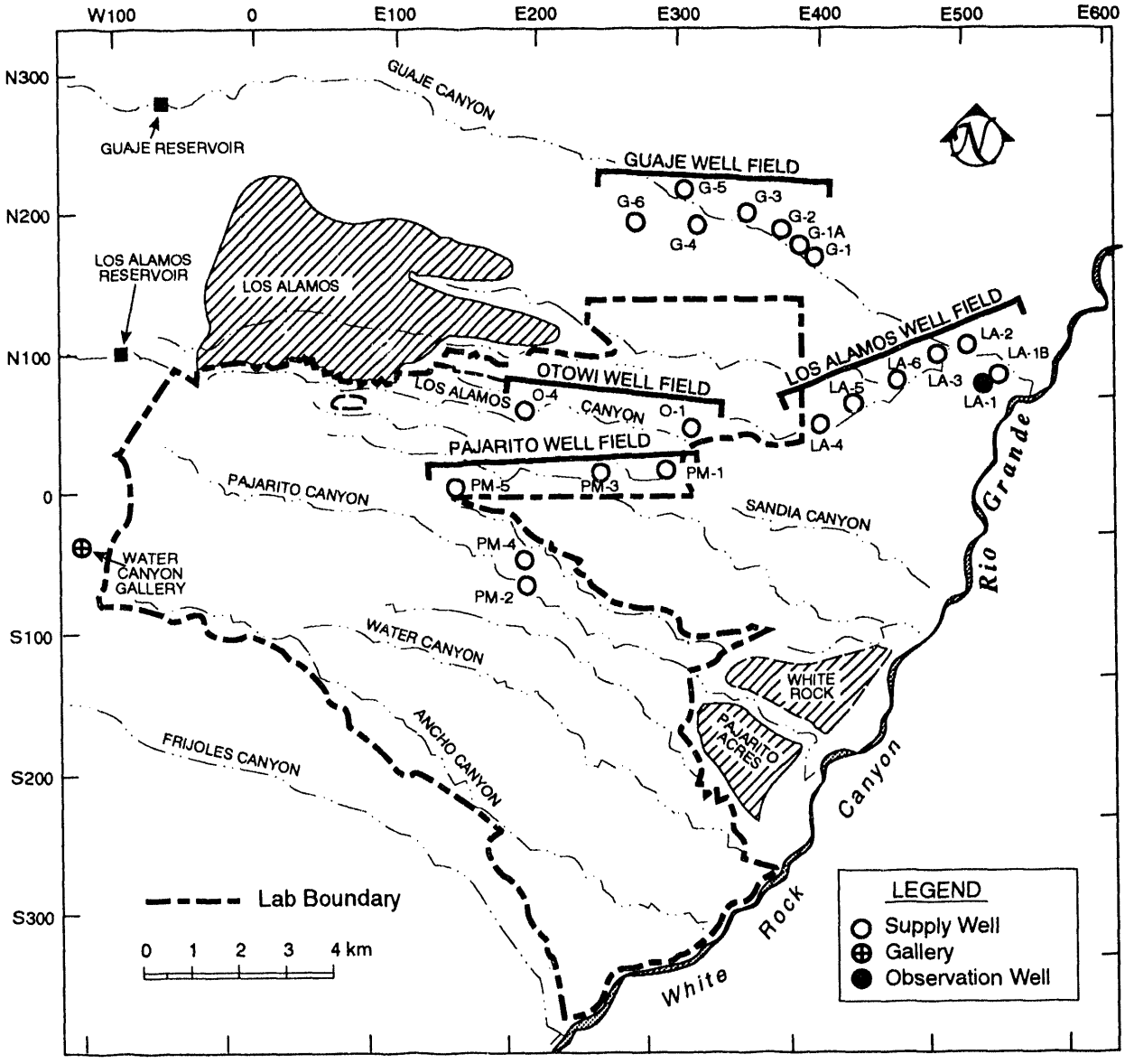

Fig. 1. Locations of reservoirs, well fields, water supply wells, and gallery water supply. Letter designations on the figure indicate wells in the Guaje (G), Pajarito (PM), Los Alamos (LA), and Otowi (O) Well Fields.

JCI, the support contractor to the Laboratory and the Department of Energy (DOE) at Los Alamos, maintains and operates the water supply system. Water from the system is sold to the County for the communities of Los Alamos and White Rock and to the National Park Service for water supply at Bandelier National Monument.

After the potable water is pumped from the wells into the distribution lines, it is lifted by booster pumps into reservoirs for storage and distribution to the Laboratory and the community. The entire water supply is disinfected before distribution to Los Alamos, White Rock, Bandelier National Monument, and Laboratory areas (Fig. 1). The nonpotable water for industrial use at TA-16 flows by gravity from the gallery in Water Canyon to the steam plant. Other nonpotable water, used for irrigation, flows by gravity from the reservoirs in Guaje and Los Alamos Canyons. The transmission lines for the nonpotable water are separate from the potable transmission lines and storage system.

JCI maintains a record of the hours of operation for each well along with records of daily and monthly water production. The monthly average of nonpumping and pumping water levels is computed from air line pressure or transducer data recorded at each well. These data are used in calculating the pumping rates, drawdown, and other well field statistics that are included in this report. The Appendix contains annual pumping and production information for each water supply well and the gallery for the period of record.

Water for the Laboratory, the communities of Los Alamos and White Rock, and Bandelier National Monument for 1991 was supplied from 15 deep wells in 3 well fields. The well fields are located on the Pajarito Plateau and in Los Alamos and Guaje Canyons east of the plateau (Fig. 1). The wells are completed in the main aquifer of the Los Alamos Area, the only aquifer capable of municipal and industrial water supply. The piezometric surface of the main aquifer ranges from 25 to 30 ft below ground level (semi-artesian) in the well field in lower Los Alamos Canyon to about 760 ft along the eastern edge of the plateau to more than 1,200 ft near the center of the plateau at Well PM-5. Water in the aquifer moves eastward beneath the plateau to the Rio Grande, where a part is discharged into the river through seeps and springs.[22]

The Water Canyon gallery, which is located west of the Laboratory on the flanks of the Sierra de los Valles, discharges water from a small aquifer perched in the volcanic rocks. Water from the two reservoirs is used for irrigation of non-Laboratory landscaping during the summer. The reservoirs are in canyons on the flanks of the mountains. Los Alamos Reservoir is located west, and the Guaje Reservoir, northwest of Los Alamos (Fig. 1). The source of water in the reservoirs is from springs, snowmelt, and summer run-off.

II. WELL FIELD CHARACTERISTICS

Production from the 3 well fields decreased 194×10^6 gallons from $1,642 \times 10^6$ gallons in 1990 to about $1,448 \times 10^6$ gallons in 1991 (Table 1). The months of heaviest production in 1991 were May, June, and July. The production during these months was 523×10^6 gallons, a decrease of 89×10^6 gallons for a similar period of heavy production in 1990. The months of lightest production were February, March, and November with a production of 260×10^6 gallons, a decrease of 16×10^6 gallons for a similar period in 1990.

Table 1. Production of Potable Water from Wells and Gallery, 1947–1991 (in Millions of Gallons)

Year	Los Alamos Field	Guaje Field	Pajarito Field	Water Canyon Gallery[a]	Production Total[b]
1947	147	0	0	84	231
1948	264	0	0	97	361
1949	302	0	0	92	394
1950	547	3	0	54	604
1951	702	68	0	39	809
1952	448	350	0	48	846
1953	444	372	0	39	855
1954	380	374	0	40	794
1955	407	375	0	33	815
1956	437	506	0	23	966
1957	350	378	0	40	768
1958	372	395	0	60	827
1959	391	478	0	54	923
1960	530	533	0	48	1,111
1961	546	624	0	54	1,224
1962	577	597	0	67	1,241
1963	539	654	0	51	1,244
1964	627	665	0	45	1,337
1965	447	571	99	72	1,189
1966	450	613	127	82	1,272
1967	373	464	481	56	1,374
1968	345	474	584	65	1,468
1969	331	435	569	80	1,415
1970	360	423	595	65	1,443
1971	412	484	657	37	1,590
1972	380	467	662	40	1,549
1973	406	475	685	49	1,615
1974	369	453	802	35	1,659
1975	356	431	749	42	1,578
1976	343	531	817	41	1,732
1977	345	515	614	57	1,531
1978	302	444	690	45	1,481
1979	289	456	662	44	1,451
1980	339	485	743	32	1,599
1981	336	469	701	45	1,551
1982	317	422	773	46	1,558
1983	221	338	904	38	1,501
1984	326	460	780	34	1,600
1985	290	456	841	37	1,624
1986	179	460	858	28	1,525
1987	217	485	892	34	1,628
1988	158	477	824	—[a]	1,459
1989	219	506	961	—[a]	1,686
1990	187	532	923	—[a]	1,642
1991	125	502	820	—[a]	1,448
Total	16,432	19,200	18,813	2,072	56,513

[a]Water Canyon Gallery no longer a potable water supply (see nonpotable production, Table 8).
[b]Production totals may not all equal the sum of the individual field totals due to rounding (see Table 3).

The difference in demand between periods of heavy and light production (i.e., summer and winter demands) is mainly because of water usage for lawn irrigation. The water levels in the wells respond accordingly, with the highest water levels observed during months of least production and the lowest water levels occurring during months of greatest production.

The production and use of water at the Laboratory and community increased from about 230×10^6 gallons in 1947 to $1,730 \times 10^6$ gallons in 1976. Water usage in 1977 declined to about $1,500 \times 10^6$ gallons and has varied from about $1,450 \times 10^6$ gallons in 1979 to about $1,628 \times 10^6$ gallons in 1987 (Fig. 2). The production in 1989 was about $1,700 \times 10^6$ gallons. The water production declined to $1,448 \times 10^6$ gallons in 1991.

The decline in 1977 and lower demand since then have been attributed largely to a rate increase for water used in the community and water-saving measures in the community and the Laboratory. Much of the landscaping in the community and Laboratory has been changed from lawns and shrubs, which require watering, to southwestern landscaping (native plants and gravels), which require little if any water other than normal rainfall.

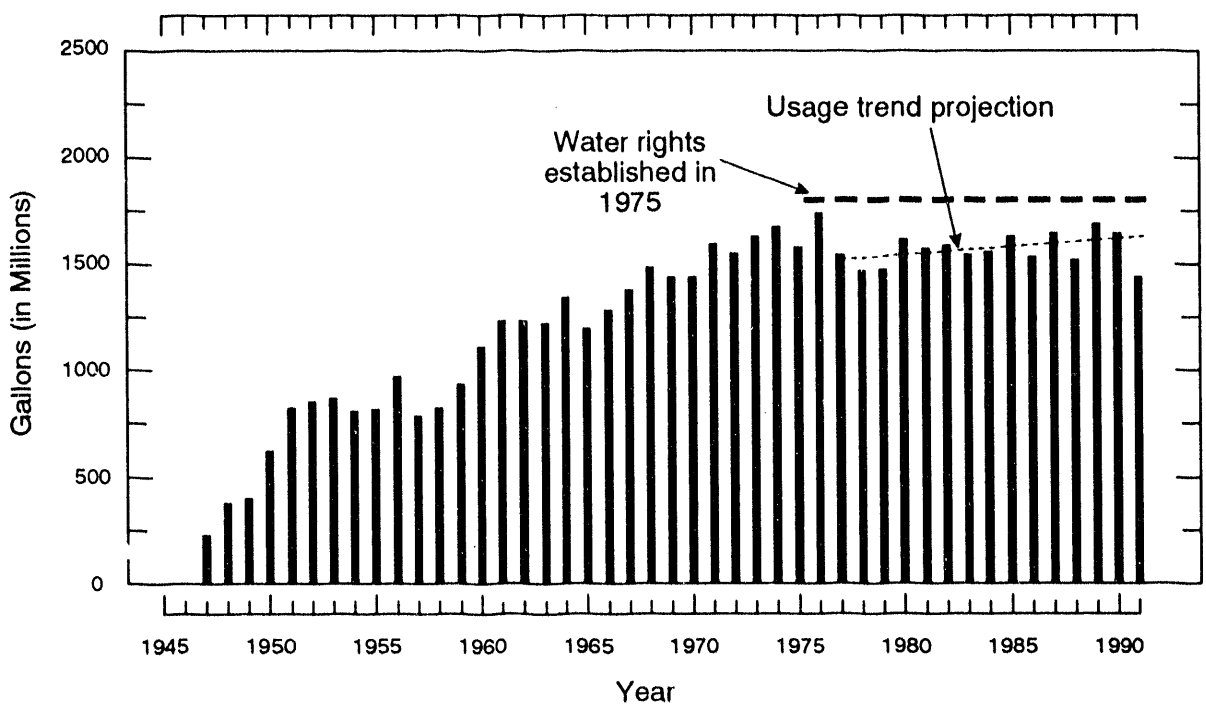

Fig. 2. Water production and usage from 1947 to 1991, and projected demands.

A projection of future water demand is shown in Fig. 2. This is an extrapolation of a least-squares line fitted to the actual data for 1977 through 1987 which had a rate of increase of about 10 million gallons a year or slightly more than one-half percent a year. Water usage in 1990 was only slightly greater than the 10-year trend while the 1991 water usage was less than the 10-year trend (Fig. 2). During the 10-year period analyzed for long range water supply planning, it was noted that Laboratory usage was almost constant at about 485 million gallons a year, with the least-squares trend declining by about 1.7 million gallons a year. The County usage showed a steady increase of about 13 million gallons a year or about 0.8% a year increase. About 60% of total annual water use occurs during the spring and summer quarters. The annual variation in water usage during that time, however, was not correlated in any statistically significant way with the amount of precipitation received during the year.

The peak demand period for 1991 was a 6-day period, June 24–June 29, when the total production was 45.8×10^6 gallons (Table 2), or about 7.6×10^6 gallons per day (gpd). This was the shortest peak demand period since 1982. The variation in water usage cannot be correlated with the amount of precipitation.

Although cumulative well field productions are nearly equal (Table 1), they do not reflect current proportionate contributions because production generally declines with the age of the well field. The wells in the Los Alamos Well Field were constructed in the period 1947 through 1960, with production peaking in 1951 and generally declining since that time (Fig. 3); wells in Guaje Well Field were constructed in the period 1950 through 1964, with production peaking in 1964 and declining since then. Wells in the Pajarito Well Field were constructed in the period 1966 through 1982, with peak production occurring in 1989.

The present yield generally reflects the age of the wells in the three fields. In 1991 about 56% of the total production came from the Pajarito Well Field, 34% from the Guaje Well Field, and 9% from the Los Alamos Well Field (Table 3).

A. Los Alamos Well Field

The Los Alamos Well Field includes six supply wells and one observation well. Three wells (LA-1, -2, and -3) were completed in 1947 to depths of about 870 ft. Because Well LA-1 produced water containing excessive sand which rapidly wore out the pumps, it was replaced by Well LA-1B in 1960. Well LA-1B was completed to a depth of 1,750 ft. During the period 1948 through 1950, Wells LA-4, -5, and -6 were completed to depths of about 2,000 ft.

Rehabilitation of LA-4 in 1986 resulted in separation of the casing which permitted excessive sand to enter the well. Because the sand could not be controlled, and since the age of the well prevented repair of the casing, it was necessary to take the well out of production. Well LA-6 was placed on standby in 1976, as the water contained excessive amounts of natural arsenic.[24]

With the declining production due to the age of the wells in the Los Alamos Well Field and the alignment and construction of the new state road through the section adjacent to the well field it was not economically feasible to renovate the distribution lines, booster station, and the wells. The 1991 production is the last year that the well field is to be used for municipal supply. One well (LA-2) is to be used to supply water to the contractor for road construction in 1992. The pumps, pump houses, and water lines were removed in 1990 from Wells LA-1, LA-4, and LA-6. During

Table 2. Peak Demand Periods 1982–1991

	Demand Period									
	June 23–July 11 1982	June 30–July 11 1983	June 8–June 18 1984	June 29–July 16 1985	July 28–August 10 1986	July 2–July 17 1987	June 18–June 26 1988	June 18–July 11 1989	May 31–July 3 1990	June 24–June 29 1991
No. of days	19	12	11	18	14	16	9	24	34	6
Total production (gal.)	145×10^6	91×10^6	81×10^6	138×10^6	91×10^6	134×10^6	63×10^6	216×10^6	297×10^6	45.8×10^6
Average daily production (gal.)	8.1×10^6	7.6×10^6	7.4×10^6	7.7×10^6	6.5×10^6	8.4×10^6	7.0×10^6	9.0×10^6	8.7×10^6	7.6×10^6
No. of days										
$>10 \times 10^6$ gal.	—	—	—	—	—	—	—	4	8	—
$>9 \times 10^6$ gal.	1	—	—	3	—	4	—	9	13	—
$>8 \times 10^6$ gal.	9	6	2	4	2	7	2	10	3	4
$>7 \times 10^6$ gal.	9	2	6	9	2	4	3	0	4	—
$<7 \times 10^6$ gal.	0	4	3	2	10	1	4	1	6	2

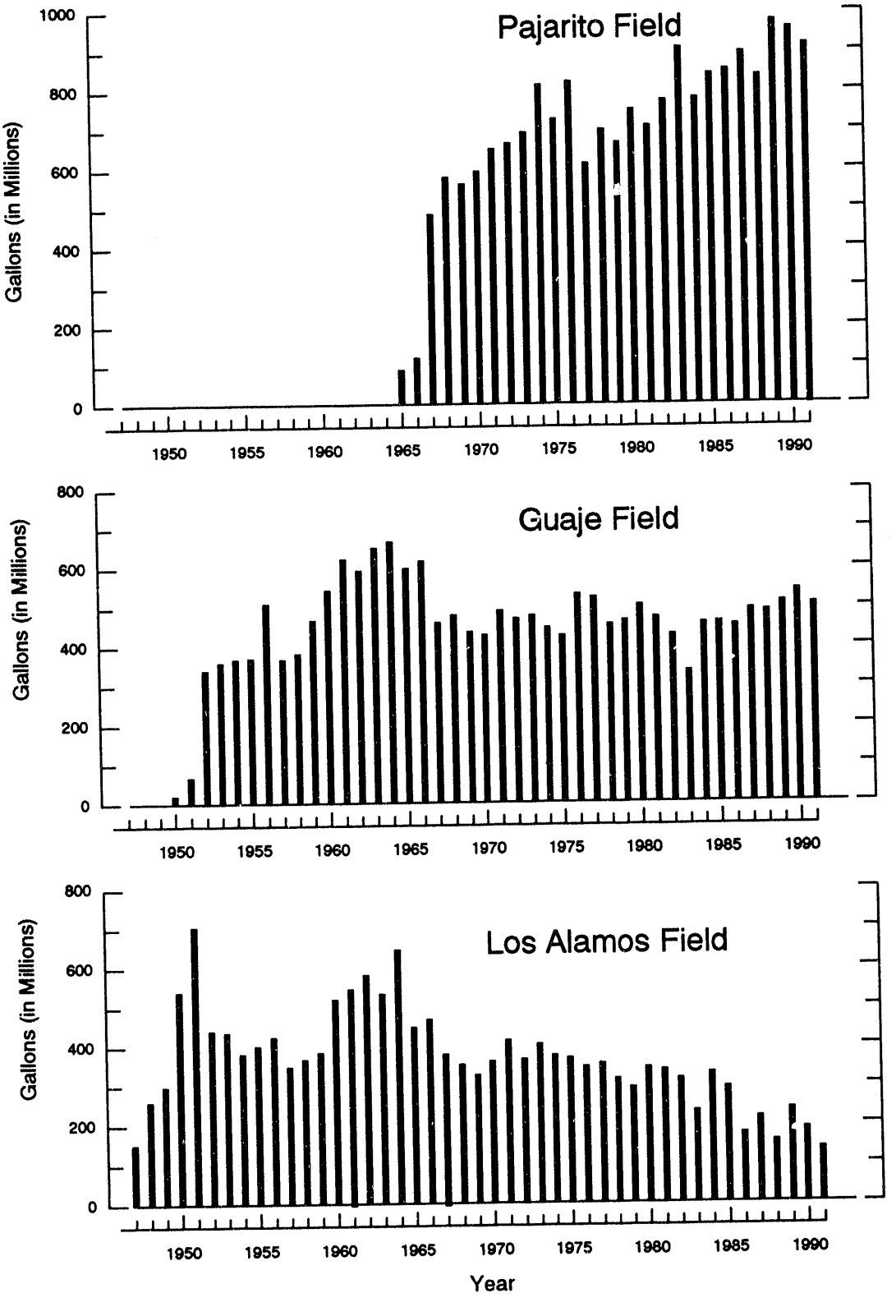

Fig. 3. Comparison of annual production from three well fields.

Table 3. Well Production Characteristics for 1990 and 1991

	Production					
	Amount (10^6 gal.)		Well Field (%)		Total Production (%)	
	1990	1991	1990	1991	1990	1991
Los Alamos Field						
Well LA-1	—	—	—	—	—	—
Well LA-1B	68.6	50.4	37	40	4	3
Well LA-2	40.3	32.7	21	26	2	2
Well LA-3	44.6	23.4	24	19	3	2
Well LA-4	—	—	—	—	—	—
Well LA-5	33.3	18.5	18	15	2	1
Well LA-6	—	—	—	—	—	—
Subtotal	186.8	125.0	100	100	11	9
Guaje Field						
Well G-1	30.8	20.9	6	4	2	1
Well G-1A	145.5	150.2	28	30	9	10
Well G-2	134.5	123.3	25	25	8	8
Well G-3	—	—	—	—	—	—
Well G-4	16.8	13.7	3	3	1	<1
Well G-5	119.2	113.0	22	22	7	8
Well G-6	84.9	81.2	16	16	5	6
Subtotal	531.7	502.3	100	100	32	34
Pajarito Field						
Well PM-1	88.2	88.6	10	11	6	6
Well PM-2	250.4	170.7	27	21	15	11
Well PM-3	244.6	229.5	26	28	15	16
Well PM-4	219.3	219.5	24	27	13	15
Well PM-5	121.0	112.1	13	13	7	8
Subtotal	923.5	820.4	100	100	56	56
Total Potable	1,642.0	1,447.7	—	—	99	99
Total Nonpotable	16.1	15.9	—	—	1	1
Water Canyon (Gallery)	9.3	12.0	—	—	—	—
Guaje Reservoir	2.2	1.5	—	—	—	—
Los Alamos Reservoir	4.6	2.4	—	—	—	—
Total Production from Permitted Sources	1,658.1	1,463.6	—	—	100	100

1991 the pump and well house were removed from Well LA-3 and the pump pulled from LA-5. The removal of the pump and well house of LA-1B is scheduled for early 1992. At the end of 1991 only Well LA-2 was in service.

With the removal of the field from service, the wells where possible will be used to monitor and evaluate the water level fluctuations resulting from the cessation of pumpage from the field. The production during 1991 was from Wells LA-1B, LA-2, LA-3, and LA-5. The production decreased about 62 x 10^6 gallons from 187 x 10^6 gallons in 1990 to 125 x 10^6 gallons in 1991 (Table 3). The well field contributed about 9% of the total 1991 production.

The average pumping rates in 1991 ranged from 278 to 565 gallons per minute (gpm). The combined pumping rate of the field increased slightly from 1,534 gpm in 1990 to 1,557 gpm in 1991 (Table 4). The specific capacities of the wells in use in 1991 were similar to the specific capacities of those in use in 1990.

The water levels in the individual wells fluctuate with the amount of production (Fig. 4). The average water levels were slightly higher in 1991 than those levels of 1990 (Table 5). The total production from wells in the Los Alamos Well Field from 1947 through 1991 was 16,432 x 10^6 gallons. Through 1991 the well field produced 29% of the total amount of municipal and industrial water used at Los Alamos from 1947 through 1991. The production from the 7 wells in the field ranged from 154 x 10^6 gallons from well LA-1 to 3,778 x 10^6 gallons from LA-4. The production of well LA-4 represents 23% of the total production from the well field (Table 6).

The annual well field production increased from 147 x 10^6 gallons to 702 x 10^6 gallons in 1951 when the Guaje Well Field was added to the system (Fig. 2 and Table 1). The average water level in the field declined about 83 ft from 38 ft in 1947 to 121 ft in 1951 (Table 6).

From 1952 to 1964 the production was high varying from 350 x 10^6 gallons in 1957 to 627 x 10^6 gallons in 1964. The first well of the Pajarito Well Field was added to the system in 1964. The average water level in the field declined about 25 ft from 121 ft in 1951 to 146 ft in 1964. Since 1965 the production from the field has varied slightly but has generally declined (Fig. 3 and Table 1). As a result of the reduced pumpage, the water level in the field has recovered. The average water level has recovered about 32 ft from 146 ft in 1964 to 114 ft in 1991. The aquifer in the well field has produced 16,432 x 10^6 gallons from 1947 through 1991. The yield has been 144 x 10^6 gallons per ft of water level decline (Table 6).

With end of production from the field there should be a general water recovery in the field. As long as it is possible, annual water levels should be measured to evaluate the long term effect of pumpage on the aquifer.

B. Guaje Well Field

The Guaje Well Field includes seven wells ranging in depths from 1,500 to 2,000 ft. Wells G-1, -2, -3, -4, and -5 were completed in 1950. Well G-1A was completed in 1954, and Well G-6 was placed in service in 1964.

The 1991 production came from six of these wells. Attempted rehabilitation of Well G-3 in 1986 damaged the casing beyond repair and the well was taken out of production. The damage caused large amounts of sand to enter the well.

Table 4. Average Pumping Rate and Specific Capacity, 1990 and 1991

	Average Pumping Rate (gpm)		Average Specific Capacity (gpm/ft of drawdown)	
	1990	1991	1990	1991
Los Alamos Field				
Well LA-1	—	—	—	—
Well LA-1B	552	565	4.4	4.5
Well LA-2	280	320	1.4	1.5
Well LA-3	302	278	1.8	1.6
Well LA-4	—	—	—	
Well LA-5	400	394	—	—
Well LA-6	—	—	—	—
Subtotal	1,534	1,557	—	—
Guaje Field				
Well G-1	242	201	1.4	1.2
Well G-1A	499	489	12.5	13.6
Well G-2	443	428	13.4	13.4
Well G-3	—	—	—	—
Well G-4	182	181	1.0	1.0
Well G-5	390	378	9.5	8.0
Well G-6	272	267	3.4	3.2
Subtotal	2,028	1,944	—	—
Pajarito Field				
Well PM-1	561	568	28.0	25.8
Well PM-2	1,319	1,329	19.4	21.1
Well PM-3	1,382	1,385	60.0	60.2
Well PM-4	1,293	1,292	32.3	30.8
Well PM-5	1,252	1,248	11.1	11.7
Subtotal	5,807	5,822	—	—
Total	9,369	9,323		

The production from the Guaje Well Field decreased about 30×10^6 gallons from 532×10^6 gallons in 1990 to 502×10^6 gallons in 1991. The well field contributed about 34% of the total production in 1991 (Table 3).

The average pumping rate of the 6 wells ranged from 181 to 489 gpm (Table 4). The combined pumping rate declined about 84 gpm from 2,028 gpm in 1990 to 1,944 gpm in 1991. There was no significant change in the specific capacities of the wells from 1990 to 1991 (Table 4).

The average nonpumping water levels 1991 in the well field remained about the same when compared to the 1990 water levels (Table 5). Increased or decreased pumpage in individual wells during the year resulted in slight declines or increases in water levels in that particular well. These water changes are normal and not considered significant (Fig. 5).

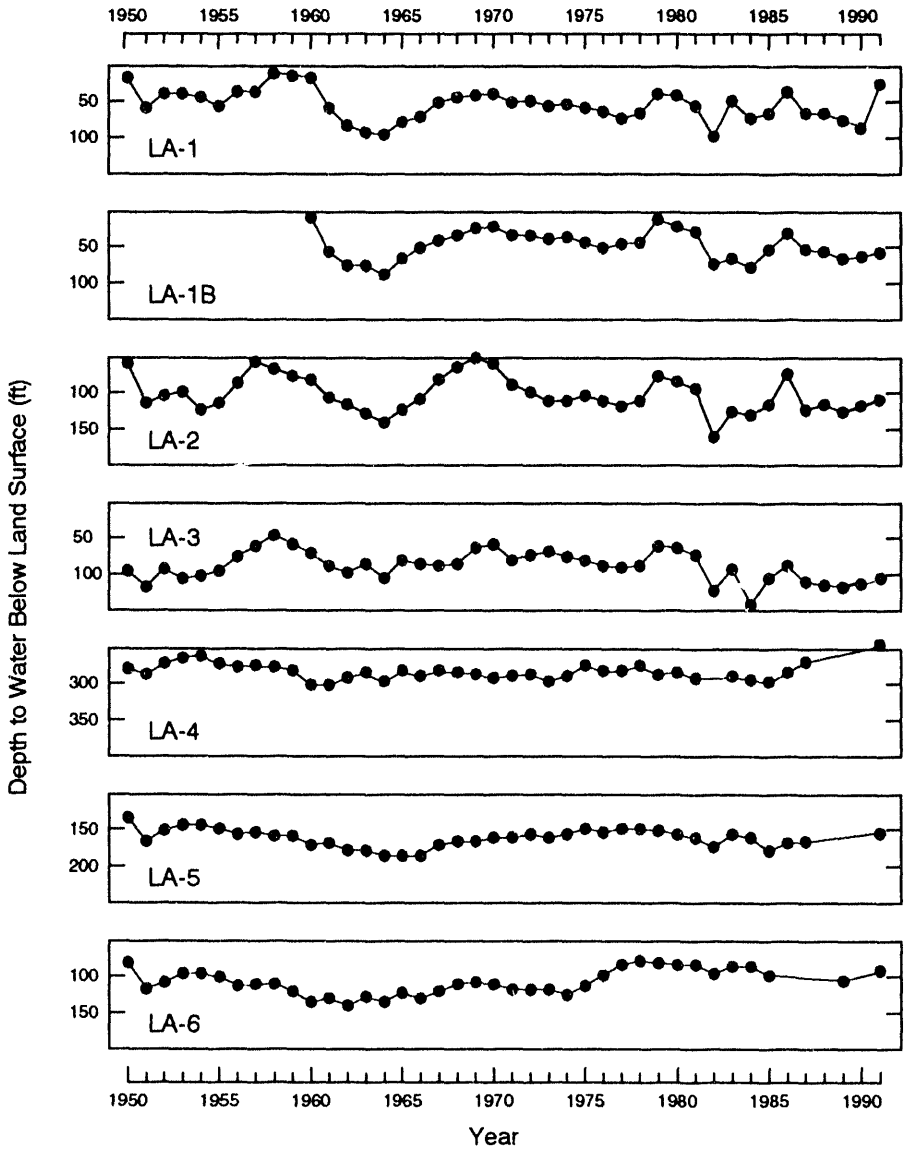

Fig. 4. Nonpumping water levels in wells in the Los Alamos Well Field. (1991 water levels measured by steel tape.)

A comparison of the average annual water levels in the well field at completion (342 ft) with the 1991 levels (398 ft) indicates water level decline has been about 56 ft (Table 7). Well field production for that period has been 19,200 × 10^6 gallons. Thus the aquifer has yielded 343 × 10^6 gallons per ft of water level decline.

It should be noted here that the annual nonpumping and pumping water levels in well G-2 were corrected for the years 1988 through 1990. These corrections do not affect the average drawdown or the specific capacities of the wells as the problem was that the incorrect length of air line was used to compute the nonpumping and pumping water levels. There have been no water levels

Table 5. Average Water Levels for Nonpumping and Pumping Wells and Average Drawdown, 1990 and 1991

	Average Water Levels				Average Drawdown (ft)	
	Nonpumping (ft)		Pumping (ft)			
	1990	1991	1990	1991	1990	1991
Los Alamos Field						
Well LA-1	—	—	—	—	—	—
Well LA-1B	70	55	196	180	126	125
Well LA-2	134	123	330	333	196	210
Well LA-3	122	112	295	284	173	172
Well LA-4	—	—	—	—	—	—
Well LA-5	—	—	—	—	—	—
Well LA-6	—	—	—	—	—	—
Average per field	108	97	—	—	—	—
Guaje Field						
Well G-1	284	282	454	451	170	169
Well G-1A	322	325	362	361	40	36
Well G-2	374	369	407	401	33	32
Well G-3	—	—	—	—	—	—
Well G-4	381	382	564	559	183	177
Well G-5	485	487	526	534	41	47
Well G-6	589	591	670	674	81	83
Average per field	406	406	—	—	—	—
Pajarito Field						
Well PM-1	752	752	772	774	20	22
Well PM-2	860	855	928	918	68	63
Well PM-3	767	768	790	791	23	23
Well PM-4	1,083	1,081	1,123	1,123	40	42
Well PM-5	1,234	1,239	1,347	1,346	113	107
Average per field	939	939	—	—	—	—

reported from well G-3 from 1987 through 1991. The well is not in use and water level measuring equipment has not been in operation. The transducer in well G-5 has not operated properly, and no water level data were collected from June through December 1991.

C. Pajarito Well Field

The Pajarito Well Field includes five wells. The wells were completed over a 17-year period, from 1965 through 1982, and range in depths from 2,300 to 3,100 ft. Because they are located on the Pajarito Plateau, the depths to water range from about 750 ft at Well PM-1 to more than 1,200 ft at Well PM-5.

Table 6. Production and Water Levels in the Los Alamos Well Field

	Production $\times 10^6$ gal.	Percent Total Production	Annual Average Water Levels (Nonpumping) Completion	1951	1964	1991
LA-1	154	<1	0[a]	59	95	10[b]
LA-1B	2,586	16	0[a]	0	81	55[b]
LA-2	1,663	10	0[a]	111	137	123[b]
LA-3	1,955	12	0[a]	116	104	112[b]
LA-4	3,778	23	189	285	291	244[b]
LA-5	3,606	21	71	162	184	158[b]
LA-6	2,890	18	3	115	132	96[b]
Total	16,432	100	38 (Av)	121 (Av)	146 (Av)	114 (Av)

[a]Flowing when completed.
[b]Measured by steel tape.

The production from the Pajarito Well Field in 1991 was about 820 $\times 10^6$ gallons, a decrease of 103 $\times 10^6$ gallons from the 923 $\times 10^6$ gallons produced in 1990 (Table 3). The field contributed about 56% of the total 1991 production. The production from Wells PM-2, -3, and -4 represented about 42% of the total water produced at Los Alamos in 1991 (Table 3).

The average pumping rates of the Pajarito wells ranged from 568 to 1,385 gpm (Table 4). Four of the wells (PM-2, -3, -4, and -5) are high-yield wells with pumping rates over 1,000 gpm (Table 4). The pumping rates from the individual wells varied slightly from 1990 to 1991 with a slight increase of the combined rate of about 15 gpm from 5,807 gpm in 1990 to 5,822 gpm in 1991.

The specific capacities of the wells in 1991 ranged from 11.7 to 60.2 gpm/ft of drawdown. There was no significant change in the specific capacities of the wells from 1990 through 1991 though there was some variation in the specific capacities of individual wells (Table 4).

The water levels in these wells fluctuated as would be expected from the amount of pumpage (Fig. 6). The average nonpumping water levels in the field remained about the same in 1991 compared to the 1990 average water levels (Table 5).

A comparison of the average annual water levels in the well field upon completion (915 ft) with the 1991 levels (939 ft) indicates the total water level decline has been about 24 ft (Table 7). Well field production for that period has been 18,813 $\times 10^6$ gallons. The aquifer has yielded 784 $\times 10^6$ gallons per ft of water level decline.

D. Otowi Well Field

The Otowi Well Field consists of two wells that were completed in 1990. Otowi 1 was completed at a depth of 2,497 with a static water level of the main aquifer at a depth of about 695 ft. Otowi Well 4 was completed at a depth of 2,585 ft with a static water level at 790 ft.

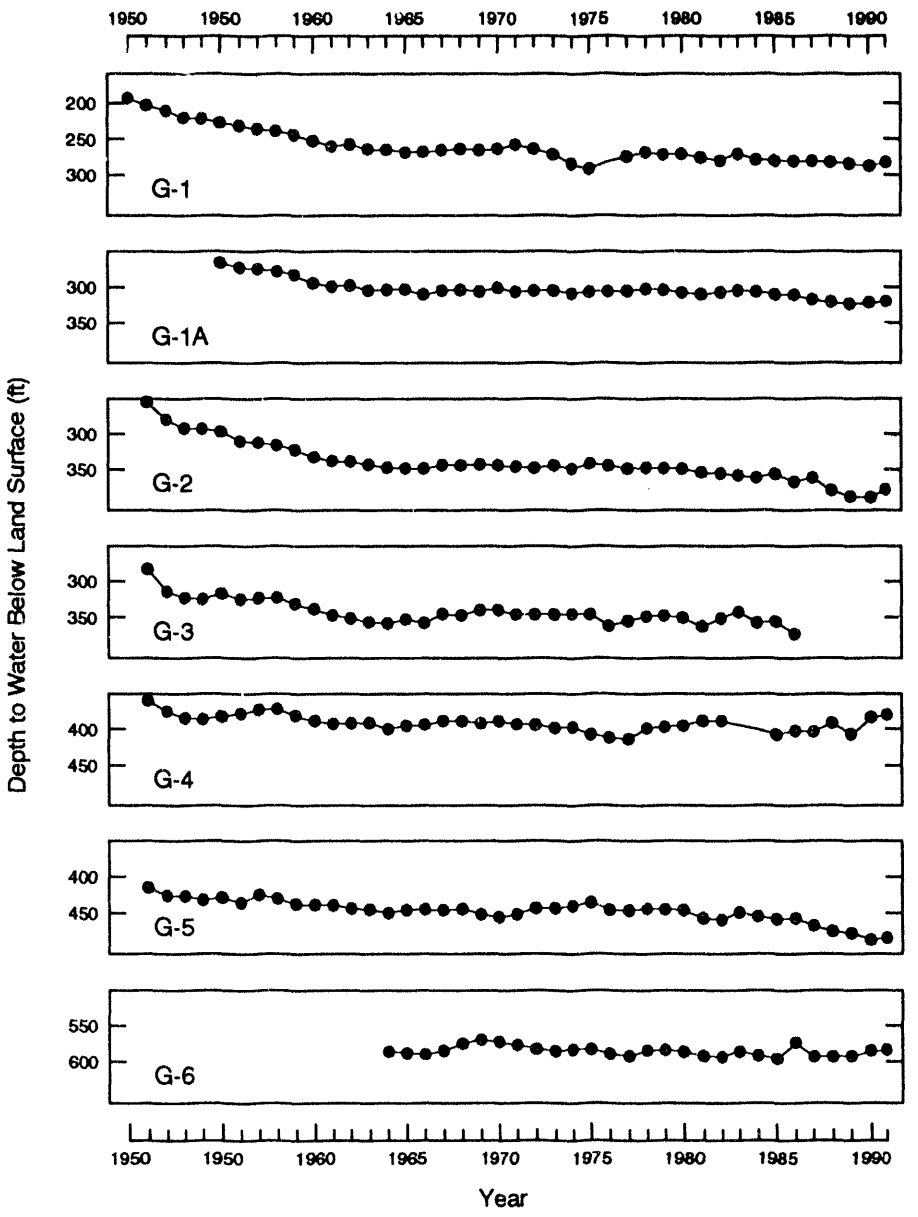

Fig. 5. Nonpumping water levels in wells in the Guaje Well Field.

At the end of 1991 neither of the wells was equipped with pumps, well houses, transmission lines, and storage tanks. It is anticipated that Otowi 4 will become operational in the latter part of 1992.

III. WATER CANYON GALLERY, GUAJE, AND LOS ALAMOS RESERVOIRS

The nonpotable water from the gallery in Water Canyon, Guaje Reservoir, and Los Alamos Reservoir is used for industrial water supply (boiler makeup) or irrigation. Water Canyon Gallery

Table 7. A Comparison of Annual Average Water Levels in Supply Wells at Completion and 1991

	Annual Average Water Level (ft)	
	Completion	1991
Guaje Field		
G-1	192 (51)	282
G-1A	265 (55)	325
G-2	279 (52)	369
G-3	310 (52)	347
G-4	357 (52)	382
G-5	417 (52)	487
G-6	576 (64)	591
Average	342	398
Pajarito Field		
PM-1	746 (65)	752
PM-2	826 (66)	855
PM-3	743 (68)	768
PM-4	1,050 (82)	1,081
PM-5	1,208 (82)	1,239
Average	915	939
Otowi Field		
O-1	695 (90)	—
O-2	790 (90)	—

was a source of potable water from the early days of the Manhattan Project until 1989 (Table 1). Rapid recharge to the gallery caused heavy sediment loads to enter the potable system. In 1989, to keep the sediments out of the potable system, the gallery was disconnected from the potable system and used only to supply make up water to the TA-16 steam plant (Table 8).

Water from Guaje and Los Alamos Reservoirs was used for municipal and industrial water supply at Los Alamos during the early days of the Manhattan Project. Use of the reservoirs for potable water supply was discontinued in 1959 because of intermittent periods of turbidity caused by storm run-off and because of difficulties in maintaining bacteriological levels below limits allowed for a municipal supply.

Both of the reservoirs and adjacent areas are now open for recreational use. The water from the reservoirs is available for irrigation of lawns and shrubs in the community and Laboratory. Parts of the water lines are above ground and are subject to freezing; thus, water use from the reservoirs is limited to the period from late spring to early fall.

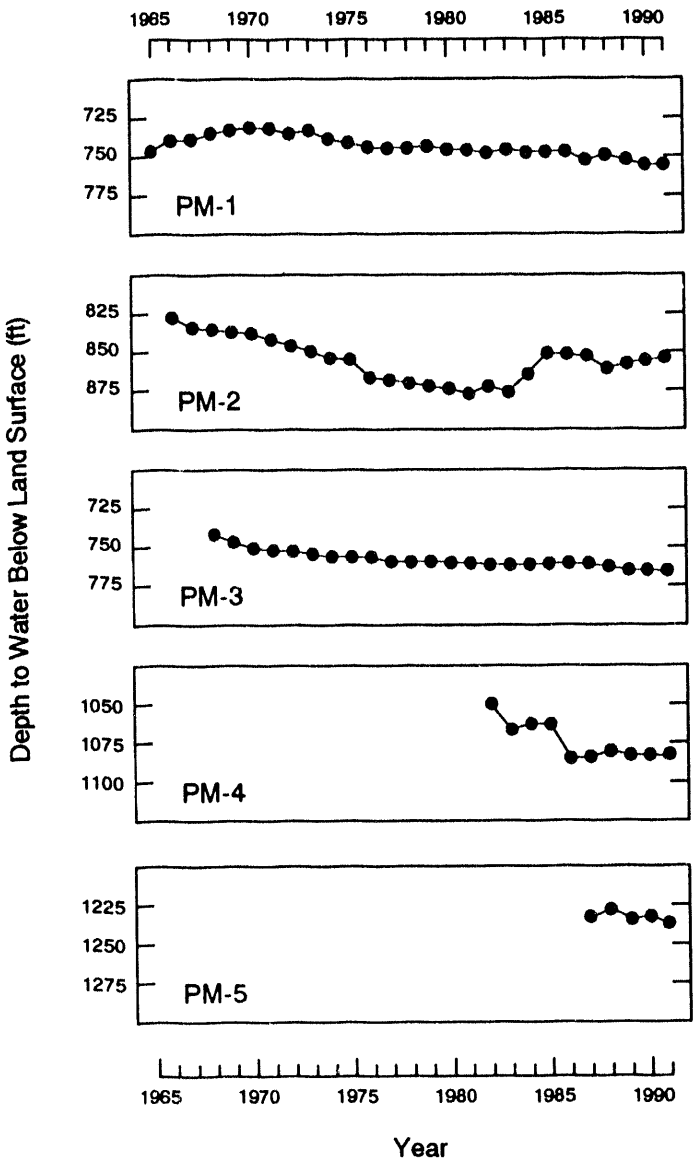

Fig. 6. Nonpumping water levels in wells in the Pajarito Well Field.

A. Water Canyon Gallery

The spring gallery in Water Canyon is dug horizontally about 30 ft into the Bandelier Tuff. The gallery or tunnel is framed with timbers and sheet metal to keep the walls and overhead from collapsing. The floor of the gallery is constructed to form a basin to collect the spring flow. About one mile of water line connects the gallery to the steam plant at TA-16 (S-Site).

The water occurs in the fractures of a welded tuff, which is underlain by a non-welded tuff. The recharge to the perched aquifer is rapid. In the spring when snowmelt occurs, the discharge from the gallery increases and causes increased suspended sediment in the water. Since 1989 the water

has been used for industrial purposes only, make up water to the steam plant at TA-16. The gallery furnished about 12 × 10^6 gallons of water to the steam plant during 1991 (Table 8).

The total discharge from the gallery was not utilized at the steam plant. The excess discharge was released to the environment. The annual potable use during the period of record (1947–1988) is shown in the Appendix.

B. Guaje Reservoir

Guaje Reservoir in upper Guaje Canyon has a capacity of 0.25 × 10^6 gallons and has a drainage area of 5.6 sq miles. The reservoir is for diversion rather than storage as perennial flow is maintained by springs in the canyon above the reservoir.

Water flows by gravity through 6.8 miles of water line for irrigation of lawns and shrubs at Los Alamos Middle School and Guaje Pines Cemetery. The line from the reservoir is not a part of, nor is it connected to the distribution system for municipal supply.

The annual production from Guaje Reservoir, when it was used for municipal water supply from 1947 through 1958, ranged from an estimated 24 × 10^6 gallons to 213 × 10^6 gallons (Table 8). There is no record of the amounts of water used for irrigation from 1959 through 1971. Since 1972 the amount of water used for irrigation has ranged from 1.5 × 10^6 gallons to 9.7 × 10^6 gallons. The amount used in 1991 was 1.5 × 10^6 gallons, down from 2.2 × 10^6 gallons used in 1990.

C. Los Alamos Reservoir

Los Alamos Reservoir in upper Los Alamos Canyon has a capacity of 13.4 × 10^6 gallons and has a drainage area of 6.4 sq miles. The water flows by gravity through about 2.6 miles of distribution lines for irrigation of lawns and shrubs at the Laboratory's Health Research Building, the Los Alamos High School, and Mesa School. The line from the reservoir is not a part of, nor is it connected to, the distribution system for the municipal water supply.

The annual production from the Los Alamos Reservoir, when it was used for the municipal water supply from 1947 through 1958, ranged from 4.8 × 10^6 gallons to 54.8 × 10^6 gallons (Table 8). There is no record of water usage from the reservoir from 1959 through 1978, but since 1978 the amount of water used for irrigation has ranged from 0.9 × 10^6 gallons to 4.6 × 10^6 gallons. The amount of water from the reservoir used for irrigation in 1991 was 2.4 × 10^6 gallons, down from the 4.6 × 10^6 gallons used in 1990.

IV. QUALITY OF WATER

The Laboratory conducts two separate programs to monitor the quality of groundwater in the area and to meet regulatory requirements. The first program, under the Laboratory's long-term environmental surveillance program, includes monitoring the quality of water from the supply wells, the gallery in Water Canyon, and reservoirs in Guaje and Los Alamos Canyons. The results of this program are documented in detail in the annual surveillance report for 1990, (Section VI.A.5.)[25] and for 1991 (Section VII.C).[26]

The second program monitors the quality of water in the Laboratory and County distribution systems to ensure compliance with the Safe Drinking Water Act (SDWA). During 1991, all water

Table 8. Production from Water Canyon Gallery and Guaje and Los Alamos Reservoirs[a]

Year	Water Canyon Gallery (10^6 gal.)	Guaje Reservoir[b] (10^6 gal.)	Los Alamos Reservoir (10^6 gal.)
Municipal Water-Supply Production			
1947		87.8	21.7
1948		119.8	21.9
1949		116.1	14.7
1950		79.9	20.6
1951		41.0	10.5
1952		131.0	33.6
1953		58.0	14.8
1954		66.0	16.9
1955		71.0	18.1
1956		24.0	4.8
1957		213.0	54.8
1958		193.0	49.4
Non-Potable Production			
1972		5.8	—
1973		9.7	—
1974		4.9	—
1975		5.3	—
1976		4.4	—
1977		4.1	—
1978		2.8	—
1979		3.7	1.3
1980		4.7	2.3
1981		2.7	2.1
1982		3.4	2.8
1983		3.4	1.4
1984		3.0	1.3
1985		2.8	0.9
1986		2.4	1.5
1987		2.8	3.2
1988		2.4	1.4
1989		4.6	3.3
1990	9.3	2.2	4.6
1991	12.0	1.5	2.4

[a]Guaje and Los Alamos Reservoir municipal supply 1947–1959; irrigation 1972–1990; Water Canyon (Gallery) municipal supply 1947–1989; industrial supply 1990–1991 (see Table 1 and Appendix).

[b]Production from Guaje Reservoir for 1951–1958 is estimated.

samples collected under the SDWA program at Los Alamos were in compliance with the regulations.[26]

A. Environmental Surveillance Program

The environmental surveillance program monitors the radiochemical and chemical quality of the water supplied for both potable and non-potable use. The water is collected at the well heads after a period of pumping. Water from the gallery is collected at the micro strainer station prior to treatment, and surface water is collected from the reservoirs. Quality of water from a well depends on the depth of the well, lithology of the aquifer and varying portions of yield from individual beds within the aquifer. The quality of water (concentrations of minerals) from the individual wells varies because of local conditions within the same aquifer (Figs. 7, 8, 9, and 10). The quality of water from Water Canyon Gallery and the Guaje and Los Alamos Reservoirs reflects surface or

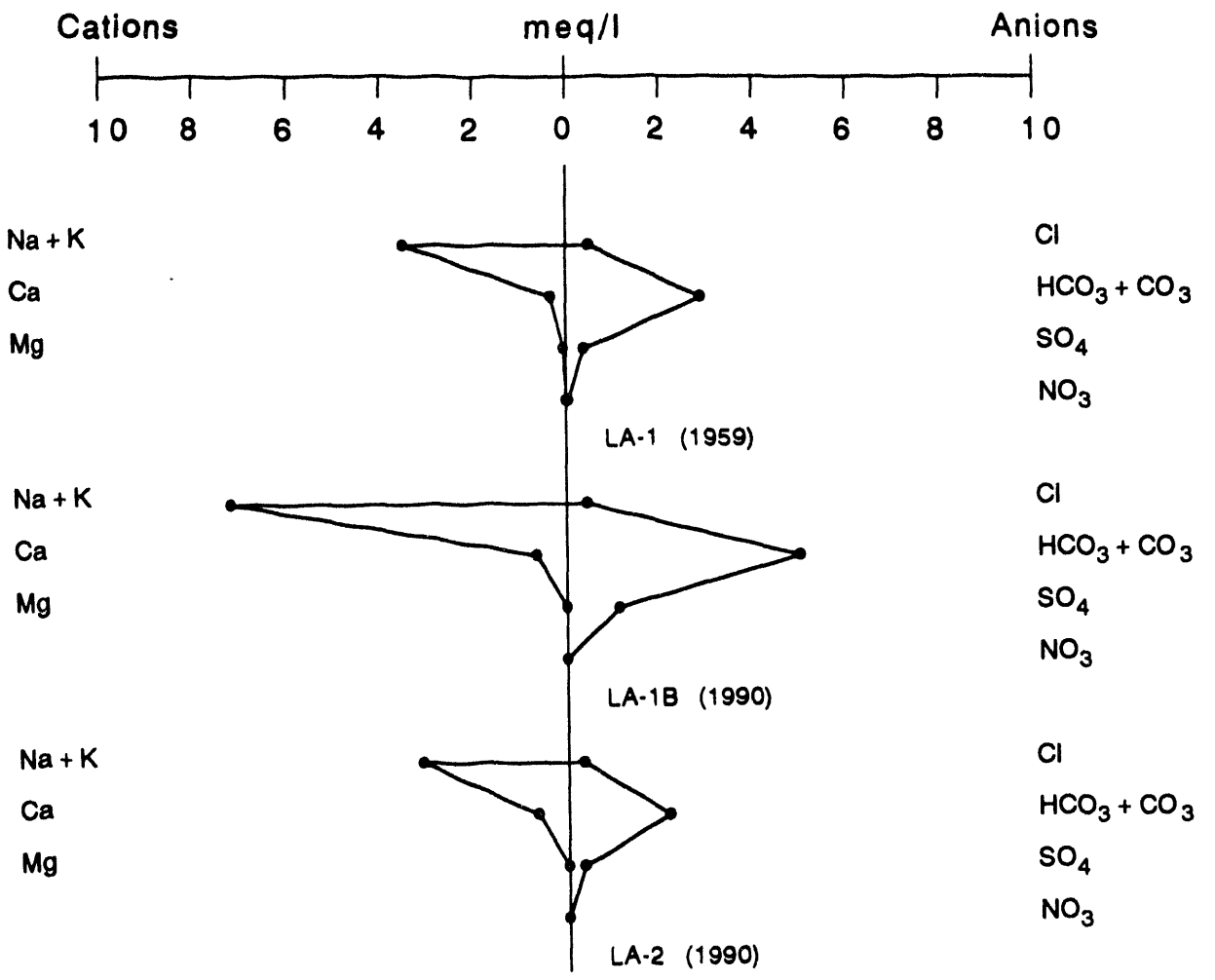

Fig. 7. Diagram representing water quality from wells in the Los Alamos Well Field.

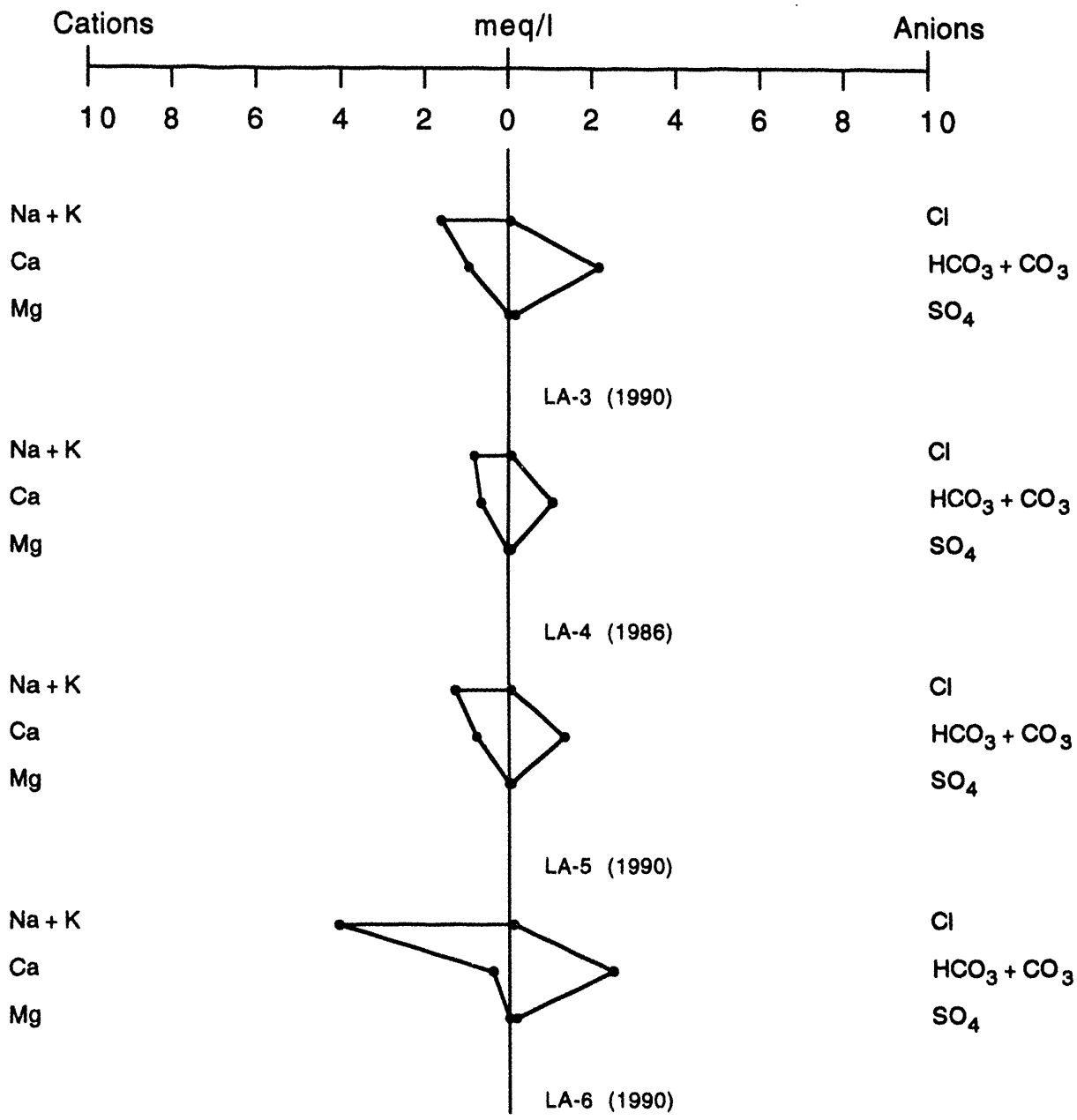
Cations
meq/l
Anions
10 8 6 4 2 0 2 4 6 8 10
Na + K
Ca
Mg
Cl
HCO3 + CO3
SO4
LA-3 (1990)
Na + K
Ca
Mg
Cl
HCO3 + CO3
SO4
LA-4 (1986)
Na + K
Ca
Mg
Cl
HCO3 + CO3
SO4
LA-5 (1990)
Na + K
Ca
Mg
Cl
HCO3 + CO3
SO4
LA-6 (1990)

Fig. 7. Cont.

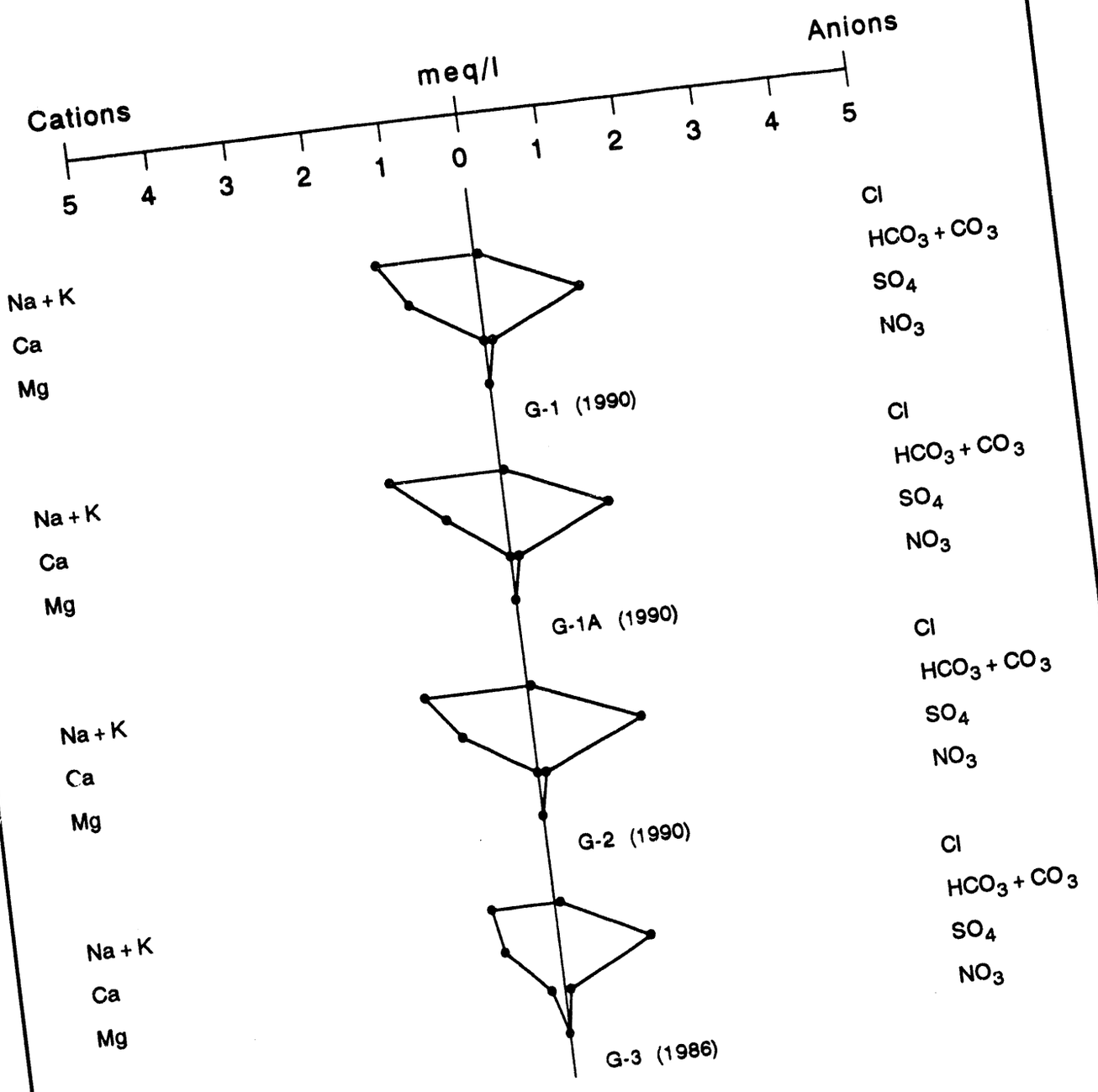

Fig. 8. Diagram representing water quality from wells in the Guaje Well Field.

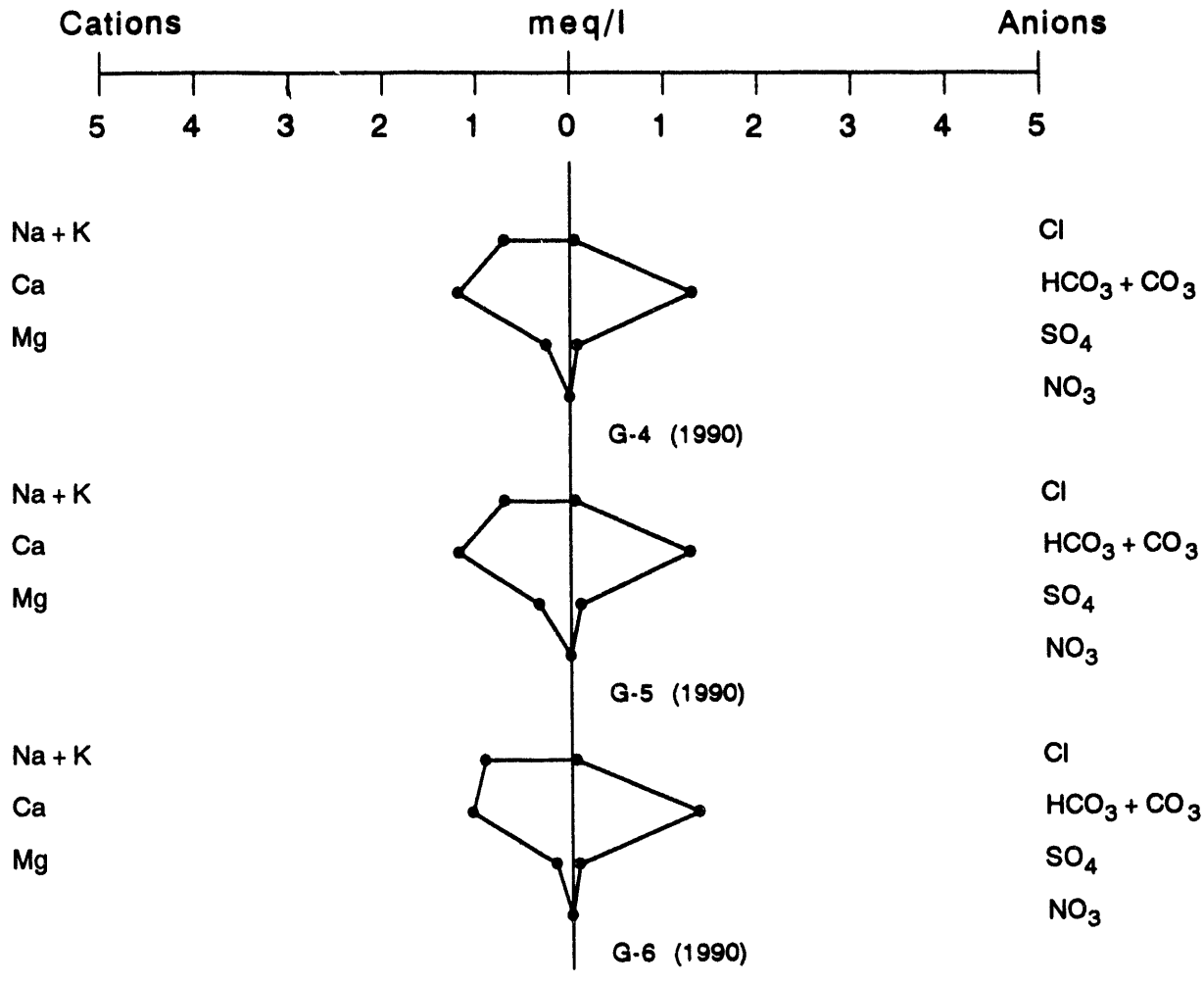

Fig. 8. Cont.

near surface water quality of low mineral contents (Fig. 11). Detailed chemical quality of water for the supply wells, Water Canyon Gallery, and Guaje and Los Alamos Reservoirs is presented in Tables 9 and 10 while the radiochemical quality is found on Table 11.

1. Supply Wells. The predominant chemical constituents in water from the Los Alamos Well Field are of the sodium-bicarbonate type (Fig. 7). The water from the well field is soft with total hardness concentrations (as calcium carbonate) ranging from 22 to 50 mg/L (hardness concentrations classification: 1 to 60 mg/L soft; 61 to 120 mg/L moderately hard; 121 to 180 mg/L hard; and >180 mg/L very hard). The total dissolved solids (TDS) concentrations ranged from 72 to 388 mg/L.

Water from wells in the upper part of the Guaje Well Field, G-4, G-5 and G-6, is a calcium bicarbonate type changing downgradient to a sodium bicarbonate water in the lower part of the

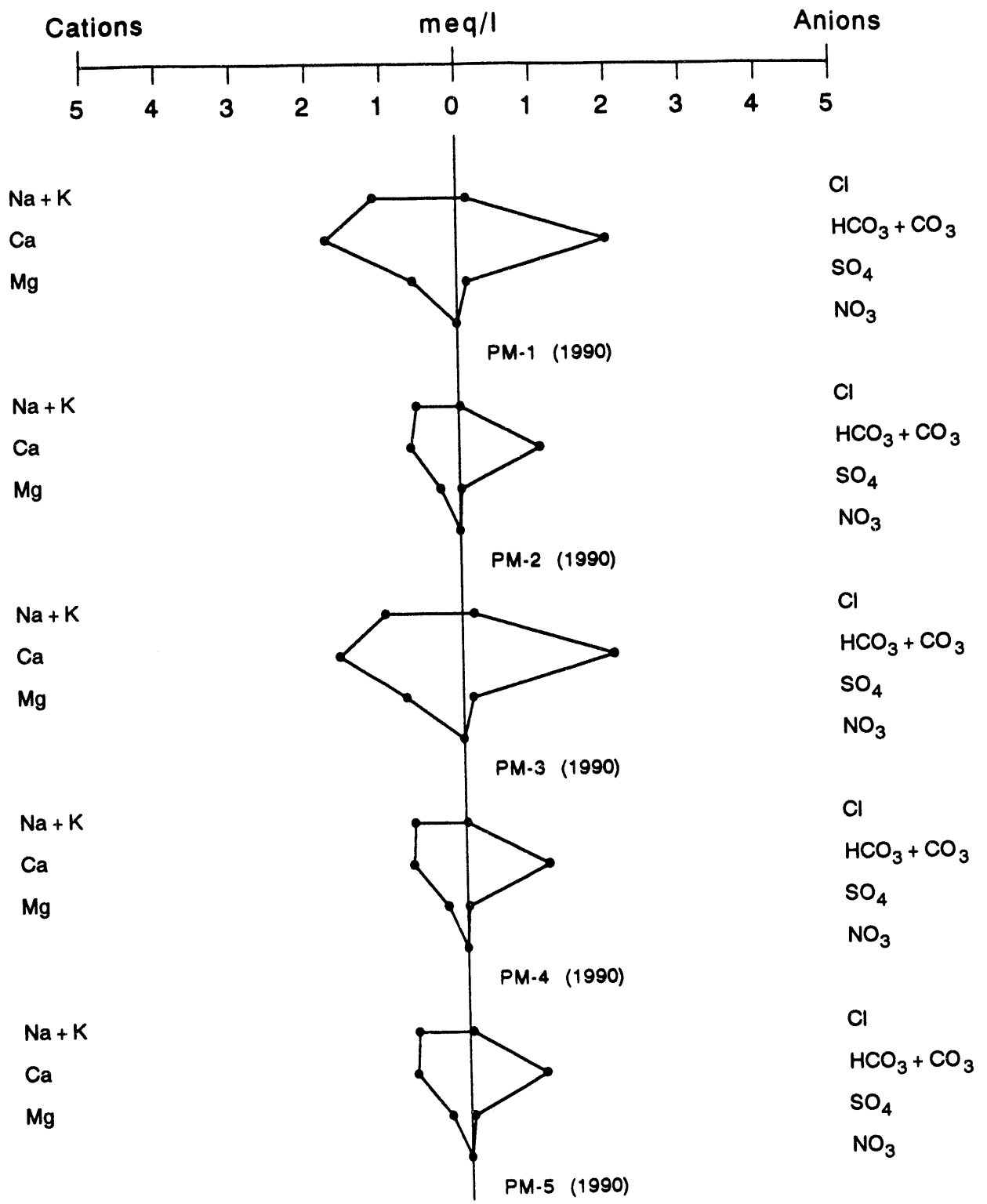

Fig. 9. Diagram representing water quality from wells in the Pajarito Well Field.

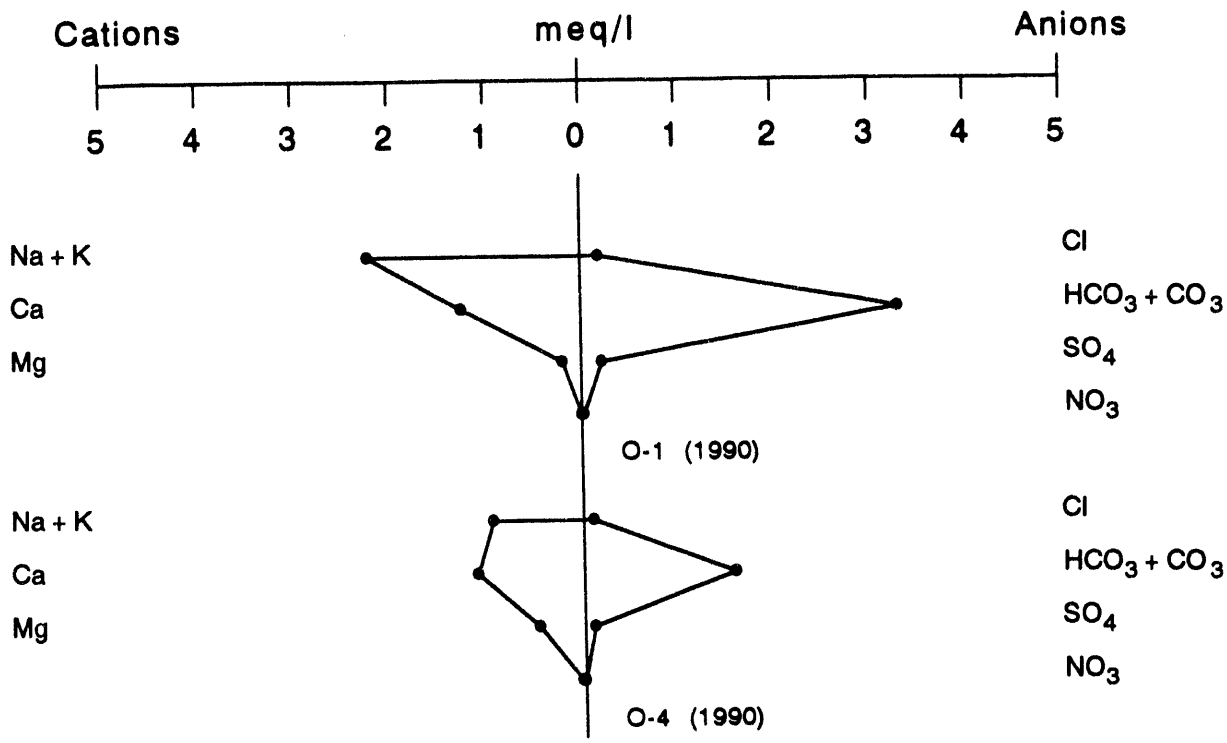

Fig. 10. Diagram representing water quality from wells in the Otowi Well Field.

field, G-1, G-1A, G-2, and G-3 (Fig. 8). The transition from one type of water to another type in the field is probably because the basalts in the upper part of the field yield more that than those in the lower part of the field. The water from the field ranges from soft to moderately hard with hardness ranging from 41 to 76 mg/L. The TDS range from 96 to 246 mg/L.

Water from Pajarito Wells PM-1 and PM-3 is of the calcium bicarbonate type (Fig. 9). The water is hard, with a hardness of about 118 mg/L and 123 mg/L respectively. The general chemical quality is quite similar with TDS of 150 and 186 mg/L respectively.

The water from Pajarito Wells PM-2, PM-4, and PM-5 is a sodium bicarbonate type water (Fig. 9). The water is soft with hardness ranging from 46 to 52 mg/L and a TDS range from 78 to 140 mg/L.

The waters from the two new wells in the Otowi Well Field are different from each other. The water from Otowi Well 1 is a sodium bicarbonate type. The water is moderately hard with total hardness of 71 mg/L and a TDS of 198 mg/L (Fig. 10).

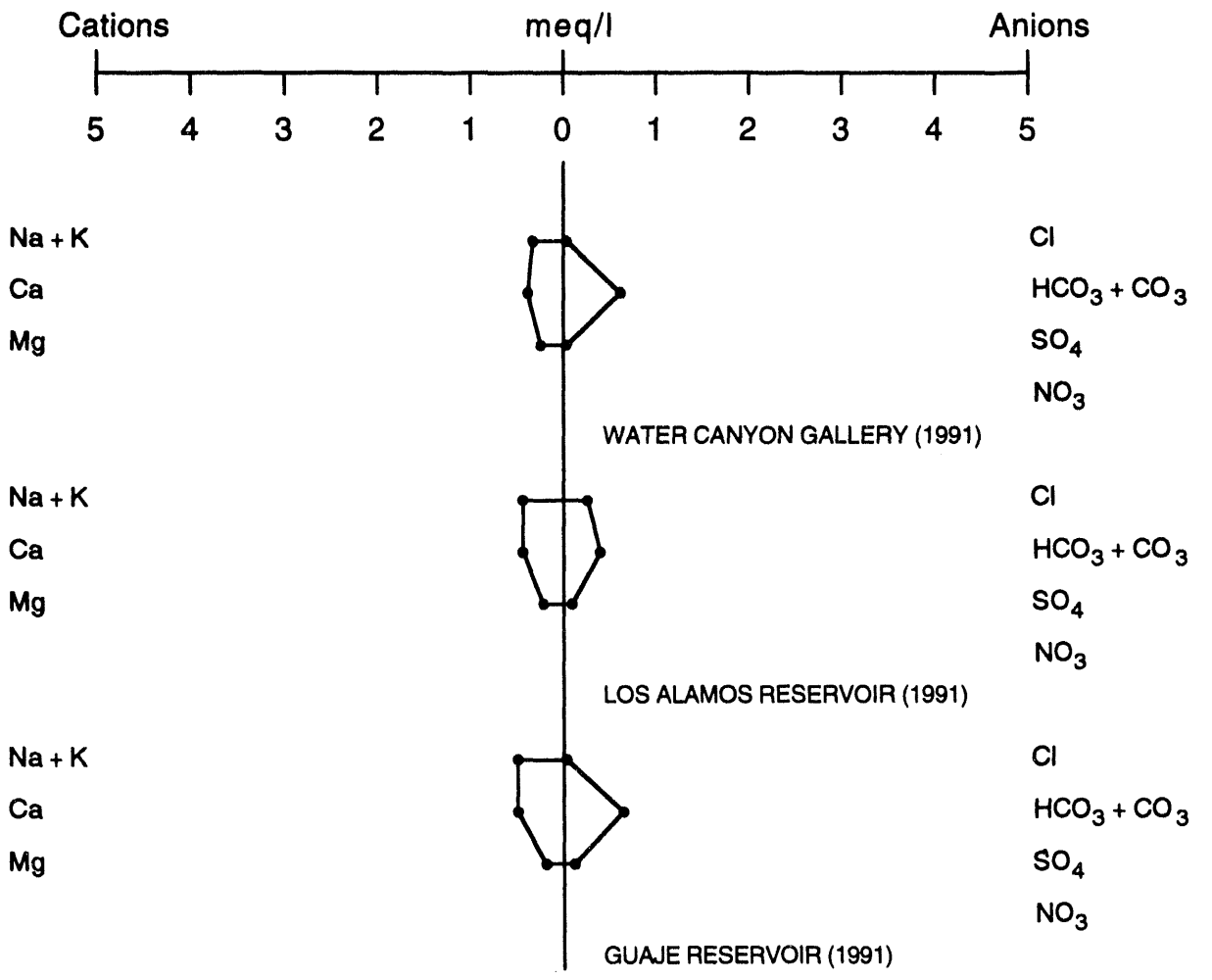

Fig. 11. Diagram representing water quality from Water Canyon Gallery and Los Alamos and Guaje Reservoirs.

The water from Otowi Well 4 is a calcium bicarbonate type. The water is moderately hard, with hardness of about 77 mg/L and TDS of 192 mg/L.

Radiochemical analyses are performed on waters from the individual wells. The only significant radiochemical constituent is uranium. The uranium is naturally occurring in the aquifer. The larger concentrations occur in water from Wells LA-1B and LA-2. The details of individual analyses from each well, chemical and radiochemical, are found in Tables 9, 10, and 11.

2. Water Canyon Gallery, Guaje, and Los Alamos Reservoirs. The water from Water Canyon Gallery is a calcium bicarbonate type (Fig. 11). The water is soft with a hardness of 28 mg/L. The TDS is low at 100 mg/L.[26]

Table 9. Chemical Quality of Water from Supply Wells, Water Canyon Gallery, and Guaje and Los Alamos Reservoirs[a]

Station	Al	SiO_2	Ca	Mg	K	Na	CO_3	HCO_3	P	Total Hardness	Conductivity (mS/m)[b]
Supply Wells											
Los Alamos Field											
Well LA-1 (52)	—	29	7	1.0	—	80	0	177	—	22	38
Well LA-1B	0.03	40	13	0	2	165	5	296	0	36	64
Well LA-2	0.02	32	13	0	1	71	5	122	0	36	28
Well LA-3	0.02	34	19	0	1	36	5	121	0	50	18
Well LA-4 (86)	—	36	13	0.2	2.4	18	0	66	<1	34	15
Well LA-5	0.01	39	16	0	1	29	5	72	0	42	14
Well LA-6	2.01	37	8	0	0	93	5	141	0	22	24
Guaje Field											
Well G-1	0.01	88	18	0	3	27	5	70	0	49	15
Well G-1A	0.01	76	15	0	3	31	5	71	0	41	15
Well G-2	0.01	76	18	0	3	28	5	77	0	50	14
Well G-3 (86)	—	55	14	1.9	2.1	17	0	73	<0.1	45	16
Well G-4	0.01	59	24	3	2	15	5	69	0	76	15
Well G-5	0.01	60	24	4	2	15	5	67	0	70	15
Well G-6	0.01	56	21	2	2	20	5	73	0	69	10
Pajarito Field											
Well PM-1	0.01	78	35	7	3	24	5	112	0	118	23
Well PM-2	0.01	80	13	3	1	12	5	56	0	46	10
Well PM-3	0.01	89	33	9	3	22	5	114	0	123	23
Well PM-4	0.01	85	14	3	2	14	5	57	0	51	11
Well PM-5	0.02	85	14	3	2	14	5	53	0	52	11
Otowi Field											
Well O-1	0.070	59	25	2.4	3.2	49	<3	196	<1	71	14
Well O-4	0.308	86	22	5.6	2.7	20	<5	87	0.3	77	16
Water Canyon Gallery	1.02	40	7	3	2	6	5	34	0	28	60
Guaje Reservoir (91)	0.2	55	10	2.4	2.9	10	<5	39	0.3	35	9
Los Alamos Reservoir (91)	0.1	32	9	2.7	2.2	9	<5	24	0.1	35	8

[a]Analysis is in mg/L except as noted.
[b]mS/m = millisiemens per meter.
NOTE: Analysis is for 1990 except as noted.

Table 10. Chemical Quality of Water from Supply Wells, Water Canyon Gallery, and Guaje and Los Alamos Reservoirs[a]

Station	Ag	As	Ba	Cd	Cr	F	Hg	NO_3-N	Pb	Se	Cl	Cu	Fe	Mn	SO_4	Zn	TDS	pH[b]
Supply System																		
Los Alamos Field																		
Well LA-1 (52)	–	–	–	–	–	1.3	–	1.8	–	–	18	–	0.03	–	20	–	–	–
Well LA-1B	0.001	0.041	0.052	0.001	0.028	3.2	0.0002	0.5	0.001	0.001	15	0.007	0.040	0.004	53	0.007	388	7.9
Well LA-2	0.001	0.011	0.088	0.001	0.021	1.7	0.0002	0.5	0.001	0.001	11	0.004	0.040	0.001	17	0.007	212	8.6
Well LA-3	0.001	0.005	0.052	0.001	0.009	0.7	0.0002	0.5	0.001	0.001	2	0.001	0.040	0.001	8	0.001	92	8.4
Well LA-4	<0.001	0.003	0.030	<0.002	<0.005	0.4	<0.0002	0.6	<0.002	<0.003	2	0.019	0.004	<0.001	4	<0.01	115	8.3
Well LA-5	0.001	0.007	0.080	0.001	0.006	0.4	0.0002	0.4	0.002	0.001	1	0.001	0.040	0.001	4	0.001	72	8.6
Well LA-6	<0.001	0.155	0.040	0.001	0.020	2.6	0.0002	0.4	0.001	0.001	3	0.003	0.590	0.016	8	0.024	200	9.1
Guaje Field																		
Well G-1	0.001	0.005	0.062	0.001	0.005	0.5	0.0002	0.4	0.001	0.001	2	0.004	0.040	0.001	5	0.013	148	8.4
Well G-1A	0.001	0.014	0.042	0.001	0.008	0.5	0.0002	0.4	0.008	0.001	2	0.006	0.040	0.001	5	0.011	246	8.4
Well G-2	0.001	0.037	0.065	0.001	0.011	0.5	0.0002	0.4	0.001	0.001	2	0.001	0.040	0.001	5	0.006	158	8.4
Well G-3 (86)	<0.001	0.005	0.017	<0.002	<0.005	0.4	<0.0002	0.7	<0.002	<0.003	3	0.015	0.005	<0.001	4	<0.01	135	8.3
Well G-4	0.001	0.003	0.017	0.001	0.005	0.3	0.0002	0.6	0.001	0.001	2	0.003	0.040	0.001	4	0.014	154	8.3
Well G-5	0.001	0.002	0.013	0.001	0.003	0.3	0.0002	0.6	0.003	0.001	2	0.005	0.040	0.001	5	0.022	96	8.3
Well G-6	0.001	0.003	0.008	0.001	0.005	0.3	0.0002	0.4	0.001	0.001	2	0.001	0.047	0.001	4	0.012	142	8.3
Pajarito Field																		
Well PM-1	0.001	0.002	0.081	0.001	0.007	0.3	0.0002	0.5	0.001	0.001	5	0.005	0.040	0.001	7	0.016	150	8.1
Well PM-2	0.001	0.001	0.027	0.001	0.007	0.2	0.0002	0.3	0.001	0.001	1	0.005	0.100	0.003	2	0.010	140	8.0
Well PM-3	0.001	0.002	0.048	0.001	0.006	0.3	0.0002	0.4	0.001	0.001	6	0.007	0.040	0.001	7	0.010	186	7.9
Well PM-4	0.001	0.000	0.029	0.001	0.012	0.3	0.0002	0.3	0.001	0.001	1	0.005	0.040	0.001	2	0.024	122	7.8
Well PM-5	0.001	0.001	0.029	0.001	0.008	0.3	0.0002	0.3	0.001	–	2	0.005	0.069	0.005	3	0.237	78	7.9
Otowi Field																		
Well O-1	<0.002	0.002	0.031	<0.001	0.005	0.5	<0.0002	1.3	0.002	0.002	7	0.018	0.170	0.015	11	0.009	198	8.6
Well O-4	<0.001	<0.002	0.035	<0.001	0.004	0.3	<0.002	0.3	0.003	<0.001	4	0.012	0.190	<0.001	6	0.012	192	8.2
Water Canyon Gallery	0.000	0.001	0.020	0.000	0.001	0.0	0.0002	–	–	0.001	–	0.001	1.000	0.006	–	0.013	–	–
Guaje Reservoir (91)	0.001	<0.02	–	0.005	0.002	0.3	<0.0002	0.0	0.001	<0.04	1	<0.007	0.11	0.007	5	<0.008	17[b]	7.4
Los Alamos Reservoir	0.001	<0.02	–	<0.005	<0.002	0.0	<0.0002	0.0	0.001	<0.04	9	<0.007	0.10	0.014	4	0.006	66	7.2

[a]Analysis is in mg/L.

[b]Standard units.

NOTE: Analyses in 1990 except as noted.

Table 11. Radiochemical Quality of Water from Supply Wells, Water Canyon Gallery, and Guaje and Los Alamos Reservoirs

Station	^{3}H (10^{-6} µCi/mL)	^{137}Cs (10^{-9} µCi/mL)	Total Uranium (µg/L)	^{238}Pu (10^{-9} µCi/mL)	$^{239,240}Pu$ (10^{-9} µCi/mL)	Gross Alpha (10^{-9} µCi/mL)	Gross Beta (10^{-9} µCi/mL)	Gross Gamma (counts/min/L)
Water Supply								
Los Alamos Field								
Well LA-1	—	—	—	—	—	—	5.4	—
Well LA-1B	0.8 (0.3)	-24 (80)	5.6 (0.6)	0.011 (0.017)	0.022 (0.015)	3.0 (3.0)	2.8 (0.4)	-120 (80)
Well LA-2	0.6 (0.3)	263 (115)	4.7 (0.1)	0.031 (0.015)	0.010 (0.010)	1.0 (1.0)	1.8 (0.4)	80 (80)
Well LA-3	0.4 (0.3)	-33 (81)	1.6 (0.1)	0.017 (0.012)	0.004 (0.011)	1.6 (0.9)	3.1 (0.5)	60 (80)
Well LA-4 (86)	-0.8 (0.4)	-62 (31)	0.2 (0.2)	-0.008 (0.013)	-0.004 (0.004)	0.0 (0.5)	2.1 (0.5)	200 (70)
Well LA-5	0.2 (0.3)	-28 (103)	0.5 (0.1)	0.047 (0.026)	0.033 (0.015)	1.4 (0.7)	3.2 (0.5)	0 (80)
Well LA-6	0.5 (0.3)	12 (73.5)	0.5 (0.1)	0.039 (0.017)	0.017 (0.012)	1.0 (0.9)	4.7 (0.6)	50 (80)
Guaje Field								
Well G-1	0.5 (0.3)	7 (76)	0.6 (0.1)	0.017 (0.012)	0.011 (0.008)	-4.0 (1.0)	1.6 (0.4)	130 (80)
Well G-1A	0.4 (0.3)	26 (76)	0.4 (0.1)	0.000 (0.010)	0.006 (0.010)	-5.0 (1.0)	1.5 (0.4)	-10 (80)
Well G-2	0.4 (0.3)	-5 (80)	0.9 (0.1)	0.005 (0.008)	0.000 (0.010)	-5.0 (2.0)	35.0 (4.0)	0 (80)
Well G-3 (86)	-0.5 (0.4)	-34 (32)	0.3 (0.2)	-0.008 (0.008)	0.000 (0.010)	2.3 (0.8)	-0.1 (0.4)	190 (70)
Well G-4	0.1 (0.3)	30 (82)	0.8 (0.1)	0.005 (0.016)	0.005 (0.005)	-3.0 (1.0)	39.0 (4.0)	20 (80)
Well G-5	0.4 (0.3)	-58 (88)	1.0 (0.1)	0.000 (0.010)	0.031 (0.013)	-4.0 (1.0)	24.0 (3.0)	20 (80)
Well G-6	0.1 (0.3)	-2 (88)	0.5 (0.1)	0.004 (0.009)	0.000 (0.010)	-4.0 (1.0)	1.1 (0.4)	90 (80)
Pajarito Field								
Well PM-1	-0.1 (0.3)	-11 (29)	2.1 (0.1)	0.008 (0.016)	0.000 (0.010)	0.9 (0.8)	4.1 (0.6)	-30 (80)
Well PM-2	-0.2 (0.3)	55 (43)	0.3 (0.1)	0.011 (0.020)	0.005 (0.014)	1.3 (0.7)	2.3 (0.4)	150 (80)
Well PM-3	-0.4 (0.3)	-37 (37)	0.8 (0.1)	0.004 (0.013)	0.000 (0.010)	0.0 (0.8)	4.6 (0.6)	-20 (80)
Well PM-4	0.1 (0.3)	18 (42)	0.3 (0.1)	0.000 (0.010)	0.005 (0.008)	0.6 (0.6)	2.2 (0.4)	170 (80)
Well PM-5	-0.2 (0.3)	13 (34)	0.2 (0.1)	0.005 (0.008)	0.005 (0.005)	0.9 (0.7)	2.3 (0.4)	120 (80)
Otowi Field								
Well O-1 (90)	-0.4 (0.3)	47 (350)	2.0 (0.1)	0.016 (0.014)	0.000 (0.010)	1.9 (0.7)	3.0 (0.5)	-120 (80)
Well O-4 (90)	0.7 (0.3)	36 (80)	0.5 (0.1)	0.044 (0.019)	-0.005 (0.011)	1.2 (0.5)	3.0 (0.4)	-190 (80)
Water Canyon Gallery	-0.1 (0.3)	82 (100)	0.2 (0.1)	0.020 (0.009)	0.008 (0.008)	1.1 (0.4)	2.1 (0.4)	-470 (90)
Guaje Reservoir	0.1 (0.3)	90 (82)	0.8 (0.1)	0.009 (0.011)	0.005 (0.010)	—	—	550 (100)
Los Alamos Field	0.1(0.3)	-8 (81)	0.2 (0.1)	0.000 (0.010)	0.005 (0.008)	—	—	600 (100)

NOTE: Analyses in 1990 except as noted.
Negative values result when individual measurements are less than the average instrumental background (shown in parentheses); they reflect values that are less than the detection limit of the method.

Water from Guaje and Los Alamos Reservoirs is the sodium calcium bicarbonate type (Fig. 11). The water from the Guaje and Los Alamos Reservoirs is soft with a hardness of 35 mg/L and a TDS of 176 and 66 mg/L respectively. No significant concentrations of radionuclides were detected. The details of individual analyses from each station, chemical and radiochemical, are found in Tables 9, 10, and 11.

B. Compliance Program

The following paragraphs summarize the results of the compliance program while details of the program and data collected are documented in the annual surveillance report for 1991.

This program includes sampling from various points in the Laboratory and County water distribution systems to ensure compliance with the Safe Drinking Water Act (SDWA) (40 CFR 141). The EPA has established maximum contaminant levels for microbiologic, organic, and inorganic constituents and radioactivity in drinking water. Most of these standards have been adopted by the State of New Mexico and are included in the New Mexico Water Supply Regulations. The NMED has been authorized by EPA to administer and enforce federal drinking water regulations and standards in New Mexico.

Compliance samples are analyzed for organic and inorganic constituents and for radioactivity at the New Mexico Health Department's Scientific Laboratory Division (SLD) in Albuquerque. The SLD reports the analytical results directly to NMED. The JCI Environmental Laboratory also collects samples throughout the Laboratory and County distribution systems and tests them for microbiological contamination, as required under the SDWA. The JCI Environmental Laboratory is certified by SLD for microbiological testing of drinking water.

During 1991, all water samples collected under the SDWA program at Los Alamos and tested by SLD in Albuquerque and by the JCI Laboratory were found to be in compliance with the maximum contaminant levels established by regulation. There were no violations nor any fines levied on the Laboratory's municipal and industrial water supplies during 1991. [26]

Each month during 1991 an average of 46 samples was collected throughout the Laboratory and County water distribution systems to determine the free chlorine residual available for disinfection and the microbiological quality of the distribution systems. These samples were collected by JCI Environmental Section personnel and analyzed in the JCI Environmental Laboratory for the presence of coliform bacteria, which is an indicator used to determine if harmful bacteria could be present. During 1991, no coliform bacteria were found. Sixty-five of the microbiological samples (approximately 12%) collected were found to have some noncoliform bacteria present. Although the presence of noncoliform bacteria is not a violation of SDWA, it may indicate stagnant water or biofilm growth in the distribution lines.

V. SUMMARY

Operations of wells and well fields in 1991 were satisfactory. Water level trends in the wells were as expected under the current amount of annual pumpage. Future operations of the wells and water supply system should be continued as in the past. Continued collection of data from wells and well fields is necessary to evaluate present and future wells and well field operations.

ACKNOWLEDGEMENTS

Statistics on well production were collected by personnel from Johnson Control World Services Inc. and were compiled for this report by the Laboratory's Environmental Protection Group.

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Appendix

Annual Statistics on Aquifer Characteristics

Well LA-1

Year	Pumping Time (h)	Production (10^6 gal.)	Pumping Rate (gpm)	Water Level (Nonpumping) (ft)
1947	3,468	54.0	259.5	—
1948	2,988	34.7	193.6	—
1949	1,361	26.7	327.0	—
1950	563	10.5	310.8	19.0
1951	1,215	14.6	200.3	59.0
1952	286	3.4	198.1	40.0
1953	0	0.0	0.0	36.0
1954	0	0.0	0.0	44.0
1955	690	9.7	234.3	51.0
1956	39	0.0	0.0	33.0
1957	0	0.0	0.0	33.0
1958	0	0.0	0.0	10.0
1959	0	0.0	0.0	13.0
1960	0	0.0	0.0	13.0
1961	0	0.0	0.0	59.0
1962	0	0.0	0.0	84.0
1963	0	0.0	0.0	90.0
1964	0	0.0	0.0	95.0
1965	0	0.0	0.0	76.0
1966	0	0.0	0.0	70.0
1967	0	0.0	0.0	52.0
1968	0	0.0	0.0	42.0
1969	0	0.0	0.0	38.0
1970	0	0.0	0.0	37.0
1971	0	0.0	0.0	51.0
1972	0	0.0	0.0	49.0
1973	0	0.0	0.0	55.0
1974	0	0.0	0.0	53.0
1975	0	0.0	0.0	58.0
1976	0	0.0	0.0	69.0
1977	0	0.0	0.0	74.0
1978	0	0.0	0.0	68.0
1979	0	0.0	0.0	38.0
1980	0	0.0	0.0	40.0
1981	0	0.0	0.0	51.0
1982	0	0.0	0.0	98.0
1983	0	0.0	0.0	46.0
1984	0	0.0	0.0	71.0
1985	0	0.0	0.0	63.0
1986	0	0.0	0.0	34.0
1987	0	0.0	0.0	70.0
1988	0	0.0	0.0	66.0
1989	0	0.0	0.0	77.0
1990	0	0.0	0.0	84.0

NOTE: Air line and recorder removed 1990; water level on 3/12/92 was 7.61 ft below top of brass valve, absolute elevation not measured.

Well LA-1B

Year	Pump Time (h)	Production (10^6 gal.)	Pump Rate (gpm)	Water Level		Drawdown (ft)	Specific Capacity (gpm/ft)
				Nonpumping (ft)	Pumping (ft)		
1960	415	36.3	1,457.8	7.0	111.0	104.0	14.0
1961	3,727	124.7	557.6	54.0	154.0	100.0	5.6
1962	3,936	129.1	546.7	72.0	169.0	97.0	5.6
1963	3,649	117.4	536.2	74.0	170.0	96.0	5.6
1964	4,174	130.3	520.3	81.0	183.0	102.0	5.1
1965	3,007	97.9	542.6	63.0	170.0	107.0	5.1
1966	2,589	83.9	540.1	50.0	169.0	119.0	4.5
1967	2,519	84.9	561.7	39.0	153.0	114.0	4.9
1968	2,183	74.0	565.0	32.0	147.0	115.0	4.9
1969	2,244	75.7	562.2	22.0	142.0	120.0	4.7
1970	2,369	79.7	560.7	22.0	143.0	121.0	4.6
1971	2,633	89.1	564.0	31.0	162.0	131.0	4.3
1972	2,215	75.3	566.6	31.0	163.0	132.0	4.3
1973	2,628	87.2	553.0	37.0	170.0	133.0	4.2
1974	2,282	73.9	539.7	35.0	161.0	126.0	4.3
1975	2,308	74.4	537.3	42.0	168.0	126.0	4.3
1976	2,521	79.6	526.2	50.0	176.0	126.0	4.2
1977	2,782	84.2	504.4	47.0	167.0	120.0	4.2
1978	2,306	75.6	546.3	42.0	162.0	120.0	4.6
1979	1,354	45.9	564.6	13.0	134.0	121.0	4.7
1980	1,955	62.9	536.3	21.0	146.0	125.0	4.3
1981	2,299	73.9	537.7	26.0	144.0	118.0	4.5
1982	3,707	108.1	486.0	71.0	180.0	109.0	4.5
1983	407	12.1	495.0	61.0	160.0	99.0	5.0
1984	2,673	96.9	604.0	75.0	201.0	126.0	4.8
1985	1,919	68.5	595.0	55.0	179.0	124.0	4.8
1986	1,598	54.9	573.0	25.0	144.0	119.0	4.8
1987	2,753	97.3	589.0	66.0	187.0	121.0	4.9
1988	2,187	75.4	574.0	60.0	192.0	132.0	4.4
1989	2,864	97.8	569.0	73.0	197.0	124.0	4.6
1990	2,072	68.6	552.0	70.0	196.0	126.0	4.4
1991	1,488	50.4	565.0	55.0	180.0	125.0	4.5

Well LA-2

Year	Pump Time (h)	Production (10^6 gal.)	Pump Rate (gpm)	Water Level		Drawdown (ft)	Specific Capacity (gpm/ft)
				Nonpumping (ft)	Pumping (ft)		
1947	963	27.6	477.7	—	—	—	—
1948	3,659	59.3	270.1	—	—	—	—
1949	1,654	41.8	421.2	—	—	—	—
1950	614	15.6	423.5	59.0	285.0	226.0	1.9
1951	2,415	57.7	398.2	111.0	305.0	194.0	2.1
1952	1,980	46.3	389.7	101.0	300.0	199.0	2.0
1953	2,201	47.2	357.4	100.0	301.0	201.0	1.8
1954	2,601	56.8	364.0	116.0	—	—	—
1955	2,223	49.4	370.4	110.0	—	—	—
1956	1,805	44.2	408.1	84.0	—	—	—
1957	1,066	29.6	462.8	53.0	277.0	224.0	2.1
1958	1,166	31.1	444.5	60.0	270.0	210.0	2.1
1959	1,599	40.7	424.2	71.0	303.0	232.0	1.8
1960	2,169	51.6	396.5	76.0	305.0	229.0	1.7
1961	2,149	44.4	344.3	101.0	313.0	212.0	1.6
1962	1,823	35.7	326.4	111.0	314.0	203.0	1.6
1963	1,999	40.7	339.3	127.0	332.0	205.0	1.7
1964	1,924	34.2	296.3	137.0	347.0	210.0	1.4
1965	1,911	39.8	347.1	121.0	330.0	209.0	1.7
1966	1,070	21.4	333.3	108.0	340.0	232.0	1.4
1967	238	4.9	343.1	78.0	304.0	226.0	1.5
1968	502	11.3	375.2	64.0	305.0	241.0	1.6
1969	155	3.8	408.6	50.0	297.0	247.0	1.7
1970	341	7.2	351.9	59.0	310.0	251.0	1.4
1971	1,787	31.8	296.6	88.0	318.0	230.0	1.3
1972	2,189	39.3	299.2	96.0	322.0	226.0	1.3
1973	2,625	46.7	296.5	106.0	334.0	228.0	1.3
1974	2,033	36.8	301.7	109.0	325.0	216.0	1.4
1975	2,310	40.2	290.0	103.0	320.0	217.0	1.3
1976	2,488	39.9	267.3	113.0	322.0	209.0	1.3
1977	2,775	42.5	255.3	118.0	314.0	196.0	1.3
1978	2,299	39.5	286.4	112.0	338.0	226.0	1.3
1979	1,353	26.2	323.0	75.0	316.0	241.0	1.3
1980	1,960	33.8	287.4	84.0	318.0	234.0	1.2
1981	1,991	34.4	300.0	94.0	336.0	242.0	1.2
1982	3,174	51.2	269.0	161.0	348.0	187.0	1.4
1983	2,752	54.5	330.0	121.0	321.0	200.0	1.6
1984	2,753	53.7	325.0	130.0	323.0	193.0	1.7
1985	2,027	37.1	305.0	112.0	291.0	179.0	1.7
1986	1,289	24.1	312.0	74.0	252.0	178.0	1.8
1987	2,619	39.6	252.0	129.0	319.0	190.0	1.3
1988	1,936	33.0	284.0	117.0	296.0	179.0	1.6
1989	2,647	43.2	272.0	141.0	329.0	188.0	1.4
1990	2,399	40.3	280.0	134.0	330.0	196.0	1.4
1991	1,705	32.7	320.0	123.0	333.0	210.0	1.5

Well LA-3

Year	Pump Time (h)	Production (10^6 gal.)	Pump Rate (gpm)	Water Level		Drawdown (ft)	Specific Capacity (gpm/ft)
				Nonpumping (ft)	Pumping (ft)		
1947	1,476	64.9	732.8	—	—	—	—
1948	3,647	82.5	377.0	—	—	—	—
1949	1,505	41.7	461.8	—	—	—	—
1950	2,793	57.8	344.9	97.0	231.0	134.0	2.6
1951	3,554	66.9	313.7	116.0	233.0	117.0	2.7
1952	2,514	58.6	388.5	94.0	218.0	124.0	3.1
1953	3,104	69.7	374.2	103.0	229.0	126.0	3.0
1954	2,595	57.3	368.0	101.0	225.0	124.0	3.0
1955	2,195	48.7	369.8	91.0	226.0	135.0	2.7
1956	1,849	42.1	379.5	74.0	222.0	148.0	2.6
1957	1,080	26.1	402.8	56.0	219.0	163.0	2.5
1958	1,612	33.6	347.4	49.0	225.0	176.0	2.0
1959	1,821	35.0	320.3	54.0	231.0	177.0	1.8
1960	2,174	38.4	294.4	68.0	230.0	162.0	1.8
1961	1,939	34.7	298.3	85.0	189.0	104.0	2.9
1962	2,361	45.4	320.5	93.0	192.0	99.0	3.2
1963	2,128	42.5	332.9	81.0	197.0	116.0	2.9
1964	2,574	50.4	326.3	104.0	217.0	113.0	2.9
1965	1,961	43.3	368.9	79.0	220.0	141.0	2.6
1966	2,236	46.1	343.6	81.0	219.0	138.0	2.5
1967	2,274	47.4	347.4	86.0	218.0	132.0	2.6
1968	2,127	42.7	334.6	82.0	251.0	169.0	2.0
1969	2,072	40.1	322.6	58.0	246.0	188.0	1.7
1970	2,303	44.0	318.4	55.0	241.0	186.0	1.7
1971	2,556	45.4	296.0	77.0	250.0	173.0	1.7
1972	2,205	39.7	300.1	73.0	251.0	178.0	1.7
1973	977	20.3	346.3	65.0	248.0	183.0	1.9
1974	2,291	43.5	316.5	73.0	244.0	171.0	1.9
1975	2,306	43.3	313.0	80.0	253.0	173.0	1.8
1976	2,474	42.3	285.0	88.0	260.0	172.0	1.7
1977	2,779	47.3	283.7	89.0	248.0	159.0	1.8
1978	2,308	42.4	306.4	87.0	250.0	163.0	1.9
1979	1,343	28.1	348.1	58.0	243.0	185.0	1.9
1980	1,952	35.1	299.9	61.0	237.0	176.0	1.7
1981	2,297	41.5	301.1	70.0	240.0	170.0	1.8
1982	3,691	54.9	247.0	118.0	246.0	128.0	1.9
1983	949	14.7	258.0	89.0	203.0	129.0	2.0
1984	838	16.6	329.0	142.0	301.0	159.0	2.0
1985	2,078	41.9	336.0	104.0	280.0	176.0	1.9
1986	1,328	26.9	338.0	88.0	255.0	167.0	2.0
1987	2,710	50.9	313.0	118.0	289.0	171.0	1.8
1988	2,130	40.1	313.0	119.0	272.0	153.0	2.0
1989	2,808	51.9	308.0	122.0	298.0	176.0	1.8
1990	2,461	44.6	302.0	122.0	295.0	173.0	1.8
1991	1,398	23.4	278.0	112.0	284.0	172.0	1.6

NOTE: Air line and recorder removed in late 1991; water level on 3/13/92 was 39.55 ft below brass valve, absolute elevation not measured.

Well LA-4

Year	Pump Time (h)	Production (10^6 gal.)	Pump Rate (gpm)	Water Level		Drawdown (ft)	Specific Capacity (gpm/ft)
				Nonpumping (ft)	Pumping (ft)		
1948	1,570	42.7	453.3	—	—	—	—
1949	940	37.5	664.9	—	—	—	—
1950	4,350	164.9	631.8	278.0	353.0	75.0	8.4
1951	4,909	173.6	589.4	285.0	357.0	72.0	8.2
1952	3,429	119.6	581.3	267.0	339.0	72.0	8.1
1953	3,034	109.1	599.3	264.0	335.0	71.0	8.4
1954	2,133	78.2	611.0	255.0	329.0	74.0	8.3
1955	2,647	94.5	595.0	268.0	341.0	73.0	8.2
1956	3,402	120.0	588.9	273.0	346.0	73.0	8.1
1957	2,844	105.4	617.7	270.0	345.0	75.0	8.2
1958	2,973	110.3	618.3	270.0	342.0	72.0	8.6
1959	3,084	113.5	613.4	275.0	346.0	71.0	8.6
1960	4,084	145.6	594.2	296.0	365.0	69.0	8.6
1961	3,687	129.7	586.3	296.0	365.0	69.0	8.5
1962	3,688	129.3	584.3	286.0	359.0	73.0	8.0
1963	3,718	130.5	585.0	280.0	351.0	71.0	8.2
1964	4,500	155.0	574.1	291.0	361.0	70.0	8.2
1965	3,110	111.4	597.0	279.0	349.0	70.0	8.5
1966	3,279	115.6	587.6	285.0	356.0	71.0	8.3
1967	2,127	77.1	604.1	278.0	350.0	72.0	8.4
1968	2,276	81.7	598.3	280.0	351.0	71.0	8.4
1969	1,694	61.8	608.0	282.0	358.0	76.0	8.0
1970	2,333	83.5	596.5	286.0	363.0	77.0	7.7
1971	2,519	89.0	588.9	287.0	373.0	86.0	6.8
1972	2,322	82.6	592.9	282.0	367.0	85.0	7.0
1973	2,616	92.4	588.7	294.0	377.0	83.0	7.1
1974	2,306	82.2	594.1	286.0	367.0	81.0	7.3
1975	2,319	82.3	591.5	272.0	355.0	83.0	7.1
1976	2,802	98.2	584.1	277.0	373.0	96.0	6.1
1977	2,741	96.4	586.2	278.0	374.0	96.0	6.1
1978	2,248	80.1	594.2	271.0	368.0	97.0	6.1
1979	2,964	104.6	587.9	280.0	376.0	96.0	6.1
1980	3,322	115.3	578.5	284.0	385.0	101.0	5.7
1981	2,573	89.4	579.1	289.0	393.0	104.0	5.6
1982	0	0	0	—	—	—	—
1983	1,840	61.5	577.0	287.0	392.0	105.0	5.3
1984	2,695	87.1	539.0	290.0	383.0	93.0	5.8
1985	2,667	86.4	540.0	292.0	378.0	86.0	6.3
1986	1,172	38.8	552.0	284.0	377.0	93.0	5.9
1987	38	1.6	—	269.0	357.0	88.0	—
1988	—	—	—	—	—	—	—
1989	—	—	—	—	—	—	—
1990	—	—	—	—	—	—	—
1991	—	—	—	—	—	—	—

NOTE: Air line and recorder were removed in 1990; water level was 244.4 ft on 6/22/90 and 244.2 ft on 3/11/91; both measurements below top of brass valve, absolute elevation not measured.

Well LA-5

Year	Pump Time (h)	Production (10^6 gal.)	Pump Rate (gpm)	Water Level		Drawdown (ft)	Specific Capacity (gpm/ft)
				Nonpumping (ft)	Pumping (ft)		
1948	1,171	40.4	575.0	—	—	—	—
1949	1,763	58.5	553.0	—	—	—	—
1950	4,052	130.1	535.1	131.0	254.0	123.0	4.4
1951	6,004	187.4	520.2	162.0	272.0	110.0	4.7
1952	3,425	109.6	533.3	147.0	259.0	112.0	4.8
1953	3,278	103.9	528.3	141.0	257.0	116.0	4.6
1954	2,546	80.1	524.4	137.0	259.0	122.0	4.3
1955	3,158	97.3	513.5	145.0	267.0	122.0	4.2
1956	3,476	104.5	501.1	150.0	276.0	126.0	4.0
1957	2,868	86.0	499.8	150.0	277.0	127.0	3.9
1958	3,009	89.9	498.0	151.0	277.0	126.0	4.0
1959	3,088	93.5	504.6	155.0	280.0	125.0	4.0
1960	4,088	119.1	485.6	168.0	288.0	120.0	4.0
1961	3,534	100.3	473.0	165.0	288.0	123.0	3.8
1962	3,735	107.7	480.6	172.0	—	—	—
1963	3,726	105.0	469.7	171.0	—	—	—
1964	4,236	118.8	467.4	184.0	—	—	—
1965	1,740	50.5	483.7	180.0	—	—	—
1966	2,817	79.3	469.2	180.0	—	—	—
1967	2,533	73.7	484.9	168.0	—	—	—
1968	2,233	63.3	472.5	161.0	300.0	139.0	3.4
1969	2,402	68.5	475.3	161.0	298.0	137.0	3.5
1970	2,353	66.1	468.2	157.0	300.0	143.0	3.3
1971	2,659	74.4	466.3	155.0	302.0	147.0	3.2
1972	2,301	64.4	466.5	153.0	304.0	151.0	3.1
1973	2,476	68.3	459.7	156.0	308.0	152.0	3.0
1974	1,903	52.5	459.8	154.0	306.0	152.0	3.0
1975	2,318	63.9	459.4	149.0	309.0	160.0	2.9
1976	2,799	77.6	462.1	150.0	310.0	160.0	2.9
1977	2,665	74.8	467.8	147.0	303.0	156.0	3.0
1978	2,274	64.9	475.8	145.0	299.0	154.0	3.1
1979	2,964	84.0	472.4	149.0	301.0	152.0	3.1
1980	3,316	92.2	463.6	153.0	300.0	147.0	3.2
1981	3,523	96.5	456.5	158.0	304.0	146.0	3.1
1982	3,654	102.3	467.0	168.0	299.0	136.0	3.4
1983	2,842	78.1	458.0	154.0	295.0	141.0	3.2
1984	2,889	72.1	416.0	156.0	281.0	125.0	3.1
1985	2,153	55.8	432.0	174.0	308.0	134.0	3.2
1986	1,376	34.6	419.0	168.0	310.0	142.0	2.9
1987	1,148	27.9	405.0	167.0	314.0	147.0	2.8
1988	351	9.9	406.0	—	—	—	—
1989	1,074	26.5	411.0	—	—	—	—
1990	1,388	33.3	400.0	—	—	—	—
1991	783	18.5	394	—	—	—	—

NOTE: Air line and recorder were removed in late 1991; water level on 12/4/91 (TV Log) was 158 ft below top of pump base (5,856.5 ft).

Well LA-6

Year	Pump Time (h)	Production (10^6 gal.)	Pump Rate (gpm)	Water Level		Drawdown (ft)	Specific Capacity (gpm/ft)
				Nonpumping (ft)	Pumping (ft)		
1948	116	4.9	704.0	—	—	—	—
1949	2,451	95.8	651.4	—	—	—	—
1950	4,490	167.9	623.2	83.0	136.0	53.0	11.8
1951	5,882	201.6	571.2	115.0	160.0	45.0	12.7
1952	3,168	110.3	580.3	108.0	151.0	43.0	13.5
1953	3,177	113.8	597.0	95.0	139.0	44.0	13.6
1954	2,894	107.1	616.8	92.0	135.0	43.0	14.3
1955	2,911	108.0	618.3	97.0	140.0	43.0	14.4
1956	3,438	125.8	609.9	106.0	149.0	43.0	14.2
1957	2,833	102.4	602.4	107.0	152.0	45.0	13.4
1958	2,957	106.9	602.5	108.0	131.0	43.0	14.0
1959	3,096	108.3	583.0	115.0	158.0	43.0	13.6
1960	4,084	138.6	565.6	130.0	172.0	42.0	13.5
1961	3,284	112.5	571.0	129.0	171.0	42.0	13.6
1962	3,886	129.4	555.0	135.0	175.0	40.0	13.9
1963	2,953	102.9	580.8	125.0	171.0	46.0	12.6
1964	4,244	138.3	543.1	132.0	172.0	40.0	13.6
1965	3,145	103.8	550.1	120.0	160.0	40.0	13.8
1966	3,173	104.0	546.3	129.0	169.0	40.0	13.7
1967	2,511	85.4	566.8	118.0	158.0	40.0	14.2
1968	2,111	71.6	565.3	109.0	150.0	41.0	13.8
1969	2,402	81.6	566.2	109.0	151.0	42.0	13.5
1970	2,337	79.1	564.1	106.0	149.0	43.0	13.1
1971	2,472	82.5	556.2	119.0	160.0	41.0	13.6
1972	2,317	79.2	569.7	117.0	155.0	38.0	15.0
1973	2,638	90.6	572.4	118.4	155.0	37.0	15.5
1974	2,337	79.8	569.1	120.0	156.0	36.0	15.8
1975	1,571	51.9	550.6	113.0	151.0	38.0	14.5
1976	175	5.1	485.7	96.0	—	—	—
1977	—	—	—	82.0	—	—	—
1978	33	1.1	572.7	77.0	142.0	65.0	8.8
1979	6	0.2	555.6	80.0	146.0	66.0	8.4
1980	4	0.1	520.8	82.0	142.0	60.0	8.7
1981	2.3	0.08	579.8	84.0	141.0	57.0	10.2
1982	—	—	—	90.0	—	—	—
1983	—	—	—	81.0	—	—	—
1984	—	—	—	83.0	—	—	—
1985	—	—	—	92.0	—	—	—
1986	—	—	—	—	—	—	—
1987	—	<0.1	—	—	—	—	—
1988	—	<0.1	—	—	—	—	—
1989	—	<0.1	—	—	—	—	—
1990	—	—	—	—	—	—	—

NOTE: Airline and recorder removed in 1990; water level on 5/9/90 was ~82.5 ft below LSD (5,770 ft); on 3/11/92 it was 98.35 below brass valve, absolute elevation not measured.

Well G-1

Year	Pump Time (h)	Production (10^6 gal.)	Pump Rate (gpm)	Water Level		Drawdown (ft)	Specific Capacity (gpm/ft)
				Nonpumping (ft)	Pumping (ft)		
1950	0	2.8	0.0	195.0	—	—	—
1951	1,168	37.7	538.0	202.0	309.0	107.0	5.0
1952	2,476	75.5	508.2	213.0	295.0	82.0	6.2
1953	3,275	97.3	495.2	221.0	292.0	71.0	7.0
1954	2,616	77.8	495.7	221.0	290.0	69.0	7.2
1955	2,406	70.5	448.4	226.0	295.0	69.0	7.1
1956	2,958	83.2	468.8	235.0	303.0	68.0	6.9
1957	2,098	55.9	444.1	236.0	307.0	71.0	6.3
1958	2,460	68.1	461.4	238.0	308.0	70.0	6.6
1959	2,952	82.4	465.2	245.0	314.0	69.0	6.7
1960	3,564	96.0	448.9	254.0	325.0	71.0	6.3
1961	4,236	112.4	442.2	260.0	333.0	73.0	6.1
1962	3,431	93.6	454.7	258.0	342.0	84.0	5.4
1963	4,519	114.9	423.8	265.0	348.0	83.0	5.1
1964	4,374	113.8	433.6	269.0	352.0	83.0	5.2
1965	3,530	90.7	428.2	268.0	352.0	84.0	5.1
1966	4,074	102.6	419.7	269.0	363.0	94.0	4.5
1967	2,615	69.9	445.5	266.0	362.0	96.0	4.6
1968	2,996	78.9	438.9	264.0	366.0	102.0	4.3
1969	2,657	68.3	428.4	266.0	376.0	110.0	3.9
1970	2,712	64.7	397.6	264.0	377.0	113.0	3.5
1971	2,908	67.9	389.2	258.0	378.0	120.0	3.2
1972	2,865	66.1	384.5	264.0	389.0	125.0	3.1
1973	2,997	67.5	375.4	271.0	403.0	132.0	2.8
1974	2,767	62.3	375.3	283.0	412.0	129.0	2.9
1975	2,467	55.7	376.3	293.0	411.0	118.0	3.2
1976	2,962	65.1	366.3	—	—	—	—
1977	2,734	57.9	353.0	275.0	426.0	151.0	2.3
1978	2,656	56.0	351.4	270.0	419.0	149.0	2.4
1979	2,998	61.7	342.9	271.0	422.0	151.0	2.3
1980	3,459	68.3	329.0	273.0	428.0	155.0	2.1
1981	4,427	81.6	307.2	275.0	444.0	169.0	1.8
1982	3,678	69.0	313.0	278.0	443.0	165.0	1.9
1983	2,871	52.2	303.0	272.0	443.0	171.0	1.8
1984	3,804	62.8	275.0	276.0	448.0	172.0	1.5
1985	3,004	48.3	268.0	278.0	450.0	172.0	1.6
1986	2,027	30.3	249.0	279.0	450.0	171.0	1.5
1987	2,070	29.2	235.0	280.0	451.0	171.0	1.4
1988	395	5.4	227.0	280.0	445.0	165.0	1.4
1989	2,010	26.9	223.0	282.0	451.0	169.0	1.3
1990	2,121	30.8	242.0	284.0	454.0	170.0	1.4
1991	1,730	20.9	201.0	282.0	451.0	169.0	1.2

Well G-1A

Year	Pump Time (h)	Production (10^6 gal.)	Pump Rate (gpm)	Water Level		Drawdown (ft)	Specific Capacity (gpm/ft)
				Nonpumping (ft)	Pumping (ft)		
1954	108	4.6	709.0	—	—	—	—
1955	1,531	53.0	577.0	265.0	316.0	51.0	11.3
1956	3,130	107.7	573.5	273.0	323.0	50.0	11.5
1957	2,470	87.0	587.0	274.0	327.0	53.0	11.1
1958	2,670	92.5	577.4	279.0	331.0	52.0	11.1
1959	2,965	102.7	577.3	284.0	333.0	49.0	11.8
1960	3,641	122.8	562.1	291.0	342.0	51.0	11.0
1961	4,297	147.3	571.3	298.0	350.0	52.0	11.0
1962	3,972	136.1	571.1	295.0	344.0	49.0	11.7
1963	4,525	149.7	551.4	301.0	350.0	49.0	11.3
1964	3,852	129.3	559.4	302.0	353.0	51.0	11.0
1965	3,505	116.5	554.0	302.0	353.0	51.0	10.9
1966	3,964	133.4	560.9	306.0	355.0	49.0	11.4
1967	2,720	91.3	559.4	302.0	351.0	49.0	11.4
1968	3,089	103.2	556.8	302.0	352.0	50.0	11.1
1969	2,695	90.7	560.9	303.0	356.0	53.0	10.6
1970	2,772	92.5	556.2	300.0	357.0	57.0	9.8
1971	3,313	111.8	562.4	303.0	361.0	58.0	9.7
1972	2,879	94.0	544.2	302.0	361.0	59.0	9.2
1973	2,760	87.9	530.8	302.0	362.0	60.0	8.8
1974	2,974	92.7	519.5	307.0	355.0	48.0	10.8
1975	2,740	85.3	518.9	304.0	351.0	47.0	11.0
1976	2,983	91.6	511.8	302.0	350.0	48.0	10.7
1977	2,942	88.7	502.5	302.0	350.0	48.0	10.5
1978	2,631	77.9	493.5	300.0	345.0	45.0	11.0
1979	2,974	88.0	493.9	301.0	345.0	44.0	11.0
1980	3,480	103.2	494.4	305.0	345.0	40.0	12.4
1981	4,212	131.2	519.1	307.0	347.0	40.0	13.0
1982	3,618	109.7	505.0	305.0	347.0	42.0	12.0
1983	2,901	86.7	498.0	301.0	336.0	35.0	14.2
1984	3,789	113.9	501.0	302.0	345.0	43.0	11.7
1985	4,430	128.4	483.0	306.0	348.0	42.0	11.5
1986	4,644	130.4	468.0	310.0	351.0	41.0	11.4
1987	4,468	122.5	457.0	320.0	362.0	42.0	10.9
1988	5,016	133.5	443.0	323.0	364.0	41.0	10.8
1989	4,663	131.5	470.0	323.0	359.0	36.0	13.1
1990	4,860	145.5	499.0	322.0	362.0	40.0	12.5
1991	5,120	150.2	489.0	325.0	361.0	36.0	13.6

Well G-2

Year	Pump Time (h)	Production (10^6 gal.)	Pump Rate (gpm)	Water Level		Drawdown (ft)	Specific Capacity (gpm/ft)
				Nonpumping (ft)	Pumping (ft)		
1951	123	3.9	528.5	259.0	—	—	—
1952	2,372	78.3	550.2	279.0	327.0	48.0	11.5
1953	3,254	105.6	540.9	290.0	334.0	44.0	12.3
1954	2,682	86.3	536.3	291.0	335.0	44.0	12.2
1955	2,487	78.8	528.1	299.0	345.0	46.0	11.5
1956	3,109	95.8	513.6	310.0	357.0	47.0	10.9
1957	2,458	76.1	516.0	311.0	360.0	49.0	10.5
1958	2,707	80.1	493.2	315.0	361.0	46.0	10.7
1959	2,938	84.6	479.9	320.0	363.0	43.0	11.2
1960	3,535	96.6	455.4	328.0	370.0	42.0	10.8
1961	3,982	105.3	440.7	336.0	375.0	39.0	11.3
1962	4,076	99.8	408.1	338.0	374.0	36.0	11.3
1963	4,563	105.7	386.1	344.0	379.0	35.0	11.0
1964	4,541	105.3	386.5	346.0	380.0	34.0	11.4
1965	3,535	82.6	389.4	346.0	381.0	35.0	11.1
1966	3,994	94.7	395.2	349.0	383.0	34.0	11.6
1967	2,743	67.6	410.7	344.0	379.0	35.0	11.7
1968	2,732	66.5	405.7	344.0	379.0	35.0	11.6
1969	2,679	68.6	426.8	344.0	381.0	37.0	11.5
1970	2,431	62.8	430.5	343.0	381.0	38.0	11.3
1971	3,420	87.4	425.9	345.0	384.0	39.0	10.9
1972	2,887	73.4	423.7	348.0	388.0	40.0	10.6
1973	2,816	72.4	428.5	344.0	385.0	41.0	10.5
1974	3,056	82.0	447.2	347.0	390.0	43.0	10.4
1975	2,724	74.5	455.8	341.0	384.0	43.0	10.6
1976	2,990	81.1	452.1	344.0	388.0	44.0	10.3
1977	2,981	80.4	449.5	346.0	388.0	42.0	10.7
1978	2,562	71.6	451.9	345.0	386.0	41.0	11.0
1979	2,975	80.0	448.0	347.0	388.0	41.0	11.0
1980	3,478	92.4	443.0	350.0	389.0	39.0	11.4
1981	1,432	38.3	445.8	352.0	390.0	38.0	11.7
1982	2,833	25.7	476.0	352.0	399.0	47.0	10.1
1983	624	16.5	441.0	356.0	399.0	43.0	10.3
1984	2,018	43.7	361.0	358.0	385.0	27.0	13.4
1985	4,339	96.6	371.0	352.0	381.0	29.0	12.8
1986	4,769	109.3	382.0	369.0	395.0	26.0	14.7
1987	4,526	109.7	404.0	366.0	399.0	33.0	12.2
1988	4,836	132.8	457.0	367.0	400.0	33.0	13.9
1989	4,820	133.9	463.0	375.0	408.0	33.0	14.0
1990	5,060	134.5	443.0	374.0	407.0	33.0	13.4
1991	4,792	123.3	428.0	369.0	401.0	32.0	13.4

Well G-3

Year	Pump Time (h)	Production (10^6 gal.)	Pump Rate (gpm)	Water Level		Drawdown (ft)	Specific Capacity (gpm/ft)
				Nonpumping (ft)	Pumping (ft)		
1951	192	7.3	633.7	281.0	—	—	—
1952	2,379	65.4	458.2	310.0	358.0	48.0	9.5
1953	3,192	76.4	398.9	322.0	360.0	38.0	10.5
1954	2,675	66.1	411.8	322.0	370.0	48.0	8.6
1955	2,369	69.4	488.3	316.0	368.0	52.0	9.4
1956	3,149	87.9	465.2	324.0	380.0	56.0	8.3
1957	2,517	70.2	464.8	324.0	385.0	61.0	7.6
1958	2,562	69.5	452.1	323.0	386.0	63.0	7.2
1959	2,931	74.6	424.2	326.0	395.0	69.0	6.1
1960	3,591	82.5	382.9	335.0	407.0	72.0	5.3
1961	3,612	79.9	368.7	343.0	414.0	71.0	5.2
1962	4,057	83.7	343.9	348.0	418.0	70.0	4.9
1963	4,555	86.7	317.2	352.0	422.0	70.0	4.5
1964	4,487	78.6	292.0	355.0	424.0	69.0	4.2
1965	3,498	65.6	312.6	350.0	419.0	69.0	4.5
1966	3,991	73.7	307.8	353.0	420.0	67.0	4.6
1967	2,752	52.9	320.4	344.0	418.0	74.0	4.3
1968	3,086	56.5	305.1	341.0	418.0	77.0	4.0
1969	2,672	50.8	316.9	338.0	417.0	79.0	4.0
1970	2,736	55.4	337.5	336.0	419.0	83.0	4.1
1971	3,337	64.2	320.6	342.0	423.0	81.0	4.0
1972	2,838	50.9	298.9	341.0	421.0	80.0	3.7
1973	2,843	47.3	277.3	341.0	418.0	77.0	3.6
1974	3,006	49.3	273.3	342.0	424.0	82.0	3.3
1975	2,632	43.1	272.9	341.0	428.0	87.0	3.1
1976	2,971	82.6	463.4	359.0	447.0	88.0	5.3
1977	2,961	78.9	444.1	353.0	448.0	95.0	4.7
1978	2,590	66.4	427.5	345.0	443.0	98.0	4.4
1979	3,014	69.0	381.0	345.0	450.0	105.0	3.6
1980	3,448	61.8	298.6	348.0	453.0	105.0	2.8
1981	4,315	66.6	257.2	357.0	467.0	110.0	2.3
1982	3,550	51.0	239.0	349.0	459.0	110.0	2.2
1983	2,183	31.3	239.0	340.0	463.0	123.0	1.9
1984	1,211	19.0	267.0	355.0	475.0	120.0	2.2
1985	1,587	22.1	232.0	351.0	470.0	119.0	2.0
1986	2,266	26.7	196.0	375.0	492.0	117.0	1.7
1987	—	<0.1	—	—	—	—	—
1988	—	3.4	—	—	—	—	—
1989	—	<0.1	—	—	—	—	—
1990	—	—	—	—	—	—	—
1991	—	—	—	—	—	—	—

Well G-4

Year	Pump Time (h)	Production (10^6 gal.)	Pump Rate (gpm)	Water Level		Drawdown (ft)	Specific Capacity (gpm/ft)
				Nonpumping (ft)	Pumping (ft)		
1951	—	12.5	—	357.0	477.0	120.0	—
1952	2,401	56.9	395.0	374.0	474.0	100.0	3.9
1953	2,677	55.2	343.7	380.0	472.0	92.0	3.7
1954	2,256	58.8	434.4	383.0	526.0	143.0	3.0
1955	1,172	22.7	322.8	378.0	481.0	103.0	3.1
1956	1,800	33.9	313.9	377.0	491.0	114.0	2.8
1957	1,324	24.2	304.6	373.0	498.0	125.0	2.4
1958	1,970	35.9	303.7	370.0	490.0	120.0	2.5
1959	1,819	31.6	289.5	378.0	494.0	116.0	2.5
1960	2,457	37.0	251.0	385.0	509.0	124.0	2.0
1961	2,787	45.0	269.1	389.0	512.0	123.0	2.2
1962	2,738	41.7	253.8	386.0	505.0	119.0	2.1
1963	3,519	46.4	219.8	388.0	504.0	116.0	1.9
1964	3,561	42.9	200.8	396.0	499.0	103.0	1.9
1965	2,100	23.8	188.9	394.0	492.0	98.0	1.9
1966	2,219	33.6	252.4	391.0	498.0	107.0	2.4
1967	2,690	44.8	277.6	388.0	509.0	121.0	2.3
1968	2,083	31.4	251.2	386.0	509.0	123.0	2.0
1969	1,309	17.4	221.5	387.0	505.0	118.0	1.9
1970	606	7.7	211.8	384.0	504.0	120.0	1.8
1971	1,640	21.0	213.4	389.0	503.0	114.0	1.9
1972	2,840	33.3	195.4	391.0	507.0	116.0	1.7
1973	3,006	37.2	206.3	392.0	521.0	129.0	1.6
1974	2,672	34.3	213.9	392.0	519.0	127.0	1.7
1975	1,977	41.0	345.6	403.0	559.0	156.0	2.2
1976	2,859	57.8	336.9	406.0	571.0	165.0	2.0
1977	2,954	62.4	352.1	406.0	589.0	183.0	1.9
1978	2,607	49.5	316.5	398.0	589.0	191.0	1.7
1979	2,974	52.9	296.4	395.0	586.0	191.0	1.6
1980	2,235	35.6	265.7	394.0	580.0	186.0	1.4
1981	432	8.2	316.4	385.0	573.0	188.0	1.7
1982	3,657	65.2	297.0	386.0	578.0	192.0	1.5
1983	2,604	42.2	270.0	—	—	—	—
1984	3,766	49.7	220.0	—	—	—	—
1985	1,747	21.7	207.0	402.0	572.0	170.0	1.2
1986	2,678	33.9	211.0	396.0	574.0	178.0	1.2
1987	2,011	25.1	208.0	398.0	573.0	175.0	1.2
1988	301	4.1	227.0	390.0	545.0	155.0	1.4
1989	1,739	21.6	207.0	401.0	562.0	161.0	1.3
1990	1,539	16.8	182.0	381.0	564.0	183.0	1.0
1991	1,254	13.7	181.0	382.0	559.0	177.0	1.0

Well G-5

Year	Pump Time (h)	Production (10^6 gal.)	Pump Rate (gpm)	Water Level		Drawdown (ft)	Specific Capacity (gpm/ft)
				Nonpumping (ft)	Pumping (ft)		
1951	—	6.7	—	414.0	—	—	—
1952	2,579	73.8	476.9	422.0	480.0	58.0	8.2
1953	1,433	37.8	439.6	425.0	467.0	42.0	10.5
1954	2,617	80.9	515.2	429.0	473.0	44.0	11.7
1955	2,529	80.4	529.9	427.0	472.0	45.0	11.8
1956	3,052	97.0	529.7	431.0	478.0	47.0	11.3
1957	2,385	64.1	447.9	424.0	466.0	42.0	10.7
1958	1,523	49.1	537.3	428.0	477.0	49.0	11.0
1959	2,917	101.7	581.1	435.0	495.0	60.0	9.7
1960	2,828	98.0	577.6	437.0	501.0	64.0	9.0
1961	3,908	134.0	571.5	438.0	507.0	69.0	8.3
1962	4,186	142.0	565.4	440.0	511.0	71.0	8.0
1963	4,528	151.0	555.8	441.0	513.0	72.0	7.7
1964	4,532	150.4	553.1	446.0	516.0	70.0	7.9
1965	3,520	117.1	554.5	443.0	516.0	73.0	7.6
1966	2,555	83.2	542.7	445.0	520.0	75.0	7.2
1967	2,405	80.0	554.4	444.0	519.0	75.0	7.4
1968	2,513	81.2	538.5	443.0	517.0	74.0	7.3
1969	2,649	83.3	524.1	450.0	520.0	70.0	7.5
1970	2,771	88.9	534.7	453.0	521.0	68.0	7.9
1971	2,657	88.3	553.9	450.0	521.0	71.0	7.8
1972	2,902	92.4	530.7	441.0	514.0	73.0	7.3
1973	3,003	97.5	541.1	444.0	515.0	71.0	7.6
1974	2,054	69.0	559.9	440.0	513.0	73.0	7.7
1975	2,266	74.7	549.4	433.0	500.0	67.0	8.2
1976	2,955	95.0	535.8	442.0	504.0	62.0	8.6
1977	2,836	92.1	541.3	444.0	504.0	60.0	9.0
1978	2,608	84.2	538.4	442.0	502.0	60.0	9.0
1979	2,766	86.5	521.5	442.0	502.0	60.0	8.7
1980	2,896	89.0	512.4	442.0	502.0	60.0	8.5
1981	2,124	66.7	523.4	451.0	528.0	77.0	6.8
1982	1,219	38.2	522.0	455.0	510.0	55.0	9.5
1983	2,904	73.2	420.0	445.0	492.0	47.0	8.9
1984	3,838	115.4	501.0	452.0	507.0	55.0	9.4
1985	2,193	67.9	516.0	453.0	509.0	56.0	9.2
1986	2,219	52.5	394.0	453.0	494.0	41.0	9.6
1987	5,732	116.7	379.0	462.0	504.0	42.0	9.0
1988	4,841	115.3	396.0	466.0	507.0	41.0	9.7
1989	4,715	110.9	392.0	474.0	514.0	40.0	9.8
1990	5,094	119.2	390.0	485.0	526.0	41.0	9.5
1991	4,981	113.0	378.0	487.0	534.0	47.0	8.0

Well G-6

Year	Pump Time (h)	Production (10^6 gal.)	Pump Rate (gpm)	Water Level		Drawdown (ft)	Specific Capacity (gpm/ft)
				Nonpumping (ft)	Pumping (ft)		
1964	1,912	45.0	392.3	581.0	659.0	78.0	5.0
1965	3,200	74.9	390.1	582.0	660.0	78.0	5.0
1966	3,931	92.2	390.9	585.0	658.0	73.0	5.4
1967	2,454	57.8	392.6	580.0	653.0	73.0	5.4
1968	2,597	56.2	360.7	574.0	647.0	73.0	4.9
1969	2,698	55.6	343.5	568.0	636.0	68.0	5.1
1970	2,765	51.0	307.4	569.0	634.0	65.0	4.7
1971	2,932	42.8	243.3	573.0	629.0	56.0	4.3
1972	2,516	57.0	377.6	578.0	670.0	92.0	4.1
1973	2,991	65.3	363.9	579.0	667.0	88.0	4.1
1974	2,950	63.8	360.5	579.0	665.0	86.0	4.2
1975	2,717	56.7	347.8	577.0	659.0	82.0	4.2
1976	2,966	57.8	324.8	584.0	662.0	78.0	4.2
1977	2,954	54.4	306.9	586.0	659.0	73.0	4.2
1978	2,218	38.4	288.9	581.0	645.0	64.0	4.5
1979	1,030	18.2	295.1	579.0	645.0	66.0	4.8
1980	1,789	34.5	321.5	583.0	670.0	87.0	3.7
1981	4,302	76.5	296.4	586.0	673.0	87.0	3.4
1982	3,763	63.6	281.0	588.0	669.0	81.0	3.5
1983	1,960	35.4	301.0	582.0	668.0	86.0	3.5
1984	3,010	55.3	306.0	589.0	666.0	77.0	3.9
1985	3,980	71.4	299.0	586.0	664.0	78.0	3.8
1986	4,420	76.7	293.0	576.0	654.0	78.0	3.8
1987	5,100	81.4	266.0	595.0	671.0	76.0	3.5
1988	5,121	82.1	267.0	591.0	669.0	78.0	3.4
1989	5,000	81.6	272.0	592.0	669.0	77.0	3.5
1990	5,202	84.9	272.0	589.0	670.0	81.0	3.4
1991	5,063	81.2	267.0	591.0	674.0	83.0	3.2

Well PM-1

Year	Pump Time (h)	Production (10^6 gal.)	Pump Rate (gpm)	Water Level		Drawdown (ft)	Specific Capacity (gpm/ft)
				Nonpumping (ft)	Pumping (ft)		
1965	2,754	99.2	600.3	746.0	786.0	40.0	15.0
1966	3,086	108.0	583.3	740.0	779.0	39.0	15.0
1967	2,870	111.0	644.6	737.0	781.0	44.0	14.6
1968	1,846	68.1	614.8	735.0	769.0	34.0	18.1
1969	951	34.4	602.9	733.0	766.0	33.0	18.3
1970	1,781	66.2	619.5	733.0	769.0	36.0	17.2
1971	2,728	101.0	617.1	733.0	766.0	33.0	18.7
1972	2,415	84.9	585.9	735.0	762.0	27.0	21.7
1973	1,688	46.5	459.1	736.0	755.0	19.0	24.2
1974	2,649	96.3	605.9	740.0	768.0	28.0	21.6
1975	2,567	94.8	615.5	741.0	766.0	25.0	24.6
1976	2,933	106.8	606.9	744.0	767.0	23.0	26.4
1977	2,969	105.4	591.7	745.0	767.0	22.0	26.9
1978	2,544	90.6	593.3	745.0	767.0	22.0	27.0
1979	2,350	83.4	591.5	744.0	766.0	22.0	26.9
1980	2,786	98.5	588.6	746.0	769.0	23.0	25.7
1981	2,789	98.5	588.6	747.0	769.0	22.0	26.8
1982	2,820	99.6	589.0	748.0	770.0	22.0	26.8
1983	2,464	86.5	585.0	747.0	769.0	22.0	26.6
1984	2,667	92.8	580.0	749.0	772.0	23.0	25.6
1985	2,760	95.4	576.0	749.0	770.0	21.0	27.4
1986	2,130	73.9	578.0	748.0	770.0	22.0	26.3
1987	2,912	102.4	586.0	752.0	773.0	21.0	27.9
1988	2,758	98.0	592.0	751.0	775.0	24.0	24.7
1989	3,014	104.9	580.0	752.0	774.0	22.0	26.4
1990	2,620	88.2	561.0	752.0	772.0	20.0	28.0
1991	2,600	88.6	568.0	752.0	774.0	22.0	25.8

Well PM-2

Year	Pump Time (h)	Production (10^6 gal.)	Pump Rate (gpm)	Water Level		Drawdown (ft)	Specific Capacity (gpm/ft)
				Nonpumping (ft)	Pumping (ft)		
1966	221	18.9	1,425.3	826.0	889.0	63.0	22.6
1967	4,336	370.0	1,422.2	834.0	888.0	54.0	26.3
1968	3,865	328.2	1,415.3	838.0	889.0	51.0	27.8
1969	3,304	279.9	1,411.9	838.0	890.0	52.0	27.2
1970	3,529	300.6	1,419.7	839.0	893.0	54.0	26.3
1971	4,035	339.5	1,402.3	841.0	898.0	57.0	24.6
1972	4,611	385.3	1,392.7	845.0	902.0	57.0	24.4
1973	4,571	380.6	1,387.7	849.0	907.0	58.0	23.9
1974	5,443	450.9	1,380.7	853.0	912.0	59.0	23.4
1975	4,644	385.3	1,382.8	854.0	913.0	59.0	23.4
1976	5,382	442.0	1,368.8	866.0	924.0	58.0	23.6
1977	3,306	272.8	1,375.3	868.0	924.0	56.0	24.6
1978	4,743	388.4	1,364.9	871.0	928.0	57.0	23.9
1979	4,671	381.8	1,262.2	872.0	924.0	52.0	26.2
1980	5,023	409.6	1,359.2	873.0	931.0	58.0	23.4
1981	4,551	370.1	1,355.4	876.0	934.0	58.0	23.4
1982	4,319	359.3	1,386.0	874.0	934.0	60.0	23.1
1983	1,922	157.9	1,369.0	876.0	935.0	59.0	23.2
1984	996	81.6	1,365.0	866.0	930.0	64.0	21.7
1985	1,749	143.3	1,365.0	851.0	916.0	65.0	21.0
1986	1,036	84.4	1,359.0	851.0	915.0	64.0	21.2
1987	351	28.3	1,340.0	851.0	907.0	56.0	23.9
1988	1,843	146.8	1,328.0	869.0	931.0	62.0	21.4
1989	1,639	130.0	1,322.0	860.0	920.0	60.0	22.0
1990	3,164	250.4	1,319.0	860.0	928.0	68.0	19.4
1991	2,141	170.7	1,329.0	855.0	918.0	63.0	21.1

Well PM-3

Year	Pump Time (h)	Production (10^6 gal.)	Pump Rate (gpm)	Water Level		Drawdown (ft)	Specific Capacity (gpm/ft)
				Nonpumping (ft)	Pumping (ft)		
1968	2,327	187.4	1,342.2	743.0	771.0	28.0	47.9
1969	3,241	254.7	1,309.8	746.0	772.0	26.0	50.4
1970	2,905	227.8	1,306.9	750.0	774.0	24.0	54.5
1971	2,774	216.3	1,299.6	751.0	774.0	23.0	56.5
1972	2,445	192.1	1,309.5	752.0	775.0	23.0	56.9
1973	3,256	257.8	1,319.6	755.0	778.0	23.0	57.4
1974	3,241	255.3	1,312.9	756.0	779.0	23.0	57.1
1975	3,421	269.3	1,312.0	757.0	780.0	23.0	57.0
1976	3,171	268.3	1,410.2	758.0	784.0	26.0	54.2
1977	2,792	235.5	1,405.8	758.0	784.0	26.0	54.1
1978	2,516	211.0	1,397.6	759.0	784.0	25.0	55.9
1979	2,359	197.2	1,393.0	760.0	784.0	24.0	58.0
1980	2,796	234.4	1,397.2	760.0	785.0	25.0	55.9
1981	2,784	232.4	1,391.3	761.0	786.0	25.0	55.6
1982	2,831	238.1	1,402.0	762.0	785.0	23.0	60.9
1983	2,496	207.6	1,386.0	762.0	785.0	23.0	60.3
1984	3,317	275.6	1,385.0	762.0	787.0	25.0	55.4
1985	2,643	221.2	1,395.0	762.0	784.0	22.0	63.4
1986	2,920	244.8	1,397.0	763.0	787.0	24.0	58.2
1987	2,984	250.2	1,397.0	763.0	788.0	25.0	55.9
1988	2,766	232.0	1,397.0	764.0	788.0	24.0	58.2
1989	2,656	221.0	1,386.0	765.0	791.0	26.0	53.3
1990	2,949	244.6	1,382.0	767.0	790.0	23.0	60.0
1991	2,752	229.5	1,385.0	768.0	791.0	23.0	60.2

Well PM-4

Year	Pump Time (h)	Production (10^6 gal.)	Pump Rate (gpm)	Water Level		Drawdown (ft)	Specific Capacity (gpm/ft)
				Nonpumping (ft)	Pumping (ft)		
1982	869	76.2	1,460	1,050	1,091	41	35.6
1983	5,267	452.5	1,432	1,066	1,101	35	40.9
1984	4,059	325.8	1,338	1,065	1,104	39	34.3
1985	4,759	379.2	1,328	1,066	1,101	35	37.9
1986	3,925	307.4	1,305	1,084	1,119	35	37.3
1987	5,071	392.2	1,289	1,081	1,117	36	35.8
1988	2,435	218.7	1,313	1,079	1,117	38	34.6
1989	5,387	418.9	1,296	1,085	1,122	37	35.0
1990	2,827	219.3	1,293	1,083	1,123	40	32.3
1991	2,832	219.5	1,292	1,081	1,123	42	30.8

Well PM-5

Year	Pump Time (h)	Production (10^6 gal.)	Pump Rate (gpm)	Water Level		Drawdown (ft)	Specific Capacity (gpm/ft)
				Nonpumping (ft)	Pumping (ft)		
1985	—	2.0	—	—	—	—	—
1986	2,047	147.3	1,199	—	—	—	—
1987	1,620	118.6	1,220	1,237	1,345	108	11.3
1988	1,754	128.6	1,221	1,233	1,345	112	10.9
1989	1,184	86.2	1,213	1,239	1,352	113	10.7
1990	1,611	121.0	1,252	1,234	1,347	113	11.1
1991	1,497	112.1	1,248	1,239	1,346	107	11.7

Water Canyon Gallery

Year	Time (h)	Production (10^6 gal.)	Discharge Rate (gpm)
1947	8,760	84.0	159.8
1948	8,784	97.0	184.0
1949	8,760	92.0	175.0
1950	8,760	54.0	102.7
1951	8,760	39.0	74.2
1952	8,784	48.0	91.1
1953	8,760	39.0	74.2
1954	8,760	40.0	76.1
1955	8,760	33.0	62.8
1956	8,784	23.0	43.6
1957	8,760	40.0	76.1
1958	8,760	60.0	114.2
1959	8,760	54.0	102.7
1960	8,784	48.0	91.1
1961	8,760	54.0	102.7
1962	8,760	67.0	127.5
1963	8,760	51.0	97.0
1964	8,784	45.0	85.4
1965	8,760	72.0	137.0
1966	8,760	82.0	156.0
1967	8,760	56.0	106.5
1968	8,784	65.0	123.3
1969	8,760	80.0	152.2
1970	8,760	65.0	123.7
1971	8,760	37.0	70.4
1972	8,784	40.0	75.9
1973	8,760	49.0	93.2
1974	8,760	35.0	66.6
1975	8,760	42.0	79.9
1976	8,784	41.0	77.8
1977	8,760	57.0	108.4
1978	8,760	45.0	86.2
1979	8,760	44.0	83.7
1980	8,784	32.0	60.7
1981	8,760	45.5	86.6
1982	8,760	45.9	94.9
1983	8,760	38.2	72.7
1984	8,784	34.0	65.4
1985	8,760	36.6	69.6
1986	8,760	28.2	53.6
1987	8,760	34.2	65.1
1988	8,784	34.5	65.5
1989	8,760	23.0	43.8
1990	8,760	9.3	—[a]
1991	—	12.0	—[a]

[a]Industrial use, the rest bypassed.

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